MALAYSIAN STANDARD

MS EN 1992-1-1:2010 (NATIONAL ANNEX)

MALAYSIA NATIONAL ANNEX TO EUROCODE 2: DESIGN OF CONCRETE STRUCTURES - PART 1-1: GENERAL RULES AND RULES FOR BUILDINGS

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Committee representation

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Association of Consulting Engineers Malaysia
Construction Industry Development Board Malaysia
Department of Irrigation and Drainage
Department of Standards Malaysia
Federation of Malaysian Manufacturers
Jabatan Bomba dan Penyelamat Malaysia
Jabatan Kerja Raya Malaysia
Malaysian Timber Industry Board
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Universiti Sains Malaysia
Universiti Teknologi Malaysia

The Technical Committee on Code of Practice for Design of Concrete Structures which developed this Malaysia National Annex was managed by The Institution of Engineers, Malaysia (IEM) in its capacity as an authorised Standards-Writing Organisation and consists of representatives from the following organisations:

Arup Jururunding Sdn Bhd

Association of Consulting Engineers Malaysia

Construction Industry Development Board Malaysia

Jabatan Kerja Raya Malaysia

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FOREWORD

The Malaysia National Annex was developed by the Technical Committee on Code of Practice for Design of Concrete Structure under the authority of the Industry Standards Committee on Building, Construction and Civil Engineering. Development of this national annex was carried out by The Institution of Engineers, Malaysia which is the Standards-Writing Organisation (SWO) appointed by SIRIM Berhad to develop standards for concrete structure.

This Malaysia National Annex shall be used together with MS EN 1992-1-1:2010, *Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings.*

Acknowledgement is given to BSI for the use of information from *UK National Annex to Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings.*

Compliance with a Malaysian Standard does not of itself confer immunity from legal obligations.

MALAYSIA NATIONAL ANNEX TO MS EN 1992-1-1:2010, EUROCODE 2: DESIGN OF CONCRETE STRUCTURES - PART 1-1: GENERAL RULES AND RULES FOR BUILDINGS

NA0 Introduction

This national annex has been prepared by the Technical Committee on Code of Practice for Design of Concrete Structures. In Malaysia, it shall be used in conjunction with MS EN 1992-1-1:2010, *Eurocode 2: Design of concrete structures - Part 1-1: General rules and rules for buildings.*

NA1 Scope

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b) the Malaysia decisions on the status of MS EN 1992-1-1:2010 informative annexes; and

c) references to non-contradictory complementary information.

NA2 Nationally Determined Parameters

Malaysia decisions for the Nationally Determined Parameters described in MS EN 1992-1-1:2010 are given in Table NA1.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
2.3.3 (3)	Value of d_{joint}	30 m	Use the recommended value.
2.4.2.1 (1)	Partial factor for shrinkage action γ_{SH}	1.0	Use the recommended value.
2.4.2.2 (1)	Partial factor for prestress $\gamma_{P,fav}$	1.0	0.9
2.4.2.2 (2)	Partial factor for prestress $\gamma_{P,unfav}$	1.3	1.1
2.4.2.2 (3)	Partial factor for prestress $\gamma_{P,unfav}$ for local effects	1.2	Use the recommended value.
2.4.2.3 (1)	Partial factor for fatigue loads $\gamma_{F,fat}$	1.0	Use the recommended value.
2.4.2.4 (1)	Partial factors for materials for ultimate limit states γ_C and γ_S	Table 2.1N	Use the recommended values.
2.4.2.4 (2)	Partial factors for materials for serviceability limit states γ_C and γ_S	1.0	Use the recommended value.
2.4.2.5 (2)	Value of k_f	1.1	Use the recommended value.
3.1.2 (2)P	Value of C_{max}	C90/105	Use the recommended value. However, the shear strength of concrete classes higher than C50/60 should be determined by tests, unless there is evidence of satisfactory past performance of the particular mix including the type of aggregates used. Alternatively, shear strength of concrete strength classes higher than C50/60 may be limited to that of C50/60.
3.1.2 (4)	Value of k_t	0.85	1.0
3.1.6 (1)P	Value of α_{cc}	1.0	0.85 for compression in flexure and axial loading and 1.0 for other phenomena. However, α_{cc} may be taken conservatively as 0.85 for all phenomena.
3.1.6 (2)P	Value of α_{ct}	1.0	Use the recommended value.
3.2.2 (3)P	Upper limit of f_{yk}	600 MPa	Use the recommended value.
3.2.7 (2)	Design assumptions for reinforcement: value of ε_{ud}	0.9 ε_{uk}	Use the recommended value.
3.3.4 (5)	Value of k	1.1	Use the recommended value.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
3.3.6 (7)	Design assumptions for prestressing tendons: value of ε_{ud}	0.9 ε_{uk} or if more accurate values are not known: ε_{ud} = 0.02 $f_{p0,1k}/f_{pk}$ = 0.9	Use the recommended values.
4.4.1.2 (3)	Value of $c_{min,b}$	Post-tensioned bonded tendons in rectangular ducts: greater of the smaller dimension or half the greater dimension. Post-tensioned bonded tendons circular ducts: diameter. Pre-tensioned tendons: 1.5 × diameter of strand or plain wire, 2.5 × diameter of indented wire.	Use the recommended values.
4.4.1.2 (5)	Structural classification and values of minimum cover due to environmental conditions $c_{min,dur}$	Table 4.3N for structural classification Tables 4.4N and 4.5N for values of $c_{min,dur}$	Use BS 8500-1:2002, Tables A6, A7, A10, A11, A12 and A13 for recommendations for concrete quality for a particular exposure class and cover reinforcement *c*. Table NA2 and Table NA3 may also be used because they present the same information given in BS 8500-1:2002 but in a more compact form.
4.4.1.2 (6)	Value of $\Delta c_{dur,\gamma}$	0 mm	Use the recommended value.
4.4.1.2 (7)	Value of $\Delta c_{dur,st}$	0 mm	0 mm unless justified by reference to specialist literature such as the Concrete Society's guidance on the use of stainless steel reinforcement [9].
4.4.1.2 (8)	Value of $\Delta c_{dur,add}$	0 mm	0 mm unless justified by reference to specialist literature.
4.4.1.2 (13)	Value of k_1, k_2, k_3	k_1 = 5 mm k_2 = 10 mm k_3 = 15 mm	Use the recommended value.
4.4.1.3 (1)P	Value of Δc_{dev}	10 mm	Use the recommended value.
4.4.1.3 (3)	Value of Δc_{dev} under controlled conditions	Expressions 4.3N and 4.4N	In both situations (1) and (2), Δc_{dev} may be reduced, i.e., 10 mm $\geq$ Δc_{dev} $\geq$ 5 mm.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
4.4.1.3 (4)	Values of k_1 and k_2	k_1 = 40 mm k_2 = 75 mm	k_1 = 40 mm k_2 = 65 mm
5.1.3 (1)P	Simplified load arrangements	The following load arrangements should be considered: a) alternate spans carrying the design variable and permanent load ($\gamma_Q Q_k + \gamma_G G_k + P_m$), other spans carrying only the design permanent load $\gamma_G G_k + P_m$; and b) any two adjacent spans carrying the design variable and permanent loads ($\gamma_Q Q_k + \gamma_G G_k + P_m$); all other spans carrying only the design permanent load, $\gamma_G G_k + P_m$.	Use any of the following three options. a) Consider the two load arrangements recommended in the Eurocode for alternate and adjacent spans. b) Consider the two following arrangements for all spans and alternate spans: i) all spans carrying the design variable and permanent load ($\gamma_Q Q_k + \gamma_G G_k + P_m$); and ii) alternate spans carrying the design variable and permanent load ($\gamma_Q Q_k + \gamma_G G_k + P_m$), other spans carrying only the design permanent load $\gamma_G G_k + P_m$; the same value of γ_G should be used throughout the structure; and c) For slabs, use the all spans loaded arrangement described in b)i) if: i) in a one-way spanning slab the area of each bay exceeds 30 m^2; ii) the ratio of the variable load Q_k to the permanent load G_k does not exceed 1.25; and iii) the variable load Q_k does not exceed 5 kN/m^2 excluding partitions. When analysis is carried out using the load arrangement described in b)i), the resulting support moments except those at the supports of cantilevers should be reduced by 20 %, with a consequential increase in the span moments. In this context a bay means a strip across the full width of a structure bounded on the other two sides by lines of support. The load arrangements in a), b) and c) are drafted using BS EN 1990:2002, Expression (6.10). Although not shown here, they can also be drafted using BS EN 1990:2002, Expression (6.10a) and (6.10b).

