iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL
FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 Issue: IV Month of publication: April 2017

DOI: http://doi.org/10.22214/ijraset.2017.4159

Volume 5 Issue IV, April 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Design Aids as per IS 800:2007 using Computer Aided Design for Tension Member

Priyanka Gupta[1], Satyendra Dubey[2]
[1]*Student - M. Tech (Structural Engineering),* [2]*Assistant Professor, Department of Civil Engineering*
GGITS, Jabalpur, M.P., India

Abstract: The B.I.S. recently revised the new IS 800:2007 . this is based on limit state method. This new code includes variety in elements like tension members, compression members, flexural members , combined axial and bending design of members. The B.I.S. has yet not published any design aids based on new IS 800:2007 For saving time in various design of structural steel section, one need to have their own computer program or design aids or spreadsheet which is based on IS 800:2007 . In this project we have developed C++ programming for design the tension member , compression member , flexural member and made an excel spreadsheet which is very helpful for calculating the load bearing capacity in steel . we can use the C++ programming software turboC because all civil software like Autocad , SAP2000, Primavera , Etabs , Revit , STAAD Pro , structural Analysis software S-frame etc are very very costly and not easily available. This project are very helpful in steel designing for all civil engineers. This project comprises three principal sections: general guidance, Design data and design table.
Keywords: IS 800:2007 , limit state design , c++ programming , load bearing capacity.

I. INTRODUCTION

The code of practice for general construction in steel is IS: 800. The IS: 800-1984 was based on elastic method of design. To reflect the latest developments and the state of the art, the third revision of IS: 800 is released in 2007. The IS: 800-2007 is based on limit state method of design. IS 800:2007 is recently modified using the limit state approach, in order to make the standard more useful and in line with standard of other developed nations. The design of tension members in IS 800:2007 has provided C++ programming to compute the tensile stress of a given angle section to reduce the computational effort. However, these C++ programming are more useful for finding the load bearing capacity if the cross section of the tension member is known. It still takes certain effort particularly for the students and inexperienced designers, to select an appropriate section from steel table for given axial tension and effective length.

In limit state method of design, the reliability of design is ensured by satisfying the requirement Design action ≤ Design strength

A. Tension Member

Tension members are liner members in which the axial forces act so as to elongate (stretch) The members. A rope, for example, is a tension members. Tension members carry loads Most efficiently, since the entire cross section is subjected to uniform stress. Unlike compression members, they do not fail by buckling (see chapter on compression members). Ties of trusses [fig (a)], suspenders of cable stayed and suspension bridges [fig.], suspenders of buildings systems hung from a central core [fig.1.1(c)](such buildings are used in earthquake prone zones as a way of minimizing inertia forces on the structure), and sag rods of roof purlins [fig.(d)] are other examples of tension members. Tension members are also encountered as bracings used for the lateral load resistance. In X type bracings [fig.1.1 (e)] the member which is under tension, due to lateral load acting in one direction , undergoes compressive force, when the direction of the lateral load is changed and vice versa. Hence, such members may have to be designed to resist tensile and compressive forces.

