Code of Practice for the Structural Use of Steel 2011

The Buildings Department (BD) has set up a Technical Committee (TC) to, among others, collect and consider the views and feedback from the building industry arising from the use of the Code of Practice for the Structural Use of Steel 2011 (Steel Code 2011). Taking into account the advice of the TC, the following amendments to Steel Code 2011 have been promulgated and Steel Code 2011 (2023 Edition) incorporating all these amendments has been uploaded to BD website www.bd.gov.hk:

(a) Appendix A – November 2016;

(b) Appendix B – May 2021; and

(c) Appendix C – March 2023.

(YU Po-mei, Clarice)
Building Authority

Ref. : BD GR/1-55/110 (VII)
First issue March 2023 (AD/NB2)

Amendments to Code of Practice for the Structural Use of Steel 2011

(November 2016)

Legends:

🟨 Revision/Addition

(3/2023)

Major amendments to the Code of Practice for the Structural Use of Steel 2011 in November 2016 included:

(a) updating the characteristic strength of reinforcement bar from 460 N/mm^2 to 500 N/mm^2 in accordance with the latest reinforcement bar standard CS2:2012 and the parameters of characteristic resistance of headed shear stud in different grades of concrete shown in Table 10.7;

(b) including an additional Table 12.2e on strength reduction factors for hot rolled reinforcing bars at elevated temperatures and Chinese standard GB/T 700-2006 in the Acceptable Standard List in Annex Al.1.3;

(c) explicating the need on second-order direct analysis for members in bending and sensitive to buckling in Equation 6.14 and the term of restrained beam mentioned in Clause 8.2 for consideration of lateral torsional buckling;

(d) standardizing the two similar terms of "oscillation" and "vibration" to the latter to remove ambiguity and tally with that in the Chinese version; and

(e) correcting the typo errors on expression of the reduction factor in Equation 9.23 and designation of buckling curves for S460 hot-finished structural hollow section in Table 8.7.

Amendments to the Code of Practice for Structural Use of Steel 2011 (November 2016)

<table>
<tr><th>Item</th><th>Clause/ Annex</th><th>Current Version</th><th>Amendments</th><th>Remarks</th></tr>
<tr><td>1</td><td>Clause 1.1 – para. 9</td><td>Section 5 contains particular requirements and guidance for deflection control and structural dynamics including serviceability criteria for wind induced oscillation of tall buildings. The section also covers durability and protection against corrosion attack.</td><td>Section 5 contains particular requirements and guidance for deflection control and structural dynamics including serviceability criteria for wind induced vibration of tall buildings. The section also covers durability and protection against corrosion attack.</td><td rowspan="2">The terms “oscillation” and “vibration” are collectively read as “vibration” for consistency.</td></tr>
<tr><td>2</td><td>Clause 1.2.5 – para. 3</td><td>Serviceability limit states correspond to limits beyond which specified in-service criteria are no longer met. Examples are deflection, wind-induced oscillation, human-induced vibration and durability.</td><td>Serviceability limit states correspond to limits beyond which specified in-service criteria are no longer met. Examples are deflection, wind-induced vibration, human-induced vibration and durability.</td></tr>
<tr><td>3</td><td>Clause 2.2 - Table 2.1</td><td>Table 2.1 - Limit states
<table>
<tr><th>Ultimate limit states (ULS)</th><th>Serviceability limit states (SLS)</th></tr>
<tr><td>Strength (including general yielding, rupture, buckling and forming a mechanism)</td><td>Deflection</td></tr>
<tr><td>Stability against overturning, sliding, uplift and sway stability</td><td>Vibration</td></tr>
<tr><td>Fire resistance</td><td>Wind induced oscillation</td></tr>
<tr><td>Brittle fracture and fracture caused by fatigue</td><td>Durability</td></tr>
</table>
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<tr><td>Brittle fracture and fracture caused by fatigue</td><td>Durability</td></tr>
</table>
Note:- For cold-formed steel, excessive local deformation is to be assessed under ultimate limit state.</td><td>The terms “Vibration” and “Wind induced oscillation” stated in Table 2.1 are amended to “Human induced vibration” and “Wind induced vibration” respectively.</td></tr>
<tr><td>4</td><td>Clause 2.3.3 – para. 3</td><td>Situations where fatigue resistance needs to be considered include the following:
• Where there are wind-induced oscillations due to aerodynamic instability. Normal fluctuations in wind loading need not be considered.
• Structural members that support heavy vibratory plant or machinery.
• Members that support cranes as defined in clause 13.7.
• Bridge structures, which will normally be designed to a bridge design code.</td><td>Situations where fatigue resistance needs to be considered include the following:
• Where there are wind-induced vibrations due to aerodynamic instability. Normal fluctuations in wind loading need not be considered.
• Structural members that support heavy vibratory plant or machinery.
• Members that support cranes as defined in clause 13.7.
• Bridge structures, which will normally be designed to a bridge design code.</td><td rowspan="2">The terms “oscillation” and “vibration” are collectively read as “vibration” for consistency.</td></tr>
<tr><td>5</td><td>Clause 2.4 – para. 1</td><td>SERVICEABILITY LIMIT STATES (SLS)
Serviceability limit states consider service requirements for a structure or structural element under normally applied loads. Examples are deflection, human induced vibration, wind induced oscillation and durability. They are described in section 5.</td><td>SERVICEABILITY LIMIT STATES (SLS)
Serviceability limit states consider service requirements for a structure or structural element under normally applied loads. Examples are deflection, human induced vibration, wind induced vibration and durability. They are described in section 5.</td></tr>
</table>

6	Clause 5.2 - Table 5.1	Note: Exceedance of the above limit is not acceptable unless a full justification is provided. Precamber deflection can be deduced in the deflection calculation. Ponding should nevertheless be avoided in all cases. Long span structures should be checked against vibration and oscillation.	Note: Exceedance of the above limit is not acceptable unless a full justification is provided. Precamber deflection can be deduced in the deflection calculation. Ponding should nevertheless be avoided in all cases. Long span structures should be checked against vibration.	The terms "oscillation" and "vibration" are collectively read as "vibration" for consistency hence the word "oscillation" is deleted.
7	Clause 5.3	**WIND-INDUCED OSCILLATION** Vibration and oscillation of a structure should be limited to avoid discomfort to users and damage to contents. For special structures, including long-span bridges, large stadium roofs and chimneys, wind tunnel model tests are recommended for their wind resistant design to meet serviceability limits.	**WIND-INDUCED VIBRATION** Vibration of a structure should be limited to avoid discomfort to users and damage to contents. For special structures, including long-span bridges, large stadium roofs and chimneys, wind tunnel model tests are recommended for their wind resistant design to meet serviceability limits.	
8	Clause 5.3.2	**Serviceability limit state** The serviceability limit states on oscillation, deflection and acceleration should be checked to ensure serviceable condition for the structure.	**Serviceability limit state** The serviceability limit states on vibration, deflection and acceleration should be checked to ensure serviceable condition for the structure.	The terms "oscillation" and "vibration" are collectively read as "vibration" for consistency.
9	Clause 5.3.3.1	*Natural frequencies* Structural analysis programmes should be used to determine the natural frequencies of vibration of buildings and structures to mitigate excessive horizontal oscillation and vertical vibration. Empirical formulae can also be used for approximated vibration analysis of typical and regular buildings.	*Natural frequencies* Structural analysis programmes should be used to determine the natural frequencies of vibration of buildings and structures to mitigate excessive horizontal and vertical vibration. Empirical formulae can also be used for approximated vibration analysis of typical and regular buildings.	The terms "oscillation" and "vibration" are collectively read as "vibration" for consistency hence the word "oscillation" is deleted.
10	Clause 5.3.5	**Serviceability criteria for communication and broadcasting towers** Communication and broadcasting services demand minimal disruption to transmission. The serviceability limits for communication and broadcasting towers are selected to meet the performance specifications of antennae and other transmission devices to be mounted on those towers. Excessive oscillation and vibration of towers should be avoided. For design, reference should be made to specialist literature.	**Serviceability criteria for communication and broadcasting towers** Communication and broadcasting services demand minimal disruption to transmission. The serviceability limits for communication and broadcasting towers are selected to meet the performance specifications of antennae and other transmission devices to be mounted on those towers. Excessive vibration of towers should be avoided. For design, reference should be made to specialist literature.	
11	Clause 6.8.3 – equation 6.14	Member lateral-torsional and torsional buckling checks are carried out separately or alternatively by replacing M_{cx} in the above equation by the buckling resistance moment M_b in Equations 8.20 to 8.22. If moment equivalent factor m_{LT} is less than 1, both Equation 6.12 or 6.13 and Equation 6.14 are required for member resistance check. $\frac{F_c}{A_g p_y} + \frac{M_x}{M_{cx}} + \frac{M_y}{M_{cy}} = \frac{F_c}{A_g p_y} + \frac{m_{LT}[\overline{M}_x + F_c(\Delta_x + \delta_x)]}{M_b} + \frac{m_y[\overline{M}_y + F_c(\Delta_y + \delta_y)]}{M_{cy}} \leq 1$ (6.14) The equivalent uniform moment factor m_{LT} for beams and the moment equivalent factor m_y for flexural buckling can be referred to Tables 8.4 a & b and Table 8.9.	Member lateral-torsional and torsional buckling checks are carried out separately or alternatively by replacing M_{cx} in the above equation by the buckling resistance moment M_b in Equations 8.20 to 8.22. If moment equivalent factor m_{LT} is less than 1, both Equation 6.12 or 6.13 and Equation 6.14 are required for member resistance check. $\frac{F_c}{A_g p_y} + \frac{M_x}{M_{cx}} + \frac{M_y}{M_{cy}} = \frac{F_c}{A_g p_y} + \frac{m_{LT}[\overline{M}_x + F_c(\Delta_x + \delta_x)]}{M_b} + \frac{m_y[\overline{M}_y + F_c(\Delta_y + \delta_y)]}{M_{cy}} \leq 1$ (6.14) The equivalent uniform moment factor m_{LT} for beams and the moment equivalent factor m_y for flexural buckling can be referred to Tables 8.4 a & b and Table 8.9. For members in bending and sensitive to buckling, imperfection on both axes should be considered if effective length has reduction in capacity about buckling in both axes.	For second-order direct analysis, imperfections in both axes should be considered for members in bending about strong axis and sensitive to lateral torsional buckling.

<table>
<tr>
<td>12</td>
<td>Clause 8.2 – para.1</td>
<td>RESTRAINED BEAMS
Restrained beams refer to beams provided with full lateral restraint to their top flanges and with full torsional restraint at their ends. In such a case, lateral-torsional buckling should not occur before plastic moment capacity.</td>
<td>RESTRAINED BEAMS
Restrained beams refer to beams provided with full lateral restraint to their top flanges and with nominal torsional restraint at their ends. In such a case, lateral-torsional buckling should not occur before plastic moment capacity.</td>
<td>Torsional restraint requirement of beams at the ends to prevent lateral torsional buckling is revised from full restraint to nominal restraint</td>
</tr>
<tr>
<td>13</td>
<td>Clause 8.7.6 - Table 8.7</td>
<td>Table 8.7 - Designation of buckling curves for different section types
<table>
<tr><th rowspan="2">Type of section</th><th rowspan="2">Maximum thickness (see note1)</th><th colspan="2">Axis of buckling</th></tr>
<tr><th>x-x</th><th>y-y</th></tr>
<tr><td>Hot-finished structural hollow sections with steel grade > S460 or hot-finished seamless structural hollow sections</td><td></td><td>a_0)</td><td>a_0)</td></tr>
<tr><td>Hot-finished structural hollow section < grade S460</td><td></td><td>a)</td><td>a)</td></tr>
<tr><td>Cold-formed structural hollow section of longitudinal seam weld or spiral weld</td><td></td><td>c)</td><td>c)</td></tr>
<tr><td>Rolled I-section</td><td>≤ 40 mm
> 40 mm</td><td>a)
b)</td><td>b)
c)</td></tr>
<tr><td>Rolled H-section</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>c)
d)</td></tr>
<tr><td>Welded I- or H-section (see note 2)</td><td>≤ 40 mm
> 40 mm</td><td>b)
b)</td><td>c)
d)</td></tr>
<tr><td>Rolled I-section with welded flange cover plates with 0.25 < U/B < 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
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b)</td><td>b)
c)</td></tr>
<tr><td>Rolled H-section with welded flange cover plates with 0.25 < U/B < 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
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c)</td><td>c)
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<tr><td>Rolled I or H-section with welded flange cover plates with U/B ≥ 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
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c)</td><td>a)
b)</td></tr>
<tr><td>Rolled I or H-section with welded flange cover plates with U/B ≤ 0.25 as shown in Figure 8.4)</td><td>≤ 40 mm
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b)</td><td>c)
d)</td></tr>
<tr><td>Welded box section (see note 3)</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>b)
c)</td></tr>
<tr><td>Round, square or flat bar</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>b)
c)</td></tr>
<tr><td>Rolled angle, channel or T-section
Two rolled sections laced, battened or back-to-back
Compound rolled sections</td><td></td><td colspan="2">Any axis: c)</td></tr>
<tr><td colspan="4">NOTE:
1. For thickness between 40mm and 50mm the value of p_c may be taken as the average of the values for thicknesses up to 40mm and over 40mm for the relevant value of p_y.
2. For welded I or H-sections with their flanges thermally cut by machine without subsequent edge grinding or machining, for buckling about the y-y axis, strut curve b) may be used for flanges up to 40mm thick and strut curve c) for flanges over 40mm thick.
3. The category “welded box section” includes any box section fabricated from plates or rolled sections, provided that all of the longitudinal welds are near the corners of the cross-section. Box sections with longitudinal stiffeners are NOT included in this category.
4. Use of buckling curves based on other recognized design codes allowing for variation between load and material factors and calibrated against Tables 8.8(a_0), (a) to (h) is acceptable. See also footnote under Table 8.8.</td></tr>
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d)</td></tr>
<tr><td>Rolled I or H-section with welded flange cover plates with U/B ≥ 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
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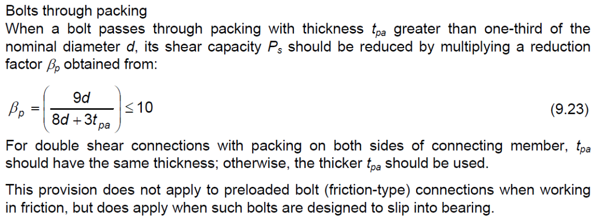
</table></td>
<td>Typo error on designation of buckling curves for the grade of hot-finished structural hollow section less than or equal to S460 is rectified.</td>
</tr>
</table>

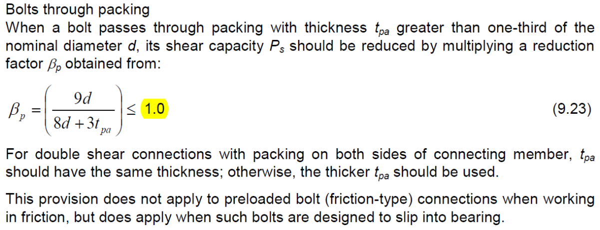
<table>
<tr>
<td>14</td>
<td>Clause 9.3.6.1.6 – equation 9.23</td>
<td>


Bolts through packing

When a bolt passes through packing with thickness t_{pa} greater than one-third of the nominal diameter d, its shear capacity P_s should be reduced by multiplying a reduction factor β_p obtained from:

$$\beta_p = \left(\frac{9d}{8d + 3t_{pa}}\right) \leq 10 \qquad (9.23)$$

For double shear connections with packing on both sides of connecting member, t_{pa} should have the same thickness; otherwise, the thicker t_{pa} should be used.

This provision does not apply to preloaded bolt (friction-type) connections when working in friction, but does apply when such bolts are designed to slip into bearing.
</td>
<td>


Bolts through packing

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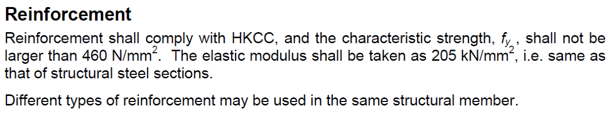
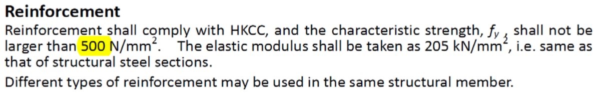
</td>
<td>Typo error on the upper bound of equation 9.23 in calculating the reduction factor β_p is rectified.</td>
</tr>
<tr>
<td>15</td>
<td>Clause 10.1.3</td>
<td>


Reinforcement

Reinforcement shall comply with HKCC, and the characteristic strength, f_y, shall not be larger than 460 N/mm^2. The elastic modulus shall be taken as 205 kN/mm^2, i.e. same as that of structural steel sections.

Different types of reinforcement may be used in the same structural member.
</td>
<td>


Reinforcement

Reinforcement shall comply with HKCC, and the characteristic strength, f_y, shall not be larger than 500 N/mm^2. The elastic modulus shall be taken as 205 kN/mm^2, i.e. same as that of structural steel sections.

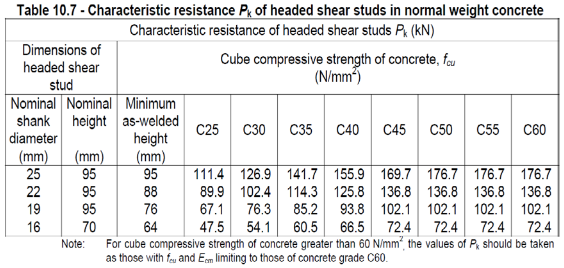
Different types of reinforcement may be used in the same structural member.
</td>
<td>The characteristic strength of reinforcement bar is changed to 500N/mm^2 to meet with the latest reinforcement bar standard CS2:2012</td>
</tr>
<tr>
<td>16</td>
<td>Clause 10.3.2.2 - Table 10.7</td>
<td>


Table 10.7 - Characteristic resistance P_k of headed shear studs in normal weight concrete

<table>
<tr><th colspan="11">Characteristic resistance of headed shear studs P_k (kN)</th></tr>
<tr><th colspan="2">Dimensions of headed shear stud</th><th colspan="9">Cube compressive strength of concrete, f_{cu} (N/mm^2)</th></tr>
<tr><th>Nominal shank diameter (mm)</th><th>Nominal height (mm)</th><th>Minimum as-welded height (mm)</th><th>C25</th><th>C30</th><th>C35</th><th>C40</th><th>C45</th><th>C50</th><th>C55</th><th>C60</th></tr>
<tr><td>25</td><td>95</td><td>95</td><td>111.4</td><td>126.9</td><td>141.7</td><td>155.9</td><td>169.7</td><td>176.7</td><td>176.7</td><td>176.7</td></tr>
<tr><td>22</td><td>95</td><td>88</td><td>89.9</td><td>102.4</td><td>114.3</td><td>125.8</td><td>136.8</td><td>136.8</td><td>136.8</td><td>136.8</td></tr>
<tr><td>19</td><td>95</td><td>76</td><td>67.1</td><td>76.3</td><td>85.2</td><td>93.8</td><td>102.1</td><td>102.1</td><td>102.1</td><td>102.1</td></tr>
<tr><td>16</td><td>70</td><td>64</td><td>47.5</td><td>54.1</td><td>60.5</td><td>66.5</td><td>72.4</td><td>72.4</td><td>72.4</td><td>72.4</td></tr>
</table>

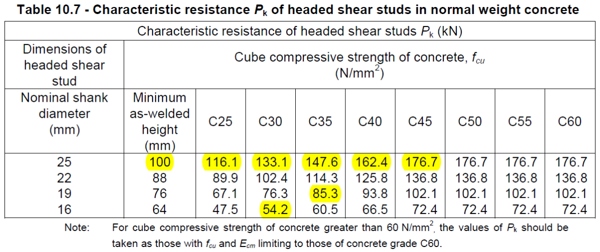
Note: For cube compressive strength of concrete greater than 60 N/mm^2, the values of P_k should be taken as those with f_{cu} and E_{cm} limiting to those of concrete grade C60.
</td>
<td>


Table 10.7 - Characteristic resistance P_k of headed shear studs in normal weight concrete

<table>
<tr><th colspan="10">Characteristic resistance of headed shear studs P_k (kN)</th></tr>
<tr><th>Dimensions of headed shear stud</th><th colspan="9">Cube compressive strength of concrete, f_{cu} (N/mm^2)</th></tr>
<tr><th>Nominal shank diameter (mm)</th><th>Minimum as-welded height (mm)</th><th>C25</th><th>C30</th><th>C35</th><th>C40</th><th>C45</th><th>C50</th><th>C55</th><th>C60</th></tr>
<tr><td>25</td><td>100</td><td>116.1</td><td>133.1</td><td>147.6</td><td>162.4</td><td>176.7</td><td>176.7</td><td>176.7</td><td>176.7</td></tr>
<tr><td>22</td><td>88</td><td>89.9</td><td>102.4</td><td>114.3</td><td>125.8</td><td>136.8</td><td>136.8</td><td>136.8</td><td>136.8</td></tr>
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</table>

Note: For cube compressive strength of concrete greater than 60 N/mm^2, the values of P_k should be taken as those with f_{cu} and E_{cm} limiting to those of concrete grade C60.
</td>
<td>(a) The column “Nominal height” is deleted.
(b) The minimum as-welded height of 25mm shank diameter shear stud is amended.
(c) The corresponding characteristic resistances of headed shear stud for various concrete cube strengths are revised.</td>
</tr>
</table>

<table>
<tr>
<td>17</td>
<td>Clause 12.1</td>
<td>DESIGN PRINCIPLES
This section aims to provide guidance on fire resistant design in steel and composite structures which deals primarily with minimising the risk of structural collapse and restricting the spread of fire through the structure.
The fire resistant design method is applicable to steel and composite structures with the following materials:
Structural steel: Hot rolled steel sections with design strengths equal to or less than 460 N/mm^2.
Cold formed steel sections with design strengths equal to or less than 550 N/mm^2.
Concrete: Normal weight concrete with cube strengths equal to or less than 60 N/mm^2.
Reinforcement: Cold worked reinforcing bars with design strengths equal to or less than 460 N/mm^2.
For steel materials other than those listed above, refer to specialist design recommendations. Alternatively, passive fire protection method should be adopted.</td>
<td>DESIGN PRINCIPLES
This section aims to provide guidance on fire resistant design in steel and composite structures which deals primarily with minimising the risk of structural collapse and restricting the spread of fire through the structure.
The fire resistant design method is applicable to steel and composite structures with the following materials:
Structural steel: Hot rolled steel sections with design strengths equal to or less than 460 N/mm^2.
Cold formed steel sections with design strengths equal to or less than 550 N/mm^2.
Concrete: Normal weight concrete with cube strengths equal to or less than 60 N/mm^2.
Reinforcement: Cold worked reinforcing bars with design strengths equal to or less than 500 N/mm^2.
For steel materials other than those listed above, refer to specialist design recommendations. Alternatively, passive fire protection method should be adopted.</td>
<td>The design strength of reinforcement bar is changed to 500N/mm^2 to meet the latest reinforcement bar standard CS2:2012</td>
</tr>
<tr>
<td>18</td>
<td>Clause 12.1.4 - Table 12.2e (added)</td>
<td>-</td>
<td>Table 12.2e - Strength reduction factors for hot rolled reinforcing bars at elevated temperatures
<table>
<tr><th>Temperature (°C)</th><th>Strength reduction factors</th></tr>
<tr><td>20 °C</td><td>1.00</td></tr>
<tr><td>100 °C</td><td>1.00</td></tr>
<tr><td>200 °C</td><td>1.00</td></tr>
<tr><td>300 °C</td><td>1.00</td></tr>
<tr><td>400 °C</td><td>1.00</td></tr>
<tr><td>500 °C</td><td>0.78</td></tr>
<tr><td>600 °C</td><td>0.47</td></tr>
<tr><td>700 °C</td><td>0.23</td></tr>
<tr><td>800 °C</td><td>0.11</td></tr>
<tr><td>900 °C</td><td>0.06</td></tr>
<tr><td>1000 °C</td><td>0.04</td></tr>
<tr><td>1100 °C</td><td>0.02</td></tr>
<tr><td>1200 °C</td><td>0.00</td></tr>
</table></td>
<td>A table extracted from BS EN 1992-1-2:2004 showing the strength reduction factors for hot rolled bars at elevated temperatures is added.</td>
</tr>
<tr>
<td>19</td>
<td>Clause 13.2.5</td>
<td>Serviceability issues
The following serviceability issues shall be addressed for towers and masts:
(a) Wind induced oscillations of antennas, structural elements and cables.
(b) Access for maintenance of steelwork can be very difficult, therefore a high quality protective system should be specified.
(c) Required stiffness for purpose (e.g. microwave alignment).
(d) Access facilities for routine maintenance and inspection shall be designed to take into account of the availability and likely competence of staff trained to climb such structures but should normally include ladders fitted with a fall arrest system and regular platforms to rest and safely place work equipment.</td>
<td>Serviceability issues
The following serviceability issues shall be addressed for towers and masts:
(a) Wind induced vibrations of antennas, structural elements and cables.
(b) Access for maintenance of steelwork can be very difficult, therefore a high quality protective system should be specified.
(c) Required stiffness for purpose (e.g. microwave alignment).
(d) Access facilities for routine maintenance and inspection shall be designed to take into account of the availability and likely competence of staff trained to climb such structures but should normally include ladders fitted with a fall arrest system and regular platforms to rest and safely place work equipment.</td>
<td>The terms “oscillation” and “vibration” are collectively read as “vibration” for consistency.</td>
</tr>
</table>

20	Clause 13.2.6	**Design issues for steel chimneys** In addition to the guidance given in clauses 13.2.1 to 13.2.5, special attention should be given to the following in the design of steel chimneys and flues: (a) Wind-excited oscillations should be considered and analyzed by aerodynamic methods. For circular chimneys the simplified method in clause 13.2.8 may be used. (b) Design should be in accordance with the appropriate provisions of the Code and in the acceptable references in Annex A2.1. (c) To control buckling in the case of a thin walled chimney with effective height to diameter ratio of less than 21 and diameter to thickness ratio of less than 130, the ultimate compressive stresses in the chimney structure arising from the three principal load combinations shall be limited to a value calculated in accordance with Table 12.2 of clause 12.1.4 which allows for reduced steel strength at elevated temperatures. If this value exceeds 140 N/mm^2, then a value of 140 N/mm^2 shall be used. The value should be reduced further for higher aspect ratios.	**Design issues for steel chimneys** In addition to the guidance given in clauses 13.2.1 to 13.2.5, special attention should be given to the following in the design of steel chimneys and flues: (a) Wind-excited vibrations should be considered and analyzed by aerodynamic methods. For circular chimneys the simplified method in clause 13.2.8 may be used. (b) Design should be in accordance with the appropriate provisions of the Code and in the acceptable references in Annex A2.1. (c) To control buckling in the case of a thin walled chimney with effective height to diameter ratio of less than 21 and diameter to thickness ratio of less than 130, the ultimate compressive stresses in the chimney structure arising from the three principal load combinations shall be limited to a value calculated in accordance with Table 12.2 of clause 12.1.4 which allows for reduced steel strength at elevated temperatures. If this value exceeds 140 N/mm^2, then a value of 140 N/mm^2 shall be used. The value should be reduced further for higher aspect ratios.	The terms “oscillation” and “vibration” are collectively read as “vibration” for consistency.

21	Clause 13.2.8	**Wind-excited oscillations of circular chimneys** Flexible slender structures are subject to oscillations caused by cross wind and along wind action. Structures with a circular cross section, such as chimneys, oscillate more strongly across than along wind. The following simplified approach may be used for across wind oscillation, see also clause 5.3: (a) The Strouhal critical velocity V_{crit} in metres per second for the chimney is to be determined by: $V_{crit} = 5\, D_t\, f \qquad (13.1)$ where *f* (in Hz) is the natural frequency of the chimney on its foundations. This may be calculated analytically or from the following approximate formula for the case of a regular cone: $f = \frac{500(3D_b - D_t)\left[\frac{W_s}{W}\right]^{\frac{1}{2}}}{h^2} \qquad (13.2)$ and h is the height of chimney (in m) D_t is the diameter at top (in m) D_b is the diameter at bottom (in m) W is the mass per metre height at top of structural shell including lining or encasing, if any (in kg) W_s is the mass per meter height at top of structural shell excluding lining (in kg) (b) If V_{crit} exceeds the design wind velocity in metres per second given by the following formula $V = 40.4\,(q)^{0.5} \qquad (13.3)$ where *q* is the design wind pressure in kN/m², severe oscillation is unlikely and no further calculation is required. (c) If V_{crit} is less than the design wind velocity, the tendency to oscillate *C* may be estimated by the following empirical formula: $C = 0.6 + K\left[\frac{10\, D_t^2}{W} + \frac{1.5\Delta}{D_t}\right] \qquad (13.4)$ where Δ is the calculated deflection (in m) at the top of the chimney for unit distributed load of 1 kPa. K is 3.5 for all welded construction, 3.0 for welded with flanged and bolted joints and 2.5 for bolted and riveted or all riveted. (d) If *C* is less than 1.0, severe oscillation is unlikely. If *C* is between 1.0 and 1.3 the design wind pressure for the chimney should be increased by a factor C^2. If *C* is larger than 1.3 stabilizers or dampers should be provided to control the oscillations.	**Wind-excited vibrations of circular chimneys** Flexible slender structures are subject to vibrations caused by cross wind and along wind action. Structures with a circular cross section, such as chimneys, oscillate more strongly across than along wind. The following simplified approach may be used for across wind vibration, see also clause 5.3: (a) The Strouhal critical velocity V_{crit} in metres per second for the chimney is to be determined by: $V_{crit} = 5\, D_t\, f \qquad (13.1)$ where *f* (in Hz) is the natural frequency of the chimney on its foundations. This may be calculated analytically or from the following approximate formula for the case of a regular cone: $f = \frac{500(3D_b - D_t)\left[\frac{W_s}{W}\right]^{\frac{1}{2}}}{h^2} \qquad (13.2)$ and h is the height of chimney (in m) D_t is the diameter at top (in m) D_b is the diameter at bottom (in m) W is the mass per metre height at top of structural shell including lining or encasing, if any (in kg) W_s is the mass per meter height at top of structural shell excluding lining (in kg) (b) If V_{crit} exceeds the design wind velocity in metres per second given by the following formula $V = 40.4\,(q)^{0.5} \qquad (13.3)$ where *q* is the design wind pressure in kN/m², severe vibration is unlikely and no further calculation is required. (c) If V_{crit} is less than the design wind velocity, the tendency to oscillate *C* may be estimated by the following empirical formula: $C = 0.6 + K\left[\frac{10\, D_t^2}{W} + \frac{1.5\Delta}{D_t}\right] \qquad (13.4)$ where Δ is the calculated deflection (in m) at the top of the chimney for unit distributed load of 1 kPa. K is 3.5 for all welded construction, 3.0 for welded with flanged and bolted joints and 2.5 for bolted and riveted or all riveted. (d) If *C* is less than 1.0, severe vibration is unlikely. If *C* is between 1.0 and 1.3 the design wind pressure for the chimney should be increased by a factor C^2. If *C* is larger than 1.3 stabilizers or dampers should be provided to control the vibrations.	The terms "oscillation" and "vibration" are collectively read as "vibration" for consistency.

22	Clause 13.5.5	**Serviceability issues** The following serviceability issues shall be addressed for long span structures: (a) Vibration from crowds. Refer to section 5 of the Code. (b) Wind induced oscillations of roof elements and cables. Fatigue may need to be checked. (c) Access for maintenance of roof steelwork can be very difficult therefore a high quality protective system should be specified for the steelwork. (d) Deflection limits for long span trusses under live and wind loads depend on circumstances. A value of span/360 may be used for preliminary design in the absence of other requirements. Significantly smaller deflection limits will be required for applications such as: aircraft hanger doors and stadia opening roofs.	**Serviceability issues** The following serviceability issues shall be addressed for long span structures: (a) Vibration from crowds. Refer to section 5 of the Code. (b) Wind induced vibrations of roof elements and cables. Fatigue may need to be checked. (c) Access for maintenance of roof steelwork can be very difficult therefore a high quality protective system should be specified for the steelwork. (d) Deflection limits for long span trusses under live and wind loads depend on circumstances. A value of span/360 may be used for preliminary design in the absence of other requirements. Significantly smaller deflection limits will be required for applications such as: aircraft hanger doors and stadia opening roofs.	The terms "oscillation" and "vibration" are collectively read as "vibration" for consistency.
23	Paragraph 13.6.4	**Vibration and oscillation** Pedestrians can be adversely affected by the dynamic behaviour of footbridges. In addition to the criteria specified in section 5 on Human-Induced Vibration, the natural frequency of a footbridge shall not be less than 3 Hz. If the natural frequency of a footbridge is less than 3 Hz which may lead to unpleasant vibration, the maximum vertical acceleration, a_v, shall be limited to an appropriate value as given in recognized design guidelines in Annex A2.3 in order to avoid unpleasant vibration.	**Vibration** Pedestrians can be adversely affected by the dynamic behaviour of footbridges. In addition to the criteria specified in section 5 on Human-Induced Vibration, the natural frequency of a footbridge shall not be less than 3 Hz. If the natural frequency of a footbridge is less than 3 Hz which may lead to unpleasant vibration, the maximum vertical acceleration, a_v, shall be limited to an appropriate value as given in recognized design guidelines in Annex A2.3 in order to avoid unpleasant vibration.	The terms "oscillation" and "vibration" are collectively read as "vibration" for consistency hence the word "oscillation" is deleted.
24	Annex A1.1.3	*Chinese standards* GB/T 247 - 1997 Rules of acceptance, package, label and certification for plate, strip and wide flat in structural steel GB/T 709 - 2006 Dimension, appearance, weight and tolerance of plate, strip and wide flat in hot rolled structural steel GB/T 1591 - 2008 High strength structural steel GB/T 5313 - 1985 Through thickness properties of steel plates YB 4104 - 2000 Steel plate for high rise building structure GB 50017 - 2003 Code for design of steel structures GB 50205 - 2001 Code for acceptance of construction quality of steel structures	*Chinese standards* GB/T 247 - 1997 Rules of acceptance, package, label and certification for plate, strip and wide flat in structural steel GB/T 700 – 2006 Carbon structural steel GB/T 709 - 2006 Dimension, appearance, weight and tolerance of plate, strip and wide flat in hot rolled structural steel GB/T 1591 - 2008 High strength structural steel GB/T 5313 - 1985 Through thickness properties of steel plates YB 4104 - 2000 Steel plate for high rise building structure GB 50017 - 2003 Code for design of steel structures GB 50205 - 2001 Code for acceptance of construction quality of steel structures	The Chinese standard GB/T 700-2006 is added in the Acceptable Standard List.

Appendix B
(PNAP APP-168)

Amendments to Code of Practice for the Structural Use of Steel 2011

(May 2021)

Legends:

🟨 Amended
🟥 Deleted

(3/2023)

Major amendments to the Code of Practice for the Structural Use of Steel 2011 in May 2021 included:

(a) clause 1.5 – addition of a symbol λ_{eff} corresponding to the amendments to clause 8.7.9;

(b) clause 3.1.2 – clarification on the definition of yield strength;

(c) Table 3.9 – addition of BS EN 10268 to supersede the withdrawn BS 1449-1-1.5 & 1.11;

(d) 3rd paragraph of clause 8.7.9 – revision of the formulas defining the effective slenderness ratios about different minor axes;

(e) clause 11.7.5(iii) – deletion of the requirement to submit Welding Procedure Specification prior to the commencement and carrying out of welding works in cold-formed hollow sections;

(f) Table 11.5 – elaboration of the conditions for welding cold-formed areas and adjacent materials;

(g) clause Al of Annex A – addition of a criterion for using the latest version of the standards listed in Annex A;

(h) clause Al.1.5 of Annex A – addition of BS EN 10147:2000; and

(i) clause Al.7.5 of Annex A – addition of BS EN 10268:2006.

Amendments to the Code of Practice for the Structural Use of Steel 2011 (May 2021)

Item	Current version	Amendments
1. Clause 1.5[1]	λ_{cr} Elastic critical load factor λ_{L0} Limiting equivalent slenderness (lateral-torsional buckling)	λ_{cr} Elastic critical load factor λ_{eff} Effective slenderness ratio λ_{L0} Limiting equivalent slenderness (lateral-torsional buckling)
2. Clause 3.1.2[2]	**3.1.2 Design strength for normal strength steels** The design strength, p_y, for steel is given by: $p_y = \frac{Y_S}{\gamma_{m1}}$ but not greater than $\frac{U_S}{\gamma_{m2}}$ where Y_s is the yield strength which is defined as the upper yield strength, R_{eH}, the stress at the initiation of yielding for steel materials with clearly defined yield point;or 0.2% proof stress, $R_{p\,0.2}$, or the stress at 0.5% total elongation, $R_{t\,0.5}$ for steel materials with no clearly defined yield point, whichever is smaller. In case of dispute, the 0.2% proof stress, $R_{p\,0.2}$, shall be adopted.	**3.1.2 Design strength for normal strength steels** The design strength, p_y, for steel is given by: $p_y = \frac{Y_S}{\gamma_{m1}}$ but not greater than $\frac{U_S}{\gamma_{m2}}$ where Y_s the yield strength is defined as : (a) the upper yield strength, R_{eH}, the stress at the initiation of yielding for steel materials with clearly defined yield point; or (b) if the yield point cannot be clearly defined, then the 0.2% proof stress, $R_{p\,0.2}$, or the stress at 0.5% total elongation, $R_{t\,0.5}$ for steel materials whichever is smaller.

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[1] Addition of a symbol λ_{eff} corresponding to the amendments to clause 8.7.9.

[2] Clarification on the definition of yield strength.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td></td><td>(c) In case of dispute, the 0.2% proof stress, $R_{p\,0.2}$, shall be adopted.</td></tr>
<tr><td>3. Table 3.9[3]</td><td>Table 3.9 - Yield and ultimate strengths for steels supplied in accordance with various national standards
<table>
<tr><th>Type of steel</th><th>Grade</th><th>Yield strength Y_s (N/mm^2)</th><th>Tensile strength U_s (N/mm^2)</th></tr>
<tr><td>British standard:
BS EN 10025
Hot rolled steel sheet of structural quality</td><td>S235
S275
S355</td><td>235
275
355</td><td>360
430
510</td></tr>
<tr><td>British standard:
BS EN 10147
Continuous hot dip zinc coated carbon steel sheet of structural quality</td><td>S220 G
S250 G
S280 G
S320 G
S350 G</td><td>220
250
280
320
350</td><td>300
330
360
390
420</td></tr>
</table></td><td>Table 3.9 - Yield and ultimate strengths for steels supplied in accordance with various national standards
<table>
<tr><th>Type of steel</th><th>Grade</th><th>Yield strength Y_s (N/mm^2)</th><th>Tensile strength U_s (N/mm^2)</th></tr>
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Hot rolled steel sheet of structural quality</td><td>S235
S275
S355</td><td>235
275
355</td><td>360
430
510</td></tr>
<tr><td>British standard:
BS EN 10147
Continuous hot dip zinc coated carbon steel sheet of structural quality</td><td>S220 G
S250 G
S280 G
S320 G
S350 G</td><td>220
250
280
320
350</td><td>300
330
360
390
420</td></tr>
</table></td></tr>
</table>

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[3] Addition of BS EN 10268 to supersede the withdrawn BS 1449-1-1.5 & 1.11.

Item	Current version				Amendments			
	British standard: BS EN 10149-2 & 3 High yield strength steels for cold forming	S315 MC	315	390	British standard: BS EN 10149-2 & 3 High yield strength steels for cold forming	S315 MC	315	390
		S355 MC	355	430		S355 MC	355	430
		S420 MC	420	480		S420 MC	420	480
		S260 NC	260	370		S260 NC	260	370
		S315 NC	315	430		S315 NC	315	430
		S355 NC	355	470		S355 NC	355	470
		S420 NC	420	530		S420 NC	420	530
	British standard: BS 1449-1-1.5 & 1.11 Cold rolled steel sheet based on minimum strength	34/20	200	340	British standard: BS EN 10268 Cold-rolled steel flat products with high yield strength for cold forming – Technical delivery conditions	34/20	200	340
		37/23	230	370		37/23	230	370
		43/25	250	430		43/25	250	430
		50/35	350	500		50/35	350	500
		40/30	300	400		40/30	300	400
		43/35	350	430		43/35	350	430
		40F30	300	400		40F30	300	400
		43F35	350	430		43F35	350	430
	Australia standard: AS 1397 Steel sheet and strip	G250	250	320	Australia standard: AS 1397 Steel sheet and strip	G250	250	320
		G300	300	340		G300	300	340
		G350	350	420		G350	350	420
		G450	450	480		G450	450	480
		G500	500	520		G500	500	520
		G550	550	550		G550	550	550

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td><table><tr><td>Chinese standard:
GB 50018
Technical code of cold-formed thin-wall steel structures</td><td>Q235
Q345</td><td>205
300</td><td>-
-</td></tr></table></td><td><table><tr><td>Chinese standard:
GB 50018
Technical code of cold-formed thin-wall steel structures</td><td>Q235
Q345</td><td>205
300</td><td>-
-</td></tr></table></td></tr>
<tr><td>4. 3rd paragraph of Clause 8.7.9[4]</td><td>For web members, buckling about principal axes and axes parallel to the legs should be considered. For angle sections connected by two or more bolts, the slenderness ratio should be calculated from the larger of the actual member length and the following:

For buckling about minor v-v axis,
$\lambda = 0.35 + 0.7\lambda_v / (93.9\varepsilon)$
For buckling about x-x axis,
$\lambda = 0.5 + 0.7\lambda_x / (93.9\varepsilon)$ (8.76)
For buckling about y-y axis,
$\lambda = 0.5 + 0.7\lambda_y / (93.9\varepsilon)$

in which $\varepsilon = \sqrt{\frac{275}{p_y}}$ and λ is the effective slenderness ratio. λ_v, λ_x and λ_y are respectively the slenderness ratios</td><td>For web members, buckling about principal axes and axes parallel to the legs should be considered. For angle sections connected by two or more bolts, the slenderness ratio should be calculated from the following:

For buckling about v-v axis,
$\lambda_{eff,v} = 0.35 \text{ x } 85.8\varepsilon + 0.7\lambda_v$ or λ_v whichever is larger.
For buckling about x-x axis,
$\lambda_{eff,x} = 0.5 \text{ x } 85.8\varepsilon + 0.7\lambda_x$ or λ_x whichever is larger. (8.76)
For buckling about y-y axis,
$\lambda_{eff,y} = 0.5 \text{ x } 85.8\varepsilon + 0.7\lambda_y$ or λ_y whichever is larger.

in which $\varepsilon = \sqrt{\frac{275}{p_y}}$ and λ_{eff} is the effective slenderness ratio. λ_v, λ_x and λ_y are respectively the slenderness ratios</td></tr>
</table>

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[4] Revision of the formulas defining the effective slenderness ratios about different minor axes.

Item	Current version	Amendments
	about minor v-axis and the x- and y-axes parallel to the two legs.	about the minor v-axis, and the x- and y-axes of the angle sections.
5. Clause 11.7.5(iii)[5]	**11.7.5 Welding at cold-formed zones** Welding may be carried out within a length 5*t* either side of a cold-formed area, provided that one of the following conditions is satisfied: (i) the cold formed areas are normalized after cold forming but before welding; (ii) the internal radius-to-thickness *r*/*t* ratio satisfies the relevant value given in Table 11.5; or (iii) the Responsible Engineer shall submit a Welding Procedure Specification (WPS) as stipulated in clause 14.3.3 for the approval of the Building Authority prior to the commencement and carrying out of welding works in cold-formed hollow sections.	**11.7.5 Welding at cold-formed zones** Welding may be carried out within a length 5*t* either side of a cold-formed area, provided that one of the following conditions is satisfied: (a) the cold-formed areas are normalized after cold forming but before welding; (b) the internal radius-to-thickness *r*/*t* ratio satisfies the relevant value given in Table 11.5; or (c) the welding procedure shall fulfill the Welding Procedure Specification (WPS) as stipulated in clause 14.3.3.

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[5] Deletion of the requirement to submit Welding Procedure Specification prior to the commencement and carrying out of welding works in cold-formed hollow sections.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr>
<td>6. Table 11.5[6]</td>
<td>
Table 11.5 Conditions for welding cold-formed areas and adjacent materials
<table>
<tr><th rowspan="3">Minimum internal radius/ thickness (r/t) ratio</th><th rowspan="3">Strain due to cold forming (%)</th><th colspan="3">Maximum thickness (mm)</th></tr>
<tr><th colspan="2">Generally</th><th rowspan="2">Fully killed Aluminium-killed steel (AL ≥ 0.02 %)</th></tr>
<tr><th>Predominantly static loading</th><th>Where fatigue predominates</th></tr>
<tr><td>≥ 3.0</td><td>≤ 14</td><td>22</td><td>12</td><td>22</td></tr>
<tr><td>≥ 2.0</td><td>≤ 20</td><td>12</td><td>10</td><td>12</td></tr>
<tr><td>≥ 1.5</td><td>≤ 25</td><td>8</td><td>8</td><td>10</td></tr>
</table>
</td>
<td>
Table 11.5 Conditions for welding cold-formed areas and adjacent materials
<table>
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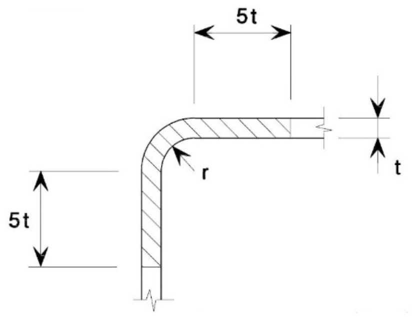
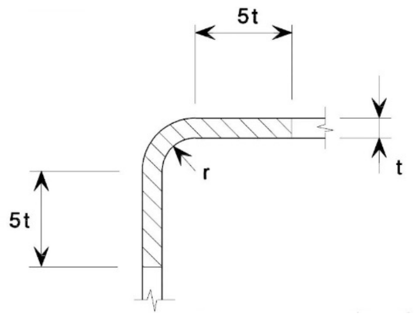
</table>
</td>
</tr>
</table>

---

[6] Elaboration of the conditions for welding cold-formed areas and adjacent materials.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td><table><tr><td>≥ 1.0</td><td>≤ 33</td><td>4</td><td>4</td><td>6</td></tr></table>

</td><td><table><tr><td>≥ 1.0</td><td>≤ 33</td><td>4</td><td>4</td><td>6</td></tr></table>


NOTE: Cold-formed hollow sections according to BS EN 10219 which do not satisfy the limits given in Table 11.5 can be assumed to satisfy these limits if these sections have a thickness not exceeding 12.5 mm and are Aluminium-killed with a quality J2H, K2H, MH, MLH, NH or NLH as defined in BS EN 10219 and further satisfy C ≤ 0.18%, P ≤ 0.020% and S ≤ 0.012%.

In other cases welding is only permitted within a distance of 5t from the corners if it can be shown by tests that welding is permitted for that particular application.</td></tr>
</table>

Item	Current version	Amendments
7. Clause A1 of Annex A[7]	**A1 ACCEPTABLE STANDARDS AND REFERENCES** This annex contains the standards considered acceptable to the Building Authority to be used together with the Code. Where it is intended to use other standards or technical references it should be demonstrated that they can achieve a performance equivalent to the acceptable standards as specified in the Code.	**A1 ACCEPTABLE STANDARDS AND REFERENCES** This annex contains the standards considered acceptable to the Building Authority to be used together with the Code. Where it is intended to use other standards or technical references, or latest version of the standards given in Annex A, it should be demonstrated that they can achieve a performance equivalent to the acceptable standards as specified in the Code.
8. Clause A1.1.5 of Annex A[8]	**A1.1.5 UK and European standards** BS EN 10025: 2004 Hot rolled products of non-alloy structural steels - Technical delivery conditions. BS EN 10164: 2004 Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions. BS EN 10210-1: 2006 Hot finished structural hollow sections of non-alloy	**A1.1.5 UK and European standards** BS EN 10025: 2004 Hot rolled products of non-alloy structural steels - Technical delivery conditions. BS EN 10164: 2004 Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions. BS EN 10210-1: 2006 Hot finished structural hollow sections of non-alloy

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[7] Addition of a criterion for using the latest version of the standards listed in Annex A.

[8] Addition of BS EN 10147:2000.

Item	Current version		Amendments	
		and fine grain structural steels. Part 1: Technical delivery requirements.		and fine grain structural steels. Part 1: Technical delivery requirements.
	BS EN 10248-1: 1996	Hot rolled sheet piling of non alloy steels. Part 1: Technical delivery conditions	BS EN 10248-1: 1996	Hot rolled sheet piling of non alloy steels. Part 1: Technical delivery conditions
			BS EN 10147: 2000	Continuous hot dip zinc coated carbon steel sheet of structural quality
9. Clause A1.7.5 of Annex A[9]	**A1.7.5**	**UK, European and ISO standards**	**A1.7.5**	**UK, European and ISO standards**
	BS 5950-7: 1992	Structural use of steelwork in building. Specification for materials and workmanship: cold formed sections	BS 5950-7: 1992	Structural use of steelwork in building. Specification for materials and workmanship: cold formed sections
	BS EN 10149-1: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 1: General delivery conditions	BS EN 10149-1: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 1: General delivery conditions
	BS EN 10149-2: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 2: Delivery	BS EN 10149-2: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 2: Delivery

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[9] Addition of BS EN 10268:2006.

Item	Current version	Amendments
	conditions for thermomechanically rolled steels	conditions for thermomechanically rolled steels
	BS EN 10149-3: 1996 Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 3: Delivery conditions for normalized or normalized rolled steels	BS EN 10149-3: 1996 Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 3: Delivery conditions for normalized or normalized rolled steels
	BS EN 10219-1: 2006 Cold formed welded structural hollow sections of non-alloy and fine grain steels. Part 1: Technical delivery requirements	BS EN 10219-1: 2006 Cold formed welded structural hollow sections of non-alloy and fine grain steels. Part 1: Technical delivery requirements
	BS EN 10249-1: 1996 Cold formed sheet piling of non alloy steels. Part 1: Technical delivery conditions	BS EN 10249-1: 1996 Cold formed sheet piling of non alloy steels. Part 1: Technical delivery conditions
		BS EN 10268: 2006 Cold-rolled steel flat products with high yield strength for cold forming – Technical delivery conditions

Appendix C
(PNAP APP-168)

Amendments to Code of Practice for the Structural Use of Steel 2011 (2021 Edition)

(March 2023)

Legends:

🟨 Amended
🟥 Deleted

(3/2023)

Major amendments to the Code of Practice for the Structural Use of Steel 2011 (2021 Edition) included:

(a) clause 1.4.1 – revision of "acceptable Q A system" to "acceptable Quality Assurance system";

(b) clause 2.1.3 – revision relating to continuous design of high strength steels;

(c) clause 3.1.1 and Table 3.1 – revision of general information of high strength steels;

(d) clause 3.1.2 and Table 4.1 – revisions of material factors γ_{m1} and γ_{m2}, and the essentials of the basic requirements for various classes of steel;

(e) Table 3.2 – revision of design strength p_y for steels supplied in accordance with BS EN standards;

(f) Table 3.3 – revision of design strength p_y for steels supplied in accordance with Chinese standard GB50017;

(g) clause 3.2 and Table 3.7 – revision of methodology to determine maximum element thickness for prevention of brittle fracture in accordance with EN 1993-1-10;

(h) clause 3.3.1 – revision of limit of ultimate tensile strength for bolts;

(i) clause 4.2.1 and Table 4.1 – revision of material factors for various classes of steel;

(j) clause 5.5.2.1 – revision of galvanizing for high strength steels;

(k) clause 7.1 – revision of general information of high strength steels;

/(l) …

(l) Table 8.3 – revision of bending strength p_b for welded sections;

(m) Table 8.5 – revision of shear buckling strength q_w for steel sections;

(n) Table 8.7 – revision of selection of buckling curves for different section types;

(o) Table 8.8 – revision of design strength p_c of compression members;

(p) clause 8.9.3 and Tables 8.10 to 8.12 – Alternative method of member buckling resistance;

(q) Tables 9.2a & 9.2b – revision of design strength of fillet welds;

(r) clauses 9.3.4 & 9.3.6.1.3 and Tables 9.5, 9.6 & 9.8 – revision of design parameters for bolts;

(s) clause 11.7.3 – revision of requirements on mechanical properties;

(t) Table 11.7.5 – revision of welding at cold-formed zones;

(u) clause 12.1.3 – revision of fire protection for connection plates and stiffeners;

(v) Table 14.2b – revision of hold time period before non-destructive testing of welds;

(w) Annex A – revisions of acceptable standards and references; and

(x) Annex D – revision of testing requirements of class 1H steel.

Amendments to Code of Practice for the Structural Use of Steel 2011 (2021 Edition) (March 2023)

Item	Current version	Amendments
1. Clause 1.1[1]	Design recommendations in **Sections 7, 8** and **9** cover the use of hot rolled steel sections, flats, plates, hot finished and cold formed structural hollow sections with steel grades up to yield stresses of 460 N/mm^2 and allow use of yield stresses between 460 N/mm^2 and 690 N/mm^2 subject to restrictions. A new buckling curve a_0 is added for hot-finished hollow sections of design strength greater than S460 or hot-finished seamless hollow sections. **Section 11** provides simplified guidance on the use of cold-formed thin gauge steel sections with a design yield strength up to 550 N/mm^2. The use of cold formed hollow sections and sheet pile sections are incorporated in this section.	Design recommendations in **Sections 7, 8** and **9** cover the use of hot rolled steel sections, flats, plates, hot finished and cold formed structural hollow sections with steel grades up to yield stresses of 460 N/mm^2 and allow use of yield stresses between 460 N/mm^2 and 690 N/mm^2 subject to restrictions.🟥 **Section 11** provides simplified guidance on the use of cold-formed thin gauge steel open sections and sheet profiles with a design yield strength up to 550 N/mm^2. The use of cold formed hollow sections and sheet pile sections are incorporated in this section.
2. Clause 1.3[2]	In order to provide a single consistent set of standards for steel materials and products, their workmanship and Quality Assurance procedures, such standards and procedures shall generally be defined in the Code or as given in the acceptable references in Annex A1.	In order to provide a single consistent set of standards for steel materials and products, their workmanship and quality assurance procedures, such standards and procedures shall generally be defined in the Code or as given in the acceptable references in Annex A1.

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[1] General clarification of section description.

[2] General clarification.

Item	Current version	Amendments
3. Clause 1.4.1[3]	**acceptable Q A system** **BA** The Hong Kong Building Authority	**acceptable Quality Assurance system** **BA** The 🟥Building Authority
4. Clause 2.1.3[4]	In plastic analysis, the joints should have sufficient moment capacity to justify analysis assuming plastic hinges in the members. They should also have sufficient rotational stiffness for in-plane stability. Stability should be properly considered in all the analyses.	In plastic analysis, the joints should have sufficient moment capacity to justify analysis assuming plastic hinges in the members. They should also have sufficient rotational stiffness for in-plane stability. Stability should be properly considered in all the analyses. For steel with yield strengths greater than 460 N/mm^2 but less than or equal to 690 N/mm^2, the global elastic analysis shall be adopted to design structural members while the cross section and the member resistances are determined in accordance with the cross-section classifications of the members.
5. Clause 3.1.1[5]	**Class 1:** Steel complying with one of the reference material standards in Annex A1.1 and basic requirements given in clause 3.1.2 and produced from a manufacturer with an acceptable Quality Assurance system. **Class 2:** Steel which has not been manufactured to one of the reference material standards in Annex A1.1 but is produced	**Class 1:** Steel complying with one of the reference material standards in Annex A1.1 and basic requirements given in clause 3.1.2 and produced from a manufacturer with an acceptable Quality Assurance system. **Class 2:** Steel which has not been manufactured to one of the reference material standards in Annex A1.1 but is produced

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[3] General clarification of definitions.

[4] Addition of design philosophy for Class 1H steel.

[5] Revision of Class 1H steel in welded sections for normal use in steel structures and cold-formed steel hollow sections only.

Item	Current version	Amendments
	from a manufacturer with an acceptable Quality Assurance system. Such steel shall be tested to show that it complies with one of the reference material standards in Annex A1.1 before being used. Requirements on the sampling rate for testing are given in Annex D1. Hot rolled steels and cold-formed structural hollow sections are covered in clause 3.1 and cold formed steel open sections and profiled sheets are covered in clause 3.8. Subject to additional requirements and restrictions given in clause 3.1.3, the Code covers an additional class of high strength steels with yield strengths greater than 460 N/mm^2 and not greater than 690 N/mm^2 produced under an acceptable Quality Assurance system:	from a manufacturer with an acceptable Quality Assurance system. Such steel shall be tested to show that it complies with one of the reference material standards in Annex A1.1 before being used. Requirements on the sampling rate for testing are given in Annex D1. Hot rolled steels and cold-formed structural hollow sections are covered in clause 3.1 and cold formed steel open sections and profiled sheets are covered in clause 3.8. 🟥
6. Clause 3.1.1[6]	**Class 1H:** High strength steels with yield strengths greater than 460 N/mm^2 but less than or equal to 690 N/mm^2 and complying with one of the reference material standard in Annex A1.1. Basic requirements for the steel and producer are given in clause 3.1.3. Requirements on the sampling rate for testing are given in Annex D1. **Class UH:** Ultra high strength steel with yield strengths greater than	**Class 1H:** High strength steels with yield strengths greater than 460 N/mm^2 but less than or equal to 690 N/mm^2 and complying with one of the reference material standards in Annex A1.1. Basic requirements for the steel and producer are given in clause 3.1.2 and high strength steels shall be produced from a manufacturer with an acceptable Quality Assurance system.🟥 **Class UH:** Ultra high strength steels with yield strengths greater than 690 N/mm^2 are not covered by the Code. Subject to the

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[6] Addition of acceptable Quality Assurance system to steel manufacturer.

Item	Current version	Amendments
	690 N/mm^2 are not covered by the Code. Subject to the approval of the Hong Kong Building Authority, they may be used in bolted tension applications in the form of proprietary high strength tie rods or bars, or in other applications. In these cases, the Responsible Engineer shall provide a full justification and ensure that all requirements are met in the submission of this material to the Hong Kong Building Authority.	approval of the🟥Building Authority, they may be used in bolted tension applications in the form of proprietary high strength tie rods or bars, or in other applications. In these cases, the Responsible Engineer shall provide a full justification and ensure that all requirements are met in the submission of this material to the 🟥Building Authority.
7. Clause 3.1.1[7]	The Code covers both elastic and plastic analysis and design. Plastic analysis and design is not permitted for uncertified steels or for steels with yield strength greater than 460 N/mm^2. High strength steels may give advantages for certain ultimate limit states but with limited improvement against buckling. Their use does not improve the performance for fatigue and serviceability limit states.	The Code covers both elastic and plastic analysis and design. Plastic analysis and design is not permitted for uncertified steels or for steels with yield strength greater than 🟥690 N/mm^2. High strength steels may give advantages for certain ultimate limit states such as compression resistances in heavily loaded columns and moment resistances in long span beams, but with limited improvement in very slender columns undergoing primarily elastic buckling. Pre-cambering may be adopted to reduce beam deflections under dead and imposed loads 🟥. Their use does not improve the performance for fatigue and serviceability limit states.

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[7] Revision of yield strength limit of Class 1H steel.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr>
<td>8. Table 3.1[8]</td>
<td><table>
<tr><th>Strength Grade</th><th>Class</th><th>Acceptable Quality Assurance system</th><th>Compliance with reference material Standard</th><th>Additional test Required</th><th>Remarks</th></tr>
<tr><td>460 < Y_s ≤690</td><td>1H</td><td>Y</td><td>Y</td><td>Y</td><td>Shall comply with basic requirements. Use is restricted.</td></tr>
</table></td>
<td><table>
<tr><th>Strength Grade</th><th>Class</th><th>Acceptable Quality Assurance system</th><th>Compliance with reference material Standard</th><th>Additional test Required</th><th>Remarks</th></tr>
<tr><td>460 < Y_s ≤690</td><td>1H</td><td>Y</td><td>Y</td><td>N</td><td>Normal use</td></tr>
</table></td>
</tr>
<tr>
<td>9. Clause 3.1.2[9]</td>
<td>Design strength for normal strength steels
γ_{m1} , γ_{m2} are the material factors given in Table 4.1. For Class 1 and Class 1H steels, γ_{m1} has the value of 1.0 and γ_{m2} has the value of 1.2. (these material factors are minimum values and the design strengths should not be greater than those given in the respective material standards.)</td>
<td>Design strength for normal strength steels and high strength steels
γ_{m1} , γ_{m2} are the material factors given in Table 4.1.🟥 These material factors are minimum values and the design strengths should not be greater than those given in the respective material standards.🟥</td>
</tr>
<tr>
<td>10. Clause 3.1.2[10]</td>
<td>• Strength:
The design strength shall be the minimum yield strength but not greater than the minimum tensile strength divided by 1.2.</td>
<td>• Strength:
The design strength shall be the minimum factored yield strength Y_z/γ_{m1} but not greater than the minimum tensile strength 🟥U_s/γ_{m2} where γ_{m1} and γ_{m2} are given in Table 4.1.</td>
</tr>
</table>

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[8] Revision of Class 1H steel in welded sections for normal use with no additional test is required.

[9] Revision of material factor and Table 4.1.

[10] Revision of material factor and Table 4.1.

Item	Current version	Amendments
11. Clause 3.1.2[11]	- **Ductility**: The elongation on a gauge length of $5.65\sqrt{S_o}$ is not to be less than 15% where So is the cross sectional area of the section.	- **Ductility:** The elongation on a gauge length of $5.65\sqrt{S_o}$ 🟥 where S_o is the cross sectional area of the section, should be as follows: For Classes 1 and 2 steel, the elongation at fracture is not to be less than 15%; For Class 1H steel, the elongation at fracture is not to be less than 10%; and The strain at the tensile strength should not be greater than 15 times the strain at the yield strength.
12. Clause 3.1.2[12]	- **Weldability:** The chemical composition and maximum carbon equivalent value for Class 1 steel shall conform to the respective reference materials standard in Annex A1.1. The minimum requirements on the chemical composition of the materials for Class 2 steel and particularly for Class 3 steel when welding is involved are as follows. The maximum carbon equivalent value shall not exceed 0.48% on ladle analysis and the carbon content shall not exceed 0.24%. For general applications, the maximum sulphur content shall not exceed 0.03% and the maximum phosphorus content shall not exceed 0.03%. When through thickness quality (Z quality) steel is specified, the sulphur content shall not exceed 0.01%.	- **Weldability:** The chemical composition and maximum carbon equivalent value for Classes 1, 2 and 1H steel shall conform to the respective reference materials standard in Annex A1.1. The minimum requirements on the chemical composition of the materials 🟥for Class 3 steel when welding is involved are as follows: a) The maximum carbon equivalent value shall not exceed 0.48% on ladle analysis and the carbon content shall not exceed 0.24%;

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[11] Revision of elongation requirement of Class 1H steel.