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
5.2 (5)	Value of θ_0	1/200	Use the recommended value.
5.5 (4)	Moment redistribution formula: values of k_1, k_2, k_3, k_4, k_5 and k_6	k_1 = 0.44 k_2 = 1.25(0.6 + 0.001 4/ε_{cu2}) k_3 = 0.54 k_4 = 1.25(0.6 + 0.001 4/ε_{cu2}) k_5 = 0.7 k_6 = 0.8	For steels with f_{yk} < 500 MPa $k_1 = k_3$ = 0.4 $k_2 = k_4$ = 0.6 + 0.001 4/ε_{cu2} k_5 = 0.7 k_6 = 0.8 For steels with f_{yk} > 500 MPa, more restrictive values than those given for steels with $f_{yk} \leq$ 500 MPa may be need to be used. PD 6687 gives further guidance on the redistribution of bending moments.
5.6.3 (4)	Values of $\theta_{pl,d}$	Figure 5.6N	Use the recommended values.
5.8.3.1 (1)	Value of λ_{lim}	$\lambda_{lim} = 20 \cdot A \cdot B \cdot C/\sqrt{n}$	Use the recommended value.
5.8.3.3 (1)	Value of k_1	0.31	Use the recommended value.
5.8.3.3 (2)	Value of k_2	0.62	Use the recommended value.
5.8.5 (1)	Methods of second order analysis	Choice of the following two simplified methods. a) Method based on nominal stiffness. b) Method based on nominal curvature.	Use either method.
5.8.6 (3)	Value of γ_{cE}	1.2	Use the recommended values.
5.10.1 (6)	Methods to avoid brittle failure of prestressed members	Methods A to E	Any of the methods A to E may be used.
5.10.2.1 (1)P	Maximum stressing force: values of k_1 and k_2	k_1 = 0.8 k_2 = 0.9	Use the recommended values.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
5.10.2.1 (2)	Maximum stressing force: value of k_3	0.95	Use the recommended value.
5.10.2.2 (4)	Minimum strength of concrete at various stages of prestressing: values of k_4 and k_5	k_4 = 50 % k_5 = 30 %	Use the recommended values.
5.10.2.2 (5)	Increase of stress at time of transfer of prestress: value of k_6	k_6 = 0.7	Use the recommended value.
5.10.3 (2)	Prestressing force immediately after tensioning: values of k_7 and k_8	k_7 = 0.75 k_8 = 0.85	Use the recommended values.
5.10.8 (2)	Value of $\Delta\sigma_{p,ULS}$	100 MPa	100 MPa unless the tendon is outwith βd from the tension face, in which case $\Delta\sigma_{p,ULS}$ = 0. β = 0.1 for $d \geq$ 1 000 mm; β = 0.25 for $d \leq$ 500 mm; the value of β may be interpolated for the values of d between 500 mm and 1 000 mm.
5.10.8 (3)	Values of $\gamma_{\Delta P,sup}$ and $\gamma_{\Delta P,inf}$	$\gamma_{\Delta P,sup}$ = 1.2 $\gamma_{\Delta P,inf}$ = 0.8 Both values taken as 1.0 if linear analysis with uncracked sections is applied.	Use the recommended values.
5.10.9 (1)P	Values of r_{sup} and r_{inf}	For pre-tensioning, unbonded tendons: r_{sup} = 1.05 and r_{inf} = 0.95 For post-tensioning, bonded tendons: r_{sup} = 1.10 and r_{inf} = 0.90 When appropriate measures (e.g. direct measurements of pretensioning) are taken: r_{sup} = 1.0 and r_{inf}= 1.0	r_{sup} = 1.0 r_{inf} = 1.0

