The Effect of Visual Stimuli of Planned Residential Streetscapes on Way Finding Behavior of First Time Visitors

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Abstract

This paper is concerned the streetscape visual stimuli making streetscape confusions as well as the visual stimuli making trouble-free bidirectional movements of first time visitors to an area. Pedestrian/vehicle streets around Saitama University, Japan were selected for the study. One forward movement movie along a streetscape with 5 movies of backward movements from different streetscapes were displayed to a group of subjects. Subjects were asked to select the correct backward movement analogous to the forward movement and a questionnaire was given to fill with the answers for individual's selection. This method was repeated by changing the forward and backward movies along streetscapes and the group of subjects. A significant variation could be identified in the backward path selection corresponding to the forward movement. Visual stimuli which caused streetscape confusions and the visual stimuli that helpful for correct path selection were identified. The visual stimuli that made streetscape confusions and that made correct selection were significantly similar among different planned streetscape groups.

Keywords: *planned streetscapes, visual stimuli, bidirectional travelling*

Introduction

This article is concerned about how people confuse in bidirectional travelling along planned streetscapes for the first time. The research study is aimed at contributing to knowledge about the relative roles of layout of the streetscape environment and local visual stimuli in bidirectional travelling.

Travelling along an environment is a progressive movement. It makes serial visions on the pedestrian's cognitive memory and these serial visions are perspective. The structure of the streetscape is developed on pedestrian's cognitive memory through the experience gained from the serial vision of the streetscape. Gordon Cullen (1961) in his book, Concise Townscape, proposed a serial approach to the design of public space in recognition of the constantly moving pedestrian vantage point. A visitor doesn't have any prior knowledge when he travels along the streetscape to a destination first time. In the absence of previous experience of the setting, information about arrangement, content and the opportunities will be acquired while navigating the places and spaces of the setting. How such information is sorted and stored in cognitive memory is dependent on the nature and specificity of individual purpose. The picture developed in cognitive memory through serial vision is helpful in returning along same path or in bidirectional travelling. Generally pedestrians remember a path with the help of visual elements present in both sides of streets. If the visual elements present in the streetscape are unique or has a quantity of distinctive qualities, then the pedestrian can easily create a good cognitive memory which will be useful in returning along the same path. However, in most of the time, first time visitors are misled by the streetscape views and they are unable to find the correct path to return. This is very prominent in planned residential areas with very similar streetscapes views. The picture created in the cognitive memory will not be helpful in most of the cases for finding the correct returning path d due to the similarities among streetscapes in the to the similarities among streetscapes in the planned landscape areas.

Objective

1. To find out whether the planned streetscape views cause confusions in bidirectional travelling

2. To find out the visual stimuli that are helpful in bidirectional travelling and the visual stimuli that cause confusions in bidirectional travelling for the first time visitors to an area.

A special consideration is given to the planned residential areas in Saitama Prefecture.

Overview of the Present Study

This article addressed the problems faced by the pedestrians in planned landscape areas. This study was attempting to find out the reason behind the misleading in bidirectional travelling of planned landscapes. The visual stimuli in the visual environment that cause confusions in the cognitive memory of the pedestrian as well as the visual stimuli that helpful for correct path selection in planned residential areas were identified in this research. It will be helpful in landscape designing and planning to make the landscape areas with unique qualities to have much more friendly environment to the residents of the area and to the visitors to the area.

Very little prior studies are available on pedestrians' behavior on streetscapes. Most of the past research studies were about path choice and the exploratory behavior of pedestrians along streetscapes. Studies on serial vision on bidirectional travelling are very much lacking in the scientific literature. Further the researches on planned landscapes are very much lacking. Ambition of landscape planners is to get the utmost benefit from the available land area, however, they could not recognize the problem behind making very similar structures on landscapes. High similarity in the streetscapes of planned landscapes causes confusions in the travelling along landscapes. This is very problematic in bidirectional travelling when the pedestrian wants to find the returning path. Past researches have not addressed this issue yet. Thus, this study shows a new arena of research on streetscapes especially the confusions occur in bidirectional travelling along planned streetscapes.

