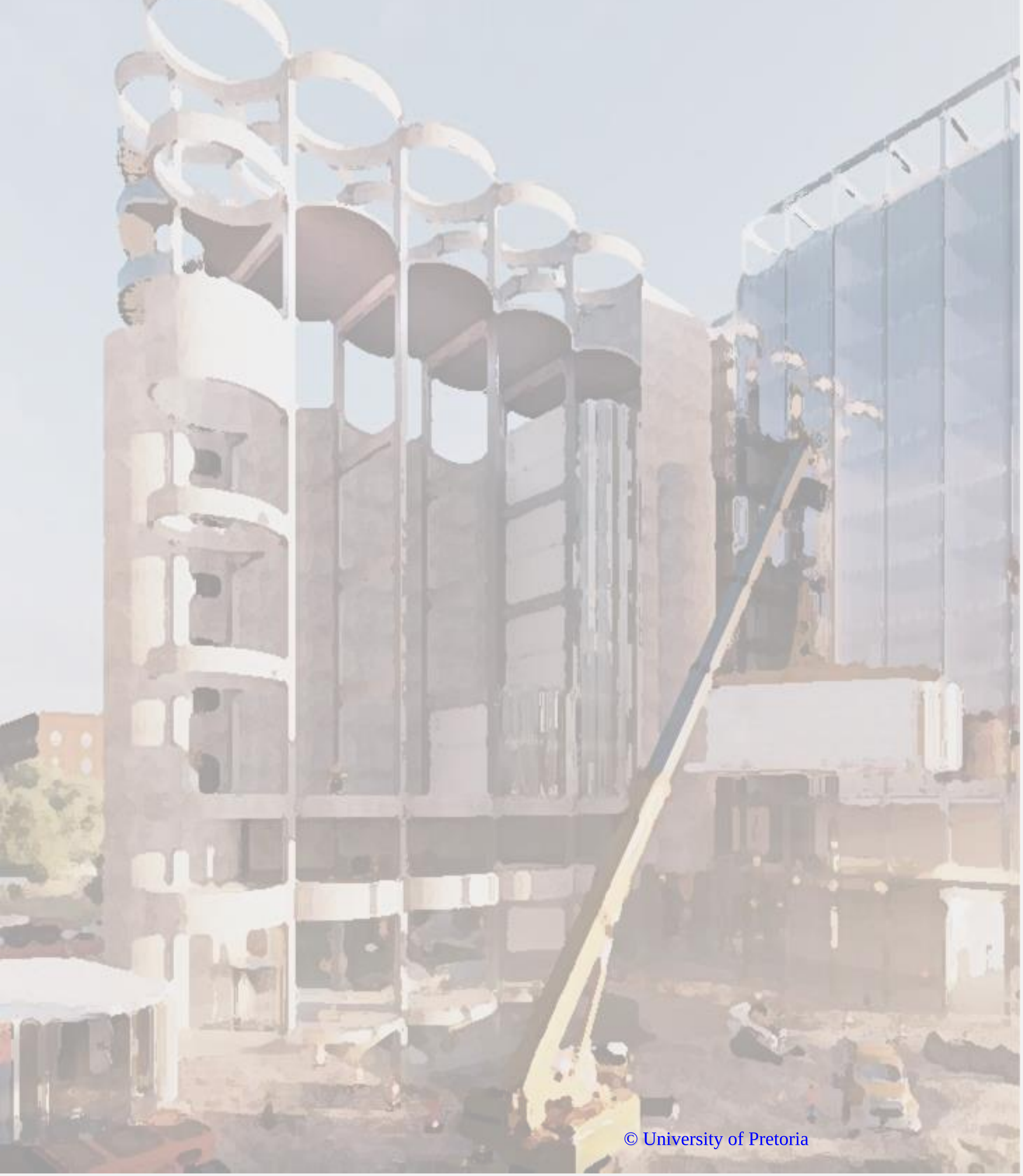
SUSTAINABLE URBAN TRANSFORMATION

RETHINKING BUILT ENVIRONMENT DEVELOPMENT THROUGH ADAPTIVE REUSE TECHNIQUES AND TECHNOLOGY



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Abstract

The built environment in the industry responsible for giving of most CO2 gas emissions and has the biggest environmental load of any industry in South Africa, yet in the 21st century with its consumer culture buildings which physical lifespan has not yet depleted get demolished and new ones built without adaptive reuse considerations (UNEP, 2009:9).

Adaptive reuse techniques are the most effective way to reduce the environmental load of a building but often it is overlooked because of its daunting nature and professionals not knowing how to approach it (Conejos, Langston, & Smith, 2012: 37).

Recent sustainability standards encourage built professionals to reuse and reduce the environmental load of the construction industry through adaptive reuse.

The aim of this dissertation is to research and develop architectural adaptive reuse technology and techniques to replace traditional demolishing and new built practice, and reuse technology for circular material lifespan in architecture. The intention is to develop a system of adapting and reusing built structure.

Declaration

In accordance with Regulation 4(c) of the General Regulations (G.57) for dissertations and theses, I declare that this dissertation, which I hereby submit for the degree Master of Architecture (Professional) at the University of Pretoria, is my own work and has not previously been submitted by me for a degree at this or any other tertiary institution.

I further state that no part of my dissertation has already been, or is currently being, submitted for any such degree, diploma or other qualification.

I further declare that this dissertation is substantially my own work. Where reference is made to the works of others, the extent to which that work has been used is indicated and fully acknowledged in the text and list of references.

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Theory
Adaptive reuse techniques and technology can promote sustainable transformation of the built environment while reducing the environmental load of the industry

Research field
Regenerative and Resilient Cities

Keywords
Adaptive reuse, urban resilience, integrated urbanism, urban education campus

Title
Sustainable urban transformation
Rethinking built environment development
through adaptive reuse techniques and technology

Client
Curro

Programme
Inner city upliftment and upskilling educational campus

Location
Hope Street, Pretoria CBD
Pretoria

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My love, Sarah, for your prayers and affirmation throughout the year. I value your love and support so much. Same

List of figures

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Content

“Never demolish, never remove or replace, always add, transform and reuse!”

- Lacaton and Vassal (2020)

The built environment industry is responsible for one third of the global greenhouse gas emissions and is the largest consumer of energy on the planet (UNEP, 2009:9). The modern sustainability criteria encourage building professionals to not only produce energy efficient buildings but also reuse and adapt existing buildings to accommodate new demands (UNEP, 2007:1).

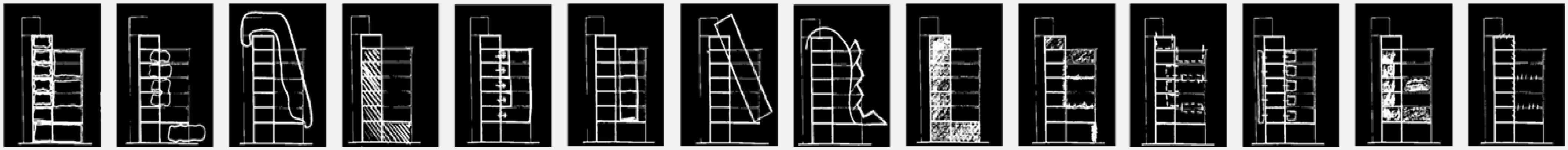
The opportunity lies to lower the environmental load of the construction development while reducing the waste caused by traditional demolishing and new building methods (DEH, 2004:17). When the physical lifespan of urban structure exceeds the useful lifespan of a building, adaptive reuse facilitates the transformation of the built environment while reducing material and construction quantity and expense through reusing and adapting the existing built environment stock (Conejos and Langston, 2010).

Intention

The aim of this dissertation is to research and develop architectural adaptive reuse technology and techniques to replace traditional demolishing and new built practice, and reuse technology for circular material lifespan in architecture. The intention is to develop a system of adapting and reusing built structure.

Significance of study

Developing an architectural adaptive reuse system when approaching built environment developments on sites with existing buildings through techniques, technology and systems of design will allow the build industry to find adaptive reuse practice less daunting and promote sustainable transformation of the built environment.



Main issue:
Environmental impact

Fig 1.1: Environmental impact (Bold business, 2019)

It is inevitable that a building will either be replaced or given new functions if it no longer serves a current need and function (Mısırlısoy, Günçe, 2016:91-98). Buildings may become irrelevant for several reasons, such as changing economic and industrial practices, demographic shifts, increasing cost of upkeep or maintenance. Urbanisation and changing of demands and agency of places result in the built environment being in constant need of transformation and development (Gorgolewski, 2008:175-188).

It is calculated that because of the excessive use of steel and concrete the built environment is responsible for 30-40% of the greenhouse gasses of the global total (GABC, 2019). The constant demand on the built environment to transform has resulted in it becoming the industry with the largest environmental load on the planet (UNEP, 2009:9).

Urban issue:
Urban transformation

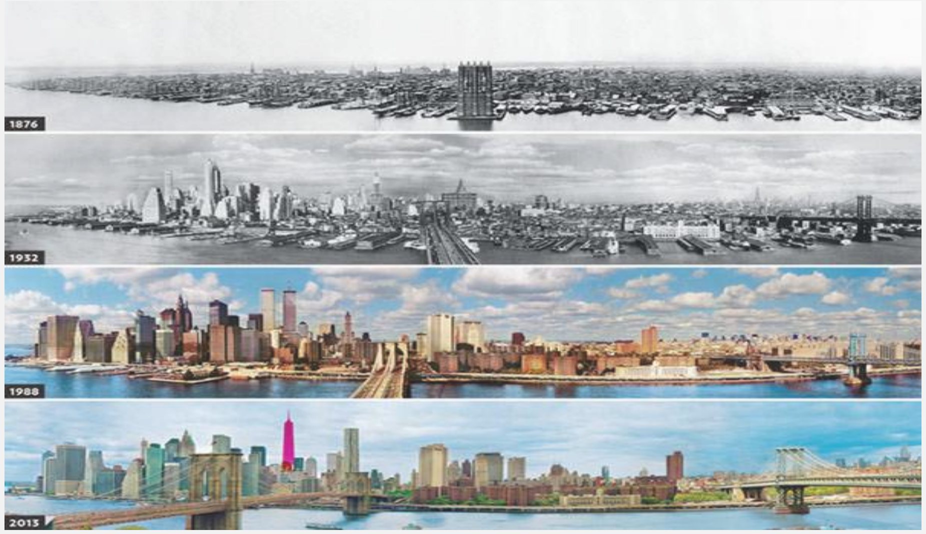


Fig 1.2: Urban transformation (Dewsbury, 2012)

Mono-functional buildings allow for economic growth and healthy work environments for their workers, but for those who don't fall into autonomous and mainstream life, exclusion from opportunities for work-, public- and interactive this often represses opportunity and stimulation for skills transferals and learning as well as small enterprises and start-ups (Thorns, 2002:152-156). There has been an increase in demand for transformation of mono-functional space to multifunctional spaces within the CBD of cities. This has been due to demand changes of more flexible urban space, the rethinking of office culture and space needed as well as people needing to have access to flexible offices, workshop and educational facilities (Cloete and Yusuf, 2018:35). Quality urban spaces have along with this also been in demand allowing people access to recreational and leisure spaces within the city (Mathe, 2020). Spaces like these activate interactive economic opportunities and allow commercial integration with access to the city and educational institutes and public spaces (Darby and Darby, 2020).

Architectural issue:
Adaptive reuse of the built environment

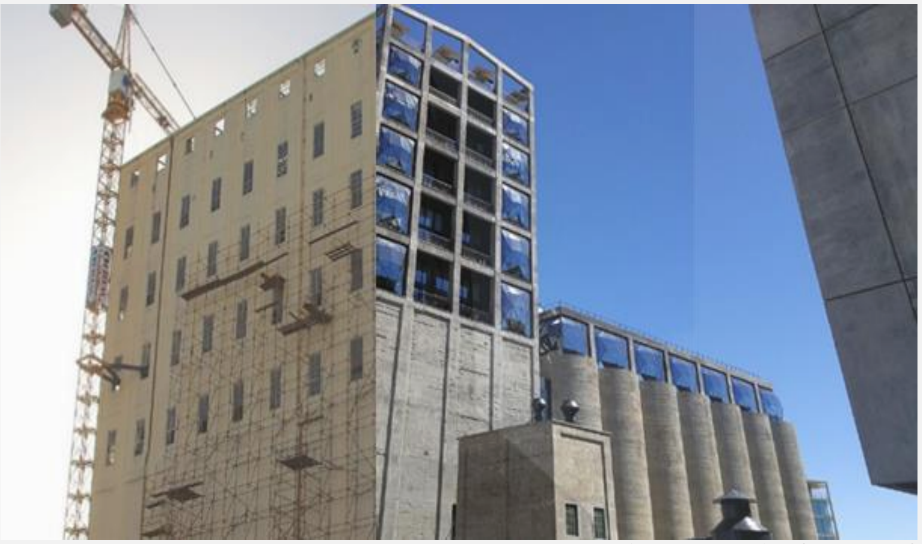


Fig 1.3: Adaptive (Peel, 2014)

The modernist theory of form follows function has become condemned (Tschumi, 1996:217). The adaptability of architecture for new functions calls for a more appropriate way of seeing architecture. Spector (2001) argues that meaning and value follows use. Adaptive reuse of buildings is a way to maintain the cultural fabric while accommodating new spatial demands (Furlan, 2017). It revitalises the urban environment by giving irrelevant buildings new purpose (Conejos, Langston, & Smith, 2011).

Addressing the demand for changes in the built environment by demolishing and building new buildings that serve new requirements is not a sustainable way of transforming the built environment. Adaptive reuse practice is less wasteful, less energy demanding, and decreases environmental load compared to demolishing and building new practice. However, it is often overlooked because of its challenges and daunting nature. Using appropriate technological systems is key to advance and contribute to these adaptative reuse techniques in the built environment, and by doing so contribute to sustainable built environment development.

Literature review

Transformation for the 21st century built environment framework

The continuous development and transformation of the urban environment is because of a constant changing of societal demands (Gorgolewski, 2005). The three spheres of sustainable development are development of spaces for economic and technology stimulation, sustainable use of natural resources, and life support systems creating livelihoods for inhabitants (EOLSS, 2021). All three of these spheres need to be adhered to for urban development to be sustainable.

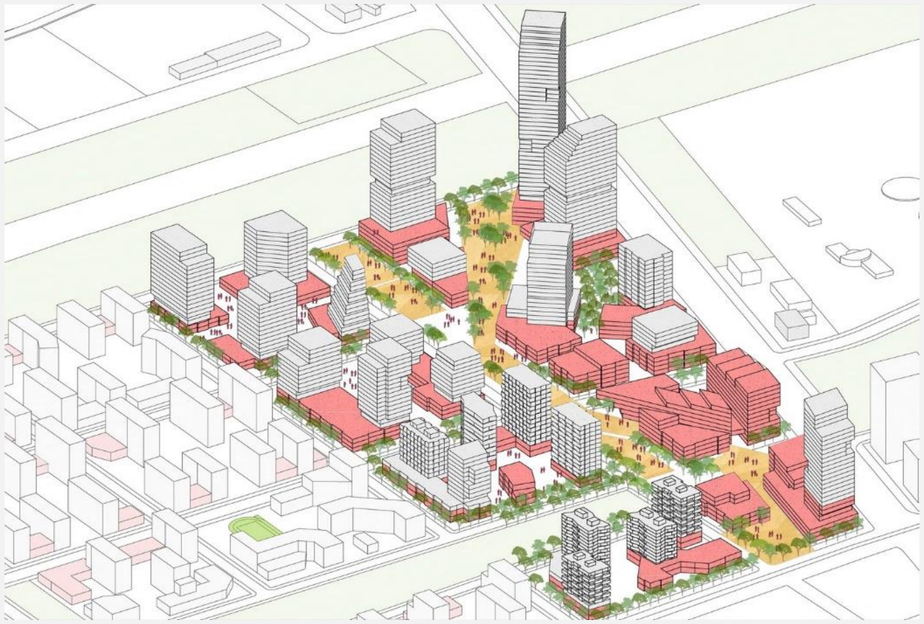


Fig 1.4: Urban development (Sasaki, 2020)

The current determined nature of urban frameworks does not adhere to the current demand for the urban environment for the 21st century. A more flexible, stimulating and utilised urban framework would advance resilience of the urban realm. The resilience of urban environments is dependent on the networking and integration of functions for the public that coincides with the building's primary functions.

This can be achieved through making amenities needed by a space open to public use (such as food stalls), so the users and space affected by the building does not end at its walls, but rather, continues to provide for the space around it (Thrift, 1996).

According to Thorns (2002:70-72) the urban framework for the 21st century calls for adaption from mass and standard to small-scale productions for innovation, flexibility and individualistic focused consumerism. The built environment should aim to become multi-tasked with horizontal labour and educational organisations and flexibility with different programmes feeding of each other for amenities and use. This ideology should serve individualistic and entrepreneurial driven markets and spaces that become a dualism between functions and programmes.

The resilience of urban environments is contributed by networking and social interaction stimulation that coincides with its primary functions (Thrift, 1996). This method of flexible and shared urban framework stimulates a bigger variety of produce, opportunities and outcomes in occupations, thus allowing the user and consumer flexibility and a variety of choices (Thorns, 2002:123)

Urban transformation through adaptive reuse techniques

2021 Pritzker prize winners, and adaptation and reuse architecture firm Lacaton & Vassal argues that demolishing existing buildings to make place for new ones is a waste of energy, material and history and even went as far as saying it is considered as an act of violence (Berg, 2021).

Adaptive reuse of buildings focuses on minimum demolition and maximum reusability of materials of demolished waste that results in less energy needed to create new structure and materials and a smaller environmental load on resources and greenhouse emissions (DEH, 2004:17). Adaptive reuse strategies can assist in transforming the built environment more sustainably (Conejos, Langston, & Smith, 2012: 37).

Tobias & Vavaroutsos (2009) argues that sustainable building theory and practice has focussed too much on the sustainability of new building and construction and how they can be more sustainable and under emphasised and spent too little resources developing the reuse construction technology and adaptability strategies of existing building stock (Conejos, Langston and Smith, 2013). The UNEP (2009) asserts this notion that there must be more focus on retro fitting and adapting existing buildings.

Fig 1.5: Adaptive reuse techniques (Author, 2021)

Reuse technology focusses on taking demolished materials and reworking them so they can form part of the new structure. It also looks at technology that can be added to the existing building that would allow it to be reused instead of demolished.

Disposal of construction components can be avoided through reuse technology that promotes design and strategies with close loop materials (Iacovidou, Purnell and Lim, 2018).
Recycling existing buildings is the most effective sustainable example of environmental load reduction in the construction industry (Gorse & Highfield, 2009). The built environment can be adapted, reused, and spatially reconfigured instead of demolished and new built for new requirements and use.

Through this the built environment can become relevant to the place's values and demands. Adapting, reusing, and rethinking of the existing building structures has the potential to have the biggest effect on the built environments environmental load (Balaras, Dascalaki, Kontoyiannidis, 2004:592-601).

Normative position

Built environment professionals should be more critical of the amount of demolition that really needs to take place to accommodate demands of the new building. When it comes to demolishing components of and existing building, adaptation strategies should not restrict the possibilities but enable opportunities of an existing structure for more sustainable development when transforming a building to accommodate new demands.

Adapting existing buildings for new or added purpose is not often practiced or well thought through because of all the challenges faced and not knowing how to approach it.

Promoting adaptive reuse through techniques and systems of design, these processes will allow to advance sustainable transformation of the built environment and allow build professionals to find adaptive reuse practice less daunting.

Fig 1.6: Normative position (Author, 2021)

Research

Research questions

Research question

How can architectural adaptive reuse techniques and technology be applied to advance sustainable transformation of the built environment?

Research sub-questions

How can adaptive techniques and technology transform existing building stock in the built environment?

How can construction material and components be reproduced from demolished or existing building stock?

How can sustainable transformation of the built environment be promoted through a system of adaptive reuse techniques and technology?

Research methodology

Intentions

The research intention is to be fulfilled through literature and case studies of relevant adaptive reuse buildings and journals to gain an understanding of the relevant and appropriate adaptive reuse possibilities that applies to the dissertation.

Research -

- The urban transformation and adaptive reuse practice in South Africa.
- Adaptive reuse strategies and technology that were applied to existing buildings.
- Techniques to reuse demolished materials of the existing building to produce construction material used in architecture.
- Sustainable design standards of South Africa.
- Adaptation techniques by which buildings and their surroundings can be adapted to carry out urban framework and concept requirements.
- Appropriate adaptation of current building/spaces for intended urban/block framework and site.

Methodology

Site and urban framework analysis are an interpretive study method used to investigate, understand, and inform potential locations. When researching subjects, theoretical understanding through literature studies should be done on a variety of relevant studies, though not all related to the topic, it should be relevant and establish the framework for case studies done (Abbasian, 2016). Data collected through this method is done to identify factors that need to be considered when proposing adaptive reuse of the built environment and analysing building space (Mısırlısoy and Günçe, 2016). Architectural case studies done are quantitative to gain data of which type of adaptive reuse techniques and technology is mostly used and appropriate and qualitative studies to understand and investigate the quality of architecture that can be made through the process. These techniques will help a system of adaptive reuse that can be applied on existing buildings. These should be conducted by analysing case studies that have relevance to the field of research. As well as to give context on the impact of the physical realization of design concept informants and systems.

The research done will create a system of informants of adaptive reuse to generate architectural components and architecture.

Research plan

The strategy is to gain an understanding of the global field of architectural adaptive reuse techniques and technology. As well as how it can be applied to the local built environment.

The plan is to research -

- adaptation strategies and technology of buildings that were adapted and reused through literature, case studies.
- reuse technology of buildings that were adapted and reused through literature, case studies.
- material reusability and reuse techniques of demolished structures through literature and case studies

Findings and analysis

Literature study

The literature study substantiates the necessity of adaptive reuse in urban and built environment transformation and inform requirements of the desktop case study for further research. Studies were done on various literature forms such as policies, reports, journals and theses to address sustainable urban transformation by studying the urban transformation of South Africa and how the built environment should respond to it sustainably, methods for sustainable transformation of the built environment and finally the making of architecture through adaptive reuse process.

Findings

South African urban transformation

South Africa's urban landscape is in need for constant transformation. This is because of changing demands because of social economic and environmental development (Gorgolewski, 2005). Currently many South African cities no not develop for the individual user and occupant of the city, this creates areas of spatial injustice and restrict access to the city (South African Cities Network, 2016:44-81). An urban framework that allows utilisation, flexibility and stimulation of economic and social opportunities would advance resilience of the urban landscape (Thrift, 1996).

The 2016 South African Cities report details urban landscapes need to transform into a balance of open and public spaces that promote social activity and quality-built area that stimulates economic opportunity while transforming sustainably through renewable resources and resilient development (South African Cities Network, 2016:47).

Rethinking South African built environment transformation

Often in transformation of the built environment in South African cities, built environment professionals only consider the out with old method that consists of demolishing existing building stock to make place for developing from the ground up new buildings (Swindon Property, 2019). Buildings often get demolished prematurely for built assets for economic motives and have minimal awareness on the environmental and social effect of it by now considering how existing build environments that still have a physical life can be adapted to transform and extent its useful lifespan (Conejos and Langston, 2010).

One of the challenges of the South African construction industry is that there is currently an increase in construction material and technology cost, this limits the industries growth (Windapo and Cattell, 2013:75). It is suggested that the excessive amount of money and resources spent on current materials and technology should rather be spent on further studies and advancing new construction materials and technology to advance the industry (Windapo and Cattell, 2013:75-76).

Sustainable design standards

Green Star SA is a rating tool developed by the Green Star Council to promote sustainable design, constructing and operations of the built environment (Green Building Council South Africa, 2017). Four of the nine categories of the rating system can be related to adaptive reuse of built environments. The first is energy use that aims to reduce energy load associated to greenhouse gas emissions of a building.

The second, innovations, recognise contribution to environmental load reduction of a building through use and production of innovative design, technology and processes. The third credits the reduction in material and environmental load through reuse and selection of construction materials and the fourth targets to reduce the impact the development has on the environment (Green Building Council South Africa, 2017). This rating system can serve as an appropriate tool to measure the quantitative effectiveness of use of adaptive reuse architecture to reduce the built environment industry environmental load.

Opportunity for adaptive reuse architecture in South African

Adaptive reuse of existing buildings allows for more opportunities of development because of the reduction in cost versus that of new built buildings (Swindon Property, 2019). Through empowering the urban transformation process more people have access to progressing built environments. The City of Tshwane has many buildings that are in need for transformation to be fit in the 21st century framework for developing cities and would be fit for purpose and in doing so would benefit the occupants and demands of spaces in the city (Samimi, 2011:4-5).

In South Africa's urban environments, buildings and spaces often are no longer fit for purpose. This presents an opportunity for methods of adaptive reuse to create new use and value by using and adapting the existing building stock (Swindon Property, 2019).

Adaptation and reuse of existing buildings

The objective is to adapt the components of the building that still has a physical lifespan to contribute so it would add value and extent the useful life of a building (Conejos and Langston, 2010). Concrete uses by far the most embodied energy (GJ) of all construction materials so where possible it should be avoided to demolish and investigated how the building can be adapted while using its existing structure (Urban Leds, 2021). According to Conejos and Langston (2010), existing built environment stock can be adapted in the following ways:

- Structural components can be added on or reduced if needed. Structural integrity assessment is key to inform future adaptation design with this method.
- Materials can be reused to serve different purposes and create new construction components; the material's lifespan and characteristics needs to be taken into consideration when using this method.
- Workmanship by builders and the skill level required to construct and adapt the existing structure needs to be taken into consideration. There is opportunity for upskilling and teaching new construction methods.
- The complexity of the design needs to take into consideration how the building needs to be adapted to fulfil the demands and brief for the new building.
- The adaptation should take into consideration climatic requirements.
- The foundation of the existing building will determine if the original structure would be able to support additions or adaptions and whether it needs to be reinforced.

Circular lifespan of construction materials

Circular construction material life span or closed loop materials cycle can be described as, "the continuous recovery and infinite recycling of construction materials in the transformation of the built environment" (Sassi, 2008:509).

The use of this method when demolishing existing built stock that no longer serves a purpose lowers the environmental load of the total materials needed for the new building as well as extract building material of no use and reintegrate them into the new building where it will be of use (Sassi, 2008). It is a way to obtain non-renewable resources of the built environment in a renewable manner through reducing the energy load, landfill mass and CO^2 emissions while transforming the built environment (Urban Leds, 2021). In a study done by Paolo Sassi (2008:510) it was found that this process is possible and feasible through natural deconstruction, recovery and recycling processes, however the quality lost over recovery and recycling should be considered.

Reusing existing components in its original form should always be considered first because it still uses less energy to produce construction components and materials and reduces waste produced by the built environment industry (Sassi, 2008:512). The recycled material should fulfil to the requirement of materials needed and its characteristics needed should not be lower than that of new materials (Sassi, 2008). Further assessments should however be done with regards to specific material characteristics requirement and making recycle materials for construction components of the new building's design (Kozminska, 2019).

Case studies

The Case study will verify how different methods of adaptive reuse were practically applied on educational, commercial and institutional buildings. Studies were done on fourteen appropriate buildings. Firstly in terms of what their main informants were, secondly how their use was affected, thirdly transformation- strategy, approach, design and extent and lastly how the existing structure was adapted, reused and materials reused.

Findings

Fig 1.7: Case study (Author, 2021)

	informants	use	transformation				existing structure		
	informant	**programme**	**strategy**	**approach**	**typology**	**extent**	**adaptation**	**reused**	**material**
1. 192 Shoreham Street	Heritage Technology Economic	Changed: Restaurant/Bar – Offices	Weavings	Extension Recycle	Mirror Oppose	Whole	Cut Add	Façade	None
2. Academia de Música de Roubaix	Renewal Heritage Cultural	Same: Music academy	Juxtapositions	Extension Recycle	Mirror Oppose	Little	None Add	All	None
3. CTCA	Renewal Cultural Technology	Changed: Silo – Art school/ restaurant	Insertions Juxtaposition	Addition Recycle	Mirror	Whole	Cut Add	Façade	None
4. Fahle House	Renewal Heritage Cultural	Changed; Boiler house – Mix-use	Insertions Juxtaposition	Extension Recycle	Mirror Oppose	Whole	Cut Add	Façade Structure	None
5. FRAC Nord-Pas de Calais	Renewal Technology Social	Changed: Warehouse – Education/exhibit	Juxtaposition	Addition Recycle	Mirror	Little	None Add	All	None
6. The Green Building	Renewal Climate Technology	Changed: Store – Mix-use	Weavings	Extension Recycle	Transform Oppose	Whole	Cut Add	Roof Façade Materials	Reused as is Low skill reused Industrial remade
7. Lesczynski Antoniny Manor	Heritage Cultural Technology	Changed: Farm building – Residential/health	Parasites Insertions	Extension Recycle	Transform Oppose	Whole	Add	Façade Structure	None
8. Ningbo history museum	Heritage Cultural Social	Changed: Residential – Museum	Juxtaposition	Separation Recycle	Transform Oppose	Whole	Add	Material	Reused as is Low skill reused
9. Old Biscuits Mill	Renewal Heritage Cultural	Changed: Factory – Commercial	Insertion Juxtaposition	Extension Recycle	Transform	Partial	Cut Add	Roof Façade Material	Reused as is Low skill reused Industrial remade
10. Palais de Tokyo	Culture Technology Social	Same: Art museum	Insertions	Extension Recycle	Transform	Whole	Cut	All	None
11. Rotermann's Old and New Flour Storage	Renewal Heritage Technology	Changed: Flour storage – Retail, Offices	Insertions Juxtaposition	Separation Addition Recycle	Mirror Derive Oppose	Whole	Cut Add	Façade	None
12. School of Architecture UCV	Renewal Culture Technology	Same: Architecture School	Insertions Weaving	Extension Recycle	Mirror Transform	Most	Cut None Add	All	None
13. The Silo	Renewal Heritage Technology	Changed: Grain silo – Residential	Insertions Weavings	Extension Recycle	Mirror Transform	Whole	Cut Add	All	None
14. Zeitz MOCAA	Renewal Heritage Technology	Changed: Grain silo – Museum, Hotel	Insertions Juxtaposition	Addition Recycle	Mirror Transform Oppose	Whole	Cut Add	All	None

Analysis

Informants

Most of the buildings that were studied were projects done mostly because of urban and building renewal purposes and the adaptive reuse informants were mostly technological capabilities and expression. Heritage and culture are the two informants that are most looked at when approaching the original structure for adaptive reuse purposes. Political, social and climate were informants less used.

