Amendments to the Code of Practice for Structural Use of Concrete 2013 (2020 Edition)

(April 2024)

Legends:

Amended

Deleted

(4/2024)

Amendments to the Code of Practice for Structural Use of Concrete 2013 (2020 Edition) in April 2024 included:

(a) Clause 3.2.8.3 and Figure 3.9a – addition of maximum allowable permanent elongation for mechanical couplers longer than 100 mm;

(b) Clauses 6.1.2.1, clause 6.9 and Figures 6.21 to 6.25 – addition of provisions for strut-and-tie system;

(c) Figure 9.5(g), (h) and (i) – addition of column transverse reinforcement details;

(d) Clause 11.7.1 – addition of mix proportion for concrete of strength not exceeding 20 N/mm^2 for minor structural and non-structural works and clarification of the limitation on the volume of concrete for exceptional project;

(e) Equation 12.2 – rectification of typo in equation; and

(f) Annex A – update of version of standard BS 8500 Parts 1 & 2 and addition of standard BS EN 206:2013.

Amendments to the Code of Practice for Structural Use of Concrete 2013 (2020 Edition)

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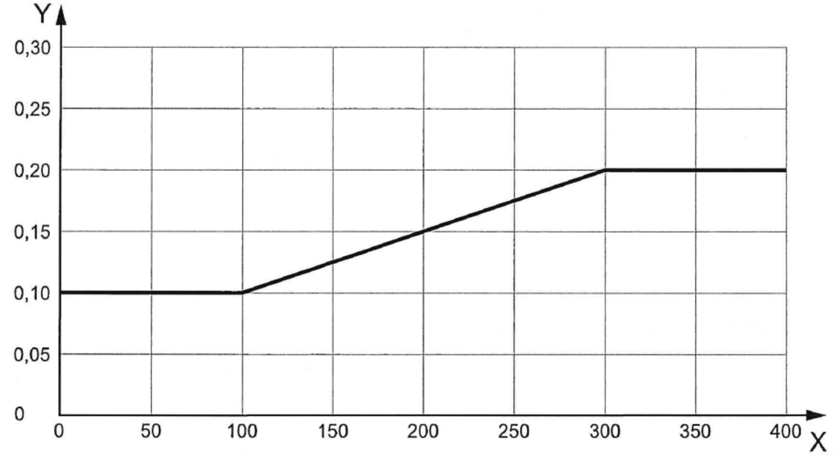
5. Clause 1.5	**1.5 SYMBOLS** F design ultimate load (e.g. $1.4G_k + 1.6Q_k$) f_{cu} characteristic compressive strength of concrete	**1.5 SYMBOLS** F design ultimate load (e.g. $1.4G_k + 1.6Q_k$) F_{tie} design resistance of non-prestressed ties f_{cb} design ultimate bearing strength based on the weaker of the two bearing surfaces f_{ce} design compressive strength of the concrete in a strut or a nodal zone f_{cu} characteristic compressive strength of concrete
6. Clause 3.2.8.3[1]	3.2.8.3 Performance of type 1 mechanical couplers Type 1 mechanical coupler satisfying the following criteria may be used as an alternative to tension or compression laps: (a) when a representative gauge length assembly comprising reinforcement of the diameter, grade and profile to be used, and a coupler of the precise type to be used, is tested in tension the permanent elongation after loading to $0.6f_y$ should not exceed 0.1 mm[1]; and ……	3.2.8.3 Performance of type 1 mechanical couplers Type 1 mechanical coupler satisfying the following criteria may be used as an alternative to tension or compression laps: (a) when a representative gauge length assembly comprising reinforcement of the diameter, grade and profile to be used, and a coupler of the precise type to be used, is tested in tension the permanent elongation after loading to $0.6f_y$ should not exceed 0.1 mm[1]; (b) For couplers longer than 100 mm, the permanent elongation greater than 0.1 mm may be accepted as per Figure 3.9a subject to crack width control requirements in clauses 7.2.1, 9.4.1 and 12.3.4; and (c) the coupler bar……

[1] Addition of maximum allowable permanent elongation for mechanical couplers longer than 100 mm.

