

Behaviour of encased RC column and steel beam

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Abstract - Reinforced Concrete-Steel (RCS) moment frames consisting of concrete columns and steel beams are one in every of many forms of hybrid structural systems that are thought-about as high-performing and cost-effective alternatives to ancient concrete or steel frames. A primary challenge within the style of RCS frames is that the correct description of the affiliation between the steel beam and also the concrete column components. Hence, a lot of of the analysis has centered on the planning and behavior of the composite beam-to-column joints, that are classified into through-beam-type and through-column-type classes. New details for encased RC column and steel beam connections are proposed. Different types of connections are used to connect steel beam to encased RC column. I section are used as steel beam. Columns subjected to gradually increasing lateral load and then analyse stress, deformation. These analysis used to study behavior of encased RC column. It helps to understand best connection. Presence of steel section in RC column can improve the strength of structure.

Keywords – encased RC column steel beam connection, finite element method, steel beam, steel sleeve, through column type

I. INTRODUCTION

Hybrid structures are more economical than steel structure or reinforced concrete structures. These structure makes effective use of steel, concrete and composite member. Recently RCS structure (Reinforced concrete column and steel beam) has gained popularity. RC columns have good axial strength and lateral stiffness and provide good energy dissipation capacity. Replacing RC beam by steel column can reduce weight and lower the seismic load due to reduced mass of structure. It can also improve ductility of structure. The combination of encased RC column and steel beam also improve earthquake resistant capacity of structure. Encased RC column consist steel section, longitudinal steel bars and transverse steel bars. Use of encased RC columns can improve stiffness and damping of structure. Steel beams have more energy dissipation capacity than RC beam. Such hybrid structure have capability of larger span and high construction speed. Major challenge in design of such structure has been the connection between steel beam and encased RC column. In this report study will be carried out on response of various connections of encased RC beam and steel beam by using FEM model.

Wakabayashi initiated research on SRC beam-column joint in japan Wide flange steel shapes used for column. Teraoka et al. studied seven specimens with a cross H steel shape for column to determine the effect of the diaphragm. The American society of civil engineers(ASCE) gives guidelines on the design of composite beam-column connections. Sheikh et al. carried out experimental program on behaviour of connection between steel beam and RC column. It showed that composite beam-column can improve strength, stiffness, ductility, and toughness.

Alizadeh et al. carried out experimental and numerical studies and showed capacity of RCS connections in terms of stiffness, ductility, energy dissipation capacity. Ghods et al. investigated behaviour of composite structure including concrete column-steel beam. Kuramoto studied shear strength and seismic performance of RCS connection. He evaluated the effect of cover plates thickness and presence of face bearing plate on the seismic performance of structure.

II. LITREATURE SURVEY

J.M. Castro, A.Y. Elghazouli and B.A. Izzuddin (2008) many sensitivity and constant investigations are undertaken victimization a complicated analysis program that accounts for material and geometric nonlinearities. This paper assesses the inelastic Seismal performance of composite steel/concrete moment resisting frames. The constant investigation shows that many parameters and assumptions will have direct implications on the dead behaviour of composite frames, as assessed through the general lateral response, inter-storey drift distribution and plastic hinge patterns. And conjointly variety of geometric parameters, related to the structural configuration, together with beam span and structural height, have a major influence on the behavior.

Keh-Chyuan TSAI, Yuan-Tao WENG, Sheng-Lin Lin, and Subhash GOEL (2004) this paper describing a complete 3-story 3-bay CFT buckling restrained braced frame (CFT/BRB) specimen that was made and tested within the structural laboratory. Pre-test nonlinear dynamic analyses counsel that the height story drift is probably going to achieve zero.025 rad once applying the 2/50 styles earthquake on the frame specimen. CFTCOLUMNS hinging at the bottom are expected, however shouldn't fail because the motion demand is moderate. Tests confirmed that the PISA3D and Opensees analyses foreseen the experimental peak shears extraordinarily well. Tests conjointly confirmed that experimental peak inter-story drifts of zero.019 and 0.023 radians well trust the target style limits of zero.02 and 0.025 radians prescribed for the 10/50 and 2/50 events, severally

