[CON 8] THE CONSTRUCTION OF LOAD BEARING MASONRY BUILDINGS IN MALAYSIA

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ABSTRACT

Masonry loadbearing construction had been utilized hundreds of years ago in Europe, but in Malaysian its utilization is scarce. Reinforced concrete approach has been the predominant method of construction. Masonry construction in Malaysia was found more than 350 years ago during the settlement of Portuguese in Melaka. The loadbearing masonry approach is widely used in developed countries because it is cheaper and forms part of one of the earliest construction techniques. The aim of this research is to investigate the level of exposure of this technique among contractors. The objective is to justify the economic viability of loadbearing construction. The method of analysis that is used is qualitative- based involving data collection and analysis. Data collection will be carried out using face to face interviews. The masonry loadbearing is cheaper than reinforced concrete. Masonry load bearing provides many advantages to the construction industry but its exposure and utilization by contractors and developers does not tally to its advantages where its economic viability is one of them. Further researches are required to investigate the advantages or otherwise of loadbearing masonry against the currently popular various precast construction methods.

Keywords: *load bearing masonry, cost, reinforced concrete, economic viability*

INTRODUCTION

Load bearing masonry is a method and structure where is the base of floors and walls are work together as a system and it is support to each other. Until now load bearing masonry has been applied based on the design of a rational engineering. The masonry walls are used to support building loads imposed by the roof, upper walls and floor slabs as well as lateral loads such as wind and soil pressure for the load bearing masonry wall system (Abdullah, Ramli, Mohd Nawi, 2015). In construction industry, load bearing is an oldest construction method.The load bearing or a structural masonry is a method of construction where the elements of a structure are built using masonry (Abdullah et al., 2015).

Generally, there are three type of structural masonry such as frame system, flat slab system and load bearing or shear wall system (Abdullah et al., 2015).Masonry is one of the simple and not a new construction method and has been used for much type of public buildings such as shopping mall, bridge, LRT railway and houses. A building can be built either from one of the system or combination of all.

PROBLEM STATEMENT

In load bearing masonry system, there are a lot of advantages in construct the buildings and houses but it still have a few of problem that need to solve it. Nowadays, many people had utilized conventional reinforced concrete system compared to load bearing masonry in Malaysia. They prefer choose reinforced concrete frame for construct the houses even the load bearing masonry is cheaper. It is because reinforced concrete approach is easier to build and high percentage of utilisation in Malaysia.

And in the load bearing masonry system, many contractors are lack of expertise or skill and experience on the system. The percentage of expertise in load bearing masonry courses among contractors is quite low. They have to focus more on practices a load bearing masonry system because of the durability in this system is better for buildings construction in Malaysia. According to understand construction website, there are an evidence which is extremely labour-intensive as it is built mainly of masonry that made by hand. They are not only less of expertise among contractor but also still not developed a machine for produces masonry. Thus, there is an objective of this study as a following:-

(i) To identify advantage of load bearing masonry
(ii) To determine the exposure of load bearing masonry system among constructors
(iii) To justify the economic viability of load bearing masonry construction in our country.

SIGNIFICANCE OF PROJECT

Significance of the project is to explore more about load bearing masonry among the contractors and peoples in Malaysia. Many people do not know an advantage of load bearing masonry wall system. They are only focus on reinforced concrete method because of it is predominant in Malaysia. And it is also can shows that load bearing masonry system can be the first method in future. Load bearing is better, economical and faster than reinforced concrete. It can provide a good houses or buildings using this system. Lastly, we can learn a lot of advantage of load bearing masonry construction. Load bearing masonry is one of oldest method in construction industry. There are few of advantage of this system like lower cost, save time and durable.

LITERATURE REVIEW

According to Abdullah (2015), load bearing masonry construction system is considered one of the most pertinent agendas in the socio-economic development of the country. Masonry is one of the simplest techniques for the construction and it is made from the collective units of stones, concrete, bricks and blocks in making a wall. The buildings of masonry portray the good architecture works in the world where is a lot buildings have been built using masonry technique that making it a building of heritage.

