# Plastic Section Moduli for I.S. Rolled Steel Beam Sections $\mathbf{Z}_{\mathrm{py}}$ about $\mathbf{Y}$-Y Axis 

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#### Abstract

There are many situations in which the I-Sections used in construction are subjected to moments about their weaker axis, i.e. the $y$-y axis. For such purposes the Plastic Section Modulus about y-y axis becomes necessary. In the present paper an attempt has been made to calculate and present the values of $Z_{p y}$, for I.S. Rolled Steel Beam Sections (with tapered flanges). Since IS $800: 2007^{[2]}$ has not given the values of $Z_{p y}$, of any section, one tapered flange I-Section, viz, 125 TFB @ $13.1 \mathrm{~kg} / \mathrm{m}$, from "Onesteel" (Australia), ${ }^{[4]}$ has been used to ascertain the correctness of calculations. The results are presented in table form in descending order.


keywords: I-Sections, $Z_{p y}$, $I S$ 800: 2007 ${ }^{[2]}$, y-y axis.

## I. INTRODUCTION

I.S. Rolled Steel Beam and Channel Sections are used as Beams, Columns, components of Built-up Beams/Columns, Members of Lattice Girder Bridges, Gantry Girders, Crane Girders, etc. There are many situations in which the I-Sections used in construction are subjected to moments about their weaker axis, i.e. the $y$ - $y$ axis, like eccentric loads on columns, members acting as beamcolumns, etc. Hence, the knowledge of Plastic Moment of Resistance becomes necessary - especially when site conditions demand the use of smaller sections. Also, the strength of any section about the main axes, both $z-z$ and $y-y$ axes, is of academic interest. For such purposes the Plastic Section Modulus about $y$ - $y$ axis becomes necessary. Leading steel manufacturers and distributors in the world e.g. British Steel, Fletcher Easy Steel (New Zealand), Onesteel (Australia) ${ }^{[4]}$, Nippon steel (Japan) etc., publish the values of $\mathrm{Z}_{\mathrm{py}}$, Plastic Section Modulii about y - y axis, in their brochures alongside the values of $\mathrm{Z}_{\mathrm{pz}}$, i.e., Plastic Section Modulii about z-z axis. In the present paper an attempt has been made to calculate and present the values of $Z_{p y}$, for I.S. Rolled Steel Beam Sections (with tapered flanges).

## II. METHOD OF CALCULATION

Typical calculations of $\mathrm{Z}_{\mathrm{py}}$ for the I-Section - ISLB $400 @ 558.2 \mathrm{~N} / \mathrm{m}$ have been given hereunder. The I-Section has been divided into 13 component areas. The area of each component is calculated and the position of centroid of each component is identified and used in the calculation of the Plastic Section Modulus of the cross section about Y-Y axis. Further, the same procedure is applied for calculation of $\mathrm{Z}_{\mathrm{py}}$ of one tapered flange I-Section, viz., $125 \mathrm{TFB} @ 13.1 \mathrm{~kg} / \mathrm{m}$, from Onesteel (Australia), ${ }^{[4]}$ to ascertain the correctness of calculations.

## A. Plastic Section Modulus, $Z_{p p}$, of ISLB 400 @ $558.2 \mathrm{~N} / \mathrm{m}$ :

For ISLB $400 @ 558.2 \mathrm{~N} / \mathrm{m}$ the various geometrical parameters, as per SP: 6(1)-1964, ${ }^{[1]}$ are as follows:
$\mathrm{h}=400 \mathrm{~mm} ; \mathrm{b}=165 \mathrm{~mm} ; \mathrm{t}_{\mathrm{f}}=12.5 \mathrm{~mm} ; \mathrm{t}_{\mathrm{w}}=8 \mathrm{~mm}$; (D) $\theta=98^{\circ} ; \mathrm{r}_{1}=16 \mathrm{~mm} ; \mathrm{r}_{2}=8 \mathrm{~mm}$;
In the Figure 1 :
Z-Z represents the horizontal neutral axis
$Z^{\prime}-Z^{\prime}$ represents the horizontal Equal Area Axis - Z-Z and $Z^{\prime}-Z^{\prime}$ axes coincide.
$\mathrm{Y}-\mathrm{Y}$ represents the vertical neutral axis
$Y^{\prime}-Y^{\prime}$ represents the vertical Equal Area Axis - Y-Y and $Y^{\prime}-Y^{\prime}$ axes coincide.

