Residential Environment Evaluation Model and Residential Preferences of the Changjiang Delta Region of China

Luo Xiaoyu¹, Ge Jian*,², Chen Fei³ and Kazunori Hokao⁴

¹ Master Student, Department of Architecture, Zhejiang University, China
² Associate Professor, Department of Civil Engineering, Saga University, Japan
³ Associate Professor, Department of Architecture, Zhejiang University, China
⁴ Professor, Department of Civil Engineering, Saga University, Japan

Abstract
Residential environment quality is one of the basic elements for quality of life, as well as the main support for activities of economy, culture and society. In this paper, the authors selected the Changjiang Delta Region of China as the study area, which is in the fastest growing region of China and having a great influence on other cities. First, questionnaire surveys focusing on residential attributes, residential satisfaction, residential preferences and residential selection factors were carried out. Then through analysis, the authors established the residential environment evaluation system and models for this area. They also found the principal components for residential selection and residential preference of citizens. The results of this research not only can give direction to the development and improvement of the residential environment of Chinese cities, but also can contribute to other similar areas in Asia.

Keywords: residential environment evaluation; residential preference; residential choice; residential satisfaction

1. Introduction
Residential environment quality is one of the basic elements for quality of life, as well as the main support for the activities of economy, culture and society. The improvement of residential environment quality has become one of the main targets of city policy and urban planning. Different approaches of studying residential environments have resulted from the efforts of different disciplines, such as anthropology, architecture, economics, environmental design, geography, psychology and sociology, applying concepts and developing topics related to their own perspectives (Aragones et al., 2002). Moore (1997) has proposed four levels of theoretical construction for organizing and integrating studies of residential environment: theoretical/conceptual orientations, frameworks, models and theories.

Residential satisfaction is one of the most important themes in the field of residential environment. Montgomery and Johansson (1988) noted that life satisfaction is closely related to residential satisfaction. Amerigo and Aragones (1997) presented a theoretical and methodological approach to the study of residential satisfaction, and gave a general view of the relationships established between people and their residential environment. There are also numerous models that seek to explain the interrelationships between residential environmental attributes and perceived satisfaction. Bonaiuto and Bonnes (2002) reported the results from a UNESCO program in Rome. In addition to empirical tests of theoretical models, the program has resulted in a survey instrument for measuring perceived residential environmental quality to assist architects redesigning urban environments. Bonaiuto et al. (2003) presented two instruments for measuring the quality of the relationship that inhabitants have with their urban neighborhoods, which consisted of 11 scales measuring the perceived environmental qualities of urban neighborhoods and one scale measuring neighborhood attachment. In Japan, there have also been researches aimed at establishing residential environmental indices for cities such as Tokyo and Kitakyushu (Asami, 2001).

Residential environmental choice is another significant topic. This deals with residential behavior through the process of decisions about moving. There are deep relationships between residential choice and satisfaction. Garling and Friman (2002) noted that residential satisfaction is a natural criterion by which to judge the success of residential choice. Conversely, residential dissatisfaction may be an important reason for moving. Dieleman and Mulder (2002) studied residential choice from the aspect of geography, and noted that life-course events such as leaving the parental home, entering the labor market, changing jobs, getting married, having children, separation and divorce, children leaving home and
retirement are often accompanied by changes in housing needs or in the importance attached to specific sites or situational characteristics of the residential environment. Garling and Friman (2002) presented a psychological conceptualization of residential choice. In their research, activities leading to the achievement of life values were identified as objectives. The weight placed on housing attributes in residential choice are consequently assumed to reflect the importance of life values as mediated by the evaluations of related objectives. A choice is made on the basis of preferences for each alternative. Residential choice, to some extent, also reflects a preferred lifestyle. Regularly spending different amounts of time on socializing, hobbies, cultural events, or outings in the countryside presumably reflects differences in lifestyle. Such differences are considered in turn to underlie the differences in preferences for housing, and the degree of residential satisfaction depends on the extent to which housing facilitates the adoption of a preferred lifestyle.

