DEVELOPMENT OF INTEGRATED FLOATING HOUSE CONCEPTUAL MODEL FOR FLOOD PRONE AREA IN MALAYSIA: NOAH PROJECT

PATRICK YAU SIAW YANG

A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Science (Construction Management)

Faculty of Civil Engineering
Universiti Teknologi Malaysia

NOVEMBER 2007

To my beloved mother, father, sisters and Clarice.

ACKNOWLEDGEMENT

From the bottom of my heart, I would like to thank to my almighty God for His grace and blessing throughout the project. And to my project supervisor, Associate Professor Dr. Mohamad Ibrahim bin Mohamad, for his patient, guidance, encouragement, and supports. Along the progress of completing this project, I encountered a bundle of problems and obstacles but with his sincerity and helpful advice, I had overcome all the challenges.

I would also like to express my high appreciation to the local experts, Department of Irrigation and Drainage, Malaysia, parties providing products catalogues, for their co-operation, providing importance data, ideas contributions, assistance and guidance in completing this project successfully.

For the completion of this project, there are also various that were directly or indirectly involved in the proceedings of this project. Their contributions and supports will be always in my remembrance.

ABSTRACT

The construction technology of integrated floating house system for flood prone area is a new idea and approach in Malaysia. Up to the present, there is still no proper design or practical concept of how beneficial is an integrated floating house during the period of flooding. The raise of the sea level due to the effect of global warming, Southwest Monsoon and Inter-Monsoon greatly increase the risk of flood for low-lying area in Malaysia. Thus, this project is an effort towards saving valuable household and human. The objective of the project is to develop an integrated floating house conceptual model with the ability to endure lateral current forces, with the specification of stability, suitable foundation, economy in costs and practicality. There are several methodologies has been carry out for this project. Observation has be done on various floating house system regardless of it purpose. The overview on the current existing floating system including the strength of the structure, materials, degree of stability, the degree of withstand the lateral forces of water current and cost of construction. Through the interview and questionnaire, the idea of floating house and the comment regarding the existing floating house was obtained from the local experts. After the investigation on the existing floating house system and the experts' opinion, a new construction technology of floating house has been developed and tested with CSC structural analysis software and several related scientifically calculation. With the validation of local experts, the conceptual model can be use to conduct the prototype testing and real time testing. This is the new integrated floating house conceptual model with comply with the standard of floating structure, safety requirements, economical and suit to the local requirement. By this new construction technology of integrated floating house, we believe that we will be able to minimize the effects of flooding for flood prone area in Malaysia.

ABSTRAK

Teknologi pembinaan rumah terapung integrasi bagi kawasan kerap banjir di Malaysia masih merupakan idea dan penyelesaian baru. Setakat ini, masih tidak terdapat rekaan terperinci dan konsep praktikal rumah terapung integrasi serta kesesuaiannya semasa berlakunya banjir. Kenaikan paras laut, musim monsoon meningkatkan risiko banjir bagi kawasan rendah di Malaysia. Oleh itu, projek ini berusaha untuk menyelamatkan nyawa dan barangan bernilai. Tujuan projek ini adalah untuk mencipta model konsep bagi rumah terapung integrasi dengan spesifikasi mampu merentangi daya lintangan arus, kesetabilan struktur, asas yang sesuai, harga yang ekonomi dan kesesuaian dalam penggunaan. Pemerhatian tentang pelbagai sistem apungan sediada diambil tanpa mengira aplikasinya. Pemantauan dibuat terhadap sistem apungan sediada merangkumi kekuatan tetulang, bahan, darjah keseimbangan, darjah merintangi daya hentaman arus air dan kos pembinaan. Temuduga telah dibuat dengan pakar tempatan untuk mendapatkan komen dan maklumat bagi sistem apungan. Dengan pengajian terhadap sistem apungan sedia ada dan pendapat pakar, satu teknologi baru dijana dengan sekali dengan model tiga dimensi dan rekaan rusuk dengan perisian tiga dimensi. Dengan pengesahan daripada pakar tempatan, model konsepsi ini boleh digunakan untuk pengujian prototype and penyelidikan sebenar. Konsep rumah terapung yang dihasilkan ini memenuhi syarat dan spesifikasi struktur apungan, aspek keselamatan, ekonomi dan sesuai dengan keperluan tempatan. Dengan adanya, teknologi ini, kita yakin bahawa kita akan dapat mengurangkan hakikat banjir di kawasan kerap banjir di Malaysia.

