Exploring solar energy design systems in peri-urban settlements for responsive architecture:

Towards the design of a multipurpose upcycling skills centre in Cato Manor.

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Dissertation submitted to the School of Built Environment and Development Studies, University of KwaZulu-Natal, in partial-fulfilment of the requirements of Master in Architecture

Durban

DECLARATION

I hereby declare that this document is my own unaided work. It is for submission to the School of Built Environment and Development Studies, University of KwaZulu-Natal, Durban, in partial fulfilment of the requirements for the degree of Master of Architecture. It has not been submitted before, for any degree or examination, at any other educational institution.

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Shuaib Bayat

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Date

"I BELIEVE THE TARGET OF ANYTHING IN LIFE SHOULD BE TO DO IT SO WELL THAT IT BECOMES AN ART"

-ARSENE WENGER.

COLLEGE OF HUMANITIES

DECLARATION – PLAGIARISM

I, Shuaib Bayat declare that

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Signed

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ACKNOWLEDGEMENT

To become an architect has been my ultimate dream in my life, and I thank the Almighty for guiding me in achieving this.

To my family and friends, who are my everyday motivation and happiness and, whose encouragement have helped me overcome the most difficult obstacles in life. I thank you! A special thanks to my mother, who is the pillar of strength in my life, and to my brothers who showed me constant love and support as the youngest sibling, as well as to my late father who always believed in my ability. I wish you were here to witness this moment

To my supervisor Mr Bonga Ntuli, I thank you for always believing in me throughout the interest of this research study and as an educator guiding me towards this career accomplishment.

ABSTRACT

Presently, cities are faced with escalating global economic and social challenges in peri-urban settlements. Despite the severity of these challenges, there remains an urgent need to incorporate sustainable development approaches within urban and peri-urban municipal structural model. Together with environmental concerns, sustainable development approaches also need to include strategies to improve socio-economic issues. South African cities have inherited the burden of the apartheid city dominance, as seen by the continued urban and spatial segregation. Since the South African post-apartheid governance, the current approaches implemented towards urban and peri-urban development have only aggravated the issues leading to the inefficiency of modern South African cities. Within the context of the urban fabric, cities are filled with numerous socio-economic inequalities which prevent the accessibility of basics services for marginalized communities. This is most prevalent in peri-urban areas.

This dissertation investigates the possibility of creating an architectural model for developing a solar energy harvested upcycling centre which can contribute to the concept of Liveable Urbanism and ultimately empower insurgent communities to resolving their energy crises, and addressing the various socio-economic and waste pollution challenges they face. Sustainable development is the primary strategy towards Liveable Urbanism, where it is understood as a process which involves leading a society on a development pathway that is social, economic and environmentally sustainable for self-sustenance. This dissertation will further examine how the specific socio-economic factors shape the vulnerability of the context in the Cato Manor District as an example of a peri-urban area faced with these modern socio-economic challenges. The theoretical framework of "Sustainable Development" will justify the concept of Liveable Urbanism and will include a literature research to highlight the current socio-economic challenges within these disadvantaged communities.

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CHAPTER ONE | RESEACH BACKGROUND AND METHODOLOGY

1.1. INTRODUCTION

South Africa Like most of Africa and other developing regions, is experiencing continuing urbanization. Peri-Urban settlements have become common across the work-live environments of the twenty-first century, where these areas are characterized by socio-economic and environmental challenges. These settlements consist of relatively dense populations, even by urban standards, as well as high dependence on transport for commuting, restricted economic activities, electricity deficiency, waste pollution, social displacement amongst insurgent communities, lack of spatial governance and inadequate infrastructure.

However, as mentioned, South Africa is not the only country faced with this phenomena. Over the last half of the 20th century, most countries in Africa have attained political independence and lifted restrictions on urban migration, and the search for work and a better life has led to rapid urbanization across the continent (Mabogunje, 1990). Peri-urban areas have been described as spheres of coexistence of the urban and rural activities (Douglas, 2006). Peri-urban areas are characterized by various land uses, varying socio-economic status and ecologically valuable but vulnerable systems (MacGregor-Fors, 2010; Parkinson and Tayler, 2003). The peri-urban realm of African cities are contested with various socio-economic and environmental challenges which hinder development growth amongst the communities of these areas. Government authorities and municipalities assist these peri-urban areas by introducing various land-use functions to improve the socio-economic and environmental challenges of these communities struggling with poverty. At the same time, these government officials also face various challenges in meeting these communities' needs. One of these challenges is the provision of basic services in peri-urban areas to make them livable, but this is often hindered by the growing environmental concerns and the limited institutional capacity of municipalities (Sutherland and Lewis, 2012; Girad, 2011).

Major cities in South Africa have undergone crucial changes within their physical characteristics and political reorganization. “Liberalization and democratization processes have indirectly caused massive migrations from the countryside and peripheral townships towards the urban areas, by people in search of a better life.”(Macagnano, 2002:158). Individuals seeking jobs as well as informal traders are being attracted to the Central Business Districts (CBD) which forces formal businesses to relocate to mid-town development areas.

The attraction of the CBD allows surrounding residential areas of the city centers to become exposed to informal settlers and illegal inhabitants, especially where unoccupied land is concerned. Peri-urban areas within the outskirt of South African cities have received the brunt of the ‘invasion’ with a rapid rising of large informal settlements, accommodating a multi-cultural variety of people living in sub-standard conditions.”(Macagnano, 2002:158).

The above contradiction is born out of what some scholars label the “Dual City”, which is a city of two realities, in the one reality citizens live with access to water, electricity, education, sanitation, healthcare and affordable housing and in the other reality, that of the “Other 90%” (Smith 2011), the city represents sites of contestation, devastating poverty and unemployment, lack of healthcare and education as well as unaffordable public transport and housing (DeFazio 2002:1). These factors play a vital role towards the living standards of people, particularly in Peri-urban communities.

The infrastructure, as well as the people of these communities, both face energy crises. As Giglmayr, (2013) states, “The future of South Africa’s electricity supply is characterized by insufficient energy sources which will not meet the demands of contemporary requirements.” This results in the distribution being centralized and mostly unidirectional, while the sources of electricity is based on the use of fossil fuels in particular coal. A “Load Shedding “crises is currently causing a substantial backlog of electricity supply since the demand rose faster than the generations capacities increased.

Figure 1.1: Inadequate and illegal electricity supply to periphery areas.

Source:www.smartcitiesdive.com/ex/sustainablecitiescollective/how-informal-settlements-are-being-transformed-dignified-spaces/245591/

(**Date Accessed:** 15 April 2018)

South Africa's unique history adds another layer to the dilemma of development for insurgent communities in peri-urban areas. The Metropolitan cities of South Africa were once identified as spaces that experienced supremacy of power and were developed around the framework of segregation and exclusion. The Apartheid government actively tried to prevent Africans from living in the city and thus the creation of the informal settlements and townships were unavoidable (Frescura, 2001: 118).

This structural governance of the city forced informal settlements and migrant labor laws to be developed on the periphery zones of the city, which had already had inadequate infrastructure of basic services. Many cities in South Africa presently are still affected by the geographic spatial planning of the apartheid city model creating a vast amount of segregated periphery spheres. (Refer to figure 1.1 as an example).

With this unique problem in mind, this research will aim to achieve an understanding of a typical South African energy deficient peri-urban settlement in the form of Cato Manor, and the community’s struggles with socio-economic difficulties. The knowledge attained will determine how a typical an insurgent community in a peri-urban settlement could respond a structured sustainable future with the integration of an architectural platform. This will further assist in establishing a model for many other South African peri-urban settlements, with the aim of assisting their socio-economic difficulties, not just for the present, but for future expansion.

1.1.1. Background and Location of Study

The Cato Manor area is approximately 2000 hectares of land and is situated six kilometers from Durban’s central business district (Figure 1.2). Cato Manor is surrounded by Manor Gardens to the east, Sherwood to the north, and Bonela to the west. The eastern sector is bordered by Cato Manor road and Jan Smuts highway to the north. The main road off Cato Manor, which is Bellair Road bisects the area from north to south in parallel to the famous Umkhumbane River. Bellair road links to the main highway which is the N2. Cato Manor offers an ideal case study for the research, as its peri-urban geographical presence, its inadequate socio-economic and environmental characteristics as well as it’s insurgent communities who reside within this settlement, encapsulates the core of the research problem.

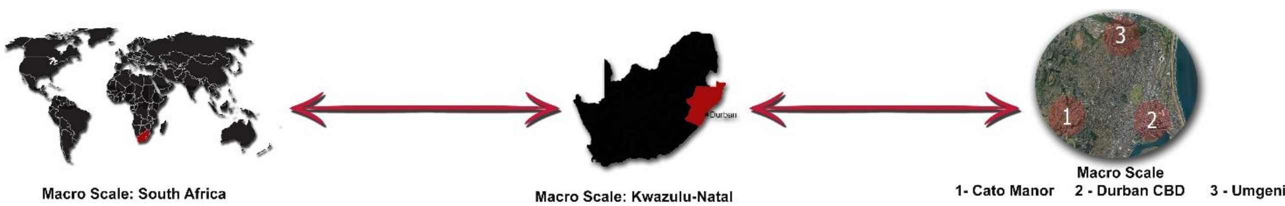


Figure 1.2: Macro scale area of study.
Source: Author (April 2018)

The Apartheid Era and Vacant Land from 1960- mid 1980

The implementation of the group areas act in 1958, resulted in the forced removals of the Indian and Blacks from the Cato Manor area. Established townships with family housing, better pay and more highly educated individuals within tightly knit communities presented greater obstacles to removals than hostel or shack dwellers in racially divided and conflict ridden areas (Hindson and Pupuma, 1996).

This resulted in housing development projects to be initiated towards the northern and southern parts of Durban to facilitate those 'relocated' persons from Cato Manor and other affected municipal areas around it. Black residents were resettled in KwaMashu and Umlazi, while Indian residents were moved to Chatsworth and Merebank (Hindson and Pupuma, 1996).

Victims and residents who avoided the forced removal from Cato Manor Area comprised of various race groups which included Indians, Colored and Black communities in the Chesterville area and a few of them still residing in Cato Manor at the time.

The history of conflict, removals and claims to the area by Indian and black residents made Cato Manor unattractive to prospective white settlement (Butler-Adam and Venter, 1984). Thus with the exception of a few Indian, black and coloured families who continued to reside in the area, large parts of Cato Manor stood vacant and began to gradually revert back to grass and woodland until the housing redevelopment schemes of the mid 1980s (ButlerAdam and Venter, 1984)

The Racial Conflict and the Implementation of Housing Projects from the 1980's onwards

The reform strategy adopted by the national government after the establishment of the Tri-Cameral system in 1983 was to incorporate the racially defined Indian and coloured groups into national political institutions as junior partners to whites (Hindson and Pupuma,1996). Therefore, The House of Delegates (HOD) program served to alleviate the previous racial conflicts, with particular attention towards Cato Manor in the Durban Metropolitan Area. The result was a number of actions and initiatives which highlighted the competing claims in the planning, redevelopment or occupation of the area (Hindson and Pupuma, 1996).

In the year 1987, The HOD initiated the low-income development housing program within several peri-urban areas.Although the housing list of the HoD was originally restricted to Indian residents, it was eventually opened up to coloured and black households, following a series of disputes over land and housing in the area in the late 1980s (Hindson and Pupuma, 1996).

Over time, anxiety was expressed by residents in neighboring white areas who feared the consequences of the location of low-income housing estates on their doorsteps (Hindson and Pupuma, 1996). As a result, the Cato Crest area fell under the escalating control of the HOD program over the 1980's and early 1990's.

Proposed developmental plans of the whole Cato Crest area became the focus of altercations between various authorities, white residents and developers which stalled developmental progress. This opened the way for further settlement by impoverished black people in the area and its growth and eventual consolidation as a shack area (Hindson and Pupuma, 1996). (Refer to Figure 1.3).

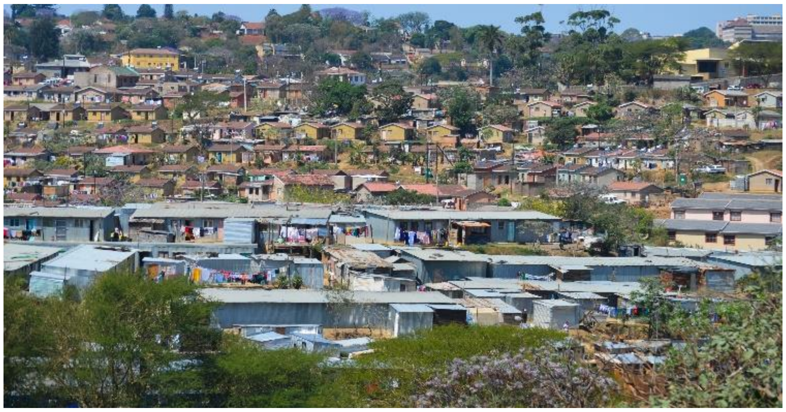


Figure 1.3: Informal RDP housing and Squatters of Cato Manor Periphery
Source:www.castcommunity.wordpress.com/category/education/page/2/
(**Date Accessed:** 15 April 2018)

In the year 1992, a representative forum known as the Cato Manor Development Forum (CMDF) was founded after holding lengthy discussions and negotiations till the year 1993. The CMDF went on to legally establishing its organization, which is known today as the Cato Manor Development Association (CMDA). The CMDA's initiatives continue to work beyond social and economic development as it also focuses on the development of social facilities, servicing infrastructure and housing projects. Despite the CMDA's efforts, much work remains to be done, and it is arguably true that an innovative and sustainable problem-solving approach is yet to be implemented.

1.1.2. Motivation / Justification of Study

The previous section has highlighted the history of Cato Manor in order to illustrate the clash over access to the area, and usage of the land by various social, racial and economic groups. As discussed, the Cato Manor area was left deserted from the early 1960's till the mid 1980's as the Indian and African residents were forcibly removed under the apartheid constraints. The second half of the 1980s saw the area being resettled through incompatible processes of peri-urban invasions and government planned residential development (Hindson and Pupuma, 1996). 20 years later, the social conflict in the area is yet to be quelled, as the community remains divided. This fact is particularly exacerbated by the areas continued lack of basic service infrastructure.

The area of Cato Manor presents a unique challenge - a combined need for socio-racial healing and basic infrastructure. This inherently invites an investigation into the potential for empowered sustainability by concurrently addressing these challenges. Furthermore, the continued lack of respect for the environment within Cato Manor and many other peri-urban communities, the inevitable energy crisis that the country is facing, and the desperate need for economic resilience, further motivates for the investigation of a "prototype" solution that can be modified and adjusted to the suit the needs and context of similar peri-urban scenarios.

1.2. DEFINITION OF THE PROBLEM, AIMS AND OBJECTIVES

1.2.1. Definition of the Problem

This thesis investigates the challenges which communities deal with in a Peri-urban settlement context. The common issues that are identified, from a macro scale perspective, is the lack of infrastructure, a fundamental human need (Figure 1.4 and 1.5). The inadequacy of electricity will be the primary focus and will set the dialog relating to solutions for this specific problem. The notion of establishing alternative methods, and education of socio-economic and environmental approaches within these peri-urban settlements will ultimately contribute to the empowerment of a self-sustained community.

Figure 1.4: Communities riot due to the lack of basic needs such as unemployment, electricity, water. etc
Source:https://www.groundup.org.za/article/cato-manors-struggle-against-state-repression-continues_3284/
(**Date Accessed:** 15 April 2018)

Figure 1.5: The Umkhbane river of Cato Manor consisting of waste pollution.
Source:https://www.iol.co.za/sunday-tribune/news/ethekwini-municipality-attempts-to-stop-river-pollution-14806239
(**Date Accessed:** 28 May 2018)

1.2.2. Aim

The primary aim of this dissertation is to investigate how architecture can respond to the energy and socio-economic challenges of insurgent communities within the peri-urban context of the Cato Manor Precinct. By identifying and understanding these challenges, this dissertation will develop a theoretical outcome to address these issues through architecture, by empowering these communities towards sustainable livelihood strategies. The result of this analysis will assist in developing a Proposed Solar Harvested Multipurpose Upcycling Centre for the Cato Manor Precinct.

1.2.2. Objectives

- To explore the origin of insurgent communities in peri-urban areas, with a focus on Cato Manor as a typical post-apartheid model
- To investigate how sustainable development can be achieved in insurgent communities in peri-urban areas.
- To focus on the potential role of solar energy and upcycling processes in empowering insurgent communities in peri-urban areas as a form of sustainable development.
- To investigate the means of incorporating solar energy and upcycling processes into an architectural tool for empowerment in the insurgent community if Cato Manor.

1.3. SETTING OUT THE SCOPE

1.3.1. Delimitation of Research Problem

This study is set within the present context -Economic, social and environmental sector - and its findings would be subject to revision, should these factors change or evolve. This research study investigates how the architectural built form can catalyze sustainable regeneration in Peri-urban settlements. The study will focus on firstly environmental, and secondly, social regenerations. The study will furthermore, place emphasis on how this can be achieved within a post-Apartheid insurgent community within the existing Peri-urban settlement of Cato Manor, located in (South Africa) Durban.

Although the community will play a key role in this research project, the scope of the proposed solution will be focused on the role of architecture in addressing the primary needs for empowerment (social), and sustainability (environmental).

This research scope will be limited and focused due to time constraints. Although the research accepts that there are many potential features in shaping a solution to the research problem, the research will focus on only a select few. As such, the building typology of this project will focus on the harvesting and distribution of renewable solar energy, as well as empowering communities through various multipurpose functions of upcycling skills development for educational and awareness purposes. This research accepts that other strategies could be viable, but will motivate for the use of solar energy and upcycling as the best location-specific solution for the research case study.

1.3.2. Definition of Key Terms

Built Environment – Structures and buildings made by man, rather than natural features.

Insurgency – Holston (1998) defines insurgency as the controversial disagreement of exclusionary process, socio-economic inequality and spatial rights. He further emphasize about the conflicts and equality across all eras. These eras includes the industrialization, post-industrialization, city transformation and urban migration.

Education – The process of learning and acquiring knowledge, skills, beliefs, values and habits towards the development of individuals.

Peri-urban – These areas are also referred to as outskirts, hinterland or urban spaces due to Peri-urbanization. These are identified as transition interface zones between rural landscapes and urban spaces. (Webster and Muller, 1999:281)

Post-Apartheid – Present time in South Africa since 1994, the birth of democratic country.

Resilient City - (resilientcity.org,2012) states that "A Resilient City is one that has developed capacities to help absorb future shocks and stresses to its social, economic, and technical systems and infrastructures so as to still be able to maintain essential the same functions, structures, systems and identity."

Sustainable Development – A conceptual approach in maintaining a balance towards human needs a result improving their lifestyles. A process which involves preserving the usage of natural resources and ecosystems for future generations to depend on. This concept emphasizes economic, social and environmental growth towards a stable relationship between human activities and the natural world. (Cerin, 2006; Dernbach J. C., 1998; Dernbach J. C., 2003; Stoddart, 2011).

Urbanism – The migration rate of people to central urban areas to meet their daily needs and income.

Informal Squatter Settlements – Refers to the illegal occupation of land within the urban fabric or it's peripheral zones. In South African context, informal squatter settlements occur on the urban peripheral zones due to the previous apartheid governance of racial segregation.

Urban Regeneration – (Colantonio & Dixon, 2011:8) states that this is the process of sustainably improving derelict urban cities and settlements. It involves restoring and repairing the economic, social and environmental sectors towards a sustainable future.

Urban Sprawl – This occurs when parts of a city, or a previous functioning cities are in disrepair and derelict. These areas are characterized by poor infrastructure, abandoned buildings, unemployment, fragmented communities, and crime and isolated within urban context.

Citizenship – Sandercock (1998) explains that citizenship is distinguished through diversity and identity which should not be suppressed but rather celebrated. She further emphasizes how society is combined of different groups and cultural diversity.

1.3.3. Stating the Assumptions

- Peri-urban settlements are generally identified as areas of high density, “decay” and “derelict” areas.
- Cato Manor has become an area affected by Durban’s urban sprawl where many civilians have claimed their spaces, since the post-apartheid era.
- These settlements are perceived as “insurgent spaces”, and as a result communities have inadequate facilities, poor infrastructure and lack of basic needs.
- It is assumed, within the parameters of this dissertation, that an architectural intervention will be a suitable response towards the challenges outlined within the Peri-urban settlement of Cato Manor.

1.3.4. Key Question

How can architecture respond to the energy and socio-economic challenges of the insurgent communities within the peri-urban context of the Cato Manor Precinct?

1.3.5. Secondary Questions

- What are the origins of insurgent communities in peri-urban areas, and how does this relate to the formation of Cato Manor as a typical post-apartheid model for insurgency in peri-urban areas?
- How can sustainable development be achieved in insurgent communities in peri-urban areas?
- What are the potential roles of solar energy and upcycling processes in empowering insurgent communities in peri-urban areas as a form of sustainable development?

- How can solar energy and upcycling processes be integrated into an architectural tool for social, economic, and environmental empowerment in the insurgent community of Cato Manor?

1.3.6. Hypothesis

The hypothesis of this dissertation proposes that architecture, through the use of the unique combination of solar-generated energy and community education through upcycling, can address the combined community needs of socio-economic and socio-environmental upliftment, empowerment, resilience, and sustainability in the Cato Manor area.

1.4. RESEARCH METHODS AND MATERIALS

This section outlines the research approach, epistemological standpoint, and methodology applied to this dissertation. It defines the procedures for data collection and identifies the techniques and methods to be used to gather all information - both primary and secondary. Finally, this section also explores how the data will be analysed and contextualized.

1.4.1. Approach

A qualitative research study is suitable for this research because it complements the theoretical and conceptual framework within the dissertations parameters. After all - it is not only the physical environment of the required infrastructure that will be investigated, but also the social, economical and environmental needs of the Cato Manor insurgent community. Furthermore, because of the history and complexity of the context of the research, which will ultimately ground the research findings, a new frame of thinking will need to be established. As such, the research will work within the parameters of a grounded-constructivist analysis.

Grounded theory analysis was arguably the only way to ensure that any findings constructed during the research would ultimately be applicable to the community of Cato Manor. Grounded theory is an approach to qualitative research analysis that emerged during the 1960's debates around the virtues of quality versus quantity. Grounded theory was introduced by the sociologists Barney

Glaser and Anslem Strauss (Pidgeon & Henwood, 1997), who chose the term grounded theory to suggest that theories should be generated by - or grounded in - the cyclical inspection and comparison of qualitative data (Pidgeon & Henwood, 1997). Furthermore grounded theorists aim to connect emerging research with already existing theories and literature in the field. This is ultimately what the research will aim to achieve and use the case study as well as the research findings to generate a prototype solution that both tests and arguments the existing frameworks around sustainable development and peri-urban areas.

Hence, theories will evolve during the course of the research - as an ongoing interchange between analysis and data collection (Pidgeon & Henwood, 1997). Charmaz's (2003) development of Constructivist Grounded Theory, expands on Grounded Theory by highlighting that the focus is on creating an interpretative portrayal of a situation, where, Charmaz (2003; 250) defines constructivist grounded theory in 3 points:

1. Grounded Strategies need not be rigid, or in any way prescriptive;
2. The focus should be on the meaning, and furthering the existing perspective;
3. Grounded theory can be adopted in constructivist grounded theory approaches, without embracing the positivist leanings of earlier proponents of grounded theory.

This suggests that an analysis and theory building method following this approach would take into account the socio-structural, socio-economic and socio-environmental needs of the Cato Manor insurgent Community.

1.4.2. Research Methods

The research design was a descriptive, cross sectional study that made use of primary data - in the form of semi-structured in depth interviews, questionnaires, observational studies and case studies, - as well as secondary data - in the form of precedent studies and an analysis of the existing literature surrounding the theoretical framework for the research.

1.4.2.1. Secondary Research

The initial underpinning of the research was established through secondary data collection in the form of a literature review, which investigates the relevant concepts and theories surrounding the topic, and three precedent studies, which similarly explore the architectural themes surrounding the topic. This research provided the theoretical framework through which the primary data were later interrogated and analysed. This form of research comprised of various published media such as: (1) Journal articles by various authors; (2) Books by various authors; (3) Reports, academic papers, and documents; and (4) World Wide Web. This research forms part of the literature review chapter where published literature relating to the research questions are explored in order to build and frame the argument.

Literature Review: Existing literature on the concepts and theories identified by the researcher will be investigated in order to understand the underpinning concept of what defines them. Furthermore, other documents relating to sustainable Peri-Urban Settlements and Empowerment of communities will be identified and analyzed so as to ensure the fabrication of a well-founded and detailed dissertation.

Precedent Studies: Precedent studies will investigate and analyze as to how other structures of a similar typology have been designed and used. These will be analyzed and will provide an understanding of how these spaces work- both within a local and international context.

1.4.2.2. Primary research

The sampling method used for the primary research component of this study will be purposive sampling. A purposive sample, also referred to as a judgmental or expert sample, is a type of non-probability sample. The main objective of a purposive sample allows the researcher to produce a sample that can be logically assumed to be representative of the population. This is often accomplished by applying expert knowledge of the population to select in a non-random manner a sample of elements that represents a cross-section of the population. Officials of the CMDA and the Area Based Management (ABM) of the Cato Manor precinct will be identified and be handed out questionnaires to answer as well as interviews which focus on the means by which a sustainably resilient and self-empowered community can be built with emphasis on empowering and focusing the community towards a resilient community.

Interviews: Interviews will have an important role in gathering research towards the topic of discussion. The topic components will consist of the following -

- The lack of electricity power supply and basic services
- The empowerment of the community towards a sustainable settlement through the role of upcycling.
- The benefits of harvesting and distributing solar energy from a fixed structural source for the community of Cato Manor.

Four interviews were conducted within this research dissertation boundaries and includes the major officials of Cato Manor who deal with the peoples challenges on a daily basis from a social and economical perspective. These officials are part of the CMDA and Area Based Management (ABM) of Cato Manor.

Questionnaires: Twenty Questionnaires, which served as a supplement to the Interviews, were handed out to the officials and professionals of the MDA and Area Based Management (ABM) of Cato Manor who are involved in the socio-economic development field.

Case Studies: were conducted within the boundaries of this research dissertation location. This includes site visits and the analysis of architectural plans and peri-urban informal settlements in Durban. These case studies were analyzed according to the context and scope of the literature review, hence relating to the theoretical and conceptual framework.

Instinctive Observations: This technique allowed the researcher to distinguish people's behavioral patterns within the environment of the research area. Observations were carried out within the same areas as interviews and questionnaire answering, to ensure accurate information and results. Observations of the sun's solar path were also crucial as the proposed intervention explores solar harvesting techniques.

Finally, to improve the reliability and validity of the research, multiple methods were utilized throughout. A triangulation of information by engaging in multiple methods, such as interviews, literature reviews and observational case studies resulted in a more valid, diverse and reliable perception of realities. Furthermore, all data were compared across the methods (i.e. between interviews and literature, between case study observations and interviews and between literature and case study observations) in order to ensure that the data was treated and analysed as a whole, rather than fragments. This allowed for any emerging or unanticipated themes to be determined.

1.4.3. Analysis: Codes And Coding

In order to investigate the constituents of the phenomenon, while keeping the context of the whole, a thematic constructivist-grounded analysis was used. To support this methodology, open coding, where labels were generated to describe the emerging themes in the data on both a detailed and abstract level (Pidgeon & Henwood, 1997) were used. In order to collapse the coded themes into a manageable size, they were then grouped into clusters based on differences and similarities. Each cluster was then labelled, and fully described for its range and variations. As the process of coding unfolded, the coded themes were refined, extended and related to each other as further material was explored (Pidgeon & Henwood, 1997). Constant comparative analysis was a technique utilized throughout the process in order to identify differences and similarities that existed between instances to ensure that the full complexity of the data was explored (Pidgeon & Henwood, 1997). The final stage of the research process involved 'recontextualising' (Morse, 1994) - or reanalysing these differences and similarities within the broader context - so that it became a more relevant part of the greater theme, and could be made applicable to other settings

1.4.4. Validity, Reliability and Rigour

To ensure the validity and reliability of the research, multiple methods were utilised throughout the research. A triangulation of information by engaging in multiple methods, such as interviews, literature reviews and observational case studies resulted in a more valid, diverse and reliable perception of realities. All data were compared across the methods (i.e. between interviews and literature, between observations and interviews and between literature and observations) in order to ensure that the data were treated and analysed as a whole, rather than as fragments of the whole. Through a process of respondent validation of any relevant research notes, a means of checking for any inconsistencies and challenging assumptions was generated, and all data were re-analyzed based on any feedback. It is also relevant to note that the sample was purposively selected based on their expected ability to assist in answering the research questions - this choice of an appropriate sample, as well as an adequate sample size ultimately assisted in ensuring that the research displayed elements of saturation and replication, thereby adding to the validity and rigour of the findings.

1.5. CONCLUSION: THESIS OUTLINE

This thesis is sub-divided into six chapters as follows:

Chapter One: The introduction unveils the research context, the justification of the research study, the research questions, the research problem statement, aims and objectives, the hypothesis as well as the research scope and it’s limitations.

Chapter Two: This chapter will the literature review, which will analyze existing solutions and positions in relation to the research problem. The critique analysis will be confined within the boundaries of the relative theories and concepts.

Chapter Three: The theoretical and conceptual framework chapter presents the foundation for the research paper, which identifies and explains the key theories and concepts which could add to the existing body of knowledge explored in chapter two.

Chapter Four: Precedent studies will analyze relevant architecture from international and local projects. This will entail relative design characteristics and their implemented principles in achieving the design solution.

Chapter Five: Case studies will discuss and analyze the author's personal first-hand experience, where local architectural examples will be studied to expand on the knowledge of the research topic.

Chapter Six: This chapter will present the analysis and discussions of the interviews, the questionnaires, as well as all the data analyzed at that specific point. Furthermore, the author will draw conclusions from the gathered research findings which will result in recommendations for the design component of the research dissertation.

2.1. INTRODUCTION – LITERATURE STRUCTURE

The following literature review aims to disintegrate the problem statement systematically in sections to understand the greater objective of the subject matter (Figure 2.1).

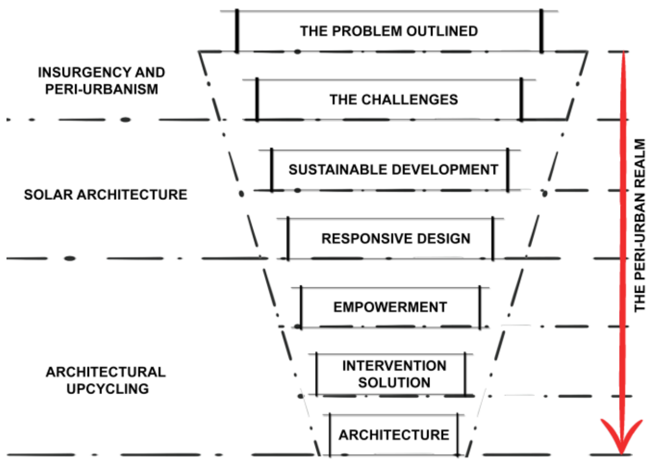


Figure 2.1: Literature Review Structure
Source: Author (08 May 2018), Durban, South Africa

The first section of this chapter will identify the geographic analysis of Cato Manor and the understanding of the contested challenges that insurgent communities are faced with in the peri-urban realm. This section further explores the framework of sustainable development, sustainable livelihood approaches, its history and any existing applications to empower the communities of Cato Manor.

The second section analyzes the energy deficiency constraints within the peri-urban realm in general, and how solar power can be a dominant source of electrification for the communities within the Cato Manor precinct. The third section then introduces 'architectural upcycling' in parallel to 'social innovation'. Upcycling is a popular term within the design practice as it is a process of taking waste material and transforming them into products that adds value. Furthermore, it is a sustainable strategy where waste material is upgraded (adds value) and recycled (reuse).