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

Key
X length of the mechanical coupler, in mm
Y permanent elongation after loading to 0.6f_y, in mm

Figure 3.9a – Maximum allowable permanent elongation for type 1 mechanical couplers</td></tr>
<tr><td>7. Clause 6.1.2.1</td><td>6.1.2.1 General
(a) Design limitations
This sub-clause deals with the design of beams of normal proportions. Deep beams (see clause 5.2.1.1(a)) are not considered. For the design of deep beams, reference should be made to specialist literature.</td><td>6.1.2.1 General
(a) Design limitations
This sub-clause deals with the design of beams of normal proportions. Deep beams (see clause 5.2.1.1(a)) are not considered. For the design of deep beams, reference should be made to specialist literature or strut-and-tie system in clause 6.9.</td></tr>
<tr><td>8. Clause 6.9[2]</td><td></td><td>6.9 STRUT-AND-TIE SYSTEM
6.9.1 General
Non-flexural components, e.g. locations near supports and concentrated loads, of reinforced concrete structures can be</td></tr>
</table>

[2] Additional of provisions for strut-and-tie system.

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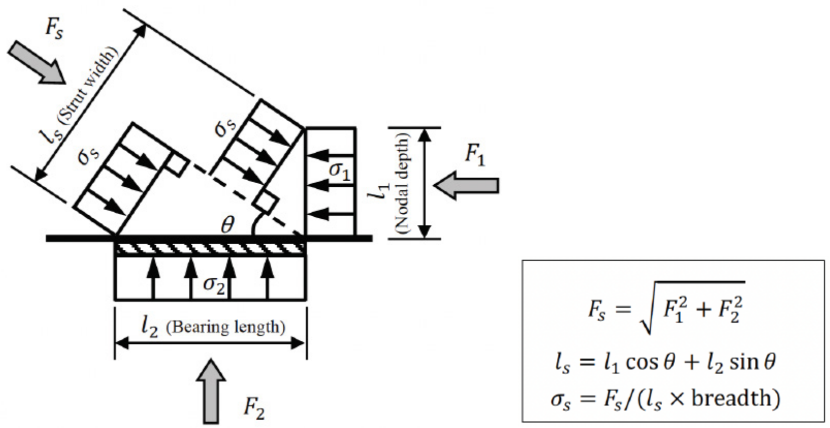
		designed using strut-and-tie model. A strut-and-tie model is an idealized pin-jointed truss, comprising concrete compression struts, reinforcement tension ties, and concrete nodes. 6.9.2 Modelling and analysis The angle between the axis of a strut and the axis of a tie (θ) shall not be less than 25° nor exceed 60°. The boundary forces and the internal forces can be determined based on the static equilibrium and the truss analysis. The dimensions of nodes shall be determined based on the nodal condition shown in Figure 6.21 by using the static equilibrium corresponding to shear failure and plastic stress state (see Figure 6.22).  Figure 6.21 – Nodal condition

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		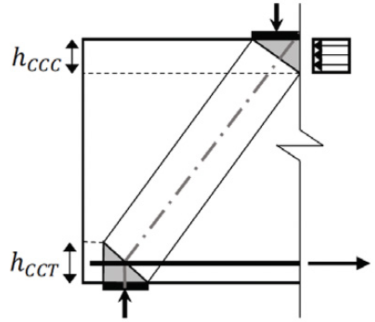 Figure 6.22 – Static equilibrium of a strut-and-tie model 6.9.3 Design 6.9.3.1 Design compressive strength of strut Design compressive strength of concrete in strut f_{ce} should be calculated from: $f_{ce} = 0.32 m f_{cu}$ 6.74 where m is the confinement modification factor taken as $\sqrt{\frac{A_2}{A_1}} \leq 2$, A_1 is loaded area, A_2 is load distribution area (see Figure 6.23).

