THE USE OF PREFABRICATION TECHNIQUES FOR PUBLIC HOUSING IN TAIWAN, REPUBLIC OF CHINA

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CONTENTS

CHAPTER I

INTRODUCTION

Introduction

Taiwan is an island with great population. As the economy develops and personal income increases in recent years, every household wants to own a house in order to lift its standard of living to a higher level. The Government has sensed the pressure keenly. In 1975, the Government promulgated the Public Housing Act. Thereafter, it enforced one public housing program - Six Year(1976-1981) program - to build totally 100,000 dwelling public housing units for the middle and low income households. The six-year public housing program divided into two stages-the 1976-1977 project and 1978-1981 project. The first two year project(1977-1978) had been designed as a pilot project. In this two years project, most of public housing were constructed in the urban metropolitan area and the public housing units usually be used for resettled the squatter or the families which houses destroyed by the public works construction. In the period of 1978-1981, the goverments not only constructed public housing in urban areas but in small cities and towns.

Since the public housing projects would construct a large quantity of public housing to improve the living standard of middle and low income families, the cost must be lowered and the time must be saved. Some local governments considered adopting the prefabrication systems because the experience of U.S. and European countries shows that the cost of prefabrication system

would be lower than the cost of traditional construction and the construction period would be shorter than traditional construction.

Purpose of the Study

Prefabricated housing makes housing components, housing modules, and housing units by assembly line techniques inside a factory. It substitutes machinery for expensive on-site labor. It divides complex jobs into a series of repetitive operations performed by semiskilled workers, and manufactures as much of the house as possible inside a plant under conditions permitting advanced technology, production, supervision, and quality control. The prefabricated housing systems have played a very important role in U.S., European, and Japanese housing market since World War II.[1] However, in Taiwan, even today the prefabrication technique for public housing is not in widespread use. Three major purposes of this study are as follows:

(1) To understand the development of prefabrication abroad and in Taiwan.

(2) To explore why using prefabrication techniques for public housing was not successful in Taiwan.

(3) To evaluate the potential of prefabricated housing in Taiwan.

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[1] Ministry of Interior, Republic of China, The Evaluation of Using Prefabrication for Public Housing, 1984.

CHAPTER II

THE BACKGROUND OF TAIWAN

Physical Nature

Taiwan is an island in the western Pacific Ocean which lies off the southeastern coast of the China Mainland. It is anchored in the East China Sea between 21°45' and 25°57' North Latitude, and between 119°18' and 124°35' East Longitude.[1] Taiwan is shaped somehow like a tobacco leaf with its tip pointing toward Japan. Taiwan area include Taiwan Island, the Peng-Hu Island, Lan-Yu and the other subordinate islands (Map I). It stretches 235 miles(377 kilometers) in length and is about 88 miles(142 kilometers) in wide at its broadest point.[2] Its total area is 13,900 square miles(36,000 square kilometers). Taiwan is mountainous. The Central Mountain Range running along from north to south which divides it into the east and west of Island.

The climate is as diverse as the island's endlessly fascinating landscapes: subtropical in the north, center and at mountain altitudes, totally tropical in the flatlands of the south. There are two distinct seasons: hot with average temperature about 27°c (May through October) and cold with an

