

## P2, 4, 5 REFLECTION

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**Theme:** Building Technology/International Facade Master

**Teachers:** Prof.dr.ing. U.Knaack, Ir.J.Smits, Ir. Cecile Calis

**Argumentation of choice of the studio :** Interest in Facade Design

**Theme:** Media facades

**Title :** Polycarbonate Multimedia Facade



## **1. GRADUATION PLAN**

### **1.1 Problem statement**

In the late years the media enhanced building envelope has evolved at considerable speed, with the result that we now have to consider a new element in architecture. The world of media facades is rapidly changing given that this kind of facades must keep in pace, as much as it can, with the latest technology of electronic world in the market. In 2009 M. Hank Haeusler had published the first book about media facades including projects which are now already old according to the evolution of new media facades and the future potential of them. In the Netherlands the world of media facades is not as well known as in other developed European countries like Germany or countries in USA. Dutch facade companies decided to take part in this market competition and invest in research of constructing systems for such applications.

One of these companies is Rollocate Groep with which I had cooperation for my graduation thesis. Rollocate is a leading façade construction enterprise specialized in Aluminium, uPVC, steel, composite, glass, maintenance and export divisions with 60 years of experience in the façade industry and employs over 550 people.

Part of my research is focusing on a case study building constructed by Rollocate where the two owners of the company have their offices and they want to integrate an innovative type of media façade element/component. The importance of the media façade is very big given that the office building is facing the A28 highway and the exterior image could be a huge benefit for the enterprise. A new media façade component produced by Rollocate could be the key of success in today's competitive market.



View of the office building heading south on A28



View of the office building heading north on A28

The second part of my research is focusing in logistic buildings and big shopping malls. A common material used for their facades, especially in the Netherlands, is the polycarbonate structural sheets. Such buildings do not require direct sunlight transmission because users are focusing on the interior works and usually these building are used for storing. Such buildings exist plenty across countries in Western Europe and usually in places where many people are passing by with the car or train. For example, when the train starts to decelerate in many stations in the Netherlands you see buildings across the road made of polycarbonate structural sheets. These facades, although they can be produced with coloured panels and printed graphics on them they seem quite dull and boring. Thus, my idea is to take advantage of this exposition of buildings in such places and improve them in a way that they can add value to the marketing and raise social awareness for people watching the animated media facade by projecting social and cultural topics.



Apeldoorn , Amsterdam ([www.rodeca.nl](http://www.rodeca.nl))



De Ark, Hendrik Ido Ambacht ([www.rodeca.nl](http://www.rodeca.nl))



Cultural Centre Ranica in Italy (<http://openbuildings.com>)

## **1.2 Goal of the research**

The goal is to achieve the development of a media facade which can fulfil several requirements for our case study buildings. The challenge of this project is the fact that there are many options of media facade technologies and through the requirements and preconditions analysed we should compare the best solutions in terms of technology and cost effectiveness. The requirements are the following:

The new media facade must be translucent in order to allow natural daylight transmission and because it is better for the interior users to have the feeling of the exterior day and night condition. Moreover, the facade must have the ability of projecting good quality graphic images and animation videos. There are many types of illuminating facades which reproduce shapes, colours and basic elements, but those which are able to support marketing and advertising images and videos are going to be included in this research. In addition, the facade must be designed in order to be visible in day and night time. Not all elements are able to produce intense light for day use.

An additional goal is the comparison of polycarbonate structural sheets with glass. By exploring the possible applications for both of them in a media facade negative and positive statements will occur.

Moreover, nowadays there is a new type of lighting, OLED lights, which have entered the market and we should compare them with the existing LEDs and see the advantages and disadvantages, maintenance, serviceability and life expectancy to get the best applicable solution for the media facade.

All in all this research should contribute firstly as the development of a media facade component for the specific needs we mentioned above and as a consulting for Rollocate which is interested in this product.

### **1.3 Research question**

*Which is the best-state of the art- technology to design a multimedia facade and which are the ways to improve it?*

This general research question can be subdivided:

- Which is the state of the art technology today?
- Will the media facade component be a separate element mounted outside or will it be integrated to the façade element, or both?
- Could Rollecate detail and construct such an element in order to sell it?
- Are there any clients in the Netherlands to absorb this kind of product in the market?
- What could be the cost of the media facade compared to all the other ones which exist on the market?
- What happens to the facade after the end of polycarbonate's lifespan?

