International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

FINITE ELEMENT ANALYSIS ON BACK TO BACK CHANNEL GAPPED COLD FORMED BUILT UP SECTION

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Abstract - *Cold formed steel widely used in construction industry it will used as structural member as well as non-structural member in the construction industry. The geometry can significantly influence the stability response of cold-formed steel members and their failure patterns. This paper present study finite element analysis on back to back channel gapped cold formed built up section. Study is carried out on back to back channel gapped cold formed built up section by changing their gapin back to back channel section & spacing in between intermediate link channel. For the finite element analysis ANSYS workbench 2016 is used. From the analysis it is found that GBU-110, S-290 with 110 mm gap & 290mm spacing in between intermediate link channels shows maximum load carrying capacity as compare to other beam section.*

***Key Words*: ANSYS, Cold-formed Steel build-up section, Two-point bending tests, FE models.**

1. INTRODUCTION

Cold-formed steel (CFS) construction can lead to more efficient designs compared to hot-rolled steel members as a consequence of its high strength, light weight, ease of fabrication, and flexibility in their cross-section profiles [2]. Cold-Formed Steel members are have been widely used in building constructions, bridge constructions ,storage racks, grain bins, car bodies, railway coaches, transmission towers, transmission poles, drainage. Facilities and cold-Formed Steel products can be classified into three categories, members, panels, prefabricated assemblies. Typical Cold-Formed Steel members such as studs, track, purlins, and grits are mainly used for carrying loads while panels and decks constitute a useful surface such as floor, roof and walls [1]. Cold formed steel sections are made from bending cold formed steel sheets. Day by day demand of cold formed steel in construction industry is increasing it should be used in structural component as well as non-structural component in building. Most of the studies in the literature only take into account the structural behavior of CFS members with just one profile and the majority of them are of numerical nature [3].

This work is aiming to study the finite element analysis on back to back channel gapped cold formed built up section by using ANSYS workbench. The study concerned with simply supported beam subjected with two points loading. The beam profile is back to back channel gapped cold formed built up section. The details of gapped section as can be seen in Fig. the gap are formed through a link- channel screwed between the webs of the back to back channel section.

2 SECTION DETAIL

Schematic views of the analytical modeling specimens With two-point loading condition is shown in Fig.1,

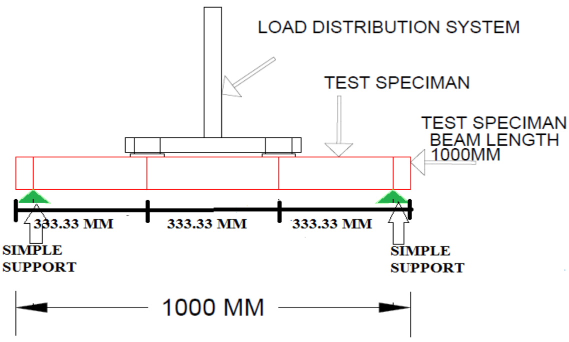

Fig.1 Two point loading set up

In the test specimen beam length is 1000 mm which is made by using channel section in the section two back to back channel section connected by using intermediate link channel section as shown in Fig.2,

