The search for hybrid tectonics in contemporary African architecture:
Encounters between the global and the local

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Abstract

The search for hybrid tectonics in contemporary African architecture:
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This thesis is based on the proposition that there is an emerging phenomenon of tectonic hybridisation in contemporary architecture in Africa where global and local ways of making are being combined. A growing awareness of this tendency was informed by an extended period of practicing, teaching, and researching architectural technology in Africa. I embarked on a directed search for examples that demonstrate this, but I soon realised that they are shaped by ongoing tectonic transitions that highlight the encounters between techno and technē, between the global and the local, and between the global North and the global South. These binaries can and should be contested, and this study seeks to understand the underpinnings and tectonic strategies of buildings that demonstrate evidence of this contestation.

The phenomenon of tectonic hybridisation was interrogated as a case study using mixed methods consisting of literature reviews, the identification, investigation and cataloguing of works, and the analysis of key projects through primary sources and visual research methods. The literature review explored different positions related to technē, technology and tectonics, and considered theories that range from Bhabha's reading of hybridisation to Frampton, Lefaivre and Tzonis' development of Critical Regionalism. In parallel, a catalogue of buildings that exhibit a tendency towards hybridisation was produced and developed into an open access website. Subsequent analysis of this uncovered common strategies across projects which could be located within the spectrum of global and local tectonics. Further examination revealed buildings that share similar tectonic strategies, which often coalesce into constellations, and key projects within these were identified for more detailed investigation. Data was gathered through personal interviews with the architects, site visits, seminars, additional literature review, and in some instances, through co-production. The data was then analysed further through cross-comparison in the form of tables, discursive textual comparison, and visual research methods.

As a result of these investigations, a significant number of works that signal a shift towards hybridisation are revealed. Further analysis clarifies their tectonic strategies, their ethical underpinnings, and how they relate to this transitional shift. A set of criteria is proposed as a measure for recognising, studying, and evaluating contemporary architecture in Africa. The prospect of this work is to extend the field into the further investigation of hybrid tectonics.

Acknowledgements

For Cordia, Teia and Anik.

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All the architects, academics, practices, and artists who generously gave their time and shared their knowledge and work. I would particularly like to thank Alice Tasca and Francesco Stassi of *Active Social Architecture* in Rwanda, Christian Benimana and Theophile Uwayezu of *MASS Design Group* in Rwanda, Bernadette Heiermann of *RWTH Aachen University* in Germany, Simon Galland of *Collectif Saga* in Nantes and South Africa, Toshiko Mori of *Toshiko Mori Architect* in New York, Carin Smuts of *CS Studio Architects* in South Africa, Kenneth Frampton, Willie Bester, and Dirk Donath posthumously.

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The University of Cape Town for sabbaticals and research grant funding.

Key terms

African architecture **encounter** **hybrid** **tectonics**
contemporary global local search shift

African architecture:
In this study this refers to architecture that was completed in Africa during the period of investigation. These buildings were designed by architects from Africa who are based on the continent, architects from Africa who are part of an ongoing diaspora and who are practicing overseas, or architects from other continents who are working in Africa (either intermittently, through various forms of co-production, or by embedding themselves on the continent over time). The works are influenced by various encounters (as will be explored in the text) that often include positional shifts by the architects, or design and construction processes that are subject to contributions by actors from the global North and the global South. It includes situated works, some of which have particular value for being rooted in indigeneity, but it does not assume there to be a universal "type" that represents Africa, and it does not prescribe to the commodification of African identities, the use of superficial typological references, or "Africanisms".

Contemporary:
In the title of this dissertation, the word contemporary refers to the most recent decade (specifically the period from January 2010 to December 2019) during which there was a particularly prolific period of architectural production in Africa that demonstrated a shift towards hybrid tectonics.

Craft:
Craft is a localised mode of production where the mental or physical skill and the knowledge of materials or a medium is applied on a relatively small scale usually making use of manual means. This is typically performed by an individual or a group of individuals with no, or a minimal, division of labour. Where there is a division of labour, the individual craftspeople are not alienated from the thinking process and have an understanding of the entire production process or are able to perform the entire process individually should they choose to do so. It does not sever the links between thinking and making and it usually aims to prevent the alienation or dehumanisation of labour. The definition of craft is becoming broader to not only include so-called traditional artisanal modes of production and handicrafts, but to also apply to the skillful manipulation of digital software and manufacturing.

Critical Regionalism:
A term coined by Alexander Tzonis and Liane Lefaivre and developed further by Kenneth Frampton. It is a movement that essentially attempts to mediate universal civilisation, modernism, and optimised technology, with regionalist elements from a particular context. These can take the form of local tectonics, considering the local light quality, or designing with the local topography, amongst others, but the movement has often been criticised for an apparent lack of specificity. Its application in the global South, moreover, is largely based on the application of Northern tropes which are merely mediated through the application of certain Southern elements.

> ***Regionalism:*** Not to be confused with Critical Regionalism, regionalism is a broader term that encapsulates various degrees of vernacularisation and design that favours local materials and contexts. Early proponents like Lewis Mumford located regionalism in opposition to the so-called International Style. It has often been applied uncritically as a branding device or a form of camouflage for Modernism, and in some instances it has been employed to promote provincialism, retribalisation or nationalism. Tzonis and Lefaivre see Critical Regionalism as a movement that developed out of regionalism.

Encounter:
This refers to the meeting of, and to the meeting points, between different ways of making, and between the global and the local. It entails an interaction with *otherness*, and it includes social and productive encounters between contributors from different contexts, the physical encounters between older and newer tectonics, and between global and local tectonics.

Global:
The term *global* in this study refers to globalised value systems as they relate to architectural production and tectonics. These systems are typically highly industrialised, and they are prone to normative application; they make use of mechanised production, mass-production, and they include the latest digital design and fabrication technologies, all of which are globally accessible or applied. These technologies are not necessarily placeless, and they can be found in close proximity to localised productive technologies. They are also often criticised for being driven by optimisation, efficiency and profit, which can result in the exploitation of social and environmental resources.

Hybrid:
In this study, the term *hybrid* is used to describe the combination of global and local tectonics. During the scoping phase of the research, it refers merely to the simultaneous employment of global and local tectonics, but through the analysis of the case its meaning evolves to require a measure of mutual subversion where global and local tectonics become inextricable, both visually and physically. While a hybrid is usually regarded as a *fait accompli*, hybridisation is a process, which is how it is used in this study to understand an emerging condition.

Local:
The term *local* in this study refers to local and localised (outside influences that have been adapted for local applications) modes of architectural production and tectonics. These refer to the use of local materials, locally available skills, or traditional techniques that are to be found in close proximity to a particular place (within a particular country or region, but often sourced within 50km), but they also refer to situated modes of production that embody a measure of uniqueness which is not based on the normative application of global tectonics. Local tectonics include materials that are to be found locally in their natural form, but they can also be reused, repurposed or recycled materials (downcycled, recycled and upcycled) that have been locally procured.

Search:
This is an ongoing process of identifying, analysing, and cataloguing contemporary works of architecture in Africa that demonstrate a shift towards hybrid tectonics. It is informed by various theoretical positions as explored in the text, architectural practice on the continent, and my own embedded experience of practicing, researching, and teaching in Africa. The search began some time before the period of formal study, and will most likely continue long afterwards.

Notes:

1. References related to the key terms are provided in the relevant chapters.

2. Despite the apparent and artificial evolution of technology and craft, of the global and the local, and of the global North and the global South as opposing binaries, these tropes are in fact intertwined. Craft is a form of technology and technology includes various forms of craft in its design, establishment, production process or maintenance. Even the most basic forms of craft and handicraft make use of fixed or handheld industrially produced machinery, while most forms of industrialised production require human skill (mental or physical) and knowledge of materials. Similarly, virtually every place on Earth is currently influenced by aspects of both the global and the local, while the global North and the global South also co-exist as ideas and physicalities.
Because of this conundrum and in line with the evolution of definitions or their more contemporary interpretations, some of the terms described in the glossary supersede or envelop others as the thesis progresses from earlier writings to more contemporary works. Many of the older texts use a now outdated definition of craft which is not inclusive of various current modes of digital and decentralised production, which means that the word "craft" is gradually absorbed in the category of "local tectonics" which includes traditional craft, handicraft, incremental production, and the mostly manual application of local materials, but it also embodies the representational values of elements that are unique to a specific place.

In the same way, the use of the term technology which formerly referred to industrial manufacturing or mass-production, is eventually superseded by the use of "global tectonics" which includes industrialised mass-production, mechanised production, and digital design and production, but specifically when it is used in a normative way that is representative of universality and global tectonics.

Shift:
A move from one condition to another; in this study it refers to an emergent condition of tectonic hybridisation, and it also refers to a change in positionality in terms of physical location or approach.

Technē:
This is a word that has its roots in ancient Greece, and which refers to the mental and physical knowledge and skills of craftspeople. It is concerned with the arts of thought and of physical expression, which links the means of production with the end product. It later becomes subsumed by the use of the term *technology*, but its meaning is explored in more detail in the body text.

Technology:
The word technology (sometimes shortened to "techno") has its roots in the terms *technē* and *logos,* and it is the practical application of knowledge based on observation and experimentation. While authors like Heidegger use it to describe exploitative industrialisation and mechanised production (as opposed to craft or handicraft), this study recognises both global and local modes of production as technology and the use of the term shifts accordingly. Traditional or hand-based modes of production (local skills, craft, and handicraft), and industrialised modes of production (which include digital production techniques, mechanised production, and mass-production) are all technological. The word *contemporary* is purposefully avoided, since many traditional skills and crafts are still used extensively and hence, are also contemporary.

Tectonics:
Tectonics is primarily concerned with making, and it is a strategy that is often used to contribute to more situated forms of architecture. It refers to the artful employment of material and construction. While it is commonly used as a way to describe lightweight or skeletal construction systems (as opposed to stereotomic systems), this study regards it as something that transcends the mere expression of structure by encompassing the act of making (which includes design and construction), material properties, and structural expression, in an artful manner.

Preface

Unknowingly, my interest in technology probably began at the age of four with the construction of "informal" shelters in my grandparents' living room in Namibia. This regular design-build practice made use of locally available skills (mine), and locally available found materials that combined global tectonics (the mass-produced living room furniture and camping mattresses) and local tectonics (the self-assembled infill of hand-crafted items made by my grandfather and handmade blankets crafted by unknown family members).

This interest in the combination of different tectonics was developed during my architectural studies at the University of Pretoria and over more than twenty years in practice where I had the occasional opportunity to test combinations of different tectonic approaches, although I was not able to articulate them at the time. This practice was galvanised through an extended personal engagement with design-build projects in *Imizamo Yethu*, through small contributions to design-build projects by others (including the Guga S'Thebe Theatre and the Village of Hope in Grabouw), and further through an award-winning entry[1] into the Solar Decathlon Africa, which took place in Morocco in 2019.

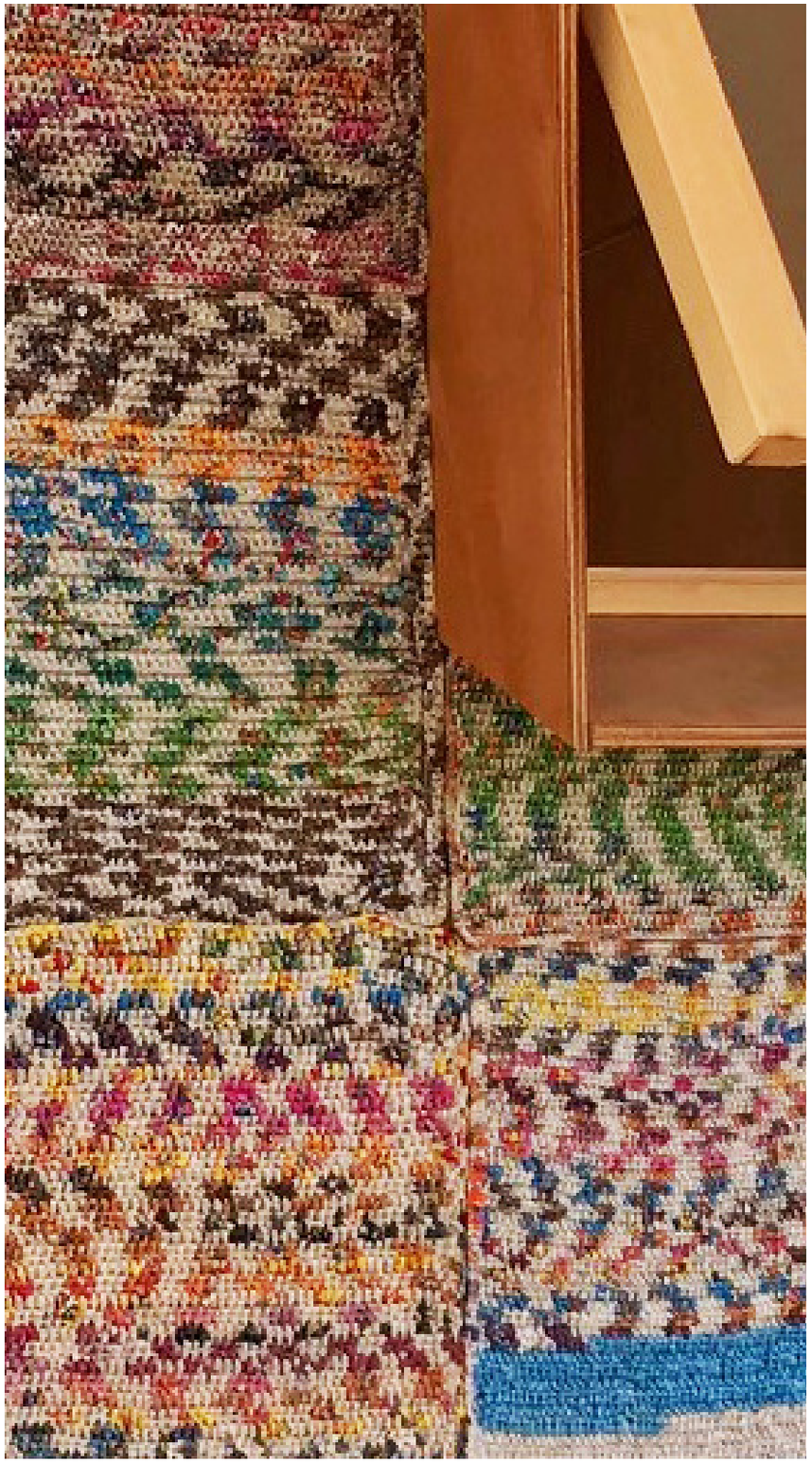


Figure 1:
A more recent experiment in combining global and local tectonics using a different type of hand-made "blanket": Crocheted cladding panels made from recycled plastic bags by ladies from The Plastic Project *in Franschhoek are fitted over the water-proofed lightweight timber framework of House Mahali at the Solar Decathlon Africa held in Benguerir, Morocco, in 2019. Author[3] with Team Mahali. Source: Team Mahali..*

The completion of two post-graduate degrees in Sustainable Development at the University of Stellenbosch's Sustainability Institute facilitated a deeper awareness of the encounter and of the relationality between people and between humans and the environment, while teaching technology at undergraduate and postgraduate level at the University of Cape Town's School of Architecture, Planning and Geomatics provided me with the background knowledge that enabled me to build a body of research and writing on architectural technology over the past eight years. This required engagement with many architects working in Africa about their approaches to, and employment of, technology, and it involved the analysis of numerous projects and their construction details. Through this practice and research, an intangible awareness began to grow about certain commonalities in contemporary architectural technologies used in Africa, which tended to evaporate as soon as I tried to concretise them.

The revelations in this study build on the body of work that emanated out of my studies at the Sustainability Institute which were endemic to ethical practice, and it brings this into the realm of the built environment and tectonics which is reinforced by my teaching and research at the University of Cape Town. Practice experience in both the global North and the global South enabled a better understanding of different conditions, while lived experience in the global North and the global South has and is contributing to an increased awareness of my own and others' experiences of otherness[2].

The search for hybrid tectonics was long, difficult, and one of many meanderings since it was a searching for something fluid and not yet known, but thanks to the generosity of many architects, academics, and students who shared their work and experiences, the path became clearer over time - it seems it takes a village after all.

Notes

1 Known as Team Mahali, *this was a joint entry between the University of Stellenbosch and the University of Cape Town which was awarded second place in the Architecture Contest.*
2 Especially through various engagements and experiences during and after the Rhodes Must Fall *and* Fees Must Fall *protests.*
3 As Architectural Team Leader.

Chapter 1: Introduction

Proposition

Architectural production is influenced by tectonic transitions, and especially during the last three centuries this has contributed to the establishment of binaries such as techno versus technē, the global versus the local, and the global North versus the global South. This study argues that these binaries can and should be contested, and it locates the making of contemporary architecture in Africa within a spectrum that includes global tectonics (in particular industrialised production and digital manufacturing) and local tectonics (which includes the use of local architectural elements and materials, decentralised production techniques and “traditional” crafts or handicrafts).

When considered separately, these modes of production or paradigms are often criticised: The former is largely predicated on optimisation and increasing the speed and efficiency of production, and it is often accused of excessive resource use and the dehumanisation of production, while the latter most likely cannot provide sufficiently for a continuously increasing demand of goods and is often accused of being elitist and overly nostalgic. The encounter between global and local tectonics is a space of discomfort, but it is also one that can allow for an ethically rooted practice that challenges the status quo. This space of discomfort is especially evident in the global South, and particularly in Africa, where several waves of colonialism and neo-colonialism overwrote and are over-writing local tectonics to a large extent. Globalisation and the increased use of digital production seem to be at odds with a deep-rooted need for the preservation of localised identities and modes of production, and the rediscovery or valorisation of indigenous knowledge systems and localised skills.

This clash of productive technologies and identities is a continuing phenomenon in the so-called post-colonial era, and the problem is essentially how these two paradigms can (and must) be combined to challenge preconceived notions of the other, while combining the advantages of both. The pioneering euphoria of digital production and the prevalence of global industrialisation has to be tempered and infused with local making, memory and identity.

A tacit awareness of an emerging form of architectural practice in Africa that combines global and local tectonics prompted me to embark on a search for representative examples that show evidence of this. My own interest, practice, and research in architectural technology informs this search, as does an awareness of the need for ethically rooted practice that recognises how long-term sustainability should influence the making of buildings.

The proposition is essentially that there is a tendency in contemporary architecture in Africa where global and local tectonics are being hybridised. Inversely, this can be framed as a question whether global and local tectonics are being hybridised in contemporary architecture in Africa. If this is occurring, one will need to discern whether it is widespread and whether specific contemporary approaches or tectonic strategies towards hybridisation can be identified. This will require an investigation into what informs these approaches and what their influences and underpinnings are. Furthermore, an understanding of how hybridisation or the combination of global and local tectonics have been theorised to date will be required. If these investigations prove fruitful, it also raises the question whether criteria can be developed to identify and evaluate works of this kind.

Consequently, the study will aim to identify, investigate, and analyse specific contemporary examples of situated architectural practice in Africa that demonstrate this phenomenon. Furthermore, the ambition is that the search should not only uncover representative examples, but that their underpinning influences – both theoretical and practical – and their tectonic strategies might be revealed, leading to the identification of certain commonalities and forms of practice that demonstrate a certain positionality, thereby charting a way forward for further research and practice.

Scope of enquiry

The scope of the enquiry is an investigation into the phenomenon of contemporary architecture in Africa that shows evidence of a shift towards the hybridisation

of global and local tectonics. Initial examination revealed that the last decade was particularly fruitful in this regard, hence buildings that were completed from 2010 to 2019 were identified for analysis. Edgerton observes that “In relation to technology the poor world is especially invisible” (2007: 85), and he writes that “The story of the poor world and technology if it is told at all is one of transfer, resistance, incompetence, lack of maintenance, and enforced dependence on rich-world technology. Imperialism, colonialism, and dependence were the key concepts, and the transfer of technology from rich to poor, the main process” (2007: 92; 2019: 39). While this trend is shifting to some extent through the work of contemporary Southern scholars and architects, especially emergent ones from Africa, there is still much work to be done to tell the stories of technology in Africa. Much has been written about the history of technology and tectonics from a Northern perspective, and there is a wide body of literature that engages with the dichotomies between the global and the local, but the global South, and particularly Africa, is underrepresented in architectural technology discourse.

Iain Low argues that “Technology and the interpretation of local materials and labour present a particularly suggestive site of investigation for ‘non-West modern’ in Africa” (2012: 140). This is echoed by Edgerton when he observes how “We don’t have a good account of the distinctiveness of the new poor world as it emerged in the twentieth century. We have neither an appreciation of the significance of ‘traditional’ technologies… nor those brought by colonising states, nor indeed that came in from the rich world”. He goes on to say that “we need to go further and see the poor world as a distinctive *technological* world, not merely a derivative one” (2007: 94). Lesley Lokko (2017: 8) notes how Africa is “confined by the expectation of being influenced rather than influencing”, while Clapperton Mavhunga (2017: ix) writes in a similar vein that:

> *“…Africa appears on the technological map of the world as a blank or as a problem – in fact, as an oceanful of problems – to be solved. But solved by whom? It was very clear to me at the turn of the century that science, technology, and innovation seemed to be things inbound from somewhere outside Africa, usually the West – hence the whole notion of technology transfer as a North to South or West to non-West flow that would* finally *lift the continent up the development ladder in the hope that perhaps, one day, Africa would be developed. Therefore, the basis of the conversation about Africa was that it was a recipient of science, technology, and innovation, not a maker of them.”*

While the transfer of architectural technology between the North and South is still taking place, there is an emergent counter-transfer where contemporary works in the South that combine global and local tectonics are influencing global architectural discourse. This study aims to contribute new knowledge to document the story of technology in Africa as it emerged out of the twentieth century and how it is being shaped in the twenty-first. It locates itself within the emerging and unstable field of architectural hybridisation in Africa, and the literature builds on the work of Homi K. Bhabha, Kenneth Frampton, Martin Heidegger, Liane Lefaivre, Achille Mbembe, Alexander Tzonis and others, to understand the encounters between the global and the local and to establish a set of criteria for the evaluation of the empirical evidence that emerges out of contemporary practice in Africa. The creation of an extensive catalogue which documents more than a hundred architectural works that were completed from the beginning of 2010 to the end of 2019, led to the identification of a series of approaches towards the combination of global and local tectonics. These approaches were then analysed further through particular constellations of works to theoretically and visually demonstrate the argument that hybrid tectonics offers a possible direction for contemporary architectural praxis in Africa that emerges through the encounter between the global and the local. The new knowledge finds itself in the identification of hybrid tendencies in architectural theory and production from the beginning of the previous century, in the creation of an online African architectural catalogue, the discovery of common tectonic strategies, the identification of representative constellations, the analysis of empirical data gathered during interviews and project visits, the establishment of criteria for analysis, and the suggestion of an approach towards hybrid tectonics which, it is hoped, can inform future research and practice in Africa and beyond.

Assumptions and limitations

This study investigates the tectonic encounters which inform contemporary architectural practice in Africa, and the tectonic approaches and strategies that emerge out of this through the combination of global and local tectonics. The historic trajectory of encounters between the global and the local is traced through literature review from the beginning of the previous century and not before, although a few key influences from the nineteenth century are mentioned in the text. The focus of the research is limited to buildings completed in Africa during the last ten years, meaning that the construction of the buildings had to have been completed between the beginning of 2010 and the end of 2019. Again, a few key architectural works that precede this period are touched on, but they serve only to inform the projects being investigated. The projects that were analysed are limited to public buildings only[1], and the projects have to demonstrate some attempt towards the hybridisation of global and local tectonics. Since the study revealed that most of the projects where there was an attempt at hybridisation involved some form of encounter between contributors from the global North and from the global South, this North-South exchange also became a consideration. Purely commercial or private projects, unbuilt projects, projects where the making of the building was not influenced by a South-North or North-South shift or exchange, and projects that do not show the intent to combine different tectonic approaches are not included in this study.

Since the encounter between the global North and the global South - both in terms of tectonics and contribution - is a common denominator in the projects of this nature that have been identified, it also allows some reflection on past colonial and post-colonial architectural practices. While a complete exploration of these practices and current theories on post-colonialism and decoloniality (including hybridity) falls outside the scope of this thesis, it is accepted that these themes inherently inform architectural production in Africa in the present, and hence selected texts were used as points of reference for the architectural analysis.

As Mavhunga (2017: 5) says, most writing about technology in the global South is about the deployment of Northern technologies during the twentieth century, which negates the existence of previous local technologies. The emphasis is placed on Northern technology, which undermines the importance of African, middle Eastern and Asian discoveries and innovations. While this is acknowledged, and the inherent potential of thousands of years of rich technological innovation in pre-colonial Africa is recognised, an extensive historic survey of pre-colonial practices falls beyond the scope of this study. Rapid globalisation and mass-production increased exponentially since the beginning of the previous century, which exacerbated the encounters between new technologies and older ones; it is during that century that the actions of humankind began to affect the planet exponentially, resulting in the current age being termed the Anthropocene[2]. It is also during that time that many philosophers and architects began to write about the inherent dangers of technology and about the opportunities that globalisation offered while in the global South, numerous countries gained their independence and emerging out of these transitions, many writers began to grapple with the need for

past meanings and memories to be valued, or to embrace pluralism and hybridity. For these reasons the study has been limited to the twentieth and twenty-first centuries only.

The empirical portion of the study focuses on the second decade of the twenty-first century, but it is important to trace the technological trajectories that were theorised and practiced in the global North from the beginning of the twentieth century and how these led up to many of the social and environmental concerns that architects are still grappling with in the North and South. Mavhunga warns that "The language of STS [Science and Technology Studies] generated from Western philosophical and empirical contexts is also exported and used to order Asian, African, and Latin American knowledge and practices, thus reducing local, non-Western registers to raw material for the scholars' own intellection" (2017: 5).

While this study draws on Northern writing and practice that grappled with the compounding technological transitions of the twentieth century, this is balanced by established and emergent writing and practice in the global South, and it is written from a Southern position and perspective. Another critique by Mavhunga is that writings on technology usually trace European or American practitioners or technologies without looking at the contributions from, or conditions in, the global South. Again, this is recognised, and many of the works that show some attempt at hybridisation as uncovered during the scoping involve some form of diaspora from South to North or North to South, while they are also acutely influenced by their Southern contexts. These architects have different approaches towards encounter, and their approaches generally show a shift from the past habits of mediating Modernism according to the doctrines of movements like Tropical Modernism or Critical Regionalism.

Given the scope of the study, my own experience in the practice, teaching and research of technology in Africa has provided me with an embedded lens that helped me to grapple with the complexities mentioned above. This study is not about the buildings in use, nor is it an analysis of their users' lived experience. It is also not an in-depth investigation into the so-called practice of design-build or into Actor Network Theory. Rather, it is about trying to understand, from a tectonic point of view, the drivers and strategies of their design and making, and to learn from their final realisation. In this way the study is not a user-centric enquiry, but a tectonic one.

Chapter 1 endnotes

1 Public buildings lend themselves to discursive analysis due to their potential for social contribution and benefit, the fact that their making allows for iterative application, their scope for innovation, and since they usually tend to benefit from larger budgets than private architecture.
2 According to Swilling (2020: 8), this is because humans have now become a geophysical force.

Chapter 2: Research design and method

This study did not begin with a premeditated framework, theory, method, or case study in mind. Rather, it emerged out of an increasing awareness of tectonic commonalities within an emerging body of architectural works in Africa which all seemed to make use of a combination of different tectonic approaches or modes of production. It was a search that was conducted over an extended period of time in research and practice, and it began some time before the commencement of the formal study. This search eventually resolved itself into a case study of the phenomenon of architectural hybridisation in Africa, the aim of which is to contribute new knowledge based on "careful empirical analysis of what actually exists, and critical reflection on how it has come to be that way" (Duminy, Andreasen, Lerise, Odendaal and Watson, 2014: 1). As Yin (2009: 18) confirms, "A case study is an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident". The study includes a body of contemporary architectural works in Africa that exhibit evidence of an attempt towards a hybridised form of architectural production, which locates itself between the global and the local. These works are analysed from a tectonic point of view which is predominantly based on qualitative analysis, although there is some quantitative[1] data that was gathered through a review of technical information and interviews with the architects.

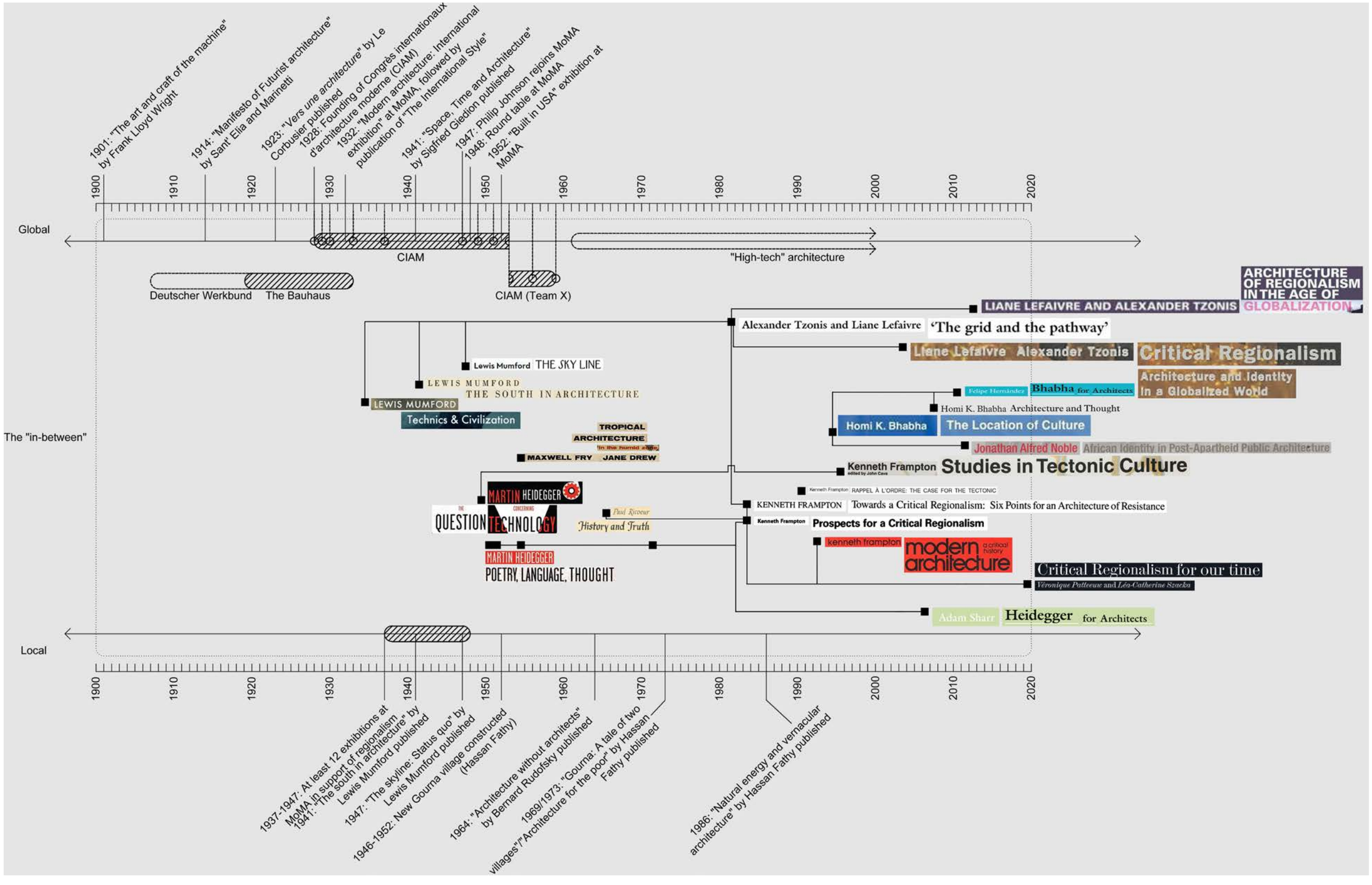

1901: "The art and craft of the machine" by Frank Lloyd Wright
1914: "Manifesto of Futurist architecture" by Sant' Elia and Marinetti
1923: "Vers une architecture" by Le Corbusier published
1928: Founding of Congrès internationaux d'architecture moderne (CIAM)
1932: "Modern architecture: International exhibition" at MoMA, followed by publication of "The International Style"
1941: "Space, Time and Architecture" by Sigfried Giedion published
1947: Philip Johnson rejoins MoMA
1948: Round table at MoMA
1952: "Built in USA" exhibition at MoMA
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020
Global
CIAM
"High-tech" architecture
Deutscher Werkbund
The Bauhaus
CIAM (Team X)
ARCHITECTURE OF REGIONALISM IN THE AGE OF GLOBALIZATION
LIANE LEFAIVRE AND ALEXANDER TZONIS
Alexander Tzonis and Liane Lefaivre 'The grid and the pathway'
Liane Lefaivre Alexander Tzonis Critical Regionalism
Architecture and Identity in a Globalized World
Lewis Mumford THE SKY LINE
LEWIS MUMFORD THE SOUTH IN ARCHITECTURE
LEWIS MUMFORD Technics & Civilization
Felipe Hernández Bhabha for Architects
Homi K. Bhabha Architecture and Thought
Homi K. Bhabha The Location of Culture
Jonathan Alfred Noble African Identity in Post-Apartheid Public Architecture
TROPICAL ARCHITECTURE in the humid zone
MAXWELL FRY JANE DREW
Kenneth Frampton edited by John Cava Studies in Tectonic Culture
MARTIN HEIDEGGER CONCERNING THE QUESTION TECHNOLOGY
Paul Ricoeur History and Truth
Kenneth Frampton RAPPEL À L'ORDRE: THE CASE FOR THE TECTONIC
KENNETH FRAMPTON Towards a Critical Regionalism: Six Points for an Architecture of Resistance
Kenneth Frampton Prospects for a Critical Regionalism
kenneth frampton modern architecture a critical history
MARTIN HEIDEGGER POETRY, LANGUAGE, THOUGHT
Critical Regionalism for our time
Véronique Patteeuw and Léa-Catherine Szacka
Adam Sharr Heidegger for Architects
The "in-between"
Local
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000 2010 2020
1937-1947: At least 12 exhibitions at MoMA in support of regionalism
1941: "The south in architecture" by Lewis Mumford published
1947: "The skyline: Status quo" by Lewis Mumford published
1946-1952: New Gourna village constructed (Hassan Fathy)
1964: "Architecture without architects" by Bernard Rudofsky published
1969/1973: "Gourna: A tale of two villages"/"Architecture for the poor" by Hassan Fathy published
1986: "Natural energy and vernacular architecture" by Hassan Fathy published

Figure 2 (previous page): *Key writings situated between the global and the local. This diagram highlights some of the key sources that were studied during the first literature review and that attempted to promote a form of mediation between the global and the local. The literature is shown in the space between the global and the local, and the works are positioned in relation to certain events that represent the binary positions of the global and the local. The list is by no means exhaustive, but it aims to establish a temporal relationality between events and to show linkages between works. The second literature review focused on emergent writings from the global South (particularly by Bâ, Mavhunga, Mbembe and others) which are not included here since they are not necessarily linked to these earlier works. Source: Author.*

The study is conscious of Hérnandez's critique that "…buildings produced by non-western architects – or in countries outside Europe and North America – are always historicised and theorised in relation to European architecture" (2010: 7), and of Noble's observation that African architectures have been mostly lost, destroyed or marginalised by colonisation, which meant that "…the only practical way to proceed is to work from within existing theories and practices of architecture, that is to say, to work from within the Western discourse of architecture but to do so by interrupting it with imaginations, and practices that were previously denied" (2011: 54). While the case study of contemporary African architecture is informed by some of its theoretical and practical antecedents in the global North, it is conducted from a Southern position and perspective, and it builds theory using emergent literature and architecture from the global South to do so. Its aim is to document and analyse contemporary architecture in Africa discursively and to contribute to technological discourse from within the continent.

The case study employs a mixed method approach, which makes use of "multiple sources of evidence" (Yin, 2009: 98; Duminy *et al*, 2014: 33) and allows for a more nuanced view of reality (Flyvbjerg, 2006: 223). It began with a wide scoping of writings on technology and tectonics, a grounding in the concepts of technological and industrial revolutions, and an in-depth literature review.

First literature review

The first literature review included an intensive reading of Martin Heidegger's works, especially *The question concerning technology* (2011) which, together with other works, led to the realisation that there is a continuing encounter and polarisation of debates between industrialisation and craft but that there is opportunity in the space between them. This polarisation of debates was reflected in a similar polarisation of architectural works, but there were also moments, both in theory and practice, which reveal a searching for a more hybridised approach to making. These moments are traced from the global North and into the global South as they manifested themselves throughout the twentieth century while being conscious of Mavhunga's call for the recognition of Southern perspectives, contributions, and conditions (2017:4)[2].

Figure 3: *Sample library, MASS Design Group's offices, Kigali, Rwanda, 2019. It clearly demonstrates extensive research into the use of local materials and labour. Samples of locally produced clay roof tiles, locally made compressed earth bricks, laterite blocks, and others which were used in the buildings that are analysed as part of this study are all visible. Source: Author.*

Second literature review

The encounters between the global and the local and specifically between the global North and the global South, and attempts to work in the space between them, led to a second intensive literature review after the empirical phase of the study, but this time from a Southern perspective through the eyes of Bâ, Bhabha, Mavhunga, Mbembe and others in order to better understand the notion of hybridity and the current African context. A number of types of encounter emerged out of the literature review, and these, in turn, informed the development of criteria for analysis.

Creation of the catalogue

According to Duminy *et al*, "the case study calls for an intensive process of contextualisation, and thus its conduct and interpretation can foster a more 'nuanced' understanding of African urban spaces and planning practices" (2014: xiv). This contextualisation was done through the literature review, but in parallel with that, the creation of a catalogue (Appendix A) was initiated where contemporary architectural works in Africa that exhibit an attempt towards a hybridised tectonic are being documented. The first set of works was selected based on textual and visual research[3] which initially began in the form of a "scrape", but it evolved into a more thorough excavation of African and other international architectural websites, educational websites, awards programs, and architectural journals[4]; the relevant project data was documented, and GPS coordinates were verified for all the buildings although many were not available. In these instances, the buildings were geographically located through further research to make the individual projects' information as complete as possible. More than a hundred buildings have been included to date, but the catalogue is not necessarily exhaustive, and the aim is for it to be a living document that can be extended within the current timeframe of the research project and beyond. The catalogue also allows for links to be traced between contributors and events over time, which is highlighted as an important part of case study research by Duminy *et al* (2014: 24). In keeping with the theme of hybridity, the catalogue itself is available as a document, but it has also been developed into an open access website in the hope that it may offer a springboard for further research.

As elaborated in the proposition, the tectonic strategies of every

Rwanda	ECCD and ECD&F Centres, Busogo School, Gasanze Pre-Primary, and Refugee Camps Education Centre	ASA (Rwanda & Italy)	2012-2016	Rwanda	Various (Gasanze indicated at 1°52'32"S 30°06'07"E)		Steel reinforcing	Reed ceilings	Local stone, clay & reeds	Repurposed steel packaging used for insulation	Locally made fired bricks
Rwanda	Kintobo Health Centre	ASA (Rwanda & Italy) & TAMassociati (Italy)	2016	Kintobo, Nyabihu District, Rwanda	1°36'24"S 29°33'12"E		Steel, concrete, polycarbonate		Local stone, cane for shaders	Repurposed steel packaging used for insulation	Locally produced pavers & blocks
Rwanda	RLS Dormitory	ASA (Rwanda & Italy)	2016	Rwamagana Lutheran Secondary School	1°56'25.14"S 30°25'55.59"E		Steel trusses & concrete, steel doors and windows	Compacted clay floors, reed screens	Local stone, local clay, lime and reeds	Repurposed steel packaging used for insulation	Locally made fired bricks
Rwanda	Rugerero Health Centre	ASA (Rwanda & Italy)	2018	Rubavu, Rwanda	1°41'16"S 29°17'45"E		Steel trusses, steel roof sheeting, steel doors and windows	Compacted clay floors, reed screens	Local stone, local clay, lime and reeds	Repurposed steel packaging used for insulation	Locally made fired bricks, stone foundations
Rwanda	Umubano Primary School extension	ASA (Rwanda & Italy)	2018	Kabeza, Kigali, Rwanda	1°58'13"S 30°07'04"E		Steel trusses and roofing, steel doors and windows, concrete frame		Reed screens, local clay	Repurposed steel packaging used for insulation	Hand-made bricks
Senegal	Thread Artists' Residency and Cultural Centre	Toshiko Mori Architect (USA)	2015	Sinthian (Koular), Tambacounda Region, Senegal	13°20'16.65"N 13°37'16.98"W		Parametrically modelled roof	Steel & concrete structure	Roof	Clay, bamboo, thatch	Reused tile fragments	Walls and roof construction

Figure 4: *Two cropped sections that were extracted out of the catalogue in Appendix A: The extract at the top is demonstrative of a vertical selection of a particularly prolific practice that has completed a number of projects over time. The extract at the bottom is demonstrative of a horizontal selection of a project that includes tectonic strategies in all of the sub-categories. Source: Author.*

building that has been assessed to date are documented in the catalogue and are assessed across the spectrum of the global and the local. Based on analysis, this spectrum was rationalised into a series of more specific sub-headings. This led to the key discovery that there are certain common tectonic strategies across architectural works and while these could be grouped in various ways, the use of 1. Global tectonics in combination with local natural materials, crafts or climatic strategies, 2. Global tectonics in combination with reused, repurposed or recycled content, and 3. Local tectonics in combination with computer-aided design and/or manufacturing, offered three categories with interesting discursive potential. The research further revealed that these common tectonic strategies are often concentrated in constellations that are sometimes geographically clustered. According to Duminy *et al* (2014: 22) the notion of *boundedness* in a case study is essential even if a case is a system and accordingly, these constellations were analysed more intensively.

The selection of emblematic works as key project studies

Based on information that was uncovered through the catalogue, a selection of emblematic works was made either vertically where an especially prolific architect or practice completed a number of works over a period of time, or horizontally where a specific project exhibited tectonic strategies across all the sub-categories. In the first case, a specific project of the relevant practice was selected for further analysis, which represents what Flyvbjerg (2001: 79) and Duminy *et al* (2014: 28) refer to as a *typical* or *representative* type (of for example the work of MASS Design Group), while the latter represents what they refer to as *extreme* or *deviant* cases which are particularly rich and revealing, and potentially allow for the generation of additional hypotheses as demonstrated by the Thread Centre by Toshiko Mori Architect (Flyvbjerg, 2001: 79; Levy, 2008: 13). Using smaller units of investigation within the case allows for the examination of specific phenomena in more detail (Yin, 2009: 50) in what Duminy *et al* refer to as an “embedded approach” (2014: 33). These emblematic projects were more intensively analysed using visual research methods[5], literature, interviews with the architects in their practices or places of work, seminars, and project visits as far as possible[6]. This allowed for the three constellations that emerged out of the three common strategies to be unpacked through the investigation of specific situated works. These investigations revealed specific modes of practice in each constellation: Accompaniment and adjacency in the case of Rwanda, didactic collages in the case of South Africa, and textile tectonics and hybrid potentials in Senegal.

Figure 5:
A reductive collage analysis of the Umubano Primary School extension in Rwanda. These collages were used to analyse and test the visual weighting of the global tectonics (top) and the local tectonics (below) that were employed. Source: Author.

Primary sources

Personal interviews were conducted with the architects of the key case studies, in their place of work as far as possible: Alice Tasca and Francesco Stassi of Active Social Architecture (ASA) in Kigali, Rwanda, Christian Benimana and Theophile Uwayezu of MASS Design Group in Kigali, Rwanda, Simon Galland of Collectif Saga in Port Elizabeth, South Africa, Carin Smuts of CS Studio in Cape Town, South Africa, Bernadette Heiermann of the RWTH Aachen University in Aachen, Germany, and Toshiko Mori of Toshiko Mori Architect remotely. Additional interviews and personal communications were conducted with Dirk Donath of the Bauhaus Universität Weimar/EIABC in Cape Town, South Africa, and with Kenneth Frampton of Columbia University via email. Interviewing the architects in their offices or places of work contributes to the understanding of their practice: These spaces are mnemonic devices, where spatial practice can be observed, where unpublished and unrealised projects can be discovered, and where libraries and material libraries can also offer insights into their material investigations.

Site visits were conducted to the key case studies as far as possible: These include Umubano Primary School in Kigali, Rwanda, by MASS Design Group, Umubano Primary School extension in Kigali, Rwanda, by ASA, Silindokuhle Preschool by Collectif Saga and Uncedo in Port Elizabeth, South Africa, and the Guga s'Thebe Theatre by RWTH Aachen University, PBSA Düsseldorf, Georgia Institute of Technology and CS Studio in Langa, South Africa. Unfortunately the Thread Artists' Residency and Cultural Centre by Toshiko Mori Architect in Sinthian, Senegal, could not be visited due to the onset of the Covid-19 pandemic. A number of other projects designed by these architects were also visited to provide a deeper understanding of their methods[7], and in some instances, the author had the opportunity to collaborate with them in teaching or practice[8].

The study is primarily concerned with the design and making of the architecture, its underlying drivers, realisation, and its execution and although important, its operation in use and ongoing performance fall outside the scope of this study; hence, interaction with the buildings' owners or users was limited, but conversations with the building owners or users took place during every project visit and informed some of the findings. The practice visits and site visits were a key part of the research, and they confirmed Flyvbjerg's view (2006: 236) that "...the most advanced form of understanding is achieved when researchers place themselves within the context being studied."

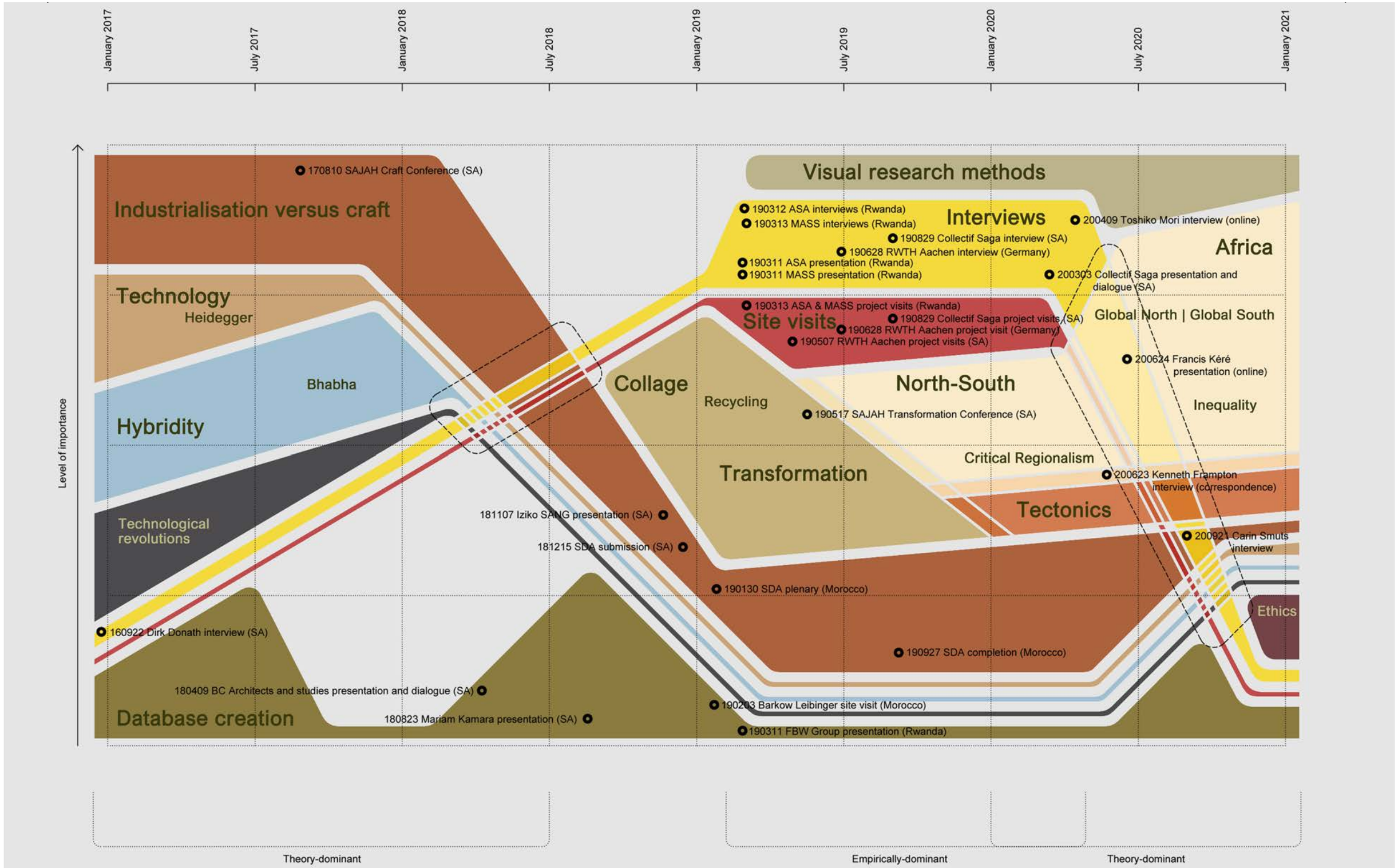
Visual research methods

The visual research methods that were used to analyse the buildings allowed for what Duminy *et al* refer to as "'intensive analysis', which arises out of the utility of the case study as a way of recognising and understanding complexity" (2014: 23). Photos of the buildings were used in the interviews to tease out the origins of materials and labour for each project. These were graphically represented, and each project was then analysed further to determine the visible balance between global and local tectonics, which is demonstrated through reductive collages. Shields (2014) regards collage as a valuable instrument for architectural analysis and design, and by not only undertaking "a study 'about' the visual, but also working 'through' visuals and visualisations" allows for the analysis of the material and immaterial aspects that influence a building's making (Pauwels and Mannay, 2019: 2). Pauwels and Mannay go on to say that "the effects of the visual product may reside in other modalities, such as the distribution of labour and economic requirements" (2019: 3), which is part of what the collages aim to demonstrate.

Flow of the research

The art of encounter informed the method, where social encounters through interviews and physical encounters through site visits contributed unique knowledge, while the concept of visual encounter between North and South was explored through collage practice of the selected projects. Once the empirical research in the form of interviews and project visits was well-advanced, the study reverted back to further analysis of literature and information gathering by way of correspondence. This centred on architectural writing and practice in the space of discomfort between the global and the local, the discourse on Critical Regionalism, tectonics, ethics, inequality, emerging theory from Africa, and the further consolidation of the themes that were researched previously.

The research process (like many) was non-linear, which generated a feedback loop that allowed for both parallel processes and iteration to occur. Northern and Southern literature and practice were analysed simultaneously, which is a strategy that is supported by Sanyal (2014: 106) and Mercer (2008: 8) in that "'it is precisely the mutual entanglement of western and non-western practices' – the intersections of the various temporalities – that must be meticulously investigated to 'enhance our understanding in incremental steps'".


January 2017
July 2017
January 2018
July 2018
January 2019
July 2019
January 2020
July 2020
January 2021
Level of importance
Industrialisation versus craft
170810 SAJAH Craft Conference (SA)
Technology
Heidegger
Bhabha
Hybridity
Technological revolutions
160922 Dirk Donath interview (SA)
Database creation
180409 BC Architects and studies presentation and dialogue (SA)
180823 Mariam Kamara presentation (SA)
Visual research methods
Interviews
190312 ASA interviews (Rwanda)
190313 MASS interviews (Rwanda)
190829 Collectif Saga interview (SA)
190628 RWTH Aachen interview (Germany)
190311 ASA presentation (Rwanda)
190311 MASS presentation (Rwanda)
200409 Toshiko Mori interview (online)
200303 Collectif Saga presentation and dialogue (SA)
Site visits
190313 ASA & MASS project visits (Rwanda)
190829 Collectif Saga project visits (SA)
190628 RWTH Aachen project visit (Germany)
190507 RWTH Aachen project visits (SA)
Collage
Recycling
North-South
190517 SAJAH Transformation Conference (SA)
Transformation
181107 Iziko SANG presentation (SA)
181215 SDA submission (SA)
190130 SDA plenary (Morocco)
190927 SDA completion (Morocco)
190203 Barkow Leibinger site visit (Morocco)
190311 FBW Group presentation (Rwanda)
Africa
Global North | Global South
200624 Francis Kéré presentation (online)
Inequality
Critical Regionalism
200623 Kenneth Frampton interview (correspondence)
Tectonics
200921 Carin Smuts interview
Ethics
Theory-dominant
Empirically-dominant
Theory-dominant

A research flow diagram (Figure 6) shows the approximate flow of the different research methods, topics, and key moments from January 2017 until January 2021. The development of the catalogue (Appendix A) is shown as a continuous process at the base of the diagram, with a few peaks and valleys which were largely capacity-driven. During the first year, the literature review and textual research took precedence and accounted for the bulk of the work: Topics like industrialisation versus craft, technology (particularly through the work of Heidegger), hybridity (particularly through the work of Bhabha, and technological revolutions dominated. These topics underpin the study, and the topics that deal with industrialisation, craft, and technology especially, required further research throughout the study period; they were also tested through public presentations in South Africa and Morocco, and through a design-build submission for the Solar Decathlon Africa. The yellow and red fields represent empirical research: The yellow field encompasses the author's interviews with selected architects and practices, along with important presentations or seminars with some of these architects; the red field encompasses the site visits to some of the interviewed architects' key works. The events in the yellow and red fields informed the visual research methods as represented at the top of the diagram. Towards the middle of 2018, investigations into industrialisation and craft evolved into the fields of collage and recycling, and the empirical research informed intensive textual research into North-South encounters, Critical Regionalism, inequality, Africa, ethics, and tectonics in particular. The shift in importance from textual research to empirical research and back to textual research is represented by the points of overlap in the diagram as textual-empirical knots that are highlighted by the two dashed boundaries.

As Skolimowski (1979) writes, technology is a form of knowledge, and McCleary argues that the production of the built environment *creates* knowledge where "Architects as builders respond to the scientific, ethical and aesthetic agenda of societies; and their production exhibits an appropriateness-to and/or appropriation-of aspects of those agenda" (1988/2007: 326). The initial encounters between industrialisation or global modes of production, and tradition or local modes of production (although these would also have been evident in many parts of the global South over time), were widely experienced and documented in the global North since the 1700s. However, as will be discussed, the global South is now arguably the space where tectonic encounters are more acutely experienced, and arguably also where there are possibilities for the Sustainable Development Goals (SDGs)[9] to be met – at least those related to responsible consumption and production[10].

Figure 6 (previous page): *The research flow diagram as explained in the preceding text. Source: Author.*

Low (2003: 34) is in favour of a post-structuralist approach to contemporary African architecture, and he argues that work that falls in this category "seems genuinely to be attempting to construct a new local response, and consciously addresses the exigencies of our current milieu[11]… [and may] reveal the more complex aspects of the corporeal nature of the social and tectonic modes of production inherent to indigenous/African spatial practice". According to Duminy *et al* (2014: 247), the case study approach is important for research in Africa since it allows for the local context to be taken into account, and "As an added benefit, this process can contribute to a wider agenda around reorienting global flows of knowledge and confronting the dominance of Northern theoretical concepts…". Through the surfacing, cataloguing, and analysis of the contemporary case in Africa, the aim is to build on Southern theory and practice that exhibits this new local response, values different knowledge sets and modes of practice equally, and that reveals the complex and fluid socio-tectonic modes of production in Africa with a view of contributing towards the reorientation of technological knowledge flows between the North and the South.

Chapter 2 endnotes

1 This includes the distance of materials and labour to key project sites, which is mainly reflected as part of the visual analyses of selected projects.
2 He writes that "The task of doing STS in nonwestern contexts need not be one of simply tracing the mobility of Western artifacts and practitioners, situating them in the Global South, and commenting on their behaviour in different environments, but taking seriously what technology means from the perspective of people of the South. It requires not merely looking at how people respond to incoming things, but placing the latter's arrival, meanings, knowledges, and materialities within the locals' technological *longue durée*" (Mavhunga, 2017: 4).
3 This research for the compilation of the catalogue is based predominantly on desktop analysis or secondary evidence (while the author had the opportunity to visit some of the works and interact with some of the architects, it was simply not possible to visit all the projects spread across the continent, nor conduct interviews with all of the contributors). However, the included works presented sufficient material in terms of texts, drawings and photos to be analysed in order to identify the tectonic strategies that were employed. Primary evidence was subsequently gathered for a selection of emblematic works, and it included interviews with the architects, seminars with the architects, visits to their practices or places of work, site visits to some of their projects, and in some cases through co-production.
4 These include, amongst others, the websites http://www.africanism.net, http://www.archidatum.com, http://www.archdaily.com, http://www.dezeen.com/, www.architectureindevelopment.org, https://www.dbxchange.eu, and https://liveprojectsnetwork.org/ The journals include, amongst others, https://africandesignmagazine.com/, Leading Architecture, The Digest of South African Architecture, The Digest of Namibian Architecture, The Architectural Review, Boundaries Magazine, and Architecture SA. The architectural awards include The Aga Khan Awards for Architecture (www.akdn.org/architecture), and The Africa Architecture Awards (http://africaarchitectureawards.com/)
5 This involved analysis of the drawings and images received from the architects and accessed in the available literature and online sources, and discussion of these with the architects. The method involved visual analysis, quantitative analysis through diagramming, and qualitative analysis through collage, all based on the analysis of available literature and interviews with the architects using visual aids.
6 Unfortunately, the pre-arranged interviews with Toshiko Mori and Kenneth Frampton had to be conducted online and via correspondence due to Covid-19, and the author was unable to visit the projects in Senegal for the same reason.
7 These include the Silindokuhle Community Hall by Indalo and Collectif Saga in Port Elizabeth, South Africa, the Guga s'Thebe Community Centre by CS Studio in Langa, Cape Town (and various others by this practice), the Gastrohut by RWTH Aachen in Köln, Germany, and the Macassar Community Venue (also known as Bong's Place) by RWTH Aachen, PBSA Düsseldorf, the University of Cape Town, the Cape Peninsula University of Technology, and Studio Light in Macassar, South Africa.
8 The author and some of his students assisted with the manufacturing of light clay panels for the Guga s'Thebe Theatre during its initial construction and he facilitated student involvement for its subsequent repair. The author also had the opportunity to collaborate with Simon Galland of Collectif Saga in the teaching of a design studio for a project in Imizamo Yethu, Cape Town.
9 These are seventeen goals that were identified by the United Nations General Assembly in 2015 with the aim of meeting them by 2030. These include no poverty; zero hunger; good health and well-being; quality education; gender equality; clean water and sanitation; affordable and clean energy; decent work and economic growth; industry, innovation and infrastructure; reduced inequality; sustainable cities and communities; responsible consumption and production; climate action; life below water; life on land; peace and justice strong institutions; partnerships to achieve the goal.
10 This is supported by Mbembe, who writes that "The continent is central to the global environmental crisis and holds some of the most potent solutions to the global ecological trap overshadowing the 21st century" (2015: 57), and he emphasises Africa's carbon capturing capacity.
11 While he writes with specific reference to the South African condition, this can be argued to have relevance for most other parts of the continent. He criticises neo-conservative approaches, mimicry, and "pseudo-Africanist" expression where external appearance, instead of the consideration of the lived experience, is emphasised.

Chapter 3: Tectonic encounters

The search for hybrid tectonics is informed by a multiplicity of encounters: These include the encounter between industrialisation and craft, the encounter between the global and the local, more specifically between the global North and the global South, and lastly the encounter between older or more established local tectonics and newer (often digital) global tectonics. While this study aims to show that these binaries are not, and should not be, clear-cut, these encounters do merit further investigation. They are explored in this chapter under the headings of Techno and *technē*, The global and the local: Architectural binaries and attempts at mediation, and The global North and the global South: Architectural encounters in Africa.

This does require an understanding of the layered meaning of tectonics, and a broader temporal contextualisation of these encounters within continuing industrial or technological revolutions. Hence, the chapter will open by unpacking the meanings of the tectonic, followed by a positioning of tectonic transitions as socio-technical events in relation to specific socio-political moments in the countries where the key case studies of this thesis are located.

Defining the tectonic

Technē, technology and the tectonic

The word tectonic has a layered meaning; it simultaneously refers to structure or a particular (often lightweight or skeletal) construction system, but it also refers to the aesthetic and poetic aspects that are associated with it. Tectonics are typically rooted in a particular social, physical and/or temporal context, and the English word's root has a long lineage. Kenneth Frampton (2002: 14) writes that:

> *"Greek in origin, the term* tectonic *derives from the term* tekton*, signifying carpenter or builder. This in turn stems from the Sanskrit* taksan*, referring to the craft of carpentry and to the use of the axe. Remnants of a similar term can also be found in Vedic, where it refers to carpentry… The poetic connotation of the term first appears in Sappho where the* tekton*, the carpenter, assumes the role of the poet… Finally, the Latin term* architectus *derives from the Greek* archi *(a person of authority) and* tekton *(a craftsman or builder)."*

Frampton (1983a: 28) also describes it as the "play between material, craftwork and gravity" and he cites Stanford Anderson (1980: 83) as saying that "'*Tektonik*' referred not just to the activity of making the materially requisite construction… but rather to the activity that raises this construction to an art form… The functionally adequate form must be adapted so as to give expression to its function. The sense of bearing provided by the entasis of Greek columns became the touchstone of this concept of *Tektonik*". Frampton builds on the work of Martin Heidegger, who wrote about the link between making and poetry, and who traced the word technology to the Greek word for technique, or *Technikon.* Skolimowski sees technology as "the mastery of techniques, the acquisition of know-how, the ability to tell what works in what circumstances" (1972: 4), while Edgerton says that the meaning of the word technology is layered, that it keeps changing, and that its current meaning is relatively new. He writes that "Technology, like 'science', is a master concept of modernity with extraordinarily slippery meanings. One minute technology is the latest technical gizmo, and the next it is the very infrastructure of human existence" (2019: x). Both Skolimowski and Heidegger see technology as something that is related to *technē,* which Skolimowski describes as "the character of crafts and skills in which manual work was of primary importance" (Heidegger, 2011a: 253; Heidegger, 2011b: 222; Skolimowski, 1972: 6). Mavhunga (2017: 3) also recognises the same Greek origin for the word technology and describes it as a joining of technē and -ology, although he laments the fact that its meaning on other continents and in other languages has not received the same attention as it has in English. Heidegger (1954/1977: 12) emphasises two important points that should be considered in relation to *technē*:

> *"One is that* technē *is the name not only for the activities and skills of the craftsman, but also for the arts of the mind and the fine arts*[1]*.* Technē *belongs to bringing-forth, to* poiēsis*; it is something poietic. The other point that we should observe with regard to* technē *is even more important. From earliest times until Plato the word* technē *is linked with the word* epistēmē*. Both words are names for knowing in the widest sense. They mean to be entirely at home in something, to understand and be expert in it. Such knowing provides an opening up. As an opening up it is a revealing… It is as revealing, and not as manufacturing, that* technē *is a bringing-forth*."

Somewhere in the late 1600s, according to Hartoonian (1994: 29), the word *technē* was replaced with technology. He also suggests that *technē* did not just signify the means of production, but the unity of the means of production and the end product and when *technē* was replaced with technology, the unity of production and end product was replaced by the dominance of the productive process only (1994: 11). The lost meaning of *technē* is described further by Collins and Selina (2006: 161) as not only encompassing the activities and skills of a craft worker, but also the "arts of the mind", which echoes Lovitt's (2007: xiv) remark that Heidegger sometimes refers to thinking as handicraft[2], but Mbembe cautions that technē "is becoming the quintessential language of reason, its only legitimate manifestation" (2019a: np.).

Frampton (2002: 93) refers to the work of Karl Bötticher and Gottfried Semper when he emphasises the poetic dimension of tectonics and argues that it is not only concerned with structural and material properties: While tectonics may primarily be concerned with structure and construction, it is not merely about the mechanical or load-bearing capabilities of structure, but about the "potentially poetic manifestation of structure in the original Greek sense of *poiesis* as an act of making and revealing" (1995: 3; 2002: 92).

Global and local tectonics

The productive and poetic qualities of tectonics, when explored in a particular context, are mostly not singular. The encounters between global and local tectonics often result in a categorical blurring, since they can be produced and employed simultaneously in what Edgerton refers to as "clashes of technological time" (2019: 28). Carlson-Reddig (2011: 273) writes that the idea of hybridising the global and the local "might begin with aspects of tectonics which can root in place – for example, the use of materials with some local genesis, hybridised by new technological constructional processes, or perhaps transformed at the root material level". While Mavhunga acknowledges Edgerton's view (2007) that technology is not always easily transferred into other spaces, he notes that "What poses as universality is someone else's culture and just enough power to spread it, even force it, upon others. The things that words denote never start as universal or available everywhere, their meanings already stabilised; they originate from a particular place, community, society, culture, and nation and then, through travel or mobility, become universal, global" (2017: 1). The biggest conundrum with global and local tectonics is that they are often both present in the same space and time.

While global or universal practices always begin somewhere, they are usually prone to outside influences and co-production, and they spread quickly. As Ricoeur (1965: 272) observes, "Even if it is possible to ascribe to such or such a country or culture the invention of writing, printing, the steam engine, etc., an invention rightfully belongs to mankind as a whole… Thus we are confronted with a *de facto* universality of mankind: As soon as an invention appears in some part of the world we can be sure it will spread everywhere". This is echoed by Edgerton (2019: xxiii), and by Schwab (2017: 91) who writes that the interconnectedness of societies means that many inventions are in some way co-produced. What, then, is a global tectonic and how does it differ from a local tectonic? It is mostly possible to identify where materials for a building come from, where the labour in their extraction or processing takes place, or where their assembly is conceptualised. However, this does not necessarily result in an automatic classification as "global" or "local" based on distance, since distance can be eroded by obtaining global technologies very close to a site, or by using them in a specific way. It also has a lot to do with how they are made, how they are applied, and what they represent; Frampton (1992: 315) captures it very succinctly by using Jørn Utzon's 1976 Bagsvaerd Church in Copenhagen as an example, where:

Figure 7:
The interior of Bagsvaerd Church showing the normative concrete column grid and precast wall elements that represent global tectonics, and the unique billowing concrete shell that represents local tectonics. Bagsvaerd Church, Copenhagen, 1976, Jørn Utzon. Source: Seier and Seier. [Online] Available: https://commons.wikimedia.org/wiki/File:Bagsv%C3%A6rd_Church_altar_organ.jpg (Accessed 22 October 2020).

"…pre-cast concrete infill elements of standardised dimensions are combined, in a particularly articulated way, with in-situ reinforced concrete shell vaults which span the principal public volumes. And while this combination of modular assembly and in-situ casting may at first appear to be nothing more than an appropriate integration of the full range of concrete techniques which are now at our disposal, the case can be made that the way in which these techniques are combined alludes to a number of dialogically opposed values. At one level, we may claim that prefabricated modular assembly not only accords with the values of universal civilisation but also 'represents' its capacity for normative application, whereas an in-situ shell vault is a 'one-off' structural invention built into a unique site. It may be argued, in the light of Ricoeur, that where the one affirms the norms of universal civilisation, the other proclaims the values of idiosyncratic culture".

The global is represented here by the regular grid made out of a concrete frame with in-fill modules (concrete blocks and precast concrete elements), while the local is represented by the less optimal and uneconomic, but unique and meaningful reinforced concrete shell over the nave. In addition to the combination of global and local tectonics in different elements, in some cases they can both be present in the same element; where materials and techniques become truly mixed, the authenticity or purity of a material and tectonic system may be subverted, and Carlson-Reddig (2011: 274) cautions that "When Louis I. Kahn remarked that a brick preferred to be employed in an arch, he may not have anticipated embedded bricks in precast panels, or the aluminium enframing of terra cotta units spaced by neoprene rather than mortar, or the thin brick, pressed into thermally and constructionally-efficient grooved insulation panels. The latter raises a poignant problematic as to the breaking point of a hybrid, wherein universal technology has so undermined its original material or tectonic root that the significant linkage to its qualities and characteristics—weight, density, and gravity for example—have been lost".

Tectonics as "a thing" and "a sign"

Frampton, even before the advent of Critical Regionalism, regarded technology as fatalistic[3], and he was concerned with its impact on specific places and their inherent socio-cultural conditions. He regards Critical Regionalism

and tectonics as having a deeper dimension and that they are a way of countering scenographic architecture and Robert Venturi's decorated shed; with reference to Heidegger's terminology, he posits a building as a "thing" and a "sign". Adamson (2010: 409) also recognises this when he writes that, similar to Heidegger, Frampton opposes the use of technology if it promotes an architecture of placelessness. Interestingly, Kenneth Frampton and Denise Scott Brown[4] both attended the first edition of the *Tropical Architecture* course at the Architectural Association in the 1950s, and as Figueira and Gil observe, "This fact is significant in view of the path both would take, whereby the 'learning' in Las Vegas and the Critical Regionalism proposals, though in opposing ways, refer to locality, identity and materiality" (2013: 73). It is also significant that post-modernism, Critical Regionalism, and tectonics all seem to endorse the use of signs in some or other form. One could argue that tectonics can be both a "thing" and a "sign", especially if one considers Frampton's own description of Bagsvaerd Church's structural grid which, through its physical making and materiality can be regarded as a "thing", but through its reference to normative universal qualities can also be regarded as a "sign".

He does seem to recognise this duality when he differentiates between 1. A technological object which meets an "instrumental need", 2. The scenographic object which could "allude to an absent or hidden element", and 3. The tectonic object "which appears in two modes" and that can be referred to as the "*ontological* and *representational* tectonic" (2002: 94). This seems to echo McCleary, who believes that the act of building can reveal the fundamental ontology of humanity, where "one seeks experience both of the world and of the technical realm; ie. transparency and opacity at the same time" (1988/2007: 334). Frampton recognises that the tectonic is positioned between a series of opposites[5], especially in the articulation of tectonic form when it situates itself between the stereotomic (heavy) and the tectonic (light) (2002: 102)[6].

Tectonic encounter

Similar to the articulation between the tectonic and the stereotomic, articulation and mediation can also be applied to different productive modes and Frampton (1995: 26) describes how "…one has to mediate between technology as a productive procedure and craft technique as an anachronistic but renewable capacity to reconcile different productive modes and levels of intentionality". In terms of the in-between, the point of articulation or the joint is regarded as the "primordial tectonic element" and these "transitions consti-

tute the very essence of architecture" (2002: 95). Frampton (2002: 102) goes on to emphasise that:

> *"Finally, something has to be said about the signification of the 'break' or the 'dis-joint' as opposed to the signification of the joint. I am alluding to that point at which things break against each other rather than connect: That significant fulcrum at which one system, surface or material abruptly ends to give way to another. Meaning may be thus encoded through the interplay between 'joint' and 'break', and in this regard rupture may have just as much meaning as connection".*

This surfaces the idea of encounter and the "third space" in the realm of tectonics and the encoding of this "joint" or "dis-joint" could be one of the aspects that can be used to differentiate between the different tropes of adjacency, collage or hybridity. Homi K. Bhabha (2004) regards the "third space" as the space on the margins of culture or between cultures (where cultural production is located), and Hérnandez (2010: 11) sees it as "…a third location, outside, or in-between, traditional binary structures… an attempt to assign spatial characteristics to the margins, those areas of irresolution between cultures, or inside them, where hybridisation occurs". The encounter and resultant "third space" in terms of different modes of tectonic production can be used to read the relationship between technology that consumes and technology that conserves, or between global and local tectonics. The relationship between what can be regarded as global and what can be regarded as local is ambiguous, and if Heidegger is read through this lens, then this relationship is alluded to in his argument that the very essence of technology is ambiguous: "The irresistibility of ordering and the restraint of the saving power draw past each other like the paths of two stars in the course of the heavens. But precisely this, their passing by, is the hidden side of their nearness" (1977: 33).

The evolution of technology and tectonics has been marked by encounters. This has been evident in encounters between different people and places, between different modes of production, and between places and production. Encounters are often established through a process of "othering", which is typically conceptualised by a dominant force to establish its own legitimacy, cement its own power, or to substantiate political, economic, or developmental aims amongst others. As Frampton says in his reading of Heidegger, "We have no choice but to reformulate the dialectical constituents of the world, to determine more consciously the necessary links obtaining between *place* and *production*, between the 'what' and the 'how' (1994: np.). Lee Ufan, who was influenced by Heidegger, writes in *The Art of Encounter* that:

> *"Everyone, however, has encounters with the outside world. Encounters are entailed in the fact that other things other than oneself exist and it is possible to enter into a dialogue with them. An encounter is an interaction with externality/otherness. Through such encounters, I take on otherness, that is, I accept or reject the outside world…* Tekhnê *(Greek for art or skill) refers to methods of concentrating the power of otherness.* Tekhnê *originally meant the wisdom connected to otherness, and it requires training and discipline of the self. My own power can be multiplied 20 or 30 times by the* tekhnê *that entails otherness"* (2010: 549).

Mbembe (2020a: np.) speaks of the "encounter between heterogenous worlds" and "the share of reinvention, adjustments and recompositions that it demanded from all the protagonists, the play of ambivalences, the mimetism, hybridity and resistance which it made possible". According to Adamson (200: 548), Ufan's art is rooted in the encounter between "made" and "unmade" things, or manmade and natural things, that are juxtaposed against people and context. All tectonic encounters are inherently rooted in the encounter between humanity and the natural environment[7], which is especially pronounced in the current age of the Anthropocene where human actions and technologies with insufficient regard for nature and society are becoming drivers for planetary change.

While there are many different types of potential encounters, this study will focus on a few specific instances of tectonic encounter that have been found to have specific relevance in Africa: The opposing paradigms of industrialisation and traditional crafts or handicrafts evolved into a battle between the global and the local which is emphasised by the confrontations between proponents of the so-called International Style and regionalism. With improved communications and increased globalisation, these encounters became more globalised and attempts at engaging with specific localities became mostly subsumed by Critical Regionalism discourse. These engagements have become especially pronounced where the global North and the global South encounter one another. The digital age or so-called fourth industrial revolution is already revealing its own encounters which will influence the way that tectonics develop; these include, amongst others, the confrontations between

the digital and the analogue, mass-production as opposed to mass-customisation, hyperdata versus zero data, and the potential increase of inequality between the rich and poor on a local level, but also the disparity in access to resources between the global North and the global South.

This section traced the evolution of the term "tectonic" and revealed how it has both ontological and representational characteristics. It is argued that tectonics can be read as both "a thing" and "a sign". The analysis shows how tectonics can manifest as both global and local ways of making. It further demonstrates that although these binary classifications are often ambiguous, the encounters between them are of particular importance, especially in the global South.

Tectonic transitions

Industrial and technological revolutions

Attempts have been made by various authors (Perez, 2002; Swilling and Annecke, 2012; and Schwab, 2017 among others) to identify the lifespans of technological transitions and in some cases, how these overlap with socio-ecological transitions (Swilling and Annecke, 2012: 54). Tectonic encounters can be tracked as part of these transitions, which tend to be marked by their own particular polarities or binary positions. This section will locate global and local encounters in relation to these tectonic transitions with reference to specific countries in the global South.

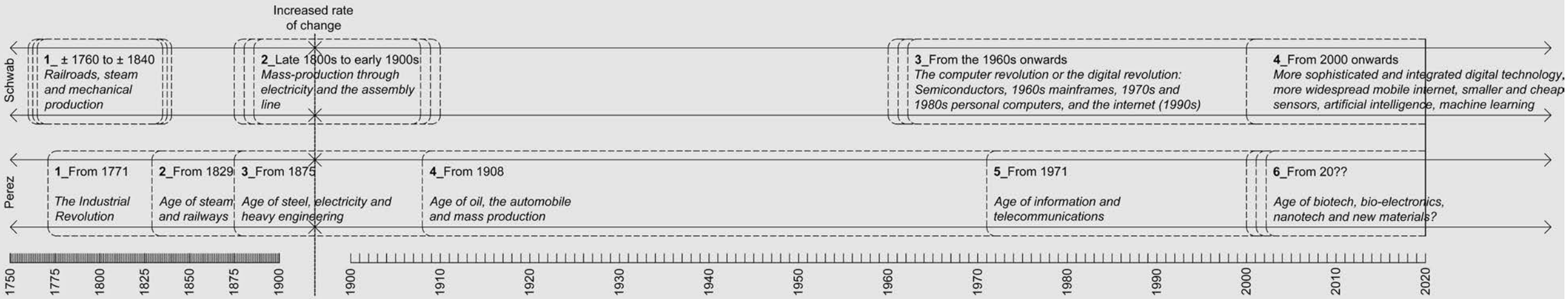
The tectonic is just as much social as it is technical, and it is just as much a process and system as it is a product. Technological change over the past three centuries has been rapid, and change was often precipitated by significant shifts or transitions that began in one or two countries and eventually spread across the globe. These large shifts were typically the result of the development of a constellation of new technologies and industries, which eventually built sufficient momentum to effect large-scale socio-economic change and development. These shifts tended to be in the form of encounters where new technologies came into contact with older technologies: They sometimes caused sudden ruptures where older technologies were replaced and became immediately obsolete, or they happened in the form of transitions where there was a time of simultaneous co-existence. The large shifts are often referred to as industrial or technological revolutions, which various authors[8] have attempted to classify. Carlota Perez (2002: 8) defines these revolutions as:

> *"…a powerful and highly visible cluster of new and dynamic technologies, products and industries, capable of bringing about an upheaval in the whole fabric of the economy and of propelling a long-term upsurge of development. It is a strongly interrelated constellation of technological innovations, generally including an all-pervasive low-cost input, often a source of energy, sometimes a crucial material, plus significant new products and processes and a new infrastructure."*

She identifies five successive technological revolutions[9] and she believes that each technological revolution has a specific techno-economic paradigm that "breaks the existing organisational habits in technology, the economy, management and social institutions" (2002: 7, 11). Her classification is somewhat more nuanced than the one that was developed by Klaus Schwab[10] (2015: np; 2017: 6) – which is now more commonly used - that currently places the world in the 4th industrial revolution[11]. Digital technology is becoming more sophisticated and integrated, which is why our current era is often referred to as "the second machine age". This interconnectedness, the combination of technologies, and the transformation of systems strongly inform contemporary architectural production in Africa as will be explored later.

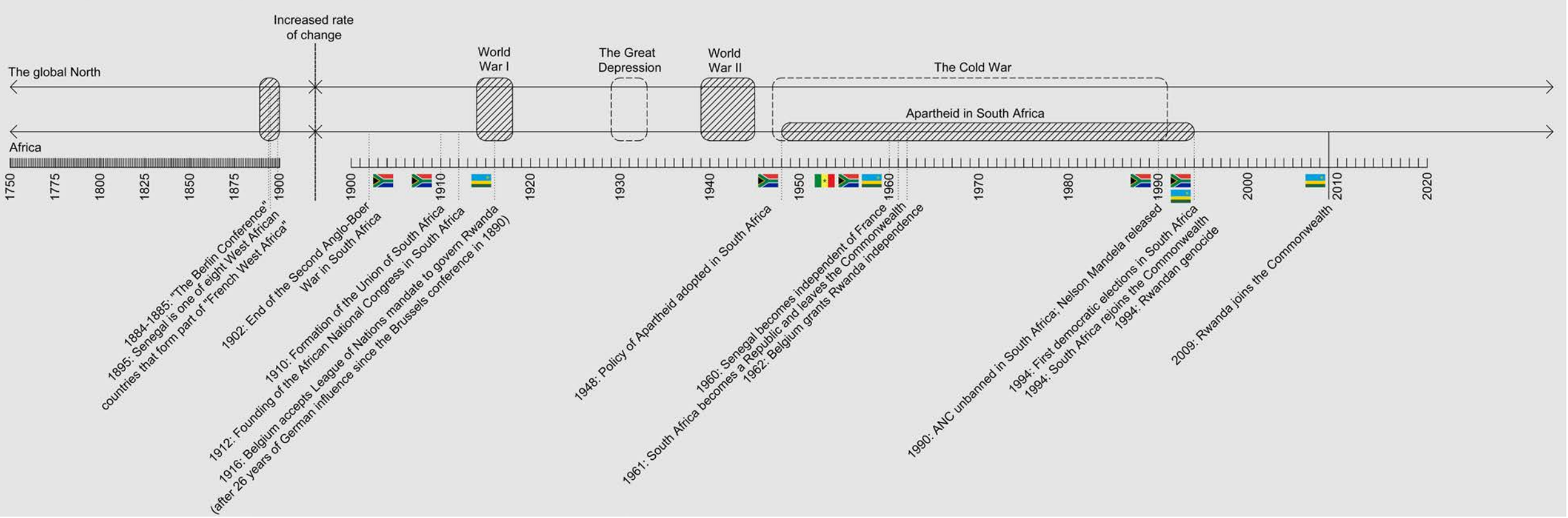
Edgerton (2019: x) writes that the fashionable idea of a fourth industrial revolution is not to be trusted (he also questions the number of revolutions), nor is the idea that history can be summed up as a series of industrial or technological revolutions since he is of the opinion that it reduces material history to a sequence of novelties. He also challenges the innovation-centric format of technological revolutions, and the timespans that have been put forward for these; this is partly due to the fact that many innovations only become widely used long after they have been invented, and new innovations often co-exist or cumulate with older technologies for long periods of time (2019: xxi, 9)[12]. Comparing different takes on industrial and technological revolutions is, however, a useful way of relating new technological inventions, innovations and systems to key architectural moments and the forces that influence architectural production.

In terms of production, these industrial and technological revolutions cause severe distress to natural systems, but they often also cause severe distress to more established productive systems and technologies; Joseph Schumpeter refers to this as 'creative destruction' (1943: 81), and it is a pro-



Timeline of industrial/technological revolutions

The timeline represents the various industrial revolutions as viewed by Klaus Schwab (2016) and technological revolutions as viewed by Carlota Perez (2002).



cess that sets newer technologies and older technologies up in an oppositional binary system of encounter[13]. According to Gevork Hartoonian, "Once more, we are facing a subtle confrontation between the past and a utopia of the future with regard to technological achievements" (1994: 82), and the calibration of this confrontation could potentially have dire consequences for society and nature. Swilling and Annecke (2012: 57) relate Perez's first five technological revolutions to resource consumption, and they note how each revolution or transition was dependent on the exploitation of specific natural resources[14]. Up to the 1950s, these revolutions were mainly dependent on biomass, but due to increased globalisation from the 1970s onwards, the use of fossil fuels, metals and minerals has escalated dramatically, "eventually displacing biomass as the primary resource base of industrial society" (2012: 57).

Technological development and the environment

Heidegger (1977: 14) writes how technology places unreasonable demands on nature, and Krell (2011: 242) understands Heidegger's definition of *Being* as lying in people's "capacity to cultivate and safeguard the earth, to protect it from thoughtless exploitation". Lovitt (1977: xxix) in his reading of Heidegger's work also emphasises how technology is about control and domination, and he writes that "Modern technology in its essence is a 'challenging revealing'. It involves a contending with everything that is. For it 'sets upon' everything, imposing on it a demand that seizes and requisitions it for use. Under the dominion of this challenging revealing, nothing is allowed to appear as it is in itself". Bernstein (1991: 91) writes that technology is not neutral, and Frampton (1994: np.) refers to the "utilitarian tyranny of technique" when he also cautions against the exploitation of nature: "With the manifest exhaustion of non-renewable resources the technotopic myth of unlimited progress becomes somewhat discredited". From Mbembe's point of view, contemporary resource appropriation and extraction resembles past colonial practices, and he a warns that humanity owes the biosphere a "debt of care" (2020: np.).

Environmental sustainability is vital but so is social sustainability, especially in the global South; Swilling (2020: 4) observes that there is a version of sustainability that focuses on technocratic solutions that favour the North, which is not something that he regards as a "just transition". He goes on to say that "A 'just transition' draws on traditions that are now particularly alive in the global South, namely commitments to social justice…", while Mbembe writes about the presence of a "different politics of human/non-human/technological

Figure 8 (previous page): *Industrial and technological revolutions in relation to key socio-political moments. The top timeline represents the various industrial revolutions as viewed by Klaus Schwab (2016) and below that, another timeline represents the sequence of technological revolutions as viewed by Carlota Perez (2002). These are shown in relation to the key socio-political moments that influenced the countries where the emblematic projects in this study are located, ie. Rwanda, South Africa, and Senegal, and are not intended to cover all the important events in other African countries. Source: Author.*

relations" in many parts of Africa (2015: 53). The so-called fourth industrial revolution or the sixth technological revolution will undoubtedly have an impact on the tectonic practices in the global South, and Africa in particular. Despite Edgerton's concerns about innovation-centred narratives and the use and availability of technologies in the global South, Swilling and Annecke (2012: 64) regard the developmental state as a potentially significant promotor of innovation although they warn that "The transition to a globalised ICT[15]-based system of production which benefits the poor majority will depend on the dynamics of a much wider socio-ecological transition that is also simultaneously underway" (2012: 63). As Collins and Selina (2006: 160) put it, human activity is now governed by efficiency, which hinges on maximum output for minimum input. This results in nature being commanded and manipulated, while human discourse is consigned to "electronic thinking and calculating machines, circulating information as an end in itself". Technology is now about disposing, not *poiēsis*, and everything is regarded as stock to be consumed. As Heidegger (1977: 25) notes, if people only become or act as the orderers of the standing-reserve (stock), they risk becoming stock themselves.

Swilling and Annecke draw on the work of Fischer-Kowalski and Haberl (2007:12-16) to position us currently in the industrial socio-ecological regime[16]. They postulate that the current industrial socio-ecological regime might transition into a sustainable socio-ecological regime "…that will be brought about by the next major socio-ecological transition as the conditions of existence of the industrial era disintegrate" and that "the deployment of the Information Age should be seen to coincide with the beginning of a new socio-ecological regime" (2012: 64-67)[17]. This is particularly interesting in light of the Covid-19 pandemic of 2020, the true effects of which will only come to light in a number of years, and which drastically impacted global travel, production, and carbon emissions amongst others, while exponentially increasing the use of digital media on a global scale.

The global and the local

Frampton writes that ancient and modern cultures have always relied on cross-fertilisation (1992: 315), and a number of authors support the view that the world is essentially becoming universalised into a single global civilisation (Buchanan, 1983: 15; Frampton, 1983a: 148; Lefaivre and Tzonis, 2012: 1, Mumford, 1941: 30)[18]. More than ever before, both the global and the local are essentially everywhere now. Heidegger writes that "we always go through spaces in such a way that we already sustain them by staying constantly with

near and remote locales and things" (2011a: 252)[19], and this view is supported by Frampton (in Crudeli, 2018: np) who observes that "the old relationship between the centre and periphery has disappeared" due to the 4th industrial revolution, which echoes King (1996: 69) who notes that there are Northern phenomena in the global South and Southern phenomena in the global North, and Lefaivre and Tzonis (2012: 1) when they say that the distance between regions has been eliminated[20] (2012: 151).

Livesey (2017: 80), while he acknowledges the view that distance has been eliminated or that the world is "flat", writes that there is substantial evidence that it seems to be becoming "spiky" again. He argues that globalisation is not inevitable, and he highlights numerous instances of de-globalisation where labour and manufacturing are becoming localised again[21]. Based on his observations, there may be increased encounters between global and local modes of production in the same location through the "reshoring" or "nearshoring" of production; as he says, "local will be chosen over global" (2017: 149). However, as a result of the 4th industrial revolution and global communications, almost all regions have become globalised to some extent, which means a general juxtaposition between the global and local can be challenged. Writing in 1935, Walter Gropius remarked that "A breach has been made with the past, which allows us to envisage a new aspect of architecture corresponding to the technical civilisation of the age we live in" (1935: 19). This is an example of the ideology of rupture put forward by a proponent of a new industrial or technological revolution. Almost a century later, this raises the question what the technical civilisation of our own time is. The fourth industrial revolution or the information age and those who have access to it or are influenced by it could be regarded as a global technical civilisation, but there are countless local technical civilisations, and in many cases, global and local technical civilisations may co-exist simultaneously or in parallel[22].

It is in the encounters between these different successive and simultaneous global and local technical civilisations where unexpected innovations might emerge. While they are often portrayed as binary conditions, this study reveals numerous attempts to work in the space of encounter between them. According to Latour (2018: 17) "…the planet is *much too narrow and limited* for the globe of globalization; at the same time, it is *too big*, infinitely too large, too active, too complex, to remain within the narrow and limited borders of any locality whatsoever." As Curtis (1986: 25) argues, "Fossilisation and pointless modernity are equally to be avoided. To reduce a tradition to still-born recipes is actually to kill it; to ignore it altogether is also the height of folly"[23]. Mark

Swilling writes:

> "*The question then becomes: what is emerging now that is suggestive of the kind of future embodied in the vision of a transformed world? And what are the conditions that make these changes possible, and cumulatively do they add up to more than the sum of the parts? In short, what is our understanding of change?"* (2020: 6).

The search for hybrid tectonics documents an emergent practice which is suggestive of a different way of making architecture in Africa. According to Swilling and Annecke (2012: 79) there are two scenarios for the next long-term development cycle: One is a tamed version of decarbonisation and dematerialisation as promoted at elite (capitalist) gatherings like the World Economic Forum (WEF), while the alternative is "…a more radical transformation driven by grassroots social movements, millions of niche innovations in more sustainable living at the community level, and accelerated investments in the new technologies of decarbonisation, resource productivity and ecological restoration". This seems to echo Heidegger who writes that people should remain aware of the unfolding of technology in order to rediscover their own essence. He argues that the growth of the "saving power" lies within technology and that it can be fostered "Here and now in little things…" (2011: 236). Although he is unclear about what the "saving power" might be, his writings do allude to more sustainable modes of production that are more localised, human-centred and planet-centred. Toshiko Mori also challenges "The conventional notion that innovation must be an abrupt agent of change" and she argues that instead of being measured according to productivity, innovation should be measured by its contribution to empowerment of communities. She goes on to say that this is especially the case for "projects that promoted small incremental steps to achieve a whole, a contingent strategy that can adjust more easily to a changing socio-political climate in volatile communities" (2013: 46). This, and her work which will be analysed later, seems to support Heidegger's call for a fostering of incremental change, which is similar to Swilling and Annecke's proposed scenario of sustainable community-based innovation and the use of technologies that support this. They promote the notion of sustainable transitions instead of revolution or rupture, and Swilling (2020: 6) similarly calls for a theory of change that is transitional, that focuses on incrementality, is rooted in environmental sustainability, and which emerges from the social to provide a glimpse of more sustainable futures. He hopes that this theory of change or "radical incrementalism", instead of only focusing

on dialogue as an agent of change, could be a way of considering actions that facilitate dialogue and enable change.

This type of dialogue originates in the act of making, and it represents a challenge to architecture and how it engages with other disciplines in a deborderised world. The works explored in this study are widely dispersed but they are small actions that represent incremental change which is bigger than the sum of its parts; these works, in most cases, are rooted in socio-environmental concerns and if their strategies can be understood critically and developed further, they could represent the first steps of a tectonic transition that can suggest more sustainable ways of making architecture in Africa.

This investigation compared different readings of industrial and technological revolutions in relation to specific socio-political events in countries of interest to this study. It shows how the global and the local continue to co-exist throughout these revolutions, and it frames them as tectonics transitions. The encounters between the global and local, in terms of making, positionality, and difference, will be discussed further in the following sections.

Techno and technē

> "*In this way, we are already sojourning within the free space of destining, a destining that in no way confines us to a stultified compulsion to push on blindly with technology or, what comes to the same, to rebel helplessly against it and curse it as the work of the devil"* (Heidegger, 2011b[24]: 231)[25].

According to Edgerton, "Tech-utopianism and dystopianism are two sides of the same much debased coin…" (2019: x). This echoes Skolimowski who writes that "Modern technology has become our alter ego. We cannot escape it and we cannot live harmoniously with it" (1972: 4), while Krell (1993: 215) is of the opinion that the essence of technology is such a fundamental aspect of the contemporary world that one cannot "opt for" or "opt out" of it. This is reflected in Schwab's view when he says that "We are not constrained by a binary choice between 'accept and live with it' and 'reject and live without it'" (2017: 4). People have for hundreds of years tried to differentiate between technology or industrialisation and craft, and as Joseph Rykwert writes, "… Vitruvius found it necessary to distinguish between *machinae* and *organa*. The first were moved, mostly cyclically, by a great force, the second could be moved by one man alone" (1992/2007: 340)[26].

Heidegger (1889-1976), in his well-known work *The question concerning technology* (1977 and 2011b), discusses the essence of modern technology at length and he contrasts it with localised traditional craft, which he refers to as handicraft manufacturing, or an artistic bringing-forth. Heidegger argues that the essence of technology is a setting-upon or challenging of humanity and nature where everything merely becomes stock to be used for a specific purpose, which is echoed by Mbembe (2019a) when he writes that "Technological escalation… is threatening to turn us all into artefacts"[27]. Heidegger calls this *enframing*, which is a reductive process through which humanity and nature become resources to be manipulated, and he cautions that this should be regarded as the "supreme danger". As George says, "Heidegger stresses the devastation and human domination of the Earth as the most visible trace left by the technological understanding of Being" (2015: 218)[28]. The essence of modernity or modern technology is usually defined in relation to tradition, and King (1996: 63) maintains that this is done in two ways: "First, diachronically, in relation to the 'traditional', pre-industrial forms of the 'pre-modern' past; second, synchronically, in relation to the other 'traditional' pre-industrial parts of the non-European, non-North American world in Asia, Africa, Latin America, which had been opened up by colonialism and its intellectual hand-maiden, anthropology". This is essentialised further by Adamson (2010: 272) who writes that globalisation and craft are usually regarded as being in opposition to one another.

Opposition between industrialisation and craft

The advantages of global production or machine manufacture are extensively documented by authors such as Charles Babbage[29] who describes in 1832 how they provide additional power, time, value-add (in terms of the conversion of materials to products) and accuracy, which is echoed by Aalto (1957/1979: 4), Nielsen (2012: 16) and Cardoso (2010: 326) but only in part, when he writes that "In those early days of industrial technology, the lure of mechanisation was mainly speed and economy, certainly not quality". Cardoso was referring to the 1840s, but he acknowledges that in the early twentieth century, mechanised production began to achieve good finishes which were previously only possible by hand. Where finishing by hand was originally required to complete the process of machine-manufacture, there was a curious reversal of value where imperfections due to manual manufacturing came to be valued, and he remarks that:

> *"Though craft is clearly unable to compete with the efficiency of machines, it purportedly retains some sort of Benjaminian aura, grounded in the uniqueness of individual manufacture. Imperfections and deviations came to be seen as legitimating characteristics. The historical roles are reversed – perfect machine work is depicted as bad and imperfect handwork as good. This is not a particularly convincing stance for a consumer society in which more, better and cheaper artifacts are made continually available through the improvement of mass production. Craft is eventually cornered into a position of terminal nostalgia or, worse, of elitism, via a notion of consumer exclusivity"* (2010: 327).

Proponents of industrialisation and global modes of production are also often highly critical of local modes of production or traditional craft practices. Frank Lloyd Wright, in *The art and craft of the machine*, writes that "The whole sentiment of early craft degenerated to a sentimentality having no longer decent significance nor commercial integrity, in fact all that is fussy, maudlin and animal, basing its existence chiefly on vanity and ignorance" (1901/2007: 10). Frampton, however, speaks of the "hermetic idealism" of Wright, in whom he says the Arts and Crafts movement culminated as "the total triumph of technique over nature" (1979: 315). Many authors and architects[30] openly condemned tradition in its entirety although some, like Le Corbusier and Sigfried Giedion, who were initially strong supporters of industrialisation, eventually had a change of heart and became proponents of the use of regional materials, skills, and cultural references. Giedion, in his book *Mechanisation takes command: A contribution to anonymous history* (1948), tracks the roots of mechanisation and its effects on people: He notes how the division of labour began in traditional production, and that the assembly line was added to reduce the amount of movement required by labourers but that eventually, instead of it adapting to the speed of people, that people had to adapt to the speed of the machine. The rising demand for lower production costs coupled with increased productivity and efficiency eventually led to the development of scientific management as promoted by F.W. Taylor in the early 1900s[31], but Taylor's stopwatch methods were eventually superseded by the work of Frank B. Gilbreth and Lillian M. Gilbreth who developed visual representations of work processes to improve the efficiencies of human motions. This, in turn, became less important through the increased use of mechanisation and the large-scale implementation of the assembly line as exemplified by Henry

Ford's factory at Highland Park in 1915. Human hands were mostly used for the manipulation of machines only, and this too became less important with the advent of the automatic assembly line in the 1920s. Production now became possible at a scale that was previously unthinkable.

Adamson (2010: 2) defines craft as "the application of skill and material-based knowledge to relatively small-scale production", which is echoed by McCullough (2010: 311). This is often one of the critiques of craft, in that it cannot cater for increasing demand in a globalised society. Hentie Louw writes that the Arts and Crafts movement never really became a popular one, and that "it could not deliver a commercially viable craft-based industrial model as an alternative to mechanical production in building" (2002: 12). He goes on to say that achieving built work at scale is another problem: "Perhaps we need to accept that there are limits to craft – that we may have finally reached a situation where artifice, like out-of-date medicine, has lost much of its potency, its capacity to serve the full range of architectural possibilities" (2002: 15). This was written before the increased use of Computer Aided Manufacturing (CAM) which enables customised mass-production, and this statement is also dependent on what is defined as "craft". Craft is, however, still regularly labelled as elitist and prone to target high-income markets, and referring to the work of William Morris, McCullough observes that "Despite his commitment to making art for the masses, his clients were almost invariably well-to-do people sympathetic with his aims" (2010: 146). McCullough (2010: 311) writes that "craft still recalls the provincial dilution of the Arts and Crafts movement into what now consists of folk art at best, and rustic shops full of tourist trinkets at worst… ever since mechanisation has taken command, craft has been stranded in bourgeois territory where few self-respecting aestheticians would dare to tread".

Adamson goes on to say that, despite a few exceptions, "one of modern craft's distinctive characteristics is its lack of basis in raw necessity. If artisanal labour was once primarily economic, in the past century and a half it has been chiefly idealistic and aesthetic" (2010: 10). This is written from a Northern perspective, and in many parts of the global South it may still be necessary – at least for the time being until it is sufficiently eroded by industrialised production or mass-produced imports – and in many cases, it is still rooted in tradition, which carries cultural or spiritual meaning, and which is transferred physically and verbally[32]. Hartoonian refers to the work of Walter Benjamin and what he called "the dissolution of the aura in the context of the mechanization of the process of production", which he describes as "the distance that mech-

anization introduces between tradition and reproduced artefact" (1994: 56). Speaking at the World Crafts Conference in 1964, Czeslaw Knothe acknowledged that craft cannot always compete economically with industry, but that it generally holds more cultural value, and he argues that this is even more pronounced in the global South where labour tends to be cheaper than it is in the global North (Adamson, 2010: 200).

The works of Augustus Pugin, John Ruskin, Thomas Carlysle, and William Morris are well-known for their condemnation of industrialised production and mechanisation, and they represent the clear totalitarian and oppositional nature of the craft paradigm to the technological paradigm. Although Coetzer (2017: 5) asserts that "Certainly not all Arts and Crafts proponents were dogmatic in the anti-machine rhetoric"[33], Louw (2002: 9) maintains that Arts and Crafts architects set themselves a "revolutionary but ultimately Quixotic task of stemming the tide of the industrialisation of building". Rossi (2017: 10) writes how Morris saw craft as being morally superior to industrial production and how he "looked back to the medieval era's craft guild system to position the 'beauty and pleasure' of a 'fast-disappearing' craftwork against the enslaving perfection of capitalist machinery". The opposition of craft to industrialisation is also highlighted by Frampton (1983: 18) who traces it back to the mid-nineteenth century when proponents of the Arts and Crafts and the Gothic Revival became opposed to Neoclassical form, industrialised processes, utilitarianism and the division of labour. Sennett, when referring to this same period, writes how craft became the "enemy of the machine" (2008: 84).