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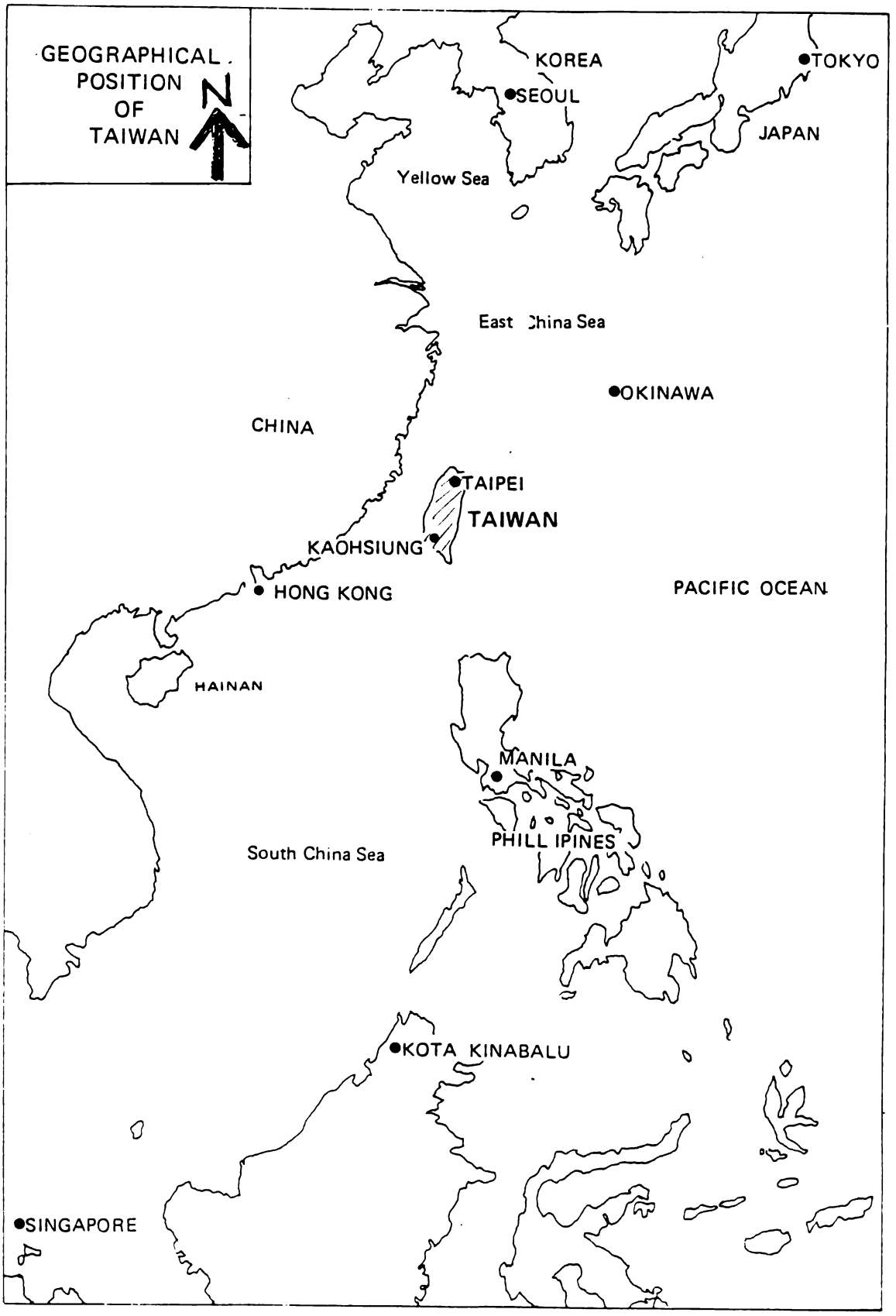
1 Danniel P. Reid, Taiwan, 1984.

2 Ministry of Interior, R.O.C., An Introduction of Housing Development in Taiwan, Republic of China, 1984.

MAP I


GEOGRAPHICAL POSITION OF TAIWAN
N
KOREA
SEOUL
TOKYO
JAPAN
Yellow Sea
East China Sea
OKINAWA
CHINA
TAIPEI
TAIWAN
KAOHSIUNG
HONG KONG
PACIFIC OCEAN
HAINAN
MANILA
PHILLIPINES
South China Sea
KOTA KINABALU
SINGAPORE

average temperature of about 15°c(November through March). The typhoon season is from June to October.[1]

History

The Chinese crossed the Taiwan straits from the Provinces of Fukien and Kwantung as early as the 12th century. From 1624 to 1641, Taiwan was under Spanish domination and from 1641 to 1661 Taiwan was ruled by Dutch.[2] In 1661, the Dutch were outset by Cheng Chen-Kung who held out from the Chinese mainland after Manchus occupied it. Large scale immigration began about 1810. The Manchu government made Taiwan a province in 1885.[3] In 1895, Taiwan was ceded to Japan at the end of the first Sino-Japanese War.[4] In 1945, Taiwan was returned to China as a result of the Cairo Agreement. After the communists took over mainland China in 1949, Taiwan became the effective territory of the Republic of China. Taipei is the Capital.

