PROGRAMME

INTRODUCTION

The major issue surrounding mining towns in a South African discourse is that they are often in very remote locations. Apart from the material that is being mined on site, there is very little in the way of natural materials. This along with the fact that mining companies, through their governance of the mining locations tend to limit any development of alternative industry in the area. All of this means that when mining operations cease that the population of these mining towns struggle to find and develop alternative income sources.

Cullinan is somewhat more fortunate in the sense that it is not located in an area of extreme remoteness, and also due to it being the place of the discovery of the world’s largest diamond, it has a fairly successful tourism industry. It is a popular weekend destination, and boasts a healthy culinary industry. This being said there are no obvious alternate industries that can be developed that will take over when the mine closes.

The area surrounding Cullinan has an agricultural heritage, and is still a relatively productive area. The inhabitants of Refilwe practice subsistence farming to help subsidise their food needs. This means that the skills exist to further develop a working agricultural industry that can be linked into the greater Cullinan scenario. The small percentage of the Refilwe population that still work at the mine are medium to high skilled workers.

A relationship exists between the alternative industry production and the public element of the new industry. The alternative industry produces products which are then sold to the public. This direct relationship is in contrast to the normal disconnected production and retail relationship where the two do not happen in the same location.

There also exists a relationship between the new alternative industry and the site. A new approach to existing industrial infrastructure allows the new alternative industry to be housed in that infrastructure. This relationship is thus symbiotic because the industry can exist because it can be housed in the existing infrastructure and the infrastructure can be retained because of the alternative industry.

Figure 6.1 - Diagram showing the relationship between public interaction, industry and rehabilitation (Author 2018)
Cullinan obviously has a highly developed Diamond industry, and the mine is famous the world over. The mine and tours thereof are a significant tourism draw card. Along with the tourism value of the mine itself once the operation ceases to produce there are a host of industrial infrastructure that not only hold significant heritage value, but also provide a large opportunity for alternative industries to be set up in the vacated infrastructure.

As previously stated the communities surrounding Cullinan have an agricultural heritage and the original farm that the mine was located on was once a flourishing farm. The soils in the area are nutritious and fertile. The opportunity exists for the land between the mine and Refilwe to be converted into farmland and land that can hold livestock. There are also chicken farms in the area.

Cullinan already has a thriving culinary industry, with many of the local restaurants actually farming their own produce to use in the kitchens. There is also a fresh produce industry where restaurants from Johannesburg and Pretoria purchase organically grown produce.

Once the mine closes, if Petra Diamonds is allowed to continue with their rehabilitation strategy for the mine, the town will lose a major part of its tourism value. When tourists come to Cullinan they want to see the mine where the largest diamond in the world was mined. Petra’s rehabilitation strategy would mean that only the No. 1 Head Gear and a few other buildings would be left on the edge of the vast pit. This image is not synonymous with the significant industry that exists at the Cullinan Diamond mine. There is already a disconnect between the mine and the town and this type of strategy would only serve to completely disconnect the town from its mining heritage.

The educational component of this project is vitally important because it is directly linked to the SED of Refilwe community. Education and skills development will allow both (retrenched) miners and their family members to develop new skills and trades which will allow them to find new jobs or start their own businesses in a post mining scenario.

The alternative industry’s that are proposed for the site will allow for students to gain practical experience and work as apprentices in whichever field they wish to study.
Agriculture is a key informant for this dissertation. It is the most obvious alternative industry for the communities surrounding Cullinan, specially because there is a heritage of farming and a working knowledge of the industry. The agriculture industry will also be able to supply the existing culinary industry existing in Cullinan.

The bi-products of the agricultural industry will be further used to create biogas which in turn will be used to fire the furnaces of the carbonisation plant. The biomass sludge can also be dried and burnt as a fuel in the carbonisation plant. Products from the carbonisation plant will then be used as feed and fertilisers in the agricultural industry, creating a closed system with no waste.

Figure 6.2 - Diagram showing the symbiotic relationship between agriculture, biogas industry and the carbonisation industry (Author 2018)
CARBONISATION

The process of carbonisation is simply the burning of a biomass in the absence of oxygen, thereby reducing the carbon base biomass to its purest carbon form.

