ALU START

ALUMINIUM SYSTEM FOR THE CONNECTION OF BUILDINGS TO THE GROUND

VIDEO | CALCULATION TOOL | DESIGN REGISTERED | ETA-20/0835

CE MARK ACCORDING TO ETA
The profile is capable of transferring shear, tensile and compressive forces into the foundation. The strengths are tested, calculated and certified according to ETA-20/0835.

ELEVATION FROM THE FOUNDATION
The profile allows to eliminates contact between the timber panels (CLT or TIMBER FRAME) and the concrete substructure. Excellent durability of the building connection to the ground.

SUPPORT SURFACE LEVELLING
Thanks to the special assembly templates, the supporting surface level is easy to adjust. The "levelling" of the entire building is simple, precise and fast.

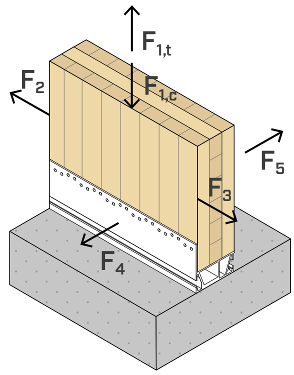
USA, Canada and more design values available online.

SERVICE CLASS SC1 SC2

MATERIAL

alu 6060 — EN AW-6060 aluminium alloy

EXTERNAL LOADS



VIDEO
Scan the QR Code and watch the video on our YouTube channel

FIELDS OF USE

Ground attachment system for timber walls. The aluminium profiles are positioned and levelled before the walls are installed. Fastening with LBA nails, LBS screws and concrete anchors.

Can be applied to:
- TIMBER FRAME walls
- CLT and LVL panel walls

DURABILITY

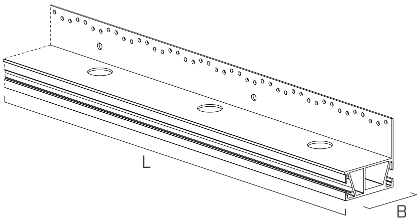
Thanks to the elevation from the foundation and the aluminium material, the building base is protected against capillary damp. The ground connection provides durability and health to the structure.

CERTIFIED STRENGTH

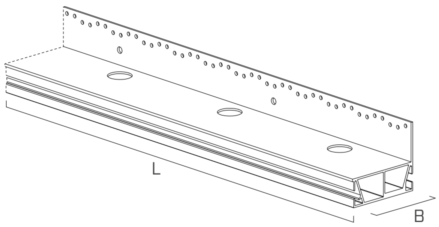
Thanks to the side flange, the profile can be fastened to the timber wall by means of nails or screws which guarantee excellent strength in all directions certified by CE marking according to ETA.

CODES AND DIMENSIONS

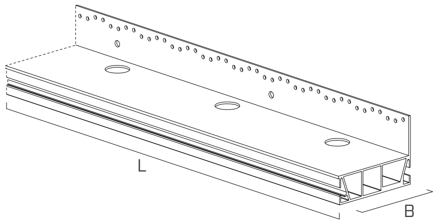
ALU START



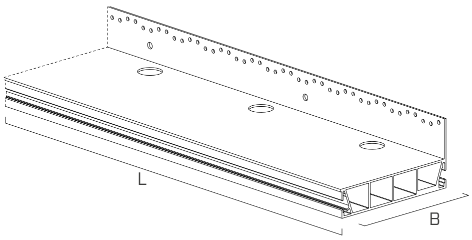
ALUSTART80



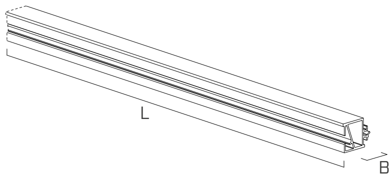
ALUSTART100



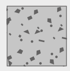
ALUSTART120



ALUSTART175



ALUSTART35

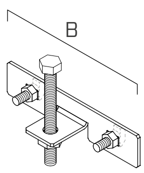
CODE	B [mm]	L [mm]	*B [in]*	*L [in]*		pcs
ALUSTART80	80	2400	*3 1/8*	*94 1/2*	●	1
ALUSTART100	100	2400	*4*	*94 1/2*	●	1
ALUSTART120	120	2400	*4 3/4*	*94 1/2*	●	1
ALUSTART175	175	2400	*6 7/8*	*94 1/2*	●	1
ALUSTART35 *	35	2400	*1 3/8*	*94 1/2*	●	1

* Lateral extension for ALUSTART profiles.

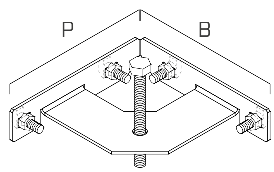
ASSEMBLY ACCESSORIES - JIG START TEMPLATES

CODE	description	B [mm] *[in]*	P [mm] *[in]*	pcs
JIGSTARTI	levelling template for linear joint	160 *6 1/4*	-	25
JIGSTARTL	levelling template for angle joint	160 *6 1/4*	160 *6 1/4*	10

The templates are supplied complete with M12 bolt for height adjustment, ALUSBOLT bolts and MUT93410 nuts.



JIGSTARTI

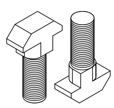


JIGSTARTL

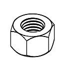
COMPLEMENTARY PRODUCTS

CODE	description	pcs
ALUSBOLT	hammer head bolt for template fastening	100
MUT93410	hammer bolt nut	500
ALUSPIN	ISO 8752 sping pins for ALUSTART35 assembly	50

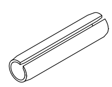
ALUSBOLT and ALUSPIN can be ordered separately from the templates as spare parts.



ALUSBOLT



MUT93410

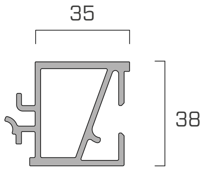


ALUSPIN

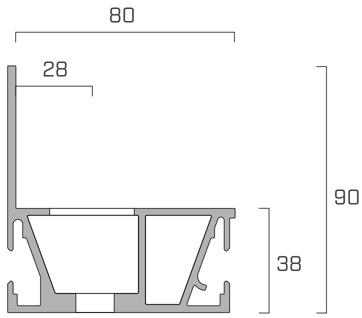
FASTENERS

type	description	d [mm]	support	page
LBA	high bond nail	4		570
LBS	round head screw	5		571
SKR	screw-in anchor	12		528
AB1	CE1 expansion anchor	M12		536
VIN-FIX	vinyl ester chemical anchor	M12		545
HYB-FIX	hybrid chemical anchor	M12		552