Masonry units used a lot of types of materials. The Mesopotamia people used the sun to dry the mud bricks for their temples and shelter in the early civilization. However, the stones that were used by Egyptians for their temples and pyramids. The mainly ingredients of masonry constructed from the use of soil, clay, calcium silicate and

concrete respectively. Masonry structures have been used from the smallest to huge building, infrastructural and monument in the earlier century. There are many building structure that have been used masonry structure for several construction in this world such as Egypt Pyramid, Babel Tower in Mesopotamia and Mohenjo Daro in the Indus valley, Kaabah's Holy and Great Wall China (Ramli, Abdullah & Mohd Nawi, 2015).

The masonry structure is always used in developed country as cheaper and early materials of construction such as United States and Europe. Cantilever wall which is without shear wall and lead to the increased thickness from top to bottom to build the masonry building based on graphical methods or simple calculation. In late of 19th century masonry began to lose its preference among the construction's material (Ramli et al., 2015).

The buildings start to choose the structure frame that replacement to the masonry structure from steel and reinforce concrete. For instance is in the year 1891,the final masonry structure was built which is Monadnock Building that have sixteen stories in Chicago was reviewed as the final triumph of customary masonry structures that was designed with 1.82m thickness of the walls by John Root (Ramli et al., 2015).

The usage of masonry structure that was found more than 350 years ago during the settlement of the Portuguese in Melaka. The model of masonry heritage building tha t they were left in Malaysia is Al-Formosa. Then, British were continued using brick masonry and widely implemented in Tanah Melayu. British was built the building such as the office and middle class residential. A modern of masonry construction was started by the British. The buildings that were found is located at Gurun Nad TUDM quarters at Tok Jalai, Jitra (Ramli et al., 2015).

After independent days it is introduce mainly in housing projects for the block materials. It has an example like a housing project was using a hollow block of low price houses in year 1970 at Taman Sri Kemuning, Jitra, Setapak Jaya Housing Estate in Setapak In 1978 and the Selayang Utara and Selayang Selatan in 1979 (Ramli et al., 2015).

Some of building that using a masonry system is still gazette as a 'national heritage' such as Bangunan Sultan Abdul Samad in Kuala Lumpur were built in year 1894, Hospital Tun Aminah in Johor Bharu and Federated Malay States Railways building. This system had been approved and gazette under the Uniform Building by Law in 1989 due to the excellent record in overseas and local using the load bearing masonry system have been recorded (Ramli et al., 2015).

The systems were used at Chembong Negeri Sembilan with low cost housing project in 1994 and it is also won that Jabatan Perumahan Negara organized the prestigious Prime Minister's Award. Since that several numbers of housing projects which is using the load bearing masonry system have been reported. The masonry structural usage is not too popular in Malaysia country even it have a few advantages to this structure (Ramli et al., 2015).

A study found the productivity by using the masonry system was influenced the project-related factors such as the type of work, building element, and method of construction and design requirement influence the productivity (Sanders & Thomas, 1992, 1993).

When understanding the factors, it will help the designers in designing the masonry structure that construct more efficiently and manageable of masonry projects.

Sustainability of masonry defined that sustainable housing as comfortable housing that incorporates friendly environment, use a natural resources, a good quality of life and economic growth (Edwards & Turrent, 2002). The provision of sustainable requires housing needs and the sustainable building material usage is an environmental responsible (Adedeji, 2012). It is because offers low maintenance, energy conservation, improve productivity, greater flexibility, improve occupant's health and use of natural resources (GBI, 2009).

The masonry system adoption in construction was widely used especially in developed country. It found a shorter time and reduce cost for the construction was influenced the adoption of masonry system (Adedeji, 2012). However, the adoption of the system among industry player is low level but awareness of technology is high.

Masonry is still the most important material for the housing construction while the developing countries have an interest in transforming masonry into variety of structure application (Ramamurthy & Nambiar, 2004). It is also innovates the design in improvements of performance and serviceability of needed (Beall, 2000). Masonry performs concurrent functions of carrying load and including space while having strong properties for fire resistance, thermal and sound insulation and protection against environmental exposure (Edwards, Gayed, Prra, & Rodriguez, 2010; Sharath, Vikas, & Kumar, 2013). As a result, masonry is a cost-effective and low-energy alternative when designed appropriately (El- Adaway, Breakah & Khedr, 2011; Adedeji, 2012; Ramamurthy & Nambiar, 2004).

