Deutsches Institut für Bautechnik

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European Technical Assessment Body for construction products

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European Technical Assessment ETA-24/0297 of 12 August 2025

English translation prepared by DIBt - Original version in German language

General Part

Technical Assessment Body issuing the European Technical Assessment:	Deutsches Institut für Bautechnik
Trade name of the construction product	Ternocem
Product family to which the construction product belongs	Belitic Calcium Sulfoaluminate Cement
Manufacturer	Heidelberg Materials AG Zementwerk Paderborn Am Atlaswerk 16 33106 Paderborn GERMANY
Manufacturing plant	Heidelberg Materials AG Werk Paderborn GERMANY
This European Technical Assessment contains	13 pages including 1 annex which form an integral part of this assessment
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of	EAD 150001-01-0301

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Specific Part

1 Technical description of the product

The belitic calcium sulfoaluminate cement "Ternocem" referred to in this document is a cement with rapid hardening features. This cement is not covered by the harmonised European standard EN 197-1.

The calcium sulfoaluminate content (Yeelimite) in this cement is 30 ± 8 % by mass.

The range of composition of the belitic calcium sulfoaluminate cement "Ternocem" is listed below:

Belitic calcium sulfoaluminate clinker	80 – 98 % by mass
Cement CEM I and/or CEM II according to EN 197-1	0 % by mass
Calcium sulfate (as defined in EN 197-1, clause 5.4)	2 – 16 % by mass
Limestone (as defined in EN 197-5, clause 4)	0 – 10 % by mass
Fly ash (as defined in EN 197-1, clause 5.2.4)	0 % by mass
Minor additional constituents (as defined in EN 197-1, clause 5.3)	< 5 % by mass[1]
Additives (as defined in EN 197-1, clause 5.5)	< 2 % by mass[2]
Organic additives (as defined in EN 197-1, clause 5.5)	< 0,2 % by mass

The belitic calcium sulfoaluminate clinker (BCSAK) is made by sintering a precisely specified mixture of raw materials (raw meal, paste or slurry) containing elements, usually expressed as oxides, CaO, Al_2O_3, SiO_2, Fe_2O_3, SO_3 and small quantities of other materials.

The beltic calcium sulfoaluminate clinker is a hydraulic material which is composed mainly of $2CaO \cdot SiO_2$ (belite) and $C_4A_3\overline{S}$ / $C_4(A,F)_3\overline{S}$ (Yeelimite). The belite content of the clinker is greater than 35 % by mass and the Yeelimite content of the clinker is 20 to 40 % by mass.

The belitic calcium sulfoaluminate cement "Ternocem" complies with the specifications of the standard EN 197-1 except the following properties, see Table 1

Table 1: Comparison of belitic calcium sulfoaluminate cement characteristics and specifications of EN 197-1

Properties of the belitic calcium sulfoaluminate cement	Properties of common cement according to EN 197-1
Belitic calcium sulfoaluminate clinker (BCSAK) (80 – 98 % by mass)	Portland cement clinker
Initial setting time < 45 min	Initial setting time ≥ 45 min (clause 7.1.2)
Sulfate content (as SO_3) > 4,0 % by mass	Sulfate content (as SO_3) ≤ 4,0 % by mass (clause 7.3, table 4)

[1] The residues of BCSA clinker process can be integrated as minor additional constituents.

[2] EN 197-1 clause 5.5 specified: The total quantity of additives shall not exceed 1,0 % by mass of the cement (except for pigments). The quantity of organic additives on a dry basis shall not exceed 0,2 % by mass of the cement. A higher quantity may be incorporated in cements provided that the maximum quantity, in %, is declared on the packaging and/or the delivery note.

2 Specification of the intended use in accordance with the applicable European Assessment Document

The belitic calcium sulfoaluminate cement "Ternocem" is cement for production of concrete, mortar, grouts and other mixes including in particular cast-in-situ and prefabricated structural concrete[3] conforming to EN 206.

