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JUDUL : SIGNIFICANT USAGE OF SLAB AND WALL FORM TECHNIQUE IN INDUSTRIALISED BUILDING SYSTEMS (IBS) FOR LOW COST HIGH-RISE APARTMENTS CONSTRUCTION

SESI PENGAJIAN: 2006/2007

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SIGNIFICANT USAGE OF SLAB AND WALL FORM TECHNIQUE IN INDUSTRIALISED BUILDING SYSTEMS (IBS) FOR LOW COST HIGH-RISE APARTMENTS CONSTRUCTION

REDZUAN BIN AB.RAHMAN

A Project report submitted as a partial fulfillment of the requirements for the award of the degree of Master of Science (Construction Management)

Faculty of Civil Engineering
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NOVEMBER 2006

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"Almighty Allah, please give blessing to them…
My mother, my wife, my sons, my lecturers,
my friends, my beloved,
and to all Muslims…this is for us"

Specially dedicated to my beloved family my wife Hjh Fadziah Hj. Ahmad, my sons Fitrizal, Mohammad Fauzan, Muhammad Fariz

For your everlasting love and care….

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Grateful thoughts and zillion thanks go to Almighty Allah (S.W.T) for giving me guidance and good health to complete the master project.

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ABSTRACT

The Industrialised Building Systems (IBS) concept adopted and applied during early sixties in Malaysia. The key reason in adopting this system essentially for housing construction is to enhance the development of low cost housing project for the lower income group. Using IBS will address issues such as quality, materials wastage, delays, dirty and hazardous worksites. In the structural classification of IBS, steel formworks are listed one of the traditional or common types of IBS. This master project conducted to study the basic concept, application and the significant usage of slab and wall form technique for low cost high-rise apartment construction industry. The study further assessed the benefit of using slab and wall form technique in high-rise low cost apartment construction. The methodology adopted for the study includes literature review, observation, interviews and using questionnaire survey. These questionnaires distributed to the respondents, which represent the professional in construction industry that have experience and knowledge on the slab and wall form technique technology and the construction procedure. The study evaluated the on ongoing and the completed project using this systems and established that this technique has the ability to reduce the time and labour involved in the project. Elemental cost analysis and cost simulation toward different types of formwork used to establish the justification of the significant usage of the tunnel form system as selected slab and wall form technique. The study concluded that the slab and wall form technique feasible alternative construction method that can improve construction industry with respect to the accomplishing better quality of works and increasing productivity. The study also determined that the adoption of this slab and wall form technique in the construction of the low cost high-rise apartments greatly benefit the building industry in various aspects such as reducing the construction cost, better planning and design coordination, speed of construction, minimising manpower on site, better quality construction, environmentally friendly, and improved site safety.

ABSTRAK

Konsep sistem pembinaan berindustri di Malaysia adalah bukan perkara baru dan telah digunapakai sejak tahun enam puluhan. Tujuan utama dalam menggunakan kaedah sistem pembinaan berindustri terutamanya pembinaan perumahan adalah untuk meningkatkan pembangunan projek perumahan kos rendah bagi memenuhi keperluan golongan penduduk yang berpendapatan rendah. Penggunaan sistem pembinaan berindustri dijangka dapat mengatasi masalah beberapa perkara seperti kualiti, bahan sisa buangan berlebihan, kelewatan siap projek, tapak yang kotor dan cara kerja di tapak yang merbahaya. Di dalam pengkelasan struktur di dalam konsep pembinaan industri, acuan keluli disenaraikan sebagai salah kaedah tradisi di dalam sistem pembinaan berindustri. Oleh itu, projek ini dijalankan khususnya untuk mengkaji konsep asas, aplikasi dan ketaranya penggunaan sistem lantai dan dinding dalam industri bangunan kos rendah. Di samping itu, kajian ini juga telah dilaksanakan dengan menilai kebaikan penggunaan kaedah lantai dan dinding ini untuk pembinaan bangunan. Kaedah yang digunakan dalam melaksanakan kajian ini merangkumi pembacaan bahan ilmiah, tinjauan, temuduga dan borang soal selidik. Borang soal selidik tersebut telah diedar kepada wakil profesional yang mempunyai pengalaman dan pengetahuan tentang kaedah lantai dan dinding dalam pembinaan bangunan.dan juga prosidur pembinaannya. Hasil daripada kajian dan penganalisaan yang dibuat, dapat dirumuskan bahawa kaedah lantai dan dinding adalah merupakan satu kaedah pembinaan yang mampu mengurangkan masa dan pengunaan buruh di dalam pembinaan tersebut. Analisa kos elemen dan simulasi kos dibuat terhadap bahan acuan yang berlainan telah menjustifikasikan pengunaan acuan terowong sebagai kaedah lantai dan dinding adalah mapan. Kajian yang telah dijalankan merumuskan kaedah lantai dan dinding adalah kaedah pembinaan pembinaan alternatif yang mampu meningkatkan kualiti dan produktivi. Secara keseluruhannya didapati bahawa sistem ini telah menyumbang kebaikan pada industri bangunan dari aspek pengurangan kos pembinaan, koordinasi perancangan dan rekabentuk yang lebih baik, masa pembinaan yang singkat, pengurangan tenaga pekerja di tapak, mesra alam sekitar, mempertingkat kualiti pembinaan dan memperbaiki tahap keselamatan di tapak.

