A Review on Dynamic analysis of precast beam column connection subject to blast loading

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ABSTRACT: Construction material such as brick, timber, concrete and steels are increasing in demand due to rapid expansion of construction activities for housing and other buildings. For structure which is constructed by using conventional concrete, itsself-weight represents a very large proportion of the total load on the structure. Precast constructions are now a day's generally been adopted in various residential and commercial projects. In this paper the RCC beam column junction is compared with precast beam column load. Initially beam-column junctions are analyzed for static linear point load which increases with time. The analysis is done by FEM tool ANSYS workbench.

KEYWORDS: Precast, beam-column junction, ANSYS.

I. INTRODUCTION

Precast concrete has been recognized as a viable way to create safe, robust, secure, quality, Structural structures and cost-effective. Nevertheless, its application in high seismic regions was Restricted, mostly because the template guidelines are not accessible relative to those available for casting- Concrete in-place structures. The advent of precast concrete has shown, through the years, Concrete building benefits, such as better quality control, simpler management of concrete construction, Schedule of building, good usage of materials and cost reduction Precast concrete has been recognized as a viable way to create safe, robust, secure, quality, Structural structures and cost-effective. Nevertheless, its application in high seismic regions was Restricted, mostly because the template guidelines are not accessible relative to those available for casting- Concrete in-place structures. The advent of precast concrete has shown, through the years, Concrete building benefits, such as better quality control, simpler management of concrete construction, Schedule of building, good usage of materials and cost reduction Precast concrete has been recognized as a viable way to create safe, robust, secure, quality, Structural structures and cost-effective. Nevertheless, its application in high seismic regions was Restricted, mostly because the template guidelines are not accessible relative to those available for casting- Concrete in-place structures. The advent of precast concrete has shown, through the years, Concrete building benefits, such as better quality control, simpler management of concrete construction, Schedule of building, good usage of materials and cost reduction Precast concrete has been recognized as a feasible means of building structural structures that are secure, robust, efficient, quality, and cost-effective.

A. Precast Structure

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.

B. Features of Blast Loads

Blast loads cannot and should not be compared to seismic load. Unlike Seismic load, blast loads occur for a very short duration. Thus material strain rate effects become a crucial point that must be considered for defining connection performances in case of blast loads. However, it is not possible to make a building both seismic proof and blast proof at the same time and blast loads are applied on a structure irregularly. Unlike seismic load intensity, blast load intensity is of very magnitude in a particular region or space for a fraction of a second.

II.STATE OF DEVELOPMENT

EhsanNoroozinejadFarsangiet. al.[1]Finite element research was analyzed on 4 forms of precast ties that are pinned, rigid, semi rigid and a new proposed component. From the slope of the total load versus deflection graph in the elastic spectrum, the stiffness of the new relation was obtained. The seismic loading adjusted from the El Centro earthquake of 0.15g and 0.5g was then added to the whole system. From the results of the study, they inferred that the new relation has adequate stiffness, power and even greater ductility. Meanwhile, the findings of the whole structure review shows that the new relation acts as a semi rigid attachment. For research, LUSAS and SAP2000 were used.

Patrick TiongLiq Yee, et al[2]after exhibiting quite a lot of advantages compared to traditional cast-in-place building, in Malaysia, the approval level of precast concrete construction is still reportedly poor. The consequences placed by tougher provisions on seismic construction will just make the situation worse. The main objective of this study was to determine the most suitable form of beam-column connections for the precast concrete industry to be implemented, particularly in regions with low to moderate seismicity. This research therefore offered a detailed literature review of the results from studies undertaken to evaluate and examine the actions of precast concrete structures installed under simulated earthquake loading with standard connections or joints. The seismic efficiency of the precast concrete system was heavily dependent on the ductility ability of the connectors connecting each precast segment, especially crucial joints such as beam-to-column connections. From the study, it was discovered that (1) hybrid post-tensioned beam-column link and (2) Dywidag Ductile Connector were among the most frequently used precast construction connectors in seismically susceptible areas.

R.A. HawilehLankeetal[3]nonlinear finite element analysis and modelling of a precast hybrid beam-column link that is subject to cyclic loads have been studied. In order to analyse the

response and forecast the conduct of the precast hybrid beam-column link subjected to cyclic loads tested at the National Institute of Standards and Technology (NIST) laboratory, a comprehensive three-dimensional (3D) nonlinear finite element model was developed. The pre-tension effect on the post-tension strand and the nonlinear material behaviour of concrete were taken into account in the model. The model response was compared with the experimental test results and at all stages of loading produced good agreement. The failure of the link resulted in the fracture of the mild-steel bars. Furthermore, the magnitude of the force developed in the steel tendon post-tensioning was also monitored and it was observed that during the entire loading history it did not yield. They concluded that successful modeling of finite elements would provide a practical and economical tool for investigating the behaviour of such links.

