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SLEEPING CABIN

MOVING MOUNTAINS OF EXPECTATIONS

Project

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Glossary

FHD	Single Deck Coach
FDD	Double Deck Coach
HQ	Headquarters
NREM	Non-Rapid Eye Movement
PWB	Psychological Well-Being
REM	Rapid Eye Movement
SC	Sleeping Cabin
SWB	Subjective Well-Being
USP	Unique Selling Point

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Chapter 00

Preface

First of all, I would like to thank the supervisory team from Delft University of Technology, mentor Robin Bronkhorst and chair Rudolf Wormgoor. Even though I was motivated and ambitious for this project myself, the supervisory team has showed their interest, motivation and ambition related to the project and they have provided clear, direct and professional guidance throughout the entire process. Their advices have been valuable and insightful. The bi-weekly meetings with Robin were prepared by him and myself, the less regular meetings with Rudolf were well prepared both ways as well. This made every meeting effective.

Secondly, many thanks to VDL for the opportunity to work on such an inspiring and interesting assignment. I would like to thank Bram Veendrick in particular. Bram was the company mentor, moreover the head of design within VDL. His critical view and feedback during the process and his support towards the end result have been contributing to the project and my development positively.

Furthermore, my gratitude for Rik de Reuver from Van Der Veer Design, who made time to have a couple of meetings and provide feedback during my process. Of course, my gratitude as well for all other employees of VDL and people that have been involved in this project and have helped me.

I have really enjoyed this project and I have delivered my business card to the designers' market. I am proud to present the next generation VDL sleeping cabin, which is moving mountains of expectations.



Figure 0
VDL Futura FDD and
FHD

Chapter 01

Executive summary

It is important that travel coach drivers are “equipped” with a well-designed sleeping cabin since approximately 20% of fatal traffic accidents are caused by sleepiness. One that will offer them comfort, rest, a good sleep and which will prepare them to get back to work after their resting shift. However, the current sleeping cabin is nothing more than an empty box with a mattress in it.

The redesigned sleeping cabin has been focussing on several challenges, such as the two main challenges: comfort and a USP; furthermore, the sub challenges which underpin the main ones: entrance, sleep, experience and the Care vision. The goal of redesigning the sleeping cabin was to design a sleeping cabin that is future proof and can be downgraded afterwards, one that is above expectations.

Literature research has been done in order to define comfort and its properties. In order to define those, some research has been done about

well-being, a state characterized by health, happiness and prosperity. After elaboration on well-being it has been split in two views, the hedonic and eudemonic view. Both views have been researched and have shown some overlap. The most important overlapping determinant is the environmental mastery, which means that it is the knowledge of managing everyday life and create a personal fitting context that fits the needs and values. Furthermore, it has been decided that several product qualities, such as ergonomic qualities should be integrated in order to reach a pleasurable experience.

Comfort has been defined as a pleasant state or relaxed feeling of a human being in reaction to its environment and several determinants as well as stages of comfort have been researched. Important to note is that the absence of discomfort does not result in comfort. However, comfort can be influenced by influential forces, such as odour, light, vibration, acoustics, temperature, anthropology

and ambient. Besides, to be able to sleep comfortable, some research has been done in relation to sleep and influential forces regarding to sleep. Such as the ideal lying position and a lavender smell that creates relaxation.

Field research has been done as well in order to get insights in the experiences and wishes of travel coach drivers. The main insight is that they have low expectations about the sleeping cabin and they experience the sleeping cabin as comfortable because of that. If they could improve one thing without changing the size of the cabin, it would be the possibility for temperature adjustment.

Different user (experience) tests have been done in order to get more understanding of obstacles, design or to validate a design. The entrance has been evaluated, as well as the cabin itself, also while being driven and the final design has been built as a mock-up and tested with several people, of which some are qualified as travel coach drivers. All user tests, as well

as the aforementioned research have been contributing to the final design.

The final design is communicating a clean design with a touch of warm design. The combination of clear white walls and ceiling with the warm wood like lower ceiling are creating a modern contrast which will make the driver feel comfortable. The cabin has been shaped more user friendly with round forms at the ceiling. Besides, the lighting has been integrated behind the lower ceiling so it is designed as ambient lighting, which creates a nice ambient and is adjustable in order to give it a personal touch.

The lighting, as well as the temperature, alarm clock and live feed are all controllable by the control panel which has been placed in a 60 degrees angle for optimal comfort. The rotation knobs offer an immediate reaction to movement which improves the usability of the control panel. Furthermore, the entrance has been redesigned. The entrance has become bigger and it opens from left to right,

which is more comfortable since less force is needed. However, the entrance is not the only USP of the sleeping cabin. The ambient lighting is one as well, especially with two different functions. Ambient light as in lighting up the cabin, but also a wake-up light that will wake the driver up at the moment the alarm clock rings. Besides, the odour diffuser offers a comfortable environment to spend time in, especially in combination with the ventilation and added climate control for optimal temperature.

The overall redesign of the sleeping cabin has been validated and the results are positive. It is a whole improvement in comparison to the current one. However, some recommendations have been provided as well, mainly for further research/development and in relation to the entrance.

Chapter 02

Introduction

2.1 VDL

VDL Group is an international industrial company devoted to the development, production and sales of semi-finished products, buses & coaches and other finished products and the assembly of cars. The group includes 92 operating companies in total which are spread throughout 19 countries. Informal, personal and open communication dominate within the VDL Group. This may be thanked to the short lines of communication and the no-nonsense culture. The company's culture is described by a VDL motto: "Strength through cooperation".

2.2 VDL Bus & Coach

Within the VDL Group there is a bus division which is operating as VDL Bus & Coach. Several bus companies are a part of VDL Bus & Coach and they are all collectively active in

the global market. Development, manufacturing, sales (and after-sales service) are the core activities of VDL Bus & Coach. The manufacturing takes place in the Netherlands and Belgium. Quality, safety, durability, comfort, low maintenance costs, low fuel consumption and the environment are all high priorities at VDL Bus & Coach.

2.3 VDL Care

VDL has decided to introduce a new vision in order to have more distinction of their competitors. The Care vision has to become an important part of the brand value "Attracting People" and will apply for all VDL products and services gradually. The aim is to turn VDL Bus & Coach in an even more market and customer oriented company, resulting in a better price position and a higher market share. To be able to do so, studies related to

comfort, experience and passenger care are required. The Care vision represents a level of comfort that is future oriented. The vision should not lean towards a decadent interior, but it should deliver far better comfort for all people on board.

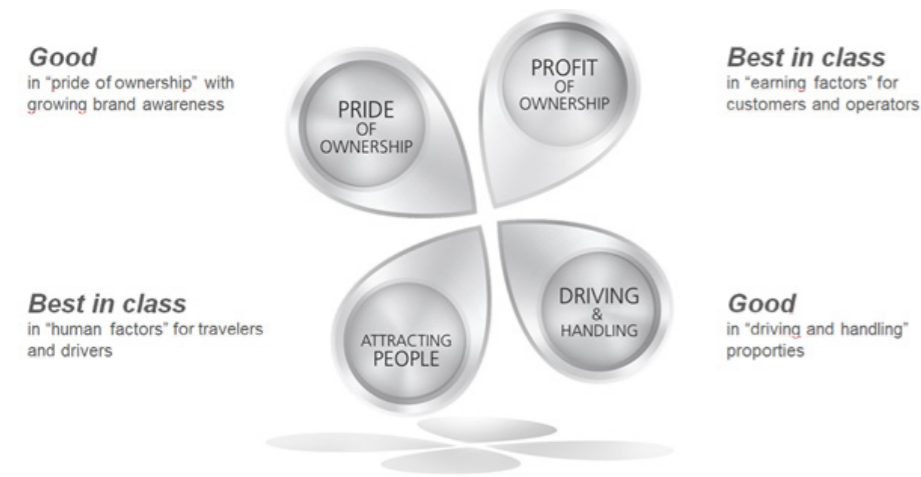
2.4 Sleeping cabin

As the name mentions, it is a cabin in which a driver can sleep. The cabin is mostly used during long trips in which two (or more) drivers are present and working in shifts. While the one is driving, the other one is resting or sleeping. However, the sleeping cabin serves as baggage storage room during shorter trips as well.

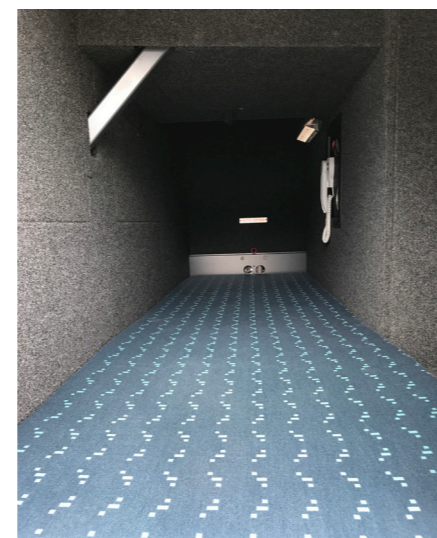
The current VDL sleeping cabin is displayed in figure 2. As can be seen it is nothing more than an empty box with a mattress. No attention has been

paid to it design wise, it looks like all components have been bought during a suppliers' sale and just have been put in.

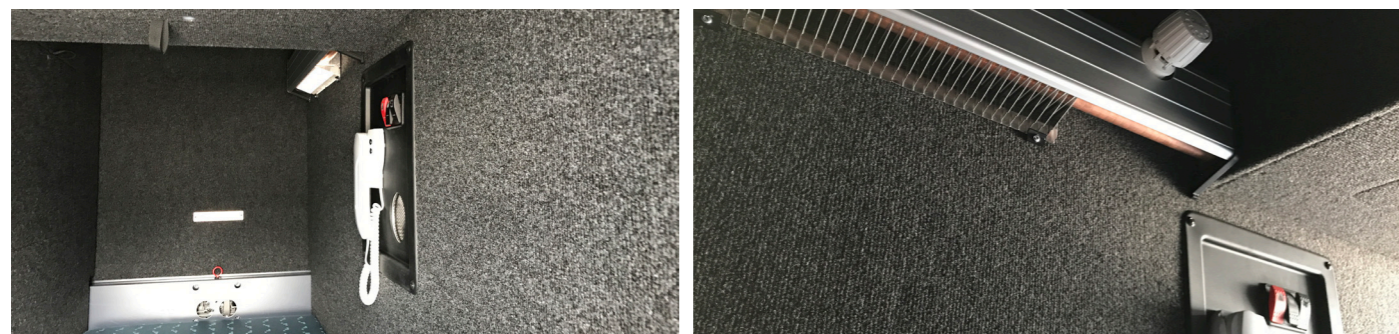
The sleeping cabin is located behind the rear entrance, it is next to the staircase in a single deck coach (FHD) as well as a double deck coach (FDD). The only difference between both coaches is the size of the entrance and cabin. The cabin is bigger in the FHD, but the entrance is less user friendly.



▲ Figure 1
VDL Care core aspects



▼ Figure 2
Current sleeping cabin



▼ Figure 3
VDL Bus & Coach HQ
Valkenswaard



Chapter 03

Explanation assignment

3.1 Problem definition

Approximately 20 % of the fatal traffic accidents within Europe are caused by sleepiness (Akerstedt et al., 2013). European countries have been sharing national statistics which have been used by France. France has published a preliminary report in which they provide data about accidents within Europe but particularly on the French roads. Of 3970 fatal accidents in total, 732 occurred on straight roads, of which 85 % were related to sleepy driving. That are 622 fatal accidents! But the sleeping cabin, which is supposed to offer comfort, luxury and rest to the bus driver, is nothing more than an empty box with a mattress currently. Because of this the bus driver is not rested optimally in order to drive as safe as possible and be alert as possible during his or her shift. Besides, there is not much distinction in design and comfort between different coaches from different brands in the top segment, especially not in relation with the sleeping cabin since no attention has been paid to it design wise.

3.2 Assignment

Design and develop an improved sleeping cabin with a unique selling point (USP) based on user experience and/or interaction that is underpinned by research in order to give VDL distinction in their market.

3.3 Main challenges

Two challenges need to be solved in order to reach the wished solution related to the assignment. However, the challenges are existing of sub-challenges which are more specific. Figure 4 shows the main challenges and their sub-challenges.

Comfort can be divided into several aspects, such as the comfort of entering the sleeping cabin and the comfort of sleeping. However, comfort is also about ergonomics (e.g. How to open the entrance? How to control the light or sound?).

One can define a USP as something that the competition is not offering. VDL recognized an opportunity and presented their Care vision, but do

changes in design create the Care vision? It needs to be defined in order to become a USP.

3.4 Sub challenges

Entrance

The entrance is one of the biggest obstacles in relation to the comfort of the sleeping cabin. Since the entrance is too small the overall experience of the sleeping cabin is less. Less comfort, less pleasure and less satisfaction is achieved.

Sleep

It is imaginable that it can be hard to fall asleep since it is a relatively small environment, without any focus on comfort nor satisfaction. There are noises, vibrations and odours present which can be experienced as unpleasant, resulting in a less qualitative and/or quantitative sleep. Some aspects as lighting, ventilation and heating are present, but their design does not contribute to the sleeping experience nor comfort in the sleeping cabin.

Experience

The sleeping cabin does not offer any designed experience. An experience can influence comfort in different ways. Increasing the comfort by putting a more comfortable mattress in the sleeping cabin does not solve the lack of comfort in general. Perceived comfort is influenced by expectations and these need to be overwhelmed by a designed experience.

Market share

The definition of the Care vision is step one within this challenge, but in this market segment, all sleeping cabins look alike and no attention has been paid to it design wise. How can the Care vision of VDL improve their market share?

3.5 Goals

The goal of this project is to design a sleeping cabin that is far above expectations. One that can be downgraded (design wise) in order to be implemented directly, but with insights of a more advanced design for future implementation, as the

Care vision aims for. As a result of the aforementioned challenges, a goal list has been created. The complete list is shown in appendix 1.

Challenges

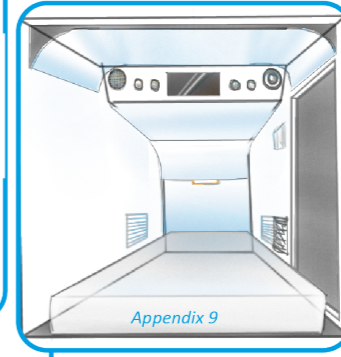
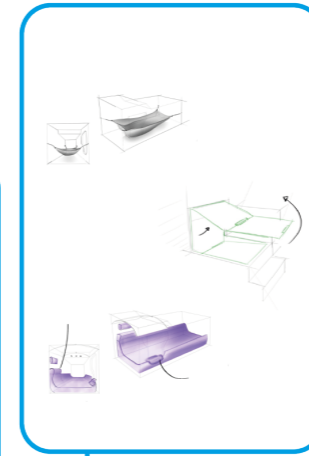
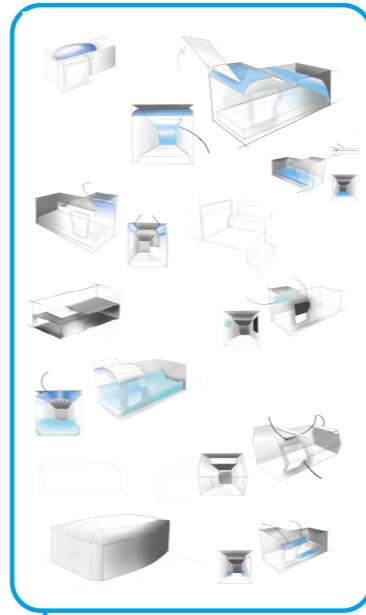
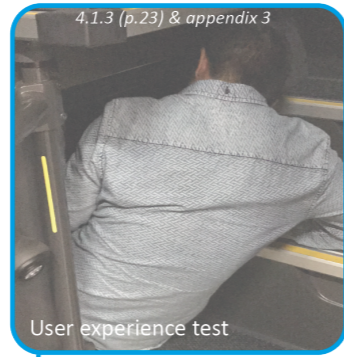
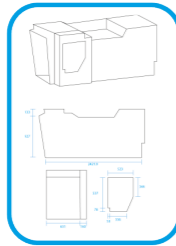
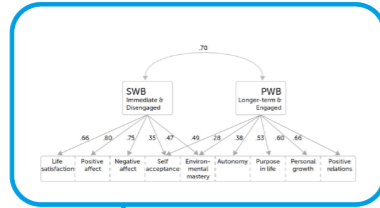
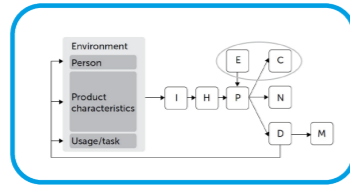


▲ Figure 4
Challenge overview

Chapter 04

Process

This chapter will provide an overview of the process. Every key point in the given overview refers to a certain part in the report or appendix in order to provide a complete process description.