The belitic calcium sulfoaluminate cement "Ternocem" is especially characterised by a rapid hardening and by a high resistance against sulfate attack on concrete.

The verifications and assessment methods on which this European Technical Assessment is based lead to the assumption of a working life of concrete incorporating the belitic calcium sulfoaluminate cement "Ternocem" of at least 50 years. The indications given on the working life cannot be interpreted as a guarantee given by the producer, but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

3 Performance of the product and references to the methods used for its assessment

3.1 Mechanical resistance and stability (BWR 1)

Essential characteristic	**Performance**
Early strength ($1 \leq t \leq 24$ h)	$R_{C,24h}$ = 28,4 MPa (≥ 10,0 MPa)
Standard strength (28 days)	$R_{C,28d} \geq$ 42,5 MPa
Initial setting time	IST = 35 min
Soundness	S = 0 mm
Sulfate content (as SO_3)	SO_3 = 11 ± 5 % by mass
Chloride content	Cl^- = 0,08 % by mass
Insoluble residue	No performance assessed.
Loss on ignition	LOI = 1,05 % by mass
Aspects of durability with relevance only for the essential characteristics linked with BWR1	
Effect of different storage temperatures on mortar which hardened under standard conditions	See Annex A, clause A1
Shrinkage of concrete	Shr_C = -0,10 mm/m
Effect of different curing temperatures on mortar at early age	See Annex A, clause A2
Sulfate resistance (external sulfate attack)	Method SR_{FPM}: See Annex A, clause A3 Method SR_{SPM}: No performance assessed.
Delayed ettringite formation	See Annex A, clause A4
Carbonation of concrete	Method C_{dcr}: See Annex A, clause A5 Method C_{rsc}: No performance assessed.

[3] e. g. EN 490, EN 516, EN 1168, EN 1317, EN 1338, EN 1340, EN 1520, EN 1858, EN 1857, EN 1916, EN 1917, EN 13084, EN 12446, EN 12737, EN 13224, EN 15037, EN 14844, EN 12839, EN 14843, EN 13978, EN 12843, EN 12951, EN 13224, EN 13813, EN 13877, EN 14843, EN 14992, EN 15037, EN 15258, EN 15435, EN 15498

Essential characteristic	**Performance**
Resistance to chloride penetration	Method M_{nss}: $M_{nss,35d}$ = 1,0 · 10^{-12} m²/s; $M_{nss,98d}$ = 2,2 · 10^{-12} m²/s Method $D_{nss,90}$: No performance assessed.
Freeze-thaw resistance without de-icing agent	Method FT_{slab}: No performance assessed. Method FT_{beam}: No performance assessed. Method FT_{CIF} (**w/b = 0,45**): S_{28} = 0,24 kg/m³; f_{C28} = 54,7 MPa; $RDM_{UPTT,28}$ = 104,4 % See Annex A, clause A6 Method FT_{cube}: No performance assessed.
Freeze-thaw resistance with de-icing agent	Method FTS_{CDF}: S_{28} = 0,08 kg/m²; $RDM_{UPTT,28}$ = 100,5 %; f_{C28} = 39,5 MPa See Annex A, clause A7 Method FT_{slab}: No performance assessed.

3.2 Reaction to fire (BWR 2)

Essential characteristic	**Performance**
Reaction to fire	No performance assessed.

3.3 Hygiene, health and the environment (BWR 3)

Essential characteristic	**Performance**
Content, emission and/or release of dangerous substances	
CMR-substances	
Substance/s classified as EU-cat. Carc. 1A and/or 1B [a)]	no performance assessed.
Substance/s classified as EU-cat. Muta. 1A and/or 1B [a)]	
Substance/s classified as EU-cat. Repr. 1A and/or 1B [a)]	
Leachable Substances	**Eluate concentration R_{64d} acc. to EN 16637-2**
TOC	1523 mg/m²
Sulfate (SO_4^{2-})	≤ 85000 mg/m²
Chloride (Cl^-)	≤ 85000 mg/m²
Fluoride (F^-)	≤ 300 mg/m²
Antimony (Sb)	≤ 28 mg/m²
Arsenic (As)	≤ 18 mg/m²
Barium (Ba)	≤ 979 mg/m²
Lead (Pb)	≤ 6,7 mg/m²