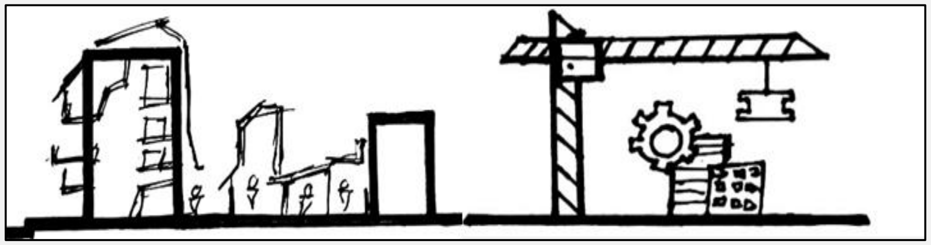


Fig 1.8: Urban/building renewal (Author, 2021)

Use

Most of the buildings seem to change their original use and programmes. This could be because the original use is no longer needed in the area or because the building has heritage value and needed to be conserved even though the development's brief requires new programme and use. In cases where the buildings' programme and use stayed the same the transformation approach was to extend and recycle the existing building and all the existing structures of the building was reused.

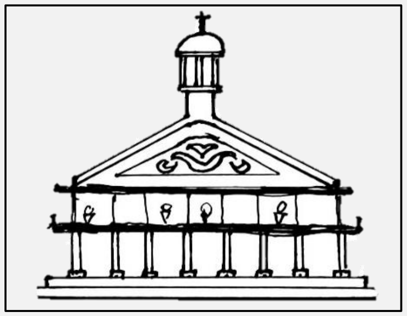
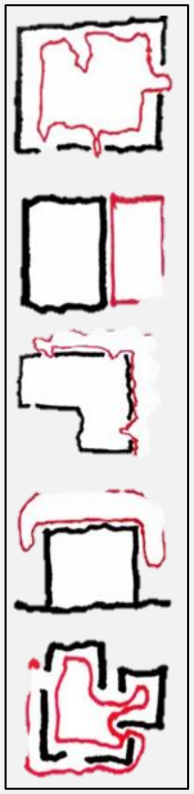


Fig 1.9: Changed use (Author, 2021)

Transformation

Strategies

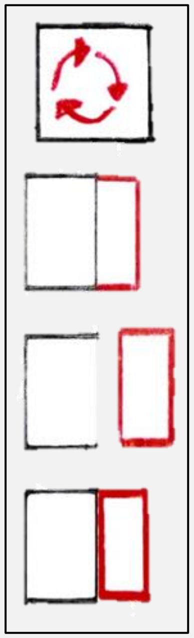


Insertions and juxtapositions are the strategies mostly use in the case studies. Insertion strategies are done mostly to preserve the façade and exterior of the buildings while adapting the interior for new use and value. Juxtaposition strategy is followed because there is not enough space within the original building, or they wanted to have a relationship between the old and new parts of the structure.

Additionally, to this there is the weaving strategy that deals with the adaptation weaving through the existing building and the wrap strategy that finds the adaptation wrapping around.

Fig 1.10: Strategies (Bollacks, 2013)

Approach



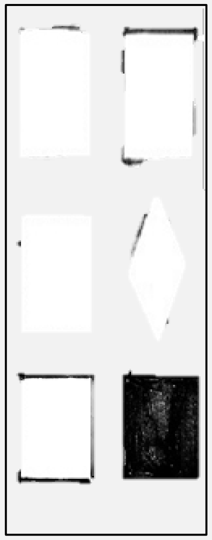
Recycle and extension were the approaches mostly used in the case studies. Recycling is a way to reduce the maximum amount of waste when adapting an existing building. It also ensures preserving its heritage and cultural value while renewing the structure. Extension is an approach that can be beneficial to use when the existing structure needs to be enlarged for new usage or to extend its original floor area.

Additionally, separation and addition strategies were used.

Fig 1.11: Approach (Author, 2021)

Typology

Mirror, transform and oppose are the typological concepts mostly followed. This is entirely informed to be the concept of the project as well as what type of renewal approach was followed.



Mirroring is a method to support the existing building's typology as well as the urban fabric of the area.

Transforming is a way to critique the existing structure's form, principles and spaces by modifying it.

Opposing often creates a dialog between old and new through opposing technology, form and process. Other concepts used less were collage, derive and prototype to generate design.

Fig 1.12: Concepts (Author, 2021)

Extent

The buildings that were studied, were mostly transformed. This could be because renewing and adapting the buildings required the existing buildings to be adapted in its entirely. However, it could also be because the bulk of the buildings chosen for the case studies were well known adapted buildings and is popular because of the extent to which it was transformed.

Existing structure

Adaptation

Cutting and adding is a way of adapting building components to allow for renewal and new use of the original structure. Cutting was done on many of the buildings that were studied to allow spaces to open, enlarge and extend for new uses. Adding was an adaptation technique used by most buildings to allow more space for use when the original structure didn't allow the space needed. Adding structure also allowed the existing building's components to be reinforced to extend its use and physical lifespan.

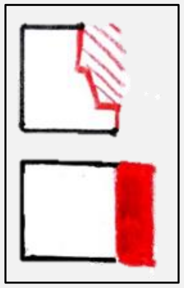
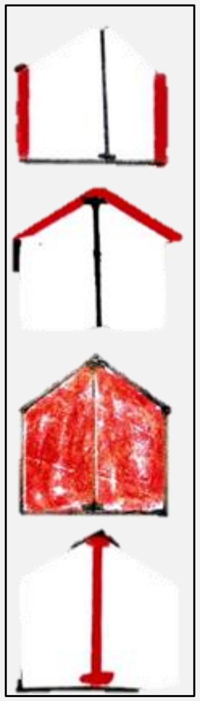


Fig 1.13: Adaptation (Author, 2021)

Reuse



The facades of buildings were found to be the most popular component of reuse, however many of the existing structures' components in the case studies done, were reused. This could largely be because of using an adaptive reuse approach to the spaces and structure.

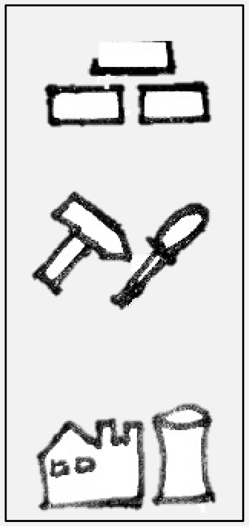
Facades often are the components mostly associated with a building's typology and thus it can be used to showcase the original building's state in relationship to the adapted state.

Other parts that were less reused in case studies were interior, roofs and materials and structure.

Fig 1.14: Reuse (Author, 2021)

Materials

The only buildings studied where materials were reused, were the Ningbo history museum and the Zeitz MOZAA buildings.



When reused, it was mostly in its existing forms but used in new techniques to display that the materials were salvaged.

Low skill level techniques were also used to break down some of existing construction debris and mixing it with concrete and moulds for non-loadbearing and aesthetics components.

In addition, industrial process remade materials weren't used in any case studies.

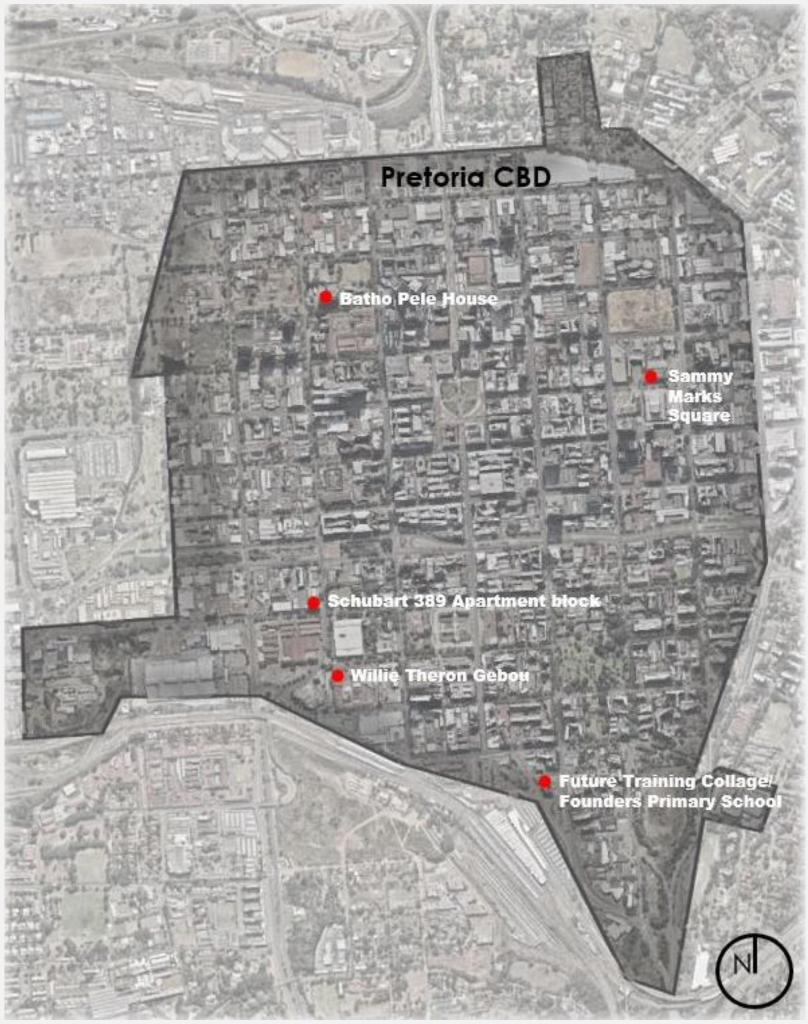
Fig 1.15: Materials (Author, 2021)

Conclusion

This research findings serve as an overall investigation into technique used in adaptive reuse projects. Further technological, process, technique, precedent and method studies will have to be done to apply to the specific building within the scope to serve as informants to the dissertation.

Design Informant development

Context site/building

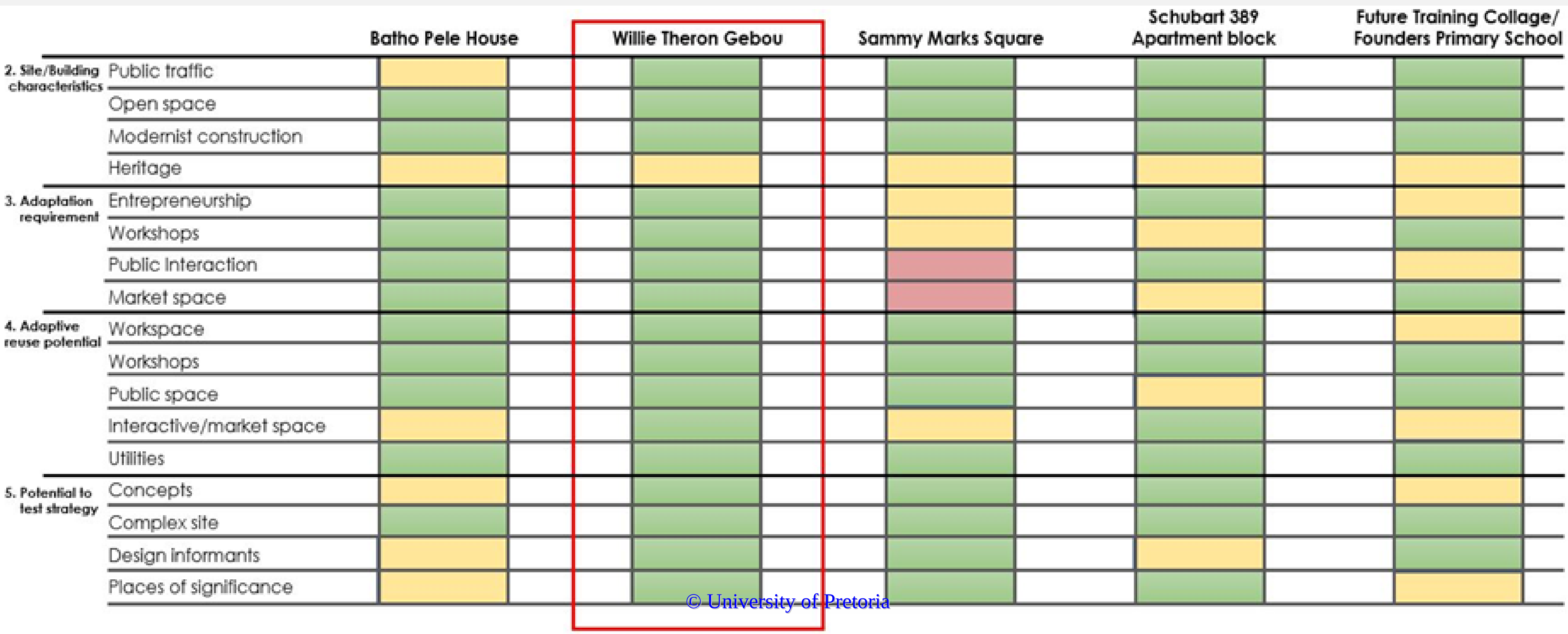


Site Selection

Because of the many buildings currently used for different purposes than their original intent, the CBD of Pretoria was identified as an appropriate context to investigate a suitable site for the adaptive reuse purposes. Potential sites were compared within four categories being site/building characteristics, adaptation requirement, adaptive reuse potential, and potential to evaluate strategy. Through a desktop study done on a site in the Pretoria CBD that were appropriate for renewal, the five sites identified for further investigation were the Batho Pele House, Willie Theron building, Sammy Marks Square, Schubart 389, and Future Training Collage and Founder Primary School. The different building sites were analysed through the categories of site/building characteristics that included: public traffic, open space, modernist construction and heritage; adaptation requirements that included Entrepreneurship, workshops, public interaction and market space; adaptative reuse potential that included workspace, workshop, public space, interactive/market space and utilities and potential to evaluate strategy that included concepts, complex site, design informants and places of significance. It was concluded that the Willie Theron building in Hoop Street would be the most appropriate structure and site for adaptive reuse transformation to be informed and applied on.

Fig 1.16: Site identification (Author, 2021)

Fig 1.17: Site selection criteria (Author, 2021)



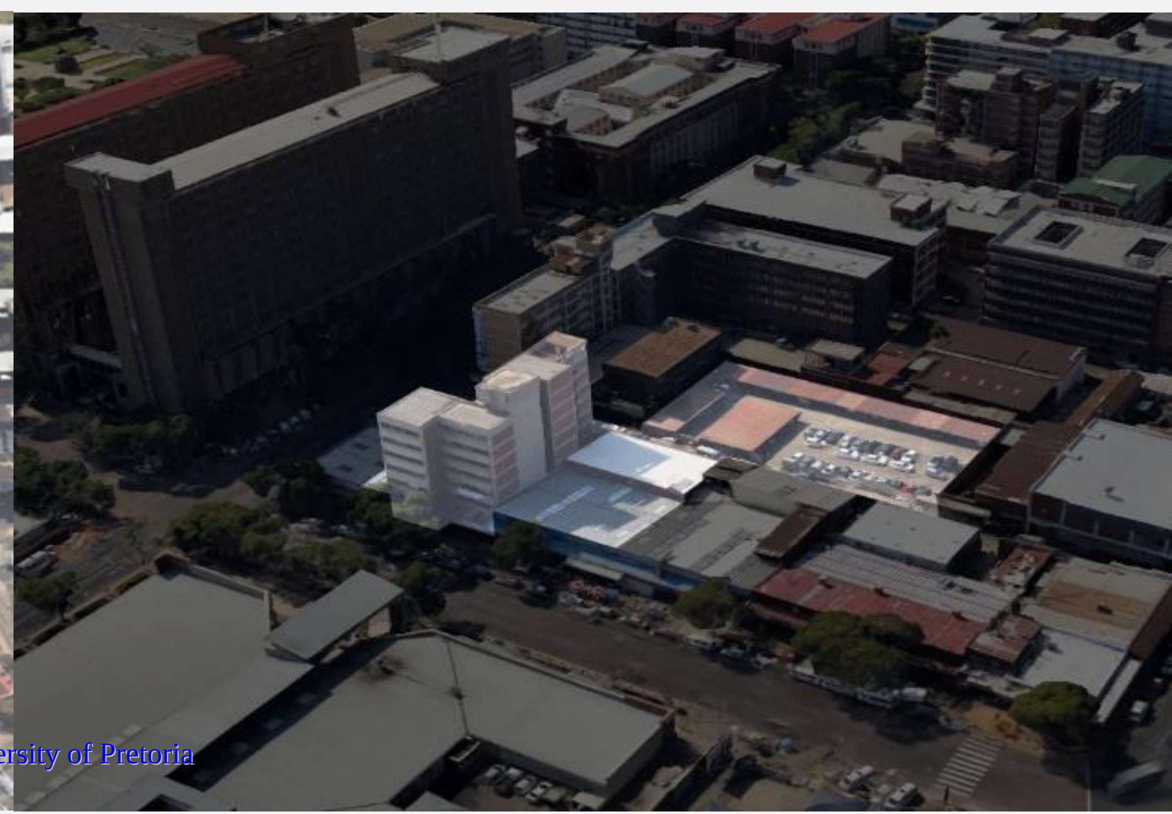
Site analysis

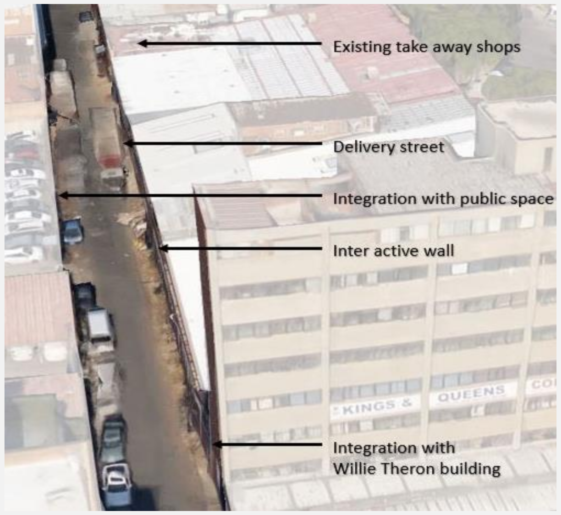
The selected site is the Willie Theron building that stretches between the busy and high motor/pedestrian traffic Bosman Street over to the parking lot area on the quiet, low motor/pedestrian traffic Hoop Street. The road through the site is used mostly for deliveries and access to the parking lot, by shop staff, college students and staff of the surrounding buildings. The area, especially the Willie Theron building, has no access to public space. Students and occupants have little integration with sites around them.

Fig 1.18: Site analysis (Author, 2021)

Fig 1.19: Site red (Author, 2021)

Fig 1.20: Site location (Author, 2021)





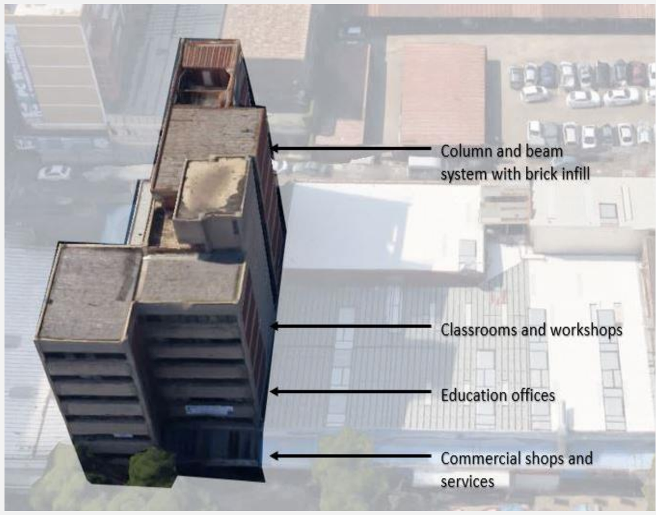


Fig 1.21: Parking (Author, 2021)

Fig 1.22: Street (Author, 2021)

Fig 1.23: Willie Theron building 1(Author, 2021)

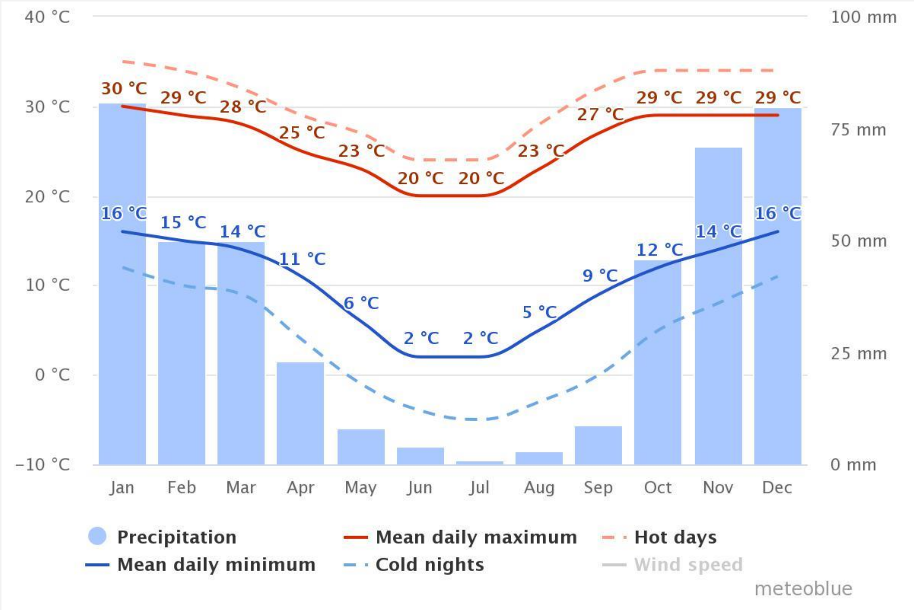
Fig 1.24: Willie Theron block 2(Author, 2021)

Climate study

Meso

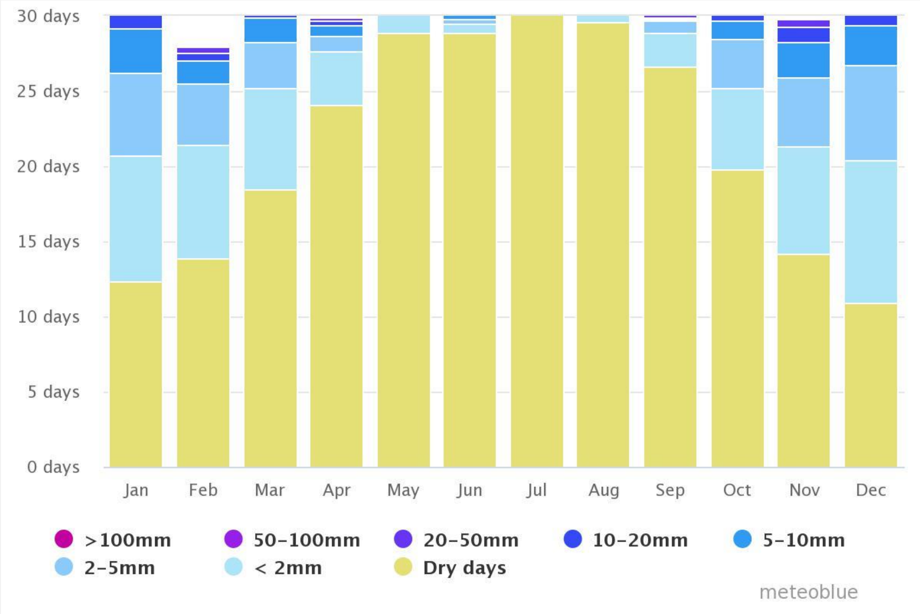
Temperatures

Fig 1.25: Temperature (Meteoblue, 2021)



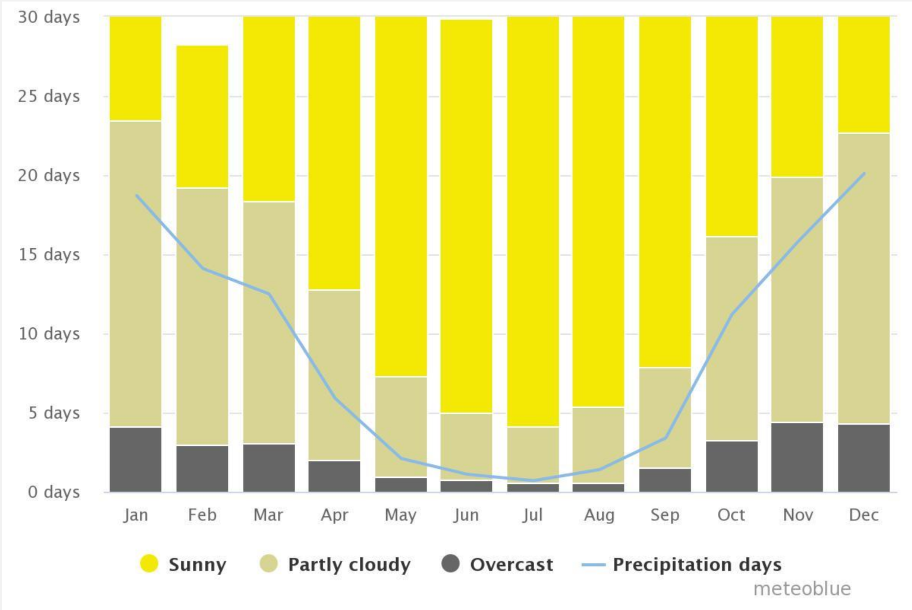
Rainfall

Fig 1.27: Rainfall (Meteoblue, 2021)



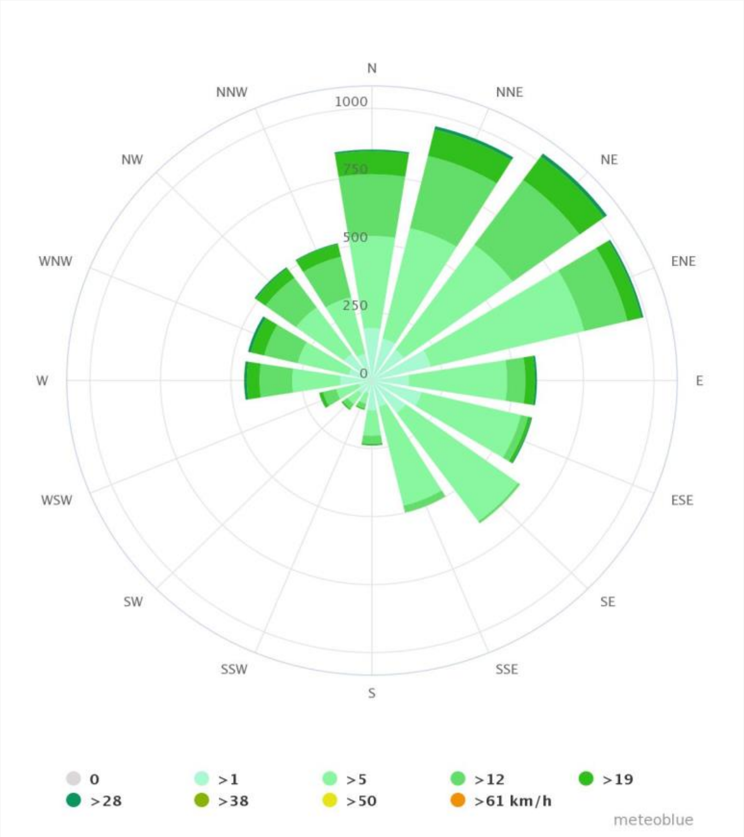
Sun study

Fig 1.26: Sun study (Meteoblue, 2021)



Windrose

Fig 1.28: Windrose (Meteoblue, 2021)



Micro

Sun study

Building to the north will affect the daylight on the building because of shadows but only in the winter.

Fig 1.29: Sun Study (Google earth, 2021)

Noise pollution

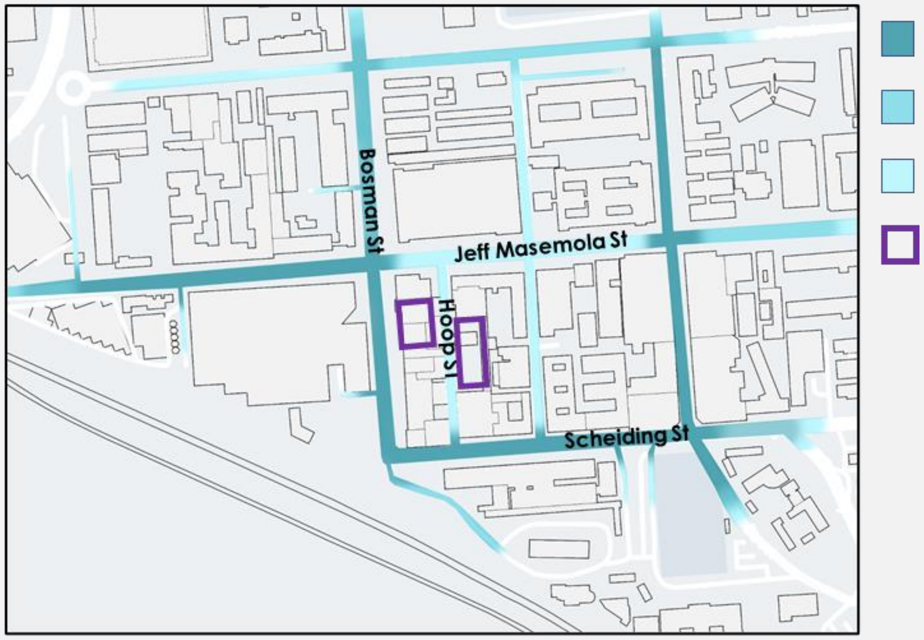


Fig 1.30: Noise pollution (Author, 2021)

Programme, Client and User

The programme intention is to approach the building by way of the 2016 South African Cities Report 25-year urban vision, which is "to integrate educational centres with commercial and residential areas to make urban recourse more accessible" (South African Cities Network, 2016:47). There is a need for upskilling and educational institutes in the urban environments. The aim is to create an integrated urban campus. The parking lot on Hoop Street has potential to be used as a space that would benefit the surrounding buildings and programmes with Hoop Street as an activated pedestrian street. Urban housing in the open lot will serve as temporary housing for the upliftment institute at the education institute. The education received will set students on a standard to uplift them from conditions as well as give them the opportunity to use skills learned and study further in one of the colleges in the area.

Programme

Urban integrated educational campus

Urban integrated educational institutes

Spaces become less exclusive and better used by multiple types of users. Education institutes should be integrated into their context to serve as multipurpose facilities that serve beyond the borders of its walls. Relationship between learning knowledge by imparting (know what) and acquisition (know why) with construction of knowledge in an applied nature (know how) should be investigated and applied to a spatial form giving (OECD, 2021). This is spatially manifested though creating an educational environment that integrates the research and knowledge capital of educators to the transfer and use of knowledge to the students through spatial forming and merging the areas that usually is kept apart.