In recent years, with the diversification of personal senses of value as well as the abundance of lifestyles, people's preferences, demands, perceptions and evaluations of their residential environment are also becoming more and more diversified. Accordingly, it is necessary to clarify the diversity of urban residential preferences and their diversified demands and perceptions. An important characteristic of a good urban residential environment is that it can offer residents a choice of all the types of residential environment they need. Each type should satisfy some people, or people at some stage of their lives.

Although research on residential environments has been a prominent element in the field of Western society for more than a quarter of a century and there is a wealth of information on the achievements of theoretical orientations, frameworks, evaluation models and indices, the literature on personal residential lifestyles is not as rich, especially relative to Eastern societies. In this research, the principal aim was to establish an index system and evaluation model for the urban residential environment of the Changjiang Delta Region of China, which will be very useful in understanding the Chinese residential environment, finding problems and planning future development. This kind of evaluation system and model has not been adequate until now in China. Furthermore, focusing on residential lifestyles, the intention was to clarify the various personal residential preferences and choices, which can help in understanding the various requests of people and offer them a choice of all the types of residential environment they need. Before this research, the authors had performed research on residential lifestyles in the two Japanese cities of Saga and Kitakyushu (Ge and Hokao, 2005 and 2006). The growth of Japanese cities is in a mature and stable state, while China is faced with a high rate of economic development and speedy urbanization. Although the residential conditions, lifestyles, consciousness and many other conditions are quite different in the two countries, the authors wish to apply the methodology established in their former researches in Japan to develop an evaluation model for Chinese cities, as well as to make clear the residential preference and choice factors.

China has about 800 large and middle size cities and more than 20,000 small cities. The urban population is increasing at an extraordinary pace, from 14% in 1980 to 35% in 2000, and the annual urban residential construction area is over six billion m². For example in Hangzhou City, which is located in the Changjiang Delta Region of China, the building construction area was 2,053ha in 2001, of which about 1,065ha consisted of housing. Therefore, the sustainable development of residential areas is one of the most important themes in the urbanization process. Chinese urban areas, which are undergoing high-speed growth were selected as the subject of research. Special attention was paid to the Changjiang Delta Area of China, which, as a highly developed area is having an important influence on not only the nearby areas but also the country as a whole, with the anticipation that this research can contribute to the sustainable development of Chinese urban residential areas. Furthermore, because the huge-scale and high-speed growth of the Changjiang Delta Region will have great influence on other regions, it is hoped that this research will make a wider contribution.

2. Methodology

The residential environment is not limited to buildings here, but refers to the wider scope of a neighborhood. Fig.1. shows the flow chart of the research.

The Changjiang Delta Area is a group of cities consisting of 11 main cities centered on Shanghai, Hangzhou and Nanjing and is the most developed region in China. The GDP of the Changjiang Delta Area is more than twice the average GDP of China. Shanghai, as the biggest city in China is located in the
bay of Changjiang River and is an important industrial site and harbor, as well as the center for business, science, technology, information and finance. It has an area of 6,340 km$^2$, 20 metropolitan districts and a population of over 20 million. Hangzhou is the capital city of Zhejiang Province, located in the southern part of the Changjiang Delta Region. There are eight metropolitan districts and five counties in Hangzhou, with a total area of 16,596 km$^2$, and a population of over 6.42 million, in which the city area is 3068 km$^2$, and the city population 3.93 million. Hangzhou is one of the seven ancient capitals of China, with a historical and cultural background. Furthermore, it is a typical southern water city of China, with many world famous natural landmarks.

3. Surveys
From February to March, 2005, questionnaire surveys were carried out among the residents of Hangzhou and Shanghai. In the survey, an attempt was made to gather samples with different household and housing characteristics in different areas of the city. Different residential areas were selected and visited, and questionnaires were sent to the residents and then collected one week later. Table 1 shows the general condition of the surveys. Table 2 shows the main contents of the questionnaire, which is divided into five parts with a total of 138 questions. As a social survey, the response rate of about 26.3%, although low for Shanghai is within the normal range. Hangzhou had a rate of 76.0%, which is quite high. The main reason for this might be that the survey was carried out under the name of Zhejiang University, which is located in Hangzhou. People might be more willing to support a university in their own city rather than one from another province.

