SERVANT CORE IN SUPPORT OF MULTI-FUNCTIONAL SERVICE FACILITIES

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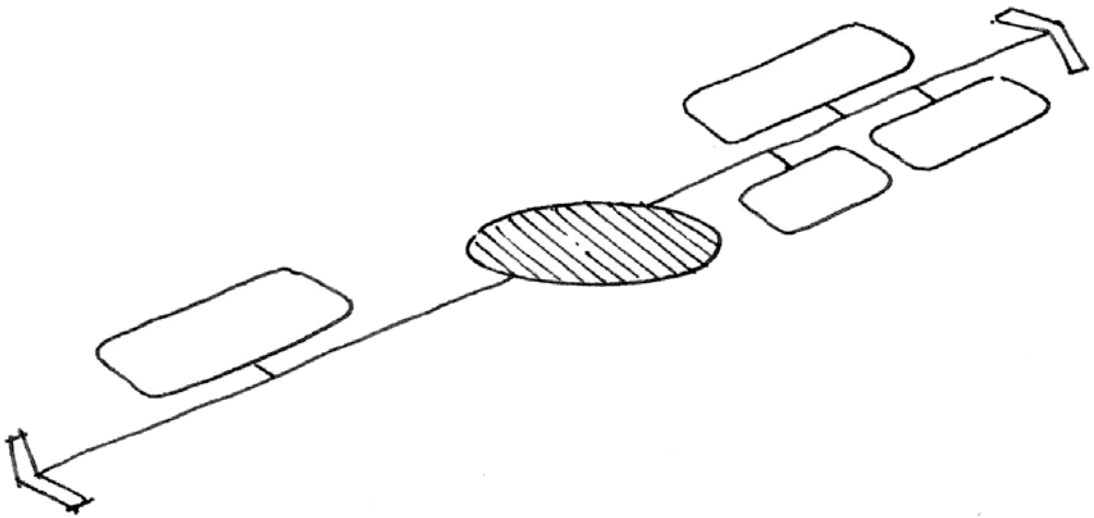
[designing for change
architecture as cognitive process]



"*Noka e tlatswa ke dinokana*" – "a river swells from little streams"

(Sesotho Proverb)

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Fig. 1 Front page: The informal context

Fig. 2 Top: Catalyst

Fig. 3 Next page: The process in a visual abstract

ABSTRACT

Architecture is never complete.

The theoretical discourse of the thesis explored the need of a building to change. This change is unpredictable, though expected. The project proposal within the informal context of Phumolong, Mamelodi, aimed to address this unavoidable nature of architecture.

The focus of the project was to provide improved services within an informal settlement, whilst generating social upliftment. The thesis investigated the current and future requirements of the informal dweller. It explored the possibility of generating public space through the establishment of a catalyst. The connection of services and public amenities has been exploited to generate an environment where the building acts as generator and it supports social interaction. Inevitably the servant core provides implicit reasoning as renewed stimulus to public gathering.

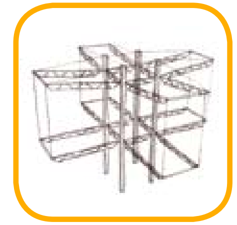
The project proposal addressed the integration of the informal user with a building system through the architectural process. This is achieved through phased development, investigating assembly and use of civic programmes.

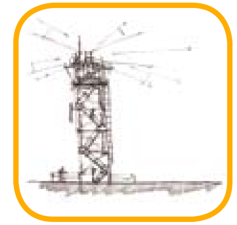
A quantitative approach towards the research was initially undertaken. However, the fluid nature of the informal settlement enthused a more qualitative approach. The need and right of the informal dweller to be served, and have access to public services and amenities justified the design proposal.

The changing fabric, user, programme and needs of the community contribute to the rate of change of a building. The changing context of Phumolong required a flexible and adaptable design intervention allowing for future interpretation. These variables influenced architecture as a cognitive process.

The design as a product within the realm of architecture represents the process of learning from the past, reacting to the present and preparing for the future.

Ultimately the design intervention exists as an ongoing process of progressive change.





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With thanks to:

My beautiful Wilna for her love, understanding and support,
The FIRM,
The studio crowd,
Jaco
Jacques Laubscher for his commitment and effort, Gary White for his support and Gus Gernecke for his mentorship

Mom
Dad and Mali
[“...faith is the substance of things hoped for, the evidence of things not seen” Hebrews 11:1]

Finally I would like to dedicate this book to my grandparents Wolfgang and Judy Gottsmann

With Jesus all things are possible

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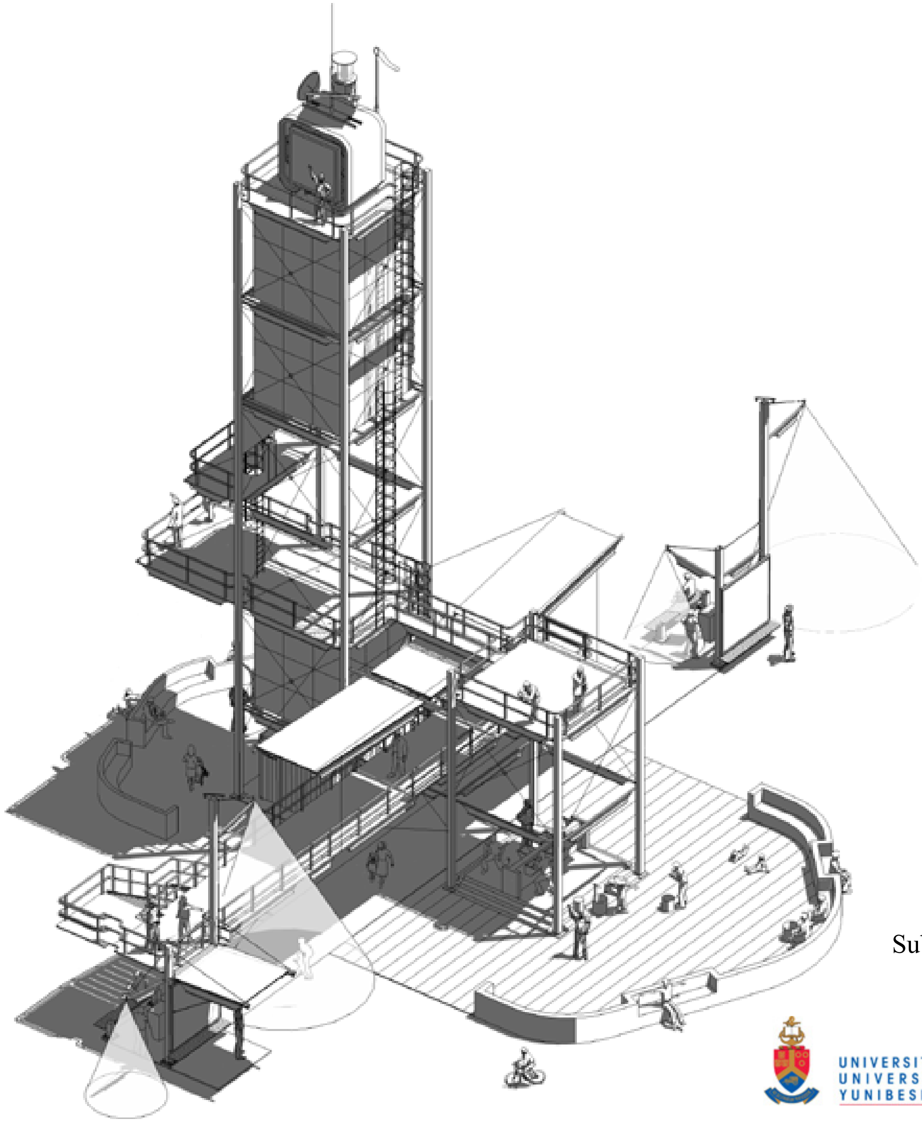
Fig. 4 Next page: Servant core

SERVANT CORE IN SUPPORT OF MULTI-FUNCTIONAL SERVICE FACILITIES

PROPOSED NEW PUBLIC SERVANT CATALYST FOR THE INFORMAL SETTLEMENT OF PHUMOLONG, MAMELODI, TSHWANE, SOUTH AFRICA



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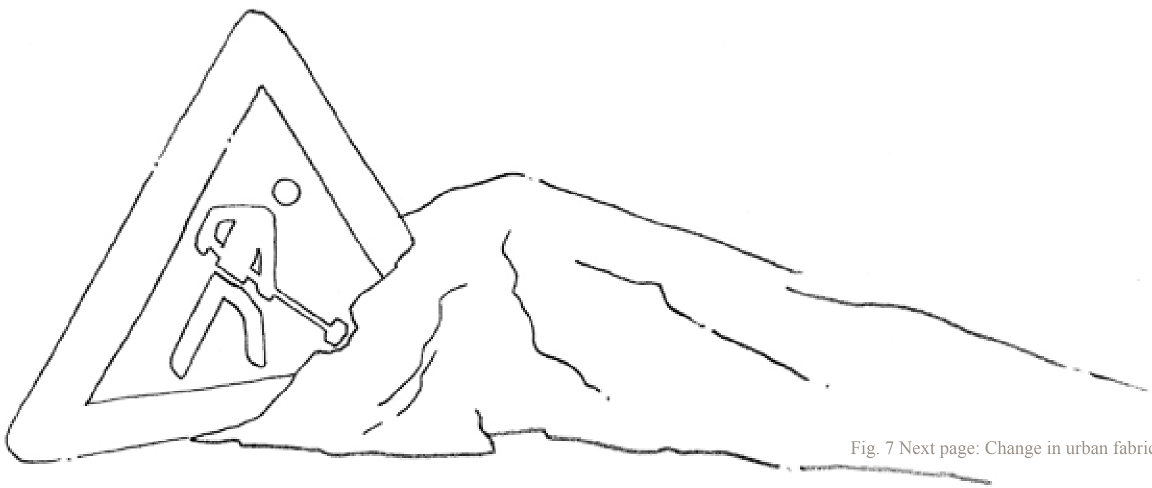
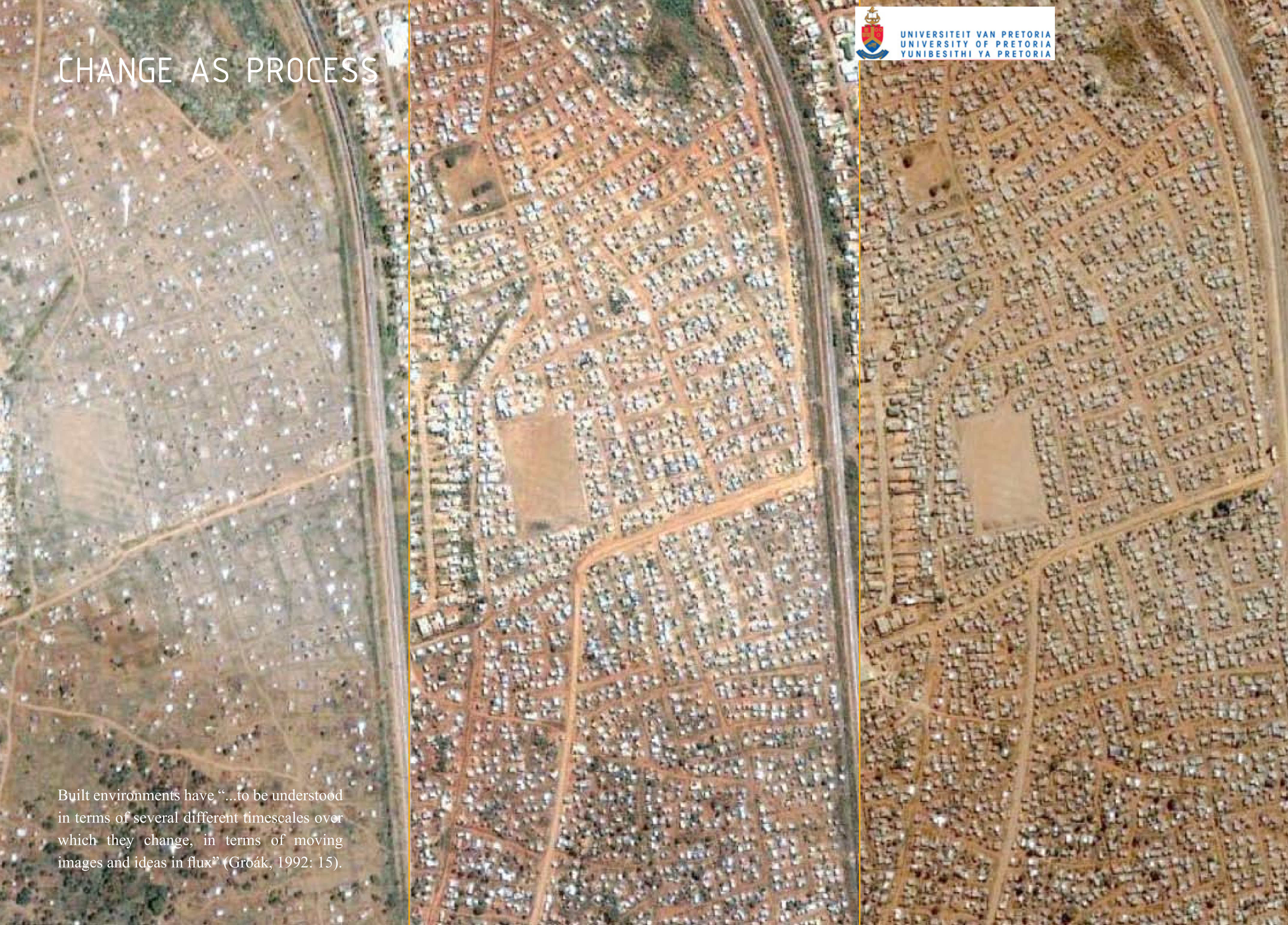


Fig. 6 Work in progress

Fig. 7 Next page: Change in urban fabric, Phumolong, Mamelodi

CHANGE AS PROCESS



Built environments have "...to be understood in terms of several different timescales over which they change, in terms of moving images and ideas in flux" (Groák, 1992: 15).

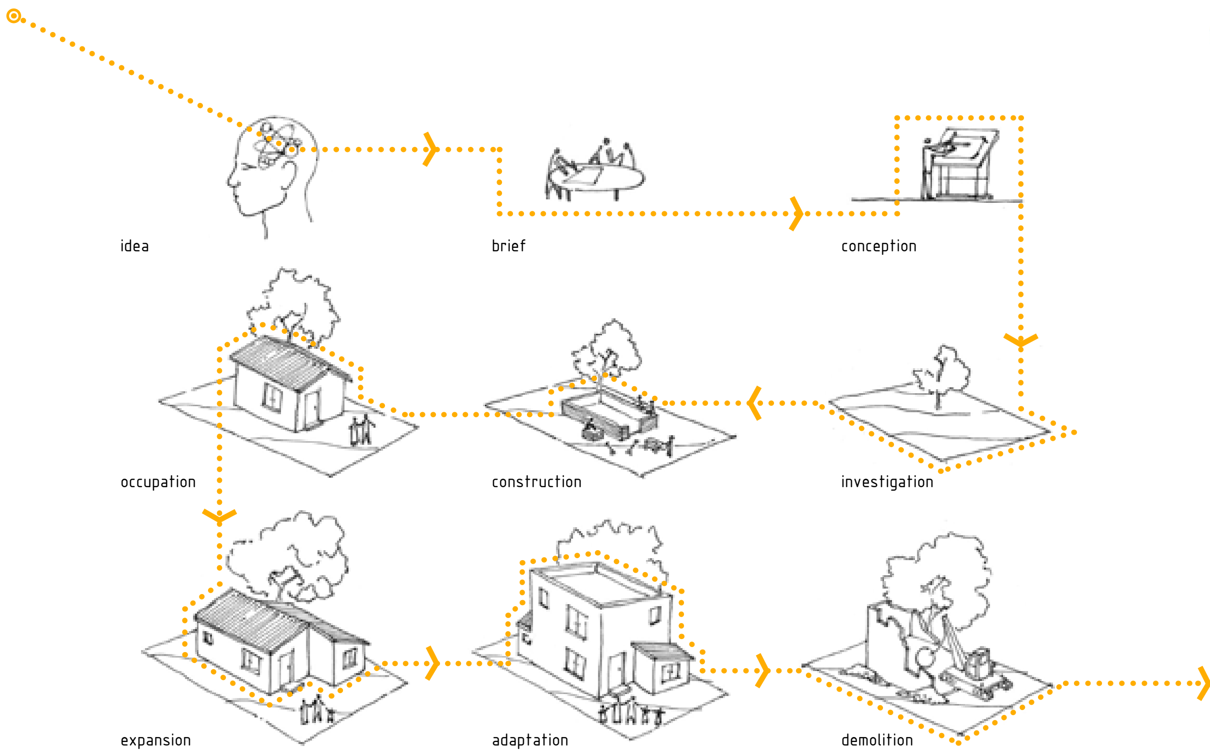


Fig. 8 Parts of the architectural process

Two adjacent buildings built about 1850

The somewhat altered two buildings in 1993

Fig. 9 The front cover of *How Buildings Learn*, by author Stewart Brand, epitomises the unavoidable nature of a buildings' need to change, whilst the original blueprints impose guidelines for future intervention.

PROBLEM STATEMENT

Architectural design and its realisation is often considered as final. Despite this expectation, very few buildings remain true to their original design purpose.

ARCHITECTURE AS PROCESS

Architecture is a process, from the initial design conception on paper to its realisation through construction and functional operation. Among others it exists as physical manifestation – space and place, however the passage of experience. Architecture is not merely a product representing the conclusion, but subsists through time by an ongoing process of learning and reacting to its ever changing input variables. Ultimately it is a process of cognition.

CHANGE

Change within the built environment and buildings are inevitable. This aspect should be embraced by designing for it from conception, through evolutionary existence and even past its destruction. Architecture is as result of an environments' continued capability of responding.

In the publication *The Idea of Building*, author Stephan Groák describes "the fundamental flows of energy and matter which impinge upon buildings, and their occupants, and the consequences of these flows in terms of buildings as complex systems of reservoirs" (Groák, 1992: 7). A building (or any entity for that matter) envisaged as a complete whole undermines the critical performance of its constituent parts. A building cannot be a static whole as it exists in an environment of flux. Its parts respond continuously and dynamically to the vast array of forces inflicted upon the system in order to allow the whole to survive in a constant state of quasi-static equilibrium. These 'built' reservoirs experience turbulence throughout their lifetime. A well designed reservoir should be capable of accommodating such change in flows of energy. A building system is a responsive environment reacting to a change by force, man-made and natural, emanating from the intense advancement in technology and services, forces derived from diverse cultures, social change, real-estate value, climatic conditions and usage. Groák further argues that "buildings have to be understood in terms of several different timescales over which they change, in terms of moving images and ideas in flux" (Groák, 1992: 15).

Most design choices are made within an isolated environment allowing limited understanding of future conditions. Change is unpredictable. No design can accurately predict future conditions, but it should consider time and its changing requirements. A good design should be accommodating of chaotic future actions without losing functional efficiency. In the publication entitled *How Buildings Learn*, Brand argues that time is needed to correct mistakes (Brand, 1995: 64). However, in contrast to the static nature of the built environment, "new usages persistently retire or reshape buildings" (Brand, 1995: 2). Brand further argues that "when we deal with buildings we deal with decisions taken long ago for remote reasons" (Brand, 1995: 2).

AN ALTERNATIVE OPTION

A built system capable of learning and evolving in time, integrating change within the system could be described as an alternative to the above. According to Brand it is necessary to design for future scenarios by "devising an 'adaptive' strategy that is exceptionally alert to changing events and can adjust quickly" (Brand, 1995: 183). Therefore any built system should be adaptable and flexible throughout its life span, acting as a response to ever-changing conditions and paradigm shifts. Groák refers to the capability of different social uses, whilst flexibility encompasses different physical changes (Groák, 1992: 15).

1863 - The original Cliff House restaurant, San Fransico, USA

1878 - Gambling casino

1900 - Private amusement palace, restaurant and ballroom

1910 - Restaurant

1946 - Restaurant & worlds largest curio shop

1954 - Restaurant

1973 - Restaurant

1991 - Restaurant

The illustrations above depict a programme that remained largely unaltered. However, time necessitated various changes to the built form.

Fig. 10 Change over time

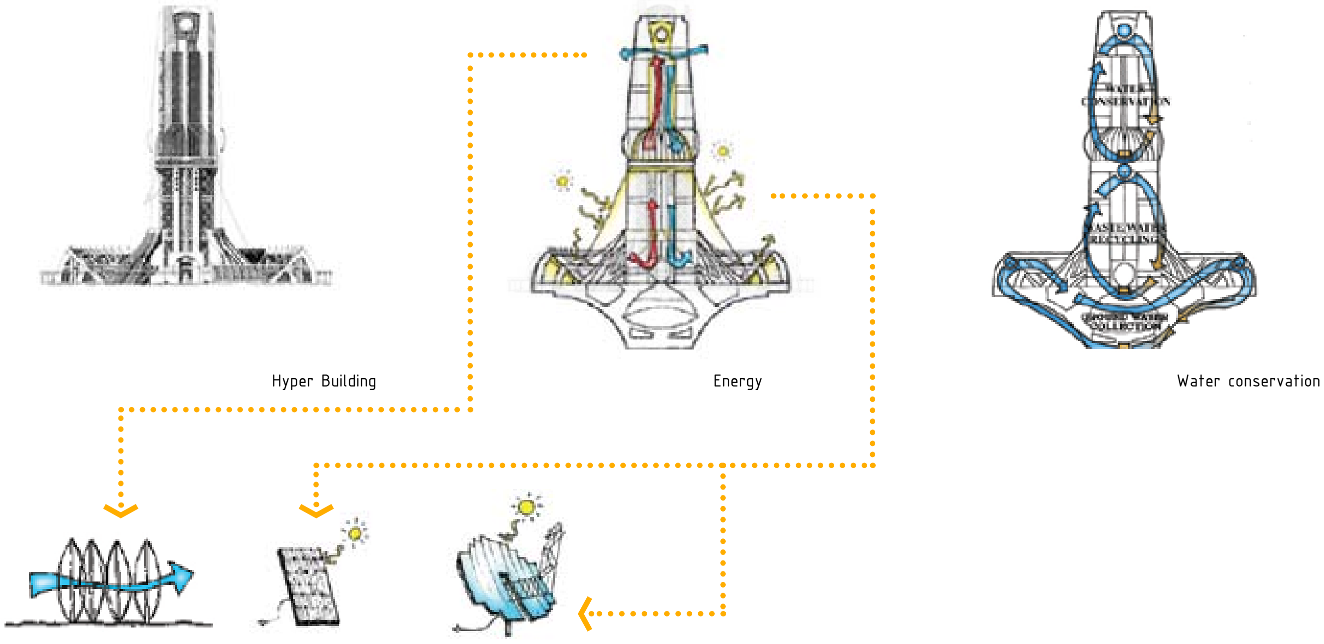


Fig. 11 The Hyper Building, accommodating residential, commercial and agricultural activities is a conceptual Arcology by Paolo Soleri

Fig. 12 The Earthship, built mainly from recycled materials, the sustainability centre uses renewable energy and water recycling strategies to increase its self-efficiency.

Fig. 13 A pavilion based on the arcology theory, Hanover Expo, 2000.

ENERGY, SYNERGY AND AUTONOMITY

Architects have a duty to formulate sustainable designs for the future because the built environment has wide ranging effects over an extended period of time.

The theory of Arcology, established by architect Paolo Soleri, aims to "embody the fusion of architecture and ecology" promoting a more "frugal, efficient and intelligent city design" (Arconsanti, [sa]: 2) this is achieved through a symbiotic relationship between parts and whole. It encourages a healthy system through the interaction of the parts. Ultimately, Arcology seeks to create an autonomous (self-sufficient) system operating on the scale of buildings, or on the larger macro scale of cities. These systems act in an intelligent manner, responding to direct and indirect forces of the built environment. In addition, these systems seek to produce their own energy and operate off-grid, remaining largely independent of off-site supplied services. The approach finds validity where development takes place within an informal settlement, because of limited infrastructure and services. However, a synergistic infrastructure is essential to operate an autonomous system. Soleri's Third Generation Arcology incorporates "modular and possibly standardised structures (which) would be articulated in a variety of arrangements… to fit specific conditions…" (Arconsanti, [sa]: 2). Resource efficiency is coherent throughout the theory of Arcology. Energy extraction and circulation in the built configuration is integral to maintain a continued existence. Expanding on Soleri's hypothesis, architecture should consider future adaptations of the building. Although an autonomous system might prove difficult, appropriate technology could increase its level of independence.

DISSIPATIVE SYSTEMS

Architecture may be perceived to behave as a dissipative system, complex by nature, subsisting through a perpetual exchange of energy across its dynamic boundaries. Architecture is reserved as an evolving stage for the user, but it is situated within a larger ecosystem.

Dissipative systems (or dissipative structures) "not only maintain themselves in a stable state far from equilibrium, but may even evolve. When the flow of energy and matter through them increases, they may go through new instabilities and transform themselves into new structures of increased complexity" (Encyclopedia of Human Thermodynamics, 2009: 3). Most organic forms depend upon a chaotic system responsible for its dynamic stability. Dissipative systems include convection, cyclones and hurricanes. To this list can be added informal settlements. The environments of these settlements exist in a quasi-state of equilibrium. In addition, their existence is provisional and depends largely on the carrying capacity of the land and external forces. This dissipative system exists as a complex configured arrangement of multiple systems in impermanent synergy. A cyclone, is an example of a dissipative system, makes use of a constant uninterrupted flow of absorbed energy to sustain its form. The cyclone will eventually cease upon the disruption of the system. Informal settlements experience a continuous, yet fluctuating exchange of matter and flow of energy. This is comprised of users, passer-bys, electricity and water among others. The discontinuation of one of these forces will influence the system and its ability to function.

CONCLUSION

The above theories and systems represent idealistic extremes that should be balanced within the pragmatic requirements of the existing. In addition, the reality of the situation, with emphasis on site and environment should be considered as the primary design force.

Fig. 14 Government subsidised house requiring owner to fund any new additions, Mamelodi, 2008.

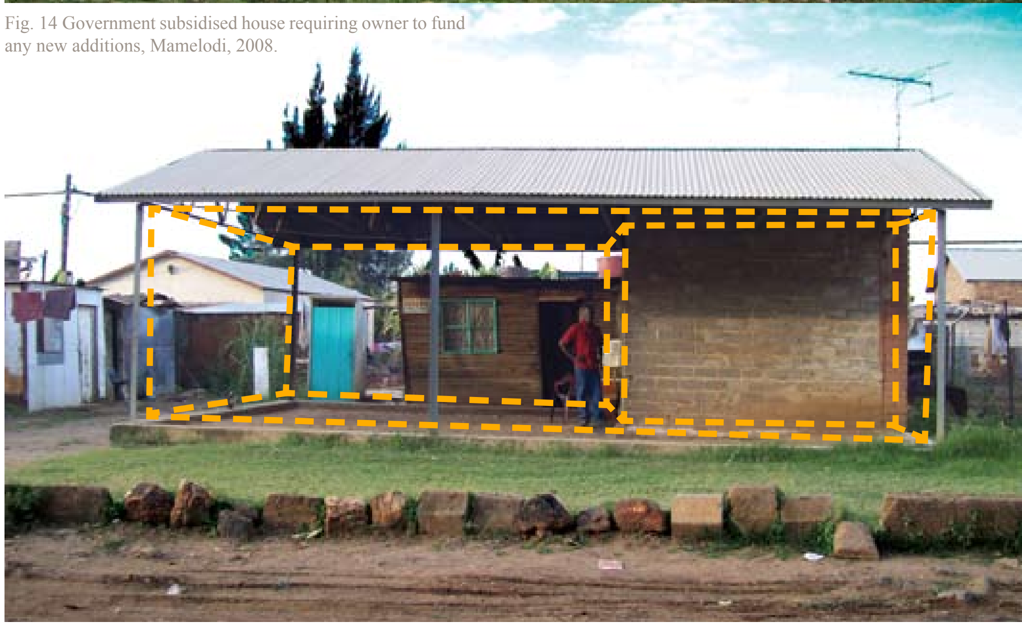


Fig. 15 Additions and alterations expected and encouraged

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Fig. 16 Sketch of informal settlement

Fig. 17 Next page: The informal settlement of Phumolong

INFORMAL SETTLEMENTS – ENVIRONMENTS OF FLUX

Architecture and society represent a complex system of parts mutually interdependent on one another in order to function as a single cohesive whole.

Fig. 18 Laundry day in Mumbai's Dharavi slum

Fig. 19 The slum of Kibera, Nairobi, Kenya depicts the recurring nature of high proximities, inferior housing conditions and lack of services within slum settlements

Fig. 20 A slum in el Salvador, Brazil faces similar problems as those experienced in slums worldwide

DEFINING CHARACTERISTICS

"In developing countries, the term 'slum'…simply refers to lower-quality or informal housing. Large, visible tracts of squatter or informal housing have become intimately connected with perceptions of poverty, lack of access to basic services and insecurity. Terms such as slum, shanty, squatter settlement, informal housing and low income community are used somewhat interchangeably by agencies and authorities" (UN-Habitat, 2003: 9).

THE NEED FOR REMEDY

It is not necessary to emphasise the poor standard of living conditions coupled with the lack of basic services and infrastructure within informal settlements, it is self evident. However, these environments require improved service delivery through immediate solutions to facilitate better living conditions.

Kofi A. Annan, preceding Secretary General of the United Nations, states in the report: *The Challenge of Slums: Global Report on Human Settlements 2003*, that "almost 1 billion people, or 32 per cent of the world's urban population, live in slums, the majority of them in the developing world. Moreover, the locus of global poverty is moving to the cities, a process now recognised as the 'urbanisation of poverty'", he further states "without concerted action on the part of municipal authorities, national governments, civil society actors and the international community, the number of slum dwellers is likely to increase in most developing countries. And if no serious action is taken, the number of slum dwellers worldwide is projected to rise over the next 30 years to about 2 billion" (UN-Habitat, 2003: vi).

The pandemic of informal settlements throughout the world continues with little sign of rescue. What may be required as an immediate response is an interim held service delivery core. This catalyst, should stimulate growth to improved living conditions.

THE SOUTH AFRICAN INFORMAL SETTLEMENT

Informal settlements are in flux by nature. Even when settlement boundaries serve as constraint, a change in urban fabric continually manifests through altering dwelling configurations. The disassembly and recycling of structures, together with new informal extensions frequently remodels the dwelling units for increased practicality. Existence is treated as temporary by authorities whilst the circumstances of settlement usually remain for an extended period of time. Most often located on the outer periphery of cities and within industrial areas, the residents are near enough to serve, but not close enough to be served. Various site visits proved the inhabitants of informal settlements throughout Tshwane, as extremely resourceful and innovative. There are wide ranging methods of existence within these fluid environments. Internal policing, construction and trading are all resolved and carried out on a scale suited to the environment.

Deemed unstable by formal criteria, these informal environments disclose schizophrenic characteristics. However, below the smog of condemnation is a functional pragmatic society capable of self-regulation and self-order, responding to the need of the user.
There exists an inherent understanding within the informal setting. Planning of informal settlements within South Africa is usually determined by the density of use coupled with external forces. The user and environment interacts on a direct level. Street grids are established in accordance with the pedestrian scale as main determinant. One of the arguments making slum definition difficult is that "slums change too fast to render any criterion valid for a reasonably long period of time" (UN-Habitat, 2003: 11). This is further supported by the changing settlement patterns within the study area of Mamelodi, Tshwane, South Africa. Any proposal attempting to address the situation should have an impermanent character, allowing for relocation once it has served its purpose. Alternatively, it could be adopt a new programme that is capable of merging into the new fabric.

The lyrics of the late musician Bob Marley sing out "some people have hopes and dreams, some people have ways and means" (Bob Marley with Chuck D, 1999). Although the informal resident may foster certain hopes and dreams, the reality of his or her context is that of basic survival.

Informal settlements establish roots: cultural, social and individual while the occupants conceive of methods for survival which need a degree of permanence (stability). This forms the supporting basis for the greater structure, the community. Life is uncertain for the inhabitants of these unstable environments yet most survival and planning strategies are based on the ideal of a constance.

It is important to understand that "slums are not static; there are ongoing dynamics that, over a period of years, may turn an established urban area into a slum or

Fig. 21 Alexander Township, Johannesburg, South Africa

Fig. 22 Lusaka informal settlement, Pretoria, South Africa

Fig. 23 Informal settlement, Pietermaritzburg, South Africa

Fig. 24 Collage portraying the vibrant life of an informal settlement

that may lead to the redevelopment of an existing slum" (UN-Habitat, 2003: 67). Some informal settlements have been in existence for many years surpassing the lives of various generations inhabiting its realm. Therefore it may be regarded as a permanent entity within the urban fabric. Unfortunately, these slums are still treated as external ailments. Informal settlements provide little more than access to economic opportunities. It is reduced to a transitory environment in which the urban immigrant may temporarily locate themselves until enough capital has been generated to emigrate (yet again). Most of the informal residents' needs are postponed. These are sacrificed in expectation of the unpredictable opportunity. Different cultures and personalities come together as a result of rural emigration. The search of economic sustenance is the major cause of these migratory patters.

The inhabitants within these settlements depend gravely on the natural environment for support. Nearby rivers are utilised for drinking water and trees for fire wood. With little service infrastructure and a limited municipal grid supply, there is often no proper sanitation or electricity. Many informal residents within South Africa are waiting to be relocated to government subsidised houses. This lengthy process often takes years to realise, leaving the occupants in a temporary state, not wanting to permanently settle down, but remaining long enough to necessitate the basic services.

Service delivery, a basic need for any individual to be able to perform coherently in society, the lack thereof is coupled with social unrest and deterioration of the physical condition. It is a pre-requisite for any development to take place, acting as catalyst to successive progression.

Section 26 (1) of the constitution states everyone has the right to have 'access to adequate housing', therefore the government has a responsibility to provide housing for the majority of its citizens who are not properly housed. Part of this strategy aims to include the informal resident within contemporary urban society. This however dissuades self-help strategies implemented by the informal dweller. It is further aggravated by conditions of overcrowding, lack of basic services and insufficient public amenities. Together with an insecure tenure, the resident refrains from improving the immediate environment, whilst hoping for external relief. Government subsidised housing,

The focus of this thesis is the need and right of the informal dweller to be served and serviced during a 'temporary' occupation phase within the informal settlement.

"A lack of public resources is the most cited reason for the deterioration of physical conditions" (UN-Habitat, 2003: 87). The needs of the informal residents are often overlooked by urban society. The informal dweller as a constitutional equal within contemporary South African society, has a right to access of services and public amenities within their environment.

HUMAN RIGHTS

Selective extraction from the South African Bill of Rights:

Section 24: Environment
Everyone has the right-
(a) to an environment that is not harmful to their health or well-being...

Section 26: Housing
(1) Everyone has the right to have access to adequate housing.
(2) The state must take reasonable legislative and other measures, within its available resources, to achieve the progressive realisation of this right...

Section 27: Health care, food, water and social security
(1) Everyone has the right to have access to-
(a) health care services;
(b) sufficient food & water; &
(c) social security.

(Constitution of South Africa, 1996, chapter 2, sections 24, 26 & 27)

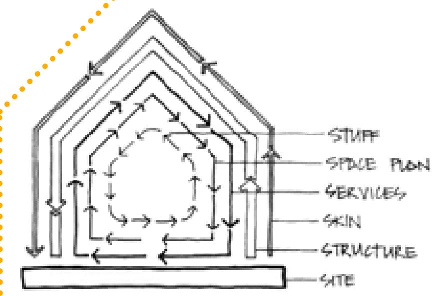


Fig. 25 The shearing layers of change

THE 6 S'S

In an attempt to gain insight into (the somewhat obvious) building system the different layered components, all with various rates of change are defined. In the publication entitled *How Buildings Learn*, the author Brand lists six aspects as the shearing layers of change, termed the 6 S's for the built environment, it is compared with its equivalent within the informal settlement.

PROGRAMME

Programme should be added as a seventh layer to the adapted Brand matrix. Programme ultimately influences the choices made for the 6S's. Programme informs the client:

- where,
- when,
- why,
- what,
- who and
- why .

It should take on the required operation it should and where it should be located. A programme's flexibility and adaptability differs from that of skin and services. It requires an inherent ability to expand and contract depending on economic forces amongst others. Any programmatic choice results in a definite yes or no answer. The timeous nature of architecture unfortunately delays this process. In addition, a host of external factors further complicates the decision making process. The appropriateness (or not) of a programme should be constantly checked during planning phases of a project and may even require change during implementation or post-occupancy.

Through programme, architecture either fails or succeeds its' client. The rate of programme change depends on the programme and its compatibility to the 6 S's. Programme cannot always be designed for. They are often succeeded by programmes believed to be more appropriate and adapted to the surrounding conditions (social, economic, etc.). Future programmes are unpredictable and the building configuration should therefore adapt to its environment.

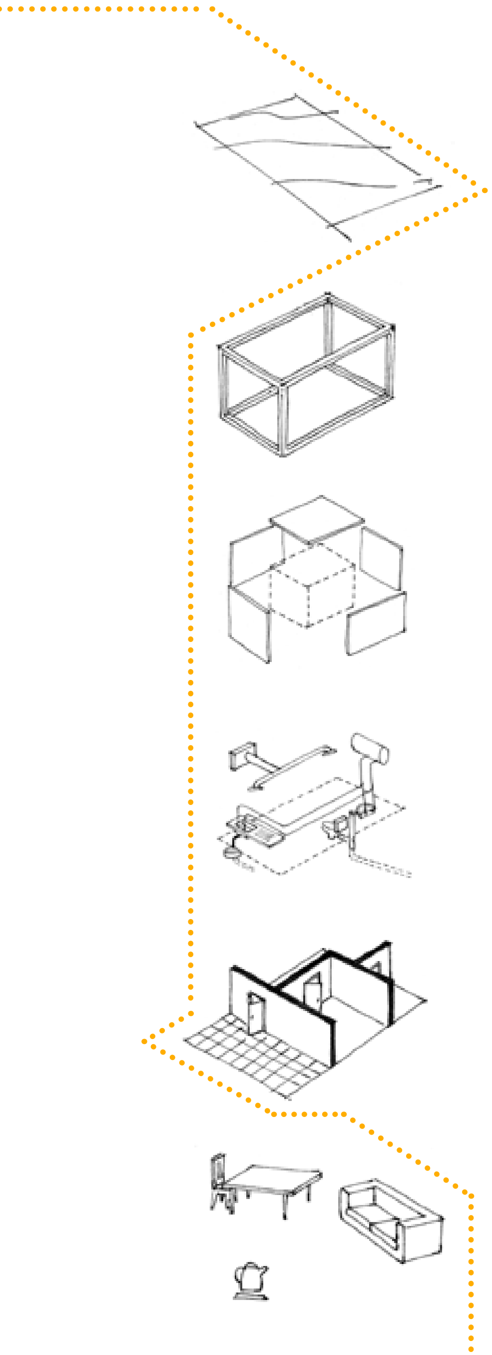


Fig. 26 The 6S's explained

	FORMAL BUILT ENVIRONMENT STEWART BRAND - *HOW BUILDINGS LEARN*	INFORMAL SETTLEMENT
SITE	• The geographical setting • The urban location • The legally defined lot • Boundaries, context outlast generations of ephemeral buildings. • "Site is eternal"	• Site is eternal, an informal settlement is not. • It is temporary for a delayed period of time. • Boundaries shift and context changes fairly rapidly.
STRUCTURE	• Foundations • Load-bearing elements • Expensive to change • These are the building • Life expectancy ranges from 30 to 300 years	• Make-shift, reused and recycled • Composed mostly of timber frames • Probability of relocation hinders any incentive for more permanent construction • Temporary and easily demountable • Loss of material kept to a minimum
SKIN	• Life expectancy = 20 years • Changes with fashion, technology, or for wholesale repair	• Must endure repeated use on various sites • Often outlasts structure
SERVICES	• The working guts of a building: • Communications wiring • Electrical wiring • Plumbing • HVAC • Moving parts like elevators and escalators • Wear out or obsolesce every 7 to 15 years	• Absent • Established on site (pit latrines and borehole water) • Obtained through illegal means from the surrounding area • Site and context specific
SPACE PLAN	• The interior layout • Walls • Floors • Doors • Can change every 3 years or so	• Relatively small floor area • Divided into smaller rooms by means of: — Self-constructed dry walls — Cupboards — Curtains
STUFF	• Chairs • Desks • Phones • Kitchen appliances • Things that twitch around daily to monthly	• Frequency of use determines change in position

03

Fig. 27 Land parcels and grid network, Phumolong, Mamelodi, South Africa

Fig. 28 Next page: The soccer field, Phumolong

SITE + CONTEXT ANALYSIS

The system should be designed to be used as an approach in various contexts. Although a-contextual to a certain extent , once rooted in an environment the design intervention should react to site conditions. The catalytic qualities of the system are capable of responding to the relevant. These 'forces' could inform the growth pattern of the system, resulting in a site specific outcome through the implementation of a generic system.

AFRICA	SOUTH AFRICA	GAUTENG	TSHWANE	MAMELODI
Sub-Saharan Africa's slum population is estimated to increase from a recorded 100,973,000 in 1990 and 166,126,000 in 2001 to 249,885,000 in 2010 and 393,104,000 in 2020, an average of 9 737 700 new inhabitants per year (UN-Habitat, [sa]: Table 4)	There is an estimated 1176 informal settlements in South Africa with a combined population of 3,560,383 (Statistics South Africa, 2004).	In 1996 there were 468,364 households living in informal dwellings in the Gauteng Province increasing to 634,160 households in 2001. There was an average increase of 33 159 households per year (Statistics South Africa, 2004).	In 2005, 124,154 informal structures were registered with the City of Tshwane Municipality. 86% of the households are single headed households with dependents, 96% fall in the income group R0-1000 per month (Gauteng Department of Housing, 2005).	The population of Mamelodi increased from 154,845 in 1991 to 256,118 in 2001. Immigration into the township almost doubled while a slow emmigration occurred out of the Pretoria City where its population decreased from 525,583 in 1991 to 525,118 in 2001 (Statistics South Africa, 2004).

study area

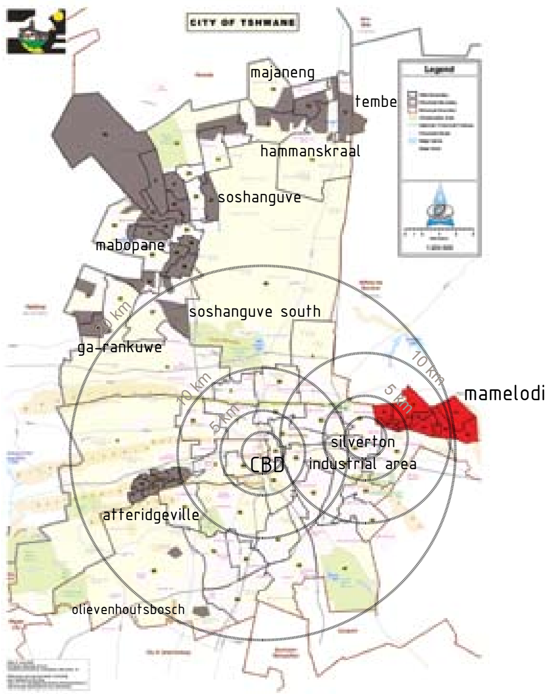


Fig. 30 Main townships hosting informal settlements in Tshwane

MAMELODI INFORMAL SECTOR

Mamelodi represents an ever expanding 'urban' fabric capable of absorbing informal settlements. This perpetuating cycle continues to give rise to new informal offspring. Unfortunately like many other South African informal settlements limited infrastructure is offered and there is a lack of public amenities to improve social and health conditions.