RESEARCH METHODOLOGY

General method

There are two most important research methods in the social sciences which is involving qualitative and quantitative study. The qualitative methods are used to interview any people that involves in the research and to investigate interpretations and meanings that people apply to specific experiences while quantitative methods is focus on calculating and relating a concepts on a statistical or specific scale. Quantitative research usually involves the design of the structure questionnaires which are then circulated to a huge group of respondents. It is mainly used a qualitative method in this study. As literature within construction remains vague on this topic, quantitative analysis methods refer to questionnaire while qualitative research is in form of interviews. The purpose of the interviews was to gather additional empirical insight into the applicability and impact of platform-based on how the load bearing wall looks like.

In this chapter, the reason of choosing qualitative methods is because it can be save time to complete the research. And it is also can get relevant and true information from the respondent that will interview. The respondent that was focusing is a contractor who is has experience and knowledge about load bearing wall. The name of first company that interviewing is Company Overview of Kasjaria-Kim Huat (M) Sdn. Bhd. at Bandar Baru Kubang Kerian, Kota Bharu. The contractors have sharing some part of load

bearing masonry in buildings construction. The second location of interview is IHS Utara Sdn. Bhd. at Shahab Perdana, AlorSetar, and Kedah. The project manager has giving information of load bearing masonry in Malaysia. There are only two contractors that were involved in this study.

Steps of the interview

There are several steps that need to be done before running this interview. The steps that need to be taken during the interview as a following:-

(i) Identify who is to interview and make an appointment
(ii) Identify the whole title that will be discussed and listed the facts that will be needed in the interview
(iii) Prepare the questions to interview in order to avoid wastage of time and not relevant of conversation
(iv) Respondents will be provided feedback to the interviewer who will ready to give information clearly in interview session
(v) Researchers will take notes and ask permission to record discussions are ongoing and destined for question if information obtained is not clear.

FINDING AND DISCUSSION

Cost of load bearing masonry

In this topic, there are two categories which are financial years of load bearing masonry and cost comparison between load bearing masonry and reinforced concrete frame. According to Abdullah et al. (2015), the revenue and gross profit of load bearing masonry for each year was increase from year 2011 to 2013. However, in cost comparison between load bearing masonry and reinforced concrete shows that the average price of load bearing masonry is cheaper than reinforced concrete.

Financial years of load bearing masonry

A research by Abdullah et al. (2015) involving the economic comparison between reinforced concrete and load bearing building showed prominent savings in the load bearing technology. From the reports and financial statements for the financial years ending 31 December of each year, there are three years with few categories of account heading such as revenue, sales cost, gross profit, administrative expenses and other operating expenses. In year 2011, the revenue is RM4,377,031 and decrease to 55,264 which is RM4,321,767 in year 2012. But it is increase to RM 4,524,890 in years 2013, 3.4% and 4.7% increases in 2013 revenue over 2011 and 2012 respectively (C.S. Abdullah et al., 2015). However, the cost of sales in year 2011 is RM (1,754,328) and increases to RM (1,975,815) in year 2012. In year 2013, its cost is RM (1,710,408). The cost of sales shows that it isinconsistent years by years which is 37.8% of revenue in 2012 compared to 40.15 and 45.7% of revenue in 2011 and 2012 respectively. The number of gross profit in year 2011 is RM 2,622,703 with 59.9%. But in year 2012, it is increases to 54.3% which is RM 2,345,952 and RM 2,719,458 with 60.1% in year 2013 (Abdullah et al., 2015).

The number of administrative expenses is RM (1,807,464) and RM (1,812,507) in year 2011 and 2012. In year 2013, it is RM (1,710,408) for the number of administrative expenses with 37.8%. Lastly, other operating expense in year 2011 is RM (779,919) with 17.8%. But decrease rapidly to RM (520.362) or 11.5% in year 2013. The number

of other operating expenses is RM (572.602) with 13.2% in year 2012 (Abdullah et al., 2015).

Based on financial years, the percentage of cost of load bearing masonry construction in our country is quite high a requisition from the client years by years. It can be replacement for reinforced concrete method in future. For example the private project have been build an apartment or condominium using load bearing masonry method in Kuala Lumpur, Penang and Singapore.

