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Kochi, India

A Self-Assembling Curtain Wall System

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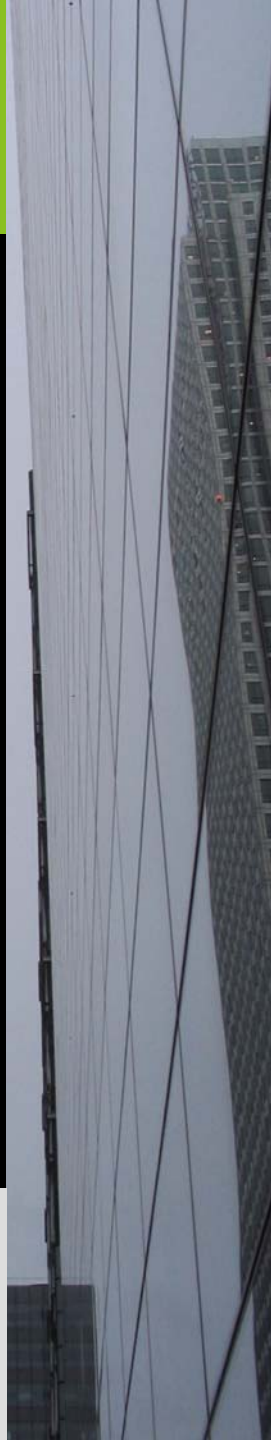


TU/e Technische Universiteit Eindhoven University of Technology

Outline

- **Problem**
- **Chances**
- **Existing Solutions**
- **Design Problem**
- **Design Method**
- **Design Results**
- **Reflection**

Problem

Assembling curtain wall system

Problem

Problems by the assembling of curtain wall elements

- Assembling conditions are unsafe and not labor friendly
- High buildings need a tower crane
- Climate conditions delete the work
- A lack of skilled labor

- The life cycle of curtain wall system is about 10 years

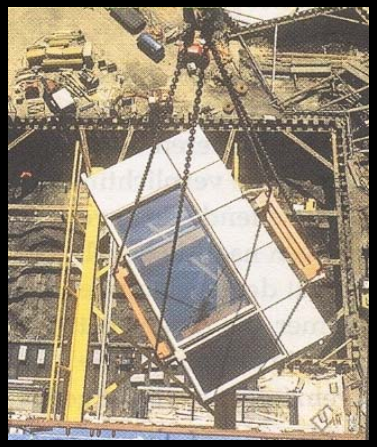
Chances

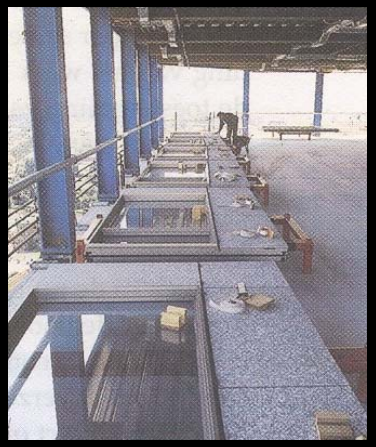
Developmets robotic technologies

- ***Mini actuators (50 mm²)***
- ***Sensors***

Existing solutions

Assembling wall elements Rembrandt Toren

1. 

2. 

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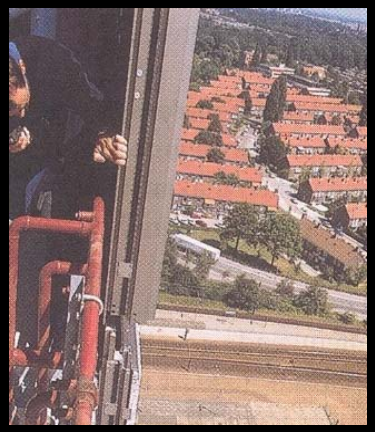
5. 

Existing solutions

Design Problem

Conclusions of the earlier study

- Safe construction site for assembly workers.
- Curtain wall is appropriate for high-rise constructions involving a steel load-bearing construction.
- The curtain walls are only made of aluminum and glass.
- The curtain wall is equipped for the assembly and disassembly processes. Its components can also be used for user functions (particularly systems) of the façade element.
- Only one remote operator is necessary for the (dis)assembly process.
- Mini- and micro-robot devices are used.

Design Problem

Design goal

Develop a concept for a self-assembling curtain wall system that is safe, labour friendly and can be used in all weather conditions, without a construction crane.

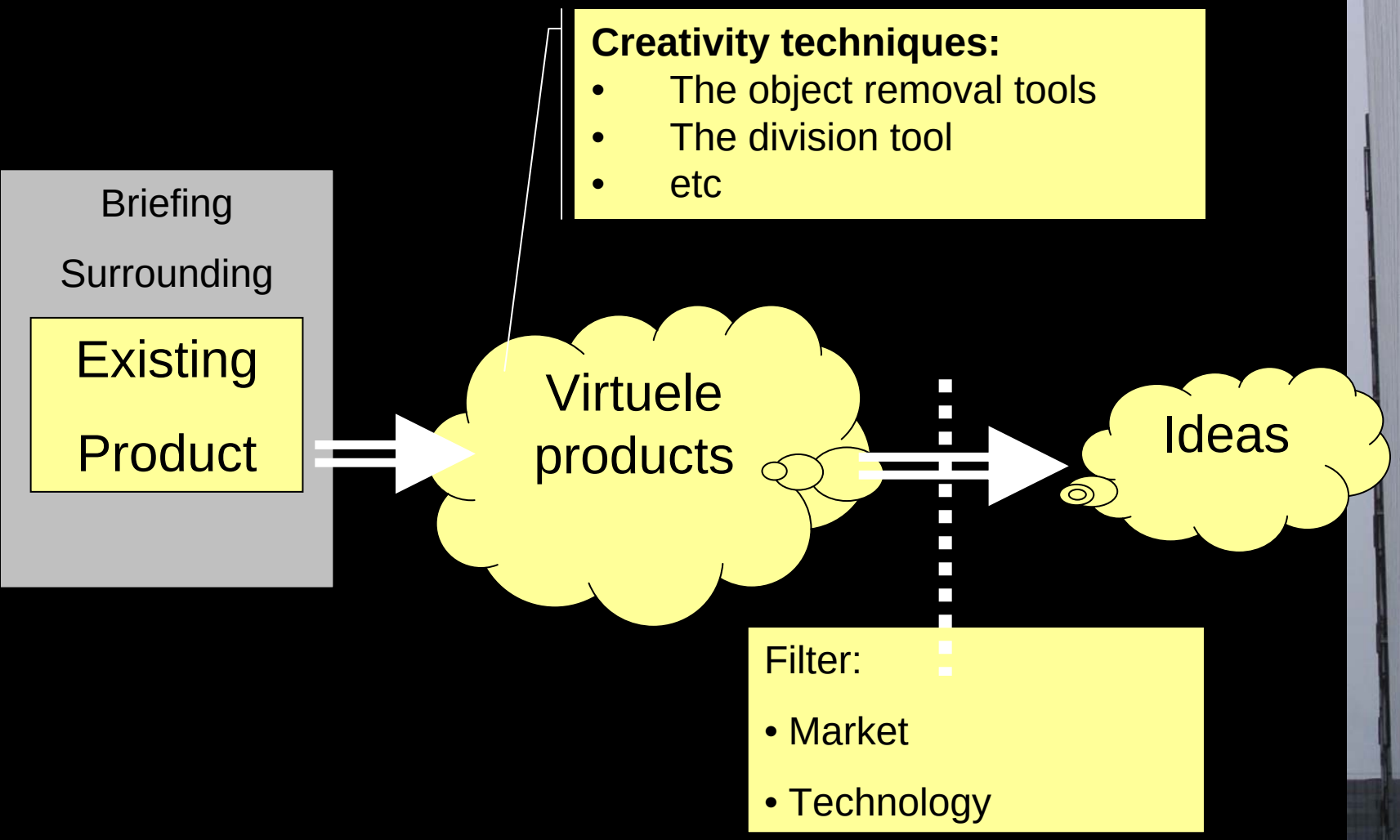
Design Method

Design steps:

1. Re-formulating the requirements.
2. Analyzing the problem.
3. Designing the concept by using morphologic schemes and Systematic Inventive Techniques (SIT).
4. Engineering the concept.
5. Creating a 3D Virtual simulation on the assembly process.
6. Reflection by experts.

