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INNOVATIVE STUDY OF REDUCED WEB SECTION IN BOLT EXTENDED ENDPLATE MOMENT CONNECTION

[1]Sreedevi Bhasin, [2]Sandra raphy, [3]Sajan jose

[1,2]PG Students, Department of Civil Engineering, Universal Engineering College, Irinjalakuda, Thrissur, Kerala, India, [3]Assistant Professor, Department of Civil Engineering, Universal Engineering College, Irinjalakuda, Thrissur, Kerala, India.

Abstract: This study has been undertaken to investigate the moment carrying capacity of reduced web section (RWS) in steel beam column joint with extended endplate moment connection. A reduced web section (RWS) with 5 numbers of vertical as well horizontal slits is analyzed using ANSYS 16.0. Extensive research has been carried out on steel moment frames to improve the cyclic performance of moment connections with reduced beam section (RBS). The RBS connections are conventionally known by the radial reduction as well as hole cutting of the beam flange, some researchers have proposed reduced web section (RWS) connections. The present study dedicates to the RWS connections with vertical-slits (VS), horizontal slits (HS) as a cost-effective alternative with multiple design parameters. This paper aims to obtain proper ranges for the geometric design parameters of the VS-RWS and HS-RWS connection. In this order, two full-scale specimens of the bolted extended end-plate VS-RWS, HS-RWS connection were tested under the cyclic loading to evaluate the performance of connections, and then a parametric study was carried out using the verified numerical models.

Index Terms **– Reduced beam section, Reduced web section, connection, slits, moment.**

1. INTRODUCTION

The moment resisting frame system had been widely used in the construction industry in seismic zones such as in earthquake prone areas. Due to the Northridge earthquakes in 1994, many traditional moment connections performed poorly in terms of providing the expected ductility, and the connections were subject to a brittle fracture. One of the ways to improve the performance of these connections is to reduce the beam section, based on the principle of the strong column-weak beam by reducing the beam flange or web to form aplastic hinge relocation in the reduced region. This region, which acts as a stress distribution area, creates some proper ductility to prevent the brittle damage to the connection. Since the web of the beam makes a small contribution to its flexural rigidity, the weakening of the beam web instead of the flange can be a good option for reducing the beam cross section as long as it provides adequate shear capacity and distribute stress. In some types of reduced web section (RWS) connections, the beam web is weakened by creating a rectangular, circular, or vertical elliptical opening. In these connections, a relatively large void is required to reduce the stresses over the beam-to-column joint, yet the large void causes the local buckling at the cutting edges of the beam web. In order to overcome this local buckling, some researchers have proposed and investigated RWS with vertical and horizontal slits connections in which the flat web is replaced by numbers of slits. In any case, although this type of connection behaves well in terms of plastic hinge formation in the reduced region, its construction is relatively difficult, costly, and time-consuming. Some researchers turned toward the RWS connections with a multi-hole web instead of a single large-opening web.. In a recent study, have introduced a new type of the RWS connections with vertical-slits (VS) and horizontal slits as an easy-to-build alternative that has multiple geometrical parameters for the control of the connection behavior. Their comparative study of the bolted end-plate VS-RWS and HS-RWS connection with the conventional RBS and with various cut-shaped RWS connections exhibits good ductility and flexural strength, as well as low-localized stresses in the end-plate welding line of the proposed connection. This paper is structured as following parts. That is devoted to the development of a finite element model (FEM) for the VS-RWS and HS-RWS connection to simulate the cyclic response of various RBS connections with different geometrical parameters of the reduced region. Based on the results, the optimum ranges for the RWS region parameters are recommended.

