



UNIVERSITEIT VAN PRETORIA
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YUNIBESITHI YA PRETORIA

A RAILWAY
SCIENCE, TECHNOLOGY and HISTORY
MUSEUM

THE SENSE OF SPACE
SENSATION

A

**RAILWAY
SCIENCE, TECHNOLOGY AND HISTORY
MUSEUM**

situate at

Salvokop, City of Tshwane

for

**Friends of the Rail
Rail Heritage Preservation Club**

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The research contained in this document is completely my work, unless otherwise indicated.



Museum complex: from left to right: workshop with coal bunker, exhibition hall, concourse building behind tower, luxury train passenger departure lounge, and train platform.

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A RAILWAY SCIENCE, TECHNOLOGY AND HISTORY MUSEUM

situate at Salvokop, City of Tshwane

1. INTRODUCTION

1.1 Proposal and motivation

To design a venue for a comprehensive, successful and sustainable railway museum, which will foster, in a well-visited, multi-focused and sustainable railway museum, an understanding of railways and related topics, past, present and future.

South Africa needs a venue for the comprehensive understanding and appreciation of the science, technology, history, operation, and development contribution underlying one of the most important products of the Industrial Revolution: the railway. The exhibits are thus not to be displays of machinery only, but should embrace *i.a.* the underlying scientific principles and technology related to railways, their propulsion, construction, operation and workings. A suitable venue fulfilling these needs does not exist currently in the area of major metropolitan population concentration in South Africa.

1.2 Subject of investigation

The development of station design provided new dimensions to both the sense and sensation of space. This is to be recaptured in the design of the museum, which requires obtaining an understanding of the influence, implications and impact railway stations and their supporting infrastructure had on architecture, the cityscape and the urban fabric, due to their large size, area and enclosed volume. Station design has contributed to modern design through the need to satisfy the uninterrupted, free-space enclosure of large volumes, necessitating progress in the knowledge of the structural application of the new materials discovered during the Industrial Revolution from which the modern architect is still benefiting. The impact of stations in these three mentioned fields furthermore had an indirect impact on society. The determination of all these influences by stations and their design will form the research subject of this dissertation.

2. DEFINITIONS AND ABBREVIATIONS

2.1 Definitions

'Tshwane' vs. 'Pretoria'

South Africa is currently undergoing a phase in its history where it is attempting to establish an identity different to that of the past. This process entails a number of changes to town names, with various parties for and against such changes. The parties concerned feel extremely strongly about this subject, to the extent of going to court to either enforce or to rescind such name changes. This document is not concerned with the merits and demerits of such arguments. It is purely a dissertation on the impact railways had on architecture, the cityscape and urban fabric. Accordingly, the names of 'Pretoria' and 'Tshwane' are used interchangeably, though generally 'Tshwane' will refer to the greater administrative grouping (similar to Greater London) and 'Pretoria' to the CBD and immediate surrounds (similar to the City of Westminster). No slight or injury is intended to any of the name-debate parties.

Round-house

A 'round-house' is a circular or semi-circular shed-structure built around a turntable. The engine is driven/moved onto the latter, turned around and reversed into the shed; it is in essence a garage for locomotives.

Train consist

This defines the make-up of a train, consisting of the locomotive and a number of passenger carriages or goods wagons.

2.2 Abbreviations

The following abbreviations have been used in this document:

CBD	Central Business District
CGR	Cape Government Railways
CSAR	Central South African Railways
GWR	Great Western Railway Company
IMR	Imperial Military Railways



L&M	Liverpool and Manchester Railway Company
NGR	Natal Government Railways
NZASM	Nederlandsche Zuid-Afrikaansche Spoorweg-Maatschappij (Netherlands South African Railway Company)
SAHRA	South African Heritage Resources Agency
SAR&H	South African Railways and Harbours
S&D	Stockton and Darlington Railway Company
TICP SDF	Tshwane Inner-City Project Spatial Development Framework

3. THEORETICAL INVESTIGATION

The influence of railway stations and their design

3.1 Abstract

The purpose of this investigation is to determine the influence which stations and their related railway infrastructure had on the cityscape, architecture, the urban fabric, development and planning of the city and its society.

To provide a fuller understanding as to why stations developed in the way they did, and why they looked as they did and to a large extent still do, the development of railways and the functioning of stations is investigated. Station design being an offspring of industrial architecture, the historical development of the latter is then outlined. The progress in and results of the developments in station architecture, required to cope with ever increasing size demands so as to enable the handling of ever-increasing passenger volumes, are then reviewed. The achieved results are compared to those of large structures built before railway station construction commenced. In conclusion, the effect that the stations, their structures, and related railway infrastructure had on architecture, the cityscape and urban development are assessed, the latter also in the light of the reduction or demise of rail services currently being experienced throughout the world. The influence of the impact in these three areas on society is then reviewed, before concluding.

This section is structured as follows:

- Introduction
- The growth of railways
- Station operation and functioning
- Further factors influencing station design
- Architectural concretization of station functions: 'cathedrals of industry'
- Influence of stations on architecture
- Influence of stations on the cityscape
- Ecclesiastic cathedrals vs. secular 'cathedrals': the influence on society
- Influence of stations on urban planning

Conclusion

3.2 Introduction

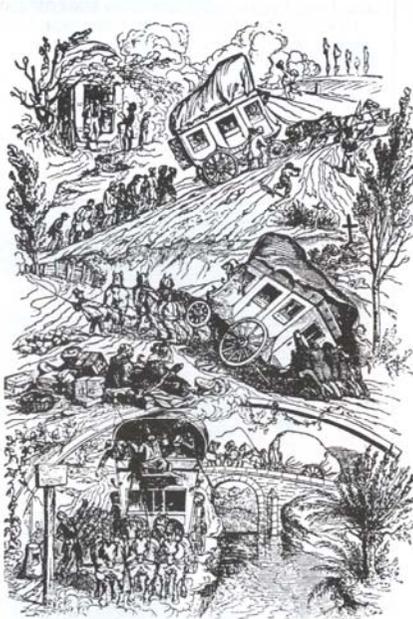


Fig. 3.1 Travel risks before the coming of the railways



Fig. 3.2 South Africa's rail network

The development of railways has had a major influence on the economy and society of the world. Railways improved communications and speeded the world up, doing largely away with slow and often dangerous road- or canal born transport. The impact of this influence is much more evident in Europe, due to railways originating and being constructed there to a much greater extent than anywhere else in the world (with the possible exception of the north-western United States of America ('USA')). Their development, flowing from the Industrial Revolution which occurred in the late eighteenth and early nineteenth centuries, facilitated the commercial, economic and subsequent political rise of Europe, and specifically of the United Kingdom, to the predominance it played in world politics up to the First and even Second World Wars. Through this predominance European powers were able to conquer the major part of the world, creating their colonial empires, which, in turn, led to the development of railways therein, opening them and their produce up for integration in the international economy of the times. South Africa, too, owes the construction of its major railway trunk lines from the coastal ports to the interior to this desire for economic integration: after the first lines were built to satisfy local (Cape Town and Durban) transport requirements and with the hinterland having little to commend its integration into the coast-centred economy, only the discovery of the hinterland's diamond and mineral wealth spurred its connection with the coast.

The extent of the influence of the development of railways has, however, stretched much further than this. The sheer size of the facilities required, leading to construction of stations of ever increasing size and their occupation of extensive areas by their infrastructure requirements (tracks, marshalling yards, sidings and workshops), changed the development of architecture, the appearance, conception and perception of the cityscape, the structure of urban layout and future development, and the reaction of society to large buildings. Railways and their structures had this profound influence, arising at first from the confrontation with the railways' expanding demands, and then with the empty spaces left behind by their currently experienced shrinkage or even demise.

Investigating and understanding the influence of railways on architecture and cityscape, and how it all came about, and the implications on urban design requires looking at the origin and history of stations and their architecture, their components and their operation.

It should be noted, due to the fact that modern railways originated in the United Kingdom ('UK'), that this will be the area focussed upon in the following. Developments in continental Europe (including the Netherlands, which had a large influence on South Africa) and the USA were similar although somewhat later, initially using British equipment and methods of operation: only with time were operations adapted to local

conditions and preferences. But, in essence, a station anywhere in the world fulfils the same functions, applies the same principles of layout, is generally built from the same choice of materials and techniques, and ultimately derives from the first British precedents. With South Africa's railway history having been influenced by both British and Dutch (initially British-influenced) precedent, I consider the focus on the developments in the United Kingdom to be sufficient to illustrate the issues being investigated.

3.3 The growth of railways

A railway is generally operated to transport, against remuneration, passengers and freight (exceptions are military and plantation railways). A railway station represents, simply stated, a place where trains stop to allow passengers to board or to alight, and freight to be loaded or unloaded. The execution of these functions requires a support structure, which is to be found in or near the station, and is discussed further on.

However, the number and appearance of railway stations, as we know them, derive from two results of the Industrial Revolution: the unprecedented need, availability and feasibility of large-scale rail transport, and its concomitant expansion of railway lines, and the progress made in the engineer's and architect's ability to construct the large structures required for them. The prior represents the reason for the proliferation of stations and yards with their resulting occupation of large areas in the urban fabric, the latter the reason for their impact on architecture and cityscape.

In turn, large-scale rail transport and the accompanying large structures were made possible by, on the one hand, the progress made in the use and application of improved materials (cast iron, wrought iron and steel, and the ubiquitous corrugated wrought iron sheeting as a lightweight roofing material), and, on the other hand, by the harnessing of steam for the powering of machines of various kinds by means other than water power. Placing the steam engine (also constructed of the improved materials) onto wheels, and linking the steam engine's piston to these, resulted in the engine moving along. This moving engine or 'locomotive' was placed on rails to guide it, and the modern railway was born. ('Rail-ways' existed beforehand, used to carry iron ore and coal from the mines to the closest canal or coast for further transportation by water, but their propulsion was by means of gravity, horses or mules. Distances that could be covered with these means were very limited, and passengers were very rarely transported. It was the mobile steam engine which made railways a generally viable option to move freight and later on passengers.)

The mentioned Industrial Revolution developments do not imply that factories and warehouses did not already exist then. They did, but on a much smaller scale, as machines were normally powered by water



Fig. 3.3 Preston Station, England



Fig. 3.4 The locomotive: a steam engine on wheels.
Women's Memorial precinct, Bloemfontein



Fig. 3.5 No. 3 Mill (1826, by Robert Owen), New Lanark, Scotland

power. Even foundries used water power to operate the bellows needed to generate the required furnace heat. Most factories were accordingly located by fast-running streams with enough power to drive the machinery involved, and were often tucked away in remote valleys. The new availability of steam-powered machines enabled entrepreneurs to operate more machines at the same time, which in turn required larger premises to house these. This need for larger factories led to the development of ‘industrial architecture’, the principles of which were initially applied to station design. – Furthermore, factories could now be located by any water, still or fast-running, as long as it was sufficient to feed the steam boilers; alternatively, the water could be led there. Accordingly, to facilitate access to their markets, factories could and were now often placed in towns and cities. However, this greater freedom of choice regarding location removed them from the proximity of rivers or canals previously required to transport their raw materials to them and their finished products from to the markets. But this did not remain a problem for long: the growing availability of railways negated the problem, and, in turn, the increased demand for freight transport contributed further to the expansion of the railway network and the traffic carried by it.

After some initial resistance, often by vested interests, against this ‘fiendish’ invention, bad for health and sanity of both passengers transported and people and animals passed (Ellis, 1954:34), railways quickly proliferated to provide the services required for the accelerated transportation of ever growing volumes of people and merchandise. These expanding railways needed stations where the required services could be provided and which, due to the ever increasing volume of passengers and freight transported (before the advent of motor and air transport), grew bigger and bigger.

To understand the growth of stations, with the resulting impact on architecture, cityscape, and urban planning, it is also necessary to understand the components making up a station, determined by the operational and support functions required to handle the rail-transported passengers and freight.

3.4 Station operation and functioning

As stated above, railways require stations for the purpose of embarking and disembarking passengers, selling tickets to them, and allowing them to wait for the departure of their trains. Furthermore, passenger luggage has to be stored, and mail has to be handled (though less so in current times, mail now being transported by motor and air transport). Freight, too, has to be warehoused, loaded and off-loaded. Locomotives, passenger carriages and goods wagons have to be maintained and serviced in workshops, and have to be stored on sidings, in round-houses and in yards when not in use. It was discovered with time that these activities are better accommodated in enclosed structures or at least under shelter, for a variety of reasons, *i.a.* weather protection, safety and access-control, the exception being the storage of



Fig. 3.6 Old time station scene: Cuneo’s “London & Birmingham Railway”

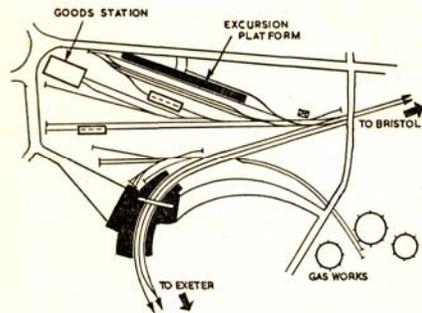


Fig. 3.7 Goods station separated from passenger Station (at bottom). Weston-super-Mare station, UK

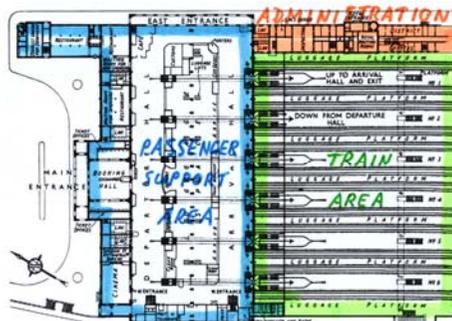


Fig. 3.8 Area functions of stations: Copenhagen



Fig. 3.9: Area of passenger/train interaction, Gare de Lyon (1897-1900), Paris

carriages and wagons.

Goods stations, round-houses and workshops were initially placed within the same area as, or in very close proximity to the passenger handling facilities. In later years they were often removed to other premises, as the land occupied by them was required to accommodate the expanding passenger facilities. This occurred in Pretoria, where, at the beginning of the twentieth century, the freight station was still part of the main passenger station, was then removed to a spur to the west, still adjacent to the present station, before finally ending up in distant premises, such as *i.a.* Hercules yard. Similarly, the Pretoria workshops were initially located to the south and south-west of the station, before being removed to Capital Park and Koedoespoort in the 1950s and 1960s. Here, however, it was the expanding workshop demands which led to their relocation; the land so vacated was left an empty swathe in the urban fabric (and is the site chosen for the proposed railway museum). – Although the goods handling and workshop facilities were subsequently removed from the passenger handling facilities, their initial incorporation in the station complex increased the size of the area and structures required by the railways, which in turn impacted on station architecture and cityscape. The removal of these functions to separate premises had further major impacts on urban planning, as they, too, generally occupied larger areas than the passenger stations themselves. It is however the accommodation of the growing passenger volume that resulted in a major impact on architecture and cityscape, and thus the passenger station will initially be focussed on, whereas the impact on urban design is common to passenger and freight stations and workshops, and will be assessed later.

A passenger station usually accommodates three, and sometimes four functions, each contained in a separate area, but linked to the others: the 'train area', the passenger support area and the railway's administration or office area. Hotels are the fourth function sometimes added to the station complex. The first or 'train area' is concerned with the handling and control of the arriving, waiting and departing trains and of the boarding or alighting passengers, using platforms adjacent to the train tracks (area of passenger/train interaction), the second area, also called the 'concourse', with providing the necessary support functions for the passengers and their contact with the railway administration by way of e.g. ticket buying and information gathering (area of passenger support), and the third and fourth areas are reserved for the railway administration's functions and guest accommodation respectively, where these are included in the same complex.

The area of passenger/train interaction occupies the largest amount of area, due to the length of trains. Increasing volumes of passenger and originally of freight traffic led to more and longer trains, necessitating the expansion of this area. This was first satisfied by freeing space through the afore-mentioned removal of the freight handling facilities to other locations. Accommodating the functions of the train area on more than

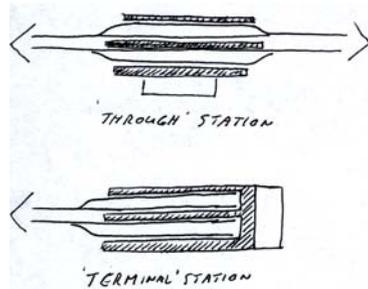


Fig. 3.10 'Through' and 'terminal' station



Fig. 3.11 Passenger support functions placed on foot-bridge itself. Hamburg *Hauptbahnhof*, Germany



Fig. 3.12 Foot-bridge, Leeu-Gamka station

one level is wellnigh impossible, due to the sheer difficulty of providing lengthy access ramps for a train to make the necessary change in level: South African Railways/Transnet considers a gradient of 1:66 as the steepest main-line gradient viable, avoiding slowing trains down too severely. Allowing for a change in level of say 8 m for an upper storey would require a costly ramp of over half kilometre length. (Exceptions do occur, for example at New York's Central Station.) Any expansion of this area is thus generally in a horizontal direction. – The station's train control function itself, historically placed within or adjacent to the track area, can be placed these days within or without it, as electronic control has obviated the need for visual contact between the controller and the trains. It is therefore not treated as a separate function or area.

The 'passenger support area' or 'concourse' should have its functions easily accessible to passengers. This requires that booking offices, ticket selling booths, information counters and toilets should be based adjacent to or in close proximity to the passengers' main route of movement, which is from the station's roadside entrance to the platforms, and *vice versa*. This arrangement allows for the streamlining and non-interruption of the main passenger flow: long deviations from this route are minimized, and disruptive cross-flows to the main direction of flow are reduced, thereby also improving the orientation of the masses moving through this area. Less important passenger support facilities, such as waiting rooms, restaurants, shops and baggage storage or collection areas can be placed further away, though they should still be within easy reach. By being located slightly further away, 'superfluous' passengers are 'removed' from the main circulation routes, instead of standing around and thereby obstructing the main routes of flow while waiting e.g. for their train to depart. – Two approaches exist for the placing of the concourse with regard to the train area: it can be on the same level as the train area's tracks and platforms, or on a different level. 'Terminal' stations usually apply the same-level approach, as, with trains entering from and leaving in the same direction, the crossing of passengers and trains can be avoided. This approach is furthermore found in small stations, a foot-bridge generally providing for the safe crossing of trains and passengers. However, space constraints or a desire to incisively split these two areas of separate functions have often forced the split-level approach, often found in large 'through' stations (stations where trains arrive and pass through, *i.e.* do not leave in the same direction as they came from). Here passenger and train traffic are required to cross each other, and safety considerations demand the provision of foot-bridges or underpasses for their separation. Placing the supportive functions on a level different to the tracks' location satisfies the safety considerations, with passengers ascending or descending to the platforms: the functions are effectively placed on a large foot-bridge or in a large underpass. Ramps, stairs, lifts and/or escalators are provided, requiring additional space and adding to the cost of construction. Combinations of same- and split-levels are also possible, but are scarce. Examples of same-level stations in South Africa are Cape Town and Pretoria (Central) stations, of split-level Johannesburg and Bel Ombre (Pretoria). – As the concourse area requires aforementioned proximity to the main flow of passengers, an increase in the concourse's



Fig. 3.13 Offices above Broad Street station (1892-93), Philadelphia



Fig. 3.14 Great Western Hotel, Paddington Station, London

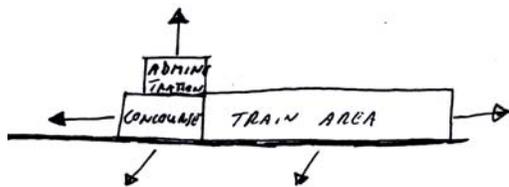


Fig. 3.15 Usual directions of expansion for different areas of station

passenger volume-related area requirements would preferably be satisfied in a horizontal direction, following the route of the street entrance-platform/train track axis: splitting it over more than two levels would result in complex and complicated movement patterns.

The railway's administration or office area's functions, where required on the premises, are not directly concerned with handling of and interaction with passengers, and thus do not require being easily accessible to them. It is thus of less importance that they be located close by and on the same level as the passenger flow routes, and they are often placed in a more remote area or on a different level, this reducing the total ground area required for the station complex. The administration part can be of any height and number of storeys. Expansion would generally be in a vertical direction due to potential ground area and resulting cost savings: horizontal expansion would only occur where vertical expansion costs would exceed those of horizontal expansion, e.g. if for some reason cheap land were still available.

In addition, many railway companies provided hotel accommodation in the large cities as part of the service to their passengers. These were usually upmarket establishments and formed either part of the station complex or were situated in very close proximity. The best-known example is the Grand Midland Hotel (1865-71, by Sir Gilbert Scott), forming part of the Midland Railway's St. Pancras station. Providing functions different to those found in the general concourse area, they were architecturally treated as a separate entity, an approach similar to that employed in accommodating the railway administration offices. As with the latter, they would also rather expand vertically than horizontally, enhancing their prestige. For purposes of this investigation, they will be seen as part of the office area.

The three areas thus have their own, different expansion possibilities, although practicality dictates that passenger/train interaction and passenger support should be on the same level, or at most only one floor apart, with sufficient routes of access between them to avoid bottle-necks. It is, however, their directions of growth which is so important in assessing the influence they had on cityscape and architecture. The vertical expansion of the administrative function had little influence of its own: this was already occurring in factories, as will be seen later. (Refer to 'Development of Industrial Architecture', Appendix 1.) It is the accommodation of the growing passenger-related activities of railways which had a major impact: the horizontal expansion requirements of the train and concourse areas dictated wider and higher spans to create the required volumetric enclosure.

South African passenger station design had to face an idiosyncrasy imposed upon it when the apartheid-policy of racial segregation was developed to its full extent as government doctrine: all station facilities had to be duplicated, for 'white' and 'non-white' passengers, to use the then current terminology. Old stations had to be adapted to meet the segregation requirements, whereas the new ones built in Johannesburg,

Cape Town and Durban had this duplication incorporated in their design. The entrance for 'whites' was normally at the front, whereas the facilities for 'non-whites' – though in many places forming the greater part of commuters – were tucked away around the corner. With the demise of the apartheid policy the segregation has fallen away, though the architectural evidence is still there. – The effect of this political aberration falls outside the ambit of this dissertation and will not be investigated in greater depth

However, the design of passenger stations is not limited to the accommodation of the mentioned three or four primary functions relating to passenger transport and train operation. There are more factors at play.

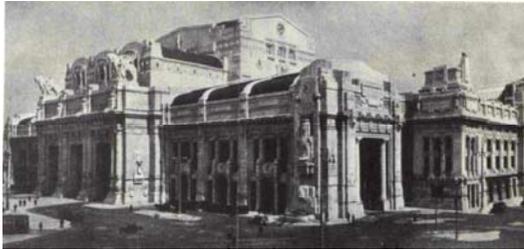


Fig. 3.16 The 'prestige' factor: Milan Central Station (1906-31, by Ulisse Stacchini), Italy

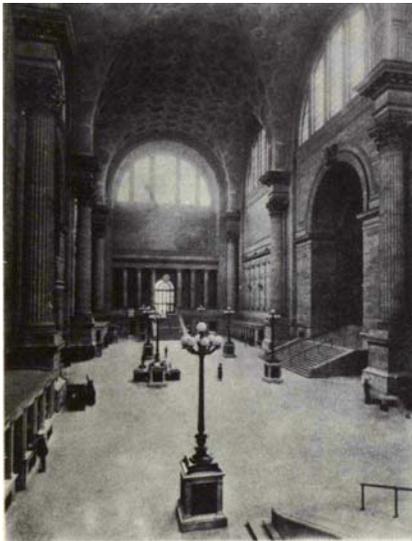


Fig. 3.17 'Waiting room': Pennsylvania Station (1906-1910, by McKim, Meade and White), New York

3.5 Further factors influencing station design

By being the point of departure or destination for the majority of all train travellers, and due to the sheer size of the resulting volume of passengers and related train movements handled, city passenger stations are more important than town or village stations. The large volume handled inherently dictates that such stations have to be large: it does not only influence the size of the train handling area, where passengers embark and disembark, but also determines the size of area required for the handling of these passengers, and the functions and services that go therewith. This total size is, as such, the concretization of the functional aspect of moving people and operating trains, and the design of a station is essentially and primarily function-driven.

However, stations, and especially large city stations, however, have to additionally give the prospective traveller a feeling of assurance in the safety of the conveyance he is about to board, and to enhance the image of integrity and solidity of the entity owning the railway (even more so when the head offices of the railways were accommodated on the same premises). In contrast to the transient train, the company or government owned railway station is the permanent, always visible representative of its owner. Furthermore, during the last quarter of the nineteenth and first fourteen years of the twentieth centuries, and mainly centred on continental Europe, growing issues of national prestige were thought to demand buildings worthy of representing the nation as a whole. The brief for the new Leipzig, Germany station (completed 1906) contained a clause stipulating that the building 'should, as an imposing architectural monument to Leipzig's commercial status, bear witness to Germany's economic expansion' (quoted in Binney & Hamm, 1984:137). Similarly, the Milan Central Station (1906-31, by Ulisse Stacchini) was deemed necessary to show off Italy's standing to the world. This philosophy of 'prestige' or power architecture is still evident in many structures of today. Aesthetic considerations can therefore not be neglected in favour of pure functional station design: Stations have the added 'necessity' of prestige, mainly concretized in the concourses building, which are built to impress the viewer, who may not necessarily be a user of it. This



Fig.3.18 Cape Government Railways Station, Cape Town (postcard)



Fig. 3.19 NZASM Station, Pretoria (postcard)



Fig. 3.20 Sannaspos Station, Free State

makes the structures even larger: aisles, staircases, waiting rooms and restaurants of great size, splendour, opulence and monumentality are often included within gigantic and towering façades. The functional design, though of primary importance, is thus enriched (or corrupted) with aesthetic and symbolic enhancements in various forms and enunciations. Architectural historian Edgar Jones summarizes that ‘The value of a building as a source of status and a means of advertising became increasingly apparent... Thus the shape of industrial [and railway] architecture in Britain was determined by aesthetic considerations and, at root, the evolving needs of manufacturing [and transportation] enterprise.’ (Jones, 1985:13). – South African examples of stations of large size and grandeur are the historic and/or new stations of Cape Town, Johannesburg, Pretoria, Durban, Pietermaritzburg, Port Elizabeth and Bloemfontein, albeit that their designs may not all inspire admiration. An odd exception to the splendour of the main stations of important cities is the rather inconsequential pre-1910 Pretoria railway station: the NZASM considered Johannesburg to be their more important station (based on passenger and freight volume handled), and put more effort in its representative effort where its business was concentrated.

The dominance of city stations nonetheless does not negate the importance of the lesser station: railway traffic is not only limited to non-stop express trains between major cities. The towns and villages served by the railways all have their stations, albeit of lesser splendour than those of the city, and sized to match the requirements of the traffic handled in these places. However, the same characteristics apply to these as to those in the cities: they were, when built, still large structures relative to those of their surroundings, and of a design to reflect the supposed solidity of the entity behind the train. – South Africa contains many such examples of smaller, yet elegantly styled and, for their urban environments, substantial station buildings: Middelburg (Transvaal), Kroonstad, Cradock, Worcester, Leeu-Gamka and Matjiesfontein. – Such smaller stations must not be confused with ‘halts’, where trains stop to allow on-coming trains to pass, and generally passengers do not board or alight. These halts offer little more than a name board and the railway staff’s offices and accommodation.

It may be noted that the provision of a platform of the same height as the passenger carriage, facilitating easy boarding of the train, is actually a luxury not found in many stations. (British and South African stations of all sizes were generally provided with them, albeit occasionally shorter than the calling train.) South African exceptions do occur: the platform at Gouda station (Western Cape) and Sannaspos (Free State) are no higher than about 150 mm above ground level. The lack of carriage-height platforms is not only a general characteristic of the rural stations in poorer countries, such as India (based on own sighting), but also of the majority of the stations in the USA.

City passenger stations thus, throughout their history, have had to combine the large and ever expanding expanse of area required to handle the passenger/train interaction and passenger support with the need of



Fig. 3.21 Low platforms at Santa Fe Station, Denton, Texas, USA

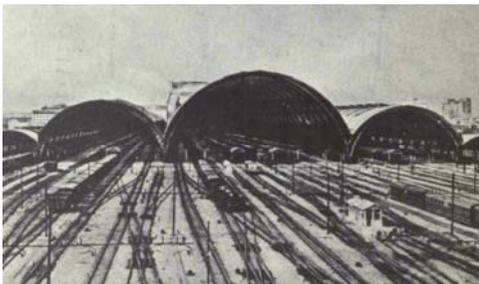


Fig. 3.22 Train area: Approach to Milan Central Station (1906-31, by Ulisse Stacchini), Italy



Fig. 3.23 Concourse, Manchester Victoria Station (1909, by William Dawes)

prestige, symbolizing the safety of transport and the solidity of the organisation behind the railway. They were therefore, generally, after the initial 'experimental' phase of early station construction, built for both functional and prestige purposes, which had to be satisfied by larger and grander station designs. However, in the architectural design the incorporation of the prestige factor was subordinate to the imperative of accommodating the identified primary functions of a station, having the respective areas and their connection operate efficiently and smoothly.

3.6 Architectural concretization of station functions: 'cathedrals of industry'

As stated, the area of a station can effectively be sub-divided into three areas, each with its own functions: the largest area of passenger/train interaction ('train area'), the smaller area of passenger support (concourse, for passenger/railway administration interaction), and the optional railway administration area. I highlighted that the prior two would generally only expand horizontally, and that the latter had a choice of doing so vertically or horizontally, albeit, in the main, vertically.

A station is thus, in fact, an integrated complex of three functions, each with its own functional, and thus architectural requirements. The prior two are usually adjacent to each other, and may be combined, but the layout of the train area will dominate, due the physical and space-intensive constraints of train operation. It also demands an area of equal level (to prevent trains or carriages from running away, should their brakes fail), sufficient length (to accommodate the longest train), and sufficient width (to accommodate both the number of trains in the station at any one point in time, as well as enough and sufficiently wide platforms for the volume of passengers boarding or leaving the trains). The greatest number of trains in a city station generally coincides with the peak of passenger volume experienced during business rush hour, with employees entering the city for their place of employment, or heading for home in the suburbs.

The concourse demands an area of sufficient size for the accommodation of functions such as ticket selling, making of reservations, providing of information, handling of baggage, catering for passengers and holding of waiting passengers, all of which should not obstruct the simultaneous space demands of the main flow of passengers between the station entrance and the trains. The supporting functions are thus generally placed adjacent to the route of main passenger flow, but sometimes within it, in the form of islands, which should not impede passenger flow. The maximum passenger volume passing through at any one time must thus be anticipated and planned for, and will peak during rush hour, as explained above.

The railway's administrative offices generally occupy a separate area, usually with their own entrances, placed either adjacent to or outside the concourse, so as to not impede the flow of passengers. This area



Fig. 3.24 The 'supershed': First Grand Central Station (1869-71), New York

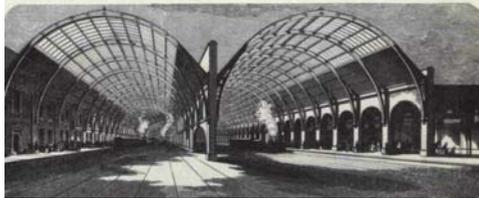


Fig. 3.25 Train-sheds of King's Cross Station (1850-52), London

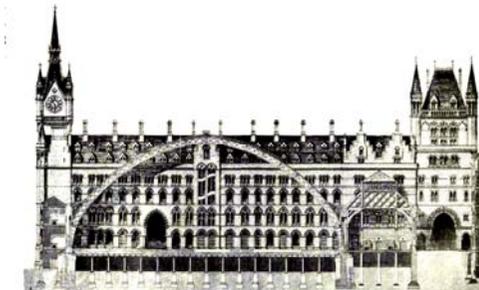


Fig. 3.26 Section of St Pancras Station (1866-68), London, with hotel behind

may thus be treated totally separately, being, in effect, a normal office structure. – A hotel is occasionally added for the convenience of passengers.

An analysis of the layout of a large station will reveal that often the three components are located in three different structures (four, if a hotel is included). These structures may be of totally independent of each other structurally, and of different styles, reflecting the difficulty of matching the engineer-orientated design of the train area to the others.

The identified need to accommodate the maximum train and passenger volumes and their respective operating and support facilities resulted in the large structures we know, and which provided the challenge to station architects and engineers. The realisation of these structures was only possible through the advances made in materials and technology, as applied in and expressed by industrial architecture. – Station architecture can be seen as a newer and specialized sub-field of industrial architecture, in that factories, being existent before the Industrial Revolution, are the older type of structure and had already anticipated structures to house more than one function, *i.e.* the manufacturing process (and the often concomitant warehousing) and the administrative functions. Station architecture differs in that it has to provide, in addition, for large, varying and transient volumes of trains and people, and the related support functions to process these volumes smoothly. Both factories and stations had to provide large structures to accommodate their respective functions. Innovative solutions were required to accommodate the expanding requirements of space to be enclosed, and, with regard to stations specifically, in the main of the station's train area: the key element to the design problem was to create an as large as possible, covered but column-free area, as columns would impede the layout of tracks and train movement, and the flow of passengers to and from them. In addition and if possible, the height of this sheltering structure had to be sufficient to allow for the engine's smoke to draw upwards and to escape through openings in the roof. The new materials available (cast iron, wrought iron and much later steel), combined with increased knowledge of their strengths, enabled the finding of the solution: the supershed. The supershed is defined by architectural historian Chris Wilkinson as 'buildings enclosing a large single volume of space with relatively long spans and without major subdivision.' (Wilkinson, 1991:vii) and is characterized by 'modular construction, standardization, mass production, prefabrication, mechanization, lightweight construction, systems integration, rapid site assembly and demountability' (*ibid*:4).

