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Authorised and notified according to Article 29 of the Regulation (EU) No 305/2011 of the European Parliament and of the Council of 9 March 2011

MEMBER OF EOTA

European Technical Assessment ETA-23/0824 of 2025/08/20

I General Part

Technical Assessment Body issuing the ETA and designated according to Article 29 of the Regulation (EU) No 305/2011: ETA-Danmark A/S

Trade name of the construction product:	Rotho Blaas ALUMEGA connectors
Product family to which the above construction product belongs:	Three-dimensional nailing plate (Joist bearings)
Manufacturer:	ROTHO BLAAS s.r.l. Via dell'Adige 2/1 IT-39040 Cortaccia (BZ) Tel. + 39 0471 818400 Internet www.rothoblaas.com
Manufacturing plant:	ROTHO BLAAS s.r.l. Held on file by ETA-Danmark A/S
This European Technical Assessment contains:	48 pages including 3 annexes which form an integral part of the document
This European Technical Assessment is issued in accordance with Regulation (EU) No 305/2011, on the basis of:	EAD 130186-00-0603 for Three-dimensional nailing plates
This version replaces:	The ETA with the same number issued on 2023-11-21

II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

1 Technical description of product

Rotho Blaas ALUMEGA connectors are two-piece, face-fixed joist bearings to be used in timber to timber or timber to concrete or steel connections.

ALUMEGA connectors are made from aluminium alloy EN AW-6082 T6 according to EN 573-3:2009. Dimensions, hole positions and typical installations are shown in Annexes A and C.

2 Specification of the intended use in accordance with the applicable European Assessment document (hereinafter EAD)

ALUMEGA connectors are intended for use in making end-grain to side-grain connections in load bearing timber structures, as a connection between a wood based joist and a solid timber or wood based header or column as well as connections between a timber joist and a concrete structure or a steel member, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Works Requirements 1 and 4 of Regulation (EU) 305/2011 shall be fulfilled.

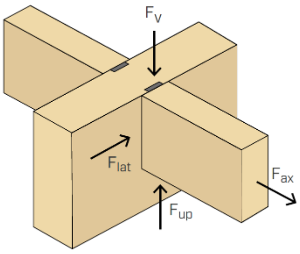
ALUMEGA connectors can be installed as connections between wood-based members such as:

- Structural solid timber according to EN 14081,
- Glued solid timber according to EN 14080
- Glulam according to EN 14080 or ETA,
- Cross-laminated timber according to ETA,
- LVL according to EN 14374 or ETA,
- FST according to ETA-14/0354,
- Engineered wood products with certified mechanical resistances for connections with dowel-type fasteners.

However, the calculation methods are only allowed for a characteristic wood density of up to 460 kg/m³ for softwood and up to 730 kg/m³ for LVL or hardwood. Even though the wood-based material may have a larger density, this must not be used in the formulas for the load-carrying capacities of the fasteners.

Annex B states the formulas for the characteristic load-carrying capacities of the connections with ALUMEGA connectors. The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code.

It is assumed that the forces acting on the ALUMEGA connector are F_1 or F_2 or F_3 perpendicular to the header axis and F_{45} perpendicular to the ALUMEGA connector axis. The forces F_2 and F_3 shall act in the symmetry plane of the joist bearing. It is assumed that the forces F_2, F_3 or F_{45} are acting with an eccentricity e with regard to the side grain surface of the header.



$F_1 = F_{ax}$	axial
$F_2 = F_v$	downward
$F_3 = F_{up}$	uplift
$F_{45} = F_{lat}$	lateral

It is assumed that the header beam is prevented from rotating. If the header beam only has installed a joist bearing on one side the eccentricity moment $M_v = F_d \cdot (B_H / 2 + e)$ shall be considered. The same applies when the header has joist bearing connections on both sides, but with vertical forces which differ more than 20%.

ALUMEGA connectors are intended for use for connections subject to static or quasi static loading.

The ALUMEGA connectors are for use in timber structures subject to the conditions defined by the service classes 1, 2 and 3 of EN 1995-1-1:2014 (Eurocode 5).

The scope of the connectors regarding resistance to corrosion shall be defined according to national provisions that apply at the installation site considering environmental conditions and in conjunction with the admissible service conditions according to EN 1995-1-1 and the admissible corrosivity category as described and defined in EN ISO 12944-2.

The provisions made in this European Technical Assessment are based on an assumed intended working life of the joist bearings of 50 years.

The indications given on the working life cannot be interpreted as a guarantee given by the producer or Assessment Body but are to be regarded only as a means for choosing the right products in relation to the expected economically reasonable working life of the works.

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

Characteristic	Assessment of characteristic
3.1 Mechanical resistance and stability (BWR 1)*)	
Joint Strength - Characteristic load-carrying capacity	See Annex B
Joint Stiffness	See Annex B
Joint ductility	No performance assessed
Resistance to seismic actions	No performance assessed
Resistance to corrosion and deterioration	See section 3.6
3.2 Safety in case of fire (BWR 2)	
Reaction to fire	The ALUMEGA connectors are made from aluminium classified as **Euroclass A1** in accordance with EN 13501-1 and Commission Delegated Regulation 2016/364
Resistance to fire	No performance assessed
3.3 General aspects related to the performance of the product	The connectors have been assessed as having satisfactory durability and serviceability when used in timber structures using the timber species described in Eurocode 5 and subject to the conditions defined by service classes 1, 2 and 3

*) See additional information in section 3.4 – 3.7

3.4 Methods of verification

Safety principles and partial factors

The characteristic load-carrying capacities are based on the characteristic values of the fasteners and the aluminium plates. To obtain design values the capacities must be divided by different partial factors for the material properties, in case of timber failure in addition multiplied with the coefficient k_{mod}.

According to EN 1990 (Eurocode – Basis of design) paragraph 6.3.5 the design value of load-carrying capacity may be determined by reducing the characteristic values of the load-carrying capacity with different partial factors.

Thus, the characteristic values of the load–carrying capacity are determined also for timber failure $F_{Rk,H}$ (obtaining the embedment strength of fasteners subjected to shear or the withdrawal capacity of the most loaded fastener, respectively) as well as for aluminium plate failure $F_{Rk,alu}$. The design value of the load–carrying capacity is the smaller value of both load–carrying capacities.

$$F_{Rd} = \min\left\{\frac{k_{mod} \cdot F_{Rk,H}}{\gamma_{M,H}}; \frac{F_{Rk,alu}}{\gamma_{M,alu}}\right\}$$

Therefore, for timber failure the load duration class and the service class are included. The different partial factors γ_M for aluminium or timber, respectively, are also correctly considered.

3.5 Mechanical resistance and stability

See annex B for characteristic load-carrying capacities of the joist bearings.

The characteristic capacities of the joist bearings are determined by calculation assisted by testing as described in the EAD 130186-00-0603 clause 2.2.1. They should be used for designs in accordance with Eurocode 5 or a similar national Timber Code.

The design models allow the use of fasteners described in the table on page 12 in Annex A:

- *Self-tapping screws in accordance with ETA-11/0030*
- *Bolts or dowels in accordance with EN 14592*
- *Metal anchors in accordance with an ETA*

In the formulas in Annex B the capacities for screws calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral fastener load-carrying-capacity.

No performance has been assessed in relation to ductility of a joint under cyclic testing. The contribution to the performance of structures in seismic zones, therefore, has not been assessed.

3.6 Aspects related to the performance of the product

3.6.1 Corrosion protection in service class 1, 2 and 3.
In accordance with EAD 130186-00-0603 the ALUMEGA connectors are made from aluminium alloy EN AW-6082 T6 according to EN 573-3:2009 and could be either anodized or coated with an organic coating.

3.7 General aspects related to the use of the product

Rotho Blaas ALUMEGA connectors are manufactured in accordance with the provisions of this European Technical Assessment using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

ALUMEGA connections

An ALUMEGA connection is deemed fit for its intended use provided:

Header – support conditions

- The header shall be restrained against rotation and be free from wane under the connector.

  If the header carries joists only on one side the eccentricity moment from the joists $M_{ec} = R_{joist}$ (b_{header}/2+33 mm) shall be considered for ALUMEGA connectors at the strength verification of the header.
  R_{joist} Reaction force from the joists
  b_{header} Width of header

- For a header with joists from both sides but with different reaction forces a similar consideration applies.

Wood to wood connections

- Joist bearings are fastened to wood-based headers by bolts or screws and to wood-based joists by dowels or screws.

- There shall be bolts or screws and dowels in all holes (full fastener pattern) or in a part of the holes (partial fastener pattern).

- The characteristic capacity of the ALUMEGA connection is calculated according to the manufacturer's technical documentation, dated 2023-09-02 and 2025-05-19.
- The ALUMEGA connection is designed in accordance with Eurocode 5 or an appropriate national code.
- The gap between the end of the joist and the surface, where contact stresses can occur during loading shall be limited. This means that for ALUMEGA connectors the gap between the surface of the flaps and the end of the joist shall be maximum 1 mm.
- The groove in the joist and the surface of the header shall have a plane surface against the whole ALUMEGA connector.
- The depth of the joist shall be so large that the top (bottom) of the joist is at least $a_{4,t}$ above (below) the upper (lower) dowel in the joist.
- Screws to be used shall have a diameter and head shape, which fits the holes of the ALUMEGA connector.

Wood to concrete or steel

The above-mentioned rules for wood-to-wood connections are applicable also for the connection between the joist and the ALUMEGA connector.

- The ALUMEGA connection is designed in accordance with Eurocodes 2, 3, 5 or 9 or an appropriate national code.
- The ALUMEGA connector shall be in close contact with the concrete or steel over the whole face. There shall be no intermediate layers in between.
- The gap between the end of the joist and the surface, where contact stresses can occur during loading shall be limited. This means that the gap between the end grain surface of the joist and that of the concrete or steel shall be maximum 1 mm.
- The bolt or metal anchor shall have a diameter not less than the hole diameter minus 2 mm.
- The bolts or metal anchors shall be placed symmetrically about the vertical symmetry line. There shall always be bolts in the 2 upper holes.
- The upper bolts shall have washers according to EN ISO 7094.

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

4.1 AVCP system

According to the decision 97/638/EC of the European Commission, as amended, the system(s) of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011) is 2+.

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

Technical details necessary for the implementation of the AVCP system are laid down in the control plan deposited at ETA-Danmark prior to CE marking.

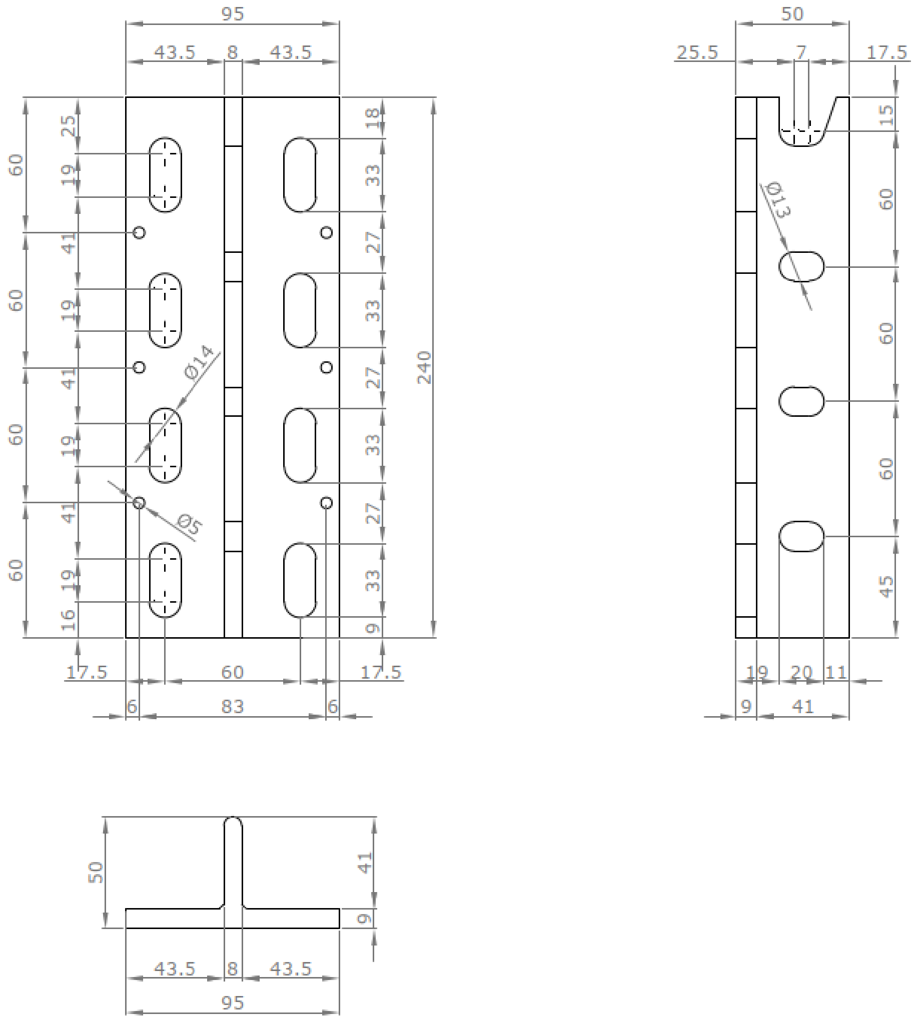
Issued in Copenhagen on 2025-08-20 by

Thomas Bruun
Managing Director, ETA-Danmark

Annex A
Product details and definitions

ALUMEGA connector HV

Face mount hanger with flanges with pre-punched holes. 8.0 mm and 9.0 mm thick aluminium alloy EN AW 6082 T6 according to EN 573-3:2009.

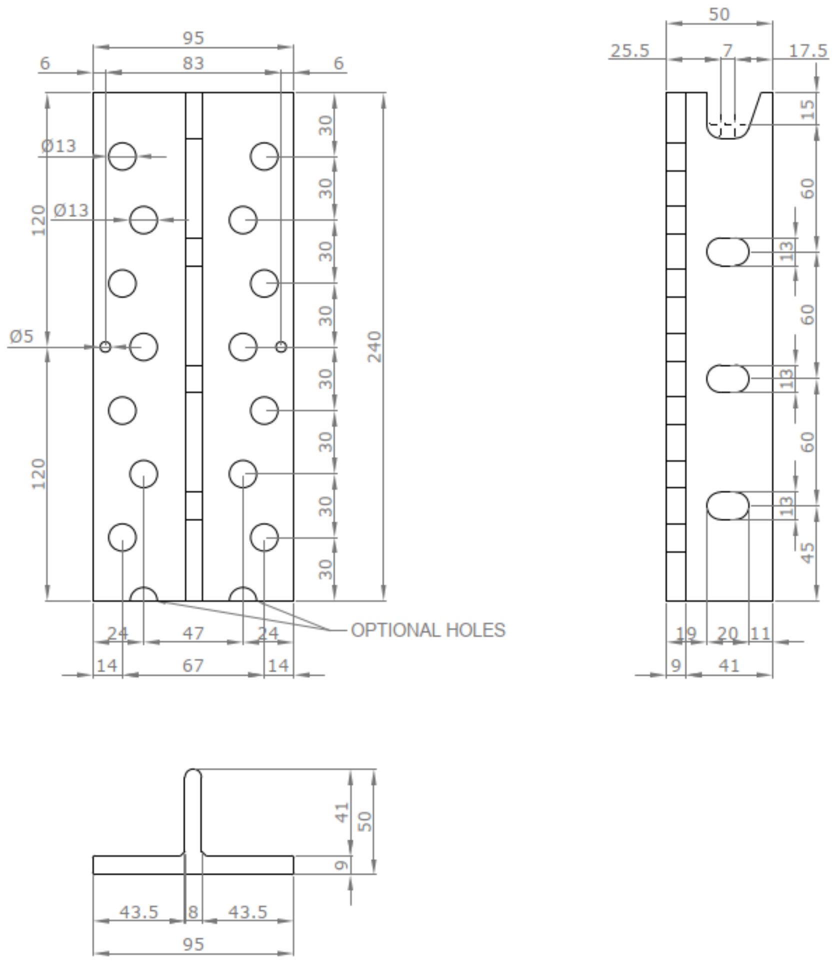


Drawing: ALUMEGA 240 HV

ALUMEGA	N° of oblong screw holes		N° of oblong bolt holes		N° of screw holes	
	N°	d	N°	d	N°	d
840	28	14 x 33	14	13 x 20	26	5
780	26	14 x 33	13	13 x 20	24	5
720	24	14 x 33	12	13 x 20	22	5
660	22	14 x 33	11	13 x 20	20	5
600	20	14 x 33	10	13 x 20	18	5
540	18	14 x 33	9	13 x 20	16	5
480	16	14 x 33	8	13 x 20	14	5
420	14	14 x 33	7	13 x 20	12	5
360	12	14 x 33	6	13 x 20	10	5
300	10	14 x 33	5	13 x 20	8	5
240	8	14 x 33	4	13 x 20	6	5

The ALUMEGA HV are also supplied in lengths of any multiple of 60 mm, with a minimum length of 240 mm which are cut to fit the lengths in the above table. For the load-carrying capacity of an ALUMEGA with intermediate size, refer to the next smaller tabulated size.

ALUMEGA connector HP
Face mount hanger with flanges with pre-punched holes. 8.0 mm and 9.0 mm thick aluminium alloy EN AW 6082 T6 according to EN 573-3:2009.