Design Method

Systematic Inventive Technique (SIT)



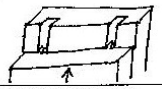
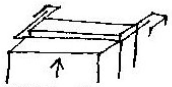
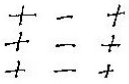
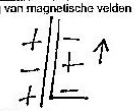
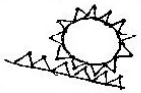
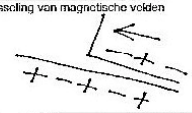
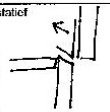
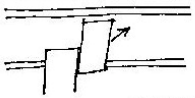
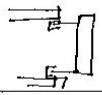
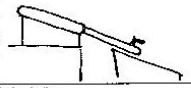
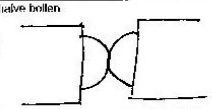
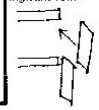
Design Method

Design meeting

Design Method

Design meeting

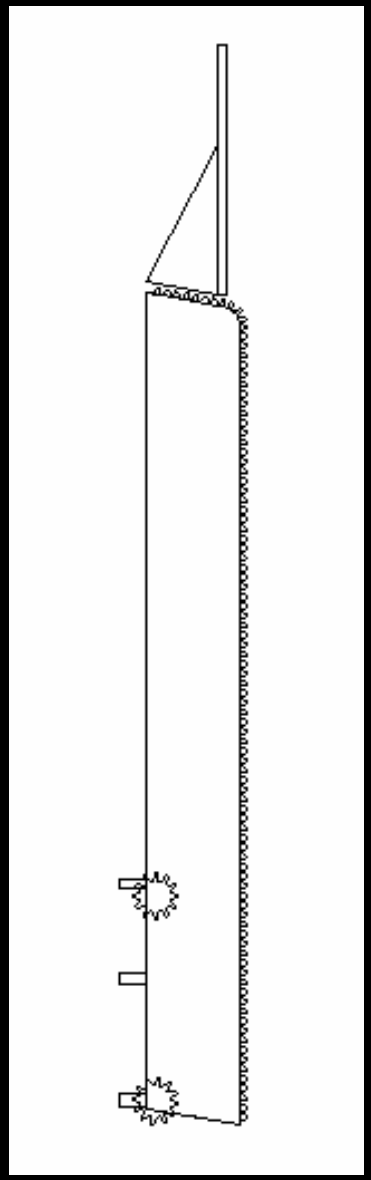
Morfologisch schema na SIT-sessie

	Concept	A	B	C	D
transporteren element naar de juiste positie, positiebepalen	geleiding door rails, rails aan voorkant element 	rails aan de constructie 	magneetschveld 		
transporteren element naar de juiste positie, aandrijving	tandwiel loopt over tandheugel 	wisseling van magnetische velden 	gemonteerd element trekt element omhoog 	transportsysteem aan constructie 	
verticaal transporteren naar de constructie	tandwiel loopt over tandheugel 	wisseling van magnetische velden 	gemonteerd element trekt element naar de gevel 		
stabiliteit op het moment dat het verticaal naar de constructie beweegt	statief 	element blijft gevel volgen 	gebruik maken van andere elementen 	geleiding achter het element 	
bevestiging aan constructie	gesp 				
detaillering, wind en waterdicht afsluiten	halve bollen 	wigwam vorm 	vorm volgt gevel 		