Population

The population distribution is related to topographic condition, climate, population policy and economic condition. According to the household registration, the population of Taiwan area was about 6 million at the end of 1945.[5] It became 18 million by the end of 1982.[6] The average population density is 500 persons per square kilomter.[7] In Taipei Municipal City -the

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1.2.3.4.6.7. Ministry of Interior, R.O.C., An Introduction of Housing Development in Taiwan, Republic of China, 1984.

5 Ministry of Interior, R.O.C., Public Housing Development in Taiwan , Republic of China, 1977.

Capital City, the population density is more than 2,500 persons per square kilometer.[1]

Economy

Taiwan's comforts and wealth corroborate what many economists and observers have called the economic "miracle" that has occurred since World War II. The Nationalist government parlayed enlightened economic policies into pure profit. It nurtured the Chinese penchant for the potent motive forces of capitalism. The populace responded resoundingly, working long hours to make the dream come true. The prescription for the island's economic health is foreign trade. In 1983, total world trade with Taiwan exceeded $45 billion.[2] More than a third of that involved the United States. In order to redress the imbalance, the governmnet of Taiwan, since 1976, has been sending an annual "Buy American" mission to the United States to purchase up to $600 million in grains, machinery and other products.[3] It's an East Asia largesse that is eagerly anticipated each year by American farmers and factories.

In 1980, the gross national product(GNP) was US $40.26 billion with an annual growth of 6.7% (During 1970-1980, the average growth rate of GNP was 9%).[4] The per capita income in 1980 was US $2,282 with an annual growth of 4.6%.[5] In Asia, only the people of Japan, Hong Kong and Singapore earn more.

1.4.5. Ministry of Interior, R.O.C., An Introduction of Housing Development in Taiwan, Republic of China, 1984.

2.3. Danniel P. Reid, Taiwan, 1984. p. 52

CHAPTER III

THE DEVELOPMENT OF PREFABRICATED HOUSING

Abroad

Before dicussing the development of prefabrication in Taiwan, there is a need to overview the growth and development of prefabrication in U.S. and Europe, because the prefabrication systems that Taiwan adopted were imported from U.S. and Europe.[1]

United States

The concept of prefabrication is originally an American pragmatic idea. As early as 1624, the English brought a panelized house of wood to Cape Ann for use by a fishing fleet, and the house was subsequently disassembled, moved, and reassembled many times.[2] Throughout the early years of American history, the log cabin provided the simple one-room dwelling unit constructed of precut logs, notched together at the corners. The type of precut construction was first brought to these shores around 1638 by Swedish immigrants. Later, many other nationalities, including Germans, Scots, Irish, Russian, contributed to the idiom making the log cabin as American as apple pie.[3] New settlements provided a market for early

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1. Ministry of Interior, R.O.C., The Evaluation of Using Prefabrication for Public Housing, 1984.

2.3. Laurence Stephan Cutler and Sherrie Stephens Culter, Handbook of Housing Systems for Designers and Developers, 1974.

prefabricators - the California Gold Rush of 1849 was a particularly lucrative market, as was the Union Army in the Civil War.[1] Early in the 1900s, the "mail-order house" became popular on the frontiers. Sears, Roebuck Company claims it sold 110,000 houses in forty years.[2] These were usually precut houses,but their production was important since it pioneered technique for the production lines, standardization, and price packaging of the housing manufacturing industry. The construction industry actually began developing its present-day characteristics around 1930. With the establishment of F.H.A., it became possible to market homes in mass volume in normal times of peace, as buyers were able to buy homes on terms they could afford.[3] Early proponents of prefabrication concluded that the way to reduce construction costs was to deliver, from the factory to the building site, parts of the structure which could be assembled without cutting or alternation. During World War II, home manufacturing met its severest test. The manufacturers were faced with the difficult task of providing emergency war housing that would meet three requirements: speed, flexibility and the reduction of on-site labor. This provided the prefabrication industry with a great opportunity-quality was sacrificed for quantity, and as a result of this effort, prefabrication gained a reputation as being "cheap" or "poor" construction.[4] Around 1950, other types of prefabrication started to make noticable inroads-such as the pre-engineered metal buildings and various