Mamelodi is a residential suburb approximately 25 km² in area. It was originally established in the 1940's as a township for black workers near the train station at Eerste Fabrieken. In time Mamelodi expanded to the East beyond the Pienaars River, locally known as the Moretela River. A cycle exists where informal residents located on the erratic edges would move into formal housing whilst newer immigrants would occupy the shifting outskirts of the township. Settlement patterns have been predominantly to the East (see fig 20-22). These informal settlements have been continuously uprooted and displaced by the expanding formal fabric of the township. The informal settlements in the extreme East and South-East of Mamelodi (informally known as Lusaka and Phumolong) were identified as areas in urgent need of basic services. In addition, high fire risks and poor sanitary conditions are prevalent in these two settlements.

The mapping of public services within the context of Mamelodi highlighted the need of a fire station. The 2008 report by the City of Tshwane Disaster Management Services listed Mamelodi Township as one incurring some of the highest shack fire incidents. During an interview with the Chief Fire Warden of Pretoria, Mr J. Pieterse, the need for a fire station was emphasised once again (personal communication, May 25, 2009). A central location would offer greatest access to fires within Mamelodi whilst also serving the surrounding areas of Nellmapius, Eersterust, Waltloo and the area of the Willows. From the investigation it is evident that a new fire station should be centrally located within Mamelodi. However, inadequate vehicular access together with the absence of fire hydrants complicates any fire fighting strategies. As an alternative, a water reservoir is investigated. This reservoir could perform the dual function of providing potable water for the informal residents, whilst it could serve as a 'fire filling station'. The main aim of such a station will be to operate as a fire hydrant in times of fire. This idea gave rise to the concept of a servant core with its primary activities based around the provision of water.

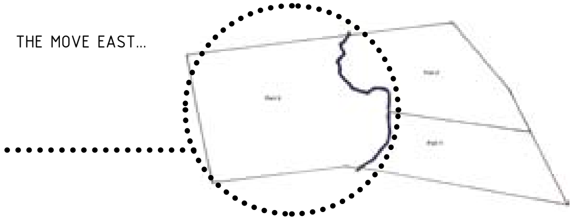


Fig. 31 Subdivision of the Farm Vlakfontein 329 JR during the 1870's

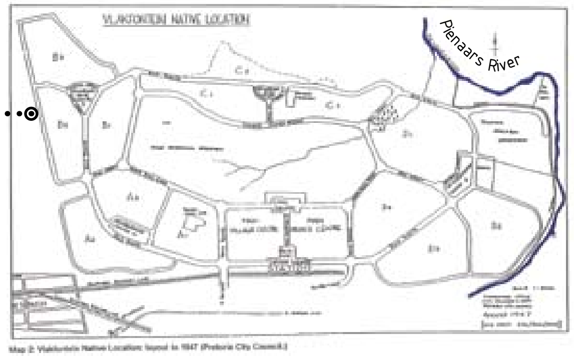


Fig. 32 Vlakfontein Native Location: 1947

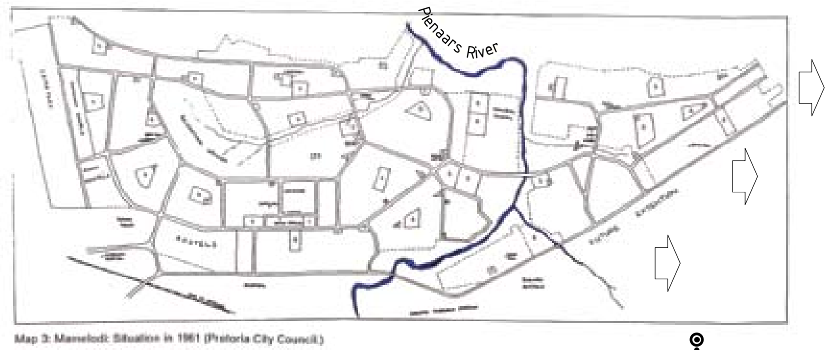


Fig. 33
Mamelodi: 1961

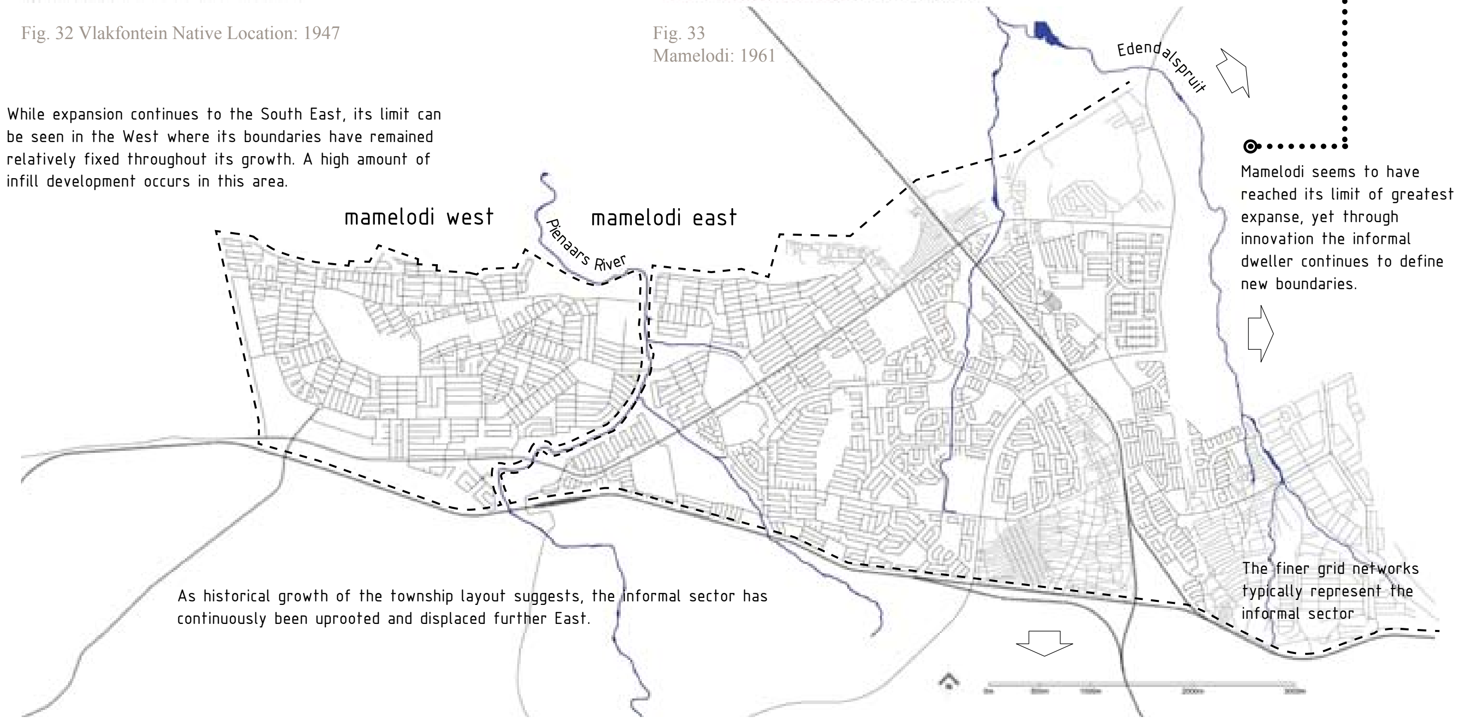


Fig. 34 Present day Mamelodi

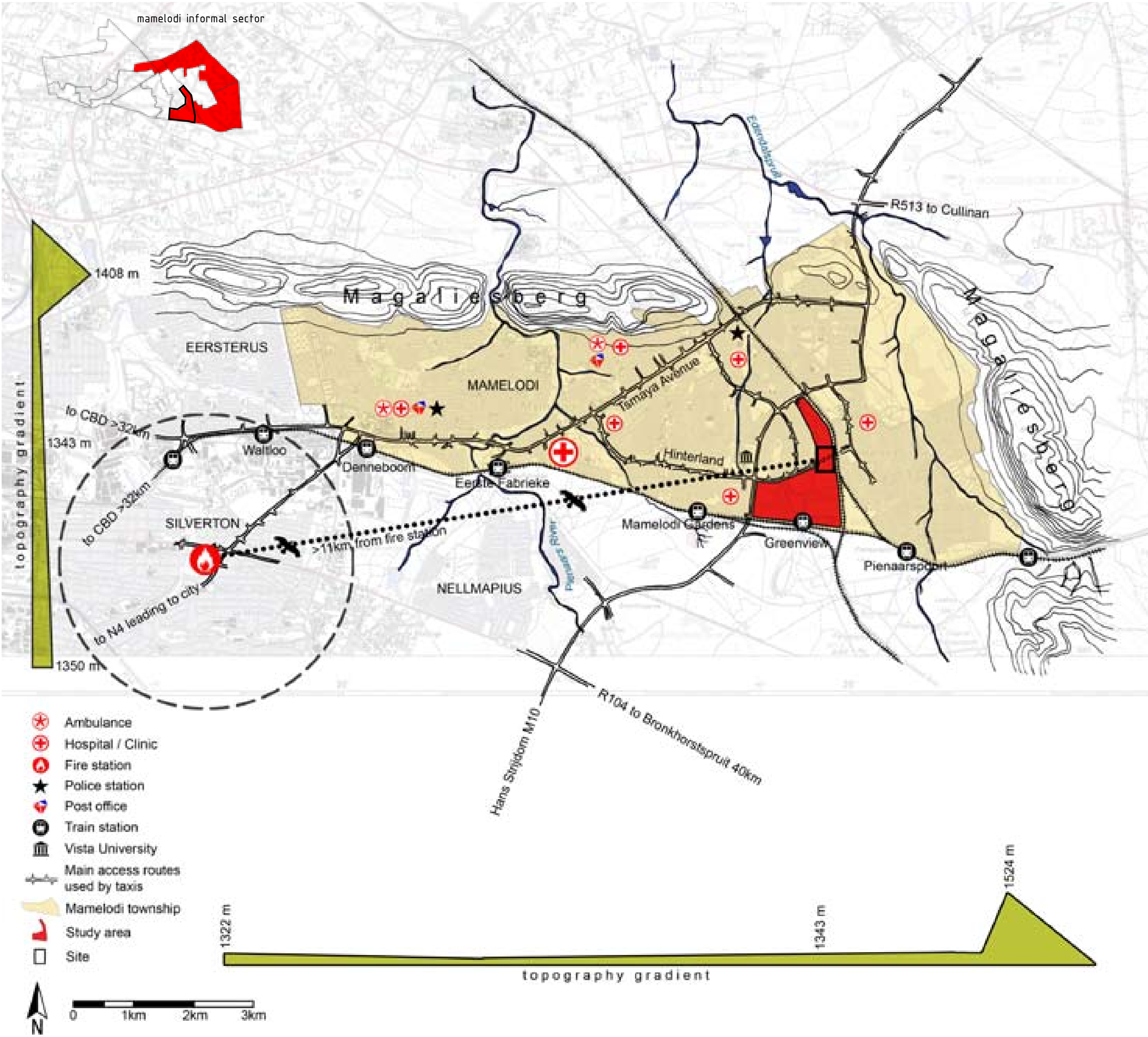


Fig. 35 Public amenities in the township of Mamelodi

Mamelodi is divided into two sectors by the Pienaars River, Mamelodi West and Mamelodi East. Mamelodi West shares a distinct border with the established township of Eersterust to the West and the industrialised area of Silverton to the South-West. The Magaliesberg mountain range defines the northern perimeter of the greater Mamelodi. Mamelodi East is bordered by the North-South lying escarpment of the Magaliesberg mountains and new commercial and residential development to the South in the Willows. Mamelodi East contains a great number of informal dwellings, particularly in the extreme East where there is significantly less formal housing and limited infrastructure. These informal dwellings encroach upon the Magaliesberg on the eastern front. The threat of shack fires exists due to the high combustion rate of the building material used, together with the internal contents. The high densities of informal dwellings further propogate the spread of fire.

Mamelodi bares traces of its numerous growth patterns, both from its pre-apartheid and post-apartheid era's. It displays evidence of the diverse urban planning typologies practised during the changing years of government and the fusion of incongruent road grids.

Fig. 36 Respecting public space

Fig. 37 Phumolong

Furthermore, Mamelodi bares testimony to the various contrasting forms of housing typologies implemented within the township. Unconstrained growth of informal housing result in the smaller informal grid patterns.

THE INFORMAL CONTEXT

The informal sector located in the East of Mamelodi predominantly consist of wards 10, 16 and 17. Collectively these wards comprise more than one third of the area of Mamelodi. Sanitation is of concern with poor health circumstances as result. Much of the material used to construct the shacks is obtained from the surrounding industries, some originating from the Ford manufacturing plant in Silverton.

A large part of the current formalised township of Mamelodi East represents consolidated informal settlements. This is the result of land that had been previously subdivided without approval that was sold or leased to the informal residents. Over time it was recognised as part of the township. Improved infrastructural networks were provided and these informal settlements were merged within the recognised township. In contrast, squatters have been relocated and the land was developed for new Reconstruction Development and Plan (RDP) houses. A constant shift takes place when the informal dweller is removed to the location of a new subsidised house, albeit within the same area. The South African Government aims to provide formalised housing and services to informal communities. However, priority is usually given to the informal settlements "of the most vulnerable and disadvantaged groups" (UN-Habitat, 2003: 129). In addition those established during the apartheid regime receive precedence (Metroplan, 2006), thus excluding the specific site under investigation due to its establishment, since 2003.

SHACK FIRES IN TSHWANE
2007 + 2008

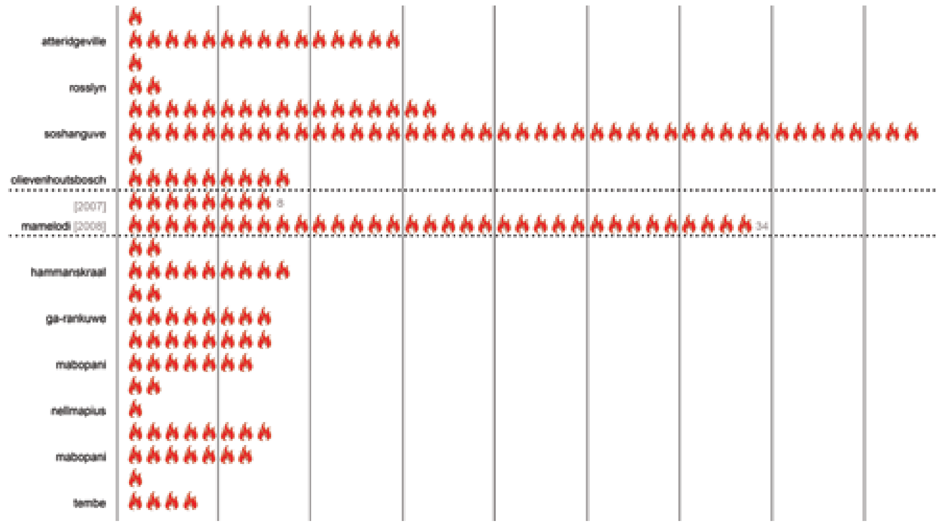


Fig. 38 Shack fires

RISK OF FIRE:
According to the Disaster Risk Atlas of Tshwane by the City of Tshwane Disaster Management Services, the predominant disaster risk in the wards situated in Mamelodi is fire, in the form of informal settlement fires, urban fires and veld fires.

		Priority Disaster Risks:									
	Wards	6	10	15	16	17	18	23	28	38	67
Priority	A	Veld fires	Informal settlement fires	Urban fires	Informal settlement fires	Informal settlement fires	Urban fires	Informal settlement fires	Urban fires	Veld fires	Urban fires
	B	Floods	Public health concerns	Informal settlement fires	Veld fires	Veld fires	Floods	Floods	Severe weather events	Floods	Special events
	C	Severe weather conditions	Floods	Floods	Floods	Floods	Severe climate events	Severe weather events	Floods	Severe weather events	Floods
	D		Veld fires	Severe weather events	Severe weather events	Extreme weather conditions	Extreme weather conditions				Severe weather events

Fig. 39 Disaster risks in Mamelodi

DEAR ALL PEOPLE RESIDING AT PHUMULONG

WE CALL A MEETING TO DISCUSS ISSUES CONCERNING OUR RESIDENCE.WE HAVE BEEN LIVING IN THIS AREA BUT NOTHING AT ALL SEEMS TO BE PROMISING SUCH AS AREA DEVELOPMENT AND INFRASTRACTURE IMPROVEMENT.

IT 'S ON OUR BEST INTEREST TO APPEAL WITH THIS MATTER TO BE ADDRESSED THROUGH SHARING IDEAS ,WE BELIVE THAT A BETTER LIFE FOR ALL WILL BE CREATED.

THE MEETING ORGANISERS ARE BUCANEER AND MUHULU.
VENUE TO BE HELD AT: THE GROUND
TIME & DATE : 9:00 ON SUNDAY

MEETING AGENDA:

- VICTIMS
- OFFENDERS
- RESOLUTION

KIND REGARDS ....

Fig. 40 Phumolong's call for services. Notice found in Phumolong

t h e   s i t e

PHUMOLONG INFORMAL SETTLEMENT

Location:
Phumolong, Ward 16, Extension 6, Mamelodi, Tshwane, South Africa.
25° 44’00” S   28° 25’00” E

The informal settlement of Phumolong, is found in extension 6 of Mamelodi and located in ward 16 of Tshwane, South Africa. It is almost completely surrounded by the township of Mamelodi except to its south where the municipal boundaries of the City of Tshwane and Metsweding meet (both situated in the Province of Gauteng).

‘Phumolong’, Sotho for ‘resting place’ is the local name for the area occupied entirely by informal settlers and shacks with almost no municipal services. The area of Phumolong is located along the curved main road of Hans Strijdom (M10) defining both its Northern and Western boundary while two converging railway tracks demarcate its Eastern and Southern limits. This area is locally referred to as ‘bridge to bridge’ and is managed by a community elected ward leader and committee. The older neighbouring community to the North-West, known as

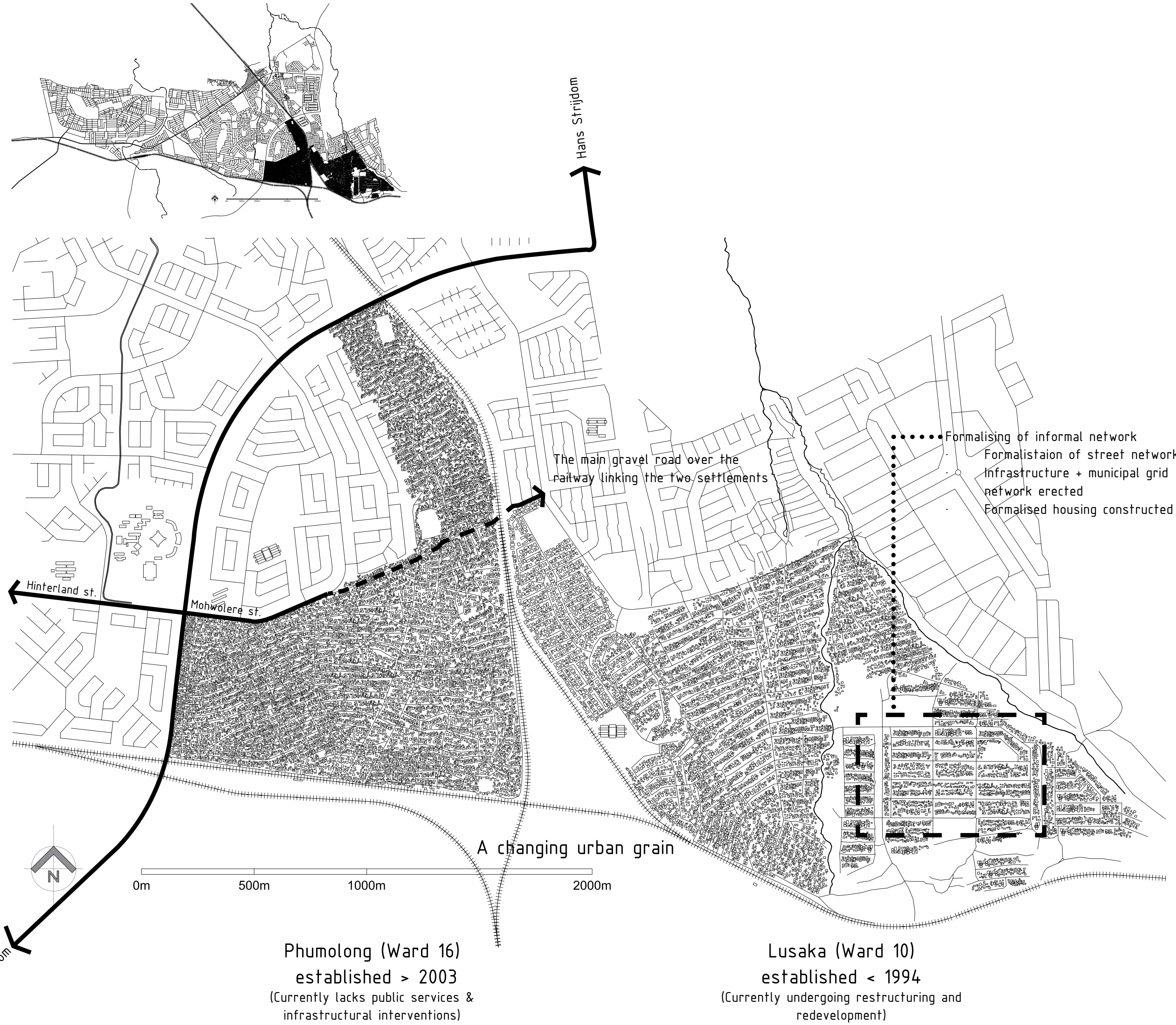


Fig. 41 Comparison between two neighbouring informal settlements within Mamelodi depicting their different stages of change in fabric

Fig. 42 Figure-ground study

Fig. 43 Major pedestrian thoroughfare

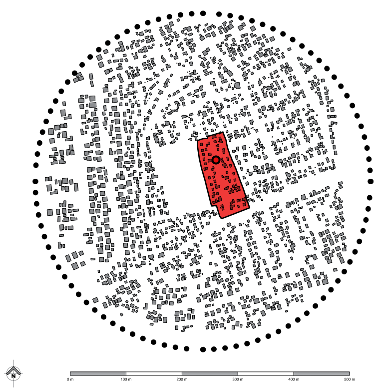


Fig. 44 Road network surrounding the site

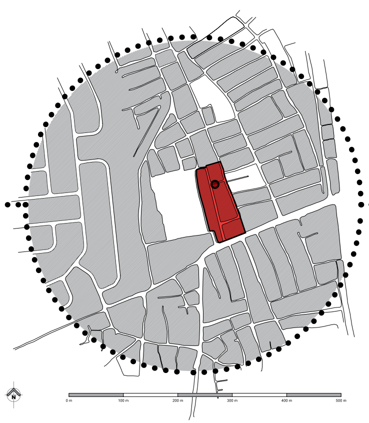


Fig. 45 Informal blocks

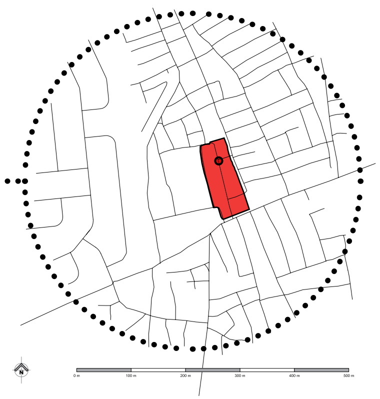


Fig. 46 Figure-ground

Marabastad by the locals, also resorts under Mamelodi extension 6 and boasts RDP housing together with the necessary infrastructure. The limited services in Phumolong are circulated from its neighbours by means of illegal 'izinyoga' (Sotho for 'snake') connections. Hose pipes are connected to garden taps within the neighbouring Marabastad and transverse the dividing asphalt roads. This practice is largely overlooked by the municipality. Upon entering Phumolong the visitor is confronted with hose pipes that meander down the gravel roads. Electrical connections on the outskirts (closest to Marabastad) occurs in a similar manner.

Mr Baloye, one of three committee leaders for Phumolong, recalls that the first squatters (of which he was one) settled and erected shacks on a vacant piece of land within ward 16 on the 29th October 2003 (personal communication, June 15, 2009). Squatters laid claim to small lots erecting their make-shift structures. A committee was elected by the community where after the community members were required to report to the committee their shack location. After this they were issued a statement of tenure, representing a right to occupy the land. Mr Baloye remembers that towards the end of 2005 the Mamelodi Council prohibited any new inhabitants from erecting their own shacks. Existing shack dwellers were given a ‘green number’ which can be found painted on the structures. This acknowledges these residents as listed on the governments list of people eligible for subsidised housing (Baloye, personal communication, June 15, 2009). This has not prevented shacks from being erected by new owner occupiers, or rented out to urban migrating tenants. The current informal settlement of Phumolong now exhibits a sea of shacks.

The committee manages any incidents within the community belonging to the ‘bridge to bridge’ region. The ward leader acts as spokesperson for the greater community (Baloye, personal communication, June 15, 2009). The committee ultimately serves as community mediator, administrator and representative. It plays an integral role in maintaining a social balance resulting in a content community. This system ensures a relatively secure environment by means of visual observation and cooperative spirit.

NEEDS IDENTIFIED BY RESIDENTS

According to section 2.1 of *The Top 20 Priority Township Programme* (Metroplan, 2006), certain needs were identified by the residents of Ward 16 (to which Phumolong belongs):

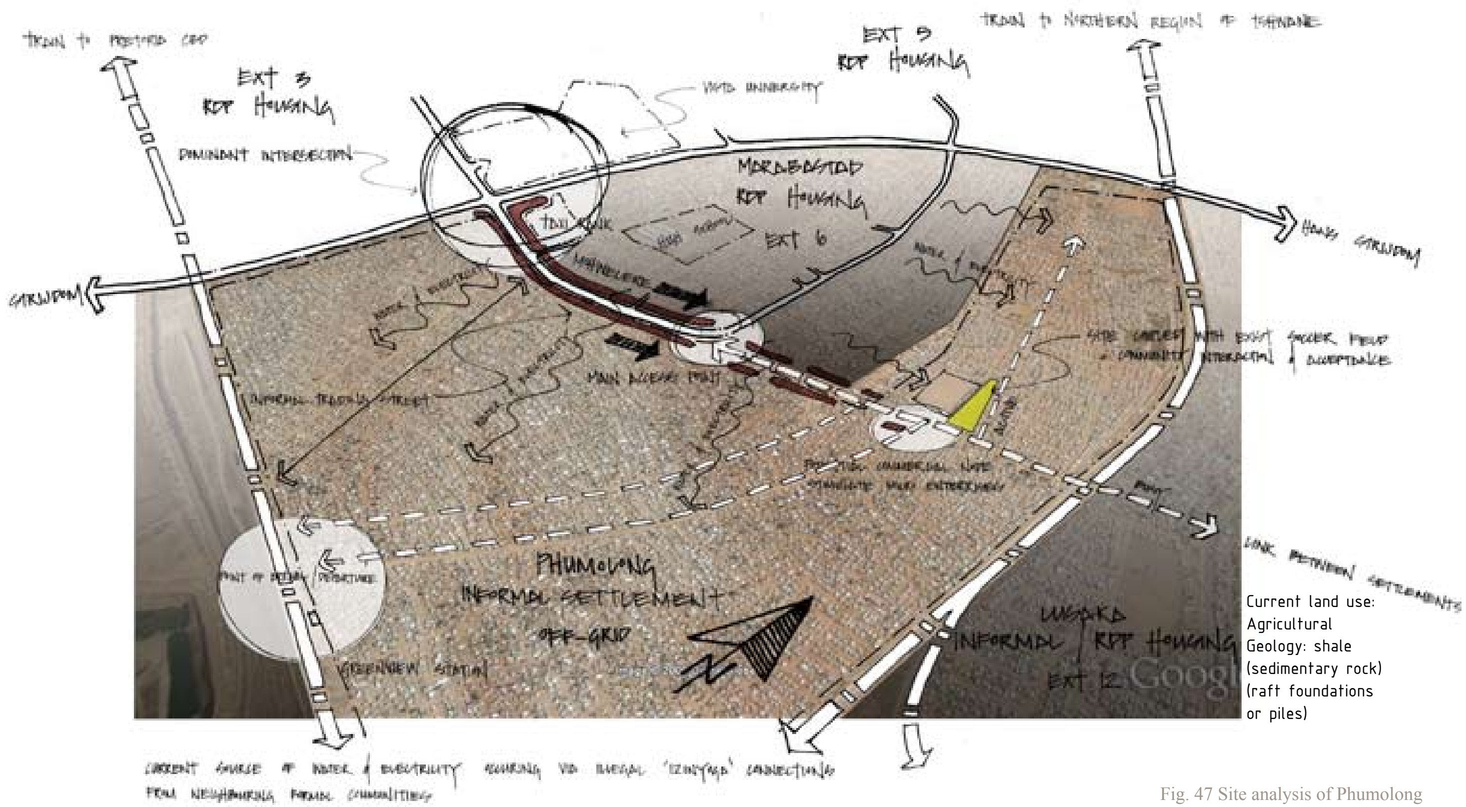


Fig. 47 Site analysis of Phumolong

- Infrastructure for informal settlements
- Housing
- Street lights
- Facilities at sports grounds
- Fire hydrants
- Crèche
- Communal play area
- Tree planting
- Opportunity for and stimulation of micro-enterprises

Supplementary needs identified during research and site investigation:

- Infrastructure:
  - Potable water
  - Sanitation (ablution facilities)
  - Lighting

ASSETS

- Highly traversed vehicular and pedestrian access route through the settlement. This presents a possible commercial route (this route offers the only alternative to the main roads of Hans Strijdom and Tsmaya Avenue crossing the railroad).
- Close proximity to the Greenview train station allows for easy access to public transport.
- Self-established and regulated community authority resulting in a relatively harmonious neighbourhood.
- The potential exists to use local labour.

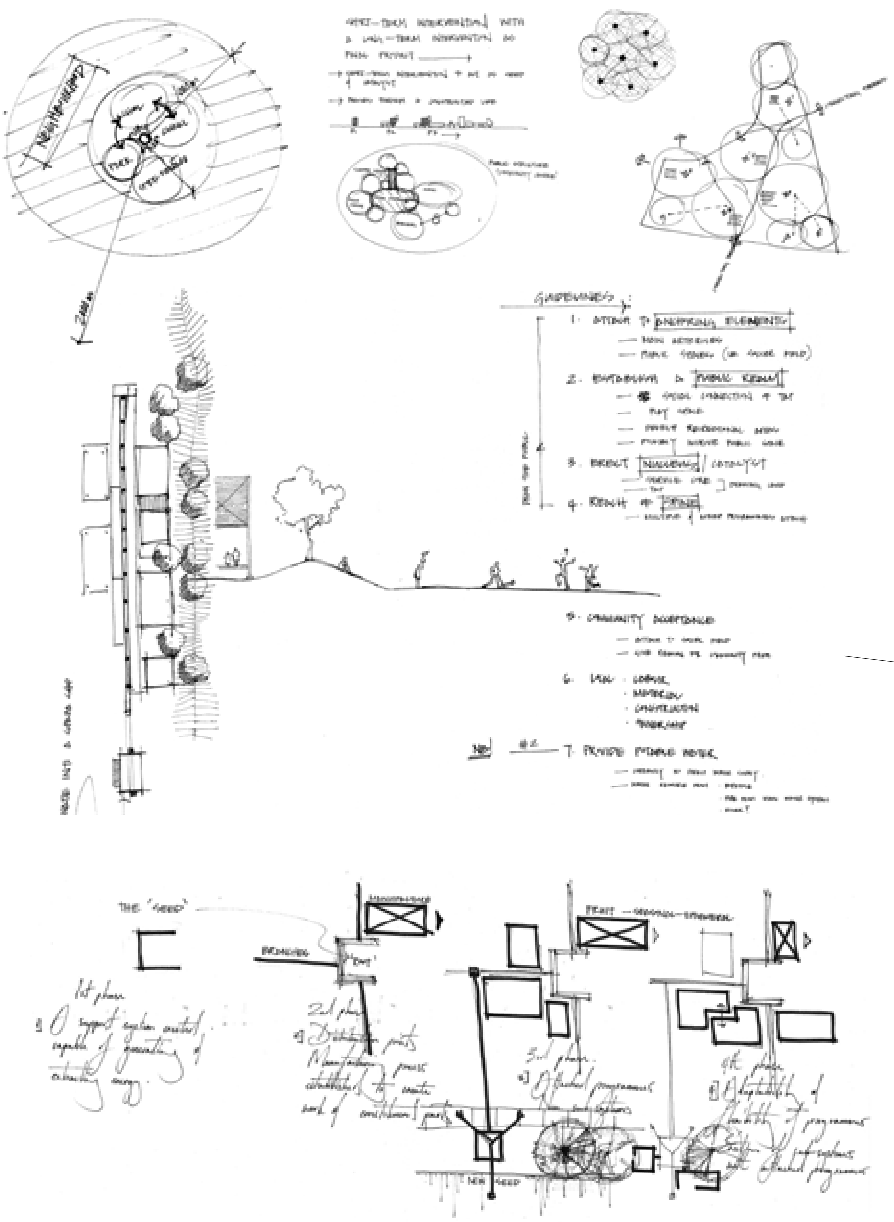


Fig. 48 Rural intervention strategies

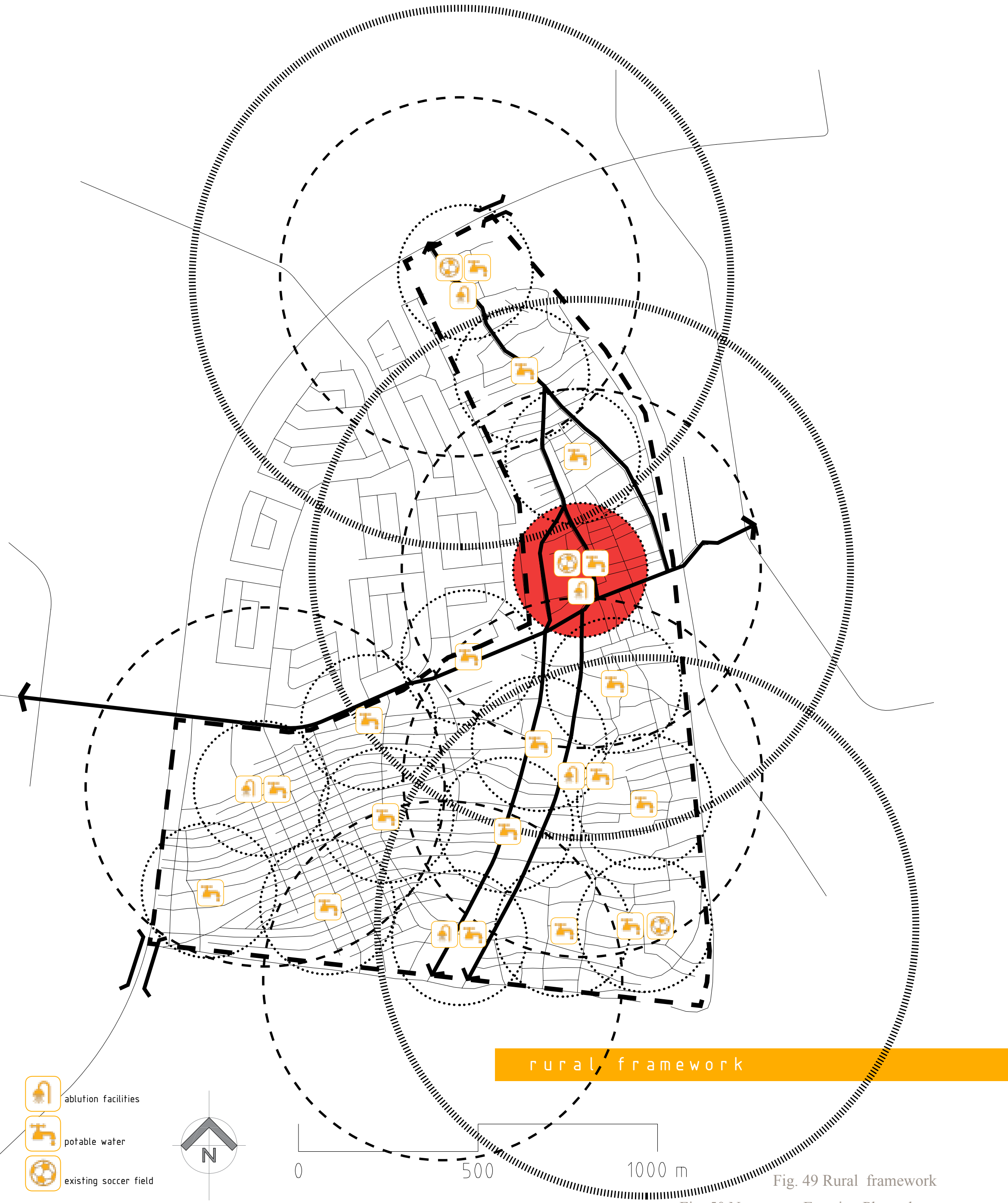


Fig. 49 Rural framework

Fig. 50 Next page: Entering Phumolong

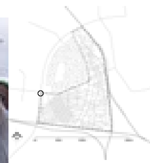
phumolong

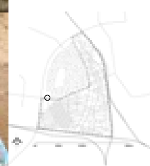
the visit

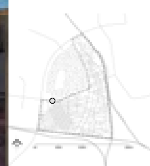
FIRST PERSON EXPERIENCE

“It’s about half past one and I’m in Mamelodi crossing the busy intersection of Hans Strijdom and Mohwelere Avenue. There are no robots, it makes for a scary experience in itself. I want to enter the squatter camp of Phumolong. It’s busy; people are arriving and departing in the various taxis. Coal, oranges, tyres, battery repairs and cooked food amongst others are being sold along the tarred road of Mohmelere Avenue. It’s too busy to take real cognisance of my environment. Time passes, it’s awkward. I need a friend. I buy a loose orange for R1, I don’t intend to eat it, it’s my ally, I need it with me so I don’t look alien…

Everything seems chaotic, maybe it’s because I’m not from here. I’ve been here before, but never to the actual site alongside the soccer field. I can’t find the route I used last time, or the lady who instructed a young girl to take me into the settlement to the comity leaders. I ask three men sitting outside a radio repair shop where the soccer field is. I’m directed. Looking for the first sign of a major access route into the settlement; all I see is a range of small narrow foot paths. I forgot the aerial photo in studio. I continue walking down the road alongside a network of small informal businesses. A Taxi hoots while driving up the road. The driver looks at me, I shift my focus to my orange.







A while has passed and I’m still searching for the entrance. The endless barrier of coloured and rusted steel on either side of the street restricts my vision to the numerous household shop fronts. I hear loud music in the distance.

It seems further than on the aerial map.

School must have just finished. There is loud screams and laughing behind and along side me. The homogeneously dressed children walk past. Some greet me verbally, some with a smile, some just stare at me. They know I’m not from here. I start juggling with my orange. It brings me some comfort. The asphalt changes to gravel. A bend in the road with a larger cluster of informal trading stands suggests I have entered the informal settlement. The road becomes narrower and more uneven. It is quieter now. The attempt at paving the street is reduced to pavers scattered approximately 1m from each other.

Fig. 51 - 56 The visit in and around Phumolong

I stop and ask a man selling sweets where the soccer field is. I'm directed straight. It's much denser than I imagined. Again, I hear loud music in the distance. The small shops and trading stands have almost disappeared. Vegetable gardens, fruit trees and discarded cars are dotted around the shacks on small irregularly shaped lots. Surprisingly I walk past a driving school, there's just uneven gravel roads…

…I'm deeper in than I expected, but I have my orange. I haven't seen any light masts or stand pipes, only shacks and pit latrines.

This area is in need of infrastructure.

Informal trading stands start appearing once again. Someone is selling a few sweets and self-packaged maize chips from a table. The people seem both innovative and resourceful.

I continue walking to the ever elusive soccer field with my trusted orange. The narrow road abruptly opens onto a gravel road, approximately 8 - 10 m wide. I recognise part of the Magaliesberg mountain range. Shacks hosting the neighbouring community of Lusaka creep half-way to the mountains' ridge. It seems far. The wider gravel road carries more vehicular and pedestrian traffic. I recognise this part on the aerial map; the site should be to my left. I try bending both space and time to see beyond the dense sea of shacks. I can't. I take a left road and pass a spaza shop, in anticipation. Suddenly the wind swept soccer field with the dirt pitch reveals itself. The wind moves a flag emblazoned with the Mamelodi Sundowns Football Club logo in the distance.

I have arrived.
It is beautiful.
It is nothing like I imagined it to be.

I eat my orange."

Fig. 57 - 60 The visit in and around Phumolong

04

Fig. 61 Lady washing clothes

Fig. 62 Next page: Informal trading stall

BRIEF DEVELOPMENT

The phased construction should be a direct result of the needs of the community. In a similar manner, this servant building should accommodate for change in its programme.

the user / client

PROJECT BRIEF

The project attempts to develop a design intervention improving service delivery whilst addressing the well-being within the informal settlement of Phumolong, Mamelodi, South Africa. The scheme should act as catalyst for social growth. In addition the design should respond to the needs of the individuals as well as that of the community.

Design should function as a generator, promoting the following:

- Provide an ordering structure within the urban fabric
- Establish as connector between built fabric and the societal life
- Facilitate improved infrastructure and services
- Resulting in improved social relations and general well-being of individuals
- Establishing community pride through participation
- Defining public space within an area lacking civic buildings.

PROBLEM STATEMENT

The lack of public amenities and services within informal settlements should be addressed with appropriate design intervention.

RESEARCH AIMS AND OBJECTIVES

- Investigate the relationship of form and programme
- Achieve a higher level of independency from off-site energy sources
- Design of energy inclusive systems
- Investigate infrastructural typology that allows for an adaptable, flexible and plug-in system.

PROJECT AIMS AND OBJECTIVES

- Establish a civic presence within the informal sector
- Provide certain services and infrastructure
- Resulting in a building that serves as a symbol of renewed hope and support.

DESIGN PROPOSAL

The design intervention within the informal settlement of Phumolong should serve as a core that provides various services. The intervention should be capable of expanding according to future needs, allowing for new and changing programmes. The intervention is a public services building defining public space.

USER

- Community
- Business owner
- Informal dweller

Fig. 63 The possible user as identified during the numerous site visits

CLIENT[S]

A number of relevant government departments could act as client. These include the Department of Housing, Department of Energy and the Department of Rural Development and Land Reform amongst others. They will be responsible for the ongoing phase expansion of the project through the relevant service department. It is likely that more than one service department will occupy the complex.

