Analysis and Design of Modified Shear Connection

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ABSTRACT:This research paper is about stiffened end plate connection which is used in steel structure as connection. This connection is actually provided instead of shear connection as shear connection was not able to be provided due to congested beam network and insufficient space for adjusting beam also it would take much time for fabrication and erection work. Hence, it is an analysis which is performed to determine and check whether this connection can be used as shear connection and whether can it be used to resist both shear force and bending moment.

KEYWORDS: Connection, Endplates, Bolts, Weld Shear Force, Bending Moment,

I. INTRODUCTION

1.Steel structural elements are base plates, columns, beams, stiffeners, connections, purlins, bracings, compression member, welding's, bolting's etc. All this element combines together to form a steel structure. Each element has its own role in steel structural design, if we study some of them in brief and start from base plate which is provided at bottom of column for taking compressive load of column and submit it to the pedestal, similarly all the elements play their role as column for compression(axial), beams designed for vertical loads of viz. live loads machine loads and dead load of itself, bracing are used to reduce sway action and acts as tension and compression members, purlins are used for supporting sheeting elements on the roof truss or roofs. All this element is connected to each other by some sorts of connections which are used in steel structures and those connections are connected by bolting or riveting actions. The type of connections designed for column to beam are known as moment connections and beam to beam as shear connection. Moment connections are connections which take moments arise in fixed frame design. Fixed frame are those frames which takes load of all the structural elements and transfer those loads to soil. These frames are quite strong and flange connection of column to beam are called as fixed frame connections or moment connection. Another type of connections which are found to be used in steel structures are called as shear connections. This connection is used in to resist shearing action which takes place on beam due to shearing action due to lateral load acting on beam in downward directions. This connection is called as beam to beam connections and also this connection is connected to the web of beam, this connection is not used to take larger loads they just carry loads of certain beam to the fixed frame.

2.Connections provided are either moment connections or shear connections both this connection are connected by either bolts or it may be connected by welds depending upon their usage and design. Beam-to-column connections are neither ideally pinned nor ideally fixed and possess finite non-zero stiffness. However, they are classified as simple (pinned), semi-rigid and rigid (fixed) depending on the connection stiffness. Such a classification helps in simplifying the analysis of frames. A connection having a small stiffness can be assumed as pinned while a connection having a large stiffness can be assumed as fixed. In the former case, the actual mid-span bending moments will be less than what is designed for while in the latter case the mid-span deflection will be more than what is calculated. Traditionally, certain configurations are idealized as pinned and certain other configurations are idealized as fixed but with a variety of new configurations being used it is important to have guideline indicating the range of stiffness for which the idealization can be used without serious discrepancy between analysis and

actual behaviour. This is done by means of connection classification.

   3.Sometimes some connections are modified and this connection are used in structural design aspects. The modification of connection is done in order to enhance the performance of specific joint.In this paper, I have modified connectionwhich is studied and on basis of software and also manual calculations are also carried out in order to study the feasibility of this connection, for connection design we have referred software of ANYSIS,IDEA STATICA,and manual calculations are carried out on basis of I.S.800 for checking designing yield strength, limit state of plastic strain, factored tensile force ,shear force designing bearing capacity of bolts ,utilization checks of shear ,shear and tension in combinations ,design tensile capacity of bolts, fillet weld throat thickness, design shear capacity of bolts, weld length, equivalent stress in weld and design strength of fillet weld. Frictional coefficient in concrete, in slip resistance, GMNA (geometrical non linearity) check is also calculated.

