

Reflection on Graduation Project

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The relation between research & design

The topic of microclimate and heat stress has quite broad coverage since it can be approached with different scales and it also depends on individual characteristics. As mentioned in the chapter 'Livability from microclimate perspectives', microclimate could be interpreted not only on urban canopy layer scale to discuss the atmosphere conditions in cities with surrounding rural areas but also in local thermal environments that differ from surrounding areas. In this thesis, the main research and design focus on neighborhood and block scale to improve thermal performance for the elderly. It is suggested that local microclimate is largely affected by surrounding urban settings which means that microclimate always varies depending on local situation. Therefore, the thesis is made up of research and design while relatively more workloads have been done on research part.

The main research splits into two main parts. The first section is about how heat waves influenced the life of the elderly and how to locate the elderly who were facing serious heat stress during heat waves while the second section focus more on the characteristics of local spatial factors such as orientations and widths of urban canyon once the study area has been chosen. The analytical framework instructed the study of the impact of heat waves on the elderly as well as spatial distribution of urban heat risks. Then the research from the perspectives of microclimate on a common typology in study area called courtyard block dwellings has been delivered to learn about the effect of different factors like size, shape and orientation. Afterwards, the attempt of spatial intervention on courtyard block dwellings through the approach of research by design has been carried out to explore the possibility and then to instruct the design. The strategies based on the results from research to mitigate heat stress on neighborhood and block scale have been introduced and the proposed design solution has been tested. To conclude, research and design are certainly supporting each other in the thesis with the relationship as a vicious circle.

The relation between project topic, the studio of Urban Metabolism & Urbanism

The faculty of Architecture and the Built Environment aims to deliver the research and study on not only urbanised areas but also the relationship between existing urban settings and nature while the track of Urbanism attracts more attention on urban issues and topics such as resilient cities and metropolitan cities. The studio of Urban Metabolism is focusing on developing future urban systems that are less damaging to the environment and more resilient to future changes. Some topics like energy, material and climate will be often mentioned with regard to Urban Metabolism. Different systems and flows will also be discussed in the studio, one of which is climate known as natural flows such as air, heat and storm water. Some discussions about mitigation of urban heat island as well as storm water management have become popular recent years and more attention has been drawn on construction of resilient cities. However, most of strategies on making cities resilience are applied through top-down approach

on large scale and less consideration has been focused on microclimate locally. Taking one of the vulnerable groups, the elderly, who were facing threaten from heat waves as a starting point, my graduation project focuses on urban design and spatial intervention of local microclimate which could be considered as the combination of different flows such as air and solar radiation to improve the outdoor thermal performance during hot summers in urban environments. The studio of Urban Metabolism can offer me necessary knowledge, tools and approaches to carry out a thorough and reasonable project.

Methods & approach

The analytical framework which illustrates how the study area in The Hague has been chosen follows linear structure and it helps to reduce the complexity of analysis. Data from different perspectives are also required to support the analysis while the timeliness and accuracy of data are also essential. Luckily, most of data is available on various official websites like CBS and KNMI in the Netherlands and some data could also be obtained from other research projects and reports like Haagse Hitte (Hoeven & Wandl, 2018). However, there is still some unexpected stuff such as deviation among data about average indoor temperature and the missing of data about building quality. Therefore, it posed a challenge that the weight of each factor is hard to define and some missing data is indispensable. In order to avoid the error caused by the accuracy of data, only the demographics from CBS and satellite images have been used to narrow down the ideal study areas to three neighbourhoods. Afterwards, other data such as average indoor temperature and dashboard of age-friendly city has been analysed to make the final decision of study area. Not comprehensive perspectives of analysis have been considered through the decision of the study area as well as only several factors play decisive roles in decision making, which shows the limitation of the analysis on The Hague. For further work on mapping the elderly who were facing heat stress during heat waves, Analytic Hierarchy Process (AHP) could be an option to determine the weights of each factor to achieve a more reasonable result if data from more perspectives could be integrated.

Experienced heat among citizens varies due to individual difference and the study areas which supposed to be relatively hotter in summer have been selected by ignore subjective impressions among citizens. Various factors such as gender, age, health situation and characteristics of surrounding environments will codetermine how each individual experience thermal environments. Consequently, different person will have different opinion on the thermal performance in totally same conditions, which also illustrates the limitation of the selected approach to only use objective data. The investigation among the citizens could help to minimize the impact of the deviation between subjective and objective if a sufficient number of samples could be achieved.

The timeliness of the research and investigation is the challenge but also limitation of this thesis. This thesis with topic about heat waves and hot weather was started from October and most of the research has been finished around January in 2020. There is no hot weather from October to January in the Netherlands so the research and investigation will generally base on literatures and people's memory. It would be better if the investigation could be conducted during summer but the schedule extinguished the possibility. Moreover, the breakout of the coronavirus globally also limited the investigation among the elderly so the study of the elderly has been conducted based on literatures and communication with Dutch people. It could be better to investigate the elderly during summer or even heat waves to support the research and design for the topic.

Last but not least for the research approaches, there is also some limitation about the criteria. Physiological equivalent temperature is a criterion to evaluate the thermal performance with the comfort value between 18 to 23 degree. However, the criterion is based on male adult so there will be limitation when the same criterion has been applied to evaluate the thermal performance of surrounding environments for the elderly. In order to avoid the deviation of criterion among different age groups, the evaluation of design has been conducted by comparison with the thermal performance of study areas before intervention. The difference could tell the effect of design and intervention properly.