Typical services that could be offered are healthcare, educational facilities, post office, grant application and associated payouts as well as the Municipal service delivery departments. The extent of the programme will depend largely on the needs of the community.

Other activities associated with small, medium and micro-enterprises could be attached to the servant spine. It is envisioned that they will be responsible for their own building construction at a nominal rent for a certain lease period. These activities will further influence the growth pattern of the servant spine.

The opportunity for advertisement or branding attached to the building structure exists. This may generate further capital income and could be utilised for maintenance and systems growth. In addition material sponsorship could be sought through active campaigning to certain manufacturers and suppliers.

Sven Lunsche, the spokesperson for Arcelor Mittal issued the following press statement on 27 February 2009 in the online newspaper, Engineering News:
"Steel giant ArcelorMittal has partnered with the South African Department of Education to build ten schools throughout the country using new steel technology. Mamelodi Primary School, in Tshwane, is scheduled for completion at the end of the year…
Mamelodi Primary School will be built using insulated panels technology, which relies on steel as a building material. It can withstand extreme weather conditions, is fire resistant and quicker to erect than when using conventional building technologies...
The total value of the programme is estimated at R250-million, with Mamelodi Primary projected to cost R39-million. The schools will be built using steel supplied by ArcelorMittal… The investment in skills ensures that the company has a pool of skilled resources for its operations and contributes towards resolving the skills shortage in the country as a whole." (Shirley, 2009: [sp])

the client

human settlements
Department:
Human Settlements
REPUBLIC OF SOUTH AFRICA

rural development & land reform
Department:
Rural Development & Land Reform
REPUBLIC OF SOUTH AFRICA

Fig. 64 Possible clients

05

Fig. 65 Services

SERVICES

Making place for the informal dweller and the services of a building.

The proposal for a servant building originates from the needs of the displaced dweller and the obligation of a Government towards service delivery.

services:

immediate provision at core

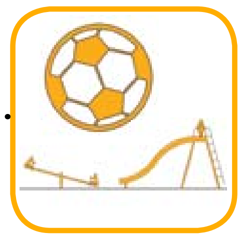
passive surveillance
as by-product

potable water
- performs as catalyst stimulating the growth of infrastructure and social activities.

washing
- social catalyst

fire store
- providing in community need

telecommunications
- social catalyst



recreation
- a relationship between servant core and existing (soccer field or alternative) space with public function. A symbiotic relationship will be established between new function and the original destination.

SERVANT CORE

The servant core as a design intervention exists as a process. A phased upgrading is envisioned introducing additional services at later stages of the project. The first stage is to initiate the catalyst whilst the modular steel units extend through later phases defining the spine[s]. Additional public amenities programmes may be accommodated through the servant spine. Any part of the programme may be detached when rendered obsolete.

The original design intervention initiated a servant core in the form of a water reservoir tower. The tower should serve as a catalyst stimulating new activities (both built and social).

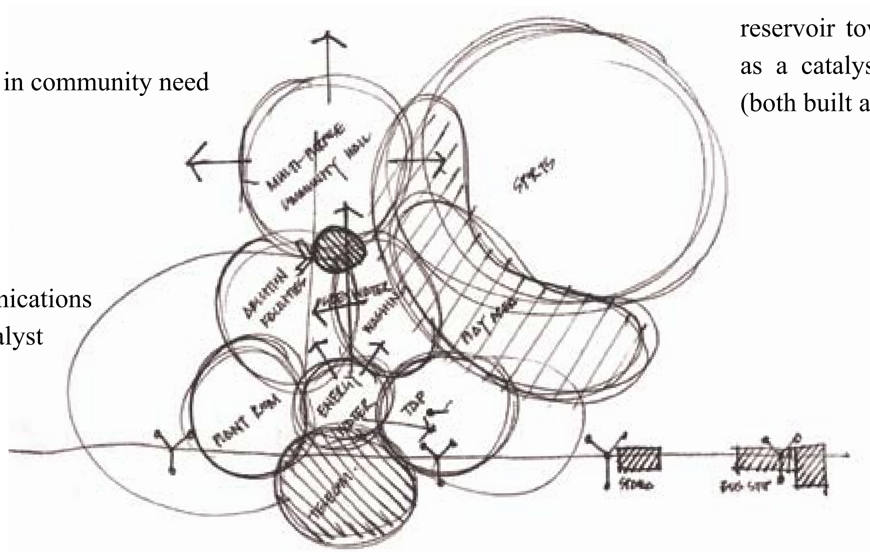
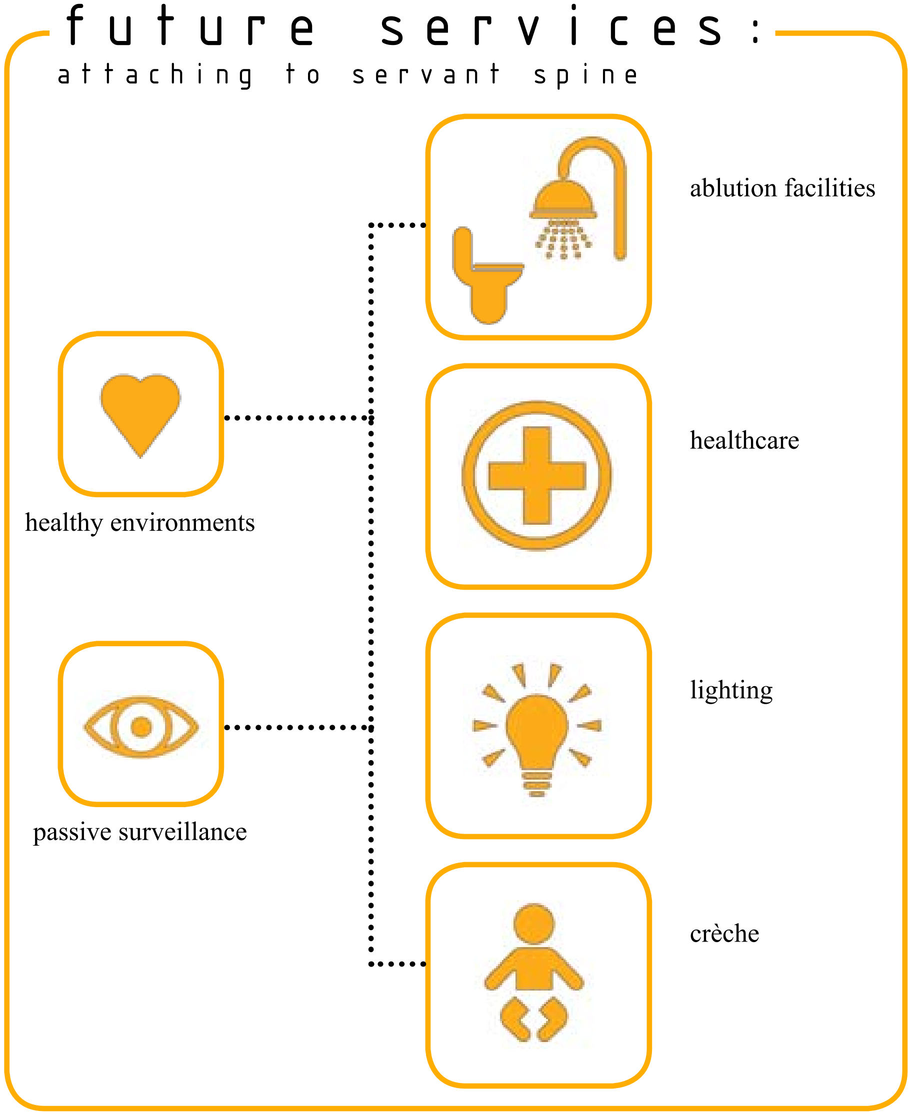
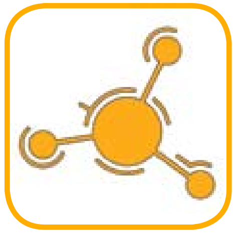


Fig. 66 Illustration of services provided at core





SERVANT SPINE

An adaptable structure should allow for reuse of the structure and its servant spine. A change in building programme or the introduction of a complete new programme should be facilitated to accommodate a future function and user.

Fig. 67 Illustration depicting future service to be attached along servant spine

06

Fig. 68 Ecoboulevard Vallecas, Madrid, Spain, 2005

PRECEDENT STUDIES

A precedent should be studied to stimulate the designer, whilst informing the design process.

Ecoboulevard Vallecas


Fig. 69


Fig. 70


Fig. 71


Fig. 72


Fig. 73

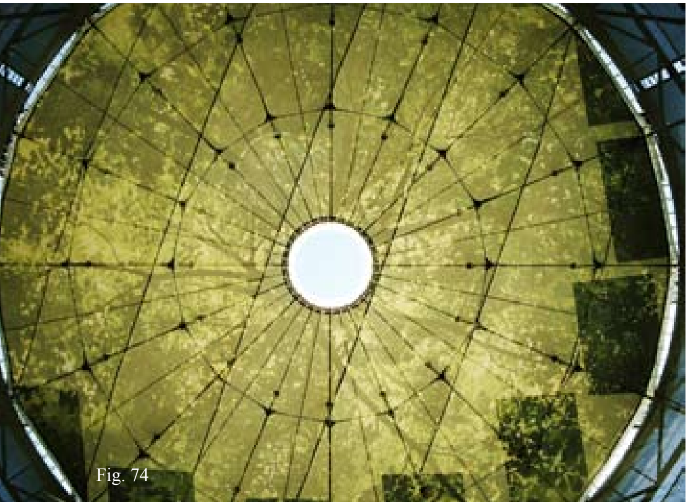
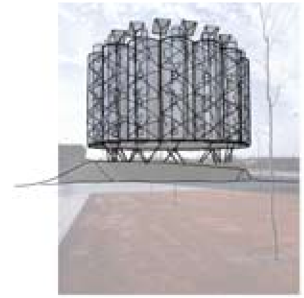


Fig. 74

Architects: Ecosistema Urbano: Belinda Tato, Jose Luis Vallejo, Diego García-Setién
Location: Pau de Vallecas, Vial C-91, Madrid, Spain
Client: Land and Housing Municipal Company, Madrid Council, Directorate of Residential Projects Innovation
Year: Phase I 2004-2005, Phase II 2006-2007
Structure: Tectum Ingeniería, S.L. (Constantino Hurtado)
Services: IP Ingeniería
Botany: Ignacio López

Fig. 75


Fig. 76



ECOBOULEVARD VALLECAS, ECOSISTEMA URBANO, MADRID, SPAIN, 2005

Problem statement: Lack of green public space in an urban desert.
Aim: The project attempts to plant a 'seed' for public space achieving regeneration through a series of stages. Within these stages 'air trees' are erected as multifunctional public spaces. The conservatory allows the urban dweller to interact with tree saplings. The saplings are nurtured to maturity to be introduced into the surrounding landscape.
Outcome: The project provides a much needed green social gathering space. It establishes a sense of community. Furthermore, it offers amelioration to its direct area and the urban fabric. The resource efficient design makes use of passive systems to perform as wind catcher and water atomizer to create a desirable microclimate. The urban intervention seeks to screen the harsh climatic conditions, yet it uses these forces to create a life supporting environment. The air trees provide a space that can be reprogrammed and even disassembled. It defines a "place for people whose shape is defined by the very activity developed in it at a given time" (Archdaily, 2008: [sp]). The temporary intervention leaves behind a green residue and may be disassembled once the trees have been planted, to be re-erected on another site.

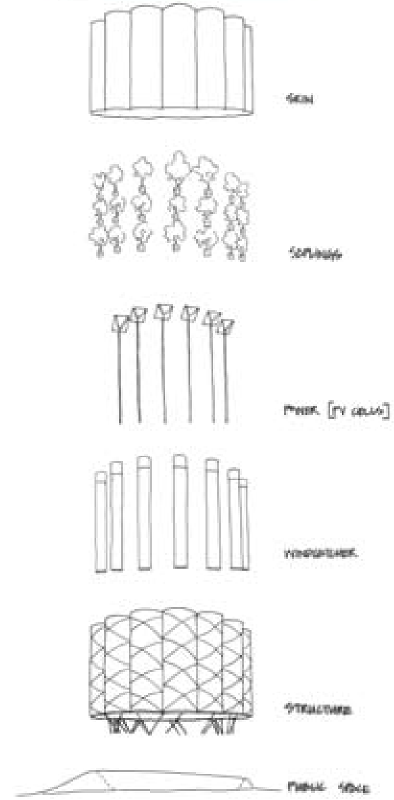


Fig. 77 Illustration of components

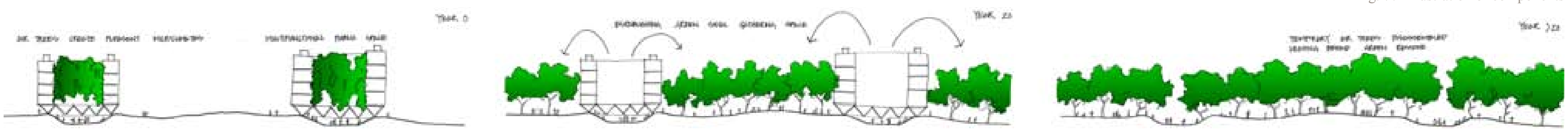


Fig. 78 Illustration of process

Sainsbury Centre for Visual Arts

Fig. 80

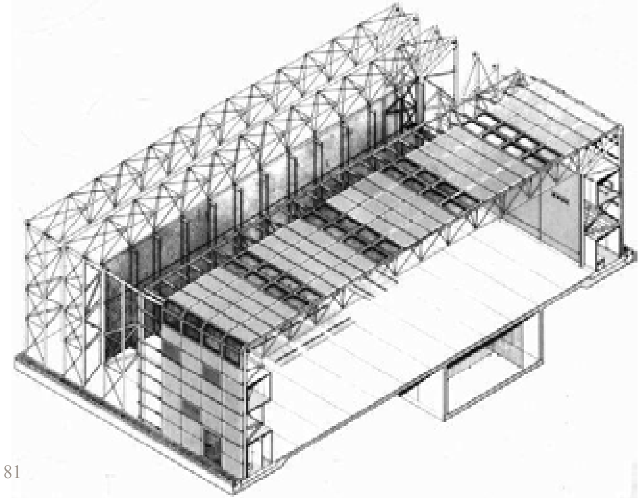


Fig. 81

Architects: Norman Foster
Location: Norwich, UK
Client: University of East Anglia
Structure: Steel space frame with modular glass and aluminium panels
Year: 1977

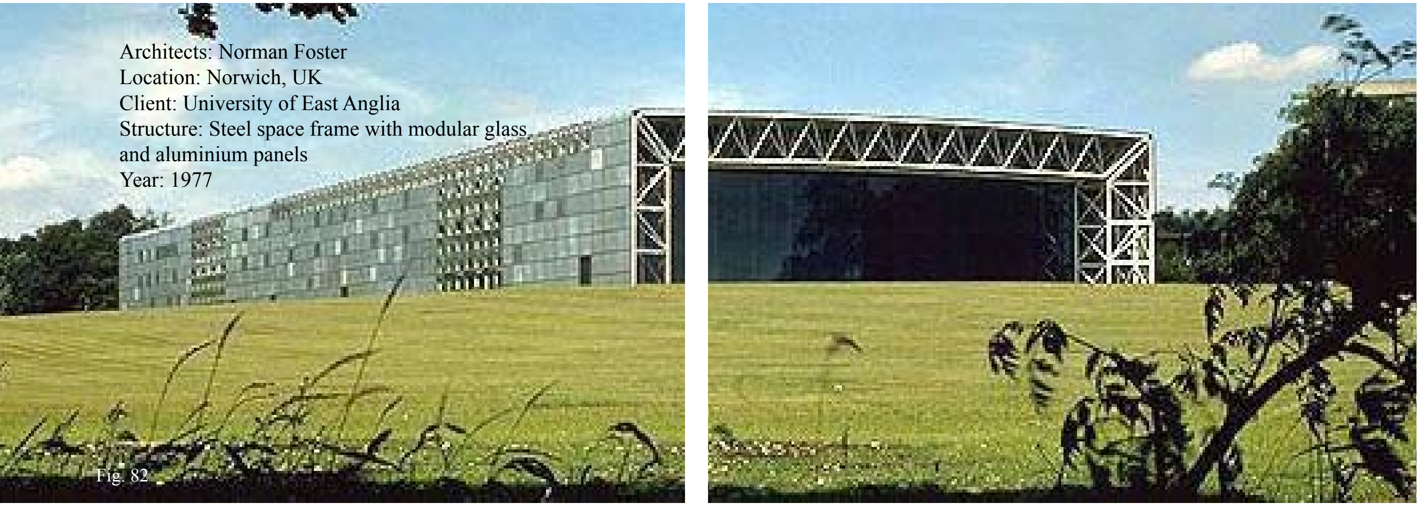
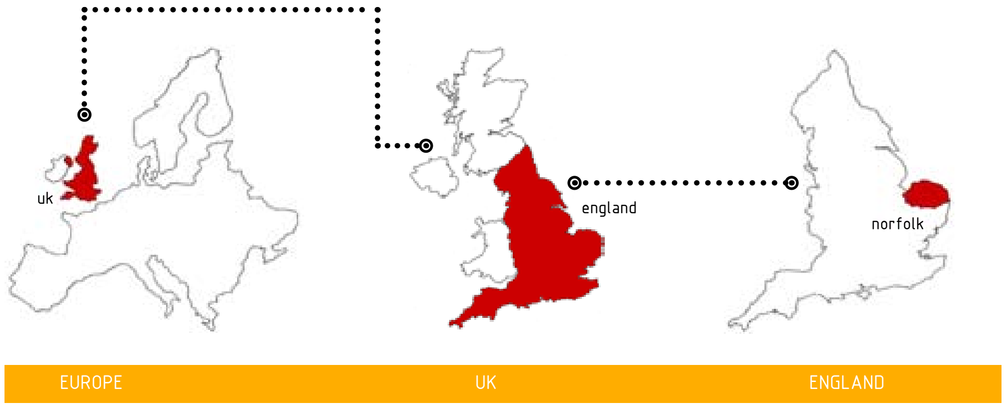


Fig. 82

Fig. 83

Fig. 84



SAINSBURY CENTRE FOR VISUAL ARTS, NORMAN FOSTER, NORWICH, UK, 1977

Problem Statement: The need for exhibition space.
Aim: To design a reprogrammable served space separated by an internal building skin from the space hosting an internal service core.
Outcome: The Sainsbury Centre for Arts was designed as an extendible public art shed. Its structure is capable of accommodating future expansion and adaptability in programme. The interchangeable white walls and roof of the external building envelope relate as one form. However, both planes are composed of modular panels enclosing an extensive steel space frame replicated along its length offering opportunity for linear extension. Internal public and private space is infused with one another while remaining discernible. It maintains a high degree of adaptability in programme and flexibility in space utility. Sir Norman Foster conceived the design by means of an integrated systems approach "based on the integration of structure and services and the swift assembly of prefabricated components" (Best, 1984: [sp]). The services, life support, are accommodated within the space frames and are concealed by the modular external and internal panels. The external building envelope protects the contents from the elements, whilst the internal envelope houses the programme.

The serviced shed can be described as: "a minimal, industrialized building type with an envelope that provides maximum internal volume, while support systems and functions are localised, usually within the cavities of lightweight lattice steel walls, floors and ceilings" (Porter, 2005: [sp]).

Best offers a more simplistic view of the serviced shed: "A lightweight kit of parts tuned to respond to growth and change" (Best, 1984: [sp]).

Possible shortcomings: Although the panels are modular and therefore exchangeable, they are custom made. Additions to the structure without intervening with the structural steel trusses are only possible in a linear direction.

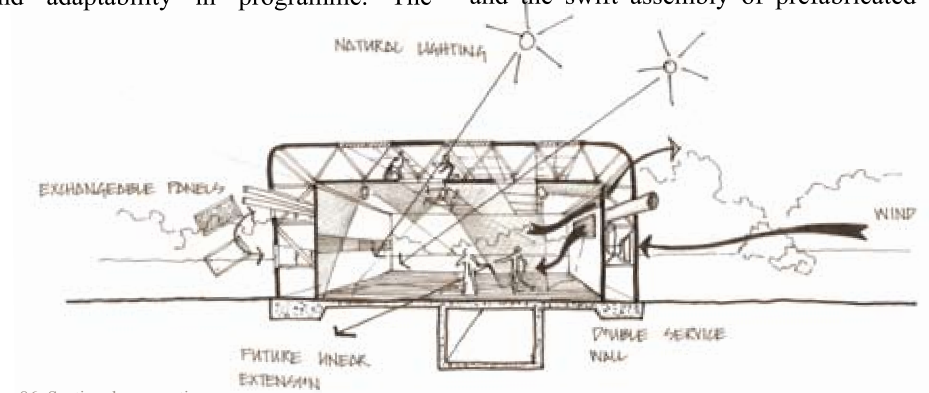


Fig. 86 Sectional perspective

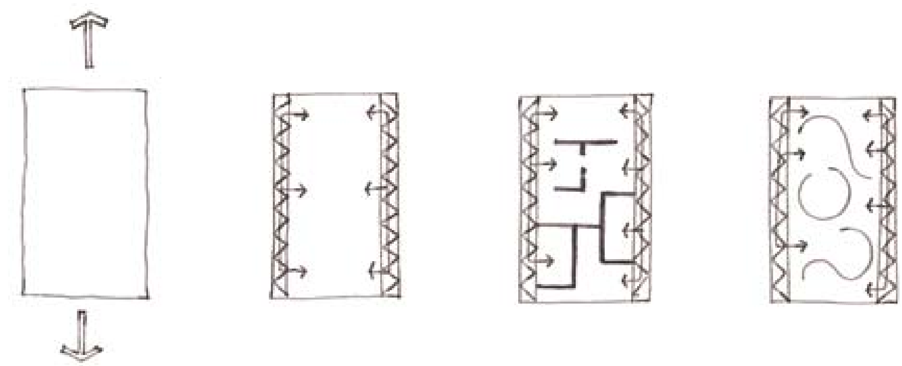


Fig. 87 Open plan allowing for extendable and adaptable exhibition space

07

Fig. 88 Shack

Fig. 89 Next page: Brickyard

BUILDING TECHNOLOGIES

Appropriate technology within an informal settlement may present itself as current existing technologies, skills and materials used within the environment. It may also be new technologies which could be transferred to the communities informing future development.

The following materials and their building technologies are believed to be appropriate technologies for the first phase of the project.


Fig. 90


Fig. 91


Fig. 92


Fig. 93

90 Dislocated timber pallets to
be used in structural framework
91 Brickyard in Mamelodi
92 Concrete blocks.
93 Timber frame construction
94 Concrete block house
construction
95 Zozo hut panel
96 Zozo hut panels being sold


Fig. 94


Fig. 95


Fig. 96

existing building technologies

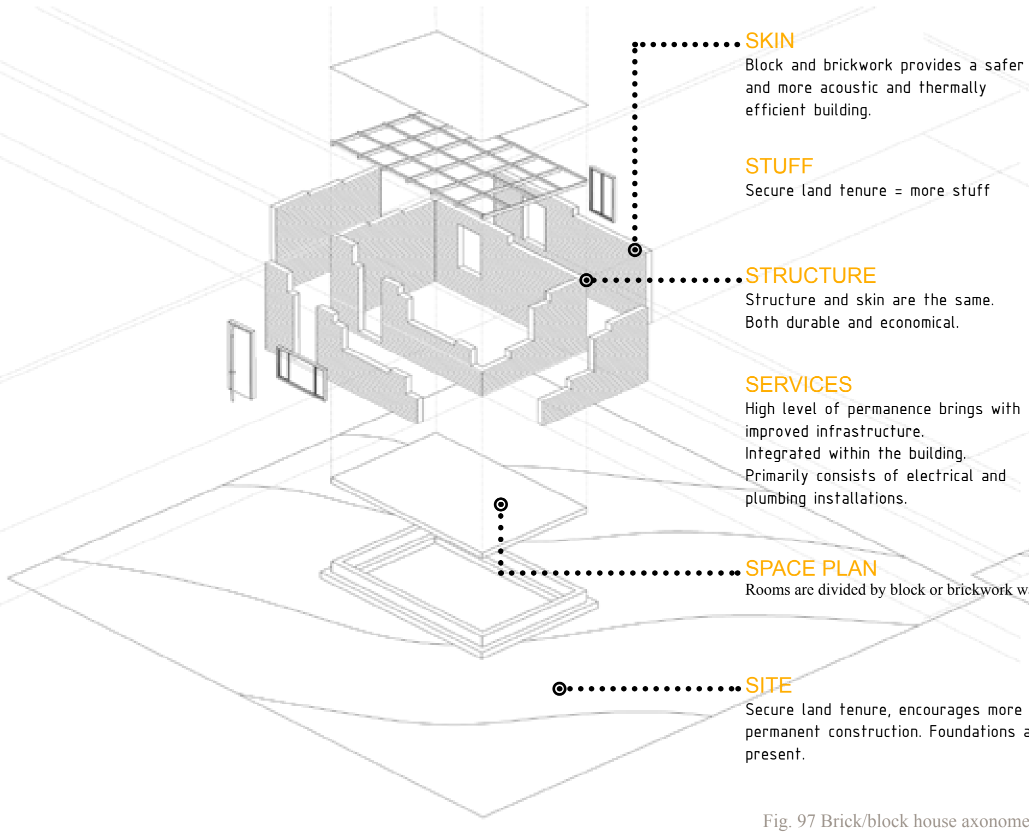


Fig. 97 Brick/block house axonometric

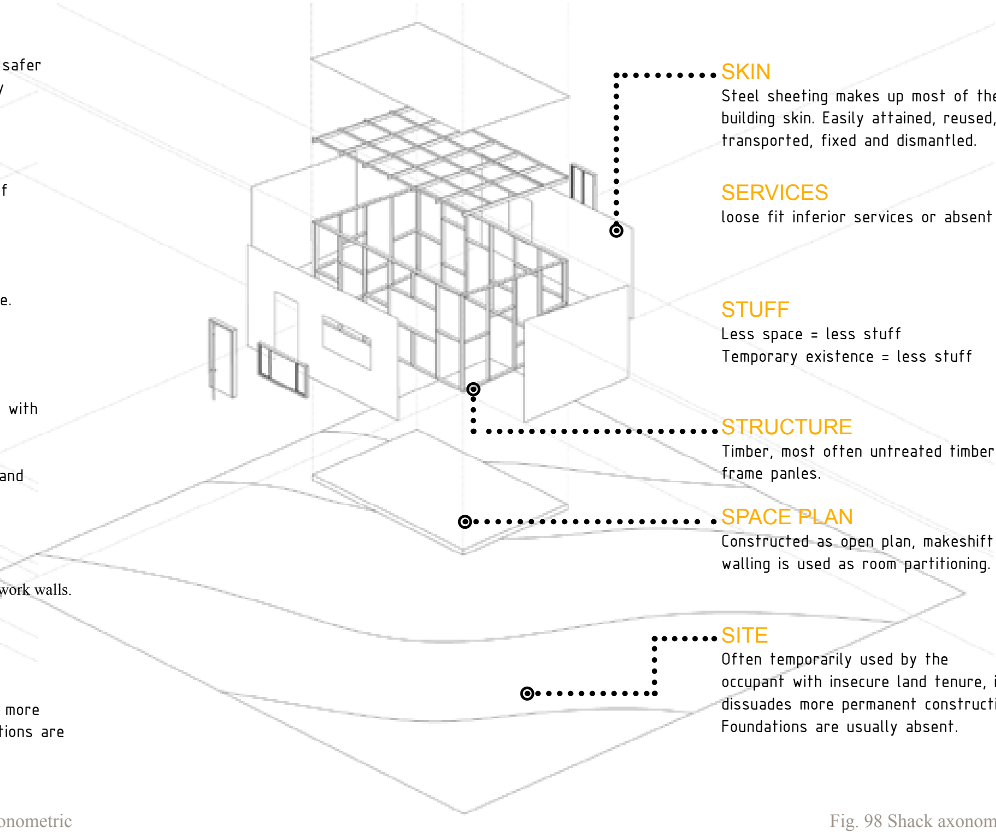


Fig. 98 Shack axonometric

THE BLOCK OR BRICKWORK HOUSE

This stereotomic building system is primarily used in the construction of government subsidised housing within the area of Mamelodi. Wet works construction typically represents a more permanent and thus settled solution to housing. It is widely used for additions and alterations by land owners in the more established wards.

THE SHACK

This tectonic construction method usually comprises of a timber or steel framed structure and cladding with steel sheeting. It provides in the essentials of architecture; enclosure and protection of man and his/her possessions. The system is quick to assemble and widely practiced by the informal community. The Zozo Hut, is constructed in a similar fashion and has established itself amongst the informal business enterprises. It is commonly erected on stands by the occupier and used as a rentable outbuilding. This system is perceived as a temporary solution and it has ability to be relocated with the user. The informal community places high premium on the ownership of building material.

Fig. 99


Fig. 100


Fig. 101


Fig. 102


Fig. 103


Fig. 104


Fig. 105


Fig. 106


Fig. 107

99-100 Finnbuilder construction
101 Abeco water tanks
102 Hydraform wall
103 Downhole drilling rig
104 Mobile Hydraform block making machine
105 Cold-formed steel truss
106 Fasteners
107-108 Hydraform wall
109 Brownbuilt cladding
110 Long span cold-formed steel truss
111 Abeco water tanks

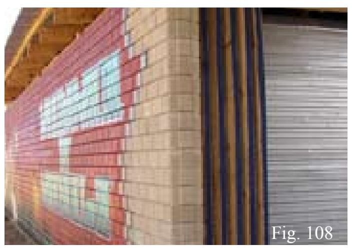


Fig. 108


Fig. 109


Fig. 110


Fig. 111

CRITERIA FOR MATERIAL CHOICE

- Ease of transport
- On-site assembly using local labour
- Self-informing assembly method by unskilled labour
- Labour intensive
- Piece assembly and construction
- On-site assembly and erection
- Skills transfer
- Low skills operation
- Economically viable
- Little or no heavy machinery to be used (due to remoteness of sites)
- Majority of work to be done by manual labour (limited electrical supply)
- No welding
- Steel fixed with nut and bolt assembly
- Ability to reuse the material upon disassembly, relocation or manipulation of the structure

MATERIALS

LIGHTWEIGHT COLD-FORMED STEEL:

Cold-formed steel sections are formed from steel sheet, flat bars, plates or strip in roll-forming machines, by press-brake or bending brake operations. Thickness of structural members vary from 0,4 mm to 6,4 mm. Thicknesses of 25 mm are capable of being formed (Wei-Wen Yu, 1985: 2).

Main advantages:

- Lightweight
- High strength-to-weight ratio
- High stiffness
- Various shapes and sections can be formed
- Allows for additions and alterations
- Minimal wastage
- Ability to erect structure in piece assembly allowing for transport of components to remote sites
- Little or no heavy machinery is needed on site

In the publication *Cold-formed Steel Design*, the author Wei-Wen Yu lists the following additional advantages:
(Wei-Wen Yu, 1985: 2)

- Nestable sections can be produced, allowing for compact packaging (and transport)
- Ease of prefabrication and mass production
- Fast and easy erection and installation
- Substantial elimination of delays due to weather
- More accurate detailing
- Nonshrinking and noncreeping at ambient temperatures
- Uniform quality
- Non-combustibility

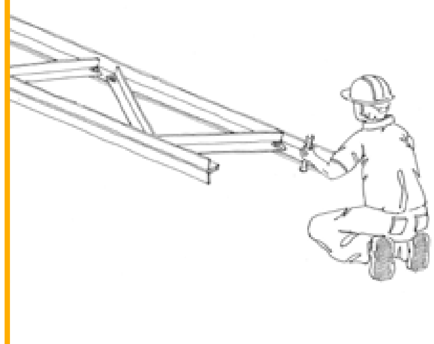


Fig. 112 Nut and bolt piece assembly of steel structure

HYDRAFORM DRY-STACKING BLOCKS:

Nut and bolt piece assembly of steel structure

Hydraform dry-stacking blocks are ideal for remote regions as they are produced on-site by means of a mobile or stationary block-making machine. The interlocking dry-stacking blocks require minimal mortar and are produced from Laterite (building sand/sub soil) and 5-10% cement. Hydraform uses soil cement Compressed Earth Block (CEB) technology. Blocks do not need to be burnt and need a minimum of 7 days curing. Hydraform equipment is made locally and the franchise provides full training and support. Block dimensions comprise 120-240mm long x 220 or 140mm wide x 115mm high. Typical strength values of 4-7MPa are achievable.

Main advantages:

- Mobile block making machines
- Blocks produced on-site
- Low-skilled operation with little or no dependence on higher skills
- Labour intensive with almost all of the production and construction process occurring on-site
- Cost-effective, fast to use and ideal for remote rural areas

Fig. 113 Hydraform interlocking dry-stacking concrete blocks

FINNBUILDER BUILDING TECHNOLOGIES:

Finnbuilder is a slip form shuttering system whereby a hand operated shuttering mechanism is filled with the necessary cement, sand and aggregate mix. Upon compaction the shuttering is slid to the next area along the length or height of the wall/column. Finnbuilder box shuttering dimensions are 480 mm (length) x 220, 150 or 110 mm (wall thickness) x 240 mm high and allow for straight as well as circular walls.

Main advantages:

- Produced on site
- Labour-intensive
- On-site soil may be used
- Low skills necessary
- Skills transfer
- Low cost - high strength

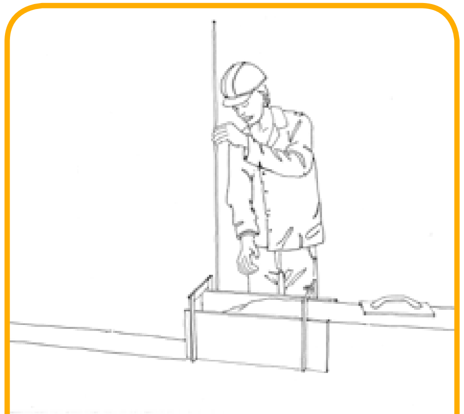


Fig. 114 Finnbuilder slip form shuttering system

BROWNBUILT PROFILE 406 mm:

Brownbuilt is used as roofing or cladding material. The interlocking profile together with its clip-fixing require no fixing holes for screws or nails, thus eliminating the damage incurred to the sheeting by such holes. Produced in widths of 406 mm the lengths are specified by client and only limited by transport (usually 18,6 m).

Main advantages:

- Sheeting may be reused
- No damage incurred by fixing holes
- It can be used in conjunction with other sheeting profiles by using the relevant flashings
- Easy construction

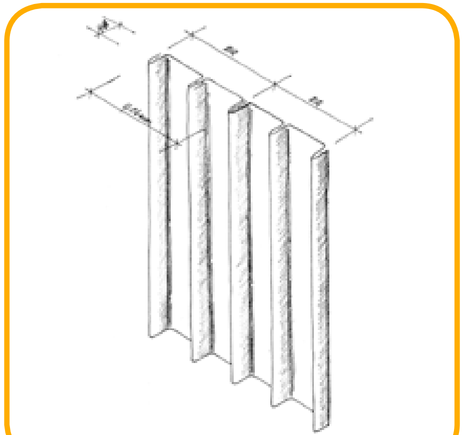


Fig. 115 Brownbuilt profile 406 mm

BROWNBUILT THERMACLAD “25”:

Prefabricated, insulated, interlocking leak-free roofing panels with integral ceiling boards.
Outer skin: brownbuilt profile 406 mm 0,58 mm thick galvanised Z275 steel sheeting with a Globalcoat™ finish to one side.
Insulating core: low-smoke emitting, self-extinguishing foamed polyisocyanurate 40 mm thick (U value 0,44w/m²°C)
Ceiling boards: masonite standard presswood 3,2 mm thick or Chromaprep.

Main advantages:

- Compatible with brownbuilt profile 406 mm sheeting and brownbuilt fixing clips
- No damage incurred by fixing holes
- Reusable.

ABECO TANKS:

Abeco lightweight pressed steel tanks are composed of prefabricated modular panels. These panels are used to erect tanks for water storage and are ideal for remote areas where access is limited and their small modular size and robustness allow for easy access and undemanding transport. Panel sizes are 1220 mm x 1220 mm or 610 mm x 1220 mm half panels produced in 3 mm 4.5 mm and 6 mm thicknesses. Max depth restricted to 4 panels (4880 mm). Hot dip galvanising aids is corrosion resistance. Panels can be painted on.

Main advantages:

- Lightweight
- Ease of transport to site
- Erected by manual labour
- Quick and easy to install

FASTENERS:

Only 3 types of fasteners, all 8 mm in diameter, are to be used on the steel structure reducing the need for a variety of fasteners and chances of error. The limited spectrum of fasteners aims to save time and ease of assembly.

1] M8 NUT + BOLT:

8 mm dia hot-dipped galvanised, high tensile grade nut and bolt.

2] GUARD-NUT TAMPER-PROOF FASTENING SYSTEM:

Tamper proof nuts and bolts such as the Guard-Nut tamper-proof fastening system may be used to prevent vandalism and theft. Guard-Nut fasteners require no special tools on installation. It is produced with conventional hex head and conforms the relevant ISO standards.