4.1 Research (p. 16)

Appendix 7

Appendix 7

Appendix 10

Problem statement

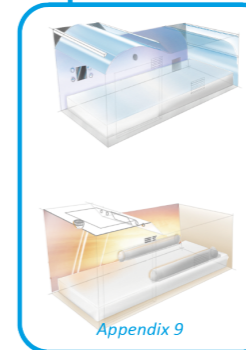
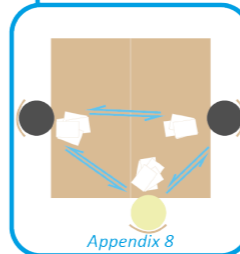
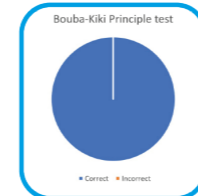
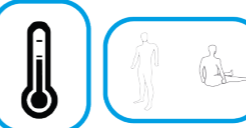
Approximately 20 % of the fatal traffic accidents within Europe are caused by sleepiness. Of 3970 fatal accidents in total, 732 occurred on straight roads, of which 85 % were related to sleepy driving. That are 622 fatal accidents! But the sleeping cabin, which is supposed to offer comfort, luxury and rest to the bus driver, to be able to drive as safe as possible and be alert as possible during his or her shift, is nothing more than an empty box with a mattress currently.

First mock up test

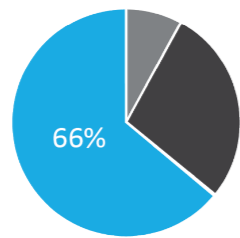


Driver interviews and observations

4.1.2 (p.21) & Appendix 4



EVALUATION GOAL LIST



8.3 (p. 43) & appendix 15



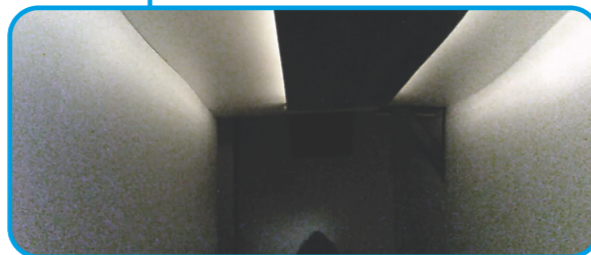
Appendix 14



Appendix 12



Appendix 11



4.1 Research

4.1.1 Literature

A cabin that can offer rest, comfort and improve the state of mind of the travel coach drivers needs to be designed.

What is meant actually, is that the well-being (a good or satisfactory condition of existence; a state characterized by health, happiness, and prosperity. ("the definition of wellbeing", 2017) of the coach drivers should be better after leaving the sleeping cabin.

Well-being can be split up in two ways (Deci & Ryan, 2006). The hedonic way of view and the eudemonic view. The hedonic view is focusing on seeking pleasure and comfort while the eudemonic is focusing on seeking to use and develop the best in oneself. These two views can be divided in two different types of well-being. The hedonic view is mostly referred to as Subjective Well-Being (SWB), because the evaluation of the happiness of people themselves is studied. SWB can be experienced as "the good life" or formulated as: people's happiness. The eudemonic view is referred to

Psychological Well-Being (PWB), described as: "to live in a manner consistent with one's best potentials" (Waterman, Schwartz & Conti, 2006).

Focussing on the sleeping cabin, the hedonic way is the one that will improve the driver's well-being. Therefore, it could be assumed that focussing on SWB would be best, however, a study has shown overlapping and complementing determinants between SWB and PWB (Keyes, Shmotkin & Ryff, 2002).

At figure 5 it can be seen that SWB is for immediate well-being while PWB is for a longer-term. Within the sleeping cabin both are important. The aim is to have the driver's well-being immediately satisfied, but also to have the driver wish for this sleeping cabin for a longer term. In order to achieve the longer-term goal, a pleasurable experience needs to be offered that will be printed on the driver's memory.

Huta & Ryan share the opinion that both views, SWB as well as PWB,

contribute to the overall human well-being and that the optimal well-being would be a combination of both. (Huta & Ryan, 2009). Nevertheless, for the sleeping cabin the environmental mastery is the interesting determinant related to the driver's well-being. Which means that it is the capacity of managing everyday life and create a personal fitting context that fits the needs and values. The sleeping cabin as environment can have an influence on the driver's well-being, but the following needs to be taken into account:

- 1) The interaction between product and user should be a pleasurable experience, resulting in improvement of the "good life" within the sleeping cabin. (hedonic view)
- 2) The sleeping cabin should stimulate the meaningful behavior of the user in order to improve happiness for a longer period of time (eudemonic view)

In order to reach a pleasurable experience some product qualities are needed. Two different product qualities

are present. Ergonomic qualities, such as the usability of a product, and hedonic qualities, the quality dimensions with no obvious relation to task related goals (Hassenzahl & Burmester, 2000). Hancock et al. also realized that products are able to have hedonic qualities and they defined "hedonomic" as science that facilitates the enjoyable aspects of human-technology interaction (Hancock, Pepe, & Murphy, 2005). The pyramid shown in figure 6 shows how the product characteristics are prioritized. The three bottom characteristics are ergonomics related. While the top two are hedonomics. In general, this pyramid represents comfort.

Comfort

Comfort is seen as a pleasant state or relaxed feeling of a human being in reaction to its environment (Vink & Hallbeck 2012). Furthermore, comfort has its determinants as well. Factors which might influence comfort or discomfort during sitting are: Comfort: luxury, safety, refreshment, well-being

Discomfort: fatigue, pain, posture, stiffness

(Helander & Zhang, 1997)

Important to note is that the absence of discomfort, does not result in comfort. Vink and Hallbeck have created a model of comfort (figure 8) in which a neutral state is present as well. Interesting in the given figure is the relation of expectations and perceived effects. Vink and Hallbeck believe that expectations are influencing the perceived effects (comfort).

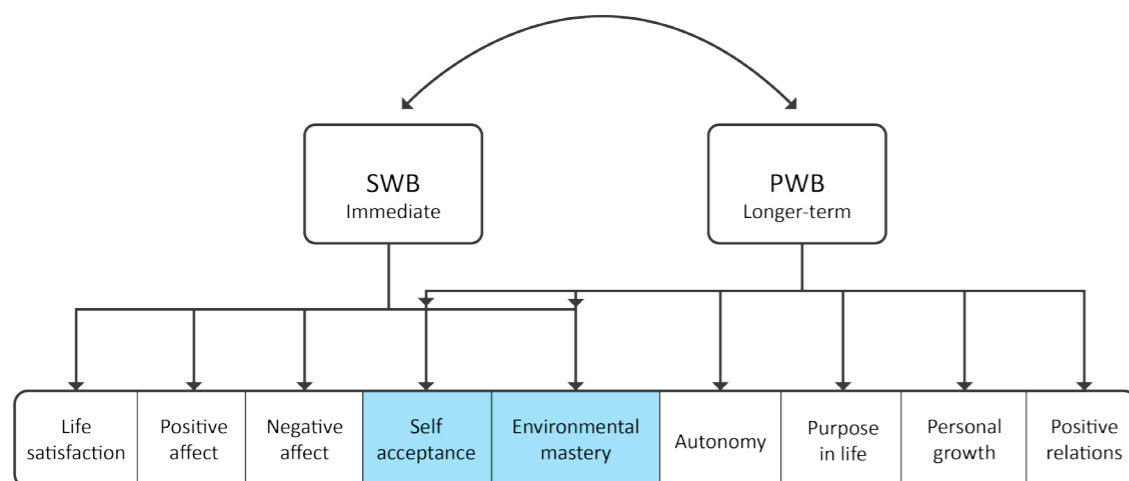
Furthermore, there are influential forces that will influence comfort or the experience of comfort in vehicles. Since it is a similar environment, these forces can be noted as influential forces of comfort in the sleeping cabin as well. Bubb and estermann have created a pyramid, based on the Maslow's hierarchy of needs, which is given as figure 7, that shows the forces on comfort in hierarchy.

Odour is the most important one according to Bubb and Estermann. A bad smell inside a vehicle (or

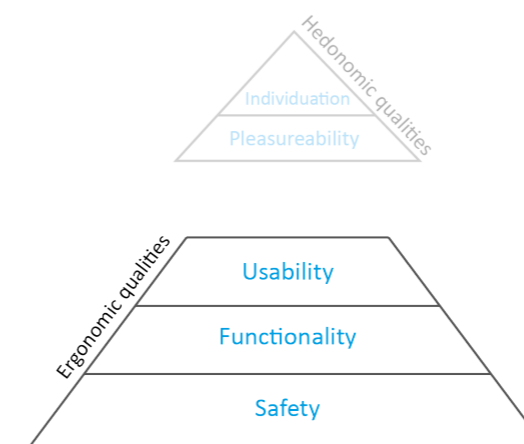
environment in general), will make it more difficult to be or experience comfort. On contrary, if a vehicle or environment smells nice, it can be concluded that it will influence the experience of comfort positively. This is because of the fact that smell is closely associated with the limbic system of the brain, which communicates emotion and behaviour (Carroll, 2008).

Furthermore, there are forces mentioned as light, vibration, acoustics, temperature, anthropology and ambience. Light can provide the experience of comfort with the aid of ambience, besides, light can have a function as well. In a dark environment, it will provide the feeling of safety. According to Hellander and Zhang, safety is one of the characteristics for comfort.

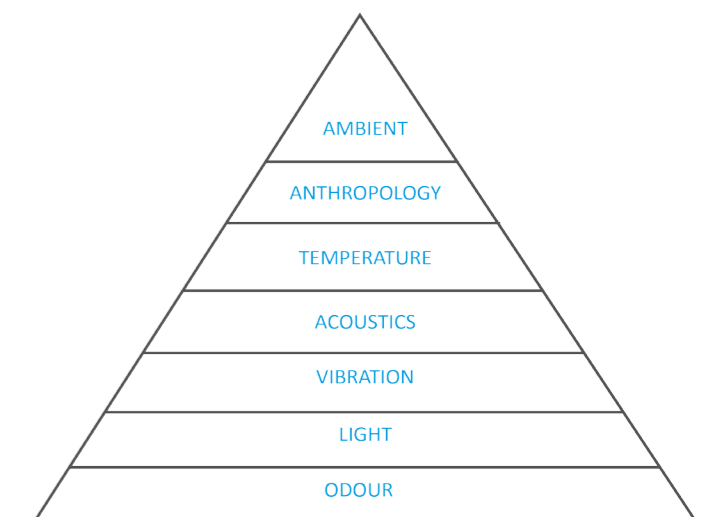
Vibration and acoustics are others. As one might imagine, a nice massage or calming music can increase the experience of comfort. However, there are also vibrations or acoustics that can decrease the experience, think about



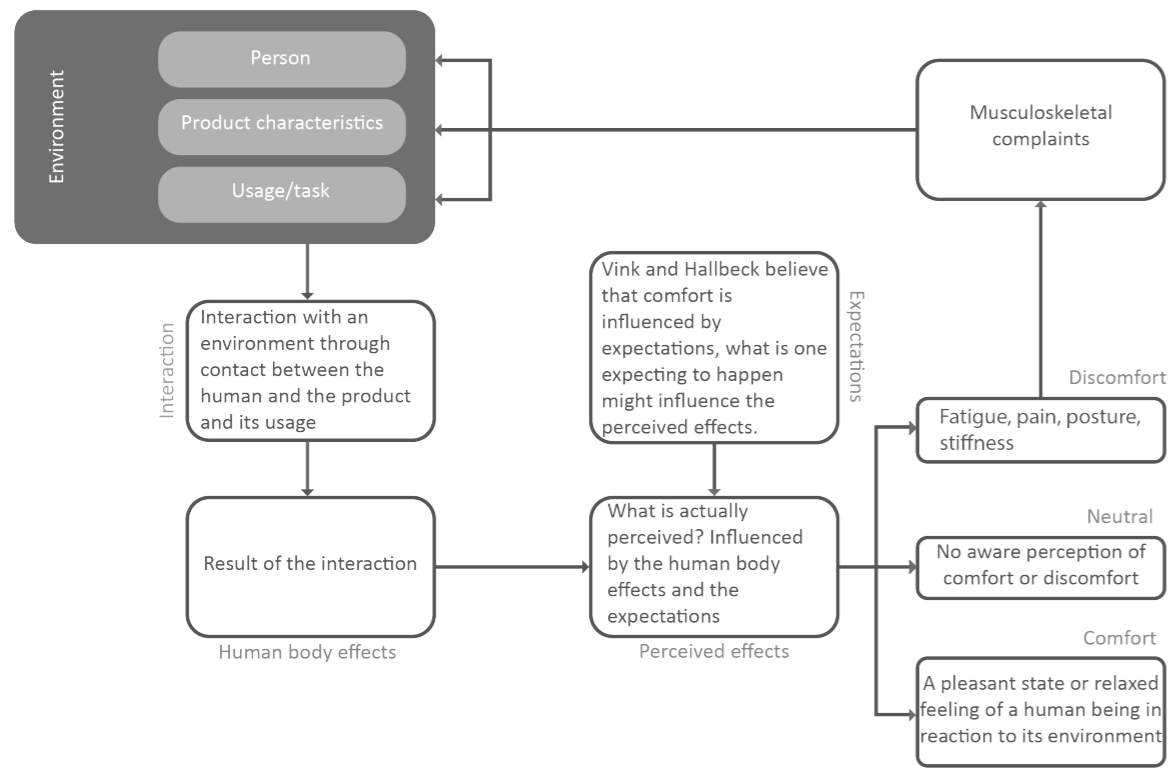
▲ Figure 5
Overlap SWB and PWB (Keyes, Shmotkin & Ryff, 2002)



▲ Figure 6
Pyramid (Hancock, Pepe, & Murphy, 2005)



▲ Figure 7
Influential forces on comfort (Bubb, & Estermann, 2000)



▲ Figure 8
Comfort model (Vink, & Hallbeck, 2002)
driving a regular car on a bumpy road.

Temperature is different. Temperature is a personal preference and it is difficult to say what is comfortable or not. The human body will try to keep itself on the correct temperature, however, too hot will make the person sweat, while too cold will not make him or her feel comfortable as well. The ideal sleeping temperature will be discussed at page 34.

Furthermore, the anthropology is mentioned. As one might imagine, comfort cannot be achieved if something is way too small. There has been taken a look at the core and emerging markets of VDL (figure 9). The result was that The Netherlands, Germany, France, Switzerland, Iceland, Poland and the UK are interesting markets. Therefore, the anthropology statistics of males between 20 and 70 years old have been researched. The conclusion was that the average male

is 182.7 cm. However, more important is the average sitting height of 94 cm.

According to Bubb and Estermann ambience means: “comfortable, beautiful and relaxing”. So, if all the other forces of influence have been taken into account, with the aim on improving comfort, the ambience has been created as well.