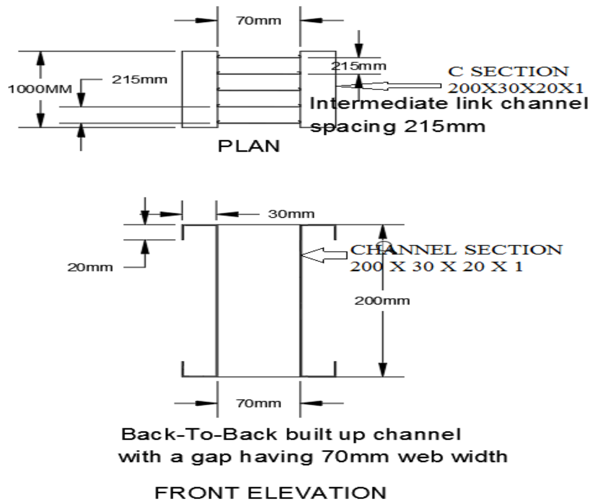

Fig.2 GBU-70, S-215

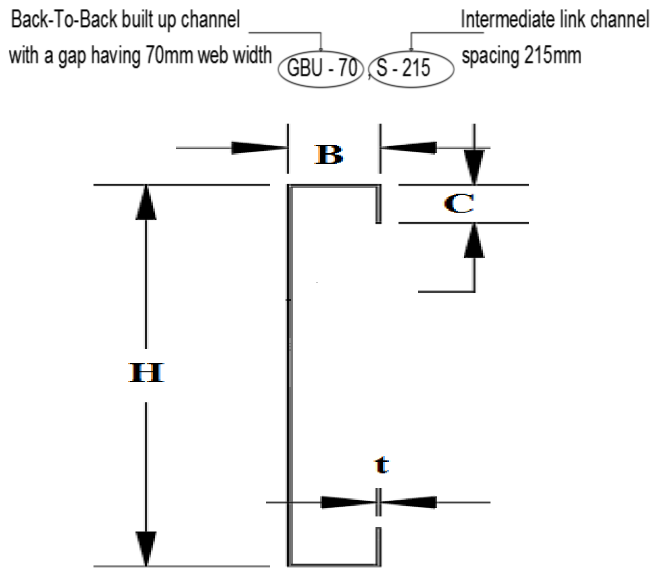

Fig.3 CFS channel section

The specimen consisted of beams made from various channels section of cold formed steel for different gap and spacing has different sizes of channel section. Size of channel sections which are used in intermediate link according to gap & spacing as shown in below table, & 200×30×20×0.9 (H×B×C×t) channel sections are used in all beams for back to back channel having length 1000mm.

Table No- 1. Channel sizes for creation of back to back channel gapped cold formed built up beam section.

Sr. No	Profile name	Channel Size in (mm)	H	B	C	t
1	GBU-70,S-215	70×30×20×0.9	70	30	20	0.9
2	GBU-70,S-290	70×30×20×0.9	70	30	20	0.9
3	GBU-70,S-365	70×30×20×0.9	70	30	20	0.9
4	GBU-110,S-215	110×30×20×0.9	110	30	20	0.9
5	GBU-110,S-290	110×30×20×0.9	110	30	20	0.9
6	GBU-110,S-365	110×30×20×0.9	110	30	20	0.9
7	GBU-170,S-215	170×30×20×0.9	170	30	20	0.9
8	GBU-170,S-290	170×30×20×0.9	170	30	20	0.9
9	GBU-170,S-365	170×30×20×0.9	170	30	20	0.9

All of the sizes of channel sections are selected by using AISI-S100-07. Total number of nine section with different gap and different spacing. Details of gap & spacing for various back to back channels gapped built up nine sections are given below table.

Table No- 2. Gap & intermediate link channel spacing sizes

Sr. no	Profile name	Gap (mm)	Spacing (mm)	Length (mm)
1.	GBU-70,S-215	70	215	1000
2.	GBU-70,S-290	70	290	1000
3.	GBU-70,S-365	70	365	1000
4.	GBU-110,S-215	110	215	1000
5.	GBU-110,S-290	110	290	1000
6.	GBU-110,S-365	110	365	1000
7.	GBU-170,S-215	170	215	1000
8.	GBU-170,S-290	170	290	1000
9.	GBU-170,S-365	170	365	1000

Symbols:
E - Young's modulus
δ - Density of steel
μ - Poisson's Ratio
Fy - yield strength of steel
H - Depth/height of the beam
B - width of the beam
C - Depth/ height of the lip
t - thickness of the beam cross-section
L - length of the beam

3. NUMERICAL ANALYSIS

3.1 General

A three dimensional (3D) finite element model was developed to determine buckling loads of the back to back channel gapped cold formed built up beam section by using the ANSYS workbench [4].

3.2 Analysis procedure

The full geometry was modeled for test specimen. Welding is done in between the link channel and the web of the back to back channel sections. Two point loads is applied at the distance of 333.33 mm from end supports.

3.3 Geometry & material modeling & meshing

Geometry for back to back channel gapped cold formed built up section should done in ANSYS workbench module as shown in Fig. & material property for back to back channel gapped cold formed built up section as shown in below table

Table No-3. Properties of cold formed steel

Material	Cold formed steel
Modules of elasticity	2 x 105 N/mm2
Poisson's ratio	0.3
Density	7850 kg/m3
Yield strength	250Mpa