1) Calculations Of Areas, Centroids And Plastic Section Modulus

Refering to Figure 2 -
Entire Web is taken as a Rectangle of -- $\left(\mathrm{h} \mathrm{X}_{\mathrm{w}}\right)=400 \mathrm{X} 8.0=\mathbf{3 2 0 0 . 0 0 0 0} \mathbf{~ m m}^{2}$

Each Tapered Flange Outstand is taken as --
i) Trapezium, ABCD
ii) Positive Spandrel area with radius $r_{1}$, i.e. the fillet between flange and web
iii) Negative Spandrel area at the toe of flange of radius $r_{2}$


Fig. 2 Flange Geometry for I, C \& T Sections
Area of Trapezium:

$$
A_{t}=A D \times((A B+C D) / 2), \text { where }
$$

$$
\mathrm{AD}=\mathrm{b}_{1}=\left\{\left(\mathrm{b}-\mathrm{t}_{\mathrm{w}}\right) / 2\right\}=(165-8) / 2=\mathbf{7 8 . 5 0 0 0} \mathbf{~ m m}
$$

$$
\mathrm{AB}=\mathrm{t}_{\mathrm{f}}-\left\{\left(\mathrm{b}_{\mathrm{l}} / 2\right) \mathrm{X} \tan (\theta-90)\right\}=12.5-\{(78.5 / 2) \mathrm{X} \tan (98-90)\}=\mathbf{6 . 9 8 3 8} \mathbf{~ m m}
$$

Therefore,

$$
\mathrm{CD}=\mathrm{t}_{\mathrm{f}}+\left\{\left(\mathrm{b}_{1} / 2\right) \mathrm{X} \tan (\theta-90)\right\}=12.5+\{(78.5 / 2) \mathrm{X} \tan (98-90)\}=\mathbf{1 8 . 0 1 6 2} \mathbf{~ m m}
$$

$$
\mathrm{A}_{\mathrm{t}}=\mathrm{AD} \times((\mathrm{AB}+\mathrm{CD}) / 2)=78.5 \times\{(6.9838+18.0162) / 2\}=\mathbf{9 8 1 . 2 5} \mathbf{~ m m}^{\mathbf{2}}
$$

Centroid of Trapezium from AB: $\mathrm{x}_{\mathrm{t}}=(\mathrm{b} 1 / 3) \mathrm{X}\{(\mathrm{AB}+2 \mathrm{CD}) /(\mathrm{AB}+\mathrm{CD})\}$

$$
\begin{aligned}
& =(78.5 / 3) \times\{(6.9838+2 X 18.0162) /(6.9838+18.0162)\} \\
& =\mathbf{4 5 . 0 2 3 6 5} \mathbf{~ m m}
\end{aligned}
$$

Centroid of Trapezium from AD: $y_{t}=\left\{\mathrm{AB}^{2}+(\mathrm{ABXCD})+\mathrm{CD}^{2}\right\} /\{3 \mathrm{X}(\mathrm{AB}+\mathrm{CD})\}$

$$
=\left\{6.9838^{2}+(6.9838 \text { X } 18.0162)+18.0162^{2}\right\} /\{3 \mathrm{X}(6.9838+18.0162)\}
$$

$$
=6.6557 \mathrm{~mm}
$$

Area of Positive Spandrel at Fillet: $=r_{1}{ }^{2}\{(\tan \alpha)-\alpha\}$, where,

$$
\begin{aligned}
\alpha_{1} & =\{(180-\theta) / 2\} X(\pi / 180) \text { radians } \\
& =\{(180-98) / 2\} X(\pi / 180)=\mathbf{0 . 7 1 5 5 8} \text { radians }
\end{aligned}
$$

