PART THREE

4. REHABILITATION AND INDUSTRIAL BUILDING TYPES

The technology and organisation of work place changes, and so do its location, servicing and spatial demands. Rehabilitation involves both the new user and the old property. In rehabilitation the potential user may be new or may be the existing occupant and that the building needs not to be old, since the procedure can apply to fitting a new tenant into newly constructed facilities. In the case of the Pretoria Technology Park, the user is new while the property is old. The concept of accommodating new activities in a rehabilitated property is a matter of mutual acceptability between the form and the context. The former pertains to the physical entity and the latter refers to the intellectual entity. The intellectual entity seeks to fit within the existing physical form while the form demands certain flexibility from the intellectual context (Lowry, 1981:421).

4.1 Industrial Buildings

Before looking into rehabilitation it is rather preferable to look at buildings as architecture, culture and history. Learning process in the field of architecture uses different ways of approaching historic material. The common method used to analyse historic architecture until the 19th century, is the distinction and classification of works of architecture in chronological sequence in epochs or periods, whereby each reflects a particular morphological unification with common characteristic. Since the 19th century to present buildings are classified according to their affiliation and styles (Lavas, 1986:13). Industrial buildings represent a style reflecting manufacturing processes of mass production. The term industrial architecture, which integrates engineering and architecture, refers to the necessity of building structures to house material handling devices and provide for the proper flow of materials, vehicles and personnel (Ingraham, 1956:10).

Jones (1985:12) suggests that an analysis for industrial architecture should follow two main lines of enquiry:

- that buildings have been placed within their architectural setting in relation both to other types of structure and to the prevailing architectural theories and beliefs (fluctuating in popular tastes).
- that building of industry have to be examined not only with reference to their designers and prevailing theories, but also in relation to local architectural traditions.

Due to advancement in the field of research and development and modern technology know-how in industrial manufacturing, most building structures from the pre- and industrial era, are abandoned, demolished or re-adapted for modern uses.

Historically, industrial activities were not associated with any particular architectural type. In the early days of manufacturing entrepreneurs were mainly focused on the issues of technology, labour organisation and finance, with industrial building architecture occupying a comparatively low priority. Most industrial buildings were simple structures, often rectangular in plan for reason of economy. Initial factories owed their appearances to watermills and cottage workshops. Some were terraced houses converted to business premises (Jones, 1985:12). These buildings are hard to classify as architecturally or historically significant (London, 1981:313).

The rehabilitation of these industrial structures is more likely to be driven by key factors of obsolescence or redundancy, aggravated by poor physical condition (Highfield, 1987:19):

- *Obsolescence* in industrial buildings occurs as a result of a shift in the manufacturing processes.
- *Redundancy* especially in old industrial buildings occurs as a result of obsolescence and age. These old buildings are usually in excellent structural condition comprising of perfectly suitable simple plans and volumes but no more needed for their original use.
- *Poor physical conditions* result when redundant or obsolete buildings stand empty for a long period, neglected, vandalised and after constant effects of the elements.

Prior to any rehabilitation process it is necessary to identify, at feasible stage, the true nature of the old buildings under consideration in terms of kind of space they contain and the kind of fabric they compromise because not all buildings are capable of conversion. A general overview show that buildings of the State Garage has the following characteristics, which according to recommendations by Eley and Worthington (1984:21), could be converted to light industrial units:

- Use category: industrial
- Building type: factories and offices
- Period: 19th to 20th century
- Characteristic location: urban
- Configuration: irregular bays
- Construction: brick, timber, steel and concrete
- Site coverage: 40% to 80%

The Pretoria State Garage courtyard comprises of industrial type of buildings. Most of the buildings stand obsolete due to a shift from its original use as a supplement for the South African Mint, accommodated laboratories of the South African Bureau of Standards (SABS) and Trigonometrical

Survey Department (TSD) (Joubert *et al* 1973:1). The site presently serves as a garage for state vehicles. The building structures are in physically good condition. The building configuration and volumes are suitable to be converted to a centre for light industrial manufacturing.

4.2 Advantages of Rehabilitation

This section analyses the advantages offered by building rehabilitation, which in most cases appears to be a more viable means of providing needed accommodation rather than opting for new construction. Highfield (1987:1) provides a list of four points, which are likely to advance rehabilitation and re-use as a better option than new construction:

1. *The availability of raw material*

Modern industries demand sophisticated building interiors, which results in a large number of old industrial buildings standing outdated, redundant or obsolete. This provides a surplus of building material suitable for rehabilitation and re-use.

2. *The quality of raw material*

Surplus of old industrial buildings in urban areas are still structurally sound because most of these buildings were overbuilt due to uncertainties in building safety and regulations. Unfortunately, the value of these structures has not always been recognised because years of neglect and lack of maintenance have made them appear shabby and decayed. The frequently unsightly appearance of these buildings should not blind communities to their potential for re-use by new industry or conversion to needed housing or small industries (Bunnell, 1978:47).

3. *The shorter development period*

One of the principal advantages of opting for rehabilitation rather than demolition and new construction is that, in the majority of cases, the new accommodation will be available in a much shorter time. Building renovation can take place in stages and in a comparatively less time than new construction. In addition to time saved during the construction phase, time is also saved during the pre-contract design and planning permission phases, which normally take much longer for new development than for rehabilitation, even where a change of use is proposed for existing building Bunnell (1978:10).

4. *The economic advantages*

The cost of converting a building is generally much less than the cost of new construction, though it is the nature of the rehabilitation property that will have a considerable bearing on the conversion cost. In addition, Bunnell (1978:8) describes some of the many contributing reasons on economic advantages as follows:

- Rehabilitation cost is greatly influenced by labour-intensive process than high cost of building materials for new construction.
- The already available infrastructure on a rehabilitated property saves the high cost of purchasing undeveloped land.
- Rehabilitation minimises the cost and energy used in building demolitions.
- Renovated properties often attract tenants that are willing to pay competitive rental rates.
- Old buildings are often acquired for a comparatively low price due to the deceiving superficial decay and poor exterior appearances of many neglected old buildings. Renovation can provide tax advantages.
- Most local authorities provide financial incentives for building rehabilitation.
- Rehabilitation imposes fewer public and social costs than new construction.

4.3 Rehabilitation Process

The rehabilitation process can be executed in varying degrees ranging from least drastic option of low-key rehabilitation to the most drastic option of leaving only the facade standing, with the erection of a completely new structure behind or total demolition of the building and erecting new buildings. Following is the scale of seven redevelopment options by Highfield (1987:20):

- *Option 1*: Retention of the entire existing building structure, together with its internal subdivisions, and upgrading of the interior finishes.

- *Option 2*: Retention of the entire existing external envelope, including the roof, and most of the interior, with minor internal structural alterations, and upgrading of the interior finishes, services and sanitary accommodation.

- *Option 3*: Retention of the entire existing external envelope, including the roof, with major internal structural alteration and upgrading of finishes, services and sanitary accommodation.

- *Option 4*: Retention of all the building's envelope walls, and complete demolition of its roof and interior, with the construction of an entirely new building behind the retained facade.

- *Option 5*: Retention of two or three elevations of the existing building, and complete demolition of the remainder, with the construction of an entirely new building behind the retained facade walls.

- *Option 6*: Retention of only one elevation, a single facade wall, of the existing building, and complete demolition of the remainder with the construction of an entirely new building behind the retained facade.

- *Option 7*: The most dramatic redevelopment option would be not to opt for rehabilitation, but to totally demolish the existing building and replace it with a new building.

During the rehabilitation process most structural elements are affected and Bidwell (1977:20) cautions that in major structural alterations, such as the removal or re-sitting of load-bearing walls, may lead to the redistribution of loading on other walls. The removal of internal cross walls may also lead to the instability of the external walls to which they are tied. Also, the effects of such measures on the interior appearance of the building must always be carefully considered. External brick walls may present greater problems. It will occasionally be possible to strengthen the existing brickwork with a new independent inner leaf or piers to carry the extra load, but where this is not possible, careful reconstruction may be inevitable. In such cases, every effort should be made to salvage as many of the exiting bricks as possible for re-use.

In terms of openings, demolitions and extensions Bidwell (1977:20) cautions that:

- Increase in the width of existing openings or the formation of new openings will also call for careful consideration to be given to the effects on the adjoining structure. Since the tendency will be to concentrate loading on to smaller areas of wall, some form of strengthening may be necessary.

- Demolition should be carried out with care. The effects on the remaining structure should be assessed, to ensure that its stability will not be impaired, and the material of the parts removed should be carefully examined to see whether they would be suitable for re-use in the repair and restoration of the remaining parts. Some of the aspects to be considered are the extensions, to assess whether or how they are to be tied into the existing brickwork, what effect they will have on sub-soil conditions and foundations, and whether they will set up any direct or indirect stresses in the existing building.