Station supersheds may either contain the areas of both passenger/train and passenger/railway interaction/passenger support within it, or be reserved for the handling of the passenger/train interaction only, with the concourse functions housed in a near-separate, different kind of structure. It is the supershed which had such a pronounced influence on architecture, the cityscape, urban development and, through these, on society.



Fig. 3.27 St. Pancras Hotel (1865-71), London



Fig. 3.28 Model of International Rail Terminal (1988), Waterloo Station, London



Fig. 3.29 The ubiquitous tower: Dearborn Station (1883-85, by Eidlitz), Chicago

Before analysing the impact of the supershed, it is of interest to obtain a background of the progress made in industrial architecture, which, through the availability of improved materials and technology made the construction of the supershed possible, the historical development of railway stations and the achievements made, reaching their zenith in the vast dimensions of the supershed, and the involvement of the architect and engineer in it, and the difficulty the profession of architecture had in accepting the new materials and methods of construction. Furthermore, the interior dimensions of the supersheds dwarfed those of the until then unchallenged large cathedrals. This background is however not essential to assessing the impact of the supershed as such, and is thus included in appendix 1.

It suffices to summarize that stations grew phenomenally: the first main line station serving London, the London and Birmingham Railway's Euston station (1836-37, by Robert Stephenson), at first covered by a column-supported 13 m span of 61 m length, has expanded through the years to now cover an area of 74,925 m² (including the non-covered track area). Station architecture culminated in Britain with William Barlow erecting the then world's largest single arched structure, London's St. Pancras station (1863-67), its wrought-iron span being 73 m wide, 209 m long, and 30 m to the point of arch. The clock tower is 68 m high. The adjoining Midland Grand ('St. Pancras') Hotel (1865-1871, by Sir Gilbert Scott) is the biggest neo-Gothic secular building in the United Kingdom (Binney & Hamm, 1984:136). – This station also illustrates the initial quandary faced by station architects: whereas the enclosure of the track area is best addressed by a purely functional design, the desire for 'prestige architecture' in and around the other areas does not lend itself easily thereto, resulting in a clash in the style of execution, united only by the continuous flow of passenger movement through both. At St. Pancras station an architect-designed, ornate, impressive, Neo-Gothic masonry-finished hotel façade in 'front' hides the engineer-designed, utilitarian, functional, iron-and-glass train-shed behind it.

Developments in the USA culminated with the construction of the world's largest single-span train-shed at Philadelphia's Broad Street station (1881-93, by Wilson and Truscott, additions by Furness and Evans), with three-pinned trussed arches spanning 91 m, with a height of 33 m and a length of 181 m. (Wilkinson, 1991:10 and Meeks, 1978:89 and 103) – However, supersheds were costly and had other drawbacks (set out in the appendix), and were at first replaced by so-called Bush sheds and then butterfly sheds. Station design itself also moved on with the times, reflecting both the Art Deco and Modernist styles, with extensive use of the new medium of reinforced concrete. However, with the loss of the supershed element from the designs, the passenger support area superseded the track area as the architecturally more dominant one, gaining large and high concourses, whereas the track area was protected only by the aforementioned low butterfly sheds. Current station designs in Europe, mainly, but not limited to suburban routes, follow the latest style trends, showing a mix of concrete, steel, glass and masonry work. The occasional station



Fig. 3.30 The superlative concourse: Thirtieth Street Station (1927-34, by Graham, Anderson, Probst and White), Philadelphia

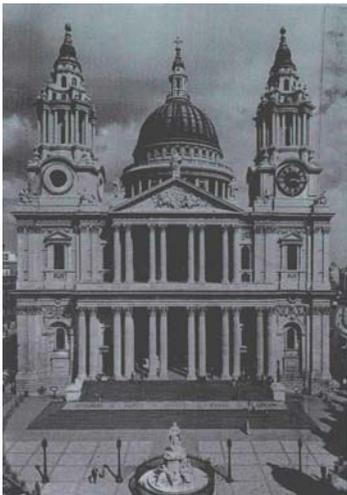


Fig. 3.31 St. Paul's (1675-1710), London

supershed is still built: a recent example is that covering the extension of London's Waterloo Station's International Rail Terminal (1988, by Nicholas Grimshaw and Associates). The latest shed being built is the new Berlin *Hauptbahnhof*, still in process of completion. Its four tracks are spanned by a shed, its appearance reflecting back on the classic train-shed of iron and glass.

Ironically, while the supershed was replaced in newer designs by the rather insignificant butterfly sheds over the platforms, it was being incorporated in the design of the concourse area. Being of vast sizes, both so as to more easily handle the volume of passengers, and for purposes of prestige, they were covered with massive spans of either cast-iron or concrete to allow for uninterrupted space. New York's Pennsylvania and Grand Central stations are good examples of this, while in South Africa this trend is evidenced in the new Johannesburg and Cape Town station concourses.

In the station complex, the supershed was generally distinct from, but linked to the also expanding horizontal passenger support area, and often, too, to the vertically expanding administration and hotel structures. The combined structure, expanding both horizontally and vertically and often with a clock tower incorporated in the design, was of a structural size not encountered before the Industrial Revolution. It is not for nothing that these station complexes, and especially the supersheds, due to their area, size and enclosed volume and silhouette, were occasionally referred to as the 'cathedrals of industry'.

The justification of this soubriquet is understood when the dimensions of ecclesiastical cathedrals are compared to those of the secular cathedrals. St. Peter's, Rome (1506-1626, by Bramante, Sangallo, Giocondo, Raphael, Peruzzi, Michelangelo, della Porta, Fontana, Vignola and Maderna) has an external length of 213 m, internal length of 183 m, internal width of 137 m, nave width of 26 m, vault height of 46 m, and internal height of cupola 102 m with internal diameter 42 m. St. Paul's, London (1675-1710, by Sir C. Wren) has an internal length of 141 m, internal width of 31 m, internal height of domes surmounting naves of 28 m, internal height of large dome 65 m with internal diameter 34 m, and an area about 6,000 m² (extracted from Fletcher, 1975).

Cathedrals were thus both shorter and narrower than the new train-supersheds. Though both nave and towers still exceeded the latter in height, drawing the eye upwards, they were not able to impart the same feeling of space to the perceiver as the stations were able to do: the experience of large space in cathedrals was curtailed by the narrowness of the nave. Having the greater tower height did not affect the experiencing of space, as they are not visible from the interior. The cathedral tower's crowning height on the city silhouette, when compared to a station, was now intimidated by the latter's greater length and bulk. However, with ever higher buildings surrounding both, both have lost on their impact.



Fig. 3.32 The old: St Martin, Landshut (1392-1432), Germany



Fig. 3.33 The new competition: Grand Central Station (1888-90, by S. Berman), Chicago

The comparison of stations and their supersheds to cathedrals is not as incongruous as it may initially seem. Before the advent of the prior the general population could only experience the awe-inspiring volume of vast enclosed space in the cathedrals of the big cities. Palaces and town halls, also being structures which contained large enclosed spaces, were not easily accessible to the everyday man, except in a serving capacity. Station architecture changed all this fundamentally.

Having traced the development of railway stations, their function, architecture and the achievements made therein, and having compared it to other larger structures preceding the introduction of stations, it is now possible to assess the effect that they, and in the main the supershed associated with them, had on architecture, cityscape, urban development and society. The impact of architecture and cityscape on society is discussed immediately after their respective assessments, whereas, with the railway infrastructure's impact on urban development and, in turn, its very tangible impact on city society, these are interlinked in one discussion.

3.7 Influence of stations on architecture

The influence of the large cities' railway stations on architecture was twofold: on the one hand, satisfying the needs of a large station led to great strides being made in the application of the new materials available and the architect's and engineer's knowledge of how to use them improved, and, on the hand, it influenced how and by whom the sensation and the sense of space and building volume were experienced.

Technological advance arose from 'inventing' the type of structure required for large stations, culminating in the flourishing of the supershed. The supershed's characteristics of 'modular construction, standardization, mass production, prefabrication, mechanization, lightweight construction, systems integration, rapid site assembly and demountability' (Wilkinson, 1991:4) were all new concepts to the then designers, and their application led to a revolution in design. Large spans could be bridged and large spaces enclosed. As designs were 'liberated' by the new and economically available materials, such as larger sheets of plate glass and corrugated iron, and stronger materials such as cast-iron, they were at the same time constrained by the uncertainty involved in using them in constructions, as no detailed information on their characteristics, such as strength and bearing capacity, was available. This handicap was only overcome as the necessary knowledge, such as the design of cast-iron trusses, became available, often only discovered empirically. Cases of supershed collapse occurred occasionally; however, the gain in knowledge led to developments still seen and felt today, as it is being readily applied to factories, hangars, warehouses and shops: for example, the large wholesaler or supermarket is presently more often than not housed in a supershed.



Fig. 3.34 St. Peter's (1248-1880), Cologne



Fig. 3.35 Leipzig *Hauptbahnhof* (1906-15, by Lossow and Kühne), Germany

Interestingly enough, the increasing application of the new materials was matched by huge debates in architectural theoreticians' circles as whether their use was ethically justifiable. The theoreticians were out of their depth, as their much hallowed principles of aesthetics were suddenly being compromised by engineer-designed structures of purely functional nature: art was deemed as having been sacrificed on the altar of functionality... Augustus Pugin (1812-52), as an example, abhorred the new materials. John Ruskin (1819-1900), of *The Stones of Venice*-fame, was embarrassed by the use of iron, only conceding that new rules had to be evolved for its use. Others expressed mixed feelings: architect George Edmund Street (1824-81) 'admired metal in pure engineering, but loathed the commingling of architecture and engineering in façades which seemed to be supported by sheets of glass. He felt that as construction in iron became more scientific, it became artistically more unsatisfactory. The naked use of iron had enjoyed a short, premature reign during the 1850s, but by the 1870s a strong reaction had set in and iron was, if possible, concealed from view.' (Meeks, 1978:91) The man in the street wanted picturesque and palatial stations, and the obliging and sensitive architect gladly provided him with it, regardless of the theoreticians' qualms. This disguise was effected with the application of the Revivalist styles, narrated under the discussion of industrial architecture (refer Appendix 1), and labelled by architectural historian Meeks as the style of 'Picturesque Eclecticism'.

The debate was further fuelled by the new approach to station architecture, with the engineer being intimately involved with the structural (and often aesthetic) aspects of the design. In the early beginnings of station design the architect was not even consulted, the design usually being entrusted to the engineer. It was only when the prestige factor in the appearance of the passenger support area became important that the architect became more involved. However, as the integration of the growing concourse with the also growing train area became more and more difficult, the respective design responsibilities were often cleanly divided between the architect and the engineer. Some architects saw the task of unifying the two structures as virtually impossible, with only some attempt at contiguity being considered possible, and the co-existence of engineer and architect was accordingly not always harmonious. (A cynic could comment that only the architect's loathing of the engineer's involvement led to the prior's debate over the acceptability and use of the new materials by architects, as otherwise, all of a sudden, the glory of a large commission – and the professional fee – had to be shared or could even be lost...)

Regarding the creation and realization of huge enclosed spaces by architects, the supershed's impact was profound: its development by, and application in railway architecture had an effect on the perception, understanding and experience of space by society at large. In the past, such experience was limited to the space contained in churches, the only large structures accessible to the man in the street. The size and height of these, generally larger and taller than any other structure in the city, had thereby historically



Fig.3.36 The clash between the architect and the engineer: the Neo-Gothic St. Pancras Hotel and concourse hiding the functional train-shed behind it



Fig. 3.37 St Peter's, Cologne (1248-1880)

proclaimed their hierarchy, their dominance in and over society. The supershed's impact here was due to the competing size of its bulk and of its enclosed space and resulting large volume contained within. The average man in the street was now able, in his pursuit of everyday activities, to experience a new sensation: the sense of vast, but structurally enclosed space, raw, unmitigated, with minimal superficial application of ornament, impressing through its incredible and uninterrupted dimensions. Previously unimaginable large (and now secular) spaces and volumes became accepted as normal, after the initial amazement yielded in the population: their users became used to non-institutional large structures and their everyday use of them, and were no longer intimidated thereby. This influenced the field of their application for the architect: he could now, with comfort and confidence, design such large structures, knowing that their users were not likely to object to them. This acceptance also explains in part the ability to later use the supershed as a station concourse for prestige purposes, as, whilst proclaiming hierarchy, both inside and outside, it impressed but no longer intimidated unnecessarily (which might have prevented its uninhibited usage by the passenger).

Furthermore, the clarity of structure and the straight-forward, undisguised use of the new materials led to the acceptance by the public of functionalism, albeit slowly and with periods of retrogression, during which the station's concourse buildings, offices and hotels were styled in various Revivalist styles such as Italianate or Neo-Gothic. The acceptance of functionalism by the population was possibly aided by its being used to the visibility of Gothic churches' structure, and now seeing this principle repeated in the train-shed, although it did take some time to make this mind-shift to the similar underlying principle, although they differed in appearance. 'The spatial quality and structural clarity of the Gothic cathedrals are in many ways comparable to that of the Victorian train-sheds. The latter, in addition, were economical, functional, simple of form and economic to build.' (Wilkinson, 1991:vii). Norberg-Schulz (1974:169) further ascertains that Baroque principles also followed a concept of open and dynamic space. The utilitarian structures of iron and glass as applied in stations echoed both these characteristics. However, in this process glass, which had replaced masonry in walls and ceilings, and shifted from being associated with a mainly religious connotation (when used in large areas): it was now as easily associated with commercial and other secular structures and activities. Concurrent with this development was the aspect of the so much larger volumes now being enclosed by secular and not only institutional structures. The perceived historic hierarchy of certain structures and the institutions represented by them was changing...

3.8 Influence of stations on the cityscape

The effect of the city station's supershed on the cityscape resulted from the visual impact it made on the city's silhouette. Historically, cathedral spires and town hall towers generally were the largest and tallest



Fig.3.38 Churches as the historic focal points:
Rostock, Germany, in 1943

structures in the cityscape, rising high above the huddled silhouette of the city. They were imbued with a commanding hierarchy due to their exceptional size, unique shape and strategic location, often placed in the centre or on the highest point of the city, increasing the perception of dominance over its surroundings. They formed points of focus around which one could imagine the city to revolve, and points of orientation in the city fabric. This perception of superiority was now being opened to competition from stations, and in the main from the supershed: The need for covering the large horizontal expansion of the train area led, as stated before, to ever more commanding vertical heights being necessitated by the structural considerations underlying the spanning the area to be enclosed.

Architectural theoretician Ching states that ‘the principle of hierarchy implies that in most if not all architectural compositions, real differences exist among their forms and spaces. These differences reflect the degree of importance of these forms and spaces, as well as the functional, formal and symbolic roles they play in the organization [the city and its society]... The manner in which the functional or symbolic differences are revealed is critical to the establishment of a visible, hierarchical order. The form or space to be seen as important or significant must be made uniquely visible. The hierarchically important form or space is given meaning and significance by being an exception to the norm, an anomaly within an otherwise regular pattern.’ (Ching, 1996:338) By being different to the surrounding structures the cathedrals had achieved a position of hierarchy. – By association, through this dominance of the skyline, the physically perceived hierarchy of these structures imbued the institutions they represented with a similar position of dominance in society and culture, which was generally not challenged. A form of power architecture is thus embedded in cathedrals, too.



Fig. 3.39 Stations as the new focal points:
St Pancras, London

This is where the effect of station architecture on the cityscape was most influential. It has to do with the exterior shape and form of stations: the appearance on the city silhouette of the stations’ then enormous supersheds, generally linked to a majestic office or hotel building and crowned by an even taller clock tower, suddenly placed new and different focal points on it. The city showed an increase not only in the number of vertical elements, but also of bulky horizontal volumes rising above the surrounding buildings. The physical hierarchy of the previously dominating institutional structures was suddenly challenged, a competing hierarchy undermining the existing.

The effect must have been startling to a citizenry only used to the spires and domes of the mainly religious institutions arising amongst them. It must have been similar to seeing a beached whale. The stations became tourist attractions, drawing vast sight-seeing crowds who came to look at these massive and unprecedented structures. Their dominant position on the skyline challenged that of the old, established institutions. New points of orientation were created, and new associations formed in the mind of the populace: St Pancras was no longer associated with a church, but with a station...



Fig. 3.40 St. Jakobi (14th century), Rostock, Germany



Fig. 3.41 Manchester Central Station (1876-80, by John Fowler)

In this way the population was prepared for the further growth of huge volume structures other than those of religion, royalty or city government, such as larger and larger factories, warehouses and department stores. Large bulk buildings became less intimidating, through their everyday use, and became accepted elements on the city skyline. Similarly, the large areas occupied by these large structures were accepted as normal, opening the way for further large-scale developments in architecture and their acceptance by society.

3.9 Ecclesiastic cathedrals vs. secular ‘cathedrals’: the influence on society

In the past, cathedrals and churches served as both focal points and as points of orientation, and historically had concretized existential meaning, emphasized by their central and dominant location in the city lay-out. Gothic churches’ longitudinal plan, verticality, lofty volume and slender spires, and the said central placement in the urban fabric marked their status. (Norberg-Schulz: 92-93) According to architectural historian and theoretician Norberg-Schulz, the church was, during the Gothic period, the central representation of what could be termed a cosmic ordered universe, whereas during the Renaissance it stood for a mathematically and geometrically ordered universe, and in the Baroque as the focus or spatial centre of meaning of the world and its centralized systems. In all periods the cathedral and the church (and thus religion) represented one of the focal points of life, together with royal residences and town administration buildings. These institutions provided the visible focal points of urban life, the conspicuous structures on which the lesser mortals’ life focussed and around which their life flooded. These erstwhile only structures of presence had directly or indirectly ruled the life of those looking up to them, and the structures exuded the trappings and symbolism of power. The church, though accessible to the masses, was reserved for the presence of God; the potentially accessible town hall was for those elected or appointed thereto; and the palaces, reserved for the king and nobility, were inaccessible unless one was a servant.

With the superseded ‘cathedrals’ slowly but surely starting to exceed the size of the afore-mentioned institutional structures (which had historically provided the focal points of society, thereby proclaiming their superiority and psychologically enforcing the institutions’ dominance over the man in the street), the latter’s visually commanding position was challenged and undermined. This was not in the sense that the population started to doubt such institutions’ authority, but the railway stations, those superior, attention-commanding and awe-inspiring structures freely accessible to them at their own discretion and nobody else’s, enabled them to experience, for the first time without intimidation, the quality of vast space and volume. This, in my opinion, removed some of the awe in which the other large-sized institutional structures (and institutions) had previously been held, in this sense freeing the ordinary man by making such spaces



Fig. 3.42 Once at the city's edge, the city has jumped across the railway: Braamfontein yards, Johannesburg, with Queen Elizabeth Bridge in the distance



Fig. 3.43 Now a barrier cutting through the city: approaches to Park Station, Johannesburg

and volumes more 'normal' to him. This competition of focal points thus undermined the traditionally important existential meanings, and contributed to the liberation from the constricting institutional systems of the past. This had social and cultural implications: the city-dweller and the visiting rural inhabitant became *blasé* about large volumes... 'The church and palace lost their importance ... and during the nineteenth century [the railway station,] the monument, the museum, the dwelling, the theatre, the exhibition hall, the factory and office building took over their role.' (Norberg-Schulz, 1974:173)

3.10 Influence of stations on urban planning

To understand the impact of the large city stations on urban planning we need to, first, look at where the first stations were placed, and the impact this placement and the railway tracks' approaches to them had on the development of the urban fabric of the city, and, secondly, the effect on the urban texture caused by the more recent decline and even demise of railway services.

Initially stations were placed where both the physical constraints imposed by railway approach and station construction (as set out in Appendix 2, 'Design considerations: choice of site') could be satisfied on available and reasonably cheap land, as initial capital was limited. This was usually on the periphery of the city, as a green-field development. If a through station was so placed, the station did not disrupt the existing city fabric, but did hamper further growth in that direction, as it and its connecting railway tracks to both sides formed a substantial barrier to communicating with the 'off', non-city side. Access to it was difficult: few bridges were provided, once again due to expense. Accordingly the land on this 'far' side was less attractive for development, and remained relatively cheap, and was then used for the housing of the poorer classes, who couldn't afford better. This development is reflected in the view of staying on the 'right' or 'wrong' side of the railway line. The situation was often exacerbated by the placing of the carriage sidings and workshops next or close to the station, so that the barrier became even wider. Adding even further to it was the subsequent placing of industrial zones next to certain stretches of the railway, for convenience of freight shipment access. 'The horrors attendant upon the transformation of the countryside into industrial belts, the 'cinder strips', was about to appear.' (Meeks, 1978:57) – Then, in turn, to facilitate convenient access by the workers to public transport or to the industries adjoining the railway lines, their residential areas were strung along these railway lines or industrial areas (within walking distance, as cars were then far and few between and alternative public transport not always easily available); furthermore so because land was cheaper there (as stated before), making it attractive to speculators and developers. The growth of the suburbs was in fact aided by the availability of railway transport. 'Commuting by railroad was abetting the flight to the suburbs.' (*ibid*:57) This urban flight was however not limited to the poor crowding around the railway-adjointing suburbs for lack of better space. The wealthy also took the opportunity to escape from the

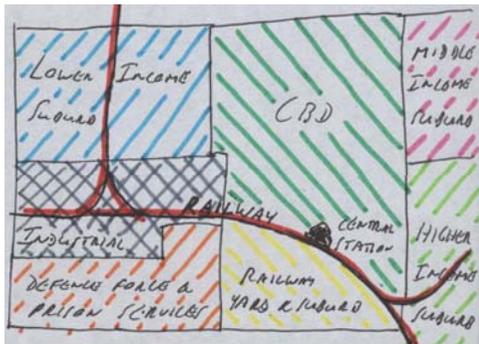


Fig. 3.44 Initial urban development pattern along Pretoria's railway lines

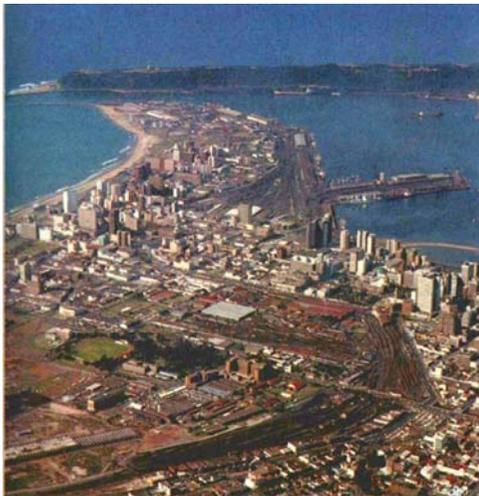


Fig. 3.45 The North Coast line terminating at Durban station (centre right) formed a barrier to the further sea-ward development of the city to its east

crowded and often insalubrious inner city environment (sanitation was not as yet a general feature), and erected or bought country estates, which they could easily reach by coach and horse from the nearest station. A ring of wealth was forming around the squalor of the worker-class suburbs. The railways and associated increased mobility were thus contributors towards urban sprawl.

The areas adjacent to the railway lines were thus seen as 'blue-collar', as they were generally populated by the lower income group. The upper classes could afford transport (horse-drawn carriages or cars) so that they, not being dependent on walking or public transport, could afford to stay in areas further away from the railway. Through this process of causation the differentiation in residential location between the various income groups became strengthened and more stratified: the further from the railway, the richer the population. (In South Africa this process was disrupted by apartheid policies.)

An example of the railway-induced settlement pattern would be Pretoria, where the NZASM's sidings, round-houses and workshops were placed to the south of the first station, and thus to the south-west of the second station. The railway workers' cottages placed to the south of the workshops have never been fully integrated into the Pretoria city fibre: It forms an isolated and near-forgotten suburb, linked only by a long foot-bridge and a circuitous vehicle access route. The first industrial area of Pretoria was then placed along the rail route to the west, curving around to the north. It is here that we find the oldest industries, bordered to the east by the central business district ('CBD') and to the west by the 'blue-collar' worker's residential area of Pretoria-West. The first upmarket residential area of Pretoria was to the east and south-east of the CBD, removed from the rail lines. The country estate of Sammy Marks, early Transvaal industrialist, was built in the 1890s close by the Pienaars River, a fair distance to the east Pretoria, but was within easy reach of the Delagoa Bay railway line. Similarly, Jan Smuts commuted by public train from his estate at Irene, south of Pretoria. – In certain cases, as during the apartheid policy-driven settlement pattern developments in South Africa, the barrier of a railway line made for a convenient and gladly used separation between the various population groups, due to its impermeability.

However, the 'off' side city and suburban development does not need to remain an area without urban fabric; generally it develops its own urban infrastructure, with its own small commercial core and community support structure, as it is, for example, too inconvenient to take a circuitous route to the 'right' side of the tracks for small purchases or other minor tasks. Thus coherent communities can form here, fairly independent of the other, so-called 'proper' side of the rail lines. Nonetheless these areas are more inward turned than 'non-barriered' communities, and focus their attention and further development into the non-railway direction. As such, the rail-adjacent areas have reacted on the railway 'feature' of the site where they developed, after the creation of this feature. It is a response no different to that of reacting on a physical, geographic feature, such as a river, coast line, lagoon, swamp, mountain or cliff face, albeit less

attractive.



Fig. 3.46 The wedge-like intrusion formed by the approaches to the terminus: Frankfurt (am Main) Station, Germany

Developments in, for example, London, Paris, Frankfurt, Cape Town and Durban were slightly different. Here the railway companies operated from terminal stations, so that the railway approach tracks were from one side of the station only. The railway companies tried to reach as close as possible to the CBD, as a convenience for their passengers and freight shippers. However, limited capital resources initially restricted them to the cheaper outer city or rural land, at some distance from the city. City authorities were also averse initially to the railways' penetrating too far into the city proper. In these cases, the city expanded differently: although the Great Western Railway's London terminus was located at a small village named Paddington, on the Edgware Road, about a mile from London, around the original diminutive station of 1838 soon clustered many buildings; but even as late as 1846, the first Paddington Station had only a plain, unornamented façade, with trees, flocks of sheep, and clumsy road coaches near its doorways. Then London quietly crept up to Paddington and embraced the village. Similarly, on the southern side of the Thames, when the London and Southampton Railway purchased the site of its Waterloo station, there were only several small streets in the vicinity. The terminus itself was built on ground occupied by cow-yards and hay-stacks (Carter, 1958:18) The city thus grew outwards to connect its centre to the station, with often the central business district itself expanding towards the stations due to the desirability for offices to be close to railway connections. The large station structures acted as a draw-card for the area and formed the catalyst for the further development of the area. The suburbs then started to envelope and burgeon between the railway approaches to the cities, resulting in the impression of fingers reaching into the urban fabric towards the city centre, although it actually happened the other way round. Development of industrial and lower income group residential areas along these fingers generally occurred in the same way as described for through stations. However, similarly to the 'off' side of through stations, the segments between the rail lines often developed as fairly cohesive suburbs, the barriers created by the intersecting railways being treated similar to non-bridgeable rivers. The smaller stations along the lines often formed the small catalyst core of such a suburb's commercial activities. – Once again the surrounding areas reacted on the barrier feature of the site where they developed, after the creation of this feature, as if it were no more than a physical, geographic feature, such as a river, swamp or cliff face. – The difference to the impact of terminal stations is that there is not really an 'off' side to these suburbs, as the CBD forms, at least partially, a link between the various suburban segments; however, outwards from the termini the rail lines do form barriers impeding easy communication between the so separated suburbs.

The exception to the discussed initial peripheral location of a station is where a railway is cut through the existing urban fabric towards the city centre, in order to gain a closer, more convenient or new access for its passengers. It is very seldom that the tracks of an originally peripheral station would be extended further into the CBD, largely due to the astronomical cost of such extensions. Exceptions are London's Charing



Fig. 3.47 The approaches to terminus stations segmenting the urban fabric: St Pancras (in centre) and King's Cross Stations (to right), London

Cross Station, extended in 1864 for 4 km from London Bridge Station at a then cost of nearly £ 4,000,000 (Carter, 1958:56), as well as London's Waterloo and Paris's Gare d'Orsay Stations. The Waterloo extension was constructed through a mix of then still rural and peri-urban land, and that of the Gare d'Orsay in a tunnel along the Seine embankment, leading to periodic flooding. The worst destruction of the urban fabric was however wrought by the late construction of the approaches to London's St Pancras (1854) and Marylebone (1899) Stations. The latter two as late-comers to London found it necessary to cut through the suburban sprawl that had developed along other existing lines, as described above. This forced the large-scale removal of the local residents. This way of locating a station, whether of a terminal or through station type, causes serious disruption and destruction of the urban texture: the existing fabric of the community and roads is destroyed by this wedge driven through it, severing social, cultural and commercial links. The pattern of movement and connection within the area is damaged on all levels, with regards to the residents' transport, economic, cultural and social connectivity: a part of the city or suburb is effectively sliced off from the area where it has focussed on for obtaining its support, such as shopping and health care. The few bridges, overcrosses and underpasses provided do only slightly alleviate the havoc caused. – Less disruptive interventions are possible: the approaches to Berlin's new *Hauptbahnhof*, utilizing the existing underground tracks of the *S-Bahn*, limit their damaging impact on the existing urban fabric.

The placement of stations did have an impact on the city's street grid. As they were normally placed where it was most convenient, in a location compatible with both the needs of railway approach construction and the closest, affordable proximity to the city centre, they were often placed in odd positions with regard to the grid, although attempts were made to have them at least face onto a main street. Also, as the locating of the streets had preceded the placement of the stations and thus could not foresee these, there is a lack of squares of ample proportions in front of so many London stations, and direct access from the CBD was sometimes circuitous. Only from the 1880's onwards were new stations planned and incorporated as focal points within the city fabric, mainly in cases where the city grew out towards the station. An example is that of the second Munich *Hauptbahnhof*: a wide boulevard was constructed from the western city gate, the *Karlstor*, to the new station. Baron Haussmann reversed the process: when cutting his boulevards through the already existing slums of Paris, he used stations, such as the Gare de l'Est, as nodes, making them all of a sudden focal points, an honour which they did not have before. In South Africa, the first Pretoria Central station was to the south of Scheiding Street, between Paul Kruger and Bosman Streets (then Market and Koch Streets). This did not provide any focal point. This situation was only amended with the Sir Herbert Baker-designed second station (1910), prominently placed at the upper end of Paul Kruger Street and providing a visual anchor to this street.

It is evident that the placing of stations and the railway alignment had a major influence on the urban texture of a city. However, its indirect contribution to the stratification of income classes into different suburbs, in

contrast to the aforesaid liberating and thus positive effects resulting from the large structure of the station appearing in the cityscape and creating the opportunity for the non-privileged to experience large spaces, should not be laid at its doorstep: this was the result of the ruthless speculation of the land developers exploiting the need of less privileged to be close to the available means of transport or their place of employment.

The foregoing reviewed the impact of the construction of the stations and their railway approaches during the railways' expansion phase. Since then, the scenario has changed drastically.



Fig. 3.48 The end: Manchester Central Station (1876-80, by John Fowler)

Trains at one time carried as 80-90% of all travellers and freight of the world. After exponential growth – which in South Africa took off in the second half of the nineteenth century and peaked around the middle of the twentieth century – railway transportation has entered a period of stagnation and decline. The train's lesser flexibility (compared to that of car and truck), the lower relative speed, and the inability of railway management to improve the services rendered to its customer base have led to this decline. The loss of passengers and freight has been exacerbated by the spatial spread of homes and employment opportunities, made possible by the ever increasing ownership of cars and trucks. Regarding passenger transport, 'in general, the continuous growth of personal wealth is paralleled by an ongoing increase in car ownership ratio, while processes of social differentiation and emancipation bring about more complex mobility patterns, for which public transport is often ill equipped. Trends in the job market also contribute to an increased multidirectional, diffused mobility. Furthermore, the locational preferences of many, if not most firms and households seem to be for low-density, car-orientated, suburban and exurban locations.... In recent decades, population growth and employment growth have been maximal in peripheral, car-orientated locations.' (Bertolini, 1998:25) The latter factor also contributes to the loss of freight traffic, as these dispersed locations are difficult to serve efficiently by rail. Also, 'there is a general trend towards the retreat of the state. As a result, railways are torn between pressures to become profitable, and pressures to contribute to an environmentally and socially sustainable mobility.' (*ibid*:25)

As a result of decreasing volumes and decreasing subsidies, many rail services are no longer viable and are either reduced in quantity or totally stopped. In the latter case, the lines over which they operate are closed down, making the stations redundant, together with the adjacent sites previously holding railway-related activities such as carriage sidings, workshops and shunting yards. These large, open and now vacant areas occupy a potentially favourable position: 'Typically, the stations were erected in the course of the nineteenth century at the limits of the city; today, those sites may be in the midst of revitalizing metropolitan cores [or where attempts are made to revitalize them], or densifying and diversifying peripheries. Often they include large and unfragmented portions of disused or underused land (most notably because of the relocation [or shrinkage] of annexed freight yards).' (Bertolini, 1998:39).