Peter Gaskell writes in 1836 that "The effects of mechanical production, as far as we have traced them, are, in the first place, to lower the value of human labour, and, in the next, to destroy it altogether, except in so far as the hands engaged in machine making are concerned, and even these are being encroached upon – machines making machines" (2010: 58). This view was compounded by opposition to scientific management and its "essential effort to strip the workers of craft knowledge and autonomous control and confront them with a fully thought-out labour process in which they function as cogs and levers" (Braverman, 2010: 81). Wilkinson writes that "When Ruskin criticised the industrialisation of the profession in the mid-19th century, he constructed a medieval fantasy as the good opposite of divided modern labour" (2017: 57), while Sennett notes how "There was no more passionate Victorian protest against such mechanical domination than the English writer John Ruskin, who appealed to his readers to scorn the very idea of a mechanical civilisation" (2008: 108). Cardoso (2010: 325), however, is of the opinion that

Ruskin was not opposed to machinery, as is often quoted or misrepresented, but that he revised his position to oppose the system where labour is relegated to unthinking manufacture. Pye (2010: 351) writes that, since Ruskin,

> *"The crafts and craftsmen have been bedevilled… by a propensity for striking attitudes. The attitude of protest I have mentioned already. Another one is the attitude of sturdy independence and solemn purpose (no truck with part-time workers: they are all amateurs; social value; produce things of real use to the community); another is the attitude of holier-than-thou (no truck with machinery; no truck with industry; horny-handed sons of toil; simple life, etc.). Another is the snob attitude, learnt from the 'fine' artists (we who practice the fine crafts are not as other craftsmen are). These are ridiculous nonsense by now…".*

Philosophies of technology

Braham and Hale describe Ruskin as one of the first generation of philosophers[34] of technology who reacted negatively, but sometimes also positively, to the industrial transitions of their time and their related socio-cultural conditions. They write how, in the early 1900s, "these ideas were beginning to harden into a sustained critique of technological utopianism" and they describe Heidegger as being the key proponent of this position (2007: xiv). The writing on technology evolved into a field that recognised the autonomy of technological development in the 1950s and 1960s with authors like Lewis Mumford and Sigfried Giedion[35] who eventually shared a belief that "society's tools had turned against their creators" (2007: xiv). Most of these writings were high-level critiques that lacked empirical evidence, which is something that the second generation of philosophers of technology aimed to rectify: Braham and Hale (2007: xiv) list authors like Albert Borgmann, Ruth Schwartz Cowan, Thomas Hughes, Michel Callon and Bruno Latour who made use of historical or ethnographic analyses to show how socio-cultural forces drove specific technological developments. Some of this work has become known as the "social constructivist" approach to technology which has evolved through the work of various societies and journals[36] into what Hans Achterhuis, another philosopher of technology, refers to as the "empirical turn" of the field. Stefan Muthesius (1998) tracks the polarisation of debates between supporters of *handwerk*[37] or craft, and supporters of industrialisation and mass-production, and he notes that they tend to have different value systems. The supporters

of craft are often seen to be idealistic and sympathetic to tradition or "simpler" ways of life, which at times becomes interwoven with nationalist tendencies; supporters of industrialisation on the other hand are often obsessed with efficiencies and progress at all costs which can lead to the exploitation of resources – both environmental and social.

Blurring the boundary between industrialistion and crafts

Adamson writes how authors like Carlysle thought that the craftsperson was disappearing, but he argues that craft was not eroded by or replaced with industrialisation or newer technologies, rather that it was only transformed or displaced into other types of activity (2010: 2). This echoes Ettema's (1981: 218) opinion that there has been an over-estimation of the extent to which mechanisation displaced craft, and that the inherent oppositional nature of technology and craft may have been a fabrication. More than a hundred years ago, many craftspeople had already become engaged in the somewhat ironic trade of manufacturing industrial machinery by hand, which increased the value of their labour in relation to the materials used. Others became employed in the finer hand-finishing of industrially produced goods, which is still the case with many digitally manufactured items. This builds on Samuel's point that "… the handicraft sector of the economy was quite as dynamic as high technology industry, and just as much subject to technical development and change." (1977: 60) Curtis (1986: 27) believes that there are "as yet untold functions for the crafts as an integrated part of an industrialising system", which is echoed by Adamson (2010: 44) who further notes that many craftspeople in the nineteenth century saw their skills in terms of continuity and ascendancy, not obsolescence, and that cutting-edge thinking at the turn of the previous century "envisioned new forms of continuity between industry and craft"[38]. Louw (2002: 11) observes how, once the immediate threat of industrialisation had worn off and craftsmen saw that their jobs remained secure, that "from the 1870s onwards, craftsmen no longer made any distinction between handicraft and machine work in what they termed 'workmanship'". Samuel argues that in many cases, mass production was pioneered in craft practices, while Reiser and Umemoto (2006: 236) observe that craft not only gets superseded, but that it migrates. The notion of the omni-competent craftsperson is mostly a myth, and it seems that there may have been an over-estimation of the extent to which mechanisation displaced craft. Rossi (2017: 8) writes that the relationship between technology and craft is a complex one, and that a more inclusive definition for crafts is needed, especially in light of its current revival which she, along with authors like Glenn Adamson, Tanya Harrod and Ned Cooke, refers to as "modern craft".

Throughout the evolution of the opposing technological and craft paradigms, there are occasional arguments for, and attempts at, a form of integration (but not necessarily hybridisation) between them. Branzi (2010: 578) writes that "The assumption of a clear-cut technical and ideological rift between handicrafts and industry does not stand up to the evidence of a vast program of functional collaboration between the two systems of manufacturing", and Ettema (1981: 202) notes that manufacturers' advertising and trade magazines[39] continually stressed the compatibility of mechanisation and craft at the turn of the previous century[40]. One of the most well-known symbols of industrialisation and the technological paradigm, *The Crystal Palace* designed by Joseph Paxton for the Great Exhibition in London in 1851, is in fact an example of integration: Samuel (1977: 57) cites authors[41] of the time who stated that steam power was used to turn all the mahogany elements for the handrails, while the more than three hundred thousand panes of glass were hand-blown. He goes on to note that "Steam power and hand technology may represent different principles of industrial organisation, and to the historian they may well appear as belonging to different epochs, the one innovatory, the other 'traditional' and unchanging in its ways. But from the point of view of 19th century capitalist development they were two sides of the same coin".

Frampton (1995: 338) discusses H.P. Berlage's (1856-1934) work where reinforced concrete and quality craftsmanship are sometimes combined, possibly due to "…the vestiges of a preindustrial culture that continued amid the industrialisation of the Netherlands", and Johnson (1960: 174) writes how Banham (1960) describes him as "the bridge between Wright and the European modern movement"[42]. This form of practice is also reflected in the *Deutscher Werkbund*[43], which was essentially a government-sponsored effort to hybridise craft with industrial manufacturing in Germany. Hermann Muthesius (1861-1927) who was one of the leaders of the *Deutscher Werkbund,* also believed that mechanisation and craft should not be seen in opposition to one another, but that craft should be integrated with factory production[44], which is echoed by Pye (2010: 341) who argues that craft should not be used as a form of protest against industry, but that it should complement it. Coetzer (2017: 5) argues that through the work of Muthesius, many Arts and Crafts principles were incorporated into the underlying thinking of the Modern Movement, and Adamson (2010: 111) highlights Muthesius' sentiments by saying that "Like other German designers such as Peter Behrens and Richard Riemerschmid, he felt strongly that reformers must work with the machine

rather than against it and argued that the opposition of artwork and factory production was a false one". Adamson (2010: 460) writes that "Despite the anticraft reputation that Modernists have somehow gained, most of them regarded handwork as existing on a continuum with Modernist industrial design, and sometimes as the beating heart at its centre". According to Gropius, "Were mechanisation an end in itself it would be an unmitigated calamity, robbing life of half its fulness and variety by stunting men and women into sub-human, robot-like automatons. (Here we touch the deeper causality of the dogged resistance of the old civilisation of handicrafts to the new world-order of the machine)" (1935: 33)[45]. The work at the Bauhaus did emphasise an engagement with both hand and machine production, which would explain why Gropius acknowledges that "Handicrafts and industry may be regarded as opposite poles that are gradually approaching each other" (1935: 54)[46].

Heidegger (2011b: 237) also seems to be arguing that the dangerous and potentially apocalyptic technological course that humanity is pursuing could be mediated and changed from within by a growing pursuance of a more inclusive and holistic form of artisanal or artistic production. This statement could be seen to be at odds with Liane Lefaivre's reading of Heidegger's work when she contrasts his thinking with that of Mumford. She argues that Heidegger's conception of the local is linked with ideas about nationhood and that he is completely opposed to technology when she states that "Heidegger's thought is grounded in a deeply anti-modernist attitude. Behind it stands a condemnation of modern technology and democracy as degraded in comparison to the heroic essence of *Heimat* and *Volk*. Far from anti-modernist, Mumford believed that regionalism was synonymous with modern" (2003: 35). While she notes that they were both concerned with "the crisis of civilisation dominated by the machine" and that they both juxtaposed the local against the global, or that they used "…'place', 'the earth', the 'land' as a 'home' and juxtaposed these to machine-ridden civilisation and technology", that their approach to regionalism is vastly different. She feels that Mumford was "not a knee-jerk opponent of the civilisation of the machine (as Heidegger was)" (2003: 37), and Sharr (2007: 2) seems to share a similar view about Heidegger's position when he says that "What is clear is that the philosopher resolutely romanticised the rural and the low-tech before, during and after Nazism, skating dangerously close to the fascist rhetoric of 'blood and soil'"[47]. Carman (2008: xiii) and George (2015: 12), on the other hand, interpret Heidegger's position not to mean a retreat from technological progress, but a clearer meditation on technology as an understanding of Being, combined with the cultivation of non-technological practices. This is echoed by Sharr (2007: 3) who, despite his earlier statement about Heidegger's romanticising of low-tech architecture, acknowledges that Heidegger celebrated both "high" and "non-expert" architecture[48] and that he did not promote an overall return to former craft-based approaches, but rather a better understanding of current practices. This requires a more critical approach to the use of global technology as a paradigm of progress which, according to Bhabha (2007: 6), is characterised by an "*uncritical* endorsement of modernisation (often identified with 'westernisation' or Eurocentrism)".

The uncritical endorsement of modernisation is often motivated through critique of the productive capacity of traditional or localised modes of production. As Frampton notes, "…the industrialisation or rationalisation of buildings as the unavoidable consequence of the inviability of high craft production in a mass society, should not be regarded as beneficial in itself, particularly where such methods lead, through an abstract optimisation, to a manifest impoverishment of the environment" (1994: np.). This is echoed by Richard Sennett who argues that "The myth of Pandora has now become a secular symbol of self-destruction. To deal with this physical crisis we are obliged to change both the things we make and how we use them. We will need to learn different ways of making buildings and transport and to contrive rituals that accustom us to saving. We will need to become good craftsmen of the environment" (2008: 12). Heidegger argues that the supreme danger inherent in the essence of technology requires careful reflection and that it can only be decisively confronted by something that is both similar and different to it, such as the artistic realm (2011b: 237). Based on his description of an artistic bringing-forth or *poiēsis*, this includes handicraft manufacturing, art, and poetic bringing into appearance (2011b: 221). Sennett sees *poiēsis* as the root of "originality", and he writes that philosophers like Plato used it to mean "something where before there was nothing" (2008: 70). Heidegger describes the essence of industrialised technology, which can be equated to global modes of production, as a "challenging-forth" or "setting upon" that is extractive, exploitative, expediting, mechanised practice where people and nature are seen as stock that can be ordered or commanded. The inverse of this would be a more natural, traditional, or local mode of production that reveals itself through *poiēsis*, and promotes a less extractive, more caring and cultivating practice (2011b: 223-226). Heidegger does however see the answer as lying within the space between these two modes.

> "*Contrary to widespread opinion, modern technology, ontologically understood as enframing, is 'no mere human doing',*

for it is as much something happening to *us as it is something that we ourselves undertake or carry out. The way out of what Heidegger calls the 'danger' of technology is thus not simply to* undo *it, to break our machines and retreat into naïve fantasies of preindustrial life. One proper response to the blind impulse toward the maximally efficient exploitation of entities is instead simply to meditate on the technological understanding of being* as *an understanding of being, as a 'destiny' (*Geschick*), even a 'gift' (*Geschenk*). And that means* letting *technical devices – airplanes, radios, computers –* be *the things they are, letting them shine radiantly as entities, as opposed to letting them sink into inconspicuousness and oblivion. Another possible response to the devastation brought on by the technological enframing of entities as standing-reserve can be found in Heidegger's effort to describe humble nontechnological things and so cultivate local nontechnological practices… By letting technological things such as super-highways and high-definition television sets* show themselves *as what they are, and by fostering nontechnological practices, Heidegger thinks, we can let the world be an authentic place, a 'locale' (*Ort*) in which human beings can genuinely 'live' or 'dwell' (*wohnen*), as opposed to a measurable spatial manifold*" (Carman, 2011: xiii).

This is similar to George's reading of Heidegger when he says that "Heidegger nurtured a sort of philosophical ambition of bringing into effect a less efficiency-oriented, less technologically totalising form of life…" (2015: 22), and a physical manifestation of this might be found in the work of Alvar Aalto whose work is known for its combination of global and local modes of production and who, according to Sharr (2007: 91), was the "exception to Heidegger's ambivalence to meeting architects". He writes how Aalto had a copy of Heidegger's book *Building dwelling thinking* on his desk[49], and that attempts were made for the two of them to meet. Heidegger's vision of the world as a locale, or of the global as local, and the acknowledgement of the value of the technological and the nontechnological, of technology and craft, or of techno and technē, reveals the ambiguous nature of spatio-technological classification. It also hints at his hunch that the space of tension between these manufactured polarities might be where the "saving power" lies.

New tectonic encounters

The ambiguous nature of technology and craft means that they are becoming increasingly flexible and integrated. Branzi notes how technological craftsmanship is often a research stage in the modern industrial cycle, where modern craft is positioned in parallel or before mass-production. He writes how "the prototype and the limited run make no pretence of being an alternative to mass-production, but treat it as a possible subsequent phase to the experiments in design permitted by the new handicrafts" (2010: 581). Rossi argues that "much of craft's contemporary currency lies in its difference from a mass-produced capitalist mainstream" (2017: 8), but Jacob (2017: 96) writes how "Acts of contemporary making involve hand, tool, machine, robot and code in a continuous spectrum of possibilities. The divisions that once clearly marked the boundary between craft and mass production rearrange themselves as, over time, forms of technology percolate through culture". Rossi (2017: 8) writes how digital experimenters[50] are "challenging historical conceptualisations of craft" and that "If the technologies of the first and second industrial revolutions challenged craft's economic relevance, its compatibility with the digital technologies of the third and fourth revolutions suggest, as *The Economist* reported in 2012, that tomorrow's factories 'may look more like those weavers' cottages than Ford's assembly line'". In Livesey's view, because of the rise of the factory, manufacturing that had been relatively fluid initially became more and more rigid and inflexible; everything has to be controlled to the second to maximise optimisation, speed, efficiency and production levels (as exemplified by Ford). However, he argues that production methods are changing in a way that is starting to require fluidity again (2017: 29).

The encounter between the digital and the analogue is one of the most prevalent phenomena in contemporary manufacturing and architecture. The relationship between Computer-Aided Design (CAD) or Computer-Aided Manufacturing (CAM) and analogue ways of designing and making either manifest themselves as being in opposition to one another, or as fruitful opportunities for co-production. Louw, when writing about CAD, notes its pervasiveness and he observes how "it crosses all boundaries, breaks down barriers and potentially could affect every aspect of the architectural creative process, from inception to on-site application" (2002: 17). While he is concerned that its widespread use will not necessarily result in the making of better buildings, he does note that it can free architects from the conventional understanding of craft and co-production and that CAM can enable a better integration of design and production in architecture. Sennett (2008: 39-42) however raises

concerns about the disembodiment that can result from the use of CAD. He regards one of its potential dangers as a reduced understanding of site on the part of the architect and he argues that since the computer has the ability to generate form and repetition quickly, the practice of ingraining context in the mind through drawing by hand is reduced: "The large issue here is that simulation can be a poor substitute for tactile experience" (2008: 42). He adds that the repetitive drawing of building elements by hand is something that improves an architect's understanding of materiality, and he is of the opinion that the circularity of drawing and making is disrupted when a final solution is arrived at too quickly through the use of algorithms, which will also impact on the understanding of scale and proportion. His other concern is overdetermination by CAD where users are not able to adapt a given result, and he writes that "If CAD does not cause this problem, the program sharpens it: The algorithms draw nearly instantly a totalised picture" (2008: 43). Citing Victor Weisskopf, Sennett writes that the excessive use of digitisation often means that the computer understands the answer, but the architect does not[51]. Ostwald's (2004: 207) concern lies with the reduction in co-production: While some CAD packages and digital platforms do allow for co-production in design and fabrication, some architects use CAD and CAM in a way that gives them unprecedented individual control over design and manufacturing. He writes that "Where in the past different types of architectural representation were translated by a team of others into the completed building, with the development of digital technology the power of the 'others' to shape architecture is reduced and the accountability of the digital architect is reciprocally increased".

Despite concerns about and objections to the use of CAD, or what Wilkinson (2017: 57) describes as "the kind of lamentations over CAD indulged in by Juhani Pallasmaa, Dalibor Veseley and Richard Sennett as a return to the Luddism of pre-socialist Morris", it has become an integral part of modern craft. Objections to its use are often misguided and apply to design flaws that would have occurred regardless of the tool employed: CAD is still only a tool which, like any other, is mostly dependent on the mental and physical capacity of its user. As Skolimowski argues, "No instrument is a cognitive claim and consequently no instrument can be thought of in terms of truth or falsity" (1972: 4). Renzo Piano (in Frampton, 1995: 383; and Louw, 2002: 19) maintains that "An architect must be a craftsman. Of course any tools will do. These days, the tools might include a computer, an experimental model, and mathematics. However, it is still craftsmanship – the work of someone who does not separate the work of the mind from the work of the hand…" Every architect's method is different: Contextual understanding, form-making ability, material consciousness, and empathy amongst others, are not dependent on the tool but on the mind employing it[52].

Livesey describes the contrasting views of CAM where one view is that 3D printing will be detrimental to the world, while another is that it could respond positively to change. His own view is that 3D printing is "the bridge between the physical world and the digital world" (2017: 48-49) and he sees beauty in the rhythm of work where humans and robots interact during production (2017: 67)[53]. The question can be raised to what extent the current conditions in Africa are suitable for the development of new tectonic innovations: The access to specific resources, the availability of labour, levels of employment, receptiveness, levels of building legislation, and the entrenchment of industrial building practices amongst others all inform architectural responses throughout the continent. Mbembe (2019a: np.; 2020b: np.) writes how a "technological escalation… has led to the emergence of computational capitalism in our times. We are no longer in the era of the machine but in the age of the algorithm".

In the 1960s, Pye (2010: 341) writes that "Nobody, however, is prepared to say where craftsmanship ends and ordinary manufacture begins. It is impossible to find a generally satisfactory definition for it [craftsmanship] in face of all the strange shiboleths and prejudices about it which are acrimoniously maintained. It is a word to start an argument with", and the space between technology and craft, or techno and technē, is becoming increasingly blurred. Cardoso (2010: 329) argues that to equate digital design or manufacturing to craft "is to deny the centrality of bodily presence as the defining element of craft… To say that it is not [craft], on the other hand, is to reject an opening that might give craft a new breath of life in the digital era". Nielsen (2012: 34) is convinced that industrialised manufacturing and craft can be harmonised to draw on the benefits of both, while Adamson (2010: 321) observes that technology and craft, "after two centuries of being conceptually severed" are beginning to converge again. McCullough (1997: 311) argues that in terms of craft, "…the usual meaning opposes high-technology processes in which the hand plays a diminished role. Thus the proposal of craft in the electronic medium is something of a paradox. But can we, here in the computer age, with fully optimistic and benevolent intent, suggest that the word needs a more inclusive definition?"

Technological development puts pressure on natural environments and on social environments with pre-existing ways of making. This section

highlighted the opposing positions between supporters of industrialisation and supporters of craft, and this oppositional framework is still prevalent in new tectonic encounters between the digital and the analogue. However, the research has revealed that this binary construct is mostly artificial.

The global and the local: Architectural binaries and attempts at mediation

The encounter between newer and more established modes of production can be framed as an encounter between the global and the local. This section discusses the polarisation between the so-called International Style and regionalism. It goes on to explore attempts at mediation between them, which builds into an exploration and re-evaluation of Critical Regionalism.

Tectonics can transmit social identities and they can carry metaphoric meaning. Local tectonics, however, usually embody these meanings more often than global ones, but by changing a product's context, its meaning often changes. As Terrio (1996: 70) observes, "Craft commodities acquire and shed culturally specific meanings and symbolic value as they are circulated and consumed. While closely tied to local contexts, the exchange and consumption of craft commodities is also mediated by complex, shifting class and taste distinctions which are in turn shaped by global developments". She cites David Harvey[54] as saying that "If the globalisation of markets and transnational consumerism characterise the continuing expansion of industrial capitalism, then this development also engenders a contradictory trend. This trend is manifest in the reassertion of local, culturally constituted identities, places, work practices, and commodities as a source of distinction and authenticity in the face of rapid change and the perceived homogeneity of transnationalism" (2010: 257).

Power relations

During the early years of twentieth century technological euphoria, Lewis Mumford stood out as someone who saw the need for the integration of different productive modes and "kinder machines". Tzonis and Lefaivre write how Mumford saw Modernist architecture as having a dogmatic, sterile, despotic and imperial design approach. They go on to say that "The Welfare State spread in the advanced industrialized democracies in the early twentieth century as a result of a process of economic, social, political and cultural modernization.

Its architecture gave prominence once more to the idea of abstract universal norms as a result of the re-emergence of the importance of the state and of the faith attached to industrialization as a vehicle of progress which a highly normative architecture had seemed to express" (1981: 126). Prior to their later change of heart, Le Corbusier (1887-1965) and Giedion's early writings (1928; 1941; 1948) enthusiastically call for the use of mechanised production, and according to Frampton (1995: 183), Mies van der Rohe (1886-1969) also argued for the acceptance of radical technological transformation. Hartoonian (1994: 69) notes how Van der Rohe's work "anticipated the silence of the culture industry", and he writes about his view that technological order should be the measure of being, not culture with its inherent multiplicity and disorder. Van der Rohe himself wrote in 1924 that "My receptiveness to the beauty of handwork does not prevent me from recognising that handicrafts as a form of economic production are lost" (1924: 245)[55].

Mumford wrote many books on technology and he was influenced by Patrick Geddes; although he shared Geddes's technological optimism, he called for syncretism or the cultural integration of industrial developments in *Technics and civilisation* (1934: 61). He noted that the mechanical was not sufficient on its own anymore and that a more integrated approach was necessary: "The emphasis in future must be, not upon speed and immediate practical conquest, but upon exhaustiveness, inter-relationship, and integration". Various moments of innovation in the space between the two totalitarian camps of industrialisation and craft, or the global and the local, can be identified and it is these moments that have sought to subvert the dominant paradigms. Hugo Häring (1882-1958), who was one of the founders of the *Congrès International d'Architecture Moderne* (CIAM) in 1928, later lodged a protest due to ideological differences with Le Corbusier and Giedion: He was in favour of a less impatient, more place-specific architecture, and Braham and Hale write that he "saw the building as a singular event emerging out of the particularities of place, program, material, and culture" (2007: 55). Ironically, some of Le Corbusier's works[56] demonstrate how he himself experimented with a more place-specific architecture and the combination of global and local modes of production. Colin St. John Wilson in his book *The other tradition of modern architecture: The uncompleted project* (2007: 15) notes that Häring's protest was in the cause "…of an architecture that would not impose a regime of pre-ordained geometrical forms on the one hand, nor the mass-produced models of industrial technology on the other." According to Sharr (2007: 99), Wilson invoked Heidegger to promote a more humane version of Modernism and similar to Critical Regionalism, he attempted to "can-

onise, to institutionalise, an alternative history – or an alternative tradition – of modern architecture". As Pawley observes:

> "*The architects of the generation of 1914, the monocled mutineers who lived through the invention of the automobile and aeroplane, were the first to embrace science and technology as a substitute for their accumulated cultural legacy, bringing these matters into the mainstream of architectural thought for the first time. They took this step as artists, licensed to find inspiration where they chose, but they soon found that immersion in science and technology threatened their old identity. Before they died, the mutineers came to realise that their art had been summoned by the machine, and not the other way around*" (1987/2007: 295).

Van Dijk (1992: 29) describes the post-war CIAM's attempts to humanise the industrialisation process and he speaks of the "image of mongrelism and ready compromise". The effort to subvert the dominant technological paradigm is also highlighted as a key aspect of Critical Regionalism by Eggener (2002: 229) who writes about its desire to subvert normative global technologies. Team 10 was a loose affiliation of architects who rebelled against the institutionalised functionalism of CIAM from within in the 1950s; they wanted to "humanise the industrialisation process" (Groenendijk and Vollaard, 1992: 29), and some of its members promoted what Frampton calls an "alternative-technology attitude to place" (1979: 317)[57]. Wilson (2007: 15) speaks of a "Resistance", represented by Alvar Aalto, and he cites Aalto's 1957 RIBA discourse where he spoke of "the hard-fighting squadron for the humanising of technique in our time" (Aalto, 1957/1979: 3; Wilson, 2007: 15). The combination of modern technology and craft is what Aldo van Eyck, who was one of the core members of Team 10, refers to as temporal depth[58] and according to Groenendijk and Vollaard, Van Eyck proposed "the entire delineation of complex relations. His answer to the problem of 'many' was a 'configurative discipline'; polarities like large-small, much-little he wished to reconcile in 'tweelingfenomenen' (twin phenomena)" (1992: 30). In addition to his support for a more humanist approach to architecture, this reconciliation of apparent polarities seems to hint at a search for hybridisation. Low writes that "It is not surprising that 'dissidents' such as van Eyck owe their difference to the embodied experiences of otherness on the African continent" (2012: 134) and he mentions the Mozambican architect Pancho Guedes as another participant in Team 10 who exemplified a striving towards the lived experience in architecture, as opposed to functional considerations only (2012: 132).

In 1932 Lewis Mumford, Philip Johnson and Henry-Russell Hitchcock arranged an exhibition with the title "Modern architecture: International exhibition" at the Museum of Modern Art (MoMA) in New York at the request of its director Alfred Barr. Barr somewhat arrogantly suggested the term "International Style" in the exhibition catalogue since the architects whose work was being exhibited came from North America and Europe, and he felt that in terms of Le Corbusier, Mies van der Rohe, J.J.P Oud, and Walter Gropius "it would be difficult to find in their work any national characteristics" (Barr, 1932: 16)[59]. Steyn (2018: 42) has a similar opinion and while he acknowledges that architects like Le Corbusier, Jörn Utzon and Aldo van Eyck were inspired by the vernacular, he maintains that they avoided cultural associations and did not see the need for their work to communicate meaning. Johnson and Hitchcock published a book called *The International Style*[60] in the same year and while Johnson left MoMA in 1934, Hitchcock and the new director Ernestine Fantl produced a number of exhibitions and books that further promoted the International Style. Nelson Rockefeller, who was the President of MoMA from 1939-1948, regarded the International Style as "a diplomatic calling card, or rather a branding device for selling the image of a powerful, modern, free American nation to a growing global audience of consumers. As a tool of nation branding in an expanding, globalising world, the 'International Style' was made to order…" (Lefaivre and Tzonis, 2012: 124). However, due to the Great Depression of the 1930s and an increasing focus on regional inequalities, MoMA became what Lefaivre and Tzonis call a "bastion of regionalism" (2012: 114). They mention at least twelve exhibitions between 1937 and 1947 that were concerned with regionalism; Johnson was away from 1934-1945 and Lefaivre (2003: 24) describes how, during this time, "regionalism took root and it grew like a weed in the midst of a well-ordered garden". John McAndrew, who was the director of MoMA from 1937-1941 arranged an exhibition on Frank Lloyd Wright's Fallingwater in 1938, and one on the work of Aino and Alvar Aalto during the same year. Lefaivre and Tzonis (2012: 116) regard Aalto as an architect who was "known for his distancing from the International Style and his adherence to regionalism" and who focused on materials, the adaptation of a building to a specific site, and the relationship of a building's profile to its surroundings. Frampton (as quoted in Crittenden and Henningsson, 1998: 79) sees his work more as the integration or re-interpretation of these two opposites when he says that "…the syntax of the Villa Mairea is a hybrid between the abstraction of modernity and concrete dimension of the vernacular". Giedion, however, in his 1941 book *Space, time and architecture*[61] did

not mention Alvar Aalto, which Lefaivre and Tzonis (2012: 121) ascribe to the fact that Aalto was a regionalist[62], although he did hasten to add Aalto's work in the second edition of the same book (Colquhoun, 1997: 14). It seems that eventually every movement wanted to "claim" Aalto as being representative of its aims. Johnson himself also seems to have changed sides when he writes in 1960 that "The International Style is its own justification. We can dislike it, which most of us may do to-day, but we are obviously much too close to have any interesting views on its future" (1960: 174).

In 1941 Lewis Mumford delivered the Dancy Lecture at Alabama College titled "The South in architecture"[63]. He located regionalism within a *critical* framework that was opposed to chauvinist applications as seen in Nazi *Heimatsarchitektur*[64], which Tzonis (2003: 19) describes as a "regionalist reaction against the universalist doctrines of modern architecture [which] was not a resistance against any real central hegemonic power but rather a fictitious 'cosmopolitan' threat subverting the national unity. A neo-tribal, illusionist and true-to-the-race architecture is called forth, cultivating genuine hysteria of siege and inspiring a delirious taxonomy of identity and exclusion". Mumford cautions against romanticising regionalism and argues that it would be a mistake to identify the regional with "the rough, the primitive, the purely local" (Mumford, 1941: 29), although he contradicts himself somewhat by noting that regionalism is not in conflict with the universal, but that regional insight can be used as a defence against the International Style and the "absurdities" of modern technology like air conditioning systems. Lefaivre (2003: 34) describes Mumford's regionalism as not being "absolutely opposed to the universal", but "infused with a notion of relativity". The seminal exhibition "Brazil Builds" took place in 1943 at MoMA and it finally included the global South in the conversation, although it was probably linked to political aims to restore the United States' relationship with Brazil during World War II[65]. In the exhibition catalogue, Philip Goodwin promotes Brazilian architecture as a good model, and he echoes Mumford by praising the Brazilian architects' consideration of climate[66].

In 1947, Philip Johnson joined MoMA again, which happened to coincide with Mumford's publication of an article in the *New Yorker*[67] in which he expressed his preference of the San Francisco Bay Area's architecture (which he labelled "Bay Region Style"[68]) to that of the International Style[69]. This set off a series of events, starting with a round table[70] at MoMA in 1948 that was organised by Alfred Barr, during which he and Hitchcock both retaliated against the Bay Region Style[71]. Hitchcock was also strongly opposed to Latin

American architecture, except when it was designed by North American architects[72]: Lefaivre and Tzonis (2012: 127) note how he particularly criticised the architecture in Brazil and Mexico, and how "The main brunt of his condescension was targeted at the very regionalist features of their architecture that had been so highly praised by Philip Goodwin in 'Brazil Builds': That is, the brise-soleil, the vault engineering, and the collaboration with prominent artists in the fabric of the building."

Attempts at mediating the global and the local during the twentieth century eventually coalesce and get consumed by Critical Regionalism. Critical Regionalism is arguably one of the most influential architectural movements of the previous century, and in the 1980s authors such as Buchanan (1984: 23) observed that "many architects see regionalism as the salvation of modern architecture". While this view is somewhat dated by now, Alexander Tzonis (2003: 10), who is one of the originators of the term Critical Regionalism, still sees it as a prominent movement because it relates to "the ubiquitous conflict… between globalisation and international intervention, on the one hand, and local identity and the desire for ethnic insularity, on the other". Kenneth Frampton and a number of other authors (1983b: 148; Carlson-Reddig, 2011: 269; Crudeli, 2018: np; Patteeuw and Szacka, 2019: 93-94) also still regard it as a valid theory since it has a political dimension[73] which is related to local identity, and because there is cross-fertilisation between political consciousness and architecture, while Avermaete, Patteeuw, Szacka, and Teerds (2019: 5) write how it has become thoroughly absorbed and integrated into contemporary practice and pedagogy.

Critical Regionalism situates itself between the global and the local, either as a force of attraction or as one of resistance, and it is known for often being practiced in the global South. Frampton (2002: 6), however, does note that regional identity may not be found everywhere anymore, which also relates to Schwab's (2017: 82) belief that the fourth industrial revolution has made identity increasingly mobile where "community" and identity is less defined by space or locality than it is by individual projects, interests and values: "The advent of online engagement and increased exposure to ideas from other cultures means that identities are now more fungible than previously. People are now much more comfortable with carrying and managing multiple identities", which echoes Noble (2014: 111) who also says that people carry several identities and reveal different ones depending on whether they are in a public, or private situation, and that they might have multiple affiliations. As Bhabha notes, "Cultures are never unitary in themselves, nor simply dualistic

in the relation of Self to Other. This is not because of some humanistic nostrum that beyond individual culture we all belong to the human cultures of mankind; nor is it because of an ethical relativism which suggests that in our cultural capacity to speak of and judge others we necessarily 'place ourselves in their position', in a kind of relativism of distance…" (2004: 52).

Despite these concerns, this study's position in terms of Critical Regionalism is similar to what Frampton (2002: 7)[74] calls an *operational critique*. He uses this term with regret to describe his reviews of architectural developments where he, "despite certain reservations, largely supported the works and the architects under consideration".

Interpreting Critical Regionalism

Liane Lefaivre and Alexander Tzonis (2003: 34) credit Mumford as being the first person to critically rethink regionalism, but the term *Critical Regionalism* was coined in 1981 by Tzonis and Lefaivre in their article called *The grid and the pathway* (1981) in order to differentiate it from previous types of regionalism which were often used in a "sentimental, prejudiced and irrational" manner (Tzonis, 2003: 10). Tzonis and Lefaivre polarise the local and the global by describing regionalism as being in opposition to universal and abstract architectures. Their position on this is unchanged, and despite the advent of social media they still maintain that "Regionalism always opposed centralization and universalization, and instead supports decentralization and autonomy" (Lefaivre and Tzonis, 2012: viii). In terms of this polarisation, Mollard (2019: 3) highlights the point that globalisation was initially expected to make a positive contribution to the world by allowing for multiple viewpoints and by embracing otherness, but that it was subsequently hijacked by a small elite that manipulated it to serve their own interests: "The globalised world promised wealth, knowledge and freedom for all – but the planet cannot contain these ideals of progress, emancipation and development. The counterattack is the resurgence of the local, the distressing realisation that there is no 'common world' to be shared". Ricoeur believes that the global and local are equally important, and according to him, the problem is that "Mankind as a whole is on the brink of a single world civilisation representing at once a gigantic progress for everyone and an overwhelming task of survival and adapting our cultural heritage to this new setting". He also sees globalisation as a positive force that makes knowledge and a basic degree of comfort more accessible, but he acknowledges that it can have a destructive effect on local culture (1965: 271). This view is still shared by contemporary authors (Schwab, 2015: np; Schwab, 2017: 34; Xu *et al*, 2018: 91) who write about the positives and negatives related to the fourth industrial revolution: Schwab goes on to say that "The big challenge for most societies will be how to absorb and accommodate the new modernity while still embracing the nourishing aspects of our traditional value systems" (2017: 91).

Globalisation's capacity to stimulate creativity and the fact that it has generated unprecedented wealth is highlighted by Lefaivre and Tzonis, although they do not say for whom; while it has achieved a flattening of obstacles, it has not created a flattening or equal distribution of wealth - the accumulation of wealth has been mostly concentrated in the global North. They do, however, acknowledge that globalisation contributed to increased inequality, wastefulness and ecological destruction, and they argue that its generally authoritarian, centralised and universal design models had a negative effect on the environment, communities and cultural heritage. On the other hand, they describe regionalism as a force that opposes centralisation and universalisation, but supports decentralisation and autonomy where architects prioritise ecological, social and cultural identity. They do recognise that the inherent danger is that it can be employed as a tool to confine certain groups to "gated belief systems", that it can create "ghost communities" and that it can be used to "retribalize" people. It could also be used in support of what Mbembe calls "nativism"[75] (2007: 28). Criticality is offered as the answer to address these concerns, and Critical Regionalism is regarded as a means to bring globalisation and regionalism together or alternatively, it can be what Mumford calls "a constant process of negotiation between the local and the global" (Lefaivre, 2003: 34).

Initially, Tzonis and Lefaivre regard Critical Regionalism as something that develops out of regionalism; regionalism is described by them as something that exhibits its own polarities in that the rise of populism shows how it can be associated with movements of reform and liberty, but that it can also be a tool of repression and chauvinism. Harwell Hamilton Harris speaks of the "regionalism of liberation" which is "especially in tune with the emerging thought of the time", has not emerged anywhere else, and is significant beyond its own locality. He opposes this to the "regionalism of restriction" which is stagnant and "prides itself on exclusiveness… It cares more for preserving an obscure dialect than for expressing a new idea. It is anti-cosmopolitan and anti-progressive. Such regionalism becomes a cloak for the misplaced pride of the region and serves to build-in ignorance and inferiority" and he believes that there is much support in architectural circles for this type of regionalism,

since "it relieves the architect of some decisions and responsibilities" (1965: 27; Frampton, 1983b: 153). These tendencies motivated Tzonis and Lefaivre to acknowledge in the same breath that Critical Regionalism has its limitations, but despite that, it is "…a bridge over which any humanistic architecture of the future must pass" (1981: 128). Lefaivre goes on to state:

> *"Why did we term Mumford's regionalism critical? After all, isn't regionalism always, by definition, critical? …it has always been critical of an outside power wishing to impose an international, globalising, universalising architecture against the particular local identity… But Mumford's regionalism is critical in a second, more important sense. It is critical not only of globalism, it is also critical of regionalism"* (Lefaivre, 2003: 34).

While Critical Regionalism was initially a reaction against pastiche and post-modernism's "top-down, reductive and universal formulas" (Tzonis, 2003: 10)[76], it soon developed into its own movement. Tzonis sees it as something that should promote a "bottom-up approach to design, that recognises the value of the identity of a physical, social and cultural situation, rather than mindlessly imposing narcissistic formulas from the top down" (2003: 11). Lefaivre and Tzonis recognise that regionalism can be a positive force, but they are aware of the fact that it also has its problems, which are often directly related to a particular socio-political context. They essentially see Critical Regionalism as a means of bringing the global and local closer together, but they are clear about the fact that regionalism changes over time and that regionalism in the present is vastly different to regionalisms of the past. It was, and still is, influenced by the global and local politics of the time[77]. Regionalist architecture has generally evolved and adapted over time and in most cases, it would have been subjected to outside influences. Curtis (1986: 25) is of the opinion that "Most vernaculars are hybrids of indigenous and imported types, and these types also change and adapt", which is echoed by Bhabha when he says that "…hierarchical claims to the inherent originality or 'purity' of cultures are untenable, even before we resort to empirical historical instances that demonstrate their hybridity" (2004: 55).

Colquhoun (1997: 18) challenges claims of criticality, and he believes that a fear of oversimplification led to the adjective "Critical" being used[78]. Almost forty years after coining the term, Tzonis and Lefaivre lament the fact that the ideas and message of their original article have mostly been misinterpreted (2017: 128), and according to Tzonis (2003: 10), its frequent misuse meant that regionalism came to mean something quite different and "Rather than being used critically – even when it was used together with that term – it was transported back to its obsolete, chauvinistic outlook"[79]. One could, however, argue that the movement has taken on a life of its own and that on the one hand, once the specificity of Greece is used as a lens to look at other contexts, that there may be a divergence from and development of certain ideas, while on the other hand, that the broad scope and generalised nature of the discussion on regionalism *per se* has left it open to interpretation. Curtis (1986: 24) argues that it would be "misleading to speak of a monolithic regionalism", since its underlying principle is to find unique responses to specific localities, although Taylor (1986: 21) believes that it is symptomatic of our time "to find all-encompassing labels for disparate personalities and works of creation that are being compared for the wrong reasons". This is similar to Leon van Schaik (1986: 19) who, in the context of countries that are experiencing development which is representative of the global North and the global South[80], regards regionalism as "another local catch-all that confirms local prejudices and excuses local lapses from international standards, be those lapses moral or cultural".

After a broad overview of regionalism from the Roman Empire to the 21st Century, Lefaivre and Tzonis (2003 and 2012) come to the conclusion that regionalism has two constants and that "One is the opposition to global systems, such as classical architecture and, more recently, the International Style; and the other is an adherence to the individual identity of regions". This is echoed by Frampton (1983b: 162) when he says that "If any central principle of critical regionalism can be isolated, then it is surely a commitment to *place* rather than *space*, or, in Heideggerian terminology, to the nearness of *raum*, rather than the distance of *spatium*". Sharr (2007: 105) is of the opinion that "…critical regionalism remains controversial because of its potential proximity to the fascist rhetoric of 'blood and soil'", but while Lefaivre and Tzonis still acknowledge its potential use as a nationalist tool to "retribalize" people, create "ghost communities" or generate consumer paradises, they are of the opinion that it also contributed to the development of "an environmental and ecological view of the world and has helped identify the long-range and long-term impact of globalisation in architecture". Frampton (1983b: 162) regards the global as a force that aims to reduce the environment to a commodity that is to be consumed, and that "Critical Regionalism would seem to offer the sole possibility of resisting the rapacity of this tendency". These are both quite ambitious claims, and while they provide a valuable and broad overview

of regionalism, Lefaivre and Tzonis' call for "regions that are embedded in a world system of complex interdependencies that are physical, social, cultural, and, above all today, ecological" (2012: 200), while praiseworthy, is difficult to frame without specific criteria. The lack of criteria is something that Özcan (1985: 14) also highlights when he says that "The line which separates a solemn, praiseworthy, regionalist achievement from a worthless pastiche or a potpurri [sic] of the past, is very thin and delicate… we still do not have any other criteria than that we have developed with modernism".

In *Critical Regionalism: Architecture and identity in a globalised world* (2003), Lefaivre and Tzonis include a broad selection of works to show its various applications[81]. Most of the included projects can be regarded as meritorious works of architecture, but while their aims and the authors' observations all seem to loosely fit the basic description of regionalism, it is difficult to assess why they are deemed to be *critical* of their approach to regionalism, and one would be hard-pressed to establish specific qualifying criteria for each category that could be used to evaluate other works that have not been included. This is something that the authors themselves effectively admit when they state that their selection "does not attempt to set up a clear-cut system of classification" (2003: 7), although Tzonis (2003: 10) describes "the test of criticism" as "the responsibility to define the origins and constraints of the tools of thinking that one uses". It was Kenneth Frampton who brought Critical Regionalism into the realm of the tectonic and who added a layer of specificity to it in his seminal work *Towards a critical regionalism: Six points for an architecture of resis*tance (1983a: 20) where he writes:

> "*Architecture can only be sustained today as a critical practice if it assumes an* arrière-garde[82] *position, that is to say, one which distances itself equally from the Enlightenment myth of progress and from a reactionary, unrealistic impulse to return to the architectonic forms of the preindustrial past. A critical arrière-garde has to remove itself from both the optimisation of advanced technology and the ever-present tendency to regress into nostalgic historicism or the glibly decorative. It is my contention that only an arrière-garde has the capacity to cultivate a resistant, identity-giving culture while at the same time having discreet recourse to universal technique*."

In a seemingly contradictory fashion, instead of a strategy of *distancing*, he goes on to describe Critical Regionalism's strategy as one of *mediation* where "the impact of universal civilization" should be mediated "with elements derived *indirectly* from the peculiarities of a particular place" (Frampton, 1983a: 21). This was also identified by Eggener who speaks about the tension between Critical Regionalism's apparent rejection of post-modernism's banality and superficiality versus its endorsement of its notion of pluralism. He dryly remarks that Critical Regionalism "depended on, and to some degree sympathized with, universal modernism, even as it worked against it… To be regional and modern involved an extremely delicate balance" (2002: 229), and Tzonis (2003: 10) describes how regionalism was used in the 1970s to describe the "modern-anti-modern struggle". Buchanan (1983: 15) sees regionalism as a way of checking or tempering Modernism and to imbue buildings with symbolic content: He regards it as a "…synthesis of what is most commonsense, dignified and enriching – sensually and symbolically – from tradition with the freedom, comforts and securities offered by industrial civilisation" (1983: 15).

Tzonis and Lefaivre's opinion that Critical Regionalism is something that develops out of regionalism, and that it is an essential part of humanistic architecture, initially seems different to Van Schaik's approach; he believes that one should "transcend that local origin and speak in the universal conversation which is on the cutting edge of mankind's growing awareness" and that a "universal culture of humanism… is the home of mankind's greatest searchings" (1986: 19), but he notes that universal culture does allow for adaptations to specific circumstances. This still seems similar to authors like Frampton and Buchanan who are very much in favour of Critical Regionalism and who argue that the universal or the global should be mediated with elements of the local. These different authors may be arguing towards a similar goal but from different directions: Tzonis and Lefaivre see regionalism or the local as the origin, while Van Schaik sees the universal or the global as the origin. They all, however, along with various other authors[83] acknowledge that there should be a form of mediation or adaptation that leaves room for a combination of both. While Frampton (2002: 18) believes any form of mediation between the global and the local will be a slow process (which is not something that tends to be tolerated in the present culture of speed), he writes that outside influences have to be appropriated, while local culture should be imbued with a sense of vitality in what he initially calls "assimilation and reinterpretation" (1992: 315). He later expands on this by saying that architecture requires "the reinterpretation and reformulation of the new, in light of specific means and conditions obtaining in a particular place and at a particular time" (2002: 18). This could be seen as an interesting inversion where an initial call for the reinterpretation of the past now calls for a reinterpretation of the future, which seems to pre-

empt Bhabha's view that "The enunciation of cultural difference problematises the binary division of past and present, tradition and modernity, at the level of cultural representation and its authoritative address" (2004: 51).

Despite his acknowledgement that the global can be adapted to the local, Van Schaik (1986: 19) approaches regionalism with suspicion, and he describes it as a "parlour game… in which on ill-defined grounds some buildings are considered 'regional' while others are described as 'international'". Frampton (in Crudeli, 2018: np) agrees that specificity should be encouraged in terms of an approach to landscape, light, climate, materials and construction, and based on his work, Patteeuw and Szacka (2019: 93) attempt to provide a succinct way of understanding Critical Regionalism as 1. A compositional understanding of the figure ground, 2. An interest in a site's material and cultural history, and 3. An awareness of the technical challenges and opportunities inherent in a particular site. This may seem like an over-simplification, although they do acknowledge that Frampton also sees it as having an ideological dimension. In his book *Modern architecture: A critical history* (1992: 327), Frampton describes Critical Regionalism as "…not so much a style as it is a critical category oriented towards certain common features…or rather attitudes", which he goes on to define as 1. Being a marginal practice which accepts modernisation but distances itself from "normative optimisation"; 2. Being consciously bounded but part of a larger context; 3. Being tectonic rather than scenographic; 4. Emphasising site-specific elements like topography, local light conditions and local climate (as opposed to artificial air-conditioning); 5. Designing for all the senses and regarding the tactile and visual as equally important; 6. Being opposed to "sentimental simulation" of the local vernacular, while supporting the reinterpretation of vernacular elements[84]; and 7. Flourishing in places that are not completely globalised[85].

Özcan (1985: 8) uses a classification that differentiates between different types of vernacular[86] that range from a conservative approach as exemplified by the work of Hassan Fathy, an interpretive vernacular or neo-vernacular, concrete modern regionalism, and abstract modern regionalism which is essentially Critical Regionalism (Özcan,1985: 8 and Folkers, 2010: 166). While Steyn (2014: 62) says that Critical Regionalism is better than the Post-Modern application of vernacular elements due its more analytical approach, he later adds that Critical Regionalism is narrow, vague, and inconsistent dogma (2018: 43, 57), and that he prefers Özcan's classification[87]. Özcan maintains that the main difference between the different types of vernacular can be based on the materials, labour, and technology that are used, and the difference can also be experienced at the level of the user or the community. While Özcan's wider spectrum is useful for the interpretation of the vernacular, Critical Regionalism (or what he refers to as abstract regionalism) is the closest category to the international or the global and hence, this is where the most pronounced encounter lies. The problem with the label "vernacular" is that is usually assigned from the outside and from what King (1996: 63) refers to as the "alien gaze", while Colquhoun (1997: 13) challenges the notion that the consideration of local climate, materials, and traditions are a necessary foundation for authentic modern architecture. Patteuw and Szacka (2019: 94), taking into account the (mostly) increased awareness of climate change, have a contrary view that "…while the current state of ecological transition confronts the profession with short cycles and economies of means, local materials, building knowledge and craftsmanship become more and more appealing if not necessary".

While Eggener acknowledges that Frampton's definition of Critical Regionalism is the most complex and astute (2002: 229), he is also of the opinion that Critical Regionalism is difficult to define beyond its basic role of mediating universal civilization with elements derived from a particular context, or as a reaction against "normative, universal standards, practices, forms, and technological and economic conditions" because it is not a product, but a method or a process (2002: 228). He also cites this as a reason for what he terms a lack of stylistic unity, which seems to contradict his statement about it not being a product, until he labels it a "style of thought and approach" (2002: 233). Ratti, Picon, Haw and Claudel (2013: np) are of the opinion that Critical Regionalism is a victim of its own success, but while its "propulsive force seems to be evaporating", that the ideas behind it "are more urgent than ever"[88]. This is similar to Avermaete *et al*'s assertion that "While many of the categories and concepts of Critical Regionalism became common in design practice in the past decades, paradoxically the text itself was all too soon referred to the pages of history books"[89] (2019: 10). They promote a re-reading of it and a reflection on its influence on architectural practice. Ratti *et al* (2013: np) argue that as soon as a particular trope of Critical Regionalism or a particular style is reproduced elsewhere, that it loses its DNA, but as Frampton insists, Critical Regionalism is not a style, but a process that can be applied virtually anywhere. Patteeuw and Szacka (2019: 94) pick up on this by mentioning the work of a number of contemporary architectural practices[90] (all European) whose work may relate to a contemporary reading of Critical Regionalism, while Folkers (2010: 226) regards the work of a number of contemporary African architects as being representative of Critical Regionalism, including 'Ora Joubert, Joe

Osae-Addo, and Francis Kéré. Kéré, (in Trangoš, 2014: 54) himself is of the opinion that "Critical regionalism is the use of innovative approaches to create an environmentally responsible, climatically sensitive and culturally embedded building". This does seem to describe his work in Africa although his former Professor, Peter Herrle, writes that "An outsider could make connections between Kéré's work and a debate between Alexander Tzonis, Liane Lefaivre, Anthony Alofsin and Kenneth Frampton that launched the concept of 'critical regionalism'" (2017: 67), but that while this connection can be made, he regards Kéré's work as unclassifiable and continually evolving.

Critical Regionalism has, despite a wide range of definitions, often resulted in stylistic similarities like the many examples of Tropical Modernism that share aesthetic similarities with one another, and more recently, what can be regarded as the Kérétification of African architecture. While discussing Salvatore Ferragamo in the context of the global fashion industry, Adamson (2010: 244) observes that craft manufacturing and its production of uniqueness results in the trendsetting moments that influence mass-production through a "cultural trickle-down effect". However, as Edgerton says, imitation and variation are a "fundamentally important mode of change… [and] the characteristic feature of our age has not been innovation but imitation" (2019: ix). Gauging by the number of contemporary practitioners – which includes Michael Murphy of MASS Design Group (2015: np) - who cite Kéré as an influence, and by the number of imitative (sometimes even mimetic reproductions) of his projects[91], it could be argued that there has been a similar "cultural trickle-down effect" that originated in his earliest body of work in Burkina Faso.

Frampton notes that Critical Regionalism should represent "world culture" (ie. different regions) and universal civilization, but that it should "deconstruct" the former and critique the latter in a process that he refers to as "double mediation" (1983a: 21). It should not be about exoticism or the appropriation of exotic forms, nor should it be what Buchanan (1983: 15) calls camouflage, and it has to impose limits on technological optimisation. Frampton describes the synthesis between universal civilisation and "world culture" through Bagsvaerd Church where the "*rationality* of normative technique" is combined with the "*arationality* of idiosyncratic form", but this could be an example where, as Eggener argues, Critical Regionalism "inadvertently marginalised and conflated the diverse architectural tendencies it championed" (2002: 228). Bhabha (2004) through his explorations, tries to ease the binary nature of a totalising generality, universalism, and rationality, with experience, subjectivity, and irrationality. The contrasting of rationality and universality

with regionalism's "sensual physicality, depth and nuance" is also posited by Buchanan (1983: 15), but in the defence of the global, he hastens to add that "True Functionalism would always have been to some degree regional. Accommodating local lifestyle and exploiting climate, local technology and materials should always have resulted in a form of regionalist expression", although Curtis (1986: 25) notes that lessons learnt from regional architecture that show the best ways of dealing with local climate can be translated into very different building functions and technologies. Frampton's notion of incorporating elements from a particular place might not be sufficient to represent "world culture", and Lewis Mumford cautions against this by arguing that:

> "*Regionalism is not a matter of using the most available local material, or of copying some simple form of construction that our ancestors used, for want of anything better, a century or two ago. Regional forms are those which most closely meet the actual conditions of life and which most fully succeed in making a people feel at home in their environment: They do not merely utilize the soil but they reflect the current conditions of culture in the region" (1941: 30).*

This does raise the question of whose culture in that region is reflected and by whom. Buchanan (1983: 15) notes that some of the best examples of Critical Regionalism can be found in contexts where technology was not yet dominant and where local traditions were still practiced; while it can be argued that technology is now globally dominant, especially in the field of communication, there are still places in the global South where tradition dominates architectural production. If work is performed in the global South by actors from the global North for example, it is quite possible that the culture that is reflected in the work could be one that is imposed from elsewhere and one which reflects the aspirations of the architects and their global audience – not necessarily those of local communities, and this could lead to the commodification of tradition. As Buchanan (1983: 16) notes:

> *"Generally, though, until recently, and still in many third world countries, local tradition was undervalued so that there was a dislocating schism between it and a shallow seemingly progressive Internationalism. Now, though, it is technology and progress which suffer a lack of faith and so there is a sentimental collapse into a nostalgic appropriation of the forms of the past. Yet disguised within them are all the mod cons that*

we are unwilling to forfeit. So traditional forms have become just more consumer items, robbed of any but the most spurious authenticity".

This is similar to Curtis's opinion that "If the result of an admiration for the vernacular is a doctrinaire application of a limited set of forms to all programmes then the result can be a sort of lunatic traditionalism" (1986: 27), which is something that Frampton (1983b: 149) also cautions against. Steyn (2014: 51) describes vernacular traditions as bottom-up practices, which he contrasts with vernacularisation which is typically an individualised top-down practice. If the culture of a local region is interpreted and reproduced by an individual architect, especially one from a different locality, that interpretation might not be representative of the truth; it may lead to a reductionist approach where elements of the local are essentialised. While Eggener (2002: 230) acknowledges the positive contributions of Critical Regionalism as bringing "much-deserved attention to otherwise neglected architectural activity", and writes that it "provided a sophisticated interpretive apparatus through which to approach this activity", he does argue that it has also "operated as a lens that can flatten, distort, or marginalise the cultural practices that it surveys". The use of the word "world culture" is an example of this flattening and even if Critical Regionalism can "deconstruct" it, its fragments will most probably remain interpretations by individuals close to the centre. Mediating the space between the global and the local might require careful calibration to engage only with the closest peripheries of the two poles in order to steer clear of their centres. If, however, the global is *the force* to be mediated with *elements* of the local, it seems to accept structural inequalities between the two.

Frampton describes the elements of the local that can be used for "governing inspiration" as the topography, the quality of light, or local tectonics, which are supported by Buchanan (1984: 25) who also adds symbolism and narrative. He argues that regionalist architecture must reflect the local culture's lifestyles, histories and aspirations, while Curtis (1996: 24) speaks about the transformation of the "generating principles and symbolic substructures of the past". Using any of these elements as inspiration relies on personal interpretations and subjectivities that are not necessarily well-informed or rooted in local knowledge and experience, which could further reinforce inequality. Colquhoun (1996: 51) believes the assumption that one culture can understand another is a paradox, and he goes on to say that "The search for absolute authenticity that the doctrine of regionalism implies is likely to create an oversimplified picture of a complex cultural situation" (1997: 18). Taylor

(1986: 21) does not have such an extreme view, but he does note that engagement with another culture comes with its own subjectivities which change over time: "One of the principal reasons why both the terms 'regionalism' and 'identity' are so suspect as tools of criticism is that the *affinities* a designer, or a patron, may feel for other cultures, or civilisations, frequently change". Colquhoun echoes the sentiment about change over time and he argues that technocratic decisions made in the centre cannot keep up with the changing needs and desires of the communities that these decisions impact, while constantly changing technologies in turn influence these very needs and desires (1996: 55). If mediating elements chosen by a subjective designer are not well-considered and integrated, they could be regarded as signs or as labels that merely signify Critical Regionalism, which is something that Frampton associates more with populism. He writes that "Its tactical aim is to attain, as economically as possible, a preconceived level of gratification in behaviouristic terms" (Frampton, 1983b: 149). Curtis (1986: 26) cautions against the types of regionalism that merely reduce elements to signs and references and notes that "Even if the Third World could afford such confectionary, it would soon tire of an import that gave so little sustenance". It could also be argued that a generalised consideration of local elements like light and topography can be signified by global tectonics with only marginal engagement with the local, and the consideration of a local element such as light is often also only used in service of global technologies[92].

Buchanan (1983: 15) also raises the problem of flattening and with designing from a distance where "so much modern architecture is a foreign importation designed in the capital for the provinces, or worse, for exotic lands quite beyond rapid comprehension". He calls for architects to treat cultures other than their own with "respect and humility" (1983: 16), which is echoed by Christian Benimana of MASS Design Group when he calls for architects to approach new contexts with humility and the acceptance that people may have been building there in a certain way for a long time[93]. While Curtis (1986: 27) calls for a "modern regionalism" or "regionalist modernism" that requires a "rigorous modernity and a rigorous understanding of the vernacular", Bernstein (1991: 4) writes that "Only by seeking to learn from the 'other', only by fully grasping its claims upon one can it be critically encountered. Critical engaged dialogue requires opening oneself to the full power of what the 'other' is saying. Such an opening does not entail agreement but rather the to-and-fro play of dialogue". This is similar to Van Schaik's (1986: 20) assertion that a "deep understanding" of the local is needed, but that there must be aspiration towards the global. The local must be acknowledged in the global to prevent

"disasters of indiscriminate borrowing" and the "terrible unthought versions of metropolitan building". He feels that architecture should not be "imitative of fashion plates from livelier shores, or simple enshrinements of the local body politic".

Sennett however sees advantages in designing from a distance, and he argues somewhat controversially that "A stronger jolt to changing how we have used resources would come in imagining ourselves to be like immigrants thrust by chance or fate unto a territory not our own, foreigners in a place we cannot command as our own. The stranger, remarks the sociologist Georg Simmel, learns the art of adaptation more searchingly, if more painfully, than people who feel entitled to belong, at peace with their surrounding" (2008: 13). Giedion (1954/2007: 311-319) and Steyn (2018: 43) agree that architects do not need to be native to a place in order to represent its traditions. However, if buildings are designed in the global South by architects from the global North on the basis of Modernist design principles and tectonics that are merely "mediated" to blend in, they could be regarded as echoes of colonialism. As Adamson (2010: 379) observes, "The twin ideals of immediacy and authenticity had, among their expressions, the seeking out of unspoiled cultures, many of which were designated as 'primitive'- a term that intertwines positive values with high-handed, superior disdain". Hérnandez (2010: 31) writes that "In situations of colonialism, translation turns into a tool for the construction and exercise of European authority", which is what King (1996: 71) cautions against when other cultures are observed from a position of authority in what he calls "intellectual imperialism".

Swilling writes about Aristotle's three conceptions of knowledge as being *technē*[94], *episteme*[95], and *phronesis*, which he describes as "the capacity for sound judgement appropriate to the context" (2020: 11). This knowledge is often lacking in the production of Modernist-based architecture in Africa, and in terms of the production of locality and power relations, the "Other Tradition" and Critical Regionalism, like Heidegger, generally show a limited understanding of the Southern position or Edgerton's "poor world". This opinion is shared by Van Schaik (2012: 52) who observes that Critical Regionalism "promoted a temperate zone, northern Modern architecture lineage, while allowing this to be moderated by the climatic needs of the tropics, but not by their own cultures". Lara (2012: 76) has a similar view when he says that "Critical Regionalism operates only in one direction – from the centre to the periphery – with little or no possibility for peripheral issues to influence the centres in return". Lim and Chang write about the "asymmetrical binary structure" where

the global North is seen as the origin of modernity, creativity, and innovation, with the global South being relegated to the role of passive receptor (2012: 9), and as Hérnandez notes, "…non-western architectures have often been studied – and inscribed historically – on the basis of a binary system of antagonism between the pre-colonial and the European or, more recently, between Euro-American modern and non-western architectures. The dismantling of binary systems and the foregrounding of cultural difference that Bhabha advocates brings about an opportunity to overcome such antagonism…" (2010: 117). As Folkers observes, "modesty and being prepared to listen are not characteristics commonly associated with architecture, which may explain the relative unfamiliarity of abstract regionalism [which he equates with Critical Regionalism], not only in Africa, but also in the rest of the world" (2010: 168). Instead of Critical Regionalism, Low (2003: 35) calls for an approach of "critical difference" which does not marginalise or predominate the Other: "Consequently, its effect is that of the complementary other, which establishes a horizontal line of dialogue, both internally and externally".

The consideration of the global South is also generally absent in Heidegger's work. While there are a number of contemporary architects[96] who are enthusiastic about certain aspects of his thinking, he also has many critics like Theodor Adorno[97], who described Heideggerian language as a cult that required a leap of faith. Sharr writes that "To him, Heidegger's vocabulary of ideal dwelling had no room for realities of poverty. It was incapable of expressing class-ridden inequality, its rosy expressions unable to deal with the privations of inequity and conflict" (2007: 89). George (2015: 15) is also sceptical about Heidegger's argument, especially his "particular technological understanding of all reality [which] is intuitively contestable on account of the grossly inegalitarian tenor of the very movement that constitutes it and on account of the intuitive impossibility of the hope it programmatically cultivates". One of the regular critiques of Heidegger's work[98] is its emphasis on provincialism with its connotations of "blood and soil", as opposed to a more inclusive cosmopolitanism or pluralism[99].

Where Heidegger does hint at the importance of mediating between techno and technē, or global and local modes of production, this is still place-bound and does not yet recognise the extent of material globalisation, nor does it take the difference or the dichotomies between the global North and the global South in account. Bernstein also recognises this when he notes that "Despite Heidegger's own appreciation of Aristotle's *Ethics*, he never does justice to what distinguishes *praxis* from *poiēsis*, or *phronēsis*[100] from *technē* – to

what Hannah Arendt calls the human condition of plurality – the basic condition of both action and speech. Typically Heidegger speaks of man – not *men* or *human beings* in their plurality – beings who are at once alike and different in their otherness and who in their speech and deeds reveal their uniqueness" (1991: 124). Bernstein refers to the "horrendous ethical-political consequences of Heidegger's question concerning technology" (1991: 120) which referred specifically to the German context during the first half of the twentieth century, but it can also be applied to global inequality, a lack of consideration of difference, and the exploitation of social and environmental capital in Africa.

Bhabha (2004: 49) writes that "Cultural diversity is an epistemological object – culture as an object of empirical knowledge – whereas cultural difference is the process of the *enunciation* of culture as 'knowledge*able*', authoritative, adequate to the construction of systems of cultural identification". This can be seen as a challenge to which types of knowledge are valued: If rational, global scientific knowledge is valued more than cultural or local knowledge, especially where "co-production" between the North and South is promoted, then the notion of an equal exchange may be flawed to begin with.

According to Bhabha (2004: 162), "Hybridity is a problematic of colonial representation and individuation that reverses the effects of the colonialist disavowal, so that other 'denied' knowledges enter upon the dominant discourse and estrange the basis of its authority – its rules of recognition". The question then arises as to what the architect's situatedness is and how equal collaborations between North and South can be created, especially in Africa where, in Bhabha's words, "the rite of power is enacted on the site of desire" (2004: 160). Some practitioners from the global North who are working in the global South embed themselves into that context by moving there permanently or at least on a long-term basis beyond the scope of a particular project, some collaborate closely with local architects, while others embed their work by strictly using local materials and labour only; there are also architects from the global South who have repositioned themselves in the global North, while still working to contribute in the global South. Distances come into play, where in some cases, there is a physical distance between the designers and the makers, while in other cases, there is a more marked distance between materials and labour with the site itself. For those who are situated on the "periphery" of the so-called "centre" (which usually refers to somewhere in the global North), the periphery *is* the centre and for more equal encounters between the global and the local to occur, the periphery needs to be centred. While speaking about neo-colonialism and the multinational division of labour,

Bhabha observes that "Such cultures of a postcolonial *contra-modernity* may be contingent with it, resistant to its oppressive, assimilationist technologies; but they also deploy the cultural hybridity of their borderline conditions to 'translate', and therefore reinscribe, the social imaginary of both metropolis and modernity" (2004: 9). The translation and reinscription of modernity often happen where the new is introduced as an insurgent, as opposed to practices that are a continuation of past and present, but as he suggests, "Globalisation… must always begin at home" (2004: xv).

Bhabha acknowledges the view of Frantz Fanon who "…recognises the crucial importance, for subordinated peoples, of asserting their indigenous cultural traditions and retrieving their repressed histories. But he is far too aware of the dangers of the fixity and fetishism of identities within the calcification of colonial cultures to recommend that 'roots' be struck in the celebratory romance of the past or by homogenising the history of the present" (2004: 13). Nationalism is not restricted to regionalism, and it can just as easily be a driving force behind globalisation: The battle that raged during the twentieth century between proponents of the International Style and those of regionalism showed how much power and geopolitics influenced architecture, especially architecture that was produced by practitioners from the global North in the global South. Mavhunga argues that there is a separation in terms of space and power when it comes to the production of science, technology, and innovation. The producers are seen to be scientists, engineers or architects (who are often concentrated in the global North), while the consumers are the general public or laypeople (often concentrated in the global South). He goes on to say that "A geophysical zoning of the definition and directionality of technology has been hammered into our brains: that technology is for academy-trained engineers, hence the emphasis on experts, and that technology can only come from the West and is 'transferred' to the *technology-poor* Global South" (2017: 4), while Benimana observes how the very existence of a global South is due to injustice that is linked to poverty, disenfranchisement, and neglect[101]. To address structural inequalities between the North and South, the recognition of otherness through horizontal co-production is essential, and as Mbembe (2020a: np.) argues, "it is about going out of oneself, encountering the others". This is especially relevant where architects are working in contexts other than their country of habitation, or origin. In a post-colonial and decolonising world, if an architect from the global South is working in the global North, and especially if an architect from the global North is working in the global South, he or she has an ethical imperative to strive for a more equal encounter with the Other.

This section expounded the opposition between the so-called International Style and regionalism, and attempts at mediation between them which eventually becomes subsumed by Critical Regionalism. It shows how many authors still regard Critical Regionalism as valid, but how this can also be countered by a number of criticisms. Its deficiencies in terms of a more equitable engagement with the global South are highlighted, while hybridity, situatedness, and the consideration of difference are surfaced as important points of consideration. The following section will explore these issues and encounters with otherness with specific reference to Africa.

The global North and the global South: Architectural encounters in Africa

Difference and hybridisation

Industrialisation and craft, and the encounters between them, are profoundly affected by the contexts in which they are practiced and employed. The polarisation of techno - the global, and technē - the local, carried on throughout the twentieth century in line with the drive for modernisation and development. Swilling (2020: 19) writes that binary thinking was established as the ultimate way of knowing during the development of Western industrial culture, but that "By contrast, Sub-Saharan African philosophy has always emphasised 'relatedness' between all things…"[102]. George (2015: vii) sees modernisation as the transposition of the "technological vision of the good life" to the global South, but Adamson writes about the World Crafts Conference of 1964 where "The egalitarian, democratic and sometimes utopian ambitions of Euro-American craft reform ran headlong into the concrete economic problems and strategies of craftspeople and advocates in Asia, Africa and Latin America" (Adamson, 2010: 199).

> *"The idea that craft is temporally out of joint has also dictated the way that craft reformers have situated themselves in space. From the late nineteenth century onwards, geographies that were supposedly untouched by the processes of modernisation were identified, studied and exploited in an effort to retain contact with an authentic past… Each of these sites has been subjected to that particular combination of care and condescension that is the hallmark of the idealist impulse. The places are real, but within modern craft discourse they often function as a purer, ungraspable Other…"*
> (Adamson, 2010: 136).

In *Poetically man dwells* Heidegger, while describing the combination of technology and *poiēsis,* observes that "The same never coincides with the equal, not even in the empty indifferent oneness of what is merely identical. The equal or identical always moves toward the absence of difference, so that everything may be reduced to a common denominator. The same, by contrast, is the belonging together of what differs, through a gathering by way of the difference" (1971: 216). This *gathering* or *belonging-together* of difference builds on his argument that artistic or craft-based production should become more integrated with the dominant technological approach, which essentially calls for a hybridised approach to making. It should be remembered that modern technology and craft in themselves are already heterogeneous, since both paradigms already employ elements of the other, and in addition to that, that hybridity, as explained by Hérnandez (2010: 77) is not merely the combination of the two, but the *reinterpretation* or *subversion* of one by the other. Moussavi (2007: 166) supports this viewpoint by adding that "Instead of declaring that differences are un-combinable, the point is to identify differences that are singular, look for connections, define systems of negotiation and find larger areas of consistency among these differentiated entities that can produce new hybrid organisations." The terms *hybrid* and *hybridisation* are often used in architectural discourse, including in Critical Regionalism writings, and as Hérnandez (2010: 77) observes:

> *"These concepts have been particularly useful in discussions about the architectures of previously colonised peoples as well as buildings produced in the so-called developing world. In early discussions, however, architectural theorists and historians approached hybridisation mostly because of its semantic implications: A term that represented a combination of materials, forms, construction techniques and ornamentation. In this sense, hybrid architectures were implicitly set against a background of 'non-hybrid' architectures or against the assumed purity of European architecture whose origins can be traced back to antiquity. Therefore, in this context, hybridity established a hierarchical system which gave authority to European architectures; an authority based upon its anteriority and its alleged homogeneity".*

Difference and hybridisation in the current global context require a somewhat different perspective when regarded from the positionality of what is referred to as the global South. Bhabha (2004: 248) writes how postcolonial theory "attempts to revise those nationalist or 'nativist' pedagogies that set up the relation of Third World and First World in a binary structure of opposition". Herz (2015: 6) writes about the "complex network of dependencies" where the global South is often "governed by the whims and fancies of Western consumerism or by larger geopolitics". As described by Perez (2002: 11), technological revolutions since the eighteenth century originated in the global North, but their effects are felt throughout the world and especially in the global South where global industry and local production are regularly at odds. Put differently by Edgerton, "What is obvious for the poor world applies to the rich world but less obviously so" (2019: xv). This statement is echoed by Duminy *et al* (2014: 3)[103] who argue that "the global South offers privileged insights into the workings of the world at large: while the project of modernity has always been a North-South collaboration, it is in the global South that the impacts of this relationship have been most immediately and starkly felt". The in-between spaces in the global South where these different productive modes exist simultaneously can, however, potentially be what Bhabha calls "innovative sites of collaboration and contestation". He refers to these opportunities as "moments or processes that are produced in the articulation of cultural differences" where indigenous knowledge can be used to articulate the dominant forms of knowledge (2004: 2).

> *"Such cultures of a postcolonial* contra-modernity *may be contingent to modernity, discontinuous or in contention with it, resistant to its oppressive, assimilationist technologies; but they also deploy the cultural hybridity of their borderline conditions to 'translate', and therefore reinscribe, the social imaginary of both metropolis and modernity."* (Bhabha, 2004: 9)

Hérnandez (2010: 66) describes these opportunities for hybridity as moments where purity can be undermined and where a hybrid is both the cause and result of tensions between modes of production[104]. According to Bhabha (2004: 213), nations are prone to react to the anxiety experienced due to rapid progress by reverting to representations of traditionalism or the archaic. He contests the nationalist and 'nativist' narratives that position the global North and South in an oppositional structure (2004: 248) and he argues for the creation of a time and space where differences cannot be totalised but can rather be made to occupy the same space in an intercultural dialogue or "global ethic of inter-regional and transnational connections" (2007: 7). While various authors[105] have critiqued Bhabha's work for globalising hybridity without sufficient contextual specificity, Hérnandez (2010: 77) contends that these critiques have in fact contributed to its development. Postcolonial discourse tends to generate binaries like global North/global South, self/other, centre/periphery, universalism/regionalism, and modern/traditional, but according to Bhabha (2004: 165) "The paranoid threat from the hybrid is finally uncontainable because it breaks down the symmetry and duality of self/other, inside/outside."

Jonathan Noble is in favour of the practice of hybridisation in African architecture and he writes that "the modern is often defined in static opposition to the premodern, to traditional or even notions of the uncivilised and the savage. A hybrid conception of the contemporary involves both an appropriation of the modern and a subversion of its exclusionary purity through the inclusion of formerly silenced narratives" (2011: 265)[106]. Bernstein (1991: 8), while discussing Hegel, argues that "I do not think we can any longer responsibly claim that there is or can be a final reconciliation – an *Aufhebung* in which all difference, otherness, opposition and contradiction are reconciled. There are always unexpected contingent ruptures that dis-rupt the project of reconciliation". In the same way, technological ruptures and transitions can emphasise the difference between global and local tectonic systems. Hybrids are often messy, and as Colquhoun (1996: 55) says, "The relationship between industrialisation and traditional cultures and techniques is not one in which they become organically fused with one another, as Le Corbusier implied, but one of hybridisation, where different cultural paradigms, detached from their original contexts, co-exist in an impure and unstable form". As Bhabha (2004: 3) observes, "The borderline engagements of cultural difference may as well often be consensual as conflictual; they may confound our definitions of tradition and modernity".

Tropes of tectonic encounters in Africa during the twentieth century

In a similar vein to Ricoeur (1965)[107], Low speaks about the "cultural genocide" that Modernism facilitated in Africa, where "Clashes of tradition and modernity have been a primary site of conflict between coloniser and colonised" (2012: 128). He goes on to say that Modernism, as a tool of colonialism in Africa, generated a continuing confrontation (read encounter) "between indigeneity and modernism as opposing socio-cultural systems with very specific

consequences for spatio-technical modes of production" (2012: 129).

One of the best-known Modernists, Le Corbusier, who designed and promoted an unapologetic version of Modernism, sometimes did exhibit regionalist tendencies and his work in Africa has also been described as such[108]. While, in many instances, Le Corbusier could be regarded as a member of what Gerneke (1998: 197) refers to as "A coven of architects in central Europe [who] presumed to create a utopian world in which elite and proletariat alike would inhabit white flat-roofed buildings in verdant cities", his later work again seems to show a more active engagement with locality. Colquhoun (1996: 55) notes that the reconciliation of modern technology with local materials and traditions would be key to Le Corbusier's work from the late 1920s onwards. According to him, Le Corbusier once remarked that Modern architecture is, or should be, conditioned by global technologies and local factors like climate and tradition[109].

Lefaivre and Tzonis list a number of his projects that exhibit regionalist tendencies, in particular his urban scheme for Nemours, Algeria, in 1934 which they feel was "driven by the recognition of the particularity of the region, the site, and the 'topography'". Curtis (1986: 28) echoes this by stating that Le Corbusier's use of *brise-soleil* in his Algerian projects was "directly inspired" by Moroccan brick *claustras* and Arabian *mashrabyas*. While Lefaivre and Tzonis describe Aalto's opinion of him as "too much of a technocratic globalist as well as International Style formalist" (2012: 151), they credit him with the birth of a new approach to Tropical Modernism in terms of his role in the design of the offices for the Ministry of National Education and Public Health[110] in Rio de Janeiro, Brazil, in 1943. The design for this building was a collaboration between Le Corbusier (who was invited by the architectural team to oversee the project), Lucio Costa, Oscar Niemeyer, Affonso Reidy, Ernani Vasconcellos, Carlos Leão, Jorge Machado Moreira, and Roberto Burle Marx. One of its most recognisable features is the façade treatment of *brise soleil,* the introduction of which is ascribed to Le Corbusier[111], although Gerneke (1998: 204) is of the opinion that Le Corbusier's role in the building may have been exaggerated and he writes that Latin American architects had already been applying sun control scientifically in the 1930s, with building codes and research on the topic going back as far as 1904. Speaking about Latin American architecture (in particular the *Ciudad Universitaria* or University City in Mexico of 1954), Harris (1965: 32) warns that if Northern architectural elements are combined with local symbolic content without regional adaptation or mediation, "the new forms from Europe could become the new colonialism of Mexico. It would then enslave rather than free". The same statement can be applied to architecture in Africa.

Following the "Brazil Builds" exhibition at MoMA in 1943, Tropical Architecture gained a large following in southern Africa (especially in South Africa and in the former Portuguese colonies of Angola and Mozambique). In the *Architectural Review,* Nikolaus Pevsner (1953: 381)[112] refers to the architecture that emanated from the architecture schools of the University of Pretoria (UP) and the University of the Witwatersrand (WITS) as "a Little Brazil in the Transvaal". Gerneke (1998: 203) writes that the publication of the *Brazil Builds* exhibition was well-received in South Africa[113], and he notes how Latin American architecture made an important contribution to the "cultural patrimony" of South Africa. Lefaivre and Tzonis (2012: 187) list practitioners in South Africa like Rex Martienssen, Norman Hanson, Gordon McIntosh, Hellmut Stauch and (probably more accurately) Norman Eaton as architects who searched for a language of modern architecture that responded to the South African context. Eaton and Stauch both travelled to Brazil to visit Niemeyer, and Gerneke sees many similarities between Stauch's 1952 Meat Board Building in Pretoria and the Ministry of National Education and Public Health in Rio de Janeiro (Gerneke, 1998: 212-216). Tzonis (2007: 216) does, however, criticise the South African architects' reductive world view which, according to him, with few exceptions focused only on efficiency and climate, and did not respond to local culture, identity, and community. This criticism is not unique to South African Modernists, since Gooden (2016: 24) observes, "Theories of space, subjectivity, and identity - cultural or otherwise – were never the primary concern of the progressive avant-garde of the modern architectural movement". This could be contested in light of the more humanistic outlook of Team 10.

Confirming a number of the reservations that have been raised previously that regionalism can often be associated with populism, "tribalism" and nationalism, Fisher (1998: 126) writes that the first cohort of architectural graduates from the University of Pretoria in 1949, one year after the National Party took control of the government, showed more ideological fervour than academic rigour, although Gerneke (1998: 215) is dubious about trying to read political overtones in design and he is of the opinion that the popularity of the so-called Brazilian Style should rather be read as a reaction against traditionalism. While Tzonis (2007: 216) argues that, in general, architectural design in South Africa at the time did not take the political and social realities into account, he is only partially correct. Architects tended to respond to the political agendas of the White minority, but not to the realities of a broader multi-ra-

cial society. Fisher goes on to say that while Pretoria regionalism may have been "tainted by historical associations of its endeavours with the ideology of apartheid", it nevertheless exhibited a sensitivity to the local context (1998: 140). While this might seem like a contradiction, a number of architects like Eaton and Stauch drew extensively on local materials and craft traditions[114], and for most of the Pretoria regionalists the local climate was a key concern. The "bad weathering of the taught-skinned and flat-roofed idiom of the International Style buildings" (Fisher, 1998: 124) had to be tempered to suit local conditions. This tendency seems to be confirmed by Cooke (1998: 232) who writes that technology was the strongest reason for criticism against pre-War Modernism in South Africa. He lists leaking flat roofs, leaking flush-mounted windows, climatically unresponsive strip windows, cracking plastered walls (due to the lack of copings), and solariums that were either too hot or too cold as some of the problems that were caused by technologies that were unsuitable to the South African climate. He posits a number of strategies that were established by a local group[115] of architects and critics as 1. Making use of technologies that suited the local building industry, 2. Using durable local materials, 3. Using rational and efficient structural systems, 4. Making use of concrete frames that were cladded with more durable materials, 5. Integrating building services into a building's structure, and 6. Ensuring that the detailing of buildings allows for good water run-off and weathering[116]. These strategies can also be read in relation to many of the selected projects that have been catalogued in Appendix A.

Lefaivre and Tzonis (2012: 160) are of the opinion that by the 1950s, regionalism was a "truly global" movement, but they note that the Architectural Association (AA) in London, England, was "one of the few centres of education and research into post-World War II African and Asian architecture in the world" during this time. Unfortunately, this statement does not seem to take the architectural schools located in Africa and Asia during this time into account (including those of UP and WITS), but the AA did engage extensively with regionalism in Africa and Asia, especially once Otto Koenigsberger[117] conceived the course on *Tropical Architecture*[118] in 1954, and during the existence of its *Department of Tropical Architecture* which was established by Maxwell Fry with James Cubbitt in 1955[119]. Phokaidis (2013: 77) writes that "'tropicality' is understood as a particular European cultural construction of other geo-cultural regions, with an emphasis on climate, environment and nature", but he emphasises that the work of Fry and Drew shows the relationship between these climatic concerns and hygiene.

Drew and Fry[120] became renowned for their work in West Africa in the 1950s, especially in Ghana and Nigeria, and they also published a number of widely used books[121]. Unfortunately, their books did not include work by African architects like Oluwole Olumuyiwa, and many of their assistants and site architects who did much of the work are also underrepresented in the publications. They did, however, acknowledge that if African architects were to build on their work, that the resulting architecture would benefit from this local knowledge (Godson, 2019: 113). Fry speaks of "a regional character answerable to local needs, a dialect of internationalism" (1960: 8), which is confirmed by Phokaides (2013: 78) who is of the opinion that Tropical Modernism was "elaborated, internationalised and canonised". He goes on to say that "Fry and Drew's work in West Africa presupposed a European-Western supremacy over local knowledge and local architectural tradition, which resulted in a reciprocal *tropicalisation* of Western Africa and Modern architecture alike". Doherty, when writing about Fry and Drew, notes how "This delicate revised modernity fuelled the desires of these decolonised states to become first world countries and alluded to a superiority of Western architectural methods" (2013: 249).

Lepik (2013: 11) refers to Udo Kultermann[122] who found that architecture in Africa by architects from the global North did not mark a new beginning, but that their work was merely adapted Modernism, which is something

Figure 9:
An example of "Little Brazil" in South Africa with its brise soleil, piloti, and juxtaposed rectilinear and curvilinear forms. Meat Board Building, Pretoria, South Africa, 1952, Hellmut Stauch. Source: Cameron Forder, 2020.

that Joe Osae-Addo cautions against when he says that "We should resist the concept of introducing recycled ideas about development in Europe as relevant in Africa" (2018: 119). Unfortunately Fry and Drew's work does not always seem to have been as well-received in Africa as it was in the global North: Jackson (2014: np) writes about a "catalogue of frustrations" that have come to light fifty years later[123], where correspondence between the college principal of Ibadan University in Nigeria, Kenneth Mellanby, and the Colonial Office in London, reveals that the frustrations from the client's side were based on cost overruns and accusations that the architecture was regarded as "dysfunctional". Fry on the other hand, dismissed the client's concerns about long-term maintenance, despite claiming that their work "concerned first the needs of the people… and secondly it concerned climate" (1960: 7). Low (2012: 131) writes that their work was mainly driven by technology and was essentially concerned with the manipulation of the building's skin, and while Godson (2019: 111) agrees that their work had a strong focus on environmental and micro-climatic issues, Lefaivre and Tzonis (2012: 160) argue that it "never matched the technological excellence and practicality of the portable *Maison Tropicale*[124] (1949-1951) designed by Jean Prouvé for the French colonies of West Africa".

This practicality is contested by Henri Chomette (in Noyer-Duplaix, 2015: 273) who refers to premanufactured prototypes that are produced in the global North as "architectural sedatives" that cannot take local conditions into account sufficiently. Rossen regards the *Maison Tropicale* as a colonial construct that "assumed that European modern architecture was superior to local building styles and that French prefabricated housing was better suited to the climate than the local vernacular" (2013: np). The house was designed in a universalist and globalist ethos where technical determinism[125] was a key factor; technology, through rationalisation and standardisation, was seen to be able to effect social change. Rodenbeck (2010: 108) in conversation with Manthia Diawara[126] refers to it as an icon of "modernist and industrial design", and she writes how the Niamey model and the two Brazzaville models were designed specifically for the semi-arid climate of Niger, and the tropical climate of the Republic of Congo respectively. She does, however, as is echoed by Rossen later, see them "…in their jaunty colonialism, their failure as models, and their fin-de-siècle neo-colonial 'repatriation'" as "complex signs for the uneasy geography of the post-colony"[127]. The view of these projects by local community members as being something alien might be emblematic of the general lack of global awareness of how projects by practitioners from the global North are sometimes perceived in the global South.

Low (2012: 129) describes some of the abovementioned attempts at situated modernism under the sub-categories of Colonial Modernism or Western Modernism, Negotiated Modern or Local Awareness, and Contested Modernism[128]. Colonial Modernist works in Africa were mainly designed by architects from the global North, and it includes works that are labelled as Tropical Modernism. He argues that these situated modernisms are "located at the intersection between competing rationalities of colonial modern and indigenous traditional", which represents "a conscious re-negotiation of the modern project". The influence of local politics and culture are key aspects of this encounter, which is also suggested by Lefaivre and Tzonis, who acknowledge that regionalist work should be about more than climate, but that it should also engage with politics and culture. According to them (2012: 169), an unsuccessful attempt was made by Josic, Candilis and Woods in 1949 for the *Nids d'abeille* in Casablanca, where they tried to address the local climate and create a high-rise version of a high-density casbah. They also refer to Olumuyiwa's 1960 Cultural Centre in Lagos, Nigeria, where an attempt was made to redefine regionalism from only being concerned with climatic context to also engaging with community (2012: 170).

Embassies were often used as opportunities to mediate global architecture with local elements, and in Africa, they were often used by the United States of America and other Western countries to counter Soviet influence during the Cold War (1947-1991). Architecture was now used as a tool for diplomacy, and the United States in particular required its embassies to be "sensitive" to local cultures under the auspices of the State Department's Foreign Buildings Operations (FBO) program. These buildings had to represent American architecture, but it was expected that they should be adapted to local conditions and cultures, although Lefaivre (2003: 32) comments that "The regionalism of the embassies, like all forms of branding, was skin-deep image-making". Pietro Belluschi, who was the Dean at the Massachusetts Institute of Technology (MIT) at the time, was named director of the Architectural Advisory Board (AAB) which provided the FBO with guidance about which architects to appoint, and to evaluate their designs, and Lefaivre and Tzonis (2012: 141) note that he was of the opinion that regionalism should be used as a "branding device in American expansionism". They refer to Jane Loeffler and Ron Robin's criticism that some of America's foreign embassies attempted to flatter local sensibilities, which often led to "contrived explanations", and sometimes also weak designs which were the "result of the superficiality of the knowledge on the part of the architects of the regional cultures in which the buildings were implanted and the naïveté to think it didn't matter. A whole

series of fantasies – orientalist, tropicalist, Gaelicist, Africanist[129] – led to an inevitable trivialisation of local motifs" (2012: 142). Özcan (1985: 11) notes how interpretations of a local vernacular often only pay lip service to regional aspects and that "architecture became more of an expression of local shapes and forms where local culture is also reduced to souvenirs and folklore". He regards the sincerity of the designer or architect as the measure which determines whether they simply want to design a "stage set with pastiche" or create good architecture. It can, however, be questioned how sincerity is to be assessed and by whom.

Harry Weese's embassy in Accra, Ghana (1958), was praised by some for its consideration of local climate and its use of local materials[130], but Lefaivre and Tzonis (2012: 142) accuse him of resorting to a kitsch and irresponsible analogy by claiming that the tapered concrete columns were inspired by African spears[131]. They mention Hugh Stubbins' consulate in Tangier, Morocco (1961)[132] as another built example where the architect made use of perforated screens on the façade which seem to have been predominantly decorative (although they were also meant to provide some semblance of privacy during the day). One of the better examples could have been Louis Kahn's unbuilt embassy in Luanda, Angola, which he designed from 1960 – 1961, and which Lefaivre and Tzonis (2012: 143) feel could have been a masterpiece of regionalist architecture. Kahn (in Latour, 1991: 122-123) claims to have observed the behaviour of local residents to generate a double façade for his building which he referred to as wrapping a building with ruins. He noted that local residents, when working outside or inside, tended to face towards a wall and not towards the street, open spaces or windows, due to the intense glare of the atmosphere. He designed a second façade made up of punctured concrete sections that were positioned in front of the windows. These had sufficient depth to diffuse natural light and to reduce glare on the inside of the building, but he was critical of the ubiquitous practice of using grillwork in front of windows, which he felt just generated multiple patterns of glare on the inside. He also made use of a double roof as many contemporary practitioners in Africa are currently doing, although its functions are inverted: He designed a "sun roof" over a "rain roof" which meant the building enclosure was shaded and the space between the two allowed for airflow that could help to cool the interior. While the double roof could have been quite effective except for not having a sufficient overhang on the northern side, Schwartz (2014: np) is of the opinion that the facades were underdeveloped and that the building's orientation was poorly considered since the double façade is only included on the western and eastern facades, while the northern and southern facades hardly had any fenestration. He notes that if the building had been rotated by ninety degrees it could have been much more effective, which might be an example of what Lefaivre and Tzonis (2012: 142) refer to as the "superficiality of the knowledge" of locality. While Kahn's building made an attempt to engage with local climate, it seems that it would only have been partially successful in this respect had it been built. The second skin, which was used in many buildings that were designed in the idiom of Tropical Modernism could be regarded as an example of what Noble (2011) describes as "white skin, black masks"[133]. The second skin is meant to represent locality by allowing the building to "blend in", but in many cases it does not seem to have been adequately considered in terms of responding to the local climate, building traditions, or culture. Something that can be commended is that Kahn's aim was not to "Africanise" the building and in relation to his design he remarks that "You can go overboard very, very easily. You can make something frivolous in a second… somebody said it looks African, which was awful" (Kahn, 1961, in Latour, 1991: 128).

Another proponent of spreading American culture in Africa and other parts of the world was Conrad Hilton of Hilton Hotels who Lefaivre and Tzonis (2012: 145) describe as someone who took "American geopolitics into his own hands". He believed that his hotels and industrial assistance to the global South could combat communism more effectively than what could be achieved through military means. He saw his buildings as ideological tools that could have a potential impact in their host countries and the Cairo Hilton of 1953, which was designed by Sedad H. Eldem of Turkey in collaboration with Gordon Bundshaft of the American company Skidmore Owings and Merrill (SOM), is a case in point. Regionalism here was again used superficially as camouflage to promote American interests, and the hotel was embellished with Pharaonic references[134].

According to Ricoeur (1965: 283), "No one can say what will become of our civilisation when it has really met different civilisations by means other than the shock of conquest and domination. But we have to admit that this encounter has not yet taken place at the level of an authentic dialogue". This meeting of the *Other* can lead to the realisation that you yourself are also just one more *other* amongst many. This was written in the latter half of the twentieth century, and one could argue that there have since been various attempts at a more authentic dialogue, with varying degrees of success and failure. Lefaivre and Tzonis (2012: 183) refer to more recent buildings in Africa that they classify as Critical Regionalist work, like Mick Pearce's 1996 Eastgate Building

in Harare, Zimbabwe, which responded to the local climate by emulating the functioning of termite mounds. This building avoided overt references to local culture, unlike a number of projects that were completed after the advent of democracy in South Africa in 1994. According to Noble,

> *"Modernisation – its technology, economy and incumbent set of cultural forms and values – emerge and develop in tandem with the very same historical process[es] that seek to conquer and exploit the peoples of the so-called 'under-developed' world… Post 1994, however, the democratic turn in South Africa polity understandably sparked a need to examine questions of identity, to re-discover a common African heritage and to reconstruct our various senses of personal and collective belonging. And I feel it is also safe to say that the desire to discover the particularity of this condition must go beyond trite arguments, such as binary logic, which narrows choice between modernisation and tradition"* (2014: 112).

Lefaivre and Tzonis (2012: 187) note how post-apartheid architects "needed to generate public spaces that creatively and critically addressed aspects of memory and identity intimately linked with repairing the wrong of the apartheid era". They describe the Constitutional Court (OMM Design Workshop, Urban Solutions Architects and Urban Designers, 2004), the Walter Sisulu Square of Dedication (StudioMAS Architects and Urban Design, 2006), and the Alexandra Heritage/Interpretation Centre (Peter Rich Architects, 2008), all in Johannesburg, South Africa, as more contemporary examples of Critical Regionalism architecture, although they note that these were often more concerned with "preservation, reuse and innovation". Tzonis (2007: 218), despite some reservations, praises the architectural resolution of the Constitutional Court, particularly for its embodiment of memory through the practice of montage. Steyn (2018: 52-54) supports the classification of the Constitutional Court and the Walter Sisulu Square of Dedication as examples of Critical Regionalism, and he also adds the Hector Pietersen Memorial Museum in Johannesburg (Mashabane Rose Architects and Urban Designers, 2002) to the list. Van Schaik, during the 1980s, wrote that regionalism in South Africa was dangerously nationalistic, but he does admit that there are healthy types of regionalism[135]. Whether he would agree with Lefaivre and Tzonis' assessment of these buildings as qualifying is difficult to assess, but a number of them do make use of local crafts and cultural references.

Figure 10:
An architectural rendering of Louis Kahn's unbuilt Embassy in Angola by Kent Larson. Source: Larson, K. (2000). Louis I. Kahn: Unbuilt masterworks. New York: The Monacelli Press. [Online] Available: https://www.amazon.com/Louis-I-Kahn-Unbuilt-Masterworks/dp/158093014X (Accessed 23 October 2020)

Although Low (2011: 19) notes that the Constitutional Court does not resort to "neo-nationalistic symbolism", Noble (2011: 122) is of the opinion that the competition-winning proposal for the Constitutional Court was chosen because it was African "via 'analogy'". While parts of it were constructed with reused bricks that were harvested from previous buildings on the site, thereby providing some local material grounding, it makes use of a number of "African" analogies like the tree, bundled reed-like columns, and the sculptural form of the library tower. He goes on to say that:

> *"These sculpted elements resonate with tectonic themes derived from African craft traditions. The elegantly curved wire frame-like construction of the library tower is derived from traditional African basket weave, and similar resonances are repeated at the tops of air-duct chimneys, which are reminiscent of baskets or hats. The report also speaks of material references to Africa, such as light-filtering screens derived, once again, from traditional basket weave, Sotho huts where storage spaces are modelled into thickened walls, memories of mud construction and battered earth walls, and polished screen [sic] floors which are reminiscent of traditional dung floors…"*

In a similar way, the Walter Sisulu Square of Dedication also makes use of references to African craft traditions and analogies like home-made perforated drum stoves (Noble, 2011: 188). Some might question whether elements like these qualify under what Lefaivre and Tzonis call "irresponsible analogy" or what Hartoonian (1994) refers to as cultural commodification, but they have been abstracted and they have been positively received (Tzonis, 2007: 217). According to Richards, market forces can determine what is perceived as "traditional" craft, and while craftspeople may not want to imitate, their economic situation might dictate their actions (World Crafts Conference, 2010: 205). Terrio (1996: 70) also recognises the commodification of tradition when she says that:

> *"Claims of cultural authenticity in advanced capitalism are often linked to an ideal, aestheticized pre-modern past as well as the groups, labour forms, and products associated with it. Indeed it is the politics of cultural authenticity in the globalisation of markets that enables 'genuine', locally produced*

Figure 11:
Collage/montage praxis at one of the Awaiting Trial Block Towers, Constitutional Court, Johannesburg, South Africa, 2004, OMM Design Workshop, Urban Solutions Architects and Urban Designers (with a later intervention called "Flame of Democracy" by UrbanWorks Architecture & Urbanism in collaboration with The Library Special Projects. Source: Author.

craft work and commodities to be maintained, revived and/ or reinvented precisely because they can be commoditized and sold as such."

Adamson (2010: 239) notes that the persistence of "traditional" craft varies depending on its context, and that it can take the form of a compromised hybrid, or that it can be a reimagining of traditional modes of production (or a combination of both). Craft absorbs, carries, and distributes meaning related to its context, but its consumption (visual or physical) is influenced by global tastes and trends. The notions of cultural borrowing and quotation are explored through the investigation of the Mpumalanga Legislature buildings in South Africa[136] by Noble (2011: 43 and 45) who notes that the "unearthing and mobilisation of precolonial signifiers" is a popular political tool, but he acknowledges that the use of these signifiers can create an "unfortunate possibility for an unquestioning and romantic legitimisation of power". These buildings make extensive use of "African" forms and decorative elements as metaphors or signifiers, which Gooden (2016: 110) is also critical of when he writes that "They are used with the hope that the implicit and explicit attributes of the objects will invest the buildings with positive connotations (cultural heritage, legitimacy, and value) and make them 'recognisable' and more acceptable to the general public than if they were rendered in the language of architectural abstraction". Noble does, however, note that appropriation can be mediated by inclusivity by saying that "The logical form of the hybrid formation that I have appealed to requires a double motion of *appropriation* and *inclusion* to render a complex figure which is also a subversion of the dominant – not a synthesis, but a layering of the form, an inclusion of difference and a resistance to closure" (2011: 264).

It is questionable whether these buildings really subvert the dominant or whether they are duplicitous in the way that their "Africanist" form and decoration conceal a more conventional structure or what Noble refers to when he says that "conventional spatial and structural means were hybridised by decorative and tectonic features derived from African experience" (2011: 52). These buildings are emblematic of a period in South African architecture following the advent of democracy in 1994 when there was a searching for an appropriate representation of the now mostly defunct "rainbow nation" ideal, where architects tried hard to invent an architectural language which combined contemporary ways of making with "traditional" forms and decorative elements. Benimana (in Murphy and Ricks, 2019: 263) is of the opinion that "The fetishization of 'African architecture' has led to its interpretation as a simple mimicry of African indigenous forms, which stands in opposition to global technological advancements as if these are mutually exclusive". In *Dark Space: Architecture, Representation, Black Identity*, Gooden (2016: 102) argues that architecture should be a "form of knowledge rather than displaying the knowledge of form, tropes and superficial 'africanisms'" where stereotyping and the commodification of identity reinforces notions of "otherness". Gundaker (2016: 39) also cautions against an uncritical form of hybridity or the mere appropriation of "African" forms:

*"*Hybridity *has also become a replacement for the more passive* influence*. But its uses seem to have travelled far from the earlier critiques of colonialism – survivors Frantz Fanon, Stuart Hall, and Homi Bhabha, who saw hybridity as a strategy used by the oppressed to strike back against empire. Instead, the critical edge of hybridity all too often softens into simpler questions of cultural borrowing and quotation: All important to investigate, but unlikely to lead critique into especially thorny territory. Quotation, including the use of 'African' forms in sites with users of African descent, calls up a modified version of formal globalism, with 'meaning' regarded as inherent in the form rather than emerging from dialogic interactions. Complexities of mutual indebtedness, appropriation, historical milieu, and local interaction also seem magically to coalesce into origins invoked via emblematic visual-material signs – especially those borrowed from peoples viewed as 'cosmological' and closer to nature."*

Critical Regionalism has claimed an extensive body of work as its own, and buildings that loosely consider climate, pay some attention to topography, have some references to local culture, make some (albeit limited) use of local materials, or engage with communication and community all seem to qualify. Despite attempts by authors such as Patteeuw and Szacka (2019: 93), Buchanan (1984: 25) and Frampton (1992: 327) to identify some common features or attitudes, there still are no definitive or specific criteria to refer to when evaluating works that could be labelled as being representative of Critical Regionalism. Patteeuw and Szacka (2019: 94) note that "Critical Regionalism became all too soon a historical document, understood as a poetic, acritical and apolitical interest in peripheral conditions", but they do argue that it is still relevant, and that Frampton's intention was for a "political tool to counter the commodification of architecture into a global consumer product".

Whether the contemporary African cases are political can be debated, and some of them may not be. They can, however, all be seen as ideological, but whether the ideologies are primarily for the benefit of the communities who the buildings are supposed to serve, is doubtful. Numerous past tropes in Africa have made use of similar strategies of mediation and cultural borrowing, but based on the information uncovered in this study, there are signs of a more recent emergence of a searching for hybrid conditions.

The diaspora and shifted African encounters at the beginning of the twenty-first century

> *"Awareness of the interweaving of the here and there, the presence of the elsewhere in the here and vice versa, the relativization of primary roots and memberships and the way of embracing, with full knowledge of the facts, strangeness, foreignness and remoteness, the ability to recognise one's face in that of a foreigner and make the most of the traces of remoteness in closeness, to domesticate the unfamiliar, to work with what seem to be opposites – it is this cultural, historical and aesthetic sensitivity that underlies the term 'Afropolitanism'"* (Mbembe, 2007: 28).

Sanyal (2014: 89) writes that "By equating the notion of 'global' with the older rhetoric of 'universal', the critics ignore the unevenness of global exchanges; and by treating 'local' as largely irrelevant, they trivialise the question of difference, which is crucial to gaining insight into the complexities of temporality and spatiality in the discourse of contemporary art". He notes that for artists to be recognised globally, they have to receive affirmation from critics and theorists who are mainly based in European and American institutions. He supports the view that there are two poles within postcolonial identity discourse: One where the centre marginalises outsiders (which is done purposefully as a way of othering, but it can also be claimed by outsiders in the name of authenticity), and one where the notion of multiculturalism or universality is promoted. He goes on to cite Price (1989: 23-36) who writes about the "universality principle" where an artificial commonality is professed by the centre and often accepted by colonial subjects as a way to participate, modernise or promote development: "No matter how rigorously an identity claim shifts positions within this polarity, the two extremes keep haunting the space in between, producing a variety of influential binaries: tradition/modernity, non-West/West, difference/sameness, ethnology/art, exclusion/inclusion, and so on. And of all the formerly colonised regions, cultural identities of sub-Saharan Africa have been especially vulnerable to this tyranny of polarities". Sanyal (2014: 95) goes on to say:

> *"If we bring to this polarised debate the institutionally trained, internationally travelled, ambitious contemporary artists of African origin, then the scene becomes even messier, for the ethnology/art binary is subsumed by a vastly more influential, contemporary one: local/global. As with all binaries, there is a clear asymmetry of status between the two terms, with 'global' enjoying an unequivocal advantage over 'local'. What is more, in its ubiquitous (ab)use in recent years, 'global' has become a contemporary alternative to 'universal', tacitly bestowed with all the connotations of the older term. Needless to say, 'technology' – which is among the most appropriate nouns today to be qualified by the adjective 'global' – plays a crucial part in this cover-up."*

Bhabha (2004: 6) observes that "For the demography of the new internationalism is the history of postcolonial migration, the narratives of cultural and political diaspora, the major social displacements of peasant and aboriginal communities, the poetics of exile, the grim prose of political and economic refugees". The migration of skilled labour to the global North as explored by

Figure 12:
The Kigali Convention Centre, Kigali, Rwanda, 2016, Spacial Solutions International GmbH (Roland Dieterle). Similar to the Mpumalanga Legislature, the reader can use their own discretion to decide whether the mimicry of indigenous form (in this case the King's Hut) is appropriate. Source: Author.