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AI - Average Index
CIDB - Construction Industry Development Board Malaysia
CMU - Concrete Masonry Unit
IBS - Industrialised Building System
ISO - International Standard Organisation
JPN - Jabatan Perumahan Negara
MC - Modular Coordination
Mod - Moderate
RI - Relative Index

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The application of Industrialised Building Systems had been decade implemented in this country. The Ministry of Housing and Local Government had started applying Industrialised Building System since sixties for the low cost high-rise apartments in Jalan Pekeliling and at Jalan Padang Tembak, Penang (Moses, 2006).

Adopting the usage of Industry Building Systems in the construction of the low cost high-rise apartments had significantly giving advantages in various aspects such as reducing the construction cost, speed of construction, minimising manpower on site, environmentally friendly, improved site safety and better quality construction (Shaari 2004).

1.2 Background of the Research

Malaysia's housing policy is gearing toward meeting the objective of ensuring access to adequate and decent shelter to all citizens, particularly the low-income groups. The national housing policy will effectively contribute to the provision of physical shelter as a basic social need toward improving and enhancing the quality of life through the erection of decent and viable human settlements. In implementing this policy, the quantitative and qualitative aspects of housing development are taking into account.

Table 1.1 shows the targets and achievements of the various Malaysia's 5-year Plans. By and large, the performance of the public and private sectors in delivery of houses was below the estimated targets except for the 3rd, 6th and 7th Malaysia Plans where the private sector performed excellently, surpassing the targets set. During the Third Malaysian Plan period, there was rapid economic and social development, leading to a great expansion of private sector, but most of the houses constructed were medium and high costs.

After the rapid expansion experienced during the Third Malaysian Plan, the economy took a downturn where the performance of the private and public sector during the Fourth and Fifth Malaysian Plan was poor. The public sector delivered 190,045 units of houses out of a target of 398,570 units, while the private sector delivered 201,933 units out of a target of 524,730 units.

During the Fifth Malaysian Plan, the public sector built only 97,126 units of houses out of a target of 149,000 units planned while the private sector delivered 203,802 units out of a target of 552,550 units planned.

During the Seventh Malaysian Plan, targets of 800,000 units of houses planned for construction and the end of 2000; however, both the private and public sectors constructed 859,480 units of houses, giving it an achievement rate of 107.4% of the target. The housing industry experienced remarkable growth in the 1990's but badly affected by the economic crisis beginning July 1997.

Under the Eighth Malaysian Plan (2001–2005), refer to Table 1-2 the overall performance of houses built under the low-cost housing category was encouraging with 200,513 units completed or 86.4 per cent of the Plan target. Of this total, 103,219 units or 51.5 per cent constructed by the public sector (Ministry of Finance, Ninth Malaysian Plan).

