Comparative Study and Analysis of Industrial Structure Made Up of Steel and Cold Form Steel under Different Seismic Zone

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Abstract— For a structural design to be satisfactory, generally four major objective-utility, safety, economy and elegance must be fulfilled. And should be designed and constructed to satisfy the design requirements for stability, strength, serviceability, fire durability etc. In comparison with conventional steel structure these are widely used in light and moderate loads. For such type conventional type of hot rolled steel is not economical so that in order to overcome these problem cold form steels are used. Mostly single storey type industrial structure well suited for industrial building. In this present paper the single storey industrial structure, roof truss supported by column is made up steel and cold form steel are modelled and analysed for same member force under different seismic zone is calculated and the results being compared by using STAAD.pro V8i SS5.A model which contains X bracing system to resist lateral force are used. The parameter which are studied in these analysis are Nodal displacement, cost.

Key words: Lateral Displacement, Roof Truss, Cold Form Steel, Bracing

I. INTRODUCTION

Cold rolled products were developed during the First World War. These are used world wild because of their versatility, suitability for lighter load bearing application. And it is difficult to think of any industry without cold form steel products do not exist in one form or any other form. Design of cold form steel products are based on IS code: IS 801-1975 and which is currently under revision. The plastic deformation process of metals at a temperature below the recrystallization temperature is called cold working. Cold forming as the effect of increasing the yield strength of steel. These are particularly increase in zones where the metal is bent by folding. Some of the main advantages comparing to the conventional steels are, high strength to weight ratio, easy to transport and erect and also all connection method of connections is possible (riveting, bolting and welding). Effective design width of a flat element is its reduced width from design basics. The portion of the width is neglected to arrive the effective design width and by using reduced the effective area the load is determined and also section properties should be find.

II. TYPES OF ELEMENTS

Cold form steel products are classified into 2 types. Stiffened and unstiffened elements. An element is supported along both longitudinal edge by webs are called stiffened element. if it supported along only one longitudinal edge is called unstiffened element and the other edges are displacing freely.

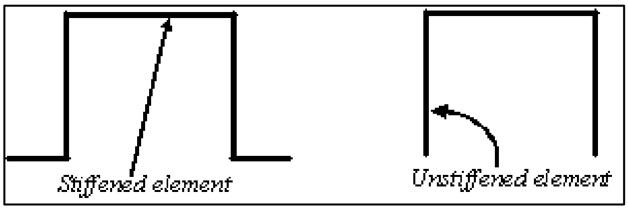

Fig. 1: Cold form steel stiffened and unstiffened element

III. BUILDING DESCRIPTION

The building considered here is industrial building. The study is carried out on the building using steel and cold form steel the basic loading on industrial structure made up of steel and cold form steel should be same.

Span of the building	= 10m
Length of the building	= 15
Eave height	= 10
Depth of the truss	= 2m (1/5th of span)
No of panel	=10
Panel length in plan	=1
Spacing of the truss	=3m
Slope of the truss	=21.8^0
Bracing type	=X bracing

IV. LOAD CALCULATION

A. *Dead Load Calculation*

Dead Wt of GI sheet = 150N
For corrugated sheet
Dead Wt of purlin = 80 N/m^2
= 80x3x1
= 240 N
Self Wt of truss = (Span/3 +5)x10
= 83.3 N/m^2
Wt of bracing = 13 N/m^2 (Assume)
Total load on each
Intermediate panel = (150+83.3+13)x(3x2) +(240)
= 1.71 kN
Load on end panel = 0.855 kN

B. *Live Load Calculation*

For 10^0 slope imposed load = 750 N/m^2
Reduce 20 N/m^2, for each degree increase above 10^0
Live load = 750-20(21.8-10)
514N/m^2
Load on intermediate
Panel = 514x3x1
= 1.54kN

C. *Wind Load Calculation*

Basic wind speed = 39 m/sec

Risk co eff (K1) = 1.0
Assume no obstruction
So that (K2) = 1.03
Assume
Plain ground (K3) = 1
Design Wind speed(Vz)= VbxK1xK2xK3
= 31.93 m/sec
Design Wind pressure = $0.6\ Vz^2$
= 0.6×31.93^2
= $0.61\ kN/m^2$
Wind load = (Cpe-Cpi)xAxPz
For h/w =1 and angle 21.8^0

