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Re-assessment of Rivet size by Empirical way for Theoretically Calculating Tensile Strength under IS code 800-1984.

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Abstract

Steel structure are used in the form of steel column base, steel roof truss, steel beam girders, and plate girders and these are fixed with either riveting or welding. While riveting in steel structure when the tensile load comes on the member, the rivet hole is deducted from the cross sectional area of member either it may be IS angle, tea section, channel section or I-Section, while assessing rivet diameter through Unwinds formula, the tensile strength usually comes less. Hence by theoretically and on empirical way the author has calculated the rivet diameter assessment through the new revised formula $\varphi = 5.6\sqrt{t}$ *than the existing formula previously in vogue by* $\varphi = 6.5\sqrt{t}$ *and find more tensile strength theoretically.*

Hence the author of this technical paper promotes the use of $\varphi = 5.6\sqrt{t}$ *in place of* $\varphi = 6.5\sqrt{t}$ *while designed of tensile steel member.*

Keywords: *Steel plates, Rivet value, Tensile Strength, IS code 800-1984*

INTRODUCTION

Steel plates are joined with lap or butt joint and fixed with either by Riveting or welding or both. While riveting the efficiency is measured for joint by dividing joint strength to strength of solid plate.

The joint strength is usually dependent on rivet diameter, thickness of plate and

number of rivet. The tearing strength of plate remains less if more dia rivets are being used and also their numbers. The rivet strength is governed with rivet value and number of rivets .Rivet value is dependent on rivet dia and thickness of plate.

Rivet value is the failure strength of rivet either in shearing or in bearing whichever is less. Shearing will be either single or double. Single shear exists when joint is lap or butt with single cover plate. Double shear will be when joint is butt with double cover plate.

Hence Fs1 = $\frac{\pi}{4}$ xd^2 xfs (for single shear exists in butt joint with single cover plate or lap joint)

Fs2 = 2x $\frac{\pi}{4}$ xd^2 xfs (for double shear exists in double cover plate butt joint)

Fb= Bearing strength of rivet
= fb x dxt

The rivet may fail either in shearing or bearing. Lesser the value of Fs and Fb will be the rivet value usually measured for single rivet.

Rivet strength= No. Of rivet x rivet value
The plate after Riveting may fail in tearing.

The tearing strength Ft=(B-nxd) x t x Ft

Where
B=Plate width, n= no. Of rivet in a rivet line, t= thickness of plate

Lesser the value of rivet strength or plate tearing strength will be the joint strength. The plate joint strength and rivet size with respect to plate thickness has been always an important aspect for joint efficiency point of view.

The Unwins formula has been in vogue hitherto for assessing the rivet shank dia (φ) on the basis of plate the thickness (t).
Formula in vogue

$$\phi = 6.05\sqrt{t}$$

For example,
if t = 10mm then **φ =6.** $\mathbf{05\sqrt{10}}$**=19.13mm=20mm**

When the steel members are joined by riveting then rivet area is deducted from steel sections when the members are being treated as tension member. More rivet sectional area wills less, the strength of joint. Hence it becomes necessary to clause and select the φ judiciously. In compression member no change will occur while choosing diameter of rivet either more or less.

Assessed formula-As the author has set an example and on this basis, it has been revealed that assessing of φ by unwins prevailing formula represents higher dia of rivet shank which reduces the tearing strength of plate as well as increasing bearing strength of rivet cum shearing also. So to get the efficiency more for joint, it is required to get assess, again the φ by revising the existing formula.

The author confines the new formulas

$$\phi_{mkv} = 5.6\sqrt{t}$$

If t=10mm,

$$\phi_{mkv} = 5.6\sqrt{10}=17.69=18mm$$

If we use 18mm φ rivet in place of 20 mm, we find that there will be little change in finding the number of rivets and strength of joint as well as efficiency which will be then higher theoretically A tabulated comparative study for setting an example will demonstrate the theme of this technical paper.

Illustration- suppose plate size is 100mmx10mm joined with lap joint providing 4 rivets in 2 rivet line. Take Ft=150 N/mm2, Fb=300 N/ mm2 and Fs=100 N/ mm2

Table: 1

Joint efficiency by unwins formula	Joint efficiency by author
$\varphi = 6.05\sqrt{10}=20mm$	$\varphi_{mkv} = 5.6\sqrt{10}=18mm$
Rivet hole dia. d=20+1.5=21.5mm	Rivet hole dia. D = 18+1.5=19.5mm
Strength of solid plate Ft= B x t x ft = 100 x 10 x 150 = 150000 N	Strength of solid plate Ft= B x t x ft = 100 x 10 x 15 = 15000 N
For rivet value Fs1= $\frac{\pi}{4}$ x d^2 x fs =0.785x21.5x21.5x100=36286.625N Fb= fb x d x t =300x21.5x10=64500N Rivet value=36286.625N	For rivet value Fs1= $\frac{\pi}{4}$ x d^2 x fs =0.785x19.5x19.5x100=29849.625N Fb= fb x d x t =300x19.5x10=58500N Rivet value=29849.625N
Tearing strength of plate Ft=(B-d) x tx ft = (100-21.5) x 10 x 150 = 117750N	Tearing strength of plate Ft=(B-d) x tx ft = (100-19.5) x 10x150=122250N

No. of rivet= $\frac{117750}{36286.625}$=3.24=4	No. of rivet= $\frac{122250}{29849.625}$=4.09=4
Arrange 4 Rivets in 2 rivet lines. Each rivet line contains 2 rivets. Ft1=(B-2d) x t x ft = (100-43)x10x150=85500N	Arrange 4 Rivets in 2 rivet lines. Each rivet line contains 2 rivets. Ft1=(B-2d) x t x ft = (100-39) x10x150=91500N
Rivet strength (RS) =No. of rivet x Rivet value =4x36286.625N=145146.5N	Rivet strength (RS) =No. of rivet x Rivet value =4x29849.625=119398.5N
Joint strength=Least of Rs & Ft=85500N	Joint strength=Least of RS & Ft=91500N
. Efficiency=$\frac{85500}{150000}$x100=57%	. Efficiency=$\frac{91500}{150000}$x100=61%
	. Efficiency increased= (61-57)/57x100=7%

CONCLUSION

The above study reveals that using of 18mm φ rivets in place of 20 mm, the efficiency of the joint increased by 7% theoretically. Hence the rivet diameter assessed by the author for steel as tension member by the author $\varphi_{mkv} = 5.6\sqrt{t}$ is more feasible than Unwins formula $\varphi=6.05\sqrt{t}$.

So the assessed formula by the author for determining the rivet diameter as $\varphi_{mkv}=5.6\sqrt{t}$ is more relevant and authentic than $\varphi=6.05\sqrt{t}$ formula. Hence the re-assessed formula $\varphi_{mkv}=5.6\sqrt{t}$ must be in vogue and should be promoted for designers for designing of steel structures.

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