Cost comparison between load bearing masonry and reinforced concrete frame

In this research, Puskas and Morgan are calculating the 5 level of 7 storey building. They have been done a calculation for each level of 7 storey building with different materials and quantity. The result was showed that the price of masonry is cheaper than frame method.

Table 1

Material and average price for 5 level of 7 storey building (Puskas & Morgan, 2015)

Material	Price of masonry (RM)	Price of frame (RM)
Concrete(m3)	97175.59	96521.56
Formwork(m2)	135925.60	150617.20
Masonry(m3)	233337.57	217772.41
Rebar(kg)	131127.58	139602.83
Total	597566.34	604514.00

From the Table 1, it shows that price of the load bearing masonry is cheaper and economical than reinforced concrete frame. There are a few type of material such as concrete, formwork, masonry and rebar. There are five stories which is use the material with different price and quantity. Each storey has its own price of load bearing masonry and reinforced concrete.

It shows that the cost of reinforced concrete is higher than load bearing masonry after calculating average price of both methods. The price of formwork and rebar for both methods is frame methods are costly rather than masonry. Therefore, load bearing masonry system must be a first method of buildings construction in Malaysia.

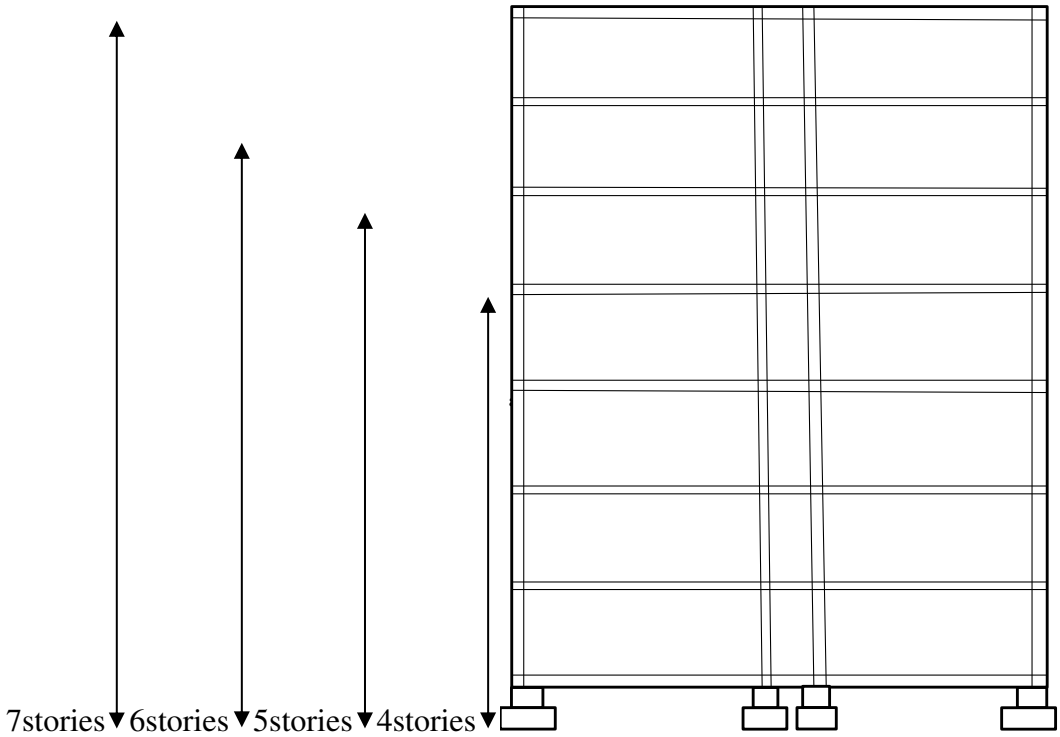

Figure 1
Typical structural cross-section of the 7 storey building (Puskas & Morgan, 2015)

Advantage of load bearing masonry
Load bearing masonry technology is not a new technique of construction and usually used in developing country. And it is offer some of an advantage compared to conventional reinforced concrete frame system in term of durability, price or cost, quality and time in build the project.