Wind ward side		Lee ward side	
0^0	90^0	0^0	90^0
EF	EG	GH	FH
-0.8	-0.8	-0.5	-0.7

Table 1:

Acc. IS handbook for small size opening the value of internal pressure co eff (Cpi)= ±0.2
Wind ward side
F1 = (-0.8-0.2) x (3x2) x0.61
Load at intermediate panel = -3.66 kN (upward force)
Lee ward side load at end panel = -1.83 kN
F2 = (-0.5-0.2) x (3x2)x0.61
= -2.56 kN (upward force)
-ve sign indicates the force cause uplift force

V. CALCULATION OF MEMBER FORCE

By using STAAD.pro V8i SS5 forces in various members are calculated and max force in top chord, bottom chord, straight and inclined member are shown below. Max force obtained from adding dead load force, live load force and wind load force.

Sl.No	Member	Max Force
1	Top Chord	223.24 kN
2	Bottom Chord	125.35 kN
3	Straight And Inclined Strut	70.968 kN

Table 4.1: Max Force in Member of the Roof Truss

VI. MODELLING

Principal rafter	ISA 125x75x6
Bottom tie	ISA 65x45x6
Strut (vertical, inclined)	ISA 60x40x8
Column	ISWB 600
Rafter bracing	ISA 20x20x3
Purlin	ISLC 350

Table 5.1: Type of Steel Section For Various Member

Principal Rafter	Channel with Lips 250x80x5 Mm
Bottom Tie	Channel with Lips 200x50x4 Mm
Strut (Vertical, Inclined)	Angle Section 80x80x5
Column	Channel with Lips 250x80x5 Mm
Rafter Bracing	Angle Section 20x20x2 Mm
Purlin	Chanel Without Lips 200x50x4 Mm

Table 5.2: Type of Cold Form Steel Section For Various Member

VII. RESULTS AND GRAPH

Industrial structure with X bracing was modelled using steel and cold form steel in it. It should be modelled and analysed using STAAD.pro V8i SS5.

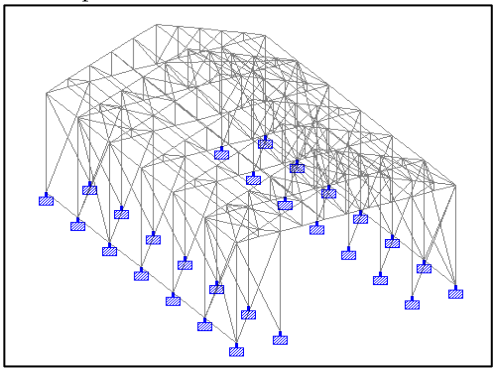

Fig. 2: Industrial structure with X bracing

SEISMIC ZONE	NODAL DISPLACEMENT(mm)
ZONE II	4.72
ZONE III	5.93
ZONE IV	7.15
ZONE V	8.95

Table 7.1: Nodal Displacement of a Structure Using Steeel With X Bracing in Various Seismic Zone

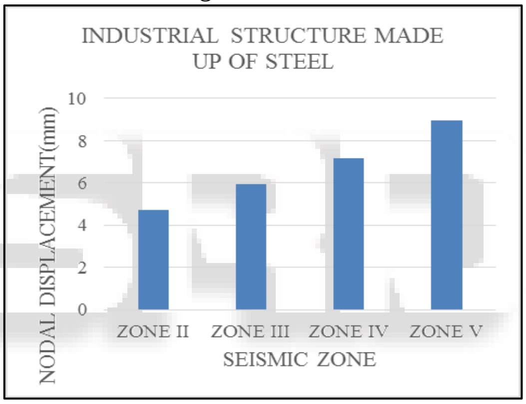

Fig. 2: nodal displacement of an industrial structure made up of steel with X bracing under different seismic zone