Lastly, this chapter will investigate the niche in the literature with regards to the contextual challenges pointed out in the first section of this chapter, by using the potential tools outlines in the second and third sections. (Figure 2.2)

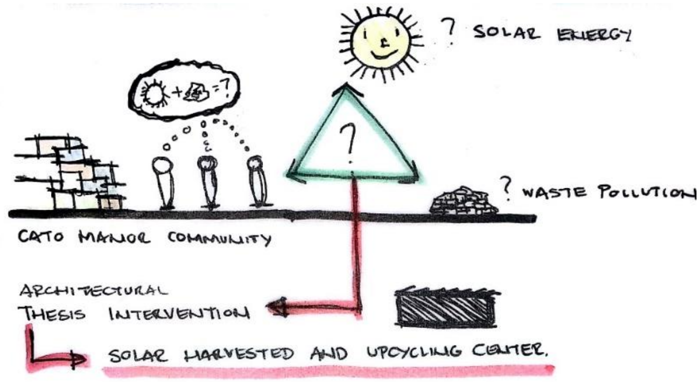


Figure 2.2: This diagram illustrates the literature review framework driver in achieving the overall objective of an architectural intervention by incorporating the three components sustainable development, waste upcycling and solar architecture.
Source: Author (08 May 2018), Durban, South Africa

2.2. Exploring "Unsustainable" Poverty and Insurgency in the Peri-Urban Settlement of Cato Manor

Urban population growth and increasing scarcity of land have pushed increasing numbers of people to live and work in high-risk, low-potential or marginal peri urban environments (CPRC, 2004).

Johnson (1972: 148) describes the peri-urban zone as being characterized by “the absence of a clear break between rural and urban conditions measured both in terms of land use and of social organization” where “various rural and urban characteristics are mixed together”. Furthermore, Johnson elaborates that this zone “also attracts various uses which are necessary for the proper functioning of an urban settlement but which would be less desirable within its actual built-up area” (p. 149).

Settlements within these peri-urban spheres are generally informal and unplanned, as sprawling settlements are established on public land which have inadequate municipal surveillance or an absence of private landlords (Figure 2.3). Informal settlements are formed along road sides, embankments of railways, or majority placed in inaccessible zones which contain outer city waste disposal dumps or steep slopes. Peri-urban informal settlements over time has become the physical interpretation of inequality within the urban context. Immigrants have populated within these ‘squatter zones’ which spreads on the outskirts of the cities

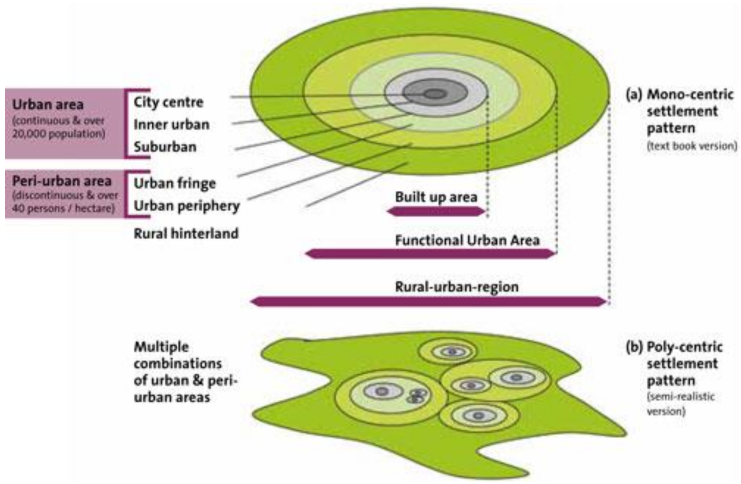


Figure 2.3: Peri-urban spatial model within urban context.
Web-Source: http://urbanchange.eu/2012/07/17/peri-urbanisation-in-europe/(**Date Accessed:** 17 April 2018)

Peri-urban sprawl is further exaggerated in South Africa by critical changes within the political sector since the start of the Post-apartheid era. The emergence of various socio-economic government strategies have led to the migration of civilians from the countryside to the townships on the outskirts of the urban city center in search of a better standard of living. Job opportunists and informal traders have populated the Central Business District (CBD) areas, leading to the abandoning of residential areas on the outskirts of the CBD, and the subsequent insurgent 'reclaiming' of these areas by both illegal and legal immigrants. Within the context of this research paper, the settlement of Cato Manor serves as an example of an impoverished peri-urban are which has become unsustainably densified by informal communities with a diverse cultural population and sub-standard living conditions (Figure 2.4).

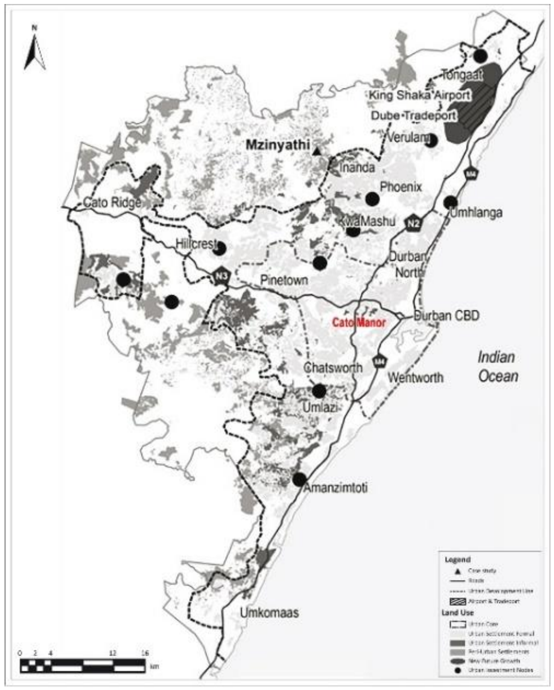


Figure 2.4: The peri-urban zones within the Durban Ethekwini region. Identifying Cato Manor as one of many peri-urban settlements.
Web Source: https://abcjournal.org/index.php/ABC/article/view/2128/2060 (**Date Accessed: 05 May 2018**)

Sandercock (1998) notes that during periods of mass urbanization and migration, particularly by the urban poor, the socio spatial temporalities of the city become hosts to "spaces of insurgent citizenship" (Sandercock 1998:39). In the context of this research paper, the theory of insurgency identifies the socio-economic and environmental challenges of the above mentioned Cato Manor District (Figure 2.5). Contradictory, Holston in Sandercock (1998) suggests that there is a need to develop a different social imagination, one which is not modernist but that "nevertheless reinvents modernisms activist commitments to the invention of society and to the construction of the state" (Holston in Sandercock 1998:39). Furthermore, Holston suggests that the source of this paradigm shift cannot lie in any formal architectural or planning production theory, but rather a symbiosis of socially responsible architecture and planning in what he dubs "spaces of insurgent citizenship" (Sandercock 1998: 39). One could easily argue that such forms of sustainable thinking have not yet been applied to many insurgent communities - but particularly not within Cato Manor.

Figure 2.5: The collage of images illustrates the contested challenges within the peri-urban settlement of Cato Manor. Mainly the primary focus of illegal electricity supply and its deficiency as well as waste pollution within the informal communities.
Web Source: http://housingfinanceafrica.org/cato-manor/ (**Date Accessed: 05 May 2018**)

2.3. Interrogating the existing definitions of Sustainable Development

"Sustainable Development" has become a common topic in discussions and debates within social and political platforms. Undoubtedly, sustainable development has become a theoretical driver in describing interpretations of contemporary societies. The Brundtland report explains sustainability as: "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs". (World Commission on Environmental Development, 1987:43).

Therefore the report warns us about the importance to re-think our lifestyles and governance. Furthermore the need for new alternative strategies are required to achieve the goals and aspirations of humanity.

The United Nations (UN) General assembly specifically note two crucial ideas which are:

- The welfare of the environment, the economy and societies unavoidable link to these
- The incorporation of sustainable development on a universal scale.

However, the role of sustainable development and the conceptualization of new alternative strategies in generating socially responsible architecture for insurgent citizenship has arguably yet to be fully explored. In order to determine the extent of this gap in the literature, one must first review the fundamentals of sustainable design.

Advocates of sustainable development urge the implementation of measures including conservation, recycling, population control and the development of alternative renewable energy sources (Rohmann, 2000). Dillard et al. (2009) interprets sustainable development as an understanding of three bilateral common goals (Figure 2.6):

1. To develop lifestyles which are perceived as environmentally friendly sustainable (People and planet).
2. To maintain economically sustainable standards of living over a period of time. (Prosperity)
3. Social sustainable living standards for present and future purposes (Peace and partnership).

Figure 2.6: The process of achieving the goals of Sustainable Development
Web Source: http://www.theguardian.com/global-development/2015/jan/19/sustainable-development-goals-united-nations (**Date Accessed:** 05 May 2018)

The Three Spheres of Sustainable Development

The essence of sustainable development is to understand the three interrelated components which are the Social, environmental and economic components (Figure2.7). Regardless of the circumstances of the context, the objective will be constant. History has proven that humanity depends on ecosystems and the benefits they provide in order to survive. Hence if the rate of environmental damage continues, the consequences will be crucial for both social and economic future development.

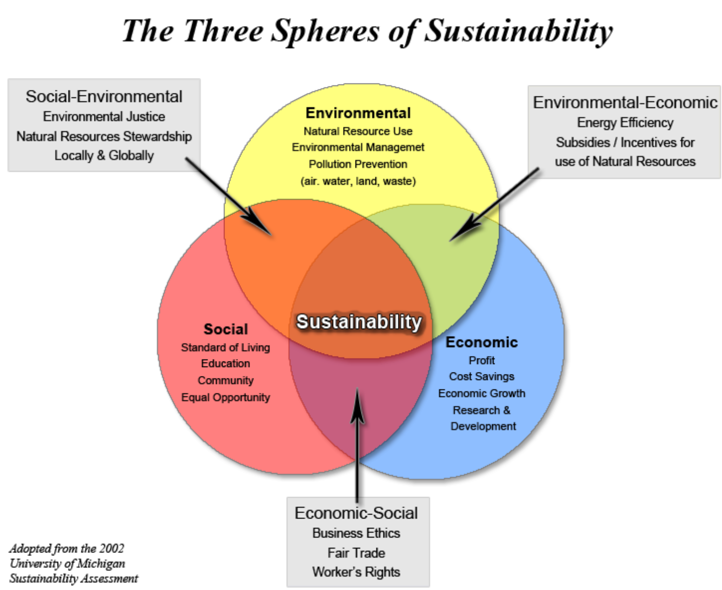


Figure 2.7: The three components of sustainable development
Web Source: https://www.vanderbilt.edu/sustainvu/who-we-are/what-is-sustainability (**Date Accessed: 05 May 2018**)

The concept of Livable Urbanism caters for all types of social groups to generate ‘eco’ friendly schemes within the urban and peri-urban contex. Therefore it promotes a nutrient and resource fixed cycle within the urban context to re-establish both the urban environment and social fabric which responds towards the conflicts and tensions amongst the natural and built environments. A fixed cycle forms a systematic process of reuse, upcycling and recycling (Figure 2.8). This system could help restore the balance between the three spheres of sustainability previously discussed.

Figure 2.8: Illustrated diagram by William McDonough's 'Cradle to Cradle' (McDonough and Braungart, 2010) design methodological approach.
Web Source:http://cmuscm.blogspot.co.za/2013/01/cradle-to-cradle-closing-loop.html(**Date Accessed:05 May 2018**)

2.4. Investigating The Possible Role Of Renewable Solar Energy and Waste Upcycling Processes

2.4.1. The Importance of Solar Energy As A Renewable Resource

This sub-section will analyze and investigate the importance of renewable energy and its accessibility towards the environment in terms of sustainable development. The sun will be studied as an energy source aiding energy deficient peri-urban settlement (Figure 2.9).

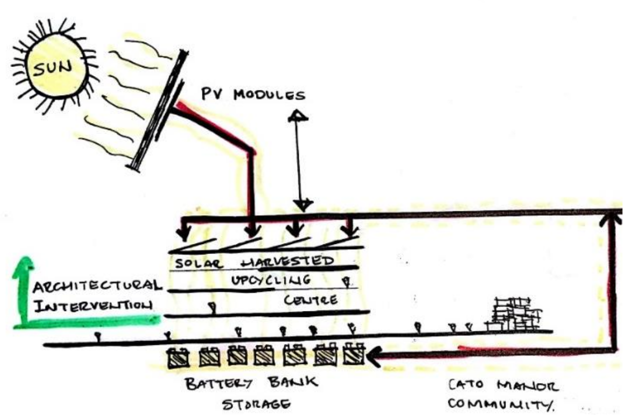


Figure 2.9: This diagram illustrates the conceptual approach of incorporating solar harvesting and distribution of solar power amongst the community of Cato Manor.
Source: Author (May 2018)

2.4.2. Renewable Solar Energy as a Source of Power

Energy is utilized in many phases of socio-economic development, as well as in construction, and the operation of material production within the built environment. Fossil fuels are non-renewable and have great environmental impacts. According to the projections estimated lifespan is 45 years for crude oil, 60 years for natural gas, 250 years for coal (Botkin Keller, 1995:313-328). Similarly in the case of nuclear power from the mining and processing of uranium to controlled fission, the processing of spent nuclear fuel, the decommissioning of power plants, and the disposal of radioactive waste, various amounts of radiation may enter and affect the environment. Nuclear power is non-renewable and estimated life for the existing uranium reserves is less than 100 years, in respect to the current consumption values.(Topaloglu,2003:21). Hence , fossil fuels and nuclear energy are not sustainable, and should be entirely omitted from future sustainable growth strategies. In the lines of sustainability, there are many types of alternate energy sources such as a solar energy, biomass, geothermal energy, water power (hydro-electric).etc.

The above mentioned renewable energy of wind, biomass, geothermal energy, water power (hydro-electric), are not applicable within the context of this research paper as it purely focus within the boundaries the peri-urban settlements, such as of Cato Manor. Solar energy is easily accessed and harnessed as it is generated directly from the sun’s radiation and it is used to generate electricity, to produce heat and light. The sun is fundamental to all life. It is the source of our vision, warmth, energy, and the rhythm of our lives. Its movements inform our perception of time and space and our scale in the universe. Guaranteed access to the sun is, thus, essential to energy conservation and to the quality of our lives. (Knowles, 2003), (Figure 2.15).

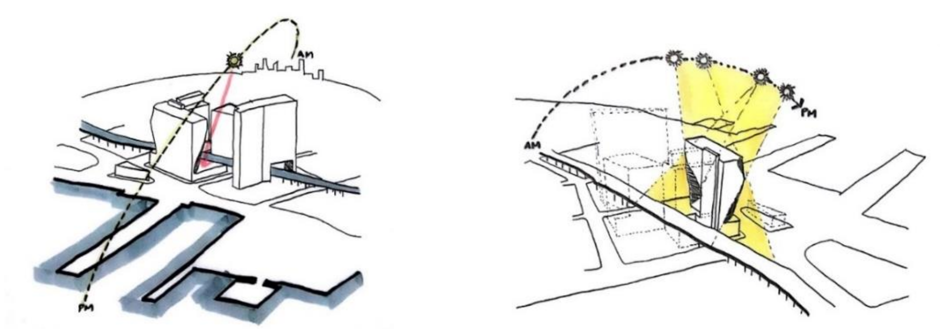


Figure 2.10: The importance of the solar path and its influence in the built environment.
Source: Author (April 2018)

To recognize the importance of solar energy, the third component of "Quality" is fundamental. If the amount of energy is fixed (1st law of thermodynamics), what is being used up, is the energy quality, or the availability of the energy to perform work. (Topaloglu,2003:21). In other words, the greater the energy quality, the more efficient it is to work with, but if the energy quality is lesser, it becomes inefficient to work with. Energy always tends to go from a more usable (higher quality) form to a less usable (lower quality) form. (Topaloglu,2003:21). This statement, the second law of thermodynamics, means that, when you use energy, you lower the quality (Botkin Keller, 1995:299). Therefore, Thomas Herzog describes the significance of solar energy as:

"Man can merely retard the process of fragmentation, therefore, by conserving resources and recycling materials in a sensible manner. He cannot halt it completely or reverse it. The physical-biological process of natural evolution alone is capable of doing this – not by reversing the second law of thermodynamics, but with the help of a practically inexhaustible source of energy outside the closed system of our planet, i.e. sun."(Thomas Herzog 1996:32)

Solar energy can be used either passively or actively. Passive usage of solar energy depends on enhancing the performance of energy in buildings in three spheres; **Cooling , lighting** and **heating**. Active usage incorporates solar energy techniques of **photovoltaic cells, solar collectors, solar ponds, power towers, ocean thermal conversion centrals and hydrogen generating solar centrals**.

The aim of this literature is to pave possible ways of integrating these technologies into the built environment, with an overall architectural expression in addition to producing energy. The intention here is to highlight design possibilities regarding the use of solar technologies into buildings with innovative approaches. Basic focus is on the harvesting and storage, appearance or aesthetics part of integration as this makes the major towards built form. PVs and thermal collectors can deliberately be used as architectural design elements in a distinctive way. The development towards passive, zero energy and zero emission buildings will cause a more frequent use of building integrated solar energy systems as a source of renewable energy. Integrating these

PV and solar thermal collectors systems into buildings is not only for clean energy but also to use them as multifunctional elements where they replace the conventional building elements (Figure 2.16). With this, the economic viability of integration is met and most importantly, they become architectural components.

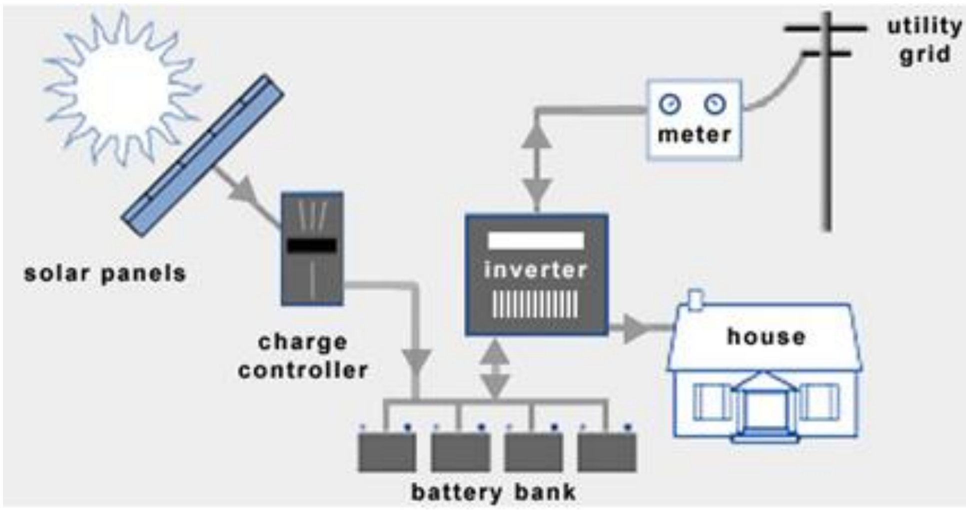


Figure 2.11: The process of architectural integration quality for incorporating, harvesting and distributing solar power creating energy efficiency buildings.
Web Source: http://greenecosolartech.com/services.html/ (**Date Accessed:** 17 April 2018)

The development of solar power technology is one of the most trending topics towards key solutions in fulfilling the energy crises in peri-urban settlements such as Cato Manor. Solar energy could be the possible solution in aiding those insurgent citizens in poverty whilst at the same time, sustainably exploring and implementing new approaches towards a resilient and self-sustaining settlement.

2.4.3 Social Innovation of Waste Material

This sub-section will aim to analyze the importance of waste material and its accessibility in terms of sustainable development. Furthermore, it will also aim to explore how empowerment could be a solution towards a sustainable and progressive community for individuals in the peri-urban settlement such as Cato Manor.

Mulgan, Tucker, Ali and Sanders (2007) argue that “social innovation is a development in many different ways from the business improvement, being the form of leading motives for social modernization often surpass material incentives and hence ‘include motives of recognition, compassion, identity, autonomy and care”(Figure 2.17). The demand to find appropriate solutions to pressing and urgent social challenges in contemporary societies is apparent, and the concern in innovation within the practice and research is increasing quite drastically. ‘’Much research on innovation fails to point out the problems regarding the underlying descriptions of ‘newness’, and thereby it overlooks the processes that constitute what is seen as innovative in the specific empirical contexts. Given the cross-sector challenges that are faced by societies, amid implications climate change, youth unemployment and the increasing costs in health and social care, it would seem logical to direct most of the focus on sustainable innovation across domains, organizations and sectors.’’(Janssen et al, 2015).

From a socio-cultural point of view, new social ideas and concepts introduce ‘newer and more originals practices, techniques, customs, intuitions, rites, manners and more’ (Hochgerner, 2010) and ‘reconfigures social practices and constellations of actors in such a manner that it is able to satisfy or answer requirements and problems.(Howaldt & Schwarz, 2010:20). ‘’Within the research on innovation, the content of it is divided into different typologies such as new processes, strategies, products, services, position, governance or rhetorical innovations’’(Hartley, 2005). Research in social innovation accentuates knowledge-in-practice and it frames improvement as contextualized and socio-economically fixed worth creation which is densely linked to the development of knowledge as well as the competencies of the actors that are involved.

It has been further investigated and illustrated of what a sustainable improvement strategy for social work may look like; To capture and rehabilitate skills and competencies, ideas, material, objects or practices from a variety of sources that might have previously been considered not just ‘old’ but ‘useless’ as well. Overall, there is an urgent call for context-sensitive innovation, discourses as well as practices. The suggestion we have here is that upcycling used as a concept as well as a mind-set is helpful in this endeavor. Upcycling can thus include a collection of actors in their role as a citizen, a professional or a volunteer. It also includes the skills and knowledge at hand and waste material such as abandoned industrial areas, disposed goods, garbage, junk yards and by-products.

Social upcycling competencies involve an eye for potential, a knowledge brokering mind-se, a willingness and boldness to act without a business plan, and the passion and drive to create and shape the future and to not just let it happen and unfold. One should take the proper initiative to make these changes happen successfully to enhance the performances of individuals and together as a community as a whole. However this line of thinking arguably does not fully correlate to existing concepts of sustainable development in the context of peri-urban insurgent settlements.

Dewar (2001:247) elaborates that within South African context, the escalating growth of urban population, social exclusion and unemployment has reached high levels of poverty throughout the urban landscape. Furthermore, there is a demand to create opportunists for individual or self-generated economic activities. Dewar (2001:247) also argues that there should be an unbiased accessibility within the city as individuals struggle to access the provided facilities. Therefore, individuals of communities need socio-economic facilities in conjunction with architectural spatial expression as it can socially empower these communities of the Cato Manor precinct (Figure 2.19).

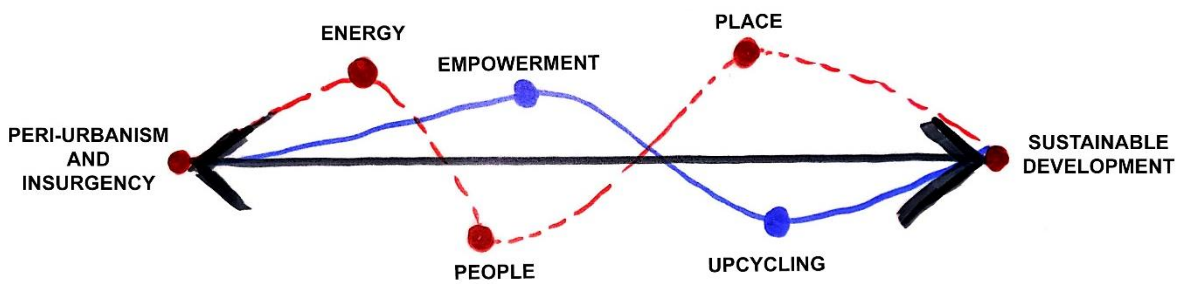


Figure 2.12: Illustrated diagram of how the literature addresses the per-urban challenges towards a sustainable future.
Source: Author (**Date Accessed: 05 May 2018**)

CHAPTER THREE | THEORETICAL AND CONCEPTUAL FRAMEWORK

3.1. INTRODUCTION

This chapter aims to analyze the structural framework of the theories and concepts which explore the relationship between the socio-economic and environmental components which could redefine the concept of Sustainable Livelihoods for insurgent communities within peri-urban areas. Furthermore, the objective is to explore practical architectural solutions for creating a sustainable and resilient settlement (Figure 3.1).

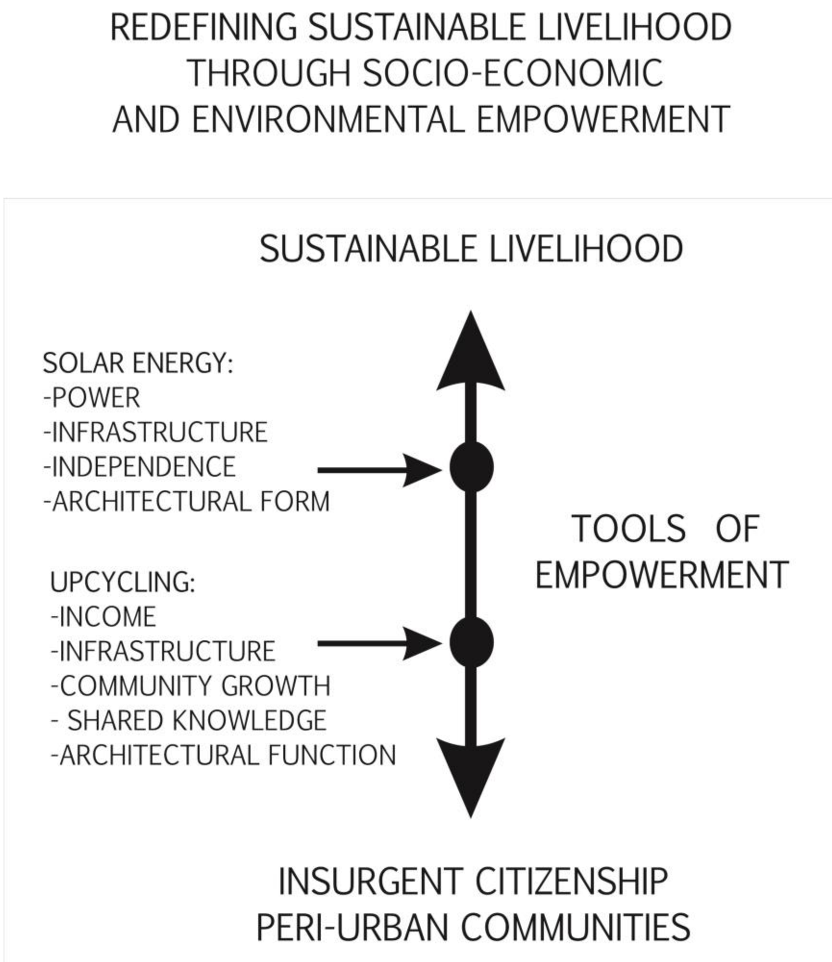


Figure 3.1: Illustrated diagram of how the theoretical and conceptual thread of the dissertation towards an architectural response.
Source: Author (**Date Accessed: 05 May 2018**)

3.2. Analyzing the Current Sustainable Livelihood Approach

SL thinking is inspired by the work of Robert Chambers in the 1980s, and has been further developed by Chambers, Conway and others in the 1990s (DFID, 2000:1.2). The sustainable livelihoods framework defines the type of developmental strategies committed to creating sustainable livelihoods for the poor and disadvantaged. The first underlying basis is to focus development methods towards the people. The sustainable livelihood framework additionally highlights the importance of a strong connection (Figure 3.3).

However, as explored within the previous chapter - much knowledge still needs to be contributed to adapting this SL Framework to insurgent communities within peri-urban areas. In order to explore how this could be accomplished, the following section will highlight how the additional concepts and strategies discussed in chapter 2 can be incorporated into the existing framework - in order to add, and not detract from its current successes.

Sustainable Livelihood Model: The sustainable livelihood framework model below demonstrates an understanding of its different components and its applications, and discusses how this framework could be expanded to better suit insurgent communities within peri-urban areas, using Cato Manor as a prototype (Figure 3.3).

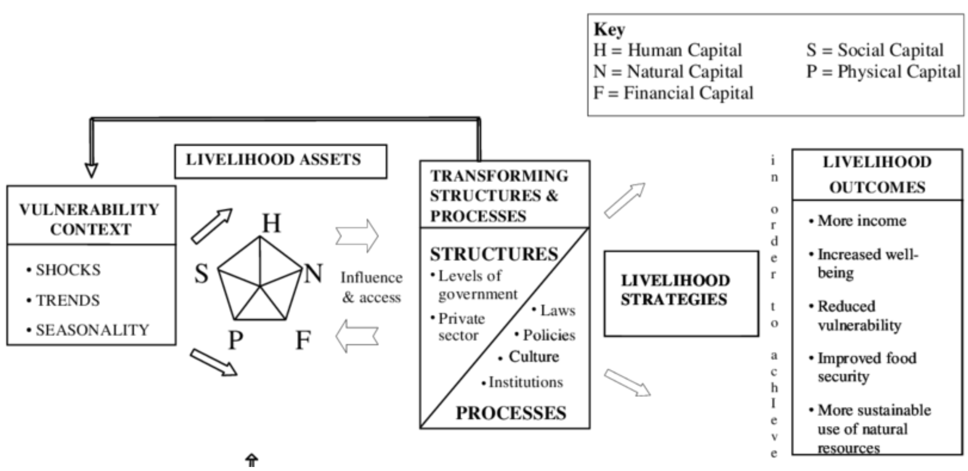


Figure 3.3: The Sustainable Livelihood Development Model
Web-Source:https://www.researchgate.net/figure/Sustainable-livelihood-framework_fig1_237250795 (**Date Accessed: 05 May 2018**)

The Vulnerability Component illustrates the exterior environment that disadvantaged and poor people dwell in. It incorporates critical trends which includes population or technological trends. Furthermore it is associated with shocks where natural disasters occur, economical inflation as well as seasonality which specifies how prices, unemployment and production deviates with different seasons. All of the above mentioned factors will have an impact towards the people's assets. **This chapter will subsequently aim to argue how solar energy and waste upcycling could contribute to resilience and stability, in order to counter-act the vulnerability of insurgent communities, with Cato Manor being the trial example.**

Human Capital Component is one of the most important assets, which entails knowledge, skill, ability to labour as well as good health. The Human Capital component is fundamental in allowing the usage of other capitals that are in existence**. Within the context of this research dissertation, this component relates to the upcycling process of how the insurgent citizens of Cato Manor will address their socio-economic challenges.**

The Social Capital Component relates to community resources where individuals obtain assistance in order to accomplish their livelihoods. This can be achieved through membership forums, networking, education and skills development programmes, and trust amongst people within communities for social upliftment. The peri-urban insurgent settlement of Cato Manor needs to become a socially cohesive community - but in order to achieve this, a platform is needed to voice the innovation of individuals **- Skills development and knowledge sharing through solar energy and waste upcycling will be used as examples for how this could be achieved within insurgent communities.**

The Natural Capital Component incorporates distinct factors, which are natural resources such as vegetation, land. Etc.-resources which are arguably limited within insurgent peri-urban communities. Chapter 1 clearly highlighted the extents of these limitations within the community of Cato Manor. **Within the context of this research dissertation, the sun will be explored as an unlimited resource with the potential for producing solar energy as an alternate source of electricity, for the energy deficient community of Cato Manor, and ultimately maximizing this resource as one of the few available to almost all insurgent communities.**

The Physical Capital Component characterizes the necessary infrastructure and goods which form a foundation towards the livelihoods that individuals within insurgent communities pursue. Once again, due to the limited resources of these communities, harnessing solar energy could serve as a platform towards empowering the insurgent communities of Cato Manor. Furthermore, waste could be reviewed as a resource for up cycling, assisting with establishing economic and physical infrastructure.

The Financial Capital Component includes the financial resources which allow individuals to gain the livelihoods they are seeking. The structure and process incorporates organizations, policies and institutions which assist the livelihoods of the disadvantaged and poor population at various levels, from household to a global scale. Investments could arguably only be encouraged through potential and innovation. Solar energy and waste up cycling could serve as tools to attract investment and generate support.

3.3. Solar Energy: A tool to Adapt the Sustainable Livelihood Model to Cato Manor

Exploring the historical relationship between people, the sun, and architecture

This sub-section will analyze and investigate the historical significance and importance of solar access towards the architectural built form from the past till present. Additionally, the sun will be examined as an energy source aiding energy deficient peri-urban settlements.

Furthermore, it will also aim to explore the efficiency of solar energy within the built environment, the different techniques to harvest solar energy within an architectural intervention- in terms daylight penetration of spaces and a source of alternate energy for electrification.