Therefore, required area $=16^{2} \mathrm{X}\{(\tan 0.71558)-0.71558\}$

$$
=39.34765 \mathrm{~mm}^{2}
$$

Centroid of Spandrel from apex C in figure above, along bisector:

$$
\begin{aligned}
\mathrm{x}_{1}= & \left\{\mathrm{r}_{1}(\sin \alpha \cos \alpha+2 \tan \alpha-3 \alpha)\right\} /\{3(\sin \alpha-\alpha \cos \alpha)\} \\
= & \{16 \mathrm{X}(\sin 0.71558 \mathrm{X} \cos 0.71558+2 \mathrm{X} \tan 0.71558-3 \mathrm{X} 0.71558)\} /\{3 \mathrm{X} \\
& (\sin 0.71558-0.71558 \mathrm{X} \cos 0.71558)\} \\
= & \mathbf{3 . 9 9 7 8} \mathbf{~ m m}
\end{aligned}
$$

Area of Negative Spandrel at Flange end: $=r_{2}{ }^{2}\{(\tan \alpha)-\alpha\}$, where,

$$
\begin{aligned}
\alpha_{2} & =\{(180-\theta) / 2\} X(\pi / 180) \text { radians } \\
& =\{(180-98) / 2\} X(\pi / 180)=\mathbf{0 . 7 1 5 5 8} \text { radians }
\end{aligned}
$$

$$
\begin{aligned}
\text { Therefore, required area }= & 8^{2} \mathrm{X}\{(\tan 0.71558)-0.71558\} \\
& =\mathbf{9 . 8 3 6 9} \mathbf{m m}^{\mathbf{2}}
\end{aligned}
$$

Centroid of Spandrel from apex B in figure above, along bisector:

$$
\begin{aligned}
\mathrm{x}_{2}= & \left\{\mathrm{r}_{2}(\sin \alpha \cos \alpha+2 \tan \alpha-3 \alpha)\right\} /\{3(\sin \alpha-\alpha \cos \alpha)\} \\
= & \{8 \mathrm{X}(\sin 0.71558 \mathrm{X} \cos 0.71558+2 \mathrm{X} \tan 0.71558-3 \mathrm{X} 0.71558)\} /\{3 \mathrm{X} \\
& (\sin 0.71558-0.71558 \mathrm{X} \cos 0.71558)\} \\
= & \mathbf{1 . 9 9 8 9} \mathbf{~ m m}
\end{aligned}
$$

B. Plastic Section Modulus OF ISLB $400 @ 558.2 \mathrm{~N} / \mathrm{m}$ ABOUT Y-Y AXIS (VERTICAL)

Web :

$$
\left(\mathrm{hX} \mathrm{t}_{\mathrm{w}}^{2}\right) / 4=\left(400 \times 8^{2}\right) / 4
$$

$$
=6400.0000 \mathrm{~mm}^{3}
$$

Left and Right Trapeziums at bottom (or top) of web:

$$
\begin{aligned}
\{\mathrm{AD} \times((\mathrm{AB}+\mathrm{CD}) / 2)\} \mathrm{X}\left(\mathrm{~b}-2 \mathrm{x}_{\mathrm{t}}\right)= & 981.25 \mathrm{X}(165-2 \mathrm{X} 45.02365) \\
& =73,547.3369 \mathbf{~ m m}^{3}
\end{aligned}
$$