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1.2.3.4. Laurence Stephan Cutler and Sherrie Stephens Cutler, Handbook of Housing Systems for Designers and Developers, 1974.

preassembled components for nonresidential use.

In the U. S. due to the tremendous promotional impact of OPERATION BREAKTHROUGH in 1969, a great number of the European systems groups have attemped to enter the American market.[1] OPERATION BREAKTHROUGH has not followed through with either the financial backup or the market aggregation guarantees which were the heart of its early promise. These are an absolute prerequisite for the high initial capital expenditure required by the production facilities.

European Experience

The rate and type of development of industrialized systems has varied greatly among the European countries. In Europe, where a very high percentage of housing is government-subsidized, the growth of prefabrication has been particularly rapid since about 1955. In France, for example, new housing construction projects are 80% prefabrication.[2] Programs initiated in England by the London Council after World War II, give a typical picture of the European experience.[3] When special subsidies were offered for housing built by systems, over 600 "housing systems" appeared on the market overnight.[4] During the following years, these hundreds of systems failed or were never developed. Presently, When approximately 75% of systems housing in England is

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1 Laurence Stephen Cutler and Sherrie Stephens Culter, Handbook of Housing Systems for Designers and Developers, 1974 2.3.4.

2 Department of Housing and Urban Development, U.S., Industrialized Building- A Comparative Analysis of European Experience,1968.

being built by only four giant systems contractors and the remaining 25% is built by another eight systems.[1]

Taiwan

General Development

OPERATION BREAKTHROUGH called on United States' industrial knowledge to solve the twin problems of a housing shortage and spiraling construction costs through a crash program of mass-produced low -costs homes. It had serious impact in U.S.. It also stimulated an interest among homebuilders in Taiwan.[2] The beginning of the prefabrication industry can be dated from 1971, with the founding of the Chung Tien Construction Company.[3] In 1973, the first prefabricated housing was built in Taipei Municipal City.[4] The potentials of this industry have attracted some huge construction companies such as National Honor Citizen Construction Company and the Pacific Construction. However, the industry had slow beginnings. From 1973 to 1983, only 7,800 dwelling units (include 5,910 public housing units) were constructed by prefabrication technique.[5] There are many types of systems in the prefabrication field, only 8 systems are available for licensing in Taiwan. Among these 8 systems, the European "Panel Systems" and "Frame Systems" are the two most

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1 Laurence Stephan Culter and Sherrie Stephens Cutler, Handbook of Housing Systems for Designers and Developers, 1974

2.3.4.5. Minstry of Interior, R.O.C., The Evaluation of Using Prefabrication for Public Housing, 1984.

often used in Taiwan.

(1) Panel Systems

The panel system is usually large slabs, or otherwise panelized units, not made in the form of a box but often large enough to constitute entire walls, partitions and floors, and substantial parts of floors and roofs. These slabs and panels are fabricated in a factory and assembled at the site. In some cases, the components of one manufacturer are incorporated in the subsystem of another manufacturer, if the two elements are compatible and dimensionally integrative.[1]

Generally, heavy panels require a huge aggregated market(300 units minimum) to justify going to systems building at all and are often limited to buildings of over two to three great design flexibility, they exhibit 20-30% cost savings.[2] It can be adapted for a variety of homes, apartments and townhouses in various sizes, shapes, styles and room arrangements. Panels, which are suitable for both low and high-rise developments, are used extensively in Great Britain, Europe, the U.S.S.R., and Japan.[3] However, because of the current building code in Taiwan, it may not be build above five stories.[4] The "Panel System" of prefabrication is usually adopted by small cities or towns in

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1.2.3. Laurence Stephan Cutler and Sherrie Stephens Cutler, Handbook of Housing Systems for Designers and Developers, 1974.

