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Dowel Type Precast Connection- Experimental and Analytical Study of Beam and Column

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Abstract: The objective of a present work is to compare an experimental and analytical study on precast frame. A precast frame development includes the whole structural components being manufactured off-site. Connection is the crucial part in precast frame because it influences the performance of structural behavior. There are various connections in the beam - column, out of which grout connection are chosen in this study. A scale model is created for the identified critical bay. A precast frame are constructed and tested under loading condition. The parameters considered for the present study are Ultimate Load Carrying Capacity, Cracking Pattern and Failure Mode, Load Displacement behavior and Energy Dissipation Capacity. The analytical study of the precast frame which are done by ANSYS software. After analyzing a frame in Ansys, both experimental and analytical works are compared in this paper.
Keywords: two dimensional precast frame, Dowel type connection, Finite Element Analysis software, critical bay, scale model.

I. INTRODUCTION

Precast concrete construction includes the whole structure components being fabricated off-site. Frames can all the while accomplish both basic and beautifying outline necessities – a wide variety of mixes, colors and finishes can be accommodated.

There are two fundamental sorts of precast building outline.

Structural frame comprises of beams, columns and slabs. Structural frames are essentially utilized for workplaces, car parks and retail developments. The cross-wall frame comprises of floor slabs and concrete walls. It is utilized fundamentally for inns, schools and doctor's facilities the structural continuity of conventional cast-in-situ structures is inherent and automatically achieves its quality as the development continues. For precast structures, there must be a conscious effort to ensure that structural continuity is made when precast parts, consist of, beams, columns and slabs are associated. As the structural components in precast building will only form a stable basic structural system after the joints are connected. The structural consideration for security and safety are vital at all stages. A load bearing structure with stabilizing elements which can manage vertical, horizontal loads and lateral loads and transmit the load to the foundation. Like conventional structures, precast structures have to be designed to withstand dead live loads as well as all the lateral loads.

Precast concrete can be developed utilizing either linear elements or spatial beam column sub-collections. Precast beam column sub-assemblage has the advantage of connecting the faces between the sub-assemblages placed away from the critical frame region. In design of precast member and connections, all the loading and restraint conditions from casting and transporting to the end utilization of the structure should be considered. The stress created in precast elements during the casting period to erection period might be more critical than the service load stresses. Special consideration should be given to the method of stripping, storing, transporting, and erecting precast components. When precast members are incorporated into the structural system, the forces and deformations occurring in and adjacent to connections (in adjoining members and in the entire structures) should be considered.

A. Literature Survey

R. Vijyapriya and K.P. Jaya [1] tested on three one-thirds scale beam-column joints including a monolithic specimen. It was concluded that the ultimate load carrying capacity of the monolithic specimen is more than the precast specimens PC1 and PC2.

K. R. Bindhu et al. [2] experimented on one-third scaled four specimens, out of which two specimens detailed as per IS 456 and SP 34 and the other two specimens as per IS 13920, were tested under a reverse cyclic loading. The specimens having special confining reinforcement as per IS 13920 had an improved energy absorption capacity than the specimens with lateral reinforcement detailing as per IS 456 and SP 34.

Alcocer et al. [3] performed experiments on two beam-column joints were tested under unidirectional and bi-directional cyclic loading. The two types of connections tested proved to be efficient and reliable that simplifies and speeds up the construction of precast concrete frame structures.

Huang et al. [4] presents three beam-column sub-assemblages the difference among the three specimens is the length of the U-shaped bar. The strains of reinforcing bars show us that the bond force is larger when the distance to the column face is smaller. Sukumar et al. [5] developed four one third scaled exterior beam-column joints under a reverse cyclic loading. The specimens failed by reason of the development of tensile cracks at the interface among beam and column.

B. Detailing Of Precast Frame

In the precast specimen the beam and column are cast separately and assembled through the precast grout connections (PC-GC). The column is casted as it supports the beam till the connection gains strength. The plan and detailing of beam, column and corbel [6], [7], [8] was carried out based on the guidelines given by in IS: 456-2000 and SP: 34-1987.

C. Precast Connection (PC)

In this kind of association, the beam was thrown completely with holes, column casted with holes and L shaped projection bars are connected the beam is put over the section. Notwithstanding the gaps accommodated the column corner openings were made for the connection of the grout.