Design result

The concept

The element

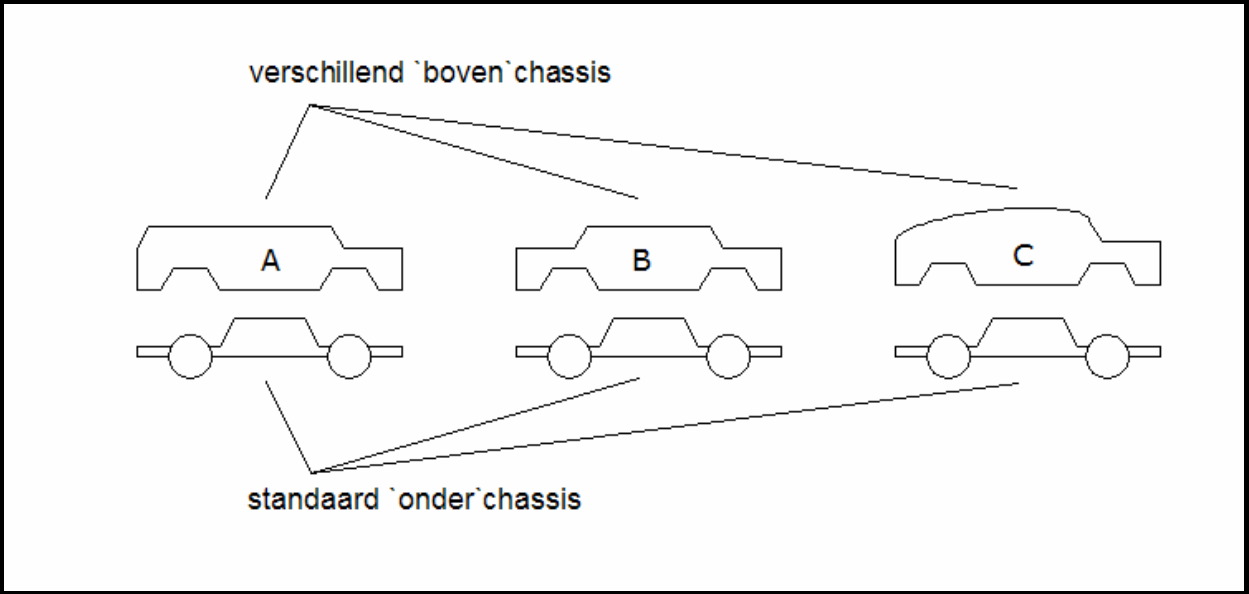


Design result

The concept

- ***The frame of the element is standard.***
- ***The filling is customized.***

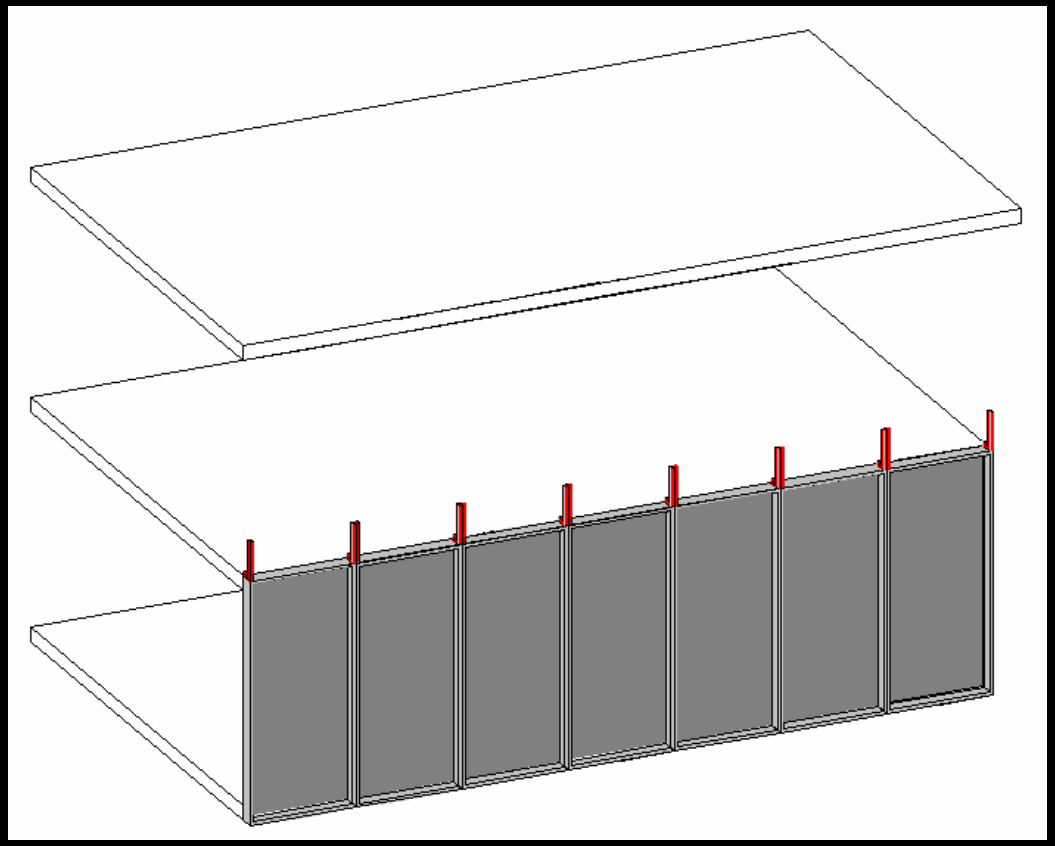
The concept is from the car industry

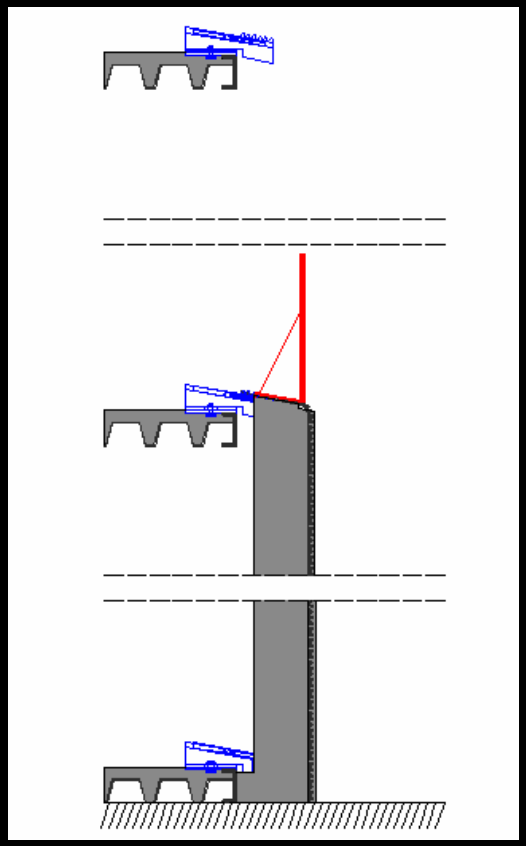


Design result

The concept

The lower row

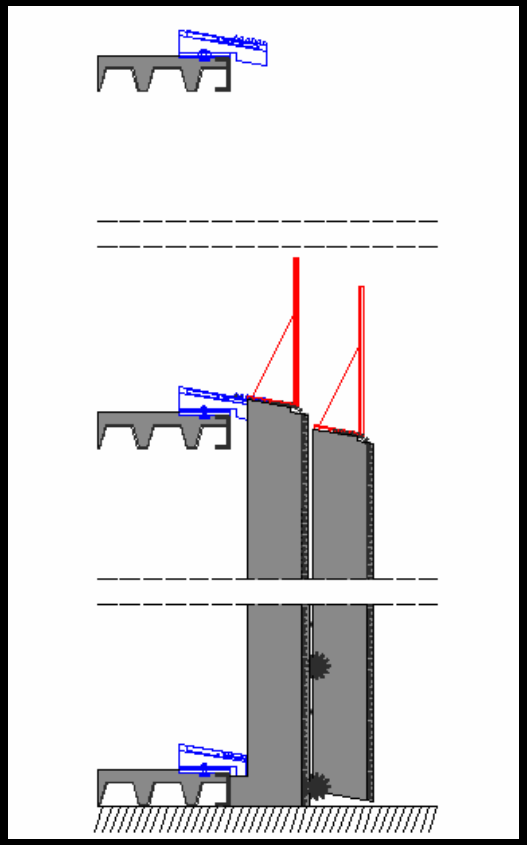


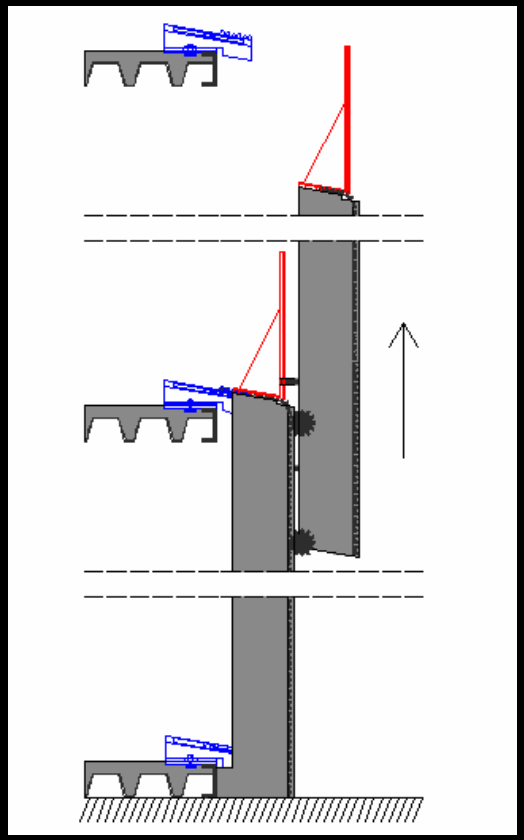


Design result

The concept

Assembling element