[12] Revision of requirement of chemical composition.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td>The chemical compositions of various grades of steel shall also conform to the requirements stipulated in the national material standards to which where they are manufactured.</td><td>b) For general applications, the maximum sulphur content shall not exceed 0.03% and the maximum phosphorus content shall not exceed 0.03%; and
c) When through thickness quality (Z quality) steel is specified, the sulphur content shall not exceed 0.01%.
The chemical compositions of various grades of steel shall also conform to the requirements stipulated in the national material standards to which where they are manufactured.</td></tr>
<tr><td>13. Table 3.2[13]</td><td>Table 3.2 - Design strength p_y for steels supplied in accordance with BS EN standards
(plates, hot rolled sections, hot finished and cold formed hollow sections)
<table>
<tr><th>Steel grade</th><th>Thickness less than or equal to (mm)</th><th>Design strength p_y (N/mm^2)</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td rowspan="5">S460</td><td>16</td><td>460</td></tr>
<tr><td>40</td><td>440</td></tr>
<tr><td>63</td><td>430</td></tr>
<tr><td>80</td><td>410</td></tr>
<tr><td>100</td><td>400</td></tr>
</table></td><td>Table 3.2 - Design strength p_y for steels supplied in accordance with BS EN standards
(plates, hot rolled sections, hot finished and cold formed hollow sections, cold formed sections and profiled sheets)
<table>
<tr><th>Steel grade</th><th>Thickness less than or equal to (mm)</th><th>Design strength p_y (N/mm^2)</th></tr>
<tr><td></td><td></td><td></td></tr>
<tr><td rowspan="5">S460</td><td>16</td><td>460</td></tr>
<tr><td>40</td><td>440</td></tr>
<tr><td>63</td><td>430</td></tr>
<tr><td>80</td><td>410</td></tr>
<tr><td>100</td><td>400</td></tr>
<tr><td>S550</td><td>50</td><td>550</td></tr>
</table></td></tr>
</table>

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[13] Addition of cold formed sections and profiled sheets to title of Table 3.2 and design strength values for S550 and S690 steel.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td>Note that the thickness of the thickest element of the cross section should be used for strength classification of rolled sections.</td><td><table>
<tr><td></td><td>100</td><td>530</td></tr>
<tr><td></td><td>150</td><td>490</td></tr>
<tr><td>S690</td><td>50</td><td>690</td></tr>
<tr><td></td><td>100</td><td>650</td></tr>
<tr><td></td><td>150</td><td>630</td></tr>
</table>
Note that the thickness of the thickest element of the cross section should be used for strength classification of rolled sections.</td></tr>
<tr><td>14. Table 3.3[14]</td><td>Table 3.3 - Design strength p_y for steels supplied in accordance with Chinese standard GB50017
(plates, hot rolled sections, hot finished and cold formed hollow sections)
<table>
<tr><th>Steel grade</th><th>Thickness less than or equal to (mm)</th><th>Design strength p_y (N/mm^2)</th></tr>
<tr><td>Q235</td><td>16</td><td>215</td></tr>
<tr><td></td><td>40</td><td>205</td></tr>
<tr><td></td><td>60</td><td>200</td></tr>
<tr><td></td><td>100</td><td>190</td></tr>
<tr><td>Q345</td><td>16</td><td>310</td></tr>
<tr><td></td><td>35</td><td>295</td></tr>
<tr><td></td><td>50</td><td>265</td></tr>
<tr><td></td><td>100</td><td>250</td></tr>
<tr><td>Q390</td><td>16</td><td>350</td></tr>
</table></td><td>Table 3.3 - Design strength p_y for steels supplied in accordance with Chinese standard GB50017
(plates, hot rolled sections, hot finished and cold formed hollow sections, cold formed sections and profiled sheets)
a) Q235 ~ Q460 steel
<table>
<tr><th>Steel grade</th><th>Thickness less than or equal to (mm)</th><th>Design strength p_y (N/mm^2)</th></tr>
<tr><td>Q235</td><td>16</td><td>215</td></tr>
<tr><td></td><td>40</td><td>205</td></tr>
<tr><td></td><td>100</td><td>200</td></tr>
<tr><td></td><td>■</td><td>■</td></tr>
<tr><td>Q345/ Q355</td><td>16</td><td>305</td></tr>
<tr><td></td><td>40</td><td>295</td></tr>
</table></td></tr>
</table>

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[14] Addition of cold formed sections and profiled sheets to title of Table 3.3 and design strength values for Q460 to Q690 steel; Revision of design strength values for Q235 to Q420 steel.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>35</td><td>335</td></tr>
<tr><td></td><td>50</td><td>315</td></tr>
<tr><td></td><td>100</td><td>295</td></tr>
<tr><td rowspan="4">Q420</td><td>16</td><td>380</td></tr>
<tr><td>35</td><td>360</td></tr>
<tr><td>50</td><td>340</td></tr>
<tr><td>100</td><td>325</td></tr>
</table>
</td><td>
<table>
<tr><td></td><td>63</td><td>290</td></tr>
<tr><td></td><td>80</td><td>280</td></tr>
<tr><td></td><td>100</td><td>270</td></tr>
<tr><td rowspan="4">Q390</td><td>16</td><td>345</td></tr>
<tr><td>40</td><td>330</td></tr>
<tr><td>63</td><td>310</td></tr>
<tr><td>100</td><td>295</td></tr>
<tr><td rowspan="4">Q420</td><td>16</td><td>375</td></tr>
<tr><td>40</td><td>355</td></tr>
<tr><td>63</td><td>320</td></tr>
<tr><td>100</td><td>305</td></tr>
<tr><td rowspan="4">Q460</td><td>16</td><td>410</td></tr>
<tr><td>40</td><td>390</td></tr>
<tr><td>63</td><td>355</td></tr>
<tr><td>100</td><td>340</td></tr>
</table>

a) Q550 ~ Q690 steel

<table>
<tr><th>Steel grade</th><th>Thickness less than or equal to (mm)</th><th>Design strength p_y (N/mm^2)</th></tr>
<tr><td rowspan="5">Q550</td><td>16</td><td>520</td></tr>
<tr><td>40</td><td>500</td></tr>
<tr><td>63</td><td>475</td></tr>
<tr><td>80</td><td>455</td></tr>
<tr><td>100</td><td>445</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td></td><td><table><tr><td>Q690</td><td>16</td><td>630</td></tr><tr><td></td><td>40</td><td>615</td></tr><tr><td></td><td>63</td><td>605</td></tr><tr><td></td><td>80</td><td>585</td></tr></table></td></tr>
<tr><td>15. Table 3.4[15]</td><td>Table 3.4 - Design strength p_y for North American steel supplied to ASTM Standards (plates, hot rolled sections, hot finished and cold formed hollow sections)</td><td>Table 3.4 - Design strength p_y for North American steel supplied to ASTM Standards (plates, hot rolled sections, hot finished and cold formed hollow sections, cold formed sections and profiled sheets)</td></tr>
<tr><td>16. Table 3.5[16]</td><td>Table 3.5 - Design strength p_y for steels supplied in accordance with Australian standards (plates, hot rolled sections, hot finished and cold formed hollow sections)</td><td>Table 3.5 - Design strength p_y for steels supplied in accordance with Australian standards (plates, hot rolled sections, hot finished and cold formed hollow sections, cold formed sections and profiled sheets)</td></tr>
<tr><td>17. Table 3.6[17]</td><td>Table 3.6 - Design strength p_y for Japanese JIS SN Steel (rolled steel for building products) to JIS G 3136 supplied in accordance with JIS standards (plates, hot rolled sections, hot finished and cold formed hollow sections)</td><td>Table 3.6 - Design strength p_y for Japanese JIS SN Steel (rolled steel for building products) to JIS G 3136 supplied in accordance with JIS standards (plates, hot rolled sections, hot finished and cold formed hollow sections, cold formed sections and profiled sheets)</td></tr>
</table>

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[15] Addition of cold formed sections and profiled sheets to title of Table 3.4.
[16] Addition of cold formed sections and profiled sheets to title of Table 3.5.
[17] Addition of cold formed sections and profiled sheets to title of Table 3.6.

Item	Current version	Amendments
18. Clause 3.1.3[18]	**3.1.3 Design strength for high strength steels** For high strength steels with a design strength greater than 460 N/mm^2 and not exceeding 690 N/mm^2 produced in accordance with the basic requirements in Annex D1.1, the design strength p_y may be taken as $Y_s/1.0$ but not greater than $U_s/1.2$, where Y_s and U_s are respectively the minimum yield strength (R_{eH}) and minimum tensile strength (R_m) specified in the relevant reference material standard or derived by the manufacturer using an acceptable Quality Assurance system. These materials typically obtain their strength through a quenching and tempering heat-treatment and there are additional restraints on fabrication and design, particularly with welding, because heat may affect the strength of the parent steel. Bolted connection should be considered for certain high strength steels when welding is not allowed. The Responsible Engineer shall justify each design on a case-by-case basis using justified parameters and formulae proposed by manufacturers and verified by himself. Correct welding procedure specifications are essential and shall be specified. When high strength steel is used in compression, it shall be limited to compact sections where local buckling of outstands will not occur. The essentials of the basic requirements for high strength steels	**3.1.3 Design strength for ultra high strength steels** For ultra high strength steels with a design strength greater than 690 N/mm^2 🟥 produced in accordance with the basic requirements in Annex D1.1, the design strength p_y may be taken as Y_s/γ_{m1} but not greater than U_s/γ_{m2}, where Y_s and U_s are respectively the minimum yield strength (R_{eH}) and minimum tensile strength (R_m) specified in the relevant reference material standard or derived by the manufacturer using an acceptable Quality Assurance system, while γ_{m1} and γ_{m2} are the material factors according to manufacturer's recommendations. These materials typically obtain their strength through a quenching and tempering heat-treatment 🟥or a thermo-mechanically controlled process. There are additional restraints on fabrication and design, particularly with welding, because heat may affect the strength of the parent steel. 🟥

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[18] Revision of design strength of ultra high strength steel.

Item	Current version	Amendments
	are as stated in Annex D1.1 except that the maximum carbon content shall not exceed 0.20% and the maximum sulphur and phosphorus contents shall not exceed 0.025%.	
19. Clause 3.1.5[19]	**3.1.5 Through thickness properties** The design strengths given in the standards refer to the longitudinal and transverse directions.	**3.1.5 Through thickness properties** The essential requirement is an adequate deformation capacity perpendicular to the plate surface to provide ductility and toughness against fracture under tension. The design strengths given in most material specifications refer to the longitudinal and transverse directions.
20. Clause 3.2[20]	**3.2 PREVENTION OF BRITTLE FRACTURE** Brittle fracture should be avoided by ensuring fabrication is free from significant defects and by using a steel quality with adequate notch toughness as quantified by the Charpy impact properties. The factors to be considered include the minimum service temperature, the thickness, the steel grade, the type of detail, the stress level and the strain rate or level. The welding consumables and welding procedures should also be chosen to ensure the Charpy impact test properties in the weld metal and the heat affected zone of the joint that are equivalent to,	**3.2 PREVENTION OF BRITTLE FRACTURE** Brittle fracture should be avoided by ensuring fabrication is free from significant defects and by using a steel quality with adequate notch toughness as quantified by the Charpy impact properties. The factors to be considered include the minimum service temperature, the thickness, the steel grade, the type of detail, the stress level and the strain rate [redacted]. The welding consumables and welding procedures should also be chosen to ensure the Charpy impact test properties in the weld metal and the heat affected zone of the joint that are equivalent to,

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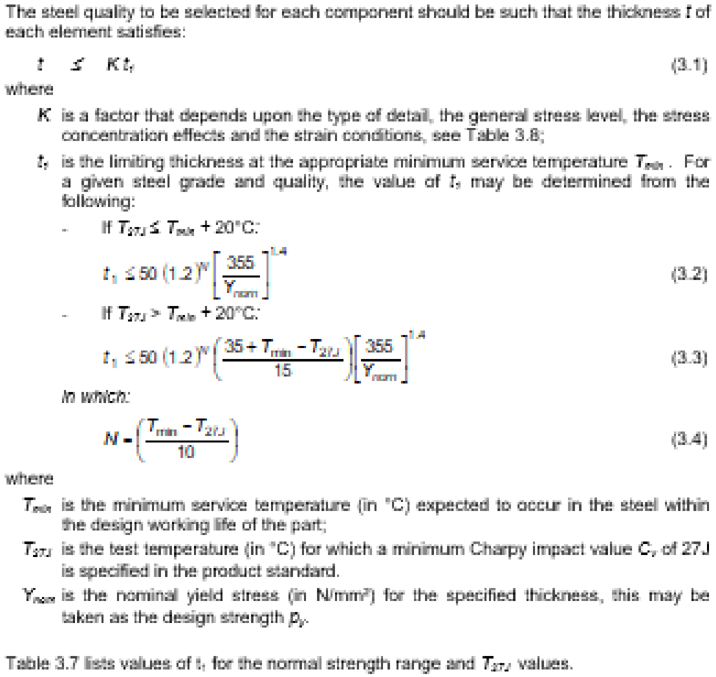
[19] Revision of requirement of through thickness properties.

[20] Revision of requirement of Prevention of Brittle Fracture.

Item	Current version	Amendments
	or better than the minimum specified for the parent material, see clause 3.4. In Hong Kong the minimum service temperature T_{min} in the steel should normally be taken as 0.1°C for external steelwork. For locations subject to exceptionally low temperatures, such as cold storage or structures to be constructed in other countries, T_{min} should be taken as the minimum temperature expected to occur in the steel within the design working life.  The steel quality to be selected for each component should be such that the thickness t of each element satisfies: $t \leq K t_1$ (3.1) where K is a factor that depends upon the type of detail, the general stress level, the stress concentration effects and the strain conditions, see Table 3.8; t_1 is the limiting thickness at the appropriate minimum service temperature T_{min}. For a given steel grade and quality, the value of t_1 may be determined from the following: - If $T_{27J} \leq T_{min} + 20°C$: $t_1 \leq 50\,(1.2)^N \left[\frac{355}{Y_{nom}}\right]^{1.4}$ (3.2) - If $T_{27J} > T_{min} + 20°C$: $t_1 \leq 50\,(1.2)^N \left(\frac{35 + T_{min} - T_{27J}}{15}\right)\left[\frac{355}{Y_{nom}}\right]^{1.4}$ (3.3) *in which:* $N = \left(\frac{T_{min} - T_{27J}}{10}\right)$ (3.4) where T_{min} is the minimum service temperature (in °C) expected to occur in the steel within the design working life of the part; T_{27J} is the test temperature (in °C) for which a minimum Charpy impact value C_v of 27J is specified in the product standard. Y_{nom} is the nominal yield stress (in N/mm²) for the specified thickness, this may be taken as the design strength p_y. Table 3.7 lists values of t_1 for the normal strength range and T_{27J} values.	or better than the minimum specified for the parent material, see clauses 3.4 and 14.3. In Hong Kong the minimum service temperature T_{min} in the steel should normally be taken as 0.1°C for external steelwork. For locations subject to exceptionally low temperatures, such as cold storage or structures to be constructed in other countries, T_{min} should be taken as the minimum temperature expected to occur in the steel within the design working life. 🟥 The guidance given in this section should be used for the selection of material for new construction. It is not intended to cover the assessment of materials in service. The rules should be used to select a suitable grade of steel from the steel products as listed in Annex A1. The rules are applicable to tension elements, welded and fatigue stressed elements in which some portions of the stress cycle are tensile. Fracture toughness need not be specified for elements only in compression. The rules shall be applied to the properties of materials specified for the toughness quality in the relevant steel product standard. Material of a lower grade shall not be used even though test results show compliance with the specific grade.

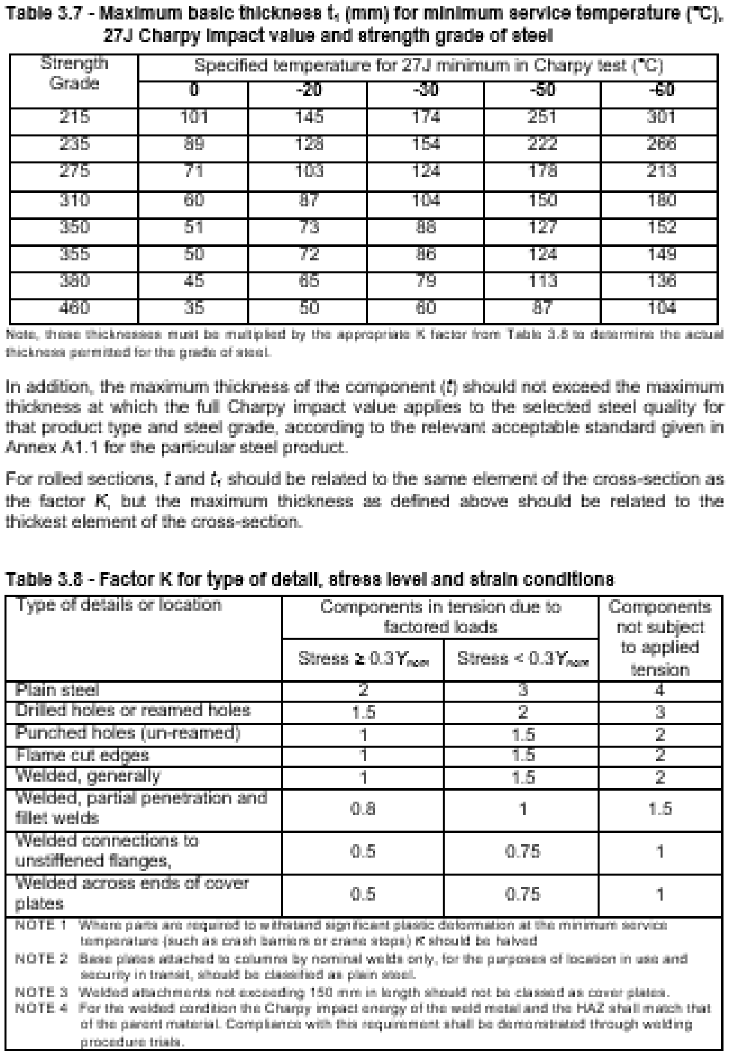
<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td>


Table 3.7 - Maximum basic thickness t_1 (mm) for minimum service temperature (°C), 27J Charpy impact value and strength grade of steel

<table>
<tr><td rowspan="2">Strength Grade</td><td colspan="5">Specified temperature for 27J minimum in Charpy test (°C)</td></tr>
<tr><td>0</td><td>-20</td><td>-30</td><td>-50</td><td>-60</td></tr>
<tr><td>215</td><td>101</td><td>145</td><td>174</td><td>251</td><td>301</td></tr>
<tr><td>235</td><td>89</td><td>128</td><td>154</td><td>222</td><td>266</td></tr>
<tr><td>275</td><td>71</td><td>103</td><td>124</td><td>178</td><td>213</td></tr>
<tr><td>310</td><td>60</td><td>87</td><td>104</td><td>150</td><td>180</td></tr>
<tr><td>350</td><td>51</td><td>73</td><td>88</td><td>127</td><td>152</td></tr>
<tr><td>355</td><td>50</td><td>72</td><td>86</td><td>124</td><td>149</td></tr>
<tr><td>380</td><td>45</td><td>65</td><td>79</td><td>113</td><td>136</td></tr>
<tr><td>460</td><td>35</td><td>50</td><td>60</td><td>87</td><td>104</td></tr>
</table>

Note, these thicknesses must be multiplied by the appropriate K factor from Table 3.8 to determine the actual thickness permitted for the grade of steel.

In addition, the maximum thickness of the component (*t*) should not exceed the maximum thickness at which the full Charpy impact value applies to the selected steel quality for that product type and steel grade, according to the relevant acceptable standard given in Annex A1.1 for the particular steel product.

For rolled sections, *t* and t_1 should be related to the same element of the cross-section as the factor *K*, but the maximum thickness as defined above should be related to the thickest element of the cross-section.

Table 3.8 - Factor K for type of detail, stress level and strain conditions

<table>
<tr><td rowspan="2">Type of details or location</td><td colspan="2">Components in tension due to factored loads</td><td rowspan="2">Components not subject to applied tension</td></tr>
<tr><td>Stress ≥ $0.3Y_{nom}$</td><td>Stress < $0.3Y_{nom}$</td></tr>
<tr><td>Plain steel</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>Drilled holes or reamed holes</td><td>1.5</td><td>2</td><td>3</td></tr>
<tr><td>Punched holes (un-reamed)</td><td>1</td><td>1.5</td><td>2</td></tr>
<tr><td>Flame cut edges</td><td>1</td><td>1.5</td><td>2</td></tr>
<tr><td>Welded, generally</td><td>1</td><td>1.5</td><td>2</td></tr>
<tr><td>Welded, partial penetration and fillet welds</td><td>0.8</td><td>1</td><td>1.5</td></tr>
<tr><td>Welded connections to unstiffened flanges,</td><td>0.5</td><td>0.75</td><td>1</td></tr>
<tr><td>Welded across ends of cover plates</td><td>0.5</td><td>0.75</td><td>1</td></tr>
<tr><td colspan="4">NOTE 1 Where parts are required to withstand significant plastic deformation at the minimum service temperature (such as crash barriers or crane stops) K should be halved
NOTE 2 Base plates attached to columns by nominal welds only, for the purposes of location in use and security in transit, should be classified as plain steel.
NOTE 3 Welded attachments not exceeding 150 mm in length should not be classed as cover plates.
NOTE 4 For the welded condition the Charpy impact energy of the weld metal and the HAZ shall match that of the parent material. Compliance with this requirement shall be demonstrated through welding procedure trials.</td></tr>
</table>
</td><td>

3.2.1 Procedure

3.2.1.1 The steel grade should be selected after taking account of:

a) Steel material properties:

- Yield strength depending on the material thickness $p_y(t)$
- Toughness quality expressed in terms of T and J_{min}

where T is the temperature under Charpy impact test; and

J_{min} is the guaranteed value of Charpy impact energy

b) Member characteristics:

- Member shape and detail
- Element thickness (t)

c) Design situations:

- Design value of minimum service temperature, T_{min}
- Maximum stress σ derived from the design condition described in clause 3.2.1.3 below
- For cold-formed steel sections with significant transverse bending, for example, cold-formed circular and rectangular hollow sections, the minimum service temperature should be reduced by 5°C.
</td></tr>
</table>

3.2.1.2 The permitted thickness of steel elements against brittle fracture should be obtained from clause 3.2.2 and Table 3.7.

3.2.1.3 The maximum stress σ derived of each structural element or connection should be determined by elastic analysis after considering various load combination including temperature effect under serviceability limit states in accordance with clause 4.3.7.

3.2.1.4 The maximum stress σ is determined using an elastic analysis under serviceability limit states.

3.2.2 Determination of maximum permissible values of element thickness

Table 3.7 gives the maximum permissible values of element thickness in terms of three stress levels expressed as proportions of the nominal yield strength:

a) $\sigma = 0.75p_y(t)$ [N/mm^2]

b) $\sigma = 0.50p_y(t)$ [N/mm^2]

c) $\sigma = 0.25p_y(t)$ [N/mm^2]

where $p_y(t)$ may be determined either from

$$p_y(t) = p_y - 0.25t \ [N/mm^2]$$

Item	Current version	Amendments
		where t is the thickness of the plate in mm or taken as R_{eH}-values from the relevant steel material specifications or standards. The tabulated values are given in terms of a choice of seven reference temperatures: +10, 0, -10, -20, -30, -40 and -50°C.

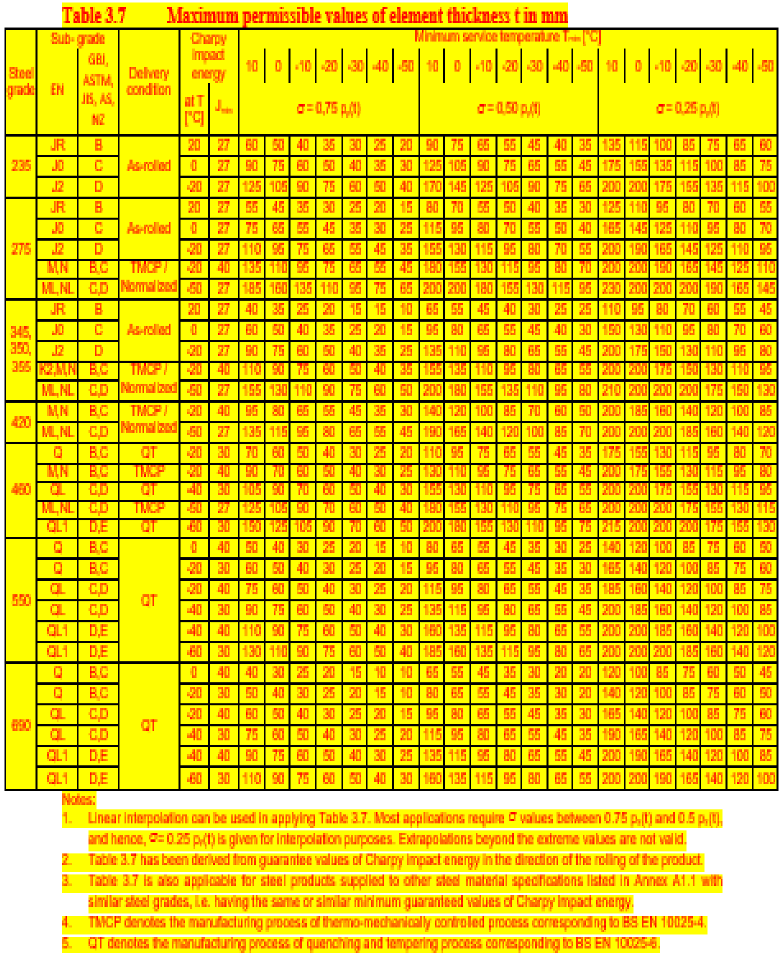
Item	Current version	Amendments
		

Table 3.7 Maximum permissible values of element thickness t in mm

Steel grade	Sub-grade		Delivery condition	Charpy impact energy		Minimum service temperature T_{min} [°C]																				
	EN	GB, ASTM, JIS, AS, NZ		at T [°C]	J_{min}	10	0	-10	-20	-30	-40	-50	10	0	-10	-20	-30	-40	-50	10	0	-10	-20	-30	-40	-50
						$\sigma = 0{,}75\ p_y(t)$							$\sigma = 0{,}50\ p_y(t)$							$\sigma = 0{,}25\ p_y(t)$						
235	JR	B	As-rolled	20	27	60	50	40	35	30	25	20	90	75	65	55	45	40	35	135	115	100	85	75	65	60
	J0	C		0	27	90	75	60	50	40	35	30	125	105	90	75	65	55	45	175	155	135	115	100	85	75
	J2	D		-20	27	125	105	90	75	60	50	40	170	145	125	105	90	75	65	200	200	175	155	135	115	100
275	JR	B	As-rolled	20	27	55	45	35	30	25	20	15	80	70	55	50	40	35	30	125	110	95	80	70	60	55
	J0	C		0	27	75	65	55	45	35	30	25	115	95	80	70	55	50	40	165	145	125	110	95	80	70
	J2	D		-20	27	110	95	75	65	55	45	35	155	130	115	95	80	70	55	200	190	165	145	125	110	95
	M,N	B,C	TMCP / Normalized	-20	40	135	110	95	75	65	55	45	180	155	130	115	95	80	70	200	200	190	165	145	125	110
	ML, NL	C,D		-50	27	185	160	135	110	95	75	65	200	200	180	155	130	115	95	230	200	200	200	190	165	145
345, 350, 355	JR	B	As-rolled	20	27	40	35	25	20	15	15	10	65	55	45	40	30	25	25	110	95	80	70	60	55	45
	J0	C		0	27	60	50	40	35	25	20	15	95	80	65	55	45	40	30	150	130	110	95	80	70	60
	J2	D		-20	27	90	75	60	50	40	35	25	135	110	95	80	65	55	45	200	175	150	130	110	95	80
	K2,M,N	B,C	TMCP / Normalized	-20	40	110	90	75	60	50	40	35	155	135	110	95	80	65	55	200	200	175	150	130	110	95
	ML, NL	C,D		-50	27	155	130	110	90	75	60	50	200	180	155	135	110	95	80	210	200	200	200	175	150	130
420	M,N	B,C	TMCP / Normalized	-20	40	95	80	65	55	45	35	30	140	120	100	85	70	60	50	200	185	160	140	120	100	85
	ML, NL	C,D		-50	27	135	115	95	80	65	55	45	190	165	140	120	100	85	70	200	200	200	185	160	140	120
460	Q	B,C	QT	-20	30	70	60	50	40	30	25	20	110	95	75	65	55	45	35	175	155	130	115	95	80	70
	M,N	B,C	TMCP	-20	40	90	70	60	50	40	30	25	130	110	95	75	65	55	45	200	175	155	130	115	95	80
	QL	C,D	QT	-40	30	105	90	70	60	50	40	30	155	130	110	95	75	65	55	200	200	175	155	130	115	95
	ML, NL	C,D	TMCP	-50	27	125	105	90	70	60	50	40	180	155	130	110	95	75	65	200	200	200	175	155	130	115
	QL1	D,E	QT	-60	30	150	125	105	90	70	60	50	200	180	155	130	110	95	75	215	200	200	200	175	155	130
550	Q	B,C	QT	0	40	50	40	30	25	20	15	10	80	65	55	45	35	30	25	140	120	100	85	75	60	50
	Q	B,C		-20	30	60	50	40	30	25	20	15	95	80	65	55	45	35	30	165	140	120	100	85	75	60
	QL	C,D		-20	40	75	60	50	40	30	25	20	115	95	80	65	55	45	35	185	160	140	120	100	85	75
	QL	C,D		-40	30	90	75	60	50	40	30	25	135	115	95	80	65	55	45	200	185	160	140	120	100	85
	QL1	D,E		-40	40	110	90	75	60	50	40	30	160	135	115	95	80	65	55	200	200	185	160	140	120	100
	QL1	D,E		-60	30	130	110	90	75	60	50	40	185	160	135	115	95	80	65	200	200	200	185	160	140	120
690	Q	B,C	QT	0	40	40	30	25	20	15	10	10	65	55	45	35	30	20	20	120	100	85	75	60	50	45
	Q	B,C		-20	30	50	40	30	25	20	15	10	80	65	55	45	35	30	20	140	120	100	85	75	60	50
	QL	C,D		-20	40	60	50	40	30	25	20	15	95	80	65	55	45	35	30	165	140	120	100	85	75	60
	QL	C,D		-40	30	75	60	50	40	30	25	20	115	95	80	65	55	45	35	190	165	140	120	100	85	75
	QL1	D,E		-40	40	90	75	60	50	40	30	25	135	115	95	80	65	55	45	200	190	165	140	120	100	85
	QL1	D,E		-60	30	110	90	75	60	50	40	30	160	135	115	95	80	65	55	200	200	190	165	140	120	100

Notes:

1. Linear interpolation can be used in applying Table 3.7. Most applications require σ values between 0.75 $p_y(t)$ and 0.5 $p_y(t)$, and hence, σ = 0.25 $p_y(t)$ is given for interpolation purposes. Extrapolations beyond the extreme values are not valid.
2. Table 3.7 has been derived from guarantee values of Charpy impact energy in the direction of the rolling of the product.
3. Table 3.7 is also applicable for steel products supplied to other steel material specifications listed in Annex A1.1 with similar steel grades, i.e. having the same or similar minimum guaranteed values of Charpy impact energy.
4. TMCP denotes the manufacturing process of thermo-mechanically controlled process corresponding to BS EN 10025-4.
5. QT denotes the manufacturing process of quenching and tempering process corresponding to BS EN 10025-6.

Item	Current version	Amendments
21. Clause 3.3.1[21]	Bolts with an ultimate tensile strength exceeding 1000 N/mm^2 should not be used unless test results demonstrate their acceptability in a particular design application.	Bolts with an ultimate tensile strength exceeding 1200 N/mm^2 should not be used unless test results demonstrate their acceptability in a particular design application.
22. Table 3.4[22]	**3.4 WELDING CONSUMABLES** All welding consumables shall conform to the requirements of the reference standards given in Annex A1.4. For steel with design strength not exceeding 460 N/mm^2 the specified yield strength, ultimate tensile strength, elongation at failure and Charpy energy value of the welding consumables shall be equal to or better than the corresponding values specified for the grade of steel being welded. The most onerous grade shall govern if dissimilar grades are welded together. For high and ultra-high strength steels, the welding material may, if necessary to produce a suitable joint, be of a lower strength; the elongation to failure and Charpy impact value should still match those of the parent material. In that case, the design strength of the weld must be based on the weld material.	**3.4 WELDING CONSUMABLES** All welding consumables shall conform to the requirements of the reference standards given in Annex A1.4. For steel with design strength not exceeding 690 N/mm^2, the specified yield strength, ultimate tensile strength, elongation at failure and Charpy impact value of the welding consumables shall be equal to or better than the corresponding values specified for the grade of steel being welded. The most onerous grade shall govern if dissimilar grades are welded together. For ultra-high strength steels, the welding consumables may, if necessary to produce a suitable joint, be of a lower strength; the elongation to failure and Charpy impact value should still match those of the parent material. In that case, the design strength of the weld must be based on the weld material.

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[21] Revision of limit of ultimate tensile strength of bolt.

[22] Revision of limit of design strength of steel.

Item	Current version	Amendments
23. Clause 3.8.1.3[23]	*High strength steel with limited ductility* For Class 1H steel strips that failed to comply with the ductility requirements list in clause 3.8.1.2, the use of steel materials should be limited to members under lateral loads primarily, and the design yield strength should be reduced as follows:	*High strength steel strips with limited ductility* For high strength S550 steel strips that failed to comply with the ductility requirements listed in clause 3.8.1.2, the use of steel materials should be limited to members under lateral loads primarily, and the design yield strength should be reduced as follows:
24. Table 3.8[24]	**Table 3.9 - Yield and ultimate strengths for steels supplied in accordance with various national standards**	**Table 3.8 - Yield and tensile strengths for steels supplied in accordance with various national standards**
25. Table 3.8 (Cont')[25]	**Table 3.9 - Yield and ultimate strengths for steels supplied in accordance with various national standards (continued)**	**Table 3.8 - Yield and tensile strengths for steels supplied in accordance with various national standards (continued)**

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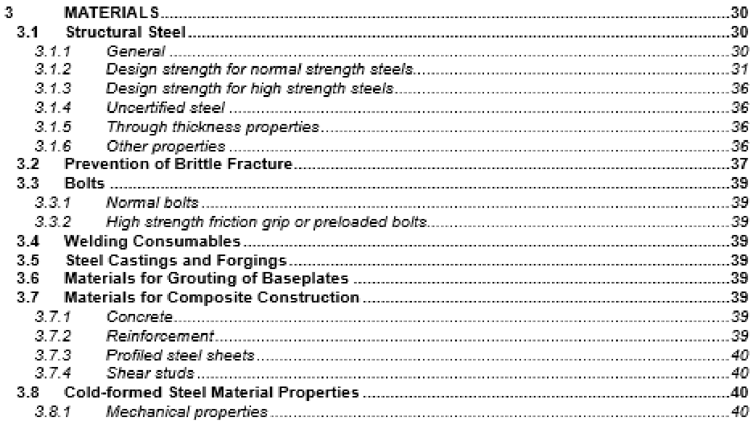
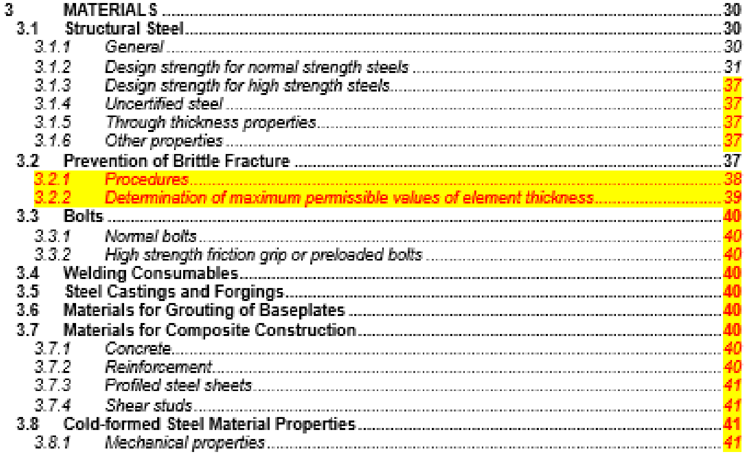
[23] Addition of high strength S550 steel.

[24] Revision of title of Table 3.9.

[25] Revision of title of Table 3.9 (continued).

Item	Current version	Amendments
26. Page Index of Clause 3[26]	 3 MATERIALS ....30 3.1 Structural Steel ....30 3.1.1 General ....30 3.1.2 Design strength for normal strength steels ....31 3.1.3 Design strength for high strength steels ....36 3.1.4 Uncertified steel ....36 3.1.5 Through thickness properties ....36 3.1.6 Other properties ....36 3.2 Prevention of Brittle Fracture ....37 3.3 Bolts ....39 3.3.1 Normal bolts ....39 3.3.2 High strength friction grip or preloaded bolts ....39 3.4 Welding Consumables ....39 3.5 Steel Castings and Forgings ....39 3.6 Materials for Grouting of Baseplates ....39 3.7 Materials for Composite Construction ....39 3.7.1 Concrete ....39 3.7.2 Reinforcement ....39 3.7.3 Profiled steel sheets ....40 3.7.4 Shear studs ....40 3.8 Cold-formed Steel Material Properties ....40 3.8.1 Mechanical properties 40	 3 MATERIALS ....30 3.1 Structural Steel ....30 3.1.1 General ....30 3.1.2 Design strength for normal strength steels ....31 3.1.3 Design strength for high strength steels ....37 3.1.4 Uncertified steel ....37 3.1.5 Through thickness properties ....37 3.1.6 Other properties ....37 3.2 Prevention of Brittle Fracture ....37 3.2.1 Procedures ....38 3.2.2 Determination of maximum permissible values of element thickness ....39 3.3 Bolts ....40 3.3.1 Normal bolts ....40 3.3.2 High strength friction grip or preloaded bolts ....40 3.4 Welding Consumables ....40 3.5 Steel Castings and Forgings ....40 3.6 Materials for Grouting of Baseplates ....40 3.7 Materials for Composite Construction ....40 3.7.1 Concrete ....40 3.7.2 Reinforcement ....40 3.7.3 Profiled steel sheets ....41 3.7.4 Shear studs ....41 3.8 Cold-formed Steel Material Properties ....41 3.8.1 Mechanical properties 41
27. Clause 4.2.1[27]	For high strength **Class 1H** steel plates and sections with a yield stress greater than 460 N/mm^2 and which are supplied from a known source complying with the specification requirements in Annex A1.1 of the Code, the partial material factor γ_{m1} should be 1.0. For ultra high strength **Class UH** steel plates and sections with a yield stress greater than 690 N/mm^2 and which are supplied from a recognized source complying with specific requirements, the partial material factor γ_{m1} should refer to manufacturer's recommendations.	For high strength **Class 1H** steel plates and sections with a yield stress greater than 460 N/mm^2 but less than or equal to 690 N/mm^2 and 🟥 complying with 🟥one of the reference material standards in Annex A1.1 🟥, the partial material 🟥factors are given in Table 4.1 For ultra high strength **Class UH** steel plates and sections with a yield stress greater than 690 N/mm^2 and 🟥 complying with 🟥one of the reference material standards in Annex 1.1, the partial material factor should refer to manufacturer's recommendations.

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[26] Revision of page index of Clause 3.

[27] Revision of Class 1H steel for normal use in steel structures and material factors.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr>
<td>28. Table 4.1[28]</td>
<td>

Table 4.1 - Material factors γ_{m1} and γ_{m2} for various classes of steels

<table>
<tr><td>Class</td><td colspan="2">$Y_s \le 460$ N/mm^2</td><td colspan="2">$460 < Y_s \le 690$ N/mm^2</td></tr>
<tr><td></td><td>γ_{m1}</td><td>γ_{m2}</td><td>γ_{m1}</td><td>γ_{m2}</td></tr>
<tr><td>1</td><td>1.0</td><td>1.2</td><td>-</td><td>-</td></tr>
<tr><td>2</td><td>1.1</td><td>1.3</td><td>-</td><td>-</td></tr>
<tr><td>3</td><td>*</td><td>*</td><td>-</td><td>-</td></tr>
<tr><td>1H</td><td>-</td><td>-</td><td>1.0</td><td>1.2</td></tr>
</table>
</td>
<td>

Table 4.1 – Material factors γ_{m1} and γ_{m2} for various classes of steels

<table>
<tr><td>Class</td><td colspan="2">$Y_s \le 460$ N/mm^2</td><td colspan="2">$460 < Y_s \le 690$ N/mm^2</td></tr>
<tr><td></td><td>γ_{m1}</td><td>γ_{m2}</td><td>γ_{m1}</td><td>γ_{m2}</td></tr>
<tr><td>1</td><td>1.0</td><td>1.1</td><td>-</td><td>-</td></tr>
<tr><td>2</td><td>1.1</td><td>1.2</td><td>-</td><td>-</td></tr>
<tr><td>3</td><td>*</td><td>*</td><td>-</td><td>-</td></tr>
<tr><td>1H</td><td>-</td><td>-</td><td>1.0</td><td>1.05</td></tr>
</table>
</td>
</tr>
<tr>
<td>29. Clause 5.5.2.1[29]</td>
<td>

High strength steels (in plate, rolled section or bar) of design strength greater than 460 N/mm^2 should not be galvanized in order to avoid metallurgical change or annealing. Bolts of ISO Grade 10.9 or higher grade or equivalent should not be galvanized, but should be sheradized and coated with zinc-rich or appropriate protective paint.

Hollow sections should be vented if they are to be galvanized.
</td>
<td>

🟥 Bolts of ISO Grade 10.9 or higher grade or equivalent should not be galvanized, but should be sheradized and coated with zinc-rich or appropriate protective paint.

Hollow sections should be vented if they are to be galvanized.

Some high strength steels with yield strength greater than 460 N/mm^2 may be sensitive to cracking during galvanization and therefore special care should be taken. Hence, suitable venting should be provided while special dipping procedures shall be executed in order to alleviate the risk of cracking and distortion.

BS EN ISO 14713-2 has provided further guidance, including information on the influence of various factors, including steel chemical composition, on the coating formation.
</td>
</tr>
</table>

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[28] Revision of material factor for Class 1, Class 2 and Class 1H steel.

[29] Deletion of restriction of galvanization to steel with design strength greater than 460 N/mm^2; Addition of recommendation for cracking due to galvanization with guideline from BS EN ISO 14713-2.

Item	Current version	Amendments
30. Clause 7.1[30]	This section covers steel grades with design strength not greater than 460 MPa and its extension to higher steel grades should be justified.	This section covers steel grades with design strength not greater than [redacted]690 N/mm^2 and its extension to higher steel grades should be justified.
31. Clause 8.1[31]	When Class 3 uncertified steel is used, the buckling curves for the steel material should be obtained from a reliable source and the material buckling strength so determined should be limited to the material strength given in clause 3.1.4. Formulae in this section are applicable to high strength steel of Class 1H provided that it meets the requirements for weldability, strength, ductility and resistance to brittle fracture specified in clause 3.1.3. For design against buckling tests may be required to determine the Robertson constant as defined in Appendix 8.4 where design curves are not available from the manufacturer.	When Class 3 uncertified steel is used, the buckling curves for the steel material should be obtained from a reliable source and the material buckling strength so determined should be limited to the material strength given in clause 3.1.4. [redacted]
32. Clause 8.2.2.1[32]	When high or ultra-high strength steel is used, the use of a plastic modulus is not permitted.	When high [redacted] strength steel is used, the use of a Class 4 slender section is not permitted. When ultra high strength steel is used, the use of a plastic modulus is not permitted.

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[30] Revision of Class 1H steel for normal use in steel structures.

[31] Revision of Class 1H steel for normal use in steel structures; Deletion of condition for design Class 1H steel with formulae in Section 8.

[32] Revision of section limit for Class 1H steel.

Item	Current version	Amendments
33. Clause 8.3.5.2[33]	p_b is the buckling strength of the beam, determined from Table 8.3a for hot-rolled sections and Table 8.3b for welded sections using a suitable equivalent slenderness λ_{LT} in clause 8.3.5.3 and relevant design strength p_y. Alternatively, formulae in Appendix 8.1 may be used to compute p_b.	p_b is the buckling strength of the beam, determined from Table 8.3a for hot-rolled sections and Table 8.3b for welded sections using a suitable equivalent slenderness λ_{LT} in clause 8.3.5.3 and relevant design strength p_y. When high strength steel is used, the use of a Class 4 slender section is not permitted. Alternatively, formulae in Appendix 8.1 may be used to compute p_b.
34. Table 8.3b[34]	**Table 8.3b - Bending strength p_b (N/mm^2) for welded sections**	**Table 8.3b - Bending strength p_b (N/mm^2) for welded sections** **(i) S275 ~ S460 steel**

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[33] Addition of section limit for Class 1H steel.

[34] Addition of bending strength for S550 and S690 steel.

Table 8.3b - Bending strength p_b (N/mm^2) for welded sections (Cont'd)

(ii) S550 ~ S690 steel

λ_{LT}	Strength grade and design strength p_y (N/mm^2)					
	S550			S690		
	490	530	550	630	650	690
25	490	527	543	606	621	652
30	456	484	499	554	568	595
35	417	443	455	505	517	540
40	381	403	414	457	467	487
45	347	366	375	411	422	446
50	315	334	345	391	401	422
55	297	319	329	369	378	396
60	284	303	312	345	353	368
65	269	285	293	321	327	339
70	254	267	274	294	297	303
75	238	248	252	264	267	272
80	219	226	228	239	241	245
85	200	205	208	216	218	221
90	183	187	189	196	198	201
95	168	171	173	179	180	183
100	154	157	159	164	165	167
105	142	145	146	150	151	153
110	131	134	135	138	139	141
115	121	124	125	128	129	130
120	113	115	115	118	119	120
125	105	107	107	110	110	111
130	98	99	100	102	103	104
135	92	93	93	95	96	97
140	86	87	87	89	90	90
145	80	82	82	84	84	85
150	76	77	77	79	79	79
155	71	72	73	74	74	75
160	67	68	68	70	70	70
165	64	64	65	66	66	66
170	60	61	61	62	62	63
175	57	58	58	59	59	59
180	54	55	55	56	56	56
185	51	52	52	53	53	53
190	49	49	50	50	51	51
195	47	47	47	48	48	48
200	44	45	45	46	46	46
210	41	41	41	42	42	42
220	37	37	38	38	38	38
230	34	34	35	35	35	35
240	32	32	32	32	32	32
250	29	29	29	30	30	30
λ_{L0}	25.7	24.7	24.3	22.7	22.3	21.7

Item	Current version	Amendments
35. Table 8.3c[35]		

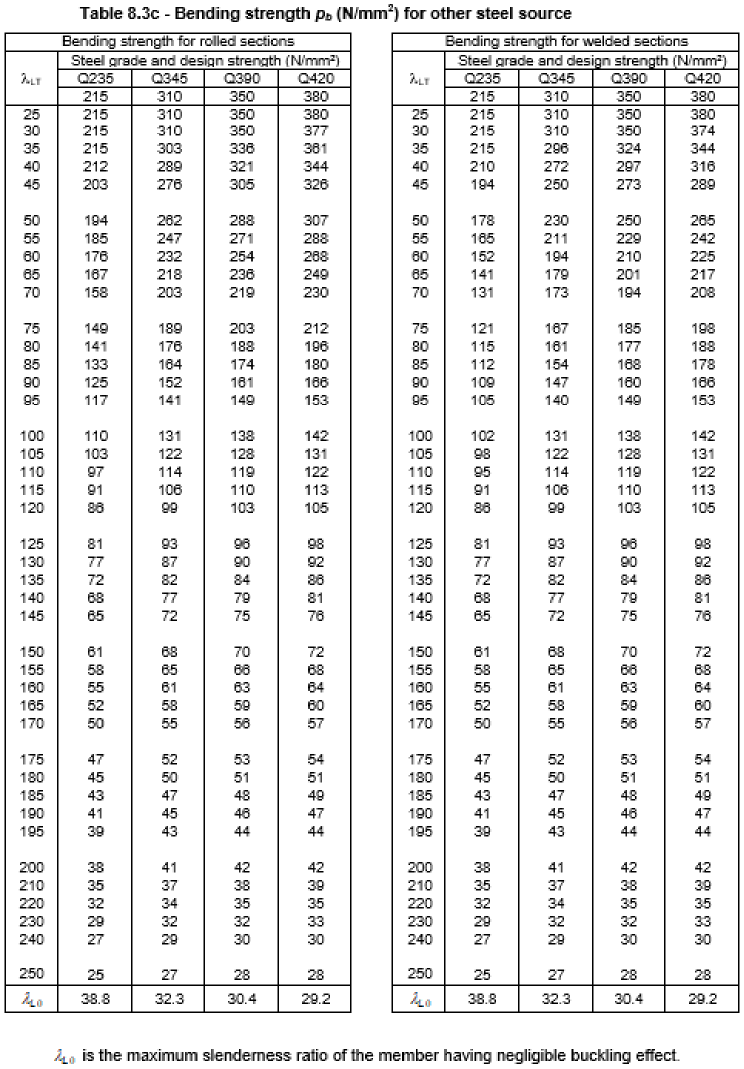

Table 8.3c - Bending strength p_b (N/mm²) for other steel source

Bending strength for rolled sections				
λ_{LT}	Steel grade and design strength (N/mm²)			
	Q235	Q345	Q390	Q420
	215	310	350	380
25	215	310	350	380
30	215	310	350	377
35	215	303	336	361
40	212	289	321	344
45	203	276	305	326
50	194	262	288	307
55	185	247	271	288
60	176	232	254	268
65	167	218	236	249
70	158	203	219	230
75	149	189	203	212
80	141	176	188	196
85	133	164	174	180
90	125	152	161	166
95	117	141	149	153
100	110	131	138	142
105	103	122	128	131
110	97	114	119	122
115	91	106	110	113
120	86	99	103	105
125	81	93	96	98
130	77	87	90	92
135	72	82	84	86
140	68	77	79	81
145	65	72	75	76
150	61	68	70	72
155	58	65	66	68
160	55	61	63	64
165	52	58	59	60
170	50	55	56	57
175	47	52	53	54
180	45	50	51	51
185	43	47	48	49
190	41	45	46	47
195	39	43	44	44
200	38	41	42	42
210	35	37	38	39
220	32	34	35	35
230	29	32	32	33
240	27	29	30	30
250	25	27	28	28
λ_{L0}	38.8	32.3	30.4	29.2

Bending strength for welded sections				
λ_{LT}	Steel grade and design strength (N/mm²)			
	Q235	Q345	Q390	Q420
	215	310	350	380
25	215	310	350	380
30	215	310	350	374
35	215	296	324	344
40	210	272	297	316
45	194	250	273	289
50	178	230	250	265
55	165	211	229	242
60	152	194	210	225
65	141	179	201	217
70	131	173	194	208
75	121	167	185	198
80	115	161	177	188
85	112	154	168	178
90	109	147	160	166
95	105	140	149	153
100	102	131	138	142
105	98	122	128	131
110	95	114	119	122
115	91	106	110	113
120	86	99	103	105
125	81	93	96	98
130	77	87	90	92
135	72	82	84	86
140	68	77	79	81
145	65	72	75	76
150	61	68	70	72
155	58	65	66	68
160	55	61	63	64
165	52	58	59	60
170	50	55	56	57
175	47	52	53	54
180	45	50	51	51
185	43	47	48	49
190	41	45	46	47
195	39	43	44	44
200	38	41	42	42
210	35	37	38	39
220	32	34	35	35
230	29	32	32	33
240	27	29	30	30
250	25	27	28	28
λ_{L0}	38.8	32.3	30.4	29.2

λ_{L0} is the maximum slenderness ratio of the member having negligible buckling effect.

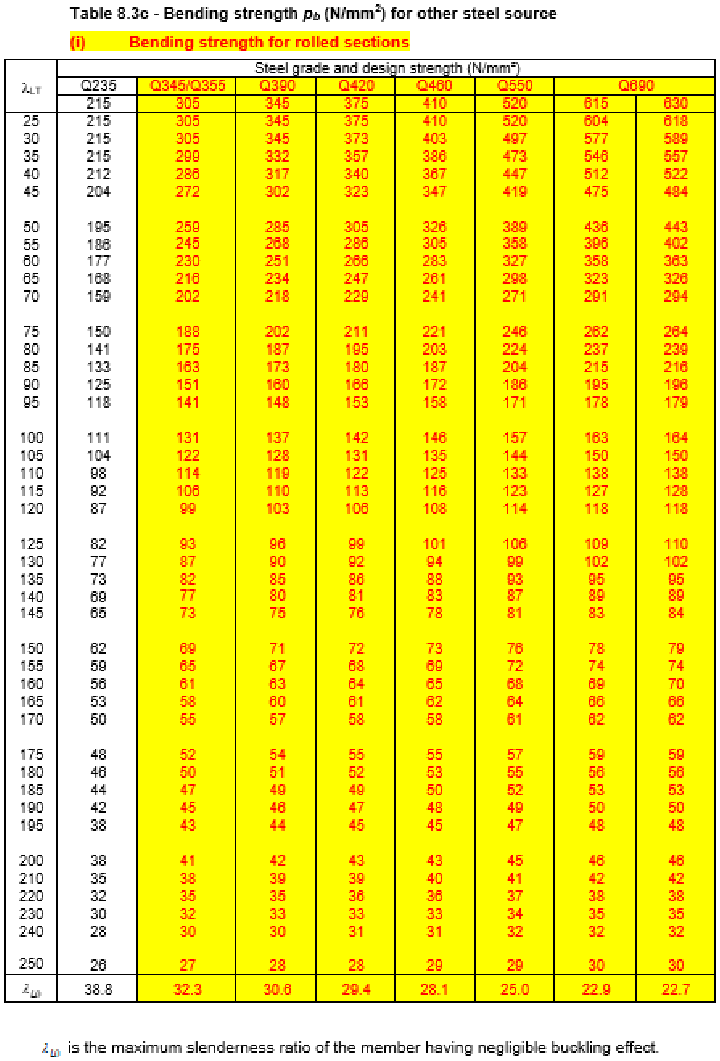

Table 8.3c - Bending strength p_b (N/mm²) for other steel source

(i) Bending strength for rolled sections

λ_{LT}	Steel grade and design strength (N/mm²)							
	Q235	Q345/Q355	Q390	Q420	Q460	Q550	Q690	
	215	305	345	375	410	520	615	630
25	215	305	345	375	410	520	604	618
30	215	305	345	373	403	497	577	589
35	215	299	332	357	386	473	546	557
40	212	286	317	340	367	447	512	522
45	204	272	302	323	347	419	475	484
50	195	259	285	305	326	389	436	443
55	186	245	268	286	305	358	396	402
60	177	230	251	266	283	327	358	363
65	168	216	234	247	261	298	323	326
70	159	202	218	229	241	271	291	294
75	150	188	202	211	221	246	262	264
80	141	175	187	195	203	224	237	239
85	133	163	173	180	187	204	215	216
90	125	151	160	166	172	186	195	196
95	118	141	148	153	158	171	178	179
100	111	131	137	142	146	157	163	164
105	104	122	128	131	135	144	150	150
110	98	114	119	122	125	133	138	138
115	92	106	110	113	116	123	127	128
120	87	99	103	106	108	114	118	118
125	82	93	96	99	101	106	109	110
130	77	87	90	92	94	99	102	102
135	73	82	85	86	88	93	95	95
140	69	77	80	81	83	87	89	89
145	65	73	75	76	78	81	83	84
150	62	69	71	72	73	76	78	79
155	59	65	67	68	69	72	74	74
160	56	61	63	64	65	68	69	70
165	53	58	60	61	62	64	66	66
170	50	55	57	58	58	61	62	62
175	48	52	54	55	55	57	59	59
180	46	50	51	52	53	55	56	56
185	44	47	49	49	50	52	53	53
190	42	45	46	47	48	49	50	50
195	38	43	44	45	45	47	48	48
200	38	41	42	43	43	45	46	46
210	35	38	39	39	40	41	42	42
220	32	35	35	36	36	37	38	38
230	30	32	33	33	33	34	35	35
240	28	30	30	31	31	32	32	32
250	26	27	28	28	29	29	30	30
λ_{L0}	38.8	32.3	30.6	29.4	28.1	25.0	22.9	22.7

λ_{L0} is the maximum slenderness ratio of the member having negligible buckling effect.

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[35] Addition of bending strength for Q355, Q550 and Q690 steel; Revision of bending strength for Q345, Q390 and Q420 steel.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td></td><td>
<p>Table 8.3c - Bending strength p_b (N/mm^2) for other steel source</p>
<p>(ii) Bending strength for welded sections</p>
<table>
<tr><th rowspan="3">λ_{LT}</th><th colspan="8">Steel grade and design strength (N/mm^2)</th></tr>
<tr><th>Q235</th><th>Q345/Q355</th><th>Q390</th><th>Q420</th><th>Q460</th><th>Q550</th><th colspan="2">Q690</th></tr>
<tr><th>215</th><th>305</th><th>345</th><th>375</th><th>410</th><th>520</th><th>615</th><th>630</th></tr>
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<p>λ_{L0} is the maximum slenderness ratio of the member having negligible buckling effect.</p>
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Item | **Current version** | **Amendments**

36. Table 8.5b[36]

Current version

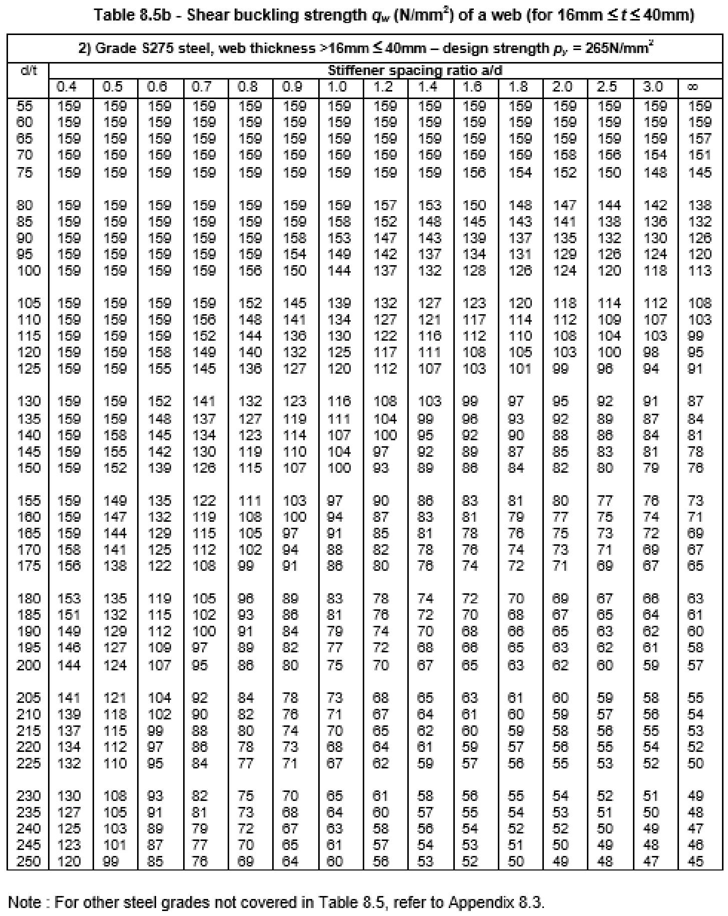

Table 8.5b - Shear buckling strength q_w (N/mm^2) of a web (for 16mm $\le t \le$ 40mm)

2) Grade S275 steel, web thickness >16mm ≤ 40mm – design strength p_y = 265N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159
60	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159
65	159	159	159	159	159	159	159	159	159	159	159	159	159	159	157
70	159	159	159	159	159	159	159	159	159	159	159	158	156	154	151
75	159	159	159	159	159	159	159	159	159	156	154	152	150	148	145
80	159	159	159	159	159	159	159	157	153	150	148	147	144	142	138
85	159	159	159	159	159	159	158	152	148	145	143	141	138	136	132
90	159	159	159	159	159	158	153	147	143	139	137	135	132	130	126
95	159	159	159	159	159	154	149	142	137	134	131	129	126	124	120
100	159	159	159	159	156	150	144	137	132	128	126	124	120	118	113
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130	159	159	152	141	132	123	116	108	103	99	97	95	92	91	87
135	159	159	148	137	127	119	111	104	99	96	93	92	89	87	84
140	159	158	145	134	123	114	107	100	95	92	90	88	86	84	81
145	159	155	142	130	119	110	104	97	92	89	87	85	83	81	78
150	159	152	139	126	115	107	100	93	89	86	84	82	80	79	76
155	159	149	135	122	111	103	97	90	86	83	81	80	77	76	73
160	159	147	132	119	108	100	94	87	83	81	79	77	75	74	71
165	159	144	129	115	105	97	91	85	81	78	76	75	73	72	69
170	158	141	125	112	102	94	88	82	78	76	74	73	71	69	67
175	156	138	122	108	99	91	86	80	76	74	72	71	69	67	65
180	153	135	119	105	96	89	83	78	74	72	70	69	67	66	63
185	151	132	115	102	93	86	81	76	72	70	68	67	65	64	61
190	149	129	112	100	91	84	79	74	70	68	66	65	63	62	60
195	146	127	109	97	89	82	77	72	68	66	65	63	62	61	58
200	144	124	107	95	86	80	75	70	67	65	63	62	60	59	57
205	141	121	104	92	84	78	73	68	65	63	61	60	59	58	55
210	139	118	102	90	82	76	71	67	64	61	60	59	57	56	54
215	137	115	99	88	80	74	70	65	62	60	59	58	56	55	53
220	134	112	97	86	78	73	68	64	61	59	57	56	55	54	52
225	132	110	95	84	77	71	67	62	59	57	56	55	53	52	50
230	130	108	93	82	75	70	65	61	58	56	55	54	52	51	49
235	127	105	91	81	73	68	64	60	57	55	54	53	51	50	48
240	125	103	89	79	72	67	63	58	56	54	52	52	50	49	47
245	123	101	87	77	70	65	61	57	54	53	51	50	49	48	46
250	120	99	85	76	69	64	60	58	53	52	50	49	48	47	45

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Amendments

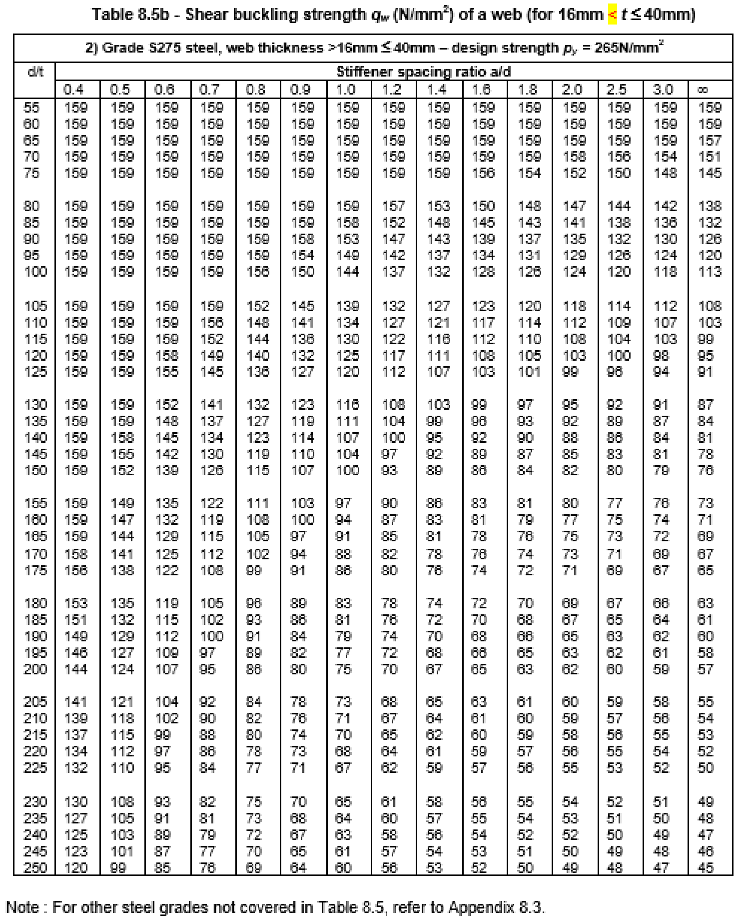

Table 8.5b - Shear buckling strength q_w (N/mm^2) of a web (for 16mm $< t \le$ 40mm)

2) Grade S275 steel, web thickness >16mm ≤ 40mm – design strength p_y = 265N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159
60	159	159	159	159	159	159	159	159	159	159	159	159	159	159	159
65	159	159	159	159	159	159	159	159	159	159	159	159	159	159	157
70	159	159	159	159	159	159	159	159	159	159	159	158	156	154	151
75	159	159	159	159	159	159	159	159	159	156	154	152	150	148	145
80	159	159	159	159	159	159	159	157	153	150	148	147	144	142	138
85	159	159	159	159	159	159	158	152	148	145	143	141	138	136	132
90	159	159	159	159	159	158	153	147	143	139	137	135	132	130	126
95	159	159	159	159	159	154	149	142	137	134	131	129	126	124	120
100	159	159	159	159	156	150	144	137	132	128	126	124	120	118	113
105	159	159	159	159	152	145	139	132	127	123	120	118	114	112	108
110	159	159	159	156	148	141	134	127	121	117	114	112	109	107	103
115	159	159	159	152	144	136	130	122	116	112	110	108	104	103	99
120	159	159	158	149	140	132	125	117	111	108	105	103	100	98	95
125	159	159	155	145	136	127	120	112	107	103	101	99	96	94	91
130	159	159	152	141	132	123	116	108	103	99	97	95	92	91	87
135	159	159	148	137	127	119	111	104	99	96	93	92	89	87	84
140	159	158	145	134	123	114	107	100	95	92	90	88	86	84	81
145	159	155	142	130	119	110	104	97	92	89	87	85	83	81	78
150	159	152	139	126	115	107	100	93	89	86	84	82	80	79	76
155	159	149	135	122	111	103	97	90	86	83	81	80	77	76	73
160	159	147	132	119	108	100	94	87	83	81	79	77	75	74	71
165	159	144	129	115	105	97	91	85	81	78	76	75	73	72	69
170	158	141	125	112	102	94	88	82	78	76	74	73	71	69	67
175	156	138	122	108	99	91	86	80	76	74	72	71	69	67	65
180	153	135	119	105	96	89	83	78	74	72	70	69	67	66	63
185	151	132	115	102	93	86	81	76	72	70	68	67	65	64	61
190	149	129	112	100	91	84	79	74	70	68	66	65	63	62	60
195	146	127	109	97	89	82	77	72	68	66	65	63	62	61	58
200	144	124	107	95	86	80	75	70	67	65	63	62	60	59	57
205	141	121	104	92	84	78	73	68	65	63	61	60	59	58	55
210	139	118	102	90	82	76	71	67	64	61	60	59	57	56	54
215	137	115	99	88	80	74	70	65	62	60	59	58	56	55	53
220	134	112	97	86	78	73	68	64	61	59	57	56	55	54	52
225	132	110	95	84	77	71	67	62	59	57	56	55	53	52	50
230	130	108	93	82	75	70	65	61	58	56	55	54	52	51	49
235	127	105	91	81	73	68	64	60	57	55	54	53	51	50	48
240	125	103	89	79	72	67	63	58	56	54	52	52	50	49	47
245	123	101	87	77	70	65	61	57	54	53	51	50	49	48	46
250	120	99	85	76	69	64	60	58	53	52	50	49	48	47	45

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[36] Revision of web thickness.

