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European Technical Assessment

ETA 16/0064
of 12.11.2018



General part

Trade name of the construction product	Geoconnect® LL
Product family to which the construction product belongs	Dowel for structural joints.
Manufacturer	STEEL FOR BRICKS GZ SL Polígono industrial Alfajarín-El Saco, parcela 10 ES-50172 Alfajarín (Zaragoza) Spain
Manufacturing plant(s)	Polígono industrial Alfajarín-El Saco, parcela 9 ES-50172 Alfajarín (Zaragoza) Spain
This European Technical Assessment contains	17 pages including 3 annexes which form an integral part of this assessment.
This European Technical Assessment is issued in accordance with Regulation (EU) 305/2011, on the basis of	Guideline for European Technical Approval (ETAG) 030 <i>Dowels for structural joints. Part 1: General</i> , Edition April 2013, used as European Assessment Document (EAD).
This version replaces	ETA 16/0064 issued on 20.01.2016.

General comments

Translations of this European Technical Assessment in other languages shall fully correspond to the original issued document.

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Specific parts of the European Technical Assessment

1 Technical description of the product

Geoconnect® LL is a dowel connector used to transfer shear loads across an expansion joint between building parts made of reinforced normal weight concrete, composed of the following main components:

- male part: a dowel bar of circular cross section made of stainless or galvanized steel and an uncoated or epoxy coated fixed reinforcement.
- female part: a sleeve made of stainless steel or polypropylene, into which the dowel bar is inserted, an uncoated or epoxy coated fixed reinforcement and a nailing plate.

The combinations of dowel bar and sleeve are shown in Table 1:

Dowel bar	Sleeve
Stainless steel X2CrNiMoN22-5-3 (1.4462)	Stainless steel X5CrNi18-10 (1.4301)
	Polypropylene
Galvanized steel 42CrMo4 (1.7225)	Polypropylene

Table 1: Combinations of dowel bar and sleeve.

Two families of Geoconnect® LL dowel connectors exist, according to the movement allowed: A1 (single dowel allowing axial movement only) and A2 (single dowel allowing axial and transverse horizontal movement).

The two components of the dowel connector are manufactured separately in the factory and assembled on the construction site into an expansion joint between concrete elements.

The fixed reinforcement in form of uncoated or epoxy coated rebars are welded to the male and female components during the manufacturing process.

The design reinforcement –reinforcement bars placed in the elements to be connected at the time of dowel installation- is defined case by case.

Where resistance to fire is required, Geoconnect® Fire is supplied as a component of the dowel connector.

The description of the Geoconnect® LL dowel connectors, which includes the description of the components, figures with schematic views of the dowel connectors as well as the dimensional limits of the elements to be connected are shown in annex A.

2 Specification of the intended use(s) in accordance with the applicable EAD

Geoconnect® LL is used to transfer shear loads across an expansion joint between:

- Floor, roof or foundation slabs in place of half-lap joints.
- Beams or supports and slabs in place of double-support joints.
- Walls in place of tongue and groove joints.

Geoconnect® LL can be used and has been assessed for the following use conditions:

- Concrete types according to EN 206-1: C25/30, C30/37 and C35/45.
- Joints with nominal width from 0 mm to 60 mm.

- For the following use categories, according to EN ISO 12944-2:
 - When stainless steel dowel bar is used: internal and external exposition with moderate contamination (corrosivity category C3).
 - When galvanized steel dowel bar is used: normal internal exposition (corrosivity category C1).

Geoconnect® LL dowels transmit static loads only.

Geoconnect® LL dowels of family A1 can be used as building stability components when stainless steel sleeves are used, since the gap between the dowel bar and the sleeve does not exceed 1 mm.

Geoconnect® LL dowels are intended to be used under fire exposure when installed with Geoconnect® Fire according to Annex A.4 and Annex C.

The provisions made in this ETA are based on a working life of the Geoconnect® LL dowel connector for the intended use of 50 years when installed in the works. These provisions are based upon the current state of the art and the available knowledge and experience.

The indications given as to the working life of the construction product cannot be interpreted as a guarantee, but are regarded only as a means for choosing the appropriate products in relation to the expected economically reasonable working life of the works.