Whilst analyzing the brief historic dominance of the sun in urban and architectural context, it is important to understand the solar access of architectural debates in the present era. Architect Ralph Knowles and Stefan Behling emphasizes on the quality of life in conjunction with the conceptual ideas perceptions within the context of physical comfort and the quality of life.

Historical Analysis of The Sun

The aim of this historic analysis is to establish the suns important role within the built environment from the historic civilizations up to the current era(Figure 3.4).Ancient civilizations considered the sun as an object of worship and as such, the sun was given a personality, and was known as a source of light and heat (Topaloglu ,2003:6). In the ancient Egyptian era, the pharaohs designed and constructed their pyramids within their religious practices, orientating their structures in alignment of the solar path.

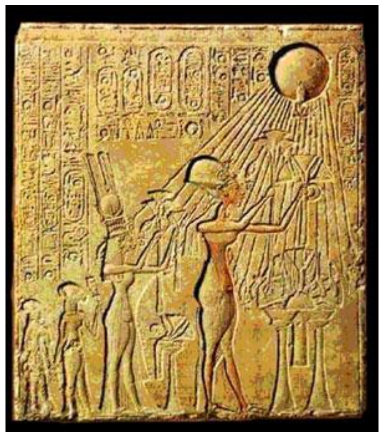


Figure 3.4: During the ancient Egypt era, “The Aten” was known as the sun-disk as it was the principle of god and a source of worship.
Web Source: http://ancientegyptonline.co.uk/amarnareligion.html (**Date Accessed :**15 May 2018)

The principles of solar architecture were established in religious buildings from the era of ancient civilization (Figure 3.5). These buildings were not just constructed to provide shelter, but at the same time to celebrate the gods. “They took their inspiration from the sun and the forces of nature; some of the earliest religious buildings took the form of calendar structures, which gave people an understanding of the passage of time through solar orientation.” (Sophia and Stefan Behling, 1996:91).

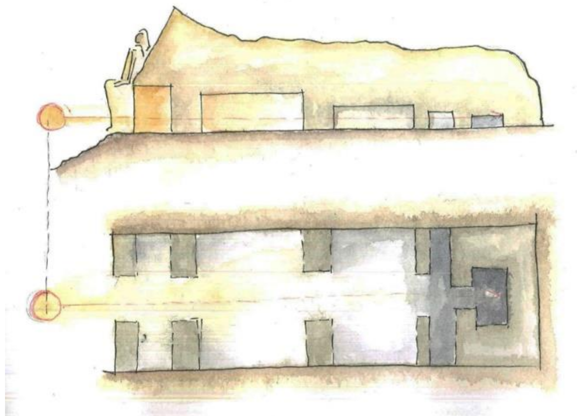


Figure 3.5: This diagram illustrates the emphasis on natural sunlight in an Egyptian temple plan.
Web Source: http://www.3nta.com/religious-architecture-and-light-part-ii/ (**Date Accessed :**15 May 2018)

Throughout the ancient world of the Egyptian, Greek, Byzantine and Roman eras, the sun always remained a dominant feature within the built environment. “Markets , forums, amphitheaters , and baths were designed to attract the public to gather and so had to offer high levels of environmental comfort , keeping the public cool in the summer and providing protection in the winter. “ (Sophia and Stefan Behling) (Figure 3.6).

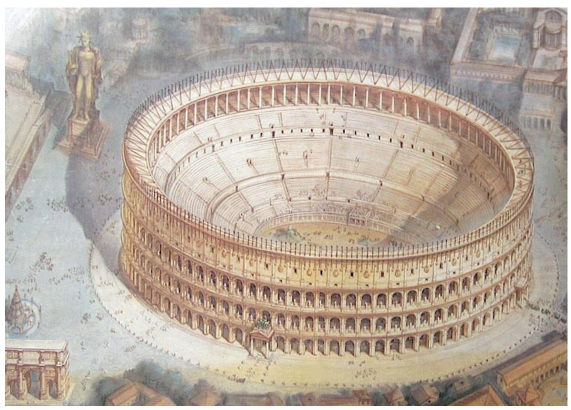


Figure 3.6: The Roman Colosseum gained maximum sunlight during the day as it received good solar access especially for spectators.
Web Source:http://tanguay.info/learntracker/page/lectureNotesItems?idCode=colosseum(**Date Accessed:** 15 May 2018)

In the Middle Ages, solar energy continued to have a strong influence on Christian architecture, inspiring the orientation of churches and being used to create fantastic effects to give worshippers a glimpse of heavenly light. (Sophia and Stefan Behling, 1996:91). Within the context of Islamic architecture, palaces and mosques were constructed by incorporating the interest of solar shading instead of lighting, to underline the aspects of comfort rather than design grandeur (Figure 3.7).

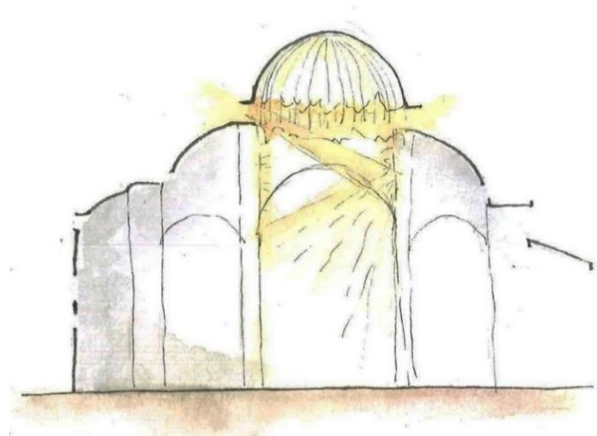


Figure 3.7: The importance of sunlight of the Hagia Sophia during the Byzantine era believed that the heavenly light would be their reward if they lived suitably devout lives. The historic structure consists of clerestory lighting which allows sunlight to penetrate the interior spaces emphasizing the importance of the sun. **Book Source:** Behling, S., Behling, S., Schindler, B. and Foster, N. (1996). *Sol power*. Munich: Prestel, p.99. (**Date Accessed:** 15 May 2018)
Date Accessed: 15 May 2018

During the ages of the industrial revolution, architect William Atkinson was the first who generated the conceptual ideas of creating architectural spaces which incorporated the penetration of sunlight. Donald Watson further queried how to find clear evidence of passive solar design in the modern era from the year 1910 onwards (Watson,1998:213). Watsons works on hospital architecture encouraged the design development criteria around the orientation of the solar path and the penetration of sunlight for hygienic purposes. Hygiene would be a key concept in the establishment of a bioclimatic design discipline, referring to the germicidal properties of daylight, which suggested that tuberculosis could be alleviated by exposure to sunlight (Lima, 1998:629-632). Atkinson's efforts led to the first documented "sun rights" legislation that limited the height of buildings for sunlight access in 1904.

The above historical review highlights the flexibility , importance and ultimate adaptability of the sun to both social and/or religious symbolism, and functional integration into architectural forms. With these traits in mind, it is now time to explore how the sun could once again adapt to the needs of society by serving as a source of energy, and an architectural tool to empower insurgent communities, and ultimately helping to expand the definition of Sustainable Livelihood for these communities.

Modern Building Integration

"The PV and solar thermal collector systems when integrated in a building, become part of the general building design and also often become general building elements." (Hestnes, 1999).

Economically, it is important that these systems are applied within the building envelope to avoid any further expenses with regards to adding extra support structures. The purpose of these systems is to change the general building components to produce maximum energy as well as to serve a binary function as it reduces expenses. "*These systems must be taken very early in the design phase and should not be treated as separate elements that are added after the design or building is completed."(Basnet 2012:p.18)*

The explanation of photovoltaic systems, the building's exterior structure has the capability to produce energy. *"Photovoltaic modules are in most cases still considered to be technical devices that need to be adjusted to the building skin, despite the fact that a variety of products that convert them into building components have been developed lately." (Basnet 2012:p.25).* This includes roofs or external wall structures, claddings, skylights, railings.etc which are exposed to sunlight (Figure 3.8).

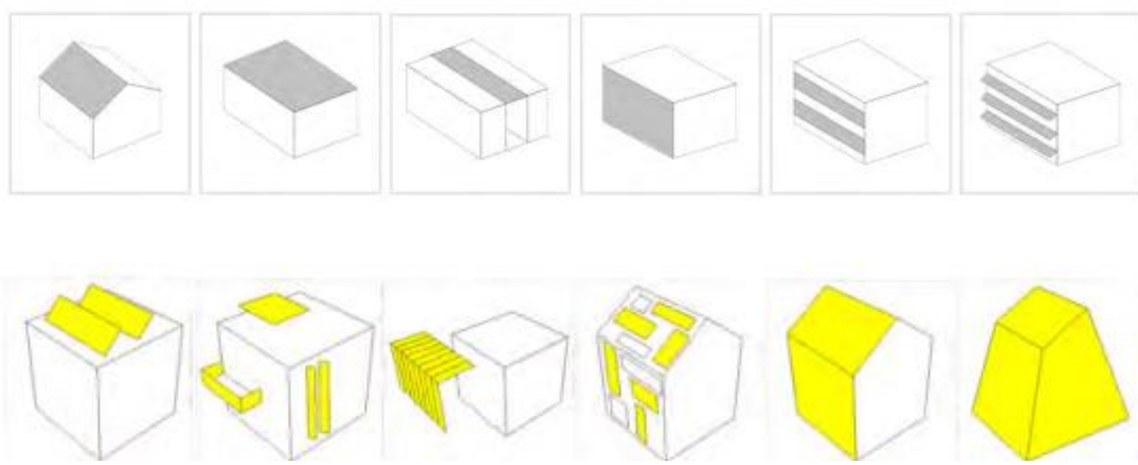


Figure 3.8: The usage of photovoltaic technology in the building envelope: Pitched roof, flat roof, atriums , facades , glazing and shading devices
Book Source: Probst, M, and Roecker, C. (2012) Criteria for Architectural Integration of Active Solar Systems IEA Task 41, Subtask A, Energy Procedure, 30, p.97 (**Date Accessed:** 22 May 2018)

Figure 3.9: The Hegger Schleiff's Aktiv Stadthaus apartment building consisting 770 conventional photovoltaic integrated solar systems on the roof structure and 348 BIVP panels into the façade.
WebSource:https://www.architecturalrecord.com/articles/11590-continuing-education-building-integrated-photovoltaics (**Date Accessed:**15 May 2018)

A photovoltaic solar system can be integrated with roof structures in numerous applications (Figure 3.9). Firstly, it can be an integrated system of an external structure of a building or secondly, the photovoltaic system can be attached as an insulation structure as this type is known as warm roof construction as it's preferably suited for extensive flat roofs. "*Using PV modules as roof covering reduces the amount of building materials needed, which is very favorable for a sustainable building and can help to reduce costs." (Basnet 2012:p.26).*

The orientation of photovoltaic systems on pitched/inclined roof systems (Figure 3.10) is important as it needs to be facing a suitable direction of sunlight for good energy production. It is also important to take into consideration the architectural aesthetics as these are the noticeable components of the building structure. "*PVs can be integrated as combined roof elements or they can be added to the roof structural system and has been termed as 'retrofits'." (Solstice energy, 2012*). These retrofits consists of photovoltaic modules which are placed on roofing structures. These photovoltaic modules are fixed onto railing systems as they grip the hooks below the roof tiles. Flat roofs allows photovoltaic systems to be placed horizontally. This system is not visible on ground level and hence it requires less aesthetic integration.

Figure 3.10: Pitched roof solar integrated systems
Web-Source:www.detail-online.com/article/call-for-entries-architectural-award-building-integrated-solar-technology-2017-30090/# (**Date Accessed:**15 May 2018)

Alternatively, photovoltaic modules can also be integrated into glass façade systems. "*Structural glazing or structural facades are constructed using highly developed profile systems, which can be filled with all types of sheeting, such as glass or frameless PV modules."(Reijenga and Kaan, 2011).* Facades of buildings offer an extensive area for the integration of photovoltaic modules, furthermore, not only will it offer aesthetic characteristics and production, it protects the building from hazardous weather conditions.

"Opaque PV module can be used as cladding elements in opaque parts of the facade while a transparent PV facade can be planned in almost the same way as a standard glazed façade."(Basnet 2012:36). The application involves a more detailed work of construction compared to normal solutions, but results in creating aesthetic architectural facades and eco-friendly characteristics which give the building an enhanced high-tech and elegant presence.

Conclusions

- Firstly, the importance of solar access and its principles in the built environment (from the ancient civilizations till the present times) have evolved and adapted in different the eras of architecture, but remain significant in many cultures and religions.
- Secondly, the underlying technological integration principles that the built environment requires to incorporate solar access in terms of daylight penetration and solar energy harvesting as a source of electrification have greatly advanced over the past few decades.
- And thirdly, a general knowledge of the existing solar technological products with their features and characteristics in order to execute the most efficient solar building typology, suggests that integrating solar energy into architectural systems could expand the existing sustainable livelihoods model.

As a result, with a thorough understanding of the above sub-section, one may now begin to understand the importance of solar architecture within the built environment. Furthermore, the previously discussed chapters of this research dissertation analyzed the challenges of Cato Manor as an insurgent community within a peri-urban realm and the constraints the citizens deal with in terms of basic needs e.g. electricity shortages and limited environmental resources. It can hence be argued that solar energy has the potential to expand the definitions of both the Natural and Physical Capital components of the existing Sustainable Livelihoods framework, whilst also reemphasizing the importance of any architectural response in addressing the needs of the Human Capital component - in the form of healthy living environments, and a positive architectural phenomenology.

3.4. Waste Upcycling: A tool to Adapt the Sustainable Livelihood Model to Cato Manor

The relationship between people, the waste crisis and shared knowledge systems

The fundamental nature of this sub-section is to recognize the theoretical and conceptual framework of upcycling. Upcycling is a common term that is used in the design world. This section elaborates on social modernization, and the community empowerment components and functional processes needed for a sustainable strategy which will allow individuals of Cato Manor and other peri-urban insurgent communities to engage in combating their socio-economic challenges.

Resources are regularly modified into valuable products that are re-usable, and when a certain lifespan of it expires, it is disposed of. The entire concept is to value the new and not the old. Furthermore, "upcycling is a sustainable alternative, where it filters through a process where the waste material is upgraded and reused as a newer and more different concept and serves of a more valuable function than it used to. For one to fully grasp and understand the concept of upcycling practice thoroughly including all its detailed perspectives, one must research its history and research the whole idea from the root for a better perspective. The concept of upcycling was formulated by McDonough and Braungart (2002/2010) in their works of ecologically intelligent design, 'Cradle to Cradle: Remaking the way we make things.' Upcycling is linked to the 'greener living' phenomenon featuring the process of repurposing things which were formerly considered and known as garbage. The perspective of 'cradle-to-cradle' has managed to seize the attention of outside communities and environmentally friendly developments. It is further argued that the large potential economies might be of a greater benefit to the systems of industries in regulating the re-use of natural materials and mechanisms within the closed circular systems (Figure 3.11).

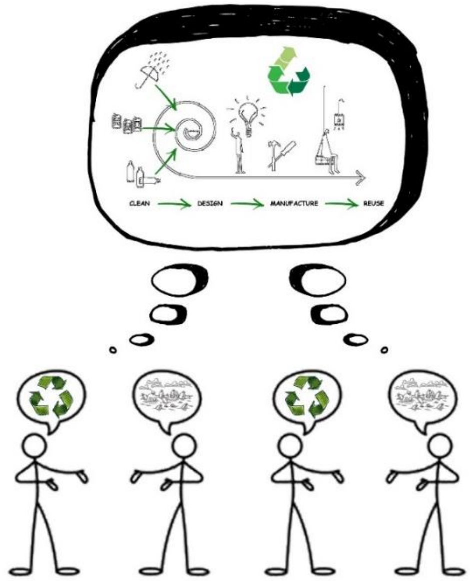


Figure 3.11: This figure illustrates the concept of upcycling amongst a community or group.
Source: Author (May 2018), Durban , South Africa

Reinventing Waste Material

Upcycling utilizes the old, and then follows a process to remodel and improve the product. Upcycling therefore serves as a lens in which an individual is able to re-examine the ‘old’ and the ‘new’ as well as to reassess and view its newer functional purpose. The ‘valuing the waste’ perception is a dual design practice and it is a political statement that creates a more sustainable result towards a practical notion that works to aid socio-economic and environmental challenges.

The conceptual framework of upcycling is taken from the industrial and technological design field for a more sustainable consumption as well as production (Figure 3.12).On the other hand, the concept of recycling fails to achieve this. ‘’Recycling barely achieves the aim of no waste due to the fact that the reprocessing of the unwanted and discarded goods requires a large amount of energy. This often results in a decrease of their constitution. Upcycling thus maintains the statement that the necessity for not only consumerism to be reduced, but recycling itself as well needs to be reduced.’’ (Richardson, 2011).

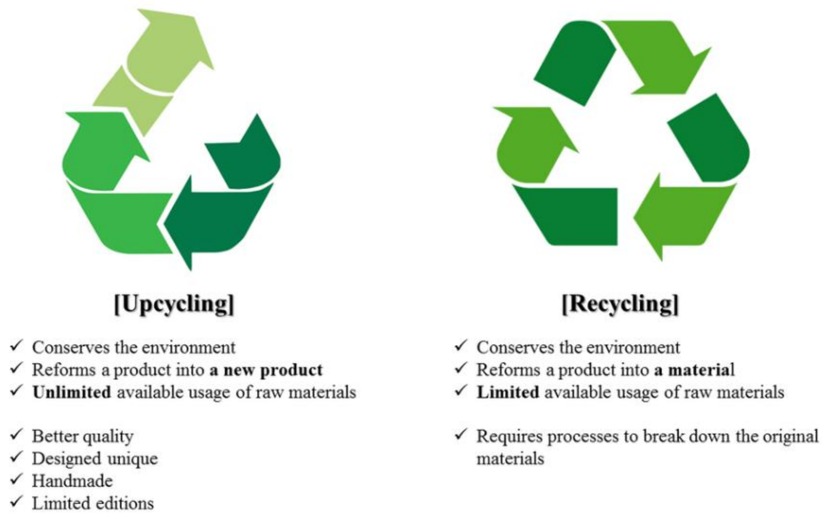


Figure 3.12: Upcycling vs Recycling
Web Source: https://greenempowermentproject.weebly.com/thoughts/what-is-upcycling-how-is-it-different-from-recycling **(Date Accessed:**20 May 2018)

If one researches the concept of upcycling, the results would probably consist of upcycled houses which consist of old shipping containers, plastic bottles or wood chips that are by-products of many other manufacture sites. ‘’If one researches further, the results will contain upcycled textiles that are used for clothes and furniture, empowerment projects that may be in the slums as well as a great number of ideas that you can use for your own day to day upcycling practices such as plastic bags, craft paper or any old household items which have now transformed into lampshades, coat racks or even jewelry.’’ (Iyengar, 2014)

An upcycled purpose or procedure has managed to improve eco-credentials, but it is mainly the story of rehabilitation as well as the noticeable procedures and processes of re-valuing waste rather than having the option of throwing that particular product or waste away when it has the ability to serve as a potential use.

As an alternative to the typical ‘getting rid of’ mentality, there is a bigger story of rehabilitation. Upcycling can take various forms, but at its core is the idea of sustainable consumption and is highly relevant to social innovation and environment raises a voice towards an uncritical production of waste and devaluation of human rights. ‘’What makes upcycling distinct from other kinds of social innovation is the incorporation of the transformation process, not only are upcycled processes and products just ‘better’ than the original, they include the aging process as well, telling stories such as ‘production with zero waste’, ‘small is beautiful’ and ‘start local, but think global’ (Earley, 2011).

‘David Miiro is part of the Social Innovation Academy (SINA) in Uganda, and aims to provide protection for the environment and promote innovative mind-sets with creative ideas, while at the same time empowering the youth through this process. Through the upcycling process of 15,000 used plastic bottles, David along with a team of volunteers go out and train their local community with the goal to protect the environment and simultaneously constructing a learning hub together (Figure 3.13).

Figure 3.13: Mpigi, Uganda SINA upcycling plastic bottle project with David Miiro. **WebSource:**https://thepollinationproject.org/grants-awarded/david-miiro-plastic-bottle-upcycling/(**Date Accessed:**20 May 2018)

A large number of the major beverage companies in Uganda are slowly phasing out the recyclable glass bottles concept and instead they are replacing them with plastic bottles. With this project, David aims to raise awareness and to show more creative and innovative ways of upcycling waste, together with creating bottle bricks that can be utilized to build environmentally resourceful shelters and houses that is able to be kind to the environment and be of great use to the citizens in need of such facilities.

Conceptualizing Social Upcycling

Conceptualizing social upcycling is made up of upcycling occurring through new combinations whether it be people, materials, technologies, knowledge, desires, ideas or needs. In every upcycling process, there is a unique and organically evolving combination, based on situated needs, skills and resources. Therefore this illustrates that an upcycling process is seldom designed once and for all, and it is rarely the outcome and the end result of strategic determination. A thorough investigation must be put into place and completed to see what comes into view if we conceive of social innovation not only as the recycling of ideas, material and practices, but also as upcycling in the sense of valuing ‘waste’ elements as the very basis for the creation of something new and valuable. As mentioned, this entails a renewed interest in the ‘old’, that which may be considered ineffective in a traditional appreciation of- and reflex focus on the new.

The Mastery of Social Upcycling and its Application

In this process of mastering the application process of social upcycling, ‘knowledge brokering’ will be discussed and further elaborated on. This term is used to explain the way in which successful individual innovators are able to systematically make use of raw material and use them for new ideas, this is thereby stressing the role of interactions across organizations, professions and domains as a core strategy to enhance innovation and make room for community empowerment. This also suggests that one should not disregard the use of raw material and older ideas but incorporate newer structures and ideas to such resources and mold them into a development that can be used across all domains.

Therefore there are many definitions of creative and innovative concepts which recognizes the existence of old innovations, yet this point is often downplayed and not as evident in efforts to identify and describe the events that manufacture revolutionary change. (Watts & Strogatz, 1998) states that, ‘’Focusing on ‘old’ material and its reuse allows for a situated perspective on both newness and value, it also allows for growth and a development within the environment.”

Conclusions

The process of upcycling has the potential to empower the community of Cato Manor, by making use of one of the few resources consistently available to it - waste.

Furthermore, the individuals of Cato Manor would also gain the ability to reconsider the value of waste materials, and take a further step to envision the future value of waste as a resource. This sub-section aids to understand the potential of upcycling in social empowerment amongst the individuals of these communities and how it enhances the innovative conceptual ideas within the upcycling processes. As such, upcycling could arguably serve as a tool in expanding the definitions of the Physical Capital (waste) component, and the Social Capital (knowledge sharing) component of the current Sustainable Livelihood framework. Furthermore, it has the potential to attract Financial Capital through its architectural expressions, and sustainable re-invention of resource cost reduction.

3.5. CONCLUSION: Towards a Sustainable Future

The analysis and discussion of this chapter puts an argument forward as to how the insurgent communities of the peri-urban settlement of Cato Manor can progress towards a self-sustaining future. As explored and mentioned in the previous chapters of this dissertation, peri-urban insurgent communities face various socio-economic and environmental challenges such as energy shortages, waste pollution and poverty.etc. The objective of this chapter was to identify resources which could serve as tools that are available within the environment of the peri-urban realm.

This chapter elaborate on the sustainable strategies which could be used to guide these insurgent communities. This includes the sun’s radiation to harvest solar energy and the upcycling of waste materials. Since this is not implemented in the peri-urban realm of Cato Manor, this calls for an architectural response to improve the infrastructure, socio-economic and environmental inequality within the Cato Manor Precinct, using these concepts and theories. This could bring about independence, community growth, shared knowledge of skills development, sustainable livelihood income, and alternate energy production within the built environment and architectural form.

4.1. INTRODUCTION

This chapter will explore two key precedent studies which will critically analyze and incorporate the theories and concepts discussed in the previous chapters of this research dissertation. The precedent studies chosen are located beyond South African boundaries as it deals with community empowerment through sustainable development and design strategies. The analysis will therefore showcase various opportunities that will arise within a sustainable development approach which will make one understand the dynamics and design requirements needed towards the architectural intervention of this dissertation. The two precedent studies will be relevant towards this research dissertations design intervention and also cross examining the primary and secondary questions allowing conclusions to be drawn towards the architectural response.

4.2. The Kathleen Grimm School for Leadership and Sustainability at Sandy Ground

Architects: SOM Architects

Location: 644 Bloomingdale Rd, Staten Island, NY 10309, USA

Project Year: 2015

Figure 4.1: The Kathleen Grimm School for Leadership and Sustainability at Sandy Ground, Staten Island, New York, United States
Web Source: https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som? (**Date Accessed :**08 June 2018)

4.2.1. Background and Energy-efficient Approach

This precedent study is focused towards the sustainable development of renewable energy by harvesting of solar radiation as an alternate source of energy as it empowers the user of this school towards a sustainable and resilient future. The Kathleen Grimm School for Leadership and Sustainability is established and designed to be one of the first net-zero-energy efficient schools in the city of New York and also making this project one of the first of its kind in the world. The school is situated in Staten Island which is located on the outskirts of central Manhattan of New York (Figure 4.2). Staten Island has at times been referred to as the forgotten borough as the citizens felt they have been neglected by the government as many individuals are underprivileged.

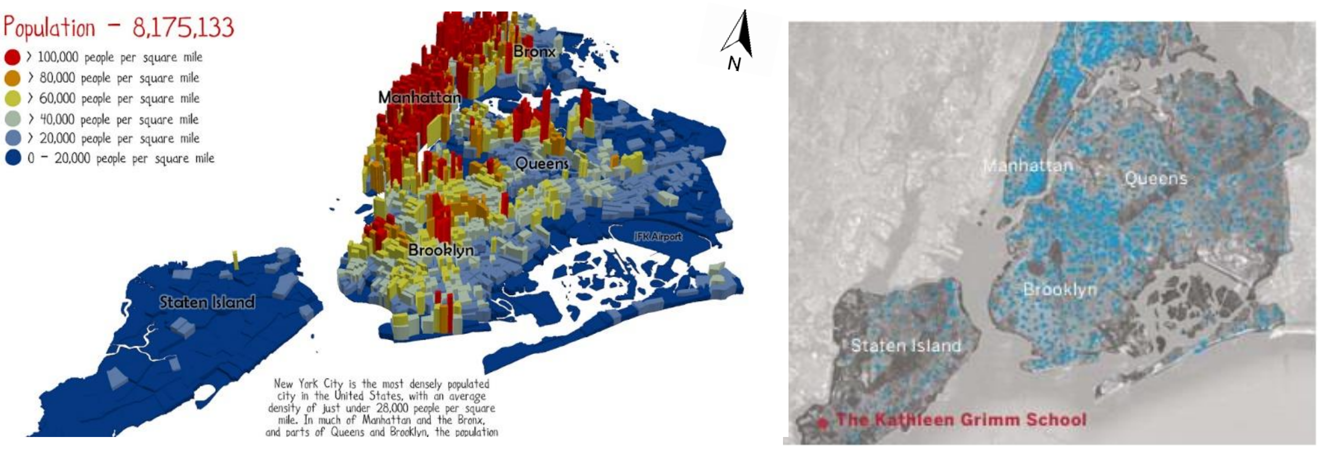


Figure 4.2: The urban context analysis of Staten Island in New York and its density.
Web.Source:https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som/ Date **Accessed :**08 June 2018)

This precedent study relates back to the theoretical and conceptual framework analyzed in chapters two and three, as the school is designed towards a sustainable design approach for the harvesting of solar energy with the means of on-site renewable sources which generates energy and is used on a yearly basis(Figure 4.3). Thus elaborating on the fundamental techniques of sustainability and empowering the user, mainly students of a young age to have knowledge of a sustainable and resilient future as it links back to the primary and secondary questions of this research dissertation.

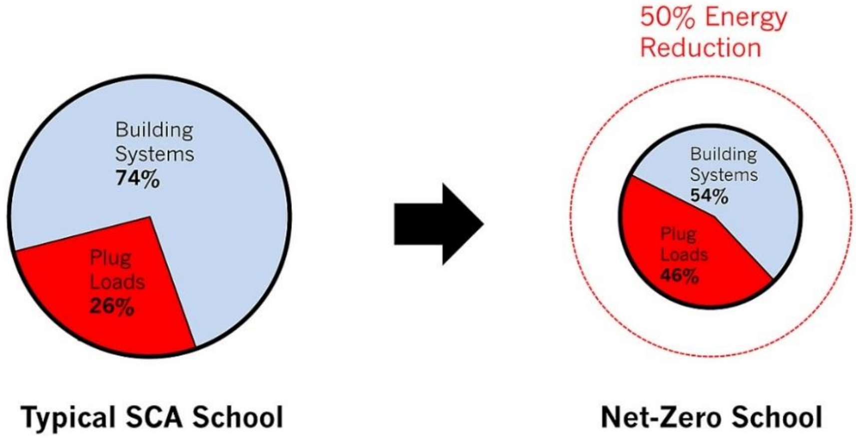


Figure 4.3: Energy consumption analysis by typical SCA schools in comparison to the Kathleen Grimm School for Leadership and Sustainability.
Web.Source:http://www.som.com/projects/the_kathleen_grimm_school_for_leadership_and_sustainability_at_sandy_ground__sustainable_design (**Date Accessed: 08** June 2018)

This precedent study sets the highest of standards in terms of sustainability as it is a prototype example for future school typologies of this significance.

The Kathleen Grimm School was commissioned by The New York City School Construction Authority (SCA) to present the facility as the first sustainability lab where it's characterized by green design strategies with an overall objective to enhance the green design efficiency of schooling facilities across the city of New York. As a result, the Kathleen Grimm School has a sustainable long term objective to reduce energy usage up to 50 percent over the coming years to follow.

4.2.2. Site and Orientation

The Kathleen Grimm School is located south-east of central New York City on Staten Island in a residential zone due to its proximity to the local community. This sustainable schooling facility acts as a means of empowerment as it stands out within its' context making it a symbol of community ownership. The site of the building is orientated true-south in achieving the maximum sunlight gain throughout the day relating to the northern hemisphere locality. The topography of the site is generally flat. Therefore, the solar technological structural system is angled along the roof and facades which are predominantly north-facing in order to receive maximum solar gain as the day passes on its east-west axial path(Figure 4.4).

Figure 4.4: The Kathleen Grimm School for Sustainability contextual response and site plan solar gain **Web.Source:**https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som/ (Date **Accessed :**08 June 2018)

4.2.3. Design Analysis and Consideration

The school is a two storey building which accommodates a variety of multipurpose spaces and activities towards the growth of sustainable development in terms of energy efficiency. The school’s accommodation program includes educational classroom facilities, energy production activities, sustainable mentoring growth, staff offices, ablutions, courtyard spaces, a gymnatorium, outdoor park and recreational facilities as well as well as storage and service facilities. The urban pattern of the surrounding residential buildings within the area is what informed the orientation of the schools form and composition. The school is up-scaled in relation to the residential massing but stands out within the context as it is a symbolic landmark for the community towards a sustainable future. The functions and spaces of the school are designed and arranged around a central courtyard. Therefore allowing the flexibility of spaces, linking the user between the indoors and outdoors. The main courtyard space consists of an indoor-outdoor cafeteria and a multipurpose gymnatorium space which consists of social activities. These are centralized break away spaces which connects the efficiency of movement and flexibility of spaces from one to another. The building also extends outwards into a sports and recreational park on the northern and southern parts of the site. The parks have energy generating recreational activities which produces renewable energy through the movement of the user (Figure 4.5 and 4.6).