S. Grambicka, S. Matiasco (2009) during this work the theoretical analysis was created with relevance the current applicable European standards, that were compared with the experimental results of the columns tested and a non-linear analysis victimisation Atena code. The values of the non-linear analysis of the composite columns with the utilization of the important measured material properties indicate a really sensible match with the tested columns, the experimental results are often used for any analysis of composite steel-concrete columns.

Eiichi Inai, Akiyoshi Mukai, Makoto Kai, Hiroyoshi Tokinoya, Toshiyuki Fukumoto, and KojiMori (2004) during this paper the behaviour of concrete-filled circular and sq. steel tubular (CFT) beam columns with a range of fabric strengths was investigated by experimentation. the inside beam-column models were tested underneath constant axial compression and cyclic horizontal load with incrementally increasing lateral deformation to clarify the results of the take a look at parameters on the behaviour. The take a look at results show that higher strength and thicker steel tubes offer higher overall behaviour of the beam column, whereas higher strength concrete has AN adverse impact on the behaviour.

A. Zona, M. Barbato & J. P. Conte The work provides the deeper insight into the nonlinear seismic response behaviour of SCC frame structures and the way it's influenced by numerous modelling assumptions. The results show that the dead partial composite action within the SCC frame structures.

Sheriff El-Tawil, 1 Member, ASCE, and Gregory G. Deierlein,2 Fellow This paper presents the formulation for a plasticity-based distributed beam-column component that may be used for the seismic analysis of three-dimensional mixed frame structures comprised of steel, concrete, and composite members. From the on top of literature review it's seen that; within the western countries like USA, Japan, and European nation etc. a lot of analysis work is dole out within the field of composite construction. A number of analysis work conducted on the experimental style & analysis of composite component like incised section or in stuffed section considering linear and nonlinear behaviour of structure. Conjointly metal formulation of steel-concrete composite element is conducting in relevant field. However code based mostly analysis of steel-concrete frame was terribly seldom examined. Thence there's scope in analysing the steel-concrete composite frame using soft wares. Therefore as a part of dissertation, dead analysis (pushover analysis) for various styles of steel-concrete frame is conducting using software application.

Michel Bruneau and David Walker;This paper reports on the following: (1) straightforward experimental investigations of pultruded fiber-reinforced plastic (PFRP) material behaviour and tests of straightforward epoxies joints to verify and enhance the according database; (2) cyclic tests of an tried PFRP rigid beam-column connections; and (3) preliminary observations relating to the seismic-resistance goodness of PFRP structures.

These are straightforward style problems that has to be addressed if PFRP structural shapes square measure to achieve broad acceptance by the look community. It's found that epoxies connections alone cannot absolutely exploit the high-strength potential of this material, which delaminating of parts is additional problematic than the inherent bearableness of the fabric. The cyclic flexural take a look at of associate degree tried rigid beam-column association has disclosed the actual delaminating weakness of the flange-to-web core of PFRP structural shapes. The development of rigid beam-column connections using unremarkably used steel details is found to be ineffective. To the current day, the employment of pultruded fiber-reinforced plastic (PFRP) in structural engineering has been rather restricted compared to the employment of steel and concrete, and it's still largely confined to specialty applications wherever resistance to extremely corrosive environments, magnetic attraction transparency, or a low weight-to-strength quantitative relation is needed. However, this trade is growing terribly apace, and also the want for conventional style tips is already being felt. Yet, several technical/practical detail-oriented queries stay unanswered. This effectively delays the broad acceptance of PFRP structural shapes by the look community.