The SERIES 76 Guard nut and bolt is a high security bolt/screw with tamper evident protective free turning sleeve. The uniquely shaped head accurately controls torque. It is surrounded by a patented, free turning protective sleeve (tapered sleeve optional, non-removable) It may be removed with a special removal tool. A further option is a highly visible red plastic security seal sleeve as well as locking additives on threads

3] 8 mm DIAMETER GALVANISED GUTTER BOLT

The gutter bolt is to be used for fixing non-structural

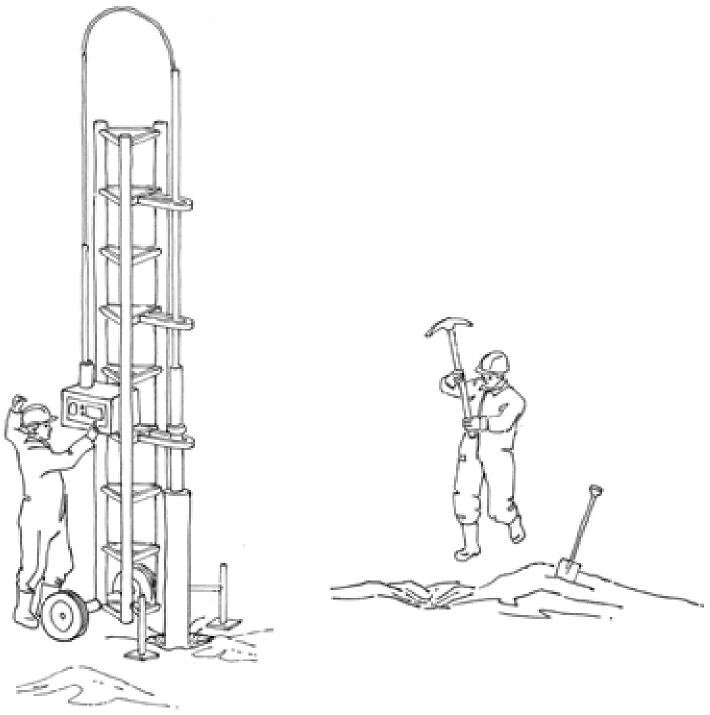


Fig. 117 Downhole drilling rig used to drill boreholes or alternatively for reinforced concrete piles

Fig. 116 Borehole/downhole drilling rig

08

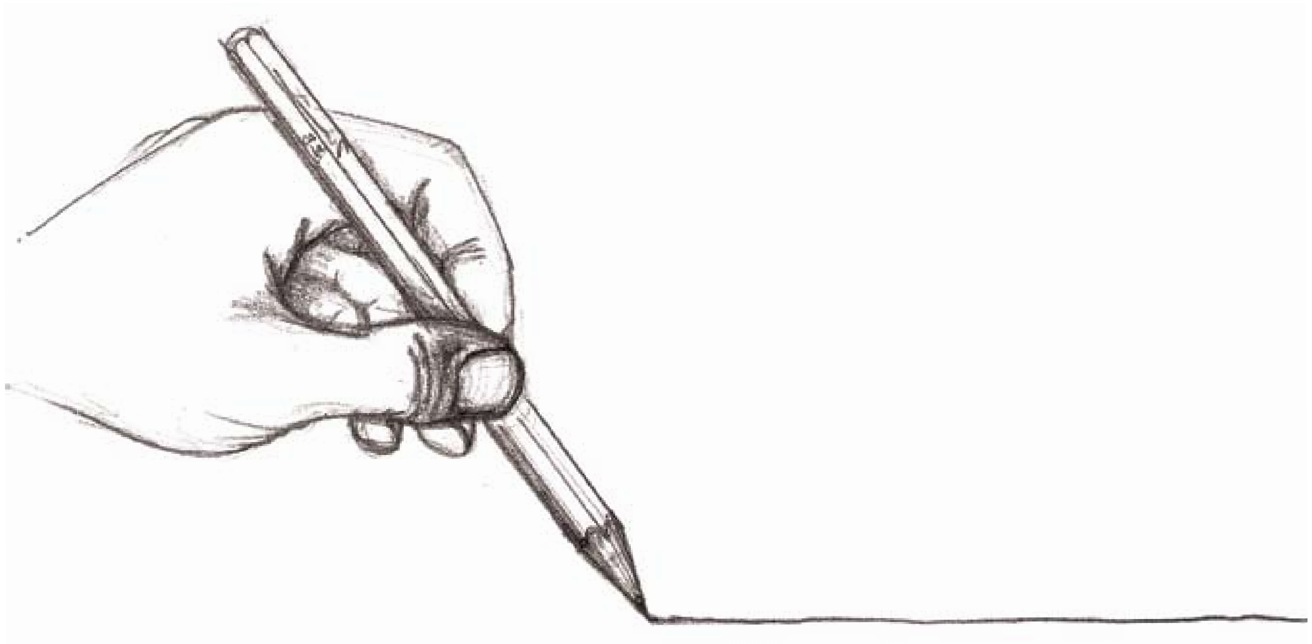
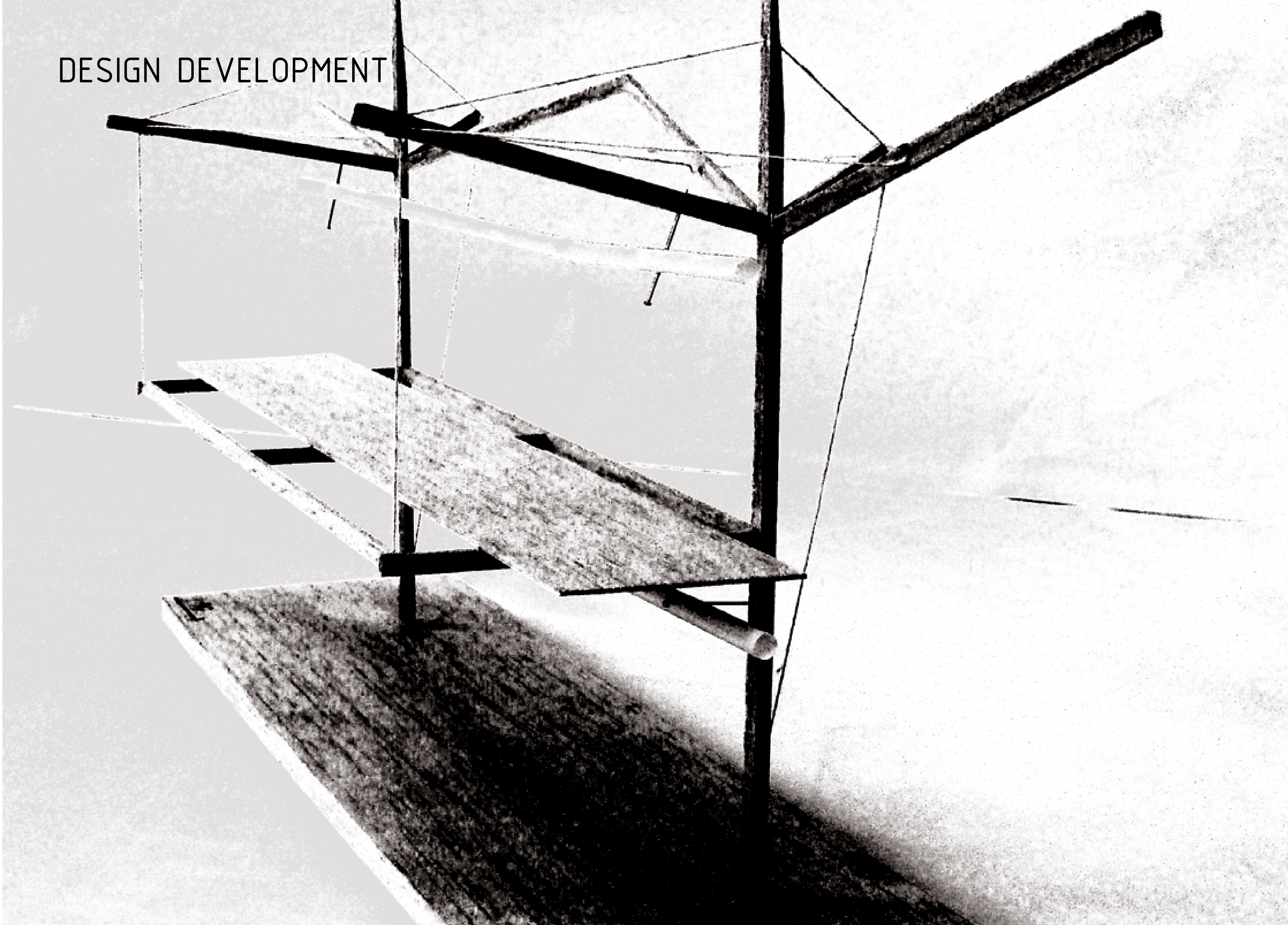


Fig. 118 The line

Fig. 119 Tensile model

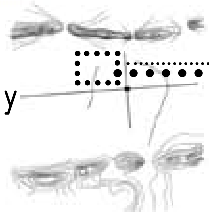
DESIGN DEVELOPMENT



JOURNEY TO THE (SERVANT) CORE
PUBLIC SERVICES AND AMENITIES BUILDING

The author originally formed part of the urban design framework UDoA, Urban Dictionary of Africa, in the North West quadrant of Pretoria city. However, it was argued that an informal settlement presented a more relevant problem.

p r e t o r i a   c i t y

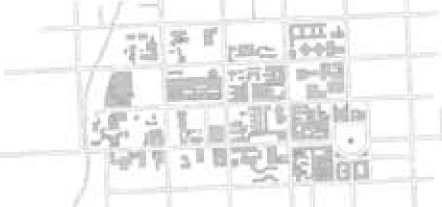


identify the hurt of the South African city
NW quadrant of the urbs quadrata

past

1947 city fabric

present



current shubart park precinct

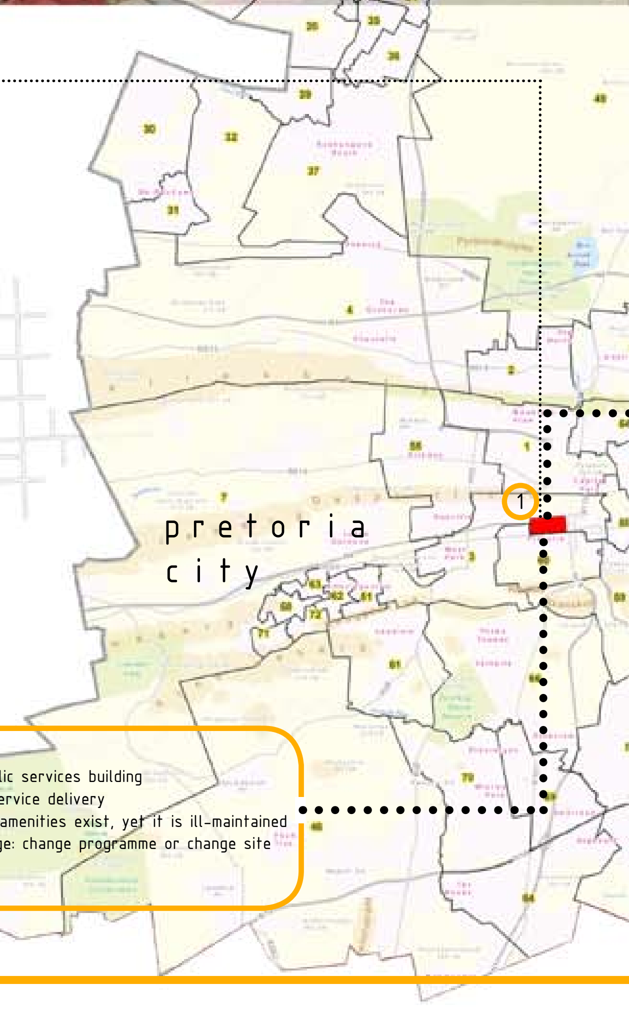
future

proposed new urban framework

a changing city fabric

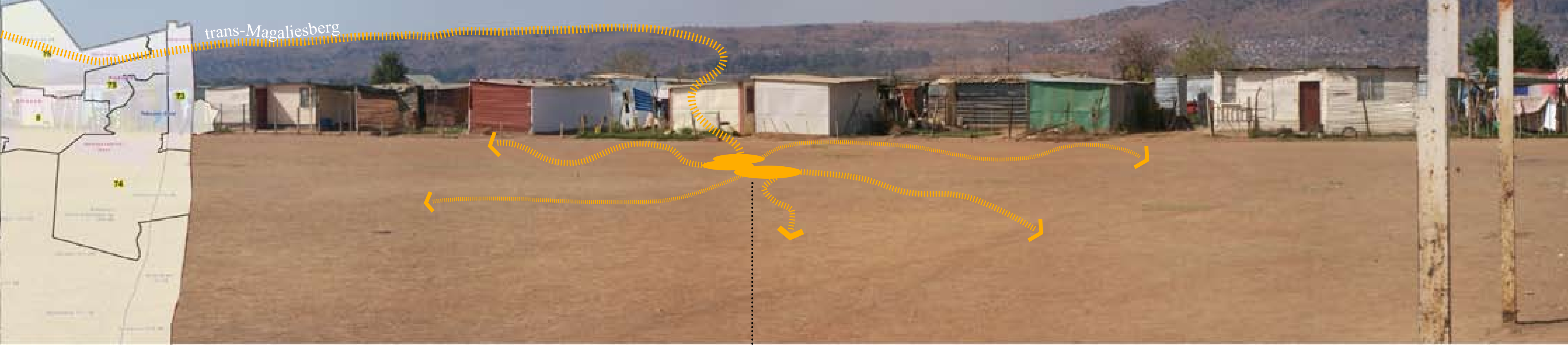
u r b a n   d e s i g n   d i c t i o n a r y
o f   a f r i c a   (U D o A)

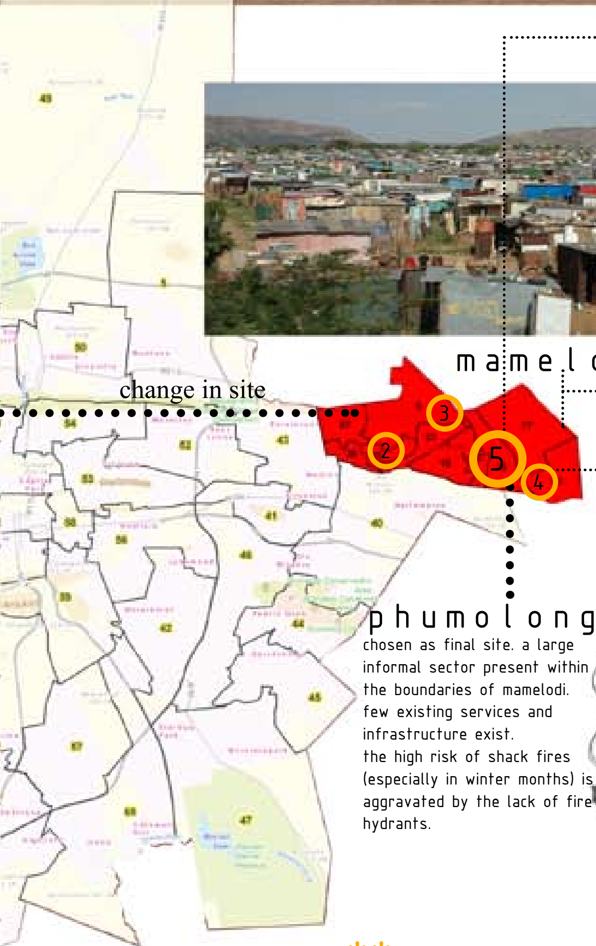
aim: regenerating urban existence and reactivating urban activity through improved infrastructure and public amenities.



programme: public services building
aim: improved service delivery
problem: public amenities exist, yet it is ill-maintained
2 options emerge: change programme or change site

Fig. 120 Journey to the core, an exploration of the theme
Fig. 121 * Shack fire
Fig. 122 ** Map of Tshwane





change in site

m a m e l o d i

l u s a k a

undergoing new housing and infrastructure development.

p h u m o l o n g

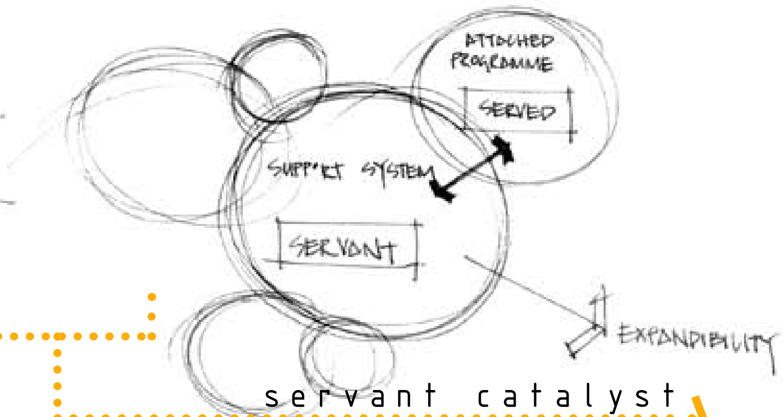
chosen as final site. a large informal sector present within the boundaries of mamelodi. few existing services and infrastructure exist.
the high risk of shack fires (especially in winter months) is aggravated by the lack of fire hydrants.

possible programme, need for a fire station?

*

a c c e s s   t o   w a t e r . . .

a pressing need is access to fire hydrants within the informal settlements



s e r v a n t   c a t a l y s t

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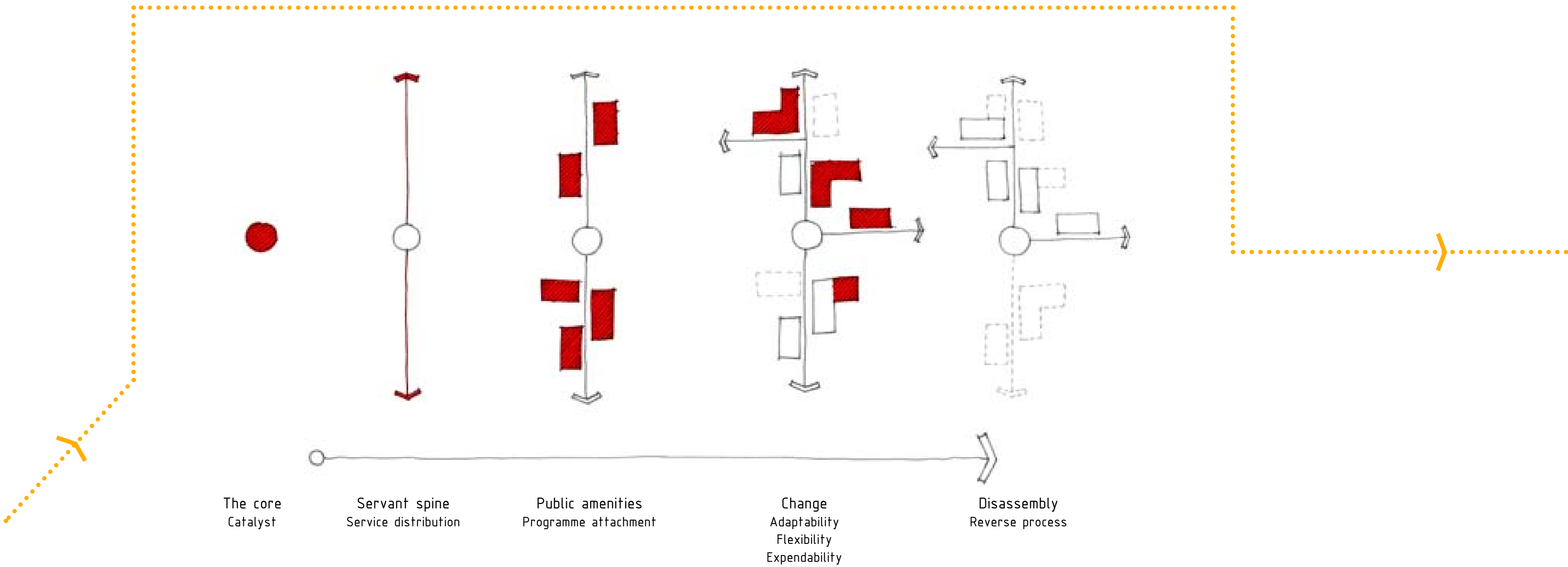


DESIGN PROCESS

Fig. 123 Developmental phases of servant building

The design system should act as a catalyst for growth. The level of growth is determined by various factors; the environment, the community and the individual. The design system could be described as a generator, for social relationships, living conditions as well as the urban/rural development.

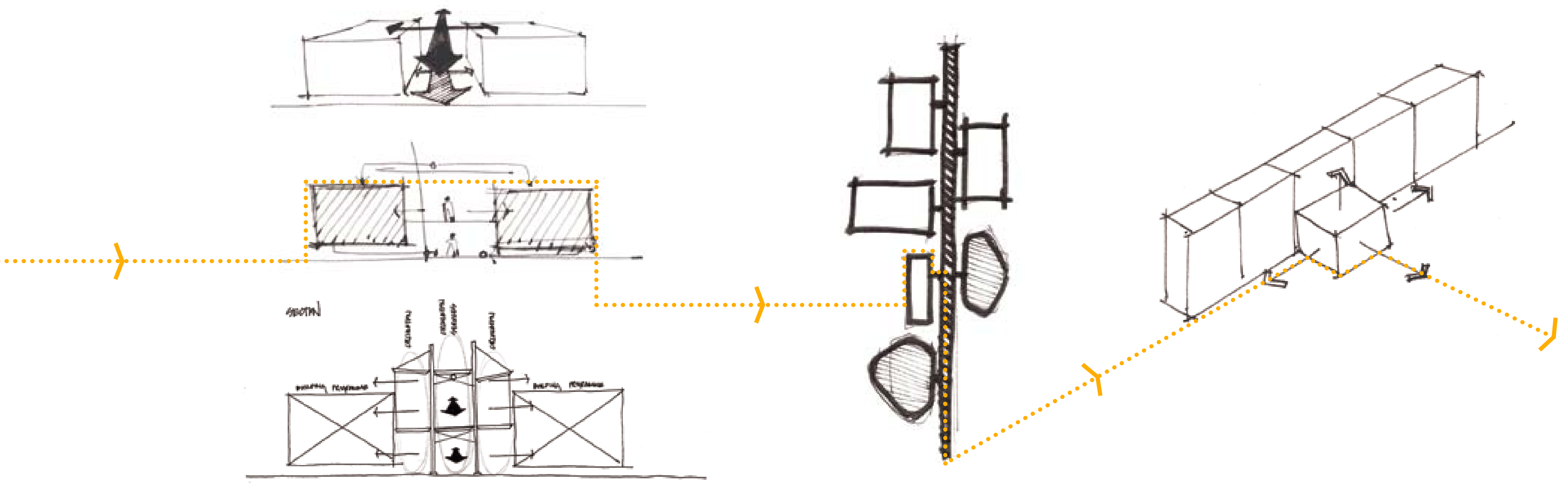
It is important that first phase operation takes place independently from the municipal grid. The system should display the ability to accommodate new technologies when necessary.

The service core should function on its own or within a larger collection. The proposed service core is established as an immediate response to the urgent need for water in Phumolong. The water reservoir would supply potable water to residents and could be used as a water store to fill the tanks of fire fighting vehicles in instances of fire.

The design could be implemented in phases, as a continuous process. Experience and need should determine the direction of growth.

During the planning phase a host environment or site is identified. The first phase oversees the assembly of the core structure using off-site material. Local labour is used and skills may be transferred.

The initial service core is a direct response to community needs. It is to act as the servant, wherein the main services are contained and from which they are distributed through extendible spines to future programmes. These infrastructural spines both distribute matter and energy as well as receive and remove waste. Ultimately they may be seen as extendible, plug-in transportation mediums by which auxiliary programmes are sustained.



Section
servant spine and
attached programmes

Change
in building typology,
material and construction

Independent programme
additions and alterations

Fig. 124 Parti diagrams

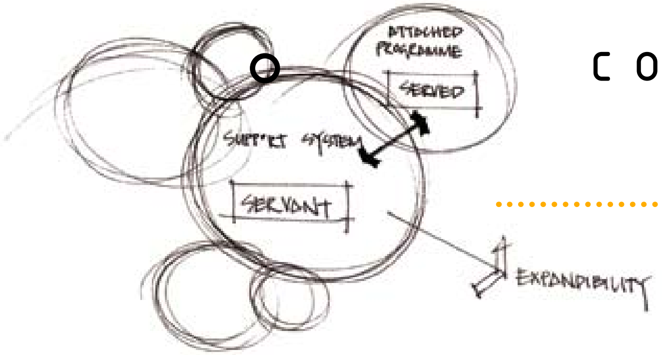
During the second phase various programmes are attached to the system along the spine. The programme could be public services carrying a degree of civic importance. Examples include clinic, police station or fire station. These programmes could be coupled with a public or recreational space. The second phase witnesses the implementation of local technologies in conjunction with available materials. This system should employ strategies of urban planning to determine hierarchy and generate public space.

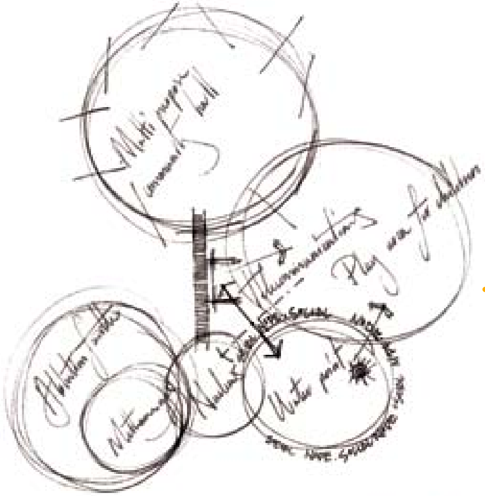
During the third phase additional programmes may be attached to the spine. These programmes could be detached when their life span has been reached. Secondary service spines may be erected to allow for growth in an alternative direction and manipulation of the space. The servant spine bears the potential to carry infrastructure. These could act as a connector of the urban fabric and could typically include street lights, ablution facilities, bus stop, etc. The third phase caters for increased flexibility and extendibility.

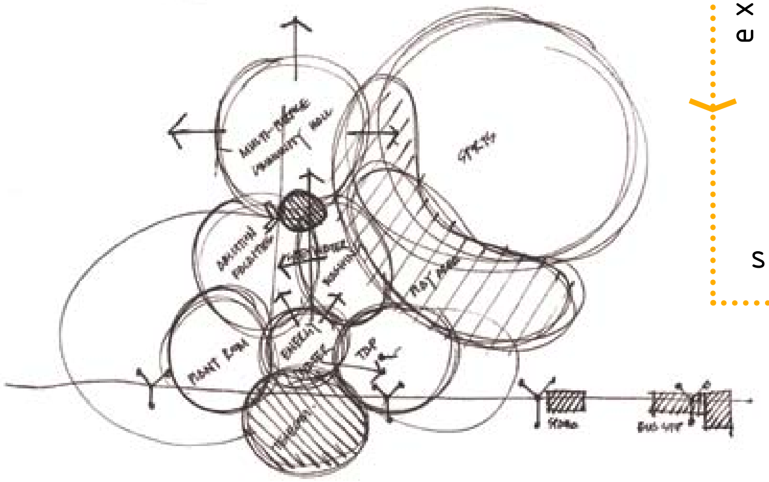
Throughout occupation the transformation of programmes may occur. This could result in the manipulation of form and layout. Secondary systems should provide for micro-enterprises (such as street vendors). At a later stage, isolated service cores may be erected some distance away, supplementing the original system to expand on its capabilities (i.e. a secondary borehole).

Should the informal residents be relocated, the lightweight steel nut and bolt assembly may be disassembled and re-erected on an appropriate site. Alternatively, it may be absorbed into the expanding urban fabric.

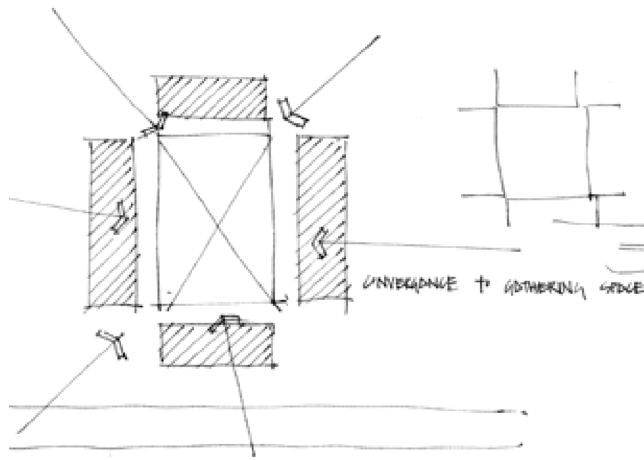
concept...



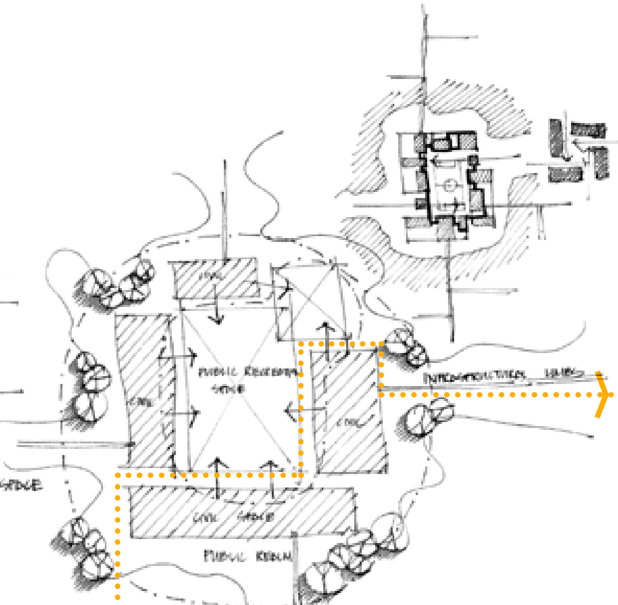




expanding on services

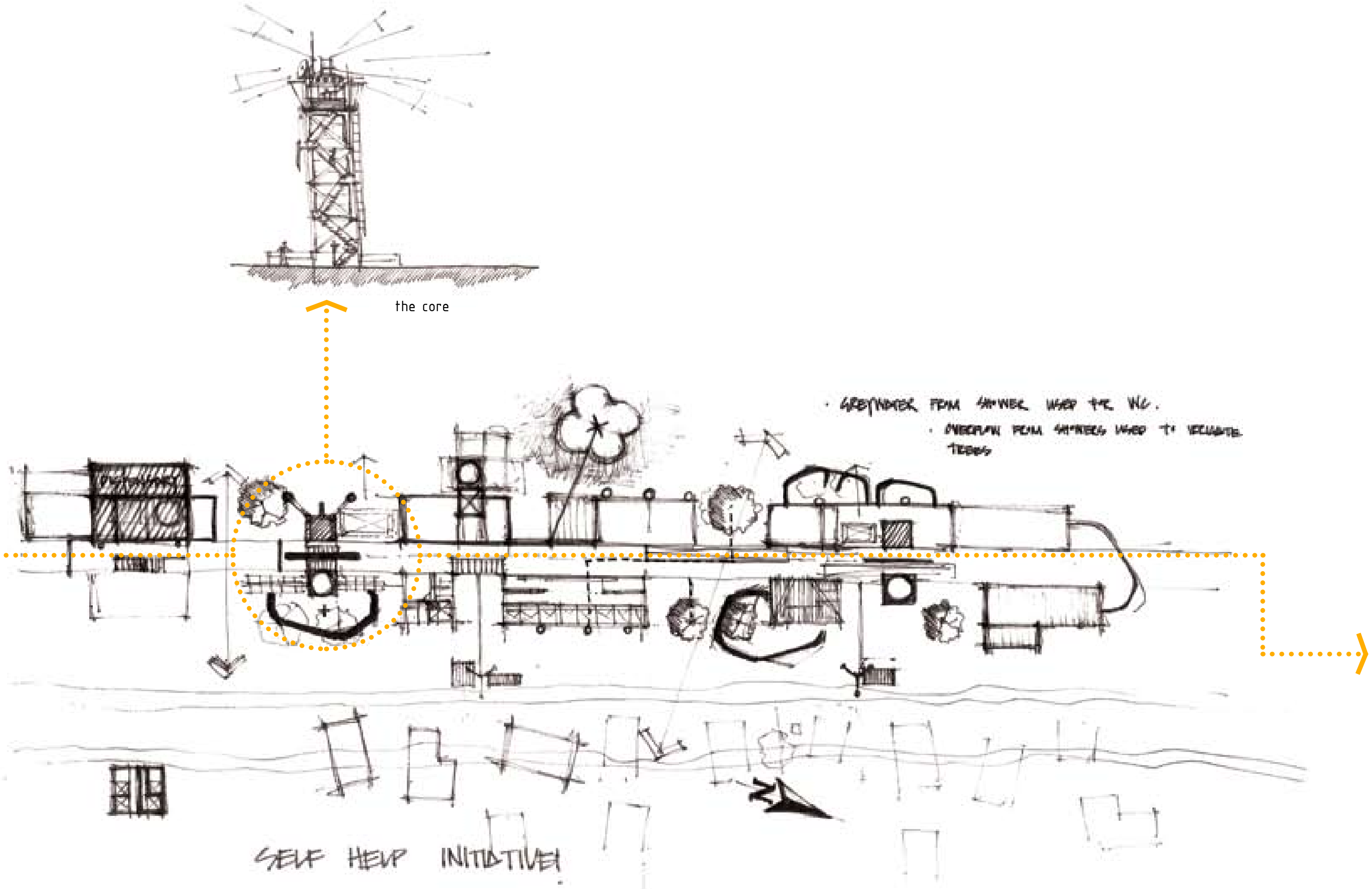


ordering the programmes around public space



service delivery

the public realm

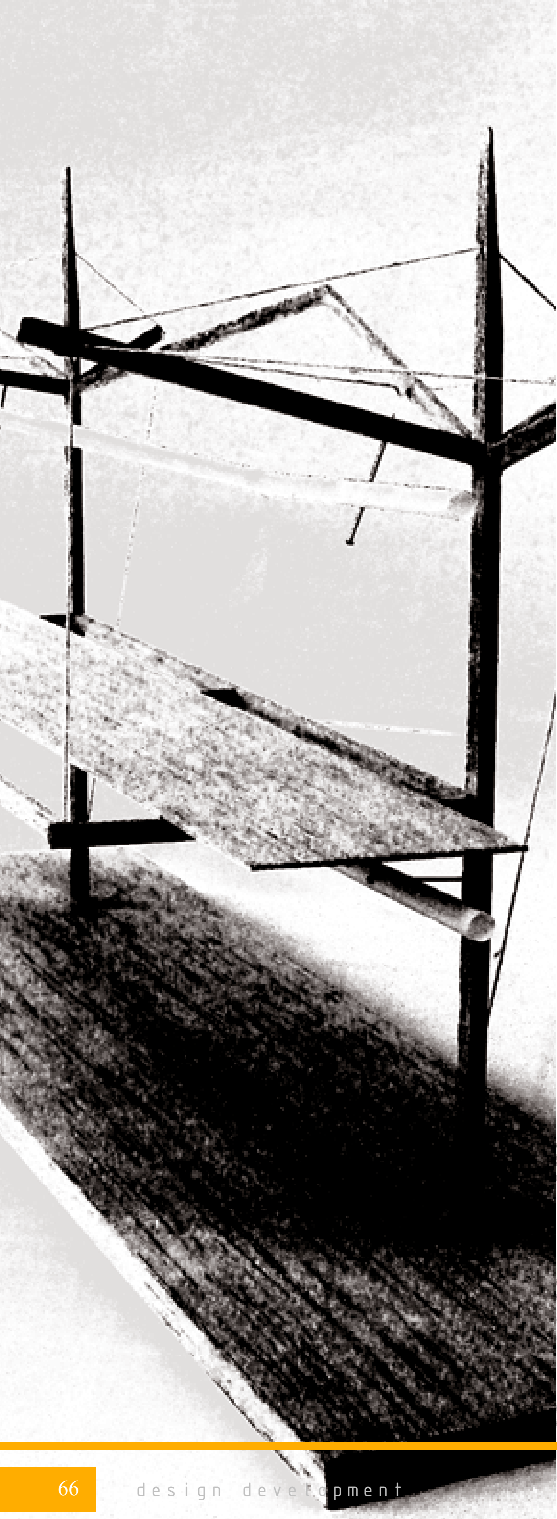


s y n t h e s i s . . .

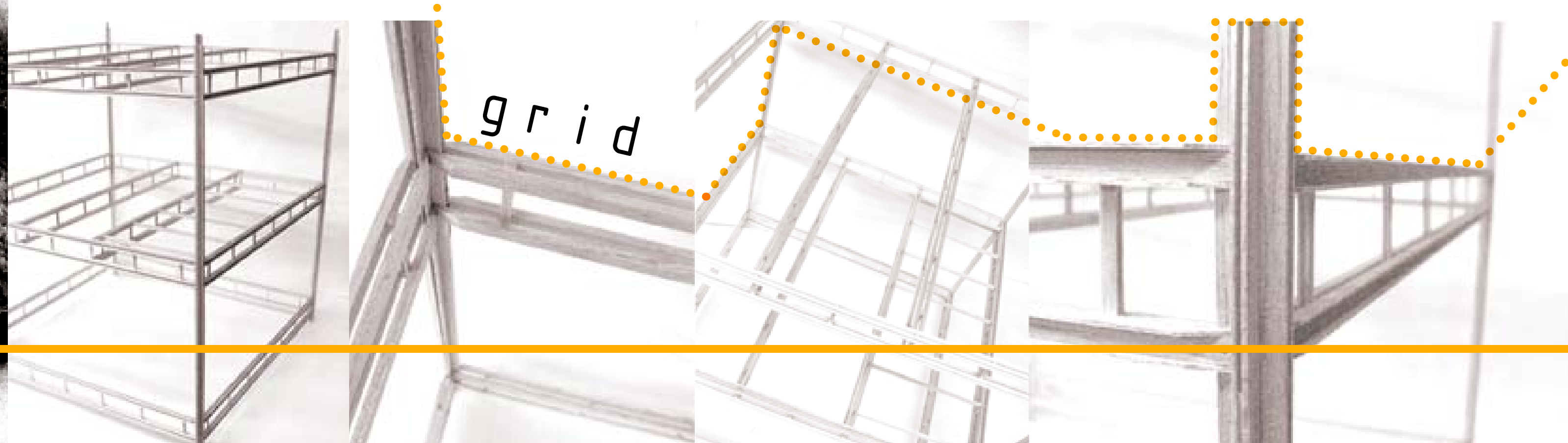
of services and the public
combining the parts into a whole

Fig. 125 Concept diagrams

structure



grid



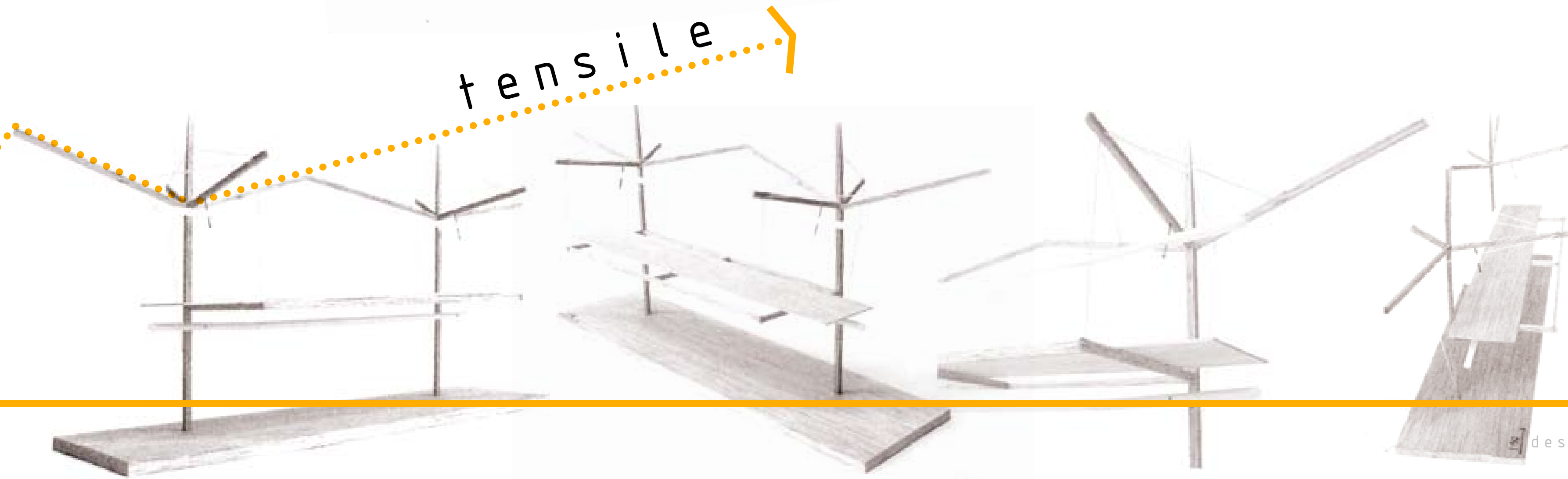
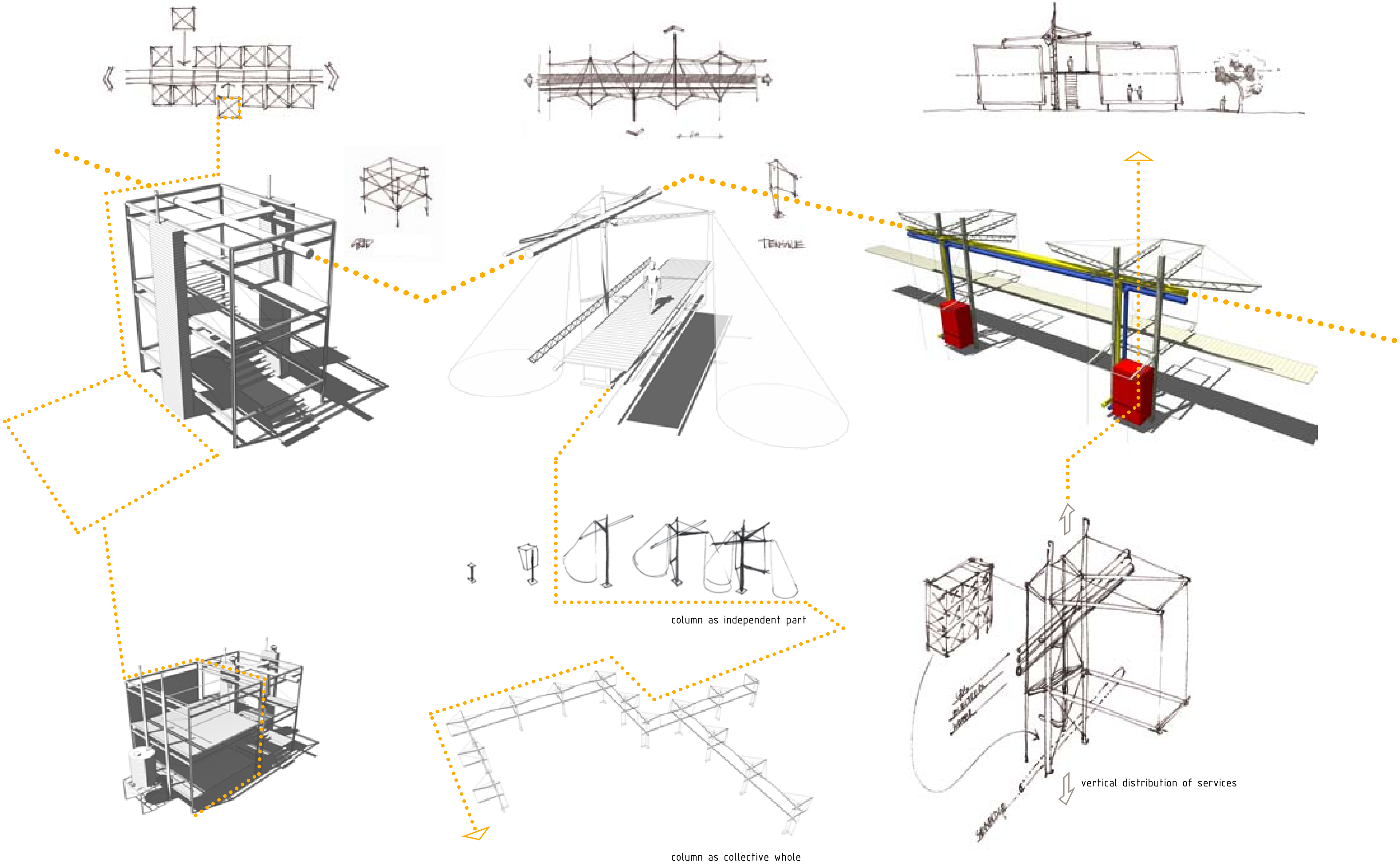
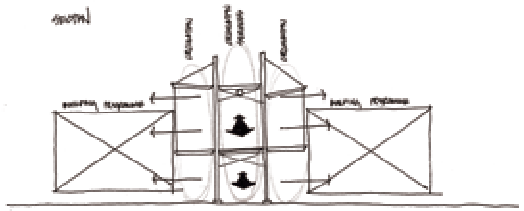
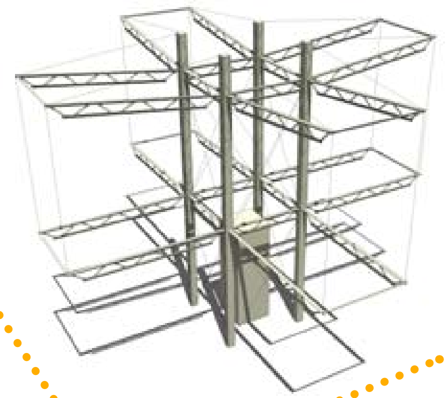


