Deutsches Institut für Bautechnik

DIBt

General building inspectorate approval

Registration office for construction products and methods
Constructional audit office
Public law institution jointly supported by the federal and state governments
Member of EOTA, UEAtc and WFTAO

Date: 05.06.2015

Reference: II 52-1.23.34-2/15

Approval number:
Z-23.34-1579

Validity
from: **3rd May 2015**
to: **3rd May 2020**

Applicant:
GEOCELL Schaumglas GmbH
Talstraße 3
08606 Oelsnitz

Subject of approval:
Filling of foam glass gravel and - stone chippings "GEOCELL" as thermal insulation under load-bearing foundation plates

This notice extends the validity of the general building inspectorate approval no. Z-23.34-1579 of 7 May 2013.
This decision includes one page. It is only valid in conjunction with the aforementioned general building inspectorate approval and may only be used together with it.

i. V. Wolfgang Misch
Head of Department

Certificated by

General building inspectorate approval

Deutsches Institut für Bautechnik

DIBt

Registration office for construction products and methods
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Public law institution jointly supported by the federal and state governments
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Approval number:
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Validity
from: **2nd May 2014**
to: **2nd May 2015**

Applicant:
GEOCELL Schaumglas GmbH
Talstraße 3
08606 Oelsnitz

Subject of approval:
Filling of foam glass gravel and - stone chippings "GEOCELL" as thermal insulation under load-bearing foundation plates

The above-mentioned subject of approval is hereby approved by the means of the general building inspectorate.
This general building inspectorate approval includes ten pages and two annexes.

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I GENERAL PROVISIONS

1 The general building inspectorate approval proves the usability or applicability of the subject of approval with respect to state building code.

2 If, in the general building inspectorate approval requirements for the special expertise and experience of the persons entrusted with the production of construction products and methods according to the § 17 paragraph 5 model building code are provided according to country regulations; it should be noted that this expertise and experience can also be evidenced by equivalent evidence from other Member States of the European Union. Where applicable, this also applies to equivalent evidence provided under the Agreement on the European Economic Area (EEA) or other bilateral agreements.

3 The general building inspectorate approval does not replace the legally required approvals, consents and certificates for the execution of construction projects.

4 The general building inspectorate approval is issued regardless of the rights of third parties, in particular private property rights.

5 Regardless of further provisions in the "specific regulations", manufacturers and distributors of the subject of approval must make copies of the general building inspectorate approval available to the user of the subject of approval and point out that the general building inspectorate approval must be available at the place of use. Upon request, the participating authorities must be provided with copies of the general building inspectorate approval.

6 The General Construction Approval may only be duplicated in its entirety. A publication of it in excerpts requires the approval of the German Institute for Structural Engineering (Deutsches Institut für Bautechnik - DIBt). Texts and drawings of advertising materials may not contradict the general building inspectorate approval. Translations of the general building inspectorate approval must contain the note "Translation of the German original version not checked by the German Institute for Structural Engineering".

7 The general building inspectorate approval is revocable. The provisions of the general building inspectorate approval can be supplemented and amended retrospectively, especially if new technical knowledge requires it.

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II SPECIFIC PROVISIONS

1 Subject of approval and scope

1.1 Subject of approval

The general building inspectorate approval applies to the production of loose foam glass gravel and its use as a thermal insulation filling.

Foam glass gravel (hereinafter referred to as thermal insulation material) is an artificial, broken granular mixture, which is produced by inflating waste glass in the grain size 30 - 60 mm.

With the thermal insulation material, a thermal barrier coating is produced at the point of use by filling and subsequent compaction.

The thermal insulation material has the name

"GEOCELL".

1.2 Scope of application

The heat insulation material may be used in the compacted state (compression ratio v = 1.3: 1) as a load-bearing thermal insulation under foundation slabs with predominantly static load.

The thickness of the compacted thermal barrier coating shall not be less than 120 mm and not exceed 600 mm.

The thermal insulation material may also be placed outside the seal when exposed to soil moisture and non-accumulating seepage[1].