Gustavo Parra-Montesinos and James K. Wight;A model to predict the shear strength versus shear distortion response of hybrid connections between concrete columns and steel (RCS) beams is conferred. Based on a pre-established most getable joint shear deformation, style equations were developed for use in each interior and exterior RCS connections in buildings situated in high unstable risk zones. The planned model is based on the definition of the state of plane strain within the joint through the event of a quantitative relation between the principal tensile and compression strains. The strength of the joints is given by contributions from the steel internet panel and concrete diagonal struts. The joint model is capable of predicting the shear force, and stirrup and concrete strains at any level of joint shear distortion for exterior joints. Additionally, the employment of the planned style equations light-emitting diode to excellent agreement between expected and measured shear strength for each interior and exterior RCS joints.

Sing-Ping Chiew, Seng-Tjhen Lie and Chao-Wei Dai; This paper centered on work the instant resistance of steel I-beam to concrete-filled tube (CFT) column uniplanar connections below monotonic static loading. The composite association are often stiffened or unstiffened. A formula was derived supported >100 numerical parametric analysis results. The key parameters were studied numerically by finite-element methodology and also the relevant ones that have an effect on moment resistance were captured within the planned formula. To verify the formula and understand clearly the static behaviour of the composite connections, eight specimens were designed and tested to failure, of that four specimens were semirigid beam-to-column connections et al were rigid connections with totally different types of stiffening details. The comparison between the predictions and take a look at results showed that the formula could be accustomed predict the instant resistance. The planned rebar filler was found to be terribly effective in improving the static behaviour of the composite connections. In this paper, moment resistance was outlined because the moment at the state wherever the structure shows yielding. In the moment rotation curves, moment resistance was outlined because the worth at the

purpose wherever the tangential modulus of the curve varies clearly. Final moment resistance was outlined because the most moment within the moment-rotation.

III. SCOPE OF RESERCH

Previous studies were carried out on different connections of steel beam and RC column. In this research paper study carried out on response of various connections of encased RC beam and steel beam by using FEM model.

IV. METHODOLOGY

To study connections behaviour ANSYS software is used. All connections made in software and analysed.

A) Material properties

For concrete member, compressive strength is selected to be 30 MPa. Modulus of elasticity and poisson's ratio are 200 GPa and 0.3 for steel and 25 GPa and 0.2 for concrete, respectively.

B) Boundary conditions and loading

To simulate the actual behavior, hinged lower end and free upper end is considered for the system. far ends of the beam are hinged. Gradually increasing lateral load applied on free end of column.

IV. PROPOSED WORK

A) Description of encased RC column and steel beam

Dimension of encased RC column sections were 480mm*480 mm. Four longitudinal steel bars of 12 mm dia. and stirrups of 6 mm dia. with a spacing of 190 mm were used for all encased RC column. Steel section used was ISHB 350. Length of column was 2930 mm. Length of beam was 4050 mm. For all specimen, encased RC column was hinged at lower end and free at top end. Far end of beam was hinged. In connection 1 (C1), steel beam connected on either side of steel section embedded in RC column by welding. In Connection 2 (C2), Steel beam wholly passed through I shaped slot cut and welded to steel section embedded in RC column. In Connection 3 (C3), external Steel plate is used to transfer loads from steel beam to concrete column. The external plate connected to RC column by using bolts. Steel beam connected to external plate by welding. Thickness of steel plates was 10 mm. Height of steel plates was 450.

