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Malaysia National Annex to MS EN 1998-1: 2015, Eurocode 8: Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings

OFFICER/SUPPORT STAFF: (NM /)

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Descriptors: earthquake, seismic design of structure, pga, site natural period, hybrid response, spectrum, return period

Contents

Committee representation

The Industry Standards Committee on Building, Construction and Civil Engineering (ISC D) under whose authority this Malaysian Standard was developed, comprises representatives from the following organisations:

Association of Consulting Engineers Malaysia
Construction Industry Development Board Malaysia
Department of Irrigation and Drainage Malaysia
Department of Standards Malaysia
Federation of Malaysian Manufacturers
Jabatan Bomba dan Penyelamat Malaysia
Jabatan Kerajaan Tempatan
Jabatan Kerja Raya Malaysia
Malaysian Iron and Steel Industry Federation
Malaysian Timber Industry Board
Master Builders Association Malaysia
Pertubuhan Akitek Malaysia
Pertubuhan Perancang Malaysia
Projek Lebuhraya Utara-Selatan Berhad
Real Estate and Housing Developers' Association Malaysia
SIRIM Berhad (Secretariat)
Suruhanjaya Perkhidmatan Air Negara
The Cement and Concrete Association of Malaysia
The Institution of Engineers, Malaysia
Universiti Putra Malaysia
Universiti Sains Malaysia
Universiti Teknologi Malaysia

The Technical Committee on Earthquake which supervised the development of this Malaysian Standard consists of representatives from the following organisations:

Association of Consulting Engineers Malaysia
Construction Industry Development Board Malaysia
Department of Standards Malaysia
HSS Integrated Sdn Bhd
Jabatan Kerja Raya Malaysia
Jabatan Meteorologi Malaysia
Lembaga Getah Malaysia
MC Hee & Associates Consulting Engineers
Master Builders Association Malaysia
Minerals and Geoscience Department Malaysia
Pertubuhan Akitek Malaysia
Perunding Bersatu
SIRIM Berhad (Secretariat)
Tesonic (M) Sdn Bhd
The Institution of Engineers, Malaysia
The Institution of Structural Engineers, Malaysia
Universiti Kebangsaan Malaysia
Universiti Malaya
Universiti Malaysia Sabah
Universiti Sains Malaysia
Universiti Teknologi MARA
Universiti Teknologi Malaysia
Universiti Tunku Abdul Rahman
W Lee & Associates Sdn Bhd
YL Design Consultancy Services

Co-opted members:

Jabatan Kerja Raya Malaysia Sabah
Jabatan Kerja Raya Malaysia Sarawak
Minerals and Geoscience Department Malaysia (Sabah)
The Institution of Engineers, Malaysia (Sabah)

Committee representation *(continued)*

The Working Groups which developed this Malaysian Standard consists of representatives from the following organisations:

Working Group 1 on Determination of PGA under local and far field seismic condition

Association of Consulting Engineers Malaysia
Association of Consulting Engineers Malaysia (Sabah)
Association of Consulting Engineers Malaysia (Sarawak)
Construction Industry Development Board Malaysia
Jabatan Kerja Raya Malaysia Sarawak
Jabatan Meteorologi Malaysia
Jabatan Mineral dan Geosains
Jabatan Perancangan Bandar dan Desa
Jabatan Kerja Raya Malaysia Malaysia
MC Hee & Associates Consulting Engineers
Perunding Hashim & NEH Sdn Bhd
Sabah Housing and Real Estate Developers Association
Universiti Malaya
Universiti Malaysia Sabah
Universiti Malaysia Sarawak
Universiti Putra Malaysia
Universiti Sains Malaysia
Universiti Teknologi Malaysia
Universiti Teknologi MARA

Co-opted member:

Sarawak Energy Berhad

Members of Working Group 2 on Vulnerability of Concrete Structures

The Institution of Engineers, Malaysia

Members of Working Group 3 on Geotechnical

The Institution of Engineers, Malaysia

Members of Working Group 4 on Non Structural Elements

Pertubuhan Arkitek Malaysia
The Institution of Structural Engineers, Malaysia

Members of Working Group 5 on Base Isolations

Malaysian Rubber Board
Universiti Teknologi Malaysia
Malaysian Rubber Board
IRC Jurutera Perunding Sdn Bhd
Doshin Rubber
Minconsult Sdn Bhd
Universiti Teknologi MARA

Members of Working Group 6 on Task Force on National Annex

The Institution of Engineers, Malaysia
The Institution of Structural Engineers, Malaysia
Universiti Teknologi Malaysia

Foreword

The Malaysia National Annex was developed by the Technical Committee on Earthquake 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 earthquake.

This standard is based on the National Annex to BS EN 1998-1:2004, *Eurocode 8: Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings* and is implemented with the permission of the British Standards Publishing Ltd.

Acknowledgement is made to BSI for the use of information from the above publication.

This Malaysia National Annex contains information on those parameters which are left open in MS EN 1998-1:2015 for national choice, known as nationally determined parameters. The Malaysia National Annex is to be read in conjunction with the MS EN 1998-1:2015, *Eurocode 8: Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings*. Reference can be made to other parts of BS EN 1998 where applicable.