4. As shown in figure below will get an idea of why we modified connections,

SIDE VIEW

TOP VIEW
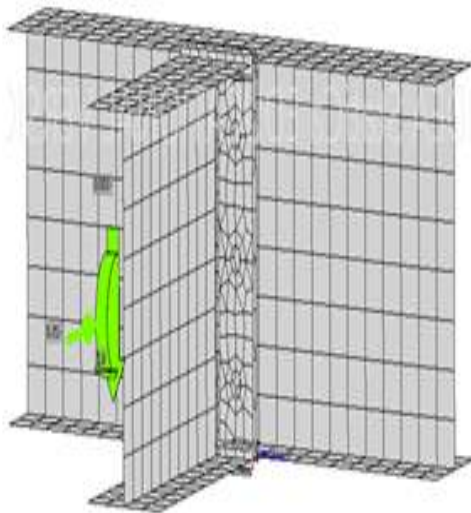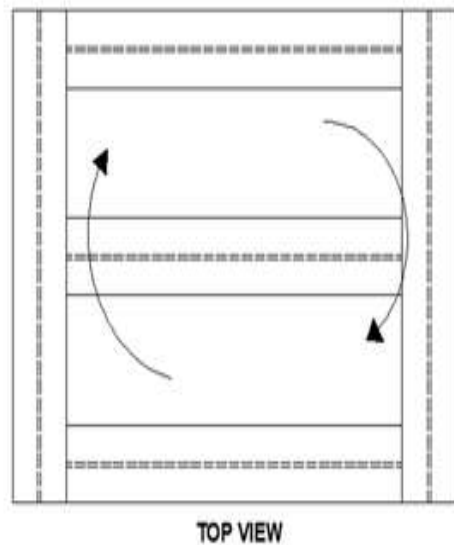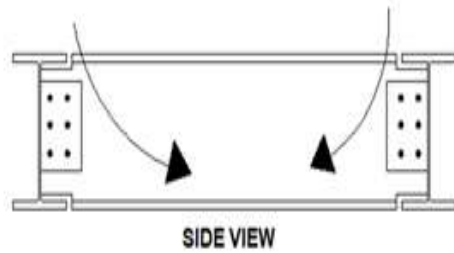
Reasons for modification of connection-
 It was found that mesh of beams was so close that it did not allow sufficient space to get adjusted for shear connection. Also, for formation of such connection it takes much time hence project may get delayed.so in order to increase workability and get simple connection it was modified to simplertype of connection as shown in figure below.
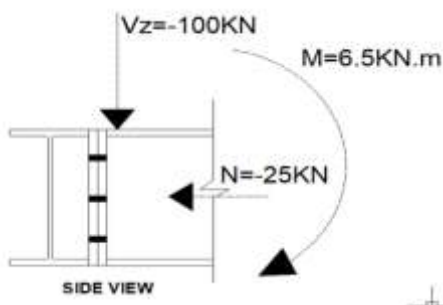
SIDE VIEW

TOP VIEW
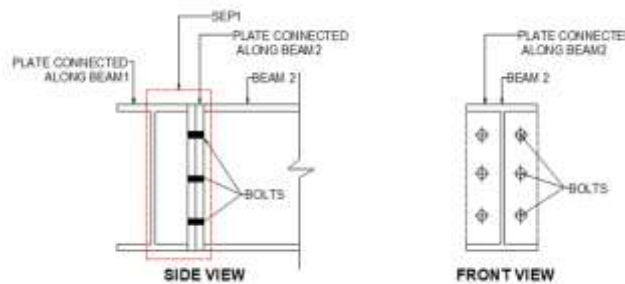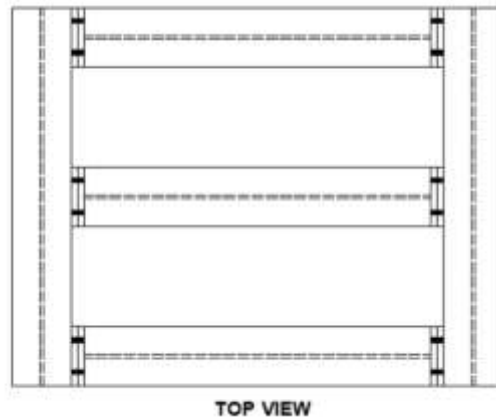
II. METHODOLOGY AND OBSERVATIONS

1.DESIGN DATA-
Grade of steel-E250
Sectional Details-ISMB250
Loading data according to IS800-2007 Cl.3.2,3.3

Calculated sizes of plates, bolts, weldsand designed and analysed using manual and software basis using IS800-2007 and software Idea Statica for connection design.