Fig. 3.49 The derelict site of the demolished workshops area, Pretoria-Salvokop



Fig. 3.50 The legacy: abandoned shed, Pretoria-Salvokop

Due to the centrality of such areas, and the large spaces made available by the demise of their original function, they can once again become a magnet for redevelopment, but containing functions other than transport: offices, shops, convention centres, recreational and sports facilities, housing and light industry. However, a crucial issue 'is the typically high development costs and comparatively low revenues, which mean that a financial deficit is structural. ... Generally, initial ambitions (such as multifunctionality and open spaces) are not checked against financial-economic feasibility, nor are they translated into hard programme demands/requisites. The inevitable result is downsizing in the course of the process. Partly as a consequence there is a strong orientation towards office development... The list of conditions considered necessary to realize the development potential is long. Most importantly, enough car parking and good accessibility by car are to be guaranteed, while public transport must improve. A broader functional mix is required, including offices, but also shops, public services and housing. This mix must be complimentary rather than concurrent to that of the city centre. ... The implementation strategy must entail an answer to the question of how the mix of profitable and non-profitable elements is achieved, and how the latter are financed.' (Bertolini, 1998:41)

To summarize: The impact of the original location of stations and their rail approaches caused a quandary with regard to urban planning: essential as they are for the functioning of local, regional and national transport and mobility, the continuous band of land occupied by the railway, once placed conveniently and non-interrupting at the edge the city, now cuts like a giant swathe through the urban fabric, which has expanded to the extent of enclosing it fully. Through no fault of its own the stations and alignments form a cut, a chasm in the city, disconnecting the areas to its sides. In mitigation it may be said that generally the railway stations and their approach alignments preceded the construction of the suburb, the latter developing around them as if they were a geographical feature, similarly accepting and accommodating the presence of these large structures and large open areas such as carriage sidings in its midst. Damage to the urban fibre was perpetrated by those railway constructions thrust into suburban or urban areas after these had been developed. This, in addition, damaged the existing commercial, social and cultural patterns of movement, forcing wholesale re-orientation by the severed components. It is the bridging of this nonetheless existent gap, which often separates areas of totally different urban characteristics, which provides a major challenge to the architect and the urban planner. And where the railways no longer run, or have vacated the workshop and yard areas, these large tracts of empty land lie as open wounds in the urban fabric, unloved, unused, unproductive, and still separating the adjoining urban areas. It is with their re-incorporation into this fabric that the architect and urban planner are challenged, but their task is often fettered by the various involved parties: developers, railway administration, municipality, residents and other users of the area concerned or its neighbourhood. Each of these parties has a different goal, the compromise solution to which is wellnigh impossible to find.

3.11 Conclusion

The developments of the Industrial Revolution resulted in the unprecedented expansion of industrial production, of which the large-scale growth of a railway network was but one aspect. This growth necessitated the construction of ever larger stations to handle growing volumes of passengers and freight, and the growing number of longer trains transporting them. Freight operations were soon separated out of city stations to make more space available for passenger traffic. A station comprises a collection of components, each with its own function. Passenger stations generally accommodated the functions of the train track area, the passenger handling concourse area, the railway administration offices, and occasionally a hotel in their vast complex, which, in effect, consisted of different and separate, but adjacent structures, linked by the flow of passenger traffic through them.

Industrial architecture, based on the historic development of factory construction, was at first applied to the design of stations, for which no precedent had existed. Soon station design developed separately, needing to specialize so as to find solutions for the demand of increased enclosed space for the track areas, these requiring larger and larger areas having to be spanned without intermediate column support. This led to the introduction of the supershed, the 'cathedral of industry'. This structure, enveloping vast space and volume, had a significant, direct impact on the cityscape, architecture and urban planning, and a more indirect one on society.

With regards to architecture, the requirements of the stations for passenger and train handling necessitated the development of the supershed, designed at first by engineers only, but then, with the increasing demands of 'prestige architecture', in conjunction with architects. These station design-related demands led to advances in the knowledge about the new materials developed during the Industrial Revolution and how to use them, which in turn has enabled the modern architect and engineer to design such structures as large factories, aircraft hangars, warehouses and shops.

The supershed also influenced architecture by changing the perception and experience of space. Large spaces were previously limited to institutional structures such as cathedrals, churches, palaces and town halls, to which general access was limited and which were associated with certain cultural values. Suddenly, by visiting a station whose train-shed's dimensions were even larger than those of the institutional buildings, everybody, regardless of background, could experience spaces unimaginable before. The use of large structures became an everyday event, no longer exceptional. This changed the field for the architect: he could now, with comfort and confidence, design such large structures for other applications, knowing that their users were unlikely to object to them as being intimidating. Furthermore,

though often interrupted by fall-backs into Revivalist styles for the concourse, office and hotel structures, the use of undisguised materials in a functionalist style in the train-shed paved the way for their usage in modern-day functionalism.

Architecture can furthermore influence people and society by such trappings as are associated with 'power architecture', but this can go even further. It can influence the psychology and culture of a nation by providing competition to established hierarchies, as symbolized by the positioning and size of previously existing structures. This appears to have contributed indirectly to a shift in social and cultural values in the population, undermining the existing hierarchy by questioning it with structures of similar or larger dimensions.

Station architecture's influence on the cityscape was the impact that the station building, in the main the supershed covering the area of passenger/train interaction, had on the city's silhouette. It provided new points of focus and orientation. It challenged the existing hierarchy of structures: suddenly the until-then-dominant structures of church, nobility and town government were not the only points of focus. The supershed opened the way for other large-scale, secular edifices to challenge the institutional ones. The population got used to structures of ever-increasing area and bulk, both in horizontal and vertical dimension, and was less prone to regard institutional edifices with unreserved awe.

With regards to urban fabric and development, it was shown that the city parts surrounding pre-existing railway stations and alignments reacted to these features as they developed, in a response no different to that of a physical, geographic feature such as a river: the urban development jumped the barrier, which did however remain to impede the integrated development of the city. Where the urban fabric pre-existed the intrusion of station and railway line, the damage to the urban, commercial, social and cultural fibre was severe and forced a re-orientation by the severed community. Due to a number of reasons the areas adjacent to railway lines generally developed as industrial and lower income group residential areas.

With the reduction in train services and the resulting closure or shrinkage of the areas required by railway operations, much of this land is becoming available for redevelopment. It represents an infill opportunity on now vacant land. It challenges the architect and the urban planner to use this opportunity to add positive features to it and its vicinity, acting as a catalyst for further development, to uplift the often down-trodden surrounds and to make them more attractive. Such redevelopments can be on large or small scale. Such redevelopments should not be based only on idealistic conceptions of what would be nice to have: they should be approached as multi-functional, but financially viable projects, which will often include office developments as a component.

Where historically the urban area reacted on a pre-existing railway feature, a redevelopment including large-scale structures may not be necessarily out of place, as the surrounding area, when originally developing, had previously actually reacted on its large-scale predecessors. Thus, on the one hand, where large structure-remnants such as train-sheds still exist, although abandoned, they could possibly be put to use for alternative functions and be spared demolition. On the other hand, where they were demolished, the architect may consider a large-scale replacement structure of similar outline or proportions as not inappropriate, as it would recall historic precedent. In contrast, where the abandoned facilities were a later incision into an existing urban fabric, the opportunity for redevelopment should be used to re-integrate the severed parts, although it should be borne in mind that in the many years of separation the two parts may nonetheless have each gone their way in adapting to it: a forced reintegration may now be as harmful an intervention as the original incision.

The inclusion of large structures in such a redevelopment is, as said, *per se* not unacceptable, seeing that it falls back on the historic precedent of its prior use, and that the original large station structure often acted as a draw-card and development catalyst in the past, for the area surrounding the station. A large, eye-catching structure or group of structures forming part of a redevelopment may once again serve as such a point of focus, in a now otherwise derelict and forgotten urban area, by creating a destination of interest and attraction therein. Turning the area into an acceptable, even desirable location should in turn contribute to its upliftment and urban regeneration.

It can thus be seen that the development of stations, with their supersheds, and the railway-related infrastructure has had a lasting influence on the development and perception of architecture, cityscape and the urban development of cities, with concomitant social and cultural implications. With the reduction in train services currently being experienced, leading to many large and open spaces becoming vacant as the railway stations, facilities and lines are closed or abandoned, the challenge is now to identify future usage for these spaces, which in turn can act as a catalyst of upliftment for the surrounding area. This, in turn, should facilitate city (re-)integration.

4. CONTEXT ANALYSIS

The context within which this proposal is set is analysed within the project, legislative, physical

As documented in Appendix 2, a choice of two possible sites was identified for the location of a railway museum in Tshwane, within close proximity of the Central Business District ('CBD'). Both were assessed for suitability as a preliminary. The preferred choice is the site located in the Salvokop suburb of Pretoria, on the CBD's south-western periphery. Not wishing to bore the reader with an onerous duplication of details, only the context of the Salvokop site has been included in the context analysis.

4.1 Project context

4.1.1 Clients and client requirements

The following entities have been identified as clients of the proposed project:

Vintage Steam Train Clubs

Friends of the Rail

As mentioned before, and based on an interview with Mr Nathan Berelowitz (2007) of this association of steam locomotive fans, new premises are required to house its collection of steam locomotives and vintage rolling stock, which comprises of the following:

Locomotives (operating)	4
Locomotives (stationary exhibits)	3
Passenger carriages	10
Goods wagons	8
Water tank wagons	3
Cabooses	2



Fig. 4.1 Friends of the Rail logo



Fig. 4.2 Present Friends of the Rail site, Capital Park, Pretoria



Fig. 4.3 Present Friends of the Rail passenger embarkation facilities

Secure sheds, workshops and sidings for locomotive and rolling stock storage, maintenance and service are required, with staff facilities. Basic office accommodation is also needed. – Excursion trains consist of maximum 1 locomotive, 10 carriages and 1 caboose, with a total length of approximately 250 m, determining the platform length required. A full ‘Christmas-special’ train accommodates about 500 passengers, for whom toilet facilities have to be provided at the departure point. A restaurant and picnic area are of less importance for train passengers, as these are required only at the point of destination.

However, with government’s large social commitments, funding provided to museums is becoming more and more limited. Future building operating and maintenance costs should thus be kept as low as possible. Alternate means of generating funds towards the upkeep of the museum and the acquisition of further exhibits will have to be considered, and thus ways of attracting more visitors and association members are desirable. The suitability of using the museum for other events, such as weddings and product launches, for purposes of generating additional funds, will be investigated and, if possible, be incorporated in the design.

Hartebeespoort Dam Railway

This club is based at the Hartebeespoort Dam and is attempting to revitalize the Pretoria-Magaliesburg line. Pretoria would be a possible point of departure for them; alternatively, the museum may serve as a destination for them. Their rolling stock collection is currently housed at Hartebeespoort Dam, and only station facilities are required in Pretoria. Running shorter trains than Friends of the Rail, such visitors are estimated at a maximum of 150 per train.

Reefsteamers

Based in Germiston, their facility required would be similar to those of the Hartebeespoort Dam Railway.

South African National Rail and Steam Museum (‘SANRASM’)

Based in Randfontein and moving to Chamdor, Krugersdorp, this is also a private association operating steam trains, generally to Magaliesburg. If they should add the proposed railway museum to their destinations, their needs would be similar to those for Hartebeespoort Dam Railway. Generally, they provide mobile barbeque facilities at their destination; few of their clients frequent proximate restaurants. Accordingly, an outside terrace or picnic area needs to be available to their passengers.

Foundations:

Transnet Heritage Foundation

This is the heritage preservation department of Transnet. Their focus of operation is centred on George. A Transnet transport museum was planned for both Newtown, Johannesburg, and for Salvokop, Pretoria, but

these plans have been shelved. A prerequisite for obtaining exhibits from The Foundation's collection is that the items so provided are to be stored securely and in terms of good museum practice.

Should the Foundation agree to the display of the Pierneef paintings to be exhibited as a further draw card to the museum, their display location would have to meet any requirements imposed.

Luxury and other train travel companies

Rovos Rail

This company previously operated from Pretoria Central station, and owned the historic Victoria Hotel opposite it, but with the inner city becoming run down, decrepit and unsafe, it relocated. Its luxury trains now depart from their head office site, Transnet's old and now unused Capital Park workshops, which are being rented by Rovos Rail. A tour of the Capital Park site revealed that the company has constructed its own facilities, in a pseudo-Victorian-style double-storey building. This contains, on the lower floor, a luxurious departure lounge, furnished in Victorian style, and baggage handling facility. On the upper level are offices. The structure is flanked by a platform of about 100 m length, of which about 30 m is covered. Although Rovos Rail runs consists of up to 20 carriages, with a total length of approximately 450 m, their platform length is sufficient as their number of passengers is far less. Passengers board at a central point and move within the train to their compartments. The train maintenance and victualling areas are in a separate building. – It is not impossible that the company would relocate its departure facilities to a suitable, secure, attractive and less remote venue; the attraction of the railway museum may be another incentive. However, passenger comfort and safety with regard to theft and mugging is of utmost importance to Rovos Rail. So as to be able to cater for this potential, an exclusive, upmarket departure lounge and secure baggage handling facility will be incorporated in the design. With the embarkation of passengers being as described before, the platform may be shorter than the full train consist. – Due to the required size of their locomotive and rolling stock storage and maintenance facilities, as available at Capital Park, these will not be accommodated at the proposed museum, but continue to be undertaken at the Capital Park site.

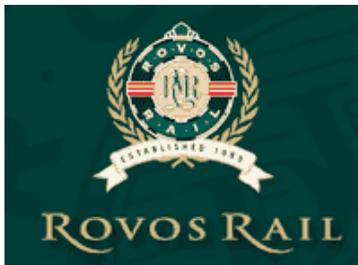


Fig. 4.4 Rovos Rail logo



Blue Train

With recent press announcements that Spoornet wishes to privatise the operations of the Blue train, the new owner may want to use facilities other than the luxury lounge currently being used at Pretoria Central station. They would thus require an upmarket waiting lounge and facilities similar to those of Rovos Rail. Though being a potential client, no additional passenger facilities above those being provided for Rovos Rail need to be incorporated in the design. However, the method of passenger embarkation on the Blue train is different, in that passengers board their appointed coach directly from the platform, and do not move down the train to the compartment. The platform as required by Friends of the Rail is of sufficient length to

Fig. 4.5 Blue Train logo

accommodate this requirement. – Once again, rolling stock maintenance will continue at their current location, in close proximity to south-east of the museum and to the south of Pretoria Central station.

Shongololo Express, Africa Train Safaris, JB Tours

These companies provide superior or standard accommodation train trips to various destinations in Southern Africa. If agreeing to use the museum as a point of departure, they would require a baggage handling area, but a less luxurious check-in area than that of Rovos Rail. However, it would be inefficient to duplicate facilities, even if they should be of different standards, and these companies will be accommodated in the facilities made available to Rovos Rail and the Blue Train. Were the companies to treat the museum only as a port of call, the station facilities required by Friends of the Rail would suffice. The length of platform as required by Blue train operations will suffice for the trains of these companies.

Model Clubs

Pretoria Model Railway Club

The model club requires secure indoor premises. Individual members model their landscapes on wooden bases of standard dimensions, with connecting tracks set at particular points enabling linkage to other modules. The area available has to be of sufficient dimensions to accommodate a full club get-together, allowing for all modellers' track modules to be linked together for a full model train run. Limited space for social activities is required, these usually occurring next to the assembled modules.

Government and institutional bodies

Department of Arts and Culture

As a possible provider of funding, the museum would have to comply with professional standards and good practice as set out in professional standards for museums. Railway related topics covered in exhibits should include the contribution made by all races and genders to the development of railway operations in South Africa to reflect the full picture, in compliance with the Department's desire of reflecting the transformation in this country. However, the exact contents of the exhibits would be the responsibility of the curator.

Department of Environmental Affairs and Tourism

As a potential draw card for tourists, this Department would be possible provider of funding. The proposed museum should thus preferably include activities which are known to draw tourists, such as live steam train rides and shunting operations.

Department of Education

As the museum is envisaged as a venue where scholars of different ages are not only exposed to exhibits appropriate to topics covered in their curriculum (such as principles of physics and economics), but also to viewing the performance of certain trades necessary for the restoration and maintenance of exhibits (boiler making, fitting and turning, welding), facilities are to be provided for the accommodation of scholars. This may enable the obtaining funds from the Department, or to alternatively generate additional funding from school classes' entrance fees. – Furthermore, individuals can be trained as artisans in these trades in the workshop, or as tourist guides in the museum. The museum would thus possibly comply with requirements for training grants provided by the Department.

City of Tshwane

As the museum would contribute to making Tshwane a city of culture and museums, thereby enhancing its status as the capital of South Africa, it could be eligible for funding assistance towards its construction and operation.

Tshwane Tourism Association

This is the metropolitan council's agency concerned with the promotion of Tshwane as a tourist destination of note, and as such would be interested in the aims of the museum. Creating a tourism attraction of sufficient potential may qualify for financial assistance.

Freedom Park National Legacy Project (including Salvokop)

Being concerned with the development of the south-western periphery of the Pretoria CBD, any development within this area would be of concern to it. The project must contribute to the prestige of the area and add to it as a draw card for both local and international tourists.

Spoornet

Being the operator of the railways in the Tshwane area, Spoornet would have to permit the necessary rail links from the museum's tracks to their network, to enable running of the steam and other trains. Such resulting crossings and switches would have to be kept to an absolute minimum so as not to interfere with existing train operations and movements. This permission is assumed in the development of this project.

Propnet

Propnet, as the landowner, through its managing agent Intersite, is concerned to the extent that the land required for the museum would have to be made available, either by letting it, preferably at a low or minimal rental, or by selling it cheaply to the project legal entity, as its contribution to the upliftment of the area and the Freedom Park precinct. It is assumed for this project that the required land will be made available by the owner as a contribution to achieving the ideal of upgrading the Salvokop precinct.

Developers or tenants

As will be discussed under 'Funding sources', if an office park or conference centre were to be incorporated in the area's development as an additional source of funding for the museum, the specific design requirements of developers and/or tenants would have to be taken into consideration. For purposes of this dissertation, it is assumed that such a development will occur in later phases, after the completion of the museum, and will then be designed to suit the particular requirements.

Other interested and affected parties

Although not *per se* clients, the following have been identified as parties influenced by developments in the suburb of Salvokop:

Museum users: train enthusiasts, scholars, researchers (being individuals, families or groups)

The museum should provide exhibits of interest in a safe and secure environment to these individuals.

Salvokop residents and pedestrians and Pretoria/Tshwane citizens

By acting as a catalyst for the development and upliftment of the area, their concerns about the current deterioration of the area may be addressed

Salvokop informal fruit traders and cell phone operators

Increasing use of the area following from the development of the site will boost their income. The museum itself does not compete with their line of business.

4.1.2 Project aims and purpose

The aim of any project is the accommodation of the various clients' desires and requirements (as set out above), enabling them to achieve their purposes and aims. Regarding the erection of the railway museum, these could be summarized as: 'Through preservation, education', with the ancillary purpose being the creation of an experience for the visitor on the one hand, and the enhancement of Tshwane on the other.

The individual client's desires, wishes and requirements can be consolidated and categorized into the following primary aim and supporting secondary and tertiary aims:

Primary aim

To foster, in a well-visited, multi-focused and sustainable railway museum, an understanding of railways and related topics, past, present and future, through the display or use of static, interactive or live exhibits.

This understanding will be achieved by providing:

- an insight into railways and related subjects in the South African context, their history and future, both to the train enthusiast and non-enthusiast
- an educational destination for scholars and other interested parties
- a venue where exhibits are enriched by becoming experiences.

Topics would be multi-focussed, covering the following:

- the development of railways in South Africa (routes, rolling stock, signalling, station architecture, etc.)
- the contribution railways made to the development of South Africa (economics, mobility, labour supply, demographics, tourism)
- the principles of physics underlying the different methods of propelling locomotives
- the operation of railways
- related signalling and telecommunication operations and its history
- safety procedures regarding contact with trains
- the related engineering (civil, mechanical, electrical), and achievements therein
- the contribution, past and present, by the various people, sexes and races of South Africa to the railways' construction and operation, and information on the jobs they perform
- the effect of social issues, apartheid and job reservation on passenger transport, station architecture, job and skills development
- other auxiliary services provided by the railways, e.g. motor transport
- the handling of mail by the railways
- the ambience and feel of rail travel in the past
- luxury and special trains in South Africa and the world

The above will be augmented by including the following

- live historic locomotive/train experiences, by providing a departure and arrival point for live steam train runs to Cullinan, Bela Bela (Warmbaths) and other destinations (provided by Friends of the Rail, Hartebeespoort Dam Railway, Reefsteamers, SANRASM and possibly by Rovos Rail)

- facilities for recording and archiving visual and audio information regarding the above, and making it available for research
- a safe and enjoyable environment, by *inter alia* including catering and picnic facilities on or close to the premises
- a base from which steam locomotive preservation associations can operate vintage steam trains
- a venue for the Pretoria Model Railway Club
- facilities for restoration, and locomotive and rolling stock service, maintenance and storage.

Secondary aims

In addition to the above, the museum would:

- contribute towards the integration of the long neglected south-western corner of Pretoria's CBD into the city's urban fabric, and become a catalyst for its further upliftment
- provide a point of attraction for tourists, contributing to making Pretoria a preferred tourist destination and strengthening the envisaged 'Tshwane Museum Park' precinct
- contribute to the upliftment of the surrounding area
- contribute in linking the Freedom Park precinct to the CBD through the creation of a strong tourism axis and contributing to development of Pretoria's Potgieter Street gateway to the CBD
- make the Salvokop area more attractive to current and future residents of the development proposed in the Tshwane urban development framework

Tertiary aims

To facilitate the above over the long term, due to limited funding being made available by government and its agencies, the museum would have to generate as much as possible of its own income to ensure its continued viability and existence, e.g. by providing a venue for banqueting, dinners, business meetings, teambuilding and training sessions, workshops. Furthermore, the possibility of developing further sources of funding by incorporating conference facilities available to third parties and commercial office space lettable to third parties is a possibility, as will be discussed under 'Funding sources'.

A contribution to financial sustainability can be made by reducing operating costs by incorporating design features contributing to the reduction of energy consumption, and utilizing low maintenance finishes.

4.1.3 Funding sources and proposal

The following have been identified as possible sources of funding for the project, and means by which such funding could be achieved:

Friends of the Rail	Surpluses generated by operations Sub-contracting for repairs
Department of Environmental Affairs and Tourism	Museum grants
Department of Arts and Culture	Museum grants
Department of Education	Grants towards educational exhibits Training grants
South African Revenue Service	Section 21 Company status
Transnet	Providing surplus historical structures
Transnet Heritage Foundation	Financial and land grants
Tshwane City Council	Financial and land grants
Tshwane Tourism	Financial grants
Corporate bodies	Financial and material sponsorships
Foreign NGOs and donor agencies	Educational grants
Other funding sources	Conference facilities Banqueting facilities Event management Commercially let office space Entrance fees Individual donations

As a further means of providing financial support to the museum, it is suggested that the full, previously workshop-occupied area owned by Transnet, on part of which the museum is proposed, be developed as a single entity comprising of the museum, office buildings and a conference centre: part of the profits generated by the latter two may then be applied to the operation and maintenance of the prior. This would lessen the dependence of the museum on government subsidies and donations by other parties. However, the design of such further facilities is seen as being later and additional phases of the museum precinct development, and will be designed at the appropriate time and to the requirements of yet to be identified developers and tenants.

The formation of a Section 21 (non-profit) company, in which the various funding agencies and other stakeholders would be potential 'shareholders', is considered to be the best form of legal entity for the creation of this museum and its related activities.

4.2 Legislative context

The project will have to comply to the following national and other laws, regulations, standards and guidelines:

National Building Regulations and Building Standards Act No. 103 of 1977

This act determines *i.a.* that, in brief, all buildings must be safe and fit for occupation. Adherence to the National Building Regulations (refer below), as a minimum, for those buildings covered by it, will satisfy conditions for the safe and acceptable construction of buildings.

South African National Standard: The application of the National Building Regulations (SANS 10400A:2003)

The general requirements for satisfying the National Building Regulations (as required in terms of the National Building Regulations and Building Standards Act No. 103 of 1977 mentioned above) are set out in this standard.

The museum project, being multifunctional, will have to comply with regulations governing its various functions. These fall under the following usage classes:

For catering facilities	A1 – Entertainment and public assembly
For auditorium facilities:	A3 – Places of instruction
For museum	C2 – Museum
For workshop (paints & varnishes)	D1 – High-risk industrial
For gift shop (< 250 m ²)	F2 – Small shop
For offices	G1 – Offices
For storage of paints/varnishes	J1 – High-risk storage
For storage of exhibition material	J3 – Low-risk storage

As the pre-dominant function is that of serving as a museum, this will be the principle category applied in determining applicable standards to be adhered to. Standards applicable to other functions, such as catering facilities, will be taken into account, as applicable.

National Heritage Council Act, Act No. 11 of 1999

This act establishes the National Heritage Council, and sets out its objects and functions, as well as method of work. The act is relevant to the extent that it establishes the body from which permission for alterations to protected structures must be obtained.

National Heritage Resources Act, Act No. 25 of 1999

This act requires per section 38(3) that a historical impact assessment be executed prior to the commencement of a development larger than 5000 m². This will have to be executed for the proposed development. Furthermore, the act determines that all manmade structures older than 60 years are protected. Demolishing or alterations may only be undertaken after approval of the South African Heritage Resources Agency has been obtained. Since two of the existing structures on the site are older than 60 years, the necessary permission for any changes to them will have to be obtained from the National Heritage Council agency (the South African Heritage Resources Agency).

The South African World Heritage Convention Act, Act No. 49 of 1999

This act provides for the incorporation of the World Heritage Convention into South African law, the recognition and establishment of World heritage sites and land matters related thereto, as well as for the administrative measures concerned therewith. This law is less related to the actual project, but contains input on preservation which merits taking note off.

Occupational Health and Safety Act, Act No. 85 of 1993

This act prescribes principles and procedures to be followed to ensure the safety of both construction workers and users of the building during construction and thereafter.

City of Tshwane Land-Usage Zoning Bylaws and Regulations

The land is classified as Transnet-owned land, and no specific regulations have been established for it by the city council. However, in completing the design, cognisance will be taken of the size and characteristics of historical precedents as they were on the site before demolition, *i.e.* big workshops and other railway related support structures.

Pretoria Inner City Spatial Development Framework

Compiled in 1999, it pre-dates the development of the Freedom Park Precinct, but as such suggests the integration of the Salvokop area with the CBD with regards to cultural and tourism aspects. It also proposes that the area preserves the current residential environment and develops it further.

Salvokop Development Framework

This proposes that the suburb be developed for urban mixed use, with due recognition of its function as a railway related industrial area and its associated residential and administrative component. The whole suburb should be a tourist destination, and the framework suggests that the railway reserve could be used by specialist trains and for the viewing of train operations. The area should invest in and capitalize from heritage conservation and allied tourism. Heritage information transfer should be encouraged. Introduction of a 'working rail yard' theme is considered suitable for this area.

With regard to the existing structures, it states that 'due to the public nature and quality of the eastern façade of the Chief Engineer's Office [(CEO)] ... it is proposed that a public square be developed east of the CEO. Such a space should incorporate the valuable historical buildings to its east (steam hammer shed and adjacent double-storey building), but may require the removal of the adjacent workshop building to [the immediate east of the CEO] to expose the CEO façade.' (Cultmatrix CC, 2003:56)

Freedom Park Urban Design Framework

This suggests the physical integration of the precinct with the CBD by means of a mixed use sustainable development as well as an activity connection. The (visual) link between Freedom Park and Church Square should be respected. It proposes commercial development of the area, but it should be borne in mind that such an area will benefit from a catalyst being introduced to ensure multi-functionality.

Tshwane Inner City Project- Spatial Design Framework ('SDF'): Phase 3: Development manual and design code

This document, prepared by a group of professional firms in 2005 as a proposal for the future development of Tshwane as 'the leading international African capital city of excellence that empowers the community to prosper in a safe and healthy environment' (TICP-ISF Phase 3,2005:2), includes *i.a.* the following points of vision:

1. improving urban management so as to make the Inner City (including the Freedom Park precinct and Salvokop suburb) safe and clean, the informal economy vibrant and a contributor to the area, and enhancing the tourism potential of the city;
2. creating a network of public squares and gardens, improving the legibility and user friendliness of the city and contributing to pedestrian movement in the area;
3. linking the three symbolic points of Freedom Park, Church Square and the Union Buildings;
4. consolidating an infrastructure, pedestrian and public transport spine along Paul Kruger and Church Streets, with developments centred around these and the core of the city to be multi-functional and utilized 24 hours a day, and these streets becoming symbolic avenues or a government walk; and
5. including environmental sustainability in developments, including water and energy efficiency, as well as social equity to the extent possible.

To facilitate achieving the desired goal, the inner city has been divided into seven precincts, of which Salvokop is one. The museum is proposed for location in this latter area, and only those SDF proposals pertinent to it will be detailed below. The SDF's input is limited (the area not falling into the 'normal' ambit of a developed, built-up but run-down city environment requiring upgrading and rejuvenation). It proposes the following for this suburb:

1. the creation of new, or enhancement of existing public squares as entrance to Freedom Park (as being separate to any created by any other developments) (TICP-ISF Phase 3,2005:14) ;
2. the creation of improved pedestrian and vehicular connection between the Museum Park and Salvokop precincts, over the railway lines;
3. the continuation of the 'government walk' idea on a local scale, connecting to Freedom Park to the south and the Defence Headquarters to the west;
4. the preservation of such axial relationships, vistas and views as there are; and
5. building heights should remain low to medium, with a 5 storey maximum;
6. no need is currently seen for the creation of underground parking as no 'space problems' exist in this area.

The above document's draft predecessor, TICP-SDF Phase 2, indicates that the suburb's water supply, sewer and storm water services are currently adequate. However, they are not in a good state, possibly having to be replaced. Furthermore, major developments in the area may require completely new infrastructure to be installed. For purposes of this dissertation, it is assumed that the existing connections are adequate, or that any expansion required will be undertaken by the local authorities.

The document wishes to prescribe what new 'Tshwane architecture' should look like, and what materials should be used in which way, drawing on the document's preparers' individual perceptions and opinions of the architecture that should be used to symbolize their understanding of the current political environment in South Africa.

However, in my opinion, the prescriptive application to all designs of components based on elements of the traditional philosophy of a specific culture, in order to superimpose onto a building an identity as conceived by only those individuals, with these components furthermore executed in the mediums of a modern, different and non-traditional technology too easily leads to superficiality: such elements easily become merely decorative of nature, a pandering to what is currently seen as *en vogue* and politically correct or opportune. It is equivalent to executing a functional water storage tower in an ornate baroque style, or a car assembly plant in English Tudor. It is as incongruous as a quartz clock, with a digital Roman numeral face, clad with a plastic housing and fitted with a re-styled cuckoo chiming the hours, being marketed as a Black Forest souvenir. – The search for identity is a natural and evolutionary process, occurring through centuries, and cannot be forced: The result is otherwise as artificial as any other quick-fix process.

I thus consider that specific guidelines may be applicable to those buildings accommodating individual government ministries and departments, enhancing a 'corporate image' for these institutions. Other structures should be subjected only to more general regulations, such as building volumes, height and boundary lines. This is to prevent the stifling, on the one hand, of creativity and individuality, and, on the other, of investment and development (due to the potentially excessive costs incurred in complying with the too specific guidelines). Buildings' designs should be allowed to respond to their existing surrounding framework, as each site has a very specific context, whilst also taking cognisance of the general vision of the future city. To make applicable to non-government structures a restrictive net of specific guidelines, in my opinion, harms the richness of architectural diversity created by the individual designer's independence: too much prescriptive and centrally controlled building plan approval leads to artificial and superficial environments, such as the Melrose Arch development, office parks, security villages, RDP townships and the eye-sores of post-war East European residential developments, such as are to be found in Prague, Bratislava and Moscow. Individuality is the generator of the depth of the architectural texture found in a town. Guidelines should only ensure that the result does not look 'cheap', but responds to the envisaged general appearance of the city and fits the desired sophistication of the city. They should not be more prescriptive.

The above opinion is supported in Carmona, Heath and Tiesdell's *Public Places – Urban Spaces* (2003:11): 'Urban designers should be wary of being too prescriptive about urban form.... While these frameworks are

sound in themselves, there is a danger of their treatment as inflexible dogma or their reduction to mechanical formulae.... Urban design should not be reduced to a formula. Application of a formula negates the active process of design that relates general principles to specific situations.’