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

Malaysia National Annex to MS EN 1998-1: 2015, *Eurocode 8: Design of structures for earthquake resistance - Part 1: general rules, seismic actions and rules for buildings*

NA1 Scope

This National Annex gives:

a) the Malaysia decisions for the Nationally Determined Parameters described in the following subclauses of MS EN 1998-1:2015:

- 2.1(1)P
- 2.1(1)P
- 3.1.1(4)
- 3.1.2(1)
- 3.2.1(1),(2),(3)
- 3.2.1(4)
- 3.2.1(5)
- 3.2.2.1(4)
- 3.2.2.2(1)P
- 3.2.2.3(1)P
- 3.2.2.5(4)P
- 4.2.3.2(8)
- 4.2.4(2)P
- 4.2.5(5)P
- 4.3.3.1(4)
- 4.3.3.1(8)
- 4.4.2.5(2)
- 4.4.3.2(2)
- 5.2.1(5)
- 5.2.2.2(10)
- 5.2.4(1),(3)
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- 5.8.2(4)
- 5.8.2(5)
- 5.11.1.3.2(3)
- 5.11.1.4
- 5.11.1.5(2)
- 5.11.3.4(7)e)
- 6.1.2(1)
- 6.1.3(1)
- 6.2(3)
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- 6.5.5(7)
- 6.7.4(2)
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- 7.1.3(4)
- 7.7.2(4)
- 8.3(1)
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- 9.2.3(1)
- 9.2.4(1)
- 9.3(2)
- 9.3(2)
- 9.3(3)
- 9.3(4), Table 9.1
- 9.3(4), Table 9.1
- 9.5.1(5)
- 9.6(3)
- 9.7.2(1)
- 9.7.2(2)b)
- 9.7.2(2)c)
- 9.7.2(5)
- 10.3(2)P

b) the Malaysia decisions on the status of MS EN 1998-1:2015 informative annexes; and

c) references to non-contradictory complementary information.

NA2 Nationally determined parameters

NA2.1 General

Malaysia decisions for the nationally determined parameters described in MS EN 1998-1:2015 are given in Table NA.1.

NA2.2 Symbols

H_S total thickness of soil layers

T_S small strain site natural period (this symbol should not be confused with T_s - duration of the stationary part of the seismic motion, stated in the main text of MS EN 1998-1:2015)

V_S weighted average shear wave velocity over the total thickness of soil layers

$V_{s,i}$ shear wave velocity of individual soil layer

d_i thickness of individual soil layer

NA2.3 Abbreviation

PGA Peak ground acceleration

R Rock

RP Return period

RSA Response spectral acceleration

RSD Response spectral displacement

SWV Shear wave velocity

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015

Clause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
2.1(1)P	Reference return period T_{NCR} of seismic action for the no-collapse requirement (or, equivalently, reference probability of exceedance in 50 years, P_{NCR}).	T_{NCR} = 475 years P_{NCR} = 10 %	T_{NCR} = 475 years P_{NCR} = 10 %
2.1(1)P	Reference return period T_{DLR} of seismic action for the damage limitation requirement (or, equivalently, reference probability of exceedance in 10 years, P_{DLR}).	T_{DLR} = 95 years P_{DLR} = 10 %	T_{DLR} = 95 years P_{DLR} = 10 %
3.1.1(4)	Conditions under which ground investigations additional to those necessary for design for non-seismic actions may be omitted and default ground classification may be used.	None	None
3.1.2(1)	Ground classification scheme accounting for deep geology, including values of parameters S, T_B, T_C and T_D defining horizontal and vertical elastic response spectra in accordance with MS EN 1998-1, 3.2.2.2 and 3.2.2.3.	None	Ground classification scheme in MS EN 1998 - 1:2015 shall be used. Alternatively, classifications in Appendix A may also be used.
3.2.1(1), (2), (3)	Seismic zone maps and reference ground accelerations therein.	None	Refer to Seismic Zone Maps published by Minerals & Geoscience Department Malaysia.
3.2.1(4)	Governing parameter (identification and value) for threshold of low seismicity.	$a_g \leq 0.78$ m/s^2 or $a_gS \leq 0.98$ m/s^2	$a_g \leq 0.78$ m/s^2 or $a_gS \leq 0.98$ m/s^2
3.2.1(5)	Governing parameter (identification and value) for threshold of very low seismicity.	$a_g \leq 0.39$ m/s^2 or $a_gS \leq 0.49$ m/s^2	$a_g \leq 0.39$ m/s^2 or $a_gS \leq 0.49$ m/s^2

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

Clause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
3.2.2.1(4), 3.2.2.2(1)P	Parameters S, T_B, T_C, T_D defining shape of horizontal elastic response spectra.	See below	See below

Eurocode recommendation

In the absence of deep geology effects, and for Type 1 spectra (where earthquakes that contribute most to the seismic hazard defined for the site for the purpose of probabilistic hazard assessment have a surface-wave magnitude, Ms, greater than 5.5)

Ground type	S	T_B (s)	T_C (s)	T_D (s)
A	1.0	0.15	0.4	2.0
B	1.2	0.20	0.5	2.0
C	1.15	0.20	0.6	2.0
D	1.35	0.20	0.8	2.0
E	1.4	0.15	0.5	2.0

In the absence of deep geology effects, and for Type 2 spectra (where earthquakes that contribute most to the seismic hazard defined for the site for the purpose of probabilistic hazard assessment have a surface-wave magnitude, Ms, less than 5.5):

Ground type	S	T_B (s)	T_C (s)	T_D (s)
A	1.0	0.05	0.25	1.20
B	1.35	0.05	0.25	1.20
C	1.5	0.10	0.25	1.20
D	1.8	0.10	0.30	1.20
E	1.6	0.05	0.25	1.20

Malaysia decision

In the absence of deep soil effects, and for site specific information Malaysia spectra. Use the table below or refer to Annex A.

Peninsular:

Ground type	S	T_B (s)	T_C (s)	T_D (s)
A	1	0.05	0.2	2.2
B	1.4	0.05	0.3	2.2
C	1.15	0.05	0.5	2.2
D	1.35	0.3	0.8	2.2
E	1.4	0.15	0.5	2.2

Sabah:

Ground type	S	T_B (s)	T_C (s)	T_D (s)
A	1	0.1	0.4	2
B	1.4	0.15	0.4	2
C	1.35	0.15	0.6	2
D	1.35	0.2	0.8	2
E	1.4	0.15	0.5	2

Sarawak:

Ground type	S	T_B (s)	T_C (s)	T_D (s)
A	1	0.05	0.5	1.2
B	1.2	0.15	0.5	1.2
C	1.3	0.2	0.5	1.2
D	1.35	0.2	0.5	1.2
E	1.4	0.15	0.5	1.2

Or alternatively, for Malaysia spectra, site natural period (T_S) calculation is required for soil deposit exceeding 30 m in depth (deep geology). Use the table below or refer to Appendix A and Appendix B.