The nature of role players in the building rehabilitation varies and requires standardised guidelines to allow for a comprehensive rehabilitation in cases that share similar concerns. Theron (1983:2 and 46) establishes the following ten general guidelines for rehabilitation, which are based on the 1980 standards for rehabilitation by the United States Department of the Interior and adapted for local conditions and specifically for the rehabilitation of the 19th century Port Elizabeth:

1. Every effort should be made to integrate alteration with an existing building or its surrounding property.
2. The distinguishing original character or qualities of the building and its site should not be diminished or destroyed.
3. All building types and structures including their site should be recognised, as products of their own time and alterations, which have no historical basis, should be avoided.
4. Changes, which have occurred during the course of time, should be regarded as evidence of the history and development of a building and its environment.
5. Any distinctive stylistic features, examples of skilled craftsmanship or ornamentation that characterise a building should be treated with care and sensitivity.
6. The gentlest method possible should be used for the cleaning of structures.
7. Every reasonable effort should be made to protect and preserve archaeological relics affected by or adjacent to any project.
8. Any alteration and additions designed for an existing property should be encouraged provided they do not destroy any significant historic, architectural, or cultural material.
9. Any new development carried out in the area should be adapted to the environment in an unobtrusive manner.
10. It is important to seek advice from qualified professional, such as architects, architectural historians and archaeologists skilled in the preservation, restoration and rehabilitation of old buildings.

5. ASSESSMENT FOR THE REHABILITATION OF THE PRETORIA STATE GARAGE

Rehabilitation of the Pretoria State Garage is vital for the site to retain and reflect its cultural significance. The Burra Charter (1999) defines the term "*cultural significance*" as the aesthetic, historic, scientific, social or spiritual value for past, present or future generations.

Pretoria State Garage is a courtyard site with masonry warehouses, garage and factory buildings, of repetitive character, with site coverage of approximately 80%. The site comprises of a number of building structures, which can be classified according to the building type, configuration and chronology. The nature of each existing structure determines the limits of its adaptability to new uses and additions. The building heights range from single to three stories.

Rehabilitation of this site aims at enhancing the traditional industrial image of the site, eradicate sense of abandonment and general dilapidation, motivate local authorities and produce an image that inspires the idea of a safe environment. Rehabilitation will include demolition of unwanted structures, general thoroughfare planning, which enables pedestrian interaction and improve access onto the site from the existing main entrance. Rehabilitation and retention of all of the existing buildings is not feasible because of the space needed to accommodate parking, landscaping and easy access and communication routes between significant buildings. The State Garage site currently contains a significant number of small single-storey buildings that flank most buildings that would be vital and maintained for the rehabilitation process.

5.1 History of the Pretoria State Garage

The Pretoria State Garage activities are currently housed in most buildings on site including those previously owned by SABS. Also on the site is the redundant Trigonometrical Survey Department (TSD) building that presently serves as storage for various government departments. Though the TSD building functions independently from the State Garage, it forms, and will be considered to be part of the State Garage due to its contribution and common architectural values shared with the rest of the buildings on site.

The site developed in a number of phases starting early in the 1940's. Though not much information is available relating to the history of the State Garage, it is evident from the assessment of physical elements that the site has undergone functional and physical changes. The street and site boundary patterns changed considerably when the site was cut-off from the (former) Mint. Schubart Street was extended southwards from Visagie Street towards Minnaar Street and from that point cutting diagonally through the southern site of the former SAR diagonal (southwest) to join Potgieter Street (figure 7). As a result of the area (land) lost during the extension the Pretoria City Council compensated the Pretoria State Garage by offering an empty site, south of the site across Minnaar Street (Joubert *et al*, 1973:2). This site is presently used as parking and it is therefore proposed as a possible site for the relocation of the current State Garage functions. Among other modifications on site, available drawings show a proposal for the extension of block E during 1945-6 and the renovation of the site in 1977 following a proposal by JON Architects (Joubert *et al,* 1973).

5.1.1 Site and space description

Building site

Building facades are divided into vertical and horizontal sections by standard window patterns and concrete lintels (figure 9). Most windows are rectangular standard industrial types. Rayfield (1994:99) recommends that window mullions should be consistent because irregular mullions spacing leads to difficulty in achieving consistent office sizes. Regular mullions provide perpendicular interface between the partition and the perimeter without awkward conditions. Rooms are cubical and form simple large boxes, with most floor heights common ranging from 3.9m, 4m, 4.4m, to 5.5m. Most rooms are spatially defined with doors designed not necessarily to enhance the maximum sense of depth. These doors can be detached and redesigned to help achieve the perceptual and behavioural organisation of the room interior.

Figure 9: North elevation of Administration Building (D1) (Source: Photo by author)

Space and architectural descriptions

An in-depth analysis of architectural spaces on site is necessary prior to any alterations. It is imperative to analyse the full ontological potential of spaces, which if understood, designers could begin to incorporate such considerations into their new design process (Leach, 1997:xv). An analysis of the architecture of the Pretoria State Garage is contained within the functional aspects, which tend to be detrimental to any semantic perspective. Rather relevant would be a review of the architectural theories at the time of Pretoria State Garage, since these might have had a substantial contribution to decision making of the times.

Sometimes, it is difficult to reach a comprehensive analysis of existing structures because some architectural designs show less clearly defined architectural principles, affiliation or generally under-training (Leach, 1997:xv). Thus, an evaluation of the existing architectural space should be minimised within the existing contemporary knowledge of the site and its designers. The interior of most buildings of the State Garage is characterised by static, rectangular and occasionally dark spaces (figure 10). Most internal walls are covered with painted cement plaster. White painted plaster and gypsum-ceiling boards define most ceilings except where the roof structure is exposed (blocks E, C2, C3, D2, D, K2, K3, L2 and L3).

Figure 10: Interior of Administration Building (Source: Photo by author)

Finally, the purpose of this investigation is not to question or interrogate the architecture on site but to extend the viability and improve the spatial qualities of buildings. This will include the analysis of exterior spaces because they form an integral part of activities on site. Todd (1985:5) cautions that exterior spaces should be planned together with interior spaces and not left out to the waste of the client's money. The design of buildings should also be informed by the nature of its site as to avoid unplanned space and uncomfortable visual or physical relationship between the built and surrounding spaces, such as the uncomfortable space between blocks D3 and E (figure 11).

Figure 11: Space between D3 and E (Source: Photo by author)

5.2 Philosophy of new insertions

This section presents an introduction into the vast and sophisticated nature of the philosophy of new insertions onto existing sites. In addition, this section intends to stimulate debate on whether or not such new insertions can reflect local architectural value. This argument is warranted by the prevailing universal concerns about the investigation of the nature of local architectural values. Architecture, as according to Leach (1997:xiv), is not the autonomous art that it is often held out to be but buildings are designed and constructed within a complex web of social and political concerns. Throughout time, the State garage was designed and constantly expanded for purely utilitarian purposes and not merely architectural.

There should be a distinction between the former structures and new insertions that speak contemporary language. The dividing line is distinct as manifested by different architectural and philosophical approaches. Such opposing architectural manifestations usually pose questions to people's attitudes, including leading figures such as designers, due to different architectural affiliations. In addition Leach (1997:xviii) argues that:

"*The process of rehabilitation and new insertions are didactically related and that the one anticipates the other in a mechanism of reciprocal presupposition*".

As a result, within the rehabilitation framework of the state garage no one is bound to do replicas for the sake of history but bring about consistency and comprehensive super-imposition of new insertions.

5.3 Comprehensive planning

Comprehensive planning focuses on the general locations, philosophies and guidelines for major design features (Todd, 1985:7). This will include general demolition on site, demolition of interior partitioning, office space planning, vertical transportation, exterior spaces, handicapped accessibility, site entry and exit, and parking.

5.3.1 General demolitions on site

The current image of the site undermines the architectural potential and the viability of the site. This situation is a result of sporadic erection of relatively small structures attached to main buildings. These structures obscure the architectural qualities and cause structural defects such as cracks on main buildings and should, as a result, be demolished (figure 12 and 13). The demolition of these structures inevitably reduces the historic material fabric but is deemed to be vital for a productive future of the site. Interior and partial demolitions are dealt with separately during the descriptions of individual buildings.