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
6.2.2 (1)	Values of $C_{Rd,c}$, v_{min}, and k_1 for normal shear	$C_{Rd,c} = 0.18/\gamma_c$ $v_{min} = 0.035k^{3/2}f_{ck}^{1/2}$ $k_1 = 0.15$	Use the recommended values. See also 3.1.2 (2)P for a requirement for concrete class > C50/60.
6.2.2 (6)	Value of v	$v = 0.6[1 - f_{ck}/250]$	Use the recommended value. See also 3.1.2 (2)P for a requirement for concrete class > C50/60.
6.2.3 (2)	Limiting values of cotθ	$1 \leq \cot\theta \leq 2.5$	$1 \leq \cot\theta \leq 2.5$, except in elements in which shear co-exists with externally applied tension (i.e. tension caused by restraint is not considered here). In these elements, cotθ should be taken as 1.0.
6.2.3 (3)	Values of v_1 and α_{cw}	$v_1 = v$ as described by Expression 6.3N or takes the values given in expressions 6.10.aN and 6.10.bN α_{cw} takes the values given in expressions 6.11.aN, 6.11.bN and 6.11.cN	$v_1 = v$ However, if the design stress of the shear reinforcement is below 80 % of the characteristic yield stress f_{yk}, v_1 may be taken as: $v_1 = 0.54(1 - 0.5\cos\alpha)$ for $f_{ck} \leq 60$ MPa $v_1 = (0.84 - f_{ck}/200)(1 - 0.5\cos\alpha) > 0.5$ for $f_{ck} \geq 60$ MPa α_{cw} is as follows: 1 for non-prestressed structures $(1 + \sigma_{cp}/f_{cd})$ for $0 < \sigma_{cp} \leq 0.25f_{cd}$ 1.25 for $0.25f_{cd} < \sigma_{cp} \leq 0.5f_{cd}$ $2.5(1 - \sigma_{cp}/f_{cd})$ for $0.5f_{cd} < \sigma_{cp} < 1.0f_{cd}$ where, σ_{cp} is the mean compressive stress, measured positive, in the concrete due to the design axial force. This should be obtained by averaging it over the concrete section taking account of the reinforcement. The value of σ_{cp} need not be calculated at a distance less than $0.5d\cot\theta$ from the edge of the support.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
			Note that the values of v_1 and α_{cw} should not be such as to give rise to a value of $V_{Rd,max}$ greater than $200(b_w)^2$ at sections more than d from the edge of a support. For this purpose the value of b_w does not need to be reduced for ducts. In the case of straight tendons, a high level of prestress (σ_{cp}/f_{cd} > 0.5) and thin webs, if the tension and the compression chords are able to carry the whole prestressing force and blocks are provided at the extremity of beams to disperse the prestressing force it may be assumed that the prestressing force is distributed between the chords. In these circumstances, the compression field due to shear only should be considered in the web, i.e. α_{cw} = 1. See also 3.1.2 (2)P for a requirement for concrete class > C50/60.
6.2.4 (4)	Range of values of $\cot\theta_f$	$1.0 \leq \cot\theta_f \leq 2.0$ for compression flanges $1.0 \leq \cot\theta_f \leq 1.25$ for tension flanges	Use the recommended value.
6.2.4 (6)	Value of k	0.4	Use the recommended value.
6.4.3 (6)	Values of β	β = 1.5 for a corner column β = 1.4 for an edge column β = 1.15 for an internal column	Use the recommended values.
6.4.4 (1)	Values of $C_{Rd,c}$, v_{min} and k_1 for punching shear	$C_{Rd,c} = 0.18/\gamma_c$ $v_{min} = 0.035\, k^{3/2} f_{ck}^{1/2}$ $k_1 = 0.1$	Use the recommended value. See also 3.1.2 (2)P for a requirement for concrete class > C50/60.
6.4.5 (3)	The value of maximum punching resistance adjacent to column $V_{Rd,max}$	$V_{Rd,max} = 0.5 v f_{cd}$	Use the recommended value.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
6.4.5 (4)	The distance kd of the outer perimeter of punching shear reinforcement from the perimeter U_{out}	k = 1.5	k = 1.5 unless the perimeter at which reinforcement is no longer required is less than 3d from the face of the loaded area/column. In this case the reinforcement should be placed in the zone 0.3d and 1.5d from the face of the column.
6.5.2 (2)	Value of v'	$v' = 1 - f_{ck}/250$	Use the recommended value.
6.5.4 (4)	Value of k_1, k_2, k_3	k_1 = 1.0 k_2 = 0.85 k_3 = 0.75	Use the recommended value.
6.5.4 (6)	Value of k_4	k_4 = 3.0	Use the recommended value.
6.8.4 (1)	Values of $\gamma_{F,fat}$ and parameters for S-N curves	$\gamma_{F,fat}$ = 1.0 Values of parameters for S-N curves for reinforcing steels given in Table 6.3N. Values of parameters for S-N curves for prestressing steels given in Table 6.4N.	Use the recommended values.
6.8.4 (5)	Value of k_2	5	To be determined by consulting specialist literature.
6.8.6 (1)	Values of k_1 and k_2	k_1 = 70 MPa k_2 = 35 MPa	Use the recommended values unless other values are agreed with appropriate authorities.
6.8.6 (3)	Value of k_3	0.9	1.0
6.8.7 (1)	Fatigue: values for N and k_1	$N = 10^6$ cycles k_1 = 0.85	Use the recommended value.
7.2 (2)	Value of k_1	0.6	Use the recommended value.
7.2 (3)	Value of k_2	0.45	Use the recommended value.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
7.2 (5)	Value of k_3, k_4, k_5	k_3 = 0.8 k_4 = 1.0 k_5 = 0.75	Use the recommended value.
7.3.1 (5)	Limitations of crack width w_{max}	Table 7.1N	Use Table NA4.
7.3.2 (4)	Value of $\sigma_{ct,p}$	$f_{ct,eff}$ in accordance with 7.3.2 (2)	Use the recommended value.
7.3.4 (3)	Maximum crack spacing in Expression 7.11: values for k_3 and k_4	k_3 = 3.4 k_4 = 0.425	Use the recommended value.
7.4.2 (2)	Values of basic span/depth ratios	Table 7.4N	Use Table NA5.
8.2 (2)	Values of k_1 and k_2	k_1 = 1 mm k_2 = 5 mm	Use the recommended value.
8.3 (2)	Minimum mandrel diameter $\varnothing_{m,min}$	Table 8.1N	Use in Table NA6a and Table NA6b.
8.6 (2)	Anchorage capacity of a welded bar	$F_{btd} = l_{td}\ \varnothing_t\ \sigma_{td} \leq F_{wd}$	Use the recommended value.
8.8 (1)	Additional rules for large diameter bars: limiting bar size	$\varnothing_{large}$ > 32 mm	$\varnothing_{large}$ > 40 mm
9.2.1.1 (1)	Beams: minimum reinforcement areas	$A_{s,min} = 0.26(f_{ctm}/f_{yk})b_t d > 0.001\ 3 b_t d$	Use the recommended value.
9.2.1.1 (3)	Beams: maximum reinforcement areas	$A_{s,max} = 0.04 A_c$	Use the recommended value.
9.2.1.2 (1)	Beams: minimum ratio of span bending moment to be assumed at supports in monolithic construction	β_1= 0.15	β_1 = 0.25
9.2.1.4 (1)	Anchorage of bottom reinforcement at an end support: area of steel provided over supports with little or no end fixity in design	β_2 = 0.25	Use the recommended value.
9.2.2 (4)	Minimum ratio of shear reinforcement in the form of links	β_3 = 0.5	Use the recommended value.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
9.2.2 (5)	Minimum shear reinforcement	$\rho_{w,min} = (0.08\sqrt{f_{ck}})/f_{yk}$	Use the recommended value.
9.2.2 (6)	Maximum longitudinal spacing of shear assemblies	$s_{l,max} = 0.75d(1 + \cot\alpha)$	Use the recommended value.
9.2.2 (7)	Maximum longitudinal spacing of bent-up bars	$s_{b,max} = 0.6d(1 + \cot\alpha)$	Use the recommended value.
9.2.2 (8)	Maximum transverse spacing of links	$s_{t,max} = 0.75d \leq 600$ mm	Use the recommended value.
9.3.1.1 (3)	Value of $s_{max,slabs}$	For principal reinforcement: $3h \leq 400$ mm For secondary reinforcement: $3.5h \leq 450$ mm Except in areas with concentrated loads or maximum moment where: For principal reinforcement: $2h \leq 250$ mm For secondary reinforcement: $3h \leq 400$ mm	Use the recommended values except for post-tensioned slabs where reference may be made to specialist literature such as The Concrete Society's design handbook [10].
9.5.2 (1)	Minimum diameter of longitudinal reinforcement in columns	$\varnothing_{min} = 8$ mm	$\varnothing_{min} = 10$ mm
9.5.2 (2)	Minimum area of longitudinal reinforcement in columns	$A_{s,min} = 0.10N_{Ed}/f_{yd}$ or $0.002A_c$, whichever is greater	Use the recommended value.
9.5.2 (3)	Maximum area of longitudinal reinforcement in columns	$A_{s,max} = 0.04A_c$ outside laps unless it can be shown that the integrity of the concrete will not be affected and that the full strength is achieved at the ULS. $A_{s,max} = 0.08A_c$ at laps	The recommended values apply. The designer should consider the practical upper limit taking into account the ability to place the concrete around the rebar. This issue is considered further in PD 6687.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
9.5.3 (3)	Maximum spacing of transverse reinforcement in columns $s_{cl,tmax}$	$s_{cl,tmax}$ should take the least of the following three values: a) 20 times the minimum diameter of the longitudinal bars; b) the lesser dimension of the column; and c) 400 mm.	Use the recommended value.
9.6.2 (1)	Minimum and maximum area of vertical reinforcement in walls	$A_{s,vmin} = 0.002A_c$ $A_{s,vmax} = 0.04A_c$ outside lap locations unless it can be shown that the integrity of the concrete is not affected and that the full strength is achieved at the ULS. This limit may be doubled at laps.	Use the recommended value.
9.6.3 (1)	Minimum area of horizontal reinforcement in walls	$A_{s,hmin}$ = 25 % or $0.001A_c$, whichever is greater.	Use the recommended values. Where crack control is important early age thermal and shrinkage effects should be considered explicitly.
9.7 (1)	Minimum area of distribution reinforcement in deep beams	$A_{s,dbmin}$ = 0.1 % but not less than 150 mm^2/m in each face and in each direction.	0.2 % in each face.
9.8.1 (3)	Value of $Ø_{min}$ for pile caps	8 mm	Use the recommended value.
9.8.2.1 (1)	Value of $Ø_{min}$ for columns and wall footings	8 mm	Use the recommended value.
9.8.3 (1)	Value of $Ø_{min}$ for tie beams	8 mm	Use the recommended value.
9.8.3 (2)	Minimum downward load for tie beams	q_1 = 10 kN/m	To be determined for each individual project but shall not less than 10 kN/m.
9.8.4 (1)	Values of q_2 and $Ø_{min}$	q_2 = 5 MPa $Ø_{min}$ = 8 mm	Use the recommended values.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
9.8.5 (3)	Values of h_1 and $A_{s,bpmin}$	h_1 = 600 mm $A_{s,bpmin}$ from Table 9.6N	Use the recommended values.
9.10.2.2 (2)	Force to be resisted by peripheral tie: values of q_1 and q_2	q_1 = 10 kN/m q_2 = 70 kN	q_1 = (20 + 4n_0) where n_0 is the number of storeys q_2 = 60 kN
9.10.2.3 (3)	Minimum tensile force that an internal tie is capable of resisting	$F_{tie,int}$ = 20 kN/m	$F_{tie,int} = [(q_k + g_k)/7.5](l_r/5)(F_t) \geq F_t$ kN/m where, $(q_k + g_k)$ is the sum of the average permanent and variable floor loads (in kN/m^2); l_r is the greater of the distances (in m) between the centres of the columns, frames or walls supporting any two adjacent floor spans in the direction of the tie under consideration; and $F_t = (20 + 4n_0) \leq 60$. Maximum spacing of internal ties = 1.5l_r.
9.10.2.3 (4)	Internal ties on floors without screed: values of q_3 and q_4	q_3 = 20 kN/m q_4 = 70 kN	$F_{tie} = (1/7.5)(g_k + q_k)(l_r/5)F_t \geq F_t$ kN/m where, $(g_k + q_k)$ is the sum of the average permanent and variable floor loads (in kN/m^2); l_r is the greater of the distances (in m) between the centres of the columns, frames or walls supporting any two adjacent floor spans in the direction of the tie under consideration; and $F_t = (20 + 4n_0) \leq 60$. Maximum spacing of transverse ties = 1.5l_r.

