ALU START

VIDEO

ETA-20/0835

ALUMINIUM SYSTEM FOR THE CONNECTION OF BUILDINGS TO THE GROUND

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 specific ETA.

RISE 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.

CHARACTERISTICS

FOCUS	raising and levelling of CLT and TIMBER FRAME panels	
WIDTH	up to 270 mm	*up to 10 5/8 in*
STRENGTH	in all stress directions	
FASTENERS	LBA, LBS, SKR-E, AB1, VIN-FIX, HYB-FIX	

VIDEO

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

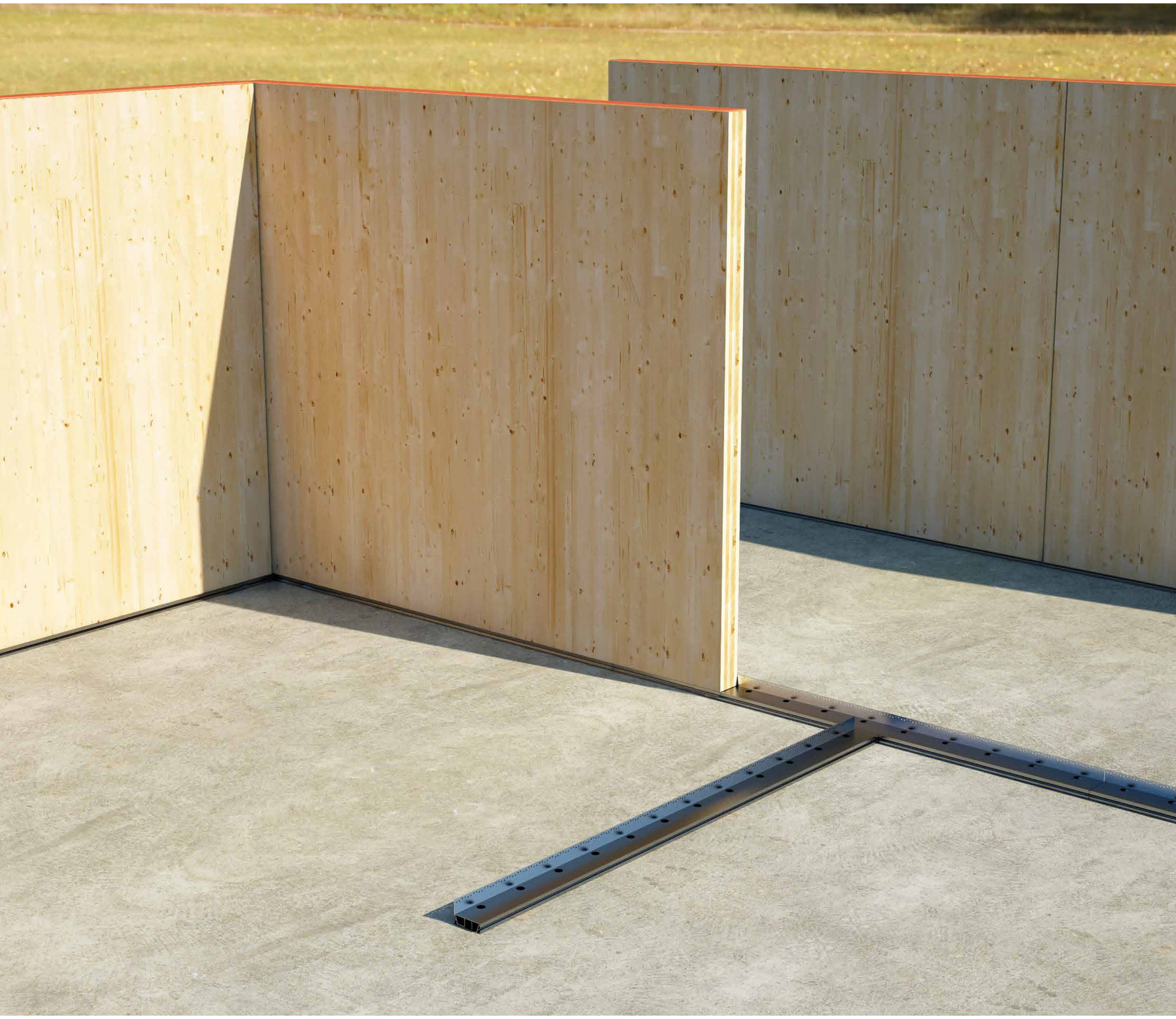
MATERIAL

Aluminium alloy three dimensional perforated plate.

FIELDS OF USE

Connection to the ground of timber buildings with riser from the foundation and levelling of the supporting surface

- CLT walls
- TIMBER FRAME walls



DURABILITY

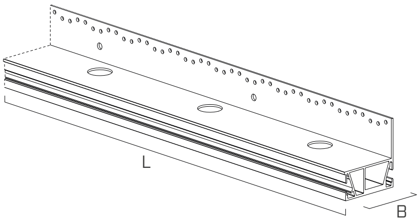
Thanks to the rise from the foundation and the aluminium material, the building base is protected against capillary rising. The ground connection provides durability and health to the structure.

CERTIFIED STRENGTH

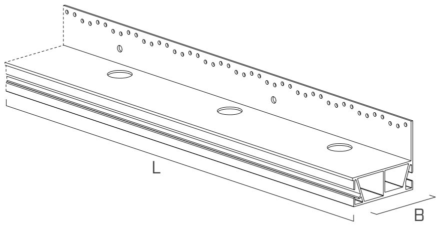
Thanks to the side flange, the profile can be fastened to the timber wall by means of nails or screws which guarantee excellent strength in all directions certified by CE marking according to ETA.

CODES AND DIMENSIONS

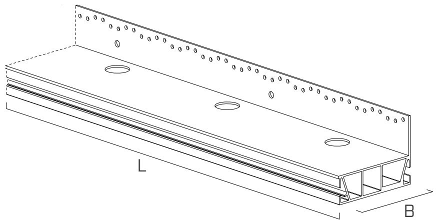
ALU START



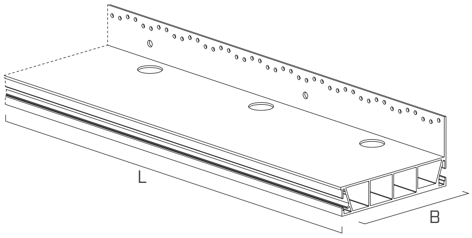
ALUSTART80



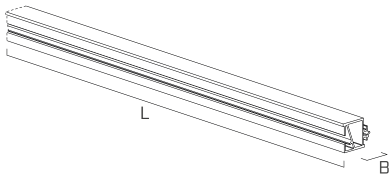
ALUSTART100



ALUSTART120



ALUSTART175



ALUSTART35

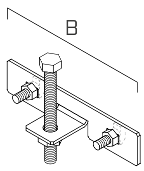
CODE	B		L			pcs
	[mm]	*[in]*	[mm]	*[ft]*		
ALUSTART80	80	*3.15*	2400	*7.87*	●	1
ALUSTART100	100	*3.94*	2400	*7.87*	●	1
ALUSTART120	120	*4.72*	2400	*7.87*	●	1
ALUSTART175	175	*6.89*	2400	*7.87*	●	1
ALUSTART35 *	35	*1.38*	2400	*7.87*	●	1

* Lateral extension for ALUSTART profiles.

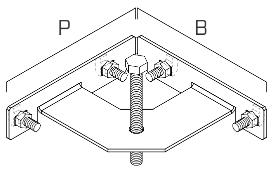
ASSEMBLY ACCESSORIES - JIG START TEMPLATES

CODE	description	B		P		pcs
		[mm]	*[in]*	[mm]	*[in]*	
JIGSTARTI	levelling template for linear joint	160	*6.30*	-	-	25
JIGSTARTL	levelling template for angle joint	160	*6.30*	160	*6.30*	10

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



JIGSTARTI

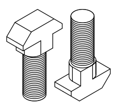


JIGSTARTL

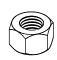
COMPLEMENTARY PRODUCTS

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

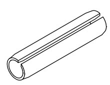
ALUSBOLT and ALUSPIN can be ordered separately from the templates as spare parts.



