Code of Practice for Structural Use of Concrete 2004

The Code of Practice for Structural Use of Concrete 2004 (the Code) was published in December 2004. Subject to the Code being used in its entirety, compliance with the requirements of the Code will be considered as complying with the provisions of the Building (Construction) Regulations (B(C)R) relating to concrete design. The concrete design for any new building development or alteration and addition works shall be based on the Code if the application for approval of the structural plans or foundation plans of which is submitted after 15 December 2006.

2. The Code specifies alternative requirements to some particular regulations of the B(C)R. The Building Authority is prepared to grant modifications of the relevant regulations of the B(C)R upon application in the specified form to permit adoption of these alternative requirements. Appendix A contains a list of the relevant B(C)R that may require such modifications.

3. From experience in the application of the Code since its publication in December 2004, some amendments and refinements to the Code for improvement have been identified. The amendments to the Code are set out in Appendix B. Major changes pertinent to the amendments are as follows:

(a) The grouping of concrete has been changed to (i) grades below and up to C45 (previously, grade below and up to C40), (ii) grades higher than C45 and up to C70 (previously, grades higher than C40 and up to C70), and (iii) grades higher than C70 and up to C100. This allows many existing design tools and computer programs continue to be used without modifying the design equations for concrete grade up to C45 which is a grade commonly used by the building industry.

(b) The simplified stress block for concrete at ultimate limit state as given in Figure 6.1 of the Code has been amended to provide a more accurate stress block for the three different groups of concrete as given in (a) above.

(c) The other amendments are generally consequential to the amendments mentioned above, corrections of printing errors, or illustrative figures.

/4. .....

4. The above amendments would be incorporated in the next reprint of the Code. The updated version of the Code is now available for viewing in the Buildings Department website http://www.bd.gov.hk/ under the "Codes of Practice and Design Manuals" page of the "Publications" section. The document may be downloaded subject to the terms and conditions stipulated in the website.

(CHEUNG Hau-wai)
Building Authority

Ref. : BD GR/1-125/58

First issue June 2007 (AD/NB2)

Index under : Code of Practice for Structural Use of Concrete
Concrete, Code of Practice for Structural Use of

List of Building (Construction) Regulations that may require modifications

Item	B(C)R	Subject	Relevant Clause/Table in the Code	Remarks
1	56(2)	Cement content is limited to 550 kg/m^3.	Clause 4.2.6	Where the cement content exceeds 550 kg/m^3, modification of the B(C)R will be required.
2	57 & Table 6	The minimum cement content is specified.	Table 4.2 and Clause 4.2.5.4	Where the cement content is less than the minimum specified, modification of the B(C)R will be required.
3	58	Concrete cubes to be 150 mm.	Clause 10.3.4.2	Where 100 mm concrete cubes are used, modification of the B(C)R will be required.
4	59 & Table 8	Acceptance criteria for concrete cubes.	Table 10.2	Where the C2 Criteria in Table 10.2 of the Code are used, modification of the B(C)R will be required.

Appendix B
(PNAP 296)
(APP-142)

Amendments to Code of Practice for Structural Use of Concrete 2004

	Revised text
AMD 1 Jun 2007	**Clause 1.2** (page 1) Delete 'Hong Kong Code of Practice for Dead and Imposed Loads for Buildings'
AMD 1 Jun 2007	**Clause 2.3.1.1** (page 8) Replace the first and second bullet points with the following: ● characteristic dead load, G_k, which shall be taken as the dead loads calculated in accordance with Building (Construction) Regulation 16; ● characteristic imposed load, Q_k, which shall be taken as the imposed loads stipulated in Building (Construction) Regulation 17; and
AMD 1 Jun 2007	**Clause 2.3.1.4 (d)** (page 9) Replace the clause with the following: (d) Vehicular impact Where vertical elements are to be designed for vehicular impact the nominal design load shall be as specified in Building (Construction) Regulation 17.
AMD 1 Jun 2007	**Figure 3.3** (page 17) At the Y-axis, replace : Shrinkage K_c with : Creep/shrinkage K_c
AMD 1 Jun 2007	**Figure 3.5** (page 17) At the Y-axis, replace : Shrinkage K_j with : Creep/shrinkage K_j