D. Scale Factor

A scale factor of four has been embraced for both trial and diagnostic model. The original has been lessened utilizing ¼ scale following the law of similitude. As indicated by law of similitude, the measurement and model were diminished by the scale factor ¼.

E. Reinforcement Details

Reinforcement points of interest of individuals are as per the following: For beam fundamental support is 4 quantities of 10mm distance across bar. Shear support are 6mm distance across 2 legged stirrups at 100mm focus to focus separating and 6mm breadth 2 legged stirrups at 50mm focus to focus dividing at the joint area. What's more, for column a longitudinal steel of 4 quantities of 10mm breadth bars. Shear support of 6mm distance across 2 legged stirrups at 100mm focus to focus dividing. Furthermore, for corbel longitudinal steel of 2 quantities of 10mm width bars and shear support of 2 quantities of 6 mm distance across bars.

II. EXPERIMENTAL AND ANALYTICAL PROGRAM

A. Casting of precast frame

For precast specimen M25 cement and Fe500 strengthened bar were utilized for the present investigation. In support confine the bar bowing of the solid example were finished by the outline itemizing. In mold preparation, moulds were frantic from 14 mm thick plywood. [9] The molds were made prepared for the throwing of examples by applying oil). Concrete was blended in turning drum blender and was exchanged to the form and compacted physically. The example were remolded following 24 hours and cured in water for 28 days. (Figure 1) speaks to the photographic portrayal of threw precast frame.

Fig. 1

B. Experimental setup

The exploratory were completed on a loading frame of 200KN limit. A screw jack of limit 360kN was settled to the loading frame for the utilization of the pivotal load along the axis of the section. Dial gages were settled at center bit of the beam and corners of the beam – column joint of edge. The photographic portrayal of precast specimen in loading frame is appeared in (Figure 2).

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Fig. 2

C. Finite element Analysis

Finite Element Analysis can be utilized all the more viably to foresee the conduct with little adequate approximations. The utilization of PC programming to display these components is significantly speedier, and to a great degree cost – viable.[10] In any case, with the help FEA programming versatile examination is workable for any number of tests. The utilization of limited component investigation to ponder these parts has been utilized. The limited component demonstrating of the edge has been done and the reaction of the joint under two points stacking and the outcomes are introduced.

D. Modeling Precast Frame

To show a precast specimen, section components to make cement and reinforcement are sufficient i.e. for support structural steel and cement. Reinforcement was furnished with discrete displaying strategy. The support in the discrete model uses beam or column segments that are related with concrete mesh nodes. Thusly, the concrete and the reinforcement work share comparative work and bond include comparative territories controlled by the help. [11], [12] there are different strategies for support displaying accessible like implanted and spread model. The displaying points of interest of precast specimen are appeared in (Figure 3) and meshing of precast specimen is found in (Figure 4).

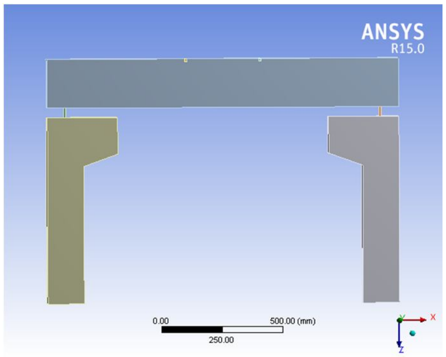

Fig. 3

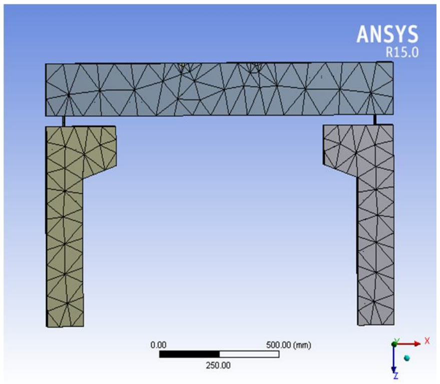

Fig. 4

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III. RESULTS AND DISSICUSSION

In this paper the ultimate load carrying capacity, load-displacement and energy dissipation obtained from the experimental is compared with the results obtained from the analytical studies using finite element models.

A. *Ultimate load Carrying Capacity*

The comparison of ultimate load obtained from the experimental and analytical study is shown in (Figure 5). It is observed both in the experimental and analytical investigation precast grout connection PC-GC exhibited higher ultimate load carrying capacity. The yield load and ultimate load carrying capacity of experimental precast specimen are 171 KN and 203 KN. The yield load and ultimate load carrying capacity of analytical precast frame are 196kN and 214kN. It was observed that the grout connection increases in load is observed to be 6.03%. The specimen PC-GC exhibited to 41.46% increases the load carrying capacity.