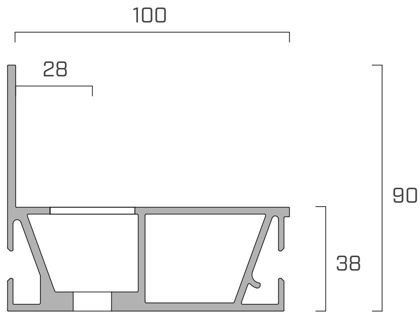
GEOMETRY



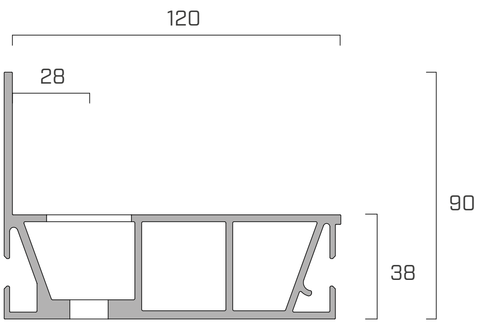
ALUSTART35



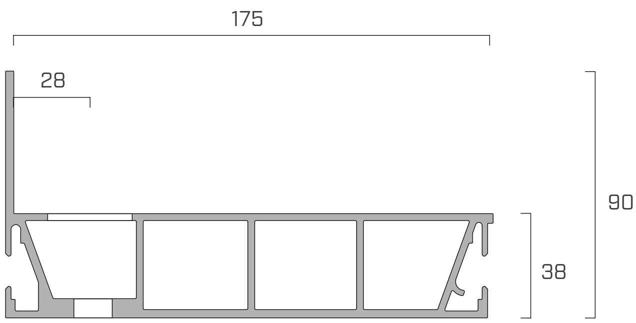
ALUSTART80



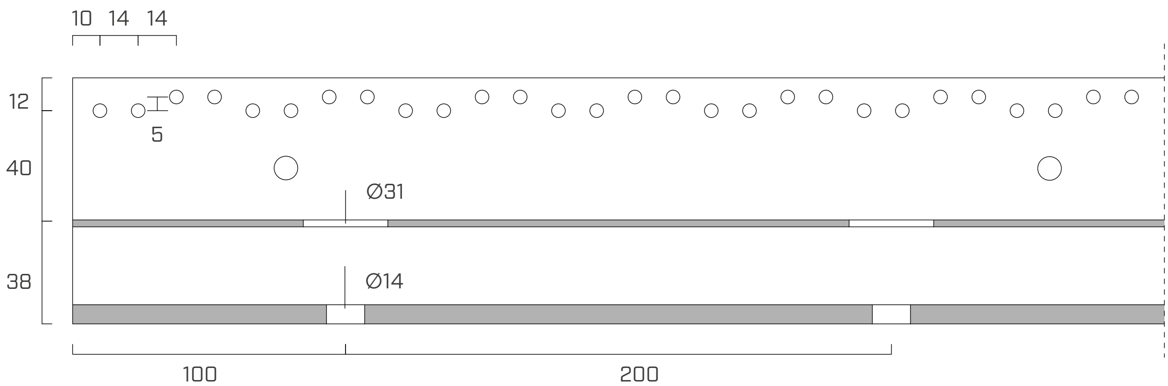
ALUSTART100



ALUSTART120



ALUSTART175

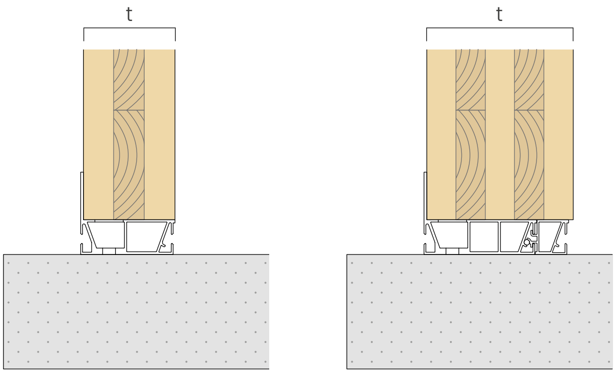


CODE	B	H	L	n_V Ø5	n_H Ø14
	[mm]	[mm]	[mm]	[pcs]	[pcs]
ALUSTART80	80	90	2400	171	12
ALUSTART100	100	90	2400	171	12
ALUSTART120	120	90	2400	171	12
ALUSTART175	175	90	2400	171	12
ALUSTART35	35	38	2400	-	-

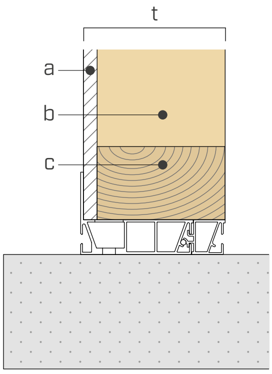
INSTALLATION

ALU START is an extruded aluminium profile designed to house the walls and to solve the foundation-wall node in timber. The profile is certified to withstand all the stresses typical for a timber wall, i.e. F_1, $F_{2/3}$, F_4 and F_5. ALU START profiles are designed to fit both CLT and Timber Frame walls. The use of the lateral extension ALUSTART35 allows its use with CLT and Timber Frame walls having greater thickness.

INSTALLATION ON CLT

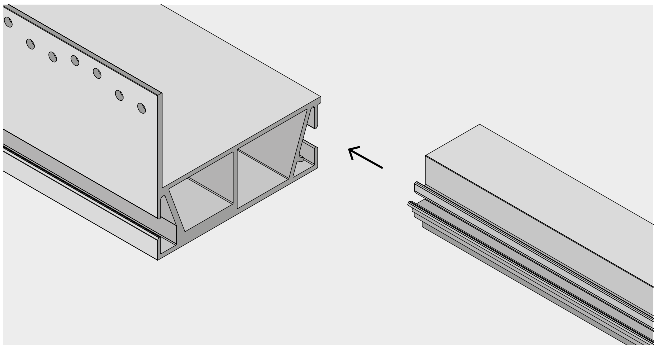


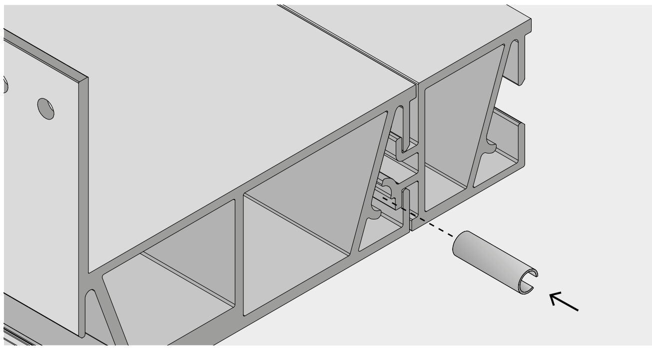
INSTALLATION ON TIMBER FRAME



a. bracing sheet
b. strut
c. beam

The ALUSTART35 side extension is easily inserted into the ALU START profiles. The compound profile is then stopped in position by two ALUSPIN pins to be inserted at the ends. It is possible to install up to two ALUSTART35 profiles on a profile with a nailed flange.





PROFILE SELECTION

profile	reference width	recommended thickness t	
		minimum	maximum
	[mm]	[mm]	[mm]
ALUSTART80	80	-	95
ALUSTART100	100	90	115
ALUSTART120	120	115	135
ALUSTART100 + ALUSTART35	135	135	155
ALUSTART120 + ALUSTART35	155	155	175
ALUSTART175	175	155	195
ALUSTART120 + 2x ALUSTART35	190	180	215
ALUSTART175 + ALUSTART35	210	195	235
ALUSTART175 + 2x ALUSTART35	245	235	270

INSTALLATION

NAILING

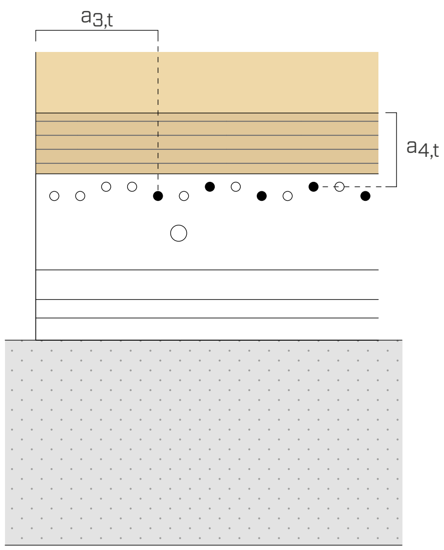
ALU START profiles can be used for different building systems (CLT / Timber Frame).
Depending on the construction technology, different nailings can be used in accordance with the minimum distances.

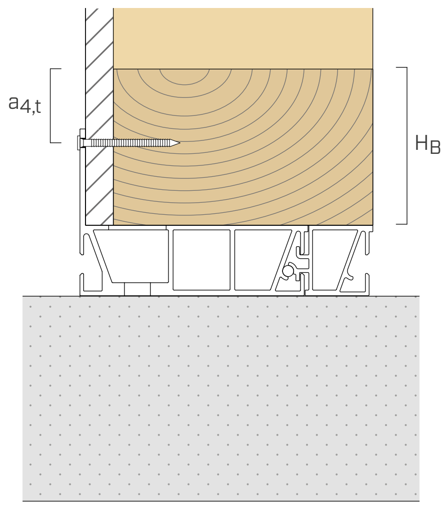
MINIMUM DISTANCES

TIMBER minimum distances			nails LBA Ø4	screws LBS Ø5
C/GL	$a_{4,t}$	[mm]	≥ 28	-
	H_B	[mm]	≥ 73	-
	$a_{3,t}$	[mm]	≥ 60	-
CLT	$a_{4,t}$	[mm]	≥ 28	≥ 30

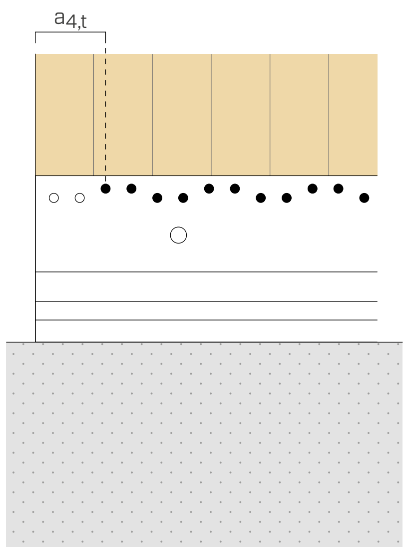
- C/GL: minimum distances for solid timber or glulam consistent with EN 1995-1-1 according to ETA considering a timber density $\rho_k \leq 420\ kg/m^3$.
- CLT: minimum distances for Cross Laminated Timber according to ÖNORM EN 1995-1-1 (Annex K) for nails and ETA-11/0030 for screws.