## 1.4 Methodology of the research

The methodology which is used in the research can be divided in three parts: research, design and evaluation.

Research: The research starts with the available literature study through books, articles, internet and interviews with experts. The aim of this is to establish the knowledge regarding media facades, the way of construction, costs, materialised projects and state of the art examples. The direct contact with Rollecate and other companies involved in the industry is important to get real numbers and feedback in the research. Through research we will be able to collect all information about media facades and used technology, filter the examples which are relevant to our needs and proceed to the design process.

Design: This step is focusing in the design and application of the innovative facade element. It should be functional, economic, easy constructed and mounted, energy efficient and fulfill the requirements given for our case study buildings. It is wise to use existing facade systems constructed by companies like Rollecate and modify them to create the media facade component in order to save energy and money.

Evaluation: The final step of evaluation is the most important because it proves that the system which is designed meets the requirements or it fails to offer the best solution. Here will be suggestions for improvements of the design according to the evaluation of the drawings and the guidance of experts from the company and university. Ideas for further research are also included in this sector.

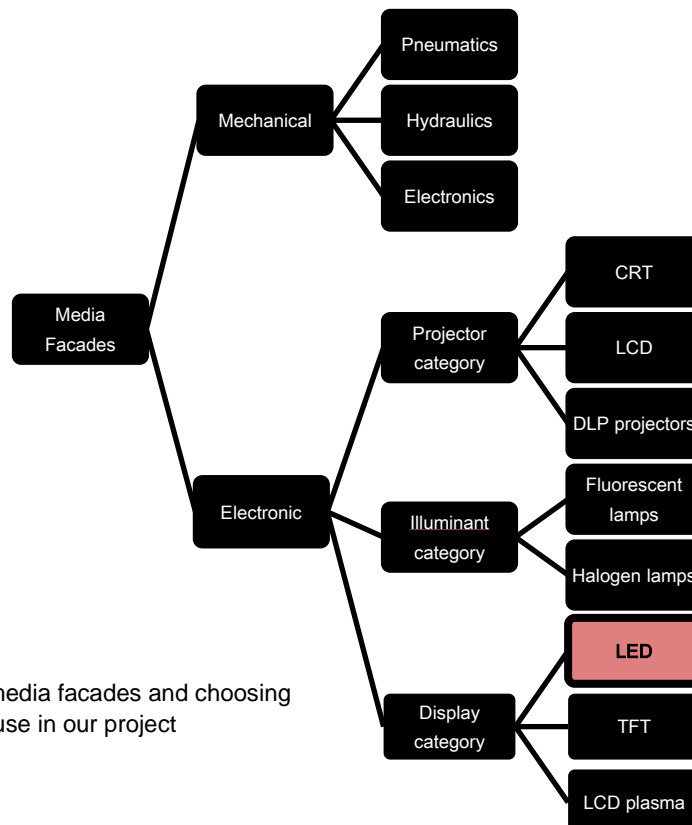


Diagram categorising media facades and choosing the technology we will use in our project

### **1.5 Scientific contribution of the research**

The media facade which is going to be developed is a realistic project asked by Rollecate Groep. The value of the research is directly related to a request of the business market and it will provide critical conclusions for subjects concerning media facade technology, costs and future potentials not only for the company but also for other enterprises. The world of media facades is still under development and as scientists mention LED lighting's 'best years' will be 2013 to 2017(<http://optics.org/indepth/3/2/5>).

Furthermore, the purpose of this research is to inform deeper people who are involved in the facade industry about the latest technology for media facades, present the world's top media facade designers and provide more technical information compared to the existing few media facade books been published. I was impressed when I searched on TU Delft library files about media facades and only five results came out in the research. One of them is the book I mentioned in the beginning and four are master thesis, one of which is only relevant to a media facade proposed for the new faculty of Architecture in TU Delft. So I am glad to have the opportunity adding my little stone to TU Delft's files.

Finally, when we will reach the design process we hope to succeed in developing a clever system which can be flexible for several applications and end to a product which can be competitive in the market.

