CLASSIFICATION OF FIRE RESISTANCE
FIRES-CR-175-13-AUPE

Reactive fire protection coating AITHON A90H applied to concrete

Reg. No. 041/S-159

The Experts on Fire Safety

CLASSIFICATION OF FIRE RESISTANCE IN ACCORDANCE WITH EN 13501-2 + A1: 2009

with direct field of application

FIRES-CR-175-13-AUPE

Name of the product:	Reactive fire protection coating AITHON A90H applied to concrete
Sponsor:	Aithon Ricerche International Srl via Mazzini 68 I-21020 Ternate (VA) Italy
Prepared by:	FIRES, s.r.o. Osloboditeľov 282 059 35 Batizovce Slovak Republic
Task No.:	PR-13-0344
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Notified Body No. 1396, Approved Body No. SK01, Member of EGOLF

1. INTRODUCTION

This classification report defines the resistance to fire classification assigned to reactive fire protection coating AITHON A90H applied to concrete in accordance with the procedures given in EN 13501-2 + A1: 2009.

2. DETAILS OF CLASSIFIED PRODUCT

2.1 GENERAL

The product is defined as a reactive fire protection applied to concrete members.

2.2 PRODUCT DESCRIPTION

The product is fully described in the reports listed in clause 3.1.

3. TEST REPORTS IN SUPPORT OF CLASSIFICATION

3.1 TEST REPORTS AND ASSESSMENT REPORT

No.	Name of laboratory	Name of sponsor	Test report No.	Test method
[1]	PAVUS, a.s. Praha CZ	Aithon Ricerche International Srl via Mazzini 68 I-21020 Ternate (VA), Italy	Pr-12-2.131-En (12. 12. 2012)	ENV 13381-3: 2002
[2]	FIRES, s.r.o. Batizovce Slovakia	Aithon Ricerche International Srl via Mazzini 68 I-21020 Ternate (VA), Italy	FIRES-AR-006-13-NUPE (15. 08. 2013)	ENV 13381-3: 2002

3.2 TEST RESULTS

Test Report	Exposure conditions	
[1] Reactive fire protection coating AITHON A90 applied to concrete slab	§ Temperature/time curve § Number of exposed sides: § Load applied: § Support conditions:	Standard temperature/time curve 1 14 kN.m/m width Tested as simply supported one way structure with 2 free edges acc. to ENV 13381-3, clause 5.2.1
[1] Reactive fire protection coating AITHON A90 applied to concrete beam	§ Temperature/time curve: § Number of exposed sides: § Load applied: § Support conditions:	Standard temperature/time curve 3 25 kN.m Tested as simply supported beam acc. to ENV 13381-3, clause 5.2.1

4. CLASSIFICATION AND FIELD OF APPLICATION

4.1 REFERENCE OF CLASSIFICATION

This classification has been carried out in accordance with clause 7.4 of EN 13501-2 + A1: 2009.

4.2 CLASSIFICATION

The product, Reactive fire protection coating AITHON A90H applied to concrete, is classified according to the following combinations of performance parameters and classes as appropriate.

Fire resistance classification:
R30 to R240

4.3 FIELD OF APPLICATION

This classification is valid according to ENV 13381-3- 2002 for the following end use applications:

1. The results of the assessment from the fire protection system tested in horizontal orientation on concrete slabs are applicable to all concrete slabs and walls with fire exposure from one side only, in both horizontal and vertical orientation.
2. The results of the assessment from the fire protection system tested in horizontal orientation on concrete beams are applicable, as tested, to all beams and columns exposed to fire from more than one side, in use in both horizontal and vertical orientation provided that the method of protection application is the same as that tested.

   Note: The influence of fire from more than one side on temperature distribution has been calculated according to EN 1992-1-2 and considered within the assessment.
3. The results of the assessment are applicable to concrete members in which the density is within the range 0,85 to 1,15 times that tested.
4. The results of the assessment are applicable to concrete members in which the concrete strength is equal to or one strength grade higher than that tested (according to EN 206-1).
5. The results are applicable to pre-stressed structures provided that rules indicated in EN 1992-1-2 are respected.
6. The results of the assessment are applicable to all concrete members in which the concrete is prepared with the same type of aggregates.
7. The results of the assessment for slabs are applicable to concrete slabs with an equal or higher thickness as that tested (i.e. 130 mm).

   The results of the assessment for beams are applicable to concrete beams with an equal or higher width as that tested (i.e. 147 mm).
8. The maximum permitted thickness of the total protection: up to 5% above the maximum thickness tested on a loaded element.
9. The minimum permitted thickness of the total protection: up to 5% below the minimum thickness tested on a loaded element.
10. The results of the assessment from testing sprayed materials applied to concrete surfaces where release from the mould has been facilitated using soluble oil or soluble emulsions, are valid for all types of soluble oil or soluble emulsion release agents.

5. LIMITATIONS

This classification document does not represent type approval or certification of the product.

The classification is valid provided that the product, field of application and standards and regulations are not changed.

Approved: Signed:

Ing. Štefan Rástocký
leader of the testing laboratory

Ing. Henrieta Lapková
technician of the testing laboratory

6. LIST OF ANNEXES

Annex 1 Concrete slabs
Fire protection thickness vs. depth in concrete. Equivalent thickness of concrete slab.
Annex 2 Concrete beams
Fire protection thickness vs. depth in concrete. Equivalent thickness of concrete beam.

Annex 1

CONCRETE SLABS

Fire protection thickness vs. depth in concrete

θ_{crit} 300 °C

dp [kg/m²]	R30	R60	R90	R120	R150	R180	R210	R240
0,483	12,5	33,8	47,8	59,3	74,7	-	-	-
2,035	0,0	11,6	23,4	41,4	51,7	59,8	69,3	-

θ_{crit} 350 °C

dp [kg/m²]	R30	R60	R90	R120	R150	R180	R210	R240
0,483	9,3	24,6	41,3	52,6	63,8	-	-	-
2,035	0,0	7,2	18,2	32,4	43,9	52,5	59,9	68,5

θ_{crit} 400 °C

dp [kg/m²]	R30	R60	R90	R120	R150	R180	R210	R240
0,483	6,0	20,0	35,3	45,9	52,9	-	-	-
2,035	0,0	2,7	13,6	22,2	35,4	45,1	52,8	59,7

θ_{crit} 450 °C

dp [kg/m²]	R30	R60	R90	R120	R150	R180	R210	R240
0,483	2,8	15,4	28,4	40,2	49,5	-	-	-
2,035	0,0	0,0	10,0	17,3	24,0	37,2	45,7	52,7