Volume 5 Issue IV, April 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

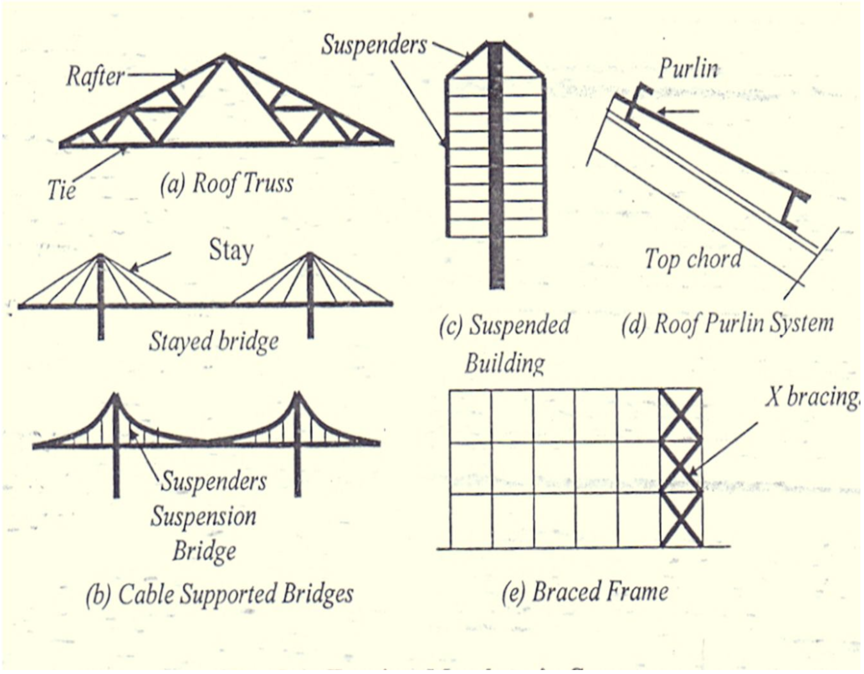

fig1.1– Tension member is structure

B. Type of Tension Member

1) *Minor Tension Member:* Rod , bolt , plate
2) *Major Tension Member:* Bridge, truss , Tie , Wire , Cable , Angle section , T-section, built-up member.

C. Design Strength of Tension Member

The factored design tension T, in the member shall satisfy the following requirement:

$$T < T_d$$

Where, T_d = design strength of the member.

The design strength of a member under axial tension , T_d is the lowest of the design strength due to yielding of gross section T_{dg} ; rupture strength of critical section,T_{dn} and block shear T_{db} , given in 6.2,6.3, and 6.4 respectively in (IS 800:2007)

1) *Design Strength due to Yielding of Gross Section:* The design strength of members under axial tension, Tdg as governed by yielding of gross section, is gross section , is given by

$$T_{dg} = A_g * f_y / \Upsilon_{mo}$$

Where, f_y = yield stress of the material,
A_g = gross area of cross- section
Υ_{mo} = partial safety factor for failure in tension by yielding

2) *Design Strength due to Rupture of Critical Section:*
   a) *Single Angles:* The rupture strength of an angle connected through one leg is affected by shear lag. The design strength, T_{dn} as governed by rupture at net section is given by:

$$T_{dn} = 0.9 * A_{nc} * f_u / \Upsilon_{m1} + \beta * A_{go} * f_y / \Upsilon_{mo}$$

Where, $\beta = 1.4 - 0.076\,(w/t)\,(f_y/f_u)\,(B_s/L_c) \leq (f_u * \Upsilon_{mo}/ f_y * \Upsilon_{m1}) \geq 0.7$

where,
W = outstand lag width
B_s = shear lag, and
L_c = length of the end connection , that is the distance between the outermost bolt direction or length of the weld along the load direction.

For preliminary sizing , the rupture strength of net section may be approximately taken as:

Volume 5 Issue IV, April 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

$$T_{dn} = \alpha * A_n * f_u / \Upsilon_{m1}$$

Where,

α= 0.6 for one or two bolt, 0.7 for three bolts and 0.8 for four or more bolts along the length in the end connection or equivalent weld length;

A_n = net area of the total cross-section;

A_{nc} = net area of the connected leg;

A_{go} = gross area of the outstanding leg; and

t = thickness of the leg

3) *Design Strength due to Block Shear:* The strength as governed by block shear at an end connection of plates and angle is calculated as given in –

a) *Bolted Connections:* The block shear strength , T_{db} of connection shall be taken as the smaller of,

$$T_{db} = (A_{vg} * f_y / (\sqrt{3} * \Upsilon_{mo}) + 0.9 * A_{tn} * f_u / \Upsilon_{m1})$$

Or

$$T_{db} = (0.9 * A_{vn} * f_u / \sqrt{3} * \Upsilon_{m1}) + A_{tg} * f_y / \Upsilon_{mo})$$

Where

A_{vg} ,A_{vn} = minimum gross and net area in the shear along bolt line parallel to external force , respectively.

A_{tg},A_{tn} = minimum gross and net area in tension from the bolt hole to the toe of the angle, end bolt line, perpendicular to the line of force respectively.

F_y,f_u = ultimate and yield stress of the material , respectively.

Q. (A) The angle Section (65*65*6) mm. find out load carrying capacity (factored load) if 04 No. of bolt 16mm diameter used in connection.