As it will be proved in the research, the construction of a media facade is very costly. Thus, potential cheaper solutions for the marketing world might lead to a new approach to media facades and their use.

## 1.6 Case study buildings

Rollocate's building is located on the south part of Staphorst, with a distance of 100m from the highway A28. It is a 5 storey glass building with spaces of 4.500 m<sup>2</sup> facing northwest and southwest.



Position of the office building(yellow dot) in the south part of Staphorst



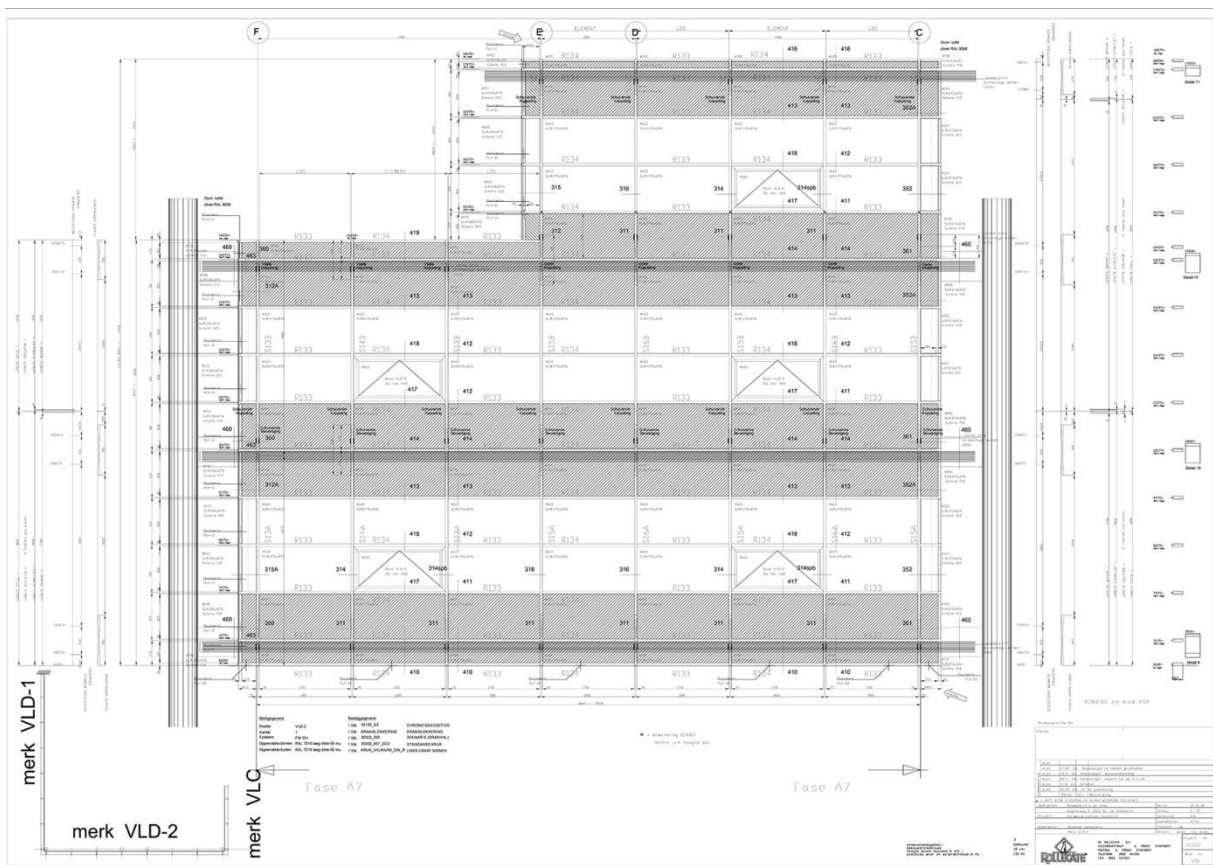
The distance from the highway is 100m, something which should be taken into consideration for choosing the appropriate LED pitch

The facade is a curtain wall system with aluminium profiles and double glazing. This is a system which enables the change of glasses on the facade and gives the opportunity of a good maintenance. It has a height of 11,5 m and a width of 16 m. In some parts there are openable windows for ventilation. In addition, around the facade there are four zones with metallic grills which are used as sunshading.

