

## PRECEDENTS

### GALZIGBAHN BY DRIENDL ARCHITECTS

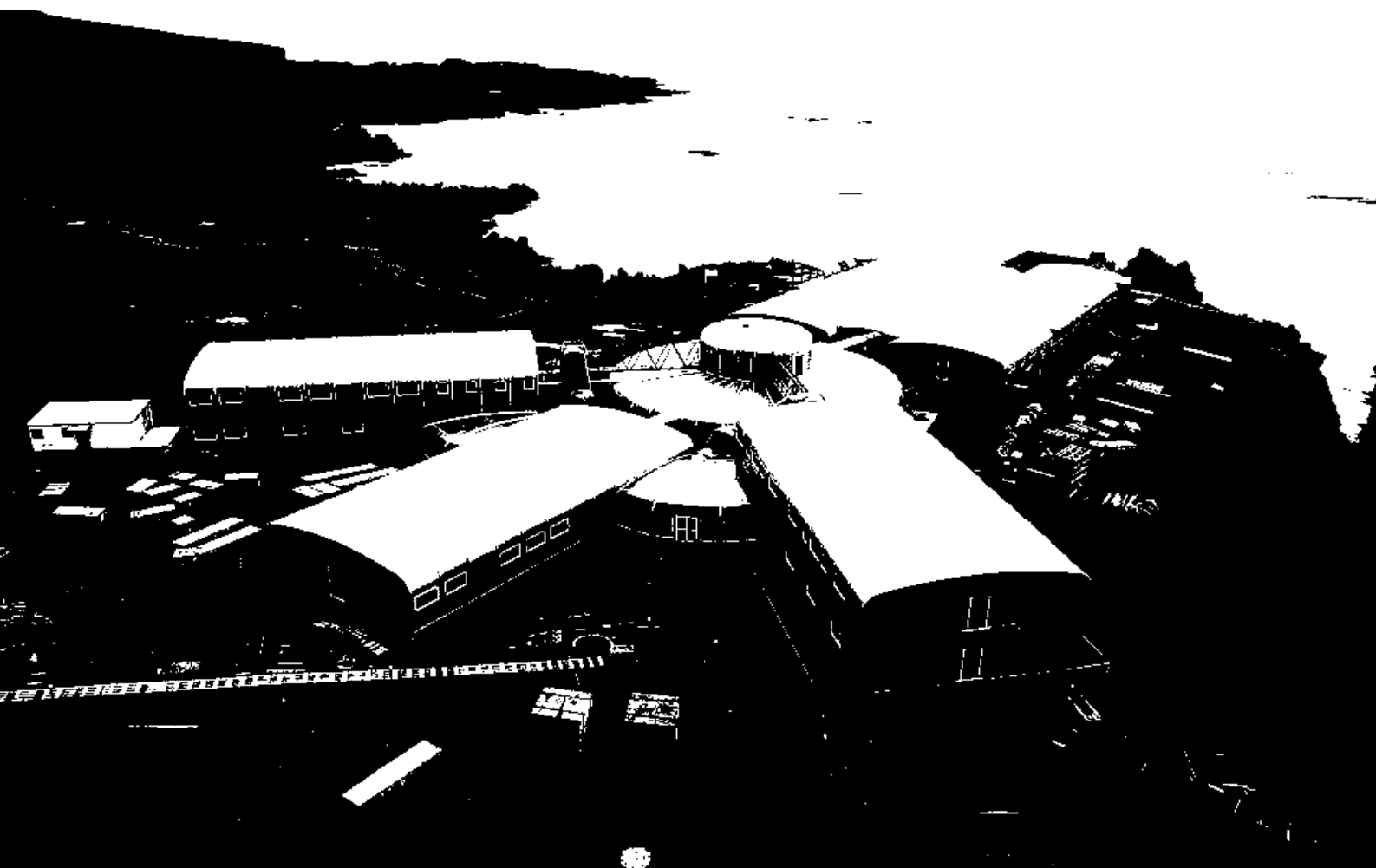
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Glass, steel, concrete - sober feedstock, yet sensual in its combination. The form of the new base station directly evolves out of the transport function it has to achieve. The desire for readability and transparency defines the material choice. Glass reveals technical inner life and previews the trip up to the mountain. Concrete grounds the construction, anchors it into the slope, creates a counterweight and is a carrier of a space truss (organized in triangulated bracing and as filigree as possible) which carries off the weight of the roof; the visible construction of the space truss (with its riggings and the chosen profiles) directly evolves from the prevailing wind and weather conditions, always standing in attention to defy wind, rain and snow-masses (<http://www.ropeways.htm>).

The funitel is coming from the hillside into the building and on a specially developed “Ferris Wheel” downwards, while the waiting passenger rises to the first floor. The passengers will be lifted by the funitel and float from the roof through a rural landscape across the glazed area to the Galzig (<http://www.doppelmayr.com>), with no constructive linkages clouding the panoramic view on the way up. Newly developed technology in people-transport sets examples for the future. What used to be bland construction without any design is now being put into the spotlight through architecture.

Georg Driendl Architects proceeded with their project as winner of a design competition. The new developments in cable-car technology – using “big-wheels” – make it much more comfortable for passengers to get onto the carriage and in this particular case provide a striking architectural accent in the village. The freestanding steel and glass structure sits on two stylish reinforced concrete walls and provides the envelope for the technology which is not fixed into the foundations of the building. Glass exposes the technical inner-life and gives the passenger from the outside a glimpse of what experience the mountain-ride will entail. The transparent, very dynamic structure which has triangular and rhombus shapes of glass covering the 2 200 m<sup>2</sup> completely enclosed skin, shapes the envelope to suit the technology inside (<http://www.driendl.at>). The architectural landmark in St. Anton encompasses the highest possible level of safety using STADIP laminated heat-strengthened glass (<http://www.doppelmayr.com>).

The highly strategic and technical design makes Galzigbahn successful; it is the stations exceptional flow and proportions which contribute to the success of the design. Apart from the effective structural system the approach to the user and the way the whole system is designed to enhance the user’s experience and commuting make this an approachable precedent.



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Marion Island is situated approximately 2 000 km southeast of Cape Point and still falls within the borders of South Africa. Communication between the island and the outside world can only take place via satellite.

