NATIONAL ANNEX

TO

CYS EN 1991-1-5:2003 (Including AC:2009)

Eurocode 1: Actions on structures

Part 1-5: General actions - Thermal actions

CYPRUS ORGANISATION FOR STANDARDISATION

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This National Annex has been approved by the Board of Directors of the Cyprus Organisation for Standardisation (CYS) on 24.01.2020.

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INTRODUCTION

This National Annex has been prepared by the CYS TC 18 Committee of the Cyprus Organization of Standardisation.

NA 1 SCOPE

This National Annex is to be used together with CYS EN 1991-1-5:2003 including AC:2009, Any reference in the rest of this text to CYS EN 1991-1-5:2003 means the above document.

This National Annex gives:

(a) Nationally determined parameters for the following clauses of CYS EN 1991-1-5:2003/AC:2009 where National choice is allowed (see Section NA 2)

- 5.3(2) (Tables 5.1, 5.2 and 5.3)
- 6.1.1 (1)
- 6.1.2(2)
- 6.1.3.1(4)
- 6.1.3.2(1)P
- 6.1.3.3(3)
- 6.1.4(3)
- 6.1.4.1(1)
- 6.1.4.2(1)
- 6.1.4.3(1)
- 6.1.4.4(1)
- 6.1.5(1)
- 6.1.6(1)
- 6.2.1(1)P
- 6.2.2(1)
- 6.2.2(2)
- 7.2.1(1)P
- 7.5(3)
- 7.5(4)
- A.1(1)
- A.1(3)
- A.2(2)
- B (1) (Tables B.1, B.2 and B.3)

(b) Guidance on the use of the Informative Annexes C and D (see Section NA 3)

(c) References to non-contradictory complementary information to assist the user to apply CYS EN 1991-1-5:2003/AC:2009 (see Section NA 4).

NA 2 NATIONALLY DETERMINED PARAMETERS

NA 2.1 Clause 5.3 Determination of temperature profiles 5.3(2) (Tables 5.1, 5.2 and 5.3)

The values indicated in table 5.1 (CYS), 5.2 (CYS) and 5.3 (CYS) shall be used.

Table 5.1 (CYS): Indicative temperatures of inner environment T_{in}

Season	Temperature T_{in}
Summer	T_1
Winter	T_2
NOTE: When no specific data are available the values T_1 = 20 °C and T_2 = 25 °C should be used.	

Table 5.2 (CYS): Indicative temperatures T_{out} for buildings above the ground level

Season	Significant factor		Temperature T_{out} in ^{0}C
Summer	Relative absorptivity depending on surface colour	0,5 bright light surface	$T_{max} + T_3$
		0,7 light coloured surface	$T_{max} + T_4$
		0,9 dark surface	$T_{max} + T_5$
Winter			T_{min}
NOTE: If no specific data are available the values T_3 = 0°C, T_4 = 2°C, and T_5 = 4°C should be used, for North-East facing elements and T_3 = 18°C, T_4 = 30°C, and T_5 = 42°C for South-West or horizontal facing elements.			

Table 5.3(CYS): Indicative temperatures T_{out} for underground parts of buildings

Season	Depth below the ground level	Temperature T_{out} in ^{0}C
Summer	Less than 1 m	T_6
	More than 1 m	T_7
Winter	Less than 1 m	T_8
	More than 1 m	T_9
NOTE: If no specific data are available the values T_6 = 8°C, T_7 = 5°C, T_8 = -5°C and T_9 = -3°C should be used.		

NA 2.2 Clause 6.1.1(1) Bridge deck types

For bridge deck types other than the ones described in 6.1.1 values of the uniform temperature component and the temperature difference component for other types of bridges should be appropriately justified.

NA 2.3 Clause 6.1.2(2) Consideration of thermal actions

In general approach 1 shall be used which states "Representative values of thermal actions should be assessed by the uniform temperature component (see 6.1.3) and the temperature difference components (see 6.1.4)."

For appropriate occupations the simpler approach 2 shall be used. "Approach (2) The vertical temperature difference component given in 6.1.4 should generally include the non-linear component, see 4(3)."

NA 2.4 Clause 6.1.3.1(4) Uniform temperature component

The minimum and maximum uniform bridge temperature components, $T_{e.min}$ and $T_{e.max}$., shall be taken from Figure 6.1 (CYS).