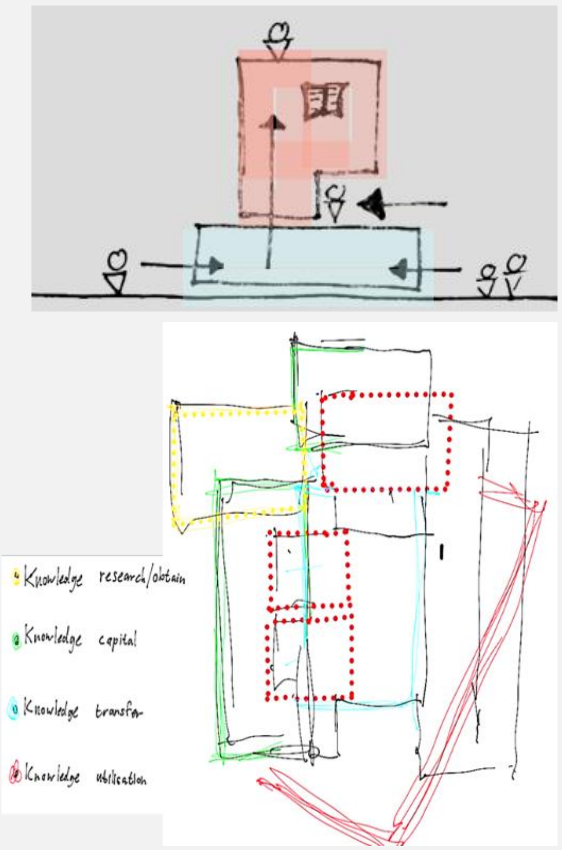


Fig 1.31: Integrated (Author, 2021)

Public oriented urbanism opportunity

The economic success is determined by the cost of the structure compared to the value added and opportunity stimulated. Including public to benefit from the resources, creates an urban carpet for the public realm to be integrated. Arcades are a great way to maximise public traffic while still allowing operations of retail and commercial shops to go on. Integrated housing for the students and users of the education building will allow for better access to amenities and benefits of the campus.

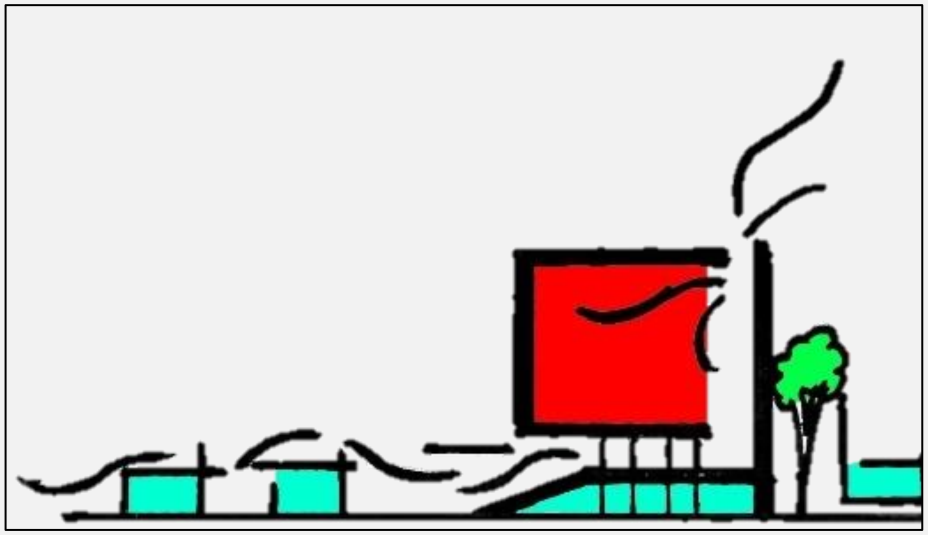


Fig 1.32: Economic opportunity (Author, 2021)

Fig 1.33: Programme requirements (Author, 2021)

Programme	Functions	Qty	Area of x (m2)	Total area (m2)	
TVET, Handicraft school	Classroom	2	50	100	
	Study area	1	50	50	
	Reception area	1	10	10	
	Staff room	1	60	60	
	Kitchenette	1	8	8	
	Lift & staircase lobby	1	8	8	
	Office	1	60	60	
	Workshop	1	100	100	
	Storage	1	30	30	
	Bathrooms	1	18	18	
	Leisure space	2	50	100	
			Total	544	m2
Steppingstone education	Classroom	4	50	200	
	Study area	1	100	100	
	Reception area	1	10	10	
	Staffroom	1	60	60	
	Kitchenette	1	8	8	
	Lift & staircase area	1	8	8	
	Office	1	60	60	
	Storage	1	30	30	
	Bathrooms	2	18	36	
	Leisure space	1	50	50	
			Total	562	m2
Pop up	Classroom	1	80	80	
	Reception area	1	10	10	
	Staffroom	1	60	60	
	Kitchenette	1	8	8	
	Lift & staircase lobby	1	8	8	
	Offices	1	60	60	
	Counceling room	4	15	60	
	Storage	1	30	30	
	Leisure space	1	50	50	
			Total	366	m2
Hope building lobby	Reception area	1	8	8	
	Office	1	60	60	
	Kitchenette	1	8	8	
	Lift & staircase lobby	1	8	8	
	Storage	1	30	30	
	Lobby	1	100	100	
	Leisure space	1	100	100	
	Maintainance room	1	50	50	
	Bathrooms	1	18	18	
			Total	382	m2
Commercial space	Office	2	50	100	
	Shop	6	100	600	
	Storage	6	30	180	
				880	m2
			Building total	2734	m2
Housing/Market/public space	Offices	2	100	200	
	Reception	1	8	8	
	Restaurant	2	200	400	
	Formal stall	4	10	40	
	Informal stall	4	6	24	
	Storage	2	30	60	
	Seating area/sport grounds	1	500	500	
	Sport/performance grounds	1	600	600	
	Bathrooms	1	60	60	
	Public housing	30	8	240	
	Housing bathrooms	2	30	60	
			Total	2192	m2
Arcade	Delivery area	1	40	40	
	Food shop	3	100	300	
	Walk way	1	300	300	
	Gathering space	5	50	250	
	Storage	2	30	60	
			Total	950	m2
			Site Total	5876	m2

Client

The client is the Curro school group that is currently looking to invest in alternative forms of education beyond primary and secondary school. Their success in the privatization of education has allowed them funds to give back to the community for upliftment in areas where education is needed. Private funding will allow the investor to run the campus in alignment with their vision to educate through all levels of needs. It will also allow for sound management from a group that has had great success in the education field, establishing one of the most respected privatised school group within South Africa.

User

Stepping-stone, upliftment and handicraft education students and the homeless in the Pretoria CBD would use the facilities. Currently, the building has no interactive and leisure spaces to spill out into. This space would allow for increased interaction between the college and the public and improve integration with the city. It would also allow for surrounding educational and commercial occupants to interact and share ideas, thus encouraging innovation and entrepreneurship. The parking lot will be transformed to improve the interaction of public and leisure space, through the inclusion of restaurants and a food market, allowing for and enabling greater economic stimulation. Lastly Hoop Street would be activated for pedestrian use opening to the Willie Theron building and the parking lot. This will allow for a habitable, healthy and safe urban public environment. The street would still be able to be used for deliveries but only on specific times.

Site/building potential analysis

Willie Theron building

This structure will inform the type of spaces available for adaptation and reuse and how the building responds to the surroundings through allowing educational spaces to be integrated into the urban landscape.

Fig 1.34: Existing building (Google earth, 2021)

The Willie Theron building structure is a concrete column and beam system with infill brick. On the southern, western and eastern facades, there are no openings and on the northern side, there are minimal windows.

The building is currently occupied by the Centrum Technical College. The bottom two floors are used as admin and offices, the second to sixth floor consists of classrooms, and the top floor is a rooftop terrace. There is potential to extend over surrounding spaces attaching to the structure of the existing building as they are only one story. The building can only be accessed from its single entrance on the ground floor on Bosman Street. The parking space is only accessed from one point on Hoop Street.

It also has minimal under roof parking. The Willie Theron building has potential to interact and open to the Hoop Street side and access parking on the western side as well as overflow above the southern and northern buildings. The parking has potential to be developed into public interaction space and parking, accessible to occupants of the surrounding buildings, as well as to the public.

The different levels and areas are enclosed and are separated from each other with no visual or circulation connection to each other. This disconnects the areas, making each floor act as a separate entity rather than a building sharing amenities and spaces.

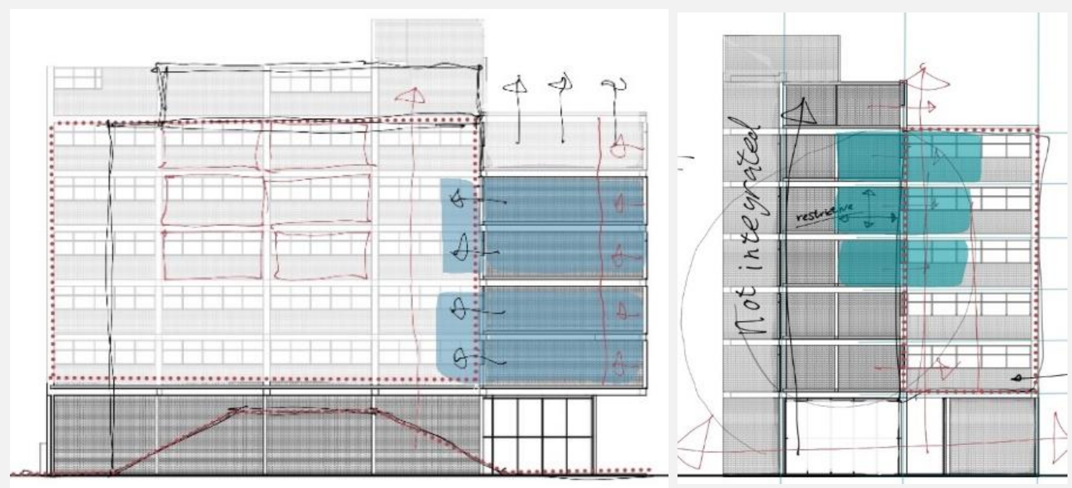


Fig 1.35: potential (Author, 2021

Problems that occur when converting office space to educational buildings is that the classroom sizes are too small and thus need to be adapted. The current Willie Theron building is not fit for purpose because of the spatial and limitations it cannot serve as an adequate building for an educational institute integrated into the urban fabric. The space intended for offices are currently used as classrooms but are too small and at least need to be doubled in size to 50m² to fulfill the spatial requirement for the new educational institute.

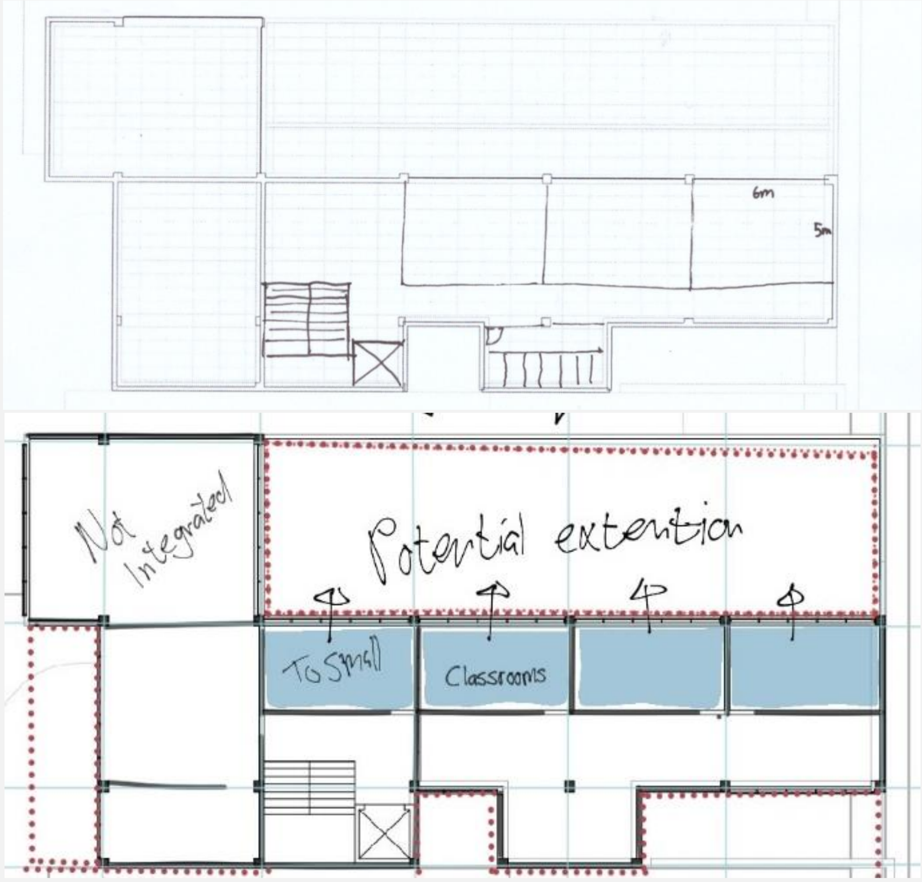


Fig 1.36: plan potential (Author, 2021)

The aim is to adapt and transform the existing Willie Theron building to a multi-level education institute to enable certain spatial requirements through conceptual adaptive reuse techniques by making use of technology that enables it. The existing building's services and technology will be reused where it is fit for purpose, adapted where changes to the physical form of the existing building can be altered to support new conceptual approaches and added to by using new technology to fulfill the conceptual, programmatic, and spatial adaptive reuse techniques needed to transform the building successfully.

Hope Street

As Hope Street is a quiet street, it can be transformed into a pedestrian arcade with deliveries scheduled during allocated off-peak times. It has the potential to be an extension of the arcade systems that exists in Pretoria.

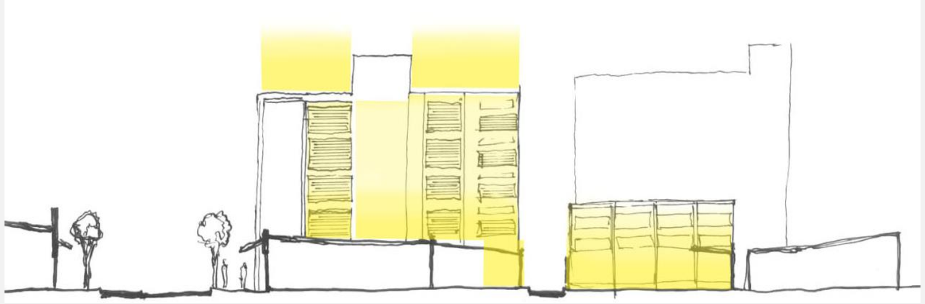


Fig 1.37: Parking potential (Author, 2021)

Parking lot

This space can become a place of interaction between students as well as the public and can also serve as housing for students and upliftment centre users.

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Technological Informant Development

Scientific

Possibilities through adaptive reuse technology

Strength of reusable and remade materials

Fig 1.38: Reuse (Pinterest, 2021)

Reusing brick debris that are crushed up would lower the load bearing quality of it, thus breaking up bricks and mixing it with cement to produce cladding material for the perforated exterior eastern skin would be an appropriate solution to reuse the debris.

Strength of old building structure

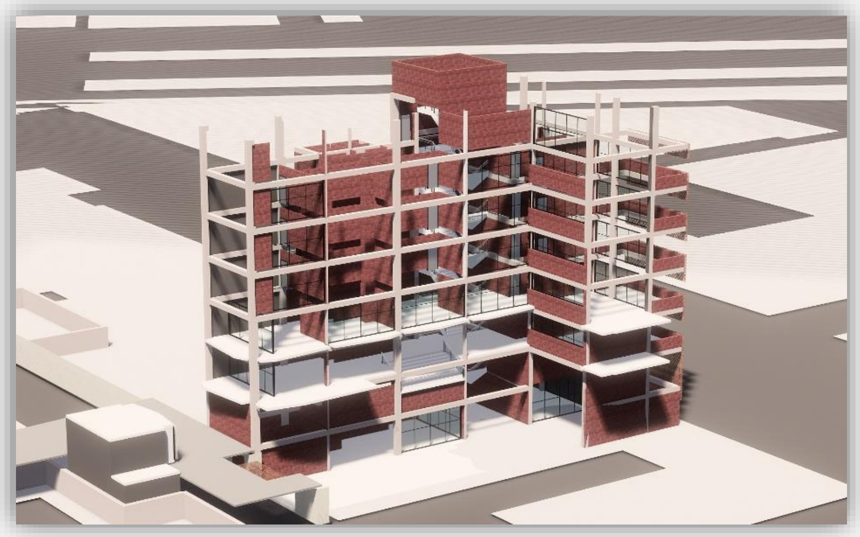


Fig 1.39: Structure (Author, 2021)

When adapting older existing buildings and adding additional load to it the existing structure must either be reinforced and supported or additional structure must be added to support the new load.

Physical characteristics of existing building

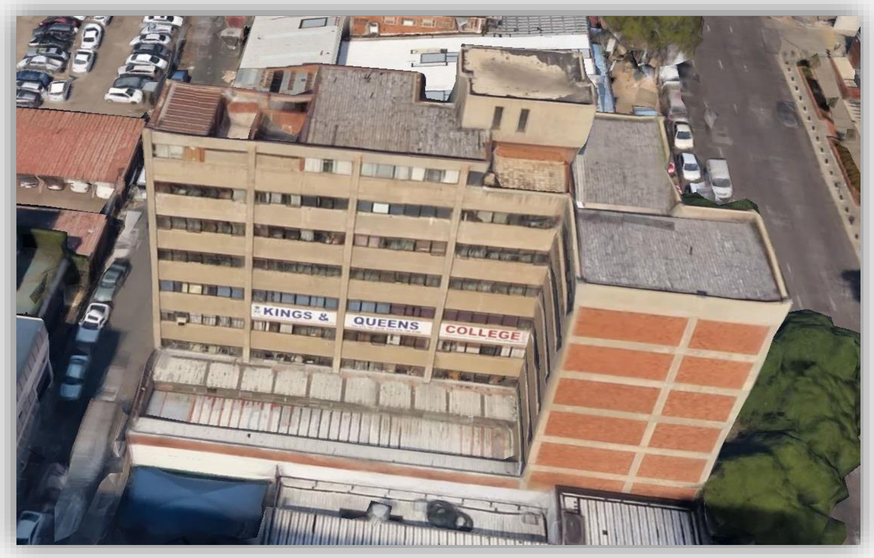


Fig 1.40: Existing characteristics (Google Earth, 2021)

Forces on the existing and new structure

Fig 1.41: forces (Author, 2021

Empirical

Application of adaptive reuse technology

Engineer specifications for technology

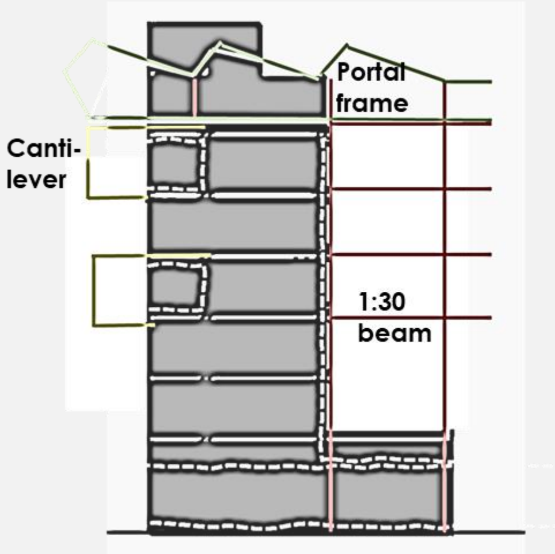


Fig 1.42: Specifications (Author, 2021)

The steel I-beams depth must be calculated at a 1:30 of its span according to civil engineering practice.

Construction process and assembly

Fig 1.43: Reuse (Pinterest, 2021)

The material's point of connection between what loads on existing structure and new structure must have expansion joints as the new structure would still need to be set. All steel bolt connections between the existing concrete and new steel structure should be chemically anchored.

Low-tech material reuse systems and process

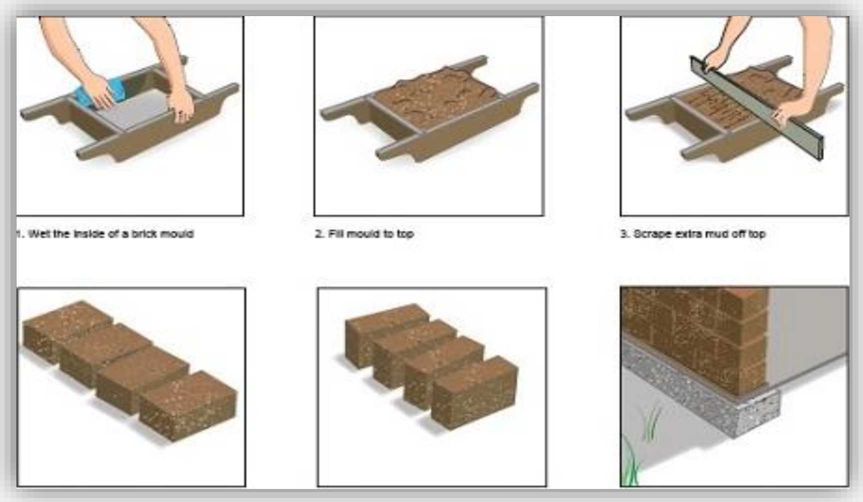


Fig 1.44: Low-tech (Pinterest, 2021)

Properties of reused material

Fig 1.45: Properties (Pinterest, 2021)

Qualitative

User interface with adaptive reuse technology

Surface finishes and requirements

Fig 1.46: surface finishes (Author, 2021)

Existing structure would be appropriate to leave as is without finish to display the quality of surfaces between old and new structure.

Quality and spatial experience

Fig 1.47: UCL (Pinterest, 2021)

All existing walls and other surfaces would need to be covered in mortar, cement screed and paint to ensure appropriate conditions for education. Reused brick for exterior skin would be left untreated to show the quality and method of reuse through material qualities.

Quality and nature of construction materials

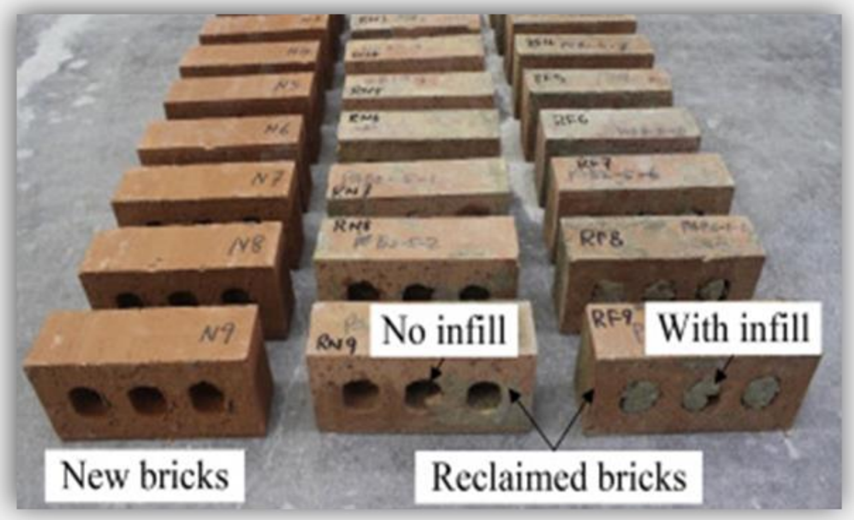


Fig 1.48: Material quality (Pinterest, 2021)

Reused material texture and interaction

Fig 1.49: Brick wall (Pinterest, 2021)

Precedents

Transformation

Strategy

School of architecture UCV by insertion, weaving and wrap strategies used. Insertions are an appropriate technique to use to open facades and the ground floor. This would allow the existing building that restricts breathing space to open to the surroundings. Weavings would serve as a technique to attach individual forms like extending the classrooms into the existing building structure. Wrapping technique will allow the skin of the building to be wrapped creating a binding form onto the existing building.

Fig 1.50: School of Architecture (Gatica, 2020)

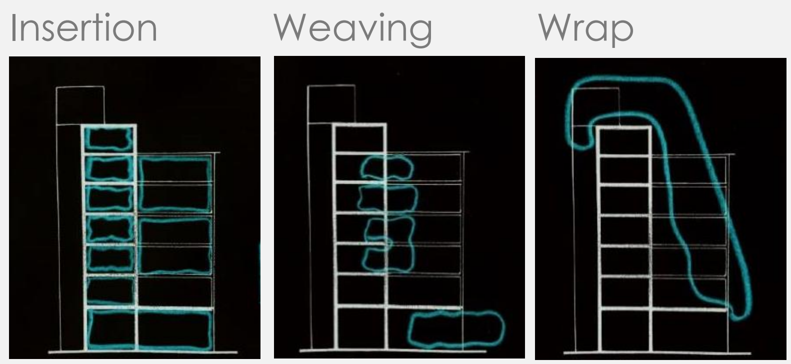


Fig 1.51: Strategy (Author, 2021)

Approach

Academia de Música de Roubaix by recycle and extension approach used. Recycling the existing building spaces for new uses can have big economic and environmental load effects reducing the total new spaces that needs to be constructed. Extending existing spaces into the area next to the building will allow for enlargement of the office spaces to be used and appropriate in size for classrooms.

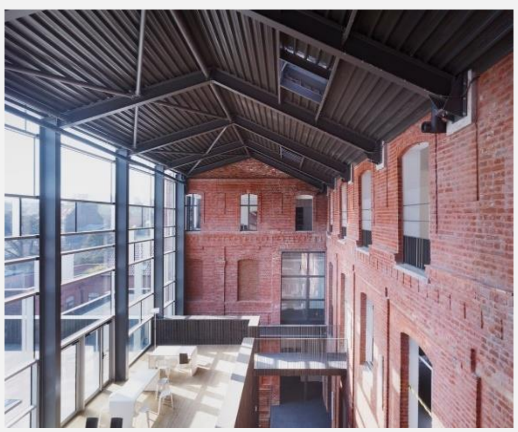


Fig 1.52: Academia de Música de Roubaix (Lanoo, 2013)

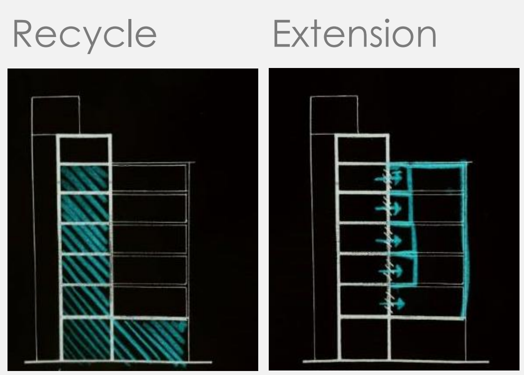


Fig 1.53: Approach (Author, 2021)

Typology

Zeitz MOCAA by mirror, transform and oppose typology used. Mirroring the existing building as an atrium will allow the structural grid to be follow making the new structure easier to solve. Transforming and opposing the existing façade changes how the building responds to the environment by perforating the sun and using lightweight materials.

Fig 1.54: Zeitz MOCAA (Heatherwick Studio, 2017)

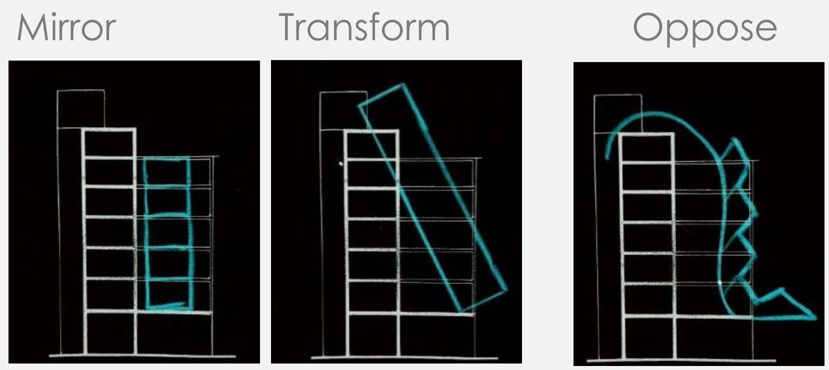


Fig 1.55: Typology (Author, 2021)

Extent

School of architecture UCV by the extent of most of the building transformed. Because the existing building was not designed to be an education institute most of the building would need to be transformed, this would also allow renewal of older finishes and systems.

Fig 1.56: UCV (Gatica, 2020)

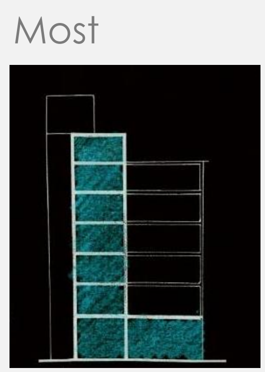


Fig 1.57: Extent (Author, 2021)

Existing structure

Adaptation

The Silo by adapt, cut and add adaptation. These techniques are used in different methods to change the physical nature of the building whether it might be to open up spaces, cut existing material or add to the building.

Fig 1.58: The Silo (Gonzalez, 2021)

Adapt Cut Add

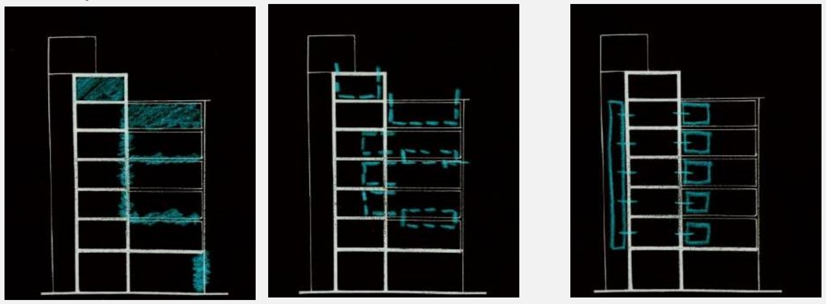


Fig 1.59: Adaptation (Author, 2021)

Reuse

Rotermann's Old and New Flour Storage by adaptation of its façade, structure and materials reuse. The demolition and cutting away from the existing façade of the Willie Theron building allows for reuse of its materials and faceds.

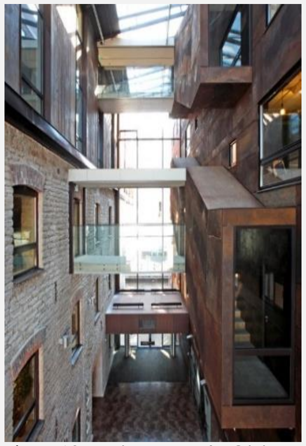


Fig 1.60: Rotermann's Old and New Flour Storage (Avaste, 2013)

Façade, Structure, Materials

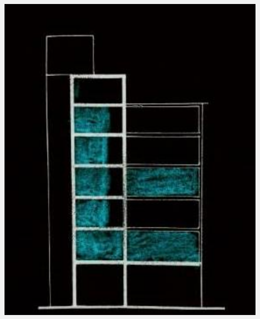


Fig 1.61: Reuse (Author, 2021)

Circular materials

Ningbo history museum is an example of where construction material's lifespan was extended through reuse as is and low skill remade techniques. The demolition techniques will need to be adjusted to extract materials according to how it would be reused. If sections of walls or bricks can be extracted it can be reused as is, broken bricks and refined crushed up brick can be remade with low skill level technology to make new construction materials.

