



FASHION FACTORY OF TOMORROW

**creating healthy and comfortable working conditions
for factory workers of the fashion industry**

reflection paper



inside garment factory PT Perdana Firsta in Bandung
[picture by Mo Smit, April 2017]

01. What is the relationship between research and design in the graduation project?

Design buildings and engineer solutions that make our living and working environment 'greener', both literally and figuratively, is one of my passions. In every design assignment I ask myself the question: how can this building contribute to making the world a healthier and more comfortable place? Therefore, choosing the fashion industry in Bandung (Java, Indonesia) as the context for my project felt as a good opportunity to design a building that has a positive influence on the lives of people. Due to documentaries and news articles I knew already something about the problems within this industry, including the unhealthy working conditions in many factories. But the more research I did during my graduation project the more problems there seemed to be. Designing within this Indonesian context was a jump into a whole new world that requires a different way of thinking. Designing for the fashion industry brought me into a world with countless problems and endless ways in which improvements are necessary.

During the first semester of my graduation project I focussed my research on the existing problems regarding the indoor environment of garment factories. I studied the four main aspects of the indoor environment: lighting, acoustics, thermal comfort and indoor air quality. But during my research I realized that there is a strong relation between the local outdoor climate, the building design (exterior and interior) and the quality of the indoor environment. So I broadened the scope of my research by including the climate characteristics of Bandung and the relation between these climate characteristics and suitable local building design strategies (also called 'passive building design strategies').

Studying all these different aspects related to the indoor conditions within garment factories was a logic thing to do, but it made it difficult to reach a sufficient level of depth in my research findings. Looking back, I'd rather have studied fewer aspects in more depth (for example: 'daylight in factories'). It was quite a challenge to go beyond creating a good summary of the key facts and connecting the dots between all the related aspects.

Observing existing factory buildings in Bandung (including a factory visit) and studying the aspects of health and comfort in the indoor environment, made it clear to me that these factory halls don't

measure up to the requirements of good indoor conditions. It seems that existing factory halls fail in terms of sustainability, human health and human comfort. It proved to me that serious and fundamental improvements are required.

After my research, I formulated the objective of my graduation project:

To design a sustainable vertically integrated clothing factory in Bandung, by making optimal use of passive building design strategies, in order to create a healthy and comfortable indoor environment for the workers.

I started my design process with a long list of requirements. Building physical requirements are very important when the goal is to create a healthy and comfortable indoor space. My research also provided information on how to use passive building design strategies such as: orientation, roof shape, facade openings, etc. This in order to achieve the desired level of health and comfort. Furthermore, when designing a sustainable and 'future-proof' factory building, aspects like material-, energy- and water-use should be taken into account. Finally, to make my factory design feasible and affordable it was crucial to keep the design solutions low-tech and low-cost.

The long list of requirements made my design process quite complex. Instead of giving some requirements priority, I directly tried to find a solution that would fit them all. After a few weeks I focussed on 'daylight accession', and that gave a breakthrough in my design process. So my design process would have been less complicated if I had focussed on one or two aspects from the beginning.

When looking at my final design, it can be concluded that my passive building design strategies solved most of the problems in the existing factory halls. These solutions are: sufficient daylight, view to the outside, natural ventilation flow, warm air outlet in the roof, window in the facade that can be opened to allow more airflow on warm days and acoustic measures to soften the noise of the machines. My research directly influenced my roof-, facade- and spatial design.

02. What is the relationship between the theme of the studio and the subject chosen by the student?

I have always been interested in how our building environment influences human health. Also, during my Bachelor I have developed a strong interest in the more technical aspects of architecture: building constructions and building physics. I designed all my project from a 'technical' perspective. First, I chose a technical or physical building aspect related to the design topic. Second, I researched this topic, and finally, I integrated this topic into my building design. By integrating technical solutions from the start of the design process, the end result could be more than 'just' a beautiful building. It could also be a smart building, with well thought-through solutions.

During my Masters I discovered that this way of designing fits perfectly into the philosophy of the studio 'Architectural Engineering' (AE). That was the reason why I chose this studio as my graduation lab. Within this AE-graduation studio it is all about integrated design projects, where architecture and engineering are irreversibly connected. There are several focus areas, among which material research, circular economy design and building physics.

The AE-graduation studio gives the students several locations to choose from, among which also the city Bandung (Java, Indonesia). Bandung has a large textile and garment industry, with factories located both in and around the city. These factories have a negative impact on the living conditions within the city. Also, another serious problem is that most of the factories have poor indoor conditions that have a negative influence on the physical and mental health of the workers.