B) Modelling in ANSYS

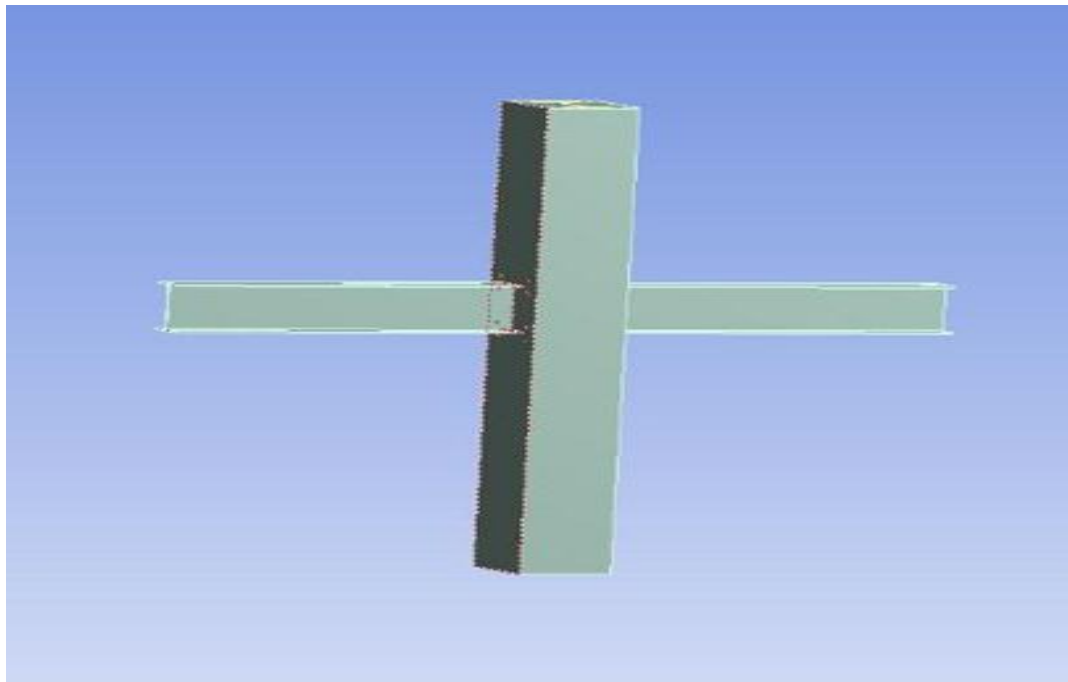


Figure 1. model of encased RC column-steel beam(I section) by welding(C1)

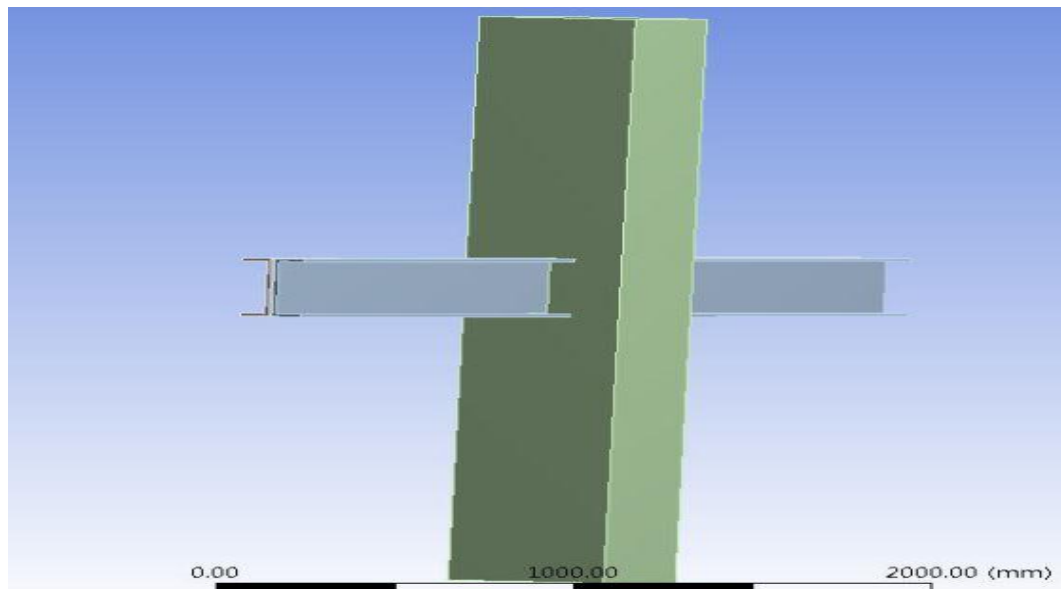


Figure 2. model of encased RC column-steel beam(I section) by passing through(C2)