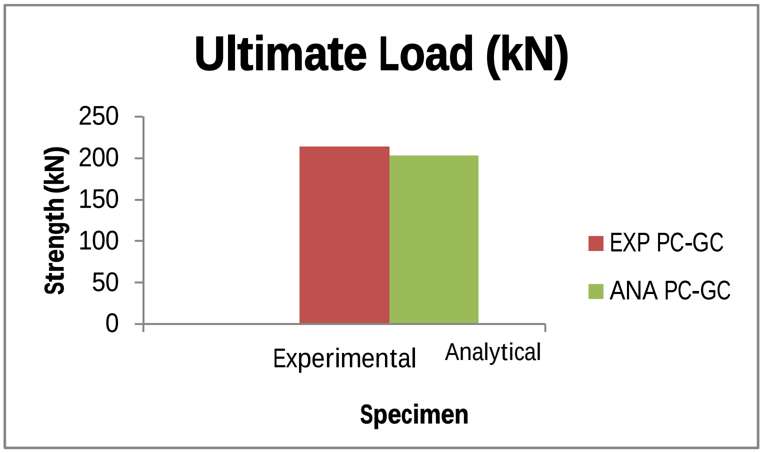

Fig. 5

B. *Crack Pattern and Failure Mode*

The pattern of cracking and the modes of failure of all the specimens are observed. For the precast-GC, the initial crack at 130 KN in the flexural hair line crack of 7mm. it is observed that the column of precast specimens were free of cracks, which satisfied the fundamental requirement of the structural design strong- column week – beam theory, in precast specimens the column damage was minor. (Figure 6) represents the crack pattern in beam of specimen PC-GC. (Figure 7) represents the crack pattern in beam –column joint of specimen PC-GC. And (Figure 8) represents a failure pattern of precast frame in analytical.

Fig. 6

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Fig. 7

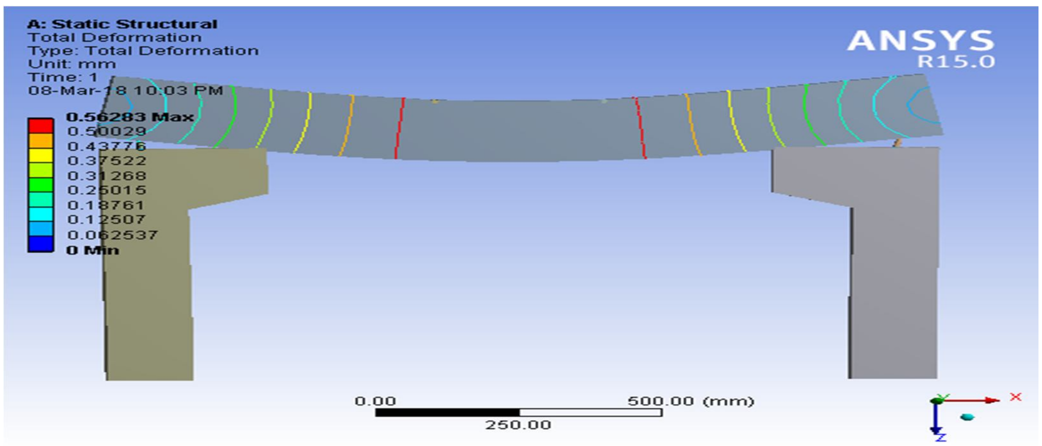

Fig. 8

C. Load-displacement Curves

To facilitate the comparison of experimental and analytical study load- displacement envelope was obtained by plotting between the maximum load and corresponding displacement. (Figure 9) shows the load- displacement envelope curves of the precast specimen. The numerical analysis matched well with the experimental analysis. In the region between the yield load and the ultimate load, the comparison in the results was within 7%.