Figure 12: Typical examples of flanked buildings (G1, G2 and G3) (Source: Photo by author)

Figure 13: Structural crack caused by attached structure (J) on K2 (Source: Photo by author)

This study proposes the demolition of buildings A, B1, B2, D4, D5, D6, D7, E, F1, F2, G1, G2, G3, H1, H2, I1, I2, J, L, M1, M2, O1 and O2 (figure 36). The demolition of these flanked structures reduces the historic material fabric but it is inevitable because they undermine the architecture and the viability of the site. The boundary wall is also due for demolition because it obscures the architecture of the site and in the past it encouraged architecturally unworthy structures such as the erection of the barbeque stand located west of L1 (figure 34).

5.3.2 Demolition of Interior Partitioning

Most interior partitions are destined for demolition warranted by the fact that they create static spaces (figure 18), which do not conform to flexible office planning discussed below in 5.3.3. Such alterations can take place because most partitions are not structural. Demolition of the existing partitions should be such that it should not present any unusual problems or structural instability. If, however, the partitions to be removed are structural, then they carry part of the structure and cannot be removed before measures are taken to transfer the loads they carry to a substitute structure or to modify the bearing partitions accordingly. When removing any partitions, whether entirely or only partly, special attention must be paid to any piping, conduits, or wiring that may be embedded in the partition and must be cut or re-routed.

The choice of new partitions, apart from economic considerations, will depend on weight considerations, fireproofing regulations, locally applicable building codes, and aesthetic and design preferences. The use of prefabricated modular partitions provides the design with high flexibility of partition layout combined with the possibility of frequent changes (Lion, 1982:48).

5.3.3 Office space planning

There are three basic approaches to office space planning: closed plan, open plan, and modified open plan. Open and closed plans were never entirely accepted (Salata, 1984:17), but modified to fit specific needs. In designing the interior Rayfield (1994:92-99) provides a list of criteria that can be used as a foundation to evaluate the above plans:

- *Space utilisation.* This section refers to the efficiency and density of the planning concept. In terms of space utilisation, the open plan is more efficient than closed plan because of the following three reasons. First, the closed plan rectilinear rooms do not allow flexible manipulation of space. Second, in case of rooms aligning along the wall perimeter, the room partitioning should align with window mullions and column location. Third, additional space is required to cater for private door swings and stand areas.
- *Planning flexibility.* Open plan offers more flexibility than closed plan. In closed plan alterations could be costly considering that in most cases walls are relocated. Relocating walls could mean that mechanical, electrical and lighting systems and carpeting are also affected.
- *Communication among personnel.* The advantages and the disadvantages of both closed and open plans depend on the kind of communication that the working environment requires. Closed plan is less conducive to interoffice communication among personnel than is open plan.
- *Office technology flexibility.* Closed plan provides more limited flexibility in responding to changes in office technology, primarily because of the difficulty in changing wire distribution for electrical and data cabling and outlets. Open plan allows great ease in interior reconfiguration.
- *Visual expansiveness.* In closed plan visual expansiveness is limited due to partitions. Open plan provides visual expansiveness that windows are opened to the whole interior than to private office spaces in closed plan.

- *Visual privacy.* Most office design requires visual privacy to reinstate a desired organisational culture or provide for specific duties. Closed plan provides greater manipulation of such desired spaces than open plan. The commonly used method to provide visual privacy to the open plan is through usage of floor standing panels, file banks or plants. This is required for managers of the park and open plan for those in the clerical support personnel who must deal with the public.
- *Acoustical privacy.* Acoustical privacy can be achievable in both open and closed plans spaces through usage of insulating walls and floor-to-floor partitions.
- *Security.* Closed plan provides for better security to classified and confidential material than open plan.
- *Cost.* An evaluation of cost with either planning approach must be considered in the context of the life of the projects and the number and extent of modifications of the space.

Vital to office space is the support and amenity spaces. Such spaces are needed for communal activities and compromise as much as 25% of the total floor space in an office building (Salata, 1984:17-40). These communal activities are divided into *communal working areas, leisure* and *amenity areas, and reception.*

- *Communal working areas.* These are areas used to provide for working groups, conferences, meetings, office machine processing equipment, goods lifts, cleaner's cupboard, and storage.
- *Social and amenity areas.* These include toilets and washing facilities, catering, and external amenity space.
- *Reception areas.* This is a lobby functioning as a recipient for visitors and security checkpoint and convenient point to monitor the building exterior.

5.3.4 Vertical transportation

Most stairs and lifts in the Pretoria State Garage buildings need to be upgraded to fully comply with the present building regulations [contained in South African Bureau of Standards (SABS) 0400-1990]. Their size and location do not conform to modern office design and building regulations and it is therefore necessary that they be upgraded and strategically repositioned. Installing a new stair, or even enlarging an existing one that is found to be too narrow to conform to building regulations, can create many problems. Apart from widening their space, it may entail extensive structural changes to the existing framework (Lion, 1982:90).

There is a need to install new stairs in most building blocks and particularly blocks D3 and C5, to meet the proposed new activities. In case of retaining existing structural elements, alterations might entail extensive structural changes to the existing framework. If the structure is able to assume the additional loads then it becomes a matter of framing new openings at each floor level and supporting whatever portion of floor has lost its continuity. The support can either be by means of new beams and columns, if required or by means of bearing partitions extending for the full height on each floor. If, however, the floor systems cannot assume the additional loads, it may be necessary, apart, from framing openings, to have an independent stair shaft built within the building (Lion, 1982:90)

Figure 14 illustrates a lift located on the eastern side of D1 that does not comply with present building regulations and certainly unfavourable for the image of the administration building. Both blocks C1 and D1 require new installation of lifts and elevators, incorporated within a new spatial design.

Figure 14: Lift in building D1 (Source: Photo by author)

5.3.5 Handicapped accessibility

The State Garage, like many buildings in Pretoria, does not provide full accessibility and facilities for disabled persons. Part of the new insertion strategy is to incorporate requirements for the handicapped. Such design guidelines are specified in the *Code of Practice for the Application of the National Building Regulations* (SABS 0400-1990:151- 155).

5.3.6 Exterior spaces

Part of the building site is the external hard spaces, which interact with buildings, plants and landforms. In most science parks such as Sophia Antipolis and Cambridge Science Parks exterior spaces play an important role in determining the image of the park. Their design should be incorporated into the entire design process. This study will only concentrate on the comprehensive planning of the exterior and not explore the design and the technological aspects of landscaping.

Insufficient circulation spaces and the proximity of buildings in the courtyard may result in the exterior spaces dominated by hard paving. According to Pinder (1990:1) the function of the paved surfaces will generally address the following interdependent issues:

- *Practicalities*, to provide a surface that addresses the quality and properties of used materials.
- *Direction*, to reveal the identity of different areas and guide people to various destinations.
- *Repose*, to provide neutral areas between highly functional spaces for resting or social purposes.
- *Hazard*, to provide awareness of dangerous areas, including junctions and pedestrian crossings.
- *Scale*, which addresses usage of materials, especially of different sizes, qualities and properties and their interfaces to each other and to the surrounding.
- *Use*, which reflects on the ownership of the property, whether private or public.
- *Character*, which offers a particular identity to the demarcated area.

The landscape of the Pretoria State Garage will probably be dominated by new design due to lack of elements of architectural significance. A challenge to the designer is to allow free and continuous circulation on site. This is regardless of physical barriers that occur on site distinguishing different areas on site. Such barriers must be subtle to allow for smooth transitions from one area to the other (Todd, 1985:5). A further investigation should address issues of overall lines, widths, location and form of junctions, relationships with associated land-form, planting, footpaths, walls, steps and buildings (Pinder, 1990:11). Figure 15 shows an area designated for central pedestrian area following the demolition of buildings G1, G2, G3, H1, H2, I1, I2 and J (figure 36). This area is centrally located such that it visually and physically connects to all major buildings and routes.

Figure 15: Pretoria State Garage central yard (Source: Photo by author)

5.3.7 Site entry and exit

There is a need to create a common entrance for the site though the necessity for secondary entrances is inevitable due to scattered nature of buildings on site and that most buildings have street facades, though not on site boundary line. Currently the state garage can only be accessed from three entrances (figure 36):

- The main entrance is located along Visagie Street between building D1 and C1. This entrance is used for both pedestrians and vehicles (figure 16).
- A secondary entrance exists along Visagie Street between building B and C1. This entrance is currently locked and offers a narrow visual contact to the designated central pedestrian area (figure 36).
- A service entrance is located along Minnaar Street between building H1 and K2.

Figure 16: Main entrance (Source: Photo by author)

It is vital to create an entrance that will allow easy access to both pedestrians and vehicles. High traffic on Visagie Street does not allow that. The rehabilitation of Minnaar Street could be extended towards the park in order to create a suitable main entrance to both the technology park and parking to the south (figure 37). This will also emphasize the north-south axis of the park. The rest of the entrances could be maintained and enhanced for future access into the park. Blocks B, C, and D have north facing street facades, which if enhanced, could be utilised as architectural interface between the park and visitors.