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*continued*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
9.10.2.4 (2)	Force to be resisted by horizontal ties to external columns and/or walls provided at each floor level: values of $F_{tie,fac}$ and $F_{tie,col}$	$F_{tie,fac}$ = 20 kN per metre of the façade $F_{tie,col}$ = 150 kN	$F_{tie,fac} = F_{tie,col}$ = the greater of $2_{Ft} \leq l_s/2.5F_t$ and 3 % of the total design ultimate vertical load carried by the column or wall at that level. $F_{tie,fac}$ in kN per metre run of wall. $F_{tie,col}$ in kN per column. Tying of external walls is only required if the peripheral tie is not located within the wall. l_s is the floor to ceiling height in m. PD 6687 gives additional requirements related to the UK building regulations and may be used in Malaysia.
11.3.5 (1)P	Value of α_{lcc} (lightweight aggregate concrete)	0.85	Use the recommended value.
11.3.5 (2)P	Value of α_{lct} (lightweight aggregate concrete)	0.85	Use the recommended value.
11.3.7 (1)	Value of k	k = 1.1 for lightweight aggregate concrete with sand as fine aggregate k = 1.0 for lightweight aggregate (both fine and coarse aggregate) concrete	Use the recommended value.
11.6.1 (1)	Values of $C_{lRd,c}$, $v_{l,min}$ and k_1	$C_{lRd,c} = 0.15/\gamma_c$ $v_{l,min} = 0.30k^{3/2}f_{lck}^{3/2}$ $k_1 = 0.15$	$C_{lRd,c} = 0.15/\gamma_c$ $v_{l,min} = 0.30k^{3/2}f_{lck}^{1/2}$ $k_1 = 0.15$
11.6.2 (1)	Value of v_1	$v_1 = 0.5\eta_1[1 - f_{lck}/250]$	Use the recommended value.
11.6.4.1 (1)	Value of k_2	0.08	Use the recommended value.
12.3.1 (1)	Values of $\alpha_{cc,pl}$ and $\alpha_{ct,pl}$ (plain concrete)	$\alpha_{cc,pl} = 0.8$ $\alpha_{ct,pl} = 0.8$	$\alpha_{cc,pl} = 0.6$ $\alpha_{ct,pl} = 0.6$