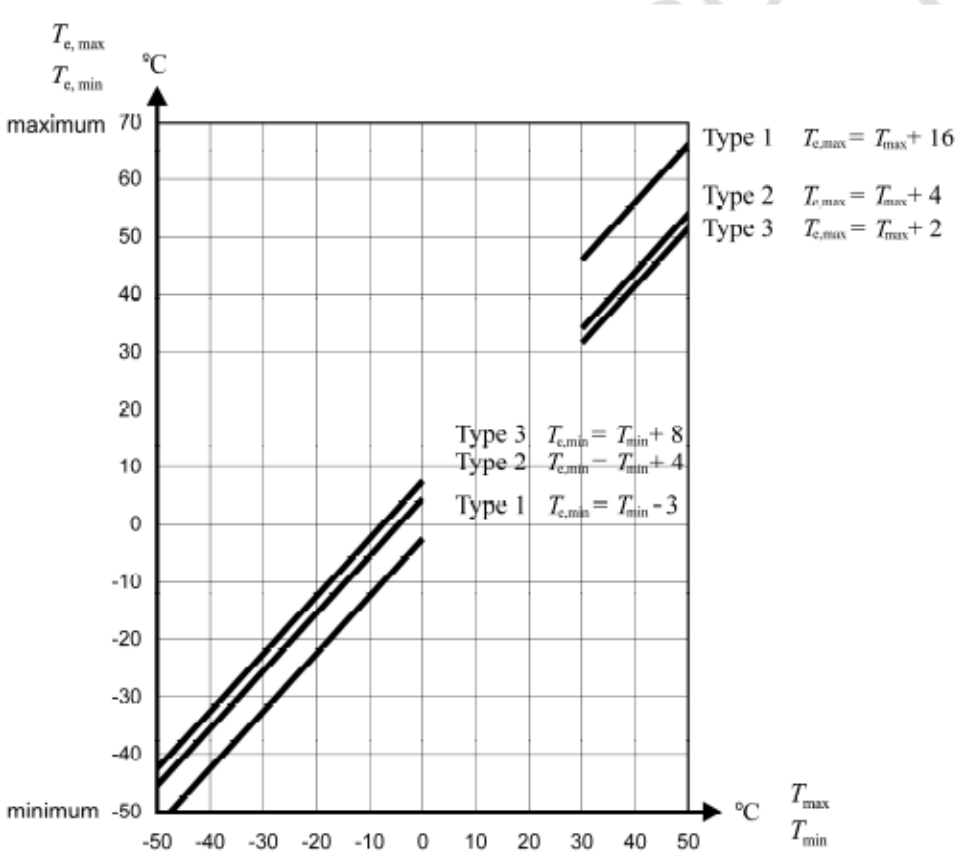


Figure 6.1 (CYS): Correlation between minimum/maximum shade air temperature (T_{min}/T_{max}) and minimum/maximum uniform bridge temperature component ($T_{e.min}/T_{e.max}$)

NOTE 1: The values in Figure 6.1 are based on daily temperature ranges of 10°C. Such a range may be considered appropriate for most Member States.

NOTE 2: For steel truss and plate girders the maximum values given for type 1 may be reduced by 3°C.

NA 2.5 Clause 6.1.3.2(1)P Shade air temperature

Minimum and maximum shade air temperatures should be appropriately justified taking into account the specific location of the structure.

NA 2.6 Clause 6.1.3.3(3) Range of uniform bridge temperature component

Values shall be specified according to Note 2 of clause 6.1.3.3 of standard CYS EN 1991-1-5:2003

For bearings and expansion joints the maximum expansion range of the uniform bridge temperature component and the maximum contraction range of the uniform bridge temperature component, if no other provisions are required, shall be

$(\Delta T_{N,exp} + 20)^oC$ and $(\Delta T_{N,con} + 20)^oC$, respectively

If the temperature at which the bearings and expansion joints are set is specified, then the maximum expansion range and the maximum contraction range should be

$(\Delta T_{N,exp} + 10)^oC$ and $(\Delta T_{N,con} + 10)^oC$, respectively.

NA 2.7 Clause 6.1.4(3) Temperature difference components

In the case of cantilever construction, the initial temperature difference value should be appropriately justified for the specific structure.