The application of the thermal insulation material in the capillary fringe of the groundwater (usually 30 cm above HGW) and in the area of pressing water is not permitted. The natural soil must be well permeable to water. In the presence of cohesive or stratified soils in which water accumulation or stratum water can occur, a drainage according to the standard DIN 4095[2] is to be provided.

2 Regulations for the construction product

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2.1 Characteristics and composition

2.1.1 Composition and manufacturing process

The thermal insulation material must conform to the composition and manufacturing process used for the approval tests. Composition and manufacturing processes are deposited with the German Institute for Structural Engineering (Deutsches Institut für Bautechnik - DIBt).

Changes may only be made with the consent of the German Institute for Structural Engineering (Deutsches Institut für Bautechnik - DIBt).

2.1.2 Environmental compatibility

With regard to environmental compatibility, the thermal insulation material must fulfill the requirements of the "Principles for assessing the effects of construction products on soil and groundwater"[3] on the basis of the minor threshold value of the LAWA (see Annex I-D.1 of these principles).

1 Water-loading capacity in the sense of DIN 18195-4: Water-proofing of buildings - Part 4: Waterproofing against ground moisture (Capillary water, retained water) and non-accumulating seepage water under floor slabs on walls, design and execution

2 DIN 4095: 1990-06 Subsoil; Drainage for the protection of structures; planning, design and execution

3 Principles for assessing the impact of construction products on soil and groundwater; Version May 2009 - Records of the Deutsches Institut für Bautechnik (German Institute for Structural Engineering)

Table 1: Requirements for thermal insulation material

Line	Element	Minor threshold value [µl]
1	Arsenic (As)	10
2	Lead (Pb)	7
3	Cadmium (Cd)	0,5
4	Chromium III (Cr)	7
5	Copper (Cu)	14
6	Nickel (Ni)	14
7	Mercury (Hg)	0,2
8	Zinc (Zn)	58

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2.1.3 Bulk density

Each individual value of the bulk density of the thermal insulation materials must, when tested according to the standard DIN EN 1097-3[4] in conjunction with Appendix 1, Section 1, amount to 130 kg / m3 and not more than 170 kg / m3 in a measuring vessel of at least 20 liters.

2.1.4 Thermal conductivity

When testing the thermal conductivity in a dry state in accordance with the standard DIN EN 12667[5] or the standard DIN EN 12939[6] in conjunction with Appendix 1, sections 1 and 2, the thermal insulation material (in the compacted state, v = 1,3: 1) must not exceed the value 10, tr = 0.080 W / (m·K).

2.1.5 Water absorption in sub-water storage

The water absorption of the thermal insulation materials (in the compacted state, v = 1,3: 1) must not exceed 10.0% by volume in sub-water storage after pretreatment in accordance with Appendix 1, Section 1 and testing in accordance with Appendix 1, Section 3.

2.1.6 Thermal conductivity in wet condition

The test of the thermal conductivity of the thermal insulation material in the wet condition shall be carried out in accordance with standard DIN EN 12667[7] or standard DIN EN 12939[8] in conjunction with annex 1, section 2.
For this purpose, the compacted samples moistened by sub-water storage according to Section 2.1.5 shall be used.
The limit value for thermal conductivity stipulated by the DIBt (German Institute for Structural Engineering) must be fulfilled.

4	DIN EN 1097-3:1998-06	Test methods for mechanical and physical properties of aggregates; Part 3: Determination of bulk density and void content
5	DIN EN 12667:2001-05	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance
6	DIN EN 12939:2001-02	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Thick products of high and medium thermal resistance
7	DIN EN 12667:2001-05	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Products of high and medium thermal resistance
8	DIN EN 12939:2001-02	Thermal performance of building materials and products - Determination of thermal resistance by means of guarded hot plate and heat flow meter methods - Thick products of high and medium thermal resistance

2.1.7 Compressive stress at 10% compression

Each individual value of compressive stress at 10% compression must be at least 570 kPa when tested in accordance with DIN EN 826[9] in conjunction with Annex 1, sections 1 and 4 for the thermal insulation material (in the compressed state, v = 1,3: 1).
At least five measurements must be carried out.

2.1.8 Behavior in freeze-thaw cycles

When tested on 5 samples according to the standard DIN 52104-1[10], method G, after 20 freeze-thaw cycles, no significant changes to the samples may be recognizable.

