International Innovative Research Journal of Engineering and Technology
ISSN: 2456-1983 Vol: 4 No: 2 December 2018

A Comparative Experimental and Analytical Study on Monolithic Frame

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Abstract: The objective of this work is to compare the analytical and experimental examination of the monolithic frame sample. The monolithic specimen is developed as a whole and no connections are given between the joints. A monolithic frame are built and tried under loading condition. A constant axial two point loading was applied to the frame with screw gauge. The accompanying components are ultimate load carrying capacity, cracking pattern and failure mode, load displacement curve and energy dissipation capacity. The analytical investigative of the monolithic specimen which are finished by FEA programming. After examining a monolithic specimen in ANSYS, both the tests are looked at in this paper.

Keywords: Monolithic specimen, two points loading, FEA programming, Load- Displacement curve.

1. INTRODUCTION

As per world practice, development of tall structures is a characteristic stage while in transit to advancement of extensive urban communities molded by lack of zones appropriate for development, and high cost of grounds, particularly in focal regions of the city. Large buildings is outlined and developed by monolithic specimen development innovation. Now a day's concrete development innovation is a progressive exchange of development industrialization to singular tasks it permits quicker, more dependable and less expensive development. Monolithic construction implies the entire structure as a solitary constant structure. In this no connections or joints are given amongst individuals and entire structure is in a perfect world developed in the meantime. Frame structures are the structures having both of beam, column and oppose the horizontal and gravity load. These structures are generally used to defeat the huge structures because of the connected loading.

Monolithic structures are made as whole and to oppose the failure which is producing because of connected load. Monolithic which gives greater strength and oppose the shear, crack and torsion all the more viably. High story building is raised by utilizing concrete development. One of the benefits of monolithic structure is simple in development, built quickly and prudent in nature. Building development as indicated by the concrete innovation is favored because of the monolithic structures permitted the entire even load circulation all through the entire floor space.

The interest for steel was diminished by and large by 7-20%, and the interest for concrete was diminished by 15 %, decreasing along these lines the general cost of development. In the event that concrete development is performed by the example, structures are built inside a shorter area. The development procedure is rearranged if a concrete unit might be organized specifically at the site. Because of their procedure includes, the concrete structures are more impervious to man-made and other horrible natural effect, they are all the more seismically safe. A concrete building is 15-20% lighter than block one. The light weight configuration diminishes material utilization and decreases cost. Because of this development innovation, the work compel is less expensive, and work may be paid just once.

2. LITERATURE SURVEY

M.A.Ferreira et al (2009) introduced the experimental test on reinforced concrete beam column connections. The experimental results were obtained from the tests on beam-column connections specimens. The influence of the compressive strength of concrete and the transverse reinforcement ratio are examined. The experimental results have been compared with the theoretical results, a partially restricted connection that assesses the percentage of restrictions obtained by the types of monolithic connections.

International Innovative Research Journal of Engineering and Technology
ISSN: 2456-1983 Vol: 4 No: 2 December 2018

K.R.Bindhu et al (2009) contrasted the conduct of joints and transverse reinforcement details according to IS 456 and IS 13920. Four 33% scale models were tested under cyclic loading condition. The specimen with the special confining reinforcement according to IS 13920 and improved the dissipation capacity of the energy compared to IS 456. One of the specimens is subjected to 3% of load and another specimen is subjected to 10% of load. From this the outcomes are looked at.

K.P.Jaya (2012) concentrated on looking at the execution of precast and beam column joint subjected to cyclic loading condition. 1/3 scale models connections are made. The experimental results were contrasted with the monolithic specimens. Axial loading was connected in the section utilizing 400KN limit actuator. The hysteresis behavior, load carrying limit, dissipation of energy and ductility factors are taken into account. The execution for the precast specimens and beam to column connections were looked at.

R.Vidjeapriya et al.(2013) investigated the reverse cyclic loading of a third model of the precast connection. The prefabricated specimen and the monolithic specimen had the same strength. The monolithic RC test specimen (ML) was designed on the basis of IS456 and IS13920 details. One of the columns of monolithic and prefabricated specimens is supported by an external hinge. And other ends move and rotate by supporting the roller. This results in a load carrying capacity, load ratio and a comparison of hysteretic behaviors.

Rohit B. Nimse et al (2014) tested connections under dynamic loading conditions. 1/3 rd scaled model of specimen are considered for testing. A specimen contains two beam bar and three column with removed center column. The course of action of instrument is of two distinct parts (I) four dial gage (ii) one straight factor differential transducer (LVDT). The different connections are tested. Also, contrast the outcomes by various connections.

Parastesh et al (2014) have developed a new ductile moment resistant to prefabricated beam links. They tested six full scale precast connections inside and outside under cyclic loading and compared their performance with monolithic connections. Experimental data is used to investigate failure mode, drift capacity, flexural strength, degradation of strength, ductility and dissipation capacity.