Left and Right Positive Spandrels at bottom (or top) of web:

$$
\begin{aligned}
\left\{\mathrm{r}_{1}^{2}[(\tan \alpha)-\alpha]\right\} \mathrm{X}\left\{\mathrm{t}_{\mathrm{w}}+2\left[\mathrm{x}_{1} \cos (90-\theta / 2]\right)\right\}= & 39.34765 \mathrm{X}\{8+2 \mathrm{X}[3.9978 \mathrm{X} \cos (90-98 / 2)]\} \\
& =\mathbf{5 5 2 . 2 1 8 9} \mathbf{~ m m}^{\mathbf{3}}
\end{aligned}
$$

Left and Right Negative Spandrels at bottom (or top) of web:

$$
\begin{aligned}
& \qquad \begin{aligned}
\left.\left\{\mathrm{r}_{2}^{2}[(\tan \alpha)-\alpha]\right\} \mathrm{X}\left\{\mathrm{~b}-2 \mathrm{x}_{2} \cos (90-\theta / 2)\right]\right\}= & 9.8369 \mathrm{X}\{165-2 \mathrm{X}[1.9989 \mathrm{X} \cos (90-98 / 2)]\} \\
& =\mathbf{1 , 5 9 3 . 4 0 8 8} \mathbf{~ m m}^{3}
\end{aligned} \\
& \text { Therefore, Plastic Section Modulus of ISLB } \underline{400 @} \begin{aligned}
& 558.2 \mathrm{~N} / \mathrm{m} \text { about } \mathrm{y}-\mathrm{y} \text { axis is: } \\
= & 6400.0000+2 \mathrm{X}(73,547.3369+552.2189-1,593.4088) \\
& =151412.2848 \mathbf{~ m m}^{3}(\text { without rounding off any value }) \\
= & \left(1,51,412.294 \mathrm{~mm}^{3}\right. \text { small error due to rounding off) }
\end{aligned}
\end{aligned}
$$

C. Plastic Section Modulus of 125 TFB @ $13.1 \mathrm{~kg} / \mathrm{m}$ (ONESTEEL, Australia) ${ }^{[4]}$ ABOUT Y-Y AXIS (Vertical) For $125 \mathrm{TFB} @ 13.1 \mathrm{~kg} / \mathrm{m}_{2}$ the various geometrical parameters are as follows:
$\mathrm{h}=125 \mathrm{~mm} ; \mathrm{b}=65 \mathrm{~mm} ; \mathrm{t}_{\mathrm{f}}=8.5 \mathrm{~mm} ; \mathrm{t}_{\mathrm{w}}=5 \mathrm{~mm} ; ~(\mathrm{D}) \theta=98^{\circ} ; \mathrm{r}_{1}=8 \mathrm{~mm} ; \mathrm{r}_{2}=4 \mathrm{~mm}$;
Area of web -- $\quad\left(\mathrm{h} \mathrm{X} \mathrm{t}_{\mathrm{w}}\right)=300 \times 7.6=\mathbf{6 2 5 . 0 0 0 0} \mathbf{~ m m}^{\mathbf{2}}$

$$
A D=b_{1}=30.0000 \mathrm{~mm} ; A B=6.3919 \mathrm{~mm} ; C D=10.6081 \mathrm{~mm} ; A_{t}=\mathbf{2 5 5 . 0 0 0 0} \mathrm{mm}^{2} ; \quad x_{t}=16.2401 \mathbf{~ m m} ; y_{t}
$$

$=4.3371 \mathrm{~mm}$; $\alpha_{1}=\mathbf{0 . 7 1 5 6}$ radians ;
Area of Positive Spandrel at Fillet $=\mathbf{= 9 . 8 3 6 9} \mathrm{mm}^{2}$; $\mathrm{x}_{1}=\mathbf{1 . 9 9 8 9 ~ \mathbf { m m } ; ~} \alpha_{2}=\mathbf{0 . 7 1 5 6}$ radians ;
Area of Negative Spandrel at Flange end $=\mathbf{2 . 4 5 9 2} \mathbf{~ m m}^{2} ; \mathrm{x}_{2}=\mathbf{0 . 9 9 9 4 5} \mathbf{~ m m}$;