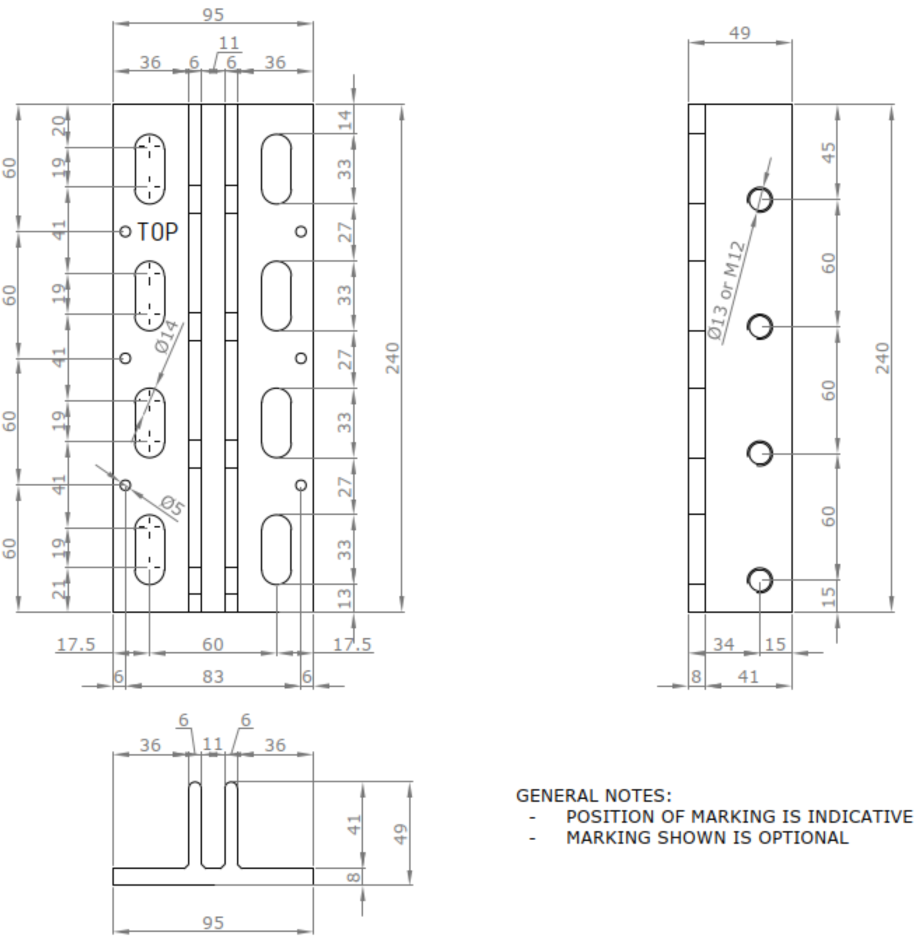
Drawing: ALUMEGA 240 HP

ALUMEGA	N° of screw holes		N° of oblong bolt holes		N° of screw holes	
	N°	d	N°	d	N°	d
840	54	13	14	13 x 20	12	5
780	50	13	13	13 x 20	12	5
720	46	13	12	13 x 20	10	5
660	42	13	11	13 x 20	10	5
600	38	13	10	13 x 20	8	5
540	34	13	9	13 x 20	8	5
480	30	13	8	13 x 20	6	5
420	26	13	7	13 x 20	6	5
360	22	13	6	13 x 20	4	5
300	18	13	5	13 x 20	4	5
240	14	13	4	13 x 20	2	5

The ALUMEGA HP are also supplied in lengths of any multiple of 60 mm, with a minimum length of 240 mm which are cut to fit the lengths in the above table. For the load-carrying capacity of an ALUMEGA with intermediate size, refer to the next smaller tabulated size.

ALUMEGA connector JV

Face mount hanger with flanges with pre-punched holes. 8.0 mm and 6.0 mm thick aluminium alloy EN AW 6082 T6 according to EN 573-3:2009.



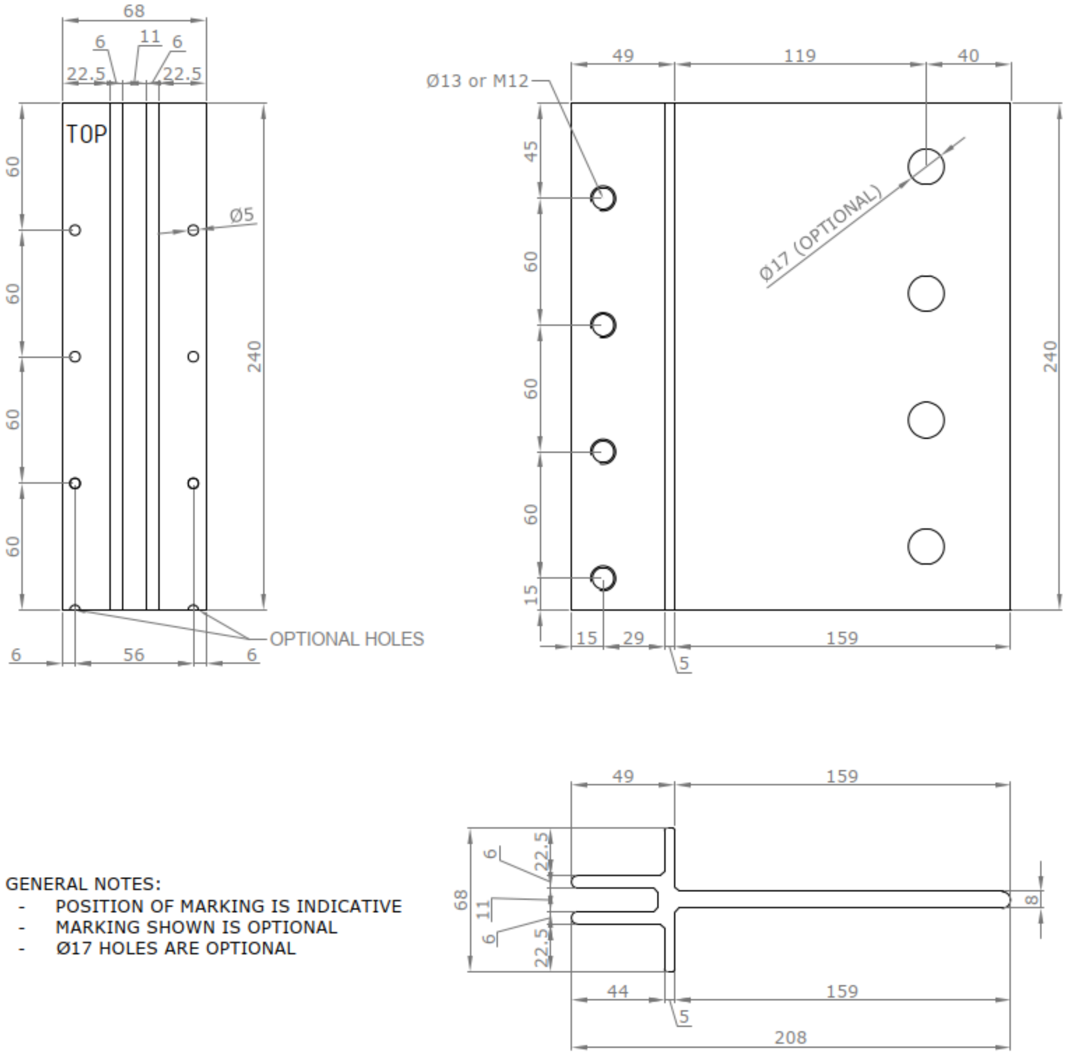
Drawing: ALUMEGA 240 JV.

ALUMEGA	N° of oblong screw holes		N° of bolt holes		N° of screw holes	
	N°	d	N°	d*	N°	d
840	28	14 x 33	14	M12	26	5
780	26	14 x 33	13	M12	24	5
720	24	14 x 33	12	M12	22	5
660	22	14 x 33	11	M12	20	5
600	20	14 x 33	10	M12	18	5
540	18	14 x 33	9	M12	16	5
480	16	14 x 33	8	M12	14	5
420	14	14 x 33	7	M12	12	5
360	12	14 x 33	6	M12	10	5
300	10	14 x 33	5	M12	8	5
240	8	14 x 33	4	M12	6	5

The ALUMEGA JV are also supplied in lengths of any multiple of 60 mm, with a minimum length of 240 mm which are cut to fit the lengths in the above table. For the load-carrying capacity of an ALUMEGA with intermediate size, refer to the next smaller tabulated size.
The M12 threaded holes may be enlarged to 13 mm diameter to enable the use of smooth shank bolts.

ALUMEGA connector JS

Face mount hanger with flanges with pre-punched holes. 8.0 mm and 6.0 mm thick aluminium alloy EN AW 6082 T6 according to EN 573-3:2009.



Drawing: ALUMEGA 240 JS

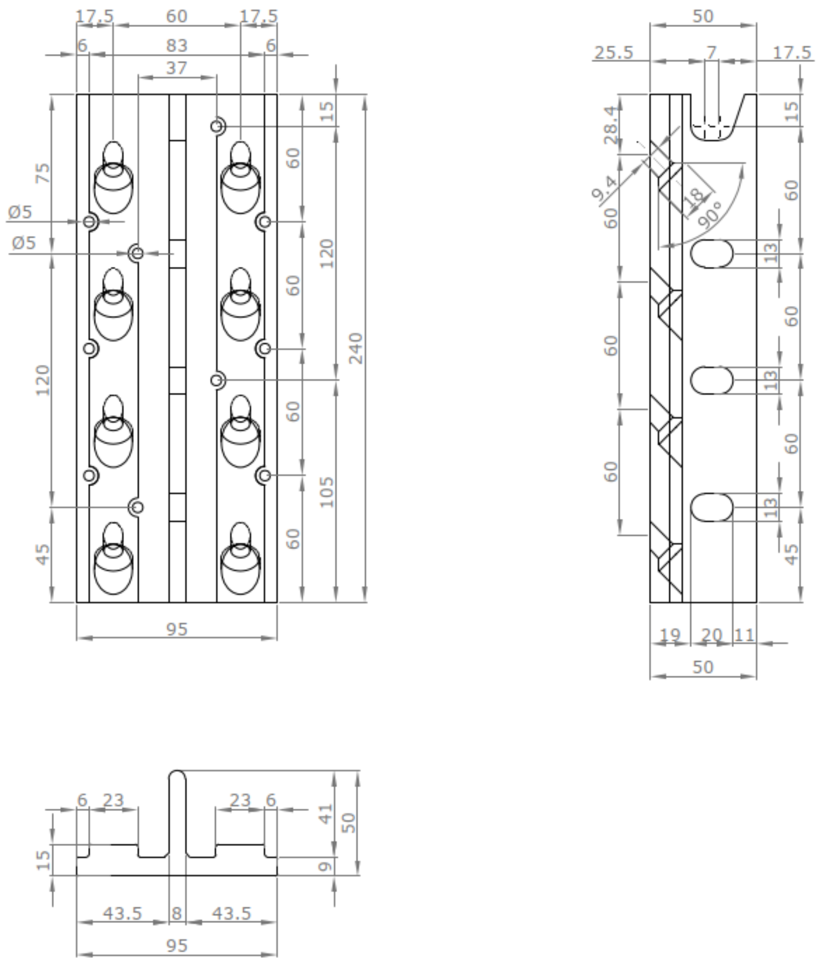
ALUMEGA	N° of dowel holes		N° of bolt holes		N° of screw holes	
	N°	d	N°	d	N°	d
840	14	17	14	M12	26	5
780	13	17	13	M12	24	5
720	12	17	12	M12	22	5
660	11	17	11	M12	20	5
600	10	17	10	M12	18	5
540	9	17	9	M12	16	5
480	8	17	8	M12	14	5
420	7	17	7	M12	12	5
360	6	17	6	M12	10	5
300	5	17	5	M12	8	5
240	4	17	4	M12	6	5

The ALUMEGA JS are also supplied in lengths of any multiple of 60 mm, with a minimum length of 240 mm which are cut to fit the lengths in the above table. For the load-carrying capacity of an ALUMEGA with intermediate size, refer to the next smaller tabulated size.

The M12 threaded holes may be enlarged to 13 mm diameter to enable the use of smooth shank bolts.

ALUMEGA connector HVG

Face mount hanger with flanges with pre-punched holes. 8.0 mm and 9.0/15.0 mm thick aluminium alloy EN AW 6082 T6 according to EN 573-3:2009.



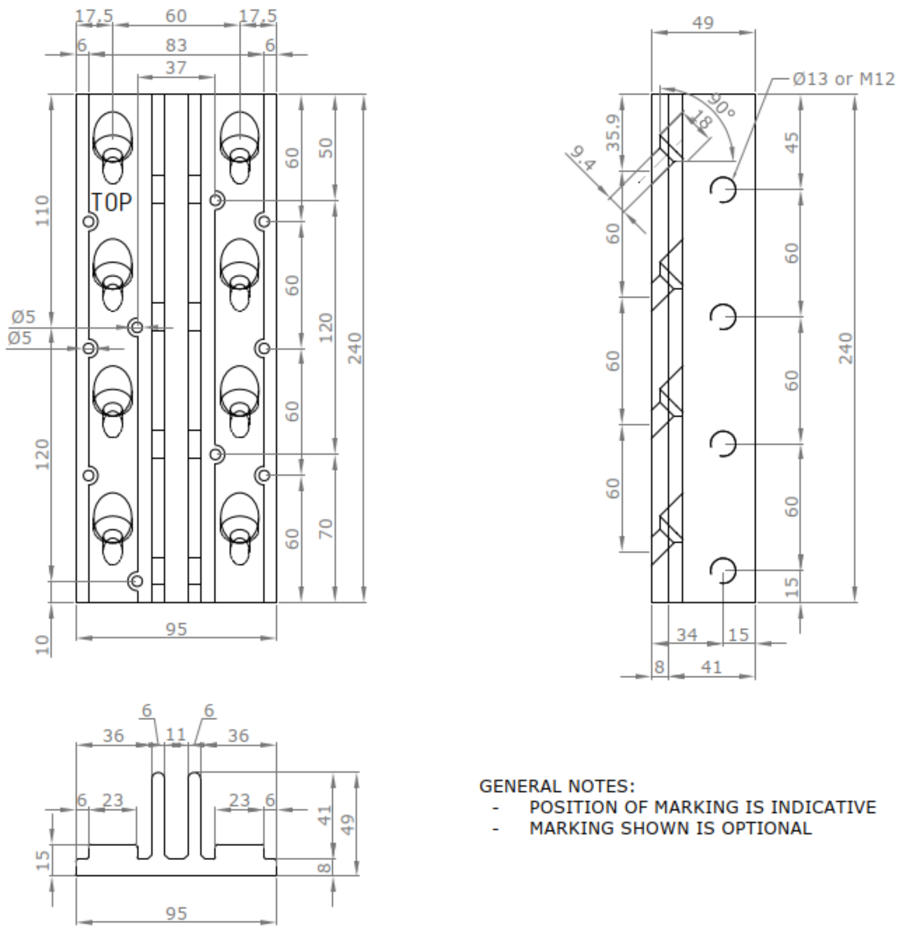
Drawing: ALUMEGA 240 HVG

ALUMEGA	N° of screw holes		N° of oblong bolt holes		N° of screw holes	
	N°	d	N°	d	N°	d
840	28	9.4	14	13 x 20	40	5
780	26	9.4	13	13 x 20	37	5
720	24	9.4	12	13 x 20	34	5
660	22	9.4	11	13 x 20	31	5
600	20	9.4	10	13 x 20	28	5
540	18	9.4	9	13 x 20	25	5
480	16	9.4	8	13 x 20	22	5
420	14	9.4	7	13 x 20	19	5
360	12	9.4	6	13 x 20	16	5
300	10	9.4	5	13 x 20	13	5
240	8	9.4	4	13 x 20	10	5

The ALUMEGA HVG are also supplied in lengths of any multiple of 60 mm, with a minimum length of 240 mm which are cut to fit the lengths in the above table. For the load-carrying capacity of an ALUMEGA with intermediate size, refer to the next smaller tabulated size.

ALUMEGA connector JVG

Face mount hanger with flanges with pre-punched holes. 8.0/15.0 mm and 6.0 mm thick aluminium alloy EN AW 6082 T6 according to EN 573-3:2009.



Drawing: ALUMEGA 240 JVG.

ALUMEGA	N° of screw holes		N° of bolt holes		N° of screw holes	
	N°	d	N°	d*	N°	d
840	28	9.4	14	M12	40	5
780	26	9.4	13	M12	37	5
720	24	9.4	12	M12	34	5
660	22	9.4	11	M12	31	5
600	20	9.4	10	M12	28	5
540	18	9.4	9	M12	25	5
480	16	9.4	8	M12	22	5
420	14	9.4	7	M12	19	5
360	12	9.4	6	M12	16	5
300	10	9.4	5	M12	13	5
240	8	9.4	4	M12	10	5

The ALUMEGA JVG are also supplied in lengths of any multiple of 60 mm, with a minimum length of 240 mm which are cut to fit the lengths in the above table. For the load-carrying capacity of an ALUMEGA with intermediate size, refer to the next smaller tabulated size.

The M12 threaded holes may be enlarged to 13 mm diameter to enable the use of smooth shank bolts.

Fastener types and sizes

Screw diameter	Length	Screw type
5.0	40 – 120	LBS or LBSH screw according to ETA-11/0030, pre-drilled or non-pre-drilled
9.0	160 – 300	VGS screw according to ETA-11/0030, pre-drilled or non-pre-drilled
10.0	100 – 180	HBSP or HBSPL screw according to ETA-11/0030, pre-drilled or non-pre-drilled

In the formulas in Annex B the capacities for self-tapping screws calculated from the formulas of Eurocode 5 are used assuming a thick steel plate when calculating the lateral load-carrying-capacity. The characteristic axial capacity of the screws is determined by calculation:

$$F_{ax,\alpha,Rk} = \min\left\{ f_{tens,k};\ \frac{n_{ef} \cdot k_{ax} \cdot f_{ax,k} \cdot d \cdot \ell_{ef}}{k_\beta} \left(\frac{\rho_k}{\rho_a}\right)^{0,8} \right\}$$

Where:

$f_{ax,k}$ Characteristic value of the withdrawal parameter in N/mm^2

d Screw diameter in mm

ℓ_{ef} Penetration depth of the thread in mm,

$\ell_{ef} = \ell$ - 9 mm for LBS, LBSH, HBSP or HBSPL screws in ALUMEGA HV, HVG and HP,

$\ell_{ef} = \ell$ - 8 mm for LBS or LBSH screws in ALUMEGA JV and JVG,

$\ell_{ef} = \ell$ - 28 mm for VGS screws in ALUMEGA HV and JV,

$\ell_{ef} = \ell$ - 15 mm for VGS screws in ALUMEGA HVG and JVG.

$f_{ax,k}$, $f_{tens,k}$, ρ_a, k_{ax} and k_β see ETA-11/0030.