I shall thus abide to these proposed regulations only to the extent that I consider it necessary to achieve the wider goals set by the SDF.

South African Museums Association: Professional Standards and Transformation Indicators

This draft publication of 2006 covers four spheres of museum operation:

1. governance and museum management;
2. collections management;
3. public programmes and visitor services; and
4. facilities.

It defines the goal of a museum to be the acquisition, conservation, research, communication and exhibition of the material evidence of people and their environment, for purposes of study, education and entertainment.

Governance and museum ethics require that experiences should be created, and services be provided that meet expectations and give value for money. The museum should pursue sustainability by forming partnerships with other institutions and stakeholders.

Collection management demands accountability, diversity and inclusiveness, and also promote a sense of identity and ownership of heritage. Collections should be safely and systematically stored. The environment should be secure and stable. Resources must be allocated to ensure the long-term physical safety of objects. A register of objects should be kept in a fireproof safe. Museum workers should be trained in the fundamentals of preventative conservation. A routine cleaning and maintenance programme should be in place. Collections should be protected from all heat sources, direct sunlight and excessive ultra-violet radiation.

Public programmes and visitor services should recognize that a museum’s services are of twofold nature, with an internal focus on collection acquisition and preservation, and a customer-orientated focus on disseminating information about the collection. Such services include making available *i.a.* permanent and temporary exhibitions, education, publications, library and research services. The provided services may

even include training and skills development in the heritage sector of staff and volunteers, thereby contributing to life-long learning and the development of a physical infrastructure around which community life can be formed. Attention should be given to reach and develop new audiences. Talks, demonstrations, special events, guided tours and exhibition information in written, audio or video format form part of such services. In consultation with local schools the museum should provide both formal and informal education services to learners.

Facilities in which a museum is housed must provide, above all, a secure environment for the displayed and stored objects, suitable space for collection care, and inviting spaces for the public programmes, including education. They should be safe for visitors, exhibitions and collections. Functions should not be held in exhibition areas unless the safety and security of all objects is assured. Public seating, public toilets and special needs such as access for the disabled must be provided. Trade and other commercial activity should further the aims of the museum.

4.3 Physical context

Location Tshwane/Pretoria is located 25° 36' S and 28° 12' E (Fullard: *Philip's College Atlas*, 1984: Index 24). Salvokop is a suburb on the south-western periphery of the CBD, separated from it by the main Johannesburg/Maputo – Pretoria – Rustenburg/Polokwane (Pietersburg) railway line. It lies on the northern foot slope of Salvokop Hill, which is crowned with the structures of the Freedom Park precinct.

(The following information on climate has been extracted from Holm and Viljoen: *Manual for energy conscious design* (1996:69-73).)

Climate Tshwane is situated in a zone with distinct rainy and dry seasons, with a large daily temperature variation and strong solar radiation.

Humidity Humidity levels are moderate, average monthly levels being below 59%.

Temperatures Maximum average annual temperature: 24.8°C
Minimum average annual temperature: 12.1°C

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Max ave monthly temp °C	28.6	28.0	27.0	24.1	21.9	19.1	19.6	22.2	25.5	26.6	27.1	28.0	24.8
Min ave monthly temp °C	17.4	17.2	16.0	12.2	7.8	4.5	4.5	7.6	11.7	14.2	15.7	16.7	12.1

Table 4.1 : Temperature statistics for Pretoria

Rainfall Average monthly rainfall: 56.17mm

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ave
Ave monthly rainfall mm	136	75	82	51	13	7	3	6	22	71	98	110	56

Table 4.2 Rainfall statistics for Pretoria

Wind	East-north-easterly to east-south-easterly winds predominate in summer, whereas in winter they originate mainly from the south-west, with a fair amount from the north-east.	
Sun angles	At 12:00 noon on solstice (21 March/23 September)	64.23°
	At 12:00 noon mid-winter (22 June)	40.73°



Fig. 4.7 Salvokop suburb and surrounding area

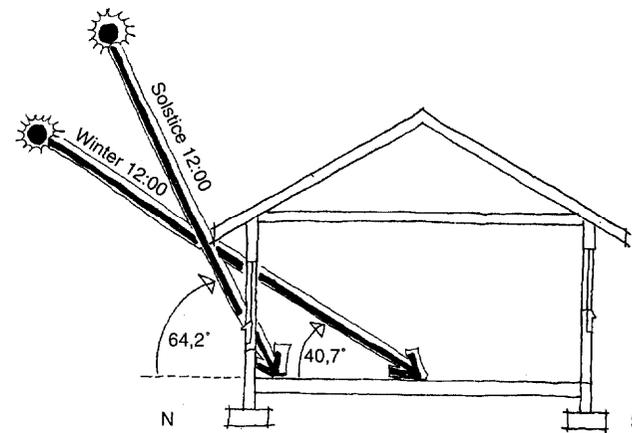


Fig. 4.6 Sun angles for Pretoria

- Geology** The underlying soil consists in the main of Timeball Hill shale, which could contain subordinate quartzite layers. Excavatability may be impeded thereby, which at worst would require blasting. (TICP SDF phase 3, 2005:32). A detailed survey of the site would need to be undertaken to discover the extent of such layers, but for purposes of this dissertation it is assumed that no such layers exist.
- Suburban fabric** The suburb of Salvokop, lying to the south of the site, is residential. It is bordered by (refer to the photo below) to the north and east by the railway tracks, to the west by the facilities of the Departments of Defence and of Correctional Services on the western side of Potgieter Street, and to the south by the Freedom Park precinct. Its history, population and income grouping will be set out under 'historical context' and 'social context'.



Fig. 4.8 Aerial photo of site, indicating site borders

A church, a school, a tuck shop, a filling station and its shop on Potgieter Street, and a scattering of informal traders are the only services available to residents. To the east of the foot-bridge is Spoornet's carriage washing facility, and to its west buildings house some of Pretoria's rail operations control. The close-by historic Chief Engineer's Office building (described subsequently under 'Existent buildings') is currently occupied by a community training facility. It is assumed that this facility will relocate to premises more accessible to its trainees, and that the building will become available for incorporation in the museum. The construction of the Freedom Park precinct to the suburb's south has resulted in the access roads being upgraded, but to date no further positive effects of this development are evident in this suburb. Parking for Freedom Park is behind the access control to it, so that there is no encouragement of tourism-orientated informal trade.

Access

Salvokop is hampered by currently having no direct vehicular link with the CBD. The only point of access for cars is from Potgieter Street. There is no vehicular access to Salvokop suburb from the north, east or south, this being impeded by the railway tracks and the hill itself. It may be improved in the foreseeable future, as draft TICP SDF Phase 2 (2005:39) shows a proposed road link paralleling an existing foot-bridge to connect the CBD's Bosman Street to Koch Street in Salvokop.

Pedestrian access to the suburb is from the north (the CBD) by means of said steel foot-bridge over the railway tracks (to the west of Pretoria Central station and east of the museum site) and from the west, from Potgieter Street along Skietpoort Street, connecting to the southern end of the foot-bridge. An informal pathway leads from the Decquar Road-over-Potgieter Street bridge ramp into the western half of the site.

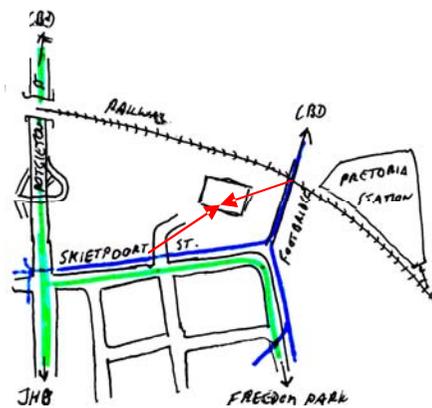


Fig. 4.9 Pedestrian (blue) and vehicular (green)

Vehicular traffic

The Salvokop suburb, and thus the site, is flanked to the west by the Potgieter Street, which is one of the major access points to Pretoria from the south. This street carries a large amount of local and through traffic. As mentioned, the only point of access to Salvokop from Potgieter Street is Skietpoort Street, which carries only intermittent car (resident and non-resident) and tourist bus traffic. The non-residents are in the main visitors to Freedom Park (this street being the only access road to the precinct), the remainder passing through to the Transnet passenger carriage washing and Pretoria operations facilities or the community training centre.

Pedestrian traffic Main pedestrian movement is across the foot bridge from the CBD into Salvokop, along

traffic flow and access point to sites (red)



Fig. 4.10 Railway on main street, Fauresmith



Fig. 4.11 Site contours

Site borders

Koch Street and dissipating into the various streets serving the residences, and in the opposite direction. Regular movement is seen throughout the whole day. Also of importance is the movement along Skietpoort Street, this being the shortest pedestrian route linking the CBD to the premises of the Departments of Correctional Services and of Defence.

The site is bordered to the north by the rail tracks, to the north-east by the buildings of Pretoria rail operations, to the east by the foot-bridge connecting the suburb over the rail tracks with the CBD, to the south by the about 5 m high embankment bordering Skietpoort Street, to the west by Potgieter Street, and to the north-west by train storage sidings. However, only the eastern half of this site will be used for the museum premises, bordered to the west by a line extending approximately north from the junction of Skietpoort Street and Second Street. The western half of the site is used partially by train tracks, connection to which will enable the train operations of the museum and workshop. An office development could be interspersed here, as proposed for the raising of financial means for the museum. A placing of offices between tracks would give character to such a development, reminiscent of Fauresmith, where the train line runs down the main street of the town.

Site description

The site is a flat, largely empty brownfield site, where formerly the workshops of Pretoria railway station were located. On its northern periphery are some buildings, described subsequently under 'Existent buildings'. A small portion of the site in the north-eastern corner is separated from the remainder by an infrequently used rail spur to the Blue train carriage washing facilities. Pedestrian access across this will be by a level crossing, controlled by automatically-closing gates, similar to that found to the south of Muizenberg station in the Cape Town area. A level crossing for vehicle will be controlled similarly by automatic booms.

Site slope

The site, having been the location of the NZASM's and its successors' workshops and shunting yards, has been levelled to on average 1351m above sea-level, with a drop of about 1 m over 150 m in a northerly direction. The upper edge of the embankment forming the southern border varies between 1354 m and 1357 m, rising towards the south-eastern corner.

Site drainage

Although the land is generally flat, the levelled area shows a gentle slope towards the northern, north-eastern and north-western edges of the site.



Fig. 4.12 Site vegetation (trees within red lines
No longer existent)

Site vegetation The area is covered by grass. In the south-eastern corner, bordered by the embankment and the foot bridge crossing the railway tracks, is a grove of trees. Along the western edge of the site are eucalypts, furthermore a few copses of various small trees are strewn over the site. The trees between the gravel road and foot path access from the south (visible on the air photo below) have been removed. Skietpoort Street to the south is bordered by jacaranda trees.

The Chief Engineer's office building (refer to 'Existent buildings') is shaded by a towering Eucalyptus tree, and five smaller trees are found to the buildings south-east.

Site access The site itself is accessible from Skietpoort Street (to the south), currently by both a gravel road and a pedestrian track. From the west it is accessed by above-mentioned informal pedestrian access from the Decquar Road bridge ramp. The east access is possible from the foot bridge by a flight of steps. Formal access from the north is blocked by the railway tracks, though it can be assumed that unauthorized crossing does occur on a minor scale.

Vehicles accessing the site go to Transnet or the training centre located in the old Chief Engineers building, as vehicular access to these buildings is currently only possible from Skietpoort Street.

The site is not used as a route by pedestrians other than those working for Transnet or the community training centre, accessing their place of employment.

Views from site To the west, in the distance behind the trees and transmission line support (refer to Fig.4.11 overleaf) the buildings of the Department of Defence can be seen, crowned by a small clock-tower. To its left, visible through a break in the trees, is Pretoria's C-max high-security level prison. This portion of the land falls largely outside of the museum site, only the immediate foreground forming part of it. In line with the proposal put forward under '4.1.3 Funding sources and proposal', the remainder would form the location for the proposed office buildings.



Fig. 4.13 View to the west

To the north is the low slung butterfly shed of Bosman Street station and, in the background, the CBD's skyline. The Chief Engineers building and the dilapidated steam hammer shed (seen slightly to the right behind the white vehicle), and adjacent structures are adjacent to Pretoria's main railway line, running behind them. The building's to the latter's east do not form part of the proposed museum development.



Fig. 4.14 View to the north

To the east is Pretoria Central station, hidden behind the steam hammer shed, and the grove of trees. The foot bridge linking the CBD to Salvokop is behind the grove. Should a

road link be built next to the foot-bridge, linking Bosman Street and Koch Street, it is assumed that this would not influence this view excessively.



Fig. 4.15 View to the east and south-east

To the south the land is bordered by an embankment levelling off towards the west. Historic railway employee houses line the far side of Skietpoort Street, located above the embankment. Beyond, on the crest of Salvokop Hill, is the Freedom Park development.



Fig. 4.16 View to the south and south-west



Fig. 4.17 180° view of site (east, south and west) from Chief Engineer's Office, indicating site borders

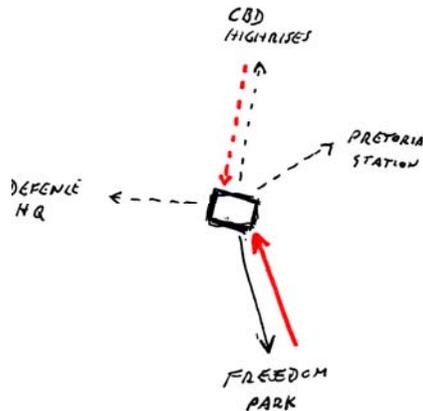


Fig. 4.18 Focal points and views inwards

Focal points

The focal feature determining the site, and the orientation of buildings on it, and of the museum design itself, is the Pretoria's main rail line, forming the Johannesburg/ Maputo - Pretoria - Rustenburg/Polokwane (Pietersburg) rail corridor.

No strong focal points exist in the immediate vicinity, except those provided by the existing historic building substance, detailed below.

In the further distance are the clock tower of Central station and the distant Telkom tower to the east, a large office block to the north, the clock tower of the Defence Force headquarters to the west (though very much in the distance and obscured by vegetation), and the flag masts of the Freedom Park development on the summit of Salvokop to the south.

Views into site

The site is overlooked from the Freedom Park precinct located on the summit of Salvokop. The façades and roofscape of the buildings below must take this into account. Views inward from other buildings (CBD high-rises) and other high vantage points are limited and from a distance, and of less significance.

Existent buildings

Very little remains of the old workshops and other railway support service structures on the site. These are, from west to east (left to right on the photos below), the CSAR's Chief Engineer (Resident Engineer)'s offices (to which another floor has been added), the smaller annex thereto, the run-down steam hammer shed (of which the lower

corrugated iron wall sheets have been gutted) and a historic double-storey hip-roofed building still used by Transnet's operational control.

The only other structures are recent single storey office building, an open-sided shed used for the storage of containers and other odds and ends, some pre-fabricated offices and shade netting for cars. An old water tank is situated to the west of the steam hammer shed. Close by the foot bridge to the east are temporary structures of Transnet.



Fig. 4.19 CSAR Resident engineer's office, 1908



Fig.4.20 Chief engineer's office, 2007



Fig.4.21 Steam hammer shed and Transnet building



Fig. 4.22 Old water tank and steam hammer shed

Of these structures, the Chief Engineer's Office, the steam hammer shed and the Transnet building are to be retained. The annex building and recent office building and shed structure are to be demolished, the prior due to obstructing the handsome main façade of the Chief Engineer's Office, the latter due to their temporary and thus detracting nature.

The above decision to demolish the annex and other mentioned structures was anticipated in the *Salvokop Development Framework*, which proposes that development should retain and 'incorporate the valuable historical buildings to [the Chief Engineer's Office's] east (steam hammer shed and adjacent double storey [Transnet] building, but may require the removal (or partial removal) of [its] adjacent workshop building ... to expose the CE Office façade and to provide a place of arrival – infill in this space has historical merit. The position of the container shed building south of the CE Office deters

the introduction of a movement system and square, which can utilize the full potential of the southern façade of the historical building.’ (Cultmatrix CC, 2003:56) It further puts forward that ‘it is of great importance that the Chief Engineer’s office and the steam hammer mill building... be re-used as actors...Introduction of a ‘working rail yard’ theme is suitable for this public space – the Friends of the Railway and similar groups would possibly be able to show engines in this space ... - the retention of the rail line for real railway activity in this zone should be actively pursued in the process ahead.’ (*ibid*:60)

4.4 Social and economic context

Population The population of Salvokop suburb, per the 2001 census statistics provided by the Statistics South Africa, is made up as follows:

Age group	0-4	5-14	15-34	35-64	65+	Total
Male	99	20	5,083	2,085	35	7,322
Female	102	232	936	460	5	1,735

Table 4.3: Population of Salvokop

The predominance of men is ascribed to the large amount of male Transnet workers being accommodated in the area. Many stay in outbuildings and backyard shacks.

Facilities Community facilities in the site's proximity are few: A church and a school are in fair condition, but some public spaces are in attention-requiring condition. Elements of the local population do not appear to be litter-conscious.

Shops A tuck shop is located at the top end of Koch Street, close to the entrance to the Freedom Park precinct. The filling station on Potgieter Street has a small 24-hour service shop attached.

Informal Trade A fruit-and-sweets seller and a public phone operator are located at the southern end of the foot bridge, ideally situated to capture the passing trade being funnelled across this. Another fruit seller is located to the south, two blocks up Koch Street.

Income groups Based on own observation, the population belongs to the low income to lower middle income group. Some houses are seen to be shared commune-type, with no cars in evidence, whereas other households do own cars, generally of older make. Some houses have corrugated iron shacks in their backyard, which are let out to tenants, which are of the very low income group.

Tourism

The tourism potential of the suburb has increased substantially by it being situated athwart the access route to the Freedom Park Precinct, although this is not being tapped into currently. Although not every visitor to Pretoria necessarily visits this destination, the projected increase in visitor numbers in the below table indicates the projected number of visitors that may visit the railway museum (statistics extracted from Tourism Master Plan of 16 May 2006):

	2004	2007 (projection)	2010 (projection)
Total overnight visitors	1 487 617	1 702 160	2 024 080
Total day visitors	3 537 045	4 096 463	4 855 942
Total visitors	5 024 662	5 798 723	6 880 022

Table 4.4: Visitors to Tshwane



Fig. 4.23 Coat of arms of SAR predecessor companies

4.5 Historic context

The site is closely linked with the development of railways in South Africa. Located in the capital of the Zuid-Afrikaansche Republiek, the NZASM's main workshops were located on this site, being the terminus both its Southern line (by way of Johannesburg and the Orange Free State to the Cape ports) and Eastern line (the Pretoria - Delagoa Bay railway line, the construction of which was its original *raison d'être*). The two lines were completed in 1892 and 1896 respectively. The passenger station terminus was located to the sites north, between the current Central and Bosman Street stations, but no major structures signified the importance of it, and none remain. The passenger station was replaced by the Sir Herbert Baker-designed Central station in 1913, located at the top, southern end of Paul Kruger Street.

The Pretoria-Pietersburg Railway Company completed its line linking these two towns in 1898. Its terminus station was situated at the location of the present Bosman Street station. With the commencement of the Anglo-Boer War the government expropriated this company, it being British owned. As the British captured the railway network of the Zuid-Afrikaansche Republiek and the Orange Free State Republic, they were initially operated as the Imperial Military Railways and, upon cessation of hostilities, as the government owned Central South African Railways.

With the formation of the Union of South Africa, the Cape Government Railways, Natal Government Railways and Central South African Railways were merged into the South African Railways & Harbours. This has in turn been corporatized into Transnet, as such being a government department run as an independent commercial entity. Transnet's rail operations have been unbundled into Spoornet and the South African Commuter Corporation. Propnet is the property-owning division of Spoornet.

In addition to the mentioned rail links, Pretoria has been joined by rail both to Rustenburg and Magaliesburg; however, the latter line is no longer operated.

As stated before, being both end point and connecting junction of the Southern and Eastern lines, the largest NZASM workshops were constructed in Pretoria in close proximity to the station, at the foot of Timeball Hill (later renamed Salvokop). It was subsequently used by the NZASM's successor companies. A large yard for rolling stock storage and shunting formed part of the precinct. The workshops remained in use until the 1960s, when their functions were moved to Capital Park and Koedoespoort. The empty sheds were left to fall into disrepair, and were demolished in the 1980s.

Only a few structures of the once vast complex remain. These are the Chief Engineers office and its annex,

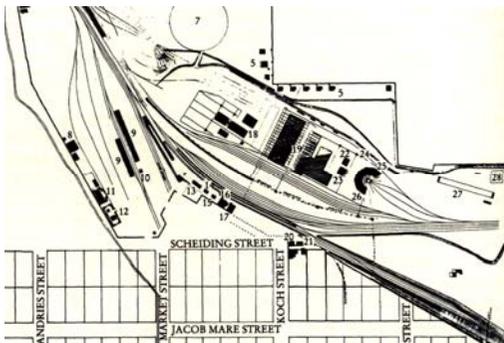


Fig. 4.24 Pretoria station yard, 1901 (north to bottom of sketch, and workshops indicated in black)



Fig. 4.26 Pretoria workshops, about 1960

both now used as a community training centre, the steam hammer shed, Spoornet operational control buildings, and an old water tank. These were illustrated under 'Extant structures'. Certain of the shunting yard's tracks are still in place and used for train storage.

Salvokop's residential component developed from the days when the NZASM built housing for its employees to the south of the railway line and workshops. The CSAR and SAR&H added to these. The houses thus span a period of construction from the 1890s to the 1930s, and are preservation-worthy heritage material. Those forming the so-called NZASM court have been renovated, but the condition of the remainder varies, with one even fire-damaged. Occasional gaps show where some have been demolished.

Though not in the immediate vicinity, there are other railway heritage related structures in the area: Central station itself, and, to its east, the now unused CSAR's carriage washing shed (the roof placed on columns made of disused and lifted rails), the auditor's office of 1928, the former station master's residence, and a few other railway employee houses.

Though not railway related, on the western side of Potgieter Street are heritage buildings belonging to the Department of Defence, including the imposing Defence headquarters. These are however distant from the core side and obscured by trees and a high wall, so that their significance as points of focus is diminished.

Of newer construction, but yet of heritage significance, is the Freedom Park precinct, located on Salvokop Hill. It is of national importance and will demand sensitivity in the design of any structure in Salvokop.

4.6 Delimitations and assumptions

The following assumptions are made for purposes of this dissertation:

The land required for the museum precinct will be made available by its owner Propnet, as a contribution to achieving the ideal of upgrading the Salvokop precinct.

Transnet will permit and install the necessary railway track and signalling equipment required to operate the museum as envisaged, serving all client train requirements, and will maintain and operate these.

Regarding the geology of the identified site, subordinate quartzite layers may occur, impeding excavatability and possibly requiring blasting. A detailed survey of the site would need to be undertaken to discover the extent of such layers, but for purposes of this dissertation it is assumed that no such layers exist.

The suburb's water supply, sewer and storm water services are currently considered as adequate, (TICP-SDF Phase 2, 2005:243). However, they are not in a good state of repair, possibly having to be replaced. Furthermore, major developments in the area may require completely new infrastructure to be installed. For purposes of this dissertation, it is assumed that the existing connections are adequate, or that any expansion required will be undertaken by the local authorities and will be connected to those incorporated in the design of the museum.

The old Chief Engineer's Office building, of 1906, on the site is currently occupied by a community training facility. It is assumed that this function will be relocated to premises more accessible to its trainees, and that the building will become available for incorporation in the museum. For this dissertation it is assumed that an interior architect will execute the design of the museum administration offices, library and small exhibit storage and quarantine areas. It is furthermore assumed that permission for the demolition of the later added annex this building will be obtained, as discussed under '4.3 Physical context: Existent buildings'.

The possible development of a conference centre and offices envisaged for the generation of additional funding for the museum will occur in subsequent phases and according to specific client requirements, and do not form part of the museum design itself.

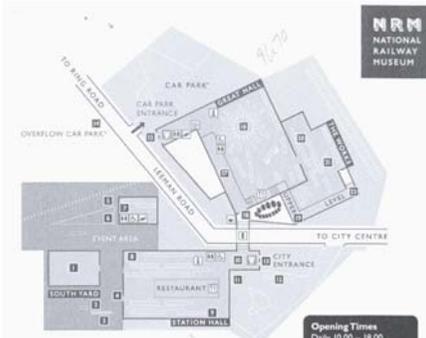


Fig. 5.1 Plan



Fig. 5.2 Entrance



Fig. 5.3 Display around the turntable

5. PRECEDENTS

One can learn from visiting institutions of the same or similar nature of the project one wants to design. For this purpose the following precedents will be reviewed for both positive and negative aspects:

National Railway Museum, York, England (visited December 2003);
Rail Transport Gallery, Cultra, Holywood, Northern Ireland (magazine review);
Musée Français du Chemin de Fer, Mulhouse, France (visited October 1993);
National Rail Museum, New Delhi, India (visited October 1998); and
James Hall Transport Museum, Johannesburg (visited March 2007)

5.1 National Railway Museum, York, England

This museum displays one of the largest collections of railway related items in the world. The locomotive and rolling stock display tracks in and around the museum are linked to the national rail network. It is housed in old workshop sheds of the London and North-Eastern Railway, the disused buildings, now named the 'Great Hall', 'Station Hall' and 'The Works', having been adapted for use as a museum, and thus having strong links with the past. The two entrances are modern structures that have been placed in front of the existing façades. The links between the halls are enclosed and covered, their walls being used for the display of the history of various British railway companies.

The new steel and glass entrances proclaim the functional nature of what is represented inside. The Great Hall is a historic masonry structure, now painted. The original roof has been replaced by a structure of triangular space-frame steel trusses, supported on the walls and new space-frame columns. Natural light is admitted through a very large window in the head wall. A mezzanine floor has been introduced in the Great Hall for the library and for smaller displays on e.g. signalling material and the history of ticketing and tickets. The Station Hall, too, is a Victorian red brick structure, but unpainted. Part of this hall's roof has been glazed to admit more natural light.

Once having entered, one passes the information/ticket-counter and gift shop. Then one is faced with the choice of entering the Great Hall or proceeding down the linking passage to the Station Hall. In the latter, locomotives and rolling stock are displayed on six parallel tracks, with platforms of generous width in between, giving the feel of a genuine station. The centre platform has been widened to accommodate a restaurant. On three tracks adjacent to the long rear wall locomotives and a number of carriages from various Royal trains are displayed. With no roof-glazing above it, it is very much darker in this area.



Fig. 5.4 The smooth, reflecting floor



Fig. 5.5 The 'Royal Trains' section



Fig. 5.6 A station scene come alive

Dimmed artificial lighting renders both the atmosphere of a station in the evening and enhances the opulence of royal splendour. It also helps in preserving these carriages and their furnishings, as exposure to natural or even too bright artificial light is reduced. This is a very successful part of the museum. The other three tracks display various passenger carriages and freight vans.

In the Great Hall the display of a wide and comprehensive variety of locomotives is centred on a working turntable. However, the display is very dense and feels cluttered – one does not get an overview easily. As I did not buy a guide (otherwise superfluous due to the excellent information boards provided with each display), I never realized that the entrance to The Works was hidden in a corner by this panoply of locomotives, and thus never saw the displays there: this makes one question the clarity of the lay-out with regard to finding one's way about unguided. The clutter is less of a problem than the inadequately marked routes. – The displays were placed on tracks embedded in an easy-to-clean, smooth, polished concrete. However, the reflection of light on this material made the display look unrealistic, more like model train locomotives standing on a kitchen table: the authenticity was compromised.

A very nice feature of the museum is an outside viewing balcony, overlooking a working and frequently-used railway line. This enables the visitor to the museum to relate the exhibits inside to the real world outside, and to discover similarities and differences. Facilities offered to visitors are, besides the exhibits, interactive learning centre, library, miniature train rides, restaurant, playground, picnic area and barbecue facilities. Rest-rooms are provided in adequate numbers and are spread over the terrain.

The issues raised are minor. The museum presents a very good collection, and includes exhibits on less prominent railway issues such as the history of ticketing, signalling and railway shipping. It appears to be well visited, and not only by railway enthusiasts, who consider this transport museum to be one of the best in the world.



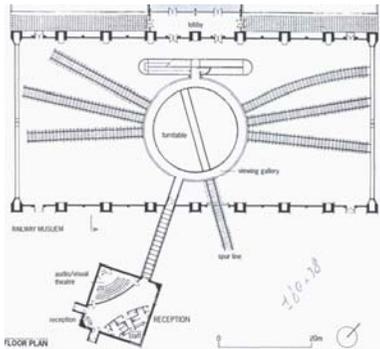


Fig. 5.10 Plan



Fig. 5.11 Exterior view

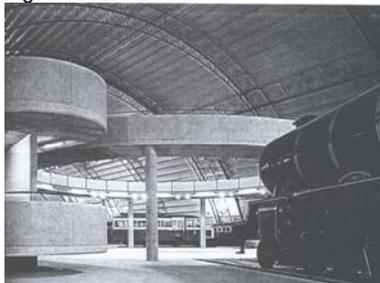


Fig. 5.12 Exhibition shed with foot-bridge and ramp

Fig. 5.7 Replica of oldest passenger train Fig. 5.8 Exhibits arranged as train ensembles Fig. 5.9 Glazed roof of Station Hall
5.2 Rail Transport Gallery, Cultra, Hollywood, Northern Ireland

This museum was reviewed by S. Greenberg in *The Architect's Journal* of 14 July 1993. – Designed by Ian Campbell and Associates and built in 1993, a large barrel vault shed reminiscent of Victorian times marks this museum, which centres its display on a turntable. The aluminium shed roof is supported on curved triangular space-frame trusses. The nine trusses were assembled in four sections on the ground and then hoisted into place. Due to the fitting of the turntable in the floor, it was impossible to counter the thrust forces of the arches with reinforcement ties embedded in the floor slab – a solution applied at London's St. Pancras station. The solution was found in the design of inclined reinforced concrete buttresses, surrounding the base of the museum, on which the trusses are anchored. These buttresses also accommodate the air-conditioning system's ducting. The walls of the shed are of blue engineering bricks. Limited natural light is admitted through a window seam touching and following the curve of the roof. The museum's area is 3,298 m² (including that of the separate entrance block), its cost of construction was £ 1,895,000, including preliminaries (£535.58/m²). Its tracks link to the rail network.

Further facilities provided are a 40-seater auditorium, lavatories and a staff room, located in the entrance building. The visitor passes through the entrance building, and crosses over a bridge, which accommodates the sloping terrain, enters the shed on a level above the display of the locomotives and rolling stock. This is supposed to recall an experience similar to that of standing on a foot-bridge, although I consider a first encounter with the exhibited locomotives on the same level more realistic to have. The bridge splits in the shed and encircles the turntable, before rejoining and leading down by means of a long ramp. However, the heavy reinforced concrete bridge structure impairs both the view of the display and the experience of the large vaulted space.

The entrance building is unusual in that it has two entrances, the reason for which is not adequately explained. The passage through to the connecting bridge is flanked by the auditorium on the one side and the public and staff facilities on the other.

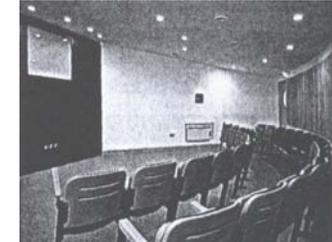
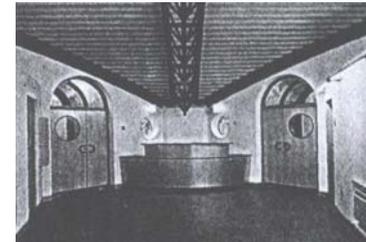
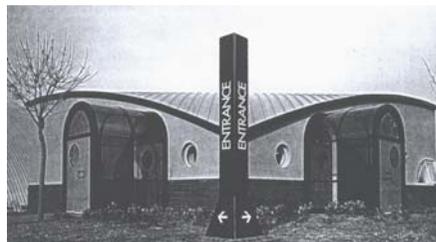


Fig. 5.13 Double entrance to museum

Fig. 5.14 Reception area

Fig. 5.15 Auditorium

5.3 Musée Français du Chemin de Fer, Mulhouse, France

This museum, also connected to the rail network, forms part of a larger complex, with a fire engine museum being located next door.

The main hall of the museum is constructed of off-shutter reinforced concrete, whereas the roof is supported on laminated timber beams. It is not a clear span, but has three bays, the spans being supported on two rows of columns. The roof is a stylized version of a saw-tooth shed: the beams are bent in shallow curves, giving a wave-like appearance, on which rest bent joists, curving upwards to form a glazed vertical opening between the upper and lower roof pitch, admitting natural light. The ceiling is very busy for a building displaying functional machines, and appears to be rather low, resulting from the combined optical effect of the downward swing of the beams and joists and their darker timber colour. Tall windows in the long walls admit more natural light. This saves on the electricity bill and is more sustainable. A mezzanine is used for the display of other railway related items.