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Plastic Section Modulus
(i) Web : $\left(\mathrm{hXt}_{\mathrm{w}}{ }^{2}\right) / 4=\left(125 \mathrm{X} 5^{2}\right) / 4 \quad=\mathbf{7 8 1 . 2 5 0 0} \mathrm{mm}^{3}$
(ii)Left and Right Trapeziums at bottom (or top) of web :

$$
\begin{aligned}
\{\mathrm{AD} \times((\mathrm{AB}+\mathrm{CD}) / 2)\} \mathrm{X}\left(\mathrm{~b}-2 \mathrm{x}_{\mathrm{t}}\right)= & 255.0000 \mathrm{X}(65-2 \mathrm{X} \mathrm{16.2401}) \\
& =\mathbf{8 , 2 9 2 . 5 4 9} \mathbf{~ m m}^{3}
\end{aligned}
$$

(iii)Left and Right Positive Spandrels at bottom (or top) of web:

$$
\begin{aligned}
\left\{\mathrm{r}_{1}^{2}[(\tan \alpha)-\alpha]\right\} \times\left\{\mathrm{t}_{\mathrm{w}}+2\left[\mathrm{x}_{1} \cos (90-\theta / 2]\right)\right\}= & \mathbf{9 . 8 3 6 9} \times\{5+2 \mathrm{X}[1.9989 \times \cos (90-98 / 2)]\} \\
& =\mathbf{7 8 . 8 6 4 2} \mathbf{~ m m}^{3}
\end{aligned}
$$

(iv)Left and Right Negative Spandrels at bottom (or top) of web:

$$
\begin{aligned}
\left.\left\{\mathrm{r}_{2}^{2}[(\tan \alpha)-\alpha]\right\} \times\left\{b-2 \mathrm{x}_{2} \cos (90-\theta / 2)\right]\right\}= & \mathbf{2} . \mathbf{4 5 9 2} \mathrm{X}\{65-2 \mathrm{X}[0.99945 \mathrm{X} \cos (90-98 / 2)]\} \\
& =\mathbf{1 5 6 . 1 3 8 1} \mathbf{~ m m}^{\mathbf{3}}
\end{aligned}
$$

Therefore, Plastic Section Modulus of 125 TFB @ $13.1 \mathrm{~kg} / \mathrm{m}$ about y -y axis is:

$$
\begin{gathered}
=781.2500+2 \mathrm{X}(8,292.549+78.8642-156.1381) \\
=17,211.8315 \mathrm{~mm}^{3}(\text { without rounding off any value }) \\
=\left(17,211.8002 \mathrm{~mm}^{3} \text { small error due to rounding off }\right)
\end{gathered}
$$

The corresponding value given in the Onesteel (Australia) ${ }^{[4]}$ Brochure is $17.2 \times 10^{3} \mathrm{~mm}^{3}$, which exactly matches with the value calculated above, considering the accuracy adopted in the brochure.

## III. RESULTS AND DISCUSSIONS

The above calculations are done for all I.S. Rolled Steel I-Sections and and presented in descending order, in tabular form below. As the value of $Z_{p y}$ calculated by the above method for a typical I-Section, i.e., $125 \mathrm{TFB} @ 13.1 \mathrm{~kg} / \mathrm{m}$, from the Onesteel (Australia) ${ }^{[4]}$ brochure has exactly matched with the value given in the brochure, it may be said that the method of calculation is satisfactory.