Item	Current version	Amendments
37. Table 8.5d[37]		

Current version

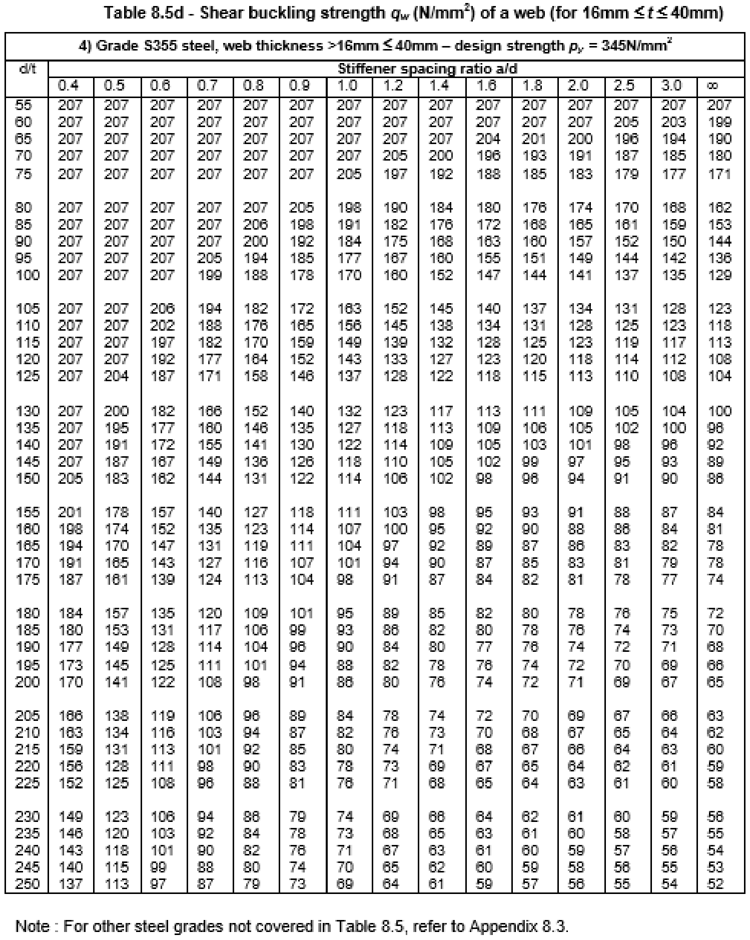

Table 8.5d - Shear buckling strength q_w (N/mm^2) of a web (for 16mm $\leq t \leq$ 40mm)

4) Grade S355 steel, web thickness >16mm ≤ 40mm – design strength p_y = 345N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	207	207	207	207	207	207	207	207	207	207	207	207	207	207	207
60	207	207	207	207	207	207	207	207	207	207	207	207	205	203	199
65	207	207	207	207	207	207	207	207	207	204	201	200	196	194	190
70	207	207	207	207	207	207	207	205	200	196	193	191	187	185	180
75	207	207	207	207	207	207	205	197	192	188	185	183	179	177	171
80	207	207	207	207	207	205	198	190	184	180	176	174	170	168	162
85	207	207	207	207	206	198	191	182	176	172	168	165	161	159	153
90	207	207	207	207	200	192	184	175	168	163	160	157	152	150	144
95	207	207	207	205	194	185	177	167	160	155	151	149	144	142	136
100	207	207	207	199	188	178	170	160	152	147	144	141	137	135	129
105	207	207	206	194	182	172	163	152	145	140	137	134	131	128	123
110	207	207	202	188	176	165	156	145	138	134	131	128	125	123	118
115	207	207	197	182	170	159	149	139	132	128	125	123	119	117	113
120	207	207	192	177	164	152	143	133	127	123	120	118	114	112	108
125	207	204	187	171	158	146	137	128	122	118	115	113	110	108	104
130	207	200	182	166	152	140	132	123	117	113	111	109	105	104	100
135	207	195	177	160	146	135	127	118	113	109	106	105	102	100	96
140	207	191	172	155	141	130	122	114	109	105	103	101	98	96	92
145	207	187	167	149	136	126	118	110	105	102	99	97	95	93	89
150	205	183	162	144	131	122	114	106	102	98	96	94	91	90	86
155	201	178	157	140	127	118	111	103	98	95	93	91	88	87	84
160	198	174	152	135	123	114	107	100	95	92	90	88	86	84	81
165	194	170	147	131	119	111	104	97	92	89	87	86	83	82	78
170	191	165	143	127	116	107	101	94	90	87	85	83	81	79	78
175	187	161	139	124	113	104	98	91	87	84	82	81	78	77	74
180	184	157	135	120	109	101	95	89	85	82	80	78	76	75	72
185	180	153	131	117	106	99	93	86	82	80	78	76	74	73	70
190	177	149	128	114	104	96	90	84	80	77	76	74	72	71	68
195	173	145	125	111	101	94	88	82	78	76	74	72	70	69	66
200	170	141	122	108	98	91	86	80	76	74	72	71	69	67	65
205	166	138	119	106	96	89	84	78	74	72	70	69	67	66	63
210	163	134	116	103	94	87	82	76	73	70	68	67	65	64	62
215	159	131	113	101	92	85	80	74	71	68	67	66	64	63	60
220	156	128	111	98	90	83	78	73	69	67	65	64	62	61	59
225	152	125	108	96	88	81	76	71	68	65	64	63	61	60	58
230	149	123	106	94	86	79	74	69	66	64	62	61	60	59	56
235	146	120	103	92	84	78	73	68	65	63	61	60	58	57	55
240	143	118	101	90	82	76	71	67	63	61	60	59	57	56	54
245	140	115	99	88	80	74	70	65	62	60	59	58	56	55	53
250	137	113	97	87	79	73	69	64	61	59	57	56	55	54	52

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Amendments

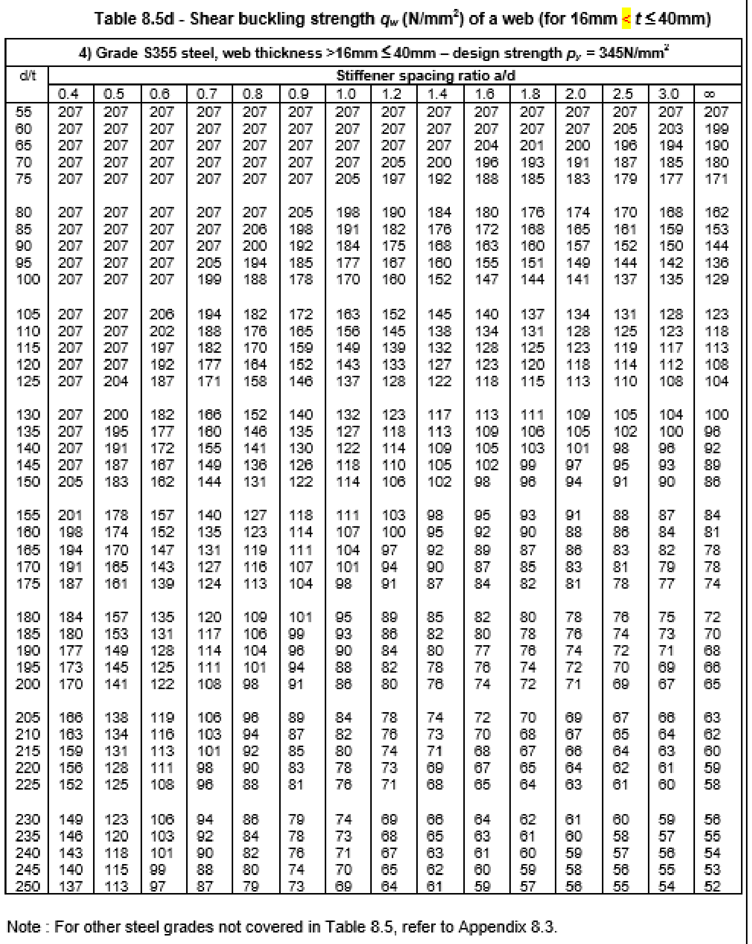

Table 8.5d - Shear buckling strength q_w (N/mm^2) of a web (for 16mm $< t \leq$ 40mm)

4) Grade S355 steel, web thickness >16mm ≤ 40mm – design strength p_y = 345N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	207	207	207	207	207	207	207	207	207	207	207	207	207	207	207
60	207	207	207	207	207	207	207	207	207	207	207	207	205	203	199
65	207	207	207	207	207	207	207	207	207	204	201	200	196	194	190
70	207	207	207	207	207	207	207	205	200	196	193	191	187	185	180
75	207	207	207	207	207	207	205	197	192	188	185	183	179	177	171
80	207	207	207	207	207	205	198	190	184	180	176	174	170	168	162
85	207	207	207	207	206	198	191	182	176	172	168	165	161	159	153
90	207	207	207	207	200	192	184	175	168	163	160	157	152	150	144
95	207	207	207	205	194	185	177	167	160	155	151	149	144	142	136
100	207	207	207	199	188	178	170	160	152	147	144	141	137	135	129
105	207	207	206	194	182	172	163	152	145	140	137	134	131	128	123
110	207	207	202	188	176	165	156	145	138	134	131	128	125	123	118
115	207	207	197	182	170	159	149	139	132	128	125	123	119	117	113
120	207	207	192	177	164	152	143	133	127	123	120	118	114	112	108
125	207	204	187	171	158	146	137	128	122	118	115	113	110	108	104
130	207	200	182	166	152	140	132	123	117	113	111	109	105	104	100
135	207	195	177	160	146	135	127	118	113	109	106	105	102	100	96
140	207	191	172	155	141	130	122	114	109	105	103	101	98	96	92
145	207	187	167	149	136	126	118	110	105	102	99	97	95	93	89
150	205	183	162	144	131	122	114	106	102	98	96	94	91	90	86
155	201	178	157	140	127	118	111	103	98	95	93	91	88	87	84
160	198	174	152	135	123	114	107	100	95	92	90	88	86	84	81
165	194	170	147	131	119	111	104	97	92	89	87	86	83	82	78
170	191	165	143	127	116	107	101	94	90	87	85	83	81	79	78
175	187	161	139	124	113	104	98	91	87	84	82	81	78	77	74
180	184	157	135	120	109	101	95	89	85	82	80	78	76	75	72
185	180	153	131	117	106	99	93	86	82	80	78	76	74	73	70
190	177	149	128	114	104	96	90	84	80	77	76	74	72	71	68
195	173	145	125	111	101	94	88	82	78	76	74	72	70	69	66
200	170	141	122	108	98	91	86	80	76	74	72	71	69	67	65
205	166	138	119	106	96	89	84	78	74	72	70	69	67	66	63
210	163	134	116	103	94	87	82	76	73	70	68	67	65	64	62
215	159	131	113	101	92	85	80	74	71	68	67	66	64	63	60
220	156	128	111	98	90	83	78	73	69	67	65	64	62	61	59
225	152	125	108	96	88	81	76	71	68	65	64	63	61	60	58
230	149	123	106	94	86	79	74	69	66	64	62	61	60	59	56
235	146	120	103	92	84	78	73	68	65	63	61	60	58	57	55
240	143	118	101	90	82	76	71	67	63	61	60	59	57	56	54
245	140	115	99	88	80	74	70	65	62	60	59	58	56	55	53
250	137	113	97	87	79	73	69	64	61	59	57	56	55	54	52

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[37] Revision of web thickness.

Item	Current version	Amendments
38. Table 8.5e[38]	Table 8.5e - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq 16$mm)	Table 8.5e - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq 16$mm)

Current version

Table 8.5e - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq 16$mm)

5) Grade Q235 steel, web thickness ≤16mm – design strength p_y = 215N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
60	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
65	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
70	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
75	129	129	129	129	129	129	129	129	129	129	129	129	128	127	124
80	129	129	129	129	129	129	129	129	129	129	127	126	124	123	120
85	129	129	129	129	129	129	129	129	127	125	123	122	119	118	115
90	129	129	129	129	129	129	129	126	123	121	119	117	115	114	111
95	129	129	129	129	129	129	127	122	119	117	115	113	111	110	106
100	129	129	129	129	129	128	124	119	115	113	111	109	107	105	102
105	129	129	129	129	129	125	120	115	111	109	106	105	102	101	97
110	129	129	129	129	127	122	117	111	107	105	102	101	98	96	92
115	129	129	129	129	124	118	113	108	104	101	98	97	94	92	88
120	129	129	129	127	121	115	110	104	100	97	94	92	90	88	85
125	129	129	129	124	118	112	107	100	96	92	90	89	86	85	81
130	129	129	129	122	115	109	103	97	92	89	87	85	83	81	78
135	129	129	127	119	112	105	100	93	89	86	84	82	80	78	75
140	129	129	125	116	109	102	96	90	85	83	81	79	77	75	73
145	129	129	122	114	106	99	93	86	82	80	78	76	74	73	70
150	129	129	120	111	103	96	90	84	80	77	75	74	72	70	68
155	129	128	117	108	100	92	87	81	77	74	73	71	69	68	65
160	129	126	115	105	97	90	84	78	75	72	70	69	67	66	63
165	129	124	113	103	94	87	81	76	72	70	68	67	65	64	61
170	129	122	110	100	91	84	79	74	70	68	66	65	63	62	60
175	129	120	108	97	88	82	77	72	68	66	64	63	61	60	58
180	129	117	105	94	86	80	75	70	66	64	63	61	60	59	56
185	129	115	103	92	84	77	73	68	64	62	61	60	58	57	55
190	127	113	100	89	81	75	71	66	63	61	59	58	56	55	53
195	126	111	98	87	79	73	69	64	61	59	58	57	55	54	52
200	124	109	96	85	77	72	67	63	60	58	56	55	54	53	51
205	122	107	93	83	75	70	65	61	58	56	55	54	52	51	49
210	120	105	91	81	74	68	64	60	57	55	54	53	51	50	48
215	119	103	89	79	72	66	62	58	55	54	52	51	50	49	47
220	117	101	87	77	70	65	61	57	54	52	51	50	49	48	46
225	115	99	85	75	69	64	60	56	53	51	50	49	48	47	45
230	113	97	83	74	67	62	58	54	52	50	49	48	47	46	44
235	112	94	81	72	66	61	57	53	51	49	48	47	46	45	43
240	110	92	79	71	64	60	56	52	50	48	47	46	45	44	42
245	108	90	78	69	63	58	55	51	49	47	46	45	44	43	41
250	107	89	76	68	62	57	54	50	48	46	45	44	43	42	40

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Amendments

Table 8.5e - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq 16$mm)

5) Grade S460 steel, web thickness ≤16mm – design strength p_y = 460N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	276	276	276	276	276	276	276	276	276	275	272	269	265	263	256
60	276	276	276	276	276	276	276	275	268	263	259	256	252	249	242
65	276	276	276	276	276	276	273	263	256	250	246	243	238	235	228
70	276	276	276	276	276	272	262	251	244	238	233	230	225	222	214
75	276	276	276	276	273	261	252	240	231	225	221	217	211	208	199
80	276	276	276	276	263	251	241	228	219	213	208	204	198	195	187
85	276	276	276	268	254	241	230	217	207	200	195	192	186	183	176
90	276	276	276	260	245	231	219	205	195	189	184	181	176	173	166
95	276	276	269	251	235	221	208	194	185	179	175	172	167	164	157
100	276	276	261	243	226	211	198	184	176	170	166	163	158	156	150
105	276	276	254	234	216	201	188	176	167	162	158	155	151	148	142
110	276	269	246	226	207	191	180	168	160	155	151	148	144	141	136
115	276	263	239	217	198	183	172	160	153	148	144	142	138	135	130
120	276	256	231	208	189	176	165	154	147	142	138	136	132	130	125
125	276	250	224	200	182	169	158	148	141	136	133	130	127	124	120
130	273	243	216	192	175	162	152	142	135	131	128	125	122	120	115
135	268	237	208	185	168	156	147	137	130	126	123	121	117	115	111
140	262	230	201	178	162	150	141	132	126	121	119	116	113	111	107
145	257	224	194	172	157	145	136	127	121	117	114	112	109	107	103
150	252	217	187	167	152	140	132	123	117	113	111	109	105	104	100
155	246	210	181	161	147	136	128	119	113	110	107	105	102	100	96
160	241	204	176	156	142	132	124	115	110	106	104	102	99	97	93
165	235	197	170	151	138	128	120	112	107	103	101	99	96	94	91
170	230	192	165	147	134	124	116	108	103	100	98	96	93	92	88
175	225	186	160	143	130	120	113	105	100	97	95	93	90	89	85
180	219	181	156	139	126	117	110	102	98	94	92	91	88	86	83
185	214	176	152	135	123	114	107	100	95	92	90	88	86	84	81
190	208	172	148	131	120	111	104	97	93	89	87	86	83	82	79
195	203	167	144	128	117	108	101	95	90	87	85	84	81	80	77
200	198	163	140	125	114	105	99	92	88	85	83	81	79	78	75
205	193	159	137	122	111	103	96	90	86	83	81	79	77	76	73
210	188	155	134	119	108	100	94	88	84	81	79	78	75	74	71
215	184	152	131	116	106	98	92	86	82	79	77	76	74	72	70
220	180	148	128	114	103	96	90	84	80	77	75	74	72	71	68
225	176	145	125	111	101	94	88	82	78	76	74	72	70	69	66
230	172	142	122	109	99	92	86	80	76	74	72	71	69	68	65
235	168	139	120	106	97	90	84	78	75	72	71	69	67	66	64
240	165	136	117	104	95	88	82	77	73	71	69	68	66	65	62
245	161	133	115	102	93	88	81	75	72	69	68	67	65	64	61
250	158	130	112	100	91	84	79	74	70	68	66	65	63	62	60

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[38] Revision of Table 8.5e - Shear Buckling Strength for S460 steel with web thickness ≤ 16mm.

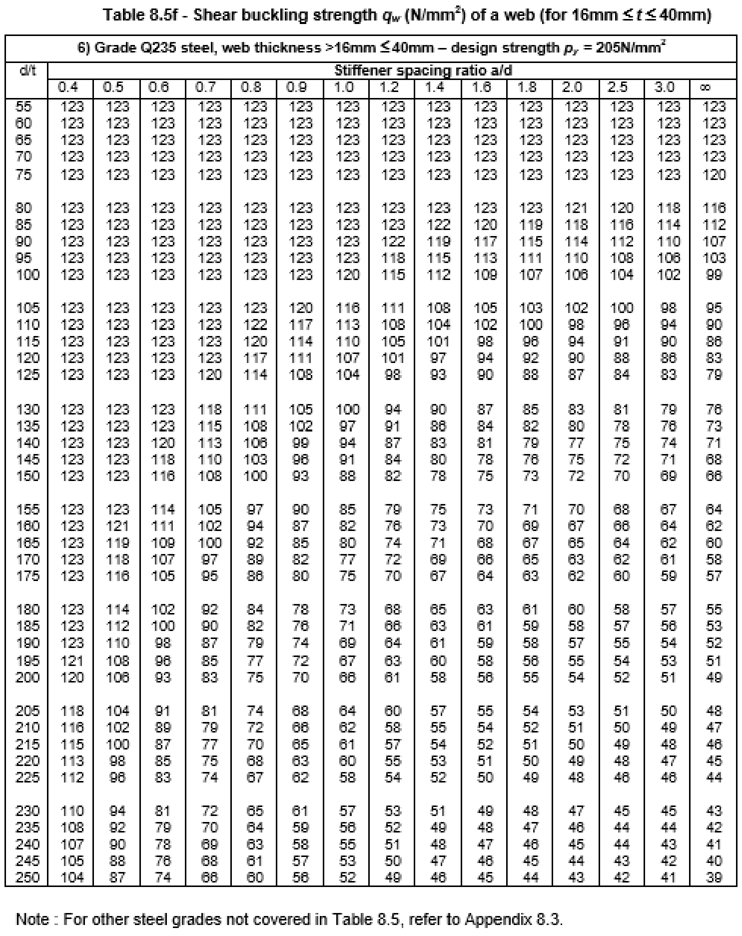
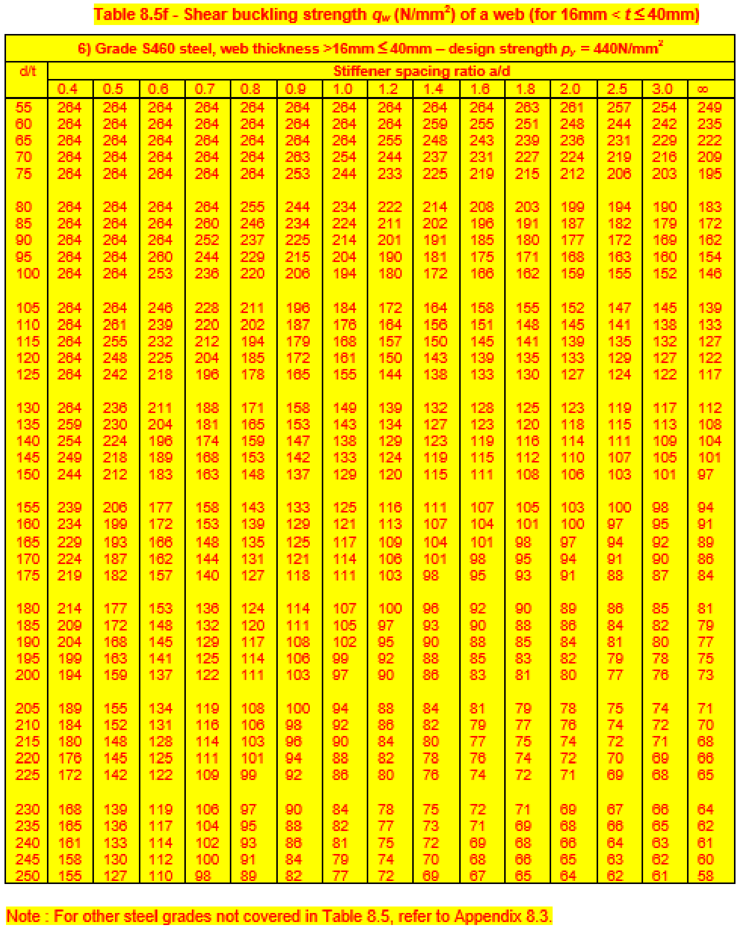
Item	Current version	Amendments
39. Table 8.5f[39]		

Table 8.5f - Shear buckling strength q_w (N/mm^2) of a web (for 16mm ≤ t ≤ 40mm)

6) Grade Q235 steel, web thickness >16mm ≤40mm – design strength p_y = 205N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
60	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
65	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
70	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
75	123	123	123	123	123	123	123	123	123	123	123	123	123	123	120
80	123	123	123	123	123	123	123	123	123	123	123	121	120	118	116
85	123	123	123	123	123	123	123	123	122	120	119	118	116	114	112
90	123	123	123	123	123	123	123	122	119	117	115	114	112	110	107
95	123	123	123	123	123	123	123	118	115	113	111	110	108	106	103
100	123	123	123	123	123	123	120	115	112	109	107	106	104	102	99
105	123	123	123	123	123	120	116	111	108	105	103	102	100	98	95
110	123	123	123	123	122	117	113	108	104	102	100	98	96	94	90
115	123	123	123	123	120	114	110	105	101	98	96	94	91	90	86
120	123	123	123	123	117	111	107	101	97	94	92	90	88	86	83
125	123	123	123	120	114	108	104	98	93	90	88	87	84	83	79
130	123	123	123	118	111	105	100	94	90	87	85	83	81	79	76
135	123	123	123	115	108	102	97	91	86	84	82	80	78	76	73
140	123	123	120	113	106	99	94	87	83	81	79	77	75	74	71
145	123	123	118	110	103	96	91	84	80	78	76	75	72	71	68
150	123	123	116	108	100	93	88	82	78	75	73	72	70	69	66
155	123	123	114	105	97	90	85	79	75	73	71	70	68	67	64
160	123	121	111	102	94	87	82	76	73	70	69	67	66	64	62
165	123	119	109	100	92	85	80	74	71	68	67	65	64	62	60
170	123	118	107	97	89	82	77	72	69	66	65	63	62	61	58
175	123	116	105	95	86	80	75	70	67	64	63	62	60	59	57
180	123	114	102	92	84	78	73	68	65	63	61	60	58	57	55
185	123	112	100	90	82	76	71	66	63	61	59	58	57	56	53
190	123	110	98	87	79	74	69	64	61	59	58	57	55	54	52
195	121	108	96	85	77	72	67	63	60	58	56	55	54	53	51
200	120	106	93	83	75	70	66	61	58	56	55	54	52	51	49
205	118	104	91	81	74	68	64	60	57	55	54	53	51	50	48
210	116	102	89	79	72	66	62	58	55	54	52	51	50	49	47
215	115	100	87	77	70	65	61	57	54	52	51	50	49	48	46
220	113	98	85	75	68	63	60	55	53	51	50	49	48	47	45
225	112	96	83	74	67	62	58	54	52	50	49	48	46	46	44
230	110	94	81	72	65	61	57	53	51	49	48	47	45	45	43
235	108	92	79	70	64	59	56	52	49	48	47	46	44	44	42
240	107	90	78	69	63	58	55	51	48	47	46	45	44	43	41
245	105	88	76	68	61	57	53	50	47	46	45	44	43	42	40
250	104	87	74	66	60	56	52	49	46	45	44	43	42	41	39

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Table 8.5f - Shear buckling strength q_w (N/mm^2) of a web (for 16mm < t ≤ 40mm)

6) Grade S460 steel, web thickness >16mm ≤40mm – design strength p_y = 440N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	264	264	264	264	264	264	264	264	264	264	263	261	257	254	249
60	264	264	264	264	264	264	264	264	259	255	251	248	244	242	235
65	264	264	264	264	264	264	264	255	248	243	239	236	231	229	222
70	264	264	264	264	264	263	254	244	237	231	227	224	219	216	209
75	264	264	264	264	264	253	244	233	225	219	215	212	206	203	195
80	264	264	264	264	255	244	234	222	214	208	203	199	194	190	183
85	264	264	264	260	246	234	224	211	202	196	191	187	182	179	172
90	264	264	264	252	237	225	214	201	191	185	180	177	172	169	162
95	264	264	260	244	229	215	204	190	181	175	171	168	163	160	154
100	264	264	253	236	220	206	194	180	172	166	162	159	155	152	146
105	264	264	246	228	211	196	184	172	164	158	155	152	147	145	139
110	264	261	239	220	202	187	176	164	156	151	148	145	141	138	133
115	264	255	232	212	194	179	168	157	150	145	141	139	135	132	127
120	264	248	225	204	185	172	161	150	143	139	135	133	129	127	122
125	264	242	218	196	178	165	155	144	138	133	130	127	124	122	117
130	264	236	211	188	171	158	149	139	132	128	125	123	119	117	112
135	259	230	204	181	165	153	143	134	127	123	120	118	115	113	108
140	254	224	196	174	159	147	138	129	123	119	116	114	111	109	104
145	249	218	189	168	153	142	133	124	119	115	112	110	107	105	101
150	244	212	183	163	148	137	129	120	115	111	108	106	103	101	97
155	239	206	177	158	143	133	125	116	111	107	105	103	100	98	94
160	234	199	172	153	139	129	121	113	107	104	101	100	97	95	91
165	229	193	166	148	135	125	117	109	104	101	98	97	94	92	89
170	224	187	162	144	131	121	114	106	101	98	95	94	91	90	86
175	219	182	157	140	127	118	111	103	98	95	93	91	88	87	84
180	214	177	153	136	124	114	107	100	96	92	90	89	86	85	81
185	209	172	148	132	120	111	105	97	93	90	88	86	84	82	79
190	204	168	145	129	117	108	102	95	90	88	85	84	81	80	77
195	199	163	141	125	114	106	99	92	88	85	83	82	79	78	75
200	194	159	137	122	111	103	97	90	86	83	81	80	77	76	73
205	189	155	134	119	108	100	94	88	84	81	79	78	75	74	71
210	184	152	131	116	106	98	92	86	82	79	77	76	74	72	70
215	180	148	128	114	103	96	90	84	80	77	75	74	72	71	68
220	176	145	125	111	101	94	88	82	78	76	74	72	70	69	66
225	172	142	122	109	99	92	86	80	76	74	72	71	69	68	65
230	168	139	119	106	97	90	84	78	75	72	71	69	67	66	64
235	165	136	117	104	95	88	82	77	73	71	69	68	66	65	62
240	161	133	114	102	93	86	81	75	72	69	68	66	64	63	61
245	158	130	112	100	91	84	79	74	70	68	66	65	63	62	60
250	155	127	110	98	89	82	77	72	69	67	65	64	62	61	58

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[39] Revision of Table 8.5f - Shear Buckling Strength for S460 steel with web thickness >16mm ≤ 40mm.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr>
<td>40. Table 8.5g[40]</td>
<td>
Table 8.5g - Shear buckling strength q_w (N/mm^2) of a web (for $t \le 16$mm)
<table>
<tr><th colspan="16">7) Grade Q345 steel, web thickness ≤16mm – design strength p_y = 310N/mm^2</th></tr>
<tr><th rowspan="2">d/t</th><th colspan="15">Stiffener spacing ratio a/d</th></tr>
<tr><th>0.4</th><th>0.5</th><th>0.6</th><th>0.7</th><th>0.8</th><th>0.9</th><th>1.0</th><th>1.2</th><th>1.4</th><th>1.6</th><th>1.8</th><th>2.0</th><th>2.5</th><th>3.0</th><th>∞</th></tr>
<tr><td>55</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td></tr>
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<tr><td>85</td><td>186</td><td>186</td><td>186</td><td>186</td><td>186</td><td>183</td><td>177</td><td>169</td><td>164</td><td>160</td><td>157</td><td>155</td><td>151</td><td>149</td><td>144</td></tr>
<tr><td>90</td><td>186</td><td>186</td><td>186</td><td>186</td><td>185</td><td>177</td><td>171</td><td>163</td><td>157</td><td>153</td><td>150</td><td>148</td><td>144</td><td>142</td><td>136</td></tr>
<tr><td>95</td><td>186</td><td>186</td><td>186</td><td>186</td><td>179</td><td>172</td><td>165</td><td>156</td><td>151</td><td>146</td><td>143</td><td>140</td><td>136</td><td>134</td><td>129</td></tr>
<tr><td>100</td><td>186</td><td>186</td><td>186</td><td>184</td><td>174</td><td>166</td><td>159</td><td>150</td><td>144</td><td>139</td><td>136</td><td>133</td><td>129</td><td>127</td><td>122</td></tr>
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<tr><td>110</td><td>186</td><td>186</td><td>186</td><td>174</td><td>164</td><td>155</td><td>147</td><td>137</td><td>131</td><td>126</td><td>123</td><td>121</td><td>118</td><td>116</td><td>111</td></tr>
<tr><td>115</td><td>186</td><td>186</td><td>181</td><td>169</td><td>159</td><td>149</td><td>141</td><td>131</td><td>125</td><td>121</td><td>118</td><td>116</td><td>112</td><td>111</td><td>106</td></tr>
<tr><td>120</td><td>186</td><td>186</td><td>177</td><td>165</td><td>154</td><td>144</td><td>135</td><td>126</td><td>120</td><td>116</td><td>113</td><td>111</td><td>108</td><td>106</td><td>102</td></tr>
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<tr><td>135</td><td>186</td><td>180</td><td>165</td><td>151</td><td>138</td><td>128</td><td>120</td><td>112</td><td>106</td><td>103</td><td>100</td><td>99</td><td>96</td><td>94</td><td>90</td></tr>
<tr><td>140</td><td>186</td><td>177</td><td>160</td><td>146</td><td>133</td><td>123</td><td>115</td><td>108</td><td>103</td><td>99</td><td>97</td><td>95</td><td>92</td><td>91</td><td>87</td></tr>
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<tr><td>150</td><td>186</td><td>169</td><td>152</td><td>136</td><td>124</td><td>115</td><td>108</td><td>100</td><td>96</td><td>93</td><td>90</td><td>89</td><td>86</td><td>85</td><td>81</td></tr>
<tr><td>155</td><td>186</td><td>166</td><td>148</td><td>132</td><td>120</td><td>111</td><td>104</td><td>97</td><td>93</td><td>90</td><td>87</td><td>86</td><td>83</td><td>82</td><td>79</td></tr>
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<tr><td>165</td><td>180</td><td>159</td><td>139</td><td>124</td><td>113</td><td>104</td><td>98</td><td>91</td><td>87</td><td>84</td><td>82</td><td>81</td><td>78</td><td>77</td><td>74</td></tr>
<tr><td>170</td><td>177</td><td>155</td><td>135</td><td>120</td><td>109</td><td>101</td><td>95</td><td>89</td><td>84</td><td>82</td><td>80</td><td>78</td><td>76</td><td>75</td><td>72</td></tr>
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<tr><td>180</td><td>171</td><td>148</td><td>128</td><td>113</td><td>103</td><td>96</td><td>90</td><td>84</td><td>80</td><td>77</td><td>75</td><td>74</td><td>72</td><td>70</td><td>68</td></tr>
<tr><td>185</td><td>168</td><td>144</td><td>124</td><td>110</td><td>100</td><td>93</td><td>87</td><td>81</td><td>78</td><td>75</td><td>73</td><td>72</td><td>70</td><td>69</td><td>66</td></tr>
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<tr><td>240</td><td>135</td><td>111</td><td>96</td><td>85</td><td>77</td><td>72</td><td>67</td><td>63</td><td>60</td><td>58</td><td>56</td><td>55</td><td>54</td><td>53</td><td>51</td></tr>
<tr><td>245</td><td>132</td><td>109</td><td>94</td><td>83</td><td>76</td><td>70</td><td>66</td><td>61</td><td>58</td><td>56</td><td>55</td><td>54</td><td>53</td><td>52</td><td>50</td></tr>
<tr><td>250</td><td>129</td><td>107</td><td>92</td><td>82</td><td>74</td><td>69</td><td>64</td><td>60</td><td>57</td><td>55</td><td>54</td><td>53</td><td>51</td><td>51</td><td>49</td></tr>
</table>
Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.
</td>
<td>
Table 8.5g - Shear buckling strength q_w (N/mm^2) of a web (for $t \le 50$mm)
<table>
<tr><th colspan="16">7) Grade S550 steel, web thickness ≤50mm – design strength p_y = 550N/mm^2</th></tr>
<tr><th rowspan="2">d/t</th><th colspan="15">Stiffener spacing ratio a/d</th></tr>
<tr><th>0.4</th><th>0.5</th><th>0.6</th><th>0.7</th><th>0.8</th><th>0.9</th><th>1.0</th><th>1.2</th><th>1.4</th><th>1.6</th><th>1.8</th><th>2.0</th><th>2.5</th><th>3.0</th><th>∞</th></tr>
<tr><td>55</td><td>330</td><td>330</td><td>330</td><td>330</td><td>330</td><td>330</td><td>330</td><td>328</td><td>320</td><td>314</td><td>309</td><td>306</td><td>300</td><td>297</td><td>289</td></tr>
<tr><td>60</td><td>330</td><td>330</td><td>330</td><td>330</td><td>330</td><td>330</td><td>325</td><td>313</td><td>304</td><td>297</td><td>293</td><td>289</td><td>283</td><td>279</td><td>270</td></tr>
<tr><td>65</td><td>330</td><td>330</td><td>330</td><td>330</td><td>330</td><td>322</td><td>311</td><td>298</td><td>288</td><td>281</td><td>276</td><td>272</td><td>265</td><td>261</td><td>252</td></tr>
<tr><td>70</td><td>330</td><td>330</td><td>330</td><td>330</td><td>323</td><td>309</td><td>297</td><td>283</td><td>272</td><td>265</td><td>259</td><td>255</td><td>248</td><td>243</td><td>234</td></tr>
<tr><td>75</td><td>330</td><td>330</td><td>330</td><td>327</td><td>310</td><td>296</td><td>283</td><td>267</td><td>256</td><td>248</td><td>242</td><td>238</td><td>231</td><td>227</td><td>218</td></tr>
<tr><td>80</td><td>330</td><td>330</td><td>330</td><td>316</td><td>298</td><td>282</td><td>269</td><td>252</td><td>240</td><td>232</td><td>227</td><td>223</td><td>216</td><td>213</td><td>204</td></tr>
<tr><td>85</td><td>330</td><td>330</td><td>325</td><td>304</td><td>286</td><td>269</td><td>255</td><td>237</td><td>226</td><td>219</td><td>213</td><td>210</td><td>204</td><td>200</td><td>192</td></tr>
<tr><td>90</td><td>330</td><td>330</td><td>316</td><td>293</td><td>274</td><td>256</td><td>240</td><td>224</td><td>214</td><td>207</td><td>202</td><td>198</td><td>192</td><td>189</td><td>182</td></tr>
<tr><td>95</td><td>330</td><td>330</td><td>306</td><td>282</td><td>261</td><td>243</td><td>228</td><td>212</td><td>202</td><td>196</td><td>191</td><td>188</td><td>182</td><td>179</td><td>172</td></tr>
<tr><td>100</td><td>330</td><td>323</td><td>296</td><td>271</td><td>249</td><td>230</td><td>216</td><td>202</td><td>192</td><td>186</td><td>181</td><td>178</td><td>173</td><td>170</td><td>163</td></tr>
<tr><td>105</td><td>330</td><td>315</td><td>286</td><td>260</td><td>237</td><td>219</td><td>206</td><td>192</td><td>183</td><td>177</td><td>173</td><td>170</td><td>165</td><td>162</td><td>156</td></tr>
<tr><td>110</td><td>330</td><td>306</td><td>276</td><td>249</td><td>226</td><td>209</td><td>197</td><td>183</td><td>175</td><td>169</td><td>165</td><td>162</td><td>157</td><td>155</td><td>149</td></tr>
<tr><td>115</td><td>330</td><td>297</td><td>266</td><td>238</td><td>216</td><td>200</td><td>188</td><td>175</td><td>167</td><td>162</td><td>158</td><td>155</td><td>150</td><td>148</td><td>142</td></tr>
<tr><td>120</td><td>325</td><td>289</td><td>256</td><td>228</td><td>207</td><td>192</td><td>180</td><td>168</td><td>160</td><td>155</td><td>151</td><td>148</td><td>144</td><td>142</td><td>136</td></tr>
<tr><td>125</td><td>318</td><td>280</td><td>246</td><td>219</td><td>199</td><td>184</td><td>173</td><td>161</td><td>154</td><td>149</td><td>145</td><td>143</td><td>138</td><td>136</td><td>131</td></tr>
<tr><td>130</td><td>311</td><td>272</td><td>236</td><td>210</td><td>191</td><td>177</td><td>166</td><td>155</td><td>148</td><td>143</td><td>140</td><td>137</td><td>133</td><td>131</td><td>126</td></tr>
<tr><td>135</td><td>304</td><td>263</td><td>227</td><td>202</td><td>184</td><td>171</td><td>160</td><td>149</td><td>142</td><td>138</td><td>134</td><td>132</td><td>128</td><td>126</td><td>121</td></tr>
<tr><td>140</td><td>297</td><td>255</td><td>219</td><td>195</td><td>178</td><td>165</td><td>154</td><td>144</td><td>137</td><td>133</td><td>130</td><td>127</td><td>124</td><td>122</td><td>117</td></tr>
<tr><td>145</td><td>290</td><td>246</td><td>212</td><td>188</td><td>171</td><td>159</td><td>149</td><td>139</td><td>133</td><td>128</td><td>125</td><td>123</td><td>119</td><td>117</td><td>113</td></tr>
<tr><td>150</td><td>283</td><td>238</td><td>205</td><td>182</td><td>166</td><td>154</td><td>144</td><td>134</td><td>128</td><td>124</td><td>121</td><td>119</td><td>115</td><td>113</td><td>109</td></tr>
<tr><td>155</td><td>276</td><td>230</td><td>198</td><td>176</td><td>160</td><td>149</td><td>140</td><td>130</td><td>124</td><td>120</td><td>117</td><td>115</td><td>112</td><td>110</td><td>105</td></tr>
<tr><td>160</td><td>269</td><td>223</td><td>192</td><td>171</td><td>155</td><td>144</td><td>135</td><td>126</td><td>120</td><td>116</td><td>113</td><td>111</td><td>108</td><td>106</td><td>102</td></tr>
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<tr><td>170</td><td>255</td><td>210</td><td>181</td><td>161</td><td>146</td><td>135</td><td>127</td><td>119</td><td>113</td><td>109</td><td>107</td><td>105</td><td>102</td><td>100</td><td>96</td></tr>
<tr><td>175</td><td>248</td><td>204</td><td>175</td><td>156</td><td>142</td><td>132</td><td>124</td><td>115</td><td>110</td><td>106</td><td>104</td><td>102</td><td>99</td><td>97</td><td>93</td></tr>
<tr><td>180</td><td>240</td><td>198</td><td>171</td><td>152</td><td>138</td><td>128</td><td>120</td><td>112</td><td>107</td><td>103</td><td>101</td><td>99</td><td>96</td><td>95</td><td>91</td></tr>
<tr><td>185</td><td>234</td><td>193</td><td>166</td><td>148</td><td>134</td><td>124</td><td>117</td><td>109</td><td>104</td><td>100</td><td>98</td><td>96</td><td>94</td><td>92</td><td>88</td></tr>
<tr><td>190</td><td>228</td><td>188</td><td>162</td><td>144</td><td>131</td><td>121</td><td>114</td><td>106</td><td>101</td><td>98</td><td>95</td><td>94</td><td>91</td><td>90</td><td>86</td></tr>
<tr><td>195</td><td>222</td><td>183</td><td>157</td><td>140</td><td>127</td><td>118</td><td>111</td><td>103</td><td>99</td><td>95</td><td>93</td><td>91</td><td>89</td><td>87</td><td>84</td></tr>
<tr><td>200</td><td>216</td><td>178</td><td>154</td><td>137</td><td>124</td><td>115</td><td>108</td><td>101</td><td>96</td><td>93</td><td>91</td><td>89</td><td>87</td><td>85</td><td>82</td></tr>
<tr><td>205</td><td>211</td><td>174</td><td>150</td><td>133</td><td>121</td><td>112</td><td>106</td><td>98</td><td>94</td><td>91</td><td>89</td><td>87</td><td>84</td><td>83</td><td>80</td></tr>
<tr><td>210</td><td>206</td><td>170</td><td>146</td><td>130</td><td>118</td><td>110</td><td>103</td><td>96</td><td>92</td><td>89</td><td>86</td><td>85</td><td>82</td><td>81</td><td>78</td></tr>
<tr><td>215</td><td>201</td><td>166</td><td>143</td><td>127</td><td>116</td><td>107</td><td>101</td><td>94</td><td>89</td><td>86</td><td>84</td><td>83</td><td>80</td><td>79</td><td>76</td></tr>
<tr><td>220</td><td>197</td><td>162</td><td>140</td><td>124</td><td>113</td><td>105</td><td>98</td><td>92</td><td>87</td><td>85</td><td>82</td><td>81</td><td>79</td><td>77</td><td>74</td></tr>
<tr><td>225</td><td>192</td><td>158</td><td>136</td><td>121</td><td>110</td><td>102</td><td>96</td><td>90</td><td>85</td><td>83</td><td>81</td><td>79</td><td>77</td><td>76</td><td>73</td></tr>
<tr><td>230</td><td>188</td><td>155</td><td>134</td><td>119</td><td>108</td><td>100</td><td>94</td><td>88</td><td>84</td><td>81</td><td>79</td><td>77</td><td>75</td><td>74</td><td>71</td></tr>
<tr><td>235</td><td>184</td><td>152</td><td>131</td><td>116</td><td>106</td><td>98</td><td>92</td><td>86</td><td>82</td><td>79</td><td>77</td><td>76</td><td>74</td><td>72</td><td>70</td></tr>
<tr><td>240</td><td>180</td><td>148</td><td>128</td><td>114</td><td>104</td><td>96</td><td>90</td><td>84</td><td>80</td><td>77</td><td>76</td><td>74</td><td>72</td><td>71</td><td>68</td></tr>
<tr><td>245</td><td>177</td><td>145</td><td>125</td><td>111</td><td>101</td><td>94</td><td>88</td><td>82</td><td>78</td><td>76</td><td>74</td><td>73</td><td>71</td><td>69</td><td>67</td></tr>
<tr><td>250</td><td>173</td><td>143</td><td>123</td><td>109</td><td>99</td><td>92</td><td>87</td><td>81</td><td>77</td><td>74</td><td>73</td><td>71</td><td>69</td><td>68</td><td>65</td></tr>
</table>
Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.
</td>
</tr>
</table>

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[40] Revision of Table 8.5g - Shear Buckling Strength for S550 steel with web thickness ≤ 50mm.

Item	Current version	Amendments
41. Table 8.5h[41]		

Current version

Table 8.5h - Shear buckling strength q_w (N/mm^2) of a web (for 16mm ≤ t ≤ 35mm)

8) Grade Q345 steel, web thickness >16mm ≤35mm – design strength p_y = 295N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
60	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
65	177	177	177	177	177	177	177	177	177	177	177	177	175	173	169
70	177	177	177	177	177	177	177	177	177	174	172	170	168	166	162
75	177	177	177	177	177	177	177	175	171	168	166	164	161	159	155
80	177	177	177	177	177	177	176	170	165	162	159	157	154	152	147
85	177	177	177	177	177	176	170	164	159	155	152	150	147	145	140
90	177	177	177	177	177	171	165	158	152	149	146	144	140	138	133
95	177	177	177	177	173	166	159	152	146	142	139	137	133	131	126
100	177	177	177	177	168	161	154	146	140	136	133	130	126	124	119
105	177	177	177	173	163	155	148	140	134	129	126	124	120	118	114
110	177	177	177	168	159	150	143	134	128	123	120	118	115	113	108
115	177	177	175	164	154	145	137	128	122	118	115	113	110	108	104
120	177	177	171	159	149	140	132	123	117	113	110	108	105	103	99
125	177	177	167	155	144	135	126	118	112	108	106	104	101	99	95
130	177	177	163	151	139	129	121	113	108	104	102	100	97	95	92
135	177	174	159	146	135	124	117	109	104	100	98	96	93	92	88
140	177	170	155	142	130	120	113	105	100	97	94	93	90	89	85
145	177	167	151	137	125	116	109	101	97	93	91	89	87	85	82
150	177	164	148	133	121	112	105	98	93	90	88	86	84	83	79
155	177	160	144	129	117	108	102	95	90	87	85	84	81	80	77
160	176	157	140	125	113	105	98	92	87	85	83	81	79	77	74
165	173	154	136	121	110	102	95	89	85	82	80	79	76	75	72
170	170	150	132	117	107	99	93	86	82	80	78	76	74	73	70
175	168	147	128	114	104	96	90	84	80	77	75	74	72	71	68
180	165	144	124	111	101	93	87	82	78	75	73	72	70	69	66
185	162	140	121	108	98	91	85	79	76	73	71	70	68	67	64
190	159	137	118	105	95	88	83	77	74	71	69	68	66	65	63
195	157	134	115	102	93	86	81	75	72	69	68	66	64	63	61
200	154	130	112	100	91	84	79	73	70	68	66	65	63	62	59
205	151	127	109	97	88	82	77	72	68	66	64	63	61	60	58
210	148	124	107	95	86	80	75	70	67	64	63	62	60	59	57
215	146	121	104	93	84	78	73	68	65	63	61	60	58	57	55
220	143	118	102	90	82	76	71	67	63	61	60	59	57	56	54
225	140	115	99	88	80	74	70	65	62	60	59	57	56	55	53
230	137	113	97	86	79	73	68	64	61	59	57	56	55	54	52
235	134	111	95	85	77	71	67	62	59	57	56	55	53	53	50
240	132	108	93	83	75	70	65	61	58	56	55	54	52	51	49
245	129	106	91	81	74	68	64	60	57	55	54	53	51	50	48
250	126	104	89	80	72	67	63	59	56	54	53	52	50	49	47

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Amendments

Table 8.5h - Shear buckling strength q_w (N/mm^2) of a web (for 50mm < t ≤ 100mm)

8) Grade S550 steel, web thickness >50mm ≤100mm – design strength p_y = 530N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	318	318	318	318	318	318	318	318	311	306	301	298	293	290	282
60	318	318	318	318	318	318	316	305	296	290	286	282	276	273	265
65	318	318	318	318	318	313	303	290	281	275	270	266	260	256	247
70	318	318	318	318	314	301	290	276	266	259	254	250	243	239	229
75	318	318	318	318	302	288	276	262	251	244	238	233	226	223	214
80	318	318	318	307	291	276	263	247	236	228	223	219	212	209	201
85	318	318	317	297	279	263	250	233	222	215	210	206	200	197	189
90	318	318	307	286	267	251	236	220	210	203	198	194	189	186	178
95	318	318	298	276	256	238	223	208	199	192	187	184	179	176	169
100	318	314	288	265	244	226	212	198	189	182	178	175	170	167	160
105	318	306	279	255	233	215	202	188	180	174	170	167	162	159	153
110	318	298	270	244	222	206	193	180	172	166	162	159	154	152	146
115	318	290	260	233	212	197	185	172	164	159	155	152	148	145	140
120	316	282	251	223	203	188	177	165	157	152	148	146	142	139	134
125	310	274	241	214	195	181	170	158	151	146	142	140	136	134	128
130	303	266	232	206	188	174	163	152	145	140	137	135	131	128	123
135	296	258	223	199	181	167	157	147	140	135	132	130	126	124	119
140	290	250	215	192	174	161	152	141	135	130	127	125	121	119	115
145	283	242	208	185	168	156	146	136	130	126	123	121	117	115	111
150	276	233	201	179	163	151	142	132	126	122	119	117	113	111	107
155	270	226	194	173	157	146	137	128	122	118	115	113	110	108	104
160	263	219	188	168	153	141	133	124	118	114	111	109	106	104	100
165	256	212	183	162	148	137	129	120	114	111	108	106	103	101	97
170	250	206	177	158	144	133	125	116	111	107	105	103	100	98	94
175	243	200	172	153	139	129	121	113	108	104	102	100	97	95	92
180	236	194	167	149	136	126	118	110	105	101	99	97	94	93	89
185	230	189	163	145	132	122	115	107	102	99	96	95	92	90	87
190	223	184	159	141	128	119	112	104	99	96	94	92	89	88	84
195	218	179	155	137	125	116	109	101	97	94	91	90	87	86	82
200	212	175	151	134	122	113	106	99	94	91	89	87	85	84	80
205	207	171	147	131	119	110	104	97	92	89	87	85	83	81	78
210	202	167	144	128	116	108	101	94	90	87	85	83	81	80	76
215	197	163	140	125	114	105	99	92	88	85	83	81	79	78	75
220	193	159	137	122	111	103	97	90	86	83	81	79	77	76	73
225	189	155	134	119	108	100	94	88	84	81	79	78	75	74	71
230	185	152	131	117	106	98	92	86	82	79	77	76	74	73	70
235	181	149	128	114	104	96	90	84	80	78	76	74	72	71	68
240	177	146	126	112	102	94	88	82	79	76	74	73	71	70	67
245	173	143	123	109	100	92	87	81	77	74	73	71	69	68	66
250	170	140	121	107	98	90	85	79	75	73	71	70	68	67	64

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[41] Revision of Table 8.5h - Shear Buckling Strength for S550 steel with web thickness >50mm ≤ 100mm.

Item	Current version	Amendments
42. Table 8.5i[42]		

Table 8.5i - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq 16$mm)

9) Grade Q390 steel, web thickness ≤16mm – design strength p_y = 350N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	210	210	210	210	210	210	210	210	210	210	210	210	210	210	210
60	210	210	210	210	210	210	210	210	210	210	210	210	207	205	200
65	210	210	210	210	210	210	210	210	209	206	203	201	198	196	191
70	210	210	210	210	210	210	210	207	201	197	195	192	189	187	181
75	210	210	210	210	210	210	207	199	193	189	186	184	180	178	172
80	210	210	210	210	210	207	200	191	185	181	178	175	171	168	163
85	210	210	210	210	208	200	192	184	177	172	169	166	162	159	153
90	210	210	210	210	202	193	185	176	169	164	160	158	153	150	144
95	210	210	210	206	196	186	178	168	161	156	152	149	145	142	137
100	210	210	210	201	190	180	171	160	153	148	144	142	138	135	130
105	210	210	208	195	183	173	164	153	146	141	137	135	131	129	124
110	210	210	203	189	177	166	157	146	139	134	131	129	125	123	118
115	210	210	198	184	171	159	150	139	133	128	125	123	120	118	113
120	210	210	193	178	165	153	143	134	127	123	120	118	115	113	108
125	210	205	188	172	158	146	138	128	122	118	115	113	110	108	104
130	210	201	183	167	152	141	132	123	117	114	111	109	106	104	100
135	210	197	178	161	146	136	127	119	113	109	107	105	102	100	96
140	210	192	173	155	141	131	123	114	109	105	103	101	98	96	93
145	210	188	168	150	136	126	118	110	105	102	99	98	95	93	89
150	207	184	163	145	132	122	115	107	102	98	96	94	92	90	86
155	203	179	158	140	127	118	111	103	98	95	93	91	89	87	84
160	200	175	153	136	123	114	107	100	95	92	90	88	86	84	81
165	196	171	148	132	120	111	104	97	92	89	87	86	83	82	79
170	192	166	144	128	116	108	101	94	90	87	85	83	81	79	76
175	189	162	139	124	113	104	98	91	87	84	82	81	78	77	74
180	185	158	136	121	110	102	95	89	85	82	80	78	76	75	72
185	182	153	132	117	107	99	93	86	82	80	78	76	74	73	70
190	178	149	128	114	104	96	90	84	80	78	76	74	72	71	68
195	174	145	125	111	101	94	88	82	78	76	74	72	70	69	66
200	171	142	122	108	99	91	86	80	76	74	72	71	69	67	65
205	167	138	119	106	96	89	84	78	74	72	70	69	67	66	63
210	164	135	116	103	94	87	82	76	73	70	68	67	65	64	62
215	160	132	113	101	92	85	80	74	71	68	67	66	64	63	60
220	157	129	111	99	90	83	78	73	69	67	65	64	62	61	59
225	153	126	108	96	88	81	76	71	68	65	64	63	61	60	57
230	150	123	106	94	86	79	75	69	66	64	62	61	60	59	56
235	146	120	104	92	84	78	73	68	65	63	61	60	58	57	55
240	143	118	102	90	82	76	71	67	63	61	60	59	57	56	54
245	140	116	99	88	80	74	70	65	62	60	59	58	56	55	53
250	138	113	97	87	79	73	69	64	61	59	57	56	55	54	52

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Table 8.5i - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq 50$mm)

9) Grade S690 steel, web thickness ≤50mm – design strength p_y = 690N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	414	414	414	414	414	414	402	386	375	367	360	356	348	343	332
60	414	414	414	414	413	397	382	365	353	344	337	331	323	318	306
65	414	414	414	414	396	378	363	344	330	320	313	307	298	293	282
70	414	414	414	400	379	360	343	323	308	297	290	285	277	272	262
75	414	414	411	385	362	341	323	301	287	278	271	266	258	254	244
80	414	414	397	369	344	322	303	282	269	260	254	249	242	238	229
85	414	414	383	353	327	304	285	266	253	245	239	235	228	224	215
90	414	404	369	338	310	287	269	251	239	231	226	222	215	212	203
95	414	392	355	322	293	272	255	238	227	219	214	210	204	201	193
100	414	380	341	306	278	258	242	226	215	208	203	200	194	191	183
105	412	368	327	291	265	246	231	215	205	198	194	190	185	182	174
110	402	356	313	278	253	235	220	205	196	189	185	181	176	173	166
115	392	344	299	266	242	224	211	196	187	181	177	174	169	166	159
120	382	331	287	255	232	215	202	188	179	174	169	166	161	159	153
125	372	319	275	245	223	206	194	181	172	167	163	160	155	152	146
130	363	307	265	235	214	198	186	174	166	160	156	154	149	147	141
135	353	296	255	227	206	191	179	167	160	154	151	148	144	141	136
140	343	285	246	219	199	184	173	161	154	149	145	143	138	136	131
145	333	275	237	211	192	178	167	156	149	144	140	138	134	131	126
150	323	266	229	204	186	172	161	151	144	139	135	133	129	127	122
155	313	257	222	197	180	166	156	146	139	134	131	129	125	123	118
160	303	249	215	191	174	161	151	141	135	130	127	125	121	119	114
165	294	242	208	185	169	156	147	137	131	126	123	121	117	116	111
170	285	235	202	180	164	152	142	133	127	122	120	117	114	112	108
175	277	228	197	175	159	147	138	129	123	119	116	114	111	109	105
180	269	222	191	170	155	143	135	125	120	116	113	111	108	106	102
185	262	216	186	165	151	139	131	122	116	113	110	108	105	103	99
190	255	210	181	161	147	136	127	119	113	110	107	105	102	100	96
195	248	205	176	157	143	132	124	116	110	107	104	102	99	98	94
200	242	200	172	153	139	129	121	113	108	104	102	100	97	95	92
205	236	195	168	149	136	126	118	110	105	102	99	97	95	93	89
210	231	190	164	146	133	123	115	108	103	99	97	95	92	91	87
215	225	186	160	142	130	120	113	105	100	97	95	93	90	89	85
220	220	181	156	139	127	117	110	103	98	95	92	91	88	87	83
225	215	177	153	136	124	115	108	100	96	93	90	89	86	85	81
230	211	174	150	133	121	112	105	98	94	91	88	87	84	83	80
235	206	170	146	130	118	110	103	96	92	89	86	85	82	81	78
240	202	166	143	127	116	107	101	94	90	87	85	83	81	79	76
245	198	163	140	125	114	105	99	92	88	85	83	81	79	78	75
250	194	160	138	122	111	103	97	90	86	83	81	80	78	76	73

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[42] Revision of Table 8.5i - Shear Buckling Strength for S690 steel with web thickness ≤ 50mm.

Item	Current version	Amendments
43. Table 8.5j[43]		

Table 8.5j - Shear buckling strength q_w (N/mm^2) of a web (for 16mm ≤ t ≤ 35mm)

10) Grade Q390 steel, web thickness >16mm ≤35mm – design strength p_y = 335N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	201	201	201	201	201	201	201	201	201	201	201	201	201	201	201
60	201	201	201	201	201	201	201	201	201	201	201	201	200	198	194
65	201	201	201	201	201	201	201	201	201	199	197	195	192	190	185
70	201	201	201	201	201	201	201	200	195	191	189	187	183	181	176
75	201	201	201	201	201	201	200	193	187	184	181	179	175	173	168
80	201	201	201	201	201	200	193	186	180	176	173	170	167	164	159
85	201	201	201	201	201	194	187	178	172	168	165	162	158	156	150
90	201	201	201	201	196	187	180	171	165	160	157	154	150	147	141
95	201	201	201	200	190	181	173	164	157	152	149	146	142	139	134
100	201	201	201	194	184	175	167	157	150	145	141	139	135	132	127
105	201	201	201	189	178	168	160	150	142	138	134	132	128	126	121
110	201	201	197	184	172	162	153	143	136	131	128	126	122	120	115
115	201	201	192	178	166	156	146	136	130	126	123	120	117	115	110
120	201	201	187	173	161	150	140	131	125	120	117	115	112	110	106
125	201	199	183	168	155	143	135	125	120	116	113	111	108	106	102
130	201	195	178	163	149	138	129	121	115	111	108	106	103	102	98
135	201	191	173	157	143	133	125	116	111	107	104	102	100	98	94
140	201	187	168	152	138	128	120	112	107	103	101	99	96	94	91
145	201	183	164	147	133	123	116	108	103	100	97	95	93	91	87
150	200	179	159	142	129	119	112	104	100	96	94	92	90	88	85
155	197	174	154	137	125	115	108	101	96	93	91	89	87	85	82
160	193	170	150	133	121	112	105	98	93	90	88	86	84	83	79
165	190	166	145	129	117	108	102	95	90	87	85	84	81	80	77
170	187	162	140	125	114	105	99	92	88	85	83	81	79	78	75
175	183	158	136	121	110	102	96	89	85	82	80	79	77	75	72
180	180	154	133	118	107	99	93	87	83	80	78	77	75	73	70
185	177	150	129	115	104	97	91	85	81	78	76	75	72	71	68
190	173	146	126	112	102	94	88	82	78	76	74	73	71	69	67
195	170	142	122	109	99	92	86	80	76	74	72	71	69	68	65
200	167	139	119	106	97	89	84	78	75	72	70	69	67	66	63
205	163	135	116	103	94	87	82	76	73	70	69	67	65	64	62
210	160	132	114	101	92	85	80	74	71	69	67	66	64	63	60
215	156	129	111	99	90	83	78	73	69	67	65	64	62	61	59
220	153	126	108	96	88	81	76	71	68	65	64	63	61	60	57
225	150	123	106	94	86	79	75	69	66	64	62	61	60	59	56
230	146	120	104	92	84	78	73	68	65	63	61	60	58	57	55
235	143	118	101	90	82	76	71	66	63	61	60	59	57	56	54
240	140	115	99	88	80	74	70	65	62	60	58	57	56	55	53
245	137	113	97	87	79	73	68	64	61	59	57	56	55	54	52
250	135	111	95	85	77	71	67	62	60	58	56	55	54	53	51

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Table 8.5j - Shear buckling strength q_w (N/mm^2) of a web (for 50mm < t ≤100mm)

10) Grade S690 steel, web thickness >50mm ≤ 100mm – design strength p_y = 650N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	390	390	390	390	390	390	385	370	360	352	347	342	335	331	321
60	390	390	390	390	390	380	367	351	340	331	325	320	312	308	297
65	390	390	390	390	379	363	349	332	319	310	303	298	290	285	273
70	390	390	390	383	364	346	331	312	299	289	282	277	269	264	254
75	390	390	390	369	348	329	312	293	279	269	263	258	251	247	237
80	390	390	380	355	332	312	294	274	261	253	247	242	235	231	222
85	390	390	367	340	316	295	277	258	246	238	232	228	221	218	209
90	390	386	355	326	301	278	261	244	232	225	219	215	209	206	197
95	390	375	342	312	285	264	247	231	220	213	208	204	198	195	187
100	390	364	329	297	270	250	235	219	209	202	197	194	188	185	178
105	390	353	316	283	257	238	224	209	199	192	188	184	179	176	169
110	385	342	303	270	246	228	214	199	190	184	179	176	171	168	162
115	376	331	291	258	235	218	204	191	182	176	172	168	164	161	155
120	367	320	278	247	225	209	196	183	174	168	164	161	157	154	148
125	358	309	267	238	216	200	188	175	167	162	158	155	150	148	142
130	349	298	257	228	208	193	181	169	161	155	152	149	145	142	137
135	340	287	247	220	200	185	174	162	155	150	146	143	139	137	132
140	331	277	238	212	193	179	168	157	149	144	141	138	134	132	127
145	321	267	230	205	186	173	162	151	144	139	136	134	130	128	123
150	312	258	223	198	180	167	157	146	139	135	131	129	125	123	118
155	303	250	215	192	174	162	152	141	135	130	127	125	121	119	115
160	294	242	209	186	169	156	147	137	131	126	123	121	118	116	111
165	285	235	202	180	164	152	142	133	127	122	120	117	114	112	108
170	277	228	196	175	159	147	138	129	123	119	116	114	111	109	105
175	269	221	191	170	154	143	134	125	119	115	113	111	107	106	102
180	261	215	185	165	150	139	131	122	116	112	110	108	104	103	99
185	254	209	180	160	146	135	127	118	113	109	107	105	102	100	96
190	247	204	176	156	142	132	124	115	110	106	104	102	99	97	94
195	241	199	171	152	139	128	121	112	107	104	101	99	96	95	91
200	235	194	167	148	135	125	118	110	104	101	99	97	94	92	89
205	229	189	163	145	132	122	115	107	102	99	96	94	92	90	87
210	224	184	159	141	129	119	112	104	100	96	94	92	90	88	85
215	219	180	155	138	126	116	109	102	97	94	92	90	87	86	83
220	214	176	152	135	123	114	107	100	95	92	90	88	85	84	81
225	209	172	148	132	120	111	104	97	93	90	88	86	84	82	79
230	204	168	145	129	118	109	102	95	91	88	86	84	82	80	77
235	200	165	142	126	115	107	100	93	89	86	84	82	80	79	76
240	196	161	139	124	113	104	98	91	87	84	82	81	78	77	74
245	192	158	136	121	110	102	96	89	85	82	81	79	77	76	73
250	188	155	134	119	108	100	94	88	84	81	79	77	75	74	71

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[43] Revision of Table 8.5j - Shear Buckling Strength for S690 steel with web thickness >50mm ≤ 100mm.