This museum, too, is entered by way of a separate entrance building where tickets and guides may be purchased and the toilet facilities are located. It also gives access to a restaurant. One then exits into an open courtyard where 'weather-resistant' displays are exhibited. Entering the main hall, near one of the corners, one is faced by rows of parallel tracks stretching away to the right. As one enters on the same level as the displays, their awe-inspiring size becomes immediately apparent. The aisles left between the rows of rolling stock display are of ample width, permitting the exhibition of smaller objects.

A very good variety of French locomotives and rolling stock, including luxuriously appointed carriages of the *Compagnie Internationale des Wagons-Lits*, is displayed on tracks embedded in gravel, with rails fixed to cross-ties, giving a more authentic effect than that discussed under the York museum.

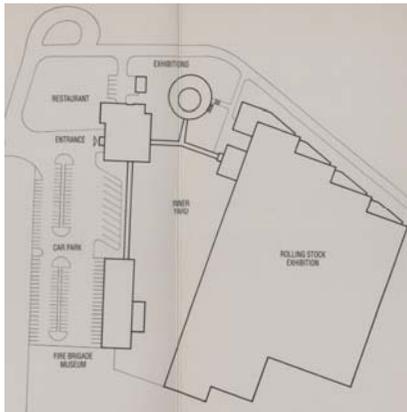


Fig. 5.16 Plan



Fig. 5.17 Exhibition hall



Fig. 5.18 Naturally lit and stylized saw-tooth shed



Fig. 5.19 Windows for natural light

Fig. 5.20 The too low ceiling effect

Fig. 5.21 Display on gravel-embedded rails

5.4 National Rail Museum, New Delhi, India

This museum, once again, is connected to the national rail network. It is unusual in that its displays of locomotives and rolling stock are located outside. Only some items are (partially) protected by shelters, some of which are old platform sheds. One passes by these to the actual museum building, built in a large diameter circular shape, reminding one of a roundhouse. To this the entrance is attached, with the ticket and information counter, a small gift shop and toilet facilities. No restaurant facilities are provided, but picnics would be possible outside on the vast 'exhibition lawn'.

The outside display of rolling stock is an excellent representation of Indian railway history, covering vehicles of three gauges (broad, metre and narrow). Many of the maharajas' private saloon carriages are also on display, but unfortunately, due to a lack of a platform, the interiors cannot be seen into. The interior display covers aspects of signalling, Indian railway companies' development, and other railway-related topics.

The large outdoor area would require garden maintenance, but with low labour costs in India this would presumably be cheaper than building maintenance. However, due to the outside storage, many of the exhibits are deteriorating, showing peeling paint and rusting metal: what is being saved on building costs necessitates it being spent on increased exhibit maintenance – if this is performed at all. The brass piping and tubing on the locomotives has also disappeared, as the area cannot be effectively secured 24 hours a day. (This problem is also encountered in South Africa, where 'free-lance wealth redistributors' are as eager to help themselves to items commanding a good scrap metal price.) The steam locomotives are therefore of a rather depleted appearance.

Although the architecture is straight forward and cost-conscious, with no large exhibition shed being part of the complex, the museum's collection is well worth a visit, if one overlooks the condition of some of the displays.



Fig. 5.22 Entrance to the museum



Fig. 5.23 Exhibits sheltered by old station structures



Fig. 5.24 Deterioration evident on exhibits



Fig. 5.25 Exhibition lawn

Fig. 5.26 Largest engine: Garratt locomotive Fig. 5.27 Smallest engine: monorail locomotive

5.5 James Hall Transport Museum, Johannesburg

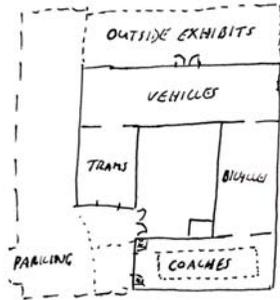


Fig. 5.28 Plan



Fig. 5.29 Entrance



Fig. 5.30 Naturally lit northern shed

This museum consists of four enclosed sheds placed around an inner courtyard. They abut on each other to permit passage from the one to the other, except at one corner where access to the courtyard is provided. Here, too, entrance and exit are located separately, the visitor progressing through the museum in an anti-clockwise direction. The southern shed contains a mezzanine floor surrounding a central well. Stairs lead up to this, but ramps for the disabled are lacking. An open shed placed next to the northern enclosed shed displays items of a larger nature, such as locomotives. The structure is very straight-forward and simple, consisting of steel columns supporting steel roof trusses, with infill walls of face brick to a height of about four metres. Above this, filling the space between the masonry and the ceiling, are panels of opaque polycarbonate, admitting filtered natural light to such an extent that only minimal artificial light sources are required on a clear day. This reduces operating costs, whilst not allowing the entrance of too intensive direct to cause damage to the exhibits. (On the northern side these panels have been painted blue, to reduce the quantity of light infall; possibly the panels should have been limited to the southern side only.) Due to the dry Highveld climate not necessitating the removal of display-damaging excessive humidity, no air-conditioning units have been installed. Louvre panels have been provided for ventilation on the mezzanine level of the southern shed, where smaller and light-weight exhibits and the administrative offices are located. The building finishes demand little maintenance which, together with the mentioned low artificial lighting requirements, assists in significantly reducing operating costs.

The choice of structure and materials makes for a low initial capital cost (relative to the European museums reviewed). The design is purely functional, yet through its simplicity a certain elegance is achieved, too.

The proportions of the sheds, the lofty height matching their width and length, coupled with the quality of light within, make for a pleasing space and atmosphere, and ample space for the displays. The exception is the shed containing the historic double-decker trams and buses, which are parked so densely that they can not be seen in full. The area of the open shed, surrounded by palisades (evidently only added since the crime epidemic commenced in South Africa) displays agricultural implements and locomotives, trucked in as the museum has no link to the rail network. However, the overhang of the shed roof is insufficient, as bleaching and other damage to the exhibits is evident where the sun reaches them. All brassware has been stolen off the locomotives, proving that the palisade fence does not adequately protect them against theft (unless the theft occurred before the erection of the fence). An old boat hulk placed in the open beyond the palisade seems to be totally ignored now and is rotting away. - The inside exhibits are in mint condition.

The entrance as such is ill-defined, using the roller-shutter door by which the exhibits are brought into the



Fig. 5.31 Mezzanine with central well



Fig. 5.32 Undefined reception area



Fig. 5.33 Congested tram and bus display area



Fig. 5.34 Deteriorating locomotives



Fig. 5.35 Suspended carriage



Fig. 5.36 Model tram club's lay-out

shed and looking very much the same as the exit. The entrance and exit being separate necessitates that an additional person must be employed to control that nobody enters or exists the museum uncontrolled, resulting in higher staff costs. The entrance area, once one has entered the museum, is ill-defined, and basically non-existent. There is no information stand or counter; post-cards for sale are displayed at the back of the shed far away from the staff member controlling the entrance; the old office desk for this staff member is tucked under the staircase leading to the mezzanine. Providing a simple, yet elegant counter would provide a more professional feel to the museum.

The interior courtyard may have been intended as a further display area, but is not fully utilized as such, possibly due to the exposure to the elements damaging the exhibits. It is now used as a picnic area, but is not pleasant to be in with its gravelled floor surface. A small kiosk is tucked away in one corner, behind which one finds the toilets. – There is insufficient parking space for buses, and their entrance from and egress to the street is difficult.

An innovative approach to exhibiting items is used for some old coaches and horse carriages: they are displayed over the central well of the mezzanine level, their wheels being fastened to two beams spaced apart to a corresponding width and laid across the central well. Also on the mezzanine level are the club facilities of the Johannesburg Model Tramway Club, their tram lay-out visible within a glass enclosure.

This museum, too, is well worth a visit. The displays offer a good insight into the development of transport in South Africa, with fairly well-documented displays and information boards. The selection of displayed objects is comprehensive, albeit a bit light on the railway side. Some identification plaques on exhibits are missing, but this would be the fault of staff and not of the architect.

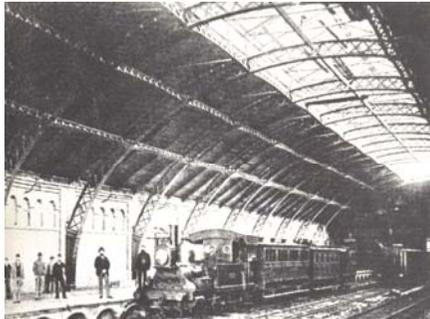


Fig. 6.1 Space and light: Cape Town Station as in 1873



Fig. 6.2 Paddington Station (by Brunel, 1854), London



Fig. 6.3 St Pancras Station (1866-68, by Barlow),

6. DESIGN PROCESS

6.1 Design concept

The main impact of station architecture, culminating in the development of the supershed, was not only through its bulk, but the sense and sensation of space which these huge, enclosed, uninterrupted volumes imparted on the man in the street. Before their development such volumes would have been associated only with institutional structures. The (re-)creation of similar vast, but yet everyday spaces, with however their own feeling and atmosphere permeating them, arising from the vibrancy of a railway station and its infrastructure, is the concept underlying the design of this museum. It is accepted that most of the display items would be static at the best of times, but it should still impart the feeling that, at the flick of a switch, the whole scene could come alive within the enveloping space.

The freedom of space created is also symbolic of the opening-up of the world by the railways to the average man in the street, by making economic means of transport available to him, providing him with the freedom to travel and discover.

Assisting in recreating the atmosphere of movement through a station, that element uniting the diversity of buildings with their respective functions, the layout of the museum re-enacts, with some slight variations, the progression of a train passenger from the street to the train through the concourse, the route passing directly or in close proximity (similar to that of Pretoria Central station) the restaurant, the luxury train passenger departure lounge, and, somewhat removed from it, the railway administration offices, whilst seeing on the periphery the supportive workshop infrastructure.

Underpinned by architectural theoretician Francis Ching's statement: 'The colour and brilliance of [direct or indirect] sunlight can create a festive atmosphere within the room or a more diffuse daylight can instil within a sombre mood.' (Ching, 1996:171), the structures making up the complex should be filled by light, though in the main with indirect light, to protect the exhibits. The feeling of openness so created adds to the symbolic freedom mentioned afore.

Elements of historic precedent will be incorporated to the extent that it assists in creating a desired ambience or illustrates certain elements, structural or otherwise, resulting from or used in industrial and station architecture in the past.

London

6.2 Design issues

In addition to the aspects arising from the stated concept, the following issues have been identified as issues or topics requiring attention so as to enable the development of an appropriate museum design:

Identification of a suitable site

Criteria for the display of exhibits and operation of trains from site (addressed in 'Appendix 2.1 Site criteria')

Identification of potential sites in or close to Pretoria (addressed in 'Appendix 2.2 Potential sites identified')

Analysis, evaluation and selection of site (addressed in 'Appendix 2.3 Comparison of sites' and '2.4 Conclusion')

Museum and vintage train operations

Principles governing museum design and operation (refer to '4.2 Legislative context: *South African Museums Association: Professional Standards and Transformation Indicators*')
Creating financially viable museums (refer to '4.1.3 Project context: funding sources and proposal')

Principles of station design and requirements for the operation of railways (refer to '4.1.1 Project context: clients and client requirements' and '3.4 Station operation and functioning')

Attraction of visitors people to the museum

Creating spatial experiences for the visitor which recreate those of real stations and their supporting infrastructure

Inclusion of educative facilities to accommodate school classes and similar-sized groups

Ensuring the visibility of the premises (addressed *inter alia* in 'Appendix 2.3 Comparison of sites')

Employing advertising principles and selling techniques to attract visitors

Recreating live atmosphere and ambience of historic and current railway travel

Displaying a representative collection of locomotives, rolling stock and other exhibits

Those visitor-drawing aspects related to the type and approach to the display of exhibits, and the marketing thereof, is seen as the responsibility of the curator and trustees of the museum; the architect must ensure that suitable space is available to realize their ideas (refer also below).

Creating movement and dynamic experiences in an environment of static exhibits:

Involving audiences with exhibits
Providing inter-active experiences
Creating virtual reality experiences (simulators, IMAX-based or other travel films)
Manipulating the senses to invoke associations and atmosphere, e.g. background station noise
Vintage train operations: recreating atmosphere of arrival, departure and movement
Displaying and possibly experiencing technical innovations

The same proviso regarding the relationship between the curator/trustees and the architect as mentioned above apply here, too.

Sustainability of a museum:

Low maintenance materials reducing future running costs
Low operating costs of museum from electricity and water savings

6.3 Basic design determinants

The execution of the design concept, and the addressing of the above issues and meeting the requirements of the accommodation schedule set out under 6.4, required allowing for or incorporation of the following:

As indicated before, and further discussed below and fully set out in Appendix 2, the physical constraints of rail layout and track siting were the main determinants in the positioning of the museum on the site, and furthermore influenced the placing of the various functions of the complex. In addition, to facilitate making the link between the exhibits inside and the real railway world outside, the main frontage of the exhibition hall was aligned parallel to the Pretoria's site-adjacent main railway line. This is line with historical precedent, as the now demolished workshops displayed the same alignment.

A further factor was the length of locomotives and rolling stock items to be accommodated, and the length of train consists made up in the exhibition hall, which influenced the structural grid of the various structures. To enable the moving of locomotives one at a time, a round-house was incorporated, based on historic site precedents. This is discussed in more detail below.

Arising from this was the very significant factor of the scale of the resulting buildings. They can not be anything but large. Historically, stations faced the same problem. However, the analysis of stations in the theoretical investigation revealed that the various functions were occasionally accommodated within one structure, but more generally they consisted of vast complexes comprised of distinct, separate structures (of

different styles and construction methods), each accommodating its respective function, yet linked through the uniting flow of people movement. In some cases, parts such a hotel were totally separate from the main complex. This concept was consciously recreated in the museum complex design, disjointing the various functions and varying the styles and appearances of the component structures, yet uniting them with the flow of visitors between them. The number of separate buildings (exhibition hall, concourse building, luxury train passenger departure lounge, workshop, train platform and round-house, all except the latter visible when approaching the main entrance to the museum), is also intended to install a conceptualization of the multi-functionality of a station complex in the visitor, whilst at the same time lessening the impression of isolation that a single, outsize building placed in an empty brown-field site would call forth.

The large enclosed volumes led to very strong geometries arising, in line with the historic station precedent: rectangular for the exhibition hall, concourse and workshop, and semi-circular for the round-house. Accommodating these functionally and aesthetically pleasing on the site, within the constraints of the track layout and the mentioned solution found to the problem of scale, was a major challenge. Various methods were used to reduce the visual strength and domination of the individual structural components on elevation, such as introduction of the butterfly roof and exterior roof-supporting columns of the exhibition hall, and the round-house wall made up of columns gradually increasing in height. The historic precedent of a tower was also incorporated, providing a focus point of greater height, both assisting visibility from afar and providing a vertical element in an otherwise very horizontally-orientated massing.

The introduction of the round-house, with its semi-circular roof, and the exhibition hall's two butterfly roofs – a re-interpretation of a traditional two-bayed, hip-roofed factory shed – also add variety to the roofscape of the complex, important as being visible from the Freedom Park precinct on the summit of Salvokop, to the south.

To improve the sustainability of the structures and to reduce the future running costs of the museum natural light was admitted as much as possible. This is in line with the stated concept of having the interiors light and open, and underlines the feeling of space and spaciousness in the concourse, round-house, workshop, and to a lesser extent in the exhibition hall (due to the sensitivity of many exhibits to direct light) and the luxury train passenger departure lounge, where a fuller sense of enclosure was deemed more appropriate to create the desired, more intimate and yet formal atmosphere.

The complex's positioning with regard to the sun did, however, not facilitate this approach, with some of the component structures' longer elevations facing north-west and north-east, due to their being lined-up with the adjoining railway lines. In these cases, various methods of sun-screening were employed, such as horizontal and vertical louvres, recessed façades and porticoes. However, façades facing south-east were



Fig. 6.4 Natural light filtering into Leipzig Hauptbahnhof (1903-06, by Reinhardt and Sössenguth), Germany

utilized to the fullest extent possible for the admission of light, contributing to the feeling of spaciousness and lightness which large openings impart. Openings to the north-east were sheltered by horizontal louvres. Alternatively, tinted glass was incorporated in some problematic façades.

Further running cost savings were obtained by utilizing natural ventilation. This approach is based on the precedent of Johannesburg's transport museum (refer to '5.5 Precedents: James Hall Transport Museum'). Ventilation boxes, louvres and opening windows have been provided in the various buildings. Though this should suffice, it would be possible to replace certain of the louvre panels with mechanical extractors or split air-conditioning units at a later point in time. With respect to the exhibition hall, the use of Zinalumen-coated roof sheeting, with an Isoboard layer beneath it, should further contribute towards reducing heat build-up. A full discussion of thermal control is set out under '7.5 Thermal control'.

Rain water run-off of the concourse and round-house buildings is captured for later use in large tanks. Other sustainability aspects influencing the design are set out in '7.6 Sustainability aspects'.

So as to minimize visual interruption of the large enclosed volumes, the structural grid was spaced wide in the exhibition hall, concourse and round-house. The structural grid spacing was also, for the exhibition hall, concourse and workshop dictated by the size of the locomotives and rolling stock to be displayed. Details of the determination thereof are set out under '6.7 Design approach' below. Discussion with engineer Karl von Geyso led to the replacement of downstand concrete-beams supporting the prior's mezzanine level floor slab and the latter two's roofs (the depth of beams having resulted in a too low visual ceiling level) with a steel-beam supported slab and truss-supported roof structures, respectively.

The review of precedents indicated that locomotives displayed outside are vandalized and stripped of their brassware. Furthermore, exposure to the elements resulted in marked signs of deterioration. The *South African Museums Association: Professional Standards and Transformation Indicators* states that all collection pieces should be properly protected against theft and deterioration. Additionally, the replacement of stolen or damaged items costs money, so that in the long-term an initial capital saving in building costs is lost. The display of the exhibits will thus be placed within the museum to be designed and protected to the best extent possible against the elements.

The full separation of the Friends of the Rail-workshop, of the luxury train passenger departure lounge and related office accommodation, the museum administrative function in the old chief engineer's office building, and of model railroad club's premises in the steam hammer shed, permit access to these at times when the museum is closed, providing for a greater measure of flexibility to their users.

Due to the size of the exhibits, the museum is larger than one with a comparative number of small exhibits. The number of visitors would accordingly be spread out over a much larger area. In determining the number of sanitary facilities to be provided, the ratio has prescribed by the *South African National Standard: The application of the National Building Regulations (SANS 10400-A:2003)* were relaxed accordingly.

As the only road access is from the intersection of Skietpoort and Second Street to the museum's south-west, the main entrance and its supporting parking area were orientated to this direction. Furthermore, a direct link between the entrance and the train platform had to be provided, the latter also being in close proximity to the luxury train passenger departure lounge.

The above reflect some of the considerations underlining the design. A more detailed description of the process addressing certain of these design determinants is set out below under '6.5 Design approach'.

6.4 Accommodation schedule

Exhibition hall:		6,618 m ²
Tracks and platforms for display of locomotives and rolling stock:	whereof	3,105 m ²
Luxury train consist		
Main-line passenger train consist		
Suburban passenger train consist		
Goods train consist		
Non-rolling stock exhibition areas of varying size and height, incl. area for locomotive driving simulators		3,513 m ²
Engine round-house:		3,848 m ²
Turntable area	whereof	347 m ²
Bays for 11 locomotives		3,501 m ²
Concourse area:		2,743 m ²
Visitor reception and information area, including ticket selling facilities	whereof	75 m ²
Temporary exhibition area		690 m ²
Restaurant and/or cafeteria, with kitchen, scullery, pantry, freezers, refuse area		710 m ²
Auditoria		189 m ²
Gift shop and store room		63 m ²
Toilet facilities		70 m ²

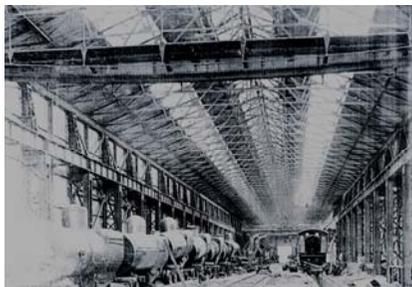


Fig. 6.5 Pretoria's 'new' central workshops

Cleaning material storage areas		6 m ²
Outside restaurant terrace		220 m ²
Luxury train (Rovos Rail/Blue Train) passenger departure lounge building:		920 m ²
Passenger departure/waiting lounge	whereof	230 m ²
Reception and baggage handling facilities		173 m ²
Offices for train operating companies		380 m ²
Warming kitchen		40 m ²
Toilets (passenger and staff)		52 m ²
Workshop:		
Tracks for locomotives and rolling stock		840 m ²
Tooling and machine area	whereof	410 m ²
Offices for Friends of the Rail steam train preservation society		120 m ²
Material stores		80 m ²
Change rooms and toilets		40 m ²
Outside repair yard		286 m ²
Existing Chief Engineer's Office building:		1,313 m ²
Museum administration offices, including safe and boardroom and staff training facilities (alternatively in the concourse auditoria)	whereof	385 m ²
Library, sound library and archives		385 m ²
Storage area for artefacts not on display and quarantine facility for for smaller newly acquired objects		385 m ²
Existing steam hammer shed:		510 m ²
Display facilities for Pretoria Model Railway Club's layout	whereof	255 m ²
Club meeting venue (new mezzanine level)		255 m ²
Outside areas:		
Storage tanks for rain water off-run		about 82,000 litres
Parking area		177 car and 9 bus bays
Garden spaces for picnic area usage		
Train operation-related requirements:		
Workshop and round-house access tracks, sidings, points and signalling		

Coaling bunker and ash pits
Water tanks and water purifier for locomotive water supply
Steam and luxury train siding and platform area, with period pieces (e.g. signalling booth and water tanks) on display (this at curator's discretion)

6.5 Visitor's route through museum

On arriving for a visit, the visitor passes by the museum tower, the exhibition hall and the luxury train passenger departure lounge towards the museum's entrance. The entrance leads into the museum's concourse, in line with historic station precedent. To underpin that this is a railway museum, the approach is along a railway track and the visitor co-uses the train's entrance, with the track continuing through the reception area to the round-house beyond. On having entered, bought an admission ticket and gleaned the necessary information – activities traditionally found in the concourse area of a station, the visitor is faced, across the concourse and a turntable, with the very reason giving rise to the development of railways and origin of stations: that steam engine on wheels, the locomotive. They are arranged in a semi-circle around the turntable. Historically, the round-house would have been at some distance from the station itself: it is for this reason that an interior courtyard flanks either side of the front half of the turntable, symbolizing the original separating distance.

The visitor may decide to proceed to the round-house immediately, or turn right into the area reserved for temporary exhibitions. This may be utilized later to accommodate the growth of permanent exhibition material. Turning left, the visitor would see and proceed down the length of the concourse, past further support functions, similar to those traditionally associated with a station concourse, successively passing the gift shop to the left and the toilet block to the right (set in the farther corner of the mentioned interior courtyard), whilst heading for the restaurant area directly straight ahead. This consists of two vintage dining cars to either side of a number of tables – the visitor would have the choice of either, or of the outside terrace. Looking out, beyond the restaurant area, the historic steam hammer shed becomes visible and can be visited. It is now used for displaying the model railroad club's layout, with their club rooms above.

Alternatively, before reaching the restaurant area, the visitor may turn left, towards the exhibition hall, which is reached through a connecting glass-walled lobby. Here flights of stairs and a lift are located, giving access to either the three auditoria, situate on the concourse's mezzanine level and accentuating the entrance to the lobby just entered, or to the mezzanine level of the exhibition hall, containing smaller exhibits on railway-related subjects and themes. Alternately, the visitor can proceed straight to the exhibition hall's lower level, with its main display of four train consists alongside platforms in the large central shed part, and further space for medium-sized or large display items in the adjoining wings. The

ground floor and mezzanine level are linked by a number of staircases.

Accessible from the long north-eastern side of the hall lies a terrace, overlooking an open space flanked to the right by the steam hammer shed and to the left by the historic chief engineer's office building. The latter building houses the museum's administrative offices, archives and library, and storage and quarantine area for smaller exhibits. Beyond the open space the train activities on Pretoria's main and busiest railway line may be observed, giving an opportunity to see and relate some of the information contained in the exhibits to real life.

The visitor proceeds outside, past a locomotive and carriage repair yard to the workshop itself. Here Friends of the Rail have their offices and undertake repairs on their locomotives and rolling stock. These activities can be observed through windows from flanking walkways. Furthermore, a foot-bridge over the repair tracks provides access to a catwalk, running through the centre of the workshop and permitting visitors to observe the repair activities and the tradesmen executing these. Exhibits on trade careers form part of the exhibits on this catwalk, serving as career orientation for visitors.

On having explored the museum to his satisfaction, the visitor may then retrace his steps to the entrance.

6.6 Envisaged exhibition themes

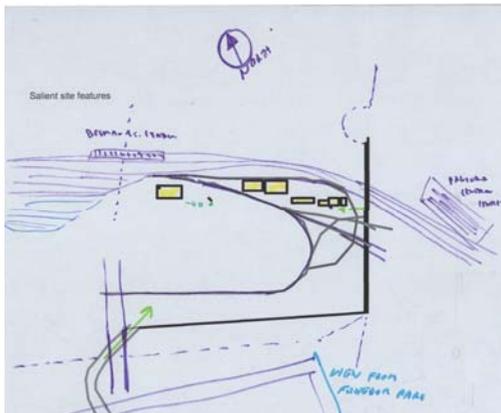
In addition to the display of locomotives, passenger carriages and goods wagons, the following themes were identified with regard to non-rolling stock exhibits:

1. Physics of underlying propulsion systems: steam, electric, diesel
2. Track, switches and crossings: construction, laying and maintenance
3. Rail gauge history
4. Signalling and train operation
5. Salvage equipment and accidents
6. Locomotive operation and driver training (simulators)
7. Civil engineering and surveying
8. Electrical and mechanical engineering
9. Telecommunications and development history
10. Station functions, operations and architecture
11. History of railway development and railway companies
12. Mail train and mail handling

13. Catering services
14. Rolling stock maintenance
15. Freight handling, containerisation and bulk freight services
16. Railway's road transport services
17. Railways and ports
18. Narrow gauge and other railways
19. Gautrain, high speed trains and monorails
20. Railway heritage preservation
21. Employment opportunities on the railways

These themes are exhibited in the various areas of the museum, including the exhibition's mezzanine level, based on an open plan concept and not strictly separated from each other by physical barriers. This gives the curator flexibility in display lay-out, allowing for changing requirements. It also facilitates the easier movement by the visitor from one area of his/her interest to another, as he does not need to return every time to a central aisle from separate display rooms, thereby exposing him/her inadvertently, whilst moving along, to further themes which might not initially have drawn his/her attention.

Exhibit information would be displayed by various means: wall-mounted or loose standing boards, touch screens, audio-visual displays, simulators and other. Two auditoria seating about 56 visitors each (the size of a large school class and the teacher) are available for the display of films or lectures. They may be combined when so desired to provide increased accommodation.



6.7 Detailed design approach

Below is set out the progress through the resolution of some of the issues identified under '6.3 Basic design determinants'.

An initial study of the site, as set out in the context analysis, determined the salient features such as access, views of and out of the site, and existing structures to be incorporated into the design of the museum.

An analysis was made of the functions to be provided by the museum: exhibition and visitor information, educational facilities, entrance and ticket counter, gift shop, steam and luxury train departure and arrival facilities, model railway club premises, administration offices, library, storage facilities for smaller or temporary exhibits, restaurant, kitchen, public toilets and staff facilities. Furthermore workshop facilities are

Fig. 6.6 Site analysis, showing alternatives for museum rail spur

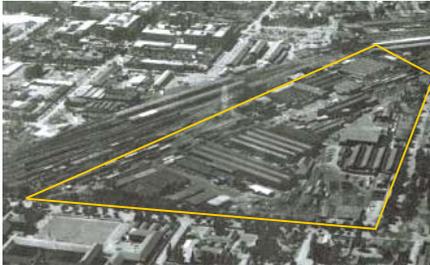


Fig. 6.7 Pretoria workshops site, Salvokop

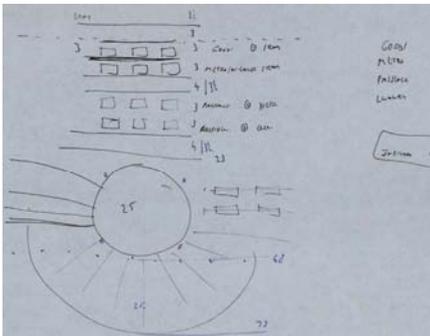
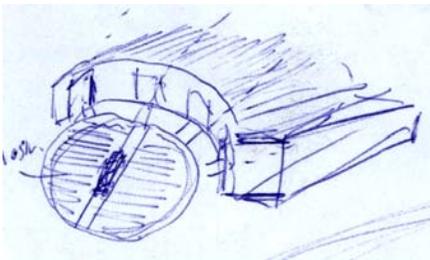


Fig. 6.8 Initial thoughts on rolling stock display layout



required by Friends of the Rail for the restoration of locomotives and carriages. A site for a future conference centre also formed part of the initial concept, to function as an additional fund raiser for the museum.

The exhibits were differentiated into rail (e.g. locomotives, carriages and wagons) and non-rail (e.g. salvage cranes, railway buses, tickets and signalling equipment). The latter vary in size from a ticket or set of crockery to buses, and thus do not all need to be displayed on ground floor level.

The need to safeguard not only the smaller items, but also such large items as the locomotives and carriages from the elements and pilferage determined that all displays should be housed indoors. The need for a large area to be covered for the large exhibits links back to the historical precedent of station sheds, and I decided to recreate the atmosphere of such station sheds to the greatest extent possible, whilst also providing sufficient space for the 'non-rail' exhibits therein. The display of four different train consists would provide the visitor with a good insight into the variety of services provided by the railway: a long-distance passenger train, a suburban passenger train, a goods train, and a train made of luxury or special carriages (such as carriages used in the 1947 Royal Train, by President Kruger or by the De Beer's Company directors). Four trains, albeit of short length, displayed on four parallel tracks will be able to substantially recreate the desired station atmosphere. These tracks need to be linked to the rail network to facilitate their easier transportation to the museum, alleviating the need for lorry transport. – With the average length of a locomotive or a passenger carriage being between fifteen and twenty meters, a platform length of about 90 m was determined as adequate for the display of one locomotive with up to four carriages. – The 'station part' of the museum would fill about half of the width of the exhibition hall; the remainder would be available for large non-rail items, such as salvage cranes, signal gantries and SAR&H road transport busses and trucks.

The exhibition hall would, however, not provide sufficient space for the exhibit of the large number of locomotives available for display, and additional display tracks are thus required. As individual locomotives need to be moved out of the museum on an *ad hoc* basis, e.g. when required to haul Transnet or Friends of the Rail vintage trains, this operation needs to be executed with minimum disruption. Would the locomotives all be parked behind each other, when the one displayed furthest from the access track is required it would necessitate unnecessarily moving all intermediate ones out onto the exterior shunting tracks. A traditional round-house would circumvent this problem. (A 'round-house' is a circular or semi-circular shed-structure built around a turntable. The engine is driven/moved onto the latter, turned around and reversed into the shed; it is in essence a garage for locomotives.) It allows unimpeded access by each and every locomotive, and is thus included in the design as a separate area for locomotive exhibition. The round-house has historic precedent: Pretoria rail yard had two round-houses at the time of the Dutch-owned NZASM, whilst

Fig. 6.9 Conceptual sketch of round-house

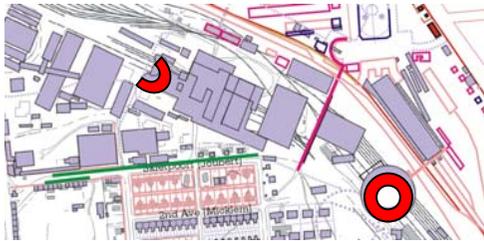


Fig. 6.10 Location of Pretoria's vanished round-houses



Fig. 6.11 Waterval-Onder round-house

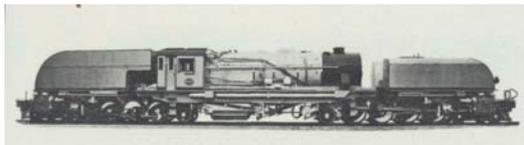
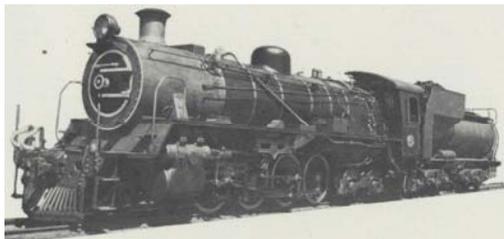


Fig. 6.12 Class GEA Garrett locomotive



others were built at e.g. Waterval-Onder. The inclusion of a round-house would acknowledge the historic links between the railway history of South African and Continental Europe, where round-houses were widely used. A further eleven engines can be displayed by incorporating the round-house. Locomotive movement would be undertaken by a small tractor-like vehicle within the museum. Furthermore, from own observation, a large number of locomotives parked one behind and next to each other on parallel tracks makes for a monotonous display, whereas the round-house locomotive display, focussed on the turntable, makes it more interesting., and illustrates historic mechanical and operational engineering. The pit of the turntable, covered for museum purposes with a revolving deck, can be used for product launches or museum exhibits.