θ_{crit} 500 °C

dp [kg/m²]	R30	R60	R90	R120	R150	R180	R210	R240
0,483	0,0	12,4	21,9	34,6	43,3	-	-	-
2,035	0,0	0,0	6,4	13,0	19,3	25,7	37,8	45,6

θ_{crit} 550 °C

dp [kg/m²]	R30	R60	R90	R120	R150	R180	R210	R240
0,483	0,0	9,5	17,7	27,8	37,6	-	-	-
2,035	0,0	0,0	2,8	9,3	14,7	20,6	28,2	37,7

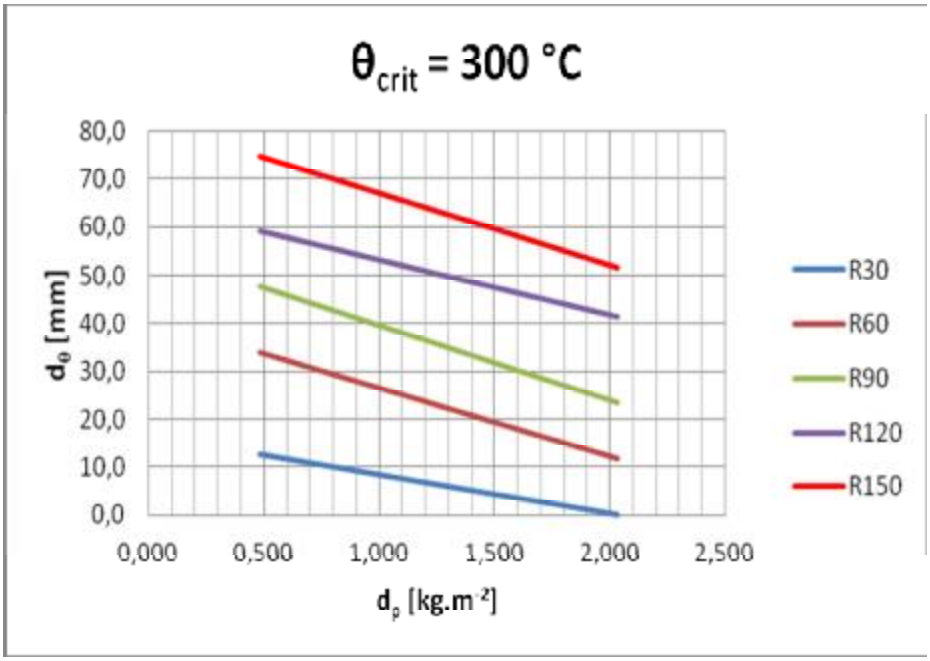
θ_{crit} 600 °C

dp [kg/m²]	R30	R60	R90	R120	R150	R180	R210	R240
0,483	0,0	6,7	14,0	22,0	31,9	-	-	-
2,035	0,0	0,0	0,0	5,5	10,8	16,0	21,0	25,0

θ_{crit} 650 °C

dp [kg/m²]	R30	R60	R90	R120	R150	R180	R210	R240
0,483	0,0	3,8	11,2	18,2	24,3	-	-	-
2,035	0,0	0,0	0,0	1,7	7,0	12,0	16,7	20,9