C++ Programming for Tension Member :

```
#include <iostream.h>
#include <conio.h>
#include<math.h>
Void main()
{
Float s,t, SA, w, Ag, fy, gamamo, Tdg, fu, gamam1, W1, ed, bs, db, B , Z , Anc , Ago, Tdn ,Avg , Avn, Atn ,
Atg , Tdb1, Tdb2, Nb, Lc, small;
Clrscr();
Fy = 250 ;
gamamo = 1.1 ;
fu = 410;
gamam1 = 1.25 ;
cout<<end<<” enter the value of gross area”<<endl ;
cin>>Ag;
cout<<endl<<”value of Tdg =”;
Tdg = Ag*(fy/gamamo);
Cout<<Tdg;
Cout<<endl<<”enter the weight per m (w) =”<<endl;
Cin>>w;
Cout<<endl<<”enter edge distance (ed) = “<<endl;
Cin>>ed;
Cout<<endl<<”value of w1 = “;
w1 = w – ed;
cout<<endl<<”value of w1 =”<<w1;
cout<<endl<<”enter value of thickness (t) =”<<endl;
cin>>t;
```

Volume 5 Issue IV, April 2017
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

```
cout<<endl<<"value of bs =";
bs = w + w1 – t;
cout<<bs;
cout<<endl<<"enter the value of end connection(Lc) = "<<endl;
cin>>Lc;
cout<<endl<<"value of B"<<endl;
B = 1.4 – 0.076*(w/t)*(fy/fu)*(bs/Lc);
Cout<<B;
Cout<<endl<<"value of Z"<<endl;
Z = (fu*gamamo)/(fy/gamam1);
Cin>>Z;
Cout<<endl<<"enter the value of db =";
Cin>>db;
If (B<=Z &&Z>=0.7)
{
Anc = (w – db – t/2)*t;
Cout<<endl<<"value of Anc"<<Anc;
Ago = (w – t/2)*t;
Cout<<endl<<"value of Ago = "<<Ago;
Tdn = 0.9*Anc*(fu/gamam1) + B*Ago*(fy/gamamo);
Cout<<endl<<"value of Tdn"<<Tdn;
Avg = Lc*t;
Cout<<endl<<"value of Avg"<<Avg;
Cout<<endl<<"enter no. of bolt";
Cin>>Nb;
Avn = (Lc – (Nb – 0.5)*db)*t;
Cout<<endl<<"value of Avn = "<<Avn;
Atn = (ed – db/2)*t;
Cout<<endl<<"value of Atn = " << Atn;
Atg = ed*t;
Cout<<endl<<"value of Atg"<<Atg;
Tdb1 = ((Avg*fy)/(sqrt(3)*gamamo)) + (0.9*Atn*(fu/gamam1));
Cout<<endl<<"value of Tdb1 = " << Tdb1;
Tdb2 = (0.9*Avn*(fu/(sqrt(3)*gamam1)))+(Atg*(fy/gamamo));
Cout<<endl<<"value of Tdb2 = " <<Tdb2;
Cout<<endl<<"smaller value between Tdb1 and Tdb2";
If (Tdb1<Tdb2)
{
Small = Tdb1;
Cout<<endl<<"small = Tdb1";
}
Else
{
Small = Tdb2;
Cout<<endl<<"small = tdb2";
}
If (Tdg<=Tdn)
{
        If(Tdg<=small)
```

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

```
 {
  Cout<<endl<<"enter value is Tdg = ";
 Cout<<Tdg;
 }
 Else
 {
 Cout<<endl<<"smaller value is";
 Cout<<small;
 }
}
Else
{
     If (Tdn<= Tdb1 II Tdn<= Tdb2)
     {
     Cout<<endl<<"smaller value Tdb =";
     Cout<<Tdn;
     }
     Else
     {
     Cout<<endl<<"smaller value is";
     Cout<<small;
     }

}
}
Else
{
Cout<<endl<<" you are enter wrong value so please put again all values because we get wrong value of B =";
Cout<<B;
}
Getch();
}
```

D. Output

Enter the value of gross area = 744mm^2
Value of Tdg = 169090.90N
Enter the weight per meter (w) = 65
Enter edge distance (ed) = 30
Value of w1 = 35
Enter value of thickness(t) = 6mm
Value of bs = 94
Enter value of end connection (Lc) = 150
Value of B = 1.0853
Value of Z = 1.443
Enter the value of db = 17.5mm
Value of Anc = 267 mm^2
Value of Ago = 372 mm^2
Value of Tdn = 170583.43N
Value of Avg = 900 mm^2

Volume 5 Issue IV, April 2017
ISSN: 2321-9653

Enter no. of bolt = 4
Value of Avn = 532.5 mm^2
Value of Atn = 127.5 mm^2
Value of Atg = 180mm^2
Value of Tdb1 = 155732.37N
Value of Tdb2 = 131665.09N
Smaller value between Tdb1 & Tdb2
Small = Tdb2
Smaller value is = 131665.09 N or 131.665 KN ans.