Wrong path selection happens in any type of streetscapes such as vehicle dominant streetscapes, pedestrians/vehicle streetscapes or pedestrian dominant streetscapes. For this study, pedestrian/vehicle streetscapes of planned residential areas were selected. Well planned landscapes could be seen in all most all urbanized areas in Japan. Since the amount of usable flat land area is less in Japan, the landscape planning is essential for the best use of the available flat land area. The landscape planners design the landscapes according to the regulations of the landscape authorities of the relevant prefectures of Japan. Within one prefecture, all the landscapes shows similar patterns, for example, all the residential areas within one prefecture shows similar way of arranging landscape elements. The study is focused on the streetscapes in residential areas around the Saitama University in Japan at the Saitama Prefecture. The streetscapes around Saitama University are pedestrian/vehicle streetscapes and the area is highly dense with residential units. When the streetscapes were subjectively observed, one can easily states that the structure of all most all streetscapes are similar to each other with similar patterns of housing units and other elements in the streetscape. Therefore it is obvious that a new pedestrian to the area will be misleading by the streetscape views. New pedestrians most of the time complaint about the difficulties they faced while travelling along streetscapes in this area. However, these complaints are just subjective. Thus, through this research, the main aim was to verify whether difficulties that pedestrians faced along streetscapes in bidirectional travelling are truly occurred due to shortcomings in the planned streetscape views.

Physical Attributes Relevant for the Study

In this study two physical attributes were considered; architectural variation and streetscape complexity.

Complexity has been defined variously as the number of elements present in a scene (Herzog; Kaplan & Kaplan, 1982) and more particularly as the "noticeable difference" between elements (Rapoport & Hawkes, 1970, p. 109). In their analysis of environmental preferences, Kaplan and Kaplan (1982) propose that people have an innate need to be involved in the environment, meaning that they gather information which they can then make sense of and integrate into

mental representations that support effective functioning. In their framework, the complexity perceived in a scene is considered an important determinant of preference because it encourages exploration and offers immediate involvement with the environment.

Researchers have long considered the number of turns in a form's silhouette, or the number of points that construct a geometric shape, to be predictive of subjective responses (Attneave, 1957). Studies have shown that perceived complexity is strongly positively associated with the number of turns in skyline silhouettes (Heath *et al.,* 2000; Nasar & Terzano, 2010; Stamps, 2002; Stamps, 2003). Stamps (1999a) compared preferences for building façades with different shapes and concluded that façades with five turns were preferred over those with four turns. Stamps (1999b) argued that the physical determinants of surface complexity can be represented in a clear and objective way by utilizing the theory of visual perception developed by Van der Laan (1983). Accordingly, he proposed that elements with lengths of 1/7e1/49 of the façade length would be perceived as surface details. He also claimed that increasing the amount of the area of the building façade covered by elements within the length of 1/7e1/49 of the façade length would increase the perceived surface complexity (Stamps, 1999a). He found that perceived surface complexity increased with increased window and door trims and ornaments that fit within these size ranges (Stamps, 1999b). Therefore architectural variation included the building shapes and the ornaments presented on the buildings in streetscapes.

A considerable complexity and a good architectural variation make a place lively. This is applicable to streetscapes as well. If a streetscape has good architectural variation and a complexity, the pedestrians feel lively and feel enthusiastic in travelling along the street. Further such streets will create memorable picture in the cognitive memory to help the traveler in bidirectional travelling.

