Hamba-Kahle

An interior intervention to long-distance rail travel in South Africa

Submitted in partial fulfilment of the requirements for the degree Master of Interior Architecture (Professional)

Department of Architecture

Faculty of Engineering, Built Environment and Information Technology

University of Pretoria
2014

STUDY LEADERS: Elana van der Wath
Nico Botes

COURSE COORDINATORS: Raymund Königk
Dr Arthur Barker

The research of this dissertation has been read as an academic paper at the 8th National Congress of the South African Journal of Art History, 19-20 September 2014. Authors: Jacobs, A & van der Wath, E.

Hamba-Kahle

An interior intervention to long-distance rail travel in South Africa

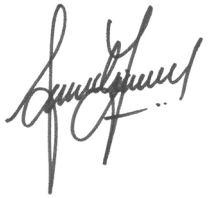
BY ANNELI JACOBS

FOR MY PARENTS

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

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

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



Anneli Jacobs

Host structure: Electrostar Multiple Unit rail car
Route: Pretoria - Cape Town
Programme: Long-distance passenger train interior
Research field: Environmental Potential (EP)

Sleutelwoorde:

Suid-Afrikaanse spoorweë
langafstand spoorvervoer
gemak
moderne reisiger

EKSERP

Openbare spoorvervoer binne-ruimtes moet aanpasbaar wees en voldoen aan ‘n wye teikenmark om die diverse behoeftes van die Suid Afrikaanse publiek aan te spreek. In `n beperkte mark is plaaslike spoorvervoer in direkte kompetisie met lugvervoer vir ‘n markaandeel. Plaaslike spoorvervoer faal tans in beide areas. Die versuim om in spoorinfrastruktuur te belê en dit op te gradeer, het gelei tot desperate pogings om dekades se internasionale spoorweg evolusie in te haal - ‘n aspek wat veral sigbaar is in die binne-ruimtes van plaaslike langafstand treine. Die ontwerp en estetiese identiteit van vervoer binne-ruimtes is generies, verouderd en spreek nie die funksionele en estesiese behoeftes van Suid-Afrikaanse reisigers aan nie. Dit het tot gevolg dat hierdie binne-ruimtes nie daarin slaag om ‘n identiteit te vestig wat sinoniem is met ons unieke demografiese samestelling nie. Hierdie kwessie word aangespreek deur gebruik te maak van ‘n heuristiese ondersoek.

Ter illustrasie van laasgenoemde word `n “Electrostar” trein struktuur gekies waarvan die binne-ruim her ontwerp word. Hamba-Kahle spreek dus die fisiese en sielkundige ongemak van die trein se binne-ruim aan, asook die afwesigheid van sosiale ruimtes, kentekens en aanwysings en die gebrek aan ‘n unieke identiteit. Die ontwerp daag die uitleg van die gemiddelde trein binne-ruim aan deur die daarstelling van `n binne-ruim wat in funksionele ruimtelike areas onder verdeel is. Die ontwerp maak voorsiening vir `n wye teikenmark deur die daarstelling van twee ergonomies ontwerpte sit eenhede waarvan die eerste `n lae koste pendelaar wa is en die tweede `n meer eksklusiewe sit eenheid wat fokus op die meer stylvolle passasier. Addisioneel is daar ook `n oornag slaap kopee en `n algemene universele wa. Deur voorsiening te maak vir informele weg-breek areas word daar aan die passasiers die geleentheid gebied vir sosiale interaksie. Sodoende fasiliteer die binneruim vir private sowel as publieke sosiale interaksie geleenthede. Die variasie wat geskep word aan die passasier bekragtig die funksionele aanpasbaarheid van die verskillende binneruimtes en bied dus meer vryheid en toegangklikheid aan passasiers. Die uitsig na buite word beklemtoon in die binne-ruim en skep sodoende ‘n unieke reis ondervinding.

Die skepping van `n hedendaagse Suid-Afrikaanse identiteit bied vir die passasier `n reis geleentheid waarmee hy kan identifiseer en waar die passasier sielkundig, emosioneel en fisies gemaklik is.

ABSTRACT

Public rail transport interiors must be adaptable and cater to a wide target market to address the diverse needs of the South African public. Local rail transport competes directly with air travel for market share. Currently, local rail transport fails on both accounts. The failure to invest in and update rail infrastructure has resulted in a desperate need to play catch up with decades of international railway evolution – a need especially visible in the interiors of local long-haul trains. The design and aesthetic identity of transport interiors are generic, dated and fail to address the functional and aesthetic needs of contemporary South African travellers. As a result, these interiors fail to establish an identity synonymous with our unique demographic make-up. The current state of local long-haul passenger rail interiors was investigated through the use of a heuristic inquiry.

An Electro Star Multiple Unit train structure was then selected in which an interior insertion is made. Hamba-Kahle addresses the physical and psychological discomfort in the train interior, the absence of social spaces, the disregard for wayfinding and the lack of contextual identity. The design challenges the insular train interior layout and divides the interior into different spatial zones. A Budget Sitter car, Premium Sitter car, Budget Sleeper and Universal Car provides seating variation for passengers and in turn integrates a wide target market. Break-away spaces are also incorporated. The programme and the spaces it creates assist the interior in mediating between private and public spaces. It facilitates chance encounters and supports retractable privacy. The interior reinforces adaptability in the use of spaces while adhering to universal design principles. The scenery from the surrounding landscapes is used in the design to enrich the interior spaces and improve the embodied experience of the user.

In establishing a contemporary South African identity, a sense of place is created with which passengers can identify and feel physically, psychologically and socially comfortable in.

Keywords:

South African railway
long-distance passenger rail
comfort
21st century traveller

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GLOSSARY

Motor car: The carriage of an electric train which houses the driver's cab at the ends.

Train car: A term most commonly used to describe a single train wagon/carriage.

Sitter: A passenger rail car with seated accommodation organised in rows.

Sleeper: A passenger rail car (usually with cabins) which facilitates sleeping accommodation.

Cabin: A private room within a passenger train, also referred to as a *compartment.*

Mainline: Railway tracks which form the primary rail route and from which branch lines extend.

Narrow gauge: South African mainline rail tracks are narrow gauge tracks, which refers to the 1065mm distance between the two tracks (international standard gauge consist of a distance of 1435mm between tracks).

Long-haul: A distinction can be made between long-distance (intercity) and short-distance (regional) commuter passenger trains. Long-distance rail can also be referred to as *long-distance.*

Short-haul: Passenger trains commuting short distances, thus between suburban areas and can also be referred to as *short-distance.*

Longitudinal seating: Seating in short-distance trains, trams or busses that are positioned across the length of the interior, therefore facing the windows of each end.

Unidirectional seating: Seats in a train, airplane or bus positioned behind one another, facing the same direction.

Facing seating: A term used to describe seats facing one another in a train.

Berth seating: Seating which can be adapted to beds for sleeping.

"Shared understanding of the conventions and mechanisms of everyday existence give interior designers and those who use the places they create a shared sensory language. It is the particular responsibility of designers to enrich the vocabulary of that language, to give their audience something that it never realized it wanted, or knew it could have" (Plunket 2007).

This dissertation explores how the interior designer can enrich the vocabulary of the interior design discipline by investigating a typology usually associated with industrial design. The author agrees with Caan (2011:112) who calls for an expanded view of the interior to "include any space with full or partial enclosure that caters to human needs and promotes well-being". Transport interiors, as enclosed spaces for temporary occupation, fit comfortably within this definition. Interior designers address both the functional and emotional needs of its users and aim to create a sense of place in interior spaces. This dissertation posits the view that the design and user experience of rail travel should be viewed through the eyes of an interior designer.

CHAPTER 01

introduction

WHY TRAVEL?

Mobility purposes both a primary need (movement in itself) and a secondary need (Kottenhoff and Anderson, 2009:39). Activities such as living, working and leisure are in most cases spatially separated and, thus, encourage the need to travel. Efficient public transport is important in enabling accessibility and communication and its importance is often misjudged or unnoticed.

1.1 INTRODUCTION

Chapter One describes the current condition of rail transport in South Africa as background and subsequently introduces the real world problem that will be addressed by this study. The current condition of rail travel is questioned and an interior intervention in local long-distance passenger train services is proposed as a means of reviving and highlighting the benefits of passenger rail as a sustainable public transport medium.

1.2 CLASSIFICATION OF CHAPTERS

PART A

The crisis in the existing long-distance rail market in South Africa is identified in **Chapter One**.

In **Chapter Two** the theoretical argument is formulated. These theoretical influences are used to support and direct the design process by establishing project-specific design guidelines.

After a critical analysis of the existing passenger trains in South Africa is conducted in **Chapter Three**, the shortcomings of local long-distance train interiors are clear. The chapter also serves to provide an overview of the historic development of the railways in South Africa. Consequently, the Electrostar train is chosen as a contemporary train structure on which to conduct an interior insertion. The need to address a wide target market is identified through an investigation of possible user profiles. Four main user groups are then targeted.

PART B

The design concept and development is discussed in **Chapter Four**.

Chapter Five and Chapter Six is accessed electronically. It shows the application of the conclusions drawn from each of the preceding chapters to arrive at a final design. The development of the design and technical resolution is illustrated visually and explained in **Chapter Five** and continues to **Chapter Six** to communicate the systems and sustainable strategies.

Figure 1.1: Fatal effects of air pollution from road traffic.

1.3 BACKGROUND

Prior to the dramatic rise in private vehicle ownership, rail travel was the most valued mode of transport in South Africa. The industry of private vehicle ownership was still in its infancy and only in the period of 1960 to 1980 did private vehicle ownership begin to flourish. Economic prosperity and socio-political changes since the 1990s has afforded the middle-class South African family the ownership of an average of two private vehicles, and the use of private vehicle travel nearly doubled overnight (Grobler 2003: ii).

This escalation, in combination with the increased popularity of air travel, forced rail travel to the back of travellers' minds when selecting a mode of transport. In Competition in Air Transport: The Case of the High Speed Train, González-Savignat (2004: 78) observes that **"[t]he dominant position of the railways began to lose its leading foothold in favour of the plane, for long distances, and the private vehicle, for shorter distances. This has resulted from the loss of competitiveness of the traditional train in relation to other transport services, originating in travel times far superior to those of alternative modes."**

Today air travel is a conventionally used means of domestic and international travel, where local long-distance rail travel has almost been relegated to a bygone era. However, Grobler (2003: ii) is of the opinion that public rail transport remains the most cost effective travel medium for the average citizen. Additionally, rail travel offers users a number of benefits that cannot be provided by other modes of transport.

Rail travel is a safer mode of travel than road travel in South Africa. The World Health Organization (WHO) is of the opinion that air pollution (which originates from the effects of road-based traffic) causes an increasing number of deaths annually (WHO 2011). According to the Road Traffic Report (Gainewe 2011: 32), approximately 14 000 fatalities occur due to roughly 11 000 road traffic accidents per year in South Africa. The risk of fatality is eight times greater in road-based transport compared to rail (Ebersöhn & Grabe 2010: 7).

Fuel combustion from the transportation sector in general is a substantial contributor to the total annual man-made carbon dioxide emissions (Bradley 2007: 2). The latest data evaluate South Africa's contribution to emissions from this sector and was collected and analysed by the International Energy Agency. This suggests that the transportation sector was responsible for 46.3 Mt CO^2 greenhouse gas emissions in one year (Cohen 2011: 2). Emissions from fuel manufacture processes also need to be considered. Emissions from energy used in refineries (including those of Sasol) contributed approximately 42 Mt CO^2 emissions to South Africa's total emissions in addition to that of direct fuel combustion (Cohen 2011: 4).

The Department of Environmental, Food and Rural Affairs of the United Kingdom also advocates the fact that passenger rail is considerably less carbon intensive (see Fig. 1.2) than air and private vehicle transport modes (Gautrain Management Agency 2012). Of all the emission causing transport media, domestic air travel is regarded the most detrimental (Hergesell & Dickinger 2012: 596). In comparison, passenger rail transport has a reduced impact on climate change. Coupled with the rising costs of oil and fuel, the need to shift towards more sustainable

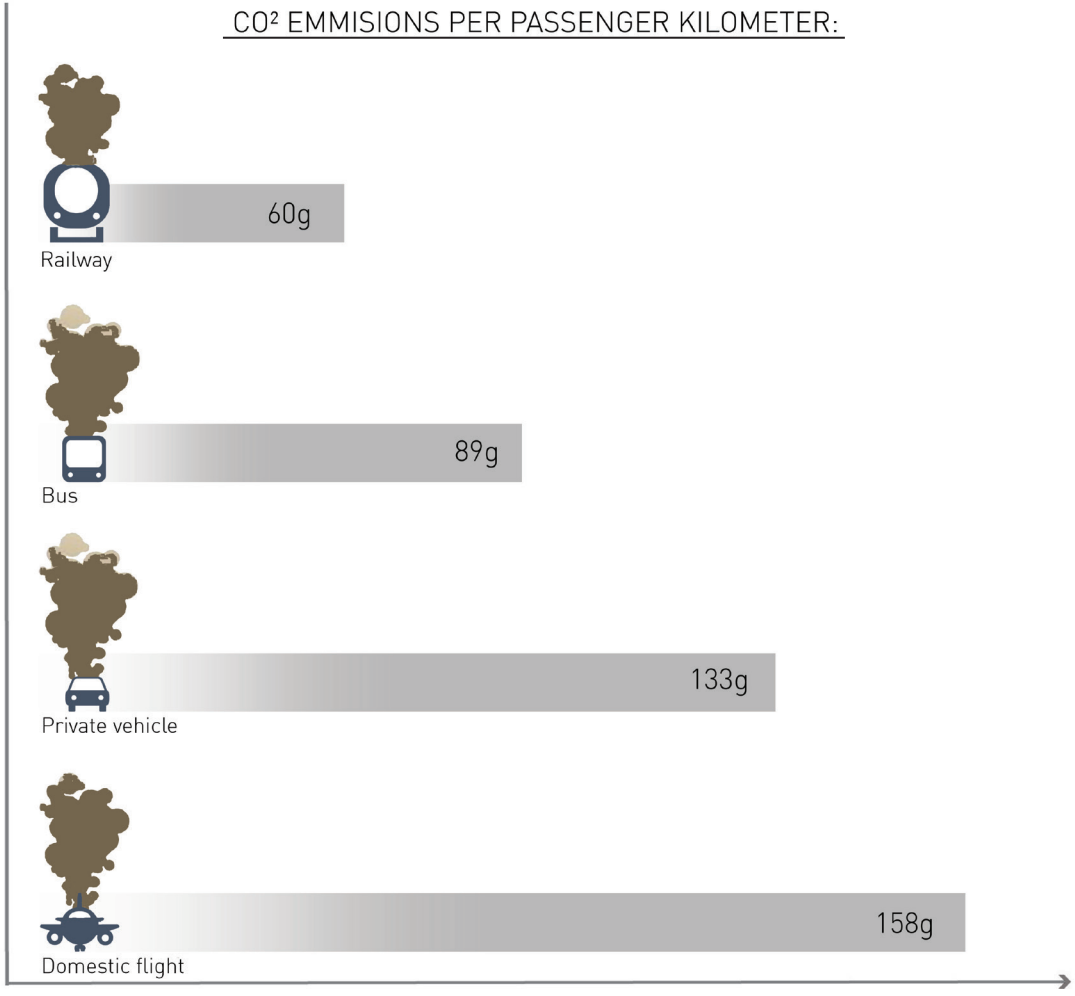


Figure 1.2: Statistic which substantiates the enivironmental sustainability of rail (Gautrain Management Agency, 2012).

living practices is apparent (McSheen 2008). This promotes the need to impose restrictions on the use of private vehicles and air travel. Decreasing private vehicle use can contribute to sustainable living practices, regarding both the reduction of carbon emissions and the relief of traffic congestion on road infrastructure (Friedrichsmeier, Matthies & Klöckner 2013: 1; Kottenhoff & Anderson 2009: 2). The Energy Research Centre, based at the University of Cape Town, conducted the Long Term Mitigation Scenarios (LTMS) study, and also proposes passenger modal shifts from air to rail to mitigate greenhouse gas emissions (Cohen 2011: 5).

Alstom Transport is a world frontrunner in the manufacture and maintenance of commercial rail equipment, rolling stock and infrastructure (Alstom Transport 2011). According to the company a flexible, new and service-proven train that can run on existing conventional rail lines is an ideal solution to the transport problems of today. Additionally, the rail transport system should provide increased comfort for its users in order to improve the attractiveness of public transport, without the added expense and environmental impact of new rail infrastructure (Alstom Transport 2011).

Based on extensive international experience gained from designing high-speed trains, Priestman (2013) is of the opinion that it is vital to motivate people to eschew private vehicle and domestic air travel and make rail their first choice. This is imperative not only to attain lower carbon emissions from transport, but to move towards a more comfortable travelling experience. Priestman (2013) believes that rail-travel should become as exhilarating as air travel and as provocative as a sports car.

The current South African long-distance train experience is not viewed in a positive light, much less as exhilarating or provocative. Local rail services are suffering a continued drop in demand and availability of acceptable long-haul passenger rail services (Metrorail 2013). South Africa would benefit from an investigation into the current condition of long-distance rail travel.

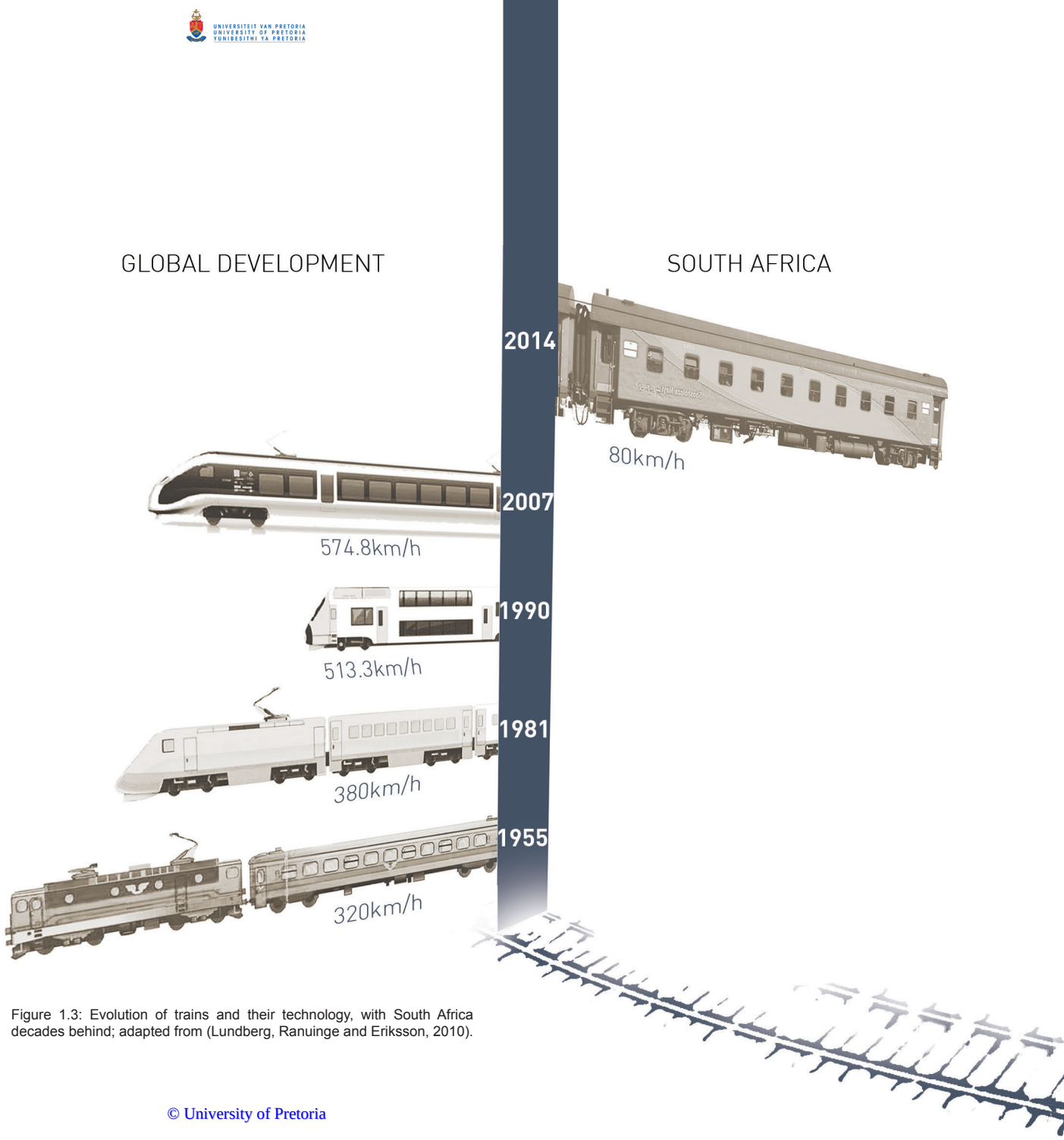


Figure 1.3: Evolution of trains and their technology, with South Africa decades behind; adapted from (Lundberg, Ranuinge and Eriksson, 2010).

1.4 THE CURRENT SITUATION:

A REAL WORLD PROBLEM

Passenger rail travel faces many challenges as a consequence of the failure to invest in and update rail infrastructure and train fleets for over 30 years (Metrorail, 2013). This under-investment over such an extensive period has resulted in a situation where rail services are suffering a continued drop in the availability and demand of acceptable long-haul passenger rail services (Metrorail 2013). Slow travelling times and poor reliability (late departures and arrivals) result in unpleasant travel experiences, which in turn encourage the use of domestic air travel – although more expensive, air travel is more convenient and reliable. It is estimated that rail transport is responsible for less than 1% of all inter-city journeys in South Africa (Munshi & Smith, 2013).

The country's failure to keep up with global developments in railway technology is evident when comparing current long-distance rolling stock with that of international long-distance train services and has resulted in a sudden need to catch up on decades of railway evolution (see Fig. 1.3). The trains have failed to transform on both a functional and aesthetic level and do not prioritise holistic user comfort. Little to no research exists on the design of long-haul transport interiors in South Africa, and even less information is available on traveller's experiences.

Globally, railway technology has developed tremendously since the 1950s. Developments include more accessible stations, better amenities, procurement of new train fleets and the upgrade of infrastructure. Contemporary high speed trains do not have to stand back to domestic air travel or long-distance road based travel for market share. For instance, in Spain an increase in market share (from 19% to 53%) was achieved by the new rapid link between Seville and Madrid (Veitch & Schwarz 2011: 7).

Passenger rail in South Africa is not currently a competitive market. Crockett and Hounsel (2005: 536) highlight the most important aspects that travellers use to determine the mode of transport: time, cost, reliability, security, comfort and convenience. Public perceptions of a mode of travel also influence a potential user's decision. Perceptions are normally shaped by experience, and negative experiences may add to the reluctance of the greater local population to use railway travel for long-distance commutes.

Metrorail (2013) admits passenger rail holds the potential to be the most convenient, affordable and safe mode of travel – it could form the backbone of an effective and dependable (commuter and intercity) public transport system. In August 2012 Business Day Live (Smith 2012) also reported that **"despite a dismal 40%-on-time performance record and dramatic drop in passenger numbers to 1.7 million from 3.2 million annually over the past four years, there is still demand for low-cost long-distance rail services".**

Regardless of the lack of development for a number of years, improvements in rail infrastructure are on the cards. This is evidenced by Passenger Railway Agency of South Africa's (Prasa) R123bn investment in new rolling stock over the next 20 years (Fin24 2013a), the proposal of seven new rail routes in Gauteng (News24 2013) and the R7bn planned upgrade of rail signal systems on Johannesburg and Pretoria rail passenger networks (Fin24 2013b). Investment is however currently focussed mainly on improvements to short-distance services like Metrorail and not on improvements to long-distance services such as the Shosholoza Meyl.

Historically rail travel in South Africa was a well-considered system which increased the mobility of citizens. However, currently it lacks the investment and upkeep that a long-distance service requires. The success of the Gautrain for short-distance travel sets a new benchmark and awakens the need for a contemporary long-distance passenger rail service that addresses the needs of South African travellers in a sustainable manner.

Local long-distance passenger rail needs to be brought into the 21st century.

Figure 1.4: Plans to improve Metrorail train fleets covered by media (Blumenthal 2013; Blumenthal 2013; Khuzwayo 2014).

1.5 THE PROBLEM

In reaction to the real world problem, the following design problems were identified during personal train travel journeys and extensive analysis:

1.5.1 THEORETICAL ISSUES

• As a result of the local underinvestment in railway transport, South Africans relate long-distance rail travel to an outdated concept. It is associated with discomfort and is regarded as an impractical method of travel.

• Local long-distance train services are currently only successful as leisure journeys, which are exclusive to tourists and high-end income groups.

1.5.2 PRAGMATIC ISSUES

• The typical interior programme and layout of train coaches have remained static.

• User comfort is not treated and addressed as a priority in the design process.

• Local long-distance trains are not universally accessible and consequently disregard a segment of the user market.

1.6 PROBLEM STATEMENT

There is a need for an interior investigation (in the form of an insertion) of a contemporary passenger train structure to accommodate the physical, social and psychological needs of South African travellers in the 21st century.

Figure 1.5: Current dismal state of local long-distance passenger trains.

1.7 RESEARCH QUESTIONS

In response to the problem statement, theoretical and pragmatic research questions are posed:

1.7.1 THEORETICAL

- What affects our attitudes towards travelling and choice of travel medium?

- Can an improved programme and interior layout of a long-distance passenger train ensure a larger target market?'

- What can rail travel learn from other modes of passenger transport?

1.7.2 PRAGMATIC

- How much space and what type of spaces do South African travellers need on a contemporary train?

- How does a contemporary train interior respond to earlier passenger train typologies and how can it be improved to simultaneously respond to the spatial needs of South African travellers?

- How are public and private spaces mediated within an insular interior environment?

- How can contemporary materials and methods of construction be used to create a new interior identity for long-distance passenger trains?

1.8 VISION AND OBJECTIVES

This dissertation challenges current, outdated views about long-distance passenger trains to create a contemporary travel experience that fits into the context of South Africa.

The research intends to update the public transport experience in our local context by altering perceptions of public transport use and the conventional train interior. The objective is to design a long-haul passenger train that responds to the need for an improved and integrated public transport network by using the existing main-line rail tracks. The project aims to be a future projection of what public transport networks should become and how these can be developed as part of a sustainable system.

Public transport interiors are therefore identified as being potential subjects for exploring the parallels of physical habitability of an interior and the psychological needs of users in a space. Focus is therefore placed on improving human experiences, comfort and well-being within a transport interior.

In summation, the dissertation aims to:

1. Identify and address the shortcomings and passenger needs pertaining to passenger trains, specific to the context of South Africa.

2. Express the role of interior design in creating a new visual identity for long-distance South African train interiors.

3. Present guidelines for designing a South African long-distance passenger train.

4. Narrate the route journey by translating it spatially.

5. Make use of contemporary materials to create a 21st century passenger train interior.

Figure 1.6: Digital collage illustrating vision for South African rail.

Figure 1.7: Logo of Passenger Rail of South Africa (Prasa 2013).

Figure 1.8: Logo of The Department of Transport (Department of Transport 2012).

1.9 USER PROFILE

For long-haul passenger transport, the transport environment needs to be adaptable and focused on a wide target market to foster social cohesion and to ensure the user a better travel experience than expected.

User groups are targeted with consideration of differences in gender, race, age, religion and main income groups. The interior should be designed in such a manner as to accommodate the diversity of the South African demographic in terms of class and user needs.

In response to the failure of existing local passenger trains to be universally accessible, specific attention will be given to accommodate this sector of the user market. It is therefore intended that members of a wide target market will make use of rail travel as their preferred mode of transport.

1.10 THE CLIENT

The design program of the study is based on the supposition that PRASA (the Passenger Rail Agency of South Africa) requires and commissions the update of the passenger rolling stock through the provision of a new long-haul passenger train fleet. The South African Department of Transport will act as financial sponsors of the project.

1.11 CONTEXTUAL PARAMETERS

The study places specific focus on long-distance passenger transport. Over long-distance commutes, a lower cost per passenger can be achieved (Kottenhoff & Andersson 2009: 6). As a mandate of the study, the reuse of the existing infrastructure is important and is to be combined with the technology of a contemporary train. The train is to run on the RR04 rail route, which forms part of the existing main rail line (see Fig. 1.9).

The Electrostar EMU (electric multiple unit) is identified as a host structure on which the insertion is conducted. The Gautrain is an ElectroStar model and was used to generate drawings of the train structure (Bombardier 2009). An Electrostar train model is a contemporary train with technology and structural dimensions suited to run on the mainline tracks. The contemporary nature of the train enables the ideal of a shorter travel time than what existing local passenger train services can provide. At an operating speed of 160 km/h, passengers will be able to commute from and between Pretoria and Cape Town in under eleven hours. This will be a significant reduction in travel time when compared to the twenty-seven hour trip of current long-distance rail services.

Figure 1.9: Proposed route.

1.12 RESEARCH STRATEGY

As an interior designer, the research questions addressed in this dissertation are of a personal nature. They were formulated on account of personal experiences and the desire to understand a particular problem more clearly and to generate a solution by using design. A heuristic enquiry is used to support the dissertation investigation with personal and tacit manifestations.

1.12.1 HEURISTIC ENQUIRY

Heuristic research (Moustakas 1994: 17) was used to gain a deeper understanding of the current character (both functional and aesthetic) of South African passenger trains. Moustakas (1990: 15) describes heuristic research as "...a way of engaging in scientific search through methods and processes aimed at discovery; a way of self-inquiry and dialogue with others aimed at finding the underlying meanings of important human experiences".

Heuristic research leads to realizations, organization and deepened understanding (Moustakas 1990: 9). This enquiry method also offers potential for gaining insight into complexities that may be revealed in answering the research question (Kenny 2012: 11).

The theoretical component of the study investigates the character and typology of the passenger train. Personal rail travel experiences of the author is presented in a reflective report based on the model of reflective writing provided by Hampton (2010).

1.12.2 DATA GATHERING

The qualitative data are gained via the following:

- Personally conducted long-haul rail journeys
- Interviews/specialist consultations
- Site visits
- A literature review
- Precedent studies

The design process is guided by precedent studies, with a focus on comfort, ergonomics, anthropometrics, inclusive design and branding. The history of passenger rail is analysed on both an international and local scale. Data of existing passenger trains are collected to determine the shortcomings of local rail transport. Through conducting personal train journeys the author also gained knowledge of the current character of passenger trains and the limits of and opportunities presented by small-space design.

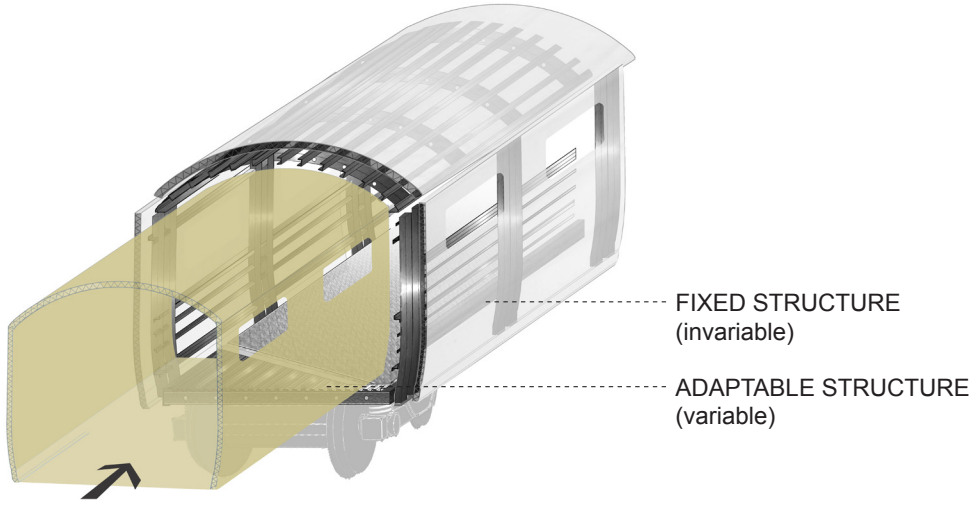


Figure 1.10: Scope of interior investigation.

1.13 DELIMITATIONS

The study places focus on the design of the interior environment of the passenger train. It excludes the technical functioning and engineering design of the train and motor car itself. A challenge is thus set to use the existing train structure as an invariable and the interior as the variable.

A distinction is made between long-distance (intercity) and short-distance (regional) commuter passenger trains. The investigation of the passenger train typology is focused specifically on long-distance rail travel and not the interior nature of short-distance commuter transport.

The constraints of the investigation are set to ensure the study showcases the scope of the interior design profession as a discipline of space-making.

1.14 CONCLUSION

This dissertation investigates the decline of the long-distance rail market in South Africa and how an interior investigation can be used to improve the attractiveness of rail travel and create a contemporary, South African rail identity. The investigation is set to respond directly to the needs of South African users. It will also be used to promote sustainable travel methods and to so re-imagine local long-distance passenger rail.

Further, the relationship between human-centered design and comfort in a transport interior is investigated and how interior design can contribute to impact positively on human well-being.

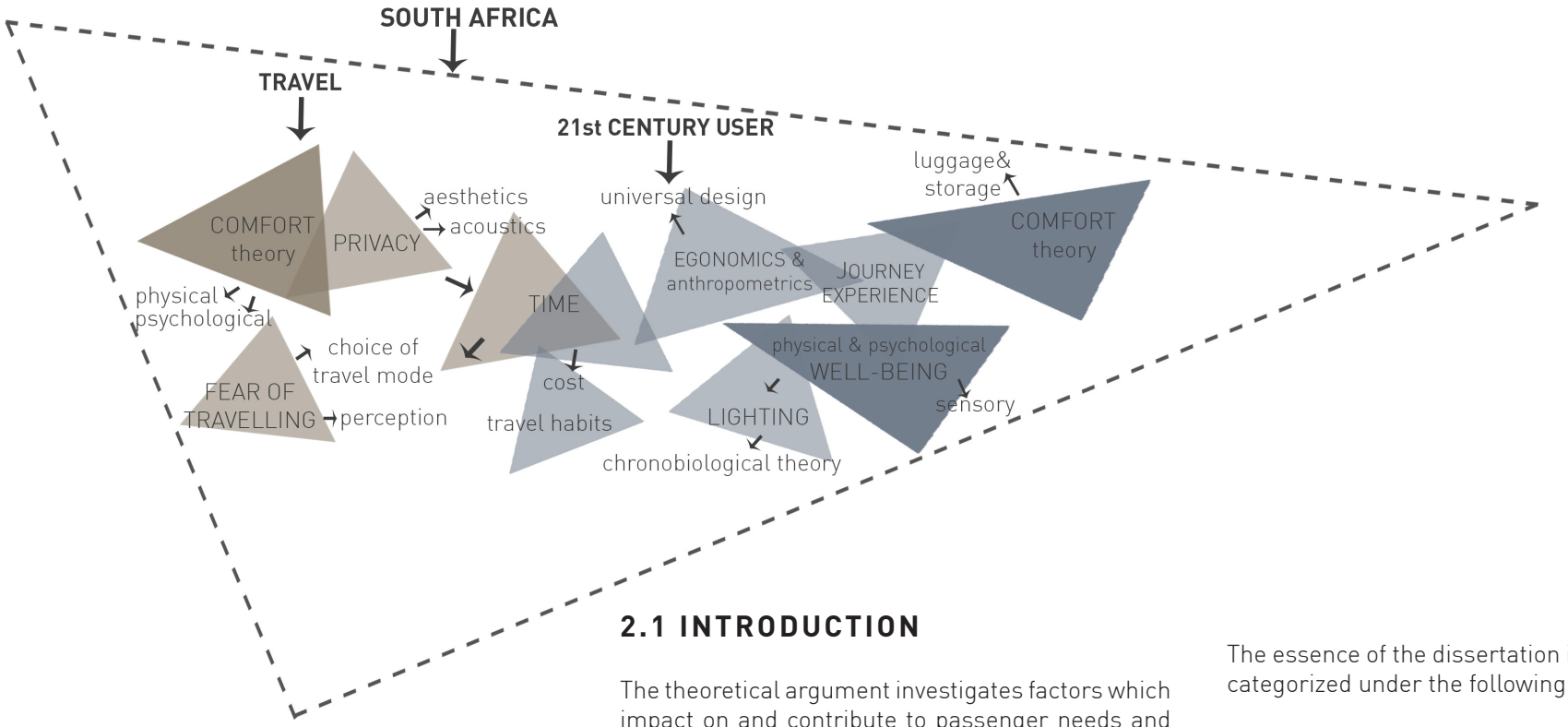


Figure 2.1: Summative illustration of influences of the study.

2.1 INTRODUCTION

The theoretical argument investigates factors which impact on and contribute to passenger needs and choices of travel mode. The investigation includes exploring the role of holistic comfort (physical, psychological and social) in travelling as intrinsic to achieving passenger well-being. Subsequently it identifies and interprets opportunities in terms of an appropriate design reaction. The Comfort Theory (Vink & Brauer 2011) is used, not to be adapted to suit the passenger train typology, but rather as a tool from which design principles may be harnessed to initiate a 21st century South African passenger train identity.

The essence of the dissertation investigation can be categorized under the following:

- travel
- 21st century
- South African

The contextual investigation supports the theoretical framework, target market and precedent studies, which all fall within the abovementioned categories and are interlinked (see Fig. 2.1). Therefore, some theory is embedded where applicable in Chapter Three, 'Context', and precedent studies are discussed where most applicable.

> "Clients [or people] should perform their best because of their environment rather than in spite of it" (Deasy 1985: 11).

2.2 HABITABLE SPACE AND THE HUMAN EXPERIENCE

Interior environments condition certain human behaviours and impacts on our state of well-being. In contradiction to this concept, the design of spaces are often conceived as stand-alone spaces or 'objects' and disregards the human occupation thereof (Caan 2011: 132). According to Helander and Zhang (1997: 895) comfort can be associated with a sense of well-being and aesthetics, where discomfort is connected to fatigue and biomechanics.

The physical occupation of space in a train is experienced on a more intimate level by its users. Inanimate objects within a space can trigger emotional responses in the user and hence affect one's emotional state (Van Gorp 2012: 12). The manner in which one behaves and interacts with the objects and the space is then driven by one's emotions. Antonio Damasio (1994) postulates the importance of designing for emotion by pointing out the dominance of emotion in one's experiences and the impact it has on the everyday. Lawson (2001: 18) also claims man has emotional needs that are expected to be filled by the space we occupy. This directly relates the psychological state of well-being to spatial needs. Design which manages to induce emotion or promote a sense of pleasure will concurrently fulfil the human need for well-being. Accomplishing this through design is complicated, as personal space bubbles, or an individual's sense of privacy, differs from person to person (Nussbaumer 2012: 183). Emotion is also not a constant state, but fluctuates.

Shashi Caan (2011: 135) states that "[d]esign in any form is meant to be used; therefore its power is exponentially greater when it touches and inspires the soul." Thus a design intervention in a space is simultaneously an intervention in the human experience. An intervention in any interior environment should not only be a visual solution, but should improve the quality of life of the user. This becomes particularly relevant when dealing with moving interior environments and the psychological effects that travelling has on its users. It also implies the importance of working with intimate scale and proportion.

2.2.1 PASSENGER PRIVACY

One reminder that human well-being and distance is interconnected is the expression too close for comfort (Lawson 2001: 102). Personal space affects the degree of privacy each passenger requires in a train and thus also impacts on their experience of comfort.

Edward T. Hall coined the term 'proxemics' in the 1960s to define zones of acceptable distances for interaction between people from different cultures and with different perceptions of personal space (Hall 1969: 1). Hall proposes four zones of proximity (refer to figure 2.2): intimate, personal, social and public (Hall 1969: 114). The degree of comfort each individual experiences with another relates to these zones of personal space (Nussbaumer 2012: 183). The manner in which a space is arranged can thus encourage or discourage human interaction, depending on each individual's perception of personal space.