NA 2.8 Clause 6.1.4.1(1) Vertical linear component (Approach 1)

The values given in Table 6.1 (CYS) shall be used for $\Delta T_{M,heat}$ and $\Delta T_{M,cool}$

Table 6.1 (CYS): Values of linear temperature difference component for different types of bridge decks for road, foot and railway bridges

Type of Deck	Top warmer than bottom	Bottom warmer than top
	$\Delta T_{M,heat}$ (^oC)	$\Delta T_{M,cool}$ (^oC)
Type 1: Steel deck	18	13
Type 2: Composite deck	15	18
Type 3: Concrete deck: - concrete box girder - concrete beam - concrete slab	 10 15 15	 5 8 8
NOTE 1: The values given in the table represent upper bound values of the linearly varying temperature difference component for representative sample of bridge geometries. NOTE 2: The values given in the table are based on a depth of surfacing of 50 mm for road and railway bridges. For other depths of surfacing these values should be multiplied by the factor k_{sur}. Recommended values for the factor k_{sur} is given in Table 6.2.		

NA 2.9 Clause 6.1.4.2(1) Vertical temperature components with non-linear effects (Approach 2)

The values specified in Figures 6.2a, 6.2b and 6.2c of standard CYS EN 1991-1-5:2003

shall be used and are valid for 40mm surfacing depths for deck type 1 and 100mm for deck types 2 and 3.

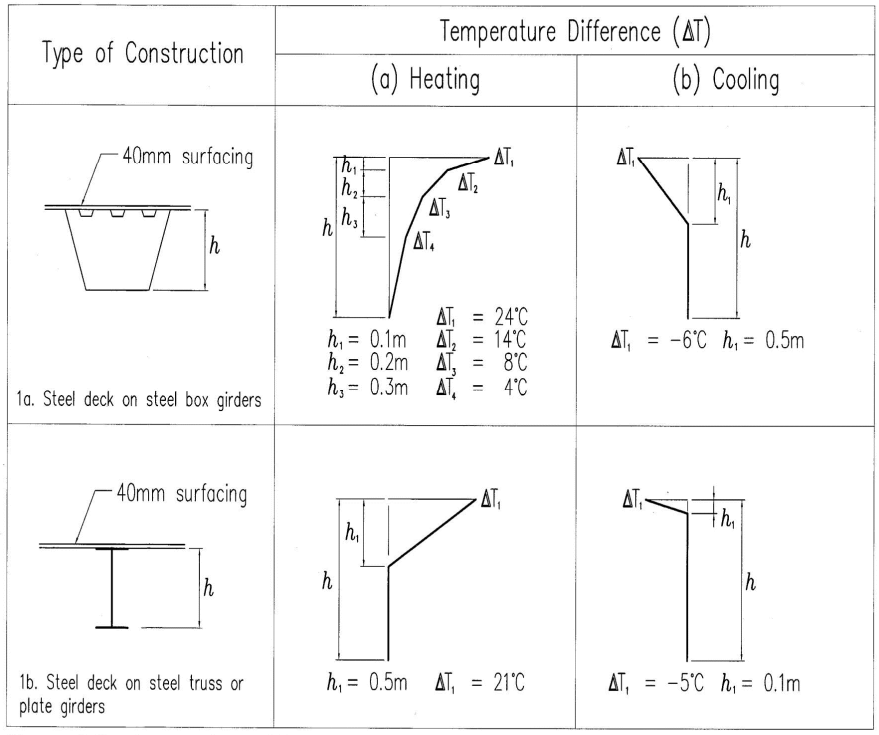


Figure 6.2a: Temperature differences for bridge decks – Type 1 : Steel Decks

*Note: The temperature difference ΔT incorporates ΔT_M and ΔT_E (see 4.3) together with a small part of component ΔT_N; this latter part has been included in the uniform bridge temperature component (see 6.1.3).

