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AN OVERVIEW OF PRECAST CONCRETE SYSTEM FOR BUILDING MAINTENANCE: MALAYSIAN PERSPECTIVE

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Abstract

Precast Concrete System which is mass produced either in factory or at site factory is widely used as building components. The components are usually designed according to the specified standard shapes and dimensions. The components will then be transported to the construction site to be placed according to the building design requirements. Previous studies indicate that without proper planning at the design, manufacturing and construction stages of the precast system, the use of precast concrete system often leads to building maintenance issues. This paper will discuss the factors that will lead to maintenance issues for building using precast concrete system. These factors will be those that need to be considered at the design, manufacturing and construction stage for the precast concrete system. Lastly, recommendations are proposed to be used by designers, contractors, manufacturers and researchers who are involved in precast concrete system.

Index Terms:*Precast concrete system, building maintenance, design, manufacturing and construction stage.*

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1. INTRODUCTION

The concept of using precast concrete system in Malaysia started after the ministry of housing and local government of Malaysia visited several European countries. This became the significant starting point for the precast concrete system in Malaysia although this system was not so popular in the early 1960's. Our Malaysia construction field achieved another new mile stone when the project Pekeliling Flat in Kuala Lumpur wassuccessfully completed within 27 months which utilized the panel pre-cast concrete wall and plank slabs.Nowadays, there are lots of local precast concrete manufacturers and still mushrooming. Most of the precast systems used in Malaysia are large panel systems, precast load bearing wall and precast non loading wall. All these systemshave been largely used for private residential projects in Malaysia which included projects in Shah Alam, WangsaMaju and Pandan, Dua Residency, Kuala Lumpur, Taman Mount Austin and TongkangPecah, Johor (CIDB, 2006). Now, precast concrete is not new to the construction industry. This method has effectively saved cost and improved the quality through the reduced of the labour intensity and construction standardization. Besides, it minimizes the wastage, less site materials, more clean and neater environment, better quality controlled, and reduces the total construction costs. Successful implementation of precast concrete system in the world are SesikuiHome(Japan), Living Solution(United Kingdom),Open House(Sweden) and Wenswonen (Netherlands).

2.0 PROBLEM STATEMENT

In the 1960's, precast concrete system was often misinterpreted with negative meaning. Normally, precast concrete building was associated with pre-fabricated mass construction method, low quality buildings, leakages, abandoned projects, unpleasant architectural appearances and other drawbacks. The public have bad impression about the precast concrete due to the poor architectural design for the old pre-fabricated buildings such asPekeliling Flats in Kuala Lumpur and Taman TunSardon,Gelugor,Penang. The very basic design for Taman TunSardon by British Research Establishment,UK created lots of problem. The lack of design such as the need for wet toilets and bathrooms lead to problems of leakage. Further more, many low cost housingswere not maintained properly and this gave the negative impression and poor image to the precast concrete buildings. (Rahman and Omar, 2006).However, lack of knowledge in structural analysis and design of pre-fabricated components also contributed to the problem of the implementation precast of concrete system. The most common

problem was the connection between the beam to column and column to base. The lack of knowledge of design could cause the poor connection at work site. The poor connection may lead to the issues of comfort and safety. When the steelwork structures are designed as the conventional reinforced concrete structural system, this concept result exposed steel beams and columns. Unfortunately, this can comes out of many problem such as leakage. The rain water can easily seep into the building joint between the wall and steel beam. On the other hand, the dampness leads to corrosion to the lighting system and the beam (Rahman and Omar, 2006).Most of the local contractors still lack knowledge in using precast system. They need to improve their skills especially for their workers in order to produce a quality precast concrete building. It would be an advantage if the local contractors upgrade their skills which ultimately will enhance the competitive advantage of the industry in facing the issue of using the precast concrete method in local construction. The local contractors should prepare themselves in design, installation and project management skills which are important elements in precast concrete system.Lack of knowledge in design for precast concrete system could lead to the safety issues. Without proper design method, this will give the negative impact for the precast concrete building. Most of the contractors in Malaysia have poor experience in constructingprecast concrete building. Therefore, lack of technical knowledge may create a negative impact for the building quality after the building was constructed. In fact, there do exits where a project facing many difficulties after awarded to be using precast concrete system to construct. The most common issues isinappropriate installation of the component on site. Due to the inaccuracy in setting out the alignment and levelling, contractors perhaps may encounter the difficulties in installation for the precast components. Precast concrete system could have the risk such as technical and quality which cause aesthetic and functional mistake. This includes blemishes, cracks, moisture penetration and poor insulation in a completed precast concrete building. Indeed, precast concrete has caused failure to fulfil the requirement of the operational and quality. In conclusion, to be successfully implemented, the system relies on effective operation of the factory, operator's skills and component. Hence, in order to achieve efficiency, there is a need to improve the handling system, storing and transporting the components.