ALUSBOLT



MUT93410



ALUSPIN

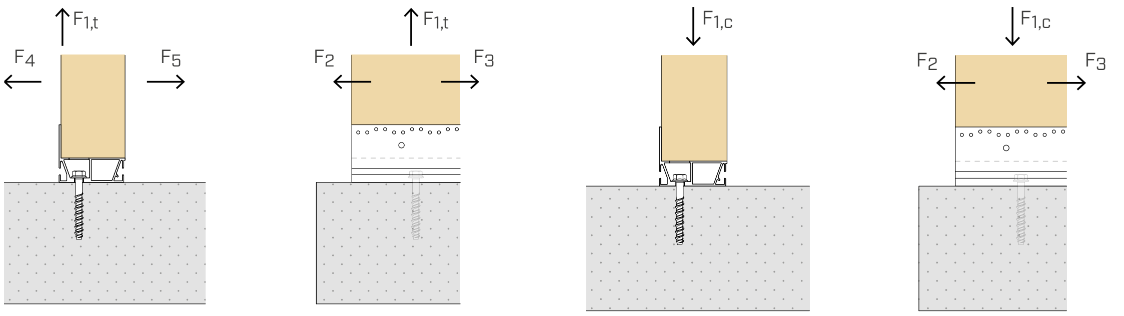
MATERIAL AND DURABILITY

ALU START: EN AW-6060 aluminium alloy.
To be used in service classes 1 and 2 (EN 1995-1-1)

FIELD OF USE

CLT/TIMBER FRAME wall joints - foundation

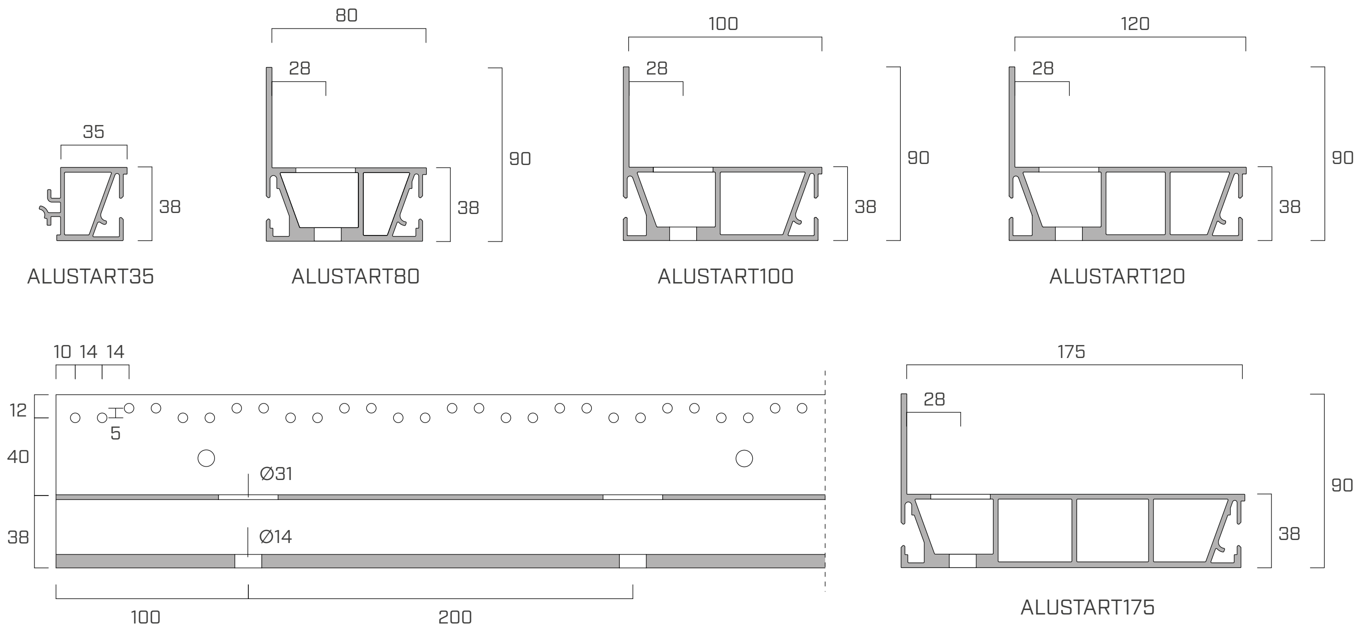
EXTERNAL LOADS



ADDITIONAL PRODUCTS - FASTENING

type	description	d [mm]	support
LBA	Anker nail	4	
LBS	screw	5	
SKR-E	screw mechanical anchor	12	
AB1	expansion mechanical anchor	M12	
VIN-FIX	chemical anchor	M12	
HYB-FIX	chemical anchor	M12	

GEOMETRY



CODE	B [mm]	B [in]	H [mm]	H [in]	L [mm]	L [ft]	n_V Ø5 [pcs]	n_H Ø14 [pcs]
ALUSTART80	80	*3.15*	90	*3.54*	2400	*7.87*	171	12
ALUSTART100	100	*3.94*	90	*3.54*	2400	*7.87*	171	12
ALUSTART120	120	*4.72*	90	*3.54*	2400	*7.87*	171	12
ALUSTART175	175	*6.89*	90	*3.54*	2400	*7.87*	171	12
ALUSTART35	35	*1.38*	38	*1.50*	2400	*7.87*	-	-

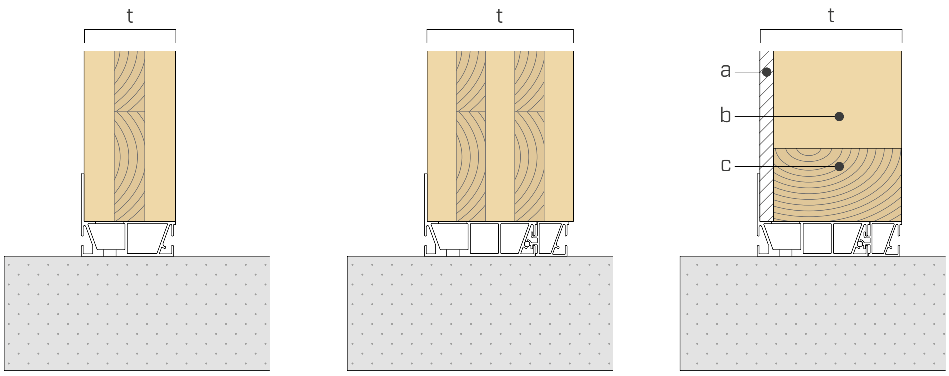
INSTALLATION | TIMBER

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 TIMBERFRAME walls.

The use of the lateral extension ALUSTART35 allows its use with CLT and TIMBER FRAME walls having greater thickness.