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

<table>
<tr><th>Clause</th><th>Nationally Determined Parameter</th><th>Eurocode recommendation</th><th>Malaysia decision</th></tr>
<tr><td></td><td></td><td></td><td>
Peninsular:
<table>
<tr><th>Ground type</th><th>S</th><th>T_B (s)</th><th>T_C (s)</th><th>T_D (s)</th></tr>
<tr><td>A</td><td>1</td><td>0.1</td><td>0.3</td><td>2.0</td></tr>
<tr><td>B</td><td>1.5</td><td>0.1</td><td>0.3</td><td>1.5</td></tr>
<tr><td>C</td><td>1.8</td><td>0.1</td><td>0.6</td><td>1.0</td></tr>
<tr><td>D</td><td>1.35</td><td>0.1</td><td>0.8</td><td>1.5</td></tr>
<tr><td>E</td><td>1.8</td><td>0.1</td><td>0.6</td><td>2.0</td></tr>
</table>
Sabah:
<table>
<tr><th>Ground type</th><th>S</th><th>T_B (s)</th><th>T_C (s)</th><th>T_D (s)</th></tr>
<tr><td>A</td><td>1</td><td>0.1</td><td>0.3</td><td>4.0</td></tr>
<tr><td>B</td><td>1.5</td><td>0.1</td><td>0.3</td><td>4.0</td></tr>
<tr><td>C</td><td>1.8</td><td>0.1</td><td>0.6</td><td>1.0</td></tr>
<tr><td>D</td><td>1.35</td><td>0.1</td><td>0.8</td><td>1.5</td></tr>
<tr><td>E</td><td>1.8</td><td>0.1</td><td>0.6</td><td>2.0</td></tr>
</table>
Sarawak:
<table>
<tr><th>Ground type</th><th>S</th><th>T_B (s)</th><th>T_C (s)</th><th>T_D (s)</th></tr>
<tr><td>A</td><td>1</td><td>0.1</td><td>0.3</td><td>1.25</td></tr>
<tr><td>B</td><td>1.5</td><td>0.1</td><td>0.3</td><td>1.25</td></tr>
<tr><td>C</td><td>1.8</td><td>0.1</td><td>0.6</td><td>1.0</td></tr>
<tr><td>D</td><td>1.35</td><td>0.1</td><td>0.8</td><td>1.5</td></tr>
<tr><td>E</td><td>1.8</td><td>0.1</td><td>0.6</td><td>2.0</td></tr>
</table>
</td></tr>
<tr><td>3.2.2.3(1)P</td><td>Parameters a_{vg}, T_B, T_C, T_D defining shape of vertical elastic response spectra.</td><td>
<table>
<tr><th>Spectrum</th><th>a_{vg}/a_g</th><th>T_B (s)</th><th>T_C (s)</th><th>T_D (s)</th></tr>
<tr><td>Type 1</td><td>0.90</td><td>0.05</td><td>0.15</td><td>1.0</td></tr>
<tr><td>Type 2</td><td>0.45</td><td>0.05</td><td>0.15</td><td>1.0</td></tr>
</table>
</td><td>
<table>
<tr><th>a_{vg}/a_g</th><th>T_B (s)</th><th>T_C (s)</th><th>T_D (s)</th></tr>
<tr><td>0.70</td><td>0.05</td><td>0.15</td><td>1.0</td></tr>
</table>
</td></tr>
</table>

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

<table>
<tr><th>Clause</th><th>Nationally Determined Parameter</th><th>Eurocode recommendation</th><th>Malaysia decision</th></tr>
<tr><td>3.2.2.5(4)P</td><td>Lower bound factor β on design spectral values.</td><td>β = 0.2</td><td>β = 0.2</td></tr>
<tr><td>4.2.3.2(8)</td><td>Reference to definitions of centre of stiffness and of torsional radius in multi storey buildings meeting or not conditions (a) and (b) of MS EN 1998-1, 4.2.3.2(8).</td><td>None</td><td>Any appropriate method may be used.
Further guidance is given in UK (BSI) PD 6698.</td></tr>
<tr><td>4.2.4(2)P</td><td>Ratio ϕ of coefficient ψ_{Ei} on variable mass used in seismic analysis to combination coefficient ψ_{2i} for quasi permanent values of variable actions.</td><td>
<table>
<tr><th>Type of variable action</th><th>Storey</th><th>ϕ</th></tr>
<tr><td>Categories A–C*</td><td>Roof</td><td>1.0</td></tr>
<tr><td></td><td>Storeys with correlated occupancies</td><td>0.8</td></tr>
<tr><td></td><td>Independently occupied storeys</td><td>0.5</td></tr>
<tr><td>Categories D–F* and Archives</td><td></td><td>1.0</td></tr>
<tr><td colspan="3">* Categories as defined in MS EN 1991-1-1.</td></tr>
</table>
</td><td>Use the recommended values.</td></tr>
<tr><td>4.2.5(5)P</td><td>Importance factor γ_I for buildings.</td><td>Class I: γ_I = 0.8
Class III: γ_I = 1.2
Class IV: γ_I = 1.4</td><td>For Malaysia, a two-tier importance factor is used to cater for (1) building categories and (2) metropolitan and suburban areas categories. Refer to Appendix C.</td></tr>
<tr><td>4.3.3.1(4)</td><td>Decision on whether nonlinear methods of analysis may be applied for the design of non- base-isolated buildings. Reference to information on member deformation capacities and the associated partial factors for the Ultimate Limit State for design or evaluation on the basis of nonlinear analysis methods.</td><td>None</td><td>None</td></tr>
<tr><td>4.3.3.1 (8)</td><td>Threshold value of importance factor, γ_I, relating to the permitted use of analysis with two planar models.</td><td>None</td><td>3D (spatial) analysis models are recommended.</td></tr>
</table>