When travelling by train, one is forced to be intimately seated next to a stranger. One shares a range of proximities one would normally share only with loved ones. A person has inherent compulsions to treat complete strangers in a certain manner (Hall 1969: 128). We exhibit this every day through our 'body language'. Sight, sound, olfaction, heat (from the adjacent person's body) and noticeability of another passenger's breath all signal the definite closeness of another individual's body (Hall 1969: 116). The presence of another passenger

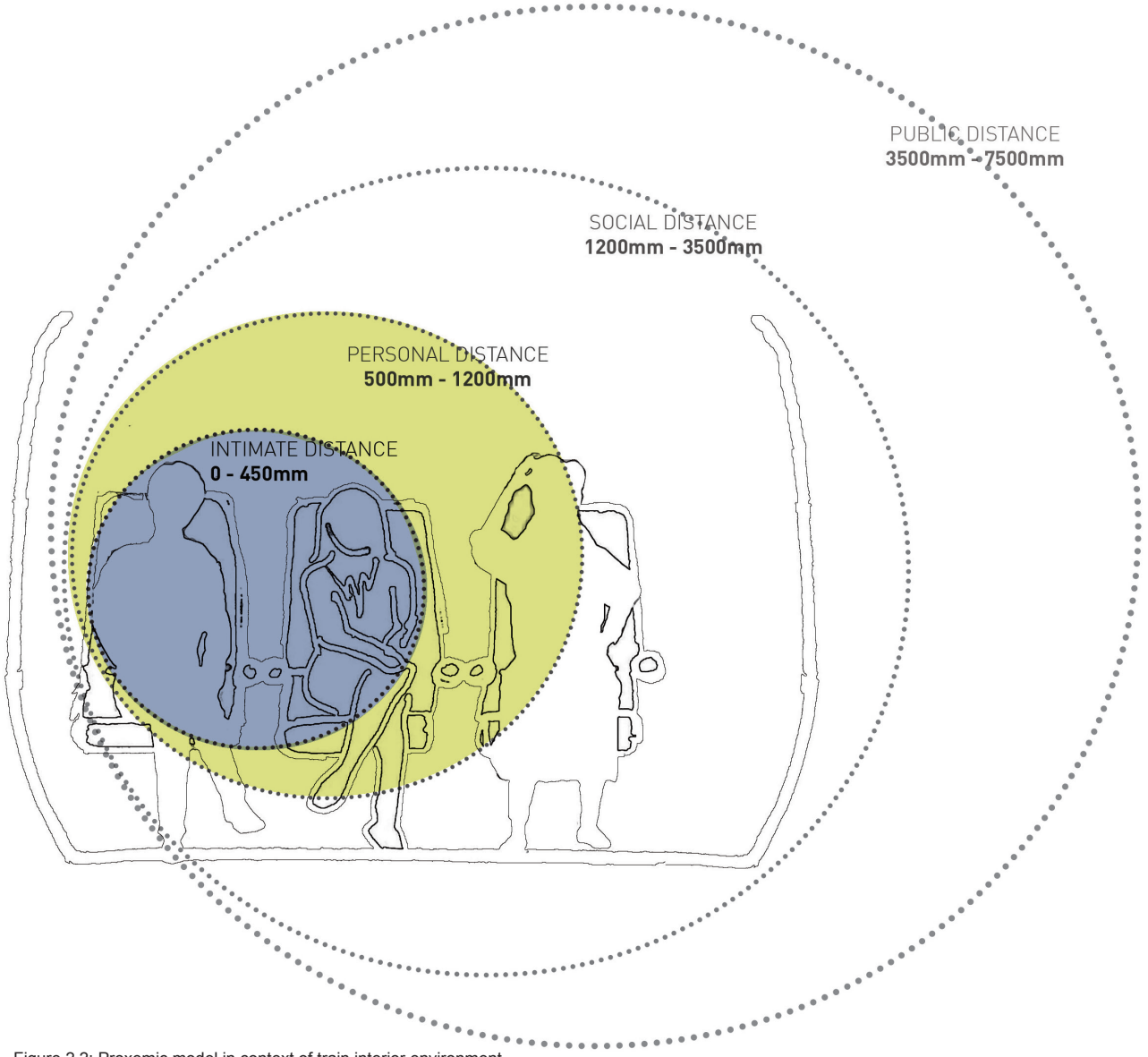


Figure 2.2: Proxemic model in context of train interior environment.

is undeniable at intimate proximity and may be overwhelming because of the prominence of this sensory involvement.

Ardelean (2008: 174) is of the opinion that Hall contests the ideas of specific set cultures and which relate back to conditions from the 1960s. In the contemporary setting, mixed cultures are common. Proxemics within a cross-cultural context, such as South Africa, is thus more complex and the proxemic model put forth by Hall cannot directly be applied in design. Hall's proxemic theory is not comprehensive to the multi-cultural condition and therefore certain assumptions were made for the purpose of this investigation. In terms of seating design and general layout of a passenger train, the design implication of proxemics is thus important. Not fully regarding the personal and spatial needs of the user and the activities they involve, contributes to why current long-distance rail fails to be a competitive market in South Africa.

THE EUROSTAR PASSENGER TRAIN

by Jenner Studio
London, England
2012

A new interior for the Eurostar train (travelling between London and Paris) was conceptually developed by Jenner Studio as a vision for the future of rail travel. As transport plays an increasingly important role in the way we connect with our environment, it needs to reflect the values of a modern, changing world. The role of design, in creating sustainable living environments and giving attention to physical comfort, is motivated as necessary for contemporary passenger rail concepts.

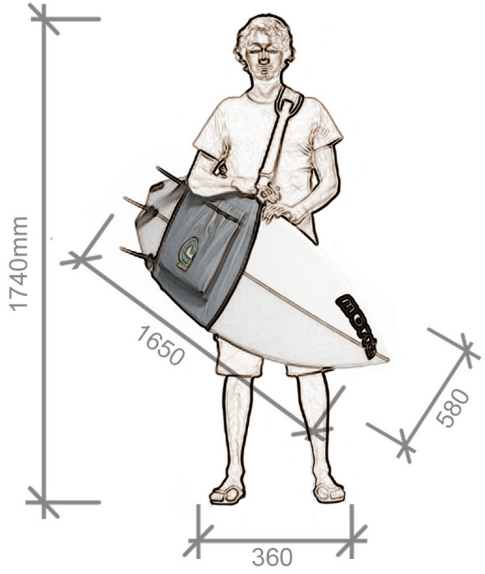
The concept builds on the significance of emotive design, on the importance of the perspective of the user, and on paying homage to the magic of travel. The concept design of the interior was completed according to the dimensions of a standard train and not a modern, wide-body train (Jenner Studio 2012). This then demonstrates how individual accommodation, in single seats, is a possibility. Individual armrests, footrests, adjustable headrests and services (such as electric sockets and internet connections) contribute to the improvement of comfort for users (Jenner Studio 2012). The possibility of affording enhanced passenger privacy through the design of the seating itself is what makes this concept remarkable. The provision of on-board entertainment with individual screens also demonstrates how the well-being of passengers can be facilitated through the vision of a contemporary rail travel experience.

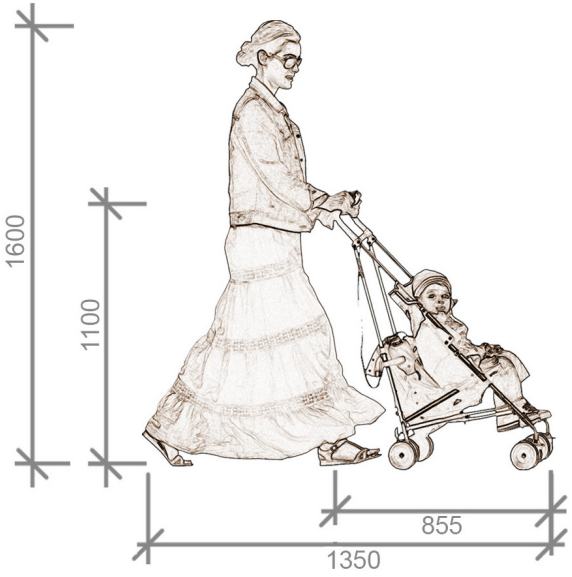
Figure 2.3: Personal entertainment screens (Jenner Studio 2012).

Figure 2.4: Private seats designed for passenger privacy (Jenner Studio 2012).

Design Application:

•Acknowledgement of the golden age of rail travel, and how it can still contribute to the needs of society, is motivated as a global responsibility. Sustainable transport provision falls under this responsibility.
•Interior environments respond to the human need for privacy within a public space and therefore emphasize the role of comfort and emotive design.





2.2.2 ANTHROPOMETRICS, ERGONOMICS AND UNIVERSAL DESIGN

Francis Ching (2007: 326) defines anthropometry as the measurement of the proportions and size of the human body. Habitable spaces can be said to function as containers for the human body. Therefore, for the body at work to function, the distancing of things and the proportions of the objects and furniture one handles should be determined by the measurements of the human body (Ching 2007: 326).

Ergonomics uses anthropometric dimensioning to enable people to execute tasks comfortably, whether walking, sitting or standing. Ergonomics can be described as the science regarding the relationship between humankind and its bodily ability to function efficiently within an environment (Nussbaumer 2012: 181).

Ergonomics and anthropometric proportioning places direct focus on the physical degree of human comfort. Movement and activity is restricted in such narrow, confined spaces as those found in a train interior. Ergonomics becomes an imminent feature when designing these spaces and forces an understanding of the dimensions and proportions of the users of the design.

The context study (refer to Chapter Three) reveals how all existing long-distance passenger trains in South Africa fail to be universally accessible.

Universal design can be defined as the establishment of products and environments that are usable and useful to the widest range of people, concerning the widest range of abilities, and functioning within the widest possible range of environments, situations or conditions (Nussbaumer 2012: 29). An universally accessible environment is therefore one which takes account of **"people who are physically disabled, people with sensory disabilities: both learning and sight, people with learning disabilities, people with mental illnesses, elderly people, young children, people with heavy luggage, people with dexterity problems, people with neurological problems, women who are very pregnant, people who are in a hurry and not looking where they are going, people that have had an accident and are temporarily disabled, people who are not wearing their glasses that day, people who are distracted or concentrating on something else"** (Osman & Gibberd 2000: 25).

The meaning behind impairment brings the need to understand the term 'disability.' Disability is defined by the United Nations (UN) Convention on the Rights of Persons with Disabilities as **"the**

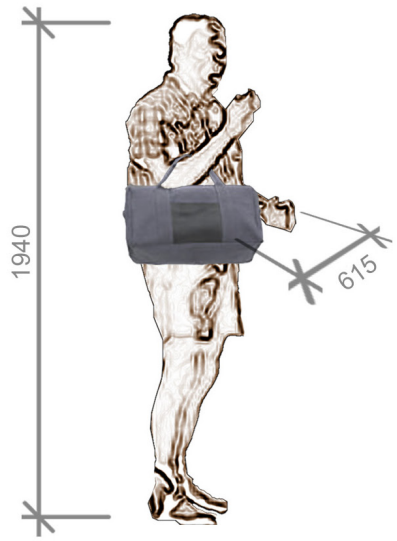


Figure 2.5: Ergonomic overview of diversity South African travellers.

interaction between persons with impairments and attitudinal and environmental barriers that hinders full and effective participation in society on an equal basis with others" (United Nations 2006). South Africa has adopted this definition of people with disabilities and has included it in Part S of the updated SANS 10400 (2011: 7). From this definition it is evident that no disability exists until the user comes across an obstacle in an environment that imposes demands the user cannot fully handle. Thus impairment becomes a disability as soon as people are faced with a lack of choice in a public environment. Emphasis on enabling passengers with impairments to use long-distance public transport is therefore a prerequisite of a contemporary passenger train.

To provide a train interior environment which is truly universally accessible and ergonomically comfortable, passengers carrying (large, heavy) luggage should be taken into account. Not only the type of luggage but also the manner in which it is being carried becomes an important design determinant; therefore, even though dimensioning mostly works with averages applicable to able-bodied individuals, an overview is conducted of the ergonomic dimensions and space requirements for movement and amenities needed to accommodate the diverse range of impairments that people experience (see Figure 2.5).

> *"Any environment that is inadequate for its intended purpose, that frustrates and annoys us, or that limits our ability to accomplish our purposes has a direct bearing on human behaviour"* (Deasy,1985:10).

2.2.3 THE PSYCHOLOGICAL EFFECTS OF TRAVELLING

Fear of travelling

Being away from home causes travellers to experience anxiety to a certain extent. Each travel instance generates an opportunity for a traveller to feel susceptible to danger (Korstanje 2011: 223).

People who have lived through traumatic events (such as accidents) are more hesitant to travel and report more symptoms of travel anxiety (Mayou & Bryant 2003: 200). This fear of travelling worsens when it rains and vision is compromised. The opportunity to travel along with relatives or friends has been shown to reduce anxiety in these situations (Korstanje 2011: 229). Anxiety can be caused by other travel- related effects, such as a fear of flying or fear experienced when having to travel without sight. The reality of any type of transportation is allied with a form of risk, where flying is widely perceived by society as a greater gamble than travelling by train, by boat or by car (Martinussen, Gundersen & Pedersen 2010: 70). This may be because of an increase in fear of flying due to health concerns and terrorist attacks (such as 9/11) and the vast media coverage it received (Van Gerwen, Diekstra, Arondeus & Wolfger 2004). Other threats and causes for added anxiety include aircraft crashes, check-in and security procedures, and a feeling of being out of control (Martinussen et al. 2010: 70). Numerous individuals (up to 40%) suffer from fear of flying, experienced as a mild unease up to severe anxiety (Martinussen et al. 2010; Fleischer, Tchetchik & Toledo 2012). A fear of flying may inflict limitations on an individual's mobility and disturb family life as well as one's career (Martinussen et al. 2010: 70). Van Gerwen, Spinhoven and Diekstra (1997: 249) propose that it is likely that a person suffering from severe fear of flying also experiences panic attacks during flights and additionally suffers from claustrophobia and/or agoraphobia.

Being visually impaired or blind may also generate a fear to travel. This fear can originate in the person himself, as a psychological effect, or from the environment surrounding the individual (Baskett 2005: 470).

Five main aspects known to cause stress and anxiety for visually impaired passengers include the possible occurrence of physical injury in an unfamiliar environment; interpersonal anxiety generated by having to interact with on-board staff or passengers (refer back to '2.2.1 Passenger Privacy'); feeling more open for attack or vulnerable; a change in one's daily routine; and ambiguous anxiety, which causes fear of the unexpected (Baskett 2005: 470).

Travel fatigue

Transient negative effects are associated with long-distance travel and are recognised as 'travel fatigue' (Waterhouse, Reilly & Edwards 2004: 946). The main factors in experiencing fatigue while travelling include (a) tediousness of the long journey, (b) a cramped posture over a long period, (c) dry cabin air, and (d) sleep loss (Waterhouse, Reilly & Atkinson 2000: 1). Anxiety from travelling, a change in one's normal routine, adaptation to the interior environment and motion sickness also result in travel fatigue (Chouker, Kaufmann, Kreth, Hauer, Feuerecker, Thieme, Vogeser, Thiel & Schelling 2010: 1). The degrees to which these effects occur differ according to the various modes of travel. Motion sickness is associated with road, air and sea travel and is also known as "carsickness". Turner and Griffin (1999: 447) state that up to 28% of individuals experience severe motion sickness when travelling.

It is anticipated that motion sickness in public road transport may be reduced with improved design which capitalizes on the outside being visible to all passengers (Turner & Griffin,1999: 459).

For long-distance commutes, immobility for an extensive period of time escalates the risk of arterial and deep vein thrombosis (Waterhouse et al. 2004: 951). This state has been labelled as 'economy class syndrome' (O'Keeffe & Baglin 2003; Waterhouse et al. 2004). The phrase 'economy class syndrome' was first used by Cruickshank in his 1988 article 'Air travel and thrombotic episodes: the economy class syndrome' (O'Keeffe & Baglin 2003: 277). Such symptoms can be alleviated in an environment where the possibility exists to walk around (Waterhouse et al. 2004: 951).

Figure 2.5: The epitomy of discomfort in transport interiors (Fidler 2014).

In conclusion it can be gathered that, as opposed to air travel, the design of the interior of a long-distance passenger train should take advantage of passengers being able to get up out of their seats and walk around. In so doing, the environment created can prevent passengers falling victim to 'economy class syndrome'. Concurrently, an interior environment can then be created which supports the occurrence of chance encounters. Rail travel can then also become a viable alternative for travellers who suffer from a fear of flying. Seating layout and orientation and the creation of break-away spaces should be explored for their potential to emphasize views to the outside and encourage

OSTRICH PILLOW
by Kawamura-Ganjavian & Studio Banana Things
Madrid, Spain
2013

Ostrich Pillow enables a micro environment in which a more comfortable power nap can be taken anywhere. It was designed ideally to use in trains, airplanes, busses, in the office, the library and other public spaces. The Ostrich Pillow is hand-stitched and filled with silicon coated micro-beads to aid in sound reduction whilst remaining light-weight. Passengers are secluded to sleep or transcend into another world (Studio Banana Things 2013).

Figure 2.6: Ostrich pillow (Studio Banana Things 2013).

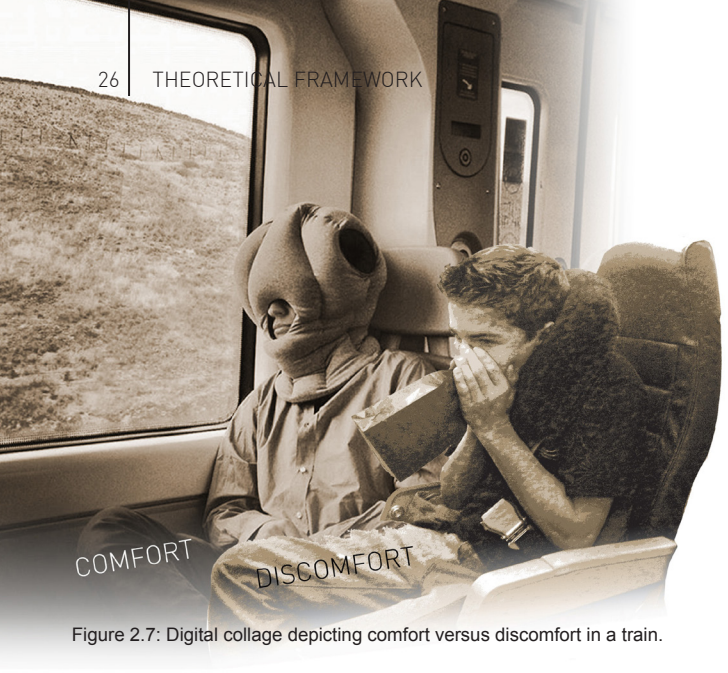


Figure 2.7: Digital collage depicting comfort versus discomfort in a train.

COMFORT PHASE	INFLUENCES
1. EXPECTATIONS	marketing, branding, hear-say
2. FIRST IMPRESSION	visual appearance, seating configurations and spaciousness, entrances
3. SHORT-TERM COMFORT	staff service and attitude
4. SHORT-TERM DISCOMFORT	comfortable seat, no obstacles
5. LONG-TERM COMFORT	onboard entertainment, scenery, opportunities for passenger to do their activities
6. LONG-TERM DISCOMFORT	variation in posture possible, upholstery of the seat
7. RESTORE/AFFIRM	possibility to complain/affirm the good experience

Figure 2.8: Stages influencing comfort, adapted from (Vink & Brauer 2011).

2.3 COMFORT

The meaning behind habitability can be extended to include the idea of comfort. Expectations and emotions (feelings of being safe, valuable or relaxed) contribute to one's first impressions of a particular environment (Vink & Brauer 2011: 2). Caan (2011: 160) also argues that comfort is another expression of our basic requirement for safety and security, and that it has developed from being a physical need to today being a psychological need as well. Therefore literal comfort, or suitable physical conditions, partnered with perceived comfort can foster a sense of well-being in people. According to Vink and Brauer (2011: 3), the difficulty of accomplishing passenger comfort is due to the fact that each passenger as an individual decides whether or not they are comfortable. In order to attain passenger comfort within a transport interior, a tool to measure and understand the idea of comfort is needed. The 'Comfort Theory' is recognised as such a tool.

2.3.1 THE COMFORT THEORY

The Comfort Theory was formulated by Peter Vink and Klaus Brauer (2011) in their book Aircraft Interior Comfort and Design. It is derived from various academic studies on comfort and ergonomics, from different authors and over a long period. This understanding of comfort was also concluded from the user perspectives of 10 032 passenger subjects. The theory was written with a focus on enhancing comfort in passenger aircraft by using design. However, the compilation of the research includes case studies concentrating on train interior layouts and services, as well as private vehicle seating design. The conclusion is made that the Comfort Theory can be applied to measure and attain interior comfort within a passenger train.

(a) Stages which influence comfort

Part one of the Comfort Theory distinguishes various stages of comfort. It is established that the experience of comfort is initially influenced by expectations. Marketing, branding, previous travel experiences and hearsay all create certain expectations and thereby influence the user's experience of comfort (Vink & Brauer 2011: 5). Upon entering the interior environment, the overall first impression of the space is then influenced by these expectations. This first impression impacts on the remainder of the travel experience, which creates the overall sense of comfort. Figure 2.8 summarises the different experiences of comfort, based on the culmination of research on comfort conducted by Peter Vink in 2005 (Vink & Brauer 2011: 4).

COMFORT	State of mind History
NO DISCOMFORT	Smell Noise Visual Input
DISCOMFORT	Climate Pressure Posture

Figure 2.9: Manifestations of comfort, adapted from (Vink & Brauer 2011).

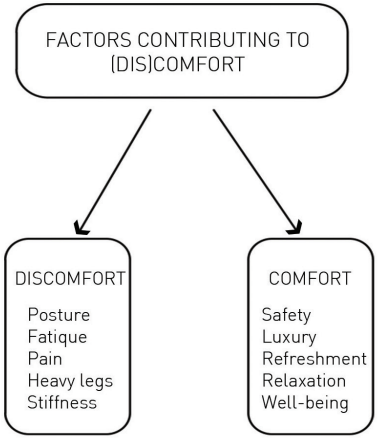


Figure 2.10: Factors of comfort, adapted from (Vink & Brauer 2011).

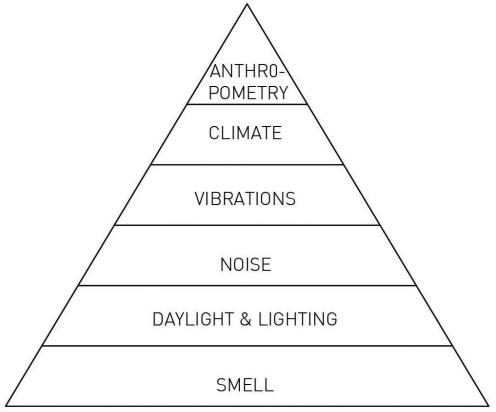


Figure 2.11: Hierarchy of main factors leading to discomfort, adapted from (Vink & Brauer 2011).

(b) Manifestations of comfort

The Comfort Theory consequently advocates three conditions which manifest in comfort: 'comfort', 'discomfort' and 'nothing experienced'. Figure 2.9 indicates the aspects which relate to each of these conditions. For long-haul passenger commutes (via airlines or trains) the comfort and service of the transport environment are key (Vink & Brauer 2011: 3).

From the different stages, a distinction between comfort and discomfort is apparent, as the incidence of comfort and discomfort is determined by different influences. Discomfort is concerned with stiffness and pressure points, where comfort points to refreshment and the degree of luxury presented in the interior environment (Helander & Zhang 1997: 911). Alternatively, when a passenger does not reason about comfort, no discomfort is experienced (Vink & Brauer 2011: 5). Conversely, a lack of discomfort does not inevitably result in comfort (Helander & Zhang 1997: 913).

(c) Inputs which lead to (dis)comfort

Numerous contributions lead to one of the three conditions of comfort. As promulgated by Bubb (2008), the main inputs which cause a negative or positive experience of comfort can be tabulated according to a hierarchy of importance (see Fig. 2.10). In essence, these factors include anthropometry, climate, noise and vibrations, and smell. Other aspects include passenger state of mind and the history of or influences from past travel experiences (Bubb 2008).

The model indicates how history influences the experience of comfort; thus the appearance of – and service within – a particular environment is subconsciously evaluated with similar past experiences as reference. This emphasises the significance of understanding the target market (Vink & Brauer 2011: 8).

A passenger's state of mind consequently influences their experience of (dis)comfort. The mindset of passengers in haste differs from that of a relaxed leisure traveller. This influences the experience of comfort within the interior environment whilst travelling (Vink & Brauer 2011: 9).

Visual information and appearance influence one's experiences in forming a first impression of comfort. Humans form an opinion of how comfortable an object is based on its form, size, patina and lightness at first sight. This visual impression is then a "mental construct" rather than an objective quality (Vink & Brauer 2011: 9).

Interior climate also has a direct impact on passenger comfort. Pleasant indoor air quality and climate often goes unnoticed until a low or high temperature or dry air causes discomfort (Vink & Brauer 2011: 11).

Posture and movements dictated by a product (such as seating) also contribute to discomfort. To avoid imposing a restricted posture, it is important for long-haul transport interiors to make variations in posture possible.

Noise and vibrations or "auditory cues" affect comfort unconsciously (Vink & Brauer 2011: 10). Within a moving vehicle, unexpected noise or vibrations cause anxiousness and therefore also discomfort. In the hierarchy of discomfort formulated by Bubb (2008), auditory cues can have a greater effect on passengers than the discomfort of their seating. Adequate pressure distribution also leads to reduced discomfort.

Subsequently, smell is a most basic factor that influences comfort and passenger behaviour. Odours within the interior and from your neighbouring passenger are sources of unavoidable discomfort.

In summation, the effects pertaining to the comfort pyramid form part of the comfort input/output schema. These inputs can further be divided into service aspects or "software", and interior aspects or "hardware". Figure 2.12 summarises these influences. Certain factors contribute to any of the three manifestations comfort could have, while others impact solely on passengers while sitting. The Comfort Theory can be used as a tool to determine where the greatest attention needs to be paid when designing an interior public transport environment – a product and service. Interaction with a product is not only a physical experience, but an emotional one as well.

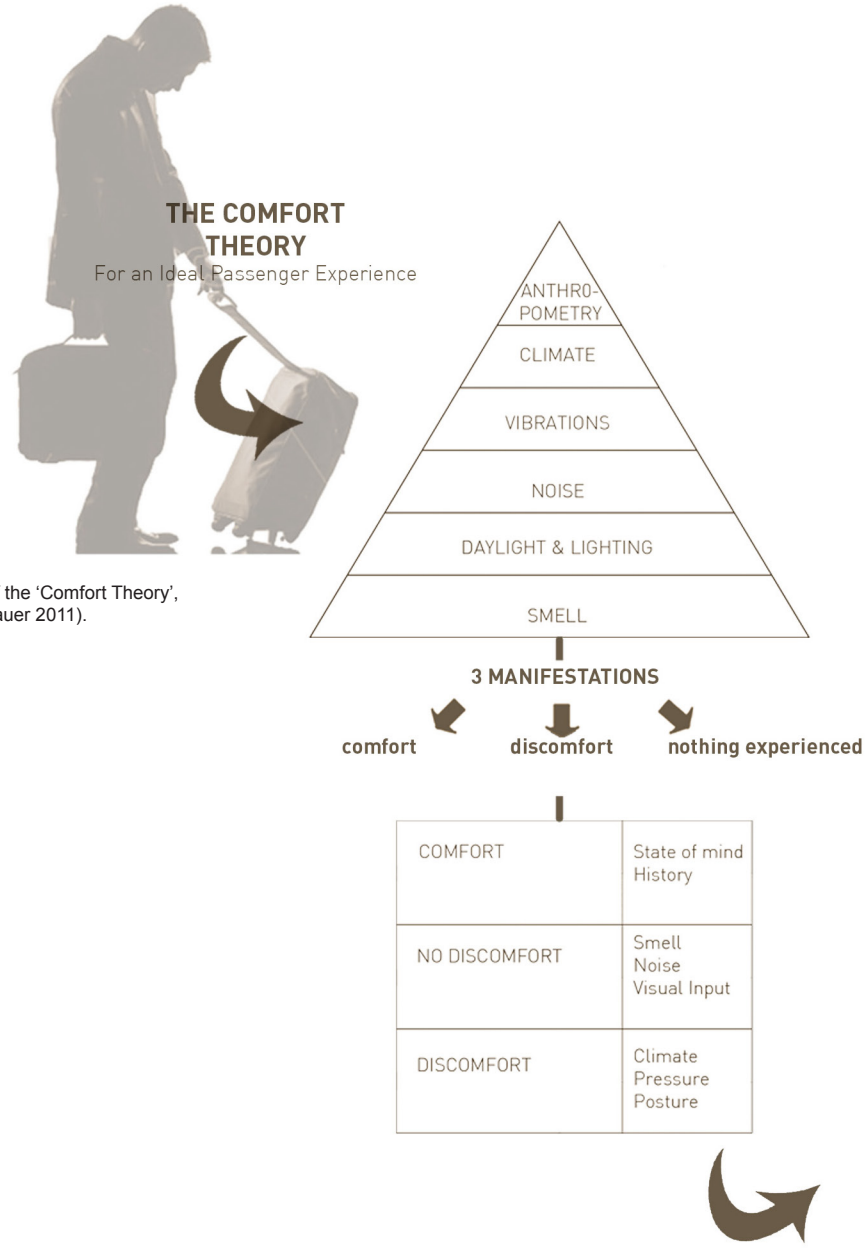
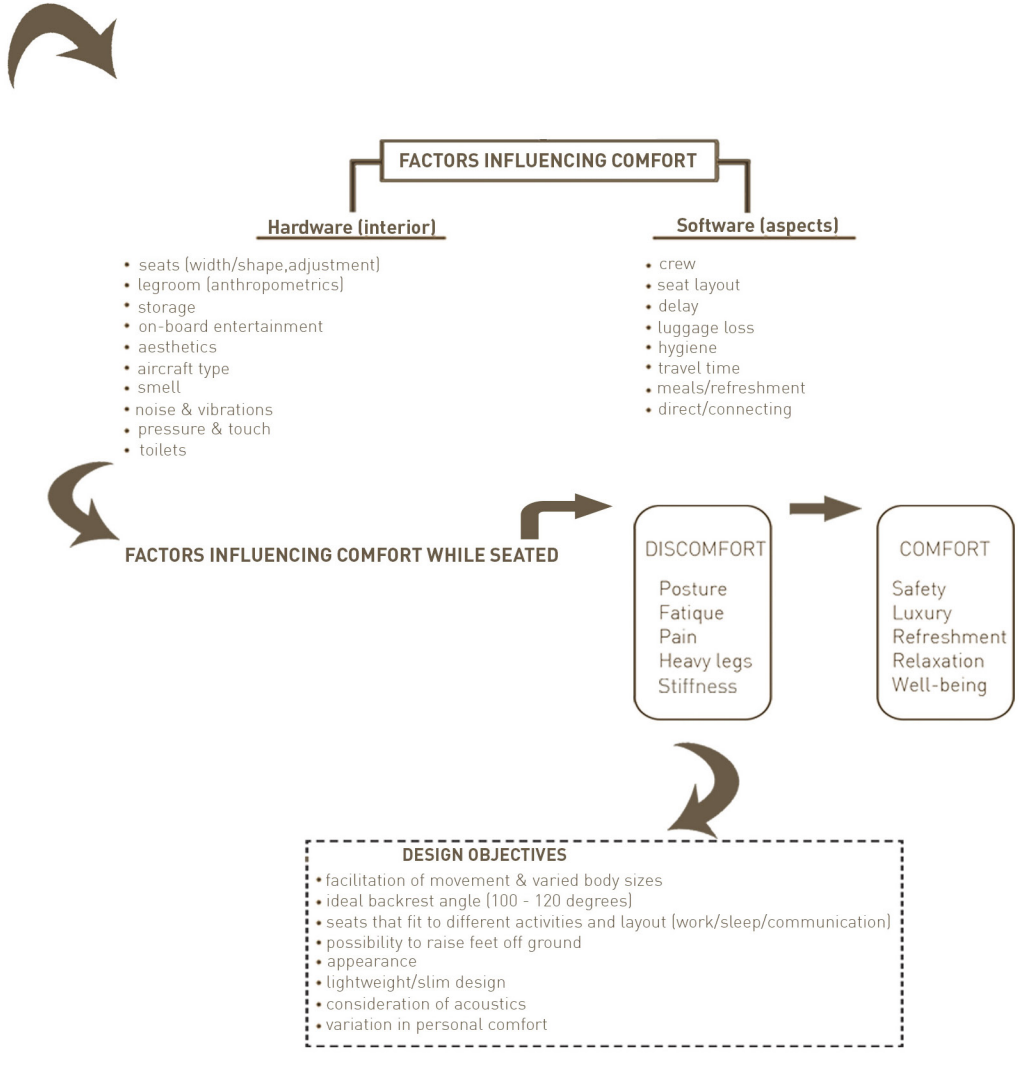


Figure 2.12: Summary of the 'Comfort Theory', adapted from (Vink & Brauer 2011).

STAGES THAT INFLUENCE COMFORT

COMFORT PHASE	INFLUENCES
1. EXPECTATIONS	marketing, branding, hear-say
2. FIRST IMPRESSION	visual appearance, seating configurations and spaciousness, entrances
3. SHORT-TERM COMFORT	staff service and attitude
4. SHORT-TERM DISCOMFORT	comfortable seat, no obstacles
5. LONG-TERM COMFORT	onboard entertainment, scenery, opportunities for passenger to do their activities
6. LONG-TERM DISCOMFORT	variation in posture possible, upholstery of the seat
7. RESTORE/AFFIRM	possibility to complain/affirm the good experience



2.4 DISCOMFORT IN CURRENT SOUTH AFRICAN PASSENGER TRAINS

The current comfort of train interiors and the experience they offer South African long-distance travellers was investigated. The findings were informed by the experiences of the author, who travelled from Johannesburg to Cape Town on the Shosholoza Meyl Tourist Class in August 2013.

This personal experience of the journey is presented in a reflective report based on the model of reflective writing provided by Hampton (2010). The author's experiences were analysed in line with the protocol for narrative analysis provided by Creswell (2007: 159), based on Moustakas' (1994) method of heuristic inquiry. The data revealed five main problematic factors pertaining to the current condition of long-haul rail. The rail travel experience emphasized the disregard for human comfort within the train.

2.4.1 HEURISTIC EXPERIENCE: THIRTY ONE HOURS ON THE SHOSHOLOZA MEYL

(a) Physical discomfort

Physical discomfort was experienced on the train due to a general lack of ergonomic considerations. Passengers struggled to enter the train. As I reached the door I realized how difficult it was to hold onto the train, open the door and simultaneously slide my body and luggage into the train.

Additionally, the bunk beds in the cabin were inaccessible as ladders were not provided in all cabins, the luggage racks were hard to reach and the general cabin space felt uncomfortable because of additional, but unusable, items such as a broken basin. The spatial planning does not cater for waiting space in front of the exits (which are situated next to the toilets), resulting in a very uncomfortable space. Sensorial discomfort was also experienced, particularly olfactory, auditory and thermal discomfort. A burning rubber smell was particularly perceptible and after a while you become sort of nauseous. The hard surfaces amplified train noise and vibrations and I suffered severe discomfort from the cold which deprived me of sleep.

(b) Psychological discomfort

A general sense of emotional discomfort is caused by the extent of the commute. I found the duration of the 1600km journey taxing. In the end, the dreaded 27 hour journey escalated to 31 hours of discomfort, stress and frustration.

The constant sideways movement of the train caused anxiety, especially when you needed to move from one train car to the next. Emotional comfort can be equated to what Caan (2011: 68) refers to as 'perceived comfort' which includes aspects "such as feelings of being secure, upbeat, valuable, and important". In terms of safety I did not feel threatened, which would have led to physical discomfort, but that I did not feel optimally secure during the journey.

Particular spaces on the train can be associated with psychological discomfort. For example, the cabin lacks a sense of comfort, presumably mainly due to the material use in the space. The hard and glossy surfaces render the cabin industrial. You do not feel as though you can make it your own space for thirty hours.

The dining car is claustrophobic and similar in character to the cabins. Similarly, the train corridor also indicates a strong sense of psychological discomfort. The corridor is intimidating- it is narrow and just keeps going. Repetitive lighting on both sides make it feel clinical.

(c) Social interaction opportunity

There is a lack of opportunity for social interaction on the Shosholoza Meyl. On the most basic level the train does not provide benches in the corridor or a small lounge where one can socialize. On the Gautrain people often engage in informal conversations with strangers. This may be because

Figure 2.13: Journey narrative from Johannesburg to Cape Town via the Shosholoza Meyl Tourist Class train.

the Gautrain has 'conversational' spaces where people are forced to face one another and start a conversation.

People on the train instinctively look for ways to socialise by moving outside their cabins into the corridor to claim that section of the corridor as an extension of their inner shared space. On the contrary, there remains a perceived lack of interaction on the train. On a previous journey (with a group of students on the Shosholoza Meyl Economy) we as a group were very boisterous, but that when we left our seats to move through to the dining car, it was dead quiet, nobody spoke.

(d) Wayfinding

Several stoppages and hold-ups were experienced during the journey. Of significance is the fact that I never knew why the train was on a stand-still or what was happening. We had to rely on hear-say amongst passengers. Train personnel did not communicate information on the train's current position or status to passengers. I thus noticed the apprehension of the passengers in the neighbouring cabin from the fear of not being able to disembark at the correct station.

With regards to context specific experiences, difficulties were also experienced in the dining car; you stand in the doorway to order and pay. There is no menu, no recognizable pay point and nobody to ask for assistance.

This disregard for accurate wayfinding starts the moment passengers leave the cabin to go to the dining car. If it is your first train journey, you may walk in completely the wrong direction. If you don't concentrate you won't know where you are. Everything looks identical in the corridor.

(e) Contextual disconnect

I experienced a contextual disconnect between myself as a passenger and my perception of the train. The appearance of the train's interior does

not feel like a modern place for the generation of today. Whistling sounds of the old train made me feel like I had transcended back into an earlier time. Although mesmerizing, I could not associate with this. The train itself sounds old, as though something is wrong.

In addition to this, there was a disregard for contemporary society's reliance on technology for entertainment. The train does not provide any place to charge devices, nor does it provide any form of 'on-board entertainment' (technological or otherwise). All my technological devices (phones and cameras) eventually stopped working on the extended trip. I can react more comfortably to a space which allows for the technological devices I use to perform daily tasks. I missed the ability to stay in touch.

The train lacks a strong sense of place. This is evidenced by the fact that the train does not accommodate for the types of luggage local travellers typically use, or the manner in which it is carried. I watched other passengers as they passed their luggage into the train through the windows.
Subsequently, the spatial planning is out of date in terms of the demands of the diversity of South African users and their needs. It falls short of a strong connection with the democratic spirit of South Africa. The Shosholoza Meyl policy prohibits mixing passengers of different gender and race within the same compartment when these passengers are not travelling together. Although this adds to a perception of safety, the lack of accommodation for social functions is limiting to the needs of contemporary South African travellers.

In contrast, I experienced a different emotion from the scenery of the surrounding landscape visible from the train. The train travels through the back of farms and flower fields – scenery which you would not otherwise have experienced.

It is evident that my identity as a 21st century South African traveller is not met by the current identity of local long-haul rail.

2.4.2 OUTCOME OF THE HEURISTIC EXPERIENCE

To avoid a constant loss of clientele, the train interior, as a habitable space, must address comfort on a more holistic level. When discussing comfort in interiors, Hausladen and Tichelmann (2010: 32) state: **"...we expect much more from an internal space than just protection from the weather: it should be readily usable and illuminated, attractive, well-proportioned and well laid out, offer safety and security, but also provide the chance for contact with the outside world, reflect its cultural background and represent its users."**

It has been established when interior spaces provide suitable physical conditions, partnered with perceived psychological comfort, they can foster a sense of well-being in people. To reach this objective, train interiors must be approached in terms of human habitation, which implies the consideration of the functional and psychological needs. This approach requires consideration of the travel experience in its entirety – a sense of comfort must be present from entry to exit, in all the interior spaces for the duration of the journey.

From the research it is evident that train journeys are often synonymous with travel fatigue and that these symptoms can be countered through movement and increased external visibility (Turner & Griffin 1999: 459). Although passengers can walk around, the author's heuristic experience indicates that they rarely do. This may be as a result of the lack of wayfinding design within the train. The Center for Inclusive Design an Environmental Access (2010: 1) describes wayfinding as "how people get from one location to another, including their information gathering and decision-making processes for orientation and movement through space". When wayfinding is neglected, users find it difficult to comprehend and subsequently use interior spaces. Wayfinding design requires the careful consideration of spatial organisation, architectural articulation and environmental information systems (including signage) in the interior. When successful, these aspects **"can assist users to find their way and maintain their sense of orientation, factors that contribute substantially to their satisfaction and frequency of use"** (Center for Inclusive Design an Environmental Access 2010: 1). The interior of long distance trains should encourage passengers to move around by applying wayfinding design principles spatially. Ideally, train interiors should also be designed to foster chance encounters. Seating layout and orientation as well as the inclusion of break-away spaces should be explored to encourage movement, to emphasize views of the landscape and as places for social interaction.

Travel experiences are typically associated with a loss of privacy (see Figure 2.2). However, privacy and social interaction are not mutually exclusive. Caan (2011: 76) states that human nature exhibits consistent dualities (such as 'the private' versus 'the public') and that humans cannot survive without a balance between these two states. The heuristic experience indicates that a loss of social contact over an extensive period of time, exacerbated by a sense of discomfort, may lead to feelings of alienation. Privacy, and by extension, the need for social interaction is largely a cultural construct that varies according to time and place (Caan 2011: 72). The author's observations about South Africans' "unique social needs" hint at the need for an in-depth local exploration of spatial requirements in the interior. This may in turn, help to generate an identity within train interiors that users can identify with.

The positive experience of the landscape emphasises the potential it holds within the interior of the train. Pallasmaa (2005: 13) describes the need for peripheral vision in space: **"Peripheral vision integrates us with space, while focussed vision pushes us out of space, making us mere spectators".** Views of the landscape, when celebrated and not merely treated as accidental due to the presence of a window, can assist in creating a deeper embodied experience of the context. Both Sharp (2013: 75-91) and Perry (2013: 95-107) discuss the link between driving and the embodied experience of the surrounding environment. Sharp (2013: 79) states that the embodied experience of driving and of being in a car, provides a site in which to understand the meanings of place. Perry (2013: 98) refers to the work of Borden (2010) who suggests that the surrounding environment, when experienced through the mobile and animated activity of driving, can generate a range of social and cultural meanings and powerful emotions, thoughts and sensations in the motorist. The emotions may be triggered by memories of the landscape, by feelings of anxiety or excitement about departure and arrival at another place (Merriman 2007: 218) or from a detachment from the here and now through "states of distracted, imaginative wanderings" (Morse 1998 in Sharp 2013:79). Although the experience of driving differs from that of travelling by train, both modes of travel offer visual encounters of the landscape whilst in motion. The interior of the train can therefore be viewed as a potential site for a deep emotional connection with the landscape. Interior design is concerned with the mediation between user, space, skin and landscape. Although this relationship is constricted within the train interior, it should be explored to offer the user a more meaningful spatial experience that addresses the feeling of 'disconnect' from within the train.