Note:
Some values for lower fire resistance were set to 0,0; it means that design temperature was not measured during the test inside the concrete neither on the surface of the concrete under protection;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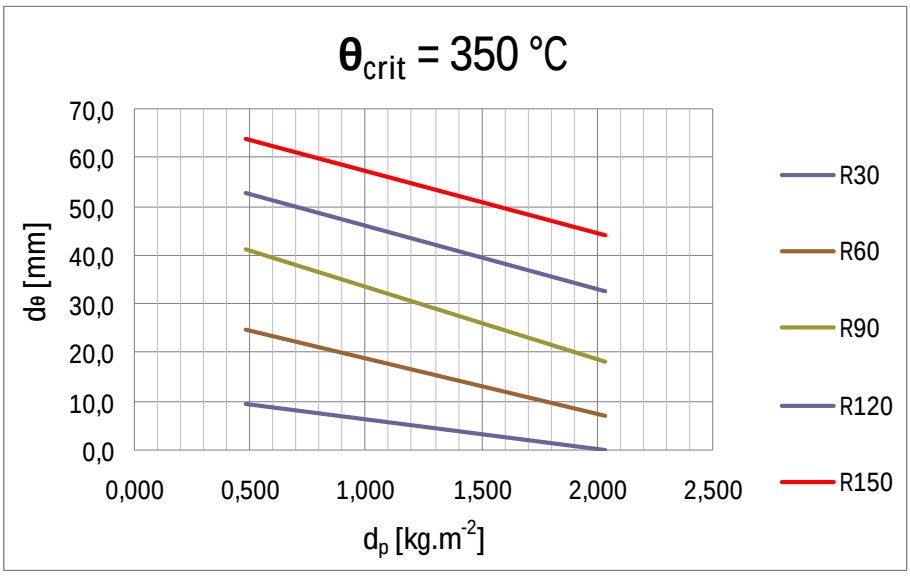
dp [kg.m-2]
R30
R60
R90
R120
R150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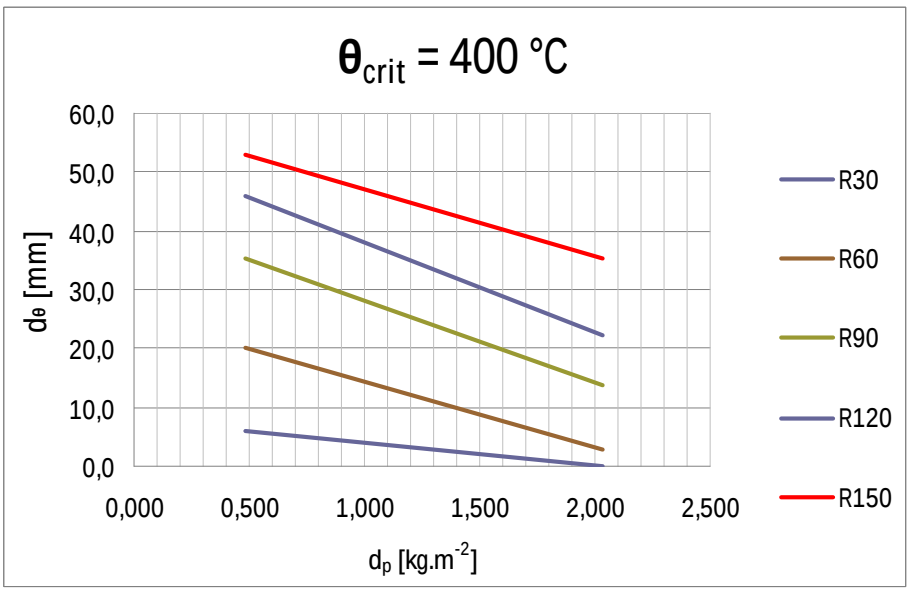
dp [kg.m-2]
R30
R60
R90
R120
R150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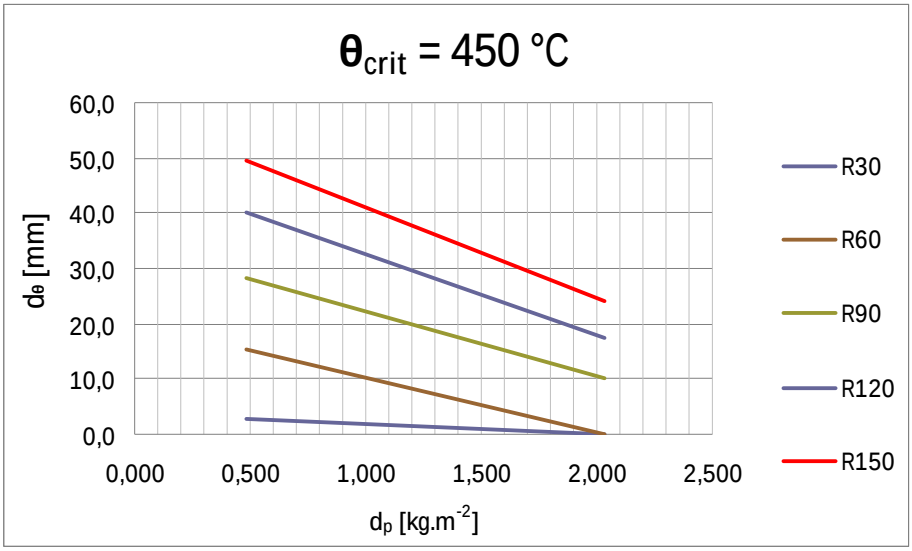
dp [kg.m-2]
R30
R60
R90
R120
R150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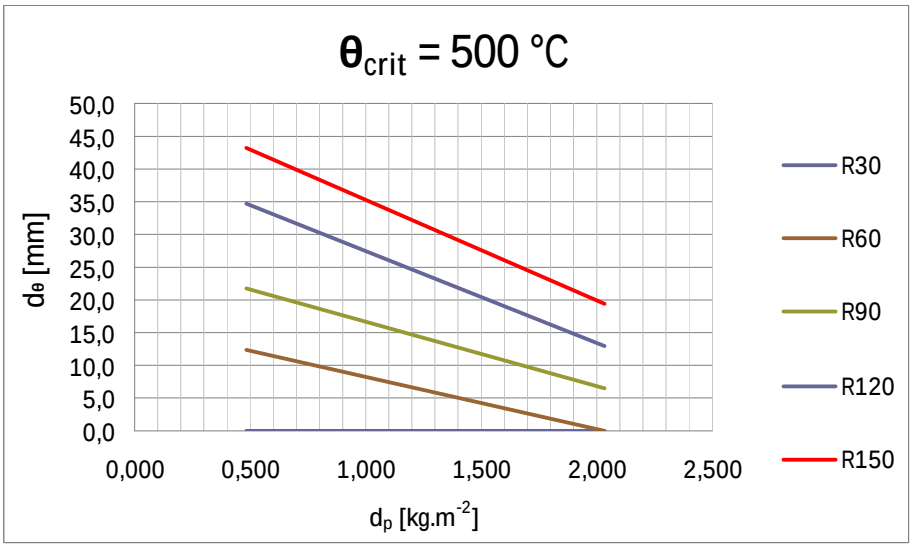
dp [kg.m-2]
R30
R60
R90
R120
R150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0,0
dθ [mm]
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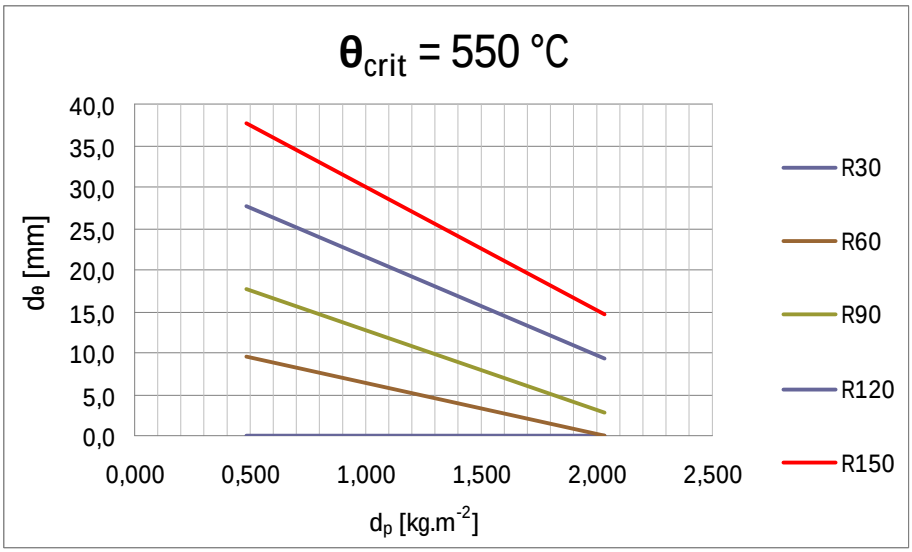
2,500
dp [kg.m-2]
R30
R60
R90
R120
R150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dθ [mm]
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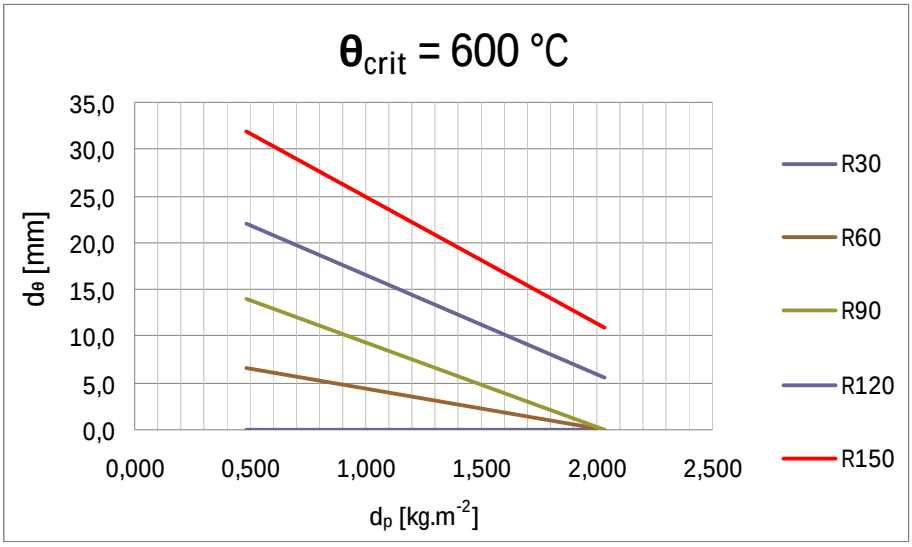
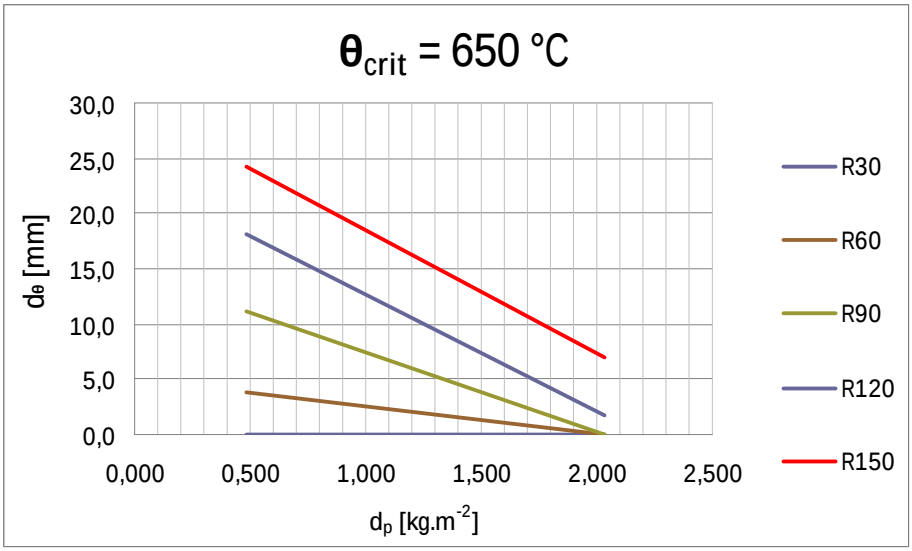
2,000
2,500
dp [kg.m-2]
R30
R60
R90
R120
R150