Sleep
People used to sleep an hour and a half

Netherlands		
	Male 20-60 yr	Male > 60 yr
Average length	181.7 cm	173 cm
Average breadth	46.8 cm	49.5 cm
Average sitting length*	94.5 cm	90 cm
Average leg length		

Germany		
	Male 18-79 yr	Male 30-34 yr
Average length	181/175.4 cm	180.2 cm
Average breadth		
Average sitting length	95.9 cm	95.5 cm
Average leg length	85.1 cm	84.7 cm

France		
	Male 18-70 yr	Male 30-34 yr
Average length	175.6 cm	176.2 cm
Average breadth		
Average sitting length	93.1 cm	93.4 cm
Average leg length	82.5 cm	82.8 cm

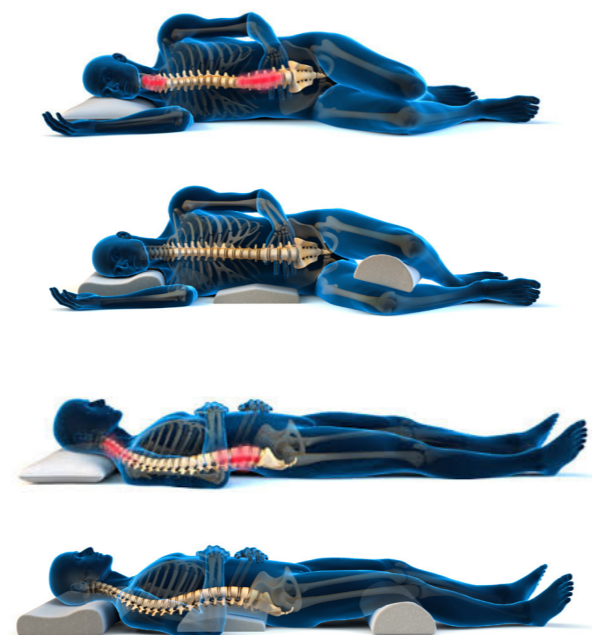
Switzerland	
	Male 20-74 yr
Average length	175.4 cm
Average sitting length	93 cm
Average leg length	82.4 cm

Iceland	
	Male
Average length	181 cm
Average sitting length	95.9 cm
Average leg length	85.1 cm

Poland	
	Male
Average length	178.7 cm
Average sitting length	94.8 cm
Average leg length	83.9 cm

United Kingdom	
	Male
Average length	177 cm
Average sitting length	93.8 cm
Average leg length	83.2 cm

▲ Figure 9
Anthropology results of VDL's core and emerging markets



▲ Figure 10
Resting the body properly

longer per night a century ago. Within the last century two phenomena have been observed in human's behaviour in relation to sleep. Self-induced sleep shortage has increased, as well as sleep loss. It might be because of a disorder or lifestyle; however, it has an impact on social welfare (Verhaert, 2011).

The sleep system's main function is to provide support to the human body during the time of sleep. This results in the allowance for recovery of the musculoskeletal system from the daily activities. Muscles are relaxed during sleep and generating almost none active force. Therefore, a stabilisation of the spine (vertebral column) is needed. The spine recovers optimally if the equilibrium is 0, so that the spine is in its natural physiological shape (Verhaert, 2011). Figure 10 is clarifying what Verhaert its mentioning. Even though the clarification, people are frequently looking for support during their rest or sleep (Ciaccia et al., 2012). The research that Ciaccia et al. have conducted is related to aircraft seats and its comfort. However, the

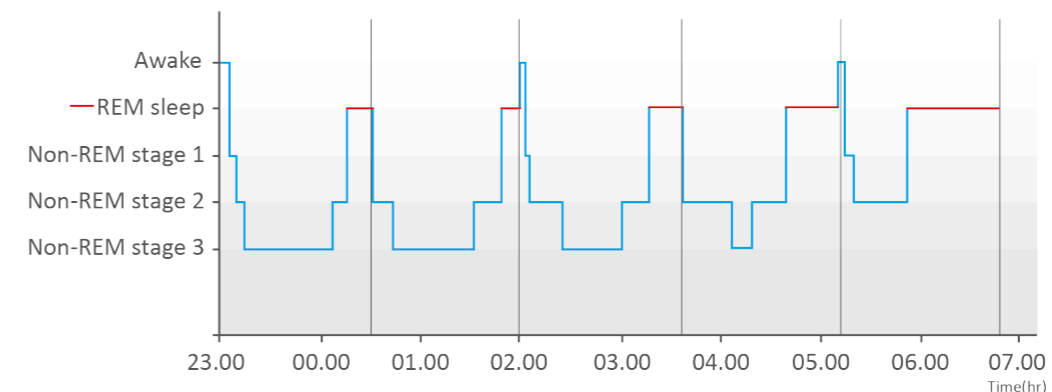
participants changed body positions and postures in order to avoid discomfort. It might be assumed that people will be doing this anywhere, despite of their body position or environment. People know themselves what they experience as comfortable or not.

When a person is asleep, he or she will experience different sleep stages unconsciously. The stages, also known as sleep cycles, can be divided in non-rapid eye movement (NREM) sleep and rapid eye movement (REM) sleep. The NREM sleep can be divided in three stages (NREM1, NREM2, NREM3) while REM only has one. NREM1 is when the person is not fully awake nor fully asleep, also referred to as drowsy sleep or somnolence. In this stage, the person will fall asleep what will result in slowing down the brain wave activity. The overall known feeling of tipping over or falling is experienced in this stage, while dreaming is relatively rare. NREM2 is the first stage in which the person is actually sleeping. Muscle activity keeps decreasing, body

temperature decreases and conscious awareness of what happens around the person starts fading completely (Mastin, 2013). Every sleep stage has its own time that a person “spends” in it. However, this time per stages differs in cycles. In the first cycle the REM sleep is much shorter than in the last cycle. Figure 11 shows the sleep stages and their cycles.

But there are also some “tools” to improve sleep. Lavender smell tends to improve the overall sleep quality. Even though the smell is most effective on the youngsters and females, the improvement is for all ages and genders. Lavender increases the REM stage and decreases NREM2 for men during sleep. (Koulivand, Khaleghi Ghadiri, & Gorji, 2013). This is underpinned by Dr. Josh Axe who says: “lavender will improve the quality and quantity of sleep, think of the length of sleep, time that takes to fall asleep and the restfulness” (Axe, 2016).

Furthermore, light stimulates the body and mind in the morning, while



▲ Figure 11
Sleep stages and cycles

▲ Figure 12
Lavender, the ideal odour for relaxation



darkness (no light) in the evening sends a signal to the human body that it is time to rest. This is done by the rising level of melatonin, the sleeping hormone ("Darkness Matters - How Light Affects Sleep", 2015). Figure 13 shows how melatonin rises. The rise of melatonin can be influenced by light and therefore someone's sleep can be influenced by light. Blue light is qualified to influence the melatonin raise since it has a short wavelength (figure 14). Figure 15 shows what happens in case a person is experiencing blue light during his or her sleep. Besides, bright light has been shown to increase level of alertness, boost mood and improve performance.

("Light therapy for better sleep - Lumie", n.d.)

The human body sets a point for body temperature, a point the human brain is trying to achieve for the body while asleep. If it is too cold or too hot in the environment, the body will struggle to achieve this set point. The drop in temperature that the human

body is creating induces sleep. If the environment becomes uncomfortably hot or cold, the person is more likely to wake up (Doheny, 2008). Therefore, it is very difficult to set the ideal sleeping temperature. What is comfortable for one person, might be disturbing for the other. A recommendation according to the knowledge of Downey and Heller is a room between 18.3 and 22.2 degrees Celsius. However, the American National Sleep Foundation indicates differently. Even though they explain the same effects of "wrong" temperatures, they indicate the ideal temperature between 15.5 and 19.4 degrees Celsius ("Best Temperature for Sleep", 2012).

Experience

Since a sleeping cabin is a product, a product experience will need to be offered. According to Hekkert a product experience it is the entire set of effects that is elicited by the interaction between a user and a product, including aesthetic experience, experience of meaning and emotional experience (Hekkert, 2006).

Since the sleeping cabin will not have the experience of meaning in particular, the focus will be on the aesthetic experience (the amount of satisfaction of all our senses) and on the emotional experience (the outcome of the human-product interaction after evaluation by the user).

A good or bad experience is based on personal experiences and expectations. However, some things will have the same effects on people. Bubb and Estermann discovered this as well. The pyramid that has already be shown in figure 5 shows influential forces for comfort (experience). Odour is the first force in the pyramid of hierarchy that can influence the comfort experience. As one can imagine, a bad smelling environment will make it harder to experience comfort.

Furthermore, the experience a light can offer. Cars are equipped with a "welcome light" for a couple of generations already. The experience of a light that responds to opening a

door/entrance will be comfortable, safe and communicating that the user is in control.

Vibration and acoustics can have different experiences. The absence of vibration and acoustics could be experienced as comfortable, luxurious and premium, while the presence of vibration and acoustics could have the opposite experience.

The temperature and ambience are providing a more general experience of comfort since they are both according to personal preferences.

4.1.2 Field

Field research has been done in order to get more insights in the experiences, thoughts and wishes of travel coach drivers, as well as some basic information. Some user tests and user experiences (4.1.3) have been done as preparation for the interviews and observations of travel coach drivers. The gained insights during user tests and user experience research served as guidelines for the questionnaire and



"Van Hool is better than VDL. VDL has a smaller entrance and sleeping cabin."



"It is unpleasant to move in the cabin because of its size, even more unpleasant to get in and out because of the small entrance."



"Getting out is harder than getting in."



"We as drivers do not expect much comfort in the sleeping cabin and we get used to it, so it becomes comfort."



"Sometimes I just sleep on a seat that is available. I put the back rest completely down and I sleep. I feel cramped in the sleeping cabin."

▲ Figure 16 Quotes of travel coach drivers

Figure 13 Melatonin raise

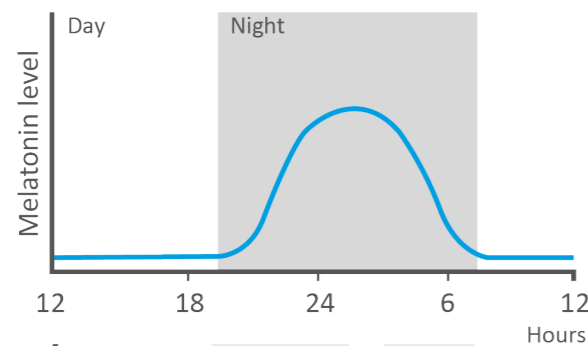
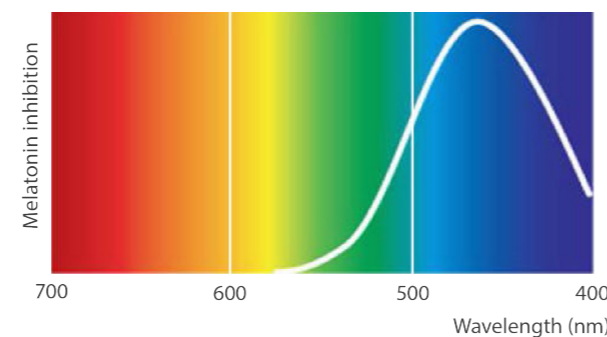
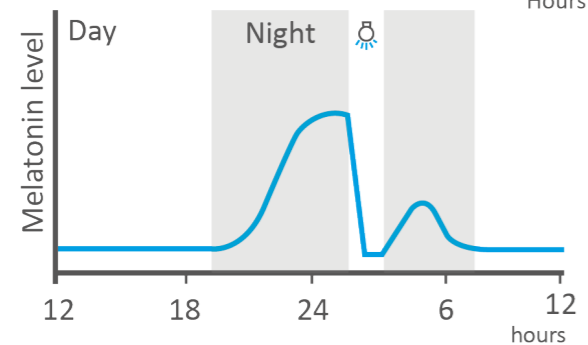


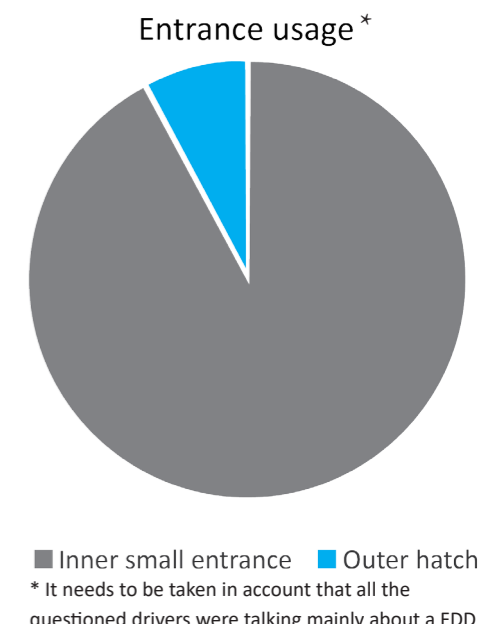
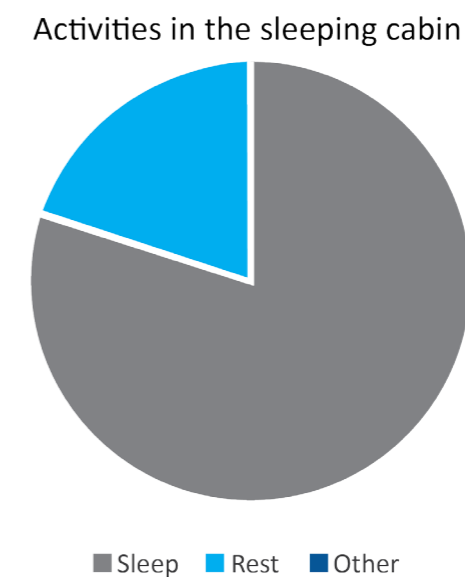
Figure 15 Melatonin influenced by light



▲ Figure 14 Light relation to Melatonin inhibition



▲ Figure 17 Overall information travel coach drivers



* It needs to be taken in account that all the questioned drivers were talking mainly about a FDD

the relevant frames for observation. The questionnaire and observation approach have been attached as appendix 4. Some quotes have been given in figure 16 to share the opinion and experiences of the drivers. Overall information related to the user group is given in figure 17.

Referring back to the quotes and observations, it has delivered valuable insights. As can be seen in figure 18, the amount of comfort decreases according to the amount of body activity to get in the sleeping cabin. Nevertheless, the sleeping cabin has been experienced as comfortable so far, mainly because the drivers do not expect much of it. Therefore, they are admitting that they got used to the cabin and they are able to sleep well in it.

What they need most is a separate climate control, this has been mentioned by 9 of the 12 drivers. The drivers value the fact that they can be in control and the temperature in the sleeping cabin is something they

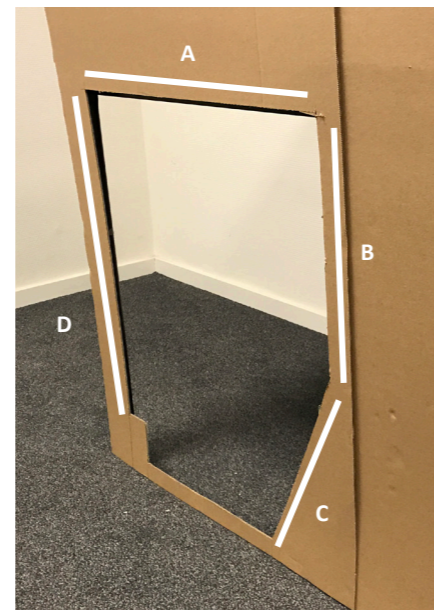
cannot control themselves completely. Other valuable aspects that were mentioned were a bigger entrance/ sleeping cabin and ventilation. Their reasoning has to do with the limited space of getting in/out and turning in the sleeping cabin. The ventilation is mentioned as something that may not leave the sleeping cabin since it is already integrated.