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

Performance of the Geoconnect® LL related to the basic requirements for construction works (hereinafter BWR) were determined according to ETAG 30 Part 1. Essential characteristics for the Geoconnect® LL are indicated in table 2.

Basic requirement	Essential characteristic	Performance	
BWR 1	Ultimate Limit State	See Annex B	
	Serviceability Limit State		
BWR 2	Reaction to fire	Stainless steel dowel bar	A1
		Galvanized steel dowel bar	A1
		Stainless steel sleeve	A1
		Polypropylene sleeve	F
	Resistance to fire	See annex C	
BWR 3	Content and/or release of dangerous substances	No dangerous substances contained (see clause 3.2.1)	
BWR 4	Nature of surfaces	Unevenness of both sides of the joint ≤ 5 mm	
General aspects relating to the performances of the construction product	Corrosion resistance	Stainless steel: [X2CrNiMoN22-5-3 (1.4462)]	C3
		Galvanized steel: [42CrMo4 (1.7225)]	C1

Table 2: Performance of Geoconnect® LL.

3.1 Essential characteristics of the product

3.1.1 General

The dowel connector corresponds to the specifications given in Table 2 and Annex B.

3.2 Assessment methods

3.2.1 General

The assessment of Geoconnect® LL for the intended use considering the basic requirements for construction works 1, 2, 3 and 4 of Regulation (EU) N° 305/2011 has been made in accordance with the Guideline for European Technical Approval (ETAG) 30-1 *Dowels for structural joints. Part 1: General*, Edition April 2013, used as European Assessment Document (EAD).

According to the manufacturer's declaration, the specification of Geoconnect® LL has been compared with the regulated dangerous substances listed on the database established on the EC construction website, with the *Indicative list of regulated dangerous substances possibly associated with construction products under the CPD, DS 041/051 Rev. 12, 22 March 2012* of the EC Experts Group, with Annex VI of the Regulation (EC) No 1272/2008 of the European Parliament and of the Council, of 16 December 2008, on classification, labelling and packaging of substances and mixtures to verify that the product does not contain such substances.

In addition to the specific clauses relating to dangerous substances contained in this ETA, there may be other requirements applicable to the products falling within its scope. In order to meet the provisions of the EU Construction Products Regulation, these requirements need also to be complied with, when and where apply.

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

According to the decision 98/214/CEE¹ of the European Commission the system of assessment and verification of constancy of performance (see EC delegated regulation (EU) No 568/2014 amending Annex V to Regulation (EU) 305/2011) given in the following table applies:

Product	Intended use(s)	Level(s) or classes(s)	AVCP System
Dowels for structural joints	For uses subject to structural performance regulations	---	2+
	For uses subject to regulations on reaction to fire	(A1 to E)*, F	4

* Products/materials that do not require to be tested for reaction to fire.

Table 3: System of assessment and verification of constancy of performance.

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

All the necessary technical details for the implementation of the AVCP system are laid down in the *Control Plan* deposited with the ITeC² and the factory production control shall be in accordance with it (the *Control Plan* specifies the type and frequency of checks/tests conducted during production and on the final product).

Products not manufactured by the kit manufacturer shall also be controlled according to the *Control Plan*.

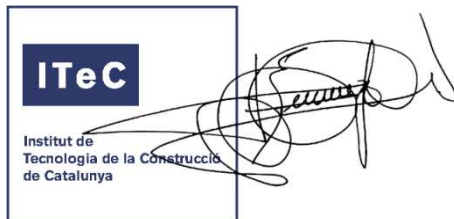
Where materials/components are not manufactured and tested by the supplier in accordance with agreed methods, then they shall be subject to suitable checks/tests by the kit manufacturer before acceptance.

¹ Official Journal of the European Communities L 080 of 18/03/98.

² The *Control Plan* is a confidential part of the ETA and only handed over to the notified certification body involved in the assessment and verification of constancy of performance.

Any change in the manufacturing procedure which may affect the properties of the product shall be notified and the necessary type-testing revised according to the *Control Plan*.

Issued in Barcelona on 12 November 2018
by the Catalonia Institute of Construction Technology.