SEISMIC ZONE	NODAL DISPLACEMENT(mm)
ZONE II	3.66
ZONE III	7.04
ZONE IV	7.35
ZONE V	7.82

Table 7.2: Nodal Displacement of an Industrial Structure Using Cold Form Steel With X Bracing in Various Seismic Zone

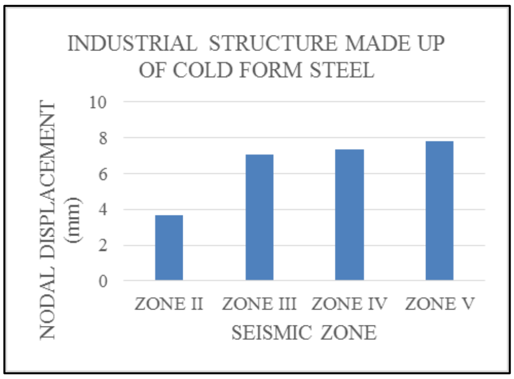

Fig. 3: Nodal Displacement of an Industrial Structure Made Up of Cold Form Steel with W X Bracing under Different Seismic Zone

S.No	Material Used	Weight Of The Building (Kn)
1	Steel	1019.249
2	Cold Form Steel	509.6245

Table 7.3: Weight Comparison of Steel and Cold Form Industrial Structure

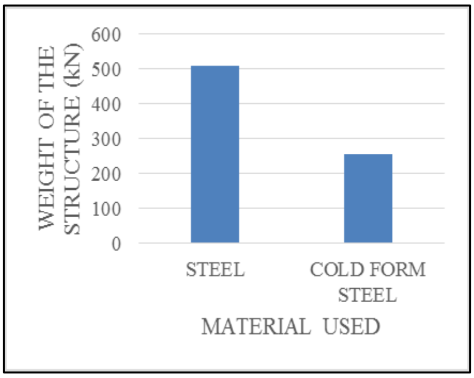

Fig. 4: Weight Comparison of Steel and Cold Form Steel

S.No	Material Used	Cost Of The Building (Rs)
1	Steel	10,50,846
2	Cold Form Steel	8,04,086

Table 7.4: Weight Comparison of Steel and Cold Form Industrial Structure

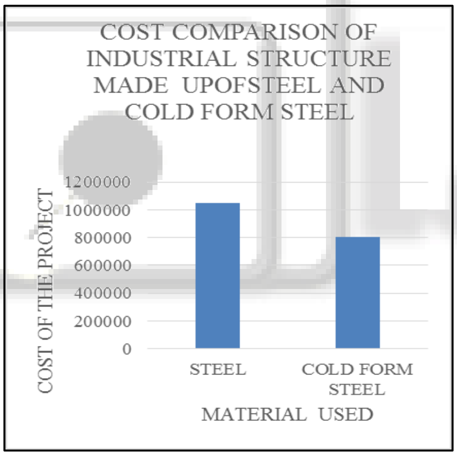

Fig. 5: Cost Comparison of Steel and Cold Form Steel

VIII. Conclusion

In this research work, the design is based on IS 800:2007 and IS 801:1975 and the study is carried out to earthquake codebook IS 1893(part 1):2002 and analysis done by taking industrial structure made up of steel and cold form steel with X bracing under different seismic zone. parameter such as mainly focused in this study is Nodal displacement, cost, weight of industrial structure made up of steel and cold form steel are compared by using STAAD.pro V8i SS5.

As we see the overall comparison of the building made up of steel and cold form steel the industrial structure made up of cold form steel performance under different seismic zone is good compare to the industrial structure made up of steel.

In zone II, the industrial structure made up of cold form steel gives 28.96% less nodal displacement compare to the industrial structure made up of steel.

In zone III, the industrial structure made up of steel gives 18.71% less nodal displacement compare to the industrial structure made up of cold form steel.

In zone IV, the industrial structure made up of cold form steel gives 2.79 % less nodal displacement compare to the industrial structure made up of steel.

In zone V, the industrial structure made up of cold form steel gives 14.45% less nodal displacement compare to the industrial structure made up of steel.

The weight of the industrial structure made up of steel is 86.62 % greater than the weight of the industrial structure made up of steel.

Total cost of the project using steel is 66% increase than the total cost of the project using cold form steel.

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