4.1.3 User tests

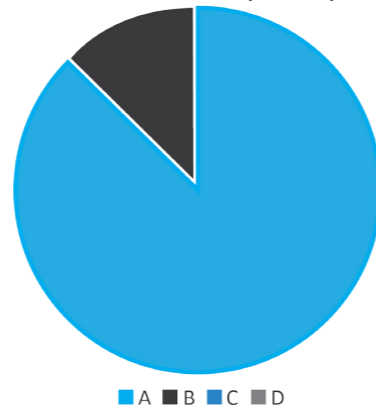
Since research has been done for every challenge and even more specific, it was hard to find literature on all topics. Therefore some user test studies have been done, which are filling the gap of missing research from literature. These user test have been providing insights and results.

Mock up

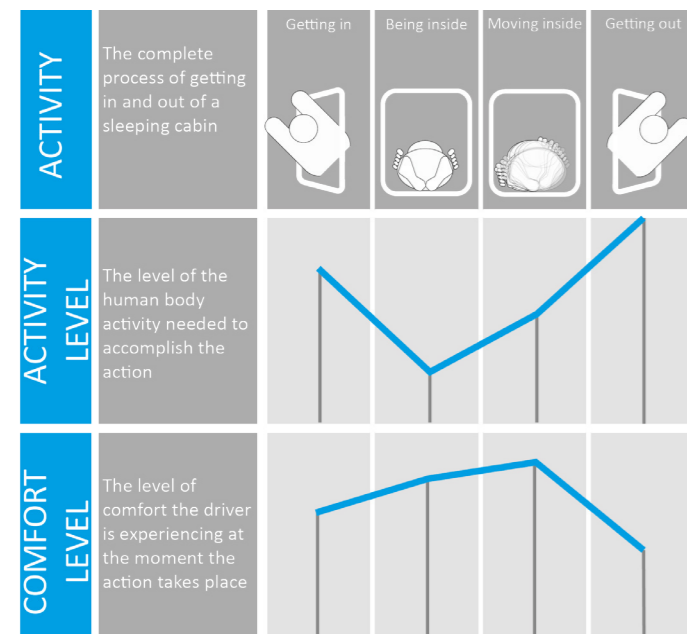
The mock up has been used in order to define the entrance's obstacles. Every side has been assigned with a letter (figure 19) and observations have been held in order to define which side is the biggest obstacle. As can be seen in figure 20 and 21, side A was the main



▲ Figure 19
Marked sides of mock up entrance



▲ Figure 20
Obstacle frequency per side



▲ Figure 18
Comfort level drivers according to interview and observations



▲ Figure 21
Side A has been marked twice as an obstacle

obstacle, and side B has been noted once as well. However, it needs to be taken into account that all participants were unexperienced in getting in or out a sleeping cabin and the entrance of it. Besides, afterwards it could be concluded that the way of getting in or out is determined by the amount of space that is available outside of the "cabin". Therefore, it is expected that more obstacles will appear in a real environment. The complete result and set up of the mock up user test can be found as appendix 2.

FHD user experience test

The goal of this test was to determine any other obstacles of the entrance and to evaluate the process of getting in while being in the environment as supposed. Besides, the sleeping cabin itself offered possibilities for user experience evaluation.

The subjects have been asked to get in, spend some time in the cabin and think out loud what they are seeing and experiencing. Finally, they would get out and share their thoughts with the

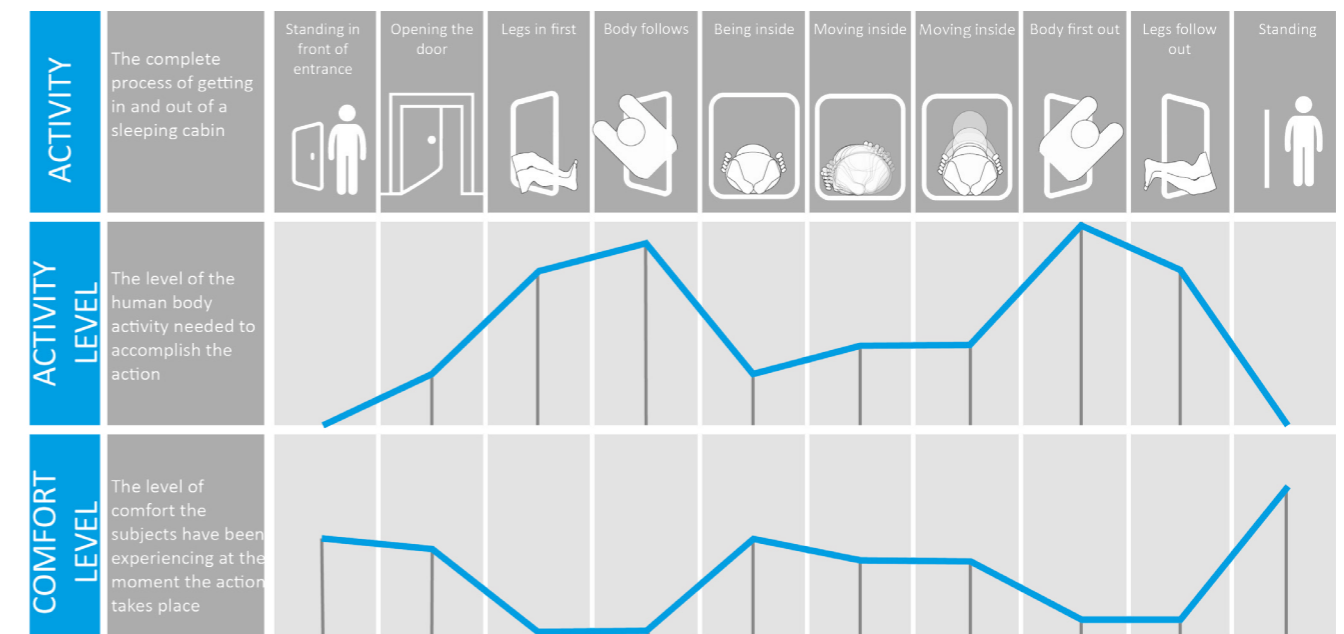
researcher. Besides, the subjects were asked to record their process of getting in, getting out and the comments they had while being inside. This offered the researcher an opportunity to evaluate it afterwards.

As expected, other obstacles appeared in comparison to the mock up user test. Since less space is available and a staircase is placed near the entrance, the way of getting in and out changes. Figure 22 shows the difficulty a subject is experiencing while getting in and out. As seen before, the comfort level decreases in relation with the increase of the body activity level.

However, compared to the experienced drivers, the comfort has been rated significantly lower (figure 23). This has to do with the expectations of a sleeping cabin and with the experience one has. Drivers have been getting in and out more often and they have developed a personal preferred way to do so. The complete FHD user experience test can be found as appendix 3.



▲ Figure 22
Subject getting in and out



▲ Figure 23
Comfort experience subjects FHD user test

Drive experience - Sleeping cabin
 The main goal was to experience the sleeping cabin while the coach was being driven. Some expectations were created because of the aforementioned interviews, observations and tests. For that reason, the researcher decided to do this test himself. The researcher also mentioned some choices he has been making in relation to his actions. Appendix 5 is discussing the whole experience, but the main conclusion is that the present vibration and noise in the sleeping cabin, are not disturbing as expected and even can have a relaxing effect. The relaxing effect is on the highway only, since a constant frequency is achieved. However, this is not a problem since the coach will be driving on the highway mostly. Furthermore, different observations have been done, such as bad distributed lighting, no comfort in controlling the light (or other functions of the control panel) and the overall lack of ambience in the sleeping cabin.

have been created. The comfort – body activity relation has been given in figure 24.

4.2 List of goals

Based on the complete research, meaning literature research, field research, user test and experience research, a list of goals has been created. The list has been created per aspect of the cabin, such as entrance, interior, cleaning, manufacturing and the sleeping cabin in general. Reaching all goals would mean that the cabin has been designed in such a way that it would solve the problem and achieve all challenges. The list of goals will be used at the validation process in order to validate the design and to reflect on the goals that are (possibly) not achieved (yet). Figure 25 is showing a part of the goal list. The part that is displayed has been picked because of their value as goal. The complete list can be found as appendix 1.

Getting in and out of the sleeping cabin was in line with the expectations that



Figure 24 Comfort and body activity relation of researcher during drive experience

Entrance

- The entrance is not smaller than: 61.5 x 52 cm
- The entrance is turning on the light at opening.
- There will take an interaction place that confirms closure/opening of the entrance.
- The entrance has a user-friendly way of opening/closing.
- The entrance unlocks (in case it is locked) automatically in case of an emergency.

Sleeping cabin interior

- The sleeping cabin is not smaller than the current sleeping cabin, which is 230 x 64 x 97 cm (inner sizes).
- Sleeping cabin height is at least 85 cm where the upper body is located.
- The temperature can be adjusted according to personal preference at all time.
- Light is adjustable in brightness.
- The sleeping cabin is providing a “feel like home” experience.
- The sleeping cabin is providing a “re-energizing” experience.
- A way of communication to the other crew is present within the sleeping cabin.
- The mattress is suited for different type of sleepers (side sleepers, back sleepers etc.).
- The buttons/switches are well integrated in the cabin and do not look as aftermarket.
- The control panel can be reached from a neutral lying position in the sleeping cabin.
- The location of the buttons/switches make sense in relation with the goal and usability of the product.
- Storage possibilities are present in which small items such as glasses, phone, tie etc. can be stored during rest period.
- There are always emergency (two) exits available.
- The emergency exits are clearly recognizable as emergency exits.

Cleaning

- Cleaning the side walls and ceiling of the sleeping cabin can be done easily by wiping it off with a cloth.
- There are no difficult edges present in which dirt can accumulate.

Manufacturing

- The sleeping cabin will not influence other manufacturing in the coach.
- The hatches from outside will not be compromised.

General

- The cabin will serve for sleeping mainly.
- The cabin contains a USP which might influence VDL’s market position positively.

Figure 25 Part of the goal list

Status



Chapter 05

Final design

The sleeping cabin is not an environment that is designed to one driver's preference. Different drivers have to feel comfortable in it, therefore it has been chosen to use a clean and basic design, with a warm touch of wood. The cabin ambience can be influenced by lighting in order to give it a personal twist according to the driver's preference.

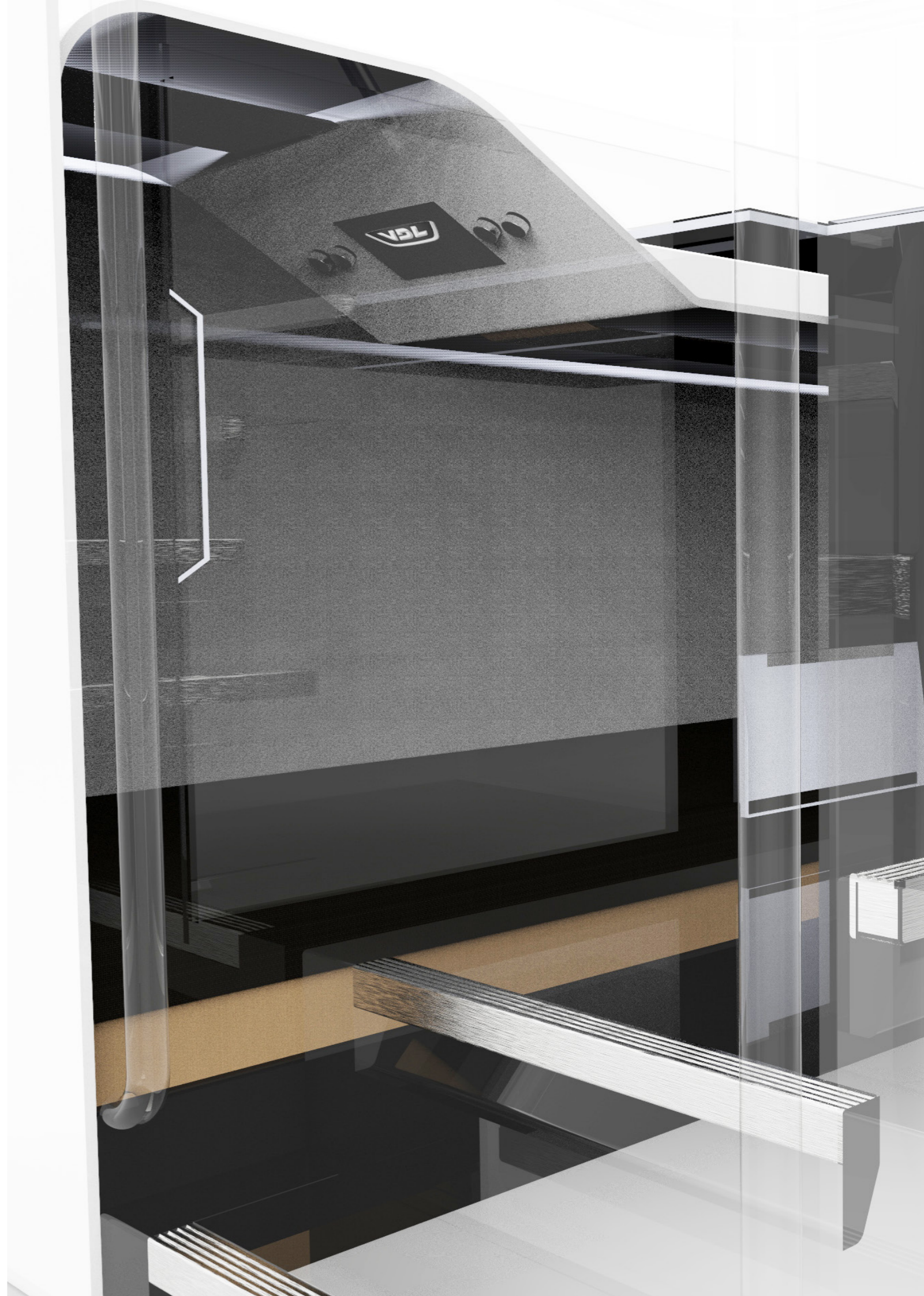
The slight change in shape makes the sleeping cabin appear friendlier while it provides an experience of being bigger than it actually is. Besides, the ergonomics have been taken into account, so it is easier to open the entrance and control the properties of the cabin.

Furthermore, a couple of experiences are offered. A welcoming experience while entering the cabin. Waking up in a lavender odour with the aid of light and feeling home because of the warm ambient lighting.

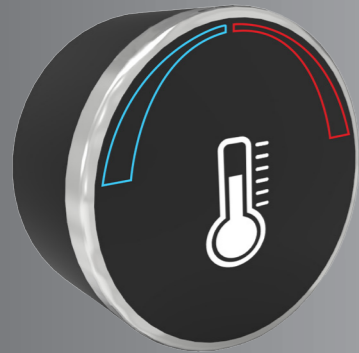
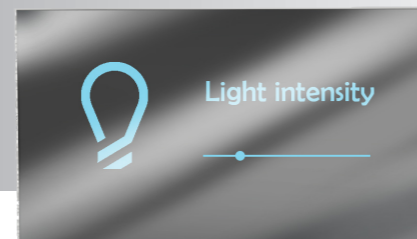
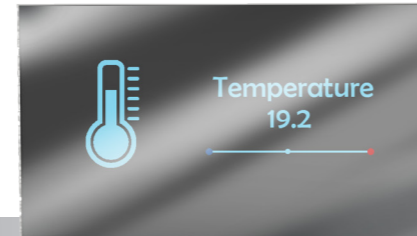
However, the cabin has been designed in such a way that it is comfortable

in every situation. Even in emergency situations in which the cabin provides an emergency signal by an alarm and red flashing light, the inner entrance and outer hatches open automatically and the control panel shows live feed via the camera of the coach cam.