Vidjeapriya. R et al[4]to research the response of an external precast beam to column link subjected to reverse cyclic loading, a 3-D nonlinear FE model was created. Tests of precast concrete ties of a one-third scale external beam column are carried out. Two relation forms have been contrasted. Included in the links is a monolithic link and two precast column beam connections I using J-bolt (ii) using Cleat Angle. For the non-linear study of the precast beam column relation, ANSYS finite element programmed was used. The one-third scale model was developed for nonlinear research. Two kinds of components, including strong elements and touch elements, were used. Compared to the experimental evidence, the finite element analysis findings compared well. It is concluded that the finite element model will reliably forecast the overall seismic activity and the inelastic efficiency of these two forms of joints if the material constitutive relation and failure criteria can be chosen correctly.

P. Polurajuetal[5]Precast building in the recent past is becoming extremely relevant. The majority of the studies published on prefabricated beam-column joints are intended to select the necessary links to be implemented, especially for low to moderate seismic regions. This paper reports on a systematic literature analysis of the studies carried out to investigate and test the actions of precast concrete structural structures installed under simulated earthquake loading with standard connections or joints. The seismic efficiency of the construction of precast concrete relies very much on the ductility of the joints framed by beams and columns that are precast. It has been recognized that (1) moment resistance beam-column attachment and (2) ductile connectors appear to be the most extensively utilized in seismic regions in precast building. In addition, refining and analysis should be carried out in order to optimize those ties to be suggested in regions with low seismicity.

MochamadTeguh, February 2016 Past earthquakes in Indonesia have caused loss of life and major damage to buildings and infrastructure. Most of the damage was experienced on non-engineered buildings, which were conventionally built with less consideration of earthquake resistant design. In this research, a precast system was introduced for non-engineered building structures to connect their practical beams and columns as a reinforced concrete frame. This paper presents experimental tests on precast reinforced concrete frames with and without infill masonry walls using local materials. All undamaged and repaired specimens were set up with the same loading arrangements where lateral loads were

gradually applied to one side of the beam column joint until the ultimate load was reached. Simple retrofitting and strengthening techniques were applied to the damaged specimens were conducted. The results were compared based on the experimental tests, and showed that retrofitted and strengthened specimens significantly increased their strength, stiffness, and displacement ductility to improve the structural behaviour of non-engineered building structures.

Ashish Kumar Tiwary, Aditya Kumar Tiwary, 2015 This paper says that a bomb explosion within or adjacent to a building causes catastrophic damage to the building's exterior as well as interior structural elements including walls, windows. Loss of lives and injuries to occupants can result from many causes such as direct blast effects, structural collapse, debris impact, fire, smoke, etc. The indirect effects can combine to inhibit or prevent timely evacuation, thereby causing additional casualties. In such cases, one or more columns of the building are damaged which results in the failure of beam slab systems and thereby causing a progressive collapse of the part or the whole structure. Thus the columns which are prone to blast must be investigated for high strain loading effects. So the paper presents the modal analysis of steel column taken from a large building frame subjected to blast loading. The implicit modal analysis was done to assess the robustness of numerical model prepared in explicit dynamic ANSYS.

M. R. Wakchaure and Seema T. Borole, 2013 In this paper, a study was conducted on the behavior of structural concrete subjected to blast loads. The comparison between long side & short side column is made & the further result was presented. In final result Percentage of Stress of Reinforced concrete column for long & short side column were presented in this paper. An extensive parametric study was carried out on a series of 8 columns at the long & short side to investigate the effect of transverse reinforcement, longitudinal reinforcement due to blast loading and finite element package ANSYS is used to analysis of RC Column subjected to blast loading.

Edward Eskew&Shinae Jang, 2012 This paper gives a systematic approach to assessing the causes and outcomes of terrorist attacks. The literature also provides a systematic framework to investigate terrorist attacks and their impacts on building structures. Common damage types from explosions to general civil structures are provided including the World Trade Center attack on 9/11 and the Murrah Building bombing. These examples provide perspectives on what can occur in a terrorist attack. Then the basic principles of an explosion are explored, which is the foundation to design analytical and experimental studies. After that, the impact of an explosion on a structure and how that is determined is discussed. Analysis techniques for a damaged structure are also explored in depth, as well as experimental methods used to validate and prove those techniques.

A. Problem statement

The construction industry is growing at a rapid pace in India. It is expected to contribute around 10 % in the GDP of India till 2030. So to meet the growing demand of houses we need to shift from monolithic construction to precast construction. But due to lack of

research and lack of confidence among labours precast construction is not utilized to the full scale. So in order to implement the precast construction we need to do more research.A G+9 RCC Commercial building is considered for analysis and design purpose in staad pro.