BOLTS, METAL ANCHORS or DOWELS diameter	Corresponding hole diameter in aluminium plate	Fastener type
Bolt M12	13 mm	Bolt according to EN 14592
Bolt M12	M12	Bolts or threaded rods with metric thread min. 8.8 according to EN ISO 4762, EN ISO 10642, EN ISO 898, EN ISO 4014, EN ISO 4016, EN ISO 4017, EN ISO 4018, EN 15048 or ETA
SBD Dowel 7,5 mm	7,5 mm	Dowel according to EN 14592
STA Dowel 16 mm	17 mm	Dowel S355 according to EN 14592
Metal anchor 12 mm	13 mm	Metal anchors according to manufacturer’s specification

Annex B
Characteristic values of load-carrying-capacities and stiffness

Two-piece ALUMEGA connectors consist of a header/column aluminium T-section HP, HV or HVG and a joist connector JV, JVG or JS. Header/column section and joist connector are joined with threaded 8.8 or greater metric steel bolts M12. The holes for the metric steel bolts in the header/column T-section have an oblong shape providing a hinge between header/column aluminium T-section and joist connector and an installation tolerance.

Header/column aluminium T-sections are HV, HVG or HP and joist connectors are JV, JVG or JS. HP is used with HBSP or HBSPL screws according to ETA-11/0030, bolts, or metal anchors. HV and JV are used with countersunk washers, LBS/LBSH screws and inclined VGS screws according to ETA-11/0030 as fasteners, HVG and JVG are used with LBS/LBSH screws and inclined VGS screws according to ETA-11/0030 as fasteners and JS is used with bolts, STA, or SBD dowels according to EN 14592.

Possible combinations are HP+JV, HP+JVG, HP+JS, HV+JV, HV+JVG, HV+JS, HVG+JV, HVG+JVG, and HVG+JS. Combinations of T-sections and joist connectors with different depth are also possible. Up to three two-piece ALUMEGA connectors may be arranged side by side.

The downward and the upward directed forces are assumed to act in the middle of the joist.

Full or partial fastener patterns are foreseen. For header connections with bolts or metal anchors, there must always be at least bolts or metal anchors in the two upper two holes for loading down or in the two lower holes for loading up.

For ALUMEGA connectors arranged side-by-side, the load-carrying capacity of the connection is the sum of the load-carrying capacities of the ALUMEGA connectors.

B.1 Timber-to-timber connections

Tensile loading parallel to the joist axis

$$F_{1,HV/HVG,Rk} = \min\left\{\max\left\{n_{45} \cdot 4,5\,\text{kN} \cdot \left(\frac{\rho_k}{350}\right)^{0,5} + 0,8 \cdot F_{2,Ed};\, n_{90,ef} \cdot F_{ax,90,Rk}\right\};\, F_{1,alu,Rk};\, F_{90,Rk}\right\} \quad \text{(B.1)}$$

$$F_{1,HP,Rk} = \min\left\{0,78 \cdot n_H^{0,9} \cdot F_{ax,Rk};\, 465 \cdot H_k;\, F_{1,alu,Rk};\, F_{90,Rk}\right\} \text{ for full fastener pattern in N} \quad \text{(B.2)}$$

$$F_{1,HP,Rk} = \min\left\{n_H^{0,9} \cdot F_{ax,Rk};\, 284 \cdot H_k;\, F_{1,alu,Rk};\, F_{90,Rk}\right\} \text{ for partial fastener pattern in N} \quad \text{(B.3)}$$

$$F_{1,JV/JVG,Rk} = \min\left\{\max\left\{n_{45} \cdot 3,5\,\text{kN} \cdot \left(\frac{\rho_k}{350}\right)^{0,5} + 0,8 \cdot F_{2,Ed};\, n_{90,ef} \cdot F_{ax,0,Rk}\right\};\, F_{1,alu,Rk}\right\} \quad \text{(B.4)}$$

$$F_{1,JS,Rk} = \min\left\{n_{J,ef} \cdot \min\left(F_{v,J,Rk};\, F_{b,Rk}\right);\, F_{1,alu,Rk}\right\} \quad \text{(B.5)}$$

Where:

n_{45}	Number of inclined screws in the header or column for HV or HVG and in the joist for JV or JVG
$n_{90,ef}$	Effective number of LBS or LBSH screws in the header or column for HV or HVG and in the joist for JV or JVG according to EN 1995-1-1, 8.7.2 (8)
ρ_k	Characteristic timber density in the header or column for HV or HVG and in the joist for JV or JVG
$F_{2,Ed}$	Characteristic action of permanent downward force F_2. The design value of the permanent action is determined by multiplying the characteristic value $F_{2,Ed}$ with $\gamma_{G,inf}$.
$F_{1,alu,Rk}$	Characteristic load-carrying capacity of the bolted connection between HV, HVG or HP and JV, JVG or JS according to EN 1999-1-1, see Table B.1. $F_{1,alu,Rd} = F_{1,alu,Rk} / \gamma_{M2}$
$F_{90,Rk}$	Characteristic load-carrying capacity according to EN 1995-1-1, 8.1.4. $F_{90,Rd} = k_{mod} \cdot F_{90,Rk} / \gamma_M$
n_H	Number of fasteners in the 13 mm holes of the header or column for HP

$F_{ax,Rk}$ Characteristic withdrawal capacity of an axially loaded header or column fastener in the 13 mm holes for HP according to EN 1995-1-1 and ETA-11/0030, $F_{ax,Rd} = k_{mod} \cdot F_{ax,Rk} / \gamma_M$

$F_{ax,90,Rk}$ Characteristic withdrawal capacity of an axially loaded header or column LBS or LBSH screw in the 5 mm holes for HV or HVG according to EN 1995-1-1 and ETA-11/0030, $F_{ax,90,Rd} = k_{mod} \cdot F_{ax,90,Rk} / \gamma_M$

$F_{ax,0,Rk}$ Characteristic withdrawal capacity of an axially loaded joist LBS or LBSH screw in the 5 mm holes for JV or JVG according to EN 1995-1-1 and ETA-11/0030, $F_{ax,0,Rd} = k_{mod} \cdot F_{ax,0,Rk} / \gamma_M$

H_k ALUMEGA connector depth in mm, $H_d = H_k / \gamma_{M2}$

$n_{J,ef}$ Effective number of 7,5 mm or 16 mm joist bolts or dowels according to EN 1995-1-1 in JS

$F_{v,J,Rk}$ Characteristic lateral load-carrying capacity of a 7,5 mm or 16 mm bolt or dowel with two shear planes in the joist according to EN 1995-1-1, $F_{v,J,Rd} = k_{mod} \cdot F_{v,J,Rk} / \gamma_M$

$F_{b,Rk}$ Characteristic embedment resistance of the joist plate according to EN 1999-1-1, $F_{b,Rd} = F_{b,Rk} / \gamma_{M2}$

Table B.1: Rotho Blaas ALUMEGA connectors: Load-carrying capacity $F_{1,alu,Rk}$, $F_{2,alu,Rk}$, $F_{3,alu,Rk}$ and $F_{45,alu,Rk}$

ALUMEGA	$F_{1,alu,Rk}$ [kN]		$F_{2,alu,Rk}$ [kN]		$F_{3,alu,Rk}$ [kN]		$F_{45,alu,Rk}$ [kN]
	Total	Per bolt	Total	Per bolt	Total	Per bolt	Total
840	434	33,4	679	48,5	630	48,5	118
780	401	33,4	630	48,5	581	48,4	110
720	367	33,4	581	48,4	532	48,3	101
660	334	33,4	532	48,3	483	48,3	92,9
600	300	33,4	483	48,3	433	48,2	84,4
540	267	33,4	433	48,2	384	48,0	76,0
480	234	33,4	384	48,0	335	47,9	67,5
420	200	33,4	335	47,9	286	47,7	59,1
360	167	33,4	286	47,7	237	47,4	50,7
300	134	33,4	237	47,4	188	47,0	42,2
240	100	33,4	188	47,0	139	46,3	33,8

Loading down:

$$F_{2,HV/HVG,Rk} = \min\left\{k_2 \cdot n_{45} \cdot F_{ax,\alpha,Rk}; k_2 \cdot n_{45} \cdot f_{tens,k}; F_{2,alu,Rk}\right\} \quad \text{(B.6)}$$

$$F_{2,HP,Rk} = \min\left\{\frac{1}{\sqrt{\left(\frac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\frac{1}{k_{H,2} \cdot F_{ax,H,Rk}}\right)^2}}; F_{2,alu,Rk}\right\} \text{for headers} \quad \text{(B.7)}$$

$$F_{2,HP,Rk} = \min\left\{\frac{1}{\sqrt{\left(\frac{1}{n_{H,ef} \cdot F_{v,H,Rk}}\right)^2 + \left(\frac{1}{k_{H,2} \cdot F_{ax,H,Rk}}\right)^2}}; F_{2,alu,Rk}\right\} \text{for columns} \quad \text{(B.8)}$$

$$F_{2,JV/JVG,Rk} = \min\left\{k_2 \cdot n_{45} \cdot F_{ax,\alpha,Rk}; k_2 \cdot n_{45} \cdot f_{tens,k}; F_{2,alu,Rk}\right\} \quad \text{(B.9)}$$

$$F_{2,JS,Rk} = \min\left\{n_{J,ef} \cdot \min\left(F_{v,J,Rk}; F_{b,Rk}\right); F_{2,alu,Rk}\right\} \quad \text{(B.10)}$$

Where:

k_2 Parameter. k_2 = 0,88 for ALUMEGA 240; k_2 = 0,8 for all other ALUMEGA sizes

n_{45} Number of inclined screws in the header or column for HV/HVG and in the joist for JV/JVG

$F_{ax,\alpha,Rk}$ Characteristic withdrawal capacity of an axially loaded VGS screw for HV/HVG or JV/JVG according to EN 1995-1-1 and ETA-11/0030, $F_{ax,\alpha,Rd} = k_{mod} \cdot F_{ax,\alpha,Rk} / \gamma_M$. If different VGS screw lengths are used in one connector, the shortest screw length determines the load-carrying capacity.

$f_{tens,k}$ Characteristic tensile capacity of an axially loaded VGS screw for HV/HVG or JV/JVG according to ETA-11/0030, $F_{ax,\alpha,Rd} = f_{tens,k} / \gamma_M$

$F_{2,alu,Rk}$ Characteristic load-carrying capacity of the bolted connection between HV, HVG or HP and JV, JVG or JS according to EN 1999-1-1, see Table B.1. $F_{2,alu,Rd} = F_{2,alu,Rk} / \gamma_{M2}$

n_H Number of fasteners in the 13 mm holes of the header or column for HP

$F_{v,H,Rk}$ Characteristic lateral load-carrying capacity of a fastener in single shear in the 13 mm holes for HP in the header or column according to EN 1995-1-1 and ETA-11/0030 assuming a thick plate, $F_{v,H,Rd} = k_{mod} \cdot F_{v,H,Rk} / \gamma_M$

$k_{H,2}$ form factor, see Table B.2

$F_{ax,H,Rk}$ Characteristic withdrawal capacity of an axially loaded header or column fastener in the 13 mm holes for HP according to EN 1995-1-1 and ETA-11/0030, $F_{ax,H,Rd} = k_{mod} \cdot F_{ax,H,Rk} / \gamma_M$

$n_{H,ef}$ effective number of laterally loaded fasteners in the 13 mm holes for HP on columns
For full pattern and 10 mm HBSP or HBSPL screws: $n_{H,ef} = 2 \cdot (0,5 \cdot n_{H,full})^{0,9}$
For partial pattern and 10 mm HBSP or HBSPL screws: $n_{H,ef} = 2 \cdot (0,5 \cdot n_{H,partial})^{0,95}$
For partial pattern and 12 mm bolts: $n_{H,ef} = 1,58 \cdot (0,5 \cdot n_{H,partial})^{0,9}$

$n_{J,ef}$ effective number of laterally loaded bolts or STA or SBD dowels in double shear for JS in the joist, see Table B.2. Other SBD dowel patterns are determined according to the manufacturer's technical documentation dated 02-09-23.

$F_{v,J,Rk}$ Characteristic lateral load-carrying capacity of a bolt or STA or SBD dowel with two shear planes in the joist according to EN 1995-1-1, for loading under an angle α between load and grain direction, $F_{v,J,Rd} = k_{mod} \cdot F_{v,J,Rk} / \gamma_M$.

α Load grain angle for the configurations shown in Annex C page 36.

$$\alpha = 25,7 \cdot \ln(L_{ALUMEGA}) - 110 \ [°] \text{ for STA dowels}$$

$$\alpha = 3,6 \cdot L_{ALUMEGA}^{0,43} \ [°] \text{ for SBD dowels}$$

For other patterns α is determined according to the manufacturer's technical documentation dated 02-09-23.

$L_{ALUMEGA}$ Connector length in mm between 240 mm and 840 mm

$F_{b,Rk}$ Characteristic embedment resistance of the joist plate according to EN 1999-1-1. $F_{b,Rd} = F_{b,Rk} / \gamma_{M2}$
For joists consisting of CLT where the aluminium joist plate is arranged parallel to the plane of the CLT member, the embedment strength for CLT may be assumed as:

$$f_{h,k} = \frac{32 \cdot (1 - 0,015 \cdot d)}{1,1 \cdot \sin^2 \alpha + \cos^2 \alpha} \cdot \left(\frac{\rho_k}{400}\right)^{1,2} \text{ in N/mm}^2$$

α Angle between the load direction and the grain direction of the CLT layer in contact with the joist plate

The minimum spacing, end and edge distance requirements for dowels in CLT joists are:

$a_1 = (3 + 2 \cos\alpha) \cdot d$ $a_2 = 3 \cdot d$

$a_{3,t} = 5 \cdot d$ $a_{3,c} = 4 \cdot d$

$a_{4,t} = 3 \cdot d$ $a_{4,c} = 3 \cdot d$

Table B.2: ALUMEGA HP connectors: Form factors $k_{H,2}$ and number of fasteners n_H
ALUMEGA JS connectors: number of fasteners n_J and effective number of fasteners $n_{J,ef}$

ALUMEGA HP	$n_{H,full}$	$k_{H,2}$	$n_{H,partial}$	$k_{H,2}$	ALUMEGA JS	STA or bolt		SBD			
	Full pattern		Partial pattern			n_J	$n_{J,ef}$	n_J	$n_{J,ef}$	n_J	$n_{J,ef}$
								Full pattern		Partial pattern	
840	54	464	28	245	840	14	12,4	54	47,2	28	24,6
780	50	398	26	211	780	13	11,3	50	42,9	26	22,5
720	46	338	24	180	720	12	10,2	46	38,6	24	20,3
660	42	282	22	151	660	11	9,16	42	34,4	22	18,2
600	38	232	20	125	600	10	8,08	38	30,1	20	16,0
540	34	186	18	101	540	9	7,01	34	25,9	18	13,9
480	30	145	16	79,9	480	8	5,95	30	21,7	16	11,8
420	26	110	14	61,2	420	7	4,90	26	17,7	14	9,71
360	22	79,1	12	44,9	360	6	3,89	22	13,8	12	7,70
300	18	53,4	10	31,2	300	5	2,92	18	10,2	10	5,80
240	14	32,8	8	19,9	240	4	2,03	14	6,89	8	4,06

Loading up:

$$F_{3,HV/HVG,Rk} = \min\left\{\max\left\{n_{45} \cdot 3{,}8\,\text{kN} \cdot \left(\frac{\rho_k}{350}\right)^{0,5}; n_{90,ef} \cdot F_{v,90,Rk}\right\}; F_{3,alu,Rk}\right\} \quad \text{(B.11)}$$

$$F_{3,HP,Rk} = \min\left\{\frac{1}{\sqrt{\left(\frac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\frac{1}{k_{H,2} \cdot F_{ax,H,Rk}}\right)^2}}; F_{3,alu,Rk}\right\} \text{ for headers} \quad \text{(B.12)}$$

$$F_{3,HP,Rk} = \min\left\{\frac{1}{\sqrt{\left(\frac{1}{n_{H,ef} \cdot F_{v,H,Rk}}\right)^2 + \left(\frac{1}{k_{H,2} \cdot F_{ax,H,Rk}}\right)^2}}; F_{3,alu,Rk}\right\} \text{ for columns} \quad \text{(B.13)}$$

$$F_{3,JV/JVG,Rk} = \min\left\{\max\left\{n_{45} \cdot 2{,}1\,\text{kN} \cdot \left(\frac{\rho_k}{350}\right)^{0,5}; n_0 \cdot F_{v,0,Rk}\right\}; F_{3,alu,Rk}\right\} \quad \text{(B.14)}$$

$$F_{3,JS,Rk} = \min\left\{n_{J,ef} \cdot \min\left(F_{v,J,Rk}; F_{b,Rk}\right); F_{3,alu,Rk}\right\} \quad \text{(B.15)}$$

Where:

n_{45} Number of inclined screws in the header or column for HV/HVG and in the joist for JV/JVG

$n_{90,ef}$ Effective number of LBS or LBSH screws in the header or column for HV or HVG; $n_{90,ef} = n_{90}$ for headers, $n_{90,ef}$ for columns see Table B.3

n_0 Number of LBS or LBSH screws in the joist for JV or JVG;

ρ_k Characteristic timber density in the header or column for HV/HVG and in the joist for JV/JVG

$F_{3,alu,Rk}$ Characteristic load-carrying capacity of the bolted connection between HV, HVG or HP and JV, JVG or JS according to EN 1999-1-1, see Table B.1. $F_{3,alu,Rd} = F_{3,alu,Rk} / \gamma_{M2}$

n_H Number of fasteners in the 13 mm holes of the header or column for HP

$F_{v,H,Rk}$ Characteristic lateral load-carrying capacity of a fastener in single shear in the 13 mm holes in the header or column for HP according to EN 1995-1-1 and ETA-11/0030 assuming a thick plate, $F_{v,H,Rd} = k_{mod} \cdot F_{v,H,Rk} / \gamma_M$

$F_{v,90,Rk}$ Characteristic lateral load-carrying capacity of a LBS/LBSH screw in single shear in the 5 mm holes in the header or column for HV/HVG according to EN 1995-1-1 and ETA-11/0030 assuming a thick plate, $F_{v,90,Rd} = k_{mod} \cdot F_{v,90,Rk} / \gamma_M$

$F_{v,0,Rk}$ Characteristic lateral load-carrying capacity of a LBS/LBSH screw in single shear in the 5 mm holes in the joist for JV/JVG according to EN 1995-1-1 and ETA-11/0030 assuming a thick plate, $F_{v,0,Rd} = k_{mod} \cdot F_{v,0,Rk} / \gamma_M$

$k_{H,2}$ form factor, see Table B.2

$F_{ax,H,Rk}$ Characteristic load-carrying capacity of an axially loaded header or column fastener in the 13 mm holes for HP according to EN 1995-1-1 and ETA-11/0030, $F_{ax,H,Rd} = k_{mod} \cdot F_{ax,H,Rk} / \gamma_M$

$n_{H,ef}$ effective number of laterally loaded fasteners in the 13 mm holes for HP in the column

For full pattern and 10 mm HBSP or HBSPL screws: $n_{H,ef} = 2 \cdot (0,5 \cdot n_{H,full})^{0,9}$

For partial pattern and 10 mm HBSP or HBSPL screws: $n_{H,ef} = 2 \cdot (0,5 \cdot n_{H,partial})^{0,95}$

For partial pattern and 12 mm bolts: $n_{H,ef} = 1,58 \cdot (0,5 \cdot n_{H,partial})^{0,9}$

$n_{J,ef}$ effective number of laterally loaded bolts or STA or SBD dowels in double shear for JS in the joist, see Table B.2. Other SBD dowel patterns are determined according to the manufacturer's technical documentation dated 02-09-23.