Ferran Bermejo Nualart
Technical Director, ITeC

ANNEX A: Description of the Geoconnect® LL dowel connectors

A.1. Description of the components (male and female)

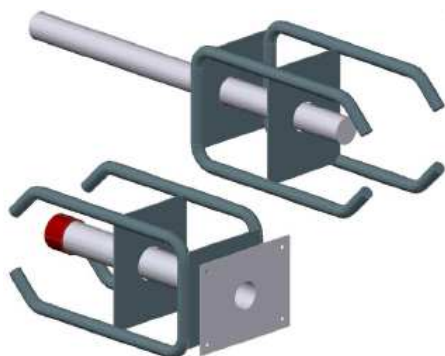


Figure A1.1: Connector Geoconnect® LL of family A1 (male and female components).

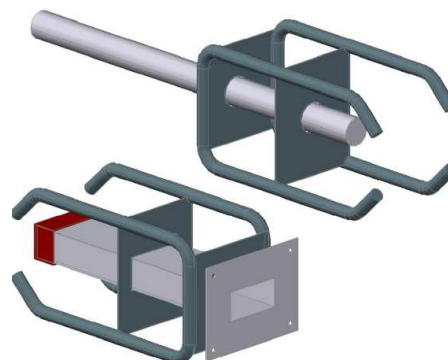
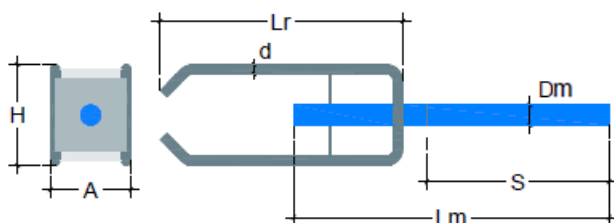


Figure A1.2: Connector Geoconnect® LL of family A2 (male and female components).

Note:

Only the variant with stainless steel sleeve is shown in both figures for clarification purposes.



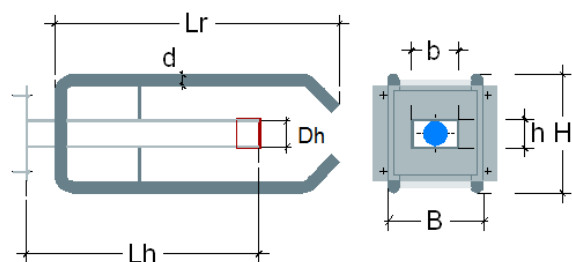
- D_m Dowel bar diameter
- L_m Dowel bar length
- S Overhung
- d Reinforcement bar diameter
- L_r Reinforcement bar length
- H Height
- A Width

Figure A1.3: Dimensions of the male component.

Reference	Dimensions of the male component (mm)						
	Dowel bar			Fixed reinforcement			
	D_m	L_m	$S^{(1)}$	d	L_r	H	A
GC-LL-20	20	320	190	10	260	110	85
GC-LL-22	22	350	205	10	260	110	85
GC-LL-25	25	390	225	12	300	125	100
GC-LL-30	30	450	255	12	300	125	100
GC-LL-35	35	520	290	16	350	140	120
GC-LL-40	40	580	320	16	350	140	120

(1) Overhung (for a concrete cover of 30 mm).

Table A1.1: Dimensions of the male component.



- D_h Sleeve height
- b Sleeve width
- L_h Sleeve length
- d Reinforcement bar diameter
- L_r Reinforcement bar length
- H Height
- B Width

Figure A1.5: Female component of family A2.

Reference	Dimensions of the female component of family A2 (mm)						
	Sleeve			Fixed reinforcement			
	h	b	L _h	d	L _r	H	B
GC-LL-20-DM	21	46	210	10	260	110	120
GC-LL-22-DM	23	47	225	10	260	110	120
GC-LL-25-DM	26	56	245	12	300	125	130
GC-LL-30-DM	31	62	275	12	300	125	130
GC-LL-35-DM	36	76	310	16	350	140	150
GC-LL-40-DM	41	77	340	16	350	140	150

Table A1.4: Dimensions of the female component of family A2.

Reference	Dimensions of the nailing plate in the female component of family A2 (mm)			
	Stainless steel sleeve		Polypropylene sleeve	
	Width	Height	Width	height
GC-LL-20-DM	120		90	90
GC-LL-22-DM				
GC-LL-25-DM	130	100	90	90
GC-LL-30-DM				
GC-LL-35-DM				
GC-LL-40-DM	150			

Table A1.5: Dimensions of the nailing plate in the female component of family A2.