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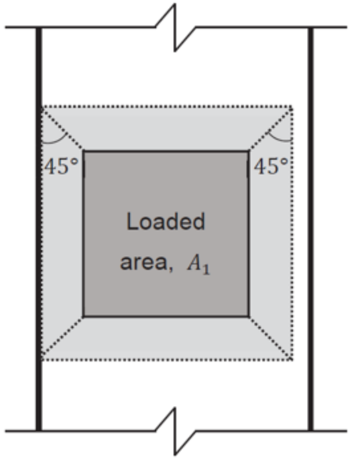
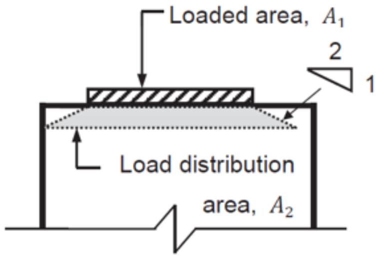
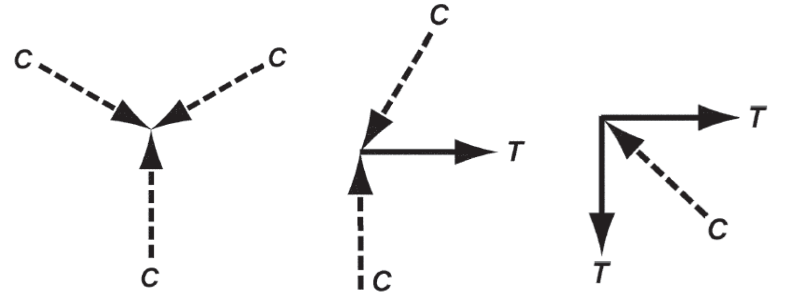
		 Plan view  Side view Figure 6.23 – Load distribution area and loaded area for determining the confinement modification factor 6.9.3.2 Design compressive strength of nodes Design compressive strength of concrete at a nodal zone f_{ce} should be calculated as follows: $f_{ce} = 0.45 m f_{cu}$ for node bounded by struts, bearing areas or both (C-C-C Node) 6.75 $f_{ce} = 0.4 m f_{cu}$ for node anchoring one tie (C-C-T Node) 6.76 $f_{ce} = 0.32 m f_{cu}$ for node anchoring two or more tie (C-T-T Node) 6.77 Classification of nodes is illustrated in Figure 6.24.

Item	Current version	Amendments
		 (i) C-C-C Node (ii) C-C-T Node (iii) C-T-T Node Figure 6.24 Classification of nodes 6.9.3.3 Design compressive strength of bearing Design ultimate bearing strength based on the weaker of the two bearing surfaces f_{cb} should be calculated as follows: $f_{cb} = 0.27mf_{cu}$ for dry bearing on concrete 6.78 $f_{cb} = 0.40mf_{cu}$ for bedded bearing on concrete 6.79 $f_{cb} = 0.80mf_{cu}$ for contact face of a steel bearing plate cast into a member or support, with each dimension not exceeding 40% of the corresponding concrete dimension. 6.80 An intermediate value of bearing stress between dry and bedded bearings may be used for flexible bedding. 6.9.3.4 *Ties* (a) Design resistance of ties Design resistance of non-prestressed ties shall be calculated as follows: $F_{tie} = 0.87 f_y A_s$ 6.81

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		(b) Arrangement of ties The reinforcing bars in a tie shall be evenly distributed across the nodal depth such that the centroid axis of the reinforcing bars coincides with the axis of the tie in the strut-and-tie model. (c) Anchorage of ties The reinforcing bars in a tie shall be properly anchored to transfer the tension force into the node through adequate anchorage of longitudinal reinforcement in accordance with clause 8.4. The anchorage begins at the location where the edge of strut meets the bearing surface (see Figure 6.25). For straight bars, they shall be extended beyond the node.

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		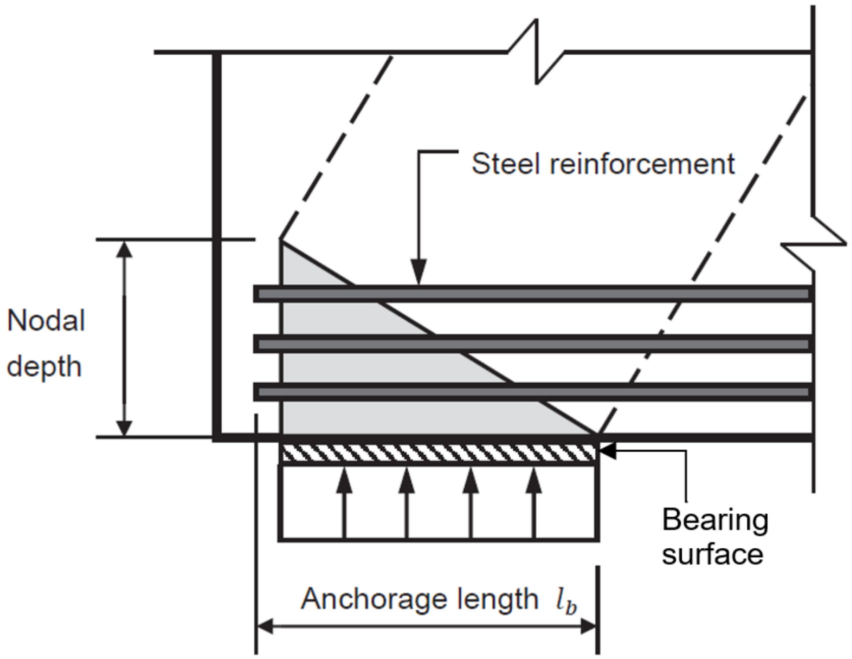 Figure 6.25 – Anchorage of tie reinforcements 6.9.3.5 *Minimum reinforcement* An orthogonal grid of reinforcing bars shall be placed evenly across each face of the section. The minimum percentage of reinforcement is 0.25%.