3.0 SIGNIFICANCE OF THE STUDY

A good practice of maintenance concept during the design and construction stage could avoid most of the defects to occur for future building. In fact, these defects may have a large maintenance cost implication if the building was constructed and design not in the maintenance concept. Designer and contractor's education and experience are the main factors that cause the defects to occur in a building. If these factors are not overcome the owner will suffer the maintenance cost at the end. Somehow, in some cases the contractors and designersare to share the maintenance and repair cost. This research is important to identify the faults and defects expected to occur in design, construction and manufacturing stage for precast concrete system. The critical factors of building maintenance will be identified and the designers, contractors and manufacturers of the precast concrete system will be able to improve the quality through recognizing the faults .

4.0PRECAST CONCRETE SYSTEM IN MALAYSIA

The concept of using the precast concrete system in Malaysia started in 1960's involving the project Tuanku Abdul Rahman Flats in Kuala Lumpur and Rifle Range Road Flats in Penang. Since then, the government has encouraged local contractors to utilize the precast concrete system in construction projects. In 1998, Ministry of Housing and Local Government and CIDB set up a Modular Design Guide. This Modular Design Guide contained the modular coordination concepts, design rules, drawing and preferred dimensions for architectural finishes material such as bricks, glass and gypsum board. The aspects of prefabricated concrete was based on modular dimensions, strength and stability. However the fire protection specification was not indicated. There were several clauses introduced by Uniform Building By Law(UBBL) which encouraged the use of the precast concrete system in the sub clause 42(1):

i. Second line stated that "11 meter square gross area" was replaced by the "10.8 meter square net area". This was suitable for the room area that had the dimension of 3000x3600mm using the modular dimension.
ii. Fourth line "9.3 meter square gross area" was replaced by the"9.0 meter square net area"
iii. Fifth line, :6.5 meter square gross area was" replaced by "6.3 meter square net area".

The local authority is only given the responsibility to inspect the work after the completion of the project for the conventional project and this not so practical. The local authority should be given the priority by the government to inspect the work in the manufacturing process, construction stage and lastly to the project completion to make sure the quality of the construction is fulfilled. The government introduced the Malaysia Standard 1064 in order to standardise the precast components in terms of dimensions in 2001. However, the MS1064 still needs to be improved as it had some vulnerable point. Types of material, design

standard.connection types, construction method and the system implementation are important of the specificationsthat are not included. With these few items, precast concrete component's quality can be improved and the contractors can utilized a standardised system easily and this this will encourage them to utilized the use of precast concrete system. The standard certainly canot be too rigid to allow for technological improvements in construction method, system and etc.Most of the innovations in material and components are made before their application in the building process. Generally, construction firmsplay the role as the integrator and catalyst for transforming new technologies into marketable products. Importantly, this can improve and develop new technology. The materials, component manufactures and high quality equipment for production proposes are among the technology adaptation. (P.C.Lim,2006)

5.0 PROCESS OF METHODOLOGY

Process methodology need to arrange systematically to achieve the aim of the research study. This process started from the topic selection followed by identifying issues, objectives, scopes, data, data collection, data analysis, conclusion and recommendation and finally the thesis write up.