For fire resistance class R30, R60, R90, R120 and R150 it is allowed to do linear interpolation between dp min a dp max as shown in above plotted graphs. For fire resistance class R180, R210, R240 it is allowed to use only maximum thickness of fire protection material except R240 and θ_{crit} = 300 °C which is not possible.

Equivalent concrete thickness at minimum thickness of protection

d_{cp} = 15 mm	T (d_{cp}, t) [°C]	d_{cc} [mm]	Equivalent thickness of concrete
T (15 mm, 30 min.)	261,9	27,4	$\varepsilon_{(0,483\ kg/m2,\ 30\ min.)}$ 12,4 mm
T (15 mm, 60 min.)	454,3	25,2	$\varepsilon_{(0,483\ kg/m2,\ 60\ min.)}$ 10,2 mm
T (15 mm, 90 min.)	582,7	23,1	$\varepsilon_{(0,483\ kg/m2,\ 90\ min.)}$ 8,1 mm
T (15 mm, 120 min.)	692,2	20,2	$\varepsilon_{(0,483\ kg/m2,\ 120\ min.)}$ 5,2 mm
T (15 mm, 180 min.)	-	-	$\varepsilon_{(0,483\ kg/m2,\ 180\ min.)}$* 0,0 mm
T (15 mm, 240 min.)	-	-	$\varepsilon_{(0,483\ kg/m2,\ 240\ min.)}$* 0,0 mm

* values were conservatively set to 0 because of the lack of test data.

Equivalent concrete thickness at maximum thickness of protection

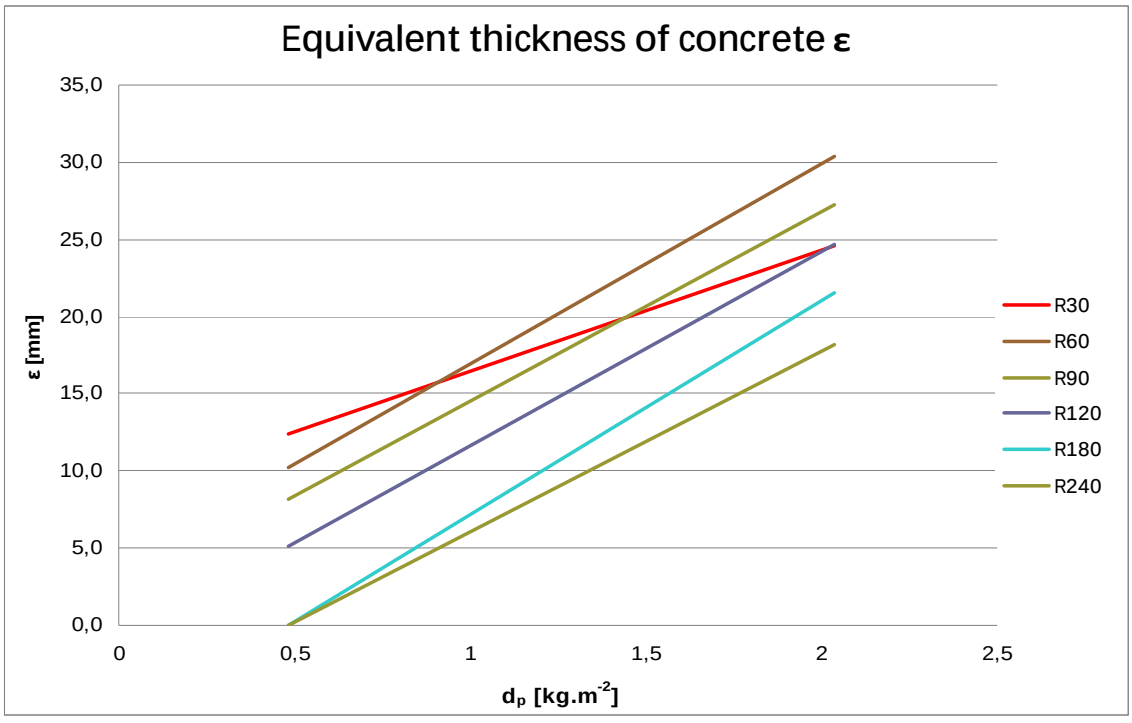
d_{cp} = 15 mm	T (d_{cp}, t) [°C]	d_{cc} [mm]	Equivalent thickness of concrete
T (15 mm, 30 min.)	159,5	39,5	$\varepsilon_{(2,035\ kg/m2,\ 30\ min.)}$* 24,5 mm
T (15 mm, 60 min.)	262,1	45,4	$\varepsilon_{(2,035\ kg/m2,\ 60\ min.)}$ 30,4 mm
T (15 mm, 90 min.)	380,5	42,2	$\varepsilon_{(2,035\ kg/m2,\ 90\ min.)}$ 27,2 mm
T (15 mm, 120 min.)	474,1	39,7	$\varepsilon_{(2,035\ kg/m2,\ 120\ min.)}$ 24,7 mm
T (15 mm, 180 min.)	611,6	36,6	$\varepsilon_{(2,035\ kg/m2,\ 180\ min.)}$ 21,6 mm
T (15 mm, 240 min.)	722,4	33,2	$\varepsilon_{(2,035\ kg/m2,\ 240\ min.)}$ 18,2 mm