| TABLE 1 DECENDING ORDER OF $\mathrm{Z}_{\mathrm{py}}$ VALUES OF I.S. ROLLED STEEL I - |  |  |
| :---: | :---: | :---: |
| Section | Area(mm ${ }^{2}$ ) | $\mathrm{Z}_{\text {Py }}$ |
| ISWB600 @ 145.1kg/m | 18514.0395 | 696001.5597 |
| ISWB600 @ 133.7kg/m | 17037.9861 | 619235.2059 |
| ISWB550 @ 112.5kg/m | 14333.9369 | 500178.7515 |
| ISMB600 @ 122.6kg/m | 15621.2421 | 429350.3500 |
| ISWB500 @ $95.2 \mathrm{~kg} / \mathrm{m}$ | 12121.9119 | 406829.5384 |
| ISHB450 @ 92.5kg/m | 11789.3459 | 402733.9091 |
| ISHB450 @ $87.2 \mathrm{~kg} / \mathrm{m}$ | 11114.3459 | 394145.0247 |
| ISHB400 @ $82.2 \mathrm{~kg} / \mathrm{m}$ | 10465.8898 | 368174.0224 |
| ISHB400 @ $77.4 \mathrm{~kg} / \mathrm{m}$ | 9865.8898 | 360549.6050 |
| ISHB350 @ $72.4 \mathrm{~kg} / \mathrm{m}$ | 9221.0742 | 332453.8195 |
| ISMB550 @ 103.7kg/m | 13211.0781 | 328074.7930 |
| ISHB350 @ 67.4kg/m | 8591.0742 | 324438.3527 |
| ISLB600@ $99.5 \mathrm{~kg} / \mathrm{m}$ | 12668.9421 | 306840.6438 |
| ISHB300 @ 63.0kg/m | 8024.9545 | 298562.9823 |
| ISHB300@ $58.8 \mathrm{~kg} / \mathrm{m}$ | 7484.9545 | 291583.5232 |
| ISWB450 @ $79.4 \mathrm{~kg} / \mathrm{m}$ | 10115.0511 | 284181.8457 |
| ISHB250@ $54.7 \mathrm{~kg} / \mathrm{m}$ | 6970.7471 | 268551.8492 |
| ISHB250 @ $51.0 \mathrm{~kg} / \mathrm{m}$ | 6495.7471 | 262155.2645 |
| ISMB500 @ 86.9kg/m | 11074.3794 | 259630.9756 |
| ISLB550 @ 86.3kg/m | 10997.3981 | 246298.6750 |
| ISWB400 @ $66.7 \mathrm{~kg} / \mathrm{m}$ | 8501.2544 | 234192.5658 |
| ISLB500 @ 75.0kg/m | 9549.8194 | 206685.6693 |
| ISHB225 @ $46.8 \mathrm{~kg} / \mathrm{m}$ | 5966.3071 | 206508.0806 |
| ISHB225 @ $43.1 \mathrm{~kg} / \mathrm{m}$ | 5493.8071 | 200491.5207 |
| ISWB350 @ $56.9 \mathrm{~kg} / \mathrm{m}$ | 7249.9020 | 200470.7328 |