5.3.8 Parking

An adjacent vacant site, across Minnaar Street to the south, may be used to accommodate a multi-storey building for parking. This initiative should provide much needed parking for the Pretoria Technology Park and adjacent sites. This site covers approximately one acre and a maximum parking plan should be reached to meet parking needs. The design of the multi-story building should take into account the existing architectural designs in the vicinity. Most current functions of the State Garage could be relocated to this site in the future.

6. ASSESSMENT OF PHYSICAL FORMS

This section assesses physical forms of the State Garage and establishes appropriate remedial measures for the rehabilitation and restoration processes. This framework focuses mainly on the old brickwork but includes other integral building components such as exterior openings, roof structures and concrete structural elements. It offers a broader assessment of problem areas and solutions and an insight into whether rehabilitation and restoration are possible to certain areas of the State Garage buildings. The rehabilitation process should be carried out without adversely affecting the architectural character or stability of the building. Remedial measures are also suggested in this section for the purpose of understanding the general principles that apply to specific cases. Any intervention on site should be preceded by a thorough inspection in order to realise the true nature of these physical features. Thus, proper remedial measures can be suggested. Aspects pertaining to the restoration of brickwork are quoted from Bidwell's (1977) "*The Conservation of Brick Buildings*" due to a wider framework that this book offers in terms of the restoration of brickwork.

The most common enemy factors contributing to the instability of the State Garage brickwork are water penetration (especially capillary moisture and roof leakage), decay and structural instability (caused by flanked buildings). Important aspects discussed of building rehabilitation and restoration include: foundation failure, leaning and bulging of walls, cracking of walls, structural frame, exterior openings, roof and sheet metals, cracks relating to arches and lintels, built-in timber, iron and steel members, bonding or brickwork, sulphate attacks, corrosion of reinforcement, mortar, interior restoration, energy aspects. These are aspects and failures are common to most old brick building and form a framework reference through which physical features of the Pretoria State Garage building structure could be investigated for further analysis. The following is a summary of the above-mentioned types of building failures and how such failures could be remedied. Different building defects analysis and remedial techniques for building elements discussed below are available from a wide range of maintenance and preservation guidelines and could be applied according to the level of craftsmanship and equipment available.

6.1 Foundation failures

Foundation failures can be the results of overloading on the foundation structure, differential settlement, or movement of the ground, and produces the characteristic symptoms of leaning, bowing and cracking. These have not been identified on site. As a matter of precaution r*emedial measures* suggest a possible redistribution of the loading move evenly and to relieve the foundation of the excess load. In terms of differential settlement, the remedial measures will usually involve tying the two elements together (in an acceptable manner). However, where there has been horizontal as well as vertical movement, rebuilding may be required. In terms of subsidence and soil movement, underpinning in some form will probably be necessary.

6.2 Damp patches

Dampness on walls is a common feature inside State Garage buildings (figure). This is mainly caused by direct penetration of rain through leaking roofs and gutters, leaking pipes, rising damp, hygroscopic salts and condensation within the building. It is important that the real cause of dampness be identified so as to select the appropriate remedial measures. Possible additional sources include lowered internal floor to the external ground level and high levels of water table. Remedial measures suggest that reconstructing the point of penetration should prevent dampness and prior to that an accurate investigation of the cause should be established (Ashurst & Ashurst, 1988:1). However, most corrugated iron roofs require replacement.

Rising damp is characterised by a descending moisture gradient within a wall from ground level sometimes to a height up to 1.5 meters. The main causes of rising damp are movement of water through capillaries and the amount of moisture absorption usually through the mortar, which also increases the damage caused by the crystallisation of salts. Removing the source of dampness can easily eliminate rising damp. Hygroscopic salts attract moisture from the atmosphere. These salts occur as a result of deposits from the wetting/drying rising damps. Remedial measures suggest that hygroscopic salts be removed by clay poultice.

Figure 17: Capillary moisture (Source: Photo by author)

6.3 Cracking

Cracking in buildings occurs in various ways that have to be investigated to determine the relevant remedial measures. Following methods investigate the different aspects of cracks in old buildings:

- The width of the cracks, which are classified in three groups of fine (width up to 1.5 mm), medium (from 1.5 mm to 10 mm) and wide (above 10 mm). Figure 13 shows a wide structural crack caused by flanked structure J on K2.
- The route of the crack, whether it passes (usually diagonal) through the brick joint, leaving the brick themselves undamaged, or passes through individual brick as well as joints (figure 18).
- Investigate whether it is the internal or external wall that has to be repaired. In figure 13 it is the external wall that require repair.
- When repairing external walls, the nature of the brick should be considered in relation to different mortar constructions of jointing (flush, raked or weathered) and pointing (flush, tuck and bastard tuck). These must be documented for the establishment of proper remedial measures during repair and restoration of brickwork.
- Fluctuation of crack in width with the season.

Remedial measures suggest that cracks can be remedied by cutting out and rebuilding, raking out filling and repair of the material. The measures are applicable to different nature of remedies required under specific circumstances.

Figure 18: Structural crack on block L (Source: Photo by author)

6.4 Built-in timber, iron and steel members

Attention should also be given to failures of related parts of old brickwork building such as *built-in timber members* and *built-in iron and steel members*. These are not visible and their existence not shown on available drawings.

Built-in timber members

The most common structural elements in such failures are timber joists, bearers, plates, lintels, stud framing and bonds timbers. Failures of such timber elements can have considerable effects on the walls, drastically reducing or eliminating lateral support, causing distortion, fracturing and occasionally outright collapse.

Remedial measures suggest the definite removal of the rotten timber treatment to eliminate any rot or insect attack present and the filling of cavities thus left, either with brick or concrete.

Built-in iron and steel members

The corrosion of iron and steel members embedded in brickwork may well cause fracturing, distortion and loosening of the bricks immediately surrounding the built-in members.

Remedial measures suggest that wherever possible corroded iron and steel should be removed from the wall and cavities bricked up. If this is not possible the ends of the iron or steel member should be cleaned until they are free from rust and protected by zinc-rich paint or bitumen before the brickwork is rebuilt. Where ties have failed through corrosion and are considered necessary to the safety of the structure, ties of stainless steel, non-ferrous metal or mild steel, should replace them and in any case care should be taken to prevent future ingress of water.

6.5 Cracks relating to arches and lintels

Cracks on arches and lintels are usually caused by the lack of properly formed abutments and the same problem can arise from the excessive deflection of a lintel over an opening.

Remedial measures suggest that when an arch abutment shows signs of failure it will normally be necessary to reconstruct both arch and abutment. Where the brickwork over a lintel has moved excessively it will be necessary to replace the lintel and rebuild the brickwork.

6.6 Failure in the bonding or tying-in of brickwork

Walls of the State Garage buildings appear to be stable. Investigating and applying some of the following remedial measures may rectify future leaning and bulging of walls.

Failure of facing leaves

This failure occurs, in most cases, to walls consists of two skins of bricks. The outer is more deceptive giving solid quality and the inner built by whatever brick possible and the bonding and coursing tended to be erratic. Symptoms are local bulging in the exterior face of the wall, often adjacent to window reveals, where a gap will open between the window frame and the brick reveal and arch soffit, or between window openings. Often the failure is accompanied by the disintegration of the mortar.

Remedial measures will be directed towards correcting the lack of bond between the brick skins. In severe cases, this may well mean that the affected parts of the wall will have to be taken down and rebuilt. Where only small areas of brickwork are involved it may well be possible to rebuild the area of loose facing brick only, obtaining a key to the inner skin by the use of metal ties, which can be secured into the load-bearing part of the wall, or by cutting out cavities to allow the headers to be secured right back into the inner skin.

Junction between structural walls

The junction between structural walls is another potential source of weakness in a brick building, being dependent for its strength on regular and sufficient bonding. The cracking is usually due to the movement of the external walls and again it must be established whether they are still moving.
Remedial measures suggest cutting out the crack and to stitch across it with new brickwork, with adequate bonding, block bonding of bonding at every course is not possible. Additional strength can be provided by its ties set into the brickwork horizontally in chase at about one-meter intervals.

Wrought iron structural ties

In many old buildings there are existing ties, usually of wrought iron, either rods or straps fixed back on the floor structure, taken through the wall and terminated on the exterior in an iron roundel or a cross made up of two length of flat iron. Cracks in the brickwork radiating out from or associated with the roundels or crosses or serious distortions of the floor structure may indicate that movement is still occurring and that further remedial measures will be required.