The dimensions of the round-house and turntable were determined by the size of the various locomotives to be displayed. Although they are not all in the possession of either Friends of the Rail or Transnet Heritage Foundation currently, their possible future acquisition is not ruled out, and thus the dimensions of a representative sample of steam locomotives operated by the railways of South Africa were assessed for display track and turntable dimension requirements. The below locomotive dimensions were extracted from Espitalier and Day's *The Locomotive in South Africa* (1989):

Locomotive class	Length (m)	Wheelbase (m)
Class GEA Garratt type	26.95	24.64
Class 18	23.16	20.62
Class 24	22.91	19.89
Class 15F	22.40	20.88
Class 15AR	21.82	19.38
Class 15BR	21.46	19.08
Class 12R	21.08	18.64
Class 16CR	20.42	17.98
Class 14CR	20.37	17.98
Class KM	20.24	17.81
Class GDA	20.09	17.78
Class 10B	19.96	16.84
Class S1	19.56	14.94
Class 5R	19.56	17.02
Class 2 Hendrie A	17.93	15.57

Fig.6.13 Class 24

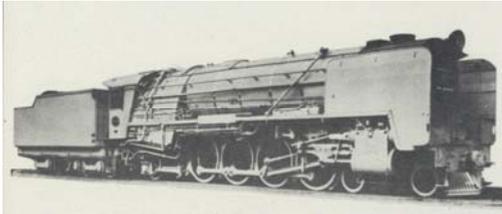


Fig.6.14 Class 15F

Class 1 Hendrie B	17.17	14.96
Class 8X	16.31	14.05
Class A	15.90	13.72
Class 6	15.47	12.73
Class H Reid	15.44	13.11
Class 7	15.27	12.60
Class 4	13.16	11.61

Table 6.1 Locomotive dimensions

Class GEA would necessitate an exceptionally large turning table and exhibition track length, and it was decided to exhibit it and Class 18 on the tracks located in the exhibition hall. The turntable diameter of 21 m accommodates the wheelbase of all other classes. An adjoining walkway breadth of 1 m on either side of the turntable allows for engine overhangs to be swung through, permitting engines of up to 23 m length to be turned. This implies display track length requirement of 23 m. Allocating the outermost display tracks on either side of the round-house 'track fan' to classes 15F and 24, as it is not necessary for visitors to pass to their further side, and providing an additional 0.5 m safety space for engine movement, allows for a visitor passage at the further end of other locomotives, width being freed by their shorter length.

The position of the entrance must be orientated to where the main stream of visitors would be approaching from. This was identified to be from Skietpoort Road (to the south-west), as most South Africans, being largely car orientated, would arrive thereby, and tourists would arrive either by car or by tourist bus. Public transport in the area, once introduced, would be from the same side. Access for pedestrians coming from the pedestrian bridge route (the east) is facilitated around the round-house by pathways through the open land.

The ticket counter and gift shop should be located in close proximity to the entrance/exit, the prior to be easily accessible for the required tickets and information, the latter to attract the custom of departing visitors passing by. Restaurant facilities and public toilets should be located centrally and close to exhibits and the routes of visitors to attract custom, with proximate access to the outside terrace from which trains passing on the main line would be visible. The supporting kitchen must be accessible by delivery vehicles.

The luxury and steam train departure and arrival facilities consist of a platform of carriage height and of sufficient length to serve the calling trains. Due to the limitations imposed by the existing Transnet carriage storage sidings to the west of the site, and the need to minimize the number of crossings over and junctions with Spoornet tracks, insufficient straight track length was available to the north of the site, and I decided to



Fig. 6.15 Pretoria workshops



Fig.6.16 Pretoria workshops 1896

fold the track back on itself in a curve, leading around to the east and south of the museum site, and then parallel to and following the embankment on the southern edge of the site. Two short connecting spurs to this alignment enable connection to the Pretoria rail network in both directions. Its diameter of 124m comfortably exceeds the minimum Transnet requirement of 91m, and will, according to the information received from Friends of the Rail members, allow all their locomotives to negotiate the curve. This layout however does necessitate the calling train to reverse into the siding; however, as this is the method of operation currently employed by Friends of the Rail, this is not seen as a problem. – A separate departure lounge and baggage handling facility is incorporated for luxury train passengers, and must be located within a reasonable distance of both the train platform and bus/car parking area. With Rovos Rail selling the ‘colonial experience’, reflected by their colonnaded, high-ceilinged building and Victorian furnishings at their Capital Park site, this requirement was reinterpreted for this design. The floor above the departure area contains offices available for luxury train operators and museum staff.

The two existing structures on the site to be retained (refer context analysis), the old Chief Engineer’s office and the steam hammer shed, would be restored structurally where required, whilst retaining to the greatest extent possible their current appearance. The prior is utilised for the storage of smaller items on the ground floor, the administrative offices on the first floor, and the library on the top floor, this currently being a large open space. The steam hammer shed, being a partly open structure, is made available for usage by the model railway club: a new structure is built within the existing shed, with the glass-enclosed display area at ground floor level and club rooms on the first floor. Existing openings are filled with glass and steel roller-shutters for after-hour protection of the displays.

The required locomotive workshop needs, as indicated by Friends of the Rail’s Nathan Berelowitz and Chris Becker, the laying of three or four parallel tracks. As the individual rolling stock items being moved in and out of the workshop for repair are of much shorter length than a full train consist, less track length is deemed satisfactory. To preclude interference with luxury or steam trains calling at the platform, rail track access to the workshop and required length of shunting track is from the west of the museum (re-laying on the route of track that was removed when the workshop facilities were closed down), and connecting with an existing rail yard spur of Spoornet. It followed logically that track access to the exhibition hall and round-house is from the west, too.

Once these issues had been determined, various combinations of track layout and function interaction were assessed for their viability and functionality (sketches 6.17-20 overleaf).

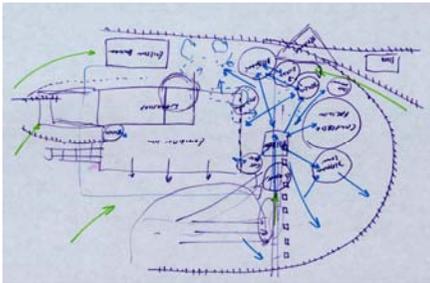
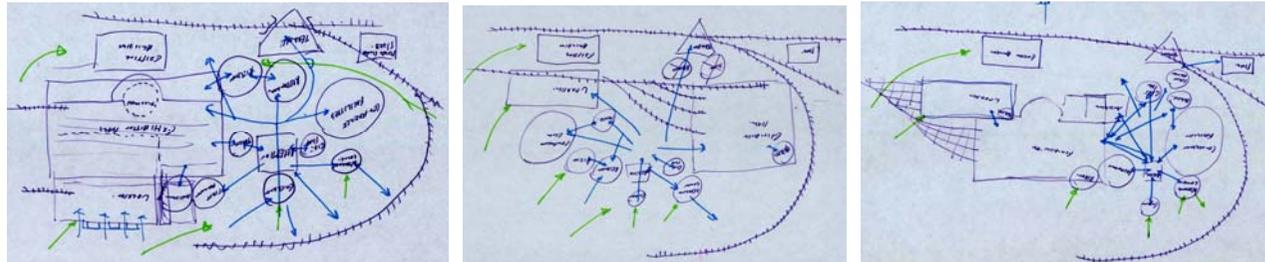


Fig.6.17-20 Track layout and function arrangement alternatives



After these preliminary analyses had been made, approximate shapes were given to the various functions, including the round-house area, and their placing on the site was investigated with regards to accessibility, appearance, visibility, functionality, containment of space and other factors (sketches 6.21-25).

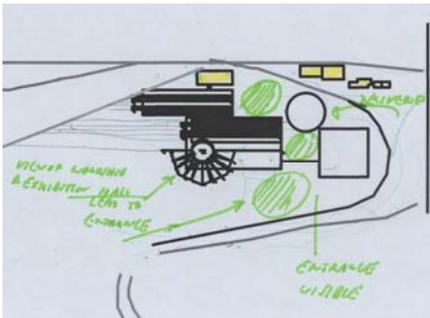
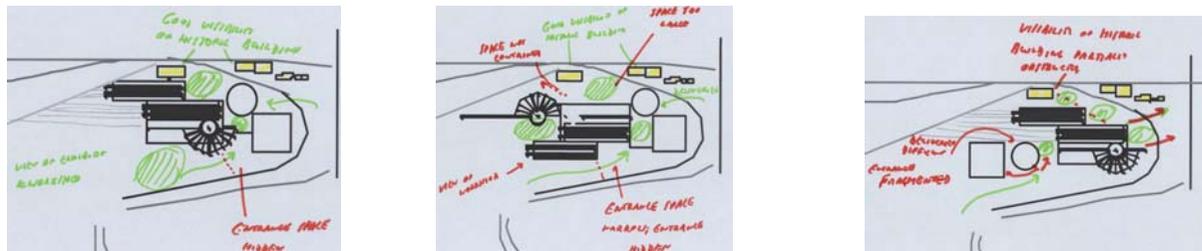


Fig.6.21-24 Shape-giving to and placing of functions



The design as per the middle image (Sketch 6.21) in the margin was considered to be the most effective, the round-house serving as a point of focus, drawing attention to the museum. The circle indicates the restaurant, the square the initially planned conference centre (see below).

The layout of the museum within the framework determined by the organization of the functions was then further refined within this preliminary layout diagram (sketch 6.26).

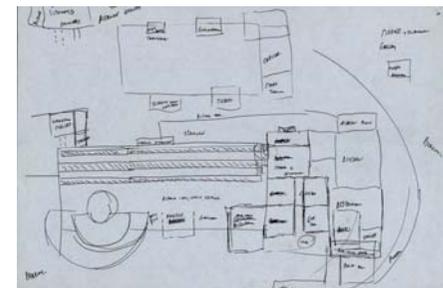
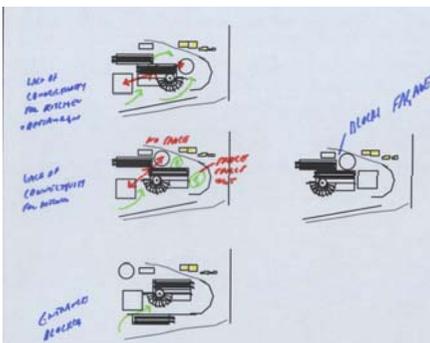


Fig. 6.26 Functional organization

To attract custom to the restaurant, I initially thought of placing two vintage dining cars within an IMAX theatre displaying film footage of scenery along a scenic railway route, and possibly matching it with a gentle vibrating movement generated by hydraulic pumps, so as to recreate an as-near-as-possible dining

Fig.6.25 Further alternatives to above

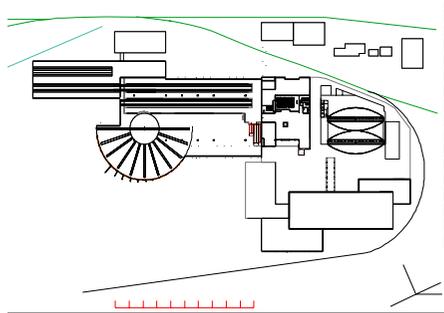


Fig. 6.27 Site plan

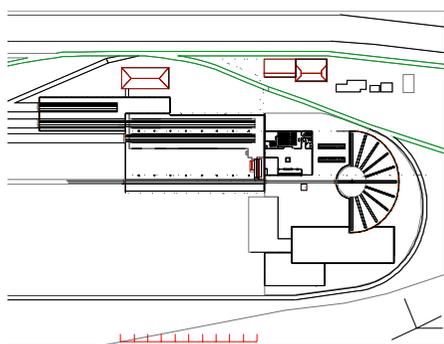
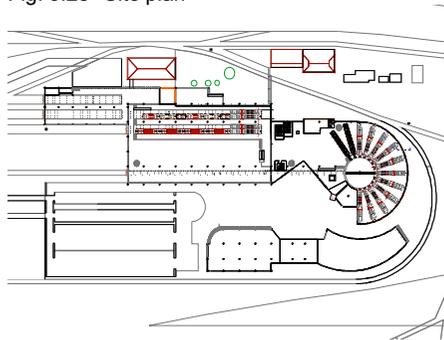


Fig. 6.28 Site plan



car experience. However, to get the full effect, a dome structure would have been required ('Omnimax' technology). With the two dining cars 'in series' being about 40m in total length, the size of the dome became impractical. I also rejected compromising on a 180° 'wrap around' screen on either side of the dining cars due to the very expensive technology required for even this reduced IMAX theatre effect. The alternative of normal film projection technology on a 180° screen is not possible, and to show it on a normal 40m or even two only 20m wide screen on either side of the dining cars (as shown by the two ellipse shapes on the plan to the left) would firstly not achieve the desired effect, and secondly require a very long distance between the projector and the screen. This not only reduces the quality of the scenery film shown, but also creates large lost space areas between the restaurant cars and the screens. The return on the capital investment would be unsatisfactory. I also rejected flat TV-type/LED screens as the effect would be exactly that of having dinner next to the TV: the desired depth between the carriage windows and the scenery considered necessary to create a sense of reality experience for the diner would be missing. The dining car concept was changed to placing them as static displays within the museum, with the kitchen adjacent to them (refer to site plans 6.27 and 6.28).

Furthermore, the round-house was found to be a too prominent and dominating shape in its assigned position. Additionally, opening it up as a visual attraction, with windows or curtain walls, caused major problems with the western afternoon sun on the exhibits. It was then turned and moved to the east, fitting into the curve of the train track and platform. Although now separated from the main exhibition hall, its new location created a second point of destination, increasing circulation past the restaurant area, with the aim of increasing patronage to ensure the latter's commercial viability (refer to site plans 6.27 and 6.28).

Initially the conference centre was placed as a separate, yet integral part of the development. However, its location between the museum proper and the platform adjacent to the train track, where the luxury and steam trains would call, created a visual, functional, thematic and artificial separation of the other two. It furthermore hindered pedestrian access to the museum entrance. An alternative design with less rigid geometric, circle-based shapes, continuing the curve of the surrounding train track, and a triangular-shaped roof linking the exhibition hall and concourse to the round-house, was included in the design, but considered and rejected by the panel performing an interim critique, as organic shapes were considered inappropriate to an effectively industrial setting, and the roof design becoming too strong and complex (refer to site plan 6.29). It was suggested that I revert to a previous design concept, which I duly did.

To address the break in linkage between the museum and the steam and luxury train's platform, I decided to move the conference centre to the far (southern) side of the track, thereby establishing the desired links, as pertinent to the museum as a self-contained entity, also clarifying the function of the different parts of the site. In conjunction with my mentor I decided that, the centre now being without the site as defined by and

Fig. 6.29 Site plan

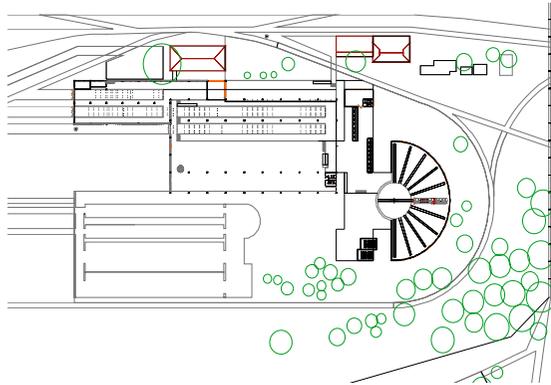


Fig. 6.30 Site plan

contained within the curve of the surrounding track, no attempt would be made to define the foot print or appearance of the conference centre: this would be the responsibility of the architect commissioned therewith, to react upon the museum and its infrastructure, this development being seen as the catalyst for the area. The conference centre being less dependent on flat ground surface, it could occupy the area both below and above the embankment and provide attractive façades both to the museum site and to Skietpoort Street (refer to site plan 6.30).

Simultaneously the round-house was moved so as to fit the curve created by the surrounding curved track more comfortably. The concourse area containing the ticket counter, auditoria, restaurant area and other supporting functions is still used to link the main exhibition hall and round-house. This layout also simplified the roof structure, as the individual 'components' could be roofed separately, joined by links of lesser hierarchy. The sketch to the left reflects this position. – The addition of the luxury train passenger departure lounge, filling the opening between the parking area and the southern end of the concourse building, completed the arrangement of the structures. This design was then further refined upon.

The sheer size of the exhibition hall, workshop shed and round-house could easily result in large and monotonous surfaces. Various ideas on how to prevent this were considered in response. The long walls of the prior were opened up with curtain wall façades (protected against the sun by overhanging or vertical louvres, as appropriate), an overhanging mezzanine level shading the ground floor, with the mezzanine furthermore interrupted by protrusions of a different material. The opening-up also makes the exhibits more visible to the passer-by, thereby advertising the exhibits and attracting his attention and potential patronage. The long workshop walls display bands of brick and opaque poly-carbon IBR, the light-permeability of the latter contributing to the reduction in future electricity consumption charges. The circular outside round-house wall consists of both brick and glass, allowing glimpses of the locomotives on display from, the platform and the pedestrian foot-bridge. The shorter walls provided less of a problem, as the large entrance doors for the train exhibits provide breaks in them.

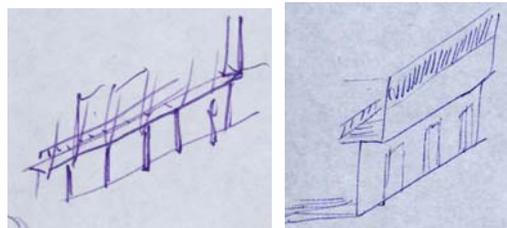
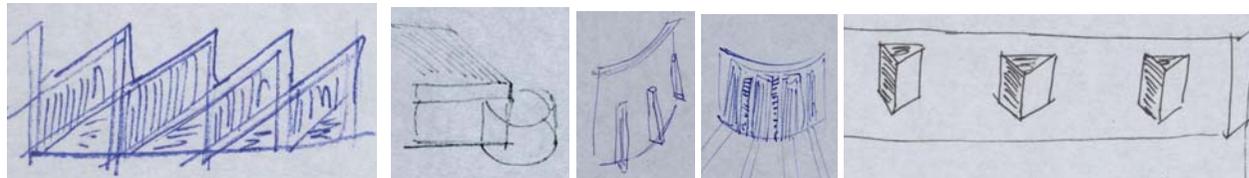


Fig.6.31-37 Potential façade treatments



The size of the above components also influenced the roof design. The exhibition hall in itself is about the size of a rugby field. With the roofs being visible from Freedom Park, they should not appear like a flat

concrete rugby field. They should be of sleek, but not boring shape, and define the areas of various functions happening underneath them. To enforce in the interior view of the roof the concept of the station shed precedent, the centre of the exhibition hall had to form a high ridge. Within this constraint various roof shapes other than a strict geometrical appearance were investigated. However, these would have necessitated the incorporation of turn-outs/switches within the museum to follow the roof shape. With the distance required to have the branching track running parallel to the originating track being 58m from the commencement of the turn out to where a further train could be exhibited, this was not considered to be practical: the exhibition hall would have become even longer. Ultimately, the parallel layout of the tracks in the museum forced a more simple solution, as they dictate that a rectangular area needs to be covered. Various light openings were also considered, but cluttered the roof and detracted from the historic station shed precedent.

I decided to cover the exhibition hall with a double butterfly roof, and to also cover the round-house with a butterfly roof. The roof over the area containing the supporting functions (information counter, restaurant) is a simpler slab structure, linking the prior-mentioned two areas. The workshop would be covered initially by a butterfly roof, but was changed to reflect the roof appearance of the exhibition hall.

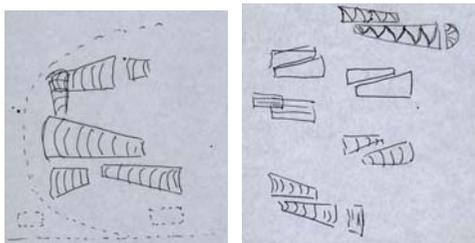


Fig. 6.38-43 Roof shapes investigated

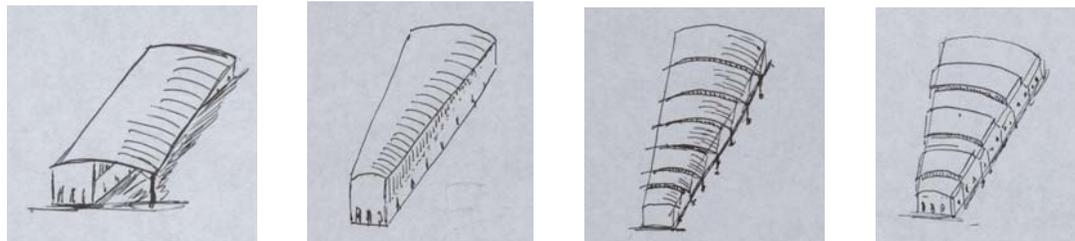


Fig. 6.44 Pretoria central workshops, with western round-house in background, 1896

Initially the exhibition hall's southern butterfly roof was extended over the roof of the supporting function structure, but this lengthening was found to be too heavy, and the roof was shortened. The roof slab over the entrance area was lowered to enable the 'dome' of the round-house roof to be seen behind it. The latter was also raised to accommodate openings permitting natural light to enter.

The choice of materials is largely based on the workshop materials as used in the now demolished Pretoria workshops, also reflecting the industrial heritage of railway architecture – steel, corrugated iron, brick and glass.

To attract visitors other than railway enthusiasts and scholars I initially considered incorporating kinetic

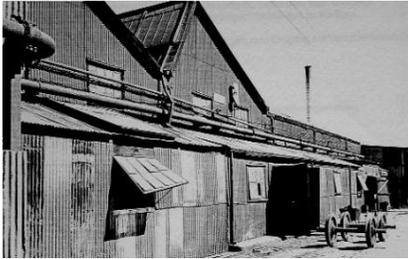


Fig. 6.45 Pretoria workshops

architectural elements in my design, such as an opening roof (possibly similar as that designed by Santiago Calatrava for the Milwaukee Art Museum, Minnesota, USA). However, the construction of such moving elements would be extremely costly, facilitate dust entering the structure, and its ongoing maintenance would require conscientious, diligent, interested, knowledgeable and thus presumably expensive staff. I therefore decided that a simpler solution is more appropriate. Attracting more visitors will thus largely be determined by the quality of exhibits and activities offered: *i.a.* 'driving' locomotive training simulators, riding miniature trains, seeing model railway displays, understanding the physics underlying the propulsion of railways, operating signalling equipment, viewing repair workshop activities with regard to education and career orientation, sighting live main line train operations from the terrace and mezzanine floor, viewing the operation of live steam trains and the calling of luxury trains, and enjoying the quality of the restaurant. 'Experiencing it' should be the key to exhibits, to make them not only interesting and educational, but also entertaining, and thus to attract visitors to the museum.

The above elaborates on the resolution of some the major design decisions faced, and reveals the startling complexity underlying what appears to be only a simple, large structure placed on a brown-field site surrounded by railways.

Fig. 6.46-51 Brownfield site before and after intervention (left and right respectively)



View from north



View from south



View from south-west

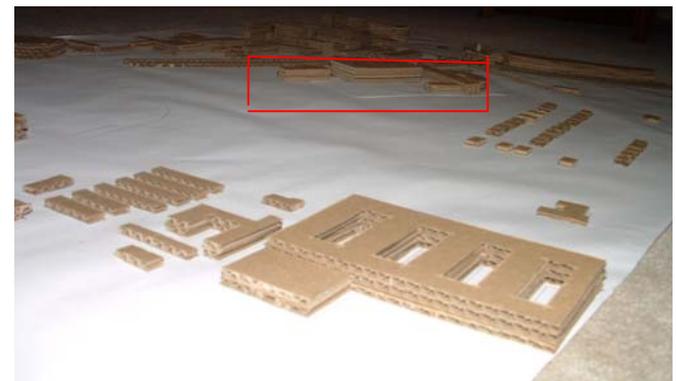


Fig. 6.52-57 Design progress

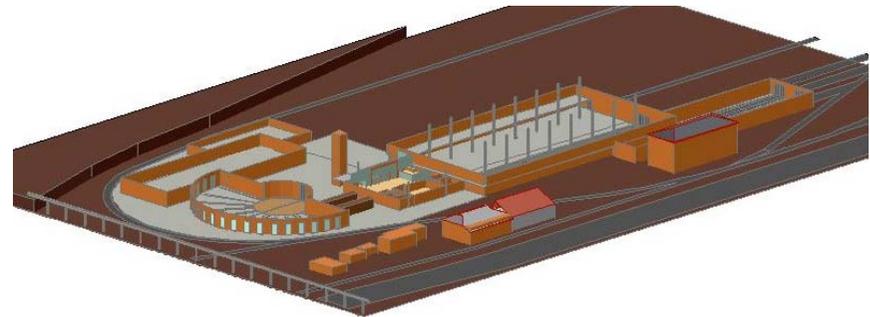
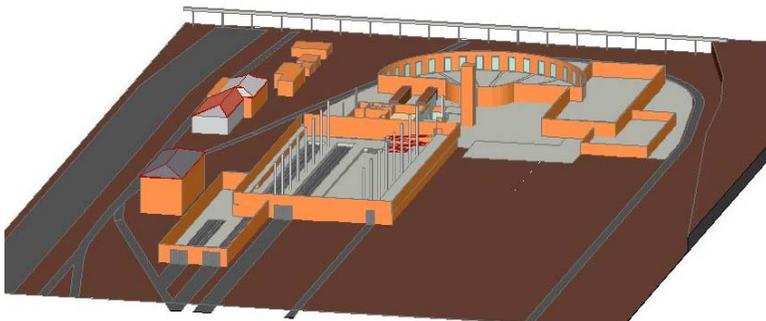
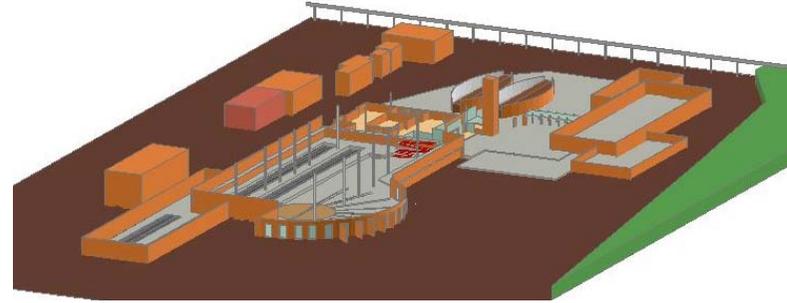
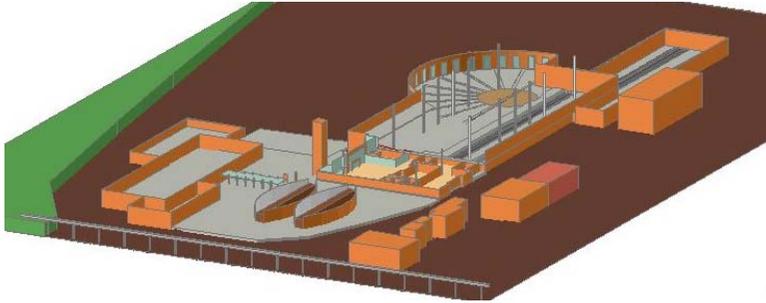
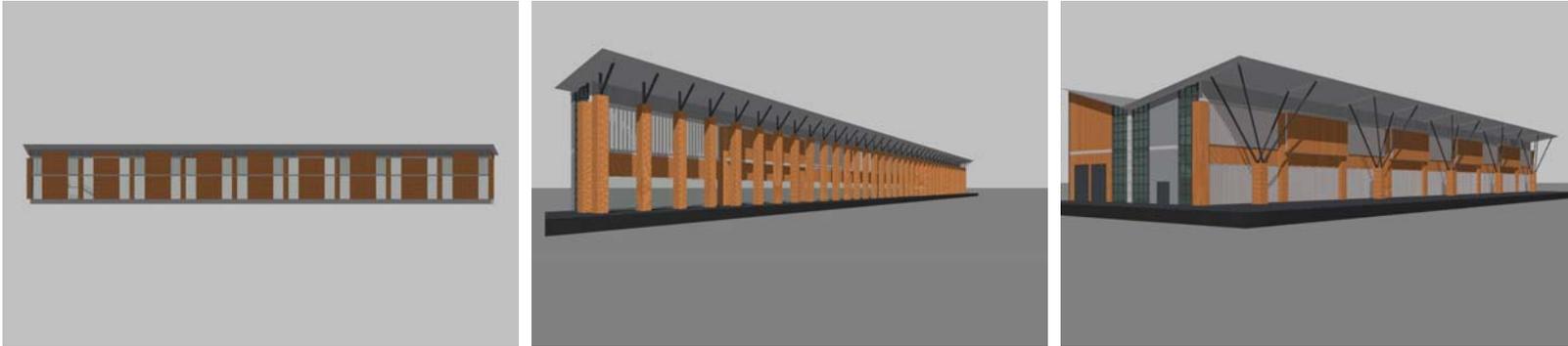
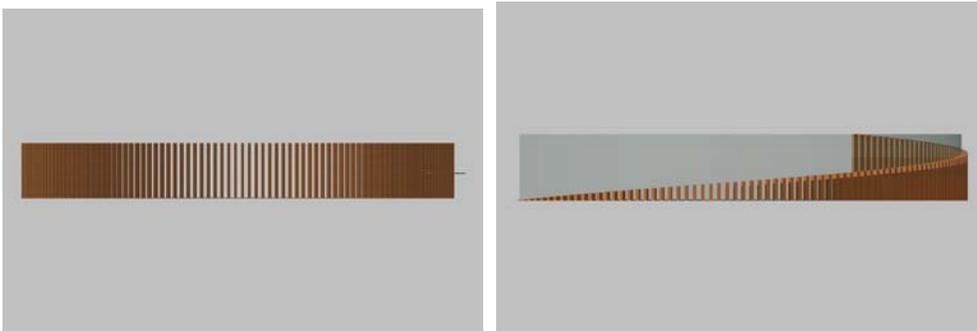


Fig. 6.58-62 Alternative façade treatments



Exhibition hall's south-western façade



Round-house's south eastern façade

Fig. 6.63 Museum complex from west



From left to right: workshop with coal bunker, exhibition hall, concourse building behind tower, luxury train passenger departure lounge, and train platform.

Fig. 6.64-65 Exterior perspectives



North-western façade: Left to right: 'Chief Engineer's Office', exhibition hall, with workshop in front, concourse building with entrance, and departure lounge. Foot-bridge to CBD in background.



North-western façade: Keft to right: Concourse building, with round-house in front, and 'steam hammer shed' to far right

7. TECHNICAL CONSIDERATIONS

7.1 Influence of the design concept

With the emphasis of the design focussed on the (re-)creation of the spatial experience and sensation of the vast and uninterrupted spaces of the station supershed and concourse, enhanced by natural light lighting them up, the desired spatial quality of the enclosures and its minimal visual impairment entailed that in certain structural aspects conceptual considerations took precedence over purely functional or economical solutions.



Fig. 7.1 Rails placed directly on to compacted soil. Capital Park, Pretoria



Fig. 7.2 A thin gravel bed suffices where low train speeds are maintained

The complex consists of five separate structures (the exhibition hall, concourse building, round-house, luxury train passenger departure lounge and company offices, and the rolling stock restoration and repair workshop). These are connected by enclosed lobbies, internal courtyards, or placed separately. Each component has its own structural system, but in essence they all employ a system of steel columns and beams which carry the roof structure. An exception is formed by the reinforced concrete columns carrying inclined steel columns, which, in turn, support the outer edge of the roof on the exhibition hall's long façades, and, also on these, a row of reinforced concrete columns support the hall's walls and mezzanine level floor slab. This latter system was also applied to the concourse building's long façades.

7.2 Sub- and superstructure

Sufficient land being available to provide for parking, no basement was necessary. Due to the heavy mass of some of the exhibits, such as track tamping machinery and old railway busses, floor slabs are generally of 340 mm depth on the ground level exhibition areas. Slabs underlying rail track in the exhibition hall, concourse and round-house are of the same thickness, being supported by well-compressed soil. This approach is vindicated by its application at the presently used Friends of the Rail site in Capital Park, Pretoria, where the shunting yard track sleepers are placed on the soil, without even the support of a gravel embankment. It does however preclude the running of locomotives and other rolling stock at any but very low speed, which prevents the vibration and shuddering and consequent sub-base and track damage arising from higher speeds. Tracks for slightly higher speeds can be placed on a thin gravel bed, still sufficient to cope with the effects of this speed. – Column foundations pads are cast to engineer's specifications.

