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RESEARCH ARTICLE

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COMPARATIVE STUDY OF IS: 800-2007 AND IS: 800-1984 ON FLEXURAL MEMBERS, COMPRESSION MEMBERS AND PLATE GIRDER

K. MURALI KRISHNA[1], J. SUPRIYA[2]

[1]PG student, Department of civil engineering, VR Siddhartha engineering college, Vijayawada, India

[2]Assistant professor, Department of Civil engineering College, VR Siddhartha engineering college, Vijayawada, India

ABSTRACT

A structural engineer is often guided in his efforts by the code of practice. The fundamental objective of code is to ensure safety and serviceability. The codes provide guidelines for the design and construction of structures .They are revised at regular intervals to reflect new developments and experience gained from past design practice. In this paper an effort has been made to bring a comparison between IS 800-1984 and IS 800-2007 to suggest the importance of new code of practice IS 800 – 2007. A detailed study of structural components such as flexural members, compressions members and plate girder has been carried out by using IS 800-1984 & IS 800-2007and comparisons are made to suggest the usage of new one.

Keywords: IS 800-1984, IS 800-2007, code of practice, Comparison of codes, Steel structures codes.

INTRODUCTION

IS 800 -2007 is based on limit state method whereas IS 800 -1984 is based working stress method. The acceptable limit for the safety and service ability requirements before failure is limit state .The objective of limit state design is to achieve a structure that will not become unfit for use with an acceptable reliability. IS 800 is basic standarad widley used and accepteded by engineers,technical institutoions, proffesional bodies and industry.

EXPERIMENTAL PROGRAM

Flexural members:

1. Laterally supported beams
2. Laterally unsupported beams

1. *Laterally supported beams:* A beam may be assumed to be adequately supported at the supports, provided the compression flange has full lateral restraint. The design bending strength, M_d shall be taken as:

$$M_d = \frac{\beta_b Z_p f_y}{\gamma_{m0}}$$

$$M_d < \frac{1.2 \times Z_e \times f_y}{\gamma_{m0}}$$ in case of simply supported

$$M_d < \frac{1.5 \times Z_e \times f_y}{\gamma_{m0}}$$ in case of cantilever beams;

Where

β_b = 1.0 for plastic and compact sections;

β_b = Z_e/Z_p for semi-compact sections;

Z_p, Z_e = plastic and elastic section modulii of the cross-section respectively;

f_y = yield stress of the material; and

2. *Laterally unsupported beams :* When abeam is not adequately supported against lateral buckling, the design bending strength is given by

$M_d = \beta_b Z_p f_{bd}$

Where

β_b = 1.0 for plastic and compact sections;

β_b = Z_e/Z_p for semi-compact sections;

Z_p, Z_e = plastic and elastic section modulii of the cross-section respectively;

f_{bd} = Design bending compressive stress, obtained as given below

$$f_{bd} = \frac{\chi_{LT} f_y}{\gamma_{m0}}$$

χ_{LT} = bending stress reduction factor to account for lateral torsional buckling, given by:

$$\chi_{LT} = \frac{1}{\phi_{LT} + [\phi^2_{LT} - \lambda^2_{LT}]^{0.5}}$$

$$\phi_{LT} = 0.5 \times [1 + \alpha_{LT}(\lambda_{LT} - 0.2) + \lambda^2_{LT}]$$

α_{LT}, the imperfection parameter is given by:

α_{LT} = 0.21 for rolled steel section

α_{LT} = 0.49 for rolled steel section

The non-dimensional slenderness ratio,

$$\lambda_{LT} = \sqrt{\frac{\beta_b Z_p f_y}{M_{Cr}}} \le \sqrt{\frac{1.2 Z_e f_y}{M_{Cr}}}$$

3. The design shear force V should be less than the design shear capacity Vd

$$V_d = \frac{f_y}{\sqrt{3} \times \gamma_{m0}} \times h \times t_w$$

where, h= Overall depth of the beam.

tw= Thickness of the web

4. In Is 800-1984 , the permissible bending stress in tension f_{bt} or in compression f_{bc} is given by $f_{bc} = f_{bt} = 0.66 f_y$

Compression members:

i. The design compressive strength P_d , of a member is given by:

$P < P_d$

Where

$P_d = A_e f_{cd}$

Where

A_e = effective sectional area

f_{cd} = design compressive stress.

ii. The design compressive stress, f_{cd}, of axially loaded compression members shall be calculated using the following equation:

$$f_{cd} = \frac{f_y / \gamma_{m0}}{\phi + [\phi^2 - \lambda^2]^{0.5}} = \chi f_y / \gamma_{m0} \le f_y / \gamma_{m0}$$