Table NA1. Malaysia decisions for Nationally Determined Parameters described in MS EN 1992-1-1:2010 (*concluded*)

Subclauses	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
12.6.3 (2)	Value of k	1.5	Use the recommended value.
A.2.1 (1)	Value of $\gamma_{s,red1}$	1.1	Use the recommended value.
A.2.1 (2)	Value of $\gamma_{c,red1}$	1.4	Use the recommended value.
A.2.2 (1)	Value of $\gamma_{s,red2}$ and $\gamma_{c,red2}$	$\gamma_{s,red2}$ = 1.05 $\gamma_{c,red2}$ = 1.45	Use the recommended values.
A.2.2 (2)	Value of $\gamma_{c,red3}$	1.35	Use the recommended value.
A.2.3 (1)	Value of η and $\gamma_{c,red4}$	η = 0.85 $\gamma_{c,red4}$ = 1.3	Use the recommended values.
C.1 (1)	Values for fatigue stress range, minimum relative rib area and β	Table C.2N β = 0.6	Use the recommended values.
C.1 (3)	Values of a, f_{yk}, k, ε_{uk}	For f_{yk} a = 10 MPa For k and ε_{uk} a = 0 Minimum and maximum values for f_{yk}, k, ε_{uk} in accordance with Table C.3N	Use the recommended values.
E.1 (2)	Values of indicative strength classes	Table E.1N	Does not apply in Malaysia. See the guidance in 4.4.1.2 (5).
J.1 (2)	Value of $A_{s,surfmin}$	0.01$A_{ct,ext}$	Does not apply in the Malaysia - see PD 6687 for an alternative Annex J.
J.2.2 (2)	Value of tanθ	0.4 ≤ tanθ ≤ 1	Does not apply in the Malaysia - see PD 6687 for an alternative Annex J.
J.3 (2)	Value of k_1	0.25	Does not apply in the Malaysia - see PD 6687 for an alternative Annex J.
J.3 (3)	Value of k_2	0.5	Does not apply in the Malaysia - see PD 6687 for an alternative Annex J.

