STABILITY OF PRECAST BEAM COLUMN CONNECTION UNDER CYCLIC LOADING

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Abstract:

Ancient Roman builders made use of concrete and soon poured the material into moulds to build their complex network of aqueducts, culverts, and tunnels. Modern uses for pre-cast technology include a variety of architectural and structural applications — including individual parts, or even entire building systems.

In the modern world, precast paneled buildings were pioneered in Liverpool, England, in 1905. The process was invented by city engineer John Alexander Brodie, a creative genius who also invented the idea of the football goal net. The tram stables at Walton in Liverpool followed in 1906. The idea was not taken up extensively in Britain. However, it was adopted all over the world, particularly in Eastern Europe and Scandinavia.

Keyword: - Precast, Beam, Column

I. INTRODUCTION

The seismic safety of precast structural systems represents a subject for investigation which is very much of a current interest worldwide. There are two main reasons for the unfavorable behavior of precast systems: (1) in many structures, some of the structural elements are designed as seismically resistant, whereat the remaining ones sustain only gravitational loads. In such cases, it is of vital importance that the latter elements keep their capacity for sustaining vertical loads also in conditions of being exposed to deformations under seismic effect; (2) inappropriate floor structures that don't have the capacity to transfer inertial forces to the seismically resistant vertical elements. Predominant type of the precast (industrial) building in Europe consists of columns tied together with beams. Among many types of different connections between precast elements, the connection using steel dowel is most common. The existing analytical and experimental investigations as well as the experience gathered from the occurred earthquakes are not sufficient enough for throwing light on their seismic behavior. This can partially be explained by the fact that modeling of the mechanisms of seismic response of connections (i.e. dowel action at large relative rotations, gap opening and closing, shear-flexure interaction) are complex and very difficult to model. In practice, connections are predominantly designed by engineering feeling and numerical verification are seldom done. There is an urgent need first to verify the existing practice and then to improve and optimize detailing and technological solution for the typical connections in the precast buildings.

A. Precast concrete products

Building and site amenities-Precast concrete building components and site amenities are used architecturally as fireplace mantels, cladding, trim products, accessories and curtain walls. Structural applications of precast concrete include foundations, beams, floors, walls and other structural components. It is essential that each structural component be designed and tested to withstand both the tensile and compressive loads that the member will be subjected to over its lifespan.

Multi-storey car parks are commonly constructed using precast concrete. The constructions involve putting together precast parking parts which are multi-storey structural wall panels, interior and exterior columns, structural floors, girders, wall panels, stairs, and slabs. These parts can be large; for example, double-tee structural floor modules need to be lifted into place with the help of precast concrete lifting anchor systems.

Fig 1.Precast parking structure showing an interior column, girders, and double-tee structural floors. The two gray circles are covers to close the lifting anchor holes.

B. Objective:

1) To study precast element and compare its aspect with RCC.
2) To study and collect data of specified ground motion for time history analysis.
3) To check and compare parameters like bending stress, shear stress and principal stress for linear and non-linear analysis.

II. METHODOLOGY

A.Ground Motions and Linear Time History Analysis

Dynamic analysis using the time history analysis calculates the building responses at discrete time steps using discredited record of synthetic time history as base motion. If three or more time history analyses are performed, only the maximum responses of the parameter of interest are selected.

Time history analysis is the study of the dynamic response of the structure at every addition of time, when its base is exposed to a particular ground motion. Static techniques are applicable when higher mode effects are not important. This is for the most part valid for short, regular structures. Thus, for tall structures, structures with torsional asymmetries, or no orthogonal frameworks, a dynamic method is needed.

In linear dynamic method, the structure is modeled as a multi degree of freedom (MDOF) system with a linear elastic stiffness matrix and an equivalent viscous damping matrix. The seismic input is modeled utilizing time history analysis, the displacements and internal forces are found using linear elastic analysis. The playing point of linear dynamic procedure as for linear static procedure is that higher modes could be taken into account.

B.Ground Motion Records

Buildings are subjected to ground motions. The ground motion has dynamic characteristics, which are peak ground acceleration (PGA), peak ground velocity (PGV), peak ground displacement (PGD), frequency content, and duration. These dynamic characteristics play predominant rule in studying the behavior of RC buildings under seismic loads. The structure stability depends on the structure slenderness, as well as the ground motion amplitude, frequency and duration. Based on the frequency content, which is the ratio of PGA/PGV the ground motion records are classified into three categories:

1) High-frequency content PGA/PGV > 1.2

2) Intermediate-frequency content 0.8< PGA/PGV< 1.2

3) Low-frequency content PGA/PGV < 0.8

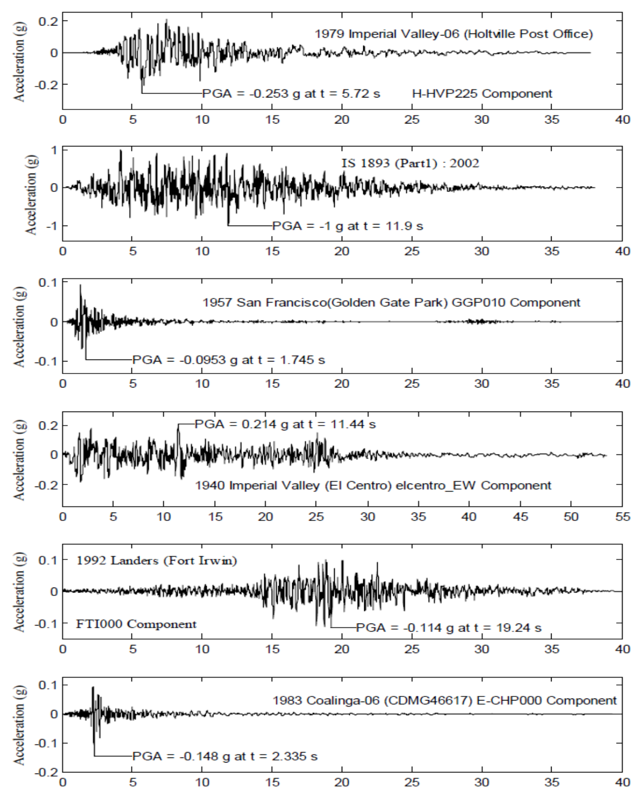

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Fig 2.Ground motion acceleration versus time with PGA value of 1979 Imperial Valley-06 (Holtville Post Office) H-HVP225 component, IS 1893 (Part1) : 2002, 1957 San Francisco (Golden Gate Park) GGP010 component, 1940 Imperial Valley (El Centro) elcentro_EW component, 1992 Landers (Fort Irwin) FTI000 component, and 1983 Coalinga-06 (CDMG46617) E-CHP000 component

III. PROBLEM STATEMENT

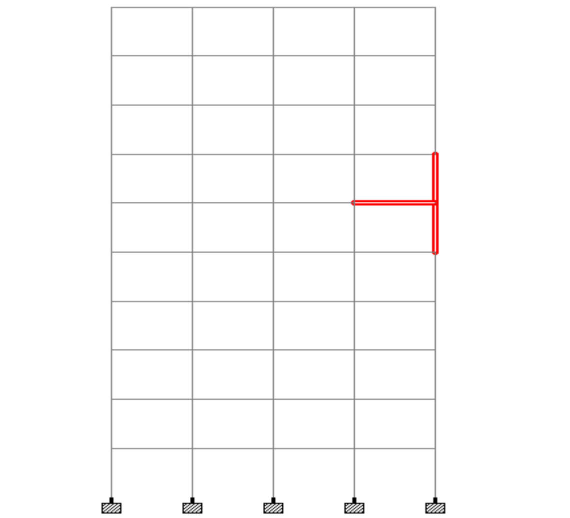


Fig 3.G + 9 Frame Storied Building And Having Loads Can Apply On Beams And Columns

A. ANALYSIS OF BEAM COLUMN FRAME

Column No	SIZE	MAIN BARS	RINGS
C1	9"X15"(230 x380)	4-12mm+2-16mm	6mm@150 Mmc/C
C2	9"X15"(230 x380)	4-12mm+2-16mm	6mm@150 Mmc/C

BEAM NO	SIZE	TOP	BOTTOM	Extra Top	STIRRUPS
PB1	230x380	2-12mm	2-10+2-12	2-12mm	8mm@150c/C