2. OBJECTIVE OF PROJECT

- Comparison of RBS with RWS
- To make comparison between all type of RBS connection with RWS on ductility
- To make comparison of RBS with RWS on stiffness

3. REDUCED WEB SECTION and REDUCED BEAM SECTION

Reduced web section are introduced in the form of slits. Types of reduced web sections are:

- Reduced web section with vertical slits
- Reduced web section with horizontal slits

Types of reduced web section is radial circular cut with same radius holes

From the whole modelling with compare to reduced beam section and reduced web section, the reduced web section with horizontal slits shows better moment carrying compared to others

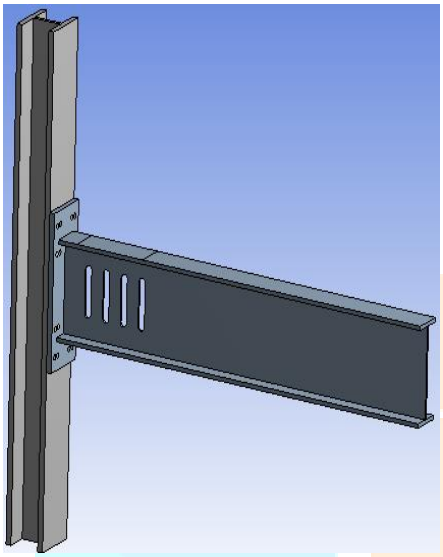

Fig 1: HS-RWS

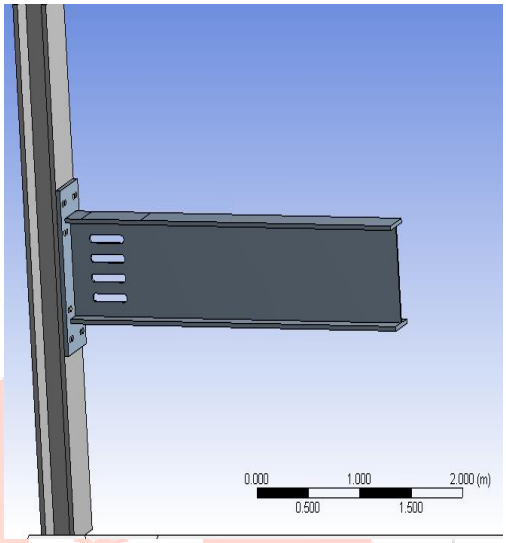

Fig 2: VS-RWS

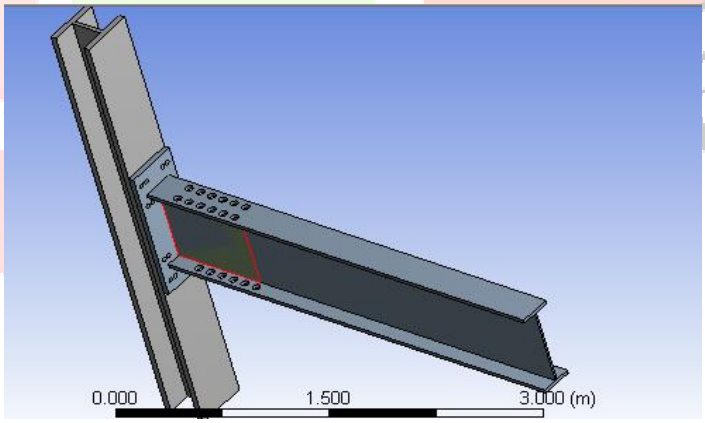

Fig 3: RBS-SH

4. MODELING AND ANALYSIS

4.1. Details of Models

a = 0.5-75% of flange width
b = 0.65-0.85% of depth of beam
c′ = 0.1-0.25 % of flange width
g/4 = % of b

a=200	b= 562	2c′ = 312	g/4=56

The reduced web section with slits is studied. Fig.4 of beam web with 5 slits with equal dimensions. Thehysteresis behavior of RWS with vertical and horizontal slits is shown in fig 6,7. Equivalent stress of RWS as shown in Fig.8,9. The RWS section with vertical as well as horizontal slits shows equal moment carrying capacity than compare with RBS. The reduced beam section with circular cutting is shown in fig 5. 60mm diameter of circular cutting in provided at beam flange contains 6 numbers of holes with 2 rows. The equivalent stress distribution is shown in fig 9.