Table 1.1 Public and private sector housing programmes target and performance of the period 1971-2000

Agency	Second M'sia Plan(1971-1975)		Third M'sia Plan(1976-1980)		Fourth M'sia Plan(1981-1985)		Fifth M'sia Plan(1986-1990)		Sixth M'sia Plan(1991-1995)		Seventh M'sia Plan(1996-2000)	
	Targeted	Completed	Targeted	Completed	Targeted	Completed	Targeted	Completed	Targeted	Completed	Targeted	Completed
PUBLIC SECTOR:												
1. Public low-cost housing	-	13,244	62,200	26,250	176,500	72,302	45,800	26,172	40,000	15,376	64,000	62,812
2. Housing in land schemes	-	41,965	60,000	36,770	110,010	36,112	57,500	32,056	56,100	8,075	9,300	7,188
3. Institutional Quarters and other staff Accommodation	-	24,240	41,300	20,560	58,500	23,258	27,000	11,284	32,600	18,776	102,700	12,015
4. SEDC'S Projects and other state projects / medium and high-cost housing	-	6,627	57,300	37,930	53,560	58,373	18,700	27,614	45,300	42,315	54,000	39,609
Sub-total		86,076	220,800	121,510	398,570	190,045	149,000	97,126	174,000	84,542	230,000	121,624
PRIVATE SECTOR:												
1. Private Developers	-	64,862	100,00	199,490	-	-	-	-	-	-	-	-
Low-cost housing		-	-	-	90,000	22,794	370,400	88,877	215,700	212,003	137,000	127,514
Medium and high-cost housing		-	-	-	259,470	79,005	169,600	107,442	170,700	339,610	418,000	596,639
2. Co-operative Societies	-		12,000	4,120	25,260	5,474	12,500	7,483	12,600	11,305	15,000	13,703
3. Individuals and Groups	-	108,872	150,000	159,070	150,000	94,660	-	-	-	-	-	-
Sub-total	-	173,734	162,000	362,680	524,730	201,933	552,500	203,802	399,000	562,918	570,000	737,856
TOTAL	-	259,810	382,800	484,190	923,300	391,978	701,500	300,928	573,000	647,460	800,000	859,480

Source: Research and Development Division, National Housing Department, Malaysia, April 2001

Table 1.2 Public and private sector housing targets and achievements, 2001-2005

Programme	Housing for the Poor			Low-Cost			Low Medium-Cost Medium			Medium-Cost			High-Cost			Total		
	Target units	Achieve units	% of Target	Target units	Achieve units	% of Target	Target units	Achieve units	% of Target	Target units	Achieve units	% of Target	Target units	Achieve units	% of Target	Target units	Achieve units	% of Target
Public Sector	16,000	10,016	62.6%	192,000	103,219	53.8%	37,300	22,826	61.2%	46,700	30,098	64.4%	20,000	22,510	112.6%	312,000	188,669	60.5%
																-		
Low-cost Housing				175,000	81,108	46.3%										175,000	81,108	46.3%
																-		
Housing for the hardcore poor	15,000	9,536	63.6%													15,000	9,536	63.6%
		[1]																
Sites and Services	1,000	480	48.0%													1,000	480	48.0%
Housing by Commerical Agencies				15,000	16,386	109.2%	10,000	15,442	154.4%	16,000	9,924	62.0%	15,000	5,753	38.4%	56,000	47,505	84.8%
Housing by Land Schemes				2,000	5,725	286.3%	1,000	695	69.5%							3,000	6,420	214.0%
Institutional Quarters																-		
																-		
Institutional Quarters and Staff Accomodation							26,300	6,689	25.4%	30,700	20,174	65.7%	5,000	16,757	335.1%	62,000	43,620	70.4%
Private Sector				40,000	97,294	243.2%	94,000	61,084	65.0%	64,000	222,023	346.9%	105,000	274,973	261.9%	303,000	655,374	216.3%
Private Developers				39,000	94,029	241.1%	90,000	53,607	59.6%	60,000	215,267	358.8%	100,000	269,320	269.3%	289,000	632,223	218.8%
Cooperative Societies				1,000	3,265	326.5%	4,000	7,477	186.9%	4,000	6,756	168.9%	5,000	5,653	113.1%	14,000	23,151	165.4%
Total	16,000	10,017	62.6%	232,000	200,513	86.4%	131,300	83,910	63.9%	110,700	252,121	227.8%	125,000	297,483	238.0%	615,000	844,044	137.2%

During the Ninth Malaysia Plan, continuous efforts undertaken by the government to ensure that Malaysians of all income levels will have access to adequate, quality and affordable homes, particularly the low-income group. In this regard, the private sector will be encouraged to build more low- and low-medium-cost houses in their mixed-development projects while the public sector will concentrate on building low-cost houses for the poor either urban or rural areas (Ninth Malaysian Plan).

