Cold Formed Sections as Secondary Framing

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***Abstract*— Purlins, girts and eave struts are secondary structural members used to support the wall and roof panels. Purlins are used on the roof; girts are used on the walls and eave struts are used at the intersection of the sidewall and the roof. Secondary members have two other functions: they act as struts that help in resisting part of the longitudinal loads that are applied on the building such as wind and earthquake loads, and they provide lateral bracing to the compression flanges of the main frame members thereby increasing frame capacity.**

The attempt is made to study the comparison of cold formed sections as a secondary members & hot rolled members those which are used in conventional building system.

***Keywords*— Economic, Cost efficient, Cold formed sections, Recyclable.**

I. INTRODUCTION

Light gauge steel structural members are cold formed from steel sheets or strips. Various formed gauge members can be divided into following heads.

1. Framing members
2. Floor and wall panels
3. Wall claddings and standard roof deck

In India, light gauge members are widely used in bus body construction, railway coaches etc., and the thickness of these members may vary from 1.0 to 3.2mm. light gauge members can be either cold-formed in rolls or by press brakes from flat steel generally not thicker than 12.5mm.

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II. CONCEPT

The name of the cold formed section itself implies that shapes are formed in cold conditions. For lighter to medium loads and smaller to medium spans use of cold formed sections are more economical than that of rolled sections. Cold formed sections fabricated from sheets, strips, and plates in roll forming machines or press brakes or bending brake operations.

Cold-Form Steel buildings are a predetermined assembly of structural members that has proven over time to meet a wide range of structural and aesthetic requirements. Cold-Form Steel building concept originated During World War II, best known Pre-fabricated building i.e. which became a household word was mass produced by hundreds of thousands to meet a need for inexpensive and standardized shelter. Requiring no special skills, these structures are assembled with only hand tools and with no greater effort could be readily dismantled and moved and re-erected somewhere else. The scientific term Cold-Form Steel buildings came into - standard engineering designs for a limited number of off the shelf configurations. As long as the purchaser standard designs the buildings could be properly called Cold-Form Steel.

- Cold-formed "Z" and "C" shaped secondary structural members (roof purlin, eave struts and wall grits) Refer fig 1.1.

It is a relatively flexible structure compared to the conventional steel framed building. I beams are then field-assembled (e.g. bolted connections) to form the entire frame of the building. Some manufacturers taper the framing members (varying in web depth) according to the local loading effects. Larger plate dimensions are used in areas of higher load effects. The choice of economic form can vary depending on factors such as local capabilities (e.g. manufacturing, transportation, construction) and variations in material vs. labour costs. Cold formed Z and C-shaped members may be used as secondary structural elements to fasten and support the external cladding. Roll-formed profiled steel sheet, wood, tensioned fabric, precast concrete, masonry block, glass curtain wall or other materials may be used for the external cladding of the building.

In order to accurately design a building, engineers consider the clear span between bearing points, bay spacing, roof slope, live loads, dead loads, collateral loads, wind uplift, deflection

criteria, internal crane system and maximum practical size and weight of fabricated members.

III. ADVANTAGES OF COLD FORMED SECTIONS

- No insect and fungal infection
- Consistency and accuracy of profile
- Versatility of profile shape
- It could be pre-galvanized or pre-coated
- Best suited for site erection
- Increase in yield strength due to cold-forming.
- Minimization of material
- As compared with thicker hot-rolled shapes, more economical design can be achieve for relatively light loads and / or short spans.
- Unusual sectional configurations can be economically produced by cold forming operations and consequently strength to weight ratios can be obtained.
- Load carrying panel and decks can provide useful surfaces for floor roof and wall construction and in other cases they can also provide enclosed shells for electrical and other conduits.
- Cold rolling can be employed to produce almost any desired shape to any desired length. Zinc coated metal can be formed.
- Earthquakes are unpredictable in terms of magnitude, frequency, duration, and location. Consequently, the ideal structure to withstand earthquake forces will behave in a consistent and predictable manner.
- Corrosion proof
- Durable
- Recyclable

IV. USES OF COLD FORMED SECTIONS

In 1950, England & United States of America started to use cold formed steel sections in building constructions. Since 1946 the use and development of thin walled cold formed steel construction in the United States have been concentrated by the essence of various edition of the "Specimen" for the design of cold formed steel structural members of American Iron and Steel Institute (AISI).

- Car bodies
- Railway Bridges
- Various types of Equipments
- Storage tanks
- Highway products
- Bridge construction
- Industrial structures
- Transmission line towers
- Multistoried buildings
- Movable sheds

V. NATIONAL & GLOBAL SCENARIO

Cold formed steel section are extensively used in industrial and many other non-Industrial constructions worldwide, it is relatively a new concept in India. These concepts were introduced to the Indian market lately in the 1990 number of multi-nationals setting up their green-field projects. Global Cold formed steel have established their presence in India by local marketing agents and certified builders. As the complete building package is supplied by a single vendor, compatibility of all the building components and accessories is assured. This is one of the major benefits of the Cold formed building system. When a building is no longer needed it can be disassembled, stored or moved to another location and re-erected because only bolted connections are used. There is no field riveting or welding & the rigid frame is strong. By using Cold formed system economy is achieved with completion of project in minimized time.