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

Clause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
4.4.2.5(2)	Overstrength factor γ_{Rd} for diaphragms.	For brittle failure modes, such as shear, γ_{Rd} =1.3. For ductile failure modes, γ_{Rd} =1.1	Use the recommended values.
4.4.3.2(2)	Reduction factor, v for displacements at damage limitation limit state.	Class I & II: v = 0.5 Class III & IV: v = 0.4	Only Class IV buildings need to be checked for damage limitation limit state based on a return period of 475 years. v = 0.5 is to be adopted.
5.2.1(5)	Geographical limitations on use of ductility classes for concrete buildings.	None	None
5.2.2.2(10)	q_o-value for concrete buildings subjected to special Quality System Plan.	Adjustment to q_o-value is a factor in the range 1 to 1.2, with no recommended value within this range.	No adjustment is permitted on q_o-value.
5.2.4(1), (3)	Material partial factors for concrete buildings in the seismic design situation.	Use the γ_c and γ_s values for the persistent and transient design situations.	Use the recommended values.
5.4.3.5.2(1)	Minimum web reinforcement of large lightly reinforced concrete walls.	The minimum value for walls given in MS EN 1992-1-1 and its National Annex.	The minimum value for walls given in MS EN 1992-1-1 and its National Annex. Single layer of reinforcing in a wall is not recommended.
5.8.2(3)	Minimum cross-sectional width $b_{w,min}$ and depth $h_{w,min}$ of concrete foundation beams	Buildings up to 3 storeys: $b_{w,min}$ = 0.25 m $h_{w,min}$ = 0.4 m Buildings with 4 or more storeys: $b_{w,min}$ = 0.25 m $h_{w,min}$ = 0.5 m	Use the recommended values.
5.8.2(4)	Minimum thickness t_{min} and reinforcement ratio $\rho_{s,min}$ of concrete foundation slabs.	t_{min} = 0.2 m $\rho_{s,min}$ = 0.2 %	Use the recommended values.
5.8.2(5)	Minimum reinforcement ratio $\rho_{b,min}$ of concrete foundation beams.	$\rho_{b,min}$ = 0.4 %	$\rho_{b,min}$ = 0.2 % in top face and 0.2 % in bottom face
5.11.1.3.2(3)	Ductility class of precast wall panel systems.	DCM	No specific requirement for precast wall panel systems.

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

Clause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
5.11.1.4	Factor k_p on q-factors of precast systems.	k_p = 1.0 for structures with connections conforming to MS EN 1998-1, 5.11.2.1.1, 5.11.2.1.2, or 5.11.2.1.3 k_p = 0.5 for structures with other types of connection	Use the recommended values.
5.11.1.5(2)	Ratio A_p of transient seismic action assumed during erection of precast structures to design seismic action defined in MS EN 1998-1, Section 3.	A_p = 0.3 unless otherwise specified by special studies	In the absence of a site specific assessment, use the recommended value.
5.11.3.4(7)e)	Minimum longitudinal steel $\rho_{c,min}$ in grouted connections.	$\rho_{c,min}$ = 1 %	Use the recommended values.
6.1.2(1)	Upper limit of q for low-dissipative structural behaviour concept.	1.5	1.5 Further guidance is given in PD 6698.
	Limitations on structural behaviour concept.	None	No limitation on structural behaviour concept. Further guidance is given in PD 6698.
	Geographical limitations on use of ductility classes for steel buildings.	None	No geographical limitations. Further guidance is given in PD 6698.
6.1.3(1)	Material partial factors for steel buildings in the seismic design situation.	Use the γ_s values for the persistent and transient design situations.	Use the recommended values.
6.2(3)	Overstrength factor for capacity design of steel buildings.	γ_{ov} = 1.25	Use the recommended values.
6.2(7)	Information as to how EN 1993-1-10 – selection of steel for fracture toughness and through thickness properties – may be used in the seismic design situation.	None	The fracture toughness and through thickness properties of the steel should be selected on a project specific basis. Further guidance is given in PD 6698.
6.5.5(7)	Reference to complementary rules on acceptable connection design.	None	Complementary rules for connection design may be developed on a project-specific basis. Further guidance is given in PD 6698.

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

Clause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
6.7.4(2)	Residual post-buckling resistance of compression diagonals in steel frames with *V*- bracings.	γ_{pb} = 0.3	$\gamma_{pb} = \gamma_{pb}{*}\, N_{b,Rd}\, (\lambda_{bar})/N_{pl,Rd}$ (γ_{pb}* times design buckling resistance over plastic resistance) γ_{pb}* = 0.7 for q ≤ 2 γ_{pb}* = 0.3 for q ≥ 5 For 2 ≤ q ≤ 5, γ_{pb}* = 0.3 may be assumed or refer to PD 6698. Further guidance is given in PD 6698.
7.1.2(1)	Upper limit of q for low-dissipative structural behaviour concept.	1.5	Use the recommended values.
	Limitations on structural behaviour concept.	None	None
	Geographical limitations on use of ductility classes for composite steel-concrete buildings.	None	None
7.1.3(1), (3)	Material partial factors for composite steel concrete buildings in the seismic design situation.	Use the γ_s values for the persistent and transient design situations.	Use the recommended values.
7.1.3(4)	Overstrength factor for capacity design of composite steel-concrete buildings.	γ_{ov} = 1.25	Use the recommended values.
7.7.2(4)	Stiffness reduction factor for concrete part of a composite steel-concrete column section.	r = 0.5	Use the recommended values.
8.3(1)	Geographical limits on ductility class for timber buildings.	None	None
9.2.1(1)	Type of masonry units with sufficient robustness.	None	None
9.2.2(1)	Minimum strength of masonry units.	$f_{b,min}$ = 5 N/mm^2 (normal to bedface) $f_{bh,min}$ = 2 N/mm^2 (parallel to bedface)	Use the recommended values.