Table NA2. Recommendations for normal-weight concrete quality for exposure classes XC, XD and XS and cover to reinforcement for a 50 year intended working life and 20 mm maximum aggregate size

Exposure conditions[a]			Cement/ combination types[b]	Nominal cover (c_{min} + Δc_{dev})[c] to reinforcement (including prestressing steel) in mm and associated recommended designed concrete and equivalent designated concrete[d]							
				15 + Δc_{dev}	20 + Δc_{dev}	25 + Δc_{dev}	30 + Δc_{dev}	35 + Δc_{dev}	40 + Δc_{dev}	45 + Δc_{dev}	50 + Δc_{dev}
Carbonation induced corrosion	XC1	Dry or permanently wet	All	C20/25, 0,7, 240 or RC25	⇦	⇦	⇦	⇦	⇦	⇦	⇦
	XC2	Wet, rarely dry	All	-	-	C25/30, 0.65, 260 or RC30	⇦	⇦	⇦	⇦	⇦
	XC3 XC4	Moderate humidity Cyclic wet and dry	All except IVB	-	C40/50, 0.45, 340 or RC50	C32/40, 0.55, 300 or RC40 (See Note 3)	C28/35, 0.60, 280 or RC35 (See Note 4)	C25/30, 0.65, 260 or RC30	⇦	⇦	⇦
Chloride induced corrosion excluding chlorides from seawater	XD1	Moderate humidity	All	-	-	C40/50, 0.45, 360	C32/40, 0.55, 320	C28/35, 0.60, 300	⇦	⇦	⇦
	XD2	Wet, rarely dry	I, IIA IIB-S, SRPC	-	-	-	C40/50, 0.45, 380	C32/40, 0.50, 340	C28/35, 0.55, 320	⇦	⇦
			IIB-V, IIIA	-	-	-	C35/45, 0.40, 380	C28/35, 0.50, 340	C25/30, 0.55, 320	⇦	⇦
			IIIB, IVB	-	-	-	C32/40, 0.40, 380	C25/30, 0.50, 340	C20/25, 0.55, 320	⇦	⇦
	XD3	Cyclic wet and dry	I, IIA, IIB-S, SRPC	-	-	-	-	-	C45/55, 0.35, 380	C40/50, 0.40, 380	C35/45, 0.45, 360
			IIB-V, IIIA	-	-	-	-	-	C35/45, 0.40, 380	C32/40, 0.45, 360	C28/35, 0.50, 340
			IIIB, IVB	-	-	-	-	-	C32/40, 0.40, 380	C28/35, 0.45, 360	C25/30, 0.50, 340

NOTES:

1. ⇦ indicates that the concrete given in the cell to the left applies.

2. Reference should be made to BS 8500-1:2002, Annex A for selecting the quality of concrete subjected to freeze/thaw conditions and concrete in aggressive ground conditions.

3. For residential building not exceeding 3 storeys high, use C28/35, 0.53, 300 for XC3 only [16]

4. For residential building not exceeding 3 storeys high, use C25/30, 0.59, 280 for XC3; use C28/35, 0.53, 300 for XC4 [16]

[a] Exposure conditions conform to BS EN 206-1:2000 or equivalent to any Malaysian standards.

[b] Cement/combination types are defined in BS 8500-2:2002, Table 1.

[c] For values of Δc_{dev}, see 4.4.1.3 (1) and (3) of Table NA1.

[d] The recommended designed concrete is taken from BS 8500-1:2002 and described in this table in terms of strength class, maximum w/c ratio, minimum cement or combination content in kg/m3. The equivalent recommended designated concrete is taken from BS 8500-1:2002 and indicated in this table by the designation RC.

Table NA2. Recommendations for normal-weight concrete quality for exposure classes XC, XD and XS and cover to reinforcement for a 50 year intended working life and 20 mm maximum aggregate size *(continued)*

Exposure conditions[a]			Cement/ combination types[b]	Nominal cover ($c_{min} + \Delta c_{dev}$)[c] to reinforcement (including prestressing steel) in mm and associated recommended designed concrete and equivalent designated concrete[d]							
				15 + Δc_{dev}	20 + Δc_{dev}	25 + Δc_{dev}	30 + Δc_{dev}	35 + Δc_{dev}	40 + Δc_{dev}	45 + Δc_{dev}	50 + Δc_{dev}
Seawater induced corrosion	XS1	Airborne salts but no direct contact	I, IIA, IIB-S, SRPC	-	-	-	C50/60, 0.35, 380	C40/50, 0.45, 360	C35/45, 0.50, 340	⇦	⇦
			IIB-V, IIIA	-	-	-	C45/55, 0.35, 380	C35/45, 0.45, 360	C32/40, 0.50, 340	⇦	⇦
			IIIB, IVB	-	-	-	C35/45, 0.40, 380	C28/35, 0.50, 340	C25/30, 0.55, 320	⇦	⇦
	XS2	Wet, rarely dry	I, IIA, IIB-S, SRPC	-	-	-	C40/50, 0.40, 380	C32/40, 0.50, 340	C28/35, 0.55, 320	⇦	⇦
			IIB-V, IIIA	-	-	-	C35/45, 0.40, 380	C28/35, 0.50, 340	C25/30, 0.55, 320	⇦	⇦
			IIIB, IVB	-	-	-	C32/40, 0.40, 380	C25/30, 0.50, 340	C20/25, 0.55, 320	⇦	⇦
	XS3	Tidal, splash and spray zones	I, IIA, IIB-S, SRPC	-	-	-	-	-	-	C45/55, 0.35, 380	C40/50, 0.40, 380
			IIB-V, IIIA	-	-	-	-	-	D35/45, 0.40, 380	C32/40, 0.45, 360	C28/35, 0.50, 340
			IIIB, IVB	-	-	-	-	-	C32/40, 0.40, 380	C28/35, 0.45, 360	C25/30, 0.50, 340

NOTES:

1. ⇦ indicates that the concrete given in the cell to the left applies.