Figure 26
Render of new design

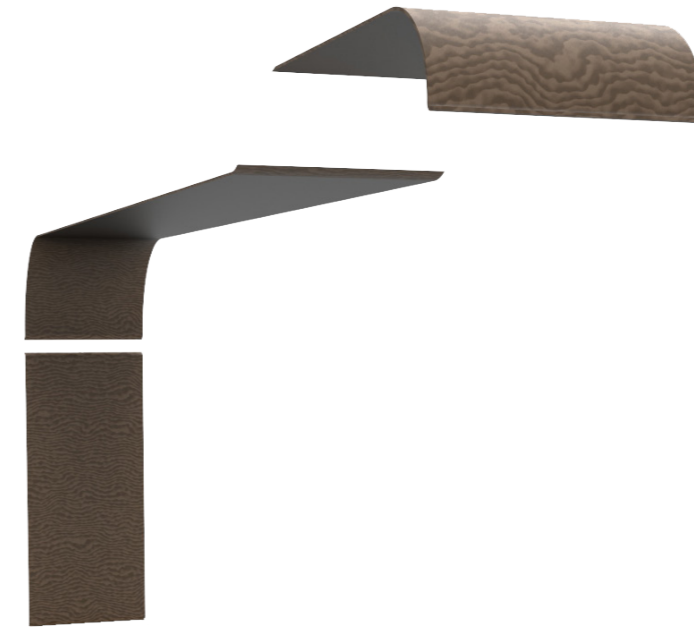
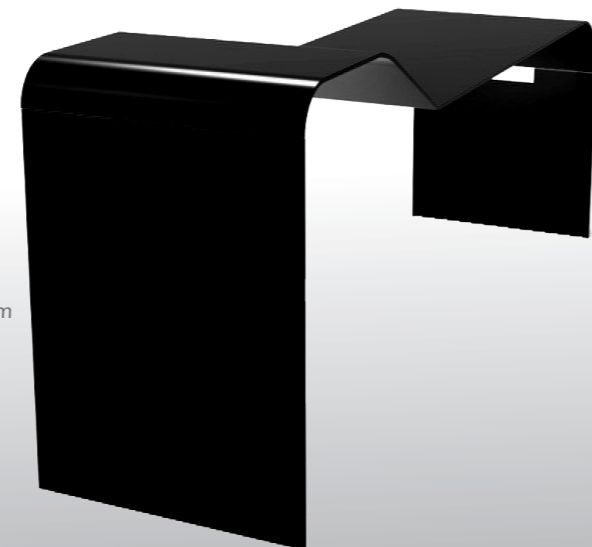
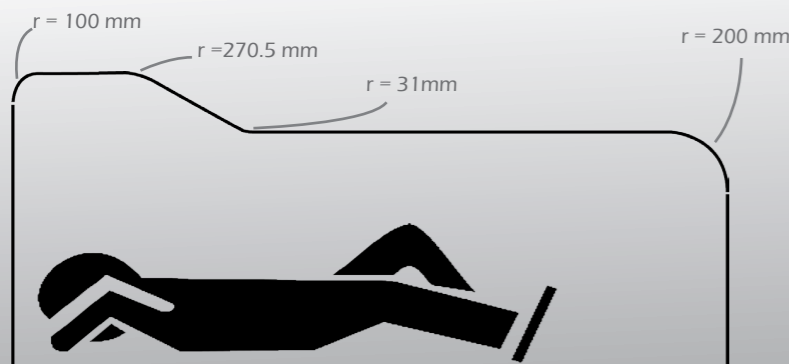


The functions offered within the control panel are as called: "best in class". An alarm clock, live camera feed and an emergency function have been introduced for the first time in this segment. Furthermore, adjusting the light intensity or sleeping cabin temperature is present as well. Besides, the control panel has been placed in an angle of 60° in order to have a comfortable experience while interacting with it.



Luxurious rotation knobs for optimal control

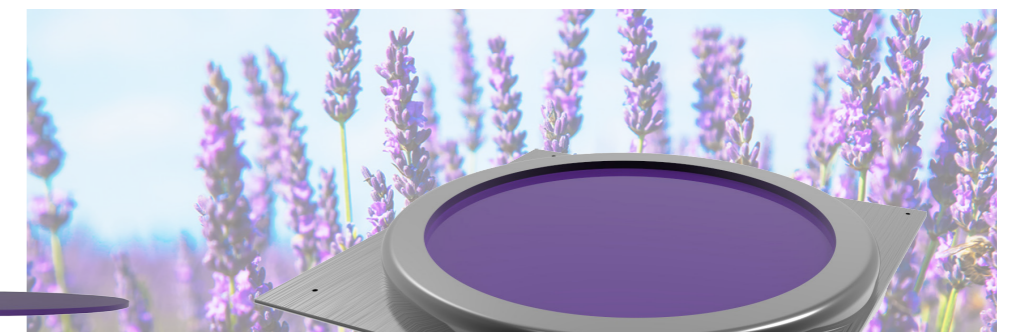
The finish of the sleeping cabin is of the highest quality in this segment. It is well integrated and there are not any sharp edges present. The round curves of the sleeping cabin salute you with friendliness.



The integrated wood panels provide a more home experience and are perfectly fitting in the modern trends. The high contrast between the white and wood results in a calming and beautiful appearance.



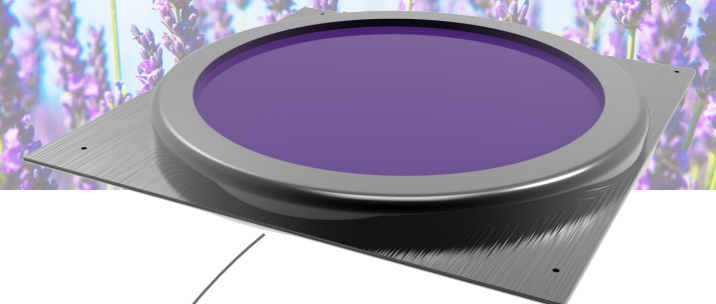
Lavender is known as an odour that will make the driver feel more relaxed before sleep and energized after. The sleeping cabin is equipped with a unique odour diffuser which activates at the opening of the entrance and during sleep.



Lavender pad



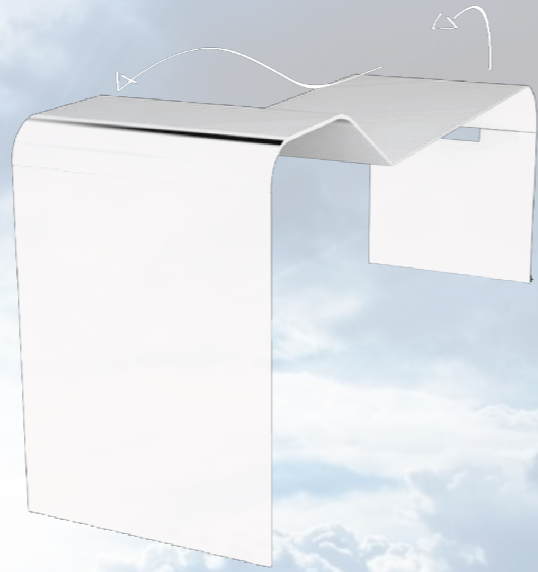
Odour diffuser is positioned behind the climate control



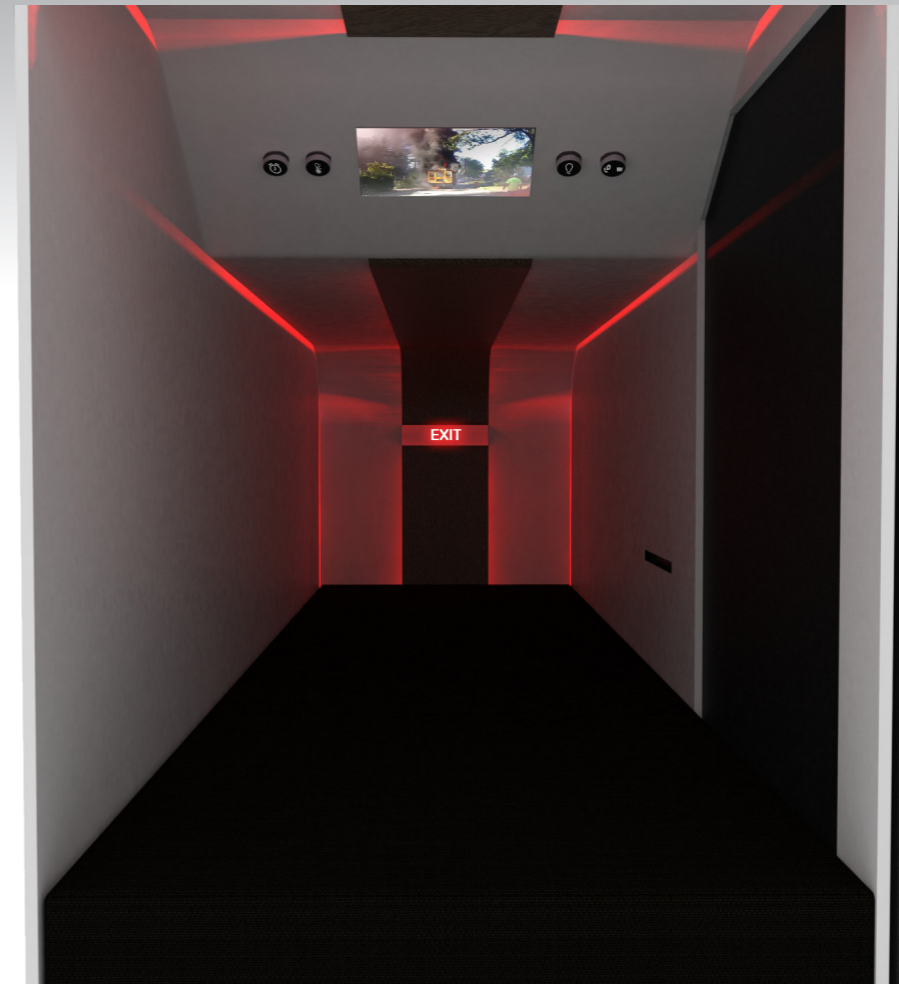
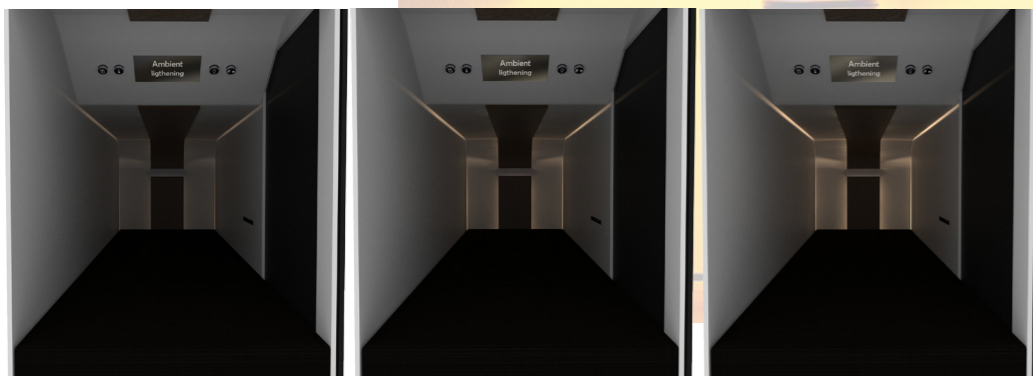
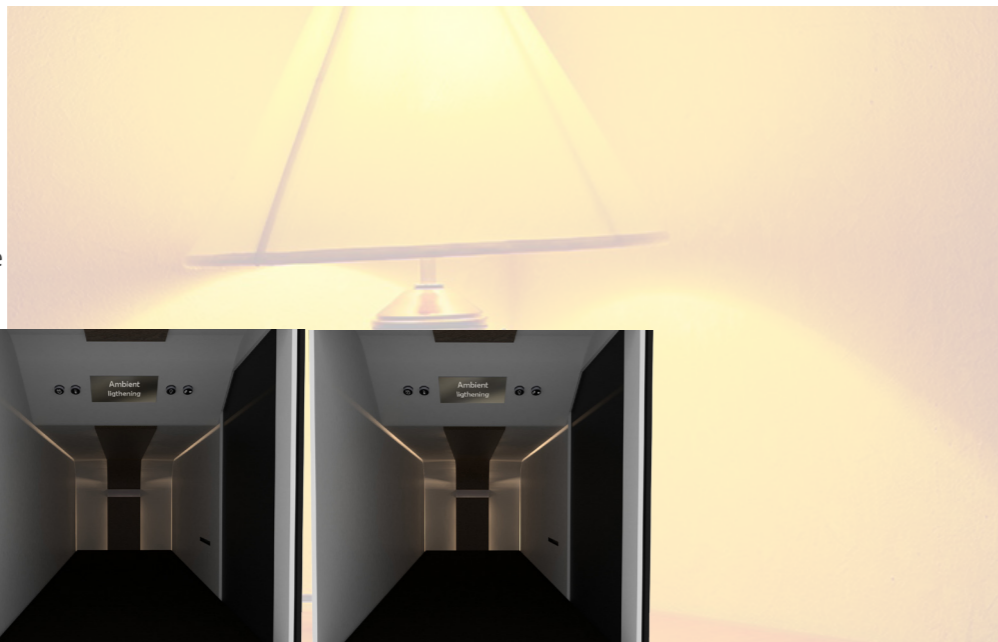
A complete individual climate control. Automatically controlling the temperature between 17.5 and 20.3 degrees Celsius in order to provide the best sleeping temperature and experience. The temperature is of course adjustable according to personal preferences at any time.



For the first time in a sleeping cabin, the wake-up light. Waking up with bright light in combination with the lavender smell will make the driver more alert and energized at wake up. Besides, the light synchronises the human body clock, so the driver will feel completely fresh after a sleep. Do not worry to wake up immediately, the wake-up light will turn on gradually as shown below, starting from the bottom leg part and ending at the top head part.

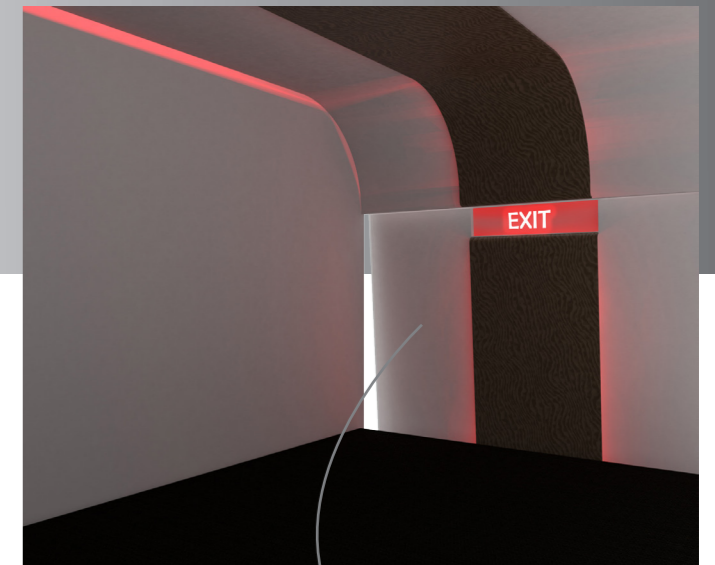
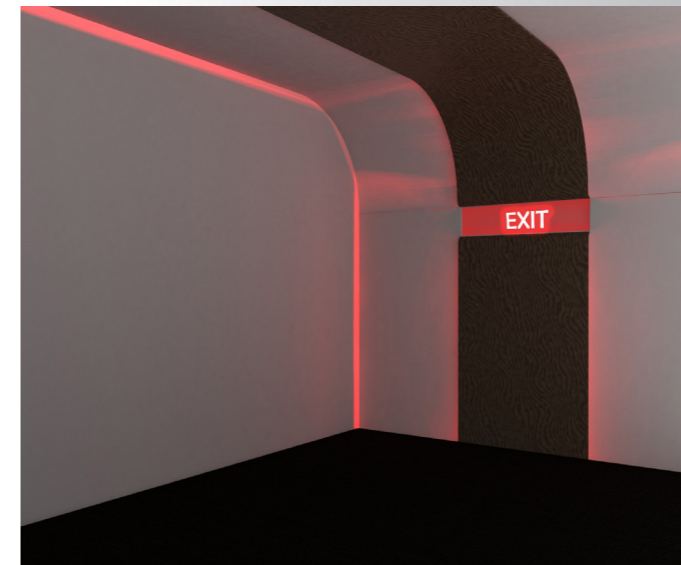


The sleeping cabin is equipped with well distributed ambient lighting. The warm coloured ambient lighting of 2700K creates a warm ambience and makes the driver feel like home. If preferred, the intensity of the ambient lighting is adjustable via the control panel.