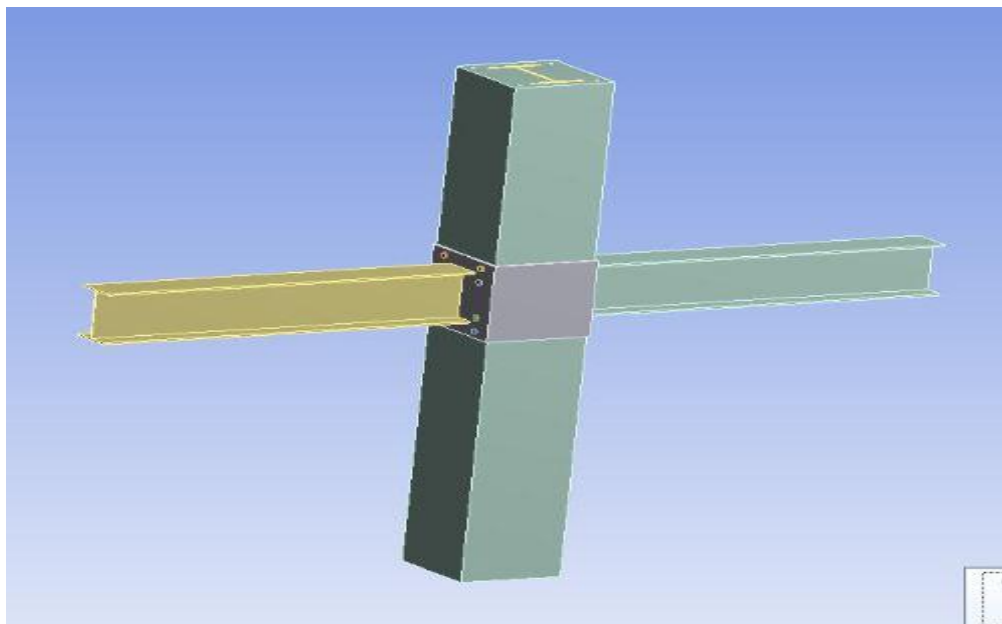


Figure 3. model of encased RC column-steel beam(I section) by external cover plate (C3)

V. RESULT

All connections subjected to gradually increasing lateral load (50,100,150,200,250 kN). Deformation and stresses found under various loads. following figures showed deformation in C1,C2 and C3 connections at 250 kN. Maximum deformation occurs in connection (C3) using by external cover plate.