2. Reference should be made to BS 8500-1:2002, Annex A for selecting the quality of concrete subjected to freeze/thaw conditions and concrete in aggressive ground conditions.

3. For residential building not exceeding 3 storeys high, use C28/35, 0.53, 300 for XC3 only [16]

4. For residential building not exceeding 3 storeys high, use C25/30, 0.59, 280 for XC3; use C28/35, 0.53, 300 for XC4 [16]

[a] Exposure conditions conform to BS EN 206-1:2000 or equivalent to any Malaysian standards.

[b] Cement/combination types are defined in BS 8500-2:2002, Table 1.

[c] For values of Δc_{dev}, see 4.4.1.3 (1) and (3) of Table NA1.

[d] The recommended designed concrete is taken from BS 8500-1:2002 and described in this table in terms of strength class, maximum w/c ratio, minimum cement or combination content in kg/m3. The equivalent recommended designated concrete is taken from BS 8500-1:2002 and indicated in this table by the designation RC.

Table NA3. Recommendations for normal-weight concrete quality for exposure class XC and cover to reinforcement for a 100 years intended working life and 20 mm maximum aggregate size

Exposure conditions[a]			Cement/ combination types[b]	Nominal cover ($c_{min} + \Delta c_{dev}$)[c] to reinforcement (including prestressing steel) in mm and associated recommended designed concrete and equivalent designated concrete[d]							
				$15 + \Delta c_{dev}$	$20 + \Delta c_{dev}$	$25 + \Delta c_{dev}$	$30 + \Delta c_{dev}$	$35 + \Delta c_{dev}$	$40 + \Delta c_{dev}$	$45 + \Delta c_{dev}$	$50 + \Delta c_{dev}$
Carbonation induced corrosion	XC1	Dry or permanently wet	All	C20/25, 0.7, 240 or RC25	⇦	⇦	⇦	⇦	⇦	⇦	⇦
	XC2	Wet, rarely dry	All	-	-	C25/30, 0.65, 260 or RC30	⇦	⇦	⇦	⇦	⇦
	XC3	Moderate humidity	All except IVB	-	-	-	C40/50, 0.45, 340 or RC50	C35/45, 0.50, 320 or RC45	C32/40, 0.55, 300 or RC40	C28/35, 0.60, 280 or RC35	⇦
	XC4	Cyclic wet and dry									

NOTES:

1. ⇦ indicates that the concrete given in the cell to the left applies.

2. Reference should be made to BS 8500-1:2002, Annex A for selecting the quality of concrete subjected to freeze/thaw conditions and concrete in aggressive ground conditions.

3. For residential building not exceeding 3 storeys high, use C28/35, 0.53, 300 for XC3 only [16]

4. For residential building not exceeding 3 storeys high, use C25/30, 0.59, 280 for XC3; use C28/35, 0.53, 300 for XC4 [16]

[a] Exposure conditions conform to BS EN 206-1:2000 or equivalent to any Malaysian standards.

[b] Cement/combination types are defined in BS 8500-2:2002, Table 1.

[c] For values of Δc_{dev}, see 4.4.1.3 (1) and (3) of Table NA1.

[d] The recommended designed concrete is taken from BS 8500-1:2002 and described in this table in terms of strength class, maximum w/c ratio, minimum cement or combination content in kg/m3. The equivalent recommended designated concrete is taken from BS 8500-1:2002 and indicated in this table by the designation RC.

Table NA4. Recommended values of w_{max}

Exposure	Reinforced members and prestressed members without bonded tendons (quasi-permanent load combination) (mm)	Prestressed members with bonded tendons (frequent load combination) (mm)
X0, XC1	0.3[a]	0.2
XC2, XC3, XC4	0.3	0.2[b]
XD1, XD2, XD3, XS1, XS2, XS3		0.2 and decompression[c]

[a] For X0, XC1 exposure classes, crack width has no influence on durability and this limit is set to produce acceptable appearance. In the absence of specific requirements for appearance this limit may be relaxed.

[b] For these exposure classes, in addition, decompression should be checked under the quasi-permanent combination of loads.

[c] w_{max} = 0.2 mm applies to parts of the member that do not have to be checked for decompression.

In the absence of specific requirements (e.g. water-tightness), it may be assumed that limiting the calculated crack widths to the values of w_{max} given in Table NA4, under the quasi-permanent combination of loads, will generally be satisfactory for reinforced concrete members in buildings with respect to appearance and durability.

The durability of prestressed members may be more critically affected by cracking. In the absence of more detailed requirements, it may be assumed that limiting the calculated crack widths to the values of w_{max} given in MS EN 1992-1-1:2010, Table 7.1N, under the frequent combination of loads, will generally be satisfactory for prestressed concrete members. The decompression limit requires that all parts of the bonded tendons or duct lie at least 25 mm within concrete in compression.

Table NA5. Basic ratios of span/effective depth for reinforced concrete members without axial compression

Structural system	K	Concrete highly stressed ρ = 1.5 %	Concrete lightly stressed ρ = 0.5 %
Simply supported beam, one- or two-way spanning simply supported slab	1.0	14	20
End span of continuous beam or one-way continuous slab or two-way spanning slab continuous over one long side	1.3	18	26
Interior span of beam or one-way or two-way spanning slab	1.5	20	30
Slab supported on columns without beams (flat slab) (based on longer span)	1.2	17	24
Cantilever	0.4	6	8

NOTES:

1. The values given have been chosen to be generally conservative and calculation may frequently show that thinner members are possible.

2. For two-way spanning slabs, the check should be carried out on the basis of the shorter span. For flat slabs the longer span should be taken.

3. The limits given for flat slabs correspond to a less severe limitation than a mid-span deflection of span/250 relative to the columns. Experience has shown this to be satisfactory.