Study Area

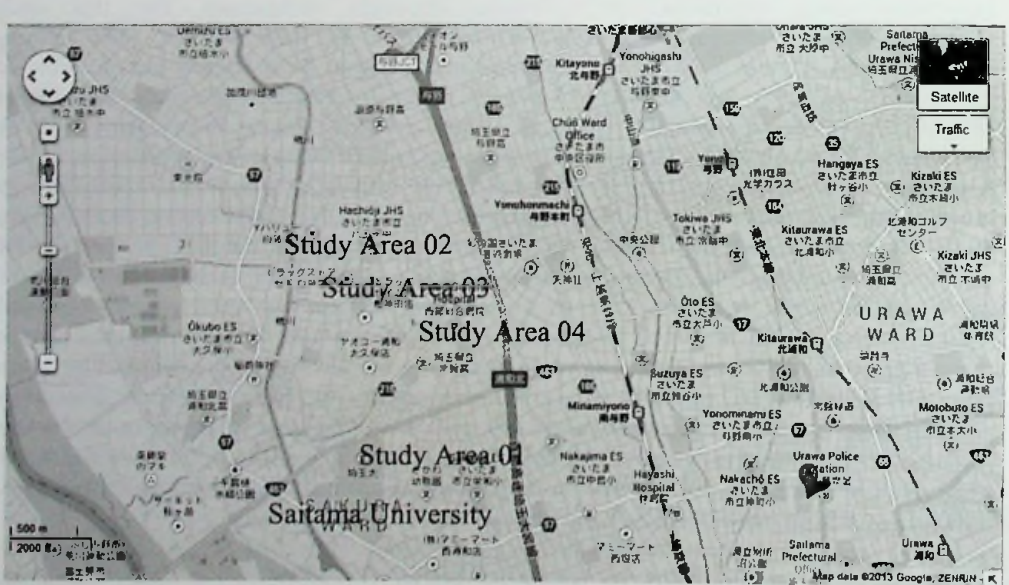

Figure 1: Selected Study Areas around the Saitama University

The study focused on 4 main planned residential areas around Saitama University. From each selected study area, 7-8 residential/vehicle streets were selected randomly for the study. Thus, altogether 30 streets were included in the study. Street network shows a grid pattern in the study area. The width of a selected street is averagely between 12-15 feet. The length varies according to the selected staring point and the ending point of the street. The streets were selected from one node to another node of the grid network. The same criteria were applied in the process of

selecting the streets for the study. The Figure 2 illustrates the grid pattern of the street network and the parameters of the selected streets.

Figure 2: Layout of Selected Streets

⟷ : Road Length – length between two nodes of street network
⟶ : Forward movement direction
1-7 : Selected streets

The streetscapes consisted of one to three stories residential units. The retail shops could rarely be observed on some of the streets. Figure 3 displays a typical residential/vehicle streetscape in the study area.

Figure 3: A Typical Residential/vehicle Streetscape around Saitama University

Methodology

Methodology consisted of selecting visual stimuli for the analysis, selecting participants for the analysis, conducting questionnaire survey and the analysis of data. Sections of methodology have explained below.

Selection of visual stimuli

Visual stimuli

Visual stimuli are the streetscape elements that act as stimuli for the pedestrians to remember their travelling path. These visual stimuli are important for creating a good picture in the cognitive memory of the traveler.

After conducting a preliminary subjective investigation of the study area, ten visual stimuli representing the two physical attributes explained above, were selected in streetscape views for further subjective analysis through an intensive questionnaire survey.

These visual stimuli are

a. shapes of houses
b. heights of houses
c. roof styles
d. color and texture of houses
e. orientation of houses
f. windows, doors or any other physical elements on houses
g. positions of windows and doors
h. front fences, walls and their appearances
i. street junctions and
j. street trees

Selection of participants

The participants in the questionnaire survey were entirely on voluntarily. The sample consisted of 60 participants representing countries like Japan, India, Sri Lanka, Nepal, Bangladesh, Vietnam, China and Pakistan. The degree of familiarity with the kind of planned urban environment presented in the images was low-to-moderate among the participants from other countries except Japan and China. However, before starting the questionnaire survey, a common question was asked from everyone that whether they have misplaced in streetscapes in any day of life they spent here. The answer from everybody was yes. Therefore, a prior conclusion was set that everyone participated in the survey had this confusion in bidirectional travelling along streets. It doesn't confine only to foreigners in Japan.

Conduction of the survey

Data collection was carried out via personal interviews with participants and via the internet. The purpose of the study and other necessary information (e.g., regarding informed consent) were presented at the "drop box" website, along with a link to start running the survey. When started, each participant was presented with series of streetscape movies from 30 selected streets of the study area. The movies were grouped with one forward streetscape movie with 5 backward

streetscape movies. One participant had to watch ten such streetscape groups and responded to ten questionnaire sheets. 60 participants were divided into 3 groups and the 10 streetscapes views for each participant group was given for the survey. Thus, there were 600 answers sheets for 30 different streets. The participants were instructed to find the correct backward movie for the given forward movie by watching the movies provided. He/she was instructed to watch movies one or two times only. In the questionnaire, the participant was requested to answer whether he/she could identify the correct backward movie and the visual stimuli that helpful for his/her selection. Participants were asked to rank visual stimuli according to the importance. Ranking scale was 1 to 10. Rank 1 is given for the most important visual stimuli that is helpful for correct backward movement selection or the visual stimuli that mislead the backward movie selection. Rank 10 is given for the least important visual stimuli. If the participant was unable to identify the correct backward movie, he or she has to give the reason for misleading by expressing what they observed in different streetscape views causing misidentification. In other words, participants were asked to point out the similarities they observed in streetscape visual stimuli among different streetscape views given to them.