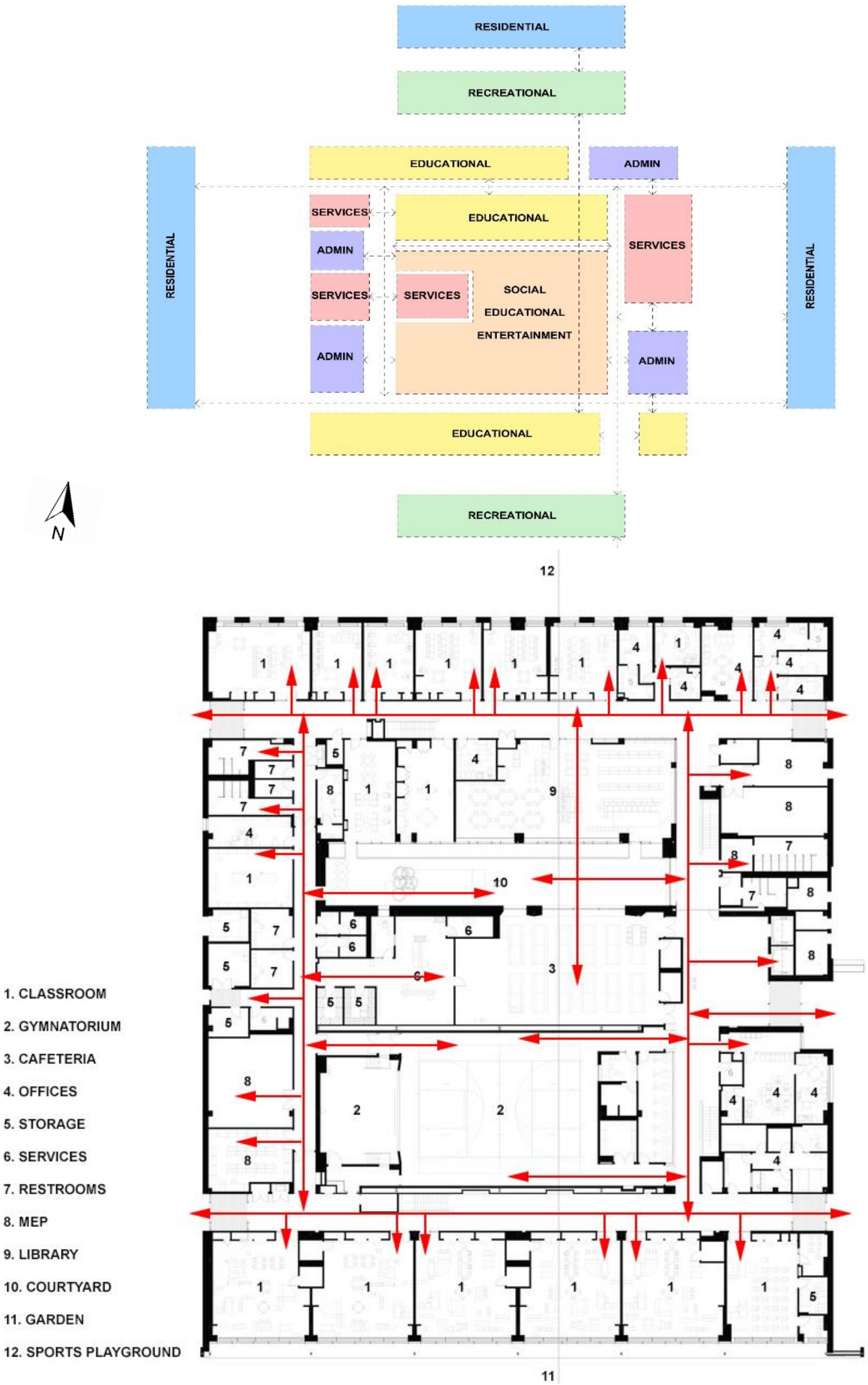


Figure 4.5: Conceptual Ground floor plan spatial analysis
Web.Source:https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som (Date **Accessed :**08 June 2018)

Figure 4.6: Conceptual First floor plan spatial analysis
Web.Source:https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som (Date **Accessed: 08** June 2018)

The theoretical framework referred to the way in which the building can help to shape people (Markus, 1993). A building can have a massive effect towards a sustainable and socio-economic future. Any building of its kind encourages the user to interact through various encounters which determines a visual stimulus and the movement of paths. The Kathleen Grimm School in this case explores the use of empowerment through sustainable development of solar renewable energy, the flexibility and transparency of different functions. Holistically, uplifting the exploration of empowerment through social and sustainable activities within this architectural response.

The project team achieved the sustainable design approach as the outcome included a photovoltaic roof system to harvest solar energy, energy efficient glazing, and vegetative roof gardens. The courtyard spaces allows for the penetration of natural daylight illuminance which emphasizes on the power of solar as a source of natural energy and also the emphasis of social togetherness amongst the users (Figure 4.7).

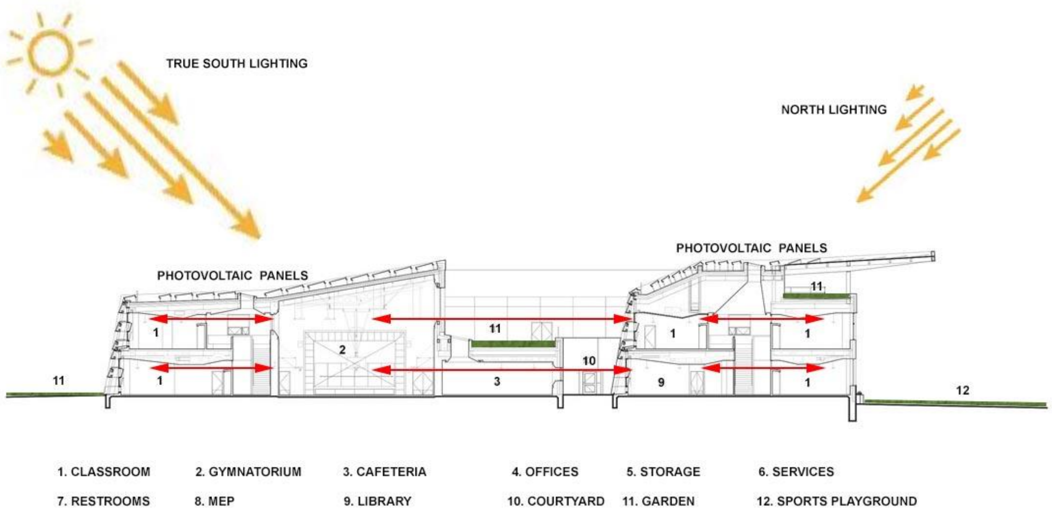


Figure 4.7: Section spatial analysis of the school.
Web. Source: Author (Date **Accessed: 08** June 2018)

4.3. Applied Building Technology

The design of every component of the school is aimed towards achieving its net-zero-energy objective. As discussed in the previous chapters of solar architecture, the exterior entails of multiple photovoltaic panels which wraps the schools building roof structure continuing along the south façade as it generates the majority of the schools energy. The schools structure also entails various passive design strategies. Alongside interior courtyard spaces, the form of the building and it's orientation in response to the site is designed to gain the advantage of maximum solar energy and daylighting, not only for the photovoltaic panel structure but for the penetration of natural lighting within the interior spaces. Clerestory and skylight systems also create the schools phenomenal solar essence. Furthermore, this building includes high performance sustainable design features, cooling and heating systems, and recovery energy ventilators as well as controlled energy ventilation which enhances the schools sublime green energy efficient performance (Figure 4.8).

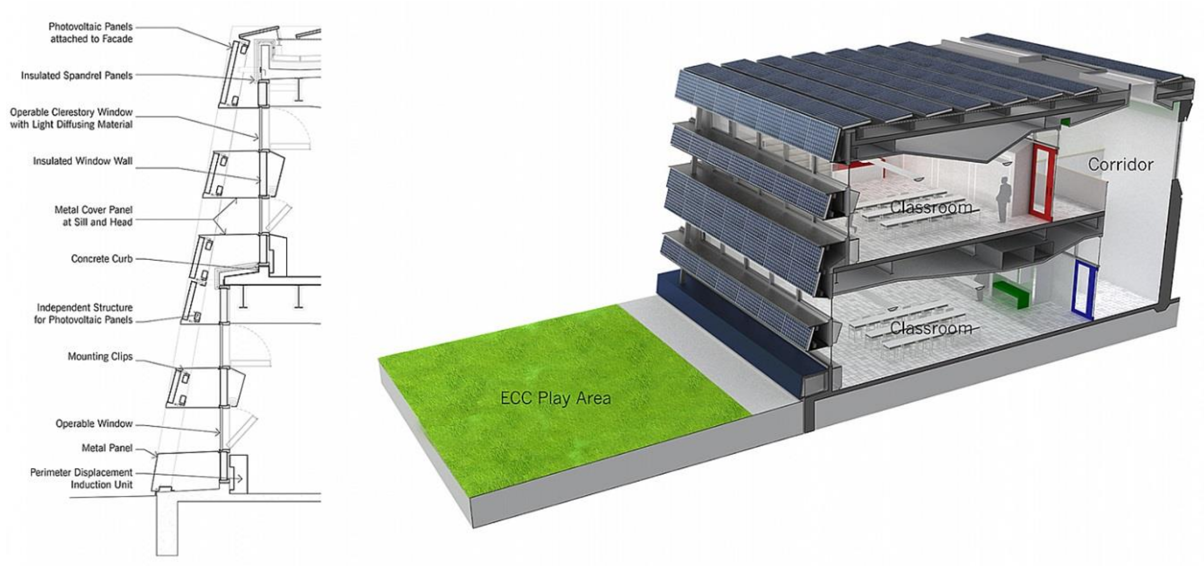


Figure 4.8: The applied building technological composition of the roof construction materials of the Kathleen Grimm School.
Web.Source:http://www.som.com/projects/the_kathleen_grimm_school_for_leadership_and_sustainability_at_sandy_ground__sustainable_design (**Date Accessed**: 08 June 2018)

4.3.1. Solar Harvesting Technology

The building structure consists of a precast concrete skin integrated with a horizontal 30-foot structural panel system. The system acts as a continuous rain screen on the west, east and north facades as it is fixed to the exterior of the interior skin envelope which creates an air and vapor free barrier of thermal gaps. The 30-foot horizontal span decreases the chance of any thermal gaps with regards to the interior construction and the external skin structure by removing common thermal gaps from insulation systems to masonry tiles.

The south facades consists of cavernous window shelves developed by the exterior walls at a 70 degree pitch. Furthermore, this feature results towards the buildings daylight performance as it is guided into the lower window shelves and the higher traditional clerestory windows to achieve the best adequate lighting quality across the four seasons as it also controls the harmful glare of the sun. The interior finishes consist of bright ceiling, floor and walls profiles as it transforms the interior spaces into active work surfaces.

With an estimated 90 percent of daylight dominance, the classrooms on the south facing facades have large overhangs which extensively shades the windows from the impact of direct sunlight, as these overhangs also serves as a function to support the photovoltaic panel system. On the other hand, the central courtyard enables southern exposure for the interior spaces. The classrooms that are north-facing receive adequate lighting from the much taller window openings. Alongside the central access path of the buildings circulation the skylight and atrium systems allows the penetration of natural light through the passage ways. The passageways receive 98 percent of natural lighting. Within the building facility, LED’s and daylighting is at an equilibrium balance for solar daylight lighting (Figure 4.9).

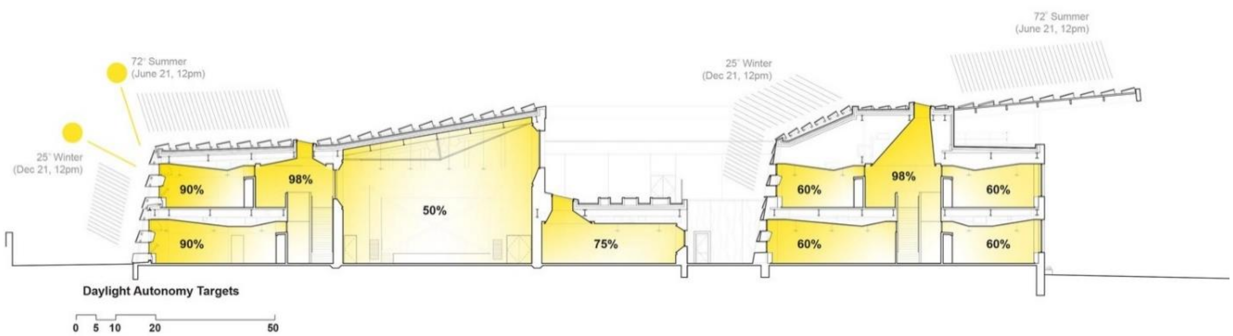


Figure 4.9: This figure illustrates the daylight autonomy targets of the schools interior spaces.
WebSource:https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som/ (**Date Accessed :**08 June 2018)

The installation of geothermal wells are structured beneath the school grounds which assists with the cooling and heating, as a result enables energy saving strategies. The reason for this system in place is because of it’s advantages, which causes the constant earth temperature to heat the school in winter, and to also release heat during the summer.

The air flow within the facility is pre-treated through the process of energy recovery ventilators, which lowers the overall service demand as it assists in balancing the humidity within the building. The provision of fresh-air is directed to classrooms via controlled ventilators. The removal of intoxicants by the usage of natural convection, the supply of fresh air is at a low-rate , which flows across floor systems that rises up to diminish the intoxicants (Figure 4.10 and 11).

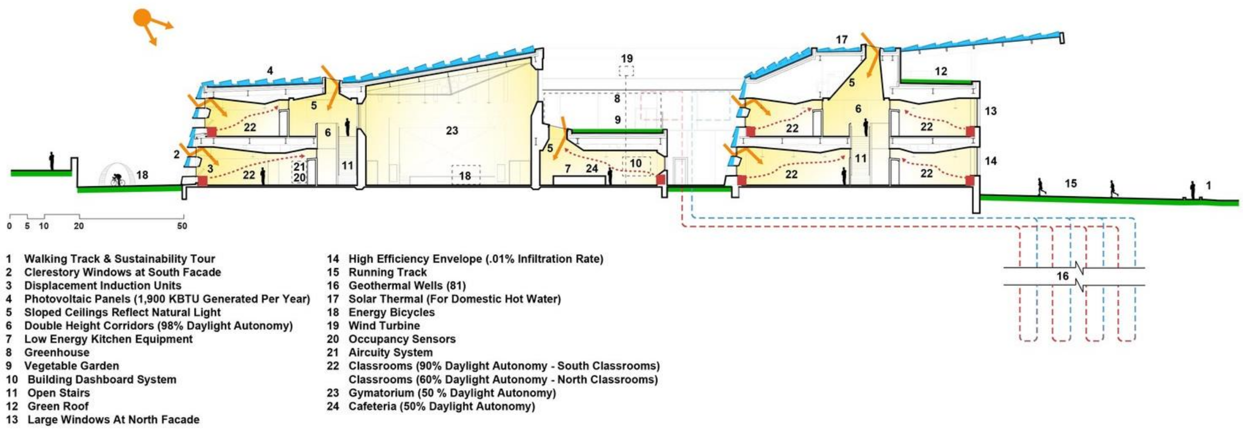


Figure 4.10: This figure illustrates the energy consumption and sustainability section of the schools structure. **WebSource:**https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som/ (**Date Accessed :**08 June 2018)

Figure 4.11: This figure illustrates the energy consumption and sustainability section of the schools structure. **WebSource:**https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som/ (**Date Accessed :**08 June 2018)

The photovoltaic structural panels are shaped and molded to develop window openings as well as skylight fenestrations which characterizes the exterior structural skim of the school as it produces energy (Figure 4.12). Instead of separate panels, the photovoltaic panel acts as a continuous system as it is treated as one panel. Therefore, it is spaced at intervals and angled in position. This results in horizontal and vertical surfaces in complimenting one another in order to maintain the school's constant energy supply. The total energy produced was 658 000kwh annually as it is more than the buildings energy consumption as a whole.

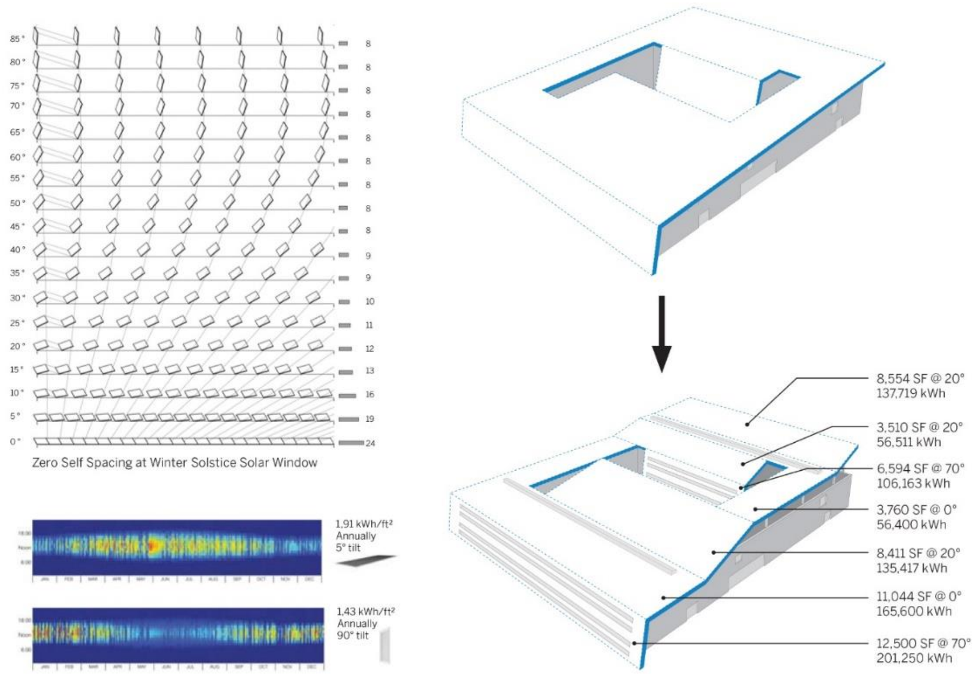


Figure 4.12: This figure illustrates a 3D visual of the photovoltaic array of the schools structure and its energy production methods.
Web Source: https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som/ (**Date Accessed :**08 June 2018)

The project team carried out numerous features to develop the design of the project with regards to its versatility and flexibility. The photovoltaic panel system is fixed onto a different steel structure in conjunction to the façade. The technical component establishes a framework as to where more photovoltaic panels can be fixed as technology advances in generations to come without interfering with the schools actual building structure. These photovoltaic components are also attached to the slab topping which makes it easier for replacement and maintenance without disrupting the roof structure. Furthermore, these components are fixed to a steel grate system which is completely separate from the roof structure.

In contrast with the other net-zero-energy efficient schools throughout the United States, the Kathleen Grimm School is designed and established to achieve its energy efficient objective and at the same time maintaining the New York City public school vision. According to The New York City School Construction Authority (SCA) standards and regulations, the schools building structure is designed with cooling and heating ranges between 70°F-78°F in order to achieve maximum thermal comfort and to therefore minimize energy usage. Ultimately focusing on the overall project objective of net-zero-energy facility, numerous decreasing strategies were put in place to concentrate on reducing peak load than of a usual typical building. Overall, these implemented strategies enhanced energy recovery, daylighting, heating and cooling as well as the building envelope performance.

4.3.2. Water Harvesting and Reuse

The architectural landscape aspects of this school project is according to the standards and regulations of the New York City Green Schools guide which entails different design guideline features. The integration of the schools design is to absorb various types of storm-water run-off on site. The site consists of permeable pavers on the pathway, sidewalks, parking lots and road ways which allows water to penetrate and seep through the ground surface. Furthermore, rainwater is infiltrated into the soil od the site, which flows and gets store into onsite retention tanks. The large green roofs beneath the solar panel roof systems decreases storm water run-off.

4.3.3. Socio-economic and Environmental Response

The Kathleen Grimm School is a hands on approach project for users of the facility on a daily basis in terms of sustainable development. This school typology is a catalyst which represents the opportunity to empower and educate students and staff of this facility. The design team of this project engaged with the respective parties during the early stages of the design development process. This resulted in weekly meetings with the respected departments and organizations involved to determine creative solutions and brainstorming challenges in achieving an overall goal of the project. The involvement of local communities assisted in informing the aesthetic components from interior to exterior planning and finishes. Graphic system user interface was integrated within the building system. However, this functions through energy competition activities amongst classrooms as they generate energy through exercises bikes and digital board games (Figure 4.13). These energy activities are structured within the school's curriculum syllabus. Hence, emphasizing on early childhood development activities that generates energy and interactive social activities with mechanical components. As a result, this type of development illustrates the suns as a fundamental source of power to sustainability use energy efficiently.

Figure 4.13: This figure illustrates the various curriculum activities within the schools syllabus that kids are getting educated through the sustainable awareness of energy production.
WebSource:https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som/ (**Date Accessed :**08 June 2018)

Figure 4.14: This figure illustrates the exercise bike activities within the school classrooms which enables the children to have competitions in energy contribution and the production of energy.
Source:https://www.archdaily.com/780383/the-kathleen-grimm-school-for-leadership-and-sustainability-at-sandy-ground-som/ (**Date Accessed :**08 June 2018)

Community Strengthening, Involvement and Empowerment: The School consists of various facilities and activities which contributes towards the sustainable development approach. However, these facilities were specifically designed by the communities needs as the user experiences the necessary mentorship towards a sustainable future(Figure 4.14(. This is a successful response architectural response as to how the built environment can be a means for environmental and socio-economic positivity. The process of encouraging a sense of community empowerment and ownership, the school's design included the voice of the community's environmental and socio-economic objective.

4.4. Precedent Conclusion

The focus of this architectural response aims towards a healthier future and a catalyst for the upcoming schools of the United States and on an international level in guiding communities towards a resilient future as well. The innovative integrated design and its soul intention to produce as much as energy from renewable from solar power on a yearly basis. In relation to the theoretical and conceptual framework discussed in chapters two and three, the theories of sustainable development is of importance as it uses the concepts of solar architecture and empowerment to enhance the students' knowledge of the architectural intervention. Upon cross examining the primary question of this research dissertation, this intervention is somehow not implemented within the peri-urban context of Cato Manor. This type of facility will be beneficial if it is implemented as its core theoretical framework analysis can be a catalyst for change especially towards the mindset of individuals and communities of those residing within the peri-urban realm.

4.5. Sunset Park Material Recovery Facility

Architect: Selldorf Architects

Location: Brooklyn, New York City

Project Year: 2014

Figure 4.15: **S**unset Park Material Recovery Facility, Brooklyn, New York, United States
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/
(**Date Accessed :**16 November 2018)

4.5.1. Background and Approach

According to (Krichel; 2014:123), waste pollution has become an important environmental issue in New York as the mega city produces approximately 11 000 tons of waste material a day. The city of New York started its largest recycling program during the past twenty five years to overcome its waste pollution crises. Therefore the city introduced a plan to merge with one of the most reputable environmental companies globally known as SIMS Municipal Recycling. This long term contracted included the selling and processing of recycling waste materials in the city of New York. SIMS as well as many other agencies within New York have called for Selldorf Architects to harness a design scheme of a new recycling facility which is situated on a pier in Sunset Park that is approximately eleven acres. The local communities around the site have voiced their need of residing next to a waste recycling plant as Selldorf Architects had the challenge to incorporate both the city's infrastructural and community's needs. Thus, this architectural response becomes a facility which is designed towards a communities experiences of sustainable growth instead of truck drop process (Krichels, 2014:124).

4.5.2. Site and Orientation

The site of the Recycling facility is located south-east of New York in the Brooklyn Precinct. This area is densely populated with a mixture of residential, industrial and recreational zones. The industrial zone is located on the peripheries of the Brooklyn precinct as it allows for the export and import of shipping from local to national boundaries(Figure 4.16 and 17). Although, most importantly allowing facilities like the recycling center to be away from the residential zones to avoid noise pollution and to facilitate a zone take urban waste to be recycled. The site north-east facing but is greatly exposed to adequate daylight during the day. Brooklyn as a whole a very robust visual presence.

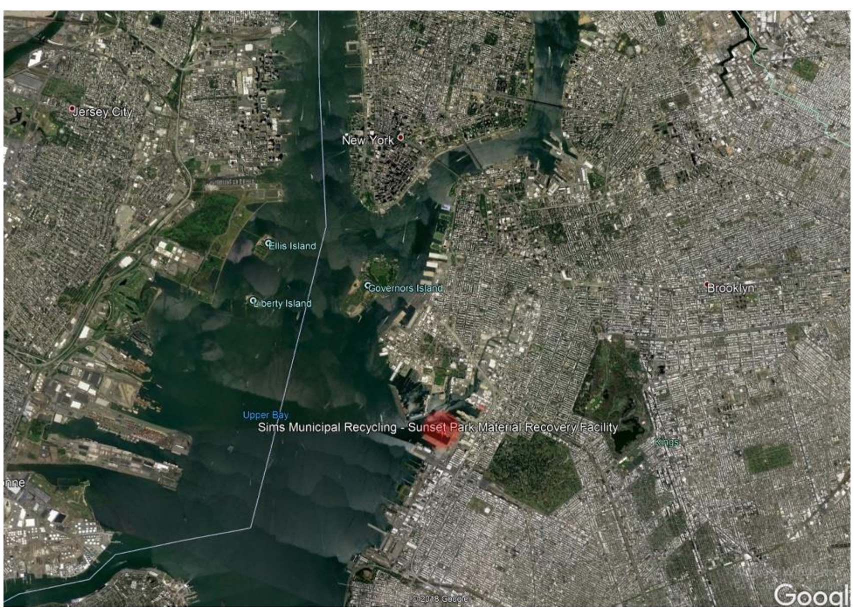


Figure 4.16: **S**unset Park Material recovery facility locality map, Brooklyn, New York, United States
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

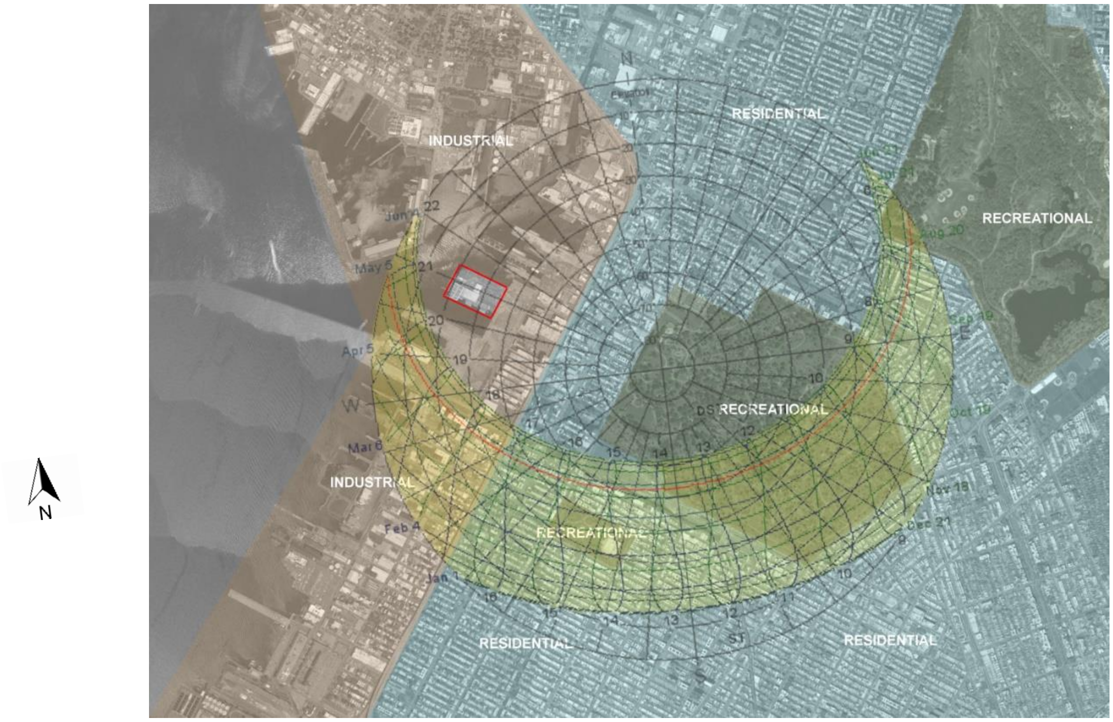


Figure 4.17: **S**unset Park Material recovery facility urban response, Brooklyn, New York, United States
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

4.6. Design Consideration and Analysis

4.6.1. Operational Functional Use

Selldorf Architects implemented the combination of a pre – engineered structural system in combination of architectural expression elements taking away the norm of a box warehouse aesthetic. This was achieved through the exposed and inverted structural elements on the exterior of the building, as it gave the steel structural members a sense of a robust visual impact (Figure 4.18).

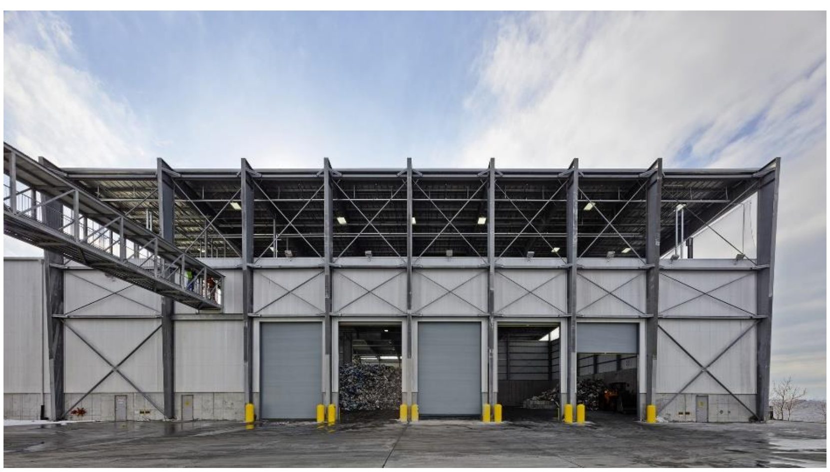
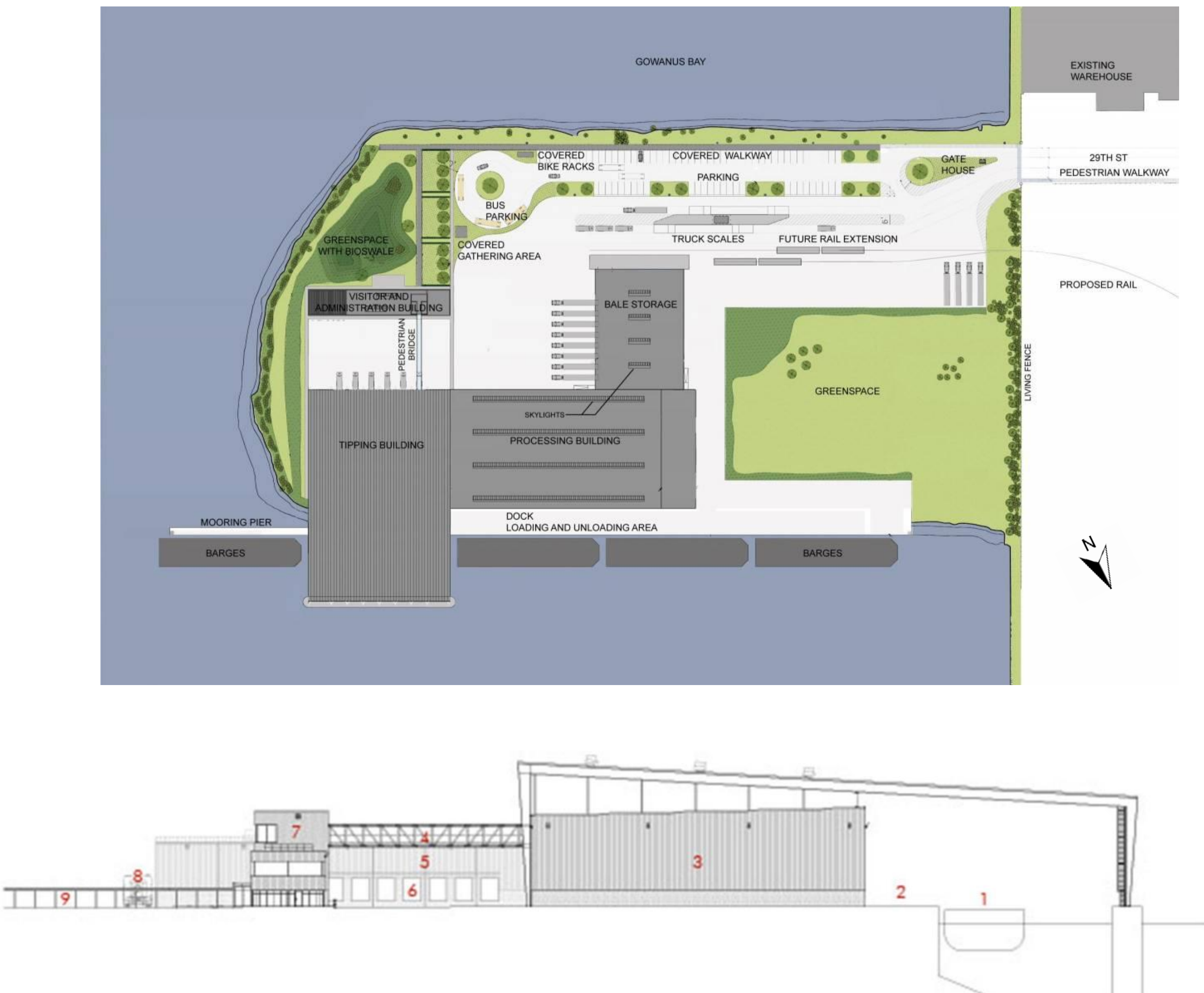


Figure 4.18: **S**unset Park Material recovery facility robust visual and structural aesthetic
Web.Source:https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

The facility's operational spatial zoning and planning, the educational area was designed around a surmount building as the recycled materials are brought in via a canal system which is linked to a processing and bale storage system as these materials are sorted and processed Krichel's (2014). Explains that most of the waste materials come through via a canal system as it follows the process from sorting to processing of the recycling facility. Thereafter these waste materials are then stored and afterwards transported via trucks, freight, or rail or shipped (Figure 4.19).