6.7 Sulphate attacks

Sulphate attacks are likely to occur when the sulphate can be transferred from the brick to the mortar and can cause severe damage or failure of the brickwork. The severity of the attack will determine the remedial measures, but in all cases the most important requirement is to remove sources of water where only particularly vulnerable elements such as parapets have been affected, it may be sufficient to modify the detailing to prevent moisture from building up. In some severe cases, however it may be necessary to rebuild. The rebuilding may have to include the use of sulphate-resisting cement, flue lining and, if it is possible from the point of view of appearance, bricks of low sulphate content.

6.8 Corrosion of reinforcement

Where moisture has penetrated to the reinforcement, often due to inadequate maintained pointing and failure of rainwater goods allowing the walls to get saturated in places, the reinforcement then corrodes leading to horizontal separation at the mortar joints.

Remedial measures suggest that once the reinforcement has started to corrode it will tend to continue to degenerate even if the source of moisture is removed. It is therefore necessary to cut out the corroded iron and if necessary replace it with galvanised steel, before making good the mortar joint.

6.9 Structural frame

Roofs of blocks C1, C2, D1, D2, K2, K3, L2 and L3 are supported on steel structures. Future sagging may be require jacking up and reinforcing the beams by welding or bolting on steel plates to provide greater stiffness. Lion (1982:28) cautions:

"an older building is in static equilibrium and that any alterations to the building structure may have unexpected and undesirable effects as a results of upsetting the equilibrium and releasing latent stresses inherent in the structure".

A thorough inspection on site should be carried out to determine the seriousness of the structural status, especially the weaknesses, as to determine appropriate remedial measures.

6.10 Floors

Most buildings on site contain double-volume spaces with the exception of the two administration buildings and blocks L1 and K1. Floors are usually made from reinforced concrete and covered using tiles or screed. Most floors are likely to be ground to allow for new services ducts and light-wells.

6.11 Exterior openings

It is possible that certain windows and doors in old buildings require complete replacement. The wood sash may be rotten, sash balance may be broken, or steel sash may be rusted badly. Windows in old buildings usually have small panes with consequent loss of light. Chances are that metal windows, which will have to be custom-built, will replace the old windows. The replacement windows must have a perfect fit to ensure proper weatherproofing of the openings. Some of the types of windows and doors used in the state garage include: fibreglass louvers, SS 31, ND9, SSF 53, SS 53, NSDAS, NDAS, NDDA and SS 32. Most windows do not need replacement but repair.

Exterior doors require replacement, in which new case frames are needed. Another complication will develop if the doors are not large enough to satisfy exit regulations. In such a case it may mean that, in addition to changing doors and frames, structural alterations will have to be made to accommodate the larger doors. Using pre-finished metal doors and frames will eliminate painting and other inconvenient maintenance work that would be required for wood doors. Aluminium doors require anodised finish, which will protect the door from discolouring and will present a visually acceptable appearance. Most doors should be re-designed to suit the holistic visually acceptable image of the park.

6.12 Roof and sheet metals

The roof is more likely to need replacement other than any other components of the building. It is evident in most State Garage buildings. The roof is indeed an important place to start an inspection, because water penetration at the roof is usually the most serious cause of deterioration in older buildings. Evidence of roof failure usually shows up inside before it is visible on the outside. At first, damp patches, flaking paint, and actual dripping water on walls or ceiling are the signs of roof trouble (figure 19). A thorough inspection needs to be carried out to determine whether it is the roofing material itself, the flashing or the gutter system that has failed. Sometimes, moisture penetration through the wall is simply a matter of poor drainage, blocked gutters, or backed-up leaders, all of which can be taken care of through routine maintenance (Shopsin, 1986:62 and 113).

Roof insulation may need replacement, especially if it is an older fibre type insulation that does not stand up as well in time as foam types. Sheet metal, if in good shape and if removed carefully, may at times be salvaged. However, this may be risky. If it is galvanised metal, it may be sufficient to warrant discarding. Only aluminium or copper are likely to be candidates for salvage, though this outlast galvanised metal by many years, but at some point will come also to a point of replacement. Replacing the sheet may also require investigation and possibly replacing the battens. In conclusion, a thorough inspection should be carried out to determine whether the roof structure supporting beneath is sound, as to avoid overloading.

Figure 19: Evidence of roof leaking (Source: Photo by author)

6.13 Mortar

The pattern of the mortar joints is a significant element in the architectural character of a historic or rehabilitated structure. Mortar joints in buildings weaken due to weathering, cracking and loss of adhesive properties during the life circle of a building. During building restoration it is necessary to consider pointing of mortar joints. The traditional appearances of an old building can be radically altered by subtle changes in the width, colour and texture of the mortar joints. During restoration the new mortar should match the colour of the old in a true historic restoration and it will have to be re-pointed into the joints in the same style as the original. However, the composition of the mortar need not duplicate the original. Most buildings were built with a cement-based mix that produced an inflexible mortar incapable of responding to thermal changes in the bricks. Lime mortar is recommended for joining and pointing (see section 6.4) because it compresses and flexes with thermal changes (Shopsin, 1986:113). Figure 20 shows the English bond of the state garage that certainly requires re-pointing. This restoration process will take time and requires specialised craftsmanship.

Figure 20: Raked-off mortar on English bond (Source: Photo by author)

6.14 Interior restoration

The interior of most buildings has been subjected to more changes than the exterior. Quite often there is little extant physical evidence to serve as a guide to restoration. In this case an architect has several acceptable alternatives (Shopsin, 1986:155-156):

- Create a modern interior: from a practical stand point the loss of the original interior finishes can be advantageous, permitting greater latitude in the choice of a new use. Greater flexibility in the case of colour, material, and layout is another advantage. The new interior may be developed so that the old exterior retains its original appearance.
- Create a conjectural re-creation of the original interior: many old buildings are similar to surviving prototypes, so that a new interior can be fashioned to approximate an old one, or missing portions of it can be restored, without the need for exhaustive research.
- Create a pastiche of old and new: in many cases, parts of the original decorative elements and finishes remain intact and can be incorporated into a new design.

It is apparent that most objects of the existing furniture cannot be considered for reuse, though an overall evaluation should be conducted to identify possible objects for refinishing.

6.15 Energy consideration

Energy is an important component in building construction. It is calculated from the time of producing building materials and later, during construction, in activating construction equipment and providing temporary light and heat. After construction a building requires power for its daily operations including lighting and activation of its mechanical systems. The amount of energy wasted when building demolition takes place, it is calculated that the energy lost, in British Thermal Units, per square foot of building area, ranges from 600 to 2000 MBTU, depending on the type of building (Lion, 1982:21).

Lion (1982:21) refers to a 12-storey office building with a typical floor of 930m², which may represent an energy loss equivalent to 20000 MBTU if demolished. When roughly calculated it is equivalent to an energy contained in 7500 tons of coal or a million gallons of oil or 200 millions cubic feet of gas. That is sufficient fuel to drive a car for approximately 40 million kilometres.

6.16 Special features

The fabric of the Pretoria State Garage contains information that is vital to the recording process and better understanding of its subsequent uses and original form. There are features on State Garage buildings that show evidence of multiple phases and interventions. Evidence is available in a wide variety of structural and decorative elements (Icomos, 1990:73):

- Figure 21: Breaks in masonry show latter addition and reinforcement of the original south wall of block E1.
- Figure 22: Former door opening, west wall of block C3 was blocked using stretcher bond instead of the original English bond.
- Figure 23: Brick column, attached to the concrete column of block D1, used for structural support of the extended block D2. This implies a change in the structural technique that was deemed appropriate when the building was extended.
- Figure 24: Two adjoining parts of the west wall of block K1 are structurally independent of each other. The south adjoining part shows evidence of blocked door or window opening and pavement, which appears to have been raised to the level of the windowsill.

These features are common on most State Garage buildings and require thorough investigation as to determine their contribution to history and rehabilitation of the site. The are other features such as the wall alignment, wall thickness, evidence for demolitions, alterations, inserted passages, decoration and dates that are still to be thoroughly investigated to realise the long-term resilience of these buildings. It not always necessary to restore these features to their original use but could be used towards a comprehensive interpretation of the site.