Statistical Analysis

The data analysis was conducted in three ways.

1. *Simple counting of ranks obtained by visual stimuli*

The data were simply counted according to the given ranks to find out which visual stimuli got high number of priority level 1. Counting was done separately for each streetscape in each streetscape group.

2. *Probability calculation of priority ranking*

In this method probability of choosing each visual stimulus by the participants was calculated for each road separately by adding the priority ranks obtained by each visual stimulus.

3. *Weighted probability calculation of priority ranking*

In this method weights were given for the ranks and weighted probabilities were calculated for each visual stimulus ranking.

Three statistical analysis methods were used to find out the best method of analyzing the 600 survey sheets results.

Results and Discussion

Analysis of questionnaire survey results

The questionnaire survey produced a total of 600 answer sheets. The participants had given the priority ranks for the 10 visual stimuli for each road separately. The ranks were recorded for correctly identified streetscapes as well as for incorrectly identified streetscapes.

Streetscape groups

There were 3 streetscape groups. Each streetscape group had 20 participants. These 20 participants were asked to watch 10 streetscape movies containing forward and backward movies of streetscapes. Streetscape group 1 consisted of views from long streetscapes with irregular topography. Streetscape group 2 consisted of views from long streetscapes. Streetscape group 3 consisted of views from short streetscapes.

Table 1 displays the percentages of incorrect identification of streetscapes by the subjects in each streetscape group.

Table 1: Percentage of Incorrect Identification of Backward Movement along Streetscapes by the Subjects

Streetscape No.	Streetscape Group 1(%)	Streetscape Group 2 (%)	Streetscape Group 3 (%)
1	25	15	40
2	10	65	10
3	20	60	35
4	60	75	10
5	55	15	20
6	25	15	10
7	50	70	45
8	70	25	15
9	80	20	20
10	55	25	25

According to the results, from the given 10 streetscapes in streetscape group 01, the ninth streetscape was the most difficult one in remembering for bidirectional travelling. 80% of subjects incorrectly identified its backward movement view. There were 5 streetscapes with more than 50% of misidentifications of backward movement views in the streetscape group 01. In streetscape group 02, 4 streetscapes had more than 50% incorrect identifications and in streetscape group 03 there is no significant incorrect identifications of backward movement movies.

However, all most all streetscapes were misidentified in bidirectional travelling at least by one subject. Thus, the evaluated streetscapes as well as most of the planned residential/vehicle streetscapes in Japan show very similar characteristics causing identification problems in travelling. This is very ordinary among first time visitors to an area.

Figure 4 and 5 display the streetscape that most of subjects could not identify correctly in the survey. Figure 04 has taken from the starting point of the forward movement along residential/vehicle street. Figure 05 has taken from the starting point of the backward movement of the same street.

Figure 4: Starting Point View of Forward Movement along Residential/Vehicle Streetscape

Figure 5: Starting Point View of Backward Movement along the Same Streetscape

The street has very monotonous characteristics from beginning to the end. There were no any unique visual stimuli to make a good picture on the cognitive memory of the pedestrian. The architectural variation along streetscape is very low. All residential units are very similar in shapes, such as roof shapes, heights, shapes of windows and doors. Further the complexity along the streetscape is also not in a good composition. All most all residential units have same color, even in windows and doors. Windows and doors are similar in sizes and shapes and there were no significant ornaments on walls except windows, doors or any ordinary opening. There were no

significant vegetation patches along street. Generally speaking from the beginning to the end of the streetscape, the architectural variation and complexity were not in a good condition to create a memorable picture in the cognitive memory of the pedestrians. Further the length of the streetscape was comparatively longer, thus, pedestrian could not remember the visual stimuli they observed at the beginning of the road when they watch the return views. Thus, the pedestrian could not identify the streetscape when he wanted to return on the same pathway. Thus, this streetscape became the most mystifying streetscape among evaluated 30 streetscapes.