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

Clause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
9.2.3(1)	Minimum strength of mortar in masonry buildings.	$f_{m,min}$ = 5 N/mm^2 (unreinforced or confined masonry) $f_{m,min}$ = 10 N/mm^2 (reinforced masonry)	Use the recommended values.
9.2.4(1)	Alternative classes for perpend joints in masonry.	None	None
9.3(2)	Conditions for use of unreinforced masonry satisfying provisions of BS EN 1996-1 alone.	None	None
9.3(2)	Minimum effective thickness $t_{ef,min}$ of unreinforced masonry walls satisfying provisions of BS EN 1996-1 alone.	None	None
9.3(3)	Maximum value of ground acceleration $a_{g,urm}$ for the use of unreinforced masonry satisfying provisions of MS EN1998-1.	$a_{g,urm}$ = 0.2 g	Use the recommended values.
9.3(4), Table 9.1	q-factor values in masonry buildings.	Unreinforced masonry in accordance with MS EN 1998-1: $q = 1.5$ Confined masonry: $q = 2.0$ Reinforced masonry: $q = 2.5$	Use the recommended values.
9.3(4), Table 9.1	q-factors for buildings with masonry systems which provide enhanced ductility.	*None*	None

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

<table>
<tr><th>Clause</th><th>Nationally Determined Parameter</th><th>Eurocode recommendation</th><th>Malaysia decision</th></tr>
<tr><td>9.5.1(5)</td><td>Geometric requirements for masonry shear walls.</td><td>
<table>
<tr><th>Masonry type</th><th>$t_{ef,min}$ (mm)</th><th>(h_{ef}/t_{ef}) max (mm)</th><th>$(l/h)_{min}$</th></tr>
<tr><td>Unreinforced, with natural stone units</td><td>350</td><td>9</td><td>0.5</td></tr>
<tr><td>Unreinforced, with any other type of units</td><td>240</td><td>12</td><td>0.4</td></tr>
<tr><td>Unreinforced, with any other type of units, in cases of low seismicity</td><td>170</td><td>15</td><td>0.35</td></tr>
<tr><td>Confined masonry</td><td>240</td><td>15</td><td>0.3</td></tr>
<tr><td>Reinforced masonry</td><td>240</td><td>15</td><td>No restriction</td></tr>
</table>
Symbols used have the following meaning:
t_{ef} thickness of the wall (see BS EN 1996-1-1);
h_{ef} effective height of the wall (see BS EN 1996 1-1);
h greater clear height of the openings adjacent to the wall;
l length of the wall.
</td><td>Use the recommended values.</td></tr>
<tr><td>9.6(3)</td><td>Material partial factors in masonry buildings in the seismic design situation.</td><td>γ_m = 2/3 of value specified in National Annex to BS EN 1996-1, but not less than 1.5.
γ_s = 1.0</td><td>Use the recommended values.</td></tr>
</table>

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

<table>
<tr><th>Clause</th><th>Nationally Determined Parameter</th><th>Eurocode recommendation</th><th>Malaysia decision</th></tr>
<tr><td>9.7.2(1)</td><td>Maximum number of storeys and minimum area of shear walls of “simple masonry building”.</td><td>
<table>
<tr><th colspan="2">Acceleration at site $a_g.S$</th><th>≤ 0.07 k.g</th><th>≤ 0.10 k.g</th><th>≤ 0.15 k.g</th><th>≤ 0.20 k.g</th></tr>
<tr><th>Type of Construction</th><th>Number of storeys (n)**</th><th colspan="4">Minimum sum of cross-sections areas of horizontal shear walls in each direction, as percentage of the total floor area per storey($p_{A,min}$)</th></tr>
<tr><td>Unreinforced masonry</td><td>1
2
3
4</td><td>2.0 %
2.0 %
3.0 %
5.0 %</td><td>2.0 %
2.5 %
5.0 %
n/a*</td><td>3.5 %
5.0 %
n/a
n/a</td><td>n/a
n/a
n/a
n/a</td></tr>
<tr><td>Confined masonry</td><td>1
2
3
4</td><td>2.0 %
2.0 %
4.0 %
6.0 %</td><td>2.5 %
3.0 %
5.0 %
n/a</td><td>3.0 %
4.0 %
n/a
n/a</td><td>3.5 %
n/a
n/a
n/a</td></tr>
<tr><td>Reinforced masonry</td><td>1
2
3
4</td><td>2.0 %
2.0 %
3.0 %
4.0 %</td><td>2.0 %
2.0 %
4.0 %
5.0 %</td><td>2.0 %
3.0 %
5.0 %
n/a</td><td>3.5 %
5.0 %
n/a
n/a</td></tr>
<tr><td colspan="6">* n/a means “not acceptable”.
** Roof space above full storeys is not included in the number of storeys.</td></tr>
</table>
</td><td>Use the recommended values.</td></tr>
<tr><td>9.7.2(2)b)</td><td>Minimum aspect ratio in plan λ_{min} of “simple masonry buildings”.</td><td>λ_{min} = 0.25</td><td>Use the recommended values.</td></tr>
<tr><td>9.7.2(2)c)</td><td>Maximum floor area of recesses in plan for “simple masonry buildings”, expressed as a percentage p_{max} of the total floor plan area above the level considered.</td><td>p_{max} = 15 %</td><td>Use the recommended values.</td></tr>
</table>

Table NA1. Malaysia values for Nationally Determined Parameters described in MS EN 1998-1:2015 *(continued)*

Clause	Nationally Determined Parameter	Eurocode recommendation	Malaysia decision
9.7.2(5)	Maximum difference in mass $\Delta_{m,max}$ and wall area $\Delta_{A,max}$ between adjacent storeys of "simple masonry buildings".	$\Delta_{m,max}$ = 20 % $\Delta_{A,max}$ = 20 %	Use the recommended values.
10.3(2)P	Magnification factor γ_x on seismic displacements for isolation devices.	γ_x = 1.2 for buildings	Use the recommended value.
Malaysia decision not indicated shall use recommended value of MS EN1998-1:2015.			

