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Site Planning of Multi-family Housing Considering Residents' Mutual Visual Interactions

Abstract

As a tool for site planning multi-family housing considering residents' psychological responses, this study presents a personal computer program which was developed to predict the amount of visual interaction at a given point in a proposed environment. A case study using questionnaire revealed that the residents' sense of privacy was related with the measures of visual radiation from surrounding buildings and paths, and the outdoor spaces in the housing site where residents feel unsafe could be predicted by lack of visual radiation from surrounding buildings.

Introduction

In Japanese urban areas, multi-family housing has become much denser and the height of apartment buildings has increased because of high land prices. This has caused a problem of visual invasion of privacy from the neighboring apartments. However, there is also a positive aspect in the residents' mutual visual interactions. It is said that "natural surveillance" of the residents on the site is essential to make the place safer (Newman,1972). If we make the apartment too closed to protect against visual invasion, it could increase the risk of crime within the housing site. Architects and planners, therefore, have to consider the optimal level of visual interactions.

As a tool for site planning considering residents' psychological responses, this study presents a personal computer program which was developed to measure the amount of visual interaction at a given point in a proposed environment. A case study was conducted to examine the relevance of the measures obtained by the program to the residents' sense of privacy and safety.

Measurement of Visual Radiation

The basic hypothesis for this study is that the residents' perceptions and attitudes concerning privacy and security from crime are a function of the amount of "visual radiation" from the surrounding buildings. Visual radiation here means numerous radiant visual lines converging on a station point. The amount of visual radiation at a given station point is postulated to depend on a visible area of surrounding surfaces which potentially emit visual lines, namely the surrounding buildings' facade with windows.

A Personal Computer Program

In a previous study by the author, a personal computer program was developed to assess an array of visual surfaces which surround an observer (Ohno, 1991). A part of this program was modified to measure visual radiation from surrounding buildings. Two different programs were created: one for measuring visual radiation converging on each apartment and the other for points in outdoor spaces. The measure obtained from the former program is expected to relate with sense of privacy, and the latter to relate with sense of safety.

Measurement Procedure

The measurement procedures of the programs are as follows.

(1) Based on the site plan and elevation of the apartment buildings, graphic data was created in the frame memory of a personal computer (see Figure 1). From the station point around which the visual radiation is to be assessed, a scanning line is drawn in each of the colored site plans on the display, and the land height and building heights along the line are identified by color code.

(Figure 1)

(2) With this data, a vertical section along the scanning line is drawn on the other plane of the display (see Figure 2). Using the tree data, a vertical section of trees cut along the scanning line is calculated and drawn on the above obtained section. In this section, many scanning lines radiate from the station point . Each of the scanning lines extends until it reaches the outline of the sectional surfaces and reads the color code to identify whether it is building facade with windows or other components like a path, tree, sky.

(3) These operations are repeated by changing the azimuth of the scanning line by five degrees until all visible directions (180 degree for indoor points and 360 degree for outdoor points) around the station point have been assessed.

(Figure 2)

(4) A chart is generated which shows the array of visible surfaces of various components. Figure 3 shows an example of the results of these assessments, which is displayed in the form of a matrix called visible components' distribution chart (VCD chart). Each cell of the VCD chart represents a result obtained by one scanning line, and each column of 27 cells represent all results for an azimuth (see Figure 4).

(Figure 3)
(Figure 4)

Measures for Describing Sense of Visual Privacy and Safety from Crime

Sense of visual privacy

Sense of visual privacy in each apartment depends on the amount of visual radiation converging on the window from surrounding buildings, but also depends on which direction the visual line comes from and how far it penetrates into the room. Therefore, the relation between visible area (volume) of the interior space of an apartment seen from a direction and its angle from the frontal direction of the room was first calculated by the program previously developed (Ohno and Takeyama, 1992). Figure 5 shows an example of the result of a calculation for a room.