$F_{v,J,Rk}$ Characteristic lateral load-carrying capacity of a dowel with two shear planes in the joist according to EN 1995-1-1, for loading under an angle α between load and grain direction, $F_{v,J,Rd} = k_{mod} \cdot F_{v,J,Rk} / \gamma_M$

α Load grain angle for the configurations shown in Annex C page 36.

$\alpha = 25,7 \cdot \ln(L_{ALUMEGA}) - 110 \ [°]$ for STA dowels

$\alpha = 3,6 \cdot L_{ALUMEGA}^{0,43} \ [°]$ for SBD dowels

For other patterns α is determined according to the manufacturer's technical documentation dated 02-09-23.

$L_{ALUMEGA}$ Connector length in mm between 240 mm and 840 mm

For joists consisting of CLT where the aluminium joist plate is arranged parallel to the plane of the CLT member, the embedment strength for CLT may be assumed as:

$$f_{h,k} = \frac{32 \cdot (1 - 0,015 \cdot d)}{1,1 \cdot \sin^2 \alpha + \cos^2 \alpha} \cdot \left(\frac{\rho_k}{400} \right)^{1,2} \text{ in N/mm}^2$$

α Angle between the load direction and the grain direction of the CLT layer in contact with the joist plate

The minimum spacing, end and edge distance requirements for dowels in CLT joists are:

$a_1 = (3 + 2 \cos\alpha) \cdot d$ $a_2 = 3 \cdot d$

$a_{3,t} = 5 \cdot d$ $a_{3,c} = 4 \cdot d$

$a_{4,t} = 3 \cdot d$ $a_{4,c} = 3 \cdot d$

Table B.3: Rotho Blaas ALUMEGA connectors: n_{90} and $n_{90,ef}$ for LBS or LBSH screws d = 5 mm in HV or HVG connectors to columns, n_0 for LBS or LBSH screws d = 5 mm in JV or JVG connectors to joists

ALUMEGA	PATTERN 1		PATTERN 2		PATTERN 3
	$n_{90,ef}$	n_{90}, n_0	$n_{90,ef}$	n_{90}, n_0	n_{90}, $n_{90,ef}$, n_0
840	21,5	26	35,5	40	14
780	19,9	24	32,9	37	13
720	18,4	22	30,4	34	12
660	16,8	20	27,8	31	11
600	15,3	18	25,3	28	10
540	13,7	16	22,7	25	9
480	12,1	14	20,1	22	8
420	10,5	12	17,5	19	7
360	8,9	10	14,9	16	6
300	7,2	8	12,2	13	5
240	5,5	6	9,5	10	4

Loading perpendicular to the symmetry plane:

$$F_{45,HV/HVG,Rk} = \min \begin{cases} \dfrac{1}{\sqrt{\left(\dfrac{1}{n_{45} \cdot F_{v,45,Rk} + n_{90} \cdot F_{v,90,Rk}}\right)^2 + \left(\dfrac{1}{k_{H,45} \cdot F_{ax,45,Rk}}\right)^2}} \\ F_{45,alu,Rk} \end{cases} \quad \text{(B.16)}$$

$$F_{45,HP,Rk} = \min \begin{cases} \dfrac{1}{\sqrt{\left(\dfrac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\dfrac{1}{k_{H,45} \cdot F_{ax,H,Rk}}\right)^2}} \\ F_{45,alu,Rk} \end{cases} \quad \text{(B.17)}$$

$$F_{45,JV/JVG,Rk} = \min \begin{cases} \dfrac{1}{\sqrt{\left(\dfrac{1}{n_{45} \cdot F_{v,45,Rk} + n_0 \cdot F_{v,0,Rk}}\right)^2 + \left(\dfrac{1}{k_{H,45} \cdot F_{ax,45,Rk}}\right)^2}} \\ F_{45,alu,Rk} \end{cases} \quad \text{(B.18)}$$

$$F_{45,JS,Rk} = \min \left\{ \frac{k_v \cdot f_{v,k} \cdot h \cdot b}{3}; F_{45,alu,Rk} \right\} \quad \text{(B.19)}$$

Where:

n_{45} Number of inclined screws in the header or column for HV or HVG and in the joist for JV or JVG

n_{90} Number of LBS/LBSH screws in the header or column for HV or HVG

n_0 Number of LBS/LBSH screws in the joist for JV or JVG

$F_{v,45,Rk}$ Characteristic lateral load-carrying capacity of a VGS screw in single shear assuming a thick plate, $F_{v,45,Rd} = k_{mod} \cdot F_{v,45,Rk} / \gamma_M$

$$F_{v,45,Rk} = f_{h,k} \cdot d \cdot \left(\sqrt{t_{IL}^2 + \frac{4 \cdot M_{y,Rk}}{f_{h,k} \cdot d}} - t_{IL} \right)$$

$f_{h,k} = 0{,}082 \cdot \rho_k \cdot d^{-0,3}$ N/mm² for headers
$f_{h,k} = 0{,}047 \cdot \rho_k \cdot d^{-0,3}$ N/mm² for joists or columns
d = 9 mm

t_{IL} = 12,7 mm for HV or JV, t_{IL} = 0 for HVG or JVG
$M_{y,Rk}$ = 27200 Nmm

$F_{v,90,Rk}$ Characteristic lateral load-carrying capacity of a LBS/LBSH screw in single shear according to EN 1995-1-1 assuming a thick plate, $F_{v,90,Rd} = k_{mod} \cdot F_{v,90,Rk} / \gamma_M$

$F_{v,0,Rk}$ Characteristic lateral load-carrying capacity of a LBS/LBSH screw in single shear according to EN 1995-1-1 assuming a thick plate, $F_{v,0,Rd} = k_{mod} \cdot F_{v,0,Rk} / \gamma_M$

$k_{h,45}$ form factor, see Table B.4

$F_{ax,45,Rk}$ Characteristic load-carrying capacity of a VGS screw in load direction F_1, $F_{ax,45,Rd} = k_{mod} \cdot F_{ax,45,Rk} / \gamma_M$

$$F_{ax,45,Rk} = 4{,}5\,kN \cdot \left(\frac{\rho_k}{350}\right)^{0{,}5} + \frac{0{,}8}{n_{45}} \cdot F_{2,Ed} \text{ for HV/HVG}$$

$$F_{ax,45,Rk} = 3{,}5\,kN \cdot \left(\frac{\rho_k}{350}\right)^{0{,}5} + \frac{0{,}8}{n_{45}} \cdot F_{2,Ed} \text{ for JV/JVG}$$

$F_{2,Ed}$ Characteristic action of permanent downward force F_2. The design value of the permanent action is determined by multiplying the characteristic value $F_{2,Ed}$ with $\gamma_{G,inf}$.

$F_{45,alu,Rk}$ Characteristic load-carrying capacity of the bolted connection between HV, HVG or HP and JV, JVG or JS according to EN 1999-1-1, see Table B.1. $F_{45,alu,Rd} = F_{45,alu,Rk} / \gamma_{M2}$

n_H Number of fasteners in the 13 mm holes of the header or column for HP

$F_{v,H,Rk}$ Characteristic lateral load-carrying capacity of a fastener in single shear in the 13 mm holes in the header or column for HP according to EN 1995-1-1 and ETA-11/0030 assuming a thick plate, $F_{v,H,Rd} = k_{mod} \cdot F_{v,H,Rk} / \gamma_M$

$F_{ax,H,Rk}$ Characteristic withdrawal capacity of an axially loaded header or column fastener in the 13 mm holes for HP according to EN 1995-1-1 and ETA-11/0030, $F_{ax,H,Rd} = k_{mod} \cdot F_{ax,H,Rk} / \gamma_M$

$$k_v = \min\left\{1; \frac{k_n}{\sqrt{b} \cdot \left(0{,}5 + \frac{112}{b}\right)}\right\}$$

k_n Parameter according to Eurocode 5 equation (6.63)

b Joist width in mm

h Joist depth in mm

$f_{v,k}$ Characteristic joist shear strength [N/mm²] $f_{v,Rd} = k_{mod} \cdot f_{v,Rk} / \gamma_M$

Table B.4: ALUMEGA connectors: Form factors $k_{H,45}$ for full and partial pattern

	$k_{H,45}$ full pattern			$k_{H,45}$ partial pattern		
ALUMEGA	HV/HVG	JV/JVG	HP	HV/HVG	JV/JVG	HP
840	26,3	24,7	49,6	24,4	22,9	29,4
780	24,4	22,9	46,0	22,5	21,2	27,2
720	22,5	21,2	42,3	20,6	19,4	25,1
660	20,6	19,4	38,7	18,8	17,6	23,0
600	18,8	17,6	35,0	16,9	15,9	20,9
540	16,9	15,9	31,3	15,0	14,1	18,8
480	15,0	14,1	27,7	13,1	12,4	16,8
420	13,1	12,4	24,0	11,3	10,6	14,7
360	11,3	10,6	20,4	9,4	8,8	12,6
300	9,4	8,8	16,7	7,5	7,1	10,5
240	7,5	7,1	13,1	5,6	5,3	8,4

B.2 ALUMEGA HP connectors fastened with bolts or metal anchors in concrete or steel

Tensile loading parallel to the joist axis

$$F_{1,HP,Rk} = \min\left\{n_H \cdot F_{ax,H,Rk}; 284 \cdot H_k \text{ [N]}\right\} \quad \text{(B.20)}$$

Loading down or up:

$$F_{2,HP,Rk} = \min\left\{\frac{1}{\sqrt{\left(\frac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\frac{e \cdot z_{max}}{I_{p,H,ax} \cdot F_{ax,H,Rk}}\right)^2}}; F_{2,alu,Rk}\right\} \quad \text{(B.21)}$$

$$F_{3,HP,Rk} = \min\left\{\frac{1}{\sqrt{\left(\frac{1}{n_H \cdot F_{v,H,Rk}}\right)^2 + \left(\frac{e \cdot z_{max}}{I_{p,H,ax} \cdot F_{ax,H,Rk}}\right)^2}}; F_{3,alu,Rk}\right\} \quad \text{(B.22)}$$

Where:

n_H	Number of bolts or metal anchors in the header connection; there must always be at least bolts or metal anchors in the two upper holes for loading down or in the two lower holes for loading up
H_k	ALUMEGA connector depth in mm, $H_d = H_k / \gamma_{M2}$
e	Distance between the load $F_{2,Ed}$ and the header surface, e = 33 mm
z_{max}	Distance between the uppermost bolt or metal anchor and the lower end of the joist bearing for loading DOWN or distance between the lowermost bolt or metal anchor and the upper end of the joist bearing for loading UP;
$I_{p,H,ax}$	Polar moment of inertia of the header fasteners where the centre of rotation may be assumed at the lower or upper end of the ALUMEGA HP;
$F_{v,H,Rk}$	Characteristic value of the lateral load-carrying-capacity per bolt or metal anchor in the header connection
$F_{ax,H,Rk}$	Characteristic value of the axial load-carrying-capacity per bolt or metal anchor in the header

For load direction F_{45}, equation (B.17) applies.

B.3 Combined loading

If $F_{1,Ed}$ or $F_{2,Ed}$ or $F_{3,Ed}$ or $F_{45,Ed}$ act simultaneously, the following interaction equation shall be fulfilled:

$$\left(\frac{F_{1,Ed}}{F_{1,Rd}}\right)^2 + \left(\frac{F_{2,Ed}}{F_{2,Rd}}\right)^2 + \left(\frac{F_{3,Ed}}{F_{3,Rd}}\right)^2 + \left(\frac{F_{45,Ed}}{F_{45,Rd}}\right)^2 \le 1{,}0 \quad \text{(B.23)}$$

B.4 Slip moduli of ALUMEGA connectors

The slip moduli do not consider the initial slip due to oversized connector holes. The slip moduli are given separately for HV/HVG/HP, JV/JVG/JS and aluminium connection between HV/HVG/HP and JV/JVG/JS. The resulting slip modulus is:

$$K_{ser} = \frac{1}{\frac{1}{K_{JV/JVG/JS,ser}} + \frac{1}{K_{alu,ser}} + \frac{1}{K_{HV/HVG/HP,ser}}} \quad \text{(B.24)}$$

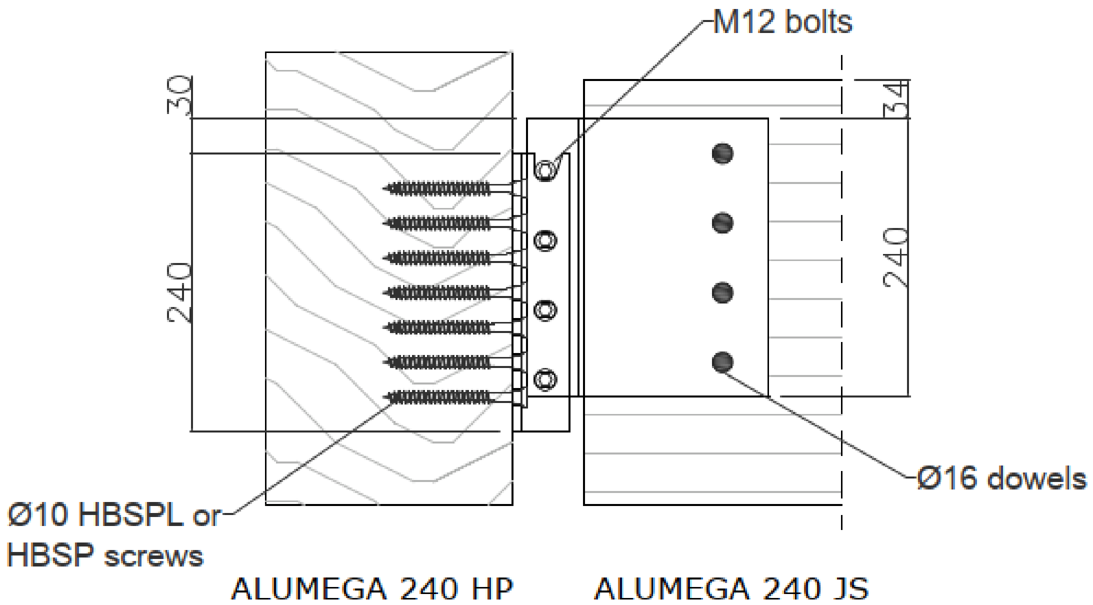
Table B.5: Slip moduli K_{ser} [kN/mm] for ALUMEGA connectors

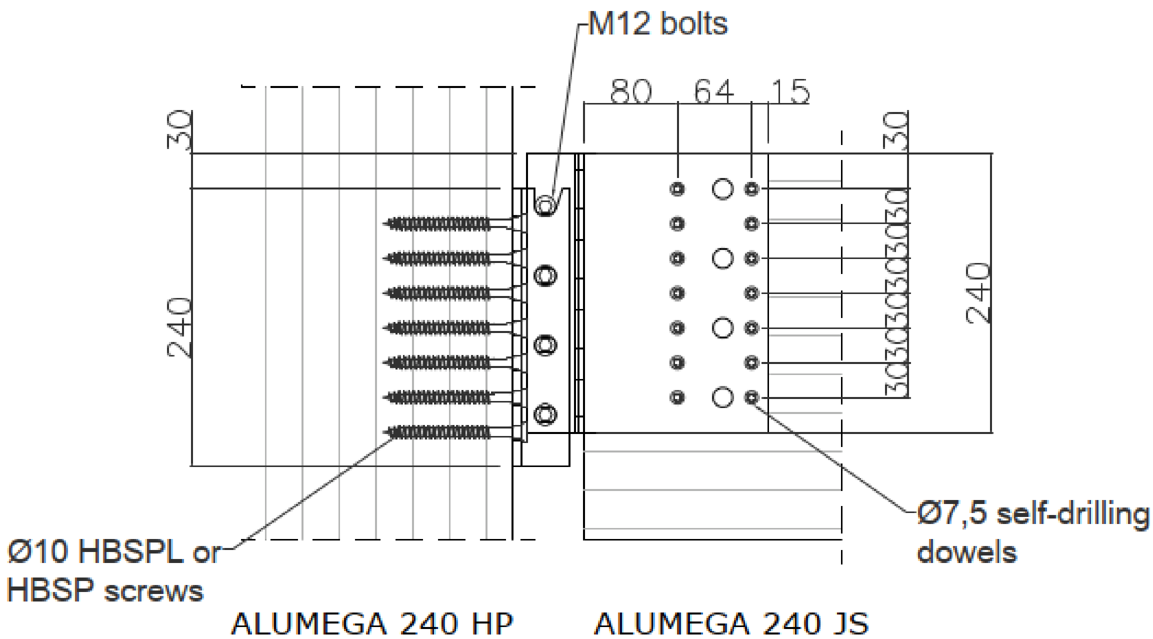
	F_1			F_2					F_3				
ALUMEGA	HV/HVG	JV/JVG	Alu	HV/HVG	HP*	JV/JVG	JS	Alu	HV/HVG	HP*	JV/JVG	JS	Alu
840	103	52	177	222	87	248	38	306	16	87	12	38	284
780	96	48	165	206	81	230	36	284	14	81	11	36	262
720	89	44	152	190	74	213	33	262	13	74	10	33	240
660	81	41	139	174	68	195	30	240	12	68	10	30	218
600	74	37	127	158	62	177	27	218	11	62	9	27	197
540	67	33	114	142	56	159	25	197	10	56	8	25	175
480	59	30	101	127	50	142	22	175	9	50	7	22	153
420	52	26	89	111	43	124	19	153	8	43	6	19	131
360	44	22	76	95	37	106	16	131	7	37	5	16	109
300	37	18	63	79	31	89	14	109	6	31	4	14	87
240	30	15	51	63	25	71	11	87	4	25	3	11	66