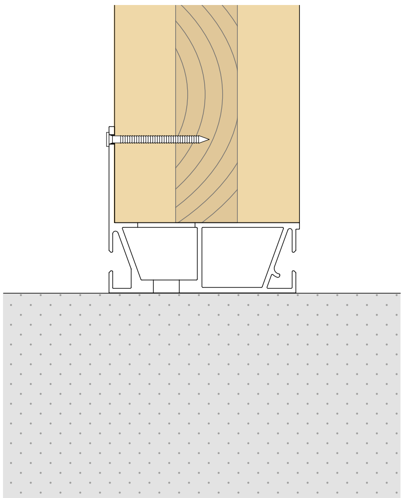
SOLID TIMBER (C) OR GLULAM (GL)





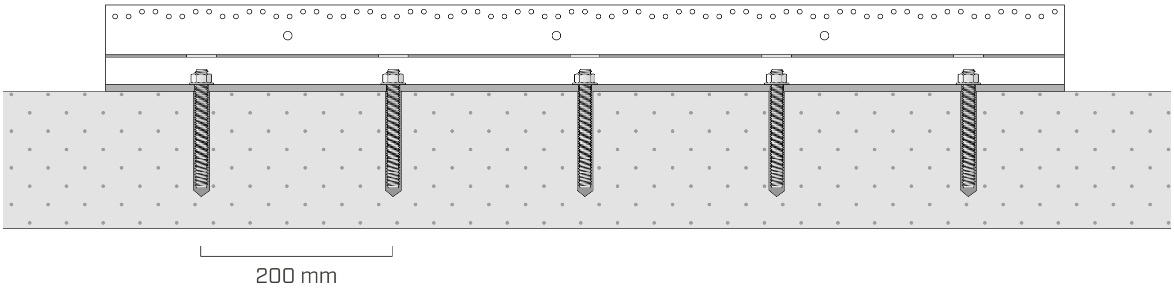
CLT

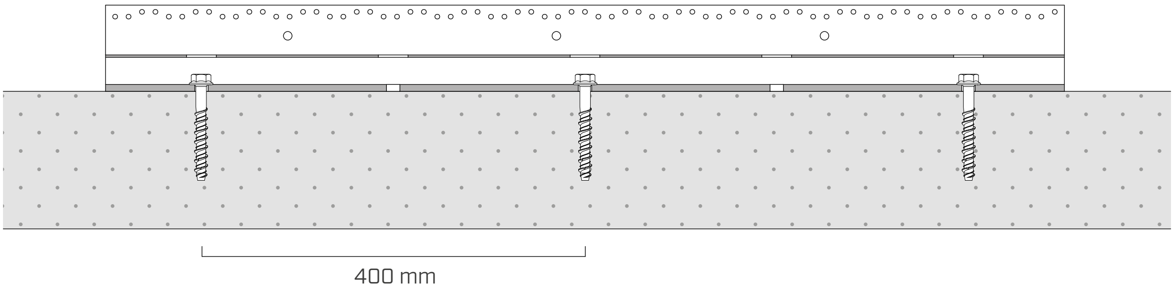




INSTALLATION | CONCRETE

The ALU START profiles must be fastened on concrete with a number of anchors suitable for the design loads.
It is possible to arrange the anchors in all the holes, or choose larger installation spacing.



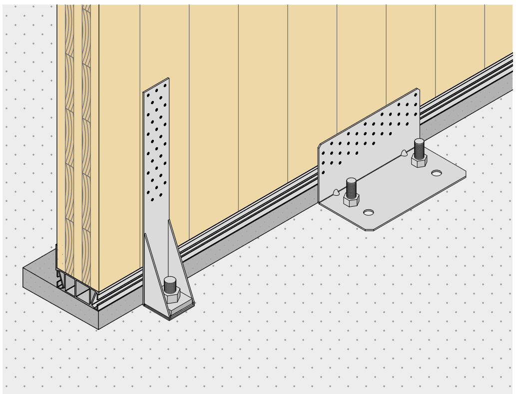


More details on how to install the profiles can be found in the "POSITIONING" section.

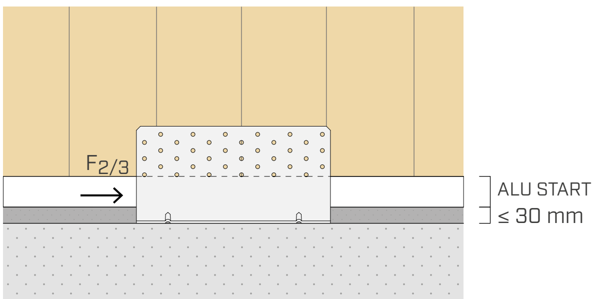
ADDITIONAL CONNECTION SYSTEMS

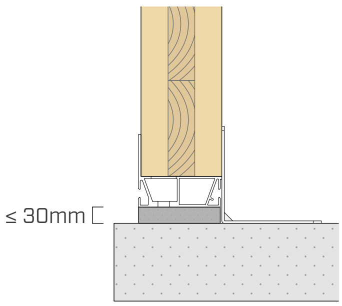
The ALU START geometry allows using additional connection systems such as TITAN TCN and WHT, even with a grout between the profile and the foundation.

Certified partial nailings are available for TITAN TCN installation which allow laying bedding grout with a thickness up to 30 mm.



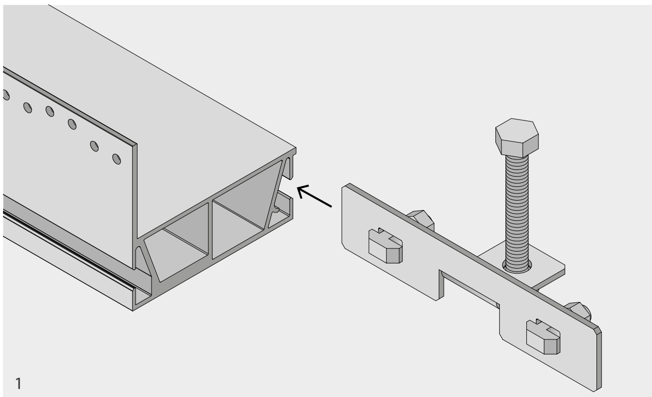
EXAMPLE OF INSTALLATION WITH TITAN TCN240