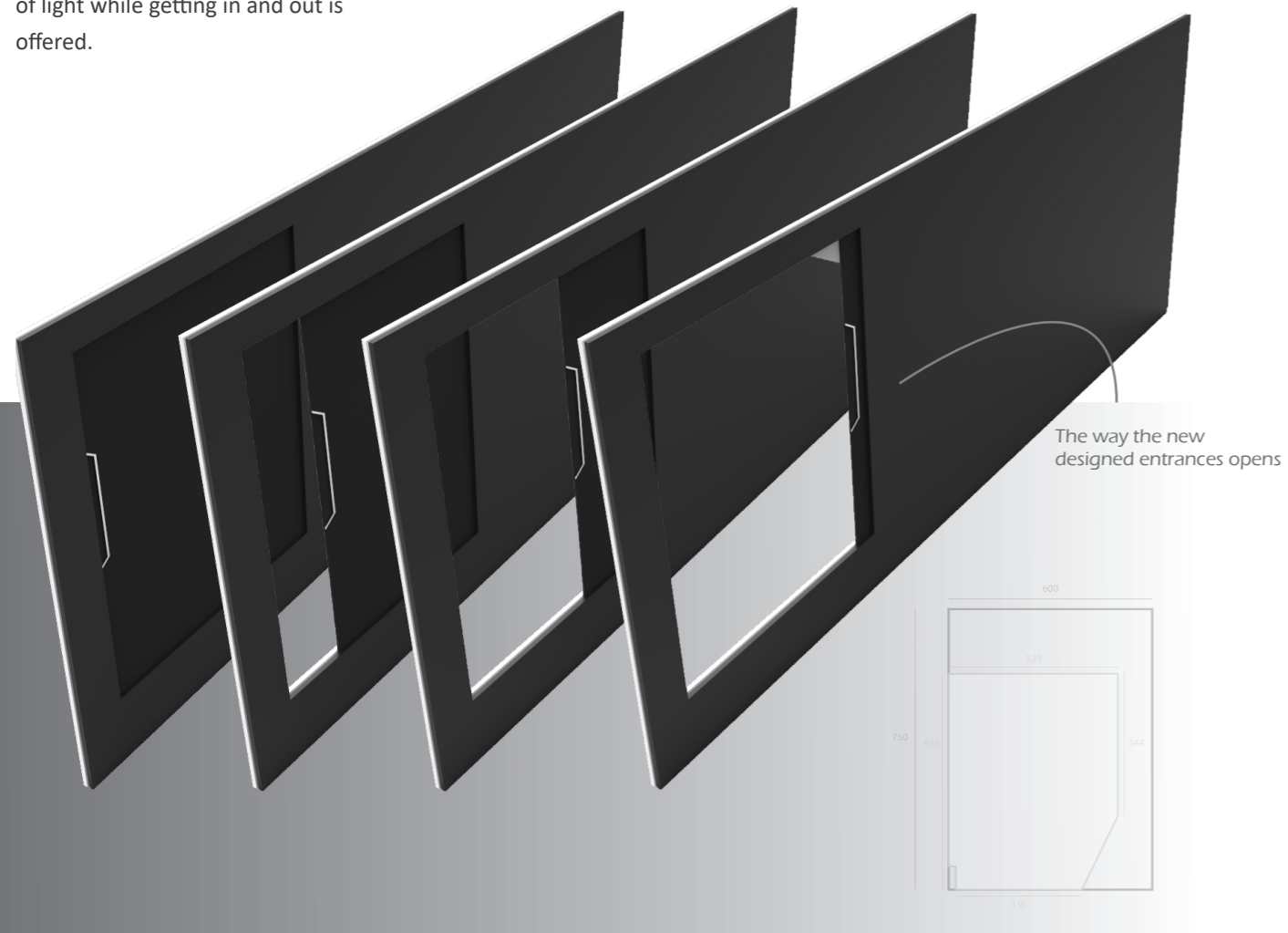
The emergency function of the sleeping cabin communicates the danger to the driver via the live feed on the control panel, red flashing lights and an alarm via the speaker. Furthermore it automatically opens the exit in order to provide comfort in such an unpleasant situation.

The emergency is automatically displayed on the screen

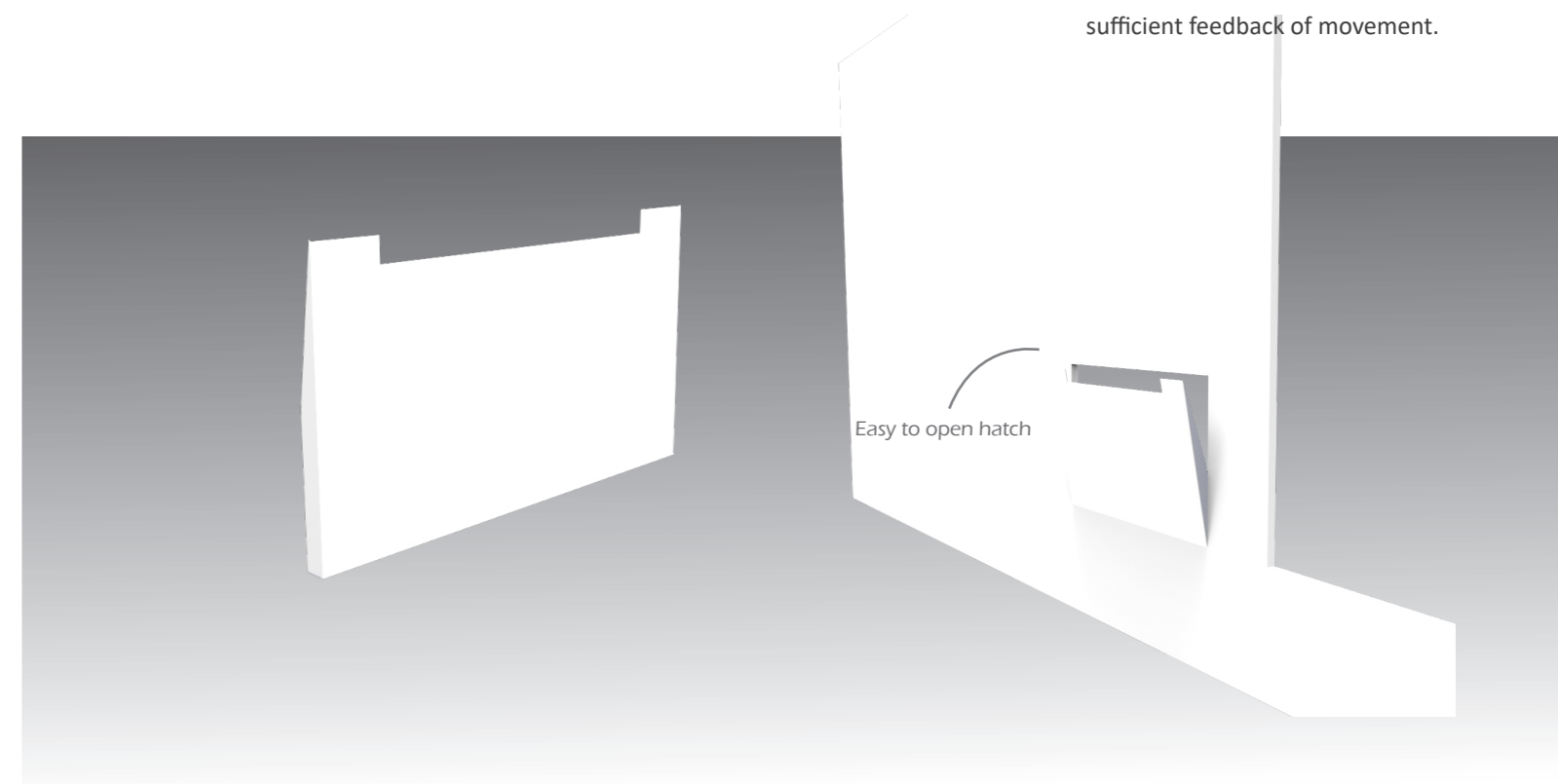


Hatch opens automatically in case of emergency, the driver can push it completely open if needed.

A new designed entrance. Bigger in size and providing more comfort by a different way of opening, besides a better experience with the aid of light while getting in and out is offered.



A hatch with storage possibilities for small items such as smartphone, tie, glasses and a wallet. It opens in an ergonomic friendly way, providing sufficient feedback of movement.



Welcomes the driver with light



The cushions can be easily removed or placed on the other side.



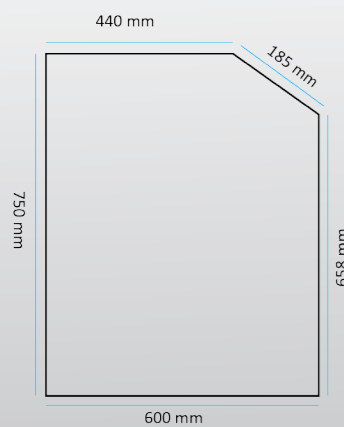
The support cushions that are delivered with this sleeping cabin are serving to create more comfort. Despite how the driver likes to sleep, support is needed in order to rest the body optimally. Besides, the driver is able to create his own environment and support according to personal preferences.

5.1 Product specifications

Cabin dimensions

The sleeping cabin has been designed within the current cabin dimensions. This would make sure that the frame, chassis and other components would not have to be adjusted, resulting in cost efficiency. However, there is a slight difference in dimensions in comparison to the previous sleeping cabin. First of all, figure 27 and 28 are showing the new designed entrance. However, the inner entrance has a slightly different shape than the outer. This has been done on purpose in order to have a rectangular shape on the outer wall, which will communicate the entrance size at the first touchpoint. It looks bigger and it might create more comfort.

Figure 29 is showing the shape and dimensions of the designed sleeping cabin. As aforementioned, curves have been introduced which results in an overall lower volume of the cabin. The difference in volume is approximately 0.08 cubic meters.



▲ Figure 27
Inner entrance size

Radius of curves

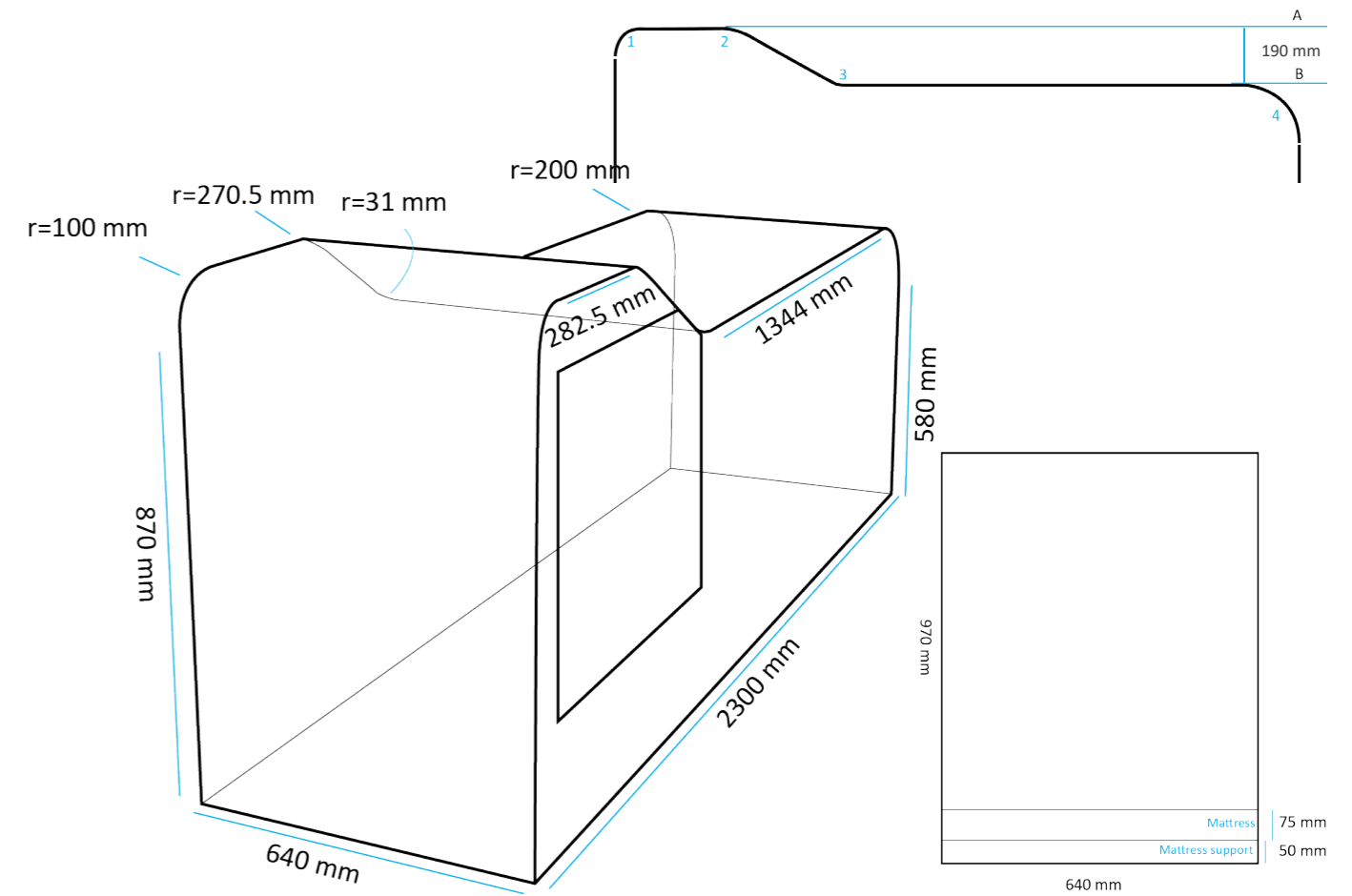
As aforementioned, the curves have been integrated in order to provide a friendlier experience and appearance. The radius' of the curves are based on the appearance, without compromising too much space. The radius is bigger at the leg end since less movement will take place, but it is taken into consideration that the hatch will need to serve as an emergency exit in case of an emergency. Therefore, it has not been designed with a bigger radius.

The radius' have been determined with some restrictions. Figure 29 shows that the distance between point A and B should be 190 mm. Since this is a restriction (already present in current sleeping cabin), the radius' of curves 2 and 3 needed to be as big and small as possible to not lose much head space.