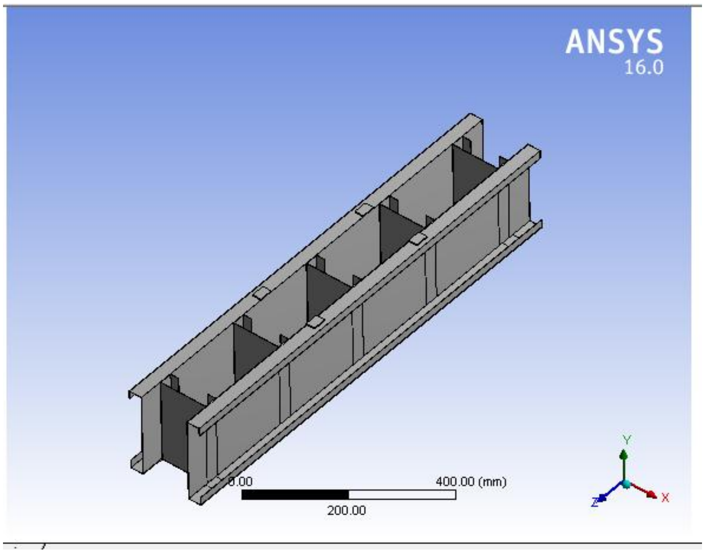

Fig.4 CFS channel section modeling in ANSYS

The specimen modeled using 4-node shell element with six degree of freedom at each node. From mesh convergence study, an optimal mesh size 10mm is used for study. A typical finite element is illustrated in Fig.

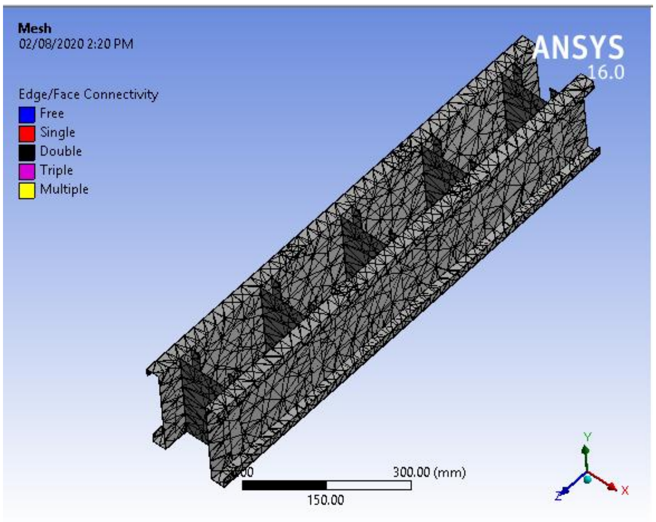

Fig.5 CFS channel meshing in ANSYS

3.4 loading & boundary condition

A three-dimensional numerical model was used to simulate. Load is applied through two point loading on simply supported beam at one third distance from support for back to back channel gapped cold formed built up beam section as shown in below Fig.

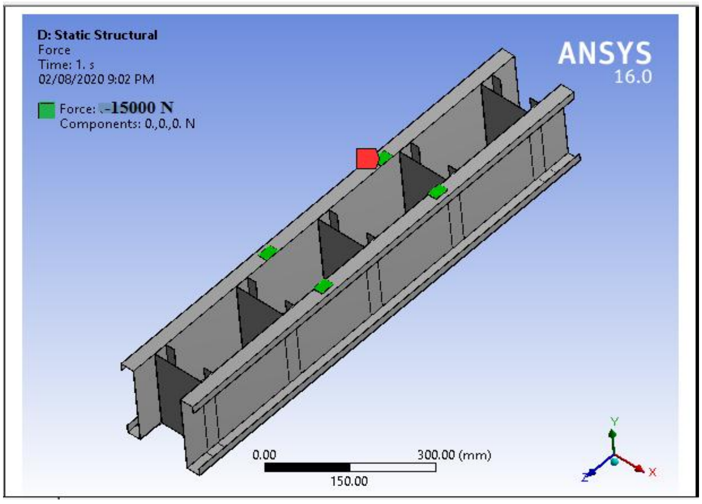

Fig.6 CFS channel loading & boundary condition in ANSYS

3.5 Analysis

A non-linear static analysis is carried out on for back to back channel gapped cold formed built up section. Large displacement analysis, Vertical displacements were also monitored at mid-span for the purposes of obtaining load–deflection graph. The parameters used in the nonlinear static Analyses were;

- Maximum number of load increments = 100.
- Initial increment size = 0.1.
- Minimum increment size = 0.000001.
- Automatic increment reduction enabled, and large displacements enabled [1]