### Table 1. General Condition of Questionnaire Survey

| City       | Number of distributions | Number of effective responses | Effective response rate (%) |
|------------|-------------------------|------------------------------|-----------------------------|
| Hangzhou  | 800                     | 608                          | 76.0                        |
| Shanghai  | 800                     | 210                          | 26.3                        |
| Total     | 1600                    | 818                          | 51.1                        |

### Table 2. Contents of Questionnaire Survey

| Number | Contents                                                  | Number of questions |
|--------|-----------------------------------------------------------|---------------------|
| I      | Personal attributes                                       | 16                  |
| II     | Residential conditions                                    | 5                   |
| III    | Evaluation on residential satisfaction                    |                     |
| IV     | Reasons for Residential choice                            | 17                  |
| V      | Residential preferences                                   | 27                  |
| Total  |                                                           | 138                 |

4. Analysis and Discussions
4.1 Personal Attributes and Residential Conditions
Table 3 shows the personal attributes and residential conditions of the two cities respectively. The gender of the survey subject is nearly half male and half female, and the age range is mainly from the 20s to 50s. The number of couples with children is over half of the total, which might be the reason why the number of people per household is mainly three. Other residential conditions such as floor space, ratio of residential cost to total income, ownership, years of residence, etc. are also shown in Table 3.

### Table 3. Personal Attributes and Living Conditions

| Items                      | Gender (%) | Age (%) | Number of Person per Household (%) | Floor Space (m$^2$) (%) | Ratio of Living Cost to Total Income (%) |
|----------------------------|------------|---------|------------------------------------|-------------------------|----------------------------------------|
|                            | Male       | Female  | <30      | 30−40     | 40−50    | 50−60 | >60 | <50 | 50−80 | 80−100 | 100−120 | >120 | <10 | 10−20 | 20−30 | 30−40 | 40−50 | >50 |<5 | 5−10 | 10−20 | >20 |<5 | 5−10 | 10−20 | >20 |
| Hangzhou                   | 49.3       | 50.7    | 25.8     | 34.0      | 23.3     | 12.2 | 4.8 | 13.5 | 11.6 | 53.5 | 4.6 | 4.9 | 10.1 | 16.3 | 59.7 | 12.9 |
| Shanghai                   | 42.7       | 57.3    | 33.7     | 29.2      | 20.3     | 13.9 | 3.0 | 4.0 | 4.5 | 73.6 | 10.4 | 1.5 | 6.0 | 0.5  | 5.7  | 61.3 | 32.4 |
|                            |            |         |          |           |          |      |     |     |     |      |     |    |     |      |      |     |    |   |      |     |    |   |      |     |

©Items

| Ownership (%)              | Building Age (y) (%) | Residence years (y) (%) |
|----------------------------|----------------------|-------------------------|
| Owned                      | Rental               | Company                 | <5 | 5−10 | 10−20 | >20 | <5 | 5−10 | 10−20 | >20 |
| Hangzhou                   | 62.4                 | 15.9                   | 21.7 | 33.8 | 38.0 | 20.3 | 7.9 | 51.1 | 30.9  | 12.8 | 5.2 |
| Shanghai                   | 45.0                 | 44.5                   | 10.5 | 46.4 | 33.3 | 13.0 | 7.3 | 59.2 | 25.7  | 10.6 | 4.5 |
4.2 Residential Environment Evaluation

In the survey, residents were asked to evaluate their satisfaction concerning the present residential environment according to a 5-grade-scale (1-thoroughly dissatisfied; 2-dissatisfied; 3-neutral; 4-satisfied; 5-thoroughly satisfied). The evaluation index system is shown in Fig.2., divided into five sections as convenience, comfort, healthy, safety and community with four levels. This is a hierarchical multi-attribute index system for urban residential satisfaction developed from the authors’ previous research (Ge and Hokao, 2004); some revisions were made in this research. The first four sections were developed from the four concepts of residential environment satisfying the basic living requirements of human beings presented by the World Health Organization in 1961 (cited by Higasa, 1977). The section on community was added to examine the spiritual needs beyond the basic material needs of the residential environments. According to this index system, “satisfaction concerning residential environment” (Level 1) depends on satisfaction with “convenience”, “amenity”, “health”, “safety” and “community” (Level 2). Attributes of Level 2 are assumed to depend on satisfaction with 15 Level 3 attributes. For example, "amenity" (Level 2) is assumed to depend on "D" (amenity of natural environment), "E" (amenity of historical environment) and "F" (amenity of living spaces) (Level 3). Furthermore, each of the 15 attributes of Level 3 is broken down into some lower level attributes in Level 4. For instance, "D" of Level 3 (amenity of natural environment) is assumed to depend on Level 4 attributes such as “immediate green areas”, “water environment”, and "parks and play areas".