In many situations lighter steel structure were invariably prepare to the heavier alternatives such as reinforce concrete or priestess concrete. The main advantages of steel structure were its intrinsic strength, prefabrication and quicker transportability to the work site and faster erection. Steel structures can easily dismantle without loss to the integrity of the original structure. Most structural steel units were prefabricated in a workshop with a superior quality control compared to In-situ construction. Tolerance specified in the Indian Standard codes for steel structural component during the fabrication erection were small compared to similar reinforced concrete structures.

Steel also plays an important role in composite construction in conjunction with reinforced and priestess concrete structure. With the development of steel as a construction material, the varieties of steel sections were also increased. Due to their outstanding features, the application of these sections in present commercial market has been tremendously increased.

VI. ANALYSIS AND DESIGN OF SECONDARY MEMBERS

Case study-

Location: Pune

Building width: 25m

Building Length: 53m

Eave height: 10m

c/c of main frames : 7.50 m

Maximum spacing of purlin: 1.3m, 1.5m & 1.7m

Wind Speed: 33m/s

A. Purlin:

The structural analysis & design of purlin section is done with the help of excel programming. Parameter like loading, length is kept constant while spacing is considered to be varied, for easy comparison of result. Table 1.1 shows CFS & conventional weight of purlin having different spacing.

Table 1.1 Summary for the Weight of Purlin

Span (m)	Conventional Weight (kN)	PEB Weight (kN)	Saving %
1.3	11.38	3.04	32.98
1.5	11.38	3.04	32.98
1.7	11.38	3.04	32.98

The graphical representation of different spacing of purlin having constant loading for the pre-engineered & conventional building system is shown in fig 1.2

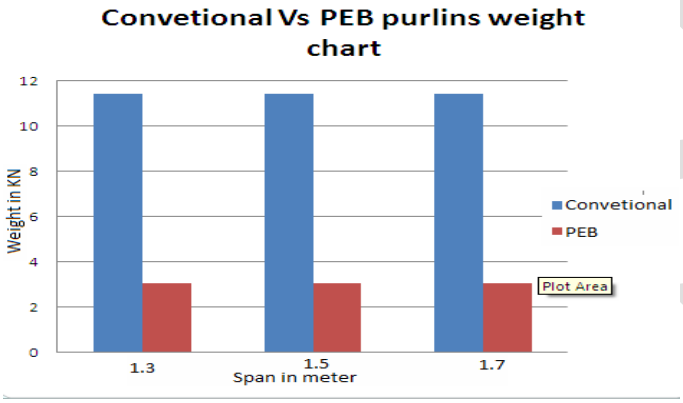

Fig 1.2 Graphical Representation Purlin Result

B. Girt:

The structural analysis & design of girt section is done with the help of excel programming. Parameter like loading, length is kept constant while spacing is considered to be varied, for easy comparison of result. Table 1.2 shows CFS & conventional weight of girt having different spacing.

Table 1.2 Summary for the Weight of Girt

Span (m)	Conventional Weight (kN)	PEB Weight (kN)	Saving %
1.3	11.38	3.04	32.98
1.5	11.38	3.04	32.98
1.7	11.38	3.04	32.98

The graphical representation of different spacing of girt having constant loading for the pre-engineered building system & conventional building system is shown in fig 1.3

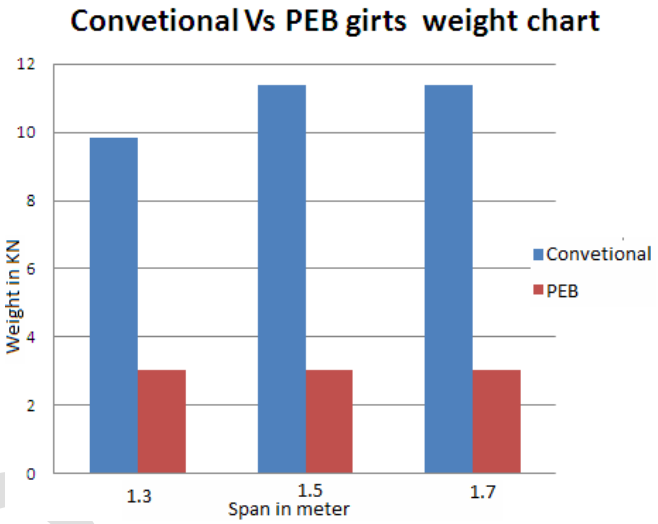

Fig 1.3 Graphical Representation of Girt Result

VII. CONCLUSIONS

The use of Z shaped secondary structural members (roof of purlins & wall girts) particularly the overlapping of Z shaped purlins at frames, results in up to 30% to 40% weight saving for the secondary members when compared to the use of hot rolled channels as purlins & girts.

In Industrial building the material & cost of the building is minimized in case of cold formed steel while in case of conventional building it was be higher both in three cases. The saving in material and cost is about 30% to 40%.

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