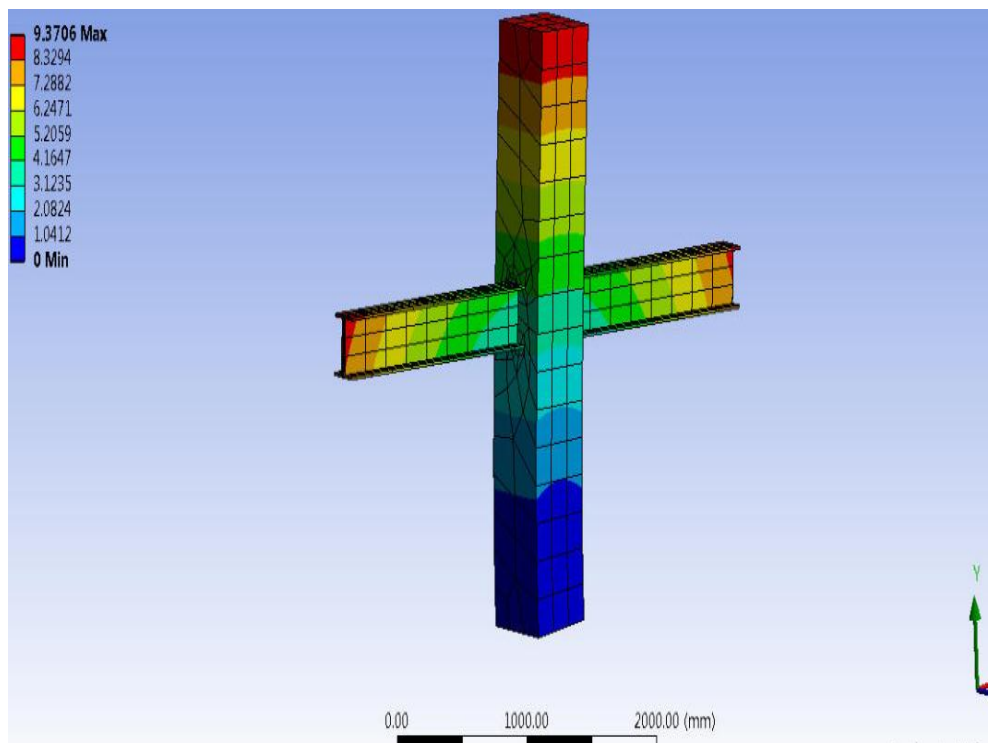


Figure 4. deformation in encased RC column-steel beam(I section) by welding (C1)

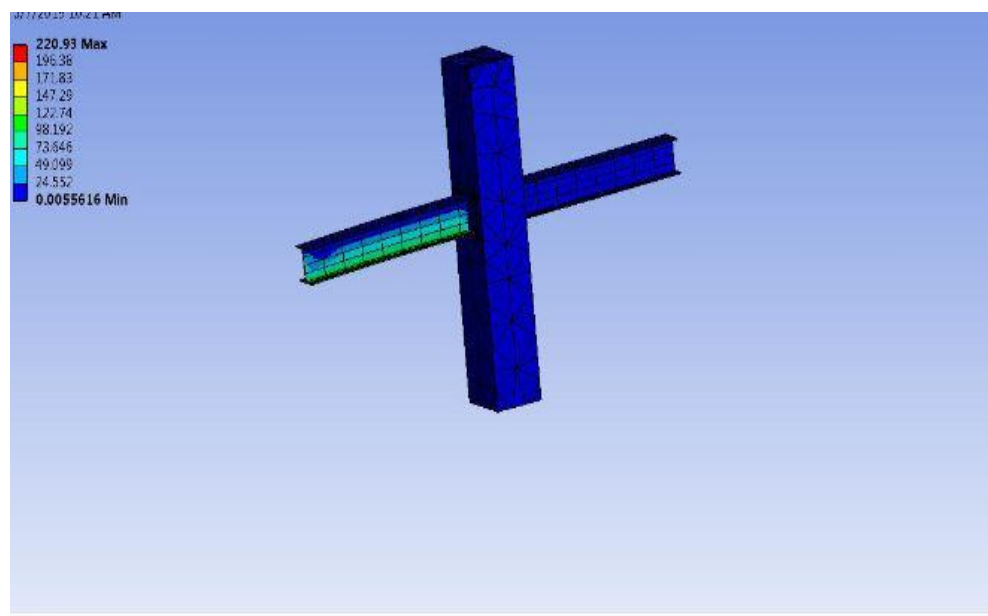


Figure 5. Stresses in encased RC column-steel beam(I section) by welding (C1)