While the problem of housing grows more acute, Malaysia is struggling to meet its own housing needs and is doing so through an increasingly advance technology. The conventional construction method, due to the slow pace of construction and higher cost, is not be able to meet the demand

Malaysia is presently taking a hard look at IBS as an answer to a housing shortage problem. The main advantages of using IBS, according to a report published by the Malaysian Ministry for Local Government and Housing Ministry, 1997, are speed of construction, quality, and economic advantage, all of which are required to meet such a large demand for housing. It been suggested that there are a number of appropriate IBS, useful for a wide range of specific uses and situations, but none of them is applicable to all construction sites. They are dependent upon and influenced by many other aspects of the housing situation, aspects such as land use, density, volume, environmental conditions, user needs, continuity of demand, and labour (Swee, 1988).

The research of this project will investigate the significant usage of the construction procedure of the slab and wall form technique of the IBS for the construction of high-rise low cost apartment.

1.3 Justification of the Research

Presently, many of the low cost high-rise apartments built with the slab and wall form technique, but none of the construction procedure explored and analysed. The contributions of this research ascertained in terms of benefits gained by both the industry and the individual.

1.4 Problem Statement

In the process of nurturing the industry towards less labour dependent, the government of Malaysia through CIDB, had aggressively promoting the development and usage of new and relevant technologies in the area. Using the IBS had seen as the alternatives that can greatly reduce construction time compare to the conventional method (Abraham Warszawski, 1999). It anticipated that by using the IBS, the foreign labour dependency can be hugely reduce where now the foreign labour controlling almost 75% of overall workers in this industry.

In line with the problems, the Prime Minister on 10 September 2004, during the 2005 budget speech, stressing that the government supporting the IBS and will ensure the usage of IBS where the essence of the industry is to reduce on foreign labour dependency and minimising of time and cost of the construction.

"Speech by Abdullah, 2004 says that the Government intends to provide an additional 100,000 units of affordable homes to be implemented through the Industrialised Building System (IBS). This system will ensure quality construction, save cost, create a safer and cleaner working environment as well as reduce the dependence on foreign workers. The usage of IBS components in Government building projects will increase from 30 percent currently to 50 percent commencing

2005. Housing developers, who utilise IBS components exceeding 50 percent, will be given full exemption on levy imposed by CIDB."

1.5 Objectives of the Study

The main aim of the research is to investigate the significant usage construction procedure of the selected slab and wall form technique of the IBS for the construction of high-rise low cost apartment.

The specific objectives were:

i. To identify types of IBS for slab and wall form technique for the construction of the high-rise low cost apartment.

ii. To identify the benefits of the slab and wall form technique for the construction of high-rise low cost apartment.

iii. To evaluate and simulate the cost comparison between the selected IBS of slab and wall form technique for the construction of high rise low cost apartment

1.6 Research Scope

This research carried out with a careful study on the data collected mainly from questionnaire survey exercise and case studies. The research will focus on the government projects that are using wall form technique of the industrialised building systems (IBS). The study is limited to low cost high-rise apartments constructed in Johor Bahru and Klang Valley. Nine projects sampled for this research.

Towards achieving these objectives, overall research made through

i. National Housing Department

ii. CIDB

iii. Contractors

iv. Consultant

v. Developers

1.7 Literature Review

Malaysia's rapid economic development and the transformation process from an upper middle income developing country towards the industrialised and developed nation status as envisaged in Vision 2020 has created the environment for the development of the construction industry. The construction industry has played an important role in establishing the infrastructure required for socio-economic development and contributing directly to economic growth. The country's processes of integration, industrialisation and urbanization have generated growth and changes in construction output.

Whilst, the construction industry plays a vital role in Malaysia's development and expected to be a major contributor towards the realisation of Vision 2020 and this industry is too dependent of the foreign labour in ensuring it to grow. Registered foreign labour in the country has rapidly increasing from approximately only 25,000 in 1990 to 278,102 in 2006 (Statistic Department and Immigration Department, 2006). The phenomenon of the foreign labour dependent were because of the lost of interest among the local to work in this industry because of 3-D problem or 3-K that is Dirty (Kitarai), Difficult (Kitsui) and Dangerous (Kiken). Through the Construction and Industry Board (CIDB) it was found that almost seventy five percent of the foreign workers whom were requesting for the advance test for the permit extension are involved in wet-trade such as carpenter, welder, bar bender, plasterer and brick layer (Shaari. 2004).