Cadmium (Cd)	≤ 1,7 mg/m²
Chromium (Cr) Chromium (Cr^{6+})	≤ 19 mg/m² 6,40 mg/m²
Cobalt (Co)	≤ 11 mg/m²
Copper (Cu)	≤ 30 mg/m²
Molybdenum (Mo)	≤ 196 mg/m²
Nickel (Ni)	≤ 39 mg/m²
Mercury (Hg)	≤ 0,56 mg/m²
Selenium (Se)	-
Thallium (Tl)	≤ 1,1 mg/m²
Vanadium (V)	≤ 22 mg/m²
Zinc (Zn)	≤ 336 mg/m²
Release scenario regarding BWR 3: S/W 1 and S/W 2	
a) In accordance with Regulation (EC) No 1272/2008	

4 Assessment and verification of constancy of performance (AVCP) system applied, with reference to its legal base

In accordance with EAD No. 150001-01-0301, the applicable European legal act is: Commission Decision 97/555/EC, as amended by Commission Decision 2010/683/EU.

The system to be applied is: 1+

5 Technical details necessary for the implementation of the AVCP system, as provided for in the applicable EAD

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited with Deutsches Institut für Bautechnik.

Issued in Berlin on 12 August 2025 by Deutsches Institut für Bautechnik

Petra Schröder
Head of Section

beglaubigt:
Wagner

ANNEX A: Assessment

A1 Effect of high temperature on mortar hardened under standard conditions

The testing procedure was done according to EAD 150001-01-0301, clause 2.2.9.

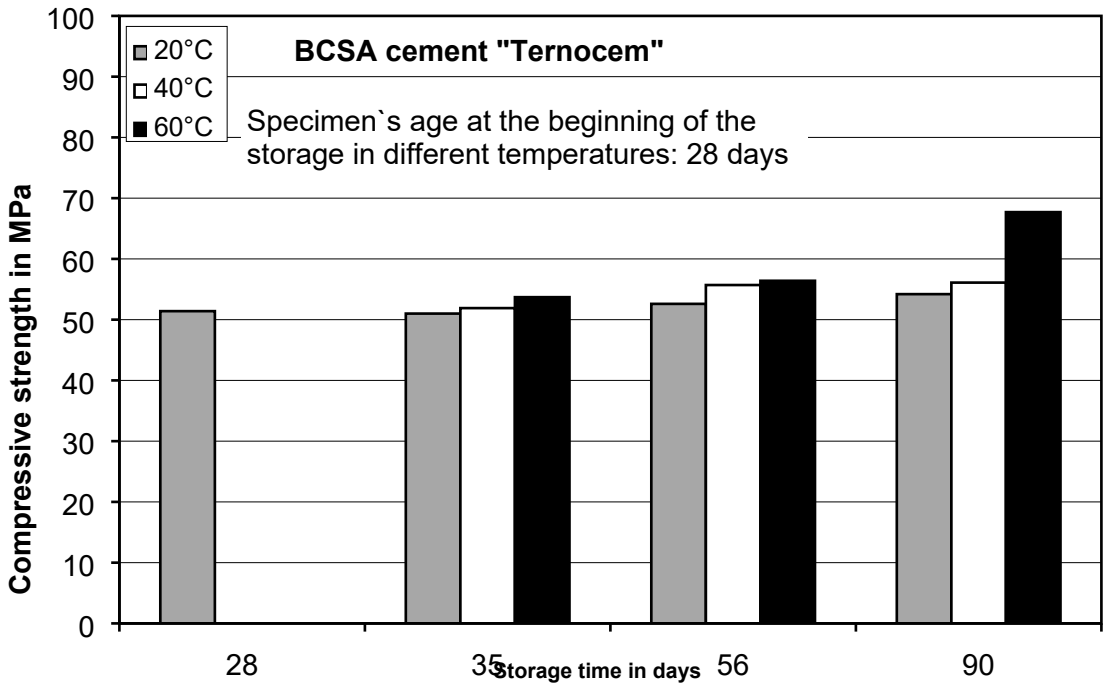

Figure A1.1: Compressive strength of mortar with BCSA based cement "Ternocem" stored at 20 °C, 40 °C and 60 °C

