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Prestress/ Precast Energy Efficient Hollow Wall and Slab Panel

Chandan Kumar Gupta[1], Anjali Rai[2] and Pratibha Yadav[3]

[1,2,3]P.G. Student, Department of Civil Engineering, Madan Mohan Malaviya University of Technology, Gorakhpur, India
E-mail: [1]chandanguptahcst.cg@gmail.com, [2]anjali3725@gmail.com, [3]pratibhayadav96@gmail.com

Abstract—*Now a days the construction time, improving the quality of concrete work, durability and cost of construction of any structure plays important role to compensate the cost of project. There are number of new technique and innovative method used, prestress/precast concrete component is one of them. The use of pretensioned concrete component like wall, slab panels creates a light structural system and energy efficient component. The overall system of prestress/precast concrete component can be integrated to form a structural frame that behaves monolithically with adequate strength, stiffness and durable to resist the seismic load. This prestress/precast concrete component can be manufactured off –site and can be easily connected on site.*
These prestress/precast concrete are joined by special connection that can provide full coordination and monolithic action to the structure.

Keywords*: Prestress/ precast concrete, pretensioned, energy efficient, monolithically, seismic load.*

1. INTRODUCTION

The state and privet sector to supply good quality energy efficient low cost housing in India have been crucial issues. The country with 1.324 billion citizens, the low cost housing are more important to provide each citizens as house is one of basic need. The government of India also started "Pradhan Mantra Awash Yojna-Housing For All (Urban)" to promote the construction of low cost housing especially for the people without house. So the prestress/precast concrete component are alternative of cast in-place structure. The cast in-place concrete has widely used, where its basic materials are easily available anywhere around the country. But for the total cost efficiency, construction speed, high quality of work, for light weight structure and environment friendly projects, the prestress/precast hollow concrete component are alternative solution for engineer.

The prestress/ precast hollow concrete component can be manufactured in large different shapes and sizes and the pretension will provide to construct much longer spans than that achieve using conventional in-situ method of construction. By this method the concrete components can be manufactured in mass quantity and under controlled factory condition.

Fig. 1: Precast example: Structure 1 (photo by J. Zachar)

Fig. 2: Precast example: Structure 1 (photo by J. Zachar)

1.1. Composite Beams And Slabs

Prestress/ precast concrete will providesavings of the concrete and steel quantities. The pretensioned precast concrete component can be integrated compositely which will save the materials of slab over an equivalent conventional cast in-place slab. The monolithic action will provide sufficient strength, stiffness and the pretensioning will resist the lateral and

transverse load. The overall hollow prestress/precast structure will be energy efficient and resist seismic load.

1.2. Shear Resistance

The prestress/ precast beam and slab are connected compositely with concrete and special connectors for shear resistance and to develop required bending moment. The slab and wall will jointed in such way that the lateral and transverse shear will minimize. There are various building design code which will guide for these horizontal shear tie that resist the shear in structure. The tie bars provided should not less than that required for vertical shear design from the ACI Building design Code (ACI 318-99). The failure mechanism due to shear is given below:

Shear failure mechanisms

a. Shear tension failure of web

b. Shear compression failure of web

c. Anchorage failure of strands

d. Flexural shear cracking of concrete

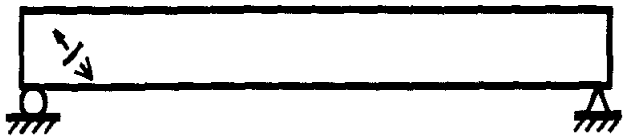

Fig. 3: Shear tension failure of web

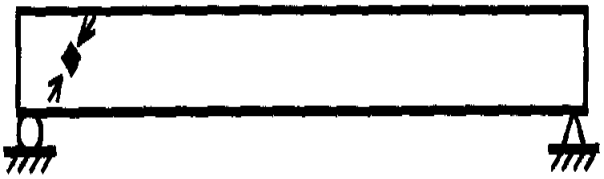

Fig. 4: Shear Compression Failure Of Web

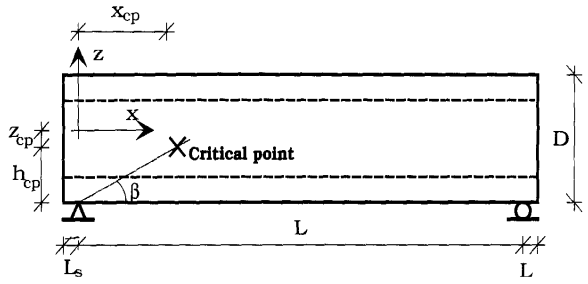

Fig. 5: Horizontal Position Of Critical Point

The vertical normal stresses occur due to reactive force at the support is enervated and where the prestress force has not fully developed. The failure mechanism is of brittle type. The shear failure of the web may be higher than the cracking resistance of the web when the dowel action of strings and the interlocking of aggregate particals.

2. SEVERAL RECENT RESEARCH WORKS

Since 1995 the several research works have been done by the state and privet bodies to study the precast concrete system behavior towards the seismic loads. There is the huge problem of seismic effect on the building so precast concrete component come in research. The posttensioned precast concrete component had been also studied in the past without considering the interaction of wall system for seismic performance. There are some research works which were conducted by privet companies involving the author.

