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NUMERICAL ANALYSIS OF DIFFERENT UNSTIFFENED BOLTS ARRANGEMENT OF END-PLATE MOMENT CONNECTION UNDER NON-LINEAR CONDITIONS

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Abstract - *A bolted connection is presented with splicing plates to facilitate assembly and increases the tightness of the joints. The joints have three modules and are arranged using bolts on the site. Cyclic experiments and finite element analysis (FEA) are performed on the mode by using Ansys software. The study reported here has experimentally evaluated a variety of unstable types of bolt assemblies for seismic applications. This connection includes a modified bolt assembly that is designed to promote a uniform distribution of forces in the bolt group. The study reported here describes the results of a full-scale test of different types of bolts using the Ansys workbench. In experimental development, the details of the test results will be suppressed and the connection performance will be checked through the Ansys workbench. Bolt extended end plate connections have shown that they can provide a considerable amount of flexibility and waste energy. These connections are pre-qualified for use in special and intermediate moment frames widely due to their superior flexibility in multi-story buildings and their ability to cause loss of energy during strong ground energy dissipation.*

***Key Words*: Splicing plates, web opening, Buckling, ANSYS 2021 R2**

1. INTRODUCTION

The end-plate connection is composed of a steel plate welded at the end of a beam section, welded with an adjacent member using rows of high-capacity bolts of full pressure. The connection can consist of two beams (splice plate connections) or a beam and a column. The end-plate moment connection is classified as flushed or extended, with or without a stiffener, and further based on the number of bolts in the stress flange.

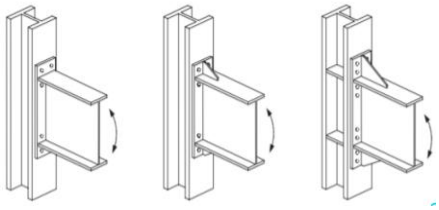

Fig -1: Extended end plate connection

Connection bonding is the main position of the beam and column, the hinge of the force transferred in the frame, and its performance directly affects the safety of the entire steel frame. A typical connection used in the steel moment frame is a fully welded connection, the full joint penetration conduit welds connect the beam flange to the column flange, and the fillet welds connect the beam web to the column flange, as shown in Figure 2.

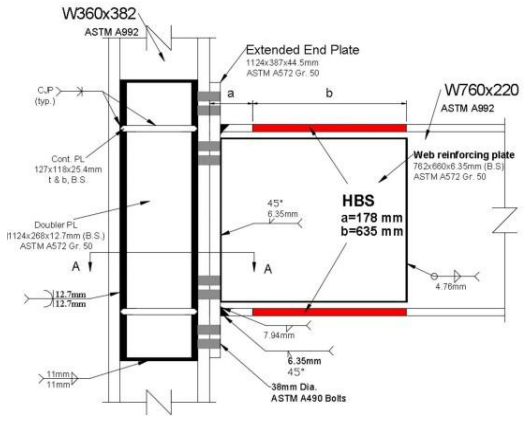

Fig -2: Connection details

Bolt extended end plate connections overcome the problems associated with field welding, speeding them to be installed during frame construction, and are more suitable for winter construction than field welded connections.

2. OBJECTIVES

The main objectives are,

1. To study the performance of load-carrying capacity with and without web opening.
2. To study the performance of load-carrying capacity with and without flange opening.
3. Rigid and unstiffened I beam to study the web and flange opening conditions in the beam.
4. To study the temperature variance in the end plate moment connection.
5. To evaluate the performance of different types of bolt arrangements in the end plate moment connection.

2.1 To study the performance of load-carrying capacity through with and without web opening.

The primary advantage of the proposed connection is the arrangement of bolts in the octagonal pattern as shown in Figure 4. The beam flange coming from the web led to the biaxial bending of the end plate about the horizontal and vertical axes passing through the beam flange.

By changing diameters,

1. 223 mm (model 1)
2. 245.3 mm (model 2)
3. 269.83 mm (model 3)
4. 296.81 mm (model 4)

By changing the position of the hole

1. 935 mm (model 5)
2. 1028.5 mm (model 6)
3. 1131.35 mm (model 7)
4. 1244.48 mm (model 8)

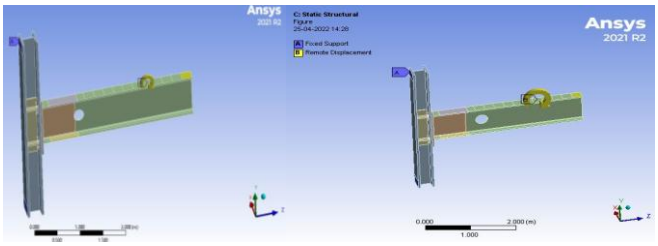

Fig -3: Web opening with 223 mm diameter and position of the hole with 1131.35 mm.

