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A REVIEW ON STEEL BEAM-COLUMN JOINT TO IMPROVE THE PERFORMANCE OF BUILDING

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Abstract - *A wide study on review paper on steel beam column joint connections has been made using Reduced Beam Section (RBS) concept. The beam is reduced on the flange with specified radii on both sides of the section from FEMA350-2000 (Ordinary Frame) and it have been analyzed in ANSYS. Stiffeners generally provided in order to increase bending stiffness of the structure and it is highly desirable for destabilizing compressive loads. The results observed on were Total deformation, Equivalent stress and strain. Performance of the building is observed at different stages and push over curve is plotted in ETABS.*

***Key Words*: Reduced Beam Section, Stiffeners, Deformation, Push over curve, ETABS, ANSYS**

1. INTRODUCTION

Structural engineering is the science and art of conniving and making, with economy and elegance, buildings, bridges, frameworks, etc. so, they can securely resist the force to which they might be subjected.

The unexpected local breakable damage of beam-to-column connections of steel moment-resisting frames in the Northridge (1994) and Kobe (1995) earthquakes created anxieties regarding the reliability of the current plan practice and detailing of connections. Severe post-earthquake investigations have exposed many factors contributing to the failure. The high stress attentiveness at the welded web and flanges and the susceptibility of the connection to the huge ductility claim are considered to be two thoughtful factors creating such failures. A regular way to solve the problem is to decrease the ductility demand on the welded zones and ease the stress concentration level. Frequent solutions to the instant frame connection problem have been anticipated several of which have been exposed to show suitable levels of ductility in frequent tests.

There are different types of connections in beam-column joint they are Welded moment connection on the flanges, Bolted end-plate moment connection on the flanges, Simple shear connection on the flanges, Gusset plate connection with dual plate flange seam of I sections or plate seam of hollow sections on the flanges or on the web.

1.1 Welded moment connection on the flanges

A welded moment connection is a Full-penetration welds are required at the beam flanges. The web plate is shop-welded to the column flange and is there to locate the accurate position of the beam and grip it till it can be welded. Supporting bars are usually mandatory beneath the full-pen welds and are occasionally left in position. Admission holes are scorched into the beam web to ease field welding. A weld about the shear flap to the beam web can be used to rise shear capacity.

1.2 Shear connection on the flanges or Web

A shear connection transmits slight or no moment. In the case of a shear connection is a partial depth end plate welded to the beam's web and a beam bolted to a column. It is a shear only connection, since the beam flanges are not firmly linked to the column. Note the gap exposed among the bottom flange of the beam and the column. Shear connections may be complete to the web of the supported member though the flanges remain unrelated. Seat or hanger connections are the lone category of shear connections that attach to the flange of the supported beam. Angles for shear connections may be devoted to supporting members by bolting. While solitary plate connections are the most economical, they must occasionally be assessed for eccentricity.

1.3 Bolted end-plate moment connection on the flanges

A moment connection transmits bending moments from a beam to a column and it is a stiff connection. A case of a moment connection is a entirely welded endplate to a beam, associated to a column flange. A welded beam to the column. The beam flange welds convey complete flange strength to the column. The shear tab was welded to the column and it is bolted to the beam web, supports the beam till it is welded and recommendate enduring shear resistance. The struggle of a bolted end plate connection is providing by a grouping of tension forces in the bolts together to one flange and compression forces in bearing at the extra flange. If there is axial force in the beam, the entire tension and compression forces are equivalent and opposite. Vertical shear is fought by bolts in bearing and shear; the force is frequently supposed to be resisted mostly by bolts together to the compression flange. These forces are demonstrated diagrammatically in the figure on the accurate. At the final limit state, the focus of rotation is at, or nearby the compression flange and for easiness in design, it may be expected that the compression resistance is rigorous at the level of the centre of the flange.

2. LITERATURE REVIEW

Various studies have been made on the literature based on the topic I have chosen and results are validated below

1. D.T. Pachoumis et al. (2010) have studied on Cyclic performance of steel moment-resisting connections with reduced beam sections -Experimental analysis and finite element model simulation. In this paper, Reduced beam section (RBS) moment-resisting connections have been developed in order to provide a highly ductile response and reliable performance. The design and detailing of the RBS member were given in EC8, Part 3. Though, the effectiveness of these references for a European profile is dubious, due to partial existing data from European research. Although the standards of the geometrical parameters were not giving to the references proposed, the plastic rotation exceeded the satisfactory 0.03 rad without any weld fracture or any sign of distress at the face of the column, on both specimens.