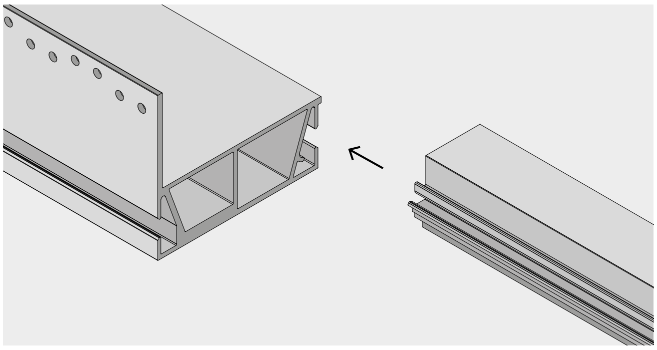


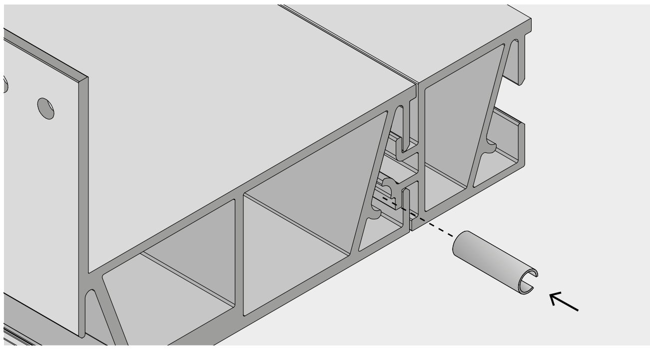
a. bracing sheet

b. strut

c. abeam

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
ALUSTART80	80 mm | *3.15 in*	-	95 mm | *3.74 in*
ALUSTART100	100 mm | *3.94 in*	90 mm | *3.54 in*	115 mm | *4.53 in*
ALUSTART120	120 mm | *4.72 in*	115 mm | *4.53 in*	135 mm | *5.31 in*
ALUSTART100 + ALUSTART35	135 mm | *5.31 in*	135 mm | *5.31 in*	155 mm | *6.10 in*
ALUSTART120 + ALUSTART35	155 mm | *6.10 in*	155 mm | *6.10 in*	175 mm | *6.89 in*
ALUSTART175	175 mm | *6.89 in*	155 mm | *6.10 in*	195 mm | *7.68 in*
ALUSTART120 + 2 x ALUSTART35	190 mm | *7.48 in*	180 mm | *7.09 in*	215 mm | *8.46 in*
ALUSTART175 + ALUSTART35	210 mm | *8.27 in*	195 mm | *7.68 in*	235 mm | *9.25 in*
ALUSTART175 + 2 x ALUSTART35	245 mm | *9.65 in*	235 mm | *9.25 in*	270 mm | *10.63 in*

INSTALLATION | TIMBER

NAILING

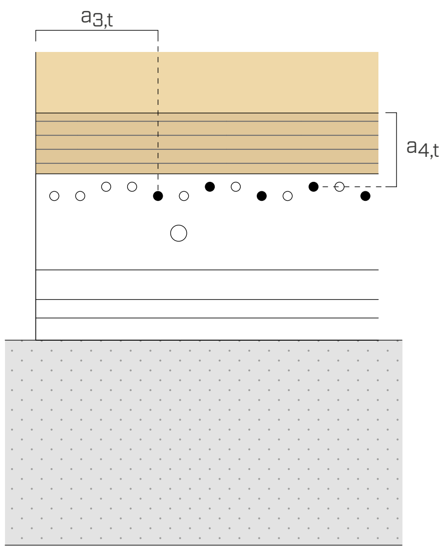
ALU START profiles can be used for different building systems (CLT / TIMBER FRAME).
Depending on the construction technology, different nailings can be used in accordance with the minimum distances.

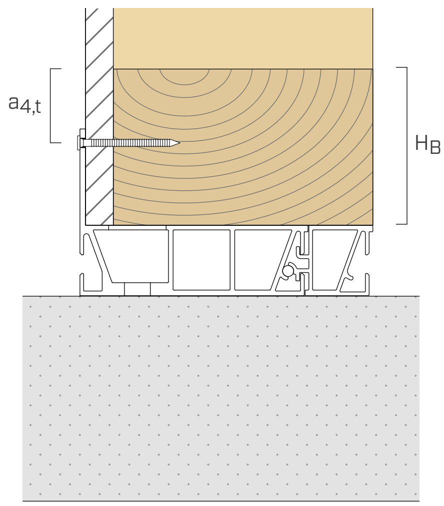
MINIMUM DISTANCES

TIMBER minimum distances			nails LBA Ø4	screws LBS Ø5
C/GL	$a_{4,t}$	[mm]	≥28 mm | *1.10 in*	-
	H_B	[mm]	≥73 mm | *2.87 in*	-
	$a_{3,t}$	[mm]	≥60 mm | *2.36 in*	-
CLT	$a_{4,t}$	[mm]	≥28 mm | *1.10 in*	≥30 mm | *1.18 in*

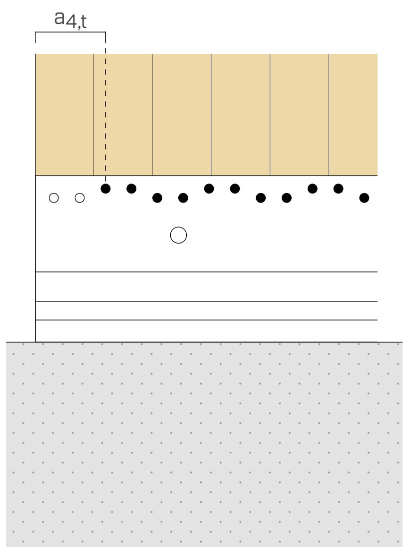
- C/GL: minimum distances for solid timber or glulam consistent with EN 1995-1-1 according to ETA considering a timber density $\rho_k \leq 420$ kg/m^3.
- CLT minimum distances for Cross Laminated Timber according to ÖNORM EN 1995-1-1 (Annex K) for nails and ETA 11/0030 for screws.

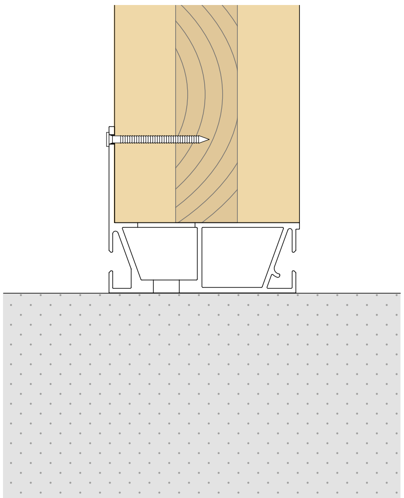
MINIMUM DISTANCES FOR NAILING ON SOLID TIMBER (C) OR GLULAM (GL)





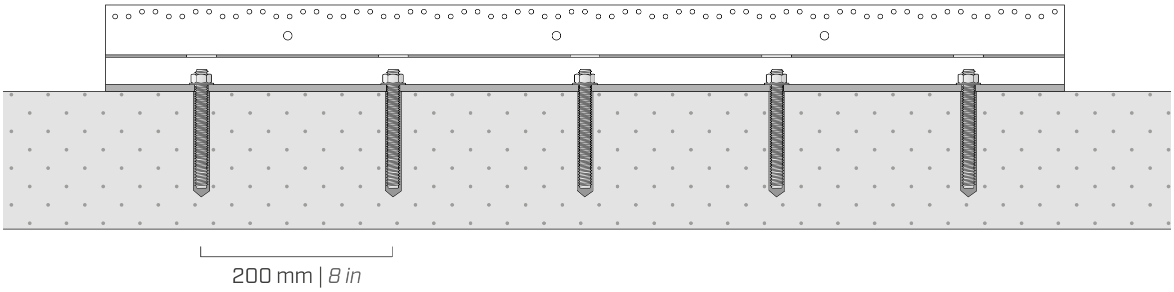
MINIMUM DISTANCES FOR NAILING ON CLT

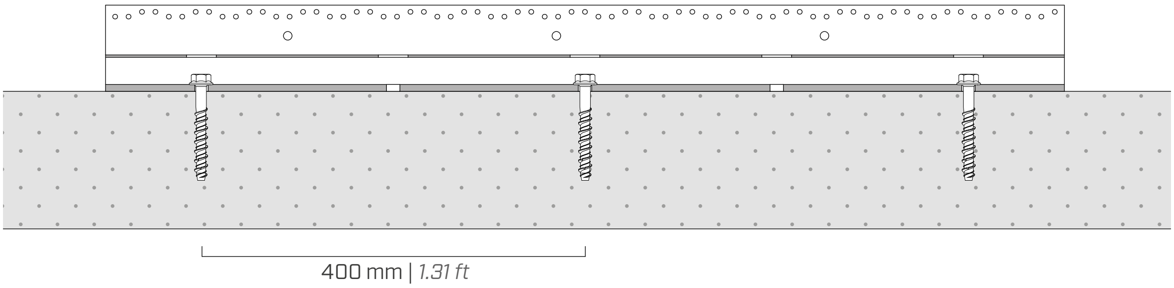




INSTALLATION | CONCRETE

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.