4. Ministry of Interior, R.O.C., Public Housing Development in Taiwan , Republic of China, 1977.

Taiwan.

(2) Frame Systems

Frame system generally constitute the frame parts of the building, such as beams and columns, fabricated off-site but assembled on-site. Into these frames are fitted infill units, such as walls, partitions, floors, ceilings and roofs, also fabricated off-site and assembled on-site. The primary advantage is the reduction of on-site work through the use of component assembly. Transportation to the work site is economical primarily because the components are small and light, and for this reason, central factories can enjoy large market areas. However, the increase in joints and materials tends to complicate the total construction process, increase the cost, and often has disadvantage such as the reduction in acoustical privacy between dwelling units.[1] Heavy weights, such as steel(sophisticated) and concrete(commom) frames are the two types of frames used most in present day construction.[2] The "Frame Type" of prefabrication was adopted in urban metropolitan and big cities for high-rise building in Taiwan.[3]

Using Prefabrication Technique for Public Housing

Under the six-year(1976-1981) public housing project, every city and county was assigned to construct a certain number of public housing units. Thereafter, in 1976, every city and county

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1.2. Laurence Stephan Cutler and Shirrie Stephens Cutler, Handbook of Housing Systems for Designers and Developers, 1974.

3. Ministry of Interior, R.O.C., The Evaluation of Using Prefabrication for Public Housing, 1984.

set up a public housing agency in order to undertake the construction and management of public housing agents promoted the system building of prefabrication because from the experience of U.S. and Europe, the prefabrication technique could lower dowm the cost and shorten the construction period.

The six-year(1976-1981) public housing project was finished in 1981. At the end of 1981, there were 5,910 public housing units(see Table I) constructed by prefabrication technique.[1] According to the Public Housing Act, those prefabricated public housing were sold to the middle and low income families and families of military serviceman, government and school employees. However, according to the statistics, 25% of prefabricated public housing were still vacant at the end of 1983.

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1 Ministry of Interior, R.O.C., The Report of Public Housing, 1984.

2 Ministry of Interior, R.O.C., The Report of the Discussion for the Policy of Public Housing Construction, 1984.

Table I

The Distribution of Prefabricated Public Housing

1976-1981

Location	Community	Type	Stories	Units
Taipei City	Nan Kang Com.	Panel	5	254
Taipei City	Hwa Jung Com.	Panel	5	140
Taipei Metro.	Wang Fung Com.	Panel	5	180
		Frame	7, 12	1,027
Kaohsiung City	Min Tsu Com.	Panel	5	629
		Frame	7, 11	919
Kaohsiung City	Chien Fang Com.	Frame	12	824
Kaohsiung City	Nan Tzu Com.	Panel	5	320
Keelung City	An Lo Com.	Panel	5	460
Tainai City	Ton Mung Com.	Frame	7	532
To Yung Coung	Kang Shin Com.	Panel	5	80
Shing Chu County	Meng Chu Com.	Panel	5	545
Total				5,910

Source: Public Housing Department, Construction and Planning Administration, Ministry of Interior, R. O. C. 1984.

CHAPTER IV

THE MAJOR PROBLEMS OF USING PREFABRICATION TECHNIQUE FOR PUBLIC HOUSING

When the government felt unable to meet the problem of building the millions of new houses needed, it was not surprising that officials looked at once to technology from the more advanced nations for the answer. In Taiwan, the government officials introduced the prefabrication technique because the U.S. and European experience showed the following advantages:

Quality Control: High-precision machinery imposes a schedule and a discipline. This result in higher tolerances, more accurate measurements with less maintence and fewer material wastes and a greater consistency of finish.

Production Control: Programmed production, timed delivery and/or erection lessen the need for a large stock inventory left in the factory or on the site. Construction is faster on the site where a more efficient order of building sequences can be maintained.

Labor Control: More extensive use of unskilled labor is possible in the factory because of improved supervision and because of the quality control inherent in the machinery.