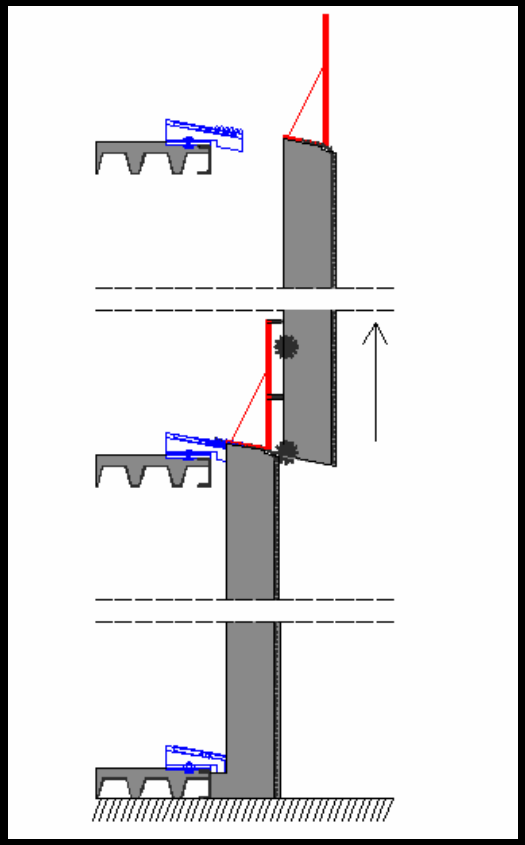


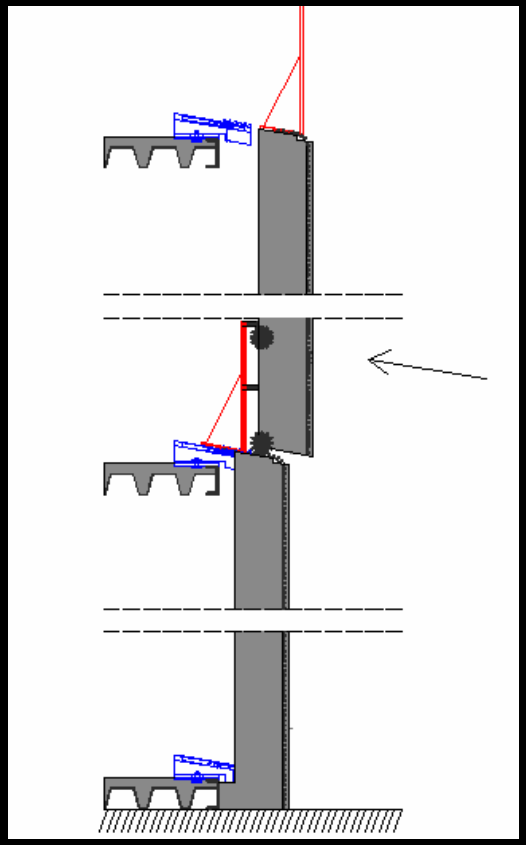


Design result

The concept

Assembling element

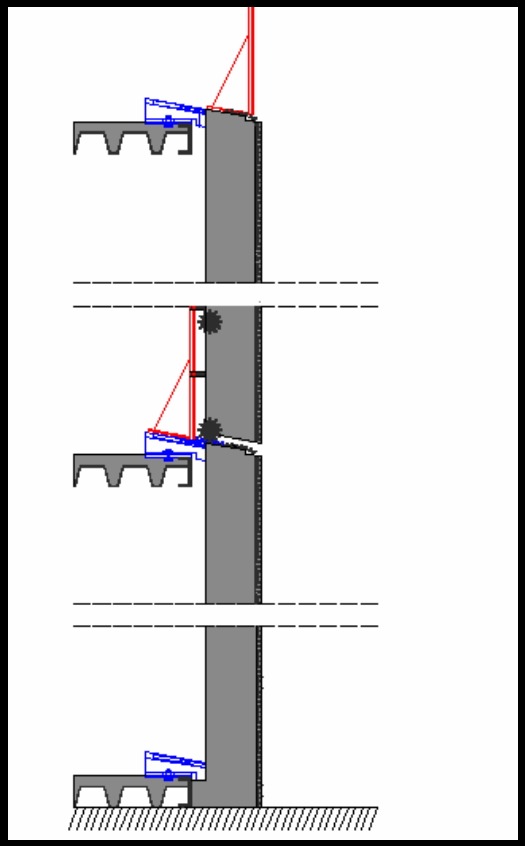


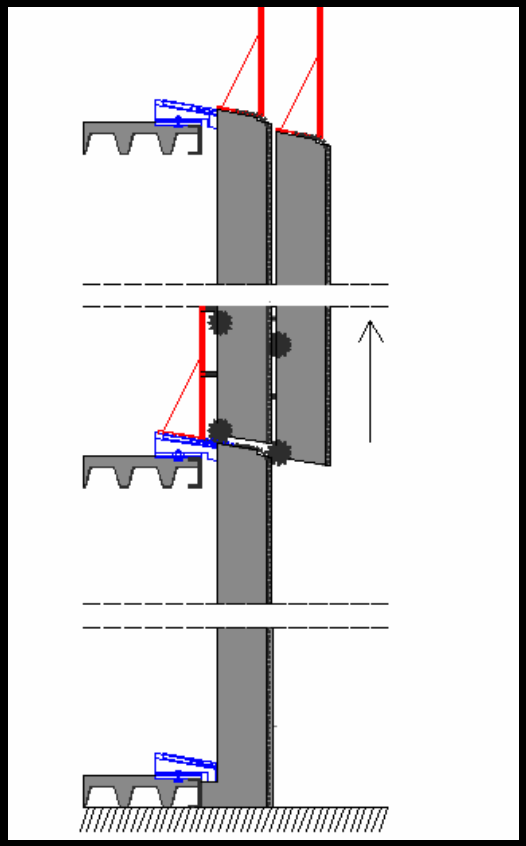


Design result

The concept

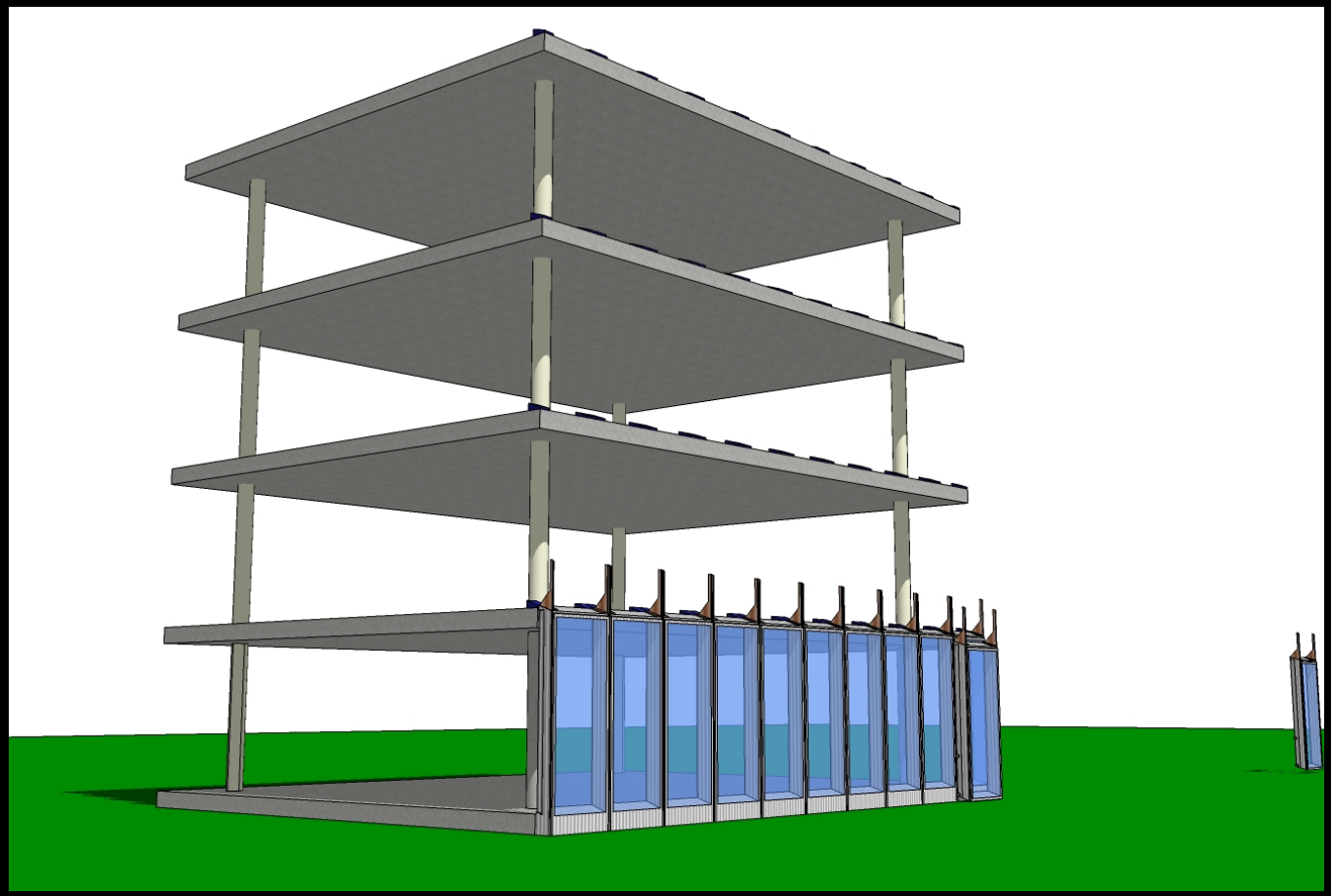
Assembling element





Design result

The concept



Design result

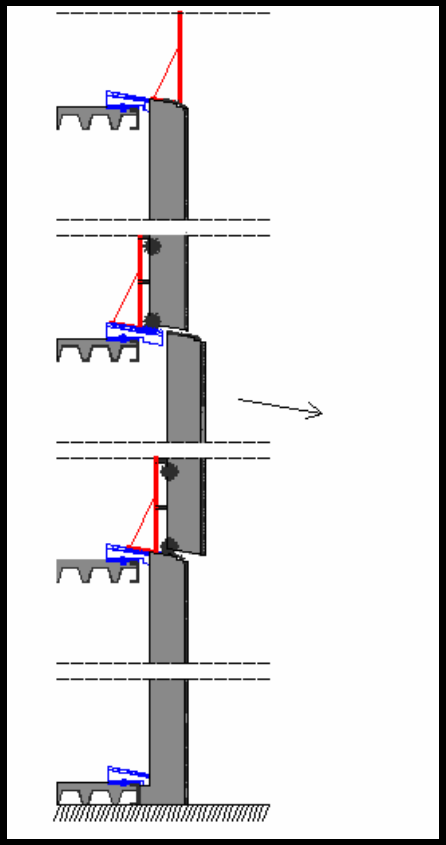
The concept

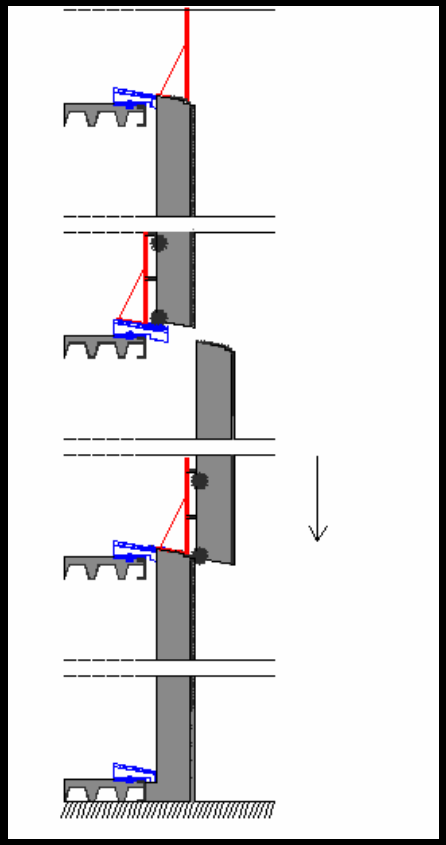
Assembling panels

Design result

The concept

Replacement element