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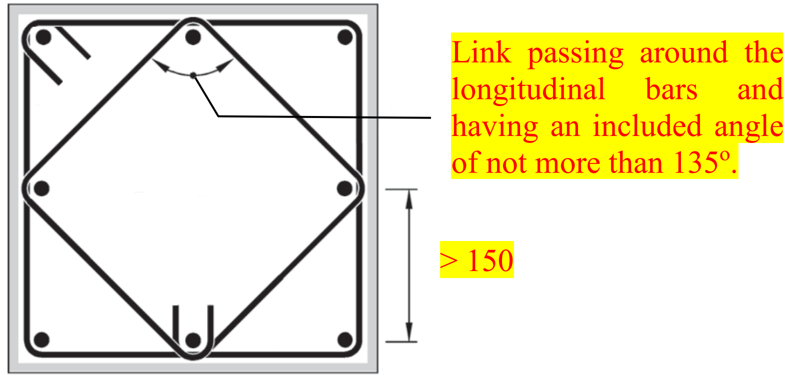
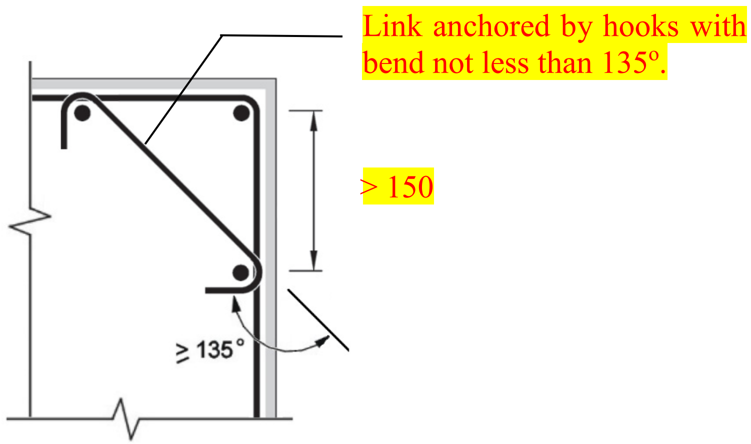
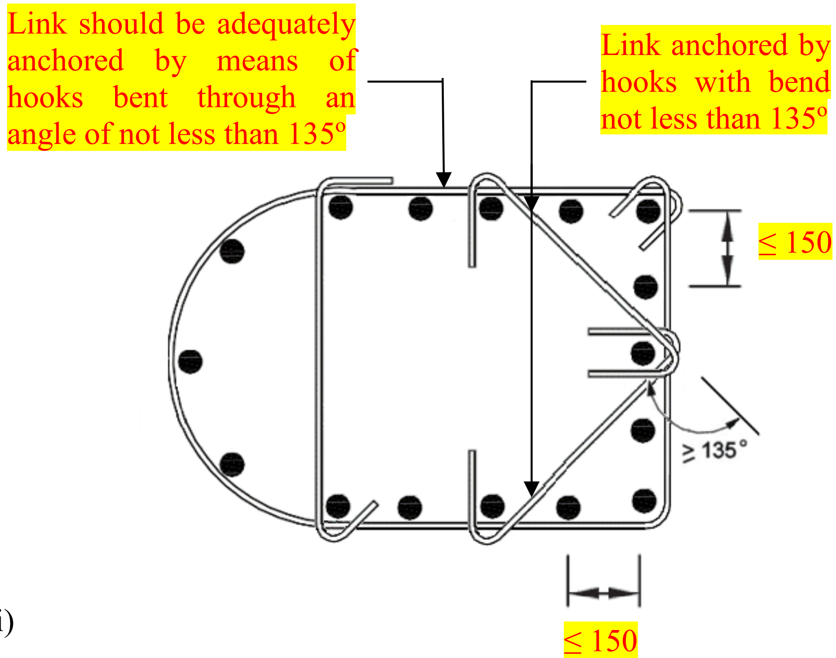
9. Figure 9.5[3]		g)  h) 

[3] Addition of column transverse reinforcement details.