Climate Control: Factory conditions release certain areas from the "building season" limitations imposed by their climate conditions. A permanent labor force can be employed when days lost to bad weather are minimized also reduced costs of training

and initiation to jobs.

Construction Period Reduction: Compared to traditional housing, the prefabricated housing substitutes machinery for on-site labor. It also makes housing components and housing units inside a factory without the limitations by climate conditions.. Therefore, it can shorten the construction time.

Cost Reduction: One of the objective of prefabricated housing is to put an end to the seasonality of home building by making it possible to produce housing in good weather or bad, inside a factory, free from the stoppages due to rain, snow, and cold. Such conditions should lead to high-volume housing and once sufficient sustained output is achieved, it is anticipated that progressively lower costs will follow.

Indeed, Taiwan acquired a faith in prefabrication from U.S. and European countries that was beyond argument. However, the use of prefabrication technique for public housing has not been successful in Taiwan. Both government and developers encountered many difficulties related to actual construction and to the business operation. The following are the major problems:

Lack of Knowledge and Training

Little practical experience in prefabrication exists in Taiwan.[1] Similarly, system building research is rarely undertaken. Few courses related to prefabrication are offered in colleges. Many engineers and technicians gain only limited

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[1] Ministry of Interior, R.O.C., The Evaluation of Using Prefabrication Technique for Public Housing, 1984.

knowledge from limited practical experienc. The lack of knowledge of most of the architects, engineers, technician and construction laborers became a very serious problem. On the one hand, public housing agencies anxious to introduce prefabrication; on the other hand, ignored the need for training program in the technical aspects of prefabrication. The lack of knowledge and training was reflected in the quality. Usually the physical quality of prefabricated public housing is worse than that constructed by traditional technique. Often, the leak of water pipe and the crack of the wall were found in the new prefabricated public housing.[1]

The Dissatisfaction of Dwellers

In Jan. 1983, the Ministry of Interior, R.O.C. authorized "Taiwan Construction Research Center" to inspect and evaluate all prefabricated public housing that was constructed under the six-year(1976-1981) public housing project.[2] After survey and study, in April 1984, the "Taiwan Construction Research Center" made a report (The Evaluation of Using Prefabrication Technique for Public Housing). The report showed many dwellers were not satisfied with their housing quality. The major dissatisfaction include:

Waterproofing and Soundproof

Of residents, 52.04% were dissatisfied with the

1.2. Ministry of Interior, R.O.C., The Report of Public Housing, 1984.

waterproofing. They complained of leaky bathrooms, walls, kitchens, balconies and roof.[1] Also 48.07% of residents were dissatisfied with the poor quality soundproofing.[2]

Interior Decoration

Resident dissatisfaction was 45.51% of residents. They complained of uneven walls, ceilings, floors and bad quality of tiles in the bathroom.[3] 45.69% of residents redecorated their interior decoration after they moved in.

Interior Structure

In Taiwan, people believe they have right to reconstruct or change their interior partition after they buy a housing. However, the partition in panel system housing usually are bearing wall. It's very dangerous to change or reconstruct the partition. The dwellers had no idea about the safety of prefabrication and the governments did not provide suitable information before the residents moved in. 36.91% of residents complained that they could not change the partition.[4]

Housing Equipment

31.33% of residents dissatisfied with the housing equipment. They complained of lacking garbage equipment, unclean storing reservoir, poor quality of duct.[5]

Housing Appearance

21.84% of residents complained of rough panel joints, bad

1.2.3.4.5.
Ministry of Interior, R.O.C., The Evaluation of Using Prefabrication for Public Housing, 1984.

quality of decorating materials, unvaried appearance and the poor choice of color.