Rose (1997: 89) argues that **"a feeling of belonging is essential to the relationship between identity and place: it's a place in which you feel comfortable, or at home, because part of how you define yourself is symbolized by certain qualities of that place".** It is clear that the train in its current state does not embody a contextual identity. The lack of comfort, associations, social space and wayfinding combine to create a space disconnected from the identity of its users.

Figure 2.14: South African landscape from the train window.

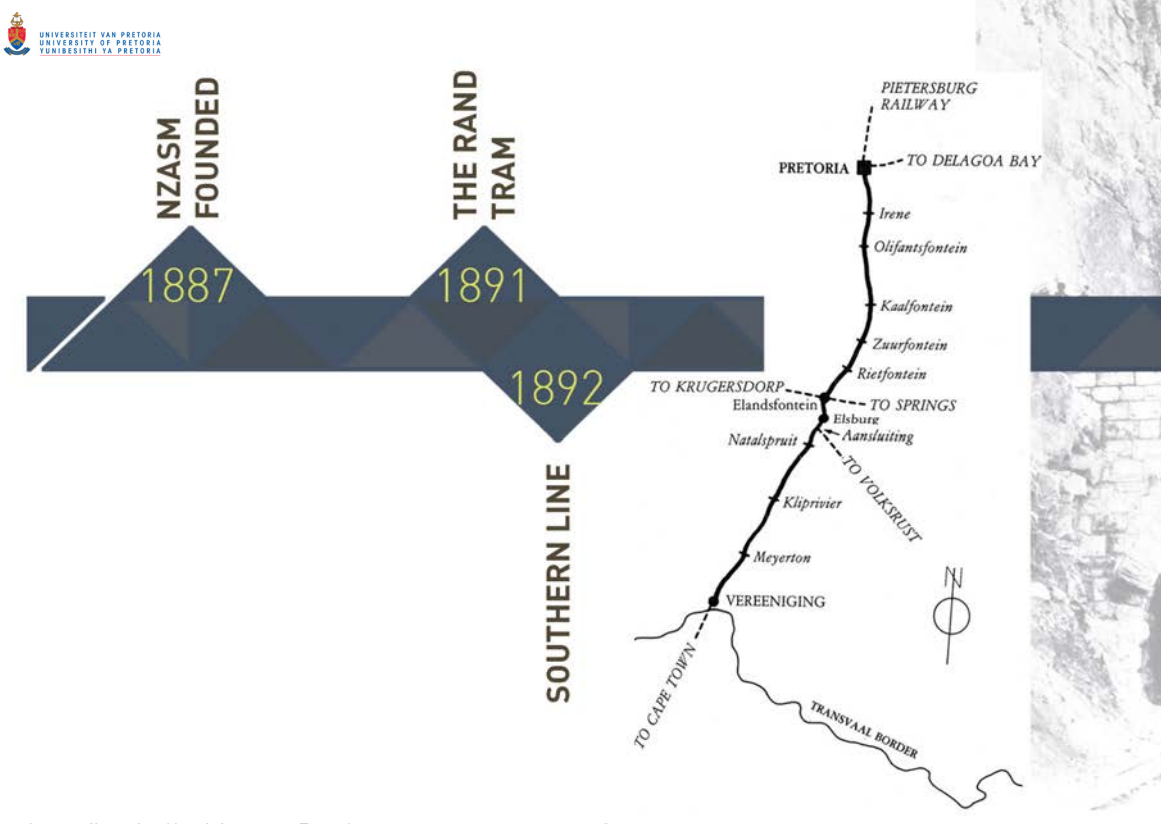
2.5 CONCLUSION

This chapter formulated the theoretical framework and identified the Comfort Theory as tool provide in physical, social and psychological user needs within a transport interior. The nature of an interior environment (and the objects therein) should support the user occupying the space, whether it be temporary or permanent.

Design for human well-being is the arsenal for transforming the train interior envelope into a travel experience currently unavailable in the South African context.

CHAPTER 03

context



3.1 INTRODUCTION

The purpose of the context study is to give an overview of the history of rail in South Africa and establish the significance of the existing mainline tracks. Existing local passenger trains are investigated in order to determine their strengths and weaknesses. Subsequently the need for a contemporary passenger train is identified. This chapter then identifies and proposes an appropriate route and existing train structure on which to conduct the intervention.

3.2 HISTORICAL CONTEXT

The proposal of a railway system in the Cape and Natal colonies came about in the late 1850s (Metrorail 2013). From the late 1880s, the gold boom in the area of Witwatersrand led to significant improvements in the industrialisation of South African developments and to attaining President Kruger's political aim, i.e. to lay a railway track to the harbour of Delagoa Bay (today known as Maputo) (De Jong, Van der Waal & Heydenrych 1988: 9). The discovery of gold led to strong conflict between the British forces and the national resistance. These forces fought all over the Transvaal for the main railway across the Transvaal all the way to Delagoa Bay. The conflict drew to a close in 1910, and the harbours and railways that led to major bloodshed were utilised to support and structure the unity of the country – to the benefit of all citizens. By the time the conflict was over, more than 11 000 km of railway track were laid and used for freight as well as for commuters (Metrorail 2013).

3.2.1 THE SIGNIFICANCE OF THE NZASM

The Nederlandsche Zuid-Afrikaansche Spoorweg-Maatschappij (NZASM) was a private company that initiated the idea of building a private railway in the Boer Republic of South Africa, which was (at that time) under the rule of government railways (De Jong et al. 1988). Due to their involvement in the unification of previous conflicted societies, the NZASM forms part of the heritage linked to the railway history of the Zuid-Afrikaansche-Republiek (De Jong et al. 1988: 9).

The Eastern Line

In 1872 the ZAR started to draw plans to lay an entire railway line between Pretoria and Maputo, from the idea generated by the land surveyor, George P. Moodie (De Jong et al. 1988: 26). In 1873 the then president of the ZAR, Thomas Francois Burgers, approved a concession to Moodie to lay a railway line that would link the Lebombo Mountains, east of the border of Mozambique, with Klipstad (today referred to as Ermelo) on the Highveld. In 1874 Moodie's entire plan collapsed due to financial constraints, without having made any progress (Van Winter 1937: 9).

Building the Eastern Line proved to be more difficult than anticipated. Financing the railway posed the biggest challenge (Engelenburg 1987: 15). The realisation of the railway line was also interrupted

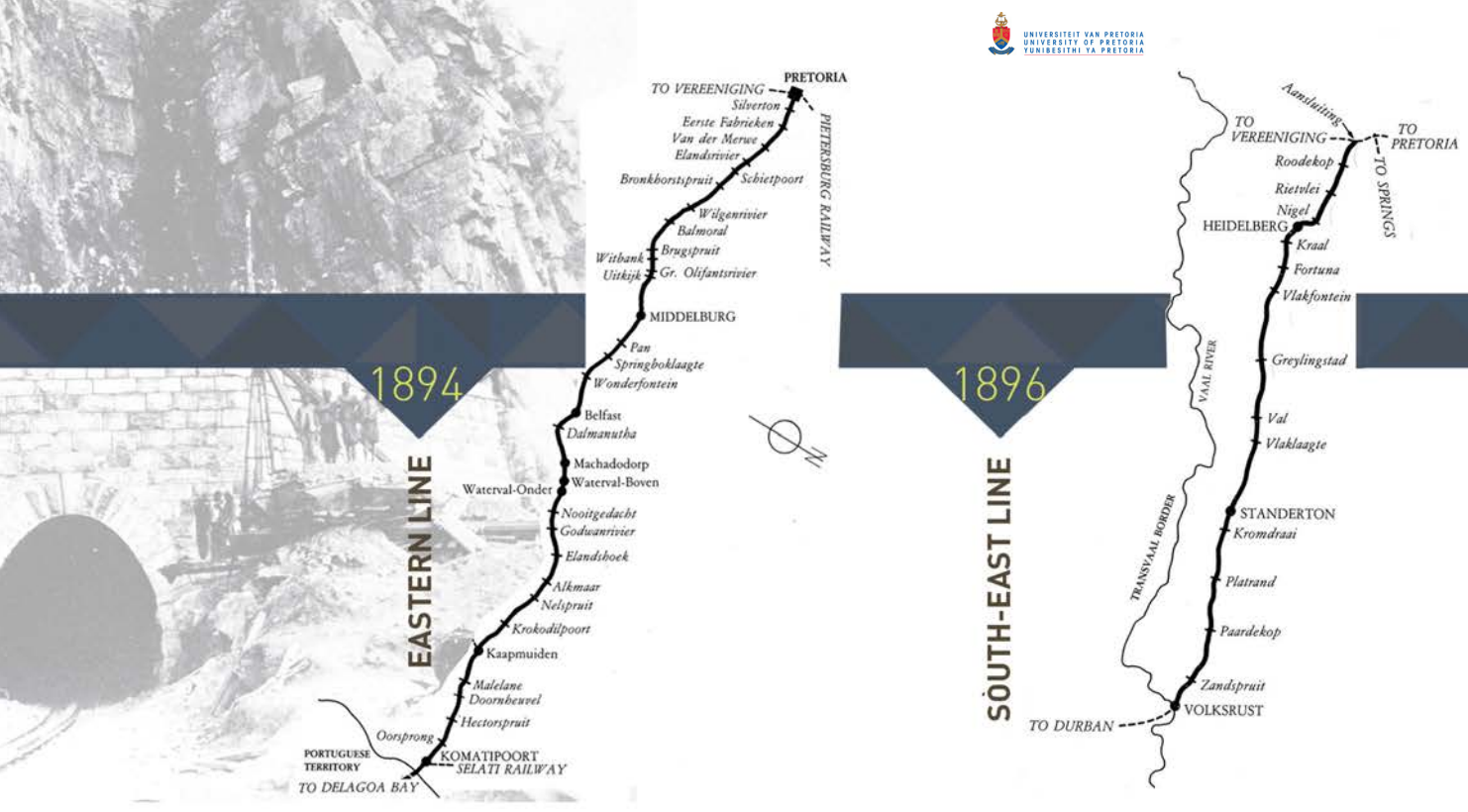


Figure 3.1: Timeline illustrating the historic developement of South African railways.

by the forced war of the ZAR against the Pedi of the Sekhukhune tribes. The First Anglo-Boer War followed shortly after (1877 to 1881), when Sir Theophilus Shepstone annexed the ZAR for Britain (De Jong et al. 1988: 27). When the ZAR regained its independence in 1881, Stephanus Johannes Paulus (Paul) Kruger was elected as the new president. Pres. Paul Kruger was the driving force behind the ZAR establishing a railway link between Pretoria and Maputo (Engelenburg 1987: 16). In 1886 the biggest discovery that enabled the ZAR to lay railway tracks to the eastern front of Maputo, and across the rest of South Africa, was the discovery of gold on the Witwatersrand (De Jong et al. 1988: 35). After this discovery the NZASM was established, with the main goal of finishing the railway line to connect Pretoria with Mozambique (Van Winter 1937: 172).

The gold mining industry slowed down in 1887, which had an effect on the progress of the railway line to the East, but returned to normal development in June 1890 (Van Winter 1937: 209). However, many calamities influenced the slow progress of the Eastern railway line, and despite all the problems the first train crossed the Komati Bridge into Mozambique on the 14th of May 1891 (Engelenburg 1987: 25). President Paul Kruger personally tightened the final screw on the completion of the railway on 2 November 1894 at Brugspruit Station. The ZAR held the official opening of the railway from 8 to 10 July 1895, (De Jong et al. 1988: 48).

The economy benefited tremendously as a result of the success of the Eastern Line. The railway line enabled faster and more affordable transportation

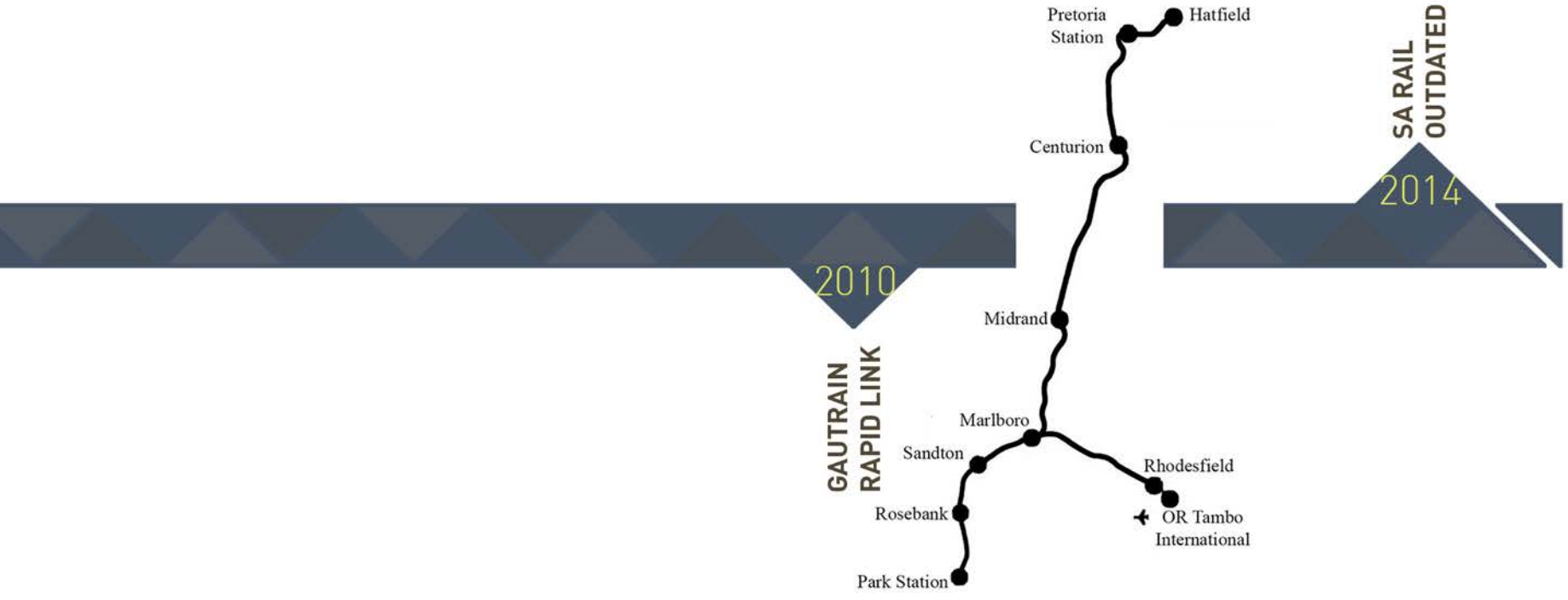
over a larger area of land than ever before (Greyling 2000: 49). The number of passengers that utilised the train service doubled in the period 1895 to 1897, when passenger numbers grew from 1 050 598 to 2 363 938 (De Jong et al. 1988: 66).

The significance of the railway line can further be articulated when considering the period of the second Anglo-Boer War (1899-1902), during which the Eastern Line served as an escape route for President Paul Kruger on 29 May 1900 (Greyling 2000: 14). The eastern railway also hosted two major battles during the second Anglo-Boer War. The first took place from 11 to 12 June 1900 at Diamond Hill, and the second at Dalmanutha, on 27 August 1900 (Greyling 2000: 17). After these events the developments by the NZASM stopped, and by 1908 the NZASM had ceased to exist (De Jong et al. 1988). Still, by the 1950s, the South African Railways (as they were known then) provided railway transport to more than 274 million passengers and established its name by claiming to be the biggest railway company on the African continent (Metrorail 2013).

During the following century, no major development took place to improve the rail infrastructure which took so long to realize. Instead, passenger rail development in South Africa became static.

The Rail Road Association of South Africa (RRA) (2014) state that rail transport was the norm for passenger travel in South Africa well into the 1960's, but that improvements to national and provincial roads **"coaxed much first and second-class traffic from rail"** and that **"the development of the long-distance mini-taxi industry after 1977 was the final blow for the third-class rail market".** Not only did passenger numbers decline, but infrastructural improvements also slowed down. The RRA highlights this by stating:

"The railway administration of the time failed to recognise the fundamental changes that were taking place in the passenger transport market. The focus was on goods transport, since main line passenger services were considered to be a loss-making 'social service'. Nevertheless, substantial investments were made by acquiring new passenger coaches, but of a design already out of date for most traveller requirements. [...]This led, ultimately, [to] long-distance passengers and commuters in particular, being forced to switch to road transport."



Today

Only in 2006 was procurement of the Gautrain Rapid Rail Link project initiated. Phase one came into operation at the start of June 2010, and the final phase was completed on 7 June 2012 (Gautrain Management Agency 2013: 34). To alleviate the severe traffic congestion experienced on the Gauteng road networks, it was decided to link the key economic nodes in Gauteng by way of a rapid rail link (Gautrain Management Agency 2013: 34). Today the OR Tambo International Airport and the Pretoria and Johannesburg Central Business Districts are connected and accessible via the Gautrain Rapid Rail Link. As the first rapid rail service in Africa, the Gautrain has given South Africans a taste of the benefits of world-class passenger rail transport (Gautrain Management Agency 2013).

Conclusion

From the timeline (see Fig. 3.1) it is evident that, with the exception of the Gautrain, no significant advancements have been made to upgrade and maintain passenger rail as a usable service. The success of the Gautrain for short-distance travel sets the new benchmark and awakens the need for a contemporary long-distance passenger rail service.

The railway had thus significantly increased the mobility of South Africans in the past. However, it is evident that, with the exception of the Gautrain, no drastic development of the NZASM railway initiative has since been undertaken. The potential market for contemporary long-distance rail travel in South Africa can therefore be identified.

MERCURY: MOVING PLATFORMS

by Priestmangoode
London, England
2010

Priestmangoode was responsible for the design of the first 'lie-flat' seat for Virgin Atlantic airlines and, at that time, served as an evolution in improving comfort for passengers (Priestman 2013). Competition between airlines no longer only involved ticket price, but comfort as well.

The Mercury train is designed to offer a transport option that offers more than the alternative modes of travel. Mercury is a double-decker train that introduces an interior concept that sets out to re-invent national rail travel and to provide a contemporary travel service. Its spatial arrangement is divided into a 'first' and 'second' class. The train is designed to incorporate an open plan layout to encourage interaction without compromising privacy. The concept mixes conventional unidirectional seats and private berths (for business meetings or families) within the same train coach (Priestmangoode 2010). As an ideal, the train also incorporates a children's play area and a bar in the first class section. To add more luxury to first class, a viewing platform and a lounge area was also suggested (Priestman 2013).

Design Application:

• Technology needs to be incorporated into trains as part of the benefits of rail travel. Integrating opportunity to use devices, such as tablets, laptops, cellphones etc., as part of the fabric of the train will enable rail travel to become a competative market in the transport industry. This will especially be an advantage when compared to air travel, where the use of devices is not a possibility.
• The accommodation of the needs of the passenger, or the travellers' perspective, can become the catalyst for change.

Figure 3.2: Interior concept of the Mercury Train (Priestmangoode 2013).

3.3 PASSENGER TRAIN TYPOLOGIES IN SOUTH AFRICA

3.3.1 INTRODUCTION TO CRITICAL ANALYSIS

As the focus of this dissertation falls within the parameters of train interior and small-space design, an important research component pertains to the analysis of the passenger train as a typology. This section of the context study presents and investigates the existing passenger trains currently running in South Africa. They are categorized under the different market sectors, including long-haul, short-haul, high-speed and safari trains. Each passenger train is discussed individually and subsequently acts as a precedent to apprise the author on the typology. Conducting personal train journeys allowed first-hand understanding of the context and how passenger train services operate locally.

Karl Kottenhoff and Evert Anderson (2009) identify "speed, simplicity and comfort at a low price" as criteria for determining the attractiveness and efficiency of trains. This argument is reinforced by the recognition of 'time', 'cost', 'reliability', 'convenience', 'comfort' and 'security' as the most important traits that determine modal choice decisions (Crockett & Hounsell 2005: 536). These assessment criteria are adapted for conducting an analysis more specific to the aims of this study. A critical analysis is important as a design informant. The role and functioning needs of a contemporary passenger train can therefore be determined. The trains and their interiors are investigated according to their physical and psychological functioning. These aspects therefore determine the practical and emotional experiences and attractiveness of the journey to the users. The adapted assessment criteria include:

1. Interior environment
2. Programme
3. Structure
4. Cost
5. Time
6. Safety and security
7. Services and systems
8. Universal access

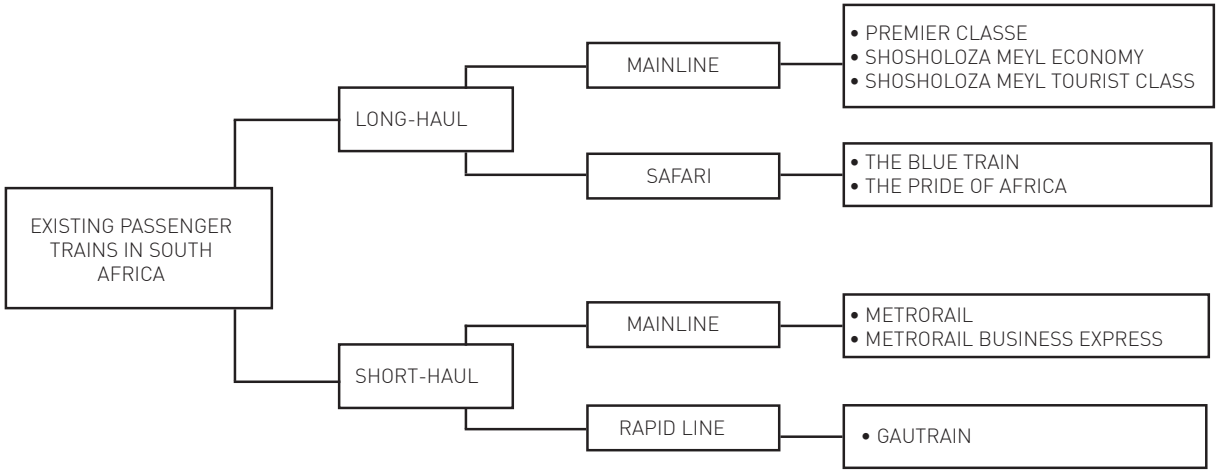


Figure 3.3: Current South African passenger rail services.

Figure 3.4: Interior of Metrorail sitter car (Ballantyne,1994).

3.3.2 (a) METRORAIL

Origin: 1990
Train speed: 100 km/h
Trip duration: Varies
Frequency: Daily (1-16 trains per day)
Passenger capacity: 48 per carriage sitting
Cost: From R5-50

The South African Transport Services (SATS), a state-owned entity, provided rail and road public transport services prior to 1990. Both Transnet and the South African Rail Commuter Corporation Limited (SARCC) took over this responsibility as from April 1990. Today Metrorail operates as a division of Prasa on the mainline tracks (Passenger Rail Agency of South Africa 2009).

Time and cost
Metrorail trains operate daily between 03h00 and 19h30. In theory these trains are supposed to be a convenient, inexpensive mode of travel. However, they are currently experienced as unreliable, with frequent delays due to late train arrivals. This impacts negatively on passengers' lives, causing them to arrive late for work and to pay for a service that is not delivered. It also causes overcrowding of the next scheduled trains. An uneven spread of journey times on the current time tables also contributes to overcrowding during peak hours.

Safety and security
There are no train staff or security personnel on board to control passenger safety. In capital cities (such as Tshwane and Cape Town) the demand for inexpensive public transport is high. Compared to other public transport modes, Metrorail provides one of the least expensive services, therefore its main users fall into the lower income groups. In a strategic plan for Prasa, Deyer, Ngwira, Heyns and Mobs (2012) identify ticket fraud as one of the major problems currently experienced by Metrorail. The manual ticketing system makes it hard to control ticketless travel and also causes "short ticketing" (where passengers purchase a ticket to the next nearest station but make a longer journey).

Services and systems
Current Metrorail rolling stock lacks essential facilities with regard to passenger comfort, such as heating, ventilation and cooling systems.

Interior environment
Metro trains provide sitting and standing accommodation only in order to achieve a higher carrying capacity; however, with the large passenger demand and unreliability of the service, overcrowding still occurs. Deyer et al. (2012) state that the interior seating types and configurations need to be redesigned and provided to be appropriate to the route length and time table. Due to vandalism and unmaintained interiors these trains are an unpleasant environment to be in. The linoleum floors are practical but have also exceeded their lifespan. Other hard interior finishes also contribute to inadequate noise and vibration absorption. All of these factors affect passenger comfort and the quality of the service itself.

Conclusion
Security and safety on trains can be improved to increase the attractiveness of rail travel. This can also be achieved by implementing an electronic ticketing system as opposed to a manual system, reducing incidences of ticket fraud and, subsequently, overcrowding. Lack of capacity can also be alleviated by providing a train service during the evening. Thus it is evident that the need for a night train and the importance of interior planning and layout can be identified. The provision of service impacts either positively or negatively on the comfort and well-being of users.

Figure 3.5: Wasted space in Metrorail Business Express (Ballantyne,1994).

Figure 3.6: Work space and vending in Metrorail Business Express (Ballantyne,1994).

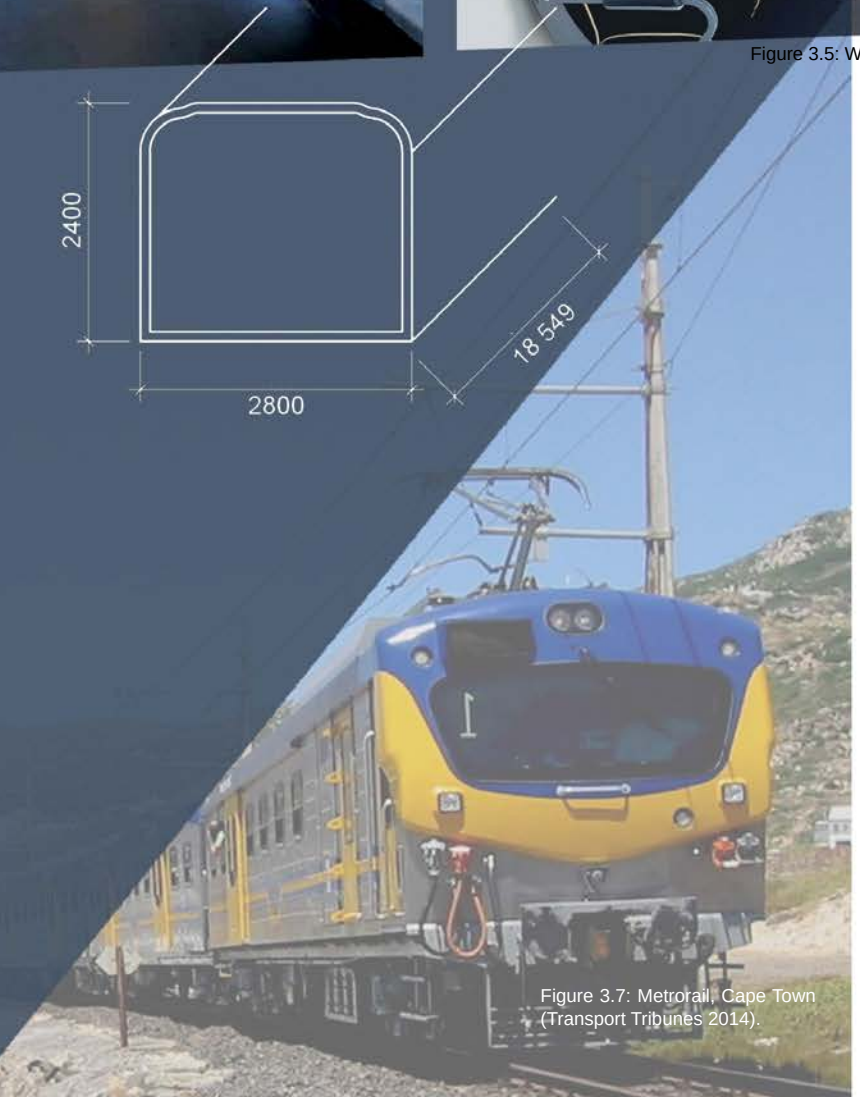


Figure 3.7: Metrorail, Cape Town (Transport Tribunes 2014).

3.3.2 (b) METRORAIL BUSINESS EXPRESS

Origin: 1990
Train speed: 100 km/h
Trip duration: Varies according to route (90 minutes, Pretoria – Johannesburg)
Frequency: Daily
Passenger capacity: 48 per carriage sitting
Cost: R320 (one week pass)

The Business Express also operates under the South African Rail Commuter Corporation Limited (SARCC) and runs on the mainline tracks.

Time and cost
Business Express trips are scheduled between 06h20 and 18h10 daily. Despite this daily travel frequency, the limited routes available throughout the day result in few travel opportunities. The specific client target results in low passenger demand, as the Business Express service offer is generally ignored. This currently leads to train set inefficiencies (Deyer et al. 2012: 43).

Interior environment
Business Express trains are designed to accommodate each passenger in a personal seat. The seating configurations provide unidirectional seating as well as facing seats. This allows business conversations, socializing or private sitting spaces. Contradictory to this, the seating layout wastes space. Reconfigured seating arrangements could increase capacity and service revenue. Even though the spacious personal seats allow a high level of passenger comfort, the seat type is more appropriate for long-distance commutes. Replacing the seats with an appropriate type will also allow for a higher capacity. Lowered costs may then increase passenger demand.

Safety and security
Security officials at each entrance/exit put the minds of passengers at ease. Ticket fraud and short ticketing is not such a problem as with the Metrorail services, as security is easier to regulate.

Services and systems
Upon embarking, passengers are welcomed with the morning newspaper and can help themselves to a cup of coffee from an on-board vending machine. Passengers can work on the train at the designated workstations in each train car, where electricity-points are provided. Alternatively, the seating layout allows for socializing or just taking in the city scenery as one travels to or from work. Heating, cooling and ventilation are regulated with a fitted HVAC system.

Structure
The Business Express attempts to offer a contemporary metro service within a train of which the technology is already outdated. For short-distance commuter transport, speed is a vital factor in gaining market share (Kottenhoff & Andersson 2009: 2). The basic structural dimensions of the Business Express are similar to that of the Metrorail trains.

Conclusion
The concept behind the Business Express train is viable, but the train speed and the emphasis on specific targeted users sets back the success of the service.

Figure 3.8: Gautrain interior (Gautrain Management Agency 2012).

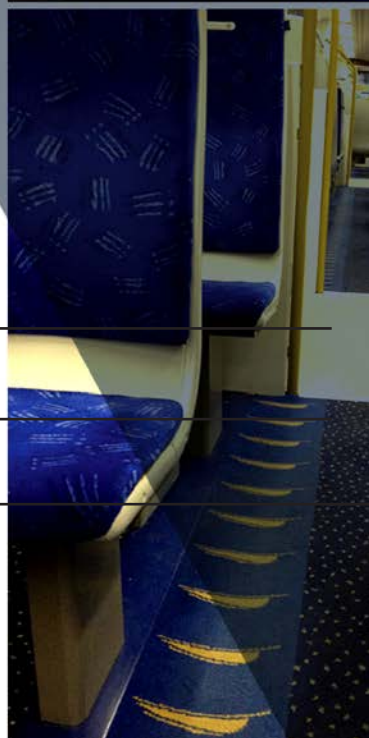


Figure 3.9: Linoleum floor finish in entrances allows for easy maintainability.

Carpet floor finish allows for acoustic absorption in train interior.

Figure 3.11: Rubber sealants between structural interior elements to reduce interior noise and vibrations.

Figure 3.10: Rubber sealents.

Figure 3.12: Large luggage rack (for passengers travelling to and from OR Tambo International Airport).

Figure 3.13: Grabrails for universal accessibility.

Finished floor level of train on same height as platform.

Figure 3.14: Universal accessibiity.

3.3.2 (c) GAUTRAIN

Origin: 2010
Train speed: 160 km/h
Trip duration: Varies (42 min; Pta Station – Jhb Park Station)
Frequency: Daily (peak times: train every 12 minutes)

The Gautrain aims to provide fast journeys with a premium service. It does not operate on the mainline, and new infrastructure was specifically planned and designed for the Gautrain rapid rail link.

Time and cost
Twenty-four trains operate daily between 05h24 and 21h12. The trains are punctual and fast. Even though the cost is greater than that of other train services it is still being widely used since its inception in 2010. The route from Pretoria Station to Johannesburg Park Station is completed within 42 minutes, which is half the journey time of the Business Express train along this same route. A further advantage is the no-booking policy of the Gautrain.

Safety and security
On-board security personnel circulate the train constantly and are equipped with CCTV satellite monitoring. These safety measures make passengers feel safe during the journey and comfortable with using the Gautrain. The electronic ticketing system also contributes to the safety of the train as ticket fraud is prevented.

Services and systems
An electronic ticketing system was implemented from the start of the Gautrain service. It brings many advantages and forms part of the success of the Gautrain so far. Food and drink is not allowed on board the train and there are also no ablution facilities on the train. This may be experienced as negative from the passenger's point of view.

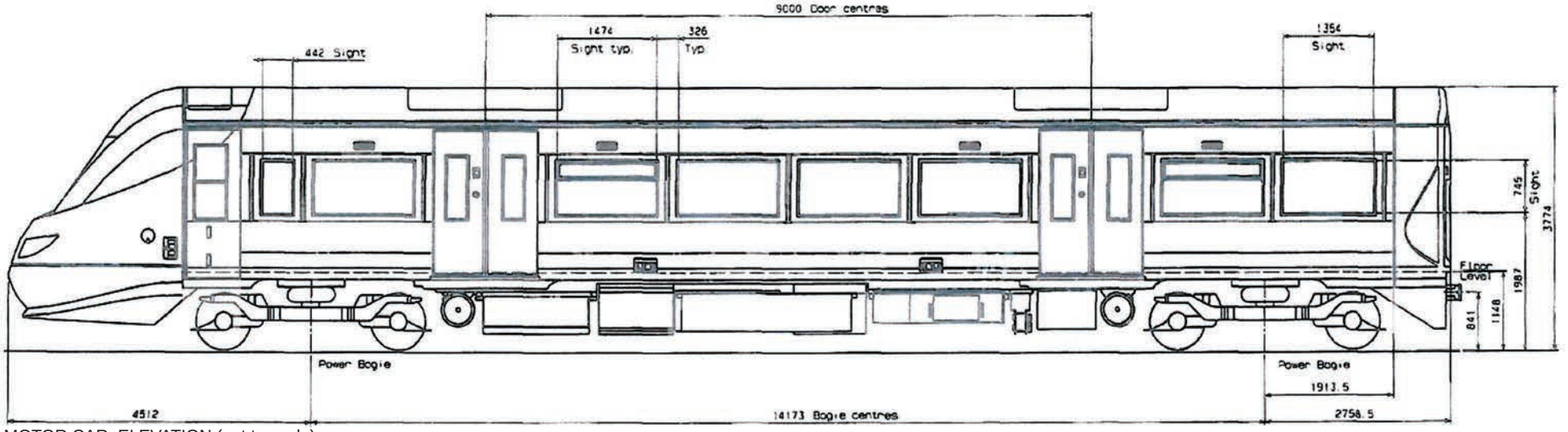
The interior climate is controlled with a fitted HVAC system. Both visual and verbal communication are supplied. Information screens and voice-recorded announcements guide users as to when and where the next station is. Electronic doors, with light-signalling, guide passengers to open the doors when they want to enter and exit the train. These systems add to the universal design of the train by letting passengers with impairments know when, where and how to alight the train. Gautrain integrates a bus service into the system to transport users to and from the Gautrain stations.

Interior environment
The interior environment can be described as quiet, calm and relaxed. The floors of all foyer spaces of the train cars are finished with linoleum. Floors of all the seating spaces are finished with carpet. This creates a warmer environment and adds to the comfort of the train experience. The finishes of the interior contributes to the absorption of noise and vibration.

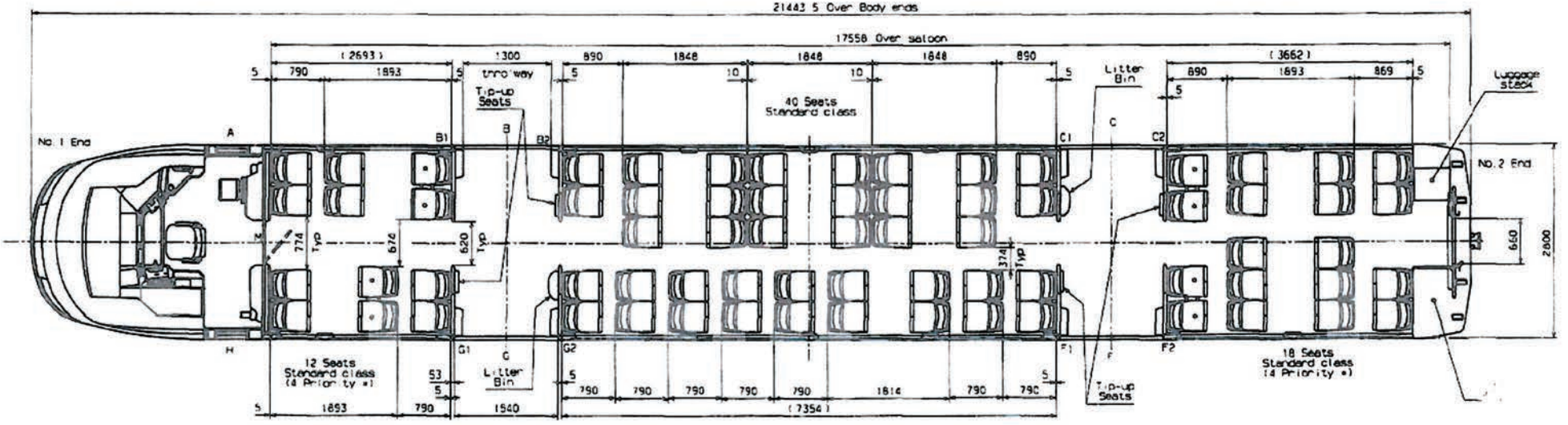
The interior of each train car consists of general transverse seating spaces. No grab bars to accommodate standing passengers are provided. This has become a problem during peak hours, when passengers often have to stand in the train when all seats are occupied. Seating layouts do however include designated wheelchair spaces and priority seats for the elderly close to entrances and/or exits. Door widths and aisles are also wider at these spaces. Double doorways are provided throughout the train, except for the doors of the driver car at each end of the train. The floor level of the train is level with the platform height. This allows wheelchair-impaired passengers to travel without any assistance, and safe, easy ingress and egress of all passengers. Grab rails on top of all aisle-seats and in foyer spaces also assist passengers when the train is moving.

Structure
The Gautrain was designed and partly manufactured by the international company Bombardier Transport, utilising modern technology and expertise. The Gautrain is a contemporary, short-distance passenger train offering a quiet, smooth and fast journey. The structural dimensions of the train are similar to that of mainline trains (such as Metrorail and Shosholoza Meyl). All these trains have a body width of 2 800mm and an approximate length of 20 000mm. This indicates that Gautrain train cars would be able to function on the mainline tracks.

Conclusion
High speed and punctuality is evidently the main driver of the success of the Gautrain. This highlights the need for contemporary trains in South Africa to offer both long- and short-distance public transport. It is also the only train service that is truly universally accessible. The project demonstrates how much more effective it is when different modes of transport are combined to function as an interconnected transport system.



MOTOR CAR: ELEVATION (not to scale)



MOTOR CAR: PLAN (not to scale)

Figure 3.15: Technical drawings of Gautrain (Electrostar) train (Domingo n.d).

3.3.2 (d) SHOSHOLOZA MEYL PREMIER CLASSE

Origin: 2001
Train speed: 80 km/h
Trip duration: 25 hours +
Frequency: Once a week
Passenger capacity: 84
Cost: R2650 p/p one way (Route A)

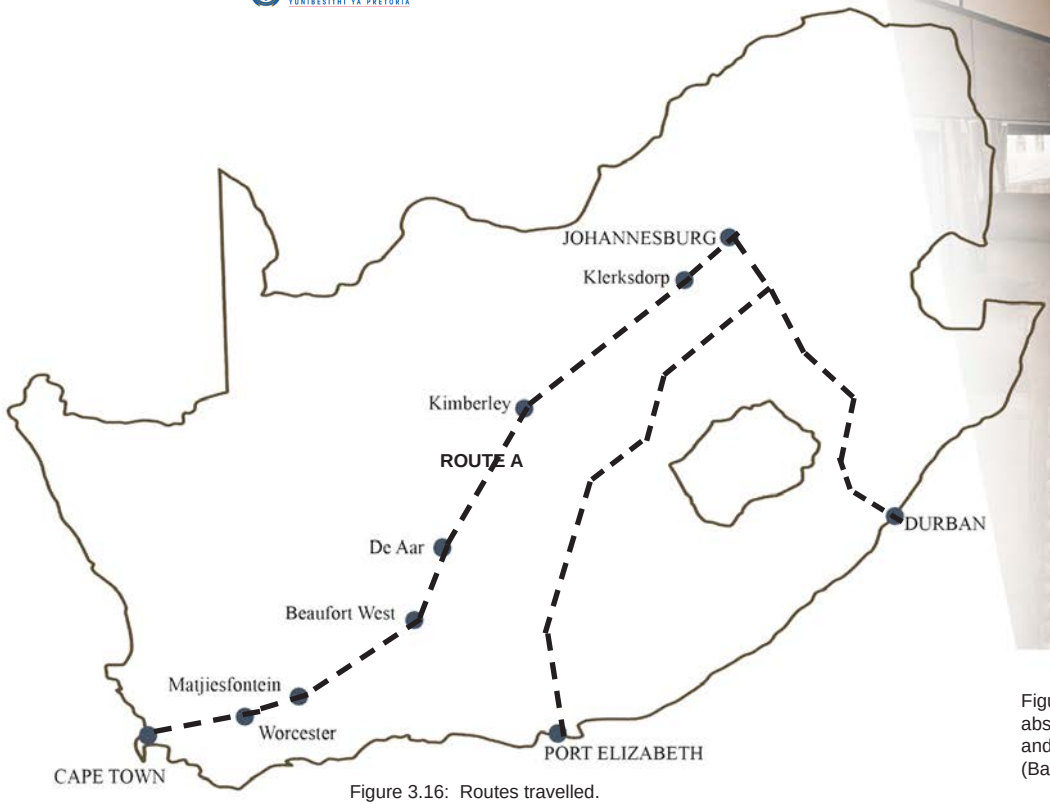


Figure 3.16: Routes travelled.