Figure 21: Breaks in masonry (Source: Photo by author)

Figure 22: Blocked door opening (Source: Photo by author)

Figure 23: Brick column of D2 attached to concrete column of D1 (Source: Photo by author)

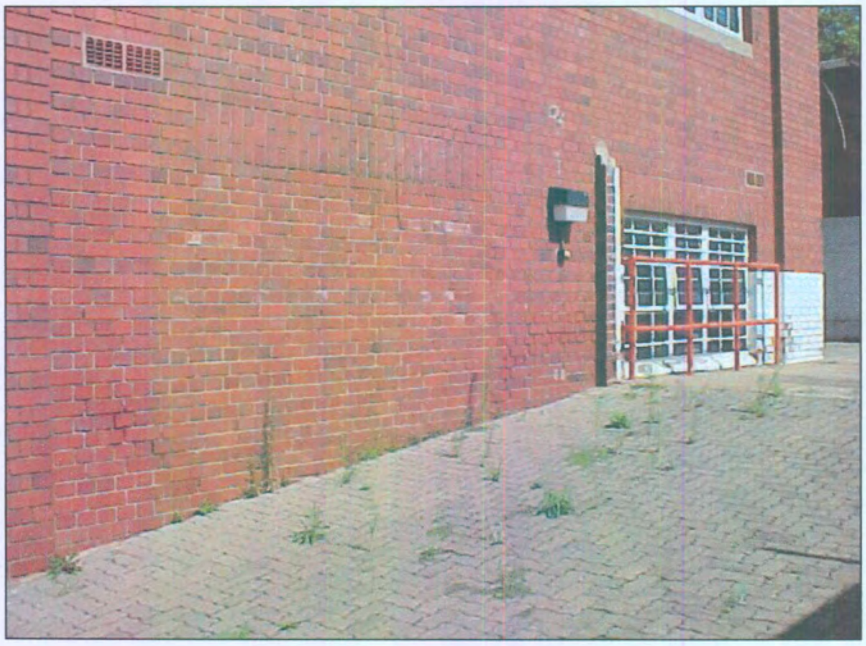

Figure 24: Blocked window opening (Source: Photo by author)

6.17 Conclusion

The above-mentioned aspects of rehabilitation and restoration methods cover a broader area of challenges that are likely to surface during a thorough inspection of the site. The Pretoria State Garage was built in different phases, from the interwar period to present. Though most building extensions were built to match the existing structures, the rehabilitation process will require variation of restoration techniques to appropriately respond to different building skills, age and materials qualities.

Common to all structures on site is the exterior brickwork, which unifies the exterior image of the courtyard and requires consistent restoration. The brickwork offers valuable knowledge on the skills and the materials used during its development phases but no specific architectural significance. This will enhance the image and the industrial past of the site in comparison with the monumental character of most buildings in the southwest quadrant of Pretoria.

In addition, a general inspection of the site indicates that there are no building elements that should be recorded as elements of architectural significance. The buildings can be classified as structurally and historically significant. Most buildings are structurally sound because they were heavily or over built to accommodate heavy equipment, especially the workshops. The historical significance is warranted by the general history of the site throughout time. Thus the site is rehabilitated on the basis of obsolesce and redundancy, offering an absolute utilitarian space with a strong industrial manufacturing background.

7. DESCRIPTION OF BUILDING BLOCKS AND THE FITTING PROCESS

This section describes building blocks that remain after the implementation of the proposed demolition list in section 5.3.1 and compares their spatial qualities to the proposed surfaces of section 3.4.1. During the fitting process it is possible that the already proposed surfaces be modified and the existing forms of the State Garage be physically altered. Following are the remaining major building blocks (figure 25 and 37):

- Building E is a single storey building that is presently used for parking.
- Buildings C and D accommodate administration offices and storerooms while their respective ground floors provide a unified parking area.
- Buildings K and L house the workshop and storeroom.
- Building B is a three-storey building currently serving as a storeroom.

An important aspect of building rehabilitation is the assessment of the long-term resilience of old buildings. This refers to a system used to define values of existing buildings (including sites) designated for rehabilitation using the following three basic elements (Jenkin and Worthington, 1997:91):

1. The building volume, particularly in sectional height and potential risers between floors, capable of providing adequate space for service installations.
2. Simple plan forms with minimum of columns that can accommodate integrated organisational demands.
3. The separation of building components into clearly definable parts.

As a result Table 3 shows descriptions of spatial qualities and surface areas of the State Garage buildings worth retaining while Table 4 compares those surface areas to the accommodation schedule of the Pretoria Technology Park, which is necessary for the fit process. Description of individual buildings is completed by the list of building elements proposed for demolition and proposed new insertions and uses.

Figure 25: Building Blocks to be retained (source: Tshwane Municipality)

7.1 Block E

Figure 26: Block E (adjacent to the south are F and F2) (Source: Photo by author)

Block E is a single story structure located southeast of the site (figure 25 and 26). The structure comprises of physically sound red face-brick walls and leaking multiple corrugated iron pitched roofs. It still retains its original function as a garage, providing parking to VIP vehicles. The floor is covered with concrete interlocking blocks. The roof structure is supported on rotten wooden trusses, iron girders and concrete beams and marked by a series of roof lights and ventilators. The height of the internal volume spanned by the trusses is approximately 3m.

The floor is covered with concrete interlocking blocks. Repeated corrugated iron pitched roofs are marked by a series of roof lights and ventilators cover the three units. The roof structure is supported on wooden trusses, iron girders and concrete beams. The height of the internal volume spanned by the trusses is approximately 3m.

It was developed in three phases increasing its surface area from 1925m² to approximately 6249m² (drawing C and D):

- Unit E1 belongs to the first phase covering an area of 1925m² (25m x 77m). It has a deep depth, long west elevation and short north and south elevations (figure 27).
- Unit E2 developed in two parts: west and north wings covering an area of 1848m² (24m x 77m) and 976m² (16m x 61m) respectively. The long north elevation of this unit is located close to the elevation of unit D3 creating closed passage.

- Unit E3 covers an area of 1500m² (50m x 30m). The horizontal space of this structure is only defined by rows of steel tubular columns.

All of the later additions are attached to the original structure (E1). These units together form a large internal space divided by rows of steel tubular columns (7.6m east-west x 15.2m north-south column bays). The interior space is defined horizontally by:

- Rows of tubular steel columns to the east.
- Blind structural walls to the south, west and north sides of unit E1.
- Structural wall to the north of unit E2 comprising of windows and buttresses. On the exterior the walls are defined by row of windows trimmed by plastered lintels and quarry tile sills.

Figure 27: North and east interior elevations of block E (Source: Photo by author)

Figure 28: West elevation of block E1 (Source: Photo by author)

Demolitions

The main elements designated for demolitions are the rusty and leaking corrugated irons, rusting steel columns and physically unified spaces and roofs, which limit daylight penetration, ventilation and ease (figure 27 and 28). The south, north and west external masonry walls may be retained and repaired. These walls are physically sound with long frontage and provide enough flexibility and structural support for future use. The remaining walls have long frontage and provide enough flexibility for conversion of the remaining interior space into smaller units for events of cultural and socio-economical significance.

New uses and insertions

This building block provides adequate space to be transformed into a centre for socio-economic activities (information centre, pavilions and banks/ATM, cafeteria/restaurant, amphitheatre and amenities) (figure 37) and underground parking for approximately 250 vehicles. It provides a grid of 12m (east-west alignment) by 15m (south-north alignment). The process of new insertions and replacement should be in accordance with contemporary architectural design practices. The following activities are proposed as new insertions:

- Socio-economic activities such as cafeteria/restaurant, four to five pavilions (10-20 m^2), reception, amphitheatre for 100 to 150 people, ATM/banks and amenities that require 410 m^2. These activities are aimed at attracting ordinary people to come to the park and give the park a social character, and while at the same time bringing income into the park. The rest of the area could be landscaped to enhance the image of the park.
- The remaining area (5839 m^2) of block E will be landscaped to form part of the pedestrian area (see Table 3).

7.2 Blocks B, C and D

Blocks B, C and D are physically sound three-storey rectangular buildings located along the boundary line looking towards Visagie Street. Both blocks C and D were extended southward with single-storey industrial buildings-type structures covered with south facing saw-tooth corrugated iron roofs. The three-storey sections of blocks B, C and D have floor-to-ceiling heights of about four metres offering adequate space for pleasant office environment and required mechanical and electrical installations. These blocks contain load-bearing walls and are subdivided internally by a network of concrete, brick and steel columns (figure 31). Window planning offers a consistent pattern of window mullions for easy space office planning (figure 29). Their first and second floors are currently used for storage and administrative purposes while their extended ground floors house workshops and provide parking for state vehicles.

Blocks C and D comprise of buildings C1, C2, C3, D1, D2 and D3 respectively (figure 36). The 1st and 2nd floors of buildings C1 and D1 currently accommodate administration offices and storerooms. They are rectangular industrial administration three storey buildings. They have pitched corrugated iron roofs. Buildings C2, C3, D2 and D3 are designed as extensions of C1 and D1 respectively and form unified parking areas (figure 30). These are typical industrial rectangular, single storey buildings covered with south facing saw-tooth corrugated iron roofs containing translucent windows (figure 30 and 31).