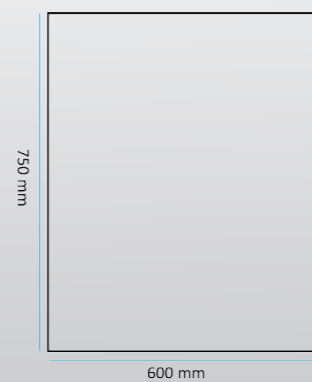
Climate control

The climate control is hidden behind the "wooden" ceiling, but its function is important. First of all, it needs to be an automatic climate control that will keep the temperature between

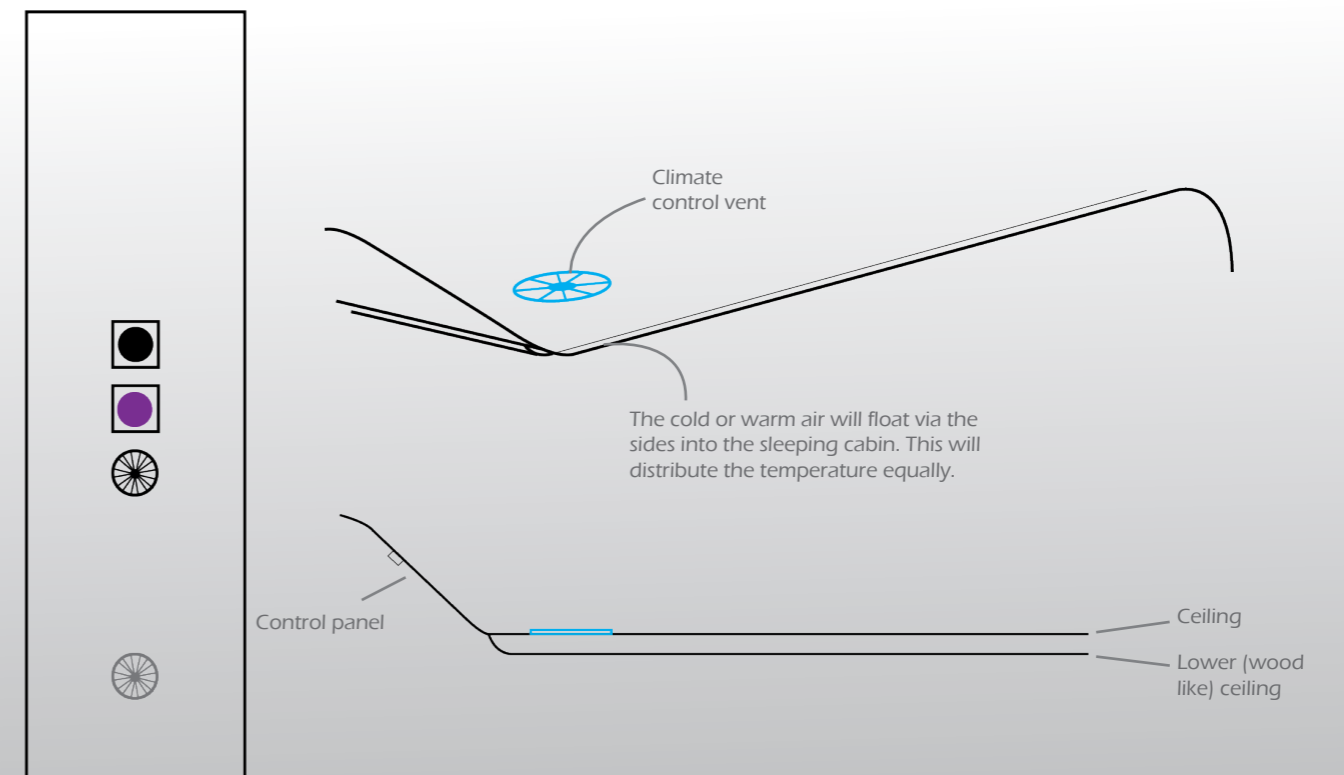
17.5 and 20.3 degrees Celsius. This temperature has been defined by the two sources (p.20) who both identify different ideal sleeping temperatures, but do agree both on the fact that it is a personal preference. Therefore, both "ideal" sleeping temperatures have been taken and averaged. It may be assumed that for most drivers such a temperature will be comfortable, besides, it is always adaptable to personal preferences. Furthermore, the airconditioned or warmed air will float fluently since it is blown into the cabin in two ways. It will "escape" the vent via the left and right side of the lower ceiling as can be seen in figure 30.



▲ Figure 29
Drawings of sleeping cabin dimensions



▲ Figure 28
Outer entrance size



▲ Figure 30
3D and side view of the climate control function and the topview of the sleeping cabin

Chapter 06

Validation

The sleeping cabin has been tested in order to validate the designed aspects. However, it needs to be mentioned that the entrance and sleep improvement have not been validated.

The sleeping cabin in general has been validated with a final test. A mock up that has been built in a real FHD has been used for the final test. The process of building the mock up can be found in appendix 12. Challenges have been validated with the aid of research or tests as well. The complete final user test can be found as appendix 14. The main findings are as followed.

The new designed sleeping cabin is scoring significantly better than the current one. Most surprising is the effect of the light appearance in combination with the control panel. Figure 31 is displaying the ratings given to the both sleeping cabins. The rating could be from 1 till 10. As can be seen, the average of the redesigned sleeping cabin is 8.2, while for the current sleeping cabin the average rating is 4.5

The subjects have been sharing their thoughts as well and some interesting quotes have been given in figure 32 in order to give an impression of the effect the redesigned sleeping cabin has. The only remark that has been given is that the travel coach drivers are restricted to lie down in a specific direction, but they have all explored and developed their own way of getting in the sleeping cabin, so it might become less comfortable in the end.

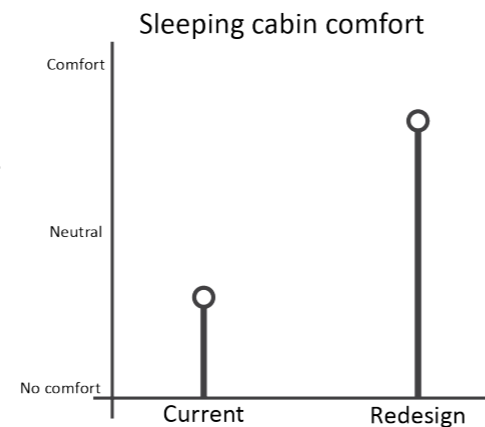
The remark is understandable, however, the sleeping cabin entrance in combination with the new designed back entrance (chapter 7, p. 41) will ask for a new way of getting in anyway. Furthermore, determining the way the driver should lie down offered the possibility to create a user friendly and user centred design.

6.1 Comfort

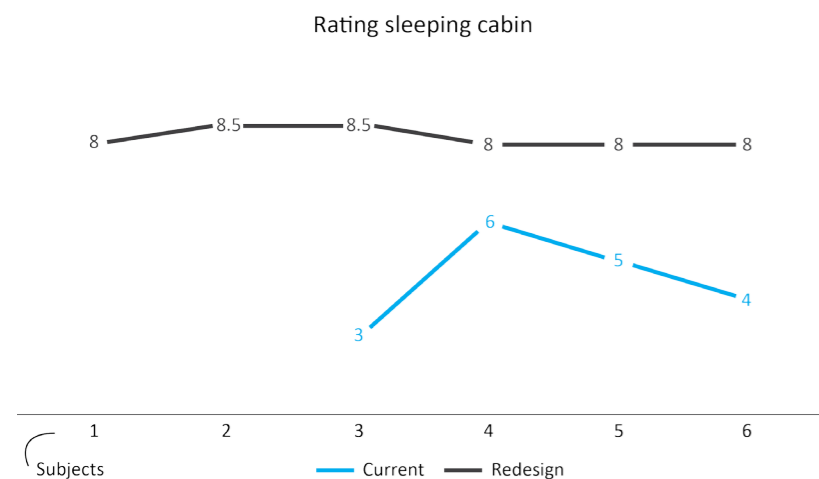
Comfort has been validated as well during the final user test. As aforementioned, comfort is not simply switching mattresses, but it is offering

a comfortable experience.

According to the subjects the redesigned sleeping cabin is offering a more comfortable experience than the current sleeping cabin. Mainly because of the appearance and light. However, the "modernisation" of the cabin has its function in the overall comfort experience as well. The comfort rating of both sleeping cabins has been displayed in figure 33.



▲ Figure 33 Ratings of the tested sleeping cabins



▲ Figure 31 Ratings of the tested sleeping cabins

This is how a sleeping cabin is supposed to look. Comfortable and modern.

This is not a dark box anymore, it is actually a place someone can sleep in.

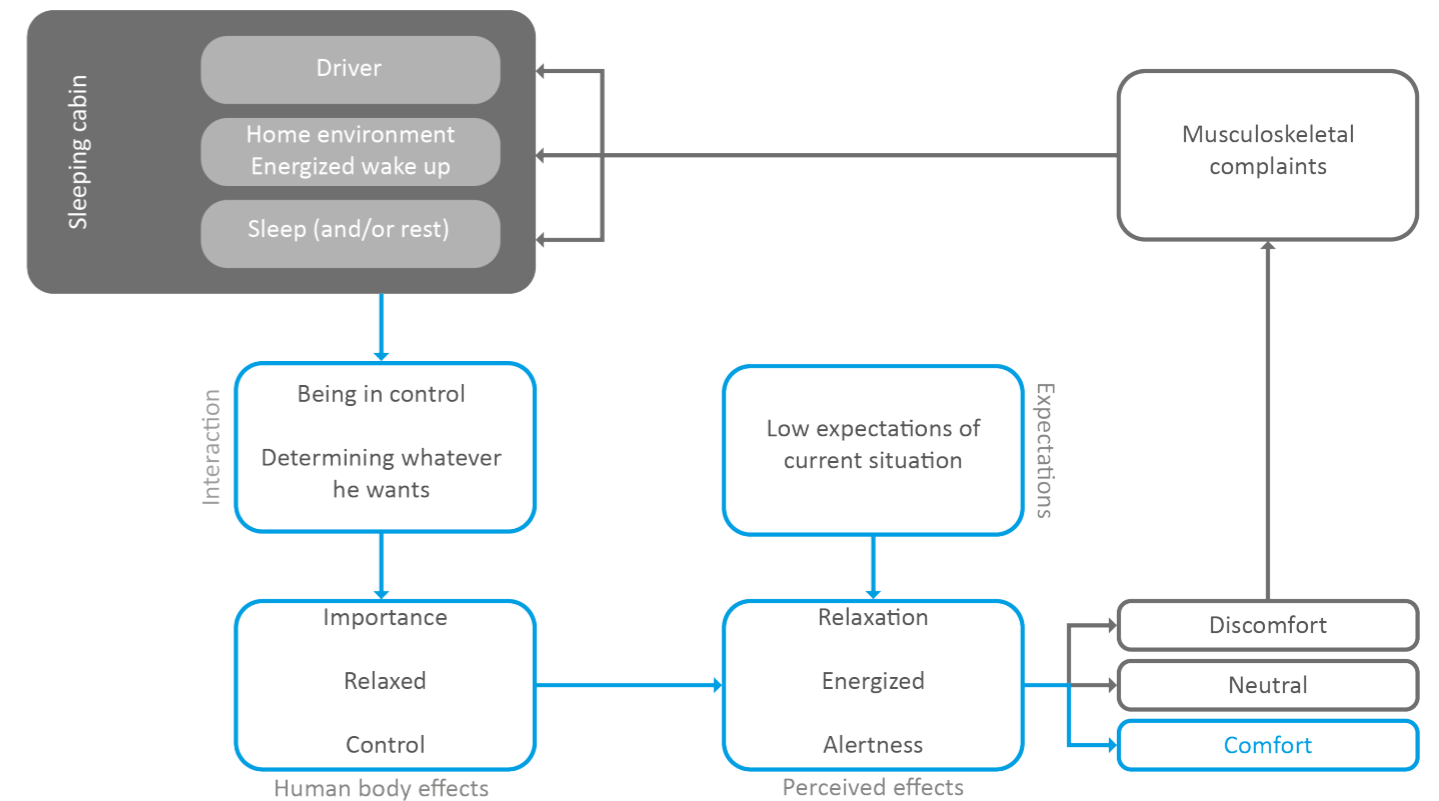
▲ Figure 32 Quotes of subjects during final user test

However, the comfort model by Vink & Hallbeck has been used as guideline in order to achieve the improvement.

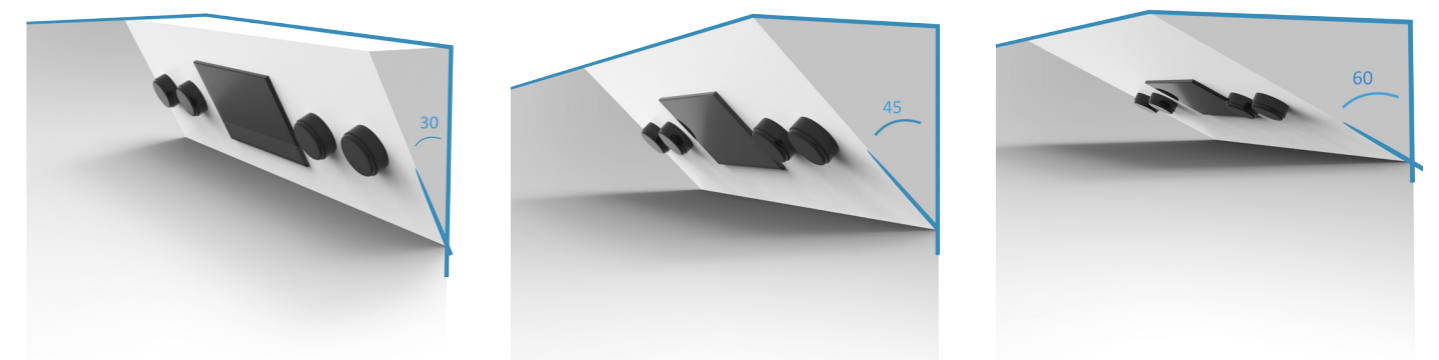
Based on the aforementioned model, the experiences have been considered as well as some choices. Figure 34 is displaying the comfort model of Vink & Hallbeck, but in the context of the redesigned sleeping cabin.

Another comfort aspect was the placement of the control panel. The first choice which was made was to move it to the ceiling in order to have direct visual to it. However, to experience comfort it was important to place the control panel in the right angle. This angle has been determined with the aid of a user test which can be found completely as appendix 10.

Figure 35 shows the three different possibilities that have been tested (except for the 0 degrees angle). The most comfortable one was the 60 degrees angle based on 100 % preference by the subjects. However, the 45 degrees angle was possible as well, but was more often experienced as less comfortable.



▲ Figure 34 Comfort model Vink & Hallbeck - sleeping cabin context





▲ Figure 35 Control panel angle possibilities


6.1.1 Experience


The experiences have been based on literature and already known experiences such as the coming home function in modern cars. Unlocking the car or opening the door will turn on the light, welcoming you to the vehicle. But also waking up with the aid of light or the experience of cosiness at home, next to the fireplace. These experiences have been taken, evaluated in relation to their properties and they have been translated into the design. The final user test shows that several designed experiences are more than appreciated within the sleeping cabin.

First of all, the welcoming light. A relatively simple translation from the inspiration to the design. The light turns gradually on while opening the entrance. The light in combination with the light colours used in the sleeping cabin resulted in a welcoming and comfortable experience. Figure 36 is sharing some experiences of subjects in relation to the welcome experience.

 I was expecting comfort, that was what invited me in.

 I would like to see what is glowing since it makes the place more comfortable.

 It was a friendly experience because the lights go on.

 The wake-up light is really nice, I can imagine the bright light will wake me up.

▲ Figure 36 Experiences of subjects during final user test

Furthermore, the ambient lighting has shown its functionality as wake up light as well as ambience creator. The light's function has been translated clearly in the experience of comfort since several subjects have mentioned it as a positive experience. The comparison with the current sleeping cabin has been crucial for this aspect since the experience might be "normal" to some people. The overall experiences that have been achieved are comfort, friendliness and an experience above expectations.

6.2 USP

The company has asked for a USP in order to distinguish the new coaches in the market. This is understandable since the sale of FHDs with sleepin cabin has decreased in the last 5 years (figure 37).

During the user tests with the mock up several reactions have shown the quality of the aforementioned USPs. Most of the designed aspects are admired and the subjects have been complementing the development

Year	Sold	% with SC
2011	128	56.14%
2012	127	36.18%
2013	94	28.4%
2014	85	27.96%
2015	88	19.82%
2016	98	17.31%

▲ Figure 37 Sales of FHD travel coaches with sleeping cabin

of the cabin. Especially the overall appearance and the control panel are complimented. A whole different ambient is created, exactly as how it has been designed to do so. Therefore it can be concluded that the overall USPs are validated and functioning as supposed.

6.2.1 Care vision

The care vision consists of several properties, but "attracting people" might be the most important one. Not

people in general, but drivers. The aim is to get the drivers desire for VDL travel coaches because of the sleeping cabin. Since they are experiencing comfort in current sleeping cabins (because of low expectations), they will gain new and higher expectations after spending some time in the redesigned sleeping cabin. This will result in a best of class comfort sleeping cabin for VDL and less comfort for their competitors. Eventually resulting in attracting drivers to share their preference in VDL travel coaches.