(Figure 5)

Each cell of the VCD chart was then given weight according to the direction (altitude (α) and azimuth of visual line (β)). Thus the numerical measure for describing sense of privacy (SP) was defined by equation (1).

$$SP = \frac{\sum_{m=-17}^{17} \sum_{n=-13}^{13} f_{mn}\ \omega_{mn}}{N_h}$$

where

$$f_{mn} = \begin{cases} 1 & \text{if component of (m, n) is buildings' facade with windows} \\ 0 & \text{otherwise} \end{cases}$$

and

ω_{mn}: the weight at the angles of α_{mn} and β_{mn}

Nh: number of cells within 180 degree (35×27)

............equation (1)

<u>Sense of safety from crime</u>

Sense of safety from crime in outdoor spaces is expected to correlate with the amount of visual radiation received from surrounding apartment buildings. Therefore, the numerical measure for describing sense of safety was defined by equation (2).

$$SS = \frac{\sum_{m=-17}^{17} \sum_{n=-13}^{13} f_{mn}}{N_a}$$

where

$$f_{mn} = \begin{cases} 1 & \text{if component of } (m, n) \text{ is buildings' facade with windows} \\ 0 & \text{otherwise} \end{cases}$$

and

Na: number of cells in all directions (72×27)

............equation (2)

A Case Study

A Survey of Residents' Evaluation on Privacy and Safety

Two housing sites near Kobe city which are different in their site planning and in the height of their apartment buildings (see Figures 6 and 7) were chosen for the survey, and questionnaires were used to obtain the residents' perceptions and attitudes concerning privacy and security. The questionnaire was distributed to selected apartments shown in Table 1. The respondents were asked to rate how much they care about neighbors' visual line on a 6 point scale, where 1 was extremely annoyed and 6 was unconcerned. Regarding the sense of safety from crime, the respondents were asked to mark the area in the housing site where (1) they do not let children play for safety reasons, and (2) they avoid by themselves at night.

Using the site plan, the computer program is applied to measure the amount of visual radiation from surrounding buildings to each individual apartment and to outdoor spaces. Finally, the correlation between the measures of visual radiation and residents' responses obtained by a survey are examined.

(Figure 6)

(Figure 7)

Results and Discussion

Sense of privacy and visual radiation

Figure 8 shows the relationship between the measure obtained by the program and the respondents' rating concerning perceived invasion of visual privacy. As shown in the figure, a liner correlation was found between them, and the correlation coefficient (0.67) supports the validity of the measure as a descriptor for sense of visual privacy.

(Figure 8)

Sense of safety and visual radiation

The calculated visual radiation to the outdoor spaces was categorized into 10 levels, where o was no visual radiation and 9 was more than 45%. The results for many station points (4m apart) distributed in the housing site was displayed in the form of a matrix shown in Figure 9. It was compared with Figure 10, which shows the areas marked by the residents as a place where they do not let children play for safety reasons. It was noted that the areas marked by the residents mostly correspond with the areas where the level of visual radiation is low. As for areas where avoided at night, no clear correspondence was noted.

(Figure 9)
(Figure 10)

Conclusion

The present study generally supports the hypothesis that the residents' perceptions and attitudes concerning privacy and safety are a function of the amount of visual radiation from surrounding buildings. Although further examination of other places is necessary to confirm the validity of the measures by the program for explaining the residents' perceptions, the present effort provides one step to establish a quantitative explanatory system for predicting human perception of their residential environment.

If the system is established, it would be a useful tool for environmental designers and planners in order to assess unbuilt environments. Although it may require some effort to generate the data of the site for the program, once we have the data, it is quite easy to assess the visual interactions at any point in a proposed environment, and places which receive excess or no visual radiation can be easily detected. If an environmental designer uses computer aided drafting (CAD) , the data is obtained without extra effort, and the designer can easily and interactively use this program in the design process.

References

1. Newman, O., *Defensible Space, Crime Prevention through Urban Design*. Macmillan Pub., 1972.

2. Ohno, R., "Ambient vision of the environmental perception: Describing ambient visual information", *Proceedings of the EDRA22,* pp. 237-245, 1991.

3. Ohno, R. and Takeyama, K., "A description method of ambient visual information: Part 4 Measurement of visual penetration into rooms", *Proceedings of he Annual Conference of Architectural Institute of Japan (D),* pp. 391-392, 1992. (in Japanese)