	Revised text
AMD 1 Jun 2007	**Clause 3.1.8** (page 18) In the definition of c_s, replace : 4.0 with : 3.0
AMD 1 Jun 2007	**Figure 3.8** (page 19) Replace : See table 3.2 with : $3.46\sqrt{\frac{f_{cu}}{\gamma_m}} + 3.21$ kN/mm^2 Replace : $2.4 \times 10^{-4}\sqrt{\frac{f_{cu}}{\gamma_m}}$ with : $\frac{1.34(f_{cu}/\gamma_m)}{E_c}$
AMD 1 Jun 2007	**Clause 4.2.7.1** (page 29) Replace : section 10 with : Table 4.5
AMD 1 Jun 2007	**Clause 5.2.1.1 (e)** (page 33) Delete "and the height is at least 3 times the section depth".
AMD 1 Jun 2007	**Clause 5.2.1.2 (b)** (page 36) In the pen-ultimate paragraph: replace : taken as the elastic or redistributed values with : taken as the greater of the elastic or redistributed values
AMD 1 Jun 2007	**Figure 6.1** (page 41) Replace : 0.9x with : 0.9x for $f_{cu} \leq 45$ N/mm^2, 0.8x for $45 < f_{cu} \leq 70$ N/mm^2, or 0.72x for $70 < f_{cu} \leq 100$ N/mm^2.

	Revised text
AMD 1 Jun 2007	**Equation 6.1** (page 41) Replace the existing equation with the following : $x \leq 0.5d$ for $f_{cu} \leq 45$ N/mm^2 ;
AMD 1 Jun 2007	**Equation 6.2** (page 41) Replace the existing equation with the following : $x \leq 0.4d$ for $45 < f_{cu} \leq 70$ N/mm^2 ; or
AMD 1 Jun 2007	**Equation 6.4** (page 41) Replace the existing equation with the following : $x \leq (\beta_b - 0.4)d$ for $f_{cu} \leq 45$ N/mm^2 ; or
AMD 1 Jun 2007	**Equation 6.5** (page 41) Replace the existing equation with the following : $x \leq (\beta_b - 0.5)d$ for $45 < f_{cu} \leq 70$ N/mm^2
AMD 1 Jun 2007	**Equation 6.8** (page 42) Replace the existing equation with the following : K' = 0.156 for $f_{cu} \leq 45$ N/mm^2 ; or 0.120 for $45 < f_{cu} \leq 70$ N/mm^2 ; or 0.094 for $70 < f_{cu} \leq 100$N/mm^2 and no moment redistribution.
AMD 1 Jun 2007	**Equation 6.9** (page 42) Replace the existing equation with the following : $K' = 0.402(\beta_b - 0.4) - 0.18(\beta_b - 0.4)^2$, for $f_{cu} \leq 45$ N/mm^2 ; or $0.357(\beta_b - 0.5) - 0.143(\beta_b - 0.5)^2$, for $45 < f_{cu} \leq 70$ N/mm^2.