2.1.9 Manufacturing and labeling

2.2.1 Manufacturing

When manufacturing the thermal insulation material, the provisions of section 2.1 must be observed.

2.2.2 Labeling

The packaging or delivery note of the construction product must be labelled with the manufacturer with the compliance mark (Ü-symbol) in accordance with the compliance symbol regulations of the countries. The labelling may only be carried out if the conditions according to section 2.3 are met.
In addition, the following information is required for the compliance mark:

- Foam glass gravel "GEOCELL", grain size 30 - 60 mm, for load-bearing thermal insulation under foundation slabs according to general building inspectorate approval no. Z-23.34-1579
- Rated value of thermal conductivity: λ = 0,11 W / (m·K)
- Rated value of compressive stress: f_{cd} = 275 kPa
- non-inflammable (building material class DIN 4102-A1)
- GEOCELL Schaumglas GmbH, 08601 Oelsnitz, Germany
- Manufacturing plant[11] and date of manufacture[11]

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2.3 Certificate of conformity

2.3.1 General

Certificate of conformity of the construction product with the provisions of this general building inspectorate approval must be carried out for each manufacturing plant with a certificate of conformity based on a factory production control and a regular external monitoring including an initial inspection of the construction product in accordance with the following provisions.
For the issuance of the certificate of conformity and external monitoring, the manufacturer of the construction product must involve a certification body recognized for this purpose and a recognized inspection body.
The certification body must provide the German Institute for Structural Engineering (Deutsches Institut für Bautechnik - DIBt) with a copy of the certificate of conformity issued by them.
The statement that a certificate of conformity has been issued shall be issued by the manufacturer.
The manufacturer must indicate the construction products by marking them with the compliance mark (Ü-symbol) with reference to the intended use.

9	DIN EN 826:1996-05	Thermal insulating products for building applications - Determination of compression behavior
10	DIN 52104-1:1982-11	Testing of natural stone; freeze-thaw cyclic test; methods A to Q
11	Manufacturing plant and date of manufacture can also be specified encrypted.	

German Institute for Structural Engineering (Deutsches Institut für Bautechnik - DIBt) also has to receive a copy of the initial test report.

2.3.2 Factory production control

In each manufacturing plant a factory production control has to be set up and carried out. Factory production control means the continuous monitoring of production which has to be carried out by the manufacturer, with which he ensures that the construction products manufactured by him comply with the provisions of this general building inspectorate approval.
The factory production control shall include at least the measures listed in Table 3.
Within the framework of factory production control, a statistical evaluation of the determined compressive strength shall be carried out. The 5% quantile value fc, 0.05 is determined in accordance with Appendix 2.
In addition, the elements according to Section 2.1.2, Table 1, lines 1 to 8 after digestion with aqua regia according to DIN EN 13657[12] as well as after elution according to LAGA 33[13] (EW98S, standard procedure) must be determined at least once in 3 months on the thermal insulation material. Compliance with the requirements of the "Principles for assessing the effects of construction products on soil and groundwater"[3] must be demonstrated by comparison with the values deposited in the DIBt. The verification of the elements relevant for the thermal insulation materials is to be carried out according to Table 2.
Table 2:

Line	Element	Analytical method
1	Arsenic (As)	DIN EN ISO 11969[14] or DIN EN ISO 11885[15]
2	Lead (Pb)	DIN 38406-6[16] or DIN EN ISO 11885[15]
3	Cadmium (Cd)	DIN EN ISO 5961[17] or DIN EN ISO 11885[15]
4	Chromium total (Cr)	DIN EN 1233[18] or DIN EN ISO 11885[15]
5	Copper (Cu)	DIN 38406-7[19] or DIN EN ISO 11885[15]
6	Nickel (Ni)	DIN 38406-11[20] or DIN EN ISO 11885[15]