The Problem of Construction Period

Like other developing and less developed countries, in Taiwan, there usually exist problem of administration when government execute a development program. The adminstration difficulties are doubled in a public housing program. In Taiwan, the authorities in charge of public housing is the Ministry of Interior at the central government level, the Provincial (Municipality) at the provincial(municipality) level and the County(City) at the local level. Lack of communication and conflicts between authorities are common and jurisdictions usually hard to define. On the other hand, the government did not authorized much power for the public housing agency. For example, after the public housing was completed, the public facilities such as sewage, roads need the help of Public Works Department. The construction process showed that using prefabrication technique really shortened the construction period.[2] Theoretically, the effect of reducing construction time could benefit a public housing project because it could reduce the burden of interest and lower the cost. However, because of weak administration, the building process usually is delayed.[3] Although there was an actual reduction

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1. Ministry of Interior, R.O.C., Public Housing Development in Taiwan, Republic of China, 1977.

2.3. Ministry of interior, R.O.C., The Report of Public Housing, 1984

of construction time, the overall costs increased because of administrative inefficiencies.

The Cost Problem

According to statistics, the cost of prefabricated public housing is always higher than the cost of traditional housing.[1] Besides the weak of administration increased the construction interest(the author mentioned above in The Problem of Construction Period), there are two main factors that account for its higher cost.

(1) Housing is a cyclical business. In traditional construction, overhead and fixed costs are purposely kept low so that the company can survive slack times.[2] In prefabricated construction, where a large factory is required, fixed and overhead costs are higher per unit of output. There is a necessity to maintain a continuous market so there can be a smooth flow of production. Mass construction is the important way to lower the cost. However, under the six-year(1976-1981) public housing program, only 10% of public housing was constructed by prefabrication technique.[3] It is obvious that prefabricated companies and factories could not supply cheap production under the six-year public housing program.

(2) Since factory production is one of the main characteristics

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1. Ministry of Interior,R.O.C., The Report of Public Housing,1984.
2. Daniel A. Hodes and Gordon F. Jensen, The Case for Industrialized Housing- Reexamined, 1973.
3. Ministry of Interior, R.O.C., The Report of Public Housing, 1984.

of prefabricated housing, almost every prefabricated system entails shipment of the finished product from the plant to the job site. For this reason , shipping or transportation is a common problem for almost all modular producers.[1] In Taiwan, they adopted European concrete systems, the constraint is usually on weight and distance. Transportation costs represent an additional cost element not present to the same degree in traditional construction. Increased production costs resulted in higher prices. Consequently, 25% of prefabricated housing units are vacant.[2]

The Social Factor

Although the admirable rate of economic growth has made Taiwan change remarkably, it remains one of the most staunchy traditional country of the Orient. For all its modern trapping, Taiwan has not succumbed to the westernization that has infected the very social fabric of such places as Hong Kong and Singapore. The heart keeps the people in Taiwan hard to accept a new technique. The development of prefabrication technique met the same difficulty. Most people did not believe in the structure of the prefabricated housing. They worried about it's safety.[3]

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1. Daniel A. Hodes and Gordon F. Jensen, The Case for Industrialized Housing-Reexamined, 1973.
2. Ministry of Interior, R.O.C., The Report of Public Housing, 1984.
3. Wu, Tzer-Yuan, The Possibility of Developing Prefabricated Housing in Taiwan, 1982.

individual entrepreneurs or corporations must underwrite the cost without assistance from government and without a guarantee that an adequate market will be available to justify the investment.

CHAPTER V

FINDINGS AND CONCLUSIONS

The use of prefabrication technique for public housing in Taiwan was considered a failure under the six-year(1976-1981) public housing program. In Taiwan, considerable attention has been focused on the difficulities that prefabricated housing manufacturers encountered in getting started, especially on the spectacular business failures. The Taiwan economy is a fairly tough environment for any new business concern. In fact, it is rare that a new industry or subindustry of the dimension of prefabricated housing can successfully emerge there. In almost every case, the major new industries are highly concentrated, with a few companies accounting for most of the buinesses. The prefabrication industry is much less concentrated. The admirable rate of economic growth in Taiwan has made a significant improvement in the living standards of the population. In the cities, the pressures of immigration have resulted in rapid population growth and housing improvements have lagged far behind the better standards of food and clothing being enjoyed. On one hand, because of the high labor and interest costs, the traditional housing technique which need long construction periods and the on-site concentrated labor, cannot afford the market gradually. On the other hand, Taiwan has a typhoon season(from June to October) which makes site

work difficult. Traditional housing systems lack the indoor factory production of large dense pre-cast concrete panels during this period, or boxes for the rapid construction of high-rise blocks of dwellings during the non-typhoon months. Therefore, the systems ought to be replaced by industrialized technique. The prefabrication technique is essential to an industrialized system building. The author believes the development of prefabrication is not impossible in Taiwan, but it needs more time to develop.