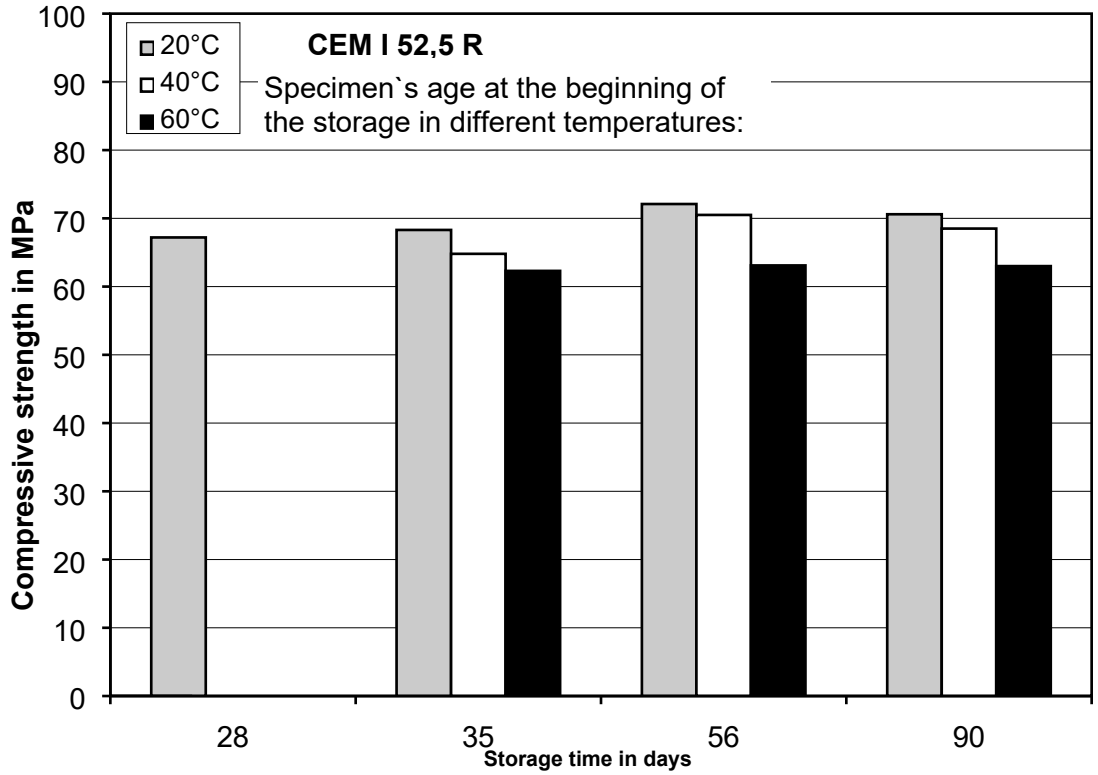

Figure A1.2: Compressive strength of mortar with CEM I 52,5 R stored at 20 °C, 40 °C and 60 °C

A2 Effect of high temperature on mortar at early age

The testing procedure was done according to EAD 150001-01-0301, clause 2.2.11.