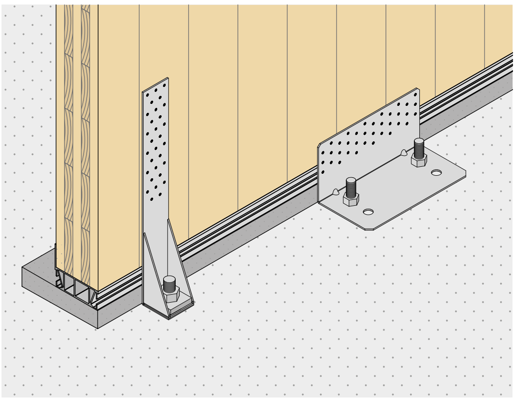
Details of the assembly phase in the "POSITIONING" section.

ADDITIONAL CONNECTION SYSTEMS

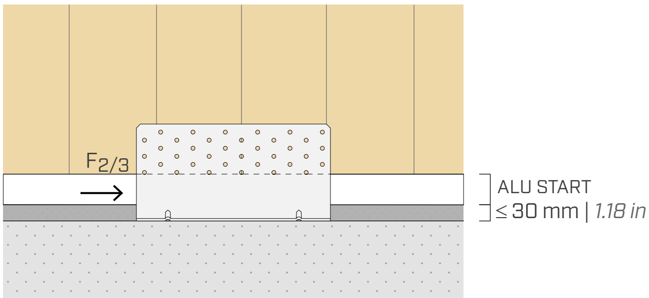
The ALU START geometry allows using additional connection systems such as TITAN TCN and WHT, even with a levelling layer between the profile and the foundation.

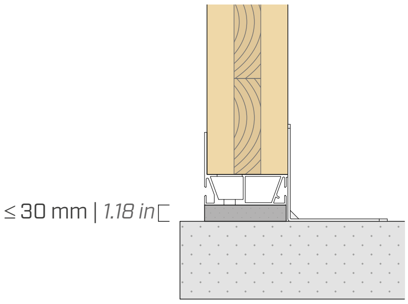
Certified partial nailings are available for TITAN TCN installation which allow laying bedding mortar with a thickness up to 30 mm.

For the structural values and nailing of the TITAN TCN angle brackets and the WHT hold downs, see the respective technical data sheets on the website.



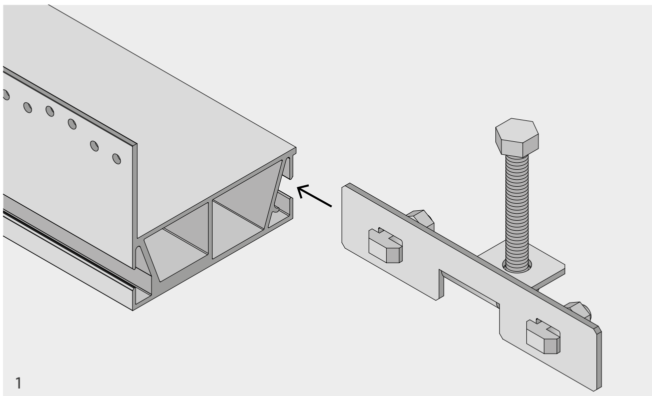
EXAMPLE OF INSTALLATION WITH TITAN TCN240

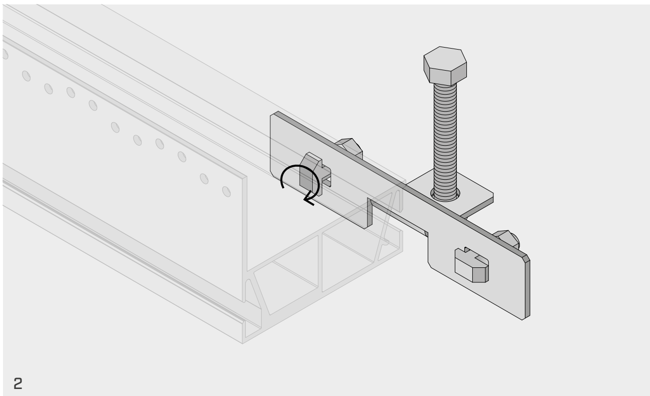


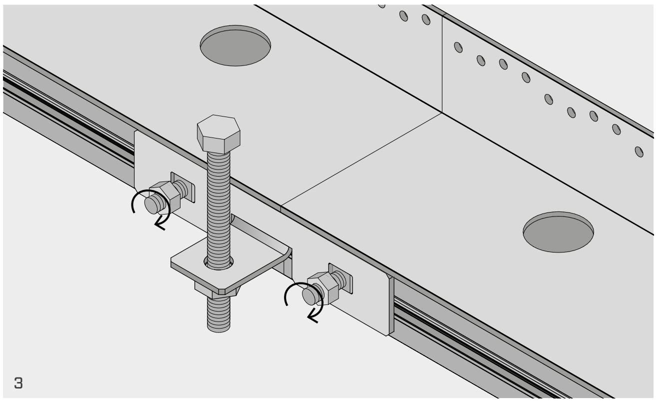


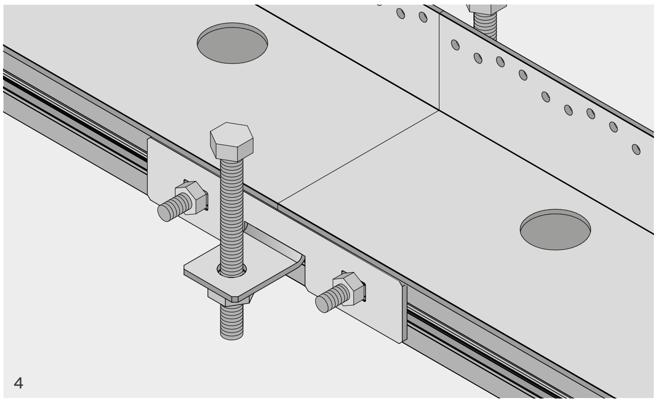
POSITIONING

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.

