Smart hybrid ventilation

**Topic**
A smart use of natural ventilation and sunlight are basic parameters of the design of comfortable low energy buildings. The research has a wide scope, from houses, offices, public buildings to greenhouses.

**Research question**
- What is the optimal relation between the architectural expression, natural ventilation and sunlight with regard to comfort and energy?
- What kind of ventilation, type of window and sunshade could lead to a state of thermal delight?

In the Senselab comfort measurements of ventilation systems can be executed. Active façades and smart user interfaces could be developed in combination with hybrid ventilation. The research aims could lead to innovative, improved ventilation and sunshade solutions for offices, greenhouses and other functions.

Mentor: Peter van der Engel and Eric van den Ham

Climate concept of the transparent hybrid ventilated Unipol Tower in Milan (architect Mario Cucinella, climate consultant Deerns).
Intervention strategies for church buildings

**Topic**
Due to the increasing secularisation many church buildings in the Netherlands will become redundant in the near future. The challenge is to adapt this religious heritage to new functions without losing the cultural, spatial and social values of the – often listed – church buildings.

The research can be linked to the projects *Transformation framework, pilot church buildings* (Prov. Noord-Brabant) and *KaDEr* (Prov. Gelderland)

**Research question:**
What are feasible architectural and technical interventions in church buildings in order to accommodate new program?

**Method:**
- case-study analysis (history, values, techniques and/or design)
- architectural design of a ‘catalogue’ (models, scenario’s, or similar) of interventions in relation to the type of church building and future functions

Contact person: Marie-Thérès van Thoor (Heritage & Architecture)
Design-to-Robotic-Production

**Topic:** While robotic approaches relying on robotic additive, subtractive and transformative techniques are increasingly integrated into production methods, the question is how they impact building design.

**Research question:**
How has robotic production evolved over time? What challenges has it met and what development can be expected in the future?

**Design Question:**
What is/will be the impact of robotic production on building design?

**Method:**
- Literature and case-study research
- Design and prototyping

**Mentor team:** Henriette Bier, Arwin Hidding
Design-to-Robotic-Assembly

**Topic:** Robotic assembly methods involve material handling i.e. feeding the components to the robot, picking/gripping and assembling/joining components, while using force control and control of chained tolerances, etc. They require identifying what assembly aspects are better handled by robots and framing respective sequence of human-robot interaction.

**Research question:**
How have robotic assembly methods evolved over time? What challenges have they met and what development can we expect in the future?

**Design Question:**
What is the impact of robotic assembly on building design and production?

**Method:**
- Literature and case-study research
- Design and prototyping

**Mentor team:** Henriette Bier, Arwin Hidding

Theme: Robotic Building
Design-to-Robotic-Operation

Topic: The embedding of intelligence into the built-environment relies on sensor-actuator mechanisms that enable buildings to interact with their users and surroundings in real-time. They require Design-to-Robotic-Operation processes that link design to building operation.

Research question:
How has robotic operation evolved over time? What challenges have they met and what development can we expect in the future?

Design Question:
What will be the impact of robotics building design and production?

Method:
- Literature and case-study research
- Design and prototyping

Mentor team: Henriette Bier, Christian Friedrich

Theme: Robotic Building

AE + T Honors Topics
Construction Connections Overview Map

**Topic**
Connections are key to combine materials, components and building elements. In order to develop new connections within the upcoming challenges of circularity, sustainability and automatisation we need an overview what's already out there and in which way these can be used or altered towards new applications.

**Research question**
Creating an overview of connection that helps to sort and evaluate their purpose. How can these collected into a map or database in order to help finding the right one for your specific problem.

**Method:**
- Literature study
- Detailing
- Architectural design case studies

Mentor: Marcel Bilow
Building product innovation: History and future

**Topic:** Rising complexity and technical demand on building products present new challenges to architects, designers, engineers, and system developers. The Circular Economy aims to radically change the industry, from the way we design buildings to the way we manage and operate them.