Figure 3.17: Flocked carpet absorbs noise and vibrations and add to a sense of comfort (Ballantyne n.d).

The Premier Classe train runs as the luxury option of the three train services offered by the Shosholoza Meyl brand and can be translated as 'first class' when compared to air travel.

Time and cost
The train operates on the mainline tracks. The route from Johannesburg Park Station to Cape Town train station is an exceptionally long journey with a limited, inconvenient travel frequency. In terms of cost this specific route is expensive when compared to other available transport services. Booking of tickets is mandatory and can be made as long as one year in advance.

Interior environment
With regard to accommodation, this train offers compartmentalised seating configurations only; however, this offers complete privacy that may enhance comfort and feelings of safety. The compartments are fitted with transverse seating which converts to beds at night. For added convenience each compartment is fitted with a fold-out table, basin and overhead storage for luggage. The inclusion of a lounge and bar (in a separate train car) provides passengers with the option of interacting with other passengers if desired. The gradation of absolute private space to public space results in long walking distances to reach the different amenities. Interior comfort is achieved to a reasonable standard. The layout and programmatic configuration of the train is conventional.

The majority of the spaces accessible to passengers consist of floors finished with broad-loom carpet. This aids better acoustic absorption and reduces the noticeability of vibrations. Interior partitions are finished with maple-wood veneer, assumed to be an attempt to reduce the industrial character of the train.

Structure
Even though the train only dates back to 2001, it is still powered by a locomotive which renders the train a service that lags behind current technological developments.

Conclusion
On account of observation, it is evident the users of this train service are mainly tourists and local leisure travellers, with ample time and seeking the train journey as an experience of a near bygone

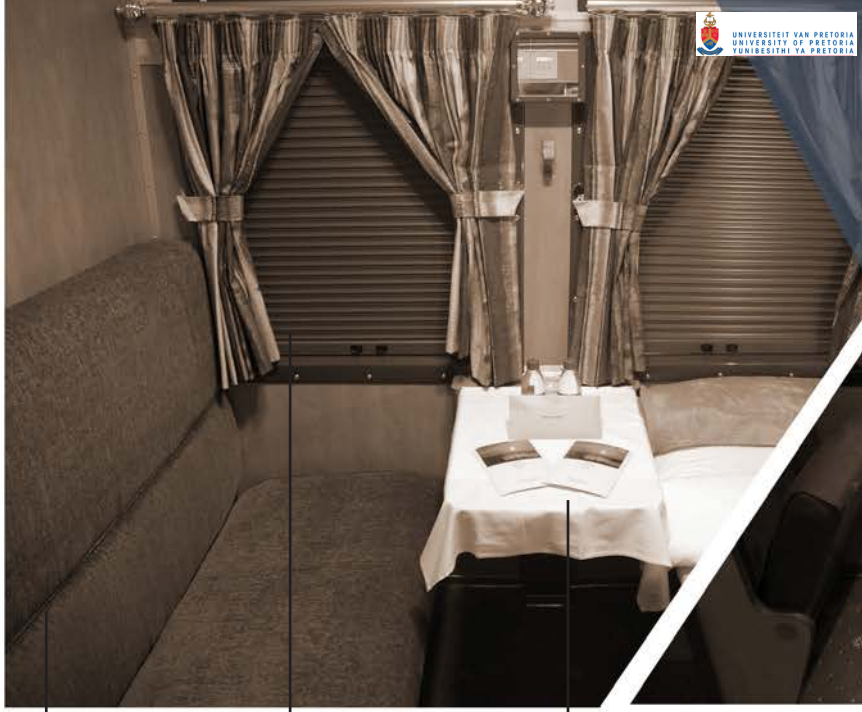


Figure 3.18: Transverse seating converted into beds for sleeping (South African Railways 2011).

Shutter blinds for self-controlled natural daylight.

Fold-down table with fixed wash hand basin underneath.

Figure 3.19: Journey is slow, but enhanced by the beauty of the South African landscape (South African Railways 2011).

All meals prepared on board in the Kitchen Car and served in the Diner Car.

Figure 3.20: Seating convertion to sleeping (South African Railways 2011).

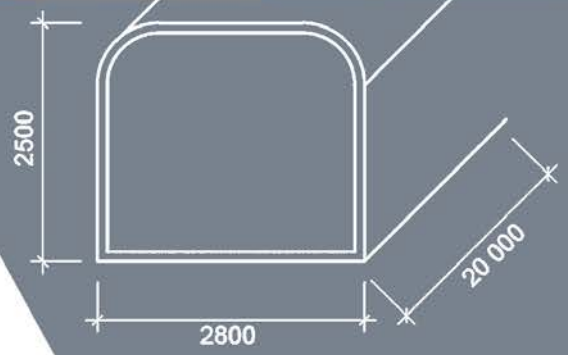


Figure 3.21: Structure dimensions

era. Thus the mandate for selecting this train is not about the destination but the journey it brings. This strengthens the argument that South Africa can benefit from a long-distance passenger train aimed at a wide target market. People are disinclined to regularly make use of the Premier Classe service because of a limited weekly time table and unsuitable departure times. Quality of service, journey and interior comfort is not reflected in the high cost of the service when compared to other available trains covering the same route.

Figure 3.23: Luggage racks used for sleeping by uncomfortable passengers (Shoberg 2010).

Figure 3.24: Unidirectional seating arrangement (Ballantyne, 1994).

Figure 3.22: Interior of Shosholoza Meyl Economy sitter (Shoberg 2010).

3.3.2 (e) SHOSHOLOZA MEYL ECONOMY CLASS

Origin: 1999
Train speed: 60 km/h
Trip duration: 28 hours
Frequency: Three times per week
Passenger capacity: 288 (72/ train car)
Cost: R360 p/p one way (Route A)

The Economy Class sitter train is the entry level train of the three Shosholoza Meyl train options.

Time and cost
The Economy Class train is the least expensive option for long-distance rail travel in South Africa. As with the Tourist Class, the main attraction of this train is thus the low fare. The duration of the trip on this 1600 km route remains unacceptably long, and this without any on-board entertainment. The experience of anxiety on this train can be severe. Booking of tickets is again required and children under the age of nine pay half-price.

Safety and security
A train manager and on-board staff are said to be provided to ensure passenger safety and comfort. However, as on the journey experienced by the author, staff attendance (with the exception of kitchen- and dining-car staff) was non-existent. There are also no security cameras or other such systems installed on the train. Non-frequent users feel uneasy and unsafe on this train, unless when travelling in a big party.

Services and systems
Both the Economy Class and the Tourist Class trains are not air-conditioned to regulate the interior temperature. Passengers need to rely on natural ventilation to try to stay comfortable during the hot South African summers. Passengers are allowed to bring their own food and drink onto the train, as the dining car only offers a limited selection and the journey is long.

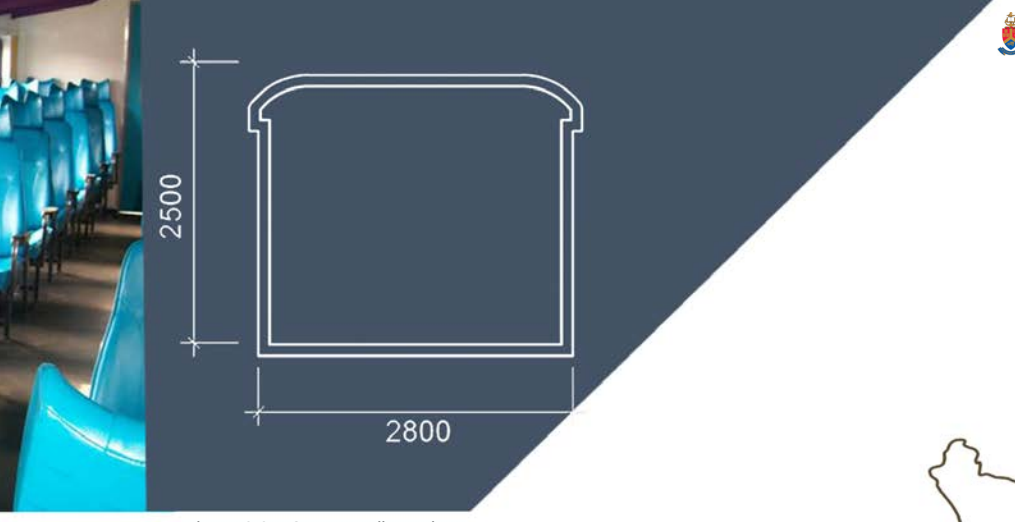


Figure 3.25: Structure dimensions.

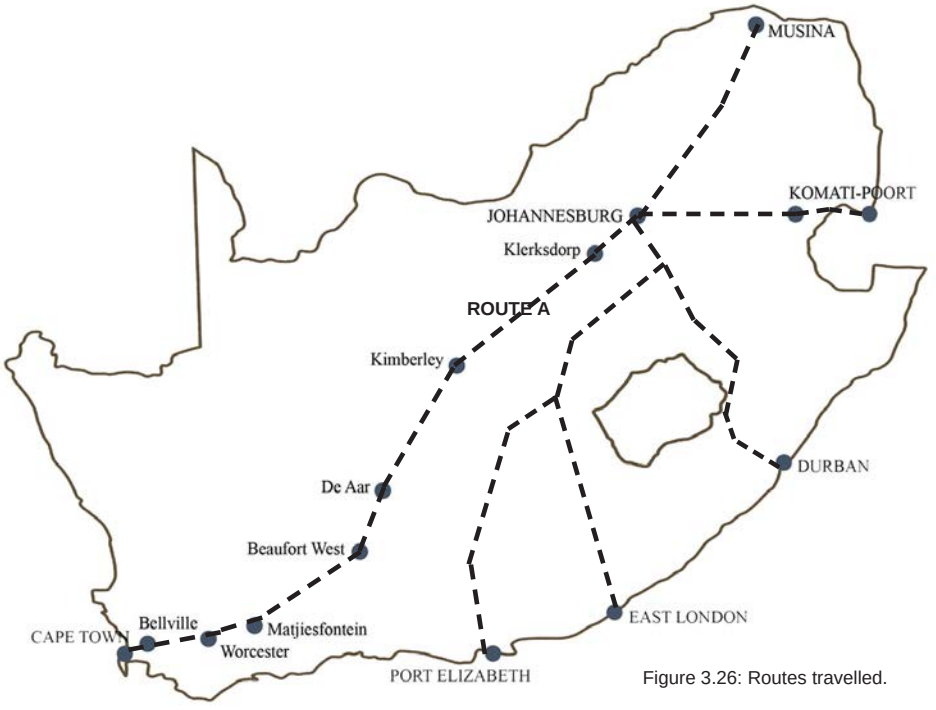


Figure 3.26: Routes travelled.

Interior environment

The train only offers a general sitting option with no distinction between class, seating type or ticket price; thus a low degree of privacy is offered (similar to economy class in air travel). The seats are experienced as comfortable at first, but with no adjustable back rest or adaptability of the seat, fatigue and discomfort (from nearly thirty hours of being seated on end) is experienced. No worktop or reading light for eating or working is available when seated either. The Dining Car is the only space that may act as a break-out space to relieve the discomfort from sitting, but can be experienced as a hard, claustrophobic space as well. The material finishes and colour scheme of the interior is mostly the same as that of the Tourist Class, with vinyl upholstered seats and linoleum flooring throughout. The industrial character of the train is experienced from within the interior and contributes to a lack of feeling comfortable and at home within the space.

Conclusion

The Economy Class train is attractive only for its low cost. Besides the low travelling speed and long duration of the trip, one cannot use time constructively by working or reading comfortably. The importance of safety and security in the design of a transport interior is also made apparent by this investigation.

3.3.2 (f) SHOSHOLOZA MEYL TOURIST CLASS

Origin: 1999
Train speed: 60 km/h
Trip duration: 28 hours
Frequency: Three times per week
Passenger capacity: 84 - 112
Cost: R620 p/p one way

The Tourist Class economy sleeper train runs as the middle class option of the three different Shosholoza Meyl trains, which all operate on the mainline tracks.

Time and cost
The low fare cost of this train is the main driver for passengers to make use of this service instead of air travel or long-distance bus services. The Tourist Class makes many stops along the Johannesburg – Cape Town route. Along with the low travelling speed, the duration of the trip is extensive and can be stressful and tiring as a result. The low travel frequency also contributes to frustration for potential users. One cannot manage to attain a booking without having to wait nearly a month for the first available open seat. Drawing from personal experiences, this is an undesirable trait in accordance with user travel/behaviour patterns.

Safety and security
A train manager and on-board staff are provided to ensure passenger safety and peace of mind. Each passenger compartment is fitted with security locks which can only be opened from inside; however, the actual safety of passengers is still questionable. Price is commonly associated with class. The low ticket cost causes doubt in the minds of potential users where the safety of the train service is concerned. The acknowledgement of the different user profiles makes spatial distribution in the design of train interiors an important consideration, in order to attract a wide target market. The policy of Shosholoza Meyl prohibits mixing passengers of different gender and race within the same compartment when these passengers are not travelling together.

Interior environment
Similar to the Premier Classe, this train offers only private, compartmentalised seating configurations. The compartments are fitted with transverse seating which converts to beds at night and are upholstered with bright purple vinyl. For passenger convenience each compartment is also fitted with a fold-out table and fixed basin with both hot and cold water supply. The sleeping compartments provide overhead storage for luggage, but lack soft finishing and a sense of comfort. Linoleum floors throughout the train are practical. However, all the hard surface finishes amplify train noise and vibrations. The

Figure 3.27: Sleeper cabin for two passengers.

Figure 3.28: Inaccessible overhead luggage storage.

Figure 3.29: Intimidating narrow aisles in interior.

Figure 3.30: Indication of aisle width (of 600mm).

Figure 3.31: Only signage in Shosholoza Meyl interior.

Figure 3.32: Wash hand basin underneath table.

Figure 3.33: Table inbetween berth seating arrangement.

dining car shares the same character and feels claustrophobic. The journey is slow with a lot of unnecessary stops, but this is compensated for by the beauty of the South African landscape. The trip is long and tiring. The layout and spatial planning is out of date in terms of the present demands of the diversity of users and their needs.

Structure

On account of its out of date technology (still being powered by a locomotive), its speed cannot be improved.

Conclusion

Security on the train can be improved to increase the attractiveness of rail travel. Interior comfort, layout and material finishes can be reinvented to include sustainable practices.

3.3.2 (g) THE BLUE TRAIN

Origin: 1920s
Train speed: 90 km/h
Trip duration: 27 hours +
Frequency: Twice a week
Passenger capacity: 74
Cost: R10 650 - R14 350 p/p

The Blue Train dates back to the 1920s, when it was first known as the Union Limited and the Union Express (Spang 2012). It is based at the Pretoria Station. The Blue Train can be described as a vehicle for collective memory and an existing mode of travel from a bygone era.

Time and cost

The Blue Train is a luxury mode of commuting which follows a fixed route from Pretoria to Cape Town. Chartered rail routes are available per request. The Blue Train offers a similar service and experience as The Pride of Africa train but within a shorter time frame. The train also runs at a different frequency and therefore provides added convenience.

Safety and security

Train staff and butlers are responsible for on-board security and the general needs of passengers. As with all other long-distance trains in South Africa, no other form of security, such as CCTV surveillance, is provided. All compartments are lockable from within to ensure privacy and safety of passengers' belongings.

Figure 3.34: Route travelled.

Services and systems

The Blue Train provides interior climate control by means of a HVAC system. This is an important factor in ensuring high comfort levels. Service excellence is provided by the preparation of all meals to a high standard. The kitchen car is equipped to accommodate Vegetarian, Halaal, Kosher and other special dietary requirements.

Interior environment

The train set comprises an electric powered locomotive, a baggage car, a club lounge car, kitchen car, dining car, a (non-smoking) lounge car, eight deluxe suite cars, two luxury suite cars, a laundry car and a conference car at the tail. In total the train can accommodate 74 guests in 37 suites (Spang 2012). An African theme is carried through in all interior spaces, making use of expensive and high-quality materials. This includes gold window trims, hardwood built-in furniture and storage, and marble in the en-suite bathrooms. It is evident that emphasis is placed on passenger comfort and luxury, which comes at a price.

Structure

The train was originally powered by a traditional coal-fired engine, but this has since been substituted with electric and diesel engine locomotives and generators for electricity needs on board. This ensures that the noise level in the interior does not exceed fifty-five decibels.

Conclusion

The Blue Train provides tourists/travellers with services, interior design and entertainment of a high, expensive standard. The service cannot function as a long-haul public transport system. The expense and intent of The Blue Train is one of exclusivity, of literally a once in a lifetime experience.

Figure 3.35: Interior of Twin Suite (The Blue Train 2014).

Figure 3.36: Interior view of bar (The Blue Train 2014).

Figure 3.37: Interior of the Observation car (The Blue Train 2014).

Figure 3.38: Deluxe Suite (The Blue Train 2014).

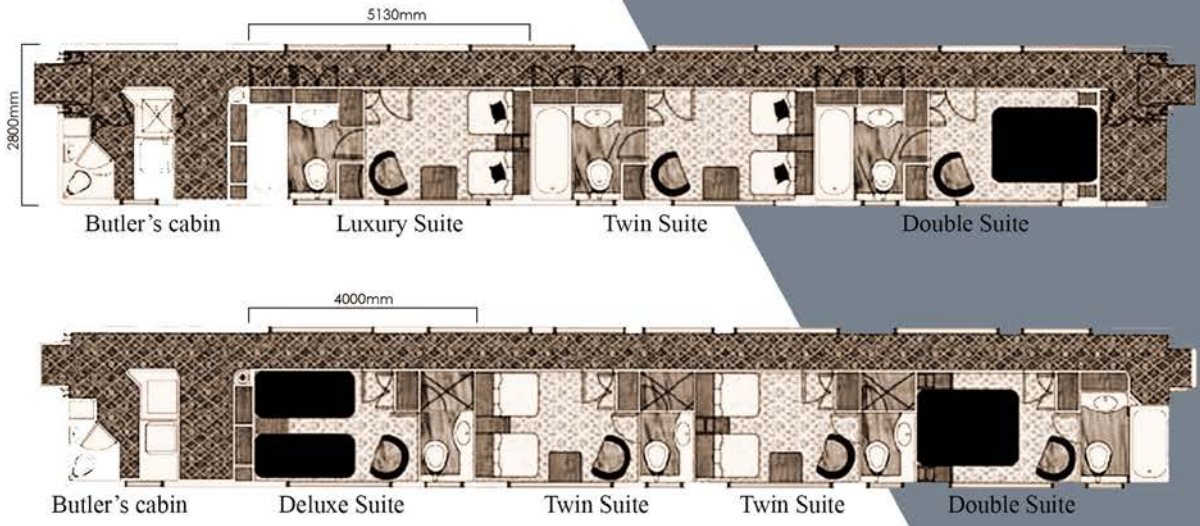


Figure 3.39: Interior layout of various cabin types (The Blue Train 2014).

3.3.2 (h) THE PRIDE OF AFRICA (ROVOS RAIL)

Origin: 1989
Train speed: 60 km/h
Trip duration: 49 hours
Frequency: Four to six trips monthly
Passenger capacity: 72
Cost: R13 600 - R27 200 p/p sharing

Rovos Rail's The Pride of Africa steel-body train operates from Capital Park Station in Pretoria. This private station of Rovos Rail originated from the fact that this location was the steam locomotion hub of the old Transvaal. Rovos Rail was founded and established by Rohan Vos in 1989. The Rovos train carriages each hold significant heritage value in their acquisition and restoration, some carriages of which date back to the nineteenth century. The Pride of Africa train prides itself on its old-world charm and in keeping the traditional passenger train experience alive (Parkinson 2012).

Time and cost
The concept of this train service is to provide a luxury safari over the course of three days, stopping at various towns for off-train excursions. These safari trips are offered on a basis of four to six trips per month and are aimed at the tourist market rather than everyday travellers.

Safety and security
Train staff and personal butlers ensure the safety and satisfaction of the passengers. Managers and other on-board staff are provided to ensure passenger safety and peace of mind. Each private compartment locks from within to secure personal belongings.

Systems and services
The Pride of Africa train provides fine cuisine for all three meals a day and also includes a high tea in the afternoon. All the private accommodation compartments are air-conditioned and are fitted with electricity points. The lounge car is fitted with a television for on-board entertainment.

Interior environment
The general make-up of the train consist of the locomotive, generator car, staff car, kitchen car, two dining cars, guest sleeper cars, a (non-smoking) club lounge car and an observation car at the end. Similar to the Premier Classe, this train only offers private, compartmentalised accommodation. The guest sleeper cars consist of three separate

Figure 3.40: Fold-down bunk bed above (Rovos Rail 2012).

Berth seats adapt to beds.

Luggage storage underneath.

Figure 3.41: Hard wood partition walls not extended up to ceiling height (Rovos Rail 2012).

Carpet floor finishes throughout.

Figure 3.42: Twin beds in Deluxe Suites (Rovos Rail 2012).

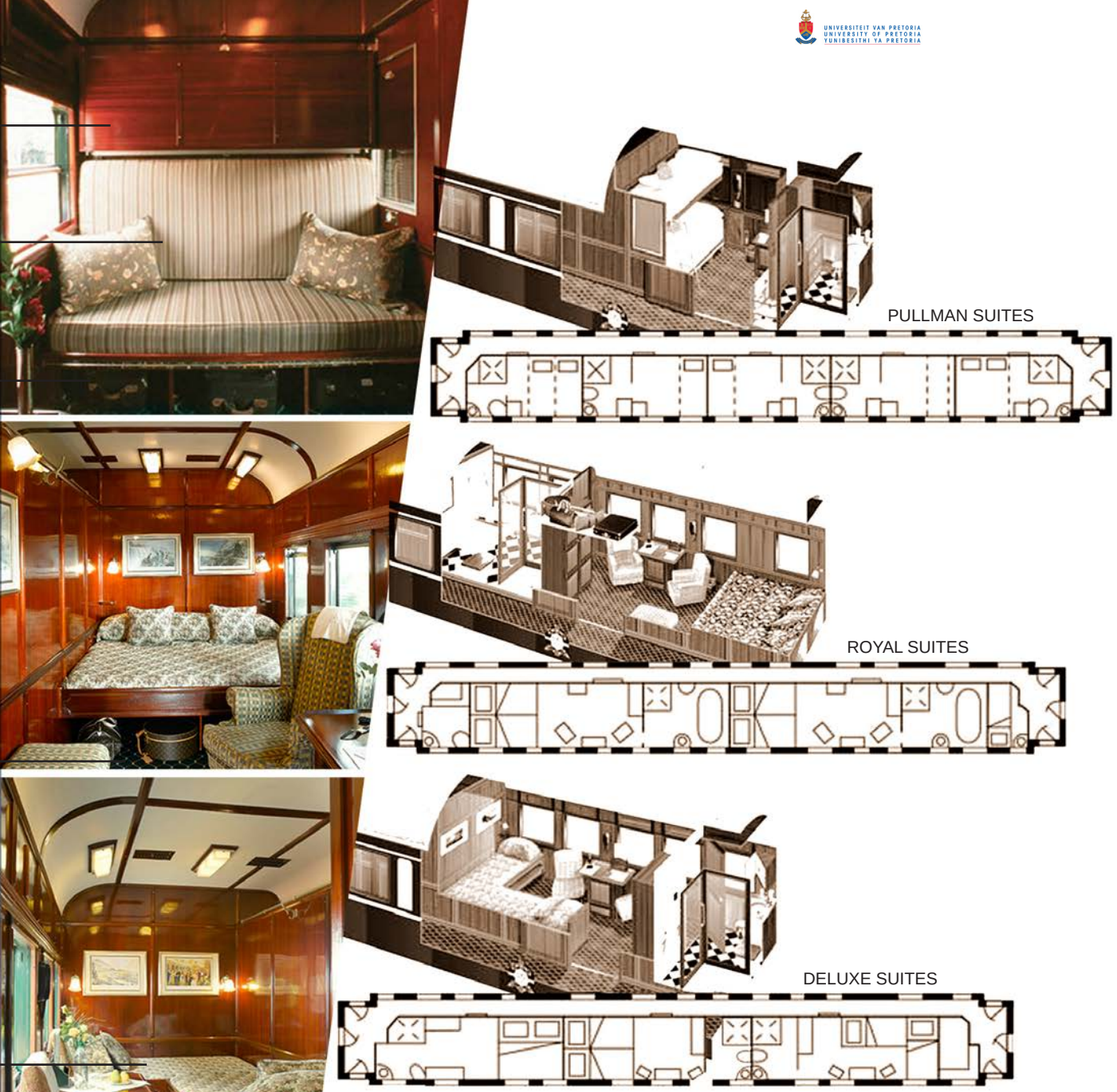


Figure 3.43: Layouts of Pullman, Royal and Deluxe Suites (Rovos Rail 2012).

carriages to provide three different class categories, including Royal suites (two per carriage), Deluxe suites (three per carriage) and Pullman suites (five per carriage). The design of the train car interiors is so style-specific that it will be expensive to alter interior layouts and finishes. However, the luxury finishes and well-considered spaces alleviate any sense of claustrophobia and ensure passenger comfort.

Structure

The use of a locomotive-powered train is deliberate and positive in this case as a contribution to the heritage of the railways.

Conclusion

The interior layout and material finishes can be reinvented to include sustainable practices. The experience of the beauty of South Africa from the train window justifies the long journey but can only be enjoyed by a limited, elite target market.

3.3.3 SUMMARY

NAME:	Metrorail 10M5 	Metrorail Plus: Business Express 	Gautrain 	Premier Class 
YEAR OF ORIGIN:	1990	2006	2010	2001
MARKET SECTOR:	Suburban	Suburban	Suburban	Long-haul
ROUTE(S):	Various suburban routes within the Tshwane, Western Cape and KwaZulu- Natal precincts	Soweto to Johannesburg Pretoria - Johannesburg Khayelitsha to Cape Town Strand to Cape Town	Pretoria - Johannesburg (Hatfield - Pta - Centurion - Midrand - Marlboro - Sandton - Rosebank - Park; OR Tambo)	Johannesburg to Cape Town Johannesburg to Durban
TIME TABLE:	03h05 - 19h30 daily with 1 to 16 trains per hour.	06h20 - 18h10 daily	24 trains operating 05h24 - 21h12 daily (Peak: train every 12min Off-peak: train every 24min Weekends: train every 30min)	Tuesdays: Jhb - Cape Town Thursdays: Jhb - Durban
OPERATING SPEED:	100km/h	100km/h	160km/h	± 60km/h
TRIP DURATION:	Depends on route	90 minutes (Pretoria to Johannesburg)	42 minutes (Hatfield - Park Station)	25 hours
TICKETING SYSTEM:	Manual (No booking required)	Manual (Booking mandatory)	Electronic (No booking required)	Manual (Booking mandatory)
COST:	From R5-50	Rates fall between Metrorail and Gautrain tariffs (R320 weekly pass).	R20 - R135	R2650 /person
DEPARTURE LOCATION: CONVENIENCE AND RELIABILITY:	Any Metrorail Station (including Pretoria Station) Unreliable, ineffieciency caused by delays. Current routes do not fit with residential - & economic nodes.	All stations concerning the locations of the routes Client target results in low passenger numbers, limited travel time oppertunity.	Any Gautrain station No late trains, fast and effective transport avoiding traffic congestion.	Johannersburg Park Station Expensive, limited trips, inconvenient travel times and trip duration.

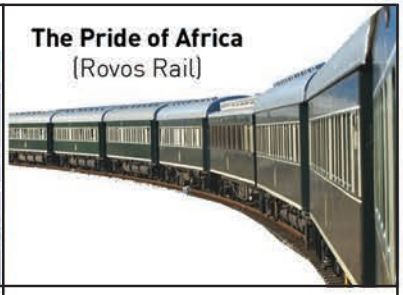
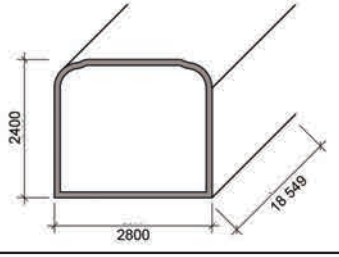
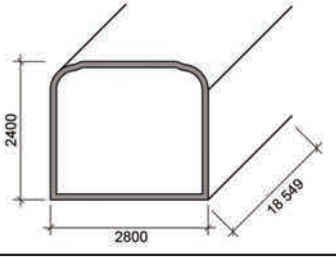
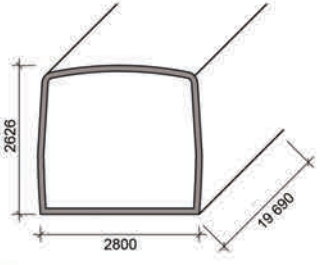
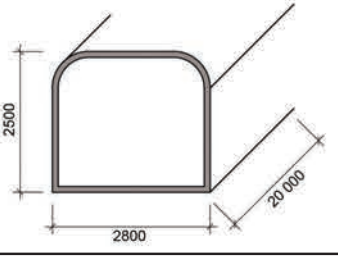
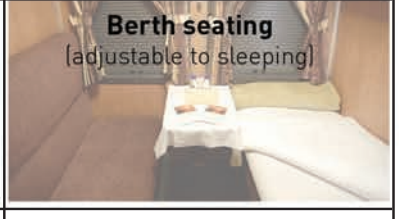
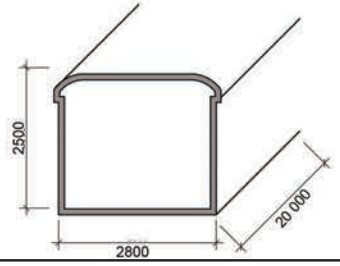
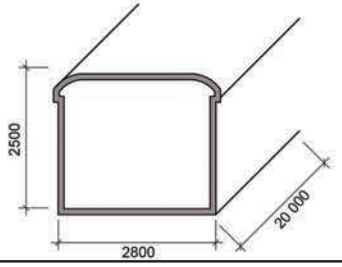
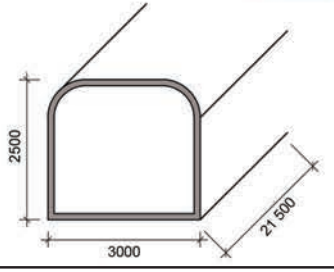
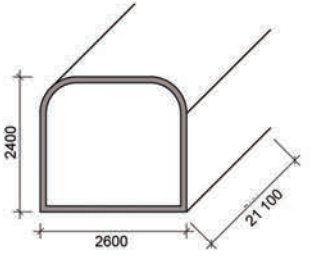
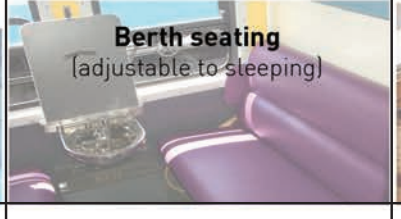
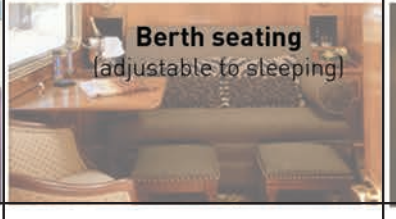
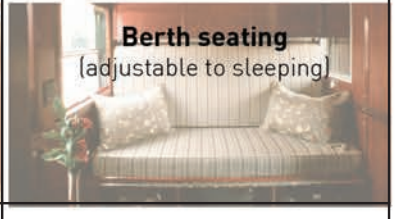
Shosholoza Meyl Economy	Shosholoza Meyl Tourist Class	The Blue Train	The Pride of Africa (Rovos Rail)
			
1999	1999	1920's	1989
Long-haul	Long-haul	Long-haul	Long-haul
Johannesburg to Cape Town; East London; Port Elizabeth; Durban; Musina; Komatipoort	Johannesburg to Cape Town; East London; Port Elizabeth; Durban; Musina; Komatipoort	Pretoria to Cape Town	Pretoria to Northern Cape Durban; Dar Es Salaam; Botswana
1 trip every Wednesday, Friday and Sunday	1 trip every Wednesday, Friday and Sunday	4 trips per month	2 - 6 trips per month
Up tp 100km/h	Up to 100km/h	90km/h	60km/h
27 hours minimum	27 hours minimum	27 - 29 hours	49 hours
Manual; booking required	Manual; booking required	Manual; booking required	Manual; booking required
R 380	R 620	R 10 650 - R 14 350 (depending on suite & season)	R 13 600 - R 27 200 (depending on suite & route)
Johannesburg Park Station Slow line speeds, late arrivals & operational conflict causes ineffecctiveness of this rail service.	Johannesburg Park Station Slow line speeds, late arrivals & operational conflict causes ineffecctiveness of this rail service.	Pretoria Station Luxurious travel, expensive and long trip duration- aimed at tourist market not everyday travel.	Capital Park Station, Pretoria Luxurious travel, expensive and long trip duration- aimed at tourist market not everyday travel.

Table 3.1: Summary of critical analysis.

				
MATERIAL FINISHES:	Stainless steel Linoleum Polycarbonate	Stainless Steel Suede fabric Linoleum Wood Veneer	Polycarbonate Cut-pile Carpet Linoleum Polymethylmethacrylate Powder-coated steel	Beach Wood verneer Suede fabric Stainless Steel Cut-pile Carpet Glass Marble
BRANDING:	metrorail GETTING SOUTH AFRICA TO WORK	BUSINESS EXPRESS metrorail	GAUTRAIN FOR PEOPLE ON THE MOVE	PREMIER CLASSE
ADAPTABILITY:	Interior comfort, layout and finishes can be improved; outdated technology thus speed cannot be increased to improve journey/ travel time.	Interior comfort, layout and finishes can be improved; outdated technology thus speed cannot be increased to improve journey/ travel time.	Interior can be altered to host a new typology. Thus inteior finishes and layoutcan be changed to fit a new programme.	Interior comfort, layout and finishes can be improved; outdated technology thus speed cannot be increased to improve journey/ travel time.
SAFETY AND SECURITY:	Safety of passengers should be improved to increase attractiveness of rail travel.	Security official at each entrance/ exit door.	On-board security personnel and CCTV satellite monitoring ensures efficient passenger safety.	No on-board security. train staff sees to passenger security
ROUTE NARRATIVE: (positive or negative)	After waiting for a late train, passengers embark onto an over-crowed train. The journey is slow and uncomfortable and passengers cannot even enjoy the city and landscape passing them by. They alight the train and rush to make it to work for which they are already late.	Upon embarking, passengers are welocomed with the morning paper and may enjoy a complemantary cup of coffee. Passengers can work, socialize or take in the city scenery as they travel to work in a comfortable, personal seat. The only thing missing is a faster journey.	Without any prior booking, passengers board the train which arrives without any delay. After taking their seat they can socialize, read or stare out the large windows to the city and landscape. Climate control and the fast travelling-speed makes the journey fly by.	The personal compartments are cold and bare. An escape to the dining car ends with disappointment as the interior only provides the minimum in comfort and spatial quality. The journey is slow but enhanced by the beauty of the South African landscape. As one alights the train one wonders if the long trip and expensive ticket was worth it.

			
Linoleum Polycarbonate Pleather Powdercoated steel Aluminium Stainless Steel Wood Laminates	Linoleum Polycarbonate Pleather Powdercoated steel Aluminium Stainless Steel Wood Laminates	Hardwood Marble Cut-pile carpet Glass Gold Ceramic Tile Leather	Leather Hardwood Cut-pile Carpet PVC Stainless Steel
Shosholoza Meyl *A pleasant experience*	Shosholoza Meyl *A pleasant experience*	THE BLUE TRAIN A WINDOW TO THE SOUL OF SOUTH AFRICA	ROVOS RAIL
Interior comfort, layout and finishes can be improved; outdated technology thus speed cannot be increased to improve journey/ travel time.	Interior comfort, layout and finishes can be improved; outdated technology thus speed cannot be increased to improve journey/ travel time.	The design of the train car interiors are so typology-specific that it will be expensive to alter interior layout and finishes. Technology (and speed) of train is outdated.	The design of the train car interiors are so typology-specific that it will be expensive to alter interior layouts and finishes. Technology (and speed) of train is outdated.
No on-board security. Safety of passengers should be improved to increase attractiveness of rail travel.	Managerial staff on board see to passenger safety. Security can be increased.	No security personnel on-board, staff and butlers ensure passenger safety and comfort.	No security personnel on-board, staff and butlers ensure passenger safety and comfort.
Upon embarking the train the seating seems spacious. Walking through the other compartments to the dining car causes discomfort to other passengers. The long distance in one sitting position causes fatique and the WC facilities are unusable. The trip is long and unpleasant.	The sleeping compartments lacks soft finishing and sense of comfort. The dining car shares the same lack of charcater and feels clostrophobic. The journey is slow with a lot of unnecessary stops but is subdued by the beauty of the South African landscape. The trip was long and tiring.	The luxury finishes and well-designed interior alleviates any sense of claustrophobia. The long distance and slow travelling speed is relieved with frequent stops and off-board excursions. The experience of the soul of South Africa from the train window justifies the long journey but can only be enjoyed by a limited, elite traget market.	The luxury finishes and well-designed interior alleviates any sense of claustrophobia. The long distance and slow travelling speed is relieved with frequent stops and off-board excursions. The experience of the soul of South Africa from the train window justifies the long journey but can only be enjoyed by a limited, elite traget market.

				
STRUCTURE (Length, width, height and usable area of each train coach).				
CAPACITY	48 passengers/ car sitting	42 (+2 laptop seats) / car	**70 - 74 passengers per car** (280 - 288 passengers/ train)	84 pasengers / train
SEATING LAYOUT				
PROGRAMME	Motor car Sitter cars	Sitter cars Information & Laptop facility Motor car	Motor cars (on each end) Sitter car (x2)	Sleeper cars (Single/couple) (family) Dining car Kitchen car Lounge/ Bar car Conference car Locomotive Communal bathrooms
UNIVERSALLY ACCESSIBLE	No	No	No	No

			
			
64 - 72 paasengers/ car	28 passengers/ car	74 passengers/ train	72 passengers / train
 **Unidirectional seating**	 **Berth seating** (adjustable to sleeping)	 **Berth seating** (adjustable to sleeping)	 **Berth seating** (adjustable to sleeping)
Dining car Sitter cars Locomotive WC facilities in each car	Dining car Sleeper cars -Coupe: 2 people -Full: 4 people Lounge car Locomotive WC's and shower facilities in each car	Club car Lounge car Dining car Kitchen car Conference car Sleeper cars -Luxury suites -(DeLuxe suites Boutique Power car Baggage car Personal car (Staff & laundry)	Observation car Conference car Lounge/ Bar car Dining car Kitchen car Sleeper cars- Pullman suites (7sqm) - Deluxe suites (11sqm) - Royal suites (17sqm)
No	No	No	No

THE METROPOLITAN EXPRESS

by von Gerkan, Marg and Partners
Hamburg – Cologne
1999

The Metropolitan Express is an executive train service connecting Hamburg and Cologne. The objective of creating this service was to provide an alternative to flying for, in particular, business travellers; therefore the design focus was retained in creating a distinctive identity for the train (Schittich 2002: 158).

The train is configured with seven coaches and separated into zones of “Silence”, “Club” and “Office.” This was done to enable passengers different spaces to work, socialize, conduct meetings or sleep (Schittich 2002: 158). Seating is arranged in rows of three, with the aisle dividing the second and third seat in each row.

The approach to the construction of the train interior is demonstrated in the avoidance of direct connections of the interior fittings to the exterior steel envelope. This also became a means of reducing interior noise and vibrations (Schittich 2002: 163).

Comfort was attained through the use of natural materials. This include birch-wood veneer, brushed stainless steel and leather. The materials were not only used for a sense of comfort, but for their ability to “age with grace” (Von Gerkan, Marg & Partner n.d).

Figure 3.44: Metropolitan Express interior seating (Von Gerkan, Marg & Partner n.d).

Figure 3.45: Club seating arrangement (Schittich 2002: 160).

Figure 3.46: Interior view of café (Schittich 2002: 161).

Figure 3.47: Natural material finishes in interior (Von Gerkan, Marg & Partner n.d).

Design Application:

- A definite approach to constructing the interior is both functional and sustainable, making the reuse of materials possible.
- Separating each train coach into smaller spaces allows the accommodation of various functions and user preferences in an otherwise limiting, small envelope.
- A contemporary train concept calls for a distinct identity.