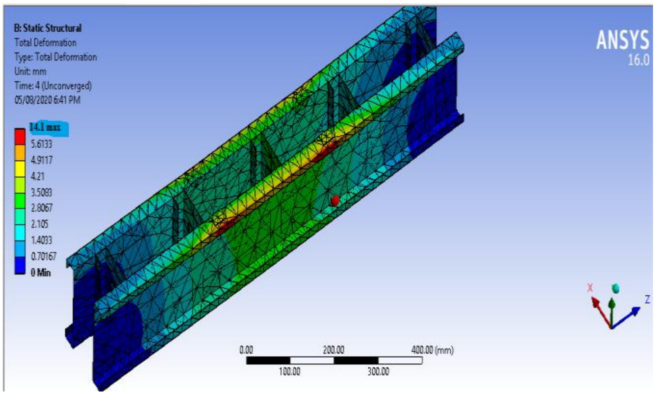

Fig.6 CFS beam maximum displacement in ANSYS

4. ANALYSIS RESULT

4.1 Load carrying capacity-

Two points loading carried out on back to back channel gapped cold formed built up section. To obtain ultimate load carrying capacity beam section. Following Fig.9, 11 and 13 shows a comparison of the load–vertical displacement curves of CFS beam obtained from finite element analysis

(FEA) used for the calibration of the model. In the numerical simulations, it can be seen that the maximum load carrying capacity of beams for various gaps like 70 mm, 110mm 170mm are as follows for 70 mm gap in beam maximum load is taken by beam GBU-70, S-290 similarly for 110mm gap in beam maximum load is taken by beam GBU-110, S-290 & for 170mm gap in beam maximum load is taken by taken by beam GBU-170, S-290 & as compare to spacing of 215mm, 290mm,365mm are 290mm spacing is more effective in 70mm,110mm & 170mm gap.

In below table ultimate load & maximum deflection for nine Back to back channel gapped cold formed built up beam section as shown in below.

Table No-4. Ultimate load & maximum displacement in mm

Sr. no	Profile name	Ultimate load in kN	Displacement in mm
1.	GBU-70,S-215	18.60	14.1
2.	GBU-70,S-290	28.95	10.6
3.	GBU-70,S-365	15.42	11.2
4.	GBU-110,S-215	27.35	16.2
5.	GBU-110,S-290	31.92	9.8
6.	GBU-110,S-365	14.82	15.3
7.	GBU-170,S-215	21.77	15.95
8.	GBU-170,S-290	30.1	10.1
9.	GBU-170,S-365	16.5	11.6

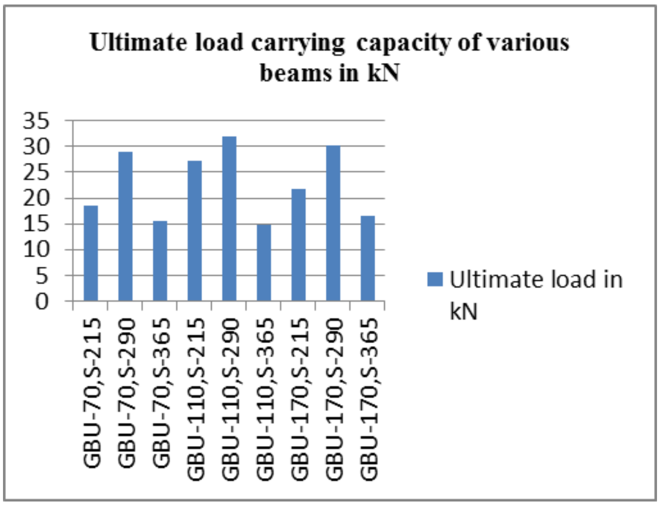

Fig. 7 Ultimate load carrying capacity of various beams in Kn

4.2 Deflection & load carrying capacity in 70mm gap with various spacing (215,290,365mm)

Table No- 5. Deflection & load carrying capacity in 70mm gap with various spacing like (215,290,365mm)

Sr. no	Profile name	Ultimate load in kN	Displacement in mm
1.	GBU-70,S-215	18.60	14.1
2.	GBU-70,S-290	28.95	10.6
3.	GBU-70,S-365	15.42	11.2