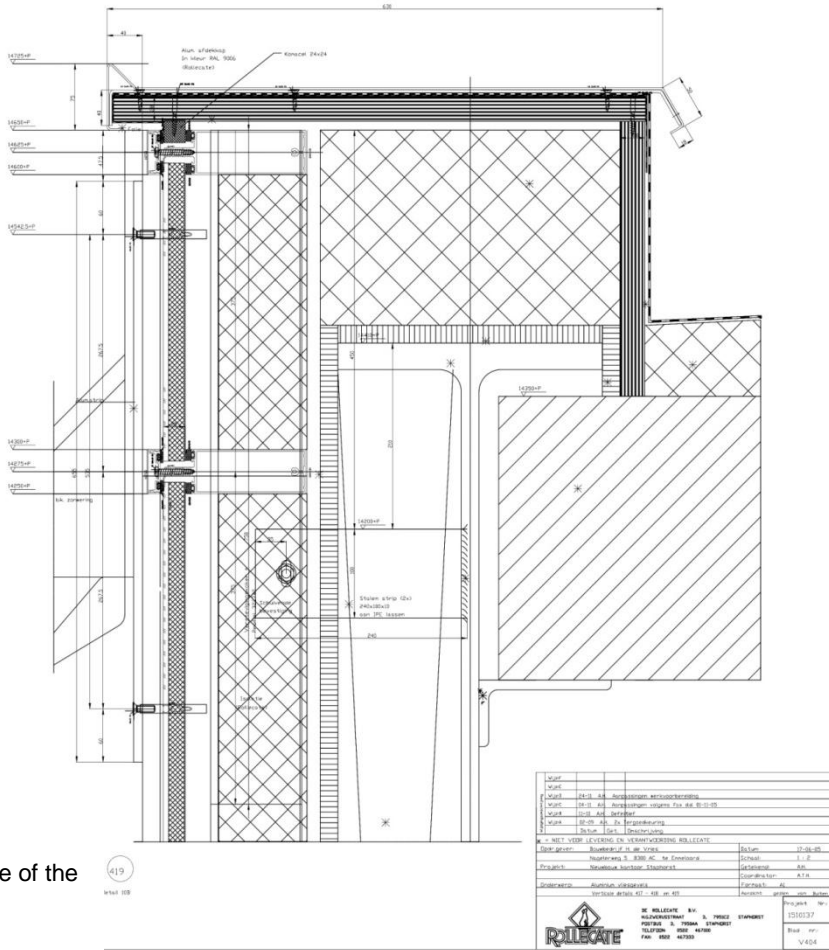




Closer image of the building with the glass facade

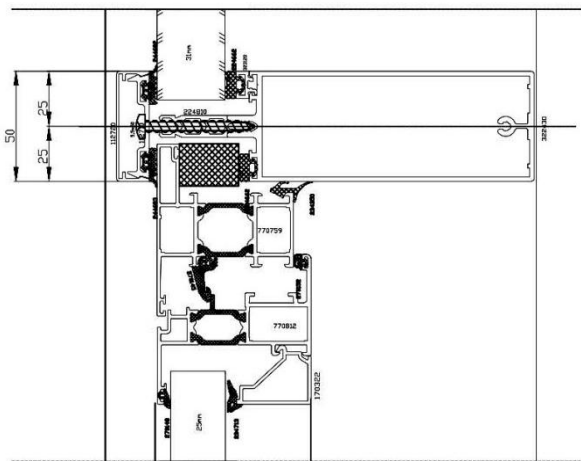


Technical elevation with the dimensions of the facade, the openings, the transparent and translucent parts (Rollocate)



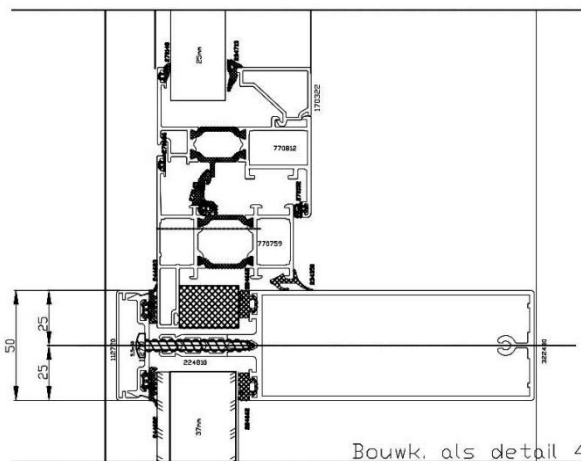
Detail at the edge of the roof showing the connection of all elements (Rollecate)