A better result was obtained from the specimen with a 223 (MODEL 1) mm diameter. Model 7 has got the better result on the basis of hole position.

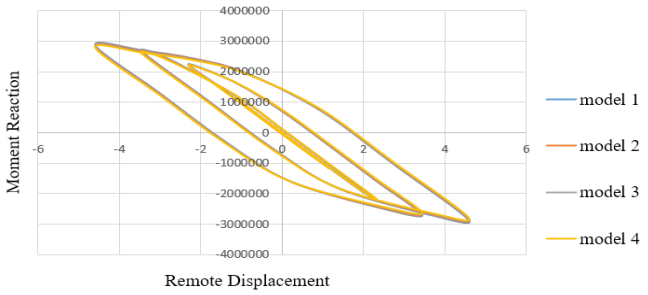

Chart -1: Moment Reaction vs Remote Displacement graph

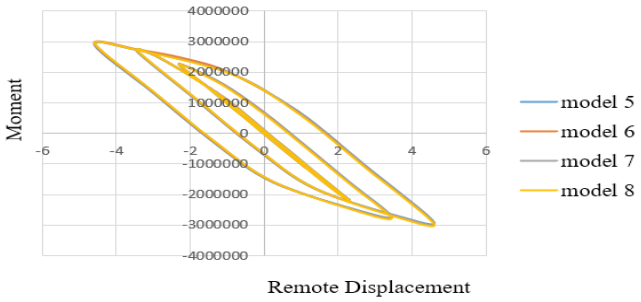

Chart -2: Moment Reaction vs Remote Displacement graph

2.2 To study the performance of load-carrying capacity through with and without flange opening.

By changing diameters,

5. 110 mm (model 14)
6. 121 mm (model 15)
7. 133.1 mm (model 16)
8. 146.41 mm (model 17)

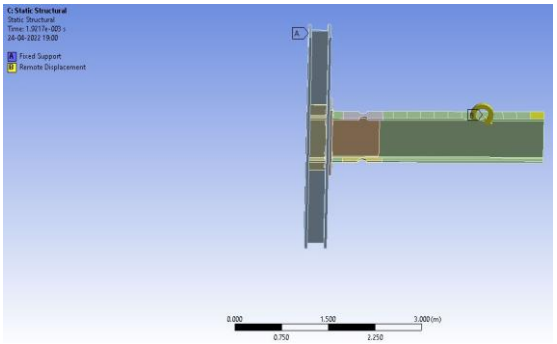

Fig -4: Diameter 223mm and 146.41mm position

A better result was obtained from the specimen with a 146.141mm (MODEL 17) mm diameter.

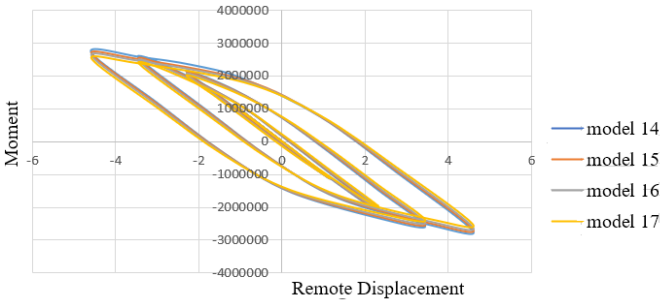

Chart -3: Moment Reaction vs Remote Displacement graph

2.3 To study the temperature variance in the end plate moment connection.

A temperature of 200^{0}C is applied to the model, then fire resistance can be determined.