POSITIONING

Assembly includes the use of special JIG START templates for the height levelling of the profiles, for the linear joint and for creating 90° angles.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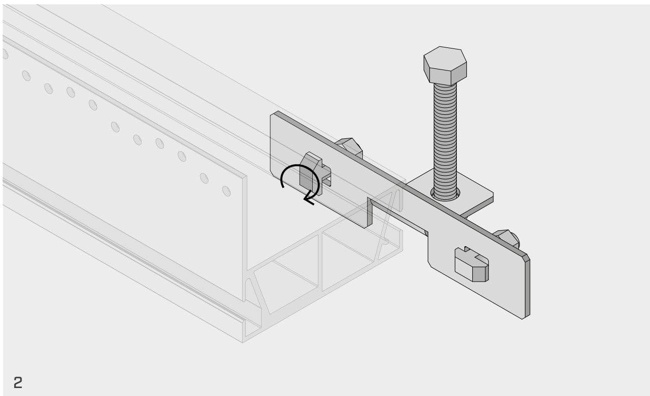
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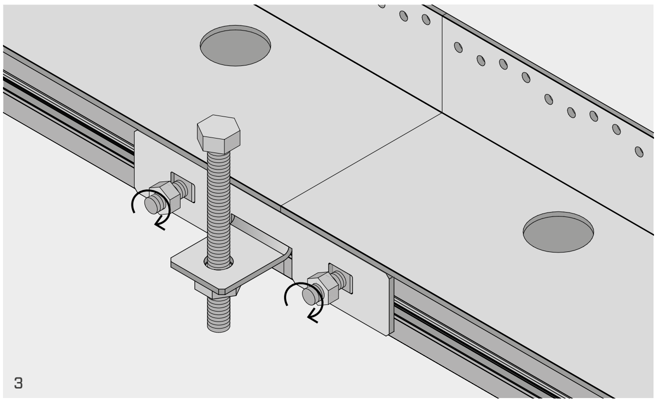
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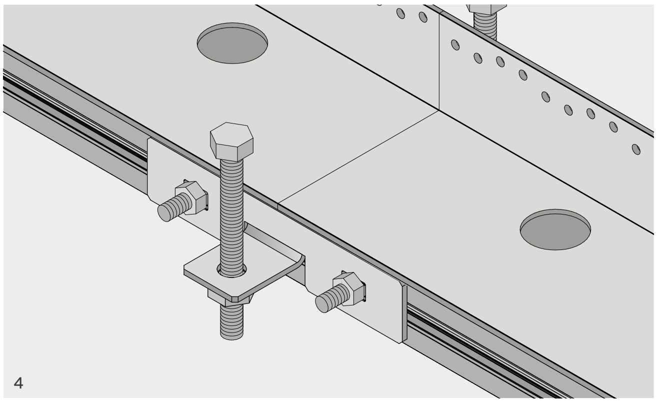
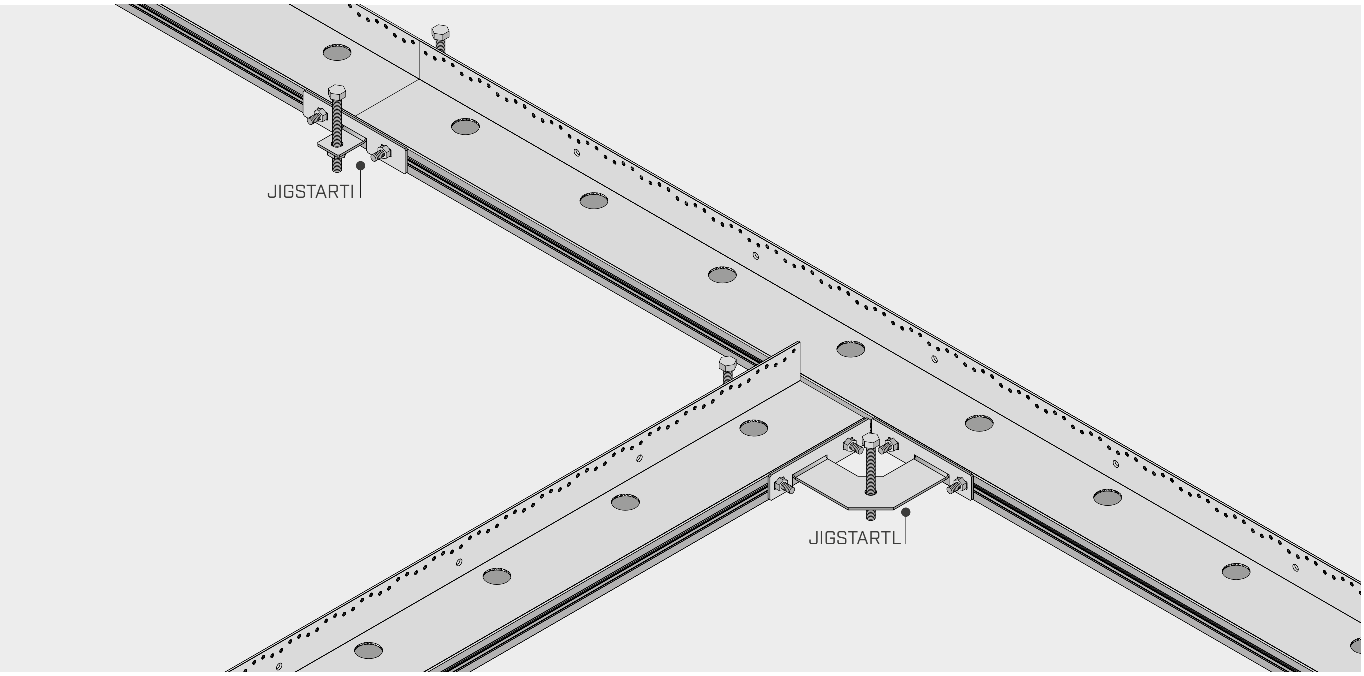
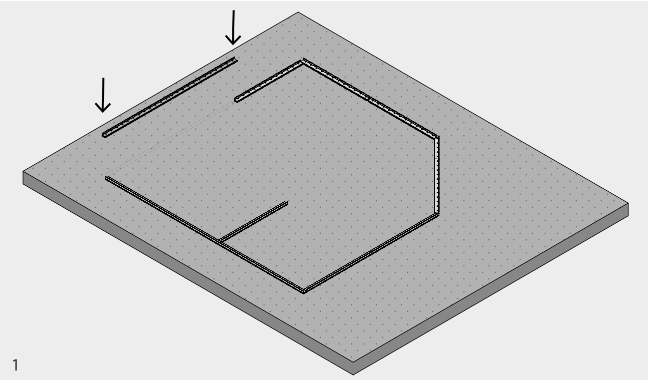

4

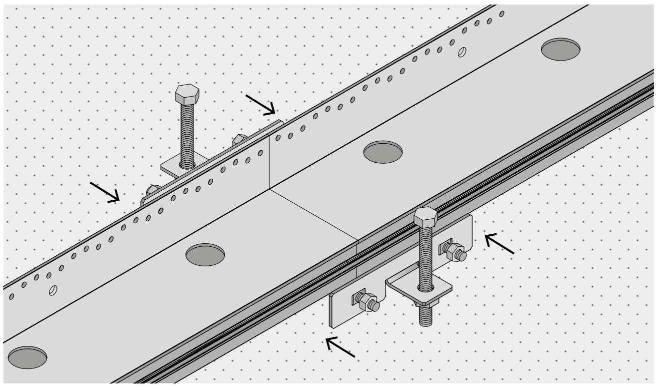
JIGSTARTI templates can connect two consecutive profiles and must be positioned on both sides of ALU START, without positioning constraints along the development.
The 90° angle bracket connection is carried out through the JIGSTARTL jigs.
On each template there is a hexagonal head bolt, which allows the height adjustment of the aluminium profiles.



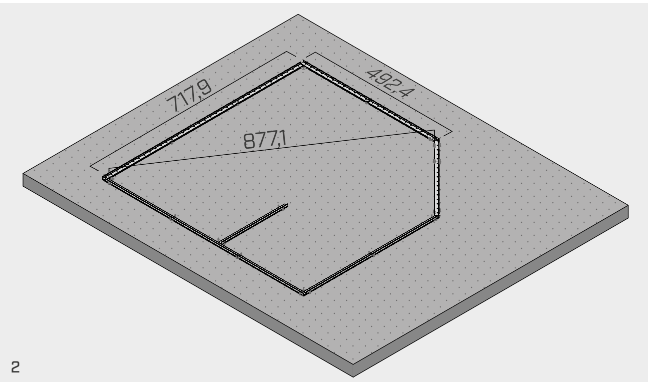
MOUNTING

VIDEO

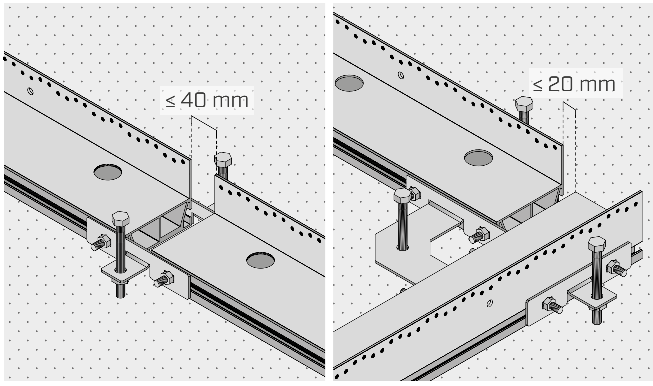




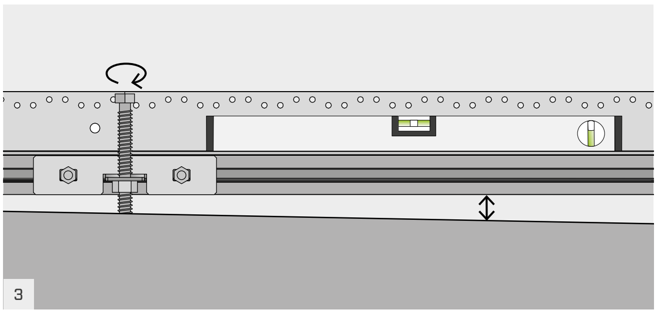
Preliminary positioning of the profiles on the laying surface using the templates and cutting the elements to size, if necessary.