419



Plan details of the curtain wall system which can be used as a base for the new design (Rollecate)

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453

Bouwk. als detail 411

Furthermore, the research is focusing in buildings' facades which can be made of polycarbonate and do not have so many requirements as an office building where occupants are working under certain conditions. Such buildings may have different geometries from straight to curved facades. For example, the growing demand for warehousing and logistics management creates the need for modern building requirements. These must serve the needs for economic, fast and safe construction, easy scalability and in height storage. These buildings, often covered with polycarbonate structural sheets are becoming the most common applications in the field of logistics. The advantage of such construction is its competitive price and the ability to avoid a number of bureaucratic procedures and additional fees for the building license.



Common facade of a logistic building covered with PCSS

In addition, the ability of polycarbonate to be cold bended on sight offers the geometry variety in the panels. Curved shapes are mostly used in buildings where aesthetics and exterior appearance is more important, like museums, stadiums and exhibition halls. Polycarbonate sheets and aluminium profiles are almost the same as in the straight occasion with the difference of being curved. These buildings have many visitors and consequently a media facade would be ideal for marketing purposes and interaction with the people.



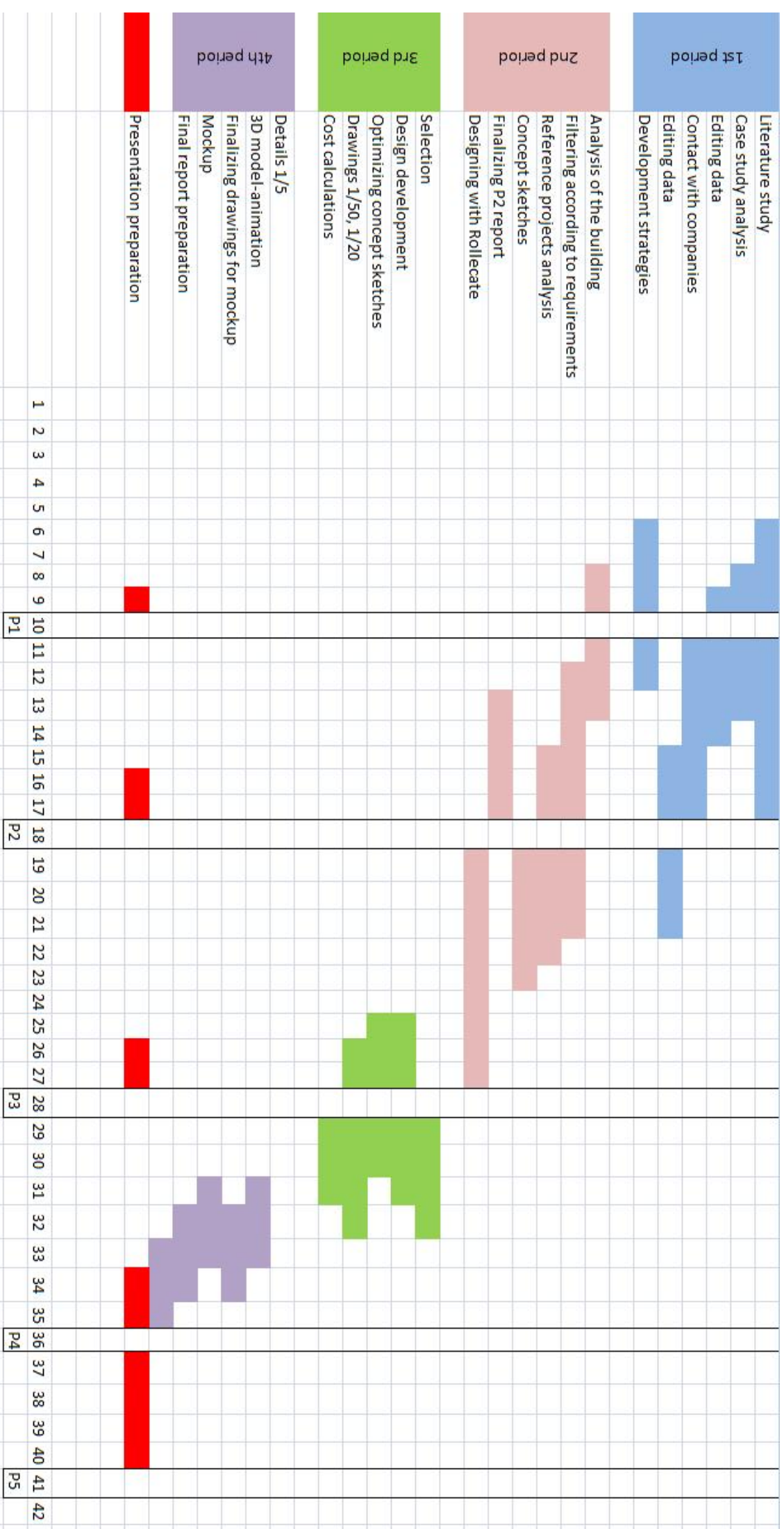
Museum of Energy in Spain with polycarbonate facade (<http://www.archiscene.net/>)