The superstructure of the exhibition hall consists of a steel portal frame spanning 30 m over the four parallel rail tracks displaying the train consists. It is flanked on either side by a 10 m wide bay containing a mezzanine level. The roof stretches for a further 5 m outwards. The complete roof structure forms a double-butterfly roof, with two box gutters. The desire to minimize visual interruption of this space resulted in the individual frames being spaced 11,500 mm apart, half the average carriage length of 23 m, as per '6.7 Design approach'. This directly affected the support of the mezzanine level floor slab. Initially a pre-cast and pre-stressed double-T beam structure was decided upon, which, based on the maximum depth-to-length ratio of 30, provided in *The way we build now: form, scale and technique* (Orton, 1988:36), gives a depth of 383 mm for a the longer span of 11,500 mm, the shorter span of 10 m between the central supporting columns and the wall being made equal to these. On discussing this with engineer Karl von Geyso, he expressed concerns that the ratios provided by Orton are not conservative enough, and that a much greater depth should be used. As this would have impaired the visual impact of the space below the mezzanine level, this proposal was rejected, and a steel beam grid support structure decided upon. With Orton's maximum ratio for rolled steel universal beams of 25 (Orton, 1988:41), with which the engineer felt more comfortable, the universal beam depth was determined as 475 mm for the span of 11,500 mm. This dimension was once again used in both dimensions. The actual floor slab being recessed from the line of the central columns, intermediate support for the permanent shuttering (QC Flooring Standard permanent shuttering by HH Robertson) was provided over 6,232 mm by rolled steel universal beams of 375 mm depth at centre-to-centre intervals of 3,833 mm. Only 250 mm depth would be required, but the greater depth was used for visual considerations, accentuating the structure.

The roof structure of the round-house was initially supported by steel universal beams, but a span of 18 m would have necessitated a visually very heavy beam depth. The problem was exacerbated by the need to support the suspended glass curtain wall from the cantilevered ends of these beams, which would further have increased the depth of the beams and their supporting columns. The beams were thus substituted by trusses.

The concourse's roof is supported by steel trusses on steel universal columns, that of the luxury train passenger departure lounge building by steel universal beams on steel universal columns, and the workshop's structure is made up of steel portal frames, the vertical portion being clad in concrete. Column and beam dimensions have been computed by the application of the material's length/depth ratios as set out in the tables in Orton (1988:30-52), but are subject to engineer's calculations. The same applies to the depth of concrete roof slabs.

7.3 Choice of materials

The choice of materials was influenced by historic precedent. The now demolished workshops and the still existing steam hammer shed on the site were in the main constructed of steel frames, clad with corrugated iron, and glass for windows and skylights. The floor slabs were of concrete. The existing Chief Engineer's Office building is a brick structure. These materials, steel, corrugated iron (or its modern derivative, IBR boards), brick and glass, were used in the museum design, plus sandstone for occasional exterior cladding and anodized aluminium louvres to assist with controlling the infall of the sun's radiation.

A large portion of the exterior surrounding area (terraces and the approach to museum complex) is paved with clay pavers. Concrete grass blocks are used for the parking bays, whereas the area used by moving traffic is tarred. Within the exhibition hall, concourse, round-house and workshop structures, the concrete slabs are floated and left with their natural finish. This will reduce the damage resulting from the movement and display of heavy items. Hard-wearing carpet tiles are used on the exhibition hall's mezzanine level floor, as only lighter exhibits are displayed here. The departure lounge building reception area, offices and traffic areas of the lounge have a wood laminate floor covering, the other part of the lounge carpets. The floor covering of all bathrooms and kitchens consists of terracotta tiles.

Interior walls are in the main plastered and painted, unless raw face brick surfaces are shown. Steel structural elements are coated with an intumescent paint. Kitchen and cloakroom walls are clad with ceramic tiles to ceiling height, facilitating cleaning. Ceilings, either consisting of permanent shuttering, concrete, insulation board or IBR-sheeting, are generally finished in light colours, increasing their reflectivity of light, to enhance the desired ambience and reduce the need for artificial lighting.

Glass is either clear or tinted, depending on the degree of exposure to the sun's radiation or the shading obtained by the installation of louvres.

Roofing material is either concrete, for slabs, or IBR-sheeting. Concrete slabs are protected by torched-on membranes for waterproofing, coated with reflective paint. The IBR-sheeting is made of Zinalume steel, the manufacturer BHP's brochure showing that in the weathered state it radiates only about a third of the heat, measured in W/m^2 , that standard galvanised steel does. (When new, it radiates more, but the long-term benefit outweighs the initial shortcoming.) (BHP, 2007:1). The recommended Safintra Saflok 700 profile is available in this material, and laying this with the minimum 2° slope, as recommended in the manufacturer's brochure (Safintra, 2007:10), becomes aesthetically satisfactory in the proposed design, in that it appears to be (almost) flat, when viewed from below and even from a fair distance.

7.4 Suspended glass wall

The design of the round-house's exterior wall is a curved row of columns steadily increasing in height to 6,545 mm, with the space over and between them filled with a suspended toughened glass wall to roof height of 7,000 mm. Per the information leaflet supplied by PFG, the maximum height for this application, using their 12 mm Armourplate glass, is 23 m. As the opening to be closed is a lesser 7,000 mm, the 10 mm glass will be used. The glass panels making up this curtain 'are fixed to the top rail [attached to the roof or a wall] by metal hangers bolted to the top edge and subsequent rows of panels then assembled downwards. The panels are bolted together at their corners by small metal fittings and the joints filled with a flexible silicone seal. In suspension, the edge and bottom panels are free to move in metal channels, allowing the whole assembly to float with the building structure. Lateral stability is given by toughened glass stabilising fins at each vertical joint. These fins can be continuous from top to floor, or cantilevered, rooting at the ceiling or floor.' (PFG, 2007:4) With the columns rising from the south-west to the north-east, and the prior being shaded by the concourse building and the taller columns shading the north-east facing glass panels for the greater part of the day, it was decided to use clear glass, making the displayed locomotives visible. – The same approach is applied to the glass curtain walls of the concourse building.

7.5 Thermal control

The design attempts to reduce operating costs and address sustainability issues, further addressed '7.5 Sustainability issues' below, by looking at means obviating the need for air-conditioning. A precedent is set for this by the James Hall Transport Museum in Johannesburg, discussed under 5.5. This entailed the encouraging of natural ventilation and the reduction of the amount of direct sun radiation into the structures, whilst not obstructing the illumination that can be obtained by the infall of indirect sun light.

Natural ventilation makes use of the principle that warm air rises, and accordingly ventilation louvre panels were provided below the roof of the concourse and the outer bays of the exhibition hall. Ventilation louvres were also placed in 'boxes' atop the exhibition hall's central bay and the workshop. To increase the draft of the ventilation, the heat build-up in the proximity of these high-placed louvres seeking escape through them could be increased by painting the roof-surface black. The accelerated air flow will draw more air into the structure. Furthermore, using the Zinalume-steel roof sheeting, as set out under 7.3 above, should substantially reduce the heat build-up in the volumes so covered. In addition, insulation boards placed under the roofing sheets of the exhibition hall will reduce heat building up. The high volumes in themselves will assist in keeping temperatures at the lower levels cooler. – The round-house is open to the turntable

side. The departure lounge building has opening windows; should these prove to be insufficient, air-conditioning units may be inserted below the individual window frames. Once again, the high volume of the lounge itself, and opening French doors and windows, will assist it remaining cooler. It is considered that these measures will make providing a centrally controlled air-conditioning system superfluous, and accordingly none has been included in the design.

Sun radiation ingress is limited by the placing of louvres, either horizontal or vertical, and where this was not considered feasible, by tinted glass. The use of the latter was limited as much as possible, due to its heightened mirror-like reflective appearance from the outside. Ample use was made of glass facing the south-east: in the mornings, the brief infall of sun would reduce the night chill in the ambient temperature, but the sun would then move on and by mid-morning have passed the (too) direct infall azimuths. Sliding doors in the concourse area will allow for a compensating movement of air. As explained under The openness of the

The kitchens and sanitary facilities are provided with extractors to the outside or to shafts, as is appropriate to their placement.

7.6 Sustainability aspects

The sustainability-related aspects with regard to thermal control and ventilation have been set out above.

A further sustainability-related features incorporated in the design is the inclusion of four large water tanks, in total of about 82,000 litres volume, in the internal courtyard, acting as recipients of the round-house's and concourse building's roof run-off, and providing irrigation water for the complex's garden. If so desired and depending on requirements, similar tanks may in the future be installed for the exhibition hall's roof run-off, in the area of the repair yard or its proximity.

The parking bays are surfaced with concrete grass block pavers, permitting the percolation of rain into the soil.

The roofs provide opportunity to install photovoltaic cell sun-panels, but have been omitted from the initial design due to their high initial capital cost off-setting energy consumption savings for a lengthy period. They may be installed later at the discretion of the museum's trustees. Furthermore, recently, critique has come forward as to their sustainability, as their production is said to require more energy than they will eventually save.

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APPENDIX 1 BACKGROUND

A1.1 The need for a railway museum in Tshwane

Railways have been a major contributor to the changes perceived in the world since the commencement of the Industrial Revolution. By facilitating land travel, allowing man to travel, and his goods to be transported over great distances within a shorter period than possible on foot or by non-motorised transport, railways have revolutionized society: it has become more mobile, and its labour and products can be made available to a much larger market, enabling the selling of surplus production and thereby stimulating economic activity. Railways have thereby had a major impact on the development of the world. – Historically, in the days before motor transport, land developers regarded the advent of a railway into an undeveloped area as one of the keys to open it up to the world, to integrate it in the wider fabric of society and to make it accessible for economic development and exploitation. Towns situated on railway lines generally grew faster than those not served by it. Mineral wealth was viably exploitable only once a railway link had been established to serve it, enabling machinery to be shipped there and the extracted ores to be sold to the world markets. Agricultural production was encouraged, as the produce of even remote areas could be sold on the market before it spoilt. The population had easier access to places of employment, whilst also being able to travel in relative comfort to holiday destinations they otherwise would never have dreamt of reaching. People became mobile and the economy grew as the world shrank in relative terms of time and distance.

Railways made the same contribution to South Africa, serving as a generator of mobility and wealth. The reasons for local railway construction illuminate their importance to the development of South Africa's society and economy: The first railway was built in 1869 to link Durban city to the harbour facilities at the Point, improving accessibility and shortening the time of transport of goods; the slow ox-wagons dragging over sandy tracks were no longer necessary. Goods shipped by railways were cheaper than those transported by wagon. – The development of the Cape rail network only got off to a proper start when the diamond mines of Kimberley required fast and suitable means of transportation for machinery, provisions and labour. In turn, only when this town became easily accessible did the diamond mines develop into a sustainable long-term industry. The same applies to the Witwatersrand: the construction of the railway from the Boksburg coal fields to the gold mines enabled the more profitable exploitation of both, and only when the Witwatersrand was linked to the ports of Natal and the Cape was their full development possible. The railway lines then encouraged further development in the areas they passed through, whereas areas not served developed much more slowly, if at all. It was for this reason that during the first two decades of the 20th century major branch line construction was undertaken in the rural areas, so as to tap into their

agricultural potential. These lines generally achieved the desired results, the areas so served developing faster than the others. It is only the advent of motor transport as an alternate and more convenient mode of transport (in it being available for immediate use and closer than a train relative to where one is or wants to be, thereby increasing personal mobility even further) which has slowed or halted railway construction, to the extent that many lines are now being closed. Furthermore, due to technological advances, older, unused equipment such as steam locomotives, wooden carriages, cattle wagons, semaphore signals and Morse telegraph apparatus is now being scrapped without examples being retained for the understanding of the past.

Due to the reduced utilization of railways, many people are unaware of the contribution railways have made and can still make towards a country's society and economy, and that they have the potential to once again become a means of mass people and freight transportation. This is seen in many European countries, where the use of railways is actively promoted. Locally, this belief in the future of rail transportation is reflected in the Gautrain project currently being undertaken to connect Johannesburg and Pretoria. A railway museum concentrating not only on the display of historic exhibits could enhance the awareness of modern rail travel's viability and rekindle an interest in its future.

As technical developments in related fields, such as engineering and electronics, improves railway operations, in turn benefiting the development of South Africa, I consider that any railway museum should also concentrate on issues other than the preservation of historic locomotives and rolling stock. Covering a wider field should contribute to the fuller understanding of the mentioned historic and current importance of railways to society and economy. Better understanding of current technical development of railways (not limited to locomotives) would be furthered by preserving other items, such as old signalling equipment and telephone switchboards, for exposure to the audience. In the same vein, the venue should not be a place of preservation only. It should expose the visitor to the wider field of more railway related topics and contribute to their education, not only in history, but also in physics, electronics, economics and sociology. It should therefore not only be focussed exclusively on trains, but also complimentary topics: the scientific principles and processes enabling train running, such as steam propulsion and electricity generation; the development of railways and the activities underlying their working; train operation and traffic control; engineering and electronic communication; professions, trades and technical skills utilized; and the railway's contribution and impact on the world in general and South Africa in particular. It is thus to be a railway science, technology and history museum, using railways as the uniting theme for different points of focus.

The only railway museum in South Africa is Transnet Heritage Foundation's museum in George, on the Cape South Coast, where it serves as a base for the popular Outeniqua Choo-Tjoe vintage steam train excursions. I believe it to be inadequate with regards to exposure, in that it is located far from the greatest

population centre of South Africa (Gauteng province). This makes it inaccessible for most people. – Unfortunately not having visited the George museum myself, I am dependent on reviewing its web-site and the personal feed-back received from friends and acquaintances who have visited it, regarding their opinion in achieving coverage of the abovementioned wider range of topics: I believe it to be fulfilling only some of the aims envisaged above. Its big attraction is the live steam train to Knysna. A museum, located in Tshwane, displaying more of Transnet Heritage Foundation’s rich collection and located in Tshwane is thus justified, in being accessible to more South Africans, potentially contributing to the wider education of more people on a greater variety of topics.



Fig. A1.1 Present Friends of the Rail site, Capital Park, Pretoria



Fig. A2.2 Present Friends of the Rail passenger embarkation facilities

The lack of comprehensive coverage of railway-related themes is consistent with my own experience: train museums (Mulhouse, France; New Delhi, India; Bulawayo, Zimbabwe) are not attractive to people other than the railway enthusiast, few or no other visitors being seen by me when visiting them. (The exception was the National Railway Museum, York, England, which was well-visited.) Due to their nature, exhibits are generally limited to static displays of what the non-rail fan would consider as obscure, obsolete and bulky machinery. Little is done to recreate the experience of rail travel or rail operation. This corroborates the need for a railway museum with a different or additional angle to it. Means will have to be found to entice visitors other than train enthusiasts to the museum, to make it a destination of choice. This may be achieved by providing a facility where exhibits become experiences. Although the quality and variety of exhibits are more the responsibility of the curator, ways of achieving this goal will form part of the design considerations.

One way of enhancing the experience of historic rail travel is by means of running live steam trains, as is done in George. The museum may serve as a base for Friends of the Rail, a Pretoria-based association of steam locomotive fans. Currently the association leases part of Rovos Rail Luxury Train Safaris’ site in Capital Park, where they store, maintain and service their locomotive and rolling stock collection and from where they operate their live steam excursion trips. They have been requested by the landlord to find a new base from which to operate, as Rovos Rail requires additional space for expansion. Friends of the Rail are thus indicated as a main client for the museum, as, similar to the George museum’s activities, the running of live steam trains will provide a draw card for museum visitors. The necessitated relocation of the association is a further impetus and incentive to create a comprehensive railway museum in Tshwane, incorporating their collection and activities with those of Transnet Heritage Foundation. – Further clients who may add to the richness of exhibits and attractions are identified below.

I thus believe there is a need for a museum covering railway-related topics in the City of Tshwane, contributing also to its status as not only a city of culture and museums, but also to it as the capital city of South Africa.

APPENDIX 2 THE HISTORY OF STATION ARCHITECTURE

A2.1 The development of industrial architecture

City passenger stations, gradually increasing in size and volume, initially depended on the progress made in the ability of industrial architecture to supply the structures enclosing the required large spaces and volumes. The industrial architect's knowledge of the construction of such large enclosure arose from the construction of larger factories needed to accommodate the increased number of larger steam-driven machines.

Before the days of steam, in the early Industrial Revolution period, factories were normally designed by the owners themselves, Jones describes the resulting early-Industrial Revolution mill buildings (1770 – 1790) as rectangular in plan, seldom more than 9 m wide (though 14 m were achieved), and rising several storeys in height, though not often more than four (six were achieved). The largest open areas were to be found in plate-glass making factories, due to the desire to make as large panes as possible. However, no efficient alternate light sources bring available, the need for daylight generally limited the width of factories. Dimensions were also dictated by the size of the machines and their need of being close to the waterwheels' driving shafts. Ceilings tended to be low. Entrepreneurs followed local vernacular, but introduced some Palladian features. Lack of ornament was general. The structures were of local stone or brick. In some cases an interior, load-bearing timber frame was used, the outside walls merely being a cladding. (Jones, 1985:16-46.) The interior spaces generally did not contain clear spans, but had columns running through them to support the upper storeys. The first important change made with respect to the future, albeit on a small scale and only where fire-proof structure was insisted upon, was the replacement of the timber-frame structure with cast-iron interior supports, made possible with improved iron-making methods and a growing understanding of civil engineering. (*ibid*:44).

As said, little use was initially made of architects when designing industrial structures. Only when factory owners became rich, achieved social standing and started to live in country houses, did they commence to employ architects, mainly when designing their new residences, but increasingly also using them in the design of new factories. (*ibid*:46). Even when the availability of steam power obviated the need for location next to a stream, and made construction in cities and towns possible, the owner-constructors still fell back on the old precedents of the 'water-power' days.



Fig. A2.1 A late water-powered factory with exceptionally strong Palladian features: Wye Mill (1814-16), Cressbrook, England.



Fig. A2.2 Long, narrow, high structures: Bean Ing or Park Mill (1792-1802), Leeds, England



Fig. A2.3 Platt Bros & Co.'s Hartford New Works (1844-91), Oldham, England

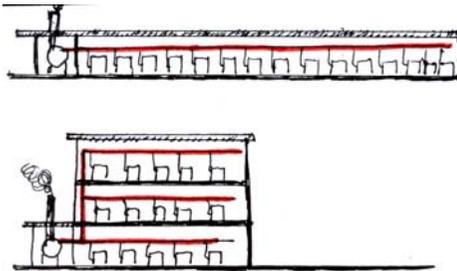


Fig. A2.4 Horizontal vs. vertical drive shafts



Fig. A2.5 The new materials: Cast-iron and glass at York Station (1871-77, by Peachy and Prosser), United Kingdom



Fig. A2.6 Crystal Palace (1850-51, by Paxton), London

Factories were now becoming much larger: the 'unlimited' availability of steam power allowed many more machines to be accommodated in one structure, realizing efficiencies of scale. The structures were increasingly multi-storied, because the inefficiently long horizontal drive shafts from the steam plant to the machines could thereby be shortened, in effect stacking the areas powered by a horizontal drive shaft on top of each other, with a vertical shaft replacing the extended horizontal drive shaft. Increased height was achieved through the increased employment of the cast-iron supporting frame. The building's width was still curtailed by the availability of sufficient day-lighting (although the fitting of gas-lighting, invented 1807, allowed for some increase in depth), factories therefore also becoming longer or arranged around a central square, and sporting many large windows on all floors. A new feature was the engine house and tall chimney attached to the building, replacing the waterwheels of old. Factory structures were now in the main executed in brick and with cast-iron frames: rows of iron columns supported the upper storeys, although the use of load-bearing exterior walls was still predominant. Large spans were still not striven for.

Now, slowly but surely, the importance of consulting engineers was realized and they were employed on an increasing scale, although they were as such not specialized yet and also acted as architects, mechanical engineers, bridge constructors and locomotive builders. Architects, though considered of secondary importance to the engineer, and up to now employed in the design of public structures, palaces, churches and upmarket city and country houses, started to seek industrial work, due to it becoming more and more lucrative. When employed, their designs still employed Palladian principles in the composition of façades, sometimes including Classical details as restrained ornamentation. One example of this is the entrance to Hardwick's Euston station, London (1836-38), boasting a massive gateway supported by fluted Doric columns executed in dressed stone. Factories and warehouses otherwise did not yet significantly contribute to the body of architectural theory. (*ibid*:58-67)

The next phase in industrial architecture was strongly influenced by the increasing application of iron. Cast-iron and the stronger wrought-iron became available in ever greater quantities and at lower costs. Also, advances in foundry, glass production, and engineering knowledge (such as the invention of the flanged beam, cylinder-process produced glass sheets and the design of trusses respectively) made structural innovation possible, including the construction and covering of large single-span arches.

The first extensive application of iron in structures was in market halls and glass houses, where spans up to 30 m were obtained. From this expertise factory roofs, market halls and train-sheds borrowed. Here we find the first indications of the sizes of the future, which were to so profoundly influence cityscape and architecture: The train-shed of the second Lime Street Station, Liverpool (1849-1850, by Richard Turner and Joseph Locke) was spanned by a then unheard-off 46(!) m wide single-span arch. What firmly established the ideas of what could be achieved with iron and glass was Joseph Paxton's Crystal Palace



Fig. A2.7 The clash between the architect and the engineer: the Neo-Gothic St. Pancras Hotel hiding the functional train-shed behind it

(1850-51), through its sheer size (though the naves were only 22 m wide) and the employment of pre-fabricated components. Station architecture culminated in Britain with William Barlow erecting the then world's largest single arched structure, London's St. Pancras station (1863-67), its wrought-iron span being 73 m wide. – Engineers used these new and now abundant materials of the Industrial Revolution not for any aesthetic appeal, but generally only to cover vast sites as cheaply and efficiently as possible: questions of decoration were subsidiary to the engineering issues faced. Interestingly enough, the glass and iron structures were seen as purely utilitarian, even too much so, and were then often masked with stone or brick masonry. Only in the 1890s did it become acceptable to show the iron and steel structures in their own right.

During this period architects were becoming more and more involved with the design of industrial buildings, resulting in these often being finished in the architectural style then predominating, such as Roman-inspired Neo-Classicism, Italian Renaissance and French Empire, with also the first evidence of eclecticism becoming apparent. Some factories and warehouses were starting to display an unheard-off richness of detail and ornament, previously considered inappropriate for such structures, though others remained strictly functional in appearance.

The later Gothic Revival found only limited application in industrial and station architecture. Preference was still given to the Italianate style in the design of factories, and this was to be so for the remainder of the century. It appears that this style was considered more appropriate to the box-like industrial structures than the irregular and 'romantic' Gothic style. – However, Ruskin's philosophy of accepting that all buildings (not only churches, palaces and houses) had merit, made it acceptable for mainstream architects to also consider industrial (and station) design worthy of their attention.



Fig. A2.8 Britain's first reinforced concrete factory (1897-98): Weaver & Co.'s flour mill, Swansea

It is however here where the field of station architecture can be found to diverge from that of industrial architecture. Station architecture had to supply solutions to horizontal expansion, due to the factors outlined under 'Station functioning and operation'. Factory architecture was still impeded by the lack of electric light and electric motors. Accordingly, as stated before, buildings were kept in the main narrow and multi-storied, whereas station sheds covered ever wider spans. Only with the advent of the production-line and the need to accommodate it in vast spaces not interrupted by lines of columns did factory architecture apply those principles already much-used in station architecture.

With regards to station architecture, it became general practice that the design of the train-shed was entrusted to an engineer, whereas the concourse, administration offices and hotel were designed by architects. (Jones, 1985:80-84). This latter development highlights the quandary faced by station architects: whereas the enclosure of the track area is best addressed by a purely functional design, the desire for

'prestige architecture' in and around the other areas does not lend itself easily thereto, resulting in a clash in the style of execution, united only by the continuous flow of passenger movement through both. St. Pancras station illustrates this at best, with an architect-designed, ornate, impressive, Neo-Gothic masonry-finished hotel façade in 'front' hiding the engineer-designed, utilitarian, functional, iron-and-glass train-shed behind it. This will presumably have caused some difficult working relationships, though it would have been one of the first instances where the need of the two professions to work together was illustrated.

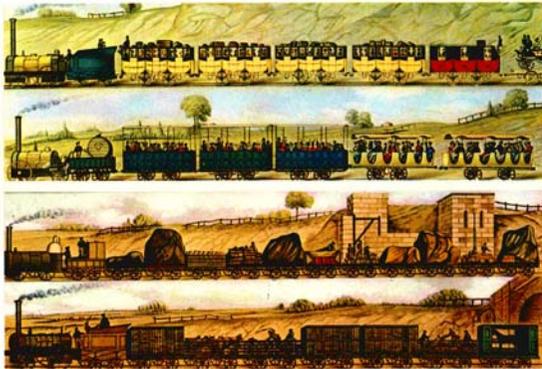


Fig. A2.9 Early passenger and freight trains, Liverpool and Manchester Railway (Aquatint by J. Shaw)

As the peak of British station building was reached in the 1860s, with the principle of the supershed firmly established, further developments in industrial architecture will only be highlighted for the sake of completeness. – Flat roofs, instead of pitched roofs, became popular for factories in the 1880s. These were coated with two layers of asphalt and, when covered with water for the sprinkler system (dammed by the parapet walls forming a tank-like structure), were virtually indestructible. Industrial and station architecture's next major stride, in the 1890s, was the replacement of cast-iron with, at first, wrought iron, and then with lighter and more reliable steel. In the same period the brick arch supported floors in factories were replaced by concrete floors. Where more daylight was needed, north-facing (for the northern hemisphere) saw-tooth roofs were introduced (also in railway workshops). Though using internal steel frames already in the 1890s, in Britain load-bearing outer walls were still required to be incorporated in the design. Only in 1909 was British law changed to allow for the external expression of a steel frame, making load-bearing walls superfluous. The first reinforced concrete structure of the United Kingdom, a flour mill designed by Hennélique and Le Brun, was built in Swansea 1897-98. (Jones, 1985:161-176)

Accommodating the expanding stations was made possible, as stated before, by the availability of improved materials and the advances in knowledge regarding their use: stations thereby achieved the supershed-size needed to fulfil their functions, with the resulting impact on cityscape, architecture and urban planning. The advances required from industrial and station architects can best be assessed by looking at the initial history of station design and the subsequent growth of stations.

A2.2 Early station design

The station is the one building type for which there was absolutely no precedent available when the need for stations arose during the Industrial Revolution. They were the truly novel building type of the era, and solutions to problems encountered were thus truly innovative.

With public railways having originated in England, all being built by private companies, it is logical that the first stations were also constructed there. However, railway station architecture made a slow start, as



Fig. A2.10 Small beginnings: Crown Street Station (1830), Liverpool and Manchester Railway

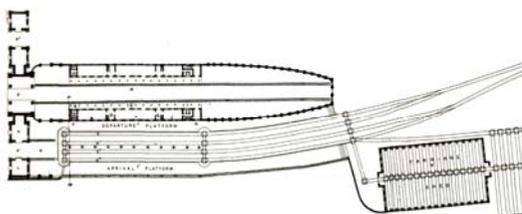


Fig. A2.11 Plan of Euston Station, London, when opened

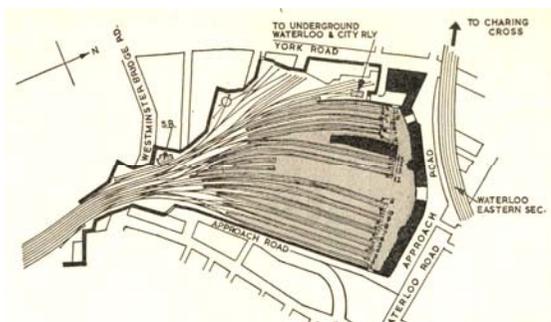


Fig. A2.12 Plan of Waterloo Station, London, in 1958

railway owners were at first concerned in the main with the conveyance of freight. Passengers were seen, at worst, as an unnecessary evil, or, at best, as a source of ancillary income, and thus very little was provided for their comfort. Railways did with time realize that profits were to be made from the conveyance of passengers, and appropriate facilities had therefore to be provided. The first railway line built with the fixed intention of also carrying passengers as part of its business was the Liverpool and Manchester Railway (L&M) company, opened 1830. Some companies only wished to cater for the rich and wealthy: the Great Western Railway (GWR) in England applied this policy so rigorously that initially it did not even provide third class coaches, as the return on investment in providing facilities for low-fare paying passengers was considered too low. The British Parliament actually passed an act in 1844 forcing the then privately operated railway companies to run at least one daily train with third class coaches over each route in both directions!

The very first stations, due to the emphasis on freight rather than passengers, were constructed with economy more in mind than passenger convenience. Platforms were not always provided, nor were enclosed spaces always made available to waiting passengers. Passengers were accommodated occasionally in dilapidated coach sheds or in small, converted goods sheds, as on the Stockton and Darlington Railway (S&D), which had been built as a freight-only operation. The few 'proper' stations existing were in no way outstanding examples of industrial architecture. When assessing the initial economy applied to station structures, it should also be borne in mind that these stations were erected by private companies with only limited capital available, the spending of which was prioritized towards the civil engineering works, locomotives and rolling stock. Also, as stated before, there were no precedents available: designs regarding the anticipated operation of the traffic could only be based on the experience gained from the old posting inns, which to date had handled the stage coach-borne passenger traffic (Carter, 1958:26). Structural reference could only be made to the industrial architecture of pre- and early Industrial Revolution days. – It is however interesting to note that the S&D's 'new' Stockton station of 1836 was already provided with a clock (*ibid*:11), a characteristic 'trade mark' of stations still seen today.

Stations geared towards passenger traffic appeared with the change in emphasis by railway companies towards the acceptance of passengers: the L&M's first Liverpool terminus of 1830 (Crown Street, by George Stephenson, later replaced by Lime Street) accordingly sported two platforms, and these were covered by a shed 9 m wide! This was the first instance of a shed being provided as part of station facilities. London's first local railway station was the 'suburban' London and Greenwich Railway's London Bridge Station, of 1836, covering an area 81 m long by 18 m wide, housing six tracks (*ibid*: 14): its area of 1,458 m² is less than that of a rugby field. In comparison, the first main line station serving London, the London and Birmingham Railway's Euston station (1836-37, by Robert Stephenson), at first covered by a column-supported 13 m span of 61 m length, has expanded through the years to an area of 74,925 m² (including

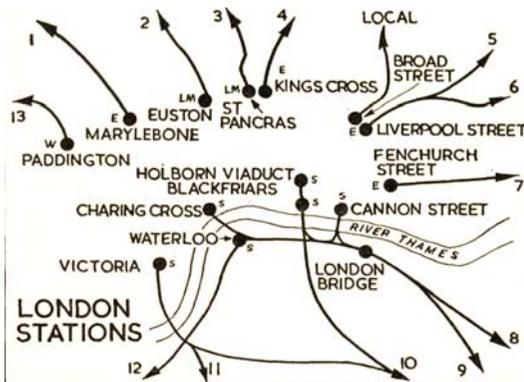


Fig. A2.13 Location of London stations

non-covered track area). London's Victoria station's area has grown to 101,250 m² (*ibid*:14). London's busiest station, Waterloo, handling 1,500 trains daily in 1958, is slightly smaller with 99,225 m². – Locomotives and carriages were initially stored in sidings within the combined passenger and goods stations, with workshops very close by. With time, however, London and other city termini's goods stations, workshops and storage sidings were located more outwards, due to then already more expensive land of the city environs prohibiting further horizontal expansion. – As said before, these early stations were not inspiring architecturally, due to the capital constraints and lack of precedents. The glorious, representative edifices associated with large city stations appeared only later, once the private railway companies had sufficient resources available to allow for their construction.

With non-passenger related functions soon separated out of the city station, it is essentially the development of the passenger station that is of interest. It was deemed necessary to protect the train area from the elements, thereby adding to passenger comfort (and, initially, preventing freight spoilage). Innovative solutions were required to accommodate the expanding requirements of space to be enclosed, in the main, of the station's train area: the key element to the design problem was to create an as large as possible, covered but column-free area, as columns would impede the layout of tracks and train movement, and the flow of passengers to and from them. In addition and if possible, the height of this sheltering structure had to be sufficient to allow for the engine's smoke to draw upwards and to escape through openings in the roof. The new materials available (cast iron, wrought iron and much later steel), combined with increased knowledge of their strengths, enabled the finding of the solution: the supershed.

This provided the necessary uninterrupted, column-free space: it is in essence from the need for expansion of the train area, really only possible in a horizontal direction, that then the vertical expansion followed, due to the structural considerations in achieving the wide spans over said horizontal area. The history of passenger station architecture thus becomes the history of the supershed, and by looking at the prior the development of the latter will be seen.

A2.3 The supershed 'cathedral'

Train-shed sizes increased steadily, leading to the supershed, earlier defined as a structure enclosing a large single volume of space with relatively long spans and without major subdivision by columns or other means. It is characterized by 'modular construction, standardization, mass production, prefabrication, mechanization, lightweight construction, systems integration, rapid site assembly and demountability (Wilkinson, 1991:4).