To achieve the objective of the research, the following steps were carry out:

1. A preliminary research was made on the factors that affect maintenance.
2.Site visit, interview and discussion session with the building owners, designers and contractors. This is done to collect data and to understand the design and construction factors that affect maintenance.
3.The questionnaire was formulated after the preliminary interviews and literature review was obtained.
4.The pilot study was conducted before the survey could be distributed to the respondents.This pilot study was important to:
a.Test the adequacy of the questions and review the adequacy of provided space for each question.
b.Estimate the time needed to fill out the questionnaire.
c.Review more possible answers and increase the list of choices.
5.After the pilot study has been achieved, the questionnaire was distributed by post, email or by hand to the potential respondents.
6. The questionnaire was collected but the incomplete questionnaire will be excluded.
7.The questionnaire collected needed to be analysed and obtaining the weighted overall factors affecting building maintenance.

5.1 METHODOLOGY FLOW CHART

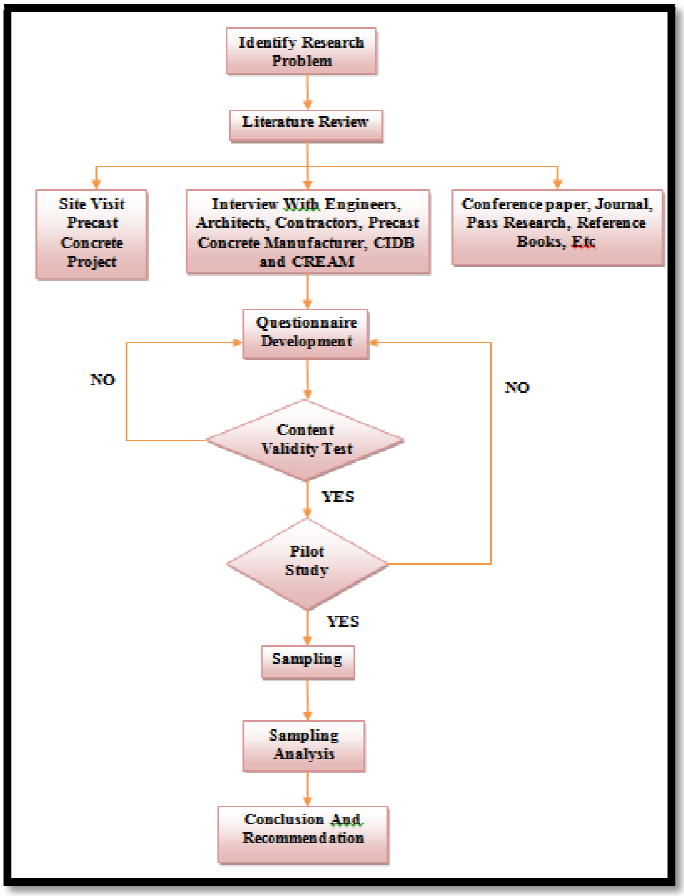

Figure 1: Flow chart of methodology

6.0DEFECTS OF THE BUILDING

Defects could be said as the deterioration in a building. Defects caused by the errors or negligence either by the designers or contractors. Sometimes, this is an unavoidable process and this could be reduced by emphasized in design, material selection and a good construction method. Gibson found that defects are related to the structure and others was related to the soiling of the elevation and low accessibility of the services. There are some common defects which included cracking and leaking. The determination of the actual defects requires need a professional inspection to find out the cause of the defects and proposed a correct solving method. In 1996, according to Assaf there were 11 major group of faults; defects in civil design, defects in architectural design, defects in maintenance practically adequacy, defects due to consultant firm administration and staff, defects due to construction

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drawings, defects due to constructioninspections, defects due to civil construction, defects due to contractors administration, defects due to construction equipment, defects due to construction materials and defects due to specification. Below are some example of the compliant in building maintenance for precast concrete system :

a)Jointing b)Fire protection c)Water leakage
d)Window and door e)Sounds operation
f)Clean water supply g)Finishing h)Air circulation
h)Lightingi)Humidity control
j)Wall cracking k)Access to cleaning area

7.0 BUILDING MAINTENANCE FACTORS FOR PRECAST CONCRETE SYSTEM

From the literature study, interview session and site visit, the factors that affect the precast concrete system that leads to building maintenance will be identified. This is very important for the questionnaire to be formulated. Generally, this following factors will be identified as shown as below:

i. Architectural design stage
ii. Structural design stage
iii. Building Services design stage
iv. Manufacturing stage
v. Construction stage