Arena in Zagreb covered with polycarbonate panels by Rodeca  
(<http://housevariety.blogspot.nl/2011/01/arena-zagreb-by-upi-2m.html>)



Omnisport in Apeldoorn with polycarbonate facade panels 23 m height  
(<http://rodeca.nl/>)

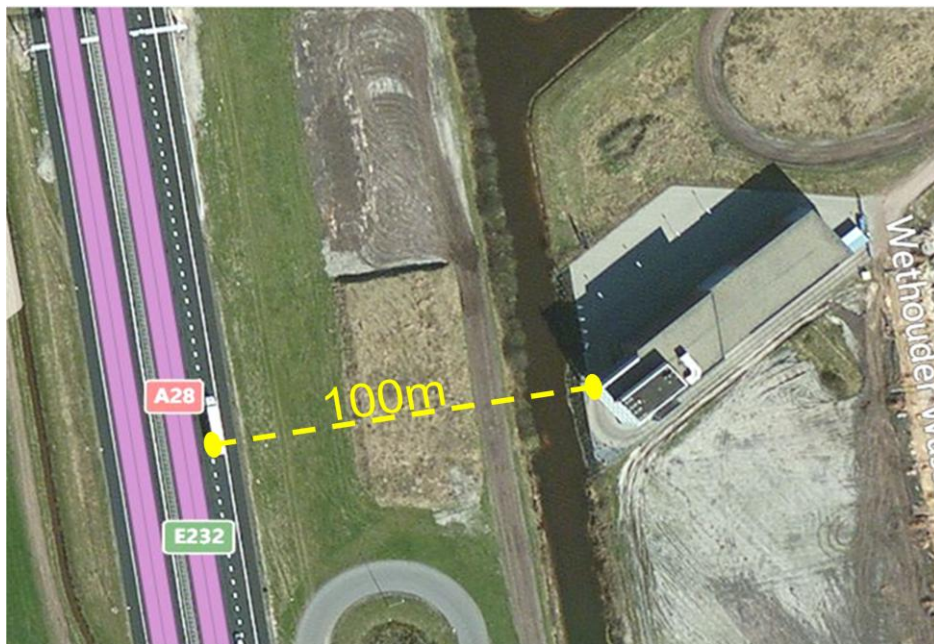


**The relationship between the theme of the studio and the case study chosen by the student within this framework (location/object)**

This MSc graduation project is being conducted at the department of Building Technology in the Faculty of Architecture, at TU Delft. The studio is called "Sustainable design graduation studio" and the graduation project's theme can relate to any of the disciplines represented within the department of Architectural Engineering & Technology, which is Structural Design, Climate Design and Facade Design.

One of my fascinations since applying for the Master in TU Delft was the media facades in buildings. Consequently, I was orienting myself to the Facade Design sector and I was very glad when I saw the opportunity of choosing a topic related to integration of LEDs for a media facade in collaboration with a Dutch facade company (Rollecate Groep).