4.2.1 Evaluation of Residential Satisfaction

Table 4. shows the average evaluation and standard deviation of items on Level 1 and 2. It can see that in Hangzhou, satisfaction concerning convenience is the highest, while amenity is the lowest.

4.2.2 Multiple Regression Analysis

Based on the author's hierarchical and multifactorial evaluation system concerning the residential environment, a multiple regression analysis was carried out on Level 1 and 2, in order to make clear the contributing factors from the lower to higher level. The analysis was conducted using the software SPSS 12.0.

(a) Hangzhou

Residential Environment Satisfaction = -0.108+0.261×Convenience + 0.215×Amenity + 0.166×Health + 0.260×Safety + 0.107×Community

(\(R^2=0.512\))

Convenience = 0.509 + 0.281A+0.264B+0.325C

(\(R^2=0.652\))

Amenity = 0.375+0.091D+0.085E+0.716F

(\(R^2=0.738\))

Health = 0.121+0.104G+0.117H+0.160I+0.576J

(\(R^2=0.771\))

Safety = 0.412+0.087K+0.073L+0.705M

(\(R^2=0.732\))

Community = 0.209+0.193N+0.754O

(\(R^2=0.817\))

(Significant above 99% according to T value) (Eq. 1)

The evaluation model was obtained based on the results of multiple regression analysis (Eq. 1). It was found that in Hangzhou, all of the factors in Level 2 contribute to the evaluation of Level 1, which means...
that the comprehensive residential environment satisfaction is strongly influenced by convenience, safety, amenity, health and community in order of importance, especially the influence of convenience, safety and amenity, which are very important.

In the multiple regression analysis of Level 2, Social Service (C) has the biggest influence on the evaluation of convenience; Amenity of living space (F) has the biggest influence on the evaluation of amenity; pollution (J) has the biggest influence on Health; Safety from crime (M) has the biggest influence on Safety; and Community organization and awareness (O) has the biggest influence on the evaluation of Community.

(b) Shanghai

Residential Environment Satisfaction = 0.340+0.203×Convenience + 0.259×Health + 0.432×Community

Convenience = 0.289 + 0.424B+0.480C

Amenity = 0.228+0.188E+0.729F

Health = 0.433+0.398I+0.463J

Safety = 0.363+0.160K+0.707M

Community = 0.412+0.150N+0.738O

(Significant above 99% according to T value) (Eq. 2)

According to the evaluation model of Shanghai (Eq. 2), it is found that three of the five factors in Level 2 contribute to the evaluation of Level 1, which means that the comprehensive residential environment satisfaction is influenced strongly by community, health and convenience in order of importance. The factors of safety and amenity, which are shown to be important in the case of Hangzhou, are not important factors in the case of Shanghai. Furthermore, in the multiple regression analysis of Level 2, which is very similar to the case of Hangzhou, Social Service (C) has the biggest influence on the evaluation of convenience; Amenity of living space (F) has the biggest influence on the evaluation of amenity; Pollution (J) has the biggest influence on Health; Safety from crime (M) has the biggest influence on Safety; and Community organization and awareness (O) has the biggest influence on the evaluation of Community.

The main factors of residential environment satisfaction of Shanghai and Hangzhou were made clear in Level 1 and 2, as well as the similarity and difference between the two cities. Furthermore, the analysis in Level 3 and 4 was made using a similar method. The more detailed results of Level 3 and 4 are not included in this paper because of its limited length.

4.3 Factors Concerning Residential Choice

In the questionnaire survey, residents were also asked about the reasons why they selected their present housing. They were asked whether they considered the 17 items important or not when they selected their present housing: 1-thoroughly unimportant; 2-unimportant; 3-neutral; 4-important; 5-very important.