Item

Current version

Amendments

44. Table 8.5k[44]

Current version

Table 8.5k - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq 16$mm)

11) Grade Q420 steel, web thickness ≤ 16mm – design strength p_y = 380N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	228	228	228	228	228	228	228	228	228	228	228	228	228	228	223
60	228	228	228	228	228	228	228	228	228	228	225	223	220	218	212
65	228	228	228	228	228	228	228	228	223	219	216	213	209	207	202
70	228	228	228	228	228	228	228	219	213	209	206	203	199	197	191
75	228	228	228	228	228	227	220	211	204	200	196	194	189	187	180
80	228	228	228	228	228	219	211	202	195	190	187	184	179	176	170
85	228	228	228	228	221	212	203	193	186	181	177	174	169	166	159
90	228	228	228	226	214	204	195	185	177	171	167	164	159	157	150
95	228	228	228	219	207	197	187	176	168	162	158	155	151	148	143
100	228	228	227	213	200	189	179	167	159	154	150	148	143	141	135
105	228	228	221	206	193	181	171	159	152	147	143	141	136	134	129
110	228	228	216	200	186	174	163	152	145	140	137	134	130	128	123
115	228	228	210	194	179	166	156	145	138	134	131	128	125	122	118
120	228	223	204	187	172	159	149	139	133	128	125	123	119	117	113
125	228	218	198	181	165	153	143	134	127	123	120	118	115	113	108
130	228	213	193	174	158	147	138	128	122	118	116	113	110	108	104
135	228	208	187	168	153	141	133	124	118	114	111	109	106	104	100
140	228	203	181	162	147	136	128	119	114	110	107	105	102	101	97
145	224	198	176	156	142	132	123	115	110	106	104	102	99	97	93
150	220	194	170	151	137	127	119	111	106	103	100	98	95	94	90
155	215	189	164	146	133	123	115	108	103	99	97	95	92	91	87
160	211	184	159	141	129	119	112	104	99	96	94	92	89	88	84
165	207	179	154	137	125	116	108	101	96	93	91	89	87	85	82
170	203	174	150	133	121	112	105	98	93	90	88	87	84	83	79
175	199	169	145	129	118	109	102	95	91	88	86	84	82	80	77
180	195	164	141	126	114	106	99	93	88	85	83	82	79	78	75
185	191	160	137	122	111	103	97	90	86	83	81	80	77	76	73
190	187	155	134	119	108	100	94	88	84	81	79	77	75	74	71
195	183	151	130	116	105	98	92	85	81	79	77	75	73	72	69
200	179	148	127	113	103	95	89	83	79	77	75	74	71	70	67
205	175	144	124	110	100	93	87	81	77	75	73	72	70	68	66
210	171	141	121	108	98	91	85	79	76	73	71	70	68	67	64
215	167	137	118	105	96	89	83	77	74	71	70	68	66	65	63
220	163	134	116	103	93	87	81	76	72	70	68	67	65	64	61
225	159	131	113	100	91	85	79	74	71	68	67	65	63	62	60
230	156	128	110	98	89	83	78	72	69	67	65	64	62	61	59
235	152	126	108	96	87	81	76	71	67	65	64	63	61	60	57
240	149	123	106	94	86	79	74	69	66	64	62	61	59	58	56
245	146	120	104	92	84	78	73	68	65	63	61	60	58	57	55
250	143	118	102	90	82	76	71	67	63	61	60	59	57	56	54

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Amendments

Table 8.5k - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq 16$mm)

11) Grade Q235 steel, web thickness ≤ 16mm – design strength p_y = 215N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
60	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
65	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
70	129	129	129	129	129	129	129	129	129	129	129	129	129	129	129
75	129	129	129	129	129	129	129	129	129	129	129	129	128	127	124
80	129	129	129	129	129	129	129	129	129	129	127	126	124	123	120
85	129	129	129	129	129	129	129	129	127	125	123	122	119	118	115
90	129	129	129	129	129	129	129	126	123	121	119	117	115	114	111
95	129	129	129	129	129	129	127	122	119	117	115	113	111	110	106
100	129	129	129	129	129	128	124	119	115	113	111	109	107	105	102
105	129	129	129	129	129	125	120	115	111	109	106	105	102	101	97
110	129	129	129	129	127	122	117	111	107	105	102	101	98	96	92
115	129	129	129	129	124	118	113	108	104	101	98	97	94	92	88
120	129	129	129	127	121	115	110	104	100	97	94	92	90	88	85
125	129	129	129	124	118	112	107	100	96	92	90	89	86	85	81
130	129	129	129	122	115	109	103	97	92	89	87	85	83	81	78
135	129	129	127	119	112	105	100	93	89	86	84	82	80	78	75
140	129	129	125	116	109	102	96	90	85	83	81	79	77	75	73
145	129	129	122	114	106	99	93	86	82	80	78	76	74	73	70
150	129	129	120	111	103	96	90	84	80	77	75	74	72	70	68
155	129	128	117	108	100	92	87	81	77	74	73	71	69	68	65
160	129	126	115	105	97	90	84	78	75	72	70	69	67	66	63
165	129	124	113	103	94	87	81	76	72	70	68	67	65	64	61
170	129	122	110	100	91	84	79	74	70	68	66	65	63	62	60
175	129	120	108	97	88	82	77	72	68	66	64	63	61	60	58
180	129	117	105	94	86	80	75	70	66	64	63	61	60	59	56
185	129	115	103	92	84	77	73	68	64	62	61	60	58	57	55
190	127	113	100	89	81	75	71	66	63	61	59	58	56	55	53
195	126	111	98	87	79	73	69	64	61	59	58	57	55	54	52
200	124	109	96	85	77	72	67	63	60	58	56	55	54	53	51
205	122	107	93	83	75	70	65	61	58	56	55	54	52	51	49
210	120	105	91	81	74	68	64	60	57	55	54	53	51	50	48
215	119	103	89	79	72	66	62	58	55	54	52	51	50	49	47
220	117	101	87	77	70	65	61	57	54	52	51	50	49	48	46
225	115	99	85	75	69	64	60	56	53	51	50	49	48	47	45
230	113	97	83	74	67	62	58	54	52	50	49	48	47	46	44
235	112	94	81	72	66	61	57	53	51	49	48	47	46	45	43
240	110	92	79	71	64	60	56	52	50	48	47	46	45	44	42
245	108	90	78	69	63	58	55	51	49	47	46	45	44	43	41
250	107	89	76	68	62	57	54	50	48	46	45	44	43	42	40

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[44] Revision of Table 8.5k - Shear Buckling Strength for Q235 steel with web thickness ≤ 16mm.

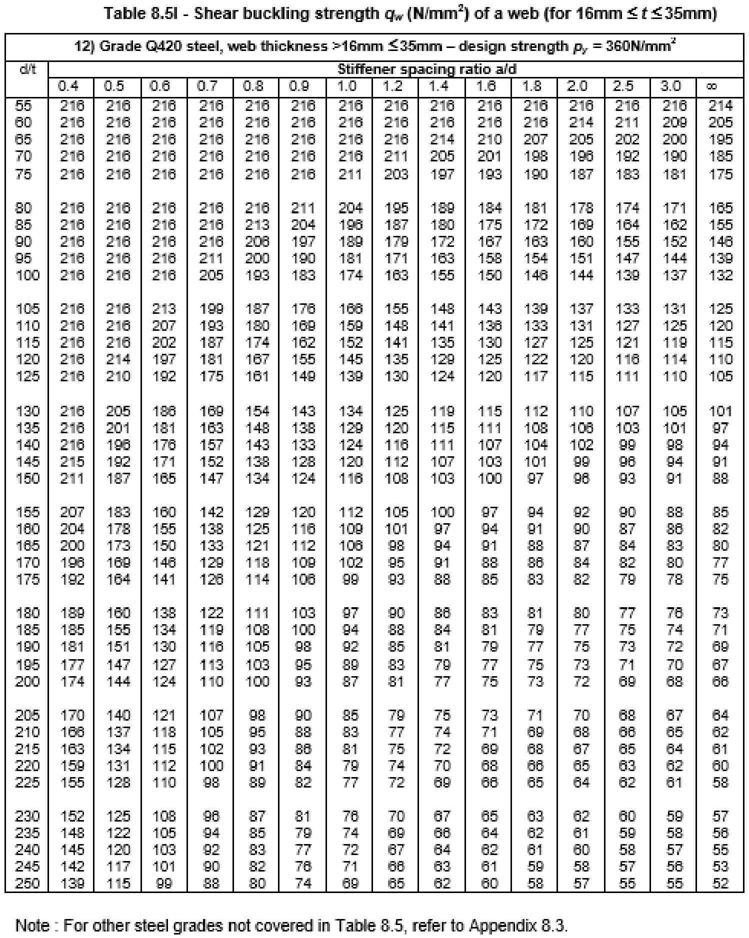
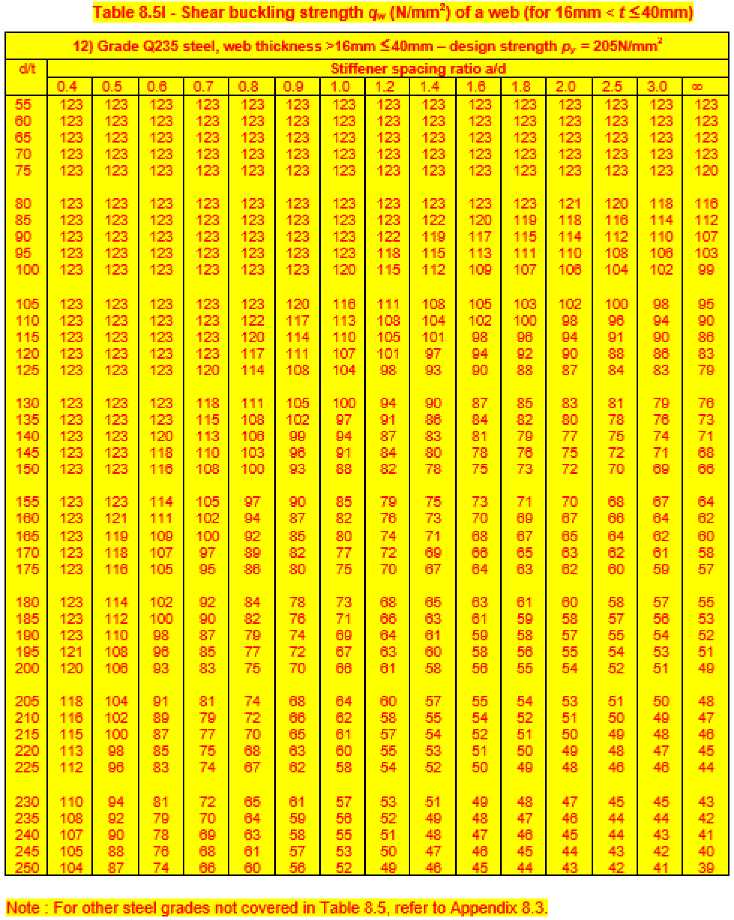
Item	Current version	Amendments
45. Table 8.5l[45]		

Table 8.5l - Shear buckling strength q_w (N/mm^2) of a web (for 16mm ≤ t ≤ 35mm)

12) Grade Q420 steel, web thickness >16mm ≤35mm – design strength p_y = 360N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	216	216	216	216	216	216	216	216	216	216	216	216	216	216	214
60	216	216	216	216	216	216	216	216	216	216	216	214	211	209	205
65	216	216	216	216	216	216	216	216	214	210	207	205	202	200	195
70	216	216	216	216	216	216	216	211	205	201	198	196	192	190	185
75	216	216	216	216	216	216	211	203	197	193	190	187	183	181	175
80	216	216	216	216	216	211	204	195	189	184	181	178	174	171	165
85	216	216	216	216	213	204	196	187	180	175	172	169	164	162	155
90	216	216	216	216	206	197	189	179	172	167	163	160	155	152	146
95	216	216	216	211	200	190	181	171	163	158	154	151	147	144	139
100	216	216	216	205	193	183	174	163	155	150	146	144	139	137	132
105	216	216	213	199	187	176	166	155	148	143	139	137	133	131	125
110	216	216	207	193	180	169	159	148	141	136	133	131	127	125	120
115	216	216	202	187	174	162	152	141	135	130	127	125	121	119	115
120	216	214	197	181	167	155	145	135	129	125	122	120	116	114	110
125	216	210	192	175	161	149	139	130	124	120	117	115	111	110	105
130	216	205	186	169	154	143	134	125	119	115	112	110	107	105	101
135	216	201	181	163	148	138	129	120	115	111	108	106	103	101	97
140	216	196	176	157	143	133	124	116	111	107	104	102	99	98	94
145	215	192	171	152	138	128	120	112	107	103	101	99	96	94	91
150	211	187	165	147	134	124	116	108	103	100	97	96	93	91	88
155	207	183	160	142	129	120	112	105	100	97	94	92	90	88	85
160	204	178	155	138	125	116	109	101	97	94	91	90	87	86	82
165	200	173	150	133	121	112	106	98	94	91	88	87	84	83	80
170	196	169	146	129	118	109	102	95	91	88	86	84	82	80	77
175	192	164	141	126	114	106	99	93	88	85	83	82	79	78	75
180	189	160	138	122	111	103	97	90	86	83	81	80	77	76	73
185	185	155	134	119	108	100	94	88	84	81	79	77	75	74	71
190	181	151	130	116	105	98	92	85	81	79	77	75	73	72	69
195	177	147	127	113	103	95	89	83	79	77	75	73	71	70	67
200	174	144	124	110	100	93	87	81	77	75	73	72	69	68	66
205	170	140	121	107	98	90	85	79	75	73	71	70	68	67	64
210	166	137	118	105	95	88	83	77	74	71	69	68	66	65	62
215	163	134	115	102	93	86	81	75	72	69	68	67	65	64	61
220	159	131	112	100	91	84	79	74	70	68	66	65	63	62	60
225	155	128	110	98	89	82	77	72	69	66	65	64	62	61	58
230	152	125	108	96	87	81	76	70	67	65	63	62	60	59	57
235	148	122	105	94	85	79	74	69	66	64	62	61	59	58	56
240	145	120	103	92	83	77	72	67	64	62	61	60	58	57	55
245	142	117	101	90	82	76	71	66	63	61	59	58	57	56	53
250	139	115	99	88	80	74	69	65	62	60	58	57	55	55	52

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

Table 8.5l - Shear buckling strength q_w (N/mm^2) of a web (for 16mm < t ≤ 40mm)

12) Grade Q235 steel, web thickness >16mm ≤40mm – design strength p_y = 205N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
60	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
65	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
70	123	123	123	123	123	123	123	123	123	123	123	123	123	123	123
75	123	123	123	123	123	123	123	123	123	123	123	123	123	123	120
80	123	123	123	123	123	123	123	123	123	123	123	121	120	118	116
85	123	123	123	123	123	123	123	123	122	120	119	118	116	114	112
90	123	123	123	123	123	123	123	122	119	117	115	114	112	110	107
95	123	123	123	123	123	123	123	118	115	113	111	110	108	106	103
100	123	123	123	123	123	123	120	115	112	109	107	106	104	102	99
105	123	123	123	123	123	120	116	111	108	105	103	102	100	98	95
110	123	123	123	123	122	117	113	108	104	102	100	98	96	94	90
115	123	123	123	123	120	114	110	105	101	98	96	94	91	90	86
120	123	123	123	123	117	111	107	101	97	94	92	90	88	86	83
125	123	123	123	120	114	108	104	98	93	90	88	87	84	83	79
130	123	123	123	118	111	105	100	94	90	87	85	83	81	79	76
135	123	123	123	115	108	102	97	91	86	84	82	80	78	76	73
140	123	123	120	113	106	99	94	87	83	81	79	77	75	74	71
145	123	123	118	110	103	96	91	84	80	78	76	75	72	71	68
150	123	123	116	108	100	93	88	82	78	75	73	72	70	69	66
155	123	123	114	105	97	90	85	79	75	73	71	70	68	67	64
160	123	121	111	102	94	87	82	76	73	70	69	67	66	64	62
165	123	119	109	100	92	85	80	74	71	68	67	65	64	62	60
170	123	118	107	97	89	82	77	72	69	66	65	63	62	61	58
175	123	116	105	95	86	80	75	70	67	64	63	62	60	59	57
180	123	114	102	92	84	78	73	68	65	63	61	60	58	57	55
185	123	112	100	90	82	76	71	66	63	61	59	58	57	56	53
190	123	110	98	87	79	74	69	64	61	59	58	57	55	54	52
195	121	108	96	85	77	72	67	63	60	58	56	55	54	53	51
200	120	106	93	83	75	70	66	61	58	56	55	54	52	51	49
205	118	104	91	81	74	68	64	60	57	55	54	53	51	50	48
210	116	102	89	79	72	66	62	58	55	54	52	51	50	49	47
215	115	100	87	77	70	65	61	57	54	52	51	50	49	48	46
220	113	98	85	75	68	63	60	55	53	51	50	49	48	47	45
225	112	96	83	74	67	62	58	54	52	50	49	48	46	46	44
230	110	94	81	72	65	61	57	53	51	49	48	47	45	45	43
235	108	92	79	70	64	59	56	52	49	48	47	46	44	44	42
240	107	90	78	69	63	58	55	51	48	47	46	45	44	43	41
245	105	88	76	68	61	57	53	50	47	46	45	44	43	42	40
250	104	87	74	66	60	56	52	49	46	45	44	43	42	41	39

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[45] Revision of Table 8.5l - Shear Buckling Strength for Q235 steel with web thickness >16mm ≤ 40mm.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>46. Table 8.5m[46]</td><td></td><td>
Table 8.5m - Shear buckling strength q_w (N/mm^2) of a web (for t ≤16mm)
<table>
<tr><th colspan="16">13) Grade Q345/Q355 steel, web thickness ≤16mm – design strength p_y = 305N/mm^2</th></tr>
<tr><th>d/t</th><th colspan="15">Stiffener spacing ratio a/d</th></tr>
<tr><th></th><th>0.4</th><th>0.5</th><th>0.6</th><th>0.7</th><th>0.8</th><th>0.9</th><th>1.0</th><th>1.2</th><th>1.4</th><th>1.6</th><th>1.8</th><th>2.0</th><th>2.5</th><th>3.0</th><th>∞</th></tr>
<tr><td>55</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td></tr>
<tr><td>60</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>182</td></tr>
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<tr><td>70</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>182</td><td>179</td><td>177</td><td>175</td><td>172</td><td>170</td><td>166</td></tr>
<tr><td>75</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>180</td><td>176</td><td>172</td><td>170</td><td>168</td><td>165</td><td>163</td><td>159</td></tr>
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<tr><td>85</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>181</td><td>175</td><td>168</td><td>163</td><td>159</td><td>156</td><td>154</td><td>150</td><td>148</td><td>143</td></tr>
<tr><td>90</td><td>183</td><td>183</td><td>183</td><td>183</td><td>183</td><td>176</td><td>169</td><td>162</td><td>156</td><td>152</td><td>149</td><td>147</td><td>143</td><td>141</td><td>135</td></tr>
<tr><td>95</td><td>183</td><td>183</td><td>183</td><td>183</td><td>178</td><td>170</td><td>163</td><td>155</td><td>150</td><td>145</td><td>142</td><td>140</td><td>136</td><td>134</td><td>128</td></tr>
<tr><td>100</td><td>183</td><td>183</td><td>183</td><td>182</td><td>173</td><td>165</td><td>158</td><td>149</td><td>143</td><td>139</td><td>135</td><td>133</td><td>129</td><td>127</td><td>122</td></tr>
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<tr><td>110</td><td>183</td><td>183</td><td>183</td><td>173</td><td>163</td><td>154</td><td>146</td><td>137</td><td>130</td><td>126</td><td>123</td><td>121</td><td>117</td><td>115</td><td>111</td></tr>
<tr><td>115</td><td>183</td><td>183</td><td>180</td><td>168</td><td>158</td><td>148</td><td>140</td><td>131</td><td>124</td><td>120</td><td>117</td><td>115</td><td>112</td><td>110</td><td>106</td></tr>
<tr><td>120</td><td>183</td><td>183</td><td>176</td><td>163</td><td>153</td><td>143</td><td>134</td><td>125</td><td>119</td><td>115</td><td>113</td><td>111</td><td>107</td><td>106</td><td>101</td></tr>
<tr><td>125</td><td>183</td><td>183</td><td>172</td><td>159</td><td>147</td><td>137</td><td>129</td><td>120</td><td>115</td><td>111</td><td>108</td><td>106</td><td>103</td><td>101</td><td>97</td></tr>
<tr><td>130</td><td>183</td><td>182</td><td>167</td><td>154</td><td>142</td><td>132</td><td>124</td><td>115</td><td>110</td><td>106</td><td>104</td><td>102</td><td>99</td><td>97</td><td>94</td></tr>
<tr><td>135</td><td>183</td><td>179</td><td>163</td><td>150</td><td>137</td><td>127</td><td>119</td><td>111</td><td>106</td><td>103</td><td>100</td><td>98</td><td>95</td><td>94</td><td>90</td></tr>
<tr><td>140</td><td>183</td><td>175</td><td>159</td><td>145</td><td>132</td><td>123</td><td>115</td><td>107</td><td>102</td><td>99</td><td>97</td><td>95</td><td>92</td><td>91</td><td>87</td></tr>
<tr><td>145</td><td>183</td><td>172</td><td>155</td><td>140</td><td>128</td><td>118</td><td>111</td><td>104</td><td>99</td><td>95</td><td>93</td><td>91</td><td>89</td><td>87</td><td>84</td></tr>
<tr><td>150</td><td>183</td><td>168</td><td>151</td><td>136</td><td>123</td><td>114</td><td>107</td><td>100</td><td>95</td><td>92</td><td>90</td><td>88</td><td>86</td><td>84</td><td>81</td></tr>
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<tr><td>165</td><td>178</td><td>157</td><td>139</td><td>123</td><td>112</td><td>104</td><td>98</td><td>91</td><td>87</td><td>84</td><td>82</td><td>80</td><td>78</td><td>77</td><td>74</td></tr>
<tr><td>170</td><td>175</td><td>154</td><td>135</td><td>120</td><td>109</td><td>101</td><td>95</td><td>88</td><td>84</td><td>81</td><td>79</td><td>78</td><td>76</td><td>75</td><td>72</td></tr>
<tr><td>175</td><td>172</td><td>150</td><td>131</td><td>116</td><td>106</td><td>98</td><td>92</td><td>86</td><td>82</td><td>79</td><td>77</td><td>76</td><td>74</td><td>72</td><td>70</td></tr>
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<tr><td>185</td><td>166</td><td>143</td><td>124</td><td>110</td><td>100</td><td>93</td><td>87</td><td>81</td><td>77</td><td>75</td><td>73</td><td>72</td><td>70</td><td>68</td><td>66</td></tr>
<tr><td>190</td><td>163</td><td>140</td><td>120</td><td>107</td><td>97</td><td>90</td><td>85</td><td>79</td><td>75</td><td>73</td><td>71</td><td>70</td><td>68</td><td>67</td><td>64</td></tr>
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<tr><td>205</td><td>155</td><td>129</td><td>112</td><td>99</td><td>90</td><td>84</td><td>79</td><td>73</td><td>70</td><td>68</td><td>66</td><td>65</td><td>63</td><td>62</td><td>59</td></tr>
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<tr><td>220</td><td>146</td><td>121</td><td>104</td><td>92</td><td>84</td><td>78</td><td>73</td><td>68</td><td>65</td><td>63</td><td>61</td><td>60</td><td>59</td><td>58</td><td>55</td></tr>
<tr><td>225</td><td>143</td><td>118</td><td>102</td><td>90</td><td>82</td><td>76</td><td>72</td><td>67</td><td>64</td><td>62</td><td>60</td><td>59</td><td>57</td><td>56</td><td>54</td></tr>
<tr><td>230</td><td>140</td><td>115</td><td>99</td><td>88</td><td>80</td><td>75</td><td>70</td><td>65</td><td>62</td><td>60</td><td>59</td><td>58</td><td>56</td><td>55</td><td>53</td></tr>
<tr><td>235</td><td>137</td><td>113</td><td>97</td><td>87</td><td>79</td><td>73</td><td>69</td><td>64</td><td>61</td><td>59</td><td>57</td><td>56</td><td>55</td><td>54</td><td>52</td></tr>
<tr><td>240</td><td>134</td><td>111</td><td>95</td><td>85</td><td>77</td><td>71</td><td>67</td><td>63</td><td>60</td><td>58</td><td>56</td><td>55</td><td>54</td><td>53</td><td>51</td></tr>
<tr><td>245</td><td>131</td><td>108</td><td>93</td><td>83</td><td>76</td><td>70</td><td>66</td><td>61</td><td>58</td><td>57</td><td>55</td><td>54</td><td>53</td><td>52</td><td>50</td></tr>
<tr><td>250</td><td>129</td><td>106</td><td>91</td><td>81</td><td>74</td><td>69</td><td>64</td><td>60</td><td>57</td><td>55</td><td>54</td><td>53</td><td>52</td><td>51</td><td>49</td></tr>
</table>
Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.
</td></tr>
</table>

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[46] Addition of Table 8.5m - Shear Buckling Strength for Q345/Q355 steel with web thickness ≤ 16mm.

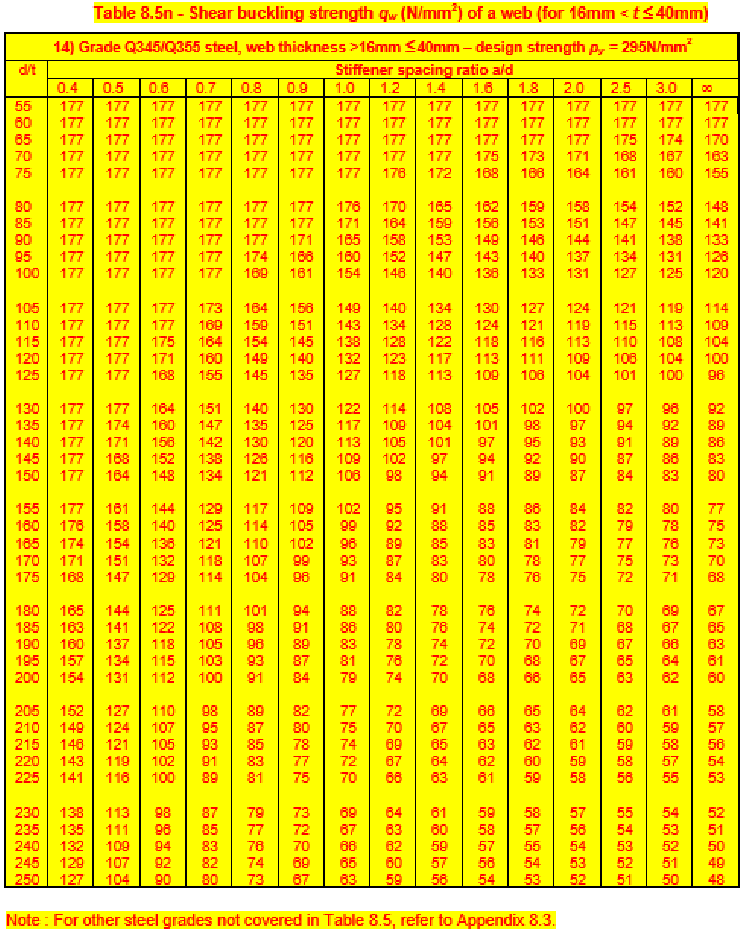
Item	Current version	Amendments
47. Table 8.5n[47]		

Table 8.5n - Shear buckling strength q_w (N/mm^2) of a web (for 16mm < $t \le$ 40mm)

14) Grade Q345/Q355 steel, web thickness >16mm ≤40mm – design strength p_y = 295N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
60	177	177	177	177	177	177	177	177	177	177	177	177	177	177	177
65	177	177	177	177	177	177	177	177	177	177	177	177	175	174	170
70	177	177	177	177	177	177	177	177	177	175	173	171	168	167	163
75	177	177	177	177	177	177	177	176	172	168	166	164	161	160	155
80	177	177	177	177	177	177	176	170	165	162	159	158	154	152	148
85	177	177	177	177	177	177	171	164	159	156	153	151	147	145	141
90	177	177	177	177	177	171	165	158	153	149	146	144	141	138	133
95	177	177	177	177	174	166	160	152	147	143	140	137	134	131	126
100	177	177	177	177	169	161	154	146	140	136	133	131	127	125	120
105	177	177	177	173	164	156	149	140	134	130	127	124	121	119	114
110	177	177	177	169	159	151	143	134	128	124	121	119	115	113	109
115	177	177	175	164	154	145	138	128	122	118	116	113	110	108	104
120	177	177	171	160	149	140	132	123	117	113	111	109	106	104	100
125	177	177	168	155	145	135	127	118	113	109	106	104	101	100	96
130	177	177	164	151	140	130	122	114	108	105	102	100	97	96	92
135	177	174	160	147	135	125	117	109	104	101	98	97	94	92	89
140	177	171	156	142	130	120	113	105	101	97	95	93	91	89	86
145	177	168	152	138	126	116	109	102	97	94	92	90	87	86	83
150	177	164	148	134	121	112	106	98	94	91	89	87	84	83	80
155	177	161	144	129	117	109	102	95	91	88	86	84	82	80	77
160	176	158	140	125	114	105	99	92	88	85	83	82	79	78	75
165	174	154	136	121	110	102	96	89	85	83	81	79	77	76	73
170	171	151	132	118	107	99	93	87	83	80	78	77	75	73	70
175	168	147	129	114	104	96	91	84	80	78	76	75	72	71	68
180	165	144	125	111	101	94	88	82	78	76	74	72	70	69	67
185	163	141	122	108	98	91	86	80	76	74	72	71	68	67	65
190	160	137	118	105	96	89	83	78	74	72	70	69	67	66	63
195	157	134	115	103	93	87	81	76	72	70	68	67	65	64	61
200	154	131	112	100	91	84	79	74	70	68	66	65	63	62	60
205	152	127	110	98	89	82	77	72	69	66	65	64	62	61	58
210	149	124	107	95	87	80	75	70	67	65	63	62	60	59	57
215	146	121	105	93	85	78	74	69	65	63	62	61	59	58	56
220	143	119	102	91	83	77	72	67	64	62	60	59	58	57	54
225	141	116	100	89	81	75	70	66	63	61	59	58	56	55	53
230	138	113	98	87	79	73	69	64	61	59	58	57	55	54	52
235	135	111	96	85	77	72	67	63	60	58	57	56	54	53	51
240	132	109	94	83	76	70	66	62	59	57	55	54	53	52	50
245	129	107	92	82	74	69	65	60	57	56	54	53	52	51	49
250	127	104	90	80	73	67	63	59	56	54	53	52	51	50	48

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[47] Addition of Table 8.5n - Shear Buckling Strength for Q345/Q355 steel with web thickness >16mm ≤ 40mm.

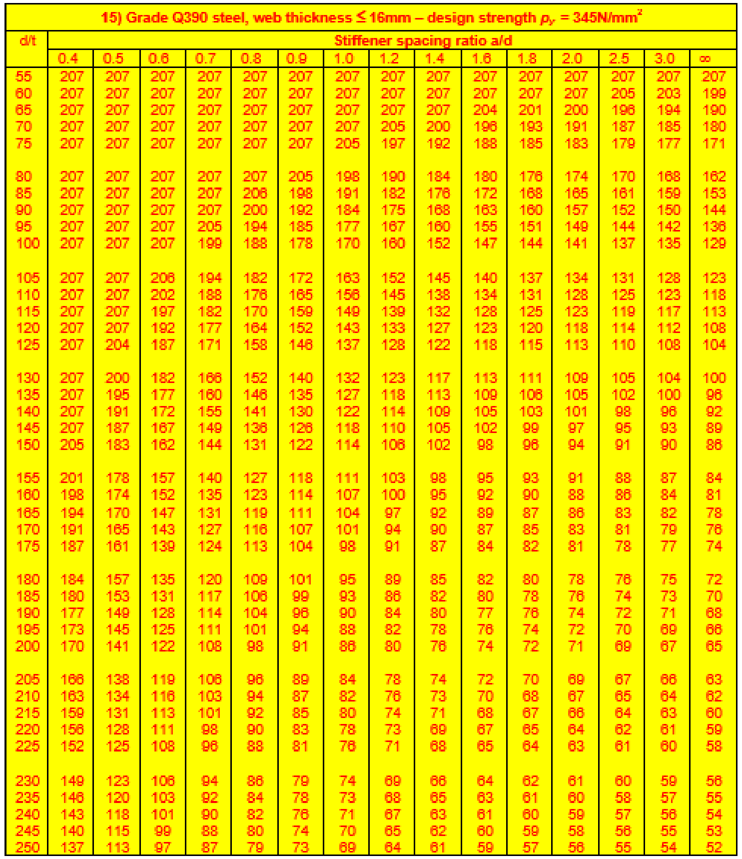
Item	Current version	Amendments
48. Table 8.5o[48]		

Table 8.5o - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq$ 16mm)

15) Grade Q390 steel, web thickness ≤ 16mm – design strength p_y = 345N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	207	207	207	207	207	207	207	207	207	207	207	207	207	207	207
60	207	207	207	207	207	207	207	207	207	207	207	207	205	203	199
65	207	207	207	207	207	207	207	207	207	204	201	200	196	194	190
70	207	207	207	207	207	207	207	205	200	196	193	191	187	185	180
75	207	207	207	207	207	207	205	197	192	188	185	183	179	177	171
80	207	207	207	207	207	205	198	190	184	180	176	174	170	168	162
85	207	207	207	207	206	198	191	182	176	172	168	165	161	159	153
90	207	207	207	207	200	192	184	175	168	163	160	157	152	150	144
95	207	207	207	205	194	185	177	167	160	155	151	149	144	142	136
100	207	207	207	199	188	178	170	160	152	147	144	141	137	135	129
105	207	207	206	194	182	172	163	152	145	140	137	134	131	128	123
110	207	207	202	188	176	165	156	145	138	134	131	128	125	123	118
115	207	207	197	182	170	159	149	139	132	128	125	123	119	117	113
120	207	207	192	177	164	152	143	133	127	123	120	118	114	112	108
125	207	204	187	171	158	146	137	128	122	118	115	113	110	108	104
130	207	200	182	166	152	140	132	123	117	113	111	109	105	104	100
135	207	195	177	160	146	135	127	118	113	109	106	105	102	100	96
140	207	191	172	155	141	130	122	114	109	105	103	101	98	96	92
145	207	187	167	149	136	126	118	110	105	102	99	97	95	93	89
150	205	183	162	144	131	122	114	106	102	98	96	94	91	90	86
155	201	178	157	140	127	118	111	103	98	95	93	91	88	87	84
160	198	174	152	135	123	114	107	100	95	92	90	88	86	84	81
165	194	170	147	131	119	111	104	97	92	89	87	86	83	82	78
170	191	165	143	127	116	107	101	94	90	87	85	83	81	79	76
175	187	161	139	124	113	104	98	91	87	84	82	81	78	77	74
180	184	157	135	120	109	101	95	89	85	82	80	78	76	75	72
185	180	153	131	117	106	99	93	86	82	80	78	76	74	73	70
190	177	149	128	114	104	96	90	84	80	77	76	74	72	71	68
195	173	145	125	111	101	94	88	82	78	76	74	72	70	69	66
200	170	141	122	108	98	91	86	80	76	74	72	71	69	67	65
205	166	138	119	106	96	89	84	78	74	72	70	69	67	66	63
210	163	134	116	103	94	87	82	76	73	70	68	67	65	64	62
215	159	131	113	101	92	85	80	74	71	68	67	66	64	63	60
220	156	128	111	98	90	83	78	73	69	67	65	64	62	61	59
225	152	125	108	96	88	81	76	71	68	65	64	63	61	60	58
230	149	123	106	94	86	79	74	69	66	64	62	61	60	59	56
235	146	120	103	92	84	78	73	68	65	63	61	60	58	57	55
240	143	118	101	90	82	76	71	67	63	61	60	59	57	56	54
245	140	115	99	88	80	74	70	65	62	60	59	58	56	55	53
250	137	113	97	87	79	73	69	64	61	59	57	56	55	54	52

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[48] Addition of Table 8.5o - Shear Buckling Strength for Q390 steel with web thickness ≤ 16mm.

Item	Current version	Amendments
49. Table 8.5p[49]		Table 8.5p - Shear buckling strength q_w (N/mm^2) of a web (for 16mm < $t \leq$ 40mm)

16) Grade Q390 steel, web thickness >16mm ≤40mm – design strength p_y = 330N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	198	198	198	198	198	198	198	198	198	198	198	198	198	198	198
60	198	198	198	198	198	198	198	198	198	198	198	198	198	197	193
65	198	198	198	198	198	198	198	198	198	197	195	193	190	188	184
70	198	198	198	198	198	198	198	198	193	190	187	185	182	180	175
75	198	198	198	198	198	198	198	191	186	182	179	177	174	172	167
80	198	198	198	198	198	198	192	184	179	175	172	169	166	163	158
85	198	198	198	198	198	192	185	177	171	167	164	161	157	155	149
90	198	198	198	198	194	186	179	170	164	159	156	153	149	147	141
95	198	198	198	198	188	180	172	163	157	152	148	145	141	139	133
100	198	198	198	193	183	174	166	156	149	144	141	138	134	132	127
105	198	198	198	188	177	167	159	149	142	137	134	131	128	126	121
110	198	198	195	182	171	161	152	142	135	131	128	125	122	120	115
115	198	198	190	177	165	155	146	136	129	125	122	120	117	115	110
120	198	198	186	172	160	149	140	130	124	120	117	115	112	110	106
125	198	197	181	167	154	143	134	125	119	115	112	110	107	105	101
130	198	193	177	162	148	137	129	120	115	111	108	106	103	101	97
135	198	189	172	156	143	132	124	116	110	107	104	102	99	98	94
140	198	185	167	151	138	127	120	112	106	103	100	99	96	94	90
145	198	181	163	146	133	123	116	108	103	99	97	95	92	91	87
150	198	177	158	141	128	119	112	104	99	96	94	92	89	88	84
155	195	173	153	136	124	115	108	101	96	93	91	89	86	85	82
160	192	169	149	132	120	112	105	98	93	90	88	86	84	82	79
165	188	165	144	128	117	108	102	95	90	87	85	84	81	80	77
170	185	161	140	124	113	105	99	92	88	85	83	81	79	78	74
175	182	157	136	121	110	102	96	89	85	82	80	79	77	75	72
180	179	153	132	118	107	99	93	87	83	80	78	77	74	73	70
185	175	149	129	114	104	96	91	84	80	78	76	75	72	71	68
190	172	145	125	111	101	94	88	82	78	76	74	73	71	69	67
195	169	142	122	108	99	91	86	80	76	74	72	71	69	68	65
200	166	138	119	106	96	89	84	78	74	72	70	69	67	66	63
205	162	135	116	103	94	87	82	76	73	70	69	67	65	64	62
210	159	131	113	101	92	85	80	74	71	69	67	66	64	63	60
215	156	128	111	98	90	83	78	73	69	67	65	64	62	61	59
220	152	125	108	96	88	81	76	71	68	65	64	63	61	60	58
225	149	123	106	94	86	79	74	69	66	64	62	61	60	59	56
230	146	120	103	92	84	78	73	68	65	63	61	60	58	57	55
235	143	117	101	90	82	76	71	66	63	61	60	59	57	56	54
240	140	115	99	88	80	74	70	65	62	60	59	58	56	55	53
245	137	113	97	86	79	73	68	64	61	59	57	56	55	54	52
250	134	110	95	85	77	71	67	62	60	58	56	55	54	53	51

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[49] Addition of Table 8.5p - Shear Buckling Strength for Q390 steel with web thickness >16mm ≤ 40mm.

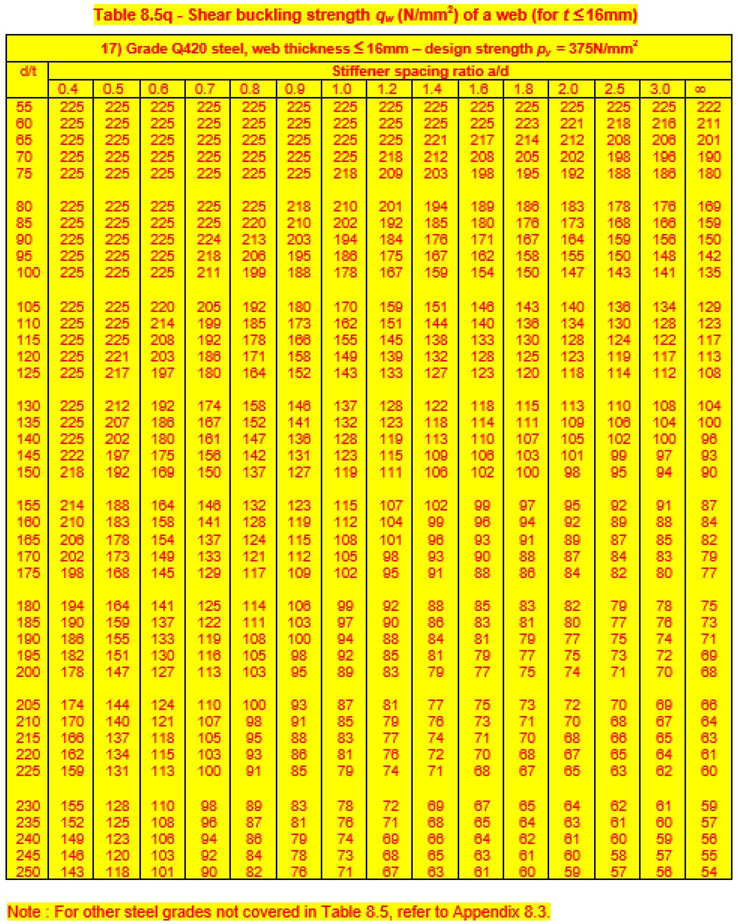
Item	Current version	Amendments
50. Table 8.5q[50]		

Table 8.5q - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq$ 16mm)

17) Grade Q420 steel, web thickness ≤ 16mm – design strength p_y = 375N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	225	225	225	225	225	225	225	225	225	225	225	225	225	225	222
60	225	225	225	225	225	225	225	225	225	225	223	221	218	216	211
65	225	225	225	225	225	225	225	225	221	217	214	212	208	206	201
70	225	225	225	225	225	225	225	218	212	208	205	202	198	196	190
75	225	225	225	225	225	225	218	209	203	198	195	192	188	186	180
80	225	225	225	225	225	218	210	201	194	189	186	183	178	176	169
85	225	225	225	225	220	210	202	192	185	180	176	173	168	166	159
90	225	225	225	224	213	203	194	184	176	171	167	164	159	156	150
95	225	225	225	218	206	195	186	175	167	162	158	155	150	148	142
100	225	225	225	211	199	188	178	167	159	154	150	147	143	141	135
105	225	225	220	205	192	180	170	159	151	146	143	140	136	134	129
110	225	225	214	199	185	173	162	151	144	140	136	134	130	128	123
115	225	225	208	192	178	166	155	145	138	133	130	128	124	122	117
120	225	221	203	186	171	158	149	139	132	128	125	123	119	117	113
125	225	217	197	180	164	152	143	133	127	123	120	118	114	112	108
130	225	212	192	174	158	146	137	128	122	118	115	113	110	108	104
135	225	207	186	167	152	141	132	123	118	114	111	109	106	104	100
140	225	202	180	161	147	136	128	119	113	110	107	105	102	100	96
145	222	197	175	156	142	131	123	115	109	106	103	101	99	97	93
150	218	192	169	150	137	127	119	111	106	102	100	98	95	94	90
155	214	188	164	146	132	123	115	107	102	99	97	95	92	91	87
160	210	183	158	141	128	119	112	104	99	96	94	92	89	88	84
165	206	178	154	137	124	115	108	101	96	93	91	89	87	85	82
170	202	173	149	133	121	112	105	98	93	90	88	87	84	83	79
175	198	168	145	129	117	109	102	95	91	88	86	84	82	80	77
180	194	164	141	125	114	106	99	92	88	85	83	82	79	78	75
185	190	159	137	122	111	103	97	90	86	83	81	80	77	76	73
190	186	155	133	119	108	100	94	88	84	81	79	77	75	74	71
195	182	151	130	116	105	98	92	85	81	79	77	75	73	72	69
200	178	147	127	113	103	95	89	83	79	77	75	74	71	70	68
205	174	144	124	110	100	93	87	81	77	75	73	72	70	69	66
210	170	140	121	107	98	91	85	79	76	73	71	70	68	67	64
215	166	137	118	105	95	88	83	77	74	71	70	68	66	65	63
220	162	134	115	103	93	86	81	76	72	70	68	67	65	64	61
225	159	131	113	100	91	85	79	74	71	68	67	65	63	62	60
230	155	128	110	98	89	83	78	72	69	67	65	64	62	61	59
235	152	125	108	96	87	81	76	71	68	65	64	63	61	60	57
240	149	123	106	94	86	79	74	69	66	64	62	61	60	59	56
245	146	120	103	92	84	78	73	68	65	63	61	60	58	57	55
250	143	118	101	90	82	76	71	67	63	61	60	59	57	56	54

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[50] Addition of Table 8.5q - Shear Buckling Strength for Q420 steel with web thickness ≤ 16mm.

Item	Current version	Amendments
51. Table 8.5r[51]		Table 8.5r - Shear buckling strength q_w (N/mm^2) of a web (for 16mm < $t \leq$ 40mm)

18) Grade Q420 steel, web thickness >16mm ≤40mm – design strength p_y = 355N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	213	213	213	213	213	213	213	213	213	213	213	213	213	213	213
60	213	213	213	213	213	213	213	213	213	213	213	213	209	208	203
65	213	213	213	213	213	213	213	213	212	208	206	204	200	198	193
70	213	213	213	213	213	213	213	209	204	200	197	195	191	189	184
75	213	213	213	213	213	213	209	201	196	191	188	186	182	180	174
80	213	213	213	213	213	209	202	194	187	183	180	177	173	170	164
85	213	213	213	213	211	202	195	186	179	174	171	168	164	161	155
90	213	213	213	213	205	195	187	178	171	166	162	159	155	152	146
95	213	213	213	209	198	189	180	170	163	157	153	151	146	144	138
100	213	213	213	203	192	182	173	162	155	149	146	143	139	137	131
105	213	213	211	197	185	175	165	154	147	142	139	136	132	130	125
110	213	213	206	192	179	168	158	147	140	136	133	130	126	124	119
115	213	213	201	186	173	161	151	141	134	130	127	124	121	119	114
120	213	213	195	180	166	154	145	135	129	124	121	119	116	114	109
125	213	208	190	174	160	148	139	130	124	119	117	115	111	109	105
130	213	204	185	169	154	142	134	125	119	115	112	110	107	105	101
135	213	199	180	163	148	137	129	120	114	111	108	106	103	101	97
140	213	195	175	157	143	132	124	116	110	107	104	102	99	98	94
145	213	190	170	151	138	128	120	112	107	103	101	99	96	94	91
150	209	186	165	146	133	123	116	108	103	100	97	95	93	91	88
155	206	181	159	142	129	119	112	105	100	96	94	92	90	88	85
160	202	177	154	137	125	116	109	101	97	93	91	89	87	85	82
165	198	173	150	133	121	112	105	98	94	91	88	87	84	83	80
170	195	168	145	129	117	109	102	95	91	88	86	84	82	80	77
175	191	164	141	125	114	106	99	93	88	85	83	82	79	78	75
180	187	159	137	122	111	103	97	90	86	83	81	80	77	76	73
185	184	155	133	119	108	100	94	88	83	81	79	77	75	74	71
190	180	151	130	115	105	97	91	85	81	79	77	75	73	72	69
195	176	147	127	113	102	95	89	83	79	77	75	73	71	70	67
200	173	143	123	110	100	93	87	81	77	75	73	72	70	68	66
205	169	140	120	107	97	90	85	79	75	73	71	70	68	67	64
210	165	136	117	104	95	88	83	77	74	71	69	68	66	65	63
215	162	133	115	102	93	86	81	75	72	69	68	67	65	64	61
220	158	130	112	100	91	84	79	74	70	68	66	65	63	62	60
225	155	127	110	98	89	82	77	72	69	66	65	64	62	61	58
230	151	124	107	95	87	80	76	70	67	65	63	62	60	59	57
235	148	122	105	93	85	79	74	69	66	64	62	61	59	58	56
240	145	119	103	91	83	77	72	67	64	62	61	60	58	57	55
245	142	117	101	90	82	76	71	66	63	61	59	58	57	56	54
250	139	115	99	88	80	74	70	65	62	60	58	57	56	55	53

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[51] Addition of Table 8.5r f- Shear Buckling Strength for Q420 steel with web thickness >16mm ≤ 40mm.

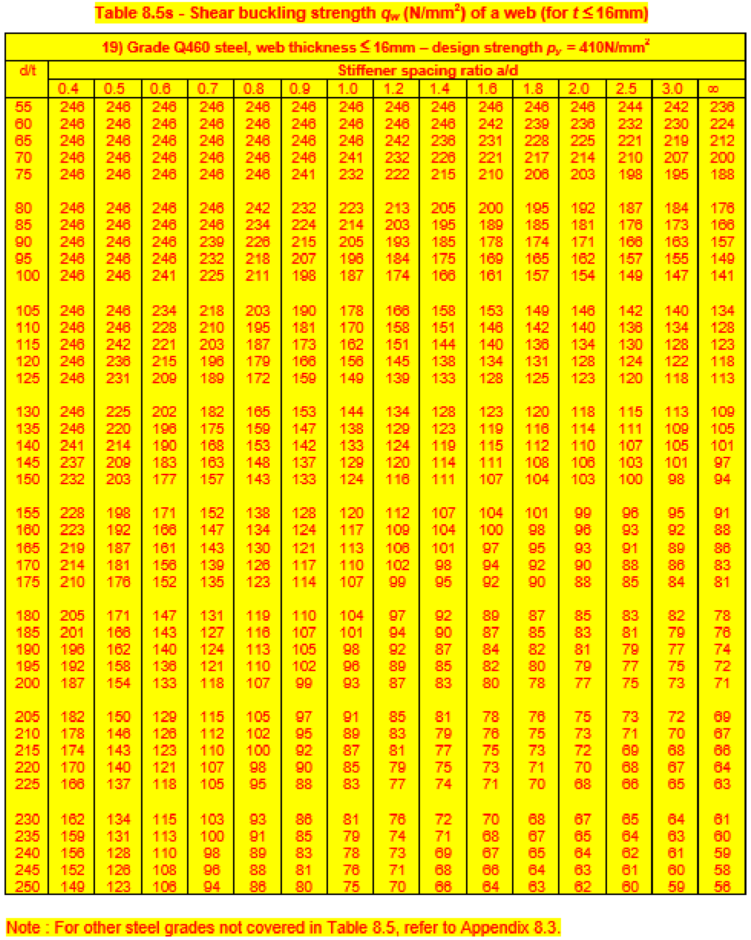
Item	Current version	Amendments
52. Table 8.5s[52]		

Table 8.5s - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq$ 16mm)

19) Grade Q460 steel, web thickness ≤ 16mm – design strength p_y = 410N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	246	246	246	246	246	246	246	246	246	246	246	246	244	242	236
60	246	246	246	246	246	246	246	246	246	242	239	236	232	230	224
65	246	246	246	246	246	246	246	242	236	231	228	225	221	219	212
70	246	246	246	246	246	246	241	232	226	221	217	214	210	207	200
75	246	246	246	246	246	241	232	222	215	210	206	203	198	195	188
80	246	246	246	246	242	232	223	213	205	200	195	192	187	184	176
85	246	246	246	246	234	224	214	203	195	189	185	181	176	173	166
90	246	246	246	239	226	215	205	193	185	178	174	171	166	163	157
95	246	246	246	232	218	207	196	184	175	169	165	162	157	155	149
100	246	246	241	225	211	198	187	174	166	161	157	154	149	147	141
105	246	246	234	218	203	190	178	166	158	153	149	146	142	140	134
110	246	246	228	210	195	181	170	158	151	146	142	140	136	134	128
115	246	242	221	203	187	173	162	151	144	140	136	134	130	128	123
120	246	236	215	196	179	166	156	145	138	134	131	128	124	122	118
125	246	231	209	189	172	159	149	139	133	128	125	123	120	118	113
130	246	225	202	182	165	153	144	134	128	123	120	118	115	113	109
135	246	220	196	175	159	147	138	129	123	119	116	114	111	109	105
140	241	214	190	168	153	142	133	124	119	115	112	110	107	105	101
145	237	209	183	163	148	137	129	120	114	111	108	106	103	101	97
150	232	203	177	157	143	133	124	116	111	107	104	103	100	98	94
155	228	198	171	152	138	128	120	112	107	104	101	99	96	95	91
160	223	192	166	147	134	124	117	109	104	100	98	96	93	92	88
165	219	187	161	143	130	121	113	106	101	97	95	93	91	89	86
170	214	181	156	139	126	117	110	102	98	94	92	90	88	86	83
175	210	176	152	135	123	114	107	99	95	92	90	88	85	84	81
180	205	171	147	131	119	110	104	97	92	89	87	85	83	82	78
185	201	166	143	127	116	107	101	94	90	87	85	83	81	79	76
190	196	162	140	124	113	105	98	92	87	84	82	81	79	77	74
195	192	158	136	121	110	102	96	89	85	82	80	79	77	75	72
200	187	154	133	118	107	99	93	87	83	80	78	77	75	73	71
205	182	150	129	115	105	97	91	85	81	78	76	75	73	72	69
210	178	146	126	112	102	95	89	83	79	76	75	73	71	70	67
215	174	143	123	110	100	92	87	81	77	75	73	72	69	68	66
220	170	140	121	107	98	90	85	79	75	73	71	70	68	67	64
225	166	137	118	105	95	88	83	77	74	71	70	68	66	65	63
230	162	134	115	103	93	86	81	76	72	70	68	67	65	64	61
235	159	131	113	100	91	85	79	74	71	68	67	65	64	63	60
240	156	128	110	98	89	83	78	73	69	67	65	64	62	61	59
245	152	126	108	96	88	81	76	71	68	66	64	63	61	60	58
250	149	123	106	94	86	80	75	70	66	64	63	62	60	59	58

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[52] Addition of Table 8.5s - Shear Buckling Strength for Q460 steel with web thickness ≤ 16mm.

Item	Current version	Amendments
53. Table 8.5t[53]		Table 8.5t - Shear buckling strength q_w (N/mm^2) of a web (for 16mm < $t \le$ 40mm)

20) Grade Q460 steel, web thickness >16mm ≤40mm – design strength p_y = 390N/mm^2														
d/t	Stiffener spacing ratio a/d													
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	234	234	234	234	234	234	234	234	234	234	234	234	234	233	228
60	234	234	234	234	234	234	234	234	234	233	230	228	224	222	217
65	234	234	234	234	234	234	234	233	227	223	220	218	214	211	206
70	234	234	234	234	234	234	233	224	218	213	210	207	203	201	195
75	234	234	234	234	234	232	224	215	208	204	200	197	193	190	183
80	234	234	234	234	233	224	216	206	199	194	190	187	182	179	172
85	234	234	234	234	226	216	207	197	189	184	180	177	172	169	162
90	234	234	234	230	219	208	199	188	180	174	170	167	162	159	153
95	234	234	234	224	211	200	191	179	171	165	161	158	153	151	145
100	234	234	232	217	204	192	182	170	162	157	153	150	146	143	138
105	234	234	226	210	197	184	174	162	154	149	146	143	139	136	131
110	234	234	220	204	189	177	166	154	147	142	139	136	132	130	125
115	234	233	214	197	182	169	158	148	141	136	133	130	127	125	120
120	234	228	208	190	175	162	152	141	135	130	127	125	121	119	115
125	234	223	202	184	167	155	146	136	130	125	122	120	117	115	110
130	234	218	196	177	161	149	140	131	125	120	118	115	112	110	106
135	234	213	190	170	155	144	135	126	120	116	113	111	108	106	102
140	233	207	184	164	150	139	130	121	116	112	109	107	104	102	98
145	228	202	179	159	144	134	126	117	112	108	105	103	100	99	95
150	224	197	173	153	140	129	121	113	108	104	102	100	97	96	92
155	220	192	167	148	135	125	117	110	104	101	99	97	94	92	89
160	216	187	162	144	131	121	114	106	101	98	95	94	91	90	86
165	212	182	157	139	127	118	110	103	98	95	93	91	88	87	83
170	207	177	152	135	123	114	107	100	95	92	90	88	86	84	81
175	203	172	148	131	120	111	104	97	93	89	87	86	83	82	79
180	199	167	144	128	116	108	101	94	90	87	85	83	81	80	76
185	195	162	140	124	113	105	98	92	88	85	83	81	79	77	74
190	191	158	136	121	110	102	96	89	85	82	80	79	77	75	72
195	186	154	133	118	107	99	93	87	83	80	78	77	75	73	71
200	182	150	129	115	105	97	91	85	81	78	76	75	73	72	69
205	178	146	126	112	102	95	89	83	79	76	75	73	71	70	67
210	174	143	123	110	100	92	87	81	77	75	73	71	69	68	66
215	169	140	120	107	97	90	85	79	75	73	71	70	68	67	64
220	166	136	118	105	95	88	83	77	74	71	69	68	66	65	63
225	162	133	115	102	93	86	81	75	72	70	68	67	65	64	61
230	158	130	112	100	91	84	79	74	70	68	66	65	63	62	60
235	155	128	110	98	89	83	77	72	69	67	65	64	62	61	59
240	152	125	108	96	87	81	76	71	67	65	64	63	61	60	57
245	149	122	106	94	85	79	74	69	66	64	62	61	59	58	56
250	146	120	103	92	84	78	73	68	65	63	61	60	58	57	55

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[53] Addition of Table 8.5t - Shear Buckling Strength for Q460 steel with web thickness >16mm ≤ 40mm.

Item	Current version	Amendments
54. Table 8.5u[54]		Table 8.5u - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq$16mm)

21) Grade Q550 steel, web thickness ≤16mm – design strength p_y = 520N/mm^2															
d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	312	312	312	312	312	312	312	312	307	301	297	294	289	286	279
60	312	312	312	312	312	312	312	300	292	286	282	279	273	270	262
65	312	312	312	312	312	309	299	287	278	271	266	263	257	253	244
70	312	312	312	312	309	297	286	273	263	256	251	247	240	237	227
75	312	312	312	312	298	285	273	259	249	241	236	231	224	221	212
80	312	312	312	303	287	273	260	245	234	226	221	217	210	207	199
85	312	312	312	293	276	260	247	231	220	213	208	204	198	195	187
90	312	312	303	283	264	248	234	218	208	201	196	192	187	184	177
95	312	312	294	272	253	236	221	206	197	190	186	182	177	174	167
100	312	310	285	262	242	224	210	196	187	181	176	173	168	165	159
105	312	302	276	252	231	213	200	187	178	172	168	165	160	158	151
110	312	294	266	242	220	204	191	178	170	164	160	157	153	150	145
115	312	286	257	231	210	195	183	170	163	157	153	151	146	144	138
120	312	279	248	221	201	187	175	163	156	151	147	144	140	138	132
125	305	271	239	212	193	179	168	157	150	145	141	139	135	132	127
130	299	263	230	204	186	172	162	151	144	139	136	133	129	127	122
135	292	255	221	197	179	166	156	145	138	134	131	128	125	123	118
140	286	247	213	190	173	160	150	140	134	129	126	124	120	118	114
145	279	239	206	183	167	154	145	135	129	125	122	119	116	114	110
150	273	231	199	177	161	149	140	131	125	121	118	115	112	110	106
155	266	224	193	171	156	144	136	126	121	117	114	112	109	107	103
160	260	217	187	166	151	140	131	123	117	113	110	108	105	103	99
165	253	210	181	161	147	136	127	119	113	110	107	105	102	100	96
170	247	204	176	156	142	132	124	115	110	106	104	102	99	97	94
175	240	198	171	152	138	128	120	112	107	103	101	99	96	95	91
180	234	192	166	148	134	124	117	109	104	100	98	96	93	92	88
185	228	187	161	144	131	121	114	106	101	98	95	94	91	89	86
190	221	182	157	140	127	118	111	103	98	95	93	91	89	87	84
195	216	178	153	136	124	115	108	101	96	93	90	89	86	85	82
200	210	173	149	133	121	112	105	98	93	90	88	87	84	83	79
205	205	169	146	130	118	109	103	96	91	88	86	85	82	81	78
210	200	165	142	126	115	107	100	93	89	86	84	82	80	79	76
215	196	161	139	124	112	104	98	91	87	84	82	81	78	77	74
220	191	157	136	121	110	102	96	89	85	82	80	79	76	75	72
225	187	154	133	118	107	100	93	87	83	80	78	77	75	74	71
230	183	151	130	115	105	97	91	85	81	79	77	75	73	72	69
235	179	147	127	113	103	95	89	83	80	77	75	74	72	70	68
240	175	144	124	111	101	93	88	82	78	75	74	72	70	69	66
245	172	141	122	108	99	91	86	80	76	74	72	71	69	68	65
250	168	139	119	106	97	90	84	78	75	72	71	69	67	66	64

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[54] Addition of Table 8.5u - Shear Buckling Strength for Q550 steel with web thickness ≤ 16mm.

Item	Current version	Amendments
55. Table 8.5v[55]		Table 8.5v - Shear buckling strength q_w (N/mm^2) of a web (for 16mm < $t \leq$ 40mm)

22) Grade Q550 steel, web thickness >16mm ≤40mm – design strength p_y = 500N/mm^2

d/t	Stiffener spacing ratio a/d													
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	300	300	300	300	300	300	300	300	298	293	289	286	281	278	272
60	300	300	300	300	300	300	300	292	284	279	275	271	266	263	255
65	300	300	300	300	300	300	290	279	271	265	260	256	251	247	239
70	300	300	300	300	300	289	278	266	257	250	245	242	235	232	223
75	300	300	300	300	290	277	266	253	243	236	231	227	220	216	208
80	300	300	300	295	279	266	254	240	229	222	216	212	206	203	195
85	300	300	300	285	269	254	242	226	216	209	204	200	194	191	183
90	300	300	294	275	258	243	229	214	204	197	192	189	183	180	173
95	300	300	286	265	247	231	217	202	193	187	182	179	174	171	164
100	300	300	277	256	237	220	206	192	183	177	173	170	165	162	156
105	300	294	269	246	226	209	196	183	175	169	165	162	157	155	148
110	300	286	260	236	216	200	187	175	167	161	157	154	150	147	142
115	300	279	251	227	206	191	179	167	159	154	150	148	143	141	136
120	300	271	243	217	198	183	172	160	153	148	144	142	137	135	130
125	297	264	234	208	190	176	165	154	147	142	138	136	132	130	125
130	290	256	226	200	182	169	159	148	141	136	133	131	127	125	120
135	284	249	217	193	176	163	153	142	136	131	128	126	122	120	115
140	278	242	209	186	169	157	147	137	131	127	124	121	118	116	111
145	272	234	202	180	163	151	142	133	126	122	119	117	114	112	108
150	266	227	195	174	158	146	137	128	122	118	115	113	110	108	104
155	260	219	189	168	153	142	133	124	118	114	112	110	106	105	101
160	254	212	183	163	148	137	129	120	115	111	108	106	103	101	97
165	248	206	177	158	144	133	125	117	111	107	105	103	100	98	94
170	242	200	172	153	139	129	121	113	108	104	102	100	97	95	92
175	235	194	167	149	135	125	118	110	105	101	99	97	94	93	89
180	229	189	163	145	132	122	115	107	102	98	96	94	92	90	87
185	223	184	158	141	128	119	111	104	99	96	94	92	89	88	84
190	217	179	154	137	125	116	109	101	96	93	91	89	87	85	82
195	212	174	150	134	122	113	106	99	94	91	89	87	85	83	80
200	206	170	146	130	119	110	103	96	92	89	86	85	82	81	78
205	201	166	143	127	116	107	101	94	89	86	84	83	80	79	76
210	196	162	139	124	113	105	98	92	87	84	82	81	79	77	74
215	192	158	136	121	110	102	96	89	85	82	80	79	77	75	73
220	187	154	133	118	108	100	94	87	83	81	79	77	75	74	71
225	183	151	130	116	105	98	92	85	81	79	77	75	73	72	69
230	179	148	127	113	103	95	90	84	80	77	75	74	72	71	68
235	176	145	125	111	101	93	88	82	78	75	74	72	70	69	66
240	172	142	122	109	99	92	86	80	76	74	72	71	69	68	65
245	168	139	120	106	97	90	84	78	75	72	71	69	67	66	64
250	165	136	117	104	95	88	82	77	73	71	69	68	66	65	62

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[55] Addition of Table 8.5v - Shear Buckling Strength for Q550 steel with web thickness >16mm ≤ 40mm.