Carbon is a very useful material and can be used in maybe different ways. Commercially carbon is used in the agricultural industry as a fertiliser or as an additive to animal feed. Activated carbon is used in water purification plants. Carbon also has applications in the medical industry, cosmetics industry and in the alcohol production industry.
THE CARBONISATION PROCESS

// PROCESS 1
1-1 // WOOD PALLETS ARRIVE FROM CHEP BY TRAIN FROM JHB PRETORIA AND ROSSLYN
1-2 // WOOD PALLETS STORED INDOORS
1-3 // PALLETES CHIPPED INTO SMALL PIECES
1-4 // WOOD CHIPS STORED IN DRYING ROOM, EXHAUST HEAT FROM FURNACES USED TO DRY
1-5 // DRY WOOD CHIPS SENT TO FURNACE.
1-6 // CHARCOAL QUALITY CHECKED

// PROCESS 2
1-7 // CHARCOAL STORED TO COOL
1-8 // CHARCOAL SENT THROUGH SHAKER DECK, FILTER SCREEN
1-9 // CHARCOAL CRUSHED INTO CARBON POWDER
1-10 // CARBON POWDER SIVED
1-11 // RAW CARBON PACKAGED AND SHIPPED

// PROCESS 3
2-1 // RAW CARBON AND USED CARBON ACTIVATED BY STEAM FROM CHP UNIT
2-2 // ACTIVATED CARBON PACKAGED AND SHIPPED
3-1 // BIOGAS BYPRODUCT FROM FURNACES USED TO POWER CHP UNIT TO CREATE ELECTRICITY AND STEAM
3-2 // STEAM USED IN CARBON ACTIVATION
CHAPTER 07 \|
ARCHITECTURAL INTENTION, CONCEPTUAL APPROACH 
AND DESIGN DEVELOPMENT
FORGING A NEW APPROACH TO INDUSTRIAL ARCHITECTURE

INTRODUCTION

Industrial architecture is an architectural style that developed as part of the industrial revolution, which was characterised by the mechanisation of production. This was the first time that large scale factories were needed to house machinery. Initially these structures were built from the same materials as previous buildings, but the industrial revolution then provided the answer to its own problem, Iron. The introduction of iron as a material, was in its own right revolutionary. The new material allowed for much larger spans, large factory halls, with relatively very little vertical support structure (iron columns). (Wilkinson, 2010, p. 35)

The structural iron-frame became synonymous with industrial architecture. The permutations are almost endless. From a strong frame it is possible to hang, place or attach almost anything to it, and the possibilities for cladding are almost endless. It is also a very economical way to build.

The current approach to industrial architecture differs from place to place, but in a seemingly current period of de-industrialisation most designers are reluctant to use old industrial infrastructure, and are more inclined to push for new developments. However, the economic climate and rising cost of materials is favors adaptive reuse of industrial infrastructure which is the most economically feasible way to redevelop industrial sites.

Figure 7.1 - Urban Framework Plan (Author 2018)

Figure 7.2 and 7.3 - Urban Framework Plan (Author 2018)
ARCHITECTURAL INTENTIONS

Several main architectural intentions were identified as a reaction to the problems that were outlined in Chapter 001. The following will serve as an explanation as to how these intentions developed the architectural solution.

ARCHITECTURAL INTENTION 001

FACILITATING THE DEVELOPMENT OF ALTERNATIVE INDUSTRY

The mine site has developed over the space of 110 years into its current layout. The entire site is designed in such a way to maximise efficiency for the diamond extraction process. The buildings are laid out in a very pragmatic way however, it is clear that there was no form of spatial planning involved in the layouts design. This is particularly evident when one looks at all the separate axes that the buildings are laid out.

The current layout of the site does not lend itself to alternative industries because of its mono-programmatic setup. For this reason, the infrastructure and its layout will have to be adapted to suit the new proposed programmes. The requirements of each on the proposed programmes in terms of sizing and services will need to be understood and the situated appropriately within the existing infrastructure. Where necessary new infrastructure will be developed using recycled materials.
ARCHITECTURAL INTENTION 002

CREATING A PUBLIC INTERACTION WITH INDUSTRIAL PRODUCTION.

“The social life in public spaces contributes fundamentally to the quality of the life of individuals and society as a whole” – W. H. Whyte

“As designers we have a moral responsibility to create physical places that facilitate civic engagement and community interaction.” - W. H. Whyte

Whilst the industrial buildings are fairly adaptable, in terms of function, their layout on the site limits the uses they can support. It is for this reason that the current mine site is difficult to navigate and even when the mine is decommissioned the site remains unfriendly to public interaction. It is therefore important that the site that has been selected will be made into a public friendly site that facilitates an interaction with the industry/industries that surround it.

