Abstract of Dissertation

Investigating Green Urbanism for Sustainable Urban Architecture;
Measuring Effects of Urban Green Elements on Oppressive Cityscapes
（持続可能な都市建築のためのグリーンアーバニズム研究；
圧迫感のある都市景観における緑の効果の評価）

アスガルザデ　モルテザ

The proportion of the world's population living in large towns or cities has grown from around 5% to 50% over the past two centuries. Demographers estimate that by 2030 approximately two-thirds of all people will live in large towns or cities. The human population is thus becoming urbanized (Anthony, 2000). Through the recent process of urban development, characterized by urban expansion and redevelopment, industrialized countries have witnessed a surge in the number, scale and complexity of urban structures. However, it has become difficult to ensure that urban space meet the demands of society. These demands include upgrading social infrastructure in a sustainable manner and the regeneration of attractive urban space that is not only safe and highly efficient, but also conscious of psychological impact.

In contemporary urban spaces, large-scale high-rise buildings are profuse. The massive construction of high-rise buildings is continuing so that there are more than 500 buildings in Japan whose height exceeds 100 meters (Munakata, 1998; Otobe, 2006). High-rise building clusters increase the usability of urban space but on the other hand they make oppressive cityscapes, which are visually sensed by residents and visitors. These cityscapes bring feelings such as discomfort, oppression and invasion of privacy (Hwang, 2007). The term "oppressiveness" is coined as a translation of the Japanese word "圧迫感" (appakukan). This word refers to cityscapes that feature high-rise buildings which cause negative psychological pressure on residents. In previous research in Japan, "圧迫感" has been referred to with these words: "Oppression", "Sense of Oppression", "Oppression Feeling" and "Sense of Physical Oppression". The word "Oppressiveness" is said to contain the hidden meaning of physical magnitude. Oppressiveness is a barrier to achieving sustainable urban development.

Neuman (2005) reviewed empirical evidence as to whether compact cities represent a form of sustainable development. Some studies have shown a positive relation between compactness and

sustainability while others have shown a negative relation. These inconsistent relationships may be partly due to methodological problems. Different studies have used different indicators for compactness and sustainability, and many studies have suffered from a lack of control over potential confounding factors. However, aside from these methodological issues, it seems apparent that compact buildings have not always fulfilled its promise of attaining a shift in community development toward more complete sustainability. Explanations of the un-sustainability of compact cities have focused mostly on the ineffectiveness of urban management (Jenks & Burgess, 2000; Williams, Burton, & Jenks, 2000). In particular, there is increasing recognition that psychological factors play a role as well. It has been argued that there is an inherent tension or paradox between the notion of the compact city and people's desire for a spacious, green, and quiet environment (cf. Wiersinga, 1997).

To date, in Japan the psychological pressure of urban space has been researched by numerous academics (Hwang, 2007; Byun, 2009; Takei 1979; Hirate, 1995). Through a research project aimed towards measuring the oppressiveness of buildings, Takei et al (Takei, 1977.9, 1977.11, 1978.9) concluded that the parameters of the physical shape of buildings is the driving factor of oppressiveness. Takei suggested that the solid angle and configuration rate of buildings are the best indicators for oppressiveness. The research determined that the permissible value of oppression is up to 8% building's configuration factor. In the case of a building with a configuration factor of over 4%, the building should be discussed as an influential element in the urban environment (Takei, 1978.1).

Takei et al (1978) suggested that ω (Configuration Factor) can show the oppressiveness perception. Hwang (2007) added the distance of viewer to the building (r) and developed the formulation to

$O = \sum \omega \times r^3$ where O is the "Oppressiveness Perception".

Previous surveys conducted in Japan reported many respondents feeling that trees in the vicinity of buildings as producing an alleviating affect on oppressiveness. (Takei, 1981) Takei et al (1983) in his research showed "tree-planting in the area around single-standing building has an impact on reducing the feeling of oppressiveness". To-date, the mitigating effect of trees on oppressiveness of cityscapes remains "unmeasured".

This research was conducted to clarify the effect of trees in "real" urban environments, to examine the different distances from trees and buildings and different kind/percent of urban greenery in the field of view. Also to assess the influence of trees in narrow sidewalks on oppressiveness (圧迫感：appakukan) and on the feeling of freedom experienced in open spaces or 'openness' (開放感：

kaihoukan) as well as to assess the relation between the effect of trees' and sky in terms of oppressiveness of cityscapes. The end goal of this research is to facilitate decision making of urban policy makers by creating a formula that included the influence of urban trees'. This research also looked at the accuracy and applicability of findings in different countries. The research findings from the cross-cultural comparison on oppressiveness show that further research is needed in this area.

The first experiment was conducted in the real urban environment of Hongo area in the center of Tokyo. Hongo Street was chosen for this experiment due to its characteristics that resembles a typical Japanese street with narrow sidewalks and high-rise buildings. This experiment was done to clarify the effect of trees on oppressiveness and assess the compatibility of Takei et al.'s (1983) research on Greenery's effect on oppressiveness in the "real urban area". Five building compounds were selected, all located in the Hongo area and twenty people were asked to sit on small chairs in front of the buildings and fill-in the pre-designed questionnaire. The mathematical value of "Solid Angle" was evaluated for all urban elements of each of the 15 cityscapes. This included trees, buildings and sky. Results showed that trees significantly reduced the oppressiveness of cityscapes. The results of the experiment were in accordance with Takei et al research but they showed more complexity relating to the effect of trees on human psychology. The perception of oppressiveness and openness are inter-connected. When an urban element successfully reduces oppressiveness (e.g. trees), it simultaneously reduces the perception of openness. The secondary effect of reducing openness is undesirable for the urban environment. Through the research it could be understood that in the urban area, many factors are influencing people and investigating the effect of only one or a few elements on human psychology is complicated. The similar effect of trees and sky on human psychology in terms of oppressiveness and perception of openness as well as the complicated effect of trees, observed in urban area led this research to do the second experiment in a more controlled environment.