2.Design steps IS800-2007(For manual calculation)
1.Calculation of shearing resistant check of bolt (IS800 Cl.10.3.3)

$$V_{dsb} = \frac{V_{sb}}{\gamma_{mb}}$$

2.Calculation of tension resistant check of bolt (IS800 Cl.10.3.3)

$$T_{db} = \frac{T_{nb}}{\gamma_{mb}}$$

3.Calculation of bearing resistant check of bolt (IS800 Cl.10.3.3)

$$V_{dpb} = \frac{V_{npb}}{\gamma_{mb}}$$

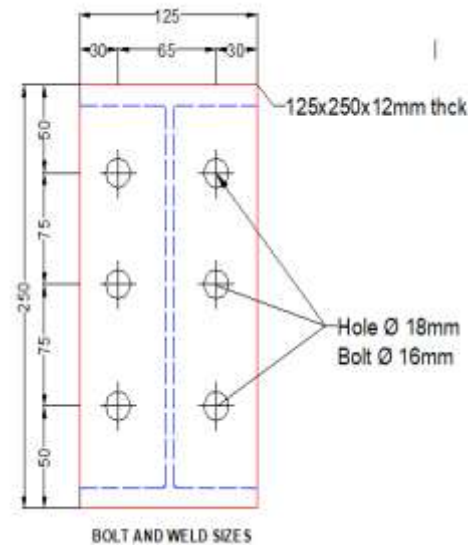4.Calculation of interaction between shear and tension (IS800 Cl.10.3.3)

$$\left(\frac{V_{sb}}{V_{dsb}}\right)^2 + \left(\frac{T_b}{T_{db}}\right)^2$$

5.Check for determining strength of weld (IS 800 Cl.10.5.10.1.1)

$$f_e = \sqrt{f_a^2 + 3 \cdot q^2}$$

$$f_{wd} = \frac{f_u}{\sqrt{3} \cdot \gamma_{mw}}$$

6.Calculation of end plate thickness and checks
7.calculation of equivalent strength, plastic strength, deformation using IS 800-2007 (Cl 5.4.1,5.5.1,5.6.1)

## III.   3.RESULTS& OBSERVATIONS –
1.SFD at connection,

2.Calculated strength of bolts and their values in shearing bearing and tension and also their combined effect was calculated and ultimate strength of bolt was calculated which is found to be around 55%< 100% has the utilization is around 55% and hence found ok. Also bolt diameter is found to be M16 -4.8, with grip length of 24mm and total count is 6 numbers. Maximum bolt force occurring was 2.7


3.Calculated weld strength and size of weld using manual calculation and software calculation also it is found that the weld thickness is of abut 4mm thick double fillet weld. Throat thickness was found to be 4mm and leg size was 5. 7mm.total length of weld is about 1305mm all over the connection.


BOLT AND WELD SIZES
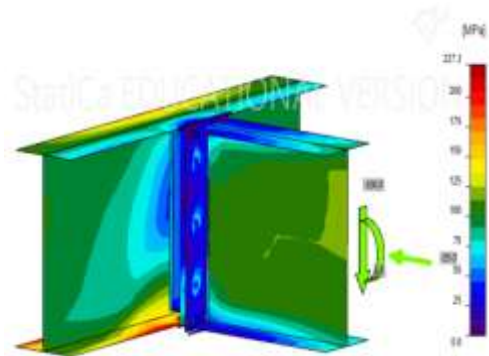
4.It is the resultantstress, equivalent stress diagram i.e., Normal stress, shear stress and deformation.
5.Calculated plastic stresses which is around 0.100% which is called as permanent deformation which is occurring due to tensile, compressive stress and by buckling, twisting or bending hence deformation is very less which proves to be safe in design.
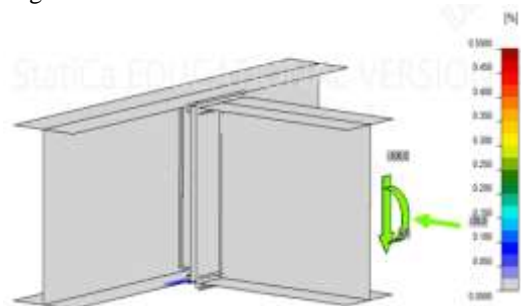

