STRUCTURAL FEASIBILITY OF A PRECAST BUILDING SYSTEM

Paththige Lakshitha Niroshan Fernando

158015 K

Department of Civil Engineering

University of Moratuwa

Sri Lanka

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Thesis submitted in partial fulfilment of the requirements for the degree Master of Science

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DECLARATION

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Prof. M.T. Jayasinghe

…… Date:

Prof. (Mrs.) C. Jayasinghe

…… Date:

Dr. C.S Lewangamage

ABSTRACT

In a global context where the need for quality housing is increasing with improved standard of living and growing population, the over exploitation of natural resources as building materials is becoming a serious problem. In addition, many construction related issues are coming up due to the increased costs, higher construction time and lack of construction labour. In this context, precast building systems with pre-stressed concrete slabs, beams and columns along with Expanded Polystyrene (EPS) based light weight concrete sandwich panels as an infill material has a great potential to become an alternative construction technique.

The research presented in the thesis was aimed at assessing the structural feasibility of the proposed system. To this end, design and constructability aspects related to the pre-stressed concrete slabs, beams and columns are presented along with a comparison of a two-storey house between this system and a conventional reinforced concrete structure. In addition, the design of pre-stressed columns is discussed in detail through the development of interaction diagrams. This system is beneficial due to the use of reduced section sizes, saving on steel and elimination of formwork and falsework.

Also, in this research, the use of mechanically recycled expanded polystyrene as 50 % of the total EPS used in a composite foam concrete panel was assessed experimentally. The results of this experimental program have been interpreted with respect to various useful structural behaviours. It is shown that the use of this foam concrete along with cement fibre boards produces a light weight wall panel that can be used very effectively for non-loadbearing walls in houses, apartment buildings, hotels and commercial buildings thus reducing the overall weight of the building while allowing rapid construction that results in a durable system.

Key words: interaction diagram, mechanically recycled EPS, pre-stressed concrete

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f_{cu} = Characteristic strength of concrete

f_{pu} = Characteristic strength of a pre-stressing tendon