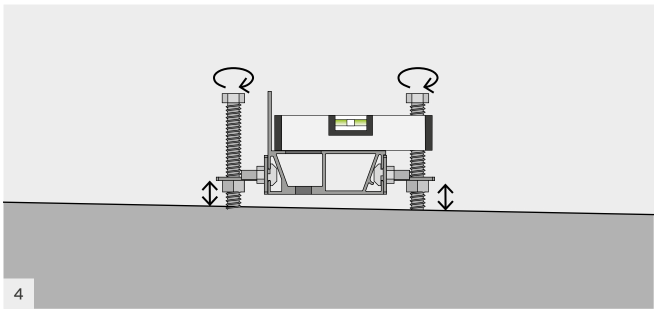
Definitive planimetric drawing with verification of lengths and diagonals.



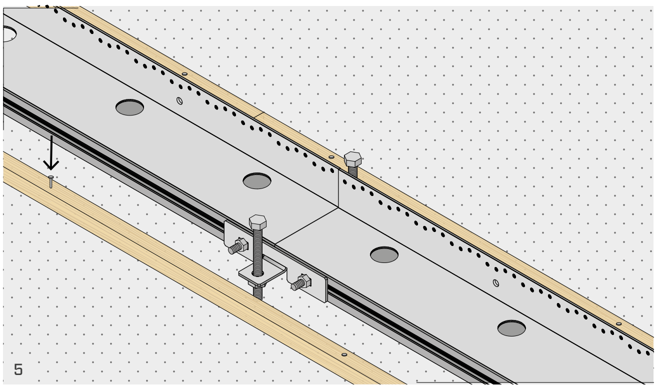
Fine adjustment with JIG START templates of the total length of the wall, compensating the tolerances of the profiles cut to size.



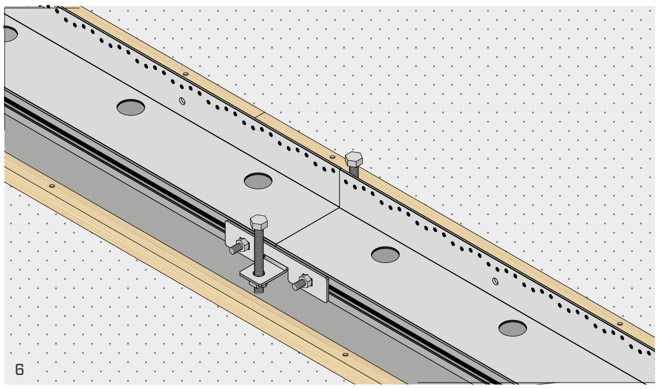
Longitudinal levelling of ALU START rods.



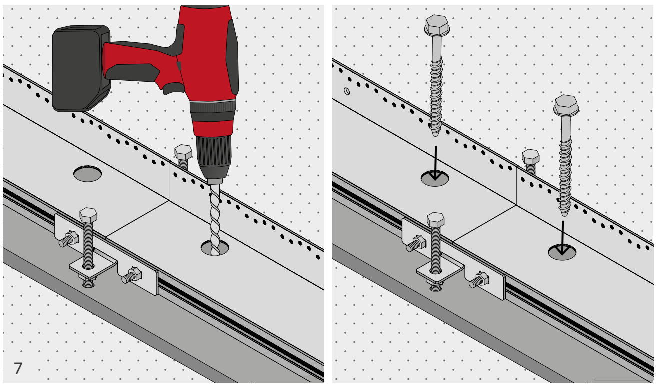
Lateral levelling of the rods.



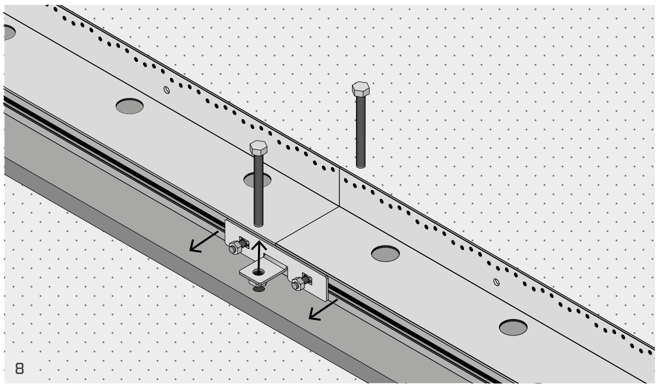
Construction of formwork with timber battens.



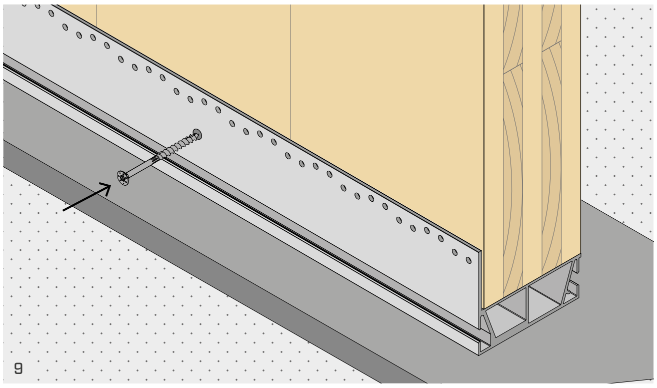
Creation of the grout between the profile and the concrete support.



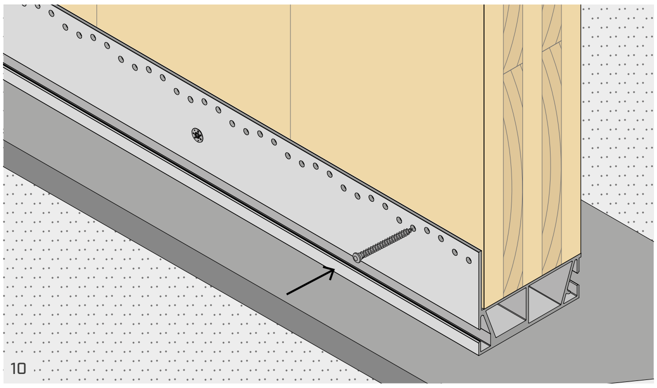
Insert the concrete anchors following the anchor installation instructions.



Removal of JIG START templates, which can be reused.



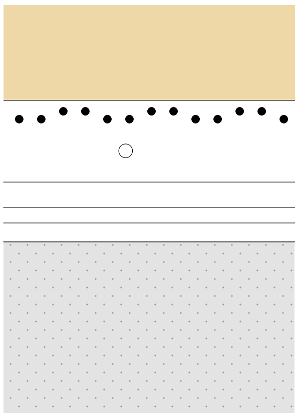
Positioning of the walls using Ø6 or Ø8 screws to bring the panel closer to the aluminium profile.



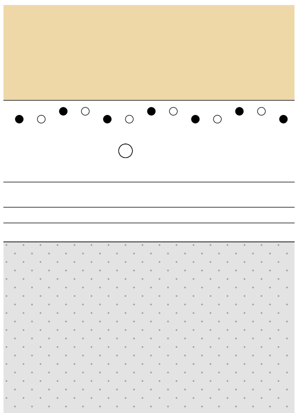
Profiles fastening with nails or screws.

PARTIAL FASTENING PATTERNS

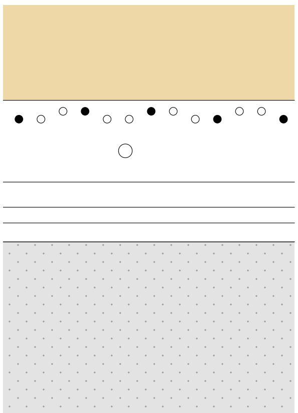
It is possible to apply partial nailing patterns according to the design and installation requirements of the walls.