The first part of my research focused on the facade of a case study office building made by Rollecate. As we mentioned in the beginning in the Netherlands media facades are not as well known as in other European countries like Germany or countries in USA and now they are entering the competition market. Same with Rollecate, they are investigating ways of developing a media facade product for the competitive market. Consequently, this part of the research is directly connected with the facade design theme.



The case study building and the distance from the motorway

The second part of the research was related to the integration of LEDs in polycarbonate facades of large span buildings like logistics and shopping malls. The purpose of getting involved with these facades was that they exist in many buildings of the Netherlands, Germany and other northern European countries, exposed to public transports, highways,

pedestrian areas etc. Their monotonous and dull facades was a reason to try upgrade them by adding value with the "live" media facade which could be interesting to people.

All in all, both parts of my research are related with the theme of the facade design and especially with the media facade design. The developing of ideas from concept to design was very helpful to take advantage of what we learnt so far in the master program. Facade design sketches, technical details, visualisations and a final mock up (is going to be constructed) are some of the final products of this master thesis.

## **The relationship between research and design**

The design is tightly related to the research and vice versa. Before starting the research we set some facts and standards according to which we had to filter our findings (see 1.2 chapter).

The research was conducted in three areas. The first area was that of the technology for LEDs and OLEDs. The second area was for media facade materialised projects, technology and costs and the third area was that of the polycarbonate structural sheets and their applications in the building industry compared to glass.

The comparison of LEDs and OLEDs created the first filter where we chose the LED technology for our design. The reasons and comparisons are described in the report as OLEDs are still under development.

Following, the research focused in the state of the art media facades which can produce animated and good resolution images. There are many types of media facades but not all of them are appropriate for this project. The goals set on the beginning for light transmission, cost, maintenance etc. created the second filter for the design. While cooperating with Rollocate and exploring the several technologies used in the media facade industry we concluded that it is a one way road for specific companies, which are controlling the market. Furthermore, the final part of the research was the polycarbonate structural sheets. Here, we filtered the available solutions for thicknesses, type of connections and applications for facades.

After, research the design attempts started in order to create the final product. Not all designs were successful but the final one reached its goal. The first design was based in the integration of LEDs in laminated glass for a spider glazing facade system. The positive about this solution is that something new was tried to be succeeded but practical matters occurred and after advice from experts in the electronics I skipped the idea.

The final design derived from the combination of PCSS and LEDs. Also in this stage I had to improve my research by exploring aspects like lifespan of both materials, possible malfunctions due to temperature rise in LEDs and maintenance issues.

In addition, due to the fact that this combination could offer several possible applications I visualised alternative design proposals two of which I detailed with drawings down to 1:1 scale.

Summarising, we can say that there was a logical development between research and design because all the aspects explored in the research were used in the final design. Of course as we include a chapter at the evaluation there is space for improvements in the final product.



## GRADUATION PLAN

- Problem statement
- Research question
  - Methodology
- Scientific contribution
- Case study buildings