* Values for full pattern. For partial pattern, multiply with 14/27

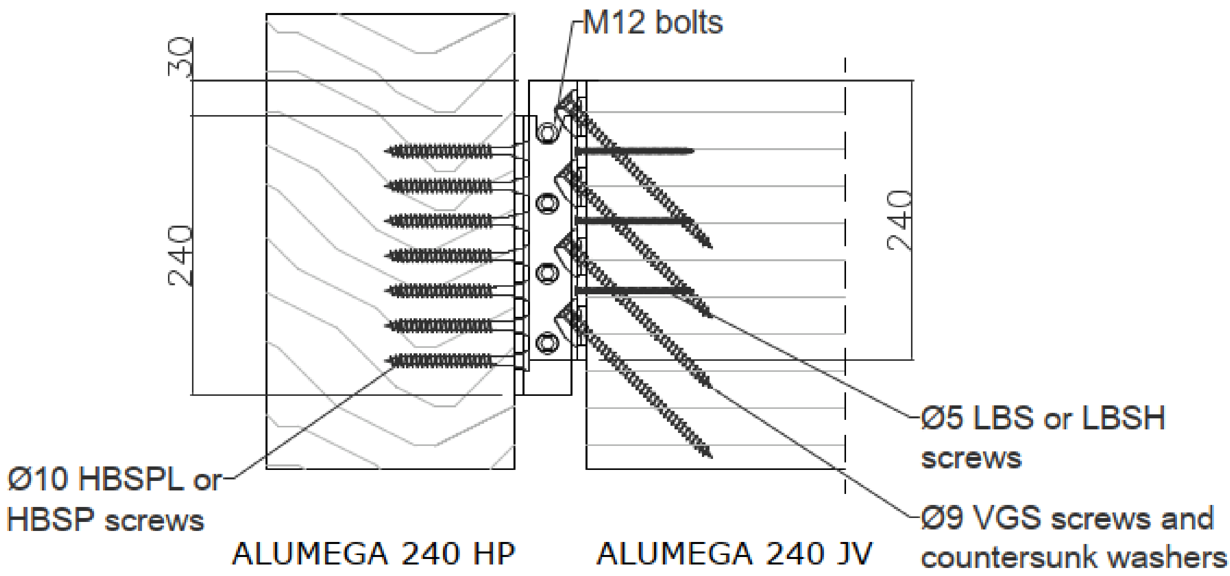
Annex C
Installation of ALUMEGA connectors