1.7.1 Industrialised Building Systems (IBS)

Industrialised Building Systems (IBS) defined as building system in which structural components manufactured in a factory, which located on-site or off-site, transported and assembled into a structure using suitable equipments with a minimal additional site works (CIDB, 2003).

The usage of IBS is widely used in Malaysia construction industry particularly for steel structure and precast concrete for construction of bridges, drainage system and other infrastructure projects. Only that the level of the usage of IBS in our construction industry, nonetheless it for buildings construction is very low compared to conventional methods of construction. The reason is that

Malaysian can get easy supply of cheap labour (foreign) from neighbouring countries to that may speed up the duration of project completion.

1.7.1.1 Characteristics of IBS

Based on CIDB (2003), the following characteristics are important to ensure the successful of IBS:

i. Industrial production of components through prefabrication

ii. High-mechanised in-situ processes such as permanent steel formworks, tunnel forms.

iii. Reduced labour during prefabrication of components and site works

iv. Modern design and manufacturing methods; involving information technology such as the usage of Computer Aided Design (CAD) and Computer Aided manufacturing (CAM).

v. Systematic Quality Control such as ISO 9000 principles.

vi. Open Building Concept permitting hybrid applications and adaptable to standardisation and modular coordination (MC).

1.8 Research Methodology

The traditional academic research methodology combines a summary and contextualisation of the conceptualised research theoretical framework, the research question, and the hypothesis, within a proposed research methodology framework (Cryer, 1996).

The research methodology consists of three distinct phases. A brief description of each phases are as follows:

1.8.1 Phase 01- Literature Review

a) Literature Review

The extensive research on the reference or textbooks, journals, magazines, internet sources and also seminars papers that relevant to the research and gives an overall view of the research statements and help the researcher to meet the objectives highlighted. The objective of this work achieved through undertaking a comprehensive literature search to which adequately define:-

i) Industrial Building Systems

ii) The benefits of industrialised building system.

b) Case Studies

Case studies of actual projects being carried out with the objective to identify the scope of the significant usage of the IBS particularly the slab and wall form technique. Nine projects in Johor Bahru and Klang Valley projects being investigated and observed.

1.8.2 Phase 02- Research Design

c) Questionnaire Survey

An industry survey conducted on contractor, consultant and client firms to identify the usage of slab and wall form technique. A pilot questionnaire, drafted from the findings of literature and case studies used prior to developing of the final questionnaire.

Towards getting the cost of the formwork of the slab and wall form technique, all data extracted from the contract documents and the suppliers of the formwork with the permission of selected contractors and suppliers.

1.8.3 Phase 03- Research Analysis and Findings

The final stage of the study is to identify the cost evaluation through the elemental cost analysis and cost simulation for the slab and wall technique for the method used in the construction towards other type of material used. Similar methods were be used in the research in developing and proposed construction procedure of the slab and wall form technique.

Case studies and questionnaires responded by the respondents gathered, compiled and sorted towards putting the data into quantitative. All relevant data translated into tables, charts or graphs and neatly summarised, analysed and concluded.