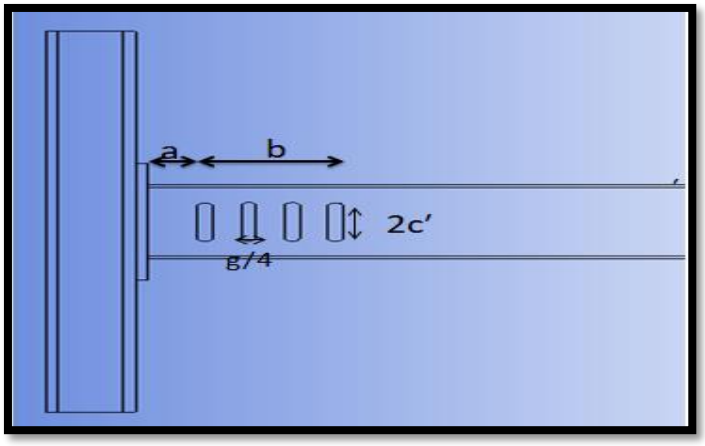

Fig 4: Details of Reduced web section

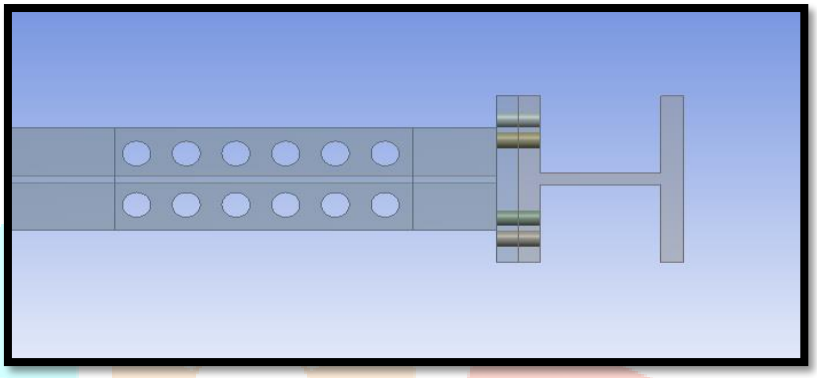

Fig 5: Details of Reduced beam section with same holes

5. Material properties

Table1: Material properties

Properties	Steel	Bolt
Young's modulus (KPa)	2×10^{11}	2×10^{11}
Yield strength (MPa)	599	490
Poisson's ratio	0.3	0.3

6. DETAILS OF COMPARISON STUDY

From the analysis, bolt extended ended plate with reduced web section and reduced beam section in which reduced web section with horizontal slits perform better than reduced beam section under cyclic loading.

6.1. Analytical models with RWS and RBS

In this study 2 models of reduced web section with slits and 1 model of reduced beam section with circular cutting is provided. They were provided in a beam column joint with column section of W360×382 and beam section of W760×220 is provided.