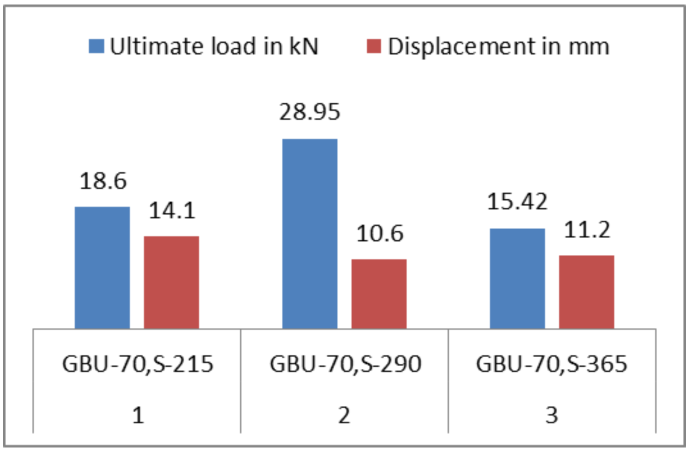

Fig. 8 deflection & load carrying capacity in 70mm gap with various spacing like (215,290,365mm)

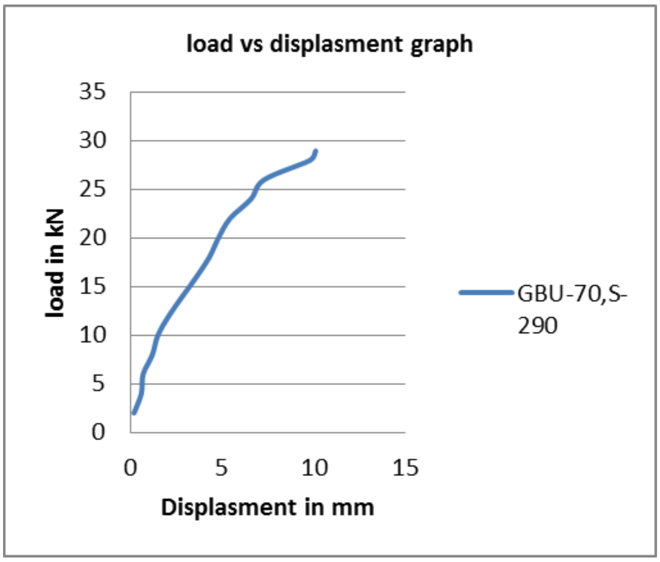

Fig.9 load verses displacement graph of GBU-70, S-290

4.3 Deflection & load carrying capacity in 110mm gap with various spacing (215,290,365mm)

Table No- 6. Deflection & load carrying capacity in 110mm gap with various spacing like (215,290,365mm)

Sr. no	Profile name	Ultimate load in kN	Displacement in mm
4.	GBU-110,S-215	27.35	16.2
5.	GBU-110,S-290	31.92	9.8
6.	GBU-110,S-365	14.82	15.3

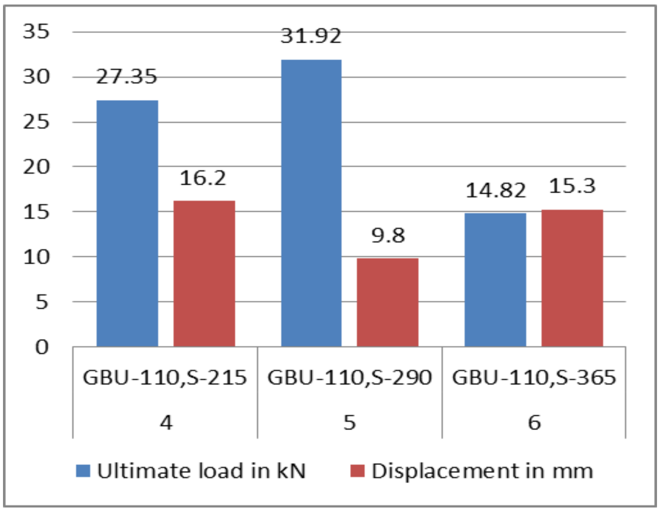

Fig. 10 deflection & load carrying capacity in 110mm gap with various spacing like (215,290,365mm)