Fig 1.62: Ningbo history museum (Wang Shu, Amateur Architecture Studio 2009)

Low skill remade techniques, Reuse as is

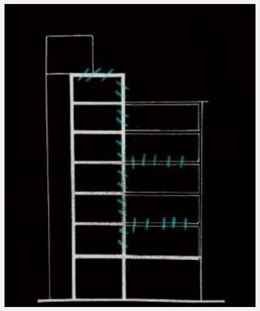


Fig 1.63: Circular materials (Author, 2021)

Strategy

Strategy framework

The purpose of this strategy is to critically analyse the existing structure and spaces, and to establish what potential building spaces might have with regards to adapting for the new demand. The spaces and structure of the existing building will also be analysed to inform the potential adaptation and reuse of spaces, as well as how they can be altered to fulfil the requirements of the development. Critical evaluation of the amount of demolition that really needs to take place to accommodate demands of the new building should be done when adapting the existing building. However, it should not be too conservative when it comes to demolishing parts of a structure. Adaptation strategies should not restrict the possibilities but rather, enable opportunities of an existing structure to allow for regeneration and renewal.

Strategies

The strategy on the urban level is to create flexible spaces for interaction and individualism. Institutional buildings and mono-functional buildings should be allowed to interact with urban spaces and the public. Entrepreneurial and learning/workshop spaces should be initiated for more people to join in with flexible spaces and programmes. Breaking the barrier between private and public spaces allows for integration with programmes. A multifunctional space that serves as a mediation space allows for growth and increased opportunity.

The site level strategy is to develop the building to serve as a point of interest for upliftment and education. However, the campus will be serving a greater purpose than just education. It will also provide an urban public space with access to food stalls, restaurants and public housing. This will allow for public amenities to be shared with the campus and in turn, increase its sustainability and resilience. While the main building can be viewed as the reference point for learning and existing private spaces, the scheme is to transfer and merge private space to absolute public space with thresholds from the street level to the inside of the building, thus giving different levels of integration.

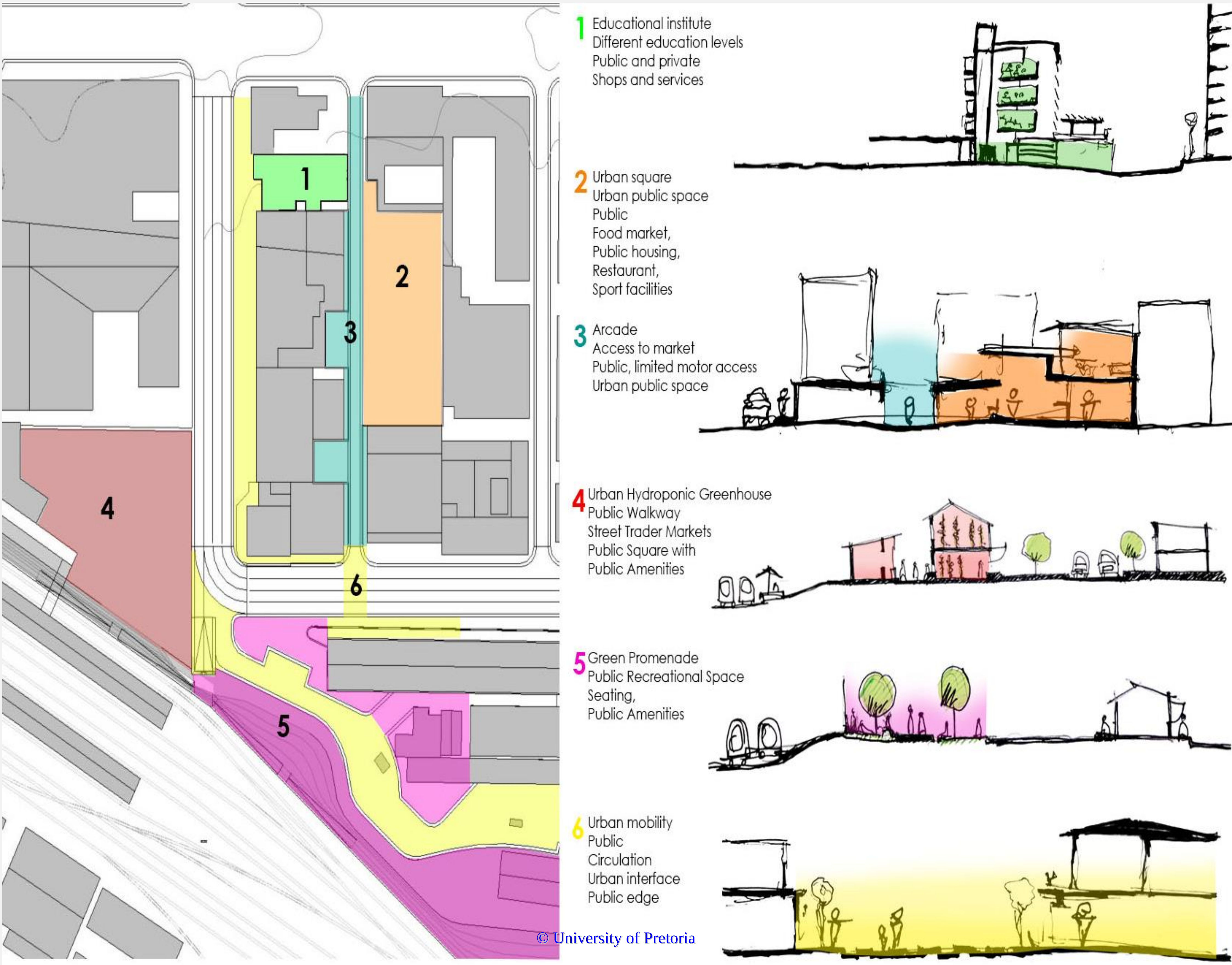
The building level strategy is to let the building serve as the main structure and spill over to open space in areas around (air and on open ground.) The building's approach to the urban edge would need to break open to allow the urban carpet to flow freely into the structure allowing for integration with the ground level plain. The strategy is to develop a technique and technology to adapt existing buildings. Demolished materials of the existing building as well as other debris of demolished buildings in the city can be used to produce materials used in the construction of the transformed building. Breaking open the building will allow for better spatial quality and use the existing main structure to facilitate new spaces overflowing into open space next to the existing building. The informants developed through relevant research done, can be applied to the Willie Theron building and thus, promote urban renewal and regeneration through adaptive reuse.

Concept Development

Urban Framework

The urban framework's intent is to break the preserve in a static conservation of the designer's idea of place making, it should be interpretable and flexible to be dictated and given value by use and function from the continuous development of place.

Fig 1.64: Urban framework (Author, 2021)

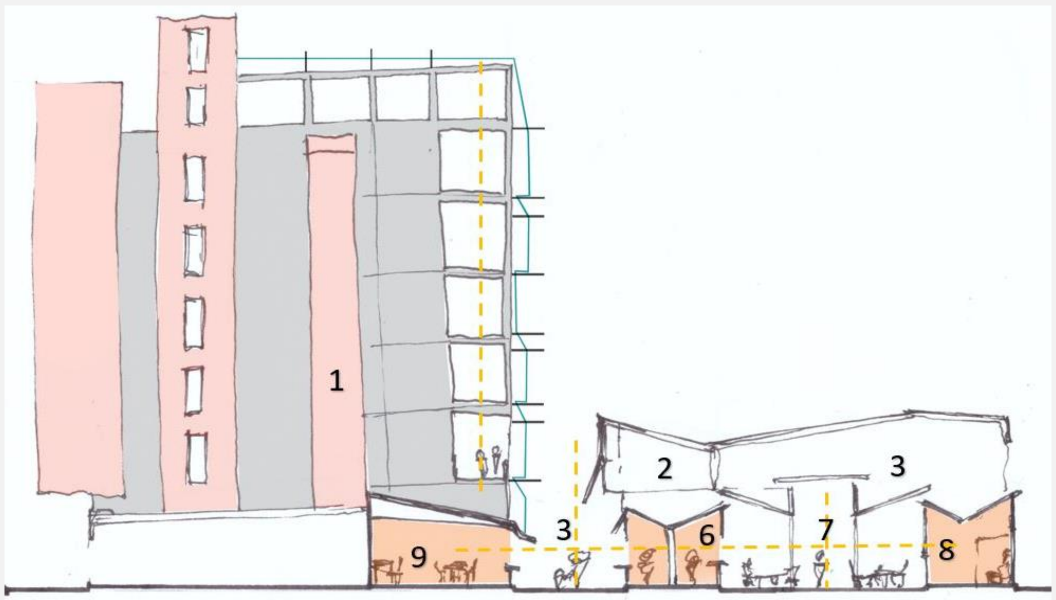


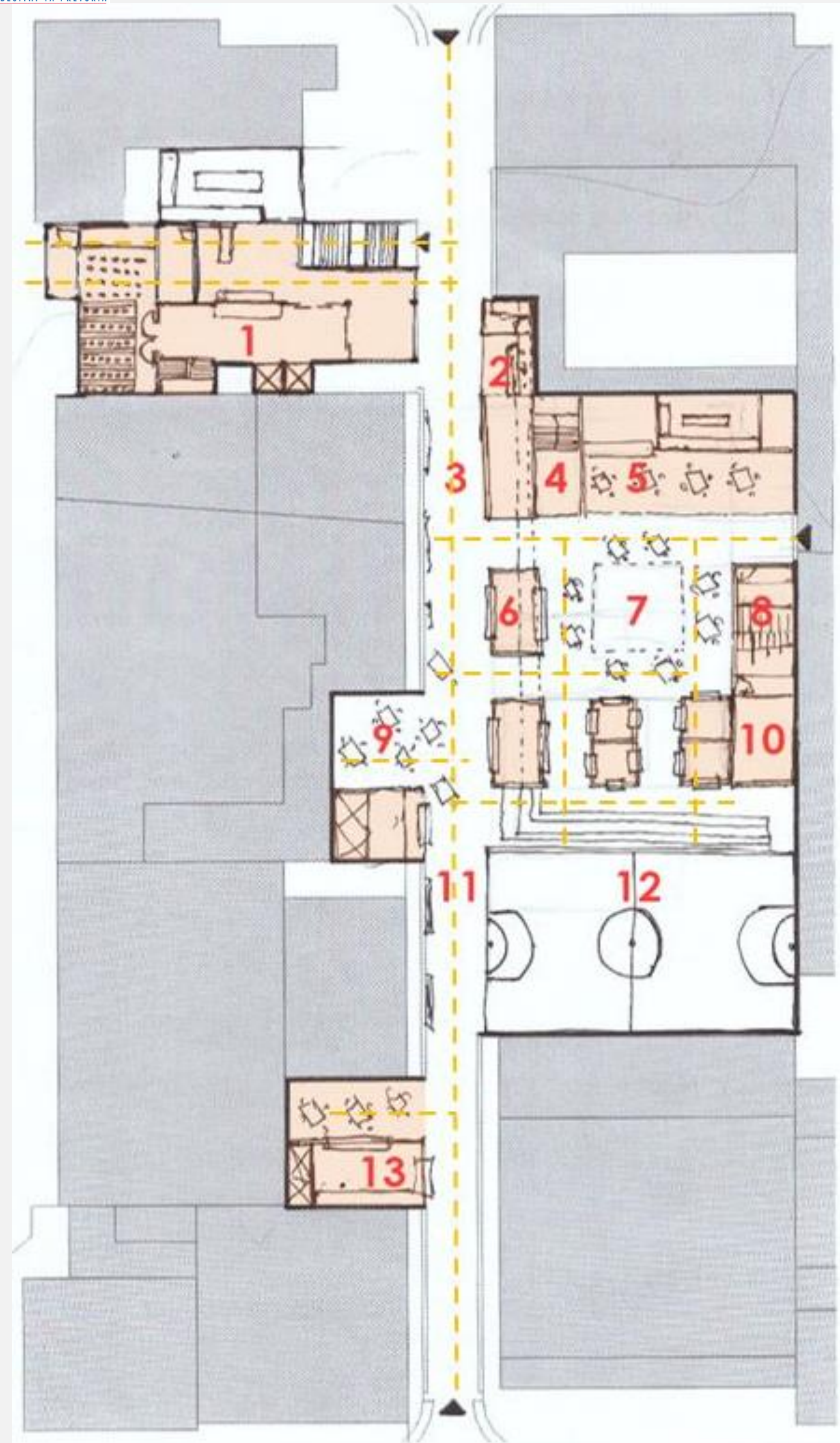
Campus Vision

The site vision is to create different levels of reuse and adaptation from the Willie Theron building that is adapted into overflowing surrounding space. The arcade becomes mediation space between public and private. The parking lot and Hope Street is activated through multifunctional and bi-functional spaces with private to public areas.

Fig 1.65: Site plan (Author, 2021)

Fig 1.66: Site section (Author, 2021)





Site description

1. Education institute
2. Site reception
3. Arcade
4. Entrance to accommodation
5. Restaurant
6. Food stall
7. Square
8. Toillettes
9. Caffe
10. Storage
11. Interactive wall
12. Sports court
13. Take away shop

Building Concept

The building vision of the institute is a building that accommodates an academic and upliftment institution as well as integrates with the city to become a central place of knowledge transfer and upliftment. The building serves as the main structure and spills over to open space in areas around (air and on open ground.) On the ground floor are commercial shops and services, the first floor is the general lobby and atrium to the school. The second floor is an upliftment centre. The third and fourth floors host a steppingstone education school and on the fifth to sixth floors is a TVET and handicraft academy. The structure serves as main component that new building components and materials made from demolished debris attach to, to accommodate new spaces.

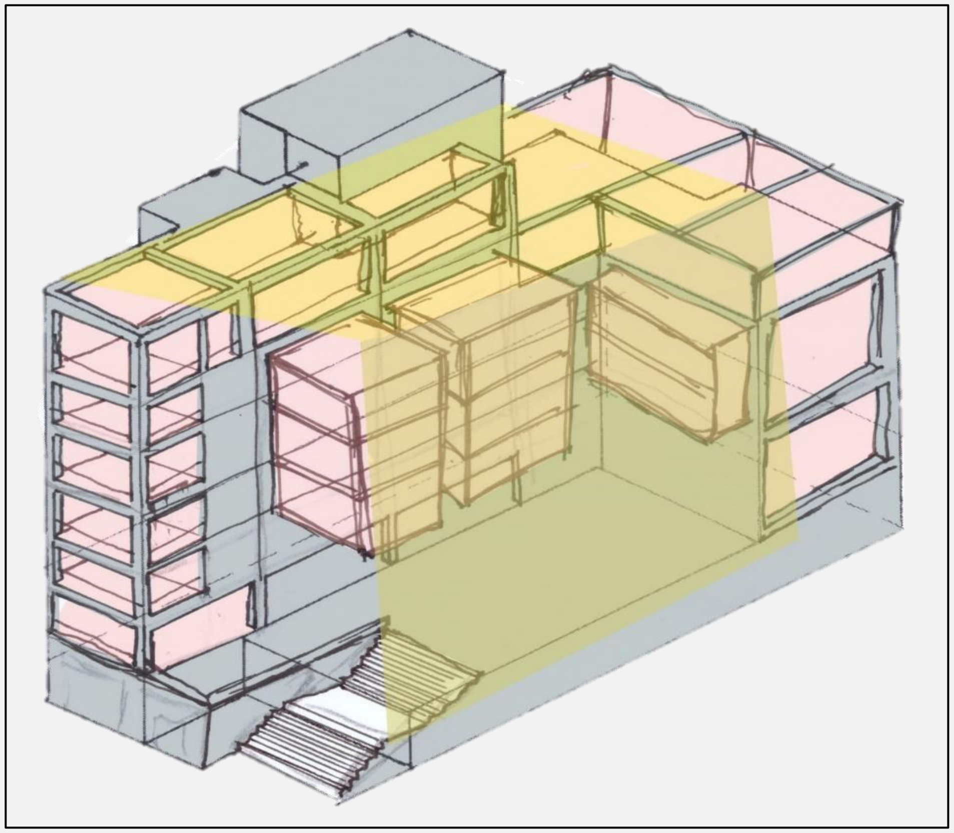
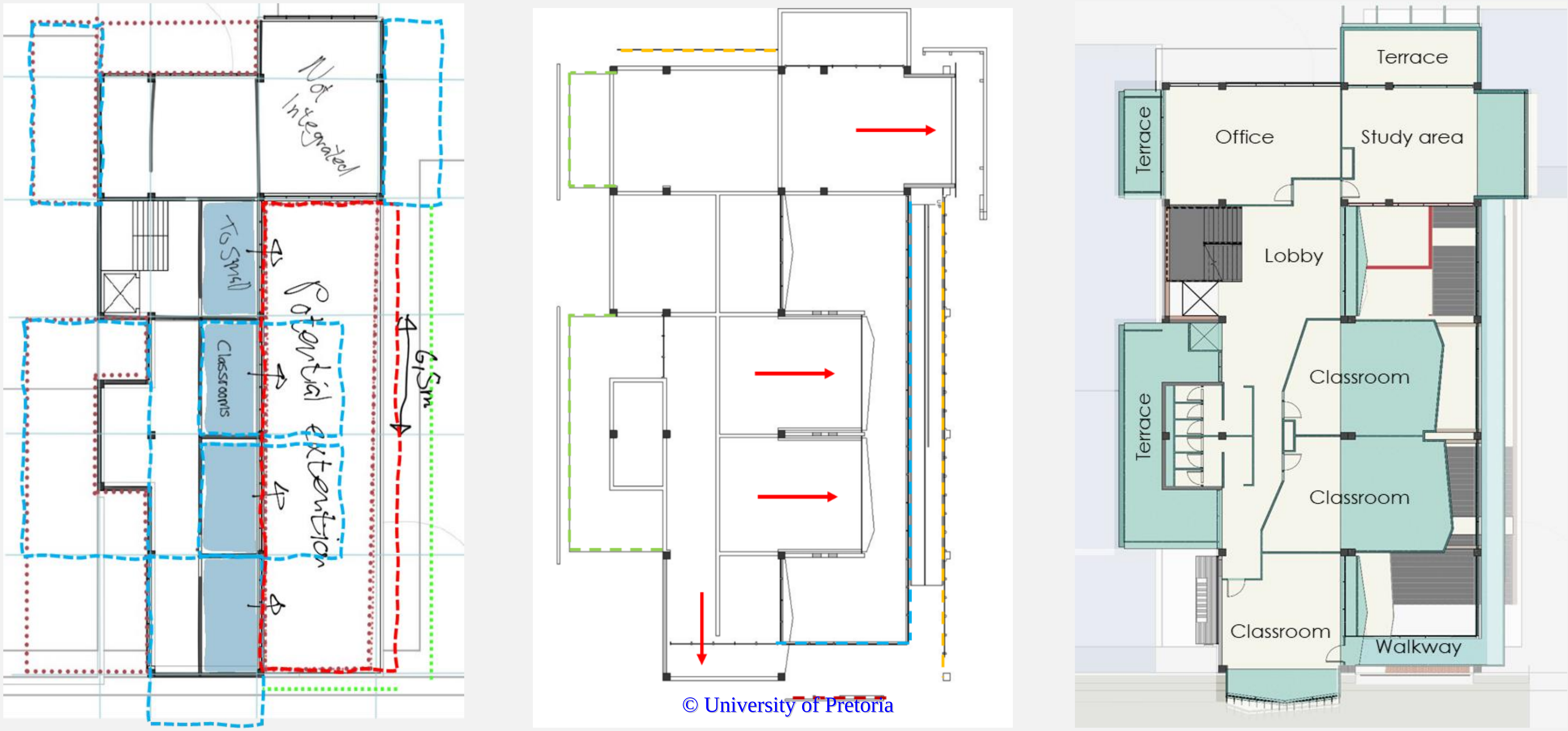


Fig 1.67: Building 3D (Author, 2021)

Fig 1.68: Building concept (Author, 2021)



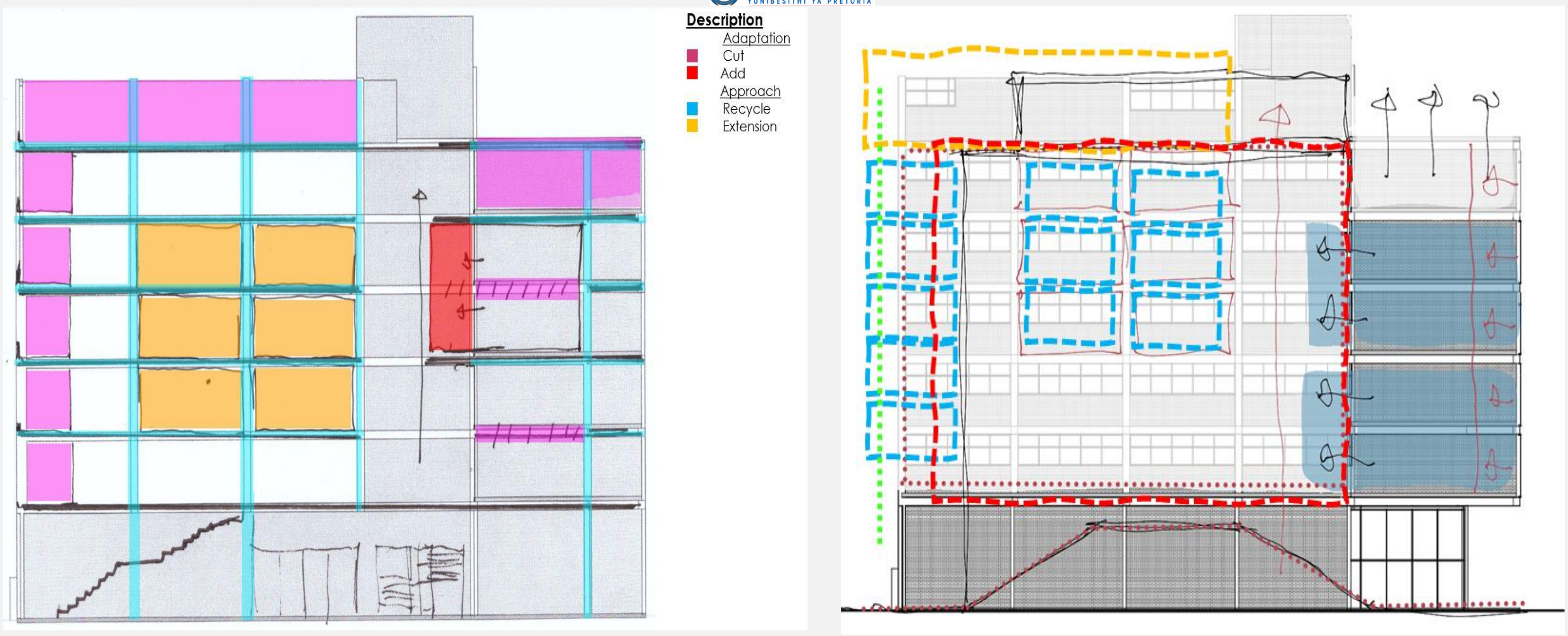
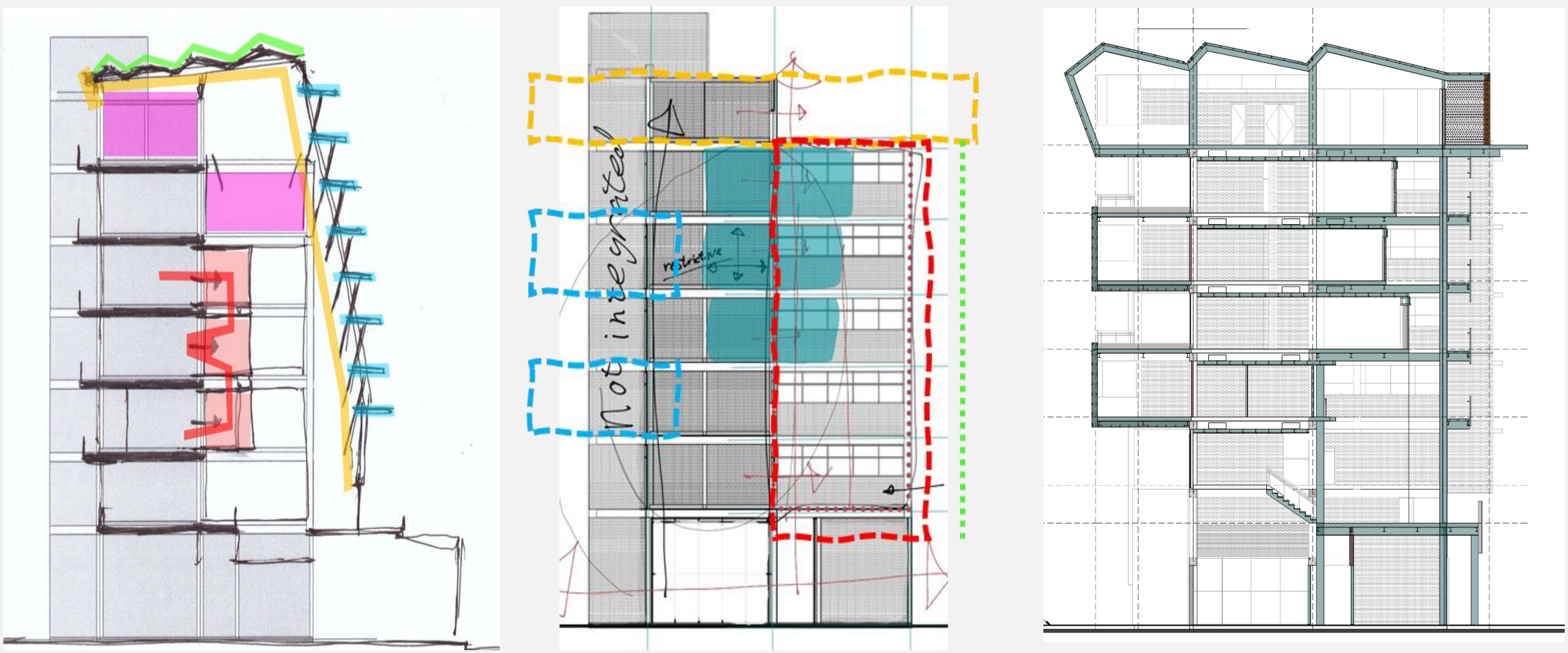


Fig 1.69: Section concept (Author, 2021)



Design Development

Ground Floor

Currently the ground floor is used for shops. The method of adaptation would be to cut by take away unnecessary space to create a passageway from Bosman to Hope Street.

Lobby

Currently the intended lobby area is the roof of shops. The method of adaptation is for the lobby to parasite onto the existing floor by latching on and into it, extending the first floor into the existing building and transforming and cutting the roof away to create circulation by entrance stairs and a floor structure.