3.4 CHOICE OF TRAVEL MODE

Travel fear and fatigue impact on a traveller's choice of travel mode, but there are also ethical facets to consider. A decrease in private vehicle use can contribute to sustainable living practices, regarding both the reduction of carbon emissions and the relief of traffic congestion on road infrastructure (Friedrichsmeier et al. 2013: 1; Kottenhoff & Anderson 2009: 2). Even though public transport in general is widely perceived as inconvenient, the present focus on achieving the triple bottom line has placed public transport in the significant position of becoming an alternative to private vehicle travel (Crockett & Hounsel 2005: 536); therefore it is imperative to understand the aspects that affect one's choice of travel mode.

Crockett and Hounsel (2005: 536) reiterate various studies on modal choice behaviour when they distinguish the most important traits that determine modal choice decisions as: time, cost, reliability, security, comfort and convenience. In addition, private car ownership, education, age, occupation and income can specifically influence aspects of leisure trips and includes choice of transport medium (Hergesell & Dickinger 2012: 599).

Passengers react differently with regard to these determinants. When, for example, comparing business travellers with leisure passengers it has been found that leisure passengers are more diverse or lenient regarding typical travel costs than business passengers (Behrens & Pels 2012: 286). Habits or past behaviour is, at that juncture, also considered a factor which determines travel behaviour (Friedrichsmeier et al. 2013: 1).

Choosing one factor above another can be challenging. Travellers have differing needs, preferences and priorities, and often a compromise has to be made.

By highlighting the strengths and weaknesses of air, rail, bus and private vehicle travel, modal choice behaviour and decisions can be understood more clearly.

Air travel

Many factors can be considered as demands that passengers are subject to. For air travel, these factors consist of early check-in, security procedures, long queues, the flight itself, and conditions within the cabin (e.g. dry air, pressure distribution and turbulence), which may all contribute substantially to travel-related stress and increased anxiety (Martinussen et al. 2010: 70; Hergesell & Dickinger 2012: 597). Passengers can also experience these demands as inconveniences. In contrast, many people prefer air travel because of how convenient it can be (Martinussen et al. 2010: 70). When considering security-check demands and access times to airports, the advantages of passenger rail and long-distance bus transport can outweigh the perceived shorter travel time by airtravel (Hergesell & Dickinger 2012: 609).

Private vehicle and bus transport

The private vehicle is widely professed to be the most convenient means of transportation, as it allows the most flexibility and is not bound to set time tables and booking procedures (Crockett & Hounsel 2005: 538). On the other hand, public rail and bus transport are more environmentally sustainable modes than individualized transport (Hergesell & Dickinger 2012: 597; Kottenhoff & Anderson 2009: 2). Air travel is considered the most detrimental considering its high usage of fossil fuels and levels of carbon-emissions (Hergesell & Dickinger 2012: 596). The universal need to reduce carbon emissions advocates that restrictions be imposed on private vehicle and air travel modes (McSheen 2008). Long-distance rapid rail links may then benefit from the role of ensuring the mass mobilisation of people.

Rail travel

Passenger trains are more comfortable than airplane cabins and bus interiors - passengers can move around, stretch and vary the position of their bodies. Passengers also have more freedom regarding meal times and refreshment options. Unlike other transport modes, rail travel offers the possibility of facing seating configurations. Work or business can more easily be done with the possibility of internet connection and laptop use (Kottenhoff & Andersson 2009: 4). Contemporary passenger train services can have a great impact on the lives of ordinary people, on employment, and on other socio-economic developments (Kottenhoff & Anderson 2009: 2).

Conclusion

By placing different means of mass transport in comparison, preferences, advantages and disadvantages are established and can be seen to affect travel mode choices. It is evident that the potential of rail travel can be harnessed to become a preferred choice of transport.

Narrative of commute between Pretoria and Cape Town:

OPTION 1
Long-distance bus service:

OPTION 2
Domestic airtravel service:

OPTION 3
Current long-distance train service:

OPTION 4
Private vehicle commute:

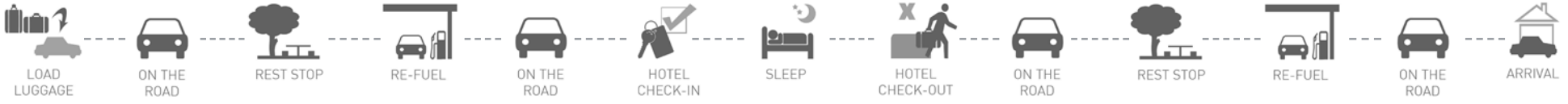


Figure 3.48: Comparison of transport modes within route narrative.

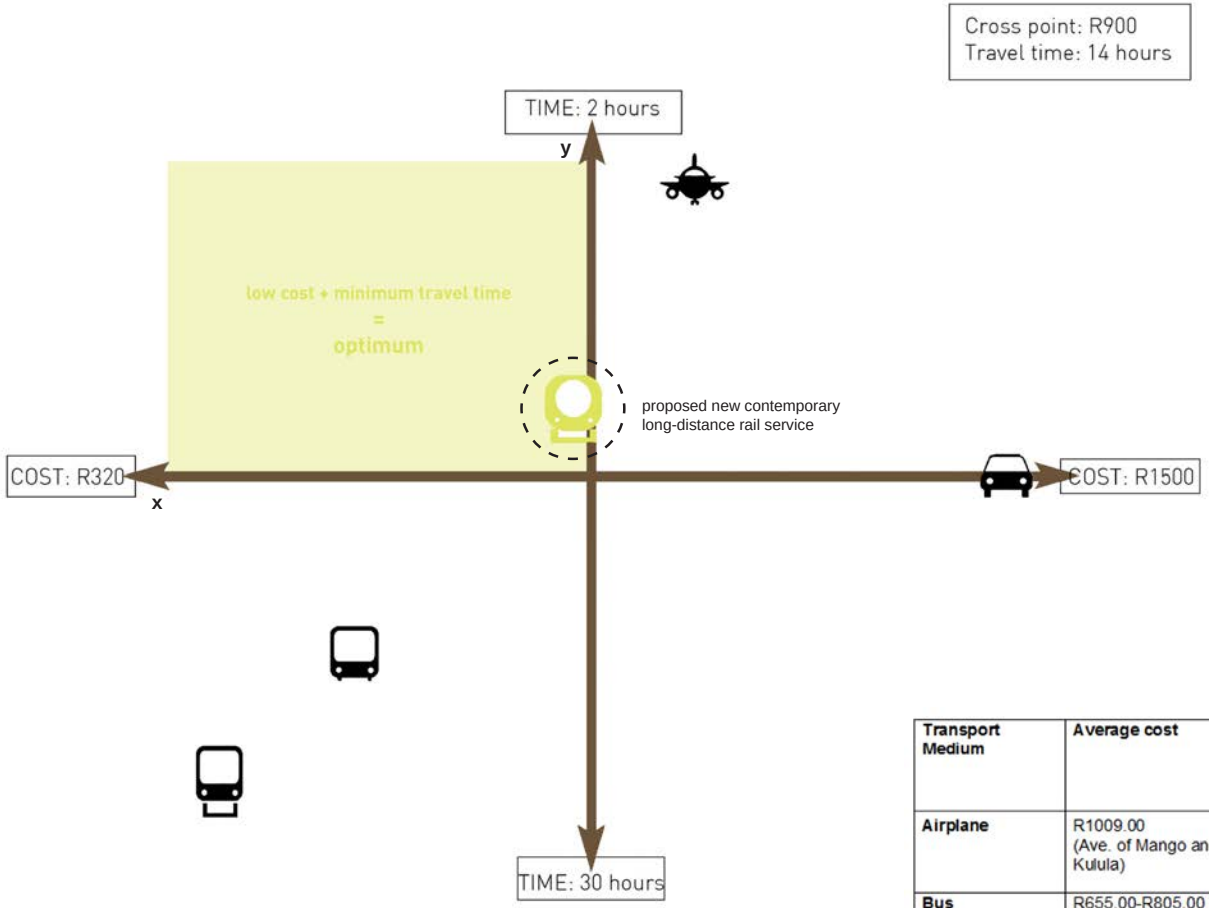


Figure 3.49: Positioning map indicating focus area of study.

3.5 POSITIONING MAP

Domestic airtravel, long-distance bus services, private vehicle travel and the current long-distance rail services where compared according to time, cost and typical delays in a journey between Cape Town and Johannesburg. The information was plotted on a positioning map (see Figure 3.49). Babin and Harris (2013) states that a positioning map is used **"to depict graphically the positioning of competing products or services, to identify oppertunities in a given industry."** It was thus established that a contemporary rail service with an average ticket cost of R900 and a total travel time not exceeding fourteen hours would be ideal. The positioning map then highlights domestic air travel as the main competition and subsequently the price bracket of which to design for.

Transport Medium	Average cost	Average physical travel time from	Added hours	Total hours
Airplane	R1009.00 (Ave. of Mango and Kulula)	2 Hours	2 Hours	4 hours
Bus	R655.00-R805.00 (Greyhound bus)	18 – 19 Hours	1 hour	20 hours
Current SA rail	R360.00-R600.00 (Shosholoza Meyl)	25 – 26 Hours	1hour	27 hours
Private car/motorcycle	R1395.65 (Average Fuel consumption: 13.5 km/l; Price p/L petrol: 13.55)	13 – 14 Hours: driving 120 km/h (no stops calculated)	1 hour	15 hours

Table 3.2: Data used to configure positioning map.

3.6 A PROPOSED NEW ROUTE

3.6.1 ROUTE IDENTIFICATION

The proposed route acts as the site of the study. Combined with the technology of a contemporary train, this not only provides a sustainable solution but is also responsible in respecting the heritage of the origin of passenger rail in South Africa.

In a recent survey conducted by Travel Start, it was determined that the flight route between Cape Town and Johannesburg is currently one of the ten busiest routes globally (Jones 2013: 10). Additionally, the derelict state of existing passenger trains in South Africa gives emphasis to the need for long-distance public transport, specifically between Johannesburg and Cape Town and its connecting towns. The needs of commuters travelling between these destinations cannot be fulfilled by only a single mode of transport. Lucky Montana, current CEO of Prasa, articulated the importance of a long-distance passenger rail service when stated that **"...there are good reasons why it shouldn't be let go because a long-distance service in a country the size of SA, even with the advent of low-cost airlines, provides important alternatives. You can't catch an airplane from Klerksdorp to Cape Town. Long-distance rail has an important part to play"** (Smith 2012).

Deyer et al. (2012) of Prasa established, in their National Strategic Plan for the future of rail in South Africa, that the existing mainline tracks and signalling can be altered to improve line speeds to up to 160 km/h.

This study therefore proposes the Pretoria – Cape Town route (on the mainline tracks). With an operating speed of up to 160 km/h, the 1600-kilometre rail route is strategically chosen to include stops at towns whithout airports and where there are universities and/or tourist attractions. With the inclusion of time to stop at intermediate stations, passengers will be able to commute from Pretoria to Cape Town in under eleven hours.

3.6.2 HOST STRUCTURE SELECTION

Electric trains have been proved to be most environmentally responsive when compared to other means of transport (refer to Figure 1.2). As a result, it is vital to use this mode of transport to the advantage of human existence (Kottenhoff & Andersson 2009: 4).

The Gautrain is an Electrostar Multiple Unit train (Bombardier 2009). Therefore the train is hauled with electric power, generated and controlled by a motor car (or units) at each end of the train. These units assume the function of a traditional locomotive.

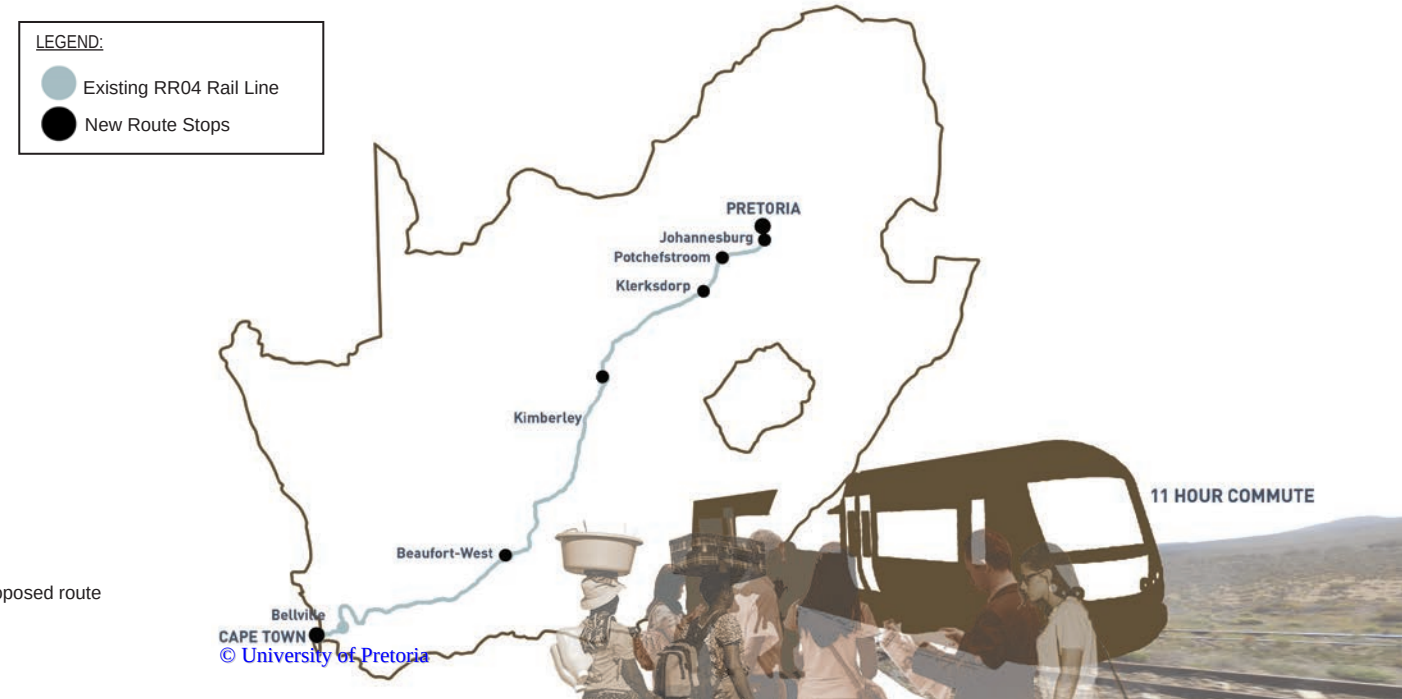


Figure 3.50: Proposed route

As the analysis of existing trains in South Africa has revealed, the body width, length and height of the Electrostar train correspond to the dimensions of trains currently operating on the mainline. The Electrostar will therefore be able to operate on the narrow gauge of the existing mainline tracks. The modern technology of the train enables the ideal of a shorter, smoother and safer journey than what is provided by current alternatives.

The Electrostar train is thus established and selected as a suitable host structure for the intervention.

LEGEND:

1. SIDE SKIRT PANELS (double-skinned aluminium extrusions)
2. ALUMINIUM FRAME
3. REINFORCING BEAMS
4. UNDERBODY
5. CORRUGATED FLOOR PLATE
6. REINFORCING BARS
7. FIBRE GLASS MAT
8. COPPER FOIL (laid in two layers)
9. FLOOR FINISH
10. INSULATION (thermal & acoustic)
11. BOGIE

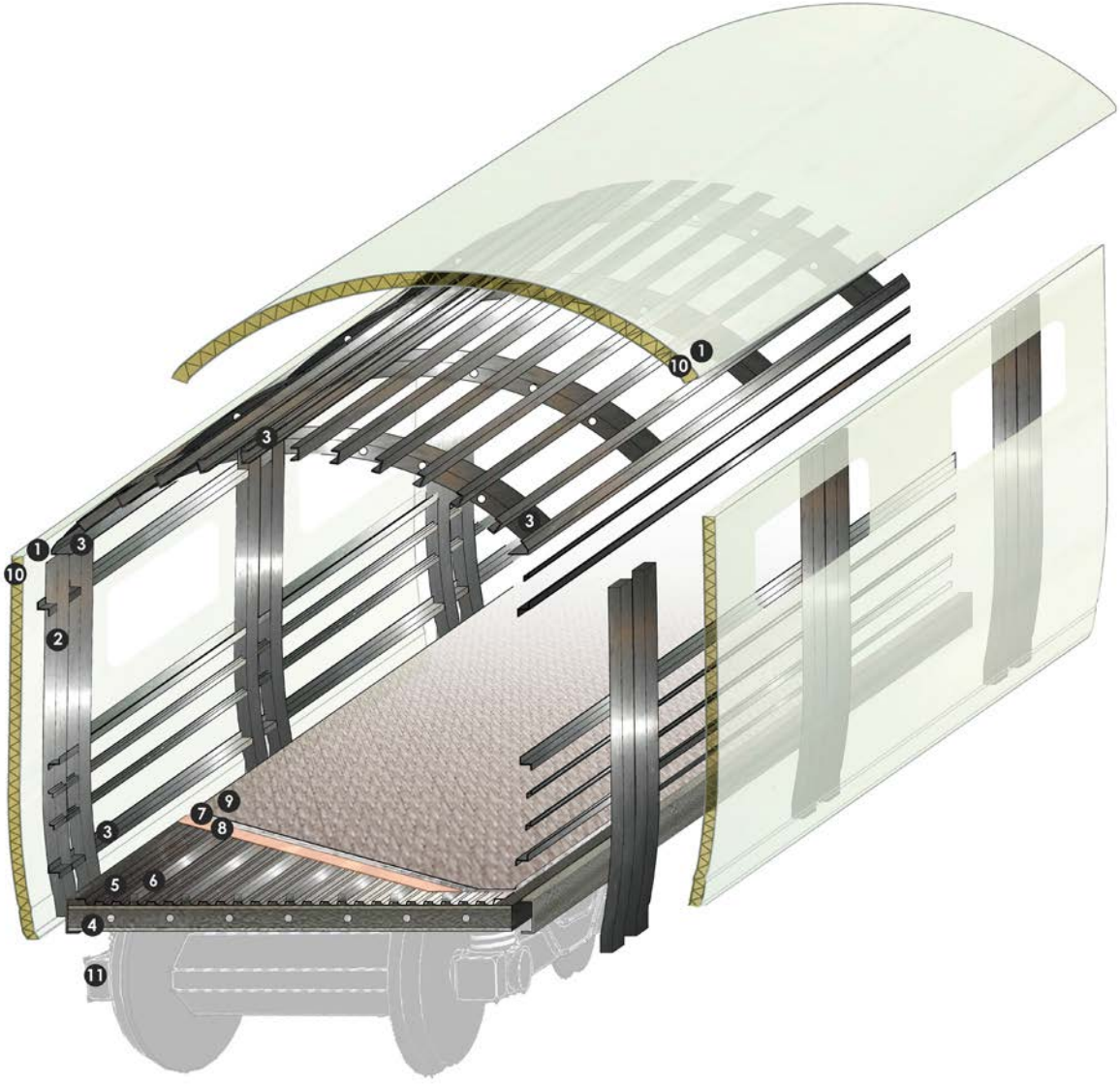


Figure 3.51: Analysis of typical train structure

3.7 TARGET MARKET

The passenger environment on a contemporary train requires being able to maintain the balance of comfort and good functionality for different kinds of passengers. Concurrently, cost should be taken into consideration (Kottenhoff & Andersson 2009: 3). A high level of comfort is a prerequisite of long-distance travel. All user profiles are attracted to train services of a high standard as long as these are reasonably priced (Kottenhoff & Andersson 2009: 30). Improved space utilisation can reduce costs while still maintaining a high standard of service, thereby increasing the inclination of users to pay for and use the service.

In relation to the role of cost: after the recent revision of the parliamentary handbook for its members, it is now stipulated that travel costs for Members of Parliament are being cut. Travelling between their homes and parliament is restricted to the most economic means of travel. Additionally, when travelling over 800 kilometres from Cape Town, the cost of overnight accommodation expenses for a member may not exceed R1 850 (Styan 2013).

Another significant factor to consider relates to the release of the most recent statistics on tourism. President Jacob Zuma proclaimed that South Africa's tourism growth rate for 2012 reached double the global average, with 9 188 368 international tourists visiting South Africa in 2012 (Department of Tourism 2013). To continue to improve tourism growth, South Africa needs to continuously become more accessible from within, thereby allowing tourism to fuel the local economy (Department of Tourism 2013).

With this stated, long-distance rail transport is presented with a need and opportunity to reduce the monopoly currently enjoyed by air travel. Also, international tourists and local governments are identified as potential passengers on a contemporary railway transport service.

3.7.1 USER GROUPS AND SPATIAL REQUIREMENTS

From the theoretical investigation it can be deduced that all user types do not require the same levels of comfort and space utility on a train. Four main user groups are therefore derived from a variety of possible passenger profiles. The user groups and staff requirements are identified to suit and reach a wider target market than aimed at by current South African long-distance rail services. In order to determine the programme, the possible user groups and their travel needs are determined in order to be translated into spatial requirements.

The interior programme should facilitate the needs of users specific to South Africa in terms of the nature and size of luggage (including bicycles, strollers, surfboards, curios and overly large baggage), the range of activities of the different users in the target market as well as the different degrees of privacy and noise levels the various users require. These context-specific considerations should then translate into a unique train interior environment- a new identity for passenger rail interiors in South Africa.

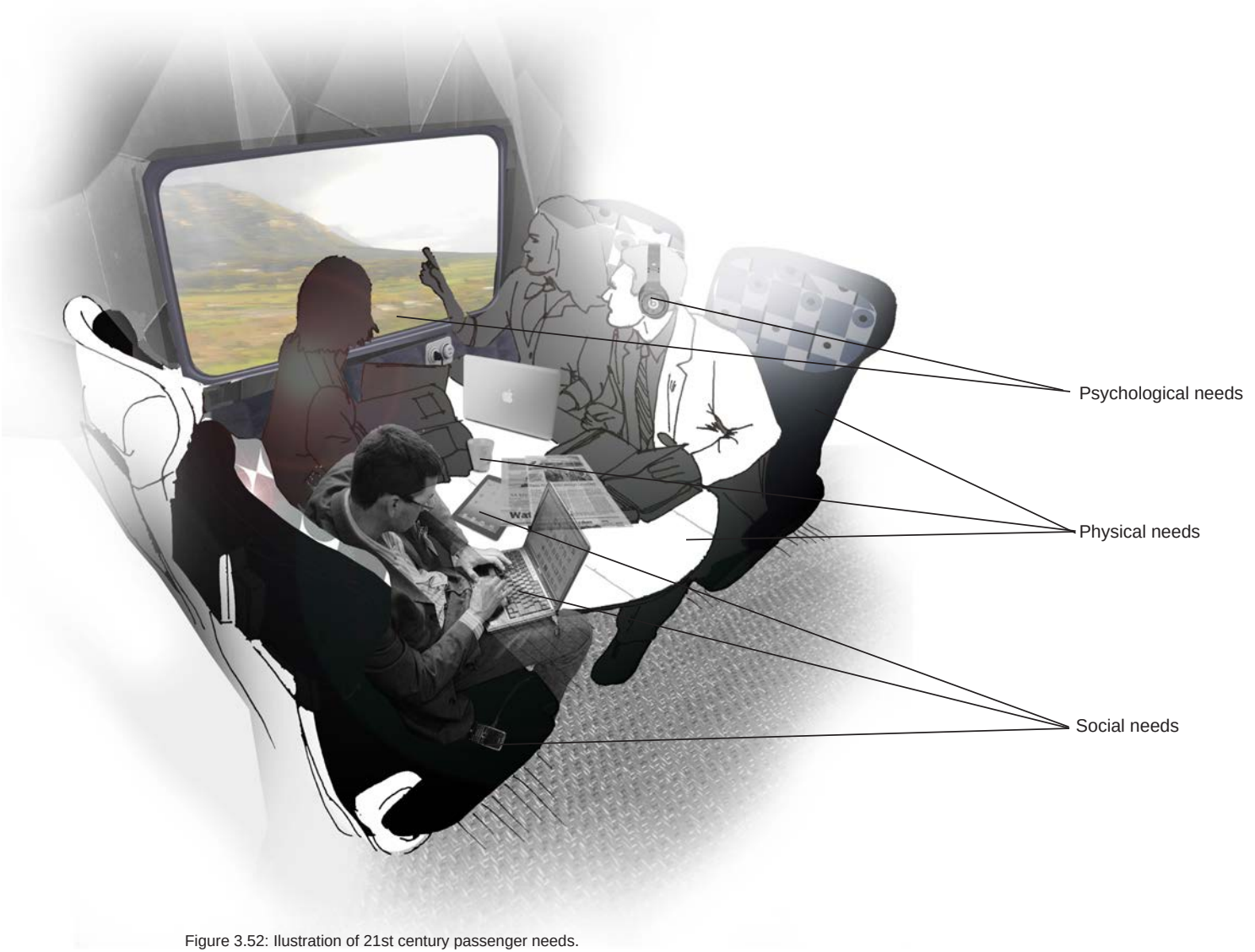


Figure 3.52: Ilustration of 21st century passenger needs.

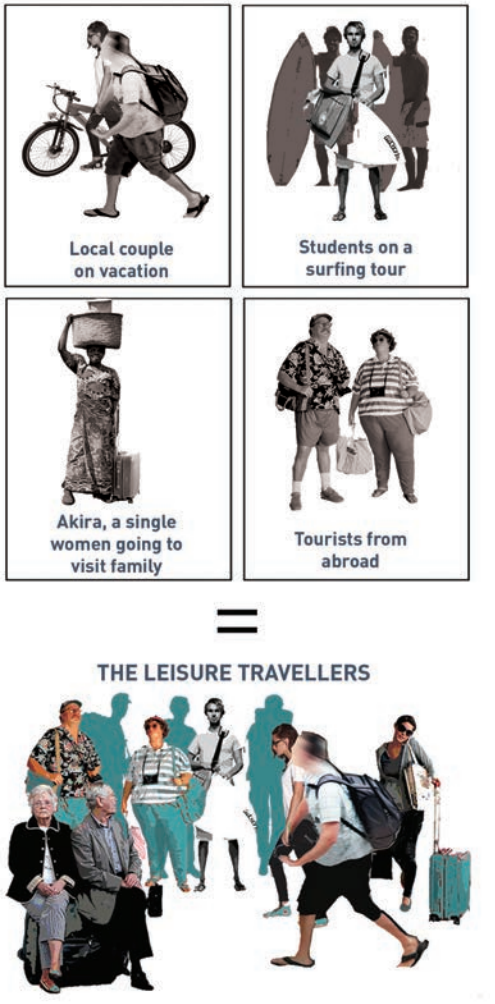


Figure 3.53: Leisure travellers.

The Leisure Passenger

This target group includes both South African citizens and tourists on a leisure trip and may include scholars on a tour. They should be enabled to enjoy the services provided on board. Travelling by train should enhance and be part of the vacation experience.

Figure 3.54: General travellers.

The General Commuter

The design of the train should create a home away from home for passengers that frequently use the services offered by the train, or for passengers with the basic prerequisite to get from A to B (in a safe, secure and comfortable environment). Passengers forming this market segment might be individuals who work between one of the set out stops, and use the service to commute on a weekend basis. It may be a large group of students or companions that would enjoy the benefits offered by the train journey, at a lower cost and with less stress.

Figure 3.55: Business travellers.

The Business Traveller

This market segment is identified as passengers that make use of the train for business purposes. It might include a young upcoming business man, a minister, or a group of commuters that are part of a firm. It can be said that it is a form of incentive to offer a tourist experience within the business travel time. For these commuters, elements of a work environment and quick access to the internet might be necessary.

Figure 3.56: Special-needs travellers.

The Special-needs Passenger

Universal design forms part of addressing a wide target market; therefore commuters with any physical impairment, mothers with strollers, or a commuter requiring extra space in order to travel are included. It might be physically difficult (without assistance) or impossible for these commuters to make use of other long-distance transport modes. Specific design adaptations need to be strategically incorporated to facilitate these passenger constraints. In designated areas of the programme, doorways and corridors are to be designed according to universal design standards.

Figure 3.57: Anticipated staff.

The Staff

In order for the train to be lucrative as a service, certain human resources are needed on board. Apart from the driver, other providers of passenger assistance would consist of security personnel, a conductor and bistro lounge staff. This means that additional seating needs must be taken into consideration.

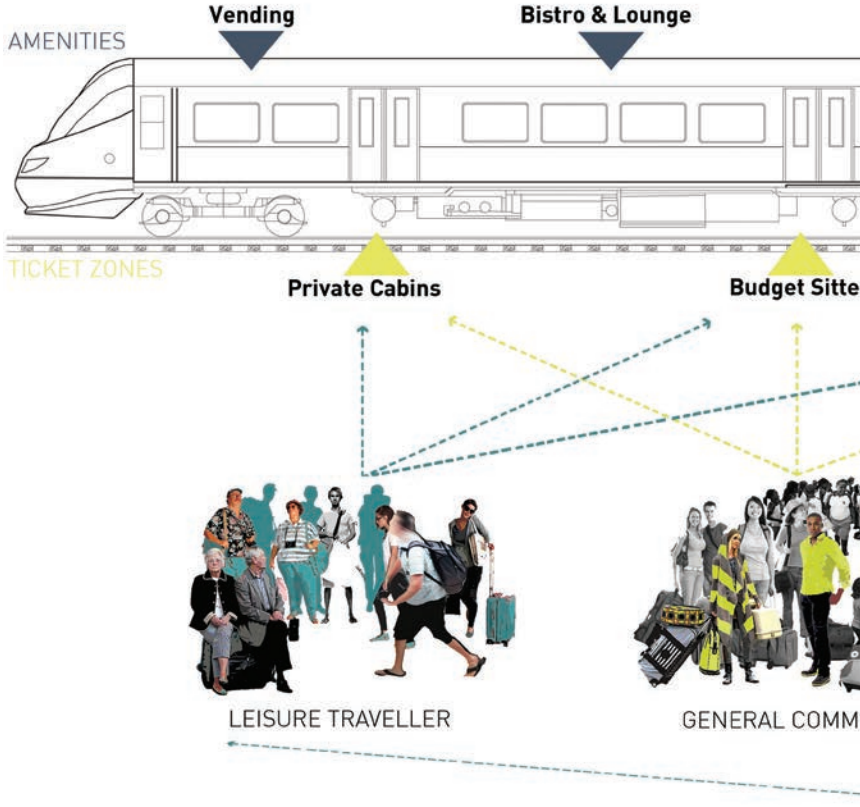
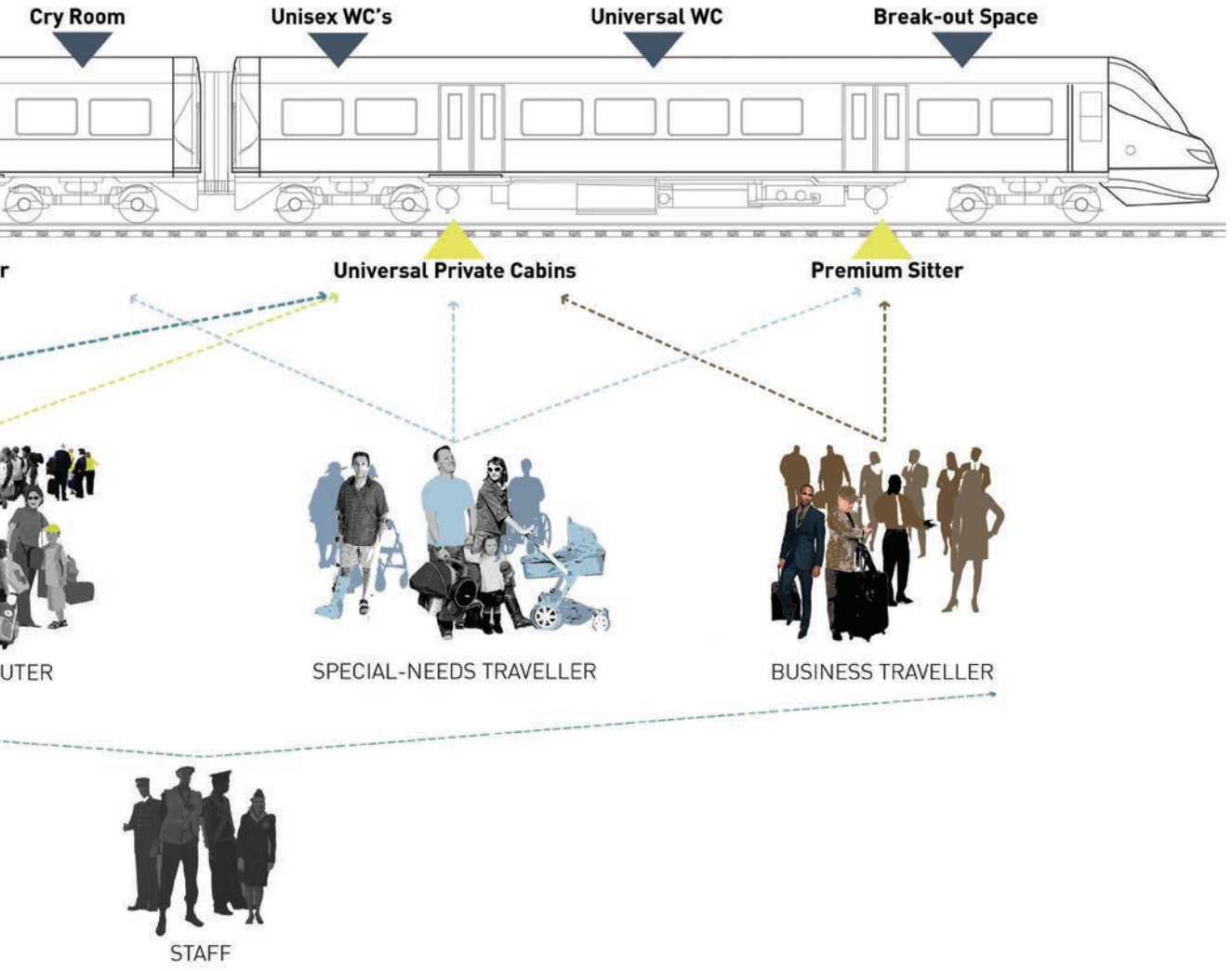


Figure 3.58: Illustration of the proposed programme.



3.7.2 PROGRAMME

It has been established that the train interior environment has to accommodate a variation between private and public spaces to take advantage of the benefits rail travel can offer.

Individuals are inclined to think of their time in a holistic way. It is thus essential to create an interior that permit people to utilize their time on the train in a manner which suits their own distinct time puzzles. Whether one wants to work, read, sleep or socialise, the interior should support the users to get the most out of their time spent on the train.

Varied spatial zones need to be created to host the diverse needs of the target market. This includes different seating configurations and sizes, coupled with different amenities. Kottenhoff and Andersson (2009: 11) indicate that a third of all passengers want to sit facing one another and a third prefer to sit behind one another in unidirectional seats. Certain passengers particularly favour window or aisle seats, while a private cabin appeals more to other passengers.

This voices the decision to include different zones or 'classes' within the programme (see Figure 3.58). These zones are translated into the ticketing system, where a variaty of seating types and amenities fit into different price brackets. In so doing, the aim to address a wide target market with a single service is accomplished.

3.8 CONCLUSION

The mainline infrastructure and train fleets in South Africa are in a dismal state and have turned long-distance passenger rail into an uncompetitive market. Current passenger trains do not fulfil the range of South African travellers' needs. From the analysis the Shosholoza Meyl highlights the issue that long-haul passenger train interiors have failed to transform on both a functional and aesthetic level. The trains fail to provide the user with sufficient amenities and holistic comfort within an appropriate travel time and at an affordable cost. This has an adverse influence on users' choice of mode of travel – actual or perceived discomfort dissuades users from using rail transport for inter-city travel. Universal design principles are also not applied and therefore a segment of the user market is excluded.

In addition to this, the technology of existing long-haul trains in South Africa is so outdated that it would be uneconomical to alter.

An Electrostar Multiple Unit is identified as a suitable host train structure to respond to the existing condition of the South African passenger train

Figure 3.59: Digital collage depicting vision of future users of South African passenger rail.

typology. As identified in the analysis of the Gautrain, the combination of its structural parameters and contemporary technology is capable of achieving the requirements of a contemporary long-haul passenger train typology to operate on the existing mainline. The train will enable a shorter, safer and more comfortable commute than is possible on existing passenger trains.

The analysis of the typology also concludes that rail travel can present benefits above other long-distance public transport modes. The strengths and weaknesses of existing typologies derived from the analysis are to be applied in the final design in reaction to the status quo.

This chapter also establishes the programme and user profiles of the intended intervention and therein addresses the current lack of inclusion of certain parts of the market. The programme is formulated specific to the South African context and the needs of 21st century South African travellers.

conclusion
PART A

South African passenger rail is in the midst of a renaissance. Recent years have seen significant rail development in the form of the Gautrain, supplemented by substantial long-term investments. This follows an international trend of railway investment in response to the advantages of rail travel. Rail travel has positive environmental credentials which render it a significant competitor to air travel. In addition, research establishes that rail travel can offer a more comfortable travel experience.

Regrettably, South African long-haul rail travel has suffered from ongoing underinvestment. The Shosholoza Meyl exemplifies this condition. It is characterised by a continued weakening in service performance, resulting in a constant decline in passenger numbers. Long-distance passenger transport in South Africa is characterised by a lack of investment in user-centred design – as evidenced by the lack of research on user experience and perceptions. The author's personal experience of the Shosholoza Meyl highlights the issue that long-haul passenger train interiors have failed to improve functionally and aesthetically. Additionally, the interior experience leaves users feeling spatially and socially isolated, misunderstood and detached from the context of both space and time. Both a contemporary and South African design identity is absent from the train interior environment. This results in a sense of alienation, where the user cannot associate with the interior on an emotional level and as such, the interior lacks a sense of place.

It is necessary to develop a train interior specific to the social, physical and psychological needs of South African users to create a distinct sense of place. It is therefore vital that passenger train interiors consider the users and their potential experiences in order to create habitable spaces which will enhance human well-being.

4.1 INTRODUCTION

This chapter communicates the design intent of the investigation and subsequently presents guidelines to design a passenger train interior that is supportive of holistic comfort and a human centred approach. The guidelines are derived from the theoretical and contextual investigation. Additionally, a conceptual approach is established from which the design was further developed.

4.2 CONCEPTUAL APPROACH

The conceptual approach to the design emerges from the aim to create a contemporary South African design identity for long-haul passenger rail.

The concept consists of two parts. In part one, an abstract visualization of the train interior was developed by using structural elements of the train to generate form. This abstraction of the train plan allows distinguishing between fixed structural elements (invariables) and adaptable elements (variables) and therefore creates a threshold of separation and inclusion. Moreover it initiates a means of challenging the insular nature of the train interior and its conventional layout.

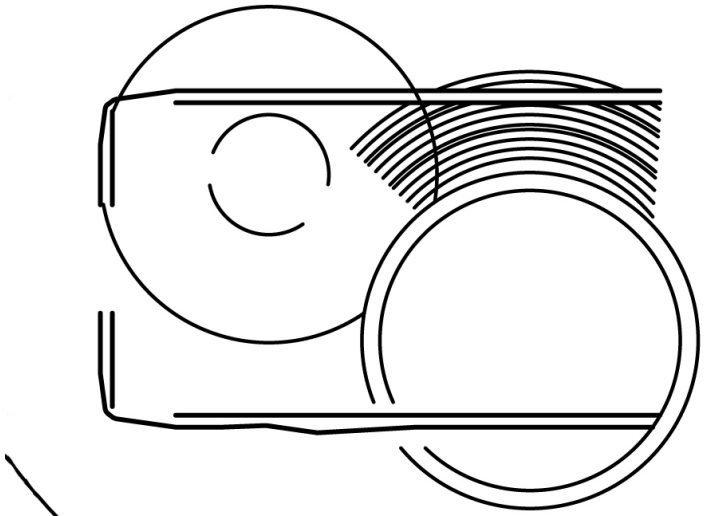
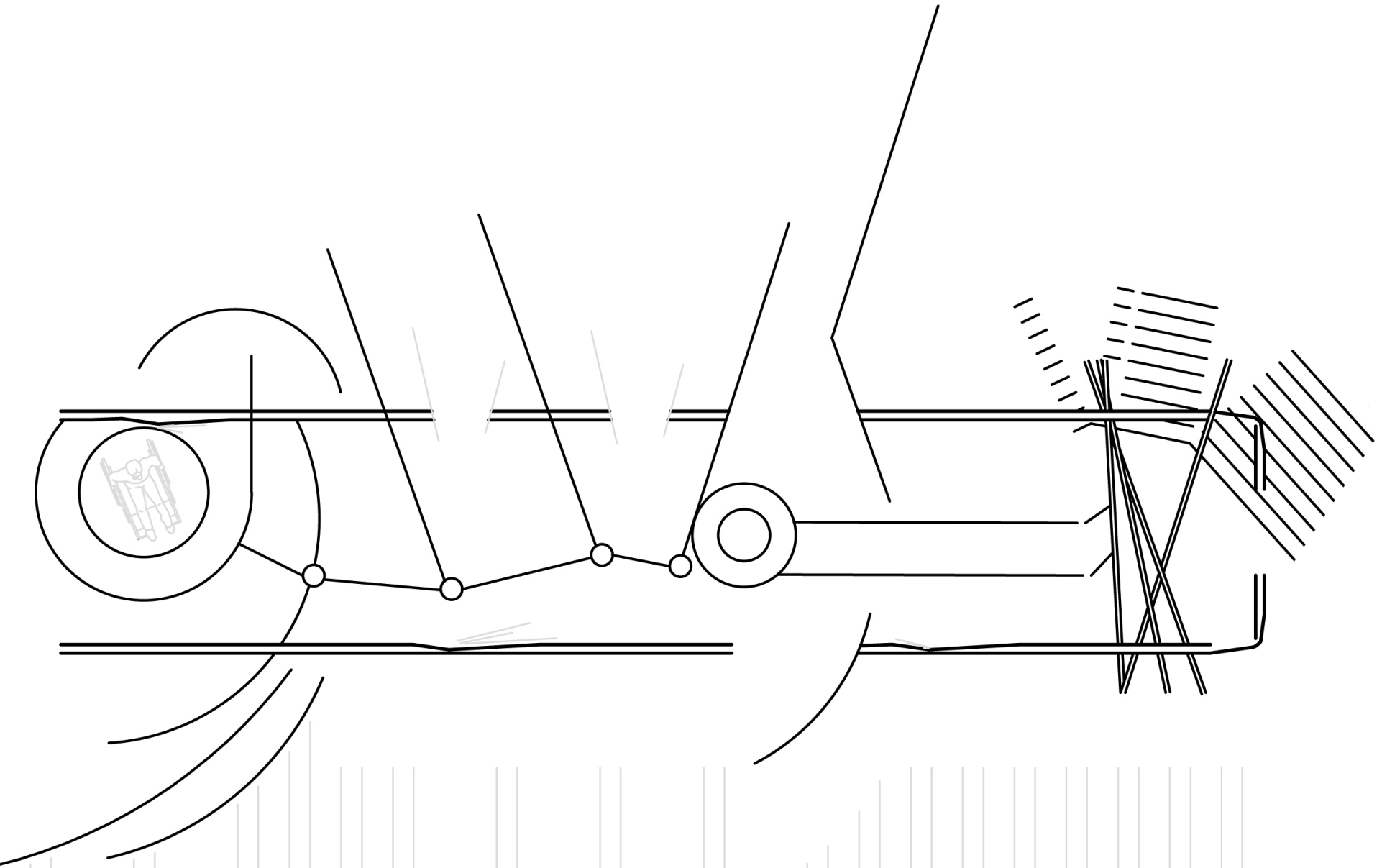


Figure 4.1: Part one of conceptual approach.