IV.RESULT AND ANALYSIS

A. ANSYS MODELING FOR C TYPE BEAM COLUMN FRAME

MODEL NO.1	BEAM COLUMN RCC
MODEL NO.2	BEAM COLUMN WITH PRECAST

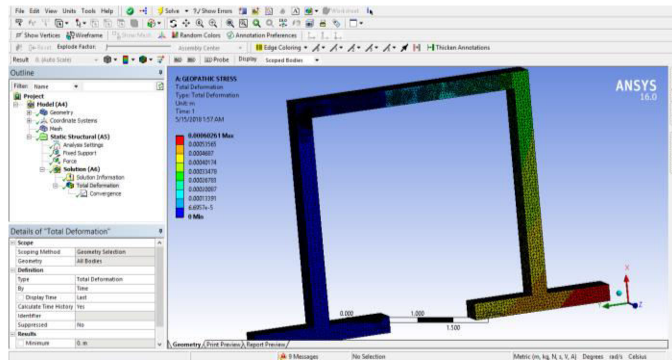


Fig 3: Beam Column RCC

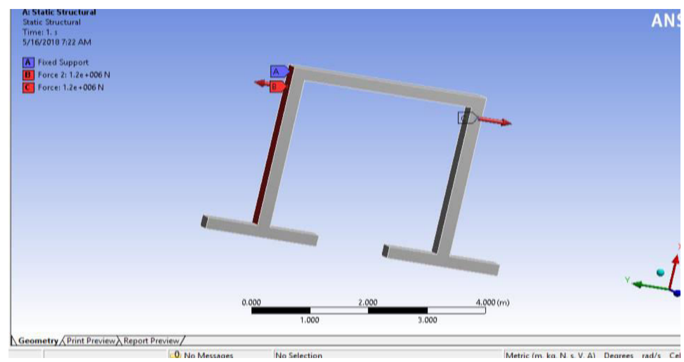


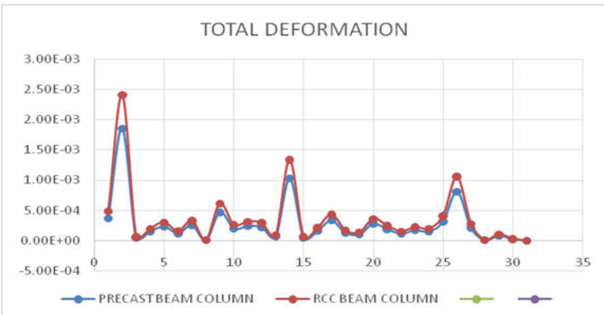
Fig 4 Beam Column With Precast

B. DYNAMIC ANALYSIS RESULTS FOR ELCENTRO TIME HISTORY DATA

- **TOTAL DEFORMATION mm**

TOTAL DEFORMATION mm		
TIME	PRECAST BEAM COLUMN	RCC BEAM COLUMN
1	3.73E-04	4.85E-04
2	1.85E-03	2.40E-03
3	5.21E-05	6.77E-05
4	1.54E-04	2.00E-04
5	2.35E-04	3.05E-04
6	1.23E-04	1.60E-04
7	2.55E-04	3.32E-04
8	9.39E-06	1.22E-05
9	4.72E-04	6.13E-04
10	2.04E-04	2.66E-04

Table 1 Total Deformation

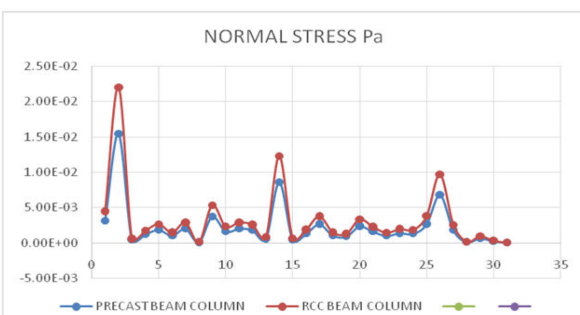


Graph 1 : Total Deformation

- **NORMAL STRESS Pa**

NORMAL STRESS Pa		
TIME	PRECAST BEAM COLUMN	RCC BEAM COLUMN
1	3.11E-03	4.44E-03
2	1.54E-02	2.20E-02
3	4.10E-04	5.86E-04
4	1.21E-03	1.73E-03
5	1.85E-03	2.64E-03
6	1.02E-03	1.46E-03
7	2.01E-03	2.87E-03
8	7.82E-05	1.12E-04
9	3.71E-03	5.30E-03
10	1.61E-03	2.30E-03

Table 2 Normal Stress

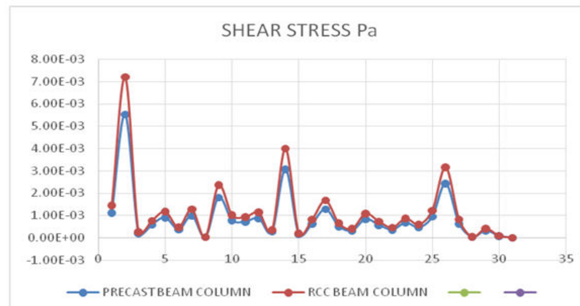


Graph 2: Normal Stress

- **SHEAR STRESS Pa**

SHEAR STRESS Pa		
TIME	PRECAST BEAM COLUMN	RCC BEAM COLUMN
1	1.12E-03	1.45E-03
2	5.52E-03	7.18E-03
3	2.00E-04	2.60E-04
4	5.93E-04	7.70E-04
5	9.03E-04	1.17E-03
6	3.67E-04	4.77E-04
7	9.82E-04	1.28E-03
8	2.80E-05	3.65E-05
9	1.81E-03	2.36E-03
10	7.86E-04	1.02E-03

Table 3: Shear Stress



Graph 3: Shear Stress

VI. CONCLUSION

In this project the comparative analysis is made for RCC and PRECAST beam column connections and following conclusions are observed For dynamic results the the El Centro data is used after analysis by using ANSYS following conclusion are made

- The total deformation In precast beam columnis observed 15 to 20 % less as compared to rcc beam column
- Equivalent Stress In precast beam column is observed 5 to 10 % less as compared to rcc beam column
- Shear Stress In precast beam column is observed 10 to 15 % less as compared to rcc beam column

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