Item	Current version	Amendments
56. Table 8.5w[56]		Table 8.5w - Shear buckling strength q_w (N/mm^2) of a web (for $t \leq$ 16mm)

23) Grade Q690 steel, web thickness ≤ 16mm – design strength p_y = 630N/mm^2

d/t	Stiffener spacing ratio a/d														
	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.2	1.4	1.6	1.8	2.0	2.5	3.0	∞
55	378	378	378	378	378	378	378	362	352	345	340	335	329	325	315
60	378	378	378	378	378	371	359	344	333	325	319	314	307	303	292
65	378	378	378	378	371	355	341	325	313	305	298	293	285	281	269
70	378	378	378	375	356	339	324	307	294	285	278	272	265	260	250
75	378	378	378	361	341	323	307	288	274	265	259	254	247	243	233
80	378	378	371	347	326	306	290	270	257	249	243	238	231	228	219
85	378	378	359	333	311	290	272	254	242	234	228	224	218	214	206
90	378	377	347	320	296	274	257	240	229	221	216	212	206	202	194
95	378	367	335	306	280	259	244	227	217	209	204	201	195	192	184
100	378	356	323	292	266	247	231	216	206	199	194	191	185	182	175
105	378	346	311	279	253	235	220	206	196	189	185	182	176	173	167
110	376	335	298	266	242	224	210	196	187	181	177	173	168	166	159
115	367	325	286	254	231	214	201	188	179	173	169	166	161	158	152
120	359	314	274	244	222	205	193	180	171	166	162	159	154	152	146
125	350	304	263	234	213	197	185	173	165	159	155	153	148	146	140
130	341	293	253	225	205	190	178	166	158	153	149	147	142	140	135
135	333	283	243	217	197	183	171	160	152	147	144	141	137	135	130
140	324	272	235	209	190	176	165	154	147	142	139	136	132	130	125
145	316	263	227	202	184	170	160	149	142	137	134	132	128	126	121
150	307	254	219	195	177	164	154	144	137	133	129	127	123	121	117
155	298	246	212	189	172	159	149	139	133	128	125	123	119	117	113
160	290	238	205	183	166	154	145	135	129	124	121	119	116	114	109
165	281	231	199	177	161	149	140	131	125	121	118	116	112	110	106
170	272	224	193	172	157	145	136	127	121	117	114	112	109	107	103
175	265	218	188	167	152	141	132	123	118	114	111	109	106	104	100
180	257	212	183	162	148	137	129	120	114	111	108	106	103	101	97
185	250	206	178	158	144	133	125	117	111	108	105	103	100	98	95
190	244	201	173	154	140	130	122	114	108	105	102	100	97	96	92
195	237	196	169	150	136	126	119	111	106	102	100	98	95	93	90
200	231	191	164	146	133	123	116	108	103	99	97	95	93	91	87
205	226	186	160	143	130	120	113	105	100	97	95	93	90	89	85
210	220	182	157	139	127	117	110	103	98	95	92	91	88	87	83
215	215	177	153	136	124	115	108	100	96	93	90	89	86	85	81
220	210	173	149	133	121	112	105	98	94	90	88	87	84	83	80
225	206	169	146	130	118	110	103	96	91	88	86	85	82	81	78
230	201	166	143	127	116	107	101	94	89	87	84	83	81	79	76
235	197	162	140	124	113	105	99	92	88	85	83	81	79	77	74
240	193	159	137	122	111	103	96	90	86	83	81	79	77	76	73
245	189	156	134	119	109	101	94	88	84	81	79	78	76	74	71
250	185	153	131	117	106	99	93	86	82	80	78	76	74	73	70

Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.

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[56] Addition of Table 8.5w - Shear Buckling Strength for Q690 steel with web thickness ≤ 16mm.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>57. Table 8.5x[57]</td><td></td><td>
Table 8.5x - Shear buckling strength q_w (N/mm^2) of a web (for 16mm < $t \leq$ 40mm)
<table>
<tr><th colspan="16">24) Grade Q690 steel, web thickness >16mm ≤40mm – design strength p_y = 615N/mm^2</th></tr>
<tr><th>d/t</th><th colspan="15">Stiffener spacing ratio a/d</th></tr>
<tr><th></th><th>0.4</th><th>0.5</th><th>0.6</th><th>0.7</th><th>0.8</th><th>0.9</th><th>1.0</th><th>1.2</th><th>1.4</th><th>1.6</th><th>1.8</th><th>2.0</th><th>2.5</th><th>3.0</th><th>∞</th></tr>
<tr><td>55</td><td>369</td><td>369</td><td>369</td><td>369</td><td>369</td><td>369</td><td>369</td><td>356</td><td>346</td><td>339</td><td>334</td><td>330</td><td>323</td><td>320</td><td>310</td></tr>
<tr><td>60</td><td>369</td><td>369</td><td>369</td><td>369</td><td>369</td><td>365</td><td>353</td><td>338</td><td>328</td><td>320</td><td>314</td><td>310</td><td>303</td><td>298</td><td>288</td></tr>
<tr><td>65</td><td>369</td><td>369</td><td>369</td><td>369</td><td>364</td><td>349</td><td>336</td><td>320</td><td>309</td><td>301</td><td>294</td><td>290</td><td>282</td><td>277</td><td>266</td></tr>
<tr><td>70</td><td>369</td><td>369</td><td>369</td><td>368</td><td>350</td><td>334</td><td>319</td><td>302</td><td>290</td><td>281</td><td>274</td><td>269</td><td>261</td><td>257</td><td>247</td></tr>
<tr><td>75</td><td>369</td><td>369</td><td>369</td><td>355</td><td>335</td><td>318</td><td>303</td><td>284</td><td>271</td><td>262</td><td>256</td><td>251</td><td>244</td><td>240</td><td>231</td></tr>
<tr><td>80</td><td>369</td><td>369</td><td>365</td><td>341</td><td>321</td><td>302</td><td>286</td><td>267</td><td>254</td><td>246</td><td>240</td><td>235</td><td>229</td><td>225</td><td>216</td></tr>
<tr><td>85</td><td>369</td><td>369</td><td>353</td><td>328</td><td>306</td><td>287</td><td>269</td><td>251</td><td>239</td><td>231</td><td>226</td><td>222</td><td>215</td><td>212</td><td>203</td></tr>
<tr><td>90</td><td>369</td><td>369</td><td>341</td><td>315</td><td>292</td><td>271</td><td>254</td><td>237</td><td>226</td><td>218</td><td>213</td><td>209</td><td>203</td><td>200</td><td>192</td></tr>
<tr><td>95</td><td>369</td><td>360</td><td>330</td><td>302</td><td>277</td><td>256</td><td>241</td><td>224</td><td>214</td><td>207</td><td>202</td><td>198</td><td>193</td><td>189</td><td>182</td></tr>
<tr><td>100</td><td>369</td><td>350</td><td>318</td><td>289</td><td>263</td><td>244</td><td>229</td><td>213</td><td>203</td><td>197</td><td>192</td><td>188</td><td>183</td><td>180</td><td>173</td></tr>
<tr><td>105</td><td>369</td><td>340</td><td>306</td><td>275</td><td>250</td><td>232</td><td>218</td><td>203</td><td>194</td><td>187</td><td>183</td><td>179</td><td>174</td><td>171</td><td>165</td></tr>
<tr><td>110</td><td>369</td><td>330</td><td>294</td><td>263</td><td>239</td><td>221</td><td>208</td><td>194</td><td>185</td><td>179</td><td>174</td><td>171</td><td>166</td><td>164</td><td>157</td></tr>
<tr><td>115</td><td>361</td><td>320</td><td>283</td><td>251</td><td>229</td><td>212</td><td>199</td><td>185</td><td>177</td><td>171</td><td>167</td><td>164</td><td>159</td><td>156</td><td>150</td></tr>
<tr><td>120</td><td>353</td><td>310</td><td>271</td><td>241</td><td>219</td><td>203</td><td>191</td><td>178</td><td>169</td><td>164</td><td>160</td><td>157</td><td>152</td><td>150</td><td>144</td></tr>
<tr><td>125</td><td>344</td><td>300</td><td>260</td><td>231</td><td>210</td><td>195</td><td>183</td><td>171</td><td>163</td><td>157</td><td>153</td><td>151</td><td>146</td><td>144</td><td>138</td></tr>
<tr><td>130</td><td>336</td><td>290</td><td>250</td><td>222</td><td>202</td><td>187</td><td>176</td><td>164</td><td>156</td><td>151</td><td>148</td><td>145</td><td>141</td><td>138</td><td>133</td></tr>
<tr><td>135</td><td>328</td><td>279</td><td>241</td><td>214</td><td>195</td><td>180</td><td>169</td><td>158</td><td>151</td><td>146</td><td>142</td><td>140</td><td>136</td><td>133</td><td>128</td></tr>
<tr><td>140</td><td>319</td><td>269</td><td>232</td><td>206</td><td>188</td><td>174</td><td>163</td><td>152</td><td>145</td><td>140</td><td>137</td><td>135</td><td>131</td><td>129</td><td>123</td></tr>
<tr><td>145</td><td>311</td><td>260</td><td>224</td><td>199</td><td>181</td><td>168</td><td>158</td><td>147</td><td>140</td><td>136</td><td>132</td><td>130</td><td>126</td><td>124</td><td>119</td></tr>
<tr><td>150</td><td>303</td><td>251</td><td>216</td><td>193</td><td>175</td><td>162</td><td>152</td><td>142</td><td>136</td><td>131</td><td>128</td><td>126</td><td>122</td><td>120</td><td>115</td></tr>
<tr><td>155</td><td>294</td><td>243</td><td>209</td><td>186</td><td>170</td><td>157</td><td>148</td><td>138</td><td>131</td><td>127</td><td>124</td><td>122</td><td>118</td><td>116</td><td>112</td></tr>
<tr><td>160</td><td>286</td><td>235</td><td>203</td><td>181</td><td>164</td><td>152</td><td>143</td><td>133</td><td>127</td><td>123</td><td>120</td><td>118</td><td>114</td><td>112</td><td>108</td></tr>
<tr><td>165</td><td>278</td><td>228</td><td>197</td><td>175</td><td>159</td><td>148</td><td>139</td><td>129</td><td>123</td><td>119</td><td>116</td><td>114</td><td>111</td><td>109</td><td>105</td></tr>
<tr><td>170</td><td>269</td><td>222</td><td>191</td><td>170</td><td>155</td><td>143</td><td>135</td><td>125</td><td>120</td><td>116</td><td>113</td><td>111</td><td>108</td><td>106</td><td>102</td></tr>
<tr><td>175</td><td>261</td><td>215</td><td>186</td><td>165</td><td>150</td><td>139</td><td>131</td><td>122</td><td>116</td><td>112</td><td>110</td><td>108</td><td>105</td><td>103</td><td>99</td></tr>
<tr><td>180</td><td>254</td><td>209</td><td>180</td><td>160</td><td>146</td><td>135</td><td>127</td><td>118</td><td>113</td><td>109</td><td>107</td><td>105</td><td>102</td><td>100</td><td>96</td></tr>
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<tr><td>205</td><td>223</td><td>184</td><td>158</td><td>141</td><td>128</td><td>119</td><td>112</td><td>104</td><td>99</td><td>96</td><td>94</td><td>92</td><td>89</td><td>88</td><td>84</td></tr>
<tr><td>210</td><td>218</td><td>179</td><td>155</td><td>138</td><td>125</td><td>116</td><td>109</td><td>102</td><td>97</td><td>94</td><td>91</td><td>90</td><td>87</td><td>86</td><td>82</td></tr>
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<tr><td>220</td><td>208</td><td>171</td><td>148</td><td>131</td><td>120</td><td>111</td><td>104</td><td>97</td><td>92</td><td>89</td><td>87</td><td>86</td><td>83</td><td>82</td><td>79</td></tr>
<tr><td>225</td><td>203</td><td>167</td><td>144</td><td>128</td><td>117</td><td>108</td><td>102</td><td>95</td><td>90</td><td>87</td><td>85</td><td>84</td><td>81</td><td>80</td><td>77</td></tr>
<tr><td>230</td><td>199</td><td>164</td><td>141</td><td>126</td><td>114</td><td>106</td><td>99</td><td>93</td><td>88</td><td>85</td><td>83</td><td>82</td><td>80</td><td>78</td><td>75</td></tr>
<tr><td>235</td><td>195</td><td>160</td><td>138</td><td>123</td><td>112</td><td>104</td><td>97</td><td>91</td><td>87</td><td>84</td><td>82</td><td>80</td><td>78</td><td>77</td><td>74</td></tr>
<tr><td>240</td><td>191</td><td>157</td><td>135</td><td>120</td><td>110</td><td>101</td><td>95</td><td>89</td><td>85</td><td>82</td><td>80</td><td>78</td><td>76</td><td>75</td><td>72</td></tr>
<tr><td>245</td><td>187</td><td>154</td><td>133</td><td>118</td><td>107</td><td>99</td><td>93</td><td>87</td><td>83</td><td>80</td><td>78</td><td>77</td><td>75</td><td>73</td><td>71</td></tr>
<tr><td>250</td><td>183</td><td>151</td><td>130</td><td>116</td><td>105</td><td>97</td><td>91</td><td>85</td><td>81</td><td>79</td><td>77</td><td>75</td><td>73</td><td>72</td><td>69</td></tr>
</table>
Note : For other steel grades not covered in Table 8.5, refer to Appendix 8.3.
</td></tr>
</table>

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[57] Addition of Table 8.5x - Shear Buckling Strength for Q690 steel with web thickness >16mm ≤ 40mm.

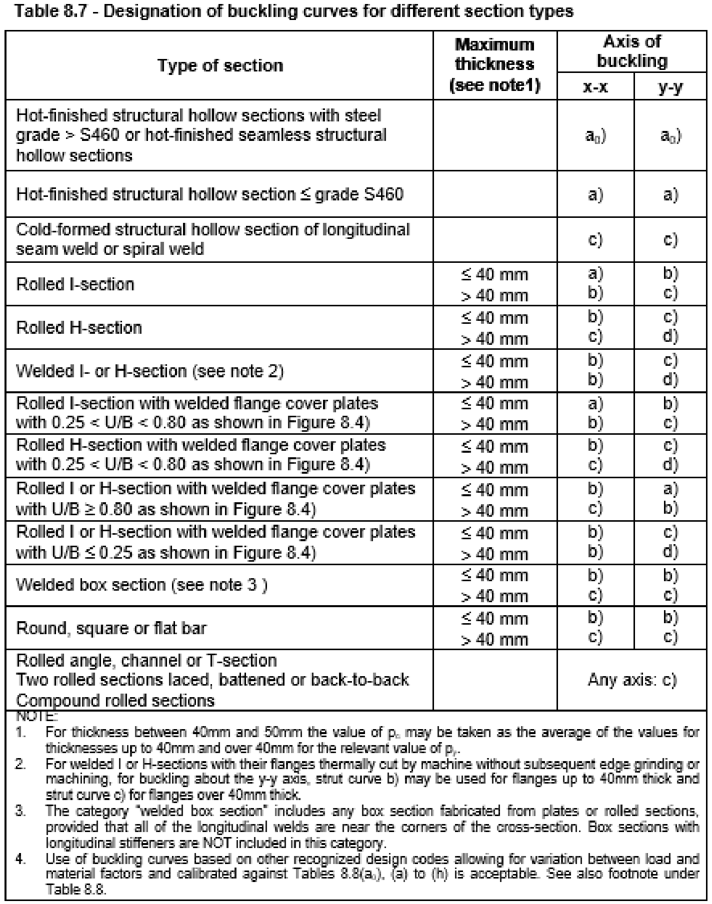
<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr>
<td>58. Table 8.7[58]</td>
<td>


Table 8.7 - Designation of buckling curves for different section types

<table>
<tr><th rowspan="2">Type of section</th><th rowspan="2">Maximum thickness (see note1)</th><th colspan="2">Axis of buckling</th></tr>
<tr><th>x-x</th><th>y-y</th></tr>
<tr><td>Hot-finished structural hollow sections with steel grade > S460 or hot-finished seamless structural hollow sections</td><td></td><td>a_0)</td><td>a_0)</td></tr>
<tr><td>Hot-finished structural hollow section ≤ grade S460</td><td></td><td>a)</td><td>a)</td></tr>
<tr><td>Cold-formed structural hollow section of longitudinal seam weld or spiral weld</td><td></td><td>c)</td><td>c)</td></tr>
<tr><td>Rolled I-section</td><td>≤ 40 mm
> 40 mm</td><td>a)
b)</td><td>b)
c)</td></tr>
<tr><td>Rolled H-section</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>c)
d)</td></tr>
<tr><td>Welded I- or H-section (see note 2)</td><td>≤ 40 mm
> 40 mm</td><td>b)
b)</td><td>c)
d)</td></tr>
<tr><td>Rolled I-section with welded flange cover plates with 0.25 < U/B < 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
> 40 mm</td><td>a)
b)</td><td>b)
c)</td></tr>
<tr><td>Rolled H-section with welded flange cover plates with 0.25 < U/B < 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>c)
d)</td></tr>
<tr><td>Rolled I or H-section with welded flange cover plates with U/B ≥ 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>a)
b)</td></tr>
<tr><td>Rolled I or H-section with welded flange cover plates with U/B ≤ 0.25 as shown in Figure 8.4)</td><td>≤ 40 mm
> 40 mm</td><td>b)
b)</td><td>c)
d)</td></tr>
<tr><td>Welded box section (see note 3)</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>b)
c)</td></tr>
<tr><td>Round, square or flat bar</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>b)
c)</td></tr>
<tr><td>Rolled angle, channel or T-section
Two rolled sections laced, battened or back-to-back
Compound rolled sections</td><td></td><td colspan="2">Any axis: c)</td></tr>
<tr><td colspan="4">NOTE:
1. For thickness between 40mm and 50mm the value of p_c may be taken as the average of the values for thicknesses up to 40mm and over 40mm for the relevant value of p_y.
2. For welded I or H-sections with their flanges thermally cut by machine without subsequent edge grinding or machining, for buckling about the y-y axis, strut curve b) may be used for flanges up to 40mm thick and strut curve c) for flanges over 40mm thick.
3. The category "welded box section" includes any box section fabricated from plates or rolled sections, provided that all of the longitudinal welds are near the corners of the cross-section. Box sections with longitudinal stiffeners are NOT included in this category.
4. Use of buckling curves based on other recognized design codes allowing for variation between load and material factors and calibrated against Tables 8.8(a_0), (a) to (h) is acceptable. See also footnote under Table 8.8.</td></tr>
</table>
</td>
<td>


Table 8.7 - Designation of buckling curves for different section types

<table>
<tr><th rowspan="2">Type of section</th><th rowspan="2">Maximum thickness (see note1)</th><th colspan="2">Axis of buckling</th></tr>
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<tr><td>Hot-finished structural hollow sections with steel grade≧ S460 or hot-finished seamless structural hollow sections</td><td></td><td>a_0)</td><td>a_0)</td></tr>
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> 40 mm</td><td>a)
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> 40 mm</td><td>b)
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d)</td></tr>
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> 40 mm</td><td>a)
b)</td><td>b)
c)</td></tr>
<tr><td>Rolled H-section with welded flange cover plates with 0.25 < U/B < 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>c)
d)</td></tr>
<tr><td>Rolled I or H-section with welded flange cover plates with U/B ≥ 0.80 as shown in Figure 8.4)</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>a)
b)</td></tr>
<tr><td>Rolled I or H-section with welded flange cover plates with U/B ≤ 0.25 as shown in Figure 8.4)</td><td>≤ 40 mm
> 40 mm</td><td>b)
b)</td><td>c)
d)</td></tr>
<tr><td>Welded box section (see note 3)</td><td>≤ 40 mm
> 40 mm</td><td>b)
c)</td><td>b)
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> 40 mm</td><td>b)
c)</td><td>b)
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[58] Revision of size of steel plate thickness in Table 8.7 for designation of buckling curve.

Item	Current version	Amendments
59. Table 8.8(b)[59]		

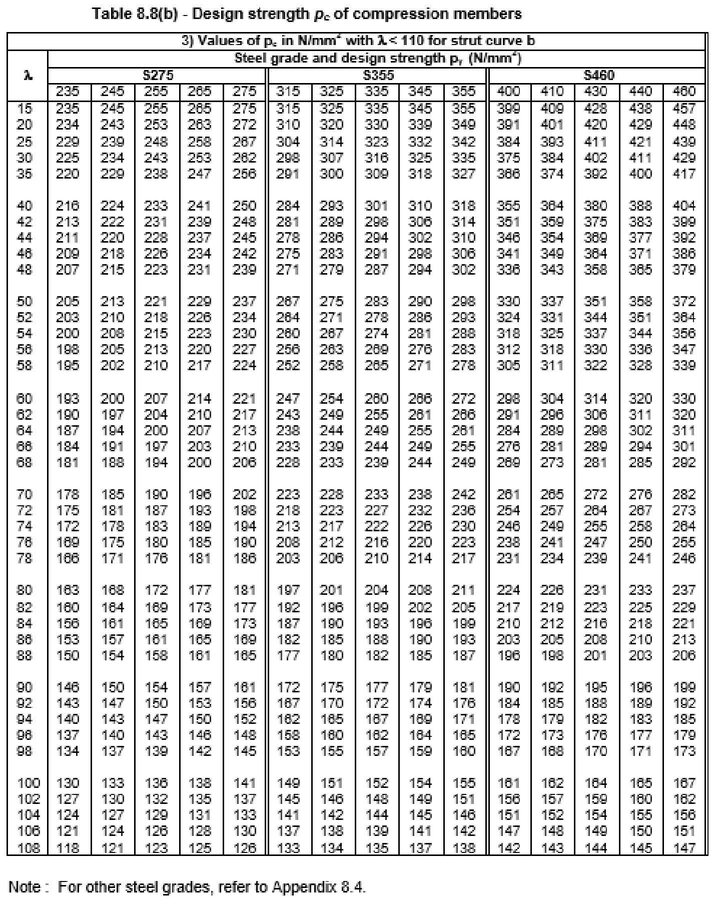

Table 8.8(b) - Design strength p_c of compression members

3) Values of p_c in N/mm² with $\lambda < 110$ for strut curve b

λ	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
15	235	245	255	265	275	315	325	335	345	355	399	409	428	438	457
20	234	243	253	263	272	310	320	330	339	349	391	401	420	429	448
25	229	239	248	258	267	304	314	323	332	342	384	393	411	421	439
30	225	234	243	253	262	298	307	316	325	335	375	384	402	411	429
35	220	229	238	247	256	291	300	309	318	327	366	374	392	400	417
40	216	224	233	241	250	284	293	301	310	318	355	364	380	388	404
42	213	222	231	239	248	281	289	298	306	314	351	359	375	383	399
44	211	220	228	237	245	278	286	294	302	310	346	354	369	377	392
46	209	218	226	234	242	275	283	291	298	306	341	349	364	371	386
48	207	215	223	231	239	271	279	287	294	302	336	343	358	365	379
50	205	213	221	229	237	267	275	283	290	298	330	337	351	358	372
52	203	210	218	226	234	264	271	278	286	293	324	331	344	351	364
54	200	208	215	223	230	260	267	274	281	288	318	325	337	344	356
56	198	205	213	220	227	256	263	269	276	283	312	318	330	336	347
58	195	202	210	217	224	252	258	265	271	278	305	311	322	328	339
60	193	200	207	214	221	247	254	260	266	272	298	304	314	320	330
62	190	197	204	210	217	243	249	255	261	266	291	296	306	311	320
64	187	194	200	207	213	238	244	249	255	261	284	289	298	302	311
66	184	191	197	203	210	233	239	244	249	255	276	281	289	294	301
68	181	188	194	200	206	228	233	239	244	249	269	273	281	285	292
70	178	185	190	196	202	223	228	233	238	242	261	265	272	276	282
72	175	181	187	193	198	218	223	227	232	236	254	257	264	267	273
74	172	178	183	189	194	213	217	222	226	230	246	249	255	258	264
76	169	175	180	185	190	208	212	216	220	223	238	241	247	250	255
78	166	171	176	181	186	203	206	210	214	217	231	234	239	241	246
80	163	168	172	177	181	197	201	204	208	211	224	226	231	233	237
82	160	164	169	173	177	192	196	199	202	205	217	219	223	225	229
84	156	161	165	169	173	187	190	193	196	199	210	212	216	218	221
86	153	157	161	165	169	182	185	188	190	193	203	205	208	210	213
88	150	154	158	161	165	177	180	182	185	187	196	198	201	203	206
90	146	150	154	157	161	172	175	177	179	181	190	192	195	196	199
92	143	147	150	153	156	167	170	172	174	176	184	185	188	189	192
94	140	143	147	150	152	162	165	167	169	171	178	179	182	183	185
96	137	140	143	146	148	158	160	162	164	165	172	173	176	177	179
98	134	137	139	142	145	153	155	157	159	160	167	168	170	171	173
100	130	133	136	138	141	149	151	152	154	155	161	162	164	165	167
102	127	130	132	135	137	145	146	148	149	151	156	157	159	160	162
104	124	127	129	131	133	141	142	144	145	146	151	152	154	155	156
106	121	124	126	128	130	137	138	139	141	142	147	148	149	150	151
108	118	121	123	125	126	133	134	135	137	138	142	143	144	145	147

Steel grade and design strength p_y (N/mm²)

Note : For other steel grades, refer to Appendix 8.4.

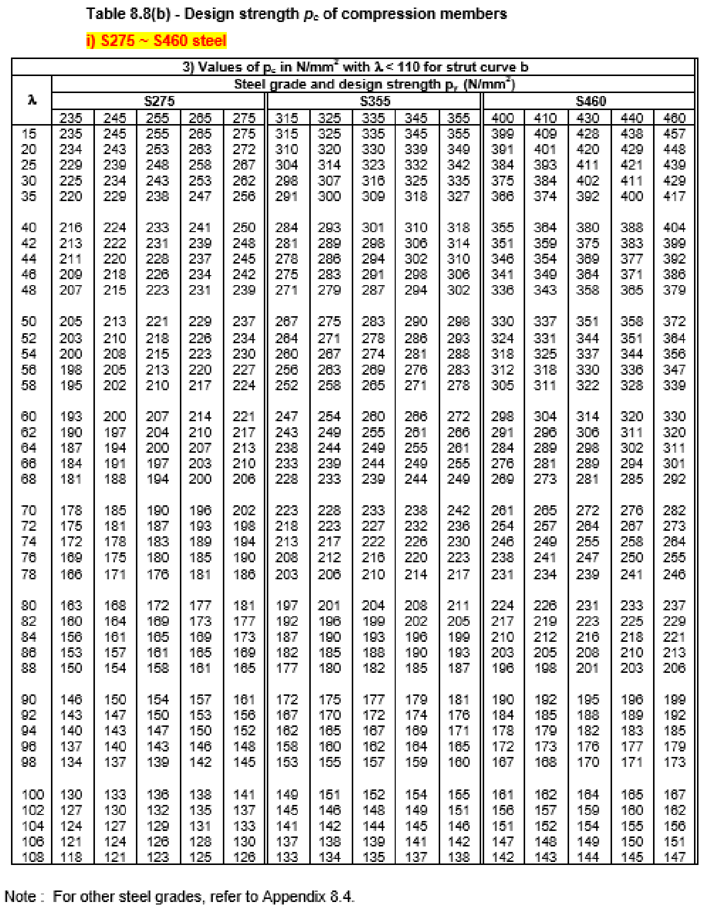

Table 8.8(b) - Design strength p_c of compression members

i) S275 ~ S460 steel

3) Values of p_c in N/mm² with $\lambda < 110$ for strut curve b

λ	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
15	235	245	255	265	275	315	325	335	345	355	399	409	428	438	457
20	234	243	253	263	272	310	320	330	339	349	391	401	420	429	448
25	229	239	248	258	267	304	314	323	332	342	384	393	411	421	439
30	225	234	243	253	262	298	307	316	325	335	375	384	402	411	429
35	220	229	238	247	256	291	300	309	318	327	366	374	392	400	417
40	216	224	233	241	250	284	293	301	310	318	355	364	380	388	404
42	213	222	231	239	248	281	289	298	306	314	351	359	375	383	399
44	211	220	228	237	245	278	286	294	302	310	346	354	369	377	392
46	209	218	226	234	242	275	283	291	298	306	341	349	364	371	386
48	207	215	223	231	239	271	279	287	294	302	336	343	358	365	379
50	205	213	221	229	237	267	275	283	290	298	330	337	351	358	372
52	203	210	218	226	234	264	271	278	286	293	324	331	344	351	364
54	200	208	215	223	230	260	267	274	281	288	318	325	337	344	356
56	198	205	213	220	227	256	263	269	276	283	312	318	330	336	347
58	195	202	210	217	224	252	258	265	271	278	305	311	322	328	339
60	193	200	207	214	221	247	254	260	266	272	298	304	314	320	330
62	190	197	204	210	217	243	249	255	261	266	291	296	306	311	320
64	187	194	200	207	213	238	244	249	255	261	284	289	298	302	311
66	184	191	197	203	210	233	239	244	249	255	276	281	289	294	301
68	181	188	194	200	206	228	233	239	244	249	269	273	281	285	292
70	178	185	190	196	202	223	228	233	238	242	261	265	272	276	282
72	175	181	187	193	198	218	223	227	232	236	254	257	264	267	273
74	172	178	183	189	194	213	217	222	226	230	246	249	255	258	264
76	169	175	180	185	190	208	212	216	220	223	238	241	247	250	255
78	166	171	176	181	186	203	206	210	214	217	231	234	239	241	246
80	163	168	172	177	181	197	201	204	208	211	224	226	231	233	237
82	160	164	169	173	177	192	196	199	202	205	217	219	223	225	229
84	156	161	165	169	173	187	190	193	196	199	210	212	216	218	221
86	153	157	161	165	169	182	185	188	190	193	203	205	208	210	213
88	150	154	158	161	165	177	180	182	185	187	196	198	201	203	206
90	146	150	154	157	161	172	175	177	179	181	190	192	195	196	199
92	143	147	150	153	156	167	170	172	174	176	184	185	188	189	192
94	140	143	147	150	152	162	165	167	169	171	178	179	182	183	185
96	137	140	143	146	148	158	160	162	164	165	172	173	176	177	179
98	134	137	139	142	145	153	155	157	159	160	167	168	170	171	173
100	130	133	136	138	141	149	151	152	154	155	161	162	164	165	167
102	127	130	132	135	137	145	146	148	149	151	156	157	159	160	162
104	124	127	129	131	133	141	142	144	145	146	151	152	154	155	156
106	121	124	126	128	130	137	138	139	141	142	147	148	149	150	151
108	118	121	123	125	126	133	134	135	137	138	142	143	144	145	147

Steel grade and design strength p_y (N/mm²)

Note : For other steel grades, refer to Appendix 8.4.

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[59] Addition of relevant steel grade S275 ~ S460 as subtitle of Table 8.8(b) for buckling curve b.

Item	Current version	Amendments
60. Table 8.8(b) (cont'd)[60]		

Current version

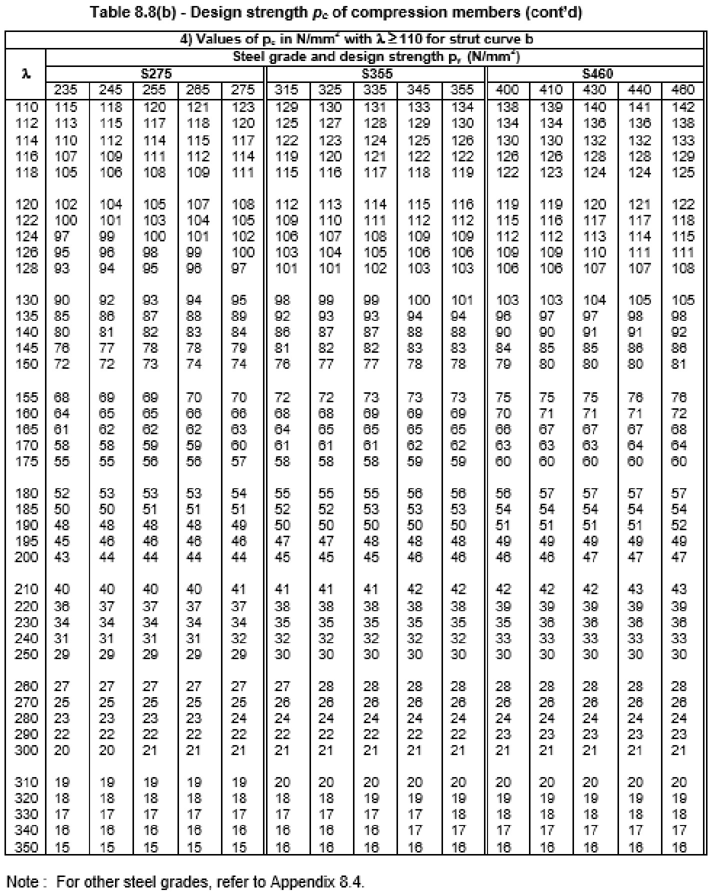

Table 8.8(b) - Design strength p_c of compression members (cont'd)

4) Values of p_c in N/mm^2 with $\lambda \geq 110$ for strut curve b

λ	Steel grade and design strength p_y (N/mm^2)														
	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
110	115	118	120	121	123	129	130	131	133	134	138	139	140	141	142
112	113	115	117	118	120	125	127	128	129	130	134	134	136	136	138
114	110	112	114	115	117	122	123	124	125	126	130	130	132	132	133
116	107	109	111	112	114	119	120	121	122	122	126	126	128	128	129
118	105	106	108	109	111	115	116	117	118	119	122	123	124	124	125
120	102	104	105	107	108	112	113	114	115	116	119	119	120	121	122
122	100	101	103	104	105	109	110	111	112	112	115	116	117	117	118
124	97	99	100	101	102	106	107	108	109	109	112	112	113	114	115
126	95	96	98	99	100	103	104	105	106	106	109	109	110	111	111
128	93	94	95	96	97	101	101	102	103	103	106	106	107	107	108
130	90	92	93	94	95	98	99	99	100	101	103	103	104	105	105
135	85	86	87	88	89	92	93	93	94	94	96	97	97	98	98
140	80	81	82	83	84	86	87	87	88	88	90	90	91	91	92
145	76	77	78	78	79	81	82	82	83	83	84	85	85	86	86
150	72	72	73	74	74	76	77	77	78	78	79	80	80	80	81
155	68	69	69	70	70	72	72	73	73	73	75	75	75	76	76
160	64	65	65	66	66	68	68	69	69	69	70	71	71	71	72
165	61	62	62	62	63	64	65	65	65	65	66	67	67	67	68
170	58	58	59	59	60	61	61	61	62	62	63	63	63	64	64
175	55	55	56	56	57	58	58	58	59	59	60	60	60	60	60
180	52	53	53	53	54	55	55	55	56	56	56	57	57	57	57
185	50	50	51	51	51	52	52	53	53	53	54	54	54	54	54
190	48	48	48	48	49	50	50	50	50	50	51	51	51	51	52
195	45	46	46	46	46	47	47	48	48	48	49	49	49	49	49
200	43	44	44	44	44	45	45	45	46	46	46	46	47	47	47
210	40	40	40	40	41	41	41	41	42	42	42	42	42	43	43
220	36	37	37	37	37	38	38	38	38	38	39	39	39	39	39
230	34	34	34	34	34	35	35	35	35	35	35	36	36	36	36
240	31	31	31	31	32	32	32	32	32	32	33	33	33	33	33
250	29	29	29	29	29	30	30	30	30	30	30	30	30	30	30
260	27	27	27	27	27	27	28	28	28	28	28	28	28	28	28
270	25	25	25	25	25	26	26	26	26	26	26	26	26	26	26
280	23	23	23	23	24	24	24	24	24	24	24	24	24	24	24
290	22	22	22	22	22	22	22	22	22	22	23	23	23	23	23
300	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21
310	19	19	19	19	19	20	20	20	20	20	20	20	20	20	20
320	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19
330	17	17	17	17	17	17	17	17	17	18	18	18	18	18	18
340	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17
350	15	15	15	15	15	16	16	16	16	16	16	16	16	16	16

Note : For other steel grades, refer to Appendix 8.4.

Amendments

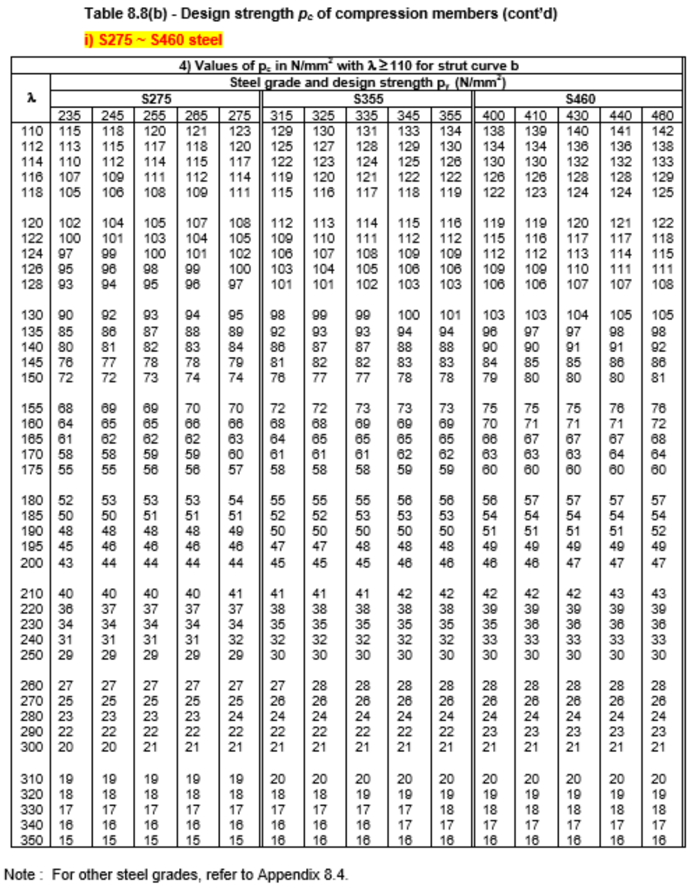

Table 8.8(b) - Design strength p_c of compression members (cont'd)

i) S275 ~ S460 steel

4) Values of p_c in N/mm^2 with $\lambda \geq 110$ for strut curve b

λ	Steel grade and design strength p_y (N/mm^2)														
	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
110	115	118	120	121	123	129	130	131	133	134	138	139	140	141	142
112	113	115	117	118	120	125	127	128	129	130	134	134	136	136	138
114	110	112	114	115	117	122	123	124	125	126	130	130	132	132	133
116	107	109	111	112	114	119	120	121	122	122	126	126	128	128	129
118	105	106	108	109	111	115	116	117	118	119	122	123	124	124	125
120	102	104	105	107	108	112	113	114	115	116	119	119	120	121	122
122	100	101	103	104	105	109	110	111	112	112	115	116	117	117	118
124	97	99	100	101	102	106	107	108	109	109	112	112	113	114	115
126	95	96	98	99	100	103	104	105	106	106	109	109	110	111	111
128	93	94	95	96	97	101	101	102	103	103	106	106	107	107	108
130	90	92	93	94	95	98	99	99	100	101	103	103	104	105	105
135	85	86	87	88	89	92	93	93	94	94	96	97	97	98	98
140	80	81	82	83	84	86	87	87	88	88	90	90	91	91	92
145	76	77	78	78	79	81	82	82	83	83	84	85	85	86	86
150	72	72	73	74	74	76	77	77	78	78	79	80	80	80	81
155	68	69	69	70	70	72	72	73	73	73	75	75	75	76	76
160	64	65	65	66	66	68	68	69	69	69	70	71	71	71	72
165	61	62	62	62	63	64	65	65	65	65	66	67	67	67	68
170	58	58	59	59	60	61	61	61	62	62	63	63	63	64	64
175	55	55	56	56	57	58	58	58	59	59	60	60	60	60	60
180	52	53	53	53	54	55	55	55	56	56	56	57	57	57	57
185	50	50	51	51	51	52	52	53	53	53	54	54	54	54	54
190	48	48	48	48	49	50	50	50	50	50	51	51	51	51	52
195	45	46	46	46	46	47	47	48	48	48	49	49	49	49	49
200	43	44	44	44	44	45	45	45	46	46	46	46	47	47	47
210	40	40	40	40	41	41	41	41	42	42	42	42	42	43	43
220	36	37	37	37	37	38	38	38	38	38	39	39	39	39	39
230	34	34	34	34	34	35	35	35	35	35	35	36	36	36	36
240	31	31	31	31	32	32	32	32	32	32	33	33	33	33	33
250	29	29	29	29	29	30	30	30	30	30	30	30	30	30	30
260	27	27	27	27	27	27	28	28	28	28	28	28	28	28	28
270	25	25	25	25	25	26	26	26	26	26	26	26	26	26	26
280	23	23	23	23	24	24	24	24	24	24	24	24	24	24	24
290	22	22	22	22	22	22	22	22	22	22	23	23	23	23	23
300	20	20	21	21	21	21	21	21	21	21	21	21	21	21	21
310	19	19	19	19	19	20	20	20	20	20	20	20	20	20	20
320	18	18	18	18	18	18	18	19	19	19	19	19	19	19	19
330	17	17	17	17	17	17	17	17	17	18	18	18	18	18	18
340	16	16	16	16	16	16	16	16	17	17	17	17	17	17	17
350	15	15	15	15	15	16	16	16	16	16	16	16	16	16	16

Note : For other steel grades, refer to Appendix 8.4.

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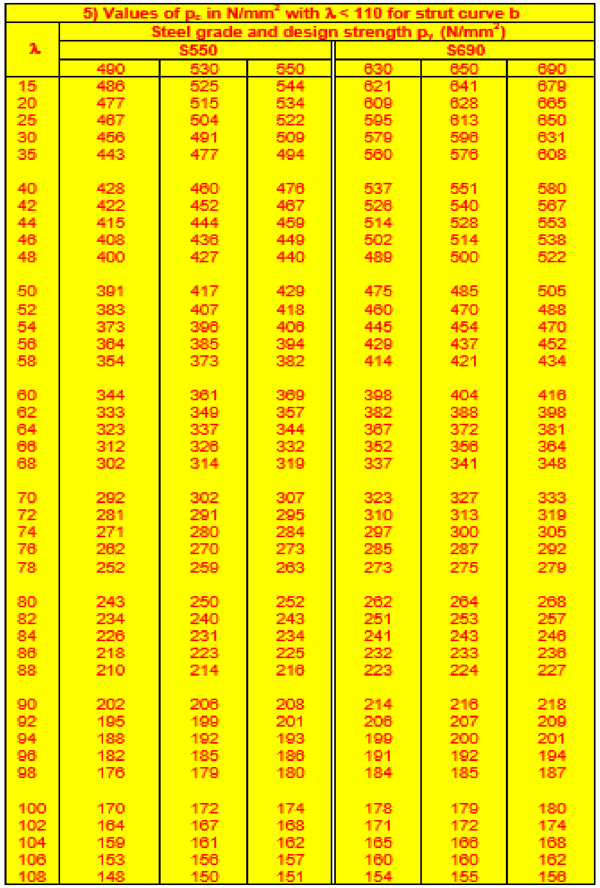
[60] Addition of relevant steel grade S275 ~ S460 as subtitle of Table 8.8(b) (Cont'd) for buckling curve b.

Item	Current version	Amendments
61. Table 8.8(b) (cont'd)[61]		**Table 8.8(b) - Design strength p_c of compression members** **ii) S550 ~ S690 steel** 

5) Values of p_c in N/mm^2 with λ < 110 for strut curve b						
λ	Steel grade and design strength p_y (N/mm^2)					
	S550			S690		
	490	530	550	630	650	690
15	486	525	544	621	641	679
20	477	515	534	609	628	665
25	467	504	522	595	613	650
30	456	491	509	579	596	631
35	443	477	494	560	576	608
40	428	460	476	537	551	580
42	422	452	467	526	540	567
44	415	444	459	514	528	553
46	408	436	449	502	514	538
48	400	427	440	489	500	522
50	391	417	429	475	485	505
52	383	407	418	460	470	488
54	373	396	406	445	454	470
56	364	385	394	429	437	452
58	354	373	382	414	421	434
60	344	361	369	398	404	416
62	333	349	357	382	388	398
64	323	337	344	367	372	381
66	312	326	332	352	356	364
68	302	314	319	337	341	348
70	292	302	307	323	327	333
72	281	291	295	310	313	319
74	271	280	284	297	300	305
76	262	270	273	285	287	292
78	252	259	263	273	275	279
80	243	250	252	262	264	268
82	234	240	243	251	253	257
84	226	231	234	241	243	246
86	218	223	225	232	233	236
88	210	214	216	223	224	227
90	202	206	208	214	216	218
92	195	199	201	206	207	209
94	188	192	193	199	200	201
96	182	185	186	191	192	194
98	176	179	180	184	185	187
100	170	172	174	178	179	180
102	164	167	168	171	172	174
104	159	161	162	165	166	168
106	153	156	157	160	160	162
108	148	150	151	154	155	156

Note : For other steel grades, refer to Appendix 8.4.

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[61] Addition of design strength for S550 and S690 steel for buckling curve b.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>62. Table 8.8(b)
(cont'd)[62]</td><td></td><td>

Table 8.8(b) - Design strength p_c of compression members (cont'd)

ii) S550 ~ S690 steel (cont'd)

<table>
<tr><th colspan="7">5) Values of p_c in N/mm^2 with $\lambda \geq 110$ for strut curve b</th></tr>
<tr><th rowspan="3">λ</th><th colspan="6">Steel grade and design strength p_y (N/mm^2)</th></tr>
<tr><th colspan="3">S550</th><th colspan="3">S690</th></tr>
<tr><th>490</th><th>530</th><th>550</th><th>630</th><th>650</th><th>690</th></tr>
<tr><td>110</td><td>144</td><td>146</td><td>146</td><td>149</td><td>150</td><td>151</td></tr>
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<tr><td>118</td><td>127</td><td>128</td><td>129</td><td>131</td><td>132</td><td>132</td></tr>
<tr><td>120</td><td>123</td><td>124</td><td>125</td><td>127</td><td>127</td><td>128</td></tr>
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<tr><td>150</td><td>81</td><td>82</td><td>82</td><td>83</td><td>83</td><td>84</td></tr>
<tr><td>155</td><td>76</td><td>77</td><td>77</td><td>78</td><td>78</td><td>79</td></tr>
<tr><td>160</td><td>72</td><td>73</td><td>73</td><td>74</td><td>74</td><td>74</td></tr>
<tr><td>165</td><td>68</td><td>68</td><td>69</td><td>69</td><td>70</td><td>70</td></tr>
<tr><td>170</td><td>64</td><td>65</td><td>65</td><td>65</td><td>66</td><td>66</td></tr>
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<tr><td>180</td><td>58</td><td>58</td><td>58</td><td>59</td><td>59</td><td>59</td></tr>
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<tr><td>200</td><td>47</td><td>47</td><td>47</td><td>48</td><td>48</td><td>48</td></tr>
<tr><td>210</td><td>43</td><td>43</td><td>43</td><td>44</td><td>44</td><td>44</td></tr>
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<tr><td>310</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td><td>20</td></tr>
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<tr><td>330</td><td>18</td><td>18</td><td>18</td><td>18</td><td>18</td><td>18</td></tr>
<tr><td>340</td><td>17</td><td>17</td><td>17</td><td>17</td><td>17</td><td>17</td></tr>
<tr><td>350</td><td>16</td><td>16</td><td>16</td><td>16</td><td>16</td><td>16</td></tr>
</table>

Note : For other steel grades, refer to Appendix 8.4.

</td></tr>
</table>

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[62] Addition of design strength for S550 and S690 steel for buckling curve b.

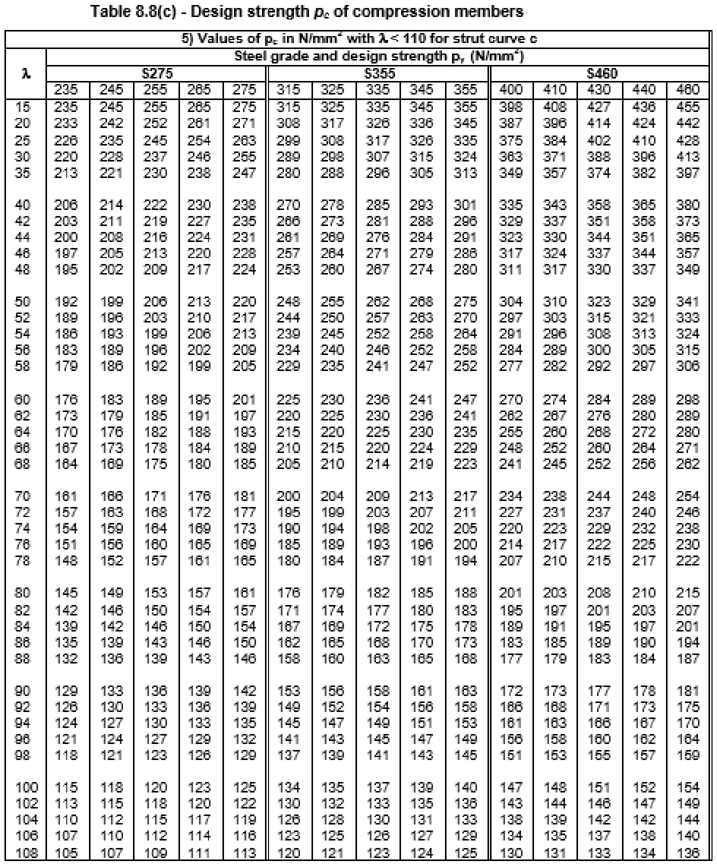
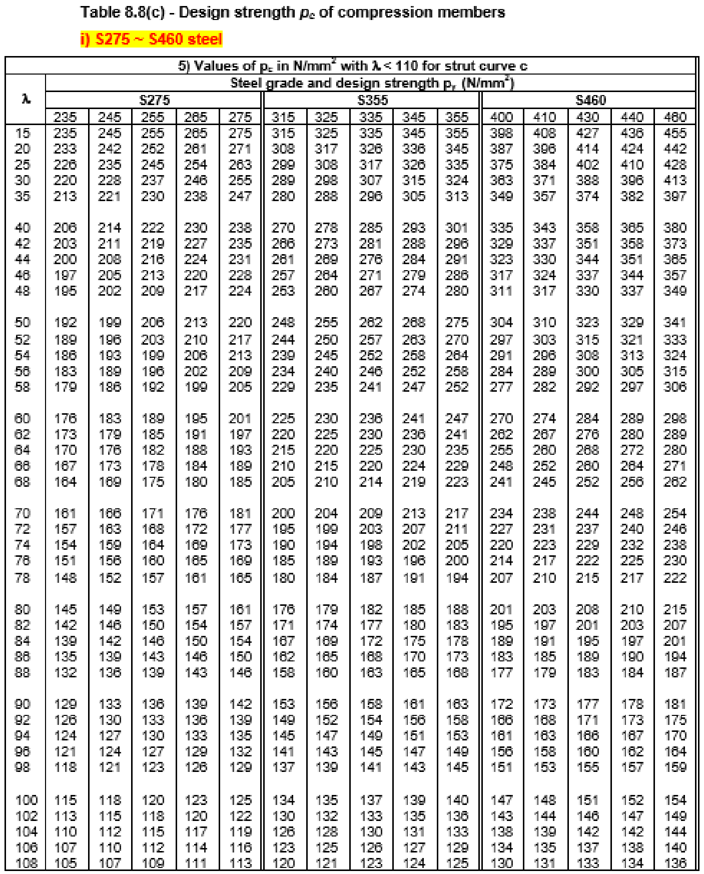
Item	Current version	Amendments
63. Table 8.8(c)[63]		

Table 8.8(c) - Design strength p_c of compression members

5) Values of p_c in N/mm² with λ < 110 for strut curve c

Steel grade and design strength p_y (N/mm²)

λ	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
15	235	245	255	265	275	315	325	335	345	355	398	408	427	436	455
20	233	242	252	261	271	308	317	326	336	345	387	396	414	424	442
25	226	235	245	254	263	299	308	317	326	335	375	384	402	410	428
30	220	228	237	246	255	289	298	307	315	324	363	371	388	396	413
35	213	221	230	238	247	280	288	296	305	313	349	357	374	382	397
40	206	214	222	230	238	270	278	285	293	301	335	343	358	365	380
42	203	211	219	227	235	266	273	281	288	296	329	337	351	358	373
44	200	208	216	224	231	261	269	276	284	291	323	330	344	351	365
46	197	205	213	220	228	257	264	271	279	286	317	324	337	344	357
48	195	202	209	217	224	253	260	267	274	280	311	317	330	337	349
50	192	199	206	213	220	248	255	262	268	275	304	310	323	329	341
52	189	196	203	210	217	244	250	257	263	270	297	303	315	321	333
54	186	193	199	206	213	239	245	252	258	264	291	296	308	313	324
56	183	189	196	202	209	234	240	246	252	258	284	289	300	305	315
58	179	186	192	199	205	229	235	241	247	252	277	282	292	297	306
60	176	183	189	195	201	225	230	236	241	247	270	274	284	289	298
62	173	179	185	191	197	220	225	230	236	241	262	267	276	280	289
64	170	176	182	188	193	215	220	225	230	235	255	260	268	272	280
66	167	173	178	184	189	210	215	220	224	229	248	252	260	264	271
68	164	169	175	180	185	205	210	214	219	223	241	245	252	256	262
70	161	166	171	176	181	200	204	209	213	217	234	238	244	248	254
72	157	163	168	172	177	195	199	203	207	211	227	231	237	240	246
74	154	159	164	169	173	190	194	198	202	205	220	223	229	232	238
76	151	156	160	165	169	185	189	193	196	200	214	217	222	225	230
78	148	152	157	161	165	180	184	187	191	194	207	210	215	217	222
80	145	149	153	157	161	176	179	182	185	188	201	203	208	210	215
82	142	146	150	154	157	171	174	177	180	183	195	197	201	203	207
84	139	142	146	150	154	167	169	172	175	178	189	191	195	197	201
86	135	139	143	146	150	162	165	168	170	173	183	185	189	190	194
88	132	136	139	143	146	158	160	163	165	168	177	179	183	184	187
90	129	133	136	139	142	153	156	158	161	163	172	173	177	178	181
92	126	130	133	136	139	149	152	154	156	158	166	168	171	173	175
94	124	127	130	133	135	145	147	149	151	153	161	163	166	167	170
96	121	124	127	129	132	141	143	145	147	149	156	158	160	162	164
98	118	121	123	126	129	137	139	141	143	145	151	153	155	157	159
100	115	118	120	123	125	134	135	137	139	140	147	148	151	152	154
102	113	115	118	120	122	130	132	133	135	136	143	144	146	147	149
104	110	112	115	117	119	126	128	130	131	133	138	139	142	142	144
106	107	110	112	114	116	123	125	126	127	129	134	135	137	138	140
108	105	107	109	111	113	120	121	123	124	125	130	131	133	134	136

Note : For other steel grades, refer to Appendix 8.4.

Table 8.8(c) - Design strength p_c of compression members

i) S275 ~ S460 steel

5) Values of p_c in N/mm² with λ < 110 for strut curve c

Steel grade and design strength p_y (N/mm²)

λ	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
15	235	245	255	265	275	315	325	335	345	355	398	408	427	436	455
20	233	242	252	261	271	308	317	326	336	345	387	396	414	424	442
25	226	235	245	254	263	299	308	317	326	335	375	384	402	410	428
30	220	228	237	246	255	289	298	307	315	324	363	371	388	396	413
35	213	221	230	238	247	280	288	296	305	313	349	357	374	382	397
40	206	214	222	230	238	270	278	285	293	301	335	343	358	365	380
42	203	211	219	227	235	266	273	281	288	296	329	337	351	358	373
44	200	208	216	224	231	261	269	276	284	291	323	330	344	351	365
46	197	205	213	220	228	257	264	271	279	286	317	324	337	344	357
48	195	202	209	217	224	253	260	267	274	280	311	317	330	337	349
50	192	199	206	213	220	248	255	262	268	275	304	310	323	329	341
52	189	196	203	210	217	244	250	257	263	270	297	303	315	321	333
54	186	193	199	206	213	239	245	252	258	264	291	296	308	313	324
56	183	189	196	202	209	234	240	246	252	258	284	289	300	305	315
58	179	186	192	199	205	229	235	241	247	252	277	282	292	297	306
60	176	183	189	195	201	225	230	236	241	247	270	274	284	289	298
62	173	179	185	191	197	220	225	230	236	241	262	267	276	280	289
64	170	176	182	188	193	215	220	225	230	235	255	260	268	272	280
66	167	173	178	184	189	210	215	220	224	229	248	252	260	264	271
68	164	169	175	180	185	205	210	214	219	223	241	245	252	256	262
70	161	166	171	176	181	200	204	209	213	217	234	238	244	248	254
72	157	163	168	172	177	195	199	203	207	211	227	231	237	240	246
74	154	159	164	169	173	190	194	198	202	205	220	223	229	232	238
76	151	156	160	165	169	185	189	193	196	200	214	217	222	225	230
78	148	152	157	161	165	180	184	187	191	194	207	210	215	217	222
80	145	149	153	157	161	176	179	182	185	188	201	203	208	210	215
82	142	146	150	154	157	171	174	177	180	183	195	197	201	203	207
84	139	142	146	150	154	167	169	172	175	178	189	191	195	197	201
86	135	139	143	146	150	162	165	168	170	173	183	185	189	190	194
88	132	136	139	143	146	158	160	163	165	168	177	179	183	184	187
90	129	133	136	139	142	153	156	158	161	163	172	173	177	178	181
92	126	130	133	136	139	149	152	154	156	158	166	168	171	173	175
94	124	127	130	133	135	145	147	149	151	153	161	163	166	167	170
96	121	124	127	129	132	141	143	145	147	149	156	158	160	162	164
98	118	121	123	126	129	137	139	141	143	145	151	153	155	157	159
100	115	118	120	123	125	134	135	137	139	140	147	148	151	152	154
102	113	115	118	120	122	130	132	133	135	136	143	144	146	147	149
104	110	112	115	117	119	126	128	130	131	133	138	139	142	142	144
106	107	110	112	114	116	123	125	126	127	129	134	135	137	138	140
108	105	107	109	111	113	120	121	123	124	125	130	131	133	134	136

Note : For other steel grades, refer to Appendix 8.4.

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[63] Addition of relevant steel grade S275 ~ S460 as subtitle of Table 8.8(c) for buckling curve c.

Item	Current version	Amendments
64. Table 8.8(c) (cont'd)[64]		

Table 8.8(c) - Design strength p_c of compression members

5) Values of p_c in N/mm^2 with $\lambda < 110$ for strut curve c

λ	Steel grade and design strength p_y (N/mm^2)														
	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
15	235	245	255	265	275	315	325	335	345	355	398	408	427	436	455
20	233	242	252	261	271	308	317	326	336	345	387	396	414	424	442
25	226	235	245	254	263	299	308	317	326	335	375	384	402	410	428
30	220	228	237	246	255	289	298	307	315	324	363	371	388	396	413
35	213	221	230	238	247	280	288	296	305	313	349	357	374	382	397
40	206	214	222	230	238	270	278	285	293	301	335	343	358	365	380
42	203	211	219	227	235	266	273	281	288	296	329	337	351	358	373
44	200	208	216	224	231	261	269	276	284	291	323	330	344	351	365
46	197	205	213	220	228	257	264	271	279	286	317	324	337	344	357
48	195	202	209	217	224	253	260	267	274	280	311	317	330	337	349
50	192	199	206	213	220	248	255	262	268	275	304	310	323	329	341
52	189	196	203	210	217	244	250	257	263	270	297	303	315	321	333
54	186	193	199	206	213	239	245	252	258	264	291	296	308	313	324
56	183	189	196	202	209	234	240	246	252	258	284	289	300	305	315
58	179	186	192	199	205	229	235	241	247	252	277	282	292	297	306
60	176	183	189	195	201	225	230	236	241	247	270	274	284	289	298
62	173	179	185	191	197	220	225	230	236	241	262	267	276	280	289
64	170	176	182	188	193	215	220	225	230	235	255	260	268	272	280
66	167	173	178	184	189	210	215	220	224	229	248	252	260	264	271
68	164	169	175	180	185	205	210	214	219	223	241	245	252	256	262
70	161	166	171	176	181	200	204	209	213	217	234	238	244	248	254
72	157	163	168	172	177	195	199	203	207	211	227	231	237	240	246
74	154	159	164	169	173	190	194	198	202	205	220	223	229	232	238
76	151	156	160	165	169	185	189	193	196	200	214	217	222	225	230
78	148	152	157	161	165	180	184	187	191	194	207	210	215	217	222
80	145	149	153	157	161	176	179	182	185	188	201	203	208	210	215
82	142	146	150	154	157	171	174	177	180	183	195	197	201	203	207
84	139	142	146	150	154	167	169	172	175	178	189	191	195	197	201
86	135	139	143	146	150	162	165	168	170	173	183	185	189	190	194
88	132	136	139	143	146	158	160	163	165	168	177	179	183	184	187
90	129	133	136	139	142	153	156	158	161	163	172	173	177	178	181
92	126	130	133	136	139	149	152	154	156	158	166	168	171	173	175
94	124	127	130	133	135	145	147	149	151	153	161	163	166	167	170
96	121	124	127	129	132	141	143	145	147	149	156	158	160	162	164
98	118	121	123	126	129	137	139	141	143	145	151	153	155	157	159
100	115	118	120	123	125	134	135	137	139	140	147	148	151	152	154
102	113	115	118	120	122	130	132	133	135	136	143	144	146	147	149
104	110	112	115	117	119	126	128	130	131	133	138	139	142	142	144
106	107	110	112	114	116	123	125	126	127	129	134	135	137	138	140
108	105	107	109	111	113	120	121	123	124	125	130	131	133	134	136

Note : For other steel grades, refer to Appendix 8.4.

Table 8.8(c) - Design strength p_c of compression members (cont'd)

i) S275 ~ S460 steel (cont'd)

6) Values of p_c in N/mm^2 with $\lambda \geq 110$ for strut curve c

λ	Steel grade and design strength p_y (N/mm^2)														
	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
110	102	104	106	108	110	116	118	119	120	122	126	127	129	130	132
112	100	102	104	106	107	113	115	116	117	118	123	124	125	126	128
114	98	100	101	103	105	110	112	113	114	115	119	120	122	123	124
116	95	97	99	101	102	108	109	110	111	112	116	117	118	119	120
118	93	95	97	98	100	105	106	107	108	109	113	114	115	116	117
120	91	93	94	96	97	102	103	104	105	106	110	110	112	112	113
122	89	90	92	93	95	99	100	101	102	103	107	107	109	109	110
124	87	88	90	91	92	97	98	99	100	100	104	104	106	106	107
126	85	86	88	89	90	94	95	96	97	98	101	102	103	103	104
128	83	84	86	87	88	92	93	94	95	95	98	99	100	100	101
130	81	82	84	85	86	90	91	91	92	93	96	96	97	98	99
135	77	78	79	80	81	84	85	86	87	87	90	90	91	92	92
140	72	74	75	76	76	79	80	81	81	82	84	85	85	86	87
145	69	70	71	71	72	75	76	76	77	77	79	80	80	81	81
150	65	66	67	68	68	71	71	72	72	73	75	75	76	76	76
155	62	63	63	64	65	67	67	68	68	69	70	71	71	72	72
160	59	59	60	61	61	63	64	64	65	65	66	67	67	67	68
165	56	56	57	58	58	60	60	61	61	61	63	63	64	64	64
170	53	54	54	55	55	57	57	58	58	58	60	60	60	60	61
175	51	51	52	52	53	54	54	55	55	55	56	57	57	57	58
180	48	49	49	50	50	51	52	52	52	53	54	54	54	54	55
185	46	46	47	47	48	49	49	50	50	50	51	51	52	52	52
190	44	44	45	45	45	47	47	47	47	48	49	49	49	49	49
195	42	42	43	43	43	45	45	45	45	45	46	46	47	47	47
200	40	41	41	41	42	43	43	43	43	43	44	44	45	45	45
210	37	37	38	38	38	39	39	39	40	40	40	40	41	41	41
220	34	34	35	35	35	36	36	36	36	36	37	37	37	37	38
230	31	32	32	32	32	33	33	33	33	34	34	34	34	34	35
240	29	29	30	30	30	30	31	31	31	31	31	31	32	32	32
250	27	27	27	28	28	28	28	28	29	29	29	29	29	29	29
260	25	25	26	26	26	26	26	26	27	27	27	27	27	27	27
270	23	24	24	24	24	24	25	25	25	25	25	25	25	25	25
280	22	22	22	22	22	23	23	23	23	23	23	24	24	24	24
290	21	21	21	21	21	21	21	22	22	22	22	22	22	22	22
300	19	19	20	20	20	20	20	20	20	20	21	21	21	21	21
310	18	18	18	19	19	19	19	19	19	19	19	19	19	19	20
320	17	17	17	17	18	18	18	18	18	18	18	18	18	18	18
330	16	16	16	16	17	17	17	17	17	17	17	17	17	17	17
340	15	15	15	16	16	16	16	16	16	16	16	16	16	16	16
350	15	15	15	15	15	15	15	15	15	15	15	15	15	15	15

Note : For other steel grades, refer to Appendix 8.4.

