

Graduation Plan

Master of Science Architecture, Urbanism

& Building Sciences

Master of Science Architecture, Urbanism & Building Sciences



Graduation Plan: Building Technology

Submit your Graduation Plan to the Board of Examiners (Examencommissie-BK@tudelft.nl), Mentors and Delegate of the Board of Examiners one week before P2 at the latest.

The graduation plan consists of at least the following data/segments:

Personal information	
Name	Weili Huang
Student number	5794552

Studio		
Name / Theme	Building Technology Graduation Studio Architectural Facades and Products Research Group	
Main mentor	Thaleia Konstantinou	Façade & Product Design
Second mentor	Eric van den Ham	Climate Design
Argumentation of choice of the studio	Facade research and design can bridge the building's design with climate design fields.	

Graduation project	
Title of the graduation project	Solar Cooling Integrated Facades Design: Exploration for minimizing cooling energy consumption in office buildings in hot-humid climate
Goal	
Location:	Shenzhen, China
The posed problem,	<p>Problem statement: Regarding specific climate contexts in warm regions, there are no clear technical solutions as design prototypes associated with design guidelines that can guide designers to identify the process of facade integration design with solar cooling technologies.</p>
research questions and	<p>Main research question: “In hot-humid climate, how can the design application of solar cooling integrated facades minimize the cooling energy consumption for office buildings and optimize the indoor thermal comfort?”</p> <p>The following are sub-questions:</p> <p>About design factors and adjustable parameters: “What are the specific design factors and adjustable pa-</p>

	<p>rameters that enable to affect the design process of solar cooling integrated facades?”</p> <p>About design solutions:</p> <p>“In terms of the performance, to what extend the solar cooling facade design solutions can reduce the cooling energy consumption and how to evaluate it?”</p> <p>About design guidelines:</p> <p>“Based on the design factors, parameters and evaluation results, how to generate the available design guidelines for SCIF?”</p>
<p>design assignment in which these result.</p>	<p>Facade design solutions integrated with solar cooling technology for new-built office buildings.</p> <p>The design assignment consists of two main sections: the design integration and the design evaluation.</p> <p>In the design integration section, there has a plan to include:</p> <ul style="list-style-type: none"> • Design framework • Concept design • Design development <p>In the design evaluation section, there has a plan to include:</p> <ul style="list-style-type: none"> • Different simulation scenarios • Design simulation • Evaluation • Design finalization
<p>Research objectives:</p> <p>To explore the design possibility of solar cooling integrated facade system for office buildings in specific climate conditions, aiming to evaluate the performance of the design proposal that contributes to reducing cooling energy consumption and optimizing indoor thermal comfort.</p> <p>The sub objectives are the following:</p> <ul style="list-style-type: none"> • To Identify all key design factors with adjustable parameters that are able to affect SCIF design process. • To provide technical design solutions (as exemplary facade prototypes) with per- 	

formance evaluation.

- To generate the design guidelines for SCIF along with relative technical strategies.

Process

Method description

The overall structure of the thesis will consist of three main sections: **research, design** and **conclusion**. Therefore, the methods used in this paper are respectively different.

First in **research section**, literature view and case study are two primary methods applied to outline the research framework. Through relevant literature and a series of reference cases, available experience and information (including the technical basics in solar energy system, state-of-the-art solar cooling technologies and facade system with solar cooling integration) will help define the key design factors with adjustable parameters, which give rise to defining the problem statement for this research accordingly. As followed, the research objectives and research questions are also formulated sequentially.

Secondly in **design section**, design exploration is certainly required. In this stage, the design process follows such a workflow: design framework set-up – concept design – design development. Within this process, technical drawings and digital models will be made.

The design outcomes are then to be tested during design evaluation phase by using some computational tools for validation, based on different simulation scenarios. In between, energy calculation work and adjustment of parameters will constantly take place. At last, it will end up with a design outcome of finalization, which will re-define the design factors and parameters generated in research section.

Finally it comes to **conclusion section**. The final design results will be analysed in this stage. Based on all the discussion results, the design guidelines will be generated experimentally. And sequentially, conclusion and reflection of entire research will be given in the end.

Literature and general practical references

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Reflection

1. What is the relation between your graduation (project) topic, the studio topic (if applicable), your master track (A,U,BT,LA,MBE), and your master programme (MSc AUBS)?

My graduation topic combines Facade & Product Design with Climate Design field together, which is also inherent with the studio's topic. Meanwhile, this focus of this topic is part of a long-term research directions in the building technology track with a dedicated research group – Architectural Facades and Products Research Group. Solar cooling integrated facade technology emphasizes the convergence of multi-systems and multi-disciplinaries knowledge, which means facade technologies, HVAC systems technologies and knowledge from solar-driven energy are in pressing need at the same time, which shows the inherent connection with the essential of the Master programme that encourage students to utilize a broad range of technology tools and diversity of knowledge to solve problems.

2. What is the relevance of your graduation work in the larger social, professional and scientific framework.

Social relevance

From a social and environmental perspective, the development of this topic aims to achieve the reduction of energy consumption for building cooling and to offer users well-being with better indoor environment. At the same time, solar cooling technologies are also expected to be an environmentally friendly alternative to harmful refrigerants for cooling. Therefore, it actually has extremely strong social value and relevance.

Professional relevance

In building industry, facade design and application technology, as well as solar cooling technology, they are both are all highly specialized areas of expertise. Knowledge gaps in these areas must be filled and improved by the collaborative effort of many researchers and designers. Therefore, it show particularly professional relevance.

Scientific relevance

Undoubtedly, this topic is a typical architectural science and technology research topic, and its research outcome is strongly related to the development of the whole facade industry and the innovation of science in building systems. Hence, its scientific attributes are undeniable!