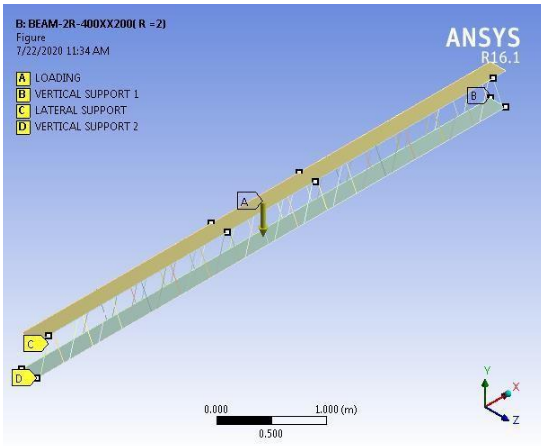

Fig-4 Load deflection curve

5.1 Depth ratio

Results obtained from the analysis for effective depth as shown in Table 2. Deformations, Maximum load and Percentage increase in load as shown in Table 2. Better performance shown by the beam having size 500X200 mm. Maximum load about 96.06 kN and deflection obtained as 80.58 mm. So the structure having sufficient ductility. Deformation of the same as shown in Fig-5. Load deflection chart for the beams as shown in Fig-6

Table -2: FEA results for effective depth

Models	R value	Deflection (mm)	Load (kN)	% increase in load
Beam-2R-300X200	1.5	51.75	39.07	1
Beam-2R-400X200	2	61.87	63.11	61.52
Beam-2R-500X200	2.5	80.58	96.06	145.87
Beam-2R-600X200	3	79.68	110.09	181.78

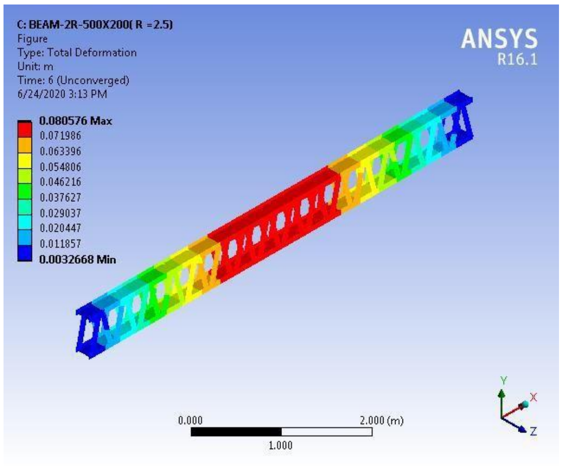

Fig-5 Deformation of beam 500X200 mm

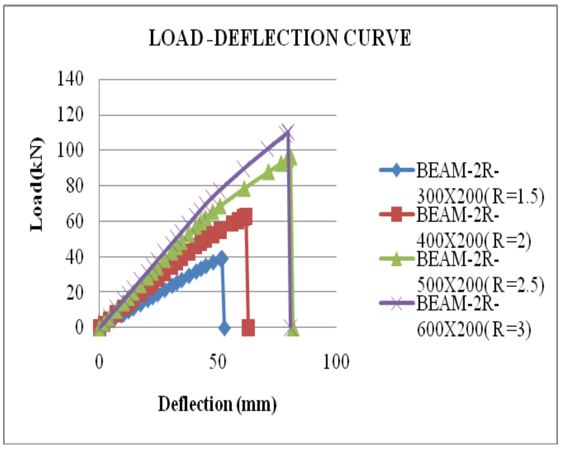

Fig-6 Load deflection curve

5.2 Breadth ratio

Results obtained from the analysis for effective breadth as shown in Table 3. Maximum deflection for the beam is 69.05 mm have R value 1, ie dimension of beam 300X300 mm also it having high ductility. Load carrying capacity is high for the beam 300X400 is about 59.27 kN. From these results the efficient section of the beam is 300X300 mm ie, R=1. Deformation of the beam 300X300 as shown in Fig-7. Load deflection curve as shown in Fig-8.