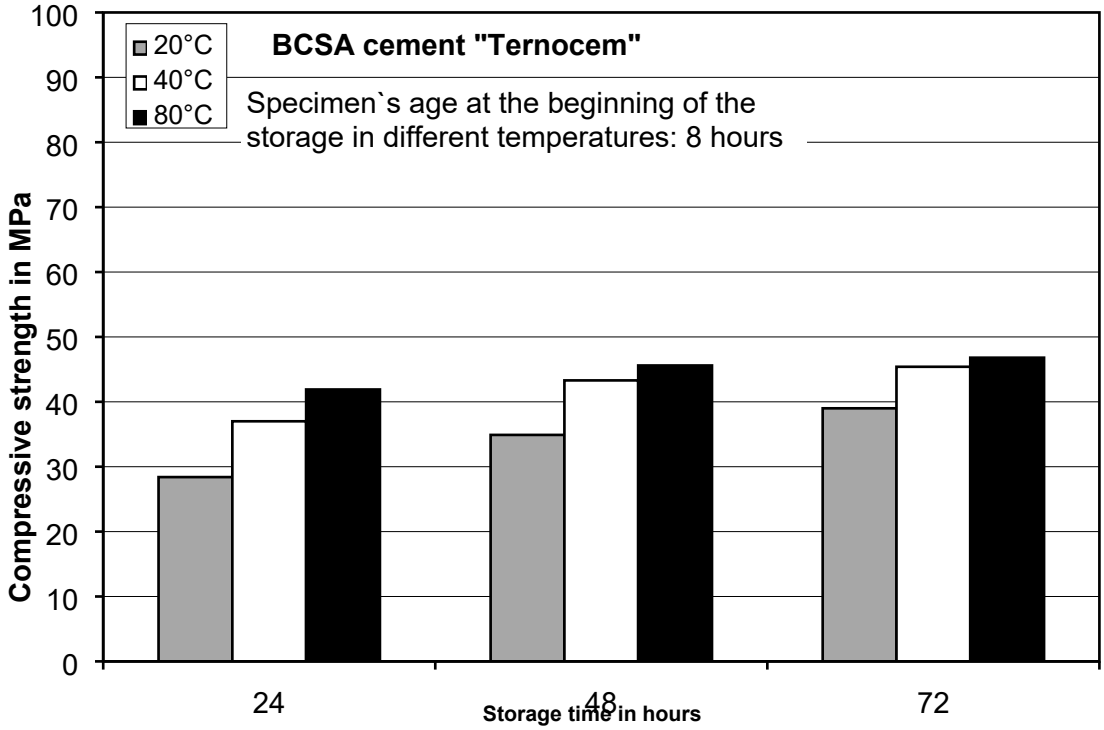

Figure A2.1: Compressive strength of mortar with BCSA based cement "Ternocem" stored at 20 °C, 40 °C and 80 °C