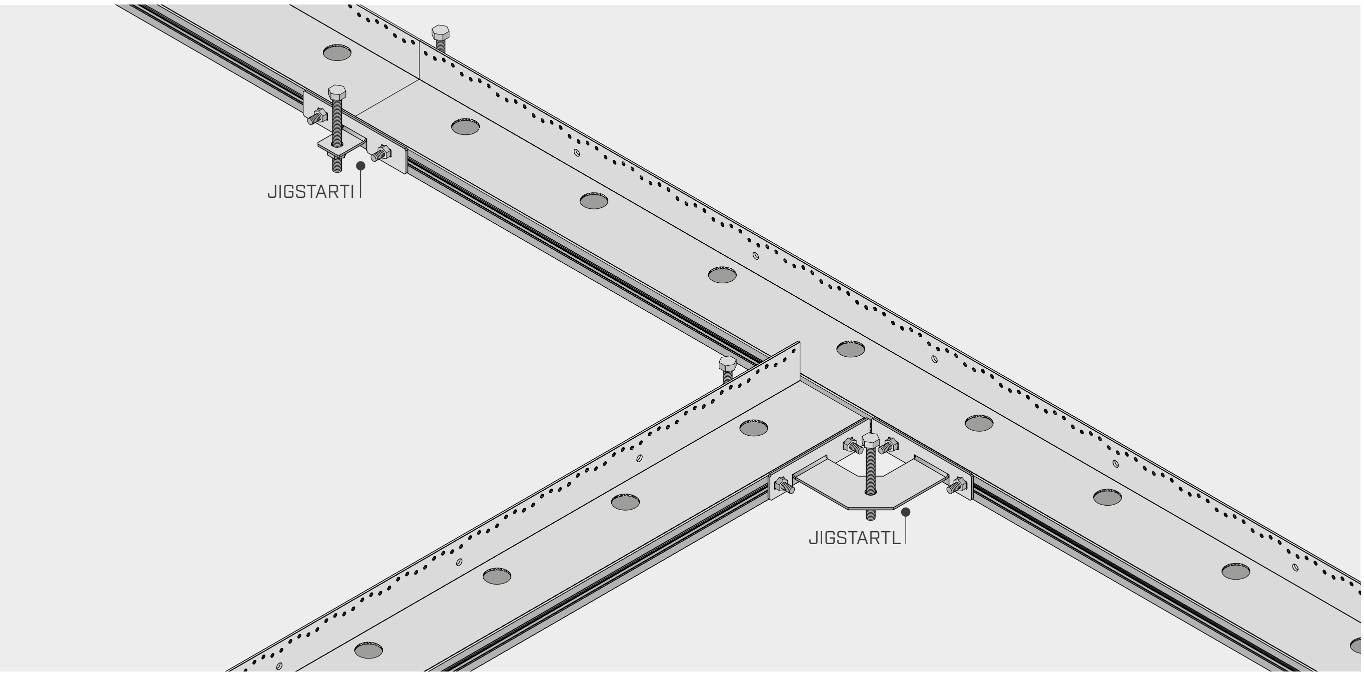






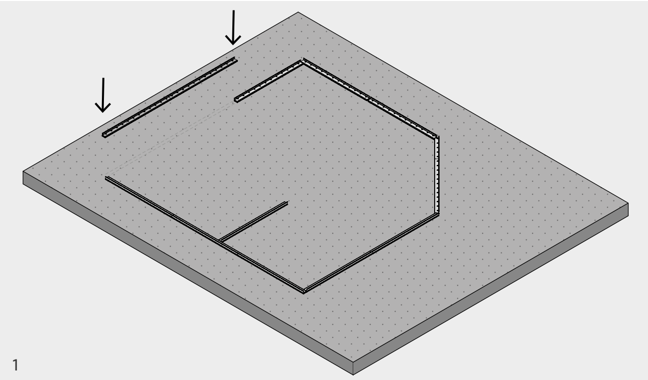


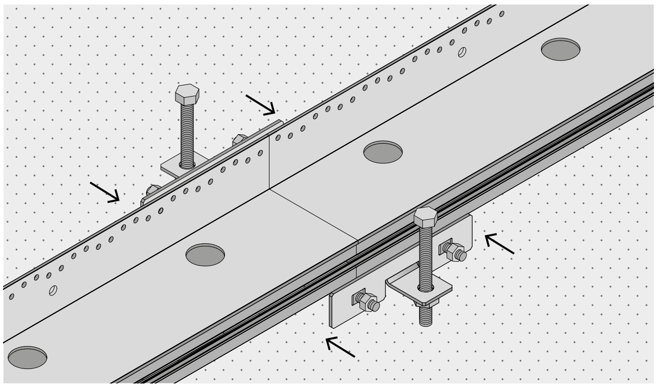
JIGSTARTI templates can connect two consecutive profiles and must be positioned on both sides of ALUSTART, without positioning constraints along the development.
JIGSTARTL templates can be used for 90° angle connection.
On each template there is a hexagonal head bolt, which allows the height adjustment of the aluminium profiles.



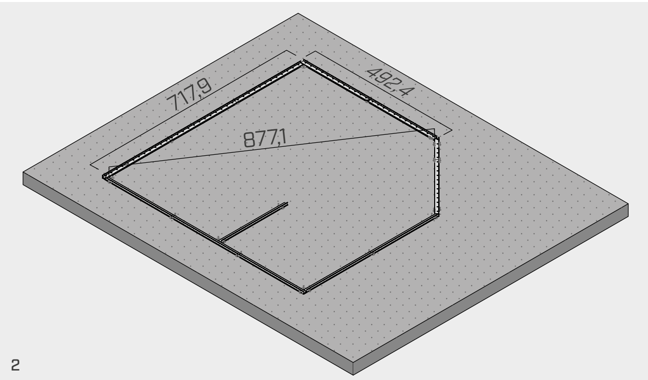
ASSEMBLY

VIDEO

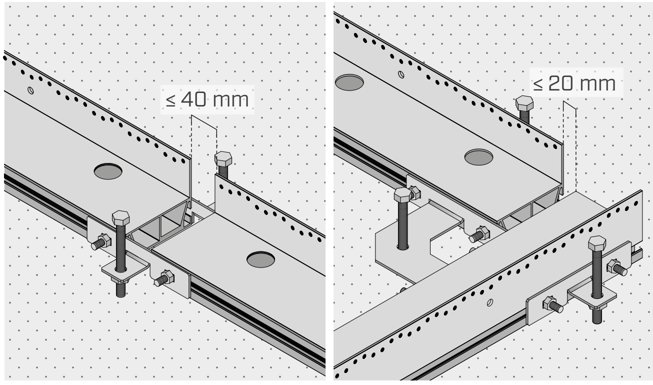




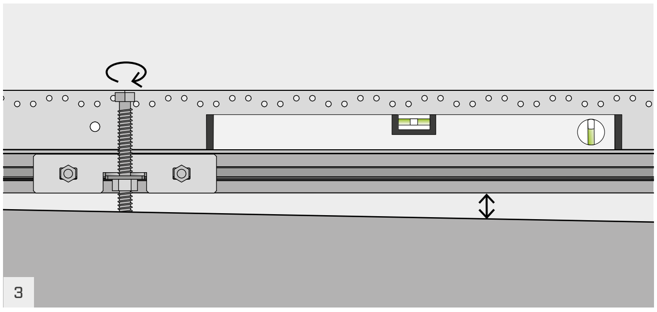
Preliminary positioning of the profiles on the laying surface using the templates and cutting the elements to size, if necessary.



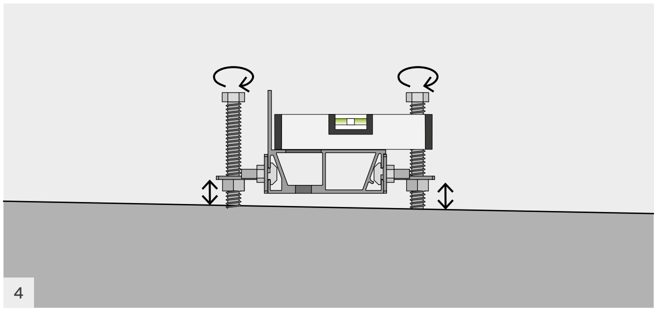
Definitive planimetric drawing with verification of lengths and diagonals.



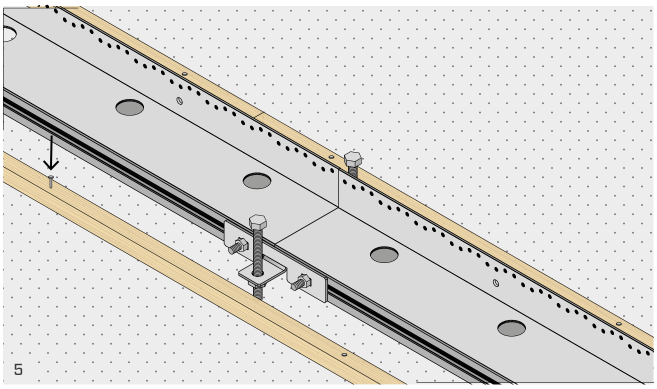
Fine adjustment with JIG START templates of the total length of the wall, compensating the tolerances of the profiles cut to size.