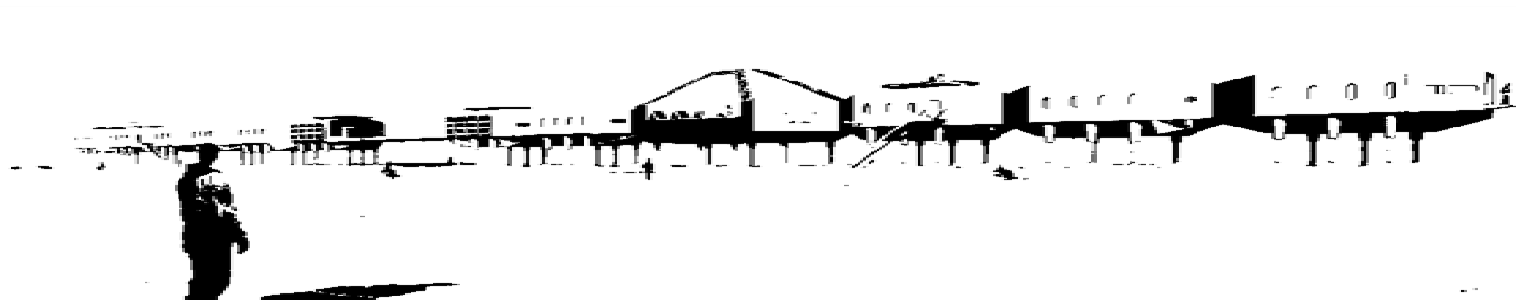
Although the new base can accommodate 90 researchers, the researchers usually come in groups of 10 to 15, and stay for up to a year (Raath 2008).

Helga Raath (Raath 2008) explained that the research base consists of a working and living area constructed from moulded steel and fibreglass panels, which can withstand the extreme weather conditions. These extreme weather conditions entail temperatures varying between -15 to 10 degrees C with winds reaching speeds of up to 180 km per hour. The wind plays a major role with regards to the chill factor.

She also said (Raath 2008) that due to environmental concerns, concrete may not be mixed on Marion Island, which meant the base couldn't feature any bricks or concrete flooring. Special glass-reinforced plastic (GRP) - a type of fibreglass - boasting good insulation properties, was used for all the panels. These panels were designed and manufactured in South Africa, from where they were shipped to the island. This was achieved through extensive research and testing to create the product most suitable to the conditions. Other features of the base include covered walkways and hallways between the climate-controlled buildings, because of the adverse weather. People can move between the buildings without being exposed to the weather (Raath 2008).

The Marion Island base is now being replicated by other overseas designers for bases in the Antarctic, and similar harsh environments.

The design seemed very relevant in the way the architecture responded and communicated the harsh climatic conditions on Marion Island. The GRP selected has great climatic response and helps in maintaining a comfortable core temperature; it thus assists in the homeostasis of the relatively small living spaces.



ANTARCTIC HALLEY VI  
by Faber Maunsell and Hugh Broughton Architects  
GRP-modules

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Situated on the Brunt Ice Shelf, Halley is the remotest of the British research stations. Halley was first built in 1956 and has since been rebuilt four times. During the summer months about 65 people live and work at Halley V, but for nine months of the year, the research station is completely cut off from the outside world. Fifteen or so people brave it out during the winter when temperatures can fall to -50°C and there is almost 24 hour darkness for three months (<http://www.discoveringantarctica.org>).

Design plans for Halley VI are both groundbreaking and futuristic. Thanks to special mechanical legs that will act like skis, Halley VI will be able to move with the ice, and be towed to different positions on the ice shelf, dramatically increasing its potential lifespan (Raath, 2008).

The central area of the research station itself will be available for recreation and relaxation. On either side, a platform will link together detachable 'modules'. Some of the modules from the north platform will provide accommodation all year round, with each big enough for eight bedrooms. On the south platform, the modules will be used for science laboratories and extra accommodation during the busy summer months (<http://www.discoveringantarctica.org>).

The new station will provide a home and work place for the people during the winter and in the summer and needs to respond to some awesome environmental challenges. Located 10,000 miles from the UK, the station will be located on a 150 metre thick floating ice shelf, which moves 1 km per annum towards the sea (<http://www.hbarchitects.co.uk>).

Snow levels rise by around 1 metre and the sun does not rise above the horizon for 100 days per year (<http://www.discoveringantarctica.org>). The new self-sufficient complex will replace the current Halley V Research Station and will be relocatable. Designed to withstand extreme winds and freezing winter temperatures of around -50°C (<http://www.discoveringantarctica.org>) The new prefabricated modular research station features a dramatic central social and recreational module. The station is designed to adapt to the changing external conditions and future science needs of BAS .

As with Marion Island the material selection was based on strength, core temperature comfort and durability. The ease with which various panels can be manufactured and assembled seemed a reachable goal for any design. The design succeeded in keeping assembly simple without limiting the creative mind.



## CONTEMPORARY ART CONTAINER BY ZAHA HADID GRP-modules

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The container, discussed here is in Hong Kong, the first of six cities on its world tour, houses commissioned artworks that reinterpret the label's iconic 1955 quilted bag, and was designed by Zaha Hadid for fashion house Chanel (<http://www.ihalife.htm>).

Due to the nature of the pavilion's geometry, two sections will be different even if only 10 cm apart. Hadid's office models whole buildings in 3D and sends the computer files to the engineer and then on to the main contractor, who builds from them directly. A practice's software models the thickness of all materials (<http://www.thecoolhunter.net>). Additionally, it can include a material's properties such as minimum radiuses from early on in the design process, making it impossible to generate unbuildable geometries. For architects so involved in exploring fluid geometries, this new shamelessness between form-making and engineering has already become essential to the studio's output. (MMS technologies use "Solidworx" for this same purpose.) All the wall panels are made from two skins of fibre-reinforced plastic (FRP), which has a very strong tensile strength (<http://www.chanel-mobileart.com>). Between these is 2.5 cm of glass fibre foam core that creates a structural depth to help deal with acoustics, gives a solid rather than a hollow sound to help with the sensuality of the material. The same detail that attaches the FRP panels to the pavilion's I-beam structure is used during transportation to fix them to scaffolding that goes directly into a 2.5 m-high x 6 m-long sea container. The pieces are fixed in place one above another. In much the same way as precious artworks are transported, they aren't wrapped — not even bubble-wrapped — to prevent surface scratches to the glossy, spray-painted finish. (<http://www.thecoolhunter.net>)

## ZARAGOZA BRIDGE PAVILION BY ZAHA HADID GRP-modules

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Zaha Hadid has chosen glass fibre reinforced concrete from the Austrian company Rieder to envelope the 275 meters long "Zaragoza Bridge Pavilion", the new symbol of the Expo 2008 in the northern Spanish Zaragoza: she has covered the outer skin of the building with 29 000 triangles in different grey shades out of fibreC (<http://www.dezeen.com>). The new bridge across the river Ebro is entrance to the Expo area and at the same time multi-level exhibition area; 10 000 visitors per hour will frequent the Main Pavilion of the world exhibition (<http://www.dezeen.com>).