Characteristic	Performance	Standard
Density (g/cm ³)	1,04	EN ISO 1183
Melt flow ratio (g / 10 min)		
(230 °C / 2,16 kg)	16	EN ISO 1133
(230 °C / 5,0 kg)	67	EN ISO 1133
Tensile modulus (MPa)	2.600	EN ISO 527-1, -2
Tensile strength (50 mm/min) (MPa)	33	EN ISO 527-1, -2
Flexural modulus (MPa)	2.700	EN ISO 178
Strength to Charpy impact (kJ/m ²)		
- Without notch (23 °C, type 1, edgewise)	32	EN ISO 179
- Without notch (0 °C, type 1, edgewise)	18	EN ISO 179
- With notch type A (23 °C, type 1, edgewise)	2,5	EN ISO 179
- With notch type A (0 °C, type 1, edgewise)	1,5	EN ISO 179
Hardness (indentation ball H 358/30) (MPa)	90,0	ISO 2039-1
Flexural temperature under load B (0,45 MPa; not annealed) (°C)	115	EN ISO 75B-1, -2
Flexural temperature under load A (1,80 MPa; not annealed) (°C)	65	EN ISO 75A-1, -2

Table A1.6: Nominal characteristics of the polypropylene of the sleeve and the nailing plate.

The fixed reinforcement is made of steel rebars according to EN 10080 of the following characteristics:

Characteristic	Performance
Yield strength (R_e) [N/mm ²]	≥ 500
Tensile strength (R_m) [N/mm ²]	≥ 550
Ultimate elongation (ϵ_u) [%]	≥ 12
R_e / R_m	≥ 1,05

Table A1.7: Nominal characteristics of the steel rebars.

The fixed reinforcement and the steel plates are uncoated or epoxy coated during the manufacturing process with thickness of 100 µm as mean value and 80 µm as minimum value. The mechanical properties of the reinforcement and of the dowel are not affected by this epoxy coating. The epoxy coating colour is maroon.

The plates used to fix the fixed reinforcement in the male and female components are made of uncoated or epoxy coated steel sheets 1,5 mm thick of steel S235 according to EN 10025-2. These plates are also used to support the dowel bars and the sleeve.

A.2. Schematic views of the dowel connectors

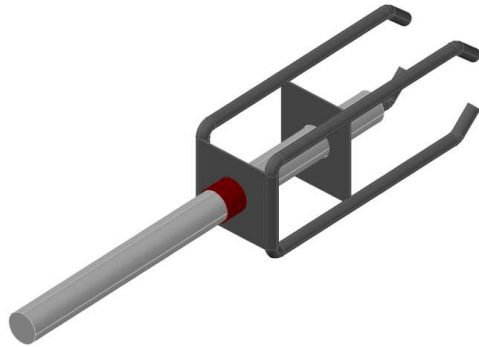


Figure A2.1: Male component.

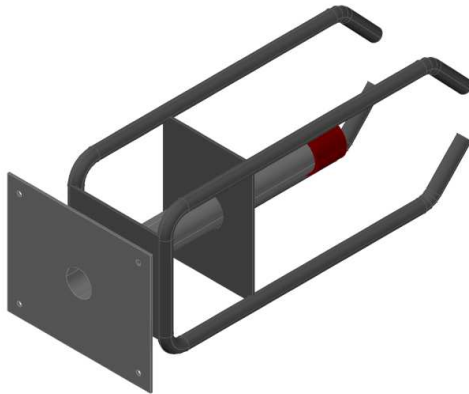


Figure A2.2: Female component with stainless steel sleeve and family A1.

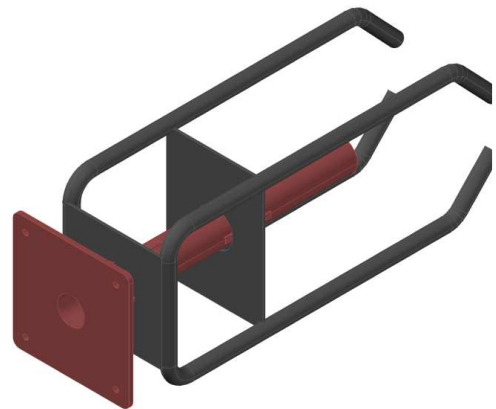


Figure A2.3: Female component with polypropylene sleeve and family A1.