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS AND ABBREVIATIONS

RM	-	Malaysia Ringgit
£	-	British Paun
€	-	Euro Dollar
NZ $	-	New Zealand Dollar
ρ	-	Density
M	-	Mass
V	-	Volume
ρ_s	-	Density of substance
ρ_w	-	Density of water
GM	-	Metacentric height
GZ	-	Righting lever
SHS	-	Square Hollow Section
RHS	-	Rectangular Hollow Section
BS	-	British Standard
DID	-	Department of Irrigation and Drainage
f_{cu}	-	Strength of concrete
f_y	-	Strength of steel
A_{st}	-	Steel Area
I	-	Moment of Inertia

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background of the study

This project focuses on the construction technology of integrated floating house system for flood prone area in Malaysia. The development of the integrated floating house system is a new idea and approach for solving flood's problem in Malaysia. Up to the present, there is still no proper design or practical on an integrated floating house during the period of flooding in Malaysia. The idea of developing an integrated floating house was inspired by the recent flood (December 2006 – January 2007) in Peninsular Malaysia (Malacca, Negeri Sembilan, Pahang and Johore) which causes million of losses in valuable household and lives. The raise of the sea level due to the effect of global warming, Southwest Monsoon and Inter-Monsoon greatly increase the risk of flood for low-lying area in Malaysia for the coming decade. Thus, this project is an effort towards minimise and eliminating the consequences of flood by saving valuable household and human. The name of Noah Project was adopted from the history of Prophet Noah with the similarity of the construction of flood prevention tools without the existing of water and for the preparation for coming flood tragedy.

1.2 Problem statement

Low-lying areas in Malaysia are highly exposed to the problems of flooding due to the high annual average rainfall varies from 2,000-2,500 millimetres and also the effect of Southwest Monsoon and Inter-Monsoon period. During the period of 17-20th December 2006, the heavy rainfall has caused floods in Johore, Malacca, Negeri Sembilan and Pahang state. During the period of 17-20th December 2006, the heavy rainfall has caused floods in Johore, Malacca, Negeri Sembilan and Pahang state. The rainfall recorded in Johore, 4 days recorded rainfall from 18-21 December 2006 for Segamat (515mm), Air Panas(785mm) and Labis(550mm) is greatly exceeding average rainfall of 6.8mm/day (Department of Irrigation and Drainage Malaysia, 2007). For Johore alone, the natural disaster has causes 109,259 flood evacuees with estimated loses of RM2.6 millions in damages of valuable goods and lives (Wan,Y.L., 2007). This natural disaster is hardly to control and the effects will cause million losses in damages of valuable goods and lives. For the forth-coming future, the flood is expected to be more critical concurrent with the global warming effects which will raise the sea level of 60 centimetres for the coming century.

Many parties who know the effects of flooding are crunching their head of thinking the solutions to control or minimise the effects of floods and from the local newspaper of new strait times dated 8 February 2007, the government is expected to spend 3.6 billion to prevent floods in Johore. The construction technology of integrated floating house system is one of the useful approaches that helps to save valuable goods and lives for flood prone area.

Our earth has a high density of 5.52g/cm^3. Thus, the floating technology itself is a great challenge because most of the material of our earth having higher density compare to water which is 1g/cm^3. The selection of the materials with consideration of density, strength and cost will determine the practicality of this construction technology in Malaysia.

Due to the new concept of construction technology of integrated floating house in Malaysia, most of the knowledge and ideas have to be obtaining from the overseas researches and experts. It will be an obstacle to gain the reliable resources and ideas from overseas experts and match to our country's situation and local requirements.

Moreover, the existing floating house technologies in overseas require an expensive investment into it which is not an economical practice in Malaysia. For example, a Sundance Floating Home in London cost £30,000 (1,000 Square Feet), Floating house in Netherland cost €250,000-€300,000 (150 Square Meter) and the floating house in Auckland, New Zealand cost NZ$110,000 (124 Square Meter) (Gareth Davies, 2005).

1.3 Aim and objectives

The aim of this project is to develop an integrated floating house conceptual model for flood prone area in Malaysia. To achieve the aim, there are three main objectives: -

a) To investigate basic fundamental of floating system.

b) To investigate current system in floating house.

c) To develop floating house technology for flood prone area in Malaysia by taking into the consideration of ability to endure the lateral current effect, floating stability, foundation system, costs and practicality.

1.4 Scope and limitation

1.4.1 Scope

The scopes of the projects are:-

a. The study focus on floating house which is integrated with a house structure.

b. The purpose of this float part of the house is to save valuable household and human.

c. Comparison with the existing concept and suit to our requirements and cost.

d. The floating part has to be simple float that has the characteristics of stable and can withstand lateral forces from the water current.

1.4.2 Limitation

The project is developing based on the limitation of:-

a) The study focus on Construction Technology of floating house with regard floating system, support system, construction technology and not includes the details analysis structure.

1.5 Importance of the study

The development of integrated floating house which suit to our local requirement and cost are very important seem that in Malaysia we still did not have a proper design and model of a practical floating house technology. Although most of the Malaysia's land are above the seas level, but we are exposed to higher risk of flood due to the high average rainfall; Southwest Monsoon and Inter-Monsoon which also will bringing high rainfall especially to the area closed to the seaside.

As a developing country, we need to catch up with the new technologies and trying our best in developing our own technologies. In the process of developing our technologies, we are learning and studying the technologies from overseas, and with our own knowledge and understanding of local conditions to develop our technologies. In the other hand, the development of integrated floating house not only proving that Malaysian are able to develop their own technology but also encouraging the new generation to be more confidence and creative to develop their own technologies and not just count on the overseas technologies.