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[64] Addition of relevant steel grade S275 ~ S460 as subtitle of Table 8.8(c) (Cont'd) for buckling curve c.

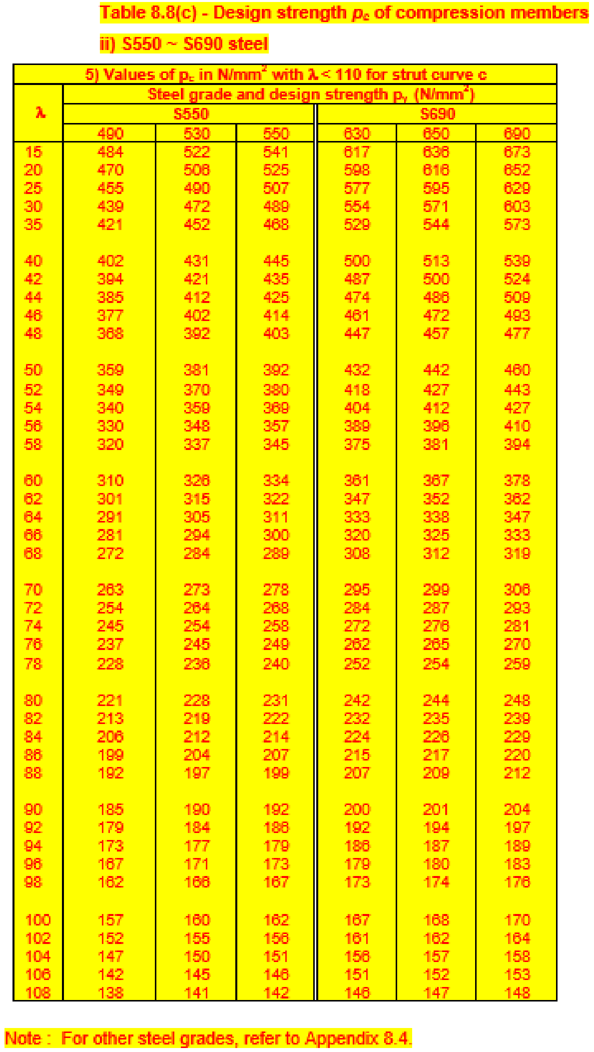
<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>65. Table 8.8(c)
(cont'd)[65]</td><td></td><td>


Table 8.8(c) - Design strength p_c of compression members

ii) S550 ~ S690 steel

<table>
<tr><th colspan="7">5) Values of p_c in N/mm^2 with $\lambda < 110$ for strut curve c</th></tr>
<tr><th rowspan="3">λ</th><th colspan="6">Steel grade and design strength p_y (N/mm^2)</th></tr>
<tr><th colspan="3">S550</th><th colspan="3">S690</th></tr>
<tr><th>490</th><th>530</th><th>550</th><th>630</th><th>650</th><th>690</th></tr>
<tr><td>15</td><td>484</td><td>522</td><td>541</td><td>617</td><td>636</td><td>673</td></tr>
<tr><td>20</td><td>470</td><td>506</td><td>525</td><td>598</td><td>616</td><td>652</td></tr>
<tr><td>25</td><td>455</td><td>490</td><td>507</td><td>577</td><td>595</td><td>629</td></tr>
<tr><td>30</td><td>439</td><td>472</td><td>489</td><td>554</td><td>571</td><td>603</td></tr>
<tr><td>35</td><td>421</td><td>452</td><td>468</td><td>529</td><td>544</td><td>573</td></tr>
<tr><td>40</td><td>402</td><td>431</td><td>445</td><td>500</td><td>513</td><td>539</td></tr>
<tr><td>42</td><td>394</td><td>421</td><td>435</td><td>487</td><td>500</td><td>524</td></tr>
<tr><td>44</td><td>385</td><td>412</td><td>425</td><td>474</td><td>486</td><td>509</td></tr>
<tr><td>46</td><td>377</td><td>402</td><td>414</td><td>461</td><td>472</td><td>493</td></tr>
<tr><td>48</td><td>368</td><td>392</td><td>403</td><td>447</td><td>457</td><td>477</td></tr>
<tr><td>50</td><td>359</td><td>381</td><td>392</td><td>432</td><td>442</td><td>460</td></tr>
<tr><td>52</td><td>349</td><td>370</td><td>380</td><td>418</td><td>427</td><td>443</td></tr>
<tr><td>54</td><td>340</td><td>359</td><td>369</td><td>404</td><td>412</td><td>427</td></tr>
<tr><td>56</td><td>330</td><td>348</td><td>357</td><td>389</td><td>396</td><td>410</td></tr>
<tr><td>58</td><td>320</td><td>337</td><td>345</td><td>375</td><td>381</td><td>394</td></tr>
<tr><td>60</td><td>310</td><td>326</td><td>334</td><td>361</td><td>367</td><td>378</td></tr>
<tr><td>62</td><td>301</td><td>315</td><td>322</td><td>347</td><td>352</td><td>362</td></tr>
<tr><td>64</td><td>291</td><td>305</td><td>311</td><td>333</td><td>338</td><td>347</td></tr>
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<tr><td>68</td><td>272</td><td>284</td><td>289</td><td>308</td><td>312</td><td>319</td></tr>
<tr><td>70</td><td>263</td><td>273</td><td>278</td><td>295</td><td>299</td><td>306</td></tr>
<tr><td>72</td><td>254</td><td>264</td><td>268</td><td>284</td><td>287</td><td>293</td></tr>
<tr><td>74</td><td>245</td><td>254</td><td>258</td><td>272</td><td>276</td><td>281</td></tr>
<tr><td>76</td><td>237</td><td>245</td><td>249</td><td>262</td><td>265</td><td>270</td></tr>
<tr><td>78</td><td>228</td><td>236</td><td>240</td><td>252</td><td>254</td><td>259</td></tr>
<tr><td>80</td><td>221</td><td>228</td><td>231</td><td>242</td><td>244</td><td>248</td></tr>
<tr><td>82</td><td>213</td><td>219</td><td>222</td><td>232</td><td>235</td><td>239</td></tr>
<tr><td>84</td><td>206</td><td>212</td><td>214</td><td>224</td><td>226</td><td>229</td></tr>
<tr><td>86</td><td>199</td><td>204</td><td>207</td><td>215</td><td>217</td><td>220</td></tr>
<tr><td>88</td><td>192</td><td>197</td><td>199</td><td>207</td><td>209</td><td>212</td></tr>
<tr><td>90</td><td>185</td><td>190</td><td>192</td><td>200</td><td>201</td><td>204</td></tr>
<tr><td>92</td><td>179</td><td>184</td><td>186</td><td>192</td><td>194</td><td>197</td></tr>
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Note : For other steel grades, refer to Appendix 8.4.
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[65] Addition of design strength for S550 and S690 steel for buckling curve c.

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<td>66. Table 8.8(c)
(cont'd)[66]</td>
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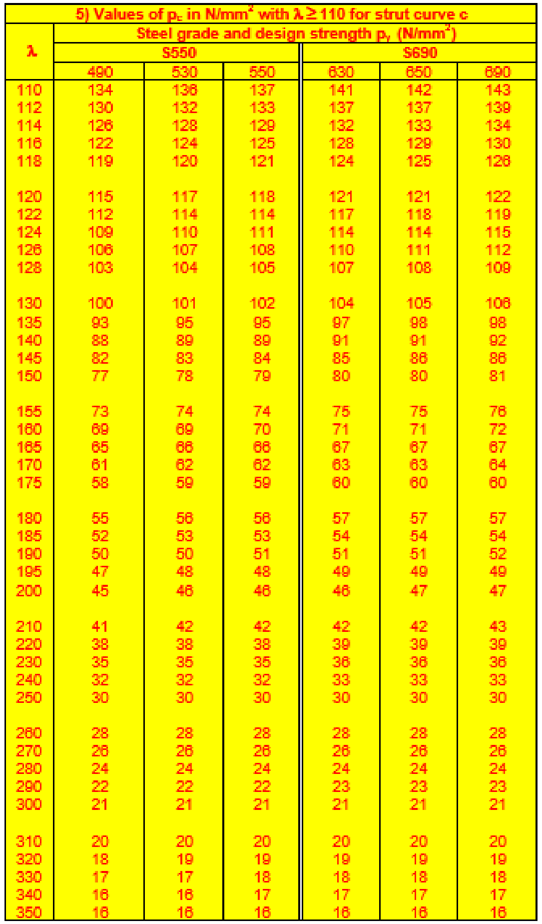
Table 8.8(c) - Design strength p_c of compression members (cont'd)
ii) S550 ~ S690 steel (cont'd)

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<tr><th colspan="7">5) Values of p_c in N/mm^2 with $\lambda \geq 110$ for strut curve c</th></tr>
<tr><th rowspan="3">λ</th><th colspan="6">Steel grade and design strength p_y (N/mm^2)</th></tr>
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<tr><th>490</th><th>530</th><th>550</th><th>630</th><th>650</th><th>690</th></tr>
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</table>
Note : For other steel grades, refer to Appendix 8.4.
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[66] Addition of design strength for S550 and S690 steel for buckling curve c.

Item

Current version

Amendments

67. Table 8.8(d)[67]

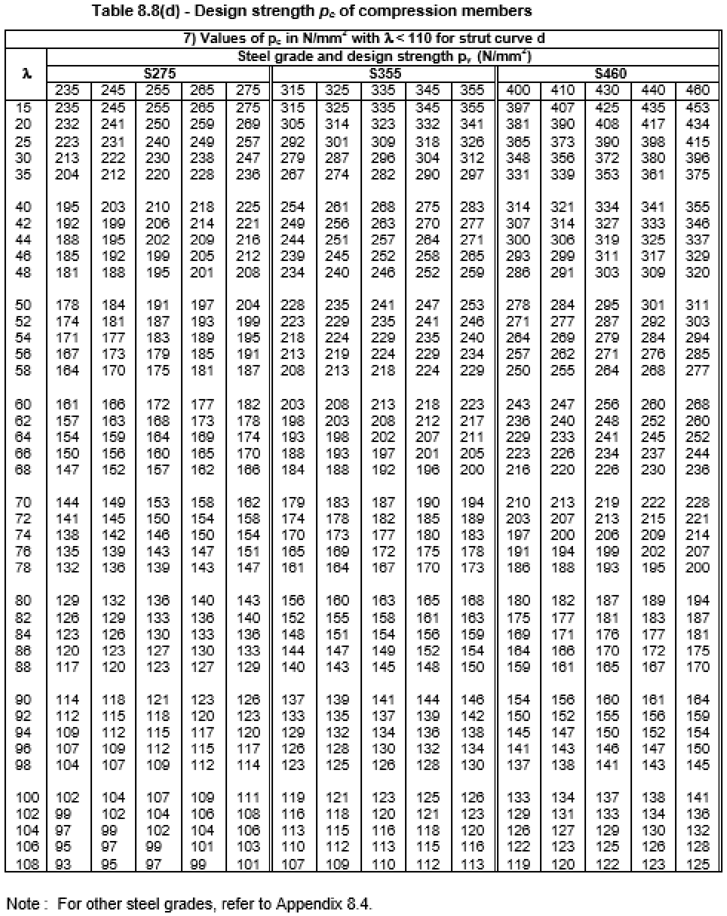

Table 8.8(d) - Design strength p_c of compression members

7) Values of p_c in N/mm^2 with $\lambda < 110$ for strut curve d

Steel grade and design strength p_y (N/mm^2)

λ	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
15	235	245	255	265	275	315	325	335	345	355	397	407	425	435	453
20	232	241	250	259	269	305	314	323	332	341	381	390	408	417	434
25	223	231	240	249	257	292	301	309	318	326	365	373	390	398	415
30	213	222	230	238	247	279	287	296	304	312	348	356	372	380	396
35	204	212	220	228	236	267	274	282	290	297	331	339	353	361	375
40	195	203	210	218	225	254	261	268	275	283	314	321	334	341	355
42	192	199	206	214	221	249	256	263	270	277	307	314	327	333	346
44	188	195	202	209	216	244	251	257	264	271	300	306	319	325	337
46	185	192	199	205	212	239	245	252	258	265	293	299	311	317	329
48	181	188	195	201	208	234	240	246	252	259	286	291	303	309	320
50	178	184	191	197	204	228	235	241	247	253	278	284	295	301	311
52	174	181	187	193	199	223	229	235	241	246	271	277	287	292	303
54	171	177	183	189	195	218	224	229	235	240	264	269	279	284	294
56	167	173	179	185	191	213	219	224	229	234	257	262	271	276	285
58	164	170	175	181	187	208	213	218	224	229	250	255	264	268	277
60	161	166	172	177	182	203	208	213	218	223	243	247	256	260	268
62	157	163	168	173	178	198	203	208	212	217	236	240	248	252	260
64	154	159	164	169	174	193	198	202	207	211	229	233	241	245	252
66	150	156	160	165	170	188	193	197	201	205	223	226	234	237	244
68	147	152	157	162	166	184	188	192	196	200	216	220	226	230	236
70	144	149	153	158	162	179	183	187	190	194	210	213	219	222	228
72	141	145	150	154	158	174	178	182	185	189	203	207	213	215	221
74	138	142	146	150	154	170	173	177	180	183	197	200	206	209	214
76	135	139	143	147	151	165	169	172	175	178	191	194	199	202	207
78	132	136	139	143	147	161	164	167	170	173	186	188	193	195	200
80	129	132	136	140	143	156	160	163	165	168	180	182	187	189	194
82	126	129	133	136	140	152	155	158	161	163	175	177	181	183	187
84	123	126	130	133	136	148	151	154	156	159	169	171	176	177	181
86	120	123	127	130	133	144	147	149	152	154	164	166	170	172	175
88	117	120	123	127	129	140	143	145	148	150	159	161	165	167	170
90	114	118	121	123	126	137	139	141	144	146	154	156	160	161	164
92	112	115	118	120	123	133	135	137	139	142	150	152	155	156	159
94	109	112	115	117	120	129	132	134	136	138	145	147	150	152	154
96	107	109	112	115	117	126	128	130	132	134	141	143	146	147	150
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100	102	104	107	109	111	119	121	123	125	126	133	134	137	138	141
102	99	102	104	106	108	116	118	120	121	123	129	131	133	134	136
104	97	99	102	104	106	113	115	116	118	120	126	127	129	130	132
106	95	97	99	101	103	110	112	113	115	116	122	123	125	126	128
108	93	95	97	99	101	107	109	110	112	113	119	120	122	123	125

Note : For other steel grades, refer to Appendix 8.4.

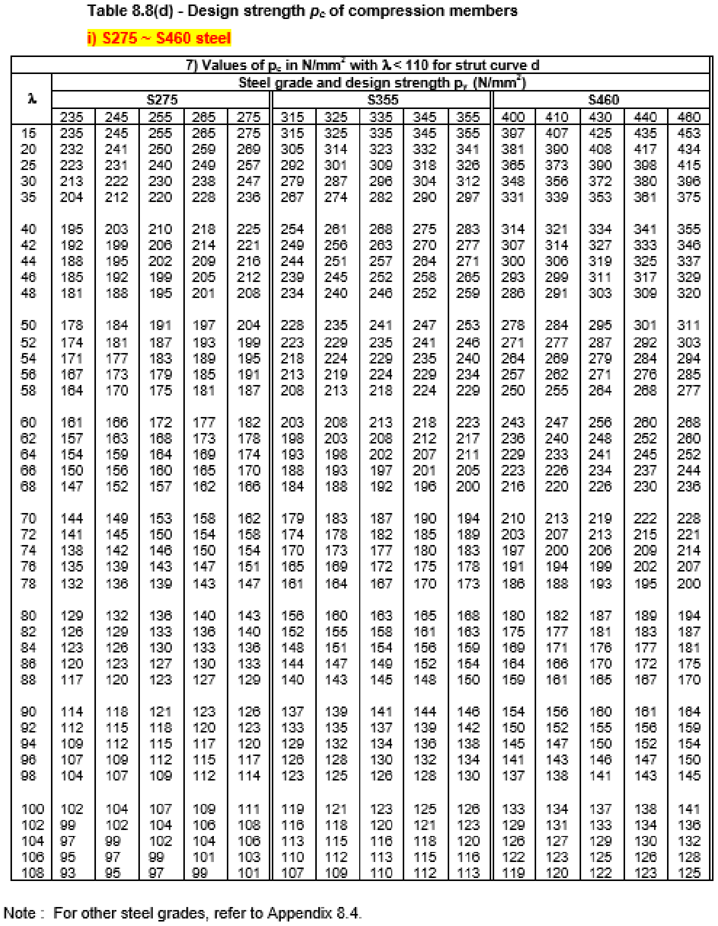

Table 8.8(d) - Design strength p_c of compression members

i) S275 ~ S460 steel

7) Values of p_c in N/mm^2 with $\lambda < 110$ for strut curve d

Steel grade and design strength p_y (N/mm^2)

λ	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
15	235	245	255	265	275	315	325	335	345	355	397	407	425	435	453
20	232	241	250	259	269	305	314	323	332	341	381	390	408	417	434
25	223	231	240	249	257	292	301	309	318	326	365	373	390	398	415
30	213	222	230	238	247	279	287	296	304	312	348	356	372	380	396
35	204	212	220	228	236	267	274	282	290	297	331	339	353	361	375
40	195	203	210	218	225	254	261	268	275	283	314	321	334	341	355
42	192	199	206	214	221	249	256	263	270	277	307	314	327	333	346
44	188	195	202	209	216	244	251	257	264	271	300	306	319	325	337
46	185	192	199	205	212	239	245	252	258	265	293	299	311	317	329
48	181	188	195	201	208	234	240	246	252	259	286	291	303	309	320
50	178	184	191	197	204	228	235	241	247	253	278	284	295	301	311
52	174	181	187	193	199	223	229	235	241	246	271	277	287	292	303
54	171	177	183	189	195	218	224	229	235	240	264	269	279	284	294
56	167	173	179	185	191	213	219	224	229	234	257	262	271	276	285
58	164	170	175	181	187	208	213	218	224	229	250	255	264	268	277
60	161	166	172	177	182	203	208	213	218	223	243	247	256	260	268
62	157	163	168	173	178	198	203	208	212	217	236	240	248	252	260
64	154	159	164	169	174	193	198	202	207	211	229	233	241	245	252
66	150	156	160	165	170	188	193	197	201	205	223	226	234	237	244
68	147	152	157	162	166	184	188	192	196	200	216	220	226	230	236
70	144	149	153	158	162	179	183	187	190	194	210	213	219	222	228
72	141	145	150	154	158	174	178	182	185	189	203	207	213	215	221
74	138	142	146	150	154	170	173	177	180	183	197	200	206	209	214
76	135	139	143	147	151	165	169	172	175	178	191	194	199	202	207
78	132	136	139	143	147	161	164	167	170	173	186	188	193	195	200
80	129	132	136	140	143	156	160	163	165	168	180	182	187	189	194
82	126	129	133	136	140	152	155	158	161	163	175	177	181	183	187
84	123	126	130	133	136	148	151	154	156	159	169	171	176	177	181
86	120	123	127	130	133	144	147	149	152	154	164	166	170	172	175
88	117	120	123	127	129	140	143	145	148	150	159	161	165	167	170
90	114	118	121	123	126	137	139	141	144	146	154	156	160	161	164
92	112	115	118	120	123	133	135	137	139	142	150	152	155	156	159
94	109	112	115	117	120	129	132	134	136	138	145	147	150	152	154
96	107	109	112	115	117	126	128	130	132	134	141	143	146	147	150
98	104	107	109	112	114	123	125	126	128	130	137	138	141	143	145
100	102	104	107	109	111	119	121	123	125	126	133	134	137	138	141
102	99	102	104	106	108	116	118	120	121	123	129	131	133	134	136
104	97	99	102	104	106	113	115	116	118	120	126	127	129	130	132
106	95	97	99	101	103	110	112	113	115	116	122	123	125	126	128
108	93	95	97	99	101	107	109	110	112	113	119	120	122	123	125

Note : For other steel grades, refer to Appendix 8.4.

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[67] Addition of relevant steel grade S275 ~ S460 as subtitle of Table 8.8(d) for buckling curve d.

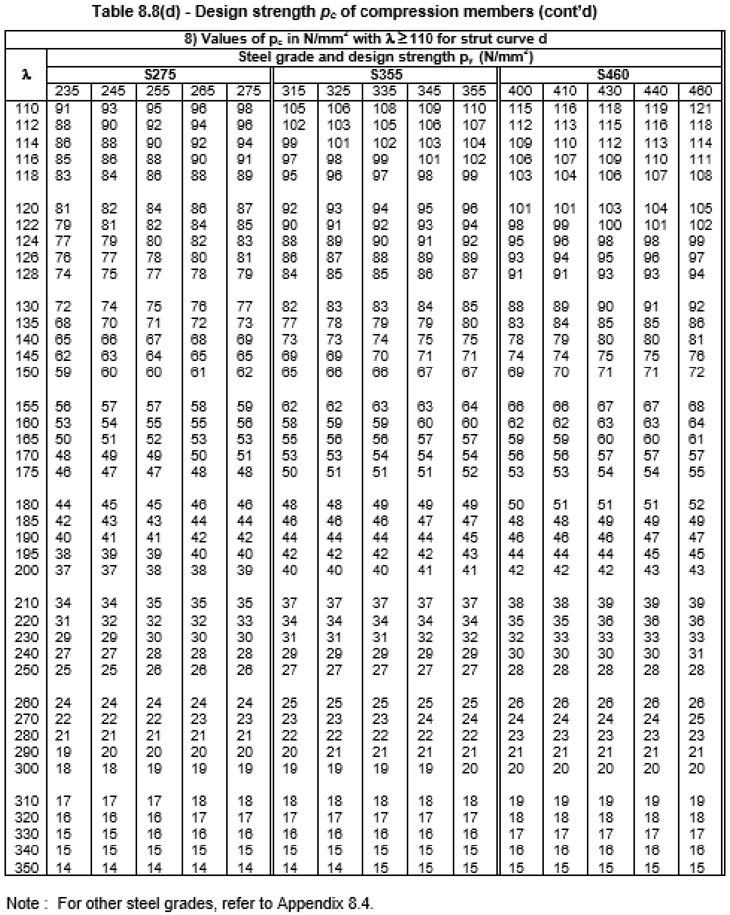
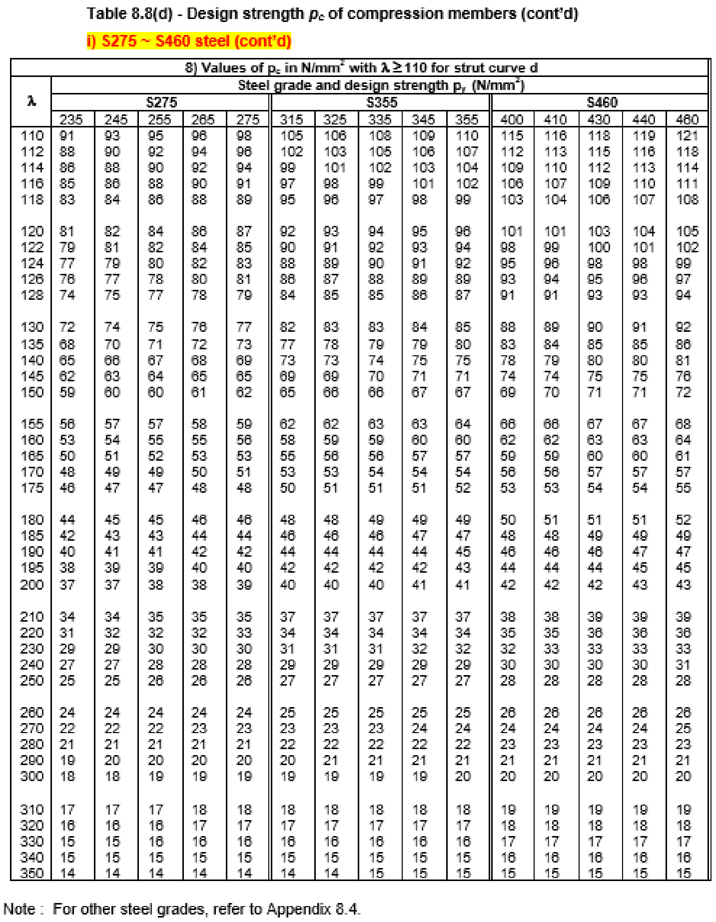
Item	Current version	Amendments
68. Table 8.8(d) (cont)[68]		

Table 8.8(d) - Design strength p_c of compression members (cont'd)

8) Values of p_c in N/mm² with $\lambda \geq 110$ for strut curve d

Steel grade and design strength p_y (N/mm²)

λ	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
110	91	93	95	96	98	105	106	108	109	110	115	116	118	119	121
112	88	90	92	94	96	102	103	105	106	107	112	113	115	116	118
114	86	88	90	92	94	99	101	102	103	104	109	110	112	113	114
116	85	86	88	90	91	97	98	99	101	102	106	107	109	110	111
118	83	84	86	88	89	95	96	97	98	99	103	104	106	107	108
120	81	82	84	86	87	92	93	94	95	96	101	101	103	104	105
122	79	81	82	84	85	90	91	92	93	94	98	99	100	101	102
124	77	79	80	82	83	88	89	90	91	92	95	96	98	98	99
126	76	77	78	80	81	86	87	88	89	89	93	94	95	96	97
128	74	75	77	78	79	84	85	85	86	87	91	91	93	93	94
130	72	74	75	76	77	82	83	83	84	85	88	89	90	91	92
135	68	70	71	72	73	77	78	79	79	80	83	84	85	85	86
140	65	66	67	68	69	73	73	74	75	75	78	79	80	80	81
145	62	63	64	65	65	69	69	70	71	71	74	74	75	75	76
150	59	60	60	61	62	65	66	66	67	67	69	70	71	71	72
155	56	57	57	58	59	62	62	63	63	64	66	66	67	67	68
160	53	54	55	55	56	58	59	59	60	60	62	62	63	63	64
165	50	51	52	53	53	55	56	56	57	57	59	59	60	60	61
170	48	49	49	50	51	53	53	54	54	54	56	56	57	57	57
175	46	47	47	48	48	50	51	51	51	52	53	53	54	54	55
180	44	45	45	46	46	48	48	49	49	49	50	51	51	51	52
185	42	43	43	44	44	46	46	46	47	47	48	48	49	49	49
190	40	41	41	42	42	44	44	44	44	45	46	46	46	47	47
195	38	39	39	40	40	42	42	42	42	43	44	44	44	45	45
200	37	37	38	38	39	40	40	40	41	41	42	42	42	43	43
210	34	34	35	35	35	37	37	37	37	37	38	38	39	39	39
220	31	32	32	32	33	34	34	34	34	34	35	35	36	36	36
230	29	29	30	30	30	31	31	31	32	32	32	33	33	33	33
240	27	27	28	28	28	29	29	29	29	29	30	30	30	30	31
250	25	25	26	26	26	27	27	27	27	27	28	28	28	28	28
260	24	24	24	24	24	25	25	25	25	25	26	26	26	26	26
270	22	22	22	23	23	23	23	23	24	24	24	24	24	24	25
280	21	21	21	21	21	22	22	22	22	22	23	23	23	23	23
290	19	20	20	20	20	20	21	21	21	21	21	21	21	21	21
300	18	18	19	19	19	19	19	19	19	20	20	20	20	20	20
310	17	17	17	18	18	18	18	18	18	18	19	19	19	19	19
320	16	16	16	17	17	17	17	17	17	17	18	18	18	18	18
330	15	15	16	16	16	16	16	16	16	16	17	17	17	17	17
340	15	15	15	15	15	15	15	15	15	15	16	16	16	16	16
350	14	14	14	14	14	14	14	15	15	15	15	15	15	15	15

Note : For other steel grades, refer to Appendix 8.4.

Table 8.8(d) - Design strength p_c of compression members (cont'd)

i) S275 ~ S460 steel (cont'd)

8) Values of p_c in N/mm² with $\lambda \geq 110$ for strut curve d

Steel grade and design strength p_y (N/mm²)

λ	S275					S355					S460				
	235	245	255	265	275	315	325	335	345	355	400	410	430	440	460
110	91	93	95	96	98	105	106	108	109	110	115	116	118	119	121
112	88	90	92	94	96	102	103	105	106	107	112	113	115	116	118
114	86	88	90	92	94	99	101	102	103	104	109	110	112	113	114
116	85	86	88	90	91	97	98	99	101	102	106	107	109	110	111
118	83	84	86	88	89	95	96	97	98	99	103	104	106	107	108
120	81	82	84	86	87	92	93	94	95	96	101	101	103	104	105
122	79	81	82	84	85	90	91	92	93	94	98	99	100	101	102
124	77	79	80	82	83	88	89	90	91	92	95	96	98	98	99
126	76	77	78	80	81	86	87	88	89	89	93	94	95	96	97
128	74	75	77	78	79	84	85	85	86	87	91	91	93	93	94
130	72	74	75	76	77	82	83	83	84	85	88	89	90	91	92
135	68	70	71	72	73	77	78	79	79	80	83	84	85	85	86
140	65	66	67	68	69	73	73	74	75	75	78	79	80	80	81
145	62	63	64	65	65	69	69	70	71	71	74	74	75	75	76
150	59	60	60	61	62	65	66	66	67	67	69	70	71	71	72
155	56	57	57	58	59	62	62	63	63	64	66	66	67	67	68
160	53	54	55	55	56	58	59	59	60	60	62	62	63	63	64
165	50	51	52	53	53	55	56	56	57	57	59	59	60	60	61
170	48	49	49	50	51	53	53	54	54	54	56	56	57	57	57
175	46	47	47	48	48	50	51	51	51	52	53	53	54	54	55
180	44	45	45	46	46	48	48	49	49	49	50	51	51	51	52
185	42	43	43	44	44	46	46	46	47	47	48	48	49	49	49
190	40	41	41	42	42	44	44	44	44	45	46	46	46	47	47
195	38	39	39	40	40	42	42	42	42	43	44	44	44	45	45
200	37	37	38	38	39	40	40	40	41	41	42	42	42	43	43
210	34	34	35	35	35	37	37	37	37	37	38	38	39	39	39
220	31	32	32	32	33	34	34	34	34	34	35	35	36	36	36
230	29	29	30	30	30	31	31	31	32	32	32	33	33	33	33
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250	25	25	26	26	26	27	27	27	27	27	28	28	28	28	28
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270	22	22	22	23	23	23	23	23	24	24	24	24	24	24	25
280	21	21	21	21	21	22	22	22	22	22	23	23	23	23	23
290	19	20	20	20	20	20	21	21	21	21	21	21	21	21	21
300	18	18	19	19	19	19	19	19	19	20	20	20	20	20	20
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340	15	15	15	15	15	15	15	15	15	15	16	16	16	16	16
350	14	14	14	14	14	14	14	15	15	15	15	15	15	15	15

Note : For other steel grades, refer to Appendix 8.4.

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[68] Addition of relevant steel grade S275 ~ S460 as subtitle of Table 8.8(d) (Cont'd) for buckling curve d.

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(cont)[69]</td>
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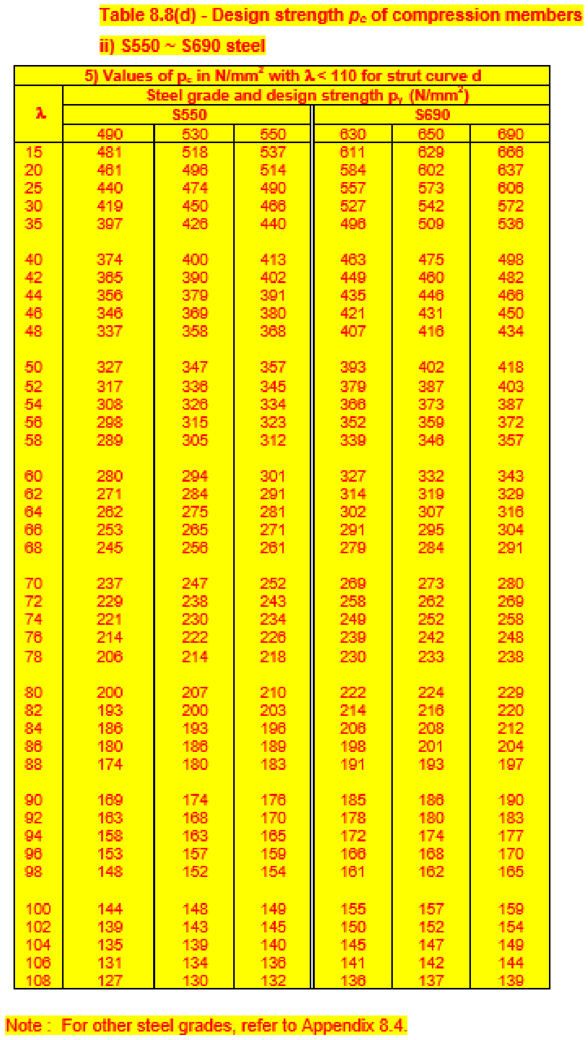

Table 8.8(d) - Design strength p_c of compression members

ii) S550 ~ S690 steel

<table>
<tr><th colspan="7">5) Values of p_c in N/mm^2 with λ < 110 for strut curve d</th></tr>
<tr><th rowspan="3">λ</th><th colspan="6">Steel grade and design strength p_y (N/mm^2)</th></tr>
<tr><th colspan="3">S550</th><th colspan="3">S690</th></tr>
<tr><th>490</th><th>530</th><th>550</th><th>630</th><th>650</th><th>690</th></tr>
<tr><td>15</td><td>481</td><td>518</td><td>537</td><td>611</td><td>629</td><td>666</td></tr>
<tr><td>20</td><td>461</td><td>496</td><td>514</td><td>584</td><td>602</td><td>637</td></tr>
<tr><td>25</td><td>440</td><td>474</td><td>490</td><td>557</td><td>573</td><td>606</td></tr>
<tr><td>30</td><td>419</td><td>450</td><td>466</td><td>527</td><td>542</td><td>572</td></tr>
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Note : For other steel grades, refer to Appendix 8.4.
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[69] Addition of design strength for S550 and S690 steel for buckling curve d.

Item	Current version	Amendments
70. Table 8.8(d) (cont)[70]		

Table 8.8(d) - Design strength p_c of compression members (cont'd)

ii) S550 ~ S690 steel (cont'd)

5) Values of p_c in N/mm^2 with $\lambda \geq 110$ for strut curve d						
λ	Steel grade and design strength p_y (N/mm^2)					
	S550			S690		
	490	530	550	630	650	690
110	123	126	128	132	133	135
112	120	123	124	128	129	131
114	116	119	120	124	125	127
116	113	116	117	121	121	123
118	110	112	113	117	118	119
120	107	109	110	114	114	116
122	104	106	107	110	111	112
124	101	103	104	107	108	109
126	98	100	101	104	105	106
128	96	98	99	101	102	103
130	93	95	96	99	99	100
135	87	89	90	92	93	94
140	82	84	84	86	87	88
145	77	78	79	81	81	82
150	73	74	74	76	77	77
155	69	70	70	72	72	73
160	65	66	66	68	68	69
165	61	62	63	64	64	65
170	58	59	59	61	61	61
175	55	56	56	57	58	58
180	52	53	53	54	55	55
185	50	51	51	52	52	52
190	48	48	48	49	49	50
195	45	46	46	47	47	47
200	43	44	44	45	45	45
210	40	40	40	41	41	41
220	36	37	37	37	38	38
230	33	34	34	34	34	35
240	31	31	31	32	32	32
250	29	29	29	29	29	30
260	27	27	27	27	27	27
270	25	25	25	25	25	26
280	23	23	23	24	24	24
290	22	22	22	22	22	22
300	20	20	20	21	21	21
310	19	19	19	19	19	20
320	18	18	18	18	18	18
330	17	17	17	17	17	17
340	16	16	16	16	16	16
350	15	15	15	15	15	15

Note : For other steel grades, refer to Appendix 8.4.

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[70] Addition of design strength for S550 and S690 steel for buckling curve d.

Item	Current version	Amendments
71. Table 8.8(e)[71]	see below	see below

Current version

Table 8.8(e) - Design strength p_c of compression members

Values of p_c in N/mm² with λ < 110 for strut curve a				
λ	Steel grade and design strength (N/mm²)			
	Q235	Q345	Q390	Q420
	215	310	350	380
15	215	310	350	379
20	214	307	346	375
25	212	304	342	371
30	210	300	338	366
35	207	296	333	361
40	204	291	328	354
42	203	289	325	352
44	202	287	323	349
46	201	285	320	345
48	200	283	317	342
50	198	280	314	338
52	197	278	310	334
54	196	275	307	330
56	194	272	303	325
58	193	269	299	320
60	191	265	294	314
62	189	262	289	309
64	187	258	284	302
66	186	254	279	296
68	184	249	273	289
70	182	245	267	281
72	179	240	260	274
74	177	235	254	266
76	175	229	247	258
78	172	224	240	250
80	170	218	233	242
82	167	213	226	235
84	164	207	219	227
86	162	202	213	219
88	159	196	206	212
90	156	190	199	205
92	153	185	193	198
94	150	179	187	191
96	146	174	181	185
98	143	169	175	179
100	140	164	169	173
102	137	159	164	167
104	134	154	159	162
106	131	149	154	156
108	128	145	149	151

Values of p_c in N/mm² with $\lambda \geq$ 110 for strut curve a				
λ	Steel grade and design strength (N/mm²)			
	Q235	Q345	Q390	Q420
	215	310	350	380
110	125	141	144	147
112	122	136	140	142
114	119	132	136	138
116	116	128	132	133
118	113	125	128	129
120	110	121	124	125
122	107	118	120	122
124	105	114	117	118
126	102	111	113	115
128	100	108	110	111
130	97	105	107	108
135	91	98	100	101
140	86	92	93	94
145	81	86	87	88
150	76	81	82	83
155	72	76	77	78
160	68	72	73	73
165	64	68	68	69
170	61	64	65	65
175	58	60	61	61
180	55	57	58	58
185	52	54	55	55
190	50	52	52	52
195	47	49	50	50
200	45	47	47	47
210	41	43	43	43
220	38	39	39	39
230	35	36	36	36
240	32	33	33	33
250	29	30	30	31
260	27	28	28	28
270	25	26	26	26
280	24	24	24	24
290	22	23	23	23
300	21	21	21	21
310	19	20	20	20
320	18	18	19	19
330	17	17	17	17
340	16	16	16	16
350	15	15	15	16

Note : For other steel grades, refer to Appendix 8.4.

Amendments

Table 8.8(e) - Design strength p_c of compression members

Values of p_c in N/mm² with λ < 110 for strut curve a					
λ	Steel grade and design strength (N/mm²)				
	Q235	Q345/Q355	Q390	Q420	Q460
	215	305	345	375	410
15	215	305	345	375	409
20	215	303	342	371	405
25	212	299	338	366	400
30	210	296	333	362	395
35	208	292	329	357	389
40	205	287	324	350	382
42	204	285	321	348	378
44	203	283	319	345	375
46	201	281	316	342	371
48	200	279	313	338	367
50	199	277	310	335	363
52	198	274	307	331	358
54	196	271	303	327	353
56	195	268	300	322	347
58	193	265	295	317	341
60	191	262	291	312	334
62	190	259	286	306	327
64	188	255	281	300	320
66	186	251	276	293	312
68	184	247	270	287	303
70	182	242	265	279	295
72	180	237	258	272	286
74	178	233	252	265	277
76	175	227	245	257	268
78	173	222	239	249	259
80	170	217	232	241	251
82	168	211	225	234	242
84	165	206	219	226	234
86	162	200	212	219	225
88	159	195	205	212	218
90	156	189	199	205	210
92	153	184	193	198	203
94	150	179	187	191	196
96	147	173	181	185	189
98	144	168	175	179	182
100	141	163	169	173	176
102	137	158	164	167	170
104	134	154	159	162	165
106	131	149	154	157	159
108	128	145	149	152	154

Note : For other steel grades, refer to Appendix 8.4.

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[71] Addition of design strength for Q355 and Q460 steel for buckling curve a; Revision of design strength for Q235, Q345, Q390 and Q420 steel for buckling curve a.

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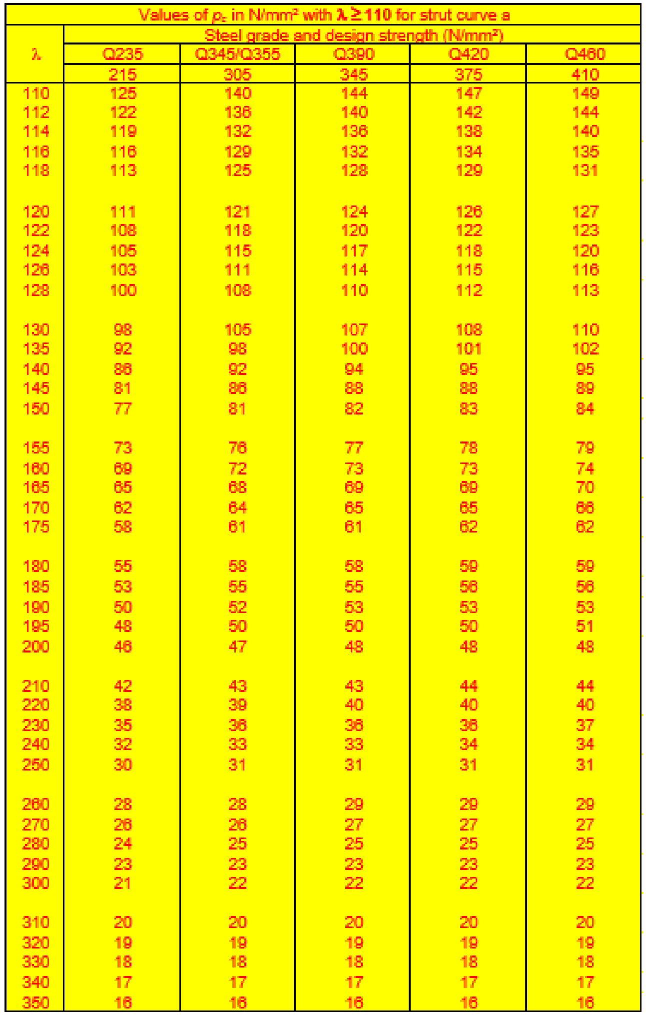
Table 8.8(e) - Design strength p_c of compression members (cont'd)



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<tr><th rowspan="3">λ</th><th colspan="5">Steel grade and design strength (N/mm²)</th></tr>
<tr><th>Q235</th><th>Q345/Q355</th><th>Q390</th><th>Q420</th><th>Q460</th></tr>
<tr><th>215</th><th>305</th><th>345</th><th>375</th><th>410</th></tr>
<tr><td>110</td><td>125</td><td>140</td><td>144</td><td>147</td><td>149</td></tr>
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Note : For other steel grades, refer to Appendix 8.4.

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Item	Current version	Amendments
72. Table 8.8(f)[72]		

Table 8.8(f) - Design strength p_c of compression members

Values of p_c in N/mm^2 with λ < 110 for strut curve b				
λ	Steel grade and design strength (N/mm^2)			
	Q235	Q345	Q390	Q420
	215	310	350	380
15	215	310	350	379
20	214	305	343	372
25	210	299	337	365
30	206	293	329	357
35	202	287	322	348
40	198	279	313	338
42	196	276	310	334
44	194	273	306	330
46	192	270	302	325
48	190	267	298	320
50	188	263	293	315
52	186	260	289	310
54	184	256	284	304
56	182	252	279	299
58	180	248	274	293
60	177	243	269	286
62	175	239	263	280
64	173	234	257	273
66	170	230	252	267
68	168	225	246	260
70	165	220	240	253
72	163	215	233	246
74	160	210	227	239
76	157	205	221	232
78	155	200	215	225
80	152	195	209	218
82	149	190	203	211
84	146	185	197	205
86	144	180	191	198
88	141	175	185	192
90	138	170	180	186
92	135	165	174	180
94	132	161	169	174
96	129	156	164	169
98	127	152	159	163
100	124	148	154	158
102	121	143	150	153
104	118	139	145	149
106	116	135	141	144
108	113	132	137	140

Values of p_c in N/mm^2 with λ ≥ 110 for strut curve b				
λ	Steel grade and design strength (N/mm^2)			
	Q235	Q345	Q390	Q420
	215	310	350	380
110	110	128	133	136
112	108	124	129	132
114	105	121	125	128
116	103	118	121	124
118	100	114	118	120
120	98	111	115	117
122	96	108	112	114
124	94	105	108	110
126	91	103	105	107
128	89	100	103	104
130	87	97	100	101
135	82	91	93	95
140	78	86	88	89
145	74	80	82	83
150	70	76	77	78
155	66	71	73	74
160	62	67	69	69
165	59	64	65	66
170	56	60	61	62
175	53	57	58	59
180	51	54	55	56
185	49	52	52	53
190	46	49	50	50
195	44	47	47	48
200	42	45	45	46
210	39	41	41	41
220	35	37	38	38
230	33	34	35	35
240	30	31	32	32
250	28	29	29	30
260	26	27	27	27
270	24	25	25	25
280	22	23	24	24
290	21	22	22	22
300	20	20	21	21
310	18	19	19	19
320	17	18	18	18
330	16	17	17	17
340	15	16	16	16
350	15	15	15	15

Note : For other steel grades, refer to Appendix 8.4.

Table 8.8(f) - Design strength p_c of compression members

Values of p_c in N/mm^2 with λ < 110 for strut curve b							
λ	Steel grade and design strength (N/mm^2)						
	Q235	Q345/Q355	Q390	Q420	Q460	Q550	Q690
	215	305	345	375	410	520	630
15	215	305	345	375	409	515	621
20	215	301	339	368	401	505	609
25	211	295	332	360	393	494	595
30	207	289	325	353	384	482	579
35	202	283	318	344	374	468	560
40	198	276	310	335	364	452	537
42	196	273	306	331	359	445	526
44	194	270	302	326	354	437	514
46	193	267	298	322	349	429	502
48	191	263	294	317	343	420	489
50	189	260	290	312	337	411	475
52	187	256	286	307	331	401	460
54	185	253	281	302	325	390	445
56	182	249	276	296	318	380	429
58	180	245	271	290	311	368	414
60	178	241	266	284	304	357	398
62	176	236	261	278	296	346	382
64	173	232	255	271	289	334	367
66	171	227	249	265	281	322	352
68	168	223	244	258	273	311	337
70	166	218	238	251	265	300	323
72	163	213	232	244	257	289	310
74	161	208	226	237	249	278	297
76	158	204	220	230	241	268	285
78	155	199	214	224	234	258	273
80	153	194	208	217	226	248	262
82	150	189	202	210	219	239	251
84	147	184	196	204	212	230	241
86	144	179	190	198	205	221	232
88	141	174	185	191	198	213	223
90	138	169	179	185	192	206	214
92	136	165	174	180	185	198	206
94	133	160	169	174	179	191	199
96	130	156	164	169	173	184	191
98	127	151	159	163	168	178	184
100	124	147	154	158	162	172	178
102	121	143	149	153	157	166	171
104	119	139	145	149	152	160	165
106	116	135	141	144	148	155	160
108	113	131	137	140	143	150	154

Note : For other steel grades, refer to Appendix 8.4.

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[72] Addition of design strength for Q355, Q460, Q550 and Q690 steel for buckling curve b; Revision of design strength for Q235, Q345, Q390 and Q420 steel for buckling curve b.

Item	**Current version**	**Amendments**

Table 8.8(f) - Design strength p_c of compression members (cont'd)

Values of p_c in N/mm² with $\lambda \geq 110$ for strut curve b							
λ	Steel grade and design strength (N/mm²)						
	Q235	Q345/Q355	Q390	Q420	Q460	Q550	Q690
	215	305	345	375	410	520	630
110	111	128	133	136	139	145	149
112	108	124	129	132	134	140	144
114	106	121	125	128	130	136	140
116	103	117	122	124	126	132	135
118	101	114	118	120	123	128	131
120	99	111	115	117	119	124	127
122	96	108	112	114	116	120	123
124	94	105	109	111	112	117	119
126	92	103	106	107	109	113	116
128	90	100	103	105	106	110	113
130	88	97	100	102	103	107	109
135	83	91	94	95	97	100	102
140	78	86	88	89	90	93	95
145	74	81	83	84	85	87	89
150	70	76	78	79	80	82	83
155	66	72	73	74	75	77	78
160	63	68	69	70	71	72	74
165	60	64	65	66	67	68	69
170	57	61	62	62	63	65	65
175	54	58	59	59	60	61	62
180	51	55	56	56	57	58	59
185	49	52	53	53	54	55	56
190	47	49	50	51	51	52	53
195	45	47	48	48	49	50	50
200	43	45	46	46	46	47	48
210	39	41	42	42	42	43	44
220	36	38	38	38	39	39	40
230	33	35	35	35	36	36	36
240	31	32	32	32	33	33	34
250	28	30	30	30	30	31	31
260	26	27	28	28	28	28	29
270	25	26	26	26	26	26	27
280	23	24	24	24	24	25	25
290	22	22	22	23	23	23	23
300	20	21	21	21	21	23	23
310	19	20	20	20	20	20	20
320	18	18	19	19	19	19	19
330	17	17	17	18	18	18	18
340	16	16	17	17	17	17	17
350	15	16	16	16	16	16	16

Note : For other steel grades, refer to Appendix 8.4.

Item	Current version	Amendments
73. Table 8.8(g)[73]		

Table 8.8(g) - Design strength p_c of compression members

Values of p_c in N/mm^2 with λ < 110 for strut curve c				
λ	Steel grade and design strength (N/mm^2)			
	Q235	Q345	Q390	Q420
	215	310	350	380
15	215	310	350	379
20	214	303	340	368
25	208	294	330	357
30	202	285	319	345
35	195	275	308	333
40	189	265	297	320
42	187	261	292	314
44	184	257	287	309
46	182	253	282	303
48	179	249	277	297
50	176	244	271	291
52	174	240	266	285
54	171	235	260	278
56	168	231	255	272
58	166	226	249	266
60	163	221	243	259
62	160	216	238	252
64	158	212	232	246
66	155	207	226	239
68	152	202	220	233
70	149	197	214	226
72	146	192	209	220
74	144	188	203	213
76	141	183	197	207
78	138	178	192	201
80	135	174	186	195
82	132	169	181	189
84	130	164	176	183
86	127	160	171	178
88	124	156	166	173
90	122	152	161	167
92	119	147	156	162
94	116	143	152	157
96	114	140	148	153
98	111	136	143	148
100	109	132	139	144
102	106	129	135	139
104	104	125	131	135
106	102	122	128	131
108	99	118	124	128

Values of p_c in N/mm^2 with λ ≥ 110 for strut curve c				
λ	Steel grade and design strength (N/mm^2)			
	Q235	Q345	Q390	Q420
	215	310	350	380
110	97	115	121	124
112	95	112	117	120
114	93	109	114	117
116	91	106	111	114
118	89	104	108	111
120	87	101	105	108
122	85	98	102	105
124	83	96	100	102
126	81	93	97	99
128	79	91	94	97
130	78	89	92	94
135	73	84	86	88
140	70	79	81	83
145	66	74	76	78
150	63	70	72	73
155	59	66	68	69
160	56	63	64	65
165	54	59	61	62
170	51	56	58	59
175	49	53	55	55
180	47	51	52	53
185	44	48	49	50
190	42	46	47	48
195	41	44	45	45
200	39	42	43	43
210	36	38	39	40
220	33	35	36	36
230	30	32	33	33
240	28	30	30	31
250	26	28	28	28
260	24	26	26	26
270	23	24	24	25
280	21	22	23	23
290	20	21	21	21
300	19	20	20	20
310	17	18	19	19
320	16	17	17	18
330	16	16	16	17
340	15	15	16	16
350	14	14	15	15

Note : For other steel grades, refer to Appendix 8.4.

Table 8.8(g) - Design strength p_c of compression members

Values of p_c in N/mm^2 with λ < 110 for strut curve c							
λ	Steel grade and design strength (N/mm^2)						
	Q235	Q345/Q355	Q390	Q420	Q460	Q550	Q690
	215	305	345	375	410	520	630
15	215	305	345	374	408	512	617
20	214	299	336	364	396	497	598
25	208	290	326	353	384	481	577
30	202	281	315	341	371	464	554
35	196	272	305	329	357	445	529
40	190	262	293	316	343	424	500
42	187	258	288	311	337	415	487
44	185	254	284	305	330	405	474
46	182	250	279	300	324	396	461
48	180	246	274	294	317	386	447
50	177	241	268	288	310	375	432
52	174	237	263	282	303	365	418
54	172	232	258	276	296	354	404
56	169	228	252	270	289	344	389
58	166	223	247	263	282	333	375
60	164	219	241	257	274	322	361
62	161	214	236	251	267	312	347
64	158	210	230	244	260	301	333
66	155	205	224	238	252	291	320
68	152	200	219	231	245	281	308
70	150	195	213	225	238	271	295
72	147	191	207	219	231	261	284
74	144	186	202	212	223	252	272
76	141	181	196	206	217	243	262
78	139	177	191	200	210	234	252
80	136	172	185	194	203	226	242
82	133	168	180	188	197	218	232
84	130	163	175	183	191	210	224
86	128	159	170	177	185	203	215
88	125	155	165	172	179	196	207
90	122	151	161	167	173	189	200
92	120	147	156	162	168	183	192
94	117	143	151	157	163	176	186
96	114	139	147	152	158	170	179
98	112	135	143	148	153	165	173
100	109	132	139	143	148	159	167
102	107	128	135	139	144	154	161
104	105	125	131	135	139	149	156
106	102	121	127	131	135	144	151
108	100	118	124	128	131	140	146

Note : For other steel grades, refer to Appendix 8.4.

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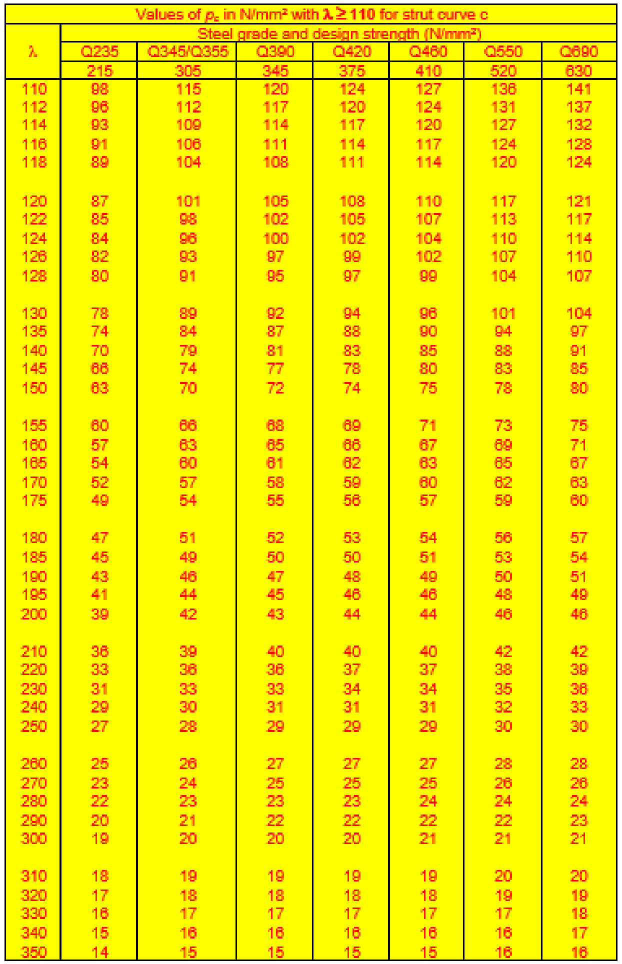
[73] Addition of design strength for Q355, Q460, Q550 and Q690 steel for buckling curve c; Revision of design strength for Q235, Q345, Q390 and Q420 steel for buckling curve c.

Item	Current version	Amendments

Table 8.8(g) - Design strength p_c of compression members (cont'd)



Values of p_c in N/mm² with $\lambda \geq 110$ for strut curve c							
λ	Steel grade and design strength (N/mm²)						
	Q235	Q345/Q355	Q390	Q420	Q460	Q550	Q690
	215	305	345	375	410	520	630
110	98	115	120	124	127	136	141
112	96	112	117	120	124	131	137
114	93	109	114	117	120	127	132
116	91	106	111	114	117	124	128
118	89	104	108	111	114	120	124
120	87	101	105	108	110	117	121
122	85	98	102	105	107	113	117
124	84	96	100	102	104	110	114
126	82	93	97	99	102	107	110
128	80	91	95	97	99	104	107
130	78	89	92	94	96	101	104
135	74	84	87	88	90	94	97
140	70	79	81	83	85	88	91
145	66	74	77	78	80	83	85
150	63	70	72	74	75	78	80
155	60	66	68	69	71	73	75
160	57	63	65	66	67	69	71
165	54	60	61	62	63	65	67
170	52	57	58	59	60	62	63
175	49	54	55	56	57	59	60
180	47	51	52	53	54	56	57
185	45	49	50	50	51	53	54
190	43	46	47	48	49	50	51
195	41	44	45	46	46	48	49
200	39	42	43	44	44	46	46
210	36	39	40	40	40	42	42
220	33	36	36	37	37	38	39
230	31	33	33	34	34	35	36
240	29	30	31	31	31	32	33
250	27	28	29	29	29	30	30
260	25	26	27	27	27	28	28
270	23	24	25	25	25	26	26
280	22	23	23	23	24	24	24
290	20	21	22	22	22	22	23
300	19	20	20	20	21	21	21
310	18	19	19	19	19	20	20
320	17	18	18	18	18	19	19
330	16	17	17	17	17	17	18
340	15	16	16	16	16	16	17
350	14	15	15	15	15	16	16

Note : For other steel grades, refer to Appendix 8.4.

Item	Current version	Amendments
74. Table 8.8(h)[74]		

Current version

Table 8.8(h) - Design strength p_c of compression members

Values of p_c in N/mm² with $\lambda < 110$ for strut curve d				
λ	Steel grade and design strength (N/mm²)			
	Q235	Q345	Q390	Q420
	215	310	350	380
15	223	313	350	378
20	213	300	336	363
25	205	287	321	347
30	196	275	307	331
35	188	262	293	316
40	180	250	278	300
42	177	245	273	293
44	173	240	267	286
46	170	235	261	280
48	167	230	255	273
50	164	225	249	267
52	161	220	243	260
54	158	215	237	253
56	155	210	231	247
58	152	205	226	240
60	149	200	220	234
62	146	195	214	227
64	143	190	208	221
66	140	186	203	215
68	137	181	197	209
70	134	176	192	203
72	131	172	186	197
74	128	167	181	191
76	125	163	176	185
78	123	159	171	180
80	120	154	166	174
82	117	150	162	169
84	115	146	157	164
86	112	142	153	159
88	110	139	148	155
90	107	135	144	150
92	105	131	140	146
94	103	128	136	142
96	100	124	132	138
98	98	121	129	134
100	96	118	125	130
102	94	115	122	126
104	92	112	118	123
106	90	109	115	119
108	88	106	112	116

Values of p_c in N/mm² with $\lambda \geq 110$ for strut curve d				
λ	Steel grade and design strength (N/mm²)			
	Q235	Q345	Q390	Q420
	215	310	350	380
110	86	103	109	113
112	84	101	106	110
114	82	98	103	107
116	80	96	101	104
118	78	93	98	101
120	77	91	95	98
122	75	89	93	96
124	73	87	91	93
126	72	85	88	91
128	70	83	86	89
130	69	81	84	86
135	65	76	79	81
140	62	72	75	76
145	59	68	70	72
150	56	64	66	68
155	53	61	63	64
160	51	58	60	61
165	48	55	56	58
170	46	52	54	55
175	44	49	51	52
180	42	47	49	49
185	40	45	46	47
190	39	43	44	45
195	37	41	42	43
200	35	39	40	41
210	33	36	37	37
220	30	33	34	34
230	28	30	31	32
240	26	28	29	29
250	24	26	27	27
260	23	24	25	25
270	21	23	23	23
280	20	21	22	22
290	19	20	20	20
300	17	19	19	19
310	16	18	18	18
320	15	16	17	17
330	15	16	16	16
340	14	15	15	15
350	13	14	14	14

Note : For other steel grades, refer to Appendix 8.4.

Amendments

Table 8.8(h) - Design strength p_c of compression members

Values of p_c in N/mm² with $\lambda < 110$ for strut curve d							
λ	Steel grade and design strength (N/mm²)						
	Q235	Q345/Q355	Q390	Q420	Q460	Q550	Q690
	215	305	345	375	410	520	630
15	215	305	345	374	407	509	611
20	214	296	332	359	390	488	584
25	205	283	318	343	373	466	557
30	197	271	304	328	356	443	527
35	188	259	290	312	339	419	496
40	180	247	275	297	321	394	463
42	177	242	270	290	314	384	449
44	174	237	264	284	306	373	435
46	171	232	258	277	299	363	421
48	168	227	252	271	291	353	407
50	164	222	247	264	284	342	393
52	161	217	241	258	277	332	379
54	158	213	235	251	269	321	366
56	155	208	229	245	262	311	352
58	152	203	224	238	255	301	339
60	149	198	218	232	247	291	327
62	146	193	212	226	240	281	314
64	143	189	207	219	233	272	302
66	140	184	201	213	226	262	291
68	137	179	196	207	220	253	279
70	134	175	190	201	213	244	269
72	132	170	185	195	207	236	258
74	129	166	180	190	200	228	249
76	126	162	175	184	194	220	239
78	123	157	170	179	188	212	230
80	121	153	165	174	182	205	222
82	118	149	161	169	177	198	214
84	115	145	156	164	171	191	206
86	113	142	152	159	166	185	198
88	110	138	148	154	161	179	191
90	108	134	144	150	156	173	185
92	105	131	139	145	152	167	178
94	103	127	136	141	147	162	172
96	101	124	132	137	143	156	166
98	99	121	128	133	138	151	161
100	96	117	125	129	134	147	155
102	94	114	121	126	131	142	150
104	92	111	118	122	127	138	145
106	90	109	115	119	123	134	141
108	88	106	112	116	120	130	136

Note : For other steel grades, refer to Appendix 8.4.

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[74] Addition of design strength for Q355, Q460, Q550 and Q690 steel for buckling curve d; Revision of design strength for Q235, Q345, Q390 and Q420 steel for buckling curve d.

Item	Current version	Amendments

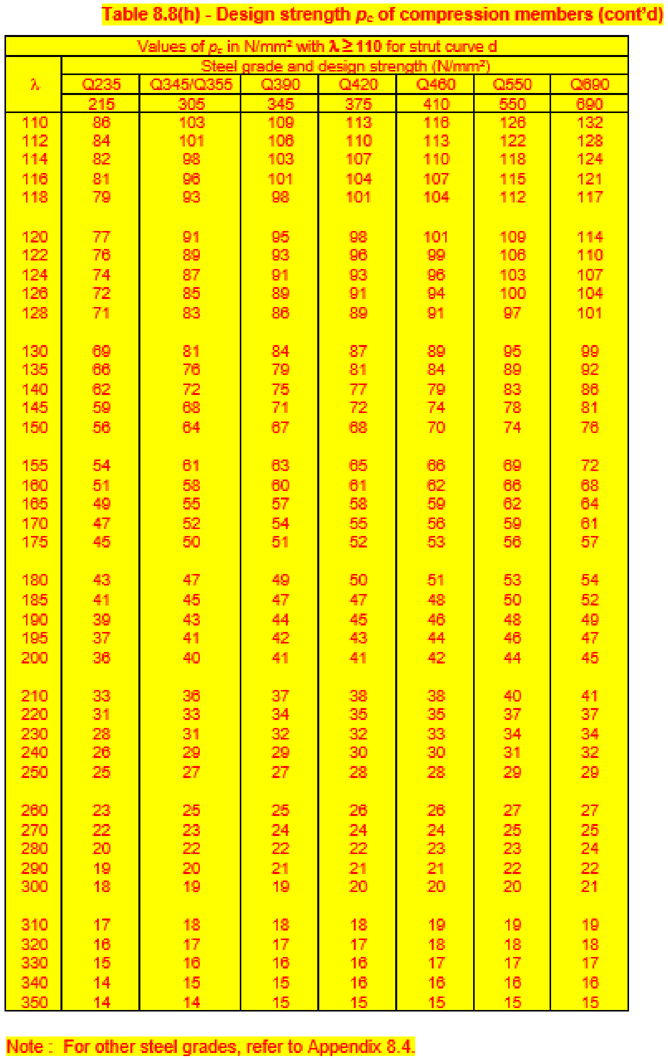

Table 8.8(h) - Design strength p_c of compression members (cont'd)

Values of p_c in N/mm² with $\lambda \geq 110$ for strut curve d							
λ	Steel grade and design strength (N/mm²)						
	Q235	Q345/Q355	Q390	Q420	Q460	Q550	Q690
	215	305	345	375	410	550	690
110	86	103	109	113	116	126	132
112	84	101	106	110	113	122	128
114	82	98	103	107	110	118	124
116	81	96	101	104	107	115	121
118	79	93	98	101	104	112	117
120	77	91	95	98	101	109	114
122	76	89	93	96	99	106	110
124	74	87	91	93	96	103	107
126	72	85	89	91	94	100	104
128	71	83	86	89	91	97	101
130	69	81	84	87	89	95	99
135	66	76	79	81	84	89	92
140	62	72	75	77	79	83	86
145	59	68	71	72	74	78	81
150	56	64	67	68	70	74	76
155	54	61	63	65	66	69	72
160	51	58	60	61	62	66	68
165	49	55	57	58	59	62	64
170	47	52	54	55	56	59	61
175	45	50	51	52	53	56	57
180	43	47	49	50	51	53	54
185	41	45	47	47	48	50	52
190	39	43	44	45	46	48	49
195	37	41	42	43	44	46	47
200	36	40	41	41	42	44	45
210	33	36	37	38	38	40	41
220	31	33	34	35	35	37	37
230	28	31	32	32	33	34	34
240	26	29	29	30	30	31	32
250	25	27	27	28	28	29	29
260	23	25	25	26	26	27	27
270	22	23	24	24	24	25	25
280	20	22	22	22	23	23	24
290	19	20	21	21	21	22	22
300	18	19	19	20	20	20	21
310	17	18	18	18	19	19	19
320	16	17	17	17	18	18	18
330	15	16	16	16	17	17	17
340	14	15	15	16	16	16	16
350	14	14	15	15	15	15	15

Note : For other steel grades, refer to Appendix 8.4.