1 BARGE
2 BARGE UNLOADING
3 TIPPING BUILDING
4 PEDESTRIAN BRIDGE
5 BALE STORAGE BUILDIING
6 TRUCK LOADING
7 EDUCATION CENTER AND ADMINISTRATION BUILDING
8 RAIL LOADING
9 COVERED WALKWAY

Figure 4.19: **S**unset Park Material recovery facility master plan and section A-A illustrating its functionality.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

4.6.2. Educational Functional System

Selldorf Architects based the facility around functionality, as its various circulation systems were created as it divides the visitors or first time users from its operations area. However, at the same time this recycling facility is designed with the intention of creating a transparent or visual barrier as the visitors experience the process of recycling from viewing platforms. Krichel(2014) describes the recycling center makes maximum use of the courtyards, hierarchy and volumes of spaces towards the user's walkable scale to make sure that this facility is not resembled as a warehouse norm. As mentioned earlier the recycling facility is designed for the need of the community as it incorporates an educational component. This is established via a pedestrian bridge system which connects to recycling viewing platform (Refer to figures 4.20 to 25).

Figure 4.20: The pedestrian bridge which links the educational and administration facility to the recycling facility.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

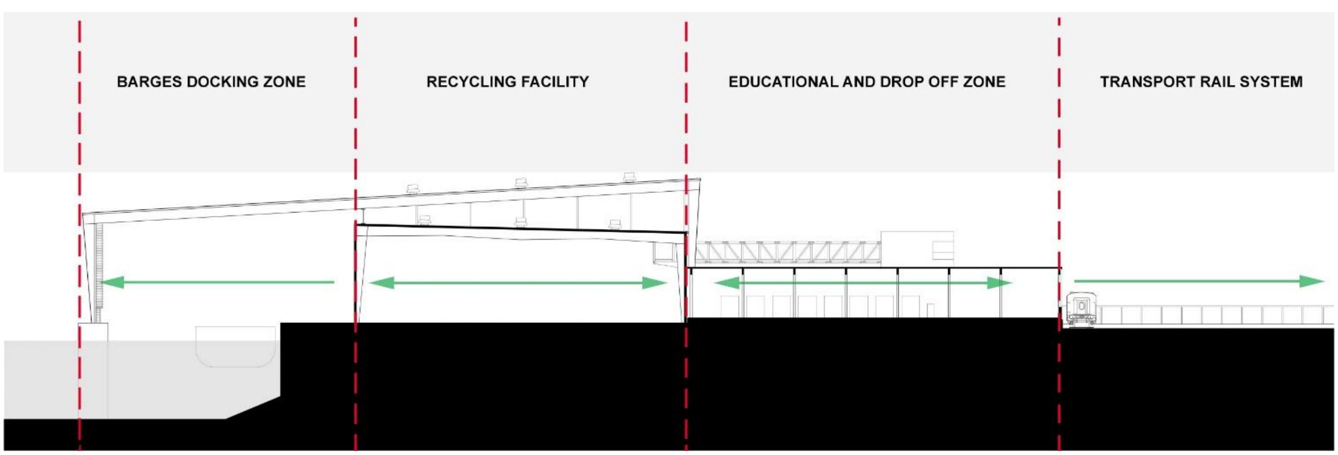


Figure 4.21: The pedestrian bridge which links the educational and administration facility to the recycling facility.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

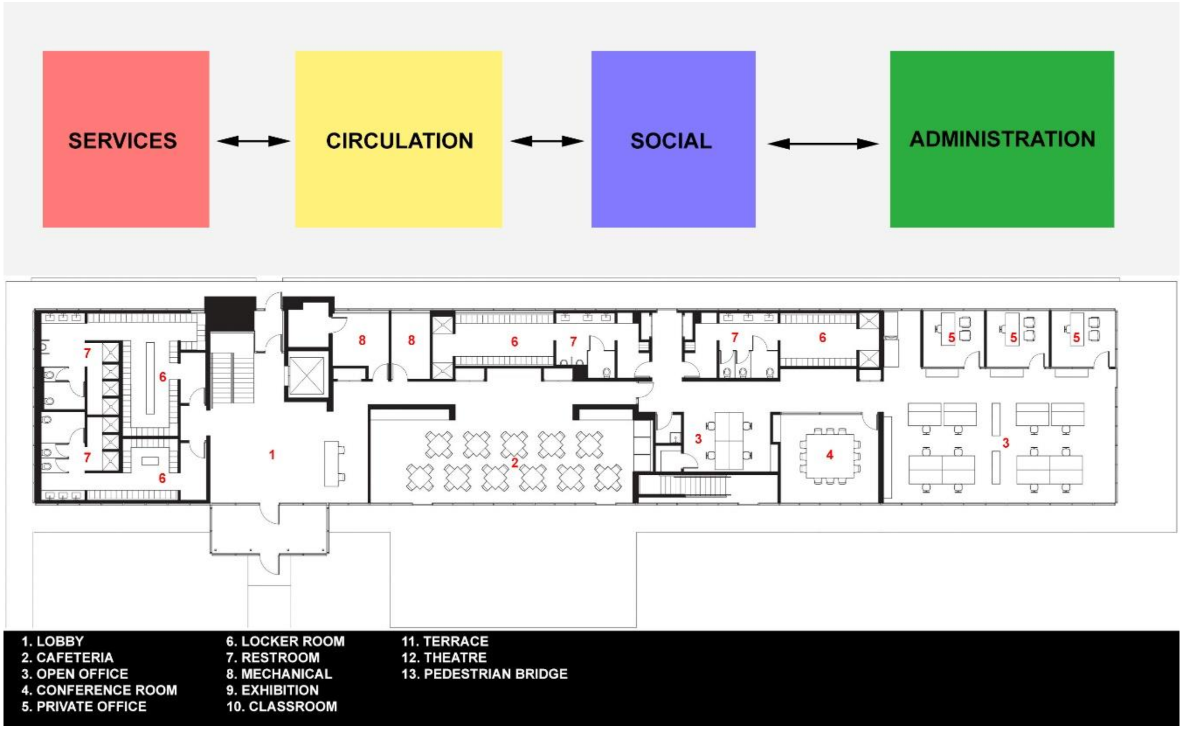


Figure 4.22: The ground floor plan of the educational facility illustrating the different uses and functions.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

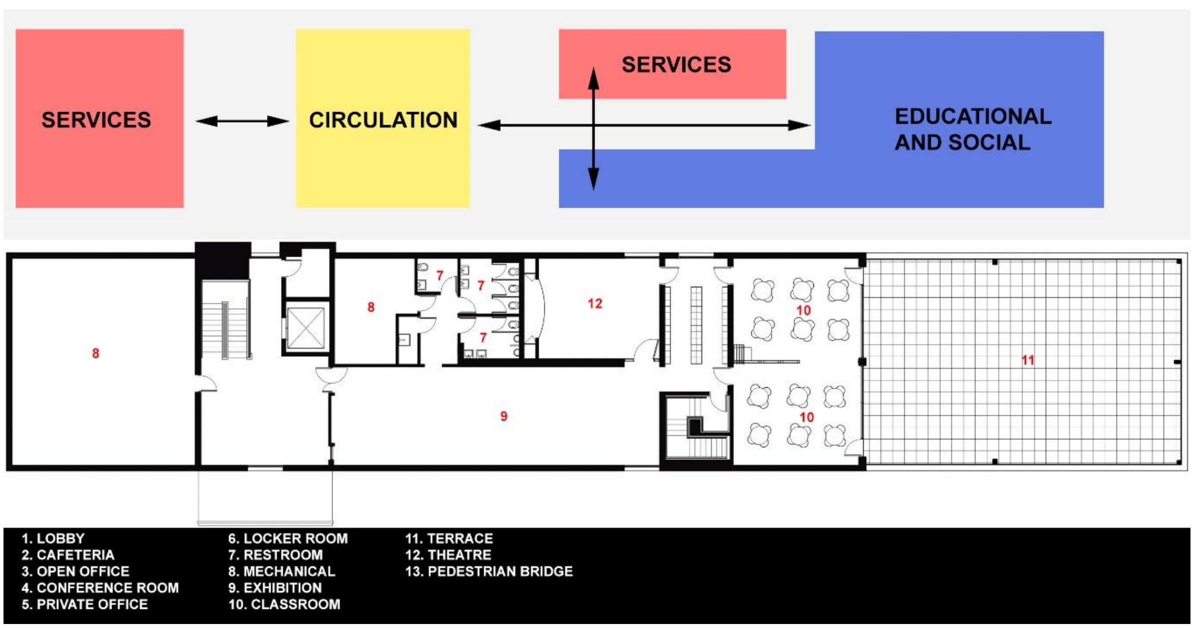


Figure 4.23: The first floor plan of the educational facility illustrating the different uses and functions.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

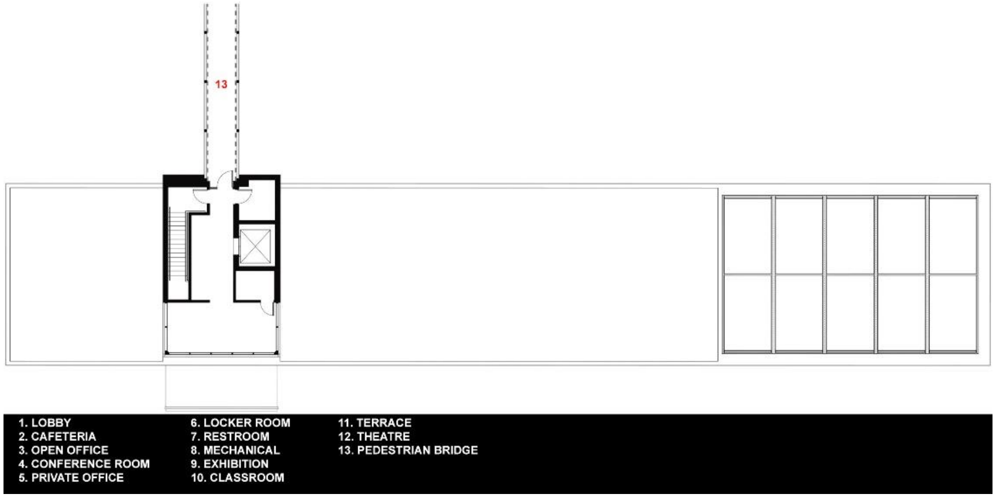


Figure 4.24: The second floor plan of the educational facility illustrating the bridge linkage to the recycling facility.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

Figure 4.25: This image illustrates the hierarchy and different level of platforms that the user experiences the process of recycling of waste materials.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

4.6.3. Sustainable Design Features

The recycling facility makes drastic environmental contribution towards the processing of recyclables but also empowering the communities socially through empowerment and awareness. The building's structure and the site itself also compromises of numerous quantities of recycled steel, glass and reusage of asphalt and rock. Krichel (2014) states the most important sustainable features includes storm water management through bio swales, a large photovoltaic roof structural system which is one of the largest in New York as well as a wind turbine system. The wind turbine is positioned in an adequate place on the site as it takes full advantage of the harbor winds which generates another source of renewable energy (Refer to figure 4.26 to 28).

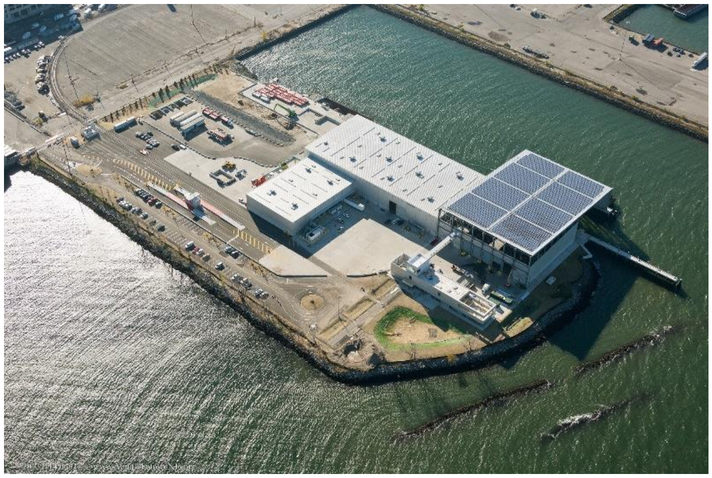


Figure 4.26: This image illustrates the aerial view of the roofs photovoltaic structure which produces renewable energy.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

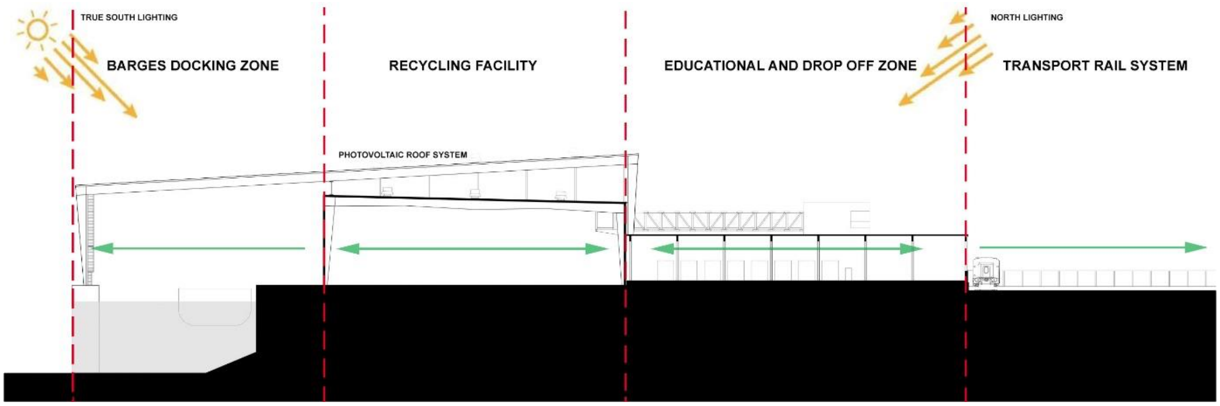


Figure 4.27: This figure showcases section B-B of the facility which illustrates the photovoltaic roof system angling true south in order to receive maximum daylight energy.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

Figure 4.28: This image illustrates the aerial view of the wind turbine located on the edge of the site. This allows for maximum use of harbor winds.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

The site has large green spaces which is designed by landscape designer Vaccaso of Park Department which emphasizes the facilities future expansion. The roof structure of the recycling center is pitched from the apex of the building which allows for adequate daylighting with the interior spaces via clerestory and skylight. This enhances a consistent stream of daylighting within the work environment(Figure 4.29).

Figure 4.29: This image illustrates the penetration of natural daylighting through clerestory and skylight windows. **Web Source:** https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

4.7. CONCLUSION

The Sunset Park Material Recycling Facility has a standard to overcome many challenges dealing with urban waste pollution by incorporating various processes of recycling by providing a platform for the community via environmental awareness and education. Therefore elaborating on sustainable design practices. The recycling facility architecture is a robust response but also adds complexity as it breaks down large mass components in precise ways which relates to human scale. (Krichel's, 2014: 126) states that each zone or space is designed carefully with considerable simplified detail to improve the human, from evolving noisy spaces into peaceful and learning environments to reflect within a building where nothing is gone to waste. The overall objective of this precedent study is to guide a city and a community towards a strategic sustainable path. The emphasis on sustainable strategies of solar energy harvesting and waste recycling is related back to the theories and concepts discussed in the previous chapters of this dissertation. This facility acts as a symbol of empowerment towards a sustainable future for the local surrounding communities (Figure 4.30).

Figure 4.30: This image shows the youth of the community embarking towards their educational journey to the recycling facility.
Web Source: https://www.archdaily.com/509387/sunset-park-material-recovery-facility-selldorf-architects/ (**Date Accessed :**16 November 2018)

The analysis of cross examining the primary question of this research dissertation, this sort of architectural response has not yet been implemented within the peri-urban context of Cato Manor. An intervention of this nature will be of a positive impact as it can be harnessed as a catalyst of growth and change especially towards the insurgent communities residing within the precinct.

5.1. INTRODUCTION

The case studies within this dissertation is to be explored within the context of the informal settlement in the peri-urban realms of Durban. These case studies identifies the socio-economic and environmental challenges discussed in the previous chapters of the insurgent communities in the informal settlement. However, at the same time identifying the available resources available to these insurgent communities and utilizing it sustainably towards self-sustaining and resilient settlement.

The following case study aims to cross examine the primary question of this research dissertation and how the theories and concepts in the previous chapters can be a tool in providing a sustainable response for the insurgent communities of the Cato Manor precinct. The first case study is located in the Quarry Road informal settlement which was organized by two organizations which are the Durban Green Corridor(DGC) and Durbanites Against Plastic Pollution (DAPP). This informal settlement is a place to many insurgent citizens located in the Clare Estate area which is situated on the peripheries of Durban as the main challenges are cable theft which leads to the illegal connection of electricity and waste pollution. The two above mentioned organizations (DGC and DAPP) have an overall objective to empower the insurgent communities towards a sustainable future to overcome their socio-economic and environmental challenges. The second case study is an architectural development situated in the Cato Manor precinct. However, the objective of this architectural response will examine how architecture can be a tool towards community empowerment.

5.1.1. Background and Location of Durban

The Durban Metropolitan region is under governance by the Ethekwini Municipality. With an approximate area of 2297km2 including a population of more than 3.6million, it is predicted that it will rise to over 4million by the year 2020.(Ethekwini Municipality, 2012). Within the Ethekwini region, the city of Durban is the heart of the region as it is evenly divided with regards to education, quality of life and income.(Ethekwini Municipality, 2011).(Refer to figure 5.1)

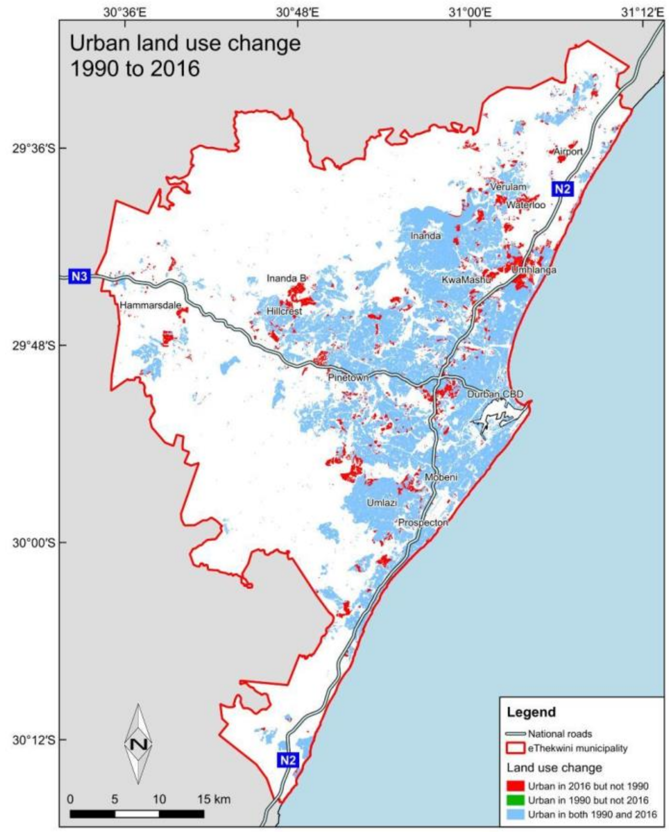


Figure 5.1: The Durban Metropolitan Region
Web-Source: https://www.wits.ac.za/urbanperiphery/ethekwini/(**Date Accessed: 30 July 2018**)

5.2. Background of The Durban Green-Corridor Eco-Centre and DAPP

The Durban Green-Corridor Eco-center and the Durbanites against Plastic Pollution (DAPP) are located parallel to the Umgeni River along the north coast of the metropolitan city of Durban. These organizations are a non-profit as it focuses on the three fundamental aspects of society which are environmental conservation, socio-economic upliftment and empowerment of local insurgent communities within informal settlements. These organization facilitates various activities involving the citizens of society who are in need, in guiding them along a sustainable career, especially within economically disadvantages communities and settlements. Furthermore, focusing on environmental conversation and eco-tourism. As a result, to establish cohesive and social inclusive communities to meet Durban's cultural diversity by inviting tourists from local and international boundaries to engage in. Therefore, focusing on a city which belongs to the citizens as a whole.

5.2.1. The Quarry Road Informal Settlement, Clare Estate, Durban

This case study was analyzed with the Durban Green Corridor, DAPP as well as the researcher of this project in gathering the findings of the waste pollution within informal settlements. This case study was undertaken because the social development officer of Cato Manor had stated there are no waste collecting schemes within the precinct. Therefore having required to team up with the Durban Green Corridor and DAPP to investigate another informal settlement site for the waste management community project which is located parallel to the M19 Highway as it intersected by the Palmiet River which flows from east to west in the Clare Estate area (Figure 5.2). This case study justifies how the involved organizations come together in creating environmental awareness amongst the insurgent communities within these informal settlements. Hence educating these communities that waste pollution can add value and can be utilized in various ways. Below are pictures taking by the researcher's experience within the waste collecting program.

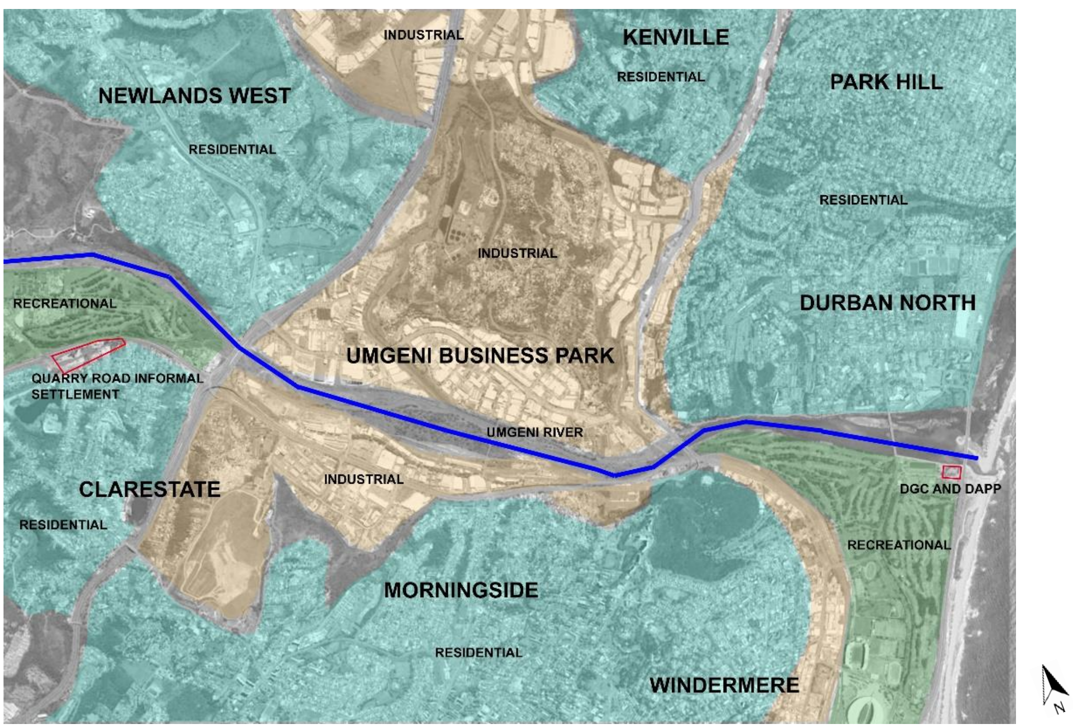


Figure 5.2: This figure illustrates the Durban Green Corridor's and Durbanites Against Plastic Pollution location in relation the Quarry Road Informal settlement on a macro scale of Durban.
Source: Author (**Date Accessed: 30 July 2018**)

5.2.3. The Site and its's Challenges

The quarry road informal settlement is located alongside the M19 highway inbetween the recreational zone of Newlands West and the residential zone of Clare Estate. The site and topography is divided into four quadrants by these insurgent citizens as it is separated by the Palmiet River (Refer to figures 5.3 to 5.4). The two main concerns that these insurgent citizens experience are electricity shortages and waste pollution. According to the IOL (2016), "the illegal connection of electricity had caused an outraged fire which left many homeless." The river serves as source water accessibility in terms of daily cleansing as this becomes hazardous in terms of environmental essence as the river is polluted on a daily basis. The spatial arrangement of these informal settlements to be situated on the river banks is because of the fertile soil as these insurgent citizens thrive on small scale farming for food (Refer to figures 5.5 to 5.8)

Figure 5.3: This figure illustrates the aerial view of the Quarry Road informal settlement and its four quadrants divided by the insurgent communities and the Palmiet River.
Source: Author (**Date Accessed: 30 July 2018**)

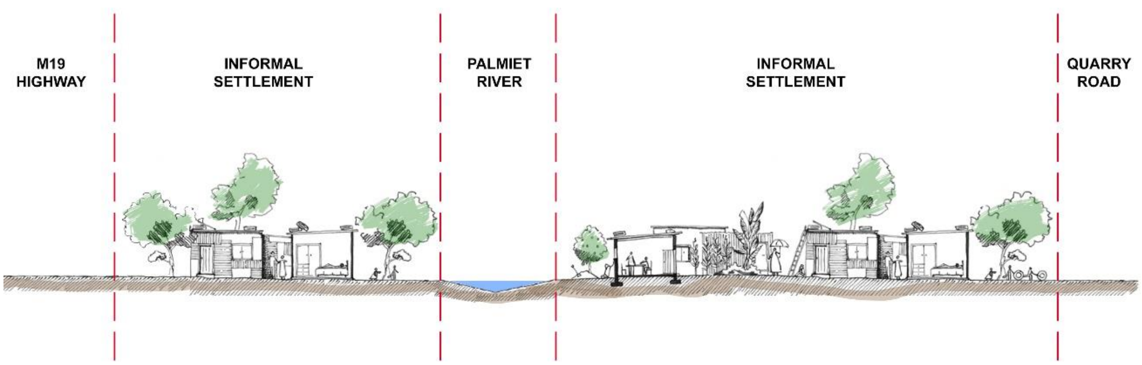


Figure 5.4: This figure illustrates a cut-through section of the informal settlement and spatial planning in relation to the Palmiet River.
Source: Author (**Date Accessed: 30 July 2018**)

Below is the authors experience through the site along the polluted Palmiet River as task of a waste management collection was done amongst the insurgent communities of this informal settlement:

Figure 5.5: The Palmiet River polluted with waste materials.
Source: Author, Durban Green Corridor, DAPP (**Date Accessed: 30 July 2018**)

Figure 5.6: The community of the informal settlement getting involved in the waste collecting program.
Source: Author, Durban Green Corridor, DAPP (**Date Accessed: 30 July 2018**)

Figure 5.7: This photo illustrates the different waste sorting bags from wood, plastic, metals and paper.
Source: Author, Durban Green Corridor, DAPP (**Date Accessed: 30 July 2018**)

Figure 5.8: This photo shows the officials of the Durban Green Corridor and DAPP and the community citizens of the informal settlement.
Source: Author, Durban Green Corridor, DAPP (**Date Accessed: 30 July 2018**)

5.3. Evaluation, Analysis and Conclusion

By cross examining the primary question of this research dissertation upon discussing the theories and concepts in the previous chapters of sustainable development, this case study of the Quarry Road informal settlement visually shows the challenges that these insurgent communities are dealt with on a daily basis. Therefore it is due to these challenges that an architectural intervention is needed as the reuse of their resources towards a strategic sustainable manner which can be incorporated within it. It also must be noted that the efforts of waste collection programmes do not receive the appropriate attention as these communities do not have the adequate facilities or infrastructure to accommodate buyback centers. The overall aim of this waste collecting program by the Durban Green Corridor and DAPP was to bring about environmental awareness amongst the insurgent communities of the informal settlement. This involved the communities of the informal settlement to come together to assist in cleaning their environment as the potential of waste material can add value to their economic circumstances and by also implementing waste buyback programs. Therefore, by incorporating these waste collecting programs within the Cato Manor settlements will aid the lack of education towards learning the skills of upcycling as it will focus towards progressive infrastructure and the community as a whole. This case study showcases the poverty and waste pollution constraints that most informal settlements are dealt with. Furthermore, providing a foundation to allow architecture to intervene in proposing a community empowerment platform of an upcycling skills development centre in guiding communities towards a sustainable and self-sustaining settlement.

5.4. Case Study: Umkhumbane Entrepreneurial Support Centre, Cato Manor, Durban, South Africa

5.4.1. Background and Site Context

Location: Harry Gwala Road, Cato Manor, Durban , South Africa

Client: Ethekwini Municipality – Area Based Management of Cato Manor

Architect: John Royal Architects

Project Year: 2003

Architecture and the built environment has the power to enhance community empowerment. The facility was developed and owned by the municipality, which serves as a platform of how the marginalized communities can be empowered through and architectural intervention. Furthermore, its impact on not just the communities, but the greater context of Cato Manor.

The Umkhumbane Entrepreneurial Support Centre is located in the historic precinct of Cato Manor which was a place that played an important role during the apartheid era, and also consisting of diverse cultures (Figure 5.9). The group areas act of the apartheid era reformed the planning of the precinct as informal settlements dwelled within the vicinity. Therefore, the precinct becoming the victim of urban sprawl due to the attraction of employment opportunities in the Durban CBD. Over time, the Cato Manor precinct became densely populated resulting in poverty amongst insurgent communities, escalating unemployment rates and the lack of skills development and education. One of the main objectives of the Area Based Management and the CMDA of Cato Manor precinct was to use this facility as a platform to help aid the socio-economic constraints of the communities within the vicinity, thus providing entrepreneurial incubators. Upon speaking to the maintenance manager of the facility, Mrs.Ntombela said that the business owners go through an application process in order to get a three year lease for their business production. The application process works due to the criteria and requirements of their business proposals. Business owners are trained and developed to enhance their skills within the three year lease span, which results in them paying a fee of +/-R3000 a month, or depending on their business sizes which costs up to R18-R20 a square meter.

The site of the Entrepreneurial Support Centre is located of Harry Gwala Road which is one of the main transport routes in the Cato Manor precinct. Cato Manor in general consists of low scaled building typologies ranging from informal settlements, RDP housing, heritage buildings and medical infrastructure. Therefore the design of this facility responds to the surrounding Context. However many critiques over the years have questioned its locality as it is isolated away from the main of Vusi Mzimela Road in Cato Manor which is parallel to the informal settlements as this facility was addressed to meet the needs of the insurgent communities residing there.