Secondly, 'Hamba-Kahle' was selected as the title for the contemporary passenger train. It is an emotive expression meaning *farewell* or, literally, to *go well*.

The phrase *hamba kahle* originates from the Bantu languages spoken by the Nguni tribes of South Africa. The Nguni tribes include the Xhosa, Zulu, Ndebele and Swazi cultures and the languages spoken are often considered dialects of a single language (Kuper 1980; Howcroft n.d). It is further argued that hamba kahle is a national well-known expression and therefore the multi-cultures of local society will be able to relate to Hamba-Kahle as the new long-distance passenger rail brand.

Among the various Nguni tribes, the identity created by Ndebele beadwork and mural art is distinctive. It emerged in a pursuit to be able to identify one another when tribes fragmented into different branches and endured war against the ZAR during the 1800s (Elliot 1993; Powell 1995). The symbols and geometric designs is a result of their dedication to culturally based rules to maintain united identity their in separation.

From the geometric Ndebele patterns, the triangle was selected as element to develop the abstract visualisation (part one) into three dimensional space. The triangulation of the structural elements was used to add dimension to the long, narrow environment of the train interior by creating polygonal forms and a non-linear layout. This method subsequently intends to aid in defining privacy in a different manner and permit improved circulation within the interior.

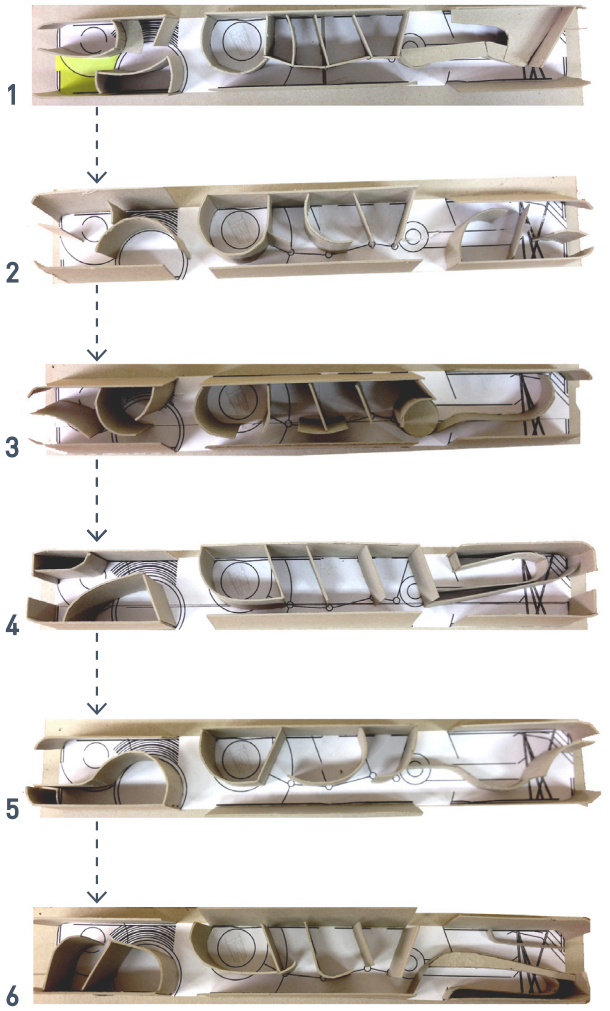


Figure 4.2: Models exploring the three dimensional development of part one of the conceptual approach.

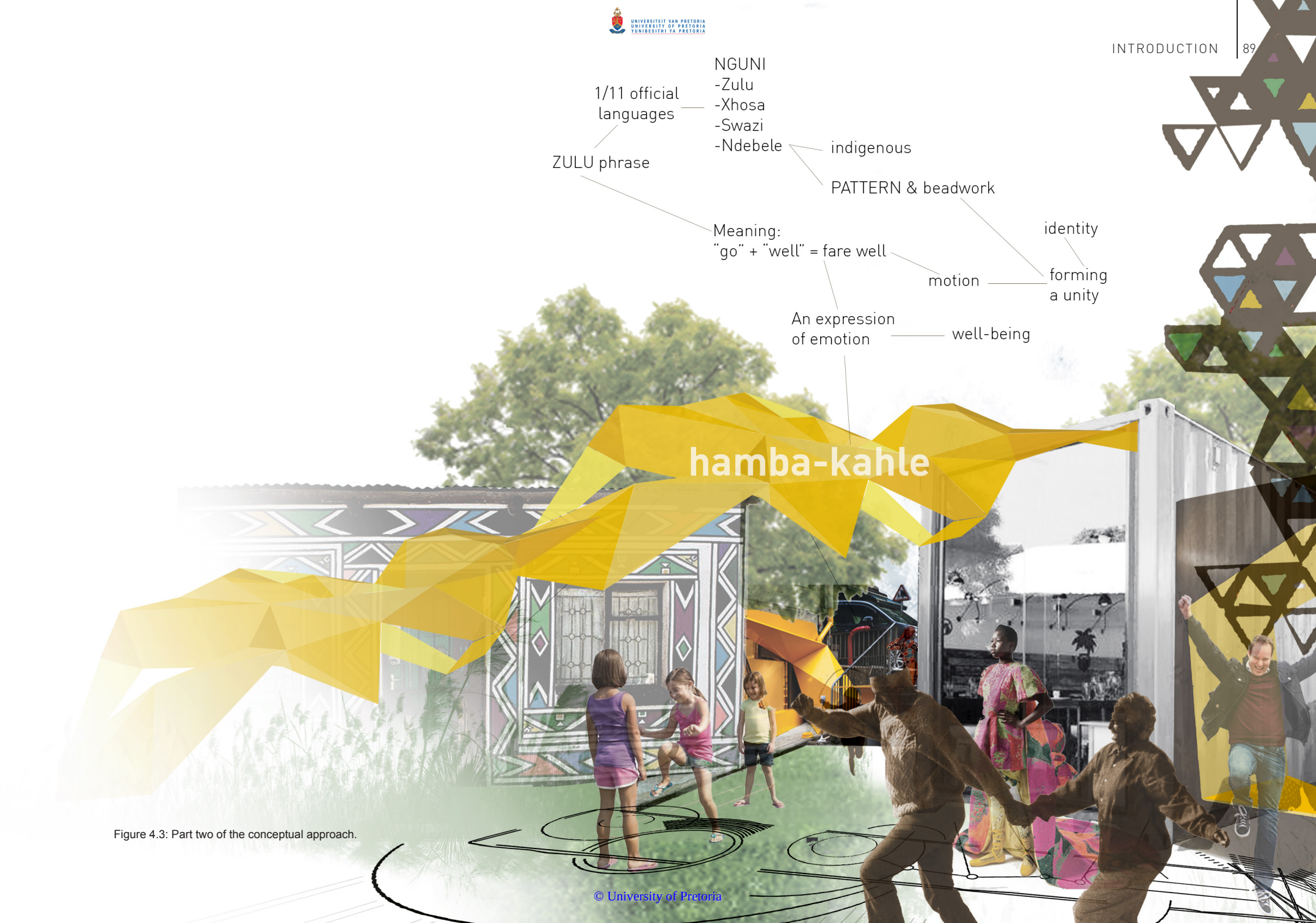


Figure 4.3: Part two of the conceptual approach.

4.3 DESIGN INTENTTIONS

By gaining a deeper understanding of those aspects identified as affecting passenger comfort, the design intent is discussed and demonstrates in what manner the design solution aims to address the five main problematic factors in current local long-distance train interiors. By using these parameters, intangible experiences can be constructed.

(a) Programmatic distribution 

The programme is distributed over five separate train cars. The location of the different spatial zones are intended to function as an ecosystem of spaces and create layers of privacy. The premium sitter car, universal car and barista bar and lounge car is designed to ensure universal accessibility between these train cars. In so doing, special-needs passengers have the freedom to travel independently with access to the benefits of the interior.

Following the guidelines derived from the Comfort Theory, spatial deliverables were set out for distinguishing between the sleeper car, premium sitter car and the budget sitter car. The deliverables inform the required space, amenities and material choices.

(b) Circulation 

Within the concept development, various exploratory models were used to create a circulation narrative (see Figure 4.2). The intent is to alleviate the intimidation and claustrophobia caused by the long corridors typically found in train interiors. By creating a circulation narrative in each train car wayfinding can also be improved. The structural partitioning is to be used to further aid in circulation and wayfinding by creating circular spaces for services and amenities and non-linear spaces to indicate the more private passenger accommodation zones.

(c) Break-away spaces 

By cutting into the wide corridor spaces where entrance/exit doors are located, break-away spaces for social interaction can be provided. The break-away spaces intend to encourage movement of the users in order to alleviate symptoms of travel fatigue. These spill out spaces can therefore ensure chance encounters and mediate between private and public zones. Additionally, these spaces are intended to draw views of the surrounding landscape into the interior and so enable the embodied experience of the users in the interior.

(d) Luggage 

Parameters for luggage storage provision was followed from the research conducted by Kottenhoff and Anderson (2009: 22). The provision of a large storage closet and overhead storage is to be provided as well as provision for large items such as bicycles. The storage racks are to be designed with perforated or translucent material insets to aid in the psychological comfort of passengers and avoid unrest over the safety their luggage.

(e) Amenities 

The provision of a cry room in the universal car intends to support parents travelling with babies or small children. Physical and psychological comfort

is then supported in creating a private, temporary space for breast-feeding and to keep boisterous children from causing discomfort to neighbouring passengers.

Electrical outlets is to be provided in all passenger accommodation zones to enable the charging of devices. Subsequently the freedom to work or socialize on the train is then supported.

The barista bar and lounge car is aimed at further creating variation for the users. Different seating configurations should further encourage social interaction opportunities and emphasise the views from the surrounding landscape.

	BUDGET	CABINS	PREMIUM
Cost	R450 - R650 pp	R650 - R950 pp	R1150 - R1550 pp
Passanger capacity	205	57	30
Seat covering material	Linin & Cotton	Vinyl	leather
Seat width	500mm	(adaptable)	520mm
Armrest width	70/140mm	(none)	94/240mm
Reclining angle	31°	180°	45°
Partition/screen		x	x
Movable reading light	x	x	x
Entertainment Screen			x
Tray table	x	x	x
Storage drawer	x	x	x
Mirror		x	x
Magazine Rack			x
Acoustic absorbent panel		x	x
Wi-fi access	x	x	x (free)
Mini-refridgerator			x
USB port	x	x	x
Electrical outlet	x	x	x
Leg rest			x
Foot rest			x
Seat tilt			x
Cup holder		x	x

Figure 4.4: Spatial deliverables.

11-11 CLUB

by Uras X Dilekci Architects
Beyoğlu, İstanbul
2013

The Beyoglu district in Istanbul has many competing bars and nightclubs from which the 11:11 club stands out. The design incorporates undulating triangular panels to create different spaces and functional surfaces in a narrow interior. The triangular surfaces create spaces within spaces to play different music in. The polygonal panels subsequently generates a sense of dimension and depth in the narrow building. Spatial pleasure is achieved with the combination of undulating surfaces, coloured lighting effects projected on these surfaces and sound (Rinaldi 2013).

Design application:
Polygonal surfaces can be used to create depth in narrow spaces.

Figure 4.5: Polygonal surfaces in the 11:11 club (Rinaldi 2013).

4.5 BRANDING

The intention of generating the brand was to be able to increase market share and appeal to the targeted users. Thus the aim was to communicate an association with exclusivity as though for everyone.

From the conceptual approach the triangular pattern was continued through to the development of the Hamba-Kahle logo. The colour palette was motivated by Ndebele earth pigments (yellow and brown). Prior to the use of red and green tones, these colours were used to create their patterned murals (Elliot 1993; Powell 1995).

Figure 4.6: Final logo.

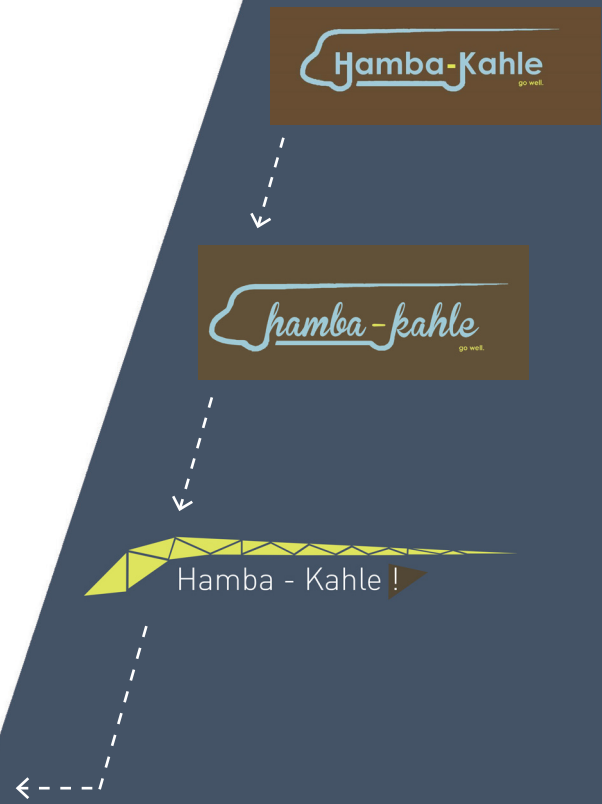


Figure 4.7: Development of Hamba-Kahle logo.

4.6. CONCLUSION

The conceptual approach was established in this chapter and informs and substantiates the design resolution and technical investigation to follow. It inherently addresses the main issues identified in the theoretical investigation and context analysis. Design guidelines are therefore presented as parameters to design a contemporary, South African passenger train interior.

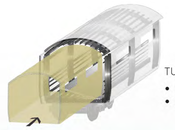
CHAPTER 05

design & technical resolution

CHAPTER 05:
DESIGN & TECHNICAL RESOLUTION

5.1 INTRODUCTION: AN APPROACH

This chapter introduces the five train cars which form the scope of the design resolution. To carry the delimitation through as an approach to construction, a tube-in-tube principle is explored in the resolution of the design.



TUBE-IN-TUBE PRINCIPLE:

- Connection against connection
- Demountability

Figure 5.1: Approach to construction

5.2 PLANS AND SECTIONS

5.2.1 SLEEPER CAR

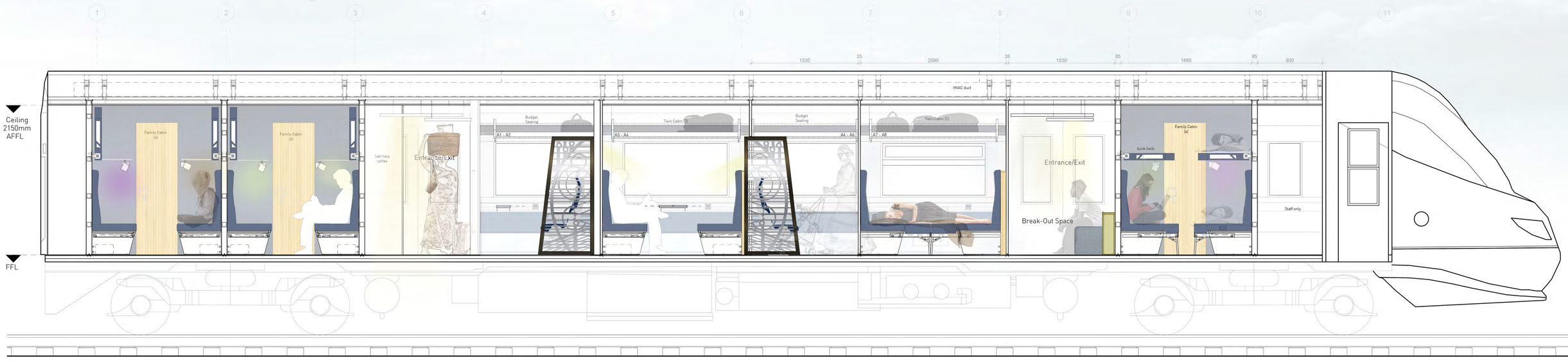
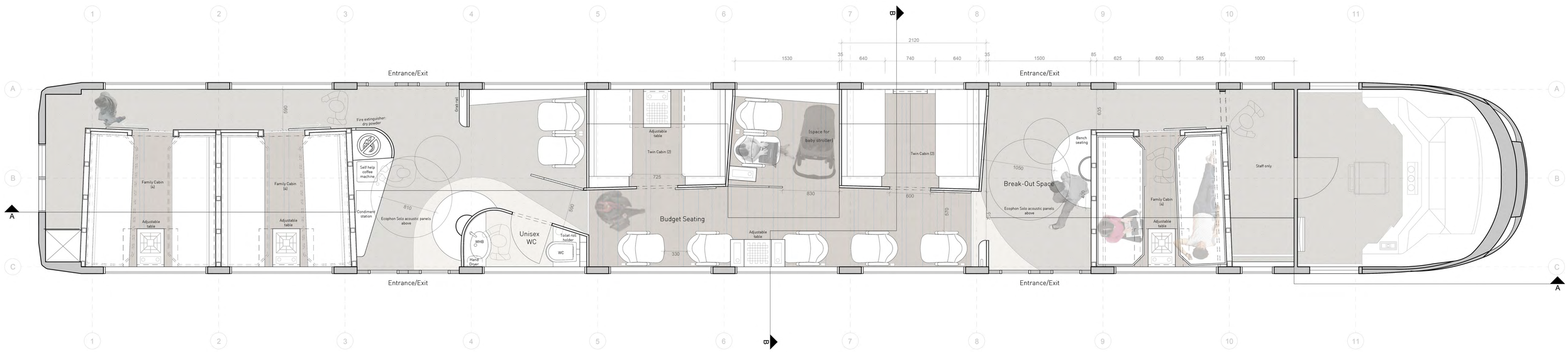


Figure 5.2: Longitudinal section (scale 1:20)

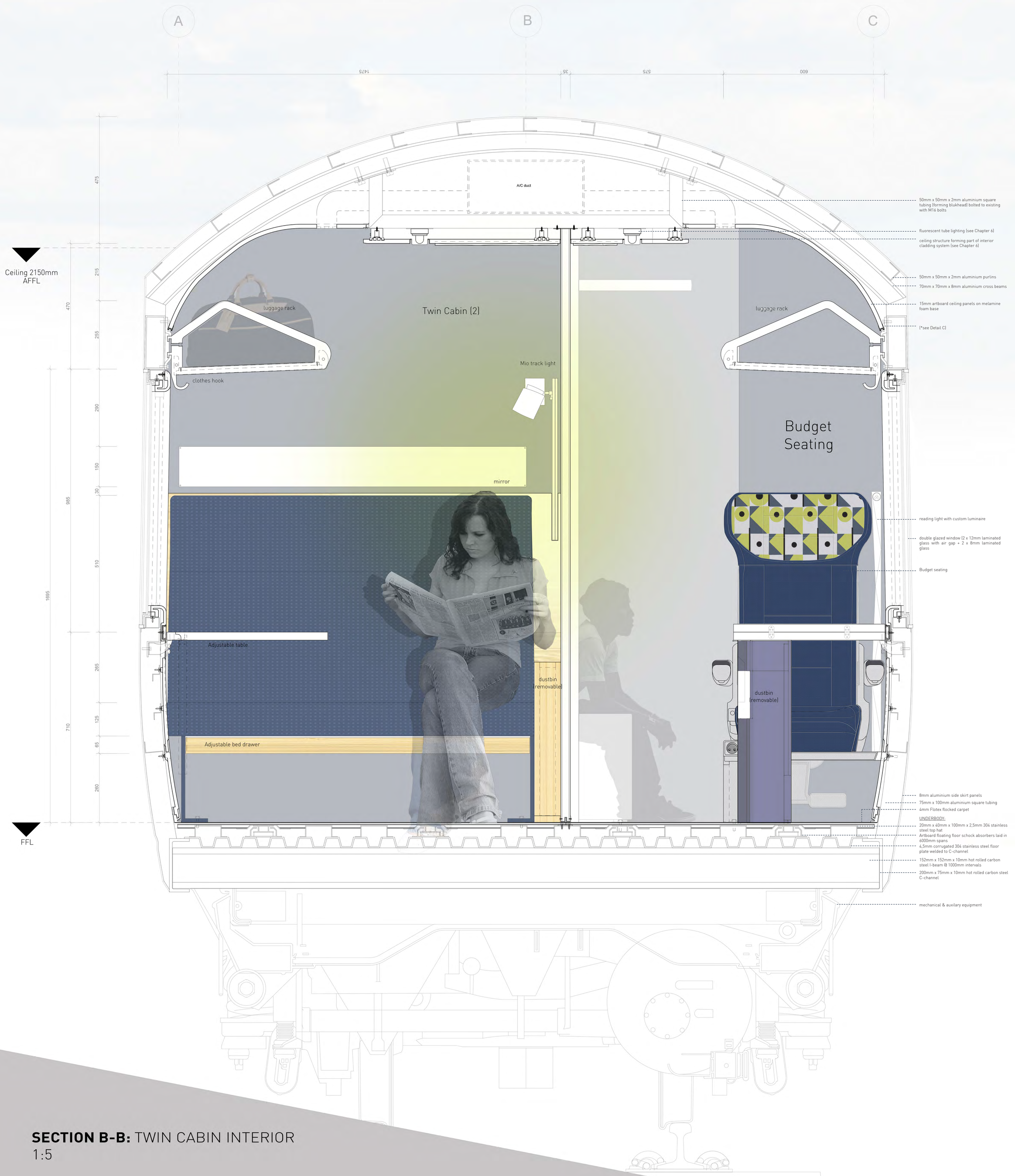
SECTION A-A: SLEEPER CAR
1:20



PLAN: SLEEPER CAR
1:20

Figure 5.3: Plan (scale 1:20)

5.2.1 SLEEPER CAR



SECTION B-B: TWIN CABIN INTERIOR
1:5

Figure 5.4: Cross section (1:5)

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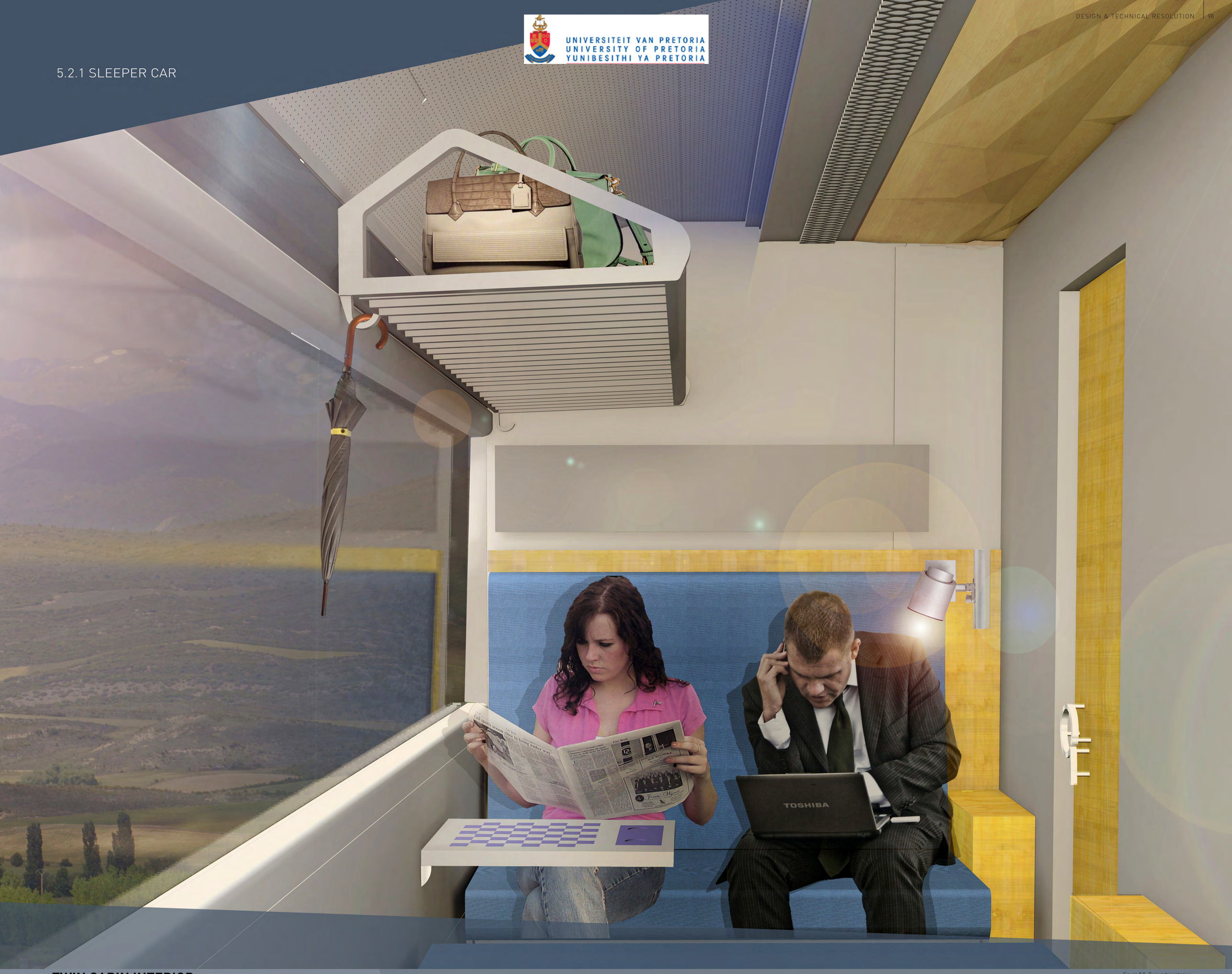
5.2.1 SLEEPER CAR



TWIN CABIN INTERIOR

Figure 5.5: Twin cabin interior

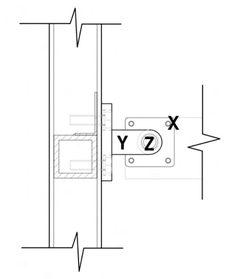
DETAIL A: PRIVACY SCREEN
1:5

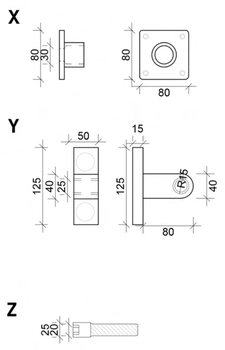
20mm x 20mm x 3mm aluminium frame

1660mm x 760mm x 1mm aluminium sheet with custom laser cut pattern tig-welded to aluminium frame with 5mm x 5mm leg length

Figure 5.6: Concept translated into privacy screen

DETAIL B: BUNK BED SUSPENSION
1:5





Component X:
80mm x 125mm x 15mm chrome plated carbon steel forging with 30mm diameter x 3mm bronze bush fixed to 70mmx 70mm x 8mm aluminium square tube with M16 bolts fixed to bunk bed side panel with M8 bolts

Component Y:
80mm x80mm chrome plated carbon steel forging

Component Z:
M30 high tensile screw pin with hexagon allenhead

Figure 5.7: Detail of bunk bed connection to interior partition

5.2.2 PREMIUM SITTER CAR

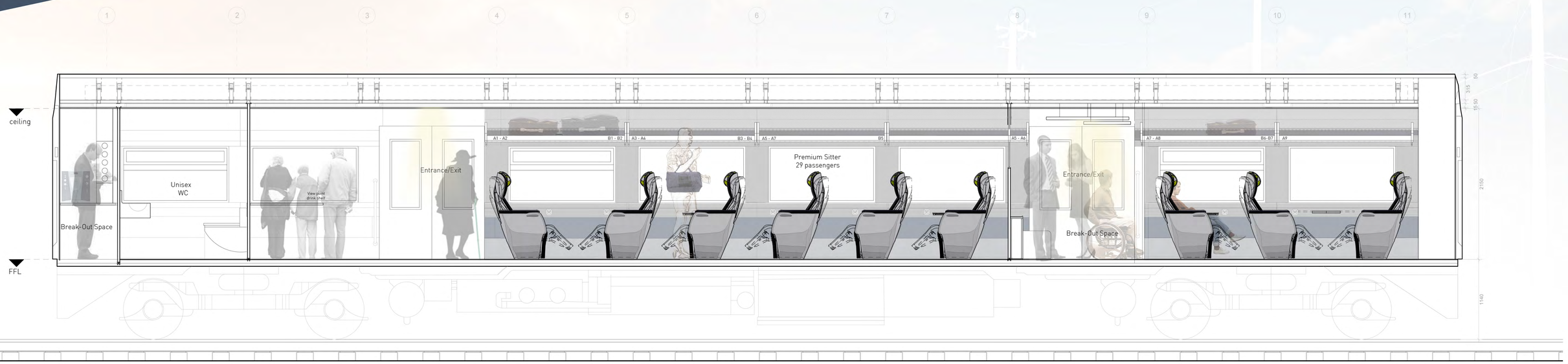
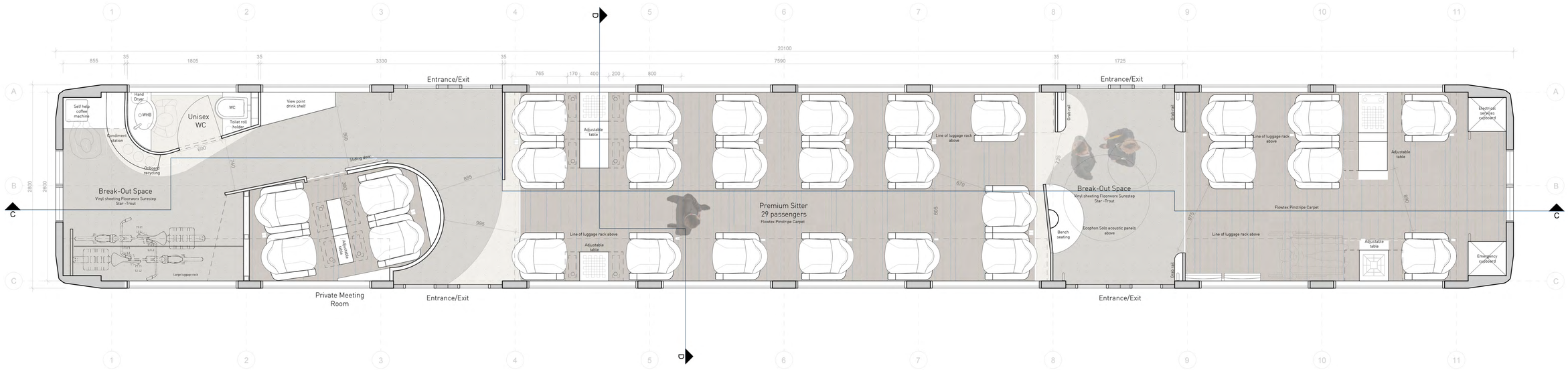


Figure 5.8: Longitudinal section (scale 1:20)

SECTION C-C: PREMIUM SITTER CAR
1:20



PLAN: PREMIUM SITTER CAR
1:20

Figure 5.9: Plan (scale 1:20)

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5.2.2 PREMIUM SITTER

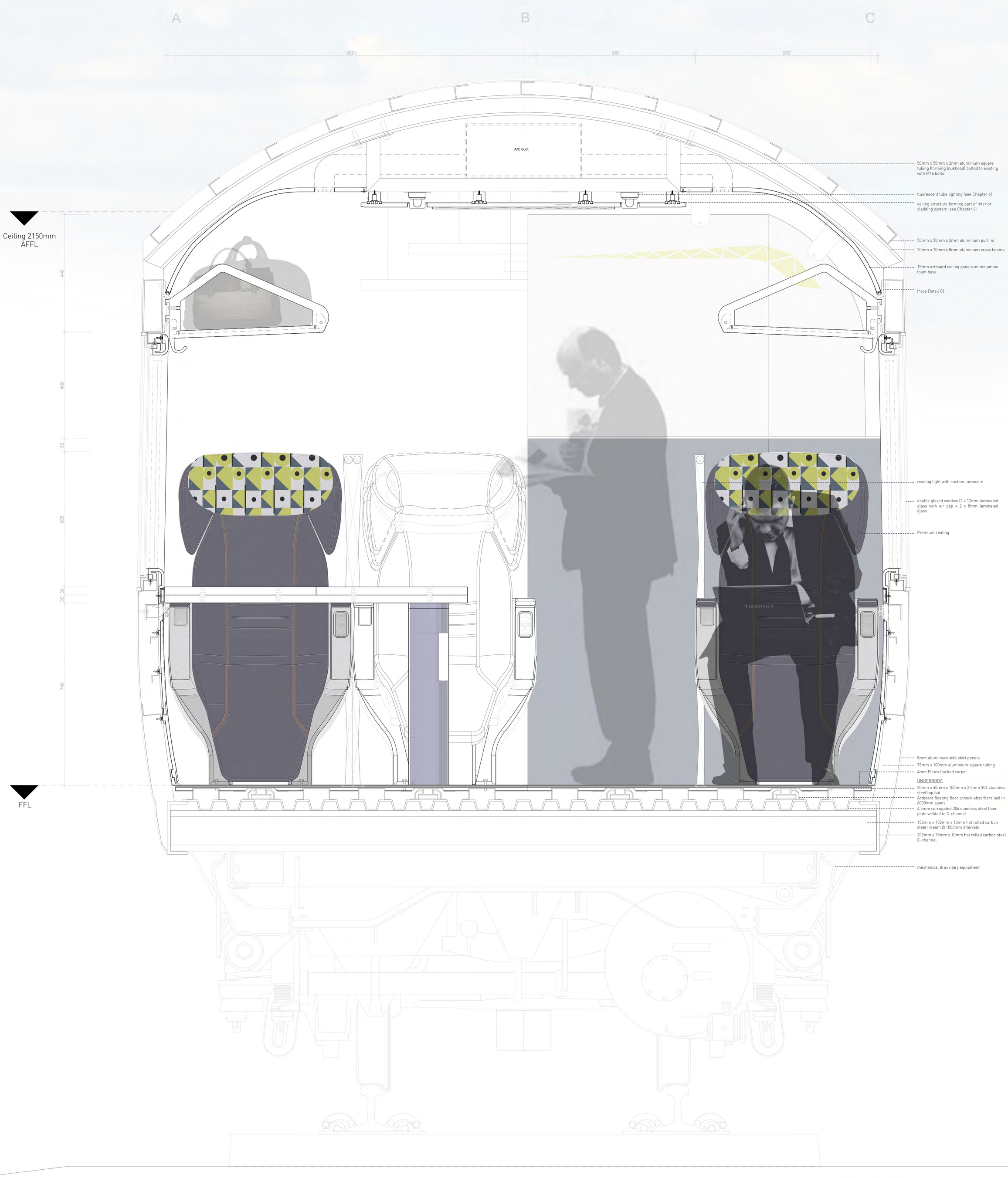
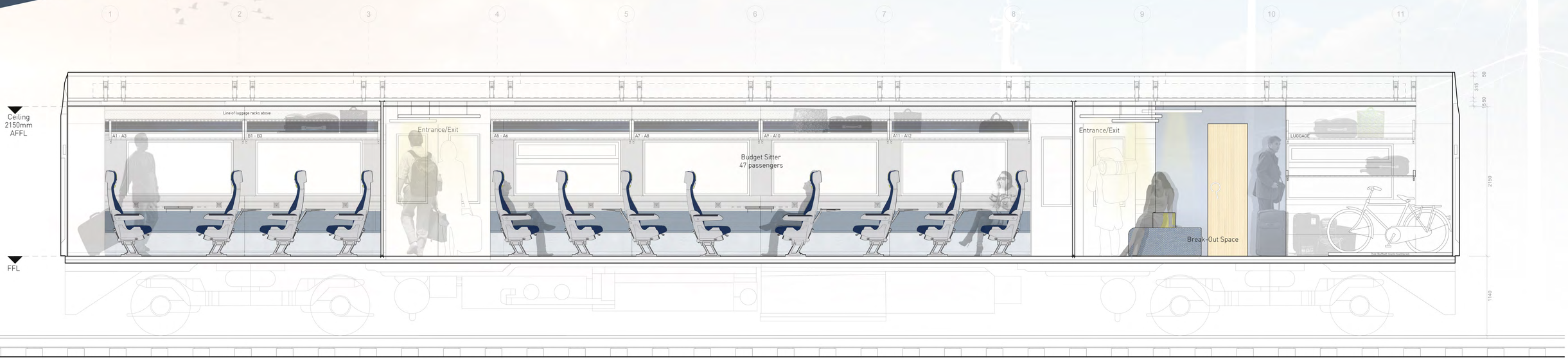


Figure 5.10: Cross section (1:5)

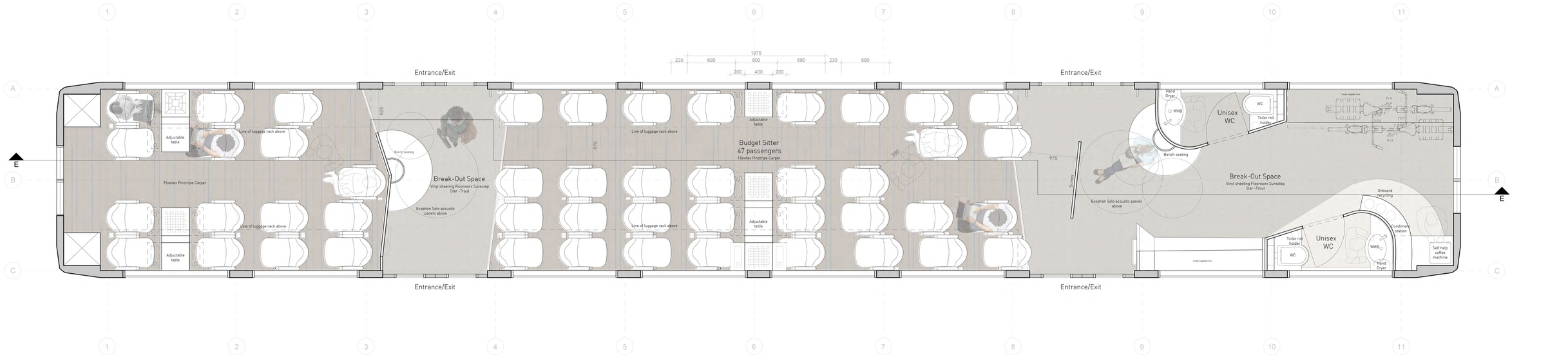
SECTION D-D: PREMIUM SITTER CAR
1:5

5.2.3 BUDGET SITTER CAR



SECTION E-E: BUDGET SITTER CAR
1:20

Figure 5.11: Longitudinal section (scale 1:20)



PLAN: BUDGET SITTER CAR
1:20

Figure 5.11: Longitudinal section (scale 1:20)