Swilling and Annecke (2012: 89), Pinther (2017: 174), and Mbembe (2007: 26) with his notion of "Afropolitanism"[137] which relates to both physical and digital mobility, is evident in shifts by architects like Francis Kéré, Kunlé Adeyemi and David Adjaye, who moved from Africa to Europe (even though they are still contributing to development in Africa). Van der Lans (2018: 117) believes that the diaspora can make an important contribution to innovation in Africa, while Pinther (2017: 174) writes that this diaspora[138] opens up "new thinking spaces" that can generate improved links between the global North and the global South. Mbembe observes how African modernity is "a migrant form of modernity, born out of overlapping genealogies, at the intersections of multiple encounters with multiple elsewheres" (2015: 54). The African architects mentioned above might be regarded as what Bhabha (1993: 169) sees as "Hybrid agencies… [who] deploy the partial culture from where they emerge to construct visions of community, and versions of historic memory, that give narrative form to the minority positions they occupy", and for these architects, one could borrow Bhabha's statement about liberated African populations that "…are now free to negotiate and translate their cultural identities in a discontinuous intertextual temporality of cultural difference" (2004: 55).

Arguably the most celebrated[139] of these hybrid agencies, at least in architectural circles, is Diébédo Francis Kéré. Born in Gando, Burkina Faso, in 1965, he initially went to Germany on a carpentry scholarship but decided to stay on to study architecture at the *Technische Universität Berlin* (TUB). Bearing his artisanal background in mind, Kéré notes his affinity for technology and he mentions how his aim while studying architecture was to find ways to improve the construction techniques in Burkina Faso (Kéré, 2008: 8; Kéré, 2020: np.; Shipwright, 2018: 14; Van der Lans, 2018: 116). He began a long-running fundraising campaign for his university project for a primary school in Gando, which was eventually completed in 2001, and it was awarded an Aga Khan Award for Architecture in 2004. As Lepik (2017a: 14) observes, "Spanning a great distance a career was developing that, on the one hand, increasingly took him away from his homeland but, on the other, only acquired its real meaning when he returned".

Lepik (2017a: 15) regards the Gando Primary School as being the key to Kéré's work. While discussing this school, Low notes that "Where the project excels is in Kéré's identification and design appropriation of local materials and construction methods for villager inclusion" (2012: 136). He goes on to say that "The creative interpretation of traditional spatial practices, of local materials and construction techniques has reasserted the role of tradition in design

and propelled an unknown designer from a remote rural village into the global imagination". The local elements are not merely mediatory or decorative, and he describes Kéré's particular production of locality as an example of the *spatio-tectonic-material imperative,* and his work does seem to reflect what Low previously referred to as "the capacity for critical reflection that locates our imagination probably best in between the grassroots and the global" (2003: 36). Shipwright (2018: 9) describes the Gando Primary School as "a manifestation of his [Kéré's] understanding of architecture as a fundamentally social act", while Folkers (2010: 228) writes that his Dano Secondary School (2007) "rises well above the poverty aesthetics typical of familiar institutes built in the modern vernacular style". Elleh (2011: 86) writes that the architecture of West Africa has always been both international and localised, and in relation to Kéré's work he speaks of the "dialectic dualities between international and localised modernities", which is echoed by Herrle (2017: 66) who sees the work in Gando as something that "resisted any sort of hasty pigeon-holing as, for example, traditional or modern". Kéré refers to his own work as a synthesis or a "third way", which combines a Northern education in ecological building with a socio-cultural embeddedness in Burkina Faso (Lepik, 2017a: 15). He sees himself as a bridge between (the Northern) culture of technology and his own (Southern) culture – maybe not of tradition – but of development (Kéré, 2020: np.). Pinther writes about his approach of mixing established local building technologies with global ones that are "equally simple and resource-frugal ('low-tech')" (2017: 175), while Lepik (2017b: 104) describes his work as a dialogue between the global North and the global South. Beygo (2017b: 20) recognises this and observes that "The blend of local skills, community effort, economic solidarity, and European input is the essence of his hybrid architectural language".

As mentioned previously, Kéré's work is often cited and re-interpreted if not copied, especially by Northern architects working in the global South; he is a prime example of an architect from Africa who is influencing Northern praxis, while still contributing to the South. This would please Mavhunga (2017: 5) who searches for examples where Africa is the driving innovatory agent which affects incoming forces over a long period of time, and Kéré's early work can be regarded as an originating trope of a new contemporary African vernacular. He does not believe that there is anything specific that defines his buildings (Shipwright, 2018: 20), but most of them do have a recognisable aesthetic signature: The use of a double-roof where corrugated metal is used to shade barrel vaults made from locally produced bricks (often made from compressed earth or hollow cement blocks), lightweight locally welded or as-

sembled lattice trusses, clay walls (made from stabilised compressed earth bricks, laterite blocks, or poured earth), moveable metal sunscreens, passive ventilation techniques, the blurring of indoor and outdoor space, and the involvement of the local community, are just a few of the architectural elements and approaches that have become stylised and can be traced through many subsequent projects in Africa by other architects. Some of these elements and approaches are also identified by Shipwright (2018: 9), Folkers (2010: 228), and Beygo (2017: 54) amongst others[140], but as Kéré himself remarks: "I had friends saying, 'Be careful, people are going to start copying you'. I was thinking, 'Oh, that's a good thing. If they copy it, it means it's good'" (Shipwright, 2018: 29).

While some of his early projects could be criticised for being overly simplistic and possibly even crude in terms of their detailing and finishing, they are highly economical and pragmatic. This is confirmed by Herrle (2017: 65) who writes that the questions raised during the design development of the Gando Primary School, seemed "banal" in 1990s Berlin. In his view, the building is not about "Africanist" expression, identity, or about the investigation of conceptual design principles for schools, but it is highly pragmatic. This might be why it is so often referenced by others, but it may also be for representational reasons. Kéré's work is, however, becoming increasingly refined and more complex (which could be related to increased budgets and to his continuously evolving praxis), but it is remaining true to its pragmatic roots.

Besides the well-documented South-to-North migration of African architects, there is also a counter trend where architects from the global North have been flocking to sub-Saharan Africa and embedding themselves on the continent or at the very least, working here for an extended period of time. A reason for this might be partly since, as Van Schaik asserts, that "creative change arises in the Provinces, not in Metropolises – although its perpetrators seek – and need to – recognition in Metropolises" (2012: 53)[141]. As Kéré observes, when he began speaking about his idea of building a school in Africa during his studies, many of his fellow students were surprised (Shipwright, 2018: 14), but there seems to have been a resurgence in recent years where architects from the global North design, and in some cases build, schools and other public buildings in the global South, especially in Africa. There are many reasons for this: It can be out of a desire or a sense of duty to contribute to society in some way, but it can also be because of financial opportunity, the opportunity to design and build, working in a less legislated environment, educational aims, tourism (including educational tourism), in some cases the search for a career-making project, or simply because it may offer a sense of architectural freedom.

Almost a century later, this is similar to Fry and Drew's experience of working in Africa[142], of which Folkers writes "it was a breath of fresh air for architects from England to be freed from the claustrophobic culture that had evolved with too great a respect for former traditions", and to that of their contemporary John Godwin, who called Africa an "architect's paradise" (Folkers, 2010: 163). Noyer-Duplaix (2015: 271) writes how Modernist architects like Henri Chomette struggled with the bureaucracy in the global North and spoke about their "escape to Africa", while Doherty (2013: 249) mentions how Africa was a "creative test-bed for architects eager to 'cut their teeth' on modernity". Herz (2015: 11) writes about the astonishing range of countries that were represented by architects practicing in Africa during that time (the same can be said today), and Folkers goes on to say that Modernist architects went to Africa "like good missionaries, first to support the colonial welfare state and then to support newly independent African nations, all in the name of humane progress and justice", but that they did not take local cultural influences into account (Folkers, 2010: 163; 2011: 52)[143]. Lokko writes about "the 'development' bind" and she is astonished that "the 'official' architecture of the continent, similar to its 'official' languages, [is] perpetually narrated by outsiders, architecture that is funded and finessed 'on behalf of', seldom 'by'" (2016: 229).

Frampton (1983b: 149) speaks about the "sporadic flourishing" of Critical Regionalism in "the cultural fissures" of the United States and Europe and he labels these fissures using Abraham Moles' term as "interstices of freedom". These same *cultural fissures* can be seen to occur where practitioners from the global North work in the global South. While Pinther sees a positive side to this counter-migration by saying that "Today, (temporary) (re-)migrations of architects and designers have helped to update artistic and architectural practice in various parts of the African continent" (2017: 177), these *interstices of freedom* can, however, be misused as opportunities to produce work that is of a quality that would not be accepted in the global North, that is less durable, with unsuitable indoor climates, and potentially unsafe. The freedom of working in contexts that are sometimes desperate, less legislated, not as climatically challenging, and where work is generally less critically received, can be misused as scenographic portfolio-building exercises behind a smokescreen of social responsiveness. As Mbembe argues, a structure of repetition should be avoided so former colonial or neo-colonial practices are

not replicated under the guise of something new[144].

Mbembe (2007: 26) also makes the link between the various diasporas and how the relationships between them, and with their places of origin are complex, and that they can have a notable influence on politics and aesthetics. He goes on to say that "When discussion arises about aesthetic creativity in contemporary Africa, and even knowing who and what is 'African', the political and cultural critics tend to pass over in silence this historical phenomenon of worlds in movement. Seen from the viewpoint of Africa, the worlds-in-movement phenomenon has at least two sides: that of dispersion, as already mentioned, and that of immersion" (2007: 27).

The complexities mentioned above raise the question whether contemporary projects are truly based on the notion of co-production or whether they represent a version of neo-colonialism. Herz (2015: 7) is of the opinion that "Sub-Saharan Africa has entered an era of neo-colonisation, driven and imposed by a global economy and multinational corporations"[145]; the same can be said for many contemporary architectural projects in Africa, but according to Lefaivre, "To make the best use of local resources, we must often seek help from people or ideas or technical methods that originate elsewhere" (2003: 37). This could be seen to be a contentious statement, since it is written from a Northern perspective and practitioners from the global South are not often invited to advise on technical methods in terms of Northern resources. The same contention can be levelled at Critical Regionalism or the discourse of vernacular architecture, which mostly developed in the global North and as King (1996: 63) argues, is "based on its own social constructions of the Other". He questions the underlying causes of an architectural construct: Not who made it, what material was used or what the building looks like, but which systems led to its making.

A vast number of social architectural projects in Africa are aid-based and funded through charitable organisations, NGOs and donor funding, which is one of the systems that govern the architecture itself[146]. In this vein, one could question the motivation for charitable foundations to approach architects who work in a specific idiom, or the root reasons for requiring the use of local material and labour. Is it only rooted in the desire to fund projects that are more socially, environmentally and economically sustainable, or do the projects that they fund also have to project a certain image that embodies the "spirit of the local" (similar to America's embassy projects during the latter half of the twentieth century)? Watson[147] (2003: 402) writes that "Operationalising particular networks requires the (opportunistic) foregrounding of particular values and belief systems, which may change under different circumstances". Are the motivations for Northern academic institutions that work in the global South purely to "make a difference", or is it partly self-serving where built projects that can be termed socially responsive and exhibited or published overseas can be realised in a less legislated context and often left behind with no long-term management or maintenance structure? Does the North's freedom to experiment sometimes leave Southern users shackled to high maintenance, deteriorating, and often dangerous buildings that were conceived as thinly veiled products of "intellectual imperialism"[148]?

Aid-based architectural production is not necessarily a "no-strings attached" scenario, and as Hérnandez (2010: 15) argues, "…the practices of 'conditionality' with which economic, educational and technological assistance is offered to nations in the developing world guarantee that the First World nations retain their position of power". This is echoed by Doherty who writes that "…the majority of architectural NGOs from the West are still very much disseminating modernity within Africa… As interests between local governments, international NGOs, and architectural projects are inextricably intertwined, is this contemporary mode of practice simply the newest facet of neocolonialism?" (2013: 251). This is tricky terrain to navigate for architects, whose values are not always neutral: Some align themselves with the "NGO rhetoric" or political agendas of donors and funding agencies (which usually pander to a Northern audience), while others are able to find an ethical or equitable way to work with (or even against) them. Lepik (2017a: 16) writes that "Many architects from the US or Europe have worked on socially motivated architectural projects in Africa, but they have always been suspected of embodying a kind of neo-colonial attitude if, for projects in developing countries, they suggested using mud bricks or similar simple materials that they were not using in their own countries"[149], but he regards Kéré's work as having credibility because he combines industrialised materials and technologies with local ones. This can, however, be said of many contemporary projects in Africa and it remains to be seen which materials and technologies Kéré will be using for his new commissions in the global North. Kéré notes that, despite certain unfavourable local connotations of building with mud in Africa, development agencies often insist on it being used (as cited by Pinther, 2017: 177). So-called "alternative" building technologies are often experimental or unknown (sometimes forgotten), and the introduction of unknown technologies in a particular context often requires training, development, and following up. Ricks (2019: 42) writes that project budgets rarely allow for research and develop-

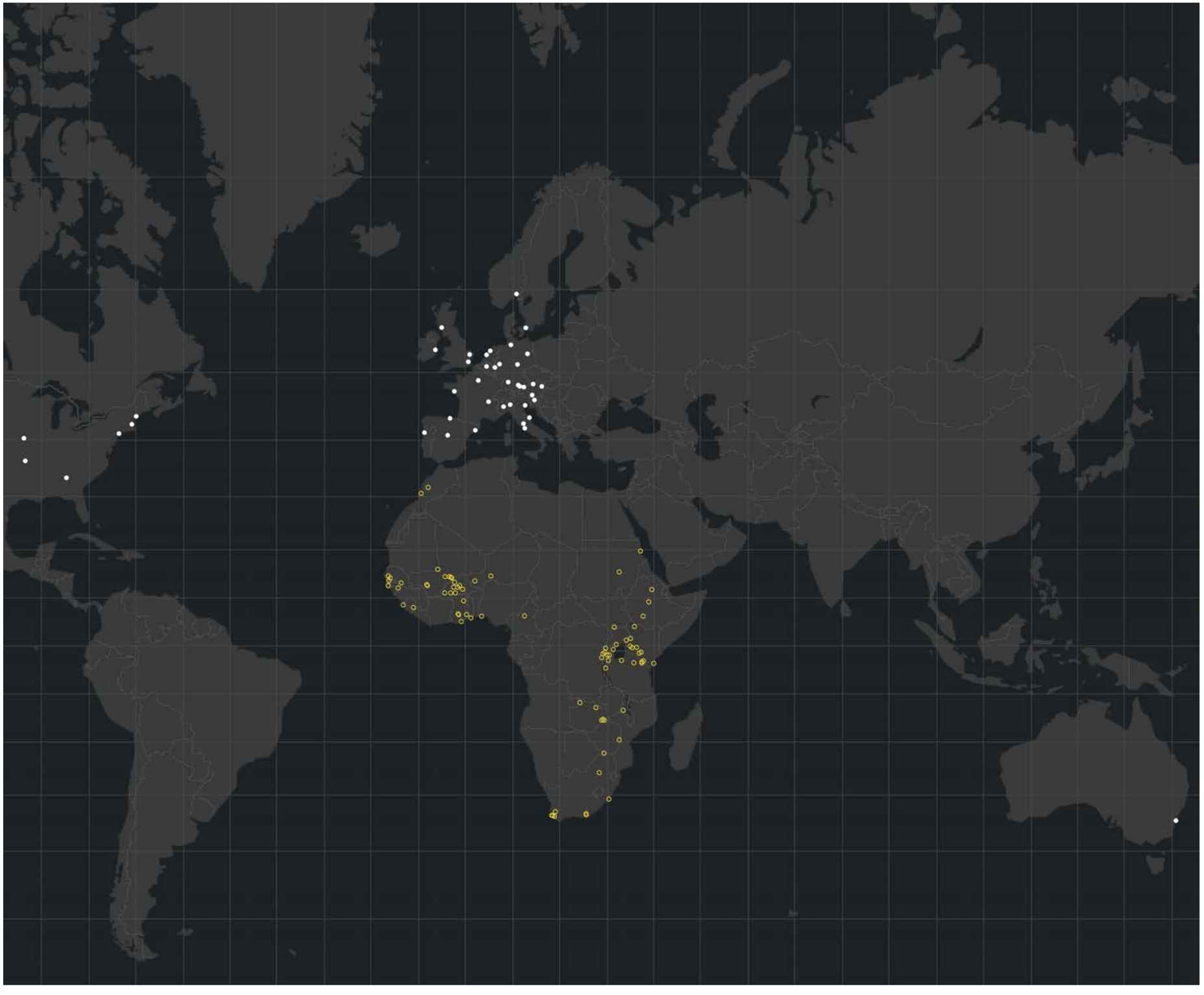


Figure 13: Practitioners and projects.
A map showing the African works completed from 2010 to 2019 that have been catalogued in Appendix A and on the website in yellow, and the origin or displaced positionality of the architects in the global North in white. The projects in Africa seem to follow a line from the southern to the north-eastern part of the continent, with a cluster in west Africa. The origin or displaced positionality of architects is concentrated in mainland Europe and the north-eastern corner of the United States of America. Source: Author.

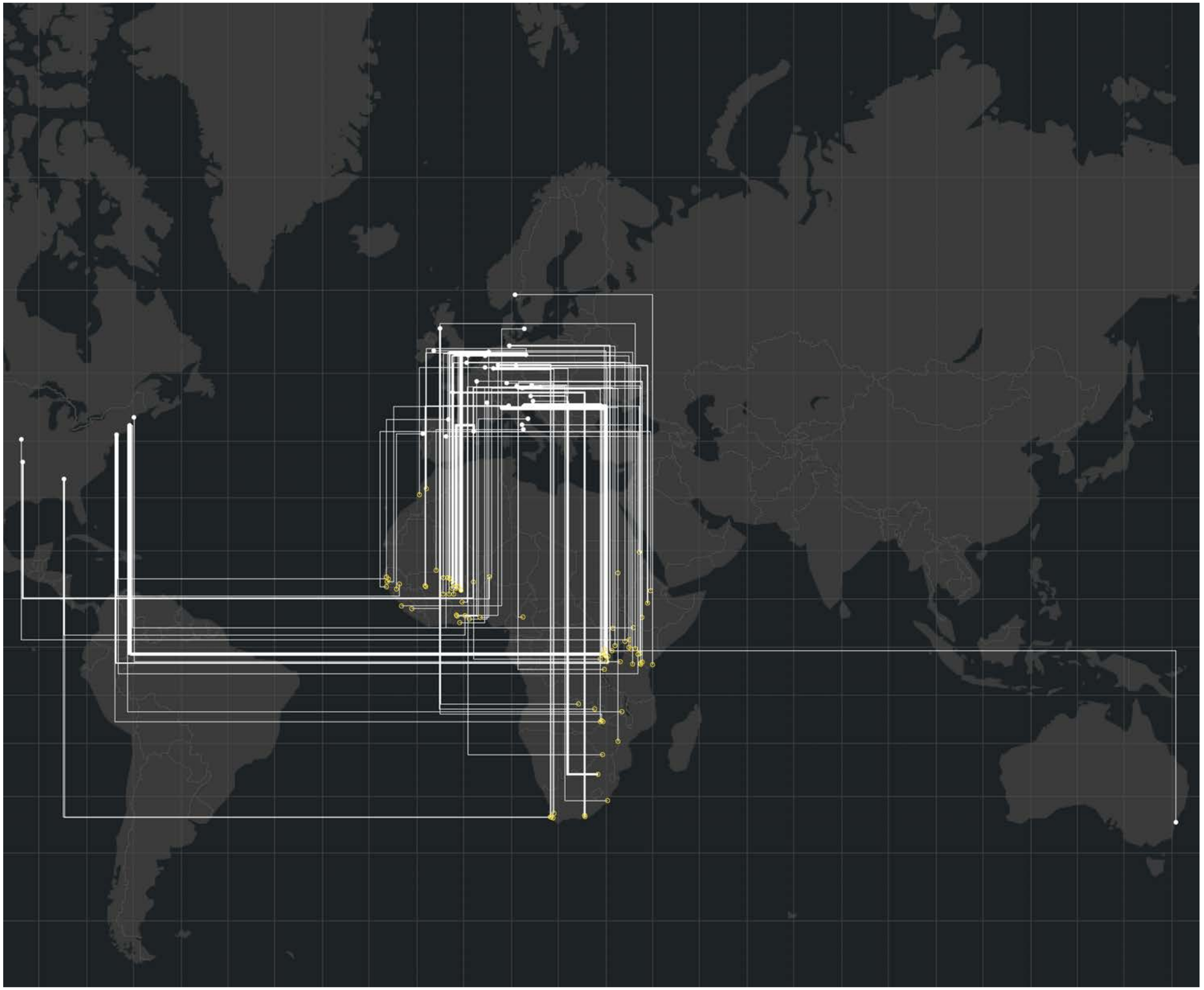
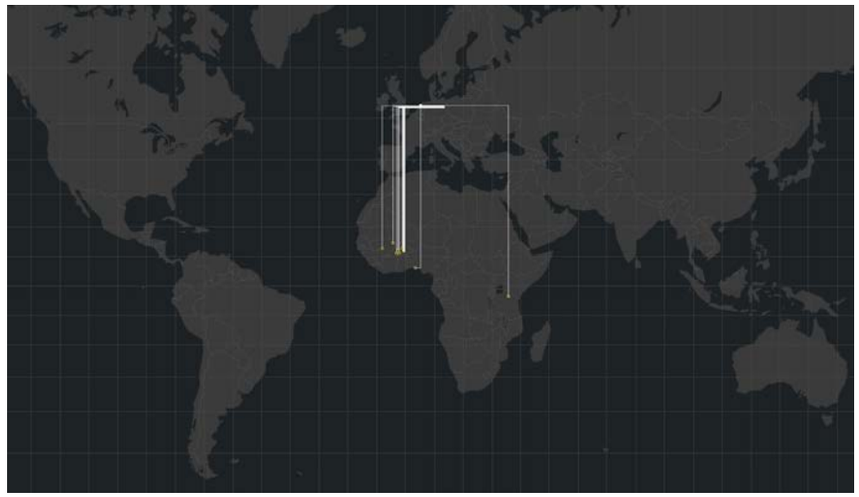


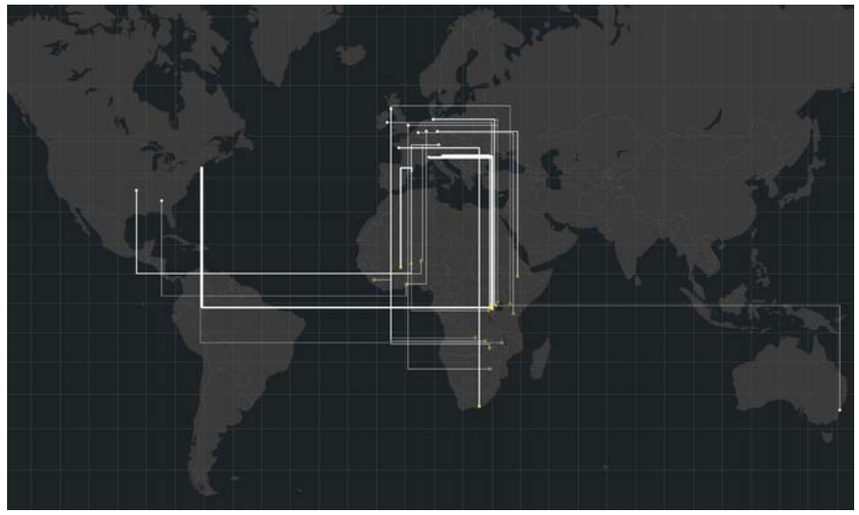
Figure 14:
Practitioner-project links
A map showing the links or lines of encounter between the Northern and Southern positions. In some instances, these can be read as an eagerness to contribute, while in others they could represent a new scramble for Africa. Source: Author.

ment, which results in an "innovation gap". Folkers' experience is similar, and he notes how funding is often building-specific, and that it does not allow for extended training, dispersion and dissemination of the technology, or improvement and development of the technology (2010: 208).

As Bhabha (2004: 160), notes, power is often enacted through objects that are disseminatory. This seems to be the primary function of many contemporary projects in Africa whose primary aim is visual dissemination for the generation of publicity in the North (either for the funding agency, an educational institution, or for the architects themselves), while their social function ends up being a by-product. The dissemination is also mainly geared for Northern affirmation and not for technological dispersion in the South. Once the object or building has been claimed and disseminated, it and its occupants are often left to their own devices, which naturally raises a number of ethical questions. Kéré (in Shipwright, 2018: 20) agrees with Andres Lepik (2013) when he remarks "I see architects who arrive in Africa, design one building, are there for just a couple of years, and then they start talking about how much they have done… that's really naïve". The need for embeddedness over time, or co-production with local professionals and/or communities becomes key, and in line with Aristotle's conceptions of *technē*, *episteme* and *phronesis*, Kéré notes that he has learned that two types of contributors are required for a project: "People with knowledge of context, and people with the ambition and means to push a topic" (Shipwright, 2018: 32). These can sometimes be same person, as in his own case for his work in Burkina Faso in particular, but it is often in the form of an encounter between contributors from the global North and contributors from the global South.

The contributions also become less place-based since, as noted previously, origin and identity are less defined by space or locality than they are by similar actions, and shared interests or values (Schwab, 2017: 82; Noble, 2014: 111). For Kéré it is about values, and reflecting on the Gando Primary School he notes that "when we finished the school, it already had a very clear value, not only in terms of comfort and aesthetics, but also in terms of how it was made, the technical ideas underlying it" (Shipwright, 2018: 18). He laments people's emphasis on ethnicity and their expectation that Africans outside Africa should be translators of their place of origin or that they are expected to represent an entire continent; according to him, it can compromise one's creativity (Shipwright, 2018: 10, 32). Lokko also writes about the expectations placed on Kéré to be a spokesperson for Africa, and the exhilarating yet lonely position of being "the one" (2017: 138).





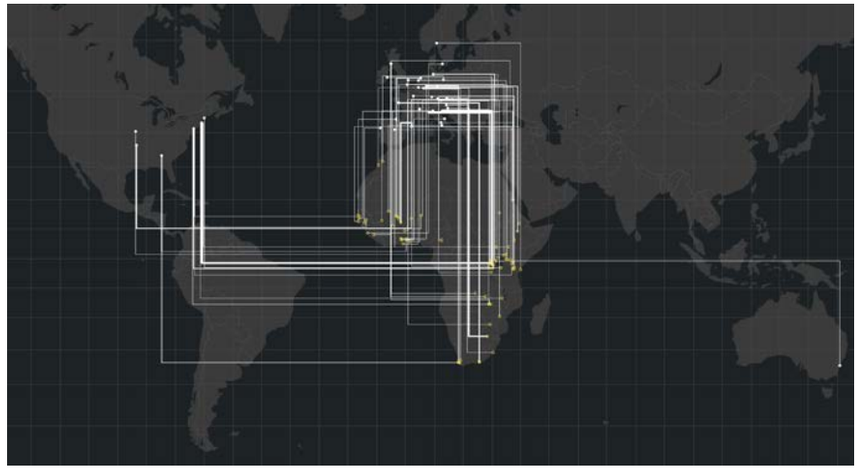


Figure 15:
Extracts from the map of encounter that isolate specific movements that influence the works completed from 2010 to 2019.

Top:
South-North migration
This shows the displacement of African architects to the global North where the likes of Kéré, Adeyemi and others have established permanent offices overseas, but still actively pursue projects in Africa.

Centre:
North-South migration
This shows a migration of architects from the global North to Africa with the view of establishing permanent offices on the continent, and in many cases immigrating themselves.

Below:
North-South forays
This map shows the remainder of works which can be regarded as forays into Africa where architects and/or educational institutions have short-term or intermittent encounters with Africa.

Except for a few very prolific practices in the centre, it is interesting to observe that a large proportion of the projects fall into the category below. Source: Author.

While Pinther (2017: 175) argues that Kéré does not use difference as a resource, Kéré himself does, however, acknowledge that when working on challenging historically loaded sites in Germany, his multiple origins mean that he is regarded as unbiased (Shipwright, 2018: 36). On some levels, this could be true for architects from the North working in the South, but in many instances, their association with countries who benefitted (and in many cases are still benefitting) from colonialism does entail a certain bias. Doherty writes that "As a Western architect in Africa, I feel perpetually tainted by the post-colonial legacy, the remnants of which obscure one's ability to practice with clarity" (2013: 251). This is further skewed if a conscious effort is not made to establish a non-hierarchical relationship for a project, and as Herz (2015: 12) observes, "An architect's origin was never neutral, never innocent". However, naïveté, knowing too little, or being biased can be just as debilitating as harbouring guilt or blame. Architects cannot be ignorant of the violence, injustice, and inequality that has marked, and in many cases is marking encounters between the North and the South, but a way to work through this could be for them to use their agency with a view to strike a critical balance between differences, and to work across boundaries - be they geographical, social, or technological. Mbembe (2019a: np.) calls for *radical agency,* where "Radical agency is not about the sharing of boundaries. It is about deborderisation[150]. It is simply not true that unless I have undergone the exact same experience as the other, I know nothing about his or her pain and should simply shut up… The political in our time must start from the imperative to reconstruct the world in common".

From a different point of view, Edgerton (2007: 84) also supports technological co-production, since it shifts the focus away from technological determinism. If a more horizontal dialogue between contributors from the global North and the global South could be pursued, the combination of global and local tectonics in contemporary buildings in Africa could be one of its physical manifestations. In other words, a *geographic and social deborderisation* could be manifested in Africa through a *tectonic deborderisation*. This will, however, only be possible if contributors from different contexts have some commonality in terms of value systems and ethics, which are equally shared and should serve as the underpinnings of tectonic production.

This section began with an exploration of difference and hybridisation, particularly as experienced in the global South. This framed a discussion about various tropes of architectural encounter in Africa during the twenti-

eth century. This informs different forms of architectural diaspora in the twenty-first century, which were uncovered through cataloguing and mapping to show the movement of architects and ideas to and from Africa. The complexities that are inherent to these shifts are expressed, and the argument is made that more equitable exchanges are required between the global North and the global South.

Chapter 3 endnotes

1 Braverman (2010: 82) writes that true craftsmanship is not the skilful manipulation of tools and materials, "but something stored up in the mind of the worker". While he was a strong critic of industrialisation and deskilling, this statement seems to suggest that craft is not merely about repetitive practice, but that it is also a cognitive skill. Sadly, he does not seem to have recognised the possibility that this cognitive skill could just as easily be employed in industrial modes of production.

2 "Philosophy, as a thinking that considered reality and therewith made it manifest in its Being, was *technē* also in its own way" (Heidegger, 1977: xxv).

3 He writes that "If we define technology as our instrumental capacity to extract support from nature, and place in Heideggerian terms (as 'that clearing where mortals dwell on earth') as opposed to that abstract space of the Renaissance, then my concern for the impact of technique on place has been around for a while" (Frampton, 1979: 314).

4 Under the name Miss Lakofsky, D.

5 He includes opposites like the smoothness and roughness or materials, and the opposing qualities of light and dark levels of illumination.

6 Referring to Gottfried Semper's work, Frampton (2002: 95) describes these opposites as follows: "Semper was to divide built form into two separate material procedures: Into the tectonics of the frame, in which members of varying lengths are conjoined to encompass a spatial field; and the stereotomics of compressive mass that, while it may embody space, is constructed through the piling up of identical units (the term stereotomics deriving from the Greek term for solid, stereos and cutting, - tomea)".

7 Skolimowski writes that a pragmatic approach to technology is purely concerned with the conquering of nature and the "universality of the concept of the tool" (1972: 5).

8 Benkler (2003 and 2006), Brynjolfsson and McAfee (2014), Drucker (1993), Kondratieff in Mason (2015), Schwab (2017), Swilling and Annecke (2012), and Perez (2009).

9 The first one, generally referred to as *The Industrial Revolution*, began in 1771 with the opening of Arkwright's Mill. The second one, which she refers to as the *Age of Steam and Railways* began in 1829, followed by *The Age of Steel, Electricity and Heavy Engineering* (1875), *The Age of Oil, the Automobile and Mass Production* (1908), and *The Age of Information and Telecommunications* (1971). She postulates that the first part of the twenty-first century may see the beginning of a sixth technological revolution that is based on the development of biotechnologies, bioelectronics, nanotechnology and new materials.

10 Schwab is the founder and Executive Chairman of the World Economic Forum.

11 He dates the first industrial revolution, which he ascribes to the advent of railroads, steam, and mechanical production, as occurring from approximately 1760 to around 1840. This is followed by the second industrial revolution from the late 1800s to the early 1900s where mass-production became commonplace due to the use of electricity and the assembly line. The third industrial revolution, also referred to as the computer revolution or the digital revolution, began in the 1960s with the development of semiconductors and mainframe computers, it continued with the widespread availability of personal computers in the 1970s and 1980s, and extends through the advent of the internet in the 1990s. Schwab is of the opinion that the fourth industrial revolution builds on the third industrial revolution, and that it began at the turn of the twentieth century; he regards its key drivers as a more widespread mobile internet, the availability of smaller and more affordable sensors, artificial intelligence (AI), and machine learning. Xu, David, and Kim (2018: 91) regard these drivers as positives on a technical and social level, and they note how AI and robotics can improve people's lives by reducing manual labour, while the world's increased interconnectedness can reduce barriers between innovators and consumers. Schwab identifies a number of reasons why he currently positions us in the fourth industrial revolution and not the third: 1. Velocity, which is due to the rapid rate of change because of our interconnectedness, 2. Breadth and depth, where multiple technologies are combined in building on the digital revolution, and 3. Systems impact, where entire systems are transformed.

12 Perez seems to recognise this to some extent when she qualifies that there is usually a time lag with the advent of a new revolution of twenty to thirty years before the technologies have matured sufficiently to be classified as a "golden age" (2002: xvii), and that the sequence from the beginning of a technological revolution runs through a financial bubble and a collapse before the so-called golden age occurs. This tends to be followed by political unrest before the start of a newer technological revolution (2002: 5).

13 Perez (2002: 25) notes that technological revolutions are initially regarded as opportunities, but that they are eventually regarded as threats since older industries and systems are usually replaced by newer ones: "The process of installation of each new techno-economic paradigm in society begins with a battle against the power of the old, which is ingrained in the established production structure and embedded in the socio-cultural environment and in the institutional framework" (2002: 36).

14 The first, for example, was based on the extraction of soil, cotton, and wool; the second on iron ore and coal; the third on iron ore, coal, copper and agricultural products; the fourth on all the previous ones with the increased exploitation of oil; and the fifth mainly on oil, minerals, biomass, agricultural products and microscopic resources.

15 Information and Communications Technology.

16 This started in the 1770s and it superseded an agrarian regime that existed for approximately thirteen thousand years (and which is still prevalent in some parts of the world), which in turn followed a hunter-gatherer regime that existed for more than a hundred thousand years. Socio-ecological regimes are identifiable through the interaction between society and natural systems, but these interactions happen mostly through the employment of labour and technology that is used to transform natural systems in such a way that they become more useful to society.

17 An important aspect related to this is the concept of *resource decoupling* or *dematerialisation* where growth in terms of economic output or human wellbeing is decoupled from the rate of use of primary resources. If less materials, energy, water, and land are used while still achieving the required rate of growth, then resource productivity is improved. A related concept is *impact decoupling* where economic growth is decoupled from negative environmental impacts; these impacts can be made during the extraction of resources, production cycles, during use, or post-consumption. Livesey also notes the importance of circularity and he writes that Steve Howard, who was the head of sustainability for the furniture giant IKEA at the time, already said in 2016 that the world has not only reached peak oil, but also "peak stuff" (2017: 105). There is ongoing tension between proponents of a new sustainable socio-ecological regime, and supporters of a more right-wing consumption-driven or growth-driven scenario. Authors like Schwab (2015: np.) predict a "supply-side miracle" that will be driven by the fourth industrial revolution: "Transportation and communication costs will become more effective, and the cost of trade will diminish, all of which will open new markets and drive economic growth". This growth-driven view does not seem to incorporate concerns about the socio-ecological impacts in terms of inequality, resource use, and ecological costs; this is particularly true when one considers the environmental impact of the North versus the environmental impact of the South – as Livesey says, " emissions don't respect borders" (2017: 110).

18 "As far as sociologists can find out, there has never been a human culture that was entirely self-contained in both time and space… every regional culture necessarily has a universal side to it. It is steadily open to influences which come from other parts of the world, and from other cultures, separated from the local region in space or time or both together. It would be useful if we formed the habit of never using the word regional without mentally adding to it the idea of the

universal – remembering the constant contact and interchange between the local scene and the wide world that lies beyond it. To make the best use of local resources, we must often seek help from people or ideas or technical methods that originate elsewhere. These outside influences must usually be modified; they must always be assimilated" (Mumford, 1941: 30).

19 He goes on to say that "All distances in space and time are shrinking… Yet the frantic abolition of all distances brings no nearness; for nearness does not consist in shortness of distance… What is incalculably far from us in point of distance can be near to us. Short distance is not in itself nearness. Nor is great distance remoteness" (1971: 162). Sharr (2007: 23) highlights the emphasis on the shrinking of distances in Heidegger's work and according to him, Heidegger regarded this as a negative phenomenon since people's proximity to their own existence was being reduced: "To him, nearness wasn't primarily a function of mathematical increment. Rather, it was a sense of emotional attachment to somewhere, something or someone – born of experience and inhabitation… Everyone's individual sense of proximity, for him, is in constant negotiation between physical situation and imagination" (2007: 62).

20 Although they do qualify this by saying that it is important to maintain a critical distance and to be a stranger to past eras.

21 This can be attributed to rapidly increasing levels of automation in the global North, unpredictable transport costs, emission reduction requirements, rising labour costs in the global South (especially China), consumer demand for better labour or environmental practices, and protectionist measures by governments that require increased local content. A somewhat different scenario might be true in the global South where, in many instances, local labour and manufacturing are sometimes cheaper than imports from abroad. He notes that the correlation of various data streams related to migration, product flows, and data flows amongst others, does not mean that these issues are necessarily linked. He writes that "We've tangled up many things which are different – like falls in transportation costs, the deployment of dense communication networks and changes in production technologies – and put them all in a box labelled 'globalisation' without putting a health warning on the outside" (2017: 9).

22 Global technical civilisations are often regarded as separate events but in reality, they tend to supersede and build on one another successively or in series with some overlaps (Xu *et al*, 2018: 90).

23 The fluidity of regional elements means that elements from one region might be appropriated by one on another continent without being questioned. Utzon's *Bagsvaerd* Church is a case in point, where Frampton (1983a: 23) describes its vault's only possible precedent as being a Chinese pagoda roof.

24 This essay was first published in 1954 in Heidegger, M. (1954). *Vorträge und aufsätze*. Pfullingen: Günther Neske Verlag. This quote is an adaptation of the 1977 translation in Heidegger, M. (Translated by Lovitt, W.) (1977). *The question concerning technology and other essays*. New York: Harper and Row, Publishers Inc.

25 Davies (2017: np.) reiterates Heidegger's thesis that technology cannot be controlled; the illusion of control trough technology and its inverse, the retreat from technology, are described as two attitudes that are equally vain: "…either he ["man"] fancies that he can in fact master technology and can by technological means – by analysing and calculating and ordering – control all aspects of his life; or he recoils at the inexorable and dehumanising control that technology is gaining over him, rejects it as the work of the devil, and strives to discover for himself some other way of life apart from it" (Lovitt, 1977: xxxiii).

26 He goes on to say that "Both words were of Greek origin: *machina* and *mechanicus* (from the Greek mechos – a means, an expedient, or a remedy) referred to any kind of contrivance; *organon* came from an archaic term, *ergon*, work" (1992/2007: 340).

27 In describing Heidegger's work, Bernstein (1991: 99) writes that: "Although it is 'correct' to speak of man controlling technology as a means, he does not control the unconcealment itself that is the essence (the presencing or revealing) of technology…The 'correct' definition of technology is being deconstructed. For the 'correct' definition focuses our attention on how man uses, masters, controls technology in order to achieve human purposes. But it obscures and conceals the way in which human beings themselves are responding to, and are claimed by, the unconcealment – the revealing of challenging-forth in which human beings become 'human resources'. This unconcealment is not the result of human handiwork or doing. On the contrary, this unconcealment determines what human activity has become in the modern epoch".

28 This is recognised by Buchanan (1984: 25) who calls for efforts to "control the destructive aspects of our rampant civilization" and he believes a cultural transformation is necessary in order to achieve this.

29 In *On the economy of machines and manufacturers* (1832).

30 Antonio Sant' Elia and Filippo Tommaso Marinetti in their *Manifesto of Futurist Architecture* argued that "Modern constructional materials and scientific concepts are absolutely incompatible with the disciplines of historic styles" (1914/2007: 18). Peter Reyner Banham, a strong supporter of technology and a sympathiser of the Futurists, argued that society has to discard its entire cultural load (Braham and Hale, 2007: 138). In his well-known work *Theory and design in the first machine age* (1960), he writes how the machine aesthetic is one of the distinguishing features of modern architecture, which is something that Philip Johnson (1960: 173) regards as "one of the more peculiar beliefs" of the 1920s. Banham influenced several other architects, including Peter Cook, who supported his totalitarian view by stating that an industrialised building process is the only way for building methods to survive (1970/2007: 190). Others like Patrick Geddes believed in the positivist aspects of machine manufacture, although they acknowledge Carlysle, Ruskin and Morris' concerns about human and ecological resources (1915/2007: 25).

31 Giedion remarks that "The stretching of human capacities and the stretching of the properties of steel derive from the same roots… Taylorism demands of the mass of workers, not initiative but automisation. Human movements become levers in the machine" (1948: 98-99).

32 Hartoonian writes that there has been a gradual secularisation of making that happened through modernisation and he notes how "the mechanization of production has made it impossible to transfer tradition, including the craft of architecture, from hand to hand and by word of mouth" (1994: 19).

33 He regards William Lethaby as an example.

34 Auguste Comte and Karl Marx are two others.

35 They also include a number of sociologists and philosophers like Jacques Ellul, Herbert Marcuse, Ivan Illich, and Jurgen Habermas.

36 Braham and Hale (2007: xv) list the Society for the History of Technology, the American Sociological Association, the Society for Philosophy and Technology and the European Association for the Study of Science and Technology, most of which publish their own journals.

37 According to Hartoonian, "More elaboration of this word comes from Theodore Adorno, who states that *Handwerk* refers 'to modes of production proper to a rudimentary economy that have been lost in the triumph of technology and degraded by their picturesque disinterment by representatives of the Modern Style.' Adorno's interpretation should be understood in relation to the historial rupture that separates the craftpersons' work from later technical progress" (1994: 33).

38 Braverman (2010) supports this view, but authors like Ettema (1981) and Samuel (1977) are opposed to it, partly since some crafts like furniture manufacturing were already dependent on the division of labour prior to mechanisation. Adamson goes on to say that, based on developments in Europe towards the end of the nineteenth century, "leading-edge thought at the *fin de siècle* envisioned new forms of continuity between industry and craft" and that "the ambition to reinscribe artisanal knowledge into industry was already well under way at the turn of the century" (2010: 46). During that time, industries like weaving lent themselves more easily to mechanisation than industries like furniture manufacturing did, but the narrative of the disappearing artisan was

mainly political since industrialisation was equated with the division of labour, which was seen to lead to de-skilling.

39 Cist, C. (1951). *Sketches and Statistics of Cincinatti in 1851*. Cincinatti: W.H. Moore. Pp. 203 and Michigan Technic. (1927). Industries of Michigan – 1: Furniture Making. In *Michigan Technic* 17, Number 30, January 1927, pp. 32.

40 He writes how foot- and hand-powered machines helped furniture makers in the nineteenth century to improve their levels of production in some instances, but that "If the new machines dramatically reduced costs in all aspects of manufacture, the techno-economic system would have collapsed, resulting in the democratisation of style or the inexpensive production of expensive-looking goods. The machines themselves, however, reveal that the greatest changes came in those operations that were already inexpensive, while the more costly technologies remained labour-intensive" (1981: 201).

41 Dodd, G. (1852). *The Curiosities of Industry and the Applied Sciences*. London: George Routledge and Co. pp. 18 and Strauss, G.L.M. (1867). *England's Workshops*. London: Groombridge and Sons. pp. 186.

42 Wright (1901/2007: 11) sees mechanisation and technology as craft's "salvation in disguise". Hartoonian (1994: 58) notes how Wright wanted to re-script tradition through new productive methods and materials, and he writes how "the nineteenth century's moral functionalists and their modernist successors highly valued machines and industrial achievements and conceived of architectural production as a process of design and building in which technology was the determinant" (1994: 6).

43 It was established in 1907 as a grouping of artists, architects, manufacturers and others, and it was a forerunner of the *Bauhaus*. It was closed by the Nazis in 1938, but it was reopened in 1949 and it is still active.

44 Muthesius saw the notion that craft would be able to mass-produce as bizarre, and he did believe that the art industry was elitist. However, he did have concerns about the imitative nature of mass-production through mechanisation, while he believed that the integration of craft with industrial production could invigorate it by imparting a form of imperfection, which could potentially re-originalise production.

45 In a somewhat contradictory way, he goes on to say that "Our age has initiated a rationalisation of industry based on the kind of working partnership between manual and mechanical production we call standardisation…" (1935: 33), while Louw observes that at Gropius' Bauhaus "the architect/artist/craftsman of the past metamorphosed into the industrial designer of the future" (2002: 13).

46 His position becomes increasingly mediatory to the extent that he ends his text in *The new architecture and the Bauhaus* (1935: 112) by saying that: "…my conception of the role of the New Architecture is nowhere and in no sense in opposition to 'Tradition' properly so-called. 'Respect for Tradition' does not mean the complacent toleration of elements which have been a matter of fortuitous chance or of individual eccentricity; nor does it mean the acceptance of domination by bygone aesthetic forms. It means and always has meant, the preservation of essentials in the process of striving to get at what lies at the back of all materials and every technique, by giving semblance to the one with the intelligent aid of the other".

47 Sharr (2007: 114) goes on to say that "The sort of mild Heideggerian infection which, for example, always sees opportunities for small places in sills and thresholds like Aldo Van Eyck, or finds potential in designing around social geometries like Hans Scharoun, has some benefits. More pervasive conditions, however, can give serious cause for concern… Where Heidegger's romantic provincialism is absorbed uncritically, it can allow right-wing ideologies to flourish. Redneck Heideggerian infections must be challenged".

48 However, in light of his political past, his romanticising of the rural could be criticised as leaning too closely toward the fascist rhetoric of rootedness in the land (which includes some and excludes others).

49 This is said to have been reported by Heidegger's biographer Heinrich Wiegand Petzet.

50 She mentions Simone Brewster, Geoffrey Mann, Gareth Neal and Michael Eden.

51 He writes that "The issue – I want to stress – is more complicated than hand versus machine. Modern computer programs can indeed learn from their experience in an expanding fashion, because algorithms are rewritten through data feedback. The problem, as Victor Weisskopf says, is that people may let the machines do this learning, the person serving as a passive witness to and consumer of expanding competence, not participating in it" (2008: 44).

52 What is open to debate, however, is whether artificial intelligence is considered a tool, or the mind behind it, or both.

53 He writes specifically about the Tesla Motors Factory in Silicon Valley where 160 robots form part of the labour force.

54 Harvey, D. (1989). *The condition of postmodernity: An enquiry into the origins of cultural change*. Cambridge: Basil Blackwell.

55 This is echoed by Adamson (2010: 10) who is of the opinion that with a few exceptions, "One of modern craft's distinctive characteristics is its lack of basis in raw necessity. If artisanal labour was once primarily economic, in the past century and a half it has been chiefly idealistic and aesthetic."

56 For example, the Maison Week-End (1935), the house at Mathes (1935), and the Maisons Jaoul in 1951 (Benton, 2009: 99).

57 The breakaway group's critique is outlined in the *De Doorn Manifesto* which eventually formed part of the *Team 10 Primer.*

58 "It seems to me that past, present, and future must be active in the mind's interior as a continuum. If they are not, the artefacts we make will be without temporal depth or associative perspective. I dislike a sentimental antiquarian attitude towards the past as much as I dislike a sentimental technocratic one towards the future. Both are founded on a static clockwork notion of time (what antiquarians and technocrats have in common). So let's start with the past for a change and discover the unchanging condition of man in the light of change – ie. in the light of the changing conditions he himself brings about" (Van Eyck, 1970: 171).

59 According to him, the aesthetic principles of the International Style are based on the technical and utilitarian employment of modern materials, structure, and planning. Buildings are concerned more with volume than mass, and they consist of light skeletons that are cladded with a light skin. Regularity and flexibility are two other hallmarks of the style and it requires the "technically perfect use of materials" without the use of ornament.

60 Hitchcock, H.R. and Johnson, P. (1932). *The International Style: Architecture since 1922*. New York: W.W. Norton.

61 Giedion, S. (1941). *Space, time and architecture: The growth of a new tradition*. Cambridge, USA: Harvard University Press.

62 Ironically Sigfried Giedion claimed that he was a regionalist in 1954, and Philip Johnson also seems to have changed sides in 1956 (Lefaivre, 2003: 31).

63 Published as Mumford, L. (1941). *The South in architecture: The Dancy Lectures Alabama College 1941*. New York: Harcourt, Brace and Company.

64 Literally translated as "home architecture", but it implies a nationalist representation of the homeland or in this case, the so-called Fatherland.

65 Probably since it was concerned about the Brazilian President, Getúlio Vargas' pro-Nazi leanings.

66 Goodwin, P. L. (1943). *Brazil builds: Architecture new and old, 1652-1942*. New York: The Museum of Modern Art.

67 Mumford, L. (1947). The sky line: Status quo, in *The New Yorker*, September 11, 1947: 106-109.

68 Which Frampton (1992: 320) also lists as an example of regionalism, together with the work in southern California by Harwell Hamilton Harris.
69 Frampton (1983b: 153) also mentions the Bay Area as a manifestation of regionalism, especially the work of William Wurster and Harwell Hamilton Harris.
70 This event may well have been reminiscent of what Gerneke (1998: 198) calls the "messianic talk-shops" that were hosted by the *Congrès Internationaux d'Architecture Moderne* (CIAM), or as he refers to it, "the propaganda arm of the Modern Movement".
71 It was also during this event that Walter Gropius claimed that the International Style developed out of its surrounding conditions and that it was regional in character (Lefaivre, 2003: 26). This confirms Taylor's observation that regionalism is "capable of stimulating vociferous defenders and opponents… to unimagined heights of critical rhetoric" (1986: 19).
72 With thinly veiled Northern superiority, he praises Harrison and Abramovitz's American Embassy in Rio de Janeiro (1952), and the American Embassy in Havana, Cuba (1953), where they avoided "the usual Latin American devices for sun control".
73 Frampton reveals that he himself has become much more politically inclined since his initial 1983 article on Critical Regionalism, and he writes that he now believes that "nothing short of governmental socialist mobilisation" will be able to address climate change and the destiny of the global South. Source: Frampton, K. (2020). *Conversation*. Personal correspondence with author via email, 23 July 2020: 1.
74 Citing Manfredo Tafuri.
75 He describes this as "an ideology glorifying differences and diversity, and fighting to safeguard customs and identities perceived as threatened" (2007: 28).
76 While Crudeli (2018: np) is of the view that the most frequent criticism of Critical Regionalism is that it was a reaction against post-modernism, and that it may have lost its value when post-modernism disappeared, Patteeuw and Szacka (2019: 93) are of the opinion that, in addition to it being a reaction against post-modernism, that it was also, especially in Frampton's view, rooted in a desire to highlight work by practitioners on "the periphery of a system centred on star figures working in specific areas of Europe". Avermaete, Patteeuw, Szacka, and Teerds (2019: 4) echo this and note that this aspect is still deserving of attention.
77 Globalisation and regionalism are inherently tied to politics and power. Lefaivre and Tzonis (2012: 13) posit the Casa dei Crescenzi (1040-1065/1100CE) in Rome as "the first politically conscious regionalist building" in the city. According to Tzonis (2003: 13), the Casa dei Crescenzi shows the beginning of "…a 'regionalist' architecture – a normative concept versus a 'regional' behavioural one". Whether it being the first is accurate or not is debatable, but as a "chaotic collage", it made use of ancient Roman ruins that were reused and repurposed in the building to symbolically resist global Papal power. Ironically this resistance to one global power is simultaneously a mediation with another former global power, since the reused and repurposed elements were emblematic of imperial Rome. The building draws on the power of the past, on local identity, local culture and local materials to resist globalisation, but it could be seen to represent a form of "tribalism" or nationalism which is sometimes central to many types of regionalism.
78 He differentiates between two meanings that are often ascribed to it in Critical Regionalism: He argues that criticality does not seem to add any more substance to the term since both regionalism and Critical Regionalism regard the local as being in danger and that it needs to be protected from the global. Secondly, that the promotion by Tzonis and Levaifre of the defamiliarization of local elements through re-contextualisation constitutes the second meaning, but that this contradicts the first. The two meanings seem to polarise the resistance against the global against the suggestion that only elements of the local are left and that they can be applied in other. He uses the Stone House Tavole (1988) in Italy by Herzog and De Meuron as an example: The combination of local "rural" stone in combination with a "rational" reinforced concrete frame to him does not constitute Critical Regionalism, but it should be regarded as a general architectural approach or an "endless text" (1997: 19). Most supporters of Critical Regionalism, however, would most probably claim it as a work that is representative of the principles of this movement, especially in relation to Frampton's reading of Bagsvaerd Church as described previously.
79 Tzonis and Lefaivre even suggest that the term *regionalism* should be replaced by *realism*.
80 He writes in relation to South Africa during the 1980s but he argues that its situation is not as unique as many make it out to be.
81 Amongst others, Alvar Aalto's Säynätsalo Town Hall in Finland (1952) is included because of its "alternative" use of site and technology, Oscar Niemeyer's Pampulha Dance Hall in Brazil (1942) for how his method allows one to "understand the limits and promise of regional constraints", Dimitris Pikionis' Pathway up the Acropolis and Philopappos Hill in Greece (1957) because of its consideration of the socio-environmental importance of architecture in the landscape, Moshe Safdie's Hebrew Union College in Israel (1988) for enhancing the sense of community in a historical context, Kengo Kuma's Hiroshige Ando Museum in Japan (2000) for its use of materials, Richard Neutra's Kaufmann Desert House in the USA (1947) for its "more traditional regionalism" that considers the relationship between the built form and the landscape, Atelier Jean Nouvel's Museum on Quai Branly in France (1999) for the dialogue generated between the city and a typically inward-looking institution, and the Renzo Piano Building Workshop's Jean-Marie Tjibaou Cultural Centre in New Caledonia (1998) for demonstrating that "fit, adaptability and sense of humaneness need not be opposed to the use of up-to-date industrial products".
82 From the French "rear-guard" as opposed to *Avant-garde*.
83 Ricoeur (1965: 274) sees it as progress when "There is a phenomenon of accumulation and a phenomenon of improvement"; Harris (1965: 28) seems to share a similar view when he says "A region may develop ideas. A region may accept ideas. Imagination and intelligence are necessary for both".
84 Curiously he seems to suggest that the use of vernacular elements from another context is also acceptable by saying that "It will moreover occasionally derive such elements from foreign sources" although he acknowledges that this could be regarded as "the paradoxical creation of a regionally based 'world culture'".
85 He lists a number of practitioners (some of whom are also supported by Lefaivre and Tzonis) whose work exhibits some of these attitudes as, amongst others, Alvaro Siza (especially for his consideration of the local topography or local fabric, and his use of local materials and craft), Luis Barragán (for his consideration of topography and landscape), Oscar Niemeyer, Affonso Reidy, Richard Neutra, Jørn Utzon (especially for his use of symbolism and representation at Bagsvaerd Church), Vittorio Gregotti, Sverre Fehn, Aris Konstantinidis, Mario Botta (for his reinterpretation of local form, particularly for the Bianchi house at Riva San Vitale in 1973), Carlo Scarpa and even Tadao Ando (for his incorporation of natural light and the internalisation of nature) (Frampton, 1983b: 151, 152, and 156-158).
86 This can be defined as the ownership of the means of production in one's own space.
87 He compares his categories with Charles Jencks' classification of Post-Modernist approaches where conservative vernacularism is regarded as straight revivalism, the interpretive vernacular and concrete regionalism are both regarded as neo-vernacular, and abstract modern regionalism is equated to contextual architecture (Steyn, 2014: 52).
88 They want to redefine Critical Regionalism as "Network Specifism". Instead of the peculiarity of place, they focus on the peculiarity of networks. They argue that "place would automatically manifest through the human lens" (2013: np), although it is unclear how structural inequalities between actors are addressed (especially if some are positioned in the global North and some are positioned in the global South).
89 They go on to say that "This historicisation of Critical Regionalism neutralised its political charge and merely turned it into an operative perspective for architectural practice" (2019: 10). They do, however, promote a re-reading of it and a reflection on its influence on architectural practice.

90 Architecten De Vylder Vinck Taillieu from Belgium (this practice split up in the spring of 2019 into Jo Taillieu architects and Architects Jan de Vylder Inge Vinck), Monadnock from the Netherlands (who they note alternate between site specificity and autonomy), and BC Architects and Studies from Belgium whose work they say is based on inclusivity and not resistance, and whose version of Critical Regionalism lies not in built form, but in method.
91 The Bethel Secondary School in Burkina Faso (2012) by Article 25, Home Kisito in Burkina Faso (2015) by Albert Faus, The French School in Togo (2016) by Segond-Guyon Architectes, amongst others.
92 Current rating tools for so-called "green architecture" typically consider natural light as a tool for the optimisation of global technologies and not for its spatial and sensory qualities.
93 Source: Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
94 Which he describes as "technical knowledge".
95 He describes this as "general wisdom".
96 Including amongst others Dalibor Vesely, Joseph Rykwert, Daniel Libeskind and Peter Zumthor (Sharr, 2007; Davies, 2017).
97 Adorno, T. (Translated by Tarnowski, K. and Will, F.) (1986). *The jargon of authenticity*. London: Routledge. This was initially published in 1964.
98 Karsten Harries, Karl Löwith, and Theodor Adorno amongst others as mentioned in Sharr, 2007, and Bernstein, 1991. Some of these authors argue that his political views and support for National Socialism cannot be separated from his philosophy.
99 As Reiser and Umemoto argue, "Instead of seeing regionalism emerge out of distinct cultures as was once the case, a universal regionalism assumes a global culture in which material logics engender regions rather than the other way around. In fact, territories are no longer only defined by physical locale" (2006: 243).
100 Bernstein (1991: 120) describes this as "the intellectual virtue or 'state of the soul' that pertains to *praxis*, just as *technē* relates to *poiēsis*".
101 Source: Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
102 He refers to the concepts of *Ubuntu* as "relational humanness" and *Ukama* as the "relatedness of everything" which includes the relatedness between humans, nature and the ancestors (Swilling, 2020: 21).
103 When referring to Comaroff and Comaroff (2011).
104 He writes how Rahul Mehrotra draws directly on the work of Homi Bhabha, and he cites the practice ELEMENTAL as one whose projects allow an expression of cultural difference (Hérnandez, 2010: 120-129).
105 These include Jane Jacobs, Robert Young, Ania Loomba, Benita Parry, and Bill Ashcroft (Hérnandez, 2010: 76).
106 He explains this further by saying "Vital aspects of African life, material tectonics, climate, landscape, patterns of dwelling, long-surviving figures and types – including imaginaries of the precolonial, handicrafts (both modern and traditional) and metaphoric symbolisations of Africa – may be brought into dialogue with the white skin of modern design. The purity of the modern may be opened to form a new hybridity; White Skin, Black Mask" (2011: 9).
107 "The phenomenon of universalisation, while being an advancement of mankind, at the same time constitutes a sort of subtle destruction, not only of traditional cultures, which might not be an irreparable wrong, but also of what I shall call for the time being the creative nucleus of great civilisations and great cultures… The fight against colonial powers and the struggles of liberation were, to be sure, only carried through by laying claim to a separate personality; for these struggles were not only incited by economic exploitation but more fundamentally by the substitution of personality that the colonial era had given rise to. Hence, it was first necessary to unearth a country's profound personality and to replant it in its past in order to nurture national revendication. Whence the paradox: On the one hand, it has to root itself in the soil of its past, forge a national spirit, and unfurl this spiritual and cultural revendication before the colonialist's personality. But in order to take part in modern civilisation, it is necessary at the same time to take part in scientific, technical, and political rationality, something which very often requires the pure and simple abandon of a whole cultural past. It is a fact: Every culture cannot sustain and absorb the shock of modern civilisation. There is the paradox: How to become modern and to return to sources; how to revive an old, dormant civilisation and take part in universal civilisation" (Ricoeur, 1965: 276).
108 Lefaivre and Tzonis (2012: 150) describe Le Corbusier's first works as regionalist and they trace his regionalist roots to his education at the Arts and Crafts school in Chaux-le-Fond.
109 He writes how Le Corbusier "…became involved with the proto-Fascist neo-Syndicalist movement, with its combination of populist regionalism and authoritarian technocracy" and that "Le Corbusier and the neo-Syndicalists conflated regionalism with modernism" (1996: 53), but his problem with this view is that it ignores the possibility that the two poles of the global and the local had been connected already by that time.
110 Also known as the Gustavo Capanema Palace.
111 Although Lefaivre (2003: 48) notes that brise soleil were originally used by Stamo Papadaki, before they were popularised by Le Corbusier and Antonin Raymond.
112 Pevsner, N. (1953). Johannesburg: The development of a contemporary vernacular in the Transvaal, in Architectural Review, 7 June 1953: 361-382.
113 He observes that Latin American architecture was widely published locally, and he writes how the South African Institute of Architects (SAIA) even hosted an exhibition in 1948 that featured Portinari murals (1998: 197).
114 Tzonis writes that "When Stauch & Partners, in their 1952 Meat Board Building, tried to incorporate in their design together with environmental specifics of the region – in the façade of the building – aspects related to cultural particulars – in the pavement of the entrance hall, stairs, and passage – they did so skilfully but using late romantic 'arts and crafts' methods" (2007: 216).
115 Mainly by a group that was made up of Norman Hanson, Gordon McIntosh, John Fassler, Roy Kantorowich, and a number of others.
116 Hanson, Tomkin and Finkelstein's 1948 Medical Centre in Johannesburg, and Kantorowich and Skacel's 1961 Telephone Exchange Building in Seapoint, Cape Town, are provided as examples that exhibit these principles.
117 Koenigsberger, who worked at the London School of Hygiene and Tropical Medicine in the early 1950s, would have had a strong influence in terms of the introduction of hygiene as a principle in the Tropical Architecture course. This, according to Figueira and Gil (2013: 71-73), was based on the "hygienist" approach which "envisioned a mediation between architecture and urban form with the express aim of preventing disease" before becoming concerned with the themes of appropriation and comfort. This aim is also evident in the work of MASS Design Group which will be analysed in more detail later.
118 He established the outline of the course with the help of George Atkinson and Leo de Syllas (Figueira and Gil, 2013: 71).
119 Fry was in charge of the course until it was taken over by Koenigsberger in 1957, and the Department lasted until his resignation in 1970.
120 They established the Office of Maxwell Fry and Jane Drew in 1946, which became Fry, Drew and Partners in 1950, until they were joined by Lindsey Drake and Denys Lasdun to form Fry, Drew, Drake and Lasdun in 1952.
121 These include, amongst others, Drew, J.B., Fry, E.M. and Ford, H.L. (1947). *Village housing in the tropics, with special reference to West Africa*. London: Lund Humphries; and Drew, J.B. and Fry, E.M. (1956). *Tropical architecture in the humid zone*. London: B.T. Batsford Ltd.
122 Kultermann, U. (1963). *New architecture in Africa*. New York: Universe Books.

123 This is the amount of time that government documents are censored for in the United Kingdom.
124 This was a housing prototype that was designed in France, which was intended to be prefabricated and mass produced in France and shipped to the French colonies. It was constructed out of a light aluminium frame and it was intended to be suitable for tropical climates. Eventually only three prototypes were constructed, two of which were found in a dilapidated state in Niamey, Niger, and Brazzaville, Republic of the Congo, from where they were removed in 2000 and shipped to be displayed in New York in 2007 and outside the Centre Pompidou in Paris and the Tate Modern in London in 2008. One was auctioned by Christie's in New York for close to $5 million in 2007 (Rossen, 2013: np).
125 As Mavhunga observes, "Contemporary discourse, private and public, is filled with hackneyed vignettes of technologically activated social change…" (2017: 4).
126 Director of the 2008 film *Maison Tropicale*.
127 Folkers (2011: 52) also writes how their return to the global North "has been criticised as neo-colonial robbery of Africa's cultural heritage".
128 Negotiated Modernism is a localised version of Modernism which includes work by architects like Pancho Guedes in Mozambique, while Contested Modernism exhibits a more critical encounter which can be evaluated through the work of Roelof Uytenbogaardt in South Africa.
129 Steyn (2018: 42), differentiates between the terms "African architecture", which he regards as geographically generalising, "Afrocentric architecture" which he regards as too self-referential and self-centred; and "Africanist architecture" which he regards as being the more appropriate term to "frame architecture that has been the product of place and local culture, while still recognising the technological advantages of globalisation".
130 According to Docomomo, it received a number of awards, including an Honor Award for Architectural Installations. Docomomo. (2019). Former US Embassy, Accra, Ghana. [Online] Available: https://www.docomomo-us.org/register/former-us-embassy-accra-ghana (Accessed 19 March 2020).
131 The embassy closed in 1998, after which it was handed over to the Ghanaian Ministry of Women's and Children's affairs, but it was subsequently demolished.
132 The building was sold, and it is currently being used by the Moroccan Ministry of the Interior and its Tangier Wilaya Council.
133 As the inverse of Frantz Fanon's well-known 1952 book "Black skin, white masks"
134 These examples are contrary to what Curtis (1986: 26) refers to as Hassan Fathy's "re-assertion of vernacular wisdom". Fathy's work, especially the development of New Gourna Village in Egypt (1946-1952) is often praised as an example of regionalism, especially for its use of traditional climatic control devices like wind scoops, ventilation slots and thick earthen walls amongst others, and for its incorporation of local materials and building methods. Özcan (1985: 8) regards him as the most important proponent of the conservative approach to vernacular architecture and he writes how he "…strived to revive a building tradition and tried to grasp it on the eve of its disappearance". He goes on to say that, unfortunately, "It did not work out well in the rural communities, whose distorted aspirations and values attached to their understanding of contemporaneity did not match the environment that Fathy offered them" (1985: 9). Low (2012: 134) ascribes New Gourna's failure to bureaucratic reasons, but he does regard it as being "emblematic of an early 'non-Western' approach to modernism".
135 Unfortunately, he only refers to examples from the global North which include the Arts and Crafts movement and practitioners like Charles Voysey and Gertrude Jekyll.
136 These were the subject of an architectural competition and they were eventually completed in 2001 by the architectural consortium MPTS, which was a collaboration between Meyer Pienaar and Tayob Schnepel Architects.
137 Mbembe, A. (2007). Afropolitanism. In Simon, N. and Durán, L. (Eds.). (2007). *Africa remix: Contemporary art of a continent*. Johannesburg: Johannesburg Art Gallery. Pp. 26-30.

138 She writes specifically about the diaspora of the 1950s and 1960s which saw African architects like Oluwole Olumuyiwa, Demas Nwoko and David Aradeon moving North.
139 According to Beygo (2017: 20), Kéré's work has been published more than 170 times, and by 2017 it had already been featured in twenty exhibitions. He has also won numerous prestigious awards, including the Aga Khan Award for Architecture in 2004, and he was the first African architect to design the Serpentine Pavilion in London in 2017 (see also Lepik, 2017b: 110).
140 See also Lepik, 2017b: 105.
141 The terms Provinces and Metropolises here do not refer purely to peripheries and centres, but Van Schaik implies that they can be more broadly located. Provinces can be inside Metropolises, while Metropolises are merely the sites where recognition is sought – they can be a cluster of Provinces or a dispersed network of scholars.
142 As outlined in *Tropical architecture in the humid zone* in 1956.
143 In another piece, he writes that "Africa was a true architectural laboratory during the 20th century, a playground for European modernist architects who here were not hindered or curbed by cultural context, historic awareness or legislation, as they were in Europe" (2011: 52).
144 Source: Mbembe, A. (2020b). *Postcolonial theory.* Live online PhD seminar session at the School of Architecture, Planning and Geomatics, University of Cape Town, 19 August 2020.
145 He refers specifically to mineral exploitation, the dumping of industrial waste in Ghana, and the appropriation of agricultural land by China.
146 Lesley Lokko writes that most projects submitted to the Aga Khan Award for Architecture rely on aid-based or NGO patronage (Lokko, 216: 227).
147 She writes in relation to an informal settlement upgrading project in Crossroads, Cape Town.
148 Using King's term (1996: 71).
149 Interestingly, Adamson (2010: 337) writes that for Heidegger and Bâ, between German and African philosophy, the earth is a common interest and metaphor. This seems to be a new shared interest in practice where architects from both contexts are employing it in Africa.
150 Mbembe uses the term *deborderisation* to agitate for the easing of geographic boundaries (most of which were established by former colonial powers) in Africa. He is not arguing that the borders or sovereign states should be ignored, but rather that African countries should cultivate an attitude that is pro-migration. The term can also be interpreted to represent the breaking down of borders or boundaries between different people or societies.

Chapter 4: Creating a tectonic catalogue of contemporary African works

This chapter explains the creation of a tectonic catalogue of contemporary architecture in Africa that evidences a shift towards hybridisation. It explains how this led to the identification of a set of emerging constellations, followed by a detailed analysis of emblematic cases within them. These are discussed under the headings of accompaniment and adjacency in Rwanda, didactic collages in South Africa, and textile tectonics and hybrid potentials in Senegal.

Shifted positionalities and ways of making

This study tracks the southward movement of ideas and architects from the global North, but it also includes the movement of ideas and architects from the global South to the global North, where they act as originators of knowledge which is often reproduced or deployed by Northern architects. As mentioned previously by Kéré, different knowledge sets or ambitions are required, which often takes the form of co-production between contributors from the global North and contributors from the global South. This study reflects on the deployment of incoming ideas and architects, but it focuses on the encounters with local ideas and contributors, and the outward dispersion of local knowledge. It is a search for what Low (2003: 35) calls a horizontal dialogue, what Van der Lans refers to as “inclusive thinking” (2018: 113), and what Swilling refers to as the sub-Saharan African notion of *Ukama* or “relationality”. At the

very least, it hopes to surface a more critically engaged local dialogue and more equal exchanges and encounters between North and South in terms of technology and tectonics. These are different to Critical Regionalist practice where Northern practices are merely mediated by Southern elements. Similar to Mavhunga's work, this study "locates Africans between their locally generated and inbound ideas, instruments and practices" (2017: 9). The key works analysed here could potentially reveal ways of working towards what he describes:

> *"The most inspirational and urgently needed innovations derive from people who respect and thoroughly understand local modes of knowledge and build upon them. They are not just looking at the local as a problem that tech (i.e. the inbound) can solve but as a source of technologies that they can synergise with incoming materials to unleash opportunity from what people are already doing"* (2017: 21).

The tectonic catalogue

The foundation for this study was the creation of a working tectonic catalogue of contemporary architecture in Africa (Appendix A) which includes a review of projects that evidence a shift towards the hybridisation of global and local tectonics. The database is a living document, and it is by no means exhaustive, but its purpose is to establish an extensive representative sample that is publicly accessible to inform both practice and further research. While the attempt at hybridisation was sometimes the explicit aim of the architects, in buildings where this is not the case it was still clearly identifiable through textual and visual research methods. As will be discussed further in the chapter on tectonic ethics, it could be argued that most of the projects in the database share a similar underlying concern for some form of social, environmental, or economic sustainability which manifests itself as an aesthetic ethos - that of social and environmental concern, or what Gaut (1998) calls ethicism.

The projects included to date were all completed during the second decade of this century, ie. from 1 January 2010 until 31 December 2019, except for a small number of earlier projects[1] that had a significant influence on others. The work is situated within the space(s) of tectonic encounters as described previously, where techno and technē, the global and the local, the global North and the global South, and new tectonic encounters form both the context and inspiration for the architecture. The projects are all located in

Africa, and they are all public buildings only. The study involved the identification, documentation and initial investigation of each building: The buildings are listed alphabetically by country, and the project name, architects (with countries of origin and/or the location of the practice), year of completion and location are all shown. The buildings have all been geographically located and accurate GPS coordinates have been provided except for a small handful of buildings where the exact building location is not discernible.

As part of this investigation, this information was subsequently developed and built into an open access website that can be accessed on https://uct.semantica.co.za/[2]. More than a hundred projects have been identified and interrogated through categories to date, but the website prompts the beginning of a more extensive undertaking to document additional projects from within the study period and beyond. The intention is that the website can be an open access resource that can be used by practitioners and researchers to contribute their own work, and to use it as a springboard for further research. The development of the website facilitated the spatialisation of the data. It

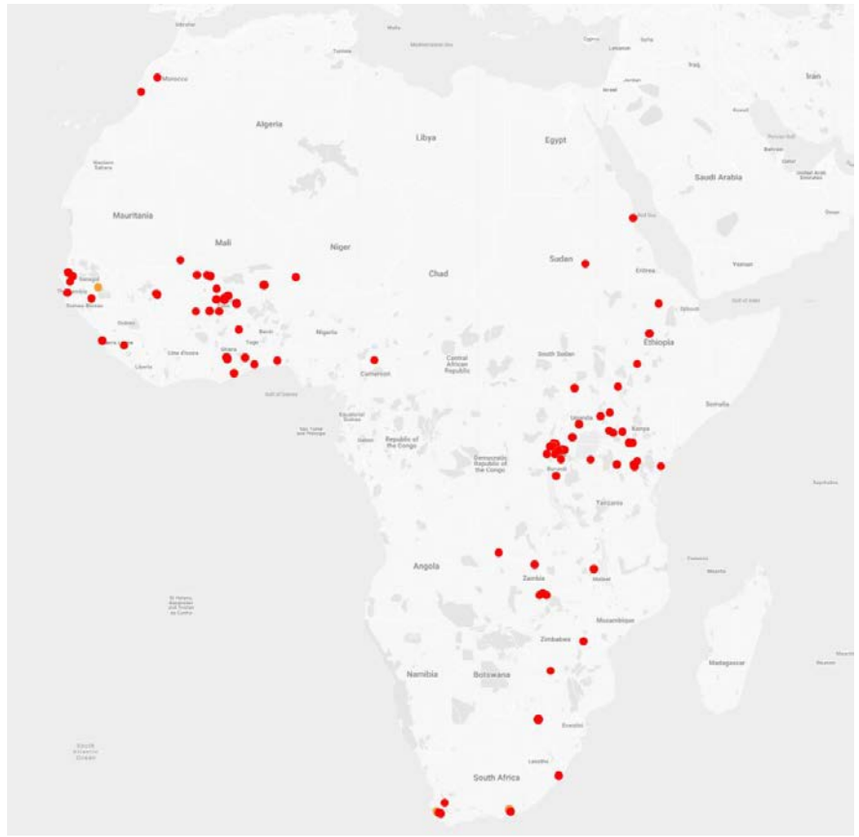


Figure 16 (above):
A QR code that can be scanned to access the website directly.

Figure 17 (left):
The interactive map on the website that shows the locations of the buildings that are catalogued in Appendix A. Source: Author, with base information by Google maps, and website assistance from Semantica and Darren Berlein.

allowed for accurate geo-location, the visualisation of connections to and from the global North, and it allowed for a clearer identification of denser groupings for further analysis.

Using the textual and visual data available for each project, the specific tectonics used for that particular project were identified and catalogued. Based on an overall reading of all the projects, these tectonics were mapped according to the headings of global and local tectonics. These two headings were then further resolved into sub-sections based on the discovery of common tectonic strategies across projects: Global tectonics has the sub-sections of CAD and CAM, and industrialised production/material innovation; local tectonics has the sub-sections traditional local craft and/or climatic strategies, the use of natural local materials, the use of reused, repurposed or recycled mass-produced materials, and localised production or incrementality. These categories emerged out of the projects, but by doing this, it allowed for the identification of strategies that were strongly represented in multiple projects, and it allowed for the identification of projects that made use of all the strategies.

While the database allows for multiple groupings to be made, three were chosen that presented strong discursive potential and that were found to have coalesced into three constellations: 1. The combination of global tectonics with local natural materials, crafts, or climatic strategies, which was particularly evident in a dense grouping of projects in Rwanda; 2. The combination of global tectonics with reused, repurposed and recycled materials, which was particularly evident in a grouping of projects in South Africa; 3. The combination of CAD and/or CAM with local tectonics, which was more dispersed although a selection of works in Senegal was emblematic of this strategy and it has the added benefit of including all of the strategies that have been included in the catalogue.

Emerging constellations

Low (2012: 129) argues that, instead of a sweeping attempt to trace a generalised trajectory of architectural production in Africa, one should rather identify tropes through specificities or "highly situated production(s)… [whose] specificity is predicated on a particular set of power alliances between colonialism and local culture informed by contexts of geography and climate as interpreted through the design agency of individual architects". He goes on to say that the

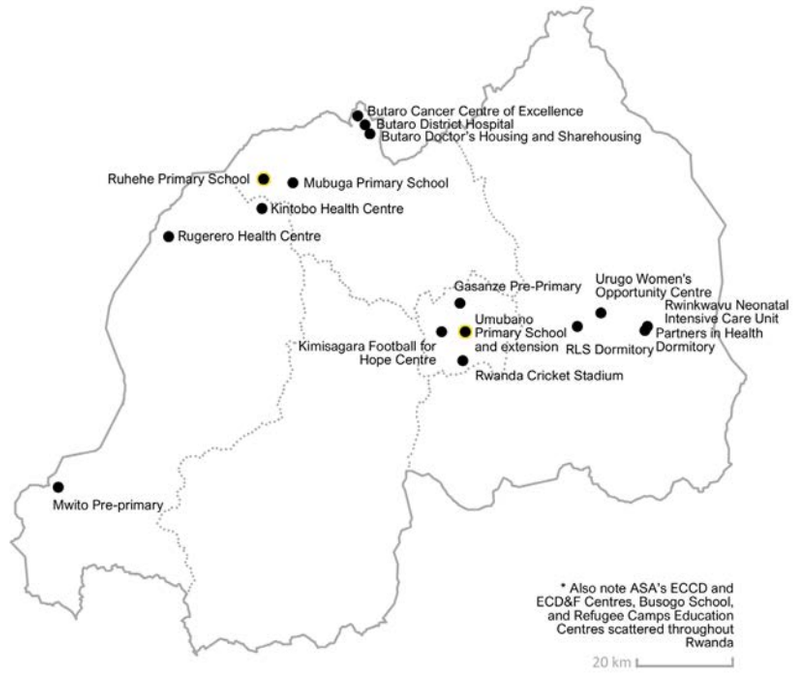


Figure 18:
Maps showing two of the emerging geographically clustered constellations as described in the body text. Rwanda is shown above and South Africa below. Works that will be analysed in more detail are highlighted in yellow. Source: Author.

re-incorporation of local culture and practices into architectural production in Africa is allowing for new forms of Southern expression within an architecture that has its roots in Modernism, but that it does not yet represent a coherent body of work: “Such projects are comparatively uncommon and unlike in the case of the West, do not present any clear evolutionary trajectory, but exist in disparate sites across the continent” which also made them less prone to classification (2012: 133).

As this study aims to show, this has shifted somewhat since then, with numerous projects that have subsequently emerged, where an attempt has been made to re-incorporate local culture and practices into contemporary architectural works on the continent. These have been produced mainly through the agency of individual architects, often facilitated by charitable foundations, NGOs, or educational institutions, or through various modes of co-production. While the work is still quite dispersed across Africa, there is now a substantial body of work which enables some form of classification and which has, in many instances, resolved itself into denser clusters that exhibit certain common traits. Writing about African Modernism, Herz (2015: 14) remarks that “Precisely because we can observe a certain commonality among the buildings of a specific country, authorship no longer lies exclusively with the individual architect but has become an expression of the specific location”, and the same can be said about contemporary practice in Africa in many instances.

The development and mapping of tectonic strategies into sections revealed certain architects who focus on selected tectonics and who have completed a large body of work in a specific country or geographic area over an extended period of time, but it also revealed certain projects that exhibited all the types of identified tectonic strategies simultaneously. These two selections of architects and projects resolved themselves into clusters or constellations of activity that share similar traits and that are often located in the same country or geographic area: The work of MASS Design Group and Active Social Architecture (ASA) in Rwanda exhibits the employment of similar tectonics over an extended period of time, the work of the RWTH Aachen (and its collaborators) and Collectif Saga in South Africa is representative of a southern African practice of employing reused, repurposed and recycled material content, while the work of Toshiko Mori Architect (TMA) in Senegal forms part of a digital constellation[3] but incorporates all the tectonic strategies identified in the catalogue. The discursive analysis of emblematic projects within each of these three constellations allows for the identification of specific traits and approaches, which are investigated in more detail in the following sections.

Figure 19:
A map showing the emerging dispersed digital constellation as described in the body text. Works that will be analysed in more detail are highlighted in yellow. Source: Author.

Accompaniment and adjacency in Rwanda

Background

As Rwanda emerged from the aftermath of the 1994 genocide with damaged social and physical infrastructure, there was an upsurge in initiatives by its newly-formed government and by numerous aid-based organisations to address the many challenges that the country faced at the time[4]. One of these is an organisation called *Partners in Health*, which was co-founded in 1987 by one Dr. Paul Farmer. After 1994, the Rwandan government embarked on the long process of rebuilding the country's health system and by 2007, Burera was one of the last districts that still did not have a hospital. When *Partners in Health* was invited by the Ministry of Health to start a new hospital they opted for this remote location, and they also decided to involve a number of young architectural students and graduates from the USA in the design of the Butaro District Hospital. Two of these young architects, Michael Murphy and Alan Ricks, would go on to establish MASS Design Group[5] which grew to include a substantial cohort of Rwandan architects and an office in Kigali. The practice would continue to work on projects related to this hospital[6], culminating in the opening of the University of Global Health Equity in 2019, but the Butaro District Hospital can be regarded as the genesis of their practice (Murphy and Ricks, 2019: 64).

Following the completion of Butaro District Hospital and the creation of MASS Design Group, a wide range of aid-based projects were completed in Rwanda, and a number of architectural practices with a similar social justice bias were either formed in Rwanda or became involved there. These include ASA which was established in Rwanda in 2012 by Tomà Berlanda and Nerea Amòros Elorduy[7], TAMassociati from Italy, Sharon Davis Design from the USA, Light Earth Designs from the UK, Architectural Field Office from Ireland, and Creative Assemblages (also founded by Elorduy) from Spain (now Uganda) among others. MASS Design Group and ASA have been particularly prolific, and both practices have been embedded in the local context for more than eight years. Murphy and Ricks went to Rwanda because of their interest in social justice and the Butaro opportunity (Murphy and Ricks, 2019), while ASA's current three principals, Alice Tasca, Zeno Riondato and Francesco Stassi went there due to their interest in social architecture, a resonance with Rwanda, and opportunity[8].

The constellation of projects that has emerged in Rwanda often ex-

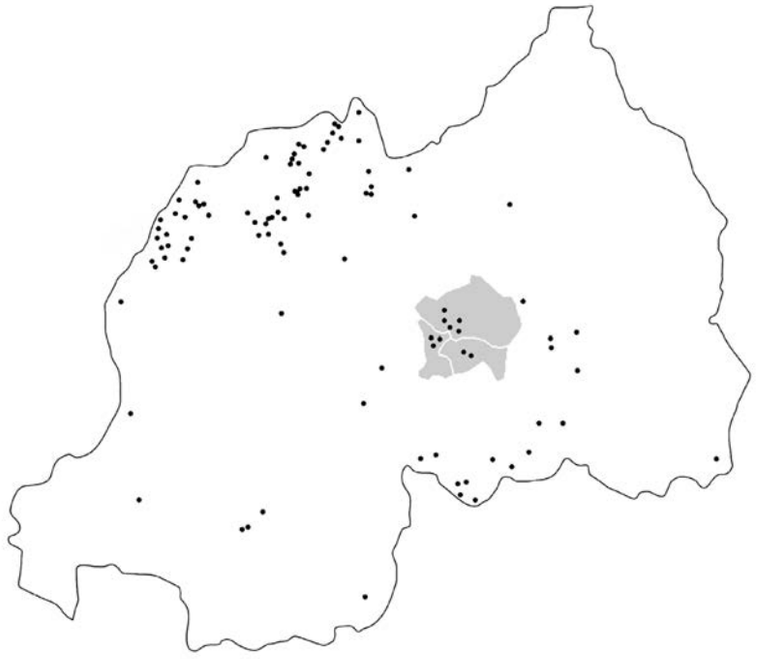


Figure 20 (above):
Butaro District Hospital, Burera District, Rwanda, 2011, MASS Design Group. Source: Iwan Baan. [Online] Available: https://massdesigngroup.org/work/design/butaro-district-hospital (Accessed 30 August 2018).

Figure 21 (below):
A map of Rwanda showing the locations of the 112 projects that ASA completed between 2012 and 2019. Source: Active Social Architecture, 2019: 4.

hibits similar tectonic traits, which can in part be attributed to a similar social justice approach, the use of local skills and materials, cost constraints, and locally implemented design standards among others, but it can also be attributed to the emergence of what Collier (2016) refers to as a "knowledge community" where architectural practices learn from each other as will be explored in the section on tectonic ethics. The buildings that have been completed in the last ten years exhibit varying attempts at the hybridisation of global and local tectonics and more often than not, they exhibit similar tectonic combinations; these will be explored further in this section first through cross-comparison, and then by analysing the Umubano Primary School in Kigali which was originally designed by MASS Design Group and was subsequently extended by ASA, and the Ruhehe Primary School by MASS Design Group and the African Design Centre.

Practice philosophies and positionality

Murphy, co-founder of MASS Design Group, reflects on how his interest in architecture began while living in Cape Town, South Africa, where he was struck by the very visible relationship between the socio-political context and the built environment, and he realised that "All architecture is social, we just sometimes don't elevate the conversation about where architecture is becoming incredibly social or political, and we must just add that to our repertoire of evaluation" (2015: np.). Ricks, his fellow co-founder, speaks about their approach as one of "building through a social justice lens", where "each choice, each detail, and material selection could shift the concept of value in the form of local jobs, new technologies, and fabrication methods" (2019: 39). This is similar to ASA's approach, which aims to "emphasize empowerment through capacity building" (Loké, 2019: 55) and the Principals of ASA emphasise that their approach is based on ethics[9]. Van der Merwe (2015: 50) writes that ASA's practice is built on the principle that good design is a fundamental human right, and according to Tasca, ASA aims to "Design to preserve natural capital, design to build social capital, design with small economic capital" (2019a: np.).

MASS Design Group's approach is based on a process that Farmer (2019: 38, 49) and Ricks (2019: 38) call "accompaniment", which is a term used by Farmer and MASS Design Group to describe the relationship between different contributors and/or beneficiaries in a given situation. This is similar to Swilling's (2020: 21) descriptions of relatedness and relationality, and it embodies the concept of a joint journey when referring to healthcare or an architectural project, where a partnership between different role players is established and maintained over time until the project or journey is deemed to have been completed. Benimana[10] says it is about challenging the time of engagement, and according to Farmer, "To accompany someone is to go somewhere with him or her, to break bread together, to be present on a journey with a beginning and an end… There's an element of mystery and openness… I'll share your fate for awhile, and by 'awhile' I don't mean 'a little while'. Accompaniment is much more often about sticking with a task until it's deemed completed, not by the accompagnateur, but by the person being accompanied" (2019: 38).

Besides working with local partners who have been embedded in the context for a long time, since their inception, both MASS Design Group and ASA have been embedded in Kigali by having permanent offices there. The encounter between Northern architects and Southern architects, contributors, and communities, does come with its challenges though and Tasca (in Loké, 2019: 67) reflects on this by saying that "At times we may see things differently to local people because we grew up in different countries, with different means, and different experiences. We have to try and understand how Rwandans relate to space, interpret proportions, consider materials and so on. We make compromises along the way because sometimes our ideas aren't accepted". Van der Merwe also highlights the difficulties in communication between different people and she notes how the employment of interpreters and local intermediaries, and becoming embedded over time, has helped to address this (2015: 52).

With remote sites, some of MASS Design Group's architects often go and live in the vicinity of a site until the project has been completed, and as Ricks says, "Perhaps the most fundamental shift was to change our preconceptions about resource limitation, and instead to look at the opportunities that abound when you are present and proximate, rather than airdropping in a prefabricated solution" (2019: 56). Jeff Mansfield (in Murphy and Ricks, 2019: 154) reflects on the "one-size-fits-all" approach of projects like the *Maison Tropicale*: He is of the opinion that projects like these might be suitable in the case of an emergency response where time constraints limit the consideration of local contextual conditions, and he sees this as the opposite of MASS Design Group's "anti-prototypical" contextually responsive approach. Murphy remarks that "resource limitation creates incredible resourcefulness", especially when working closely with builders, engineers, and craftspeople (2019: 57), which is echoed by Stassi and Tasca[11] who observe that the difference of practicing in Rwanda as opposed to the global North is the limited resources and material choices. However, they also see this as an opportunity

to go back to the essential in architecture, and Tasca describes their tectonic approach as lo-fab (which refers to local fabrication), low-tech, and locally available (which can be seen to include both global and local tectonics). This is similar to Benimana and Doran's description of MASS Design's approach of "Local Fabrication (Lo-Fab) that uses locally sourced materials and labour. This generates economic stimuli, cultural capital, and user investment that stay with the building and its community and radically lowers CO^2 and energy emissions" (2020: np.). Murphy (2016: np.) describes the four pillars of Lo-Fab as hiring locally, sourcing regionally, training where possible, and investing in dignity, while Tasca goes on to say that:

> *"In Rwanda they build with earth, wood, bamboo, and techniques that they developed over centuries to respond to climatic constraints. There is so much knowledge and richness that was developed by non-architects… the role of the architect is to envision how the vernacular can transform into something new according to the way we live now"*[12].

This is echoed by Stassi[13] who says that they try to use local knowledge, materials, and construction techniques, but in a way that aims to improve these or "push them further"[14]. In terms of the encounter between North and South, Stassi remarks that one of the challenges of using new or improved techniques is that local community members who have some construction knowledge are often set in their ways, and that there is sometimes initial resistance against architects from the global North who are perceived as outsiders "telling them what to do"[15]. Stassi and Tasca eventually realised that this encounter can be mediated by empowering local community members to be trade leaders or master craftspeople[16], which is echoed by Murphy and Ricks (2019: 98) who note how the Butaro District Hospital led to the creation of several guilds[17]; they mention the engineer and builder Bruce Nizeye as one of their key collaborators, and one who makes use of a guild system that is reminiscent of Arts and Crafts practice (Murphy, 2016: np.; Murphy and Ricks, 2019: 98). They go on to say that for the Butaro Doctor's Housing and Doctor's Sharehousing, design-build practices were used, and workshops for carpentry and masonry were established on site (2019: 105). This use of craft for wider public benefit is a far cry from the type of craft practice that is only reserved for the elite and those who can afford it, and most likely would have pleased Morris with its redemptive application.

Benimana, Senior Principal and Managing Director of MASS Design Group, remarks that context is a major driver and informant of their design process. He also emphasises the importance of limitations, and that careful thought and conversation are required when the use of local materials is considered. According to him, the physical material matters less than the act of localising it[18] and he goes on to say that "Design is never neutral. It either hurts or heals. Our mission is to research, build, and advocate for architecture that promotes justice and human dignity" (2019a: np.). While MASS Design Group and ASA's approaches may be similar, their structure and size are vastly different. MASS Design Group is a 501(c)3 not-for-profit organization with fourteen principals and senior directors, a substantial staff cohort, and offices in Boston, Poughkeepsie, Santa Fe, Bozeman, and Kigali, while ASA is a small five-person conventional architecture practice based only in Kigali. Tasca, one of ASA's Principals, is critical about large non-profit companies[19] and she sees advantages in smaller organisations but despite ASA's size, the practice has completed a large number of projects in the past eight years.

The tectonic landscape

According to Benimana (2019a: np.), MASS Design Group's aim is that "Each project must achieve a simple, legible and transmissible idea". From a tectonic point of view, one could argue that their work in Rwanda is quite successful in this regard since, similar to some of Kéré's work, their tectonic strategies are visible in numerous projects by other practices both within and beyond Rwanda. The same can be said of the work of ASA, and Benimana admits to being inspired by their work too[20]. The works that emerge out of the knowledge community of MASS Design Group, ASA, and a number of other practices exhibit similar tectonic traits that have been influenced by the condition of parallel production over an extended period of time. Some of these tectonic strategies have also begun to be replicated by local communities in the built fabric near to some of these practices' buildings (Benimana, 2019a: np.). While there is not sufficient space to analyse the entire oeuvres of these practices, a few representative projects have been selected from the catalogue in Appendix A for a discursive overview of tectonic strategies within the wider constellation. Two of these projects will later be analysed in more detail, but in terms of general similarities, a few common tectonic strategies are revealed, and they can be classified either as global or local tectonics.

In terms of global tectonics, the reinforced concrete frame, steel trusses and/or a steel structure, steel roof sheeting, and steel doors and windows are common strategies. Since Rwanda is located in a seismic zone,

most of the projects have a reinforced concrete framework, or in the case of ASA's ECCD and ECD and F centres, concealed steel reinforcing in the brickwork, or in Sharon Davis Design's projects an independent steel framework. Even though cement is produced in Rwanda by Cimerwa, it is a centralised, highly mechanised and industrialised process, both in its production and application, and although this might be mediated to some extent by local mixing, on-site casting of elements, or its use in compressed stabilised earth bricks (CSEBs), it is still regarded as a global tectonic strategy. Steel is generally imported from China, Kenya or Uganda, and steel trusses are commonly used[21] to achieve larger spans and to make Vierendeel trusses for clearstory windows (Rwanda's equatorial position means that the sun travels virtually directly from east to west)[22]. Steel is also used for doors and windows, and for steel roofing sheets (which are formed in Kigali). The ubiquitous corrugated sheet is widely used throughout the global South, but Edgerton emphasises its importance in Rwanda by saying "Corrugated iron was not just an urban technology. It was used to replace thatch roofs on traditional rural buildings as well. In Rwanda corrugated iron was first used by the Belgian colonisers for their public buildings. By the end of the twentieth century a lighter type was the standard roofing material of even the poorest homes. Farmers' houses build [sic] of adobe had corrugated iron roofs, and were called *terres-tôles* (earth-sheets). As the only part of the house villagers cannot make, the iron roof became a prized possession, it was looted from Tutsis' homes in the genocide of 1994. As the tables turned, Hutu refugees trudged to the Congo bearing sheets on their backs, others buried them in their fields" (2007: 98; 2019: 41). According to Stassi, corrugated sheeting is still associated with status and wealth, and it is still the most diffused roofing material in Rwanda[23]. He acknowledges that it is problematic in terms of thermal transmission and noise when it rains, but that it is widely used because of the balance that it achieves between cost and comfort. Similarly to concrete, steel production is also centralised, highly mechanised and industrialised, and in Rwanda's case a large proportion of it is imported. Steel roofing sheets are formed in Kigali, and steel members are generally cut and welded on site to make trusses, doors, and windows, but due to its material origins and production methods, steel is also regarded as a global tectonic strategy.

Common local tectonic strategies are the use of natural stone, compressed earth bricks, compressed stabilised earth bricks, locally fired brick produced through small-scale methods, elements made from local reeds, bamboo, sisal, or tree bark (typically ventilation screens and ceilings), and locally made clay roof tiles. Initially regarded as a nuisance (Murphy, 2016:

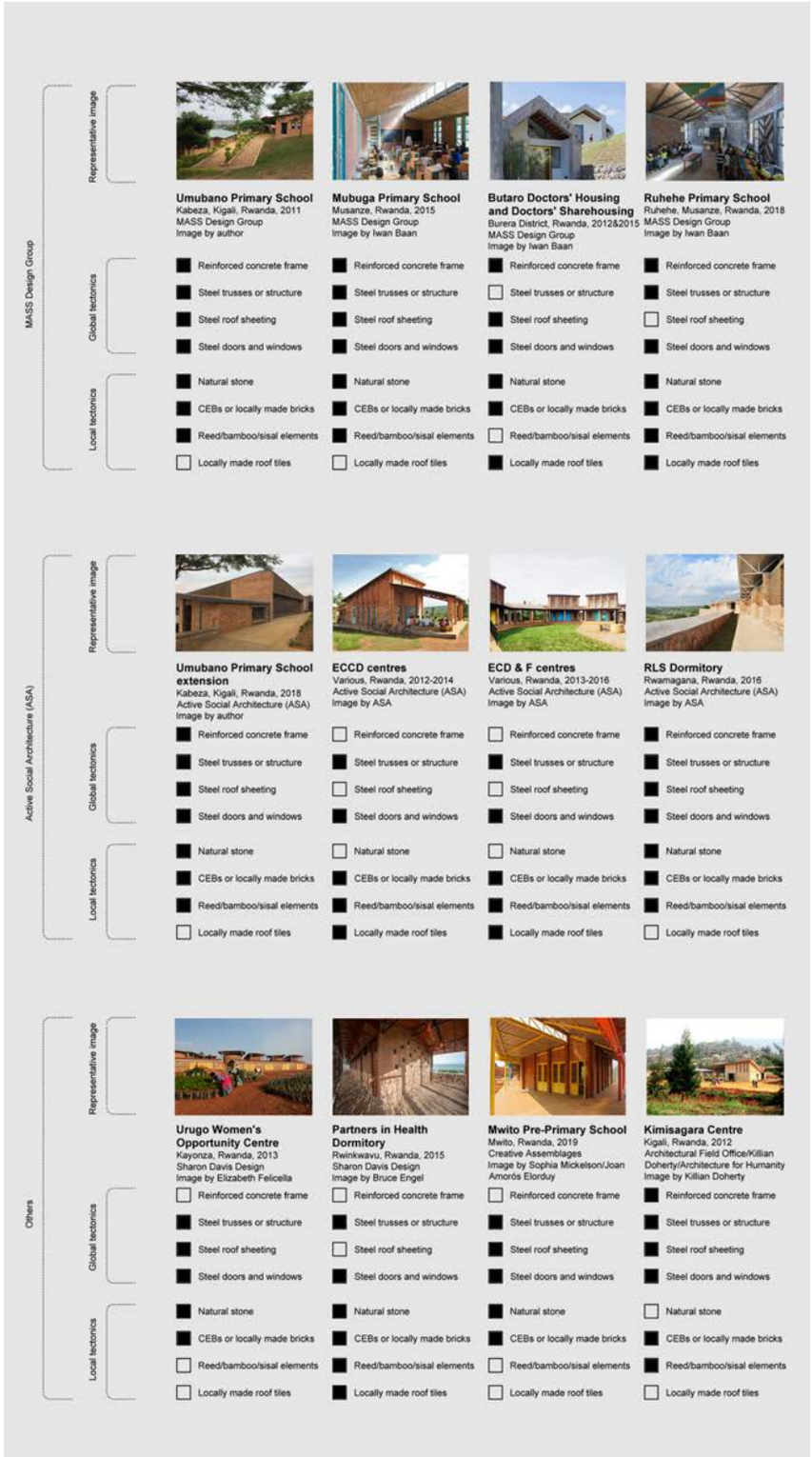


Figure 22:
A selection of works from the Rwandan tectonic constellation showing common tectonic strategies across buildings. The included works are representative samples of projects by MASS Design Group, ASA, and other practices that use similar tectonic strategies. Source: Author, with images by author and others as cited.

np.), volcanic stone has become a particularly popular material in Rwanda. This stone is usually excavated and removed from arable land to allow for the cultivation of crops; the stones are typically piled up and used to create fences, although there is a vernacular tradition that Ricks calls "polka dot walling" (2019: 61). In this case the stones are used for the construction of building walls, but they are separated by wide mortar joints to create a dotted effect which, according to Benimana and Stassi[24], is because cement is associated with status. This is similar to Riondato's observation that brick is widely accepted in Rwanda due to its familiarity while adobe, even though it might be more environmentally sustainable, is associated with poverty. He goes on to say that cement blocks are often the preferred material since they are associated with development and wealth; clients sometimes insist on their use despite their social[25] and environmental disadvantages (Loké, 2019: 59). The way that MASS Design Group usually applies volcanic stonework is different to polka-dot walling: It is cut and laid by hand in a very slow labour-intensive process, but in the long term it enabled the original masons of Butaro District Hospital to create a co-operative which has gone on to work in many other parts of Rwanda (Lepik, 2013: 225; Ricks, 2019: 61). The use of the stone is due to its local availability, to generate local employment and skill building, cost benefits, for its aesthetic potential, but also since MASS Design Group is "interested in privileging craftsmanship and the human handprint" (Ricks, 2019: 61). As Murphy and Ricks (2019: 67) go on to say in relation to the Butaro District Hospital:

> *"Intentionally labour-intensive practices and local materials – such as the volcanic rock from the Virunga mountain chain – delivered site-appropriate and sustainable design, reduced the embodied carbon of the project, and ensured that 85 percent of the costs of building were invested into the local economy. The careful coordination of design and construction resulted in savings of more than 30 percent compared to other hospitals currently built in Rwanda."*

Figure 23:
Global and local tectonics as used by ASA showing their respective advantages and some of the reasons for using them. Source: Active Social Architecture, 2019: 21.