Besides, drivers are most important. Not only to drive the vehicle, but also for the complete journey experience of passengers. It seems that passengers value the state of mind and interaction of and with the driver. Even though some bad experiences occur during a trip, the driver can make it all right (De Jong, 2017). By redesigning the sleeping cabin for the driver, he will experience more comfort among other personal experiences. This will affect the journey experience of passengers indirectly since the driver will be in a

better mood.

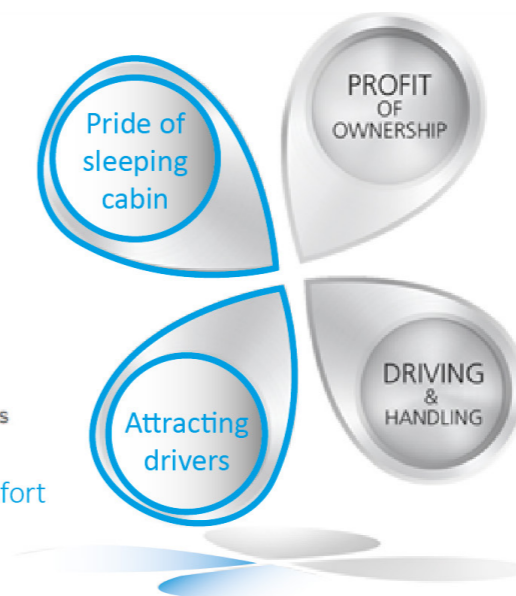
The aforementioned is underpinned by the final user test in which the drivers state that this is how the sleeping cabin should look like. It has become an environment that can actually be called a sleeping cabin, instead of an empty box with mattress.

Concluding, based on all tests in relation to the validation of the redesign, it succeeded to create a sleeping cabin that is above expectations and containing several USPs that will distinguish VDL from their competitors, resulting in a better market share.

The designed sleeping cabin is moving mountains of expectations.

Good
in "pride of ownership" with growing brand awareness
Best in class "pride of sleeping cabin ownership"

Best in class
in "human factors" for travelers and drivers
Best in class comfort



Best in class
in "earning factors" for customers and operators

Good
in "driving and handling" properties

▲ Figure 38 Overview USP Care

Chapter 07

Discussion and recommendation

Discussion and recommendation
Some things have not been taken into account while designing or validating. Within this chapter some topics will be discussed and recommended afterwards.

First of all, the current sleeping cabin contains a support bar, crossing from the left side wall to the ceiling (figure 39). This bar is part of the construction of the travel coach and according an engineer it is needed. However, it is possible to strengthen the construction otherwise, but calculations would have to be made in order to define the strength, costs and more. A short discussion resulted in the fact that these calculations will take place for the new travel coach anyway and therefore I am recommending the company to relocate the support bar. A possibility could be behind the lower ceiling at the leg end. In case the calculations result in "mission impossible", it is recommended to design the support bar in such a way that it can have a function, for example as handle to get up or get in.



▲ Figure 39 Support bar in current sleeping cabin

Furthermore, the manufacturing process has not been taken into account. It should not lead to any difficulties since the mock up could be made and the reachability is considered (but not investigated). However, a more efficient way of manufacturing might be introduced. First some companies will have to be found that can offer the new materials in the correct sizes, preferably pre-adjusted so it can fit easily in the sleeping cabin. Furthermore, the way of integrating all materials might be automated in case the labour would be too expensive (comparison amount of work, time and result).

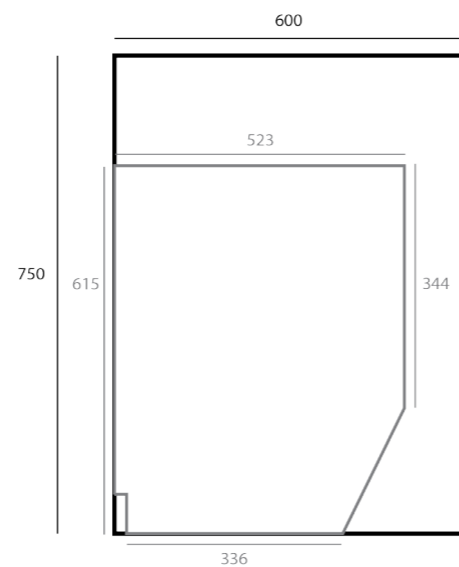
In relation to the validation of the entrance and the improvement of sleep some recommendations have been made.

To start with the entrance. As can be seen in figure 40, the entrance has changed its shape. It has become a rectangular shape instead of one with quite some corners. But, more important is the difference in the

staircase. Another student, Pei-Chiang Lin, used this staircase in order to improve the experience of entering and leaving the travel coach. It is recommended to combine the two projects in one mock up and test the comfort and experience of the sleeping cabin entrance. The visual representation of the recommended mock-up and end result has been given in figure 41, 42 and 43.

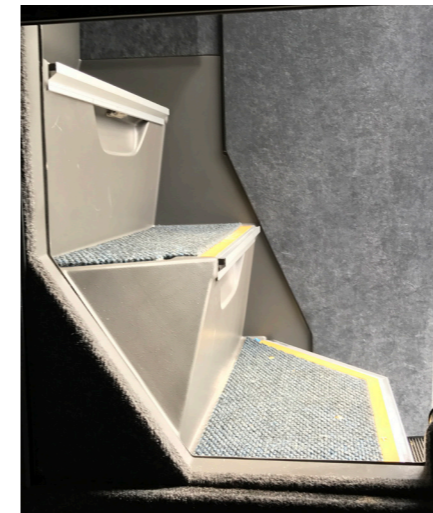
In case the company decides not to do so or the test results are disappointing, it is still necessary to change something in relation to the sleeping cabin entrance and the sharp edges the stairs have. Figure 44 and 45 are showing the current view to the staircase from inside the sleeping cabin and the sharp edges the stairs have. While getting in and out the cabin, the driver can get cut easily and this is not acceptable.

Finally, the sleep improvement has been based on literature research and has not been field tested or validated. This is a more difficult process because it is a complex system to measure sleep



▲ Figure 40 Entrance difference, old vs new

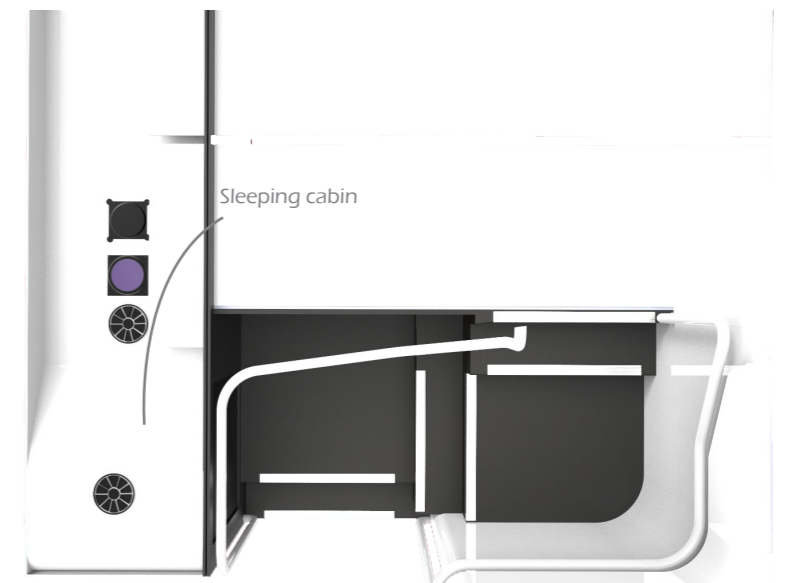
quality, especially in an environment such as a sleeping cabin of a travel coach. Therefore, it is recommended to the company to define pros and cons if this should be tested before producing the sleeping cabin. As informed in this report, the drivers are able to sleep in the regular sleeping cabin, so it can be assumed that they will not experience any difficulty to fall asleep in the new designed sleeping cabin as well. Nevertheless, marketing strategies might need proof of improvement in order to define it as a USP.



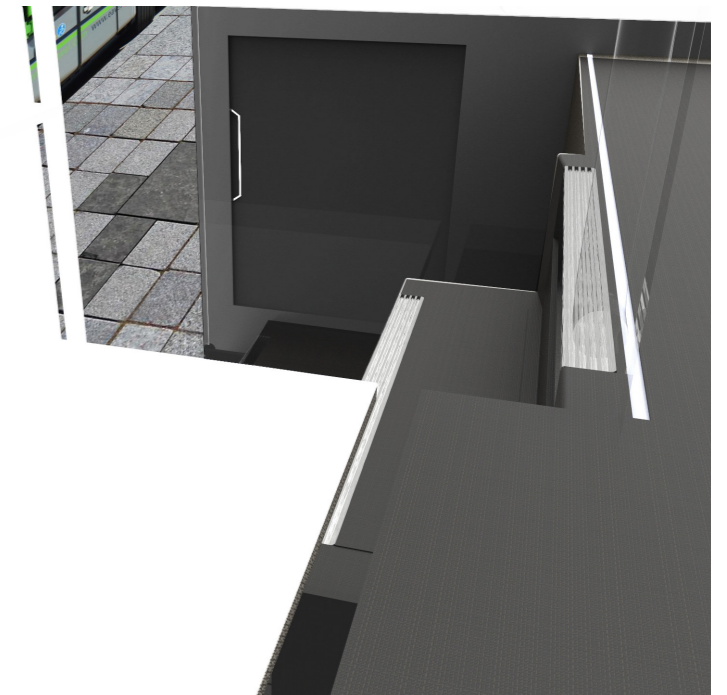
▲ Figure 44 Staircase view from inside



▲ Figure 45 Sharp edges stair steps



▲ Figure 41 Top view of the entrance recommendation



▲ Figure 42 Outside view of the new entrance



▲ Figure 43 New entrance with welcoming light while getting out

Chapter 08

Reflection

8.1 Critical self assessment

A graduation project can twist in all directions. Most important is to have it twist the way I would like it. Based on the result, planning and time schedule it can be said that the project succeeded. However, some shift in attention and direction has been noticeable. I became more focussed on getting the design and experience of the sleeping cabin above expectations, all based on research and that led to less time spend on material explorations and actual tests with a full-scale mock-up. Furthermore, it would have been better in case more attention was paid to the manufacturability. Design related decisions have been made from an economical point of view. Thinking of weight and material costs, but without thinking of an easier way to manufacture such a sleeping cabin. Since this aspect is missing, it is a learning moment to keep track of all needed aspects in relation to designing and delivering work. Furthermore, the goal was to develop a sleeping cabin that was far above expectations, one

that could be downgraded design wise to be developed at the moment, but also show future proof design. This has been done partly and it has to do with the fact that I have been designing with a two-year time frame in mind, not taking any innovative and futuristic designs into account. This is something that should be considered, design for 2025, downgrade to 2020 and compare to 2017. Overall, I believe the project went well and that the sleeping cabin is moving mountains of expectations.

8.2 Project reflection

A graduation project is something that needs to be done once and immediately the way it is supposed to be. The project will communicate the designer's skills and knowledge to the outside world and therefore it would be a pity in case some mistakes, which eventually could have been prevented, have been made by choosing the project.

The company has been offering a well-prepared project luckily, that completely fitted the ambitions and

interests as a designer. Besides, the project offered a lot of freedom to integrate and include development goals as well. Even though this is positive, it has its negative influence as well. Defining more guidelines could result in a better end result from the company's perspective. Nevertheless, as already mentioned in the preface, the guidance provided by VDL was excellent and VDL as company is a comfortable working environment.

The combination of several projects and several students from Delft University of Technology students is one that is of great value as well, but to get maximum result the aforementioned guidelines would be needed.

Overall, I am satisfied with the project and company. Every project has its improvement opportunities, as well as this one. Nevertheless, I would definitely recommend other students to apply for a graduation project at VDL.

8.3 Product reflection

As aforementioned at 8.1, the goal was to develop a sleeping cabin that showed a future proof design, however, this has not been done completely. Nevertheless, the sleeping cabin is integratable within a two year time frame.

Furthermore, it was aimed to have a sleeping cabin that is based on a clean design, but warm and home appearing at the same time. The material choice was crucial at this point; however, hygiene needed to be taken into account as well. This was contradictory to one each other, hygienic materials are more often cold, while the aim was to use warm materials. Since the sleeping cabin will be used as baggage compartment in case no driver will spend time in it and it will need to be cleaned after trips, hygiene has gotten the preference instead of the warmer appearing materials. However, as reflected before, there has not been paid enough attention on material choices. There might be a material that is warm and hygienic as well.

Besides, the sleeping cabin has introduced several functions that have not been seen before in travel coaches, this results in several USPs for VDL which allows them to introduce the Care Vision. However, some development still needs to be done, especially in relation to the entrance since it is a big obstacle in relation with comfort.

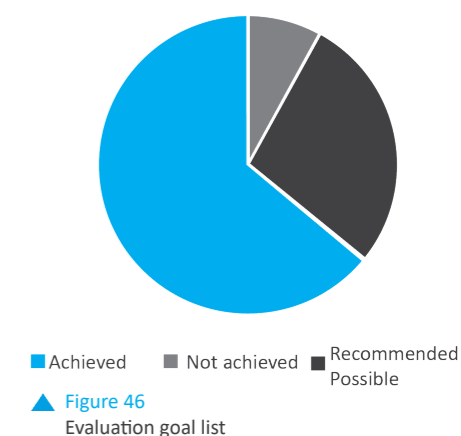
Furthermore, the mock up has been created in order to validate the design. But it might be an idea to create a separate mock up, not one in the real environment (travel coach). This would offer the opportunity to create the new entrance as well and validate the entrance or to experiment with several entrance possibilities.

Overall, it can be concluded that the product succeeded. Looking at the complete goal list in appendix 15 it shows that 66.6% of the goals has been reached, 25.9 % of the goals have been recommended or considered, so 7.4% of the goals have not been "touched" (figure 46). Besides, the final user test

shows enthusiastic reactions from subjects, especially since the cabin is designed how it actually should be. Comfortable and appearing as a sleeping cabin.

The shortened goal list, which has been shown in chapter 4, p. 25, has been evaluated on the next page (figure 47). Green status means the goal has been reached. An orange status means that it has been recommended or that it can be reached with small future developments, while the red status means that the goal is not reached (for a reason) or not considered.

EVALUATION GOAL LIST



Entrance

The entrance is not smaller than: 61.5 x 52 cm

The entrance is turning on the light at opening.

There will take an interaction place that confirms closure/opening of the entrance.

The entrance has a user-friendly way of opening/closing.

The entrance unlocks (in case it is locked) automatically in case of an emergency.

Sleeping cabin interior

The sleeping cabin is not smaller than the current sleeping cabin, which is 230 x 64 x 97 cm (inner sizes).

Sleeping cabin height is at least 85 cm where the upper body is located.

The temperature can be adjusted according to personal preference at all time.

Light is adjustable in brightness.

The sleeping cabin is providing a “feel like home” experience.

The sleeping cabin is providing a “re-energizing” experience.

A way of communication to the other crew is present within the sleeping cabin.

The mattress is suited for different type of sleepers (side sleepers, back sleepers etc.).

The buttons/switches are well integrated in the cabin and do not look as aftermarket.

The location of the buttons/switches make sense in relation with the goal and usability of the product.

Storage possibilities are present in which small items such as glasses, phone, tie etc. can be stored during rest period.

There are always emergency (two) exists available.

The emergency exist are clearly recognizable as emergency exit.

Cleaning

Cleaning the side walls and ceiling of the sleeping cabin can be done easily by wiping it off with a cloth.

There are no difficult edges present in which dirt can accumulate.

Manufacturing

The sleeping cabin will not influence other manufacturing in the coach.

The outer hatches will not be compromised.

General

The cabin will serve for sleeping mainly.

The cabin contains a USP which might influence VDL's market position positively.

Status



Chapter 09

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Figure 47
Reflection on
given goal list

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