Figure 6.2 a Temperature Differences for Bridges Decks-Type 1: Steel Decks

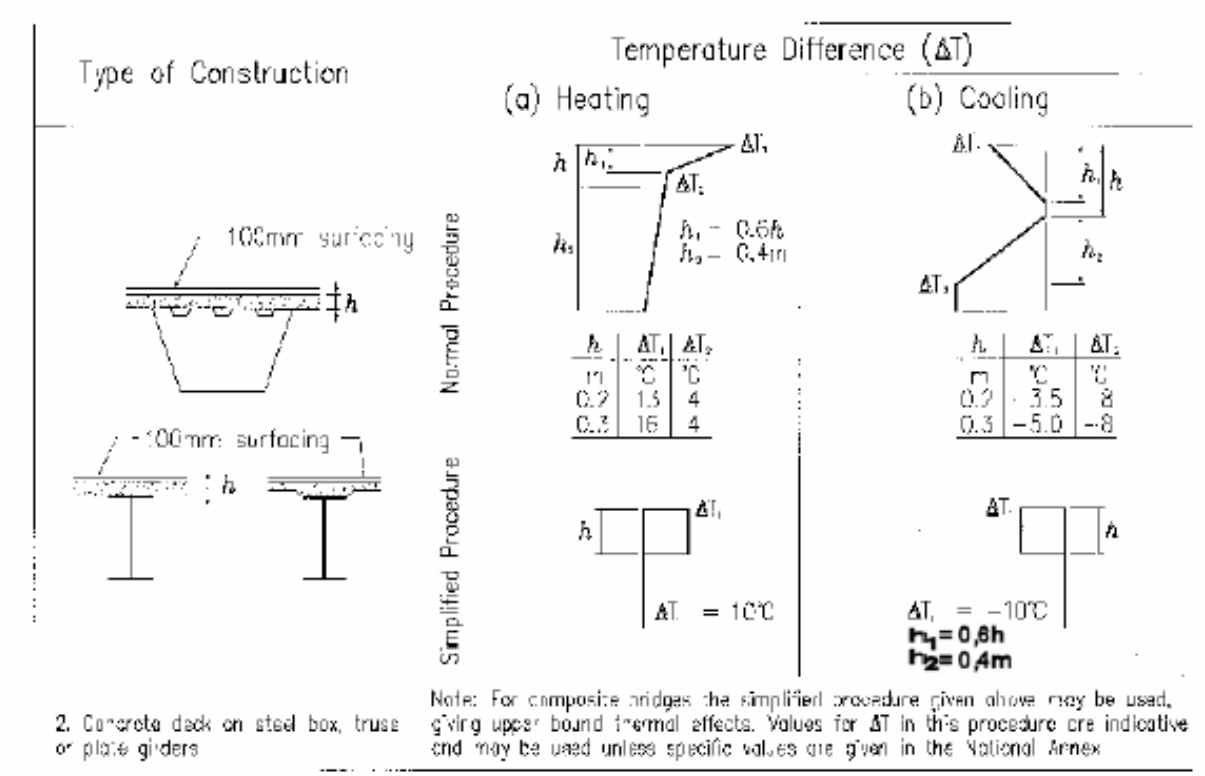
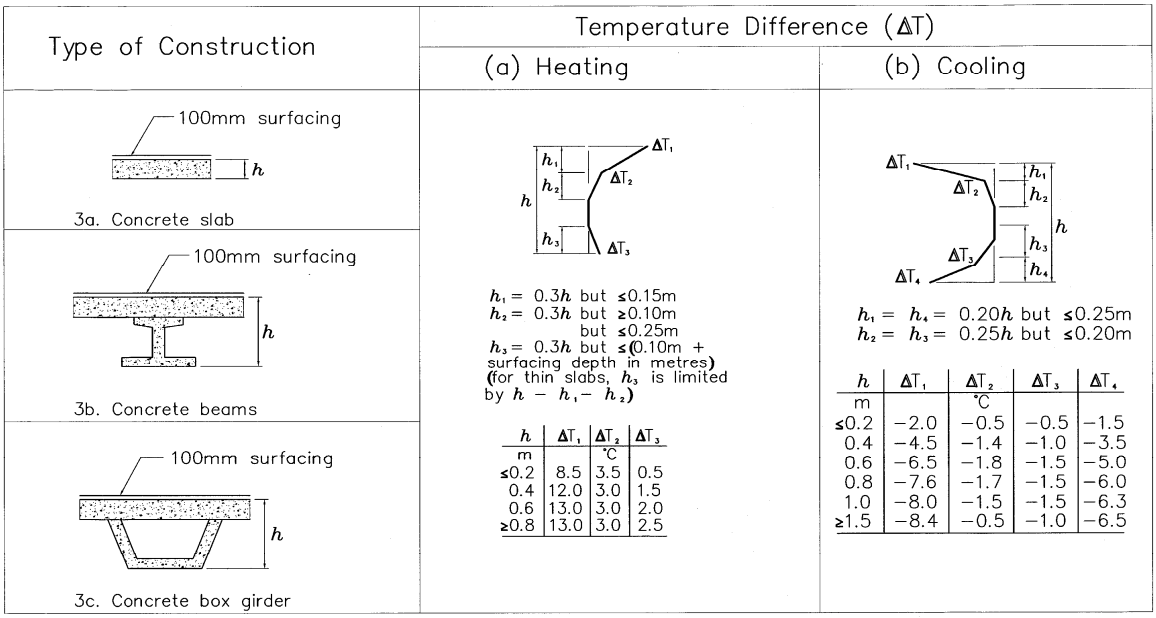


Figure 6.2a: Temperature differences for bridge decks – Type 2 : Composite Decks

*Note: The temperature difference ΔT incorporates ΔT_M and ΔT_E (see 4.3) together with a small part of component ΔT_N; this latter part has been included in the uniform bridge temperature component (see 6.1.3).