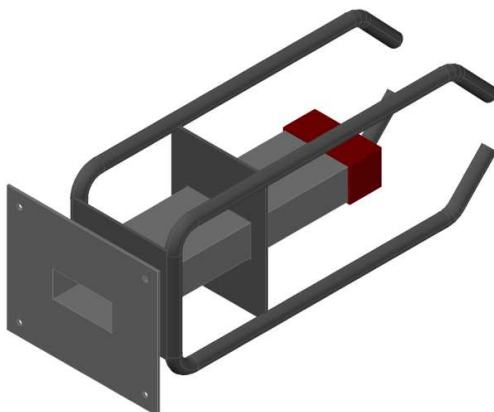


Figure A2.4: Female component with stainless steel sleeve and family A2.

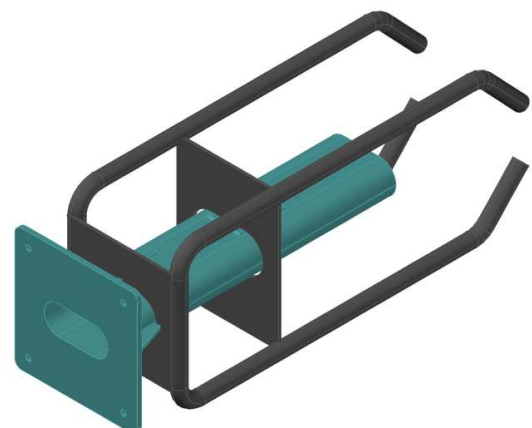


Figure A2.5: Female component with polypropylene sleeve and family A2.

A.3. Dimensional limits of the elements to be connected

Reference	Minimum thickness of the concrete elements to be connected (mm)
GC-LL-20	180
GC-LL-22	180
GC-LL-25	200
GC-LL-30	200
GC-LL-35	250
GC-LL-40	250

Table A3.1: Minimum thickness of the concrete elements to be connected.

Reference	Minimum dowel bar introduction in the sleeve (mm)						
	Joint width (w) (mm)						
	0	10	20	30	40	50	60
GC-LL-20	190	180	170	160	150	140	130
GC-LL-22	205	195	185	175	165	155	145
GC-LL-25	225	215	225	235	245	255	165
GC-LL-30	255	245	235	225	215	205	195
GC-LL-35	290	280	270	260	250	240	230
GC-LL-40	320	310	300	290	280	270	260

Table A3.2: Minimum dowel bar introduction in the sleeve (mm).

A.4. Geoconnect® Fire

Geoconnect® Fire consists of a mineral wool panel (20 mm or 30 mm thickness) coated with an intumescent layer of 2,5 mm thickness, with the dimensions shown in table A4.1. Technical specification of Geoconnect® Fire is identified and kept at ITeC. Geoconnect® Fire is supplied by Steel for Bricks under his responsibility.

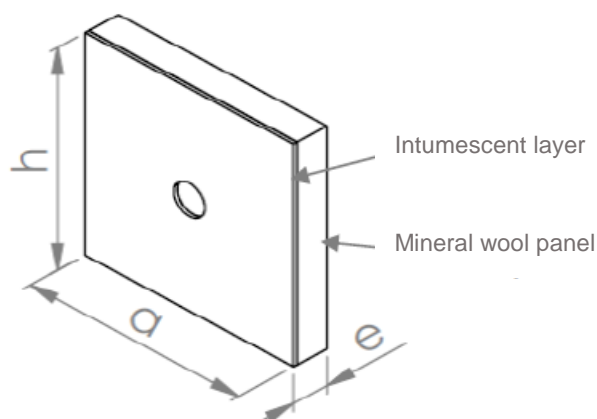


Figure A4.1: Geoconnect® Fire.

Dowel bar diameter (mm)	Geoconnect® Fire		
	Hole diameter (mm)	Minimum height h (mm)	Minimum width a (mm)
20 (GC-LL-20)	21	150	150
22 (GC-LL-22)	23	152	152
25 (GC-LL-25)	26	155	155
30 (GC-LL-30)	31	160	160
35 (GC-LL-35)	36	165	165
40 (GC-LL-40)	41	170	170

Table A4.1: Geoconnect® Fire dimensions.