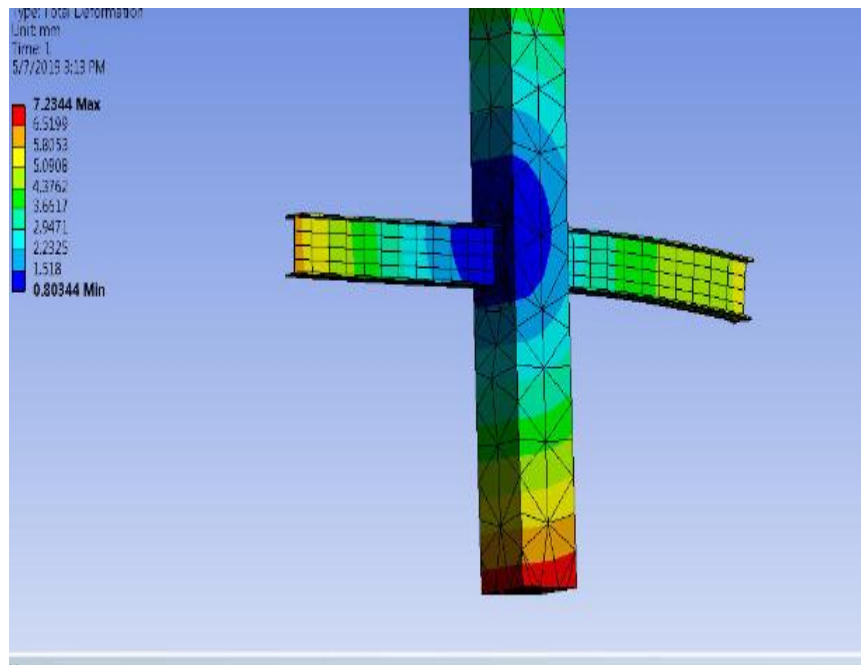


Figure 6. Deformation in encased RC column-steel beam(I section) by passing through (C2)

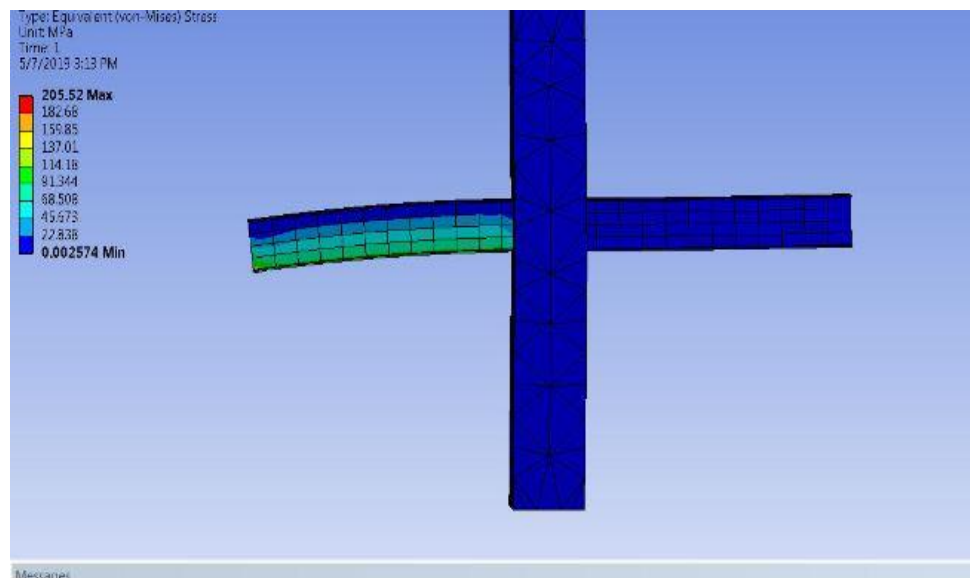


Figure 7. Stresses in encased RC column-steel beam(I section) by passing through (C2)