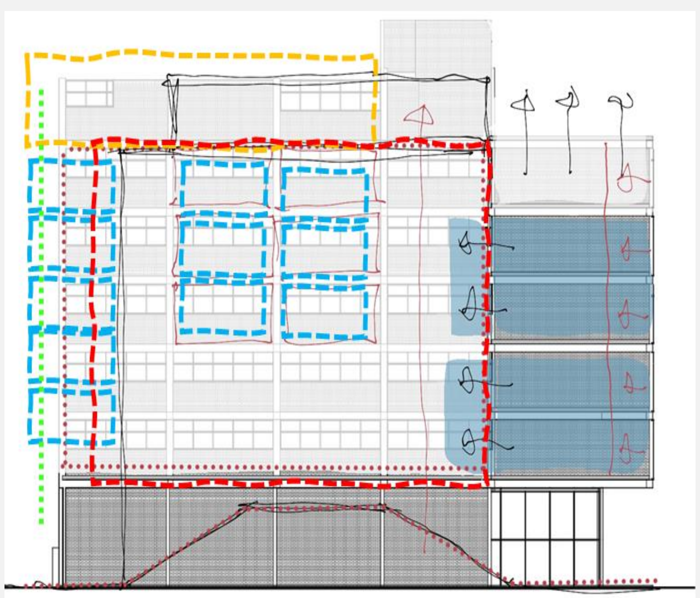
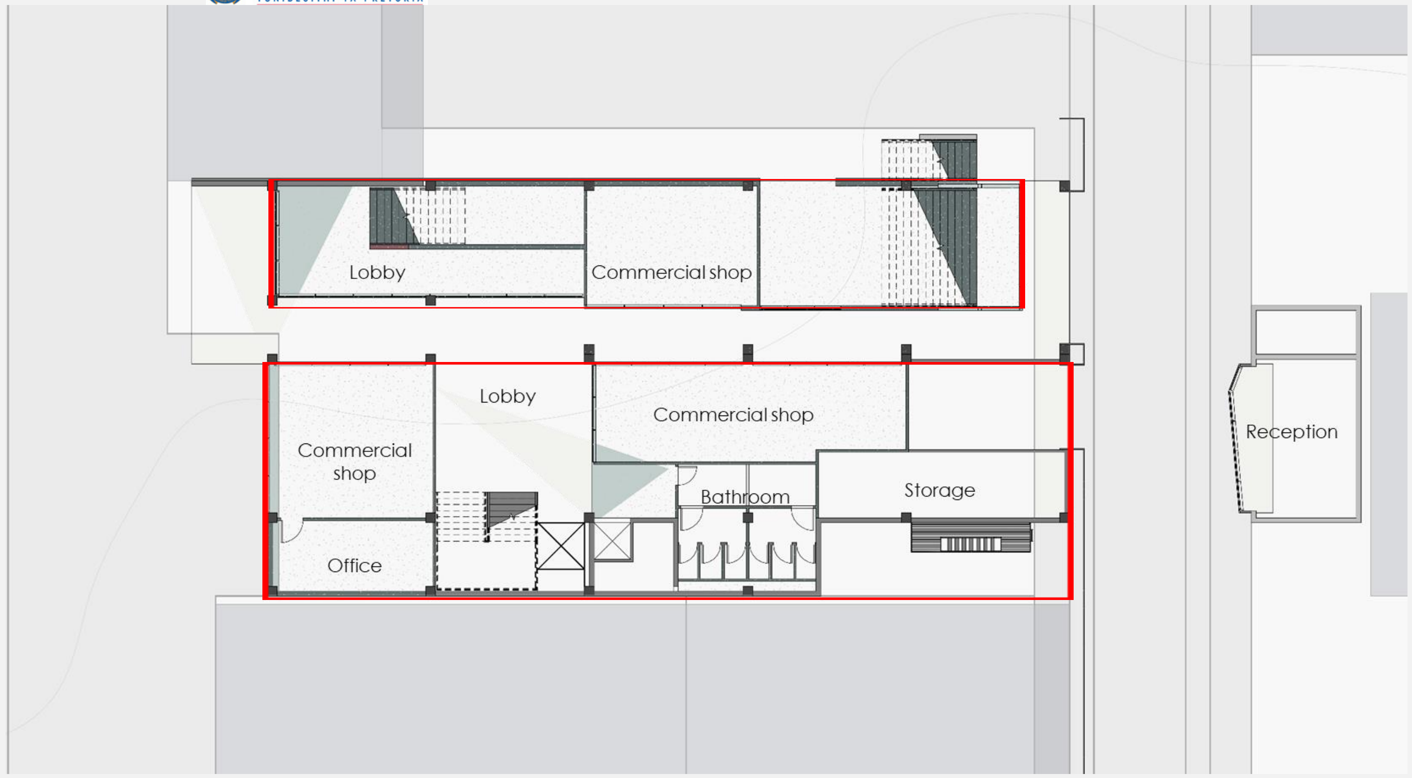
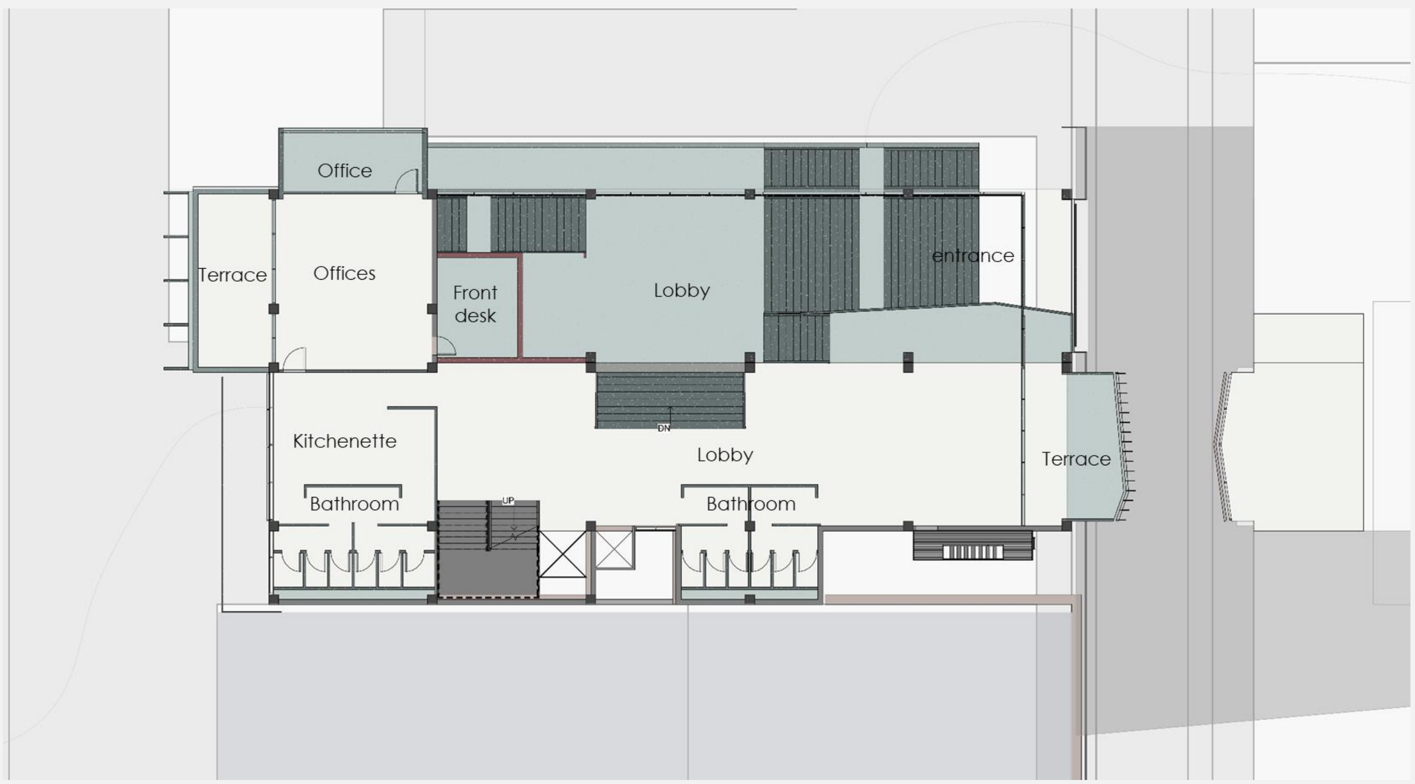


Fig 1.70: Lobby section (Author, 2021)



Ground floor

Fig 1.71: Ground floor development

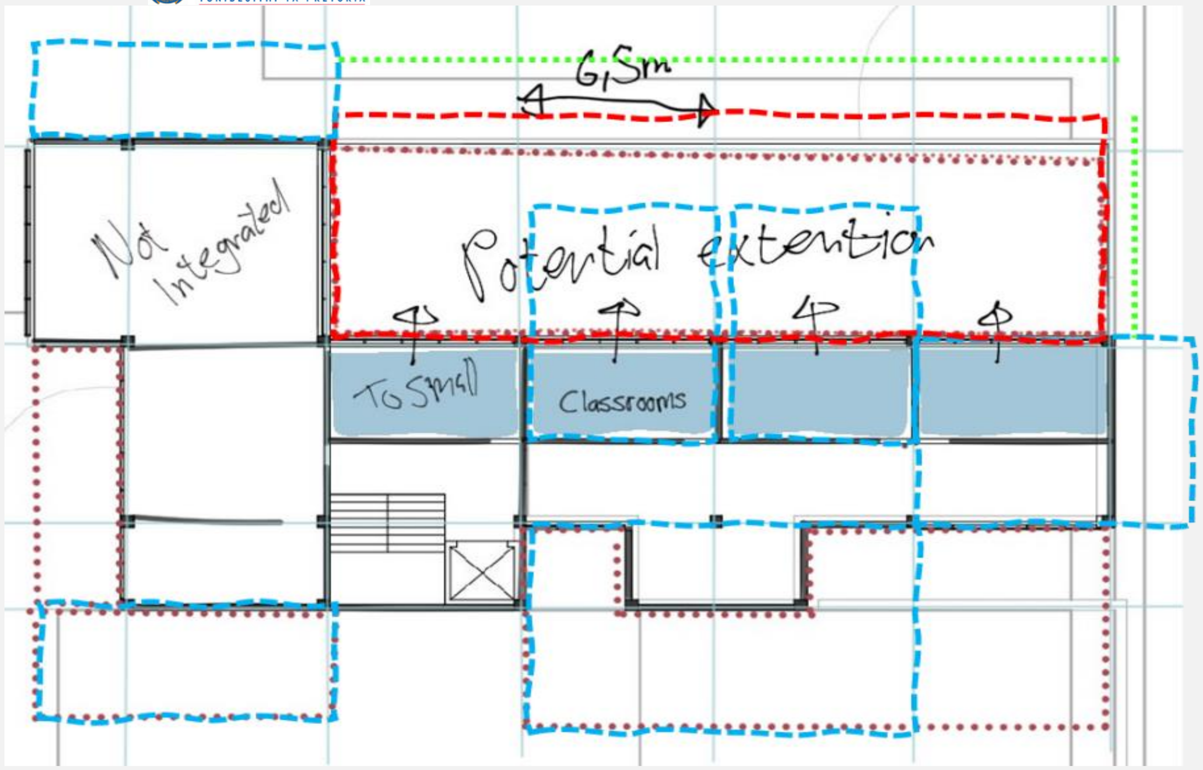


First floor

Fig 1.72: First floor development (Author, 2021)

Classrooms

The existing classroom are too small and thus would need to be enlarged through weaving spaces into the existing building and structure to extend the space into the atrium. This will add space to existing classrooms through mirroring existing structure but opposing form to break the current uniform nature of the classrooms.

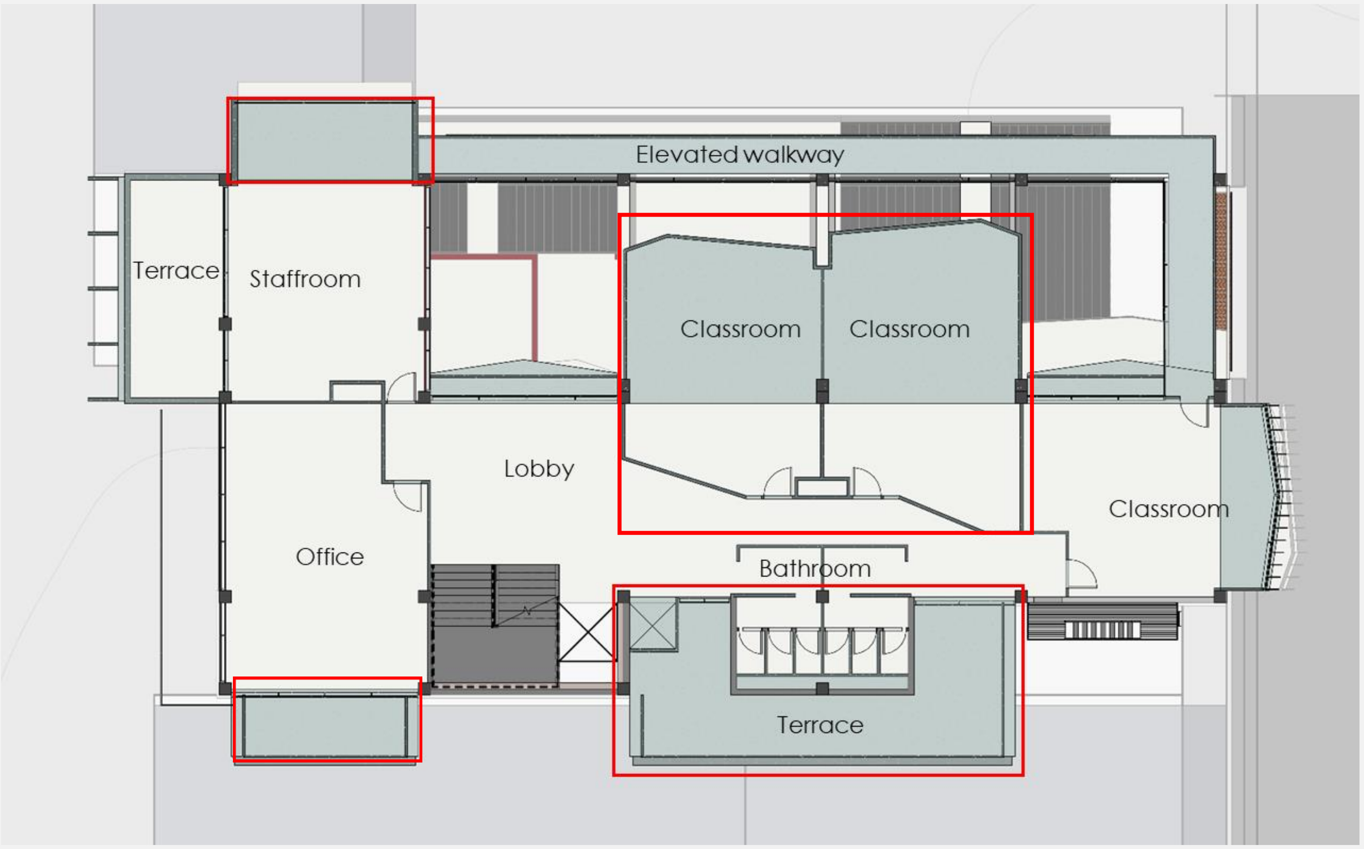


Southern storage and terraces

On the southern side of the building extensions would latch onto the existing building cantilevering and creating storage space on every second floor as well as terraces on top of them

Western spatial enlargement

The existing western flank of the building would need to be enlarged through extending the northern façade and mirror the existing façade.



Third Floor

Fig 1.73: Third floor development (Author, 2021)

Atrium

The northern airspace of the building is intended to serve as an addition to the existing building connecting the institute with a juxtaposition atrium with glass facades. This would oppose the existing building's language of concrete and brick but mirror the existing structural grid.

Workshop studio

Currently there is a temporary structure on the top floor which will be removed making space for the workshop studio that will be added to the top of the building. This will wrap over the existing building structure opposing the existing language of the building.

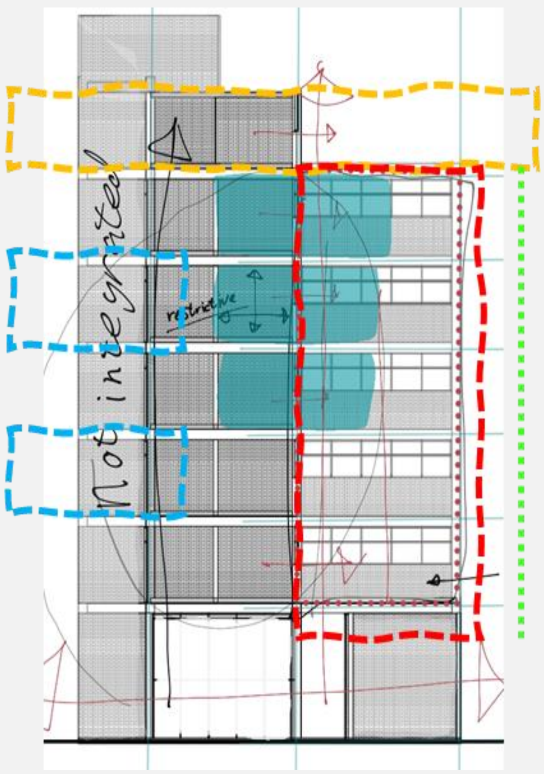
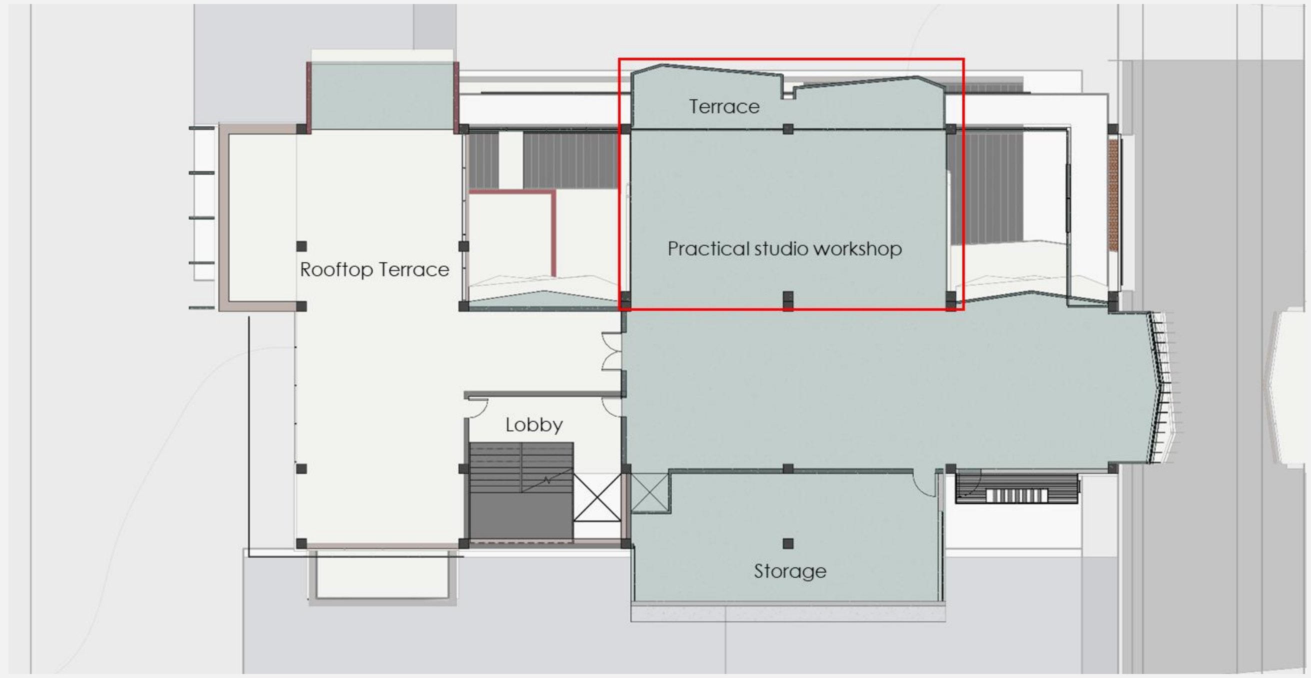


Fig 1.74: section a-a (Author, 2021)

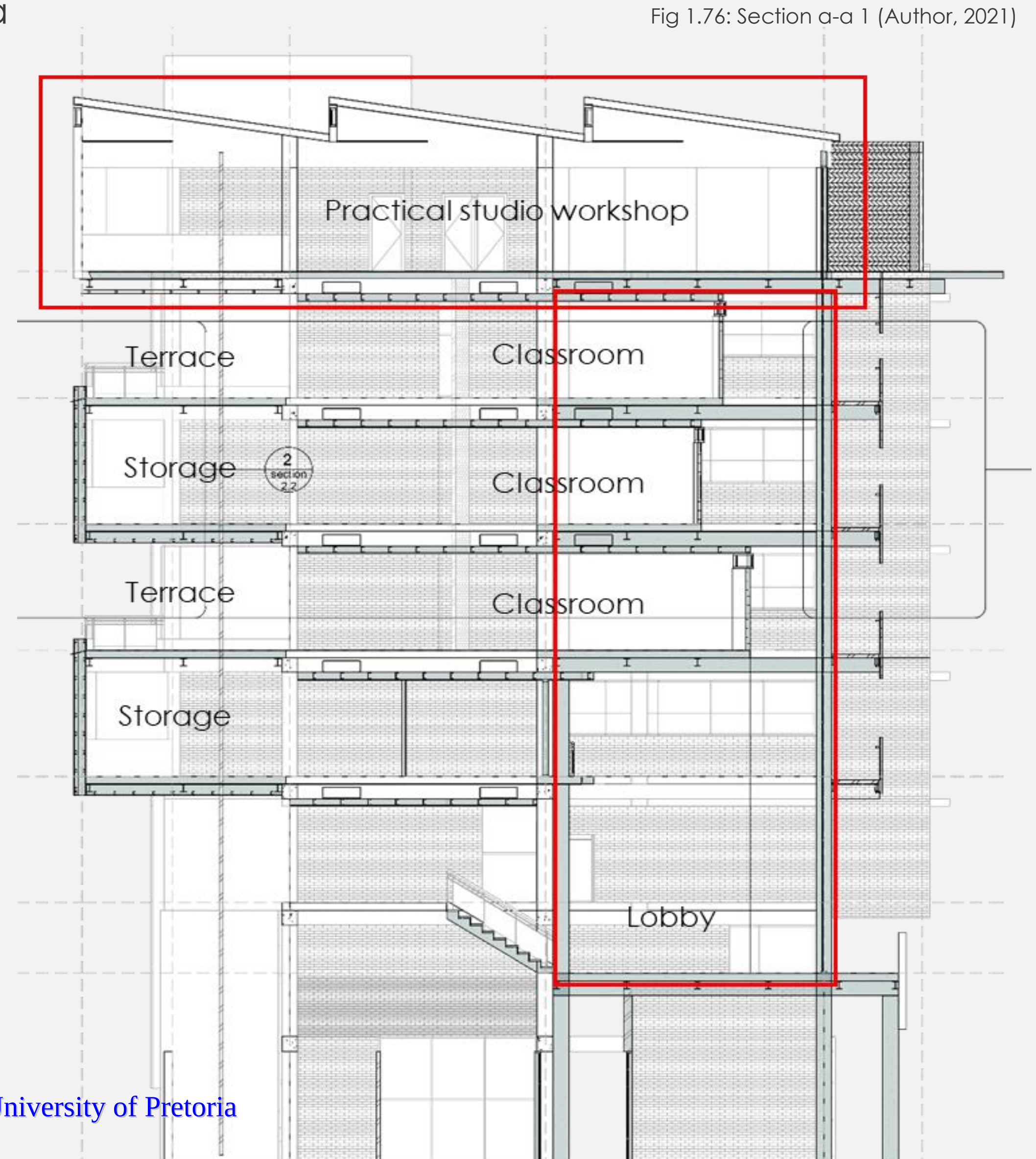


Sixth floor

Fig 1.75: Sixth floor development (Author, 2021)

Section a-a

Fig 1.76: Section a-a 1 (Author, 2021)



Eastern Skin

On the eastern side on the atrium a separated perforated skin made of salvaged brick demolished in the building would protect the atrium from sun as well as break up the light creating sun patterns in the atrium.

Northern and western skin

The skin would be added to the outside of the atrium on the northern façade of the atrium separated by exterior walkways. Inserting perforated skin and horizontal walkways would facilitate with climate control of the building by blocking direct sunlight to the building in summer times but allowing sunlight in, in winter.

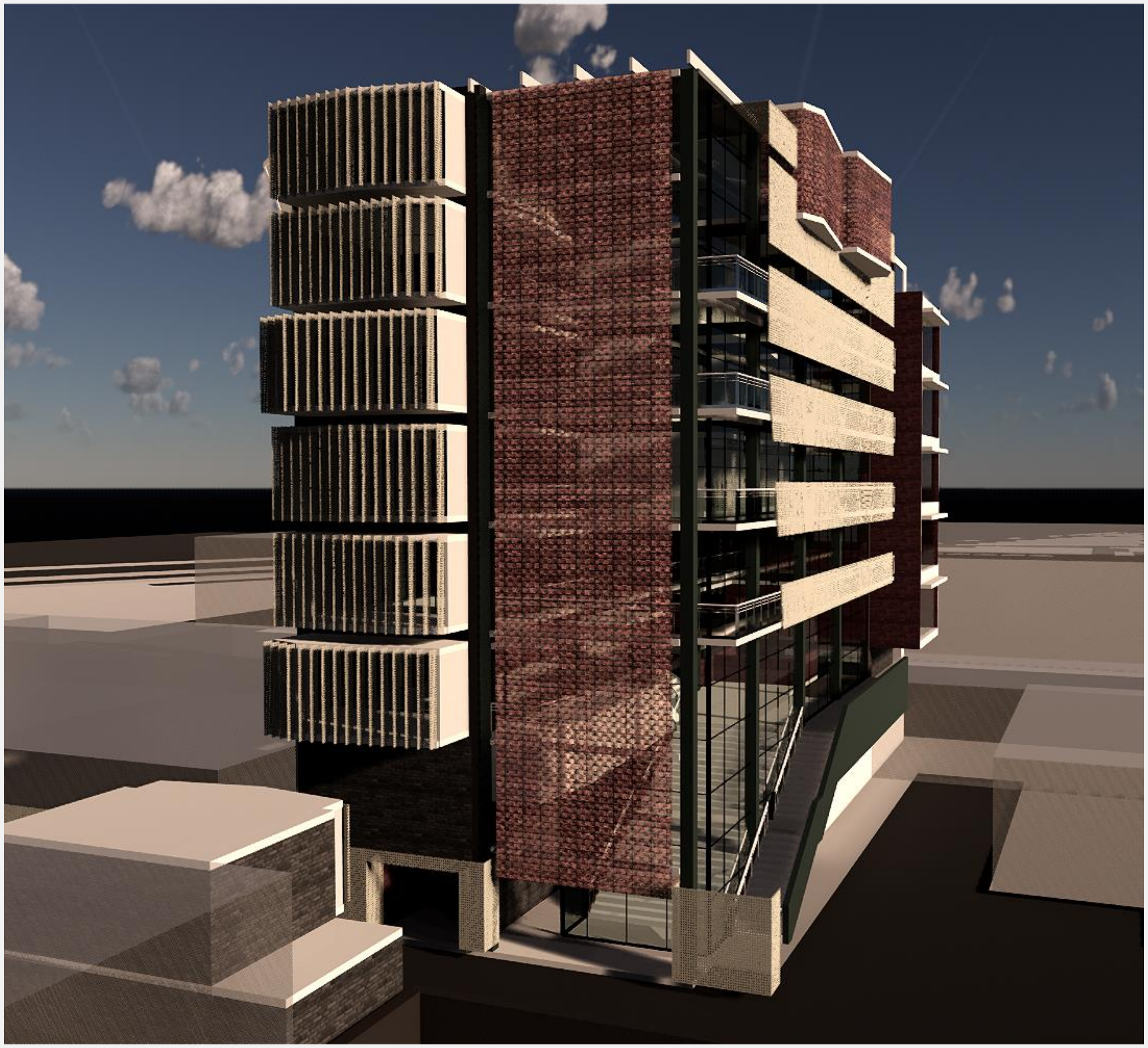
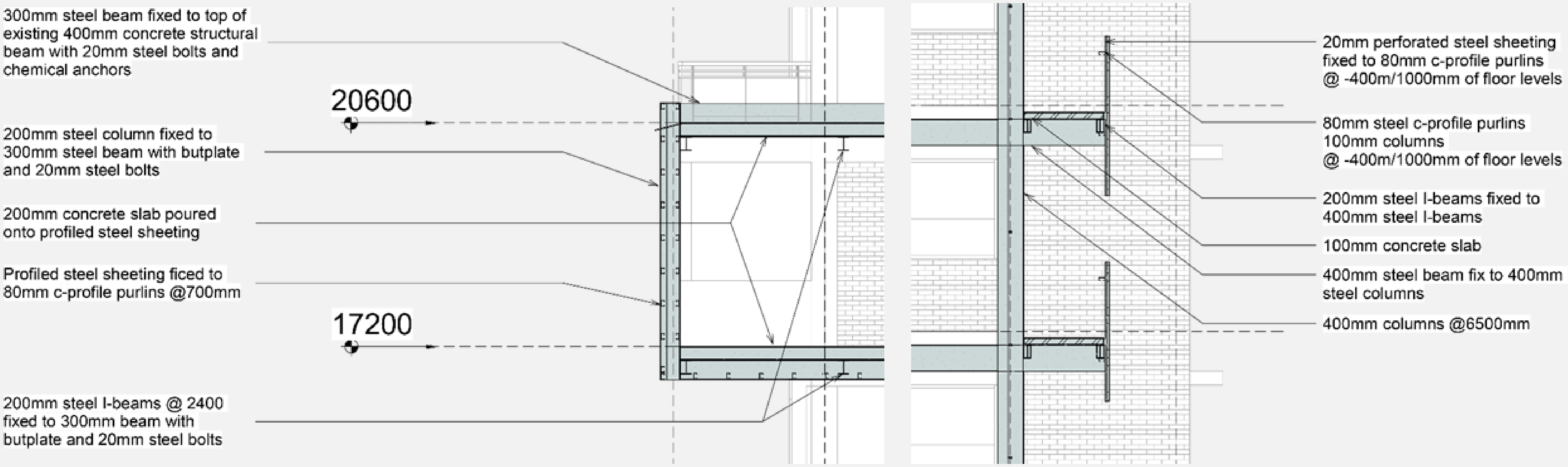


Fig 1.77: Render 1 (Author, 2021)

Fig 1.78: Details 1 (Author, 2021)



Technological Development

Argument

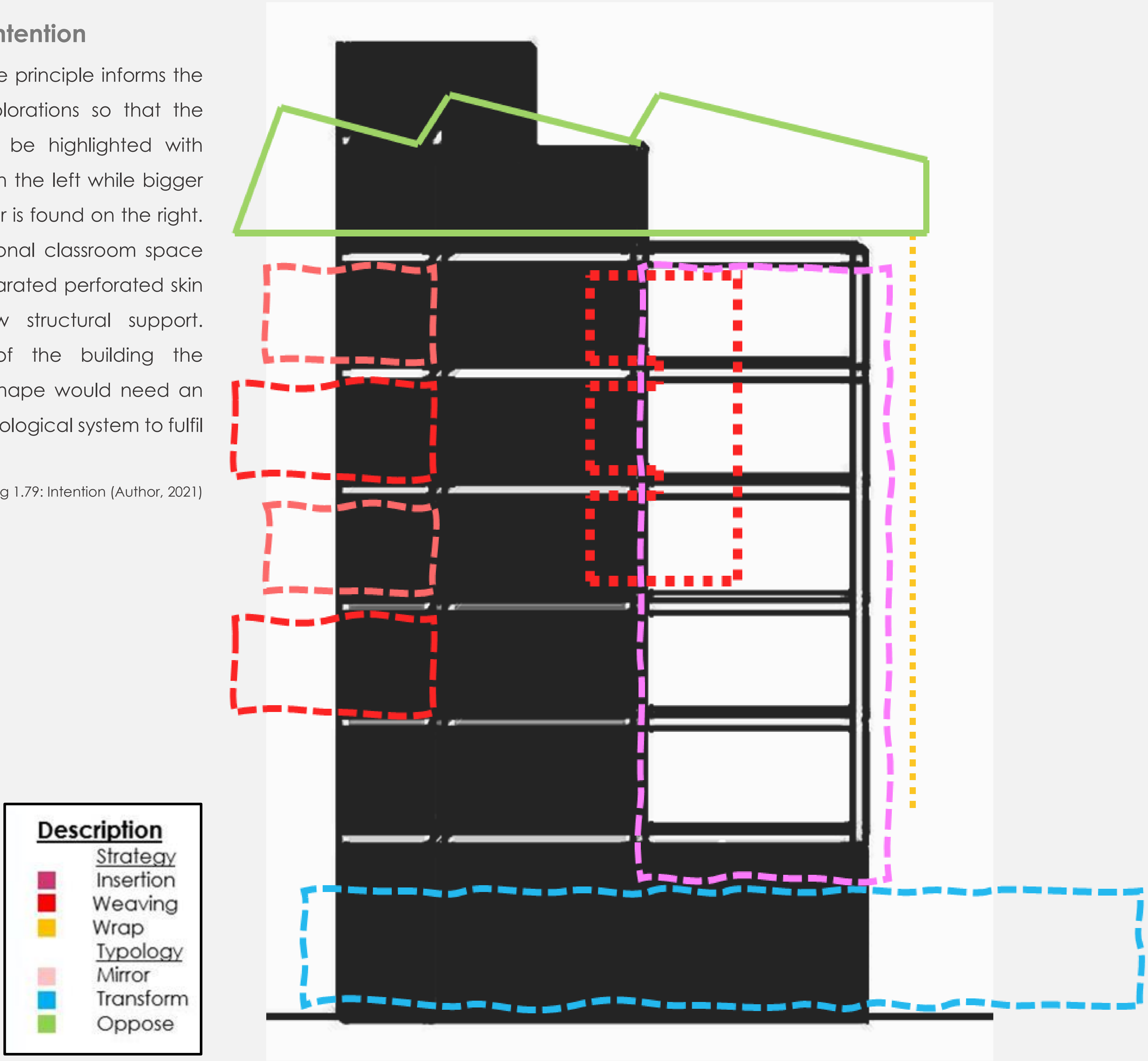
The technological intention to transform the existing Willie Theron building to a multi-level education institute is to enable certain spatial requirements through conceptual adaptive reuse techniques by making use of technology. The existing building's services and technology will be reused where is seemed to be fit for purpose, adapted where changes to the physical form of the existing building can be altered to support new conceptual approach and added to by using innovative technology to fulfil the conceptual, programmatic, spatial adaptive reuse techniques needed to transform the building successfully. Economically any building parts reused from the existing building structure would reduce the building cost and make the development more economically sustainable. Localised skills training to reuse the existing building components and debris for building components in the new building would also reduce the financial cost as well as uplifting the local community through upskilling and financial gains.