Figure 6 and 7 display the streetscape views that the subjects could identify easily in bidirectional travelling. This streetscape has some unique characters such as it starts from a residential area and it ends from a commercial area. Thus, the pedestrian has many visual stimuli along the streetscape to remember the pathway correctly in the cognitive memory. The architectural variation is in a considerable condition since the street occupied with residential units as well as commercial units. The shapes and sizes of buildings are different. Further the complexity along street is varied along streetscape. Therefore all subjects in the survey could easily identify the streetscape. Further the length of the streetscape is comparatively low facilitating the pedestrian to remember the visual stimuli along streetscape.

Figure 6: Beginning of the Forward Movement along Streetscape

Figure 7: Beginning of the Backward Movement along Same Streetscape

After evaluating streetscape identification, the next step was to identify the visual stimuli that helpful in the backward movement identification and the visual stimuli that made confusions in the identification. It was done using 3 statistical methods explained under Methodology section.

After analysis of 600 survey sheets results using 3 statistical methods, the method, weighted probability calculation of priority ranking gave the best results. Thus, the results of weighted probability calculations were explained below.

Weighted Probability Calculation of Priority Ranking

In this method weights were given to each level of priority. The weighting procedure is given below.

Priority Rank:	1	2	3	4	5	6	7	8	9	10
Weight:	10	9	8	7	6	5	4	3	2	1

For each streetscape for each visual stimuli, 20 participants of each streetscape group had given different priority levels. All these priority levels were multiplied by the respective weights and the weighted sum for each visual element for 30 streetscapes were calculated. Further the calculation was undertaken for correctly selected streetscapes and incorrectly selected streetscapes separately. Figure 08 and Figure 09 display the outcomes of weighted probability calculations.

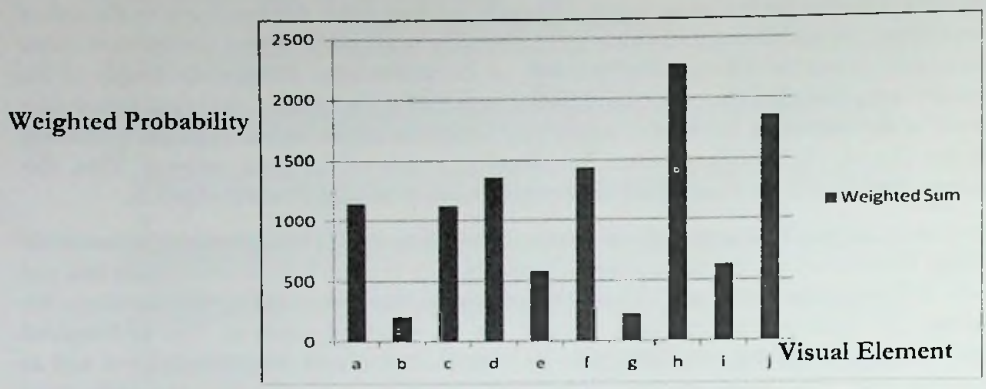

Figure 08: Weighted Probability vs. Visual Elements for Correctly Selected Streetscapes

The front fences or walls and their appearance are the most important visual stimulus in a streetscape for the pedestrians to find out their returning path in bidirectional travelling. This visual stimulus showed many variations causing a substantial complexity to the streetscape. Second most important visual stimulus is the trees along streetscapes. Street trees make the streetscape lively with the different tree cutting patterns. If a house has enough space, Japanese people use that space for gardening. Japanese gardens are very unique and attractive. Thus, if a streetscape has gardens with differ pruning patterns, then the pedestrians could easily remember the streetscape view. Further it contributes to increase the complexity along street. Thirdly, windows, doors or any other elements on houses along streetscapes were important for the pedestrians to keep the streetscape view in their cognitive memory.

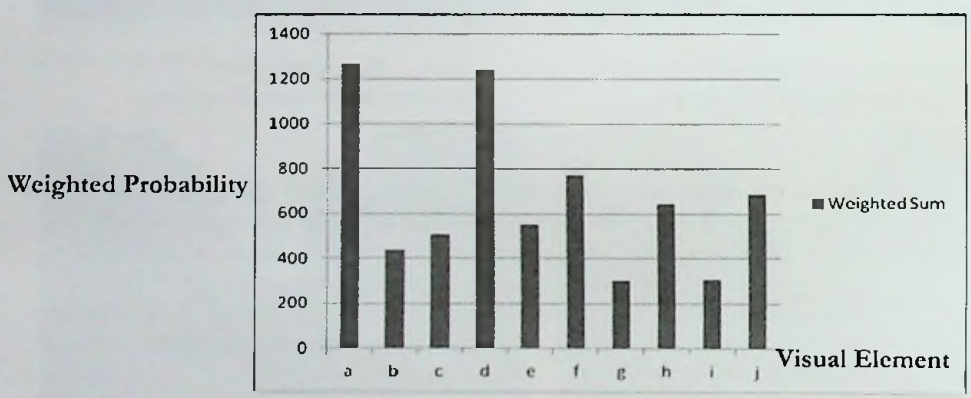

Figure 09: Weighted Probability vs. Visual Elements for Incorrectly Selected Streetscapes