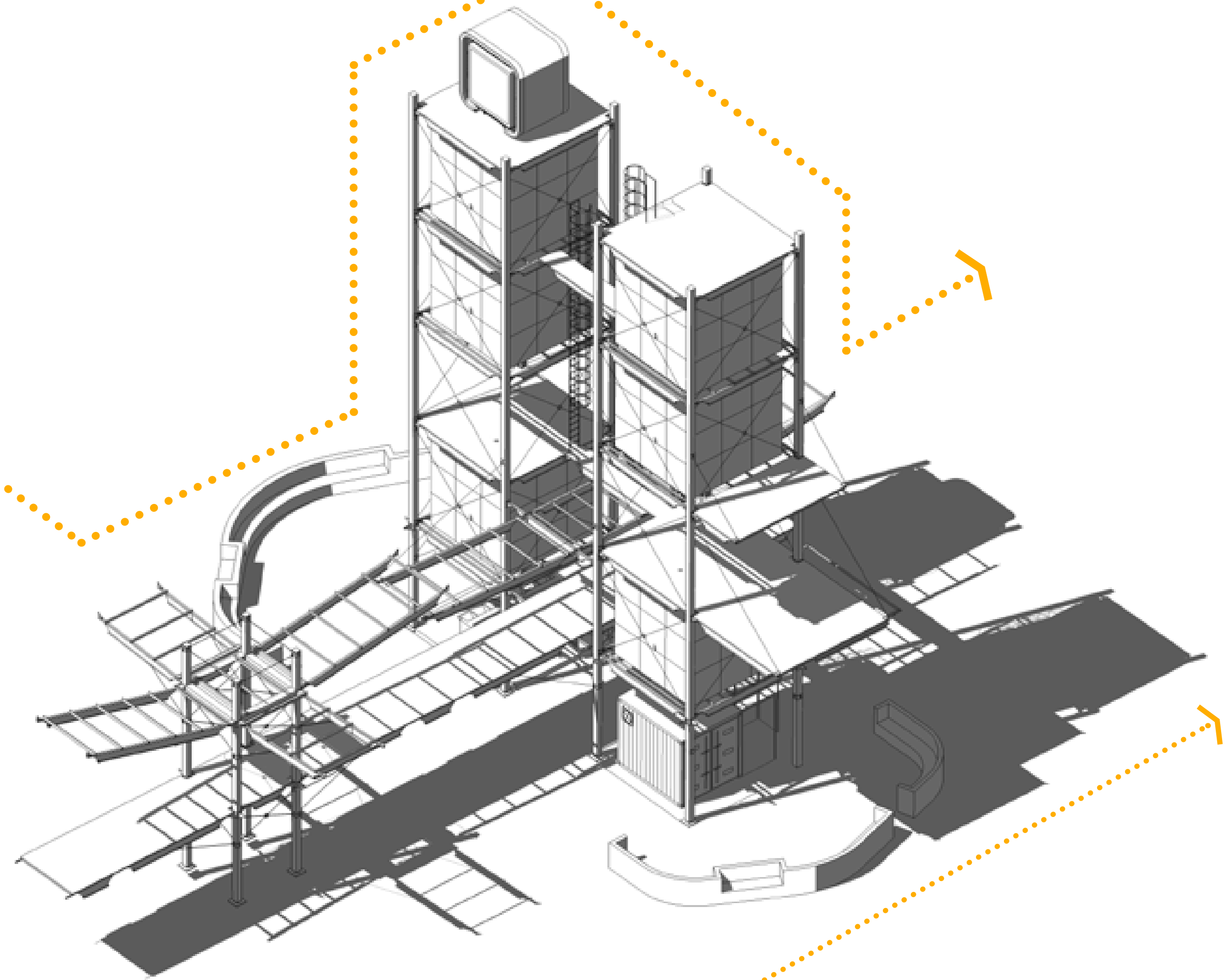
Fig. 126 Concept models


column as independent part
vertical distribution of services
column as collective whole

core and spine development







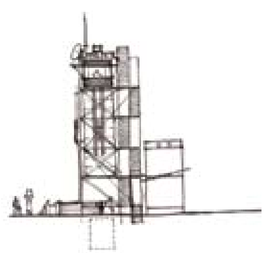
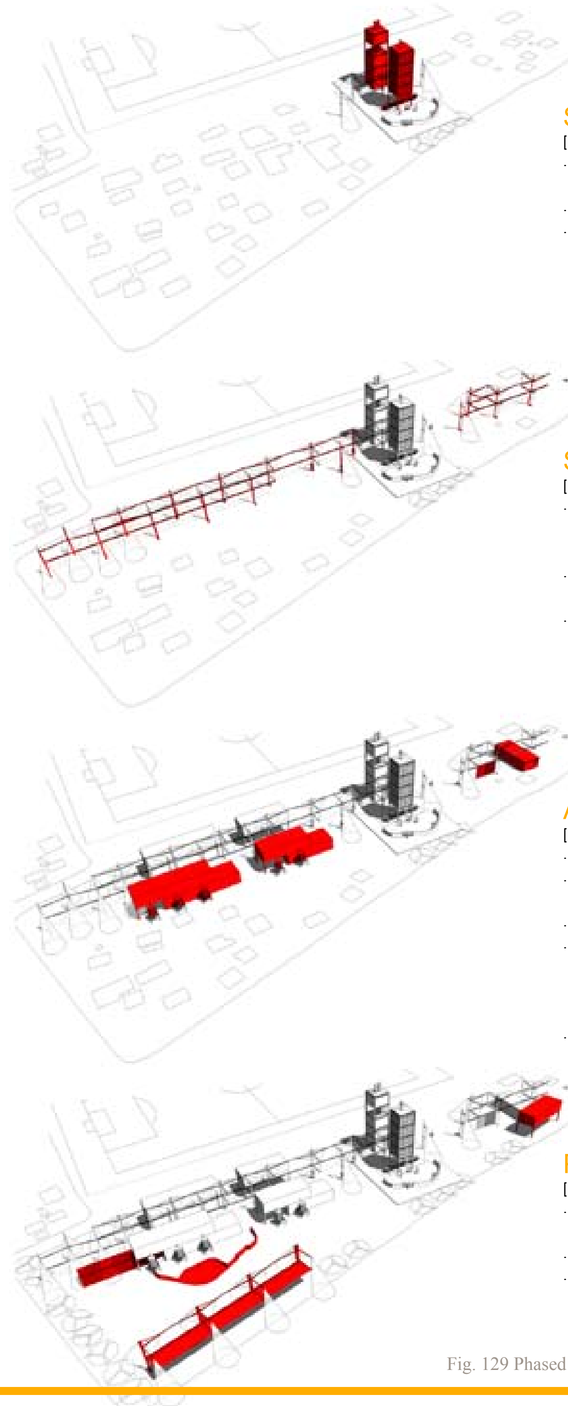


Fig. 127 Concept development

servant core to servant spine

Fig. 128 Access to public amenities



SERVANT CORE

[Service delivery intervention responding to urgent need]

- Erect service core utilising on-site resources (borehole water)
- Provide potable water
- Lightweight steel structure and standardised water tank panels allow for easy transport via 'bakkie' and erection by local labour within short time span

SERVANT SPINE

[Service distribution]

- Lightweight steel tensile structure fixed with nut & bolt assembly allows for erection by local labour and easy handling (no cranes or machines needed)
- these limbs may be seen as extendible, plug-in transportation
- mediums by which auxiliary programmes are sustained

AUXILIARY PROGRAMMES

[Attaching civic programmes]

- Secondary services and amenities provided
- eg. ablution facilities, telecommunications, clinic, police station
- Civic structure attached to service spine
- Building additions to make use of local technology using lightweight steel structures clad with corrugated sheeting (reminiscent of the ubiquitous shack) as well as dry stacking HYDRAFORM blocks
- 'Mechano' like assembly allows for disassembly if needed

PRIVATE PROGRAMMES

[Informal additions]

- Privately run micro-enterprises (informal traders) may attach to activity spine.
- Public space activated by community intervention.
- Gathering spaces and recluse spaces shaped by growth of the building system

Fig. 129 Phased development of building system based on earlier structure and layout

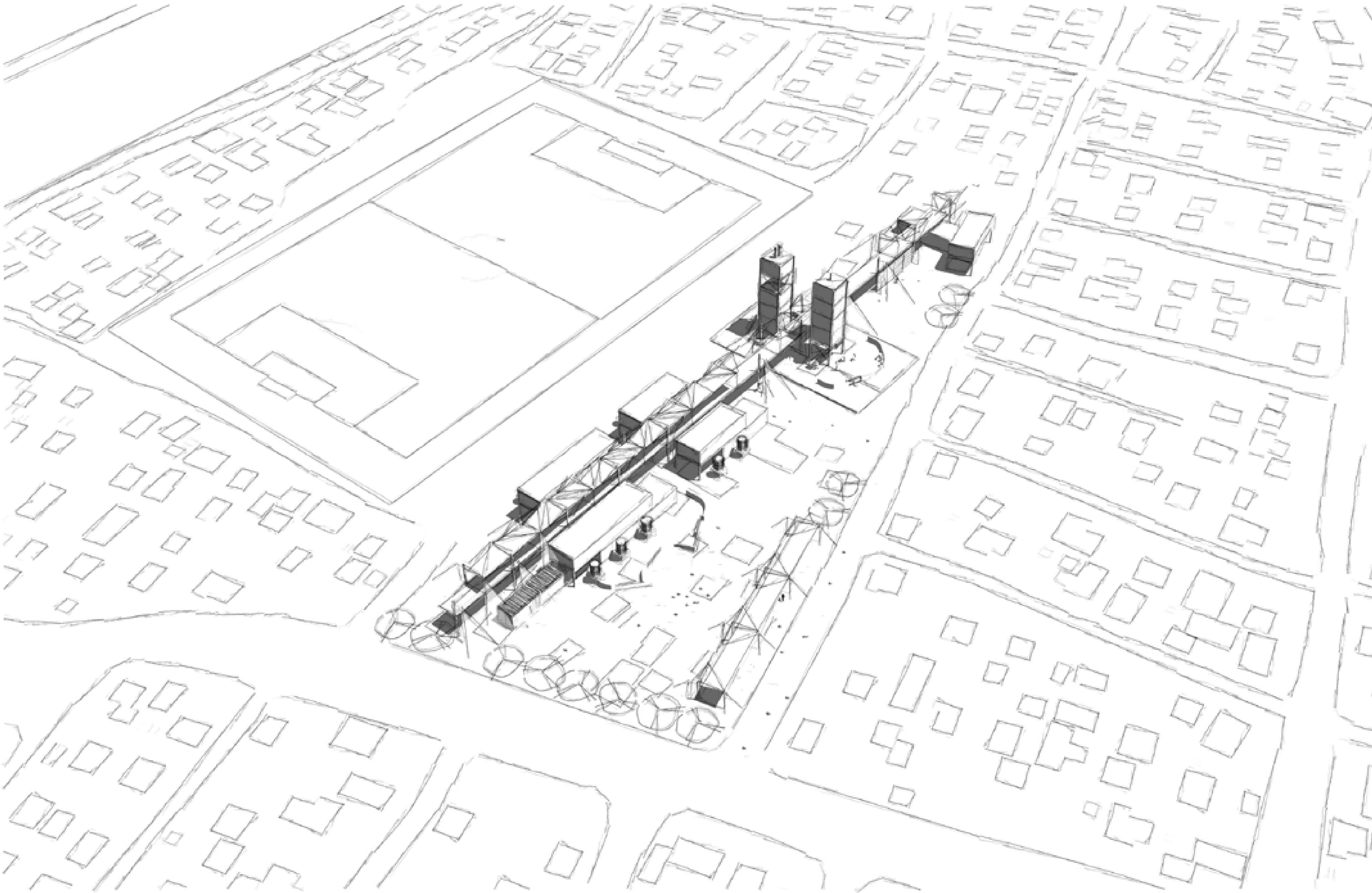


Fig. 130 Birds eye view of preliminary design intervention

Fig. 131 Perspective of preliminary design intervention

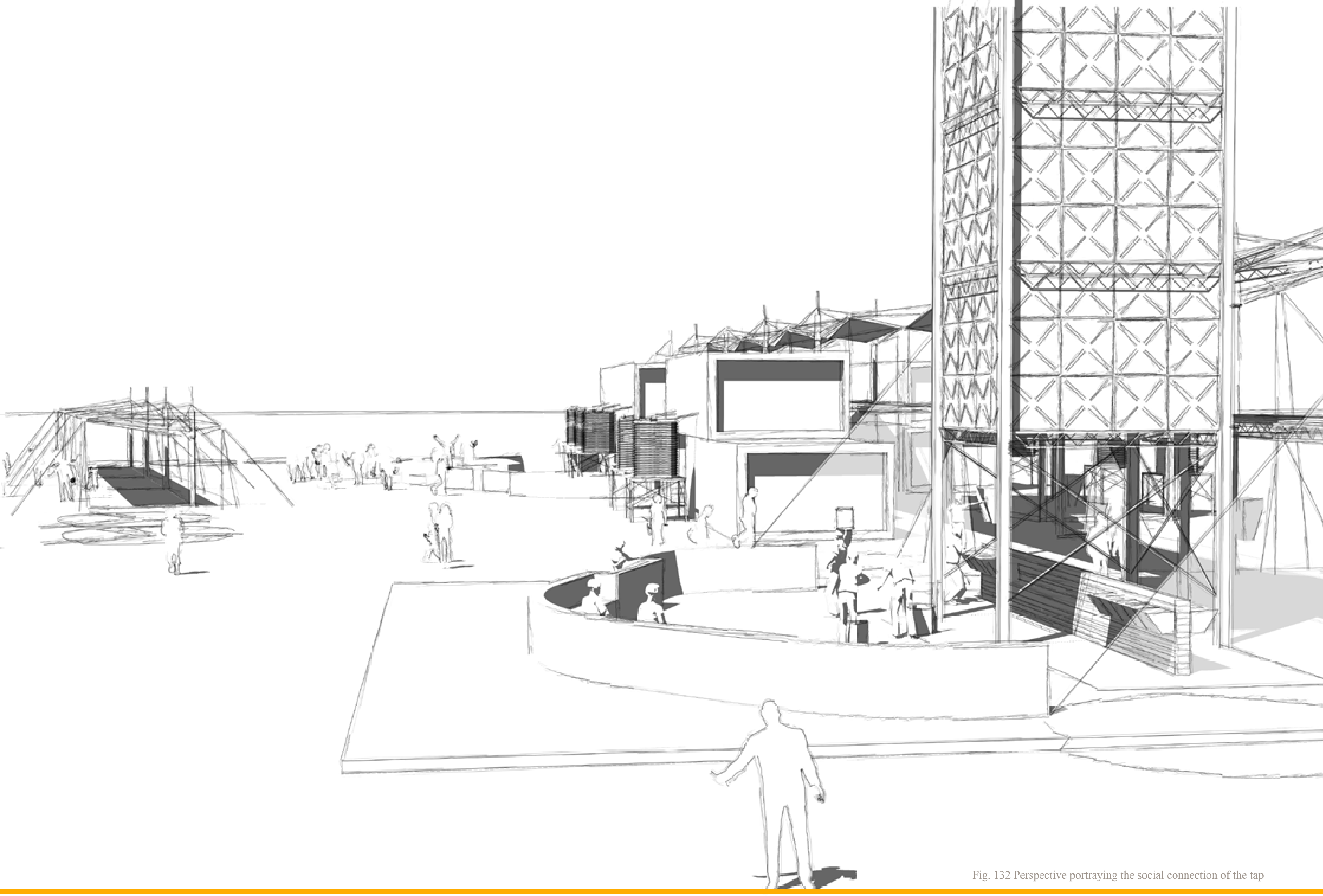


Fig. 132 Perspective portraying the social connection of the tap

ADDENDUM

CALCULATIONS

Although figures are based on assumptions the following are examples of how calculations may be based around an estimated community of 2000 people.

VOLUME OF WATER RESERVOIR

Water volume needed per day for a community of ≈ 2000

There is approximately 32 shacks per 10 000 m² (100m x 100m) in the informal settlement of Phumolong.
Assume a family of 5 per household on average.
Therefore 33 x 5 = 165 people/10 000 m²

Community standpipes are usually located at 200 m radii intervals
Therefore area served within 200m radius:
$\pi(r)^2 = \pi(200)^2 = 125\ 000\ m^2$

Population:
125 000/10 000 = 12.5 x 165 people = 2062.5 people/200 m radii

Borehole yield:
Borehole yield ≈ 1.5 ℓ/s (based on surrounding borehole yields)
24hrs ≈ 129 600 ℓ/day
12hrs ≈ 64 800 ℓ/12hrs

Water per capita per day:
Metric handbook: 20 – 40 ℓ/c/day
Dept. of Water & Environmental Affairs: 25 ℓ/c/day (desired increase to 50 ℓ/c/day)
Therefore average ≈ 37.5 ℓ/c/day

Thus: 64 800 ℓ/37.5 ℓ/c/day ≈ enough water for a community of 1728 in a 12 hour period or a community of 3456 in a 24 hour period

Thus: a community of 2062.5 requires 77 343 ℓ/day
Therefore storage tank size (1000 ℓ = 1 m³) ≈ 77 m³

ANAEROBIC METHANE PRODUCTION

A septic tank behaves as an anaerobic digester and is used in isolated areas. It is important to note that the biodigester proposed for this project is used as a temporary holding tank. The sludge from this holding tank would be removed by commercial trucks transporting the waste to a nearby treatment plant (approximately 5 km from site at the sewage disposal works) for disposal. However, during the storage period, methane gas is produced naturally and it could be extracted and stored as a fuel.

Methane gas (CH4), is a natural carbohydrate gas.

Advantages of anaerobic fermentation:
Reduced odour, disease control, pollution control, self-sufficiency, fertiliser production and biogas production.

"Anaerobic fermentation or digestion discovered by J. Louis Mouras in 1860 led to the development of the septic tank by means of which odours and water pollution are controlled. Pathogens are killed and the bulk of the waste is reduced at least 50 per cent" (Holm, 1983: 73).

Minimum ignition temperature of methane: 650ºC
Minimum ignition temperature of petrol: 480-550 ºC

In the publication *Energy Conservation in Hot Climates*, 1 m³ of waste material produces 0.75 m³ of gas per day (Holm, 1983: 74).

Quantities of biogas in typical wastes (Holm, 1983: table 7.2)

Material	Unit gas production m³/day 0.028	Volume of gas/ mass waste m³/kg	% methane
Sewage (human)	0.22	0.31 – 0.74	68
Cattle	0.014	0.094 – 0.31	65
Chickens		0.31 – 0.62	60

Domestic daily biogas consumption (Holm, 1983: table 7.4)

Use	Quantity of biogas m³/day
Cooking and baking (1 person)	0.255
Cooking and baking (5-6 persons)	1.5 – 2
Hot water (kitchen, bath and shower)	5.0
Bath once	0.6
Shower once	0.35
Refrigerator	2.5 – 3.0
Lighting (5 hours)	3.0

Volume of biogas produced in m³ per day for a community of 2062.5:
2062.5 x 0.028 = 57.75 m³/day
Such volume of gas may be sold and used as gas to cook for 255 people or 96.25 lighting hours (19.25 x 5 hours lighting)

SOLAR WATER GEYSER

Type: Solar geyser, Thermosiphon close-coupled system
Output: A 250 ℓ storage tank with 1 collector (2 m²) allows for 5 showers/3hours.
Manufacturer: SolarTech (South Africa)

Calculations are based on figures made available from SolarTech, a South African solar water geyser supplier.

The K250i indirect SolarTech water heating system is a close-coupled system (tank higher than the collectors) using a natural thermosiphon method of water circulation. 1 collector of 2 m² is capable of heating 250 ℓ of water every 4 hours (approximately) (SolarTech, 2009). The average water consumption per shower is 30 - 50ℓ (Solarheat, 2005). With the use of low-flow shower heads, shower water may be reduced by 50 – 75% (Smeddle, [sa]: 86), thus reducing the shower water to approximately 15 - 25 ℓ.

Hot water form a geyser is usually mixed with cold water to bring the shower water to an ambient temperature of between 30 - 40 ºC. Thus not all 250ℓ of hot water in the geyser is used directly for shower water. Temperature within a solar tank may typically be 80ºC. Assuming ambient shower temperature is 37ºC, the ratio of hot to cold water is 1:3 [(80 + 25 + 25 + 25) / 4)] (25ºC average temperature of cold water from tap).
Assuming average water consumption per shower is 20ℓ (15 - 25ℓ), 5 of which is made up of hot water. Thus a 250ℓ solar collector tank (at 80ºC) can supply hot water for 50 showers.

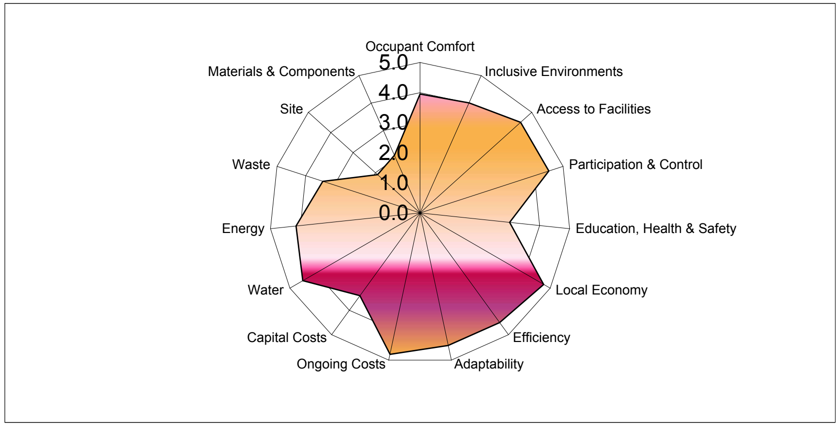
Assuming that at maximum operation the public ablution facility can support 1000 people/day, the amount of water needed for showering will approximately be = 1000 people x 20ℓ = 20 000ℓ
Hot water needed (1:3) = 5000ℓ of the 20 000ℓ for hot water.

1000 showers/50 showers per 250ℓ tank = 20 units
Thus 20 solar water geysers and collectors are needed for 5000ℓ of hot water simultaneously. However, shower use is throughout the day and will decrease the amount of solar water heating systems needed at once.

This calculation is based mainly on assumptions. Final figures should be discussed with specialists. However, the design intervention has provided ample installation area for additional units to be installed.

SUSTAINABLE BUILDING ASSESSMENT TOOL (SBAT- P) V1

PROJECT		ASSESSMENT	
Project title:	Servant Core	Date:	Oct-09
Location:	Mamelodi, Tshwane	Undertaken by:	D Gottsmann
Building type:	Multi-functional public amenities building	Company / organisation:	
Internal area (m2):	750	Department of Rural Development & Land Reform	
Number of us users:	n.a		



Social	4.0	Economic	4.4	Environmental	3.2
Overall	3.9	Classification	VERY GOOD		

SUSTAINABLE BUILDING ASSESSMENT TOOL

Used as an impact assessment tool during the design process, the SBAT system aids in providing possible approaches towards reducing the buildings impact on the environment.

However, the system is open to misuse and may not reflect the true environmental impact of the completed building. Certain approaches towards architecture have also not been considered.

Werner Sobek stated:
"Environmental efficiency is not a goal in itself but simply a by-product of good building" (Dwell, 2009: 94)

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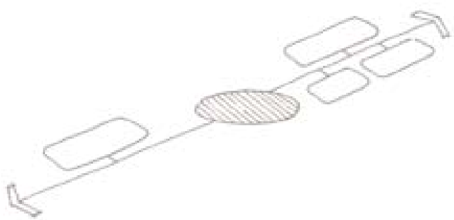

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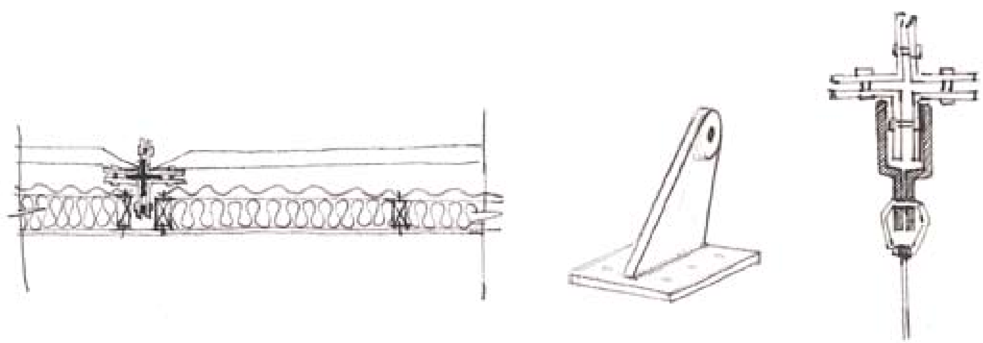
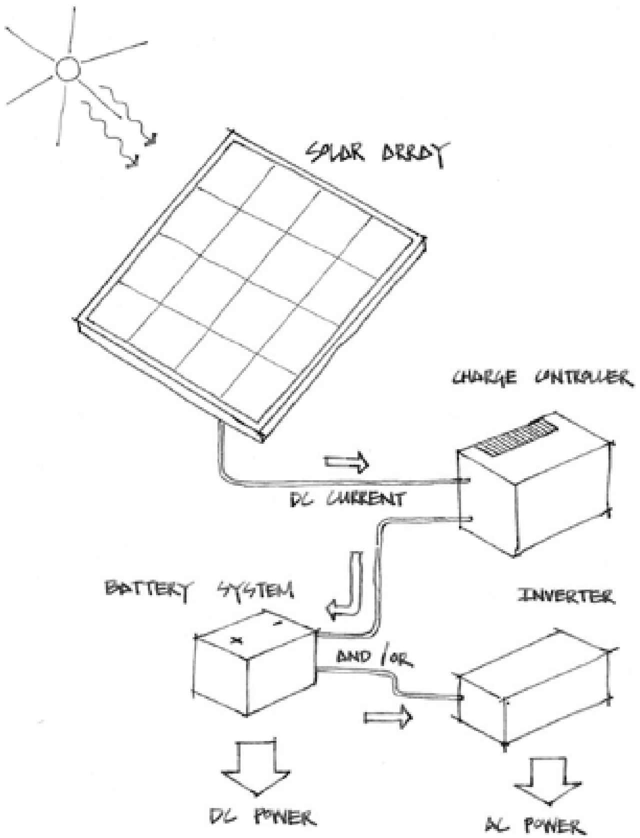


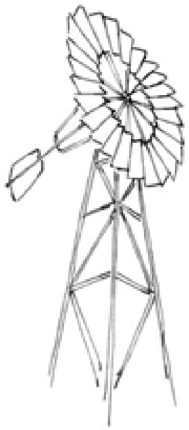
Fig. 133 Details

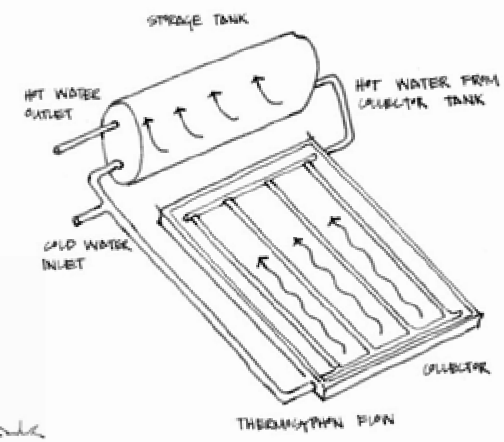
Fig. 134 Next page: Silhouette of structure within its context

TECHNICAL

POTENTIAL ENERGY SOURCES AND WATER CONSERVATION STRATEGIES







SOLAR PANELS

Type: Solar panels
Source: Solar rays
Output: Ranges from 10 to 240 W power output are common. A typical 240W photovoltaic (PV) module of approximately 1.4 m^2 in area produces power voltages of 12/24V
Cost: ± R3000 - R10 000
Inverter-battery charger ± R9000
12V Willard solar battery ± R800
Advantages: automatically run and requires little maintenance.
Supplier: Gwstore

WINDMILL

Type: Windmill
Source: Wind
Output: 5kW at 12m/s and 258W at 4 m/s
Cost: R25 000 - R150 000 (2009)
Comments: The 4.6m rotor requires a start-up wind speed of 2 m/s
Manufacturer: Turbex

WIND TURBINE GENERATOR

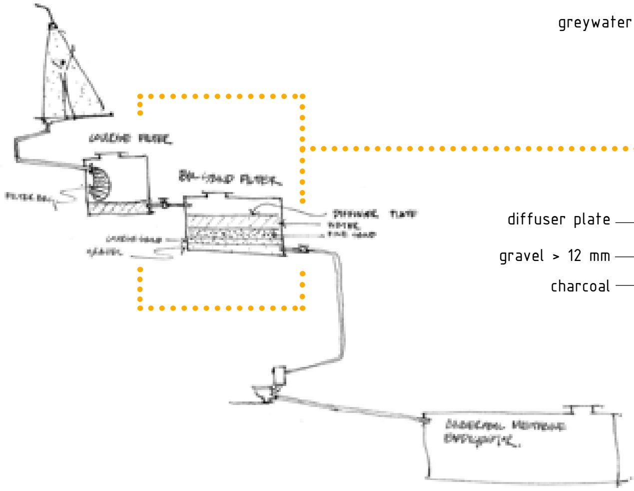
Type: Wind turbine generator
Source: Wind
Output: 900 W power output at 17 m/s
Cost: R50 000 - R250 000
Advantages: start up wind speed at 3.5m/s
Manufacturer: Lakota Aeromax 900W Wind Turbine

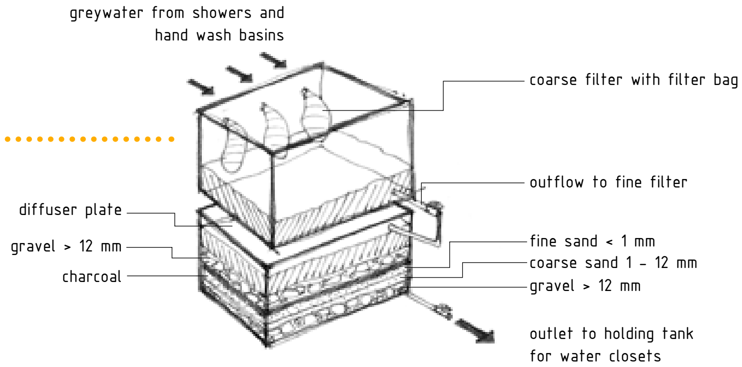
HAND PUMP

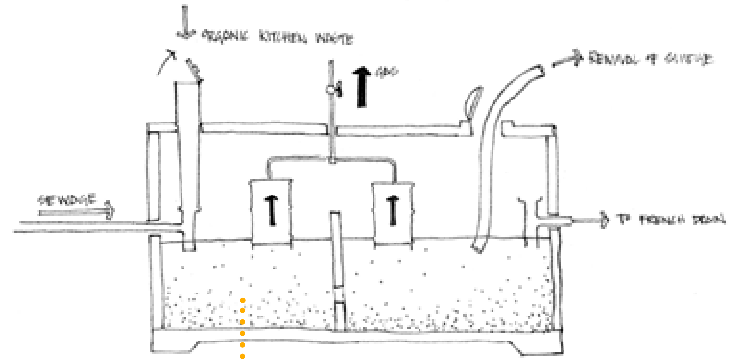
Type: Hand pump, reciprocating (plunger)
Source: manual labour
Output: 5-10 m^3/day
Cost: R5000 - R15 000
Comments: the cost of using numerous pumps in close proximity due to higher water demands, (requiring more boreholes to be sunk) may render this operation too expensive

SOLAR GEYSER

Type: Solar geyser, Thermosiphon close-coupled system
Source: Solar rays
Output: A 250 l indirect solar water heating system with 1 collector (2 m^2) provides for 5 showers/3hours.
Cost: ± R3500 - R7000
Advantages: No pumps are required to circulate water
Manufacturer: SolarTech





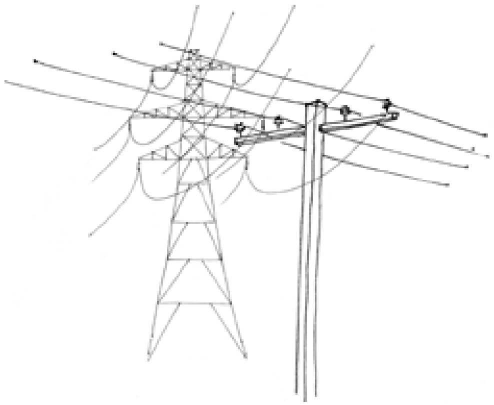


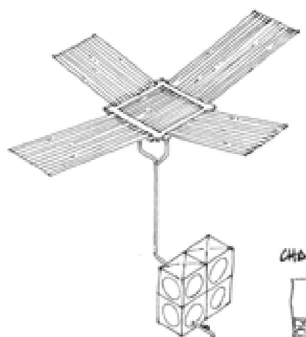
GREYWATER FILTRATION

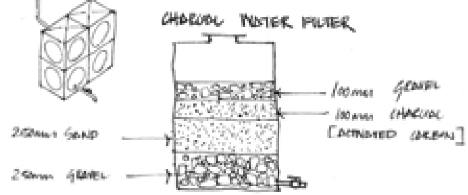
Type: Greywater filtration system
Source: Greywater from ablution facilities
Output: Filtered water used in water cistern
Cost: R1000 - R10 000 (depending on tank size)
Comments: Filtered water not harmful to anaerobic methane biodigestor
Manufacturer: Construction by local community

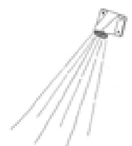
ANAEROBIC METHANE BIODIGESTER

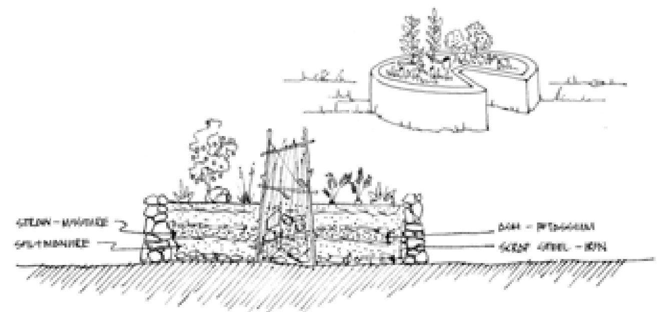
Type: Anaerobic methane biodigester
Source: Human excreta and organic waste
Output: 1 m^3 of waste material produces 0.75 m^3 of gas per day
Gas production per person per day = 0.03 m^3 (Holm, 1983: 76)
Cost: Variable
Comments: Gas may be used for cooking or to heat water
Manufacturer: Construction by local community











NATIONAL GRID

Type: National grid
Source: Municipal grid
Output: 400-800 kWh/month (domestic low)
Cost: 62.57c /kWh (2009)
Comments: The national power grid is an option to be considered once the necessary infrastructure has been installed in the relevant area
Supplier: Eskom

RAINWATER HARVESTING

Type: Rainwater harvesting
Source: Rainwater
Output: Roof area x average rainfall = 44.4 m^2 x 0.674 m (weathersa, 2009) = 30 m^3 potential rainwater catchment per structure
Cost: R5000 - R10 000 (depending on tank size)
Comments: Rainwater could be further filtered and used in ablution facilities or unfiltered for irrigation
Manufacturer: Abeco tanks

REDUCED TOILET FLUSHING

Type: Reduced toilet flush systems
Source: Greywater
Output: Multi-flush systems use as much water as needed so long as the handle is held down. Dual-flush systems use 3 l (light setting) or 6 l (heavier setting)
Cost: R200 - R700
Comments: conventional toilets use between 11 – 15 l per flush
Manufacturer: Gypsy

LOW-FLOW SHOWERHEADS

Type: Low-flow showerheads and tap aerators
Source: Borehole water or municipal
Output: Reduces shower water by 50 – 75% (Smeddle, [sa]: 86)
Cost: R50 - R300
Comments: Aids in reducing water consumption
Manufacturer: Energywise

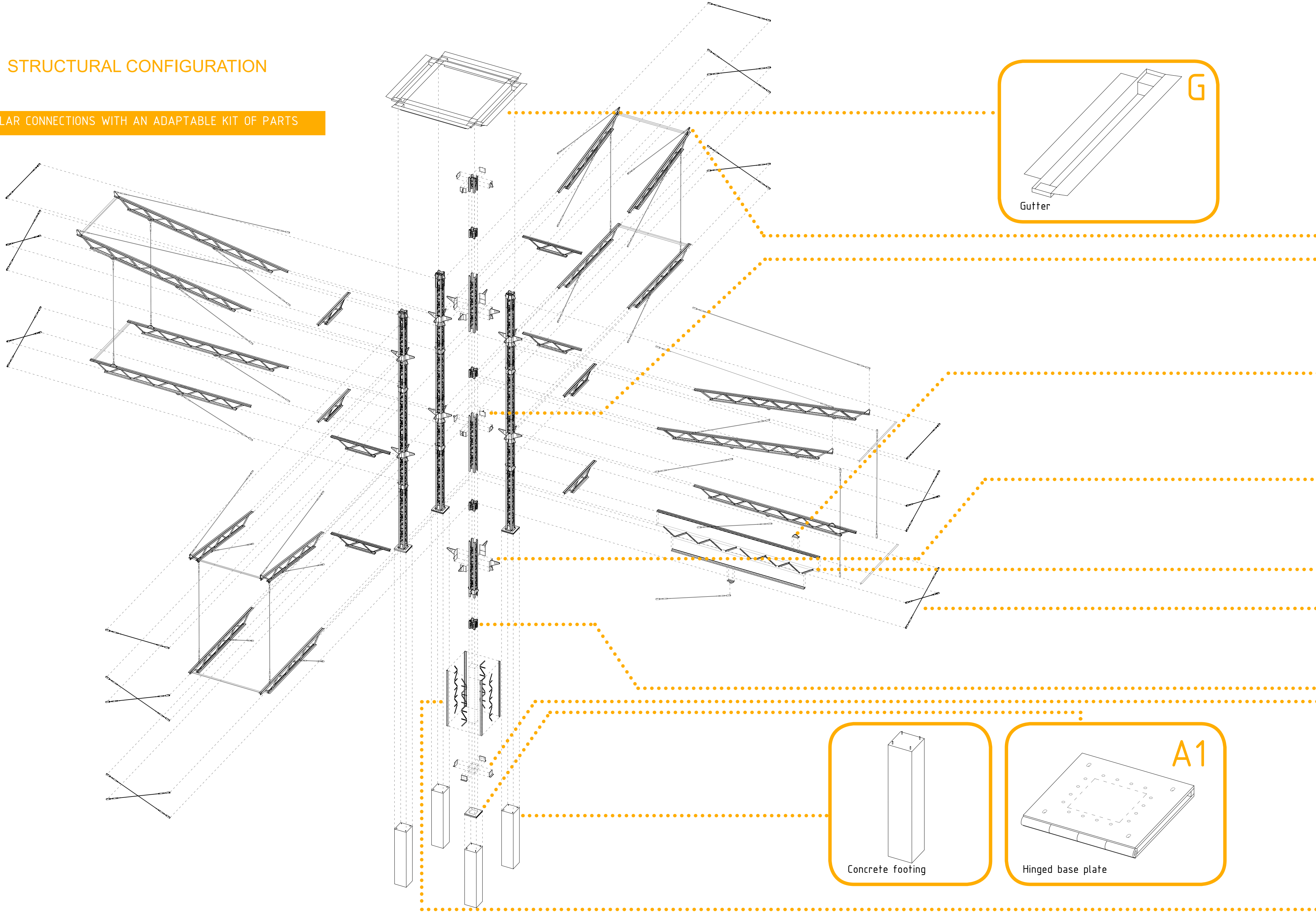
KEYHOLE GARDENS

Type: Keyhole gardens
Source: Excess filtered greywater
Output: Vegetables
Cost: Natural and recycled material used
Comments: Less susceptible to water loss through evaporation.
Manufacturer: Local community intervention

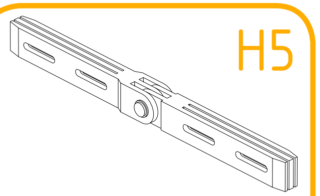
Fig. 135 Energy sources and water conservation strategies

STRUCTURAL CONFIGURATION

MODULAR CONNECTIONS WITH AN ADAPTABLE KIT OF PARTS

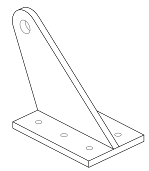


H5



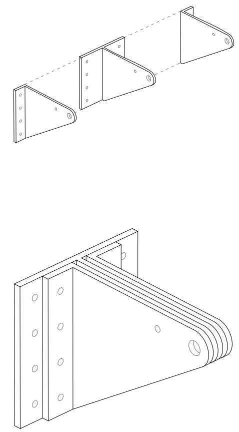
Horizontal hinged joint connector between beam and beam

H4



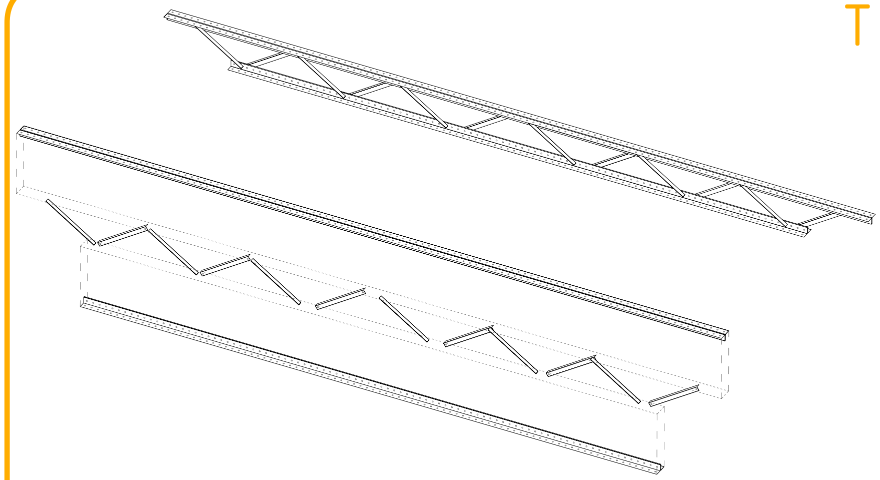
Cable to beam

H1



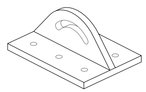
Truss to column

T



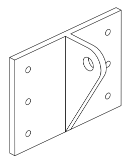
T – Truss composition of cold formed angle irons (50 x 50 x 3 mm). For design purposes top and bottom chord increment lengths = 500 mm. All chords to be pre-drilled with 9mm dia holes spaced at 50 mm centres. Diagonal webs manufactured from 30 x 30 x 2 mm angles in lengths of 420 mm. Trusses of increasing depths are produced by fixing the web at closer intervals.