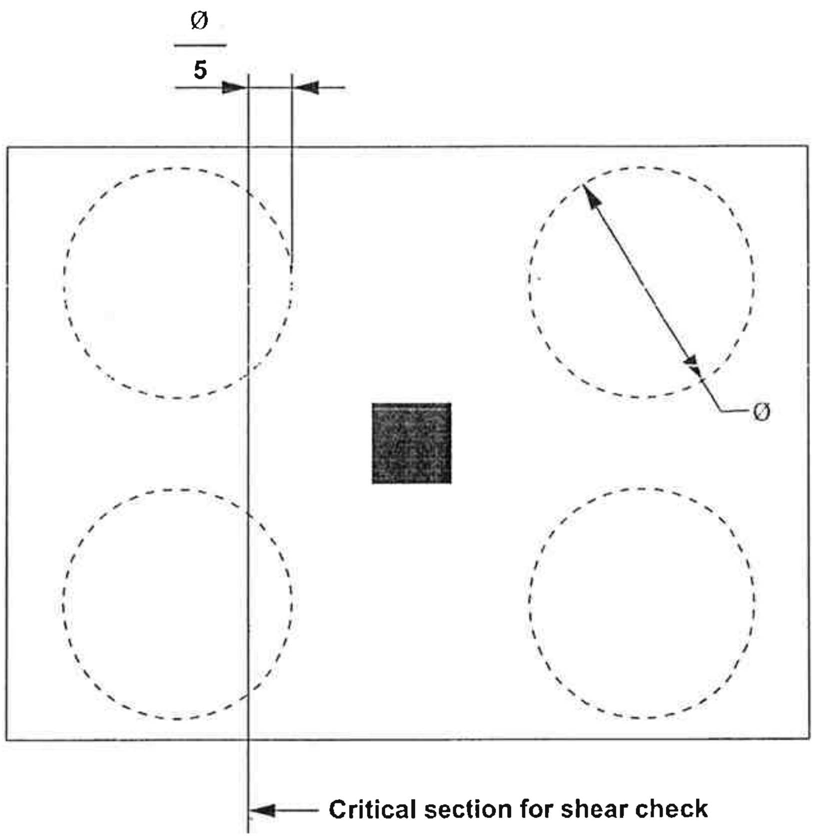
	Revised text
AMD 1 Jun 2007	**Equations 6.11 and 6.14** (page 42) Replace the existing equations with the following : x = (d - z)/0.45 , for $f_{cu} \leq 45$ N/mm^2 ; or (d - z)/0.40 , for 45< $f_{cu} \leq 70$ N/mm^2 ; or (d - z)/0.36 , for 70< $f_{cu} \leq 100$ N/mm^2.
AMD 1 Jun 2007	**Equation 6.17** (page 42) Replace the existing equation with the following : $$A_s = \frac{M + k_1 f_{cu} b_w d(k_2 d - h_f)}{0.87 f_y (d - 0.5 h_f)}$$ where k_1 = 0.1 for $f_{cu} \leq 45$ N/mm^2, 0.072 for 45< $f_{cu} \leq 70$ N/mm^2 and 0.054 for 70< $f_{cu} \leq 100$ N/mm^2; and k_2 = 0.45 for $f_{cu} \leq 45$ N/mm^2, 0.32 for 45< $f_{cu} \leq 70$ N/mm^2 and 0.24 for 70< $f_{cu} \leq 100$ N/mm^2.
AMD 1 Jun 2007	**Equation 6.18** (page 43) Replace the existing equation with the following: $$\beta_f = 0.45 \frac{h_f}{d} \left(1 - \frac{b_w}{b}\right)\left(1 - \frac{h_f}{2d}\right) + K' \frac{b_w}{b}$$
AMD 1 Jun 2007	**Table 6.3** (page 44) In the last column, replace : ≥400 with : 400
AMD 1 Jun 2007	**Clause 6.1.2.5** (page 45) In line 9 under item (e): replace : αand βare both greater than 45° with : α and β are both equal to or greater than 45°.

	Revised text
AMD 1 Jun 2007	**Table 6.8** (page 55) In third column, replace : $A_{sb} >$ with : $A_{sb} \geq$
AMD 1 Jun 2007	**Figure 6.12** (page 67) Replace : 1.4ν_t (see clause 6.1.5.6(b) with : 1.4ν_t (see clause 6.1.5.6(c))
AMD 1 Jun 2007	**Clause 6.1.5.7(e)** (page 69) In the last sentence: Replace : $0.4ud/087f_{yv}$. with : $\nu_r ud/087f_{yv}$, where ν_r is defined in Table 6.2.
AMD 1 Jun 2007	**Clause 6.2.1.3** (page 75) In line 3 under item (c), replace : 6.49 with : 6.48
AMD 1 Jun 2007	**Figure 6.17** (page 77) Interchange all 'k_1' and 'k_2'. Interchange all 'M_1' and 'M_2'.
AMD 1 Jun 2007	**Clause 6.3.2** (page 84) In the second paragraph, replace : St. Venant torsional stiffness with : torsional constant