1.8.4 Research Strategy Chart

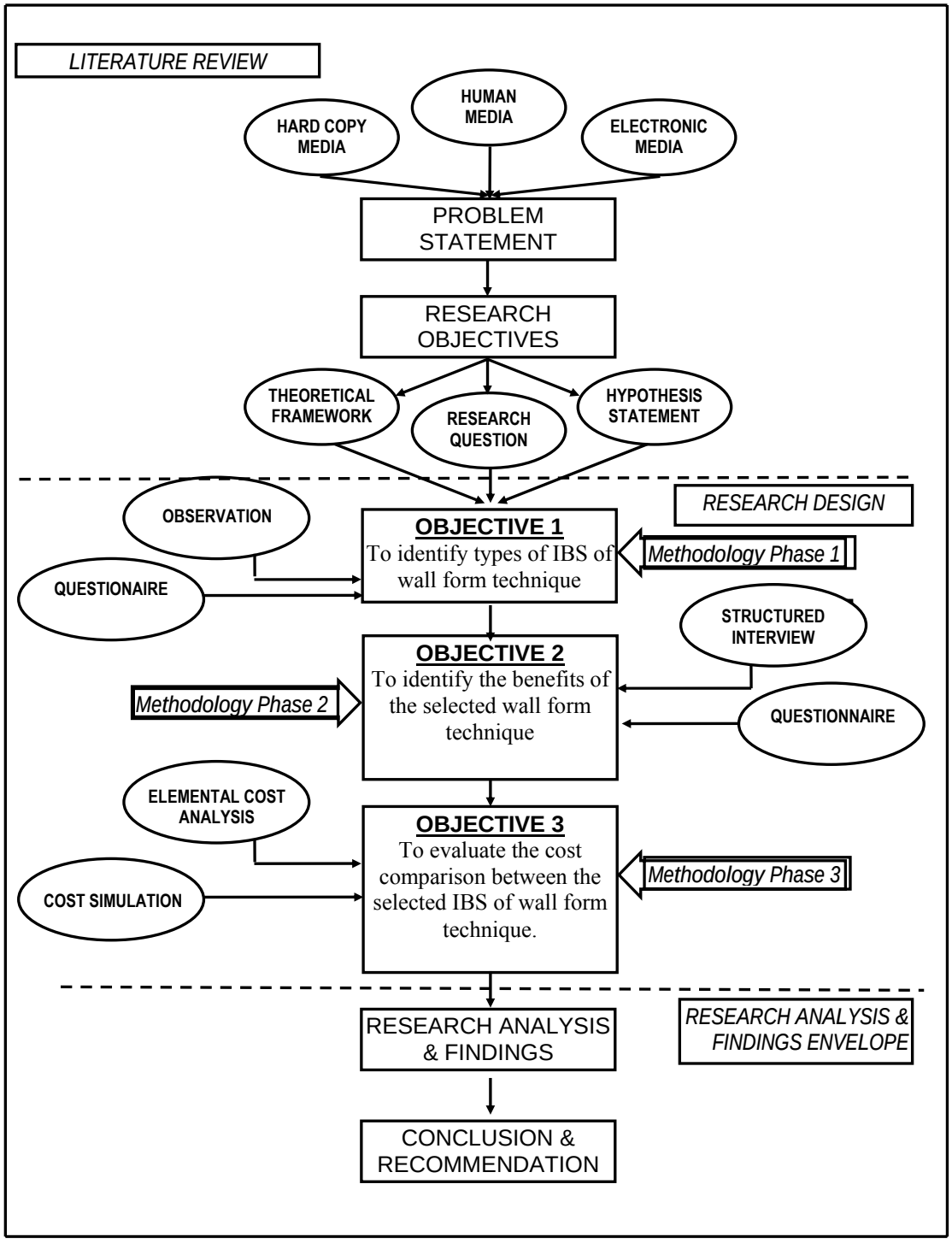

Figure 1.1 Research strategy chart

1.9 Master Project Structure

The structure of the project is frame into seven major chapters and a brief summary of each chapter's contents presented below:-

Chapter 1. Introduction of study, discuss on the master project undertaken and the important of the research. It then justifies the need for the research; aims, scope, objective, limitation of research and brief research methodology adopted

Chapter 2. Literature review where more details literature review of industrialised buildings systems and it advantages and the construction practices considered. This includes the types and definitions of IBS and the explanation construction using the IBS. Types of low cost and method of the construction discussed..

Chapter 3. Formwork for concrete where tunnel form system, aluminium formwork and timber formwork used and detail on the construction procedure of the systems explained.

Chapter 4. Research methodologies give the overall view of research methodology including the identifying the type of the slab and wall technique used in the low cost high-rise apartments, basic concept of the system including its definition and phases of construction.

Chapter 5. Cost analysis and case studies for each trade and type of formwork discussed and elaborated. Elemental cost analysis used for analysing for each project. Cost simulation done for each type of formwork. All relevant data received from the contractors documented and analysed. Each case studies project elaborated and explained.

Chapter 6. Data analysis and results where all data received from the case studies, questionnaires responded by the respondents and interview survey gathered and sorted. All data gathered and synthesised. All relevant data translated into tables, charts or graphs and summarised, analysed and discussed.

Chapter 7. Discussion and recommendation where presents the summary and conclusion of the master project. It discusses and concludes the key finding of the research and recommendation highlighted.