Figure 2 had shown the factors which are successfully identified and will be survey and identify the critical factors which are lead to building maintenance for precast concrete system through this five category. The questionnaire will utilize likert scale which to identify weather these factors are strongly affect, affect, moderately affect, slightly affect or does not affect to the precast concrete system in building maintenance. Thus, recommendations and suggestions will be forwarded through the identified critical factors in order to produce a better quality of the precast concrete system.Hopefully feedbacks from the precast concrete designers, contractors and manufacturers will be successfully identified:

1 The critical factors which lead to building maintenance.
2.The correlation of the factors and the effects of factors.
3.To propose a suggestion and recommendation

1.Architectural Design	**2.Structural Design**
a)Specifying finishing b)Functional layout c)Natural Ventilation d)Shape and seize of precast concrete e) Window and door opening f) Access to cleaning area	a)Joint details at panel to panel connections b)Grade concrete c)Locating conduits and pipe opening at critical structural location d)Internal crack control e)Location of panel joints f)Loading g)Sounds transmission h)Fire rating i)Connection details for supported beams and slabs
3.Building Services And Maintenance design	**4.Manufacturing Stage**
a)Pre plan and predetermined M&E services b)M & E services space provision c)Lighting d)Sound protection e)Technical details f)Plumbing and sanitary services g)M & E coordination work h)Ease of repair replacement	a)Procedure for quality control b)Approval manufacturing machine by Sirim c)Procedure test the quality of the IBS component d)The use of raw material with specification e)Inspection from the responsible authority f)Workers experience g)Management of the company h)Storage
5.Construction Stage/Installer	
a)Procedure to install the precast component b)Detailed information install stage for precast component c)Process of lifting and install d)Skilled labor e)Equipment	

Figure 2: Summary building maintenance factors

8.0EXPECTED OUTCOMES

The crucial maintenance factors during the manufacturing, construction, and design stage need to be identified in order to produce a better quality of the precast concrete building. The objective of the research in the end will be achieved so that a better recommendation and the model of solution. Thus, all the information and data gathered from this study will be useful especially for the CREAM,CIDB, architects, contractors, manufacturer, engineer or academic to ensure precast concrete building is incorporated with maintenance concept in Malaysia.

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BIOGRAPHIES

ENGR. Ng Ban Kiong,is a civil and structural engineer in consultancy and currently pursuing his master degree in University Tun Hussein Onn Malaysia. He received his bachelor degree in Civil Engineering from University Tun Hussein Onn Malaysia. Few years experience in civil engineering design. He is also a member of Board of Engineering Malaysia(BEM) and Institution of Engineering Malaysia(IEM).He has published over six conference papers and journals. His research work is mainly about precast concrete system and building maintenance.

Assoc. Prof.Dr.ZainalAbidinAkasah is an experienced academician in engineering education with over twenty five years of teaching experience in higher education. He is currently the Head of Department of the Building and Construction Engineering in the Faculty of Civil and Environmental Engineering. He obtained his Doctorate from UniversitiTeknologi Malaysia (UTM) with his thesis related to the Maintenance Management Process Model for School Buildings. Prior to that he obtained his MSc. in Building Technology from the UniversitiSains Malaysia, his Bachelor of Technology with Education in Civil Engineering from UTM and his Diploma in Architecture from the same University. Assoc. Prof. Dr ZainalAbidinAkasah teaches several subjects in civil engineering namely, Intelligent buildings, Acoustics, Lighting and Vibrations in Building and Engineering Drawing and CAD. He is also actively involved in consultancy and the training of trainers. His recent consultancy projects are for the Landscape Design Project under the Ministry of Education and the training of trainers forthe KolejKemahiranTinggi MARA (KKTM) project. His involvement in the KKTM project includes giving trainings on Computer Aided Design (CAD) for Piping Design and Building Automation. Assoc. Prof.Dr.ZainalAbidinAkasah is currently are recipient of several research grants. His research interests are in the applicationof IT in architectural engineering, 3-D Visualization applications in building engineering, Computer Aided Design, and facilities management and maintenance, process modelling and engineering education.