Although there is also limitation of outdoor thermal performance between simulation and reality (Taleghani, Tenpierik, & van den Dobbelssteen, 2014b, 2014a), the approach of research by design to learn about the effect of spatial interventions in courtyard block dwellings on outdoor thermal performance is really effective and helpful. The method control variates has been applied to have a comprehensive understanding that how parameters which codetermine physiological equivalent temperature are influenced by space and vegetation. The complexity of

microclimate has been simplified and the outcome from research by design instructed the design of heat refuges a lot.

Societal, academic & ethical relevance

European Environment Agency stated that the number of heat waves has substantially increased across Europe in recent years (European Environment Agency (EEA), 2016). Tens of thousands of premature deaths have been caused by heat waves since 2000 and larger economic impacts could be expected such as exacerbate peaks in electricity consumption in summer (Baumert & Selmán, 2003; European Environment Agency (EEA), 2016). The impact of urban heat on human life and nature could not be overlooked especially in northern and western Europe where increasing number of heat waves has been witnessed in the countries with wild weather annually. As a consequence, heat waves and urban heat have already become a societal issue which will cause more unexpected deaths and uneven distribution of heat risks among the citizens (Fernandez Milan & Creutzig, 2015).

Existing urban settings have strong interaction with urban heat island and cause uneven distribution of heat risk. The situation will become even worse when it happens to the elderly who live individually or with a partner in their own homes, which could be uncovered from the statistics of monthly death among different age groups offered by CBS. The risk caused by uneven distribution of urban heat will be enhanced among the elderly when the elderly are dressing improperly or not informed with coming heat waves. Therefore, this thesis focuses on the elderly and propose to design for them to decrease the heat stress.

However, although the elderly are proved to be vulnerable to hot weathers, others such as babies, people who are overweight, people in nursing homes or hospitals and people who are socially isolated are also facing high heat risks (Fernandez Milan & Creutzig, 2015). Due to limitation of privacy and availability of data, the mortality, to which the elderly contribute most, is the few data that reveals the unnegligible impacts of global warming. The influence on other vulnerable group is hard to discover but it is also necessary and crucial to take other vulnerable groups into consideration in the thesis. Therefore, some strategies and design proposed in the thesis also consider about the interests of other people who are vulnerable to hot weathers in order to pursue fairness and equality.

As a thesis of graduation project, the potentials to contribute to the discussion of urban renewal process under the pressure from global warming could be discovered, which reveals the scientific relevance of the topic and project. Most urban microclimate design is on smaller scale compared with urban planning and always depends on the situation in the sites, which shows less potentials of application in other places. The research of typology study and design of temporal spatial interventions could add up to the potentials of urban microclimate design to be applied in more places with a proper adjustment. Besides, some strategies for courtyard block dwellings and temporal spatial interventions in the public spaces could also be an approach that join the public health institutions and urban planning sector and then offer more efficient benefits to the public.

Transferability of results

This thesis focuses on neighbourhood and block scale to discuss about the solution to improve the outdoor thermal performance in the Netherlands which is the blank between public health intervention which is effective on individuals and urban planning which usually focuses on city or regional scale. The approach that the scope narrows down in the selected test field from larger scale to smaller scale and then the results from research and design feedback to larger scale could also be applied in other researches.

The study typology courtyard block dwellings is common in the Netherlands and the researches have been focusing on orientation and the shape of block instead of materials and pavements, which uncover its potentials to inspire the research of similar typology in other locations. Moreover, this representative typology mainly appeared in the Netherlands around 1920s to 1950s, which is facing the challenge of urban renewal in coming years especially under the pressure of rising global temperature. Therefore, the research in this thesis could help to inspire the coming renewal process.

However, the research based on simulation with ENVI_MET also reveals its limitation since the models have been simplified by remove fences and vegetation inside the courtyards in order to reduce the workload of the computer.

The actual microclimate should be more complex than the result from simulations and microclimate also varies depending on surrounding urban settings so the result from research and design in this thesis also have limitation to apply to other places with similar typology. Instead, it could help to offer the brief impression to researchers and designers and more analysis should be carried out according to local situation to have a comprehensive understanding of study or design areas.

Discussion of ethical issues and dilemmas encountered

The main challenge encountered during the research and design is the missing investigation among the elderly. Not only the issue of schedule but also the breakout of the corona-virus restrict the investigation among the elderly during heat waves and it is also hard to learn about the demands from the elderly in study areas. The literature review and communication with Dutch people help to minimize the impact of missing data but the outcome of design still seems to be general instead of focusing on the elderly or specific group of the elderly in study areas.

When it comes to potential applications of the design outcome in practice, most of the strategies are flexible which means they have great potentials to apply but the cooperation with stakeholders is challenging. For example, either 'rent' private lands to plant trees inside courtyards or the application of temporal spatial interventions need the coordination with stakeholders like individuals who own the lands or the sponsors such as NGO or municipalities. Moreover, taking planting trees inside courtyards as an example, since the trees will provide shades not only on the ground but also on the facades of buildings, some owners may prefer the sunlight coming into their bedroom instead of being blocked by trees. The stakeholders need to be convinced by the effects of interventions and then application of the design outcomes will be available.