The development of a public square will be used to facilitate this interaction. Frederick Law Olmsted’s (1822-1903), a visionary landscape architect’s, concept of the ‘inner park’ and the ‘outer park’ (Project for Public Spaces, 2005) is not only relevant to urban parks, but is also relevant to the design of public squares/piazza’s and can be seen in the design of public squares that predate his concept. The concept can be extrapolated to the ‘outer square’ and the ‘inner square’. Two of the best examples of this are the Piazza del Campo in Siena, Italy and the Piazza Bra in Verona, Italy. See Figures 7.4 and 7.5.
ARCHITECTURAL INTENTION 003

A RECYCLED INDUSTRY

The intention is not only to adaptively reuse the existing industrial infrastructure but also to reuse materials from the infrastructure that is no longer needed. The existing material palette and the proposed new palette have many common components. The new buildings and the buildings that are being adapted will use the same materials. There will be a far lesser need to import new materials for the proposed new structures. The existing site currently has a high-embodied energy due to the types of materials that are used in industrial architecture. Therefore, by reusing some of existing structural components and other materials will mean that the cost of the new development will be greatly reduced in terms of embodied energy and carbon footprint.

The manpower needed to dismantle some of the infrastructure and then adapt and reassemble it will also provide a host of jobs for the local community and also allow from the development of skills for the community.
CONCEPTUAL APPROACH

The present mining industry is by nature very mono-dimensional; it only serves the purpose of extracting a non-renewable resource from a site. The mining industry is by definition unsustainable and does not hold any real resilience (ability to adapt) potential. The infrastructure used to achieve this is designed for the sole purpose of production. When the raw material is exhausted the existing industrial infrastructure is no longer needed. This results in the site and related infrastructure being decommissioned and abandoned or decommissioned and demolished. The contrasting approach is to reuse the site and its infrastructure, by repopulating the site with alternative industries and creating a symbiotic relationship between the industry, the public and the industrial heritage.

(RE)INDUSTRIALISATION

In a post mining context, the industry that the infrastructure supported no longer exists. Therefore, the reason for the infrastructure to exist is also redundant. However, the infrastructure still holds value from a heritage and from a latent potential perspective.

The potential exists for alternative industry to reoccupy the infrastructure and once again give the infrastructure a purpose. Care needs to be taken to ensure the integrity of the industrial infrastructure from a heritage standpoint. Each industrial element needs to be evaluated on its merit as a heritage component and then the appropriate theoretical principle needs to be applied so as to enhance the usefulness and potential of each industrial element.
The initial design concept was to create a public square by developing a building on the south east edge of the site. The building was partially submerged in the landscape, and had a green roof.

Figure 7.6 - Early conceptual sketch (Author 2018)

Figure 7.7 - Early conceptual sketch (Author 2018)
DESIGN INTERAION 001

Figure 7.8 - Early conceptual sketch (Author 2018)

Figure 7.9 - Early conceptual sketch (Author 2018)
DESIGN INTERAION 001

Figure 7.10 - Sketch showing development of public square (Author 2018)

Figure 7.11 - Sketch showing development of public square with view to open pit (Author 2018)
Figure 7.12 - Sketch showing the development of public square - staggered building (Author 2018)

Figure 7.13 - Sketch showing the interior spaces of the staggered building (Author 2018)

Figure 7.14 - Sketch showing the interior spaces of the staggered building (Author 2018)
Figure 7.15 - Further integration of public square and surrounding buildings (Author 2018)
Figure 7.16 - Sketch showing the development of buildings
(Author 2018)
FINAL DESIGN - SITE PLAN

Figure 7.17 - Final Design Site Plan (Author 2018)
CHAPTER 08

DESIGN AND TECHNICAL RESOLUTION
DESIGN

PLANS - SITE PLAN

MAIN ENTRANCE
WAREHOUSE ADAPTIVELY REUSED AS SHOPS
SECONDARY ENTRANCE
OUTDOOR AUDITORIUM
PUBLIC SQUARE
EXISTING BUILDING ADAPTIVELY REUSED TO HOUSE A RESTAURANT
EXISTING WINDER HOUSE - ADAPTIVELY REUSED AS CARBONISATION
NEW CARBONISATION PLANT
HEADGEAR NO. 1
VIEWING POINT

Figure 8.1 - Final Site Plan (Author 2018)
DESIGN PLANS

MAIN ENTRANCE
WAREHOUSE ADAPTIVELY REUSED AS SHOPS
SECONDARY ENTRANCE
OUTDOOR AUDITORIUM
PUBLIC SQUARE
EXISTING BUILDING ADAPTIVELY RE-USED TO HOUSE A RESTAURANT
EXISTING WINDER HOUSE - ADAPTIVELY REUSED AS CARBONISATION
NEW CARBONISATION PLANT
HEADGEAR NO. 1
VIEWING POINT