Item	Current version	Amendments
75. Clause 8.9.3[75]		**8.9.3 Member buckling resistance – (Alternative to 8.9.2)** Members which are subjected to combined bending and axial compression should satisfy: $\frac{F_c}{A_g p_{cx}} + k_{xx}\frac{M_x}{M_b} + k_{xy}\frac{M_y}{M_{cy}} \leq 1$ (8.82a) $\frac{F_c}{A_g p_{cy}} + k_{yx}\frac{M_x}{M_b} + k_{yy}\frac{M_y}{M_{cy}} \leq 1$ (8.82b) where F_c, M_x and M_y are the design values of the compression force and the maximum moments about the major (x-x) axis and the minor (y-y) axis along the member, respectively M_b is the buckling resistance moment in clause 8.3.5.2 M_{cy} is the moment capacity about the minor axis from clause 8.2.2 p_{cx},p_{cy} are the axial strength under column buckling about the major (x-x) axis, and the minor (y-y) axis k_{xx}, k_{xy}, k_{yx}, k_{yy} are the interaction factors given in Table 8.10. Refer to Table 8.10 for members not susceptible to torsional deformations, or refer to Table 8.11 for members susceptible to torsional deformation

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[75] Addition of Clause 8.9.3 for alternative method of member buckling resistance design.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>76. Table 8.10[76]</td><td></td><td>

Table 8.10 Interaction factors for combined axial compression and bending

<table>
<tr><th rowspan="2">Interaction factors</th><th rowspan="2">Type of sections</th><th colspan="2">Design assumptions</th></tr>
<tr><th>Elastic cross-sectional properties Class 3, Effective cross-sectional properties Class 4</th><th>Plastic cross-sectional properties Class 1, Class 2</th></tr>
<tr><td>k_{xx}</td><td>I-sections
RHS</td><td>$C_{mx}\left(1+0.6\bar{\lambda}_x\frac{F_c}{P_{cx}}\right)$
$\leq C_{mx}\left(1+0.6\frac{F_c}{P_{cx}}\right)$</td><td>$C_{mx}\left(1+\left(\bar{\lambda}_x-0.2\right)\frac{F_c}{P_{cx}}\right)$
$\leq C_{mx}\left(1+0.8\frac{F_c}{P_{cx}}\right)$</td></tr>
<tr><td>k_{xy}</td><td>I-sections
RHS</td><td>k_{yy}</td><td>$0.6k_{yy}$</td></tr>
<tr><td>k_{yx}</td><td>I-sections
RHS</td><td>$0.8k_{xx}$</td><td>$0.6k_{xx}$</td></tr>
<tr><td rowspan="2">k_{yy}</td><td>I-sections</td><td rowspan="2">$C_{my}\left(1+0.6\bar{\lambda}_y\frac{F_c}{P_{cy}}\right)$
$\leq C_{my}\left(1+0.6\frac{F_c}{P_{cy}}\right)$</td><td>$C_{my}\left(1+\left(2\bar{\lambda}_y-0.6\right)\frac{F_c}{P_{cy}}\right)$
$\leq C_{my}\left(1+1.4\frac{F_c}{P_{cy}}\right)$</td></tr>
<tr><td>RHS</td><td>$C_{my}\left(1+\left(\bar{\lambda}_y-0.2\right)\frac{F_c}{P_{cy}}\right)$
$\leq C_{my}\left(1+0.8\frac{F_c}{P_{cy}}\right)$</td></tr>
<tr><td colspan="4">For I- and H-sections and rectangular hollow sections under axial compression and uniaxial bending M_x, the coefficient k_{yx} may be $k_{yx} = 0$.</td></tr>
</table>

Note:

$$\bar{\lambda}_x = \frac{\lambda_x}{\pi\sqrt{\frac{E}{P_y}}}$$

$$\bar{\lambda}_y = \frac{\lambda_y}{\pi\sqrt{\frac{E}{P_y}}}$$

</td></tr>
</table>

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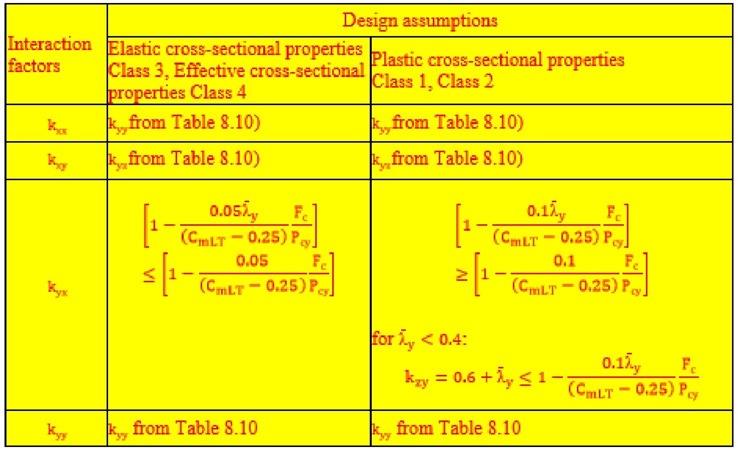
[76] Addition of Table 8.10 for alternative method of member buckling resistance design.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>77. Table 8.11[77]</td><td></td><td>
Table 8.11 Interaction factors kij for members susceptible to torsional deformations



<table>
<tr><td rowspan="2">Interaction factors</td><td colspan="2">Design assumptions</td></tr>
<tr><td>Elastic cross-sectional properties Class 3, Effective cross-sectional properties Class 4</td><td>Plastic cross-sectional properties Class 1, Class 2</td></tr>
<tr><td>k_{xx}</td><td>$k_{yy}$from Table 8.10)</td><td>$k_{yy}$from Table 8.10)</td></tr>
<tr><td>k_{xy}</td><td>$k_{yx}$from Table 8.10)</td><td>$k_{yx}$from Table 8.10)</td></tr>
<tr><td>k_{yx}</td><td>$\left[1-\frac{0.05\bar{\lambda}_y}{(C_{mLT}-0.25)}\frac{F_c}{P_{cy}}\right] \leq \left[1-\frac{0.05}{(C_{mLT}-0.25)}\frac{F_c}{P_{cy}}\right]$</td><td>$\left[1-\frac{0.1\bar{\lambda}_y}{(C_{mLT}-0.25)}\frac{F_c}{P_{cy}}\right] \geq \left[1-\frac{0.1}{(C_{mLT}-0.25)}\frac{F_c}{P_{cy}}\right]$
for $\bar{\lambda}_y < 0.4$:
$k_{zy} = 0.6+\bar{\lambda}_y \leq 1-\frac{0.1\bar{\lambda}_y}{(C_{mLT}-0.25)}\frac{F_c}{P_{cy}}$</td></tr>
<tr><td>k_{yy}</td><td>k_{yy} from Table 8.10</td><td>k_{yy} from Table 8.10</td></tr>
</table>
</td></tr>
</table>

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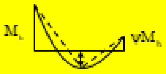
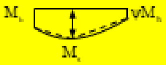
[77] Addition of Table 8.11 for alternative method of member buckling resistance design.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>78. Table 8.12[78]</td><td></td><td>

Table 8.12 Equivalent uniform moment factors, C_m in Tables 8.10 and 8.11

<table>
<tr><td rowspan="2">Moment diagram</td><td rowspan="2" colspan="2">Range</td><td colspan="2">C_{mx} and C_{my} and C_{mLT}</td></tr>
<tr><td>Uniform loading</td><td>Concentrated load</td></tr>
<tr><td></td><td colspan="2">$-1 \le \psi \le 1$</td><td colspan="2">$0.6 + 0.4\psi \ge 0.4$</td></tr>
<tr><td rowspan="3">
$\alpha_h = M_s / M_h$</td><td>$0 \le \alpha_s \le 1$</td><td>$-1 \le \psi \le 1$</td><td>$0.2 + 0.8\alpha_s \ge 0.4$</td><td>$0.2 + 0.8\alpha_s \ge 0.4$</td></tr>
<tr><td rowspan="2">$-1 \le \alpha_s \le 0$</td><td>$0 \le \psi \le 1$</td><td>$0.1 - 0.8\alpha_s \ge 0.4$</td><td>$-0.8\alpha_s \ge 0.4$</td></tr>
<tr><td>$-1 \le \psi \le 0$</td><td>$0.1(1-\psi) - 0.8\alpha_s \ge 0.4$</td><td>$0.2(-\psi) - 0.8\alpha_s \ge 0.4$</td></tr>
<tr><td rowspan="3">
$\alpha_h = M_h / M_s$</td><td>$0 \le \alpha_h \le 1$</td><td>$-1 \le \psi \le 1$</td><td>$0.95 + 0.05\alpha_h$</td><td>$0.90 + 0.10\alpha_h$</td></tr>
<tr><td rowspan="2">$-1 \le \alpha_h \le 0$</td><td>$0 \le \psi \le 1$</td><td>$0.95 + 0.05\alpha_h$</td><td>$0.90 + 0.10\alpha_h$</td></tr>
<tr><td>$-1 \le \psi \le 0$</td><td>$0.95 + 0.05\alpha_h(1 + 2\psi)$</td><td>$0.90 + 0.10\alpha_h(1 + 2\psi)$</td></tr>
<tr><td colspan="5">For members with sway buckling mode the equivalent uniform moment factor should be taken $C_{mx} = 0.9$ or $C_{my} = 0.9$ respectively.</td></tr>
<tr><td colspan="5">C_{mx} , C_{my} and C_{mLT} should be obtained according to the bending moment diagram between the relevant braced points as follows:
<table>
<tr><th>moment factor</th><th>Bending axis</th><th>Points braced in direction</th></tr>
<tr><td>C_{mx}</td><td>x-x</td><td>y-y</td></tr>
<tr><td>C_{my}</td><td>y-y</td><td>x-x</td></tr>
<tr><td>C_{mLT}</td><td>x-x</td><td>x-x</td></tr>
</table></td></tr>
</table>

</td></tr>
</table>

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[78] Addition of Table 8.12 for alternative method of member buckling resistance design.

Item	Current version	Amendments
79. Page index[79]	**8 DESIGN OF STRUCTURAL MEMBERS ... 75** **8.1 GENERAL ... 75** **8.2 RESTRAINED BEAMS ... 75** *8.2.1 Shear capacity ... 75* *8.2.2 Moment capacity ... 76* *8.2.3 Beams with web openings ... 77* *8.2.4 Castellated beams ... 78* **8.3 LATERAL-TORSIONAL BUCKLING OF BEAMS ... 79** *8.3.1 Intermediate and end lateral restraints ... 79* *8.3.2 Torsional restraint ... 80* *8.3.3 Normal and destabilizing loads ... 80* *8.3.4 Effective length for lateral-torsional buckling ... 80* *8.3.5 Moment resistance to lateral-torsional buckling ... 82* **8.4 PLATE GIRDERS ... 89** *8.4.1 Design strength ... 89* *8.4.2 Minimum web thickness for serviceability ... 89* *8.4.3 Minimum web thickness to avoid compression flange buckling ... 89* *8.4.4 Moment capacity of restrained girders ... 89* *8.4.5 Effects of axial force ... 90* *8.4.6 Shear buckling resistance ... 90* *8.4.7 Intermediate transverse web stiffeners ... 90* *8.4.8 End anchorage ... 105* *8.4.9 Panels with openings ... 105* *8.4.10 Web capacity and stiffeners design ... 105* *8.4.11 Other types of stiffeners ... 108* *8.4.12 Connections between web stiffeners and webs ... 108* *8.4.13 Connections between web stiffeners and flanges ... 108* **8.5 BUCKLING RESISTANCE MOMENT FOR SINGLE ANGLE MEMBERS ... 109** **8.6 TENSION MEMBERS ... 109** *8.6.1 Tension capacity ... 109* *8.6.2 Members with eccentric connections ... 109* *8.6.3 Single and double angle, channel and T-sections ... 109* *8.6.4 Double angle, channel and T-sections with intermediate connections ... 110* **8.7 COMPRESSION MEMBERS ... 110** *8.7.1 Segment length ... 110* *8.7.2 Effective length in general ... 110* *8.7.3 Restraints ... 111* *8.7.4 Slenderness ... 111* *8.7.5 Compression resistance ... 111* *8.7.6 Compressive strength ... 112* *8.7.7 Eccentric connections ... 127* *8.7.8 Simple construction ... 127* *8.7.9 Effective length of sections in triangulated structures and trusses ... 127* **8.8 TENSION MEMBERS UNDER COMBINED AXIAL FORCE AND MOMENTS ... 128** **8.9 COMPRESSION MEMBERS UNDER COMBINED AXIAL FORCE AND MOMENTS ... 129** *8.9.1 Cross-section capacity ... 129* *8.9.2 Member buckling resistance ... 129* **8.10 TORSIONAL AND FLEXURAL-TORSIONAL BUCKLING OF COMPRESSION MEMBERS ... 132** **8.11 PORTAL FRAMES ... 132** *8.11.1 General ... 132* *8.11.2 Elastic design ... 132* *8.11.3 Plastic design ... 132* *8.11.4 In-plane stability ... 132* *8.11.5 Out-of-plane stability ... 135* **8.12 LACED AND BATTENED STRUTS ... 139** *8.12.1 Laced struts ... 139* *8.12.2 Battened struts ... 139*	**8 DESIGN OF STRUCTURAL MEMBERS ... 75** **8.1 GENERAL ... 75** **8.2 RESTRAINED BEAMS ... 75** *8.2.1 Shear capacity ... 75* *8.2.2 Moment capacity ... 76* *8.2.3 Beams with web openings ... 77* *8.2.4 Castellated beams ... 78* **8.3 LATERAL-TORSIONAL BUCKLING OF BEAMS ... 79** *8.3.1 Intermediate and end lateral restraints ... 79* *8.3.2 Torsional restraint ... 80* *8.3.3 Normal and destabilizing loads ... 80* *8.3.4 Effective length for lateral-torsional buckling ... 80* *8.3.5 Moment resistance to lateral-torsional buckling ... 82* **8.4 PLATE GIRDERS ... 91** *8.4.1 Design strength ... 91* *8.4.2 Minimum web thickness for serviceability ... 91* *8.4.3 Minimum web thickness to avoid compression flange buckling ... 91* *8.4.4 Moment capacity of restrained girders ... 91* *8.4.5 Effects of axial force ... 92* *8.4.6 Shear buckling resistance ... 92* *8.4.7 Intermediate transverse web stiffeners ... 92* *8.4.8 End anchorage ... 118* *8.4.9 Panels with openings ... 119* *8.4.10 Web capacity and stiffeners design ... 119* *8.4.11 Other types of stiffeners ... 122* *8.4.12 Connections between web stiffeners and webs ... 122* *8.4.13 Connections between web stiffeners and flanges ... 122* **8.5 BUCKLING RESISTANCE MOMENT FOR SINGLE ANGLE MEMBERS ... 123** **8.6 TENSION MEMBERS ... 123** *8.6.1 Tension capacity ... 123* *8.6.2 Members with eccentric connections ... 123* *8.6.3 Single and double angle, channel and T-sections ... 123* *8.6.4 Double angle, channel and T-sections with intermediate connections ... 124* **8.7 COMPRESSION MEMBERS ... 124** *8.7.1 Segment length ... 124* *8.7.2 Effective length in general ... 124* *8.7.3 Restraints ... 125* *8.7.4 Slenderness ... 125* *8.7.5 Compression resistance ... 125* *8.7.6 Compressive strength ... 126* *8.7.7 Eccentric connections ... 151* *8.7.8 Simple construction ... 151* *8.7.9 Effective length of sections in triangulated structures and trusses ... 151* **8.8 TENSION MEMBERS UNDER COMBINED AXIAL FORCE AND MOMENTS ... 152** **8.9 COMPRESSION MEMBERS UNDER COMBINED AXIAL FORCE AND MOMENTS ... 153** *8.9.1 Cross-section capacity ... 153* *8.9.2 Member buckling resistance ... 153* **8.10 TORSIONAL AND FLEXURAL-TORSIONAL BUCKLING OF COMPRESSION MEMBERS ... 156** **8.11 PORTAL FRAMES ... 160** *8.11.1 General ... 160* *8.11.2 Elastic design ... 160* *8.11.3 Plastic design ... 160* *8.11.4 In-plane stability ... 160* *8.11.5 Out-of-plane stability ... 163* **8.12 LACED AND BATTENED STRUTS ... 166** *8.12.1 Laced struts ... 166* *8.12.2 Battened struts ... 166*

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[79] Revision of page index of Section 8.

<table>
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<tr>
<td>80. Table 9.2a[80]</td>
<td>
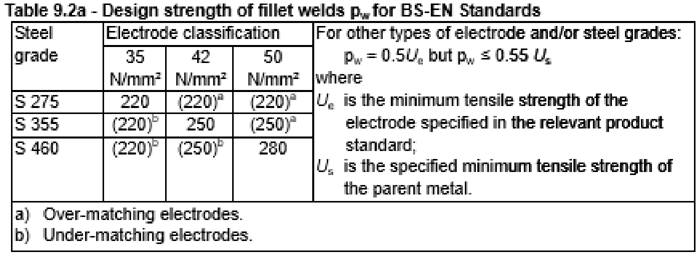
Table 9.2a - Design strength of fillet welds p_w for BS-EN Standards
<table>
<tr><td>Steel grade</td><td colspan="3">Electrode classification</td><td rowspan="5">For other types of electrode and/or steel grades:
$p_w = 0.5U_e$ but $p_w \le 0.55\ U_s$
where
U_e is the minimum tensile strength of the electrode specified in the relevant product standard;
U_s is the specified minimum tensile strength of the parent metal.</td></tr>
<tr><td></td><td>35 N/mm²</td><td>42 N/mm²</td><td>50 N/mm²</td></tr>
<tr><td>S 275</td><td>220</td><td>(220)[a]</td><td>(220)[a]</td></tr>
<tr><td>S 355</td><td>(220)[b]</td><td>250</td><td>(250)[a]</td></tr>
<tr><td>S 460</td><td>(220)[b]</td><td>(250)[b]</td><td>280</td></tr>
<tr><td colspan="5">a) Over-matching electrodes.
b) Under-matching electrodes.</td></tr>
</table>
</td>
<td>
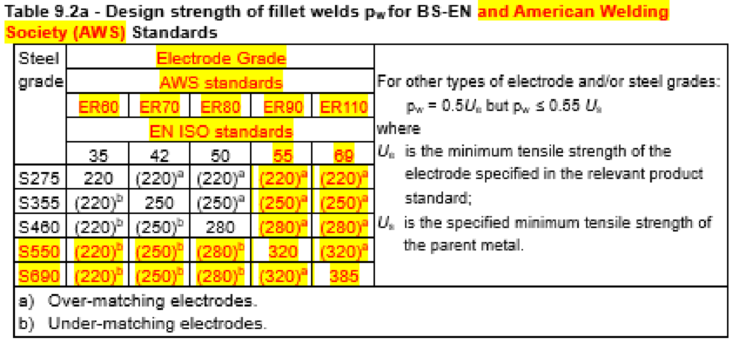
Table 9.2a - Design strength of fillet welds p_w for BS-EN and American Welding Society (AWS) Standards
<table>
<tr><td rowspan="5">Steel grade</td><td colspan="5">Electrode Grade</td><td rowspan="10">For other types of electrode and/or steel grades:
$p_w = 0.5U_e$ but $p_w \le 0.55\ U_s$
where
U_e is the minimum tensile strength of the electrode specified in the relevant product standard;
U_s is the specified minimum tensile strength of the parent metal.</td></tr>
<tr><td colspan="5">AWS standards</td></tr>
<tr><td>ER60</td><td>ER70</td><td>ER80</td><td>ER90</td><td>ER110</td></tr>
<tr><td colspan="5">EN ISO standards</td></tr>
<tr><td>35</td><td>42</td><td>50</td><td>55</td><td>69</td></tr>
<tr><td>S275</td><td>220</td><td>(220)[a]</td><td>(220)[a]</td><td>(220)[a]</td><td>(220)[a]</td></tr>
<tr><td>S355</td><td>(220)[b]</td><td>250</td><td>(250)[a]</td><td>(250)[a]</td><td>(250)[a]</td></tr>
<tr><td>S460</td><td>(220)[b]</td><td>(250)[b]</td><td>280</td><td>(280)[a]</td><td>(280)[a]</td></tr>
<tr><td>S550</td><td>(220)[b]</td><td>(250)[b]</td><td>(280)[b]</td><td>320</td><td>(320)[a]</td></tr>
<tr><td>S690</td><td>(220)[b]</td><td>(250)[b]</td><td>(280)[b]</td><td>(320)[a]</td><td>385</td></tr>
<tr><td colspan="7">a) Over-matching electrodes.
b) Under-matching electrodes.</td></tr>
</table>
</td>
</tr>
<tr>
<td>81. Table 9.2b[81]</td>
<td>
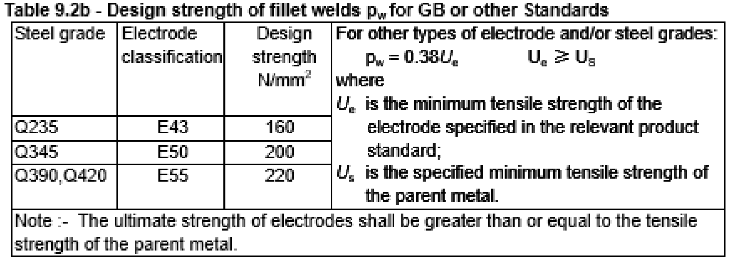
Table 9.2b - Design strength of fillet welds p_w for GB or other Standards
<table>
<tr><td>Steel grade</td><td>Electrode classification</td><td>Design strength N/mm²</td><td rowspan="4">For other types of electrode and/or steel grades:
$p_w = 0.38U_e$ $U_e \geqslant U_S$
where
U_e is the minimum tensile strength of the electrode specified in the relevant product standard;
U_s is the specified minimum tensile strength of the parent metal.</td></tr>
<tr><td>Q235</td><td>E43</td><td>160</td></tr>
<tr><td>Q345</td><td>E50</td><td>200</td></tr>
<tr><td>Q390,Q420</td><td>E55</td><td>220</td></tr>
<tr><td colspan="4">Note :- The ultimate strength of electrodes shall be greater than or equal to the tensile strength of the parent metal.</td></tr>
</table>
</td>
<td>
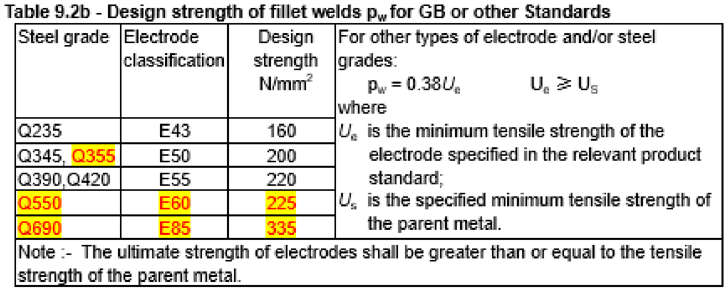
Table 9.2b - Design strength of fillet welds p_w for GB or other Standards
<table>
<tr><td>Steel grade</td><td>Electrode classification</td><td>Design strength N/mm²</td><td rowspan="6">For other types of electrode and/or steel grades:
$p_w = 0.38U_e$ $U_e \geqslant U_S$
where
U_e is the minimum tensile strength of the electrode specified in the relevant product standard;
U_s is the specified minimum tensile strength of the parent metal.</td></tr>
<tr><td>Q235</td><td>E43</td><td>160</td></tr>
<tr><td>Q345, Q355</td><td>E50</td><td>200</td></tr>
<tr><td>Q390,Q420</td><td>E55</td><td>220</td></tr>
<tr><td>Q550</td><td>E60</td><td>225</td></tr>
<tr><td>Q690</td><td>E85</td><td>335</td></tr>
<tr><td colspan="4">Note :- The ultimate strength of electrodes shall be greater than or equal to the tensile strength of the parent metal.</td></tr>
</table>
</td>
</tr>
</table>

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[80] Addition of design strength of electrode for S550 and S690 steel and design strength of electrode complying AWS.

[81] Addition of design strength of electrode for Q355, Q550 and Q690 steel.

<table>
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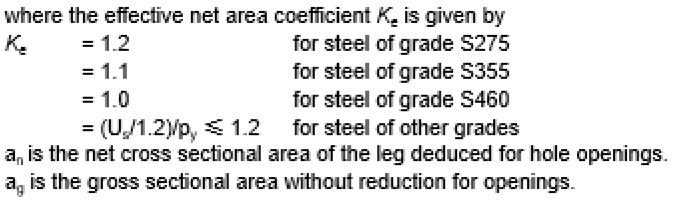
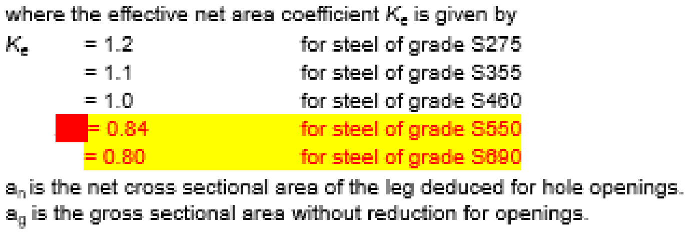
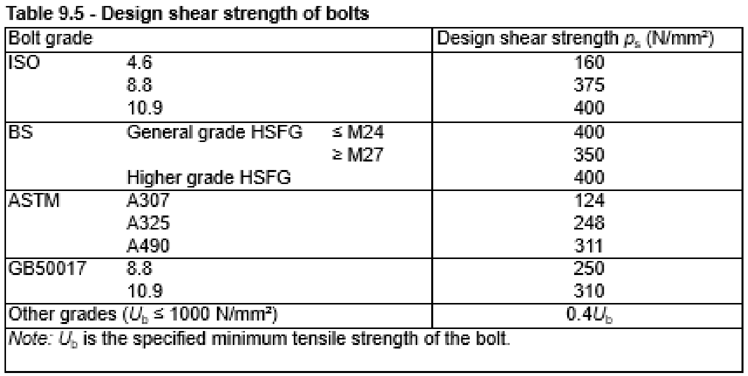
<td>82. Clause 9.3.4.4[82]</td>
<td>
where the effective net area coefficient K_e is given by
K_e = 1.2 for steel of grade S275
= 1.1 for steel of grade S355
= 1.0 for steel of grade S460
= $(U_s/1.2)/p_y \lesssim 1.2$ for steel of other grades
a_n is the net cross sectional area of the leg deduced for hole openings.
a_g is the gross sectional area without reduction for openings.</td>
<td>
where the effective net area coefficient K_e is given by
K_e = 1.2 for steel of grade S275
= 1.1 for steel of grade S355
= 1.0 for steel of grade S460
= 0.84 for steel of grade S550
= 0.80 for steel of grade S690
a_n is the net cross sectional area of the leg deduced for hole openings.
a_g is the gross sectional area without reduction for openings.</td>
</tr>
<tr>
<td>83. Table 9.5[83]</td>
<td>
Table 9.5 - Design shear strength of bolts
<table>
<tr><th colspan="3">Bolt grade</th><th>Design shear strength p_s (N/mm²)</th></tr>
<tr><td>ISO</td><td>4.6</td><td></td><td>160</td></tr>
<tr><td></td><td>8.8</td><td></td><td>375</td></tr>
<tr><td></td><td>10.9</td><td></td><td>400</td></tr>
<tr><td>BS</td><td>General grade HSFG</td><td>≤ M24</td><td>400</td></tr>
<tr><td></td><td></td><td>≥ M27</td><td>350</td></tr>
<tr><td></td><td>Higher grade HSFG</td><td></td><td>400</td></tr>
<tr><td>ASTM</td><td>A307</td><td></td><td>124</td></tr>
<tr><td></td><td>A325</td><td></td><td>248</td></tr>
<tr><td></td><td>A490</td><td></td><td>311</td></tr>
<tr><td>GB50017</td><td>8.8</td><td></td><td>250</td></tr>
<tr><td></td><td>10.9</td><td></td><td>310</td></tr>
<tr><td colspan="3">Other grades ($U_b \leq 1000$ N/mm²)</td><td>$0.4U_b$</td></tr>
<tr><td colspan="4"><i>Note:</i> U_b is the specified minimum tensile strength of the bolt.</td></tr>
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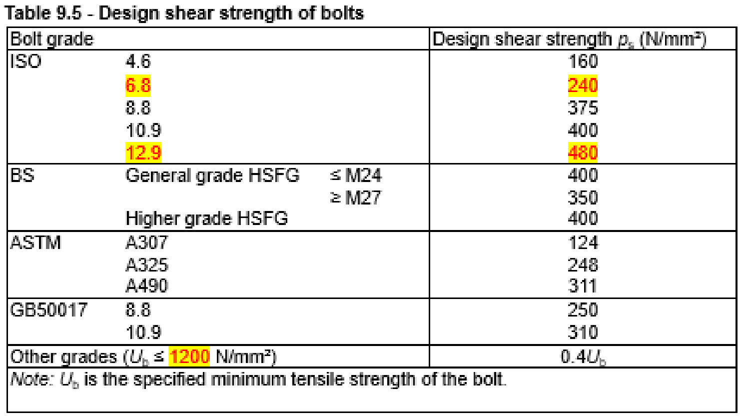
<td>
Table 9.5 - Design shear strength of bolts
<table>
<tr><th colspan="3">Bolt grade</th><th>Design shear strength p_s (N/mm²)</th></tr>
<tr><td>ISO</td><td>4.6</td><td></td><td>160</td></tr>
<tr><td></td><td>6.8</td><td></td><td>240</td></tr>
<tr><td></td><td>8.8</td><td></td><td>375</td></tr>
<tr><td></td><td>10.9</td><td></td><td>400</td></tr>
<tr><td></td><td>12.9</td><td></td><td>480</td></tr>
<tr><td>BS</td><td>General grade HSFG</td><td>≤ M24</td><td>400</td></tr>
<tr><td></td><td></td><td>≥ M27</td><td>350</td></tr>
<tr><td></td><td>Higher grade HSFG</td><td></td><td>400</td></tr>
<tr><td>ASTM</td><td>A307</td><td></td><td>124</td></tr>
<tr><td></td><td>A325</td><td></td><td>248</td></tr>
<tr><td></td><td>A490</td><td></td><td>311</td></tr>
<tr><td>GB50017</td><td>8.8</td><td></td><td>250</td></tr>
<tr><td></td><td>10.9</td><td></td><td>310</td></tr>
<tr><td colspan="3">Other grades ($U_b \leq 1200$ N/mm²)</td><td>$0.4U_b$</td></tr>
<tr><td colspan="4"><i>Note:</i> U_b is the specified minimum tensile strength of the bolt.</td></tr>
</table></td>
</tr>
</table>

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[82] Addition of coefficient Ke for S550 and S690 steel.

[83] Addition of bolt grade ISO 6.8 and 12.9; Revision of shear strength of other bolt grade.

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<td>84. Table 9.6[84]</td>
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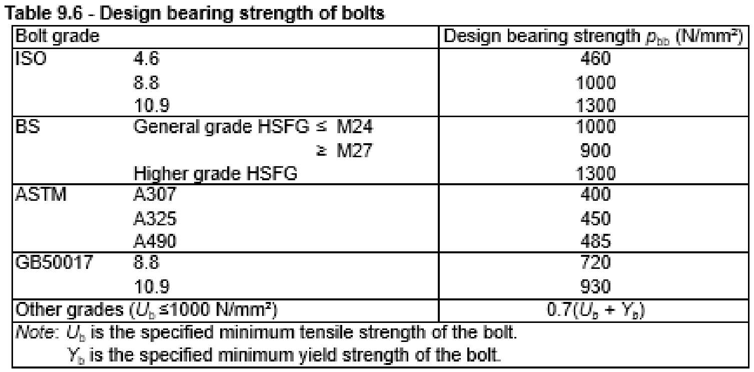
Table 9.6 - Design bearing strength of bolts
<table>
<tr><th colspan="2">Bolt grade</th><th>Design bearing strength p_{bb} (N/mm²)</th></tr>
<tr><td>ISO</td><td>4.6
8.8
10.9</td><td>460
1000
1300</td></tr>
<tr><td>BS</td><td>General grade HSFG ≤ M24
≥ M27
Higher grade HSFG</td><td>1000
900
1300</td></tr>
<tr><td>ASTM</td><td>A307
A325
A490</td><td>400
450
485</td></tr>
<tr><td>GB50017</td><td>8.8
10.9</td><td>720
930</td></tr>
<tr><td colspan="2">Other grades (U_b ≤1000 N/mm²)</td><td>$0.7(U_b + Y_b)$</td></tr>
<tr><td colspan="3"><i>Note:</i> U_b is the specified minimum tensile strength of the bolt.
Y_b is the specified minimum yield strength of the bolt.</td></tr>
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<td>
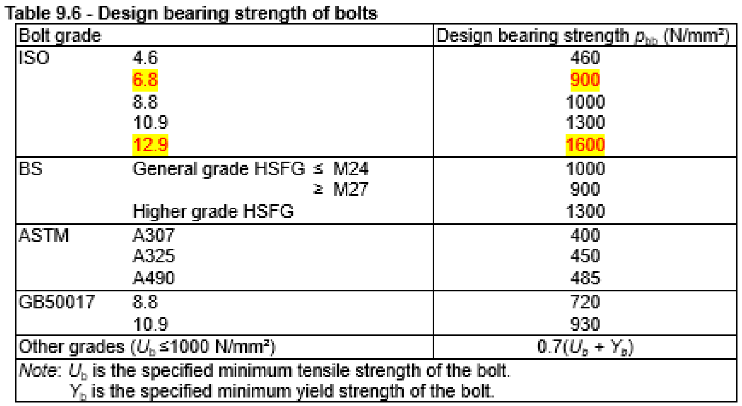
Table 9.6 - Design bearing strength of bolts
<table>
<tr><th colspan="2">Bolt grade</th><th>Design bearing strength p_{bb} (N/mm²)</th></tr>
<tr><td>ISO</td><td>4.6
6.8
8.8
10.9
12.9</td><td>460
900
1000
1300
1600</td></tr>
<tr><td>BS</td><td>General grade HSFG ≤ M24
≥ M27
Higher grade HSFG</td><td>1000
900
1300</td></tr>
<tr><td>ASTM</td><td>A307
A325
A490</td><td>400
450
485</td></tr>
<tr><td>GB50017</td><td>8.8
10.9</td><td>720
930</td></tr>
<tr><td colspan="2">Other grades (U_b ≤1000 N/mm²)</td><td>$0.7(U_b + Y_b)$</td></tr>
<tr><td colspan="3"><i>Note:</i> U_b is the specified minimum tensile strength of the bolt.
Y_b is the specified minimum yield strength of the bolt.</td></tr>
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<td>85. Clause 9.3.6.1.3[85]</td>
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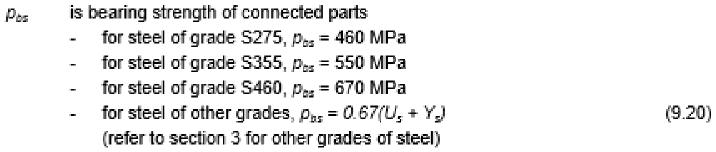
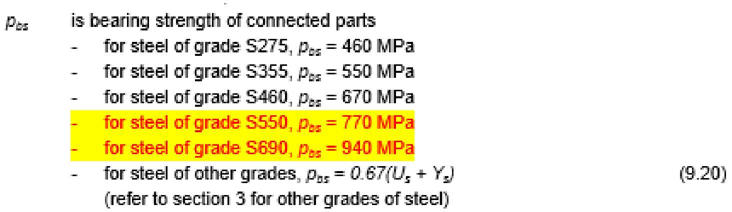

p_{bs} is bearing strength of connected parts
- for steel of grade S275, p_{bs} = 460 MPa
- for steel of grade S355, p_{bs} = 550 MPa
- for steel of grade S460, p_{bs} = 670 MPa
- for steel of other grades, $p_{bs} = 0.67(U_s + Y_s)$ (9.20)
(refer to section 3 for other grades of steel)
</td>
<td>

p_{bs} is bearing strength of connected parts
- for steel of grade S275, p_{bs} = 460 MPa
- for steel of grade S355, p_{bs} = 550 MPa
- for steel of grade S460, p_{bs} = 670 MPa
- for steel of grade S550, p_{bs} = 770 MPa
- for steel of grade S690, p_{bs} = 940 MPa
- for steel of other grades, $p_{bs} = 0.67(U_s + Y_s)$ (9.20)
(refer to section 3 for other grades of steel)
</td>
</tr>
</table>

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[84] Addition of bolt grade ISO 6.8 and 12.9.

[85] Addition of bearing strength of connected parts for S550 and S690 steel.

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<td>86. Table 9.8[86]</td>
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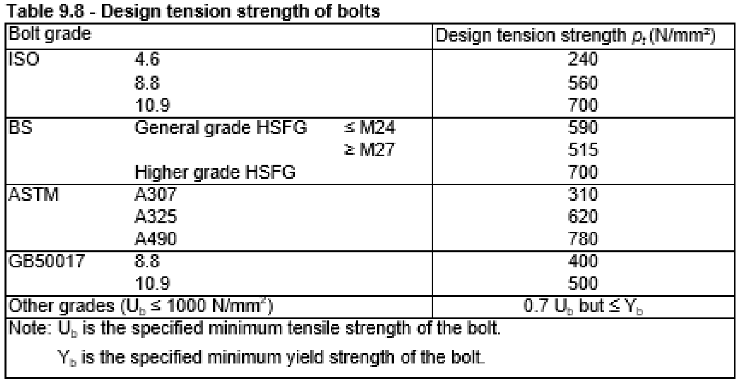
Table 9.8 - Design tension strength of bolts
<table>
<tr><th>Bolt grade</th><th></th><th></th><th>Design tension strength p_t (N/mm²)</th></tr>
<tr><td>ISO</td><td>4.6</td><td></td><td>240</td></tr>
<tr><td></td><td>8.8</td><td></td><td>560</td></tr>
<tr><td></td><td>10.9</td><td></td><td>700</td></tr>
<tr><td>BS</td><td>General grade HSFG</td><td>≤ M24</td><td>590</td></tr>
<tr><td></td><td></td><td>≥ M27</td><td>515</td></tr>
<tr><td></td><td>Higher grade HSFG</td><td></td><td>700</td></tr>
<tr><td>ASTM</td><td>A307</td><td></td><td>310</td></tr>
<tr><td></td><td>A325</td><td></td><td>620</td></tr>
<tr><td></td><td>A490</td><td></td><td>780</td></tr>
<tr><td>GB50017</td><td>8.8</td><td></td><td>400</td></tr>
<tr><td></td><td>10.9</td><td></td><td>500</td></tr>
<tr><td colspan="3">Other grades (U_b ≤ 1000 N/mm²)</td><td>0.7 U_b but ≤ Y_b</td></tr>
<tr><td colspan="4">Note: U_b is the specified minimum tensile strength of the bolt.
Y_b is the specified minimum yield strength of the bolt.</td></tr>
</table>
</td>
<td>
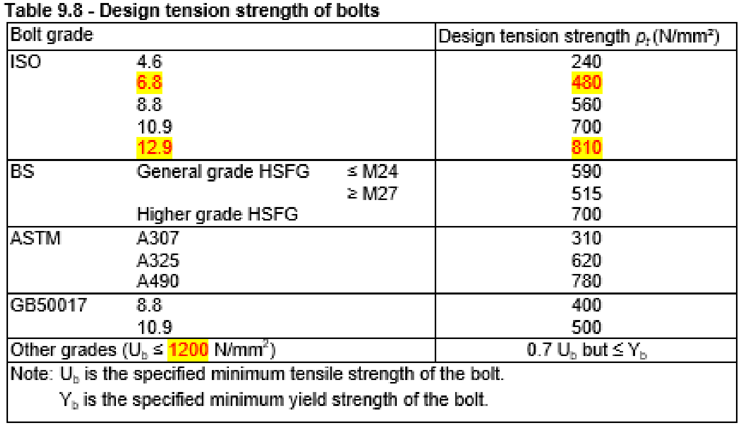
Table 9.8 - Design tension strength of bolts
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<tr><th>Bolt grade</th><th></th><th></th><th>Design tension strength p_t (N/mm²)</th></tr>
<tr><td>ISO</td><td>4.6</td><td></td><td>240</td></tr>
<tr><td></td><td>6.8</td><td></td><td>480</td></tr>
<tr><td></td><td>8.8</td><td></td><td>560</td></tr>
<tr><td></td><td>10.9</td><td></td><td>700</td></tr>
<tr><td></td><td>12.9</td><td></td><td>810</td></tr>
<tr><td>BS</td><td>General grade HSFG</td><td>≤ M24</td><td>590</td></tr>
<tr><td></td><td></td><td>≥ M27</td><td>515</td></tr>
<tr><td></td><td>Higher grade HSFG</td><td></td><td>700</td></tr>
<tr><td>ASTM</td><td>A307</td><td></td><td>310</td></tr>
<tr><td></td><td>A325</td><td></td><td>620</td></tr>
<tr><td></td><td>A490</td><td></td><td>780</td></tr>
<tr><td>GB50017</td><td>8.8</td><td></td><td>400</td></tr>
<tr><td></td><td>10.9</td><td></td><td>500</td></tr>
<tr><td colspan="3">Other grades (U_b ≤ 1200 N/mm²)</td><td>0.7 U_b but ≤ Y_b</td></tr>
<tr><td colspan="4">Note: U_b is the specified minimum tensile strength of the bolt.
Y_b is the specified minimum yield strength of the bolt.</td></tr>
</table>
</td>
</tr>
</table>

---

[86] Addition of bolt grade ISO 6.8 and 12.9; Revision of tension strength of other bolt grade.

Item	Current version	Amendments
87. Clause 11.7.3[87]	**11.7.3 Mechanical properties** Cold forming is a process whereby the main forming of metal section is done at ambient temperature. It changes the material properties of steel and impairs ductility as well as toughness but enhances strength. These changes may also limit the ability to weld in cold deformed areas. The extent to which the properties are changed depends upon the type of steel, the forming temperature and the degree of deformation. The basic requirements on strength and ductility are given in clause 3.1.2. As a conservative design, no strength enhancement is allowed. To ensure sufficient notch toughness, the minimum average Charpy V-notch impact test energy at the required design temperature should be in accordance with clause 3.2.	**11.7.3 Mechanical properties** Cold forming is a process whereby the main forming of metal section is done at ambient temperature. It changes the material properties of steel and impairs ductility as well as toughness but enhances strength. 🟥 The extent to which the properties are changed depends upon the type of steel, the forming temperature and the degree of deformation. Accounting for the changes in material properties, welding requirements as stipulated in clause 11.7.5 shall be followed. The basic requirements on strength and ductility are given in clause 3.1.2. As a conservative design, no strength enhancement in round corners due to cold-forming is allowed. To ensure sufficient notch toughness, the minimum average Charpy V-notch impact test energy at the required design temperature should be in accordance with clause 3.2.

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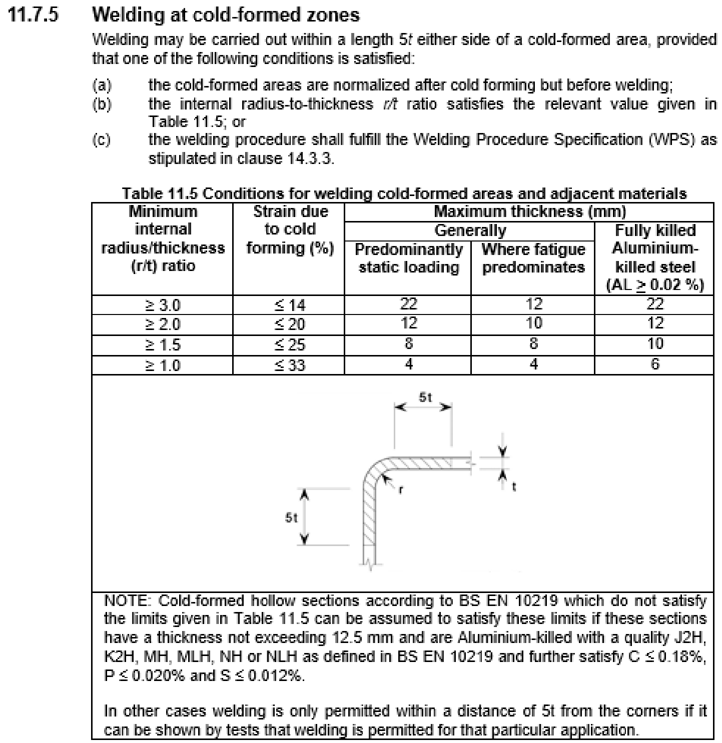
[87] Deletion of limitation of welding in cold formed areas; Addition of welding requirement.

Item

88. Table 11.7.5[88]

Current version



11.7.5 Welding at cold-formed zones

Welding may be carried out within a length 5*t* either side of a cold-formed area, provided that one of the following conditions is satisfied:

(a) the cold-formed areas are normalized after cold forming but before welding;
(b) the internal radius-to-thickness *r/t* ratio satisfies the relevant value given in Table 11.5; or
(c) the welding procedure shall fulfill the Welding Procedure Specification (WPS) as stipulated in clause 14.3.3.

Table 11.5 Conditions for welding cold-formed areas and adjacent materials

Minimum internal radius/thickness (r/t) ratio	Strain due to cold forming (%)	Maximum thickness (mm)		
		Generally		Fully killed Aluminium-killed steel (AL ≥ 0.02 %)
		Predominantly static loading	Where fatigue predominates	
≥ 3.0	≤ 14	22	12	22
≥ 2.0	≤ 20	12	10	12
≥ 1.5	≤ 25	8	8	10
≥ 1.0	≤ 33	4	4	6

NOTE: Cold-formed hollow sections according to BS EN 10219 which do not satisfy the limits given in Table 11.5 can be assumed to satisfy these limits if these sections have a thickness not exceeding 12.5 mm and are Aluminium-killed with a quality J2H, K2H, MH, MLH, NH or NLH as defined in BS EN 10219 and further satisfy C ≤ 0.18%, P ≤ 0.020% and S ≤ 0.012%.

In other cases welding is only permitted within a distance of 5t from the corners if it can be shown by tests that welding is permitted for that particular application.

Amendments

11.7.5 Welding at cold-formed zones

Welding may be carried out in the corners and the adjacent cold-formed zones, provided that one of the following conditions is satisfied:

🟥 (a) the internal radius-to-thickness r/t ratio satisfies the relevant value given in Table 11.5; or

Table 11.5 Conditions for welding cold-formed areas and adjacent materials

Minimum internal radius/thickness (r/t) ratio	Strain due to cold forming (%)	Maximum thickness (mm)		
		Generally		Fully killed Aluminium-killed steel (AL ≥ 0.02 %)
		Predominantly static loading	Where fatigue predominates	
≥ 3.0	≤ 14	22	12	22
≥ 2.0	≤ 20	12	10	12
≥ 1.5	≤ 25	8	8	10
≥ 1.0	≤ 33	4	4	6
🟥				

(b) the welding procedure shall fulfill the Welding Procedure Specification (WPS) as stipulated in clause 14.3.3.

Alternatively, welding may be carried out in the corners and the adjacent cold-formed zones of those cold-formed hollow sections which are produced to those relevant materials specifications of cold-formed hollow sections given in Annex A1.1.

---

[88] Deletion of restriction of welding at cold formed zone.

Item	Current version	Amendments
89. Clause 12.1.3[89]	Whenever fire protection materials are required to achieve the specified fire resistance period, the thicknesses of the fire protection materials should be derived from standard fire tests at accredited laboratories whilst the recommendations should be prepared by a suitably qualified person. Alternatively, current assessment methods include (a) standard fire tests, (b) limiting temperature methods, (c) performance-based design methods, and (d) simplified calculation methods.	Whenever fire protection materials are required to achieve the specified fire resistance period, the thicknesses of the fire protection materials should be derived from standard fire tests at accredited laboratories whilst the recommendations should be prepared by a suitably qualified person. Alternatively, current assessment methods include (a) standard fire tests, (b) limiting temperature methods, (c) performance-based design methods, and (d) simplified calculation methods. Connection plates, stiffeners and similar elements should be ordinarily treated with the same fire protection thickness as the primary steel member to which they are attached.

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[89] Addition of fire protection requirement for connection plates.

Item	**Current version**	**Amendments**
90. Clause 14.3.6.4[90]	*14.3.6.4 Hold time before final NDT* Owing to the risk of delayed cracking, a hold time period of at least 16 hours should generally be allowed before the final inspection is made of as-welded fabrications. This hold time should be reduced for thin materials whose yield strength is less than 500 N/mm^2 or should be increased for materials of combined thickness greater than 50 mm or of a yield strength over 500 N/mm^2. Typical hold times conforming with this requirement are illustrated in Table 14.2b. The hold time is the waiting time normally required after completion of welding. In high restraint situations (e.g. cruciform welds), the hold time might need to be increased; with evidence of continual satisfactory production, hold times might be reduced. For material with a yield strength greater than 500 N/mm^2 hold time should be decided by a welding engineer and Table 14.2b should not be used.	*14.3.6.4 Hold time before final NDT* Owing to the risk of delayed cracking, a hold time period of at least 16 hours should generally be allowed before the final inspection is made of as-welded fabrications. This hold time should be reduced for thin materials whose yield strength is less than 🟥690 N/mm^2 or should be increased for materials of combined thickness greater than 50 mm or of a yield strength over 🟥690 N/mm^2. Typical hold times conforming with this requirement are illustrated in Table 14.2b. The hold time is the waiting time normally required after completion of welding. In high restraint situations (e.g. cruciform welds), the hold time might need to be increased; with evidence of continual satisfactory production, hold times might be reduced. For material with a yield strength greater than 🟥690N/mm^2, the hold time should be 🟥submitted by the Responsible Engineer based on the advice of a welding engineer or the supplier of the welding consumables, and Table 14.2b should not be used.

---

[90] Revision of yield strength of steel for hold time.

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<td>91. Table 14.2b[91]</td>
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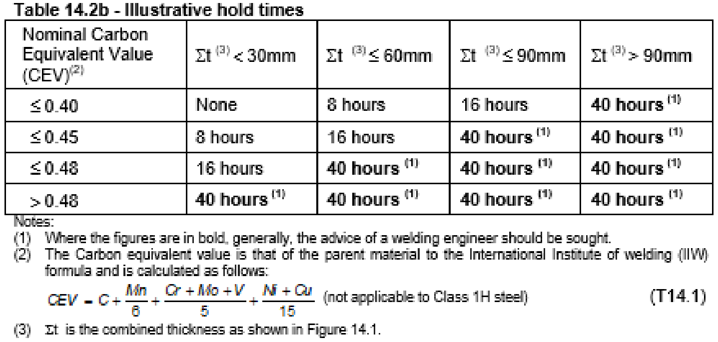

Table 14.2b - Illustrative hold times

<table>
<tr><th>Nominal Carbon Equivalent Value (CEV)⁽²⁾</th><th>Σt ⁽³⁾ < 30mm</th><th>Σt ⁽³⁾ ≤ 60mm</th><th>Σt ⁽³⁾ ≤ 90mm</th><th>Σt ⁽³⁾ > 90mm</th></tr>
<tr><td>≤ 0.40</td><td>None</td><td>8 hours</td><td>16 hours</td><td>40 hours ⁽¹⁾</td></tr>
<tr><td>≤ 0.45</td><td>8 hours</td><td>16 hours</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td></tr>
<tr><td>≤ 0.48</td><td>16 hours</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td></tr>
<tr><td>> 0.48</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td></tr>
</table>

Notes:
(1) Where the figures are in bold, generally, the advice of a welding engineer should be sought.
(2) The Carbon equivalent value is that of the parent material to the International Institute of welding (IIW) formula and is calculated as follows:

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \quad \text{(not applicable to Class 1H steel)} \qquad (T14.1)$$

(3) Σt is the combined thickness as shown in Figure 14.1.

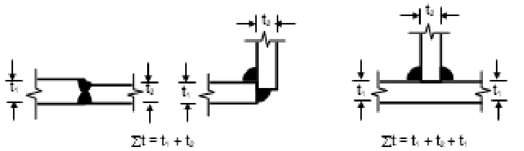

Figure 14.1 - Combined thickness

Whatever hold-time period is to be used shall be stated in the inspection records.

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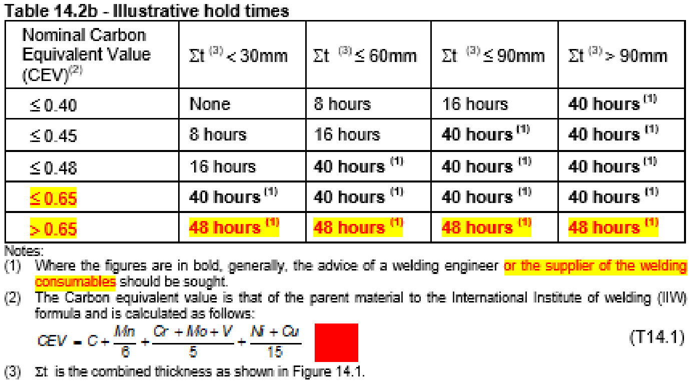

Table 14.2b - Illustrative hold times

<table>
<tr><th>Nominal Carbon Equivalent Value (CEV)⁽²⁾</th><th>Σt ⁽³⁾ < 30mm</th><th>Σt ⁽³⁾ ≤ 60mm</th><th>Σt ⁽³⁾ ≤ 90mm</th><th>Σt ⁽³⁾ > 90mm</th></tr>
<tr><td>≤ 0.40</td><td>None</td><td>8 hours</td><td>16 hours</td><td>40 hours ⁽¹⁾</td></tr>
<tr><td>≤ 0.45</td><td>8 hours</td><td>16 hours</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td></tr>
<tr><td>≤ 0.48</td><td>16 hours</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td></tr>
<tr><td>≤ 0.65</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td><td>40 hours ⁽¹⁾</td></tr>
<tr><td>> 0.65</td><td>48 hours ⁽¹⁾</td><td>48 hours ⁽¹⁾</td><td>48 hours ⁽¹⁾</td><td>48 hours ⁽¹⁾</td></tr>
</table>

Notes:
(1) Where the figures are in bold, generally, the advice of a welding engineer or the supplier of the welding consumables should be sought.
(2) The Carbon equivalent value is that of the parent material to the International Institute of welding (IIW) formula and is calculated as follows:

$$CEV = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15} \qquad (T14.1)$$

[redacted]

(3) Σt is the combined thickness as shown in Figure 14.1.

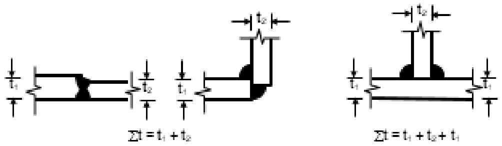

Figure 14.1 - Combined thickness

Whatever hold-time period is to be used shall be stated in the inspection records.

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<td>92. Annex A1.1.1[92]</td>
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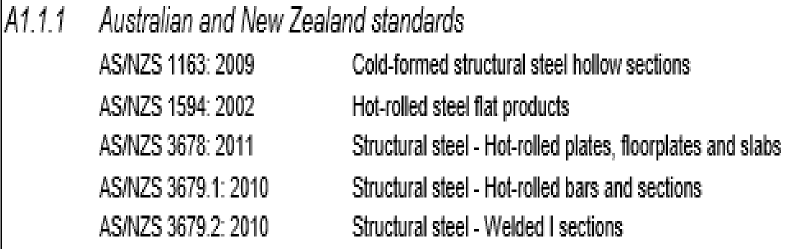

<i>A1.1.1 Australian and New Zealand standards</i>

<table>
<tr><th></th><th></th></tr>
<tr><td>AS/NZS 1163: 2009</td><td>Cold-formed structural steel hollow sections</td></tr>
<tr><td>AS/NZS 1594: 2002</td><td>Hot-rolled steel flat products</td></tr>
<tr><td>AS/NZS 3678: 2011</td><td>Structural steel - Hot-rolled plates, floorplates and slabs</td></tr>
<tr><td>AS/NZS 3679.1: 2010</td><td>Structural steel - Hot-rolled bars and sections</td></tr>
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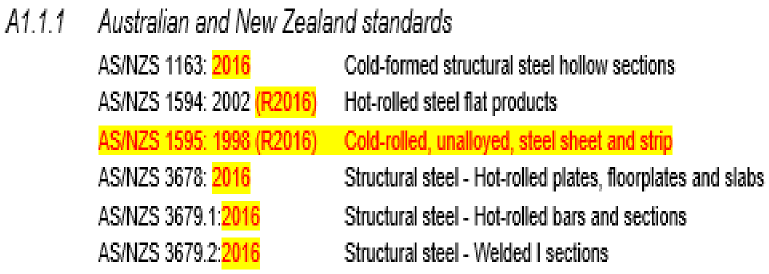

<i>A1.1.1 Australian and New Zealand standards</i>

<table>
<tr><th></th><th></th></tr>
<tr><td>AS/NZS 1163: 2016</td><td>Cold-formed structural steel hollow sections</td></tr>
<tr><td>AS/NZS 1594: 2002 (R2016)</td><td>Hot-rolled steel flat products</td></tr>
<tr><td>AS/NZS 1595: 1998 (R2016)</td><td>Cold-rolled, unalloyed, steel sheet and strip</td></tr>
<tr><td>AS/NZS 3678: 2016</td><td>Structural steel - Hot-rolled plates, floorplates and slabs</td></tr>
<tr><td>AS/NZS 3679.1:2016</td><td>Structural steel - Hot-rolled bars and sections</td></tr>
<tr><td>AS/NZS 3679.2:2016</td><td>Structural steel - Welded I sections</td></tr>
</table>

</td>
</tr>
</table>

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[91] Revision of hold times for CEV > 0.48; Deletion of restriction of Class 1H steel for formula of CEV calculation.

[92] Revision of updated standards.

93. Annex A1.1.2[93]	*A1.1.2 American standards* ASTM A36/A36M-08 Standard Specification for Carbon Structural Steel ASTM A500/A500M-10a Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes ASTM A514/A514M-05(2009) Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding ASTM A572/A572M-07 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel ASTM A618/A618M-04(2010) Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing ASTM A847/A847M-11 Standard Specification for Cold-Formed Welded and Seamless High Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance ASTM A913/A913M-07 Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST) ASTM A992/A992M-11 Standard Specification for Structural Steel Shapes	*A1.1.2 American standards* ASTM A36/A36M-19 Standard Specification for Carbon Structural Steel ASTM A283/A283-18 Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates ASTM A308–2010 Standard Specification for Steel Sheet, Terne (Lead-Tin Alloy) Coated by the Hot-Dip Process ASTM A423/A423M–19 Standard Specification for Seamless and Electric-Welded Low-Alloy Steel Tubes ASTM A500/A500M-21a Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes ASTM A514/A514M-18e1 Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding ASTM A529/A529M-19 Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality ASTM A572/A572M-21e1 Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel ASTM A588/A588M-19 Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance ASTM A595/A595M-18 Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use ASTM A618/A618M-21 Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing ASTM A653/A653M-20 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process ASTM A656/A656M-18 Standard Specification for Hot-Rolled Structural Steel, High-Strength Low-Alloy Plate with Improved Formability ASTM A709/A709M-21 Standard Specification for Structural Steel for Bridges

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[93] Revision of updated standards.

Item	Current version	Amendments
		ASTM A847/A847M-21 Standard Specification for Cold-Formed Welded and Seamless High Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance
		ASTM A871/A871M-20 Standard Specification for High Strength Low-Alloy Structural Steel Plate with Atmospheric Corrosion Resistance
		ASTM A875/A875M-21 Standard Specification for Steel Sheet, Zinc-5 % Aluminum Alloy-Coated by the Hot-Dip Process
		ASTM A913/A913M-19 Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)
		ASTM A924/A924M-20 Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
		ASTM A945–2006 Standard Specification for High-Strength Low-Alloy Structural Steel Plate with Low Carbon and Restricted Sulfur for Improved Weldability, Formability, and Toughness
		ASTM A973/A973M-20 Standard Specification for Structural Steel Shapes
		ASTM A992/A992M-20 Standard Specification for Structural Steel Shapes
		ASTM A1011/A1011M-18a Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

Item	Current version	Amendments
94. Annex A1.1.3[94]	*A1.1.3 Chinese standards* GB/T 247 - 1997 Rules of acceptance, package, label and certification for plate, strip and wide flat in structural steel GB/T 700 - 2006 Carbon structural steel GB/T 709 - 2006 Dimension, appearance, weight and tolerance of plate, strip and wide flat in hot rolled structural steel GB/T 1591 - 2008 High strength structural steel GB/T 5313 - 1985 Through thickness properties of steel plates YB 4104 - 2000 Steel plate for high rise building structure GB 50017 - 2003 Code for design of steel structures GB 50205 - 2001 Code for acceptance of construction quality of steel structures	*A1.1.3 Chinese standards* GB/T 247 - 2008 Rules of acceptance, package, label and certification for plate, strip and wide flat in structural steel GB/T 700 - 2006 Carbon structural steel GB/T 709 - 2019 Dimension, appearance, weight and tolerance of plate, strip and wide flat in hot rolled structural steel GB/T 1591 - 2018 High strength low alloy structural steel GB/T 5313 - 2010 Steel plates with through-thickness characteristics YB 4104 - 2000 Steel plate for high rise building structure GB/T 16270 - 2009 High strength structural steel plates in the quenched and tempered condition GB 50017 - 2017 Code for design of steel structures GB 50205 - 2020 Standard for acceptance of construction quality of steel structures
95. Annex A1.1.4[95]	*1.1.4 Japanese standards* JIS G 3101: 2010 Rolled steels for general structure JIS G 3106: 2008 Rolled steels for welded structure JIS G 3136: 2005 Rolled steels for building structure JIS G 3350: 2009 Light gauge steels sections for general structure JIS G 3352: 2003 Steel decks JIS G 3444: 2010 Carbon steel tubes for general structure JIS G 3466: 2010 Carbon steel square rectangular tubes for general structure JIS A 5523:2006 Weldable hot rolled steel sheet piles JIS A 5528:2006 Hot rolled steel sheet piles	*A1.1.4 Japanese standards* JIS G 3101: 2020 Rolled steels for general structure JIS G 3106: 2020 Rolled steels for welded structure JIS G 3136: 2012 Rolled steels for building structure JIS G 3350: 2021 Light gauge steels sections for general structure JIS G 3352: 2014 Steel decks JIS G 3444: 2021 Carbon steel tubes for general structure JIS G 3466: 2021 Carbon steel square rectangular tubes for general structure JIS A 5523:2021 Weldable hot rolled steel sheet piles JIS A 5528:2021 Hot rolled steel sheet piles

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[94] Revision of updated standards.

[95] Revision of updated standards.