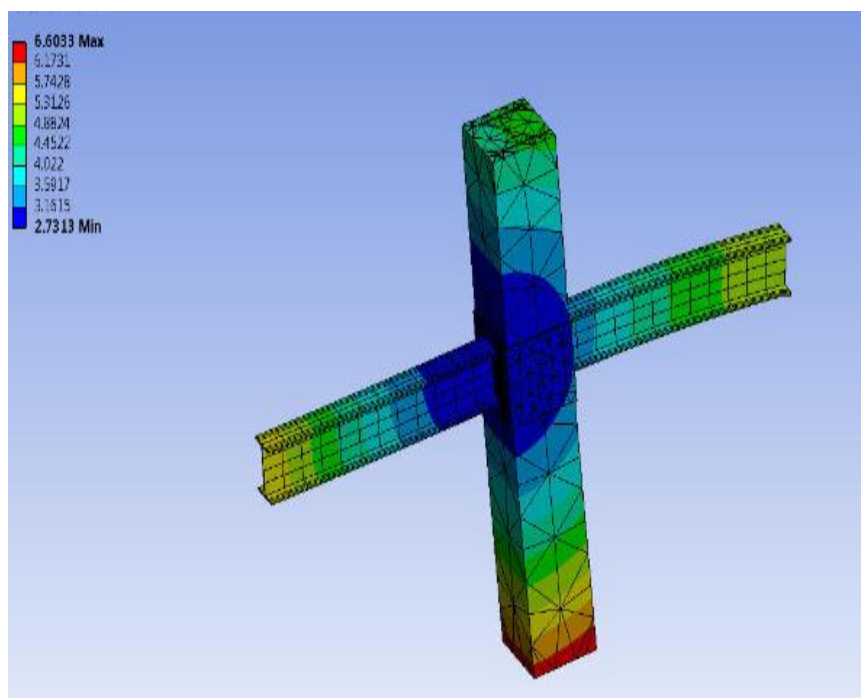


Figure 8. Deformation in encased RC column-steel beam(I section) by external cover plate (C3)

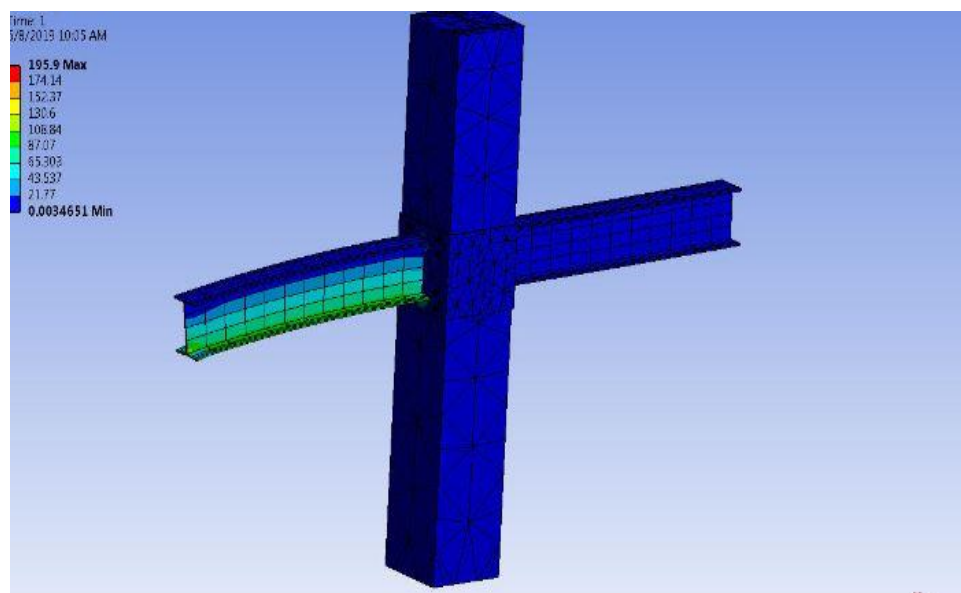


Figure 9. Stresses in encased RC column-steel beam(I section) by external cover plate (C3)

VI. CONCLUSION

In this investigation, the basic structural and behavioural of through-column-type beam-to-column of different thicknesses and hardened with one and 2 transverse stiffeners were researched absolutely on the premise of test perceptions and finding. Additionally, the power removal practices of the investigate examples were reenacted through numerical displaying, and subsequently the numerical outcomes were went to survey the after effects of the lareral load on the load capability of the joint. Deformation in connection of encased RC column-steel beam by using external cover plate is less than welding and passing through connection.

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