Figure 8.2 - Overall Ground Floor Plan (Author 2018)
DESIGN

PLANS - GROUND FLOOR PLAN

Figure 8.3 - Ground Floor Plan (Author 2018)
DESIGN

PLANS - GROUND FLOOR PLAN - PORTION A

Figure 8.4 - Portion of Ground Floor Plan - Portion A (Author 2018)
DESIGN

PLANS - GROUND FLOOR PLAN - PORTION B

Figure 8.5 - Portion of Ground Floor Plan - Portion B (Author 2018)
DESIGN

PLANS - GROUND FLOOR PLAN - PORTION C

Figure 8.6 - Portion of Ground Floor Plan - Portion C (Author 2018)
DESIGN

PLANS - GROUND FLOOR PLAN - PORTION D

Figure 8.7 - Portion of Ground Floor Plan - Portion D (Author 2018)
INTRODUCTION

The post-industrial fabric of Cullinan consists of the industrial heritage structures and the landscape. There is a disconnection between these structures and the resultant state of the natural landscape. The technology that is used in industrial architecture is simple and precise, it is not overly complicated and is easy and fast to construct. As was the necessity of the industrial revolution. The technical resolution of the proposed development will follow the same principles albeit with modern variations.

TECTONIC CONCEPT

The tectonic concept that has developed as a result of the architectural intentions and programmatic informants is uncomplicated and relies heavily on the existing tectonics of the surrounding infrastructure. The key element of industrial architecture is the portal frame. The intention of the tectonic concept is to replicate the simplicity of the structure whilst adapting it to best suit the programmes of the proposed new industry. Because the majority of the materials utilised, in the construction of the new and adaption of the existing buildings, are recycled, disassembled and reassembled in a different configuration, the tectonics of the existing and the tectonics of the new remain similar. The bolted connections of the steel structural elements remain a central theme of the construction, as does the way in which steel is connected to concrete. The concrete structure however has been modified to form a conduit for the building's services.
Figure 8.8 and 8.9 - Sketches showing detail development (Author 2018)
Figure 8.10 and 8.11 - Sketches showing detail development (Author 2018)
Figure 8.12 and 8.13 - Sketches showing detail development (Author 2018)
SECTION A-A

Figure 8.14 - Section A-A (Author 2018)
Figure 8.15 - Section A-A - Detail 1 (Author 2018)

Figure 8.16 - Section A-A - Detail 2 (Author 2018)
Figure 8.15 - Section A-A - Detail 1-3 (Author 2018)
Figure 8.16 - Section A-A - Detail 1-2 (Author 2018)
Figure 8.17 - Section A-A - Detail 1-1 (Author 2018)
SECTION B-B

Figure 8.18 - Section B-B (Author 2018)
SECTION C-C

Figure 8.19 - Section C-C (Author 2018)
WATER MANAGEMENT STRATEGY

WATER COLLECTION

Figure 8.22 - Diagram showing potential water capturing (Author 2018)
## RAIN WATER HARVESTING CALCULATIONS

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</table>

ANNUAL TOTAL (mm²): 674 1361210.4 141337.8 615699 1851949.8

*Calculated with a 0.9 Runoff Coefficient

Figure 8.23 - Table showing rain water harvesting calculations (Author 2018)

The is a significant amount of water that can be captured from the roofs on a yearly basis. This water will be used to service different parts of the development. See Figure 8.22. Water from the winder house building and the new carbonisation plant will be used in the production of electricity through a turbine. The water will be transformed into steam by the residual heat from the carbonisation furnaces. This electricity will then be used by the buildings on the site, thus further reducing the site’s carbon footprint and operational costs of the site.

Water that is captured (indicated in green) is to be used to supply sanitary fixtures. Water captured from the restaurant roof (indicated in orange) will be stored and used for irrigation purposes. Water that is captured from the main building’s roof (indicated in blue) will flow into storage tanks that will then be filtered to provide potable water to the site. The amount of rainwater captured will be adequate to supply the site’s needs. If there is a shortage of water, underground water can be pumped from the mine and used on site. This underground water is currently the major source of water for the mine operations.
DAYLIGHTING AND SOLAR SHADING ANALYSIS

As previously noted the western and eastern facades need to be protected from direct sunlight and solar heat gain. The roof structures have been designed to provide the correct amount of light into each space.