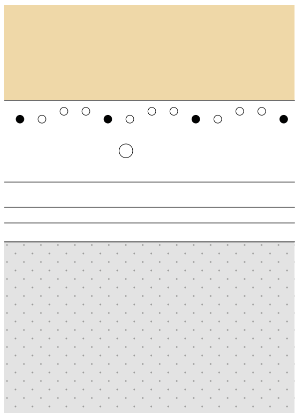
TOTAL FASTENING*



PATTERN 1



PATTERN 2



PATTERN 3

* This pattern is not suitable for solid timber/glulam in the presence of shear loads $F_{2/3}$.

pattern	fastening holes Ø5		
	type	Ø x L [mm]	n_v [pcs/m]
total	LBA LBS	Ø4 x 60 Ø5 x 50	71
pattern 1			35
pattern 2			23
pattern 3			17

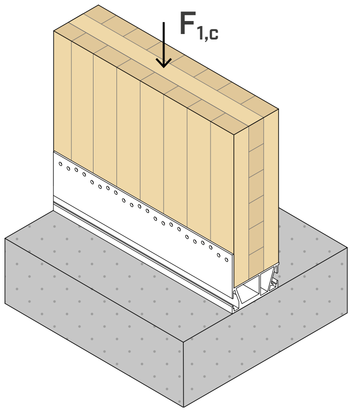
STRUCTURAL VALUES | TIMBER-TO-CONCRETE | $F_{1,c}$

It is possible to cut the profiles according to the design requirements; profiles with length less than 600 mm are to be considered for compressive strength only.

STRENGTH ON ALUMINIUM SIDE

configuration	reference width [mm]	γ_{alu}	ALUMINIUM $R_{1,c,k}$ [kN/m]	ALUMINIUM $\rho_{1,c,Rk}$ [MPa]
ALUSTART35	-	γ_{M1}	**88,8**	**2,5**
ALUSTART80	80		**504,2**	**6,3**
ALUSTART100	100		**630,2**	**6,3**
ALUSTART120	120		**961,1**	**8,0**
ALUSTART100 + ALUSTART35	135		**719,0**	**6,3(1) + 2,5(2)**
ALUSTART120 + ALUSTART35	155		**1049,9**	**8,0(1) + 2,5(2)**
ALUSTART175	175		**1540,6**	**8,8**
ALUSTART120 + 2x ALUSTART35	190		**1138,7**	**8,0(1) + 2,5(2)**
ALUSTART175 + ALUSTART35	210		**1629,4**	**8,8(1) + 2,5(2)**
ALUSTART175 + 2x ALUSTART35	245		**1718,2**	**8,8(1) + 2,5(2)**

(1) Value referred to the main profile.
(2) Value referred to ALUSTART35 extension.



For walls of different widths to the reference width, the compression strength of the aluminium profile can be calculated by multiplying the parameter $\rho_{1,c,Rk}$ by the actual width of the wall.

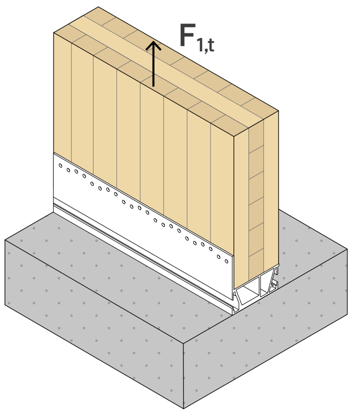
For example, for a wall thickness of 140 mm, the ALUSTART100 profile coupled with ALUSTART35 will be used. Accordingly, $R_{1,c,k}$ is calculated as follows:
$R_{1,c,k} = 6{,}30 \cdot 100 + 2{,}54 \cdot 35 = 719$ kN/m

The compression strength of the timber wall should be calculated by the designer according to EN 1995:2014.

STRUCTURAL VALUES | TIMBER-TO-CONCRETE | $F_{1,t}$

STRENGTH ON TIMBER-TO-ALUMINIUM SIDE

profile	pattern	CLT $R_{1,t\ k\ timber}$ [kN/m]	C/GL $R_{1,t\ k\ timber}$ [kN/m]	ALUMINIUM $R_{1,t\ k\ alu}$ [kN/m]	ALUMINIUM γ_{alu}	CONCRETE $k_{t,\ overall}$	$K_{1,t\ ser}$ [N/mm · 1/m]
ALUSTART80	total	**130,0**	**108,0**	102	γ_{M1}	1,88	7200
	pattern 1	**64,5**	**53,0**				
	pattern 2	**42,0**	**36,5**				
	pattern 3	**31,0**	**26,0**				
ALUSTART100	total	**130,0**	**108,0**			1,62	
	pattern 1	**64,5**	**53,0**				
	pattern 2	**42,0**	**35,0**				
	pattern 3	**31,0**	**26,0**				
ALUSTART120	total	**130,0**	**108,0**			1,44	
	pattern 1	**64,5**	**53,0**				
	pattern 2	**42,0**	**35,0**				
	pattern 3	**31,0**	**26,0**				
ALUSTART175	total	**130,0**	**108,0**			1,23	
	pattern 1	**64,5**	**53,0**				
	pattern 2	**42,0**	**35,0**				
	pattern 3	**31,0**	**26,0**				



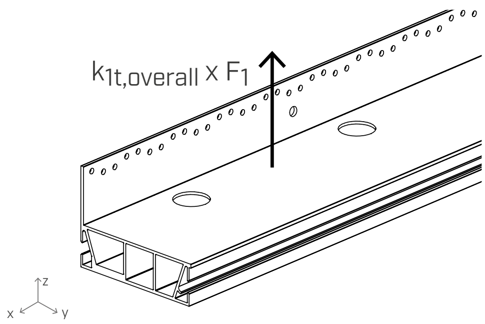
• C/GL: solid timber or glulam.
The installation of the ALUSTART35 extension, or the presence of a grout layer up to 30 mm with minimum class M10, do not affect the values in the table.

CONCRETE STRENGTH

profile	configuration on concrete	holes fixing Ø12 type	holes fixing Ø12 Ø x L [mm]	total fastening 5 anchors/m $R_{1,t\,d\,concrete}$ [kN/m]	partial fastening 2,5 anchors/m $R_{1,t\,d\,concrete}$ [kN/m]
ALUSTART80	uncracked	VIN-FIX 5.8/8.8	M12 x 140	48,6	24,3
		HYB-FIX 8.8	M12 x 140	86,5	43,3
		SKR	12 x 90	28,1	14,1
		AB1	M12 x 100	49,2	24,6
	cracked	VIN-FIX 5.8/8.8	M12 x 195	38,9	19,5
		HYB-FIX 8.8	M12 x 195	70,2	35,1
		SKR	12 x 90	15,2	7,6
		AB1	M12 x 100	31,5	15,7
	seismic	EPO-FIX 8.8	M12 x 195	42,4	21,2
ALUSTART100	uncracked	VIN-FIX 5.8/8.8	M12 x 140	56,4	28,2
		HYB-FIX 8.8	M12 x 120	100,4	50,2
		SKR	12 x 90	32,6	16,3
		AB1	M12 x 100	57,0	28,5
	cracked	VIN-FIX 5.8/8.8	M12 x 195	45,2	22,6
		HYB-FIX 8.8	M12 x 195	81,5	40,7
		SKR	12 x 90	17,7	8,8
		AB1	M12 x 100	36,5	18,3
	seismic	EPO-FIX 8.8	M12 x 195	49,2	24,6
ALUSTART120	uncracked	VIN-FIX 5.8/8.8	M12 x 140	63,5	31,7
		HYB-FIX 8.8	M12 x 120	113,0	56,5
		SKR	12 x 90	36,7	18,3
		AB1	M12 x 100	64,2	32,1
	cracked	VIN-FIX 5.8/8.8	M12 x 195	50,8	25,4
		HYB-FIX 8.8	M12 x 195	91,7	45,8
		SKR	12 x 90	19,9	10,0
		AB1	M12 x 100	41,1	20,5
	seismic	EPO-FIX 8.8	M12 x 195	55,3	27,7
ALUSTART175	uncracked	VIN-FIX 5.8/8.8	M12 x 140	74,3	37,2
		HYB-FIX 8.8	M12 x 120	132,3	66,1
		SKR	12 x 90	43,0	21,5
		AB1	M12 x 100	75,1	37,6
	cracked	VIN-FIX 5.8/8.8	M12 x 195	59,5	29,7
		HYB-FIX 8.8	M12 x 195	107,3	53,7
		SKR	12 x 90	23,3	11,7
		AB1	M12 x 100	48,1	24,1
	seismic	EPO-FIX 8.8	M12 x 195	64,8	32,4

ANCHORS VERIFICATION FOR STRESS LOADING $F_{1,t}$

Fastening elements to the concrete through anchors shall be verified according to the load acting on the anchor, which can be evaluated through the tabulated geometric parameters (k_t).



