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Comparision Between Limit State Method & Working Stress Method for Steel Structure

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Abstract:
Now a day's the use of steel in construction are increase as compare to the reinforced concrete structure. Recently IS: 800-1984, Code of practice for general construction in steel was revised in November 2007. Most of the consultant are design the steel structure by working stress method after the revision of IS: 800. The proposed work for the project is analysis of complete industrial building by plastic method and its design by limit state method. The analysis and design of industrial building consists of truss, purlin, compression and tension members, gantry girder, truss/gantry column, column base and connection. The analysis and design of steel structure by working stress method should be carried by using software available in the practice. The sections obtained by limit state method should be compare with sections obtained by working stress method to check the economy in the design.

Keywords: IS 800-1984 , IS800-2007 , LIMIT STATE METHOD, Working stress Method, sections comparison etc.

I. INTRODUCTION:

Codes of practice provide the minimum requirements that a design has to satisfy. In India, Bureau of Indian Standards (B.I.S.) is the statutory body that publishes the codes of practice to be followed in the Indian Professional practice. Though the codes of practices issued by B.I.S. are revised after 20 to 25 years, the second revision of IS 800 was published in 1984. The third revision of the code was released after about 24 years, in December 2007, by the B.I.S. The material contained in the code reflects the state-of-the-art of knowledge and is based on the provisions in other international codes as well as other research publications. This version of the code is based on the Limit state method of design philosophy whereas the earlier version was based on Working stress method. The revised Code IS: 800-2007 will enhance the confidence of designers, engineers, contractors, technical institutions, professional bodies and the industry will open a new era in safe and economic construction in steel.

II. ADVANTAGES OF STEEL AS A STRUCTURAL MATERIAL

1. Steel members have high strength per unit weight, therefore a steel member of small section which has little self weight is able to resist heavy load.
2. Being light, steel members can be conveniently handled and transported.
3. Properly maintained [steel structures have a long life.].
4. The properties of steel mostly do not change with time.
5. Steel being a ductile material, so it does not fail suddenly.
6. Addition and alteration can be made easily to steel structure.
7. Steel has the highest scrap values among all building material.

CONCEPT OF LSM: The objective of the design is to achieve a structure that will remain fit for use during its life with acceptable target reliability. In other words, the probability of limit state being reached during its life should be very low. The acceptable limit for the safety and serviceability requirements before failure occurs is called limit state. The structure shall be designed on the basis of the most critical limit state and shall be checked for other limit state. Steel structure are to be designed and constructed to satisfy the design requirement with regard to stability, strength , serviceability, brittle fracture fatigue , fire and durability. Such that they meet the following.

a. Remain fit with adequate reliability and be able to sustain all action and other influences experienced during construction and use.
b. Have adequate durability under normal maintenance.

MAJOR MODIFICATIONS

In the latest revision of IS: 800, the following major modifications have taken place:
a) The standard is based on limit state method, reflecting the latest developments and the state of the art.
b) In view of the development and production of new varieties of medium and high tensile structural steels in the country, the scope of the standard has been modified permitting the use of any variety of structural steel provided the relevant provisions of the standard are satisfied.
c) The standard has made reference to the Indian Standards now available for rivets, bolts and other fasteners.

A). LIMIT STATES METHOD OF DESIGN

Separate Partial Safety Factors for different loads and combinations are considered based on the probability of occurrence of the loads. Similarly different safety factors for materials are also considered depending on perfection in material characteristics and fabrication/ erection tolerances. Different permissible deflections considering different material of construction have also been proposed.

B) TENSION MEMBERS

Tension members have been designed by considering not only

failure of the net cross section (after taking Shear Lag) but also considering yielding of the gross cross section and rupture of the section at the joint.

C) COMPRESSION MEMBERS

Design of Compression members considers the appropriate buckling curve out of total four numbers depending on the type of section and the axis of buckling. Earlier version of the Working Stress Method of design considered only one buckling curve for all types of members irrespective of the nature of buckling.

D) MEMBERS SUBJECTED TO BENDING

Reduction in Flexure capacity due to high Shear Force has been elaborated in detail. New version introduces tension field design of plated steel girders.

E) MEMBERS SUBJECTED TO COMBINED FORCES

Moment Gradient across a member / element considered in detail, while designing against combined action of axial force and bending moment in an element of a structure.

F) WORKING STRESS METHOD OF DESIGN

Working Stress Method (WSM) of Design has been kept in a separate chapter with minor modifications (compared to the earlier code) and in tune with the specifications of the new code to ensure smooth transition from WSM to LSM for Practicing engineers and Academicians whosoever desires. Working Stress Method of design considered only one buckling curve for all types of members irrespective of the nature of buckling.

G). MEMBERS SUBJECTED TO BENDING

Reduction in Flexure capacity due to high Shear Force has been elaborated in detail. New version introduces tension field design of plated steel girders.