Figure 24 (above):
Polka dot walling. Source: MASS Design Group.

Figure 25 (below):
Dressed volcanic stone as it is typically used by ASA and MASS Design. Source: Author.

According to Stassi and Tasca[26], labour-intensive practices are pushed to the point where, instead of ordering gravel, contractors often prefer to order stone which is then chipped into gravel by hand on site. Tasca (2019a: np.) remarks how working with volcanic stone at the Rugerero Health Centre "was a headache" because it was so hard to extract and process.

The regular use of compressed earth bricks[27] or locally fired bricks usually allows for the local extraction of material and the use of local labour. Riondato notes how the reason for the extensive use of brickwork is its availability, even in rural areas where there are informal kilns and local small-scale producers or co-operatives, and Stassi[28] says that brick is the one material that is common knowledge in Rwanda. Riondato does however lament that they are often of poor quality, and that the lack of standardisation also means that bricks always have to be tested[29] to ensure their stability. This is echoed by Stassi and Tasca[30] who note how every building element is mocked-up or prototyped on site (often through an iterative process of building, demolition, and re-building) before proceeding in bulk. Riondato (in Loké, 2019: 59), Stassi and Tasca[31] also highlight the encounter between people and the environment in the production of bricks where, especially if they are fired, the process leads to deforestation[32] and pollution. They do, however, acknowledge that as part of the country's overall carbon footprint, when compared to countries in the global North, this is negligible. Hence, despite the use of cement in the mortar and the firing of the bricks, the social benefits of using brick in Rwanda outweigh its comparatively small environmental footprint. Because of its local material origin, the mode of production (through informal kilns, small-scale operations, and co-operatives) and the manual labour involved in its application, brickwork in Rwanda can be regarded as a local tectonic strategy.

The brickwork is usually left unplastered and it is often used in a perforated bond for natural ventilation although in ASA's ECD centres, these perforation patterns are also employed for visual and haptic stimulation, which is regarded as an educational resource (Lepik, 2013: 221; Boundaries, 2015: 38; Van der Merwe, 2015: 60). Local reeds, bamboo, sisal, and tree bark often feature in contemporary Rwandan projects, and these are usually processed locally and used for ventilation screens or ceilings. The importance and potential long-term benefit of using local labour is emphasised by Tasca who notes that "For us, the process of developing the project is important and allows us to better understand how much impact we can have at a social level. How many people can learn trades, produce better quality bricks, or make buildings that are better ventilated or illuminated? Through participating in the construction of the project, they may gain the skills to improve their own homes as well" (Tasca in Loké, 2019: 59). Active participation by community members can also contribute to their acceptance of a project and the extent to which they take ownership of it (Riondato in Loké, 2019: 59).

As mentioned, the concrete structural frame, steel trusses and frames, steel doors and windows, glazed openings, and corrugated roof sheets are typically used in conjunction with local tectonics like locally made clay bricks, reed or bamboo screens, and wall cladding made from natural stone by both MASS Design Group and ASA. This can be seen to conform to Buchanan's strategy to "use as the basic type the abstract frame of Modernism, and within its 'cage' have permanent as well as more temporary, elements that are more explicitly local" (1984: 25). Smith and Berlanda similarly describe the advantages of a reinforced concrete frame construction with masonry infill instead of concrete slab systems[33], and they write that "This system is not the only option, but the larger point is that vernacular construction methods and materials can be transformed or integrated with more modern methods or materials" (2018: 87). Although Curtis (1986: 26) quips that "It seemed as if the concrete frame and the air conditioner were together conspiring to demolish local identity from architecture altogether", these are not necessarily mutually exclusive if used critically. The combination of global and local tectonics will be analysed in more detail in the following section by using two buildings that are representative of the work of MASS Design Group and ASA: The Umubano Primary School extension in Kigali (the School was originally completed by MASS Design Group in 2011, but the analysis will focus on its extension by ASA in 2018), and the Ruhehe Primary School by MASS Design Group and the African Design Centre, also completed in 2018.

Encounters in the works

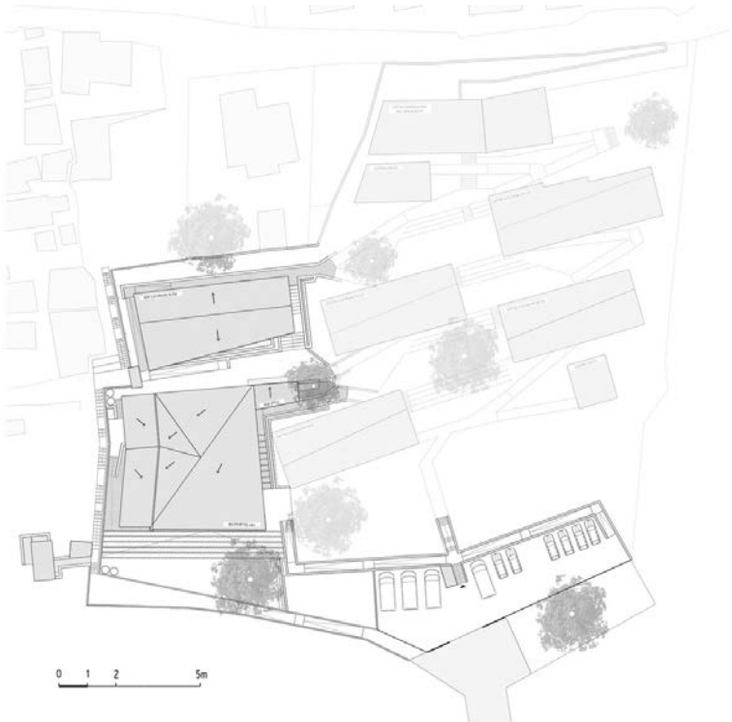
Initially funded by *A Partner in Education* from the United Kingdom, the first phase of Umubano Primary School was designed and completed by MASS Design Group in 2011 (Murphy and Ricks, 2019: 267). It was originally planned for three hundred pupils from five to eleven years old, and it consisted of seven single-storey buildings spread over five terraces. Mimicking the Rwandan practice of using switchbacks to traverse steep agricultural terraces (Holm and Kallehauge, 2015: 219), its walkways and outdoor classrooms blend comfortably into the hillside. The roofs are stepped in the middle to accommodate clearstorey windows which allow for additional natural light and cross-ventilation, and the materials were selected based on their local avail-

ability and suitability. Mostafavi (2013: 274) notes how the school became a landmark and a drawcard for the neighbourhood, which may have resulted in it requiring an extension that was subsequently completed by ASA in 2018.

One of MASS Design Group's aims with its educational projects is to improve lighting and ventilation in school buildings and to make considerate use of local materials and resources. The original classrooms at Umubano Primary School were made using a combination of global and local tectonics: In terms of global tectonics, a reinforced concrete frame provides earthquake resistance, Vierendeel trusses support the stepped roof, steel sheeting allows for lower roof angles against the steep slope, and steel doors and windows are used for their durability. Locally made clay bricks are used for infill, which is often perforated for natural ventilation, natural stone is used for retaining walls, and papyrus reed is used for ceilings and door infill. This basic palette had to be followed by ASA for their extension, but they did make a few adjustments: They raised the new buildings off the ground on plinths to prevent rising damp, and where MASS Design Group's buildings had ventilation screens on the one side and windows on the other, ASA's buildings have windows on both sides. They also made use of larger reeded ventilation panels and they introduced repurposed material for insulation. Even with a similar material palette, the project reads as an interesting encounter and dialogue between the two architectural practices[34].

Stassi and Tasca[35] previously mentioned that the palette of available building materials in Rwanda is limited, but that local conditions require the combination of global and local tectonics. The encounter between different modes of production is clearly expressed in the Umubano Primary School extension, and a visual analysis of the origins of materials and labour in the following pages shows the key materials and labour techniques, and their relative distances from the site. As discussed in the previous sections, tectonics are ontological and representational; some global tectonics are sourced locally, while some local tectonics have to be sourced from afar (and locally discarded materials of global origin which are reused, repurposed or recycled can also be regarded as local tectonics).

The base materials needed for global tectonics at the Umubano Primary School extension were mainly sourced elsewhere: Approximately 50% of the steel that forms the base material for the corrugated roof sheeting is predominantly imported from China, Uganda and Kenya, with the remainder produced in Rwanda. This includes the labour required for its initial extraction



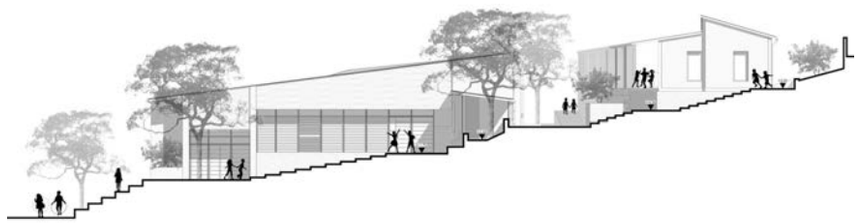


Figure 26 (top):
The site plan of the Umubano Primary School, Kigali, Rwanda. The seven buildings of the first phase, completed in 2011 by MASS Design Group, are located on the right while the extensions, completed in 2018 by ASA, are shown in dark grey on the left. Source: ASA.

Figure 27 (centre):
The section of the Umubano Primary School extension, Kigali, Rwanda, completed in 2018 by ASA. Source: ASA.

Figure 28 (below:
A view of the Umubano Primary School and its extensions, MASS Design Group and ASA, Kigali, Rwanda, 2012 and 2018. Source: Active Social Architecture, 2019: 7.

Umubano Primary School extension
Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

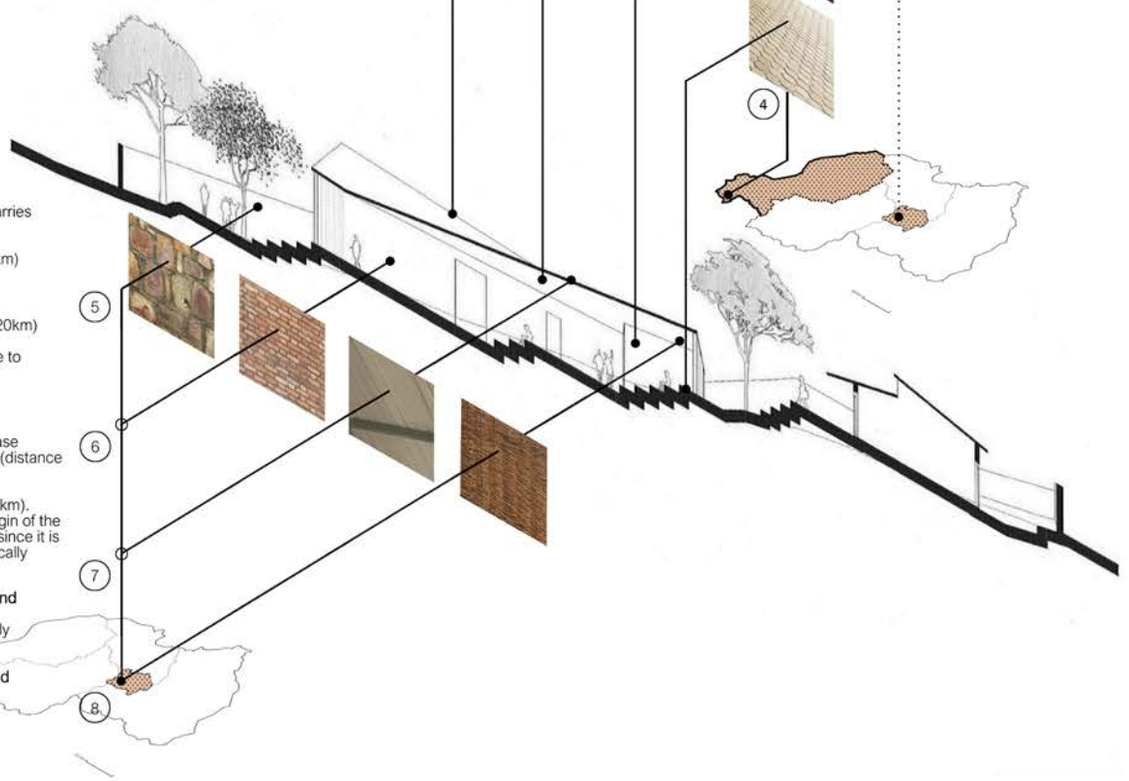
Active Social Architecture (ASA)

At the Umubano Primary School extension, the adjacency of global and local tectonics is clearly evident: Cement, concrete, steel roof sheeting, and steel doors and windows are used in combination with local stone, locally made bricks, reeds, lathes, and repurposed material for insulation. ASA had to broadly conform to the material palette that was used by MASS Design Group for the first phase of the school, which means that the basic material combination matches that of the older buildings to a large extent.

Materials like polycarbonate sheeting, glazing, and fixings that are used to a lesser extent have not been included in this analysis. It should also be noted that the cement used in the mortar for the stone and bricks walls is not taken into account for the visual weighting, since its material percentage in terms of the wall as a whole is negligible. The dominant material content of the stone and bricks walls is local, and it includes the use of local sand in the mortar.

While the cement and a percentage of the steel that is used in the project is extracted and/or processed in Rwanda, these materials are classified as global tectonics since their modes of production are highly industrialised and their application is normative.

*The QR code above can be used to access the website database that was established as part of this study, and it willl provide a link to this project's base information.



Local tectonics

5 **Material: Walls and foundations**
Natural stone harvested from on-site excavations and procured from Kigali quarries (distance < 20km)
Labour: Walls and foundations
Processed by hand on site (distance = 0km)

6 **Material: Walls**
Natural clay obtained locally (distance < 20km)
Labour: Walls
Sun-dried clay bricks made by hand close to the site (distance < 20km)

7 **Material: Insulation**
Protective layer for rolled roof sheeting base material - waste material obtained locally (distance < 20km)
Labour: Insulation
None - repurposed material (distance = 0km). While there was labour involved at the origin of the roof material, this is disregarded as local since it is repurposed material that was obtained locally

8 **Material: Shading/ventilation screens and ceilings**
Locally harvested reeds and lathes: Initially Umuseke reeds, now Eucalyptus lathes (distance < 20km)
Labour: Shading/ventilation screens and ceilings
On site (distance = 0km)

Global tectonics

1a **Material: Roof covering**
Approximately 50% of material imported mostly from China, Uganda and Kenya (distance from 10 000km - 500km)
Labour: Roof covering
Extraction and intitial processing in China, Uganda and Kenya

2a **Material: Steel structure**
Approximately 60% of material imported mostly from China, Uganda and Kenya (distance from 10 000km - 500km)
Labour: Steel structure
Extraction and intitial processing in China, Uganda and Kenya

3a **Material: Steel doors and windows**
Approximately 60% of material imported mostly from China, Uganda and Kenya (distance from 10 000km - 500km)
Labour: Steel doors and windows
Extraction and intitial processing in China, Uganda and Kenya

1b **Material: Roof covering**
Approximately 50% of material produced locally in Rwanda (distance < 250km)
Labour: Roof covering
Local manufacturing and processing in Kigali, mainly by Safintra and Tolirwa (distance < 20km)

2b **Material: Steel structure**
Approximately 40% of material produced locally in Rwanda (distance < 250km)
Labour: Steel structure
Locally cut and welded in Kigali (distance < 20km)

3b **Material: Steel doors and windows**
Approximately 40% of material produced locally in Rwanda (distance < 250km)
Labour: Steel doors and windows
Locally cut and welded in Kigali (distance < 20km)

4 **Material: Cement for structural concrete, mortar, surface beds, and precast pavers**
Cement produced locally in Rwanda by Cimerwa (distance < 250km)
Labour: Cement for structural concrete, mortar, surface beds, and precast pavers
Concrete mixed in Kigali and pavers cast on site (distance < 20km)

and processing, but fortunately 50% of the production of roof sheets occurs in Kigali, mainly by Safintra and Tolirwa. This means that the roof sheeting could be obtained within Kigali and was transported for less than 20 kilometres to Umubano Primary School from its production facility. The steel required for the structural elements like roof trusses and columns, and for the doors and windows, has similar origins: Approximately 60% of the steel for these elements is predominantly imported from China, Uganda and Kenya, with the remainder produced in Rwanda. This includes the labour required for its initial extraction and processing, but it is cut and welded in Kigali within 20 kilometres of the site. Kigali has its own cement factory, Cimerwa, which is less than 250 kilometres from Umubano Primary School, and its product was used for the structural concrete elements, mortar, surface beds, and precast pavers[36]. The concrete is mixed in Kigali and the pavers were cast on site, but since cement and concrete are representative of global modes of production they do still fall under global tectonics.

The materials and labour used for the local tectonic strategies were all sourced from within 20 kilometres of the site: Natural stone was harvested from on-site excavations and procured from within Kigali to be dressed on site, clay bricks were made near the site with local clay, locally harvested *Umuseke* reeds and Eucalyptus lathes[37] were used for ventilation panels, and repurposed packaging material was used for roof insulation[38]. There is a layering or adjacency of global and local throughout the building: The foundations, for example, consist of a 50mm layer of sand blinding, stone foundations, and a concrete ring beam topped with asphalt which serves as a damp proof course. True to their philosophy of pushing material usage forward, ASA has also developed their own roofing "package", which consists of corrugated sheeting on a thin layer of repurposed insulation material, on a layer of timber planks. The insulation material is in fact the 2mm thick aluminium-faced spongy packaging material rolled into the flat imported steel sheets used to form the roofing material, and it is typically discarded when the sheets are cut and formed into corrugated profiles. This system is used despite reservations from the clients about having visible steel structures, since the insulation and timber help to reduce the transmission of sound from the metal roofing sheets to the metal roof structure[39].

The encounter of architects who are originally from the global North with local contributors and community members seems to have been a comfortable one with this project, and the relationship between the architects and the users is amicable and familiar. The Director of Umubano Primary School,

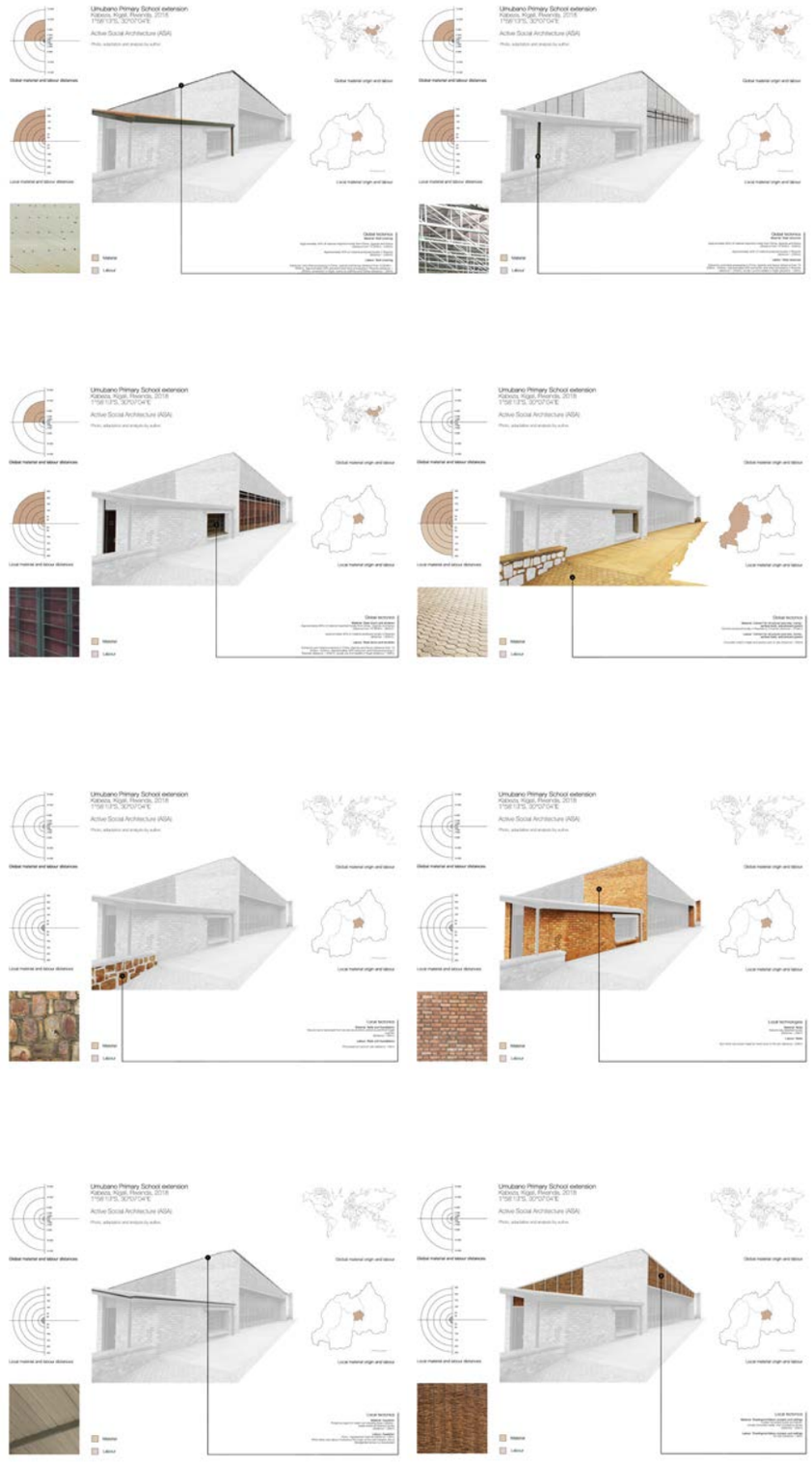


Figure 29 (previous page):
A visual analysis of the origins of materials and labour that were used for the Umubano Primary School extension. Source: Author.

Figure 30:
A visual analysis of the origins of materials and labour that were used for the Umubano Primary School extension. Larger scale versions of the images can be viewed in Appendix C. Source: Author.

Jean de Dieu, comments positively on the architecture and tectonic strategies, while the school's staff members note the comfortable indoor climate and natural ventilation. They also appreciate the visual and haptic aspects of the building's interiors, especially the reed ceilings which they describe as "glamorous"[40]. The project manifests ASA's (and MASS Design Group's) desire to prioritise local materials and labour, and to engage with the local community and end users. The visual analysis demonstrates that in terms of the balance between global and local, the local clearly seems to be dominant in this encounter.

Ruhehe Primary School by MASS Design Group was completed in 2018 and it was also a design-build project for the African Design Centre (ADC)[41]. It was completed in the same year as the Umubano Primary School extension, and similar to that project, it was also an extension to an existing school. The project aims to set a scalable standard for school design and construction in Rwanda[42] and while it still exhibits traces of MASS Design Group's first phase of Umubano Primary School, Ruhehe Primary School's remote location, the practice's evolution (in terms of experience and staff members involved), and the involvement of the ADC, resulted in a somewhat shifted set of tectonic encounters.

The school serves one thousand one hundred and twenty children from pre-primary level up to grade six, and MASS Design Group regards it as the first "proof of concept" of educational design principles that they developed at the Mubuga Primary School that was completed by them in 2015 in Musanze District, Rwanda. Through an extensive immersion process, ADC fellows were able to produce a community-centred design concept that emphasizes capacity building at all project stages" (MASS Design Group, 2020b: np.). According to Samson (2018: np.) the initial community engagement by ADC fellows took three days, and while the extensivity of this immersion can be questioned, the longer-term involvement during and after construction can be regarded as an extension of this.

The intervention by MASS Design Group and the ADC consists of two curved walls for privacy (made from concrete and steel that is cladded with volcanic stone), with four new buildings radially distributed along it between two existing classroom buildings. Two other existing classrooms were demolished, which can be questioned in terms of environmental impact, and it is unclear whether any material was harvested from the demolition. While Ruhehe's design approach is similar to that used for the Umubano Primary School and

Figure 31:
A visual collage analysis of the Umubano Primary School extensions that tests the visual balance between global and local tectonics. The local tectonics are clearly dominant. Source: Author.

its extension, its form-making and tectonics are rather different.

In terms of global tectonics, a reinforced concrete frame is used as the primary structure on account of the seismic conditions in Rwanda. Similar to the Umubano Primary School and its extension, the cement is produced in Rwanda by Cimerwa which is less than 250 kilometres from the site, and it is used for structural concrete, mortar, surface beds, and for precast pavers. Even though its use in the concrete is mitigated to some extent by using local volcanic ash and sand from Musanze District, it is still regarded as a global tectonic strategy due to its mode of production. Steel is used for roof trusses, columns, doors and windows; the steel is imported from Uganda and supplied by Roofings Manufacturing Limited in Kigali, and despite the fact that it is re-cycled steel and that it is cut and welded on site, it is also still regarded as a global tectonic strategy. The architects did not use corrugated sheeting to roof the Ruhehe Primary School, but they did make use of polycarbonate sheeting for rooflights and while the origin of the base material is unknown, it is supplied by *Quincaillerie Manteco* in Kigali and it was most likely produced by Safintra in Kigali[43]. The roof forms are of a standard double-pitch configuration (most likely because of the varied orientation where clearstoreys would not have been as successful as at Umubano Primary School), which resulted in light shelves being installed below the polycarbonate rooflights. It is unclear how the use of polycarbonate sheeting in line with the roof form affects solar gain, but the light shelves screen the direct sun, they enable good ambient light conditions, and they provide a colourful contrast with the charcoal steel trusses and natural timber ceiling.

MASS Design Group and the ADC made a concerted effort to use local tectonic strategies for the Ruhehe Primary School. The brickwork for the project, even though it is made up of SKAT fired bricks, was produced in Musanze District by a co-operative called *COOMIVA*, while the roof tiles were made by hand by *Nyirangarama* in Rulindo District less than fifty kilometres away with clay that was sourced from the same District. According to Murphy and Ricks (2019: 309) the tiles help to reduce rain noise, but it is unclear what the balance is between the thermo-acoustic advantages and the cost (although this in turn, has to be balanced with the social and environmental advantages). Volcanic stone quarried at Gahunga Quarry in Musanze District within ten kilometres of the site was used extensively. It is a common material in the District and local builders are familiar with it, although its use (except for polka dot walling) is usually limited to dry-stacked construction. In this case the concrete and steel, even though they are "expensive and not easily attain-

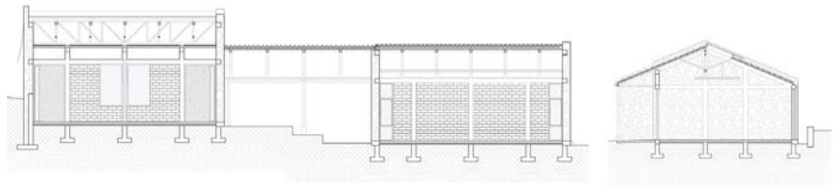


Figure 32 (top and centre):
The site plan and typical sections of Ruhehe Primary School, Kigali, Rwanda. The new buildings were completed in 2018 by MASS Design Group and the African Design Centre. Source: MASS Design Group.

Figure 33 (below):
A view showing some of the encounters between global and local tectonics at Ruhehe Primary School, Kigali, Rwanda. Source: MASS Design Group.

Ruhehe Primary School

Ruhehe, Musanze District, Rwanda, 2018
1°31'59"S, 29°33'29"E

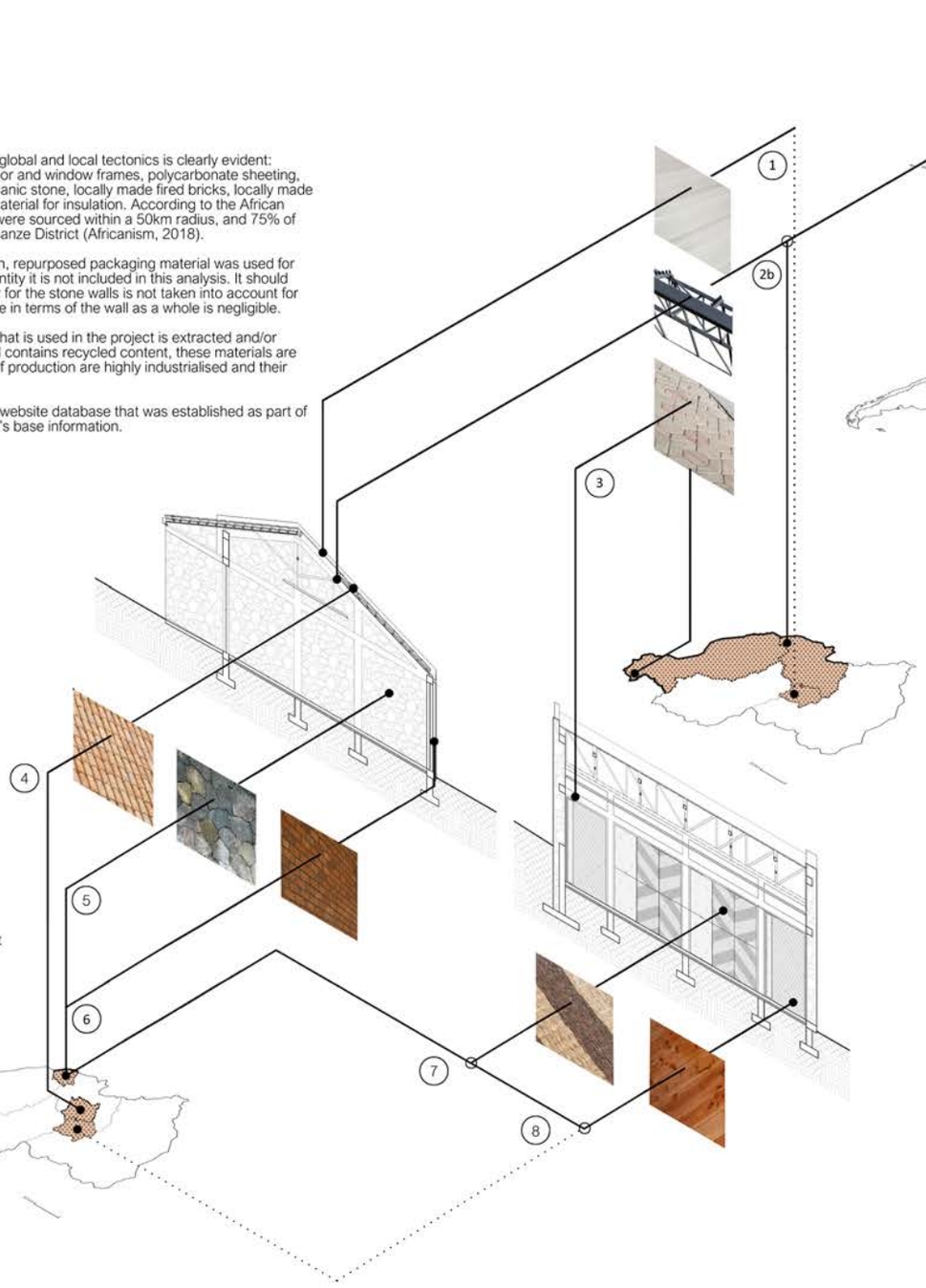
MASS Design Group with the African Design Centre

At the Ruhehe Primary School, the adjacency of global and local tectonics is clearly evident: Cement, concrete, steel for trusses, columns, door and window frames, polycarbonate sheeting, and glass are used in combination with local volcanic stone, locally made fired bricks, locally made clay roof tiles, sisal, tree bark, and repurposed material for insulation. According to the African Design Centre, more than 80% of the materials were sourced within a 50km radius, and 75% of the budget was spent in Ruhehe Village and Musanze District (Africanism, 2018).

Similar to the Umubano Primary School extension, repurposed packaging material was used for insulation, but due to its comparatively small quantity it is not included in this analysis. It should also be noted that the cement used in the mortar for the stone walls is not taken into account for the visual weighting, since its material percentage in terms of the wall as a whole is negligible.

While the cement and a percentage of the steel that is used in the project is extracted and/or processed in Rwanda, and even though the steel contains recycled content, these materials are classified as global tectonics since their modes of production are highly industrialised and their application is normative.

*The QR code above can be used to access the website database that was established as part of this study, and it willl provide a link to this project's base information.



Local tectonics

4 **Material: Roof tiles**
Clay obtained in Rulindo District (distance < 50km)
Labour: Roof tiles
Hand made by *Nyirangarama* in Rulindo District (distance < 50km)

5 **Material: Stone wall cladding**
Natural volcanic stone quarried at *Gahunga Quarry* in Musanze District (distance < 10km)
Labour: Stone wall cladding
Extraction at *Gahunga Quarry* in Musanze District (distance < 10km), shaped on site (distance = 0km). * Stone used as cladding over steel and concrete framework

6 **Material: Fired clay brick walls**
Material from Musanze District (distance < 25km)
Labour: Fired clay brick walls
Manufacturing of SKAT fire bricks in Musanze District by *Cooperative COOMIVA* (distance < 25km)

7 **Material: Ventilation screens**
Sisal and tree bark harvested in Musanze District (distance < 25km)
Labour: Ventilation screens
Woven on site (distance = 0km)

8 **Material: Solid doors and timber ceilings (with recycled insulation on top)**
Cypress from Musanze District supplied by *Atelier Economa General* (distance < 25km)
Recycled plastic insulation from Kigali (distance < 100km)
Labour: Solid doors and timber ceilings (with recycled insulation on top)
Cypress extraction and processing in Musanze District (distance < 25km). No labour for recycled insulation

Global tectonics

1 **Material: Polycarbonate sheeting and glazing**
Material origin unknown. Polycarbonate sheeting supplied by *Quincaillerie Manteco* in Kigali (distance < 100km)
Labour: Polycarbonate sheeting and glazing
Extraction and initial processing unknown. Labour for polycarbonate forming possibly by *Safintra* in Kigali

2a **Material: Steel for trusses, columns, and door and window frames**
Recycled material imported from Uganda (distance < 500km) and supplied by *Roofings Manufacturing Limited* in Kigali (distance < 100km)
Labour: Steel for trusses, columns, and door and window frames
Extraction and initial processing in Uganda

2b **Material: Steel for trusses, columns, and door and window frames**
Recycled material imported from Uganda (distance < 500km) and supplied by *Roofings Manufacturing Limited* in Kigali (distance < 100km).
Labour: Steel for trusses, columns, and door and window frames
Cut and welded on site (distance = 0km)

3 **Material: Cement for structural concrete, mortar, surface beds, and precast pavers**
Cement produced locally in Rwanda by Cimerwa (distance < 250km). Mixed with local volcanic ash and sand from Musanze District (distance < 25km
Labour: Cement for structural concrete, mortar, surface beds, and precast pavers
Original production by Cimerwa (distance < 250km), concrete mixed locally and pavers cast on site (distance = 0km)

able" (Raskin, 2019: np.) were used to enable the stone cladding to be raised up to almost five metres high for the curved screen walls. Ventilation screens are made from sisal and tree bark harvested within twenty-five kilometres in Musanze District and woven on site, while solid timber was used for doors and ceilings. With a nod to ASA, repurposed insulation was sourced from Kigali and used in the ceilings, while the timber is cypress from Musanze District that was supplied by *Atelier Economa General*[44].

According to a number of sources[45], the ADC reports that 75% of the school budget was spent in Musanze District and 80% or more of the materials were locally sourced within 50km. 35% of the skilled labour on site was female and 60% of these females were trained through the African Design Centre's on-site training initiatives (MASS Design Group, 2019: 21). The ADC[46] also notes that 99% percent of the building's materials were sourced from within 150 kilometres of the site. This may be true in terms of purchasing, but the base materials' origin is often from much further afield. Benimana[47] agrees that the notion of "local" should be questioned, and visual analysis reveals that even if the percentage of local sourcing is accurate, many locally obtained materials should be classified as global tectonics. It is also unclear whether these percentages are calculated by mass, volume or cost, but most likely they are calculated based on local spending and labour hours (Stott, 2017: np.). Nevertheless, the visual analysis shows that the local tectonics still dominate.

Like many African countries, the encounter between the global and local becomes immediately evident in Rwanda when one considers material availability. According to Smith and Berlanda (2018: 59), Rwanda relies on the importation of certain building materials, especially steel, and they note that international partnerships are needed in terms of construction materials and expertise. They do however warn that conflicts could arise through the encounter of groups that have access to these international economies, and groups that rely on local economies. They emphasise the importance of labour-intensive construction practices and cite a preliminary study by the *Technische Universität München* for Rwanda which states "The development of the urban environment must be based on strategies which stimulate economic growth (GDP), the provision of services, and job creation" (Weisel, Kittel, Rōssel and Gnädinger, 2011: 90). They also go on to mention that the Conceptual Masterplan for Kigali[48] asserts that "In countries with high underemployment, planning and design solutions should consider the goal to employ as many citizens as possible, and therefore 'labour saving' or highly mechanised strategies

Figure 34 (previous page):
A visual analysis of the origins of materials and labour that were used for Ruhehe Primary School. Source: Author, based on a photo by Alan Ricks of MASS Design Group.

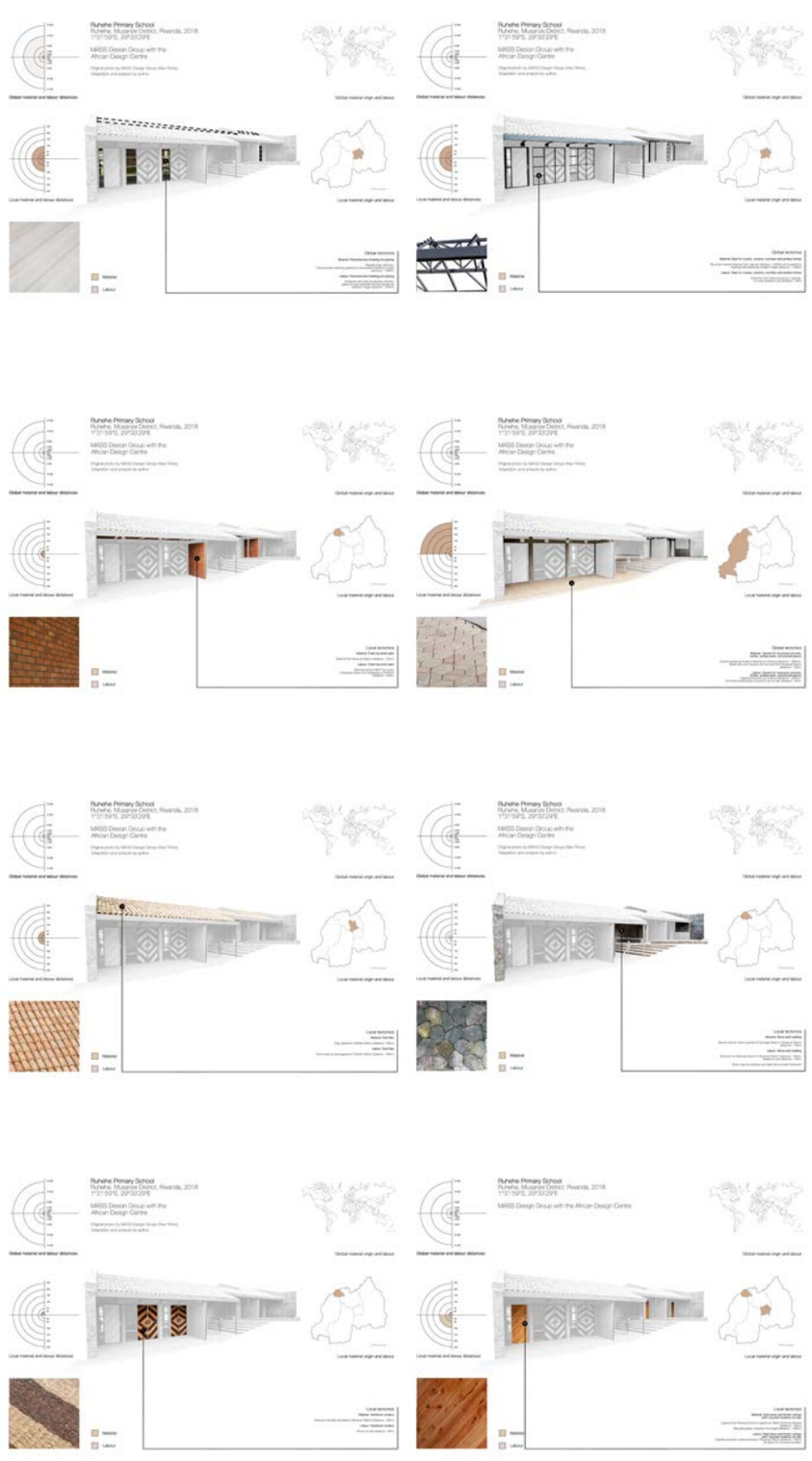


Figure 35:
A visual analysis of the origins of materials and labour that were used for Ruhehe Primary School. Larger scale versions of the images can be viewed in Appendix C. Source: Author, based on a photo by Alan Ricks of MASS Design Group.

should be avoided" (OZ Architecture, 2007: 7). Riondato, however, emphasises that a relative lack of outside influences in Rwanda is a problem:

> "*There is a limited spectrum of things that the average person here can experience and opportunities that they can access. I don't have a solution for that, but the lack of external influences is definitely something that should be addressed. Not because the influences are going to directly affect the production or the design of buildings; rather, it would allow for the development of increased understanding and critical thought around certain approaches. If people have a broad range of stimulation and references to select from, they can make more informed decisions*" (Loké, 2019: 64).

Stassi and Tasca[49] also speak about the limited material choices in Rwanda, which is why they focus on "lo-fab, low-tech, and locally available" materials and methods of production.

A balance of tectonic strategies is clearly necessary. MASS Design Group and ASA[50] cite various reasons for using their particular material palettes: To create local employment and generate empowerment (especially of women and minorities), for cost efficiency, so it can serve as a teaching device (to be replicated in other projects or by local communities), to allow community involvement (both in design and construction), to improve learning (through atmosphere, as a didactic device or through visual and haptic stimulation), to improve existing construction practices, to improve interior comfort levels, and to improve health and sanitation systems. Additional reasons include lowering a project's environmental impact and carbon footprint, and in the hope that it will enable local communities to relate to the projects.

Global and local tectonics at the Umubano Primary School extension and Ruhehe Primary School are used in combination with one another; they are visually and physically separable and thus not completely hybridised, but they exist in a comfortable state of adjacency. One could view the adjacency of elements in a similar manner to those used in the Northern Cape Legislature Buildings in South Africa, which Noble (2011: 105) compares to the Mpumalanga Legislature buildings in South Africa (which were included in Lefaivre and Tzonis' list[51] of South African examples of Critical Regionalism) as follows: "In most cases, cultural representations were applied to building surfaces [in the Mpumalanga Legislature], while the supporting architecture

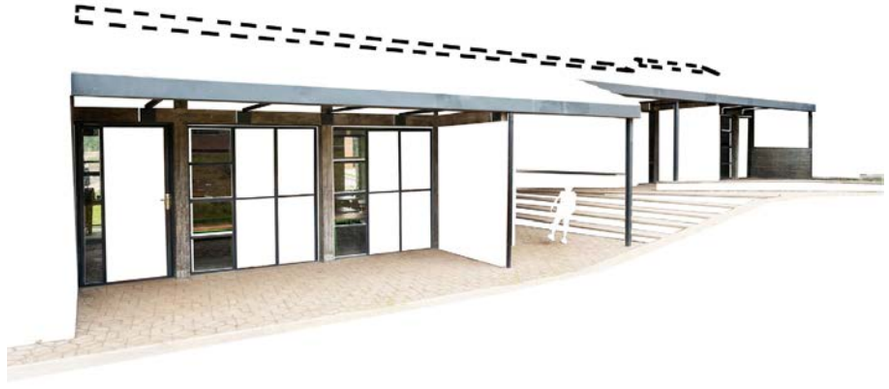


Figure 36:
A visual collage analysis of Ruhehe Primary School that tests the visual balance between global and local tectonics. Similar to the Umubano Primary School extension, the local tectonics clearly dominate. Source: Author.

was one which followed more standard, pragmatic requirements. The Northern Cape Legislature, by contrast, constantly resists unity. Instead, the architecture plays with a multiplicity of fragments. Differences of structure and skin, of texture, materiality and colour, of plain wall and handcrafted surface are brought into close proximity but rarely synthesised".

This is similar to his description of the Walter Sisulu Square of Dedication (which is also part of Lefaivre and Tzonis' list) where he writes of its dualist representation that "depicts images of generic Johannesburg buildings made from concrete frame and brick infill, situated alongside further images derived from African craft and building traditions, sapling framework constructions, textile mats, beadwork and woven baskets. In each case, a relation of grid to decorative infill is made explicit" (2011: 198). This encounter between the North and South is evident in the adjacency of different materials in African architecture, and Noble writes that "the relation of the *modern* with the *past* may also be stated as a relation of *hard* to *soft* – where the contemporary medium of concrete, glass and steel is set in relation to older aesthetic motifs derived from grass, mud, bone, egg shells and reeds. And, I contend that this relation of hard to soft – as a mediation of present to past - has posed unique challenges…" (2014: 121).

The tectonic strategies that MASS Design Group uses are rooted in their social justice approach which aims for the generation of wider benefit by employing local populations and enabling the transfer of skills (especially for women and minorities), but they are also influenced by climate, materials, culture, remoteness, cost constraints, existing standards and replicability[52] among others. ASA's ECD centres and their sixty sanitation facilities for UNICEF are similarly designed for replicability, both in terms of modular replicability by UNICEF, but also in terms of material and constructional replicability by local community members; these replicable designs are usually improved after the first implementation to ensure that relevant local factors and economic efficiencies are addressed (Loké, 2019: 56[53]).

The need for taking all of the abovementioned factors into account is confirmed by Benimana[54], but he emphasises the importance of the relationship between the social and the tectonic when he refers to Giancarlo de Carlo's opinion that nothing should be made that is degrading to the labour that made it. As mentioned previously, he is of the opinion that the concept of "the local" in terms of material origins should be carefully considered, and he notes how it can sometimes be used in relation to a particular town, region, or

country. The term is fluid, and according to him, the material matters less than localising the act of making. This can be seen to encompass both local and global tectonics depending on their appropriateness for a specific context and condition, and the challenge is to achieve a balance between an ecological response and socio-economic requirements.

This is similar to ASA's approach, which seeks to "balance environmental impact and sustainability in relation to cost" (Loké, 2019: 55), although Tasca laments the condition that the global often leads to the erosion of the local which, to her, refers specifically to culture and materiality (Loké, 2019: 67). As Riondato (in Loké, 2019: 67) says,

> *"The influence of the Global North is so powerful. You can see its impact on students and designers throughout the region—skyscrapers are the same everywhere, for example. I think we should advocate for a new direction for architecture— not just copy-paste from elsewhere. The architect should aim to be less global and more local, and seek out a new architectural language for East Africa."*

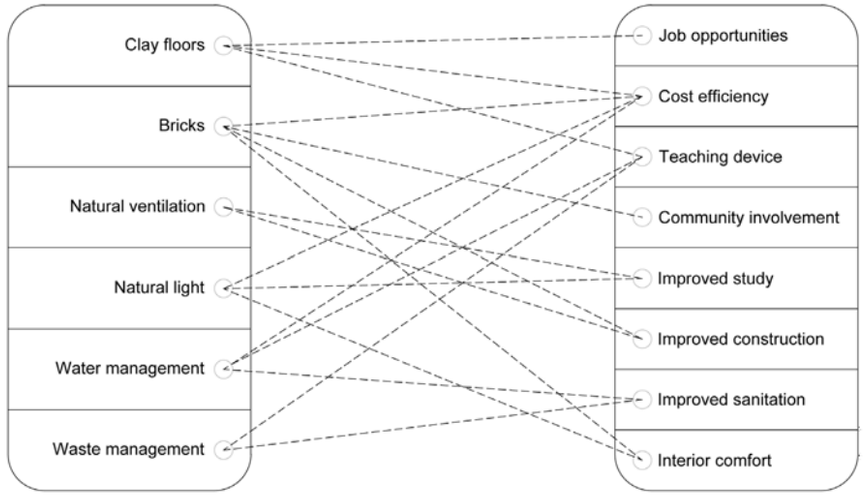


Figure 37:
The advantages of ASA's "low-tech" approach towards materiality, climate and systems. This is explained in relation to the Rugerero Health Centre but can be applied to most of their works. Source: ASA, adapted by author.

Didactic collages in South Africa

Background

According to Roger Fisher, "Man is a nomad, always encountering foreign cultures. In their meetings, there is hybridisation, not only through cultural osmosis – that is, in order to survive, the newly-arrived need to understand, adapt and adopt indigenous knowledge, particularly as this relates to food and shelter – but in the process the indigenes too acquire new understanding – reverse cultural osmosis" and he writes that in Africa, there is a "continuing hybridisation of technologies and techniques adapted to current practice and materials while being informed by the inner logic of their appropriate use of their place with the locally available materials and employing of available skills" (2019: 2).

Unfortunately, this is probably not entirely true in the case of South Africa where many indigenous knowledges were suppressed or over-written by colonialism and apartheid. It has, however, happened in some instances and while Fisher was referring primarily to past vernacular traditions, these processes are also prevalent in so-called "informal" contexts where a contemporary vernacular has evolved where the bulk of locally available materials are often previously used ones. Reitz, Baerlecken, Heiermann and Molestina (Undated: 1) support the view that the vernacular is something that can be made from locally available materials which include both natural materials and waste materials. These reused, repurposed or recycled[55] materials are often what Edgerton refers to as *creolised* materials, and they include the ubiquitous corrugated roof sheet and the now familiar repurposed shipping container. Edgerton writes that:

> *"Corrugated iron, asbestos-cement and cement were not invented in the poor world, they were first exported to it, and then locally-produced. The growth of the poor world went along with a massive increase in use of these 'old' technologies from the rich world, and yet also, importantly, it was a story of the spread of distinctive uses of these technologies. One can usefully describe them as* creole *technologies, not least as a way of pointing to the fact that most technologies in use are to varying extents creole. By a creole technology I mean one which finds a distinctive set of uses outside the time and place where it was first used on a significant scale. This is to be distinguished from transferred technologies, though I include the latter in cases where the transferred technology is essentially no longer in use in the originating territory. Often, but not necessarily, these technologies originating elsewhere combine in original ways with local technologies, forming hybrids, which not only combine creole technologies with local technologies, but also themselves become new creole technologies"* (Edgerton, 2007: 100-101).

As Adamson (2010: 240) observes, "poverty and geography combine to place artisans in a reactive relation to mass production", and Edgerton goes on to say that "The poor world was particularly fast-growing and changing in the twentieth century. It depended on a complex, original and changing technological landscape which included, importantly, mass technologies first developed elsewhere but used in distinctive ways. The technologies of the poor megacity, and particularly the materials from which it has been made, are a key case: They represent, today, a distinctive, new technology of poverty" (2007: 94). This has become even more prevalent in the twenty-first century and despite Edgerton's critique of innovation-centred narratives, these poverty-driven technologies undoubtably often exhibit innovatory practices. Low shares a similar view when he writes that high levels of poverty and urbanisation in Africa have established a common practice of people building for themselves: "Using predominantly 'found' materials they apply incredible ingenuity to establish instant human settlements, maintaining Africa's claim to a prodigious building culture" (2012: 133)[56].

South Africa's first democratic elections took place in 1994, but post-1994 optimism soon gave way to a reality that is marked by widespread unemployment, poverty, and extreme inequality. South Africa's position in the global South already puts it at a disadvantage in terms of global inequality, but this is exacerbated by local inequalities and a lack of access to resources for a large part of the population. Körbes recognises South Africa in particular as having a tradition of innovation through the use of reused, repurposed or recycled content (2010: 185), since almost fourteen percent[57] of South Africa's population lives in "informal" dwellings which are typically self-built, predominantly out of reused, repurposed or recycled materials. This has resulted in a measure of tectonic invention and innovation which is not necessarily based on environmental concern, but because of economic necessity. As Baerlecken *et al* (2014: 250) observe, "What is perceived and experienced as aesthetically rich from an outside perspective is a necessary economy of reuse from within". Edgerton writes that the technologies of poverty are often overlooked,

since “the poor world is thought of as having traditional local technologies, a *lack* of rich world technologies, and/or has been subject to imperial technological violence” (2019: xxiv), but according to Folkers, these technologies of poverty or “informal” tectonics have “the capacity to renew and to inspire architecture at large. The creativity that has been developed by the inhabitants of the informal city in the area of technological solutions and cultural identity should not be underestimated” (2010: 217).

A substantial number of architects, academics and architectural students from the global North have been designing and building projects in South Africa over the past number of years to engage with disadvantaged contexts, and a cluster of educational institutions from the global North has been quite prolific in this regard, often working with local educational institutions like the University of Cape Town and the Cape Peninsula University of Technology, and with local collaborators like CS Studio Architects. A Germanic cluster which includes, among others, the Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, the Peter Behrens School of Arts (PBSA) Düsseldorf, Germany, the Technische Universität München (TUM), Germany, the Universität Stuttgart, Germany, the Carinthia University of Applied Sciences, Austria[58], and the University of Art and Design in Linz, Austria, have been working in South Africa for more than ten years in some instances. These Germanic institutions have also often been working in close collaboration with other Northern institutions like the Georgia Institute of Technology (“Georgia Tech”) from the USA and the Faculty of Architecture at the University of Ljubljana, Slovenia. They undertake so-called design-build projects, which are employed as educational tools, but are also seen as opportunities for social outreach in South Africa and in other parts of the global South[59]. This practice is open to criticism and there are many other reasons and motivations for this type of engagement, but this section will focus mainly on the tectonic strategies themselves. Based on the data in Appendix A, a constellation of works is revealed in South Africa which shows a high concentration of the employment of reused, repurposed and recycled materials or “informal” tectonics, which are often combined with other local and global tectonics, particularly in the work by the RWTH Aachen, PBSA Düsseldorf, Georgia Tech, and the Universität Stuttgart. Work that exhibits similar tectonic strategies is also being undertaken by the emerging architectural practice Collectif Saga, based in France and South Africa, which has been doing particularly innovative work in the Eastern Cape, also sometimes in collaboration with educational institutions[60] and with local collaborators like Indalo and Uncedo.

Figure 38:
Sibusiso Mbhele's house in Bergville, South Africa. The elevated building is made in the form of an airplane using corrugated metal, repurposed minibus taxis and various found objects. Source: Paul Waters, 2010. [Online] Available: https://blackwatertown.files.wordpress.com/2010/05/100_2888.jpg (Accessed on 17 April 2019).

The inspirational value of "informal" tectonics should not be seen as a celebration of poverty nor should they be romanticised or commercialised as yet another curio or superficial Africanism, or what Botz-Bornstein calls "regionalist kitsch" (2010: 19). Rather, if considered critically, these tectonics hold the potential to engage with socio-environmental issues that can inform mainstream practice in the global South and in the global North, similar to Fisher's notions of osmosis and reverse-osmosis. As Bahamón and Sanjinés (2010: 8) observe, "recycling is one of the most potent strategies available to us for reducing human impact on the environment". The level of innovation that is required to repurpose materials and change their meaning through new tectonic applications should be recognised and while the use of "informal" technologies may be ascribed to their inspirational value, or an opportunity for experimentation, architectural novelty and dissemination, or because of socio-environmental concerns, they are often, like many of the buildings in the very contexts that they are usually sited in, used because of financial constraints and out of necessity. Through their use, these "informal" tectonics become didactic tools, not only for architects, educators and architectural students from South Africa or abroad, but also for the local communities who they aim to serve. The work of the collaboration between the RWTH Aachen, PBSA Düsseldorf, and Georgia Tech, which goes by the name of "Design.Develop.Build.", and the work of Collectif Saga, both with their respective collaborators, will be analysed in more detail to compare the collagist combination of global and local tectonics, with an emphasis on "informal" tectonics.

Practice philosophies and positionality

Bernadette Heiermann of the RWTH Aachen recognises the fact that all contexts are different and she notes that the approach of Design.Develop.Build. is partly rooted in place, but she acknowledges that the personal interests[61] that their members take with them also play a part in their tectonic strategies (2019: np.). She acknowledges the influences of Francis Kéré, Rural Studio, and practices[62] who work with adobe construction on her own work (2019: np.), but her motivation for working in Africa was purely incidental: She was asked by a politician from the Austrian Green Party to assist with a project which "was very much influenced by Rural Studio" (Heiermann, 2019: np.). The project aimed to identify European Universities that could assist with the design and construction of educational spaces in South Africa in order for students from the global North to gain an understanding of the global South. The hope was that the practical learning gained in a design-build experience, and the realisation of the need for social contribution could inform their future careers. She admits that she has become very critical of this notion of "architecture that helps… that might put the wrong ideas into the heads of the students". In relation to this initial project[63], she saw it as problematic that students were given the sense that they are able and entitled to make a contribution in other societies, and she saw this as being reminiscent of a colonial way of thinking[64]. Rural Studio was sometimes criticised for working "on the assumption that, since middle-class white students minister to poor Blacks, the program must be paternalistic" or that it is about charity by liberal White people (Dean and Hursley, 2002: 12; Chua, 2002: 171), but Samuel Mockbee counters this by saying that there is a benefit to, and contribution from, both the educational institution and the communities where the projects are built.

Heiermann acknowledges that the type of work that Design.Develop.Build. is doing in the global South would not be possible in Europe due to its generally more legislated environment, but that it does place much more responsibility on the teaching staff. Similarly, Simon Galland of Collectif Saga notes how municipalities in South Africa often turn a blind eye to projects in the so-called townships, which can be problematic in terms of safety and legislation[65]. Heiermann says that the idea of doing things in Africa that one cannot or will not do in the global North is also colonial, but as an educational model she is convinced by the opportunities that design-build offers; she wanted to find better ways of doing it after their first project and she made the key decision of coming back to South Africa often after completing it. This allowed Design.Develop.Build. to develop their praxis and to build relationships with local contributors and communities. One of their most important local relationships is with Carin Smuts of CS Studio Architects, which was established in South Africa in 1989. This practice is known for its socio-environmental approach, which was inspired by the writings of the Kenyan author Ngũgĩ wa Thiong'o[66] as explained by Smuts[67]. In terms of architectural inspirations, Smuts adds the Gehry Residence by Gehry Partners in Santa Monica, California (1978), and the Villa dall'Ava by OMA in Paris (1991) which she was able to visit; she specifically highlights the point that both of these projects are made up of vastly different elements and, in the case of Gehry's house, portions that were constructed at different times, but that in both cases they form a coherent whole (Smuts, 2020: np.). Similar to a number of her own projects, these two buildings can also be regarded as collages.

As mentioned previously, the partners in Design.Develop.Build. are all from the global North, with RWTH Aachen and the PBSA Düsseldorf being based in Germany, and Georgia Tech being based in the USA. However, the

RWTH Aachen, under the guise of Design.Develop.Build., has been active in South Africa for approximately fifteen years: They completed the Montic Factory Preschool in 2006, the Ithuba Skills College Hall in 2008, and as catalogued in Appendix A as part of this study, they completed a number of projects in South Africa since 2010, sometimes with various collaborators: RWTH Aachen, as Design.Develop.Build., completed the Oppie Koppie Creche in Prince Alfred Hamlet in 2010, and they completed the Ithuba Science Lab at the Ithuba Community College in Magagula Heights, Johannesburg, in 2012. Design.Develop.Build., this time made up of the RWTH Aachen, PBSA Düsseldorf and Georgia Tech, completed the Guga S'Thebe[68] Theatre in collaboration with CS Studio Architects in Langa, Cape Town, in 2016, and in 2019 Design.Develop.Build., consisting of the RWTH Aachen and PBSA Düsseldorf, completed the Macassar Community Venue (also known as "Bong's Place) in Macassar, Cape Town, in collaboration with the University of Cape Town, the Cape Peninsula University of Technology, and Studio Light.

Collectif Saga on the other hand, is a small emergent architectural practice which was established in 2014 in Nantes, France, by Pierre Y. Guérin, Camille Sablé, Anastasia Rohaut, Simon Galland and Sylvain Guitard[69]. Galland spent a semester in Port Elizabeth, South Africa, during his first year of postgraduate architectural studies at Nelson Mandela Metropolitan University where he was inspired by Kenyan-born South Africa architect Kevin Kimwelle who also uses reused and repurposed materials in his buildings. Collectif Saga mentions Smuts of CS Studio Architects as one of their key architectural influences, along with Christophe Hutin, Lucien and Simone Kroll, and Elemental (Saga, 2015: 5), while Galland[70] specifically highlights Carin Smuts and Francis Kéré. Galland completed his studies in France[71] before returning to South Africa in 2015 to work on the temporary Silindokuhle Community Hall in Joe Slovo West, Port Elizabeth, with Kimwelle and his social enterprise Indalo[72]. Galland remained there for five years[73] in order to keep Collectif Saga embedded in Port Elizabeth and to maintain the relationships with local community members, companies and organisations[74] that he had built up over the years. This is in line with the practice's philosophy which aims to "avoid the cliché of 'coming, giving, leaving' of social projects, and place it in a long term process" (Saga, 2015: 5). Their approach is to involve as many people as possible, especially local community members, since they believe that it fosters a sense of shared ownership. They regard their work as a co-operative act and see their approach as "a good way to avoid the common errors of a humanitarian mission (lack of engagement after the team leaves, no sense of ownership, lack of understanding between the community and the team)" (Saga, 2017: 7; 2015: 31).

The tectonic landscape

As is evident in Appendix A, a number of contemporary works[75] in Africa make use of "informal" tectonics, but there is a high concentration of works using this approach in South Africa. South Africa's tectonic landscape is vast[76], and its structural inequality manifests itself both spatially and tectonically. Many local architects practice using mainly global tectonics, while some have been experimenting with the purposeful combination of these with local tectonics, and fewer still have been incorporating "informal" tectonics into their work[77]. For various reasons, the use of "informal" local tectonics and other local tectonic strategies feature strongly in the work carried out by educational institutions and architects from the global North who are practicing in South Africa, particularly in the execution of design-build projects.

Globally, one of the longest-running design-build programs that has consistently been engaging with "informal" tectonics in combination with other local and global tectonic strategies, is Auburn University's Rural Studio in the USA. It works in what can be regarded as pockets of the global South[78] within the global North, and it has been operational since 1993. It was founded by Samuel Mockbee and D.K. Ruth during a time when "American architecture had retreated from social and civic engagement to a preoccupation with style" (Dean and Hursley, 2002: 1) and sadly, this is still the case in many parts of the world today. One of Mockbee's convictions were that "the architectural profession has an ethical responsibility to help improve the living conditions for the poor", and that it should "challenge the status quo into making responsible environmental and social changes" (Mockbee cited in Dean and Hursley, 2002: 1). He believed that architectural education should embrace the making of real buildings and that it is morally obliged to provide opportunities for the contribution to wider society. Mockbee refers to Rural Studio as a collage of different ideas and experiences where architecture, education, social contribution, and environmental considerations are brought together (Dean and Hursley, 2002: 4 and 71). This collaging of experiences manifests itself in the built form of Rural Studio's projects, and in a similar way, the projects by Design.Develop.Build. and its collaborators are a pedagogical collage where many different actors contribute at different stages over a period of time[79]. This collaging of process is also evident in their projects, which can be regarded as assemblages of global and local tectonics. Collectif Saga's projects are even more collagist in terms of their tectonic resolution, and they usually have

extensive material palettes that are entirely dependent on intermittent sponsorship and the availability of found materials and objects.

A found object can be natural or man-made, it can be a complete object or a fragment, it can be bought or obtained freely, and it usually holds some aesthetic significance, meaning, or potential for an artist or architect. Pablo Picasso is widely credited for being the first artist to use found objects in his art in a public setting[80], and this practice was developed and popularised further through the work of Marcel Duchamp with his so-called "ready-mades"[81]. Mbembe (2015: 53) writes that "Duchamp signed the death of the work of art in the classical sense of the term", but his work was defended in a journal called *The Blind Man*[82] in 1917 where the points were made that the very choosing of an object is already a creative act, that it is legitimised as a piece of art by removing its initial usefulness as an everyday object, and that by giving it a new identity, its meaning is changed (Louw, 2019: 44). Mbembe goes on to say that the "discovery" of African art in the global North during the early 1900s served as a reminder that image and form could be reconciled in the object[83], and through breaking from primitivism and neo-primitivism he writes that art is "a forming that consists in constantly doing, undoing, and redoing; assembling, dis-assembling and re-assembling – this idea is typically 'African'. It fully resonates with *the digital spirit of our times*" (2015: 54). The artistic practice of using found objects in Africa is well-established, with internationally recognised artists like El Anatsui, William Kentridge and Willie Bester who make regular use of found objects. Their work is rich with symbolic meaning, and because of the ways in which they change a found object's meaning, they manage to shift the perspective of the viewer in how he or she sees it.

The potential for embodied meaning in reused, repurposed and recycled materials is important, and Botz-Bornstein observes that "elements of waste can present powerful citations about life" (2010: 17). As James (2008: 37) writes in relation to the Nigerian-based Ghanaian artist El Anatsui's work, the found object is "not related to the Duchampian tradition; instead, Anatsui focuses on the object's connection to the human hand. Like the invisible remnants of DNA, he says, all objects – used and abandoned – carry the deposits of the object's user." Baerlecken, Reitz, Müller and Heiermann (2014: 247) write how Anatsui transforms an object's status from a waste material to a noble material, while inscribing it with symbolic content. Materials, especially reused, repurposed and recycled materials and found objects, can be imbued with new meaning, and as Noble (2011: 94) points out[84], "…the modern *sangoma*[85] will often adopt modern objects, such as bottle tops and feather

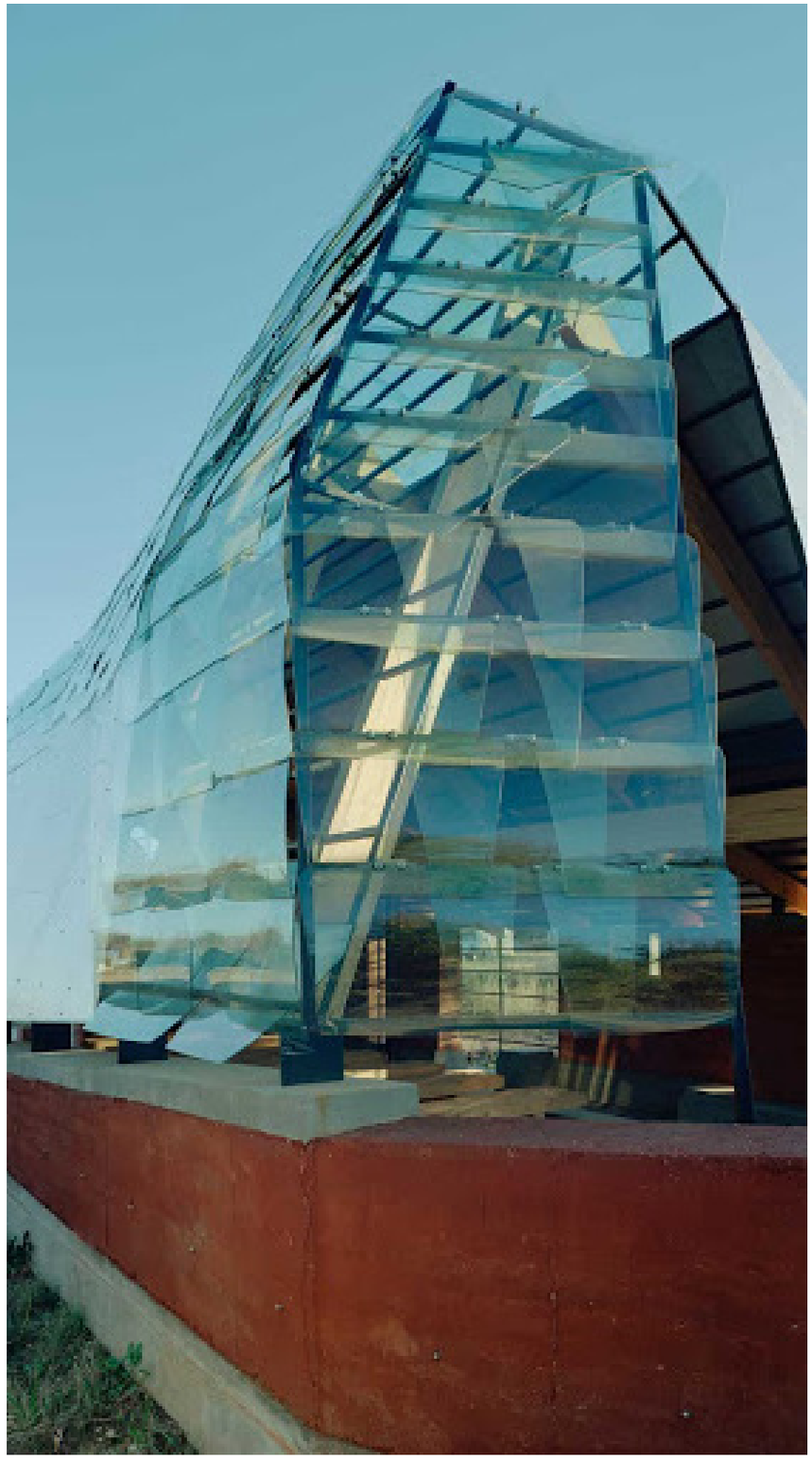


Figure 39:
A range of tectonic strategies are employed at the Mason's Bend Community Centre (also known as the Glass Chapel): "Informal" local tectonics in the form of repurposed car windscreens are combined with other local tectonics in the form of rammed earth, and global tectonics in the form of concrete, steel, aluminium, and laminated timber (although it is made from locally harvested cypress). Mason's Bend, Alabama, USA, 2000, Rural Studio. Source: Timothy Hursley, Rural Studio. [Online] Available: http://ruralstudio.org/project/glass-chapel/ (Accessed 16 September 2020).

dusters, ritualise them and use them in conjunction with traditional emblems. The *sangoma* creates a hybrid mix of modern and traditional elements". This is echoed by Baerlecken *et al* when they describe Anatsui's work as a "historical dialogue, tying present-day waste to the production of traditional cultural artefacts" (2014: 247).

Bester's work in particular is highly charged with political commentary, but it is also rooted in ethicism where environmental concerns, socio-political commentary and aesthetics meet. His artistic collages and assemblages were brought into the realm of architecture with his own house which was initially completed[86] by CS Studio Architects in collaboration with the artist in 1996. This collaboration was extended with the design and construction of the Dawid Klaaste Multi-Purpose Centre in Laingsburg in 2005 where repurposed materials and found objects (including a railway carriage) were incorporated into the design (Frey, 2016: 118). Frey, in relation to the work of CS Studio Architects, writes how the reuse of building elements can induce "memorial evocation" and that this is a big advantage for their projects (2016: 49).

> *"In Africa, however, building is imagined as a prayer to the ancestors, and this respectful attitude is linked to a cyclical use of materials. Buildings are constructed from the immediate material that surrounds the site, and the ensuing natural cycle of building and decay from soft natural materials metaphorically translates a cyclical conception of architecture and nature: the purposes of this life and respect for the elders who observe from the other, the living and the dead."* (Noble, 2011: 40)

Writing about the concept of circularity, Livesey observes that: "Technically difficult, under supported by established interests and out of step with our culture of the new, the circular economy has not yet taken off in the way its proponents had hoped" (2017: 106). This is written from a Northern perspective, and while there are highly developed technocratic implementations of circularity in the North, there is an everyday practice of circularity in the South, which is partially based on the cultural considerations as mentioned by Noble, but also on resource scarcity and need. This is confirmed by Bahamón and Sanjinés (2010: 7) who write that the recycling of building material was common practice in the global North until the nineteenth century, but that today it is mainly prevalent in the global South. According to Louw, "The current abundance of the flotsam and jetsam of capitalist mass-production, es-

Figure 40 (above):
Tête de taureau *(Bull's Head), 1942, Pablo Picasso. Source: Author, 2019, Musée National Picasso-Paris, France.*

Figure 41 (left):
Repurposed liquor caps were used for El Anatsui's installation piece Dissolving continents *in 2017. Aluminium and copper, 9000x3600mm. Source: Author, Zeitz MOCAA, Cape Town, South Africa, 2019.*

pecially in the global South, presents both an opportunity and a responsibility. While reclaimable or recyclable materials are also a finite resource, the prevalence of consumerism and a culture of wastefulness means that these types of materials will be readily available (and affordable) for the foreseeable future" (2019: 50). Waste, being a finite resource, is dependent on the prevalence and ubiquity of discarded products based on current and past manufacturing processes which is echoed by Sennett when he cites Benjamin Disraeli[87] as describing "waste as the negligence of privilege" (2008: 110) and Frey, who adds that resources' "equitable distribution requires governance" (2016: 53). Eglash and Foster (2017: 132) write about "generative waste"[88], where generative justice is used to employ waste for social and environmental benefit, but one of the key considerations for the use of reused, repurposed and recycled content, besides its environmental advantages, is cost. Livesey (2017: 114) writes about the cost savings that the use of recycled content can generate in formal manufacturing, but this is even more applicable in terms of "informal" practice. In this context recycling can, however, lead to its own encounters and Frey (2016: 52) writes that conflicts often arise in the field of collection and recycling of materials between small-scale operators or solidarity groups, and industry. These encounters are confirmed by Smuts[89] and they can take place during the collection of material, during construction and during maintenance, particularly of local tectonics.

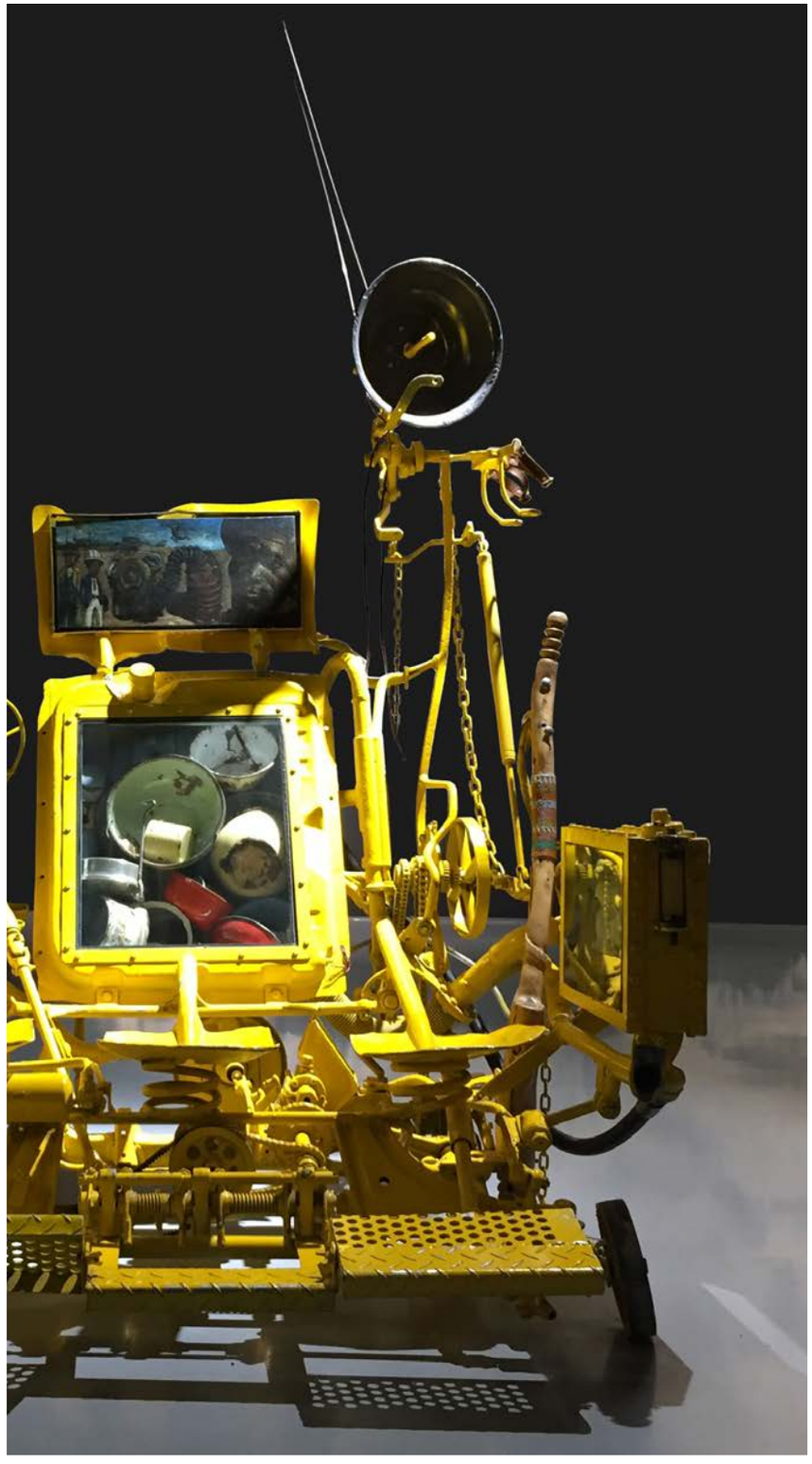


Figure 42 (opposite):
House Bester, Kuilsriver, Cape Town, South Africa, CS Studio Architects with Willie Bester, 1996. Source: Author.

Figure 43 (left):
Poverty driven, *Willie Bester, 2002, metal and found objects, 166 x 255 x 142cm. Source: Author, Zeitz MOCAA, Cape Town, South Africa, 2019.*

Weathering is often a concern when working with materials that have outlived their initial useful life, and the extent to which long-term weathering or maintenance is concerned is an ethical consideration. The ephemeral snapshot in time or "shadow form"[90] of a completed project often conceals the realities of rapid deterioration, climatic or social inappropriateness, and ongoing maintenance requirements with their associated economic and temporal implications. Practical difficulties like these are often exacerbated by the use of experimental technologies, unqualified labour and the view of Africa as a less-stringently regulated laboratory[91] for experimentation. Bahamón and Sanjinés (2010: 8) question the safety of using reused, repurposed and recycled materials, both in terms of the products themselves and in terms of the processes or practices employed for their extraction and reuse. Experimental practices, which are often localised reinterpretations of traditional craft practices or the experimental use of locally available materials, are what Pye (2010: 341) refers to as the "workmanship of risk" where the quality of a technology is not predetermined. This is opposed to the workmanship of certainty where the resultant quality can be determined beforehand, and which is usually associated with mechanised production or global tectonics[92]. Frampton regards durability as something that has a physical and a cultural dimension, and that architects have an ethical responsibility towards the ecology not to design buildings that are not durable (Crittenden and Henningsson, 1998: 78). He does, however, also argue that there is a difference between the type of durability that allows for weathering, and durability that is generated through regular maintenance, as is the case with vernacular Japanese architecture.

One can question whether buildings should be "maintenance free" and durable in a static sense or whether they should be durable in a fluid sense where maintenance is factored in as a social practice to retain skills and foster a sense of community. Louw (2017) explores the similarities between the vernacular Japanese practices and contemporary practices in South Africa, but countless pre-colonial African buildings like the Great Mosque in Djenne, the traditional *!haru oms* or *matjieshuise*[93] in South Africa's Richtersveld, and the Basotho practice of *litema*[94] demonstrate the long tradition of maintenance as a social practice in Africa. This practice can also allow for a measure of local autonomy and continuous reinvention and self-expression. Frampton goes on to say that "The question of maintenance is an ethical issue", and the requirement for regular maintenance can be a positive aspect if it creates employment, extends a building's lifespan, and keeps skills or craft traditions alive. As Adamson (2010: 263) observes, "the commonplace crafts of repair and maintenance have received comparatively slight attention" and one could

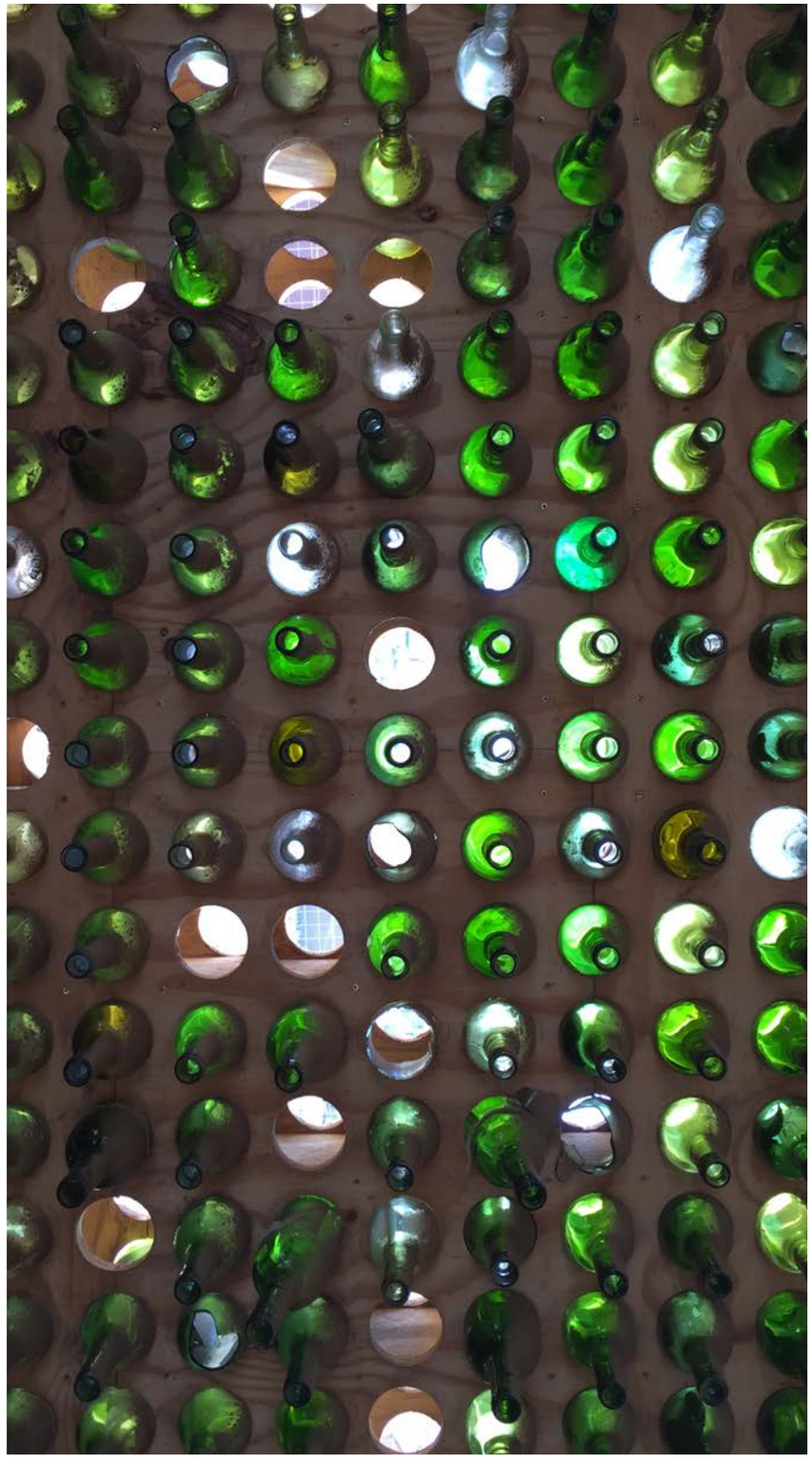


Figure 44:
The damage to the repurposed glass bottles in the wall of the Silindokuhle Community Hall. Source: Author, 2019.

argue that there is craft in maintenance, which is related to the practice of "informal" tectonics.

These concepts inform the material choices and prototypes[95] developed by Collectif Saga, and they note how, at the Silindokuhle Preschool, "The main rule was to always opt for easily replicable techniques… [which] ensures that they can easily maintain the facility once the construction is finished" (Saga, 2017: 17). The work of Collectif Saga is informed by that of CS Studio Architects (Saga, 2015: 5[96]), who in turn worked in close collaboration with Design.Develop.Build. on the Guga S'Thebe Theatre in Langa, Cape Town. Despite their own employment of reused, repurposed, and recycled materials, CS Studio Architects is of the view that there is not a strong maintenance culture in South Africa anymore and Smuts notes how her practice usually designs in such a way as to limit the need for maintenance. Hence, they mostly make use of fired clay bricks, aluminium doors and windows, and precoated metal roof sheeting, and they aim to limit the number of moving parts in their buildings[97].

Design.Develop.Build., Collectif Saga and the Universität Stuttgart in particular regularly employ reused, repurposed and recycled content or "informal" tectonics in their work, along with other local tectonics and global tectonics. South Africa has a well-established industrialised construction industry, but it also has a rich heritage in terms of vernacular pre-colonial and colonial architecture, which is further informed by an emergent "informal" vernacular. These different modes of production are often used together based on their respective advantages and disadvantages. A selection of works by Design.Develop.Build., Collectif Saga and the Universität Stuttgart with their respective collaborators as extracted from Appendix A reveal a number of similar tectonic approaches and elements.

In terms of global tectonics, cement, concrete, and mass-produced fired bricks are used in almost all of the cases because of their abundance, availability, efficiency, durability and general affordability (Koch and Bäcker, 2012: 43), but Reitz *et al* (Undated: 2) and Baerlecken, Reitz and Duncan (2012: 6) note that the use of new steel and structural timber at the Montic Factory Preschool, Ithuba Science Lab and Oppie Koppie Creche, while needed to generate longer spans, led to an increase in costs. Another reason for using global tectonics is because South Africa's construction industry is highly regulated and standardised, which means that engineering codes, national building regulations, municipal by-laws and insurance requirements among

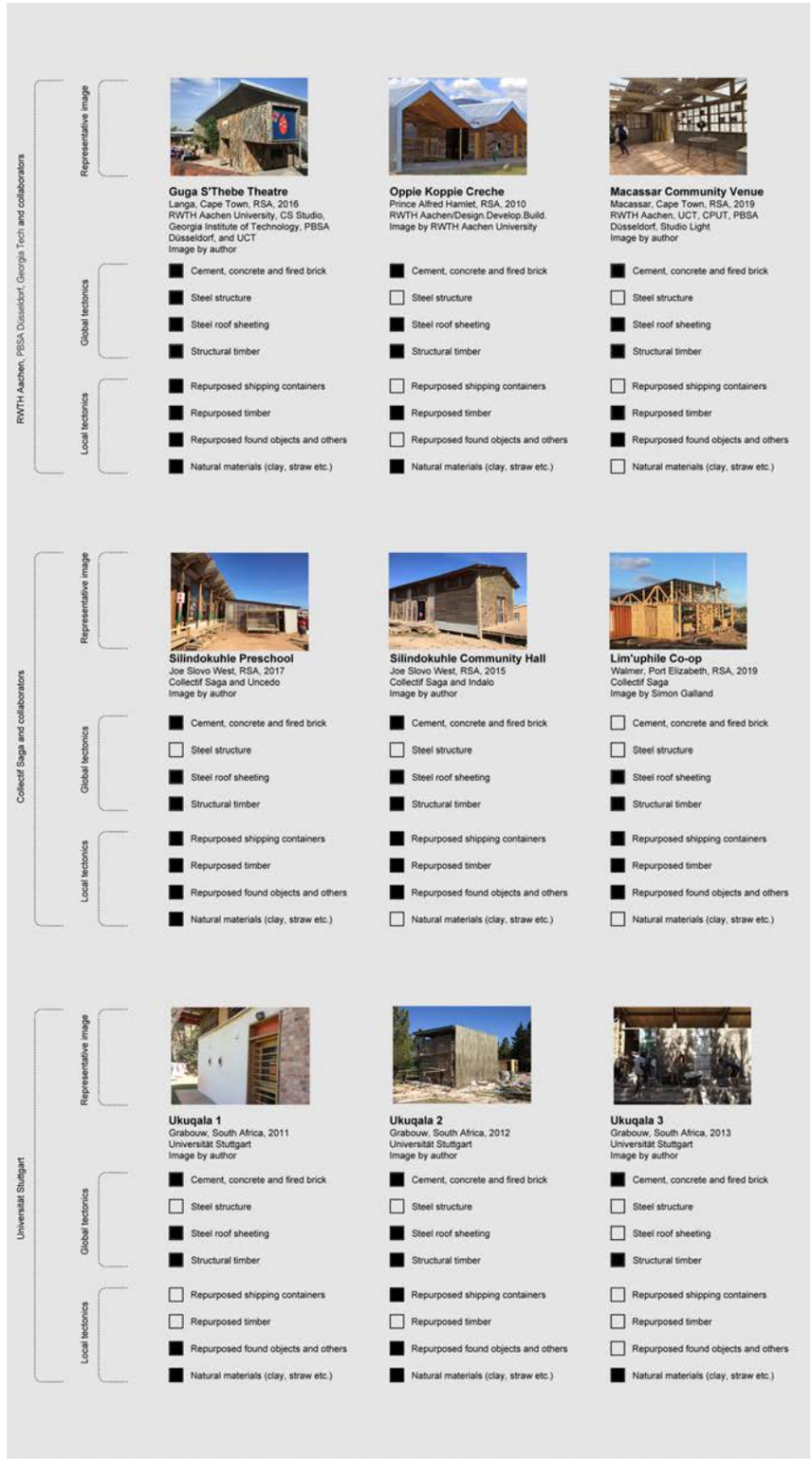


Figure 45:
A selection of works from the South Africa tectonic constellation showing common tectonic strategies across buildings. Source: Author, with images by author and others as cited.

others play a significant role in the specification of tectonic strategies. Structural steel is used in some instances, but steel roof sheeting, similar to many other places in the global South, is ubiquitous, readily available, and used in almost all instances. Its use in most of the selected works is informed by its weight and relative ease to work with, especially by student volunteers and amateur builders. It also has structural potential beyond its normal application as is evident in the Silindokuhle Preschool, and it allows buildings which are often larger than the structures that surround them to blend into their surroundings to some extent. Structural timber is also used in most instances, for its structural efficiency, availability, cost, ease of construction, and its environmental advantages[98]. Sometimes, however, global tectonics are used to achieve pre-meditated forms that can be based on contributors' own interests, like the folded roof at the Oppie Koppie Creche which was linked to a civil engineering student's PhD thesis.

The selected projects all incorporate local tectonics, which include the employment of reused, repurposed and recycled materials and found objects in the form of "informal" tectonics: Discarded mass-produced materials and elements like shipping containers, timber elements like pallets and crates, and numerous other found objects and materials are given new life, thereby extending their life cycle and reducing the overall embodied energy of these buildings. A big advantage of reused, repurposed, and recycled materials and found objects is usually that they can be obtained cheaply or free of charge (Koch and Bäcker, 2012: 56; Saga, 2017: 17, Collectif Saga, 2017: 60[99]). This is confirmed in the construction of Collectif Saga and Indalo's Community Hall in Joe Slovo West (completed in 2015), which they note was built for the same amount that an RDP[100] house of 32-36m² is usually built for, but that they managed to achieve a coverage of 138m² by using repurposed materials and efficient building techniques (Indalo and Collectif Saga, 2015: 18; Saga, 2015: 13). Reitz *et al* (Undated: 2) note that material properties like availability, strength, durability, insulation values, toxicity from cradle to grave, and ease of construction should also be considered; Collectif Saga similarly considers the strength and durability of reused, repurposed, and recycled materials, especially during their prototyping stages where these qualities are tested (Saga, 2017: 17). Smuts[101] however, despite her own regular use of reused and repurposed materials and elements, warns that repurposed materials can sometimes be more expensive than new ones (she refers to her own previous experience with the use of repurposed doors).

For Design.Develop.Build., the practice of using repurposed material

started with the Oppie Koppie Creche where they noticed wooden fruit crates being transported on trucks, which led them to discover discarded ones that they could repurpose, along with unsellable unfired bricks that they obtained locally free of charge[102]. The "informal" tectonics are used in conjunction with other local tectonic strategies, and similar to the harvesting of discarded materials, these often include the harvesting of locally available natural resources. Materials like local timber, straw, clay, and stone are typically processed by hand on site, and together with the global tectonics and "informal" local tectonics, they result in collages that are pedagogical by nature during construction, but also after completion. At the Oppie Koppie Creche, for example, the repurposed fruit crates were combined with adobe mud brick (Heiermann's personal interest) and lime plaster. The reasons for choosing local tectonics are generally based on climate, cost, and social and environmental sustainability; local materials and skills reduce the need for transport, lower a project's carbon footprint, support the local economy, and promote local participation (Koch and Bäcker, 2012: 35[103]).

Two of the selected works, the Guga S'Thebe Theatre in Langa, Cape Town, by Design.Develop.Build. and CS Studio Architects, and the Silindokuhle Preschool in Joe Slovo West, Port Elizabeth by Collectif Saga and Uncedo, both completed in 2016[104], will be analysed in more detail in the following section.

Encounters in the works

Frampton writes that Hartoonian "sees the act of montage as the one mediatory agent whereby tradition may be reinterpreted and hence recollected in face of the operational inroads and transformations wrought by technology" (1994: xiv). This is similar to Eglash and Foster's view when writing about African makerspaces which "align themselves under the general ethos of bricolage, skill sharing, and creative collaboration among those with many different interests, they are also locally and culturally situated" (2017: 128), and the works explored here both evidence the practice of montage or collage.

The Guga S'Thebe Theatre in Langa, Cape Town, was a collaboration between Design.Develop.Build. (consisting of the RWTH Aachen, PBSA Düsseldorf, and Georgia Tech in this instance) and CS Studio Architects. It is located immediately south of the Guga S'Thebe Arts, Culture, and Heritage Village which was designed by CS Studio Architects and completed in 1999; the Theatre was developed as part of *World Design Capital Cape Town 2014*,

and it was funded through the efforts of Kristina Bacht and the German architecture magazine *AIT*. According to Frey (2016: 94), the project offered an opportunity of exchange between different contributors where CS Studio Architects "was limited to the formulation of the master plan and the general principle; subsequent decisions and implementation of details were the responsibility of the visiting architecture professors. The general impression is that the atmosphere of a 'good-will mission' is tangible", but Smuts adds that their role included the initial liaison with the local community and the arduous process of obtaining the necessary approvals form the local authorities (2020: np.).

AIT initiated the process in 2008/2009[105] with the intention to fund the design and building of an orphanage in Cape Town[106], but according to Heiermann[107], the City of Cape Town insisted that they should rather build a two-hundred seat theatre, which she felt was quite a daunting prospect for a University project. This did, however inform the choice of tectonic systems: Since design-build projects are dependent on curricula and semester timetables, construction is by nature intermittent and Design.Develop.Build had to consider how to make the theatre useable after only the first phase of construction. This was partly due to the security concerns of leaving an incomplete structure behind for an extended period, but also to provide a much-needed

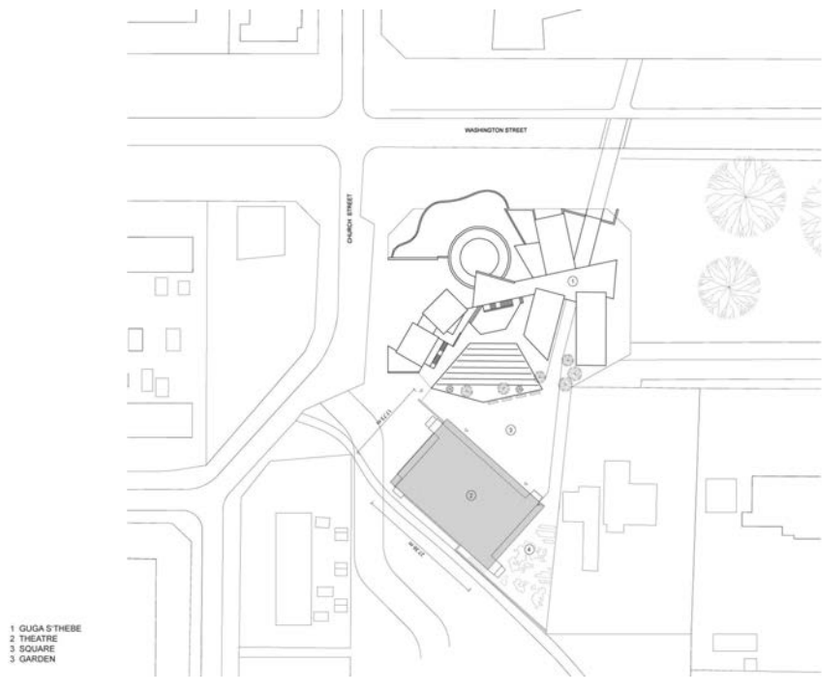


Figure 46 (opposite):
The Guga S'Thebe Theatre's location with CS Studio Architects' Guga S'Thebe Arts, Culture, and Heritage Village to the North. Source: Design.Develop.Build.

Figure 47 (left):
The Guga S'Thebe Theatre, Langa, Cape Town, 2016, Design.Develop.Build with CS Studio Architects. Source: Author, 2019.

Guga s'Thebe Theatre

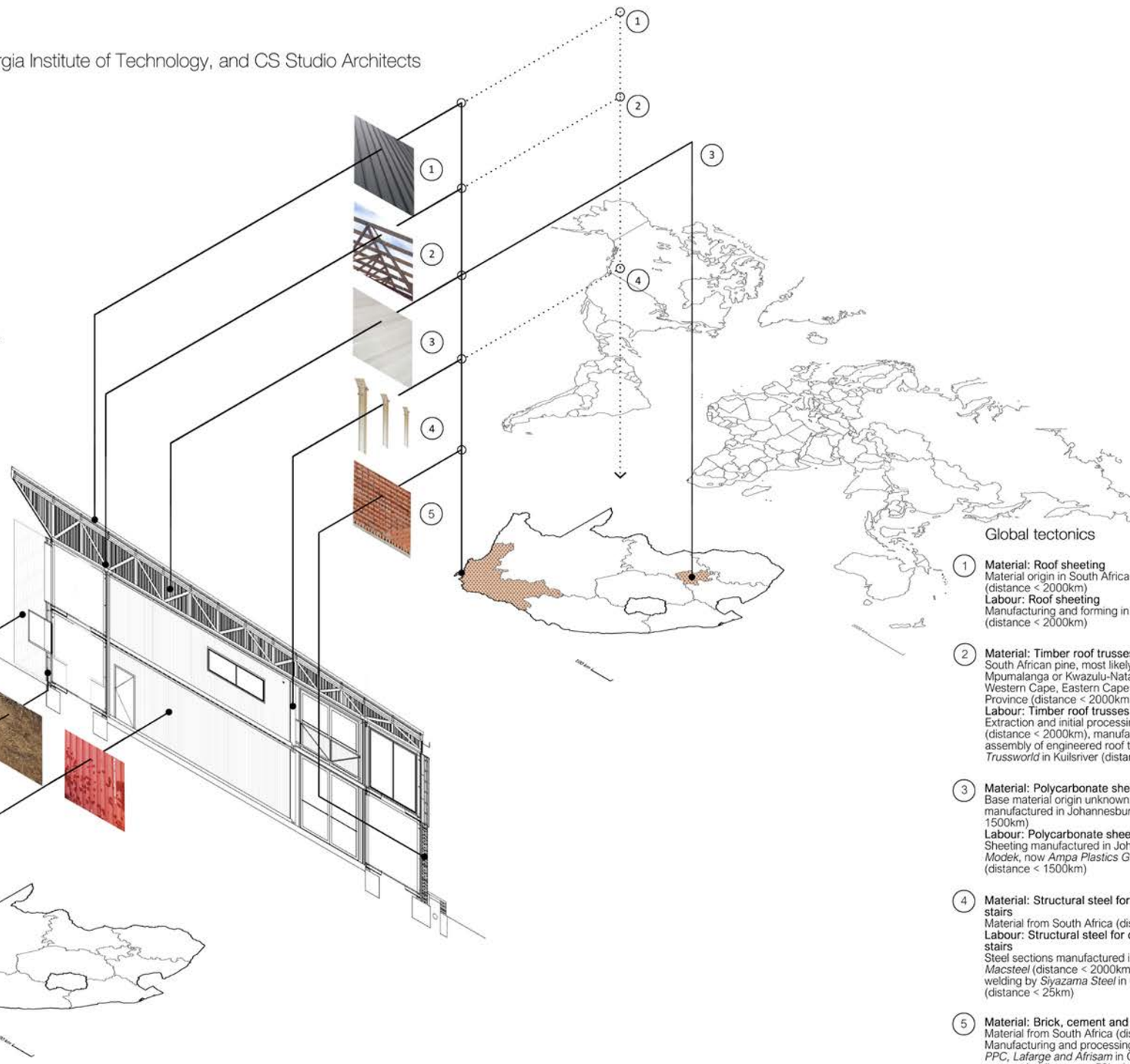
Langa, Cape Town, South Africa, 2016
33°56'40"S, 18°31'27"E

RWTH Aachen University, PBSA Düsseldorf, Georgia Institute of Technology, and CS Studio Architects

The Guga s"Thebe Theatre is a didactic collage of global and local tectonics, both in terms of process and product: Structural steel, steel roof sheeting, polycarbonate sheeting, engineered timber trusses, fired bricks, cement and concrete are used in combination with repurposed shipping containers, repurposed fruit crates, clay, straw.