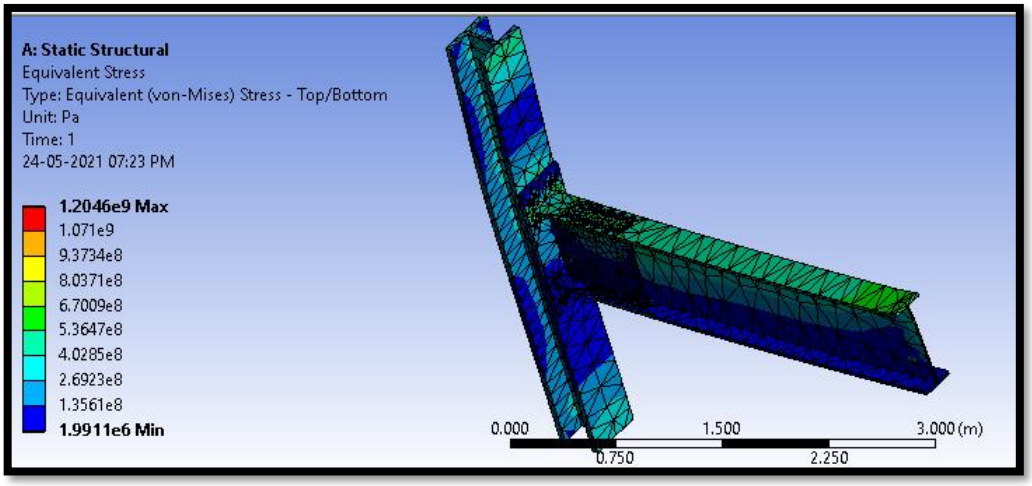

Fig 6: Stress distribution of RBS-SH

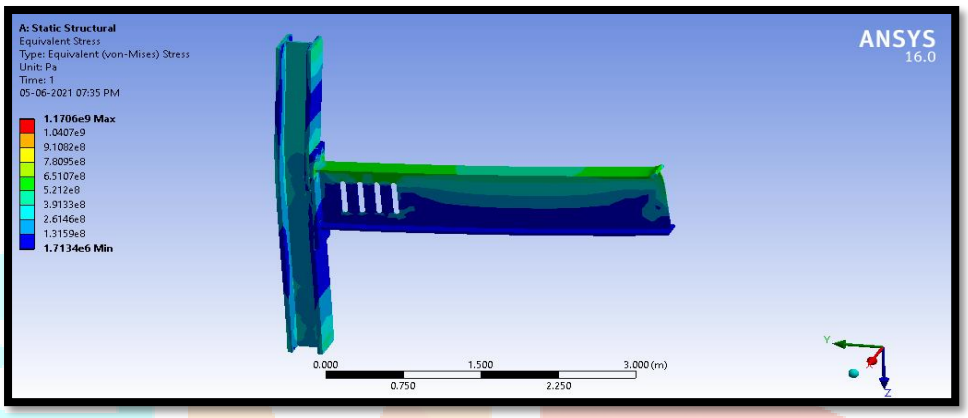

Fig 7: Equivalent stress distribution of beam web with vertical slits

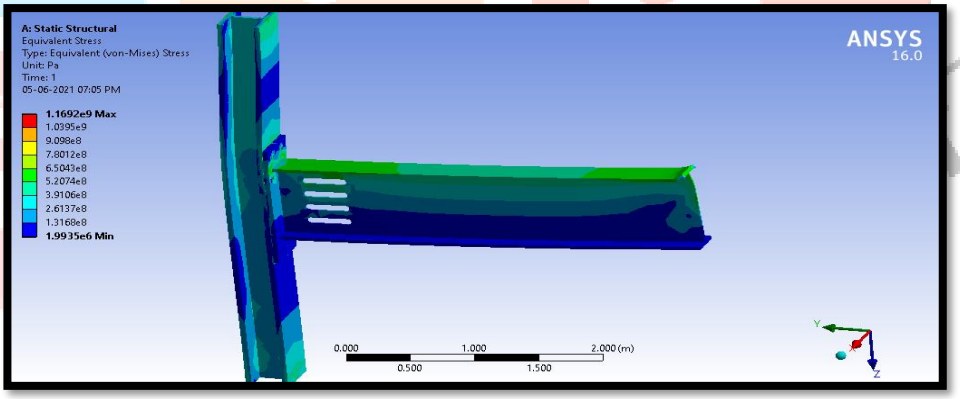

Fig 8: Equivalent stress distribution of beam web with horizontal slits

6.2. RESULT AND DISCUSSION

The maximum moment and their corresponding rotation was noted. The result obtained from analysis using ANSYS 16.0 is shown below. The reduced web section with slits is studied. Fig.,7,8 shows stress distribution of beam web with 5 slits with equal dimensions. The reduced section with circular hole is shown in fig 6. The hysteresis behavior of RWS with vertical and horizontal slits is shown in fig 9,10,11. The RWS section with vertical as well as horizontal slits shows equal moment carrying capacity than compare with RBS.

