

# REFLECTION

MSc Architecture, Urbanism and Building Sciences, Building Technology track  
Faculty of Architecture and the built environment  
Technische Universiteit Delft

Sustainable design graduation studio

Topic: Integrated Concentrating Solar Facade, Cast glass component, embedded photovoltaic solar cells  
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## **Aspect 01: The relationship between research and design.**

The thesis conducted research on sustainability and light behaviour as it interacts with solid cast glass brick with the focus on energy production. The goal was to analyse the light behaviour in solid glass as it is refracted inside the glass and changes its direction when it bounces on different surface at a certain angle.

The literature study has been a fundamental part of the thesis, thereby different glass technology and sustainable solutions were investigated. Then the literature study was integrated into the design. Research techniques that were used, are both individual concepts and experiments by applying reference projects. Exploring both directions provided proper knowledge to solve the challenges, which were formed in the design question. The conclusion of the geometry study led the way for further evaluation of the project in a building scale, and Crystal House was chosen for the case study. Every decision which was made during the process based on researches and simulations, therefore the thesis can be characterised as „*Design by Research*”.

## **Aspect 02: The relationship between the theme of the graduation lab & the subject/case study chosen by the student within its framework.**

Sustainable design graduation is part of the Building Technology master program. The studio explores innovative technologies in three different types of disciplines, namely Facade design, Structural design, Climate design and Computational design. The object of the thesis is structural cast glass focusing on energy production. Therefore, it takes the structural design and climate design into account. Nevertheless, it has to mention the importance of the computational part which facilitated the workflow from the beginning to the end of the thesis.

Structural cast glass is a new approach to use glass as a main load-bearing system in architecture. The goal of the thesis is to further discover the possibilities of structural cast glass through analysing solid glass as it interacts with light rays. Designing a new type of cast glass which can work as a solar concentrator not only can fulfil its structural task but it can redirect the light into specific areas/ points where photovoltaics panels can be placed. Several geometries were studied and simulated to check the interaction with light. The project explores the feasibility of new innovative technologies with sustainable approach.

### **Aspect 03: The relationship between the methodical line of approach of the graduation lab and the method chosen by the student in this framework**

In each period of the graduation project was dedicated to solve certain problems. The design project was based on design by research method, thus several scientific articles and acknowledged journals were used during the literature study to get proper knowledge to move on. Companies were asked about the current status of the technologies as well as exhibitions were visited.

In the design phase, research was done on several components and each decision-making narrowed down the project and led to find the final component which fits best in the context. In all steps in the design, research was a key factor to solve the dedicated designs.

### **Aspect 04: The relationship between the project and the social context**

Technology plays a vital role in sustainability to utilize renewable energy in order to develop sustainable or even self-sustainable technologies. The question of sustainability is indubitable. The quickly growing global energy use has already raised several concerns over supply difficulties, exhaustion of energy resources and massive environmental impacts all over the world. Therefore, sustainability has become an essential concept in everyday life.

One of the most abundant, inexhaustible and clean renewable energy resources is the solar energy. In one day the irradiation from the sun on the Earth gives about 10000 times more energy than the daily use of the population. One of the promising technologies which can produce electricity on site directly from the sun is the Photovoltaics. The project focuses on a special kind of photovoltaics technology called concentrated photovoltaics system. This system usually consists of an optical device as well, which concentrates the light into one point (to the panels). Due to the variety size of the panels, it can be easily integrated in the facade or on the roof without having a big visual impact.

Nowadays the daylight and the visual comfort is very important for the occupants of the building in order to achieve proper indoor comfort. It is a great opportunity design a fully transparent facade especially if it is made of structural glass. Not only fully transparent structure can be achieved but a fascinating, unique facade as well. The fully transparent facade improves the quality of daylight and the view too.

Combination of concentrated photovoltaics system and structural cast glass result a new component which works as an optical device as well as a structural element. The proposed system is not ostentatious and can be applied in small part of the building, or it can be used in an entire facade.

The only drawback of the system is that the additional photovoltaic panels would deteriorate the visual effect of the glass facade. Therefore, the position of the panels is crucial and it has to find the most appropriate place in order to have the lowest visual impact on a transparent facade.