**Research question:**
How have building products evolved over time? What challenges have they met and what development can we expect in the future?

**Design Question:**
What will be the impact of the Circular Economy and energy transitions on the development of building product design, fabrication, and supply?

**Method:**
-Literature and case-study research.
-Stakeholder interviews.

**Mentor team:** Tillmann Klein, Juan F. Azcarate-Aguerre

Theme: Façade Design/Climate Design
**Topic: Additive manufacturing for the building envelope**

(Group of 3-4 MSc Students)

Following the development of the additive manufacturing done at TU Delft, AE+T, this MSc group should investigate the potentials of various building materials (steel, Aluminium, Brick, Concert, glass, polymers, wood, paper) and functional integration for the performative building envelope. The idea is to develop integral building envelopes as real and functioning construction component.

**Research question:**
How can AM be used for functional integration in building envelopes?

**Design Question:**
What are design, material, function and process implications?

**Method:**
- Investigation of current state of the Art
- Definition of functional requirements
- Investigating material properties within the AM process
- 1:1 building and testing

Mentor: Ulrich Knaack / Lia Tramoni

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**Theme: Façade Design / Additive manufacturing**

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AE + T Honors Topics
Biodegradable Materials in Building Envelopes

**Topic**
- Dwellings (possible office buildings)
- Follow up of graduation project 05/2013
- Scouting for new materials, technologies or composites
- Building Physics
- Design and construction processes
- New products for buildings

**Research question**
What products and systems will enhance the use of biodegradable material in building envelopes?

**Method:**
- Literature study
- Experiments and Interviews
- Detailing
- Architectural design studies

Mentor: Tillmann Klein
Façade integration of strategies and new technologies to tackle urban environmental challenges

Large cities face severe environmental problems such as air pollution and high temperatures (urban heat islands). At the same time, façade design has traditionally focused on protective and regulative functions to conceive comfortable indoor spaces. Besides energy generation through solar collection, the external surfaces of buildings have not been largely explored in terms of their potential to improve urban environmental conditions.

Research question:
What are the current technological possibilities and what are their prospects for improving the urban environment through façade integration?

Design Question:
How can we integrate these technologies in façade components and systems seeking to promote widespread application?
What are the design possibilities and constraints derived by their application in the building envelope?

Method:
- State-of-the-art review of technological possibilities
- Interviews with experts and manufacturers
- Architectural concepts for façade components and/or systems.
Mentor Ulrich Knaack
Glass bundle truss elements

Mentor: Ate Snijder
Design for Disassembly

**Topic**
- Office Facades
- Follow up of graduation project 05/2013 focussing on curtain walls
- Looking at other industries (automotive,..)
- Design and construction processes
- New connection and material technologies and combinations

**Research question:**
What connection technologies will be required in the future to allow disassembly of facades?

**Method:**
- Literature studies
- Experiments and Interviews
- Detailing
- Architectural design studies

Mentor: Ulrich Knaack / Arie Bergsma / Tillmann Klein
**Deconstructable Sandwich-elements**

**Topic:**
The use of sandwich-elements have proven to be a sensible building methodology in terms of saving time and space on the construction site. At the same time, the success of sandwich-elements relies on the physical integration of materials in a composition that is difficult to disassemble. How does that fit in a in regenerative construction industry?

**Research question:**
How are prefabricated sandwich façade elements designed for multi-cyclic use?

**Method:**
- Definition of state-of-the-art of sandwich-elements
- Specification functional requirements and multi-cycle requirements
- Alternative solutions
- (Environmental) Assessment of alternative solutions

Mentor: Charlotte Heesbeen
**Sustainability data informed façade design**

**Topic:**
The design of the building’s skin is governed by energy efficiency and less by sustainability performance of materials. As a matter of fact, the development of a harmonized approach to do so, has just begun.