The global tectonics are used mainly in a supportive role and together with the shipping containers, they are mostly concealed from the outside. The "informal" tectonics, particularly the facade made up of repurposed fruit crates and the underlying form of the repurposed shipping containers, are visualy dominant. While the containers were bought and not obtained as discarded waste, they are still regarded as a local material since they reached the end of their shipping life cycle in Cape Town.

*The QR code above can be used to access the website database that was established as part of this study, and it willl provide a link to this project's base information.



Local tectonics

6 **Material: Timber cladding**
Repurposed fruit crates from Ceres/Wolseley via *VV4 Agri* (distance < 150km)
Labour: Timber cladding
Cut and processed on site (distance = 0km).

7 **Material: Light clay insulation panels**
Clay and straw from Cape Town surrounds (distance < 50km) and recycled pallets from Epping (distance < 5km)
Labour: Light clay insulation panels
Made on site (distance = 0km)

8 **Material: Repurposed shipping containers**
Containers obtained from Cape Town harbour via *Containers 4U* and *Bigbox* (distance < 25km) *While the containers were bought and not not obtained as discarded waste, they are still regarded as a local material since they reached the end of their shipping life cycle in Cape Town
Labour: Repurposed shipping containers
Cutting and structural adjustment done in Cape Town (distance < 25km)

Global tectonics

1 **Material: Roof sheeting**
Material origin in South Africa (distance < 2000km)
Labour: Roof sheeting
Manufacturing and forming in South Africa (distance < 2000km)

2 **Material: Timber roof trusses**
South African pine, most likely from Mpumalanga or Kwazulu-Natal, followed by the Western Cape, Eastern Cape and Limpopo Province (distance < 2000km)
Labour: Timber roof trusses
Extraction and initial processing in South Africa (distance < 2000km), manufacturing and assembly of engineered roof trusses by *Trussworld* in Kuilsriver (distance < 25km)

3 **Material: Polycarbonate sheeting**
Base material origin unknown, sheeting manufactured in Johannesburg (distance < 1500km)
Labour: Polycarbonate sheeting
Sheeting manufactured in Johannesburg by *Modek*, now *Ampa Plastics Group (Pty) Ltd.* (distance < 1500km)

4 **Material: Structural steel for columns and stairs**
Material from South Africa (distance < 2000km)
Labour: Structural steel for columns and stairs
Steel sections manufactured in South Africa by *Macsteel* (distance < 2000km). Cutting and welding by *Siyazama Steel* in Cape Town (distance < 25km)

5 **Material: Brick, cement and concrete**
Material from South Africa (distance < 2000km). Manufacturing and processing by *Corobrick, PPC, Lafarge and Afrisam* in Cape Town and surrounds (distance < 50km)
Labour: Brick, cement and concrete
Manufacturing and processing in Cape Town and surrounds (distance = 50km)

amenity sooner rather than later, even if it would only be partially completed initially.

To provide a useable space after two to three months meant that they had to opt for a construction system that could be assembled quickly which, despite some initial reservations, led them to use shipping containers "like big bricks"[108]. Baerlecken *et al* (2014: 246) see the building as "an architecture of rematerialisation through reuse and recycling" and as part of the local tectonic strategy in the building, the shipping containers were used in conjunction with a number of other reused and repurposed materials and elements, which is a practice that Design.Develop.Build.'s collaborators on the project, CS Studio Architects, also has extensive experience in (Frey, 2016: 49). According to Heiermann, using the shipping containers was primarily a pragmatic decision which was also informed by the proximity of Cape Town Harbour, where they felt it would be easy to source containers which have reached the end of their shipping life. The containers were eventually sourced via *Containers 4U* and *Bigbox* from Cape Town Harbour[109], which is less than twenty-five kilometres from the site. Smuts[110] acknowledges the extensive research that the Northern contributors did in relation to the use of shipping containers which is reflected in a number of articles where Reitz *el al* (Undated: 6) and Baerlecken *et al* (2012: 7; 2014: 250) list the advantages of their standard modular size, strength, and relatively low costs per square metre and per cubic metre[111], although they acknowledge that the need for openings between containers and to the outside, insulation requirements, and potential toxicity in their coatings are problematic. The aim was to use the containers as a bearing structure only, so they could become "invisible" and not be emblematic of container architecture or informality (Reitz *el al*, undated: 7). Instead, the containers could be used to build a structure which is very robust, and which could be filled in and cladded in due course, with the added advantage that the decision of what could be used for cladding would only need to be made later. Initial ideas that the containers would need to be insulated, and of using hydroform bricks or clay in some way, would inform these decisions in due course (Baerlecken *et al*, 2012: 7). While both options would allow for modular construction, speed, and cost efficiencies, the added insulation advantages of light clay would also offer an opportunity for Heiermann to explore her own interest of working with pre-fabricated adobe elements; these were already tested at the Ithuba Science Lab in a slightly different application using a lightweight rammed adobe structure, and in subsequent projects (Heiermann, 2019: np.).

Figure 48 (previous page):
A visual analysis of the origins of materials and labour that were used for the Guga S'Thebe Theatre. Source: Author.

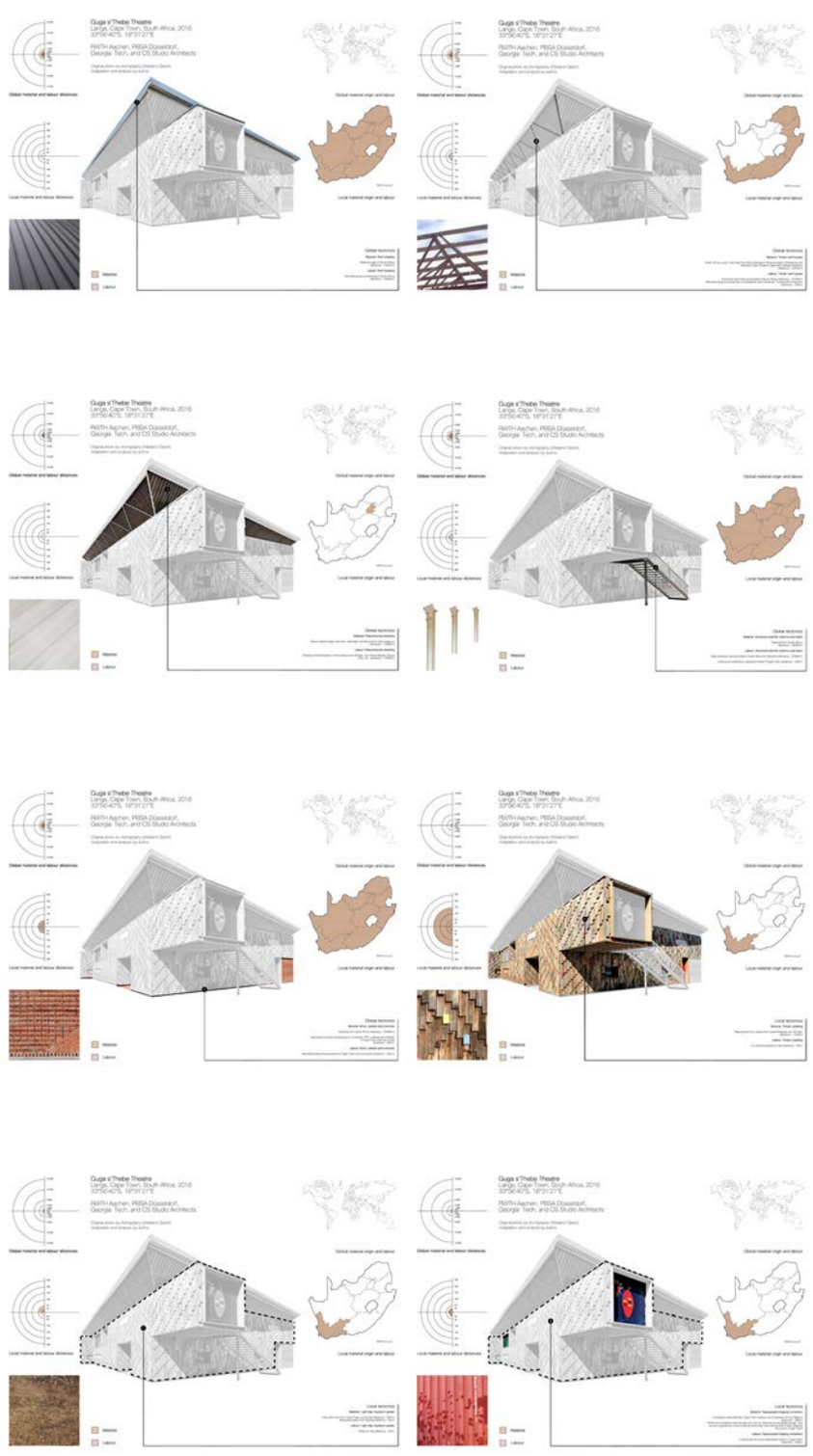


Figure 49:
A visual analysis of the origins of materials and labour that were used for the Guga S'Thebe Theatre. Larger scale versions of the images can be viewed in Appendix C. Source: Author.

The pre-fabricated adobe panels were invented and developed by Design.Develop.Build. in Cape Town in consultation with the Austrian clay engineer Elias Rubin[112]. Straw and clay that were obtained from within fifty kilometres were compressed into timber formwork made from repurposed wooden pallets from Epping (less than five kilometres away) and these were then fixed onto the containers using metal brackets. The combination of light clay and repurposed shipping containers may seem somewhat counter-intuitive, since the adjacencies of past and present, natural and artificial, or soft and hard materials as described by Noble (2014: 121) can be challenging. However, as Frey (2016: 47) mentions, industrially produced insulation materials often include high levels of volatile organic compounds (VOCs) and their use is exacerbated by continuously increasing thermal regulatory requirements that do not necessarily take other socio-environmental costs into account. Heiermann[113] says that working in Africa is somewhat easier than Europe in terms of thermal requirements, but that insulation, especially when using shipping containers, is an important consideration and an opportunity for experimentation and innovation. The light clay panels provide an effective insulation layer and the fact that they are applied externally (as opposed to internal insulation which is usually used with containers) helps to prevent moisture build-up between the container wall and the insulation itself, while thermal zoning is created by the external "wall" of containers that serve as a buffer zone for the theatre space itself (Baerlecken, 2014: 252).

Figure 50 (opposite):
The collage of prefabricated light clay elements being fitted onto the containers. Source: Author, 2013.

Figure 51 (left):
One of the prefabricated light clay elements made by students from the RWTH Aachen and the University of Cape Town being taken out of its repurposed timber formwork. Source: Author, 2013.

Various cladding options were considered, and Smuts[114] remembers how the material palette and pattern were only finalised when all the materials were on site. A prototyping workshop with the Cape-Town based artist Heath Nash led to the development of various options using plastic and rubber, but unfortunately these materials were not recycled and there were concerns about durability which led to them not being used. Instead, the team opted for repurposed fruit crates, similar to the ones that were used at the Oppie Koppie Creche in Prince Alfred Hamlet, which were sourced from *W4 Agri* in Ceres and Wolseley (less than one hundred and fifty kilometres from the site)[115]. Different methods, both analogue and digital, were used to test the façade patterns, which were inspired by traditional Congolese *Shoowa* textiles[116] (Baerlecken, Heierman and Reitz 2016: 56). The digital patterns were developed mainly by Daniel Baerlecken and students from Georgia Tech, who also designed the suspended acoustic panels in the interior made from wooden frames and stretched fabric.

A number of global tectonic strategies were used, mainly for the support of the roof structure, and they were able to be sourced from within South Africa. CS Studio Architects[117] believes that the one thing in every project that merits investment is the structure: They regularly make use of a steel portal frame structure with infill (which is reminiscent of the use of framed construction systems with infill as explored in the Rwandan works) which provides a strong, durable and robust structure that allows for flexibility and future adaptation. Smuts[118] is sceptical about allowing students or unskilled labour to build the primary structure for a building, and she believes that their work should be restricted to the infill and more cosmetic work. Hence, a steel framework made from material that was supplied by *Macsteel* and welded by *Siyazama Steel* in Cape Town was inserted as a primary structure to support the V-shaped timber trusses, which are made of South African pine, engineered by *Trussworld* in Kuilsriver (Design.Develop.Build., 2016: np). Baerlecken *et al* (2014: 250) write that the gang-nailed timber trusses are readily available and cost-effective, and that they provide an interesting architectural feature on the inside and outside. These support the metal roof sheeting that was produced in South Africa, and polycarbonate panels by *Ampa Plastics Group*[119] on the sides, which allow natural light into the central space of the building. Cement and concrete were sourced from *PPC*, *Lafarge* and *Afrisam*, while *Corobrick* in Cape Town supplied the bricks that were used for the patterned outside wall towards the rear of the building.

According to Heiermann[120], sustainability is the primary criteria for

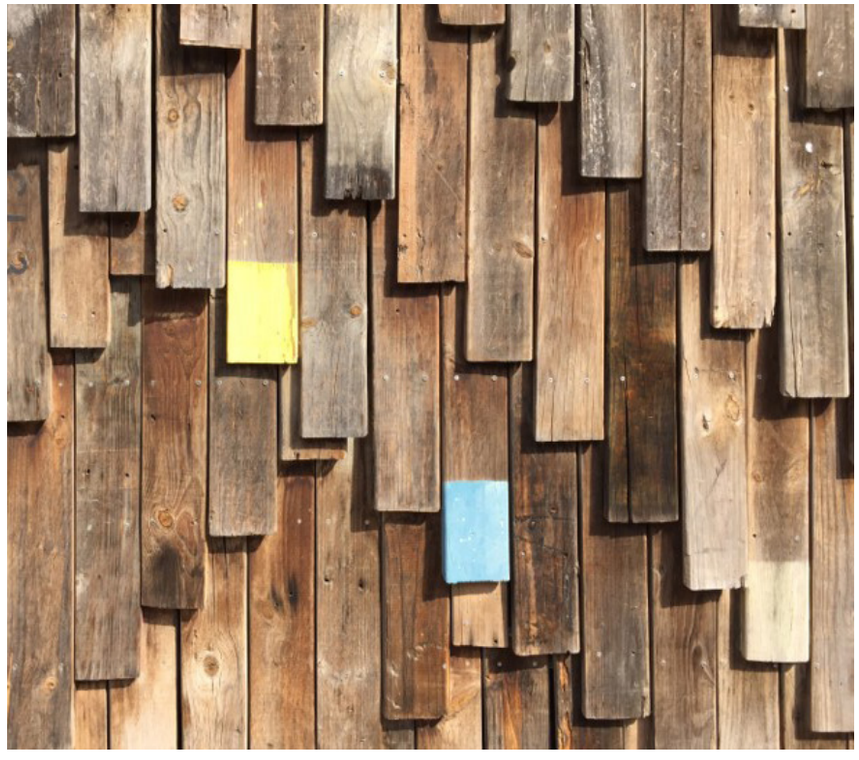


Figure 52 (above):
The initial options for the Guga S'Thebe Theatre's cladding were prototyped in Cape Town during a workshop with the artist Heath Nash. Source: Author, 2013.

Figure 53 (below):
The final cladding solution made up of repurposed fruit crates. Source: Author, 2019.

choosing materials, and the approach of Design.Develop.Build. is based on what can be found in a particular context. This can apply to both materials and skills, and they usually attempt to improve these existing materials and skills in what they do. In this case, all of the materials were locally available, but their origins are often further afield in South Africa. Frey writes that the combination of different tectonic strategies on the Guga S'Thebe Theatre "allowed generalisation, exchange and transfer in all technical directions through dealing with recovery of materials or entire building elements and the implementation of newly 'rediscovered', explored and systematically studied techniques" (2016: 94). This echoes Reitz *et al* (Undated: 7) who write that "Combining re-used or recycled waste materials with traditional earth construction methods could be a key element of neo-vernacular low cost construction methods". The desire to mix reused, repurposed, and recycled materials with natural materials and traditional techniques is also expressed by Galland[121], who wanted to use wattle and daub construction for the Silindokuhle Preschool's rear wall.

In terms of maintenance and robustness, Smuts[122] observes how well the Guga S'Thebe Theatre has weathered. This is despite its recent fire damage which, incidentally, mostly only impacted the global tectonics (the roof trusses, metal roof sheeting, and the light fittings), while the local tectonics are mostly unscathed; Smuts[123] notes how a recent inspection by herself and the engineers revealed that the shipping containers, cladding and insulation suffered no fire damage. She recalls how the well-known South African architect Roelof Uytenbogaardt once told her that one should pay attention to the spaces between buildings and that they are often more important than the buildings themselves[124]; when observing the spaces between the global tectonics in the visual collage analysis of the building, it becomes clear that the bulk of the building – which is composed of local tectonics – is the most important.

Local tectonics and especially "informal" local tectonics are a recognisable part of Collectif Saga's work. The Silindokuhle Preschool is a case in point, and the majority of the materials used in the building are either reused, repurposed, or recycled. The project was initiated by a local resident, Patricia Piyani, who is also the Principal and owner of the Preschool, along with the non-profit organisation Silindokuhle Preschool, to serve eighty to hundred and twenty children aged one to six years. It forms part of a series of interventions which include the Silindokuhle Community Hall (which served as a temporary preschool[125] while the main one was being built), and a substantial vegetable garden in front of the new preschool. Various techniques were tested at the Community Hall where one of the key objectives was to "try to develop simple

Figure 54:
A visual collage analysis of the Guga S'Thebe Theatre that tests the visual balance between global and local tectonics. The local tectonics are clearly dominant. Source: Author.

and reproducible processes, which would give the community the tools and knowledge to reproduce these processes for their own development" (Saga, 2015: 13).

The new preschool building was built in four and a half months by the architects, volunteers from various organisations, and members of the local community. Its 220m² footprint is light, and the raised floor of the classrooms is supported on 48 precast concrete footings to allow for natural run-off. The architects emphasise that they generally choose easily available waste materials, which are often similar to the ones that members of the community regularly use for their own constructions and which they would generally also have access to (Saga, 2017: 17; Collectif Saga, 2017: 60). These are collected and tested through prototyping to ensure that the building elements that are developed can be easily replicated by local community members, and Galland[126] notes how cost is the primary reason for using reused, repurposed, or recycled materials.

The "informal" local tectonics of the Silindokuhle Preschool include a wide range of materials and found objects which were all sourced from with twenty-five kilometres of the site and assembled on site. Repurposed fishing crates that were obtained from Port Elizabeth's harbour were used for a planted shading structure or "green roof" over an outside play area, a repurposed

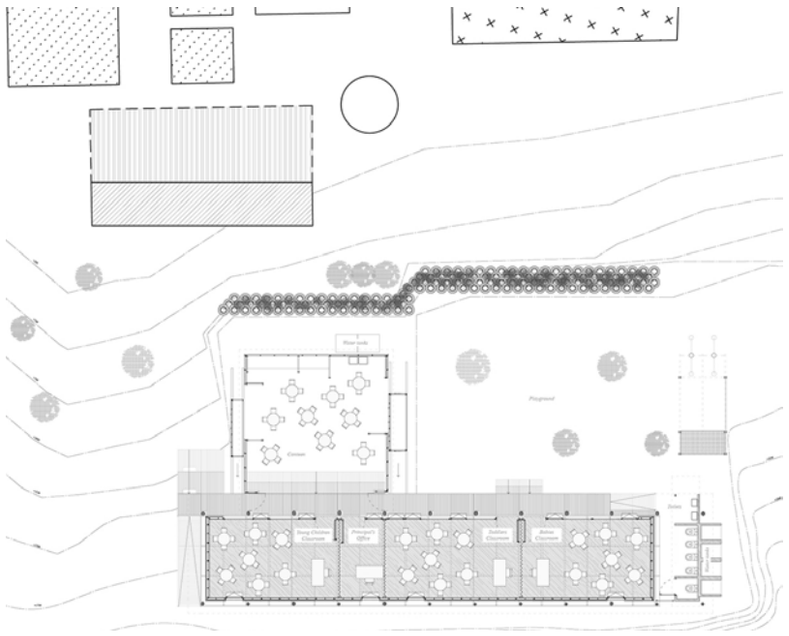


Figure 55 (opposite):
The ground floor plan of the Silindokuhle Preschool, Joe Slovo West, Port Elizabeth, South Africa, 2017, Collectif Saga. Source: Collectif Saga.

Figure 56 (left:
A view of the classrooms and the column grid which is separated from the enclosing envelope. Source: Author.

industrial racking system was combined with reused cardboard tubes to create a truss system over the hall, and the same racking system was used for wall framing and a sliding bay window. Eucalyptus trees were harvested in a nearby plantation and were used as the primary structure: The material selection drives the design, and the columns were separated from the envelope due to their lack of uniformity. To make them more durable while avoiding potentially harmful substances like creosote, the architects used the Japanese *Shou sugi ban* technique which involves the charring of the outer layer of timber. The building envelope consists of a "curtain wall" of reused RDP window frames on the northern façade, and repurposed timber pallets with carpet underlays for insulation, all plastered with "papercrete" (recycled cardboard mixed with a small percentage of cement) on the southern façade. Internal walls consist of repurposed pallets and reused cardboard tubes which were used in an overlapping configuration in an attempt to improve the acoustics between classrooms. In addition to these, further repurposed materials like the bricks for the retaining walls, reused rainwater tanks, and various found objects like wheels and pulleys were also used to save costs[127].

The global tectonics on the project are used mainly for pragmatic reasons when they are more affordable, accessible, durable, practical, or stronger than local tectonics[128]. They include concrete for the footings (the cement is manufactured in South Africa, but the concrete was mixed on site), which is somewhat mitigated by using crushed recycled glass as aggregate. A limited quantity of industrially produced structural timber (South African pine) was

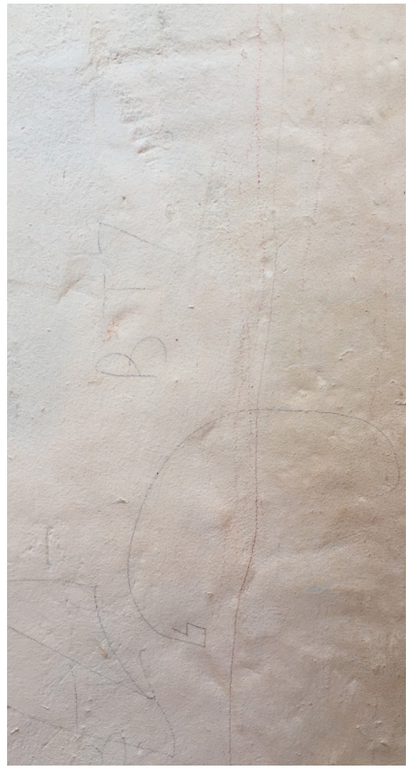


Figure 57 (opposite):
The roof trusses made up of repurposed steel racking and cardboard tubes. Source: Author, 2019.

Figure 58 (left):
Part of the material palette showing some of the "informal" tectonic strategies. Source: Author, 2019.

Silindokuhle Preschool

Joe Slovo West, Port Elizabeth, Eastern Cape, South Africa, 2016
33°49'46"S, 25°29'53"E

Collectif Saga and Uncedo

The Silindokuhle Prechool is a didactic collage of global and local tectonics, both in terms of process and product. Its large material palette reflects the building's didactic purpose, which is aimed primarily at the local community.

Steel roof sheeting, polycarbonate sheeting, structural timber, cement, concrete and glass are used in combination with repurposed fishing crates, repurposed industrial racks, repurposed cardboard tubes, repurposed carpet underfelt, reused window frames, recycled cardboard and locally harvested Eucalyptus. Reused bricks were also used for small retaining walls and the supporting structure for the water tanks, while a number of found objects were used throughout the building, but these are not included in the analysis due to their comparatively small quantities.

*The QR code above can be used to access the website database that was established as part of this study, and it willl provide a link to this project's base information.

Local tectonics

6 **Material: Repurposed fishing crates for planted shading structure**
Repurposed fishing crates obtained from Port Elizabeth Harbour (distance < 25km)
Labour: Repurposed fishing crates for planted shading structure
No labour in terms of manufacturing for recycled material

7 **Material: Steel wall framing and roof trusses**
Repurposed industrial racks from Port Elizabeth (distance < 25km) combined with cardboard tubes from Port Elizabeth for trusses (distance < 25km)
Labour: Steel wall framing and roof trusses
No labour in terms of material manufacturing for repurposed material. Trusses made on site (distance = 0km)

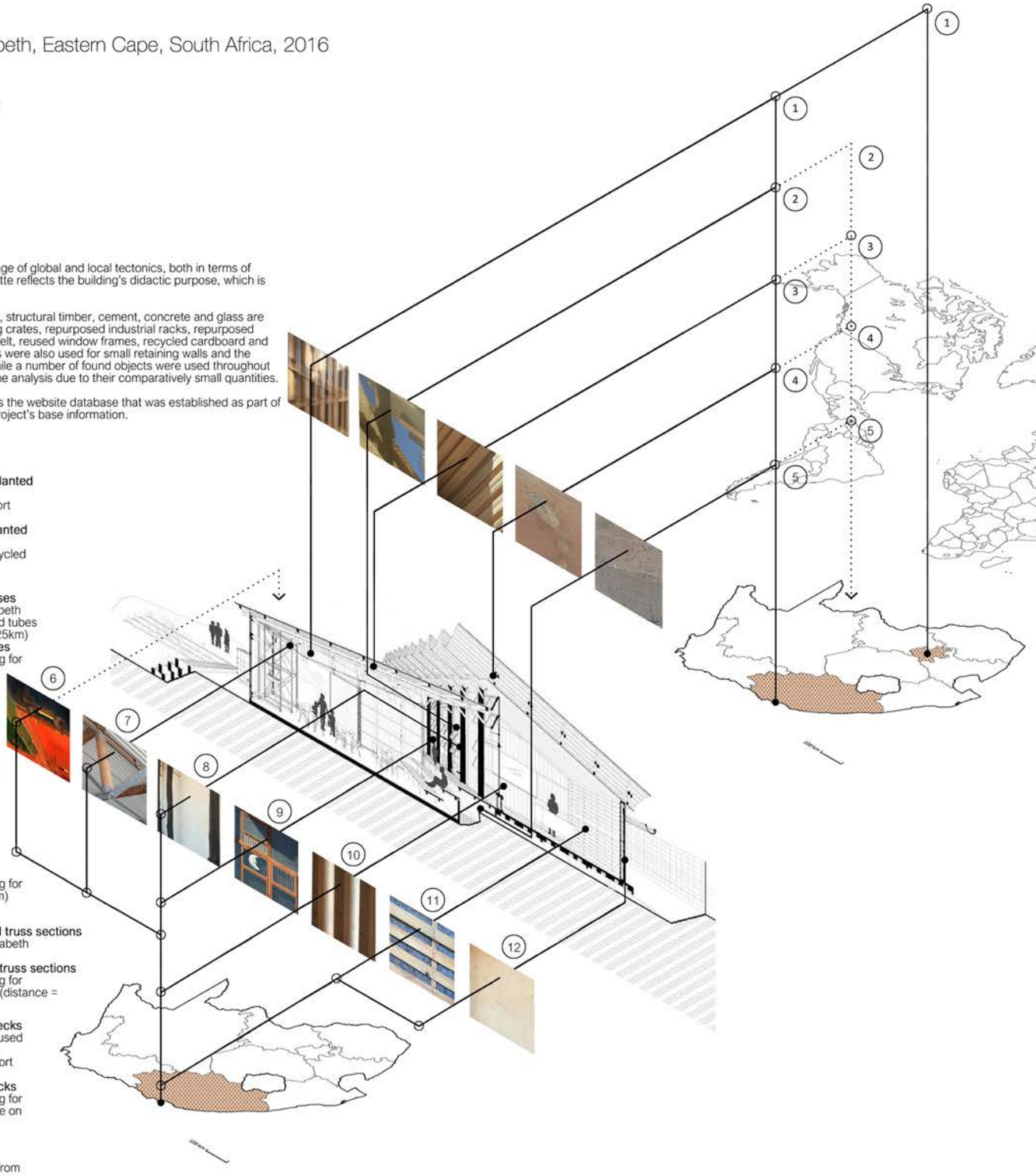
8 **Material: Timber columns**
Eucalyptus columns from nearby plantation (distance < 25km) and treated on site (distance = 0km)
Labour: Timber columns
Cut in nearby plantation (distance < 25km) and treated on site with Japanese *Shou sugi ban* technique (distance = 0km)

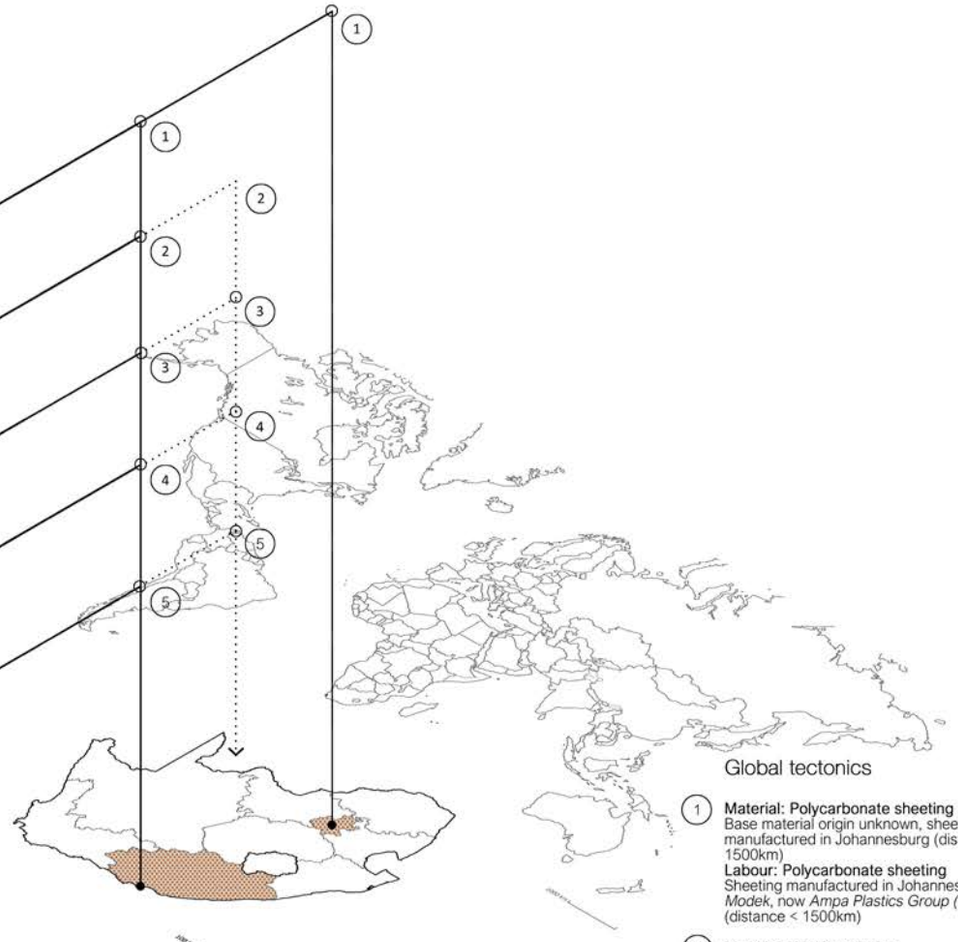
9 **Material: Timber window frames**
Reused RDP timber frames from Port Elizabeth (distance < 25km)
Labour: Timber window frames
No labour in terms of material manufacturing for reused material. Cut on site (distance = 0km)

10 **Material: Cardboard tube wall panels and truss sections**
Repurposed cardboard tubes from Port Elizabeth (distance < 25km)
Labour: Cardboard tube wall panels and truss sections
No labour in terms of material manufacturing for repurposed material. Trusses made on site (distance = 0km)

11 **Material: Repurposed timber walls and decks**
Repurposed pallets and repurposed textile used for walls, shelving planks from repurposed industrial racks used for decking. All from Port Elizabeth (distance < 25km)
Labour: Repurposed timber walls and decks
No labour in terms of material manufacturing for repurposed or reused material. Panels made on site (distance = 0km)

12 **Material: External plaster**
Papercrete made with recycled cardboard from Port Elizabeth (distance < 25km)
*Requires some cement content
Labour: External plaster
Mixed and applied on site (distance = 0km)





Global tectonics

1 **Material: Polycarbonate sheeting**
Base material origin unknown, sheeting manufactured in Johannesburg (distance < 1500km)
Labour: Polycarbonate sheeting
Sheeting manufactured in Johannesburg by *Modek*, now *Ampa Plastics Group (Pty) Ltd.* (distance < 1500km)

2 **Material: Window glazing**
Material origin in South Africa (distance < 1500km).
Labour: Window glazing
Material cut in Port Elizabeth by *Specialised Aluminium Systems* (distance < 25km)

3 **Material: Corrugated sheeting**
Material origin in South Africa (distance < 1500km)
Labour: Corrugated sheeting
Manufactured in South Africa (distance < 1500km). Processed in Port Elizabeth by *Aveng Trident Steel* (distance < 25km). *Mitigated by purchasing material incorrectly made for another project

4 **Material: Structural timber for beams and roof trusses**
South African pine, most likely from Mpumalanga or Kwazulu-Natal, followed by the Western Cape, Eastern Cape and Limpopo Province (distance < 1500km)
Labour: Structural timber for beams and roof trusses
Extraction and initial processing in South Africa (distance < 1500km). Cutting and assembly on site (distance = 0km)

5 **Material: Concrete pad footings & surface bed**
Cement from South Africa (distance < 1500km). *Some material mitigation by using crushed glass as aggregate for footings
Labour: Concrete pad footings & surface bed
Manufacturing and processing in South Africa (distance < 1500km). Readymix for surface bed mixed in Joe Slovo West by *Concrete 4 U* (distance < 5km). Concrete for footings mixed on site (distance = 0km)

used, new glazing was manufactured in Port Elizabeth, and polycarbonate sheeting manufactured by *Ampa Plastics Group* in Johannesburg was also used. The roof sheeting is regarded as a global tectonic strategy, although it can also be seen as a "found material" to some extent; it was discovered serendipitously at a local supplier where it could be purchased at cost, since it was previously manufactured incorrectly (in the wrong colour) for another project[129]. It was also used innovatively by applying it in two layers (with a nod to Kéré) to save on a roofing structure and to provide a ventilated airspace: The top layer of sheeting is shaped using timber spacers to give it improved spanning capabilities, while the bottom layer of sheeting serves as the primary waterproofing layer. The ventilated airspace above and below the classrooms, together with the appropriate orientation and roof overhangs, make the indoor temperature fairly comfortable, despite the relative lack of insulation.

Innovation sometimes comes at a cost, and Galland[130] acknowledges that the sealing of the building can be improved to prevent dust ingress and birds from entering. The question about durability and maintenance has been raised previously and while the building is showing signs of weathering, it has to be borne in mind that many of the materials have already had previous

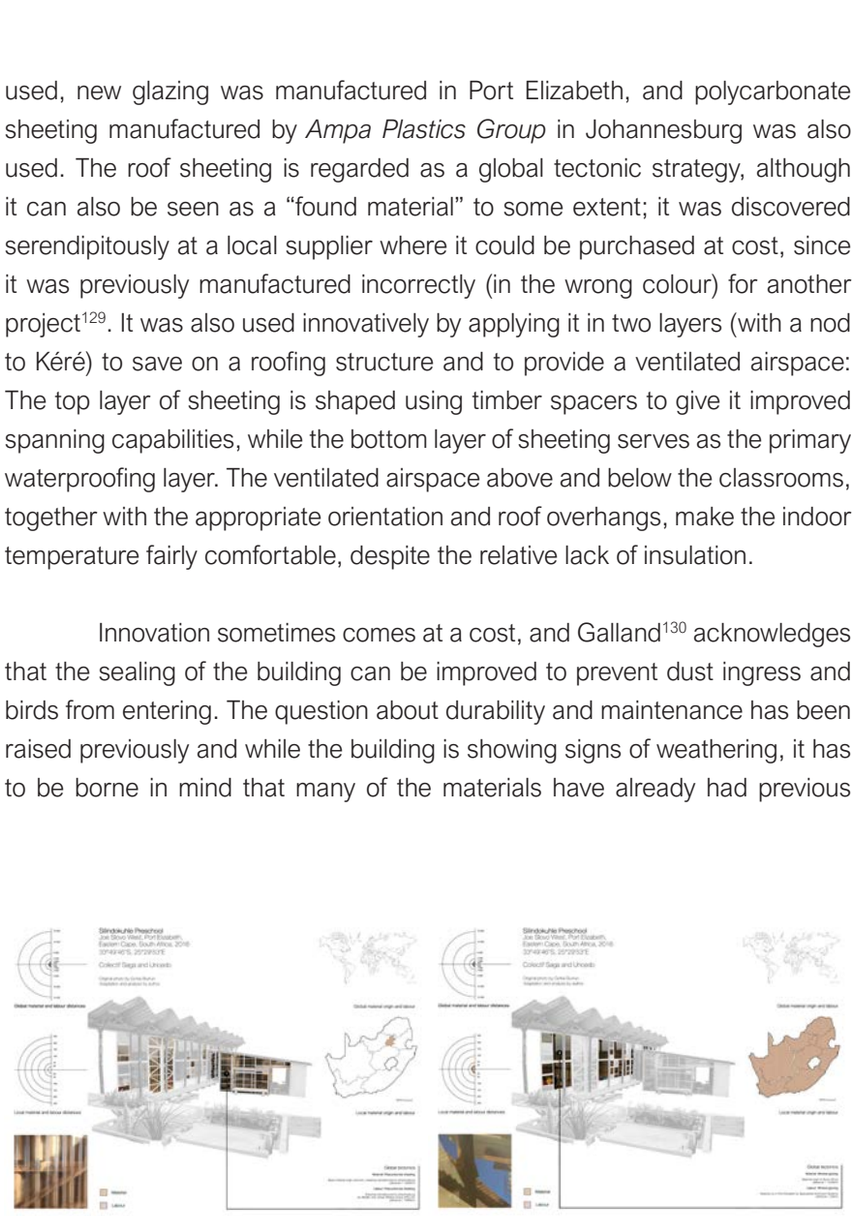


Figure 59 (previous page): *A visual analysis of the origins of materials and labour that were used for the Silindokuhle Preschool. Source: Author, based on a photo by Gorka Biurrun.*

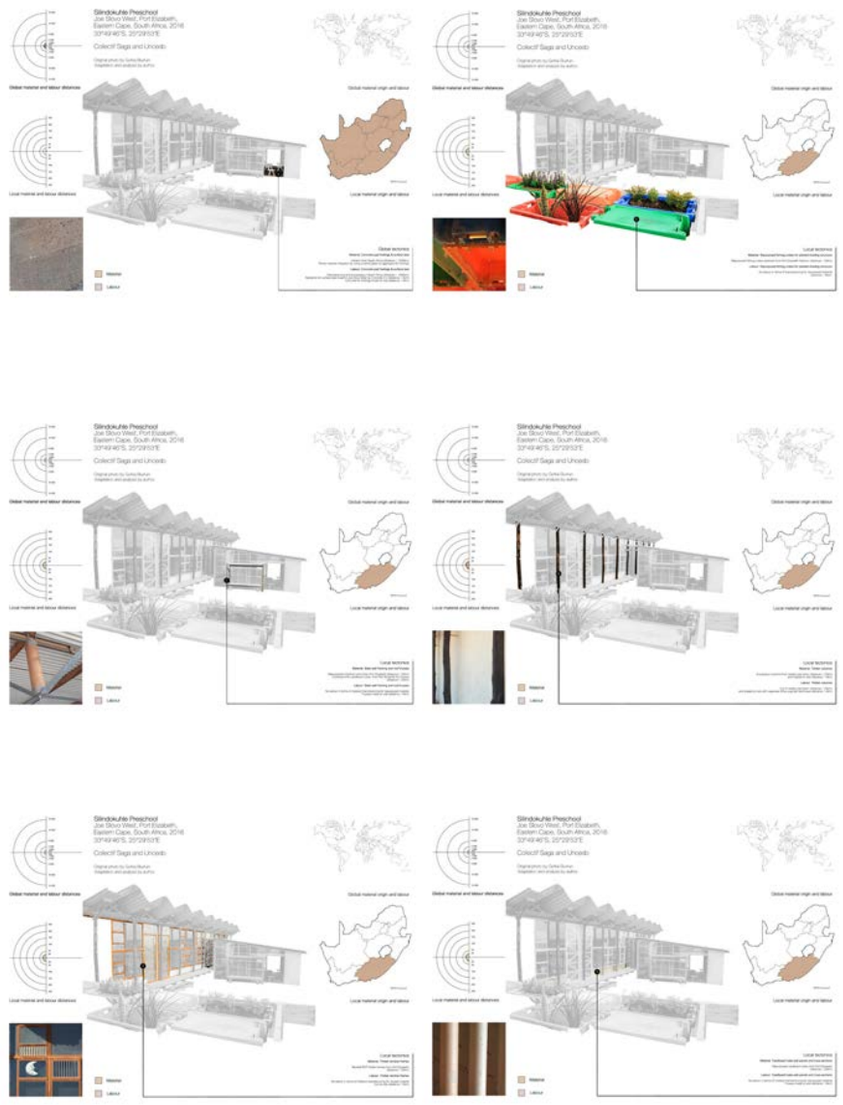


Figure 60 (opposite and left): *A visual analysis of the origins of materials and labour that were used for the Silindokuhle Preschool. Larger scale versions of the images can be viewed in Appendix C. Source: Author, based on a photo by Gorka Biurrun.*

uses, and based on that, it is ageing remarkably well. Some experiments like cardboard tube walls were not as successful as some of the other elements, and the owners have been doing some maintenance (mainly painting) by themselves. However, Collectif Saga's continual engagement with the building and its owners is encouraging and their interest in their buildings' performance over time should enable them to improve their library of techniques in due course. The size of the Silindokuhle Preschool's material palette is striking, and it evidences Collectif Saga's method of sourcing what is locally available. The visual collage also highlights an interestingly fine visual grain, which is most likely a result of using a wide range of materials that could only be sourced in limited quantities.

As Bahamón and Sanjinés (2010: 8) observe, the design process when working with reused, repurposed and recycled materials is often inverted: Instead of design, specification and detailing being followed by construction, the process is now one where the materials are sourced first, and prototyping is followed by the refinement of details before final design drawings are prepared. Collectif Saga confirms this, since their practice of collecting materials runs in parallel with their participatory design process (Saga, 2017: 17), and Galland remarks "Collect first, then design with what you have" (2019: np.). He notes how a design is iterative and that it often has to be adjusted depending on which found materials or objects they gain access to.

The encounters in the Guga S'Thebe Theatre and the Silindokuhle Preschool reveal themselves as collages, in terms of the contributors, the processes and the final products. The encounters between contributors from the global North and the global South have been discussed, and the two projects involved somewhat different positionalities. The Design.Develop.Build. group is based in the North, but they have been involved intermittently in South Africa over a long period of time, while also working with local architects like CS Studio Architects. This relationship has been described as complex, which is probably not unusual in collaborations between educational institutions and practitioners. Heiermann[131] mentions language and communication as challenges when working in the global South, which is similar to those experienced in Rwanda by ASA in particular (Van der Merwe, 2015: 52). She does, however, emphasise the advantages in mutual learning, especially where contributors from the global North get the opportunity to learn from the South about the postcolonial condition. Collectif Saga on the other hand, as a small architectural practice, aimed to embed themselves in South Africa continuously over a period of five years and while they have had some interactions with ed-

Figure 61:
A visual collage analysis of the Silindokuhle Preschool that tests the visual balance between global and local tectonics. The global and local tectonics have a similar weighting, but the extent of the material palette is clearly evident. Source: Author, based on a photo by Gorka Biurrun.

ucational institutions these have been mainly research-based and not in terms of design and construction. For the Guga S'Thebe Theatre, the design was prepared in Germany and the USA and it was presented to the local community; while some community members were involved in the construction, there does not seem to have been a drive for skills transfer other than for students. Collectif Saga's more participatory design and construction approach seems to have generated wider community involvement and some skills transfer, although their aim of replicability does not necessarily seem to have borne fruit, with very little evidence of any of their innovations having been replicated by the local community.

In both projects, the global and local tectonics are used together and while they can be clearly identified, they sometimes conceal or over-write one another in the form of a palimpsest. Both projects show clear evidence of the encounters between industrialisation and craft, particularly in the practices of reusing, repurposing, and recycling. Globalisation, and its culture of planned obsolescence[132], has inherently given rise to new tectonic practices. The discarding of mass-produced items and their global distribution allows for the re-scripting of standardised products, resulting in a re-originalisation of meaning. In relation to contemporary practices in Africa, Doris (2006: 283) observes that:

> *"At its core is a guiding metaphor: The notion of Trash-Becoming-Treasure draws us back to the redemptive function of Art in colonized and neo-colonized spaces, and helps preserve Art as a special category of practice. It also neatly mirrors and reifies the polarizing conception of the 'First World' colonizer as monolithic, industrial oppressor and the colonized 'Third World' subject as resilient, industrious bricoleur."*

As some contemporary manufacturing processes evolve towards bio-manufacturing which uses natural materials as a base material, the practice of reusing, repurposing, and recycling materials that are composed of finite resources might become less attractive, and collage practice might shift to include more natural or biological materials. However, for the foreseeable future, the global economy will ensure the continuing manufacturing and distribution of materials and elements that will invariably become waste products - at least for some - and as Leslie writes, "Much like the meshing of shards of montage… the world is to be put back together – but it is a montage praxis, using debris and rubbish, the broken pots and torn scraps, not the high, sublime reordering of harmony in a bloodless, hands-off aestheticism" (2010: 392).

Textile tectonics and hybrid potentials in Senegal

Background

Hal Foster is of the opinion that "The search for the architecture of the computer age is on; but, ironically, it has led Gehry and others to use academic sculpture as a model, at least in part" which embodies the "disconnection between skin and structure" (2001: 1). Frampton notes how the sculptural character of these types of works relies on image-making for distribution by the media and while he concedes that sculptural properties do not necessarily need to be separated from space and structure, he makes the point that "one can easily see how the cult of the free-standing object is closely linked to the populist franchising of culture, to the so-called Bilbao effect" (2002: 9). He describes digital means as an important tool in the production of construction drawings, structural calculations, and in the design and modelling of environmental systems amongst others, but he cautions that "its stochastic use for the generation of form as an end in itself is more questionable, since this can be just as gratuitously formalistic as any other heuristic device solely indulged in for the purposes of aesthetic display" (2002: 10). Since Frampton wrote this, digital design and modelling has become much more prevalent and sophisticated: The use of Building Information Modelling (BIM) and parametric design has enabled new modes of documentation and form-making which, while they could still be employed in a willful or narcissistic manner, can also allow new structures to emerge which are rooted in their context and that can be combined with local skills and materials if they are used critically.

Mbembe raises the question "What remains of the human subject in an age when the instrumentality of reason is carried out by and through information machines and technologies of calculation?" (2019a: np.) He wonders who will set the boundaries between the calculable and the incalculable, or the quantitative and the qualitative, and he goes on to ask whether we will be able "to invent different modes of measuring that might open up the possibility of a different aesthetics, a different politics of inhabiting the Earth, of repairing and sharing the planet?" (2019a: np.) It might be in the bridging or the blurring of these boundaries that a start can be made: Swilling and Annecke (2012: 70) note how information and communications technology, combined

with renewable energy systems and the decarbonisation of development, can provide a bridge between a new industrial transition and a new socio-ecological regime. Schwab (2017: 18) regards the "Internet of Things" (IoT) as one of the primary links between the physical and the digital, and he describes it as "a relationship between things (products, services, places, etc.) and people". He believes that networks across national boundaries are necessary in order to adapt to the fourth industrial revolution, which ties in with Mbembe's (2019a: np.; 2019b: np.; 2020: np.) notion of "deborderisation". Digitisation and connected technologies have enabled the construction of the selected works in the constellation explored here.

Ostwald (2004: 207) writes how architects have now begun to use digital modelling to design forms "that have previously been difficult, if not impossible, to visualise or construct", and McCullough (1997/2010) believes that craft can be performed through computers. This is echoed by Adamson (2010: 241) who says that "configurations of people and machines are seen not as inherently oppositional, but rather as an interwoven field in which the organic and artificial combine". Writing about McCullough's work, he notes how "the digital restores craft to centre stage" (2010: 310); McCullough maintains that digital design and production can make small-scale localised production competitive again, and a number of contemporary architectural projects in Africa demonstrate this by combining global digital tectonics with local tectonics.

The work of Toshiko Mori Architect is of interest in this regard, in particular her two projects in Senegal, the Thread Artists' Residences and Cultural Centre (2015), and the Fass School and Teachers' Residence (2019). Mori's projects in Senegal are representative of what Mbembe (2019a: np.; 2020b: np.) refers to as "the age of the algorithm", although here application of some of its tools was done critically and with the explicit aim of valuing local knowledge and skills that are informed by responsible resource use. The combination of digital design with local skills and materials provided the impetus for the development of buildings that are forward-looking while still having respect for local tradition.

Practice philosophies and positionality

Toshiko Mori was born in Kobe, Japan, in 1951 during the American occupation following World War II. She was exposed to a broad range of Japanese influences[133] before moving to the USA with her parents at the age of fourteen. After initially enrolling to study art, she ended up studying architecture at the

Irwin S. Chanin School of Architecture (The Cooper Union) in New York City, where one of her key influences[134] was John Hejduk. She recalls how he was one of the earliest teachers there to be concerned with social issues, that he lamented the state of humanity and tried to instill empathy for marginalised people[135]. His ideas about fabrication would also spark her own interest in the notion that architects should be involved in thinking about making as an extension of design[136]. He encouraged his students to be confident in their work, which Mori took to heart by presenting her thesis project to a potential client after she had completed her studies. After working for Edward Larabee Barnes from 1976 to 1981, she had the confidence to establish her own practice, Toshiko Mori Architect, in 1981 while she was still in her twenties (Mori, 2018: np.[137]).

When she was a child, Mori's father took her to see the Hiroshima Peace Memorial, which would have a lasting impact on her. The horrors of war, the nuclear attacks and their after-effects were still a painful part of everyday life, but the experience of the Memorial was an especially visceral one for her. The building was designed by Kenzō Tange and Mori identifies with his approach of trying to design iconic structures that still relate to the human scale, and how he managed to incorporate Modernist architectural ideas from the West with traditional local Japanese technologies[138] (Mori, 2019: np.[139]). She admires the work of architects and artists like Tange, Masayuki Nagare, Genichiro Inokuma, George Nakashima, and Isamu Noguchi, and she regards them as global citizens who "showed us how to operate beyond national borders… who transcended national associations and learned to relate to others outside, and then to be 'other' and to see the culture they have seen with a critical eye" (2019: np.). Another influence is Togo Murano and in what could be a description of her own work, she says that he had the ability to make the traditional contemporary and that he "walked right on the edge between a fantasy and reality. His work is vernacular and contemporary at the same time; he conceptualized his ways to put old right against new in a very subtle and fresh manner" (Mori in Belogolovsky, 2016: np). Tange was a Metabolist, and according to Kurokawa, the Metabolists believed that "technology is an extension of humanity" which "contrasts with the Western belief that modernisation is a repetition of a conflict between technology and humanity" (1977/2007: 233).

Mori often refers to Tange's Kagawa Prefectural Office (1958), whose reinforced concrete structure is representative of a traditional wooden structure, and she notes how the building was almost completely built by hand

"with nearly nothing" due to material and equipment shortages after the War[140] (Mori, 2019: np.). While it was modern, the local community could also identify with the building in relation to traditional Japanese architecture. It points to a pragmatic approach where the use of local materials and skills are out of necessity, but this practice inherently also embeds a sense of local identity and memory into the work. Mori draws inspiration from traditional Japanese architecture which, according to her has "a sense of clarity and tectonics" (Mori in Belogolovsky, 2016: np.) and although she points out that the circumstances, scale, and materiality of the Kagawa Prefectural Office are vastly different to those of the Thread Centre[141], the architects both seem to have a similar appreciation of, and respect for, local traditional skills and they were both able to combine global and local tectonics into their buildings.

Tange's work is sometimes labelled as Critical Regionalism (as is the work of Raimund Abraham, one of Mori's other influences[142]): Lefaivre and Tzonis (2012: 174) write that Tange was sympathetic with the ideas of Team 10 and he presented the Kagawa Prefectural Office at CIAM Otterlo in 1959[143]. During this event, Tange is quoted as saying that "I cannot accept the concept of *total* regionalism… tradition can be developed through *challenging* its own shortcomings, implying the same for regionalism", which Lefaivre and Tzonis regard as a clear definition of Critical Regionalism.

Mori, however, believes that Critical Regionalism needs to be reconsidered from a different perspective, and in a contemporary re-reading of Critical Regionalism, it is more about "how much do we impose, how do we actually relate to different cultures instead of just repeatedly setting very similar-looking buildings everywhere"[144]. This can be seen in her Senegalese projects where tradition is respected, but some of its structural limitations are challenged through design and especially through what she refers to as textile tectonics, which will be explored later in this section.

Mori believes that architects carry a responsibility towards the environment and that sustainability should be common sense, which involves the consideration of ecologies and communities (Mori, 2019: np.). She notes that climate change influences everything and she argues that architects should be vocal about it; it is for this reason that she founded *VisionArc*[145] in 2009 with the aim of reshaping her practice and to facilitate the "methodological observation of a world at risk… to explore, to understand, and to manage upcoming risks on a higher level" (Lepik, 2020: 8). Her aim is to contribute to the dialogue surrounding global sustainability issues (2020b: 13), and Lepik goes on to say that "VisionArc is clearly driven by the ambition to take an ethical position and enact positive change" (2020: 8).

Mori notes that "as an architect, one has to embrace the context" (2018: np.) and she believes that intense observation is required to perceive challenges from a different position (2020b: 11). She recognises the differences between working in the global South and the global North, and while she mentions the climatic differences, she highlights the disparities in terms of access and material wealth. Building on her own experiences in post-World War II Japan, her personal experience as "the other" in America (Mori, 2019: np.), and Hejduk's philosophical framing of social awareness, her concern with the underserved communities in many parts of the global South and especially the dispersed communities in Senegal are grounded in her own positionality[146].

Mori has written about the ethical dimension of architecture and she is clear about her aims when she says that "I really think that I want to work on projects that have some benefit to humanity, that create values, that do more than just accommodate and function" (2018: np.); she notes how "Part of the Thread Centre's mission is to show that art and architecture are not tertiary privileges, but the rights of all people across the world" (2020b: 54).

Weber writes how, when Mori went to South Africa to accept an architecture award[147], she was challenged by some architects who "protested that a Japanese-American had no right to think she could build on the African continent", but that she managed to convince them that "she was a person for whom differences did not exist except to be overcome" (2020: 229). Nader Tehrani (in Mori, 2019: np.) observes that "speaking the language of 'the other'" is "a latent imperative" in Mori's work, and in terms of her own displacement from Japan to America, she says that "being away from my own culture, one starts to have a sensibility of understanding 'the other'", which leads her to believe that empathy is more important than origin (2019: np.).

The tectonic landscape

Most architects nowadays make use of computers for drawing and documentation purposes, but this does not necessarily mean that digital technology is used to generate form, nor does it mean that it is actively converted into digital manufacturing. The catalogue of projects in Appendix A, however, reveals a constellation of contemporary projects in Africa that make use of digital design and manufacturing as a global tectonic strategy that is used in combination

with local tectonics. The selected projects are somewhat dispersed, mainly across western and northern Africa[148], and they seem to be concentrated around specific architects and institutions who in most cases have completed at least more than one project on the continent. They do not perpetuate the practice of separating structure and skin which often happens with complex three-dimensional computer-generated forms as raised by Foster (2001), nor do they aim to generate a three-dimensional sculptural form as an end in itself or to serve as a "populist franchising of culture" (which Frampton is concerned about in relation to digital technologies). They all generate powerful images, and in some instances one can question whether image-making is the key driver, but they do demonstrate concern for the environment and the people who inhabit it through their material use, the incorporation of local traditional skills, an awareness of resource constraints, and in a number of cases, re-movability.

All the selected projects in the constellation make use of a combination of global tectonics and local tectonics. They all make use of computer aided design and/or manufacturing and they make use of industrialised production or material innovation to some extent. Almost all of them combine this with local traditional crafts and local material content (natural and/or reused, recycled, or repurposed), and they all make use of localised production in some way. The interesting thing is how the use of local tectonics does not inhibit the generation of striking and complex three-dimensional forms using global tectonics as the form-making device.

The *Loom-Hyperbolic Higher Atlas* by Barkow Leibinger Architekten is a case in point. It was completed in 2012 for the 4th Marrakesh Biennale in Morocco, and it appropriated a section of the ruins next to the famous Koutoubia Mosque (which means it could also be read as form of adaptive reuse). It was the express aim of the architects to combine global tectonics through the use of algorithm programming software (especially the programs *Rhino* and *Grasshopper*) with local tectonics by making the installation using found materials and traditional skills (Barkow Leibinger Architekten, 2017: np.; Grozdanic, 2012: np.). The parametrically modelled form was related to its site by halving the five-metre grid of the existing ruins and using that as the foundational module, while the physical making was informed by the traditional Moroccan weaving technique that makes use of a loom made from a wooden frame. The structure was made using 100mm diameter pine poles that were cut and peeled by hand, connected using locally welded steel brackets and weighed down with local stone. Cotton thread of 3-4mm in diameter was then woven

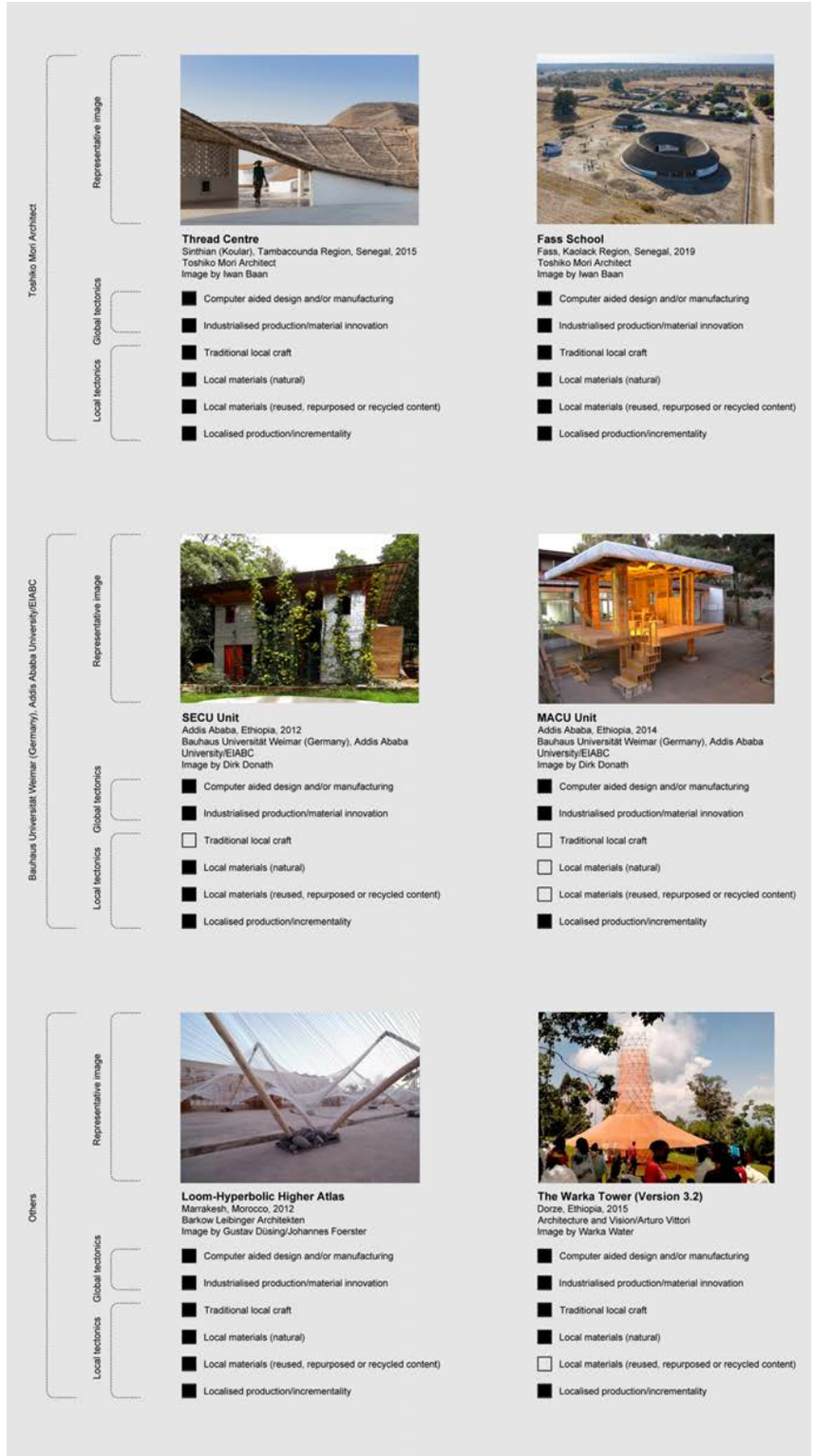


Figure 62:
A selection of works from the tectonic constellation that uses computer-aided design and manufacturing in combination with local tectonic strategies. Common global and local tectonic strategies are identified across buildings. Source: Author, with images by others as cited.

over this structure to create a three-dimensional skin. The architects note how their ambition was to transform a traditionally two-dimensional woven surface into a three-dimensional form that can be spatially experienced by visitors to the Biennale, which can best be described as what Mori (2020b: 129[149]) calls textile tectonics. Noble cites the architect Jeremy Rose as saying that "the rounded forms of indigenous architectures are tectonic in origin, being derived from soft materials such as mud, grass and reeds, a pattern that requires careful, if not difficult, translation for a modern context" (2011: 247), and the architects observe how, in their translation, "The irregular slightly bent forms of the wood poles soften the hard geometry of our digital computer drawings sympathetically" (Barkow Leibinger Architekten, 2017: np.). Due to the sensitive nature of its site, the structure was designed to have no lasting physical impact and it was subsequently removed after the Biennale[150].

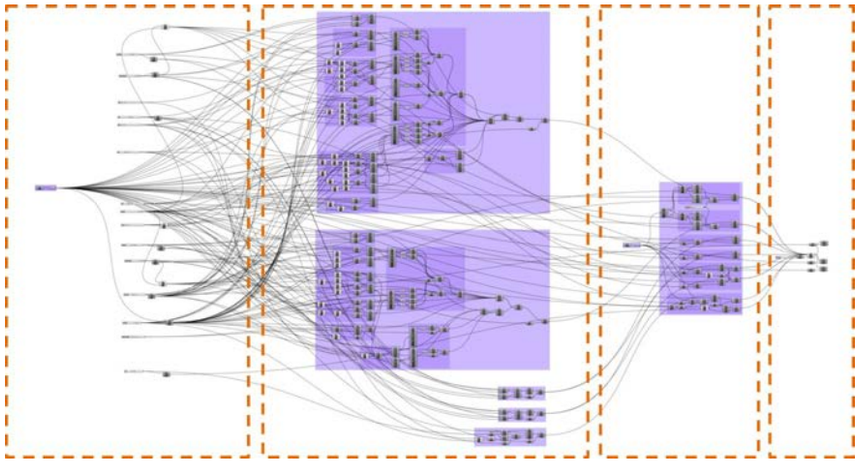
The parametrically modelled Warka Tower that was designed by Arturo Vittori of *Architecture and Vision*, in particular version 3.2[151] that was erected in Dorze, Ethiopia in 2015, is another example of a removable application of textile tectonics. It is situated at an altitude of 2400 metres above mean sea level, and its primary function is to collect rainwater and to harvest fog and dew from the atmosphere (Architecture and Vision, 2018: 5). The tower structure itself is 9,5 metres high but it only weights 80 kilogrammes; this is achieved by using a triangulated bamboo framework made up in five mod-

Figures 63 and 64: *Loom-Hyperbolic Higher Atlas, Marrakesh, Morocco, 2012, Barkow Leibinger Architekten. Source: Gustav Düsing / Johannes Foerster, Barkow Leibinger Architekten. [Online] Available: https://barkowleibinger.com/archive/view/exhibition_loom_hyperbolic (Accessed 25 June 2018).*

ules that are tied together using rope made of natural fibres, with a polyester mesh stretched along the inside of the structure. The water is funneled into a storage tank with a capacity of three thousand litres, which rests on a base of natural stone. A more horizontal canopy along the base of the tower prevents evaporation, but it also provides a shaded area for its users. According to Architecture and Vision, the entire structure can be assembled on site in less than a day by sixteen people[152], and it can be manually maintained using local materials and spare mesh (2018: 29).

Another series of projects in Ethiopia which make use of digital design and manufacturing are the experimental SECU[153] and MACU[154] units that were designed and built by the Bauhaus Universität Weimar and the Ethiopian Institute of Architecture, Building Construction and City Development (EIABC) at Addis Ababa University under the direction of Prof. Dr. Ing. Dirk Donath[155]. These projects do not employ textile tectonics, but they nevertheless merge digital design and manufacturing with local tectonics. The SECU unit does this to a lesser extent[156], but the MACU unit on the other hand, is parametrically designed using *Rhino*, *Grasshopper*, a self-developed *C#.net* add-on, and *Control Artcam,* and its eight hundred and thirty four 18 millimetre thick Eucalyptus components are digitally fabricated using a CNC cutter (Franco, 2015: np.). Its components are entirely premanufactured, and the prototype was assembled by students on site in a single day[157].

While these projects are all exemplary in their combination of digital global tectonics and local tectonics, Toshiko Mori Architect has managed to synthesise them seamlessly into two permanent buildings of a larger scale.



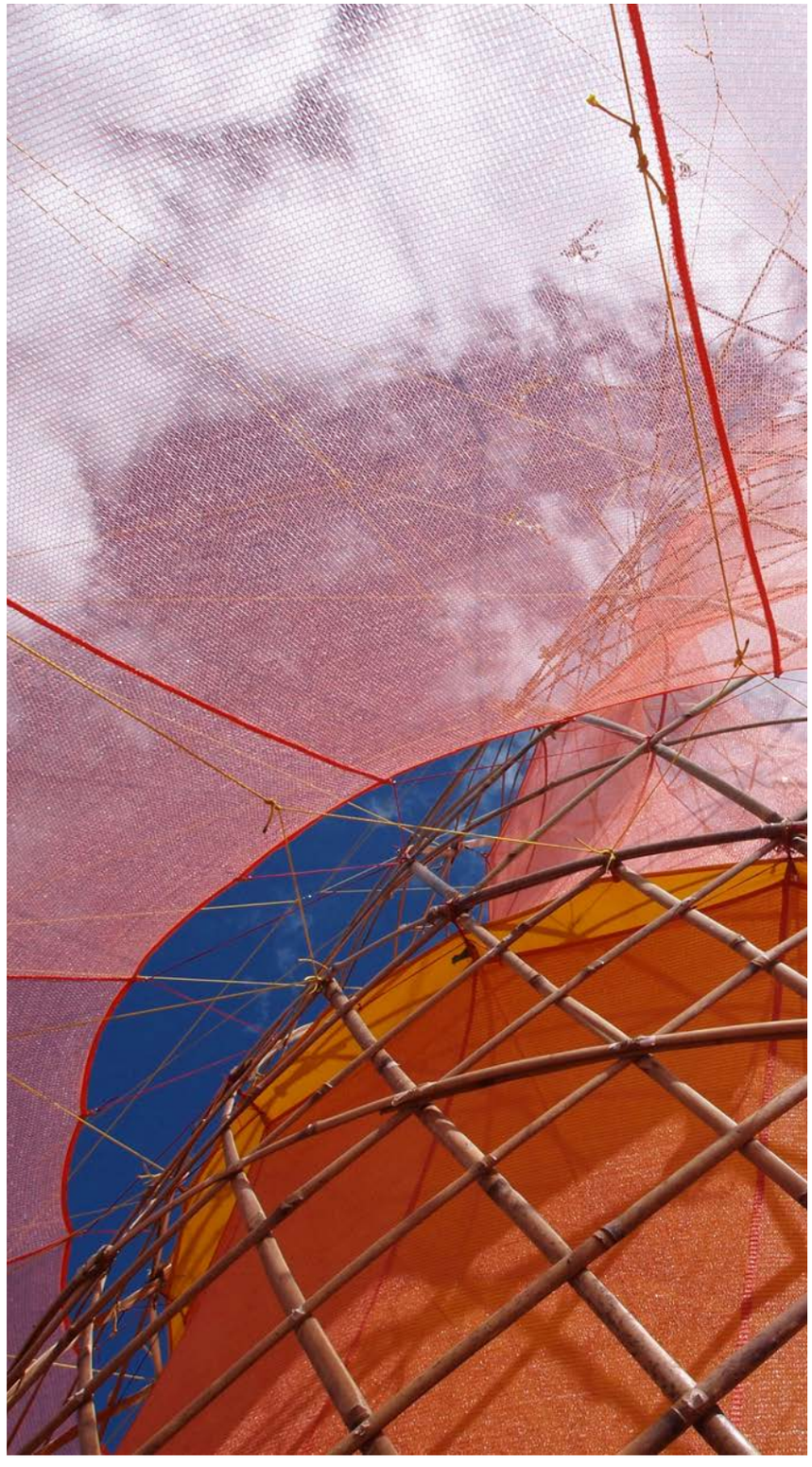


Figure 65 (opposite):
The parametric concept for the MACU unit, showing the adjustable parameters in the first block, clustered components in the second block, the program that allocates the positions for the different geometries in the third block, and the connection of some of these in the fourth block. Source: Dirk Donath (Bauhaus Universität Weimar/ EIABC).

Figure 66 (left):
A partial view of the Warka Tower showing the triangulated bamboo assembly and the stretched polyester mesh that collects droplets of water from the atmosphere. Source: Architecture and Vision / Arturo Vittori. [Online] Available: https://www.akdn.org/architecture/project/warka-water (Accessed 12 April 2019).

Donath[158] regularly cited Gropius, and Mori also has a connection to the Bauhaus: She sees herself as a member of the third generation of the Bauhaus legacy, since Walter Gropius and Marcel Breuer's students[159] were her mentors, especially John Hejduk as mentioned previously, and the Bauhaus' emphasis on the connection between design and making strongly informs her work. Similar to Barkow Leibinger Architekten, she shares a fascination with weaving and its translation into architecture and similar to the Warka Towers, water harvesting is a key aspect in her Senegalese projects. Besides the horizontal commonalities with other contemporary works, Mori's work in Senegal is also part of a vertical lineage of works that is grounded in past Senegalese projects with a Critical Regionalist bearing. The Agricultural Training Centre by UNESCO/BREDA Dakar that was completed in 1977 in Nianing, Senegal, and the Daara Koranic School by Raoul Snelder that was completed in 1981 in Malika, Senegal, both exhibit similar strategies to those employed in the Thread centre. Both projects have structurally efficient vaulted roof forms made with minimal means, which in both cases create generous interior volumes (by making use of brick arches and reinforced concrete beams respectively) while clearly articulating the discharge or rainwater which, unfortunately, does not seem to be harvested (which had such a catalytic effect at Thread). These buildings both make use of cement stabilised earth brick walls that are combined with breeze blocks and large openings respectively to allow for natural ventilation.

Özcan (1985: 9) writes how the Agricultural Training Centre's labour-intensive building system was developed to "generate a new architectural language", while at the Daara Koranic School, an architectural language was generated as an "archetype for construction problems of a country with scarce building materials". Both of these descriptions could just as easily have been applied to the Thread Centre. Özcan warns that an interpretative approach to vernacular architecture has its limitations when elements that are typically used for smaller scale units or buildings are applied to larger civic structures, unless "a reinterpretation is made or what has existed is stretched" (1985: 12). This stretching of the capabilities of technologies, materials or forms, is something that is one of the hallmarks of both the Thread Centre and the Fass School. Since the tectonic approaches and encounters in these two buildings are similar, the encounters between global and local tectonics will be investigated in the following section through a tectonic analysis of the Thread Centre only. However, the two projects are of the same family – they are both strongly infused with temporal depth through the incorporation of memory and imagination, and through their combination of global and local tectonics they situate themselves in such a way as to embrace difference.

Encounters in the works

Early in her career, Mori designed a number of shops for fashion designers[160] including the likes of Issey Miyake, and she became fascinated with textiles and weaving. She went on to design a number of exhibitions that were concerned with textiles and weaving [161], including one called "Josef and Anni Albers: Designs for Living" at the Cooper Hewitt Museum in 2004[162], which was curated by Nicholas Fox Weber with Matilda McQuaid and Susan Brown. Weber is the Executive Director of the Josef and Anni Albers Foundation[163] which is the client for both the Thread Centre and the Fass School, and he would end up collaborating closely with Mori on both projects. Weber initially asked Mori to design a concept for an archive building based on Anni Albers' weaving entitled "City" (1949), which was never built, but its underlying ideas would inform the design of the Thread Centre and the Fass School in due course (Weber, Mori and Mostafavi, 2014: np.). Mori observes how the process of weaving with its warp and weft is similar to the ones and zeros of computation (2020b: 130), and she remembers how

> *"Issey Miyake would be working with textile designers, so you'd see how it's being woven. Some of them are hand-woven, mechanically woven, some are digitally woven. I've learned so much about the possibility of different types of material, mixing materials and layering together, or pleating together, and expanding together, and interaction between what I call in my research the three modes of fabrication: hand-made, machine-made, and digital fabrication. That really comes from my observations of their work and techniques"* (2018: np.).

The idea of weaving in architecture, according to Rodenbeck (2010: 112) is related more to a feminine and an African notion of architecture: Referring to the *Maison Tropicale* and other demountable architecture, she writes that "The idea of *maisons démontables* departs from one line of thinking in Western architectural theory which understands architecture, Western architecture, to be based on the funerary monument, drawing on things that were made to be solid and lasting and eternal as models. According to this alternative focus residential architecture is based on the tent—and associated, via the link with weaving and textiles, with the feminine. So there's a split between the permanent, eternal and ideal, the monumental, and the fungible, the reweavable, the *démontable*, which has always been secondary".

Mori has a deep admiration for the work of Josef and Anni Albers, and their work has informed both her practice and her teaching. A number of her students prepared designs that explored the concept of weaving during her *Le Kinkeliba Studio* in Senegal in 2010 and one of them, Jordan MacTavish, prepared a design for a site in Senegal which essentially provided the underlying form-making ideas for the Thread Centre (Weber *et al*, 2014: np.; Fixsen, 2015: np.). He ended up working for her and his project's design was developed through TMA into what was eventually constructed. This type of co-production where students prepare designs as part of their curriculum which are then developed further by a practice does raise questions of authorship, acknowledgement, and financial contribution on the part of the institution and the practice, and while it is unclear how the studios' travel and accommodation were funded, it is reported that TMA performed the architectural work pro bono. The final plan form of the Thread Centre with its oval courtyards is inspired by Josef Albers' *Alpha, Beta, Gamma, Delta* series of 1939 (Mori, 2014: np.), but one of Anni Albers' works, "In orbit" (1957) has two juxtaposed ovals forms that also share some similarity with the plan of the Thread Centre. In addition to these similarities, the roof forms that were generated using parametric software also have some commonality with the explorations by Josef Albers with his students at Black Mountain College using folding techniques in 1946 (Weber *et al*, 2014: np.).

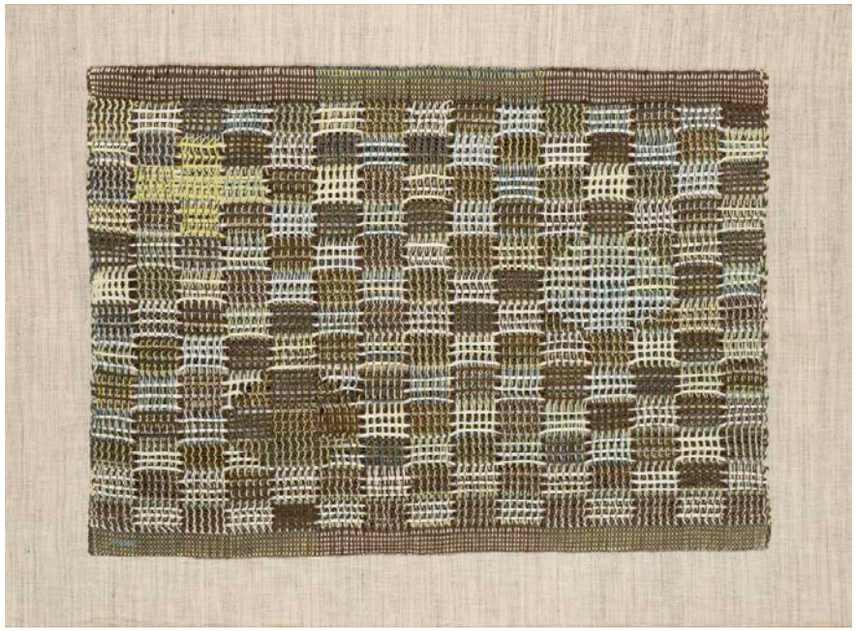


Figure 67 (opposite):
In Orbit, *1957, Anni Albers. Source: The Josef and Anni Albers Foundation. [Online] Available: https://ocula.com/art-galleries/david-zwirner/artworks/anni-albers/in-orbit/ (Accessed 2 October 2020).*

Figure 68 (left):
Josef Albers and some of his students examining a folded paper structure at Black Mountain College in 1946. Source: Genevieve Naylor. [Online] Available: https://www.researchgate.net/figure/Paper-folding-experiments-by-Josef-Albers-and-Students-Black-Mountain-College-New_fig1_235929057 (Accessed 2 October 2020).

The Thread centre has a low-slung profile, and its programme is essentially arranged around two generous oval courtyards. Large covered outside spaces provide shelter from the heat and from the rain during the Tambacounda District's short wet season, but the long dry months especially informed the design of the building's expansive and recognisable roof form. The general shortage of water prompted the architects to focus on rainwater harvesting and storage, which contributed to the shaping of the roof and necessitated the inclusion of two large underwater storage cisterns. Another important aspect of the building is to respect local techniques and materials, and Mori says that "By respecting the character of local practice and vernacular building typologies, we sought to thread an existing cultural infrastructure into new building propositions" (2020b: 14). One of the aims of the project is to empower the local community through architectural innovation and the Centre's programme facilitates this by offering an artists' residency, performance and gathering space, a library, a plant nursery, water collection, agricultural training, and a workshop for economic development (2020b: 54).

While studying, Mori worked for the artist, sculptor, and landscape architect Isamu Noguchi during weekends and holidays. Noguchi shared an office with Buckminster Fuller and Mori observes that "Those two were best friends, but they were polar opposites, because Fuller believed in everything artificially constructed — manmade technology, ideas of geometry — whereas Noguchi was completely into natural materials, natural elements: humans, stones, water" (Mori, 2018: np.). This experience seems to have stood her in good stead, since the encounter between these two seemingly polar opposites is evident in the Thread Centre and the Fass School where global and local tectonics are purposefully combined.

The most noticeable aspect of the Thread Centre is arguably its roof, and Mori says that "Essentially what we did is we took an African hut and made it into a large public structure"[164]. While this may sound superficial, the way that the traditional vernacular form was reinterpreted is very sophisticated. Mori reflects on the installation of a suspended scale model of the Thread Centre's roof at the 2017 Chicago Architecture Biennale "Making new history" which, with a nod to Mbembe's concept of deborderisation, aimed to show that the architectural divisions based on social and economic difference could be broken. She says that:

> *"The critical purpose of the installation was to call attention to the preconceived architectural stereotypes attached to*

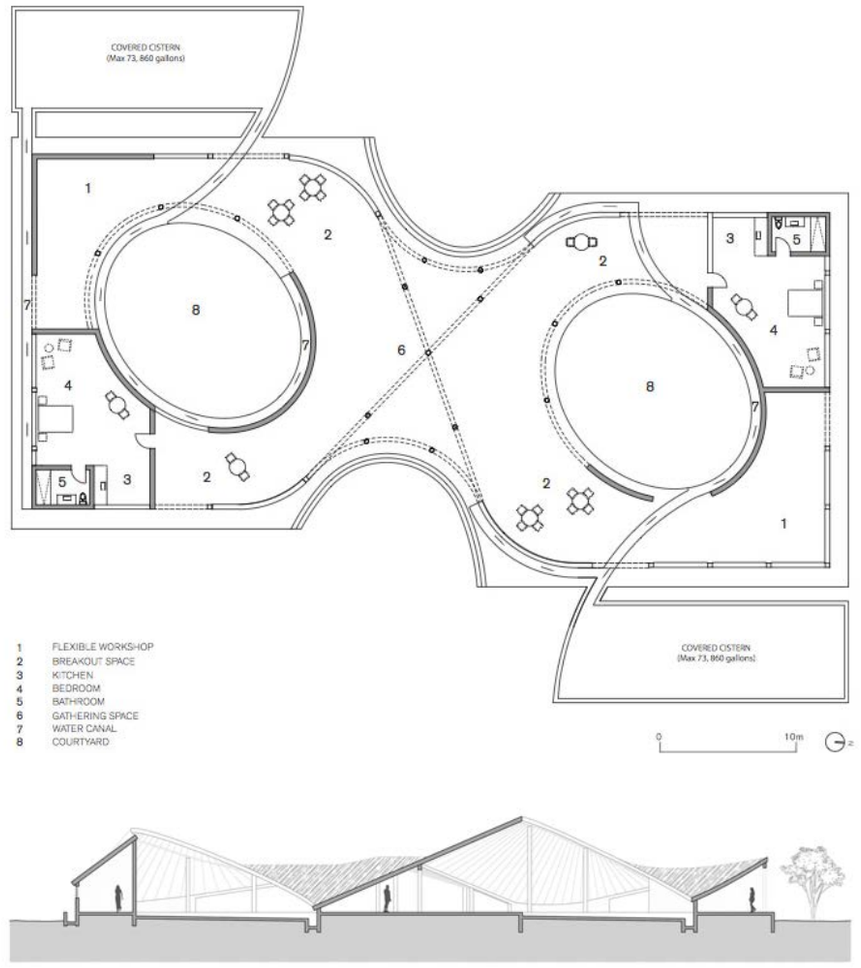


Figure 69 (above):
The floor plan and section of the Thread Centre showing the two oval courtyards, and the water channels leading to the two underground water storage cisterns. Source: Toshiko Mori Architect.

Figure 70 (below):
The recognisable roof profile of the Thread Centre. Source: Iwan Baan. [Online] Available: https://tmarch.com/thread (Accessed 1 October 2020).

Thread Artists' Residency and Cultural Centre

Sinthian (Koular), Tambacounda, Senegal, 2015
13°20'16.65"N, 13°37'16.98"W

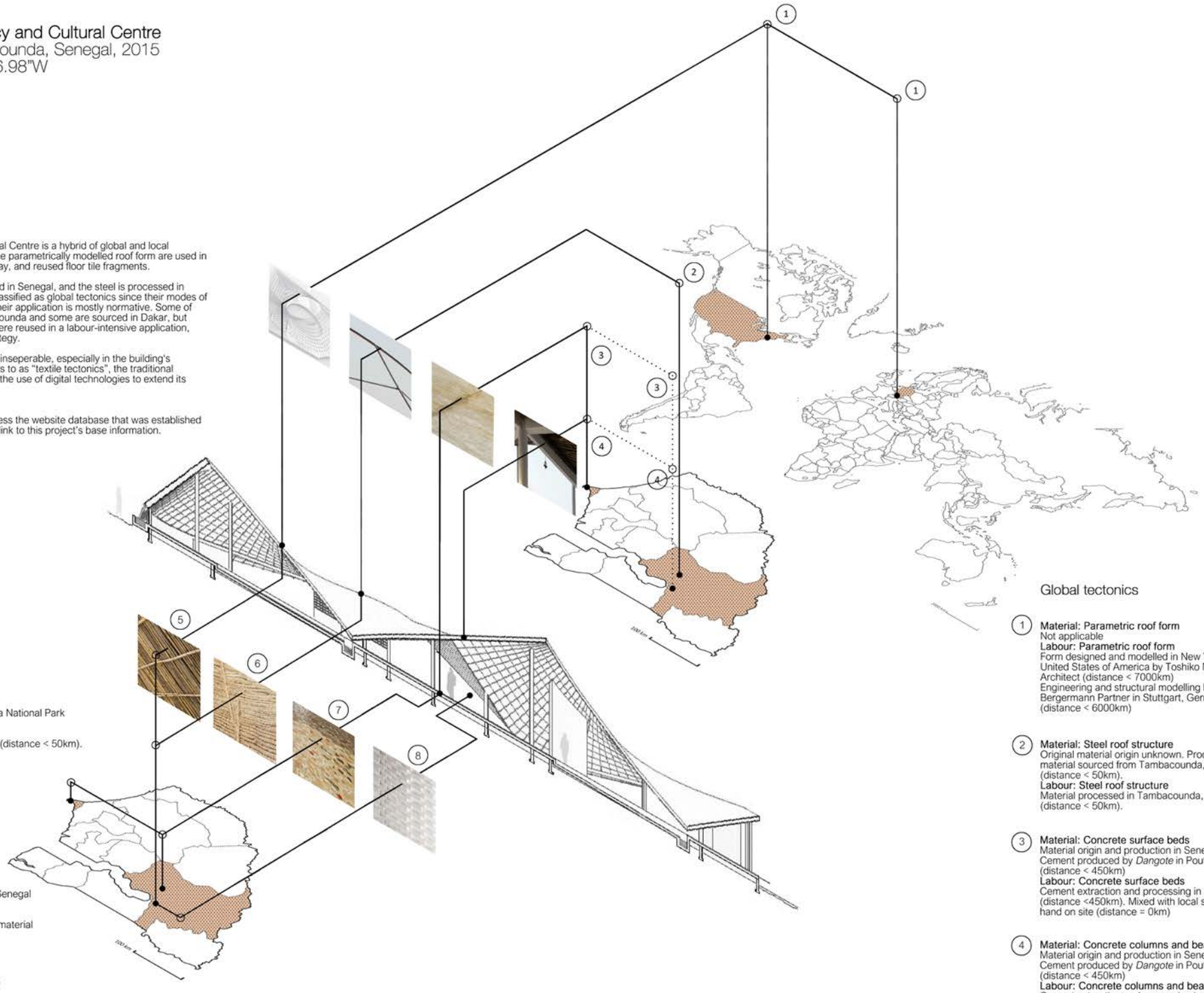
Toshiko Mori Architect

The Thread Artists' Residency and Cultural Centre is a hybrid of global and local tectonics. Cement, concrete, steel and the parametrically modelled roof form are used in conjunction with local bamboo, thatch, clay, and reused floor tile fragments.

The cement is extracted and/or processed in Senegal, and the steel is processed in Tambacounda, but these materials are classified as global tectonics since their modes of production are highly industrialised and their application is mostly normative. Some of the tile fragments are sourced in Tambacounda and some are sourced in Dakar, but since they are discarded materials that were reused in a labour-intensive application, they are regarded as a local tectonic strategy.

The global and local tectonics are mostly inseperable, especially in the building's recognisable roof form. In what Mori refers to as "textile tectonics", the traditional Senegalese roof form is inverted through the use of digital technologies to extend its vernacular application.

*The QR code above can be used to access the website database that was established as part of this study, and it willl provide a link to this project's base information.



Local tectonics

5 **Material: Roof substructure**
Locally grown bamboo from Niokolo-Koba National Park (distance < 50km)
Labour: Roof substructure
Extraction in Niokolo-Koba National Park (distance < 50km). Processing on site (distance = 0km)

6 **Material: Thatch**
Thatch grown and processed in Sinthian (distance < 5km)
Labour: Thatch
Extraction and processing in Sinthian (distance < 5km)

7 **Material: Floor tiles**
Reused floor tile fragments from Dakar (distance < 450km) and Tambacounda, Senegal (distance < 50km)
Labour: Floor tiles
No extraction and processing for reused material (distance = 0km)

8 **Material: Brickwork**
Local clay from Sinthian (distance < 5km)
Labour: Brickwork
Extraction in Sinthian (distance < 5km) Bricks made on site (distance = 0km)

Global tectonics

1 **Material: Parametric roof form**
Not applicable
Labour: Parametric roof form
Form designed and modelled in New York, NY, United States of America by Toshiko Mori Architect (distance < 7000km)
Engineering and structural modelling by Slaich Bergermann Partner in Stuttgart, Germany (distance < 6000km)

2 **Material: Steel roof structure**
Original material origin unknown. Processed material sourced from Tambacounda, Senegal (distance < 50km).
Labour: Steel roof structure
Material processed in Tambacounda, Senegal (distance < 50km).

3 **Material: Concrete surface beds**
Material origin and production in Senegal. Cement produced by *Dangote* in Pout (distance < 450km)
Labour: Concrete surface beds
Cement extraction and processing in Senegal (distance <450km). Mixed with local sand by hand on site (distance = 0km)

4 **Material: Concrete columns and beams**
Material origin and production in Senegal. Cement produced by *Dangote* in Pout (distance < 450km)
Labour: Concrete columns and beams
Cement extraction and processing in Senegal (distance <450km). Mixed with local sand by hand on site (distance = 0km)

> *vernacular forms. The installation demonstrated that these forms are inherently imbued with sophisticated wisdom and design excellence, and with accurate observation and careful attention, we can achieve elegant solutions using such traditional forms and techniques"* (2020b: 55).

She writes that "Vernacular knowledge was extended into more contemporary engineering techniques to create a large, institutional public building using local labour and materials" (2020b: 55). Parametric design, as a global tectonic strategy, was used to invert the local tectonic strategy of a traditional pitched roof form and to provide as large a surface as possible to maximise the usable footprint and to harvest rainwater, which is collected in two 570m³ reservoirs (Mori, 2020b: 55; Mostafavi, 2016: 218)[165]. TMA worked in close collaboration with the structural engineers Schlaich Bergermann Partner (SBP)[166] in New York and Stuttgart on its design and construction; SBP wrote a number of books about bamboo construction so they are familiar with the material, but the parametric form and the required spans presented a number of challenges. They undertook the computational analysis for the roof's structure, which resolved itself essentially into hyperbolic paraboloids with two juxtaposed oval openings. The inversion of the roof allows for the creation of courtyards and shaded outside areas, and the two openings allow for natural ventilation and structural support, while also allowing the sound of drumming to emanate from the courtyards (Mori, 2014: np.; 2020b: 55)[167]. The bamboo for the roof structure was obtained from Niokolo-Koba National Park within fifty kilometres of the site[168], while the thatch was harvested on site. Its application is thicker than usual to improve its insulation and acoustic properties, and Mori notes how a similar application at the Fass School makes a difference of close to seven degrees Celsius from outside to inside (Mori, 2019: np.). The roof construction of the Fass School is similar to that of the Thread Centre, although its form was more clearly inspired by the impluvium compounds of Ziguinchor and Casamance in Senegal (Mori, 2020b: 68).

Safety, comfort, and social interaction are driving factors in Mori's work, and she is also acutely aware of the issues around maintenance. According to her, "When you think of a building being well maintained, you have to think of life cycle and performance, by whom and how it is maintained. Materials — where it came from, where it's going. And then I think I'm very careful about who's building and supply chain, because it becomes part of community" (2018: np.). In the case of Thread, Mori notes how the thatching is sometimes blown off in high winds, but that local community members are able to

Figure 71 (previous page): *A visual analysis of the origins of materials and labour that were used for the Thread Centre. Source: Author, based on a photo by Iwan Baan.*

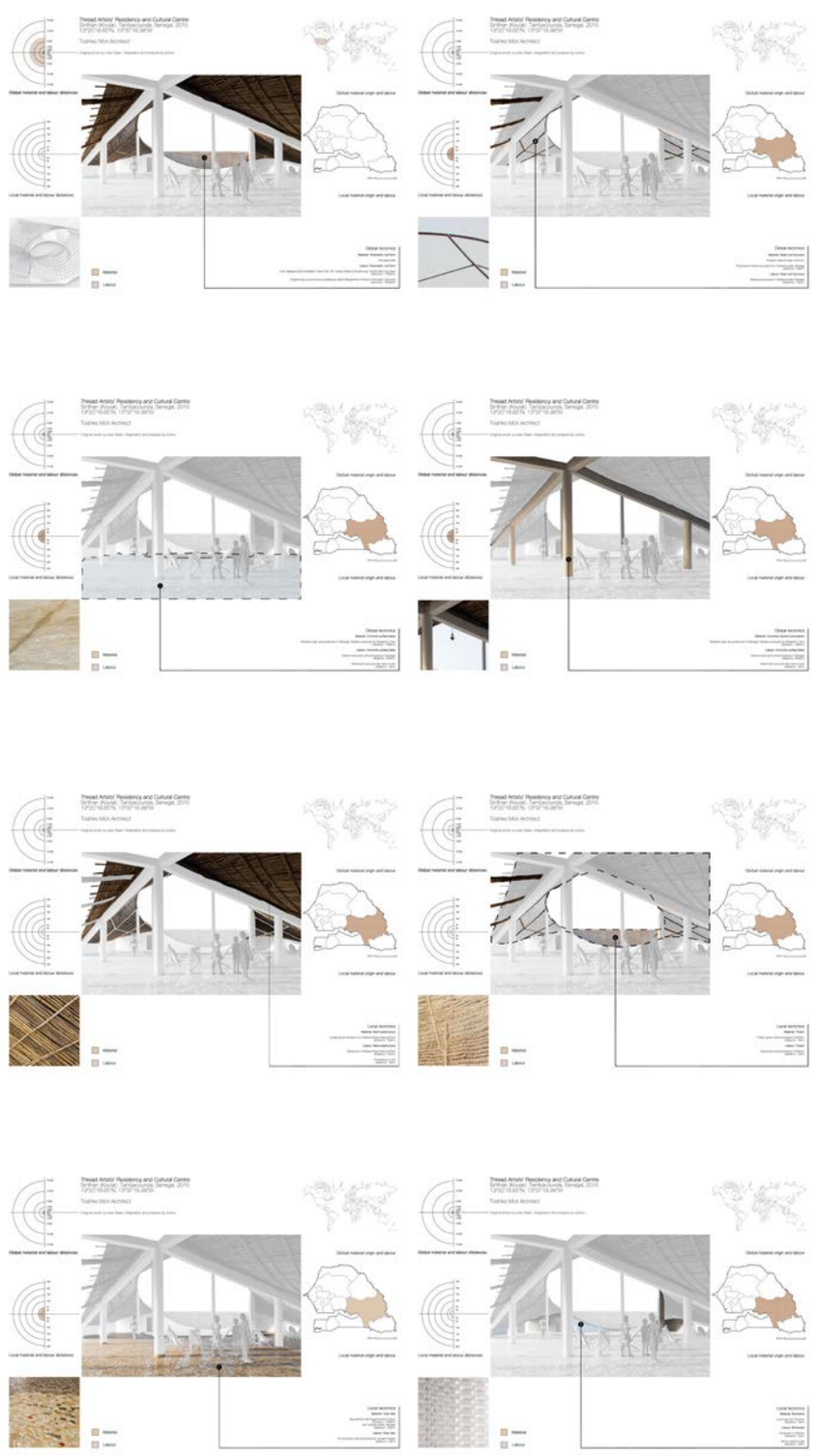


Figure 72: *A visual analysis of the origins of materials and labour that were used for the Thread Centre. Larger scale versions of the images can be viewed in Appendix C. Source: Author, based on a photo by Iwan Baan.*

cut the grass locally and repair it themselves using their traditional thatching techniques. This provides occasional employment, but it also contributes to the community's sense of ownership. The roof was rethatched recently, and she recognises the value of maintaining not only the building itself, but also the local skills that enable its repair[169]. This is reminiscent of the Japanese tradition of rebuilding the *Ise Jingu* shrine, which is keeping traditional skills alive, while also regularly employing a large group of local artisans (Louw, 2017).

Similar to textiles, the Thread Centre's roof's strength is based on its organisational composition where density and layering provide stiffness where needed. Reitz and Baerlecken (2009: 61) write how textile techniques used in the form of "knotted nets" are interconnected fields that are able to transfer forces very effectively, and Mori notes how "The key to applying textile tectonics to structural frameworks intelligently is the rethinking of structure as not simply a matter of balancing compression against tension, but rather conceiving the surface as an area that transmits forces" (2020b: 131). Anni Albers (2010: 29) writes that design and making are inextricable and that "The structure of a fabric and its weave – that is, the fastening of its elements of threads to each other – is as much a determining factor in its function as is the choice of the raw material. In fact, the interrelation of the two, the subtle play between them in supporting, impeding, or modifying each other's characteristics, is the essence of weaving".

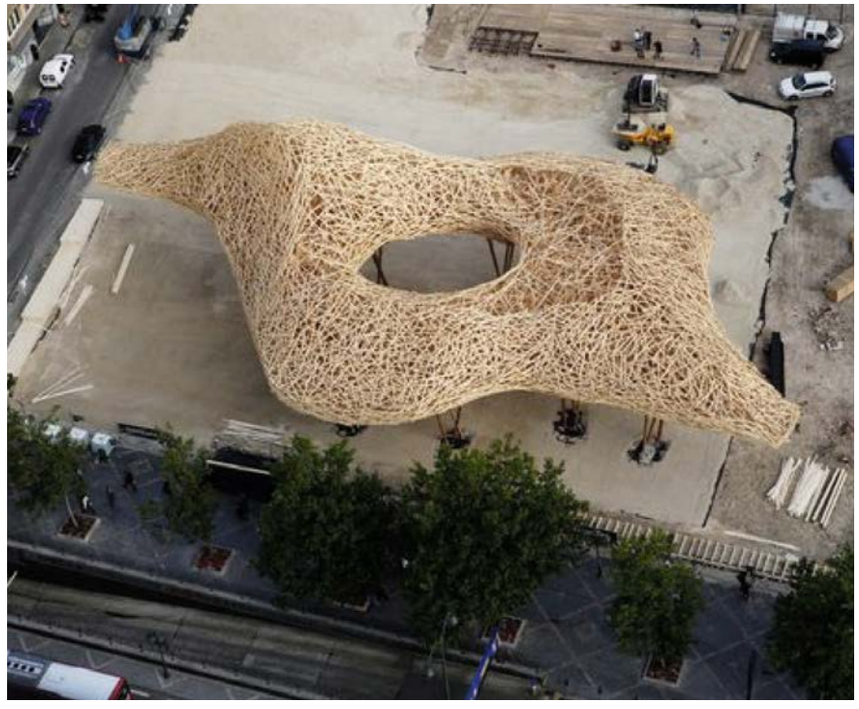
Figure 73 (opposite):
The Fass School. Source: Iwan Baan/Sofia Verzbolovskis [Online] Available: https://tmarch.com/fass (Accessed 2 October 2020).

Figure 74 (left):
Impluvium houses in Senegal. Source: Holm and Kallehauge, 2015: 143 (photographer unknown).

The roof construction employs techniques that are typically associated with weaving as inspired by the work of Anni Albers: There is variation in the spacing of certain elements depending on whether additional strength is required or not and there are different overlapping configurations; in some instances (where the roof form is flatter) two pieces of bamboo are used perpendicularly on top of one another, while in other instances (where the roof form is radial) the elements are woven in such a way that one perpendicular piece is sandwiched between two parallel ones (Mori, 2014: np.[170]). As a textile technique that makes use of straight elements to form curved surfaces, this is what Reitz and Baerlecken (2009: 61) describe as *interlacing bars* in reference to the work of Arne Quinze, in particular his installation entitled "Uchronia" at the Burning Man festival in 2006, and "Cityscape" in Brussels in 2007. In Mori's buildings the bamboo is tied together using a Japanese lashing technique (Mori, 2020b: 61, 73), which makes the roof a dynamic structure that has enough flexibility to move in high winds, but which allows it to return to its original form afterwards. The individual joints and the weaving technique help to disperse the applied forces and loads, in the same way that textiles are able to. Referring to the work of Anni Albers[171], Mori calls this textile tectonics, and one of her aims is to explore the relationship between textiles and architecture "to extend the attributes and concept of textile tectonics to reconceive architecture" (2020b: 129).

Mori's focus on weaving and the individual joint is reminiscent of Semper and Frampton's work, especially if one considers Frampton's view of the joint as the "primordial tectonic element" (2002: 95). In addition to culture as infrastructure, she also sees details as infrastructure where "fragments may contain larger messages and become essential moments" (2020b: 17), and her close engagement with detailing and tectonics is evident in the "Dialogue in details" exhibition[172] at the 2012 Venice Biennale, which challenges the viewer to consider the possibility that "the details of architectural practice, the physical joinery, the valuable little interstices, can be compounded or intensified to the scale of infrastructure" (2020b: 164).