6.Deformation was calculated using both taking bending moment under consideration and ignoring bending moment, as we can see that the type of connection required is of shear connection and hence the value of bending moment will be quit

less so we just had a view of how shall be the shear connection deformation be using bending moment and without bending moment.
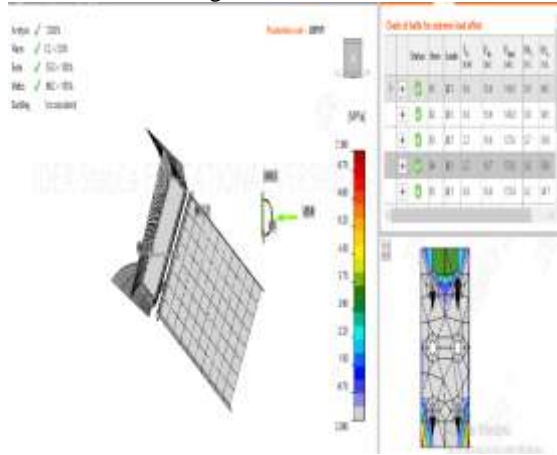
this diagram shows the deformation of connection when moment is considered, and the diagram shown below in which moment is not taken in account.
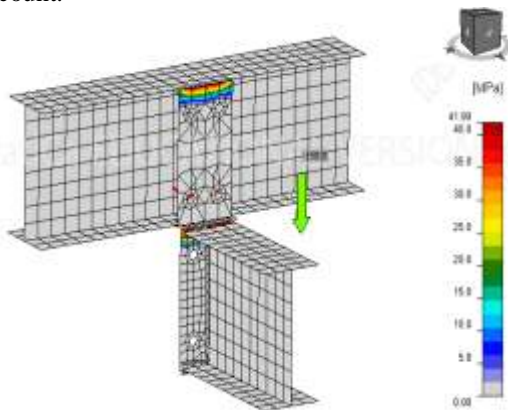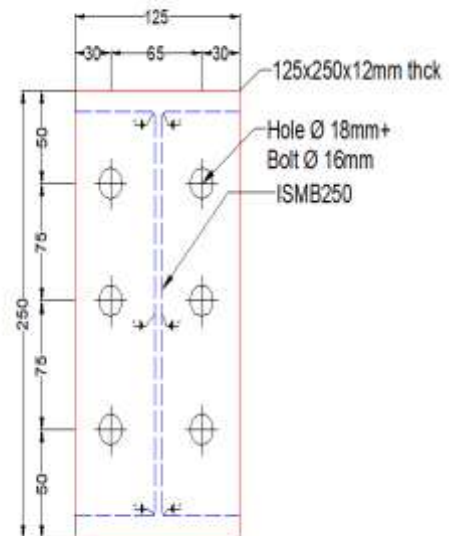

IV. RESULTS AND CONCLUSION-
PLATE SIZE -125X250X12mm
SIZE OF STIFFNER-59X225X12mm
BLOT SIZE-16mm dia-6nos-24mm length
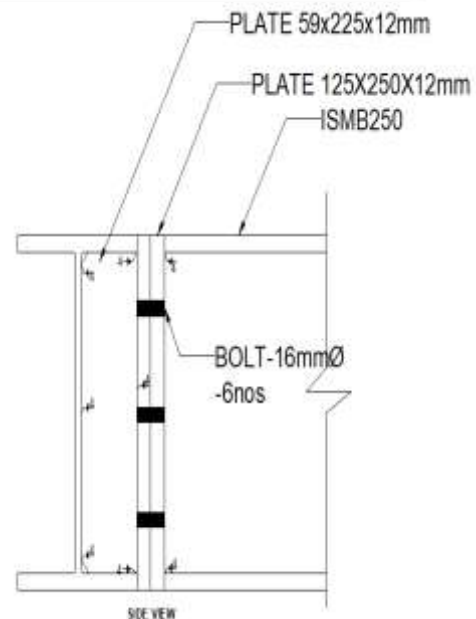WELD SIZE-4mm double fillet weld 1305mm length

CHECKS AND ANALYSIS-
ANALYSIS OF CONNECTION-100% …OK
PLATES UTILIZATION -0.2%<5% …   OK
BOLT UTILIZATION-55%<100%........OK
WELD CONNECTION-98.2%<100%.... OK

DETAILED VIEW

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