**Research question:**
How can sustainability data be used to inform the design process of façades?

**Method:**
- Definition of the case study facade
- Inventory of relevant (sustainability) indicators
- Impact assessment on case study facade
- Description of method used

Mentor: Charlotte Heesbeen
Adjustable prefabricated system for Cost-effective Building Renovation at district level

**Topic:** Prefabrication of the retrofitting components has the potential to achieve high performance results while minimising on-site construction time. However, the choice of measures to be implemented on building level, should depend on the specific context.

**Research question:**
What industrialised renovation approach is suitable to accommodate energy saving measures, depending on each specific energy supply context?

**Design Question:**
Design and detailing of a adaptable and customizable system for manufacturing and construction of prefabricated insulating panels?

**Method:**
- Investigation of current state of the Art
- Definition of functional requirements
- Detailing, 1:1 Mockup

**Info:** Follow-up of 2ndSkin projects.
**Mentor team:** Thaleia Konstantinou, Tillmann Klein
**Partners:** various

Theme: Façade Design/ Climate design
Energy systems for LT-ready Building Renovation

**Topic**: The Dutch government has the ambition to improve the Dutch building stock to energy neutral. To achieve this goal, it is necessary to develop products and processes for renovating residential buildings, as well as decarbonizing the energy supply. The synergy between energy savings both on building and district systems needs to be considered.

**Research question**: How to identify the energy supply system that is suitable for specific districts and what energy efficiency measures would that require on building scale?

**Method**:
- Investigation of current state of the Art of energy systems
- Definition of functional requirements for buildings
- Map potential for district renovations

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**Info**: Follow-up of 2ndSkin projects.
**Mentor team**: Thaleia Konstantinou, Sabine Jansen
**Partners**: various
**Integral business models for zero-energy renovation solutions: Pilot case Amsterdam Zuidoost.**

**Topic:**
The Energy Agreement for Sustainable Growth (SER 2013), indicates that 300,000 dwellings have to be renovated annually to achieve a carbon neutral building stock by 2050. Refurbishment upscaling has been hindered by the lack of information about solutions, in terms of technological options, the energy consumption and the aspects that support a successful business model, such as cost, revenue structure, stakeholders and circularity.

**Research question:**
What integral approach is needed to address the complexity in the refurbishment decision-making

**Method:**
- Literature research on business models for refurbishment.
- Definition of technical options for buildings
- Evaluation of performance

**Info:** Follow-up of 2ndSkin projects.
**Mentor team:** Thaleia Konstantinou, Sabine Jansen
**Partners:** various
Topic: Circular economy design asks for new architectural solutions. Climate targets for 2050 require new insights and considerations regarding improvement on energy and material circularity. The building stock of the Central government Real Estate agency is facing a major renovation challenge. This transition of work-buildings from 1965-1995 requires integrated, energy-producing, adaptable, architecturally high-quality examples.

Research question: How do the existing building characteristics of this envelop influence the potential for renewal: creating insight and analysis of the potential of what is already there and what may come.

Method:
- Casestudies showing building method & construction
- Casestudies showing material use & connections
- Casestudies showing architectural characteristics
- Literature study on energy and material circularity

Mentor team: Anne Snijders (architectural Engineering)
Thaleia Konstantinou (Building Product Innovation)

September 2, 2019
Architectural Values of Residential Neighbourhoods

**Topic:** Residential neighbourhoods in post-war New Towns are not recognised as cultural heritage, yet. At the same time, they are facing major challenges like the energy transition and need for densification, asking for interventions in architecture and urban setting. Before large-scale renovation processes start, more knowledge about their characteristics is needed, to prepare for a respectful approach and (physically and socially) sustainable neighbourhoods.

**Research question:**
What are the values and attributes of the architecture in residential neighbourhoods in New Towns (1965-1985)? How can we respect and optimise these in design interventions?

**Method:**
- Case Study research
- Ethnographic research
- Observation, documentation, analysis
- Research by Design

**Mentor:** Lidwine Spoormans

Theme: Heritage & Design