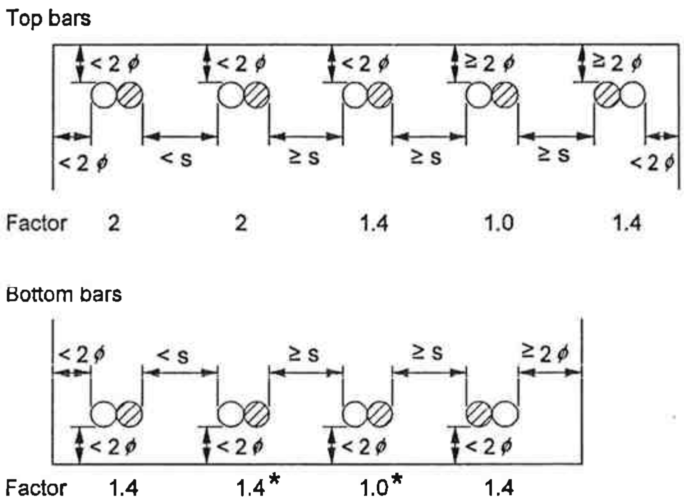
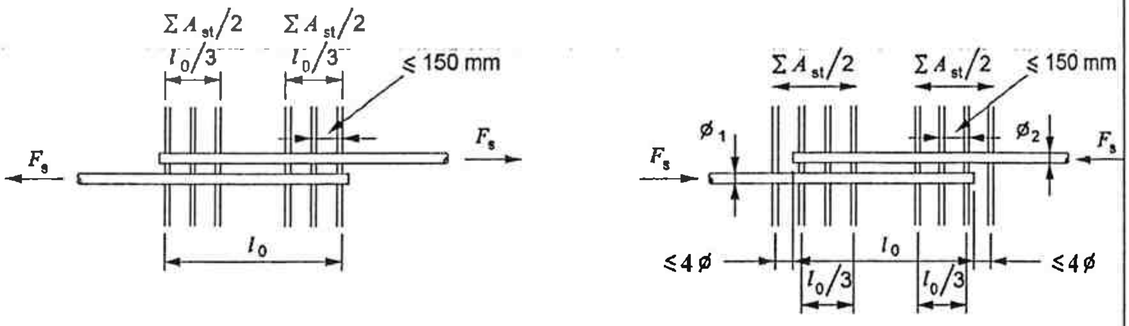
	Revised text
AMD 1 Jun 2007	**Equation 6.64** (page 84) Replace the existing equation with the following : $C = \frac{1}{2}\beta h_{\min}^{3} h_{\max}$.
AMD 1 Jun 2007	**Table 6.17** (page 85) In the last line, replace : N/mm^3 with : N/mm^2
AMD 1 Jun 2007	**Table 6.18** (page 85) Replacing the existing Table 6.18 with the following:
AMD 1 Jun 2007	**Clause 6.7.2.2** (page 91) In line 7, replace : L_c with : l_c

	$v_t \le v_{t\,min}$	$v_t > v_{t\,min}$
$v \le v_c + v_r$	Minimum shear reinforcement; no torsion reinforcement	Designed torsion reinforcement but not less than the minimum shear reinforcement
$v > v_c + v_r$	Designed shear reinforcement; no torsion reinforcement	Designed shear and torsion reinforcement
Notes: v_r is defined in Table 6.2.		

Table 6.18 - Reinforcement for shear and torsion

	Revised text
AMD 1 Jun 2007	**Figure 6.19** (page 92) Replace the existing Figure 6.19 with the following new Figure 6.19.  **Figure 6.19 – Critical section for shear check in a pile cap**
AMD 1 Jun 2007	**Clause 7.1.5** (page 96) In line 6, replace : at the ends of the ranges with : in table 3.2
AMD 1 Jun 2007	**Clause 7.2.3** (page 97) Before the definition of *a*' under equation 7.2, add: ε_1 is the strain at the level considered, calculated ignoring the stiffening effect of the concrete in the tension zone,

	Revised text
AMD 1 Jun 2007	**Clause 7.2.3** (page 97) In the paragraph after equation 7.2, replace : In this 7.2 with : In equation 7.2
AMD 1 Jun 2007	**Table 7.4** (page 101) In Notes 2, replace : clause 6.1.2.4(c) with : clause 6.1.2.4(b)
AMD 1 Jun 2007	**Table 7.5** (page 101) In Notes 2, replace : A with : $A'_{s,prov}$
AMD 1 Jun 2007	**Clause 7.3.6(a)** (page 105) Under the third bullet point, replace : $1/(1+\phi)$ times the short-term modulus where ϕ with : $1/(1+\phi_c)$ times the short-term modulus where ϕ_c
AMD 1 Jun 2007	**Figure 7.1a)** (page 106) In the strain diagram, replace : f_s / E with : f_s / E_s
AMD 1 Jun 2007	**Clause 8.6** (page 114) In the paragraph after the definitions of notations for equation 8.7, replace : equation 8.5 with : equation 8.7