Figure 6.2 b: Temperature Differences for Bridge Decks-Type 2 : Composite Deck



h	ΔT1	ΔT2	ΔT3
m		°C	
≤0.2	8.5	3.5	0.5
0.4	12.0	3.0	1.5
0.6	13.0	3.0	2.0
≥0.8	13.0	3.0	2.5

h	ΔT1	ΔT2	ΔT3	ΔT4
m		°C		
≤0.2	−2.0	−0.5	−0.5	−1.5
0.4	−4.5	−1.4	−1.0	−3.5
0.6	−6.5	−1.8	−1.5	−5.0
0.8	−7.6	−1.7	−1.5	−6.0
1.0	−8.0	−1.5	−1.5	−6.3
≥1.5	−8.4	−0.5	−1.0	−6.5

Figure 6.2c: Temperature differences for bridge decks – Type 3 : Concrete Decks

*Note: The temperature difference ΔT incorporates ΔT_M and ΔT_E (see 4.3) together with a small part of component ΔT_N; this latter part has been included in the uniform bridge temperature component (see 6.1.3).

NA 2.10 Clause 6.1.4.3(1) Horizontal components

If no other information is available and no indications of higher values exist, the value 5ºC as a linear temperature difference between the outer edges of the bridge independent of the width of the bridge shall be used.

NA 2.11 Clause 6.1.4.4(1) Temperature difference components within walls of concrete box girders

A linear temperature difference of 15ºC shall be used.

NA 2.12 Clause 6.1.5(1) Simultaneity of uniform and temperature difference components

The values of ω_N= 0,35 and ω_M= 0,75 shall be used.

NA 2.13 Clause 6.1.6(1) Differences in the uniform temperature component between different structural elements

The recommended values for the differences in the uniform temperature component T = 15ºC between main structural elements (e.g. tie and arch); and T = 10ºC and 20ºC for light and dark colour respectively between suspension /stay cables and deck (or tower) shall be used.

NA 2.14 Clause 6.2.1(1) P Consideration of thermal actions

In the design procedure an equivalent linear temperature difference shall be used.

NA 2.15 Clause 6.2.2(1) Temperature differences

For concrete piers (hollow or solid), the linear temperature difference 5ºC between opposite outer faces shall be used.

NA 2.16 Clause 6.2.2(2) Temperature differences

The linear temperature difference between the inner and outer faces of 15ºC shall be used.

NA 2.17 Clause 7.2.1(1)P Shade air temperature

Minimum and maximum shade air temperatures shall be appropriately justified taking into account the specific location of the structure.

NA 2.18 Clause 7.5(3) Values of temperature components (indicative values)

The linear temperature difference component value 15ºC shall be used.

NA 2.19 Clause 7.5(4) Values of temperature components (indicative values)

In the absence of any specific information on characteristic values of the element temperature the value of the difference of temperature of 15ºC shall be used.

NA 2.20 Clause A.1(1) General

Minimum and maximum shade air temperatures shall be appropriately justified taking into account the specific location of the structure.

NA 2.21 Clause 20 A.1(3) General

If no information is available T_0 shall be taken as 10ºC. In case of uncertainty concerning sensitivity of the bridge to T_0, it is recommended that a lower and upper bound of an interval expected for T_0 are considered.

NA 2.22 Clause A.2(2) Maximum and minimum shade air temperature values with an annual probability of being exceeded p other than 0,02

The following values shall be used:

k_1 = 0,781;

k_2 = 0,056;

k_3 = 0,393;

k_4 = - 0,156;

NA 2.23 Clause B(1) (Tables B.1, B.2 and B.3) Temperature differences for various surfacing depths

The values indicated in table B.1 (CYS), B.2 (CYS) and B.3 (CYS) shall be used.