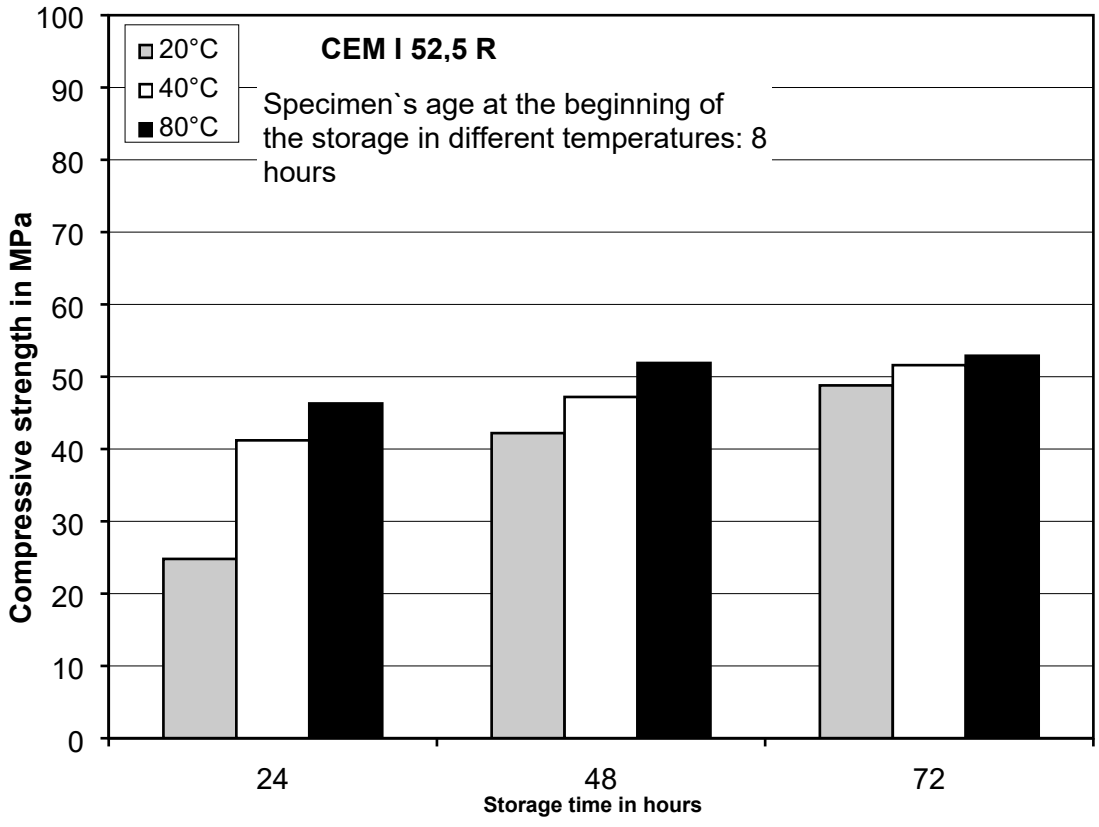

Figure A2.2: Compressive strength of mortar with CEM I 52,5 R stored at 20 °C, 40 °C and 80 °C

A3 Sulfate resistance – Method: Flat prism method SR_{FPM}

The testing procedure was done according to EAD 150001-01-0301, clause 2.2.12 and Annex A.

Table A3.1: Relative elongation and dynamic elastic moduli for mortar with BCSA cement "Ternocem" for the assessment of the sulfate resistance

Storage duration [d]	Rel. elongation [mm/m]		Dyn. E-Modulus [kN/mm²]			
	"Ternocem", 20 °C	"Ternocem", 5 °C	"Ternocem" sulfate solution, 20 °C	"Ternocem" sulfate solution, 5 °C	"Ternocem" $Ca(OH)_2$ solution, 20 °C	"Ternocem" $Ca(OH)_2$ solution, 5 °C
0	0,00	0,00	33,69	33,72	33,85	33,18
14	0,00	0,02	35,60	35,75	34,48	33,81
28	0,00	0,00	36,24	36,74	34,73	34,81
56	0,00	0,01	36,72	37,95	35,39	36,08
91	0,02	0,05	38,02	40,90	35,81	36,29
182	0,04	0,05	39,94	42,85	36,67	37,36

A4 Delayed ettringite formation

The testing procedure was done according to EAD 150001-01-0301, clause 2.2.13 and Annex C.
The following mortars were tested:

M1: 100 % by mass "Ternocem"
M2: 20 % by mass "Ternocem", 80 % by mass CEM I 52,5 R
M3: 20 % by mass "Ternocem", 80 % by mass CEM I 42,5 R-SR
M4: 100 % by mass CEM I 42,5 R-SR

Table A4.1: Relative elongation of mortars M1, M2, M3 and M4 at 5 °C and 20 °C

Storage duration [d]	Relative elongation [mm/m]							
	M1, 20 °C	M1, 5 °C	M2, 20 °C	M2, 5 °C	M3, 20 °C	M3, 5 °C	M4, 20 °C	M4, 5 °C
0	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
14	0,00	0,00	0,01	0,00	0,02	0,00	0,02	0,00
28	0,00	-0,02	0,01	0,02	0,02	0,00	0,01	-0,04
56	0,02	-0,02	0,04	0,02	0,05	0,01	0,04	0,00
91	0,01	0,00	0,06	0,06	0,02	0,02	0,01	-0,01
182	0,01	-0,03	0,06	0,04	0,06	-0,01	0,03	-0,02

A5 Carbonation of concrete – Method: Direct carbonation resistance C_{dcr}

The testing procedure was done according to EAD 150001-01-0301, clause 2.2.14.