	Revised text
AMD 1 Jun 2007	**Figure 8.5** (page 116) Replace the existing Figure 8.5 with the following new Figure 8.5.  ϕ = diameter of the lapped reinforcement s = 75 mm or 6ϕ whichever is the greater * Note : For laps in bottom of section as cast minimum cover criteria applies to corner bars only **Figure 8.5 – Factors for lapping bars**
AMD 1 Jun 2007	**Figure 8.6** (page 118) Replace the existing Figure 8.6 with the following new Figure 8.6.  a) bars in tension b) bars in compression **Figure 8.6 – Transverse reinforcement for lapped splices**

<table>
<tr><td></td><td>Revised text</td></tr>
<tr><td>AMD 1
Jun 2007</td><td>

Clause 8.8 (pages 118-119)

In the line preceding Figure 8.7,

replace : In figure 8.7a, n_1=1, n_2=1
with : In figure 8.7a, n_1=1, n_2=2

In the second and last paragraphs, delete '(see clause 9.2.4)'.

At the end of the last paragraph, insert the following:

$A_{ct,ext}$ denotes the area of the tensile concrete external to the links, defined by Figure 8.7c.

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Figure 8.7 (page 118)

Replace the existing Figure 8.7 with the following new Figure 8.7.

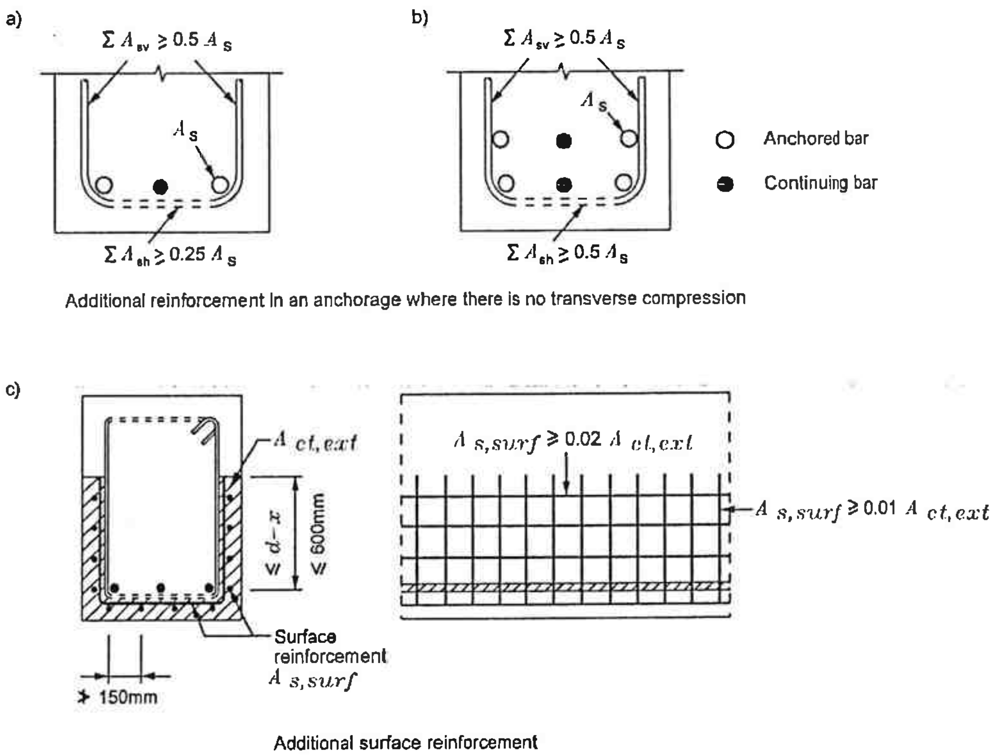

Figure 8.7 – Additional reinforcement for large diameter bars

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	Revised text
AMD 1 Jun 2007	**Clause 9.1** (page 128) Add the following paragraphs at the end of the clause 9.1: Detailing of members should normally comply with both the general detailing rules given in clauses 9.2 to 9.8 and the particular rules for ductility given in clause 9.9. However, members not contributing in the lateral load resisting system do not need to conform to the requirements of clause 9.9.
AMD 1 Jun 2007	**Equation 9.4** (page 131) Replacing the existing equation 9.4 with the following: $A_{sv} \geq v_r b_v s_v/(0.87 f_{yv})$ 9.4 where v_r is defined in Table 6.2.
AMD 1 Jun 2007	**Clause 9.4.3** (page 133) Replace : A full anchorage length beyond the centreline of the supporting member should be provided for top tension reinforcement of a cantilevered projecting structure. with : A full anchorage length should be provided for the top tension reinforcement of a cantilevered projecting structure. Where full rotational restraint is provided at the near face of the supporting member, i.e. the face at which the bar enters the supporting member, the anchorage shall be deemed to commence at 1/2 the width of the supporting member or 1/2 the effective depth of the cantilevered projecting structure whichever is the less, from the near face of the supporting member. Where the cantilevered projecting structure is a continuous slab or beam and the support is not designed to provide rotational restraint in the analysis of the continuous structure, the anchorage shall be deemed to commence at the far face of the supporting member.
AMD 1 Jun 2007	**Clause 9.9.1.1(d)** (page 138) Before the definition for f_{yt}, add: n number of bars uniformly spaced around circular sections, or the number of longitudinal bars in the layer through which a potential plane of splitting would pass,