The selection of Geoconnect® Fire thickness will be done depending on the initial joint width in such a way that the dowel bar unprotected length is the lowest possible. When two Geoconnect® Fire are installed due to the initial joint width, they are positioned adjacent to each other with the intumescent coated layers facing the concrete slabs.

The working life of Geoconnect® Fire has not been assessed in the framework of this ETA and is lower than the working life of the Geoconnect® LL dowel connectors. Therefore, an adequate maintenance and repair, when necessary, of the fire protective product is required.

ANNEX B: Mechanical performances of the Geoconnect® LL dowel connectors

B.1. Introduction

The mechanical performances of the dowel connector are to be used in conjunction with the design method given in Annex A of ETAG 030-1.

B.2. Ultimate Limit State

The design of the connexion based on Geoconnect® dowel connectors is made case-by-case for each project. The design reinforcement -rebars placed aside to the dowel male and female components- are added to the elements to be connected at the time of dowel installation. Therefore, the concrete edge failure strength is determined case-by-case based on the calculation model given below.

The lowest value of the following three possible failure modes (steel failure, through-the-thickness failure and concrete edge failure) will define the ultimate shear resistance of the dowel connector.

- (1) Steel failure ($V_{Rd,s}$): according to Eurocode 3 using the reduction factors of ETAG 030-1 (0,9 for single dowels allowing axial movement only –family A1 of table 1- and 0,81 for single dowels allowing axial and transverse horizontal movement –family A2 of table 1-).
- (2) Through-the-thickness failure ($V_{Rd,ct}$): according to Addendum 2 of ETAG 030-1, as described below:

$$V_{Rd,ct} = 0,14 \cdot K \cdot (100 \cdot \rho_1 \cdot f_{ck})^{1/3} \cdot u \cdot d_m / \beta$$

where:

$$K = 1 + (200 / d_m)^{1/2}$$

d_m : mean effective cross section of the slab [mm].

ρ_1 : mean reinforcement ratio in directions parallel and perpendicular to the slab edge.

$$\rho_1 = (\rho_{1x} + \rho_{1y})^{1/2} \leq (0,5 \cdot f_{cd} / f_{yd}) \text{ or } (0,02)$$

f_{cd} : design concrete compression strength.

f_{yd} : design reinforcement yield strength.

f_{ck} : characteristic concrete compression strength [MPa].

β : load factor;

$\beta = 1,4$ (dowel connector installed at the edge of the slab).

$\beta = 1,5$ (dowel connector installed at the corner of the slab).

u : basic control perimeter according to Figure B2.1 [mm]

$$u = 2 \cdot c + l_c + \pi \cdot d_m \cdot 1,5$$

c : concrete cover.

l_c : virtual diameter of the dowel connector, representing the column diameter in the punching failure. This distance is to be taken as the distance between the axis of the two stirrups next to the dowel for all dowel sizes.

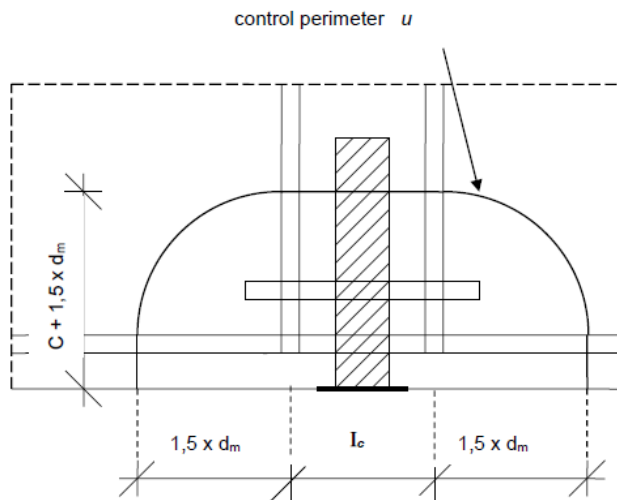


Figure B2.1: Basic control perimeter.