* lower value of equivalent concrete thickness for maximum d_p and for R30 is because the reaction of intumescent material sprayed in maximum thickness was still in progress.

d_{cp} Depth in protected concrete [mm]

T (d_{cp}, t) Temperature in protected concrete in depth = 15 mm and time t [°C]

d_{cc} Depth in unprotected concrete [mm]



Note: Lower value of equivalent concrete thickness for maximum d_p and for R30 is because the reaction of intumescent material in maximum thickness was still in progress.

Annex 2

CONCRETE BEAMS

Fire protection thickness vs. depth in concrete

θ_{crit} 300°C

d_p [kg/m^2]	R30	R60	R90	R120	R150
0,493	22,9	50,1	-	-	-
2,092	0,0	28,4	51,7	-	-

θ_{crit} 350°C

d_p [kg/m^2]	R30	R60	R90	R120	R150
0,493	17,9	44,3	68,5	-	-
2,092	0,0	18,0	43,8	67,7	-

θ_{crit} 400°C

d_p [kg/m^2]	R30	R60	R90	R120	R150
0,493	12,9	38,4	57,4	-	-
2,092	0,0	7,2	35,9	53,4	-

θ_{crit} 450°C

d_p [kg/m^2]	R30	R60	R90	R120	R150
0,493	7,9	32,6	50,5	-	-
2,092	0,0	0,0	28,0	45,0	67,6

θ_{crit} 500°C

d_p [kg/m^2]	R30	R60	R90	R120	R150
0,493	2,9	26,8	44,7	-	-
2,092	0,0	0,0	19,9	36,6	52,7

θ_{crit} 550°C

d_p [kg/m^2]	R30	R60	R90	R120	R150
0,493	0,0	21,1	39,0	-	-
2,092	0,0	0,0	11,7	28,1	43,9

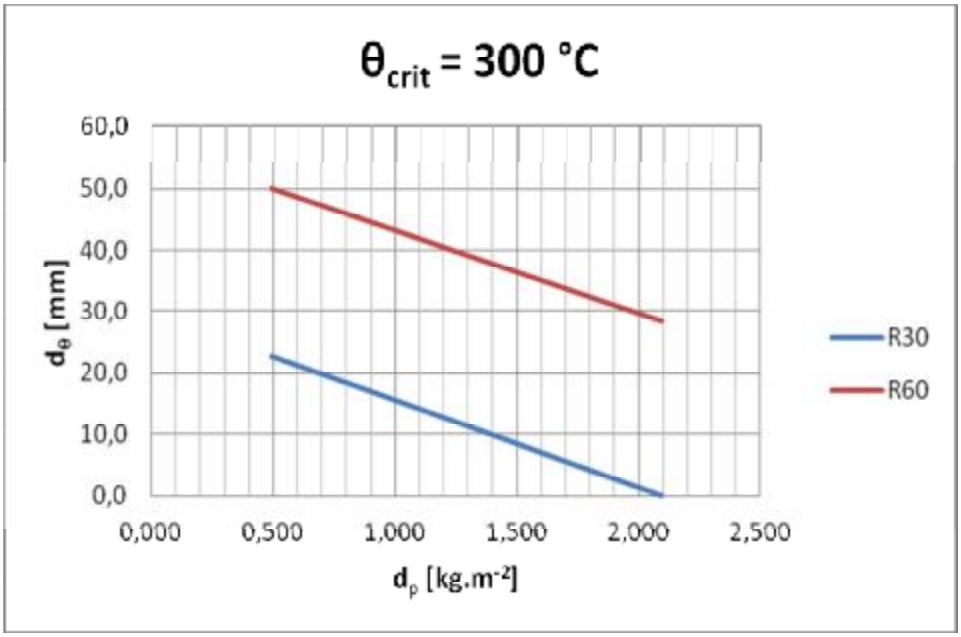
θ_{crit} 600°C

d_p [kg/m^2]	R30	R60	R90	R120	R150
0,493	0,0	15,6	33,2	-	-
2,092	0,0	0,0	3,6	18,9	35,1

θ_{crit} 650°C

d_p [kg/m^2]	R30	R60	R90	R120	R150
0,493	0,0	10,0	27,4	-	-
2,092	0,0	0,0	0,0	9,3	26,3