The development of floating house technology also inspires Malaysian that actually we knowing that there are technologies to solving our own problems, for example, flood. But the only thing we lack is we did not have our local existing technology to overcome it and which a proper technology, we are no longer crunching our head during flood period but we overcome it with confidence.

It is very sad scenario that not many of us as Malaysian citizen realise that we should go further in our construction today with the modern type of construction technology. There is no other reason for us not to move ahead in construction technology aligns with others rising up technology such as space engineering and information technology.

1.6 Brief Research Methodology

The research methodology designed for this project is towards the development of integrated floating house model for flood prone area in Malaysia. The research carry out by investigate the current floating system regardless the type of structure, data collection from local experts and feedback on the rationale of the study, proposed design, proposed materials and floating mechanism. Generally the research methodology of this project can be divided into six stages as show in methodology flow chart Figure 1.1. Six methodology stages are:

Stage 1: Case Study: Investigation of current floating house system.

Stage 2: Catastrophy and needs of the technology

Stage 3: Interview, data collection and analysis

Stage 4: Development of Integrated Floating House

Stage 5: Validation of Floating House, modification and improvement

Stage 6: Final result of Validated Integrated Floating House Model

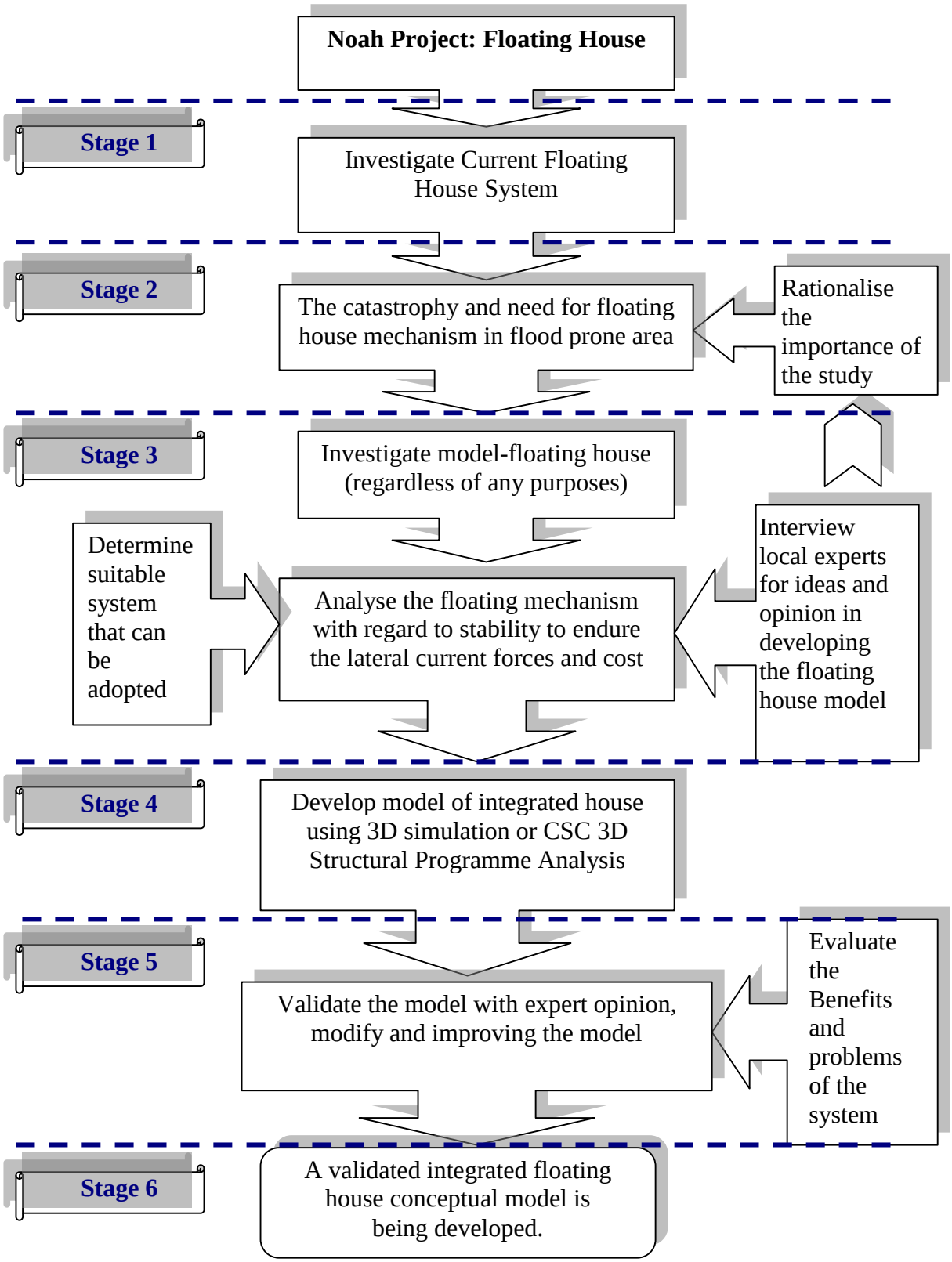

Figure 1.1: Research methodology flow chart