(a) Hangzhou

At first, the subjects who selected their present housing based on passive selection reasons such as allowance from company, estate from parents were excluded. SPSS 12.0 was then used to perform a Principal Component Analysis (with Quatimax rotation). As a result, three principal components with an Eigen-value above 1.0 were obtained. The cumulative percentage of variance of these three components was about 66.8%, showing a fairly good significance (Tables 5 and 6. show the component matrix of each residential choice item. According to the above analysis, it can be seen that there are three main axes from which the residents can select their housing in Hangzhou. The first is the physical residential environment axis related to convenience, amenity, health, safety and community facility; the second is the community communication environment axis related to community facility, organization and activity, and distance from relatives’ home; the third is the building and cost axis related to building spaces, formation, height, house rent and cost.

(b) Shanghai

A Principal Component Analysis (with Quatimax rotation) of Shanghai’s data was carried out using a method similar to Hangzhou, which obtained three principal components with an Eigen-value above 1.0. The cumulative percentage of variance of these three components are nearly 70%, showing a fairly good significance (Tables 7. and 8. show the component matrix of each residential choice item.

There are three main axes from which residents can select their housing in Shanghai. First is the comprehensive residential environment axis including both physical and social residential environment; second is the building and cost axis related to building spaces, formation, height, house rent and cost, etc; and third is the public safety axis.

It can be seen that the axes of Hangzhou and Shanghai are almost the same (the 1st axis in Shanghai is the combination of the 1st and 2nd axes in Hangzhou, and the 2nd of Shanghai is the same as the 1st of Hangzhou), but in Shanghai, the 3rd axis of public safety appeared separately. This might be the difference between a large and small city. In large cities such as Shanghai, the crime rate is much higher than in small cities, therefore residents are more concerned about
crime and safety when selecting their housing.

4.4 Residential Preference

In the questionnaire survey, residents were also asked about their residential preferences: their subjective preference and sense of value regarding residential environment, but not their present living conditions. There were 27 items concerning residential preference in the survey, and in each item the subject was asked about the importance regarding one residential preference based on a 5-grade-scale.

A Principal Component Analysis was carried out using SPSS 12.0 on all the subjects of Shanghai and Hangzhou. The authors combined all of the samples in Hangzhou and Shanghai mainly because residential preference is the latent consciousness of people regarding their residential environment, without having a deep relationship with the present environment in which they are living. First, all of the 27 items of residential preferences were analyzed. The authors then excluded the samples with all component scores lower than 0.5, and conducted the Principal Component Analysis again. From Table 9. it can be seen that there are five components with an Eigen-value higher than 1.0. Table 10. shows the component matrix of each residential preference item.

**Component-1:** the scores on Preference 6, 7, 12, 17, 18, 19 and 22 are high, which stand for the physical residential environment such as convenience, amenity, healthy and so on.

**Component-2:** the scores on Preference 11, 13, 20...
and 26 are high, which stand for the community communication environment such as community activity, neighbor and relative ties.

**Component-3:** the scores on Preference 2 and 15 are high, which stand for the location of the housing, related to the location in the city, distance to workplace, and so on.

**Component-4:** the scores on Preference 8, 24 and 25 are high, which stand for the building and cost, such as floor area, space utility, cost, and so on.

**Component-5:** the score on Preference 10 is high, which stands for hobbies related to living, such as how leisure activities influence residential preference.

The ideal residential environment of citizens is firstly the axis of physical environment, and then community communication environment, location, building and cost and hobbies are also the main axes for a preferred residential environment. This will make clear the directions and significant factors for city planning and residential environment development.

Five axes of residential preference were obtained, in which the physical residential environment, community environment, and building and cost are the same as the residential choice axes, while location and hobby are two new axes from the analysis of residential preference. Although these two factors are not seen in the real word when citizens select their housing, they exist in the residential preferences of people as latent factors. These factors should be taken into serious consideration during the development and improvement of residential environments for the future.