Table B.1 (CYS) – Recommended values of ΔT for deck type 1

Surfacing thickness	*Temperature difference*				
	Heating				Cooling
	ΔT_1	ΔT_2	ΔT_3	ΔT_4	ΔT_1
mm	°C	°C	°C	°C	°C
unsurfaced 20 40	30 27 24	16 15 14	6 9 8	3 5 4	8 6 6

Table B.2 (CYS) – Recommended values of ΔT for deck type 2

Depth of slab (*h)*	Surfacing thickness	*Temperature difference*	
		Heating	Cooling
		ΔT_1	ΔT_1
m	mm	°C	°C
0,2	unsurfaced	16,5	5,9
	waterproofed [1)]	23,0	5,9
	50	18,0	4,4
	100	13,0	3,5
	150	10,5	2,3
	200	8,5	1,6
0,3	unsurfaced	18,5	9,0
	waterproofed [1)]	26,5	9,0
	50	20,5	6,8
	100	16,0	5,0
	150	12,5	3,7
	200	10,0	2,7
[1)] These values represent upper bound values for dark colour			

Table B.3 (CYS) – Recommended values of ΔT for deck type 3

Depth of slab (h)	Surfacing thickness	*Temperature difference*						
		Heating			Cooling			
		ΔT_1	ΔT_2	ΔT_3	ΔT_1	ΔT_2	ΔT_3	ΔT_4
m	mm	°C	°C	°C	°C	°C	°C	°C
0,2	unsurfaced	12,0	5,0	0,1	4,7	1,7	0,0	0,7
	waterproofed [1)]	19,5	8,5	0,0	4,7	1,7	0,0	0,7
	50	13,2	4,9	0,3	3,1	1,0	0,2	1,2
	100	8,5	3,5	0,5	2,0	0,5	0,5	1,5
	150	5,6	2,5	0,2	1,1	0,3	0,7	1,7
	200	3,7	2,0	0,5	0,5	0,2	1,0	1,8
0,4	unsurfaced	15,2	4,4	1,2	9,0	3,5	0,4	2,9
	waterproofed [1)]	23,6	6,5	1,0	9,0	3,5	0,4	2,9
	50	17,2	4,6	1,4	6,4	2,3	0,6	3,2
	100	12,0	3,0	1,5	4,5	1,4	1,0	3,5
	150	8,5	2,0	1,2	3,2	0,9	1,4	3,8
	200	6,2	1,3	1,0	2,2	0,5	1,9	4,0
0,6	unsurfaced	15,2	4,0	1,4	11,8	4,0	0,9	4,6
	waterproofed [1)]	23,6	6,0	1,4	11,8	4,0	0,9	4,6
	50	17,6	4,0	1,8	8,7	2,7	1,2	4,9
	100	13,0	3,0	2,0	6,5	1,8	1,5	5,0
	150	9,7	2,2	1,7	4,9	1,1	1,7	5,1
	200	7,2	1,5	1,5	3,6	0,6	1,9	5,1
0,8	unsurfaced	15,4	4,0	2,0	12,8	3,3	0,9	5,6
	waterproofed [1)]	23,6	5,0	1,4	12,8	3,3	0,9	5,6
	50	17,8	4,0	2,1	9,8	2,4	1,2	5,8
	100	13,5	3,0	2,5	7,6	1,7	1,5	6,0
	150	10,0	2,5	2,0	5,8	1,3	1,7	6,2
	200	7,5	2,1	1,5	4,5	1,0	1,9	6,0
1,0	unsurfaced	15,4	4,0	2,0	13,4	3,0	0,9	6,4
	waterproofed [1)]	23,6	5,0	1,4	13,4	3,0	0,9	6,4
	50	17,8	4,0	2,1	10,3	2,1	1,2	6,3
	100	13,5	3,0	2,5	8,0	1,5	1,5	6,3
	150	10,0	2,5	2,0	6,2	1,1	1,7	6,2
	200	7,5	2,1	1,5	4,3	0,9	1,9	5,8
1,5	unsurfaced	15,4	4,5	2,0	13,7	1,0	0,6	6,7
	waterproofed [1)]	23,6	5,0	1,4	13,7	1,0	0,6	6,7
	50	17,8	4,0	2,1	10,6	0,7	0,8	6,6
	100	13,5	3,0	2,5	8,4	0,5	1,0	6,5
	150	10,0	2,5	2,0	6,5	0,4	1,1	6,2
	200	7,5	2,1	1,5	5,0	0,3	1,2	5,6

[1)] These values represent upper bound values for dark colour

NA 3 DECISION ON USE OF THE INFORMATIVE ANNEXES C AND D

NA 3.1 Annex C

Annex C may be used

NA 3.2 Annex D

Annex D may be used

NA 4 REFERENCES TO NON-CONTRADICTORY COMPLEMENTARY INFORMATION

None

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NA to CYS EN 1991-1-5:2003 (Including AC:2009)

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