Note: Some values for lower fire resistance were set to 0,0; it means that design temperature was not measured during the test inside the concrete neither on the surface of the concrete under protection;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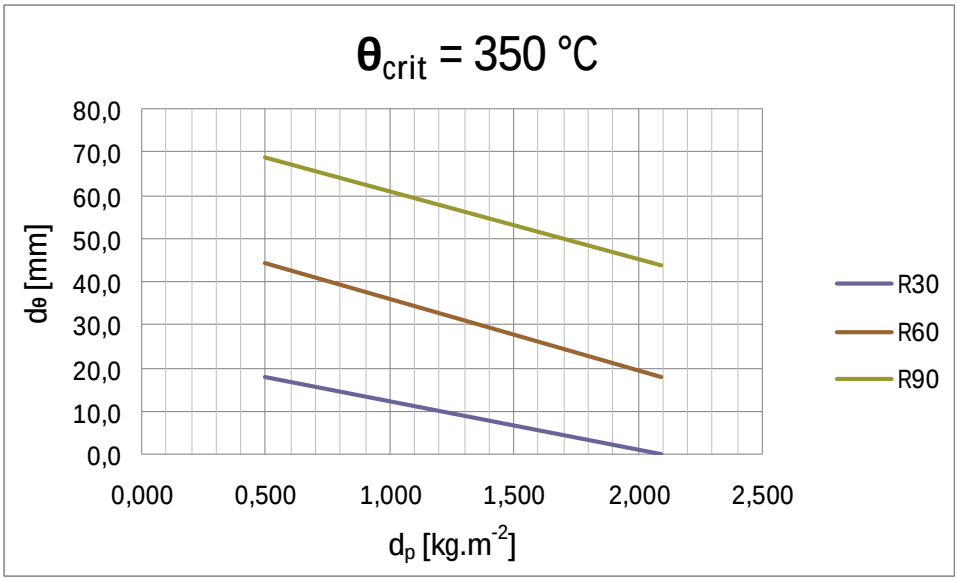
dp [kg.m-2]
R30
R60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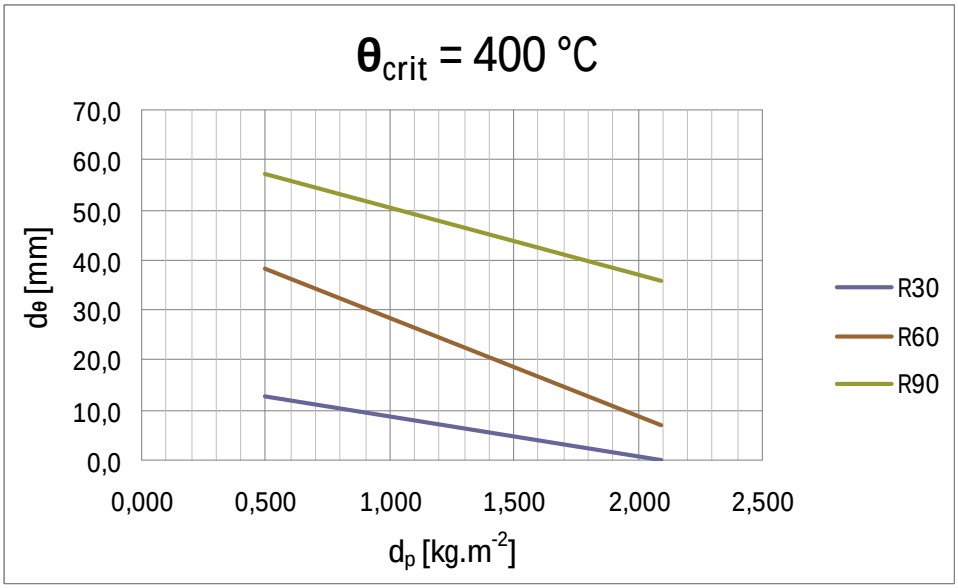
dp [kg.m-2]
R30
R60
R90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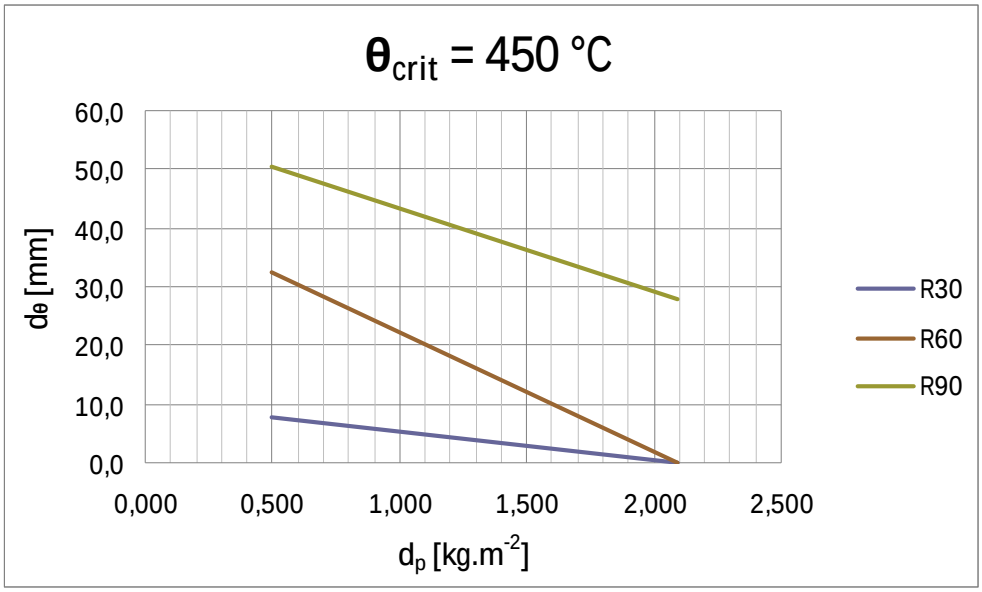