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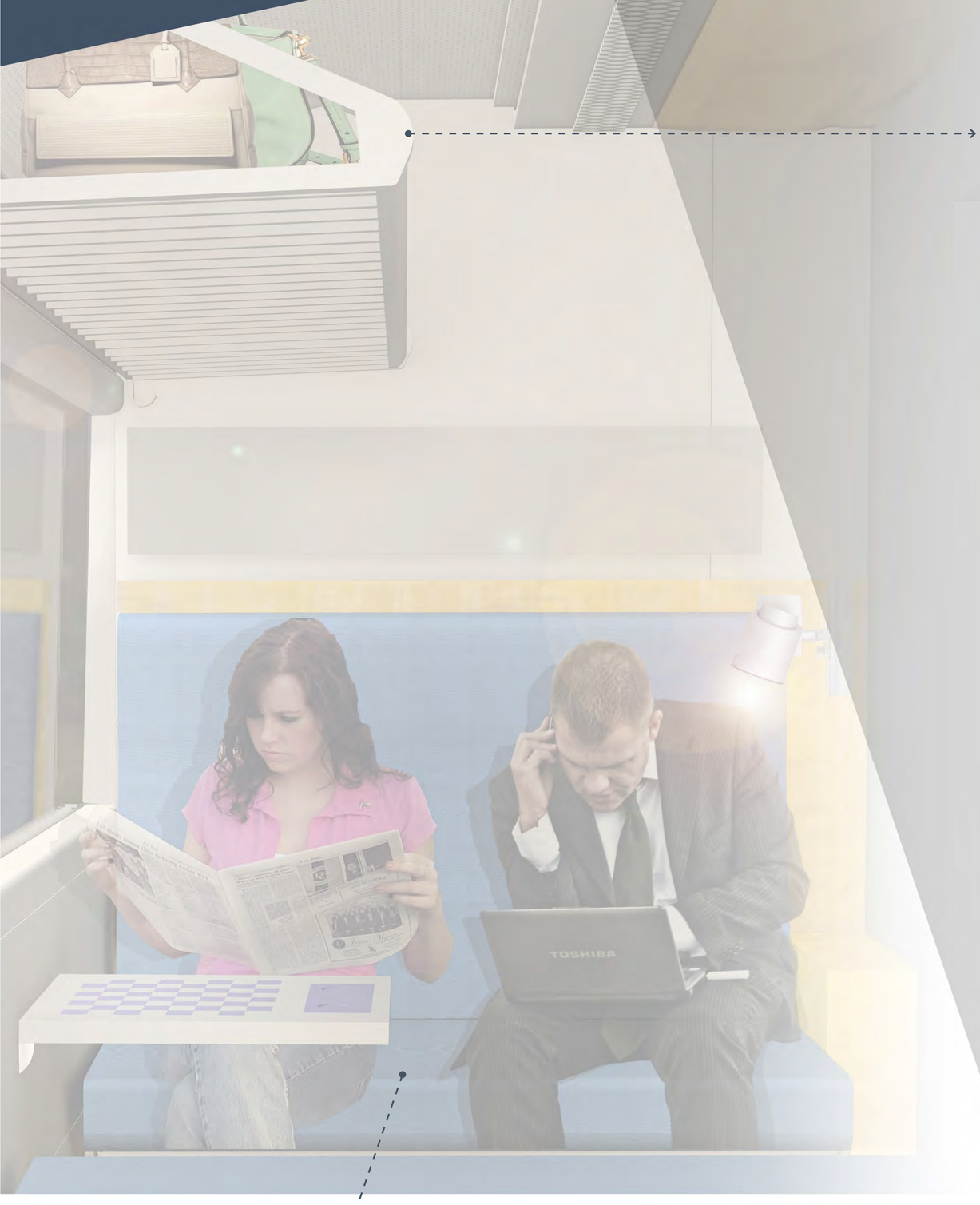
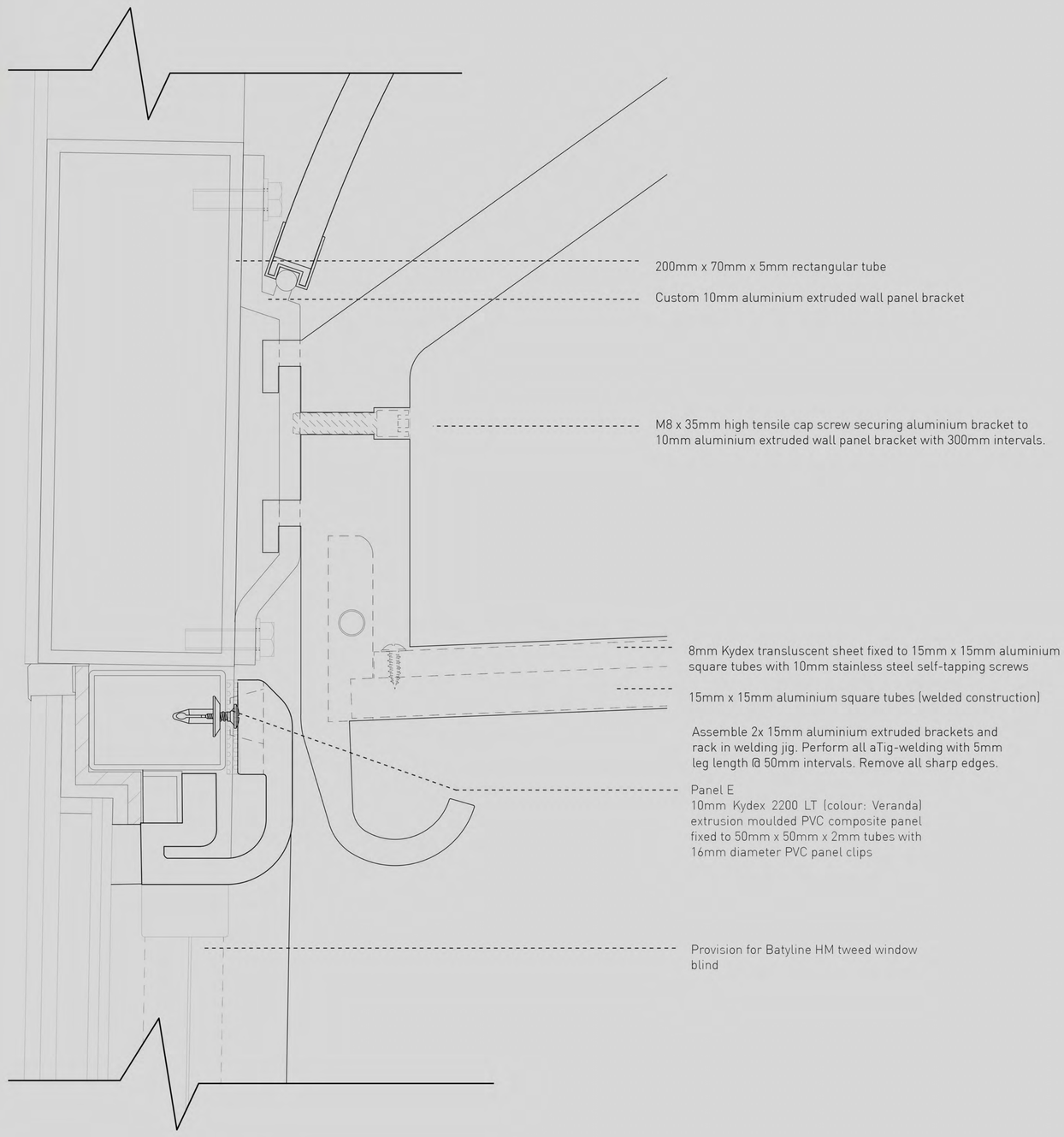
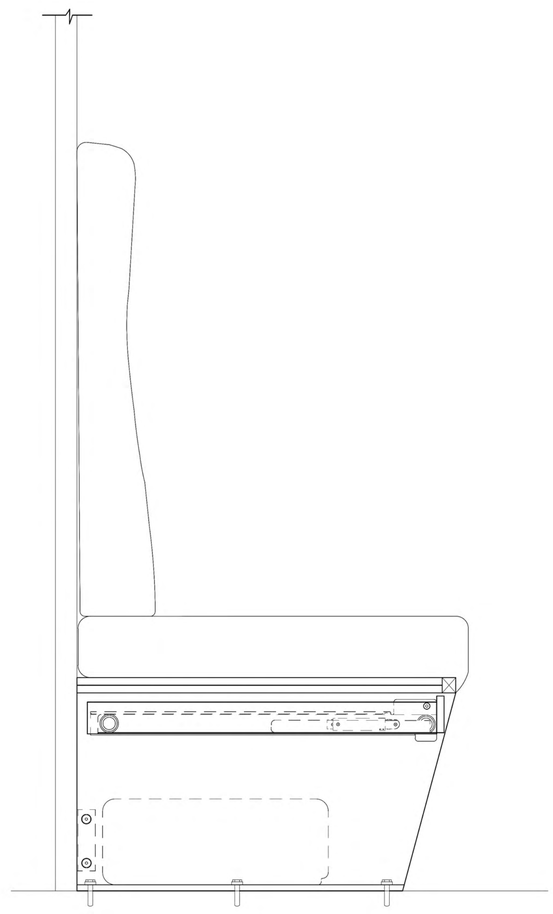
5.2.3 BUDGET CAR- DETAILS RESOLUTION (c) - (d)

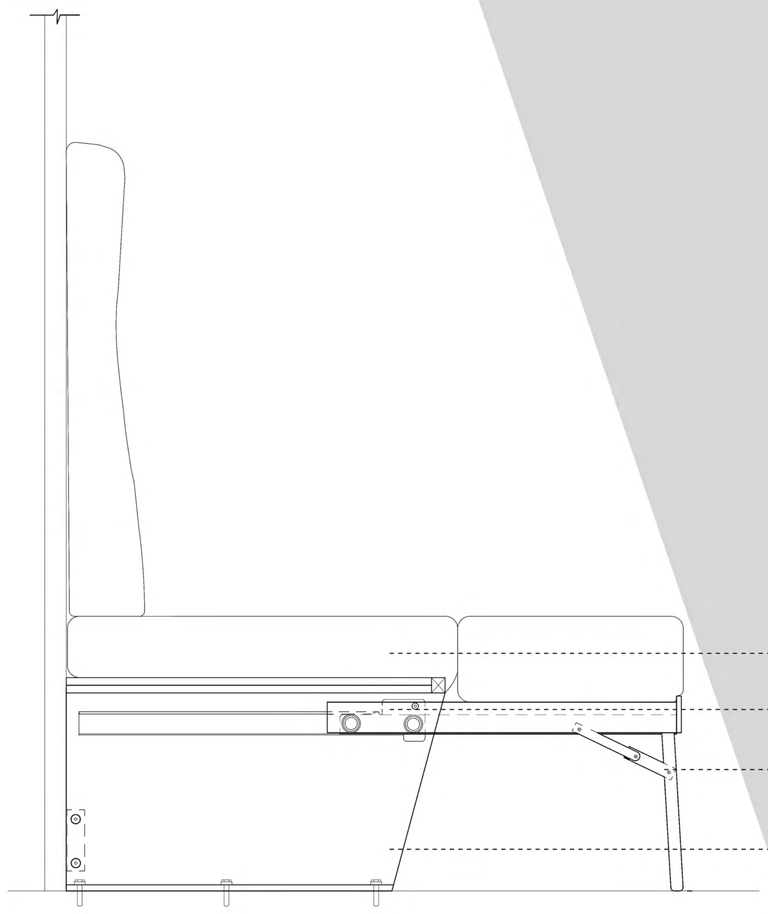


DETAIL C: LUGGAGE RACK
1:1



DETAIL D: BERTH SEATING
1:5





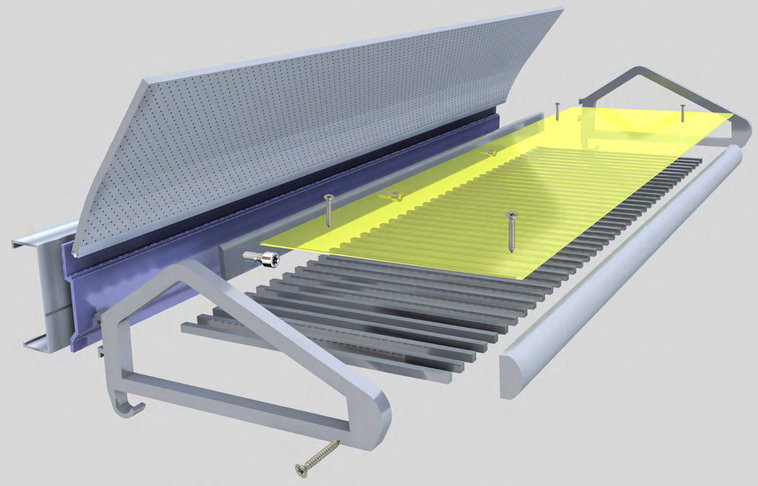
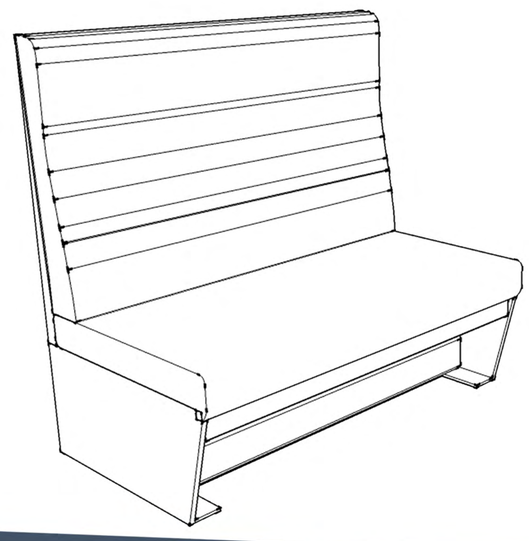
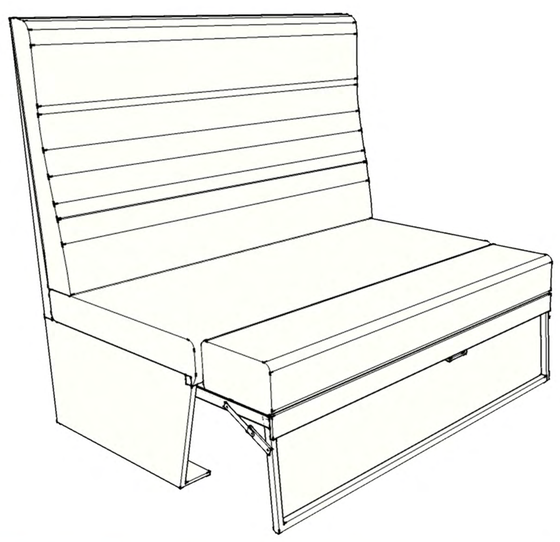


Figure 5.13: Detail of luggage rack connection to train structure



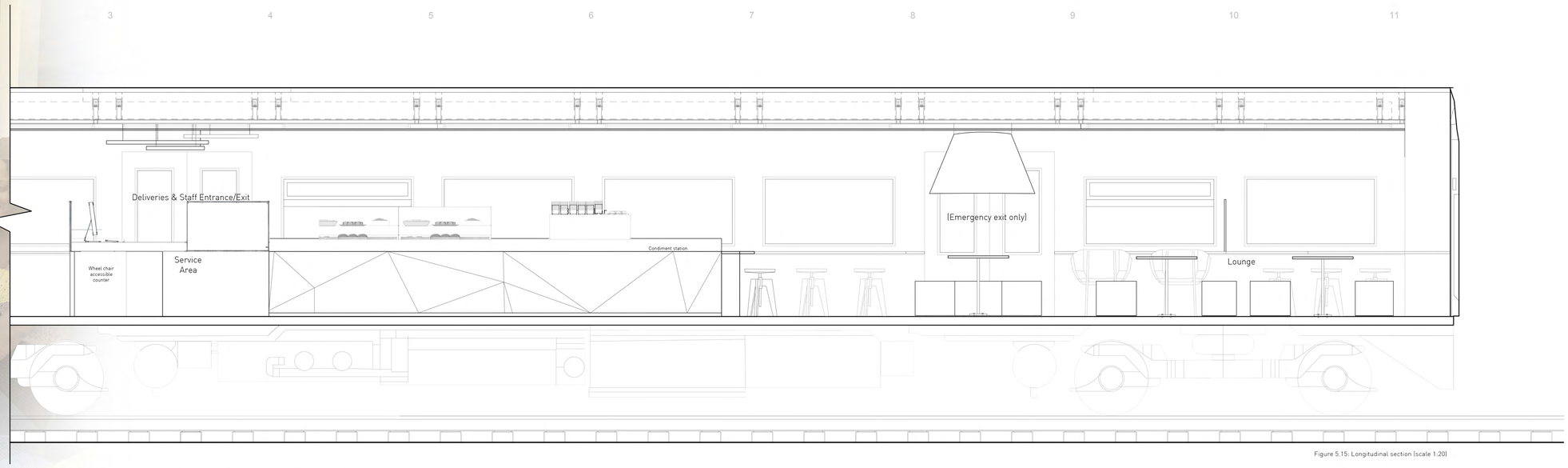
DAY CONFIGURATION



NIGHT CONFIGURATION

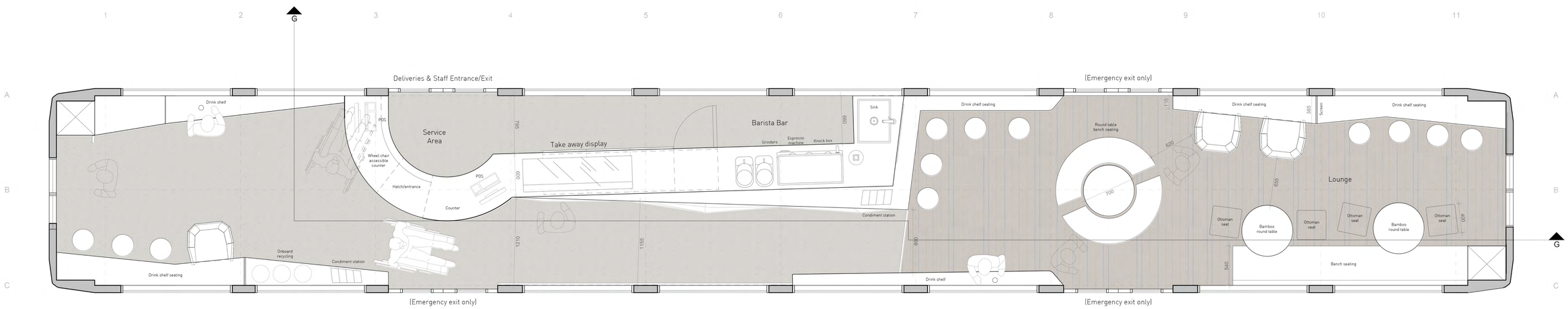
Figure 5.14: Detail of berth seating transformation

5.2.4 BARISTA BAR AND LOUNGE CAR



SECTION G-G: BARISTA BAR AND LOUNGE
1:20

Figure 5.15: Longitudinal section (scale 1:20)



PLAN: BARISTA BAR AND LOUNGE
1:20

Figure 5.16: Plan (1:20)

Figure 5.18: Cry room interior

CRY ROOM INTERIOR

Figure 5.18: Barista bar and lounge interior

BARISTA BAR & LOUNGE INTERIOR

5.2.5 UNIVERSAL CAR

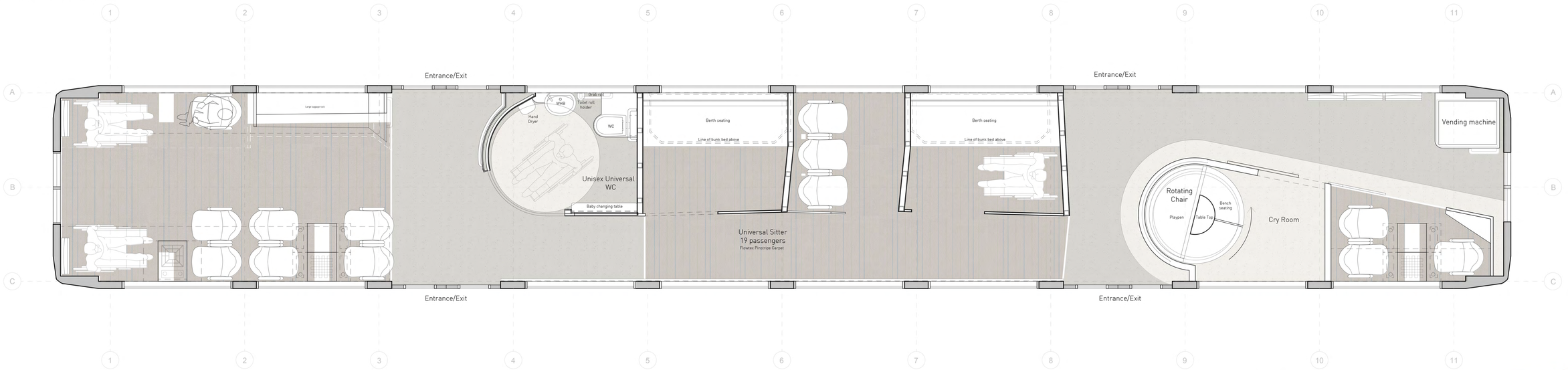


Figure 5.19: Plan (1:20)

5.3 CONCLUSION

The combination of mixed zones in the train cars and the non-linear layout addresses the physical and psychological discomfort of passengers. The concept is carried through to the detail resolution of finishes, furniture and structure to create a unique South African specific train interior.

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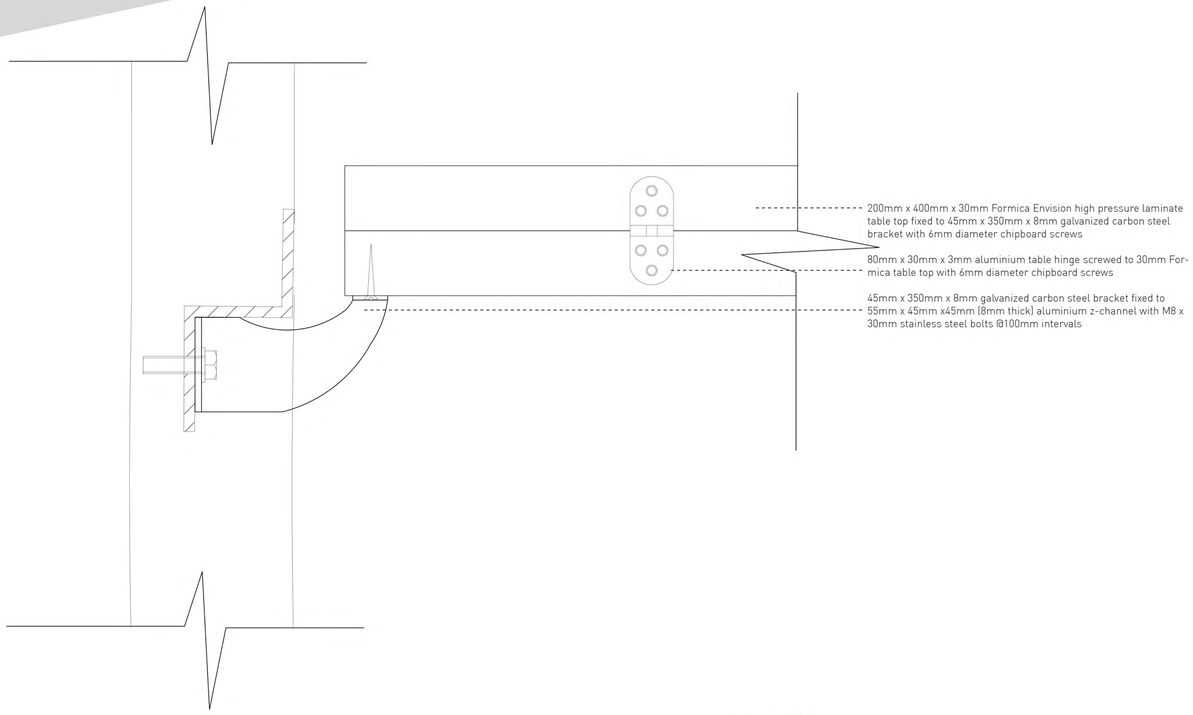
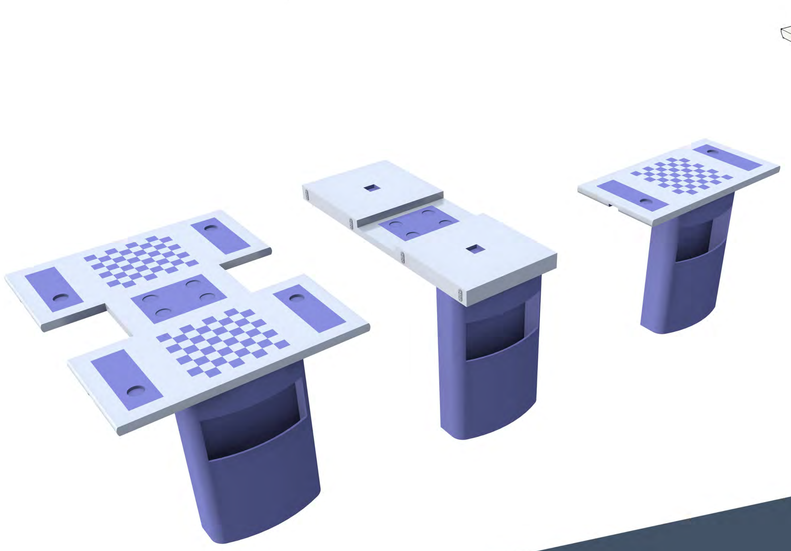
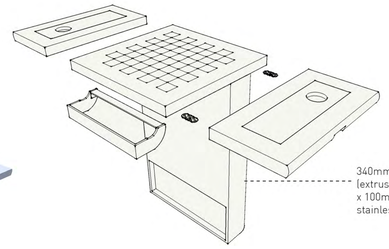
DETAIL G: TABLE ASSEMBLY

1: 1







CHAPTER 06:
SYSTEMS

6.1 INTRODUCTION: A SUSTAINABLE APPROACH

The following aspects form the focus of the sustainable approach of the investigation:

- demountability of insertion
- low embodied energy material specification
- local sourcing of materials as far as possible
- in-service recycling system

6.2 ACOUSTICS

6.2.1 Strategy

A comparison between the proposed Hamba Kahle train and current Shosholoza Meyl operating in South Africa

The average absorption coefficients and reverberation times have been calculated for the proposed Hamba-Kahle train and the Shosholoza Meyl passenger train in order to draw a comparison of current acoustic qualities of materials used versus proposed materials.

6.2.2 Acoustic calculations

Room	Surface	Quantity	Length	Width	Total Surface Area (S)	500Hz	1000Hz	2000Hz	S x 500Hz	S x 1000Hz	S x 2000Hz		T 500	T 1000	T 2000
Twin Cabin Hamba Kahle	Floor	1	1.2	2.25	2.7	0.06	0.15	0.25	0.162	0.405	0.675		0.06	0.05	0.045
	Wall 1	1	2.2	2.2	4.84	0.65	0.90	0.95	3.146	4.356	4.598				
	Wall 2a	1	1.1	2.1	2.31	0.38	0.32	0.15	0.8778	0.7392	0.3465				
	Wall 2 b	1	2.1	0.25	0.525	0.11	0.18	0.30	0.05775	0.0945	0.1575				
	Wall 2c	1	2.1	0.3	0.63	0.82	0.71	0.67	0.5166	0.4473	0.4221				
	Wall 2d	1	2.2	2.2	4.84	0.59	0.83	0.91	2.8556	4.0172	4.4044				
	Window	1	1.474	0.745	1.09813	0.30	0.30	0.20	0.329439	0.329439	0.219626				
	Shelf	1			4.2	0.10	0.09	0.08	0.42	0.378	0.336				
	Ceiling	1	2.1	1.5	3.15	0.65	0.90	0.95	2.0475	2.835	2.9925				
	Table Top	1	0.4	0.8	0.32	0.72	0.52	0.57	0.2304	0.1664	0.1824				
				Total Surface Area (S)	24.61313			Total Absorbtion (A)	10.64309	13.76804	14.33403				
				Total Volume (V)	6			Average absorbtion (α)	0.432415	0.559378	0.582373				
Room	Surface	Quantity	Length	Width	Total Surface Area (S)	500Hz	1000Hz	2000Hz	S x 500Hz	S x 1000Hz	S x 2000Hz		T 500	T 1000	T 2000
Seating area Hamba Kahle	Windows	4	1.474	0.745	4.39252	0.30	0.30	0.20	1.317756	1.317756	0.878504		0.07	0.08	0.07
	Wall 1a	2	1.1	4.047	8.9034	0.80	0.32	0.15	7.12272	2.849088	1.33551				
	Wall 1b	2	4.5	0.25	2.25	0.11	0.18	0.30	0.2475	0.405	0.675				
	Wall 1c	2	4.5	2.1	18.9	0.59	0.83	0.91	11.151	15.687	17.199				
	Wall 1d	2	4.5	0.3	2.7	0.82	0.71	0.67	2.214	1.917	1.809				
	Wall 2	1	1.96	1.6	3.136	0.65	0.9	0.95	2.0384	2.8224	2.9792				
	Wall 3	1	2.6	2.1	3.6	0.38	0.32	0.15	1.368	1.152	0.54				
	Floor	1	4.5	2.6	11.7	0.57	0.69	0.71	6.669	8.073	8.307				
	Seats 15	15	0.455	0.9	6.1425	0.38	0.35	0.38	2.33415	2.149875	2.33415				
	Door 1	1	2.1	0.625	1.3125	1.00	1.00	1.00	1.3125	1.3125	1.3125				
	Door 2	1	1	1.9	1.9	0.04	0.03	0.02	0.076	0.057	0.038				
				Total Surface Area	64.93692			Total Absorbtion	35.85103	37.74262	37.40786				
				Total Volume (V)	25.74			Average absorbtion (α)	0.55209	0.58122	0.576065				
Room	Surface	Quantity	Length	Width	Total Surface Area (S)	500Hz	1000Hz	2000Hz	S x 500Hz	S x 1000Hz	S x 2000Hz		T 500	T 1000	T 2000
Shosholoza cabin	Wall 1	1	1.5	2.2	2.3	0.01	0.01	0.01	0.023	0.023	0.023		1.98	1.36	0.99
	Wall 2	2	2	2.2	8.8	0.01	0.01	0.01	0.088	0.088	0.088				
	Wall 3	1	1.5	2.2	3	0.01	0.01	0.01	0.03	0.03	0.03				
	Window	2	0.5	1	0.50	0.18	0.12	0.07	0.09	0.06	0.035				
	Window in wall 3	2	0.3	2	1.2	0.03	0.03	0.02	0.036	0.036	0.024				
	Door	1	1.8	6	10.8	0.01	0.01	0.01	0.108	0.108	0.108				
	Floor	1	2	1.5	3	0.06	0.15	0.25	0.18	0.45	0.75				
				Total Surface Area	29.6			Total Absorbtion	0.555	0.795	1.058				
				Total Volume (V)	6.6			Average absorbtion (α)	0.01875	0.026858	0.035743				
Room	Surface	Quantity	Length	Width	Total Surface Area (S)	500Hz	1000Hz	2000Hz	S x 500Hz	S x 1000Hz	S x 2000Hz		T 500	T 1000	T 2000
Shosholoza seating	Seats 16	15	0.455	0.9	6.1425	0.38	0.35	0.38	2.33415	2.149875	2.33415		1.05	1.16	1.07
	Wall 1	2	2.2	4.5	16.8	0.01	0.01	0.01	0.168	0.168	0.168				
	Wall 2	1	2.2	2.6	5.72	0.01	0.01	0.01	0.0572	0.0572	0.0572				
	Wall 3	1	2.2	2.6	5.72	0.01	0.01	0.01	0.0572	0.0572	0.0572				
	Windows	6	1	0.5	3	0.18	0.12	0.07	0.54	0.36	0.21				
	Floor	1	4.5	2.6	11.7	0.05	0.05	0.07	0.585	0.585	0.819				
	Door	1	1.9	6	11.05	0.01	0.01	0.01	0.1105	0.1105	0.1105				
	Glass in door	1	0.5	0.7	0.35	0.03	0.03	0.02	0.0105	0.0105	0.007				
				Total Surface Area	60.4825			Total Absorbtion	3.86255	3.498275	3.76305				
				Total Volume (V)	25.74			Average absorbtion (α)	0.063862	0.057839	0.062217				

Table 6.1: Acoustic calculations

The results of the acoustic investigation indicate that a lower reverberation time is achieved in both the cabin and seating area of the proposed design intervention when compared to the same environments of the Shosholoza Meyl train interior. Therefore better acoustic comfort is achieved.

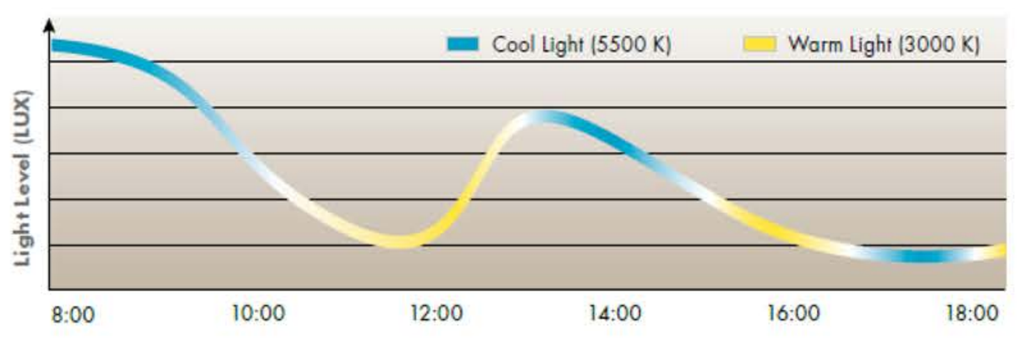
6.3 ARTIFICIAL LIGHTING

6.3.1 Strategy

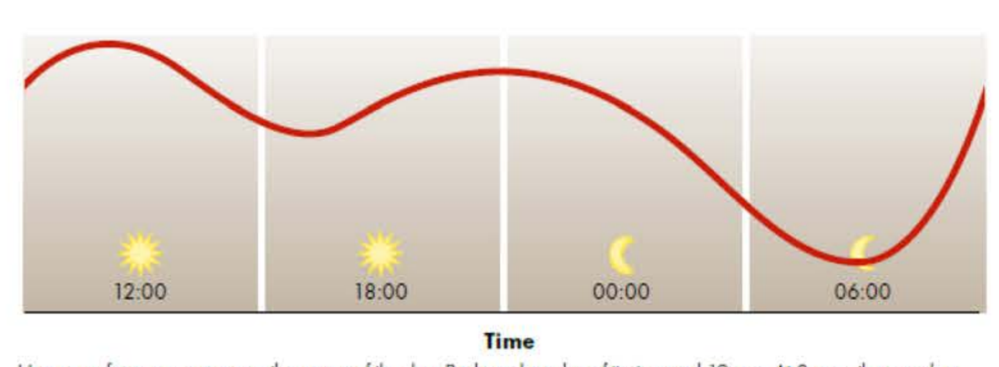
Chronobiologically-adapted LED lighting; the use of different light temperatures to influence circadian rhythm.

Individuals are born with a "natural internal clock" (known as circadian rhythm) and is controlled by daylight. This can be manipulated by artificial lighting to contribute to the physical and psychological comfort of individuals (Horvatitsch 2011). Cool colour temperatures can set the mood for a concentrated state of mind, where warm light colour temperatures assist relaxation (Webb 2006; Glamox 2013).

By alligning the human performance curve with a variation in light colour temperature, an interior environment can be created which supports passenger moods. Cool coloured light temperature in the morning, mid-afternoon and early evening can enhance psychological and physical energy levels of passengers. In late morning and late afternoon, warmer colour temperatures will aid in increasing physical and psychological comfort (Webb 2006). In applying this concept of chronobiologically-adapted LED lighting in the interior of Hamba-Kahle, the colour temperature can be controlled using onboard software and control gear to support holistic comfort of passengers.



Dynamic lighting: variation in light levels and colour temperature over the course of the day.



Human performance curve over the course of the day: Body and mind are fittest around 10 a.m. At 3 a.m., they reach a low.

Figure 6.1: Chronobiological theory (Glomax 2013).

6.3.2 Lighting calculations

Artificial lighting standards BS EN 13272:2001 (as set out by 'Railway applications- Electrical lighting for rolling stock in public transport systems') was followed to determine the number of lamps and type of illumination required in the various zones of the Hamba- Kahle train interior.