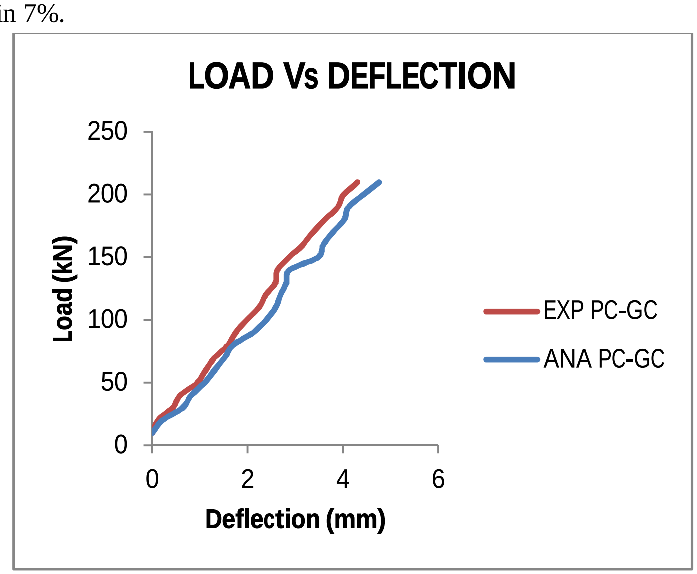

Fig. 9

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D. Energy Dissipation Capacity

The energy dissipated capacity is plotted for the precast frame is shown in (Figure 10). Precast grout connection exhibited good cumulative energy dissipated. At the initial stages of loading up to 2mm of deflection the energy dissipative capacity of specimens remains same. Whereas precast specimen PC-GC has exhibited very good energy dissipation capacity. It shows that the experimental precast frame which has good energy dissipation capacity than the analytical precast frame.

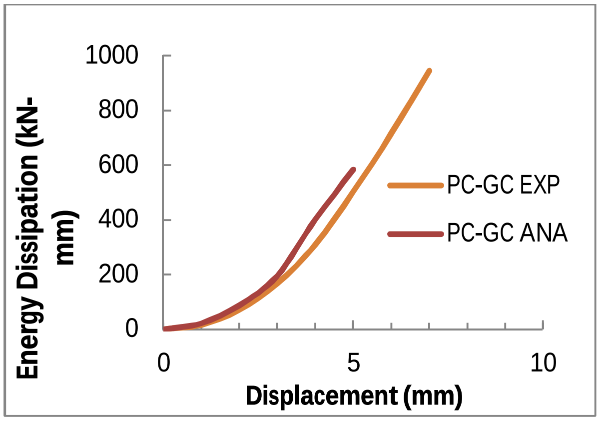


Fig. 10

REFERENCES

[1]. R. Vidjeapriya, V.Vasanthalakshmi and K.P.Jaya, "Performance of exterior precast concrete beam-column dowel connections under cyclic loading", International journals of civil engineering, October 2013.

[2]. Vandana R.K and Bindhu K.R, "RCC Interior Beam Column Joints under Reversed Cyclic Loading", International Journal of Scientific & Research, volume 5, issue 7, July 2014.

[3]. Sergio m alcocer, Rene Carranza and David Perez-navarrete, "Behaviour of a precast concrete beam-column connection", 12th WCEE 2000.

[4]. L.F. Huang, J.Feng, "Experimental Study on Seismic Behavior of Interior joints of Precast Prestressed Concrete Frames", 14th World Conference on Earthquake Engineering,

[5]. P.M. Sukumar, R. Vidjeapriya, K.P.Jaya, "Performance of Exterior Beam- Column Joint Under Seismic Type Loading", ISET Journal of Earthquake Technology, paper no.503 vol.46, No.2, June 2009, pp 47-64

[6]. IS: 456-2000, Indian Standard Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.

[7]. IS: 1893-2002, Code of practice for Criteria for Earthquake Resistant Design of Structures Part 1 General Provisions and Buildings, Bureau of Indian Standards, New Delhi.