96. Annex A1.1.5[96]	*A1.1.5 UK and European standards* BS EN 10025: 2004 Hot rolled products of non-alloy structural steels - Technical delivery conditions. BS EN 10164: 2004 Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions. BS EN 10210-1: 2006 Hot finished structural hollow sections of non-alloy and fine grain structural steels. Part 1: Technical delivery requirements. BS EN 10248-1: 1996 Hot rolled sheet piling of non alloy steels. Part 1: Technical delivery conditions BS EN 10147: 2000 Continuous hot dip zinc coated carbon steel sheet of structural quality	*A1.1.5 UK and European standards* BS EN 10025-1: 2019 Hot rolled products of non-alloy structural steels. Part 1: General technical delivery conditions BS EN 10025-2: 2019 Hot rolled products of non-alloy structural steels. Part 2: Technical delivery conditions for non-alloy structural steels BS EN 10025-3: 2019 Hot rolled products of non-alloy structural steels. Part 3: Technical delivery conditions for normalized/normalized rolled weldable fine grain structural steels BS EN 10025-4: 2019 Hot rolled products of non-alloy structural steels. Part 4: Technical delivery conditions for thermomechanical rolled weldable fine grain structural steels BS EN 10025-5: 2019 Hot rolled products of non-alloy structural steels. Part 5: Technical delivery conditions for structural steels with improved atmospheric corrosion resistance BS EN 10025-6: 2019 Hot rolled products of non-alloy structural steels. Part 6: Technical delivery conditions for flat products of high yield strength structural steels in the quenched and tempered condition BS EN 10164: 2018 Steel products with improved deformation properties perpendicular to the surface of the product - Technical delivery conditions. BS EN 10210-1: 2006 Hot finished structural hollow sections of non-alloy and fine grain structural steels. Part 1: Technical delivery requirements. BS EN 10210-2: 2019 Hot finished steel structural hollow sections. Tolerances, dimensions and sectional properties. BS EN 10210-3: 2020 Hot finished steel structural hollow sections. Technical delivery conditions for high strength and weather resistant steels. BS EN 10248-1: 1996 Hot rolled sheet piling of non alloy steels. Part 1: Technical delivery conditions BS EN 10147: 2000 Continuous hot dip zinc coated carbon steel sheet of structural quality (withdrawn, and replaced by BS EN 10346:2015) BS EN 10149-1: 2013 Hot rolled flat products made of high strength steels for cold forming – Part 1: General technical delivery conditions BS EN 10149-2: 2013 Hot rolled flat products made of high strength steels for cold forming – Part 1: Technical delivery conditions for thermomechanically rolled steels

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[96] Revision of updated standards.

Item	Current version	Amendments
		BS EN 10149-3: 2013 Hot rolled flat products made of high strength steels for cold forming – Part 1: Technical delivery conditions for normalized or normalized rolled steels BS EN 10346: 2015 Continuously hot-dip coated steel flat products for cold forming. BS EN 10219-1: 2006 Cold formed welded structural hollow sections of non-alloy and fine grain steels. Technical delivery requirements BS EN 10219-2: 2019 Cold formed welded steel structural hollow sections. Tolerances, dimensions and sectional properties BS EN 10219-3: 2020 Cold formed welded steel structural hollow sections. Technical delivery conditions for high strength and weather resistant steels

Item	Current version	Amendments
97. Annex A1.1.6[97]	*A1.1.6 Standards for destructive tests* BS EN 10002-1: 2001 Tensile testing of metallic materials. Part 1: Method of test at ambient temperature. (Withdrawn in the UK, replaced by BS EN ISO 6892-1: 2009) BS EN 10045-1: 1990 Charpy impact test on metallic materials – Part 1: Test method (V- and U-notches) (Withdrawn in the UK, replaced by BS EN ISO 148-1: 2010) BS EN ISO 148-1: 2010 Metallic materials - Charpy Pendulum impact test. Part 1: Test method BS EN ISO 6892-1: 2009 Metallic materials - Tensile testing. Part 1: Method of test at ambient temperature ASTM E8/E8M-09 Standard Test Methods for Tension Testing of Metallic Materials ASTM E23-07ae1 Standard Test Methods for Notched Bar Impact Testing of Metallic Materials ASTM A770/A770M-03 (R2007) Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications JIS G 3199: 2009 Specification for through-thickness characteristics of steel plate, wide flat and sections AS/NZS 3678: 2011 Structural steel – Hot-rolled plates, floorplates and slabs GB 5313:2000-T Specification for through-thickness characteristics of steel plate, wide flat and sections	*A1.1.6 Standards for destructive tests* BS EN ISO 148-1: 2016 Metallic materials - Charpy Pendulum impact test. Part 1: Test method BS EN ISO 6892-1: 2019 Metallic materials - Tensile testing. Part 1: Method of test at ambient temperature ASTM E8/E8M-21 Standard Test Methods for Tension Testing of Metallic Materials ASTM E23-18 Standard Test Methods for Notched Bar Impact Testing of Metallic Materials ASTM A770/A770M-03 (R2007) Standard Specification for Through-Thickness Tension Testing of Steel Plates for Special Applications JIS G 3199: 2021 Specification for through-thickness characteristics of steel plate, wide flat and sections AS/NZS 3678: 2016 Structural steel – Hot-rolled plates, floorplates and slabs GB 5313:2010 Steel plate with through-thickness characteristics

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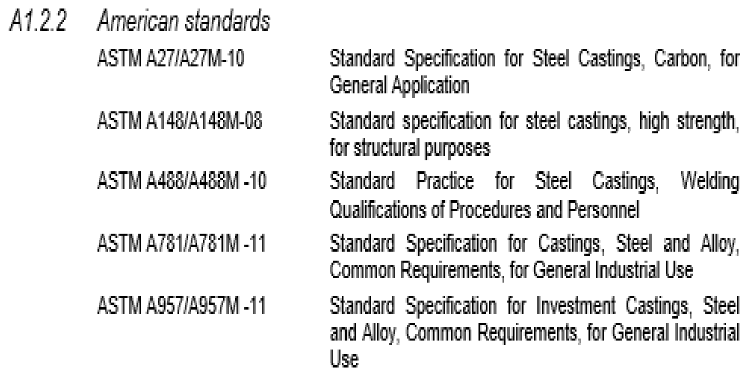
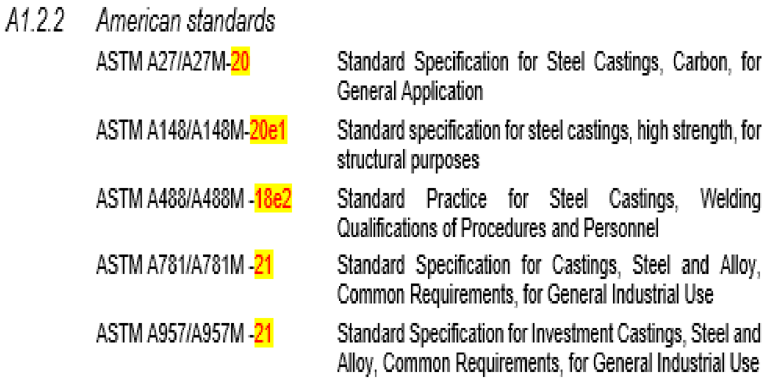
[97] Revision of updated standards.

Item	Current version	Amendments
98. Annex A1.2.2[98]	 *A1.2.2 American standards* ASTM A27/A27M-10 Standard Specification for Steel Castings, Carbon, for General Application ASTM A148/A148M-08 Standard specification for steel castings, high strength, for structural purposes ASTM A488/A488M -10 Standard Practice for Steel Castings, Welding Qualifications of Procedures and Personnel ASTM A781/A781M -11 Standard Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use ASTM A957/A957M -11 Standard Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use	 *A1.2.2 American standards* ASTM A27/A27M-20 Standard Specification for Steel Castings, Carbon, for General Application ASTM A148/A148M-20e1 Standard specification for steel castings, high strength, for structural purposes ASTM A488/A488M -18e2 Standard Practice for Steel Castings, Welding Qualifications of Procedures and Personnel ASTM A781/A781M -21 Standard Specification for Castings, Steel and Alloy, Common Requirements, for General Industrial Use ASTM A957/A957M -21 Standard Specification for Investment Castings, Steel and Alloy, Common Requirements, for General Industrial Use
99. Annex A1.2.3[99]	 *A1.2.3 Chinese standards* GB50017 – 2003 Code for design of steel structures	 *A1.2.3 Chinese standards* GB50017 – 2017 Code for design of steel structures

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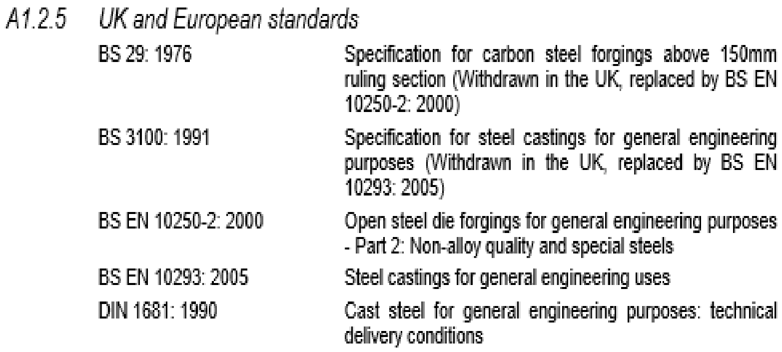
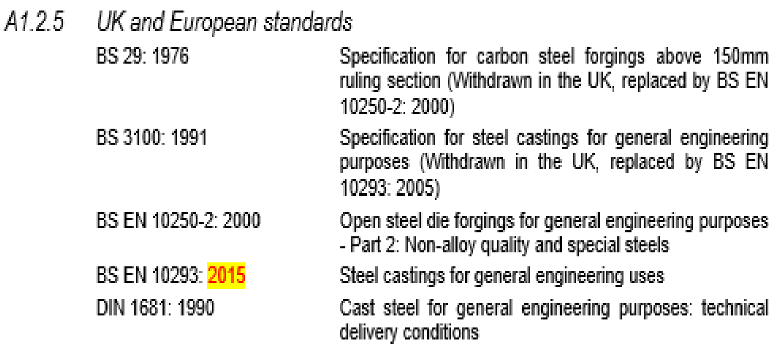
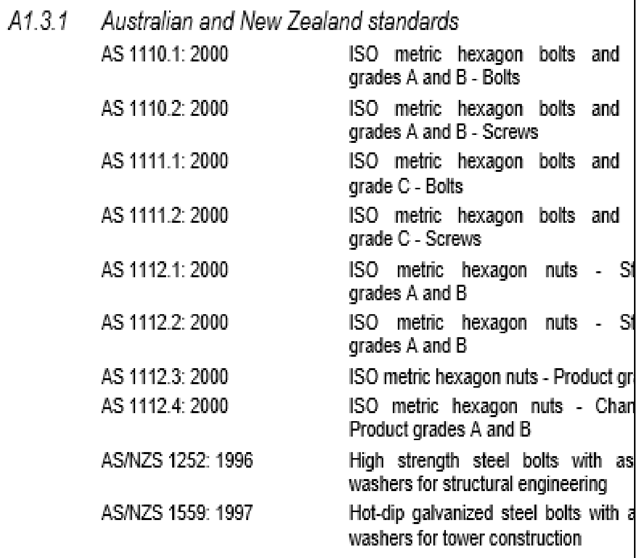
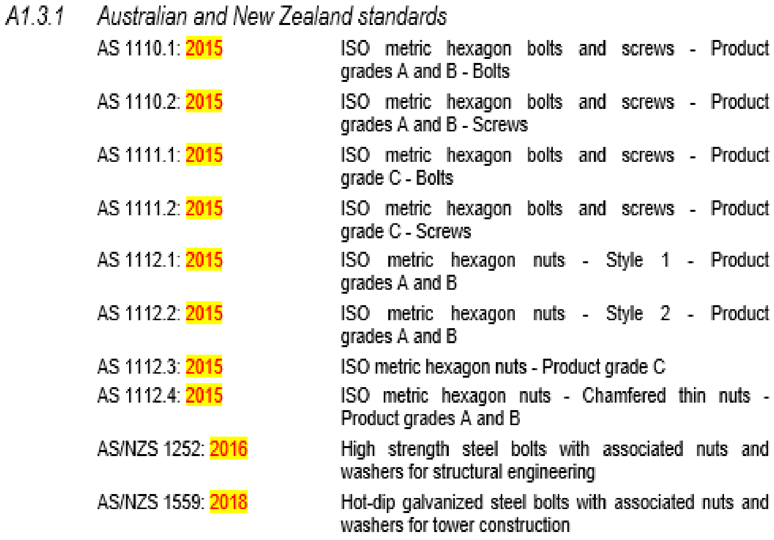
[98] Revision of updated standards.
[99] Revision of updated standards.

Item	Current version	Amendments
100. Annex A1.2.5[100]	 *A1.2.5 UK and European standards* BS 29: 1976 — Specification for carbon steel forgings above 150mm ruling section (Withdrawn in the UK, replaced by BS EN 10250-2: 2000) BS 3100: 1991 — Specification for steel castings for general engineering purposes (Withdrawn in the UK, replaced by BS EN 10293: 2005) BS EN 10250-2: 2000 — Open steel die forgings for general engineering purposes - Part 2: Non-alloy quality and special steels BS EN 10293: 2005 — Steel castings for general engineering uses DIN 1681: 1990 — Cast steel for general engineering purposes: technical delivery conditions	 *A1.2.5 UK and European standards* BS 29: 1976 — Specification for carbon steel forgings above 150mm ruling section (Withdrawn in the UK, replaced by BS EN 10250-2: 2000) BS 3100: 1991 — Specification for steel castings for general engineering purposes (Withdrawn in the UK, replaced by BS EN 10293: 2005) BS EN 10250-2: 2000 — Open steel die forgings for general engineering purposes - Part 2: Non-alloy quality and special steels BS EN 10293: 2015 — Steel castings for general engineering uses DIN 1681: 1990 — Cast steel for general engineering purposes: technical delivery conditions
101. Annex A1.3.1[101]	 *A1.3.1 Australian and New Zealand standards* AS 1110.1: 2000 — ISO metric hexagon bolts and grades A and B - Bolts AS 1110.2: 2000 — ISO metric hexagon bolts and grades A and B - Screws AS 1111.1: 2000 — ISO metric hexagon bolts and grade C - Bolts AS 1111.2: 2000 — ISO metric hexagon bolts and grade C - Screws AS 1112.1: 2000 — ISO metric hexagon nuts - St grades A and B AS 1112.2: 2000 — ISO metric hexagon nuts - St grades A and B AS 1112.3: 2000 — ISO metric hexagon nuts - Product gr AS 1112.4: 2000 — ISO metric hexagon nuts - Char Product grades A and B AS/NZS 1252: 1996 — High strength steel bolts with as washers for structural engineering AS/NZS 1559: 1997 — Hot-dip galvanized steel bolts with a washers for tower construction	 *A1.3.1 Australian and New Zealand standards* AS 1110.1: 2015 — ISO metric hexagon bolts and screws - Product grades A and B - Bolts AS 1110.2: 2015 — ISO metric hexagon bolts and screws - Product grades A and B - Screws AS 1111.1: 2015 — ISO metric hexagon bolts and screws - Product grade C - Bolts AS 1111.2: 2015 — ISO metric hexagon bolts and screws - Product grade C - Screws AS 1112.1: 2015 — ISO metric hexagon nuts - Style 1 - Product grades A and B AS 1112.2: 2015 — ISO metric hexagon nuts - Style 2 - Product grades A and B AS 1112.3: 2015 — ISO metric hexagon nuts - Product grade C AS 1112.4: 2015 — ISO metric hexagon nuts - Chamfered thin nuts - Product grades A and B AS/NZS 1252: 2016 — High strength steel bolts with associated nuts and washers for structural engineering AS/NZS 1559: 2018 — Hot-dip galvanized steel bolts with associated nuts and washers for tower construction

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[100] Revision of updated standards.

[101] Revision of updated standards.

Item	Current version		Amendments	
102. Annex A1.3.2[102]	*A1.3.2 American standards*		*A1.3.2 American standards*	
			ASTM A193-2014	Standard Specification for Alloy-steel and Stainless Steel Bolting Materials for High Temperature Service
	ASTM A194/A194M-10a	Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature, or Both	ASTM A194/A194M-20a	Standard Specification for Carbon Steel, Alloy Steel and Stainless Steel Nuts for Bolts for High Pressure or High Temperature, or Both
	ASTM A307-10	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength	ASTM A307-21	Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
	ASTM A325-10	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength	ASTM A325-2014 (withdrawn)	Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
	ASTM A325M-09	Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)	ASTM A325M-2014 (withdrawn)	Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength (Metric)
	ASTM A490-10ae1	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength	ASTM A490-14a (Withdrawn)	Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
	ASTM A490M-10	Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)	ASTM A490M-14a (Withdrawn)	Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
	ASTM A563-07a	Standard Specification for Carbons and Alloy Steel Nuts	ASTM A563/A563M-21a	Standard Specification for Carbons and Alloy Steel Nuts
	ASTM F436-11	Standard Specification for Hardened Steel Washers	ASTM F436-19	Standard Specification for Hardened Steel Washers
	ASTM F436M-10	Standard Specification for Hardened Steel Washers (Metric)	ASTM F436M-19	Standard Specification for Hardened Steel Washers (Metric)
	ASTM F1852-08	Standard Specification for 'Twist Off' Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength	ASTM F1852-14 (Withdrawn)	Standard Specification for 'Twist Off' Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
			ASTM F3125/F3125M-21	Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength
			ASTM F3148-17a	Standard Specification for High Strength Structural Bolt Assemblies, Steel and Alloy Steel, Heat Treated, 144ksi Minimum Tensile Strength, Inch Dimensions

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[102] Revision of updated standards.

Item	Current version	Amendments
103. Annex A1.3.5[103]	*A1.3.5 UK , European and ISO standards* BS 3692: 2001 — ISO metric precision hexagon bolts, screws and nuts, Specification BS 4190: 2001 — ISO metric black hexagon bolts, screws and nuts, Specification BS 4320: 1968 — Specification for metal washers for general engineering purposes. Metric series BS 4395-1: 1969 — Specification for high strength friction grip bolts and associated nuts and washers for structural engineering - Part 1: General grade BS 4395-2: 1969 — Specification for high strength friction grip bolts and associated nuts and washers for structural engineering - Part 2: Higher grade bolts and nuts and general grade washers BS 4604-1: 1970 — Specification for the use of high strength friction grip bolts in structural steelwork - Metric series - Part 1: General grade (Withdrawn in the UK, replaced by BS EN 1993-1.8: 2005) BS 4604-2: 1970 — Specification for the use of high strength friction grip bolts in structural steelwork - Metric series - Part 2: Higher grade (parallel shank) (Withdrawn in the UK, replaced by BS EN 1993-1-8: 2005) BS EN 1993-1-8: 2005 — Eurocode 3 ; Design of steel structure. Design of joints BS 4933: 2010 — Specification for ISO metric black cup and countersunk head bolts and screws with hexagon nuts BS 7419: 1991 — Specification for holding down bolts BS 7644-1: 1993 — Direct tension indicators - Part 1: Specification for compressible washers (Replaced by BS EN 14399-9: 2009 but remains current) BS 7644-2: 1993 — Direct tension indicators - Part 2: Specification for nut face and bolt face washers (Replaced by BS EN 14399-9: 2009 but remains current)	*A1.3.5 UK , European and ISO standards* BS 3692: 2014 — ISO metric precision hexagon bolts, screws and nuts, Specification BS 4190: 2014 — ISO metric black hexagon bolts, screws and nuts, Specification BS 4320: 1968 — Specification for metal washers for general engineering purposes. Metric series (Withdrawn, and replaced by BS EN ISO 898-3:2018, BS EN ISO 7091:2000, BS EN ISO 7092:2000, BS EN ISO 7093:2000, and BS EN ISO 7094:2000) BS 4395-1: 1969 — Specification for high strength friction grip bolts and associated nuts and washers for structural engineering - Part 1: General grade (Withdrawn, and replaced by BS EN 14399-1: 2015, BS EN 14399-2: 2015, BS EN 14399-3: 2015, BS EN 14399-4: 2015, BS EN 14399-5: 2015, BS EN 14399-6: 2015, BS EN 14399-7: 2018, and BS EN 14399-8: 2018) BS 4395-2: 1969 — Specification for high strength friction grip bolts and associated nuts and washers for structural engineering - Part 2: Higher grade bolts and nuts and general grade washers (Withdrawn, and replaced by BS EN 14399-1: 2005, BS EN 14399-2: 2015, BS EN 14399-3: 2015, BS EN 14399-4: 2015, BS EN 14399-5: 2015, BS EN 14399-6: 2015, BS EN 14399-7: 2018, and BS EN 14399-8: 2018) BS 4604-1: 1970 — Specification for the use of high strength friction grip bolts in structural steelwork - Metric series - Part 1: General grade (Withdrawn in the UK, replaced by BS EN 1993-1.8: 2005) BS 4604-2: 1970 — Specification for the use of high strength friction grip bolts in structural steelwork - Metric series - Part 2: Higher grade (parallel shank) (Withdrawn in the UK, replaced by BS EN 1993-1-8: 2005) BS EN 1993-1-8: 2005 — Eurocode 3 ; Design of steel structure. Design of joints BS 4933: 2010 — Specification for ISO metric black cup and countersunk head bolts and screws with hexagon nuts BS 7419: 1991 — Specification for holding down bolts BS 7644-1: 1993 — Direct tension indicators - Part 1: Specification for compressible washers (Replaced by BS EN 14399-9: 2009 but remains current) BS 7644-2: 1993 — Direct tension indicators - Part 2: Specification for nut face and bolt face washers (Replaced by BS EN 14399-9: 2009 but remains current)

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[103] Revision of updated standards.

Item	Current version	Amendments
Annex A1.3.5 (Cont’d)	BS EN 14399-9: 2009 High strength structural bolting for preloading. System HR or HV. Part 9: Direct tension indicators for bolts and nuts assemblies BS EN ISO 4014: 2011 Hexagon head bolts: Product grades A and B BS EN ISO 4016: 2011 Hexagon head bolts: Product grade C BS EN ISO 4017: 2011 Hexagon head screws: Product grades A and B BS EN ISO 4018: 2011 Hexagon head screws: Product grade C BS EN ISO 4032: 2001 Hexagon nuts, style 1: Product grades A and B BS EN ISO 4033: 2001 Hexagon nuts, style 2: Product grades A and B BS EN ISO 4034: 2001 Hexagon nuts: Product grade C BS EN ISO 7091: 2000 Plain washers: Normal series, Product grade C	BS EN 14399-1: 2015 High-strength structural bolting assemblies for preloading. General requirements. BS EN 14399-2: 2015 High-strength structural bolting assemblies for preloading. Suitability for preloading. BS EN 14399-3: 2015 High-strength structural bolting assemblies for preloading. System HR. Hexagon bolt and nut assemblies. BS EN 14399-4: 2015 High-strength structural bolting assemblies for preloading. System HV. Hexagon bolt and nut assemblies. BS EN 14399-5: 2015 High-strength structural bolting assemblies for preloading. Plain washers. BS EN 14399-6: 2015 High-strength structural bolting assemblies for preloading. Plain chamfered washers. BS EN 14399-7: 2018 High-strength structural bolting assemblies for preloading. System HR. Countersunk head bolt and nut assemblies. BS EN 14399-8: 2018 High-strength structural bolting assemblies for preloading. System HV. Hexagon fit bolt and nut assemblies. BS EN 14399-9: 2018 High strength structural bolting for preloading. System HR or HV. Part 9: Direct tension indicators for bolts and nuts assemblies. BS EN ISO 898-1:2013 Mechanical properties of fasteners made of carbon steel and alloy steel. Bolts, screws and studs with specified property classes. Coarse thread and fine pitch thread. BS EN ISO 898-2:2012 Mechanical properties of fasteners made of carbon steel and alloy steel. Nuts with specified property classes. Coarse thread and fine pitch thread. BS EN ISO 898-3:2018+A1:21 Fasteners. Mechanical properties of fasteners made of carbon steel and alloy steel. Flat washers with specified property classes View details. BS EN ISO 4014: 2011 Hexagon head bolts: Product grades A and B. BS EN ISO 4016: 2011 Hexagon head bolts: Product grade C. BS EN ISO 4017: 2011 Hexagon head screws: Product grades A and B. BS EN ISO 4018: 2011 Hexagon head screws: Product grade C. BS EN ISO 4032: 2001 Hexagon nuts, style 1: Product grades A and B. BS EN ISO 4033: 2001 Hexagon nuts, style 2: Product grades A and B. BS EN ISO 4034: 2001 Hexagon nuts: Product grade C. BS EN ISO 7091: 2000 Plain washers: Normal series, Product grade C.

Item	Current version	Amendments
104. Annex A1.4.1.1[104]	*A1.4.1.1 American standards* AWS D1.1/D1.1M: 2010 Structural Welding Code - Steel AWS D1.3/D1.3M: 2008 Structural Welding Code - Sheet Steel	*A1.4.1.1 American standards* AWS D1.1/D1.1M: 2010 Structural Welding Code - Steel AWS D1.3/D1.3M: 2008 Structural Welding Code - Sheet Steel AWS A5.5/5.5M: 2014 Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding AWS A5.23/5.23M: 2021 Specification for Low-Alloy and High Manganese Steel Electrodes and Fluxes for Submerged Arc Welding AWS A5.28/A5.28M: 2005 Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding AWS A5.29/A5.29M: 2010 Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding

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[104] Revision of updated standards.

Item	Current version	Amendments
105. Annex A1.4.1.2[105]	BS EN 758: 1997 – Welding consumables. Tubular cored electrodes for metal arc welding with and without a gas shield of non-alloy and fine grain steels. Classification (Withdrawn in the UK, replaced by BS EN ISO 17632: 2008) BS EN ISO 17632: 2008 – Welding consumables. Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steel. Classification BS EN 1011-1: 2009 – Welding - Recommendations for welding of metallic materials. Part 1: General guidance for arc welding BS EN 1011-2: 2001 – Welding - Recommendations for welding of metallic materials. Part 2: Arc welding of ferritic steels BS EN 22553: 1995 – Welded, brazed and soldered joints - Symbolic representation on drawings	BS EN 758: 1997 – Welding consumables. Tubular cored electrodes for metal arc welding with and without a gas shield of non-alloy and fine grain steels. Classification (Withdrawn in the UK, replaced by BS EN ISO 17632: 2008) BS EN ISO 17632: 2008 – Welding consumables. Tubular cored electrodes for gas shielded and non-gas shielded metal arc welding of non-alloy and fine grain steel. Classification BS EN 1011-1: 2009 – Welding - Recommendations for welding of metallic materials. Part 1: General guidance for arc welding BS EN 1011-2: 2001 – Welding - Recommendations for welding of metallic materials. Part 2: Arc welding of ferritic steels BS EN 22553: 1995 – Welded, brazed and soldered joints - Symbolic representation on drawings BS EN ISO 14174: 2018 – Welding consumables. Fluxes for submerged arc welding and electroslag welding. Classification. BS EN ISO 18275: 2018 – Welding consumables – Covered electrodes for manual metal arc welding of high-strength steels – Classification BS EN ISO 18276: 2017 – Welding consumables – Tubular cored electrodes for gas-shielded and non-gas-shielded metal arc welding of high-strength steels – Classification BS EN ISO 16834: 2012 – Welding consumables – Wire electrodes, wires, rods and deposits for gas shielded arc welding of high-strength steels – Classification BS EN ISO 26304: 2018 – Welding consumables - Solid wire electrodes, tubular cored electrodes and electrode-flux combinations for submerged arc welding of high strength steels - Classification (ISO 26304:2017)

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[105] Revision of updated standards.

Item	Current version		Amendments	
106. Annex A1.4.2.2[106]	*A1.4.2.2*	*UK European and ISO standards*	*A1.4.2.2*	*UK European and ISO standards*
	BS EN 288-3: 1992	Specification and approval of welding procedures for metallic materials. Part 3: Welding procedure tests for the arc welding of steels (Withdrawn in the UK, replaced by BS EN ISO 15614-1: 2004+A1: 2008)	BS EN 288-3: 1992	Specification and approval of welding procedures for metallic materials. Part 3: Welding procedure tests for the arc welding of steels (Withdrawn in the UK, replaced by BS EN ISO 15614-1: 2017+A1: 2019)
			BS EN ISO 15607:2019	Specification and qualification of welding procedures for metallic materials – General rules
			BS EN ISO 15609-1:2019(E)	Specification and qualification of welding procedures for metallic materials – Welding procedures specification – Part 1: Arc welding
	BS EN ISO 15614-1: 2004 +A1: 2008	Specification and qualification of welding procedure for metallic materials. Welding procedure test. Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys	BS EN ISO 15614-1: 2017 +A1: 2019	Specification and qualification of welding procedures for metallic materials - Welding procedure test - Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys
	BS EN ISO 15614-8:2002	Specification and qualification of welding procedures for metallic materials – welding procedure test. Part 8: Welding of tubes to tube-plate joints	BS EN ISO 15614-8:2016	Specification and qualification of welding procedures for metallic materials – Welding procedure test - Part 8: Welding of tubes to tube-plate joints
107. Annex A1.4.3.2[107]	*A1.4.3.2*	*UK European and ISO standards*	*A1.4.3.2*	*UK European and ISO standards*
	BS EN 287-1: 2004	Qualification test of welders. Fusion welding. Part 1: Steels	BS EN 287-1: 2011	Qualification test of welders. Fusion welding. Part 1: Steels (Withdrawn, and replaced by BS EN ISO 9606-1:2017)
	ISO 9606-1: 1994	Approval testing of welders. Fusion welding. Part 1: Steels	ISO 9606-1: 2017	Qualification testing of welders. Fusion welding. Steels
	BS EN 1418:1998	Welding personnel. Approved testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials	BS EN 1418:1998	Welding personnel. Approved testing of welding operators for fusion welding and resistance weld setters for fully mechanized and automatic welding of metallic materials (Withdrawn, and replaced by BS EN ISO 14732:2013)
	BS 4871-3:1985	Specification for approval testing of welders to approved welding procedure. Part 3: Arc welding of tube to tube-plate joints in metallic materials	BS 4871-3:1985	Specification for approval testing of welders to approved welding procedure. Part 3: Arc welding of tube to tube-plate joints in metallic materials
	BS 4872-1:1982	Specification for approval testing of welders to welding procedure approval is not required. Part 1: Fusion welding of steel	BS 4872-1:1982	Specification for approval testing of welders to welding procedure approval is not required. Part 1: Fusion welding of steel
			BS EN 14732:2013	Welding personnel. Qualification testing of welding operators and weld setters for mechanized and automatic welding of metallic materials

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[106] Revision of updated standards.
[107] Revision of updated standards.

108. Annex 1.4.4.2[108]	*A1.4.4.2 UK European and ISO standards* BS 3923: Part 1: 1986 — Methods for ultrasonic examination of welds. Part 1: Methods for manual examination of fusion welds in ferritic steels (Withdrawn in the UK, replaced by BS EN 1714: 1998) BS EN 1714: 1998 — Non-destructive testing of welded joints. Ultrasonic examination of welded joints (Withdrawn in the UK, replaced by BS EN ISO 17640: 2010) BS EN ISO 17640: 2010 — Non-destructive testing of welds. Ultrasonic testing, Techniques, testing levels and assessment BS EN 571-1: 1997 — Non-destructive testing. Penetrant testing. Part 1 : General principles BS EN 970: 1997 — Non-destructive examination of fusion welds. Visual examination (Withdrawn in the UK, replaced by BS EN ISO 17637: 2011) BS EN ISO 17637: 2011 — Non-destructive testing of welds. Visual testing of fusion welded joints BS EN 1290: 1998 — Non-destructive examination of welds. Magnetic particle examination of welds (Withdrawn in the UK, replaced by BS EN ISO 17638: 2009) BS EN ISO 17638: 2009 — Non-destructive testing of welds. Magnetic particle testing BS EN 1435: 1997 — Non-destructive examination of welds. Radiographic examination of welded joints BS EN ISO 9934-1: 2001 — Non-destructive testing. Magnetic particle testing. Part 1 : General Principles The abstracted essentials for typically used welding symbols are given in **Annex C**.	*A1.4.4.2 UK European and ISO standards* BS 3923: Part 1: 1986 — Methods for ultrasonic examination of welds. Part 1: Methods for manual examination of fusion welds in ferritic steels (Withdrawn in the UK, replaced by BS EN 1714: 1998) BS EN 1714: 1998 — Non-destructive testing of welded joints. Ultrasonic examination of welded joints (Withdrawn in the UK, replaced by BS EN ISO 17640: 2018) BS EN ISO 17640: 2018 — Non-destructive testing of welds. Ultrasonic testing, Techniques, testing levels and assessment BS EN 571-1: 1997 — Non-destructive testing. Penetrant testing. Part 1 : General principles (Withdrawn and replaced by BS EN ISO 34521-1:2021) BS EN ISO 3452-1 :2021 — Non-destructive testing. Penetrant testing. General principles BS EN 970: 1997 — Non-destructive examination of fusion welds. Visual examination (Withdrawn in the UK, replaced by BS EN ISO 17637: 2016) BS EN 1290: 1998 — Non-destructive examination of welds. Magnetic particle examination of welds (Withdrawn in the UK, replaced by BS EN ISO 17638: 2016) BS EN ISO 17637: 2016 — Non-destructive testing of welds. Visual testing of fusion welded joints BS EN ISO 17638: 2016 — Non-destructive testing of welds. Magnetic particle testing BS EN ISO 17639: 2022 — Destructive tests on welds in metallic materials. Macroscopic and microscopic examination of welds BS EN 1435: 1997 — Non-destructive examination of welds. Radiographic examination of welded joints (Withdrawn, and replaced by BS EN ISO 17636-1:2013, and BS EN ISO 17636-2:2013) BS EN ISO 9934-1: 2016 — Non-destructive testing. Magnetic particle testing. Part 1 : General Principles BS EN ISO 17636-1:2013 — Non-destructive testing of welds. Radiographic testing. X- and gamma-ray techniques with film BS EN ISO 17636-2:2013 — Non-destructive testing of welds. Radiographic testing. X- and gamma-ray techniques with film

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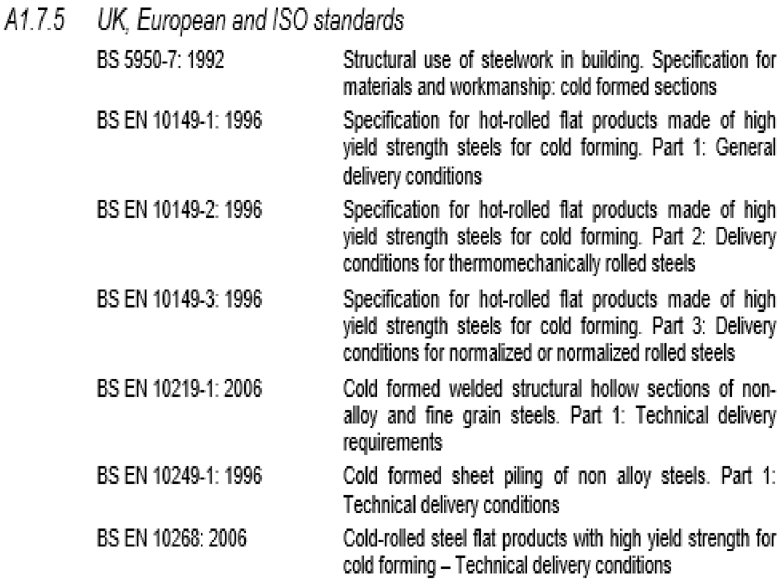
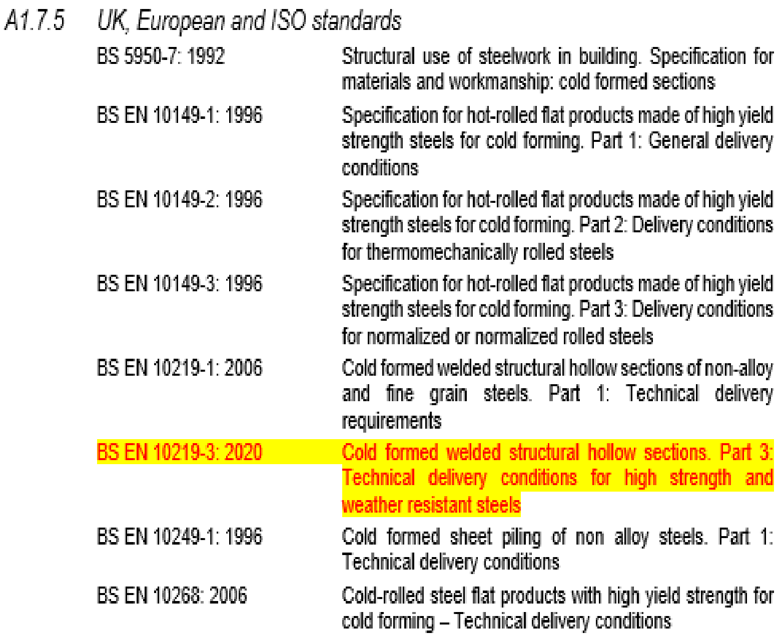
[108] Revision of updated standards.

Item	Current version	Amendments
		BS EN ISO 10893-2:2011 + A1:2020 Non-destructive testing of steel tubes. Automated eddy current testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of imperfections BS EN ISO 10893-3:2011 + A1:2020 Non-destructive testing of steel tubes. Automated full peripheral flux leakage testing of seamless and welded (except submerged arc-welded) ferromagnetic steel tubes for the detection of longitudinal and/or transverse imperfections BS EN ISO 10893-8:2011 + A1:2020 Non-destructive testing of steel tubes. Automated ultrasonic testing of seamless and welded steel tubes for the detection of laminar imperfections BS EN ISO 10893-9:2011 + A1:2020 Non-destructive testing of steel tubes. Automated ultrasonic testing for the detection of laminar imperfections in strip/plate used for the manufacture of welded steel tubes BS EN ISO 10893-10:2011 + A1:2020 Non-destructive testing of steel tubes. Automated full peripheral ultrasonic testing of seamless and welded (except submerged arc-welded) steel tubes for the detection of longitudinal and/or transverse imperfections

Item	Current version	Amendments
109. Annex 1.4.5[109]	*A1.4.5 Destructive test methods for welds* BS EN 875:1995 Destructive tests on welds in metallic materials. Impact tests. Test specimen location, notch orientation and examination (Withdrawn in the UK, replaced by BS EN ISO 9016: 2011) BS EN ISO 9016: 2011 Destructive tests on welds in metallic materials. Impact tests. Test specimen location, notch orientation and examination BS EN 876:1995 Destructive tests on welds in metallic materials. Longitudinal tensile tests on weld metal in fusion welded joints (Withdrawn in the UK, replaced by BS EN ISO 5178: 2011) BS EN ISO 5178: 2011 Destructive tests on welds in metallic materials. Longitudinal tensile tests on weld metal in fusion welded joints BS EN 895:1995 Destructive tests on welds in metallic materials. Transverse tensile test (Withdrawn in the UK, replaced by BS EN ISO 4136: 2011) BS EN ISO 4136: 2011 Destructive tests on welds in metallic materials. Transverse tensile test BS EN 910:1996 Destructive tests on welds in metallic materials. Bend tests (Withdrawn in the UK, replaced by BS EN ISO 5173: 2010) BS EN ISO 5173: 2010 Destructive tests on welds in metallic materials. Bend tests BS EN 1043-1:1996 Destructive tests on welds in metallic materials. Hardness testing hardness test on arc welded joints (Withdrawn in the UK, replaced by BS EN ISO 9015: 2011) BS EN ISO 9015: 2011 Destructive tests on welds in metallic materials. Hardness testing hardness test on arc welded joints BS EN 1320:1997 Destructive tests on welds in metallic materials. Fracture tests BS EN 1321:1997 Destructive tests on welds in metallic materials. Macroscopic and microscopic examination of welds BS EN ISO 6505:1-3: 2005 Metallic materials. Brinell hardness test BS EN ISO 6507:1-3: 2005 Metallic materials. Vickers hardness test	*A1.4.5 Destructive test methods for welds* BS EN 875:1995 Destructive tests on welds in metallic materials. Impact tests. Test specimen location, notch orientation and examination (Withdrawn in the UK, replaced by BS EN ISO 9016: 2022) BS EN ISO 9016: 2022 Destructive tests on welds in metallic materials. Impact tests. Test specimen location, notch orientation and examination BS EN 876:1995 Destructive tests on welds in metallic materials. Longitudinal tensile tests on weld metal in fusion welded joints (Withdrawn in the UK, replaced by BS EN ISO 5178: 2019) BS EN ISO 5178: 2019 Destructive tests on welds in metallic materials. Longitudinal tensile tests on weld metal in fusion welded joints BS EN 895:1995 Destructive tests on welds in metallic materials. Transverse tensile test (Withdrawn in the UK, replaced by BS EN ISO 4136: 2022) BS EN ISO 4136: 2022 Destructive tests on welds in metallic materials. Transverse tensile test BS EN 910:1996 Destructive tests on welds in metallic materials. Bend tests (Withdrawn in the UK, replaced by BS EN ISO 5173: 2010) BS EN ISO 5173: 2010 Destructive tests on welds in metallic materials. Bend tests BS EN 1043-1:1996 Destructive tests on welds in metallic materials. Hardness testing hardness test on arc welded joints (Withdrawn in the UK, replaced by BS EN ISO 9015: 2016) BS EN ISO 9015: 2016 Destructive tests on welds in metallic materials. Hardness testing hardness test on arc welded joints BS EN 1320:1997 Destructive tests on welds in metallic materials. Fracture tests (Withdrawn and replaced by BS EN ISO 9017:2018) BS EN 1321:1997 Destructive tests on welds in metallic materials. Macroscopic and microscopic examination of welds (Withdrawn and replaced by BS EN ISO 17639:2022) BS EN ISO 9017:2018 Destructive tests on welds in metallic materials. Fracture test BS EN ISO 17639:2022 Destructive tests on welds in metallic materials. Macroscopic and microscopic examination of welds BS EN ISO 6505:1-3: 2005 Metallic materials. Brinell hardness test BS EN ISO 6507:1-3: 2005 Metallic materials. Vickers hardness test

Item	Current version		Amendments	
110. Annex A1.7.5[110]	 *A1.7.5*	*UK, European and ISO standards*	 *A1.7.5*	*UK, European and ISO standards*
	BS 5950-7: 1992	Structural use of steelwork in building. Specification for materials and workmanship: cold formed sections	BS 5950-7: 1992	Structural use of steelwork in building. Specification for materials and workmanship: cold formed sections
	BS EN 10149-1: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 1: General delivery conditions	BS EN 10149-1: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 1: General delivery conditions
	BS EN 10149-2: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 2: Delivery conditions for thermomechanically rolled steels	BS EN 10149-2: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 2: Delivery conditions for thermomechanically rolled steels
	BS EN 10149-3: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 3: Delivery conditions for normalized or normalized rolled steels	BS EN 10149-3: 1996	Specification for hot-rolled flat products made of high yield strength steels for cold forming. Part 3: Delivery conditions for normalized or normalized rolled steels
	BS EN 10219-1: 2006	Cold formed welded structural hollow sections of non-alloy and fine grain steels. Part 1: Technical delivery requirements	BS EN 10219-1: 2006	Cold formed welded structural hollow sections of non-alloy and fine grain steels. Part 1: Technical delivery requirements
			BS EN 10219-3: 2020	Cold formed welded structural hollow sections. Part 3: Technical delivery conditions for high strength and weather resistant steels
	BS EN 10249-1: 1996	Cold formed sheet piling of non alloy steels. Part 1: Technical delivery conditions	BS EN 10249-1: 1996	Cold formed sheet piling of non alloy steels. Part 1: Technical delivery conditions
	BS EN 10268: 2006	Cold-rolled steel flat products with high yield strength for cold forming – Technical delivery conditions	BS EN 10268: 2006	Cold-rolled steel flat products with high yield strength for cold forming – Technical delivery conditions

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[109] Revision of updated standards.

[110] Revision of updated standards.

Item	Current version	Amendments
111. Annex A2.3[111]	**A2.3 UK and European Standards** BS 5950: Structural use of steelwork in building: Part 1: 2000 Code of practice for design - Rolled and welded sections (Withdrawn in the UK, replaced by group of BS EN 1993-1-1: 2005, BS EN 1993-1-5: 2006, BS EN 1993-1-10: 2005, BS EN 1993-5: 2007, BS EN 1993-6: 2007 & BS EN 1993-1-8: 2005) Part 2: 2001 Specification for materials, fabrication and erection - Rolled and welded sections (Withdrawn in the UK, replaced by BS EN 1090-2: 2008) Part 3: 1990 Design in composite construction - Code of practice for design of simple and continuous composite beams (Withdrawn in the UK, replaced by BS EN 1994-1-1: 2004) Part 4: 1994 Code of practice for design of composite slabs with profiled steel sheeting (Withdrawn in the UK, replaced by BS EN 1994-1-1: 2004) Part 5: 1998 Code of practice for design of cold formed thin gauge sections (Withdrawn in the UK, replaced by BS EN 1993-1-3: 2006) Part 6: 1995 Code of practice for design of light gauge profiled steel sheeting (Withdrawn in the UK, replaced by BS EN 1993-1-3: 2006) Part 7: 1992 Specification for materials and workmanship: cold formed sections Part 8: 2003 Code of practice for fire resistant design (Withdrawn in the UK, replaced by BS EN 1993-1-2: 2005) BS 499-2c: 1999 Welding terms and symbols. Part 2c : European arc welding symbols in chart form BS 5427-1: 1996 Code of practice for the use of profiled sheet for roof and wall cladding on buildings. Part 1: Design BS 7608: 1993 Code of Practice for Fatigue Design and Assessment of Structures BS EN 1090-2: 2008 Execution of steel structures and aluminium structures. Part 2 : Technical requirements for the execution of steel structures BS EN 1991-2: 2003 Eurocode 1: Actions on structures. Part 2: Traffic loads on bridges	**A2.3 UK and European Standards** BS 5950: Structural use of steelwork in building: Part 1: 2000 Code of practice for design - Rolled and welded sections (Withdrawn in the UK, replaced by group of BS EN 1993-1-1: 2005, BS EN 1993-1-5: 2006, BS EN 1993-1-10: 2005, BS EN 1993-5: 2007, BS EN 1993-6: 2007 & BS EN 1993-1-8: 2005) Part 2: 2001 Specification for materials, fabrication and erection - Rolled and welded sections (Withdrawn in the UK, replaced by BS EN 1090-2: 2008) Part 3: 1990 Design in composite construction - Code of practice for design of simple and continuous composite beams (Withdrawn in the UK, replaced by BS EN 1994-1-1: 2004) Part 4: 1994 Code of practice for design of composite slabs with profiled steel sheeting (Withdrawn in the UK, replaced by BS EN 1994-1-1: 2004) Part 5: 1998 Code of practice for design of cold formed thin gauge sections (Withdrawn in the UK, replaced by BS EN 1993-1-3: 2006) Part 6: 1995 Code of practice for design of light gauge profiled steel sheeting (Withdrawn in the UK, replaced by BS EN 1993-1-3: 2006) Part 7: 1992 Specification for materials and workmanship: cold formed sections Part 8: 2003 Code of practice for fire resistant design (Withdrawn in the UK, replaced by BS EN 1993-1-2: 2005) BS 499-2c: 1999 Welding terms and symbols. Part 2c : European arc welding symbols in chart form BS 5427-1: 1996 Code of practice for the use of profiled sheet for roof and wall cladding on buildings. Part 1: Design BS 7608: 1993 Code of Practice for Fatigue Design and Assessment of Structures BS EN 1090-1: 2009+A1:2011 Execution of steel structures and aluminium structures. Part 1: Requirements for conformity assessment of structural components BS EN 1090-2: 2008 Execution of steel structures and aluminium structures. Part 2 : Technical requirements for the execution of steel structures BS EN 1991-2: 2003 Eurocode 1: Actions on structures. Part 2: Traffic loads on bridges

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[111] Revision of updated standards.

Item	Current version	Amendments
112. Page Index of Annex A[112]	ANNEX A REFERENCES .... 341 A1 ACCEPTABLE STANDARDS AND REFERENCES .... 341 A1.1 *Steel materials* .... 341 A1.2 *Castings and forgings* .... 343 A1.3 *Bolts* .... 344 A1.4 *Welding* .... 347 A1.5 *Materials for composite design* .... 350 A1.6 *Shear studs* .... 350 A1.7 *Cold-formed steel materials* .... 350 A1.8 *Dimensions and tolerances of sections* .... 351 A1.9 *Protective treatment* .... 353 A1.10 *Other acceptable references* .... 353 A2 INFORMATIVE REFERENCES .... 354 A2.1 *Practice Notes for Authorized Persons and Registered Structural Engineers* .... 354 A2.2 *The Steel Construction Institute, UK* .... 354 A2.3 *UK and European Standards* .... 354 A2.4 *Australian Standards* .... 355 A2.5 *General references* 355	ANNEX A REFERENCES .... 341 A1 ACCEPTABLE STANDARDS AND REFERENCES .... 341 A1.1 *Steel materials* .... 341 A1.2 *Castings and forgings* .... 344 A1.3 *Bolts* .... 345 A1.4 *Welding* .... 349 A1.5 *Materials for composite design* .... 353 A1.6 *Shear studs* .... 353 A1.7 *Cold-formed steel materials* .... 354 A1.8 *Dimensions and tolerances of sections* .... 355 A1.9 *Protective treatment* .... 356 A1.10 *Other acceptable references* .... 356 A2 INFORMATIVE REFERENCES .... 357 A2.1 *Practice Notes for Authorized Persons and Registered Structural Engineers* .... 357 A2.2 *The Steel Construction Institute, UK* .... 357 A2.3 *UK and European Standards* .... 357 A2.4 *Australian Standards* .... 359 A2.5 *General references* 359
113. Annex D1[113]	**D1 TESTING TO ESTABLISH STEEL CLASS** Class 2 steel: Where steel is not supplied in accordance with one of the recognized reference material standards in Annex A1.1 and the supplier has an acceptable quality assurance system, testing should be carried out to establish compliance with one of the five reference material standards in Annex A1.1. Tests shall include tensile strength and ductility, notch toughness and chemical composition. At a minimum one test in each category shall be made for every 20 tonnes of steel or part thereof the same product form, of the same range of thickness or diameter, and of the same cast. The results of each test and the characteristic value obtained by statistical analysis shall not be less than the value required	**D1 TESTING TO ESTABLISH STEEL CLASS** Class 1 steel and Class 1H steel: No additional testing is needed as these steels comply with one of the reference material standards in Annex A1.1 and the basic requirements given in clause 3.1.2, and the steels are produced from a manufacturer with an acceptable Quality Assurance system. Class 2 steel: Where steels are not supplied in accordance with one of the recognized reference material standards in Annex A1.1 but are produced from a manufacturer with an acceptable Quality Assurance system, such steels shall be tested to show that they comply with

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[112] Revision of page index of Annex A.

[113] Addition for Class 1 and Class 1H steel; Revision of Class 2 and Class 3 steel.

Item	Current version	Amendments
	by the standard. Table D1a below lists the essential performance requirements for hot rolled structural steel sections, flats, plates and hot finished and cold formed structural hollow sections. Table D1b lists the essential performance requirements for structural sections of cold formed steel. Class 3 steel: Uncertified steel shall be tested for tensile strength and ductility to demonstrate that it has a yield strength of at least 170N/mm^2, an elongation of at least 15% and an ultimate tensile strength of at least 300N/mm^2. One test in each category shall be made for every 20 tonnes of steel or part thereof the same product form, of the same thickness or diameter. If the steel is to be welded, the Responsible Engineer may additionally require tests for weldability as described in Annex D1.1. Quality control of testing The testing shall be carried out to meet the reference material standards given in Annex A1.1 by a HOKLAS accredited laboratory or by other laboratory accreditation bodies which have reached mutual recognition agreements/arrangements with HOKLAS.	one of the reference material standards in Annex A1.1. Tests shall include tensile strength and ductility, notch toughness and chemical compositions. At a minimum one test in each category shall be made for every 20 tonnes of steels or part thereof the same product form, of the same range of sizes and thicknesses, and of the same cast. The results of each test and the characteristic value obtained by statistical analysis shall not be less than the value required by the standard. Class 3 steel: Uncertified steels shall be tested for tensile strength and ductility to demonstrate that they have a yield strength of at least 170N/mm^2, an elongation of at least 15% and a tensile strength of at least 300N/mm^2. One test in each category shall be made for every 20 tonnes of steels or part thereof the same product form, of the same range of sizes and thicknesses. If the steels are to be welded, the Responsible Engineer may additionally require tests for weldability as described in Annex D1.1. Quality control of testing The testing shall be carried out to meet the reference material standards listed in Annex A1.1 by a HOKLAS accredited laboratory or by other laboratory accreditation bodies which have reached mutual recognition agreements/arrangements with HOKLAS.

Item	Current version	Amendments
114. Annex D1.1[114]	**D1.1 Essential requirements** **Strength:** The design strength shall be the minimum yield strength but not greater than the minimum tensile strength divided by a material factor with a minimum value of 1.2. **Resistance to brittle fracture:** The minimum average Charpy V-notch impact test energy at the required design temperature shall be in accordance with clause 3.2 of the Code in order to provide sufficient notch toughness. **Ductility:** The elongation on a gauge length of $5.65\sqrt{S_o}$ is not to be less than 15% where S_o is the cross sectional area of the section. **Weldability:** The chemical composition and maximum carbon equivalent value for Class 1 steel shall conform to the respective reference materials standard in Annex A1.1. The maximum carbon equivalent value for steels to Class 2 shall not exceed 0.48% on ladle analysis and the carbon content shall not exceed 0.24%. For general applications the maximum sulphur content shall not exceed 0.03% and the maximum phosphorus contents shall not exceed 0.03%. When through thickness quality (Z quality) steel is specified the sulphur content	**D1.1 Essential requirements** The basic requirements for structural steels are: ● **Strength** [redacted] ● **Resistance to brittle fracture** [redacted] ● **Ductility** [redacted] ● **Weldability** [redacted] [redacted] Table D1a lists the essential performance requirements for typical hot rolled sections and plates, and hot finished and cold formed structural hollow sections. Table D1b lists the essential performance requirements for typical cold formed thin gauge steel.

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[114] Revision of basic requirement of structural steel with simplified description.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td></td><td>shall not exceed 0.01%. The chemical compositions of various grades of steel shall also conform to the requirements stipulated in the national standards where they are manufactured.
If it is required to weld Class 3 steel, then it shall also comply with the above.</td><td></td></tr>
<tr><td>115. Table D1a[115]</td><td>
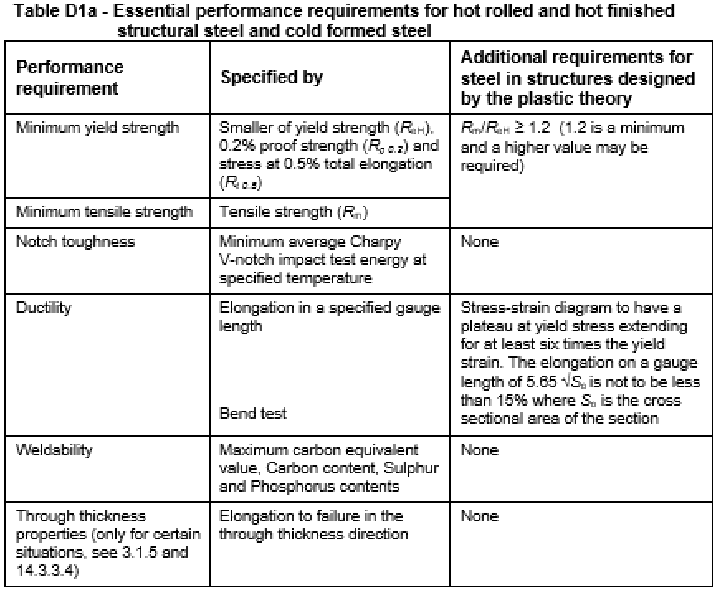
Table D1a - Essential performance requirements for hot rolled and hot finished structural steel and cold formed steel
<table>
<tr><th>Performance requirement</th><th>Specified by</th><th>Additional requirements for steel in structures designed by the plastic theory</th></tr>
<tr><td>Minimum yield strength</td><td>Smaller of yield strength (R_{eH}), 0.2% proof strength ($R_{p\,0.2}$) and stress at 0.5% total elongation ($R_{t\,0.5}$)</td><td rowspan="2">$R_m/R_{eH} \geq 1.2$ (1.2 is a minimum and a higher value may be required)</td></tr>
<tr><td>Minimum tensile strength</td><td>Tensile strength (R_m)</td></tr>
<tr><td>Notch toughness</td><td>Minimum average Charpy V-notch impact test energy at specified temperature</td><td>None</td></tr>
<tr><td>Ductility</td><td>Elongation in a specified gauge length
Bend test</td><td>Stress-strain diagram to have a plateau at yield stress extending for at least six times the yield strain. The elongation on a gauge length of 5.65 $\sqrt{S_o}$ is not to be less than 15% where S_o is the cross sectional area of the section</td></tr>
<tr><td>Weldability</td><td>Maximum carbon equivalent value, Carbon content, Sulphur and Phosphorus contents</td><td>None</td></tr>
<tr><td>Through thickness properties (only for certain situations, see 3.1.5 and 14.3.3.4)</td><td>Elongation to failure in the through thickness direction</td><td>None</td></tr>
</table>
</td><td>
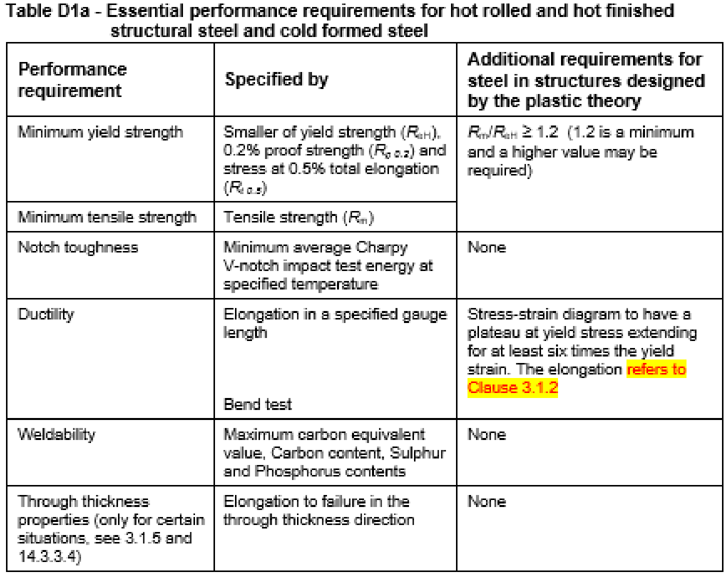
Table D1a - Essential performance requirements for hot rolled and hot finished structural steel and cold formed steel
<table>
<tr><th>Performance requirement</th><th>Specified by</th><th>Additional requirements for steel in structures designed by the plastic theory</th></tr>
<tr><td>Minimum yield strength</td><td>Smaller of yield strength (R_{eH}), 0.2% proof strength ($R_{p\,0.2}$) and stress at 0.5% total elongation ($R_{t\,0.5}$)</td><td rowspan="2">$R_m/R_{eH} \geq 1.2$ (1.2 is a minimum and a higher value may be required)</td></tr>
<tr><td>Minimum tensile strength</td><td>Tensile strength (R_m)</td></tr>
<tr><td>Notch toughness</td><td>Minimum average Charpy V-notch impact test energy at specified temperature</td><td>None</td></tr>
<tr><td>Ductility</td><td>Elongation in a specified gauge length
Bend test</td><td>Stress-strain diagram to have a plateau at yield stress extending for at least six times the yield strain. The elongation refers to Clause 3.1.2</td></tr>
<tr><td>Weldability</td><td>Maximum carbon equivalent value, Carbon content, Sulphur and Phosphorus contents</td><td>None</td></tr>
<tr><td>Through thickness properties (only for certain situations, see 3.1.5 and 14.3.3.4)</td><td>Elongation to failure in the through thickness direction</td><td>None</td></tr>
</table>
</td></tr>
</table>

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[115] Revision of ductility performance requirement.

Item	Current version	Amendments
116. Annex D1.2[116]	**D1.2 Additional requirements for high strength steels** Steel for plates and section with a yield strength greater than 460 N/mm^2 but not exceeding 690 N/mm^2 shall comply with the basic requirements given in Table D1a. It shall be produced by a manufacturer in accordance with an acceptable quality assurance system. Data shall be available to show that the specified properties in terms of yield strength, tensile strength, Charpy impact energy and chemical composition are consistently obtained. A minimum of one test in each category shall be made for every 20 tonnes of steel or part thereof the same product form, of the same range of thickness or diameter, and of the same cast. The category, thickness or diameter range should be classified in the same way as the product standard.	[redacted]

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[116] Deletion of Annex D1.2.

Item	Current version	Amendments
117. Annex D1.3[117]	**D1.3 Design strength for high strength steels** High strength steels with yield stresses above 460 N/mm^2 but not exceeding 690 N/mm^2 typically obtain their strength through a quench and tempering heat-treatment process and are known as RQT steels. This presents additional constraints in terms of fabrication and design, particularly with welding because heat may affect the strength of the parent steel. Different manufacturers use different manufacturing processes and chemical compositions for steel and therefore the Responsible Engineer should obtain the particular product specification and ensure that it complies with the requirements for design strength, buckling characteristics, ductility, weldability requirements, welding consumable requirements (under matched / matched / over-matched), pre-heat requirements, inter-pass temperature limits, etc.	[redacted]
118. Annex D1.4[118]	**D1.4 Quality control of testing** The testing shall be carried out to meet the reference material standards as contained in Annex A1.1 by a HOKLAS accredited laboratory or by other accredited laboratories which have reached mutual recognition agreements/arrangements with HOKLAS.	**D1.[redacted]2 Quality control of testing** The testing shall be carried out to meet the reference material standards as contained in Annex A1.1 by a HOKLAS accredited laboratory or by other accredited laboratories which have reached mutual recognition agreements/arrangements with HOKLAS.

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[117] Deletion of Annex D1.3.

[118] Renumbering of Annex D1.4 to D1.2.

<table>
<tr><th>Item</th><th>Current version</th><th>Amendments</th></tr>
<tr><td>119. Table D2[119]</td><td>
Table D2 - Minimum material property requirements for various high strength steels
<table>
<tr><th colspan="2">Steel</th><th>Source</th><th>Yield Strength
Y_s N/mm^2</th><th>Ultimate Strength
U_s N/mm^2</th><th>Elongation</th></tr>
<tr><td>Bisplate</td><td>60</td><td>Australia</td><td>500</td><td>590-730</td><td>20%</td></tr>
<tr><td></td><td>70</td><td></td><td>600</td><td>690-830</td><td>20%</td></tr>
<tr><td></td><td>80</td><td></td><td>690</td><td>790-930</td><td>18%</td></tr>
<tr><td>HT690</td><td>70</td><td>Japan</td><td>590</td><td>690</td><td>(Min 20% reqd.)</td></tr>
<tr><td>HT780</td><td>80</td><td></td><td>685</td><td>780</td><td>(Min 20% reqd.)</td></tr>
<tr><td>RQT</td><td>601</td><td>UK</td><td>620</td><td>690-850</td><td>(Min 20% reqd.)</td></tr>
<tr><td>RQT</td><td>701</td><td></td><td>690</td><td>790-930</td><td>(Min 20% reqd.)</td></tr>
<tr><td>HPS</td><td>485W</td><td>USA</td><td>485</td><td>-</td><td>(Min 20% reqd.)</td></tr>
<tr><td>ASTM A913</td><td>70</td><td></td><td>485</td><td>620</td><td>16%</td></tr>
<tr><td>ASTM A514</td><td>100</td><td></td><td>690</td><td>760 – 895</td><td>18%</td></tr>
<tr><td>S500Q</td><td></td><td>Europe</td><td>440 - 500</td><td>540 – 590</td><td>(Min 20% reqd.)</td></tr>
<tr><td>S550Q</td><td></td><td></td><td>490 - 550</td><td>590 - 640</td><td>(Min 20% reqd.)</td></tr>
<tr><td>S620Q</td><td></td><td></td><td>560 - 620</td><td>650 - 700</td><td>(Min 20% reqd.)</td></tr>
<tr><td>S690Q</td><td></td><td></td><td>630 - 690</td><td>710 - 770</td><td>(Min 20% reqd.)</td></tr>
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Note: The minimum elongation limit is 15% for all steel.
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<tr><td>S550Q</td><td></td><td></td><td>490 - 550</td><td>590 - 640</td><td></td></tr>
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<tr><td>120. Table D4[120]</td><td>
Table D4 - Various normally used bolt strengths
<table>
<tr><th>Bolt source and grade</th><th>Design shear stress p_q (N/mm^2)</th><th>Design bearing stress p_b (N/mm^2)</th><th>Design tensile stress p_y (N/mm^2)</th><th>Ultimate tensile strength p_u (N/mm^2)</th></tr>
<tr><td>ISO 4.6</td><td>160</td><td>460</td><td>240</td><td>400</td></tr>
<tr><td>ISO 8.8</td><td>375</td><td>1000</td><td>560</td><td>800</td></tr>
<tr><td>ISO 10.9</td><td>400</td><td>1300</td><td>700</td><td>1000</td></tr>
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<tr><td>ISO 10.9</td><td>400</td><td>1300</td><td>700</td><td>1000</td></tr>
<tr><td>ISO 12.9</td><td>480</td><td>1600</td><td>840</td><td>1200</td></tr>
</table>
</td></tr>
</table>

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[119] Revision of elongation for source of steel from Europe; Deletion of minimum elongation limit.

[120] Addition of bolt grade ISO 6.8 and 12.9.