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12	DIN EN 13657	Characterization of waste - Digestion for subsequent determination of aqua regia soluble portion of elements in waste
13	LAGA EW 98	"directive for the handling of physical, chemical analysis of waste, contaminated soil and materials in the sector (as of 2002)
14	DIN EN ISO 11969:1996-11	Water quality - Determination of arsenic - Atomic absorption spectrometric method (hydride technique)
15	DIN EN ISO 11885:1998-04	Water quality — Determination of 33 elements by inductively coupled plasma optical emission spectrometry
16	DIN 38406-6:1998-07	German standard methods for the examination of water, waste water and sludge - cations (Group E) – Determination of lead by atomic absorption spectrometry (AAS) (E6)
17	DIN EN ISO 5961:1995-05	Water quality — Determination of cadmium by atomic absorption spectrometry
18	DIN EN 1233:1996-08	Water quality - Determination of chromium - Atomic absorption spectrometric methods
19	DIN 38406-7:1991-09	German standard methods for the examination of water, waste water and sludge; cations (group E); determination of copper by atomic absorption spectrometry (AAS) (E 7)
20	DIN 38406-11:1991-09	German standard methods for the examination of water, waste water and sludge; cations (group E); determination of nickel by atomic absorption spectrometry (AAS) (E 11)

Line	Element	Analytical method
7	Mercury (Hg)	DIN EN 1483[21]
8	Zinc (Zn)	DIN 38406-8[22] or DIN EN ISO 11885[15]

The previous digestion with aqua regia takes place according to DIN EN 13657[23].
The results of the factory production control shall be recorded and evaluated. The records must contain at least the following information:

- Designation of the construction product or of the starting material and of the constituents
- Type of inspection or test
- Date of manufacture and testing of the construction product or of the starting material or elements
- Result of checks and inspections and, if applicable, comparison with the requirements
- Signature of the person responsible for the factory production control

The records must be kept for at least five years and submitted to the inspection body involved in external monitoring. They are to be submitted to the German Institute for Structural Engineering (Deutsches Institut für Bautechnik - DIBt) and the responsible building supervisor on request.
If the test result is insufficient, the manufacturer must immediately take the necessary measures for the correction of the defect. Construction products that do not comply with the requirements must be handled in such a way that confusion with the corresponding ones is excluded. Once the defect has been corrected, the relevant test must be repeated without delay, as far as technically possible.

Table 3: Tests as part of the certificate of conformity

Characteristic By section	Inspection By section	Minimum frequency	
		Factory production control	External monitoring
Bulk density 2.1.3	2.1.3	1 x daily	2 x annually
Thermal conductivity 2.1.4	2.1.4 Annex 1/1	-	2 x annually
Water absorption in sub-water storage 2.1.5	2.1.5 Annex 1/2	-	1 x annually
Compressive stress at 10% compression 2.1.7	2.1.7	1 x daily	2 x annually

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21	DIN EN 1483:1997-08	Water quality - Determination of mercury
22	DIN 38406-8:2004-10	German standard methods for examination of water, waste water and sludge - Cations (group E) - Part 8: Determination of zinc - Method by atomic absorption spectrometry (AAS) using an air-ethine flame (E 8)
23	DIN EN 13657:2003-01	Characterization of waste - Digestion for subsequent determination of aqua regia soluble portion of elements in waste

Characteristic By section	Inspection By section	Minimum frequency	
		Factory production control	External monitoring
Behavior in freeze-thaw cycles 2.1.8	2.1.8	-	1 x annually
Thermal conductivity of wet samples[24] 2.1.6	2.1.6	-	1 x annually
Environmental compatibility elements[26] according to Table 1	Table 2	1 x every 3 months[26]	2 x annually

2.3.3 External monitoring

In each manufacturing plant a factory production control has to be set up and carried out. Factory production control means the continuous monitoring of production which has to be carried out by the manufacturer, with which he ensures that the construction products manufactured by him comply with the provisions of this general building inspectorate approval.
The factory production control shall include at least the measures listed in Table 3.
Within the framework of factory production control, a statistical evaluation of the determined compressive strength shall be carried out. The 5% quantile value fc, 0.05 is determined in accordance with Appendix 2.
In addition, the elements according to Section 2.1.2, Table 1, lines 1 to 8 after digestion with aqua regia according to DIN EN 13657[12] as well as after elution according to LAGA 33[13] (EW98S, standard procedure) must be determined at least once in 3 months on the thermal insulation material. Compliance with the requirements of the "Principles for assessing the effects of construction products on soil and groundwater"[3] must be demonstrated by comparison with the values deposited in the DIBt. The verification of the elements relevant for the thermal insulation materials is to be carried out according to Table 2.
The records must be kept for at least five years and submitted to the inspection body involved in external monitoring. They are to be submitted to the German Institute for Structural Engineering (Deutsches Institut für Bautechnik - DIBt) and the responsible building supervisor on request.