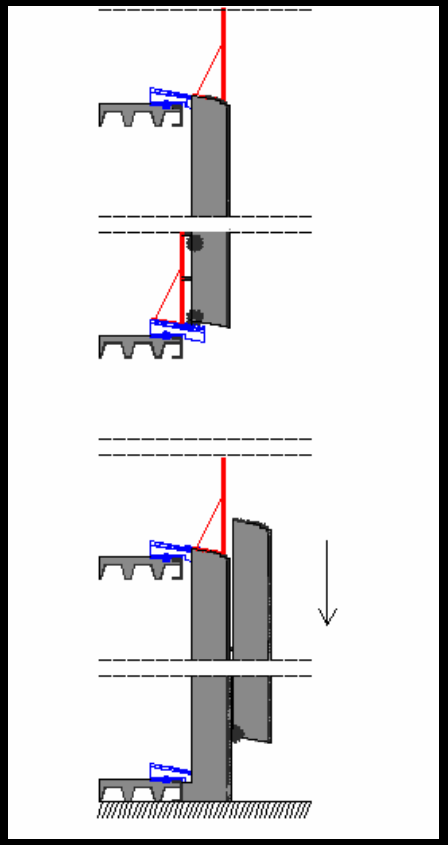


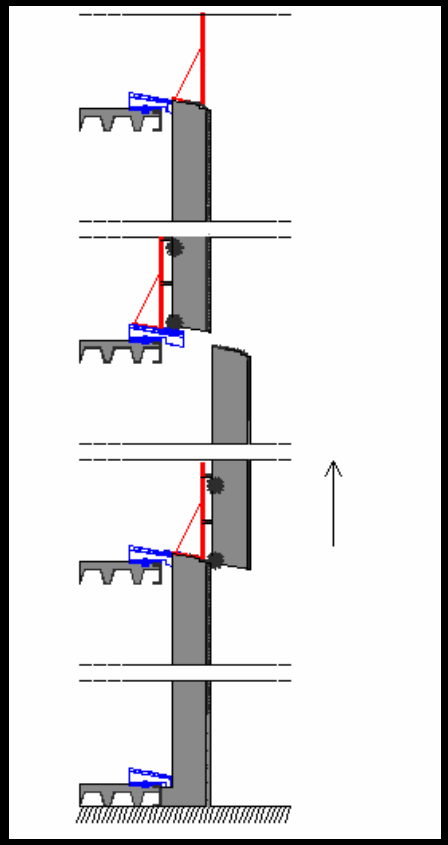


Design result

The concept

Replacement element

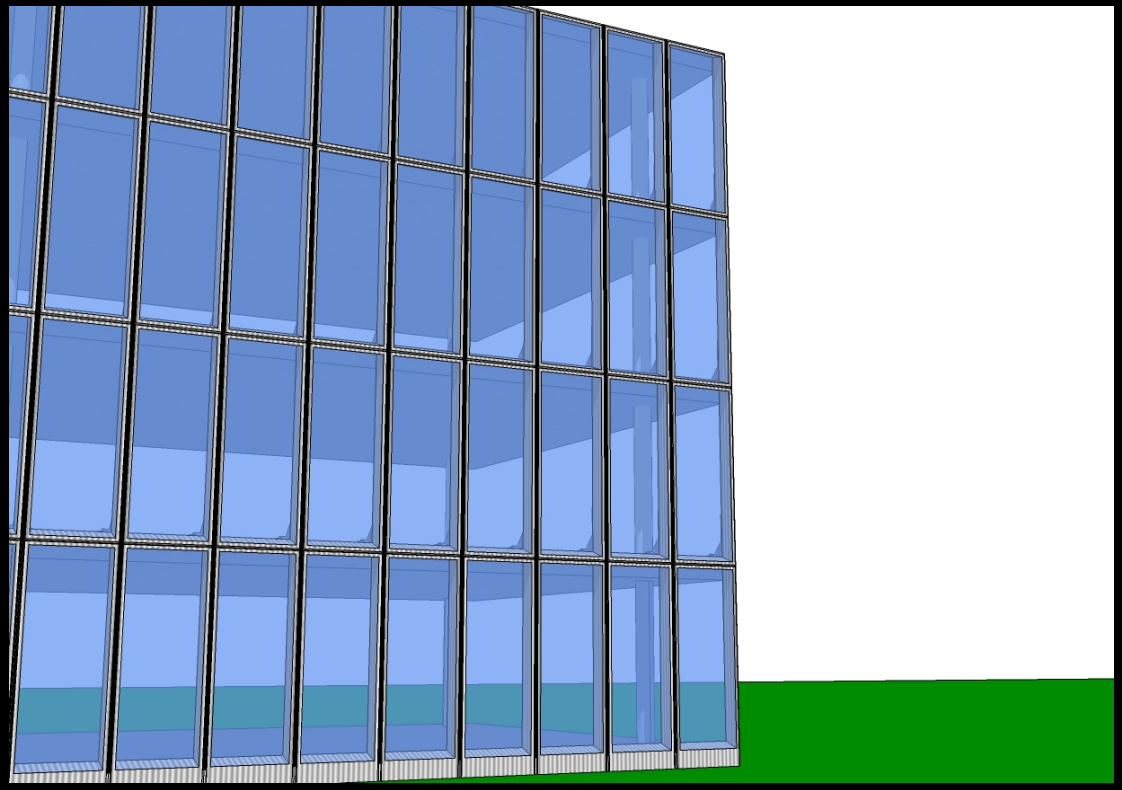




Design result

The concept

Replacement panel



Design result

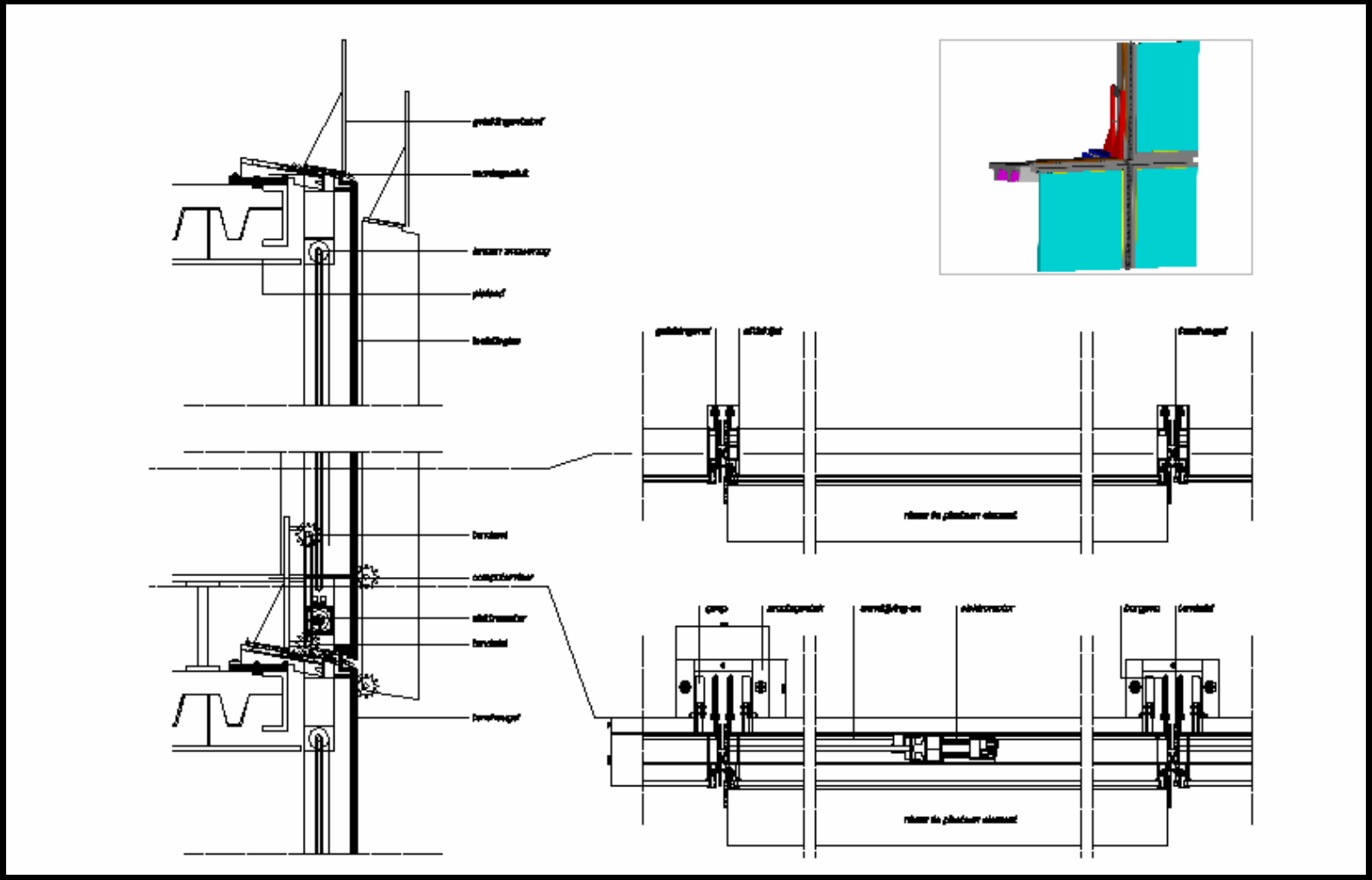
The concept

Replacement panel

Design result

Engineering

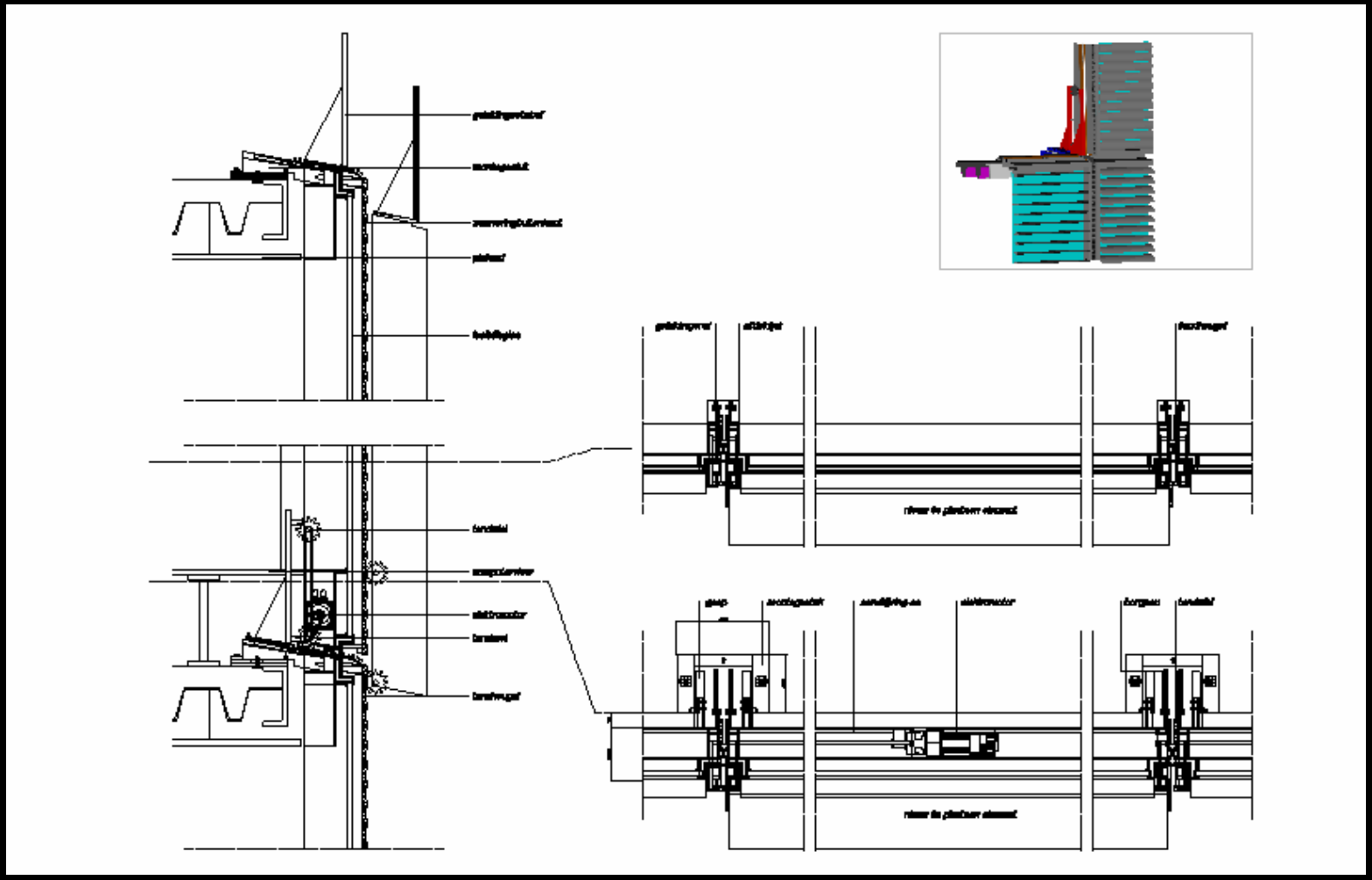
Prototype A



Design result

Engineering

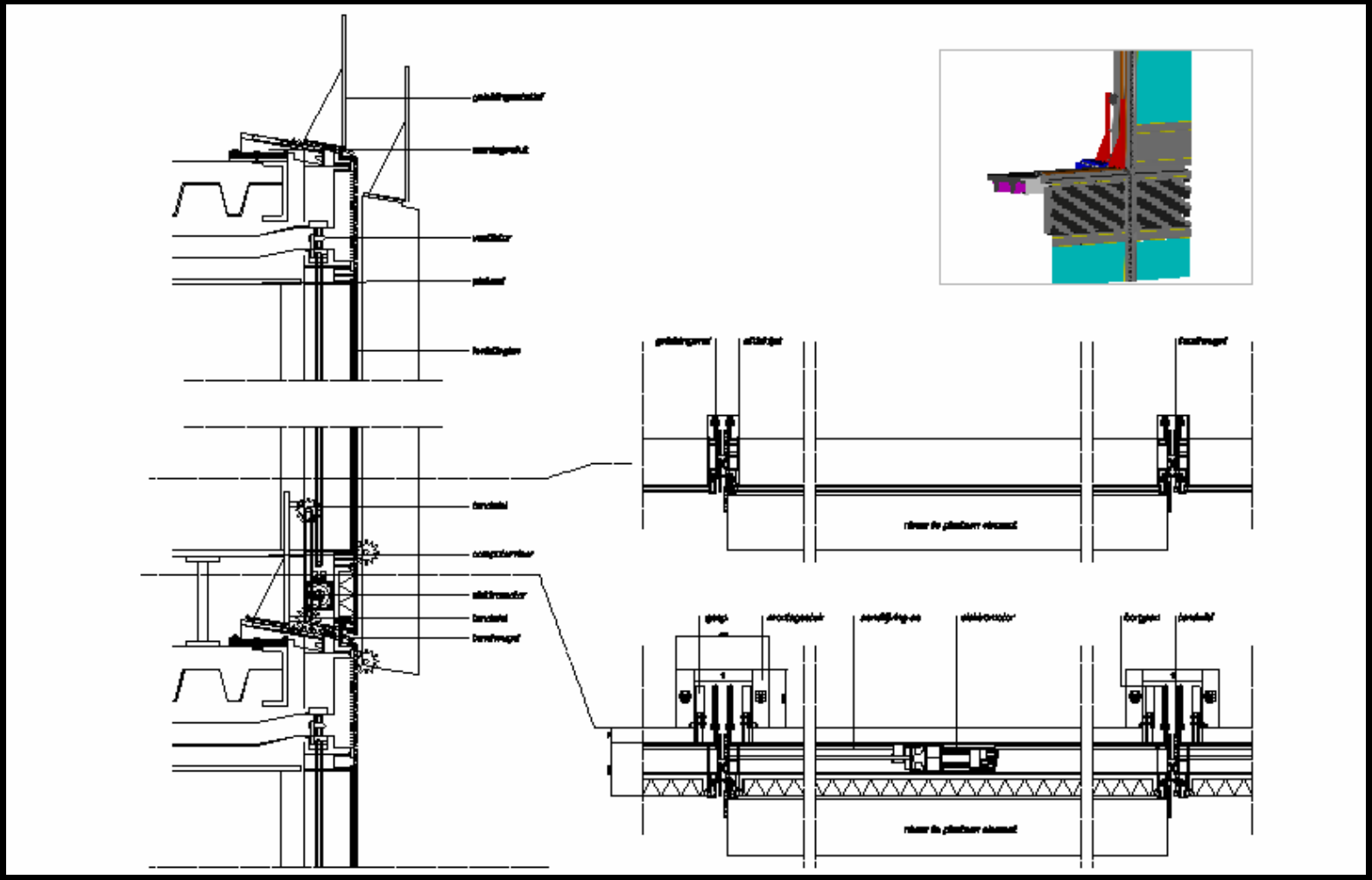
Prototype B



Design result