Figure 29: North elevation of blocks C and B (showing entrances on Visagie Street) (Source: Photo by author)

Figure 30: Southeast corner of block D (Source: Photo by author)

All building blocks consist of load bearing walls and internal column network. Blocks C1, D1, D2, D3, C2 and C3 consist of concrete columns, steel columns, and masonry columns respectively.

The internal area of (drawing A and B):

- Ground floor of D1 measures 68m long by 11,5m wide with internal height of 3,9m.
- Ground floor of C1 measures 43m long by 11,5m wide with internal height of 3,9m.
- D2 measures 68m long by 20m wide with internal height of 4m.
- D3 measures 68m long by 17m wide with internal height of 5,5m.
- C2 measures 43m long by 20m wide with internal height of 4,4m.
- C3 measures 43m long by 17m wide with internal height of 4,4m.

Internal spaces of D1 and C1 are divided by column bays, which minimise the optimum planning of the interior. If the new design language proposes maintaining existing structural framework, it will then be necessary for new partitions for private spaces or support areas to be aligned with interior columns and perimeter pilasters within the walls (Rayfield, 1994:100). Floor-to-ceiling heights offer enough space for mechanical and electrical installation, and adequate height for pleasant office environment. Window planning offers a consistent pattern of window mullions for easy space office planning.

The first and second floors of unit D1 are currently used as administration offices for the State Garage, while the ground floors of C1 and D1 including units D2, D3, C2 and C3 are currently used as workshops and parking for state vehicles. The first and second floors of C1 are currently under-used and provide small-subdivided units suitable for office space.

Figure 31: Unified interiors of D1, D2 and D3 (Source: Photo by author)

Demolitions

Major alterations required in blocks B, C and D are the replacement of the leaking corrugated roof structure and re-designing of the interior, which will incorporate horizontal and vertical circulations.

Renovation, replacement and demolition of some of the interior walls and erection of new partitions should be in accordance with modern office planning and design. Maximum exploitation of light already penetrating the buildings should be encouraged during demolition so as to avoid excessive use of artificial lighting and electrical systems.

New uses and insertions

The major alterations that are required in block C1 and D2 are the re-designing of the interior: horizontal and vertical communication and partitioning. Blocks C and D require the replacement of the roof structure and partitioning for new activities to be housed inside. Maximum exploitation of light already penetrating the buildings should be encouraged. The interior spaces provide the following (see plans):

- Second floor of D1 offers an area of approximately 780m² that can accommodate the *Centre for Innovation Financing*, which requires a minimum space of 600m². This centre could be accommodated in an open plan office space and closed office space for the manager. The remaining 180m² offer adequate space for an exhibition hall (100m²), future expansions, restrooms, services and circulation.

- Second floor of C1 offers an area of 490m² that is suitable for accommodating the *Technology Park Library*. This is a functional library of the park that stores material related to the park, which park visitors can utilise.

- First floors of C1 and D1 offer a total area of 1270m² that is suitable to accommodate offices of the *Centre for Technology Transfer,* which requires approximately 900m². Two lecture rooms can occupy the remaining space, each occupying an area of 100m² installed with audio-visual equipment. The remaining space could accommodate circulation, services and restrooms.

All ground and first floors of C1 and D1 occupy a total of 2540m² for new uses.

- Both ground floors of blocks C and D offer a total internal area of approximately 5383m² (plan). This is 3383m² more than requested for maximum occupancy space for an incubator, which could be reserved for future expansions. Addition of new partition walls in accordance to the window mullions patterns provides the incubator with adequate depth for units ranging from 90m² to
- 200m². Most of the units will align along the perimeter wall, including office for the manager of the incubator, cafeteria, reception and amenities.

- *Atrium.* Open central space is required to provide daylight penetration, ventilation and ease of access to new subdivisions. Both buildings C2 and D2 are centrally located such that they are suitable for the insertion of an atrium.

- *Window pattern.* New wall openings will be introduced to provide required illumination from the building exterior.

- *Columns and roof structures.* The new structural framework should consolidate the remaining perimeter wall and carry new loads. The existing steel structure is in good condition and can be modified to support the new floor and roof structures.

There should be a clear distinction between the old and the new insertion. Such distinctions are manifest within the context of the existing structures. The free plan principle should be incorporated in the design to provide flexibility for moving partitions, fluidity from space to space and the introduction of the essence of time in space.

Access was constantly denied and drawings not available of block B. The building was previously owned by the Trigonometrical Survey Department (figure 32). It is a three-storey building in physically sound condition. It is expected to have the same architectural qualities (volumes, plan and construction material) as the three storey buildings of D and C. The building was previously used for administrative purposes and if repartitioned could accommodate the Pretoria Technology Park Museum. This museum will display information relating to the history of the Pretoria State Garage and its effects to the neighbouring sites. The total surface area of this block is not known but estimated to 1500m², which could be used entirely for the park museum.

Figure 32: North elevation of block B (Source: Photo by author)

7.3 Blocks K and L

Blocks K and L were built to resemble each other (figure 37). They each have 41m east facing frontages with depth of 43.7m. The east facing portions are single double-volume storey buildings consisting of load bearing perimeter walls and a row of columns supporting pitched corrugated iron roof. Flanked buildings J and I obscure their elevation to the central courtyard (figure 15 and 37). Blocks K and L are currently used as warehouses and workshops for heavy vehicles. The double volume portion of block K (K2 and K3) has an internal height of about 6.5 metres (figure 35) while block L (L2 and L3) has 8.6 metres allowing easement for additional mezzanine floor. These blocks were each extended westward with two-storey west-facing buildings (K1 and L1), located six meters from the west boundary wall. Each block has a west facing 40m frontages with depth of 20m. They are covered by flat concrete slab roof. Each block offers an internal space of approximately $800m^2$ on each floor with internal height of four meters on ground floor and three meters on first floor. A bridge links the two top floors (figure 33), while K1 has an elevated tower on the northeast corner. These units fell into complete disuse.

These structures formerly housed heavy machinery reflected by their strong structural qualities (Joubert, Owens, Van Niekerk & Partners: Architects, 1973:9). Their structure consists of load bearing perimeter walls and an internal network of concrete columns. They each contain a floor-to-ceiling height of about four meters and are covered by flat concrete slab roof. A bridge links their two top floors. These units fell into complete disuse. These blocks used to house the SABS laboratories and could be easily converted (from their current function-workshops) to accommodate similar activities.

Figure 33: Blocks K and L (Source: Photo by author)

Demolition

The main elements designated for demolitions are:

- The roof sheeting of units L2, L3, K2 and K3, which require replacement.
- Present partitioning walls in all units, especially L1 and K1. These units are designated to house laboratories for advanced technologies and accommodation for tenant companies.

New uses and insertions

Blocks K and L provide adequate space to accommodate the technology building and tenant companies. The roof height in these units allows an easement for additional mezzanine floor. K2 and K3 have floor-to-ceiling height of about 6.5m while L2 and L3 have approximately 8.6m. Units K1 and L1 are capable of accommodating laboratories for advanced technologies. Each floor in every unit covers an approximate area of $800m^2$. Each laboratory requires approximately $400m^2$ and tenant companies occupy areas ranging from $80m^2$ to $300m^2$.

Unit K2, K3 and ground floor of K1 are capable of accommodating the technology building as follows:

- Systems and automation services ($400m^2$) in the west end of K2.
- Telecommunication services ($400m^2$) in the east end of K2.
- Multimedia services ($400m^2$) in the west end of K3.
- Quality analysis and certification services ($400m^2$) in the east end of K3.
- Business services (400 m^2) in the south end of the ground floor of K1.
- Ancillary spaces: amenities (60 m^2), library (100 m^2), reception (20 m^2) and approximately 400 m^2 reserved for common areas and circulation to occupy the remaining spaces in K2, K3 and ground floor of K1.

Business services on the ground floor of K1 will be connected to the rest of the laboratories in K2 and K3 through doors that already exist between the areas. The total surface area required for the technology building amounts to 2580 m^2, 400 m^2 (reserved for circulation and common areas) more as compared to the initial $2180m^2$ in section 3.4.1.

Figure 34: West elevations of K1 and L1 (Source: Photo by author)

The first floor of K1 (remaining) and block L (Units L1, L2 and L3) offer a total of 4190m² for accommodation of tenant companies.