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| ISMB450 @ $72.4 \mathrm{~kg} / \mathrm{m}$ | 9226.6287 | 187142.4228 |
| :---: | :---: | :---: |
| ISLB450 @ 65.3kg/m | 8313.5629 | 174700.6499 |
| ISWB300 @ $48.1 \mathrm{~kg} / \mathrm{m}$ | 6132.7538 | 171017.3535 |
| ISHB200 @ 40.0kg/m | 5094.4317 | 163466.5906 |
| ISHB200 @ 37.3kg/m | 4754.4317 | 159280.8236 |
| ISLB400@ $56.9 \mathrm{~kg} / \mathrm{m}$ | 7243.0429 | 151412.2848 |
| ISMB400 @ 61.6kg/m | 7845.5766 | 149677.9681 |
| ISWB250 @ $40.9 \mathrm{~kg} / \mathrm{m}$ | 5204.6097 | 149672.2745 |
| ISLB350 @ $49.5 \mathrm{~kg} / \mathrm{m}$ | 6301.3229 | 134609.8771 |
| ISMB350 @ $52.4 \mathrm{~kg} / \mathrm{m}$ | 6671.3366 | 129734.4638 |
| ISLB325 @ 43.1kg/m | 5489.8429 | 111885.2017 |
| ISMB300 @ $44.2 \mathrm{~kg} / \mathrm{m}$ | 5626.3766 | 110469.0531 |
| ISHB150@34.6kg/m | 4407.7485 | 105310.2341 |
| ISWB225@33.9kg/m | 4323.9499 | 99773.2533 |
| ISHB150 @ $30.7 \mathrm{~kg} / \mathrm{m}$ | 3897.7485 | 98250.5616 |
| ISHB150 @ $27.1 \mathrm{~kg} / \mathrm{m}$ | 3447.7485 | 92741.4388 |
| ISLB300@37.7kg/m | 4807.7887 | 89983.8892 |
| ISMB250@37.3kg/m | 4755.4268 | 89709.9925 |
| ISWB200 @ $28.8 \mathrm{~kg} / \mathrm{m}$ | 3670.8699 | 78704.1064 |
| ISLB275 @ $33.0 \mathrm{~kg} / \mathrm{m}$ | 4201.7366 | 73546.4652 |
| ISMB225 @ $31.2 \mathrm{~kg} / \mathrm{m}$ | 3971.4992 | 66320.5747 |
| ISLB250@ $27.9 \mathrm{~kg} / \mathrm{m}$ | 3552.8868 | 55372.3314 |
| ISWB175 @ $22.1 \mathrm{~kg} / \mathrm{m}$ | 2811.2942 | 51273.4065 |
| ISMB200@25.4kg/m | 3232.6737 | 49994.2680 |
| ISLB225 @ $23.5 \mathrm{~kg} / \mathrm{m}$ | 2991.6392 | 39228.1679 |
| ISLB200@19.8kg/m | 2526.7608 | 36916.0099 |
| ISMB175 @ 19.3kg/m | 2462.0105 | 32098.0608 |
| ISWB150@ 17.0kg/m | 2166.5342 | 31940.0391 |
| ISLB175 @ 16.7kg/m | 2129.7208 | 28339.0502 |
| ISMB150 @ $14.9 \mathrm{~kg} / \mathrm{m}$ | 1900.3895 | 22322.7948 |
| ISLB150 @ 14.2kg/m | 1808.3208 | 22120.6197 |
| ISMB125 @ 13.0kg/m | 1660.4695 | 19583.5487 |
| ISLB125@11.9kg/m | 1512.2067 | 18374.8708 |
| ISMB100 @ 11.5kg/m | 1459.7495 | 18224.3327 |
| ISJB225 @ 12.8kg/m | 1627.7958 | 16290.2658 |
| ISJB200@9.9kg/m | 1264.3682 | 9353.5390 |
| ISLB100 @ 8.0kg/m | 1021.0958 | 8204.7936 |
| ISLB75 @ $6.1 \mathrm{~kg} / \mathrm{m}$ | 771.3828 | 6395.9855 |
| ISJB175@8.1kg/m | 1027.6482 | 6320.9247 |
| ISJB $150 @ 7.1 \mathrm{~kg} / \mathrm{m}$ | 900.7682 | 5960.8423 |

## IV. CONCLUSIONS

All leading Steel manufacturers and distributors in the world provide the values of Plastic Section Modulii for $\mathrm{z}-\mathrm{z}$ and y - y axes of all sections manufactured/distributed by them. IS 800:2007 ${ }^{[2]}$ gives Plastic Section Modulii about z-z axis only, and further, only for two types of sections, viz. I and $C$ sections.
The importance of $\mathrm{Z}_{\mathrm{py}}$ values has already been mentioned in the introductory part. Hence, the values presented here for $\mathrm{Z}_{\mathrm{py}}$, verified for a typical section of Onesteel (Australia) ${ }^{[4]}$ may be considered to be correct and useful. However, a further scrutiny of the methodology and calculations, presented here, is always helpful.

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