Explorations

Architectural intention

The adaptive reuse principle informs the technological explorations so that the techniques could be highlighted with small extensions on the left while bigger extensions per floor is found on the right. The atrium, additional classroom space as well as the separated perforated skin would need new structural support. Sitting on top of the building the workshop studio shape would need an appropriate technological system to fulfil the profile.

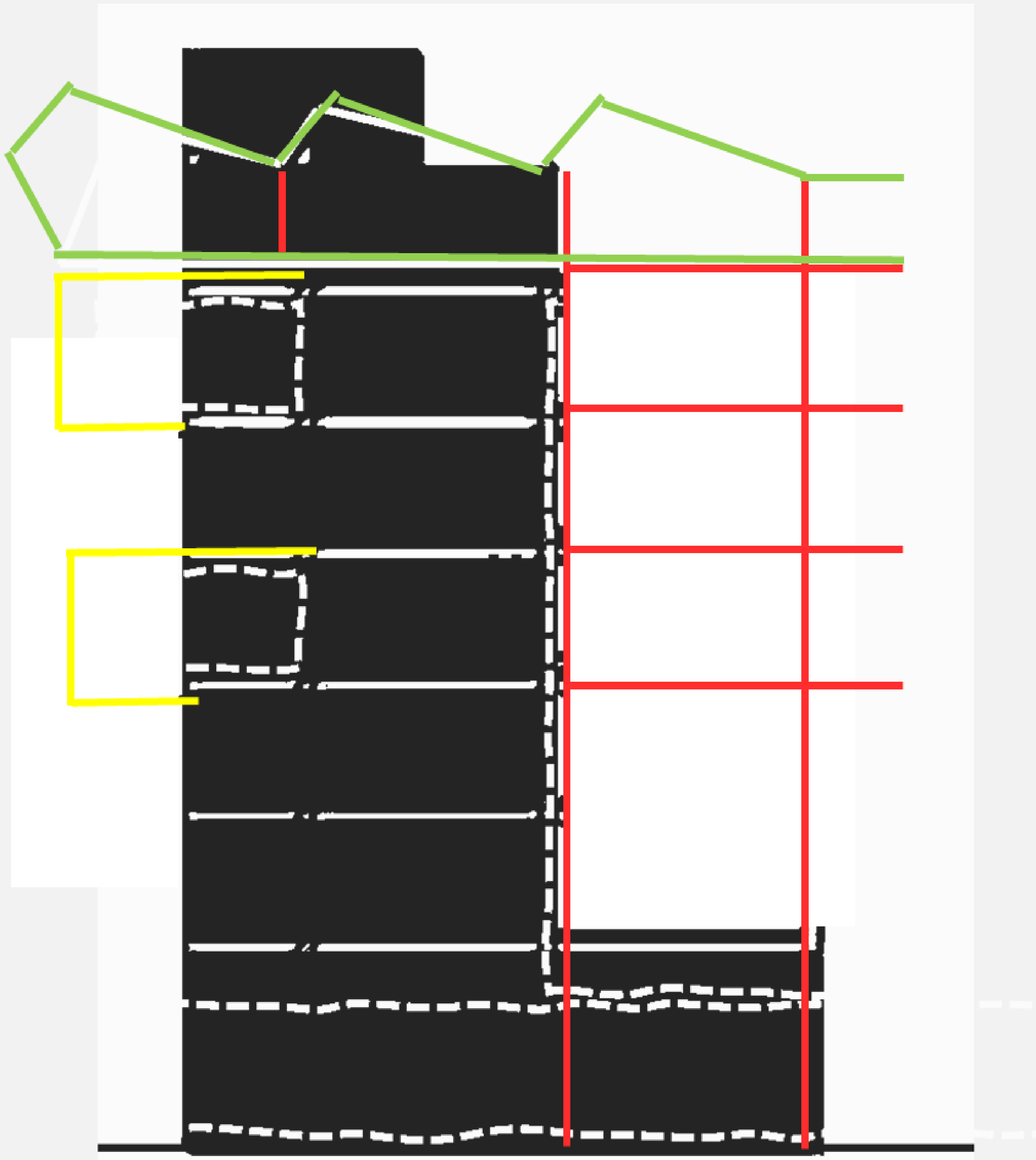
Fig 1.79: Intention (Author, 2021)



Technological intention

Certain adaptive reuse techniques and strategies were researched and applied to the new building. Technological solutions were implemented and experimented with to find solutions on how the design concept intentions could be constructed. Clip on structure to existing structure in yellow is used because it is isolated extrusion with a small overhang. Juxtaposition steel column and beam structure in red is used to extend classrooms and spatial atrium. Portal frame in green is used to create a spatial studio workshop on top of the building.

Fig 1.80: Technological (Author, 2021



Description

Strategy
- Insertion
- Weaving
- Wrap

Typology
- Mirror
- Transform
- Oppose

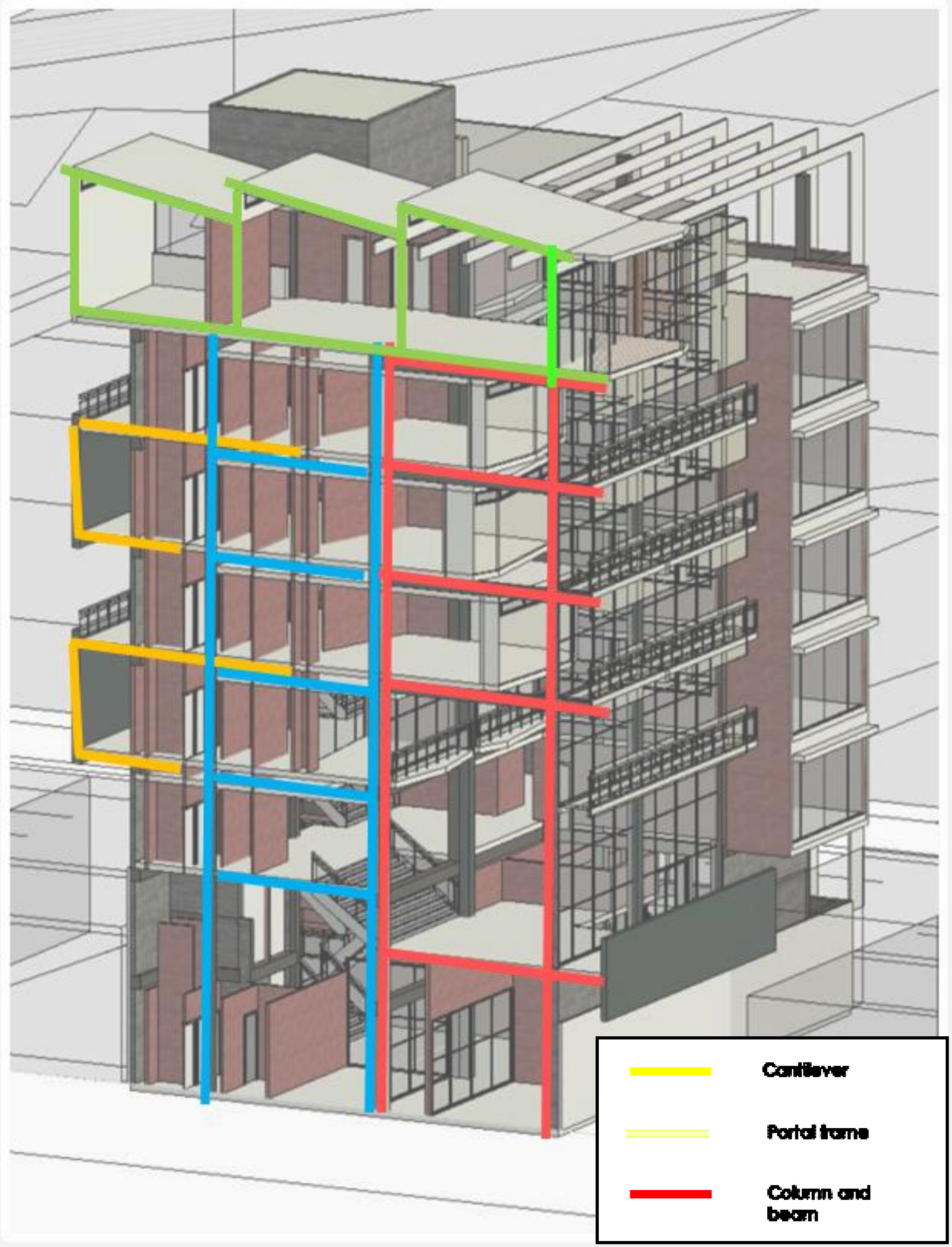
)

Structural systems

Blue represents the existing concrete 400x400mm column and 200x400mm beam structure. The existing structure would not have been designed to support additional loads and thus an independent structure would need to be placed alongside it. Represented in red is the primary new steel structure, this would support extensions, the atrium and skin as well at the workshop studio space. Yellow represents the secondary new steel structure supporting the skin and walls of the classrooms.

Fig 1.81: Structural 1 (Author, 2021)

Fig 1.82: Structural 2 (Author, 2021)



Services and systems

A central cooling system would distribute cool air from the central system on the existing second floor through ducks lining up on the floors. This would then be distributed in each floor in the ceiling space by ducts.

Fig 1.83: Services (Author, 2021)

Environmental response

Form

Northern shading is provided by horizontal exterior walkways to shade the atriums and building from the sun. Vertical elements shade the eastern façade through use of movable louvers and the western façade through long concrete louvers that run down the building's façade.

Fig 1.84: Render 2 (Author, 2021)

Fig 1.85: Render 3 (Author, 2021)

Technological

Hot air is then released by the classrooms and spaces by rising and released through the ceiling openings into the atrium and extracted out of the roof of the atrium space when cooling is needed.

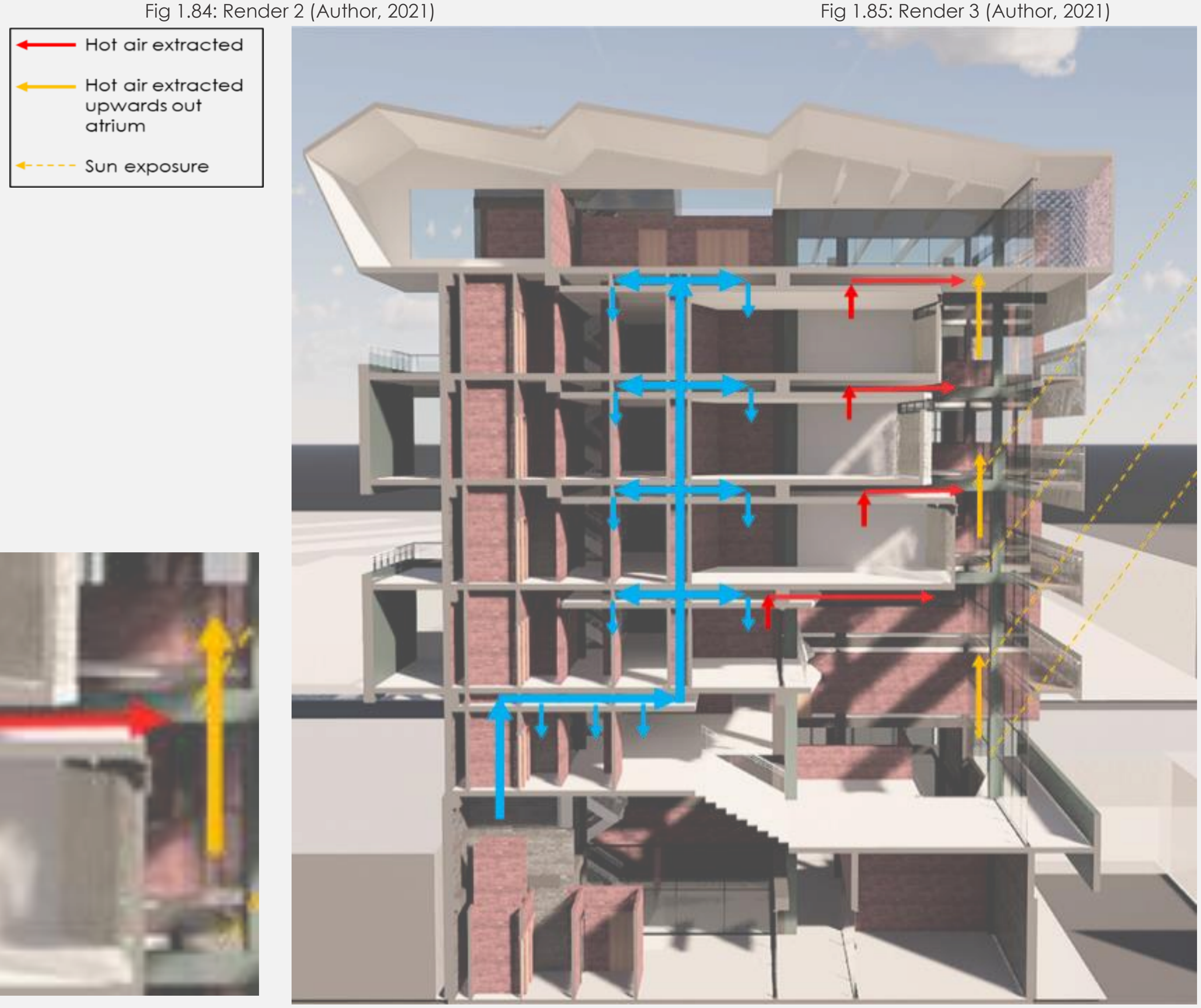
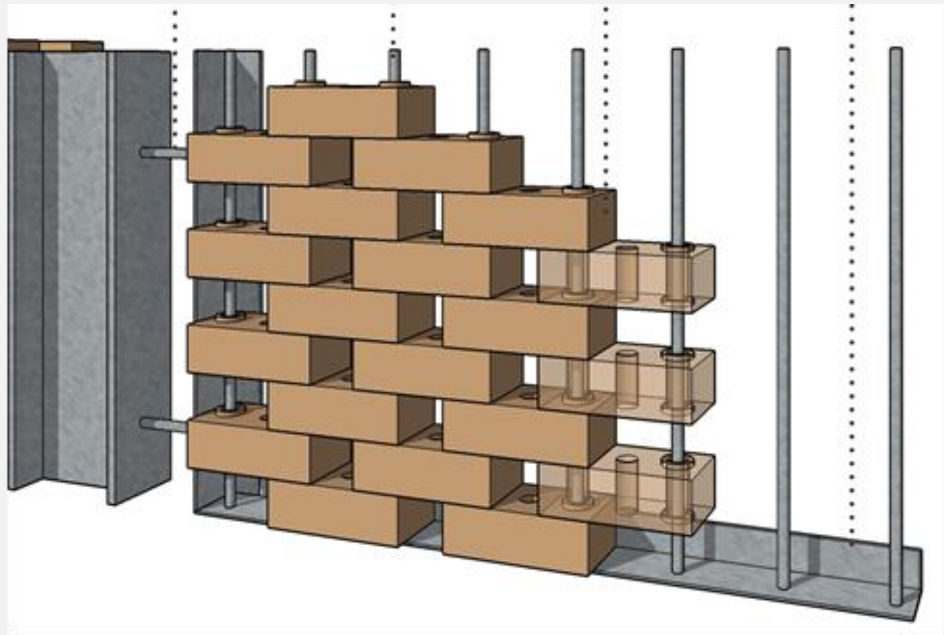


Fig 1.86: Environmental (Author, 2021)

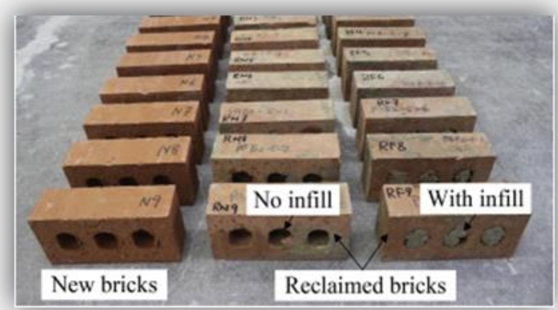


Available materials

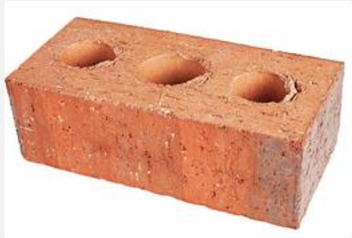
Materials available for technology and construction would be brick and concrete debris of the existing building parts that were demolished and of other demolished buildings in the area. After considering reuse material, standard local produced materials would be considered first before importing materials.

Fig 1.87: Reusing bricks (Pinterest, 2021)

Reusing brick



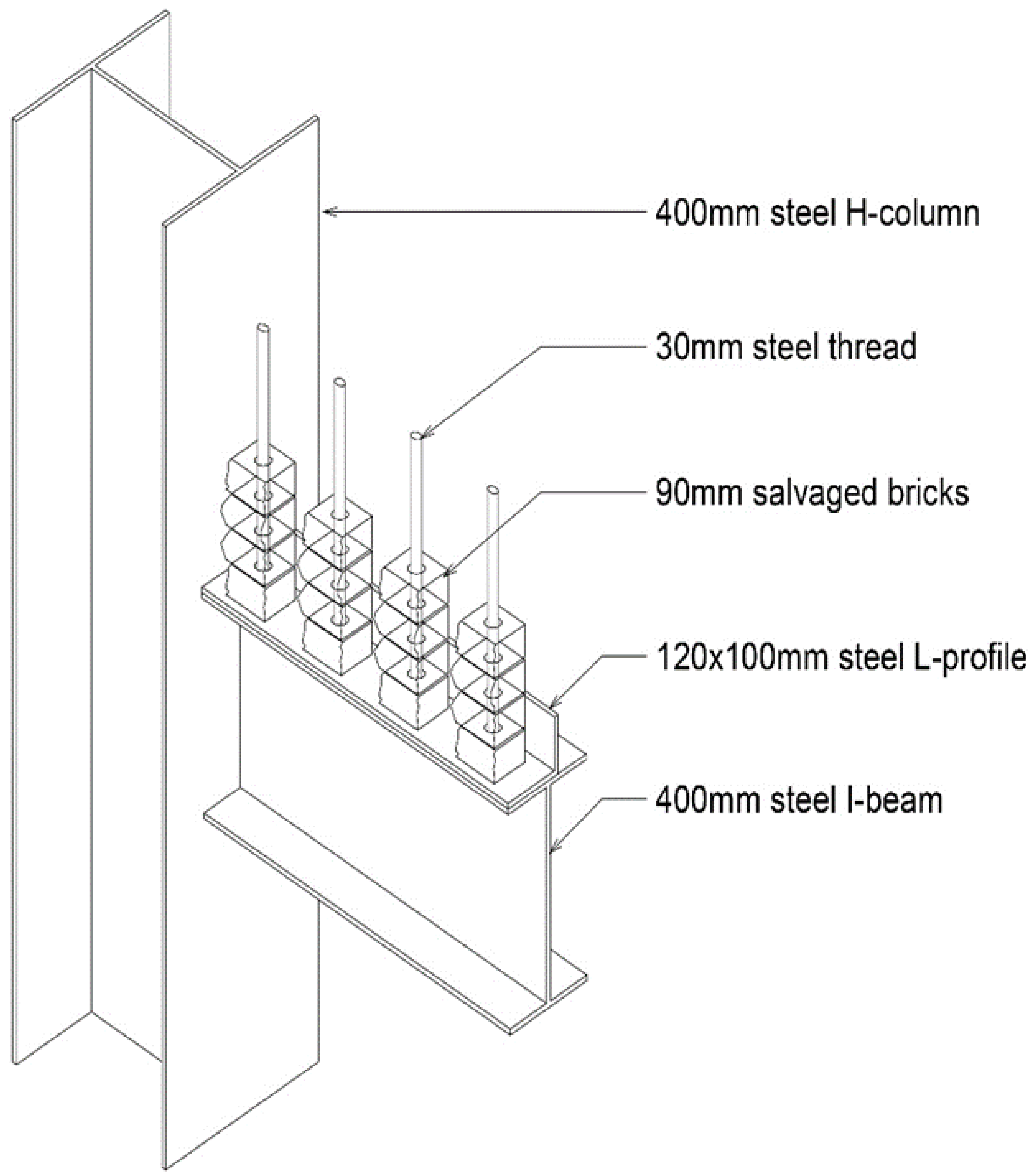
1. Extract brick panels by cutting with electrical hand saw.



2. Broken bricks can be used if 1 hole is intact.

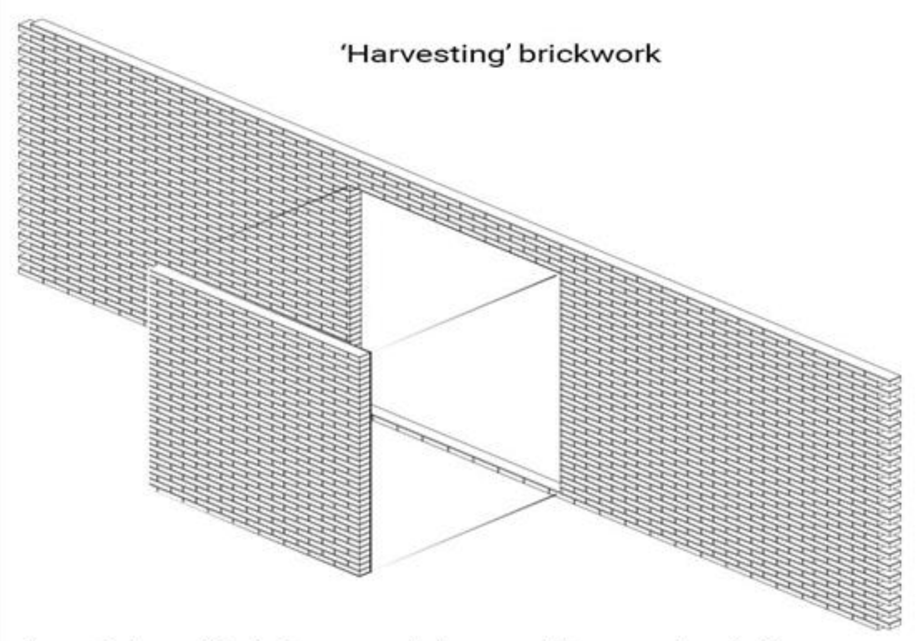
Informant exploration

Technological exploration


400mm steel H-column
30mm steel thread
90mm salvaged bricks
120x100mm steel L-profile
400mm steel I-beam

Salvaged walls

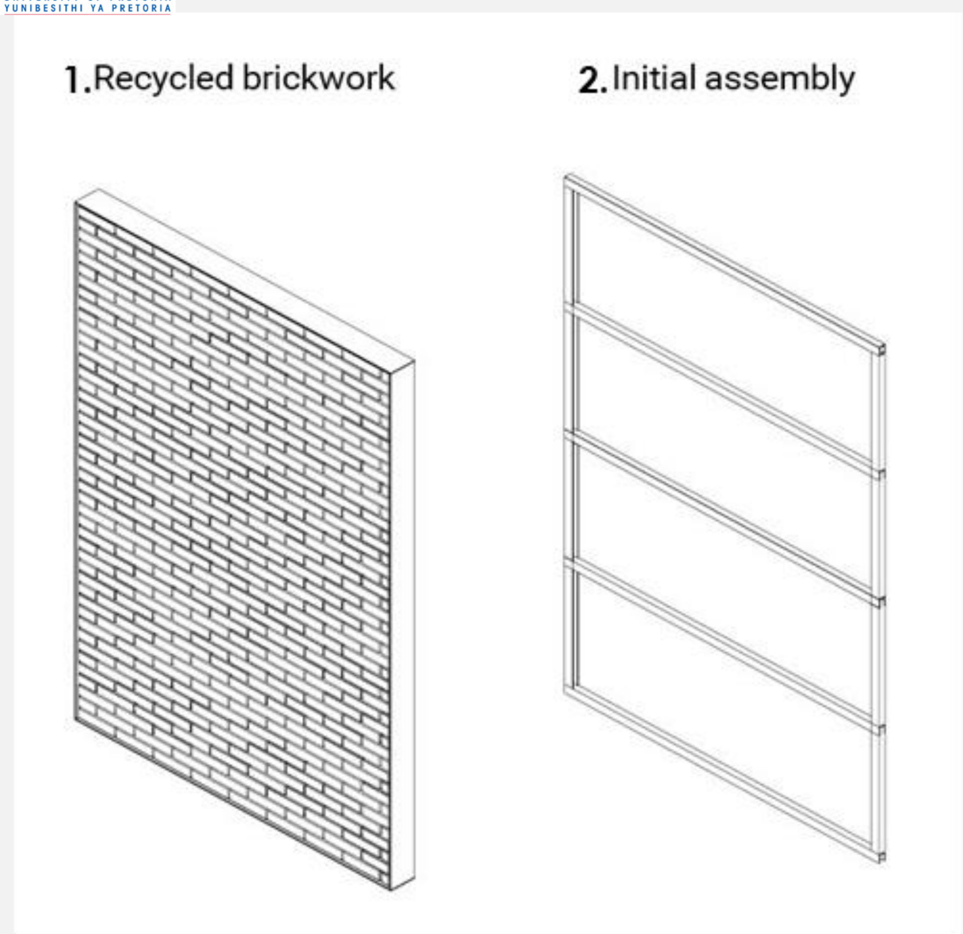
Fig 1.88: Salvaged Walls (Pinterest, 2021)

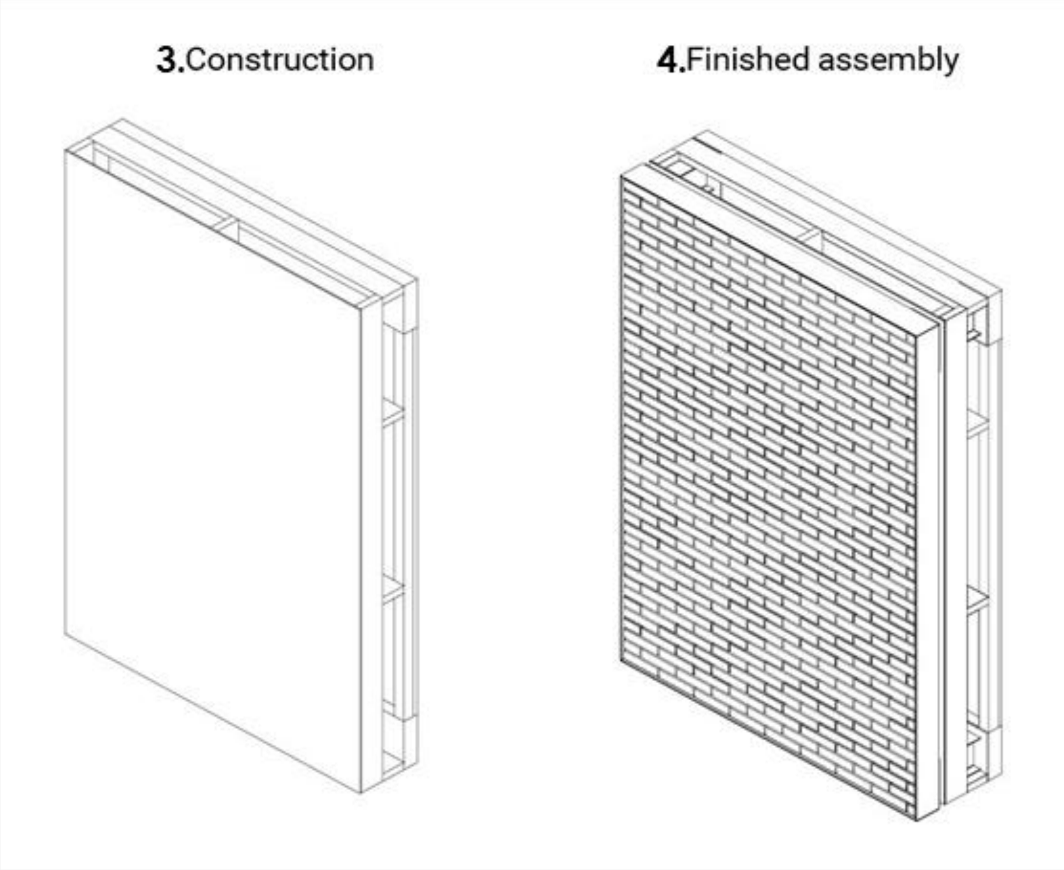


1. Extract brick panels by cutting out existing wall parts at 1m² blocks with electrical hand saw.

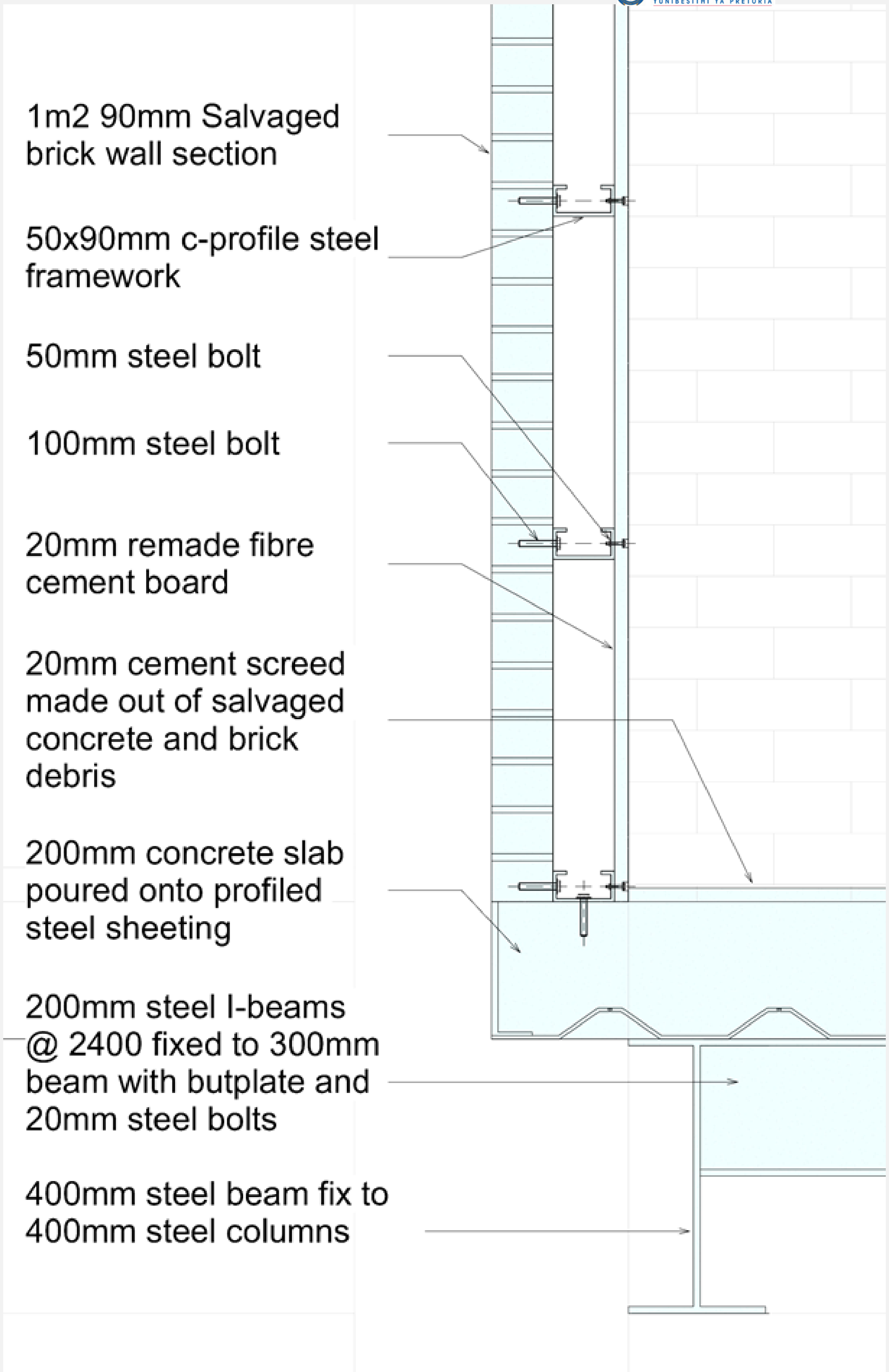
2. Assess usability by looking for cracks and damage as well as test strength.