Where

$\phi = 0.5[1 + \alpha(\lambda - 0.2) + \lambda^2]$

λ = non-dimensional slenderness ratio = $\sqrt{\frac{f_y}{f_{cc}}}$

f_{cc} = Euler buckling stress = $\frac{\pi^2 E}{(KL/r)^2}$

Where

KL/r = effective slenderness ratio

α = imperfection factor

χ = stress reduction factor

λ_{m0} = partial safety factor for material strength.

iii. In Is 800 -1984 the direct stress in compression on the gross sectional area of axially loaded compression members shall not exceed $0.6f_y$ nor the permissible stress σ_{ac}, calculated using the following formula:

$$\sigma_{ac} = 0.6 \frac{f_{cc} \times f_y}{[(f_{cc})^n + (f_y)^n]^{1/n}}$$

Where

σ_{ac} = permissible stress in axial compression, in MPa;

f_y = yield stress of steel, in MPa;

f_{cc} = elastic critical stress in compression, = $\frac{\pi^2 E}{\lambda^2}$

E = modulus of elasticity of steel; 2×10^5 MPa

λ (= l/r) = slenderness ratio of the member, ratio of the effective length to appropriate radius of gyration; and

n = a factor assumed as 1.4

Plate girder:

A plate girder is basically an I-beam built up from plates using riveting or welding.

Serviceability requirement:

i. When transverse stiffeners are not provided,

$\frac{d}{t_w} \le 200\varepsilon$ (Web connected to flanges along both longitudinal edges)

$\frac{d}{t_w} \leq 90\varepsilon$ (Web connected to flanges along one longitudinal edge)

ii. When only transverse stiffeners are provided(in webs connected to flanges along both longitudinal edges),

1. When $3d \geq c \geq d$

$$\frac{d}{t_w} \leq 200\varepsilon$$

2. When $0.74d \geq c \geq d$

$$\frac{c}{t_w} \leq 200\varepsilon_w$$

3. when c < d

$$\frac{d}{t_w} \leq 270\varepsilon_w$$

4. When c > 3d, the web shall be considered as unstiffened.

iii. When transverse stiffeners and longitudinal stiffeners at one level only are provided (0.2d from compression flange)

1. When $2.4 \geq c \geq d$

$$\frac{d}{t_w} \leq 250\varepsilon_w$$

2. When $0.74d \leq c \leq d$

$$\frac{c}{t_w} \leq 250\varepsilon_w$$

3. When $c < 0.74d$

$$\frac{d}{t_w} \leq 340\varepsilon_w$$

iv. When a second longitudinal stiffener (located at neutral axis is provided)

$$\frac{d}{t_w} \leq 400\varepsilon_w$$

Where

d = depth of web

t_w = thickness of web

c = spacing of stiffeners

ε_w = Yield stress ratio of the web $= \sqrt{\frac{250}{f_{yw}}}$

f_{yw} = Yield stress of the web

v. In Is 800-1984 For unstiffened web: The greater of

$\frac{d_1\sqrt{\tau_{va,cal}}}{816}$ and $\frac{d_1\sqrt{f_y}}{1344}$ but not less than $\frac{d_1}{85}$

Where

d_1 =depth of the web

$\tau_{va,cal}$ = calculated average stress in the web due to shear force.

For vertically stiffened webs: the greater of 1/180 of the smallest clear panel dimension

And $\frac{d_2\sqrt{f_y}}{3200}$ but not less than $\frac{d_2}{200}$

For webs stiffened both vertically and horizontally with horizontal stiffener at a distance from the compression flange equal to 2/5 of the distance from the compression flange to the neutral axis: the greater of 1/180 of the smaller dimension in each panel, And $\frac{d_2\sqrt{f_y}}{4000}$ but not less than $\frac{d_2}{250}$

When there is also a horizontal stiffener at the neutral axis of the girder: the greater of 1/180 of the smaller dimension in each panel, And $\frac{d_2\sqrt{f_y}}{6400}$ but not less than $\frac{d_2}{400}$

CONCLUSIONS

Based on the above investigation the following conclusions are made

- Code of practice ensures safety by specifying certain essential minimum requirements for the design.
- Important clauses of IS 800 -1984 and IS 800 -2007 are presented in this paper.
- The design of plate girders according to new code IS 800 – 2007 is very efficient compared to old one.
- The code IS 800 – 2007 is suitable for the current design of practice because it includes some other provisions and advances to the sustainable design.
- The latest code of practice is mostly using by the majority of designers and construction authorities.

REFERENCE

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