dp [kg.m-2]
R30
R60
R90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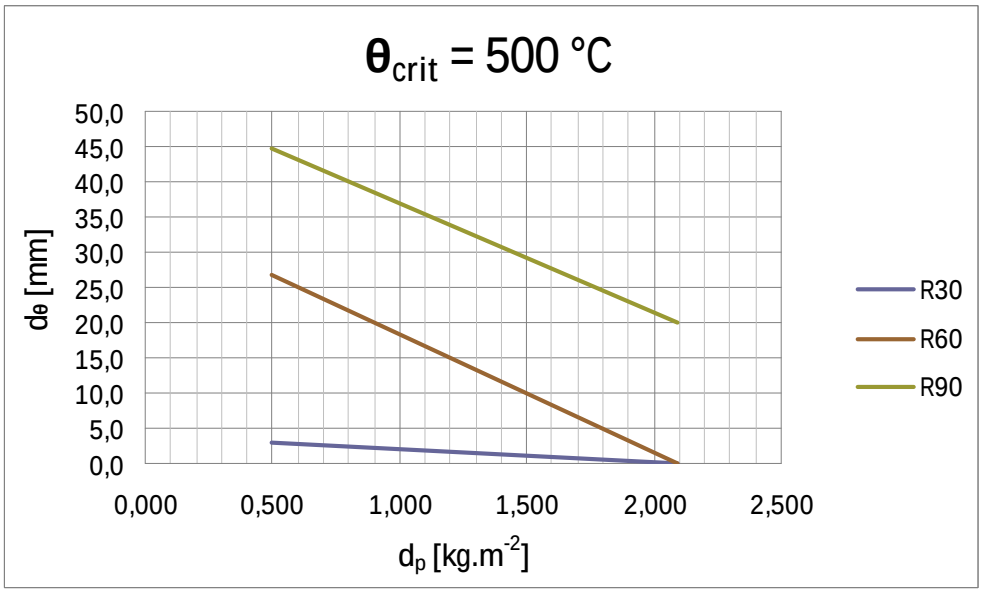
dp [kg.m-2]
R30
R60
R90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dθ [mm]
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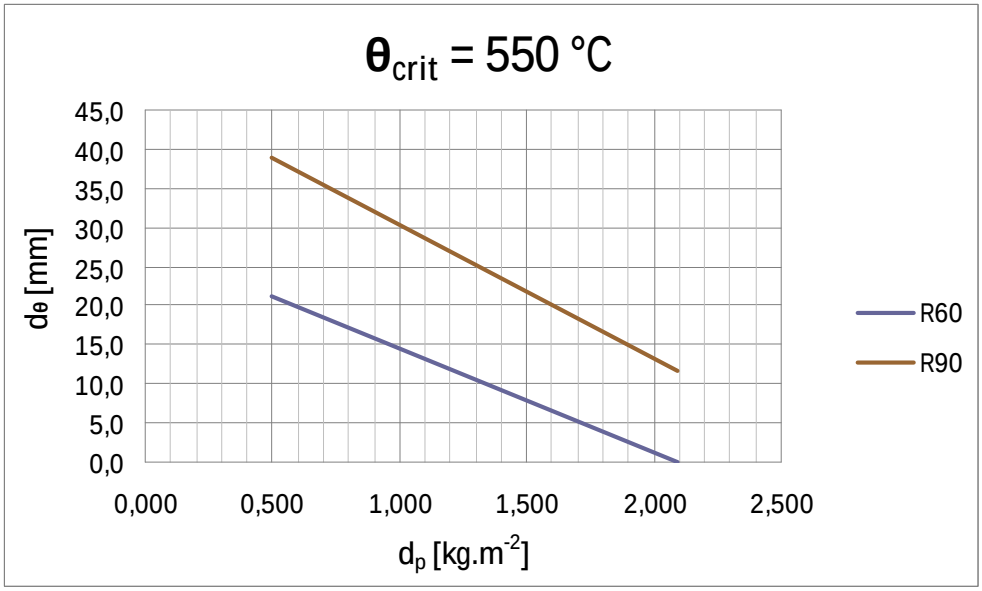
dp [kg.m-2]
R30
R60
R90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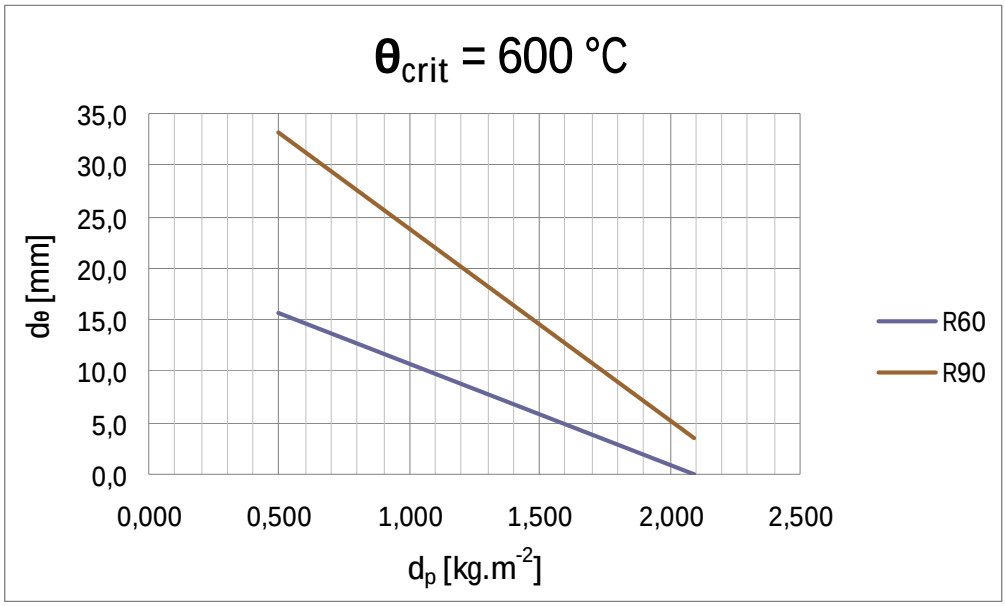
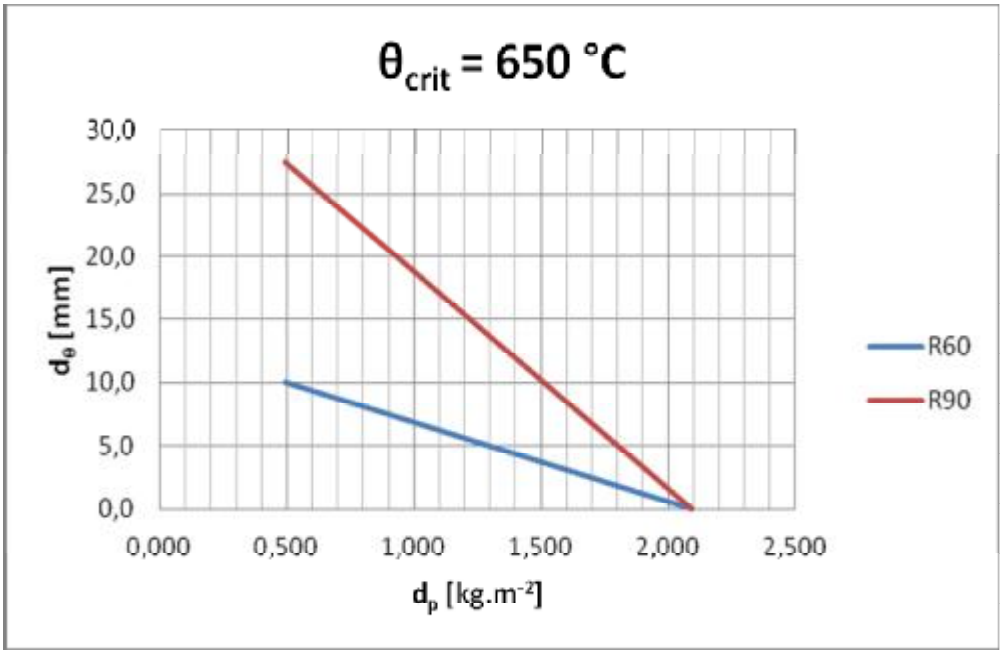
dp [kg.m-2]
R60
R90