Figure 8.24 - Solar analysis showing the lighting (21 July) levels for the building without any solar shading devices. In the northern walkway the lighting levels are too high and therefore there will be significant solar heat gain.

Figure 8.25 - Solar analysis showing the lighting (21 December) levels for the building without any solar shading devices. In this scenario the eastern portion of the building experience very high levels of solar heat gain. It is evident from this analysis that shading devices are extremely important for the thermal comfort of the building.
Figure 8.26 - Solar analysis showing the lighting (21 July) levels for the building with solar shading devices. The analysis shows that solar shading devices greatly reduce lighting overexposure and solar heat gain.

Figure 8.27 - Solar analysis showing the lighting (21 December) levels for the building with solar shading devices. The analysis shows that solar shading devices greatly reduce lighting overexposure and solar heat gain. This reduction will enhance the thermal comfort of the building.
SBAT ANALYSIS - COMPLETED SITE

The Sustainable Building Assessment Tool (SBAT) system has been designed to help evaluate the sustainability of buildings in their planned or existing state. The tool can be used by designers to understand the shortcoming of a design or existing building in relation to several poignant criteria, namely economic, social and environmental.

The tool has been designed to be especially helpful for buildings in developing countries, where larger economic and local economic issues are most often one of the key priorities.

The SBAT tool can also be used as part of a design iteration process to evaluate how specific designs functions in terms of sustainability and then enhance the areas where the design is lacking.
Figure 8.28 - View from main square towards brewery and ceramics courtyard (Author 2018)
Figure 8.29 - Internal view of ceramics courtyard (Author 2018)
Figure 8.30 - Internal view of education courtyard (Author 2018)
Figure 8.31 - View from pit towards observation tower (Author 2018)
Figure 8.32 - Northern side of new building towards winder house building, showing headgear No. 1 in background (Author 2018)

Figure 8.33 - Western side of public square towards new building (Author 2018)
Figure 8.34 - Internal view of metal working studio (Author 2018)
CHAPTER 09 \ \  CONCLUSION

The intention of this dissertation was to develop an alternative to the rehabilitation and closure strategies currently planned for the Cullinan mine.

In the not too distant future South Africa faces an overwhelming challenge, which will result from the exhaustion of mineral resources in the mining sector. Mines are reaching a point where the gold and diamonds are either running out, or are too deep to mine safely. This coupled with ever increasing demands for salary and benefit raises for workers and the massive escalation of cost of electricity will force redundancy and job loses on an unprecedented scale.

The development of this alternative strategy means that the people of Cullinan and the people of Refilwe can have a future in a post-mining scenario. Alternative industry will allow them to continue to exist in their current lives albeit with a new skills set, and a renewed outlook on their community.

There has been a considerable investment in providing both infrastructure and housing for workers and staff in mining towns, which, as I have said, are often in very remote locations.

In my dissertation I have a possible solution for Cullinan. It does not represent a blanket solution to the overall problem but because of its historical and its geographic proximity to major centres in Gauteng it proposed a means whereby the town can in a way ‘re-invent’ itself for the benefit of at least some of the people who have made Cullinan and Refilwe home.

The overall problem in this country is vast when one considers the livelihood and well being of the labour force.

Mines have been forced through legislation to make considerable financial provision for the restitution of mining sites, but unless a global that encompasses the future of employees and their dependants is created, it is likely that there will be a crisis not only on humanitarian, but also a political level, which will impact heavily on the future of South Africa.

In a small way i have addressed this future scenario, but there needs to be a widely based an futuristic plan evolved in which architecture necessarily will play a major part.

Although this is a conclusion to my master’s dissertation I remain aware of the great impact that the exhaustion of mineral resources will have on our population in years to come.
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APPENDICES

APPENDIX A - CRITERIA FOR CULTURAL WORLD HERITAGE SITES - UNESCO

THE CRITERIA FOR CULTURAL WORLD HERITAGE SITES ARE:

i. "Represents a masterpiece of human creative genius and cultural significance"

ii. "Exhibits an important interchange of human values, over a span of time, or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning, or landscape design"

iii. "To bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared"

iv. "Is an outstanding example of a type of building, architectural, or technological ensemble or landscape which illustrates a significant stage in human history"

v. "Is an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture, or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change"

vi. "Is directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance"

THE CRITERIA FOR NATURAL WORLD HERITAGE SITES ARE:

vii. "Contains superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance"

viii. "Is an outstanding example representing major stages of Earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features"

ix. "Is an outstanding example representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems, and communities of plants and animals"

x. "Contains the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation"

(UNESCO World Heritage, 2018)