2. Kulkarni Swati Ajay et al. (2013) have evaluated on a Study of Reduced Beam Section Profiles using Finite Element Analysis. Reduced beam section (RBS) is one of the numerous connection sorts, which is reasonable and general for use in new steel moment frame structures in seismic region. To proceed RBS connection, approximately portion of the beam flanges at a rapid distance from column face is purposefully cut so that the yielding and plastic hinge occurs within this zone of flanges. Stress contours are of smooth nature for the radius cut RBS. For the trapezoidal and straight cut RBS connections stress attention is experiential at the re-entrant corners eventually might lead to fracture of the beam flange. At 0.05 radians beam lateral torsional buckling and column flange twisting remained create almost similar in all cases.

3. Luis Calado et al. (2012) have studied on Experimental Behavior of Steel Beam-To-Column Joints: Fully Welded Vs Bolted Connections. The tests have been achieved experimentally on specimen's illustrative of frame structure beam-to-column joints close to the ones typical of European design training. In this paper the results attained from the experimental tests on two other connection solutions, i.e. top and seat with web angle (TSW) and fully welded connections (WW), planned for the same beam-to-column joints are obtainable. The experimental outcomes obtained in this investigation allow to describe the collapse methods, the rotation capacity and the final bending strength of bolted and welded beam-to- column connections. The major aspects leading the cyclical and the Monotonic behavior of bolted (TSW) and welded (WW) connections have remained shown against experimental outcomes. It has been shown that the panel region does not disturb the behavior of the TSW connections, which instead is mostly associated to the tension angle geometry and strength properties.

4. C.E. Sofias et al. (2013) have investigated on Experimental and FEM analysis of reduced beam section moment endplate connections under cyclic loading. Two key thoughts have been established to provide extremely ductile response and reliable presentation: strength the connection and/or weak the beam framing to the column, in order to avoid damages of the particular column. The failing of specific sections of the beam in order to alteration them into dependable energy dissipative zones. In both specimens the connection area continued in the elastic zone due to plastic hinge development in the RBS zone. It must be noted that outcomes from experimental and FEM replication were in very good correlation creation the FEM approach reliable for additional usage.

5. Lewei Tong et al. (2015) have assessed on Cyclic behavior of beam-to-column joints with cast steel connectors. In this paper it presents a complete study on steel beam-to-column joints equipped with weld-free cast steel connectors used as consumable energy-dissipating components. The undeveloped idea was to use the connectors as the main basis of distortion and energy dissipation, and to understand fast repair of the joints by simple replacement of theories connectors after earthquakes. A preliminary numerical study was carried out to further investigate the behavior of the proposed joints, where it was found that the numerical results agree well with the test results. It was shown that the accumulated plastic damage of the specimens with the C2 type connector was much larger than that of the joints with C1 type connectors, and it was confirmed that higher bolt forces could be induced for the WT1 connectors due to significant prying action Based on the test and numerical results, preliminary design recommendations related to connection detailing were proposed, and a component-based approach was put forth for normal design of such connections.

6. Hong Chao Guoa et al. (2017) have analyzed on Experimental study of cross stiffened steel plate shear wall with semi-rigid connected frame. There is merged interaction among the infill steel plate and frame edges in the steel plate shear wall construction. The bearing capacity and stiffness of SPSW structure not solitary depends on the segment proportions of frame and wall, but also relays to the stiffness of joint connection. The beam-to-column connection is easy to construct using semirigid joints which enhances the deformation and energy dissipation capacities of SPSW structure and effectively avoids the brittle failure of traditional welded joint. The cross stiffened SPSW structure with semi-rigid connected steel frame, as the combination of two one-way parts, makes full use of the advantages of semi-rigid joint and SPSW, which include the virtuous deformation and rotation capacity, modest construction, informal installation of semi-rigid joint, and durable lateral rigidity, stable hysteretic behaviors, good energy dissipation capacity of SPSW. This system not solitary meets the necessity of structural ultimate bearing capacity, but similarly takes structural ductility into consideration. It is characterized by simplified construction, superior seismic performance, and

high material utilization, which has great applications value in seismic fortification zone.