Linear interpolation of values for dp between 0,493 and 2,092 kg/m2 is possible for fire resistance R30, R60 and R90 (see graphs) except R90 for θ_{crit} = 300 °C. For fire resistance R90 (θ_{crit} = 300°C), R120 and R150 only values for dp=2,092 kg/m2 are possible. Fire resistance R30 for θ_{crit} = 550 °C, 600 °C and 650 °C is possible with fire protection dp=0,493 kg/m2. Fire resistance R120 (θ_{crit} = 300°C), R150 (θ_{crit} = 300°C, 350°C and 400°C) is not possible.

Equivalent concrete thickness at minimum thickness of protection

d_{cp} = 55 mm	T (d_{cp}, t) [°C]	d_{cc} [mm]	Equivalent thickness of concrete	
T (55 mm, 30 min.)	123,8	71,6	$\varepsilon_{(0,493\ kg/m2,\ 30\ min.)}$	16,6 mm
T (55 mm, 60 min.)	257,8	81,4	$\varepsilon_{(0,493\ kg/m2,\ 60\ min.)}$	26,4 mm
T (55 mm, 90 min.)	410,6	78,5	$\varepsilon_{(0,493\ kg/m2,\ 90\ min.)}$	23,5 mm
T (55 mm, 120 min.)	-	-	$\varepsilon_{(0,493\ kg/m2,\ 120\ min.)}$*	0,0 mm

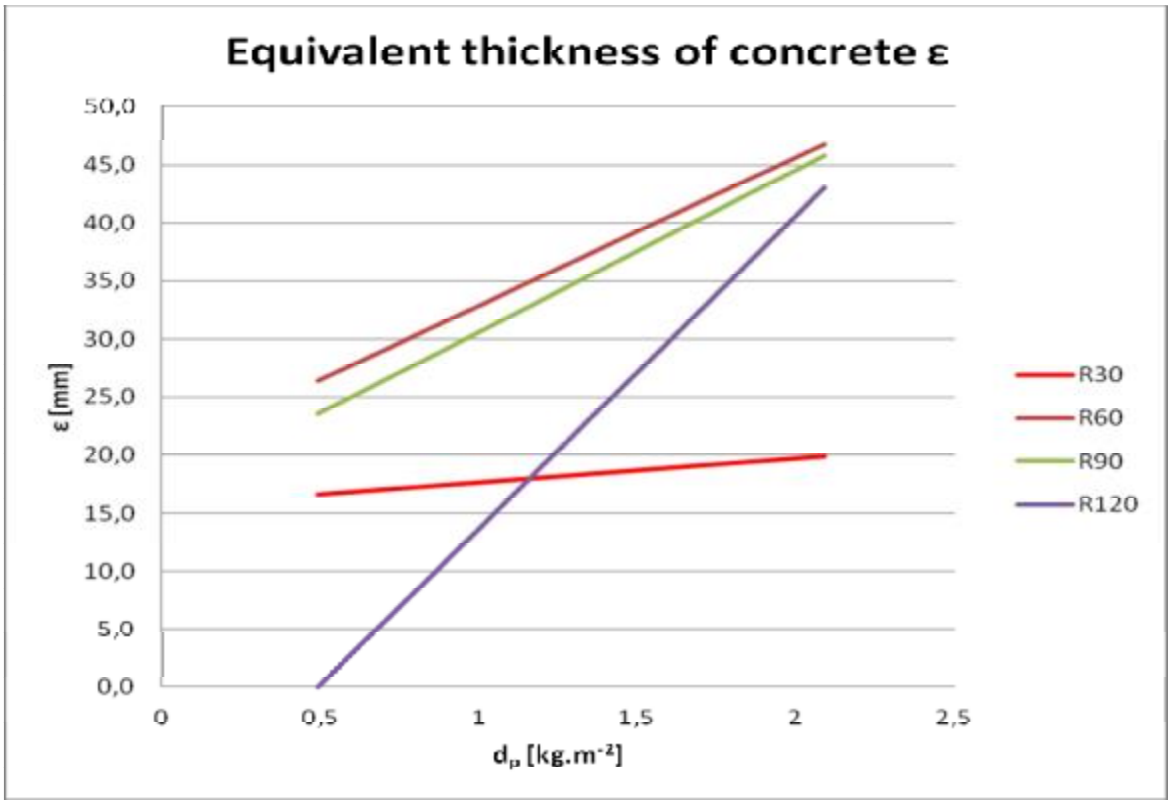
* value was conservatively set to 0,0 because of the lack of test data.

Equivalent concrete thickness at maximum thickness of protection

d_{cp} = 55 mm	T (d_{cp}, t) [°C]	d_{cc} [mm]	Equivalent thickness of concrete	
T (55 mm, 30 min.)	111,6	74,8	$\varepsilon_{(2,092\ kg/m2,\ 30\ min.)}$*	19,8 mm
T (55 mm, 60 min.)	164,1	101,8	$\varepsilon_{(2,092\ kg/m2,\ 60\ min.)}$	46,8 mm
T (55 mm, 90 min.)	279,4	100,8	$\varepsilon_{(2,092\ kg/m2,\ 90\ min.)}$	45,8 mm
T (55 mm, 120 min.)	390,7	98,1	$\varepsilon_{(2,092\ kg/m2,\ 120\ min.)}$	43,1 mm

* lower value of equivalent concrete thickness for maximum d_p and for R30 is because the reaction of intumescent material sprayed in maximum thickness was still in progress.

d_{cp}	Depth in protected concrete [mm]
T (d_{cp}, t)	Temperature in protected concrete in depth = 55 mm and time t [°C]
d_{cc}	Depth in unprotected concrete [mm]



Note: Lower value of equivalent concrete thickness for R30 is because the reaction of intumescent material was still in progress. Value for R120 and minimum d_p was conservatively set to 0,0 because of the lack of test data.