Apart from its design and visual impact, the design has a strong sustainable component reached through material selection. The composition of fibreC out of degradable, purely mineral raw materials entirely complies with the current trend of natural, environmental-friendly and sustainable materials (<http://www.dezeen.com>). Opposite to the Expo-Theme, sustainability has been certified in May according to DIN EN ISO 14.001 (<http://www.tuvie.com>). With this "organic approach", Zaha Hadid's design of the bridge as well as the use of the material fibreC fit with the EXPO theme "Water and Sustainable Development". The innovative material fibreC enables big creative freedom in terms of mouldability, colour and processing (<http://www.tuvie.com>). Today, fibreC meets architectural challenges, which apparently made it impossible to employ concrete even a few years ago (<http://www.ihalife.com>).

Both the Mobile Chanel Exhibition as well as the Pavilion Bridge made use of the very lightweight and durable GRP material. What one really grasped about the material from these two designs, is the absolute endless possibilities of shapes and spaces reachable by using GRP.





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'PUYO' is a Japanese onomatopoeia that expresses the sensation of touching the vehicle's soft body. It is meant to convey a warm, friendly impression (<http://world.honda.com>). The PUYO represents a new idea in mobility that brings together 'clean', 'safe' and 'fun' functionality in an environmentally responsible, people-friendly minimalist design featuring an ultra-high efficiency, small frame and fuel cell technology to please both users and onlookers alike (<http://world.honda.com>).

### **Interior design**

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Developed to have a 'Silky Feel', the PUYO's interior is designed to provide a refreshing, people-friendly space imbued with a feeling of transparency. Features such as an instrument panel monitor, controls that take advantage of the elastic qualities of cloth to rise up when the vehicle starts up, luminous fluid meter displays, and a joystick for intuitive operation are all designed to gently support occupants' senses and sensibilities (<http://world.honda.com>).

### **Exterior design**

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The development theme for the PUYO exterior was to create a cornerless, 'Seamless Soft Box' form that is kind to both people and the environment. The goal was to create a personable design with the feel of an adorable pet, while taking advantage of the maximum spaciousness of the box-shaped design. The PUYO's 'gel body' features soft materials to promote greater real-world safety. Moreover, the body has been made luminescent to guide people into the proper operating position and notify them of the vehicle's condition, facilitating a more intimate relationship between people and their cars (<http://www.hydrogencarsnow.com>).

The car posed to be a design anomaly and through expert material selection the Japanese really succeeded in capturing the world. The vehicle design was based on all the individuals' senses and they considered every stage of commuting and driving. The vehicle has a material richness with isoskin, elastics and transparency it also has advanced technological features which makes it a liberating precedent.



## Definition

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An aerial ropeway is defined as:-

"Any apparatus for the overhead transport of passengers or goods in carriers running along or drawn by overhead cables supported by towers, pylons or other similar structures, together with any machinery, equipment or plant connected therewith."

(N.B. this Code of Practice will not deal with ropeways or lifts used for industrial purposes).

## Planning

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When planning the location and route of an aerial ropeway the following factors must be carefully considered:

### (a) Amenity Value

The aerial ropeway including any further extension shall be so located that adequate facilities for inter-connecting public transport are available at the terminals.

### (b) Route

An aerial ropeway including any future extension shall be routed so that its effect on the environment is minimal; this involves consideration of noise pollution, unsightly construction and any detrimental visual impact on the local environment. In the design of the routing of the aerial ropeway or its extension, due regard shall be given to the effect on/from existing neighbouring build-up areas or natural habitat, such as vegetation, roads, railways, aircraft flight paths, electric power lines, streams, buildings, bridges and slope stability. An environmental impact assessment shall be carried out to address this subject in accordance with any other legislative requirement in force in Hong Kong. Adequate consultation on various details of the project shall be conducted with relevant organizations and the local community. If land resumption is a related issue on the project, all necessary procedures as required by any other legislative requirement in force in Hong Kong shall be followed.

### (c) Emergency Access

Adequate access to terminal stations by emergency vehicles as may be required by the Director of Fire Services (abbreviated to "DFS") shall be provided. A rescue plan shall also be drawn up in consultation with DFS and the Director to deal with emergencies during operation.

## 1. GENERAL DESIGN

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Every part of an aerial ropeway system and its associated equipment shall be designed with consideration given to the safety of the passengers, general public and operating staff, and shall be designed in compliance with this Code of Practice.

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All systems must be designed, operated and maintained in accordance with the following principles of safety, which are to be applied in the order given:

\_ Eliminate or, if that is not possible, reduce risks by means of design and construction features;

\_ Define and implement all necessary measures to protect against risks which cannot be eliminated by the design and construction features;

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Because of the high probability of any structure in Lesotho being subject to severe winds and very heavy rainfall, the design of any exposed equipment and the selection of any materials used in the construction of an aerial ropeway shall give due regard to these factors.