The brickwork of the Thread Centre is inspired both by the work of Josef Albers, and by local Senegalese examples which are reminiscent of Tropical Modernism (Mori, 2014: np.; 2020b: 58). This led the architects to adapt Albers' technique of angling bricks to allow for openings between them to allow natural ventilation[173]. According to Mori, the local soil is highly alkaline which makes it ideal for compressed earth bricks, which meant that all the brickwork could be made on site using a local base material[174]. Another local



Figures 75 and 76: *Interlacing bars used as a textile technique for* Cityscape, *Brussels, 2007, by Arne Quinze. Source: Arne Quinze [Online] Available: https://www.arnequinze.com/art-and-exhibitions/cityscape (Accessed 4 November 2020).*

tectonic strategy was to use broken tile fragments for the flooring: The reused fragments were sourced from Dakar (which is approximately 450 kilometres away) and Tambacounda (within 50 kilometres of the site). Despite the distance to site, the fact that the fragments are being reused qualifies them as a local tectonic strategy. The tile fragments also have an interesting parallel with Tange's Kagawa Prefectural Office which has a famous mural[175] by Genichiro Inokuma, but Mori points out a mural by the City Architect Tadashi Yamamoto in the building for which he used discarded broken tiles to depict agricultural scenes (2019: np.).

While Mori claims that "the design of the Thread Centre relies exclusively on local materials and construction techniques" (2020b: 54), there are a number of global tectonics besides the parametric roof form that were used based on the definition in this study. They were, however, used sparingly, and while the primary concrete structure was envisaged from the start, Mori admits that steel members were introduced[176] to enable the thatch roof to achieve the necessary spans and form[177]. The cement for the concrete (which was mixed in Tambacounda) was extracted in Senegal and sourced from *Dangote* in Pout, which is about 450 kilometres away. The origin of the base material for the steel is unknown, but it was processed in Tambacounda within fifty kilometres of the site[178]. A global tectonic that is not strictly speaking part of the architecture is the highly advanced plastic liner for the underground cisterns, which was supplied by Yuki Nomura from Japan (Weber in Mori, 2020b: 229),

Figure 77 (opposite):
The structural steel members used in combination with the bamboo and thatch for the roof. The steel members were eventually wrapped with thatch to reduce their visibility. Source: Iwan Baan. [Online] Available: https://www.archdaily.com/608096/new-artist-residency-in-senegal-toshiko-mori/54ffa407e58ece792b00001a-process3-png (Accessed 2 October 2020).

Figure 78 (left):
A collage analysis of the Thread Centre that tests the visual balance between global and local tectonics. The global and local tectonics have a similar weighting, and interestingly the global and local tectonics are almost all present in both conditions. This is different to the previous projects where they were mostly either global or local, but the simultaneity in this case suggests that they are not easily separable. This suggests a different condition where the classification becomes blended and begins to shift towards a hybrid condition. Source: Author, based on a photo by Iwan Baan.

but its inclusion is crucial to the success of the agricultural operations since it prevents evaporation and contamination. An advantage of the structural frame (as described by Gropius, 1935, and by Berlanda and Smith, 2018) is that it makes wide-span structures possible with a reduction in material but by replacing low-carbon materials with high-carbon ones. Although high-carbon materials like steel and concrete are structurally more efficient, they do contribute significantly to a structure's embodied energy. However, the use of digital or parametric software that enables traditional low-carbon materials to achieve wider spans and innovative forms could potentially revolutionise building practice, especially in the global South.

In terms of her own encounter with local tectonics in Senegal, Mori notes how local community members did not really have to be trained, since they already had the necessary skills and that there were not any inherent challenges; the incorporation of local materials, labour, and traditional skills was seamless and she remarks that "I was very much surprised as to how well, how precisely they were building. I think they have methods of building in modules and organised layers"[179]. The project management and construction were undertaken by local community members under the leadership of Dr. Magueye Ba[180], which means that ease of construction by hand was important[181]. The design and structural resolution of the roofs at Toshiko Mori's Thread Centre and Fass School do not have what Frampton describes as "no other aim than the generation of exotic form as an end in itself" when he critiques some modes of digital design and production. These buildings expand the possibilities of the local materials and craft traditions and allows them to exceed their previous capabilities. The innovative forms allow them to achieve greater spans (albeit with some assistance from concealed structural steel elements), previously unimagined shapes, and to harvest rainwater in an architecturally expressive way, while still representing local form-making traditions. The reinterpretation of tradition, the use of local materials and craft, and the consideration of climate add additional layers of meaning to the digitally designed and modelled form; the socio-environmental underpinnings of the building's tectonic resolution, and Mori's consideration of otherness (both social and natural) are based on her own ethical positionality. In Lepik's words, "Eventually, everything has led back to the ethical footprint of architecture: rethinking and expanding an architecture practice towards the existential challenges with which our global society is confronted, Toshiko Mori has contributed substantially to what has been called the *social turn in architecture*" (2020: 9).

This chapter begins with a description of the creation of a tectonic

catalogue that is based on the identification and investigation of more than a hundred works to date, and its development into an open access website which can be expanded and developed over time. Through the discovery of common tectonic strategies across the spectrum of the global and the local, a number of constellations of works could be discerned that make use of similar strategies. Detailed analysis of emblematic works within these was undertaken through primary data collection and visual analysis. Through these analyses, this chapter offers insights into specific approaches towards the hybridisation of global and local tectonics in Africa.

It develops a constellation of works where a combination of global tectonics is used in a state of adjacency to local tectonics, especially local labour and natural materials, as can be seen in an extensive range of projects in Rwanda. A second constellation of works reveals a tendency where local "informal tectonics" are used in combination with global tectonics to serve as didactic collages for students and local residents in South Africa. And finally, it reveals a distributed digital constellation of works, and how emblematic works of this constellation in Senegal combine global digital form-making with local materials and building practices in what can be understood as textile tectonics. These constellations and analyses demonstrate the existence of critically situated practices across geographies.

Chapter 4 endnotes

1 Specifically those by Francis Kéré in Burkina Faso.
2 The information was researched and uploaded by the author, using base information from Google maps and website infrastructure by Semantica. This was made possible through UCT Research Grant funding. The ambition is to source further funding to improve the graphic content of the site and to add additional projects from within the study period and beyond.
3 This is a dispersed constellation of projects that made use of computer-aided design (CAD) and computer-aided manufacturing (CAM) to generate form and to facilitate tectonic assembly.
4 Furthermore, Rwanda had an annual growth rate of 8% from 2001 to 2012 (Holm and Kallehauge, 2015: 167).
5 The acronym MASS stands for a Model of Architecture Serving Society, and it was founded in 2008 by Michael Murphy and Alan Ricks.
6 Butaro Doctors' Housing (2012), Butaro Cancer Centre of Excellence (2013), Butaro Sharehousing (2015), and Butaro Oncology Support Centre (2019).
7 ASA was founded by Tomà Berlanda and Nerea Amòros Elorduy in 2012, and was taken over by Francesco Stassi, Alice Tasca, and Zeno Riondato in 2014.
8 Alice Tasca from Italy initially went for three months in 2010 to study local materials and technology before returning a year later to teach at what is now known as the *School of Architecture and Built Environment* at the University of Rwanda. She eventually purchased ASA from its original founders in 2014 along with Zeno Riondato and Francesco Stassi. Riondato from Italy joined ASA in 2012 while Stassi, also from Italy, moved to Rwanda in 2013 specifically to work with ASA, since he saw a more pronounced need in Africa for socially minded architecture. Source: Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
9 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
10 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
11 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
12 Tasca, A. (2019b). *Personal interview with author,* ASA's office, Kigali, Rwanda, 12 March 2019.
13 Stassi, F. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
14 He mentions brickwork specifically, where different bonds or perforated patterns can be used to allow for variation and natural ventilation.
15 Stassi, F. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
16 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
17 According to Lepik (2013: 225), the project employed up to 3500 people for the foundations and structural work, and it contributed $4 400 000,00 to the local economy.
18 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
19 Tasca remarks that "After working with several nonprofits, I realized that the idea of a 'nonprofit' doesn't really exist. It just involves profiting in a different way. Some of these agencies are big machines that have a lot of overheads and can only direct so much into their projects. We prefer to have a client that wants to invest money in a project—not prioritizing a financial return, but a return for the future of this country. In contrast, smaller NGOs have less bureaucracy related to fundraising, internal management, and how they might select the community for which they want to design the project. That framework tends to lead to better outcomes" (Tasca in Loké, 2019: 56). One of ASA's other Principals, Zeno Riondato, acknowledges that their practice adapts some of the principles that are typically used by non-profit organisations, but that they prefer to minimise the bureaucracy involved with those (Loké, 2019: 56). ASA also aims to operate as a social enterprise through *ASAReacts*, the purpose of which is to work specifically with the Rwandan Ministry of Health.
20 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
21 Stassi recalls some initial experiments with timber roofing structures, but he describes them as being problematic since locally sourced structural timber is often not dried, it is not as durable as steel, and there is no sustainably sourced local structural timber in Rwanda. According to him, the nearest certified source is in Uganda (2019: np.).
22 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.; Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
23 Stassi, F. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
24 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.; Stassi, F. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
25 Since they generally do not allow for community involvement or local production.
26 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
27 Stassi and Tasca (2019: np.) mention that the use of earth construction (including CEBs) is not permitted for public buildings in Rwanda, although this does seem to be contradicted by a number of completed public buildings like the Butaro Doctor's Housing, the Kimisagara Football for Hope Centre, and the Urugo Women's Opportunity Centre among others, all of which made use of compressed earth bricks (although in some instances they may have been stabilised).
28 Stassi, F. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
29 ASA does this by putting them in water to see if they become clay again, which is similar to Kéré's method of demonstrating the durability of his stabilised bricks to the community.
30 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
31 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
32 Trees are often chopped down to obtain the timber that is needed to fire the bricks.
33 They write that it uses less concrete (and therefore saves cost) since it makes use of traditional materials and technologies, local labourers can be trained to work with reinforced concrete quite easily, while local residents can build and finish the walls using local or traditional methods. They go on to note that another advantage is that thin-tile floors or vaulted ceilings can be made with masonry materials and technology using the Catalan vaulting technique, and that the system's structural geometry, together with its material properties, can address moderate seismic design requirements while using the minimum amount of material.
34 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.; Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
35 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
36 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.; Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's

office, Kigali, Rwanda, 12 March 2019.
37 The rate of eradication of the reeds became too high, and their use was subsequently substituted by more durable Eucalyptus lathes.
38 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
39 While their clients prefer not to have the steel roofing structure visible, ASA sees this assembly of adjacent materials as a good compromise which is cost-effective and one that balances cost, comfort, and aesthetics (Stassi and Tasca, 2019: np.).
40 De Dieu, J. (2019). *Personal communication*, Umubano Primary School, Kigali, Rwanda, 13 March 2019.
41 This organisation was launched in September 2016 and it was fully funded by MASS Design Group. It focuses on design education and leadership in Africa.
42 It is funded by the charitable foundation M² and the District of Musanze, and according to MASS Design Group, the school "offers opportunities far beyond the construction of a building. This project aims to prove that design interventions across a school campus can improve learner outcomes, increase satisfaction among students and teachers, and increase student retention rates.
43 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.; Uwayezu, T. (2019). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
44 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.; Uwayezu, T. (2019). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
45 MASS Design Group (2019), and the African Design Centre as cited by *Afritecture* [Online] Available: http://africanism.net/ruhehe-school-an-exemplary-case-of-building-with-and-by-local-community/ (Accessed 22 October 2019) and *Archidatum* [Online] Available: http://www.archi-datum.com/projects/ruhehe-school-african-design-centre/ (Accessed 10 September 2020)
46 African Design Centre. (2019). *Curriculum*. [Online] Available: https://www.africandesigncentre.org/curriculum (Accessed 10 September 2020)
47 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
48 OZ Architecture. (2007). *Kigali Conceptual Masterplan*, November 2007: 7.
49 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
50 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.; Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
51 Lefaivre and Tzonis, 2012: 187.
52 In terms of educational design, Rwanda's existing UNICEF standards have to be used as a starting point, but MASS Design Group's aim with their schools is to generate new replicable design standards that are based on a critical engagement with these (Gruits in Murphy and Ricks, 2019: 155).
53 And Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
54 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
55 In this study, "recycled" refers to downcycled, recycled and upcycled materials. With recycling, the original product is destroyed in the process.
56 In many cases instant settlements become known by words associated with these practices (for good or bad), like the North African term *bidonvilles*, where buildings were made from flattened oil drums or *bidons*, the Moroccan *mudun safi* or "metal towns", the *imijondolos* in Durban, South Africa, where packing crates for John Deere tractors were used to make houses in the 1970s (Edgerton, 2007: 97; 2019: 41), or "temporary" relocation areas like *Blikkiesdorp* (Afrikaans for "tin can town") in Cape Town, whose name is a reference to *blikkies* or tin cans since the settlement is made mostly out of corrugated metal sheets like most "informal" or temporary settlements. This has a further connotation with the personal residence and studio of Carin Smuts of CS Studio Architects, since this rather unique building was dubbed Blikkiesdorp by disgruntled local residents who felt that its aesthetic was not in keeping with the other buildings in Seapoint, Cape Town (the word was also graffitied onto the building's boundary wall).
57 Statistics South Africa. (2020). *The living conditions*. [Online] Available: http://www.statssa.gov.za/?page_id=595 (Accessed 15 September 2020)
58 Under the name buildCOLLECTIVE.
59 The University of Art and Design in Linz (under the name BASE*habitat*) also works in Botswana, the Central African Republic, the Democratic Republic of Congo, Thailand, Bangladesh, and India; the RWTH Aachen, PBSA, and Georgia Tech (under the name Design.Develop.Build.) also work in Botswana, Guinea, and Ghana.
60 The *Ecole Nationale Supérieure d'Architecture* (ENSA) *de* Nantes, and the Nelson Mandela Metropolitan University.
61 Heiermann's own personal interest is adobe construction (Heiermann, 2019: np.).
62 She mentions Roswag und Ziegert, especially their design-build project in Bangladesh with Anna Heringer.
63 The Montic Factory Preschool in Johannesburg, 2006.
64 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
65 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
66 In particular his book *Detained: A writer's prison diary* first published in 1981.
67 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
68 According to Frey (2016: 93), *Guga S'Thebe Kudala Usophulela* is an idiom in the Xhosa language "praising an ageing serving platter for its enduring service".
69 Its creation was initiated by Simon Galland and Sylvain Guitard.
70 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
71 At the *École Nationale Supérieure d'Architecture de Nantes* (ENSA Nantes) where he also completed his undergraduate education.
72 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
73 He returned to France on 27 September 2020 partly due to challenges related to the Covid-19 pandemic and in order to be involved with two new projects in Nantes.
74 These include *Love Stay* and *Indalo* among others (Saga, 2015: 9).
75 These include, among others, the SECU and MACU units in Ethiopia by the Bauhaus Universität Weimar and Addis Ababa University/EIABC in 2012 and 2014; the Kibera Hamlets School in Kenya by Selgas Cano, Hello Everything, and Studio 14 in 2016; the Konokono Vaccination and Educational Clinic in Kenya by Selgas Cano, Ignacio Peydro and MIT students in 2014; the Katiou Library in Burkina Faso by Albert Faus in 2014; and Mwito Pre-Primary School in Rwanda by Creative Assemblages in 2019.
76 According to the South African Council for the Architectural Profession (SACAP), there are more than ten thousand registered architectural professionals and candidates. [Online] Available: https://www.sacapsa.com/ (Accessed 16 September 2020)

77 These include architects like CS Studio, Crafford and Crafford Architects (now PlanEco), the Natural Building Collective, Tsai Design Studio, and Collis and Associates, among others.
78 Rural Studio mainly works in what is known as West Alabama's Black Belt. The area's name originally in referred to its black topsoil, but it gained a layered meaning because of the widespread employment of African American slave labour on the region's cotton plantations. Mockbee refers to spaces like the Black Belt as "taboo landscapes" where affluent people often fear to tread (Dean and Hursley, 2002: 6).
79 The author and some of his students were fortunate enough to participate briefly in the manufacturing of light clay panels for the Guga S'Thebe Theatre in Langa, and also in the wall construction for Ukuqala 3 with staff and students from the Universität Stuttgart.
80 *Still life with chair caning* (1912) was the fist and he expanded on his practice with well-known pieces like *Bull's Head* (1942).
81 Especially his works *Fountain* (1917) and *Bicycle Wheel* (1913).
82 The Blind Man. 1917. The Richard Mutt case. In *The Blind Man*, May 1917, Number 2, pp. 5. [Online] Available: https://monoskop.org/images/6/6f/The_Blind_Man_2_May_1917.pdf (Accessed on 16 April 2019).
83 He writes that "The magic of the arts of Africa and its diaspora has always derived from its power of dematerialisation, its capacity to inhabit the commonplace and sensible, precisely with the aim of transforming it into an idea and event" (Mbembe, 2015: 53).
84 Referring to Clara da Cruz Almeida's description of the Northern Cape Legislature Building in Kimberley, South Africa, which was designed by Luis Ferreira da Silva Architects and completed in 2004.
85 A sangoma refers to a traditional healer or so-called "witch doctor" in southern Africa.
86 The house has been continually evolving since then.
87 He refers to his novel *Sybil* or *The Two Nations*, which he wrote in 1845.
88 They focus specifically on the Agbogbloshie Makerspace Platform (AMP) in Ghana, which can "facilitate a new synthesis between international developments in innovation and the creation of more locally formed, locally contingent, and locally led maker groups" (2017: 133).
89 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
90 Braverman (2010: 79) writes in 1974 that a building's process of production is "replicated in paper form before, as, and after it takes place in physical form". He refers to this paper replica as "the shadow form".
91 As described by Folkers (2011: 52).
92 It should be noted that risk and certainty in relation to global and local tectonics can often be inverted in the global South, where a familiar material and technique that can be easily maintained might often be less risky than an expensive imported element that requires specialist knowledge to maintain.
93 An Afrikaans word which, when literally translated means "reed mat houses". These *matjiehusie* or *!haru oms* as they are called in the Nama language, are still used by the Nama today (Louw, 2017: 98).
94 The practice of making decorative geometric patterns on the outside of dwellings by moulding or engraving the outer earthen skin, which sometimes also involves adding colour to the surfaces.
95 Some of the techniques that they used at the temporary Community Hall are a repurposed shipping container, car tyres and repurposed concrete elements for retaining walls, repurposed telephone poles for the primary structure, repurposed pallets for walls, recycled glass for aggregate in the floor slabs, and repurposed glass bottles for a semi-translucent gable wall. Some techniques result in elements that are easier to maintain than others: The tyres, poles and pallets are fairly easy to maintain and replace, but one of the lessons learnt was that the glass bottles are not durable enough and extensive breakage (primarily because of vandalism) resulted in the building being partially exposed to the elements (Galland, 2019: np.).
96 And Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
97 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
98 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.; Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
99 And Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.; Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
100 The acronym stands for Reconstruction and Development Program, which is a policy that was implemented in 1994 in South Africa that aimed to provide large numbers of affordable housing units to disadvantaged members of the population.
101 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
102 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
103 And Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
104 Some sources state that the Guga S'Thebe Theatre was completed in 2015. Unfortunately, the building suffered extensive fire damage in August 2020 and efforts are underway to obtain the necessary funds to repair it.
105 According to Smuts (2020: np.), *AIT* initially engaged with CS Studio Architects and subsequently approached the RWTH Aachen and PBSA Düsseldorf to also become involved.
106 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
107 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
108 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
109 Design.Develop.Build. (2016). *Guga S'Thebe Children's Theatre*. [Online] Available: https://architizer.com/projects/guga-sthebe-childrens-theatre/ (Accessed 6 May 2019)
110 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
111 This can be challenged based on the need for insulation and finishing, while container costs have also risen significantly in recent years.
112 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
113 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
114 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
115 Design.Develop.Build. (2016). *Guga S'Thebe Children's Theatre*. [Online] Available: https://architizer.com/projects/guga-sthebe-childrens-theatre/ (Accessed 6 May 2019)
116 Some sources state that the façade is based on patterns found in Xhosa beadwork (Architizer. 2017. *Guga S'Thebe Children's Theatre*. Retrieved from https://architizer.com/projects/guga-sthebe-childrens-theatre/ on 10 May 2019: 1)
117 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.

118 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
119 *Ampa Plastics Group (Pty.) Ltd*., previously known as *Modek*.
120 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
121 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
122 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
123 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.
124 This is similar to Georges Braque's assertion that the space between objects in a collage is very important.
125 Despite the new preschool having been operational since 2017, the temporary one was also being used as a preschool during a visit in 2019, mainly due to the lack of similar facilities.
126 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
127 Galland, S. (2020). *Availability – Composition - Improvisation*. Presentation, Appropriate Technologies elective, BAS Honours program, School of Architecture, Planning and Geomatics, University of Cape Town, South Africa, 3 March 2020.; Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
128 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
129 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
130 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.
131 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.
132 Brooks Stevens, an industrial designer, is credited with the modern use of the term. He used it in a speech at a marketing conference in 1954 (Livesey, 2017: 98-99). Livesey writes how planned obsolescence was initially intended as a positive measure to provide more employment during the Great Depression, but that the environmental costs were not considered at the time (2017: 98).
133 She remembers how her grandmother took her to Kyoto every weekend, and that she became deeply familiar with the architecture, culture and literature (2019: np.).
134 She lists John Hejduk, Raimund Abraham, Tod Williams, Richard Meier, Bernard Tschumi, Ricardo Scofidio, and Charles Gwathmey.
135 She specifically mentions his 1984 entry for the Prinz-Albert-Palais competition in Berlin. Entitled "Victims", it is also referred to as "a construction of time" (Mori, 2020b: np.).
136 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
137 And Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
138 Kisho Kurokawa, a former student of Kenzō Tange and a fellow Metabolist, sees Shin'ichiro Okada as one of the pioneers who attempted to combine global (Western) references with traditional Japanese ones (Kurokawa, 1977/2007: 233).
139 And Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
140 Mori (2019: np.) specifically mentions how local timber craftspeople made the formwork by hand, and how stone was placed by hand in the building's ground floor.
141 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
142 Frampton (1992: 318) emphasises his sensitivity towards tectonic form and topography.

143 This is documented in Team 10 Online. (Undated). *Otterlo (the Netherlands) 7-15 September 1959, CIAM '59: The end of CIAM*. [Online] Available: http://www.team10online.org/ (Accessed 7 April 2020).
144 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
145 A thinktank led by Landon Brown.
146 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
147 Toshiko Mori Architect was awarded a Certificate of Excellence for the Thread Artists' Residency and Cultural Centre at the Africa Architecture Awards in 2017.
148 Mainly Senegal, Morocco and Ethiopia. However, there are some in other parts of Africa, like the Rwanda Cricket Stadium by Light Earth Designs (2017), the Guga S'Thebe Theatre in South Africa by CS Studio, Georgia Institute of Technology, PBSA Düsseldorf, and RWTH Aachen University (2016), and Ithuba Science Lab in South Africa by RWTH Aachen University (2012).
149 And Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
150 Unfortunately, by the time that the author had an opportunity to visit the site, the installation had already been removed.
151 Twelve full-scale prototypes have been built to date, but the first pilot prototype was Version 3.2 (Architecture and Vision, 2016: 10).
152 Manufacturing takes four weeks with eight people involved (Architecture and Vision, 2016: 30).
153 "Sustainable Emerging City Unit".
154 "Mobile Automated Contemporary Unit".
155 Until his unfortunate disappearance in 2017.
156 It makes use of automated production for its compressed straw boards, which are used with compressed wood, rubber, and metal components (Donath, 2016: np.; Franco, 2015: np.).
157 Donath, D. (2016). *Personal communication with author*, School of Architecture, Planning and Geomatics, University of Cape Town, South Africa, 22 September 2016.
158 Donath, D. (2016). *Personal communication with author*, School of Architecture, Planning and Geomatics, University of Cape Town, South Africa, 22 September 2016.
159 She mentions Edward Larrabee Barnes who studied under Breuer, and Hejduk who studied under Gropius and Breuer.
160 Rei Kawakubo of Comme des Garçons, a series of Charivari shops, and eventually Issey Miyake (Mori, 2018: np.).
161 "Extreme textiles – Designing for high performance" curated by Matilda McQuaid (2005), "Fashioning felt" curated by Susan Brown (2009), and "Colour moves: Art and fashion by Sonia Delaunay" curated by Matilda McQuaid and Susan Brown (2011).
162 It ran from 1 October 2004 – 27 February 2005 at the Cooper Hewitt, Smithsonian Design Museum, New York (Mori, 2020b: 123).
163 This began as a non-profit organisation that Josef Albers founded in 1971.
164 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
165 With an average daily consumption of 3 cubic metres per day, they can provide enough water for irrigation for seven months of the year (Berlanda, 2016: 7).
166 In particular Michael Stein.
167 Mori's consideration of not only structure and aesthetics, but also sun, shadow, ventilation and acoustics, addresses Reitz and Baerlecken's (2009: 63) call for the incorporation of these concerns when using textile systems as a base for algorithmic modelling.
168 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
169 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
170 And Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
171 Mori notes that the work of Anni Albers was the inspiration for calling the building "Thread" (2020a: np.).

172 This ran from 29 August 2012 – 25 November 2012, and it was curated in the form of a dialogue between TMA's work and the work of five well-known architects (Frank Lloyd Wright, Marcel Breuer, Ludwig Mies van der Rohe, Paul Rudolph, and Phillip Johnson). In a description which could just as well be applied to the Thread Centre, Mori writes that "It demonstrated an effort to respect their legacy but simultaneously to invent a contemporary solution" (2020b: 164).
173 A similar angled pattern to the brickwork was also used for the locally sourced timber doors (Fixsen, 2015: np.; Mori, 2020b: 58).
174 Custom-made metal moulds were used to make three types of CEBs on site: Curved ones (400x200x150mm) for the walls around the courtyards using sand and only a little cement, flat rectangular ones (400x100x100mm) for the perforated walls using a 3:1 sand-cement ratio, and slightly larger rectangular ones (400x200x120mm) for the rest of the walls using mostly lime (Berlanda, 2016: 5).
175 The mural is called *Wa-Kei-Sei-Jaku* or *Harmony, Respect, Purity and Tranquillity*. This refers to the four pillars of the tea ceremony.
176 According to Berlanda, these were introduced by the local contributors (2016: 8).
177 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
178 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
179 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.
180 With some assistance in terms of costing from a Tambacounda engineer called Thiam Cheikh Sidarth.
181 This meant that larger roofing elements like the oval ring beams were built on the ground and then tilted up by hand (Mori, 2014: np.).

Chapter 5: Tectonic ethics

The preceding chapters highlight a number of ethical issues related to technology, difference, professional practice, aesthetics, and the environment. Most of the works in the catalogue, and especially the selected works in the three constellations, are all strongly motivated and informed by the ethical positionality of the architects who designed them (and sometimes by that of the funders of the buildings). Even though there is not much common ground when it comes to architectural ethics, this chapter offers a brief overview of considerations that can help to locate the emerging phenomenon of hybrid tectonics in relation to ethics.

Architecture is regarded by several authors as a form of ethical investigation that is based on the consideration of habitation, people, personal subjectivities, and professional practice amongst others, and the consideration of these issues is further informed by social, political, environmental, and personal contexts and subjectivities (Vitruvius, 1960; Harries, 1984: 160; Levine, Miller and Taylor, 2004: 103; Ostwald, 2004: 218; Sweeting, 2004: 5; Collier, 2006: 307). Collier (2006: 308) argues that architects can use *moral imagination* to provide spaces for social life, and that this function is inherently an ethical one; architects are however not necessarily moral, and the pursuit of respect, empathy, dialogue, responsibility, and the understanding of specific socio-environmental contexts requires the fostering of “social, ecological

and technological knowledge". Harries (1975: 14) writes that architecture can contribute to the establishment of the ethos of a place or a community, and that this is its ethical function, while Ostwald (2004: 204) traces the origins of ethics to the relationship between an individual and the collective in terms of shared values.

Technology and ethics[1]

According to Hartoonian (1994: 1), Laugier's primitive hut's architectonic form could only have been achieved by considering both values and technē, and he goes on to say that "Heidegger considered *techne* both 'poetic and revealing'. In this paradox, *techne* not only designates tools and fabrication, but signifies, primarily, its place in the world of values, that is, 'knowing'" (Hartoonian, 1994: 40). While Heidegger's value system can be questioned in terms of his involvement with the Nazis (George, 2015: 21), he does have a clear concern about the impact of technology on (some) people and the environment. According to Harries (1984: 160), Heidegger's description of a farmhouse in *Building, Dwelling, Thinking* (1954) describes the ethos of dwelling by incorporating community, spirituality and nature, although he does raise the question whether it could be seen as a "romantically anachronistic idealisation" which does not offer the potential freedoms that are associated with modern life. Bernstein (1991: 88) also highlights Heidegger's emphasis on ethics in relation to technology and he refers to Heidegger's remark that "The greatest care must be fostered upon the ethical bond at a time when technological man, delivered over to mass society, can be kept reliably on call only by gathering and ordering all his plans and activities in a way that corresponds to technology (Heidegger, 2011c: 174). Frampton (in Crittenden and Henningsson, 1998: 81; Frampton, 1979: 314) is also of the opinion that it is impossible not to question values when considering architecture, and he says that it is often linked to ideology, while Skolimowski (1972: 9) observes that moral and social considerations are powerful forces in the production and implementation of technologies. He goes on to argue that technological possibilities should not only be concerned with profit, but that they must be concerned with their intended and unintended consequences. He refers to these types of technologies as "socio-technological possibilities" that "incorporate concern with the well-being of society and individuals" (1972: 9).

The relationship between the Arts and Crafts movement and social values is well-documented: Nielsen (2012: 10) and Jacob (2017: 96) note how for John Ruskin, design was integral to its social and economic context and that it acted as a "moral compass". Coetzer (2017: 2) and Hartoonian (1994: 56) acknowledge that proponents of the Arts and Crafts were concerned about the moral issues of architectural production, and Hartoonian admires their awareness that secularisation was eroding traditional values[2]. He goes on to say that "We should rather give attention to the dichotomy between technology and the moral values of tradition in Morris's thought. Morris was critical of the industrial developments of his time because of their impact on moral values, but nevertheless, his vision of the 'pleasure of work' proposes an industrial technology integrated with the ethics and morality of the guild system" (1994: 30). Frank Lloyd Wright referred to Morris as the great socialist and to Ruskin as the great moralist, and he believed that had Morris lived in a time where machines had been slightly more advanced, it would have become apparent to him that they could be a democratising force (2007: 2). In Wilkinson's opinion, William Morris might well have approved of the work being done at the Bauhaus and that he recognised the value of mechanisation in later years (2017: 57), although Hartoonian writes that "Morris, in his struggle against the alienation of industrial work, was seduced by the myth of handwork and its beauty. Gropius, in contrast, misrepresents the differences between craft and industrial technology and thus dismisses the whole issue of secularization" (1994: 32). While Hartoonian (1994: 16) is of the opinion that technology transcended cultural values during early Modernism, the Bauhaus and proponents of the International Style also saw their cause as something that is rooted in social needs, and Casciato (1996: 7) writes that "In the first decades of the twentieth century a group of architects, advocates of a renewal of the arts and architecture that was motivated by an 'ethical' conception of construction, participated in the search for a 'style' consistent with the needs of the new era". She goes on to mention the exhibition *Architecture Internationale* that was arranged by André Lurçat in 1926 in Nancy, France, where he "expressed his enthusiasm for social programme which in the machine era would become another significant feature of modernism". Coetzer (2017: 1) contends that the values of some African architectural practices are similar to those of the Arts and Crafts movement, whether intentionally so or not[3]. He writes how there are similarities between the Arts and Crafts' "values of honesty, truth and simplicity and an overall drive toward sustainability" and the contemporary global "emergence of an 'architecture of care'". Coetzer also highlights the importance of what he calls *allure*, or aesthetic appeal, which "can become overdetermined by technocratic energy audits and a pious humility that considers any sign of architecture as an unwanted imposition on 'the user' and a wasteful extravagance" (2017: 2).

Branzi (2010: 577) warns that the continued resistance of craft against industrialisation has often created a perception that craft inherently has values (as opposed to industrialisation), and Jacob (2017: 96) warns that one should not be drawn into "the fictional satisfactions of nostalgia" when it comes to craft and that the "world of authenticity is all too easy to parody as a hipster fantasy". This is echoed by Rossi (2017: 10) who notes that "the marginalised authenticity on which 'modern craft' rhetoric is based is highly compromised". Jacob goes on to say that "To reclaim the act of craft from nostalgia and traditionalism means to recast it once again as a force of conceptual intelligence, political agency and social possibility" (2017: 96). This is similar to Rossi's view when she observes how craft, with its "ethical association of authenticity… offers a tangible moral compass in uncertain times" (2017: 10). This is, however, often not the case in contemporary building practice and Rossi, when considering comments made by Zaha Hadid about labour conditions in Qatar, says that the "relationship architects have with those who make their ideas is complex and controversial. But it is still a question worth asking. What happens when consumers start to question the conditions of those who make their buildings, just as many demand ethical conditions in the manufacturing of clothing, coffee and even smartphones?" (2017: 10). Hartoonian writes that "One might argue that we need to have second thoughts in regard to a concept of construction that, in lieu of the early process of mechanization, would take refuge in the moral values of the guild system (as did the Arts and Crafts movement) or else would invent grand narratives speculating on the redemptive forces of technology" (1994: 9). While his scepticism may be well-founded, the continuing cycles of totalising attitudes between industrialisation or technology and craft are mostly ideological and they miss the point that different ways of making can all contribute to the social good if they are critically considered.

Skolimowski argues that "techniques within a social system become value-weapons" and he differentiates between technologies that are socially beneficial and technologies that are detrimental or indifferent to the need for social benefit (1979: 4). He goes on to say that "Technology is not a thing-in-itself. It is and always has been part of the social structure, belonging to a larger cultural framework". He refers to this as the *dialectical concept of technology*, where technology's place in the realm of human knowledge is "determined by the nature of the dialogue concerning the aspirations of society and the potentials of technology" (1979: 6-7).

Sennett (2008: 97) refers to the work of the philosophers Adam Smith and David Hume for whom empathy meant "imagining oneself as another, in all his or her difference, rather than simply likening him or her to ourselves", and as Skolimowski urges, "The next stage in the development of technology will have to be in response to the urgency of our social problems rather than to the inherent possibilities contained in various branches of engineering… new forms of technological knowledge will consist in inventing the means for solving important social problems" (1972: 10). Kéré seems to echo this when he observes that in the global North, "Over-regulation and over-industrialisation is preventing community life from developing" (Shipwright, 2018: 33), which Shipwright refers to as an "illiteracy of participation".

Difference

The phenomenon of architects from the global North working in the global South potentially raises what Watson (2003: 396) calls *conflicting rationalities* where people have "fundamentally different worldviews and different value-systems", or what Sweeting (2016: 4) refers to as *asymmetries* in terms of ethics and morals. Where the design decisions are made in the global North with only minimal contributions from the global South, the "asymmetry between those with agency over design decisions and those affected by these decisions and the norms they establish" creates a power imbalance. He also calls for the avoidance of *moralisation*, "given the high-handed tone adopted by the modern movement and critiques of architects pursuing their own agendas at the expense of those they design for". These issues can be addressed to some extent through horizontal dialogue and co-production which is to the benefit of all the contributors and those impacted by buildings and spaces, and by gaining a "deeper knowledge of alternative rationalities" (Watson, 2007: 76).

When considering this in relation to an architecture of care, Christian Benimana[4] of MASS Design Group says that working in the global South requires architects to be extra-careful, while Stassi and Tasca[5] of ASA are of the opinion that it is necessary to give up one's own background and culture in part to respond to a different culture. Tasca[6] notes how ethics in a social enterprise is relative to one's commitment to improving people's living conditions while being open to other positions; in some cases, a balance can be achieved, but this is only possible when there is engagement over a long period of time. She notes how architects from the global North are often perceived as being privileged in positions of authority and that they can sometimes be resented for refusing inferior work. This raises an ethical conundrum in the encounter

between North and South where there is a tension between the attempt to equalise power relations between architects from the North and contributors or community members from the South without compromising on the quality of the built work. She notes how they have occasionally been asked by clients to do things which are illegal or compromised, and that they had to refuse this based on their professional ethics. This, however, conflicts to some extent with their simultaneous efforts to approach difference and power relations ethically.

Levine *et al* (2004: 104) note that both physical and symbolic aspects are important considerations in terms of ethics, and that ethical and cultural identity are linked. According to Noble, the "veneration of indigenous histories, mythologies, practices and material cultures" in Africa often have nationalist undertones, but that "there is also a more ethically oriented project here, concerned with the recognition of formally [sic] subjugated narratives and traditions" (2014: 120). Edgerton writes how so-called non-industrial technological practices are still prevalent in the global South and that they remain largely invisible. By surfacing the combination of global and local practices through co-production in the contemporary African case, these practices are shown to be relevant and applicable both locally and elsewhere. He writes that "we should not fall for the idea that we have an adequate account of the technology of the rich world, which we have to 'decentre' to get a decent account of the poor world. We have to decentre that account to get a good account of the technology of both" (2007: 87).

Professional ethics

Murphy of MASS Design Group (2019: 222), cites Dr. Jean William Pape who regards architecture not as a trade, but as something that trades in dignity. Collier (2006: 309, 310) notes how ethics is written into various countries' professional architectural codes of conduct, and she highlights three important ethical aspects of professional ethics as being social practice, the practice of virtue, and the practice of learning. According to her, architecture is a social practice which is linked to the creation of spaces and structures for the inhabitation by people, while collaboration and the pursuit of excellence in practice can be regarded as virtuous, especially if it is based on the principles of empathy, integrity and relationships that are built on trust. Professional practice should support professional relationships through the development of "knowledge communities" and learning opportunities, which should include reflection on past practices with the view of shifting present and future practices. Taking this seriously has the potential to address past inadequacies, and

to address issues like sustainability and transformation. Critical consideration of past practices such as Modernism in Africa, Tropical Modernism, and Critical Regionalism, and learning from their shortcomings, can assist with the development of moral imagination in present practice. As Collier (2006: 314) observes,

> *"There is a deep connection between our evaluation of the actions of others and our evaluation of our own possibilities as moral agents. By imaginatively recreating the past choices of others we may come to recognise our own mistakes, narrow-mindedness and tendencies to espouse unsuitable possibilities or to neglect suitable ones. If we recognise our own self-deception in this manner we can guard against recurrences in the future".*

Normative rational design principles that originated in the global North have been regularly applied, "often with missionary zeal, in colonial and postcolonial territories where development and modernisation came to mean the same thing" (Watson, 2003: 396). This is echoed by Berlanda (2015: 59), and by Coetzer (2017: 4) who writes that, since Ruskin, there has been a "problematic and conflicted aspect of 'aid' and 'development' – 'the expert' helping 'the native' attain a higher level of civilisation". According to Collier (2006: 312), architects should use "moral imagination in critical reflection" since the same moral rules cannot be applied everywhere. Moral imagination can be practiced through responsive empathy towards others (or "imagining ourselves as the other") and through "the tapping of a situation's possibilities" by imagining how different solutions will impact a specific context in the long term. Local aspirations can be challenging though, and as Folkers writes about his own experiences, "residents saw mud building as local and old-fashioned, and therefore associated it with poverty and backwardness, whereas building in cement and corrugated iron represents progress, modern life, growing wealth and a carefree world" (2010: 210). Kéré, when speaking about his work in Gando, notes how the local community was expecting buildings made of concrete, glass and metal, and that their expectations had to be managed, but he also notes how their aspirations in terms of technology were more open to adaptation than other considerations would have been[7]; if durability or a new or different construction method can be demonstrated, then change becomes possible (Kéré, 2020: np.; Shipwright, 2018: 15, 16). It could be regarded as somewhat concerning that he notes how the absence of building regulations in Burkina Faso means that one only has to convince the

local community (Shipwright, 2018: 30), but in lieu of doing nothing, it places even more ethical responsibility on the architect and the professional team to do things properly, and especially to consider aspects around durability and maintenance.

Impermanence and maintenance should not always be regarded as negative, and as Edgerton notes, maintenance is one of the most widely distributed skills (2008: 80). As Murphy says, buildings like the Great Mosque at Djenne in Mali, and the King's Hut in Rwanda, are radical because of their vulnerability. He writes that "by baring its vulnerability the building succeeds at two incredible feats. First, miraculously, it preserves itself by inspiring an impulse to stewardship among its users. And second, even more incredibly, it occasions the demonstration of the community's commitment to supporting its members, and to a shared value" (2019: 358). Kéré (in Shipwright, 2018: 16) differentiates between the permanent and the impermanent[8]: He regularly employs a granite and/or concrete plinth, a reinforced concrete framework, lightweight steel trusses and corrugated sheeting for roofs; in some cases[9], he mixes 8-10% cement into his building's compressed earth bricks, while in other cases[10] he uses clay mixed with straw that is raised by hand and will most likely require maintenance (the skill for which is available locally) over time.

According to Herrle (2017: 65), the Gando Primary School has to be durable (schools are expected to be permanent, while houses are allowed to be impermanent), hence mud construction could not be used. This means that community aspiration drove the use of cement in the compressed earth bricks and allowed Kéré to "violate the 'pure doctrine' of appropriate building". The use of permanent and impermanent materials by architects in Africa does raise the question whether a similar approach is used by these same architects when working in the global North; even if this approach is based on economy and necessity - meaning that cost constraints, challenges in terms of access, and more moderate climates can sometimes lead to the paring down of a design to its absolute minimum and necessarily has to result in the economic use of materials - it should be done according to the highest standards and not just be "good enough" for Africa if it would not be accepted in the global North. Kéré, although his body of work in the global North is still developing, has made use of similar approaches to materiality and participation in a number of his exhibitions and installations in various contexts.

He used local material principles in the *Camper Pop-up Store* at the Vitra Campus in Germany (2015), he used hempcrete for the *Permanent Ex-*

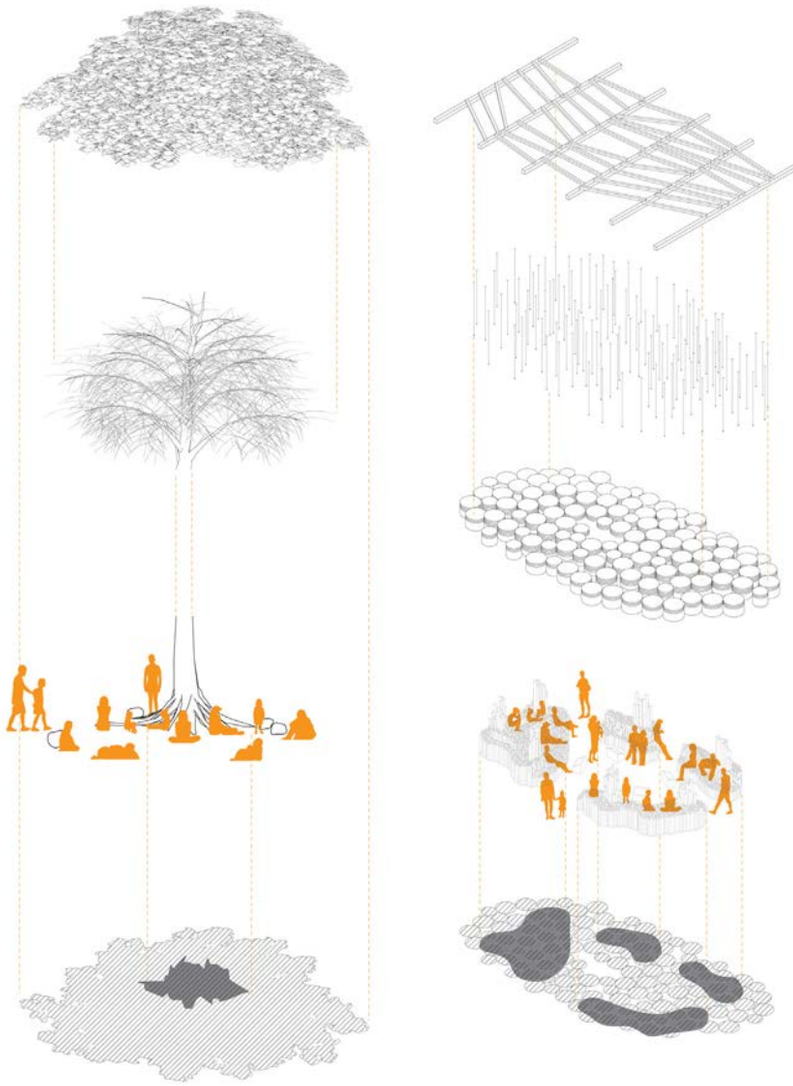


Figure 79:
Conceptual and spatial mimicry combined with local tectonics at Canopy*, Louisiana Museum of Modern Art Denmark, 2015, Kéré Architecture. Source: Holm and Kallehauge, 2015: 162.*

hibition at the International Red Cross and Red Crescent Museum in Switzerland (2012) although he initially wanted to use rammed earth[11] (Kéré, 2020: np.), he allowed for participatory practice or "building" with community at the *Sensing Spaces Pavilion* at the Royal Academy of Arts in London (2014)[12], he used locally produced multi-coloured cords for *Colorscape* at the Philadelphia Museum of Art, USA (2016)[13], and he made use of locally obtained wooden logs for *Canopy* at the Louisiana Museum of Modern Art in Denmark (2015) and for the *Place of Gathering* at the first Chicago Architecture Biennial (2016) (Lepik and Beygo, 2017: 154, 162, 164, 165 and 168).

The regular need for community involvement can make this challenging, which is why project budgets should include adequate allowances for training, prototyping, and improvements. The ethics of experimentation and seeing Africa as a laboratory where substandard workmanship can be excused is questionable and double standards should not apply to health and safety. According to Low, "Most African nations project a developmental ethic. In contrast to the neo-liberal capitalist agenda of the West, developmentalism promotes an other architecture". He writes that Kéré's work exemplifies this, especially his schools, where "education and traditional value have contributed toward the production of an exemplary local architecture of excellence" (2008: 7), while Lepik (2017b: 106) sees his work as a blending of ethics and aesthetics.

Ostwald (2004: 213) writes that ethical debates in architecture have often centred on the honesty of material expression, function, and the representation of a physical or temporal context, but he notes that this does not address issues of justice or community ethos. Professional ethics in architecture also raises questions about the design of certain building types (military installations, polluting industries, etc.), designing for extreme wealth or excess, and designing for oppressive regimes or political groups, amongst others. As Sweeting (2016: 2) observes, "architecture enables particular patterns of living while limiting other possibilities", and the highly problematic and questionable ethics of technologies and architectures that support spatial separation and segregation are a continuing global phenomenon. While Watson (2003: 404; 2007: 76) argues that values cannot be acontextual and that the concept of universal ethics should be questioned, Sweeting argues that ethics in architecture runs parallel to ethics in general, but specifically in terms of the relationship between architects and those they design for. One can then raise the question of who it is that architects design for, and being a profession, it implies that this includes not only the direct client (the person or body paying the fees), but anyone who will be impacted by the work now and in future. Collier (2006: 308) writes that architects' decisions taken during the design process and in their practice in general affect anyone who is impacted by their work over an extended period of time, which makes ethics "internal" to the practice of architecture. The practice and evaluation of architecture is also highly subjective, and while professionals are expected to serve the social good, individual architects might have a different opinion about what that is and how to address it (Ostwald, 2004: 212).

Besides the ethical concerns in terms of the building or product, ethical concerns in terms of practice itself are also important and can include issues such as labour relations, professional conduct, honesty, and integrity. Sweeting (2004: 5) writes that ethics is implicit to design, and instead of assessing whether a product is ethically good, one should rather assess how and to what extent architects incorporate ethics into their design practice and the process leading up to it. This extends into the ethics of education, especially in relation to the so-called practice of design-build, which is often practiced (pun intended) in the global South by institutions from the global North. Berlanda (2015: 61) highlights some of the ethical concerns in relation to this when he writes about the funding imbalance between the costs for the student/staff experience and the costs allocated for the building itself and for direct local benefit. He describes the funding allocation for the Konokono Vaccination Clinic (2014) in Turkana, Kenya, by Selgas Cano, Ignacio Peydro and students from the Massachusetts Institute of Technology (MIT) as being problematic, since "A cursory glimpse at the studio costs reveals that the overall expenses for the MIT team's travel and accommodation, around US$20,000, represent over one third of the overall budget. In the long run these price tags should lead to a reconsideration of the ethics of foreign-led design/build projects in so-called 'developing' countries. The proliferation of the Western quest for exotic adventures has led to a new form of educational colonialism, where it is extremely hard to see how the important material means employed by foreign agents contributes to redress growing global inequality, or at the very least improve local capacities and skills". A wide range of ethical issues need to be considered and acknowledged when working in a different context, especially when architects or educators from the global North work in the South behind a veneer of the social good without acknowledging all their own motivations. As George (2015: 159) observes,

> *"Ethics, Heidegger claims, is similarly infested with calculative thinking… The ethos of rational morality has sweeping in-*

fluence on modern social and political morality. For instance, if ethical reasons can be rendered for the flow of development aid from the global north to the south, they seem to be unproblematic and justified without reference to anything else. Certain abstraction is working here about the rational purity of the moral act of assisting the distant poor with no reference whatsoever to political cultural agendas that might underlie such acts."

Ethics and aesthetics

Levine *et al* write that architecture is about integrity through which "desires, needs, commitments, and values… are recognised and represented as such" (2004: 107). According to them, architecture can represent the values, ethics, and ethos of an individual or a community (Levine *et al*, 2004: 109), but it can also exhibit what Coetzer (2017: 2) refers to as *allure*, or aesthetic appeal. Unfortunately, investment into aesthetics is sometimes considered as an unnecessary extravagance. As Mark Lamster (in Murphy and Ricks, 2019: 362) says, "Traditionally, when the needs are great and resources few, aesthetics are first to be jettisoned – a decision justified on ethical grounds". Harries (1984: 165) is of the opinion that the natural language of a place needs to be understood aesthetically and experientially, and that ethics is related to place-making and the creation of a sense of place. This thinking does seem to inform some of the thinking behind Critical Regionalism, the ethos of which was to incorporate a sense of locality through abstraction, mediation, and dialogue, although unfortunately the dialogue was not always horizontal. As Ostwald cautions, "...buildings that are commended for their 'regional' character are typically being rewarded for their appearance more than any serious use of local and sustainable trades, materials, and customs" (2004: 214). The use of digital technologies like CAD and CAM raises its own ethical concerns, and Ostwald (2004: 201) writes that:

"*In cyberspace the opportunity exists to create architecture that encourages emancipation, equality, and social participation. Such digital architecture has the capacity to support transcendent thinking and to dramatize the challenges facing the political and natural environments of the physical world. For once architecture should be able to evoke the highest moral and spiritual values of society without the constraints of gravity, materiality, or budget. Yet, instead of realising such possibilities, or even attempting to approach these issues, digital architecture has become a curiously nihilistic playground for many designers who are primarily concerned with the generation of new forms.*"

He acknowledges that the generation of new forms is not problematic *per se*, since it is a standard pursuit of both digital and physical architecture, but that instead of being inspiring or uplifting on an aesthetic level, these forms are often jarring in terms of their lack of connection to real-world issues. He questions the apparent lack of ethical considerations that are taken into account during the production of digital architecture, and he goes on to say that "…the reaction evoked by much digital architecture is a result of innate incoherence in the work that is caused by the presence of an aesthetic defect, a defect that is propagated by the neglect of ethical considerations" (2004: 202).

Gaut (1998: 182) puts forward the notion of *ethicism*, which can be used to evaluate whether something is "aesthetically meritorious (or defective) insofar as it manifests ethically admirable (or reprehensible) attitudes". Ostwald (2004: 203) supports Gaut's view and he writes that attentiveness or care (as described by Coetzer, 2017: 1) are ethical attitudes that can be aesthetically expressed. Although he writes mainly about digital architecture, he argues that the neglect of ethical considerations could result in a sense of incoherence which manifests itself as an aesthetic defect (2004: 212). Ethicism is also mentioned by Collier (2006: 308) who writes that ethics and aesthetics are linked; she does not believe that the "separatist thesis" can be maintained any longer, and she notes how the inhabitation of a certain environment can also shape the sense of ethics of the people impacted by it since spaces can carry cultural meaning. The rejection of the separatist thesis is shared by Murphy (2019: 26, 31) who, citing Giancarlo de Carlo, speaks about the "false dichotomy" between beauty and justice.

Environmental ethics

Swilling (2020: 19) regards the very notion of being a human in the Anthropocene as an ethical question. Hattingh (1999) outlines a range of possible positions[14] in relation to environmental ethics, and while an in-depth exploration of these different positions is not possible here, the clear link between architecture and environmental ethics in some form should be emphasised. Skolimowski writes that technology should not be "the mere application of

science, or the mere extension of existing techniques, but… a highly selective process of inventing and discovering techniques and processes in order to solve large and small problems which arise in the cross-section of the natural world and the man-made technological world" (1972: 10). Levin *et al* (2004: 104) write that architecture mediates between people and the environment, and they are of the opinion that environmental ethics and architecture should be linked, considering the increasing pressure on the natural environment which the construction industry is contributing to significantly.

As Van der Lans (2018: 113) observes, "The physical impact on the environment is extreme. Reduced energy consumption, waste control, efficient planning and thoughtful use of material" are not sufficiently addressed, while social issues such as poverty and unemployment threaten the safety and stability of many places in Africa. Praise for projects on an environmentally ethical basis is often misplaced, and where some might be lauded for being "environmentally friendly", they should sometimes rather be considered as examples of "greenwashing". Ostwald (2004: 214) differentiates between an "environmental aesthetic" and an "environmental ethic", and Collier (2006: 312) lists a few strategies that could be used to shift towards an environmental ethic as the use of local resources, renewable energy, environmentally responsive design, the recycling of materials, energy-efficient design, and the consideration of community needs. Lamster (in Murphy and Ricks, 2019: 363) is concerned about market-driven architecture that claims environmental or social justice for its own aims and he exclaims that "We've had greenwashing; is altruism-washing next?".

The complexity of the challenges related to climate change also has many social implications, including those directly related to tectonics. Benimana and Doran (2020: np.) write that "this complexity is further compounded by a systemic illiteracy of the direct and indirect impacts our decisions and specifications have from cradle to gate. Our focus on "sustainability" and operational energy has exacerbated this issue via the unintended consequence of both delaying our investments into reducing embodied energy and, arguably worse, building a globalized supply chain to enable energy efficiency. While we now have a firm grasp on the U-Value of a casement window, we know little to nothing about how that window was made, by whom, from what, and from where".

The internal environment is important too, since comfort is also an ethical consideration (Levine *et al*, 2004: 108). The consideration of ergonomics, phenomenological aspects, and indoor climate are all related to ethics,

and these issues are sometimes not given due attention in the realm of digital architecture. Levine *et al* (2004: 114) interpret Ostwald's assessment of digital architecture being unsettling because it has "an ethical basis that is explained, at least in part, as a result of the absence of consideration of what is good for people and the environment, and also of what is just in the eyes of the community". Hattingh (2011: 92) highlights issues of justice in relation to environmental ethics, and where there are encounters between the global North and the global South. He particularly questions "whether there is adequate and effective exchange between the holders of scientifically based knowledge about climate change, and the holders of indigenous or local knowledge about climate change based on the direct and/or culturally mediated experiences of lived realities", and he calls for a "shared ethics of global climate change" (2011: 94).

Tectonic ethics

Mbembe (2018: np.) is of a similar view when he says that "The only way in which to ensure its [the world's] sustainability or its duration is to share it as equitably as possible", and he calls for "a different ethics" that enables the world to be shared democratically between people, but also with nature in its broader sense. This echoes Harries (1984: 165) who writes that architecture should be used in service of people as part of their environment and that the environment should not be seen as something that can be manipulated and controlled. This raises the question of how tectonic ethics is positioned in terms of "a different ethics", and how it relates to technological ethics, planning ethics, and environmental ethics, which all have social and moral underpinnings.

Tectonic ethics is specifically concerned with architectural production and how a building is designed and made, which makes it both representational and ontological - it is concerned with both aesthetics and construction. It encompasses issues that include, amongst others, its socio-technical contexts, construction practices, professional practices, how, where, and by whom building elements are produced, difference and inequality (especially in terms of economic access and access to resources), the environment, and aesthetics as it relates to the notions of ethicism (Gaut, 1998), care, and allure (Coetzer, 2017). The contemporary architectural works in Africa that are explored in this study are all based on at least some of these ethical principles (although the ethics of some projects' realisation can be questioned), and a few common approaches address Ostwald's (2004) concerns about digital

architecture's relationship to people and the environment, while others exhibit the use of local resources, the recycling of materials, environmentally responsive design and community involvement as hoped for by Collier (2006).

The conflicting rationalities and critical difference as mentioned by Watson (2003) and Low (2003) are clearly evident in many examples, and architects attempt to engage with this in the work through different approaches that could signal a shift towards hybrid tectonics. Since this study is concerned with architectural work in Africa, the ethics related to the encounter with difference, access, justice, transformation, and inequality requires especially careful consideration and needs to be considered in relation to context as opposed to only considering universal ethical norms; unfortunately, the ethical underpinnings of contemporary practice do not always reflect this.

This chapter draws on various writings related to the ethics of architectural practice, and on personal interviews with some of the architects of the key project studies analysed previously. While not conclusive, it raises a number of important questions and it provides a basic outline of considerations related to technology and ethics, ethics related to difference, professional ethics, ethics and aesthetics, and environmental ethics. By bringing these issues into the realm of the tectonic in the context of Africa, it contributes to the reflection of the work in the global South, in the following chapter on hybrid tectonics.

Chapter 5 endnotes

1 A full overview of technological ethics is not possible here, but a brief overview of ethics in relation to previous chapters is used to provide some background for the development of an approach towards tectonic ethics.
2 He compares this awareness to Walter Benjamin's concept of the loss of aura, or "the distance that mechanisation introduces between tradition and reproduced artefact" (1994: 56).
3 He specifically mentions Anna Cowen and Collis and Associates' Tsoga Environmental Resource Centre (2004) in Cape Town, South Africa, and he compares this to Ernest Barnsley's Rodmarton Manor (1931) in the United Kingdom.
4 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.
5 Stassi, F., and Tasca, A. (2019). *Personal interview with author*, ASA's office, Kigali, Rwanda, 12 March 2019.
6 Tasca, A. (2019b). *Personal interview with author,* ASA's office, Kigali, Rwanda, 12 March 2019.
7 Like politics or religion, for example.
8 As opposed to the formal and the informal.
9 Like Gando Primary School and the Gando Primary School extension.
10 Like the Songtaaba Women's Centre and Atelier Gando.
11 He remarks how he struggled with the authorities to allow its use until he eventually found a villa in Geneva that made use of this material, but in the end it turned out to be too expensive.
12 Visitors were invited to add straws of various colours to an initially bare honeycomb structure.
13 The cords are suspended from a steel framework, and the relationship between the two materials represents the encounter between the global North and the global South.
14 These include the technocratic "ethical" position of the "ruthless developer", a more moderate position of resource conservation and development, one of wilderness preservation, ethical extensionism, ecological sensibility, and radical environmental ethics.

Chapter 6: Hybrid tectonics

Buchanan initially makes the connection between Critical Regionalism and hybridity in 1983 when he says that “Regionalism can be no mere syncretism or slick collage of elements from Modernism, history and region. Instead, it must be a genuine hybrid, a totally new configuration which may include a remembrance of the past, but transformed or framed in terms of its significance for today” (1983: 16) [1]. Unfortunately, his definition of hybrids is vague, and the difference between hybrids and collages is not explained; without a clear definition and analytical framework, the validity of the listed examples can be questioned, since the criteria used to classify them as hybrids is unclear. He does, however, expand on this in a later article where he calls for a hybrid regionalism that fuses “what is still vital in local tradition with the best of what global civilization has to offer” (1984: 24)[2].

This chapter extracts a set of criteria for the identification and evaluation of hybrid tectonics. This is supported by a discussion of how the emblematic cases within the three identified constellations that are analysed in detail in chapter 4 relate to these criteria.

The need for specificity and establishing the criteria

Eggener (2002: 235) argues that "As a concept, critical regionalism sought to be both general and particular. It ended by reinforcing the former at the expense of the latter", while Hérnandez (2010: 74-77) writes about the criticism[3] levelled against Bhabha's interpretation of hybridity that he generalises context and that the use of the term also lacks specificity. Bhabha's discussions of hybridity also do not focus on the practice of making or architecture. Building on Frampton's definitions of Critical Regionalism and tectonics, the framework of hybrid tectonics aims to focus on the specificities of architectural production in Africa, where there was a shift towards the hybridisation of global tectonics and local tectonics. In terms of mediation between the global and the local, the same element must be used for comparison or hybridisation: Global tectonics should be compared or combined with local tectonics[4]. The primary difference between Critical Regionalism and hybrid tectonics is that the latter is concerned specifically with materiality, construction and the art of assembly. As Frampton (1983a: 27) suggests, "the primary principle of architectural autonomy resides in the *tectonic* rather than the *scenographic*". Patteeuw and Szacka (2019: 93) write how Frampton regarded local contextual specificity as the context in which an alternative approach could develop, one "in which the tactile would surpass the visual, the tectonic would win over the scenographic, and the hybrid would be favoured over the homogenous". In hybrid tectonics, the global and local are compared using the same criteria[5] and in order to address structural inequality the global and local are regarded on an equal basis, and not as a centre and a periphery. The global should not be mediated by local elements, but the global and local should have a similar weighting, especially when the global is represented by the North and the local is represented by the South.

As Tzonis and Lefaivre (1981: 123) note, in order to understand a specific work, one needs to consider the context that it was created in (this includes the historic and the social context), how the work is influenced by specific social formations and how it influences human connections. The origins and relationship between designers and communities should also be carefully considered, and as Tzonis and Lefaivre argue, "No new architecture can emerge without a new kind of relation between designer and user" (1981: 128). This is vitally important in terms of Eggener's critique that "Identifying an architecture that purportedly reflects and serves its locality, buttressed by a framework of liberative, empowering rhetoric, critical regionalism is itself a construct most often imposed from outside, from positions of authority" (2002: 228). In the context of Critical Regionalism's regular application in the global South, he goes on to describe it as one of Jane M. Jacobs' "optimistically designated postcolonial formations" that were produced by colonialism and which are still inhabited by it (1996: 14). This ties in with Bhabha's view that:

> *"Hybridity is the revaluation of the assumption of colonial identity through the repetition of discriminatory identity effects. It displays the necessary deformation and displacement of all sites of discrimination and domination. It unsettles the mimetic or narcissistic demands of colonial power but reimplicates its identifications in strategies of subversion that turn the gaze of the discriminated back upon the eye of power. For the colonial hybrid is the articulation of the ambivalent space where the rite of power is enacted on the site of desire, making its objects at once disciplinary and disseminatory… If the effect of colonial power is seen to be the production of hybridisation rather than the noisy command of colonialist authority or the silent repression of native traditions, then an important change of perspective occurs"* (2004: 159-160).

Due to the complexity of tectonic origins and their distribution between North and South, where some global technologies are still imported or transferred, while others are produced locally along with traditional local technologies, the lines between global and local are becoming increasingly blurred. Because of this, Edgerton (2007; 2019:43) prefers to use the term *creole*[6] technologies as opposed to hybrids, which he sees as something that merely refers to a dualistic combination of what is here referred to as global and local (this is despite the fact that the word *creole* itself is often used to describe things of a dualistic nature). He writes that "the technology poor world cannot be reduced either to its stock of rich world technologies, or traditional, local technologies, or hybrids between the two. A new technological world of technologies derived and adapted from those of the rich world in complex ways, and then often entering into hybrids, are some of the complexities the term seeks to capture" (2007: 109). He sometimes uses the terms hybrid and *creole* interchangeably, but the semantic differentiation between *creole*[7] and hybrid does not recognise the complexity inherent to the current use of the concept of hybridity as developed by Bhabha and others. Fisher (2019) also uses the terms creolisation and hybridisation interchangeably when discussing their application in the African context. Edgerton does acknowledge that "while the term [*creole*] is very suggestive, it reaches the end of its usefulness

when confronted with some technological novelties in the poor world" (2007: 109). While the nuances described by Edgerton in relation to *creole* technologies are valued, the conditions he covers with the term are applied to the concept of hybrid tectonics in this thesis.

Hérnandez (2010: 58) sees hybridity as a useful vehicle to study "the particularities of sociocultural interaction between different groups in circumstances of colonialism and contemporary globalisation". He emphasises that it is not a simple mixture of two or more elements, but that it is about the rearticulation of culture where binary systems are dismantled in order to unsettle purity or homogeneity. Bearing Tzonis and Lefaivre's emphasis on context, social formations and human connections in mind, to evaluate works using the framework of hybrid tectonics buildings have to be analysed simultaneously on a global and local level. Building on the work of a number of previous authors' efforts to establish approaches and attitudes towards Critical Regionalism (Frampton, 1992: 327; Buchanan, 1984: 25; Pateeuw and Szacka, 2019: 93), with a focus on Frampton's definition of tectonics (2002: 94) and Low's call for critical difference and a horizontal dialogue (2003: 35), a clear set of criteria can be distilled for the evaluation of hybrid tectonics.

In terms of ontological criteria (or the "thing"), the following criteria need to be evaluated: 1. Response to local climate, 2. Response to local topography, 3. The incorporation of local materials in relation to global materials, and 4. The incorporation of local labour or traditional techniques in relation to global labour or techniques. In terms of representational criteria (or the "sign"), the following criteria need to be evaluated: 1. The appropriate reinterpretation of local patterns or forms, 2. The balance that is achieved between the representation of normative global tectonics and local tectonics that are unique to the context, and 3. Its social focus, how a horizontal dialogue is created and how inequality is addressed in terms of the positionality of the architects (especially in terms of the power relations between global and local contributors), and in terms of all the other criteria. This aspect forms part of a building's ontological make-up, but it is also a signifier that positions the work on an ethical level within the global discourse. Amadou Hampâté Bâ writes that most African works of art "whether plastic or in the oral tradition, had several levels of meaning: A religious meaning, a meaning as entertainment and an educational meaning" and that one has to analyse an object on multiple levels (2010: 384). The multiple layers of spirituality or symbolism, entertainment (which can be read through aesthetics and representation) and education (which can be read through layers of memory and the dissemination of technology or technē) are represented in the ontological and representational criteria. As Chomette (in Noyer-Duplaix, 2015: 273) argues, working in Africa requires a unity between technology and culture, while Mbembe writes that the crisis of the image "is at the point of being resolved by contemporary Afro-diasporic creation" (2015: 54).

Both the ontological and representational criteria have to be underpinned by social, environmental, and economic sustainability. A work's ethical basis and how it combines aspects of the global and local optimally and equally in order to support so-called three-tiered sustainability can imbue a building with a greater sense of inclusivity and it is an important aspect of hybrid tectonics. The term hybridity is used in an architectural sense not only to describe what Hérnandez (2010: 77) calls the "combination of materials, forms, construction techniques and ornamentation" as it is so often done, and which he believes establishes a hierarchy between the different elements in favour of Northern architectures, but it is used here from a Southern perspective that aims to generate a non-hierarchical value system between North and South:

> *"The political content inherent in the term hybridity implies that such mixtures are never innocuous acts. In postcolonial discourse, even the simple operation of mixing styles, materials and techniques triggers questions about who does the mixing, in what circumstances does the mixing take place or who documents that mixing historically. Thus, the notion of hybridity emerges as a sophisticated mechanism for the continued study and understanding of architectures beyond mere form"* (Hérnandez, 2010: 82).

	Tectonic mode	Criteria
Sustainability and ethical underpinnings	Ontological tectonic criteria	Response to local climate
		Response to local topography
		The incorporation of local materials in relation to global materials
		The incorporation of local labour or traditional techniques in relation to global labour or techniques
	Representational tectonic criteria	The appropriate reinterpretation of local patterns or forms
		The balance that is achieved between the representation of normative global tectonics and local tectonics that are unique to the context
		Its social focus, how a horizontal dialogue is created and how inequality is addressed in terms of the positionality of the architects (especially in terms of the power relations between global and local contributors), and in terms of all the other criteria.

Figure 80:
A table that outlines the ontological and representational criteria for the evaluation of hybrid tectonics. Further to the discussion that follows, a table that compares the selected works in the three constellations can be viewed in Appendix B. Source: Author.

It is for this reason that the search for hybrid tectonics in Africa considers projects where there is some form of encounter between contributors from the North and South and between global and local modes of production. This is documented from a Southern perspective that takes cognisance of African ways of making, and the study employs both ontological and representational criteria for evaluation. Osae-Addo (2018: 120) writes that "True development must embrace the African sustainable and traditional building systems, while also understanding the complex influences of foreign ideas on our heritage", and as Folkers (2010: 233) observes, "the best contemporary African architecture is hybrid in nature. The combination of formal and informal elements, of modern and traditional materials and technology, and the mixture of traditional and international formal aspects, can come together to form a uniquely African architecture, which can be measured against the best academic architecture in the world", and Herrle echoes this when he says that "In the stress field of globalisation and outside the mainstream, architectures are emerging that cannot be accommodated in the pattern of competing thought categories: for example, local versus international, or traditional versus modern. They are hybrids – just as hybrid as the human lifestyles that give rise to them and make use of them" (2017: 68).

An analysis of the selected works that were discussed under the three emerging constellations shows that they all conform differently to the criteria for hybrid tectonics, which will be outlined briefly in the following sections.

The work of MASS Design Group and ASA in relation to hybrid tectonics

Murphy maintains that one of MASS Design Group's aspirations is "making sure that every building that we work on has a very simple, singular idea. I call this a mission of a building, that it seeks to achieve through its tectonics, through its identity, to the way it's built — a singular, simplified concept" (2015: np.). This continuity through process and product, and its tectonic expression, is clearly legible in both the work of MASS Design Group and ASA. Benimana[8] cautions that architects should not fall into the trap of accepting the status quo, and he mentions the long-standing natural phenomenon of cultural cross-pollination, adoption, and adaptation, which he describes as a two-way exchange (although he acknowledges that this is not always an equal one). He notes that this requires flexibility in terms of design decision-making, and this can be observed in the combination of different tectonic approaches in their Rwandan works. Bearing this in mind, the status quo is often the uncritical use of global tectonics, but it can also entail the uncritical use of local tectonics.

If the Umubano Primary School extension and the Ruhehe Primary School are considered based on the criteria of hybrid tectonics it is evident that both projects respond to the local climate mainly by providing large covered outside spaces, rooflights or clearstorey windows made from polycarbonate sheeting in combination with glazed windows for natural light, and woven ventilation screens or perforated brick walls that are used in conjunction with doors and windows for cross-ventilation. They both respond to the local topography through stepped construction, while Umubano Primary School also uses terraces to mediate the steep slope. Both projects make extensive use of local materials and labour, which are used in combination with global materials and their associated labour. Some of the local techniques are based on traditional practices which have in some cases been adapted for contemporary conditions, and some of these have been appropriately reinterpreted, along with local form-making practices like the terraces and switchbacks at Umubano Primary School. According to Tshepo Mokholo, an ADC fellow who worked on Ruhehe Primary School, the building "really challenges the architectural vernacular of the area at the same time that it borrows a lot from it" (as quoted by Samson, 2018: np.). Both projects achieve a good balance between global and local tectonics, and the local tectonics appear to dominate in both instances. They exhibit a horizontal dialogue between North and South (in terms of the positionality of contributors and in terms of tectonics) and the works are both based on the ethical underpinnings of the respective practices.

Their long-standing presence in Rwanda enables both MASS Design Group and ASA to maintain relationships with their collaborators and communities, which also allows for the establishment of feedback loops. Both practices make extensive use of post-occupancy analysis to gauge the long-term success of their projects and to inform their future work. Stott (2017: np.) writes how Ricks acknowledges that MASS Design Group's analyses that are published annually sometimes involve some extrapolation and that they are still being developed, but "At this stage, the economic measurements being conducted by MASS centre around measuring the principles espoused in their #LoFab campaign—that is to say, how much of the building's construction budget is being spent locally, and how many hours of employment it has created within the community. The environmental impact can be measured through both carbon emissions and importantly, embodied carbon in the building's materials, metrics that many in the industry are now familiar

with… Ricks adds, though, that 'most of the places we work don't have manufacturer specifications that give you all that information, so we need better ways of creating the carbon coefficients for the way most buildings are built.' Educational outcomes are measured by recording the number of workers who take part in 'capacity building' workshops to learn new skills. Finally, emotional value can be summarized as the collection of testimonials on display in MASS Design Group's videos, such as their *Beyond the Building* series. This final aspect may be more difficult to measure scientifically, but it is nonetheless a key component of the firm's process". Stassi from ASA notes how they also do post-occupancy analysis whenever possible, and that these analyses often reveal that community members who comment positively on certain projects are those who acquired new skills that they have been able to apply after the project had been completed (Loké, 2019: 64).

Both practices make a point of appointing between 30-50% females for project construction, especially as masons to empower them with skills that can be applied elsewhere. ASA has employed similar strategies in other parts of the global South, and while MASS Design Group has done the same[9], they have also produced work in the global North that uses similar strategies, unlike many other practices who produce work in Africa. Similarly to ASA, their approach to architecture is shaped by ethics, and not only by efficiencies (Murphy and Ricks, 2019: 60), which is particularly poignant when considered in relation to one of their most important commissions to date, the *National Memorial for Peace and Justice* in Montgomery, Alabama, USA (2018). While its tectonic strategies are very different to those employed in the global South, its ethical approach and its consideration of social justice is similar. Their Lo-fab pavilion for the Boston Biennial in 2015 on the other hand combines global and local tectonics by making use of "state-of-the art collaborative robotic fabrication techniques and a merger of traditional craftsmanship and computationally driven manufacturing processes" (MASS Design Group, 2020a: np.). Murphy (2016: np.) sees Lo-Fab construction as something that can be applied equally successfully in the global South and in the global North and that besides the end product, the process itself can generate benefits.

Figure 81 (opposite): *MASS Design Group's Lo-Fab pavilion for the Boston Biennial in the USA, 2015. Source: Mark Pasnik, MASS Design Group. [Online] Available: https://mass-designgroup.org/work/design/design-biennial-boston (Accessed 31 August 2018).*

In a similar way that the past - the spectre of the genocide but also traditional cultural practices and arts like *imigongo* -, and the present - which is marked by (sometimes misplaced) developmental optimism – exist in a state of adjacency in Rwanda, the tectonic strategies in the buildings analysed above do the same. The global and local tectonics, in their state of adjacency, are not entirely merged as would be the case with a true hybrid, but like the process described by Farmer (2019: 38, 49) and Ricks (2019: 38), they exist as a form of accompaniment where there is an interesting power struggle between global and local. The question as to which tectonic is the accompagnateur and which is the accompanied, is not necessarily clear-cut: In some cases, the global tectonic (concrete for example) might outlast the local (reeds or bamboo for example), but in other cases, the local (volcanic rock, or reeds and bamboo that are regularly maintained and replaced), might outlast the global (steel for example, which could deteriorate over time). However, the important point here is that the sense of accompaniment and adjacency, which are inherent to the process of aid provision and in the design and the delivery of the buildings, are also manifested in their tectonics.

The work of RWTH Aachen, Collectif Saga, and their respective collaborators in in relation to hybrid tectonics

In terms of the hybrid tectonics criteria, both the Guga S'Thebe Theatre and the Silindokuhle Preschool aim to respond to the local climate despite using local tectonics whose performance may not necessarily comply with local climatic regulations. Despite not having optimal orientation or covered outside spaces, the use of light clay insulation for the walls and thermal buffering for the inside space at the Guga S'Thebe Theatre mediates the use of containers, while the Silindokuhle Preschool's orientation, overhang, ventilated roof and (albeit limited) insulation also address some climatic concerns. The Theatre is on a flat site which does not require much consideration of the natural topography (although its finished floor level is somewhat low), but the Preschool is terraced, and its classrooms are raised off the ground to allow for natural

water run-off towards the vegetable garden.

Both buildings make extensive use of local materials (both natural and reused, recycled, or repurposed). Whereas the Theatre mainly employed students, the Preschool's aim was to involve as many local residents as possible. There are no cultural references or reinterpretations of local patterns or forms at the Preschool (although one could argue that it aims to reference local "informal" practices), but the Theatre's cladding makes references to Congolese *Shoowa* textiles. Whether this is appropriate to the South African context can be questioned, but the reference is not literal nor what Botz-Bornstein calls "regionalist kitsch". Both projects achieve a good balance between global tectonics and local tectonics, with the local tectonics (in particular "informal" tectonics) being visually dominant at the Theatre despite the use of a number of global tectonic strategies, whereas the Preschool has a more equal distribution between global and local, but with a remarkably large palette and a fine visual grain. The ethical issues around durability and maintenance have been discussed and remain open to evaluation over time, but the power relations between global and local contributors are one of the more complex issues in these projects.

Heiermann[10] emphasises the positive impact that the design-build experience has on students. The University system is generally focused on the individual and on private authorship, but a staggered design-build process relies on co-authorship between institutions, students, private sector contributors and community members. She notes how students who are not necessarily part of the entire process and who might only have been involved in certain elements of the building, still feel a sense of ownership of the project; this collective authorship is reminiscent of a collage of process and a collage of participation between different contributors. Both the process and the final product are intended to be didactic for students and local community members, although Smuts (2020: np.) notes that there was little to no skills transfer to local community members during the building of the Guga S'Thebe Theatre[11]. There may have been some community members who were employed for menial and unskilled labour, but the learning was aimed primarily at students from the global North. An ethical concern which is often raised in relation to design-build projects is that a large percentage of the funding is used for the travel and accommodation expenses of staff and students from Northern institutions. According to Frey (2016: 94), in the case of the Guga S'Thebe Theatre, "It is remarkable that students and teachers have kindly provided the project elements and their implementation on the site, and that they have personally funded their travel and the expenses for their stay", but whether this was through personal funds or sponsorship is unclear.

It appears that the dialogue between North and South may not have been entirely horizontal for the Theatre: According to Smuts[12], the involvement of local contributors and local communities are not always clearly articulated with design-build projects and she feels that there is limited understanding in the global North for the amount of time, responsibility, and liability that local architects contribute[13]. She notes how CS Studio Architects' involvement with the Guga S'Thebe Theatre was extensive and that it went without any reimbursement or professional fees[14]. Smuts describes the relationship between the Northern educational institutions and CS Studio Architects as complex, and she also notes how the project process for the Guga S'Thebe Theatre ran very differently to their own practice. She says that CS Studio Architects always engages with local communities in a participatory design process that she refers to as "the helicopter exercise" where local community members are asked to articulate and draw what their vision of the project is in ten years' time. With the Guga S'Thebe Arts, Culture, and Heritage Village, this process included engagements with the Langa Development Forum, street questionnaires, workshops, and public meetings, all before the architects put pen to paper. In the case of the Guga S'Thebe theatre, she recalls that the design process took place in the global North without community involvement, except for a public presentation of the pre-prepared design, although she notes that this does not seem to have had any negative long-term impact[15].

Collectif Saga bases their practice on their "ethic vision of life" and they state that architects must play a role in community self-actualisation (Saga, 2015: 5; 2017: 5). Despite being embedded in Port Elizabeth continually for five years, they acknowledge their positionality by stating "we are not *native*", which motivates them to spend time to get to know the contexts that they work in. Prior to working on the Silindokuhle Preschool, they spent three months doing interviews, workshops, and observation with students from the *Ecole d'Urbanisme de Paris* (Saga, 2017: 13). They write that the design was "negotiated collectively" (Collectif Saga, 2017: 59) and they note how they used "an active participatory process with the community" through workshops with parents, children, and teachers. This was primarily to do a thorough needs assessment and program development which led to a first sketch proposal[16]. The site was always open to members of the public to contribute as and when they could (Saga, 2017: 16, 19), and the architects note that this enabled the community to be involved throughout the process of design

and construction. In relation to the Community Hall, they write how "The aim of the project was to integrate the local community in the process of designing and building as much as possible. In fact, coming from a completely different environment, it was inconceivable for us to do it on our own" (Saga, 2015: 25). The architects seem to have aimed to enable a more equal exchange of contribution and benefit between North and South, and they state that "It was a two-way knowledge exchange in the sense that we have a lot to learn from the community who everyday build and rebuild using limited resources from their own environment" (Saga, 2015: 13). The process of design and construction can both be regarded as collage practice where vastly different ideas and experiences were combined to generate the final product.

A positive outcome of their practice in South Africa is that Design. Develop.Build. and some of its partners have used some of the tectonic strategies that they developed in the global South in applications in the global North. Baerlecken *et al* (2012: 3), mention the *Bottle Tower* or *Tower of Babel* and the *Hanger Structure* installations at the Georgia Institute of Technology in 2011[17], while Heiermann[18] lists the *Gartenhaus* made from prefabricated light clay in Aachen, Germany in 2017 (based on the system developed in South Africa), a proposal for a Children and Youth Centre made from nine shipping containers in Germany (with some similarity to the Guga S'Thebe Theatre), and the *Recycling Mies* pavilion in Aachen that was completed by Design.Develop.Build. in 2015 using approximately 95% reused, repurposed, and recycled content[19]. They also completed the so-called *Gastrohut* in 2019 using a participatory process, shipping containers and an engineered roof structure in the Ebertplatz in Köln, which has echoes of the Guga S'Thebe theatre.

Galland[20] remarks that industrial refuse is the same everywhere in the world, so Collectif Saga is able to use a similar approach, materials and techniques in the global South and in the global North. He recalls how Collectif Saga, after completing the Silindokuhle Preschool, felt the need to translate what they learnt in South Africa to the French context[21]. Reused, repurposed, and recycled materials form a key component in their work, regardless of context, and the practice has completed a number of projects and installations in France using the same materials that they use in South Africa[22].

The work of Design.Develop.Build. and Collectif Saga is experimental. In the case of Design.Develop.Build., some of the building elements are made using highly specialised "low tech" methods (in terms of the equipment required and in terms of the skills required) and it is probably too special-

Figure 82:
The Gastrohut, *Ebertplatz, Köln, 2019, Design.Develop.Build. Source: Author, 2019.*

ised to be replicated by local communities, although they have been replicated by some of the same contributors in the global South and in the global North. Their didactic potential is focused mainly on students and practitioners, whereas Collectif Saga's didactic aim is to show local community members alternative ways of making. Their tectonic strategies are somewhat easier to replicate by hand without specialist knowledge, although they are often unique and very dependent on specific found objects.

The work by the selected educational institutions and practices in South Africa generally conforms to Rural Studio's mantra that everyone deserves good design, and in line with the concept of ethicism, Dean and Hursley argue that Mockbee's work is essentially about the combination of aesthetics and ethics (2002: 85). As Galland[23] emphasises, hybridity is a necessity, and the buildings analysed above embody a mixture of local "informal" tectonics, natural local tectonics, and global tectonics. Like the work of MASS Design Group and ASA, the different tectonic strategies remain visually and physically separable, meaning the selected works are also not regarded as true hybrids, but they manifest as collages or assemblages that challenge context and perception. The "informality" of the process and product responds to the contexts that the projects are situated in, and it challenges the notion that architecture in the global South should be economical to the point of blandness, where frugality and pragmatism become devoid of artistic content[24]. They are generally rooted in an aestheticised socio-environmental ethic or ethicist approach which is non-linear and assimilatory: They conform to Louw (2019: 56), Wilson (1987: 20) and Frampton's (1983a: 20) identification of an architecture of resistance, where there is a resistance against the overtly global, the overtly local, against normative functionalism, and above all, against limitations.

The work of Toshiko Mori Architect in relation to hybrid tectonics

One of Mori's big concerns, which is evidenced through her establishment of VisionArc, is climate change (2019: np.), and the Thread Centre shows a clear intention to respond to the local climate. In relation to Thread, she observes that there was not a tradition in Tambacounda District of storing rainwater (2014: np.), and with the introduction of the underground rainwater collection cisterns at Thread, a thriving agricultural collective was formed[25] which came as a surprise to the architect[26]. She observes how the agriculture collective seems to have become more active than the cultural groups at Thread, so the building has unexpectedly become a catalyst[27] for sustainable agriculture due to its roof design and rainwater harvesting elements (2020b: 57[28]). The

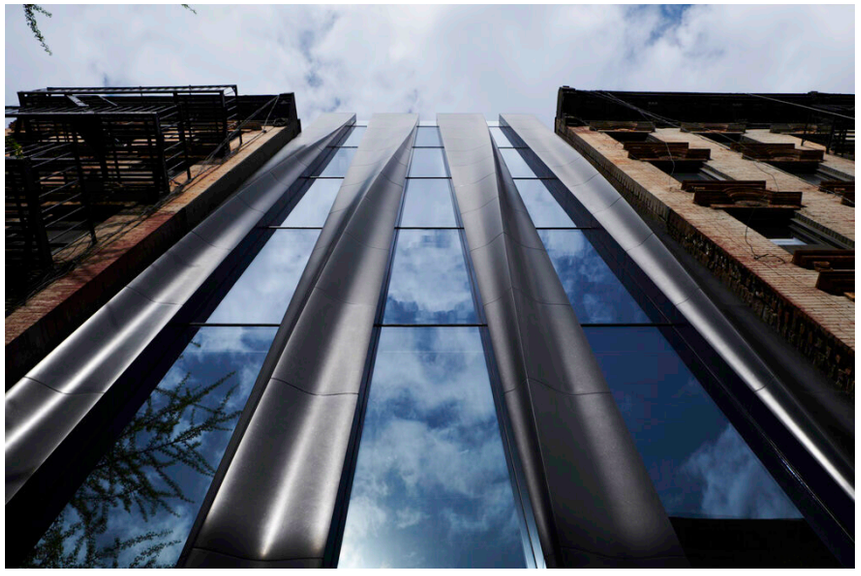
consideration of natural ventilation, shading, and insulation are all evident in the design, and the building has a low-slung form to respond to the flat local topography[29] (2020b: 54). The incorporation of local materials (almost exclusively) and the incorporation of local labour (almost exclusively[30]) goes a long way towards improving the building's carbon footprint and to empower members of the local community. There is an appropriate level of interpretation of vernacular forms through the parametric inversion of the roof and there is a very good balance between global and local tectonics.

While her practice is not based in Senegal, Project Architect Jordan MacTavish from TMA travelled to the site three times, and Mori visited the country several times to observe local materials and practices, and to lead two studios in Senegal (in 2010 and 2012) with students from the Harvard Graduate School of Design (Weber *et al*, 2014: np.; Fixsen, 2015: np.[31]). If one considers her close collaboration with the Josef and Anni Albers Foundation which has been active there for more than twenty years (Fixsen, 2015: np.), its affiliate the American Friends of Le Korsa (AFLK)[32] that runs the Centre, and particularly the intense involvement of Dr. Magueye Ba, one could argue that there was an embeddedness by proxy. Mori observes that AFLK is a "very robust, on-the-ground organisation that helps to maintain and operate everything they do, which I think is very important so that it's not as if it's an organisation that builds something that gets photographed and published and then they leave"[33]. She goes on to say that their assistance "has allowed international and local actors to partner by way of achieving a sustainable, respectful, and encouraging relationship with the local community" (2020b: 54).

Based on Schwab's predictions that high-income cognitive and creative occupations and low-income manual occupations are likely to increase with the fourth industrial revolution, it does raise concerns that it could exacerbate existing structural inequality. The World Economic Forum's *Global Risks Report 2016* mentions the emergence of the "(dis) empowered citizen" who is empowered and disempowered at the same time through the use of emerging technologies. He or she has access to information but not to decision-making which is something that any transnational network should be cognisant of. According to the World Economic Forum (WEF), "as technology empowers citizens to find information, connect with others and organise, those citizens feel disenfranchised by distant elites" (WEF 2016: 7). This might be one of the few shortcomings of the Thread Centre and despite Lepik's (2020: 8) assertion that the Thread Centre and Fass School "were planned with and for the local community, using local materials and knowledge, but also upgrading tra-

ditions and introducing new technologies", and despite mention being made of some community participation during the design phase when the students visited Senegal, there seems to have been limited decision-making on the part of the local villagers prior to construction. Berlanda (2016: 3) writes that "The original massing was much more complex, but during the course of 2012, Toshiko Mori travelled to Sinthian twice, and discussions there led to simplifying and refining both the massing and the roof structure quite a few times, using local knowledge as a sounding board for the design process" which seems to indicate some local feedback (not necessarily decision-making) during the design phase, but there was more local decision-making during the construction of the project which does make the dialogue between North and South somewhat more horizontal. Mori remarks that "The last thing I want to do is to impose something quite foreign to the villagers"[34], and the fact that Thread is made almost entirely of local materials using local skills goes a long way to achieving this aim. The dialogue between New York and Senegal was made possible by modern technologies[35] and Thread is emblematic of Mbembe's concept of deborderisation (Mbembe, 2019a: np.; 2019b: np.; 2020a: np.).

Architecture can generate opportunities to increase the value and sustainability of manual labour and a person's decision-making power by developing existing skills to become more cognitive, creative and unique; the combination of high-income cognitive and creative occupations and low-income manual occupations mentioned above was used to build the Thread Centre, but due to the skill building that took place in terms of the manual



Figures 83 and 84:
The street façade of 277 Mott Street, New York, USA, 2019, Toshiko Mori Architect. Source: Michael Vahrenwald, David Jaubert. [Online] Available: https://tmarch.com/mott (Accessed 2 October 2020).

labour employed, the same construction team with its improved skills could be employed on other projects. Approximately forty local villagers were employed to build the Thread Centre and using their pre-existing building knowledge and the new skills they learnt there, they were able to also build the Fass School along with a number of additional community members[36].

As Schwab argues, the fourth industrial revolution "does not mean that we face a man-versus-machine dilemma. In fact, in the vast majority of cases, the fusion of digital, physical and biological technologies driving the current changes will serve to enhance human labour and cognition" (2017: 40). The challenge will be to place equal value (psychologically and economically) on different types of labour. Although Schwab cautions that the fourth industrial revolution could increase inequality as labour is substituted by capital through the use of robotics and algorithms, with the Thread and Fass projects the use of algorithms did not substitute local labour, but rather gave it new life. As Reitz and Baerlecken (2009: 61) argue, computer algorithms based on textile techniques can lead to the generation of new architectural forms, but it can also allow for continuous feedback loops between the digital and the analogue. Mori maintains that "The building and technique relate directly to the creative capacity and fine skills of the local community, by way of ensuring jobs for villagers and instilling knowledge for future maintenance and management" (2020b: 55).

Mostafavi (in Weber *et al*, 2014: np.) observes that Mori makes two kinds of projects: One kind that has a clearer lineage to the Bauhaus (mostly in the global North), and another kind where the work with her students in the global South appears to generate a different type of form which is more experimental with references to weaving and textiles and has more of a social focus. Mori, however, notes how the use of materials and experimentation are important, regardless of whether one uses traditional or high-tech materials (2014: np.). She writes that "because of its intelligent and ecological potential that allows knowledge flow, textile tectonics can be adaptable to diverse economies that are capable of survival in low and middle-income countries as well as upper-middle-income economies" (2020b: 137), and while some of her work in the North contrasts with her work in Senegal, Lepik is of the opinion that "it is clear that there is underlying commonality: to use the power of research-based design to upgrade and improve working and living conditions in a holistic and sustainable way" (2020: 9). TMA has not directly applied the local tectonics used in Senegal in other parts of the global North, but the parametrically designed twisting structural forms or textile tectonics of the Thread Centre and Fass School's roofs share familial traits with the roofing structures of the Brooklyn Children's Museum Rooftop Pavilion (2015)[37], the Buffalo and Erie County Botanical Gardens (project), and the Hudson Park and Boulevard Subway Canopy and Café (2015)[38]. Mori notes how the roof for the Botanical Gardens, although it is made from an ETFE membrane, has a similar sinuous form and a sense of structural continuity[39]. There are also some similarities with the facades of the building at 277 Mott Street in New York (2019) which is not strictly speaking an example of textile tectonics, but its façade was also digitally designed and manufactured[40]. Mori writes about the Thread Centre that:

> *"Instead of imposing an externally perceived or borrowed identity, or resorting to nostalgia for the 'traditional', this effort is to dignify and rediscover latent potential and architectural identity through a community's authentic history while moving it toward future possibilities"* (2020b: 55).

The Thread Centre's combination of global tectonics, especially the application of computer-aided design and parametric modelling, and local tectonics, which embody almost the entirety of the building's material content, seems to suggest the closest condition to a hybrid out of the works explored here. Based on the visual collage analysis, it becomes clear that, different to the buildings analysed previously, in this case it is mostly impossible to separate the global tectonics and the local tectonics. The buildings embody a subversive text where global tectonics in the form of parametric modelling subvert the restrictions of vernacular form, but while local tectonics that include traditional techniques and labour push back against the normative application of computer-aided design[41], this does not necessarily represent a counter-subversion. Like weaving, the global and local become almost inextricable through the use of textile tectonics, but the search for a true hybrid continues.

Chapter 6 endnotes

1 He cites the work of Geoffrey Bawa, Denys Lasdun (particularly the Hurva Synagogue), and Mario Botta (particularly his Ticinese houses) as examples of hybrids. Frampton (1983b: 149), in turn, refers to the "hybrid nature" of Catalan Regionalism during the latter part of the twentieth century.

2 He writes that "One form this hybridization may take is by combining the benefits and appropriateness to modern life of modern architecture's functional planning and efficient appliances with the assurance and appropriateness to region of tried and tested local techniques. Where local materials are available, and local crafts persist and are still sufficiently productive and economic, architects should continue to use them" (1984: 24).

3 Specifically through the work of Robert Young, Bill Ashcroft, Jane Jacobs, Ania Loomba and Benita Parry.

4 Critical Regionalism often combined different aspects like global tectonic systems with concern for local light conditions, but using different comparative criteria or elements could result in a material, social, economic and ecological imbalance in terms of the process and product.

5 Tectonics only and not global tectonics combined with other elements that can serve as governing inspiration like local light conditions for example.

6 Edgerton (2007: 101) writes that the term *creole* comes from the Spanish *criollo* (which originally refers to mixed-race people), meaning "derived from, but different to, the originating case".

7 Which was initially used to describe someone with a hybrid anthropological origin.

8 Benimana, C. (2019b). *Personal interview with author,* MASS Design Group's office, Kigali, Rwanda, 13 March 2019.

9 Their Cholera Treatment Centre in Haiti (2015) is particularly interesting, and its perforated metal façade exhibits a range of tectonic strategies, being digitally designed, but locally bent by hand.

10 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.

11 This is markedly different to the Guga S'Thebe Arts, Culture, and Heritage Village where 79% of the labour force was from Langa (Smuts, 2020: np.).

12 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.

13 She remarks that the design, approval, and construction processes in the North tend to be more linear and transparent than in the global South, where lateral impacts like cultural differences, politics, and corruption can dramatically affect project programmes, which in turn impacts on the amount of time that local architects have to contribute.

14 According to Smuts, the only monetary benefit was that the German institutions funded the travelling expenses and a one thousand Euro stipend for her to travel to Germany to take part in a workshop with the students.

15 Smuts, C. (2020). *Personal interview with author*, CS Studio Architects office, Cape Town, South Africa, 21 September 2020.

16 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.

17 These structures were designed using computer modelling software and built on campus using repurposed PET bottles and clothes hangers for an international competition called the *Tower of Babylon* which was sponsored by the Global Alliance of Technical Universities.

18 Heiermann, B. (2019). *Personal interview with author,* Rheinisch-Westfälische Technische Hochschule (RWTH) Aachen, Germany, 22 June 2019.

19 The reused, repurposed and recycled materials were previously used for an exhibition called *Mies 1:1 Das Golfclub Projekt* in Krefeld, 2013.

20 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.

21 Galland, S. (2020). *Availability – Composition - Improvisation*. Presentation, Appropriate Technologies elective, BAS Honours program, School of Architecture, Planning and Geomatics, University of Cape Town, South Africa, 3 March 2020.

22 Galland (2020: np.) specifically mentions their *Désirs d'Îles* project where the process and product are based on a similar approach to the one they employ in South Africa.

23 Galland, S. (2019). *Personal interview with author, WERK*, Port Elizabeth, South Africa, 29 August 2019.

24 Nader Tehrani (in Mori, 2019: np.) observes how the social act often trumps architecture.

25 Mori lists yams, beans, okra, eggplant, moringa, and the gluten-free grain fonio (2020b: np.). The plant agriculture is run mostly be women, while the men have subsequently started a bee-farming enterprise.

26 She notes that for a Japanese American it was counter-intuitive that one could control crops better in a dry climate, since the amount of water that the plants are exposed to can be controlled (2020a: np.).

27 According to Mori (2020b: 57), the centre empowered more than a hundred women via *Groupement d'intérêt économique* (GIE) which has enabled them to establish an already expanding agricultural enterprise for subsistence farming and to earn income from surplus production.

28 And Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.

29 Its plinth is raised 500mm off the ground to facilitate canalisation, but the overall massing is still considerate of the topography.

30 One of the exceptions was Gregoire Bienquench, a Bassari from the Kedougou region, who was the main roof assembler (Berland, 2016: 5).

31 And Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.

32 A non-profit organisation that was founded in 2005 by Nicholas Fox Weber. [Online] Available: https://www.aflk.org/about/history/ (Accessed 1 October 2020)

33 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.

34 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.

35 Mainly by telephone, although Mori did arrange for Dr. Ba and his engineer to travel to New York (Mori, 2014: np.),

36 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.

37 The Brooklyn Children's Museum Rooftop Pavilion is made out of tubular steel elements and ETFE panels and is described as "a hybrid vaulted roof structure" (Mori, 2020b: 172).

38 This structure is a double-curved shell structure whose "geometry and shape become the structural support system" (Mori, 2020b: 173).

39 Mori, T. (2020a). *Personal interview with author, online via Zoom*, 9 April 2020.

40 Its street façade consists primarily of glass and CNC milled stone (whose origin is unfortunately not local, since it is Zimbabwe Black granite which was fabricated by Campolonghi Montignoso in Italy), while its rear façade has twisted aluminium fins that mimic the front façade (Marani, 2019: np.; Mori, 2020b: 200).

41 According to Berlanda (2016: 8), the local contributors added the steel beams to the roof construction, which subverted the architect's desire to use only local materials for the roof. The steel beams were eventually covered with thatch to conceal them to some extent.

Chapter 7: Conclusion

Background

The proposition of an emerging tendency in contemporary architecture in Africa where global and local ways of making are being combined led to a deep search for hybrid tectonics. It began with an initial investigation of contemporary architecture in Africa which was influenced by my own embeddedness as a researcher, teacher, and practitioner on the continent. This surfaced numerous projects by different architects and in different contexts that suggested a shift towards the hybridisation of global and local tectonics. The question then arose whether this was a widespread practice and if so, whether some of its influences, underpinnings, and tectonic strategies could be identified. This led me to engage in a directed search to identify and investigate projects that exhibit this tendency, and to understand both the theoretical and practical aspects related to this phenomenon.

In exploring the phenomenon of tectonic hybridisation, the investigation adopted a case study approach using mixed methods. This included an iterative literature review, the creation of a catalogue of works, the collection of empirical data from practice, and analysis using textual and visual methods. This revealed that the body of work in question is influenced by a multiplicity of encounters that include those between techno and technē, between the global and the local, and between the global North and the global South. Based on this research, which was undertaken from a Southern perspective, it reinforces the position that binaries can - and should - be contested. The work

shows that there is a spectrum across the recurring binary positions where situated forms of practice are occurring within the context of tectonic transitions. These transitions are subject to the relationality between people, and between people and the environment: In Africa in particular, environmental conditions such as climate change, resource depletion, and pollution, coupled with social conditions such as population growth, urbanisation, the loss of identity, and various forms of diaspora, are exacerbated by economic conditions such as poverty, local inequalities, and structural inequality between the global North and the global South. These conditions inform, or should inform, the making of architecture.

It has been recognised that in large parts of the global North, and in many parts of the global South, mainstream architecture is on an unsustainable trajectory. Buildings are often highly engineered using industrialised manufacturing processes with insufficient attention paid to their socio-environmental costs. Traditional local ways of making, local identity and memory, passive design principles, unequal access to resources (financial, educational and material), inequality, and the need for community involvement through skills building and employment creation are generally poorly considered. On the other hand, using only local materials, local labour, craft, and incremental construction will not be able to provide for increasing demand and contemporary building programs. Local tectonics often do not conform to current health and safety standards, nor do they allow for the incorporation of emergent technologies or for new tectonic encounters to occur. These concerns informed the search for hybrid tectonics and it is suggested that a shift towards a more hybridised approach to making can begin to address some of them.

Reflective summary

The research focused on contemporary architecture in Africa, particularly buildings that were completed during an especially prolific period from 2010 to 2019 by architects in whose work this shift is manifested. Africa is a vast space, and the cataloguing of contemporary works across the spectrum of global and local tectonics reinforces its condition as one of diverse contexts with highly specific conditions. It has had a long history of exchange with the outside world, but the uni-directional encounters between local populations and tectonics with those from the global North have historically been unequal and skewed in favour of outside interests. Architecturally, this is evident in the importation of foreign ways of making over hundreds of years of colonialism which largely over-wrote traditional ways of making; during the twentieth century, various forms of vernacularisation, and movements like Tropical Modernism and Critical Regionalism - despite sometimes having good intentions – had many blind spots and remained Northern tropes with modest local inflection or mediation.