Scope of Study

To think about the experimental outcomes and analytical outcomes and accomplish a correct representation in analytical model to suit the experimental results. Finite element modeling creation can be utilized for parametric examination.

3. MONOLITHIC CONNECTION DETAILS

The monolithic frame consists of beam and column casted monolithically. The monolithic frame (ML) was composed by IS: 456-2000. The beam flexural support consisted of four bars with one bar on each side of the transverse reinforcement Two quantities of 20 mm diameter bars were provided) in the compression zone as tension reinforcement and two quantities of 20 mm distance across bars. The shear reinforcement comprised of 8mm distance across two legged stirrups divided at 200mm in the center column and 100mm at last column. The column support additionally organized as four 20mm width bars and parallel ties were divided at 200mm.

4. EXPERIMENTAL PROGRAM

4.1 Casting of specimen

For monolithic specimen M25 grade of cement and Fe500 structural steel bar were utilized for the present investigation. In mold preparation, moulds were made from 12 mm thick plywood. As the molds were produced using plywood, nails were given all through the length of the shape to keep up the measurement of the mould and prevent keep the protruding (of the molds amid cementing. The molds were made prepared for the throwing of examples by applying oil). Concrete was blended in rotating drum blender and was exchanged to the form and compacted physically. The sample was demolded following 24 hours and cured in water for 28 days. Figure 1 speaks to the photographic portrayal of monolithic frame.

Figure 1. Casted Monolithic Frame

ISSN: 2456-1983 Vol: 4 No: 2 December 2018

4.2 Experimental setup

The experiments were completed on a loading frame of 270KN limit. Two dial gages were fixed at center portion of the beam and corners of the beam – column joint of edge. The photographic portrayal of monolithic specimen in loading frame is appeared in figure 2.

Figure 2. Experimental Setup of Monolithic Frame

5. ANALYTICAL STUDY

Finite Element Analysis can be utilized to study the response of structural components. While this is a method that produces real life response, it is extremely time consuming, and the use of materials can be quite costly. But with the help FEA software versatile analysis is possible for any number of samples. The use of finite element analysis to study these components has been used.

5.1 Modelling Monolithic Frame

To show a monolithic beam, column components to make cement and reinforcement are sufficient i.e. for support structural steel and cement. The modeling details of monolithic specimen are appeared in figure 3 and meshing of monolithic specimen are found in figure 4.

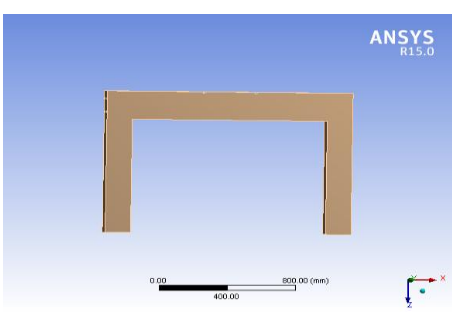

Figure 3. Modeling of Monolithic Frame

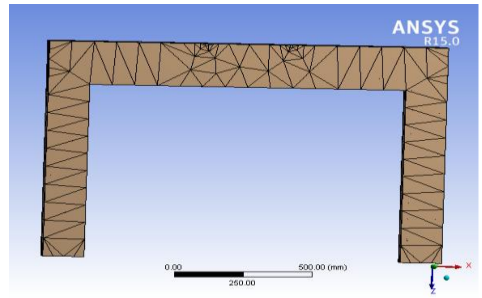

Figure 4. Meshing of Monolithic Frame

6. COMPARSION OF RESULTS

6.1 Experimental Results

Perceptions were produced using the experimental examinations. The present examinations are (I) Ultimate Load Carrying Capacity (ii) Cracking Pattern and Failure Mode (iii) Load-Displacement Behavior (IV) Energy Dissipation Capacity.

6.1.1 Ultimate Load Carrying Capacity

In experimental results the yield load and ultimate load carrying capacity for the monolithic frame are 140KN and 164KN.

6.1.2 Crack pattern

The pattern of cracking and the failure modes are watched. For the monolithic specimen, ML, the principal flexural break happened at the middle of the beam traverse at 80KN. The crack gradually increases at every incremental load. (i.e.) crack develops from 5mm to 100mm at 135 KN in the flexure zone. Figure 5 speaks to the crack pattern of monolithic specimen ML. figure 6 speaks to the crack pattern of beam – column of specimen ML.

Figure 5. Represent Crack Pattern in Beam of Specimen

International Innovative Research Journal of Engineering and Technology
ISSN: 2456-1983 Vol: 4 No: 2 December 2018

6.1.3 Load –displacement relationship

The Load - displacement curve for the monolithic specimen is shown in Figure 7.