Item	Current version	Amendments
		i)  Figure 9.5 – Column transverse reinforcement
10. Clause 9.9.2.2(c)[4]	(c) Anchorage Links and ties should be adequately anchored by means of hooks with bend not less than 135° in accordance with clause 9.5.2 (see Figure 9.5b, c, d & e). Where ……	(c) Anchorage Links and ties should be adequately anchored by means of hooks with bend not less than 135° in accordance with clause 9.5.2 (see Figure 9.5b, c, d, e, g, h & i). Where ……
11. Clause 11.7.1[5]	Structural concrete for all works should be obtained from concrete suppliers who are certified under the Quality Scheme for the Production and Supply of Concrete (QSPSC) or similar equivalent, except for those located at remote areas (such as	Structural concrete should be obtained from concrete suppliers who are certified under the Quality Scheme for the Production and Supply of Concrete (QSPSC) or similar equivalent, except for those located at remote areas (such as outlying islands) or where the total

[4] Addition of Figures 9.5(g), (h) and (i)

[5] Addition of mix proportions for concrete of strength not exceeding 20N/mm² for minor structural and non-structural works and clarification of the limitation on the volume of concrete for exceptional project.

<table>
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<tr><td></td><td>outlying islands) or where the volume of concrete involved is less than 50 m^3. Even for these “exceptional” projects, the structural concrete should be obtained from a supplier operating an approved quality system.</td><td>volume of concrete per building project involved is less than 50 m^3. Even for these “exceptional” projects, the structural concrete should be obtained from a supplier operating an approved quality system.

Concrete with strength not exceeding 20 N/mm^2 may be made using mix proportions, batching by weight, selected from Table 11.1a for minor structural and non-structural works such as on-grade slabs, blinding layer, U-channels/stepped channels, bedding and haunching for pipe works, concrete footings for posts and fences, and mass concrete fill which does not sustain appreciable loading.

<table>
<tr><th rowspan="2">Concrete Strength</th><th rowspan="2">Material</th><th colspan="2">Weight of aggregate per bag of cement kg</th><th rowspan="2">Maximum free water/ cement ratio</th></tr>
<tr><th>45 kg bag of cement</th><th>50 kg bag of cement</th></tr>
<tr><td rowspan="2">10 N/mm^2</td><td>Fine aggregate</td><td>145</td><td>160</td><td rowspan="6">0.65</td></tr>
<tr><td>20 mm coarse aggregate</td><td>185</td><td>205</td></tr>
<tr><td rowspan="2">15 N/mm^2</td><td>Fine aggregate</td><td>120</td><td>130</td></tr>
<tr><td>20 mm coarse aggregate</td><td>165</td><td>180</td></tr>
<tr><td rowspan="2">20 N/mm^2</td><td>Fine aggregate</td><td>95</td><td>105</td></tr>
<tr><td>20 mm coarse aggregate</td><td>145</td><td>160</td></tr>
<tr><td colspan="5">Note: Cement shall be ordinary Portland cement.</td></tr>
</table></td></tr>
</table>

Item	Current version	Amendments
		Table 11.1a – Mix proportions for concrete for minor structural and non-structural works
12. Equation 12.2[6]	$f_{pb} = f_{pe} + \frac{70000\lambda_1}{l/d}\left(1 - 0.7\lambda_2 \frac{f_{pu}A_{ps}}{f_{cu}bd}\right)$ 12.2	$f_{pb} = f_{pe} + \frac{7000\lambda_1}{l/d}\left(1 - 0.7\lambda_2 \frac{f_{pu}A_{ps}}{f_{cu}bd}\right)$ 12.2
13. Annex A	BS 8500-1:2006 Concrete. Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier BS 8500-2:2006 Concrete. Complementary British Standard to BS EN 206-1. Specification for constituent materials and concrete	BS 8500-1:2015 Concrete. Complementary British Standard to BS EN 206-1. Method of specifying and guidance for the specifier BS 8500-2:2015 Concrete. Complementary British Standard to BS EN 206-1. Specification for constituent materials and concrete BS EN 206:2013 Concrete – Specification, performance, production and conformity

[6] Rectification of typo in equation.