Figure 16: strong alloy structure, enhancing safety (Louw: 2004)

## 2. CARRIAGE CONSIDERATIONS

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### Carriage Parameters

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All carriages must comply with some basic design requirements which are detailed below:

- > 01 Each person shall be in general assumed to be equivalent to a 75 kg mass (Rudolph, 2007).
- > 02 Standing passengers are allowed if the carriage is suitably designed for that purpose (Rudolph, 2007).
- > 03 The boarding time for each carriage shall be assumed to be 3 seconds per person up to 10 persons and 1.5 seconds per person thereafter (Rudolph, 2007).
- > 04 The safety factor of the structure, hanger and all load bearing components shall be at least 4. (10 mm grp: safety factor 10) (Rudolph, 2007)
- > 05 The design calculations shall take into account all probable static and dynamic forces that will be encountered in operation (including fatigue loading), such as vehicle weight itself, passenger load, wind force, inertia forces at trestles, starting acceleration and braking (Rudolph, 2007).
- > 06 The enclosure of the carriage shall be so designed as to prevent the passengers from being thrown out in case of accident and must have the facility to prevent passengers from getting out of a closed carriage. Also, all doors should be closed, either manually or automatically, from the outside and shall not be opened from inside the carriage except by the attendant in the case of an attended carriage (Rudolph, 2007).
- > 07 All carriages shall have adequate natural ventilation. The transparent material for the window opening shall be shatterproof (Rudolph, 2007).
- > 08 **Minimum sizes for carriages** (Rudolph, 2007)
  - For standing passengers:  
Floor area  $A = N/6 \text{ m}^2$   
(N = number of passengers)  
Height H = 2.0 m
  - For seated passengers:  
Seat width W = 0.5 m  
Floor area A =  $0.33 \text{ m}^2$  (per passenger)

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### Speed (Rudolph, 2007)

- > 01 As the ropeway technology develops there will be a natural increase to the maximum permissible speeds. The variation of speed of vehicles due to either acceleration or deceleration shall not cause disagreeable sensation to passengers. This development will not be discouraged although the recommended safe maximum speeds at the present time will be:
  - Monocable (closed carriage) 4.0 m/s
  - Monocable (open carriage) 2.0 m/s
  - Multi-cable (with one rope for supporting purpose) 7.0 m/s
  - Multi-cable (with more than one rope for supporting purpose) 8.0 m/s
  - To & fro (attended carriage) 12.0 m/s
  - To & fro (unattended carriage) 8.0 m/s
- > 02 When carriages are in constant motion for loading and unloading the maximum speed shall not be greater than 0.25 m/s and the detached carriages will be stationary during loading and unloading to limit safety risks.
- > 03 It should be re-emphasized that the maximum speed of any system must be designed with safety in mind. Ropeway engineers will specify all this.



Figure 17: a typical terminal with proper signage and safety (Louw: 2007)

### 3. STATIONS

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#### Structures

The building structures and facilities shall be constructed in accordance with the requirements as stipulated in the Buildings Ordinance for Aerial Transport Systems. The designs of the terminal buildings shall take account all the forces upon them, including rope tensions and an earthquake loading (Rudolph, 2007).

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#### Access

Queuing area shall be provided at each terminal for passenger boarding. The queuing area shall be sufficiently large to cater for the maximum passenger flow.

The layout and deposition of the stations shall be such that the access and exit points are clear, even at times of maximum passenger flow. The circulation of passengers is, as far as possible, unhindered. Sufficient covered space shall be provided, under average passenger flow conditions, for waiting passengers.

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#### Prohibited Areas

Passengers shall not have access to any area housing machinery or operational equipment and shall be given access only to the boarding and alighting areas.

All machinery and equipment shall be adequately guarded with noise attenuation facilities. The driving gear and the return deflection devices shall be protected against weather.

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#### Boarding Area

At boarding areas in those stations where the carriages are in constant motion, enough space to accommodate the passengers queuing up for boarding the carriages shall be available. In all cases, sufficient space shall be provided, under average passenger flow conditions, for waiting passengers under cover or shelter from the weather. Sufficient public hygiene facilities shall be available at all times.

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#### Emergency Lighting

Emergency lighting in the terminals or other stations for passenger boarding shall be available from a secure supply. Such supply should conform to the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection and Testing of Installations and Equipment issued by Fire Services Department.

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#### Prevention of Fire

Upon receipt of building plans, Director of Fire Services will be responsible for formulating requirements/recommendations for the intended use of such terminals and/or stations. In addition, proper management of terminals and/or stations with specific reference to good housekeeping, effective control of passengers, unobstructed entrances/exits, etc. are essential for prevention of fire. Any such requirement of the Director of Fire Services shall be complied with (Rudolph, 2007).

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#### Notices

The following notices shall be posted in a conspicuous place in each terminal and station and shall be kept in good condition:

- > 01 Notices, in both Sotho and English, containing the messages as required in the Regulations and, in addition, giving warning of hazards related to moving machinery, and
- > 02 Notices, in both Sotho and English, and either with a red or yellow background, giving warning of the danger of fire in the terminal/station, as well as in the vicinity of the ropeway line.