(3) Concrete edge failure ($V_{Rd,ce}$): according to Addendum 3 of ETAG 030-1 and using the calculation model defined by the following:

- The concrete cone starts at the centre of the dowel connector. When the distance of the dowel to the nearest concrete face (top or underside of the slab) is $H_{slab} / 2$, then $H_{spec} = H_{slab} / 2$
- $b_{cone} = (2 \cdot H_{spec}) / \tan 33^\circ$
- Consideration of the force transmitted by the hook: the force transmitted by the hook is weighted if the concrete cone resulting from the calculation model does not include completely the part of the stirrup affected by the hook. The length of the stirrup inside the concrete cone is less than the sum of half the mandrel diameter of the stirrup and the diameter of the stirrup ($0,5 \cdot d_b + d_s$).

This weighting is introduced in the formula of $V_{u,cal,1}$ by a reduction coefficient (actual length / theoretical length).

- $X_1 = 0,25$
- $X_2 = 0,82$

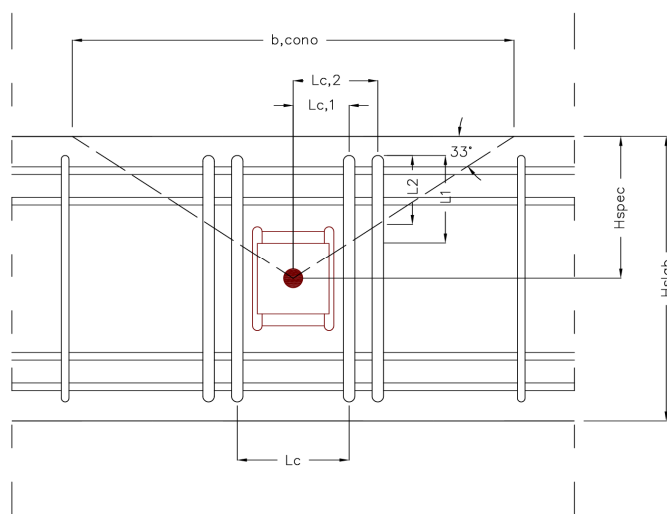


Figure B2.2: Calculation model of the design reinforcement.

$$V_{Rd,ce} = V_{Rd,1} + V_{Rd,2} \leq A_s \cdot f_{yk}$$

where:

$$V_{Rd,1} = X_1 \cdot X_2 \cdot \sum \Psi_i \cdot A_s \cdot f_{yk} \cdot (f_{ck}/30)^{1/2} / \gamma_c$$

$$V_{Rd,2} = \pi \cdot d_s \cdot \sum l'_{1,i} \cdot f_{bd}$$

$V_{Rd,1}$: Design force transmitted into the concrete by the stirrups arranged to the left and right of the dowel connector, only taking into account the part which can be allocated to the hook (bent pin at the top and bottom faces of the slab).

$V_{Rd,2}$: Design bonding action along the straight part of the stirrup between top and bottom faces of the slab.

B.3. Serviceability Limit State

The design values of $V_{Rd,ce,SLS}$ (serviceability shear force related to cracking) are obtained from the following expression:

$$V_{Rd,ce,SLS} = 0,58 \cdot V_{Rd,ce}$$

where:

$V_{Rd,ce}$ is the shear resistance for concrete edge failure (see clause B.2).

ANNEX C: Resistance to fire performance

C.1. Classification

The loadbearing reinforced concrete floor consisting of slabs connected with Geoconnect® LL dowel connectors in accordance with section 1 of this ETA, protected with Geoconnect® Fire in accordance with section A.4, is classified R120 according to EN 13501-2.

The resistance to fire test was performed according to EN 1365-2.

C.2. Limits of the performance applicability

The given resistance to fire performance is assessed to be valid considering:

- Connector family: A1 (single dowel allowing axial movement only).
- Connectors loaded up to the design shear strength values in accordance with ETA 16/0064, in function of the connector used, the slabs characteristics and reinforcement design, and the joint width.
- The concrete slabs and reinforcements, as well as local reinforcements of the connectors, must be designed to have a resistance to fire R120. The minimum slab thickness must be 200 mm with a minimum concrete cover of the slabs lower reinforcements of 40 mm. The concrete surface at the edge of the slabs must be flat and smooth to reach an adequate seal of the joint in case of fire.
- The maximum initial length of the dowel bar unprotected within the initial joint width (not covered by Geoconnect® Fire) must be 10 mm. See also section A.4 for Geoconnect® Fire installation criteria.