H3



Cable to beam

H2



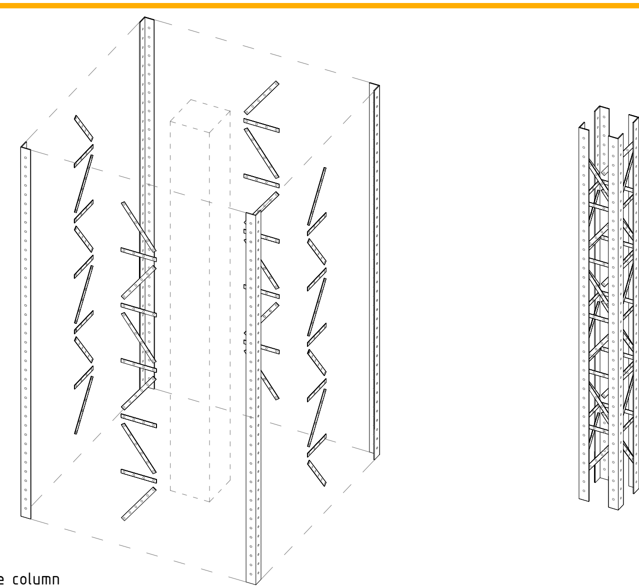
Cable to column

X

Turnbuckle with high tensile steel cable

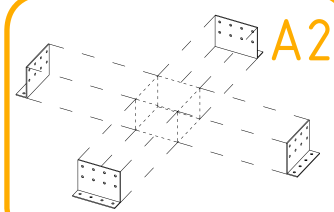
Kit of parts:
A – Footing connections
C – Lattice column
F – M8 nut and bolt
G – Gutter
H – Mild steel hinges
J – Vertical connection joint
T – Composite webbed truss
X – Cable bracing
All steel members to be hot dipped galvanised
Fasteners either M8 bolt and nut or 8 dia gutter bolt

C



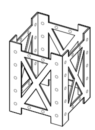
Lattice column

A2



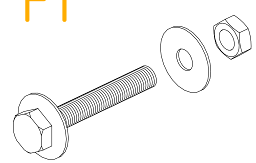
Column to base plate

J

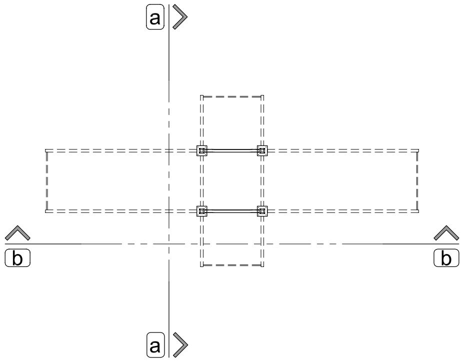


Column to column

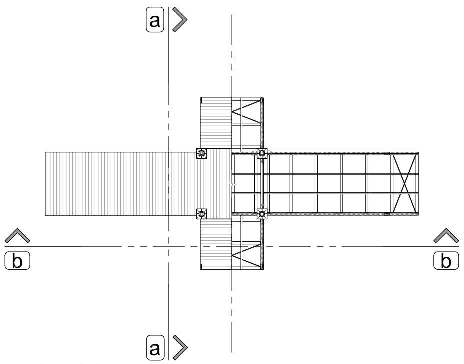
F1



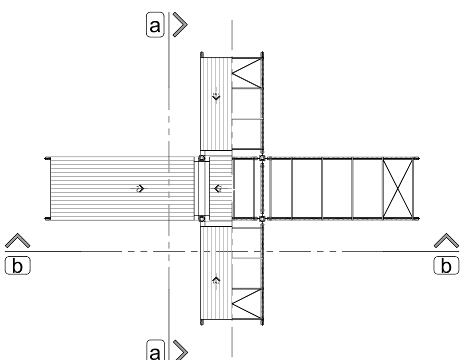
Fastener



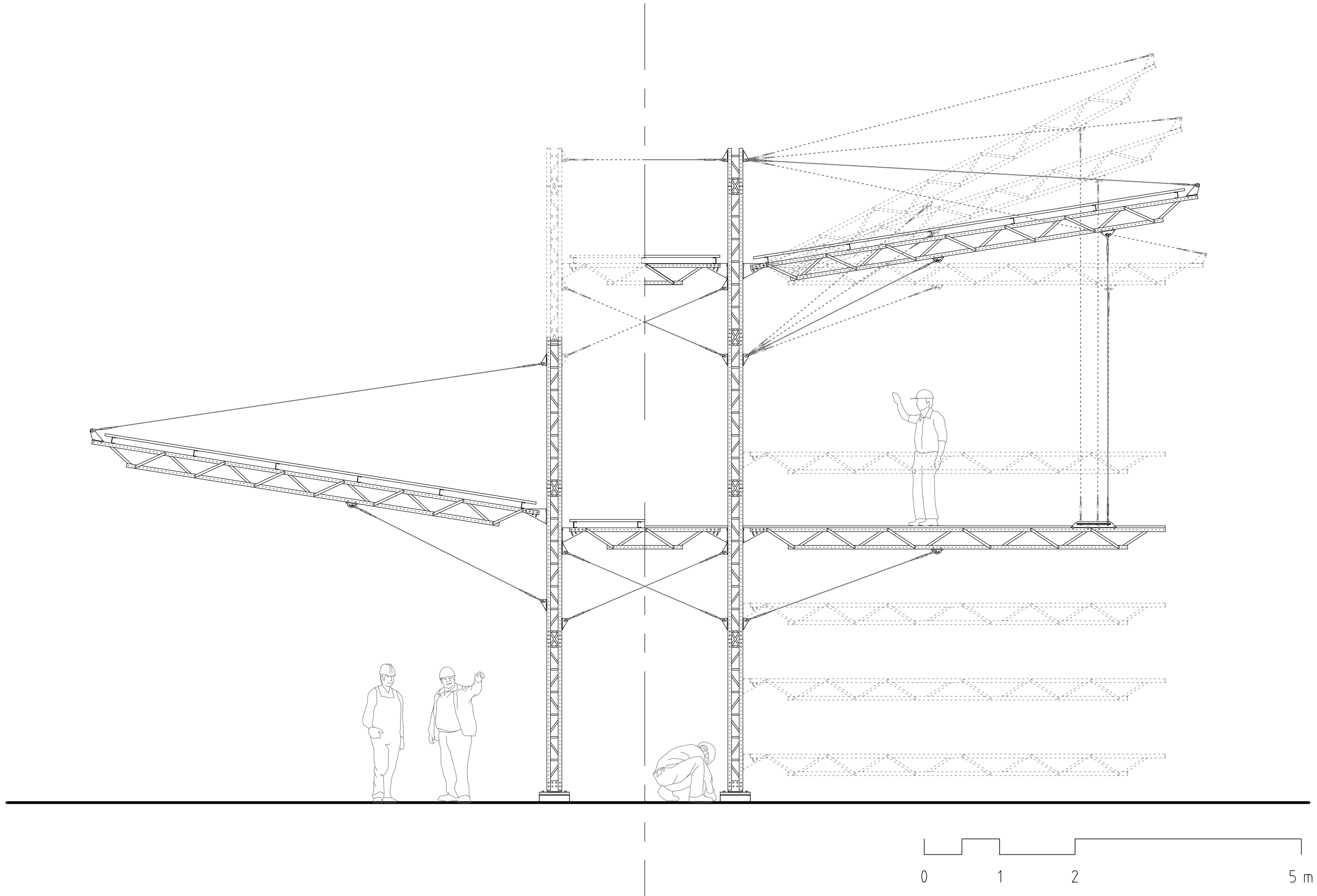
Ground



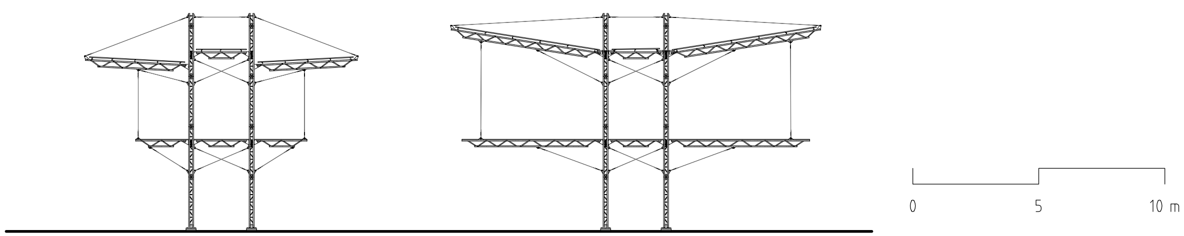
Level 1



Roof



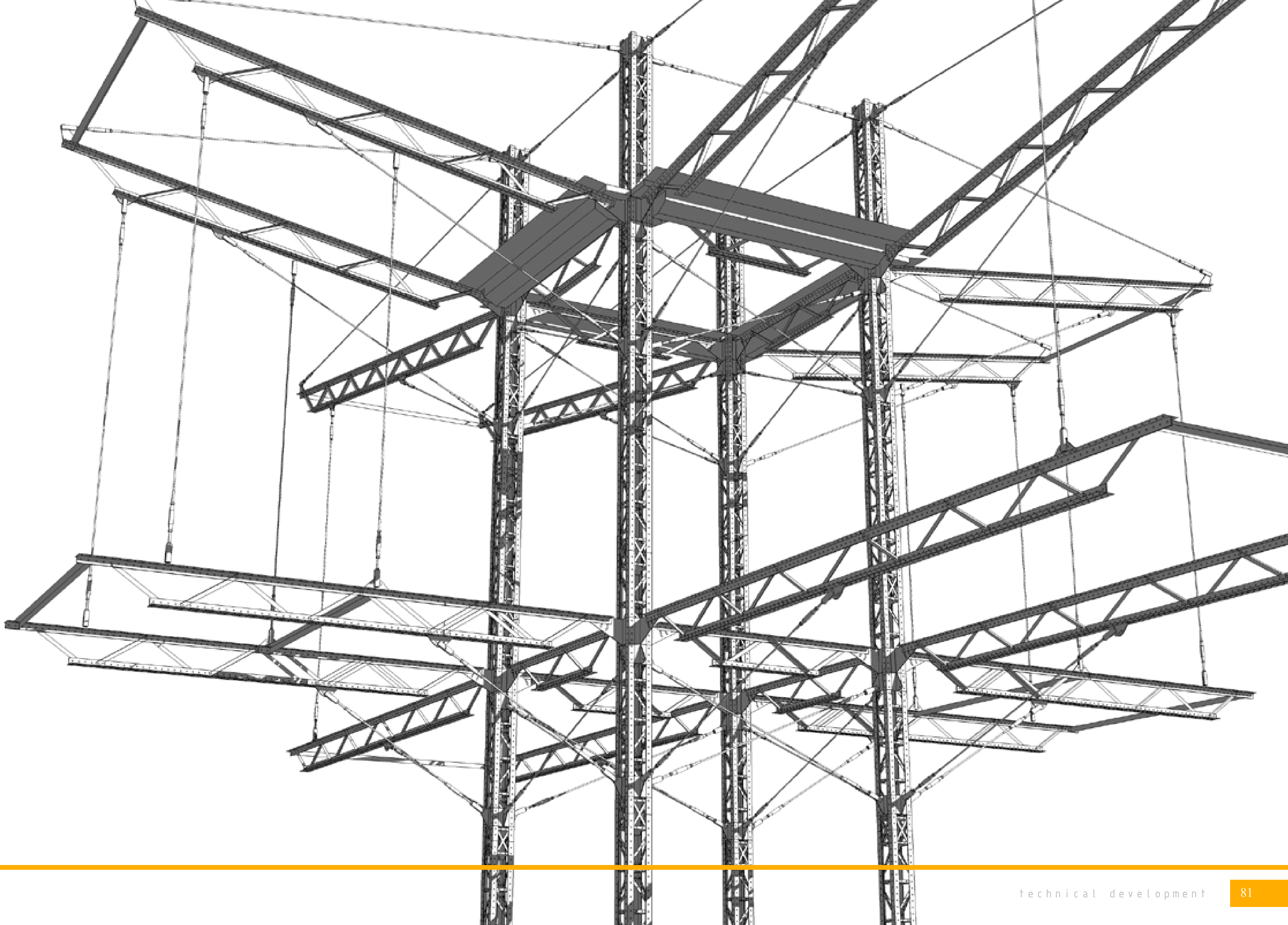
Structural flexibility

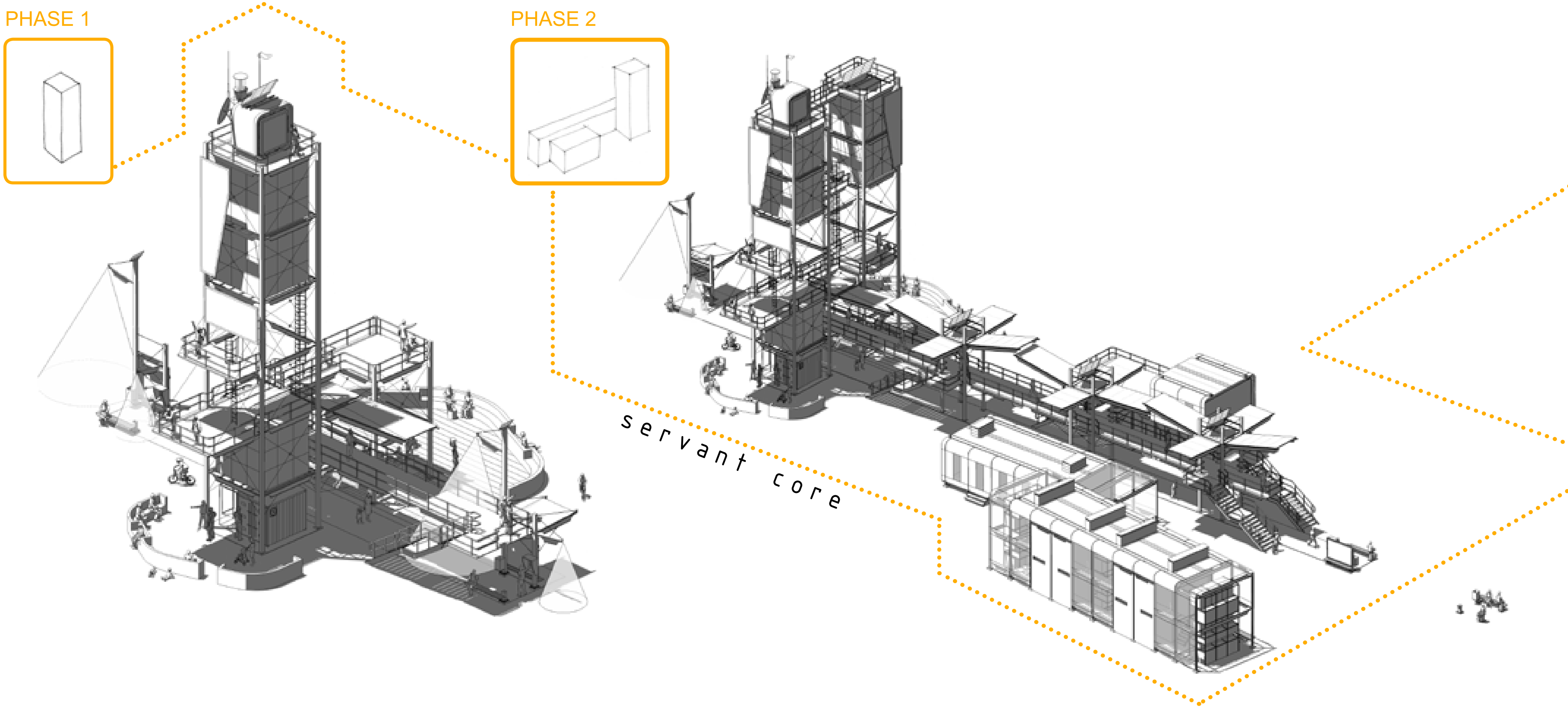


a-a

b-b

Tensile structure



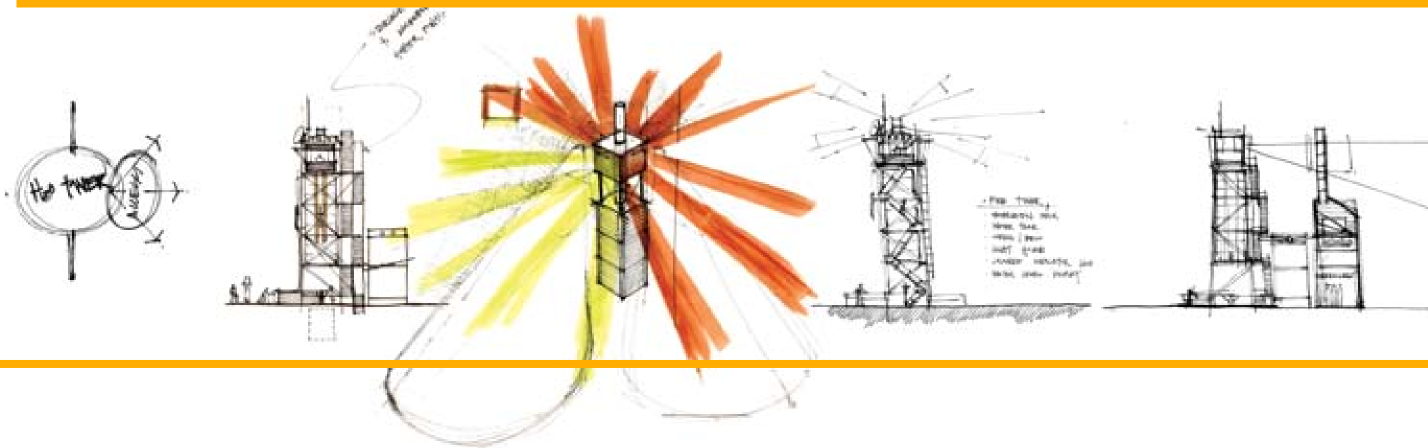


Servant Core

The servant core as a design intervention exists as a process. A phased upgrading is envisioned introducing additional services at later stages of the project. The first stage is to initiate the catalyst whilst the modular steel units extend through later phases defining the spine[s]. Additional public amenities programmes may be accommodated through the servant spine. Any part of the programme may be detached when rendered obsolete.

The original design intervention initiated a servant core in the form of a water reservoir tower. The tower should serve as a catalyst stimulating new activities (both built and social).

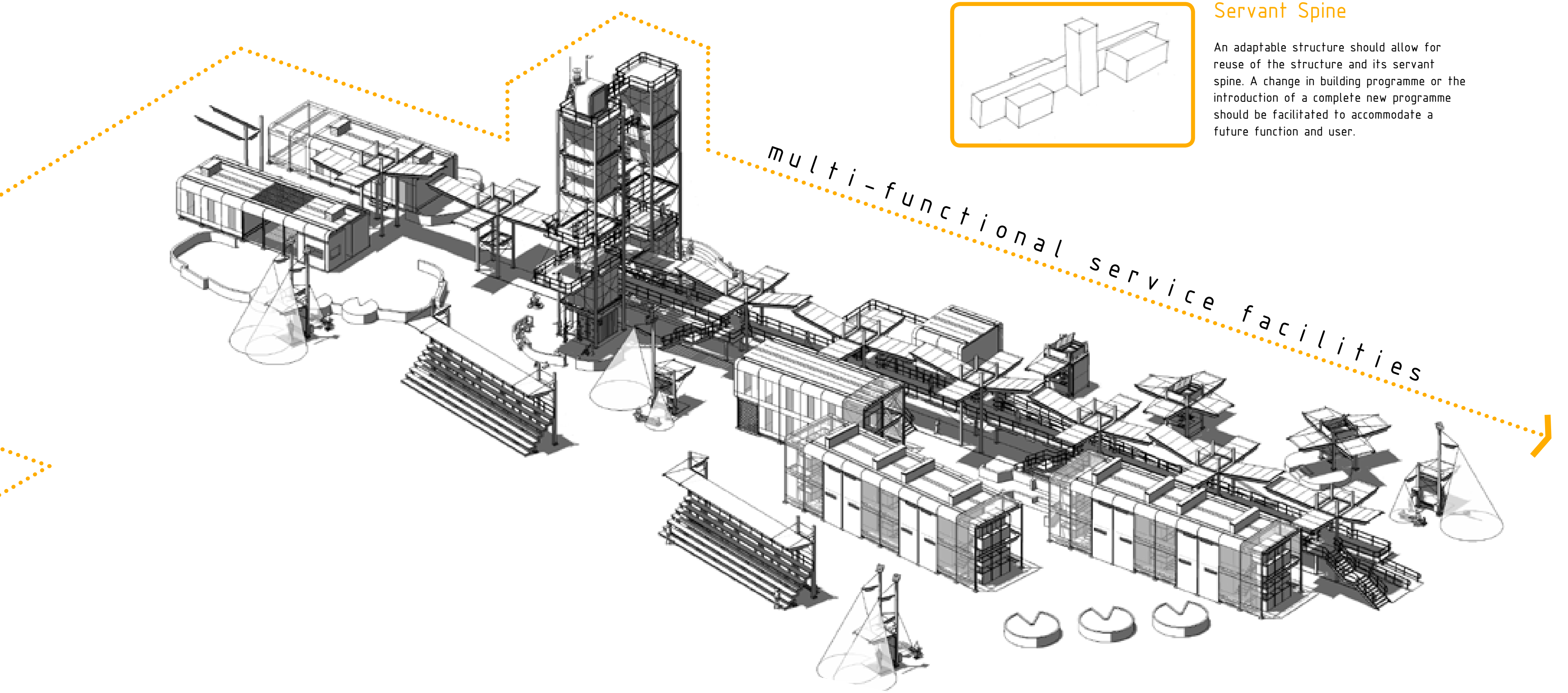
SERVANT CORE TO SERVICE SPINE

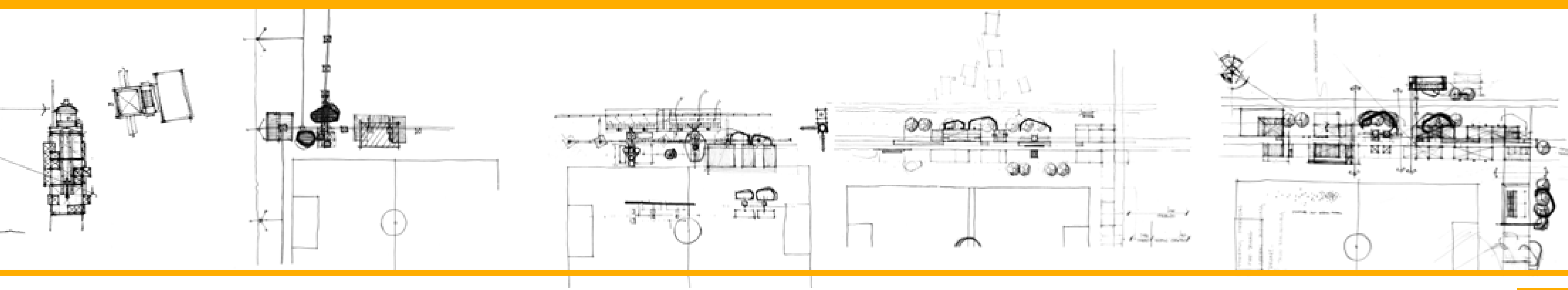


PHASE 3

Servant Spine

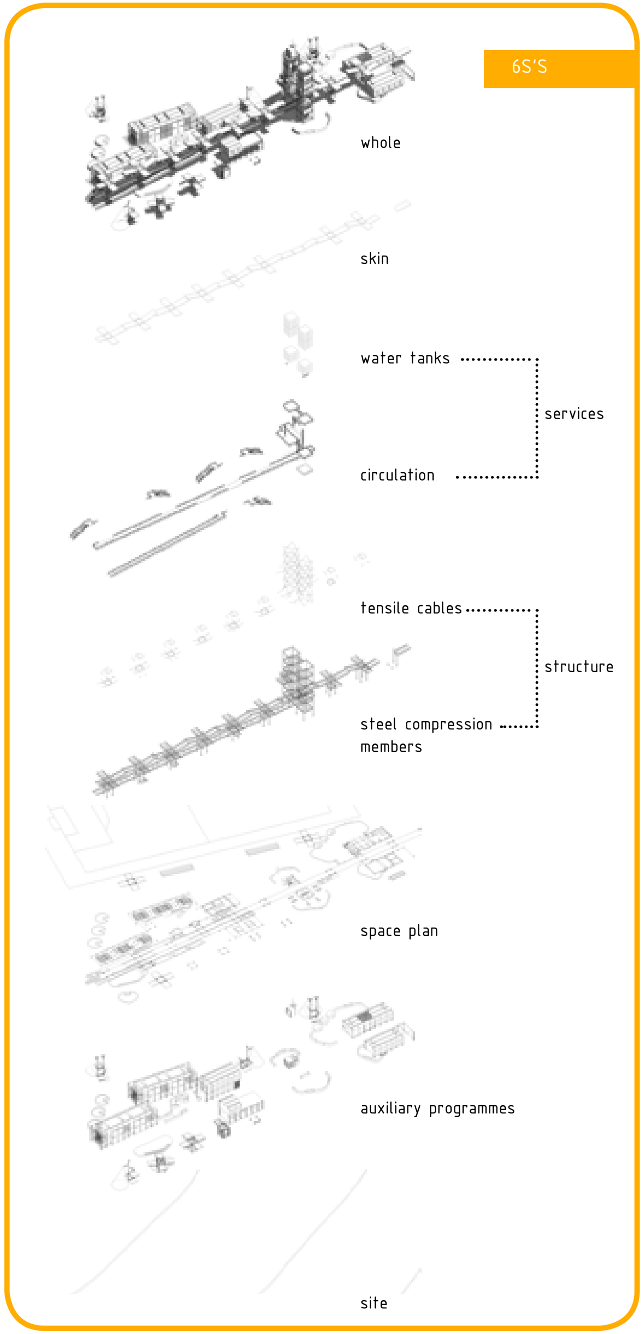
An adaptable structure should allow for reuse of the structure and its servant spine. A change in building programme or the introduction of a complete new programme should be facilitated to accommodate a future function and user.



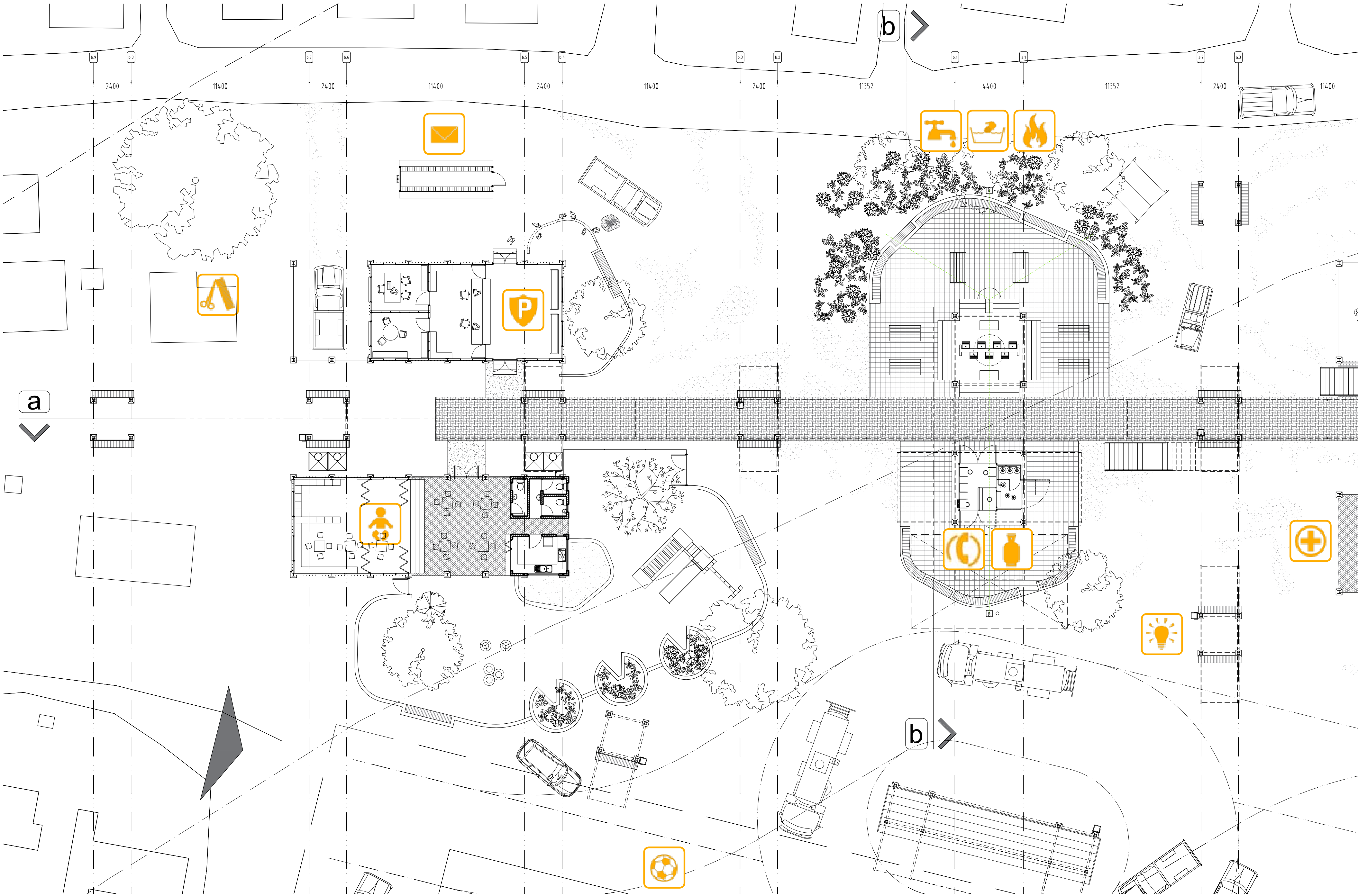


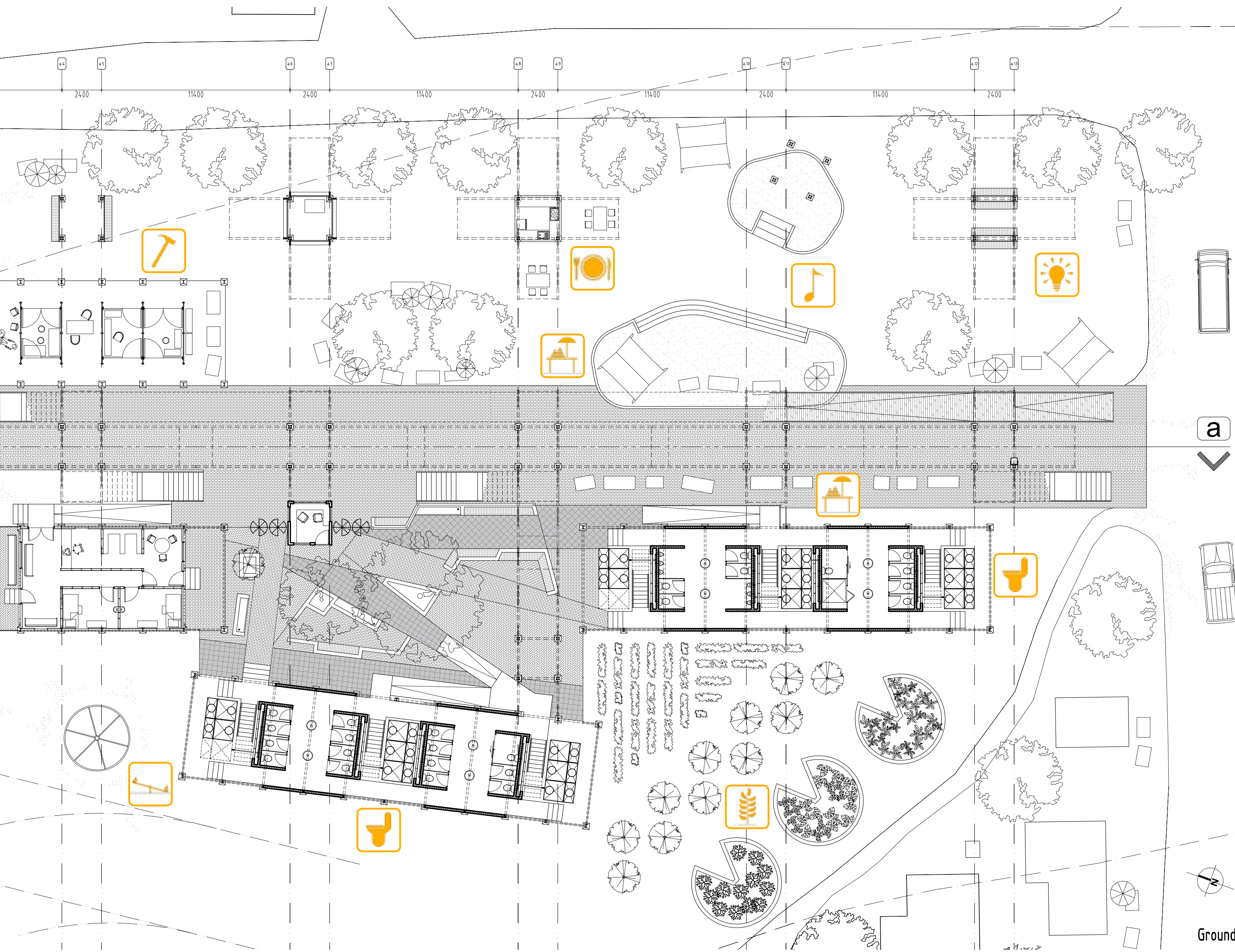
Locality map

Distance relation to educational facilities, taxi rank and main roads



Site plan
Representation of possible scenario at advanced stage of the servant cores life

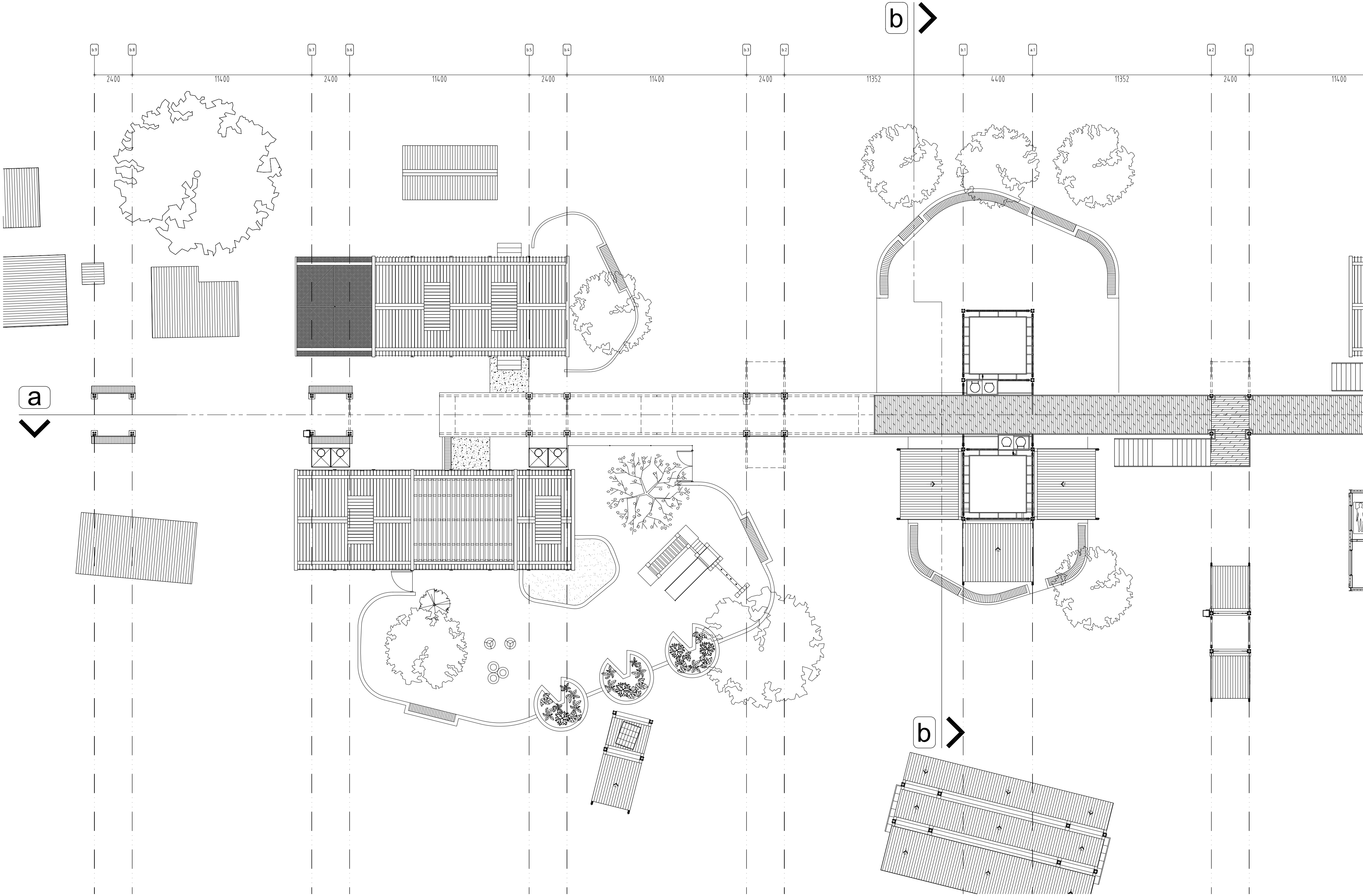

b
b9
b8
b7
b6
b5
b4
b3
b2
b1
a1
a2
a3
2400
11400
2400
11400
2400
11400
2400
11352
4400
11352
2400
11400
a
b

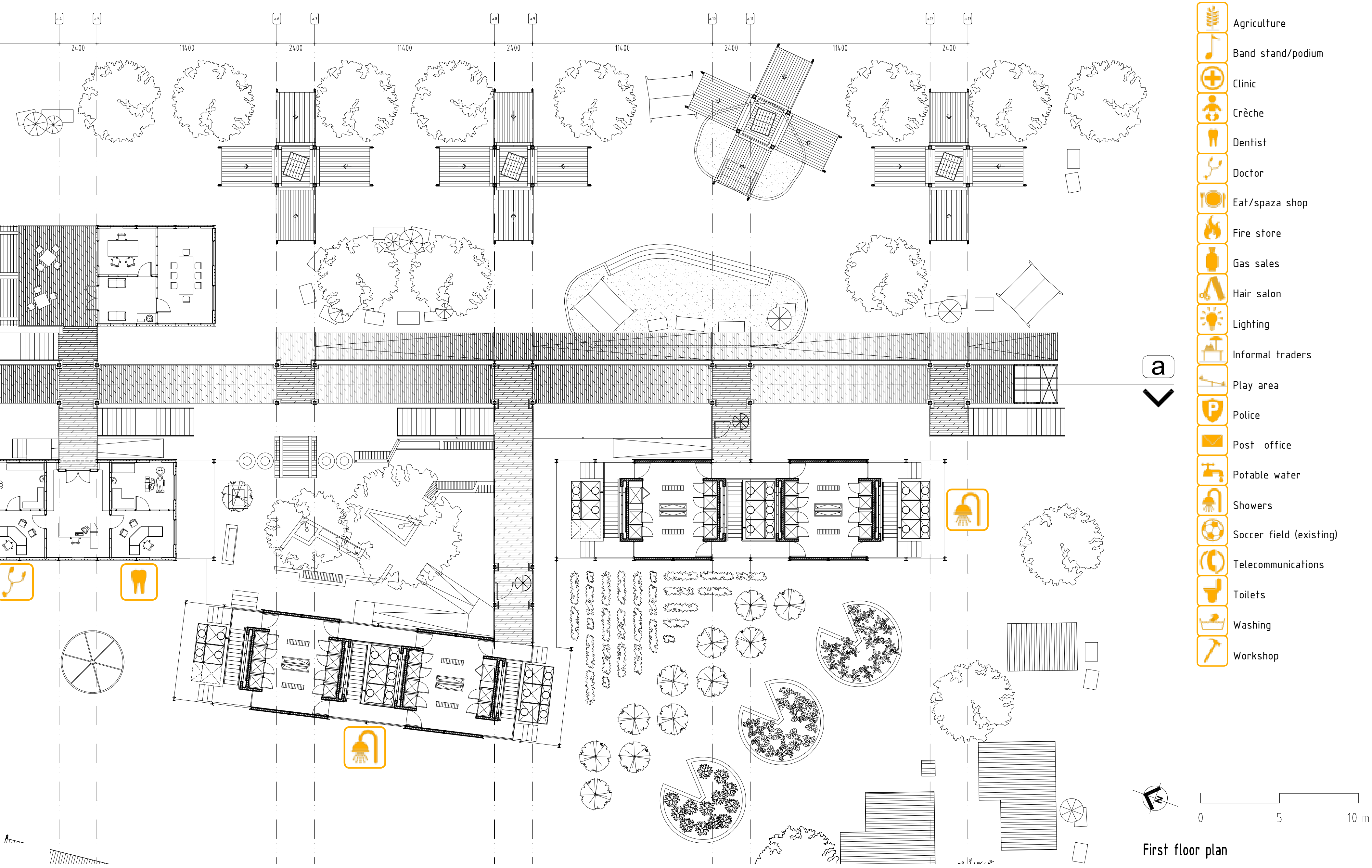


- Agriculture
- Band stand/podium
- Clinic
- Crèche
- Dentist
- Doctor
- Eat/spaza shop
- Fire store
- Gas sales
- Hair salon
- Lighting
- Informal traders
- Play area
- Police
- Post office
- Potable water
- Showers
- Soccer field (existing)
- Telecommunications
- Toilets
- Washing
- Workshop

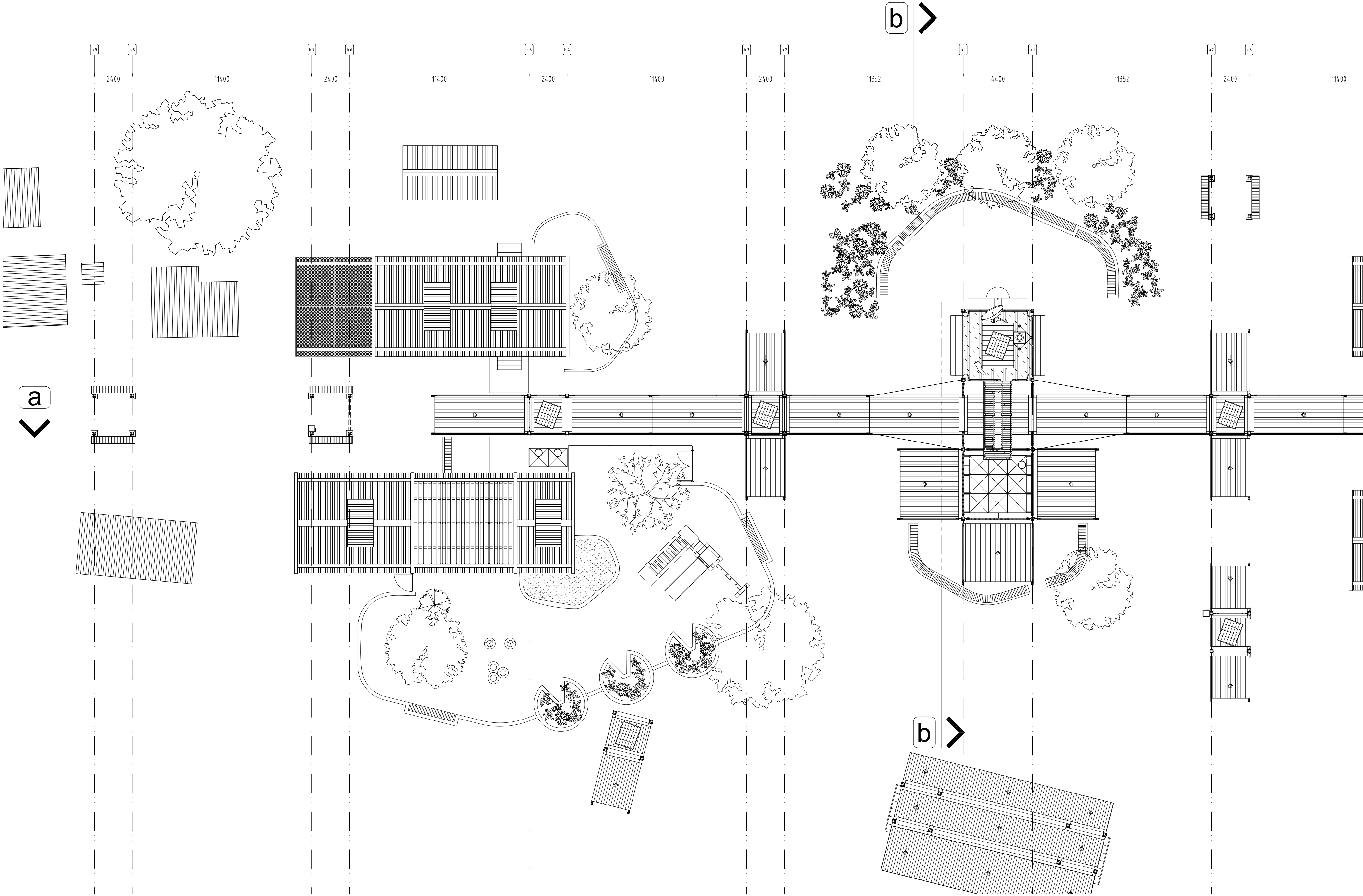
0 5 10 m

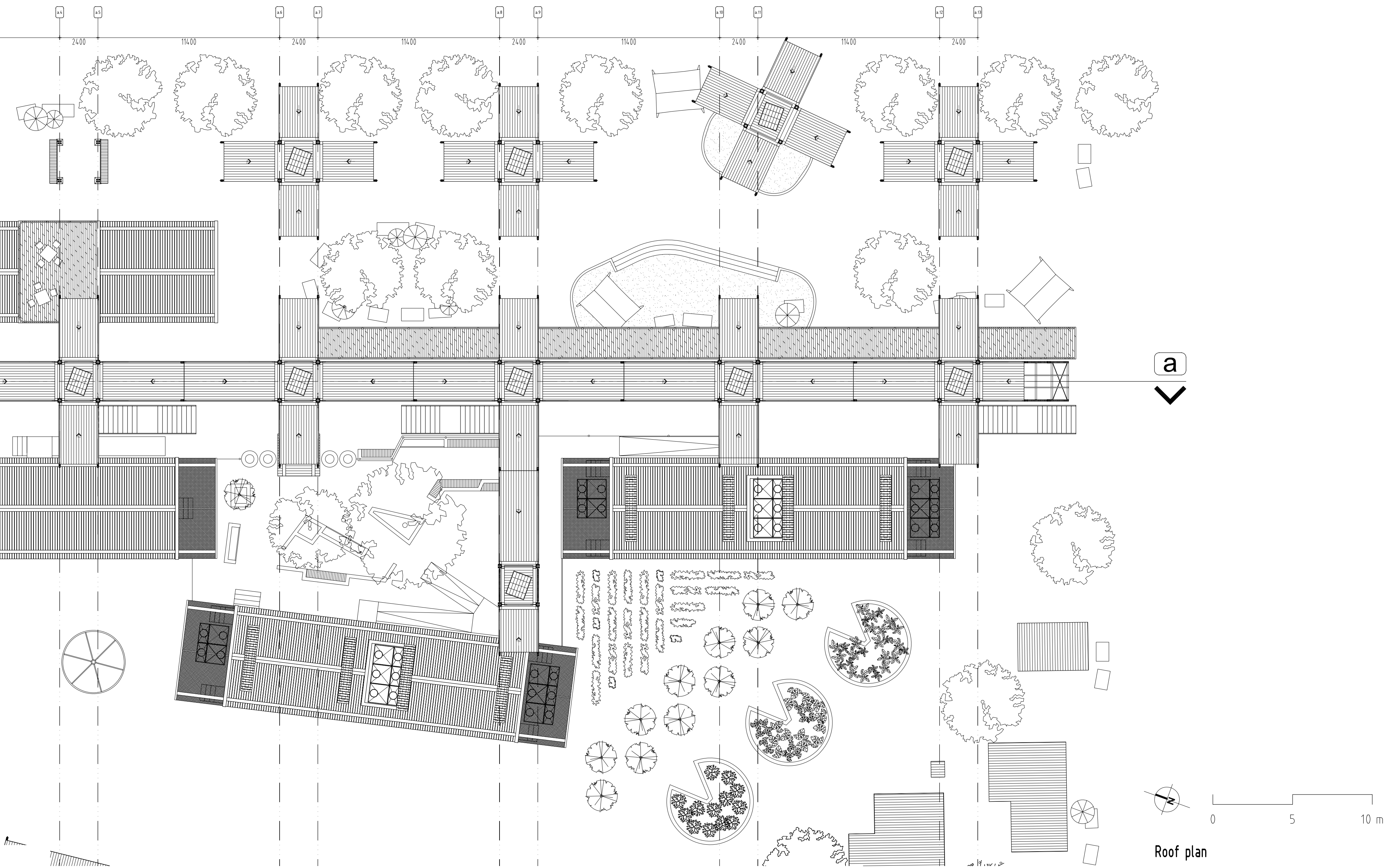
Ground plan


b
a
b
b.9
b.8
b.7
b.6
b.5
b.4
b.3
b.2
b.1
a.1
a.2
a.3
2400
11400
2400
11400
2400
11400
2400
11352
4400
11352
2400
11400