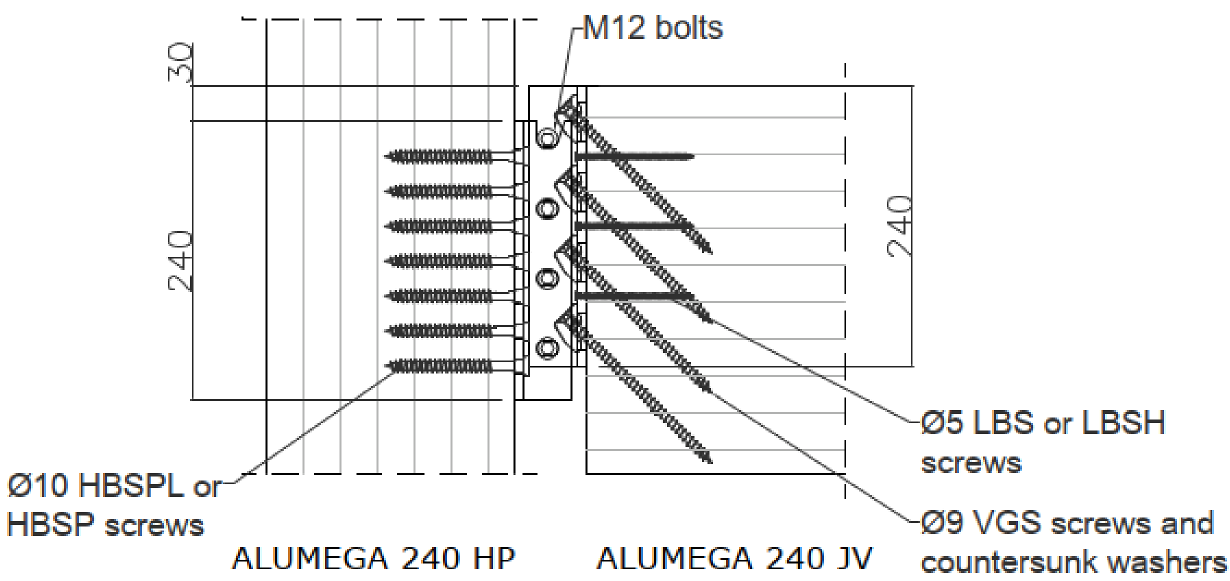
ALUMEGA HP + ALUMEGA JS



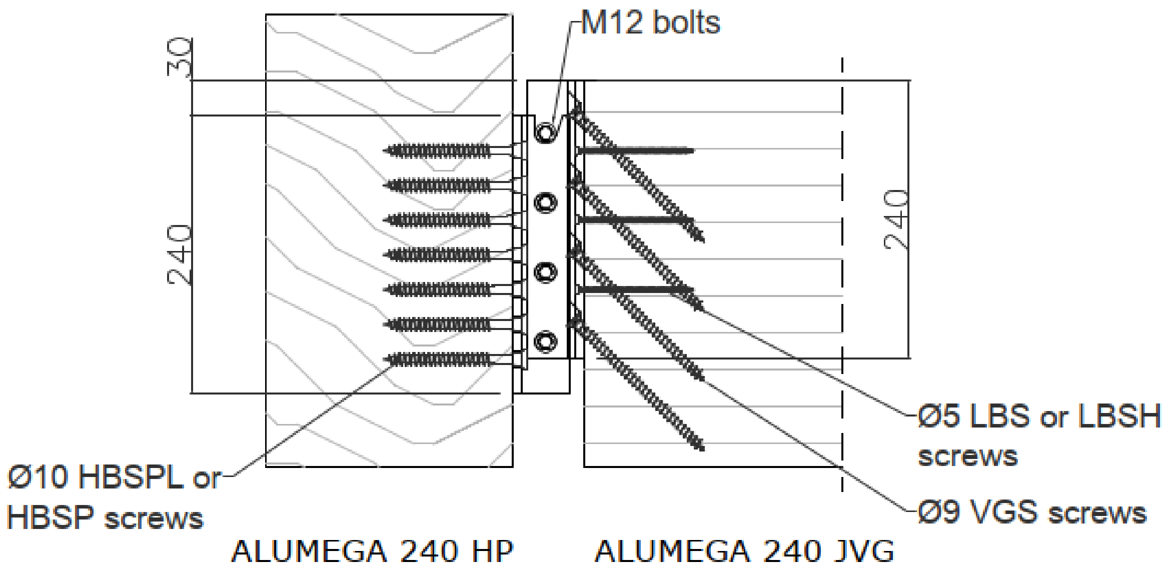


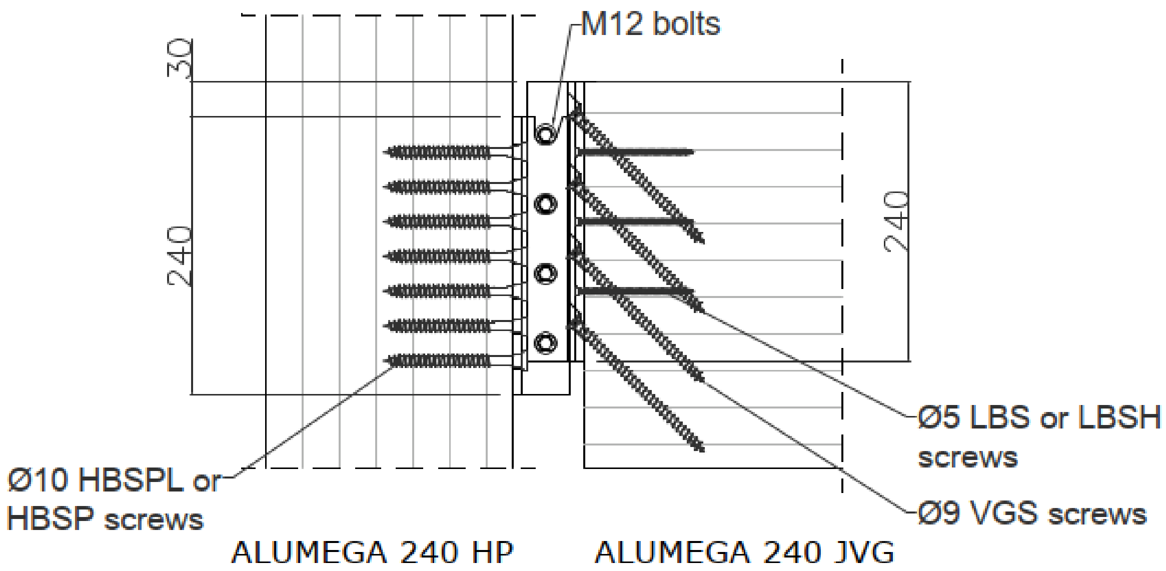
ALUMEGA HP + ALUMEGA JV



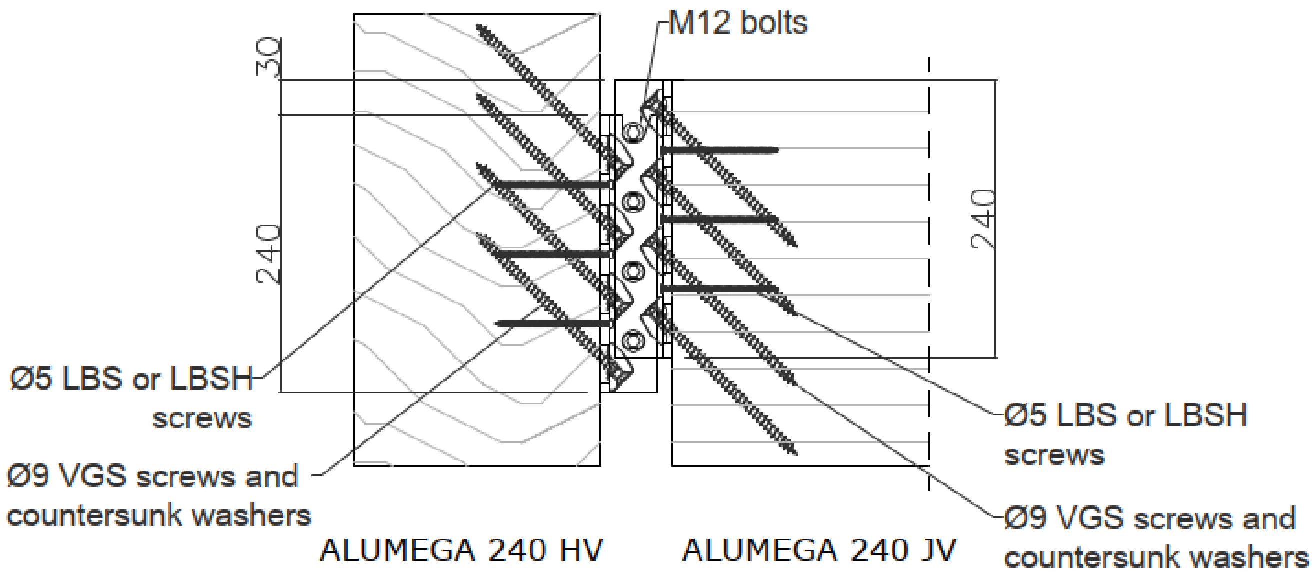


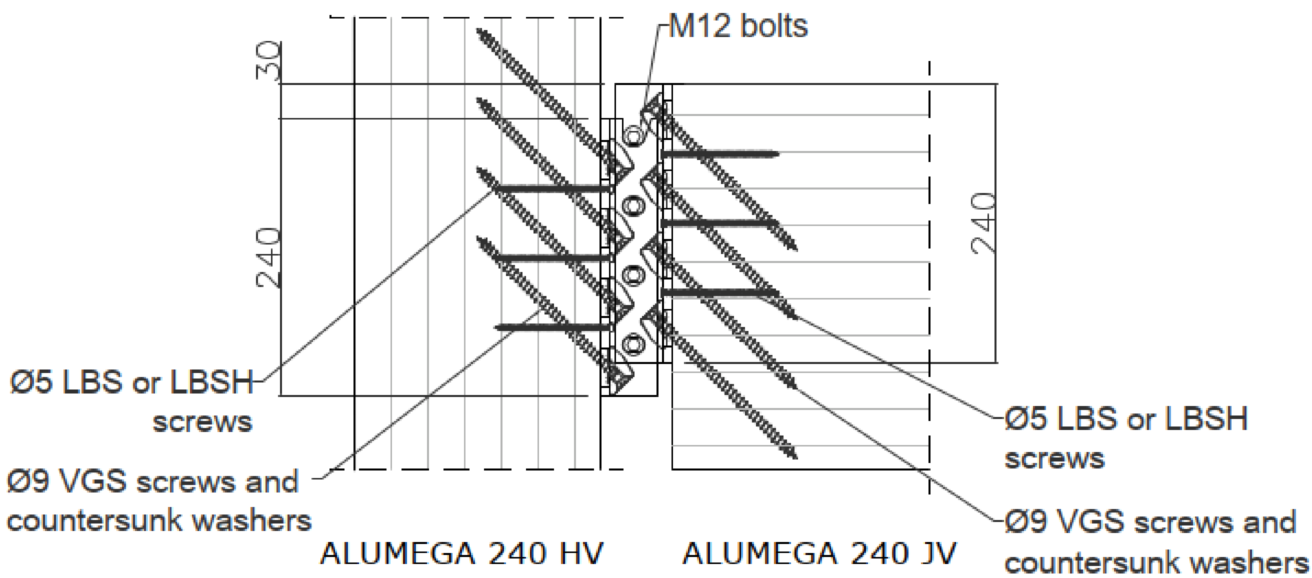
ALUMEGA HP + ALUMEGA JVG



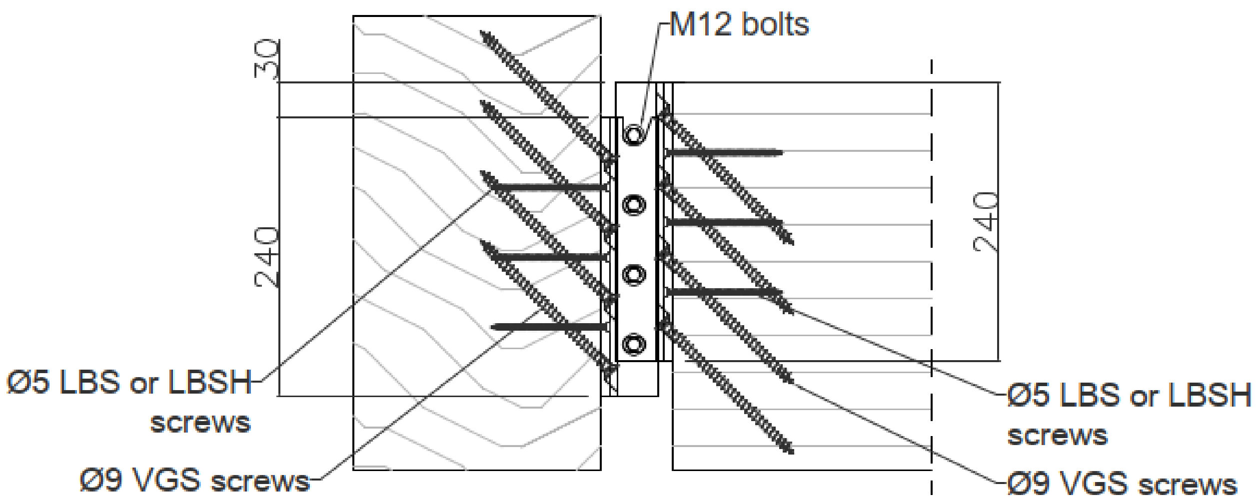


ALUMEGA HV + ALUMEGA JV

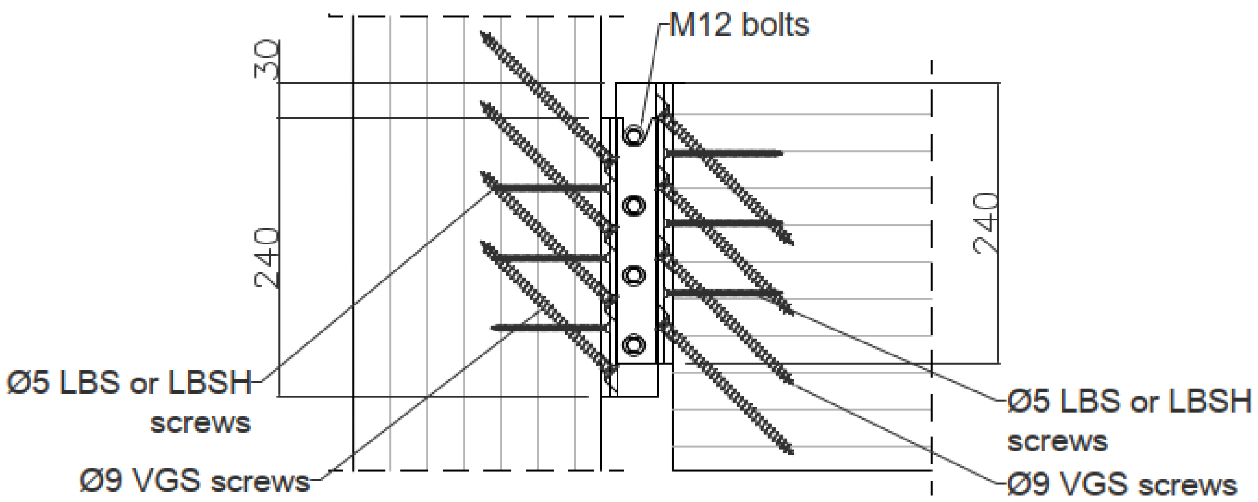




ALUMEGA HVG + ALUMEGA JVG

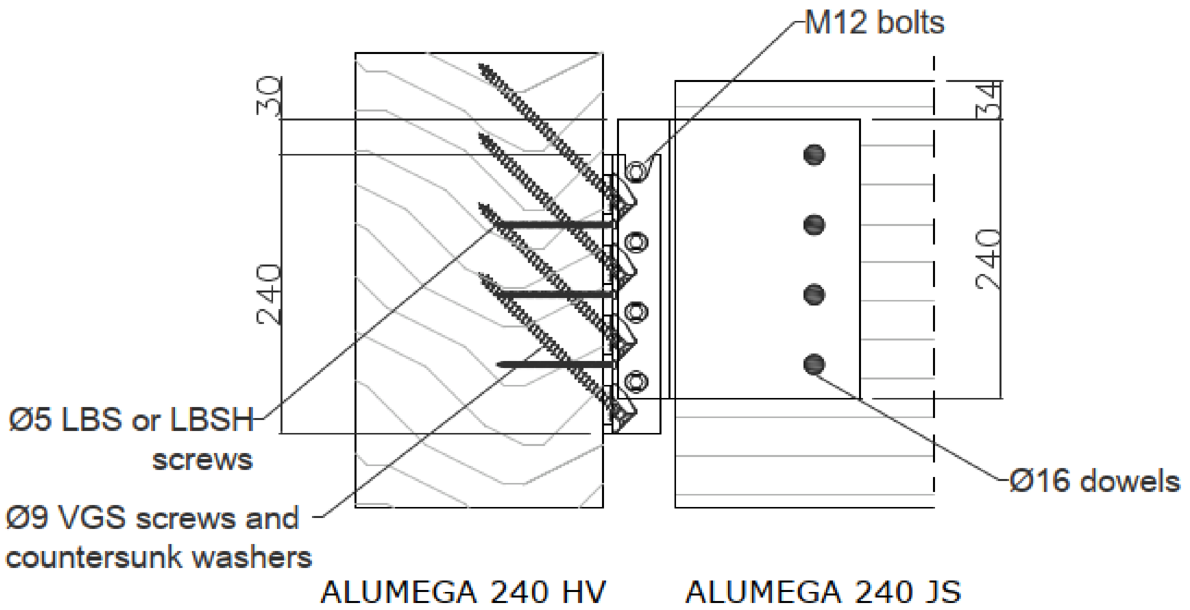


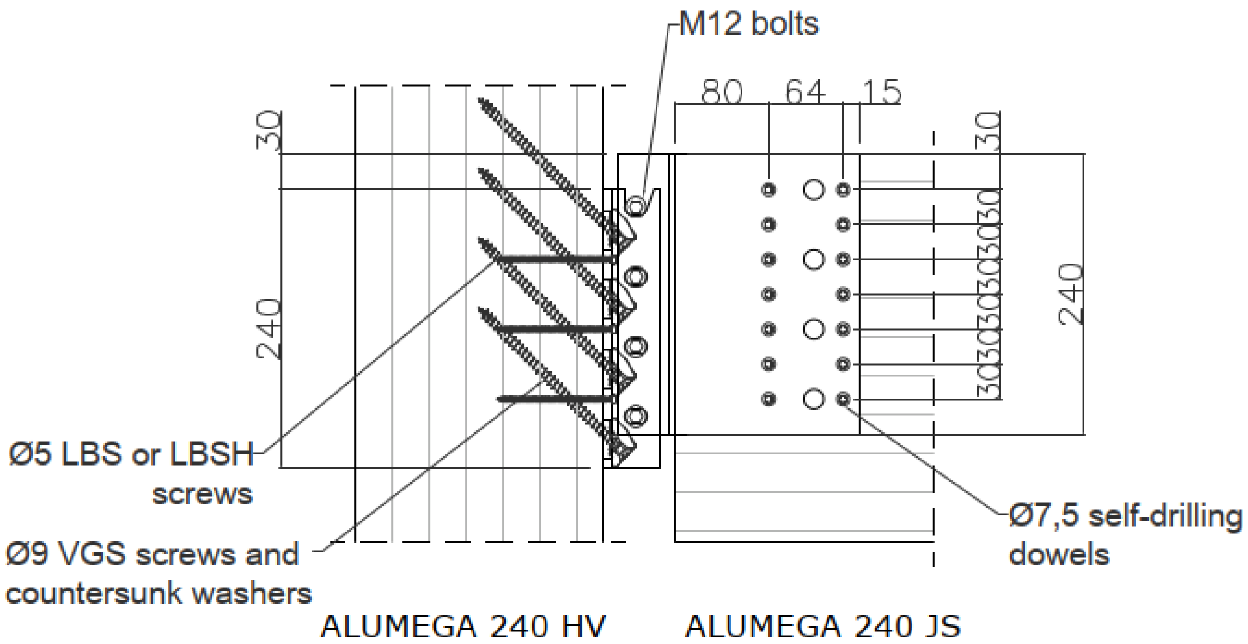
ALUMEGA 240 HVG ALUMEGA 240 JVG



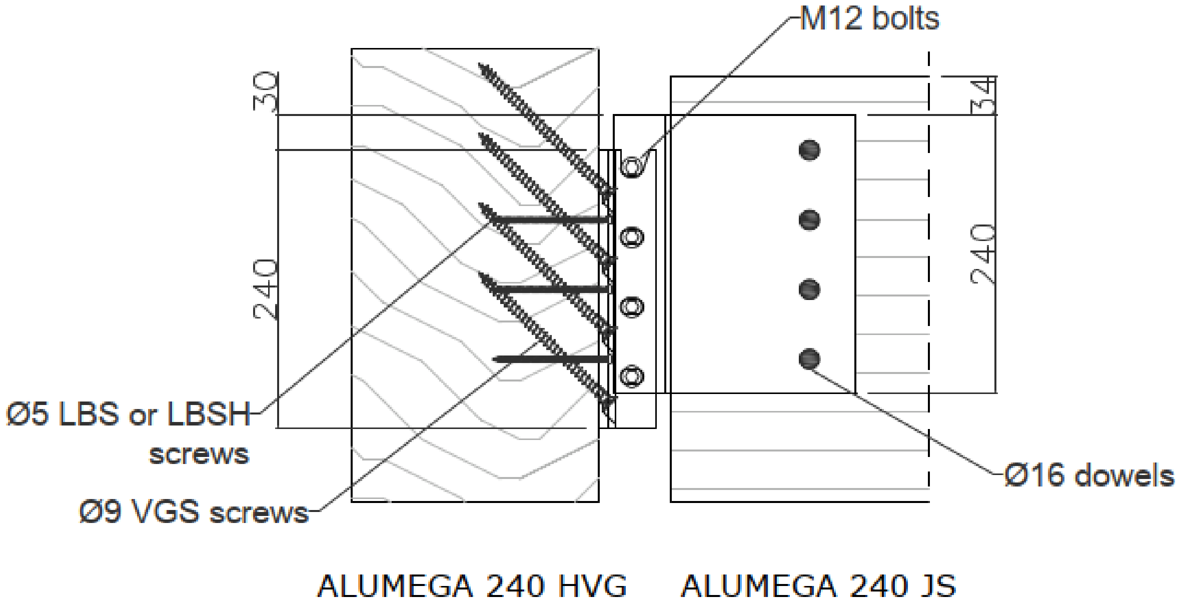
ALUMEGA 240 HVG ALUMEGA 240 JVG

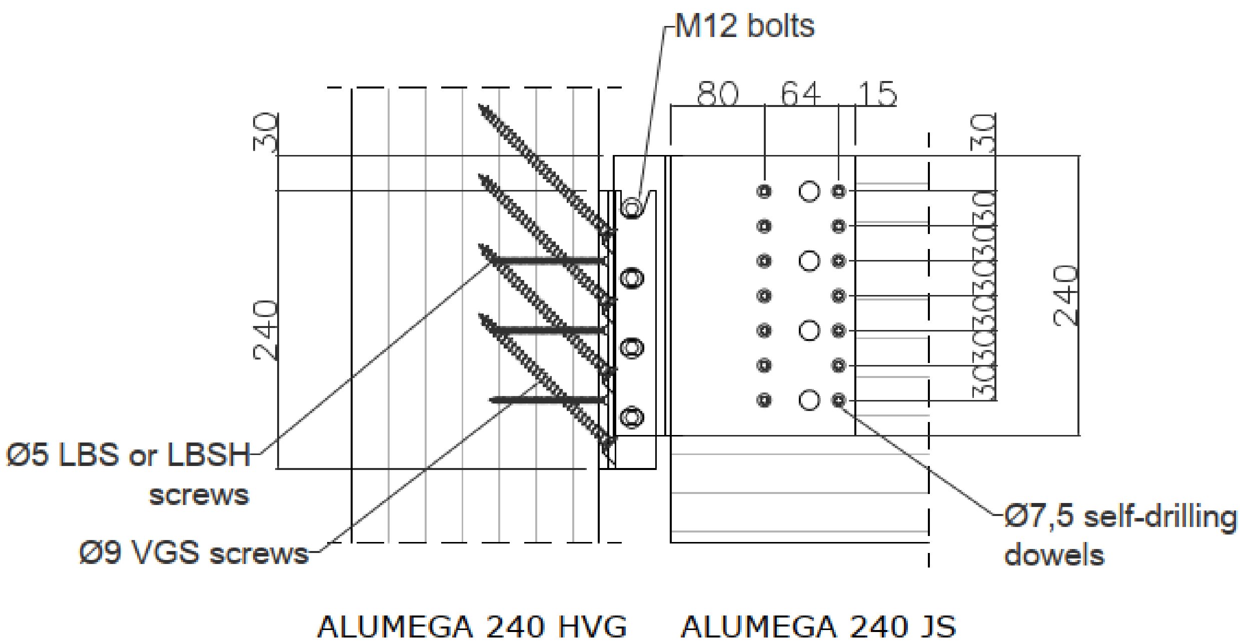
ALUMEGA HV + ALUMEGA JS



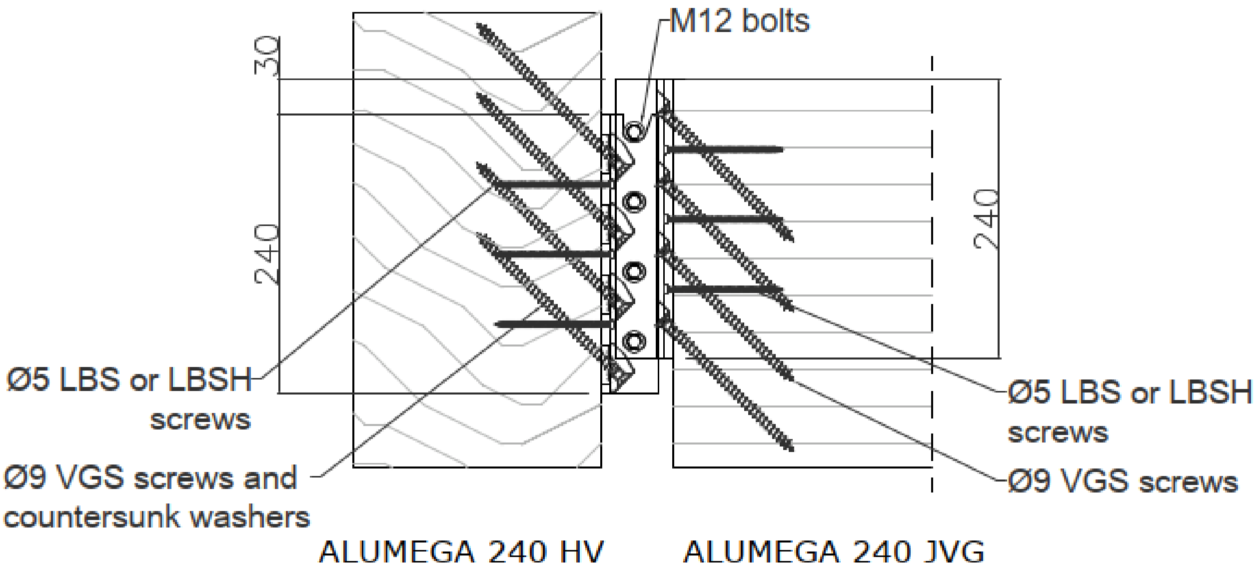


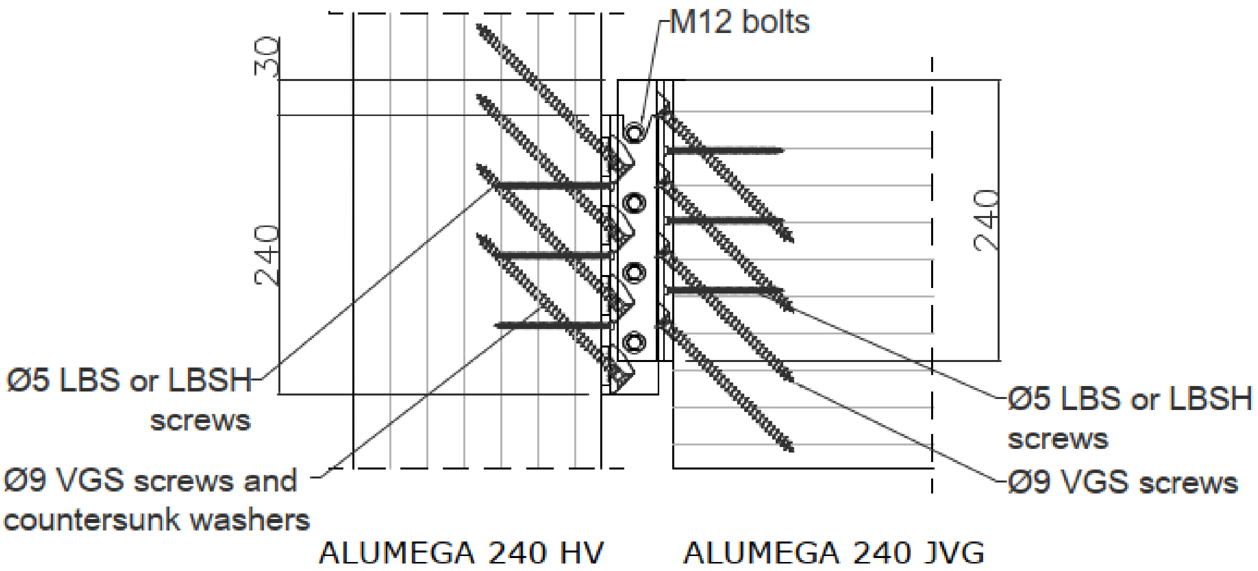
ALUMEGA HVG + ALUMEGA JS



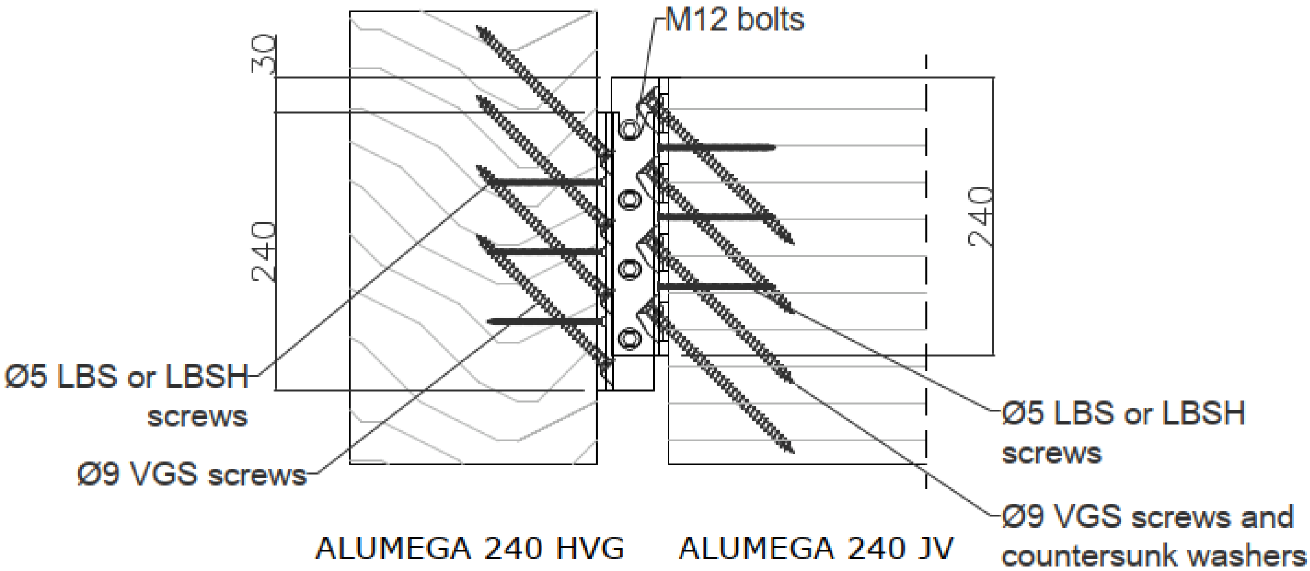


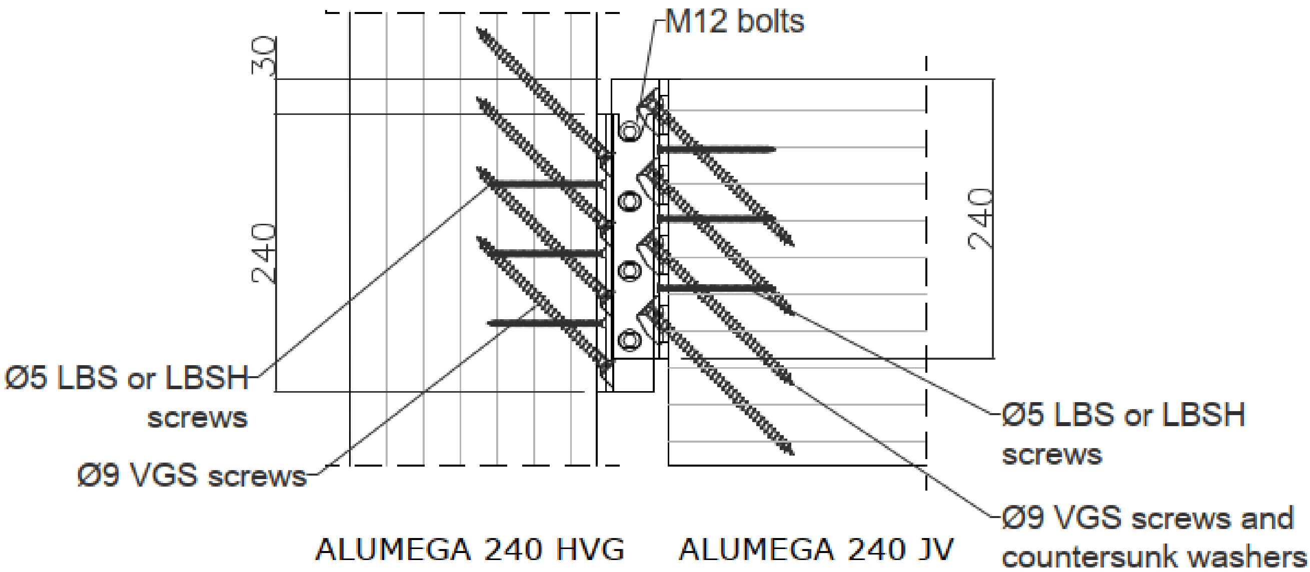
ALUMEGA HV + ALUMEGA JVG



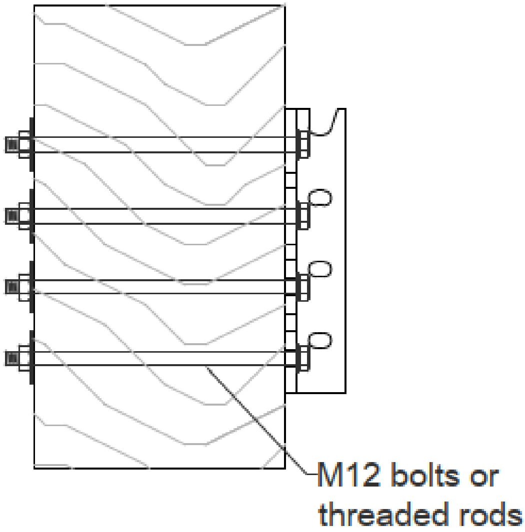


ALUMEGA HVG + ALUMEGA JV

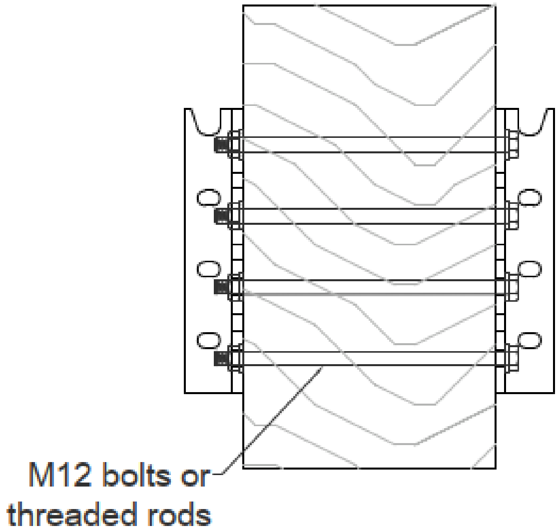