NA3 Decisions on the status of the informative annexes

NA3.1 Elastic displacement response spectrum (MS EN 1998-1:2015, Annex A)

MS EN 1998-1:2015 informative Annex A should not be used. The basis of the Malaysia response spectrum is based on elastic displacement.

NA3.2 Determination of the target displacement for nonlinear static (pushover) analysis (MS EN 1998-1:2015, Annex B)

MS EN 1998-1:2015 informative Annex B may be used as an informative annex. Further guidance is given in PD 6698.

NA4 References to non-contradictory complementary information

The following contains non-contradictory complementary information for use with MS EN 1998-1:2015:

PD 6698:2008, Background paper to the UK National Annexes to BS EN 1998-1, BS EN 1998-2, BS EN 1998-4, BS EN 1998-5 and BS EN 1998-6.

Annex A
(normative)

Horizontal elastic response spectrum of ground types A to E (5% damping) for Peninsular Malaysia, Sabah and Sarawak

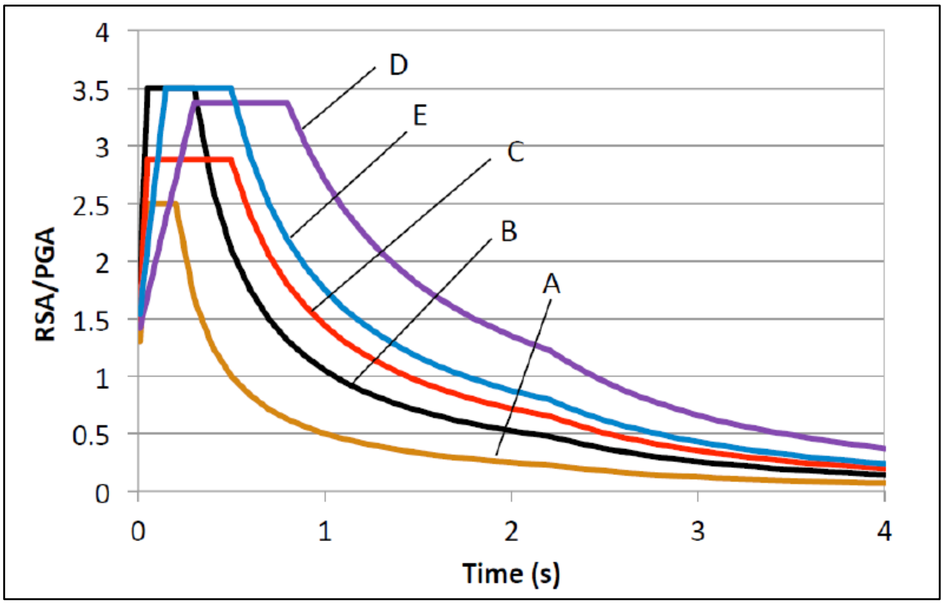

Figure NA1. Horizontal elastic response spectrum of ground types A to E (5% damping) for Peninsular Malaysia

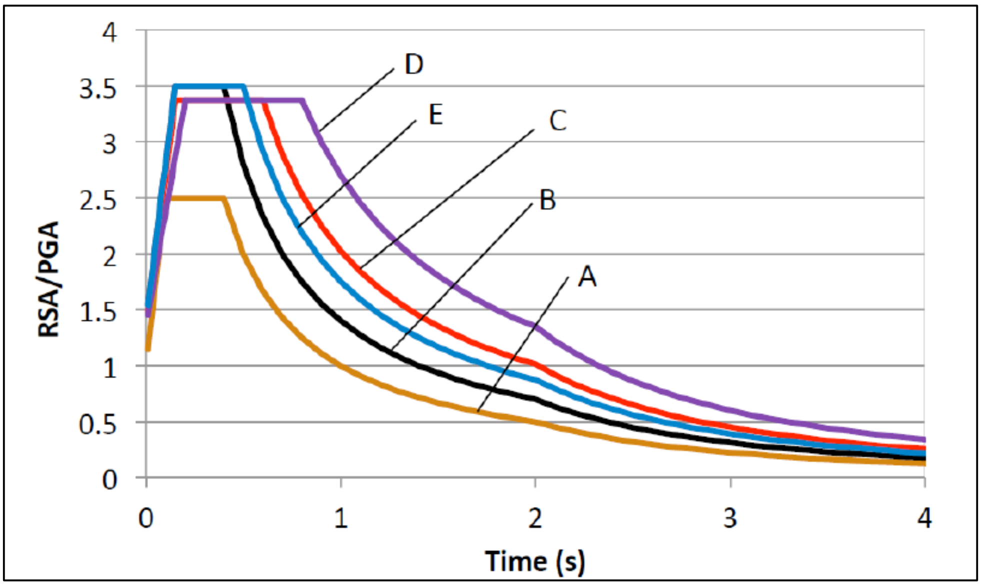

Figure NA2. Horizontal elastic response spectrum of ground types A to E (5% damping) for Sabah