Table -3: FEA results for effective breadth

Models	R Value	Deflection	Load(kN)	% of increase in load
Beam-2R-300X200	1.5	52.75	39.07	1.0
Beam-2R-300X300	1	69.05	46.76	19.69
Beam-2R-300X400	0.75	57.39	59.27	51.72

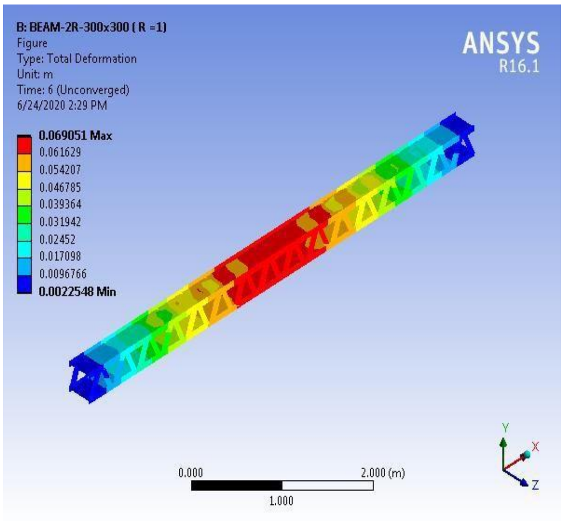

Fig-7 Deformation of beam 300X300 mm

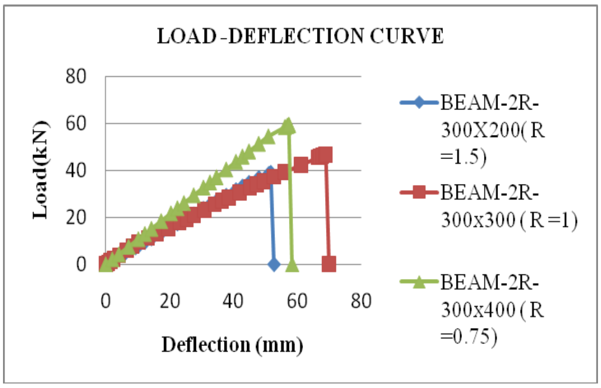

Fig-8 Load deflection curve

5.3 Alignment study

Results obtained from the finite element analysis for different arrangements of truss members as shown in Table 4. Four types of beams were tested to know about the efficiency of each arrangement. Back to back connection and face to face connection shows efficient load carrying capacity. In validation members are placed in face to face arrangement. Here the back to back connection shows better result than face to face to connection. Maximum load about 42.64 kN and possess high ductility i.e., deflection about 59.22 mm. Deformation of the B2B connected beam and load deflection for each beam as shown in Fig-9 and Fig-10 respectively.

Table -4: FEA results for different alignment of truss members

Models	Connection	Deflection	Load(kN)	% of increase in load
B-2R-300X200	F2F	52.75	39.07	1
B-2R-300X200	B2B	59.22	42.64	9.15
B-2R-300X200	F2B	49.75	37.69	3.54
B-2R-300X200	B2S	2.05	1.54	96.07

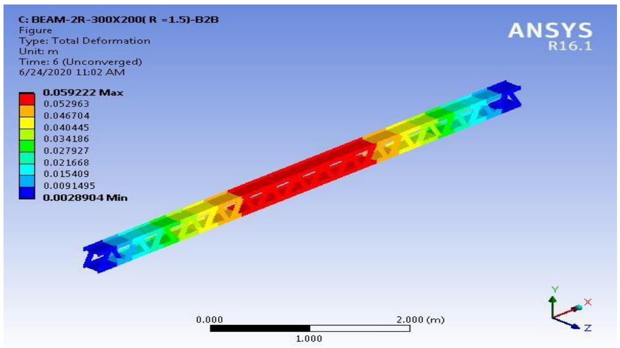

Fig-9 Deformation of beam-connection B2B

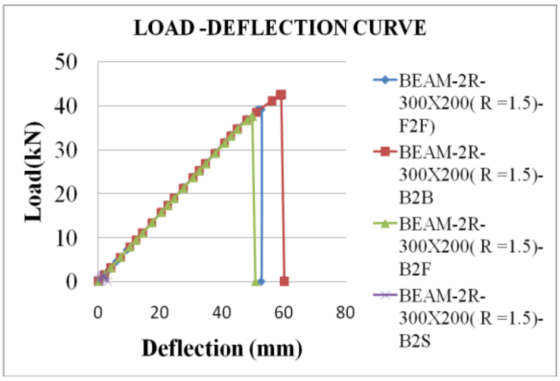

Fig-10 Load deflection curve

6. STRUCTURAL PERFORMANCE OF RECTANGULAR SLAB

Test conducted to study the structural performance of rectangular floor slab along with multi span truss beam. Here the one-way slab tested under flexural strength. Different sizes of slabs were tested for compare each other. The size of the beam taken as 300X200 mm. The truss members are connected back to back. Slabs of size 5X1 m, 5X2 m, 5X3 m, 6X1 m, 6X2 m and 6X3 m were tested. Finite element analysis results are as shown in Table 5. Flexural strength of slabs is tested under four-point loading. Flexural strength was high for all specimens. Ductility also increases. Load deflection curve as shown in Fig-11. Slabs of size 5X3 m and 6X3 m possess high load carrying capacity and ductility.