2.1 Precast Concrete Wall Panel With Prestress/Precast Half Slab.

To study the seismic behavior of precast concrete wall panel with precast/prestressed half slab plus topping. in 2003 the cyclic quasi static test was conducted. The model of two story structure was tested to show up to four story low cost housing. The horizontal components of the precast wall panel were connected covered with grouting material. The specimen model and hysteretic used in this research is shown in fig.6

2.2 Precast/Prestressed Concrete Sandwich Panels For Thermally Efficient Floor/Roof

To achieve quality, economy, and speed construction requirements the precast concrete floor system is used.

This paper present the research of precast concrete sandwich panels for radiant heated floor and roof uses. The main purpose of precast concrete sandwich panels was to overcoming of the existing precast floor systems by being thermal insulated, lightweight, stiff and sufficient strength. The flexural and shear testing of floor system is done experimentally and testing of fire resistance, fatigue test and seismic load test are also done.

2.3 Evaluation Of Post-Tension Hybrid Precast Wall Frame Building

The seismic behavior of 4 and 8 story precast wall frame(PWF) and shear wall frame (SWF) building designed with frame shear ratio β=0.025 and 0.5,was found under suite of earthquake records scaled to show the DE level and the MCR-level hazards under unidirectional excitation .The study of effect of vertical component of earthquake motion is also done. The SWF buildings have larger residual drifts compare to the PWF buildings. PWF buildings show the good resistance to earthquake.

Fig. 6: PC-wall panel with precast/prestressed half slab full-scale model

3. APPLICATION OF PRESTRESS/PRECAST CONCRETE HOLLOW WALL AND SLAB PANEL

3.1 Low Cost Residential Building

Due to the demand of low cost housing, the government of India has purposed many programs. The five storey precast concrete structure with 2100 sqm ground floor area had been built at south by using the dry joint system and the vertical elements were connected by the joint system of NMB-splices sleeve. For the fire resistance the dry joints system were

Kelayan, south kalimantam, marsh apartment Chennai as low cost housing (flats). By the manufacturing of prestress/precast concrete component the construction of house of low cost will be easy and of sufficient strength

3.2. Energy Efficient Building

Only the construction of house is not sufficient it should be energy efficient so that it also is environmental friendly. The hollow provided in the block will make it energy efficient.

3.3 Major industrial building

Now a days every industry needs quick construction of building with sufficient strength and earthquake resistance. The introduction of the prestress/precast concrete structure will give the way to solve this problem. The concept of equivalent monolithic action, precast concrete hollow wall and slab panels were used to form elevated ground floors for all buildings. This project consists of main production of buildings and powerhouse, warehouse, water treatment plant, official buildings.

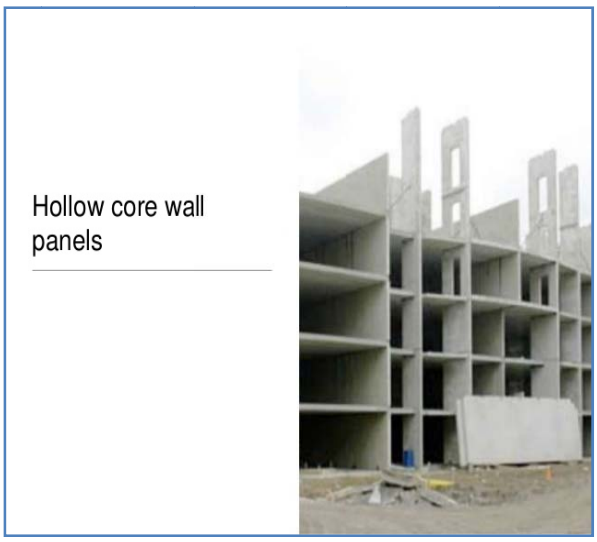

Fig. 7: Hollow Core Wall Panels

4. ADVANTAGES

1. Used where the labour charges are more and labour are difficult to found.
2. It reduces the overall cost of project.
3. Easy to construct.
4. Less reinforcement is required as compare to RCC structure.
5. Less maintenances cost.
6. Component are of light weight.

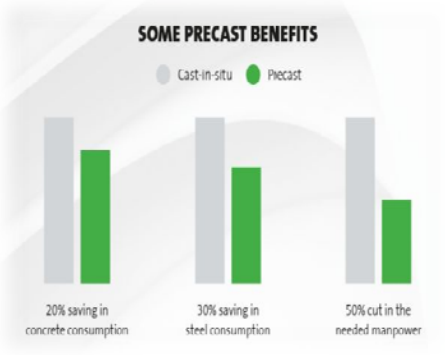

Fig. 8: Comparison Of Cast In Situ And Precast

5. DISADVANTAGES

1. It required good quality control.
2. Skilled labour are required to cast these concrete panels.
3. Special connectors are required to connect these blocks.

6. CONCLUDING REMARKS

In this paper it is shown that the building and other structure can build economically and with speed by the uses of prestress/precast concrete components. The efficiency of labour can be achieved through the factory controlled mass production techniques and good quality of material.

The prestress/precast concrete hollow wall and slab panels can be jointed vertically and horizontally to form a building frame which behave as completely monolithic. The monolithic action makes it of good strength, stiffness and durable to resist seismic loading. Prestress/precast concrete component are successful in both high and low rise building.

7. ACKNOWLEDGEMENT

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