4. The values of k in the table may not be appropriate when the form-work is struck at an early age or when the construction loads exceed the design load. In these cases, the deflections may need to be calculated using advice in specialist literature, e.g. the Concrete Society's report on deflections in concrete slabs and beams [11] and an article for the Magazine of Concrete Research entitled *Are existing span to depth rules conservative for flat slabs?* [12].

5. The ratio of area of reinforcement provided to that required should be limited to 1.5 when the span/depth ratio is adjusted. This limit also applies to any adjustments to span/depth ratio obtained from expression 7.16a) or 7.16b) from which this table has been derived for concrete class C30/37.

Table NA6a. Minimum mandrel diameter to avoid damage to reinforcement for bars and wire

Bar diameter, Ø (mm)	Minimum mandrel diameter, $Ø_{m,min}$ for bends, hooks and loops (see MS EN 1992-1-1:2010, Figure 8.1) (mm)
≤ 16	4Ø
>16	7Ø

NOTE. Scheduling, dimensioning, bending and cutting of reinforcement should generally be in accordance with BS 8666.

Table NA6b. Minimum mandrel diameter to avoid damage to reinforcement for welded reinforcement and fabrics bent after welding

Location of transverse bar defined as a multiple of the bar diameter bar diameter, Ø (mm)	Minimum mandrel diameter, $Ø_{m,min}$ (mm)
Transverse bar inside or outside a bend or centre of a transverse bar ≤ 4Ø from a bend	20Ø
Centre of transverse bars > 4Ø from a bend	4Ø for Ø ≤ 16
	7Ø for Ø ≤ 20
NOTE. Scheduling, dimensioning, bending and cutting of reinforcement should generally be in accordance with BS 8666.	

NA3 Decisions on the status of informative annexes

MS EN 1992-1-1:2010 Annexes A, B, D, F, G, H and I may be used in Malaysia.

MS EN 1992-1-1:2010 Annexes E and J are not applicable in Malaysia. The UK's publication, PD 6687, provides an alternative informative Annex J that is acceptable for use in Malaysia.

NA4 References to non-contradictory complementary information

NA4.1 General references

The following is a list of references that contain non-contradictory complementary information for use with MS EN 1992-1-1:2010:

PD 6687:2005, *Background paper to the UK National Annexes to BS EN 1992-1-1 and BS EN 1992-1-2*

Guidance on the use of stainless steel reinforcement, Technical Report 51, Concrete Society, 1998 [9]

Post-tensioned concrete floors - Design handbook, Technical Report 43, The Concrete Society, 2005 [10]

Deflections in concrete slabs and beams, Technical Report No. 58, Concrete Society, 2005 [11]

VOLLUM, R.L. and T.R. HOSSAIN, *Are existing span to depth rules conservative for flat slabs?,* Magazine of Concrete Research, vol. 54, issue 6, 2002 [12]

Standard method of detailing structural concrete - A manual for best practice, The Institution of Structural Engineers/Concrete Society, [13]

Allowance for thin structural elements in residential buildings up to 3 storeys in height - Working Group 1 of Technical Committee (IEM-SWO) for Standards in Design of Concrete Structures[1].

[1] To be published in The Institution of Engineers, Malaysia Bulletin.

NA4.2 References for design for robustness

A building shall be constructed so that in the event of an accident the building shall not suffer collapse to an extent disproportionate to the cause [8][14]. Approved Document A to The Building Regulations 2000 [15] cites the details and design approaches in BS 8110 as being one acceptable method of meeting this requirement. BS 8110 will be superseded by MS EN 1992-1-1, however, not all the requirements of BS 8110 are featured in this standard. Therefore, those requirements of BS 8110 that are not covered by MS EN 1992-1-1 may be referenced to PD 6687 as non-contradictory complimentary information.

Bibliography

[1] MS EN 1991-1-1:2010, *Eurocode 1: Actions on structures - Part 1-1: General actions - Densities, self-weight, imposed loads for buildings*

[2] MS EN 1990:2010, *Eurocode - Basis of structural design*

[3] MS 523:2000, *Concrete - Part 1: Specification, performance, production and conformity*

[4] BS 8110 (all parts)*, Structural use of concrete*

[5] BS 8500-1:2002, *Concrete - Complementary British Standard to BS EN 206-1 - Part 1: Method of specifying and guidance for the specifier*

[6] BS 8500-2:2002, *Concrete - Complementary British Standard to BS EN 206-1 - Part 2: Specification for constituent materials and concrete*

[7] BS 8666, *Scheduling, dimensioning, bending and cutting of steel reinforcement for concrete. Specification*

[8] PD 6687:2005, *Background paper to the UK National Annexes to BS EN 1992-1-1 and BS EN 1992-1-2*

[9] Concrete Society. *Guidance on the use of stainless steel reinforcement*, Technical Report 51, Camberley: Concrete Society, 1998

[10] Concrete Society. *Post-tensioned concrete floors - Design handbook*, Technical Report 43, Camberley: Concrete Society, 2005

[11] Concrete Society. *Deflections in concrete slabs and beams*, Technical Report No. 58, Camberley: Concrete Society, 2005

[12] Vollum, R.L. and T.R. Hossain. *Are existing span to depth rules conservative for flat slabs?*, Magazine of Concrete Research, vol. 54, issue 6, 2002

[13] Institution of Strucural Engineers/Concrete Society. *Standard method of detailing structural concrete - A manual for best practice*, London: The Institution of Structural Engineers/Concrete Society, 2006

[14] United Kingdom. *The Building Regulations 2000*. London: The Stationery Office

[15] United Kingdom. *The Building Regulations 2000 Approved Document A: Structure*. London: The Stationery Office, 2004

[16] Working Group 1 of Technical Committee (IEM-SWO) for Standards in Design of Concrete Structures. *Allowance for thin structural elements in residential buildings up to 3 storeys in height*[1]

[1] To be published in The Institution of Engineers, Malaysia Bulletin.

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