	1	2	3	4	5	6	7.1	7.2	8.1	8.2	9.1	9.2	10	11	12	13.1	13.2	14.1	14.2	15	16	17	18.1	18.2	19	20	21
E (Lux Needed: lx)	200	75	50	50	50	78	10	140	10	140	12	138	62	300	300	26	24	10	140	200	150	150	34	16	150	150	150
A (Surface Area: m²)	8.7	4.5	4.6	3	1.3	1.8	20	20	12	12	6	6	6	51.5	3.4	3.4	3.4	7.6	7.6	2.7	1.2	3.3	2.8	2.8	2.8	3.3	6.1
E * A	1740	337.5	230	150	65	140.4	200	2800	120	1680	72	828	372	15450	1020	88.4	81.6	76	1064	540	180	495	95.2	44.8	420	495	915
F (Lumens: lm)	3050	350	3050	3050	3050	210	2.7	3050	2.7	3050	2.7	3050	170	1950	3050	2.7	350	2.7	3050	3050	350	350	350	2.7	3050	350	3050
R (Room Index)	0.92857	0.92857	0.20455	1.15385	1.15385	0.71429	0.59524	0.59524	0.59524	0.59524	0.59524	0.59524	1	1	0.64286	0.64286	0.64286	0.45143	0.45143	0.45143	0.26786	0.57143	0.45143	0.45143	0.45143	0.5	0.92857
Width (m)	2.6	2.6	0.9	6	6	2	2	2	2	2	2	2	2.6	2.6	1.8	1.8	1.8	1.264	1.264	1.264	0.75	1.6	1.264	1.264	1.264	1.4	2.6
Heiht (2h)	2.8	2.8	4.4	5.2	5.2	2.8	3.36	3.36	3.36	3.36	3.36	3.36	2.6	2.6	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
U (Utilization Factor)	0.35	0.35	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.35	0.35	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.35
M (Maintanance Factor	0.66148	0.44129	0.66148	0.66148	0.66148	0.49383	0.44129	0.66148	0.44129	0.66148	0.44129	0.66148	0.52557	0.57373	0.66148	0.44129	0.44129	0.44129	0.66148	0.66148	0.44129	0.44129	0.44129	0.44129	0.66148	0.44129	0.66148
LLMF	0.89	0.7	0.89	0.89	0.89	0.7	0.7	0.89	0.7	0.89	0.7	0.89	0.8	0.89	0.89	0.7	0.7	0.7	0.89	0.89	0.7	0.7	0.7	0.7	0.89	0.7	0.89
LMF	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
LSF	0.98	0.95	0.98	0.98	0.98	0.94	0.95	0.98	0.95	0.98	0.95	0.98	0.99	0.85	0.98	0.95	0.95	0.95	0.98	0.98	0.95	0.95	0.95	0.95	0.98	0.95	0.98
RSMF	0.96	0.84	0.96	0.96	0.96	0.95	0.84	0.96	0.84	0.96	0.84	0.96	0.84	0.96	0.96	0.84	0.84	0.84	0.96	0.96	0.84	0.84	0.84	0.84	0.96	0.84	0.96
F*U*M	706.126	54.0585	625.426	625.426	625.426	32.1483	0.36936	625.426	0.36936	625.426	0.36936	625.426	31.2715	391.57	625.426	0.36936	47.8804	0.36936	625.426	625.426	47.8804	47.8804	47.8804	0.36936	625.426	47.8804	706.126
n = E*A / F*U*M	2.46415	6.24323	0.36775	0.23984	0.10393	4.36726	541.473	4.47695	324.884	2.68617	194.93	1.3239	11.8958	39.4565	1.63089	239.331	1.70425	205.76	1.70124	0.86341	3.75937	10.3383	1.98829	121.29	0.67154	10.3383	1.2958
n (Number of Lamps)	3	7	1	1	1	4	542	5	324	3	194	2	12	40	2	240	2	206	2	1	4	11	2	122	1	11	2
							14.4m		8.6m		5m					6.4		5.5m						3.2m			
							7.2m		4.3m		2.5m					4 x 1. 6m									1.6m		

Table 6.2: Lighting calculations

Programme	Spatial zone	Number of lamps	Lamp identification	Lamp specification	Luminaire identification	Luminaire specification	Advantages
Sleeper Car	General lighting: Family Sleeper cabin **>300lx**	N= 2		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5 base 16mm diameter LUMILUX cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Double, Spazio Product code: 3984.8.05D: 80W/230V/G5 Dimmable	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	Reading lights: Family Sleeper cabin **>50lx** (in conjunction with Deco Flex LED strips)	N= 2		LIGHTIFY PAR16 TW LED, Osram GU10 base 6Watt/240V 50mm diameter TUNABLE WHITE Colour Temp: 2700 - 6500K Colour rendering (Ra) = 80-89 Lifespan: 20 000h Energy efficiency class A		Mio Spot Track, for LED Spazio Product code: 4127.1 Colour: Silver	•Adjustable colour temperature •Colour controllable via smart devices (iOS; Android) •Dimmable via LIGHTIFY app •Good colour rendering •Allows passengers to adapt environment; enhances comfort
	Celing flood lighting: Family Sleeper cabin **>50lx** (in conjunction with Deco Flex LED strips)	N= 6,4m (4 x 1,6m)		DECO FLEX RGB LED strip lights, Osram 3,6W/640mm 12V 50mm cut intervals	No luminaire	N/A	•Suitable for compact spaces •Dimmable for energy efficiency •Colour change suiable for chronobiologically-adaptive LED lighting for improved well-being in transport interiors
	General: Twin Sleeper **>300lx**	N= 2		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Double, Spazio Product code: 3984.8.05D: 80W/230V/G5 Dimmable	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	Reading lights: Twin Sleeper **>50lx** (in conjunction with Deco Flex LED strips)	N= 2		LIGHTIFY PAR16 TW LED, Osram GU10 base 6Watt/240V 50mm diameter TUNABLE WHITE Colour Temp: 2700 - 6500K Colour rendering (Ra) = 80-89 Lifespan: 20 000h Energy efficiency class A		Mio Spot Track, for LED Spazio Product code: 4127.1 Colour: Silver	•Adjustable colour temperature •Colour controllable via smart devices (iOS; Android) •Dimmable via LIGHTIFY app •Good colour rendering •Allows passengers to adapt env enhances comfort
	Celing flood lighting: Twin Sleeper **>50lx** (in conjunction with reading lights)	N= 3,2m (2 x 1,6m)		DECO FLEX RGB LED strip lights, Osram 3,6W/640mm 12V 50mm cut intervals	No luminaire	N/A	•Suitable for compact spaces •Dimmable for energy efficiency •Colour change suiable for chronobiologically-adaptive LED lighting for improved well-being in transport interiors
	General illumination: Aisle 1 **≥75lx**	N= 1		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	General illumination: Aisle 1 **>75lx**	N= 1		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	General lighting: Budget Sitter Seating **>150lx** (in conjunction with Deco Flex LED strips)	N= 2		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	Reading lights: Budget Sitter **>50lx**	N= 8		PARATHOM PRO MR16 advanced advanced LED reflector, Osram Product code: 20 36° ADV 5 W/930 GU5.3 base 12V 50mm diameter WARM WHITE Colour Temp: 3000K Colour rendering (Ra) = 90 Lifespan: 50 000h Energy efficiency class A		Custom luminaire	•Extremely long lamp life •Dimmable for passenger comfort •Robust agianst vibrations •Can withstand frequent on/off switching •High colour consistancy
	Break-away spaces **>75lx**	N= 7		LED STAR PAR16 LED reflector Osram Product code: 50 36° 5,5 W/827 GU10 base 230V 50mm diameter WARM WHITE Colour Temp: 2700K Colour rendering (Ra) = 80 Lifespan: 25 000h Energy efficiency class A		LIGHTIFY Downlight Osram Product code : Downlight TW TW Colour: White 82mm x 90mm GU10 holder designation	•Long lamp life •Shock proof •Vibration proof •low energy consumption •Can be installed in Ecophon Solo acoustic ceilings without light leakage and without affecting the surface integrity
	Coffee vending station **200lx**	N= 1		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
Programme	**Spatial zone**	**Number of lamps**	**Lamp identification**	**Lamp specification**	**Luminaire identification**	**Luminaire specification**	**Advantages**
Sitter Car	General lighting: Budget Sitter **>150lx** (in conjunction with Deco Flex LED strips)	N= 10		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	Reading lights: Budget Sitter **>50lx**	N= 48		PARATHOM PRO MR16 advanced advanced LED reflector, Osram Product code: 20 36° ADV 5 W/930 GU5.3 base 12V 50mm diameter WARM WHITE Colour Temp: 3000K Colour rendering (Ra) = 90 Lifespan: 50 000h Energy efficiency class A		Custom luminaire	•Extremely long lamp life •Dimmable for passenger comfort •Robust agianst vibrations •Can withstand frequent on/off switching •High colour consistancy
	Unisex WC(s) **>150lx**	N= 4		LED STAR PAR16 LED reflector Osram Product code: 50 36° 5,5 W/827 GU10 base 230V 50mm diameter WARM WHITE Colour Temp: 2700K Colour rendering (Ra) = 80 Lifespan: 25 000h Energy efficiency class A		LIGHTIFY Downlight Osram Product code : Downlight TW TW Colour: White 82mm x 90mm GU10 holder designation	•Long lamp life •Shock proof •Vibration proof •low energy consumption •Can be installed in Ecophon Solo acoustic ceilings without light leakage and without affecting the surface integrity
	Coffee vending station:Budget Sitter **200lx**	N= 3		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	Break-away space: Budget Sitter **>75lx**	N= 7		LED STAR PAR16 LED reflector Osram Product code: 50 36° 5,5 W/827 GU10 base 230V 50mm diameter WARM WHITE Colour Temp: 2700K Colour rendering (Ra) = 80 Lifespan: 25 000h Energy efficiency class A		LIGHTIFY Downlight Osram Product code : Downlight TW TW Colour: White 82mm x 90mm GU10 holder designation	•Long lamp life •Shock proof •Vibration proof •low energy consumption •Can be installed in Ecophon Solo acoustic ceilings without light leakage and without affecting the surface integrity
	General lighting: Premium Sitter **>150lx** (in conjunction with Deco Flex LED strips)	N= 10		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	Premium Sitter: Break-away space **>75lx**	N= 7		LED STAR PAR16 LED reflector Osram Product code: 50 36° 5,5 W/827 GU10 base 230V 50mm diameter WARM WHITE Colour Temp: 2700K Colour rendering (Ra) = 80 Lifespan: 25 000h Energy efficiency class A		LIGHTIFY Downlight Osram Product code : Downlight TW TW Colour: White 82mm x 90mm GU10 holder designation	•Long lamp life •Shock proof •Vibration proof •low energy consumption •Can be installed in Ecophon Solo acoustic ceilings without light leakage and without affecting the surface integrity
	Reading lights: Premium Sitter **>50lx**	N= 30		PARATHOM PRO MR16 advanced advanced LED reflector, Osram Product code: 20 36° ADV 5 W/930 GU5.3 base 12V 50mm diameter WARM WHITE Colour Temp: 3000K Colour rendering (Ra) = 90 Lifespan: 50 000h Energy efficiency class A		Custom luminaire	•Extremely long lamp life •Dimmable for passenger comfort •Robust agianst vibrations •Can withstand frequent on/off switching •High colour consistancy
	Break =away space: Premium Sitter **>75lx**	N= 7		LED STAR PAR16 LED reflector Osram Product code: 50 36° 5,5 W/827 GU10 base 230V 50mm diameter WARM WHITE Colour Temp: 2700K Colour rendering (Ra) = 80 Lifespan: 25 000h Energy efficiency class A		LIGHTIFY Downlight Osram Product code : Downlight TW TW Colour: White 82mm x 90mm GU10 holder designation	•Long lamp life •Shock proof •Vibration proof •low energy consumption •Can be installed in Ecophon Solo acoustic ceilings without light leakage and without affecting the surface integrity
	Foot lighting **>150lx** (in conjunction with general illumination)	N= 28m (8,6m + 14,4m + 5m)		DECO FLEX RGB LED strip lights, Osram 3,6W/640mm 12V 50mm cut intervals	No luminaire	N/A	•Suitable for compact spaces •Dimmable for energy efficiency •Colour change suiable for chronobiologically-adaptive LED lighting for improved well-being in transport interiors
	Ceiling flood lighting **>150lx** (in conjunction with general illumination)	N= 28m (8,6m + 14,4m + 5m)		DECO FLEX RGB LED strip lights, Osram 3,6W/640mm 12V 50mm cut intervals	No luminaire	N/A	•Suitable for compact spaces •Dimmable for energy efficiency •Colour change suiable for chronobiologically-adaptive LED lighting for improved well-being in transport interiors
Programme	**Spatial zone**	**Number of lamps**	**Lamp identification**	**Lamp specification**	**Luminaire identification**	**Luminaire specification**	**Advantages**
Universal Car	General lighting: Budget Sitter zone **>150lx** (in conjunction with Deco Flex LED strips)	N= 5		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	Reading lights: Budget Sitter **>50lx**	N= 12		PARATHOM PRO MR16 advanced advanced LED reflector, Osram Product code: 20 36° ADV 5 W/930 GU5.3 base 12V 50mm diameter WARM WHITE Colour Temp: 3000K Colour rendering (Ra) = 90 Lifespan: 50 000h Energy efficiency class A		Custom luminaire	•Extremely long lamp life •Dimmable for passenger comfort •Robust agianst vibrations •Can withstand frequent on/off switching •High colour consistancy
	General lighting : Universal Sleeper cabin **300lx**	N= 2		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Double, Spazio Product code: 3984.7.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
	Reading lights: Universal sleeper cabin **>50lx** (in conjunction with Deco Flex LED strips)	N= 2		LIGHTIFY PAR16 TW LED, Osram GU10 base 6Watt/240V 50mm diameter TUNABLE WHITE Colour Temp: 2700 - 6500K Colour rendering (Ra) = 80-89 Lifespan: 20 000h Energy efficiency class A		Mio Spot Track, for LED Spazio Product code: 4127.1 Colour: Silver	•Adjustable colour temperature •Colour controllable via smart devices (iOS; Android) •Dimmable via LIGHTIFY app •Good colour rendering •Allows passengers to adapt environment; enhances comfort
	Foot lighting **>50lx** (in conjunction with reading lights)	N= 3,2m (2 x 1,6m)		DECO FLEX RGB LED strip lights, Osram 3,6W/640mm 12V 50mm cut intervals	No luminaire	N/A	•Suitable for compact spaces •Dimmable for energy efficiency •Colour change suiable for chronobiologically-adaptive LED lighting for improved well-being in transport interiors
	Celing flood lighting **>50lx** (in conjunction with reading lights)	N= 3,2m (2 x 1,6m)		DECO FLEX RGB LED strip lights, Osram 3,6W/640mm 12V 50mm cut intervals	No luminaire	N/A	•Suitable for compact spaces •Dimmable for energy efficiency •Colour change suiable for chronobiologically-adaptive LED lighting for improved well-being in transport interiors
	Universal WC: Acoustic lighting **>75lx**	N= 11		LED STAR PAR16 LED reflector Osram Product code: 50 36° 5,5 W/827 GU10 base 230V 50mm diameter WARM WHITE Colour Temp: 2700K Colour rendering (Ra) = 80 Lifespan: 25 000h Energy efficiency class A		LIGHTIFY Downlight Osram Product code : Downlight TW TW Colour: White 82mm x 90mm GU10 holder designation	•Long lamp life •Shock proof •Vibration proof •low energy consumption •Can be installed in Ecophon Solo acoustic ceilings without light leakage and without affecting the surface integrity
	Cry Room: Acoustic lighting **100lx**	N= 11		LED STAR PAR16 LED reflector Osram Product code: 50 36° 5,5 W/827 GU10 base 230V 50mm diameter WARM WHITE Colour Temp: 2700K Colour rendering (Ra) = 80 Lifespan: 25 000h Energy efficiency class A		LIGHTIFY Downlight Osram Product code : Downlight TW TW Colour: White 82mm x 90mm GU10 holder designation	•Long lamp life •Shock proof •Vibration proof •low energy consumption •Can be installed in Ecophon Solo acoustic ceilings without light leakage and without affecting the surface integrity
	Aisle: General illumination **>75lx**	N= 2		T5 HE XT fluorescent tube, Osram Product code: 35W/865 G5base 16mm diameter Lumilux cool daylight Colour Temp: 6500K Colour rendering (Ra) = 80-89 Lifespan: 45 000h Energy efficiency class A+		Alubat Fluorescent luminaire (T5) Single, Spazio Product code: 3984.7.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	•Extremely long service life •Low premature failure •Dimmable for lower energy consumption •Good colour rendering •Uniform illumination
Programme	**Spaces**	**Number of lamps**	**Lamp identification**	**Lamp specification**	**Luminaire identification**	**Luminaire specification**	**Advantages**
Bistro	General illumiation **300lx**	N= 40		NATURA T5 fluorescent tube Osram		Alubat Fluorescent luminaire (T5) Double, Spazio Product code: 3984.8.05D: 80W/230V/G5 for dimmable lamps G5 holder designation	

Table 6.3: Specification

6.4 INTERIOR CLADDING SYSTEM

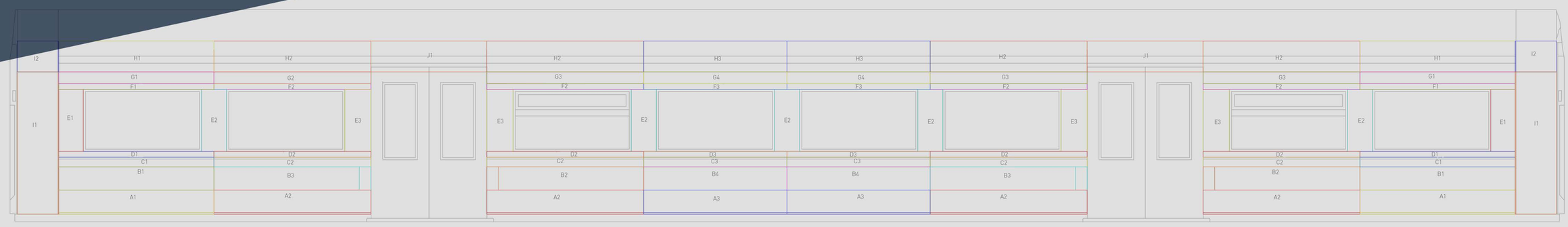


Figure 6.2: Interior cladding module matrix

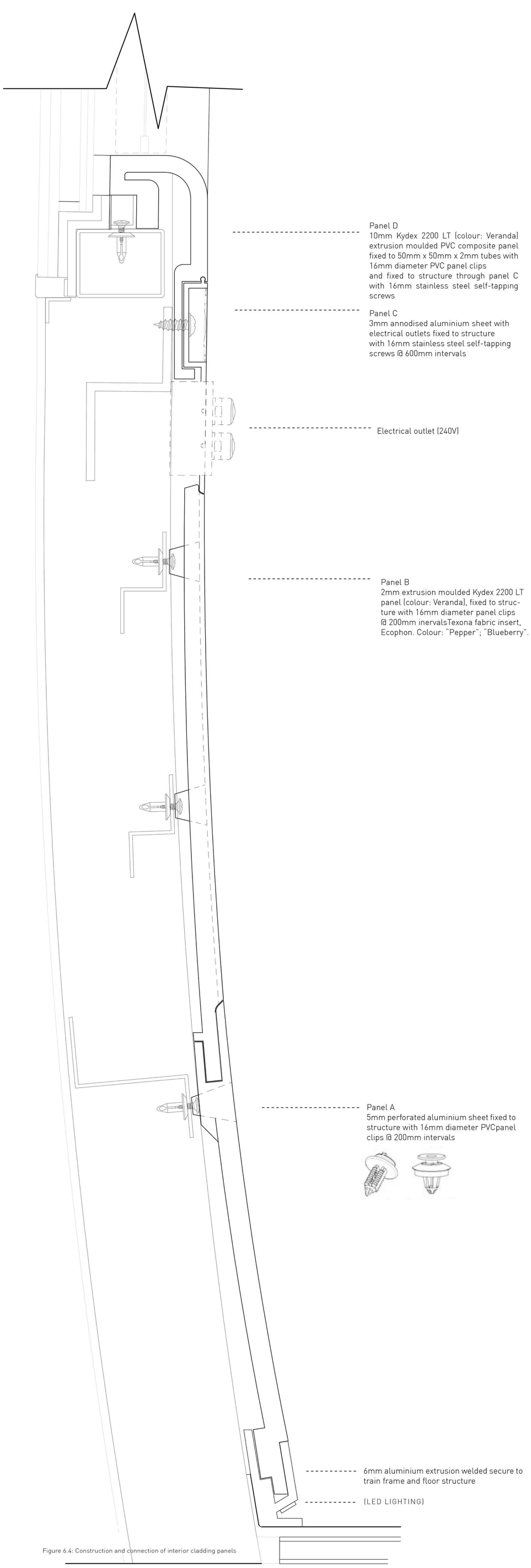


Figure 6.4: Construction and connection of interior cladding panels

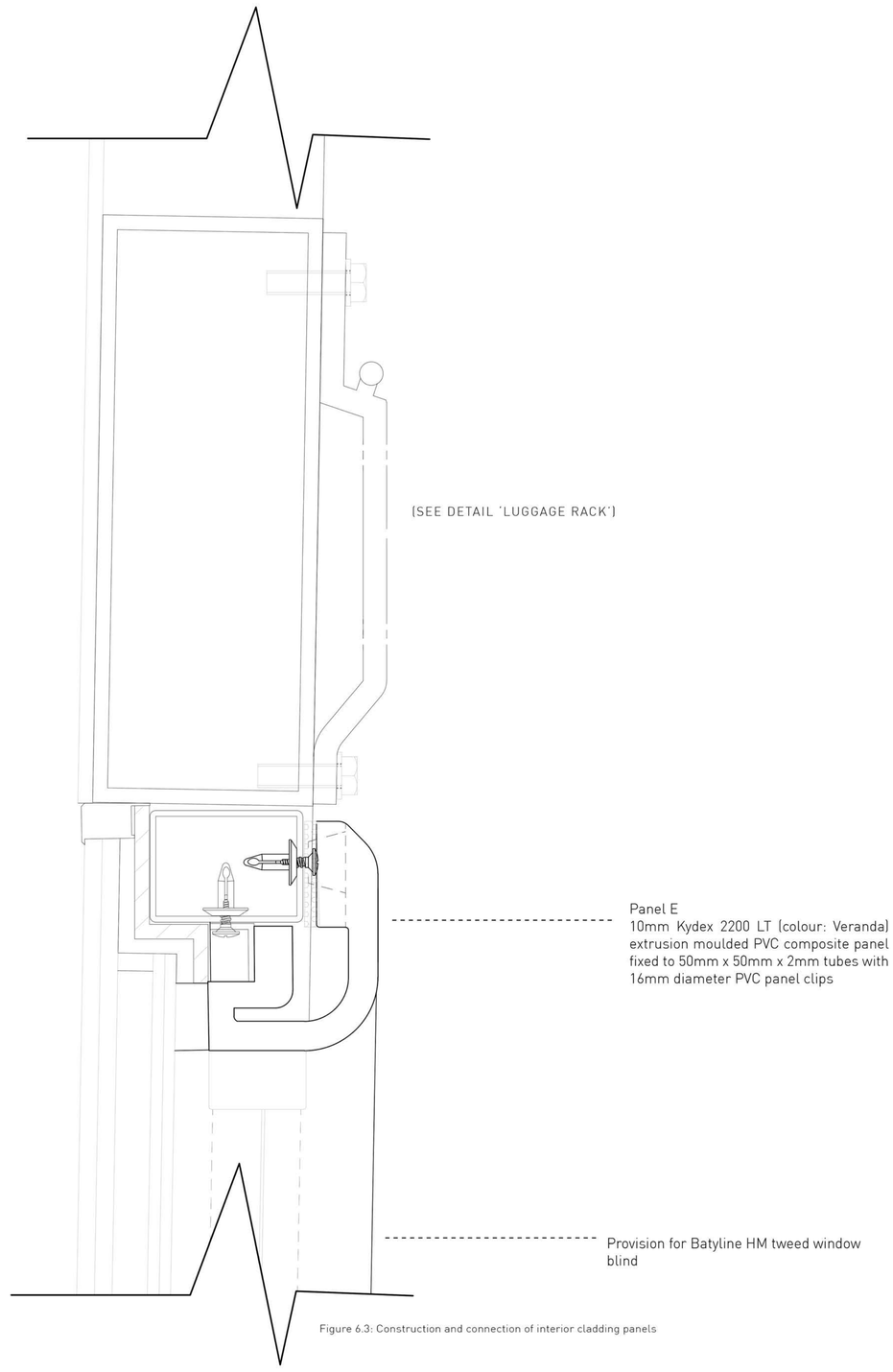


Figure 6.3: Construction and connection of interior cladding panels

DETAIL F: INTERIOR CLADDING PANELS
1:1

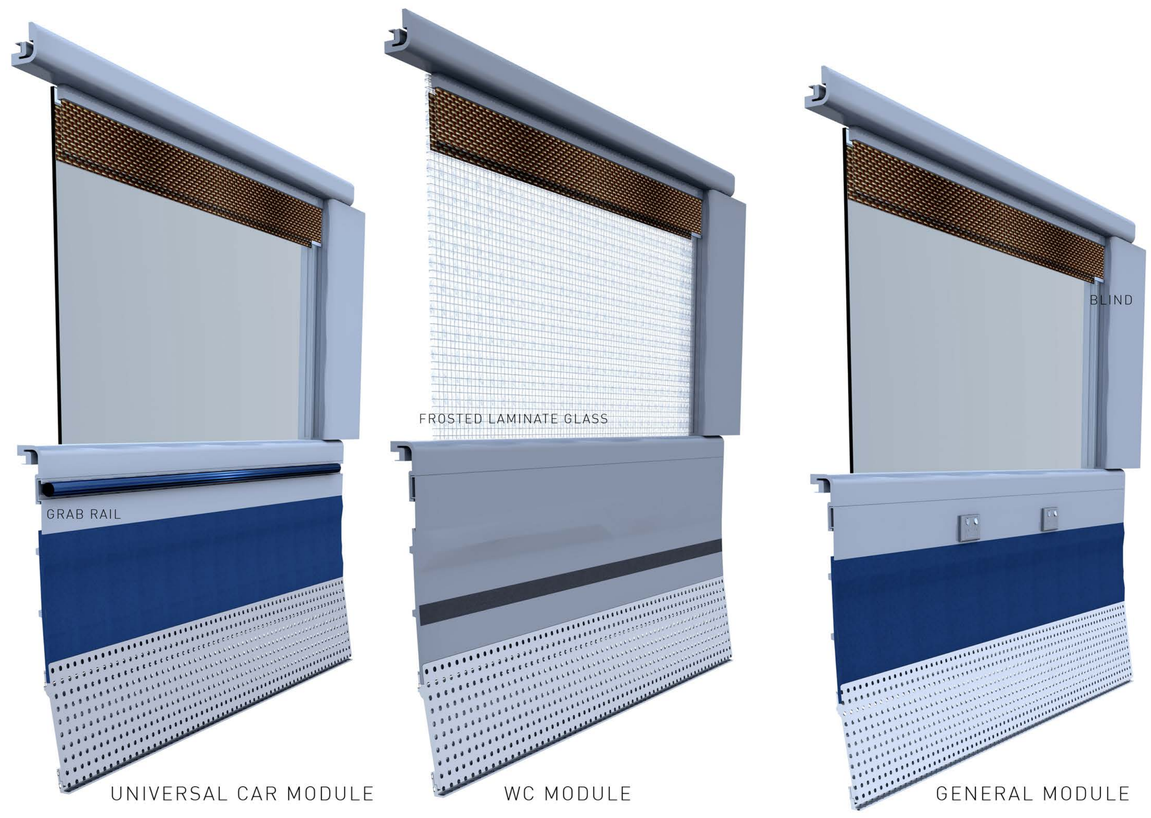
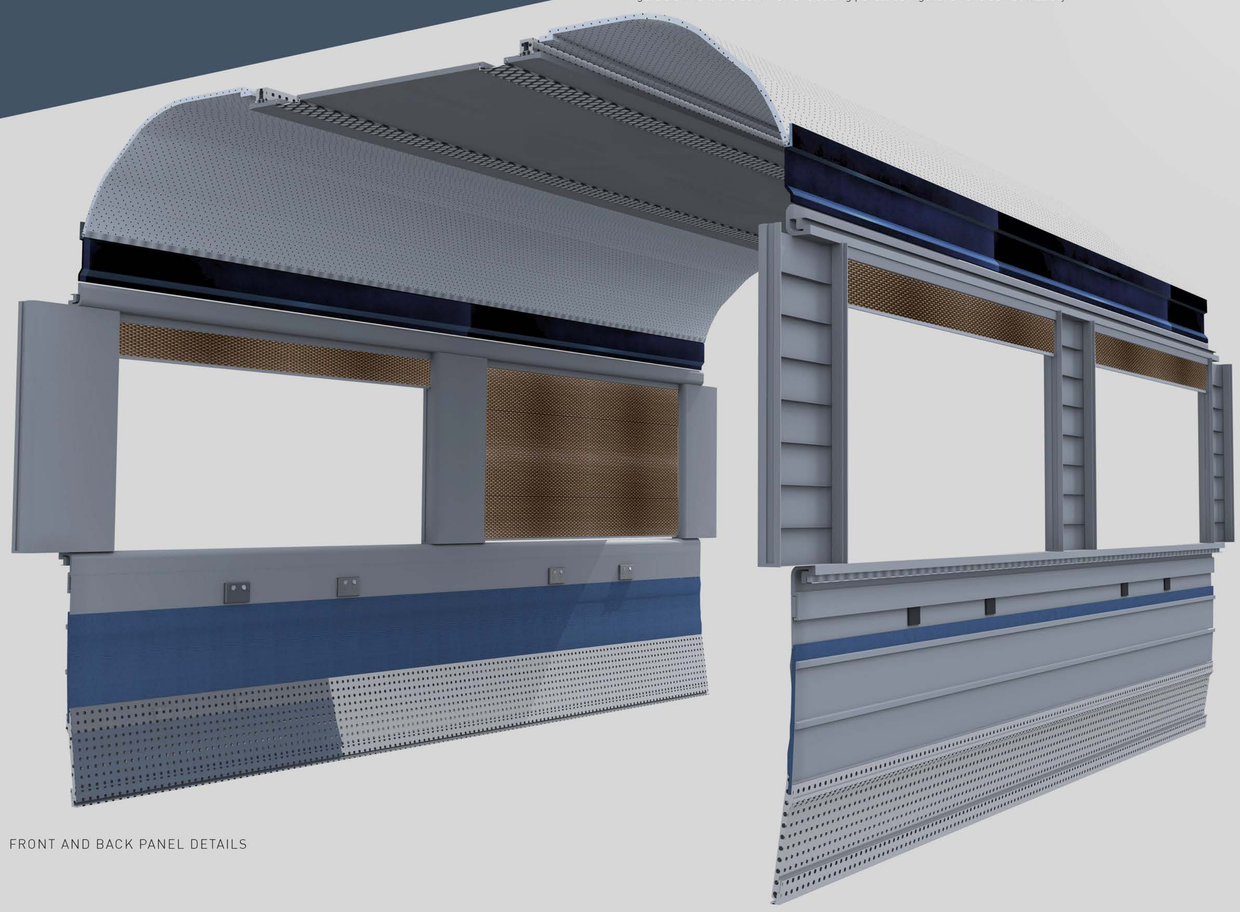


Figure 6.5: Cladding panels' modular versatility

DETAIL E: INTERIOR CLADDING PANELS
1:1

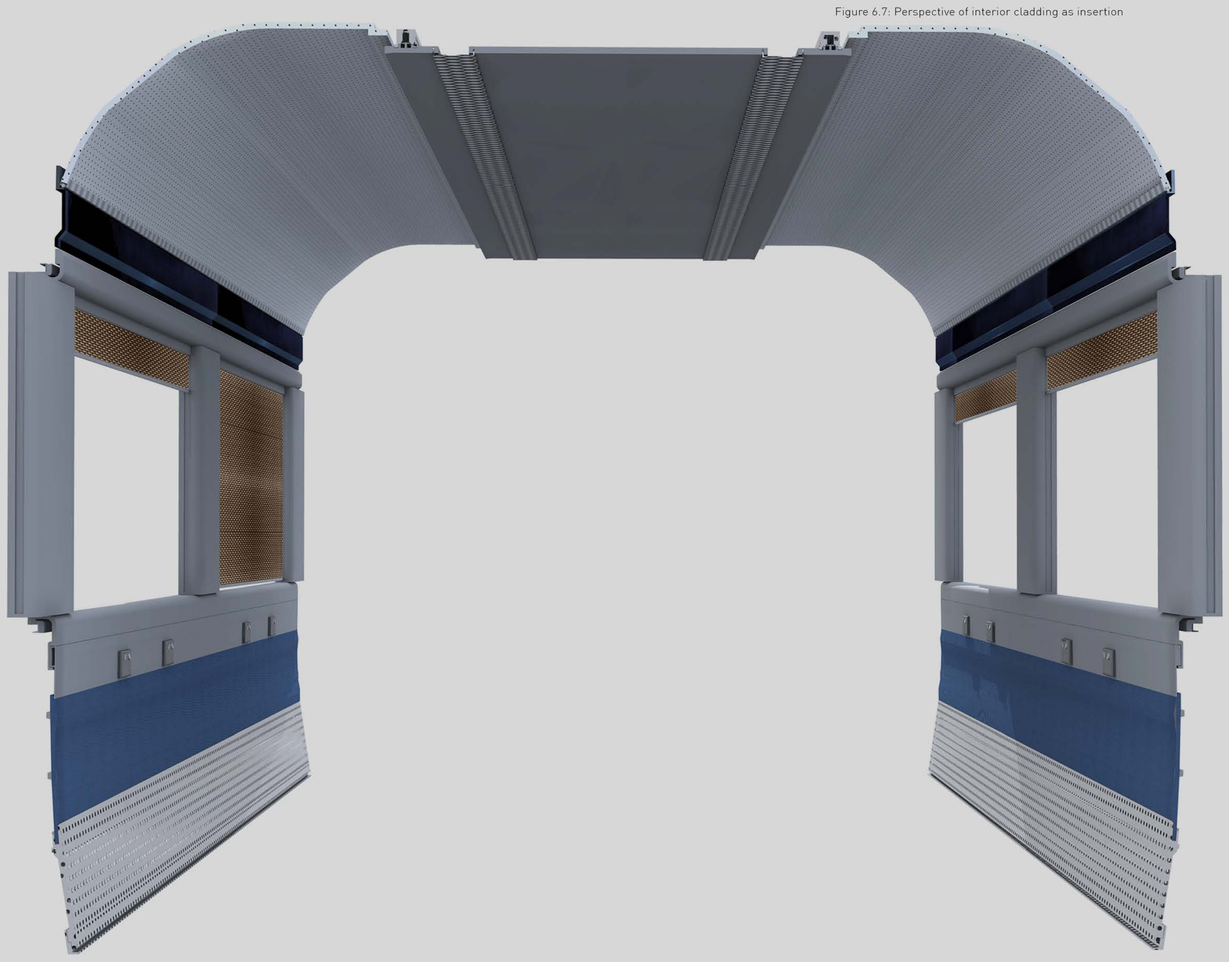
6.4 INTERIOR CLADDING SYSTEM

Figure 6.6: Front and back view of cladding panels configuration and demountability



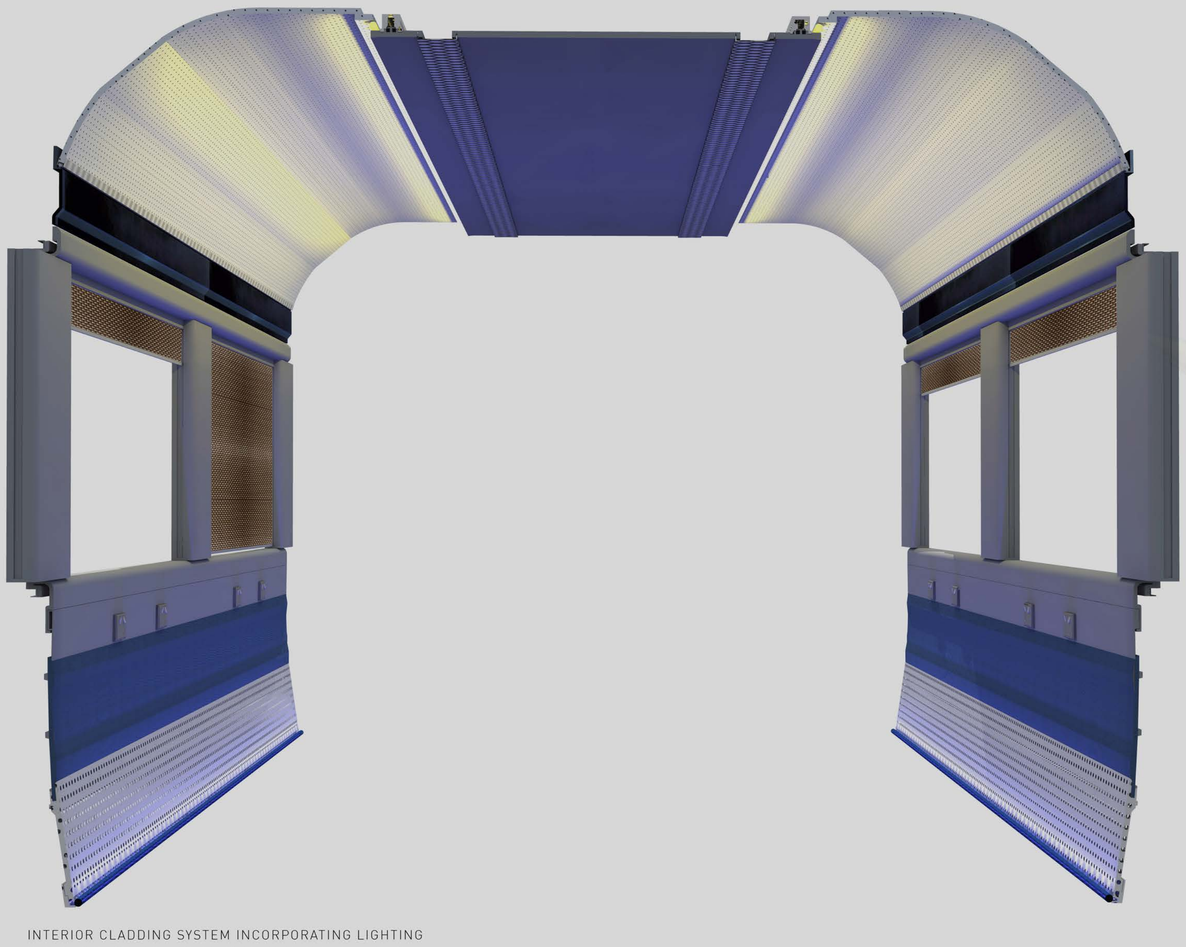
FRONT AND BACK PANEL DETAILS

Figure 6.7: Perspective of interior cladding as insertion



PERSPECTIVE VIEW OF CLADDING SYSTEM
AS PART THE INTERIOR INSERTION

Figure 6.8: LED lighting incorporated into cladding system



INTERIOR CLADDING SYSTEM INCORPORATING LIGHTING
AND SUBSEQUENTLY THE CHRONOBIOLOGICAL THEORY.

6.5 MATERIALS AND COLOUR PALETTE

SEATING SPECIFICATION:

PREMIUM SEATING TRANSFORMATION

BUDGET SEATING TRANSFORMATION

FLOORS:

- **'Flotex Pinstripe' flocked carpet**
  Product code: Baker Street 565012
  Flotex flocked carpet is specified for its suitability in a transport interior; the carpet finish is thin, durable, easily maintainable, safe against bacteria, dust & dust mites and is produced sustainably.

- **Floorworx vinyl sheeting 'Surestep star'**
  Product code:176422 Trout
  Floorworx is the only local vinyl flooring manufacturer. 'Surestep star' was further specified for its anti-static properties; it is light-weight, durable, has excellent stain resistance and is 100% recyclable.

WALL PARTITIONS & INTERIOR CLADDING:

- **Artboard Recore Fireco** (composite board)
  25mm; with 5mm anodised aluminium sheet finish
  Artboard recore panels is a light-weight composite board (thermosetting polymer and glass fibres) developed for rail and marine interior structures. The panels are light-weight, offers high stiffness & dimensional stability, is a good acoustic insulator, is resistant to fire, water and chemicals and is easily processed and formable.

- **Moniflex transport insulation**
  20mm
  Moniflex insulation is lightweight (optimises energy use); moisture- and moulding resistant; recyclable & biodegradable; economically to cut and easy to handle; non-toxic and has a long lifecycle

- **Kydex 2200LT t**ransport PVC composite thermoplastic
  Product colour code: Veranda 53562
  Product colour code: Heather 42650
  Kydex is a light-weight thermoplastic developed and produced specifically for mass transport interiors (such as trams, trains, airplanes and busses). The material has excellent formability and fabrication properties, has excellent resistance to chemicals, graffiti & stains and meets Federal Rail Administration requirements against flammability, toxicity and smoke emissions.

- **Texona durable acoustic fabric**
  Product colour code: Blueberry.
  Nearest NCS colour sample S 7020-R80B.
  Ecophon Texona fabric is specified for wall panel inserts for its impact resistance and sound absorption characteristics.

- **Ferrari Batyline HM Tweed** (PVC fabric)
  Batyline HM tweed is a tear-resistant, UV-resistant and flame retardant PVC fabric. The fabric uses 'texyloop' technology and is therefore 100% recyclable. It is further specified for its resistance to humidity, acoustic comfort and easy maintenance properties.

SEAT UPHOLSTERY:

- **Camira 'Aura' transport upholstery**
  Product code: CAM322
  Aura from Camira fabrics was specified as it was developed as a transport upholstery fabric. The fabric offers high abrasion resistance and durability (80 000 martindale cycles), is fire- and stain resistant, recyclable and is produced using 100% renewable electricity.

- **Camira transport leather upholstery**
  Product code: Classic "Powder" VAC20
  The 'Classic' range from Camira fabrics was specified as it is used in transport interiors for seating applications. The fabric offers a luxurious feel, easy maintainability and high durability (50 000 flexes).

- **Robin Sprong "Liquorice" vinyl fabric**
  Yellow Chess Dot
  Product Code: RR20003
  Locally designed and produced surface designs using local designers adds South African identity to the train interior.

VANITIES & COUNTERTOPS

- **Surrino** solid surfacing
  Colour: "EGGSHELL"
  Locally produced (as opposed to Corian) and is a non-porous, hygienic, fire-resistant and formable material suitable for transport applications.

Figure 6.9: Moodboard of colour palette and materials

6.6 CONCLUSION

The interior cladding system successfully incorporates lighting and acoustic comfort and uses modern materials to further create a comfortable train saloon interior for the 21st century South African passenger.

In response to the advantages of rail travel and the international trend of investment in rail, the dissertation investigation identifies the dismal state of South African passenger trains and services. Through conducting a heuristic enquiry it was established that the Shosholoza Meyl epitomises this condition and lacks investment in user-centred design.

Hamba-Kahle encourages the use of sustainable, universally accessible transport and allows long-distance passenger rail to compete in market share by including a range of users in its interior design. The design addresses the physical and psychological discomfort in the train interior, the absence of social spaces and the lack of contextual identity. The design successfully challenged the insular train interior layout with the division of the interior into different spatial zones, shifts in circulation, non-linear space creation and multi-user approach. The mediation between private and public spaces allows for chance encounters and offers users the ability to adapt the space temporarily to suit their specific comfort needs. The embodied experience of users is enhanced by emphasising the scenery from the surrounding landscape in the interior finishes and break-away spaces.

Hamba-Kahle results in a contemporary and South African design identity, where users can associate with the interior both on an emotional level and physically. The interior insertion creates a transport environment that supports social interaction while simultaneously providing spaces of privacy for passengers. An interior supportive of the physical space, social activities and well-being of contemporary South African travellers is created.

CHAPTER 07

list of references

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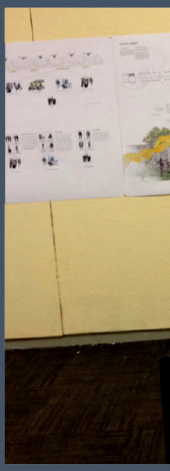
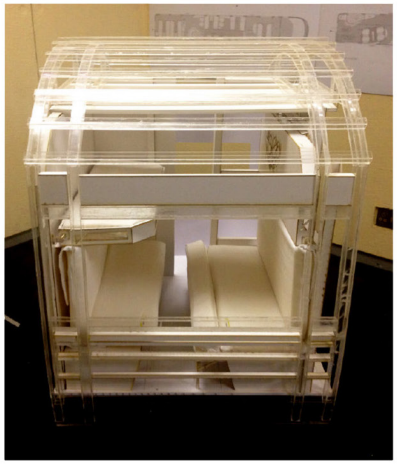
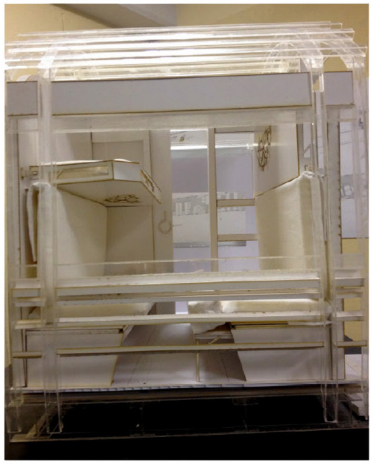
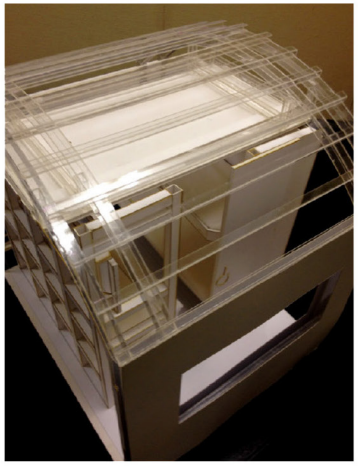
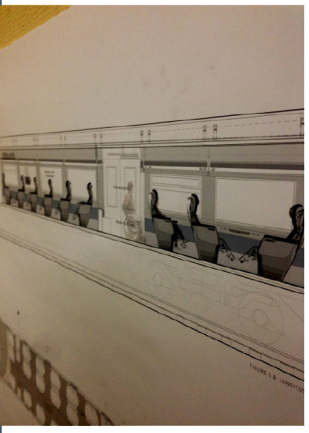
APPENDIX A
FINAL MODEL & PRESENTATION



ACKNOWLEDGEMENTS

Werner: there are no words to express my gratitude.

Paul: the big brother I look up to.

My parents: you are my heroes.

Jánel: without you I couldn't have carried on every day.

Liné, Heidi, Margaux & Joanet: I am thankful for such supportive and helpful friends.

M, M & M: Marina, Michelle and Marise your studio support made all the difference.

Nico, Elana and Raymund: Thank you for being an inspiration, your dedication and supporting me to the end.