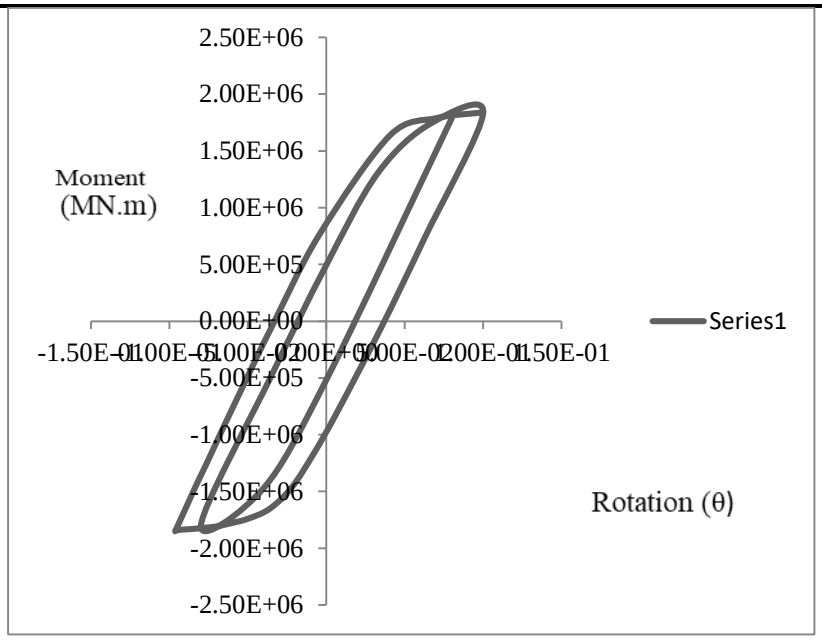

Fig 9: Moment Rotation graph of beam flange with RBS having same holes

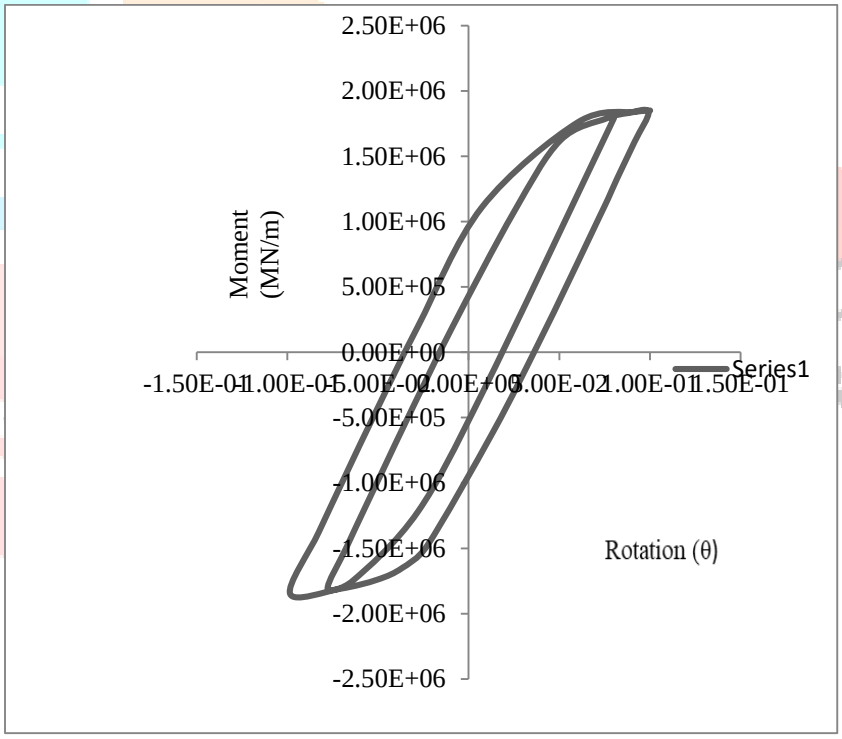

Fig 10: Moment Rotation graph of beam flange with RWS having Vertical slits

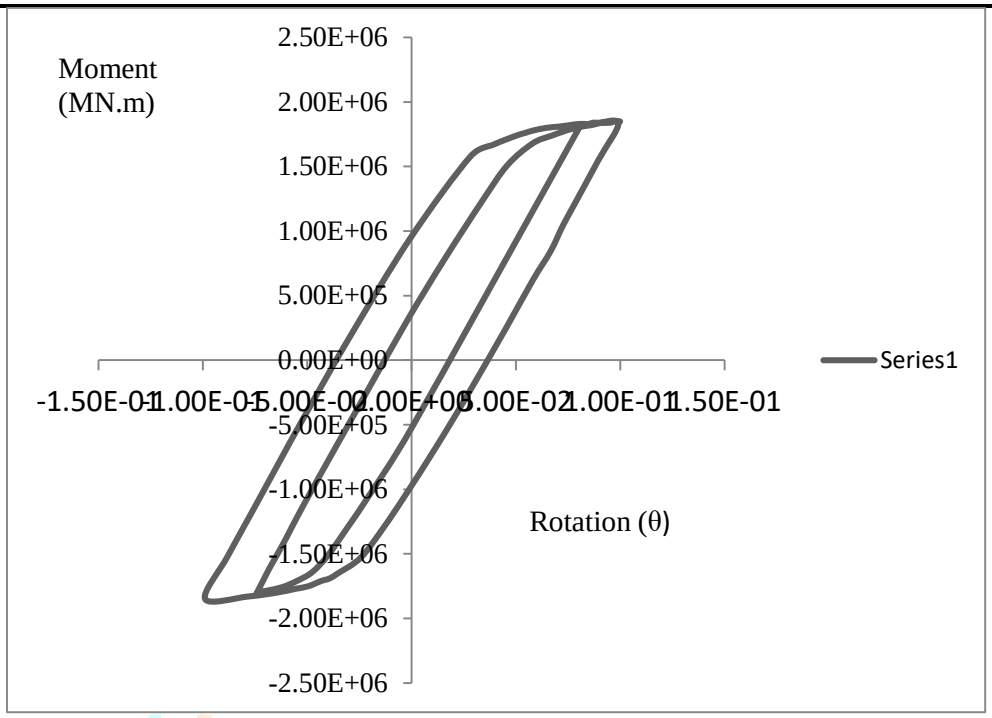

Fig 11: Moment Rotation graph of beam flange with RWS having Horizontal slits

Table 2: Analytical results of models

Models	Moment	Rotation	Stiffness	Ductility
RBS-SH	1.84	0.07	2051	3.4
VS-RWS	1.85	0.09	2055	3.9
HS-RWS	1.86	0.09	2066	3.7

7. CONCLUSIONS

From analysis of moment connection with extended endplate of beam-column joint with reduced web section and reduced beam section. The reduced web section with horizontal slits can carry moment more than any other models as shown in the table. The stiffness is better for model HS-RWS. Comparison with the RBS and RWS, two connections were able to move the plastic hinge region away from the column face, exhibit good hysteresis behavior. The results also showed that the moment carrying capacity of the RWS connection is 10% higher than that of RBS. Both RWS and RBS connections exhibited good ductility and stiffness. And the ductility is higher for reduced web section with vertical slits as shown in table 2.

REFERENCES

[1] AISC358-16/ANSI Prequalified connections for special and intermediate steel moment frames for seismic applications, including supplement No.1

[2] Hamidreza Nazaralizadeh a , Hamid Ronagh, Parham Memarzadeh , Farhad Behnamfar (2020) "Cyclic performance of bolted end-plate RWS connection with vertical-slits" *Journal of Constructional Steel Research*© 2020 Elsevier Ltd

[3] Antonella B. Francavilla, Massimo LatourVincenzo Piluso, Gianvittorio Rizzano (2018) "Design of Full Strength Full-Ductility Extended End-plate beam-to-column joints"*Journal of Constructional Steel Research* © 2017 Elsevier Ltd

[4] Xiaofeng Zhang and James M. Ricles (2006) "Experimental Evaluation of Reduced Beam Section Connections to Deep Columns" *Journal of Structural Engineering*