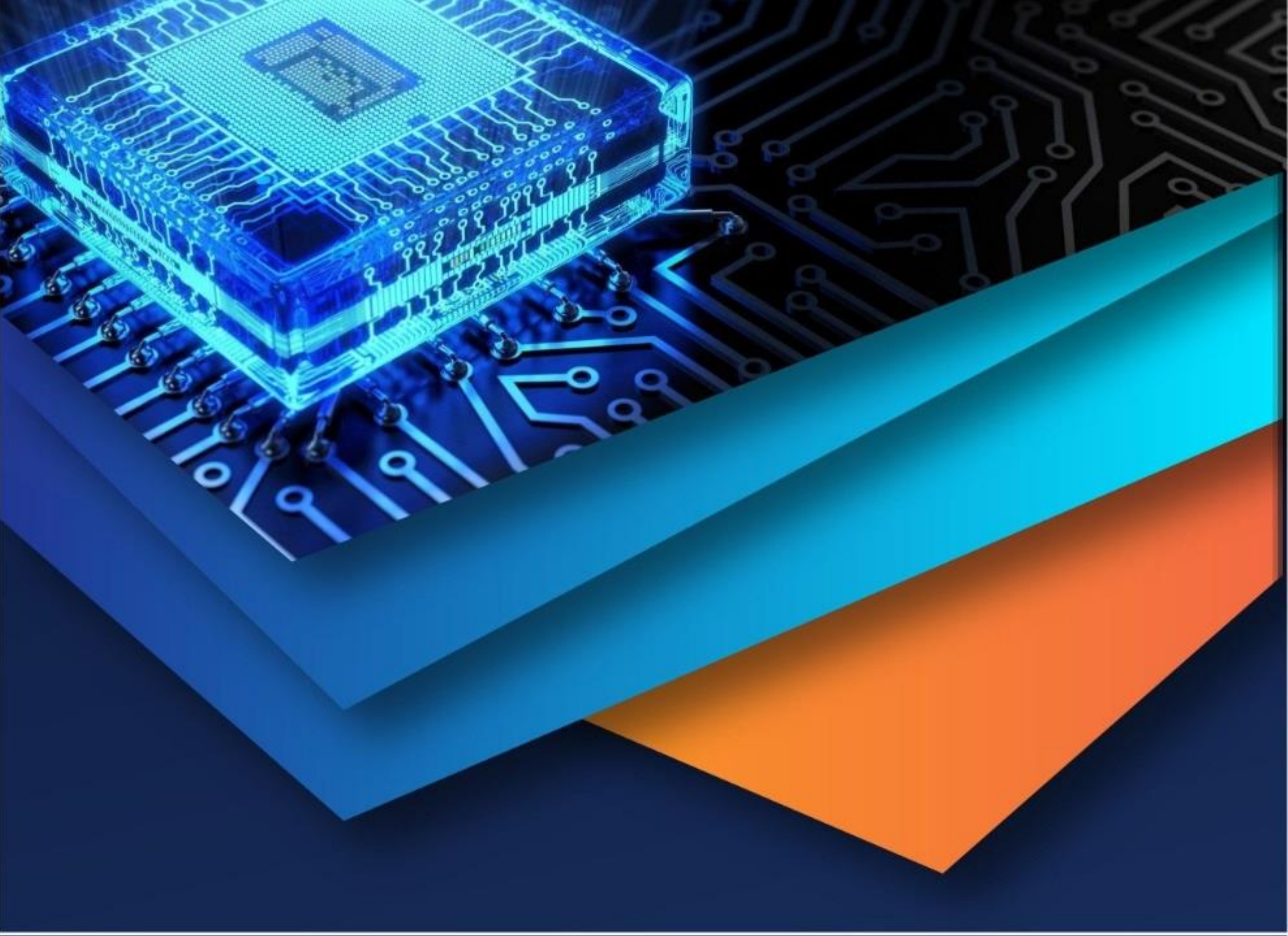
[8]. IS: 800-1984, Code of Practice for General Construction in Steel, Bureau of Indian Standards, New Delhi.

[9]. H.-K. Choi, Y.-C. Choi, C.-S. Choi, "development and testing of precast concrete beam-to-column connections", Engineering Structures 56 (2013) 1820–1835 Contents lists.

[10]. Kulkarni, S., Li, B. and Yip, W. "Finite Element Analysis of Precast Hybrid-Steel Concrete Connections under Cyclic Loading", Journal of Constructional Steel Research, Vol. 64, No. 2, pp. 190-201, 2008.

[11]. Wang, Y., Xuan, Y. and Mao, P. "Nonlinear Finite Element Analysis of the Steel-Concrete Composite Beam to Concrete-filled Steel Tubular Column Joints", International Journal of Nonlinear Science, Vol. 9, No. 3, pp. 341-348, 2010.

[12]. Hawileh, R.A., Rahman, A. and Tabatabai, H. "Nonlinear Finite Element Analysis and Modeling of Precast Hybrid Beam-Column connection subject to cyclic loads", Applied Mathematical Modeling, Vol. 34, No.9, pp. 2562-2583, 2010.



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