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## RESEARCH

LEDs and  
OLEDs

Media  
facades

PCSS

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## DESIGN

~~Spider glazing  
media facade~~

PCSS media  
facade

Visualizations-  
Sketch Designs

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## EVALUATION

Pros and  
Cons

Rollecate  
feedback

Further  
steps

P4  
reflection

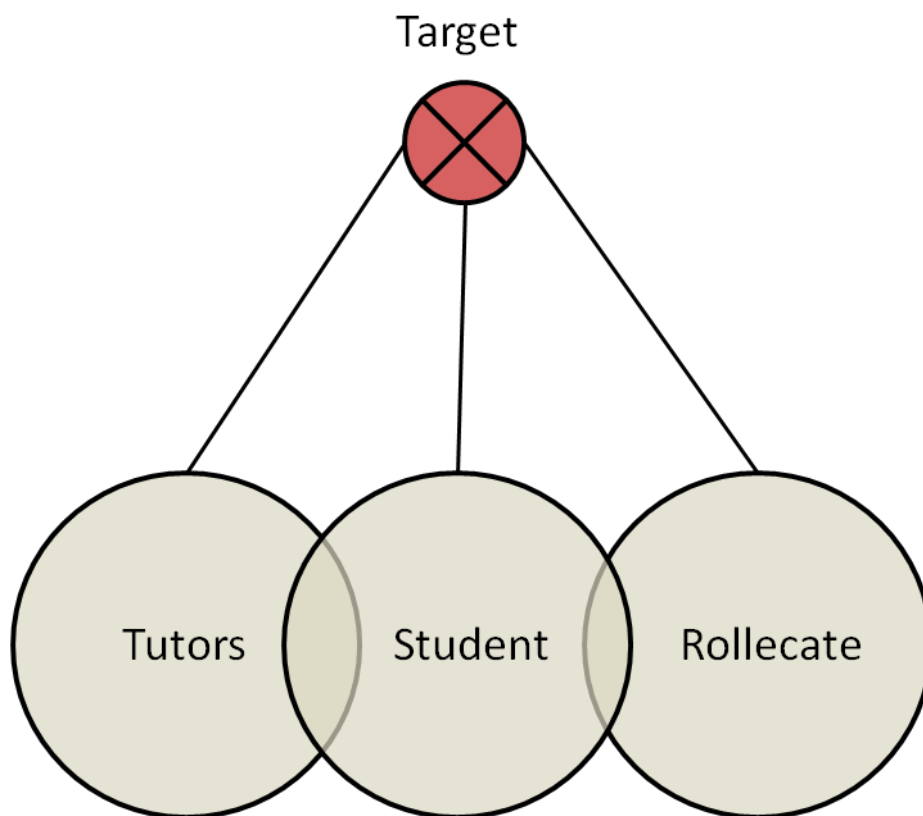
Diagram representing the development of the current thesis

## The methodical approach of the studio and the method chosen by the student

Within the studio the best methods to approach the design was the research in all available sources through books, articles, web and direct contact with the companies. Moreover, it was important to collect and analyze reference projects related to the topic. As it is described in the 1.4 chapter the methodology of the research was divided in the three parts of research, design and evaluation.

Starting with the research I collected and analyzed the technology for media facades, LEDs and OLEDs and polycarbonate structural sheets through literature, articles and the internet. I came in contact through e-mails with all the big companies in the media facade industry which provided me with precious information. In addition, the constant collaboration with Rollecate was very helpful to exchange information and discuss the outcomes of the research and the design. Their project was directly related to the media facade topic so they also had offers and details which helped me enrich my study.

The design process took place after filtering the requirements. The initial targets for the media facade component to be functional, economic, easy constructed and mounted, energy efficient and easy maintain were succeeded. The interdisciplinary design model which was used here through my mentors, Rollecate and me gave the opportunity to develop and always ameliorate my design proposals.



Interdisciplinary design model which was used in the graduation thesis

Finally, the evaluation stage came, where we concluded that the system which is designed meets the requirements set in the beginning. The final product was a simple solution competitive in today's market. The success in my opinion was in the fact that the design was able to fulfil all the case study buildings and creating a media facade which can be materialised according to different needs.

## **The relationship between the project and the wider social context**

The world of media facades has not been for a while so much in favour of the sustainable designers, given that they require energy consumption and cause light pollution. Things have changed nowadays with the evolution of technology in materials and electronics as we are able to use recyclable materials, like polycarbonate or glass and adjust the brightness of the LEDs integrated in the facade. LEDs are energy efficient for lighting and can be recycled as well.

We live in a world where the information and advertisement exists in every part of our daily life and we have to keep in pace with it in order to develop and progress. Media façades in urban spaces offer great potential for new forms of collaborative multi-user interaction. Furthermore, they allow the connection of people and triggering social interaction between the different users. Like we visualised in Rollecate's warehouse, beyond the marketing purpose of the facade there can be also cultural messages for promoting the local place in a touristic way. Messages to raise social awareness is also a possibility like it happens in the Rotterdam Central Station with the three media facades placed recently. In Milan at Piazza del Duomo, GKD managed to create a point of attraction with the media facade in the place where the 700 year old Arengario Museum was being renovated, which was often used as a giant screen for a football match and many people gathered and socialised. Consequently, we observe that media facades can add value to the public place and entertain people.