The projects that were analysed revealed the tectonic as the primary architectural identifier, as opposed to type, form, or identity. Reflection on this work led to the proposition of an approach entitled hybrid tectonics. Hybrid tectonics is both an operational critique of previous forms of mediation such as Critical Regionalism, Tropical Modernism, and various forms of vernacularisation, and a proposal for an approach and a set of criteria that can be used to evaluate contemporary architectural works that aim to engage with the issues raised above. The approach is underpinned by sustainability and tectonic ethics and it encompasses both ontological and representational criteria in terms of tectonics in particular. Ontological criteria include the response to local climate, the response to local topography, the incorporation of local materials in relation to global materials, and the incorporation of local labour or traditional techniques in relation to global labour or techniques; representational criteria include the appropriate reinterpretation of local patterns or forms, the balance between global and local, and a project's social focus, horizontality, and how it addresses inequality in terms of positionality. This requires ethical underpinnings that go beyond professional ethics and environmental ethics, but that take cognisance of inequality, difference and social responsibility, and what is often termed ethicism. It is argued that a shift towards the hybridisation of global and local tectonics is necessary, since employment of the former can result in improved performance that allows room for new and emergent tectonics, while employment of the latter can permit more sustainable resource use, thereby contributing to the preservation of local memory and identity.

In the same way that past and present technologies and tectonics co-exist, so do global and local tectonics, and the encounters between them have opened a space for alternative and more sustainable modes of production. The research commenced with the interrogation of the recurring narrative of the polarisation of industrialisation and craft, or techno and technē. This encounter is shown to be largely fictional, since industrialised manufacturing and craft are intertwined and have always been mutually dependent. The second encounter that was investigated is between the global and the local, where architectural binaries were established between the universal and the regional, but again, numerous attempts at mediation between the two positions since the beginning of the twentieth century have been discovered. The

global and local continue to co-exist. The third encounter is a very real one between the global North and the global South, and Africa in particular. When explored through an architectural lens during the twentieth century, this encounter reveals the glaring inequalities that are still experienced in our present time, and how the mediations of the global were often a veneer which was not rooted in a desire for a more horizontal exchange. It is also evident that the global North and global South often co-exist in the same context. The fourth encounter is with the new: This includes the encounter with new technologies and tectonics, access to which is marked by inequality, and it also involves new positionalities or encounters with otherness where architects who are practicing in Africa work across boundaries. During the twenty-first century, these architects are either part of the latest generation of an enduring diaspora from Africa to the global North, or part of the inverse condition where architects from the global North produce work intermittently or embed themselves in Africa over an extended period.

The analysis confirms that the relevant works in Africa are tectonically situated across the spectrum of the global and the local. Within this spectrum, the research has enabled the identification of common strategies which have been used to facilitate discursive analysis. Under global tectonics, a number of projects make use of computer-aided design (CAD) and/or computer-aided manufacturing (CAM), while virtually all of them make use of some form of industrialised production or involve some form of material innovation using global tectonics. Under local tectonics, the use of traditional local craft and/or climatic strategies is a regular strategy, as are the use of localised production and incrementality and the use of local natural materials, while the use of reused, recycled, or repurposed materials is a strategy that is gaining traction. A catalogue that documents the works and their tectonic strategies has been developed into an interactive open access website that contains the relevant data for every project. It provides a useful platform for discursive analysis, and while it is by no means exhaustive, it includes over a hundred buildings and it is a living document that can be added to continuously.

Further research led to the discovery of a number of constellations of projects that share common tectonic strategies, which are often concentrated in a specific geographic area or country. Three of these constellations were analysed in further detail by investigating selected emblematic works within them through the gathering of empirical evidence.

The first constellation reveals a tendency where there is a clear adjacency of global and local tectonics, and where the use of local natural materials and the empowerment of local communities are a key consideration in the projects. This tendency is evident in a large number of projects in Rwanda, and it is typically achieved by embedded practices that have had permanent offices in the country for an extended period. They often foster the practice of accompaniment between the architects, their collaborators, and the beneficiaries of the buildings, but this is also physically manifested in the tectonics of the buildings themselves.

The second constellation includes projects that make extensive use of reused, recycled, or repurposed local content, and the works take the form of didactic collages that combine these informal tectonics with natural local tectonics and global tectonics that often include digital design and/or manufacturing. This was particularly evident in South Africa in a long-standing albeit intermittent practice of design-build projects, mostly by a Germanic cluster of educational institutions who often partner with others from the USA and Europe, or with local practitioners.

The third constellation presents itself as a distributed tendency that is not geographically bounded and it includes a number of works that show the interesting possibilities of combining CAD and CAM with local tectonics. This constellation most clearly demonstrates the shift towards the hybridisation of global and local tectonics. When viewed through the lens of hybridity, these works, particularly two emblematic works in Senegal, reveal a measure of subversion where global tectonics reinterpret and invert local ones: Through the use of parametricism and digital structural modelling, or textile tectonics, the spanning and coverage capabilities of the appropriated traditional construction systems are exponentially increased through reinterpretation and inversion (read subversion); at the same time, there is some push-back by local tectonics which have been developed over hundreds of years and to some extent they subvert the exclusionary purity of the global tectonics by imposing certain limitations and by prescribing the design of the assembly system and connections.

In the analysed works, the encounters between techno and technē, the global and the local, the global North and the global South, and between pre-existing and new tectonics, are shifting towards a more integrated and horizontal condition that is tectonically demonstrative of deborderisation. This, in turn, facilitates the dissolution of hierarchies that are established by the production of binaries.

Conclusion

The investigation has confirmed the existence of a dynamic and emergent tendency in contemporary architecture in Africa where a Southern sensibility has enabled the combination of global and local tectonics. Within the period of study alone, more than a hundred buildings evidencing this have been identified, analysed and catalogued. Through further analysis, specific approaches and tectonic strategies were uncovered that were used to identify a set of constellations of works that share specific strategies.

These works demonstrate situated forms of practice which are influenced by various encounters, and informed by the architects' positionalities, value systems and ethical underpinnings. Heidegger's questioning of technology, Frampton's work on tectonics, Critical Regionalism as developed by Frampton, Lefaivre and Tzonis, Bhabha's expounding on hybridity, and Mbembe's notions of Afropolitanism and deborderisation proved to be appropriately productive to situate the investigation of contemporary practice in Africa within the context of encounters.

Through the research, a set of criteria was developed that can be used to identify and evaluate hybrid tectonics. These criteria were employed to analyse emblematic projects within three constellations that include a constellation in Rwanda, a constellation in South Africa, and a broader digital constellation. While the works in Rwanda and South Africa approximate hybridisation, they rather represent a practice of adjacency, accompaniment, and collage, where individuals or individual pieces are still readily identifiable in the process and the final product. These distinctions become blurred in the digital constellation of works, where the global and local become decidedly difficult to separate. Emblematic works within this constellation are of particular interest where the combination of global and local tectonics can be regarded as the discovery that most closely resembles a hybrid condition.

The proposition was that there is a tendency in contemporary architecture in Africa where global and local tectonics are hybridising. The research has revealed that there are numerous works that demonstrate an approach towards this hybridisation, but a true hybrid remains elusive.

Furthermore, the work explored here has outgrown superficial Africanisms and it is generally moving beyond past mediations of the global towards a more equitable exchange between North and South. The previous predominance of Northern influence is being contested by the works that have been identified and catalogued through the research. This has surfaced a new emergent condition where the South is actively contributing to contemporary global discourse.

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This research has opened a space for an ongoing pursuit that explores work which is contributing to more horizontal exchanges between the global North and the global South. The work is manifested through the acts of design and making, not just in the South but recently also in the North. The research contributes to the discourse of technology and tectonics in Africa from within the continent. It does this by tracing the tectonic trajectories that influence contemporary architectural production in Africa, through the creation of a publicly accessible catalogue of contemporary works that show evidence of a shift towards hybridisation, the identification of common tectonic strategies within the spectrum between the global and the local, the surfacing of tectonic constellations, the analysis of empirical data related to emblematic works within these, the development of a set of criteria that can be used for analysis of the works, and the suggestion of a shift towards an approach that can be termed hybrid tectonics.

The search for hybrid tectonics reveals an emerging and still evolving form of practice in Africa which is underpinned by tectonic ethics, and where the specificity of local situatedness is key. The analysis has shown that a more horizontal exchange between both global and local modes of production offers a productive way of engaging with difference. The research contributes to this engagement by opening a fertile field for further investigation towards hybrid tectonics as a socially centred practice that is rooted in the dissolution of binaries.

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Note

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Appendix A

Table 1: The tectonic catalogue

As explained in the body text, the tectonic database is a catalogue of contemporary architectural works in Africa that demonstrate an attempt to combine global and local tectonics, and that were completed from January 2010 until December 2019 (except for a few key works prior to this period). Its contents are explained in detail in the body text, hence an additional description is not provided here.

The catalogue is not exhaustive, and works are being added to it continuously. It has also been developed into a website as part of this study, which can be accessed via https://uct.semantica.co.za/ or using the adjacent QR code.

In the column called “Project name and function”, the emblematic works that were analysed in more detail are highlighted in orange.

Country	Project name and function	Architect(s)	Year of completion	Location	GPS Coordinates
Burkina Faso	Atelier Gando	Kéré Architecture (Germany)	Under construction 2013-	Gando, Burkina Faso	11°50'55"N 0°29'29"W
Burkina Faso	Bethel Secondary School	Article 25 (UK)	2012	Gourcy, Burkina Faso	13°11'30"N 2°21'21"W
Burkina Faso	Bobodioulasso Chapel and Socio-Cultural Centre	Caravatti | Caravatti (Italy)	2016 & 2019	Matourkou, Bobodioulasso, Burkina Faso	11°05'14.6"N 4°20'29.8"W
Burkina Faso	Centre de Santé et de Promotion Sociale	Kéré Architecture (Germany)	2014	Laongo, Burkina Faso	12°32'37"N 1°16'45"W
Burkina Faso	Centre for Educational, Professional and Sports Integration	Albert Faus (Spain/Burkina Faso)	2012	Rimkieta, Ouagadougou, Burkina Faso	12°22'31"N 1°36'01"W
Burkina Faso	Dano Secondary School	Kéré Architecture (Germany)	2007	Dano, Burkina Faso	11° 8'55.17"N 3° 3'0.52"W
Burkina Faso	Gando Primary School, Teacher's housing, and Gando Primary School extension	Kéré Architecture (Germany)	2001, 2004 & 2008	Gando, Burkina Faso	11°50'31.96"N 0°29'13.86"W
Burkina Faso	Gando School Library	Kéré Architecture (Germany)	2012	Gando, Burkina Faso	11°50'31.96"N 0°29'13.86"W
Burkina Faso	Gando Secondary School (Naaba Belem Goumma Secondary School)	Kéré Architecture (Germany)	2011, ongoing	Gando, Burkina Faso	11°50'38"N 0°29'12"W
Burkina Faso	Home Kisito	Albert Faus (Spain/Burkina Faso)	2015	Ouagadougou, Burkina Faso	12°19'51.50"N 1°32'35.62"W

Type (Design-build, aid etc.)	Global tectonics		Local tectonics			
	Computer-aided design and/or manufacturing	Industrialised production/material innovation	Traditional local craft and/or climatic strategies	Local materials (natural)	Local materials (Reused, recycled or repurposed content)	Localised production/ incrementality
Charitable Foundation, Educational		Roof sheeting	Modified clay building techniques	Clay/mud walls, stone foundations		Roof structure, clay building
Architectural charity		Steel trusses		Local laterite		Laterite bricks
Unknown		Steel structure and roof, RC slabs		Local laterite		Laterite bricks
Charitable Foundation		External concrete block skin, steel lattice trusses, roof sheeting	Modified clay building techniques	Internal CEB skin, eucalyptus		Roof structure, CEBs
Charitable Foundation		Concrete structure, roof sheeting	Woven ceiling	Stone, earth		Compressed earth bricks, roof trusses
Charitable Foundation		Concrete structure, steel lattice trusses, roof sheeting, metal louvres		Walls (laterite stone blocks)		Roof structure
Charitable Foundation		Concrete structure, 8-10% cement mixed into CEBs, steel lattice trusses, roof sheeting, metal louvres	Modified clay building techniques	Clay/mud walls, stone used in plinth		Roof structure, CEBs
Charitable Foundation		Concrete structure, roof sheeting	Clay pots incorporated in roof	Local clay for walls, stone used in plinth, Eucalyptus screens		Roof structure, CEBs
Charitable Foundation		Concrete structure, cement mixed with poured earth, steel lattice trusses, roof sheeting, metal louvres	Modified clay building techniques, local pots used as part of cooling system	Poured clay/mud walls (mixed with cement and aggregate), stone used in plinth		Roof structure, poured earth walls
Unknown		Steel roof structure	Local furniture-making technique with plastic mesh used for mosquito nets. Traditional plaster inside.	Stone, earth		Barrel vaults, compressed earth bricks. Smaller steel sections.

Burkina Faso	Katiou Library	Albert Faus (Spain/Burkina Faso)	2014	Komsliga Department, Burkina Faso	12°10'54.4"N 1°37'45.6"W
Burkina Faso	Léo Surgical Clinic and Health Centre	Kéré Architecture (Germany)	2014	Léo, Burkina Faso	11°05'06"N 2°06'02"W
Burkina Faso	Lycée Schorge Secondary School	Kéré Architecture (Germany)	2016	Koudougou, Burkina Faso	12°13'0.67"N 2°22'41.63"W
Burkina Faso	Naaba Belem Goumma Secondary School	Kéré Architecture (Germany)	Under construction	Gando, Burkina Faso	11°50'39.26"N 0°29'12.00"W
Burkina Faso	Noomdo Orphanage	Kéré Architecture (Germany)	2016	Koudougou, Boulkiemdé province, Burkina Faso	12°13'7.87"N 2°23'55.03"W
Burkina Faso	Opera Village	Kéré Architecture (Germany)	Under construction	Laongo, Burkina Faso	12°32'39.79"N 1°16'49.91"W
Burkina Faso	Professional Training Centre for Women	Albert Faus (Spain/Burkina Faso)	2016	Boassa, Burkina Faso	12°18'42.67"N 1°36'58.40"W
Burkina Faso	Songtaaba Women's Centre	Kéré Architecture (Germany)	Under construction 2011-	Gando, Burkina Faso	11°50'56"N 0°29'27"W
Burundi	Library of Muyinga (following on from Open Structures and Case Study 1 in Katanga, Congo)	BC Architects & Studies (Belgium) with LUCA Architecture University, Brussels.	2012 design (Completion date unknown)	Muyinga, Burundi	2°51'13"S 30°20'07"E
Cameroon	NEXT STEP Ngaoubela	Technische Universität München (Germany)	2016	Tibati, Cameroon	6°31'20"N 12°35'56"E
Ethiopia	SECU Unit	Bauhaus Universität Weimar (Germany), Addis Ababa University/EIABC (Dirk Donath)	2012	Addis Ababa, Ethiopia	9°00'48"N 38°43'46"E
Ethiopia	MACU Unit	Bauhaus Universität Weimar (Germany), Addis Ababa University/EIABC (Dirk Donath)	2014	Addis Ababa, Ethiopia	9°00'44"N 38°43'53"E

Charitable Foundation		Steel roof structure, rebars supporting ceiling		Stone, earth	Polycarbonate panels from a demolished house in Madrid	Compressed earth bricks, smaller steel sections
Charitable Foundation		Concrete structure, concrete window reveals, 8-10% cement mixed into CEBs, steel lattice trusses, roof sheeting, metal louvres	Modified clay building techniques	Clay for CEBs, stone used in plinth		Roof structure, CEBs
Charitable Foundation		Steel lattice roof structure, concrete frame, perforated concrete ceilings, concrete platforms	Wind catchers / *malqafs*	Laterite stone shaped into bricks, eucalyptus	Furniture from repurposed construction materials	
Charitable Foundation		Concrete structure, roof sheeting		Local clay mixed with concrete		Roof structure
NGO		Concrete frame and some flat concrete roofing, steel roof structure, corrugated metal roofing, steel and concrete window elements		Laterite	Recycled steel for window elements	Laterite blocks for walls, CEBs for vaults
Charitable Foundation		Concrete columns & foundations, steel lattice trusses		Compressed clay bricks, eucalyptus	Stage & auditorium	Roof structure, CEBs
NGO		Steel roof structure		Stone, earth		Compressed earth bricks
Charitable Foundation		Concrete platform & pilotis, steel trusses, roof sheeting	Clay pots incorporated in walls, local mud construction infill	Local clay for walls		Roof structure, mud wall infill
Design-build and local NGO		Steel doors	Sisal hammock weaving	Local clay, sisal		Compressed earth blocks, locally made roof tiles
		Concrete courses, in-situ ringbeams, metal roofing		Local clay		Air dried adobe bricks, woven screens
Design-build	Automatically fabricated straw boards	Roof structure, straw panels		Straw, stone foundations	Cladding	Foundations
Design-build	Digital fabrication & parametric design	Plywood				Small-scale components

Ethiopia	The Warka Tower (Version 3.2)	Architecture and Vision/Arturo Vittori (Italy) Also members from USA, UK, Lebanon, Nigeria and Ethiopia	2015	Dorze, Ethiopia	6°11'40"N 37°34'27"E (Approximate)
Ethiopia	Woldyia Maternity Centre	Vilalta Studio (Spain)	2017	Weldiya, Ethiopia	11°49'54"N 39°35'57"E
Ghana	Abetenim Library	Eskaapi (France, Germany, USA, Spain)	2017	Abetenim, Ghana	6°48'0.44"N 1°23'8.44"W
Ghana	Abetenim School	Alberto Figueroa (Spain)	2017	Abetenim, Ghana	6°48'0.17"N 1°23'6.71"W
Ghana	Haduwa Arts and Culture Institute	[Applied] Foreign Affairs, Institute of Architecture, University of Applied Arts, Vienna	2014 and ongoing	Apam, Ghana	5°18'0.07"N 0°43'28"W
Ghana	Midwives Quarters	Georgia Institute of Technology (USA), Peter Behrens School of Arts (Germany), Havè Technical Institute (Ghana)	2017	Havè Etoe, Ghana	6°45'27"N 0°21'43"E
Ghana	MUDCafeteria (Vocational School)	TU Vienna (Anna Schweiger and Jaap Willemsen)	2017	Tamale-Yendi Road, Sang, Ghana	9°25'13"N 0°16'27"W (Approximate)
Ghana	Yeboahkrom School	Andrea Tabocchini & Francesca Vittorini (Italy)	2017	Yeboahkrom, Ghana	6°36'24"N 1°20'50"W
Guinea-Bissau	5 Kindergartens	ColectivoMEL (Portugal)	2016	Gabu/Cacheu/Bafatá/Bisau, Guinea-Bissau	12°17'26"N 14°15'03"W (Gabu, 1 of 5)
Kenya	Asilong Christian High School	BNIM (USA)	2018	West Pokot, Asilong, Kenya	1°33'43"N 34°57'33"E
Kenya	The Craft School	University Build Collective: Bauen für Orange Farm, TU München (Germany), Jomo Kenyatta University of Agriculture and Technology (Kenya), University of Augsburg (Germany)	2012	Kangundo Road, Nairobi, Kenya	1°18'20"S 37°09'08"E
Kenya	Eco Moyo Education Centre (I and II)	The Scarcity and Creativity Studio (SCS), Oslo School	2017	Ezamoyo, Nzunguni Village, Kilifi County, Kenya	3°31'3.47"S 39°49'30.90"E

Unknown	Parametric design	Polyester mesh and polyester cable, hemp rope. Development of superhydrophobic materials	Bamboo construction based on local weaving, use of local tools	Bamboo, false banana fibre, stone		Small-scale lightweight components (modular & foldable)
Commission		Precast concrete & steel	Window grilles shaped according to traditional Ethiopian pattern, mothers' waiting area inspired by traditional *tukuls*	Bamboo		
Fundraising		Roof sheeting		Local earth (rammed), wood, stone		Rammed earth
Fundraising		Roof sheeting		Local earth (rammed), wood, stone		Rammed earth
Design-build	Physical models digitised for structural optimisation	Concrete bases, canvas covering	Traditional textile techniques being investigated for vertical screens	Bamboo	Repurposed materials being investigated for vertical screens	Bamboo arches
Design-build	Digital design methodology mentioned?	Metal roofing		Bamboo, lateritic soil, timber, raffia palm & creepers		Sandcrete blocks
Design-build		Steel trusses, metal sheeting, cement		Local soil for rammed earth walls, local straw		Rammed earth walls, locally made straw mats and rope
Fundraising		Roof sheeting		Local earth, wood, stone		Rammed earth
EU Institute		Steel structure		Thatch		
Unknown		Steel trusses, roof sheeting, concrete		Wicker screens, woven papyrus ceilings		Locally made bricks (which partly acted as formwork), steel welded on site
Design-build		RC frame	Solid stone masonry	Bamboo, reed, stone		Bamboo, stone
Design-build		Concrete structure, metal sheeting		Coral stone, local earth mixed with		Stonework, timber work

		of Architecture and Design (AHO) (Norway)			(Approximate: Building not visible June 2018)
Kenya	Kibera Hamlets School	Selgas Cano (Spain), Hello Everything (USA), Studio 14 (Kenya)	2016	Kibera, Nairobi, Kenya	1°18'55.05"S 36°46'57.52"E
Kenya	Kibera Public Space Projects (KPSP)	Kounkuey Design Initiative (KDI) (USA/Kenya)	2006 through 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, ongoing	Kibera, Nairobi, Kenya	1°19'02"S 36°48'03"E and others
Kenya	Konokono Vaccination and Educational Clinic	Selgas Cano, Ignacio Peydro and MIT students (Spain and USA)	2014	Kokuselei, Turkana, Kenya	4°02'12"N 35°43'02"E (Approximate)
Kenya	Okana Centre for Change	Pavilions for Okana/TU Delft (Laura Katharina Strähle and Ellen Rouwendal)	2017	Okana, Kenya	0°08'46.8"S 34°52'23.6"E
Kenya	Sacred Heart Cathedral of Kericho	John McAslan + Partners (UK)	2015	Kericho, Kenya	0°21'47.87"S 35°17'26.35"E
Kenya	St. Jerome's Centre	Build X (formerly Orkidstudio) (UK/Kenya)	2014	Nakuru, Kenya	0°14'56"S 36°09'15"E
Malawi	Kusungu Maternity Waiting Village	MASS Design Group (USA)	2015	Kasungu, Malawi	13°02'12"S 33°28'44"E
Mali	Centre for Earth Architecture	Kéré Architecture (Germany/Burkina Faso)	2010	Mopti, Mali	14°29'39"N 4°11'49"W
Mali	Gangouroubouro Primary School	LEVS Architecten (The Netherlands) and Technical College Sevaré (Mali)	2013	Gangouroubouro, Mali	14°24'8.08"N 3° 1'45.51"W
Mali	Jigiya So Rehabilitation Centre	Caravatti | Caravatti (Italy)	2014	Katì Plateau, Mali	12°45'13"N 8°04'13"W
Mali	National Park	Kéré Architecture (Germany/Burkina Faso)	2010	Bamako, Mali	12°39'36"N 7°59'55"W
Mali	Practical Training College	LEVS Architecten (The Netherlands)	2013	Sangha, Mali	14°28'34.02"N 3°18'20.84"W

				cement for plaster, softwood		
Sponsorship	Computational design and coordination	Scaffolding & couplers			Museum installation, scaffolding	
		Steel structure, steel roof sheeting, concrete elements		Local clay		Soil stabilised bricks, bamboo
Design-build		Concrete bricks, scaffolding			Museum installation, structure, roofing	
NGO		Ferrocement		Bamboo		
Church		Concrete structure (local pouring system)	Mosaic, local skills assisted in design of roof pattern	Local cypress, Kenyan soapstone, granite, and blue stone		Clay tiles, cypress ceiling slats
Design-build & charitable /humanitarian design organisation		Pillar cores (Veneer by-product)		Local clay	Pillar cores (Veneer by-product)	Clay in grain bags for walls
Charitable Foundations		Steel roofing concrete		Local clay, local timber		Compressed earth bricks, joining local timber members for trusses
Charitable Trust		Concrete structure, 7% cement mixed into CEBs, steel lattice trusses, steel roof sheeting	Modified clay building techniques	Clay/mud walls, stone used in plinth		Roof structure, CEBs
Charitable Foundation		Steel profiles, poligny rafters		Local clay		Compressed bricks
Charitable Foundation		Steel structure & roof				Concrete blocks
Charitable Trust		Concrete structure, concrete grilles, steel lattice trusses, steel roof sheeting		Local sandstone		Roof structure, local stonework
Charitable Foundation			Mixing indigenous	Local clay		Compressed bricks

Mali	Tanouan Ibi Primary School	LEVS Architecten (The Netherlands) and Technical College Sevaré (Mali)	2013	Tanouan Ibi, Dogon Plateau, Mali	14°20'36"N 2°57'46"W
Mauritania	Castles of Sand	FAREstudio (Italy)	2014	Mbera Refugee Camp	15°50'04"N 5°47'55"W
Morocco	Loom-Hyperbolic Higher Atlas	Barkow Leibinger Architekten (Germany)	2012	The ruin at the Mosque Koutoubia, Marrakesh, Morocco	31°37'27.53"N 7°59'38.42"W
Morocco	Morocco Preschool	BC architects & studies + Tommaso Bisogno with KULeuven faculty of architecture	2017	Aït Ahmed, Morocco	30°27'30.60"N 9°31'48.96"W
Nigeria	Makoko Floating School (and MFS II and III)	NLÉ Works (The Netherlands & Nigeria)	2013 (Collapsed 2016, MFS II constructed for Venice Biennale 2016 and MFS III in Belgium 2018)	Lagos, Nigeria	6°29'39.33"N 3°23'40.97"E (Not extant)
Niger	American International School extensions	Atelier Masōmī / United4Design (Iran, USA, Niger, Germany)	2018	Niamey, Niger	13°31'30"N 2°04'28"E
Niger	Dandaji Daily Market	Atelier Masōmī	2018	Dandaji, Niger	14°16'41"N 5°07'42"E
Niger	Hikma Cultural Complex	Atelier Masōmī / United4Design (Iran, USA, Niger, Germany)	2018	Dandaji, Niger	14°16'54"N 5°07'48"E
Niger	Niamey 2000	Atelier Masōmī / United4Design (Iran, USA, Niger, Germany)	2017	Niamey, Niger	13°31'16"N 2°10'50"E
Rwanda	Butaro Cancer Centre of Excellence	MASS Design Group (USA)	2013	Burera District, Northern Province, Rwanda	1°24'30"S 29°50'12"E
Rwanda	Butaro Doctor's Housing and Sharehousing	MASS Design Group (USA)	2012 & 2015	Burera District, Northern Province, Rwanda	1°24'46"S 29°50'23"E
Rwanda	Butaro District Hospital	MASS Design Group (USA)	2011	Burera District, Northern Province, Rwanda	1°24'34"S 29°50'29"E

			berries into earth mix			
Charitable Foundation		Cement waterproofing on barrel vaults	Local ceramic tubes for ventilation	Local clay		Compressed bricks
UN Partnership		Steel trusses, concrete, plastic pipes, and tarpaulins	Traditional fabric ceilings	Local sand		Sandbag construction
Temporary installation	Geometric form generated with Grasshopper/Rhino	Steel plates and tube connectors	Traditional weaving	Local timber and yarn	Mosque ruins reused	Hand-cut timber and weaving
Charitable Foundation		Concrete frame for earthquakes, steel shading structure	Earth & lime plaster and roofing	Lime and stone. Bamboo for shading		Walls, roof
Charitable Foundation & UNDP		Plastic barrels for flotation. MFS II: Steel connectors, prefabrication etc.		Local timber and bamboo	Plastic barrels	Structural framework
School		Concrete beams, steel structure		Local clay	Reused steel sections for doors	Compressed bricks
Commission		Concrete frame		Local clay	Recycled metal canopies	Compressed earth bricks
		Formwork, concrete	Local dome-building, plastering and waterproofing	Local clay	Reused steel sections for doors	Steel doors, brick domes
Housing prototype		Concrete beams? Steel structure	Weaving for shading structure	Local clay		Compressed bricks
Charitable organisation and government.		Steel roofing, reinforced concrete frame		Volcanic rock from the Virunga mountains		
Charitable organisation and government.		Clay tile roofing/steel roof sheeting respectively, reinforced concrete frame		Local clay, timber and Volcanic rock from the Virunga mountains		Compressed earth bricks, joining timber members for trusses
Charitable organisation and government.		Steel roofing, reinforced concrete frame		Volcanic rock from the Virunga mountains		

Rwanda	ECCD and ECD&F Centres, Busogo School, Gasanze Pre-Primary, and Refugee Camps Education Centre	ASA (Rwanda & Italy)	2012-2016	Rwanda	Various (Gasanze indicated at 1°52'32"S 30°06'07"E)
Rwanda	Kimisagara Football for Hope Centre/Kimisagara Community Centre	Architectural Field Office (AFO)/Killian Doherty Architectural Practice/Architecture for Humanity (Ireland/Rwanda)	2012	Kimisagara, Kigali, Rwanda	1°56'58"S 30°03'05"E
Rwanda	Kintobo Health Centre	ASA (Rwanda & Italy) & TAMassociati (Italy)	2016	Kintobo, Nyabihu District, Rwanda	1°36'24"S 29°33'12"E
Rwanda	Mubuga Primary School	MASS Design Group (USA)	2015	Musanze, Rwanda	1°32'15"S 29°38'29"E
Rwanda	Mwito Pre-primary	Creative Assemblages (Spain/Uganda)	2019	Mwito, Bushenge sector, Nyamasheke District, Rwanda	2°23'08.6"S 28°59'26.9"E
Rwanda	Partners in Health Dormitory	Sharon Davis Design (USA)	2015	Rwinkwavu, Rwanda	1°57'58"S 30°36'50"E
Rwanda	RLS Dormitory	ASA (Rwanda & Italy)	2016	Rwamagana Lutheran Secondary School	1°56'25.14"S 30°25'55.59"E
Rwanda	Rugerero Health Centre	ASA (Rwanda & Italy)	2018	Rubavu, Rwanda	1°41'16"S 29°17'45"E
Rwanda	Ruhehe Primary School	MASS Design Group (USA) with the African Design Centre (ADC)	2018	Ruhehe, Musanze District, Rwanda	1°31'59"S 29°33'29"E
Rwanda	Rwanda Cricket Stadium	Light Earth Designs (UK)	2017	Gahanga, Kigali, Rwanda	2° 1'44.13"S 30° 6'26.02"E
Rwanda	Rwinkwavu Neonatal Intensive Care Unit	MASS Design Group (USA)	2014	Rwinkwavu, Rwanda	1°57'48"S 30°36'56"E
Rwanda	Umubano Primary School	MASS Design Group (USA)	2011	Kabeza, Kigali, Rwanda	1°58'13"S 30°07'04"E

Clients		Steel reinforcing	Reed ceilings	Local stone, clay & reeds	Repurposed steel packaging used for insulation	Locally made fired bricks
FIFA and non-profit organisation		Concrete structure, steel roof structure, steel roof sheeting		Local stone, clay and earth		Local made bricks, local stone and compressed earth
Health Builders Government		Steel, concrete, polycarbonate		Local stone, cane for shaders	Repurposed steel packaging used for insulation	Locally produced pavers & blocks
Government, charitable foundation		Vierendeel trusses, steel structure & roofing, steel doors and windows, reinforced concrete frame		Reed ceilings, local clay		Hand-made bricks
Private funding		Cement, steel roof sheeting	Soil retention uses local knowledge		50% reused, recycled or repurposed content (metal structure, openings, plywood and tiles)	
Humanitarian organisation		Steel columns & roof structure		Stone foundations, eucalyptus screens		Compressed bricks
Client		Steel trusses & concrete, steel doors and windows	Compacted clay floors, reed screens	Local stone, local clay, lime and reeds	Repurposed steel packaging used for insulation	Locally made fired bricks
Fund-raising and government		Steel trusses, steel roof sheeting, steel doors and windows	Compacted clay floors, reed screens	Local stone, local clay, lime and reeds	Repurposed steel packaging used for insulation	Locally made fired bricks, stone foundations
Government, charitable foundation		Concrete and steel structure for boundary walls, steel trusses, polycarbonate sheeting		Volcanic stone, clay. sisal and tree bark, cypress	Repurposed steel packaging used for insulation	Hand-made bricks, roof tiles woven screens
Client	Structural modelling	Geogrid reinforcing, low-carbon agro-waste-fired bricks		Local clay	Waste stone for flooring	Catalan vaulting
Government		Steel roofing, reinforced concrete frame		Volcanic rock from the Virunga mountains		
Government, charitable		Vierendeel trusses, steel roofing,		Reed ceilings, local clay		Hand-made bricks

Rwanda	Umubano Primary School extension	ASA (Rwanda & Italy)	2018	Kabeza, Kigali, Rwanda	1°58'13"S 30°07'04"E
Rwanda	Urugo Women's Opportunity Centre	Sharon Davis Design (USA)	2013	Kayonza, Rwanda	1°55'12.69"S 30°29'42.49"E
Rwanda	Vocational Training Centre	Dominikus Stark Architekten (Germany)	2010	Nyanza, Rwanda	2°21'03"S 29°46'01"E
Senegal	Eco-maison, H2OS	TAMassociati (Italy)	2017	Keur Bakar Diahité, Senegal	13°51'10.60"N 16°18'5.83"W
Senegal	Fass School	Toshiko Mori Architect (USA)	2019	Fass, Kaolack Region, Senegal	14°21'09"N, 16°01'58"W (approximate)
Senegal	Lecture Building, Alioune Diop University	IDOM (Spain)	2017	Bambey, Senegal	14°41'49.60"N 16°28'46.99"W
Senegal	Thread Artists' Residency and Cultural Centre	Toshiko Mori Architect (USA)	2015	Sinthian (Koular), Tambacounda Region, Senegal	13°20'16.65"N 13°37'16.98"W
Senegal	School in Tionck-Essil	DAW Arquitectos (Spain)	2018	Tionck-Essil, Ziguinchor, Senegal	12°47'43.23"N 16°30'38.26"W
Sierra Leone	Bio-Learning Centre	Architecture Sans Frontières Denmark	2014	Sussex, Sierra Leone	8°21'36"N 13°13'51"W
Sierra Leone	Swawou School for Girls	Build X (formerly Orkidstudio) (UK/Kenya)	2016	Swawou Layout, Kenema, Sierra Leone	7°54'50"N 11°10'17"W
South Africa	Guga s'Thebe Children's Theatre	CS Studio (RSA), Georgia Institute of Technology (USA), PBSA Düsseldorf (Germany), RWTH Aachen University (Germany), UCT (RSA)	2016	Washington Street, Langa, Cape Town, South Africa, 7455	33°56'40.49"S 18°31'27.24"E
South Africa	Iphiko (Ithuba Community College)	Basehabitat, University of Art and Design in Linz (Austria)	2010	Magagula Heights, Johannesburg, South Africa	26°25'24"S 28°12'42"E
South Africa	Ithuba Multi-purpose Hall (Ithuba Community College)	Faculty of Architecture, University of Ljubljana (Slovenia)	2011	Magagula Heights, Johannesburg, South Africa	26°25'23"S 28°12'43"E

foundation		reinforced concrete frame, steel doors and windows				
Government, charitable foundation		Steel trusses and roofing, steel doors and windows, concrete frame		Reed screens, local clay	Repurposed steel packaging used for insulation	Hand-made bricks
Humanitarian organisation		Steel columns & roof structure		Local clay		Compressed bricks
Private initiative		Corrugated sheeting, structural steel, steel doors, windows and screens		Local clay, papyrus and wicker		Locally made bricks, papyrus ceiling linings, wicker door infill
Pilot project		Steel roof structure	Woven screens	Bamboo for screens, thatch, clay		Compressed bricks
Charitable Foundation	Parametrically modelled roof	Small steel members	Plan shape, roof	Clay, bamboo, thatch	Reused tile fragments	Walls and roof construction
Client		Steel structure				Mass produced ventilation blocks
Charitable Foundation	Parametrically modelled roof	Steel & concrete structure	Roof	Clay, bamboo, thatch	Reused tile fragments	Walls and roof construction
Charitable foundation		Roof		Local clay		Compressed earth blocks & vaults
Environmental Foundation	3D modelling used to brief local craftsmen	Concrete, fibre cement roof sheeting, polycarbonate		Local timber		Local truss assembly
Design-build & charitable/humanitarian design organisation		Steel roof structure	Woven screens	Local clay		Compressed bricks
Design-build	Façade patterns tested using analogue and digital methods	Roof sheeting, polycarbonate sheeting, engineered roof trusses, steel structure, brick, cement and concrete		Straw and clay	Shipping containers, cladding	Cladding, insulation, floor tiles
Design-build		Lightweight steel trusses, concrete structure		Local clay		Compacted straw and loam mixture
Design-build		Lightweight steel trusses, concrete structure		Local clay		Compacted straw and loam mixture

South Africa	Ithuba Science Lab (Ithuba Community College)	Design.Develop.Build.: RWTH Aachen University (Germany)	2012	Magagula Heights, Johannesburg, South Africa	26°25'21"S 28°12'41"E
South Africa	Lim'Uphile Co-op	Collectif Saga (France)	2019	Walmer, Port Elizabeth	33°59'35"S 25°34'53"E
South Africa	Macassar Community Venue ("Bong's Place")	University of Cape Town (RSA), Cape Peninsula university of Technology (RSA), RWTH Aachen (Germany), PBSA Düsseldorf (Germany), Georgia Tech (USA), Studio Light (RSA)	2019	3 Link Avenue, Macassar, Cape Town	34°03'48"S 18°45'41"E
South Africa	Mapungubwe Interpretation Centre	Peter Rich Architects (RSA), John Ochsendorf (MIT, USA) & Michael Ramage (UK)	2009	Mapungubwe National Park South Africa	22°14'29"S 29°24'17"E
South Africa	Mzamba Schools (Ithuba School: Preschool I & II, Grade 2, Grade 3)	Bauen für Orange Farm, TU München (Germany). Grade 3 with buildCOLLECTIVE, Carinthia University of Applied Sciences (Austria)	2011, 2013, 2014	Mzamba, Eastern Cape, South Africa	31°05'18"S 30°09'10"E
South Africa	New Holy Saviour Hall (Walmer Creche)	Poise Consulting Engineers (with Simon Galland from Collectif Saga) LYT Architects	2019	Mpukane Street, Walmer, Port Elizabeth, South Africa	33°59'46"S 25°35'00"E
South Africa	Oppie Koppie Creche	Design.Develop.Build.: RWTH Aachen University (Germany)	2010	Prince Alfred Hamlet, South Africa	33°17'02"S 19°18'54"E
South Africa	Schap! '09: Ithuba Community College	buildCOLLECTIVE: Carinthia University of Applied Sciences, FH Kärnten (Austria)	2009	Magagula Heights, Johannesburg, South Africa	26°25'21"S 28°12'41"E
South Africa	Schap! '11: Ithuba Community College	buildCOLLECTIVE: Carinthia University of Applied Sciences, FH Kärnten (Austria)	2012	Magagula Heights, Johannesburg, South Africa	26°25'23"S 28°12'42"E
South Africa	Schap Mzamba '14: Ithuba School: (Grade 4)	buildCOLLECTIVE: Carinthia University of Applied Sciences, FH Kärnten (Austria)	2014	Mzamba, Eastern Cape, South Africa	31°05'18"S 30°09'10"E

Design-build	Parametric software used by *Transsolar* to determine opening positions and thickness of floors and roofs.	Lightweight steel structure		Clay, straw		Lightweight rammed adobe structure, locally welded trusses
Architecture Collective		Roofing, polycarbonate			Pallets, timber, containers, tyres, brick fragments, greenhouse, found objects	Roof structure
Design-build	3D printed translucent panels	Roofing, polycarbonate, concrete blocks			Timber, pallets	Timber structure, windows
National	Structural modelling	Steel structure, concrete sub-structure		Local clay		Locally made brick tiles, stone cladding and vaults
Design-build		Concrete slab, concrete blocks, fibre cement roofing		Local earth		Earth plaster, earthen walls in steel mesh and hessian
NPO		Cement, steel I beams, structural timber, corrugated sheeting, polycarbonate			Coca-cola pallets, cladding made from recycled plywood boards taken from demolished building and discarded crates	Pallet walls, plywood shingles
Design-build		Folded modular timber structure and metal roof		Clay	Reused bricks and repurposed fruit crates	Adobe mud brick with lime-clay plaster
Design-build		Concrete blocks, reinforced concrete, DOKA timber		Clay, straw		Timber structure, straw-light-clay walls
Design-build		Concrete blocks, light steel trusses		Clay, straw		Timber structure, light clay walls
Design-build		Concrete blocks & columns, fibre cement sheeting		Clay, timber lathes		Rammed earth wall

South Africa	Silindokuhle Community Hall	Collectif Saga (France) and Indalo (South Africa)	2015	Joe Slovo West, Port Elizabeth, South Africa	33°49'43"S 25°29'38"E
South Africa	Silindokuhle Preschool	Collectif Saga (France) and Uncedo (South Africa)	2017	Joe Slovo West, Port Elizabeth, South Africa	33°49'46"S 25°29'53"E
South Africa	Ukuqala 1, 2 & 3	Universität Stuttgart (Germany)	2011-2013	Village of Hope, Grabouw, South Africa	34° 8'23.68"S 19° 0'0.46"E
South Sudan	Healthcare Centre Mondikolok	David Kraler & Christoph Lachberger (Austria)	2015	Kajo Keji, South Sudan	3°54'52"N 31° 37'36"E
Sudan	Paediatric Centre	TAMassociati (Italy)	2012	Port Sudan, Sudan	19°39'0.36"N 37° 9'26.62"E
Sudan	The Salam Centre for Cardiac Surgery, including Prayer and Meditation Pavilion, and Container Medical Compound	TAMassociati (Italy)	2007 Surgery and Pavilion, 2009 Container Medical Compound	Khartoum, Sudan	15°30'36.76"N 32°39'47.74"
Tanzania	Amani Library	Social Practice Architecture (France & Germany)	2016	Kibaoni, Tanzania	3°01'13"S 37°33'59"E
Tanzania	Bike Shop and Community Shop	C-re-a.i.d. (Belgium, Tanzania)	2015 & 2016	Msitu Wa Tembo, Manyara Region, Tanzania	3°33'54"S 37°17'58"E (Approximate)
Tanzania	Black Rhino Academy	NLÉ Works (The Netherlands & Nigeria)	2018	Karatu, Tanzania	3°19'33"S 35°39'08"E
Tanzania	Kibwigwa Secondary School	Technical University of Munich (Germany)	2015	Dodoma, Tanzania	4°25'26"S 29°52'01"E
Tanzania	Milembe Girls School	Scattergood Design (UK)	2017	Misungwi District, Tanzania	2°52'55"S 33°6'47"E
Tanzania	Njoro Children's Library	Patricia Erimescu	2016	Njoro Primary School, Mailisita, Kilimanjaro Region, Tanzania	3°19'24"S 37°16'40"E
Togo	French School	Segond-Guyon Architectes (France)	2016	Ave Sarakawa, Lome, Togo	6° 7'24.53"N 1°12'55.76"E
Uganda	Gahinga Batwa Village	Studio FH (now Localworks) (Germany/Sweden, Uganda)	2018	Kisoro, Gahinga, Uganda	1°21'06"S 29°37'14"E (Approximate)
Uganda	Kachumbala Maternity Unit	HKS Architects and Engineers (UK)	2018	Kachumbala, Uganda	1° 13'36"N 34°06'43"E

Architecture Collective		Roofing, polycarbonate		Eucalyptus columns (telephone poles)	Pallets, telephone poles, glass bottles, tyres, found objects	Roof structure, doors and windows
Architecture Collective		Polycarbonate sheeting, metal roof sheeting, glazing, structural timber, concrete		Eucalyptus columns	Fishing crates, steel racking, window frames, cardboard tubes, cardboard, pallets, carpet underfelt, bricks, various found objects	Foundations, floors, walls, roof structure
Design-build		Roofing		Strawbales, eucalyptus poles/lathes	Windows (washing machine doors and bottles), cladding, truck sidings	Walls
NGO		Steel trusses	Mud plastering	Local earth		Incremental timber trusses, locally made adobe bricks & steel windows
Emergency NGO client		Structural steel, cement, sheeting	Passive ventilation/cooling techniques	Coral stone, timber		Locally made bricks
Emergency NGO client		Steel roof structure	Traditional bed-making technique used for weaving of screens & canopies	Straw, bamboo, stone	Containers	
Unknown		Roof sheeting	Cypress doors, bamboo screens	Stone, clay, timber		Rammed earth construction
NGO, Design-build		Steel members, sheeting and mesh		Local stone, sand	Repurposed plastic bottles	Timber joined for trusses
Charitable Foundation (School)		Concrete structure, upside-down catenary arches		Local clay		Compressed earth bricks
Design-build	Digital structural design	Concrete shell on Zollinger roof construction				Zollinger roof members
Charitable Foundation		Roof sheeting, cement		Local bamboo and stone		Custom prototyped louvres locally made, cement blocks made on site
Charitable Foundation		Metal sheeting		Local clay	Repurposed concrete blocks & timber	Compressed earth bricks
		Steel roof structure, concrete elements		Local clay		Compressed earth bricks
Pro-bono/charitable trust		Metal roofing, polycarbonate sheeting	Inspired by lightweight Batwa forest dwelling	Stone, eucalyptus, bamboo, grass mats, earth	Recycled engine oil for painting	
Design-build		Concrete block columns, roof		Local clay		Compressed earth bricks, terracotta screens

Uganda	Multi-purpose Hall at St. Bernard's	Studio FH (now Localworks) (Germany/Sweden, Uganda)	2016	Mannya, Rakai, Uganda	0°47'41"S 31°25'55"E
Uganda	Ross Langdon Health Education Centre	Ross Langdon (Australia), Studio FH (now Localworks) (Germany/Sweden, Uganda)	2016	Mannya, Uganda	0°47'36"S 31°25'50"E
Uganda	RUCID College for Organic Agriculture	Studio FH (now Localworks) (Germany/Sweden, Uganda), Light Earth Designs (UK)	2017	Lubanja, Mityana District, Uganda	0°26'15"N 32°02'32"E
Zambia	The Mutende Project II	Build X (formerly Orkidstudio) (UK/Kenya)	2013	Mutende's Harold Mwenge Memorial Academy, Paskale Road, Chingola, Zambia	12°34'45.14"S 27°50'32.66"E
Zambia	Mwabwindo School	Selldorf Architects (Germany/USA)	2019	Mwabwindo, Southern Zambia	15°27'42"S 28°59'13"E (Approximate)
Zambia	Prototype School for Zambia	Technische Universität München (Germany)	2014	Woodland B Basic School, Lusaka, Zambia	15°26'40.36"S 28°21'2.39"E
Zambia	Sachibondu Hospital	Build X (formerly Orkidstudio) (UK/Kenya)	2018	Sachibondu, Mwinilunga, Northwest Province, Zambia	11°31'34.43"S 24°28'3.37"E (Approximate: Building not visible June 2018)
Zambia	Shiyala Primary School	Build X (UK/Kenya)	2017	Chongwe, Zambia	15°17'26"S 28°40'07"E
Zimbabwe	PORET Permaculture Community Kindergarten	Anna Heringer (Germany)	2012	Chaseyama, Manicaland, Zimbabwe	19°37'05"S 32°31'33"E (Approximate)

Charitable Foundation (School)		Concrete structure, metal roofing, polycarbonate sheeting		Hemp fabric, stone		
Charitable Foundation		Metal roofing, polycarbonate sheeting, clay bricks	Mukeka reed mat ceiling	Eucalyptus, reeds	"Litres of Light" repurposed plastic bottles for roof lights	Eucalyptus beams joined with steel straps
Charitable Trust		Metal roofing		Eucalyptus, earth		Compressed earth bricks, Eucalyptus beams joined with steel straps
Humanitarian design organisation & design-build		Roof sheeting, steel, cement	Traditional fabric ceiling	Mud		Fired mud-brick, reduced structural sizes
Educational non-profit organisation		Steel structure and corrugated roofing		Local clay		Locally made compressed earth bricks
Design-build		Timber trusses		Local clay		Adobe bricks
Humanitarian design organisation		Concrete structure		Local clay & timber		Compressed earth bricks & brick vaults
Non-profit organisation		Steel drums, roof sheeting, steel trusses		Local earth		Rammed earth-filled steel drums
Client		Laminated timber	Thatching	Thatch, stone, mud		Timber structure, cladding

- Coordinates refer to the exact location of the building, except where stated otherwise.

Appendix B

Table 2: Comparing emblematic cases in terms of hybrid tectonics

As referred to in the body text, this Appendix shows the table comparing the selected works out of the Rwandan, South African, and digital constellations using the criteria for hybrid tectonics.

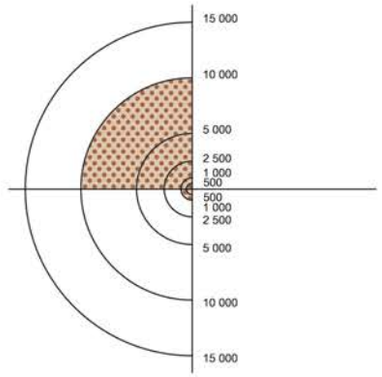
	Tectonic mode	Criteria	Ruhehe Primary School (MASS Design Group)	Umubano Primary School extension (Active Social Architecture)	Guga s'Thebe Theatre (RWTH Aachen University, PBSA Düsseldorf, Georgia Institute of Technology, CS Studio Architects)	Silindokuhle Preschool (Collectif Saga and Uncedo)	Thread Cultural Centre (Toshiko Mori Architect)
Sustainability and ethical underpinnings	Ontological tectonic criteria	Response to local climate	Yes, large covered outside spaces for shelter, rooflights and windows for natural light, screens for natural ventilation	Yes, large covered outside spaces for shelter, clearstoreys and windows for natural light, screens and perforated brickwork for natural ventilation	Yes, some. Light clay insulation for walls and thermal buffering of theatre space. Orientation and sealing are not optimal and there are only limited covered outside spaces.	Yes, some. Good orientation and shading, good ventilated roof, but only limited insulation and thermal sealing.	Yes, openings in roof and perforations in brick allow for natural ventilation. Orientation considers sun and breezes, while large covered outside spaces provide shading. Thicker than usual thatch improves insulation, while rainwater harvesting and storage are a key aspect of the design.
		Response to local topography	Stepped construction	Terraces and switch-back walkways couple with stepped construction	Flat site did not require much response to topography, but the building's finished floor level is quite low.	Terraced construction with raised classrooms to allow for water run-off.	Low-slung building form does not impose on the horizontal landscape.
		Incorporation of local materials in relation to global materials	Volcanic stone, local clay for bricks and roof tiles, local sisal and tree bark for screens, local timber for ceilings and doors, repurposed insulation. These are used in conjunction with cement and steel.	Local stone, local clay for bricks, local umuseke reeds and Eucalyptus lathes, repurposed insulation. These are used in conjunction with cement and steel.	Shipping containers, light clay insulation, and repurposed fruit crates and pallets. These are used in conjunction with corrugated sheeting, polycarbonate, a structural steel frame, structural timber trusses, and new brick and concrete elements.	Repurposed fishing crates, repurposed industrial racking for walls and trusses, repurposed cardboard tubes for walls and trusses, reused window frames, locally harvested Eucalyptus columns, repurposed pallet walls and floors, repurposed carpet underfelt and papercrete walls. These are used in conjunction with structural timber, glazing, polycarbonate sheeting, corrugated metal sheeting and concrete footings and a slab.	Local bamboo, thatch, clay, and reused tile fragments. These are used in conjunction with steel and cement through a computer-aided design process.
		Incorporation of local labour or traditional techniques in relation to global labour or techniques	Stone masonry, brickmaking and laying, weaving of sisal and tree bark. Labour for the extraction and processing of cement and steel takes place elsewhere.	Stone masonry, brickmaking and laying, weaving of reeds and lathes. Labour for the extraction and processing of cement and steel takes place elsewhere.	The light clay panels and timber cladding allowed for extensive student participation, but some of the elements required specialist equipment for installation, like the containers, steel frame and trusses. Labour for the extraction and processing of the global tectonics takes place elsewhere.	The "informal" tectonics enabled local residents to participate extensively and allow for local maintenance overt time. Labour for the extraction and processing of the global tectonics takes place elsewhere.	Inversion of a traditional roof form, local brick making, local roof construction based on traditional techniques, local thatching. Labour for the extraction and processing of cement and steel takes place elsewhere, as does the parametric design process.

	Tectonic mode	Criteria	Ruhehe Primary School (MASS Design Group)	Umubano Primary School extension (Active Social Architecture)	Guga s'Thebe Theatre (RWTH Aachen University, PBSA Düsseldorf, Georgia Institute of Technology, CS Studio Architects)	Silindokuhle Preschool (Collectif Saga and Uncedo)	Thread Cultural Centre (Toshiko Mori Architect)
Sustainability and ethical underpinnings	Representational tectonic criteria	Appropriate reinterpretation of local patterns or forms	*Imigongo* patterns in woven screens	Stepped terraces and switchbacks	Analogue and digital reinterpretation of Congolese *Shoowa* textiles for cladding. The appropriateness to South Africa could be questioned.	Some reinterpretation of "informal" construction methods.	Traditional West African collective dwellings used as inspiration for the parametrically inverted forms.
		Balance between global and local	Good balance between global and local with local tectonics seeming to dominate	Good balance between global and local with local tectonics seeming to dominate	The local tectonics are clearly visually dominant.	Good balance between global and local, especially through the use of "informal" tectonics.	Very good balance between global and local – visually the two tectonic strategies are virtually inseparable.
		Social focus, horizontality and addressing inequality in terms of positionality and other criteria	Strong social focus, practice embedded in Rwanda for a long period of time with many Rwandan employees, empowerment of local leaders (design leader through ADC and construction leaders through guild practices), females and minority groups. The practice employs similar methods in the global North.	Strong social focus, practice embedded in Rwanda for a long period of time with some Rwandan employees, empowerment of local leaders (construction leaders through guild practices), and females in particular.	Strong educational focus, but with limited skills transfer to the local community. Complex power relations between Northern education institutions and Southern contributors.	Strong social focus with participatory design and construction. Close involvement of the community throughout the process, with the practice embedded in South Africa for five years.	Strong social and environmental focus. Almost exclusive local sourcing and manufacturing, with embeddedness by proxy through local representation. Empowerment through the development of existing skills.
	Specific position in terms of tectonic ethics		Social justice approach through the practice of accompaniment.	Ethical underpinnings with the aim for social-environmental-economic balance.	Didactic purpose for students with socio-environmental underpinnings.	Didactic purpose for local communities with socio-environmental underpinnings.	Environmental and social sustainability underpinned by empathy towards 'the other'.

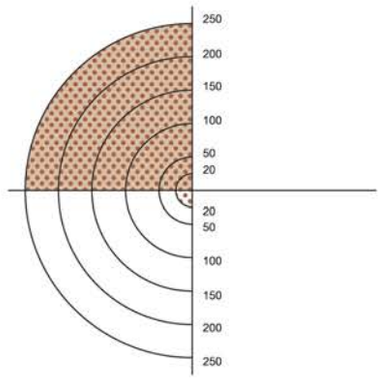
Appendix C

Enlarged visual analyses of emblematic cases

This appendix contains enlarged versions of the visual analyses that are discussed in chapter 4.



Global material and labour distances



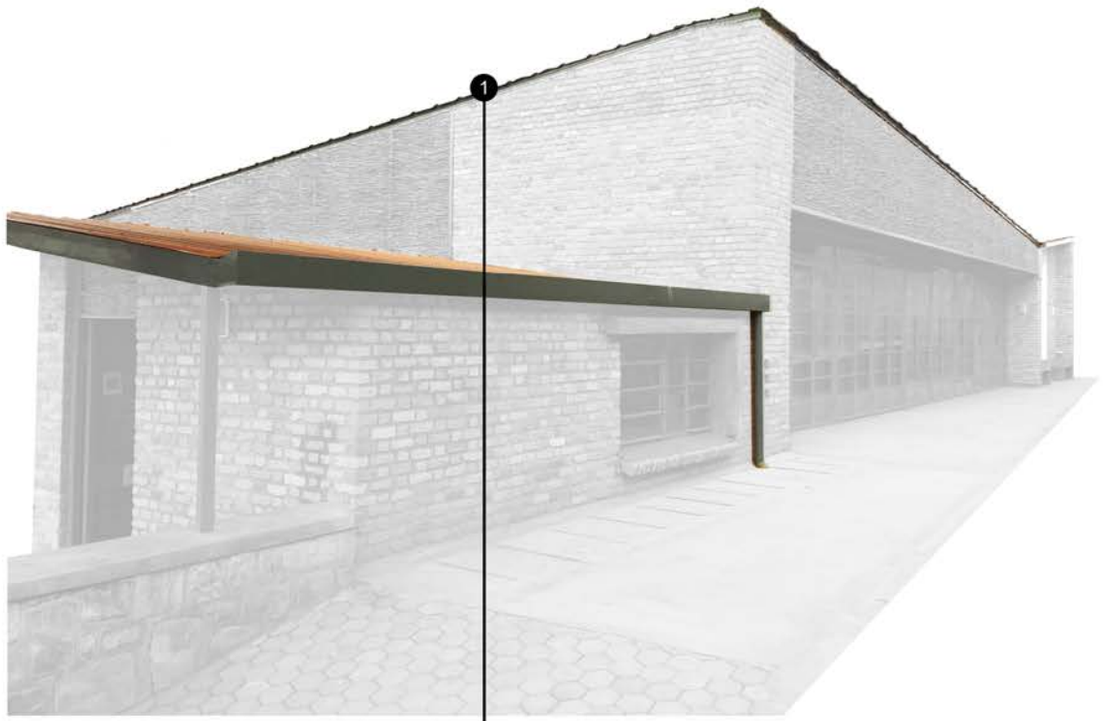
Local material and labour distances

Umubano Primary School extension

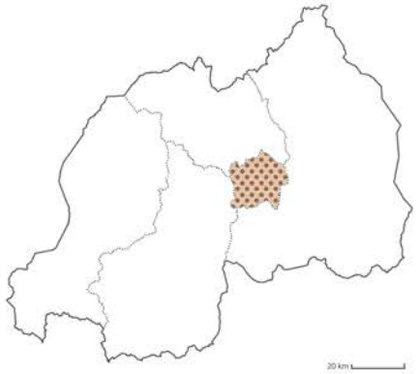
Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

Active Social Architecture (ASA)

Photo, adaptation and analysis by author.



Global material origin and labour



Local material origin and labour

Material

Labour

Global tectonics

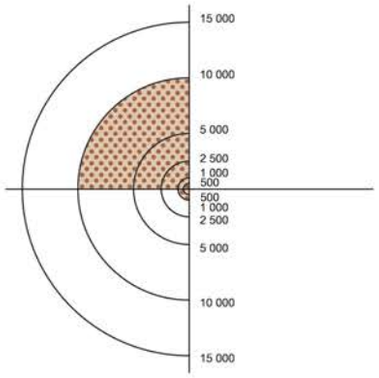
Material: Roof covering

Approximately 50% of material imported mostly from China, Uganda and Kenya (distance from 10 000km - 500km)

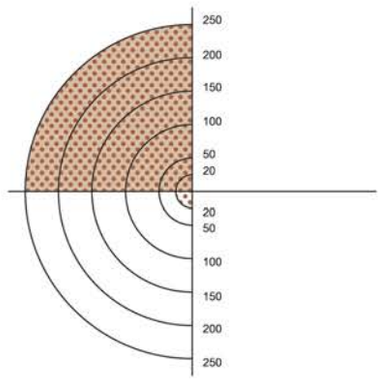
Approximately 50% of material produced locally in Rwanda (distance < 250km)

Labour: Roof covering

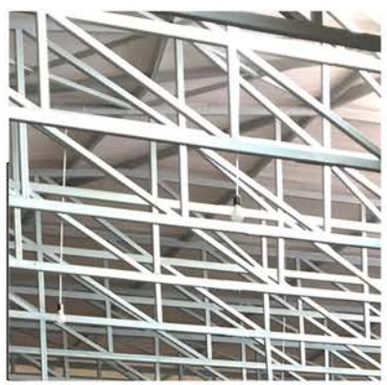
Extraction and initial processing in China, Uganda and Kenya (distance from 10 000km - 500km). Approximately 50% extraction and initial processing in Rwanda (distance < 250km), production in Kigali, mainly by Safintra and Tolirwa (distance < 20km)



Global material and labour distances



Local material and labour distances



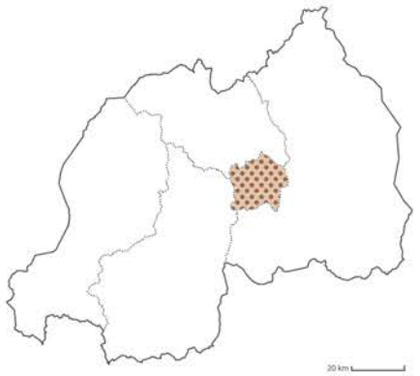
Umubano Primary School extension

Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

Active Social Architecture (ASA)

Photo, adaptation and analysis by author.

Global material origin and labour



Local material origin and labour

Material

Labour

Global tectonics

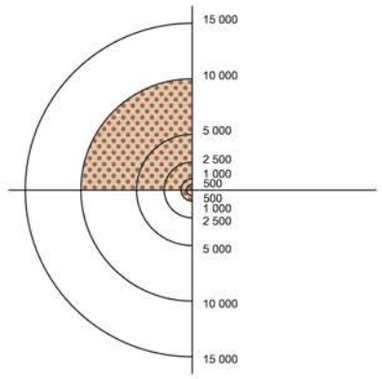
Material: Steel structure

Approximately 60% of material imported mostly from China, Uganda and Kenya (distance from 10 000km - 500km)

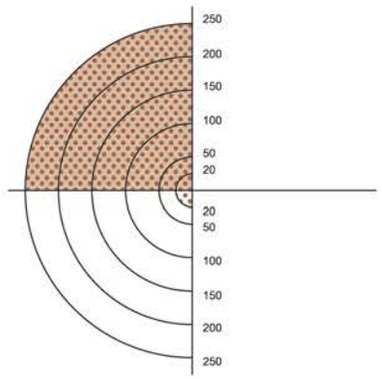
Approximately 40% of material produced locally in Rwanda (distance < 250km)

Labour: Steel structure

Extraction and initial processing in China, Uganda and Kenya (distance from 10 000km - 500km). Approximately 40% extraction and initial processing in Rwanda (distance < 250km), locally cut and welded in Kigali (distance < 20km)



Global material and labour distances



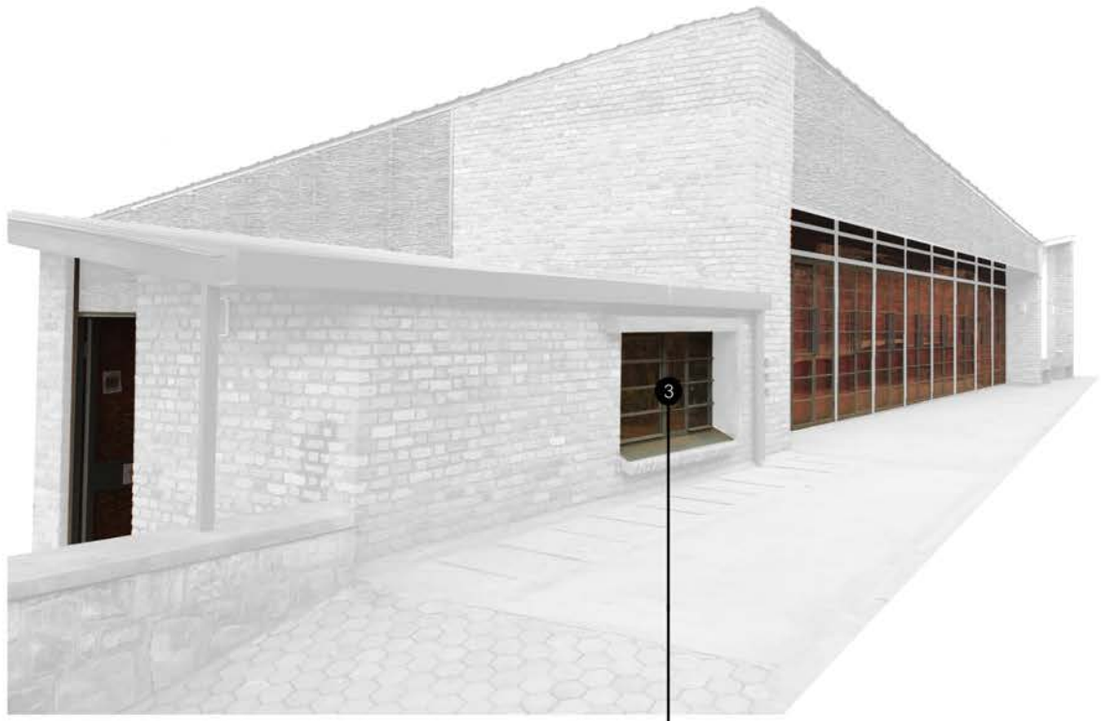
Local material and labour distances

Umubano Primary School extension

Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

Active Social Architecture (ASA)

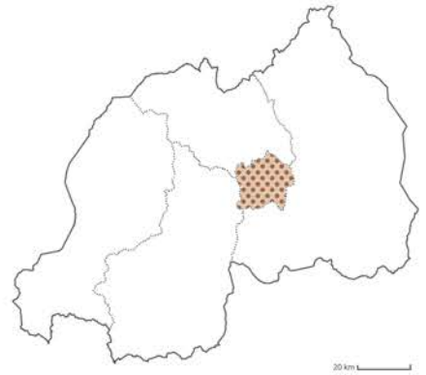
Photo, adaptation and analysis by author.



Material

Labour

Global material origin and labour



Local material origin and labour

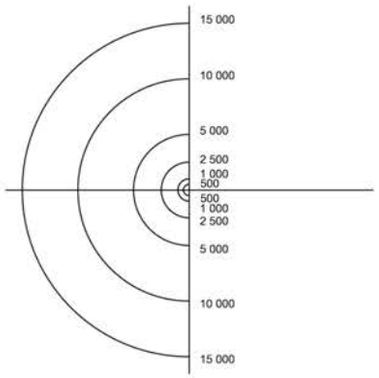
Global tectonics

Material: Steel doors and windows
Approximately 60% of material imported mostly from China, Uganda and Kenya (distance from 10 000km - 500km).

Approximately 40% of material produced locally in Rwanda (distance < 250km).

Labour: Steel doors and windows

Extraction and initial processing in China, Uganda and Kenya (distance from 10 000km - 500km). Approximately 40% extraction and initial processing in Rwanda (distance < 250km), locally cut and welded in Kigali (distance < 20km)



Global material and labour distances

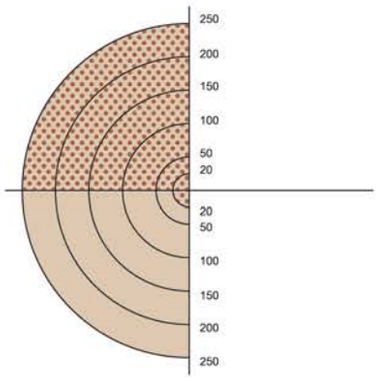
Umubano Primary School extension

Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

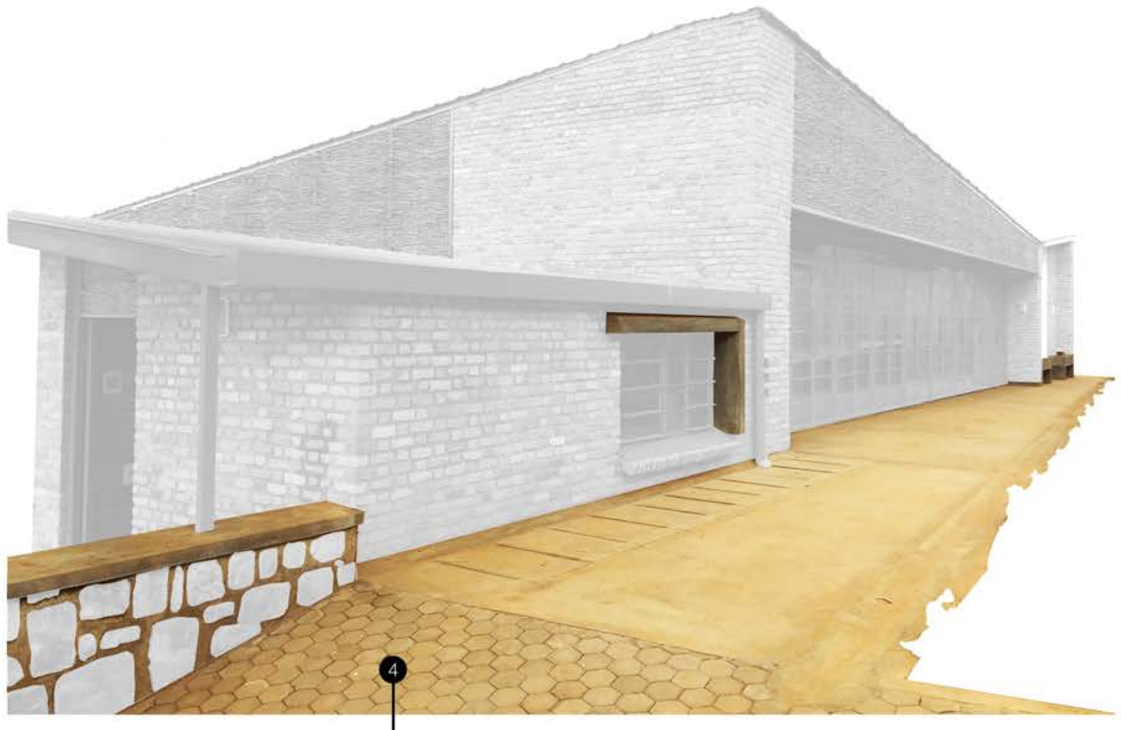
Active Social Architecture (ASA)

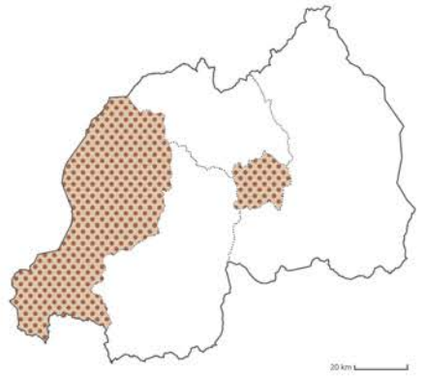
Photo, adaptation and analysis by author.

Global material origin and labour



Local material and labour distances





Local material origin and labour

Material

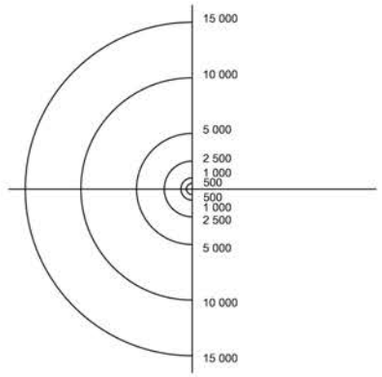
Labour

Global tectonics

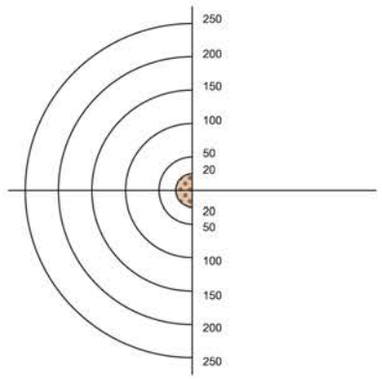
Material: Cement for structural concrete, mortar, surface beds, and precast pavers
Cement produced locally in Rwanda by Cimerwa (distance < 250km)

Labour: Cement for structural concrete, mortar, surface beds, and precast pavers

Concrete mixed in Kigali and pavers cast on site (distance < 20km)



Global material and labour distances



Local material and labour distances

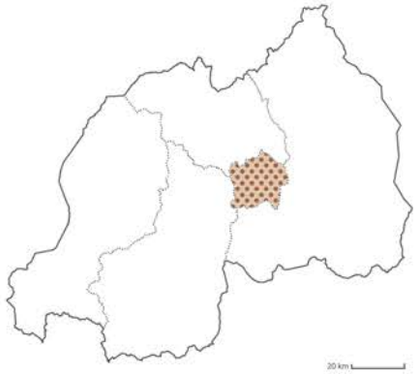
Umubano Primary School extension

Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

Active Social Architecture (ASA)

Photo, adaptation and analysis by author.

Global material origin and labour



Local material origin and labour

Material

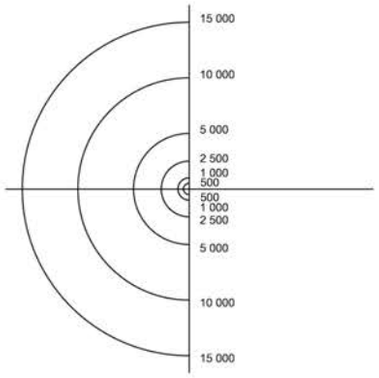
Labour

Local tectonics

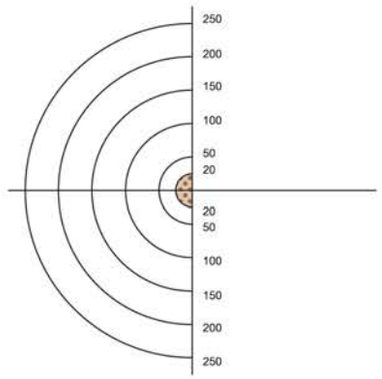
Material: Walls and foundations
Natural stone harvested from on-site excavations and procured from Kigali quarries
(distance < 20km)

Labour: Walls and foundations

Processed by hand on site (distance = 0km)



Global material and labour distances



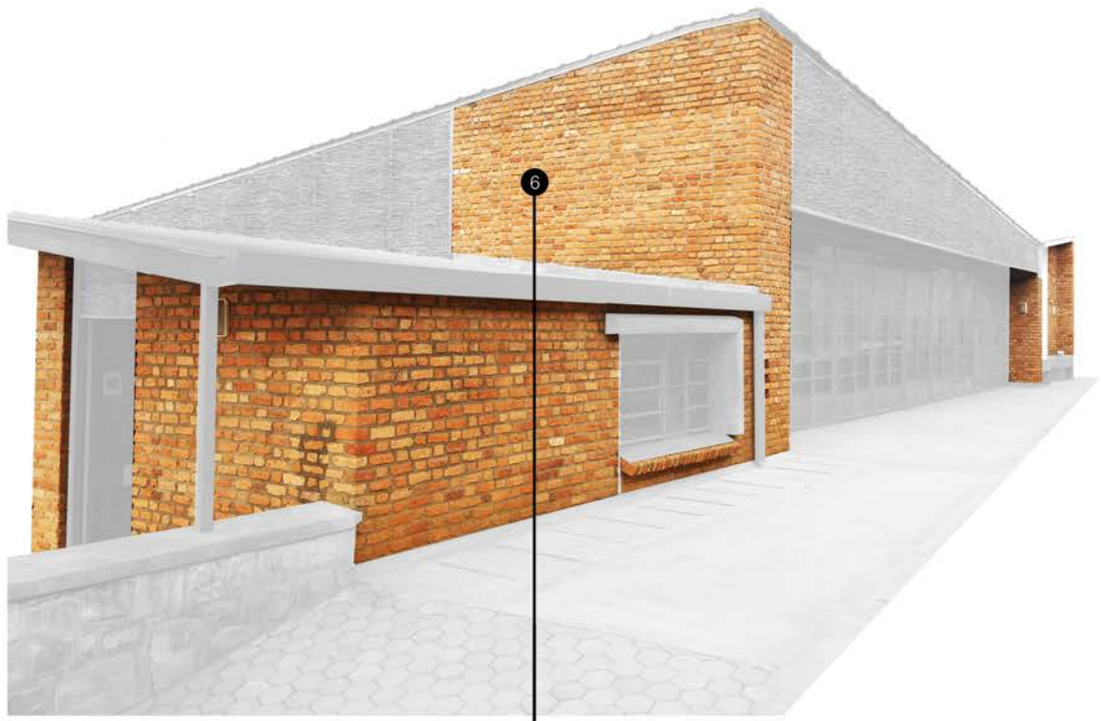
Local material and labour distances

Umubano Primary School extension

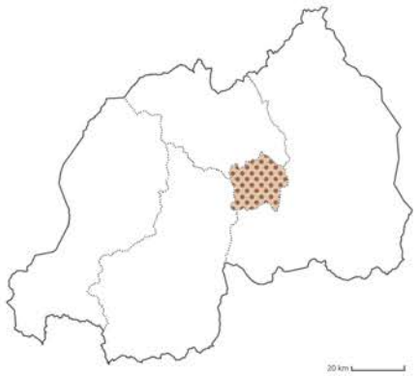
Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

Active Social Architecture (ASA)

Photo, adaptation and analysis by author.



Global material origin and labour



Local material origin and labour

Material

Labour

Local technologies

Material: Walls
Natural clay obtained locally (distance < 20km)

Labour: Walls

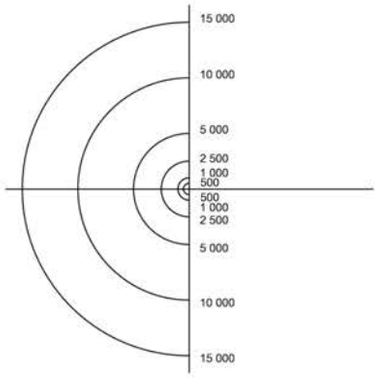
Sun-dried clay bricks made by hand close to the site (distance <20km)

Umubano Primary School extension

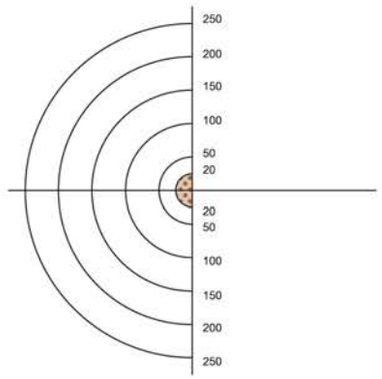
Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

Active Social Architecture (ASA)

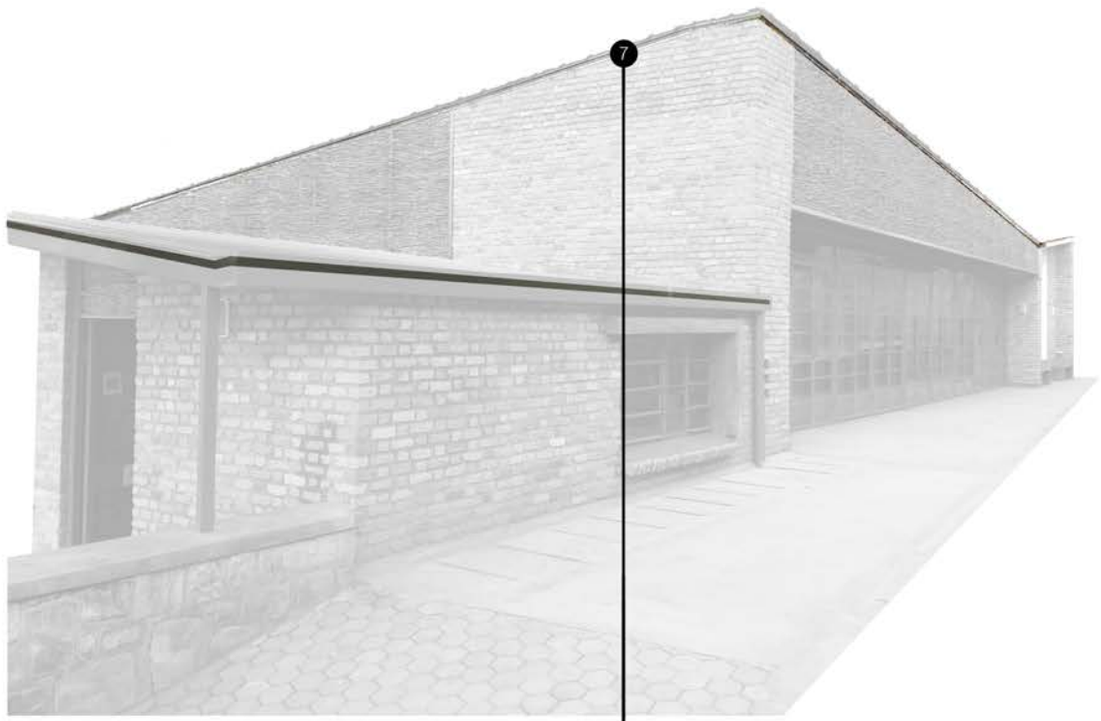
Photo, adaptation and analysis by author.



Global material and labour distances



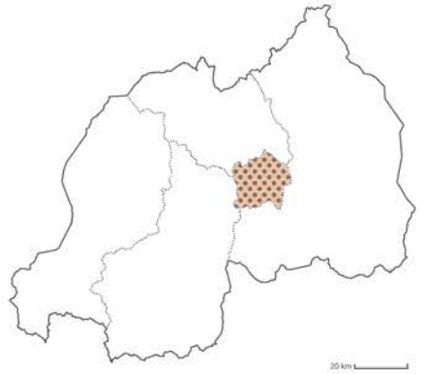
Local material and labour distances



Material

Labour

Global material origin and labour

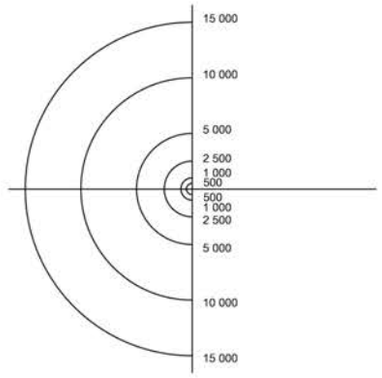


Local material origin and labour

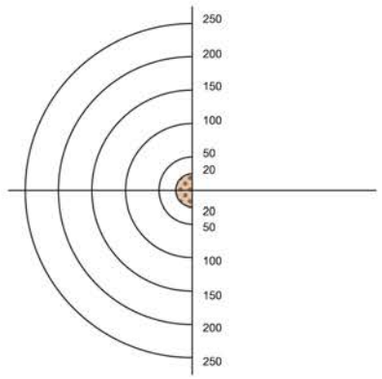
Local tectonics

Material: Insulation
Protective layer for rolled roof sheeting base material - waste material obtained locally (distance < 20km)

Labour: Insulation
None - repurposed material (distance = 0km)
While there was labour involved at the origin of the roof material, this is disregarded since it is repurposed



Global material and labour distances



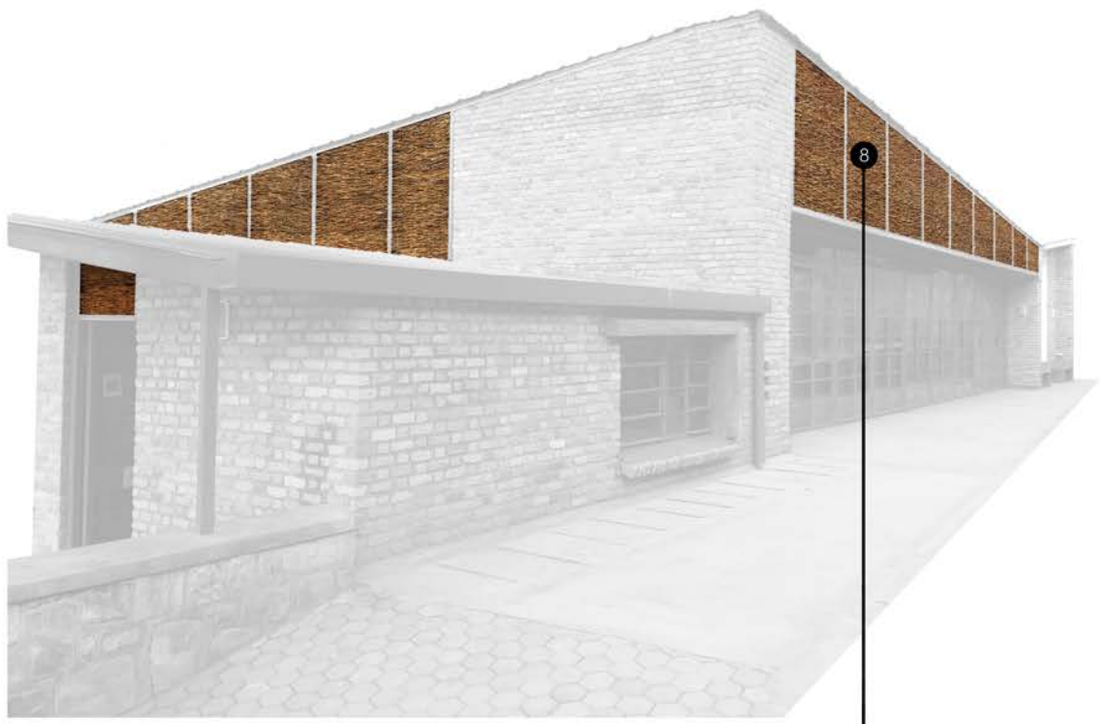
Local material and labour distances

Umubano Primary School extension

Kabeza, Kigali, Rwanda, 2018
1°58'13"S, 30°07'04"E

Active Social Architecture (ASA)

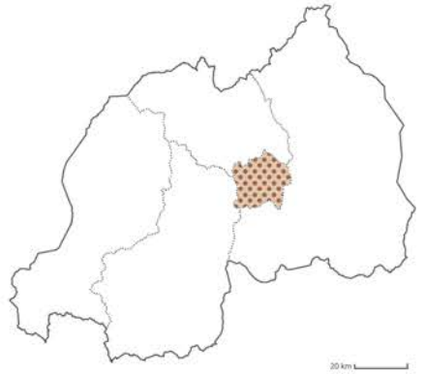
Photo, adaptation and analysis by author.



Material

Labour

Global material origin and labour

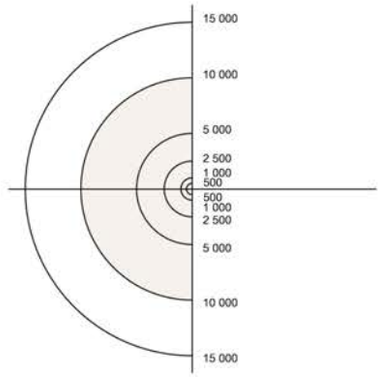


Local material origin and labour

Local tectonics

Material: Shading/ventilation screens and ceilings
Locally harvested reeds and lathes:
Initially Umuseke reeds, now Eucalyptus lathes
(distance < 20km)

Labour: Shading/ventilation screens and ceilings
On site (distance = 0km)



Global material and labour distances

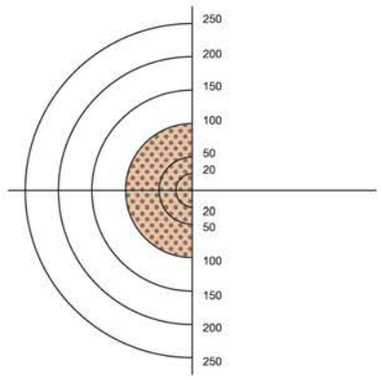
Ruhehe Primary School

Ruhehe, Musanze District, Rwanda, 2018
1°31'59"S, 29°33'29"E

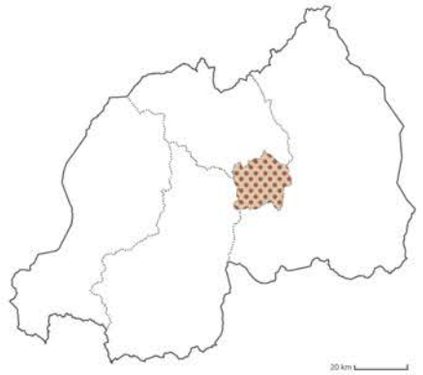
MASS Design Group with the
African Design Centre

Original photo by MASS Design Group (Alan Ricks).
Adaptation and analysis by author.

Global material origin and labour



Local material and labour distances



Local material origin and labour

Material

Labour

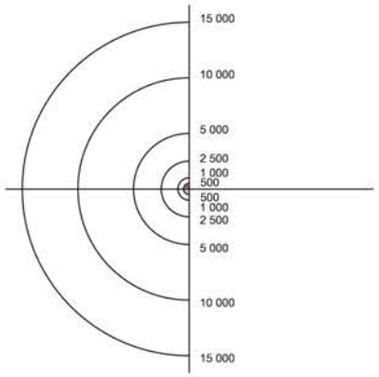
Global tectonics

Material: Polycarbonate sheeting and glazing

Material origin unknown.
Polycarbonate sheeting supplied by *Quincaillerie Manteco* in Kigali (distance < 100km)

Labour: Polycarbonate sheeting and glazing

Extraction and initial processing unknown.
Labour for polycarbonate forming possibly by *Safintra* in Kigali (distance < 100km)



Global material and labour distances

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1°31'59"S, 29°33'29"E

MASS Design Group with the
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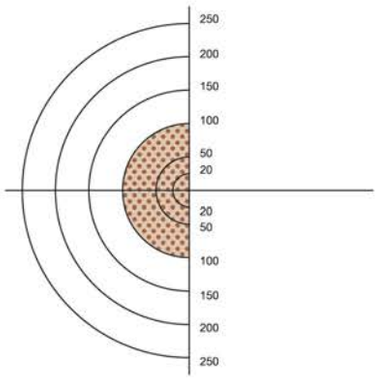
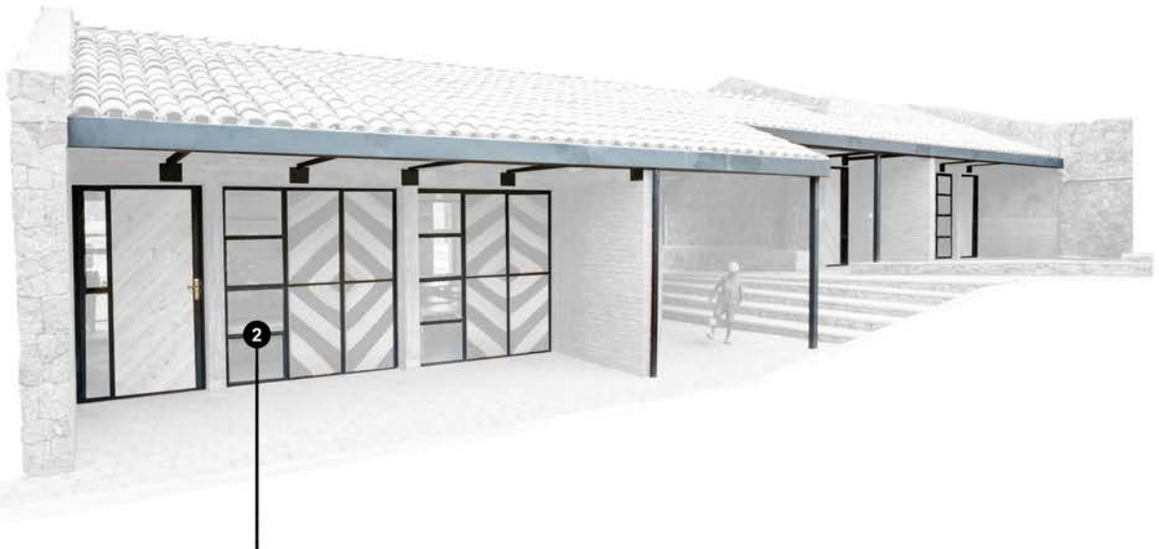
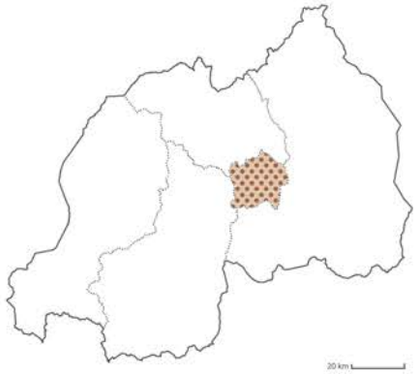
Global material origin and labour



Local material and labour distances





Local material origin and labour

Material

Labour

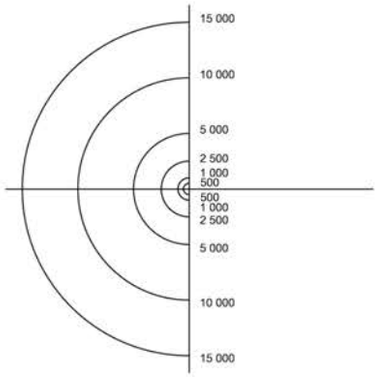
Global tectonics

Material: Steel for trusses, columns, and door and window frames

Recycled material imported from Uganda (distance < 500km) and supplied by *Roofings Manufacturing Limited* in Kigali (distance < 100km)

Labour: Steel for trusses, columns, and door and window frames

Extraction and initial processing in Uganda.
Cut and welded on site (distance = 0km)



Global material and labour distances

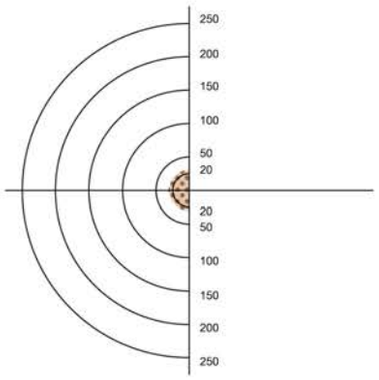
Ruhehe Primary School

Ruhehe, Musanze District, Rwanda, 2018
1°31'59"S, 29°33'29"E

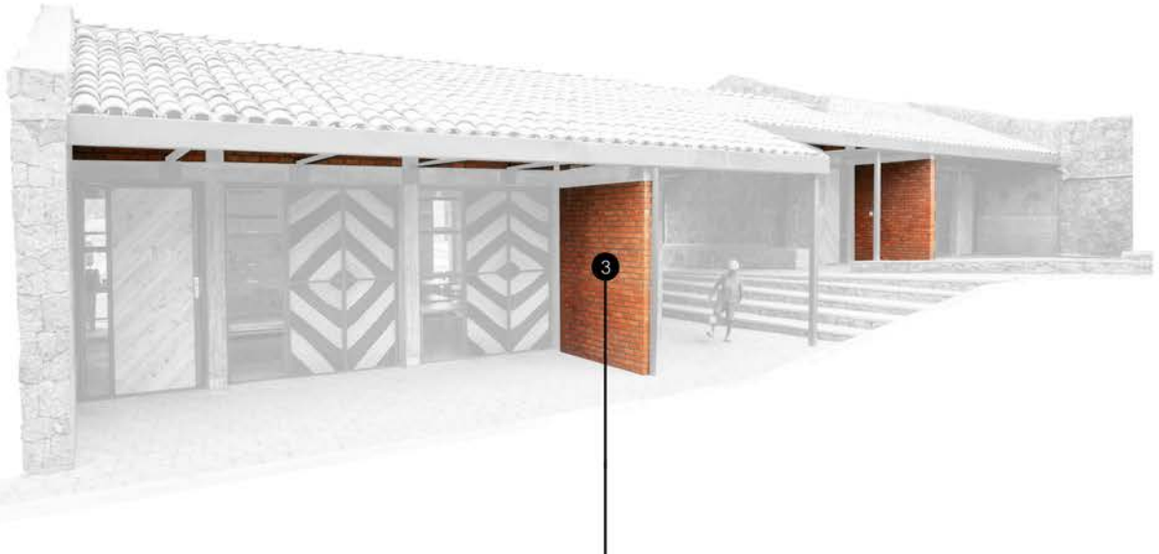
MASS Design Group with the
African Design Centre

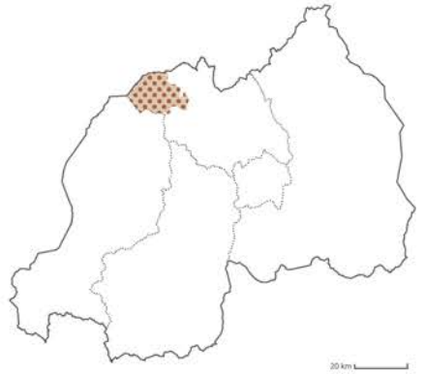
Original photo by MASS Design Group (Alan Ricks).
Adaptation and analysis by author.

Global material origin and labour



Local material and labour distances





Local material origin and labour

Material

Labour

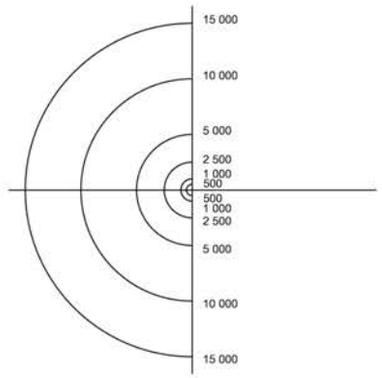
Local tectonics

Material: Fired clay brick walls

Material from Musanze District (distance < 25km)

Labour: Fired clay brick walls

Manufacturing of SKAT fire bricks
in Musanze District by *Cooperative COOMIVA*
(distance < 25km)



Global material and labour distances

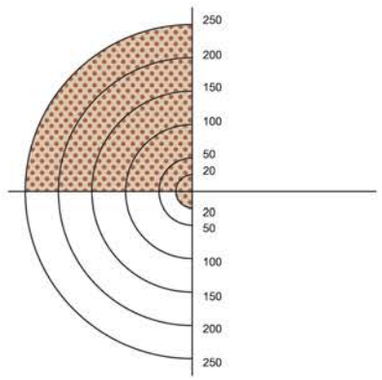
Ruhehe Primary School

Ruhehe, Musanze District, Rwanda, 2018
1°31'59"S, 29°33'29"E

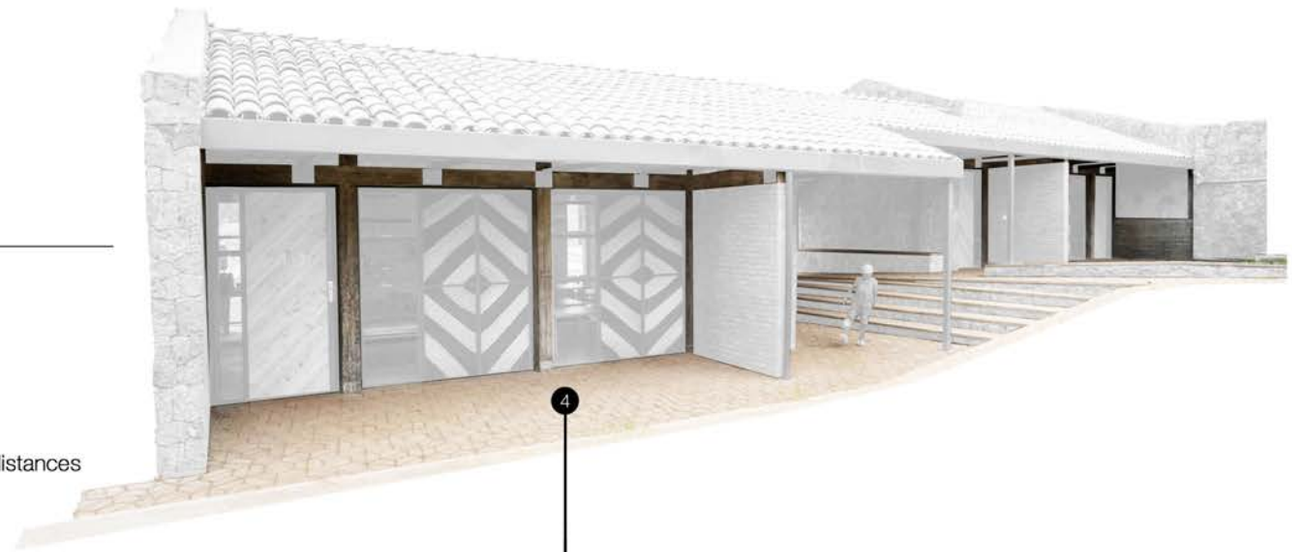
MASS Design Group with the
African Design Centre

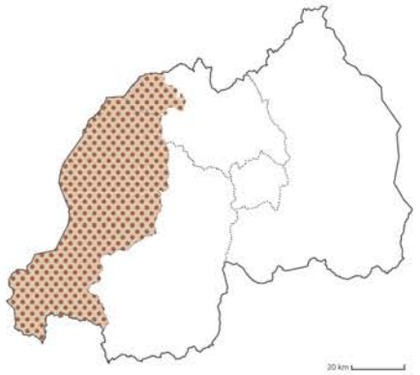
Original photo by MASS Design Group (Alan Ricks).
Adaptation and analysis by author.