B. Analysis of model in Staad

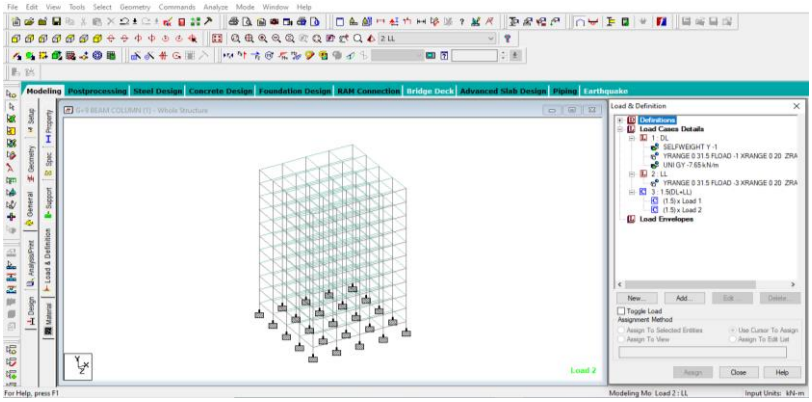


Fig 1 modeling in Staad

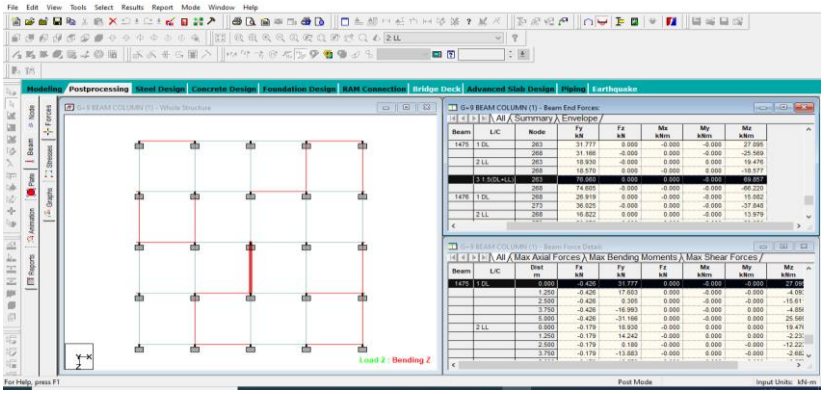
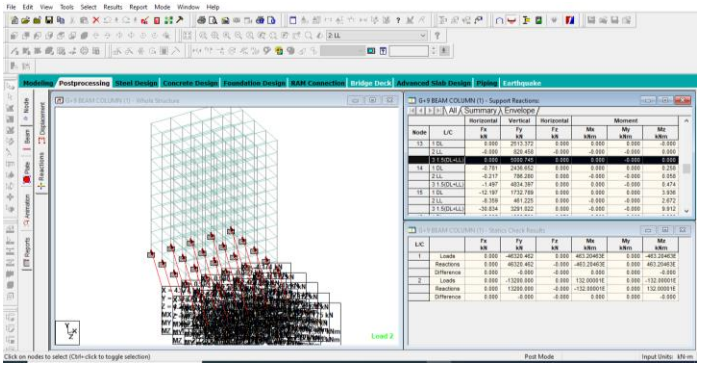


Fig 2 MaxBending moment of beams in staad for RCC



For RCC Structure Maximum Bending Moment is observed at Beam No. 263 as shown in Fig. 4.3.2. is 76.06 KN and Maximum Column Force at node point 13 is 5000KN is observed .The concrete design output obtained from Staad file is shown in fig along with its RCC details

III. CONCLUSION

The research showed that the reaction variations between precast frames and the RC frame are important under heavy seismic excitation, so it is worthwhile to develop nonlinear models appropriate for precast frames in seismic analysis. The seismic efficiency of the precast concrete system was heavily dependent on the ductility ability of the connectors connecting each precast segment, especially crucial joints such as beam-to-column connections. the increase in the number of terrorist attacks especially in the last few years has shown that the effect of blast loads on buildings is a serious matter that should be taken into consideration in the analysis process. The dynamic performance of the design of precast concrete depends very much on the ductility of the joints framed by beams and columns that are precast. The purpose of this analysis was to decide the most appropriate type of beam-column connections. The dimensionless hysteresis models of two types of joints were proposed and found the rationality of the monolithic precast joint model was confirmed. The models will serve as an important method for the seismic performance review and investigation of design parameters of pre-cast links, claim the researchers.

A. Details for ANSYS Models for Precast and RCC

- Column Size – 300 x 750 mm
- Reinforcement for Column –12T – 16No
- Beam Size –230 x 450 mm
- Reinforcement for Beam – Top –12T -2, Bottom- 12T -2, Shear – 10T@120 C/C
- Total Maximum Load –5000 KN

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