3 Provisions for design and calculation

3.1 Design

Proof of the stability of the foundation is not the subject of this general building inspectorate approval. When arranging the thermal insulation material under a load-bearing foundation slab, deformations occur due to compression of the insulation layer. It may be assumed that if the tension is maintained in accordance with section 3.2.3, a compression of 2% is not exceeded. For structures that are sensitive to subsidence, these deformations may need to be considered. Shear stresses are not permitted. For the derivation of horizontal loads special design measures should be provided.

24 For this purpose, the samples moistened by sub-water storage according to section 2.1.5 shall be used

25 Taking into account the values stored in the DIBt

26 The results of the external monitoring can be counted towards the results of the factory production controls

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3.2 Calculation

3.2.1 Thermal conductivity

Deviating from the standard DIN 4108-2[27], clause 5.3.3, the load-bearing thermal insulation may be taken into account in the calculation of thermal insulation in accordance with the provisions of this general building inspectorate approval, even if it is arranged outside the seal.

For mathematical proof of the thermal resistance, the following design value of the thermal conductivity applies to the thermal insulation layer:

$$\lambda = 0.11 \text{ W / (m·K)}$$

3.2.2 Planning thickness

When calculating the thermal resistance, the planning thickness must be used.

The planning thickness is the minimum thickness of the thermal insulation layer compressed in the ratio v = 1,3: 1.

3.2.3 Proof of the stability of the foundation

For proof of stability, the maximum measurement value of the compressive stress f_{cd}[28] of the compacted thermal barrier coating according to Table 4 may be taken into account.

The measurement value of the compressive stress f_{cd}[28] of the compacted thermal barrier coating in Table 4 is given by the nominal value of the compressive strength $f_{c,\,nominal}$ divided by the partial coefficient of safety for the material properties $_{yM}$[29] and the adjustment factor α[30].

The standards DIN EN 1997-1[31], DIN EN 1997-1 / NA[32], DIN 1054[33] and DIN 1054 / A1[34] are decisive for proving the stability and serviceability of the foundation. When assessing subsidence, the deformations of the thermal barrier coating must also be taken into account.

Table 4:

Plate type designation	Nominal value of compressive strength $f_{c,\,nominal}$	Measurement value of compressive stress $_{cd}$[28] = $f_{c,\,nominal}$ / $_{yM}$29 * α[30])
GEOCELL	570	275

3.2.4 Fire behavior

The thermal insulation material is a not flammable building material (building material class DIN 4102-A1) according to the standard DIN 4102-4[35].

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27	DIN 4108-2:2003-07	Thermal protection and energy economy in buildings - Part 2: Minimum requirements to thermal insulation
28	defined as	c = compression, d = design
29	defined as	Partial safety factor for the building material or product property (see DIN 1055-100: Actions on structures - Part 100: Basis of design, safety concept and design rules, Section 8.3)
30	defined as	Production-specific adjustment factor
31	DIN EN 1997-1:2009-09	Eurocode 7: Geotechnical design - Part 1: General rules; German version EN 1997-1:2004 + AC:2009
32	DIN EN 1997-1 / NA	National Annex - Nationally determined parameters - Eurocode 7: Geotechnical design - Part 1: General rules
33	DIN 1054:2010-2	Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1
34	DIN 1054/A1:2012-08	Subsoil - Verification of the safety of earthworks and foundations - Supplementary rules to DIN EN 1997-1:2010; Amendment A1:2012
35	DIN 4102-4:1994-03	Fire behavior of building materials and building components; Synopsis and application of classified building materials, components and special components

4 Regulations for the completion

The thermal insulation material must be installed according to the manufacturer's processing instructions.
The poured thermal insulation material is to be compacted in the ratio v = 1,3: 1.
The thickness of the fill, taking account of the above-mentioned compaction, shall be carried out in such a way that the specified planning thickness of the thermal barrier coating is not exceeded at any point.
For planning thicknesses greater than 300 mm, the thermal insulation material must be poured in two layers and compacted in each case.
Between the thermal barrier coating and the foundation plate a release layer has to be placed, i.e. PE film.