Global material origin and labour



Local material and labour distances





Local material origin and labour

Material

Labour

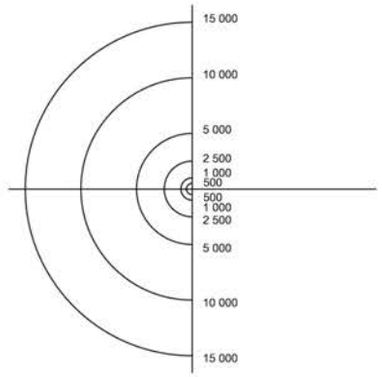
4

Global tectonics

Material: Cement for structural concrete, mortar, surface beds, and precast pavers

Cement produced locally in Rwanda by *Cimerwa* (distance < 250km).
Mixed with local volcanic ash and sand from Musanze District (distance < 25km)

Labour: Cement for structural concrete, mortar, surface beds, and precast pavers
Original production by *Cimerwa* (distance < 250km).
Concrete mixed locally and pavers cast on site (distance = 0km).



Global material and labour distances

Ruhehe Primary School

Ruhehe, Musanze District, Rwanda, 2018
1°31'59"S, 29°33'29"E

MASS Design Group with the
African Design Centre

Original photo by MASS Design Group (Alan Ricks).
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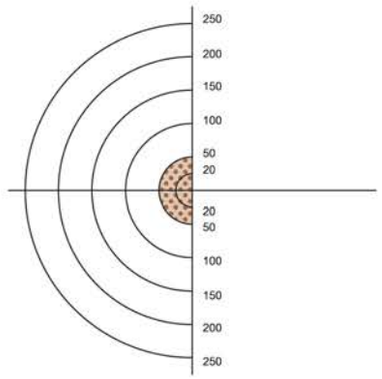
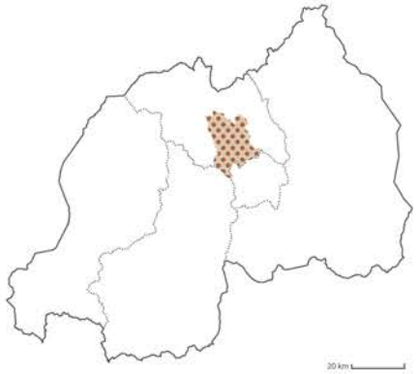
Global material origin and labour



Local material and labour distances



Local material origin and labour

Material

Labour

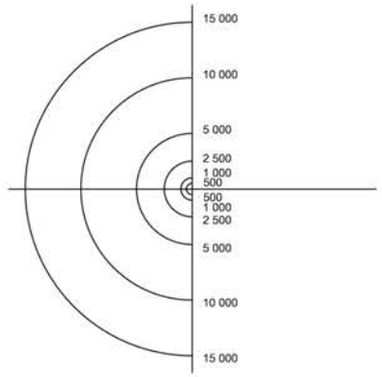
Local tectonics

Material: Roof tiles

Clay obtained in Rulindo District (distance < 50km)

Labour: Roof tiles

Hand made by *Nyirangarama* in Rulindo District (distance < 50km)



Global material and labour distances

Ruhehe Primary School

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1°31'59"S, 29°33'29"E

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African Design Centre

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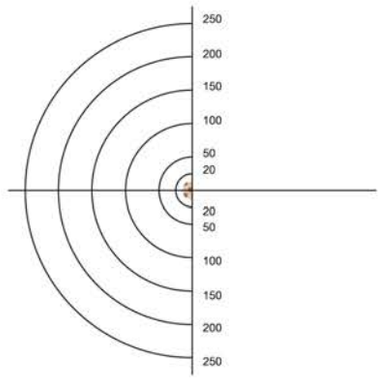
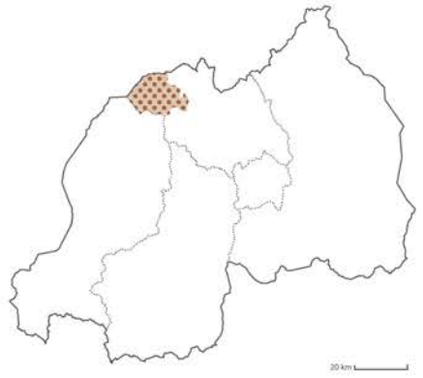
Global material origin and labour



Local material and labour distances



Local material origin and labour

Material

Labour

Local tectonics

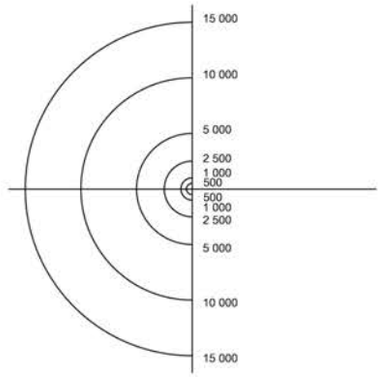
Material: Stone wall cladding

Natural volcanic stone quarried at *Gahunga Quarry* in Musanze District (distance < 10km)

Labour: Stone wall cladding

Extraction at *Gahunga Quarry* in Musanze District (distance < 10km), shaped on site (distance = 0km).

* Stone used as cladding over steel and concrete framework



Global material and labour distances

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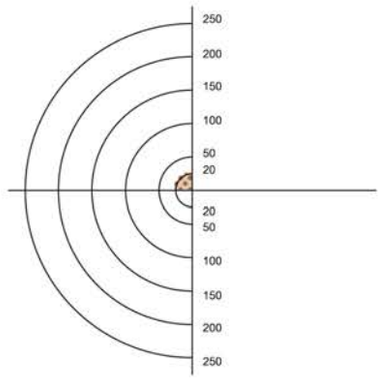
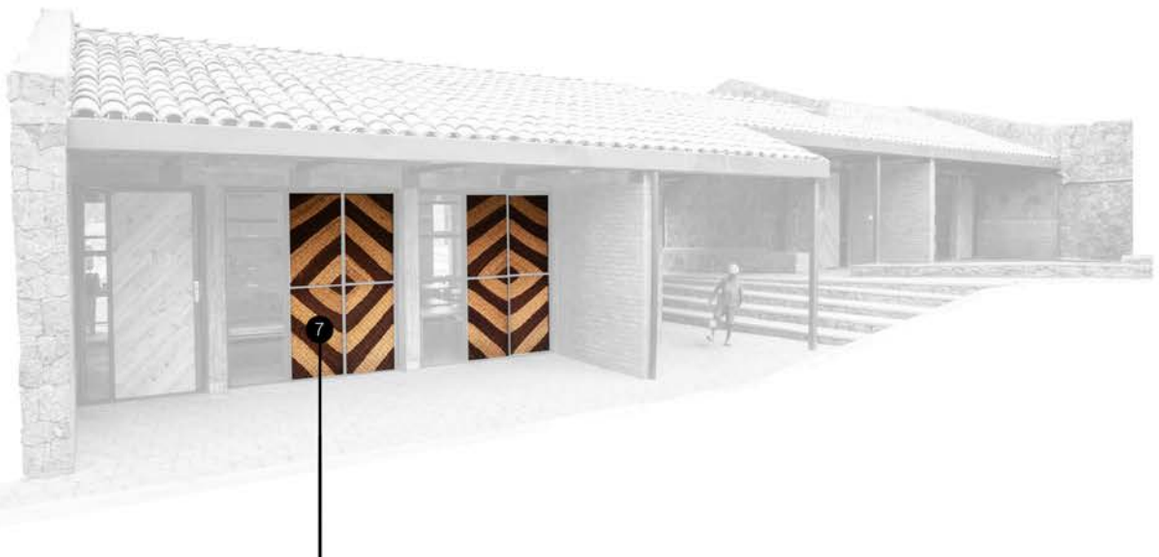
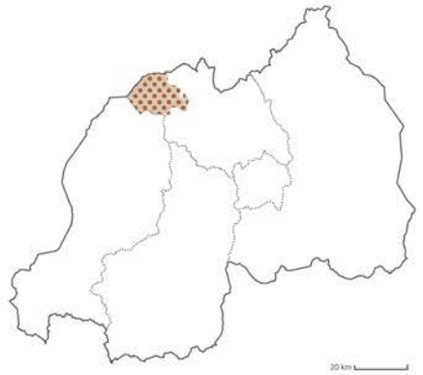
Global material origin and labour



Local material and labour distances





Local material origin and labour

Material

Labour

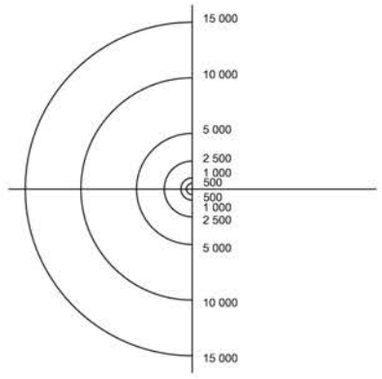
Local tectonics

Material: Ventilation screens

Sisal and tree bark harvested in Musanze District (distance < 25km)

Labour: Ventilation screens

Woven on site (distance = 0km)



Global material and labour distances

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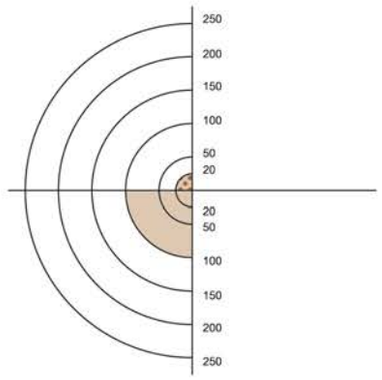
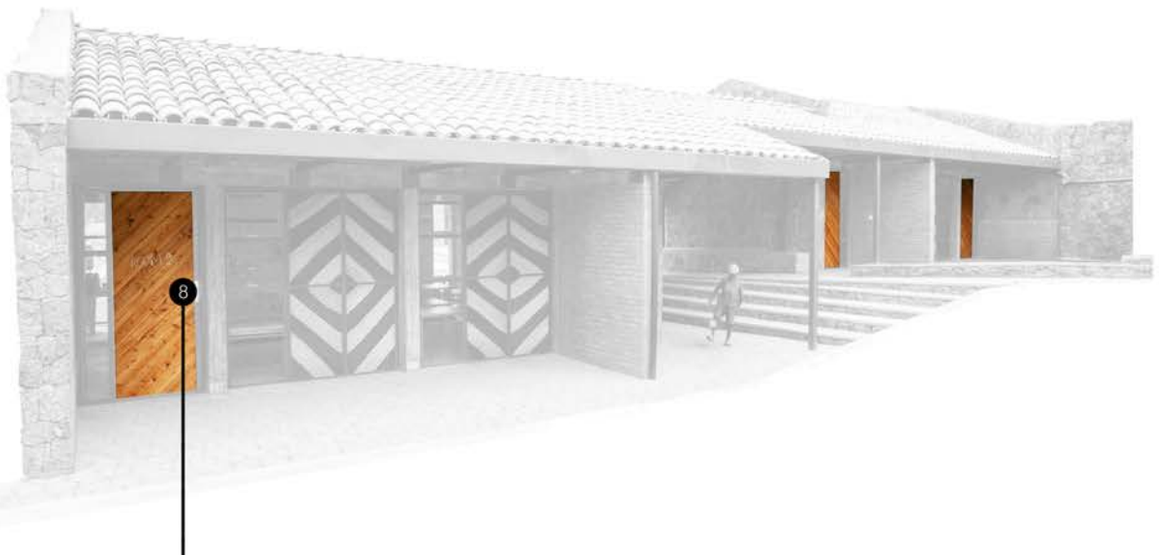
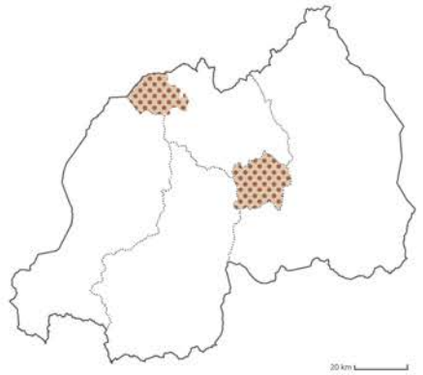
Global material origin and labour



Local material and labour distances





Local material origin and labour

Material

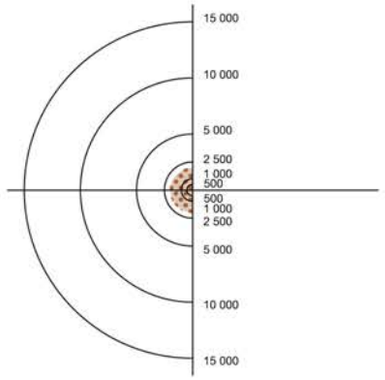
Labour

Local tectonics

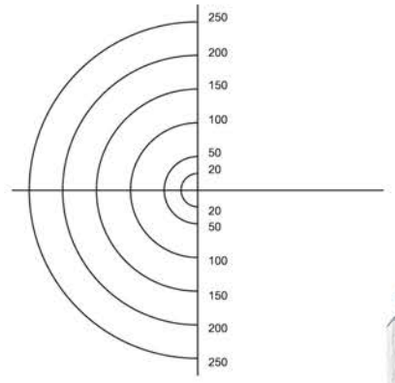
Material: Solid doors and timber ceilings (with recycled insulation on top)

Cypress from Musanze District supplied by *Atelier Economa General* (distance < 25km)
Recycled plastic insulation from Kigali (distance < 100km)

Labour: Solid doors and timber ceilings (with recycled insulation on top)
Cypress extraction and processing in Musanze District (distance < 25km)
No labour for recycled insulation



Global material and labour distances



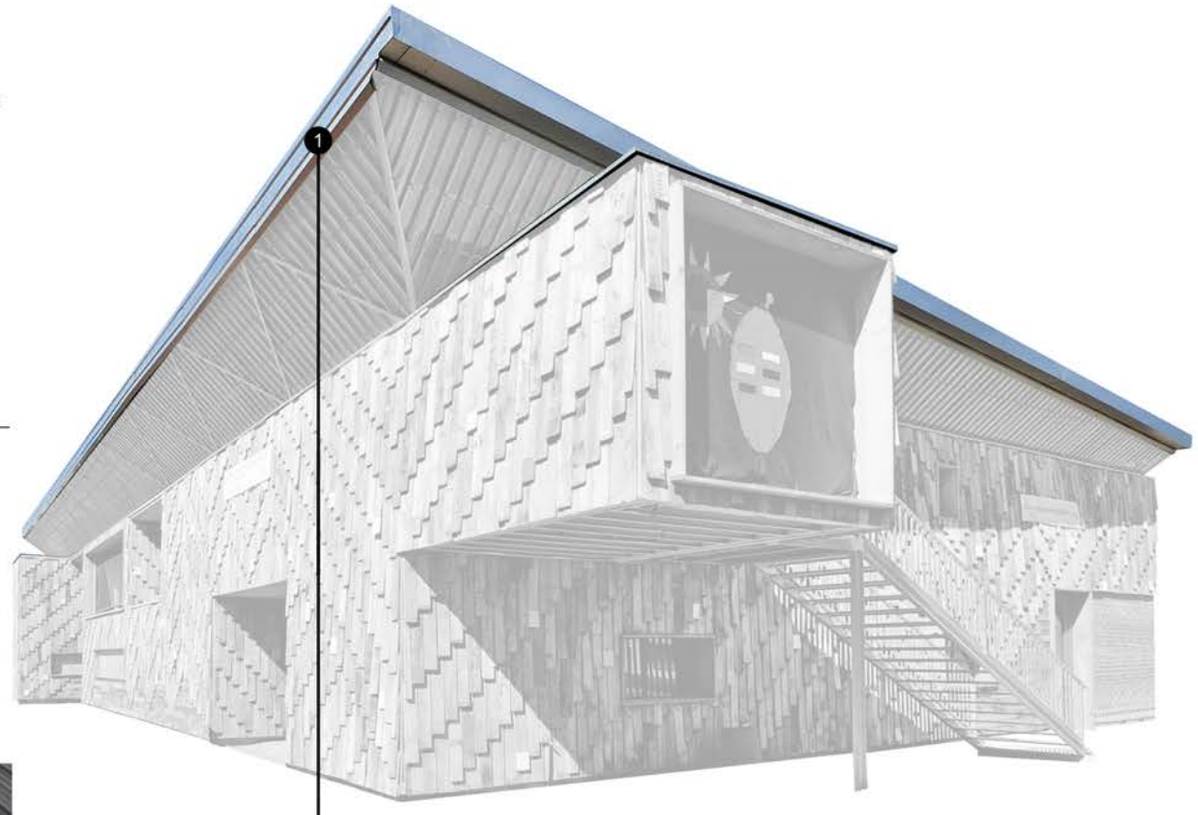
Local material and labour distances

Guga s'Thebe Theatre

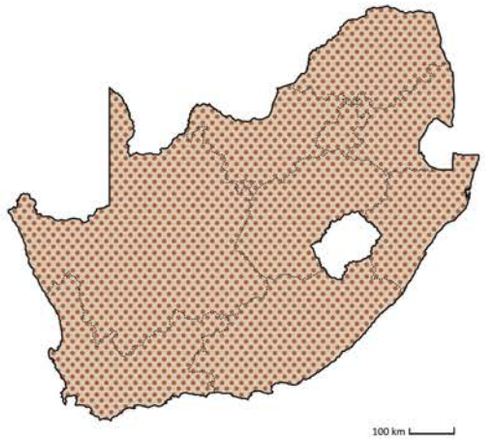
Langa, Cape Town, South Africa, 2016
33°56'40"S, 18°31'27"E

RWTH Aachen, PBSA Düsseldorf,
Georgia Tech, and CS Studio Architects

Original photo by Archigraphy (Wiieland Gleich).
Adaptation and analysis by author.



Global material origin and labour



Local material origin and labour

Material

Labour

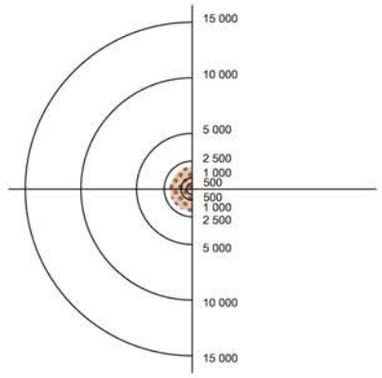
Global tectonics

Material: Roof sheeting

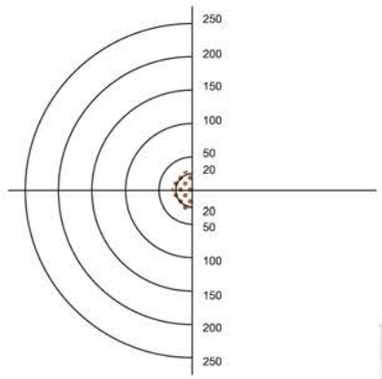
Material origin in South Africa
(distance < 2000km)

Labour: Roof sheeting

Manufacturing and forming in South Africa
(distance < 2000km)



Global material and labour distances



Local material and labour distances

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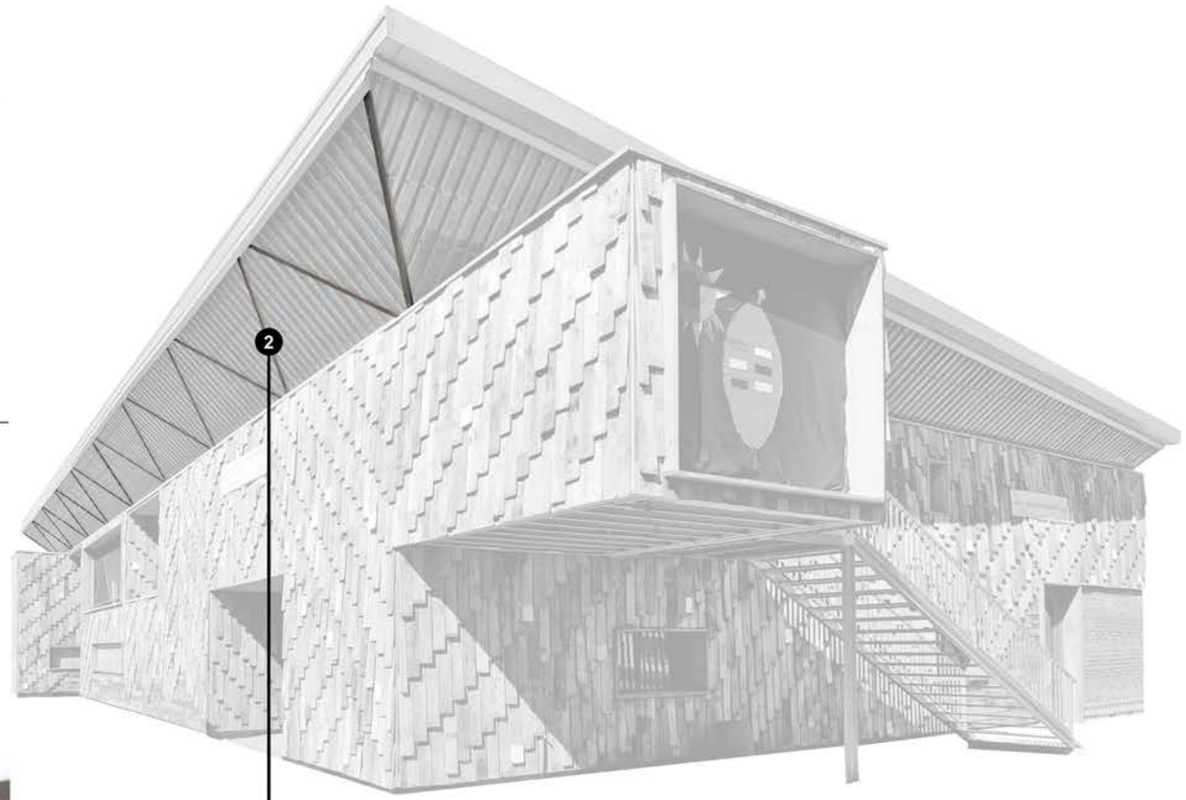
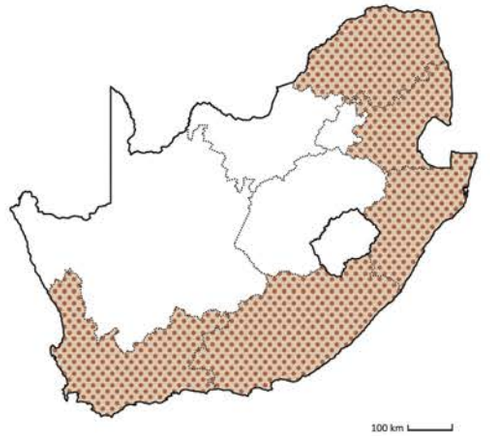


Global material origin and labour



Local material origin and labour

Material

Labour

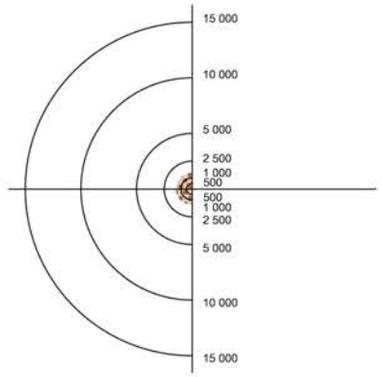
Global tectonics

Material: Timber roof trusses

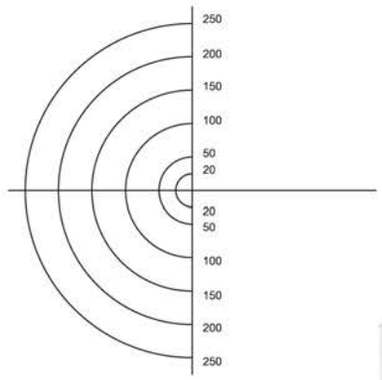
South African pine, most likely from Mpumalanga or Kwazulu-Natal, followed by the Western Cape, Eastern Cape and Limpopo Province (distance < 2000km)

Labour: Timber roof trusses

Extraction and initial processing in South Africa (distance < 2000km)
Manufacturing and assembly of engineered roof trusses by *Trussworld* in Kuilsriver (distance < 25km)



Global material and labour distances



Local material and labour distances

Guga s'Thebe Theatre

Langa, Cape Town, South Africa, 2016
33°56'40"S, 18°31'27"E

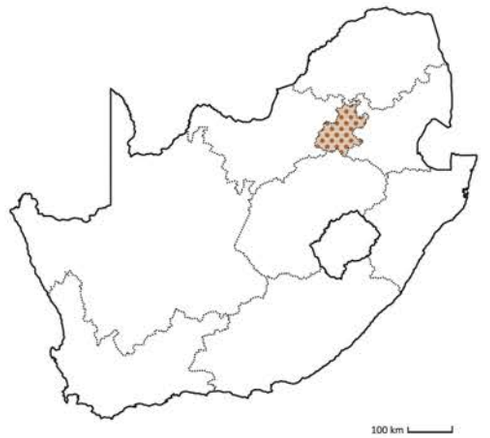
RWTH Aachen, PBSA Düsseldorf,
Georgia Tech, and CS Studio Architects

Original photo by Archigraphy (Wieland Gleich).
Adaptation and analysis by author.

Material

Labour

Global material origin and labour



Local material origin and labour

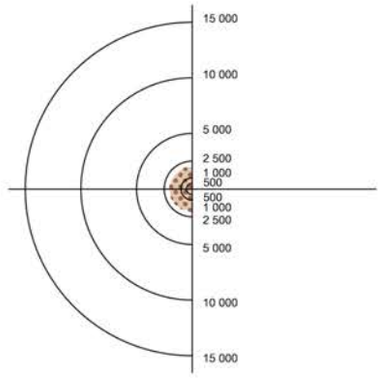
Global tectonics

Material: Polycarbonate sheeting

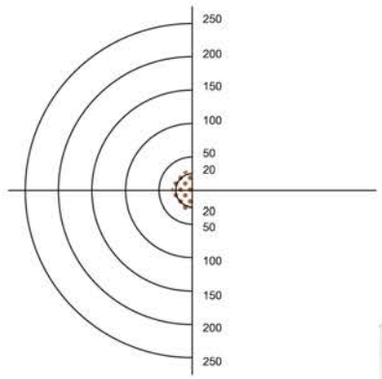
Base material origin unknown, sheeting manufactured in Johannesburg (distance < 1500km)

Labour: Polycarbonate sheeting

Sheeting manufactured in Johannesburg by *Modek*, now *Ampa Plastics Group (Pty) Ltd.* (distance < 1500km)



Global material and labour distances



Local material and labour distances

Guga s'Thebe Theatre

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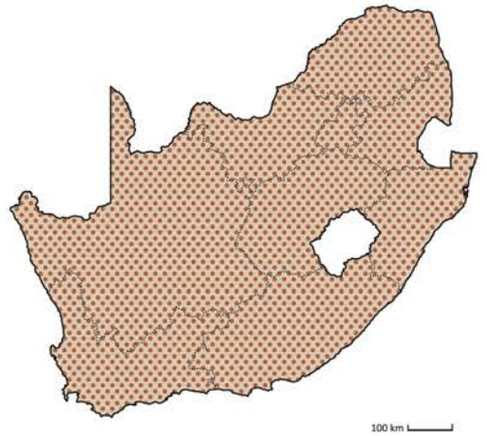
Global material origin and labour



Local material origin and labour

Material

Labour

Global tectonics

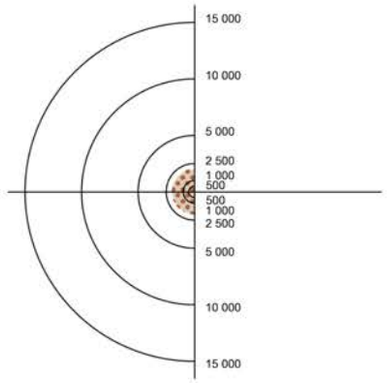
Material: Structural steel for columns and stairs

Material from South Africa
(distance < 2000km)

Labour: Structural steel for columns and stairs

Steel sections manufactured in South Africa by *Macsteel* (distance < 2000km)

Cutting and welding by *Siyazama Steel* in Cape Town (distance < 25km)



Global material and labour distances

Local material and labour distances

Guga s'Thebe Theatre

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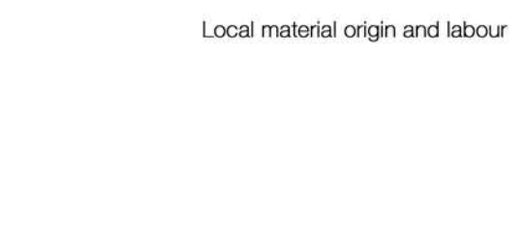


Global material origin and labour

Local material origin and labour

Material

Labour

5

Global tectonics

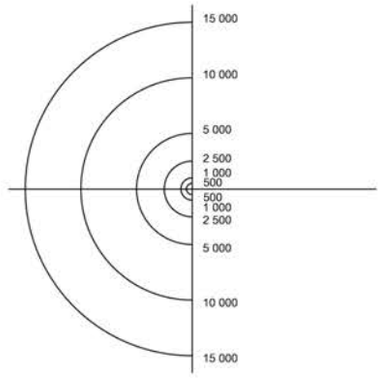
Material: Brick, cement and concrete

Material from South Africa (distance < 2000km)

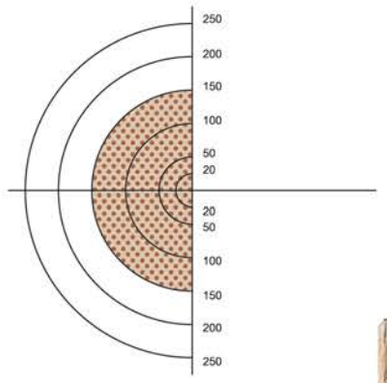
Manufacturing and processing by *Corobrick, PPC, Lafarge and Afrisam* in Cape Town and surrounds (distance < 50km)

Labour: Brick, cement and concrete

Manufacturing and processing in Cape Town and surrounds (distance ≈ 50km)



Global material and labour distances



Local material and labour distances

Guga s'Thebe Theatre

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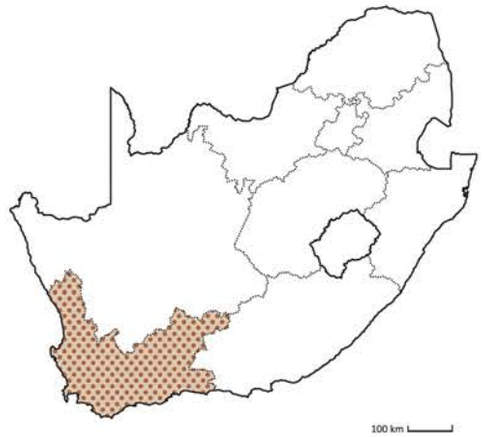
Global material origin and labour



Local material origin and labour

Material

Labour

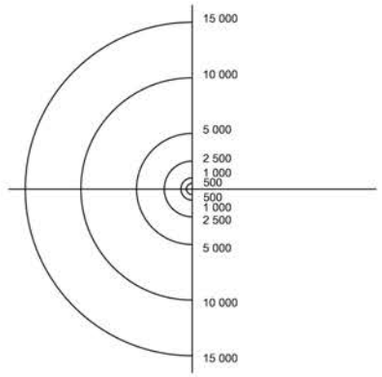
Local tectonics

Material: Timber cladding

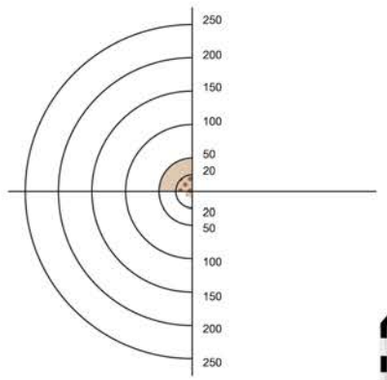
Repurposed fruit crates from Ceres/Wolseley via *VV4 Agri*
(distance < 150km)

Labour: Timber cladding

Cut and processed on site (distance = 0km)



Global material and labour distances



Local material and labour distances

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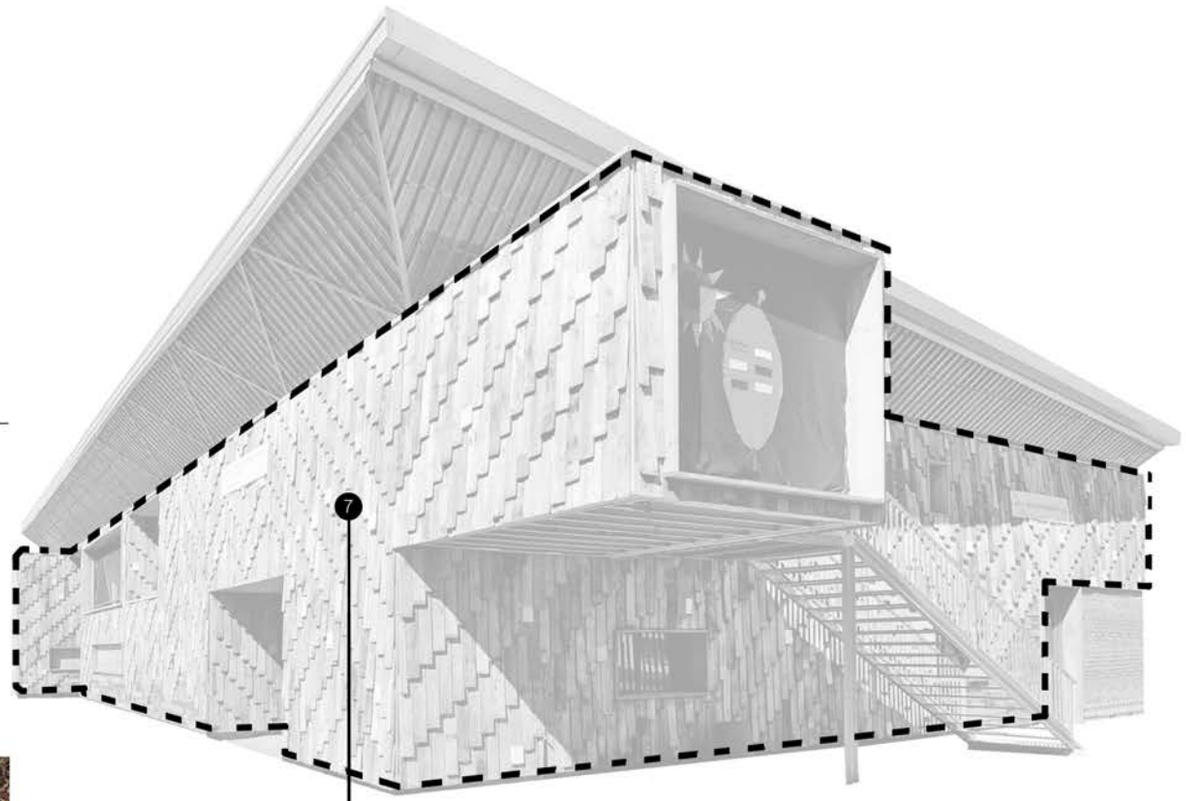
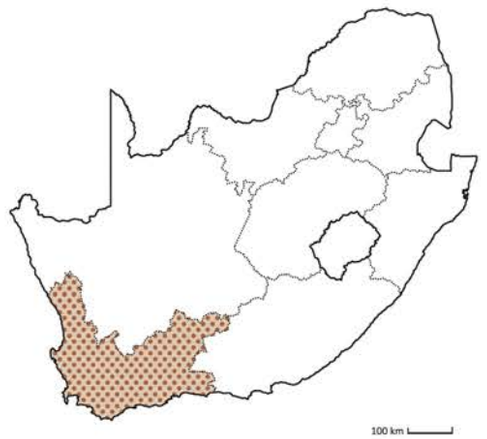


Global material origin and labour



Local material origin and labour

Material

Labour

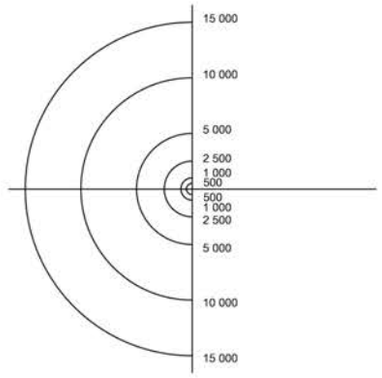
Local tectonics

Material: Light clay insulation panels

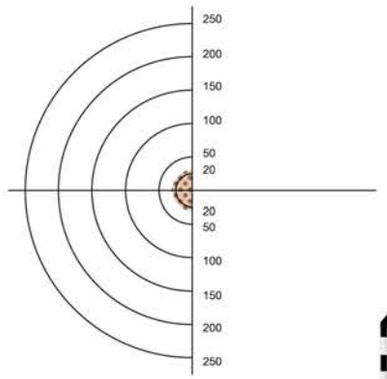
Clay and straw from Cape Town surrounds (distance < 50km)
Recycled pallets from Epping (distance < 5km)

Labour: Light clay insulation panels

Made on site (distance = 0km)



Global material and labour distances



Local material and labour distances

Guga s'Thebe Theatre

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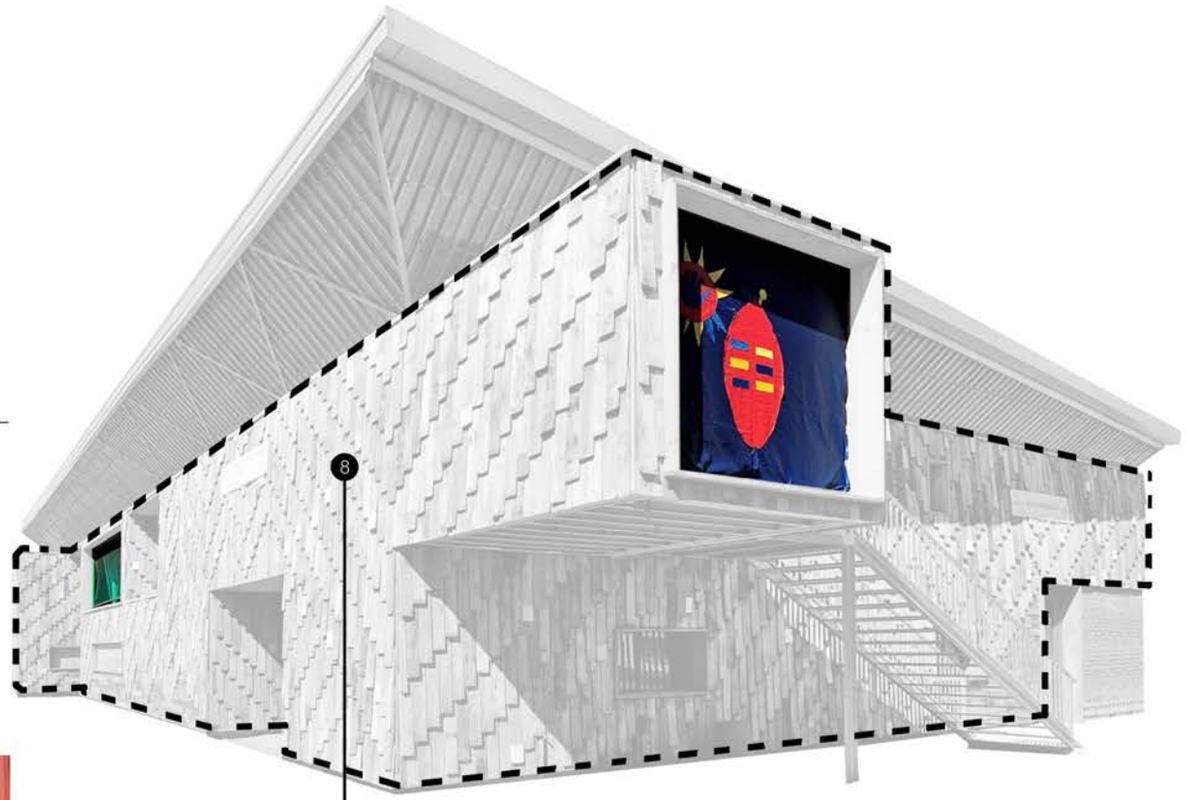
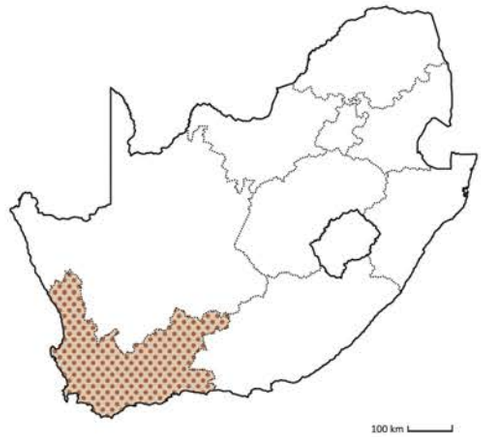


Material

Labour

Global material origin and labour



Local material origin and labour

Local tectonics

Material: Repurposed shipping containers

Containers obtained from Cape Town harbour via *Containers 4U* and *Bigbox* (distance < 25km)

*While the containers were bought and not not obtained as discarded waste, they are still regarded as a local material since they reached the end of their shipping life cycle in Cape Town

Labour: Repurposed shipping containers

Cutting and structural adjustment done in Cape Town (distance < 25km)

Silindokuhle Preschool

Joe Slovo West, Port Elizabeth,
Eastern Cape, South Africa, 2016
33°49'46"S, 25°29'53"E

Collectif Saga and Uncedo

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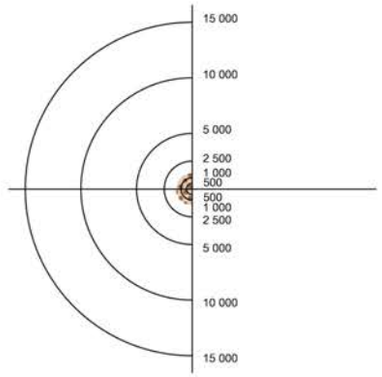
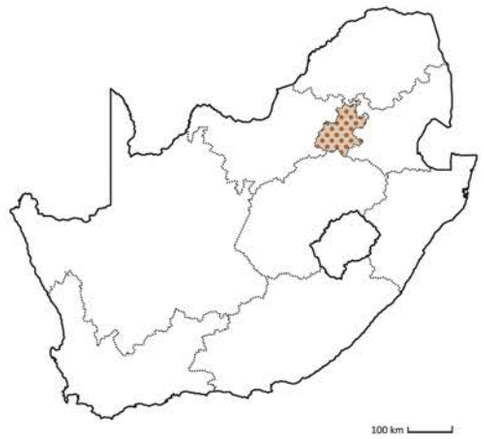
Adaptation and analysis by author.



Global material and labour distances

Local material and labour distances

Global material origin and labour



Local material origin and labour

Material

Labour

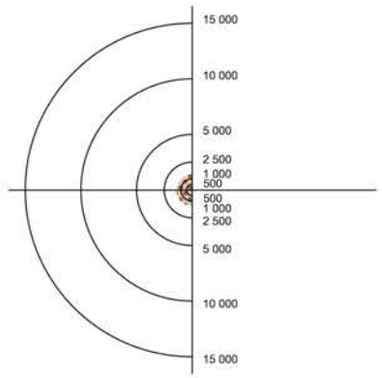
Global tectonics

Material: Polycarbonate sheeting

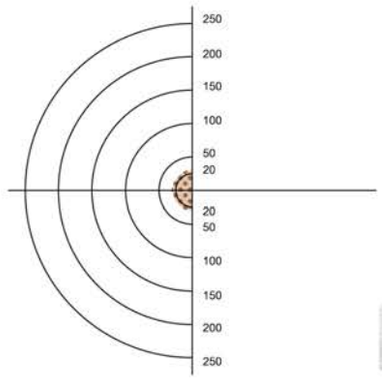
Base material origin unknown, sheeting manufactured in Johannesburg
(distance < 1500km)

Labour: Polycarbonate sheeting

Sheeting manufactured in Johannesburg
by *Modek*, now *Ampa Plastics Group (Pty) Ltd.*
(distance < 1500km)



Global material and labour distances



Local material and labour distances

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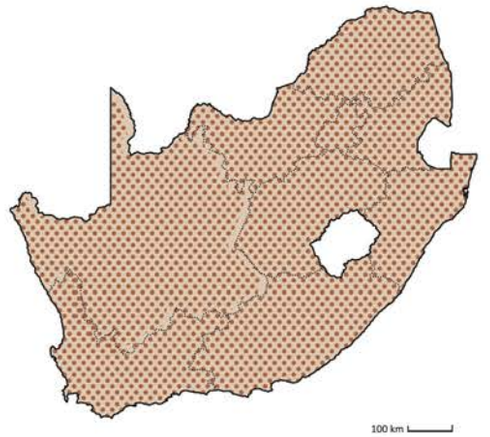
Global material origin and labour



Local material origin and labour

Material

Labour

Global tectonics

Material: Window glazing

Material origin in South Africa
(distance < 1500km)

Labour: Window glazing

Material cut in Port Elizabeth by *Specialised Aluminium Systems*
(distance < 25km)

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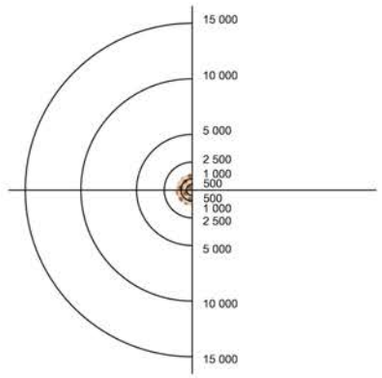
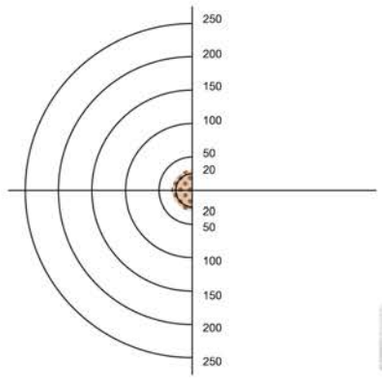


Global material and labour distances

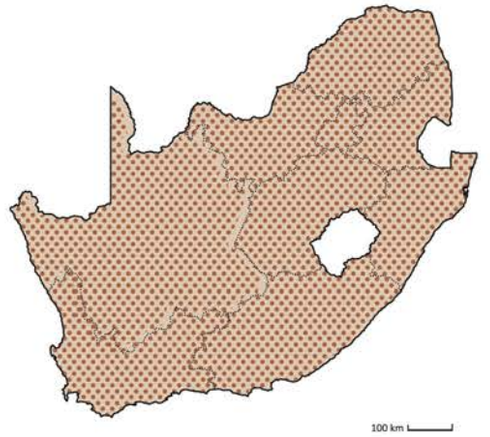


Local material and labour distances

Material

Labour

Global material origin and labour



Local material origin and labour

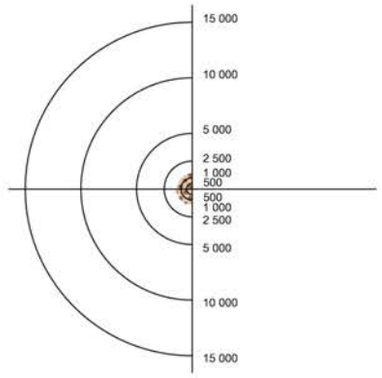
Global tectonics

Material: Corrugated sheeting

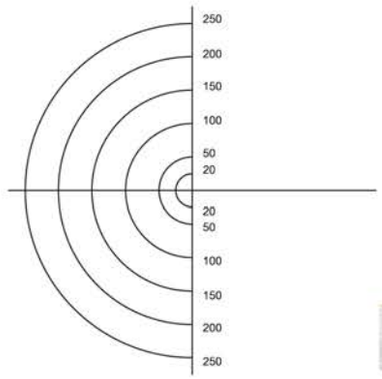
Material origin in South Africa
(distance < 1500km)

Labour: Corrugated sheeting

Manufactured in South Africa (distance < 1500km)
Processed in Port Elizabeth by *Aveng Trident Steel* (distance < 25km)
*Mitigated by purchasing material incorrectly made for another project



Global material and labour distances



Local material and labour distances

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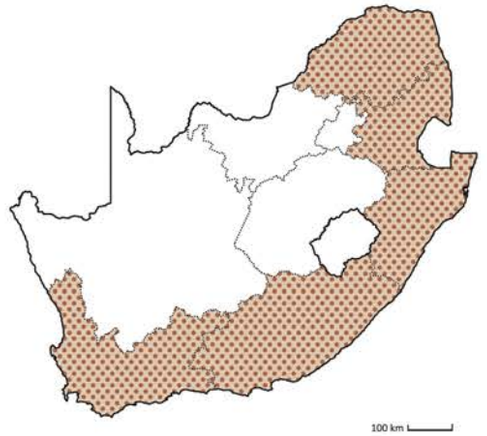
Global material origin and labour



Local material origin and labour

Material

Labour

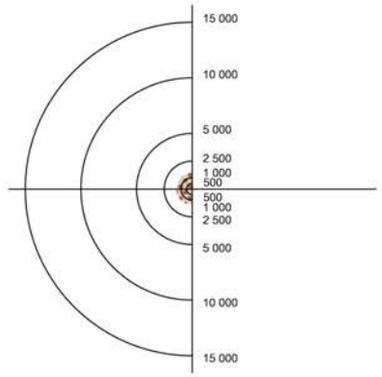
Global tectonics

Material: Structural timber for beams and roof trusses

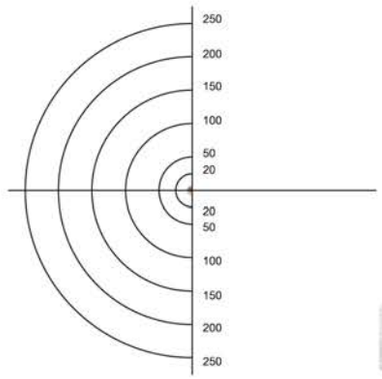
South African pine, most likely from Mpumalanga or Kwazulu-Natal, followed by the Western Cape, Eastern Cape and Limpopo Province (distance < 1500km)

Labour: Structural timber for beams and roof trusses

Extraction and initial processing in South Africa (distance < 1500km)
Cutting and assembly on site (distance = 0km)



Global material and labour distances



Local material and labour distances

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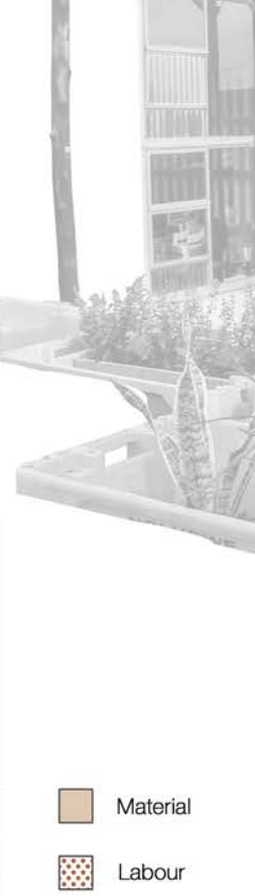
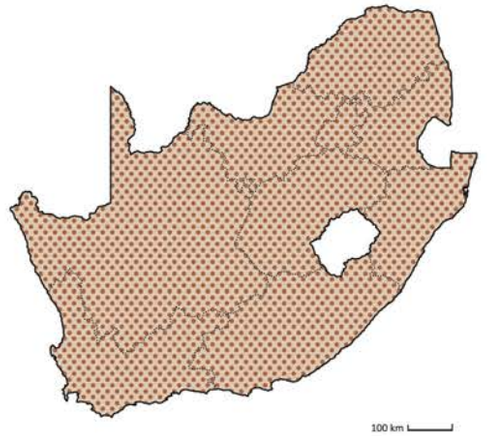


Material

Labour

Global material origin and labour



Local material origin and labour

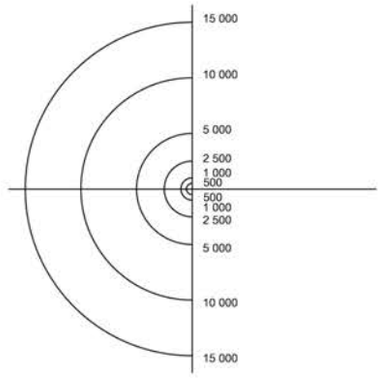
Global tectonics

Material: Concrete pad footings & surface bed

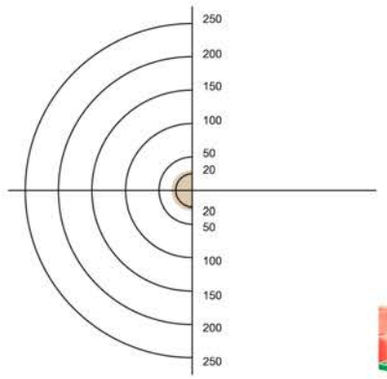
Cement from South Africa (distance < 1500km)
*Some material mitigation by using crushed glass as aggregate for footings

Labour: Concrete pad footings & surface bed

Manufacturing and processing in South Africa (distance < 1500km)
Readymix for surface bed mixed in Joe Slovo West by *Concrete 4 U* (distance < 5km)
Concrete for footings mixed on site (distance = 0km)



Global material and labour distances



Local material and labour distances

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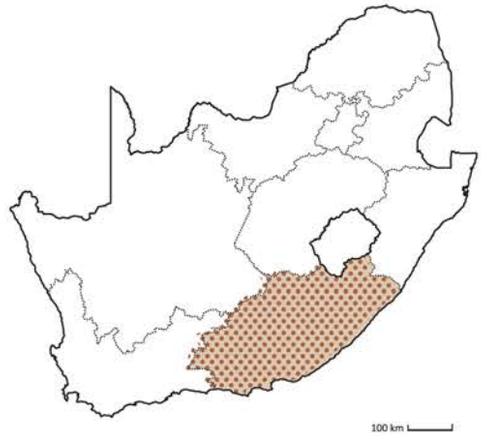
Global material origin and labour



Local material origin and labour

Material

Labour

6

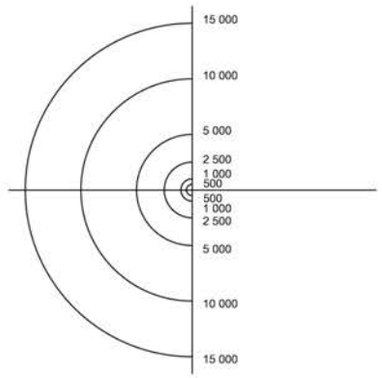
Local tectonics

Material: Repurposed fishing crates for planted shading structure

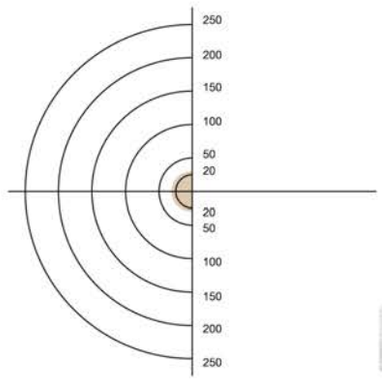
Repurposed fishing crates obtained from Port Elizabeth Harbour (distance < 25km)

Labour: Repurposed fishing crates for planted shading structure

No labour in terms of manufacturing for repurposed material (distance = 0km).



Global material and labour distances



Local material and labour distances

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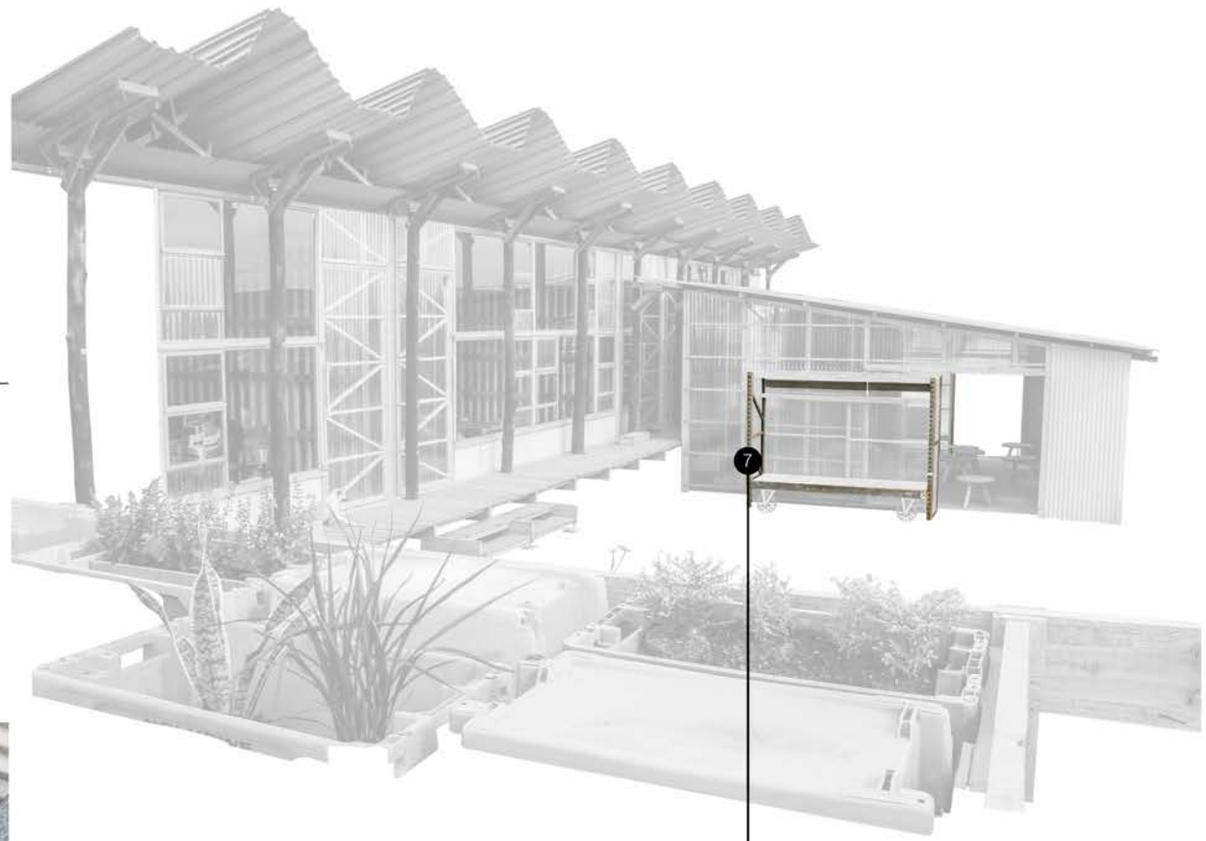
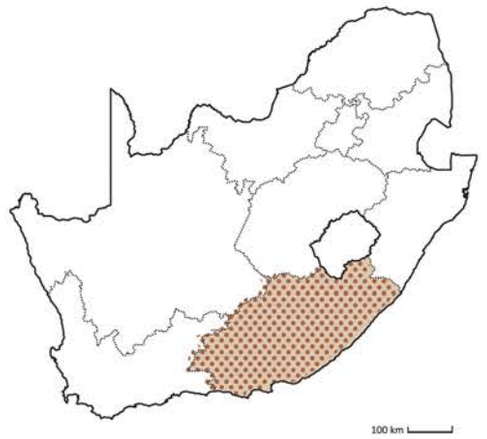


Material

Labour

Global material origin and labour



Local material origin and labour

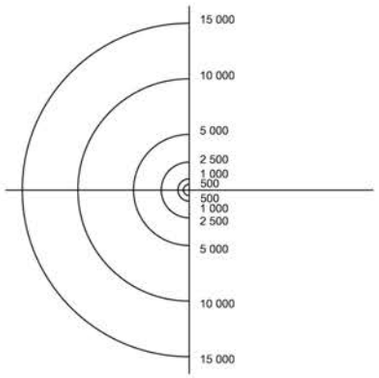
Local tectonics

Material: Steel wall framing and roof trusses

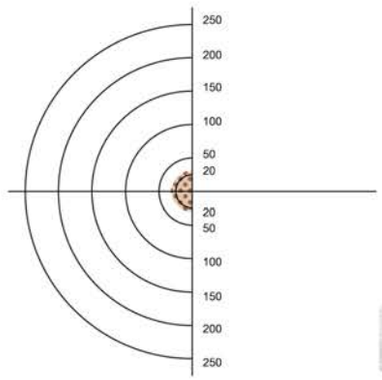
Repurposed industrial racks from Port Elizabeth (distance < 25km)
combined with cardboard tubes from Port Elizabeth for trusses
(distance < 25km)

Labour: Steel wall framing and roof trusses

No labour in terms of material manufacturing for repurposed material
Trusses made on site (distance = 0km)



Global material and labour distances



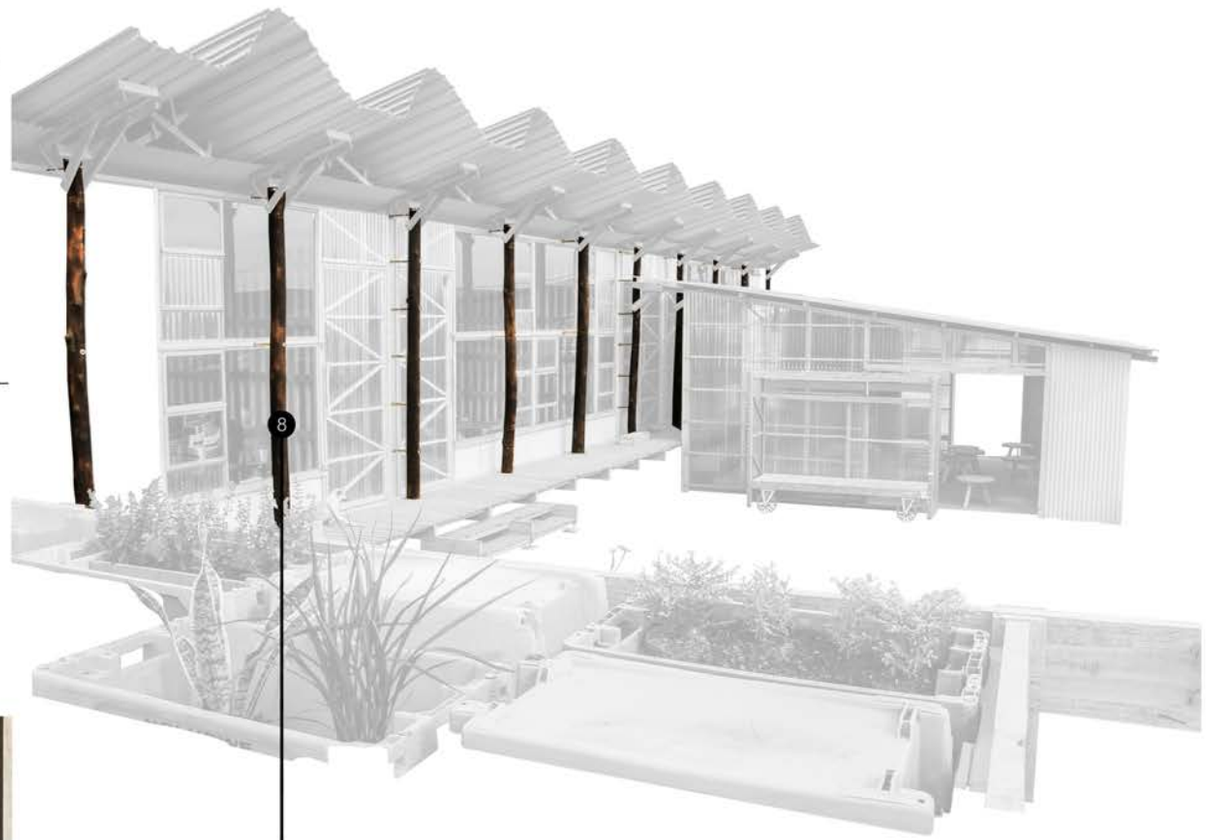
Local material and labour distances

Silindokuhle Preschool

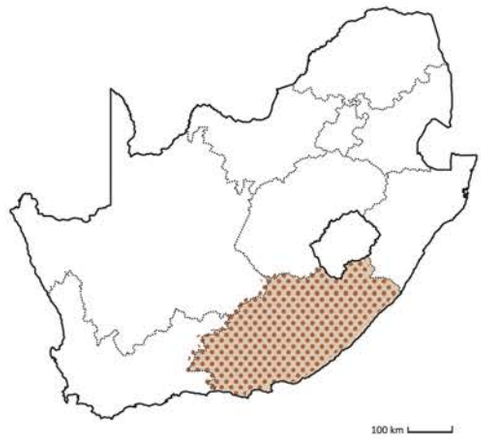
Joe Slovo West, Port Elizabeth,
Eastern Cape, South Africa, 2016
33°49'46"S, 25°29'53"E

Collectif Saga and Uncedo

Original photo by Gorka Biurrun.
Adaptation and analysis by author.



Global material origin and labour



Local material origin and labour

Material

Labour

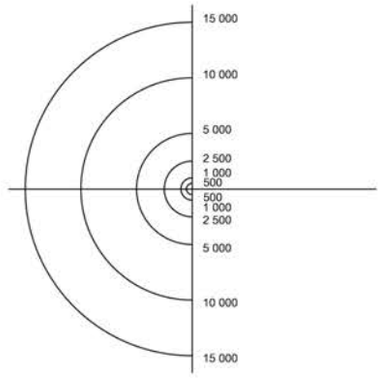
Local tectonics

Material: Timber columns

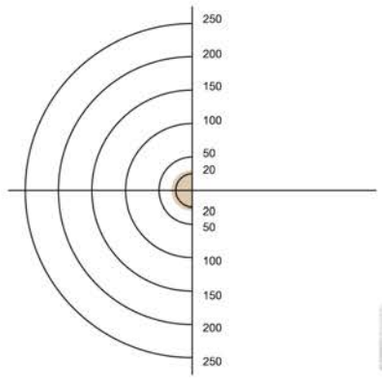
Eucalyptus columns from nearby plantation (distance < 25km)
and treated on site (distance = 0km)

Labour: Timber columns

Cut in nearby plantation (distance < 25km)
and treated on site with Japanese *Shou sugi ban* technique (distance = 0km)



Global material and labour distances



Local material and labour distances

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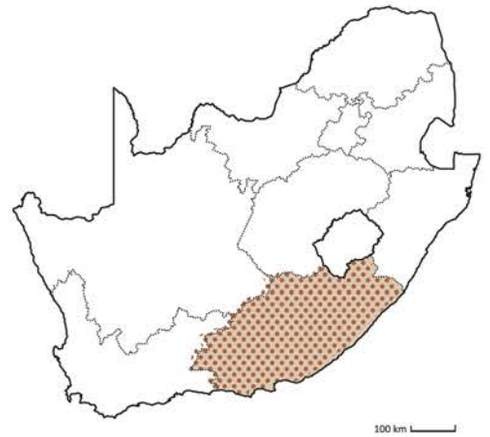
Global material origin and labour



Local material origin and labour

Material

Labour

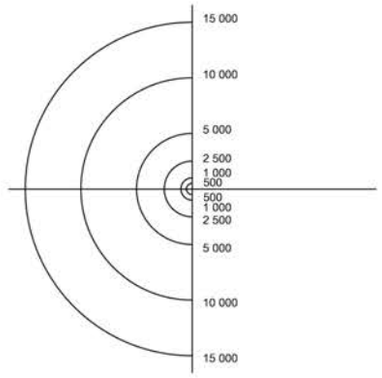
Local tectonics

Material: Timber window frames

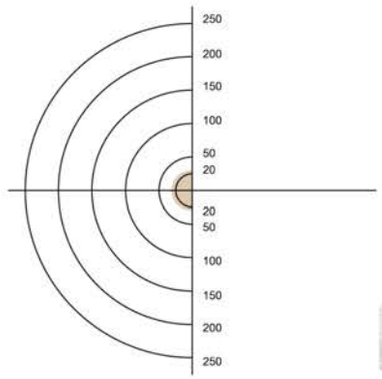
Reused RDP timber frames from Port Elizabeth
(distance < 25km)

Labour: Timber window frames

No labour in terms of material manufacturing for reused material
Cut on site (distance = 0km)



Global material and labour distances



Local material and labour distances

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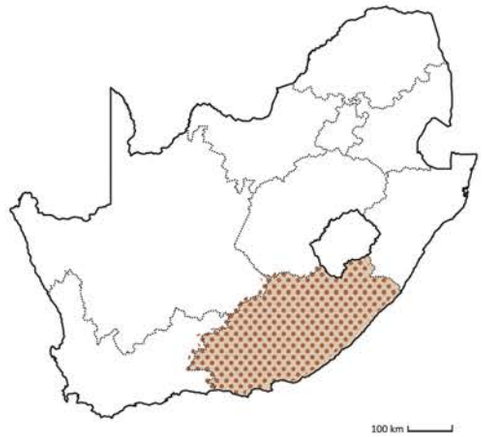
Global material origin and labour



Local material origin and labour

Material

Labour

Local tectonics

Material: Cardboard tube wall panels and truss sections

Repurposed cardboard tubes from Port Elizabeth
(distance < 25km)

Labour: Cardboard tube wall panels and truss sections

No labour in terms of material manufacturing for repurposed material
Trusses made on site (distance = 0km)

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Collectif Saga and Uncedo

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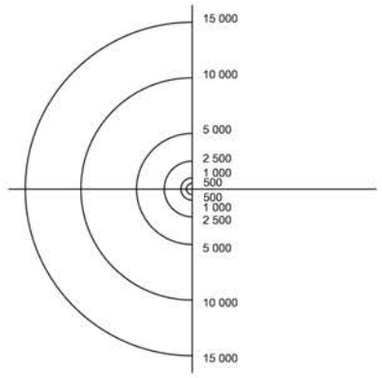
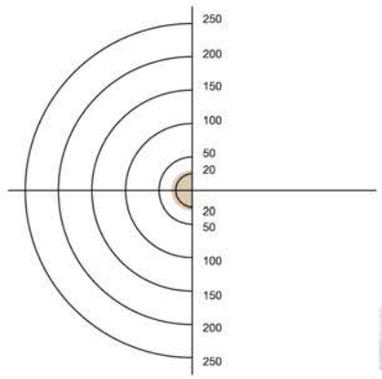
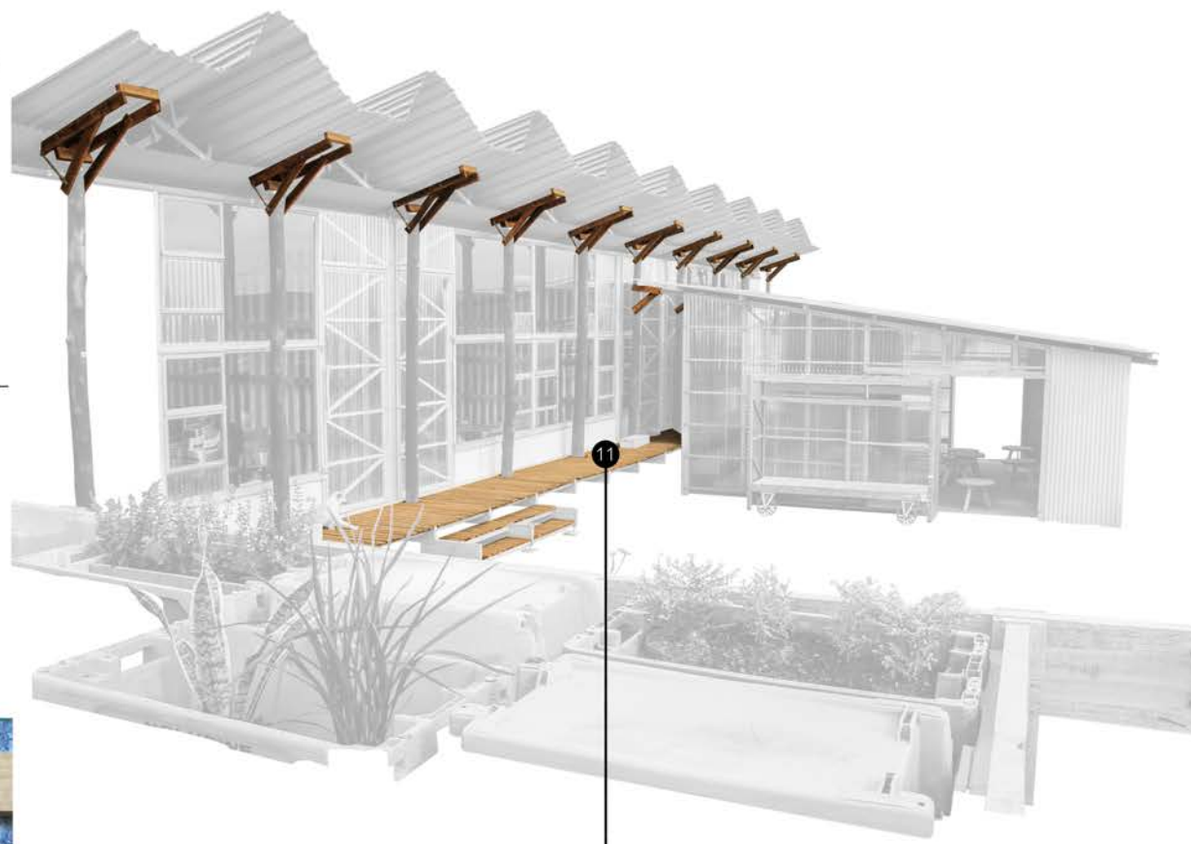


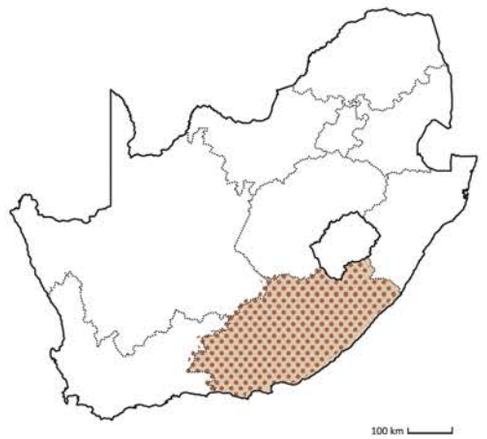
Global material and labour distances



Local material and labour distances



Global material origin and labour



Local material origin and labour

Material

Labour

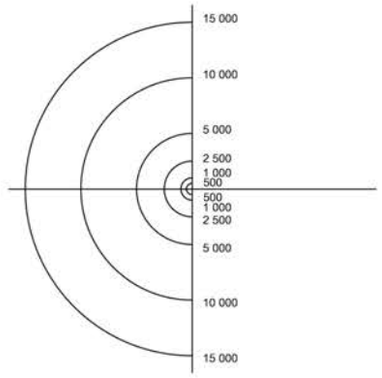
Local tectonics

Material: Repurposed timber walls and decks

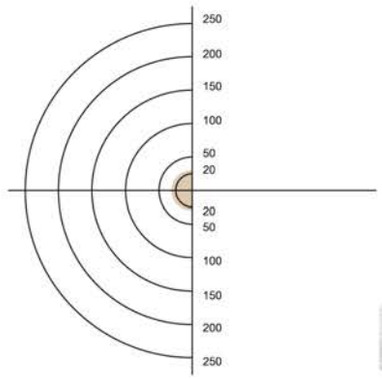
Repurposed pallets and reused textile used for walls,
shelving planks from repurposed industrial racks used for decking
All from Port Elizabeth
(distance < 25km)

Labour: Repurposed timber walls and decks

No labour in terms of material manufacturing for repurposed or reused material.
Panels made on site (distance = 0km)



Global material and labour distances



Local material and labour distances

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Collectif Saga and Uncedo

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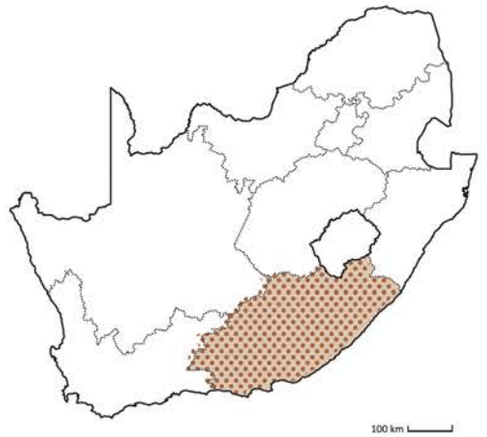
Adaptation and analysis by author.

Material

Labour

Global material origin and labour



Local material origin and labour

Local tectonics

Material: External plaster

Papercrete made with recycled cardboard from Port Elizabeth
(distance < 25km)
*Requires some cement content

Labour: External plaster

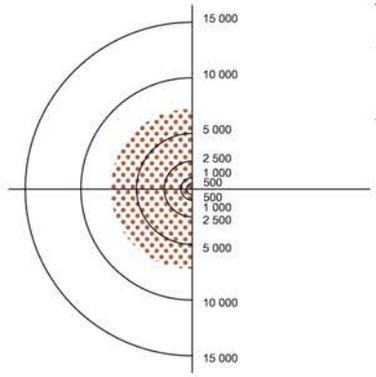
Mixed and applied on site
(distance = 0km)

Thread Artists' Residency and Cultural Centre

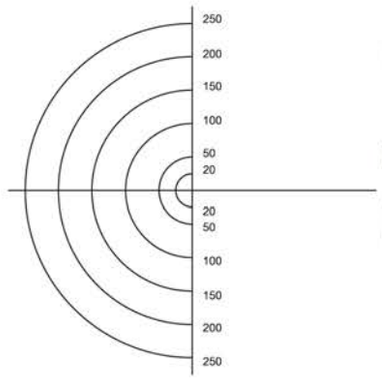
Sinthian (Koular), Tambacounda, Senegal, 2015
13°20'16.65"N, 13°37'16.98"W

Toshiko Mori Architect

Original photo by Iwan Baan. Adaptation and analysis by author.

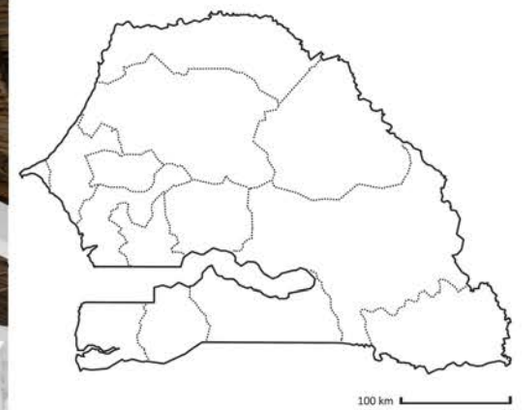


Global material and labour distances



Local material and labour distances

Global material origin and labour



Local material origin and labour

Material

Labour

Global tectonics

Material: Parametric roof form

Not applicable

Labour: Parametric roof form

Form designed and modelled in New York, NY, United States of America by Toshiko Mori Architect (distance < 7000km)

Engineering and structural modelling by Slaich Bergermann Partner in Stuttgart, Germany (distance < 6000km)

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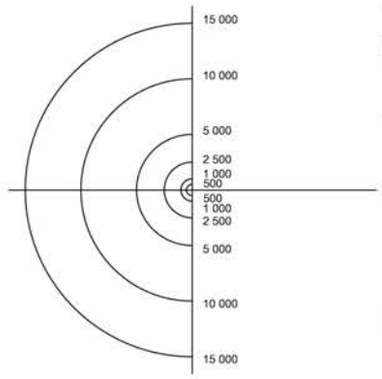
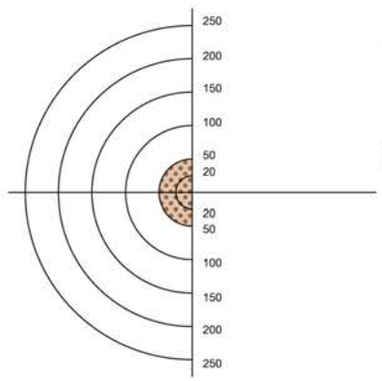
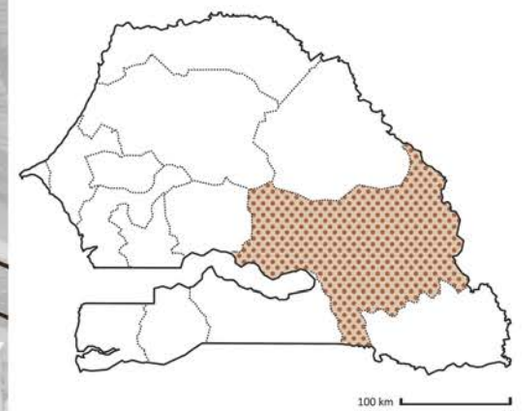


Global material and labour distances



Local material and labour distances

Global material origin and labour



Local material origin and labour

Material

Labour

Global tectonics

Material: Steel roof structure

Original material origin unknown

Processed material sourced from Tambacounda, Senegal (distance < 50km)

Labour: Steel roof structure

Material processed in Tambacounda, Senegal (distance < 50km)

Thread Artists' Residency and Cultural Centre

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13°20'16.65"N, 13°37'16.98"W

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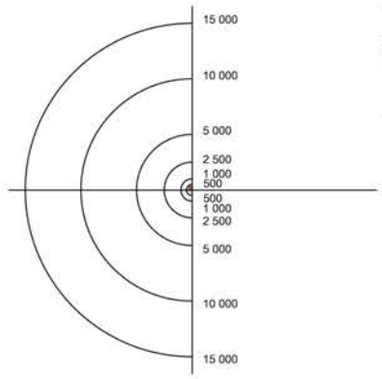
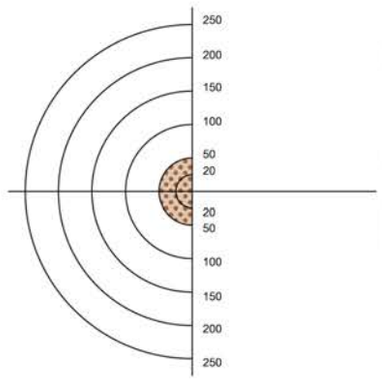
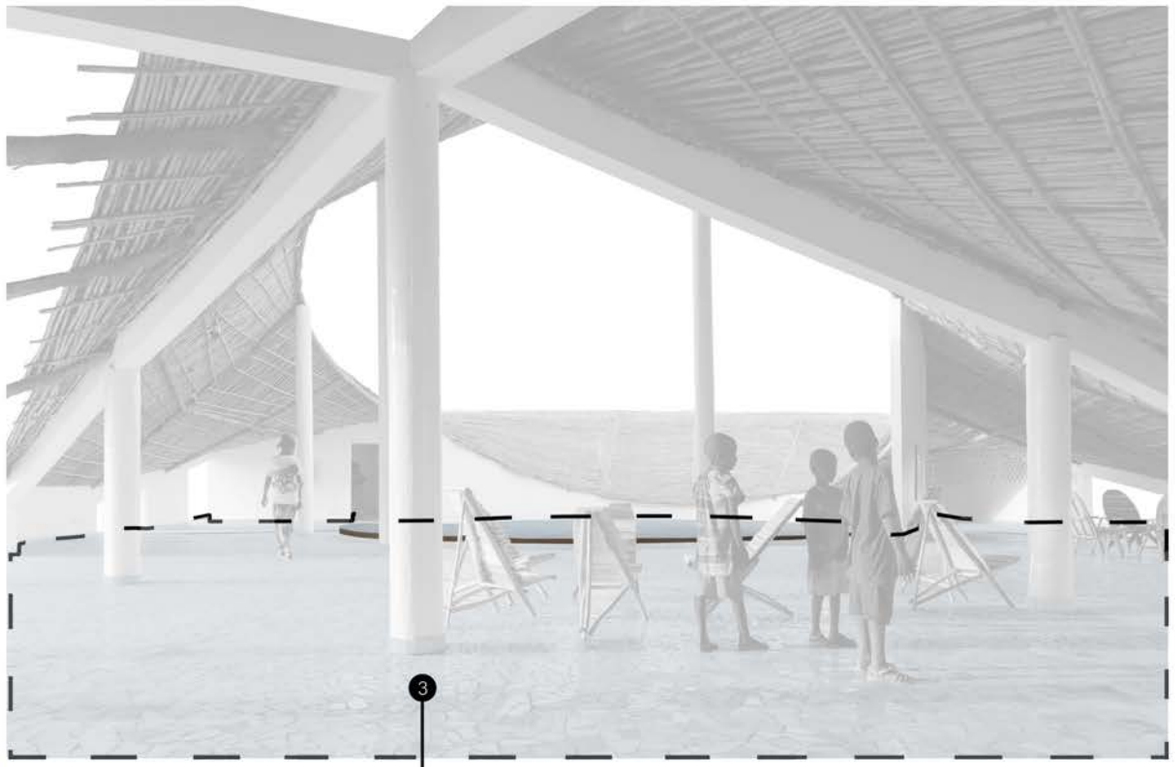


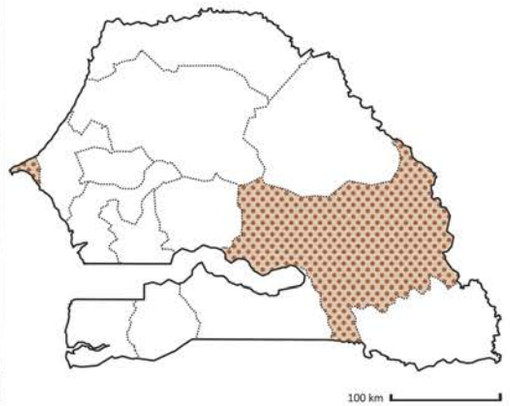
Global material and labour distances



Local material and labour distances



Global material origin and labour



Local material origin and labour

Material

Labour

Global tectonics

Material: Concrete surface beds

Material origin and production in Senegal. Cement produced by *Dangote* in Pout (distance < 450km)

Labour: Concrete surface beds

Cement extraction and processing in Senegal (distance <450km)

Mixed with local sand by hand on site (distance = 0km)

Thread Artists' Residency and Cultural Centre

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13°20'16.65"N, 13°37'16.98"W

Toshiko Mori Architect

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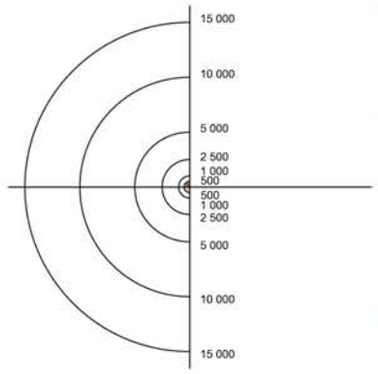
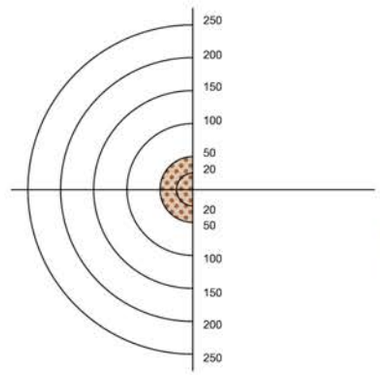


Global material and labour distances

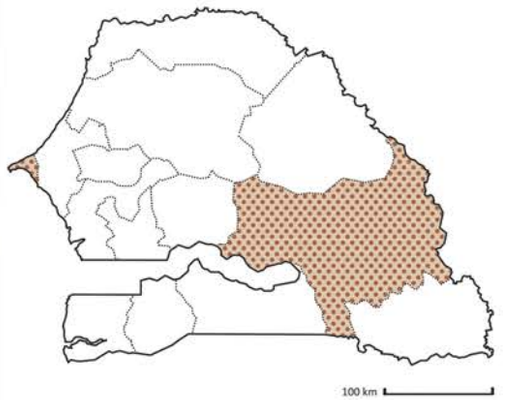


Local material and labour distances

Material

Labour

Global material origin and labour



Local material origin and labour

Global tectonics

Material: Concrete columns and beams

Material origin and production in Senegal. Cement produced by *Dangote* in Pout (distance < 450km)

Labour: Concrete surface beds

Cement extraction and processing in Senegal (distance <450km)

Mixed with local sand by hand on site (distance = 0km)

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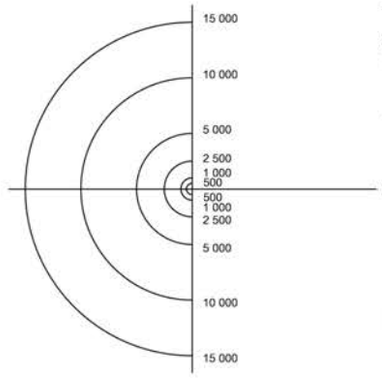
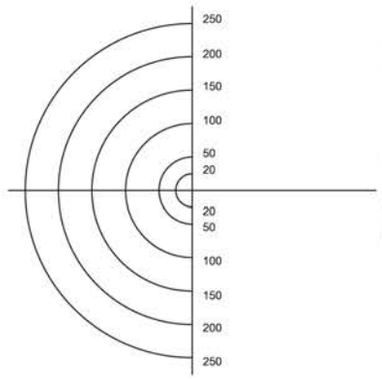
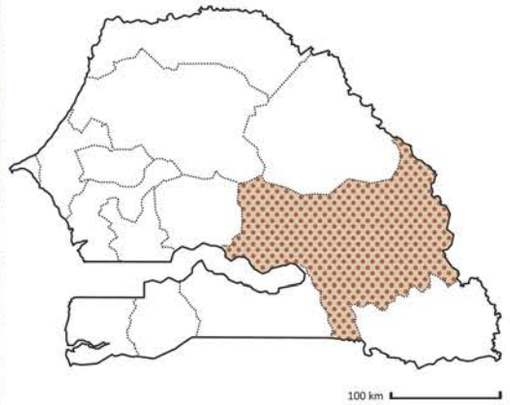


Global material and labour distances



Local material and labour distances

Global material origin and labour



Local material origin and labour

Material

Labour

Local tectonics

Material: Roof substructure

Locally grown bamboo from Niokolo-Koba National Park
(distance < 50km)

Labour: Roof substructure

Extraction in Niokolo-Koba National Park
(distance < 50km)

Processing on site
(distance = 0km)

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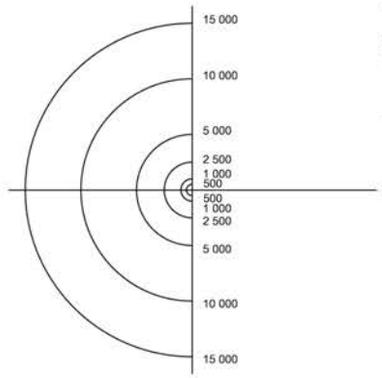
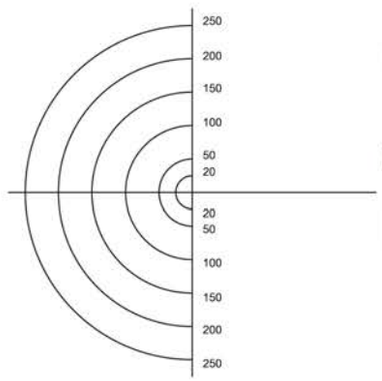


Global material and labour distances



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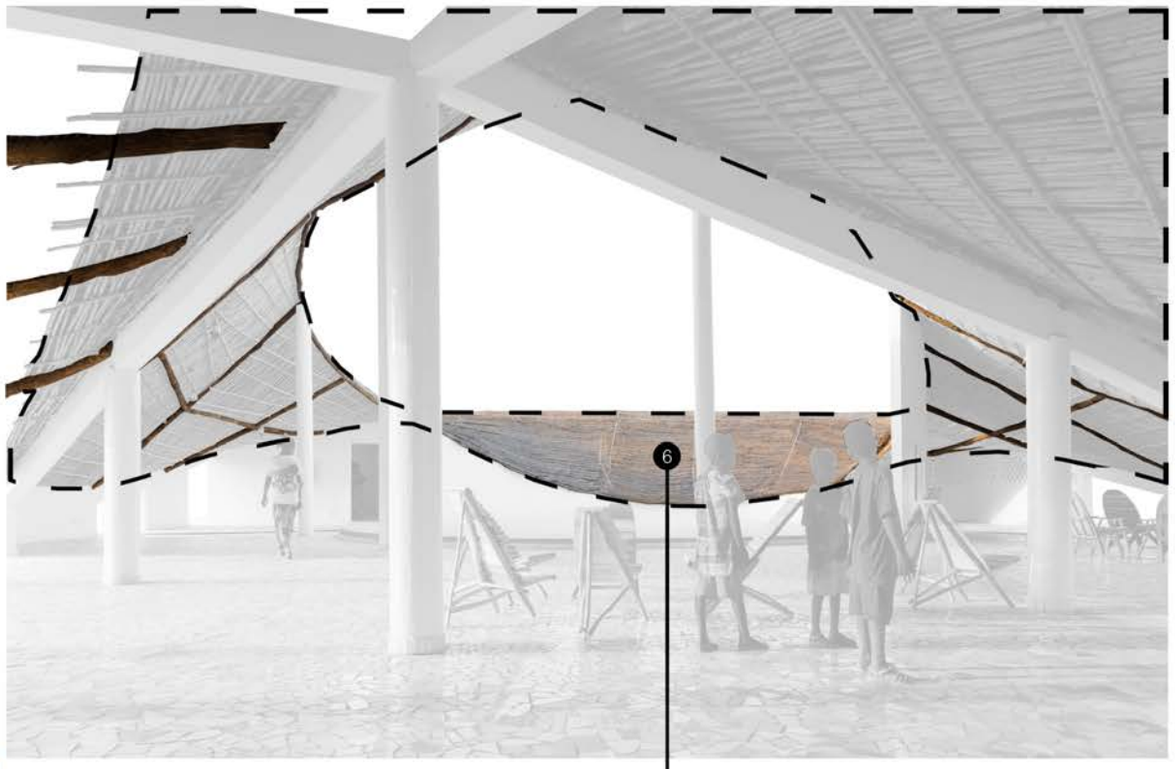
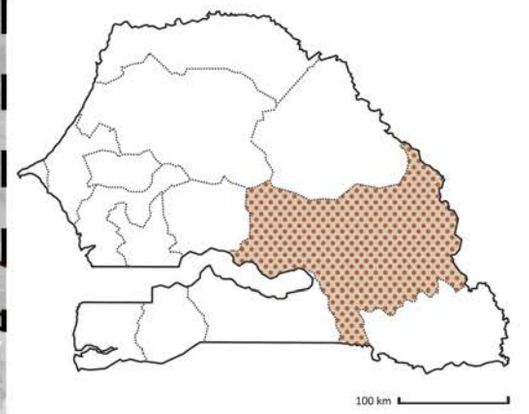


Material

Labour

Global material origin and labour



Local material origin and labour

Local tectonics

Material: Thatch

Thatch grown and processed in Sinthian (distance < 5km)

Labour: Thatch

Extraction and processing in Sinthian (distance < 5km)

Thread Artists' Residency and Cultural Centre

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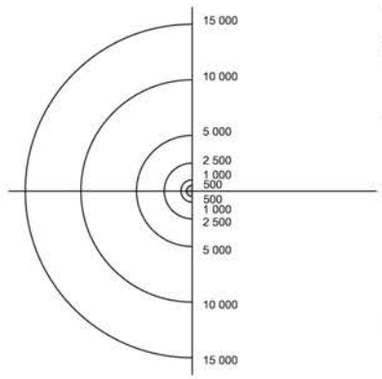
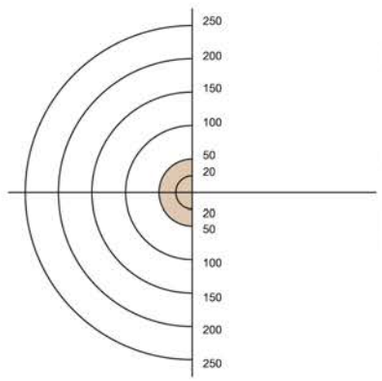
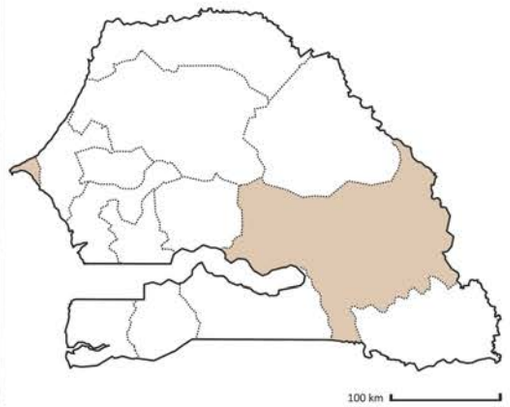


Global material and labour distances



Local material and labour distances

Global material origin and labour



Local material origin and labour

Material

Labour

7

Local tectonics

Material: Floor tiles

Reused floor tile fragments from Dakar
(distance < 450km)
and Tambacounda, Senegal
(distance < 50km)

Labour: Floor tiles

No extraction and processing for reused material
(distance = 0km)

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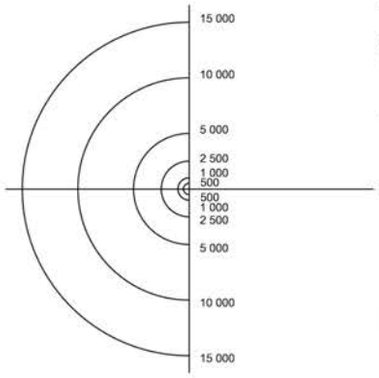
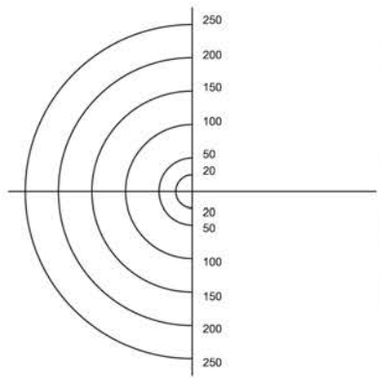
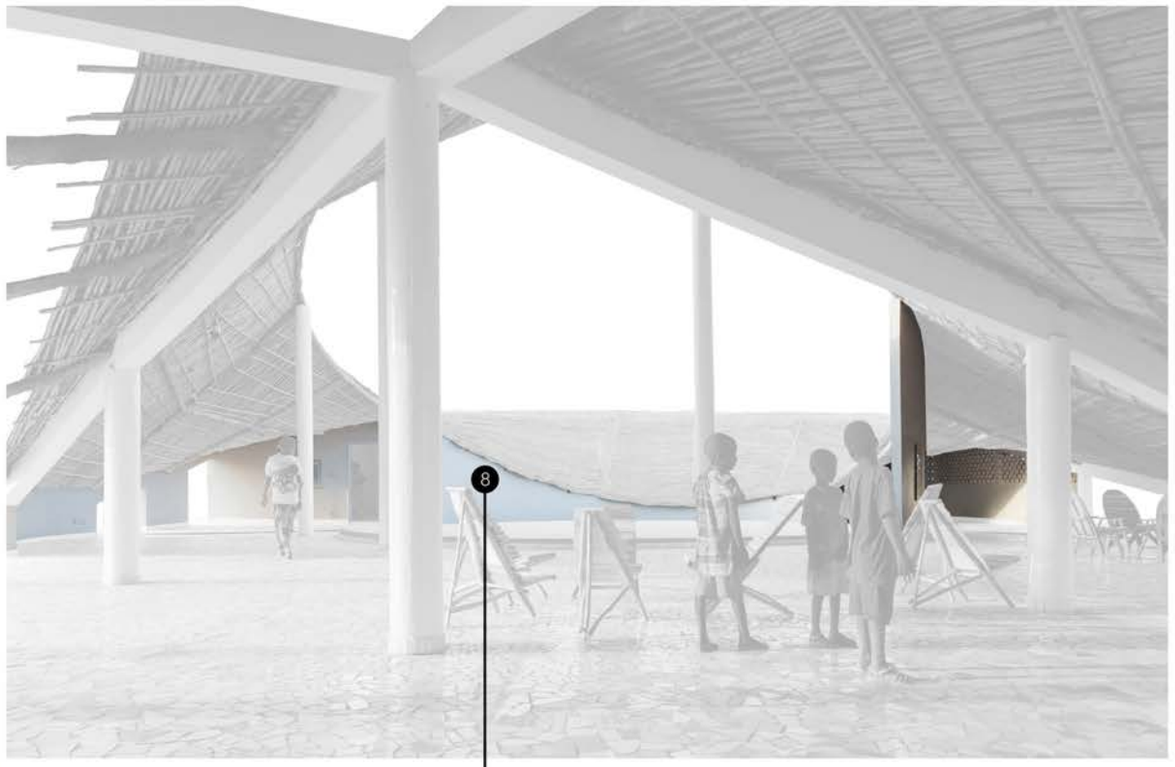


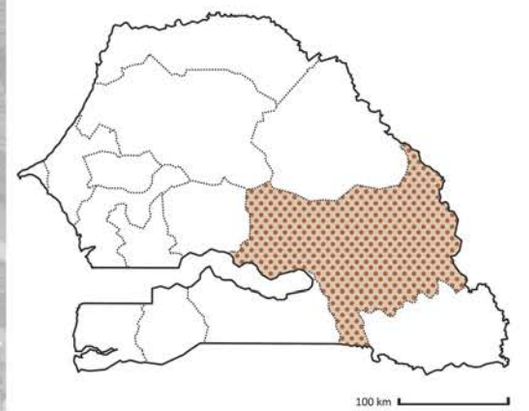
Global material and labour distances



Local material and labour distances



Global material origin and labour



Local material origin and labour

Material

Labour

Local tectonics

Material: Brickwork

Local clay from Sinthian
(distance < 5km)

Labour: Brickwork

Extraction in Sinthian
(distance < 5km)

Bricks made on site
(distance = 0km)

Appendix D

Declaration

I hereby:

(a) Grant the University free license to reproduce the above thesis in whole or in part, for the purpose of research;

(b) Declare that:

(i) The above thesis is my own unaided work, both in conception and execution, and that apart from the normal guidance of my supervisor, I have received no assistance apart from that stated below;

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Michael Paul Louw 28 February 2021

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