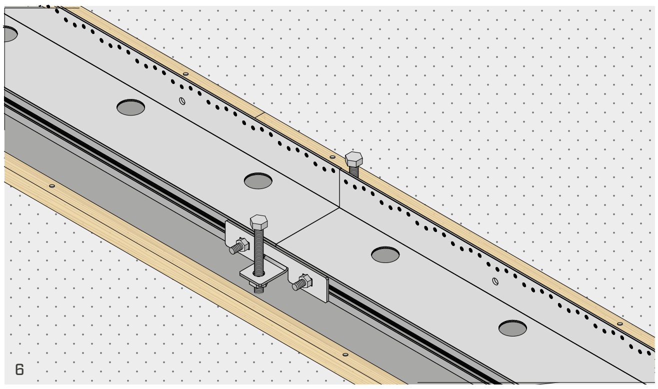
Longitudinal levelling of ALU START rods.



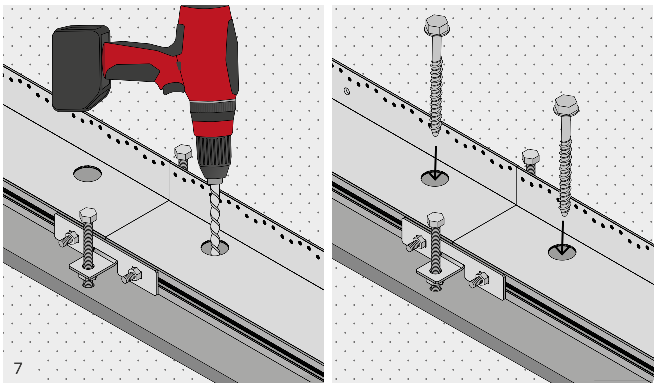
Lateral levelling of the rods.



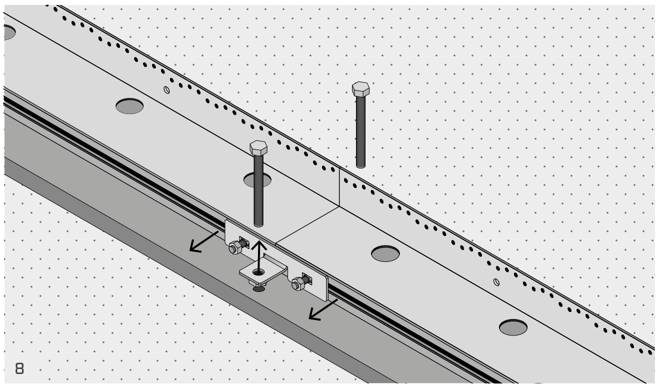
Construction of formwork with timber battens.



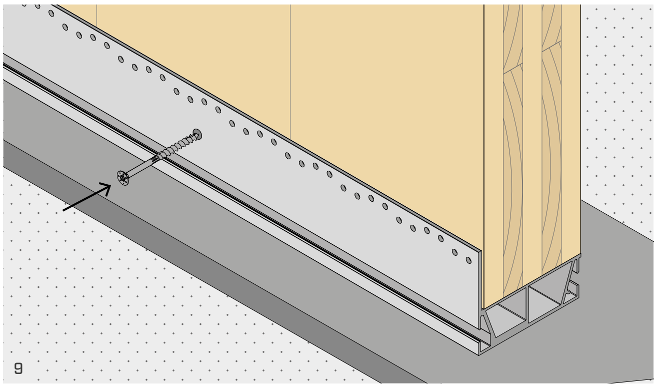
Creation of the bedding layer between the profile and the concrete support.



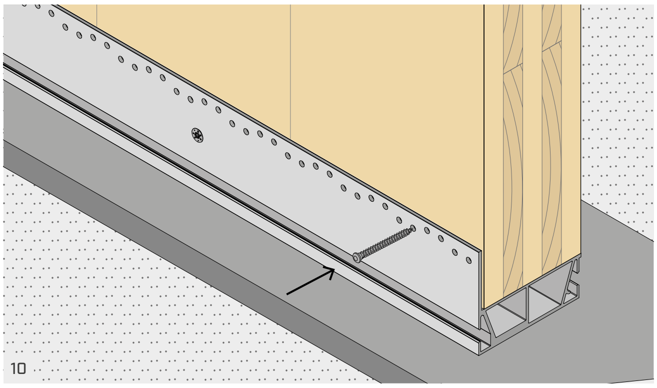
Insert the concrete anchors following the anchor installation instructions.



Removal of JIG START templates, which can be reused.



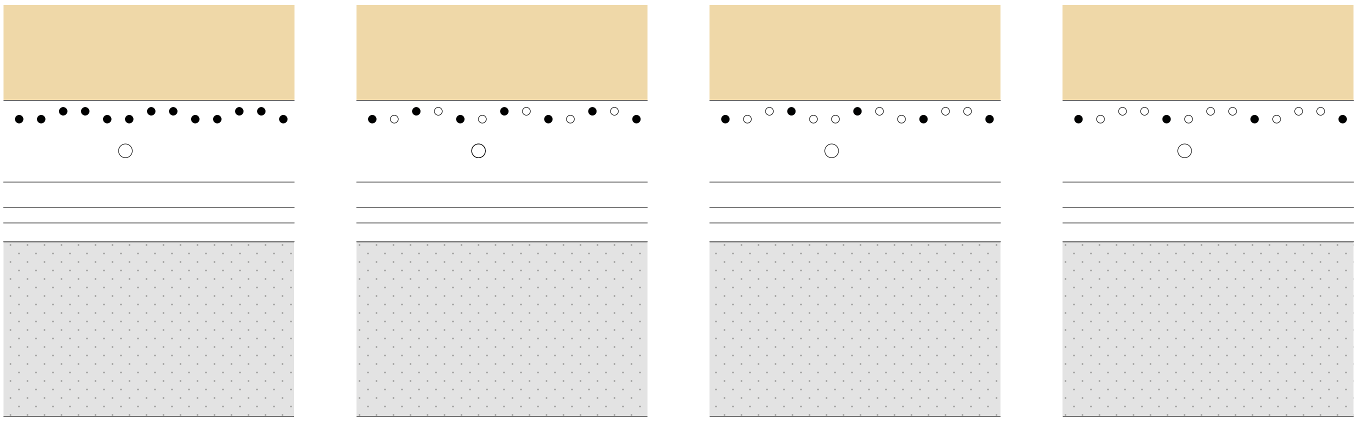
Positioning of the walls using Ø6 or Ø8 screws to bring the panel closer to the aluminium profile.



Profiles fastening with nails or screws.

ALUSTART | 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 use on solid timber/glulam in the presence of shear loads $F_{2/3}$.

nailing pattern	holes fastening Ø5		
	type	Ø x L [mm]	n_v [pcs/m]
Total fastening	LBA nails screws LBS	Ø4,0 x 60 Ø5,0 x 50	71
Pattern 1			35
Pattern 2			23
Pattern 3			17

STRUCTURAL VALUES | COMPRESSION JOINTS $F_{1,c}$

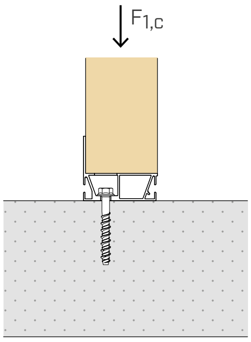
It is possible to cut the profiles according to the design requirements; profiles with length less than 600 mm | *1.97 ft* are to be considered for compressive strength only.

COMPRESSION STRENGTH $F_{1,c}$ ON ALUMINIUM SIDE

configuration	reference width [mm]	ALUMINIUM γ_{alu}	$R_{1,c,k}$ [kN/m]	$\rho_{1,c,Rk}$ [MPa]
ALUSTART35	-	γ_{M1}	**88,8**	**2,54**
ALUSTART80	80		**504,2**	**6,3**
ALUSTART100	100		**630,2**	**6,3**
ALUSTART120	120		**961,1**	**8,01**
ALUSTART100 + ALUSTART35	135		**719,0**	**6,30(1) + 2,54(2)**
ALUSTART120 + ALUSTART35	155		**1049,9**	**8,01(1) + 2,54(2)**
ALUSTART175	175		**1540,6**	**8,8**
ALUSTART120 + 2 x ALUSTART35	190		**1138,7**	**8,01(1) + 2,54 (2)**
ALUSTART175 + ALUSTART35	210		**1629,4**	**8,8(1) + 2,54(2)**
ALUSTART175 + 2 x ALUSTART35	245		**1718,2**	**8,8(1) + 2,54(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.