Fig. A2.14 King's Cross Station (1850-52), London



Fig. A2.15 Train-sheds of King's Cross Station, London

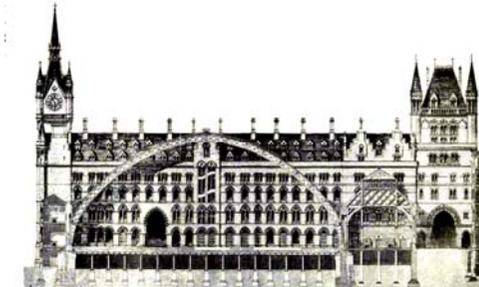


Fig. A2.16 Section of St Pancras Station (1866-68), London, with hotel behind

Though iron-and-glass shed structures were first used as greenhouses, the impetus for their further development was supplied by the railways. (The invention of the single span was actually pre-empted by *inter alia* the Romans, with the Pantheon's dome spanning 43 m, but the skill of building structures of such dimensions was lost during the Middle Ages.) Since the world's first major stations were constructed in the United Kingdom, the history of the station design development, and thus of the supershed, is concerned mainly with that country's stations, but continental European design development will be covered briefly.

A mere twenty years after the small beginnings of 1830, an incredible 46 m wide single-span arch of 114m length covered the area of the second Lime Street Station, Liverpool (1849-1850, by Richard Turner and Joseph Locke). There followed the smaller-span train-sheds of London stations King's Cross (1850-52, by Lewis Cubitt) and the second Paddington (1852-54, by Isambard Brunel and Matthew Wyatt). Birmingham's New Street Station (1850-54, by E.A. Cowper and William Baker) boasted a 64 m span, indicating the vast strides made in engineering expertise within a very short period. In 1866-68 William Barlow and R.M. Ordish designed and erected the then world's largest single arched structure at London's St. Pancras station, the wrought-iron span being 73 m wide and the tie bars being concealed underneath the rail tracks. The use of glass in these structures' roofs filled the interior with light, 'transforming the solemn character of vast halls at one stroke. Light flooded the interior as never before, so that the old distinction of a ceiled room and an unroofed street was dissolved. From this moment on such "room-streets" became a familiar sight in great cities.' (Meeks, 1978:62)

Some of the above and other stations will be discussed in greater detail below, illustrating the progress made in the covering of vast areas:

- The Great Northern Railway (later London and North-Eastern Railway) London terminus, King's Cross Station, being considered then as an unnecessary extravagance by some shareholders, was said to have 'a vista of extraordinary effect' (quoted, without source, by Carter, 1958:42). The two sheds of 22 m height spanned 32 m each; their ironwork was virtually devoid of any ornamentation. This building is clearly functional, the façade clearly reflecting the profile of the sheds beyond. The design was purely and undisguised functionality, Cubitt himself describing it as 'fitness for purpose and the characteristic expression of that purpose' (quoted, without source, by Binney & Hamm, 1984:133). As with the S&D's Darlington station, the clock tower between the two arches serves as a reminder of the importance that time now took on, with even minutes becoming of importance in the punctual running of tight train schedules.
- The Great Western Railway Paddington Station shed was 213 m long and 73 m wide, but made up of a three-bay shed (*ibid*:135), reducing the span of the arches. In contrast to King's Cross, its ironwork



Fig. A2.17 Hamburg *Hauptbahnhof* (1903-06)



Fig. A2.18 Leipzig *Hauptbahnhof* (1906-15), Germany



Fig. A2.19 Station design by Nervi (1943)

sported rich ornamentation of Moorish and Oriental motifs. Its impressive shed structure was hidden by Hardwick's Great Western Hotel (1851-53) built as a totally separate Italianate-style block in front of it.

- The Midland Railway's St Pancras Station's train-shed was only dislodged from its position as the then largest iron-built structure by the 1889 Paris Exhibition's Galerie des Machines. The shed is 209 m long, 73 m wide and 30 m to the point of arch. The clock tower is 68 m high. (Unfortunately 10,000 people were removed from the London suburban slum areas when the station was built, without receiving any compensation, a practice no longer possible.) The adjoining Midland Grand ('St. Pancras') Hotel (1865-1871, by Sir Gilbert Scott) is the biggest neo-Gothic secular building in the United Kingdom (*ibid*:136). Its public rooms could be reached directly from the station.
- The Cheshire Lines Committee Manchester Central Station (early 1880s, presumably by John Fowler) is the second-largest train shed of England, being of 168 m length, 64 m span width and 30 m height. It has now been converted into a conference centre, as the rail operations in Manchester have become more centralized. (*ibid*: 134)
- Regarding continental stations, the first supershed-type structure was the Paris Gare de l'Est (1847-52, by François Duquesnay) with a span of 30 m.
- Germany's Hamburg *Hauptbahnhof*, (1903-06, by Reinhardt and Sössenguth) is continental Europe's widest single-span shed, 72 m wide, and 35 m high. (*ibid*:139-140 and Meeks, 1978:173)
- Another German station, Cologne's *Hauptbahnhof* (1888-94, by Georg Frantzen), unusual in being located in the very city centre, is 255 m long and 92 m wide. (Binney & Hamm, 1984:139)
- Also in Germany, Leipzig *Hauptbahnhof* (1906-15, by Lossow and Kühne) was, when opened, the largest station in the world. Its concourse is 300 m long, and the train shed is made up of six bays of 40 m span. Its covered area is a massive 72,500 m². (*ibid*:137)
- Italy's Milan Central Station (1906-31, by Ulisse Stacchini), is Europe's second-largest station, with a covered area of 66,000 m². It is the last major station in Europe to have a steel-built shed, with five spans of respectively 12 m, 45 m, 73 m, 45 m and 12 m width. (*ibid*:140-141)
- Pier Luigi Nervi designed a precast concrete station hall spanning 200 m in 1943, which would have dwarfed all previous arches, but it was never realized. (Wilkinson, 1991:11)



Fig. A2.20 The superlative concourse: Thirtieth Street Station (1927-34, by Graham, Anderson, Probst and White), Philadelphia



Fig. A2.21 The ubiquitous tower: Dearborn Station (1883-85, by Eidlitz), Chicago

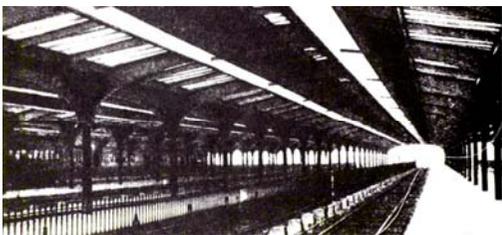


Fig. A2.22 Bush shed, Hoboken station (1904), New York

- In the USA, the first all iron arched train-shed of significance was built at Cleveland, Ohio, USA in 1865-66 by B. Morse with a span of 55 m. (Meeks, 1978:89)
- Developments in the USA culminated with the construction of the world's largest single-span train-shed at Philadelphia's Broad Street station (1981-93, by Wilson and Truscott, additions by Furness and Evans), with three-pinned trussed arches spanning 91 m, with a height of 33 m and a length of 181 m. (Wilkinson, 1991:10 and Meeks, 1978:89 and 103)

The largest station ever built is the second New York Grand Central Station (1903-12), handling 600 trains and 100,000 passengers daily (though some of the older and smaller London and Paris termini exceeded this, handling 1,000 trains and 200,000 passengers a day). Grand Central Station's track area was placed underground over two levels, which then did not call for a large shed. However, its concourse made up for this: 114 m long, 38 m wide and 37 m high. The nearby Pennsylvania Station's concourse height reached a remarkable 46 m. (Meeks, 1978:92)

In looking at the above growth, it should be borne in mind that these large and high sheds were then mostly hidden behind a similarly superlative concourse, office or hotel block or combination thereof, as the 'open display' of the purely functional train-shed was not considered acceptable by many architects, as discussed below under 'Influence of stations on architecture'. As the sheds became larger and higher, these blocks had to grow, too, increasing the bulk of the station complex. This was paired by the afore-mentioned need for prestige and power architecture.

Many stations in Great Britain, continental Europe and North America, including most of the above-mentioned, sported a clock-tower of some shape or other. They often emulated the design of the British Houses of Parliament's 'Big Ben', with its overhanging upper part surmounted by a lantern-sporting, steep, pyramidal roof. (*ibid*:95) The tower became such an integral part of station design that to most people in these areas the word 'station' conjures up the image of a large structure with a tower appended to it.

This increase in railway station size illustrates the lead-up to the zenith of station supershed construction. They did, however, have disadvantages, which led to their demise in the station environment: though providing protection against inclement weather, their ventilation was often insufficient to remove the engine's smoke, discomforting passengers and staff; the sulphur in the coal burnt attacked the cast- and wrought-iron members of the structure, resulting in costly maintenance; and the cost of the sheds themselves were also prohibitive. To reduce the engineering effort and thus costs, the track area was spanned by a number of parallel sheds (bays) of narrower and lower spans. Then the invention of the



Fig. A2.23 Art Deco influences in the now closed Bothaville Station (1930s), Free State



Fig. A2.24 Modernist Verona station (ca. 1950), Italy



Fig. A2.25 Model of International Rail Terminal (1988), Waterloo Station, London

patented Bush-shed sounded the death-knell of large train-sheds: they consisted of a low, sulphur-damage-proof reinforced concrete vault spanning two tracks from the centres of their adjacent platforms and 5 m above the tracks. Being so low, long slots in the vault, now only a few inches above the smoke stack, allowed the engines to discharge their smoke harmlessly into the outside air. They were first used by Lincoln Bush at Hoboken station, New York, in 1904. – Shortly, in turn, they were supplanted by the butterfly shed. This covered only the platforms and provided only incomplete protection against the elements: ‘The public be damned; the company saved money’. (Meeks, 1978:122) – Yet, though supersheds were no longer incorporated in station designs, those built are largely still around (exceptions being Second World War casualties), and their influence on cityscape and architecture can still be assessed today by paying them a visit.

With African weather being more clement than its European counterpart, and with lower comparative traffic volumes, train-sheds are scarce in South Africa, but did form part of the original station designs for Cape Town, Port Elizabeth and Durban. Johannesburg’s Park Station (1895-97) was provided with a cast-iron and glass shed protecting the island-style platform. (The full station building design by Klinkhamer of Amsterdam was never executed due to the political unrest leading up to the Anglo-Boer War. (De Jong, Van der Waal & Heydenrich, 1988:93) Since then, the new Durban and Johannesburg Park stations’ platforms are sheltered by the concourse area above, Pretoria’s has been provided with a saw-tooth roofed steel shed, and Cape Town’s new stations shelters passengers with butterfly-type platform shelters. Port Elizabeth still uses its original train-shed.

Station design moved on with the times, reflecting both the Art Deco and Modernist styles, with extensive use of the new medium of reinforced concrete. However, with the loss of the supershed element from the designs, the passenger support area superseded the track area as the architecturally more dominant one, gaining large and high concourses, whereas the track area was protected only by the aforementioned low butterfly sheds. Current station designs in Europe, mainly, but not limited to suburban routes, follow the latest style trends, showing a mix of concrete, steel, glass and masonry work. Exceptionally, station supersheds are still built: a recent example is that covering the extension of London’s Waterloo Station’s International Rail Terminal (1988, by Nicholas Grimshaw and Associates). The latest shed being built is the new Berlin *Hauptbahnhof*, still in process of completion. Its four tracks are spanned by a shed, its appearance reflecting back on the classic train-shed of iron and glass.

Ironically, while the supershed was replaced in newer designs by the rather insignificant butterfly sheds over the platforms, it was being incorporated in the design of the concourse area. Being of vast sizes, both so as to more easily handle the volume of passengers, and for purposes of prestige, they were covered with massive spans of either cast-iron or concrete to allow for uninterrupted space. New York’s



Fig. A2.26 Galerie des Machines (1889), Paris



Fig. A2.27 St. Paul's (1675-1710), London

Pennsylvania and Grand Central stations are good examples of this, while in South Africa this trend is evidenced in the new Johannesburg and Cape Town station concourses.

For the sake of completeness, the further development of the supershed will be covered briefly. It was greatly employed in the construction of exhibition halls and covered malls. The single-arch spanned space reached its zenith with the Galerie des Machines, designed by Cotamin and Dutert for the 1889 Paris Exhibition: it was 114 m wide (wider than the length of a rugby field), 420 m long and 46 m high. 'It represented the accumulation of constructional experience gained throughout the nineteenth century. It innovated the structural principle of the three-pinned arch, pioneered the use of structural steel and its massive proportions have never really been equalled.' (Wilkinson, 1991:6). This also represented the record for the widest span until 1960. – The need for airship hangars in the early twentieth century saw new applications for the supershed. Then came the need for not only production-line assembly plants, requiring roof-lit wide-span sheds, but also for large aeroplane hangers. During this period the USA took the lead, Europe unfortunately falling behind. The invention of the space frame, cable-supported roofs and cantilevered structures has provided additional alternatives for the construction of supersheds. (*ibid*: ix)

To summarize: The need of stations requiring ever larger areas to facilitate their functions, and mainly those associated with the interaction of the passengers with the trains, led to the development of the supershed, that large and uninterrupted space catering for the horizontal expansion of the train area. The supershed was distinct from, but linked to the also expanding horizontal passenger support area, and often to the vertically expanding administration and hotel structures. The combined structure, expanding both horizontally and vertically and often with a clock tower incorporated in the design, was of a structural size not encountered before the Industrial Revolution. It is not for nothing that these station complexes, due to their area, size and enclosed volume and silhouette, were occasionally referred to as the 'cathedrals of industry'.

It will be interesting to compare the secular cathedrals' dimensions to actual cathedrals.

A2.4 Cathedrals and churches: their dimensions and influence

The comparison of stations and their supersheds to cathedrals is not as incongruous as it may initially seem. Before the advent of the prior the general population could only experience the awe-inspiring volume of vast enclosed space in the cathedrals of the big cities. Palaces and town halls, also being structures which contained large enclosed spaces, were not easily accessible to the everyday man, except in a serving capacity. Station architecture changed all this fundamentally.



Fig. A2.28 St Peter's (1248-1880),
Cologne

A brief look at the statistics of various cathedrals (extracted from Fletcher, 1975) will underline the validity of this comparison based on size:

- St. Peter's, Rome (1506-1626, by Bramante, Sangallo, Giocondo, Raphael, Peruzzi, Michelangelo, della Porta, Fontana, Vignola and Maderna): internal length 183 m, internal width 137 m, external length 213 m, nave width 26 m, vault height 46 m, internal height of cupola 102 m with internal diameter 42 m
- St. Paul's, London (1675-1710, by Sir C. Wren): internal length 141 m, internal width 31 m, internal height of domes surmounting naves 28 m, internal height of large dome 65 m with internal diameter 34 m, area about 6,000 m²
- Hagia Sophia (532-37, by Anthemius of Trallis and Isidore of Miletus): span width 33 m
- Wells cathedral (c.1180-c.1425, *s.n.*): nave width 10 m and vault height 20 m
- Westminster Abbey (960-1745, *i.a.* James, Hawksmoor, R. and W. Vertue): vault height 31 m
- Notre-Dame, Paris (1163-c.1250, begun by Bishop Maurice de Sully): vault height 37 m
- Reims cathedral (1211-90, by *i.a.* Bernard de Soissons): vault height 42 m
- Amiens cathedral (1220-88, by Robert de Luzarches): length 137 m, width 46 m over nave and 4 aisles (not uninterrupted space), nave width 14 m, vault height 43 m
- Chartres cathedral (12th – 16th centuries, *s.n.*): length 134 m, width over choir 46 m, nave width 15 m, vault height 37 m
- Milan cathedral (c.1385-1485, by *i.a.* Amadeo, Dolcebuono and Buzzi), with exception of Seville the largest Medieval cathedral: nave width 17 m, vault height 45 m, internal height of dome 66 m
- St. Peter's cathedral, Cologne, the largest Gothic church of Northern Europe (1248-1880, *s.n.*): length 143 m, width 84 m, nave width 13 m, vault height 46 m, tower height 142 m, area 8,400 m²

Cathedrals were thus both shorter and narrower than the new train-supersheds. Though both nave and towers still exceeded the latter in height, drawing the eye upwards, they were not able to impart the same feeling of space to the perceiver as the stations were able to do: the experience of large space in cathedrals was curtailed by the narrowness of the nave. Having the greater tower height did not affect the experiencing of space, as they are not visible from the interior. The cathedral tower's crowning height on the city silhouette, when compared to a station, was now intimidated by the latter's greater length and bulk. However, with ever higher buildings surrounding both, both have lost on their impact.

APPENDIX 3 SITE EVALUATION AND CHOICE

The location of a railway museum must satisfy. In the main, the client's requirements, which revolve about its visibility and its accessibility by road and rail (should the latter is needed for the running of vintage steam trains), in addition to the accommodation and display of items which are desired to be exhibited. Access by rail, in turn, is dependent on accommodating physical constraints imposed by the site's slopes and gradients which may preclude the laying of the required tracks at acceptable costs, and the proximity of the city's rail network. The factors are set out in greater detail in this appendix, followed by the identification of suitable sites within or on the borders of the Pretoria CBD, their evaluation and a choice of the most suitable site.

A3.1 Site criteria

The site should be situated in an area where it can contribute positively to the enhancement of Tshwane (Pretoria) as a leading city of Africa and as the capital city of South Africa.

It must be suitable to accommodate the functions of the railway museum. As the museum is intended to not only entail the display of static exhibits, but also to serve as a point of departure and arrival for heritage and luxury trains, it must have access to the Tshwane rail network, to be able to function as a station. The site must also comply with the general physical requirements of a station regarding location and linage to existing rail operations.

The existing railway network of Tshwane comprises of a circular or 'ring rail' system around the inner city, the nearer northern suburbs and the nearer and further eastern suburbs. From this line branch off feeder lines to industrial and residential areas on the periphery of the municipal area (Ga-Rankuwa, Soshanguwe and Atteridgeville) and long-distance lines to the south (Johannesburg/Cape Town/Durban), south-west (Magaliesburg/Mafikeng), west (Rustenburg/Thabazimbi), north (Polokwane/Zimbabwe) and east (Nelspruit/Maputo). The southern, western and eastern lines also serve some eastern and southern suburbs (Centurion, Atteridgeville and Mamelodi respectively), whereas the feasibility of introducing a suburban service to Hammanskraal on the northern line to Polokwane is being investigated.



Fig. A3.1 Pretoria's railway network

As stated above, the museum can only incorporate the functions of a vintage steam train and luxury train station if it has access to the rail network being used by the trains serving it: otherwise a train can neither arrive nor go anywhere. Friends of the Rail require access to the Pretoria network's ring line itself (for steam train runs clockwise or anti-clockwise around Pretoria) and its connections to the north (for their destinations of Bela Bela (Warmbaths) and Rooiwal power station), the east (Cullinan) and the south (Johannesburg). Rovos Rail and the Blue Train require access to the same rail connections, but the latter furthermore that the link should be electrified, or easily electrifiable, with overhead catenary, to enable the running of the electric locomotives used to haul the Blue Train.

Within the constraints of the network connection a physical principal largely determines the actual location of a railway station on a railway line (and thus also of a railway museum doubling-up as a station): gravity. Firstly, if a locomotive, rolling stock (carriages and wagons) or a complete train is stationary on level terrain, it cannot roll away, even should the brakes fail. Locating a station on level terrain thus adds to the safety of

rail operations, including shunting. Secondly, it is easier for a locomotive or train to start off on the level, and being able to continue on the level for as far as possible whilst building up speed, than having to start off against the pull of gravity. A 'level' start is more energy efficient and thus economic. If level terrain is not available, it has to be created, resulting in expensive earthworks and increased project costs for the client. Sites have thus to be evaluated as to the availability of sufficient level land and, if such land is not available, the possibility of limiting earthworks to an affordable amount.

The level land must be able to accommodate the length of the heritage or other trains being operated. Heritage trains run by Friends of the Rail consist on average of 10 coaches, plus engine, but Rovos Rail luxury trains may consist of up to 20 coaches. These train consists determine an uninterrupted platform length of between 250 m and 450 m. Rovos Rail, at their current facilities at Capital Park, has only a 100m length platform, with passengers boarding centrally and dispersing to the front and back of the train. This approach is feasible due to the limited number of luxury train travel passengers; however, for Friends of the Rail trains this would be unsatisfactory when running with up to 500 passengers during the Christmas season. The chosen site would thus have to accommodate a 250 m minimum platform length.

Due to the size of the intended locomotive and rolling stock exhibits (a Class GEA Garrett locomotive is just short of 30m) display areas have to be large to accommodate these. It also being more cost efficient to 'drive in' the locomotive and rolling stock displays on rail track (compared to requiring cranes to lift the large and heavy exhibits off and onto flat bed road transport), the display area has to be level and accessible to rail connection. A round-house, allowing operational locomotives individual access to the rail network, by driving from their own bay onto a turntable, to be turned and connected to the link line, obviates the necessity to move other locomotives out of the way, should they be stored in line on parallel tracks. The train display area, displaying per track a train consist made up of a locomotive and some carriages or wagons, would be well served with a number of parallel track lengths linked to the network, facilitating the 'drive in' accessibility. The required distance of 40-55 m end to end of two switches connecting two parallel tracks 3-4 m apart would have to be accommodated in an outside yard area, further impacting the amount of land required.

Furthermore, any commercial or community serving venture: stations should preferably be placed close to where their user client base (passengers or freight shippers) is located with regards to point of origin and point of destination. Similarly, a railway museum should respect the same principle: it should identify where its users (visitors) would be arriving from, and the site must be as easy to find and access, so as to facilitate its user friendliness. This should benefit visitor numbers. This must also consider factors such as safety and savouriness of access routes and parking facilities.

A site close to an existing rail line with train movement seen at short intervals would facilitate relating the exhibits of the museum to what is to be experienced visually in close proximity, and thereby assist in bridging the gap between theory and reality. From a historian's point of view it would lend additional poignancy to the museum if it were situated on or near a site with connections to the early beginnings of Pretoria and its early links to the development of the rail network in South Africa.

In the current circumstances of limited availability of financial resources, a museum must attract visitors: it must advertise itself, it should stimulate the passer-by's interest and entice him inside. Advertising demands good visibility. This can be attained through presence, prominence or individuality of the structure, its exhibits and programmes, or a combination of all these. It should thus be visible from a preferably busy thoroughfare, vantage points and landmarks, albeit at a distance. Easy access is also of importance.

With the museum's client base anticipated to be train and railway enthusiasts, tourists wishing to explore the city of Pretoria's palette of attractions, school classes, restaurant patrons, and conveners and attendees of conferences, exhibitions, product launches, receptions and other events staged on the museum's premises, it is important to assess the potential site with regard to its visibility to and accessibility by these potential users/clients. Proximity to existing tourist attractions would also be off advantage, as it would facilitate the attraction of the drive-by visitor, or could advantageously be incorporated as a stop-over between two destinations of the 'must-see-tourism-agenda'.

Financial sustainability being preferred, it is proposed that the area of which the museum complex will form part should include commercial office space, to be let to third parties for the generation of additional museum funding. The site selected must thus both be able to accommodate the envisaged office space and be acceptable to the business community, thus enhancing its letting potential. Furthermore, the environment must appear attractive and healthy to the future user.

With the South African museum visitor, staff member and office employee generally arriving either by bus or car, land to provide for sufficient parking for the site must be available.

A safe or policeable environment is another prerequisite. Not only the safety of the museum visitor, staff member and office employee is to be ensured, but also that of the displays, as, for example, the 'freelance removal' of all copper and brass elements of locomotives is a favourite and prevalent occupation of South African 'scrap metal' dealers.

In conclusion: Potential sites of enhancement for Tshwane must be assessed for rail access, slopes, area, location, user accessibility, visibility and safety.

A3.2 Potential sites identified

As stated above, the museum is intended to contribute to the enhancement of Tshwane (Pretoria), but the physical constraints identified inherently dictate the need for a sufficiently large tract of level land with rail access to the Pretoria rail network. Such land is only found on the outskirts of the CBD, and only two locations allow for rail access:



Fig. A2.3 Location of Bel Ombre (top) and Salvokop (bottom) sites

1. A site to the north-east of Bel Ombre suburban passenger train station ('Bel Ombre site'): Though on the north-western fringe of the CBD, it is cut-off and isolated from it by factories and workshops, and by it being situated within a return loop of a suburban railway line. To the north of it are the Pretoria sewerage works, whereas to the west is a large electricity substation. 300 m to the east, but not visible from it due to a rise in the land and with access impeded by said return loop, is Paul Kruger Street (a northern gateway to Pretoria and, to its east, the Pretoria Zoo. It is within viewing distance of the Daspoort Ridge to the north.

2. A site to the south of the railway line, south-west of Pretoria Central suburban and long-distance station and south of the Bosman Street suburban passenger train station ('Salvokop site'): It is situate next and parallel to the Bosman Street station and within viewing distance of Central station. The railways' Pretoria workshops were originally located here, but have since been moved to Koedoespoort. The historic structures have nearly all been demolished. A foot-bridge gives direct pedestrian access to the Central station and the CBD, whereas access for vehicles is from the west only, albeit from one of Pretoria's main gateways from the south, Potgieter Street. The site is separated from the Department of Defence headquarters and the adjacent Pretoria's maximum security prison complex to the west by this street. To the north, across the railway line, is the southern periphery of the Tshwane Museum Park area, envisaged as an area of museums within the CBD. It is within viewing distance from Salvokop ridge to the south, on which the new national symbol of Freedom Park has been constructed.

A3.3 Comparison of sites

The assessment of the two sites with regard to the criteria set out before produced the following results:

	Bel Ombre site	Salvokop site
Enhancement of Tshwane	The site is about 300 m from the closest gateway to Pretoria CBD (Paul Kruger Street), but not visible from it, hidden by a knoll. From the south large sheds and workshops preclude visibility. To the west lie extensive sewerage works. To the north is no major road. The Tshwane development frameworks exclude this area, indicating its relative unimportance.	It is visible from Potgieter Street gateway to Pretoria, although visibility is somewhat impaired by the latter being situated partly in a railway underpass cutting. Future office block developments could impair the visibility further. The Tshwane development frameworks earmark this area for development, and a separate (but as yet unimplemented) development plan having been compiled, indicating its importance, with the Freedom Park precinct being in close proximity.



Rail network connectivity	Connection is only in a northern (clockwise) direction to the Pretoria ring line, precluding the running of trains to the south, or the return from there. A connection to the south would entail the additional construction of a lengthy rail link of about 1km, adding to the project costs. The clients require full connectivity.	Connection is available to the ring line in both directions, with only short connecting tracks being required.
Slope of site	The site slopes from the south-east to the north-west, with a height difference of 9 m.	The site is largely level, with a slope to the north of 1m in 150 m.
Slope of train departure track	A level connection to the Bel Ombre line is feasible on land already excavated.	A level connection to the Pretoria ring line is feasible.
Length of platform	A 250 m platform can be accommodated easily.	A 250 m platform can be accommodated easily.
Connectivity to adjacent rail lines	Unless land earmarked for future Spoornet expansion cannot be utilized, the largest available level area lies 2 m above the adjacent rail's level. Major excavation work is required to equalize the exhibition area's height to that of the access rail. The existing levelled Spoornet land is either hidden in a cutting or far removed from the logical placement of the museum building (close to the access road).	A substantial area of the virtually level land lying on the same level as the access rail makes further excavation work unnecessary.



Site access	The site is difficult to find, hidden behind large workshops and/or a land rise, and access is only by means of a dead-end road to the sewerage works, not facilitated by the circuitous routes dictated by the one-way road system of the area.	Access is from a road connecting to one of the main southern access roads to the CBD, and visible from it before entering a railway-underpass cutting. A direct road connection from the CBD to Salvokop has been proposed in the 2006 SDF. A historic connecting foot bridge to the CBD already exists. The site is visible from Salvokop/Freedom Park, Bosman Street Station and Pretoria Central Station.
Visibility of train movements	Out of peak hours, Bel Ombre station is only served by one suburban passenger train about every half hour (own observation)	Rail traffic (shunting, freight, main line and suburban passenger trains) is seen about every 5 minutes (own observation).
Historic railway association	None. Bel Ombre station was completed in 1984 as terminus for the suburban passenger traffic to the north-western suburbs.	The first Pretoria railway workshops and sidings were located on this site. In close proximity are historic houses constructed for railway workers.
Visibility of site	The site is hidden by large factories and workshops. Visibility from the east (Paul Kruger Street and the Pretoria Zoo) is blocked by a rise in the land. The intermediate site may be developed in the future, further reducing visibility. It is visible from Bel Ombre station. Visibility from Daspoort Ridge (school grounds) is not important, as it is not accessible to the general public due to lack of infrastructure.	The site is very visible from the Freedom Park precinct, and is visible to pedestrian and vehicular traffic on Skietpoort Avenue and from Potgieter Street, before the latter enters a cutting. The upper edge of the cutting could furthermore be utilized to attract attention (advertising possibilities). The 2006 SDF indicates a possible development by the Department of Correctional Services on the corner of Potgieter Street and Skietpoort Avenue, which may impair visibility. It is



		furthermore visible from Pretoria Central and Bosman Street stations.
Desirability as location for offices, restaurant or events venue	Situated on a dead-end road leading only to the sewerage works, with no surrounding commercial office space and none envisaged in the Tshwane development frameworks, the desirability as an office location or conference/events venue is doubtful. There are no retail facilities within easy reach.	Situated on a main gateway to Pretoria, with an envisaged direct road and existing pedestrian link to the CBD, and the area being strongly pushed in terms of future development (being the entrance to the Freedom Park precinct), this area could become very desirable as an office location or for the staging of events. There are no retail facilities within easy reach.
Proximity to other tourism attractions	The Pretoria Zoo and Aquarium is about 300 m to the east, but no direct visual or infrastructure connection exists. The aquarium entrance is not well developed. The main entrance to the Zoo is even further east. The development of the intermediate site would further complicate access.	Visible from the Freedom Park precinct and its access routes, as well as from two stations (potential points of arrival) and, though separated by a rail line, from the Museum Park area of the CBD, the link to tourism facilities and attractions is strong. The museum development can further enhance the tourist potential of the area.
Parking	Sufficient land is available.	Sufficient land is available.
Safety of environment	The isolation of the area could facilitate safety, as any person observed would be considered suspect – there being very little other activity in this area. However, isolated spots with tourists or office workers are or could become favourite haunts for muggers.	Its better accessibility, more passing traffic, the presence of residential units, the proximity of the Freedom Park precinct as a prestige development of national importance and the anticipated upliftment of the area should contribute to making this area comparatively safer than the Bel Ombre site.

Health and well-being	The substantial electric sub-station may cause concern about the possible influence of magnetic waves on the health of people constantly in its proximity. The smell of the sewerage works, though generally not noticeable, may cause discomfort on certain days, depending on the strength and direction of the wind.	No potential risks identified.
Client and other comments	When interviewed about various aspects of the project, all parties were appalled at the idea of working in this area: Mr N Berelowitz (Management, Friends of the Rail), Mr Chris Becker (Designer of alternatively proposed Friends of the Rail premises at Hercules yard), Dr R de Jong (Cultmatrix CC), and Prof K Bakker and Mr P Vosloo (both University of Pretoria). Reasons given were <i>i.a.</i> inaccessibility, remoteness from tourism venues and safety concerns.	The mentioned parties all suggested that this site would be a much more desirable location, as addressing the concerns raised regarding the other site.

A3.4 Conclusion

The above analysis shows more points in favour of the Salvokop site. The Bel Ombre site is hampered by its isolation, near-total invisibility and distance from important access routes and other tourist attractions, proximity to sewerage works, and the lack of easy access from a major road. The Salvokop site will benefit from its exposure to train stations and a main road gateway to Pretoria, its proximity to the Salvokop/Freedom Park and Museum Park tourist attractions, and the easier terrain for the running of trains and access of display areas. It will furthermore assist in removing the stigma attached to the area as being the 'Prison corner' and 'Boot camp' of Pretoria (arising from the location, to the west of Potgieter Street, of the Department of Defence's headquarters and the Pretoria C-Max Prison complex).

The desirability of this site is also underpinned by the proposals contained in the *Salvokop Development Framework*: 'It is of great importance that the Chief Engineer's office and the steam hammer mill building... be re-used as actors...Introduction of a 'working rail yard' theme is suitable for this public space – the Friends of the Railway and similar groups would possibly be able to show engines in this space ... - the retention of the rail line for real railway activity in this zone should be actively pursued in the process ahead.' (Cultmatrix CC, 2003:60)

I thus conclude that the Salvokop site is more appropriate for the placing of a railway museum and a departure point for steam heritage and luxury trains.

Fig. 6.66-71 Perspectives



Approach



Entrance and reception area



View of round-house from reception area



Concourse, with gift shop to left, auditoria on mezzanine level, dining car restaurant in background and existing steam hammer shed visible beyond



Lobby to exhibition hall, with staircase and lift to mezzanine level



Exhibition hall, with freight and passenger train display, platform exhibition space, and surrounding mezzanine level

TECHNICAL DOCUMENTATION



Museum complex: View from west: left to right: workshop with coal bunker, exhibition hall, concourse building behind tower, luxury train passenger departure lounge, and platform (own Jpeg)



TECHNICAL DOCUMENTATION

Location plan 1:5000 and site plan 1:500

Ground floor plan 1:500

First floor plan 1:500

Elevations 1:500

Section AA 1:100

Details 1 - 10

Section BB 1:100

Details 11 - 12

Sections CC - HH 1:200

Ground floor plan 1:333 (Scale chosen to fit A0 page)