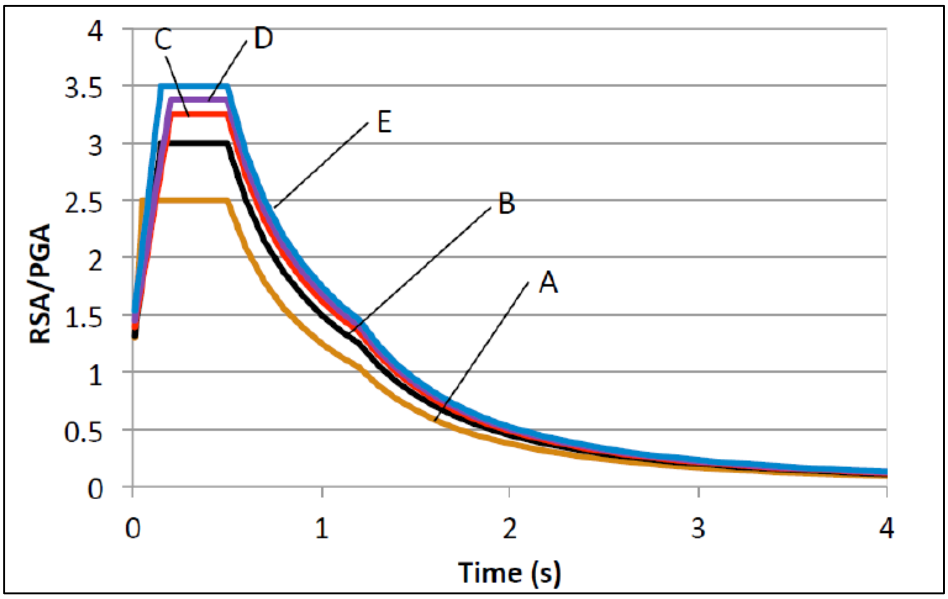

Figure NA3. Horizontal elastic response spectrum of ground types A to E (5% damping) for Sarawak

Appendix A
(normative)

Ground classification scheme in accordance to site natural period

Table AA.1 Ground classifications scheme in accordance to site natural period

Ground type	Description and Range of Site Natural Period, *TS* (s)*
A	Rock site, OR a site with very thin sediments and *TS* < 0.15 s
B	A site not classified as Ground Type A, C, D or E
C	A site with sediments of more than 30 m deep to bedrock AND *TS* = 0.5 – 0.7 s
D	A site with sediments of more than 30 m deep to bedrock AND *TS* = 0.7 – 1.0 s
E	A site with sediments of more than 30 m deep to bedrock AND *TS* = > 1.0 s, OR deposits consisting of at least 10 m thick of clays/silts with a high plasticity index (PI > 50)

NOTE. A soil site is characterised by its small-strain site natural period (TS) of the soil layer down to the depth of much stiffer sediments or bedrock. For soil sediments of more than 30 m deep to bedrock, TS can be estimated using the formula:

$$V_S = \frac{H_S}{\sum_i^n \frac{d_i}{V_{s,i}}}$$

$$T_S = \frac{4 \times H_S}{V_S}$$

The values of the site natural period (*TS*), small-strain shear modulus or shear wave velocity (*SWV*, *VS*) of soils can be measured by various geotechnical or geophysical testing techniques. Sedimentary layers with SPT-N value greater than 100 can be omitted in the computations of site natural period and weighted average *SWV*.

Generally two boreholes for a block of low-rise building is sufficient. Spacing of boreholes for multi-storey buildings should be 15 m to 45 m. More boreholes are necessary for problematic and erratic soil formation. The arithmetic mean of the site natural period TS shall be adopted for site classification.

Appendix B
(normative)

Normalised elastic response spectrum for ground types A to E (5% damping) for Malaysia

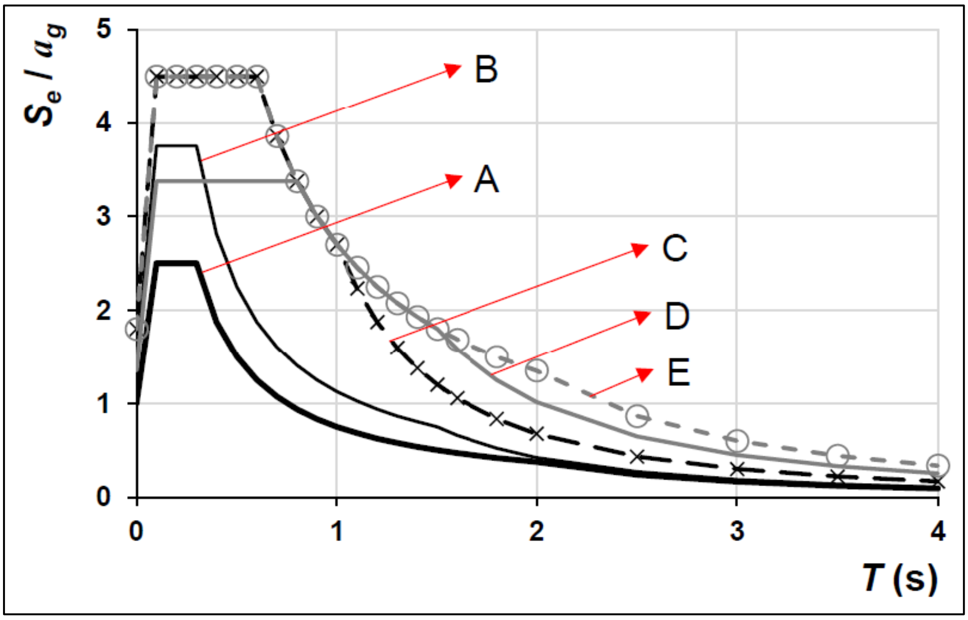

Figure AB1 Normalised horizontal elastic response spectrum for ground types A to E (5% damping) for *Peninsular Malaysia*