5. Conclusions

In this research, the authors applied the methodology established in their former researches in Japan to develop an evaluation model for Chinese cities, as well as to make clear the residential preference and choice factors of Hangzhou and Shanghai in the Changjiang Delta Region of China. However, this research is not intended as a comparison of China and Japan, therefore, the comparison results of the two countries are not listed in the paper. From the regression analysis of Level 1 and Level 2, a similar tendency of the main factors influencing residential satisfaction in the two countries was obtained, as well as the structure of the main factors and the accuracy of the analysis. Furthermore, the main factors of residential choice and preference of China obtained in this research also has the same level of accuracy as Japan. Therefore, the authors consider that the survey and analysis methods applied in this research could be effective for the study.
of residential satisfaction, choice and preference.

Furthermore, it can be seen that, although there are some factors of residential environment satisfaction and preference which are not elicited in housing selection behavior, they are independent from lifestyle and are requested by various kinds of lifestyle. Therefore, the development and improvement of residential lifestyle should fulfill the different requirements and various kinds of lifestyle. An important characteristic of a good urban residential environment is that it offers residents a choice of all the types of residential environment they need. Therefore, the research should be performed through multiple factorial, interdisciplinary and dynamic approaches, so that the influence of lifestyle on residence and the different residential qualities required by different lifestyles can be captured, and the quality of life improved effectively and efficiently. This is a significant theme for the field of urban planning, urban policy and residential environment construction.

On the basis of research in Japan, the authors believe it was effective to apply the same method to study the residential environment of Chinese cities, and also that by using the general and standard evaluation system and analysis method, the common points and differences among different countries, regions and cities can be clarified. Actually, Chinese cities have special characteristics that are different from Japanese cities, which should be studied in the future; but as a first step, this paper did not focus on the regional differences. The general evaluation system and items were used to obtain the general factors of residential satisfaction, residential choice and residential preference. In the future, on the basis of this research, an attempt should be made to try to find out the special factors and establish an evaluation system with Chinese characteristics. The authors also think it is possible to perform a cluster analysis to find the residential choice pattern of citizens in the future. It will then be possible to analyze the relationship between the choice pattern and residential satisfaction and preference. The research of this paper is a fundamental and important step for further research.

Acknowledgements

The authors wish to express their deep gratitude to the Fukuoka Asia Urban Research Institute of Japan for the financial support of this research; and also to Mr. Greg Bent B.Ed, TESOL, English teacher of the South China Normal University, for his checking and revision of the English of this paper.

References

1) Amerigo, M., Aragones, J. I. (1997) A theoretical and methodological approach to the study of residential satisfaction. Journal of Environmental Psychology, 17, pp.47-57.
2) Aragones, J. I., Francescato, G., Garling, T. (2002) Evaluating residential environments. Residential Environments: Choice, Satisfaction, and Behavior, London: Bergin & Garvey, pp.1-14.
3) Asami, Y. (2001) Residential environment: methods and theory for the evaluation. Tokyo: University of Tokyo Press.
4) Bonaiuto, M., Fornara, F., Bonnes, M. (2003) Indexes of perceived residential environment quality and neighborhood attachment in urban environments: a confirmation study on the city of Rome. Landscape and Urban Planning, 65, pp.41-52.
5) Dieleman, F. M., Mulder, C. H. (2002) The geography of residential choice. Residential Environments: Choice, Satisfaction, and Behavior, London: Bergin & Garvey, pp.35-54.
6) Garling, T., Friman, M. (2002) A Psychological Approach to the study of residential choice and satisfaction. Residential Environments: Choice, Satisfaction, and Behavior, London: Bergin & Garvey, pp.55-80.
7) Ge J., Hokao K. (2005) Research on the formation of urban residential lifestyles through case studies of lowland city Saga and non-lowland city Kitakyushu. Journal of Lowland Technology International, 7 (2), pp.100-109.
8) Ge J., Hokao K. (2006) Research on residential lifestyles in Japanese cities from the viewpoints of residential preference, residential choice and residential satisfaction. Landscape and Urban Planning, 78 (3), pp.165-178.
9) Higasa, H. (1977) Urban Planning, Tokyo: Kyoritu Press.
10) Montgomery, H., Johansson, U.S. (1988) Life values: their structure and relation to life conditions. Applied Behavioral Economics, 1, pp.420-437.
11) Moore, G. T. (1997) Toward environment-behavior theories of middle range. Advances in Environment, Behavior, and Design. New York: Plenum Press, pp.1-40.