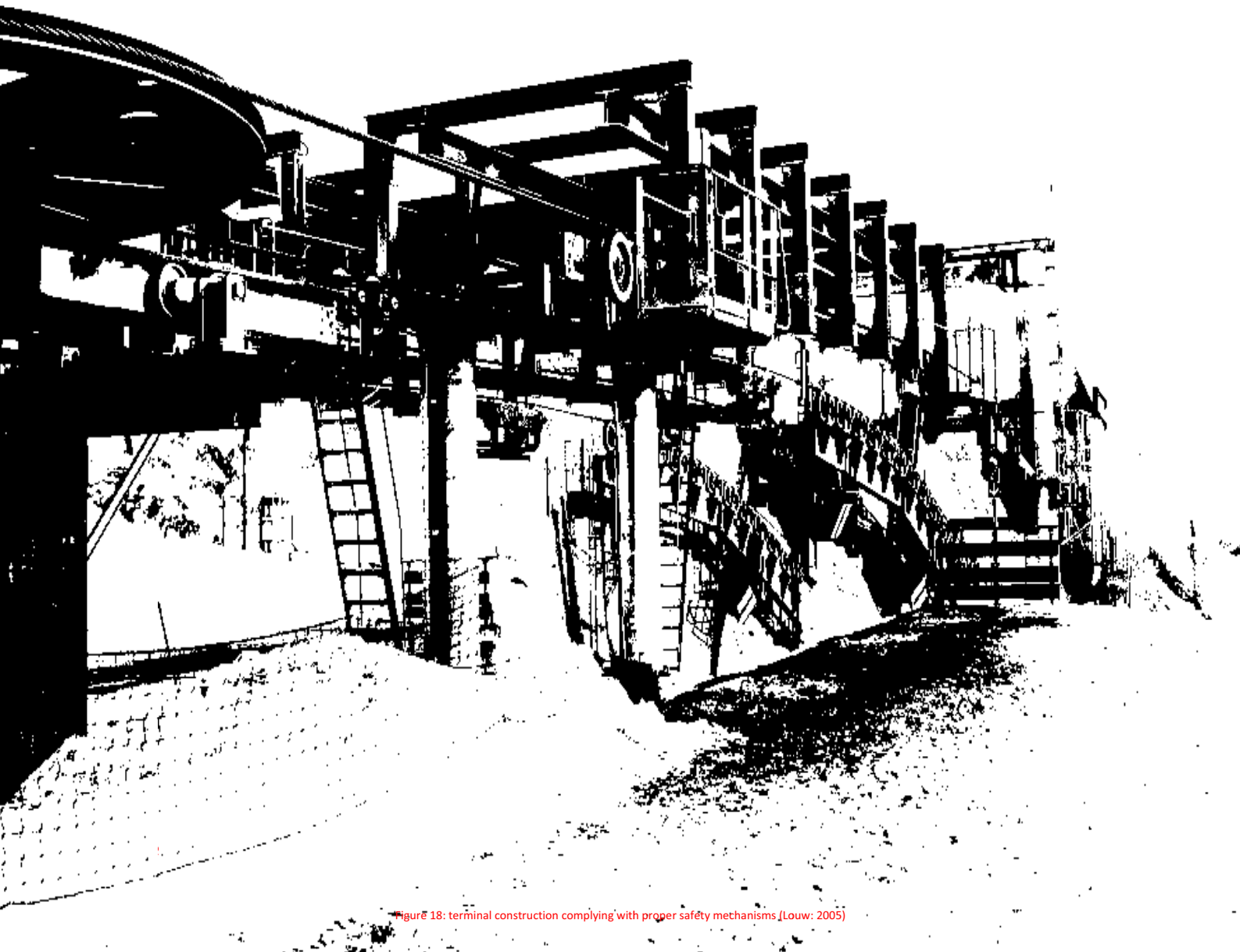


Figure 18: terminal construction complying with proper safety mechanisms (Louw: 2005)

#### 4. CONSTRUCTION CONDITIONS

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##### Route

In Lesotho, the probability of having strong prevailing wind at the site where the aerial ropeway is going to be installed is high. To determine the wind effect on the aerial ropeway, a full scale in-situ investigation shall be conducted prior to the detailed design of the aerial ropeway. The duration of the investigation shall be sufficient to determine the seasonal fluctuation of the wind direction and magnitude. The design of the aerial ropeway shall cater for the wind effect obtained in the full-scale in-situ investigation. The engineer will do this.

A geotechnical assessment of the proposed route should be carried out, based on which a site investigation programme should be designed and implemented (Rudolph, 2007). The design of aerial ropeway foundations shall be in accordance with the requirements of the Geotechnical Manual for Slopes (Rudolph, 2007) and shall be submitted for approval to the appropriate government department or office as required by legislation or the design brief. The aero view route of an aerial ropeway should be straight

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##### Profile

The profile of the aerial ropeway (longitudinal side elevation) shall be, as far as practicable, parallel to the terrain over which it passes (Rudolph, 2007).

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##### Integrity of the installation

- > 01 The aerial ropeway shall be designed and constructed in such a way that, while in operation, any failure of any component will not affect the safe operation of the aerial ropeway and will not cause other components to fail (Rudolph, 2007).
- > 02 All components of the aerial ropeway shall be properly designed to facilitate routine monitoring and maintenance in order to avoid failure (Rudolph, 2007).
- > 03 The operation of the aerial ropeway shall be able to be stopped manually at any time (Rudolph, 2007).

#### 5. COMMUNICATIONS

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There is a constant need to maintain adequate verbal contact between the terminals and the passengers or other operational staff on board of the carriages, especially at times of emergency (Rudolph, 2007). Therefore, the following forms of communication equipment shall be provided to ensure that effective communication is available at all times .

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##### Telephone

All terminals shall be connected to the public telephone service. In addition to this requirement, an internal telephone system connected to the major sections of the ropeway is required.

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##### Wireless Communication System

A wireless communication system, approved by the Director-General of Telecommunications, shall be provided. The system shall not interfere with other similar systems in Lesotho. For the aerial ropeway with attended carriages, a wireless communication system shall be provided at the carriages for the communication between the carriages and terminals.

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##### Public Address System

The line of a multi-carriage aerial ropeway shall be provided with a public address system that is audible within the carriages from any point on the line. In addition, portable loud-hailers are recommended for 'on-the-spot' communication in case of emergency. At least one of these modes of communication shall be readily available at all times. Any cables that are also used for the transmission of any electrical systems shall be suitably protected and isolated.

TERMINAL 1  
ON  
OFF

Off

>> SA Border Post  
1968m

Terminal 1 to terminal 2  
8km  
18 minutes  
(3 hours by car)

TERMINAL 2  
Off  
ON

ON  
Off

>> Sani Pass Summit  
2873m

Terminal 2 to terminal 3  
21km  
47 minutes

TERMINAL 3  
Off  
ON

ON

>> Thabana Ntlenyana summit  
3482m

Total trip time (one way)  
29km

65 minutes

Total trip time (two way)  
58km

Figure 19: proposed terminal layout and data

## CONCEPTUAL THINKING

### TERMINAL ANALYSIS AND PLANNING

A thorough Environmental Impact assessment has revealed that the impact of a dirt road is less on the ecological milieu than that of a tar road and the impact of an aerial transport system is five times less on the same ecological milieu than that of the dirt road. An Aerial Transport System has thus been proposed to replace the current dirt road and hence limit the impact on the mountain ecosystem and increase ecotourism. The transport system with accompanied structures will also create employment, both during and after construction.