Based on the weighted probability calculations for incorrectly selected streetscapes, shapes of houses were the mostly misleading visual character along streetscapes. Either sides of street have residential units with similar characters such as size, shape, roof pattern, etc. It is basically due to the landscape planning regulations of Saitama Prefecture. For each residential unit there is a fixed plot size, for single houses, for two story houses, for 3 or more story houses separately. Thus, the sizes of houses and shapes became similar to each other. Therefore, if a pedestrian tries to remember the street by just watching the houses along the street, it will practically be very unsuccessful. Secondly, color and texture of houses along streetscapes caused confusions in selecting correct returning path for pedestrians. Windows, doors or any other elements on houses were also misleading the subjects in bidirectional travelling.

The Summary of the Analysis

According to the weighted probability calculation of survey results, front fences or walls and their appearances were the most important streetscape visual stimuli for the first time visitors to the study area for easy identification of returning path. Secondly street trees were helpful for them in bidirectional travelling.

First time visitors to the study area were misled by the shapes of the houses along streetscapes. Secondly due to color and texture of houses, the pedestrians could not create a unique cognitive memory for each streetscape to find out the correct returning path in bidirectional travelling. If the streetscapes were observed, one can agree with the above results since all most all houses were painted in dull colors with nearly similar tones. Further Japanese houses have very unique architecture giving similar shapes to all houses. In other words, the architectural variation along a streetscape and among streetscapes is very low in evaluated residential/vehicle streets. It causes the low complexity among streetscapes as well.

Further, sternly use of landscape regulations in landscape planning of residential areas in Saitama Prefecture caused such similarities along streetscapes.

Weighted analysis resulted same third level of priority for windows, doors or any other elements for correctly selected views and for incorrectly selected views. Thus, these visual stimuli could not be highlighted under any event.

Conclusions

This study was an attempt to analyze the pedestrians' behavior in bidirectional travelling along residential/vehicle streetscapes. The main objective was to find out whether the planned streetscape views cause confusions in bidirectional travelling. The objective was comparable with the study results of evaluated residential/vehicle streetscapes. Building shapes, sizes, color, texture and the ornaments presented on the buildings in streetscapes caused architectural variations. In the evaluated streetscapes, the variations among these characters were very stumpy. Thus, the architectural variation along and among streetscapes were low, causing to have an unclear picture of the streetscape in the cognitive memory of the pedestrians. Visual complexity occurs with the good variations among the visual stimuli along streetscapes. However due to strictly confine to the landscape regulations in Saitama Prefecture, all most all residential areas have similar landscape patterns. It causes to have similar streetscape patterns to the streets as well. Thus, the first time visitors to the study area get confused in bidirectional travelling due to high similarities in streetscape in streetscape views within and among different streets in the study area.

The results shows that the importance of planning and designing streetscapes with some unique architectural qualities for the differentiation of one streetscape from another. It will be very helpful for the residents of the area as well as for the visitors to the area for trouble free travelling and for interesting travelling for their destinations.

This research addressed a problem occurring with the planned landscapes. Although many visual elements exist along planned streetscapes, they could not act as visual stimuli for the travelers along these streets. It is basically due to monotonous planning designs applied to the landscapes. In this research most of the pedestrians remember their returning path based on the appearances of the front fences and walls. Thus, the results prove the lack of good land marks along streets for easy and interesting travelling along streetscapes in the planned residential areas. Therefore, in landscape planning, although the planners have to follow the landscape planning rules, they can think about new designing methods of landscape to have unique architectural characteristics within the planning regulation boundaries. Then the people who use these planned landscapes will have to face minimum difficulties in their day today activities. Further, the travelers will feel

interesting in walking along such varied streetscapes. Thus, this research shows the need of such unique landscape plans for residential landscape areas in future.

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