Table A5.1: Compressive strength of concrete made with BCSA cement "Ternocem" (w/c = 0,50)

age	pre-storage 7 d			pre-storage 28 d		
	MPa					
	single values		mean value	single values		mean value
1	2	3	4	5	6	7
after pre-storage	47,3	49,3	48,8	54,8	56,0	56,5
	49,1	49,2		56,1	58,9	
	47,5	50,2		57,2	56,2	
35 d	65,3	68,9	67,1	68,7	68,9	69,4
	68,1	66,6		70,4	68,0	
	65,3	68,3		70,5	70,2	
after 140 d main storage	69,5	66,7	67,7	74,9	75,4	73,3
	69,2	68,2		70,9	73,9	
	66,8	65,6		70,6	73,8	

Table A5.2: Carbonation depth of concrete made with BCSA cement "Ternocem" (w/c = 0,50)

main storage	Concrete C2 with BCSA cement "Ternocem"			
	pre-storage 7 d		pre-storage 28 d	
d	mm			
	single values	mean value	single values	mean value
1	2	3	4	5
14	0,00	0,00	0,00	0,00
	0,00		0,00	
	0,00		0,00	
28	0,10	0,13	0,60	0,53
	0,00		0,50	
	0,30		0,50	
56	2,50	2,50	0,60	0,67
	2,50		0,50	
	2,50		0,90	
98	3,80	3,47	1,10	1,13
	3,10		1,00	
	3,50		1,30	
140	4,30	3,83	1,80	1,70
	3,40		1,50	
	3,80		1,80	

The carbonation depth of the concrete is compared to data which are given in EAD 150001-01-0301, Annex D. The calculated carbonation speeds for concrete made with BCSA cement "Ternocem" are given in Table A5.3.

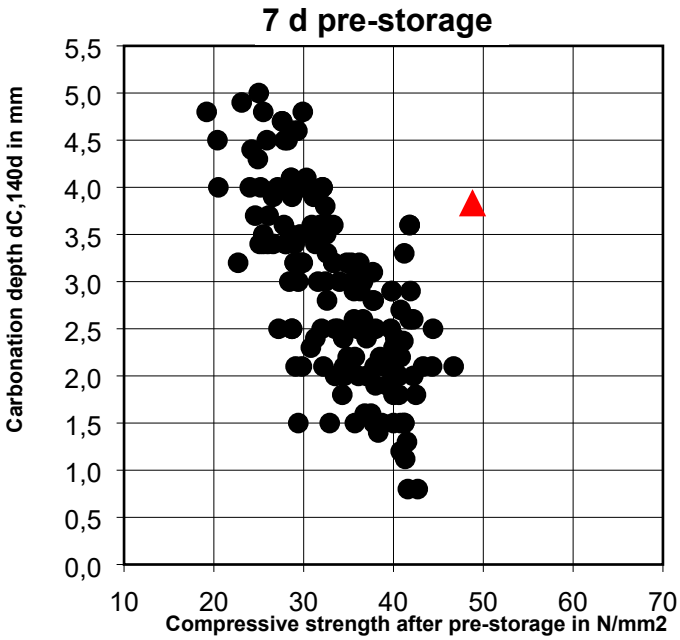

Figure A5.1: Carbonation depth compared to the compressive strength after 7 d pre-storage