ALUMEGA HP FIXED WITH BOLTS OR THREADED RODS TO TIMBER

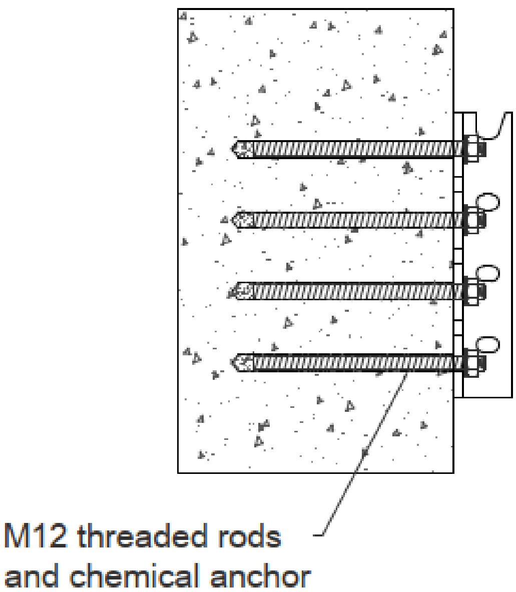


SINGLE SIDED
ALUMEGA 240 HP

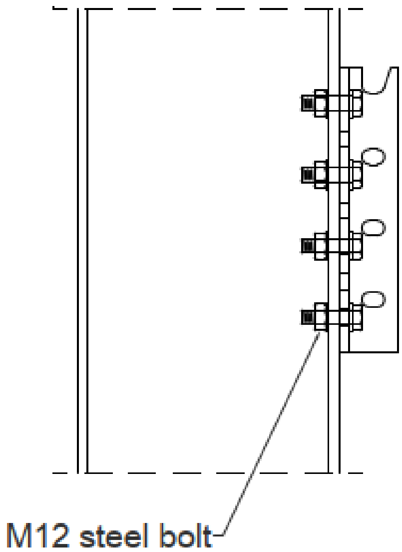


DOUBLE SIDED
ALUMEGA 240 HP

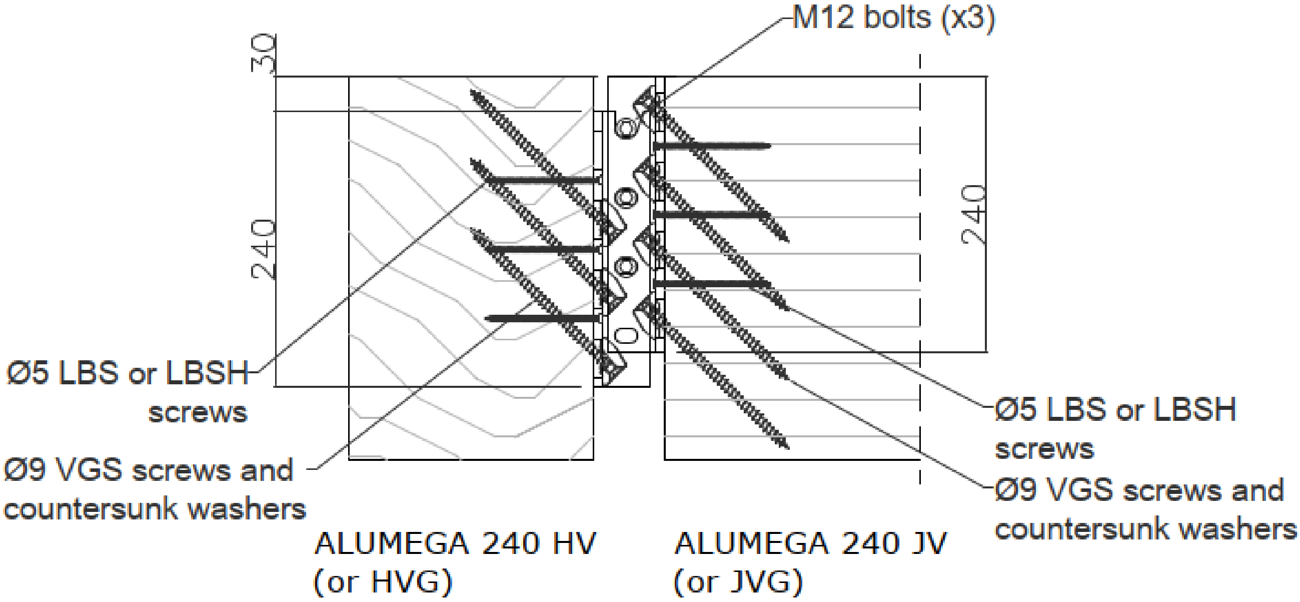
ALUMEGA HP FIXED TO CONCRETE



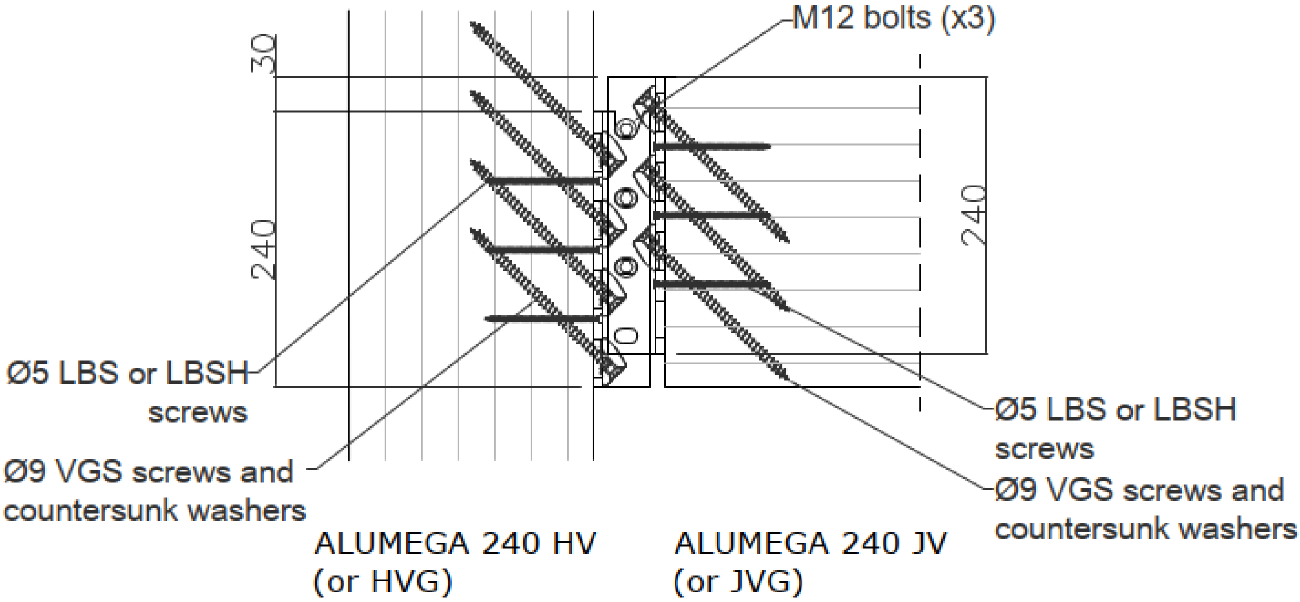
ALUMEGA HP FIXED TO STEEL



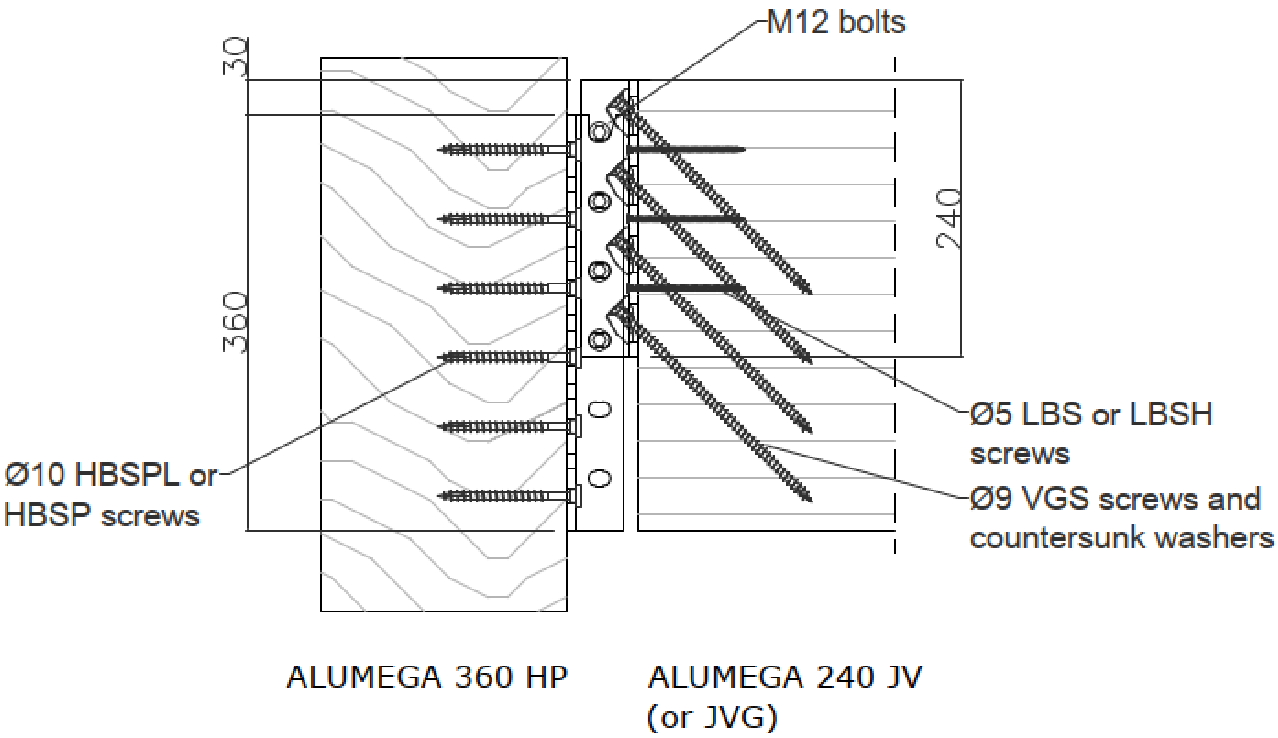
ALUMEGA HV PARTIAL PATTERN +
ALUMEGA JV FULL PATTERN



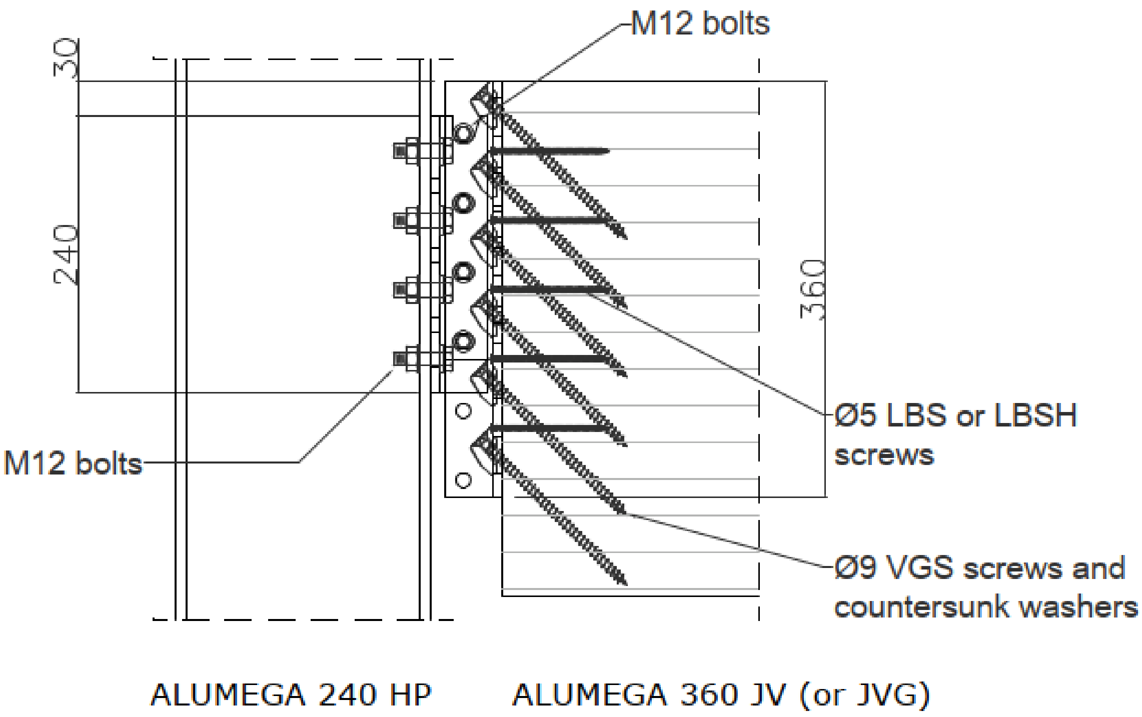
ALUMEGA HV FULL PATTERN +
ALUMEGA JV PARTIAL PATTERN



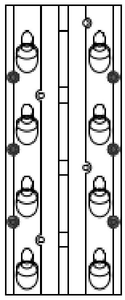
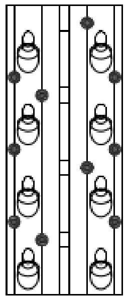
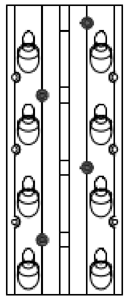
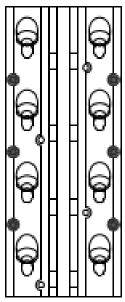
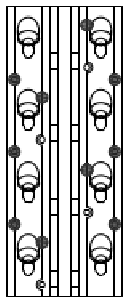
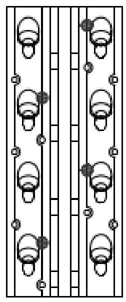
ALUMEGA HP PARTIAL PATTERN + ALUMEGA JV FULL PATTERN



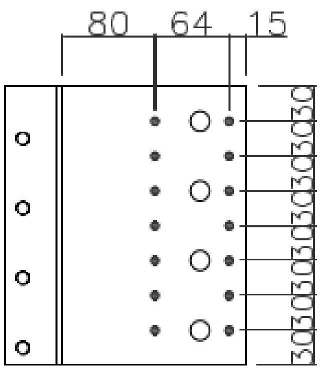
ALUMEGA HP FULL PATTERN + ALUMEGA JV FULL PATTERN



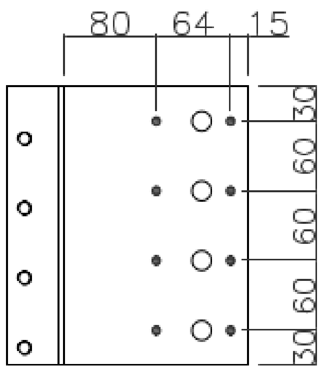
ALUMEGA HVG - ALUMEGA JVG
PATTERNS WITH LBS-LBSH SCREWS