	Revised text
AMD 1 Jun 2007	**Clause 9.9.2.1(a)** (page 139) Replace : The area of longitudinal reinforcement shall not be greater than 4% of the gross concrete area except that at laps the area may increase to 5.2%. with : The area of longitudinal reinforcement for strength design shall not be greater than 4% of the gross concrete area except that at laps the area may increase to 5.2%.
AMD 1 Jun 2007	**Clause 10.3.4.1** (page 143) In the first bullet point in paragraph 2, replace : clause 13.1.8.1 with : clause 12.1.8.1
AMD 1 Jun 2007	**Clause 10.3.6.1** (page 147) In line 4 of the last paragraph, replace : all concrete mixes of grade C60 or above with : all concrete mixes of grade greater than C60
AMD 1 Jun 2007	**Table 12.1** (page 166) In the second column, replace : **C30** with : **C35**
AMD 1 Jun 2007	**Clause 12.3.4.3** (page 166) In line 5 of the second paragraph, replace : class 1 and class 2 with : groups a) and b) In line 6 of the second paragraph, replace : class 3 with : group c)

	Revised text
AMD 1 Jun 2007	**Table 12.2** (page 166) In the third column, replace : **C30** with : **C35**
AMD 1 Jun 2007	**Clause 12.3.7.1** (page 168) Replace the second bullet point (including the Note) with the following : ● the design stresses in the concrete in compression are derived either from the stress-strain curve given in figure 3.8 or from the simplified stress block given in figure 6.1, with γ_m = 1.5 in both cases;
AMD 1 Jun 2007	**Equations 12.2 and 12.3** (page 168) Replace the existing equations with the following: $$f_{pb} = f_{pe} + \frac{70000\lambda_1}{l/d}\left(1 - 0.7\lambda_2 \frac{f_{pu}A_{ps}}{f_{cu}bd}\right) \quad 12.2$$ $$x = \lambda_2\left[\left(\frac{f_{pu}A_{ps}}{f_{cu}bd}\right)\left(\frac{f_{pb}}{f_{pu}}\right)d\right] \quad 12.3$$ where λ_1 = 1 for $f_{cu} \le 60$ N/mm², or $1 - 0.017\sqrt{f_{cu} - 60}$ for $f_{cu} > 60$N/mm², and λ_2 = 2.58 for $f_{cu} \le 45$ N/mm², 2.78 for $45 < f_{cu} \le 70$ N/mm², or 3.09 for $70 < f_{cu} \le$ 100 N/mm²'.
AMD 1 Jun 2007	**Table 12.5** (page 171) In the second column, replace : **30 N/mm²** with : **35 N/mm²**
AMD 1 Jun 2007	**Clause 12.3.8.7** (page 171) In the caption, replace : *where* $V_r = 0.4 f_{cu} b_v d$ for $f_{cu} \le 40$N/mm² or $0.4(f_{cu}/40)^{2/3} b_v d$ for $f_{cu} > 40$N/mm² with : *where* $V_r = v_r b_v d$ *and* v_r *is as defined in Table 6.2.*

	Revised text
AMD 1 Jun 2007	**Equation 12.7** (page 172) Replace the existing equation with the following : $$\frac{A_{sv}}{s_v} = \frac{V_r}{0.87 f_{yv} d} \qquad 12.7$$
AMD 1 Jun 2007	**ANNEX A** In the first paragraph, replace : the Code of Practice for the Structural Use of Concrete (Limit State Approach) with : this Code of Practice
AMD 1 Jun 2007	**ANNEX A** Delete the second bullet point, i.e. '• Hong Kong Code of Practice for Dead and Imposed Loads for Buildings'

(6/2007)