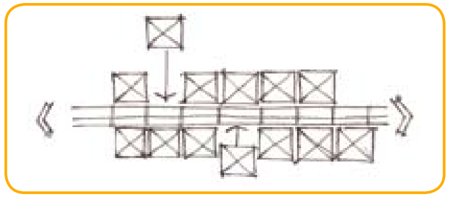


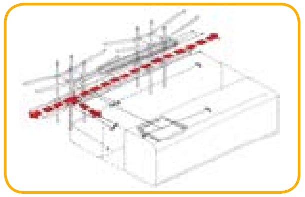
First floor plan


b
b.9
b.8
b.7
b.6
b.5
b.4
b.3
b.2
b.1
a.1
a.2
a.3
2400
11400
2400
11400
2400
11400
2400
11352
4400
11352
2400
11400
a
b

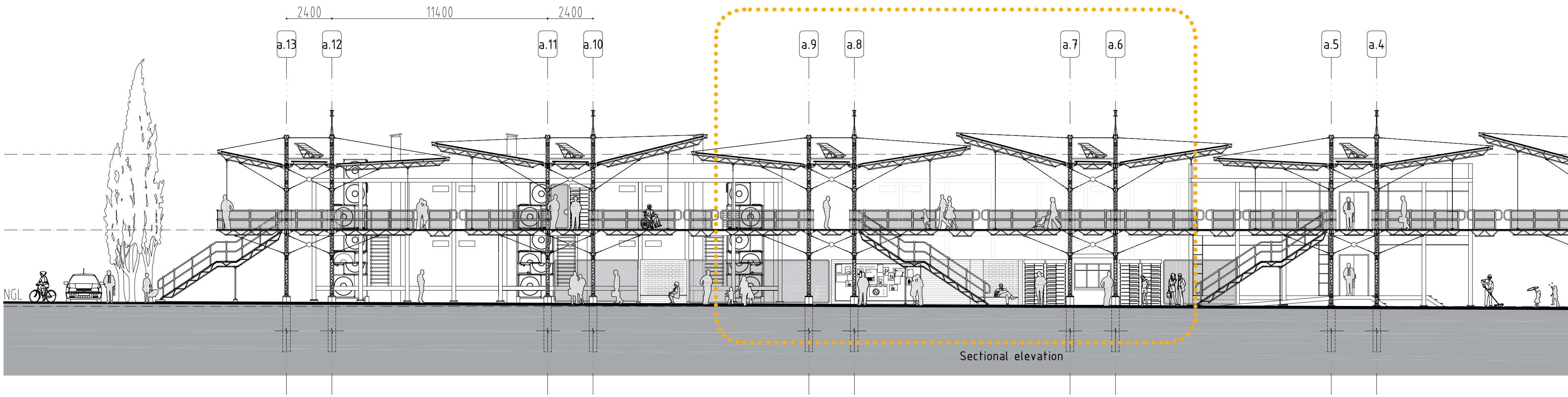

a.4
a.5
a.6
a.7
a.8
a.9
a.10
a.11
a.12
a.13
2400
11400
2400
11400
2400
11400
2400
11400
2400
a
0
5
10 m

Roof plan



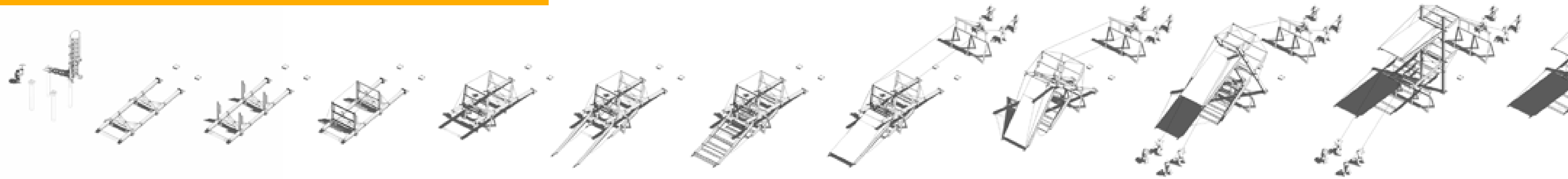


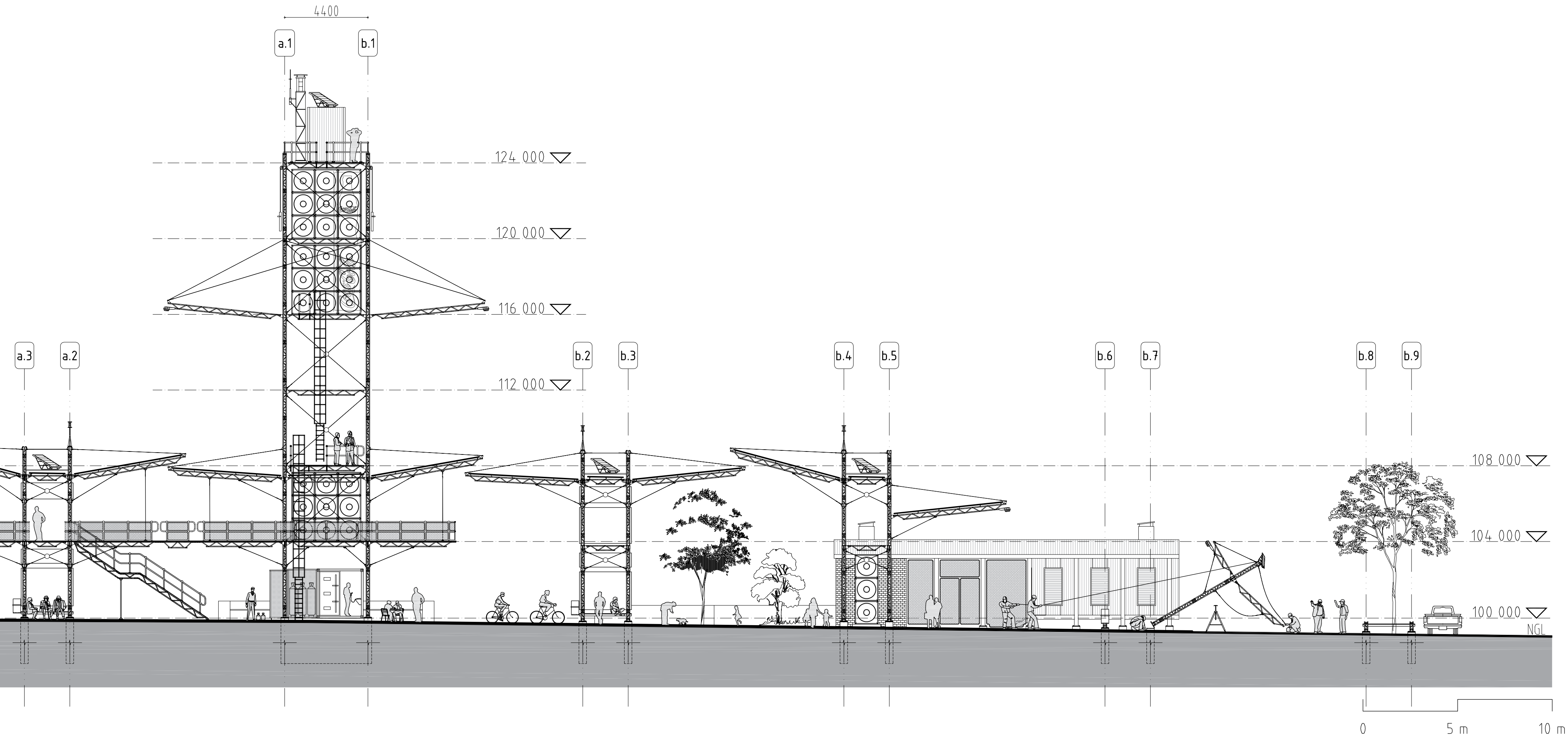
programme attachment



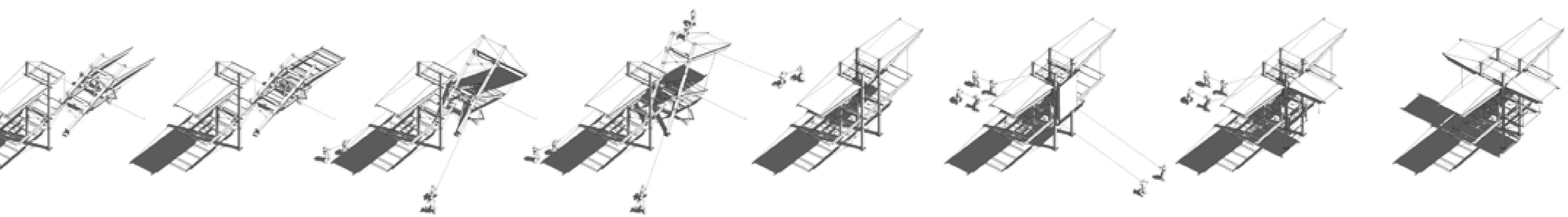
Sectional elevation

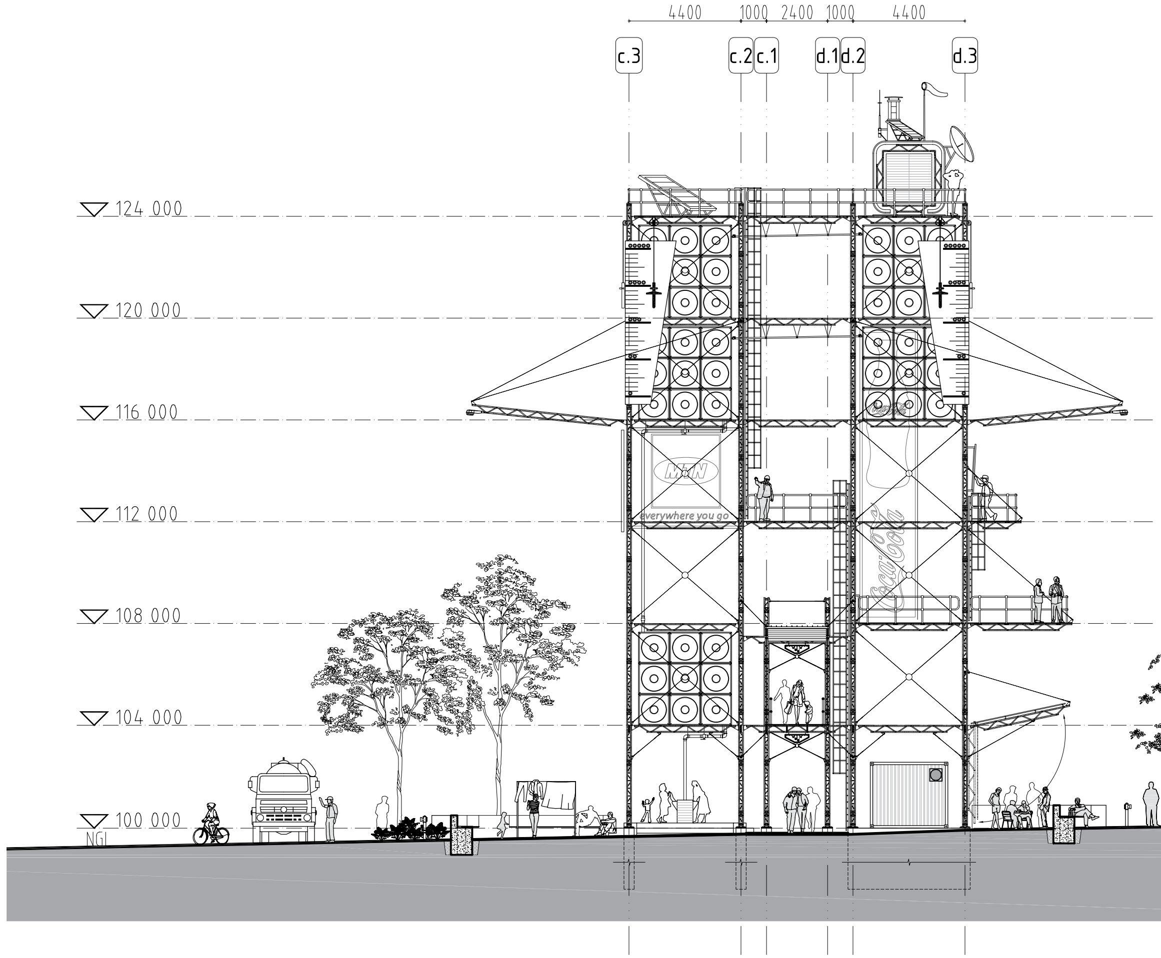
STRUCTURAL ASSEMBLY




4400
a.1
b.1
124 000
120 000
116 000
112 000
a.3
a.2
b.2
b.3
b.4
b.5
b.6
b.7
b.8
b.9
108 000
104 000
100 000
NGL
0
5 m
10 m

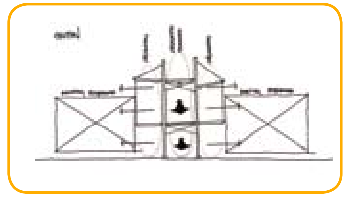
Section a-a





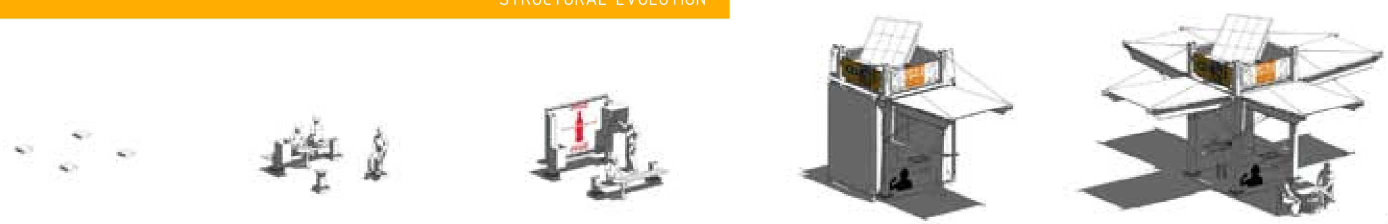
0
5 m
10 m

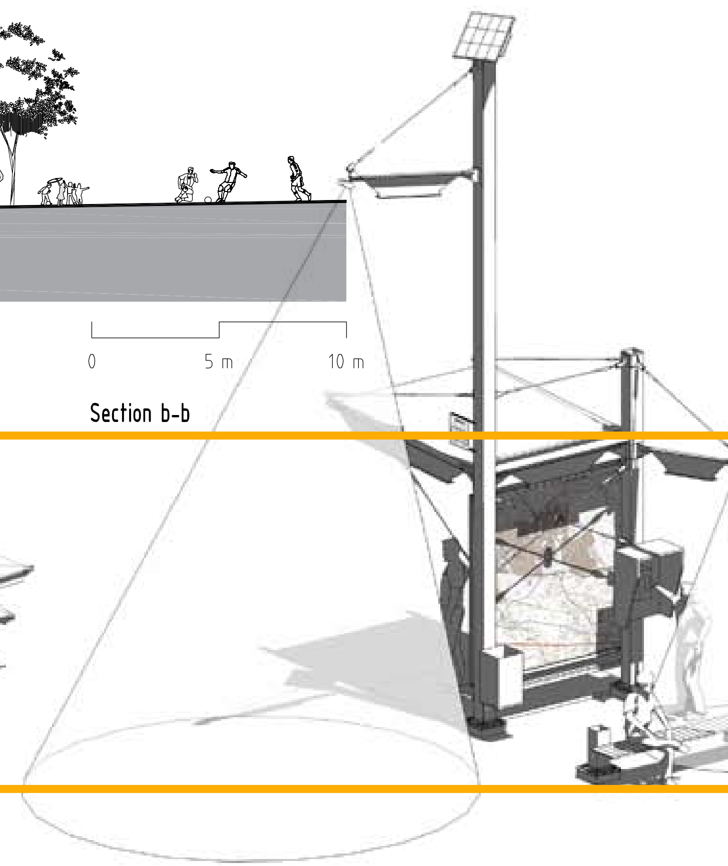
Section b-b

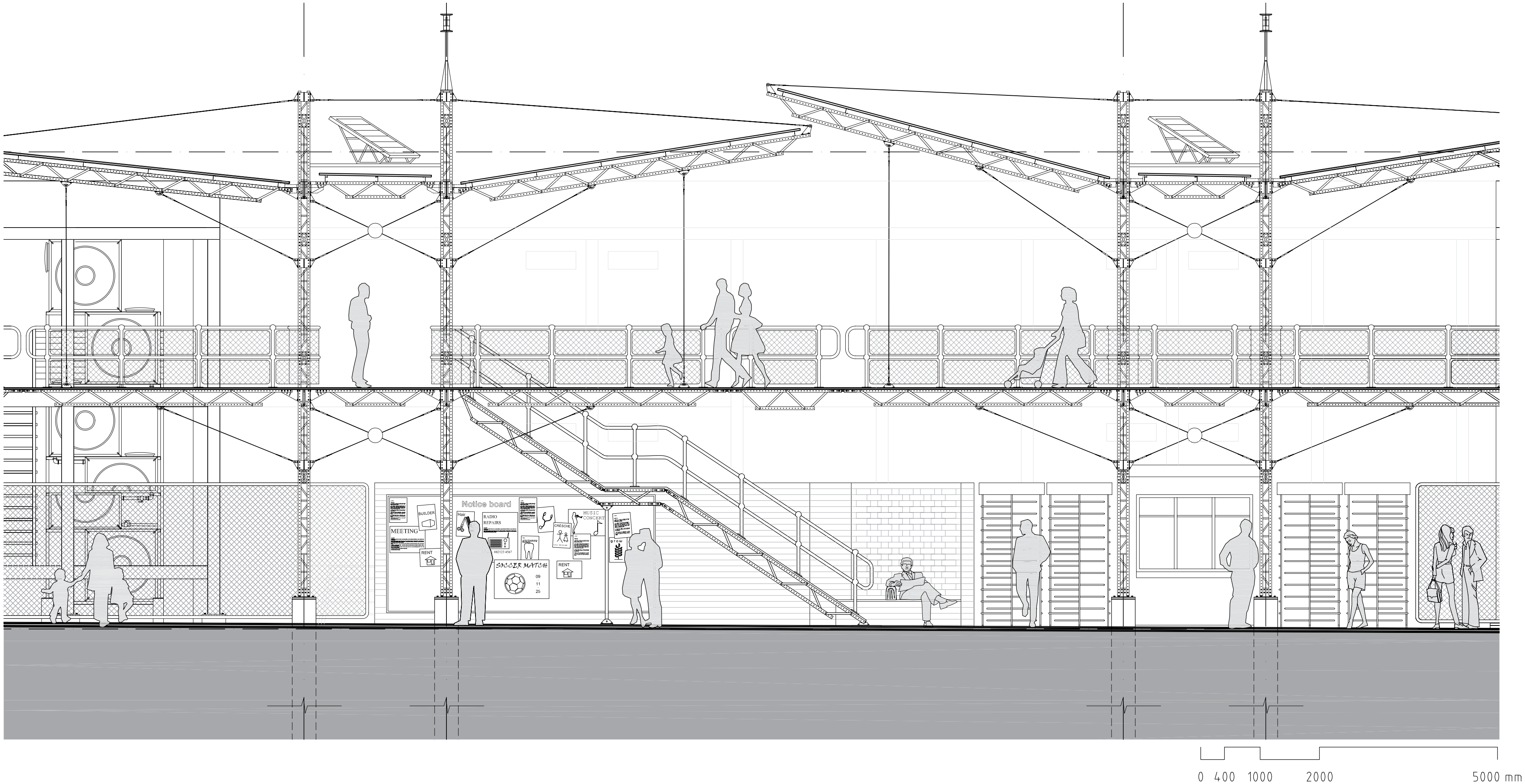


service distribution

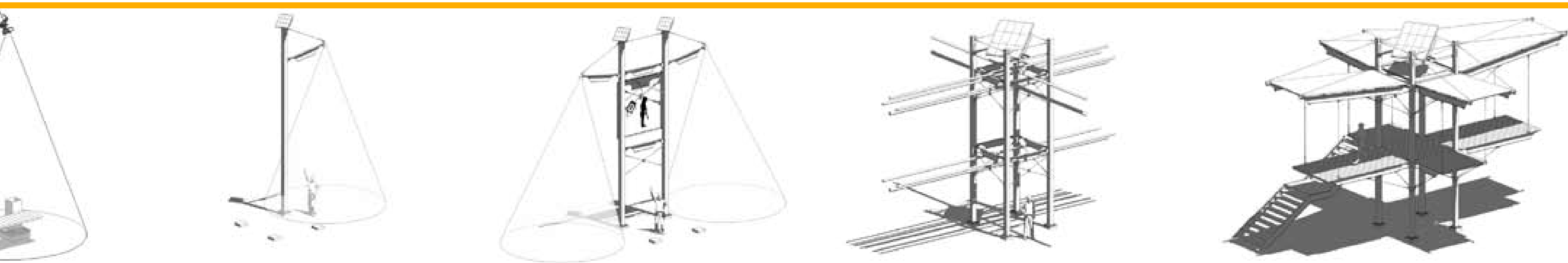
STRUCTURAL EVOLUTION



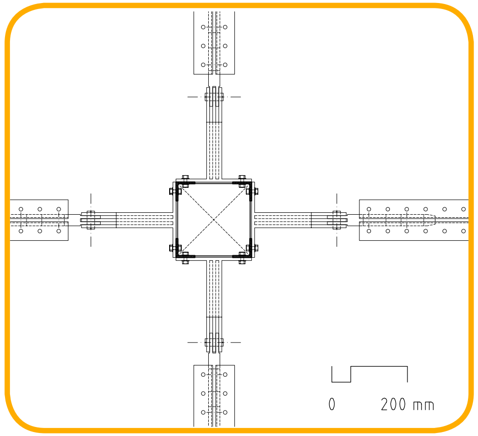




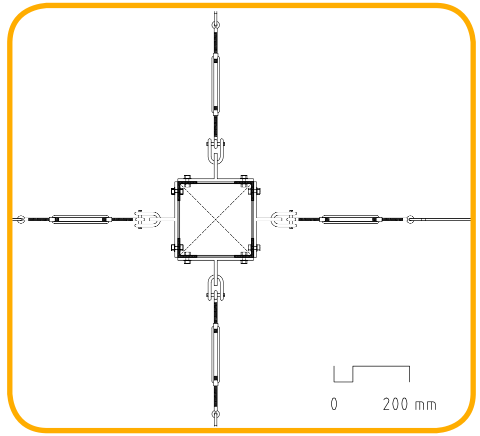
Sectional elevation



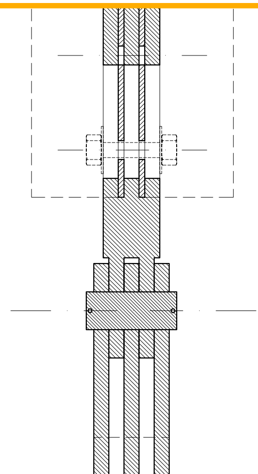
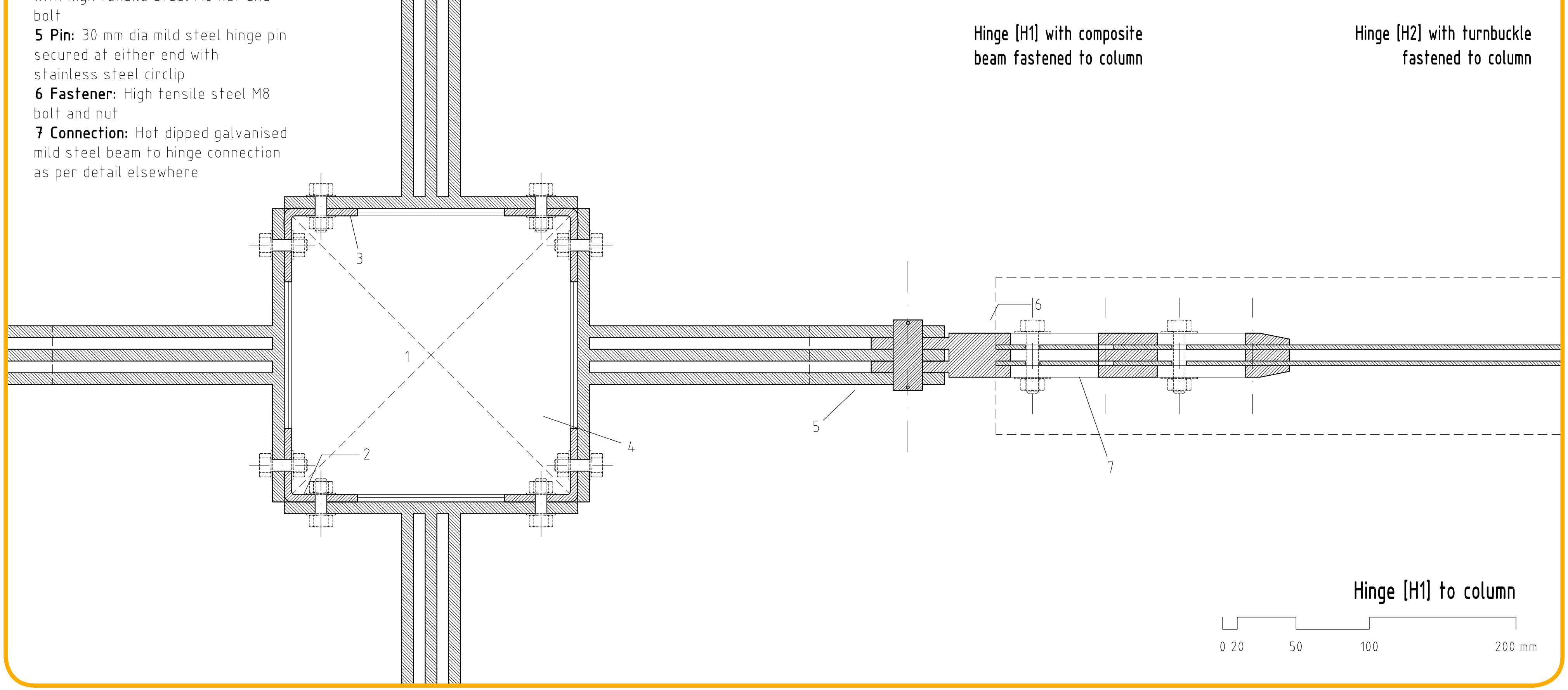
1 Column: Purpose made hot dipped galvanised steel lattice column
2 Corner bracing: 50 x 50 x 3,5 mm cold formed steel angle iron with pre-drilled 9 mm dia holes at 50 mm centres
3 Diagonal bracing: 30 mm wide x 2,5 mm thick flat steel web shop welded to angle irons prior to delivery on site and under factory conditions
4 Hinge: Hot dipped galvanised mild steel hinge [H1] manufactured off site under factory conditions and delivered on site as type H1 of the kit of parts
Fastened to steel lattice column with high tensile steel M8 nut and bolt
5 Pin: 30 mm dia mild steel hinge pin secured at either end with stainless steel circlip
6 Fastener: High tensile steel M8 bolt and nut
7 Connection: Hot dipped galvanised mild steel beam to hinge connection as per detail elsewhere



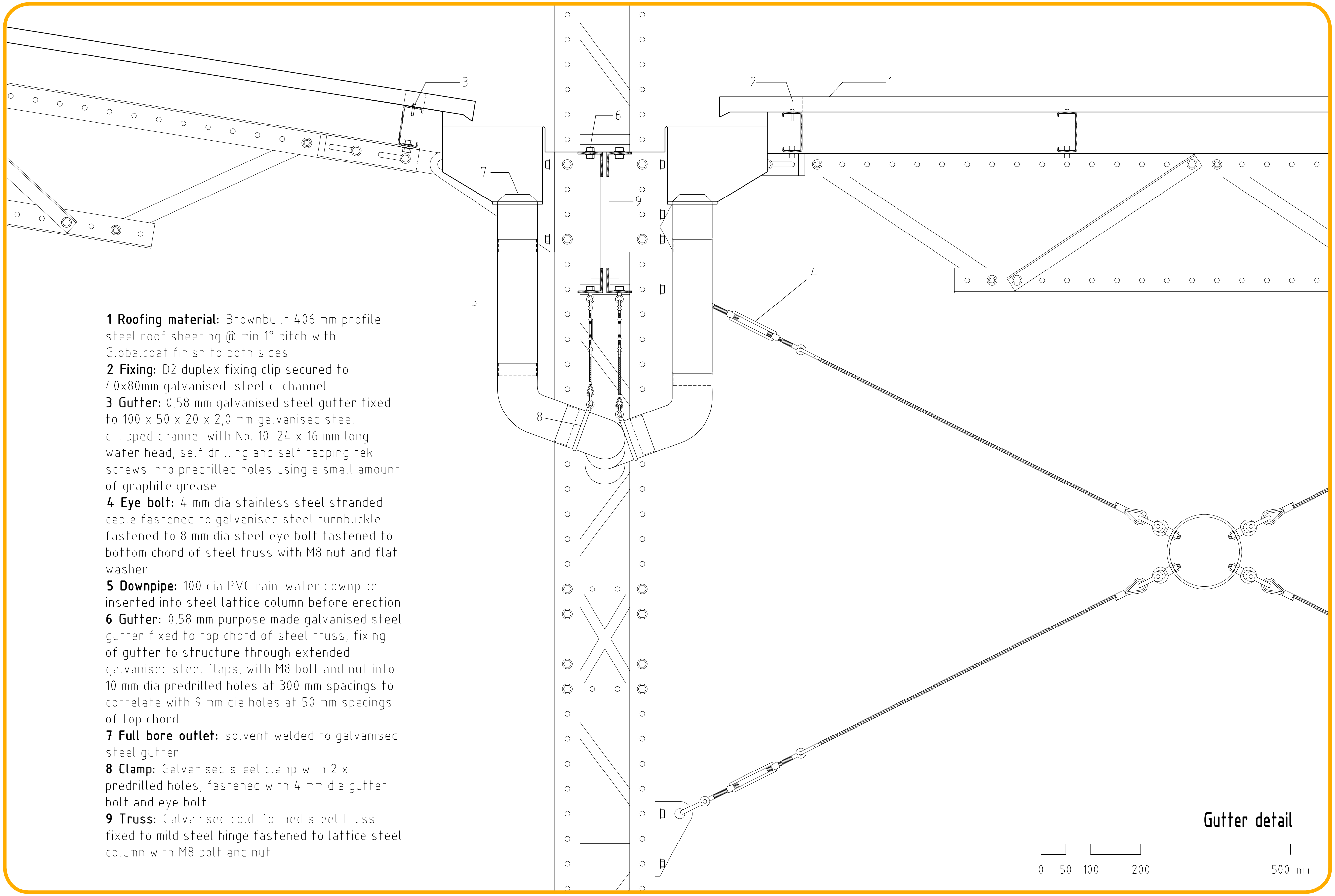
Hinge [H1] with composite beam fastened to column



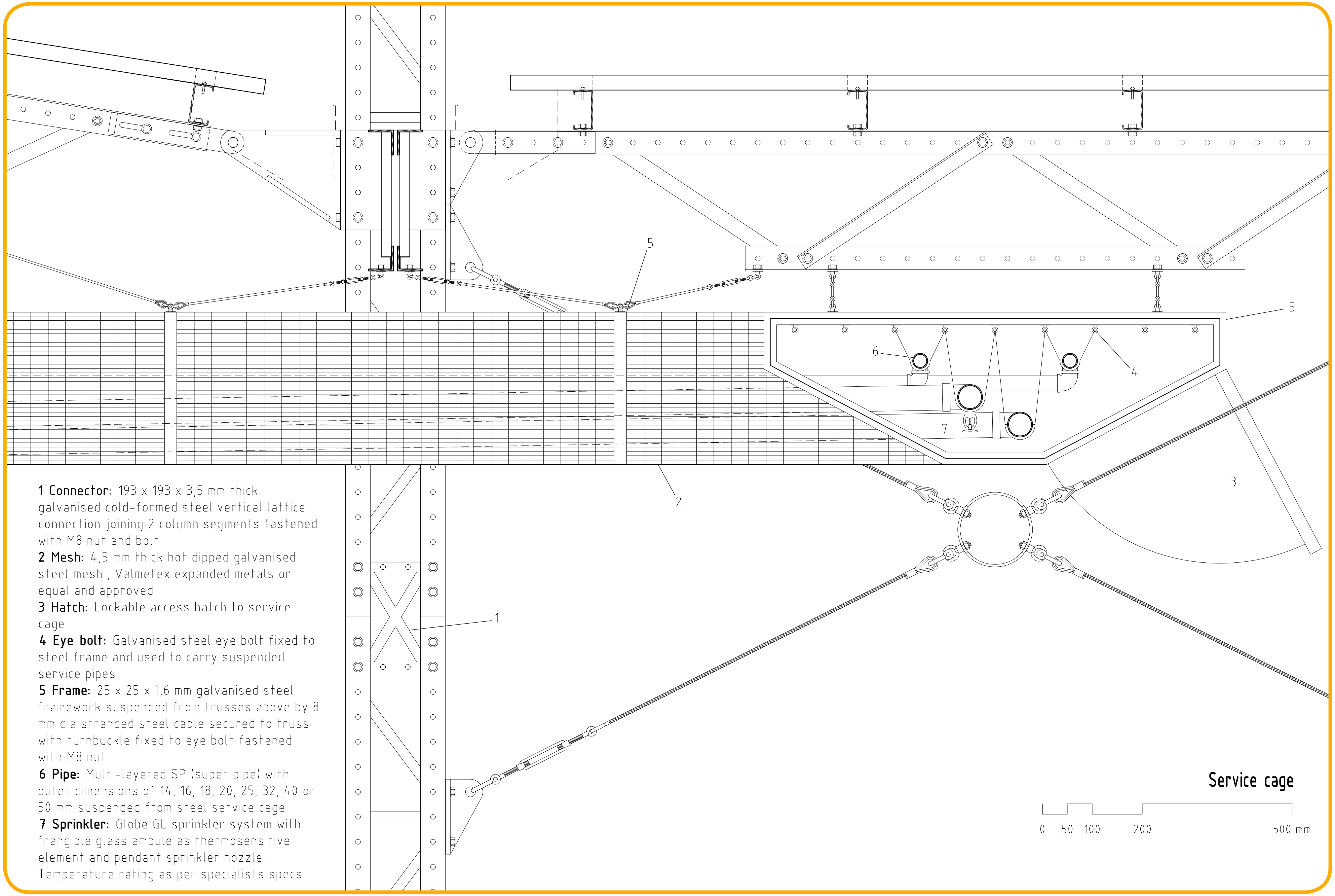
Hinge [H2] with turnbuckle fastened to column

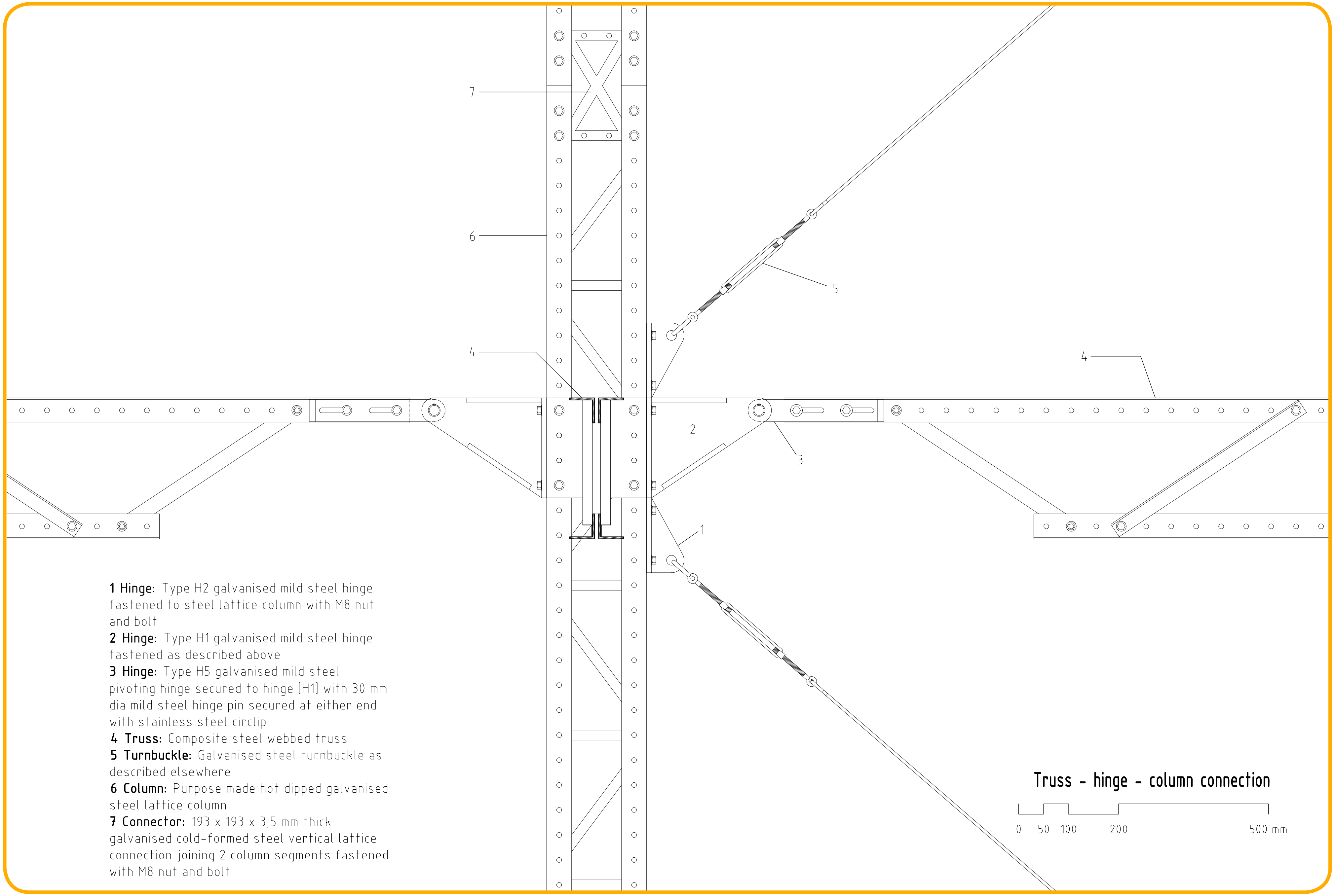
Hinge [H1] to column



1 Roofing material: Brownbuilt 406 mm profile steel roof sheeting @ min 1° pitch with Globalcoat finish to both sides
2 Fixing: D2 duplex fixing clip secured to 40x80mm galvanised steel c-channel
3 Gutter: 0,58 mm galvanised steel gutter fixed to 100 x 50 x 20 x 2,0 mm galvanised steel c-lipped channel with No. 10-24 x 16 mm long wafer head, self drilling and self tapping tek screws into predrilled holes using a small amount of graphite grease
4 Eye bolt: 4 mm dia stainless steel stranded cable fastened to galvanised steel turnbuckle fastened to 8 mm dia steel eye bolt fastened to bottom chord of steel truss with M8 nut and flat washer
5 Downpipe: 100 dia PVC rain-water downpipe inserted into steel lattice column before erection
6 Gutter: 0,58 mm purpose made galvanised steel gutter fixed to top chord of steel truss, fixing of gutter to structure through extended galvanised steel flaps, with M8 bolt and nut into 10 mm dia predrilled holes at 300 mm spacings to correlate with 9 mm dia holes at 50 mm spacings of top chord
7 Full bore outlet: solvent welded to galvanised steel gutter
8 Clamp: Galvanised steel clamp with 2 x predrilled holes, fastened with 4 mm dia gutter bolt and eye bolt
9 Truss: Galvanised cold-formed steel truss fixed to mild steel hinge fastened to lattice steel column with M8 bolt and nut