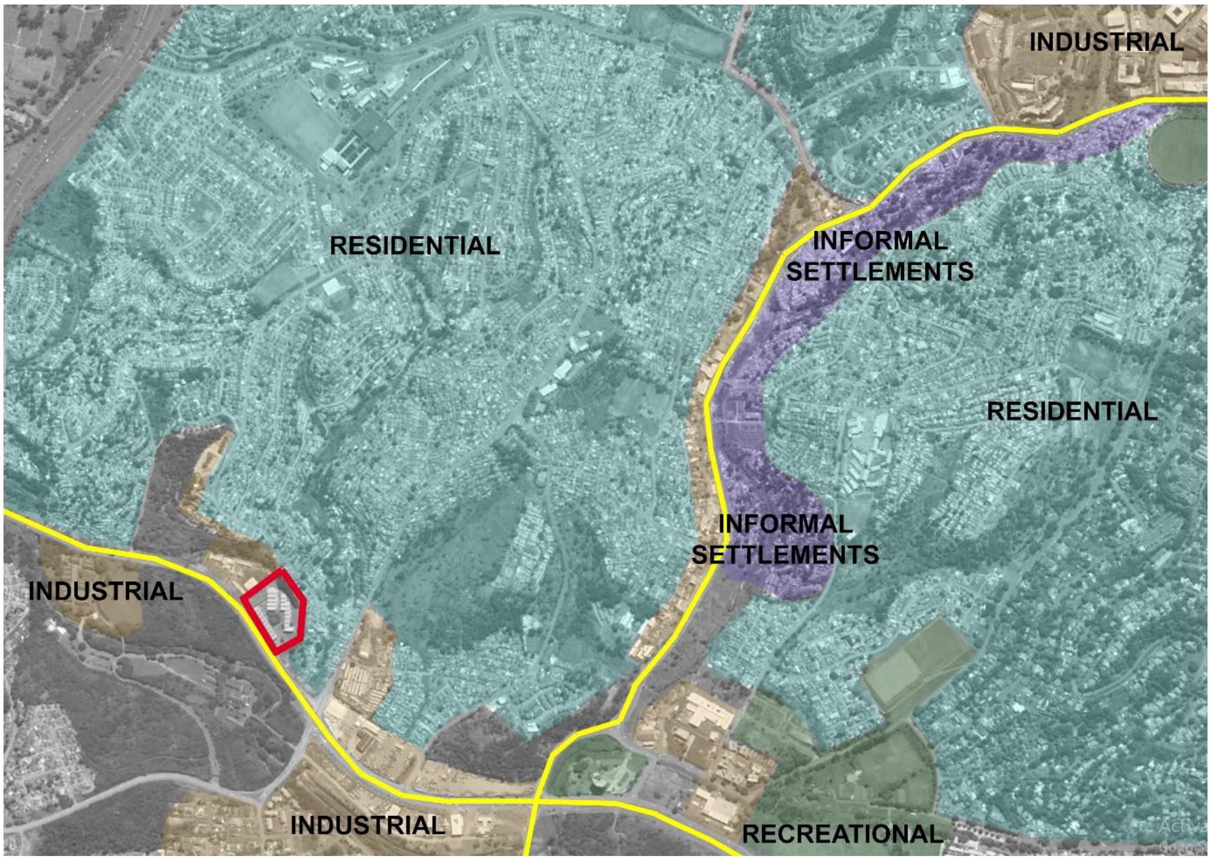


Figure 5.9: Site map of surrounding context of the Umkhumbane Entrepreneurial Support Centre in Cato Manor
Source: Author,(**Date Accessed: 03 September 2018**)

5.4.2. The Project Conceptual Approach

The Entrepreneurial Centre emphasizes around the concept of empowerment and skills development. Furthermore, serving as a platform to assist in business planning, tendering, administration and other entrepreneurship skills. The clients design brief required for a facility which allowed for workshop spaces to be within a safe environment, but at the same time maximizing accessibility and visibility of the user. The design of the facility incorporates acourtyard which acts as a security feature as it allows for visibility and social activity across the site. The facility consists of rentable workshops, training facilities and an administration block (Figure 5.10).

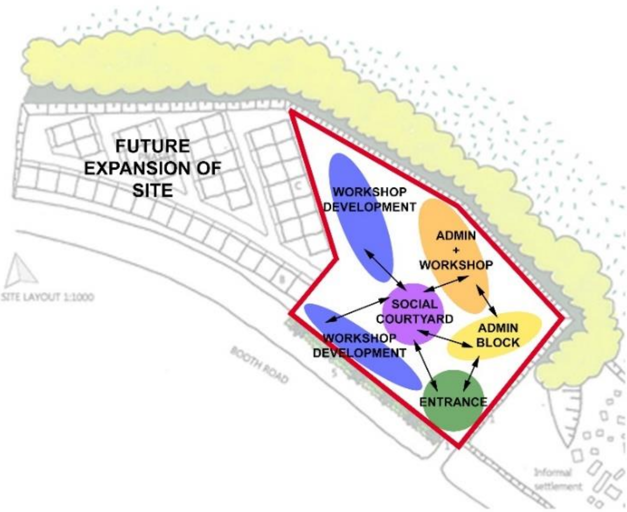


Figure 5.10: Site Plan, Entrance and spatial zoning of The Umkhumbane Entrepreneurial Support Centre.
Source: John Royal Architects (**Date Accessed: 03 September 2018**)

Upon entering the site, the user of the facility experiences the central courtyard space which brings about a sense of ownership as this facility is for the community. According to the architect John Royal(2018), the entrepreneurial center is in the form of a right hand which emphasizes on power. The access of the facility is the ‘wrist’ the thumb is symbolized in the southern part of the complex, and the rest of the fingers are symbolized in the northern part of the site.

5.4.3. The Sustainable Approach

The construction composition of the facility consists of local materials and also basic construction materials because of cost factors. The site and design layout is orientated north as the saw-tooth roof design allows for the east natural sun lighting and the south indirect lighting. The sky lighting minimizes the need for artificial lighting, but upon various visits, it was noted that on an overcast cloudy day, the interior spaces were dull. The roof area structure is maximized for rain water harvesting. The orientation and slope of the roof does have the potential to incorporate future solar energy systems (Figure 5.11).

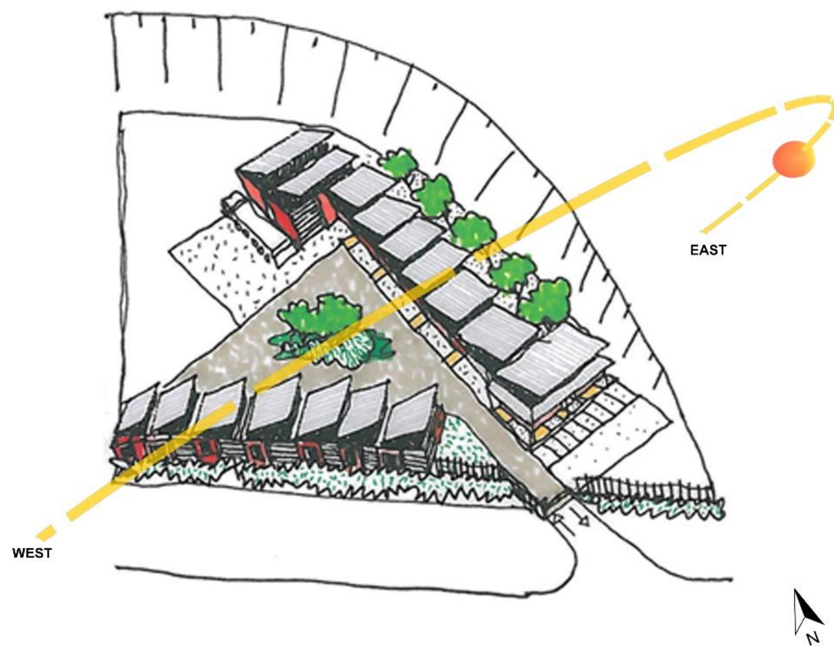


Figure 5.11: Conceptual Form and solar path of The Umkhumbane Entrepreneurial Support Centre.
Source: John Royal Architects (**Date Accessed: 03 September 2018**)

5.4.4. Architectural Response

The facility addresses the contextual issues on site. The placement of semi-pubic, public and private spaces are defined by the incubators, the courtyard space and the administration facilities (Figure 5.12).

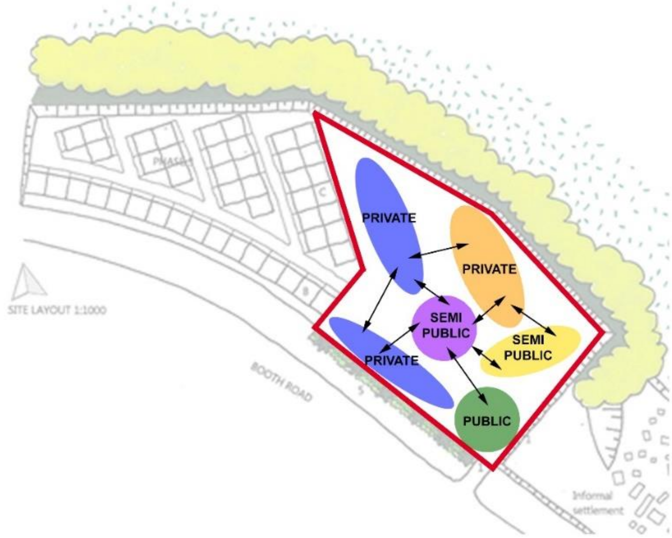


Figure 5.12: The analysis of the public to private zones of the Umkhumbane Entrepreneurial Support Centre.
Source: John Royal Architects (**Date Accessed: 03 September 2018**)

The fine details of this facility anchors it's identity in relation to the surrounding context. The project proposal involved the local insurgent communities to construct the facility, which also means empowering the skills of local artisans and craftsman, but the idea fell short due to circumstances. The workshop spaces vary in sizes due to the scale of the business owners whether their manufacturing is either large or small scaled. There are two typologies which exists in this facility which are the large and small scaled workshop incubators (Refer to figures 5.13 to 5.18).

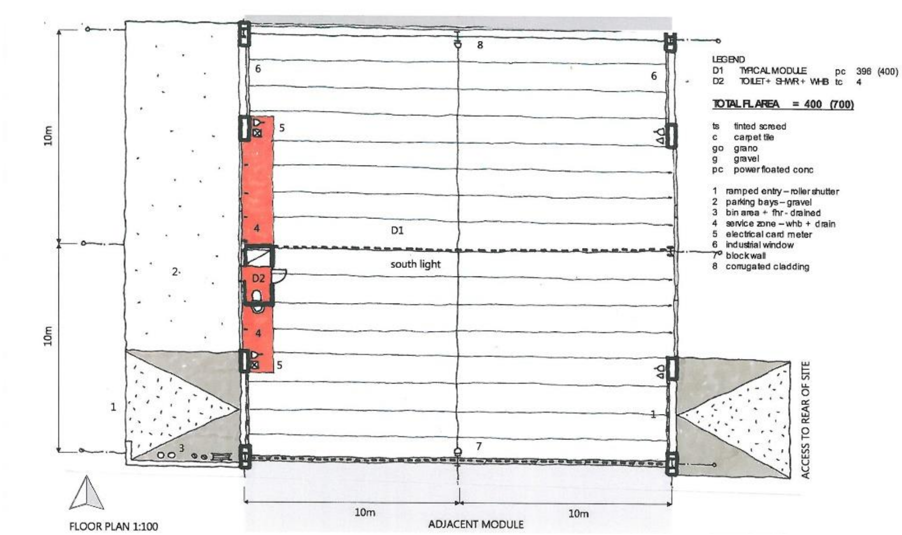


Figure 5.13: The floor plan view of the large business unit incubator typology.
Source: John Royal Architects (**Date Accessed: 03 September 2018**)

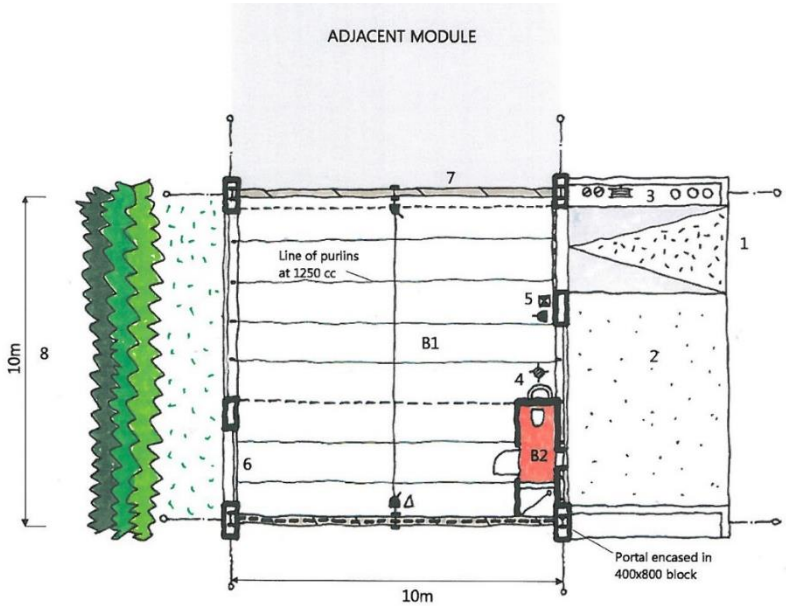


Figure 5.14: The floor plan view small business workshop incubator typology.
Source: John Royal Architects (**Date Accessed: 03 September 2018**)

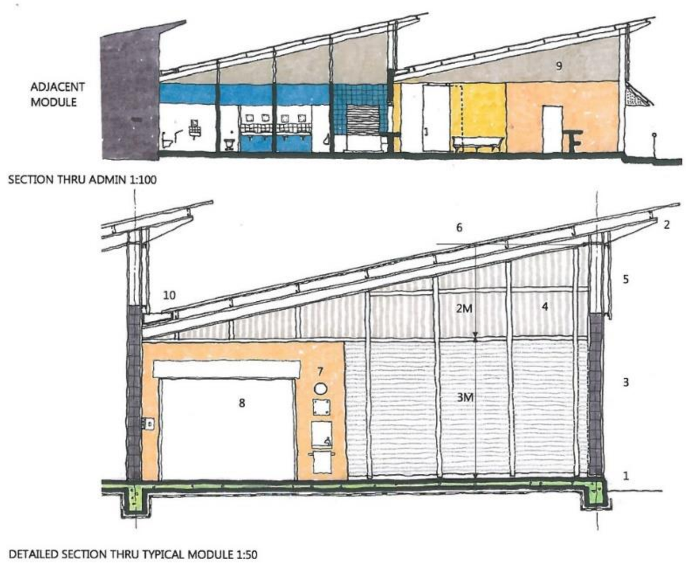


Figure 5.15: Section of business workshop incubators and the administration facilities.
Source: John Royal Architects (**Date Accessed: 03 September 2018**)

Figure 5.16: A typical business operation within the incubator structure.
Source: Author,(**Date Accessed: 03 September 2018**)

Figure 5.17: The Entrepreneurial Support Centre courtyard spaces which allows for social integration and visibility across the site.
Source: Author (**Date Accessed: 03 September 2018**)

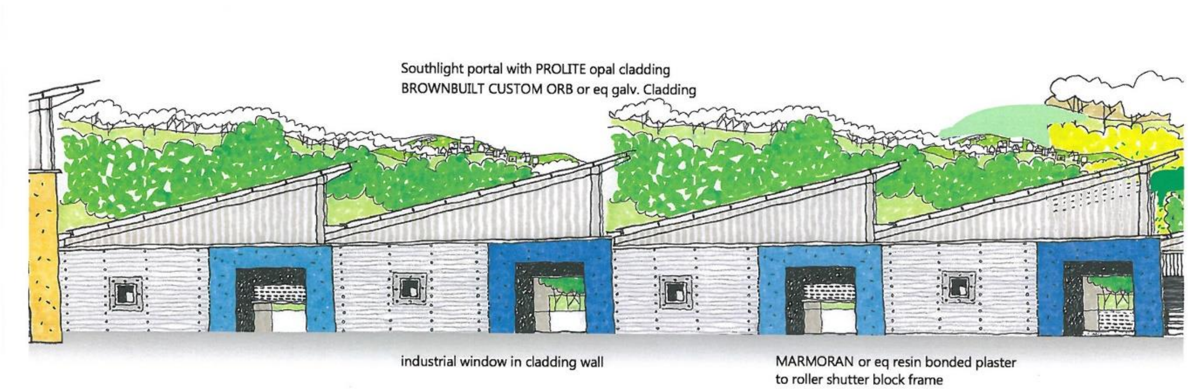


Figure 5.18: Elevation from the courtyard spaces.
Source: John Royal Architects **Date Accessed: 03 September 2018**)

5.4.5. Evaluation and Analysis

Overall, the lack of regenerative activity does occur, because the facility in interpreted as an isolated node with the lack of integration in its immediate surrounding context. Furthermore, this project was part of a master plan but it did not materialize over time. The skills development and entrepreneurship incubators are only for the tenants and users of the facility, which eposes an opportunity for a much more enhanced architectural intervention which has more public and social interaction exposure to the insurgent communities of Cato Manor.

5.5. CASE STUDY CONCLUSION

The analysis of the two case studies utilized the assessment criteria of this research dissertation. Upon the analysis of the first the case study clean up in the informal settlement, there is a need for a larger-scaled awareness center for the insurgent communities in the peri-urban realms of Durban as it can be a catalyst for sustainable development change ,education, empowerment and awareness. Due to the some extreme poverty challenges within informal settlements, there is a lack of infrastructure that incorporates the sustainable strategies in aiding the challenges of the insurgent communities. Based on the analysis of the waste pollution pick up experience within the informal settlement, the transition of transforming this into an economic livelihood opportunity is by empowering insurgent communities of informal settlements through skills development and education knowledge. This further leads to the study of the second case study of the Umkhumbane Entrepreneurial Support Centre in Cato Manor.

The Umkhumbane Entrepreneurial Support Centre illustrates how architecture can assist the empowerment of these insurgent communities within the lines of function and design. Due to its simplistic function and design, it anchors it's presence amongst the context and communities of Cato Manor in aiding the socio-economic challenges. However, the facility is need of a better social and environmental response. There are many architectural elements considered within the Entrepreneurship Centre as it can be informed to design and develop a specific typology which involves the process of upcycling and solar energy as discussed in the previous theories and concept chapters of this research dissertation. It can create an important process in ensuring an architectural platform of this nature can be a positive impact towards the insurgent citizens of Cato Manor to guide them towards a self-sustaining and sustainable future.

CHAPTER SIX | FIELDWORK ANALYSIS, DISCUSSION

6.1. INTRODUCTION

This chapter aims to explore interviews and discussions with the officials of the CMDA and the Area based Management of Cato Manor. The main officials leading these organizations were interviewed and handed out questionnaires for answering, as it was used as a tool for further insight into socio-economic and environmental challenges of the insurgent communities of Cato Manor. Further questionnaires were carried out to the supplementary staff of the organizations to gain a further understanding towards the findings of this research(Figure 6.1). The candidates opinions, perceptions and firsthand experience of the socio – economic, environmental and energy challenges that these insurgent communities are faced with has led to a greater understanding of what type of architectural response can be implemented, which will encourage empowerment towards a sustainable future. Overall, the data required has been put into guidelines and solutions, where the best possible design brief can be created towards solar harvesting upcycling skills center.

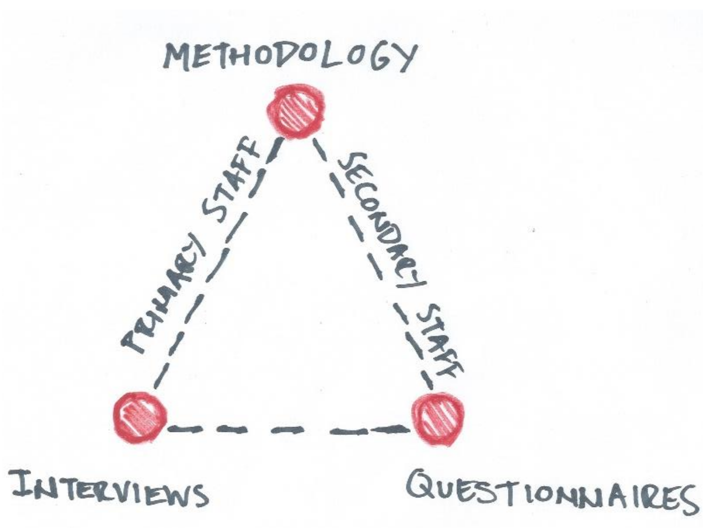


Figure 6.1: Research methodology approach in using interviews and questionnaires to gather primary data
Source: Author (**Date Accessed: 08** June 2018)

The research study within the literature review in conjunction with the primary and secondary data material, addresses the problem statement identified in chapter one of this Dissertation to answer the primary question of this dissertation:

In the Cato Manor Precinct, the socio – economic environmental and energy challenges are at vast amongst the insurgent communities. Due to the over populated informal settlements residing, in the area, many of these insurgent individuals struggle to meet their daily needs on a daily basis. Therefore impacting on their future growth as a community. The effects of the above mentioned challenges impacts on these insurgent community's employment, health and future education. The primary prevention must incorporate a sustainable and holistic approach to improve the future growth and lifestyle of these insurgent communities as a whole. Cato Manor has a strong sense of community and place, but the lack of infrastructure in aiding their challenges is minimal. Together with a strong sense of community and a sustainable infrastructure approach can assist in improving the livelihoods of the insurgent communities of Cato Manor.

The overall aim of this research is to explore and grasp the understanding of the socio – economic, environmental and energy challenges how it's effected the insurgent communities of Cato Manor. Therefore, this will assist in exploring the needs of the community in providing them with an architectural platform with the incorporation of sustainable strategies. Therefore, motivating an appropriate design response which can be a progressive movement towards a sustainable and resilient settlement and community.

"How can architecture respond to the energy and socio-economic challenges of the insurgent communities within the peri-urban context of the Cato Manor Precinct?"

6.2. Analysis of Research Findings

All research and findings were obtained from the staff member experience of the organizations who deal with the insurgent communities of Cato Manor on a daily basis. The existing energy deficient, socio – economic and environmental challenges are currently been dealt with by the Area Based Management of the CMDA of the Cato Manor precinct. This information was gathered by the primary and subsequent staff members of the organizations based on this research dissertations aims, objectives and key questions.

The Attitude of the Participants towards the challenges and its effects on the Community

The insurgent communities feel neglected as their challenges do not get attended to as the Area Based Management and CMDA do not have the necessary infrastructure or government backing/support to aid in their difficulties. These organizations over the years have been trying tirelessly to intervene in order to seek the needs of these insurgent communities. According to the participants the youth are predominantly affected as they lack the financial aid to become educated resulting in poverty and many sort of issues such as crime, unemployment, squatter settlements, drug abuse, etc. The response to this leads to these organizations to become strained by increasing number of insurgent communities of the peri – urban realm of Cato Manor. Informal settlements are increasing, unemployment has become of vast which leads to environmental degradation and crime to survive on a daily basis.

The Threats that Cause Insurgent Communities to Become Vulnerable

According to the Area Based Management and CMDA, there are many factors that leave insurgent communities in a vulnerable situation. Below are the most common factors:

The increase of unemployment amongst the insurgent communities of Cato Manor leaving many families and individuals to reside in informal squatter settlements. The officials of the Area Based Management and CMDA have stated mostly individuals amongst the youth do not have adequate or no education which results in poverty from a young age. Many parents and guardians also do not have the financial capacity to educate and empower the youth. As a whole, resulting in a downfall of socio – economic empowerment.

Due to the increase of informal settlements, the unemployment rate is vast where the struggle of meeting daily needs becomes common. One of the main challenges in this research dissertation is energy deficiency with the peri – urban settlement of Cato Manor. Furthermore, where the insurgent communities illegally connect electricity from local power stations to their informal settlements.

According to the officials of these organizations, there is a vast amount of waste – pollution amongst the informal settlements. However, waste pollution can be seen as a valuable resource to earn a livelihood if there is a platform for these insurgent communities to engage in sustainability. There is a need of socio – economic and environmental platform which can make a statement towards these insurgent communities and to Cato Manor as a precinct.

Present Community programs responding to the Challenges

The Area Based Management and CMDA of Cato Manor are spearheading all community projects with regards to socio – economic and environment challenges that these insurgent communities are dealt with. The Key towards these successful projects are first hand engagement with the insurgent communities, however during the inception stages presently lack infrastructure to provide a stable platform for these communities. Below are some of the programs implemented:

Social Development, Institutional Development and Communications Overview

This involves the Development of a comprehensive and social development strategy towards

Assisting the key challenges such as energy deficiency, electricity crime due to unemployment, health in terms of the people and environmental degradation. However, architecturally, the lack of infrastructure is not implemented thoroughly in assisting these challenges.

Skills Development Program

Skills Development plays an important role in making sure the insurgent citizens of Cato Manor are guided and taught on how to strategically earn an alternate income. However, upon interviewing the officials of the Area Based Management and CMDA, a demand for skills development of waste material could be a solution as this is the most common resource available to the communities. A sustainable architectural platform will most certainly be a bold statement to facilitate these skills development programs

Security Programs – One of the major challenges amongst these insurgent communities is crime. The roots of crime develop from the vast unemployment rate in Cato Manor, which mostly occurs within the informal squatter settlements. By incorporating a sustainable skills development program, this approach will aid the socio – economic crisis amongst the insurgent communities of Cato Manor.

Early Childhood Development (ECD)

The Area Based Management and CMDA of Cato Manor have developed the ECD program to ensure the grounding of educational and skills development of the youth. There are over 3000 local children who do not have access to proper education and reside within the informal squatter settlements. With the assistance of over 300 staff who volunteer to develop the knowledge of the youth, there is a need for adequate educational and skills development infrastructure which will allow the parents and guardians of these children to be educated especially towards a sustainable and resilient future.

Local Economic Development (LED)

This program focuses on the unemployment economic crises. Many individuals within these insurgent communities, have business plans but do not have the infrastructure to start up their businesses. The LED Programs invests in these individuals plans in order to help grow their business, but looking at the bigger picture, these businesses will further employ many other individuals aiding the unemployment rate, However, the officials are in need of an upcycling sustainable strategy which increase the process of skills development of the individuals in these insurgent communities to seek employment opportunities.

According to the interviewees, majority of the individuals in the insurgent communities do not respond to the programs because of the lack of infrastructure. Many of these individuals in these insurgent communities voice their opinions and perspective where they believe they do not have a platform of their own to thrive and grow as a progressive and resilient community.

6.3. A Positive Way Forward

Upon discussing towards a positive approach in aiding the energy deficient and the socio – economic challenges, there is a great need for a sustainable response towards the insurgent communities of Cato Manor. These insurgent communities need to be educated towards a sustainable future primarily focusing on utilizing resources around them and are easily accessible. Within the literature review of this research dissertation, the employment of sustainable development of solar energy and upcycling was discussed as strategies to propose solutions in aiding the energy deficient and socio – economic challenges. Therefore, breaking down the process:

Unemployment has led to the increasing number of informal settlements which resulted in these insurgent communities to illegally connect electricity because they cannot afford it. Therefore the sustainable response of solar energy comes into play where this can be a possible solution to run an architectural intervention off – grid in order to facilitate an upcycling skills development center.

As a result, holistically empowering these insurgent communities towards a sustainable and resilient future in aiding their challenges.

The following interviews were concluded in gathering the required information:

1- **Mlunzizi Mthembu: Eco- Tourist Guide and employer of Durban Green Corridor.**

The interview was based upon the social and environment projects in Durban amongst the communities. Mr Mthembu explained that their goal as the Durban Green Corridor is to create environmental awareness amongst communities. He further assisted me into joining their team into doing the earlier case study in the Quarry Road informal settlement with regards to the waste pollution and waste sorting. He also emphasized that there is a need for a large scale upcycling facility to educate and enhance the skill development of the marginalized to improve their socio-economic challenges. The theoretical framework within this interview entailed Insurgent Citizenship, Sustainable Development, Theory of Empowerment and Upcycling.

2- Nkosinathi Zondi: Local Economic Development Officers of Cato Manor

This interview was based upon the economic development and general overview of Cato Manor. Mr Zondi has stated that the majority of the individuals in the precinct suffer from extreme poverty and unemployment. He went onto further state that the load shedding electricity cut off occurs very often. This is due to illegal connection of electricity to homes and squatter camps as a result straining the national grid. This is because people cannot afford electricity. Due to his experience, his job requires him to develop various economic and skills development programs to help the community of Cato Manor. However, due to the vast population at large, there is a lack of infrastructure to facilitate these programs. Upon describing the proposed Solar Harvested Upcycling Skill Development Center, he said that the facility of this nature will surely aid the socio-economic challenges of Cato Manor, as the community will surely benefit from it at large. This interview touched upon the Theoretical framework of Insurgent citizenship, sustainable Development and theory of empowerment through upcycling.

3- Khanyi Msweli: Social Development Manager/Officer of Cato Manor

This interview was based upon the social development and the communities of Cato Manor. Mrs Msweli has stated that due to the extreme poverty within the communities of Cato Manor, theft and drug abuse has been a common problem especially amongst the youth. She goes onto state that her job on a daily basis entails co-ordination and facilitation of community programs for social upliftment and awareness. Therefore hosting local forums in the local school halls which allows the community to come together. This forums consists of various departments from safety and security, department of health, sports and recreation NGO's and CBO's. She goes through a system where she facilitates, co-ordinates and collaborate. During these forums she plans the projects and at times speaks to the community as a whole to uplift them on most cases. Upon discussing the architectural intervention of the researchers dissertation. She states the idea of a Solar Upcycling Skills Center will be a great platform for the community of Cato Manor. Furthermore, a facility becoming and anchor of empowerment, education and awareness.

4- Muhammed Suleman- Director of Africa Alternate Energy Solutions

This interview was based upon solar energy technology in supporting the thesis topic of exploring solar energy systems in Peri-Urban settlements. Upon explaining the proposed architectural intervention of having a facility been run-off solar energy, Mr Suleman emphasized on the importance of the sun's source of an energy as this can be the future for most buildings to take into consideration. He went on to further explain the pros and cons of a solar powered facility, as the initial cost factor can be high, but cost effective for the long haul. This is also important because of the illegal connections of electricity in Cato Manor, a solar run facility can ease the strain of the national grid in order to aid the challenges of communities are faced with to execute the buildings functionality. The theme discussed within this interview was purely on solar architecture.

Questionnaires

The Questionnaires (refer to appendix) were done within the precinct of Cato Manor at the offices of the Area Based Management and CMDA which is based in the Inthutuko Junction in precinct. There were 10 questionnaires handed out to the secondary professionals and officials of the Area Based Management and the CMDA..

The questionnaires are categorized into 4 sections with 21 questions. The 4 sections were based on general personal analysis, macro analysis of electrification constraints in Cato Manor and natural resource of coal depletion, upcycling and skills development to aid socio – economic challenges and lastly a potential architectural response to facilitate the above challenges within the Cato Manor precinct. The categorized sections aim to acquire information from the officials and professionals of the Area Based Management as they experience firsthand challenges of the communities of Cato Manor on a daily basis. The structure of the questionnaire was structured to gain the relevant information needed in order to draw a conclusion to an architectural response. The questions range from multiple choice questions to simplified open ended questions which requires shorter answers.

Analysis of Sections and Questions

Section B- Questions 1-6:

This section investigates the perception of the professional's knowledge of global warming and the depletion of coal in producing electricity. Majority of the respondents felt threatened as they do experience electricity cut-outs from time to time. The respondents feel that the solar energy is a great idea for an alternate source of electricity. Within the Cato Manor precinct the idea needs to be explored as it will aid the electrification challenges as this precinct holds a sentimental value in their lives in connecting with the communities on a daily basis.

Section C- Questions 7-13:

This section investigates the socio-economic analysis of how upcycling of waste material can be as an income generator for the communities of Cato Manor. Majority of the respondents dispose of various waste materials. Furthermore, majority of the respondents feel that a skills development and educational programme will improve the socio-economic challenges of the communities in Cato Manor. Therefore, upcycling products will add value to their daily lives and in terms of art it is aesthetically pleasing as they want to acquire the knowledge to have the ability to manufacture these products.

Section D- Questions 1-4:

This section investigates the possibility of a solar harvested upcycling skills center. The respondents feel that there is a need of this type of architectural intervention which will educate and enhance the skills of the community in guiding them towards a self-sustaining future.