Due to my interest in the problem of the poor indoor conditions in the textile and garment factories in Bandung, 'building physics' automatically became my main focus area. Creating a healthy and comfortable indoor environment is only possible when taking the building physical aspects as important requirements for the design in terms of good solutions for providing daylight, natural ventilation, etc. Using passive building design strategies, in order to achieve good indoor qualities, helped to design a sustainable building as active, electricity-consuming systems are minimized. It also helped to keep the design affordable. Choosing local, sustainable and affordable materials resulted in the use of bamboo, wood, coconut-fibres and the re-use of metal sheets from the existing factory.

Looking at my final design, one can conclude that architecture and engineering are well connected. The factory design is low-tech and relatively basic, but it provides effective measures to create a healthy and comfortable indoor environment.

03. What is the relationship between the methodical line of approach of the studio and the method chosen by the student?

A graduation project at the Architectural Engineering studio is divided into two parts, both with the duration of one semester: 1) extensive research; 2) design. Personally I like this approach, since the research provides valuable information for the design process. After gaining knowledge on the chosen topic and collecting scientific information, it was in a certain way easier to make choices in the design process that can be well substantiated.

In previous design projects I always followed the same approach (research a chosen topic before starting the design process). Therefore I feel very comfortable with this way of working and I really appreciated the intensive focus on research. This gave me the possibility to find a lot of information on the chosen research topic without initially having to spend too much time working on design solutions. As a result, the research led to more fact-based information, without visual or stylistic influences of what I would prefer as a designer. This fact-based information was very useful for making well-considered choices during the design process.

For my research I used various research methods such as literature study, own observations and a questionnaire for factory workers. It turned out that this combination indeed gave me the possibility to establish a more complete overview and an analysis of the problems concerning the indoor environment of textile and garment factories.

The field trip to Bandung took place only halfway through the first semester (after 10 weeks). This was challenging for me, as my research depended to a large extent on the field trip. It was rather difficult for me to be very productive with my research before the field trip. The trip was important to get the research going. Being at the location, observing the problems in a local garment factory and experiencing the atmosphere of Indonesia changed my perspective.

After we returned from the two-week-long field trip I became even more productive, since I knew much more about the context of my research topic. But by then time was running short. I also struggled with finding a balance between the width and the depth of my research in the few weeks I had left. Looking back at my research paper, it was too broad to cover the whole indoor environment (light-

ing, ventilation, thermal conditions and acoustics) of factories as my topic. Therefore, I should have restricted my topic, for example 'daylight in factories'.

Though I really enjoyed doing research, I found the first semester quite tough in terms of deliverables. It was the first time in my life that I spend so much time writing. For someone like me that is very tough, because of my serious level of dyslexia. Having trouble to find the correct professional and scientific words and to formulate logic sentences, I had to spend a lot of time putting my findings on paper instead of actually doing the research.

Though the research phase provided valuable information, it turned out that the shift to the design phase (after the P2) was harder than I expected. I had a long list of requirements for my factory building, and directly from the beginning I wanted to find an integrated solution that would fit all of these requirements. As a result, the design process was slow and I got stuck often. It would have probably been a smoother process if I had put my focus on just one or two aspects and search for separate solutions instead of trying to find one perfect integrated solution all at once.

Furthermore, it would have helped my design process if I had made more use of models instead of just sketches and drawings. Halfway through the design process I made some sketch models to study the roof shape, which turned out to be very useful for further decision-making. So I should have used this method earlier in the design process. The same goes for the use of a daylight simulation program. I used this to study different roof shapes in order to decide what would be the best shape to prevent direct sunlight from entering the building while providing the interior with as much daylight as possible. If I would have used this simulation program earlier in the process, I could have made my final decision on the roof design sooner.

Unfortunate was the number of software and technical issues that I encountered with the simulation program. These issues were difficult to solve, even with the help of the faculty's IT-helpdesk. It took a few weeks to solve the errors, with as a result that my graduation planning delayed.

04. What is the relationship between the project and the wider social context?

My graduation project focusses on the improvement of the indoor working environment in garment factories. Worldwide a lot of research has been done to address the issues of the working conditions in these factories. The main problems are absence of sufficient daylight, poor artificial lighting, to high indoor temperatures, to much noise and poor indoor air quality. Although these problems are well known and addressed, hardly any steps of improvement are taken.

In ancient Asian civilizations there was a consciousness and expertise on how to design buildings in a way that they make the best use of the local climate, to create comfortable indoor conditions. This is called 'passive building design strategies'. It seems that today this knowledge is either lost or simply neglected when it comes to designing and building factory halls. They are built as the most cheap and simple halls, neglecting the local climatic conditions and the activities that will take place inside.

My conclusion: the application of passive building design strategies for garment factory buildings is not at all common today. However, these could provide suitable and affordable solutions to improve the working conditions in garment factories worldwide. Therefore, it is the main objective of this project to design a factory with a healthy and comfortable indoor environment by using passive building design strategies.



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