Table -5: FEA results for truss beam with rectangular floor slab

Model	Deflection(mm)	Load(kN)	% of increase in load

1S-6X1 mm	59.69	582.20	1
1S-6X2 mm	84.24	1411.20	142.39
1S-6X3 mm	82.79	2627.30	351.27
1S-5X1 mm	0	676.37	1
1S-5X2 mm	49.75	1571.40	132.33
1S-5X3 mm	61.48	3415.10	404.92

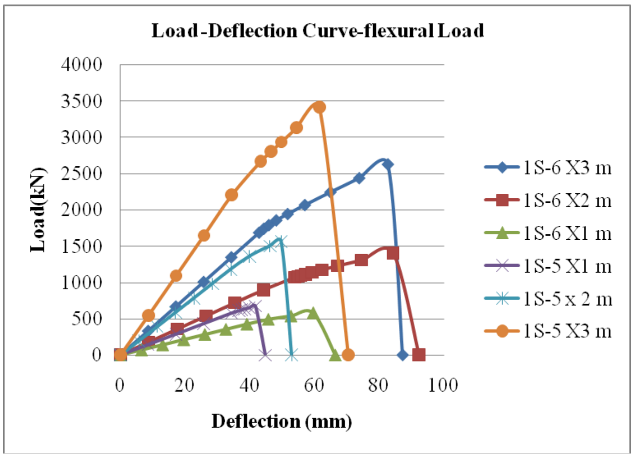

Fig-11 Load deflection curve

7. STRUCTURAL PERFORMANCE OF SQUARE SLAB

Test conducted to study the structural performance of square floor slab along with multi span truss beam. Punching load test is carried out to analyze the structure. In punching load test the slab were supported on four sides and load applied at centre. Total four number of slabs were tested. Test set up of the specimen as shown in Fig-12. Slabs of size 2X2 m, 3X3 m, 4X4 m and 5X5 m were tested. Results from finite element analysis listed in Table 6.

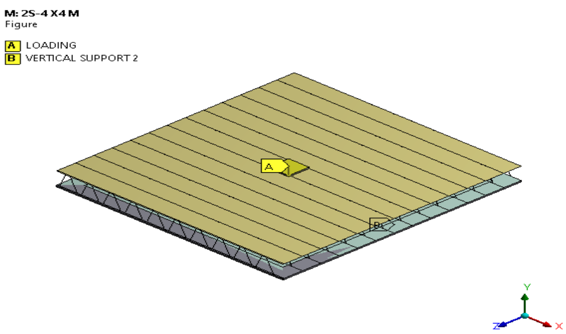

Fig-12 Test set up of the specimen

Table -6 FEA results for truss beam with square floor slab

Models	Deflection(mm)	Load(kN)	% of increase in load
2S-2X2 m	22.96	828.03	1
2S-3X3 m	27.55	1160.6	40.16
2S-4X4 m	32.47	1269.90	53.36
2S-5X5 m	40.01	1503.30	81.55

Load carrying capacity and ductility propertiesare increasing with increasing size of the specimen. Maximum load carrying capacity 1503 kN and maximum deflection about 40.01. Percentage of increase in load is about 80 %. Load deflection curve as shown in Fig-13 and deformation of slab size of 5X5m as shown in Fig-14.