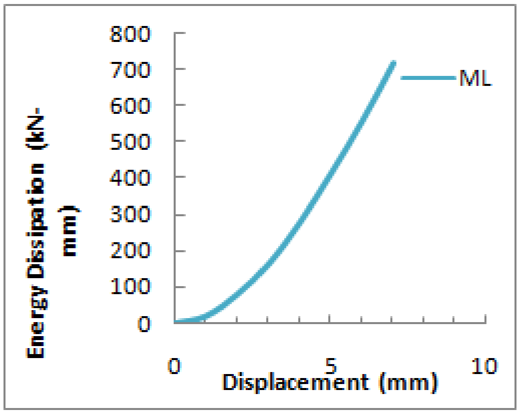

Figure 7. Load-Displacement Curve of Monolithic Specimen (Experimental)

6.1.4 Energy dissipation capacity

At the initial stages of loading up to 1 mm of displacement the energy dissipative capacity of all the specimens remains same. At the displacement of 2.5mm the monolithic specimen shows reduction in the cumulative energy dissipation. Figure 8 represents the energy dissipation in monolithic frame.

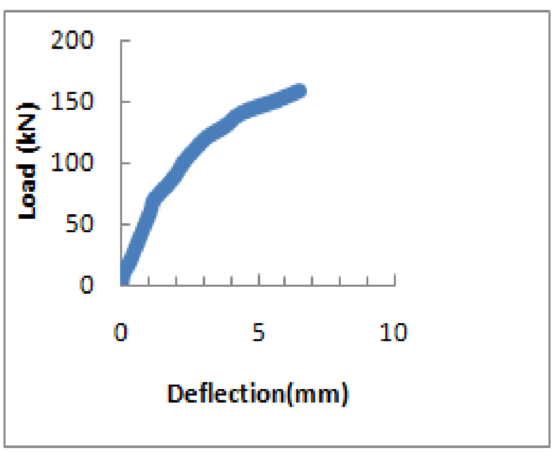

Figure 8. Represents Energy Dissipation Energy

6.2 ANALYTICAL RESULTS

The finite element analysis was carried out on the monolithic frame. Analytical results are observed below.

6.2.1 Ultimate load carrying capacity

The yield load and ultimate load carrying capacity of the monolithic frame are 127KN and 158 KN.

6.2.2 Load displacement curve

The load displacement curve for the monolithic frame is given below.

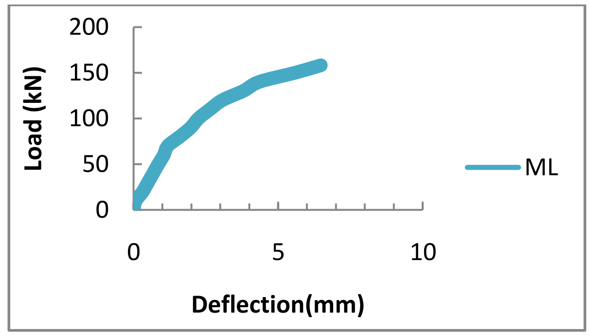

Figure 9. Represents a Load Displacement Curve for Monolithic Frame (Analytical)

6.2.3 Failure mode

The failure mode on a monolithic failure is shown below in figure 10.

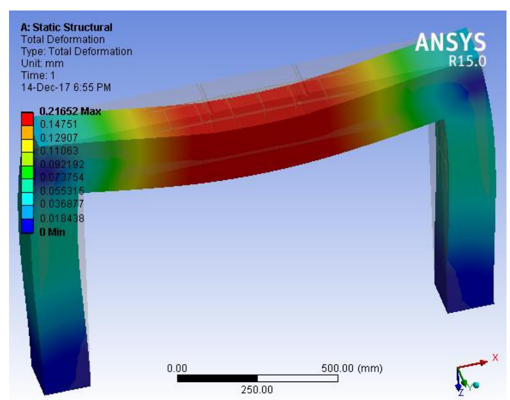

Figure 10. Failure Mode of Monolithic Specimen

6.2.4 Energy dissipation capacity

At the initial stages of loading up to 1mm of displacement the energy dissipative capacity of all the specimens remains same. At the displacement of 4mm the monolithic specimen shows reduction in the cumulative energy dissipation.

International Innovative Research Journal of Engineering and Technology
ISSN: 2456-1983 Vol: 4 No: 2 December 2018

Figure 11 represents the energy dissipation capacity of the monolithic frame.