Durability
Load bearing masonry wall is very important in term of durability in buildings construction. This system is more durable than reinforced concrete frame system. It is because during a process of load bearing masonry wall, a concrete will fill into a hole of block of masonry. And it is also can bear the burden and a weightofbuildings.

It have a description of product in precast concrete load bearing masonry wall panel such as cement, aggregate, water, chemical and sand. Actually there is a mixing ratio for one meter cube. The calculation of ingredients in load bearing masonry has to correct and appropriate. If its calculation was wrong, the buildings might be collapse.The following materials and proportioned for product descriptionstated:-

Table 2
Ratio of product description

No.	Materials	Mixing ratio for 1m3
1.	Cement	355 kg
2.	Sand	953 kg
3.	Aggregate	944 kg
4.	Chemical RHEOBUILD 1100 RM	4.26 liter
5.	Water	160 liter

Cost

From the total cost of whole building, load bearing masonry is more economical compared to conventional reinforced concrete building. The load bearing masonry system only need skilled worker to lay the number of bricks or blocks and does not use any expensive machine, tool or equipment.Reducing the use of reinforced concrete, more cheap foundation designs due to uniform load, more efficient roof design and using flat floor constructionto achieve the saving (N.A. Ramli et al., 2014).Otherwise, it can reduce the labour and methods cost where is the system does not have an intensive time for the advance method in preparation and fabrication in beginning of the construction. The elimination of formwork cost for columns and beams as well as from the savings for using raft foundation instead of piled foundations (C.S. Abdullah et al., 2015).

Quality in processing

In wall panel load bearing, the process of build the buildings or houses is very good quality compared to reinforced concrete frame. The systems in any project have been done very neat and orderly because of the wall will be produce at the factory and transported to the construction site. The concrete is reusable mold which is cures in a controlled environment. However, the reinforced concrete frame has to produce a concrete at the construction site with a lot of method need to provide during the process. And it is also do not friendly environment and any incident can be happen at the site such as the workers do not focus with their work from make a foundation to the upper of roof. It is because reinforced concrete system has many works or method to do than load bearing masonry system.

Time of build load bearing masonry

In load bearing masonry system, it takes a short period to finish the project.the load bearing masonry faster compared to reinforced concrete construction. It can reduce time of works in constructing the buildings. Actually, load bearing masonry is more to precast which is the wall are directly combined become one house. It is not only save time in completing the project but it is also does not need a lot of energy of workers, machine or cost. The system also can finish three houses in one day. It is different with reinforced concrete frame where is taking in months or minimum two weeks that most quickly in completing the houses.

Table 3

Different between load bearing masonry and reinforced concrete frame

Load bearing masonry	Reinforced concrete frame
• Do not have column (precast)	• Have column
• Very durable	• Not durable
• Quality in wall panel of load bearing is good	• Quality in conventional reinforced concrete system is quite not good
• Low cost	• High cost
• Save time (3 houses per day)	• Takes a long time (months)

Level of exposure among contractor

In Malaysia, the load bearing masonry wall system is an important methodin a construction industry. The contractors had learned this system since studied in bachelor of civil engineering either in local or overseas universities. The level of exposure among

contractors is quite good because they learned how to construct load bearing masonry wall system, characteristic of size of wall or column and type of block. But they do not practice and cover much on load bearing masonry technique. The contractors are lack of expertise and experience in this system.

They need to use the knowledge with do some practices for improving their skilled in load bearing masonry. It is also can increase the requisition of the system among the client in future. The system can be a replacement of the conventional reinforced concrete system.

CONCLUSION

In Malaysia, conventional system is more predominant in construction industry. This is because the perception toward reinforced concrete system is sufficient and its building is easier to build and maintain. Otherwise, the system provides better technology compared to load bearing masonry wall system. And in the exposure load bearing system among contractors is a little when they have knowledge but they do not have any expertise in this system. It is also because load bearing masonry building is difficult to renovate.

RECOMMENDATION

As a contractor, they need to do promotion and proof the strength of the masonry structure among client. The load bearing masonry buildings are more beautiful than reinforced concrete. Its technique also faster, better and cheaper compared to reinforced concrete. Based on financial years and cost comparison between the system and reinforced concrete system, it is cheaper and high demand from the client. Load bearing masonry is economical than reinforced concrete method. It is very good and suitable for Malaysia.

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