Frank Iffländer
Head of unit

Certified by

Annex 1

Tests

1 Pretreatment of the test material

For the tests, test material which has been pretreated in a compulsory mixer shall be used, observing the specific bulk density specified in section 2.1.3 of the specific regulations of this approval.

2 Thermal conductivity

The samples for the determination of the thermal conductivity according to the standard DIN EN 12667 or the standard DIN EN 12939 are produced by pouring the insulating material into sample holders with dimensions of approx. 800 mm x 800 mm x 100-200 mm test thickness. The insulating material is compressed in the ratio v = 1,3: 1. The measuring area is 500 mm x 500 mm.

3 Water absorption in sub-water storage

The samples for determining the water absorption are prepared by pouring the insulating material in a plastic frame with plastic bottom with the internal dimensions of about 570 mm x 570 mm x 145 mm. The insulating material is compressed in the ratio v = 1,3: 1. The top of the plastic frame is covered with a perforated plate. The filled plastic frame is immersed in a suitable vessel for 28 days at 23 ° C completely submerged. The immersion depth is 10 cm.
After every 10 minutes dripping of the vertical plastic frame, the water absorption is determined by weighing after 1 minute, 14 days and 28 days.

4 Compressive stress at 10% compression

The tests shall be carried out in square test frames measuring 200 mm x 200 mm x approx. 170 mm.
The test material is to be compacted before the test in the ratio v = 1,3: 1

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Annex 2

Determination of the 5% quantile value of the compressive strengths in the factory production control

The 5% quantile value of the compressive strength shall be determined once a year as part of the factory production control per product type and manufacturing plant in sample evaluation according to Section 2.3.2, Table 2, with a confidence level of 75% as follows.
When evaluating the first 35 samples, the standard deviation should be estimated (unknown).

The 5% quantile value for the case "σ unknown" (for unknown standard deviation) is at normal distribution

$$x_{0,05} = x - K_S \cdot s_x$$

whereby
- $x_{0,05}$ statistical estimate for the 5% quantile
- x Sample mean value
- K_S quantile factors considering the specified probability of statement W = 0.75 according to with v = n -1 (n = number of samples) and
- s_X is standard deviation.

Quantile factors K_s according to Table A2.1[1]

v=n-1	2	3	4	5	6	7	8	9	10	11	12	13	14
K_s - value	3,15	2,68	2,46	2,34	2,25	2,19	2,14	2,10	2,07	2,05	2,03	2,01	1,99

Quantile factors K_s according to Table A2.1[1]

v=n-1	15	17	19	24	29	34
K_s - value	1,98	1,95	1,93	1,90	1,87	1,85

The 5% quantile value for the case "σ unknown" (for known standard deviation) is at normal distribution

$$x_{0,05} = x - K_\sigma \cdot s_x$$

whereby
- $x_{0,05}$ statistical estimate for the 5% quantile
- x Sample mean value
  quantile factors considering the specified probability of statement W = 0.75 according to with v = n -1 (n = number of samples) and
- σ_X is standard deviation.

Quantile factors K_s according to Table A2.2[1]

v=n-1	2	3	4	5	6	7	8	9	10	11	12	13	14
K_s - value	2,02	1,98	1,94	1,91	1,89	1,87	1,86	1,85	1,85	1,84	1,83	1,82	1,81

Quantile factors K_s according to Table A2.1[1]

v=n-1	15	17	19	24	29	34	49	99
K_σ - value	1,81	1,80	1,79	1,78	1,77	1,75	1,74	1,71

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1 from "Principles for the assessment of building materials, components and designs in the test mark and approval procedure" of the IfBt in the version of May 1986

2 ISO 12941: 1997-05 Statistical methods for the quality surveillance of construction products and components