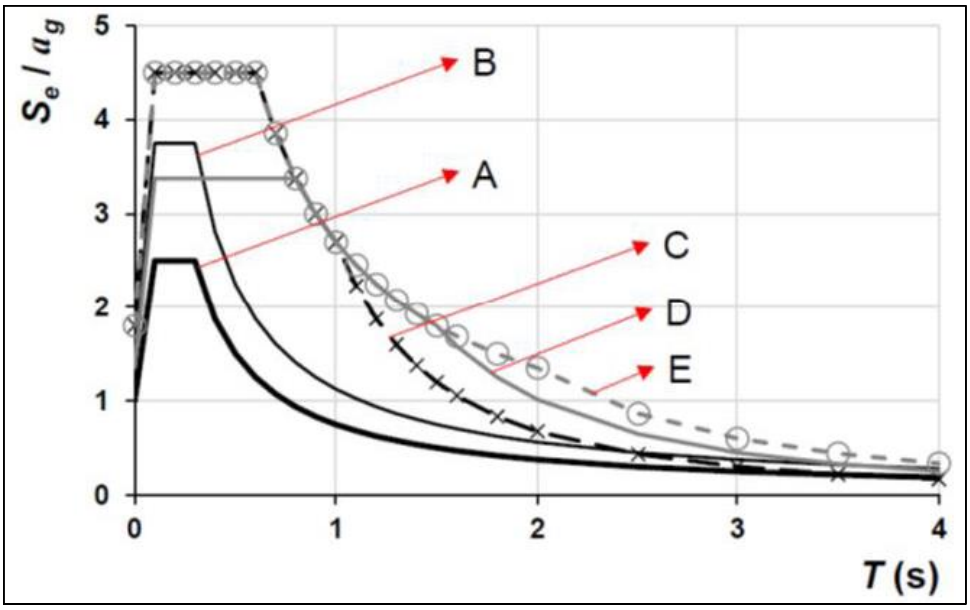

Figure AB2 Normalised horizontal elastic response spectrum for ground types A to E (5% damping) for Sabah

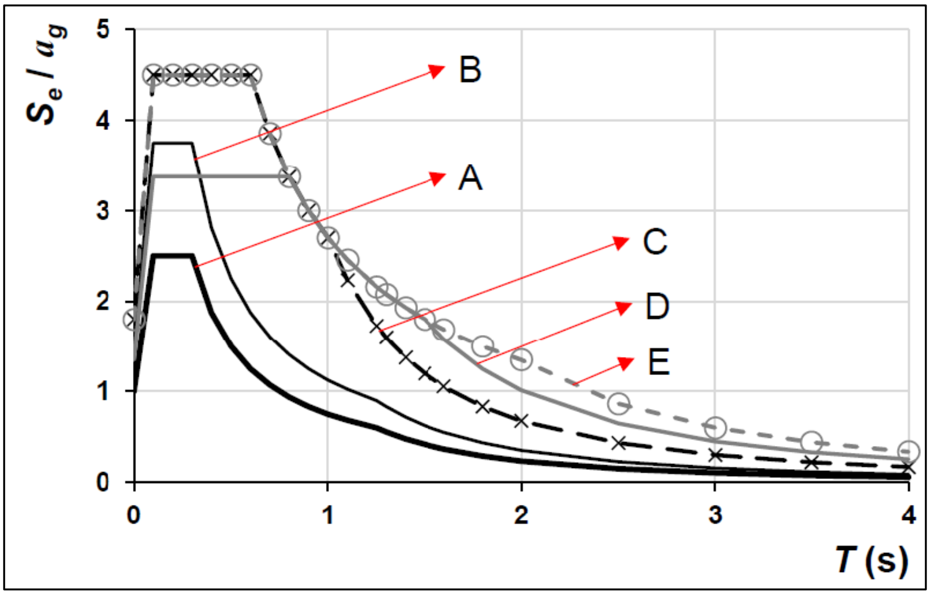

Figure ABE3 Normalised horizontal elastic response spectrum for ground types A to E (5% damping) for *Sarawak*

Appendix C
(normative)

Importance factor (γ_I) for Malaysia

Table AC1. Importance factor (γI) for Malaysia

Building importance class	Importance factor 1 ($\gamma I1$)	Recommended building categories	Area importance class	Importance factor 2 ($\gamma I2$)	Recommended area categories
I	0.8	Minor construction	A	0.7	Areas other than those classified as B
II	1.0	Ordinary buildings (individual dwellings or shops in low rise buildings)	B	1.0	*Metropolitan areas in major centres of population
III	1.2	Buildings of large occupancies (condominiums, shopping centres, schools and public buildings)	N.A	N.A	N.A
IV	1.5	Lifeline built facilities (hospitals, emergency services, power plants and communication facilities)	N.A	N.A	N.A

NOTE. The delineation of areas into Class A and B is to be drawn up for approval by the relevant government departments taking into considerations of political, social and economical factors.

The compounded importance factor can be calculated with the following formula.

$$\gamma I = \gamma I1 \times \gamma I2$$

The design acceleration can be calculated with the following formula.

$$a_g = \gamma I \, a_{gR}$$

Bibliography

[1] MS EN 1992-1-1:2010, *Eurocode 2 - Design of concrete structures - Part 1-1: General rules and rules for buildings*

[2] BS EN 1993-1-10:2010, *Eurocode 3 - Design of steel structures - Part 1-10: Material toughness and through-thickness properties*

[3] BS EN 1996-1-1:2005, *Eurocode 6 - Design of masonry structures - Part 1-1: General rules for reinforced and unreinforced masonry structures*

[4] MS EN 1998-1:2015, *Eurocode 8 - Design of structures for earthquake resistance - Part 1: General rules, seismic actions and rules for buildings*

[5] PD 6698:2008, *Background paper to the UK National Annexes to BS EN 1998-1, BS EN 1998-2, BS EN 1998-4, BS EN 1998-5 and BS EN 1998-6*

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