Elaborating further for an architectural platform to be implemented, the incorporation of a social and communitive environment where the insurgent communities can be empowered through skills development of waste material in different forms of spaces and functions such as:

- An Upcycling school
- Retail and entrepreneurship startup business programs of upcycling products
- Skills development workshop spaces
- Technological facilities for educational growth
- Art and skills workshop spaces
- A safe and secure environment for all these activities to be incorporated
- Social platforms such as community halls and auditoriums
- Training facilities to allow for volunteers to come and educate on skills development

Interviews vs Questionnaires (Refer to table 1)

	INTERVIEWS	**QUESTIONNAIRES**
PROBLEM	• Energy deficiency • Waste pollution • Informal Squatter Settlements • Environmental degradation • Socio-economic challenges • Crime • Unemployment • Poverty • Health Issues	• Energy deficiency • Waste pollution • Informal Squatter Settlements • Environmental degradation • Socio-economic challenges • Crime • Unemployment • Poverty • Health Issues
OVERALL SUSTAINABLE DEVELOPMENT GOAL	• Utilizing natural resources • Resources of waste material • Alternate energy usage	• To use waste material for skills development • Alternate energy usage

	• Community empowerment through sustainable development • Sustainable Skills development strategies	• Social empowerment through sustainable development of resources available to the insurgent communities
SOLAR	• Using solar energy to reduce the constraints of the electricity grid system • Exploring solar harvesting in the peri-urban settlement will be beneficial.	• A renewable source of energy which is dominant in the built environment. • Will be beneficial to the peri-urban settlement of Cato Manor if implemented.
UPCYCLING	• Waste pollution is vast and upcycling can solve many aspects such as environmental awareness, skills development, education and unemployment by selling upcycling waste products.	• Can assist socio-economic challenges, environmental awareness. • Upcycling can eradicated unemployment and provide the opportunity for employment.
ARCHITECTURAL CONTRIBUTION	• To provide a platform of the insurgent community of Cato Manor to facilitate and upcycling skills center which is run off the electricity national grid by using solar energy.	• To provide a platform of the insurgent community of Cato Manor to facilitate and upcycling skills center which is run off the electricity national grid by using solar energy. • To providing workshops spaces for training and learning • An upcycling schools

REDFINING SUSTAINABLE LIVELIHOODS	• To develop a model which can assist the Cato Manor precinct and other peri-urban settlements towards a sustainable future. • To aid the socio-economic and energy challenges.	• To develop a model which can assist the Cato Manor precinct and other peri-urban settlements towards a sustainable future. • To aid the environmental and socio-economic challenges.

Table 1 : Interview and Questionnaire conclusions and similarities.
Source: Author (**Date Accessed :**08 June 2018)

6.3. CONCLUSION

The primary data gathered via interview discussions, precedents, case studies and questionnaires is important in understanding the key theories and concepts discussed in the previous chapters of this dissertation as it serves as a sustainable solution moving forward when designing for the insurgent communities of Cato Manor. To establish a simple but sustainable response in addressing the challenges of the insurgent communities in providing them a solar harvested upcycling skills center. The sole intention is to guide these insurgent communities towards a sustainable and resilient future in utilizing the resources available to them to aid the energy and socio – economic challenges. Therefore, understanding the importance of analyzing architecture as well as the socio – economic and environment challenge towards the affected insurgent communities. Architecture becomes the mediator between energy crises the socio – economic and environmental challenges as well as the insurgent communities, so that it can be a symbol of empowerment.

CHAPTER SEVEN | CONCLUSION AND RECOMMENDATIONS

7.1. INTRODUCTION

This dissertation explores the fundamental approaches towards aiding the socio-economic, environmental and energy challenges of the insurgent communities by empowering them through the theoretical framework of sustainable development. Infrastructure and programs can therefore be successful when these insurgent communities are connected and empowered. This includes the shared knowledge amongst the insurgent communities as to how the can use available resources in their environment sustainably. Therefore it is important to revisit the hypothesis of this dissertation:

"The hypothesis of this dissertation proposes that architecture, through the use of the unique combination of solar-generated energy and community education through upcycling, can address the combined community needs of socio-economic and socio-environmental upliftment, empowerment, resilience, and sustainability in the Cato Manor area."

The research information accumulated and gathered for this dissertation has provided key insights into understanding the socio-economic and environmental problems arising from the challenges that the insurgent communities of Cato Manor are dealt with. These insights are key factors to understanding the fundamental objectives of the research and the way forward. The research applies most directly to the challenges of the insurgent communities of Cato Manor. A sustainable approach should be defined by its surrounding locality as well as by its characteristics (social, economic and environmental). The more sustainable strategies are put into place, the more powerful a community will be and respected with regards to their own independence and empowerment.

The key theories and concepts of this research dissertation encourages the relationship between architecture, society and theory is multilayered. Architecture has a dominance in terms of visible and real physical structure, which impacts people's lives on a daily basis. However, architecture is not just a representation or an expression of a society, but rather it has an impact upon and within the social realm. Architecture defines and creates paces are created for everyday living, as these spaces co-exist with the people who dwell there. These spaces can facilitate affects, movements, activities, interactions, beliefs and views. Rather than just acting as a passive object, architecture acts as an instrument to express emotions, social and environmental interactions. It is in creative play of architecture that an insurgent community of Cato Manor can begin to see itself through a new vision, and maybe more positively. Architecture therefore, can be viewed as a societal intermediate presence to build stronger and more positive communities towards sustainable future.

7.2. Recommendations

The primary and secondary data collected through the literature, theories, concepts, interviews, discussions, precedents, case studies and visual observations, have all directed a way forward towards the need for a solar harvested upcycling skills development center in Cato Manor. This involved the process of analyzing architecture, energy constraints, socio-economic and environmental challenges which has revealed how spaces and places can impact and affect insurgent communities.

The need for a solar harvested upcycling skills development center must be designed in consultation with concerned organizations of the CMDA and The Area Based Management of Cato Manor as previously mentioned in this research dissertation. The intention of these consultations is to develop an understanding and a way forward of the key theories and concepts discussed in the previous chapters, to therefore establish a building brief for this needed proposed facility.

This research dissertation is concerned with the design of a solar harvested upcycling skills development center, to address the energy crises, socio-economic an environmental challenges of the insurgent communities of the Cato Manor precinct. The provision and design of a solar harvested upcycling skills development center may not provide an immediate solution to these above mentioned challenges, but it sets in motion a process of empowerment through sustainable development for the insurgent communities of Cato Manor. This therefore sets a precedent for many other peri-urban settlements in South Africa and beyond international boundaries, keeping in mind the theoretical and conceptual framework, as the architecture will respond to the surrounding context of those areas.

7.3. Evolution of the Brief

The academic nature of this project deals with realistic trending challenges such as energy crises, socio-economic and environmental challenges within the peri-urban settlement of Cato Manor, as it aims to provide a design response to deal with these challenges. The building is not just to and upcycling center, but to also integrate itself within the insurgent communities of Cato Manor to make it known that is is their platform for self-sustenance, growth and empowerment. The project should engage a sustainable holistic approach in terms of the type of accommodation to be provided for the insurgent communities. It calls to address the educational, recreational, environmental and cultural needs of the insurgent communities. The building must offer these insurgent communities a secure and supportive environment, it can be enhanced by encouraging cultural and societal interaction, and by discouraging isolation from the city as a whole.

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APPENDICES

Questionnaire

Please note: the questionnaire requires you to be as honest as possible, as all answers are confidential, and will be safeguarded for a period of four to five years after which, it will be destroyed.

Part A: Personal Analysis

1. Age: 0-16 □ 16-25 □ 25-35 □ 35-45 □ 45-65 □ 65+ □

2. Nationality: ______________________________

3. Ethnicity: Black □ White □ Coloured □ Indian □ Other(specify) □ ____________

4. Occupation: ______________________________

Part B: Macro Analysis

1. What does the term climate change mean to you?

____

____

2. It is estimated that coal will run out within the next 110 years, and gas earlier in just 54 years. How do you feel about this?

____

____

3. Do you have any personal connection towards the Cato Manor Precinct on a daily basis?

____

____

4. Have you ever considered the impacts of electricity shortages within your community?

____

____

5. What do you think of Solar Power as a fundamental source of electricity supply?

____

____

6. Have you ever considered the impacts of waste pollution within your community? If yes, please state your opinion?

____

____

Part C - Socio - Economic Analysis

7. Does your household dispose waste material?

____

____

8. If you do, do you recycle any of the following?

☐ Electronic Objects ☐ Fabric ☐ Garden Waste ☐ Metal ☐ Paper ☐ Plastic

☐ Other ____

9. Would you be more inclined to sell or buy products made from upcycled waste material?

☐ Yes ☐ No ☐ Maybe

10. Would you be interested in learning the skills development of upcycling of waste material to make something different? Eg. Furniture from recycled wood

☐ Yes ☐ No ☐ Maybe

11. Here is a collection of upcycled products from waste material. Upcycling materials is a method of creating something new and different from its original purpose. Please study the pictures and answer the following questions?





12. Please tick the words below that would describe these items of upcycled products.

☐ Sustainable ☐ Eco Friendly ☐ Art ☐ Unique ☐ Useful

☐ Alternative ☐ Boring ☐ Experimental ☐ Helping the environment

☐ Eye-catching ☐ Pointless ☐ Trendy ☐ Original ☐ Uncomfortable

☐ Other ____

13. Would you be interested in purchasing items like the ones in the pictures above for home furnishings? Please explain your answer.

____

____

Part D - Architectural Analysis

1. Will an architectural platform of a Multipurpose Solar Harvesting Upcycling Awareness Centre for Cato Manor benefit the socio-economic and environmental challenges of the community?

____

____

2. Should this platform facilitate research for education and awareness towards the community of Cato Manor?

____

____

3. What other functions / facilities do you think is necessary to be included towards a sustainable future for Cato Manor?

____

____

4. Do you think the interaction between this architectural platform and the community of Cato Manor will be a positive impact towards a sustainable future?

____

____

Interview Schedule: The Area Based Management

I. **Opening**

A. (**Establish Rapport**) [shake hands] My name is Shuaib Bayat. I am a master in architecture student at UKZN and I am currently working on my dissertation which will be exploring solar energy design systems in peri-urban settlements for responsive architecture, in addition towards the design of a multipurpose upcycling skills centre in Cato Manor.

B. (**Purpose**) I would like to ask you some questions about your background in socio-economic development and some experiences you have had

C. (**Motivation**) I hope to use this information to better understand how architecture can aid the socio-economic constraints of disadvantaged communities.

D. (**Time Line)** The interview should take about 15-20 minutes. Are you available to respond to some questions at this time?

(**Transition:** Let me begin by asking you some questions about yourself)

II. **Body**

A. (Topic) General information

1. How long have you lived in Durban?

a. Did you study in Durban?

2. How long have you been in the socio-economic development field?

a. What motivated you to pursue your profession?

b. What exactly does your job description entail?

(**Transition to the next topic:** Moving on, let's speak about some of your experiences as a socio-economic development practitioner)

B. (Topic) Experiences

1. Does your job require you to deal with disadvantaged individuals and communities only?

a. If not, what other aspects of socio-economic development do you deal with?

b. Do you deal with these issues on a daily basis?

2. Which socio-economic challenges do you specifically focus?

a. What are the general scenarios or challenges that individuals and communities are faced with?

b. Generally, what sort of process or programmes do they go through in aiding these specific socio-economic challenges?

3. What is the process or programme, i.e. what are the procedures that these programmes entail?

a. What are the individual programme procedures?

b. What are the community activities/programmes procedures?

(**Transition to the next topic:** Now that I understand what the programme procedures are , I would like to know what type of socio-economic functions/spaces that can be facilitated in an architectural platform)

C. (Topic) Architectural Environments

1. What kind of spaces do you as a socio-economic practitioner need in order to do your job?

a. In our opinion, are the current existing socio-economic facilities adequate enough?

b. What would be the ideal kind of environment for you, which would produce optimal results towards individuals/community empowerment and upliftment?

2. What are the different types of spaces used by individuals/communities to be empowered and uplifted within the programmes carried out?

a. In our opinion, are there spaces of this nature currently existing adequate?

b. What would be the ideal space for individuals/communities during the process of these programmes? What kind of environment would positively empower and uplift them?

(**Transition to the next topic:** I would like to briefly move on to your personal experience with your architecture)

D. (Topic) Experience with architecture

1. What is your understanding of empowering and uplifting environments?

2. In your opinion, how can architecture have a positive effect on the empowerment and upliftment of disadvantaged socio-economic individuals/communities ?

a. If so, in what way?
b. Have you had any experiences of such cases, and if so can you share that with me?

3. How has your working environment affected the way you work?
(**Transition:** Well, it has been a pleasure finding out more about you. Let me briefly summarize the information that I have recorded during our interview.)

III. **Closing**
A. (Summarize) Brief summary of data gathered in interview.
B (Maintain Rapport) I appreciate the time you took for this interview. Is there anything else you think would be helpful for me to know? And is there anyone, in your opinion, that could further assist me in my research?
C. (Action to be taken) I should have all the information I need. Would it be alright to call you if I have any more questions? Thanks again.

Interview Schedule: Africa Alternative Energy Solutions

I. **Opening**

A. [shake hands] My name is Shuaib Bayat. I am a master in architecture student at UKZN and I am currently working on my dissertation which will be exploring solar energy design systems in peri-urban settlements for responsive architecture, in addition towards the design of a multipurpose upcycling skills centre in Cato Manor.

B. (**Purpose**) I would like to ask you some questions about your background in in the solar energy technology field and your experience you have in it. I would like to gain a further understanding of its usage and implementation with regards to the built environment.

C. (**Motivation**) I hope to use this information to better understand how the integration of architecture and solar technology can aid the energy constraints in disadvantaged and peri-urban settlements.

D. (**Time Line)** The interview should take about 15-20 minutes. Are you available to respond to some questions at this time?

(**Transition:** Let me begin by asking you some questions about yourself)

II. **Body**

A. (Topic) General information

1. How long have you lived in Durban?

a. Did you study in Durban?

2. How long have you been in the solar energy technology field?

a. What motivated you to pursue your profession?

b. What exactly does your job description entail?

(**Transition to the next topic:** Moving on, let's speak about some of your experiences in the field of solar technology)

B. (Topic) Experiences

1. What specific scale and complexity of projects does your job requires you to do?

a. What other aspects of solar technology or alternative energy do you engage with ?

b. Do you deal with projects on a daily basis and is there a growing need for alternative energy?

2. What is the most challenging aspects of solar technology in this modern era?

a. What are the general scenarios or challenges that are dealt within the solar technology field?

b. Generally, what sort of processes or training is required to take on a challenge which has serious complexity in the solar technology field?

(**Transition to the next topic:** Now that I understand what your job experiences are , I would like to know what type of solar technology functions/spaces that can be facilitated in an architectural platform)

C. (Topic) Architectural Environments

1. Generally what are the requirements to implement solar technology within an architectural building?

a. In your opinion, are the current implementation of solar technology making a difference within the built environment?

b. What would be the ideal kind of environment and climate , which would produce optimal results towards the most efficient solar technology system in place?

c. Do are your thoughts and success of the integration of solar technology and architecture?

(**Transition:** Well, it has been a pleasure finding out more about you. Let me briefly summarize the information that I have recorded during our interview.)

III. **Closing**

A. (Summarize) Brief summary of data gathered in interview.

B (Maintain Rapport) I appreciate the time you took for this interview. Is there anything else you think would be helpful for me to know? And is there anyone, in your opinion, that could further assist me in my research?

C. (Action to be taken) I should have all the information I need. Would it be alright to call you if I have any more questions? Thanks again.

COLLEGE OF HUMANITIES: MASTERS RESEARCH

INFORMED CONSENT FORM

(To be read out by researcher before the beginning of the interview). One copy of the form to be left with the respondent; one copy to be signed by the respondent and kept by the researcher.

My name is Shuaib Bayat. (Student number 213503634). I am currently doing a masters research document on "**Exploring solar energy design systems in peri-urban settlements for responsive architecture: Towards the design of a multipurpose upcycling skills centre in Cato Manor."** Ultimately the research will guide the design of a proposed new Solar Harvest Distribution Centre in Cato Manor.

I understand that participation in this research is purely voluntary. I am under no obligation to participate and may cease my participation at any time as I see fit. There are also no reward/benefits given for participating in the research. I understand that efforts will be made to keep research confidential and will be stored at UKZN for 5 years after the study. I have been informed that I am free to contact the dissertation supervisor as follows for further information and can withdraw from the research at any point without any consequences. This project is currently being supervised by Mr. Bonga Ntuli at the School of the Built Environment and Development Studies, University of KwaZulu-Natal.

Student.Contact.Details:
Shuaib Bayat. School of the Built Environment and Development Studies. University of KwaZulu-Natal, Durban.

Cell: 0735432048

Email: shuaibb4@gmail.com

Supervisor Contact Details:
Bonga Ntuli. School of the Built Environment and Development Studies. University of KwaZulu-Natal, Durban.

Cell: 0786053322

Email: ntulib@ukzn.ac.za

_____________________________ ___________________

SIGNATURE OF PARTICIPANT DATE

EXPLORING SOLAR ENERGY DESIGN SYSTEMS IN PERI-URBAN SETTLEMENTS FOR RESPONSIVE ARCHITECTURE

Towards the design of a multipurpose upcycling skills centre in Cato Manor

PROBLEM STATEMENT - AIMS - OBJECTIVES

The rationale justifying this architectural response is to explore solar energy design systems in order to ease the strain of the national electricity grid system to improve the socio-economic, environmental, and energy challenges of Cato Manor. Therefore to holistically empower and educate the insurgent communities by proposing an Upcycling Skills Development Centre with the integration of Solar Energy and Passive Design Systems.

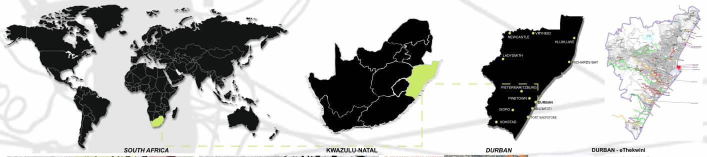
- *To explore the origin of insurgent communities in peri-urban areas, with a focus on Cato Manor as a typical post-apartheid model*
- *To investigate how sustainable development can be achieved in insurgent communities in peri urban areas.*
- *To focus on the potential role of solar energy and upcycling processes in empowering insurgent communities in peri-urban areas as a form of sustainable development.*
- *To investigate the means of incorporating solar energy and upcycling processes into an architectural tool for empowerment in the insurgent community if Cato Manor.*

WHO ? Insurgent Communities of Cato Manor

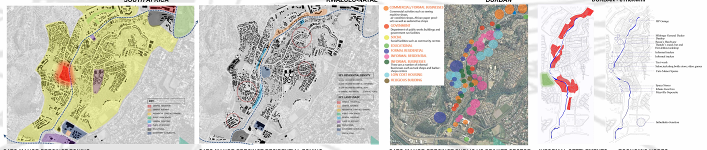
WHAT ? Because of the lack of infrastructure and socio-economic awareness

WHY ? To provide a solar harvested upcycling centre for socio-economic , education and awareness purposes.

SITE SELECTION — THE CATO MANOR PRECINCT

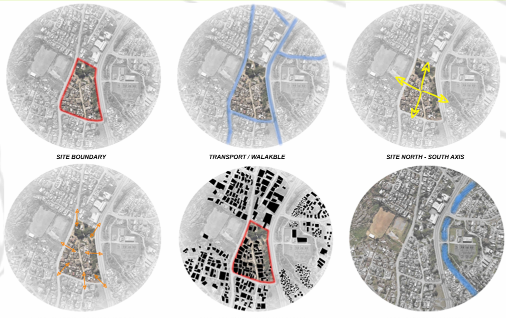


SOUTH AFRICA — KWAZULU-NATAL — DURBAN — DURBAN - eThekwini



CATO MANOR PRECINCT ZONING — CATO MANOR PRECINCT RESIDENTIAL ZONING — CATO MANOR PRECINCT PUBLIC VS PRIVATE SECTOR — INFORMAL SETTLEMENTS — ECONOMIC NODES

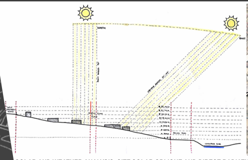
SITE ANALYSIS - VUSI MZIMELA ROAD — THE CATO MANOR PRECINCT

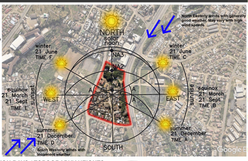


SITE BOUNDARY — TRANSPORT / WALKABLE — SITE NORTH - SOUTH AXIS

DESIRED LINES / ACCESSABILITY — FIGURE GROUND LAYOUT / EXISITNG — ENVIRONMENTAL FEATURES

THE SITE CONTEXT AND PERFORMANCE



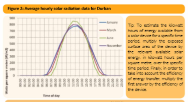


SOLAR AND WEATHER ANALYSIS, SITE SOLAR OBLIQUE AND DIRECT RADIATION RAYS / TOPOGRAPHY HEIGHTS

Table 1: Mean daily global radiation on flat and tilted surfaces (kWh.m-2.day-1)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Ave
0°	5.53	5.40	4.89	3.99	3.28	3.03	3.17	3.62	4.02	4.77	5.15	5.74	4.38
35°	5.00	5.31	5.49	5.31	5.01	5.11	5.12	5.07	4.76	4.90	4.78	5.06	5.08
65°	3.49	4.04	4.68	5.14	5.26	5.61	5.50	5.07	4.27	3.90	3.42	3.42	4.48

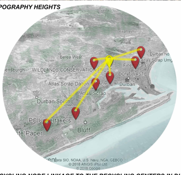
Figure 2: Average hourly solar radiation data for Durban



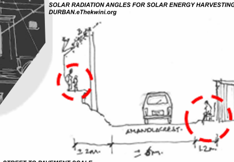
Tip: To estimate the kilowatt hours of energy available from a solar device for a specific time period, multiply the exposed surface area of the device by the relevant available solar energy, in kilowatt hours per square metre, over the specific time period. Finally, in order to take into account the efficiency of energy transfer, multiply the first answer by the efficiency of the device.

$$Power\ (kWh) = area\ (m^2) \times solar\ energy \left(\frac{kWh}{m^2}\right) \times Eff._{device}$$

SOLAR RADIATION ANGLES FOR SOLAR ENERGY HARVESTING IN DURBAN.eThekwini.org

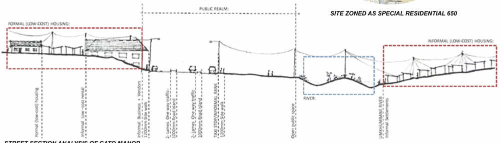


PROPOSED UPCYCLING NODE LINKAGE TO THE RECYCLING CENTERS IN DURBAN



STREET TO PAVEMENT SCALE

SITE ZONED AS SPECIAL RESIDENTIAL 650



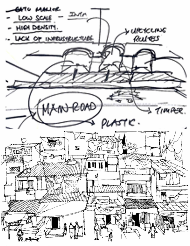
STREET SECTION ANALYSIS OF CATO MANOR

SITE SELECTION CRITERIA

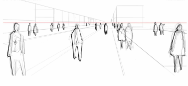
THEORIES USED	THEMES	CRITERIA
Insurgent Citizenship	Socio-economic and environmental challenges	Contested Spaces Former apartheid buffer zone Marginalized communities The potential to empower the marginalized communities through upcycling skills development
Genius Loci, Critical Regionalism And Solar Architecture	Site specific, place based, people based an mixed uses	Street front exposure Pedestrian Movement Physical connection to surrounding communities and context Historical significance Orientation Topography Proximity to transport routes ,nodes, amenities, site easily accessible Potential to develop an effective public space Location to varies activities
Theory of empowerment	Social inclusion, upliftment and empowerment	Potential for environment regeneration and awareness Potential to strengthen communities Proximity to environmental features
Liveable Urbanism	The inclusion of environmental focus and sustainability towards a self-sustaining and resilient settlement	Potential empowerment and skills development Potential socio-economic development Potential for social intervention

WHO ARE THEY?	WHAT DO THEY DO?
• FORMAL RESIDENTS • INFORMAL DWELLERS • TRADERS • BUSSINESS WOMAN • BUSSINESS MEN • HOMELESS • CRAFTSMEN • STUDENTS • ARTISTS • SPORTSMEN • STREET KIDS • BUILDERS • FAMALIES • ELDERLY • PARAPLEGICS • LOCAL VISITORS • RELIGIOUS WORSHIPERS ALL PEOPLE FROM ALL WALKS OF LIVES	• TRADERS • BEADS • CLOTHING • CURIOS • SEWING • FURNITURE • UPHOLSTERY • ARTS AND CRAFT • SHOE MENDING/ POLISHING • BARBER • SALON • SMALL ITEM TRADE • SERVICES(CAR WASH REPIAR) • BUILDERS • SPAZA SHOPS • BOTTLE STORES • RESTURANTS • BED AND BREAKFASTS

THE PEOPLE OF CATO MANOR



A HIGH DENSITY PRECINCT AND LACK OF INFRASTRUCTURE



A LOW SCALE PRECINCT

BRIEF HISTORICAL EVENTS

1950 - THE OCCURANCE OF THE FIRS INFORMAL SETTLEMENTS

1959 - RIOTS AND EXPLOSION OF THE POWER STATION AMONGST THE INFORMAL SETTLEMENTS

1960 - THE FORCES REMOVALS DURING THE APARTHEID ERA

INFORMAL TRANSPORT ROUTES

TIMBER INFORMAL HOUSES

INFORMAL PEDESTRIAN PATHWAYS

WASTE POLLUTION OF THE UMKHUMBANE RIVER

INFORMAL SETTLEMENTS ON TO THE STREET

INADEQUATE STREET ACTIVITY

INADEQUATE LOW-COST HOUSING

ILLEGAL ELECTRICITY CONNECTION

WASTE POLLUTION OUTSIDE INFORMAL HOUSES

INSURGENT CITIZENS RIOT

INADEQUATE TRADING SPACES AND BUS STOPS

NO ADEQUATE FACILITY TO BUILD

COMMUNITIES RIOT FOR NEEDS

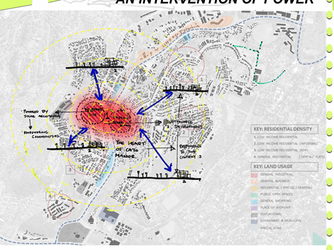
THE PROPOSED URBAN DESIGN INTERVENTION OF CATO MANOR

"TO CREATE THE EXPERIENCE FROM INFORMALITY TOWARDS A PLATFORM OF EMPOWERMENT AND SUSTAINABLE DEVELOPMENT "

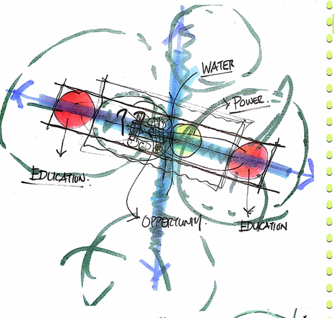
THEORETICAL AND CONCEPTUAL FRAMEWORK OF THE URBAN INTERVENTION AND ARCHITECTURAL RESPONSE

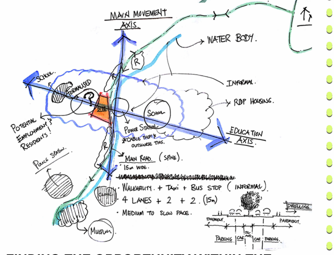
ANALYZING THE SITE PERFORMANCE AND THE SURROUNDING CONTEXT

AN INTERVENTION OF POWER

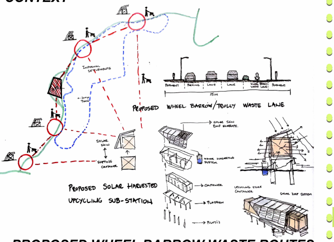


IDENTIFYING THE POWER BODIES

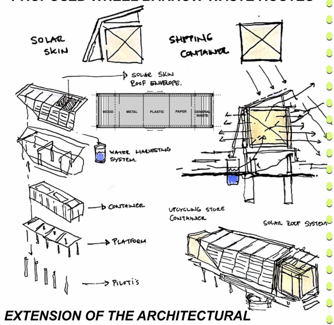




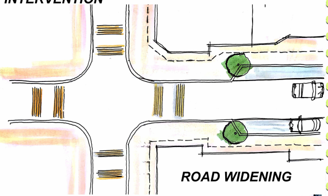
FINDING THE OPPORTUNITY WITHIN THE CONTEXT



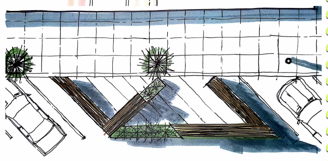
PROPOSED WHEEL BARROW WASTE ROUTES



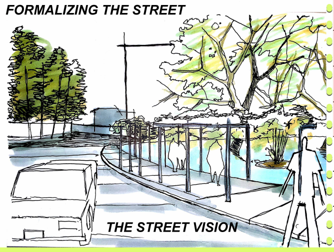
EXTENSION OF THE ARCHITECTURAL INTERVENTION



ROAD WIDENING



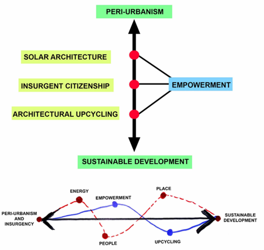
FORMALIZING THE STREET



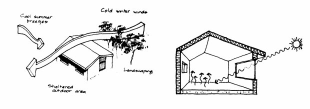
THE STREET VISION

THEORETICAL AND CONCEPTUAL FRAMEWORK

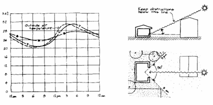
Sustainable Development	Socio-Economic and Environmental Challenges
Insurgent Citizenship	Insurgent Communities of Cato Manor
Genius Loci	The Architectural Intervention As A Focal Node Of Place Cato Manor
Theory of Empowerment	Empowerment of Awareness, Education And Skills Development
Critical Regionalism	Responding To Local Context Resources And Material
Solar Architecture	Solar Harvesting And Passive Solar Design Techniques
Architectural Upcycling	Skills Development Education Through Cleaning, Manufacturing, Designing and Resusing Waste Material
Livable Urbanism	Towards A Self-Sustaining And Resilient Settlement



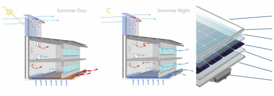
PASSIVE SOLAR DESIGN ARCHITECTURE



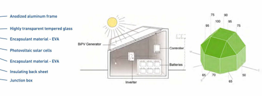
SITE ORIENTATION / PLANNING



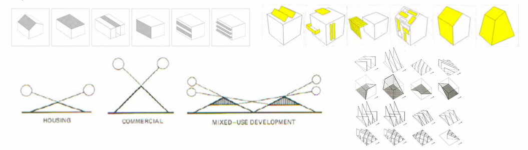
IMPORTRANCE OF HEAT STORAGE



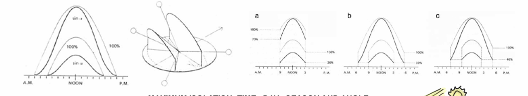
VENTIILATION DRAUGHTS TO REDUCE HEAT



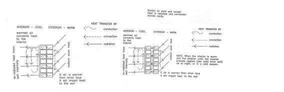
ENERGY PRODUCTION: PHOTOVOLTAIC SYSTEM AND STORAGE



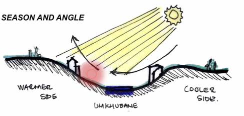
SOLAR TECHNOLOGY + BUILDING INTEGRATION



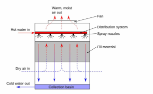
MAXIMUM ISOLATION: TIME . DAY , SEASON AND ANGLE



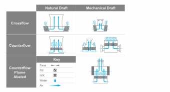
SOLAR THERMAL WALLS



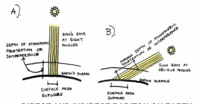
GENERAL TOPOGRAPHY OF CATO MANOR



WIND TOWER COOLING SYSTEMS

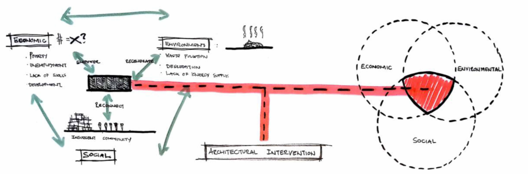


VARIOUS TYPES AND FUNCTIONALAITIES

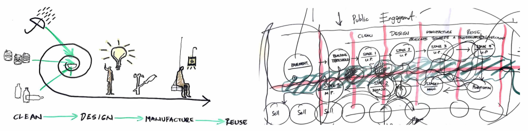


DIRECT AND INDIRECT RADITON ON EARTH

THE INTEGRATION OF SOLAR TECHNOLOGY AND UPCYCLING



GUIDING THE COMMUNITY TOWARDS A SELF-SUSTAINING FUTURE



THE PROCESS OF UPCYCLING AND IT'S FUNCTIONALITY

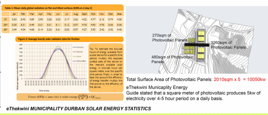
THE SITE PERFORMANCE IN TERMS SOLAR TECHNOLOGY