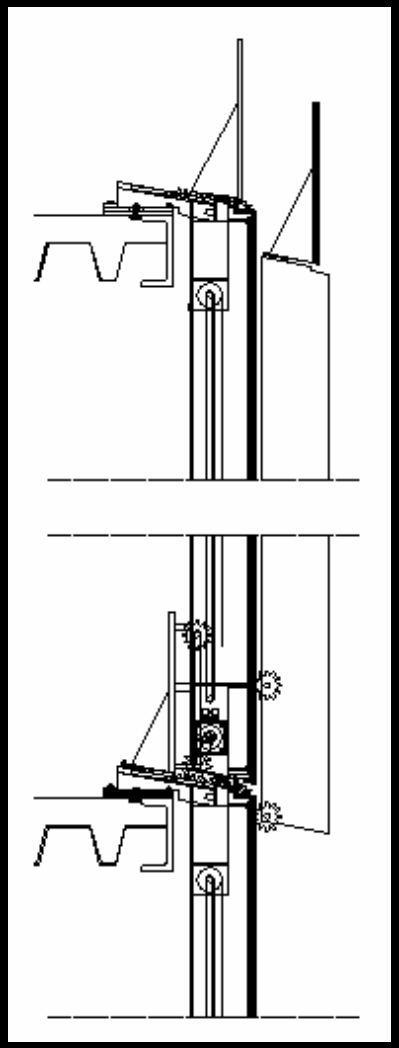
Engineering

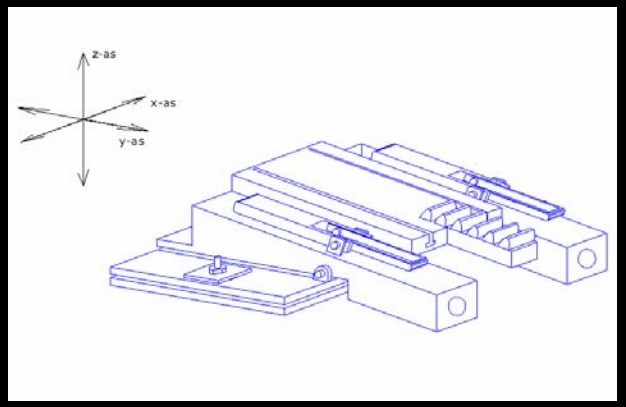
Prototype C

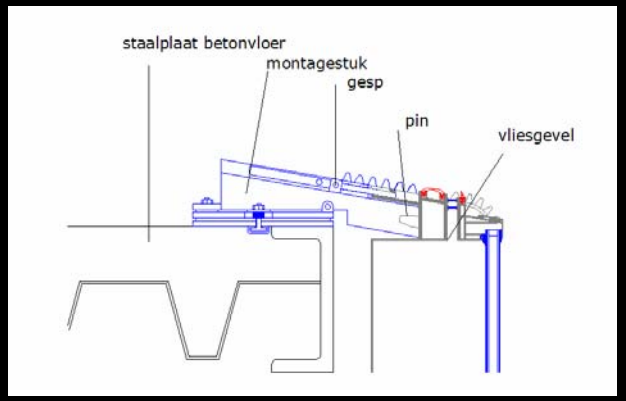


Design result

Fixing

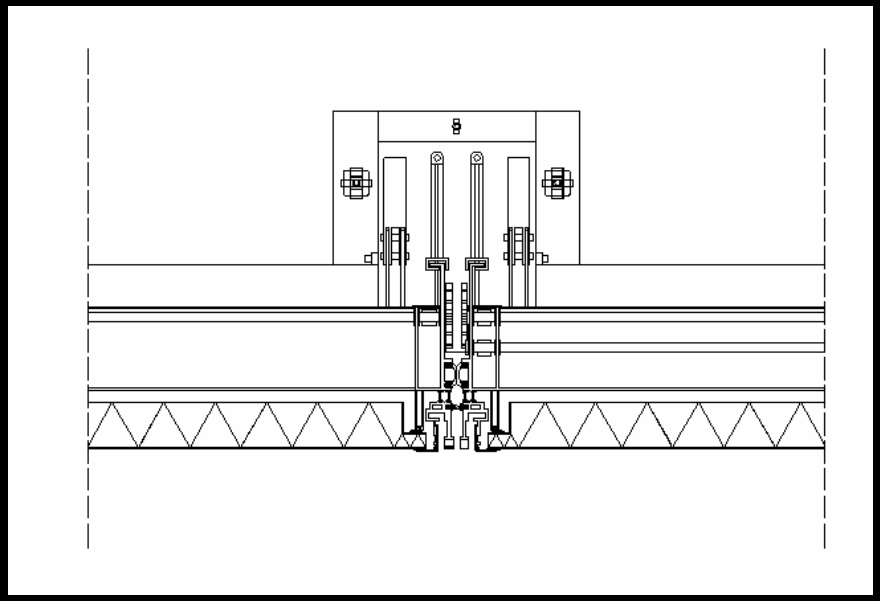


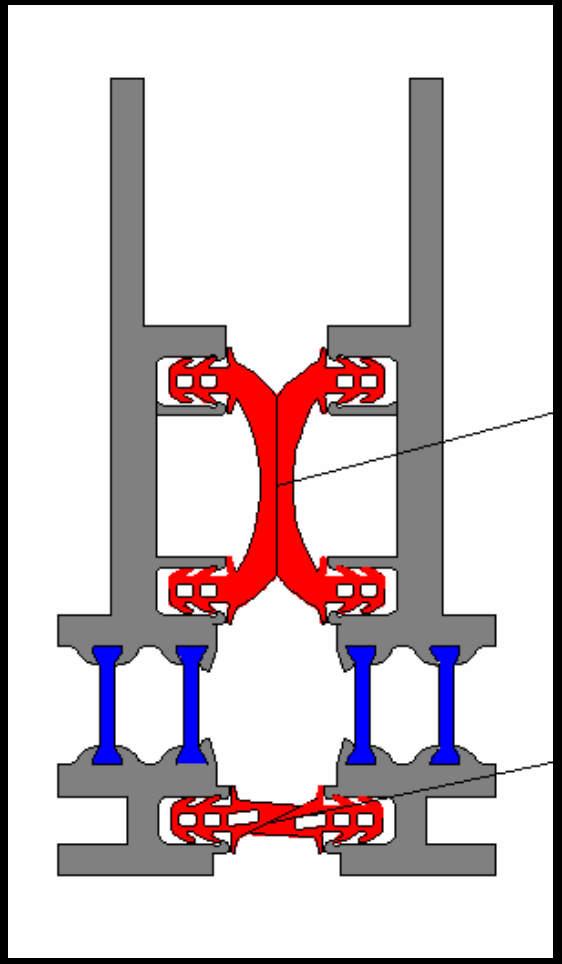




Design result

Wind and water sealing





Reflection

Comments by the industry

- ***No influences of climate by guiding system.***
- ***Doubt if market is interested for such façade facilities.***
- ***Integration of the electric drive and the positioning very interesting.***
- ***Reliability of the guidance system and water and wind sealing is weak.***
- ***Easy for renewal is interesting.***

Reflection

Discussion

- ***Most of the requirements are full filled.***
- ***Not the whole façade is self assembly.***
- ***Same parts have not still been tested, such as wind and water sealing, gear transmission and guide rails.***
- ***The cost of the driving motor is relatively high and has to much power output fur the functions as ventilation and sunscreens. A solution would be to use a replicable motor.***

Reflection

Conclusions

- ***The concept (dis)assembly work is safer and more labour-friendly.***
- ***Weather conditions have less influence on the progress of the construction work.***
- ***There is drive for ventilation and sunscreens.***

Reflection

Coming research

- ***Testing the water and wind sealing between the elements.***
- ***Testing the guiding of the elements***
- ***More research to a suitable drive.***

QUESTIONS?