Informant exploration





Technological exploration


1m2 90mm Salvaged brick wall section
50x90mm c-profile steel framework
50mm steel bolt
100mm steel bolt
20mm remade fibre cement board
20mm cement screed made out of salvaged concrete and brick debris
200mm concrete slab poured onto profiled steel sheeting
200mm steel I-beams @ 2400 fixed to 300mm beam with butplate and 20mm steel bolts
400mm steel beam fix to 400mm steel columns

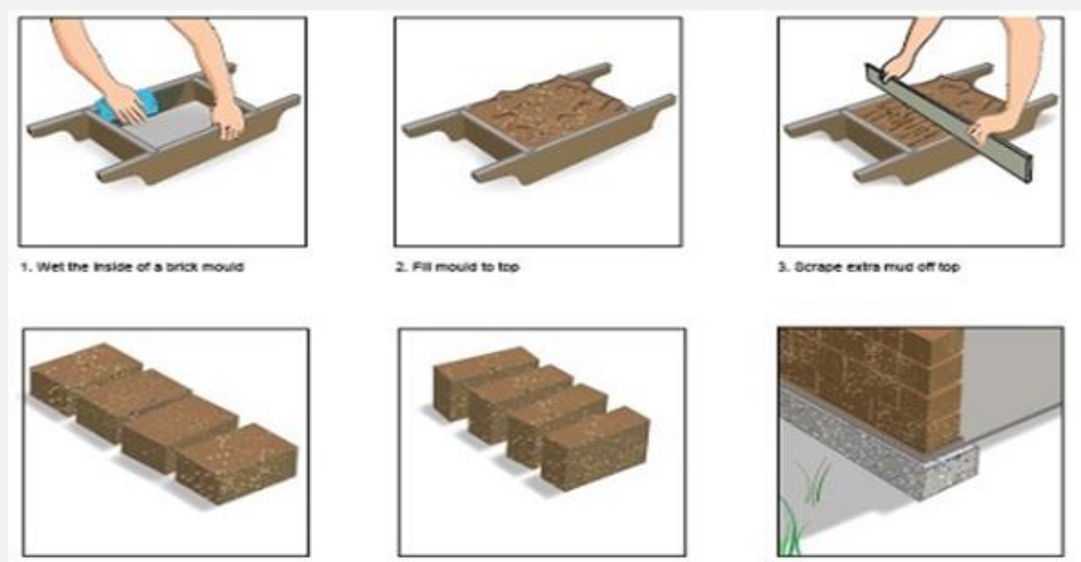
Remaking components

Fig 1.89: Remaking components (Pinterest, 2021)

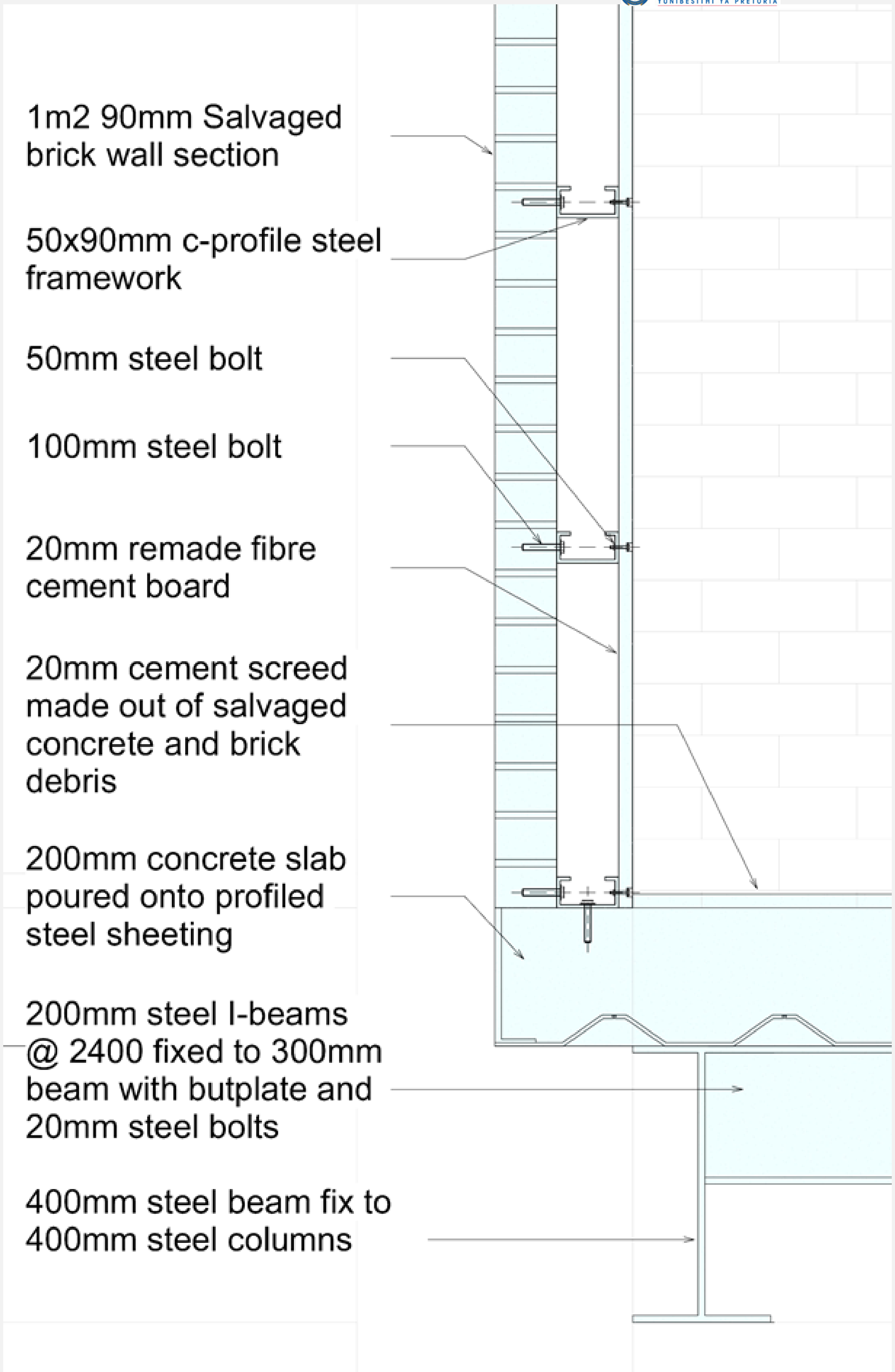
1. Debris that can not be used for construction components can be broken up

2. Concrete, and brick powder can be reintroduced to building to serve as finishing surfaces and screeds

Informant exploration



Technological exploration


1m2 90mm Salvaged brick wall section
50x90mm c-profile steel framework
50mm steel bolt
100mm steel bolt
20mm remade fibre cement board
20mm cement screed made out of salvaged concrete and brick debris
200mm concrete slab poured onto profiled steel sheeting
200mm steel I-beams @ 2400 fixed to 300mm beam with butplate and 20mm steel bolts
400mm steel beam fix to 400mm steel columns

Technological components

The blue shaded areas represent the material and spaces which have been added to the existing building on each floor.

Ground floor

The ground floor opens and creates a passageway and connection between Bosman and Hope Street. It also serves as vertical circulation to the lobby of the educational institute on the first floor. Steel stairs would need to be added with support for vertical circulation to the lobby.

Lobby

The first floor leads up as the urban carpet onto the main entrance and lobby of the building. Section b-b and a-a shows the urban carpet and extension into the building lobby as well as the space created over the atrium. Column and beam steel structure as specified is needed to support the lobby as well as stairs to the entrance.

Classrooms

As seen on the section a-a and 3rd-5th floor plans, the existing classroom spaces have been extended into the atrium and over the alleyway. The different classrooms extend into the atrium at different lengths to create a personalised feel to each classroom. This is made possible through concrete slabs poured onto profiled steel sheeting fixed to 200mm steel beams that is attached to 400mm beams spanning over from the new column that sits next to the building to the new one on the far side.

Southern storage/terraces and western spatial enlargement

On the western flank of the building the floor is extended to the north and southern side to make room for bigger offices and study rooms. The southern storage and terraces are made possible through a portal frame structure as seen in Detail 1 that consists of 300mm steel beams fixed to the top of existing 400mm concrete structural beams with steel bolts and chemical anchors. The structure hangs down from this is a 200mm steel column fixed to a 300mm steel beam. A 400mm steel beam is then fixed to the existing face/column supporting the floor below.

Atrium

Section a-a shows that the atrium also wraps around the extension to serve as ventilation and vertical connection to the institute. The atrium's glass facade is supported by the 400mm steel columns spaced at 6500mm with a support structure that runs between them.

Workshop studio

As seen on Section a-a, the workshop studio on the top floor extends over the atrium space. The 300mm portal frame structure is supported by 400mm steel columns and extends over the edges of the building. The roof and walls, profiled steel sheeting wrap around the structure and is supported and fixed to 200mm c-profile steel purlins spaced at 700mm.

Eastern skin

The eastern Facade can be seen with the brick skin that is made of salvaged brick that is crushed up and remade into cladding material. These bricks are then fixed to steel cables that span vertically down the façade. This technique won't be able to be load bearing so perforated cladding can be made of it. The northern skin extends far past the enclosed glass façade that would allow extra outside space for students on each floor as well as access to the structure and wrapping technique.

Northern and western

Elevated walkways wrap between the skin and atrium glass façade to serve as horizontal exterior circulation as well as shading for summer period from the sun on the glass façade. This is made possible through extended 400mm beams connected to 200mm steel I-beams that support 100mm concrete slabs. Northern skin is perforated steel sheeting fixed to 80mm c-profile purlins at -400mm and 1000mm of floor levels allowing for light into the atrium with the workshop studio extending through it.

Connections

Components

Callout 1 shows two kinds of structures are used to extend space. The first on the left being a portal frame that clips onto the existing building and overhangs the façade. This is because no columns can be added further than the existing façade and the extension it minimum. The second being columns added with beams spanning and extensions of space pushed into the atrium.

Method of assembly

Detail 1 shows the method of assembly for the clip-on structure on the southern side of the building providing storage and terraces and Detail 2 the skin system of the northern façade with exterior walkways in between the atrium glass facade and the perforated steel skin.

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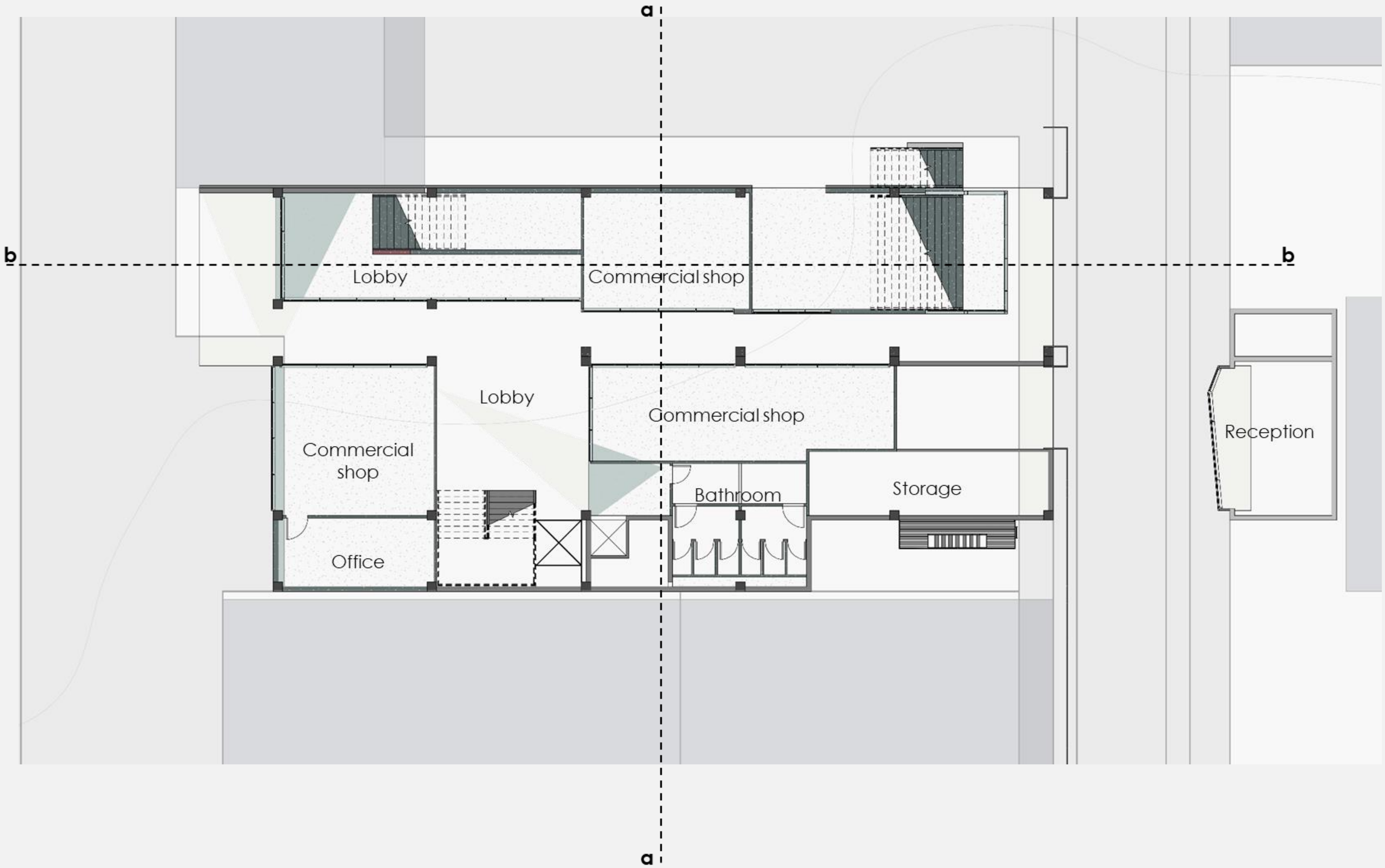
Conclusion

Appropriate technological solutions for the specific existing building were explored for technological solutions. However, these are not the only types of technological solutions that can be used to adapt and reuse existing buildings. Further investigation should be done in the available construction methods and skills of adaptive reuse of existing structures and materials. Each existing building adaptively reused can have multiple technological solutions for the various techniques applied on them and should be researched accordingly to use and promote adaptive reuse of existing buildings where possible, instead of demolishing and building new. In this way the useful lifespan of building structures can be extended.

