Graduation Plan

Personal information

Name: Antigoni Lampadiari-Matsa
Student number: 4516907

Graduation Studio

Name/Theme: Building Technology Graduation Studio
Teachers: Ulrich Knaack, Regina Bokel
Argumentation of choice of the studio: Part of the Building Technology Track

Graduation Project

Title of the graduation project: Adaptive fabric façade for a high-rise in Paris

Research Objectives

Main objective

To design an adaptive fabric façade for a high-rise in Paris

Sub objectives

- To research the properties of different fabrics/textiles
- To investigate their properties in terms of thermal and acoustical insulation, as well as transparency levels, UV protection, water and airtightness, reaction to fire, soiling behaviour
- To explore the kind of the desired adaptivity (light-sun/temperature-heat/air-wind)

Research Question

Main research question

- How can an adaptive fabric façade be designed, a façade that will be responsible for improving the indoor comfort in terms of thermal and acoustical insulation, as well as shading and sun control in a high-rise in Paris?

Sub questions

- Which are the main problems of high-rises that should be tackled?
- Which are the most suitable fabrics/textiles as a solution to the above problems?
- Which is the most effective design of a façade component that meets the requirements?
- How can the desired adaptivity be achieved? With what kind of mechanisms?

Method Description
Literature survey

The first part of the project consists of a literature survey concerning the various types of fabrics/textiles and more specifically their properties. In addition, the available coatings will be mentioned and their advantages, as well as some new technologies, which are being integrated gradually to fabrics (photovoltaic films, PCMs). Subsequently, a comparison table on fabrics will be produced depending on the advantages and disadvantages of each one of them. Then, a list of reference projects will be mentioned, in which fabrics/textiles are used, either as roof -which concerns usually most of the cases- or as façade components.

Furthermore, a research will be conducted concerning high-rise buildings. The main problems of such buildings will be explored and then some reference projects will be mentioned focusing on the ways architects and engineers dealt with the highlighted problems.

Moreover, the climate conditions of Paris will be examined (diffuse and direct radiation, average temperature, wind direction and speed, humidity levels) and also the required indoor comfort will be defined.

Lastly, a number of design concepts will be presented -based mainly on façade principles- that could be applied to high-rises and are suitable for dealing with the already mentioned problems.

Analysis and conclusions

After the completion of the literature review, all the gathered information will be analysed and as a first step a certain number of fabrics/textiles will be highlighted according to their endurance, as well as their good thermal and acoustical properties, transparency levels, UV protection, water and airtightness, reaction to fire, soiling behaviour. Secondly, two or three design concepts will be chosen in order to be developed further. This choice will be based on their adaptivity, feasibility, thermal and acoustical insulation properties, transparency and shading, air and water tightness, reaction to fire, soiling behaviour. Finally, a case study will be selected onto which the façade concepts could be applied.

Design phase

The designed concepts mentioned above will be developed further. The design will become more detailed and physical models will be constructed as well. Subsequently, calculations will be conducted concerning their thermal and acoustical performance. Afterwards, the one with the best performance that will meet all the requirements will be finally chosen. This final concept is going to be analysed once again and designed further with detailed drawings and calculations. A final physical model-prototype will also be constructed. Finally, conclusions about this proposal will be drawn and suggestions will be made in order to avoid possible mistakes and failures in the future.

Relevance
Designing an adaptive fabric/textile façade for a high-rise can have many advantages in terms of sustainability. The protection of the environment and the reduction of the energy use constitute two main goals of the sustainable design. Such façade components can be rather lightweight, which has an impact on the structural elements of the rest of the building that can be reduced and thus less material is used. Another aspect, which should be taken into account, is that of recycling. Nowadays, technology has been significantly developed towards this direction. For instance, the French company “Serge Ferrari” has developed a procedure named “Texyloop” that renders membranes recyclable and also it aims to create new materials, which can then be reintroduced into the membrane fabrication process. Furthermore, the properties of fabrics concerning their transparency, translucency, insulation and solar protection, as well as coatings, such as low-e coatings, applied onto them can be rather beneficial for creating low energy buildings. Consequently, such design solutions could be considered an innovative sustainable idea in the building domain that will also be responsible for reducing construction costs.

Bibliography
1. Garbe, T., editors: Lang, W., McClain, A., Tents, Sails, and Shelter: Innovations in Textile Architecture, (based on a presentation by Dr. Jan Cremers)
13. Hemel, M., Kuit, B., (2010), Supermodel: making one of the world’s tallest tower, nai010 publishers