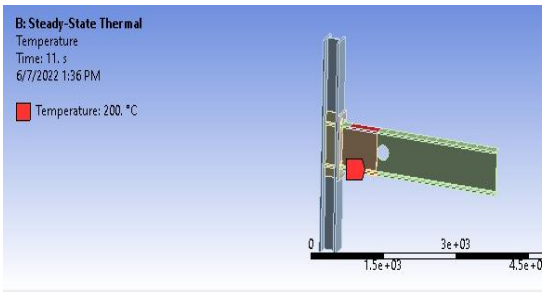

Fig -5: Thermal application by using steady-state thermal

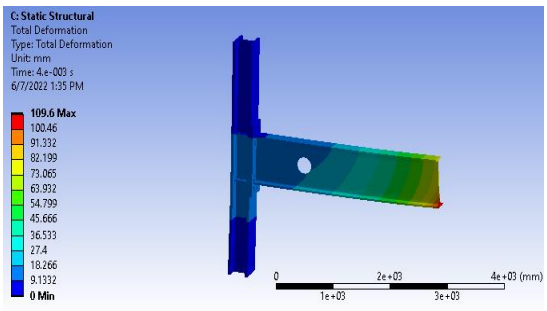

Fig -6: Total deformation after applying temperature

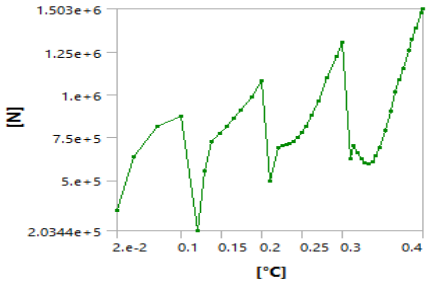

Chart -4: Temperature vs Force graph

2.4 To evaluate the performance of different types of bolt arrangement in end plate moment connection.

It includes two types of bolt arrangements, four-bolt arrangements, and six-bolt arrangements.

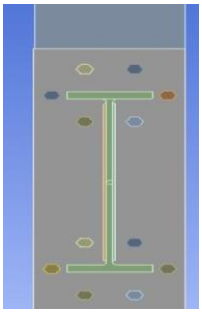

Fig -7: 4 bolts

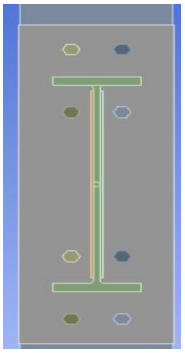

Fig -8: 6 bolts

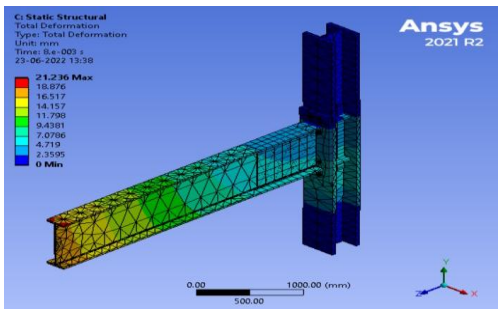

Fig -9: 4 bolts deformation

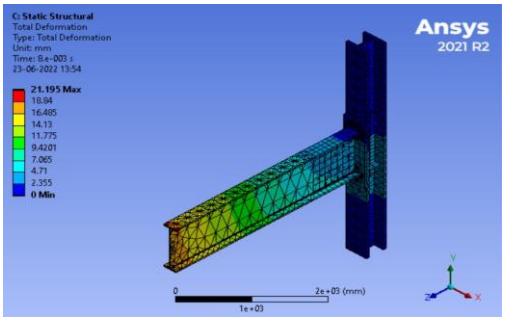

Fig -10: 6 bolts deformation

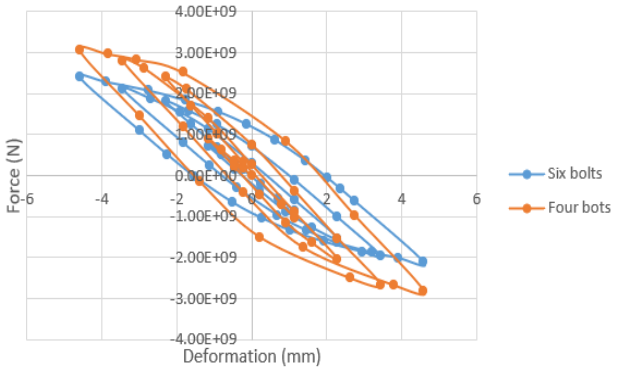

Chart -5: Combination graph (force vs deformation) for 4 and 6 bolts arrangement

Four-bolt arrangements are much better than six-bolt arrangements. The maximum force value can be seen on the four bolt arrangements with 310kN.

3. CONCLUSIONS

This study is mainly related to the study reported herein experimentally evaluates unstiffened different types of bolt arrangement for seismic applications.

The details of experimental developments are done using the ANSYS software. It is clear that model 1 and model 7 have a high buckling load as compared to others. Buckling load resistant capacity can be improved by using the web opening. Model 16 with flange removal is from a hole diameter of 146.41mm. Here model 16 shoes less moment reaction as compared to others. So in these cases, less stress, as well as less failure, will occur.

When a temperature of 200°Cis applied to the model, the maximum total deformation can be seen at about 109.6mm and equivalent stress of 503.54MPa. by evaluating the performance of providing different bolt arrangements four-bolt arrangement is much better than the six-bolt arrangement. Because the maximum force value can be seen on the four bolt arrangements with 300k.

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