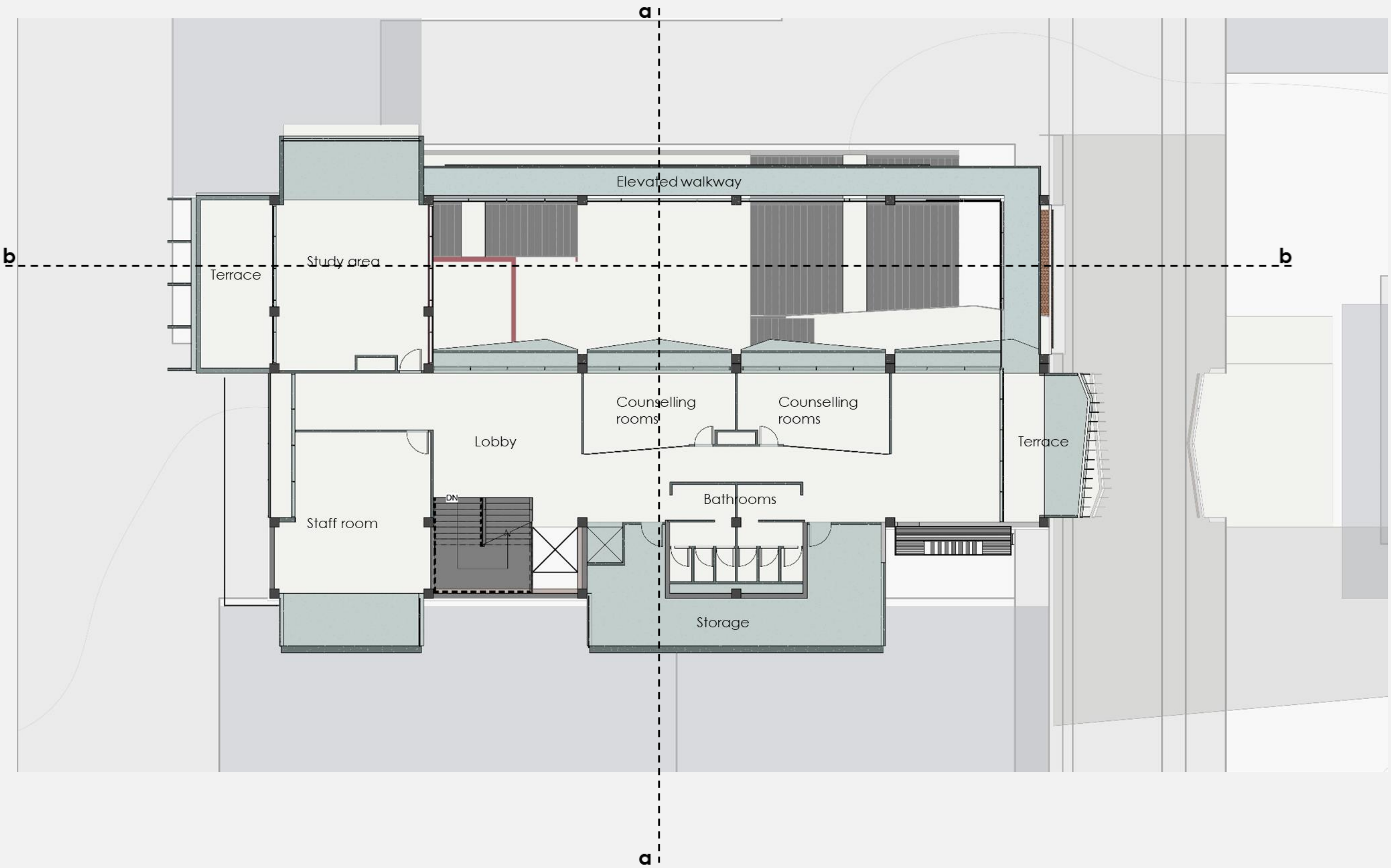
Addendum

Ground floor plan

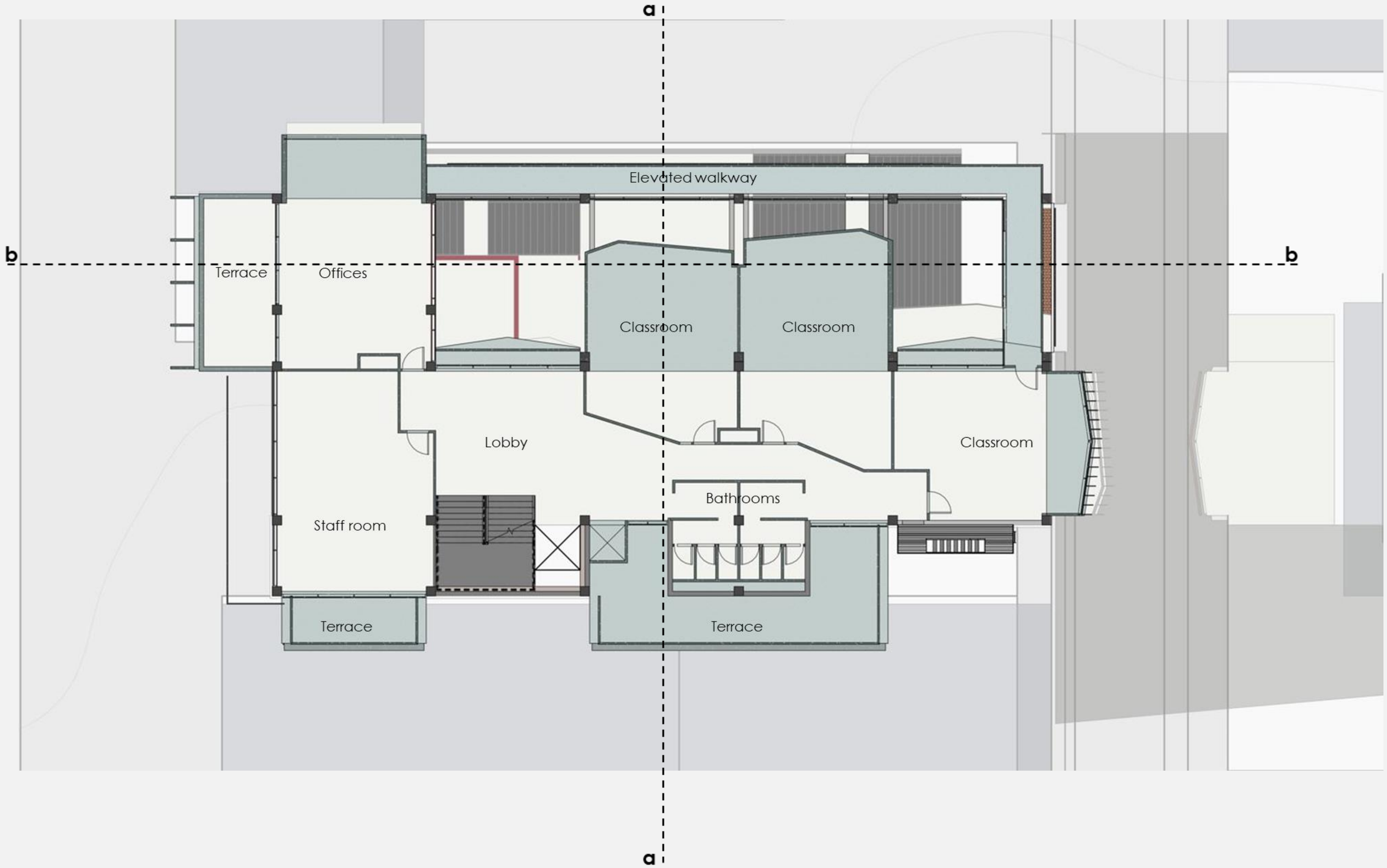


First floor plan

Second floor plan

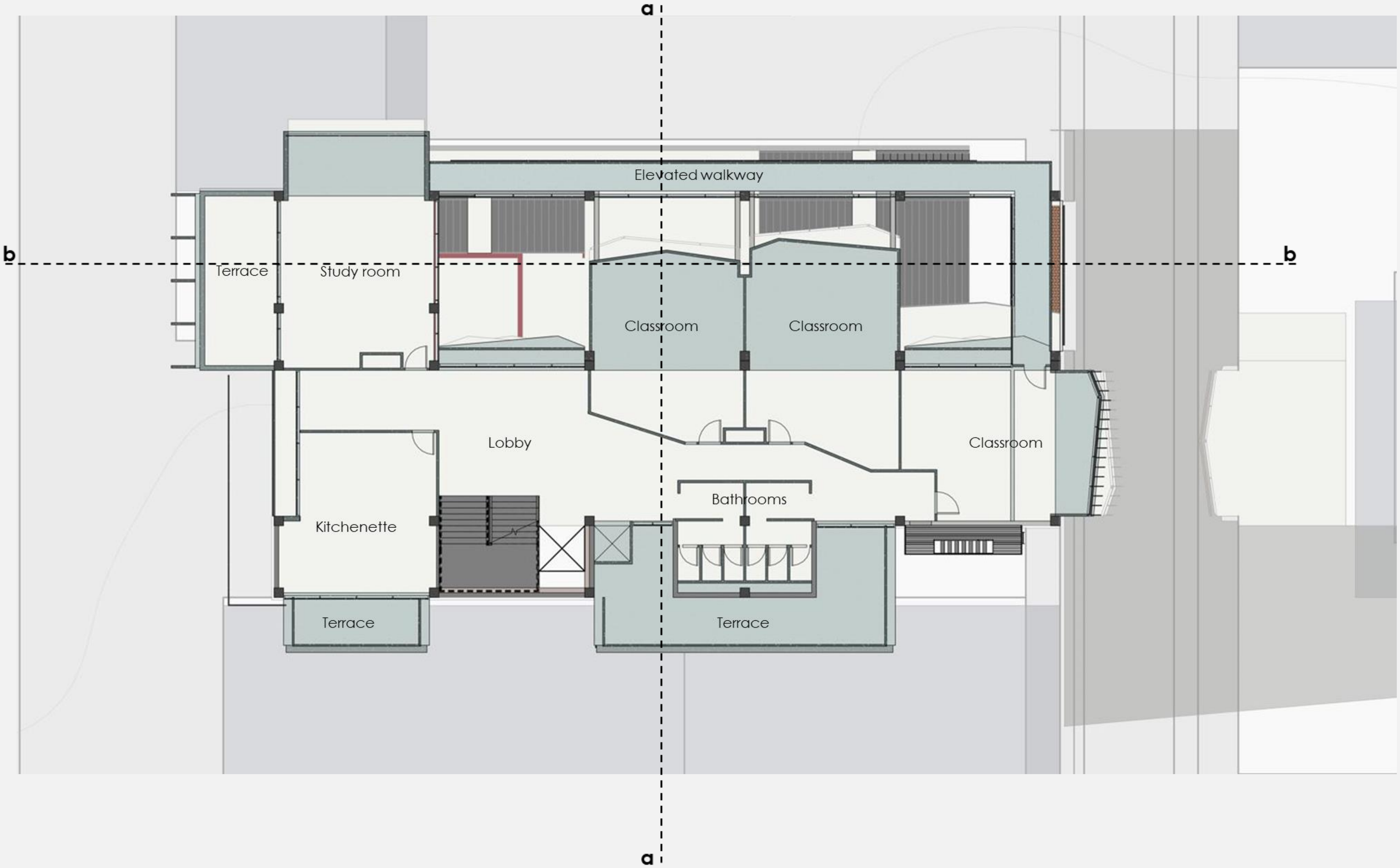


Third floor plan

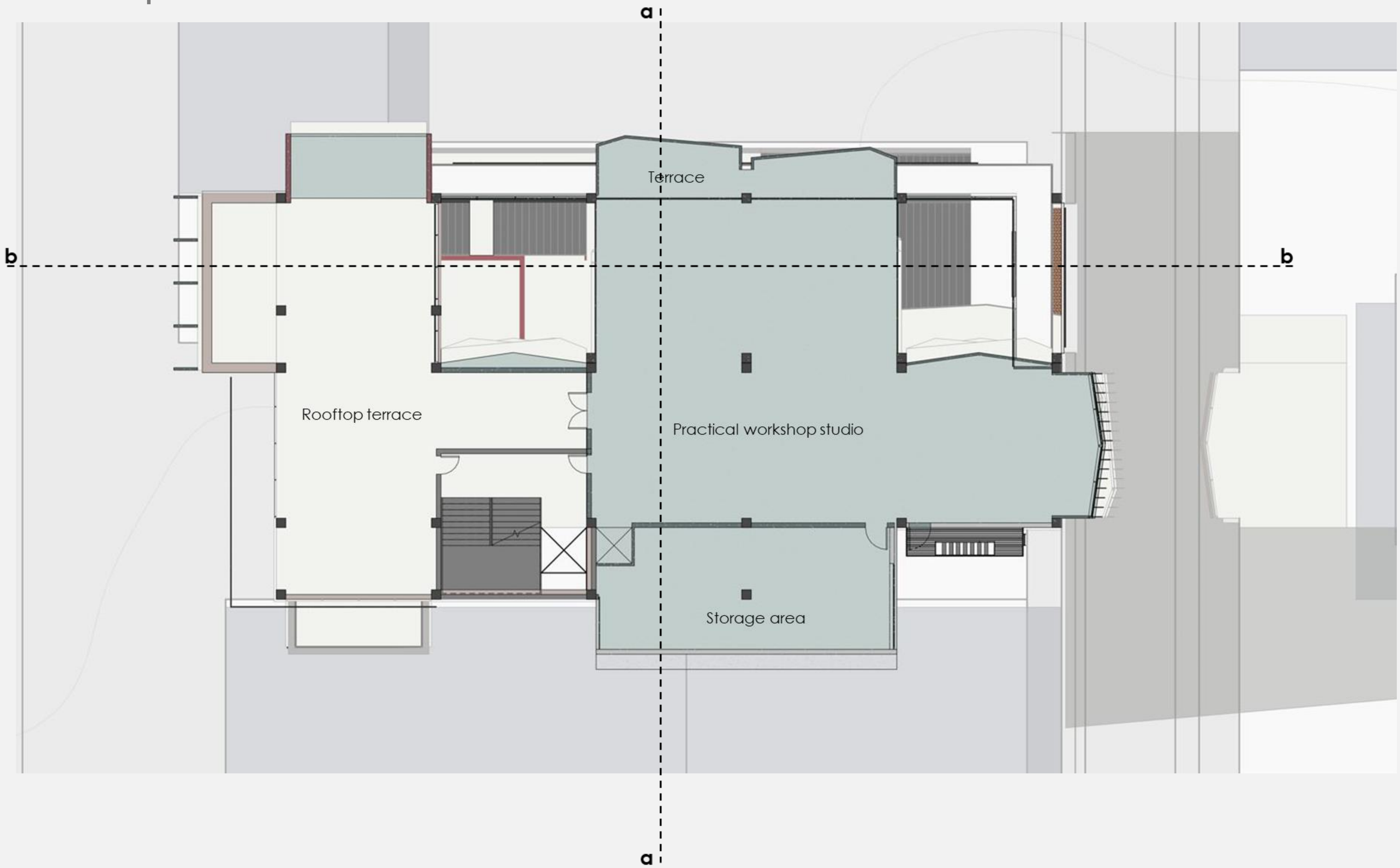


Fourth floor plan

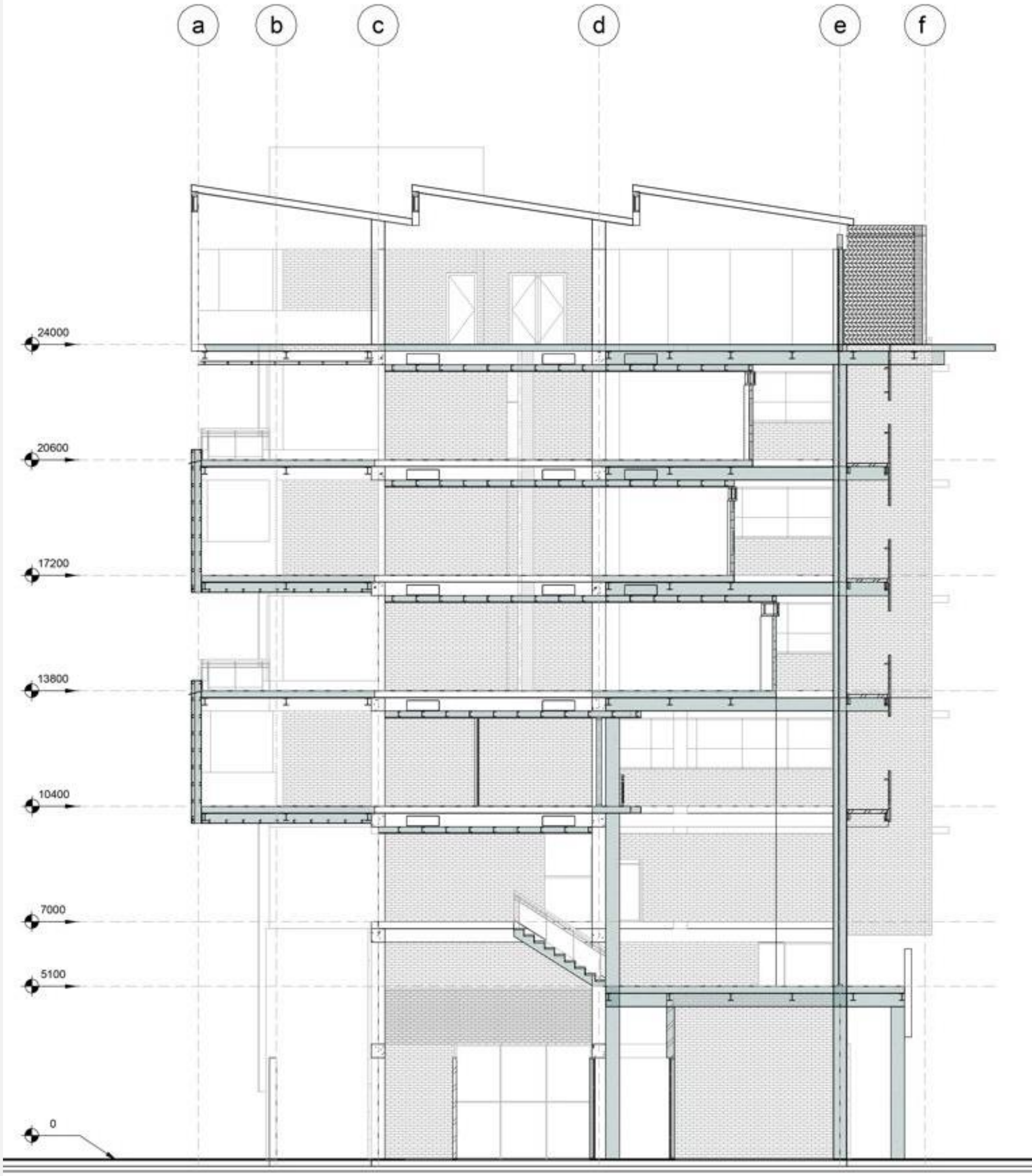
Fifth floor plan



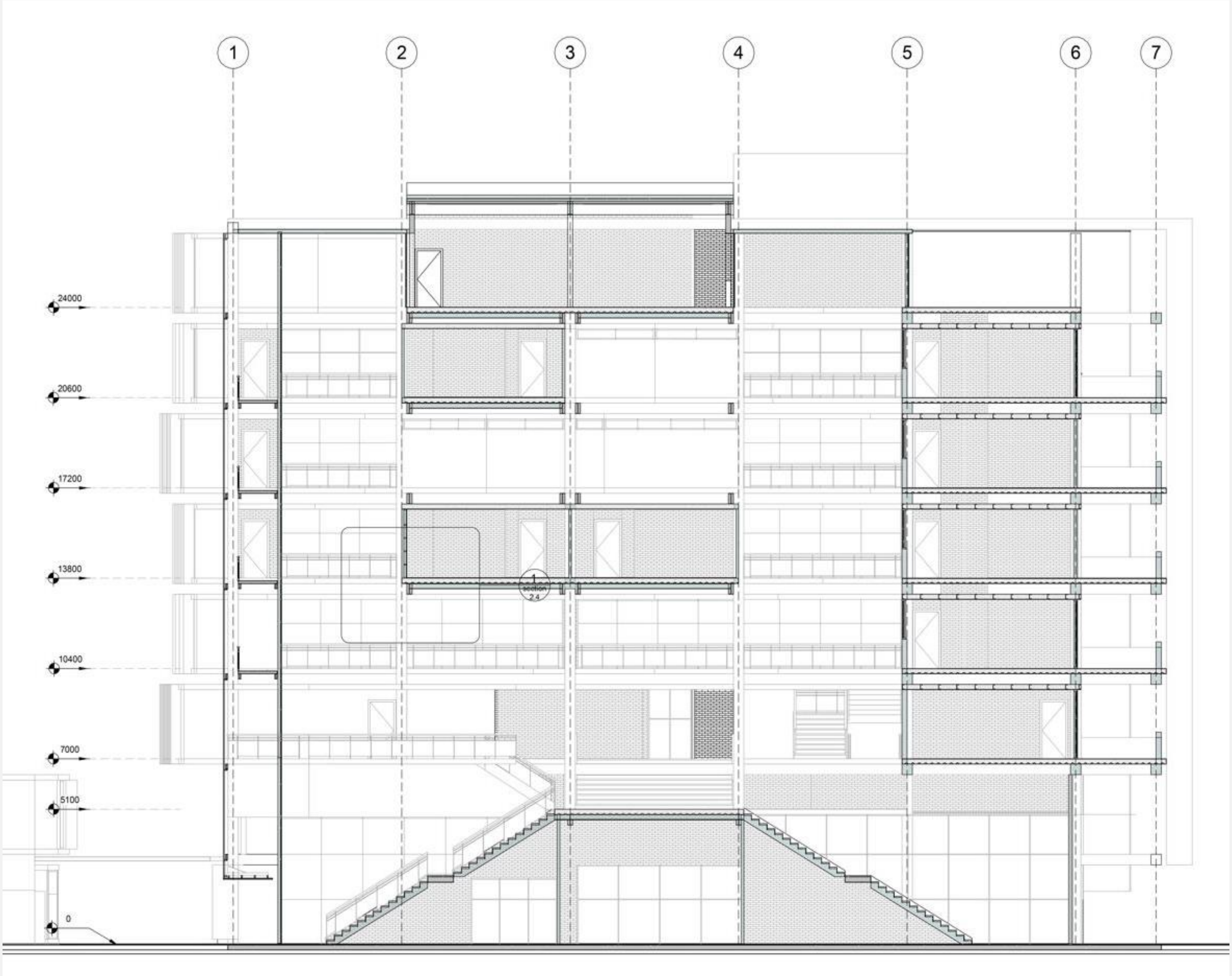
Sixth floor plan



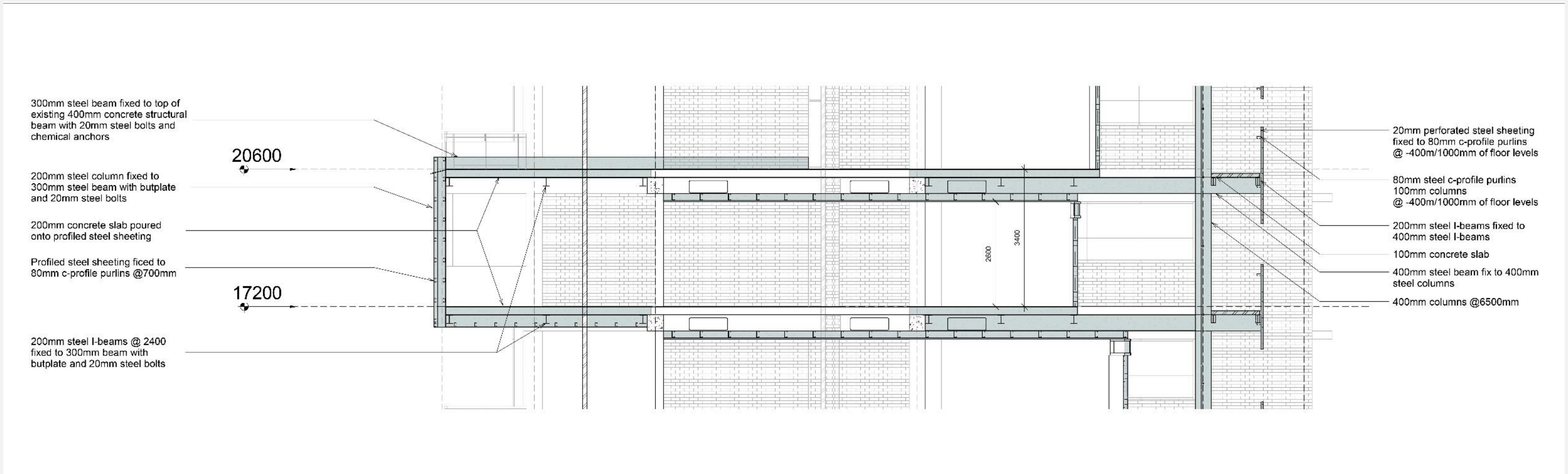
Section a-a

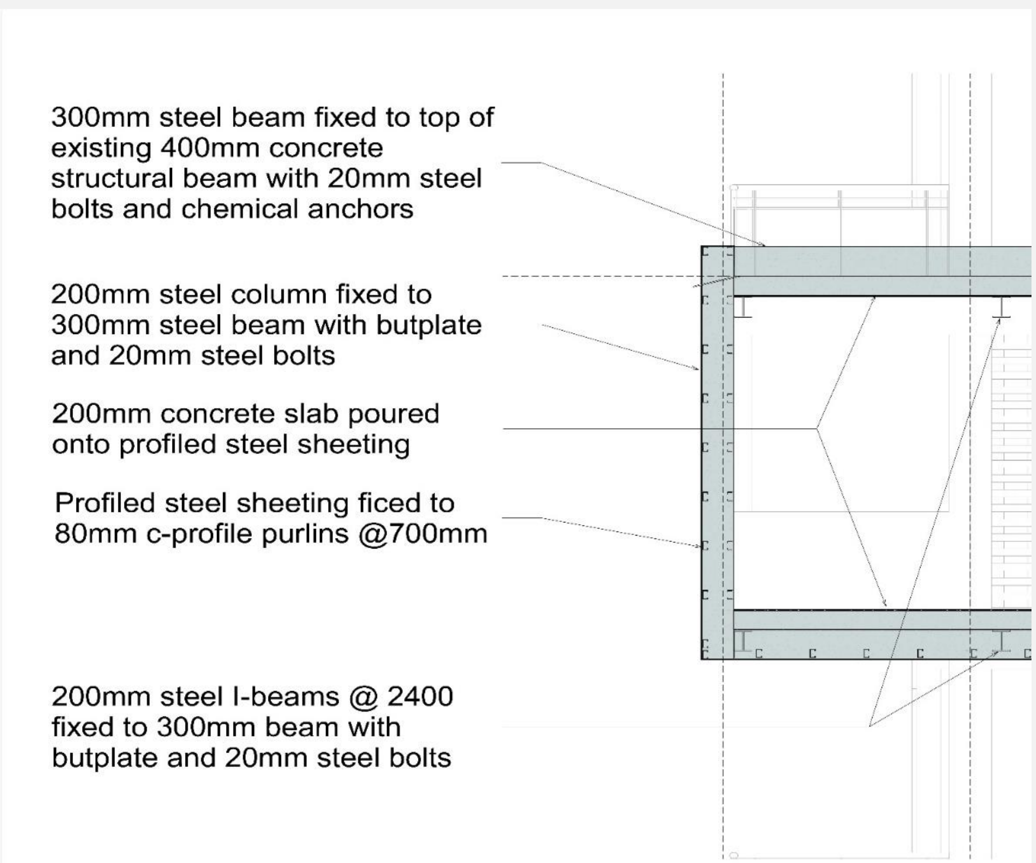


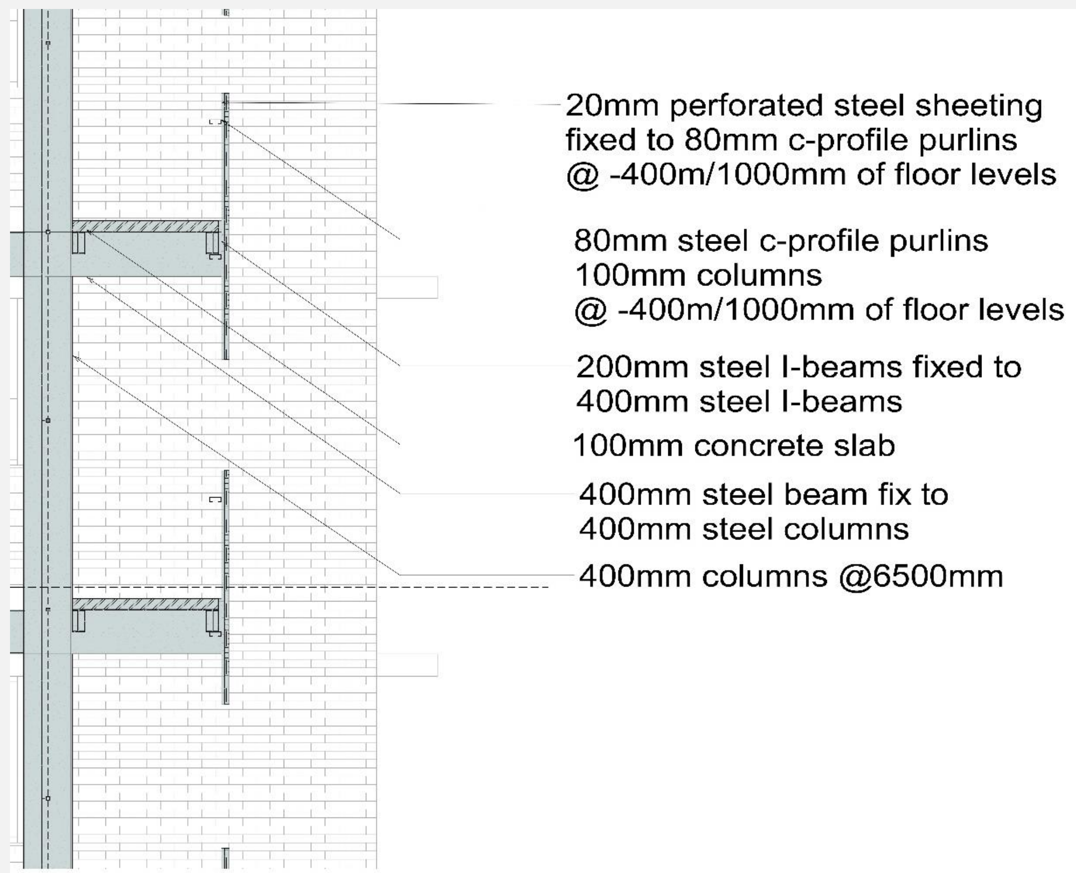
Section b-b

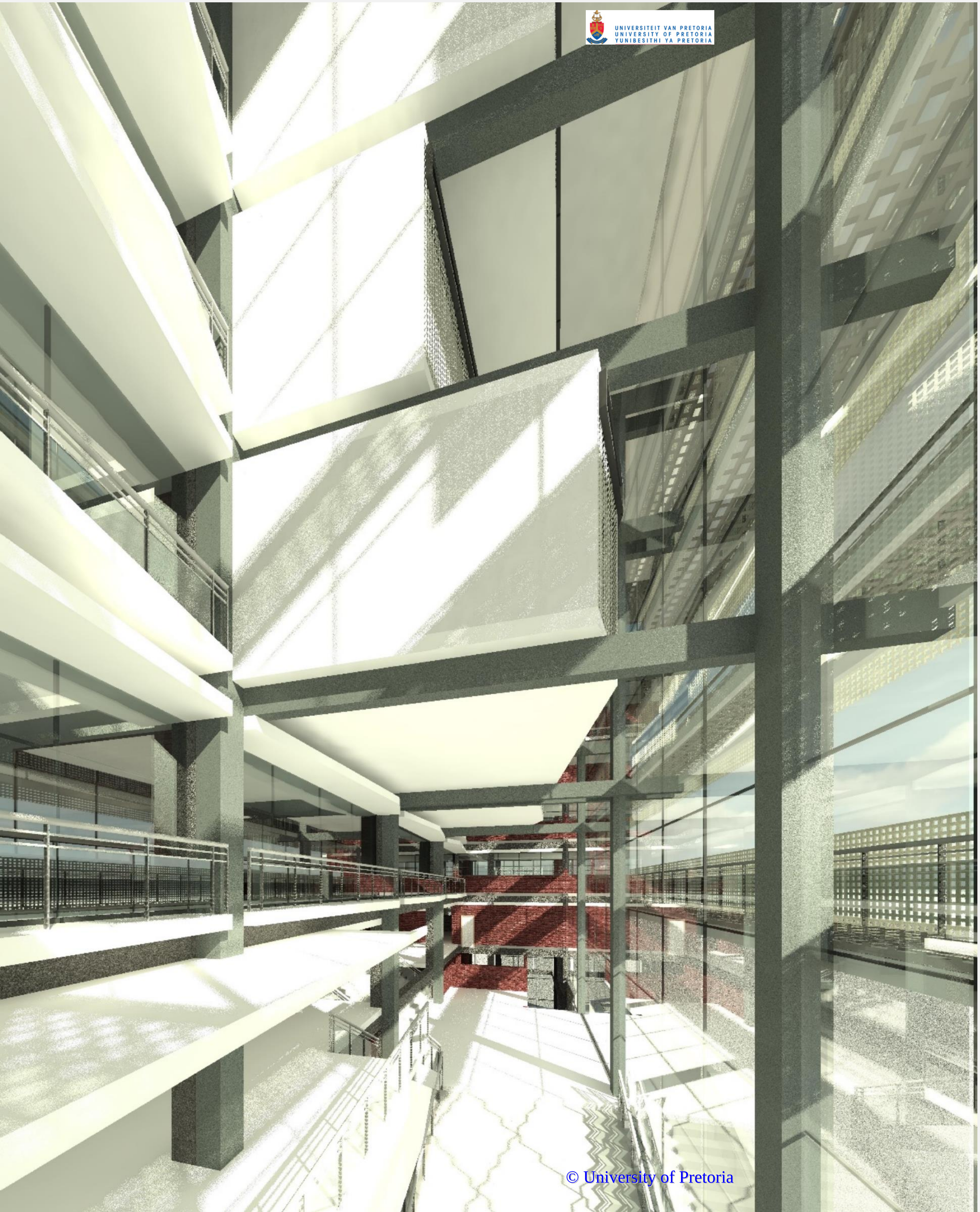


Callout 1


300mm steel beam fixed to top of existing 400mm concrete structural beam with 20mm steel bolts and chemical anchors
20600
200mm steel column fixed to 300mm steel beam with butplate and 20mm steel bolts
200mm concrete slab poured onto profiled steel sheeting
Profiled steel sheeting ficed to 80mm c-profile purlins @700mm
17200
200mm steel I-beams @ 2400 fixed to 300mm beam with butplate and 20mm steel bolts
2600
3400
20mm perforated steel sheeting fixed to 80mm c-profile purlins @ -400m/1000mm of floor levels
80mm steel c-profile purlins 100mm columns @ -400m/1000mm of floor levels
200mm steel I-beams fixed to 400mm steel I-beams
100mm concrete slab
400mm steel beam fix to 400mm steel columns
400mm columns @6500mm


300mm steel beam fixed to top of existing 400mm concrete structural beam with 20mm steel bolts and chemical anchors
200mm steel column fixed to 300mm steel beam with butplate and 20mm steel bolts
200mm concrete slab poured onto profiled steel sheeting
Profiled steel sheeting ficed to 80mm c-profile purlins @700mm
200mm steel I-beams @ 2400 fixed to 300mm beam with butplate and 20mm steel bolts


20mm perforated steel sheeting fixed to 80mm c-profile purlins @ -400m/1000mm of floor levels
80mm steel c-profile purlins 100mm columns @ -400m/1000mm of floor levels
200mm steel I-beams fixed to 400mm steel I-beams
100mm concrete slab
400mm steel beam fix to 400mm steel columns
400mm columns @6500mm



Environmental assessment

SBAT

Introduction

The SBAT is an assessment to test and achieve a high sustainability performance in buildings through addressing sustainability in a holistic approach focussing on environmental, social and economic criteria. The criteria are based on the WWF 2006 Living planet indexes definition of sustainability and measure to achieve living standards of above 0.8 on the Human Development Index for the built environment assessed (Gibberd, 2020).

Assessment

The scores of each objective are rated between 0 and 5 and depending on what weight each criteria in each objective holds scaled accordingly. Assessments done are by Jacques De Klerk-De Klerk and the results should be seen as indicative until validated. The assessment answers are given because of intended procedures during the design and construction process.

Results

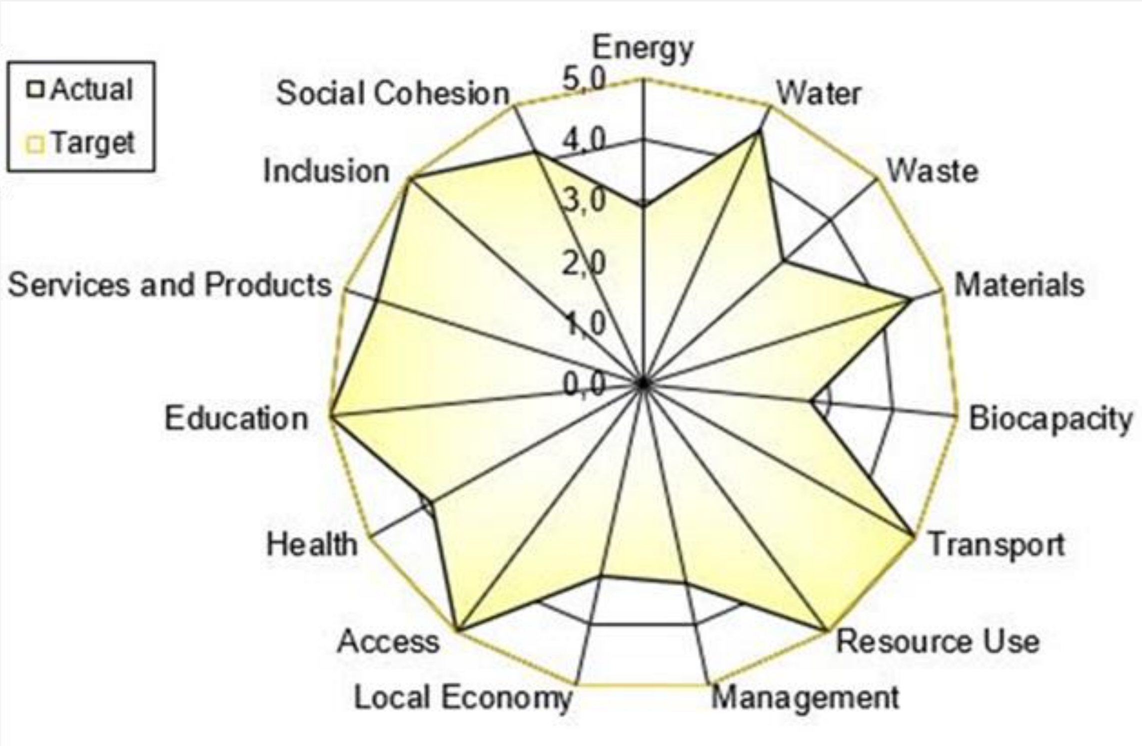


Fig 1.90: SBAT (Author, 2021)

Conclusion

The result shows the intended building will have a high sustainability performance in terms of inclusion, education, access, resource use and transport. These results can also be attributed to the location of the site being in the central city with many amenities within its immediate surroundings. The lower sustainability ratings are energy, waste and biocapacity which is because of the little green space and fertile land. The low levels of waste and energy sustainability should not be seen as negative as it is higher than what would result if the existing building were to be demolished and a new one built in its space. So even if the criteria are low the adaptive reuse process still raises them higher than what would have been.

Reflection

Introduction

The dissertations intention was to question the status quo of the transforming built environment and how the process of development could be adjusted to fulfil sustainable built environment requirements of the 21st century. The method investigated to accomplishing these goals were to research and apply adaptive reuse techniques and technology instead of traditional demolish and rebuilt practice. The significance of this dissertation falls within the practice of promoting sustainable transformation of the built environment through research and development of techniques and technological principles to adaptively reuse existing architectural structures. Also promoting sustainable built environment development and transformation through inquiring into advancing the practice of adaptive reuse.

Reflection

Development of a normative position

The initial normative position brought to light the responsibility of adapting existing structures with regards to reuse of space as well as changing the function and programme of buildings for new use. However, it did not take into consideration the vast adaptation and requirements new developments would require as well as the scaling of such practice to urban building levels. Practice as such would require adaptation of the existing buildings typology, methodology, services and physical form as well as the buildings relationship to the urban context and environment. The developed normative position of adaptive reuse takes into consideration the extent of demolition, opportunities of existing spaces, structure and what adaptive reuse techniques and technology will equip and allow for as well as the material and component reuse of debris and existing construction components.

Problem and issues

An inquiry was done into the current state of transformative development of the built environment in the urban setting. The existing problem was identified as the inability of the architectural industry to sustainably develop the built environment. However, this allowed for an opportunity to develop and research how the built environment's useful life span could be extended when its physical lifespan exceeded the current use of an existing building. Through doing so the environmental load of the construction process could be lowered and thus making the process more sustainable.

Exploration and research

Research explorations were done in the form of transformation of the built environment for the 21st century and adaptive reuse-built environment transformation literature reviews to develop research strategies and questions. Appropriate literature studies were done to gain a theoretical understanding of the area of inquiry and through this set up categories for a toolkit to do case studies on relevant adaptive reuse buildings. The findings of the literature study helped to understand and identify opportunities in the South African built environment transformation industry and how sustainable design standards could be fulfilled through adaptive reuse of existing buildings and circular lifespan of construction components and materials.

Case study findings were then analysed with regards to their adaptation in informants, use their transformation strategies, approach, typology and extent and the existing structures adaptation, reuse and materials to develop principle of adaptive reuse which could be applied to adapt existing buildings.

Concept development

The general informants of the dissertation were first the site, which was selected through analysis of appropriate existing buildings in the Pretoria CBD. It was established that the Willie Theron building on Bosman Street would be the appropriate building because of its character, adaptation requirements, reuse potential and potential to test the dissertation strategies. Secondly, the programme, which requirements and specifics were investigated to inform spatial requirements that would need to be fulfilled by the adapted buildings new use. Conceptual informants were investigated for the potential that the current building and structure holds to be adapted and reused. A theoretical and practice-based understanding of urban integrated education campuses was developed to adapt the current relationship of the building to its surroundings as well as the spaces within. Finally adaptive reuse techniques that were found and analysed within the case studies were applied on the existing building structure to establish potential alterations and how the building could respond to these techniques.

Design development

The urban framework was developed by investigating the street level interaction and needs to establish a more flexible programme allowing spaces to be filled with use and functions of need and value. On a site level integrated urban campuses were investigated to create urban public spaces and amenities shared by the educational institute and the public. This was to make the use of spaces more sustainable though co-used facilities. Through critical critique of the existing spaces, adaptive reuse techniques that was analysed from the case study results were applied on the Willie Theron building to develop the spatial requirements of the education institute. These were in form of a steppingstone education facility, upliftment school and handicraft academy. The results would be in a multi-level integrated education facility that shares amenities and spatial, conceptual and physical form, use and methodology.

Technology development

The adaptive reuse design techniques were used as a base for technological approaches. Through understanding the possibilities of structural systems appropriate technological solutions were chosen to promote and display the conceptual intentions. The technological solutions were developed by analysing the existing building's structure, technology, services and potential. While iterating technological solutions, a theoretical understanding was researched on the bases of scientific data for material and structural reuse and adaptation, empirical data through structure and technology specialists' critique on technological and structural systems and qualitative theory for the overall technological conceptual approach.

Career contribution

The intention for the dissertation was to research and develop a system of architectural adaptive reuse techniques and technology. Using such an approach to a site that have existing buildings on would allow architects and developers that would usually not know how to approach such projects, design and initiate more appropriate sustainable projects. This does not only refer to environmental sustainability but also in economic and social sustainability through initiating projects that would otherwise not been able to be developed because of costs and environmental requirements.

Conclusion

The initiation of the dissertation started because of the concern regarding the environmental load of the current built environment industry. Through investigation it was established that any amount of reuse of existing buildings to fulfil new development requirements would be more sustainable than total demolition and rebuilding, thus an investigation into making adaptive reuse more accessible was done. The result was then applied on an existing appropriate building within the CBD of Pretoria taking into consideration the appropriate adaptation and need thereof. This resulted into a building as a prototype and process as a toolkit to lead other adaptive reuse projects through techniques and technology.

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