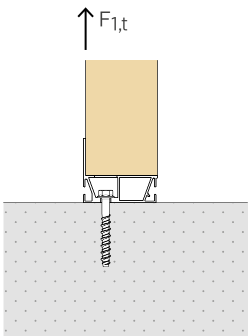
For example, for a 140 wall, ALUSTART100 + ALUSTART35 profile is selected.
$R_{1,c,k}$ = 6,30*100 + 2,54*35 = 719 kN

The compression strength of the timber wall should be calculated by the designer according to EN1995-1-1.

STRUCTURAL VALUES | TENSILE JOINT $F_{1,t}$

TENSILE STRENGTH $F_{1,t}$ ON TIMBER-TO-ALUMINIUM SIDE

F_1		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 $k_{t,\ overall}$	RIGIDITY $K_{1,t,ser}$ [N/mm * 1/m]
ALUSTART80	Total	**130**	**108**	102	γ_{M1}	1,88	7200
	Pattern 1	**64,5**	**53**				
	Pattern 2	**42**	**36,5**				
	Pattern 3	**31**	**26**				
ALUSTART100	Total	**130**	**108**			1,62	
	Pattern 1	**64,5**	**53**				
	Pattern 2	**42**	**35**				
	Pattern 3	**31**	**26**				
ALUSTART120	Total	**130**	**108**			1,44	
	Pattern 1	**64,5**	**53**				
	Pattern 2	**42**	**35**				
	Pattern 3	**31**	**26**				
ALUSTART175	Total	**130**	**108**			1,23	
	Pattern 1	**64,5**	**53**				
	Pattern 2	**42**	**35**				
	Pattern 3	**31**	**26**				



The installation of the ALUSTART35 extension, or the presence of a mortar layer up to 30 mm | *1.18 in* with minimum class M10, do not affect the values in the table.

TENSILE STRENGTH $F_{1,t}$ ON CONCRETE SIDE

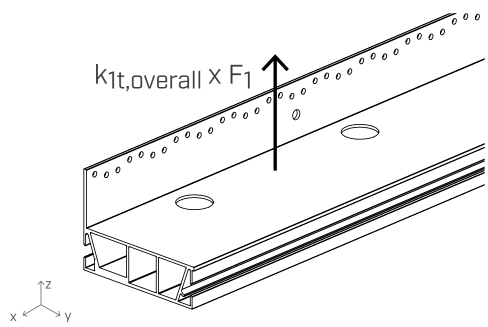
	configuration on concrete	holes fixing Ø12 type	Ø x L [mm]	total fastening 5 anchors/m $R_{1,t,d\ concrete}$ [kN/m]	partial fastening 2,5 anchors/m $R_{1,t,d\ concrete}$ [kN/m]
ALUSTART80	• uncracked	VIN-FIX 5.8	M12 x 130	43,0	21,5
		VIN-FIX 8.8	M12 x 120	40,4	20,2
		HYB-FIX 8.8	M12 x 120	73,0	36,5
		SKR-E	12 x 90	35,0	17,5
		AB1	M12 x 100	49,2	24,6
	• cracked	VIN-FIX 5.8	M12 x 180	35,8	17,9
		VIN-FIX 8.8	M12 x 190	39,4	19,7
		HYB-FIX 8.8	M12 x 190	71,0	35,5
		SKR-E	12 x 90	12,7	6,3
		AB1	M12 x 100	31,5	15,7
	• seismic	HYB-FIX 8.8	M12 x 190	28,1	14,1
ALUSTART100	• uncracked	VIN-FIX 5.8	M12 x 130	49,8	24,9
		VIN-FIX 8.8	M12 x 120	46,9	23,4
		HYB-FIX 8.8	M12 x 120	84,8	42,4
		SKR-E	12 x 90	40,6	20,3
		AB1	M12 x 100	57,0	28,5
	• cracked	VIN-FIX 5.8	M12 x 180	41,6	20,8
		VIN-FIX 8.8	M12 x 190	45,7	22,9
		HYB-FIX 8.8	M12 x 190	82,4	41,2
		SKR-E	12 x 90	14,7	7,4
		AB1	M12 x 100	36,5	18,3
	• seismic	HYB-FIX 8.8	M12 x 190	32,6	16,3
ALUSTART120	• uncracked	VIN-FIX 5.8	M12 x 130	56,1	28,0
		VIN-FIX 8.8	M12 x 120	52,7	26,4
		HYB-FIX 8.8	M12 x 120	95,4	47,7
		SKR-E	12 x 90	45,7	22,9
		AB1	M12 x 100	64,2	32,1
	• cracked	VIN-FIX 5.8	M12 x 180	46,8	23,4
		VIN-FIX 8.8	M12 x 190	51,4	25,7
		HYB-FIX 8.8	M12 x 190	92,7	46,4
		SKR-E	12 x 90	16,6	8,3
		AB1	M12 x 100	41,1	20,5
	• seismic	HYB-FIX 8.8	M12 x 190	36,7	18,3
ALUSTART175	• uncracked	VIN-FIX 5.8	M12 x 130	65,7	32,8
		VIN-FIX 8.8	M12 x 120	61,7	30,9
		HYB-FIX 8.8	M12 x 120	111,7	55,8
		SKR-E	12 x 90	53,5	26,8
		AB1	M12 x 100	75,1	37,6
	• cracked	VIN-FIX 5.8	M12 x 180	54,7	27,4
		VIN-FIX 8.8	M12 x 190	60,2	30,1
		HYB-FIX 8.8	M12 x 190	108,5	54,3
		SKR-E	12 x 90	19,4	9,7
		AB1	M12 x 100	48,1	24,1
	• seismic	HYB-FIX 8.8	M12 x 190	43,0	21,5

DIMENSIONING OF ALTERNATIVE ANCHORS | $F_{1,t}$

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

The anchor group must be verified for:

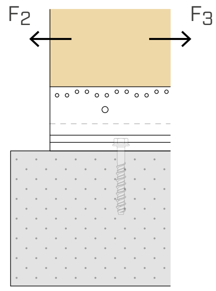
$N_{Ed,z,bolts} = F_{1,t} \times k_{1,t,overall}$



STRUCTURAL VALUES | SHEAR JOINT $F_{2/3}$

SHEAR STRENGTH $F_{2/3}$ ON TIMBER-TO-ALUMINIUM SIDE

		CLT	C/GL	CONCRETE		RIGIDITY
$F_{2/3}$		$R_{2/3,k\ timber}$ [kN/m]		e_y [mm]	e_z [mm]	$K_{1,t,ser}$ [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



The installation of the ALUSTART35 extension, or the presence of a mortar layer up to 30 mm | *1.18 in* with minimum class M10, do not affect the values in the table.