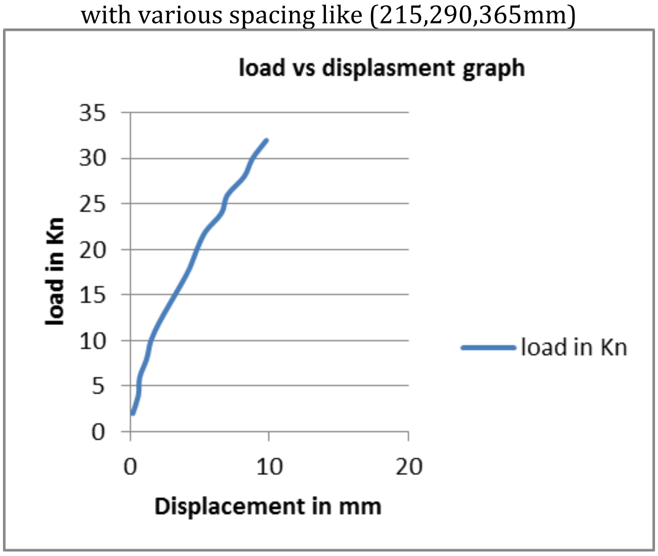

Fig.11 load verses displacement graph of GBU-110, S-290

4.4 Deflection & load carrying capacity in 170mm gap with various spacing (215,290,365mm)

Table No- 7. Deflection & load carrying capacity in 170mm gap with various spacing like (215,290,365mm)

Sr. no	Profile name	Ultimate load in kN	Displacement in mm
7.	GBU-170,S-215	21.77	15.95
8.	GBU-170,S-290	30.1	10.1
9.	GBU-170,S-365	16.5	11.6

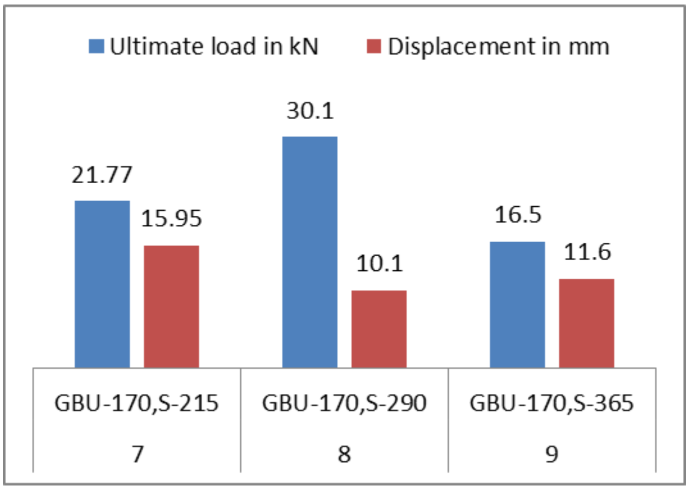

Fig. 12 deflection & load carrying capacity in 170mm gap with various spacing like (215,290,365mm)

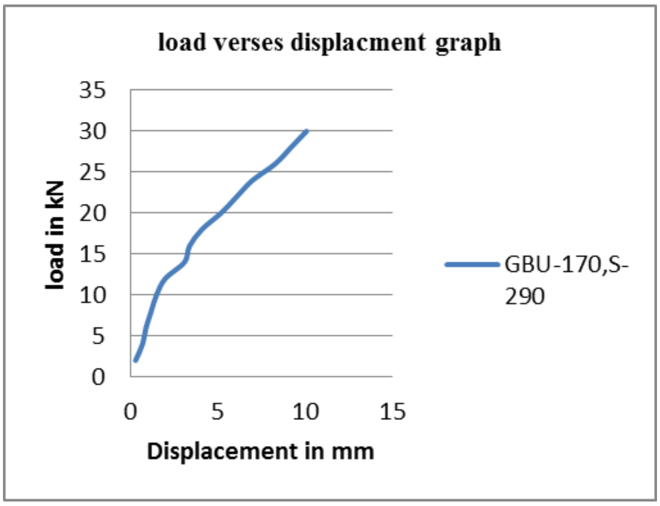

Fig.13 load verses displacement graph of GBU-170,S-290

5. CONCLUSIONS

Two-point bending numerical simulations performed with the finite element program ANSYS were made.in finite element analyses we found that ultimate load carrying capacity for back to back channel gapped cold formed built up beam section. we also get the graph of load versus displacement. From finite element analysis we found that as comparing to gap 110 mm gap shows better result with intermediate 215mm link channel spacing it will show more load carrying capacity than 70mm & 170mm gap. GBU-110,S-290 shows ultimate load carrying 31.92 KN & GBU-170,S-290 shows ultimate load carrying 30.1 & GBU-70,S-290 shows ultimate load carrying 28.95 from it is we conclude that as gap increase load carrying capacity but up particular gap 110 mm after that gap increase load carrying capacity will decrease.

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