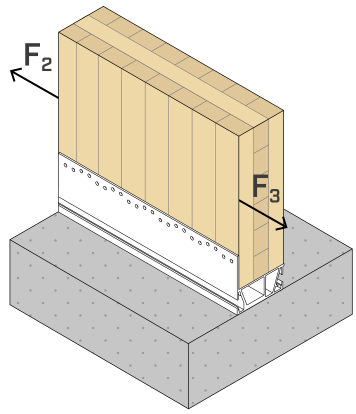
The anchor group must be verified for:

$N_{Ed,z,bolts} = F_{1,t} \times k_{1,t,overall}$

STRUCTURAL VALUES | TIMBER-TO-CONCRETE | $F_{2/3}$

STRENGTH ON TIMBER-TO-ALUMINIUM SIDE

		CLT	C/GL	CONCRETE		
profile	pattern	$R_{2/3,k\ timber}$ [kN/m]		e_y [mm]	e_z [mm]	$K_{2/3,ser}$ [N/mm · 1/m]
ALUSTART80	total	112,4	-	29,5	80,5	12000
	pattern 1	55,4	44,7			8000
	pattern 2	36,4	29,4			4000
	pattern 3	26,9	21,7			3000
ALUSTART100	total	112,4	-			12000
	pattern 1	55,4	44,7			8000
	pattern 2	36,4	29,4			4000
	pattern 3	26,9	21,7			3000
ALUSTART120	total	105,9	-			12000
	pattern 1	52,2	42,1			8000
	pattern 2	34,3	27,7			4000
	pattern 3	25,3	20,4			3000
ALUSTART175	total	90,2	-			12000
	pattern 1	44,4	35,8			8000
	pattern 2	29,2	23,6			4000
	pattern 3	21,6	17,4			3000



• C/GL: solid timber or glulam
The installation of the ALUSTART35 extension, or the presence of a grout layer up to 30 mm with minimum class M10, do not affect the values in the table.

CONCRETE STRENGTH

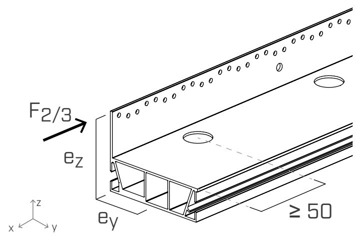
			total fastening 5 anchors/m	partial fastening 2,5 anchors/m
configuration on concrete	fastening holes Ø12 type	Ø x L [mm]	$R_{2/3,d\ concrete}$ [kN/m]	
uncracked	VIN-FIX 5.8	M12 x 140	**94,0**	**47,0**
	VIN-FIX 8.8	M12 x 140	**129,0**	**64,5**
	SKR	12 x 90	**83,0**	**41,5**
	AB1	M12 x 100	**94,6**	**50,3**
cracked	VIN-FIX 5.8	M12 x 195	**94,0**	**47,0**
	VIN-FIX 8.8	M12 x 195	**106,0**	**53**
	HYB-FIX 8.8	M12 x 195	**129,0**	**64,5**
	SKR	12 x 90	**54,2**	**27,1**
	AB1	M12 x 100	**94,6**	**50,5**
seismic	EPO-FIX 8.8	M12 x 195	**51,2**	**25,6**

ANCHORS VERIFICATION FOR STRESS LOADING $F_{2/3}$

Fastening to concrete using alternative anchors must be verified on the basis of the load acting on the anchors, which depend on the fastening configuration. In order to consider an anchor as a reagent it is necessary that the distance of the anchor from the profile edge is at least 50 mm.

The anchor group must be verified for:

$V_{Ed,x,bolts} = F_{2/3}$
$M_{Ed,z,bolts} = F_{2/3,d} \times e_y$
$M_{Ed,x,bolts} = F_{2/3,d} \times e_z$



In which $F_{2/3,d}$ represents the shear stress acting on the ALU START connector.
The check is satisfied if the design shear strength of the anchor group is greater than the design stress: $R_{2/3,d\ concrete} \geq F_{2/3,d}$.

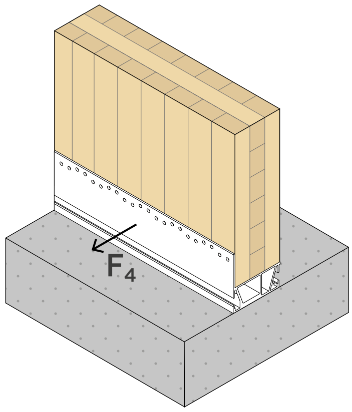
STRUCTURAL VALUES | TIMBER-TO-CONCRETE | F_4

STRENGTH ON TIMBER-TO-ALUMINIUM SIDE

	ALUMINIUM		CONCRETE	
profile	$R_{4,k\ alu}$ [kN/m]	γ_{alu}	$k_{4t,\ overall}$	$K_{4,ser}$ [N/mm · 1/m]
ALUSTART*	**100**	γ_{M1}	1,84	27000

* valid for all profiles.

The installation of the ALUSTART35 extension, or the presence of a grout layer up to 30 mm with minimum class M10, do not affect the values in the table.



SHEAR STRENGTH ON CONCRETE SIDE

configuration on concrete	fastening holes Ø12 type	fastening holes Ø12 Ø x L [mm]	total fastening 5 anchors/m $R_{4,d\ concrete}$ [kN/m]	partial fastening 2,5 anchors/m $R_{4,d\ concrete}$ [kN/m]
uncracked	VIN-FIX 5.8	M12 x 140	**48,6**	**24,3**
	HYB-FIX 8.8	M12 x 120	**83,3**	**41,7**
	SKR	12 x 90	**28,3**	**14,2**
	AB1	M12 x 100	**48,5**	**24,3**
cracked	VIN-FIX 5.8	M12 x 195	**38,9**	**19,5**
	HYB-FIX 8.8	M12 x 195	**67,7**	**33,8**
	SKR	12 x 90	**17,5**	**8,8**
	AB1	M12 x 100	**31,7**	**15,8**
seismic	EPO-FIX 8.8	M12 x 195	**33,1**	**16,5**

ANCHORS VERIFICATION FOR STRESS LOADING F_4

Fastening to concrete using alternative anchors must be verified on the basis of the load acting on the anchors, which depend on the fastening configuration.

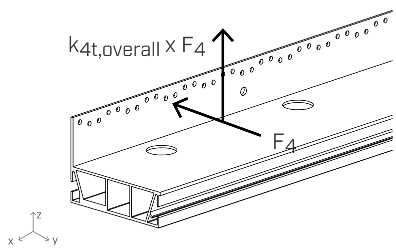
The anchor group must be verified for:

$V_{Ed,y,bolts} = F_{4,Ed}$

$N_{Ed,z,bolts} = F_{4,Ed} \times k_{4t,overall}$

In which $F_{4,d}$ represents the shear stress acting on the ALU START connector.

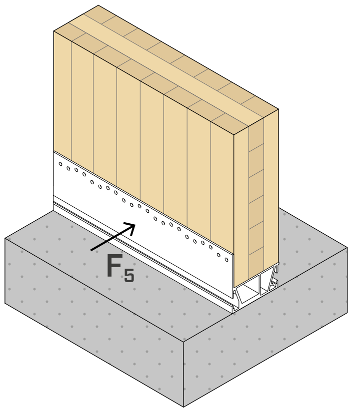
The check is satisfied if the design shear strength of the anchor group is greater than the design stress: $R_{4,d} \geq F_{4,d}$.