The proposed Aerial Transport System will start from the SA Border Post (TERMINAL 1 – 1 968 m) (Turco, 1994) Sani Pass Summit (TERMINAL 2 – 2 873 m) (Turco, 1994) to Thabana Ntlenyana (TERMINAL 3 – 3 482 m) (Turco, 1994). It will be 8 km (was 33 km by car) from terminal 1 to 2 and another 21 km from terminal 2 to 3, making the total trip 29 km, approximately one hours' ride in one direction. If the funitel moves at 7.5 m/s (27 km/h):

	DISTANCE	TIME TRAVELLED
Terminal 1 to terminal 2	8 km	18 minutes
Terminal 2 to terminal 3	21 km	47 minutes
Total trip time (one way)	29 km	65 minutes
Total trip time (two way)	58 km	130 minutes

Table 1: Terminal design and distances travelled

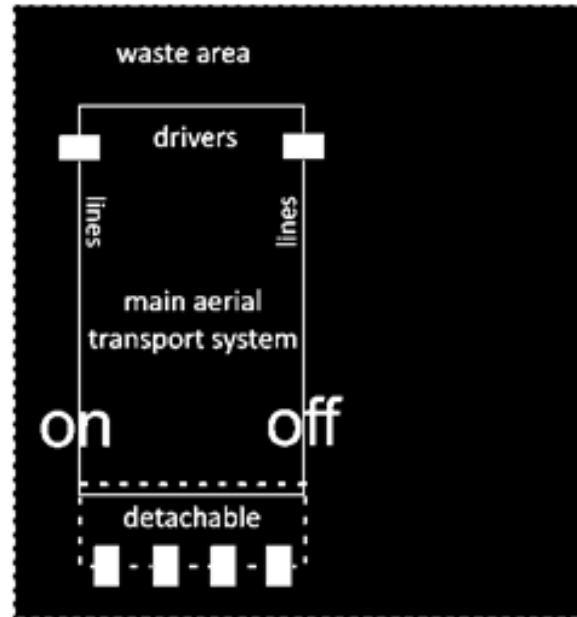
### TERMINAL PROPOSAL

The Doppelmayr/Garaventa Group is the world quality and technology leader in ropeway engineering (Rudolph, 2007). The Group develops efficient passenger transport systems for summer and winter tourism resorts as well as state-of-the-art passenger transport systems for the urban environment, airports, shopping malls, sports complexes, adventure parks, trade fairs and other facilities with corresponding transport requirements (Rudolph, 2007) Commuters usually have to access a carrier via a flight of stairs, which could be a rather laborious trek for commuters with backpacks, bicycles, canoes, skies or luggage. To facilitate access for commuters the group have engineered a big wheel solution (view attached CD) for a cable car. The funitel enter the terminal at an upper level, are taken down to the level below (entrance level) by means of a big ferris wheel and then follow a gentle curve through the loading and unloading area at creep speed until they are finally raised back up to the station exit by a second big ferris wheel, from where they are launched onto the line. The commuters thus come off the trail and board the funitels at ground level.

A special feature of this system is the double configuration of the rope loop: one continuous rope produces four rope lines. There are two parallel ropes on both the uphill and downhill sides. The drive is via a vertical bull wheel (ca 5.2 m). The central counterweight tension system operates via three bull wheels on a common movable carriage (Doppelmayr has also used hydraulic tension systems on other funitels). In the station curves, the funitels are transported along running rails by means of tyre conveyors. The entire ropeway machinery is fixed to the roof beams of the building. No central columns are required which would hinder the flow of the commuters (Rudolph, 2007)

## CORE SYSTEM analysis

. funitel



- . visibility
- . signage
- . branding
- . colour
- . understandable
- . functional
- . efficient
- . paraphernalia loading
- . paraphernalia offloading

- . engineered structures
- . supporting engineered structures
- . commuting spaces
- . restaurant
- . toilets
- . kiosk
- . information
- . ticket booths
- . control point
- . waiting areas
- . shops
- . atm
- . local trade
- . donkie stop
- . parking
  - . cars
  - . taxi's
  - . busses

### ADVANTAGES OF AERIAL TRANSPORT SYSTEM:

- > work/business opportunities
- > minimal environmental impact
- > multi-functional transport system
- > seasonal adaptable transport system
- > tourist attraction
- > affordable transport
- > safe transport
- > effective all-round transport
- > environmentally friendly transport
- > enhances local economy
- > supply remote areas with power

Figure 20: terminal design considerations and system analysis planning

The terminal 1 will consist of two commuting levels.

On both levels all facilities and doorways should be clearly visible and reachable. The design should enhance movement and not create confusion or friction within the flow. Boundaries, subsets and clear signage should direct and guide the user indefinitely. Zones will be allocated so that the commuter can be directed without difficulty, this will also make ticketing and terminal mapping more effective. The same zone-principles will be applied on both ground level and the first level. By applying these principles one will induce a system with useful indicators **dep0A, dep0B or ar1A, ar1B** applied onto signage, mapping and ticketing.

ZONE 0 >> ground floor

> DEPARTURES

People will enter the building at ZONE 0 from where they can proceed either to the recreational space (local craft), toilets or board the carriage which will take them up the pass to terminal 2 and hence terminal 3. The departing level should be designed so that all the various facilities and operating structures should be visible and reachable.

There will be two definite boarding zones.

Zone A will be for immediate boarding where the cable car is still creeping through the terminal and commuters board while the cable car is in motion.

Zone B will be for prolonged boarding where the cable car is detached and loading of paraphernalia (suitcases, stock, trade, equipment, canoes, bicycles, pushchairs and wheelchairs) will proceed while commuters board.

ZONE 1 >> first floor

> ARRIVALS

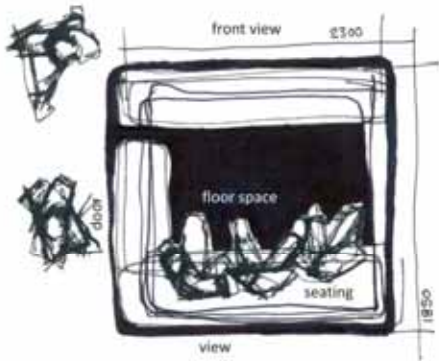
There will also be two definite disembarking zones:

Zone A will be for immediate disembarking where the cable car is still creeping through the terminal and commuters get off while the cable car is in motion.