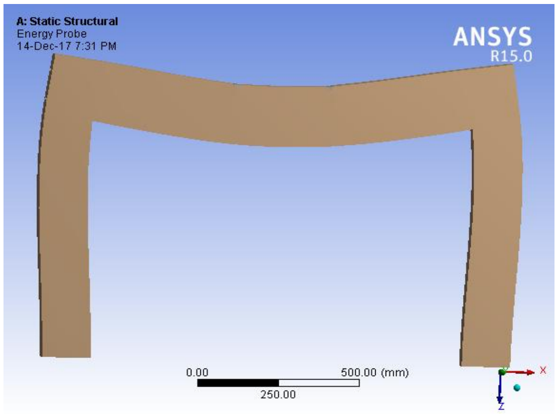

Figure 11. Represents Energy Dissipation of Monolithic Frame

7. COMPARISON OF RESULTS

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.

7.1 Ultimate load carrying capacity

The comparison of ultimate load obtained from the experimental and analytical study. It is observed that in all the cases the experimental study which is slightly equal the analytical study.

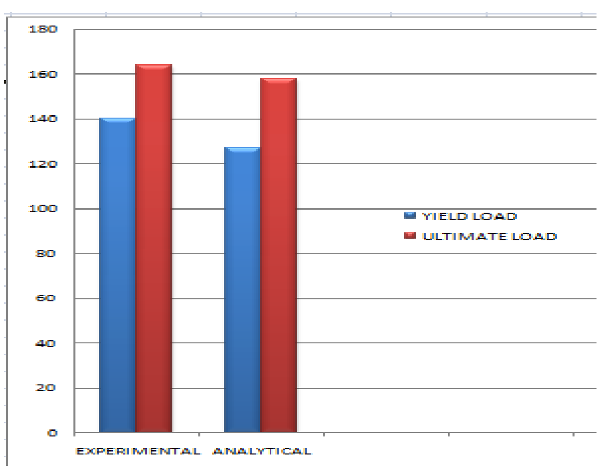

Figure 12. Represents the Comparison of Ultimate Load Carrying Capacity of ML

7.2 Load-displacement envelope curves

To facilitate the comparison of the experimental and analytical study load- displacement envelope was obtained by plotting between the maximum load sustained in each cycle and corresponding displacement. Figure 13 shows the load- displacement envelope curves of the specimen ML. the analytical results matched well with the experimental results up to yield load. In the region between the yield load and the ultimate load, the variation in the results was within 6%.

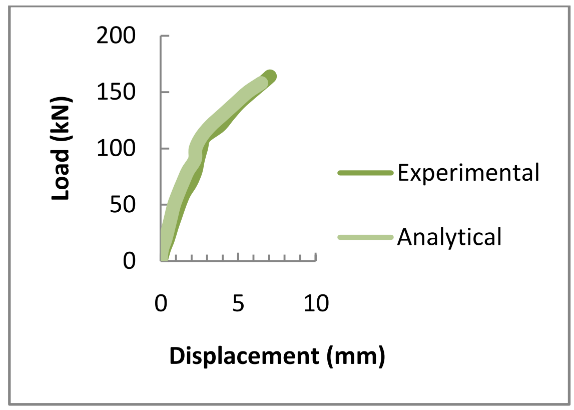

Figure 13. Comparison of Load- Displacement Envelope for ML

7.3 Energy dissipation capacity

The cumulative energy dissipated during each displacement is plotted for the monolithic frame is shown in figure 14. The percentage variation of the total energy dissipated by the monolithic specimen is within 30%.

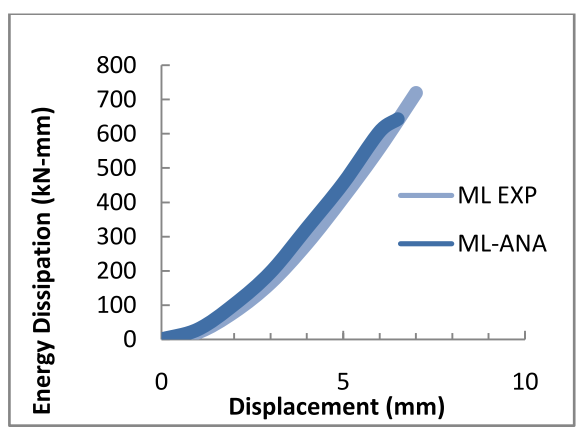

Figure 14. Comparison of Energy Dissipation in ML

International Innovative Research Journal of Engineering and Technology
ISSN: 2456-1983 Vol: 4 No: 2 December 2018

8. CONCLUSION

These studies demonstrate the behavior of monolithic specimen, and compare the experimental results with the analytical results. A monolithic specimen is casted and tested in the loading frame. Two points loading were applied at the middle and corners. From that the experimental results are tabulated. By using finite element analysis, analytical results are tabulated.

Based on this the results are compared and they are briefly discussed above. The parameters such as ultimate load carrying capacity, crack failure, load- displacement curve, energy dissipation. With the help of this parameters results, we found that the experimental results which are slightly higher than analytical results.

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