SHEAR STRENGTH $F_{2/3}$ ON CONCRETE SIDE

			total fastening 5 anchors/m	**partial fastening** 2,5 anchors/m
configuration on concrete	**holes fastening Ø12** **type**	**Ø x L** [mm]	$R_{2/3,d\ concrete}$ [kN/m]	
• uncracked	**VIN-FIX 5.8**	M12 x 130	**94,0**	**47,0**
	VIN-FIX 8.8	M12 x 120	**108,0**	**54,0**
	HYB-FIX 8.8	M12 x 120	**129,0**	**64,5**
	SKR-E	12 x 90	**102,2**	**53,6**
	AB1	M12 x 100	**94,6**	**50,3**
• cracked	**VIN-FIX 5.8**	M12 x 180	**94,0**	**47,0**
	VIN-FIX 8.8	M12 x 190	**105,0**	**52,0**
	HYB-FIX 8.8	M12 x 190	**129,0**	**64,5**
	SKR-E	12 x 90	**51,7**	**38,6**
	AB1	M12 x 100	**94,6**	**50,3**
• seismic	**HYB-FIX 8.8**	M12 x 190	**45,0**	**22,5**

DIMENSIONING OF ALTERNATIVE ANCHORS | $F_{2/3}$

Fastening to concrete using alternative anchors must be verified on the basis of the stressing forces of 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:

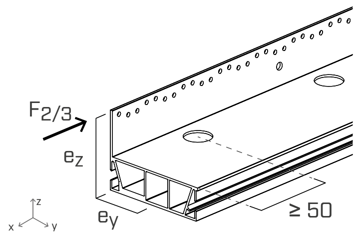
$V_{Ed,x,bolts} = F_{2/3}$

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

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

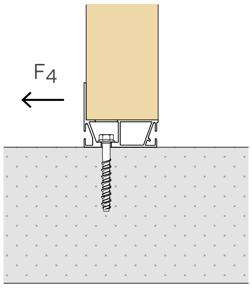
with $F_{2/3,d}$ = shear stress acting on the ALU START connector

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 | SHEAR JOINT F_4

SHEAR STRENGTH F_4 ON TIMBER-TO-ALUMINIUM SIDE



	ALUMINIUM		CONCRETE	RIGIDITY
F_4	$R_{4,k\ alu}$ [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 mortar layer up to 30 mm | *1.18 in* with minimum class M10, do not affect the values in the table.

SHEAR STRENGTH F_4 ON CONCRETE SIDE

configuration on concrete	holes fastening Ø12 type	holes fastening 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 130	**42,9**	**21,5**
	VIN-FIX 8.8	M12 x 120	**40,0**	**20,0**
	HYB-FIX 8.8	M12 x 120	**70,3**	**35,2**
	SKR-E	12 x 90	**35,8**	**17,9**
	AB1	M12 x 100	**48,5**	**24,3**
• cracked	**VIN-FIX 5.8**	M12 x 180	**35,8**	**17,9**
	VIN-FIX 8.8	M12 x 190	**39,2**	**19,6**
	HYB-FIX 8.8	M12 x 190	**68,3**	**34,2**
	SKR-E	12 x 90	**12,8**	**6,4**
	AB1	M12 x 100	**31,7**	**15,8**
• seismic	**HYB-FIX 8.8**	M12 x 190	**21,9**	**11,0**

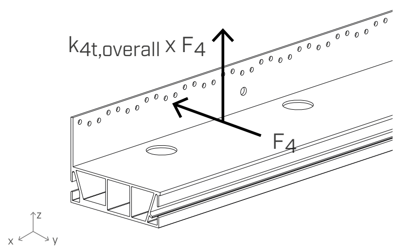
DIMENSIONING OF ALTERNATIVE ANCHORS FOR STRESS F_4

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

The anchor group must be verified for:

$V_{Ed,y,bolts} = F_{4,Ed}$
$N_{Ed,z,bolts} = F_{4,Ed} \times k_{4t,overall}$
with $F_{4,d}$ = shear stress acting on the ALUSTART connector

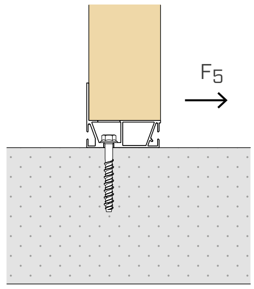
The check is satisfied if the design shear strength of the anchor group is greater than the design stress $R_{4,d} \geq F_{4,d}$.



STRUCTURAL VALUES | SHEAR JOINT F_5

SHEAR STRENGTH F_5 ON TIMBER-TO-ALUMINIUM SIDE

		CLT	C/GL	CONCRETE	RIGIDITY
F_5		$R_{5,k\ timber}$ [kN/m]		$k_{5t,overall}$	$K_{5,ser}$ [N/mm * 1/m]
ALUSTART80	Total	**25,8**	**23,9**	1,83	5500
	Pattern 1				
	Pattern 2	**18,9**			
	Pattern 3	**13,5**	**19,6**		
ALUSTART100	Total	**25,8**	**23,9**	1,53	
	Pattern 1				
	Pattern 2	**18,9**			
	Pattern 3	**13,5**	**19,6**		
ALUSTART120	Total	**25,8**	**23,9**	1,39	
	Pattern 1				
	Pattern 2	**18,9**			
	Pattern 3	**13,5**	**19,6**		
ALUSTART175	Total	**25,8**	**23,9**	1,28	
	Pattern 1				
	Pattern 2	**18,9**			
	Pattern 3	**13,5**	**19,6**		



The installation of the ALUSTART35 extension, or the presence of a mortar layer up to 30 mm | *1.18 in* with minimum class M10, do not affect the values in the table.

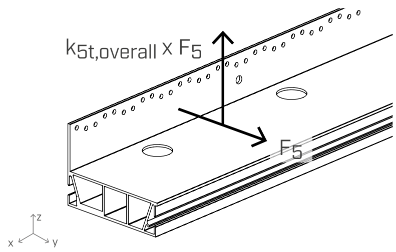
SHEAR STRENGTH F_5 ON CONCRETE SIDE

			total fastening 5 anchors/m	**partial fastening** 2,5 anchors/m
configuration on concrete	**type**	**holes fastening Ø12** **Ø x L** [mm]	$R_{5,d\ concrete}$ [kN/m]	
• **uncracked**	**VIN-FIX 5.8**	M12 x 130	**42,9**	**21,5**
	VIN-FIX 8.8	M12 x 120	**40,0**	**20,0**
	HYB-FIX 8.8	M12 x 120	**70,3**	**35,2**
	SKR-E	12 x 90	**35,8**	**17,9**
	AB1	M12 x 100	**48,5**	**24,3**
• **cracked**	**VIN-FIX 5.8**	M12 x 180	**35,8**	**17,9**
	VIN-FIX 8.8	M12 x 190	**39,2**	**19,6**
	HYB-FIX 8.8	M12 x 190	**68,3**	**34,2**
	SKR-E	12 x 90	**12,8**	**6,4**
	AB1	M12 x 100	**31,7**	**15,8**
• **seismic**	**HYB-FIX 8.8**	M12 x 190	**21,9**	**11,0**

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

DIMENSIONING OF ALTERNATIVE ANCHORS FOR STRESS F_5

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



The anchor group must be verified for:

$V_{Ed,y,bolts} = F_{5,Ed}$

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

with $F_{5,d}$ = shear stress acting on the ALUSTART 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

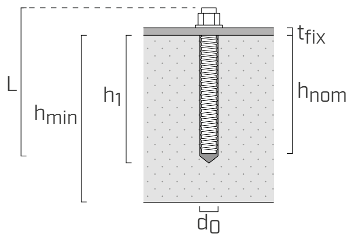
installation	anchor type		t_{fix}	h_{ef}	h_{nom}	h_1	d_0	h_{min}
	type	Ø x L [mm]	[mm]	[mm]	[mm]	[mm]	[mm]	[mm]
ALU START*	VIN-FIX 5.8	M12 x 130 (1)	7	102	102	110	14	200
	VIN-FIX 8.8	M12 x 120 (2)	7	96	96	105	14	
	SKR-E	12 x 90	7	64	83	105	10	
	AB1	M12 x 100	7	70	80	85	12	
	VIN-FIX 5.8	M12 x 180 (3)	7	152	152	160	14	
	VIN-FIX 8.8 HYB-FIX 8.8	M12 x 190 (2)	7	167	167	175	14	

(1) INA12130 threaded rods: see the plates catalogue, page 520.

(2) MGS11288 threaded rods to be cut to size: see the plates catalogue, page 534.

(3) INA12180 threaded rods: see the plates catalogue, page 520.

* Valid for all profiles.



t_{fix} fastened plate thickness
h_{nom} nominal anchoring depth
h_{ef} effective anchor 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 according to EN 1995-1-1.
  The design values of the anchors for concrete are calculated in accordance with the respective European Technical Assessments.

  The connection design strength values are obtained from the values on the table 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 hypotheses 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 EOTA TR45/EN 1992-4, 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).