- First floor of K1 (800m²)
- Ground and first floors of L1 (800m² each)
- L2 and L3 (895m² each)

The first floor of K1 is linked to block L by an existing bridge (figure 31). The double volumes of L2 and L3 have approximately 8.6m heights that can be easily accommodate mezzanine floors during expansion of tenant companies. The total area for accommodation of tenant companies is 2190m² more than the initial 2000m² requested in section 3.4.1. If these spaces are not entirely occupied they could be reserved for future expansion of the park though unused they might affect negatively on the image of the park.

7.4 Landscape and image

The demolition process of unwanted buildings in section 5.3.1 and the conversion of a substantial surface area (5839m²) of Block E to landscape (see Table 4) provide pedestrian activities with additional spaces. The overall site density was also reduced from an estimated 80% coverage to approximately 57% leaving about 43% for landscaping. It is therefore an opportunity to implement guidelines recommended by Pinder (1990:1) for pedestrian surfaces: *practicalities*, *direction*, *repose*, *hazard*, *scale*, *use* and *character*.

Figure 35: Interior of blocks K2 and K3 (Source: Photo by author)

Building Block	Area in m^2	Total Area in m^2	Height in meters (m)	Construction	Building configuration
Block B				Brick and concrete	Long and narrow with shallow depth
Ground floor	500		4.4		
1st floor	500		3.9		
2nd floor	500		3.9		
Total area		1500			
Blocks C and D				Brick, wood and concrete	Long and narrow with shallow depth
1st floors of D	780		3.9		
2nd floors of D	780		3.9		
1st floors of C	490		3.9		
2nd floors of C	490		3.9		
Total area		2540			
D- ground floor (combined)	3298		4.4	Brick, concrete and steel	Unified long and narrow bays with deep depth
C- ground floor (combined)	2085		4.4		
Total area		5383			
Block K and L				Brick, concrete and steel	Double volume Unified long and wide bays with deep depth
L (west) ground & 1st floors	800x2		4		
K (west) ground & 1st floors	800x2		4		
L (double volume)	895X2		8.6		
K (double volume)	895X2		6.5		
Total area		6780			
Block E				Brick, wood and steel	Unified long, medium and narrow bays with deep and medium depth
E (1st Phase)	1925		3		
E (2nd phase: 1848 + 976)	2824		3		
E (3rd phase)	1500		3		
Total area		6249			
Total area (all buildings)		**22452**			

Table 3: Descriptions of spatial qualities of the Pretoria State Garage buildings worth retaining

Rehabilitated buildings			New use		
	Area in m²	Total Area per centre	Centre	Technology Park: Total area	Total area per rehabilitated building
Blocks C1 and D1					
1st floors of D1	780				
2nd floors of D1	780				
1st floors of C1	490				
2nd floors of C1	490				
Total area		2540	**Management centre**	2540	2540
Block K and L			**Technology building**	2590	
L1- ground & 1st floors	800x2		**Accommodation for tenant companies**	4190	
K1- ground & 1st floors	800x2				
L2 (double volume)	895				
L3 (double volume)	895				
K2 (double volume)	895				
K3 (double volume)	895				
Total area		6780			6780
Blocks C and D			**Incubator**	5383	
D- ground floor (entire)	3298				
C- ground floor (entire)	2085				
Total area		5383			5383
Block E			**Socio-economic activities**	410	
E1	1925		**Converted to landscape**	5839	5839
E2 (1848 + 976)	2824				
E3	1500				
Total area		6249			410
Block B			**Museum**		
500x3		1500		1500	1500
Total area (final)		**22452**		**22452**	**22452**

Table 4: Comparison of surface areas for fit process of the Pretoria Technology Park

7.5 Operational program of the Pretoria Technology Park

The following operational program provides a framework for the implementation of proposed action plans and identifies possible funding organisations such as the University Pretoria, the CSIR and the Department of Trade and Industry (and partnership programs) as partners in setting-up the park. The park should form a company [Management Company of the Pretoria Technology Park (MCPTP)] that will manage the park and liaison with interested organisations and stakeholders. Refer to section 3.3 for description of services offered by the following centres.

1. MANAGEMENT CENTRE

1. Technology Transfer Unit

Service	**Industrial Liaison Office**
Proposing authority:	DTI, University of Pretoria and CSIR
Financing authority:	DTI
Implementing authority:	MCPTP
Operating authority:	MCPTP

Service	**Observatory and Information Office**
Proposing authority:	DTI, University of Pretoria and CSIR
Financing authority:	DTI, University of Pretoria and CSIR
Implementing authority:	MCPTP
Operating authority:	MCPTP

Service	**Career Advisory Office**
Proposing authority:	University of Pretoria
Financing authority:	CSIR, University of Pretoria and Department of Education
Implementing authority:	MCPTP
Operating authority:	MCPTP

2. Innovation Financing Unit

Service	**Seed Capital Office**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI and partnership program
Implementing authority:	MCPTP

Operating authority:	MCPTP

Service	**Venture Capital Office**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI and partnership program
Implementing authority:	MCPTP
Operating authority:	MCPTP

2. TECHNOLOGY BUILDING

Service	**Business Services**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI
Implementing authority:	DTI and MCPTP
Operating authority:	MCPTP

Service	**Multimedia services**
Proposing authority:	University of Pretoria, MCPTP and DTI
Financing authority:	DTI
Implementing authority:	DTI and MCPTP
Operating authority:	MCPTP

Service	**Telecommunication Services**
Proposing authority:	CSIR, University of Pretoria and MCPTP
Financing authority:	Department of Telecommunications
Implementing authority:	MCPTP and University of Pretoria
Operating authority:	MCPTP

Service	**System and Automation Services**
Proposing authority:	CSIR, University of Pretoria and MCPTP
Financing authority:	DTI
Implementing authority:	MCPTP, CSIR and University of Pretoria
Operating authority:	MCPTP

Service	**Quality Analysis and Certification Services**
Proposing authority:	CSIR, University of Pretoria and MCPTP

Financing authority:	DTI
Implementing authority:	MCPTP, CSIR and University of Pretoria
Operating authority:	MCPTP

3. INCUBATOR

Service	**Incubator**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI
Implementing authority:	MCPTP
Operating authority:	MCPTP

Service	**Accommodation for Technology-Based Companies**
Proposing authority:	MCPTP and DTI
Financing authority:	DTI
Implementing authority:	MCPTP
Operating authority:	MCPTP

4. MUSEUM

Service	**Museum**
Proposing authority:	MCPTP
Financing authority:	Department of Arts, Culture, Science and Technology
Implementing authority:	MCPTP
Operating authority:	MCPTP

5. CENTRE FOR SOCIO-ECONOMIC ACTIVITIES

Service	**Centre for Socio-Economic Activities**
Proposing authority:	MCPTP
Financing authority:	MCPTP
Implementing authority:	MCPTP
Operating authority:	MCPTP

8. GENERAL CONCLUSION

The site contains about 22452m² surface area in structurally sound and historically significant obsolete and redundant buildings. The good condition of construction materials, easy to convert configurations and ample surface areas provide the rehabilitation with significant raw materials and economic advantages. A rehabilitation assessment carried out on the Pretoria State Garage confirms the fitting capacity and compatibility between the designated new user and the existing property. The discovery, theoretically, elongates the life circle of this industrial site, which possesses both the historical and structural significance and promotes the relevance of research to local manufacturing industries.

The amount and nature of material fabric that the State Garage is able to retain and rehabilitate hope to inspire those in urban conservation and promote sustainable development as opposed to total demolition. Thus, the rehabilitation of the Pretoria State Garage and the incorporation of the Pretoria Technology Park will positively contribute towards eradicating sense of abandonment and general dilapidation and produce an image that inspires the idea of a safe environment in the southwest quadrant.

The rehabilitation assessment revealed the long-term resilience of the State Garage buildings and their capability of house high technology facilities of the Pretoria Technology Park. This is consequently hoped to revive, innovate and restore the traditional manufacturing character of the site and the southwest quadrant of Pretoria Central. This intervention also retains some of the site's significant current activities such as administration in blocks D and C, and research in K and L.

This assessment provides guidelines for the documentation and systematisation of significant buildings and approach to the restoration of building components. Guidelines to conduct an in-depth analysis and maintenance of historic material are available from a wide range of sources including "*Guide to recording historic buildings*" by ICOMOS (1990). The restoration of the exterior brickwork and other integral building components will contribute towards enhancing the historic role played by building materials in these old industrial buildings. This initiative stimulates creative architectural design and the debate on the mutual existence between the old and the new. The outcome of this assessment may warrant future employment on sites of similar nature such as Marabastad and Pretoria West (already discussed in the study) and systematisation for public use and education.