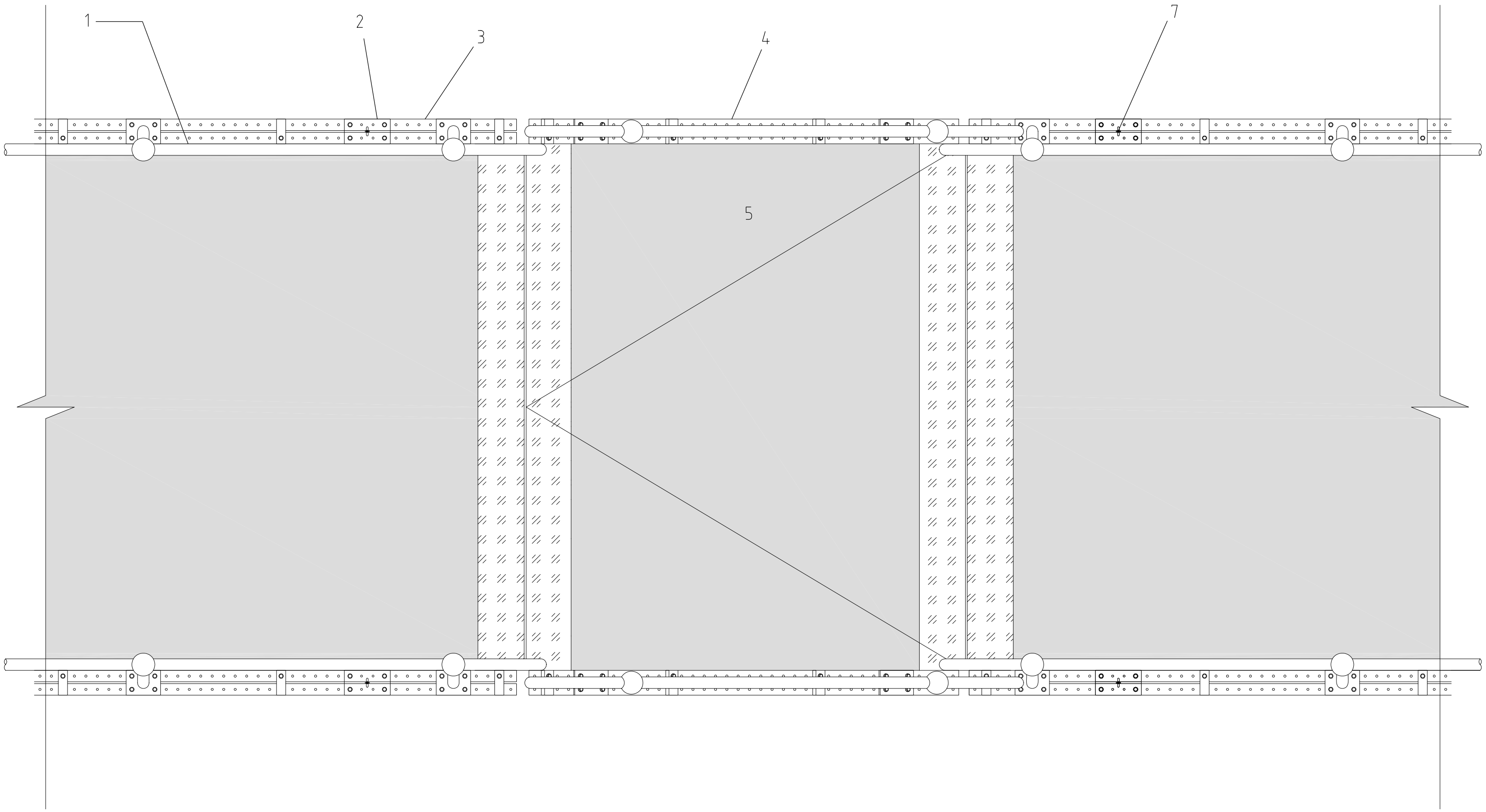
1 Connector: 193 x 193 x 3,5 mm thick galvanised cold-formed steel vertical lattice connection joining 2 column segments fastened with M8 nut and bolt
2 Mesh: 4,5 mm thick hot dipped galvanised steel mesh , Valmetex expanded metals or equal and approved
3 Hatch: Lockable access hatch to service cage
4 Eye bolt: Galvanised steel eye bolt fixed to steel frame and used to carry suspended service pipes
5 Frame: 25 x 25 x 1,6 mm galvanised steel framework suspended from trusses above by 8 mm dia stranded steel cable secured to truss with turnbuckle fixed to eye bolt fastened with M8 nut
6 Pipe: Multi-layered SP (super pipe) with outer dimensions of 14, 16, 18, 20, 25, 32, 40 or 50 mm suspended from steel service cage
7 Sprinkler: Globe GL sprinkler system with frangible glass ampule as thermosensitive element and pendant sprinkler nozzle. Temperature rating as per specialists specs



1 Hinge: Type H2 galvanised mild steel hinge fastened to steel lattice column with M8 nut and bolt
2 Hinge: Type H1 galvanised mild steel hinge fastened as described above
3 Hinge: Type H5 galvanised mild steel pivoting hinge secured to hinge [H1] with 30 mm dia mild steel hinge pin secured at either end with stainless steel circlip
4 Truss: Composite steel webbed truss
5 Turnbuckle: Galvanised steel turnbuckle as described elsewhere
6 Column: Purpose made hot dipped galvanised steel lattice column
7 Connector: 193 x 193 x 3,5 mm thick galvanised cold-formed steel vertical lattice connection joining 2 column segments fastened with M8 nut and bolt

Truss - hinge - column connection

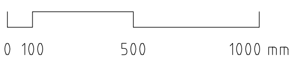
0 50 100 200 500 mm

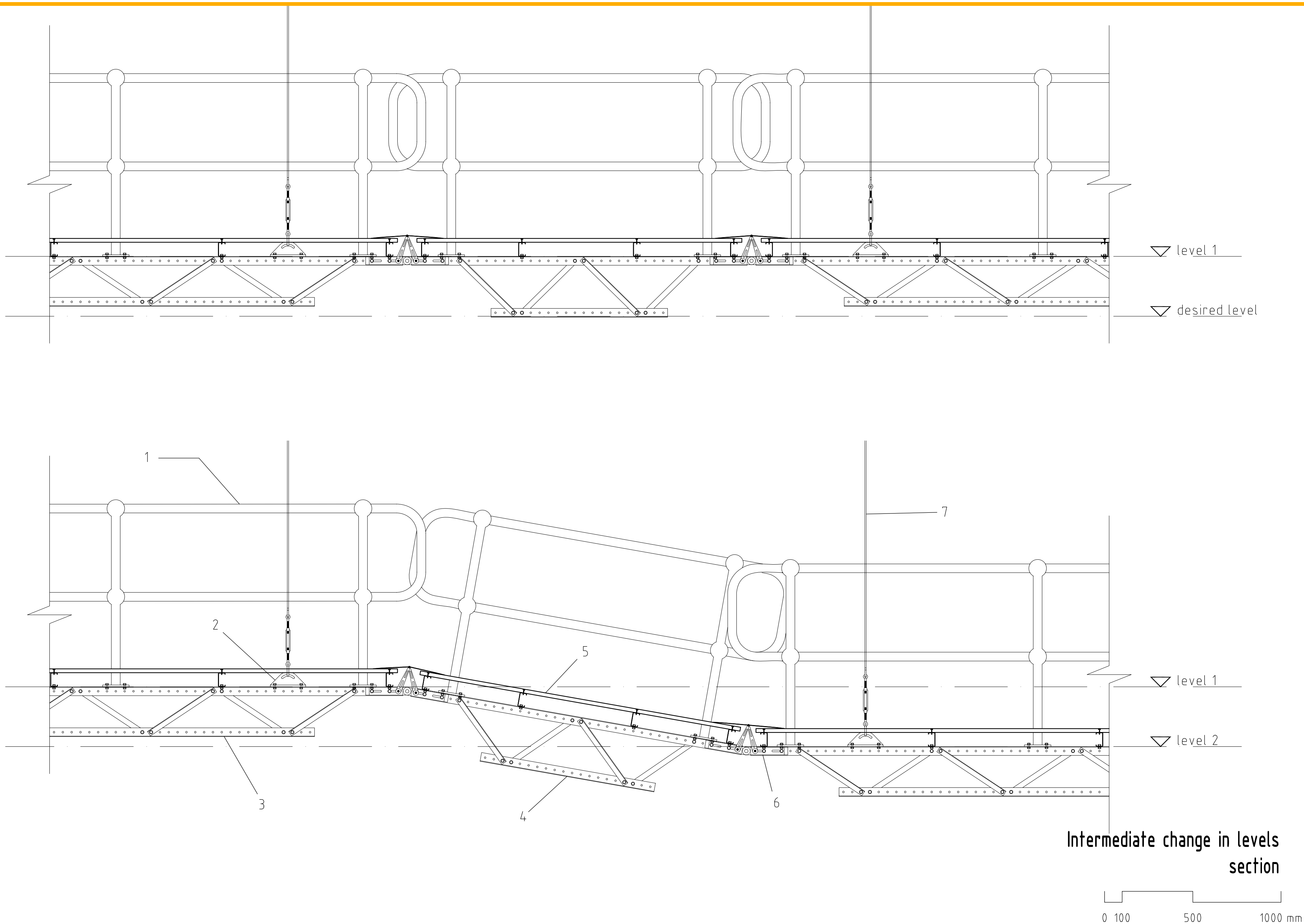


1 Balustrade: Mild steel ball type We cro lok hand-rail system with stanchions placed max 1,8 m apart fastened to top chord of composite beam with galvanised M8 nut and bolt
2 Hinge: Type H3 galvanised mild steel hinge
3 Truss: Truss composition of cold formed angle irons (50 x 50 x 3 mm). For design purposes top and bottom chord increment lengths = 500 mm. All chords to be pre-drilled with 9 mm dia holes spaced at 50 mm centres. Diagonal webs manufactured from 30 x 30 x 2 mm angles in lengths of 450 mm. Trusses of increasing depths are produced by fixing the web at closer intervals.

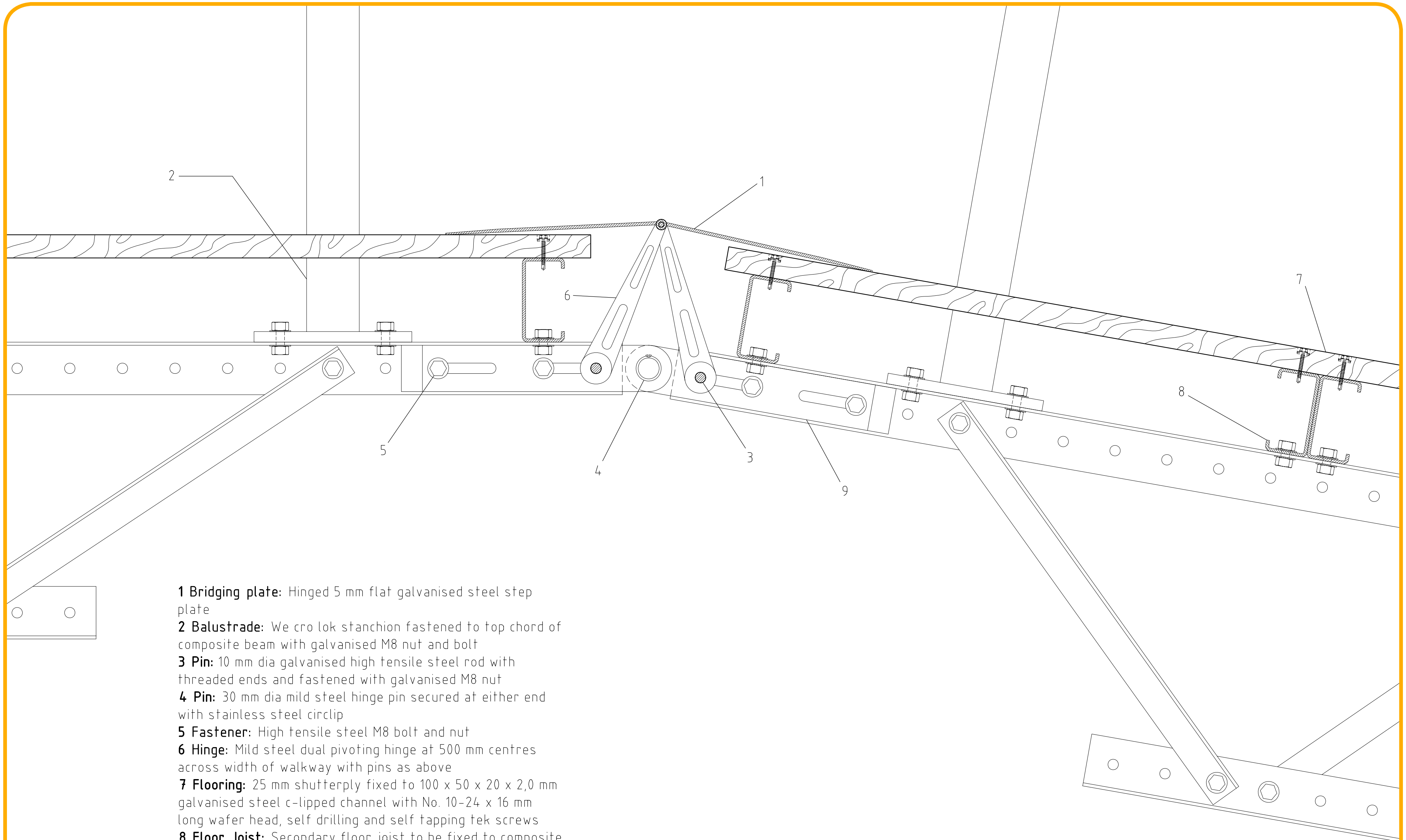
4 Truss: 2000 mm intermediately connected composite webbed truss
5 Flooring: 25 mm shutterply fixed to 100 x 50 x 20 x 2,0 mm galvanised steel c-lipped channel with No. 10-24 x 16 mm long wafer head, self drilling and self tapping tek screws
6 Connector: Galvanised mild steel hinged connector joining beam to beam and secured to beams with M8 nut and bolt
7 Cable: 4 mm dia stainless steel stranded cable

Intermediate change in levels plan



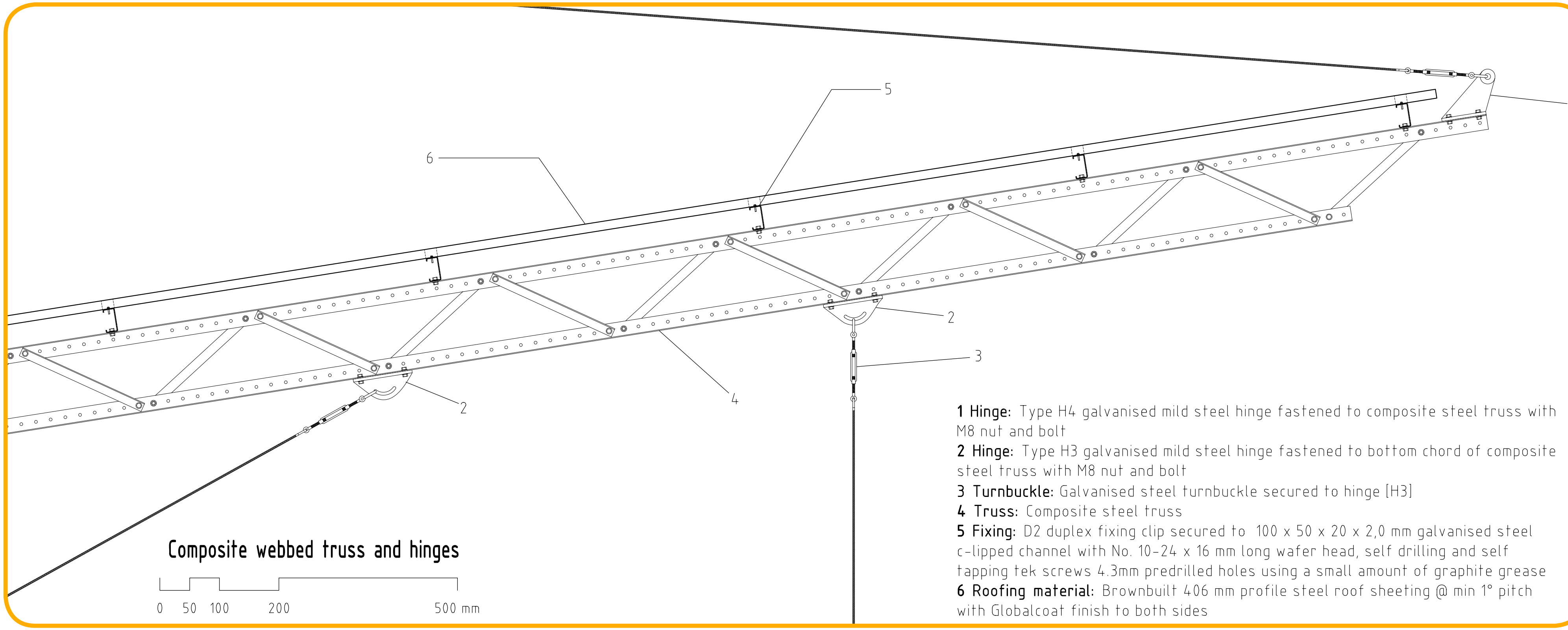


Intermediate change in levels
section



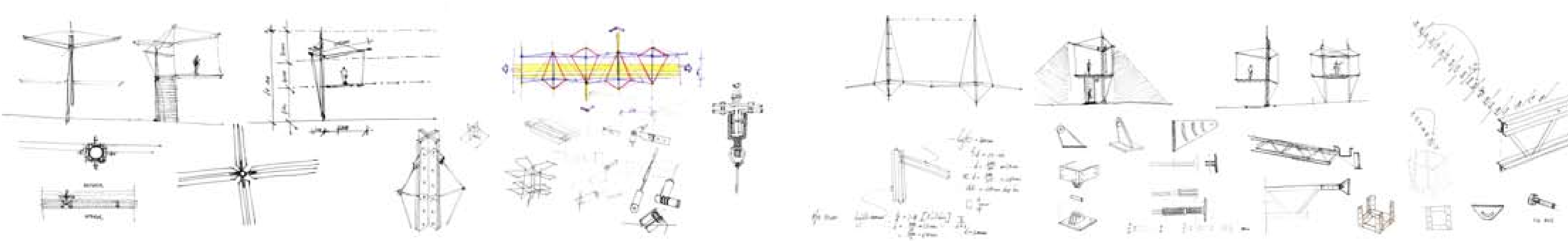
1 Bridging plate: Hinged 5 mm flat galvanised steel step plate
2 Balustrade: We cro lok stanchion fastened to top chord of composite beam with galvanised M8 nut and bolt
3 Pin: 10 mm dia galvanised high tensile steel rod with threaded ends and fastened with galvanised M8 nut
4 Pin: 30 mm dia mild steel hinge pin secured at either end with stainless steel circlip
5 Fastener: High tensile steel M8 bolt and nut
6 Hinge: Mild steel dual pivoting hinge at 500 mm centres across width of walkway with pins as above
7 Flooring: 25 mm shutterply fixed to 100 x 50 x 20 x 2,0 mm galvanised steel c-lipped channel with No. 10-24 x 16 mm long wafer head, self drilling and self tapping tek screws
8 Floor Joist: Secondary floor joist to be fixed to composite steel beam where 2 shutterply floor boards meet
9 Connector: Galvanised mild steel hinged connector joining beam to beam and secured to beams with M8 nut and bolt

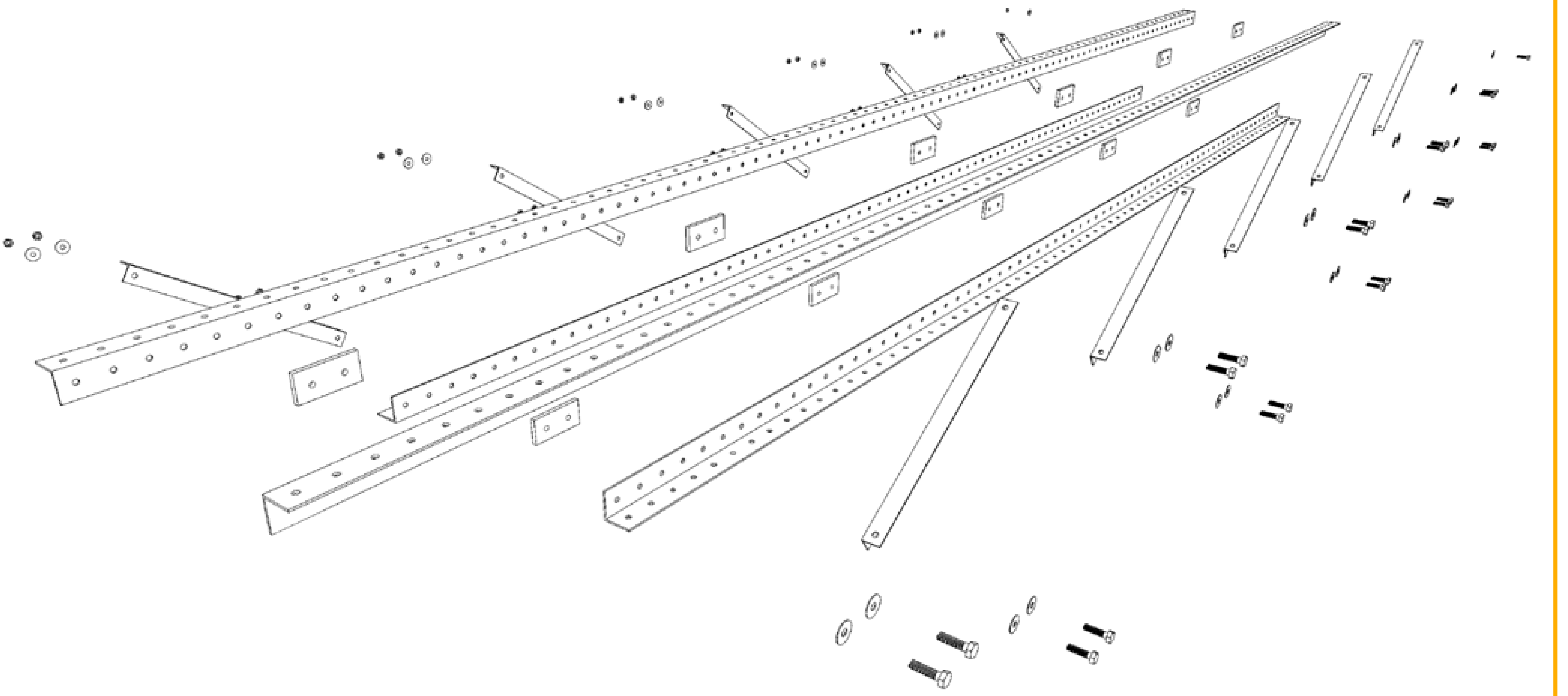
Beam to beam connection



Composite webbed truss and hinges

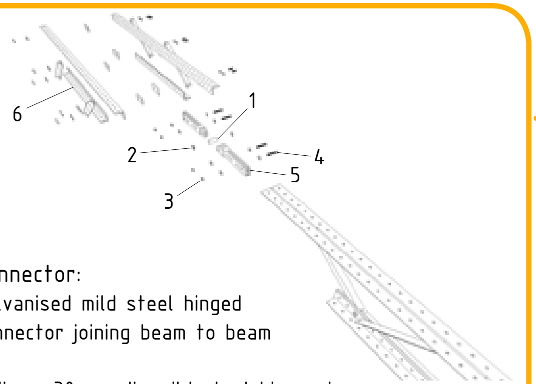
1 Hinge: Type H4 galvanised mild steel hinge fastened to composite steel truss with M8 nut and bolt
2 Hinge: Type H3 galvanised mild steel hinge fastened to bottom chord of composite steel truss with M8 nut and bolt
3 Turnbuckle: Galvanised steel turnbuckle secured to hinge [H3]
4 Truss: Composite steel truss
5 Fixing: D2 duplex fixing clip secured to 100 x 50 x 20 x 2,0 mm galvanised steel c-lipped channel with No. 10-24 x 16 mm long wafer head, self drilling and self tapping tek screws 4.3mm predrilled holes using a small amount of graphite grease
6 Roofing material: Brownbuilt 406 mm profile steel roof sheeting @ min 1° pitch with Globalcoat finish to both sides





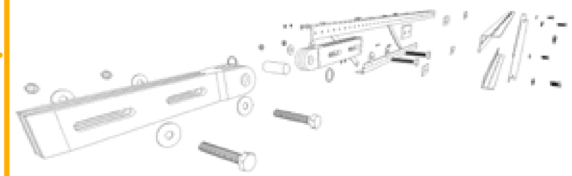
Assembly of composite steel webbed truss

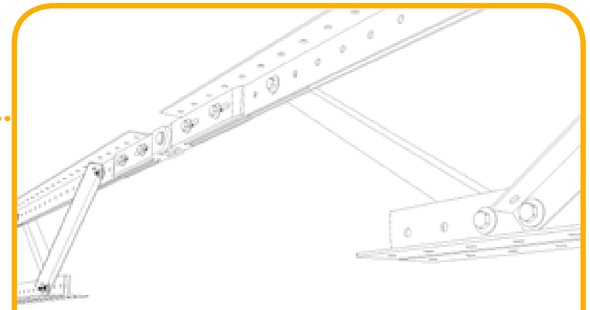
Truss composition of cold formed angle irons (50 x 50 x 3,5 mm). For design purposes top and bottom chord increment lengths = 500 mm. All chords to be pre-drilled with 9 mm dia holes spaced at 50 mm centres. Diagonal webs manufactured from 30 x 30 x 2 mm angles in lengths of 450 mm. Trusses of increasing depths are produced by fixing the web at closer intervals.

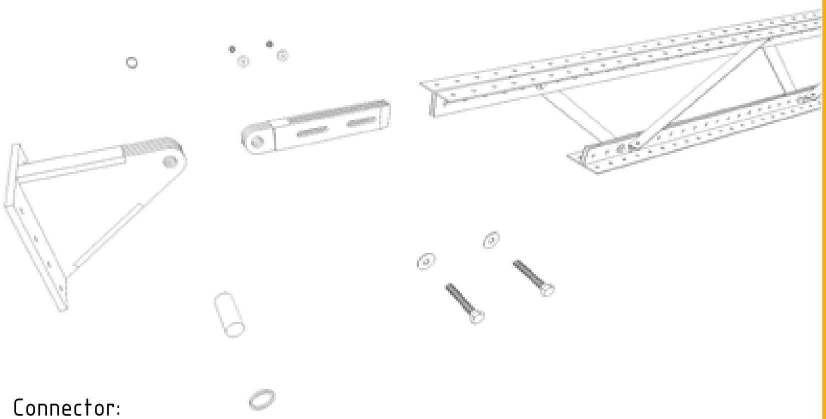


Connector:
Galvanised mild steel hinged
connector joining beam to beam

1 Hinge: 30 mm dia mild steel hinge pin
2 Fastener: Stainless steel circlip
3 Tamper proof nut: Galvanised high tensile steel series 76 M8 Guard-Nut
4 Fastener: High tensile steel M8 bolt
5 Hinge: Type H5 galvanised mild steel pivoting hinge
6 Truss chord: 50 x 50 x 3,5 mm cold-formed steel angle iron used as top and bottom chord of truss.

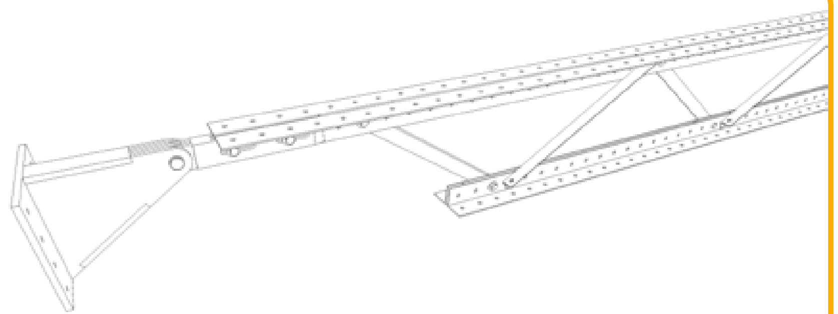






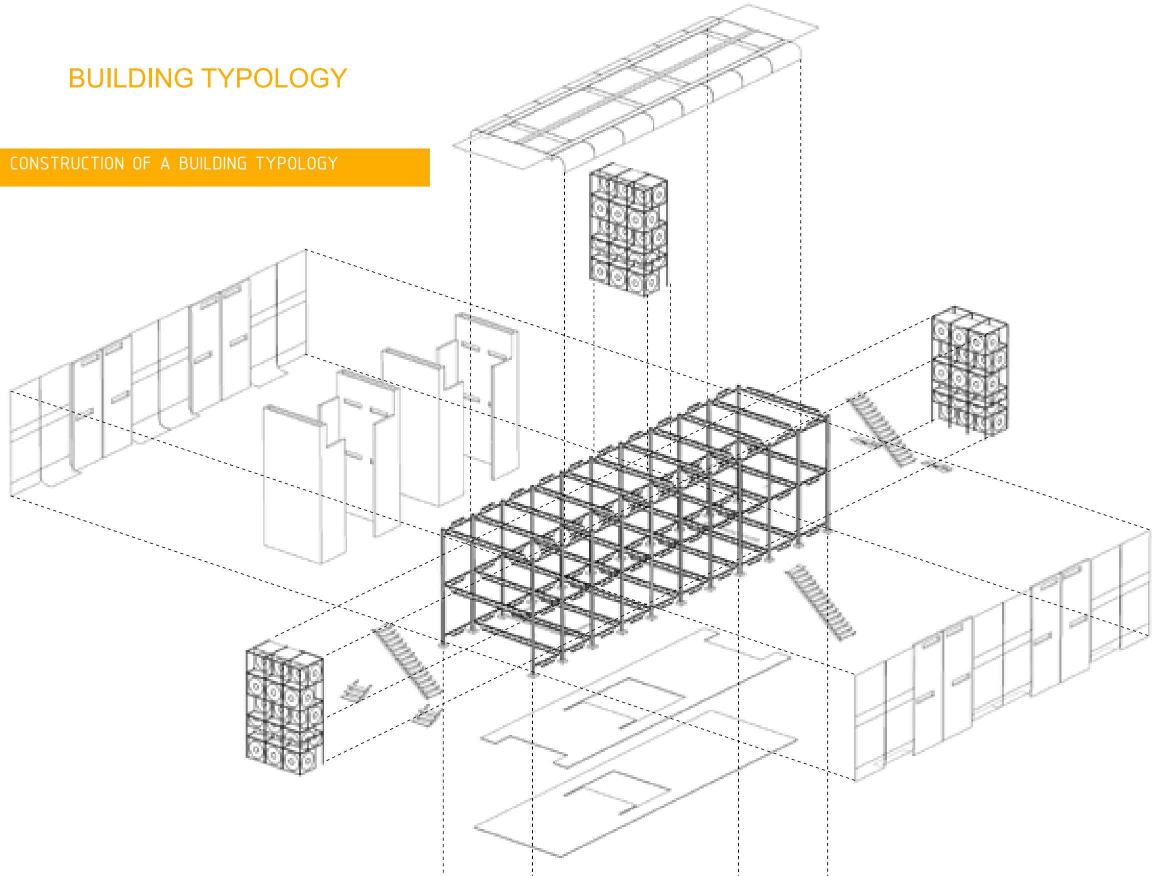
Connector:
Galvanised mild steel hinged connector joining
beam to hinge H1 secured to steel lattice column

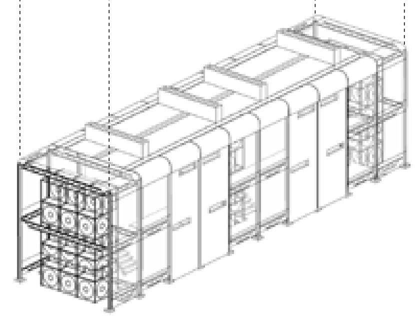
component parts as described elsewhere



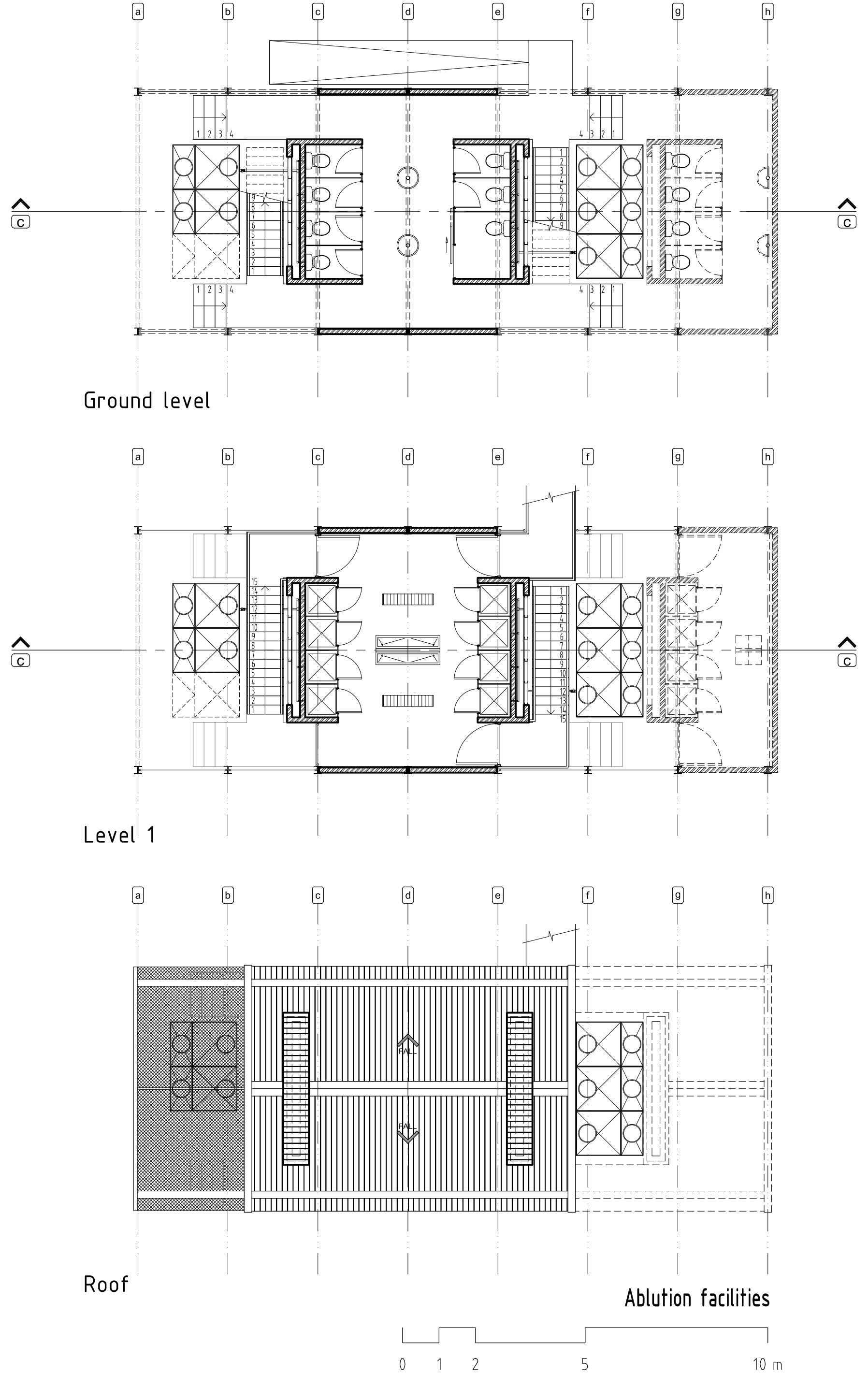
BUILDING TYPOLOGY

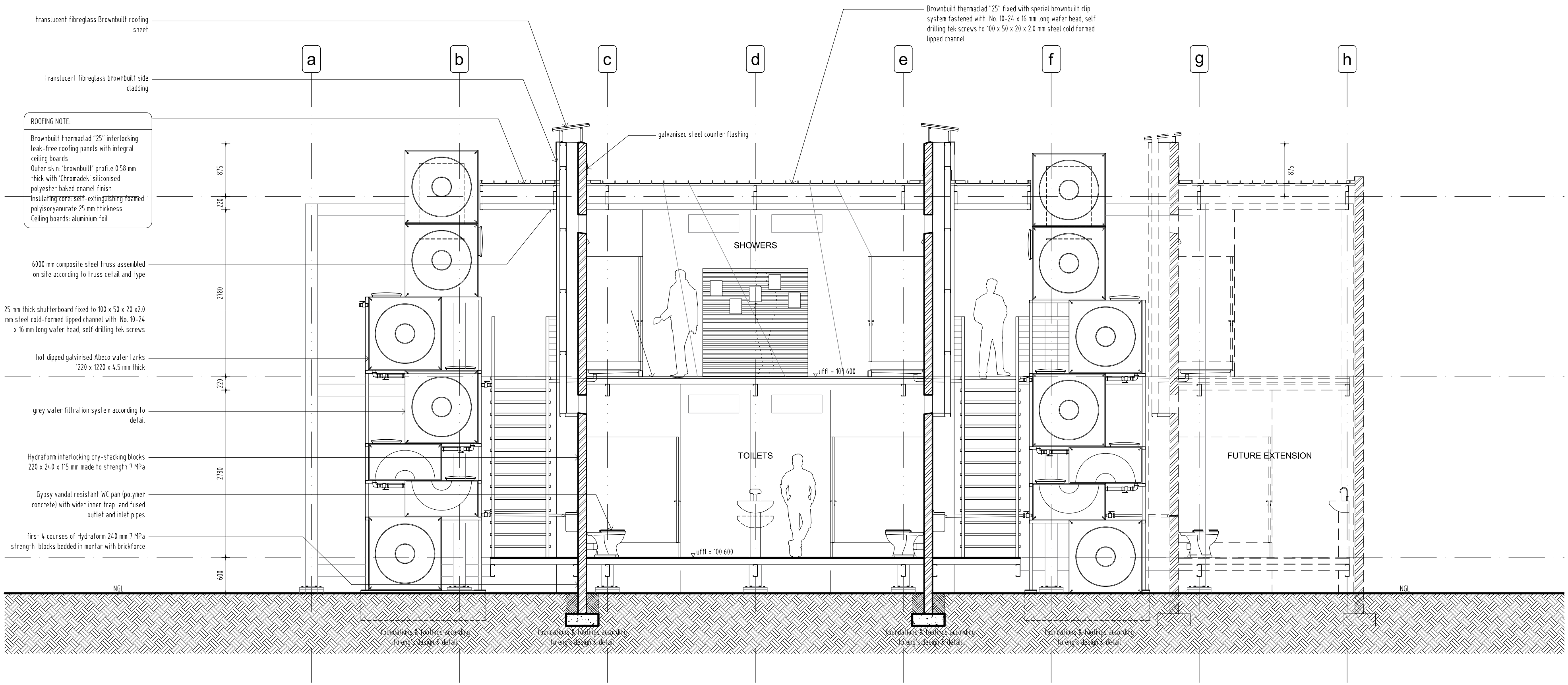
CONSTRUCTION OF A BUILDING TYPOLOGY





MODULAR
BROWNBUILT SKIN

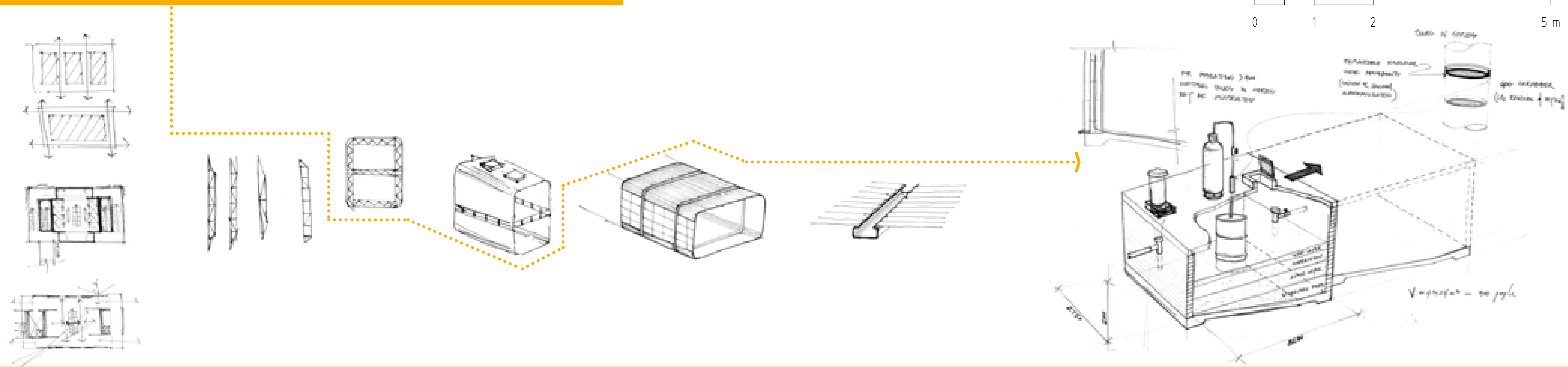




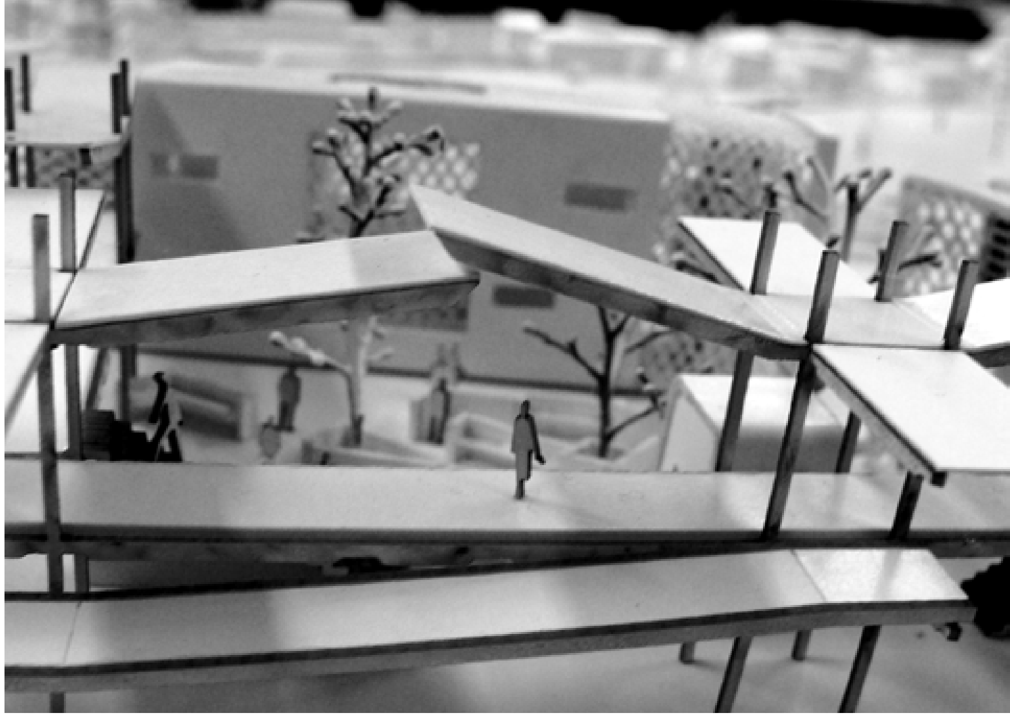
section through ablution facilities

0 1 2 5 m

CONSTRUCTION OF A BUILDING TYPOLOGY



MODEL - DAYTIME



MODEL - NIGHTTIME