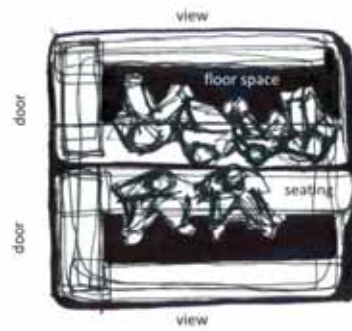
Zone B will be for prolonged disembarking where the cable car is detached and off-loading of paraphernalia (suitcases, stock, trade, equipment, canoes, bicycles, pushchairs and wheelchairs) will proceed while commuters disembark from the carriage.

People will disembark from the carriages on ZONE 1 from where they can progress either to the restaurant, shops, and toilets or exit the building.

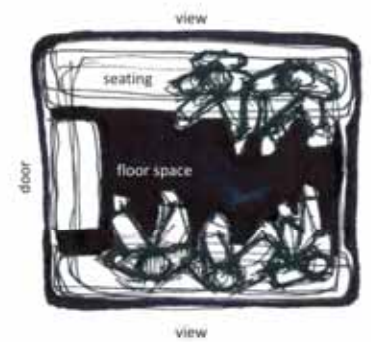
The Doppelmayr/Garaventa "ferris wheel" system (as discussed) will be implemented. The above mentioned zoning will be then designed around the functioning engineered structures.



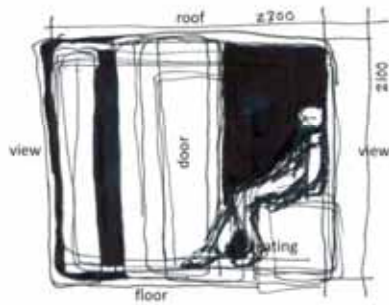
CARRIAGE LAYOUT 1  
on plan



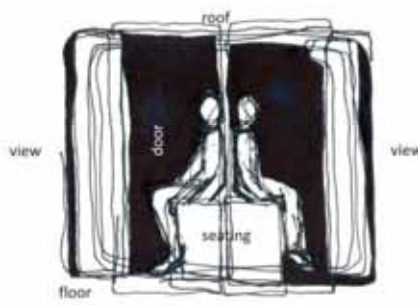
CARRIAGE LAYOUT 2  
on plan



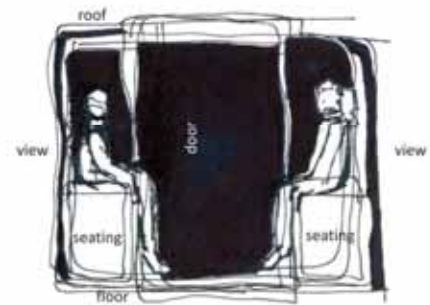
CARRIAGE LAYOUT 3  
on plan



CARRIAGE LAYOUT 1  
on elevation



CARRIAGE LAYOUT 2  
on elevation



CARRIAGE LAYOUT 3  
on elevation

A range of suspended cable vehicles exist each designed to function within a specific context. Gondolas, funitels, funifors and reversible ropeways are the most general and known vehicles found. All of them have the same distinguishable silhouette and variation is expressed in colour and branding. Each of the above is described in the Appendices 1: Terminology section. A ski terminal or urban transportation terminal will either have a standard seating unit where all 100 units are the same or a standing unit where all the units are standing, but within a single terminal there will never be a combination of both seater and standing units. Below is a brief discussion of the standard seater and standing vehicles.

#### Interior of the “seating unit”

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These high performance structures are usually made out of a light alloy corrosion-resistant framework which is connected to a hanger with equipped shock-absorbers. The body is also made of an alloy metal and some of its components are made out of leather, a composite or a rubber to ensure shock resistance and thermal insulation ([www.poma.net](http://www.poma.net)). These materials allow partial repairs at low cost. The cabins are designed to provide a functional cabin. In addition the sets are shaped and arranged to give the passengers room to move around the cabin with ease. The vehicles usually have a double swivel-arm door for easy access (Rudolph, 2008). The vehicle has a textured aluminium floor surface and an alloy ceiling. An alloy ski holder is fixed to the doors and the commuter places his skis or snowboard inside the holder as he enters the vehicle.

#### Interior of the “standing unit”

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These units have exactly the same material silhouette as the seating unit but the whole interior space is empty and a 360° tubular handrail is the only addition to the interior ([www.poma.net](http://www.poma.net)).

These vehicles are usually 2080m x 2320m in width and allows for a head height of 1850m ([www.poma.net](http://www.poma.net)).

#### In conclusion

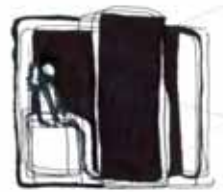
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By understanding the standard system and entity the designer can rethink the space, function and materials currently in use. By realising the importance of the user and understanding how the existing vehicle work one can respond by utilizing new sustainable materials and applying inclusive design principles.



NEW CARRIAGE TYPOLOGIES

STANDARD  
CARRIAGE LAYOUT  
on plan

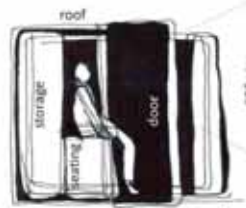
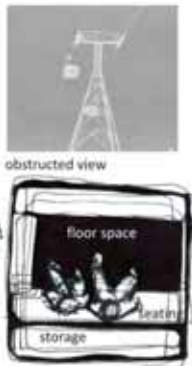


STANDARD  
CARRIAGE LAYOUT  
on elevation

10 (+1)  
STANDING  
UNIT



METAMORPH 1  
CARRIAGE LAYOUT  
on plan



METAMORPH 1  
CARRIAGE LAYOUT  
on elevation

4/5 SEATER  
UNIT



METAMORPH 2  
CARRIAGE LAYOUT  
on plan



METAMORPH 2  
CARRIAGE LAYOUT  
on elevation

2 + (2)  
"PIC-NIC"  
UNIT



Figure 22: carriage design, ergonomic application and planning

The current design consists of three basic layouts:

Layout one >>

A row of seats is placed along one vertical plane of the vehicle and the user has a 360° view to the outside. This layout has an uncomfortable space in front of them and a lot of wasted surface and space. (figures 20,21)

Layout two >>

The seats are placed along the central axis of the vehicle (back-to-back) and the user has a 180° view to the outside. In this layout one has effective utilization of the interior space and the unit can transport more commuters per hour than layout 1. (figures 20,21)

Layout three >>

Two rows of seats are placed opposite each other. Even though this layout exploits the space fully the users face each other and their theoretical 180° view is obstructed. (figures 20,21)

The above layouts are all a four-sided entity with four corners a 0° horizontal top plane (the roof) and a 0° horizontal bottom plane (the floor). The above mentioned views are only applicable on a horizontal plane when the vertical plane of sight is considered, the reader will note that the standard cable car only allow a 180° view (ground to sky) when the user are directly next to a window. In all other scenarios the user has a 35° - 45° vertical plane view. (figures 20, 21)

The actual design proposal

On plan >>

Responding on layout 1:

One can utilize the wasted space by moving the row of seats forward in order to create a storage space behind the seats.