SITE PLAN / SOLAR HARVESTING SCALE: 1:1000

TIME	MARCH	JUNE	SEPTEMBER
6 AM			
7 AM			
8 AM			
9 AM			
10AM -12PM			
1 PM			
2 PM			
3 PM			
4 PM			
5 PM			

THE SITE ENERGY HEAT MAP

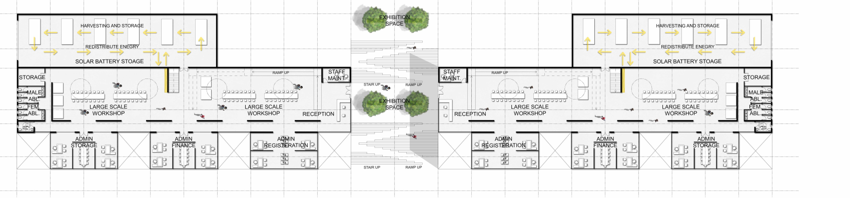
REQUIRED KILOWATTS



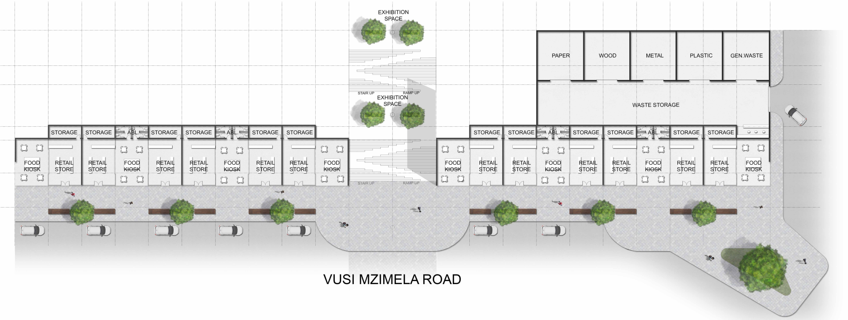
eThekwini MUNICIPALITY DURBAN SOLAR ENERGY STATISTICS

SPLIT LEVEL FLOOR PLAN SCALE: 1:200

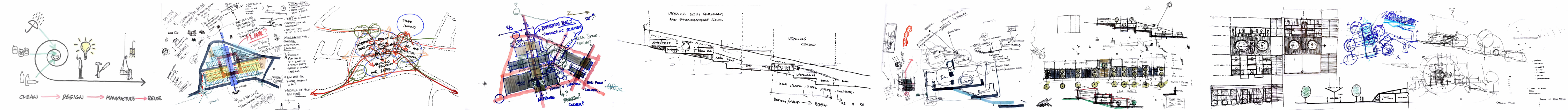
SECOND FLOOR PLAN SCALE: 1:200



FIRST FLOOR PLAN SCALE: 1:200

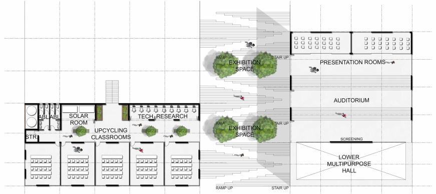


GROUND FLOOR PLAN SCALE: 1:200



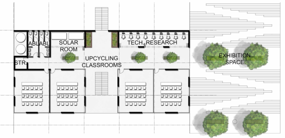
SECOND LEVEL FLOOR PLAN

SCALE: 1:200



THIRD LEVEL FLOOR PLAN

SCALE: 1:200



FOURTH LEVEL FLOOR PLAN

SCALE: 1:200

FIFTH LEVEL FLOOR PLAN

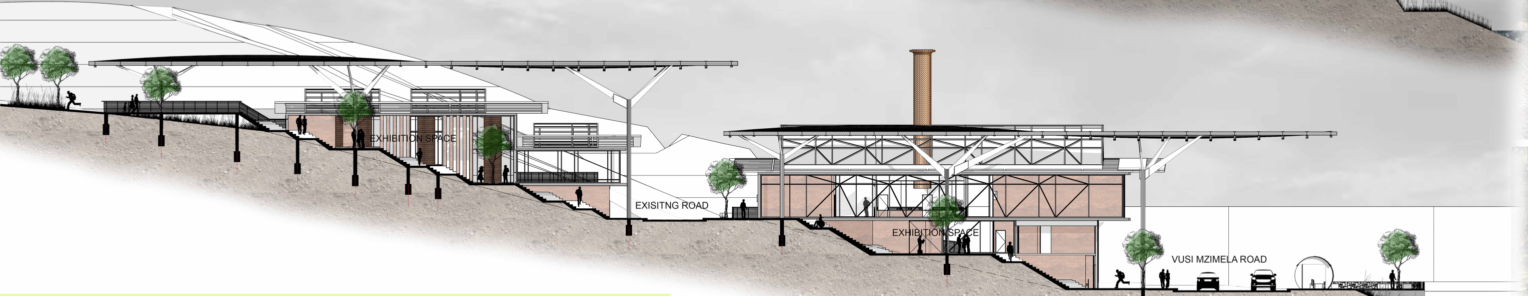
SCALE: 1:200

SECTION A-A **SCALE : 1:100**

EAST ELEVATION **SCALE : 1:100**

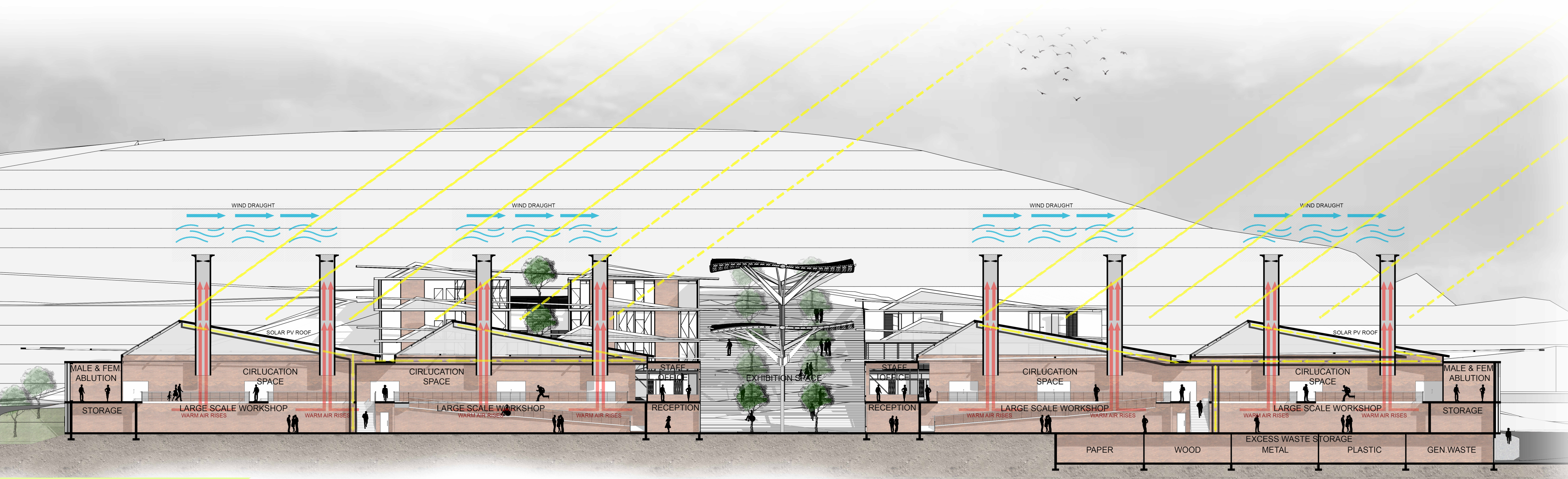
3D PERSPECTIVES

SOUTH ELEVATION **SCALE : 1:100**

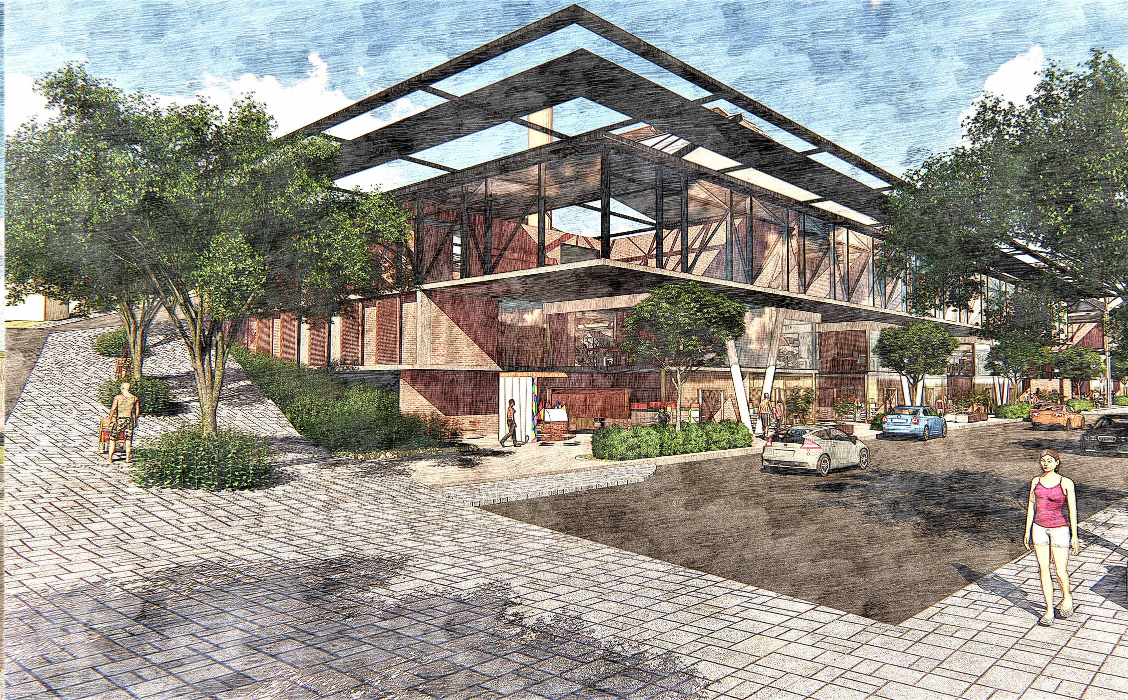


SECTIONAL ELEVATION OF EXHIBITION **SCALE : 1:100**

3D PERSPECTIVES



SECTION B-B
SCALE : 1:100



PRECEDENT AND CASE STUDIES INFLUENCING THE ARCHITECTURAL RESPONSE

THE ANALYSIS OF THE RESEARCHED PRECEDENT, CASE STUDIES AND SITE DEVELOPMENT

PRECEDENT AND CASE STUDIES

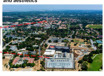
Stanford University Central Energy Facility, Palo Alto, CA, United States
Architects: ZGF Architects
Location : Palo Alto, CA, United States
Project Year : 2015

The Stanford University in California has one of the most technological advanced central energy facility in the United States and on international level. The year 2011, the universityinvestigated various options to change its old cogeneration energy facility, as a long term lifespan was needed of a 35-year cycle taking into consideration and its pledge of carbon noninterference. The project implements opportunities to showcase Stanford university's objective towards a leading environmental management institution, progressive technological innovation in establishing themselves as a world renown university for research and teaching. Identifying the effects of climate change produced by greenhouse gas emissions is one of the fundamental Issues towards socio-economic and environmental challenges in the present era, therefore allowing Stanford university to step forward to creating the awareness of energy efficiency to the next level. Therefore, resulting in solutions that will be implemented on the university premises.

DESIGN INSPIRATION

Solar roof systems serving functionaitly and aesthetics

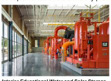
CAMPUS PLAN



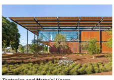
Driving concept of the University as it becomes the heart of the univiersity

FLOOR PLANS

Main ground floor plan illustrating the usage of energy and water storage for education purposes of the univeristy

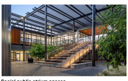


Interior Educational Water and Solar Storage



Tectonics and Material Usage

Classrooms to eduate about the facility

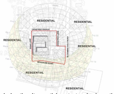


Social public atrium spaces

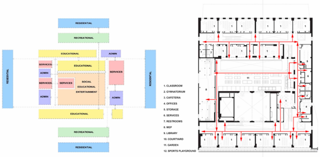
The Kathleen Grimm School for Leadership and Sustainability
Architects: SOM Architects
Location : 644 Bloomingdale Rd, Staten Island, NY 10309, USA
Project Year : 2015

The Kathleen Grimm School for Leadership and Sustainability at Sandy Ground is established and been designed to be one of the first net-zero-energy schools in the city of New York and also making this project one of the first of its kind in the world. The school is designed for the harvesting of energy with the means of on-site renewable sources which generates energy and is used on a yearly basis. The project sets the highest of standards in terms of sustainability as it is a prototype example for future school typologies of this significance.

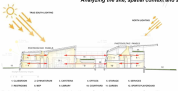
Solar transparent envelope roof structure for maximum energy absorption



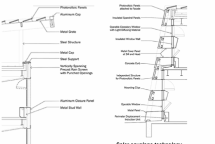
Analyzing the site, spatial context and solar path



The school's spatial zoning and planning from public to private spaces



Relationship of spaces which allows for the penetration of sunllight



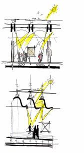
Solar envelope technology

The implementation of net-zero sustainability strategies

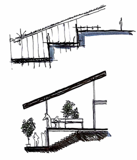
Renzo Piano Building Workshop Studio
Architects: Studio Piano Architects
Location : Genoa, Italy
Project Year : 1969

An open plan office space illuminated from above. Polyester panels arranged like a series of waves allowed only the north light through, while protecting against the heat of the sun from the south. The main elements of the structure was a square-based steel pyramid which gave form to the whole building as well as the complexity engagement with the sites steep gradient.

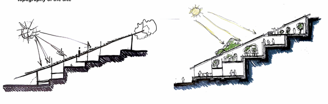
The Piano Studion in Genoa has a unique engagement with the sloping topography of the site



Solar energy used to illuminate artificial lighting



Social engagement on different platforms and levels

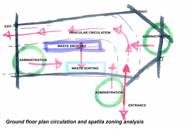


The cut and fill method for the appropriate site engagement. Therefore taking a sustainable approach

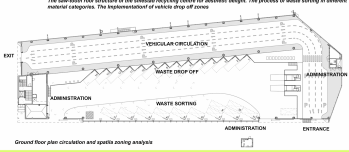
Smestad Recycling Centre
Architects: Longva Arkitekter
Location : Oslo, Norway
Project Year : 2015

The Smestad recycling center showcases a new typology of it's kind with the incorporation of an indoor sorting of waste and disposal facility. This recycling center is situated in a residential zone as a significant care is aimed towards it's surrounding and neighboring context. The structure is robust of it's kind, with dual integrated areas alongside a hall, as it serves the purpose for the access for the public and the other for the buildings operationsdient.
The logistics operation component was one of the fundamental aspects in terms of the design criteria. The local municipality of Oslo's master plan has strict regulations and guidelines in terms of the buildings size and setting of placement. It was fundamental to maximize the accessibility of traffic flow and parking bays for the public, to provide enough spaces for waste factions, as adequate circulation is needed for operations. The main hall caters for 34 vehicles with ers and 16 waste fractions. The public area is prominent as it is raised above the operation spaces. The exterior spaces consists of an extensi ing system which controls traffic as it avoids excess congestions both o terior and exterior of the building.

The saw-tooth roof structure of the smestad recycling centre for aesthetic delight. The process of waste sorting in different material categories. The implementationf of vehicle drop off zones



Ground floor plan circulation and spatila zoning analysis



Ground floor plan circulation and spatila zoning analysis

Sunset Park Material Recovery Facility

Architect: Selldorf Architects
Location: Brooklyn, New York City
Project Year: 2014

The Sunset Park Material Recovery Facility is a processing center for New York City's curbside metal, glass, and plastic recyclables which is being undertaken by Sims Municipal Recycling and the City of New York. Located on an 11 acre waterfront pier in Sunset Park, the design was influenced by its programmatic use as a recycling center which inspired reuse throughout.

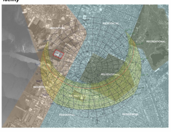
The masterplan organizes buildings to support functionality, creates distinct circulation systems to safely separate visitors from operations, and adds two acres of native plantings. Buildings are also organized to create the site's own urban context. The 140,000 sf facility includes a Tipping Building, where recyclables arrive by barge and truck; Processing Building that houses more than $25,000,000 in complex sorting equipment, as well as electrical compressor, fire pump, and supervisor rooms; Bale Storage Building served by eight loading docks; and a building for personnel (lunch room, locker rooms, offices) and an Education Center.

The Education Center is one of the project's most unique features. The structure contains programs for school children and the public including classrooms, exhibitions, and interactive demonstration displays. A key element of the design is a steel bridge which connects the Education Center to a viewing platform inside the Processing Facility. The viewing platform allows students and visitors to see the recycling process in action.

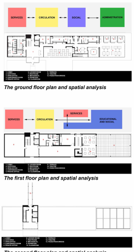
Working within a pre-engineered building, one of the design challenges was to find ways to articulate the program and give an overall expression to the facility that would distinguish it from ordinary big box construction. In response, structural elements are inverted to appear on the exterior, giving steel girders and lateral bracing a greater visual impact.

The facility makes a major environmental contribution by delivering recyclables by barge—a strategy which minimizes the distance collection trucks must travel and eliminates 240,000 miles of annual vehicle travel from roadways. Recycled materials are used throughout: site fill is made from a composite of recycled glass, asphalt, and rock reclaimed from the Second Avenue subway construction; buildings are made from recycled steel; and plazas are finished with recycled glass. Other sustainable measures include the largest application of photovoltaics in New York City, a wind turbine which generates 15% of the facility's power, and bioswales for stormwater management.

The exterior industrial aesthetic appearance of the waste recovery facility



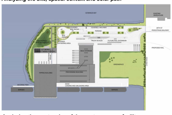
Analyzing the site, spatial context and solar path



The ground floor plan and spatial analysis

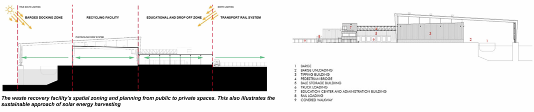
The first floor plan and spatial analysis

The second floor plan and spatial analysis



Analyzing the master plan of the waste recovery facility

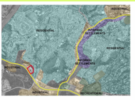
The pedestrian bridge linking the educational facility to the recycling center



The waste recovery facility's spatial zoning and planning from public to private spaces. This also illustrates the sustainable approach of solar energy harvesting

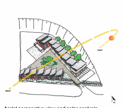
Umkhumbane Entrepreneurial Support Centre
Architects: John Royal Architect
Location : Harry Gwala Road, Cato Manor, Durban , South Africa
Project Year : 2003

Architecture and the built environment has the power to enhance community empowerment. The facility was developed and owned by the municipality, which serves as a platform of how the marginalized communities can be empowered through and architectural intervention. Furthermore, its impact on not just the communities ,but the greater context of Cato Manor. The Umkhumbane Entrepreneurial Support Centre is located in the historic precinct of Cato Manor which was a place that played an important role during the apartheid era, and also consisting of diverse cultures. The group areas act of the apartheid era reformed the planning of the precinct as informal settlements dwelled within the vicinity. Therefore , the precinct



Analyzing the site, spatial context and solar path

Analyzing the site plan and spatial zoning



Aerial perspective view and solar analysis

Variations of workshop spaces

Small scale workshops

Large scale workshops

Saw tooth roof structure on the interior elevation. Showcasing the light industrial essence

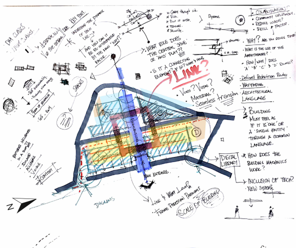
Entrance of the site

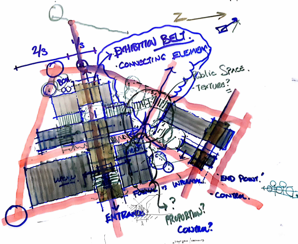
Interior functionality of the workshop spaces

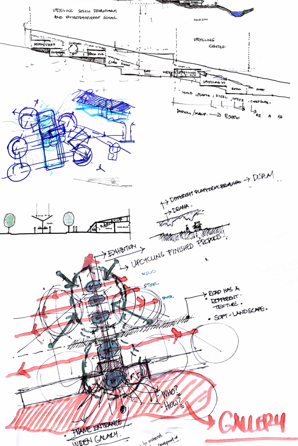
Central courtyard spaces for social integration

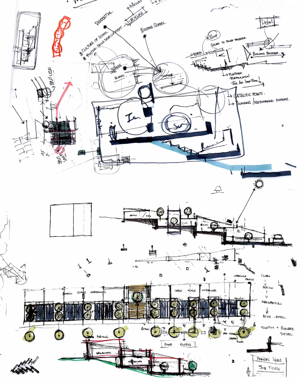
SITE DEVELOPMENT

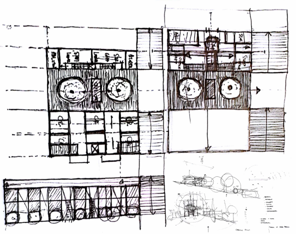
HIERARCHY	CATEGORY	DESCRIPTION	AREA	QUANTITY	AREA TOTAL
		UPCYCLING PRODUCTION			
Primary	A	Large Scaled Workshops (Cleaning, Designing, Manufacturing, Testing)	200	5	1000
		Small Scaled Workshops (Cleaning, Designing, Manufacturing, Testing)	100	5	500
		Waste Sorting (Wood, Plastic, Metal, Paper.etc)	500	1	500
		Exhibiton Space (Offices, Ablutions , Stores)	500	1	500
		EDUCATIONAL/SKILLS DEVELOPMENT			
	B	Admin Offices	40	3	120
		Staff Facilities (Rooms)	20	5	100
		Admin Reception	60	1	60
		Student Tech/Computer/Reseach Lab	200	1	200
		Student Library	150	1	150
		Storage	30	1	30
		Conference Room Theatre	300	1	300
		Studio Classes	60	4	300
		Student / Staff Ablutions	60	2	120
		ENTREPRENEURIAL INCUBATORS / SPACES			
	C	Ground Floor Retail Spaces	1000	Varies	1000
		Offices Spaces	250	Varies	250
		Entrepreneurial Consulting Workshop Spaces	600	Varies	600
		Ablutions	60	2	120
		COMMUNITY / PUBLIC FACILITIES			
	D	Restaurant / Food Retail	70	4	280
		Dining Area (Kitchen, Storage)	300	1	300
		Ablutions	60	2	120
		GENERAL FACILITIES / STORAGE			
Secondary	E	General Stores	15	10	150
		Meter Rooms	20	2	40
		Information Foyer	60	1	60
		Bin / Disposal Area	50	1	50
		RESILIENCE AND SUSTAINABILITY			
	F	Grey Water			
		Black Water			
		Water Storage			
		Solar Technology			1000
		Area Excluding Circulation			10400
		Circulation: Publib and Private	Varies		1000
		Service Ducts	Varies		40
		Structure	Varies		60
		Total Area			11500



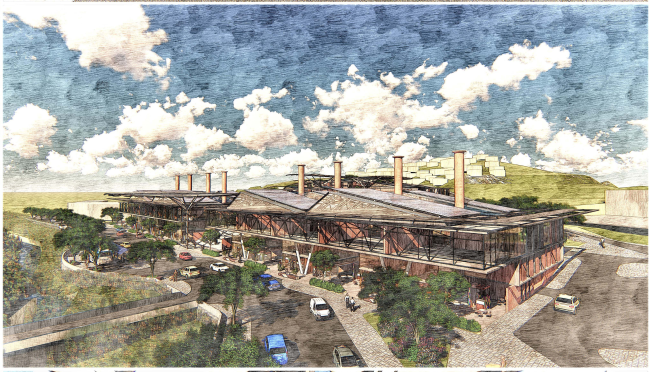




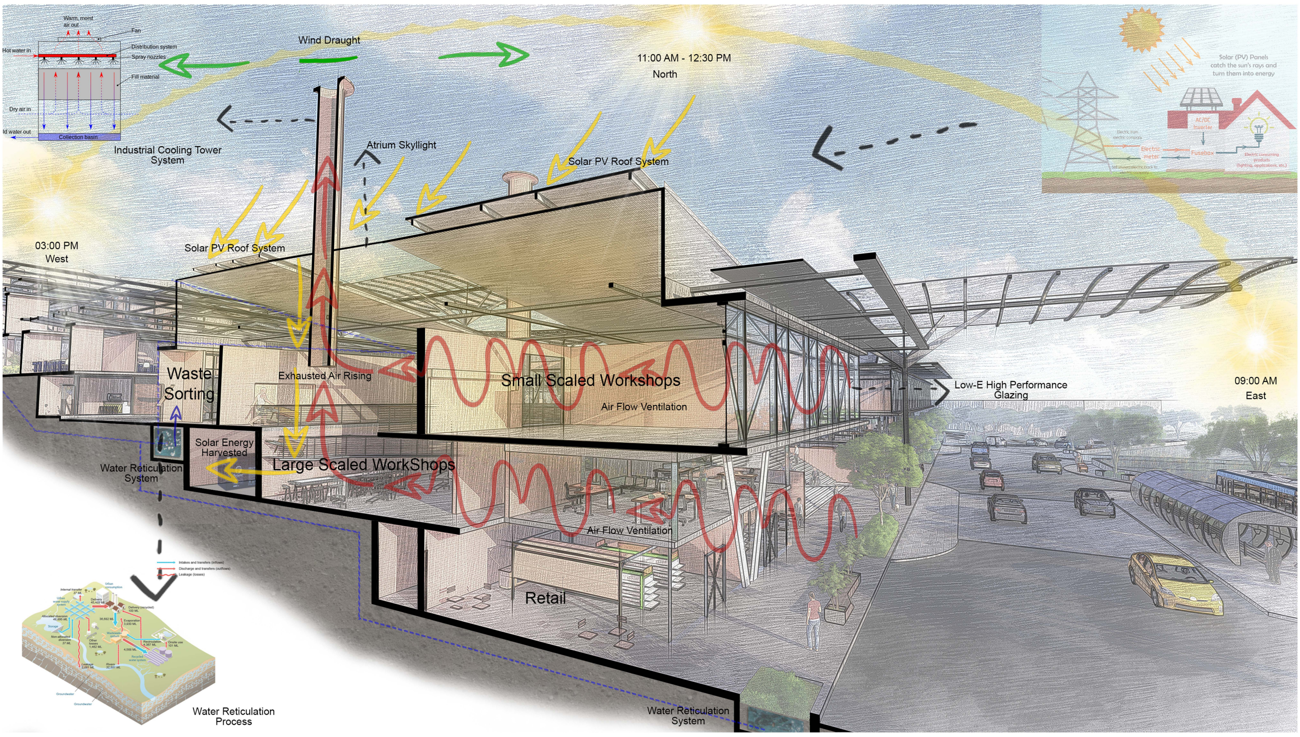




3D PERSPECTIVES



AXONOMETRIC SOLAR AND SUSTAINABLE SECTION ANALYSIS



Solar Harvesting & Daylight Penetration

The design meets the off-grid requriments as the sole purpose of this intervention is to harvest solar energy to faciliate the fucntionality of and upcycling centre. Furthermore, the design allows for dayllight penetration through lareg lightwell roof opening as it emphasizes the essence of power.

Natural , Mechanical and Atrium Ventilation

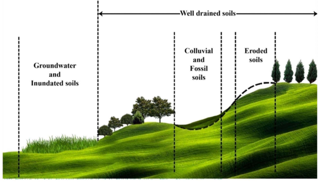
The natural ventilation design is simple and robust. The environmental design approach for the building aims to maximize ventiltion through the atrium spaces, window openings and atriums. Therefore keeping air flow constant

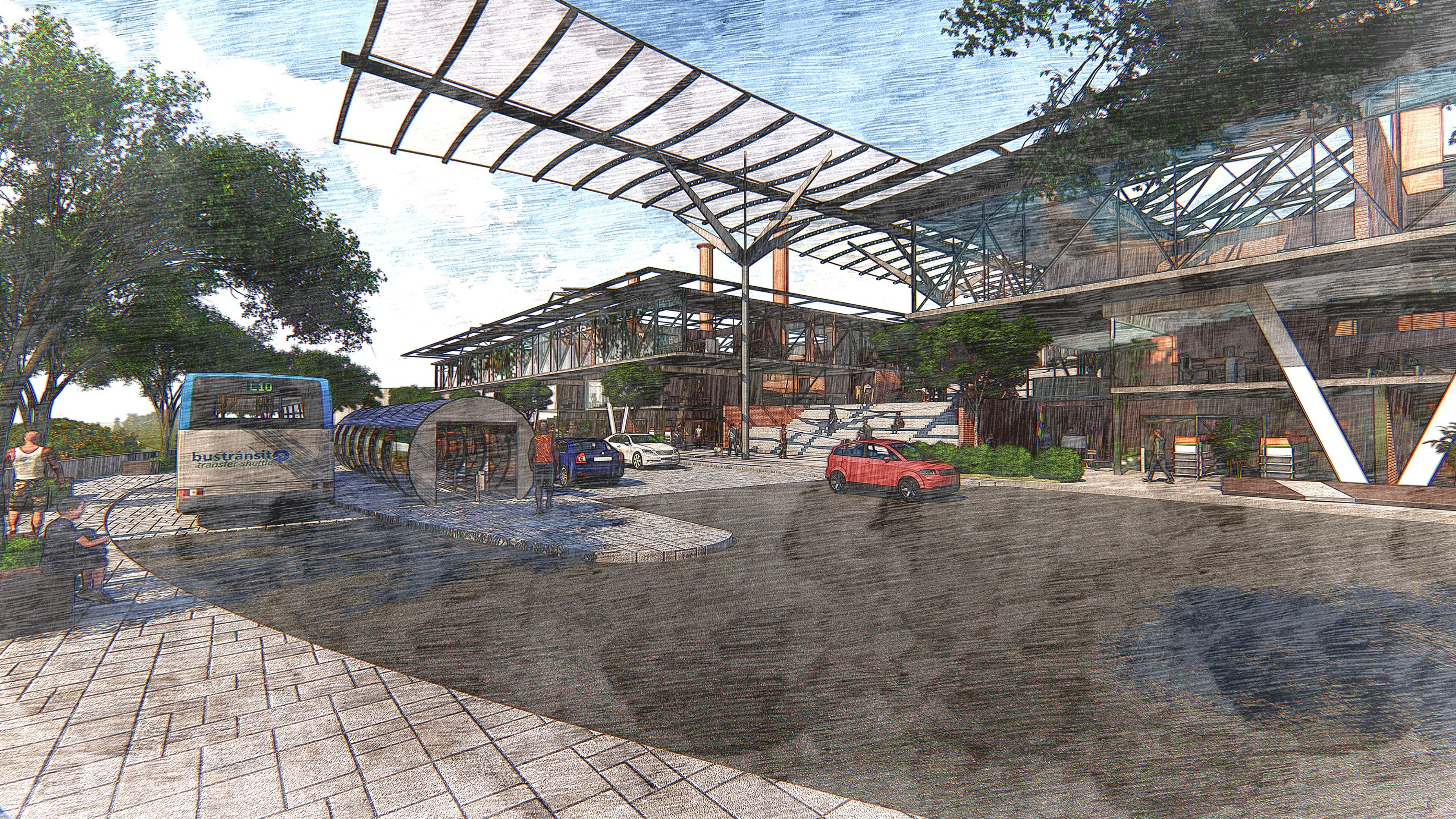
Rainwater Management

Due to the sites drastic slope from west to east, rainwater harvesting is collected by water reticulation systems beneath the structure as it serves as catchement areas.

Outdoor Comfort

The building design provides for the creation of a micro climatic region for comfortable outdoor spaces

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