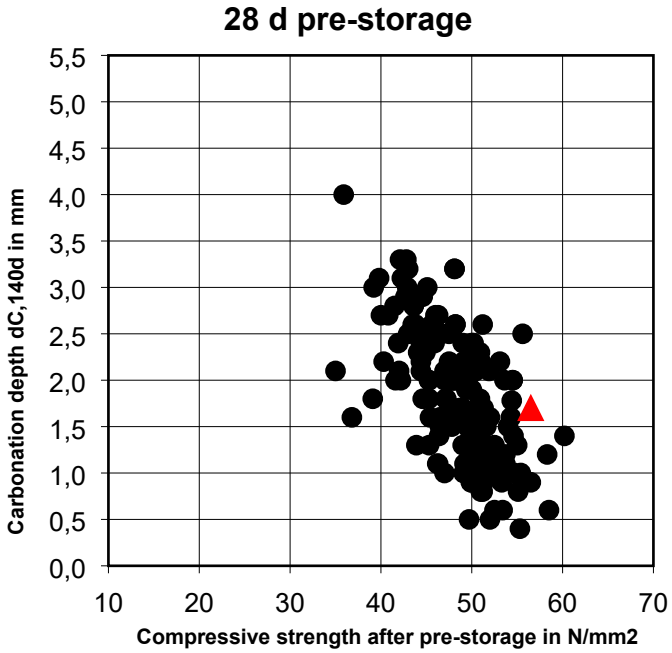

Figure A5.2: Carbonation depth compared to the compressive strength after 28 d pre-storage

A6 Freeze-thaw resistance without de-icing agent – Method: CIF procedure FTS_{CIF}

The testing procedure was done according to EAD 150001-01-0301, clause 2.2.16.

Deviating from the standard procedure, the w/c ratio of the concrete was set to w/c = 0,45.

Table A6.1: Compressive strength of the tested concrete made with BCSA cement "Ternocem" after 28 d

Specimen	Compressive strength [f_{C28}]
-	MPa
1	53,8
2	55,6
3	54,7
mv	54,7

Table A6.2: Single values (sv) and mean value (mv) of scaling (CF-Procedure) and relative dynamic modulus of elasticity (RDM) of concrete made with BCSA cement "Ternocem" after 8, 14 and 28 freeze-thaw cycles (FTC)

FTC	RDM			Scaling		
-	%			kg/m²		
-	sv		mv	sv		mv
2	3	4	5	6	7	8
8	103,8	102,0	102,9	0,02	0,02	0,02
	104,0	102,4		0,02	0,02	
	102,1	-		0,02	-	
14	104,1	103,5	104,2	0,07	0,04	0,05
	104,7	103,8		0,04	0,05	
	105,1	-		0,03	-	
28	104,4	103,8	104,4	0,33	0,21	0,24
	105,1	103,8		0,24	0,25	
	104,8	-		0,19	-	

A7 Freeze-thaw resistance with de-icing agent – Method: CDF procedure FTS_{CDF}

The testing procedure was done according to EAD 150001-01-0301, clause 2.2.17.

Table A7.1: Fresh concrete properties and compressive strength of the tested concrete made with BCSA cement "Ternocem"

Property	Unit	Concrete C4
Flow table a_{10}	mm	470
Air content	%	4,1
Density	kg/m³	2300
28 d compressive strength	N/mm²	39,5

Table A7.2: Single values, mean value and standard deviation of scaling (CDF procedure) of concrete made with BCSA cement "Ternocem"

Freeze-thaw cycles	Scaling of samples						Standard deviation
	1	2	3	4	5	mean value	
-	kg/m²						
4	0,01	0,01	0,01	0,01	0,01	0,01	0,00
6	0,02	0,02	0,02	0,02	0,02	0,02	0,00
14	0,03	0,03	0,03	0,03	0,03	0,03	0,00
28	0,08	0,09	0,06	0,07	0,07	0,08	0,01

Table A7.3: Single values, mean value and standard deviation of relative modulus of elasticity (CDF procedure) of concrete made with BCSA cement "Ternocem"

Freeze-thaw cycles	Relative modulus of elasticity of samples						Standard deviation
	1	2	3	4	5	mean value	
-	%						
4	100,6	100,0	98,7	100,0	99,6	99,8	0,7
6	100,6	100,5	98,9	99,5	99,6	99,8	0,7
14	101,2	100,9	99,4	100,8	100,7	100,6	0,7
28	101,2	101,5	99,0	100,8	100,2	100,5	1,0