Due to the spatial compression one has left little room for wheelchair movement and the space can become inclusive by protruding out of the anterior plane and enlarging the space to allow for all users (inclusive 1500mm Ø). The unit are then rotated 35° horizontally so that the towers no longer visually pollute the view but the user can now gaze past the towers onto the landscape. (figures 20,21)

In section >>

Responding on layout 1:

All the spatial changes on plan will be visible in section as well. The altered unit are then rotated 25° on the vertical plane, this rotational change will also enlarge the current 35° - 45° vertical plane view to 60° - 70° vertical plane view (figure). By enlarging these visual spaces one create the illusion of a bigger inner context and the user starts to experience the real larger context

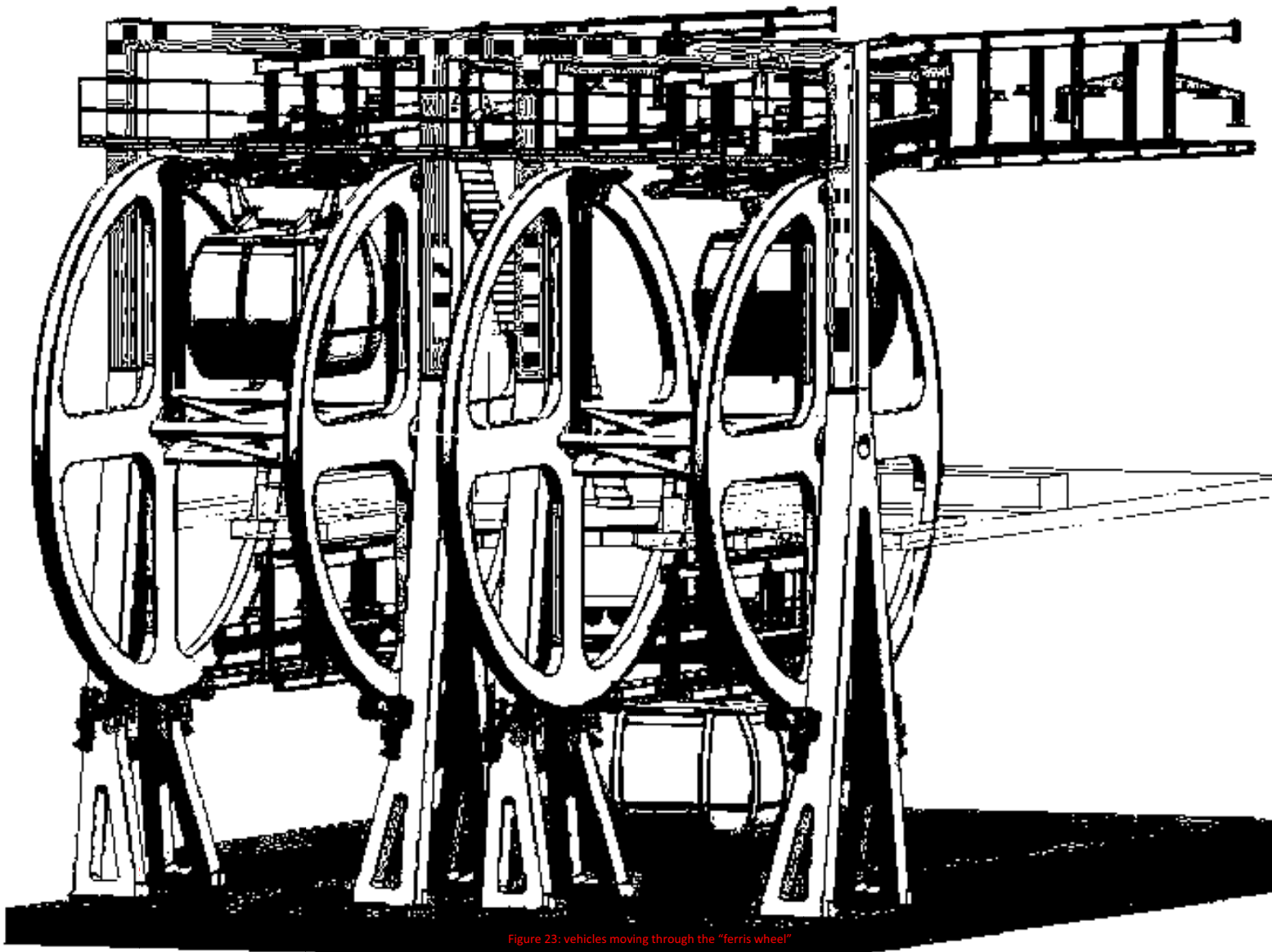


Figure 23: vehicles moving through the "ferris wheel"

.In general >>

The design should be adaptable and accommodate users and activities during summer, autumn, winter and spring. By having a single unit which can change in accordance to the need/activity of the user on can house all the mentioned activities. The concept is thus having one single shell, which can metamorph into a standing, seating or 'pic-nic' unit. By having clip-on or slip-in mechanisms, various structures can be attached or removed in order to house the different activities as the climate changes through the year.

the cabins can be adapted to meet the customer's specific requirements, including:

**technical features:**

- ventilation, radio, lighting, passenger handrails or hangrails , ski-holders, bicycle holder, storage compartments, etc.

**aesthetic design:**

- wide choice of colors (plain or two-colored),
- customized interior trim and decoration.
- Recyclable interior components

A long-travel suspension system installed above the extruded, riveted aluminum sections forming the structural framework ensures optimum comfort for passengers. The windows are made from PMMA with UV-filters. Cabin design provides operating personnel with immediate access to inspection points. The door opening/closing mechanism should be inserted in a compact, removable box and combines the door closing and locking functions.