Findings

Through the discussion of using prefabrication technique in Taiwan in the previous chapters, the author has following findings:

(1) Industrialization is significantly changing the skill-mix of the construction labor force by eliminating many of the traditional on-site craft skill; by increasing demands for engineers, technician, and supervisory staff; and by creating new demands for multi-skilled workers, machine operators and assemblers.

(2) The architect is vitally involved as the use of an industrialized building system demands a rational approach not only to site organization, erection and manufacturing process, but also within the architect's office. A balance must be achieved between design requirements and construction requirements. The architect should be aware of the function of the production control organization and how it can help him control the project. He should, for instance, realize the full

implication of making design changes late in the predevelopment program.

(3) The manufacturer has to absorb the new attitude and supply factory-finished subassemblies which are larger and more complex than previously done on-site. In addition, the packaging of components is according to a more specific and rigorous schedule.

(4) In addition to immediate direct benefits from mass production, continuous large-scale industrialized building introduces the possibility of obtaining substantial indirect, long-run external benefits. Such external benefits arise from concentration of research and development expenditures, specialization in factories producing prefabrication machinery, establishment of vocational training programs in prefabrication skills, and more experience in production, distribution, transportation and erection.

(5) Consumer acceptance is probably the most important single determination of the future growth of prefabricating housing. Regardless of how much government support is forthcoming, unless the consumer accepts the end product there will be no marked and no growth. Therefore, to understand what the consumer needs is very important for the prefabrication factory.

Conclusion

Based on the above findings, the following are the author's perception of the issues facing Taiwan:

(1) Although prefabricated housing systems have played a very improtant role in U.S. and European housing market, however, implementation is but one aspect of larger process of society and is therefore affected decisively by environment in which a particular program is implemented.

(2) The government agents and planners often forget to consider the importance of understanding the nature of the existing social context prior to the introduction of the new technique. They also neglect to consider the fact that new technique can create unintended problems and precipitated unexpected side-effects.

(3) Competence and commitment are needed at all levels of the implementation of prefabrication industry. This implies not merely technical skills relevant to the program, but also managerial expertise in implementation, and human skills in personnel management. Lastly, political skills to obtain and sustain cooperation and support from leaders of public opinion in the community and country are much needed.

(4) Efficient use of industrial technology requires substantial changes in the traditional relationships among designers, building components producers, and contractors, so as to achieve unified managerial coordination of the building process.

(5) A sucessful prefabricated housing operation requires a large and sustained operation. This means more than just a large "potential" market; it means a specific market that can be

counted on to yield a steady flow of sales. Plants must be tailored to meet the needs of specific, well-defined markets. The author believes a large and profitable market will develop for prefabricated housing production in Taiwan, but this development will take time. Right now, to control the expansion of plant capacity in order to keep pace with market size is the best way to survive. Successful prefabricated housing producers are those that are building their markets. They are developing their builder-dealer organization and they are concentration on producing a product that will meet the needs of their customers.

In summary, although a successful future is predicated for the industrialized housing industry, the companies in the industry should take into account the fact that European and U.S. systems of industrialied housing are not expected to be major factor in the success of this industry. In Taiwan, the housing industry, as presently constituted, is completely incapable of a mass market. The only way to surmount the crisis, is through volume manufacture of housing units, using assembly line techniques with standardization of operation and quality controls, and under conditions where production is carried on inside the factory, in and out of season, during good weather and bad. In order to survive, the housing industry has to make the transition to industrialized housing. The housing goals can only be attained through mass production, mass distribution and mass erection.

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