STRUCTURAL VALUES | TIMBER-TO-CONCRETE | F_5

STRENGTH ON TIMBER-TO-ALUMINIUM SIDE

		CLT	C/GL	CONCRETE	
profile	**pattern**	$R_{5,k\ timber}$ [kN/m]		$k_{5t,overall}$	$K_{5,ser}$ [N/mm · 1/m]
ALUSTART80	total	**25,8**	**23,9**	1,83	5500
	pattern 1	**25,8**	**23,9**		
	pattern 2	**18,9**	**23,9**		
	pattern 3	**13,5**	**19,6**		
ALUSTART100	total	**25,8**	**23,9**	1,53	
	pattern 1	**25,8**	**23,9**		
	pattern 2	**18,9**	**23,9**		
	pattern 3	**13,5**	**19,6**		
ALUSTART120	total	**25,8**	**23,9**	1,39	
	pattern 1	**25,8**	**23,9**		
	pattern 2	**18,9**	**23,9**		
	pattern 3	**13,5**	**19,6**		
ALUSTART175	total	**25,8**	**23,9**	1,28	
	pattern 1	**25,8**	**23,9**		
	pattern 2	**18,9**	**23,9**		
	pattern 3	**13,5**	**19,6**		



• C/GL: solid timber or glulam.
The installation of the ALUSTART35 extension, or the presence of a grout layer up to 30 mm with minimum class M10, do not affect the values in the table.

CONCRETE STRENGTH

			total fastening 5 anchors/m	**partial fastening** 2,5 anchors/m
configuration on concrete	**fastening holes Ø12** **type**	**Ø x L** [mm]	$R_{5,d\ concrete}$ [kN/m]	
uncracked	VIN-FIX 5.8	M12 x 140	**48,6**	**24,3**
	HYB-FIX 8.8	M12 x 120	**83,3**	**41,7**
	SKR	12 x 90	**28,3**	**14,2**
	AB1	M12 x 100	**48,5**	**24,3**
cracked	VIN-FIX 5.8	M12 x 195	**38,9**	**19,5**
	HYB-FIX 8.8	M12 x 195	**67,7**	**33,8**
	SKR	12 x 90	**17,5**	**8,8**
	AB1	M12 x 100	**31,7**	**15,8**
seismic	EPO-FIX 8.8	M12 x 195	**33,1**	**16,5**

* $k_{5t,overall}$ was assumed to be 1,83 for safety reasons.

ANCHORS VERIFICATION FOR STRESS LOADING F_5

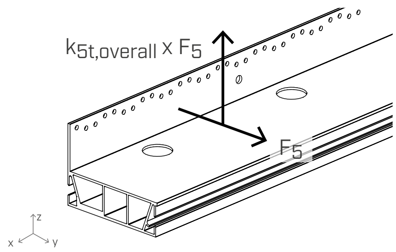
Fastening to concrete using alternative anchors must be verified on the basis of the load acting on the anchors, which depend on the fastening configuration.

The anchor group must be verified for:

$V_{Ed,y,bolts} = F_{5,Ed}$
$N_{Ed,z,bolts} = F_{5,Ed} \times k_{5t,overall}$

In which $F_{5,d}$ represents the shear stress acting on the ALU START connector.

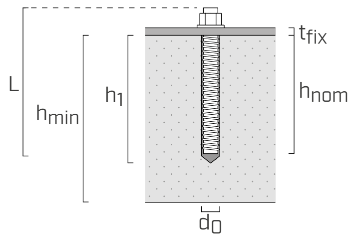
The check is satisfied if the design shear strength of the anchor group is greater than the design stress: $R_{5,d} \geq F_{5,d}$.



ANCHORS INSTALLATION PARAMETERS

profile	anchor type		t_{fix}	h_{ef}	h_{nom}	h_1	d_0	h_{min}
	type	Ø x L [mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
ALU START*	VIN-FIX 5.8	M12 x 140	7	115	115	120	14	200
	VIN-FIX 8.8	M12 x 140	7	115	115	120	14	
	HYB-FIX 8.8	M12 x 140	7	115	115	120	14	
	SKR	12 x 90	7	64	83	105	10	
	AB1	M12 x 100	7	70	80	85	12	
	VIN-FIX 5.8	M12 x 195	7	165	165	170	14	
	VIN-FIX 8.8	M12 x 195	7	165	165	170	14	
	HYB-FIX 8.8	M12 x 195	7	165	165	170	14	
	EPO-FIX 8.8	M12 x 195	7	170	170	175	14	

Precut INA threaded rod, with nut and washer: see page 562.
MGS threaded rod class 8.8 to be cut to size: see page 174.
* The values in the table are valid for all ALU START profiles.



t_{fix} fastened plate thickness
h_{nom} nominal anchoring depth
h_{ef} effective anchoring depth
h_1 minimum hole depth
d_0 hole diameter in the concrete support
h_{min} concrete minimum thickness

ALUSTART | COMBINED STRESSES

With regard to timber and aluminium, it is possible to combine the effect of the different actions through the following expressions:

$$\left(\frac{F_{1,t,Ed}}{R_{1,t,d}}\right)^2 + \left(\frac{F_{2/3,Ed}}{R_{2/3,d}}\right)^2 + \left(\frac{F_{4,Ed}}{R_{4,d}}\right)^2 \leq 1$$

$$\left(\frac{F_{1,t,Ed}}{R_{1,t,d}}\right)^2 + \left(\frac{F_{2/3,Ed}}{F_{2/3,d}}\right)^2 + \left(\frac{F_{5,Ed}}{R_{5,d}}\right)^2 \leq 1$$

Regarding checks on the anchor side, the results of the loads must be applied to the group of anchors, following the indications of the diagrams relating to each load direction.

GENERAL PRINCIPLES

- Characteristic values comply with the EN 1995:2014 standard in accordance with ETA-20/0835.
- The design values of the anchors for concrete are calculated in accordance with the respective European Technical Assessments.
- Design values can be obtained from characteristic values as follows:

$$R_{1,c,d} = \frac{R_{1,c,k}}{\gamma_{alu}} \cdot l$$

$$R_{1,t,d} = min \begin{cases} \dfrac{R_{1,t,k\ timber} \cdot k_{mod}}{\gamma_M} \cdot l \\ \dfrac{R_{1,t,k\ alu}}{\gamma_{alu}} \cdot l \\ R_{1,t,d\ concrete} \cdot l^* \end{cases}$$

$$R_{2/3,d} = min \begin{cases} \dfrac{R_{2/3,k\ timber}\ k_{mod}}{\gamma_M} \cdot l \\ \dfrac{R_{2/3,k\ alu}}{\gamma_{alu}} \cdot l \\ R_{2/3,d\ concrete} \cdot l^* \end{cases}$$

$$R_{4,d} = min \begin{cases} \dfrac{R_{4,k\ alu}}{\gamma_{alu}} \cdot l \\ R_{4,d\ concrete} \cdot l^* \end{cases}$$

$$R_{5,d} = min \begin{cases} \dfrac{R_{5,k\ timber} \cdot k_{mod}}{\gamma_M} \cdot l \\ R_{5,d\ concrete} \cdot l^* \end{cases}$$

The dimension l is the length of the profile used, to be used in metres in the formulas. The minimum length is 600 mm, except in the case where the profile is subject to compression.

The dimension l* is the length of the profile used approximated to the lower multiple of 200 mm, to be used in metres in the formulas. The minimum length is 600 mm.

E.g. l = 680 mm   l*= 600 mm

- The calculation process used a timber characteristic density of ρ_k=350 kg/m^3 for timber and ρ_k=385 kg/m^3 for CLT of timber C24. A C25/30 class concrete with a thin reinforcement and minimum thickness indicated in the table has been considered.
- Dimensioning and verification of timber and concrete elements must be carried out separately.
- The strength values on the concrete side are valid for the calculation hypothesis defined in the respective tables; for boundary conditions different from the ones in the table (e.g. minimum distances from the edge, lower number of anchors/m), the anchors-to-concrete can be verified using MyProject calculation software according to the design requirements.

The anchors seismic design was carried out in performance category C2, without ductility requirements on anchors (option a2) elastic design according to EN 1992:2018, with α_{sus}= 0,6. For chemical anchors it is assumed that the annular space between the anchor and the plate hole is filled (α_{gap} = 1).

- The product ETAs for the anchors used in the concrete-side strength calculation are indicated below:
  - VIN-FIX chemical anchor according to ETA-20/0363;
  - HYB-FIX chemical anchor according to ETA-20/1285;
  - EPO-FIX chemical anchor according to ETA-23/0419;
  - SKR screw-in anchor according to ETA-24/0024;
  - AB1 mechanical anchor according to ETA-17/0481 (M12).

INTELLECTUAL PROPERTY

- An ALU START model is protected by the Registered Community Design RCD 008254353-0002.