Table : Design table of tension members (Using Bolt)

Designaion	Thickness	Sectional Area (Ag)	Weight per metre	Dia of hole	Dai of bolt	No. of bolt	Length of leg (mm)	Edge distance	End distance	Load carring capacity
	(t) (mm)	(mm²)	(Kg)	(mm)	(mm)		=W	(mm)	(mm)	(KN)
ISA 65*65	6	744	5.8	17.5	16	2	65	30	30	65.2
ISA 65*65	8	976	7.7	17.5	16	2	65	30	30	86.93
ISA 65*65	10	1200	9.4	17.5	16	2	65	30	30	108.66
ISA 65*65	6	744	5.8	17.5	16	3	65	30	30	98.43
ISA 65*65	8	976	7.7	17.5	16	3	65	30	30	131.24
ISA 65*65	10	1200	9.4	17.5	16	3	65	30	30	164.05
ISA 65*65	6	744	5.8	17.5	16	4	65	30	30	131.67

E. Result
The Load carrying capacity (factored load) if The angle Section (65*65*6) mm 04 No. of bolt 16mm diameter = 131.665KN .

II. CONCLUSION
A. According to IS 800:2007 using limit state approach , tables are prepared for design tensile strength of a given angle section with respect to the effective length.
B. The designer can select the appropriate steel section using these tables which ensures that the section is capable of resisting the anticipated loading with an adequate margin of safety.
C. It removes the tedious trial and error method of design.
D. Many developed country have prepared tables for design aids as per their standard code. In india there are no such types of tables according to the new IS 800:2007 code which is based on limit state method design.
E. We can prepared a computer program in C++ programming language may be prepared to compute the tensile strength of various section available in the steel table.
F. Finally a design aids is given in ready reference tabulated format for various angle section.

III. FUTURE SCOPE
A. Design of tension member using varios section like channel section, T-section, plate section etc.
B. Design of HSFG bolt can be included.
C. Tension member using welding connection.
D. Two, three or more row can be considered in spreadsheet.
E. Revision of SP-6 can be done by now IS800-2007.

Volume 5 Issue IV, April 2017
ISSN: 2321-9653

REFERENCES

[1] IS CODE 800:2007 Indian Standard Code of Practice For General Construction in Steel, Bureas Of Standards, New Delhi.
[2] B.Jena ,SSCI (2004), An Overview of Limit State Design Of Steel Structures And IS 800-84,NIT, Rourkela.
[3] Gupta Mohan and Gupta L.M., "Design Aids For Steel Compression Members as Per New IS 800. "Nov 07-08,2008, Bhilai Institute Of Technology,Durg(C.G.).
[4] Handbook Of structural steelwork, 3rd BCSA,SCL, Londan.
[5] Kalyanaraman, V., (2002). " A Review of IS 800 Revision Process", IIT ,Madras.
[6] Subramanian, N.,((2008). Design of Steel Structures, Oxford University Press, New Delhi.
[7] Subramanian, N.,(2005), "Design using Advanced Analysis of Steel structures" , New Building Materials and Construction.
[8] Handbook Design of steel structure by " S.K. DUGGAL".
[9] The C programming language paperback – 2015 by brain W. kerrighan/ Dennis Ritchie (author).
[10] Design of steel structure by "B.C.PUNMIA".
[11] IS 800:1984 code of practice for general construction in steel.
[12] M.K.S. &S.I. units steel tables by R. AGOR.
[13] The C Programming Language by Brian W. Kernighan, Dennis M. Ritchie .
[14] C Programming in 12 Easy Lessons by Greg Perry.
[15] C Programming: A Modern Approach by K.N. King Highly recommended.
[16] M R Shiyekar, "Limit state design in structural steel," PHI Learning Private Limited, New Delhi 110001, 2011.