7. M. Kidd et al. (2016) have estimated on Current UK trends in the use of simple and/or semi-rigid steel connections. In this paper, Simple and/or semi-rigid steel connections are normally used to join structural members together in the construction of steel framed structures within the UK. The terms 'simple' and 'semi-rigid' refer to the connection existence planned to resist shear and axial forces individual (i.e. assumption of pin-joint behavior and no bending moments). Steel box sections (SHS's & RHS's) are not normally used as main columns on construction plans. A total of 88% of the respondents take met their use on projects 25% of the while or less. On projects wherever tubular box sections are the main columns, the favored method of joining an incoming open segment to them is a fin plate connection. If a 'blind' connection is absolutely necessary, the survey indicated that Hollo-bolts were the preferred fastener to use (as opposed to Blind Bolts).

8. Hongwei Ma et al. (2011) have studied on Experimental study on two types of new beam-to-column connections. In this paper, structure including of unceasing compound spiral hoop reinforced concrete (CCSHRC)column and steel concrete composite (SCC) beam has together the compensations of steel structures and concrete structures. Dual types of beam-to-column connections applied in this structural system are obtainable in this paper. The connection particulars are as follows: the main bars in beam concrete pass over the core zone for mutual sorts of connections. For connecting bar connection, the steel I-beam webs are related through bolts to a steel plate passing over the joint though the top and bottom flanges of the beams are associated by four straight and two X-shaped bars. For bolted end-plate connection, the steel I-beam webs are connected by stiffened stretched end-plates and eight long shank bolts transitory over the core area. In order to study the seismic behavior and failure devices of the connections, quasi-static tests were conducted on different types of full-scale joining subassemblies and core region specimens. The load-drift hysteresis loops demonstration a plateau for the connecting bar assembly though they are exceptional plump for bolted end-plate connection. The shear capacity formulas of both sorts of connections are accessible and the standards considered by the formula approve well with the test outcomes.

9. Zhiwei Lu et al. (2019) have examined on Experimental study on a precast beam-column joint with double grouted splice sleeves. The construction rapidity and quality of precast frame structures are significantly influenced by weld, tie, prestress, cast concrete requirements, etc. on site. In this paper, precast beam-column joint related by double grouted sleeves is planned. This paper presents an investigate on seismic behavior of the joint exposed to static and cyclical loadings. In these six precast specimens with dissimilar assembly lengths, transition bar diameters and different kinds of grouted sleeve and one cast-in-place control sample were confirmed. From study, Outcomes show that the double grouted sleeve splices in joints achieve well. The preliminary stiffness of prefabricated specimens is more than that of the control specimen and the load bearing capacity of the prefabricated specimens is alike to that of the control specimen. As the evolution rebar diameter rises from 16 mm to 18 mm, the energy dissipation capability of the prefabricated specimens is greater by 64.8% but is around 41% lower than that of the control specimen due to their comparatively lesser deformation capacity. Threads in the grouted sleeve take an adverse impact on the distortion and energy dissipation abilities of the joints. The method for cast-in-situ joint is satisfactory for forecasting the flexural capacity of precast joint linked by double filled sleeves.

10. Qingning Li et al. (2017) have evaluated on Experimental Research on Seismic Performance of a New-Type of R/C Beam-Column Joints with End Plates. This paper studied on various of fabricated beam-column connections through end plates. In the concrete beams joints are connected to column by end plates and six high strength extended bolts transitory through the core zone. Finally, in order to rise the stiffness and shear strength, stirrups are exchanged by the steel plate hoop in the core sector. To review the fail performance of the fabricated beam-column joining samples, a quasi-static test is showed for nine full-scale representations to find the hysteresis curves, skeleton curves, ductility, energy dissipation capacity, and further seismic indicators. The experimental outcomes demonstrate that all samples failed in bending in a flexible mode with a beam plastic hinge and the hysteresis curves are admirably plump for the end plate connections. After the seismic indexes, the fabricated connection samples show better seismic performance, which can offer situation for the application of prefabricated frame structure in the earthquake zone.

3. CONCLUSIONS

From the detailed literature review, the points inferred are as under,

- Ductility property of the welded connection is higher than bolted connection.
- Reduced beam section is much effective in welded joint when compared bolted joint since there is no deviation in results between Notched and Un notched bolted connection.
- Ductility property of the welded connection is higher than bolted connection.
- The maximum total deformation of all the sections are almost equal, hence there is no change in deformation even there is provision of reduced beam section in the flange.
- The maximum stress values are higher in bolted connection when compared to welded connection.

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