H). MEMBERS SUBJECTED TO COMBINED FORCES

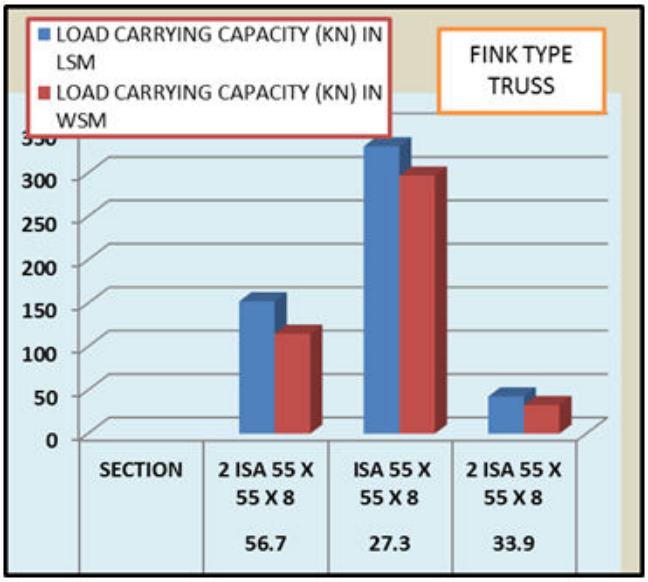
Moment Gradient across a member / element considered in detail, while designing against combined action of axial force and bending moment in an element of a structure.

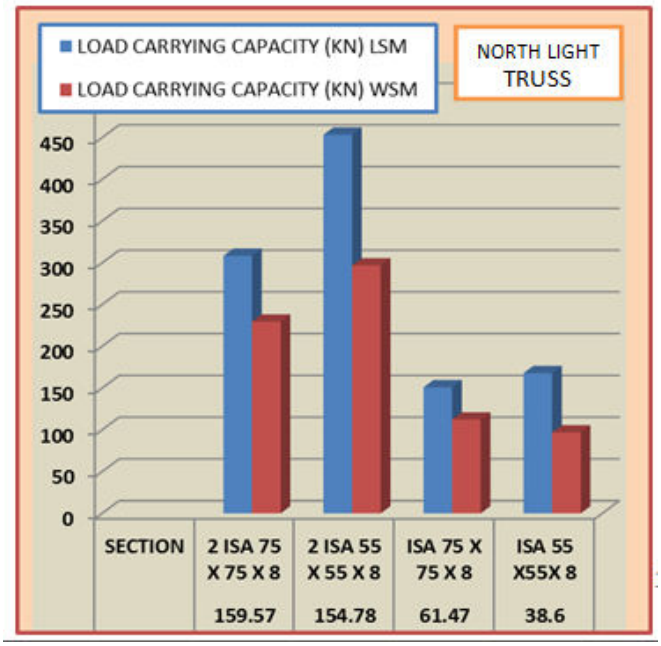
Table.1. Analysis Of Fink Truss By Wsm & Lsm Comparision Of Load Carrying Capacity Of Same Cross Section Of Steel

MEMBER	DESIGN LOAD (KN)	SECTION	LOAD CARRYING CAPACITY (KN) IN LSM	LOAD CARRYING CAPACITY (KN) IN WSM
Principle Rafter	**56.70**	**2 ISA 55 X 55 X 8**	**152.19**	**115**
Main Tie	**27.30**	**ISA 55 X 55 X 8**	**330.90**	**297**
Inclined member	**33.90**	**2 ISA 55 X 55 X 8**	**42.83**	**32.72**

Table2. Analysis of north light truss by wsm & lsm comparision of load carrying capacity of same cross section of steel

MEMBER	DESIGN LOAD (KN)	SECTION	LOAD CARRYING CAPACITY (KN) LSM	LOAD CARRYING CAPACITY (KN) WSM
Principle Rafter	159.57	2 ISA 75 X 75 X 8	308.53	229.57
Main Tie	154.78	2 ISA 55 X 55 X 8	453.59	297
Inclined member	61.47	ISA 75 X 75 X 8	150.94	112.39
Vertical Member	38.6	ISA 55 X55X 8	167.93	96.90





III. CONCLUSION

The limit state method uses different partial safety factor based on theory of probability, involving the separate condition of different kinds of failure type of material and types of loads, Assessment of dead loads can be made more accurately than live loads. Allowable stress design assumes same factor of safety for dead loads and live loads, while for

limit state design method partial safety factor are different for dead and live load . As a result the weight of steel that will result by two approaches will be different and will necessarily depend upon the ratio of live loads and dead loads. Generally, for structures this ratio varies from 0.25 to as high as 4.0; low rise steel building generally fall in the upper range of these ratios, since in allowable stress design method safety factor for dead load and live load is same regardless of their ratio, heavier members will result and factor of safety will increases as the live load to dead load ratio decreases. Saving in weight of steel of the order of 15% for tension and compression members. And 10% for beams may be achieved by limit state method. On the other hand with high live load to dead load ratios the increase in weight of steel is quite low.

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