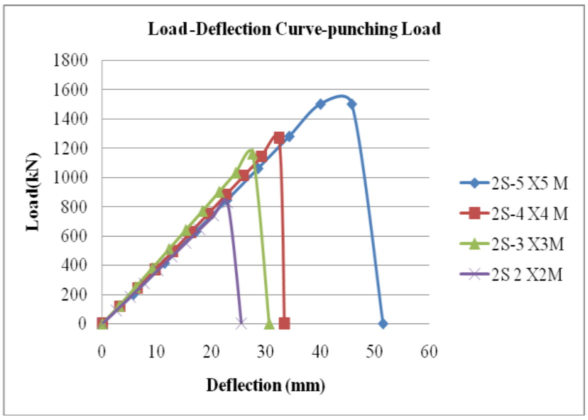

Fig-13 Load deflection curve

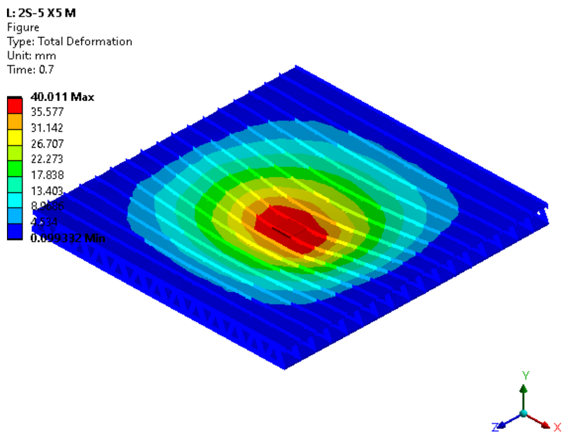

Fig-14 Deformation of square slab along with CFS truss beam

8. CONCLUSIONS

Cold formed steel is a type of steel which is entirely different from hot rolled steel. Manufacturing process of the cold formed steel undertaken at room temperature. Cold formed steel available in various sections such as lipped channel sections, C shaped sections, U shaped sections etc. These sections can be together will form a truss beam. We can use this as roof truss as well as floor truss. Lipped channel sections are used here to form truss beam. The sections are connected by back to back connection which posses high load carrying capacity and ductility. Multi span CFS truss beam posses high load carrying capacity than single span CFS truss. Breadth of the beam taken as the spacing between truss beams. Flexural strength and load carrying capacity increasing with increasing size of slab. In case of punching shear test load carrying capacity increases up to 80 % than smaller size slab. Floors with light weight cold formed steel multi span trusses can be effectively used in all types of buildings. They posses high load carrying capacity, high flexural strength and economical.

REFERENCES

[1] Dan Dubina,Raul Zaharia(2006), “Stiffness of joints in bolted connected cold-formed steel trusses,” Journal of Constructional Steel Research Vol-62

[2] James V. Wood,John L. Dawe (2006), “Small-Scale Test Behavior of Cold Formed Steel Roof Trusses, “Journal of structural engineering, ASCE, Vol 32

[3] James V. Wood, John L. Dawe(2006), “Full-Scale Test Behavior of Cold-Formed Steel Roof Trusses, “Journal of structural engineering, ASCE

[4] J.L. Dawea, Yi Liu b, J.Y. Li(2010), “Strength and behaviour of cold-formed steel offset trusses, “Journalof Constructional Steel Research Vol-66

[5] B. W. Davis, R. Parnell(2010), “Vibration Performance of Lightweight Cold-Formed Steel Floors,” Journal of structural engineering, ASCE, Vol-136

[6] Than Nguyen Dao, John W. van de Lindt(2012), “Seismic performance of an innovative light-gauge cold-formed steel mid-rise building,“Journal of structural engineering, ASCE

[7] Mahen Mahendran, Poologanathan Keerthan.(2013), “Improved shear design rules of cold-formed steel beams,” Journal of Constructional Steel Research Vol-83

[8] Amin Ahmadi, ChrisMathieson, G. Charles Clifton, James B.P.(2013), “An experimental study on a novel cold-formed steel connection for light gauge open channel steel trusses,” Journal of Engineering Structures Vol-99

[9] Chris Mathieson, G. Charles Clifton, James B.P(2016), “Novel pin-jointed connection for cold-formed steel trusses,” Journal of Constructional Steel Research , Vol-116

[10] Mehran Zeynalia, Adele Shelley, H.R. Ronagh c(2016), “An experimental study into the capacity of cold-formed steel truss connections,” Journal of Constructional Steel Research Vol-127

[11] D.H. Bondok, H.A. Salim(2017), “Failure capacities of cold-formed steel roof trusses end-connections,” Journal of Constructional Steel Research

[12] Mehran Zeynalia, Sattar Bolkhari, Pooria Rafeei(2018), “Structural performance of cold-formed steel trusses used in Journal of Constructional Steel”

[13] Li-min Tian, Yue-feng Kou, Ji-pingHao, Lin-wei Zhao(2018),”Flexural performance of a lightweight composite floor comprising coldformed steel trusses and a composite mortar slab,” Journal of structural engineering