The second experiment was conducted to assess the relation between the effect of trees and sky in terms of the perception of oppressiveness in urban environment. The fact, observed by many researchers including first experiment of current research showed that sky and trees have a similar mitigating effect on oppressiveness. In terms of environmental psychology trees could be addressed as pieces of sky on the streets. The second experiment was conducted to clarify this relation in a controlled experimental room. The other aim of this experiment was to separate trees, sky and buildings from other urban elements and study their effects on each other in a controlled environment. One of the cityscapes of Hongo Street was chosen and reconstructed utilizing 3D-Computer Graphics. Different "numbers" of trees in different "distances" from the observer as well as different "building heights" were adding, in total 48 photos were generated for the

experiment. The photos were projected onto a wide screen in the experiment room to visualize the urban environment situation and scale. Photos were shown to 40 participants and they answered a pre-designed questionnaire after looking at each generated scene. Results of this experiment confirmed the effectiveness of trees in reducing oppressiveness. The experiment responses showed that the sky is much more effective on oppressiveness than trees, but that trees have the ability to bring the perception of oppressiveness for each cityscape close to the medium of the oppressiveness scale which is measured on a scale of one to seven.

The formulation that showed the most correlation with the perception of oppressiveness and openness was found to be as follows:

$$\sum\{(\omega - \alpha) \times r^3\}$$

Where "ω" is the configuration rate, "r" is the distance from the building complex and "α" is the configuration factor of "Trees Covering Building".

The results also showed the different effect of trees covering the view of the sky and trees covering the view of the buildings. The effect of trees that cover the building's façade is significantly better than those parts of trees that cover the sky. Therefore, it could be assumed that greenery that covers only the building's façade is the best option to decrease the building oppressiveness (圧迫感: appakukan) while at the same time not really decreasing openness (開放感: kaihoukan). This assumption needs further investigation and is the reason that led to the third experiment.

The third experiment was conducted to assess the accuracy of the hypothesis that all kinds of greenery have similar effects on human psychology, specifically on oppressiveness and openness in the urban environment. The other aim of this research was to see if the greenery on the façade of the building would mitigation the oppressiveness of cityscapes while also inducing a feeling of openness. The methodology for this experiment was very similar to second experiment. The same cityscapes of Hongo Street were chosen and reconstructed utilizing 3D-Computer Graphics. Different parameters of greenery on the façade of the building with different "amounts", "Leaf Density", and "allocations", as well as "different building heights" were added; totally fifty-one photos were generated for the experiment. The photos were projected on a wide screen in the experiment room to visually reconstruct the urban environment. Photos were shown to twenty participants and they answered a pre-designed questionnaire after looking at each generated scene.

Results of the experiment unexpectedly showed that the greenery on the façade of the building had a negative impact on the perception of oppressiveness. The greenery on the façade was hypothetically

assumed to have a similar effect with trees, and thereby mitigate the oppressiveness, but results showed the opposite. The impact of greenery on the façade of the building is either not significantly positive or totally negative. The location of greenery on the façade of the building showed significant impact on the perception of oppressiveness. The higher the greenery is on the building's façade, the better the impact is on oppressiveness. This shows that not all types of greenery would contribute to the urban environmental psychology in the same positive way. It is possible that the impact of greenery on the façade could be improved if a more aesthetically pleasing design was applied to the greenery on the façade.

The results of this experiment challenge the part of the idea of green urbanism, which focuses on increasing the quantity of greenery in the urban area in order to achieve a better urban environment. In fact, this research shows that further research on the assumptions of green urbanism theory is necessary. This research aims to provide a tool to assist policy decision makers improve the urban environment and therefore needs to be applicable in different cities and countries. The next experiment looks at whether oppressiveness could be different from nation to nation. This question led current research to the next and final experiment of this thesis.

The fourth experiment was conducted to assess the influence of nationality and cultural background on the perception of oppressiveness.

So far, the research about oppressiveness and openness in the urban environment has been conducted only in Japan. That is also why the word "圧迫感" (apakukan) and "開放感" (kaihoukan), which are equivalent to "oppressiveness" and "openness" respectively, are Japanese concepts. Other nationalities might also feel this oppressiveness even if they don't have specific words or research. Therefore proving the applicability of these concepts to other nations would prove the transnational nature of the problem. Twelve photos from the "Marunouchi" area in central Tokyo and twelve photos of the area around "Victoria Street" of London were selected and shown to twenty Japanese and twenty British nationals in Tokyo and London respectively. Results showed that while there are differences in perception of oppressiveness, British perceive a significant amount of oppressiveness, however, the oppressiveness perceived by British nationals is significantly less than Japanese nationals. Through the analysis, a significant difference between females and males was also observed. Women showed more sensitivity to oppressiveness than men and their responses changed dramatically when greenery was introduced to the scene.

Results showed that the difference between the Japanese males and females was less than the difference between British males and females. These results show the importance of introducing and

defining oppressiveness in other countries and addressing the problem in order to make the urban environment more livable.

In conclusion, this research is a step towards identifying the key parameters of healthy urban landscape. This in turn will help researchers and urban policy makers to understand which kind of landscapes have the strongest positive psychological effects, and therefore, from a health and well-being perspective, what can be done to improve urban settings in terms of research and regulations. Further development of the formulation can give concrete decision-making power to policy makers in terms of legislating regulations for the construction of cityscapes that are less oppressive. Such an understanding would then contribute to the search for functional urban architecture beneficial to human health and environmental sustainability.