	PATTERN 1	PATTERN 2	PATTERN 3
ALUMEGA HVG			
ALUMEGA JVG			

ALUMEGA JS
PATTERNS WITH SELF-DRILLING DOWELS



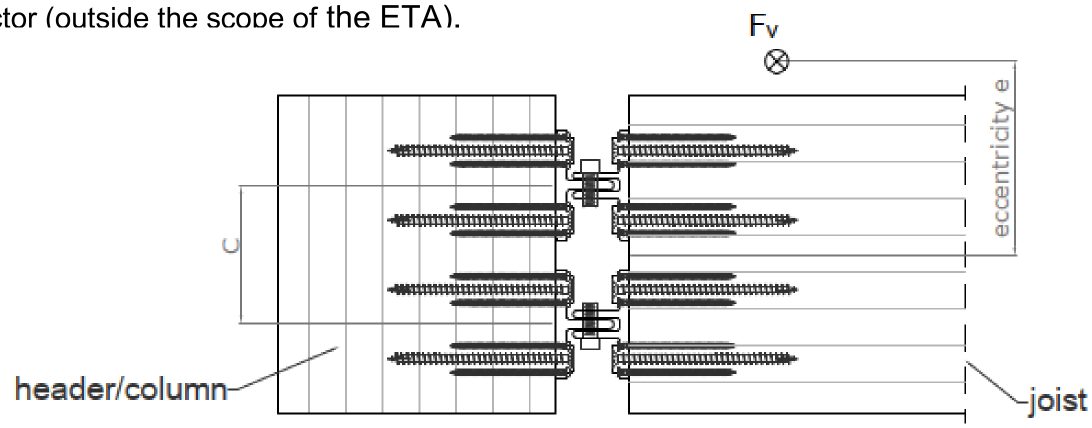
FULL PATTERN



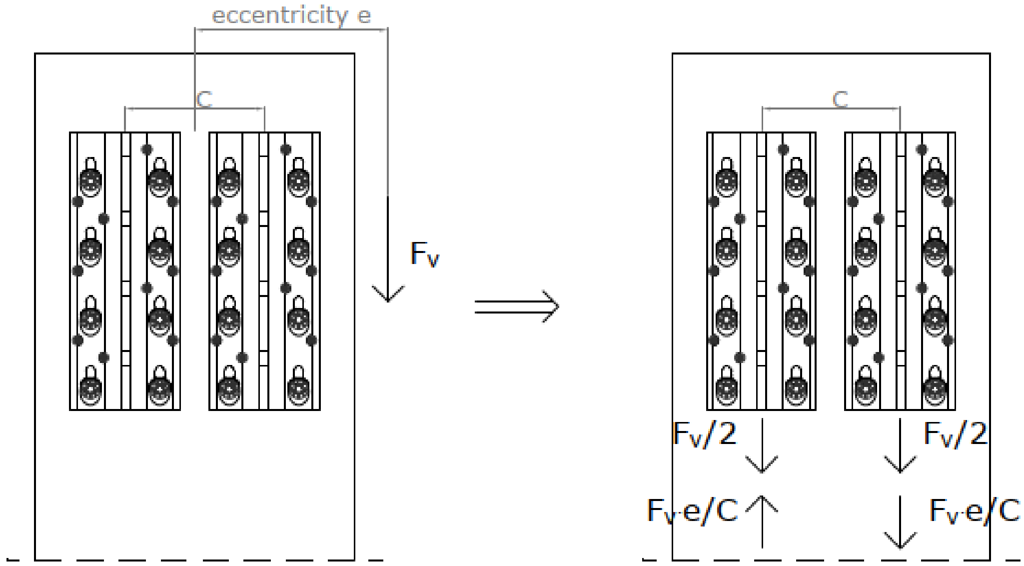
PARTIAL PATTERN

TORSION ON ALUMEGA CONNECTORS SIDE-BY-SIDE

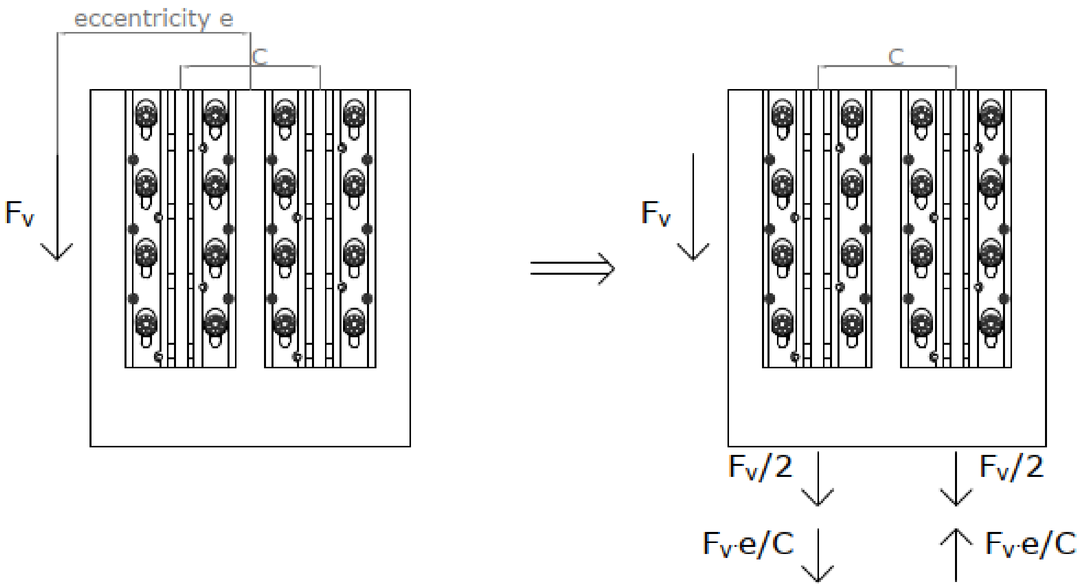
Torsion on the ALUMEGA connections can be resisted by using side-by-side connectors or with an additional connector (outside the scope of the ETA).



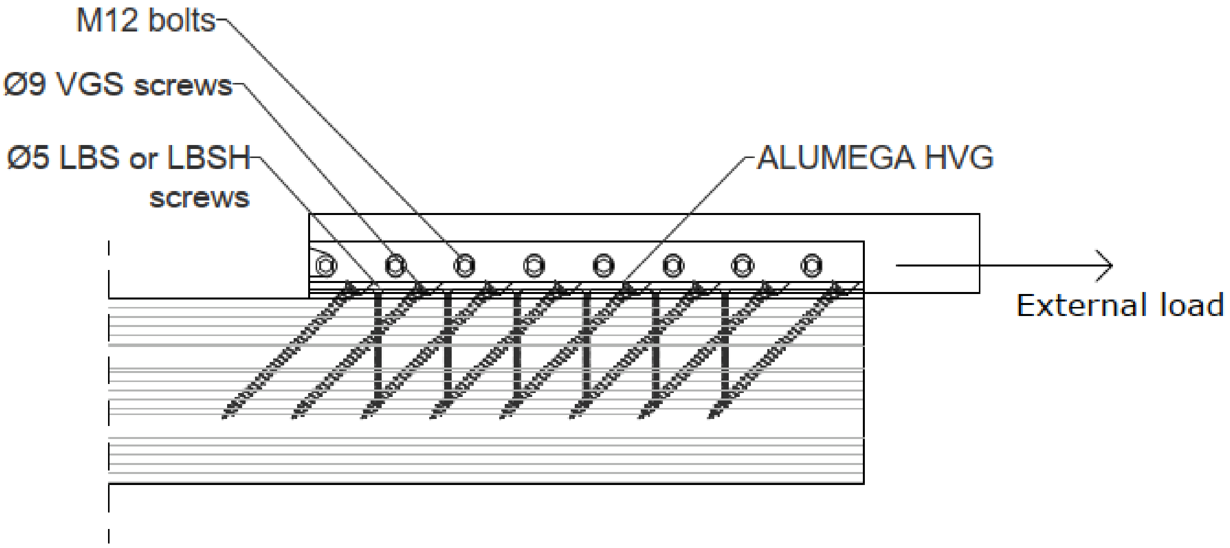
Eccentric force on the header/column connectors



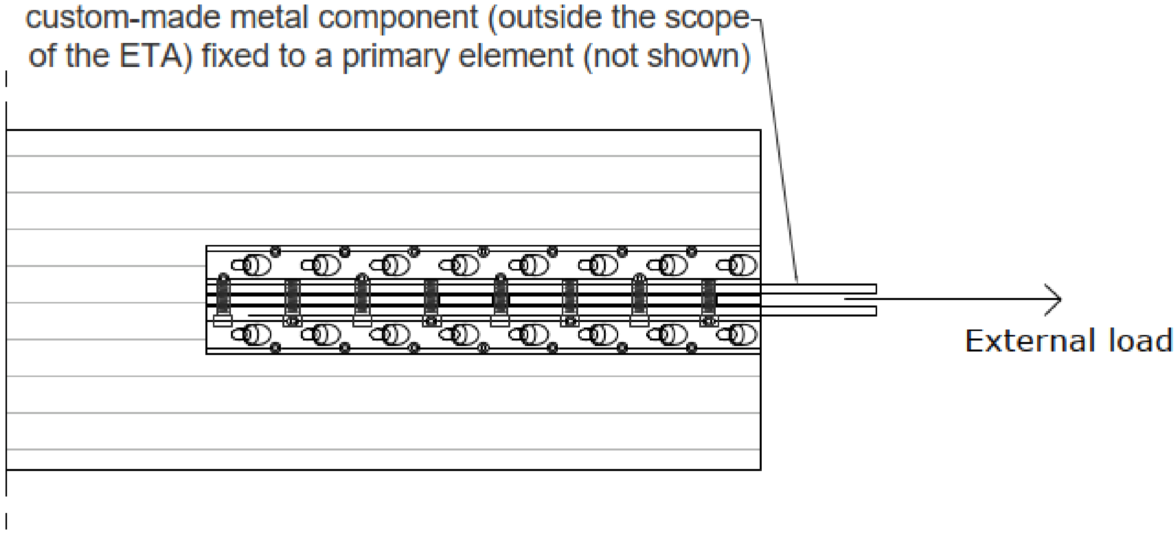
Eccentric force on the joist connectors



ALUMEGA HVG CONNECTORS USED AS HOLD-DOWN/ TIE

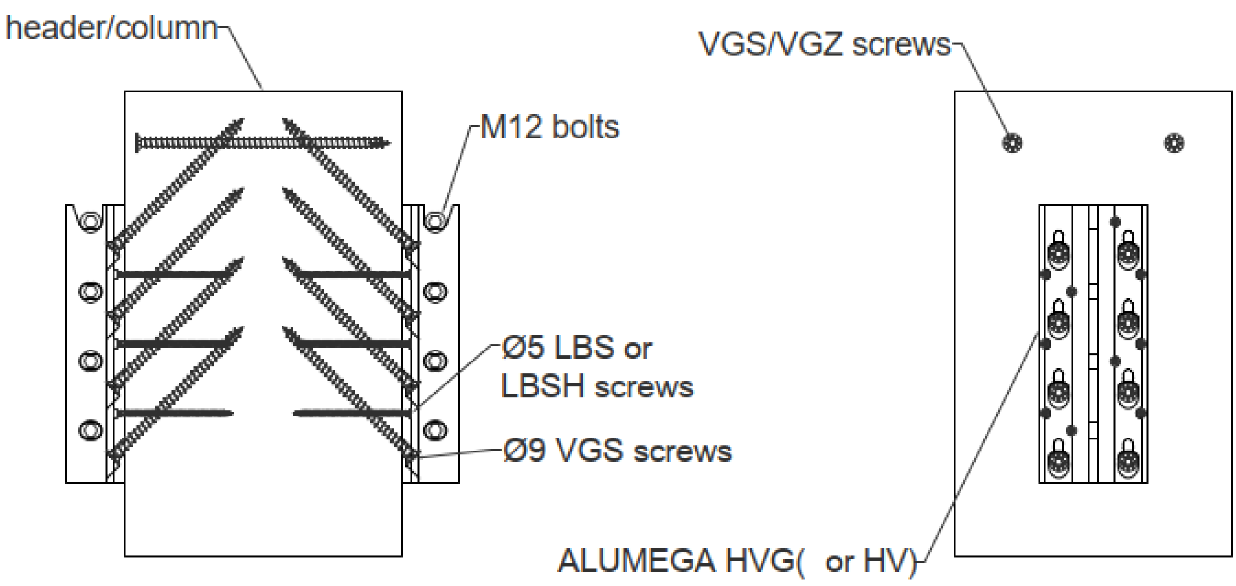


SECTION



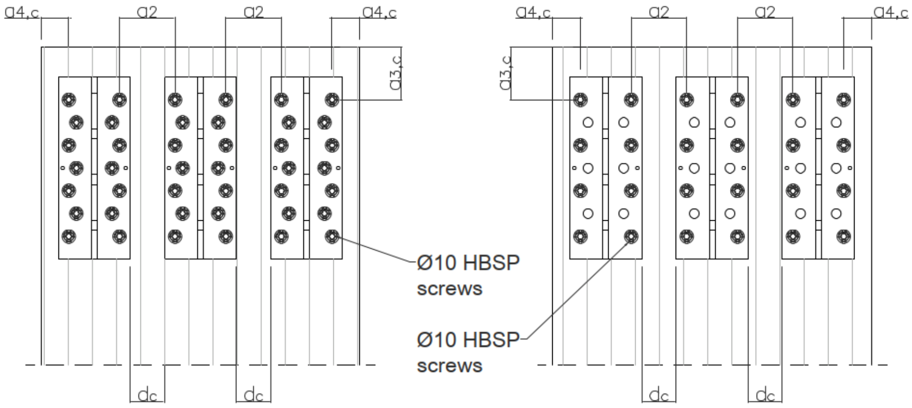
PLAN

DOUBLE SIDED ALUMEGA HVG FIXED TO HEADER/COLUMN WITH REINFORCEMENT SCREWS



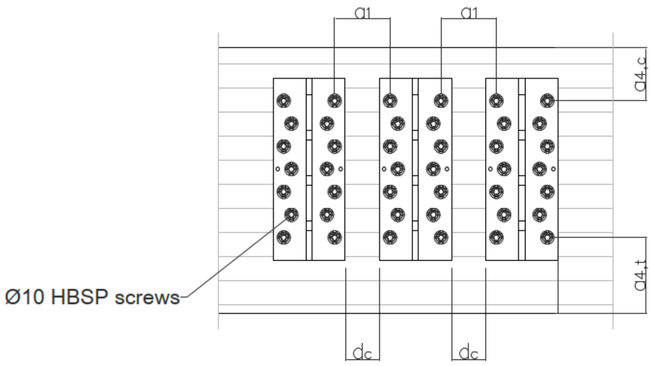
VGS reinforcement screws transfer tensile stresses perp. to grain outside the contact areas between connector plates and timber members caused by the load components perpendicular to the shear plane in the screw parts above the connectors.

ALUMEGA HP SIDE-BY-SIDE



ALUMEGA HP FULL PATTERN FIXED TO COLUMN

ALUMEGA HP PARTIAL PATTERN FIXED TO COLUMN

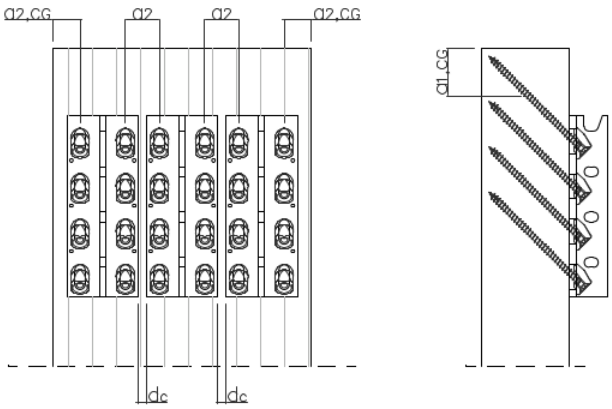


ALUMEGA HP FULL PATTERN FIXED TO HEADER

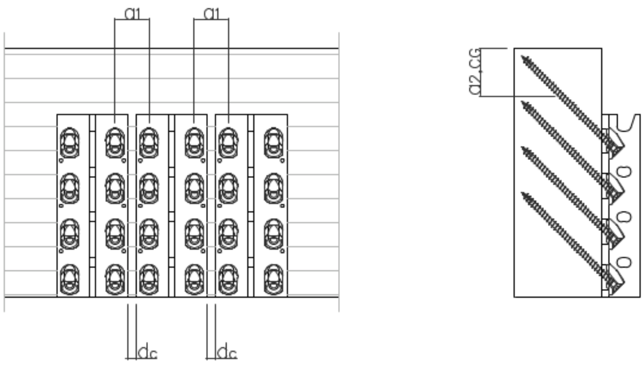
Load direction F_2, ALUMEGA HP column, non-pre-drilled holes: $a_{3,c} \geq 7$ d $a_{4,c} \geq 3.6$ d

For all other minimum spacing and distance requirements see ETA-11/0030.

ALUMEGA HV SIDE-BY-SIDE



ALUMEGA HV FULL PATTERN
FIXED TO COLUMN



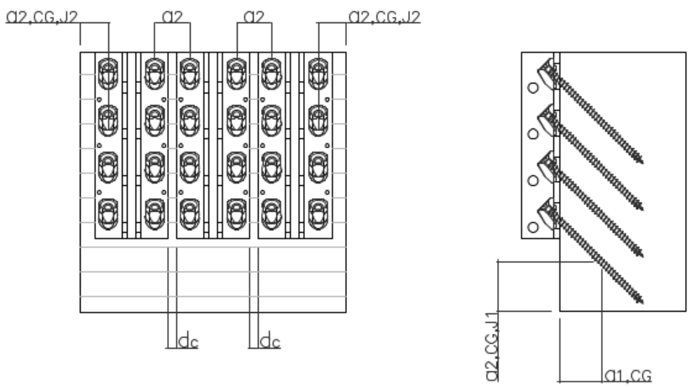
ALUMEGA HV FULL PATTERN
FIXED TO HEADER

Load direction F_2, ALUMEGA HV column, non-pre-drilled holes: $a_{1,CG} \geq 8.4$ d $a_{2,CG} \geq 4$ d

Load direction F_2, ALUMEGA HV header, non-pre-drilled holes: $a_{2,CG} \geq 4$ d

For all other minimum spacing and distance requirements see ETA-11/0030.

ALUMEGA JV SIDE-BY-SIDE



ALUMEGA JV FULL PATTERN
FIXED TO JOIST

Load direction F_2, ALUMEGA JV, non-pre-drilled holes: $a_{1,CG} \geq 6$ d $a_{2,CG,J1} \geq 8.4$ d $a_{2,CG,J2} \geq 4$ d

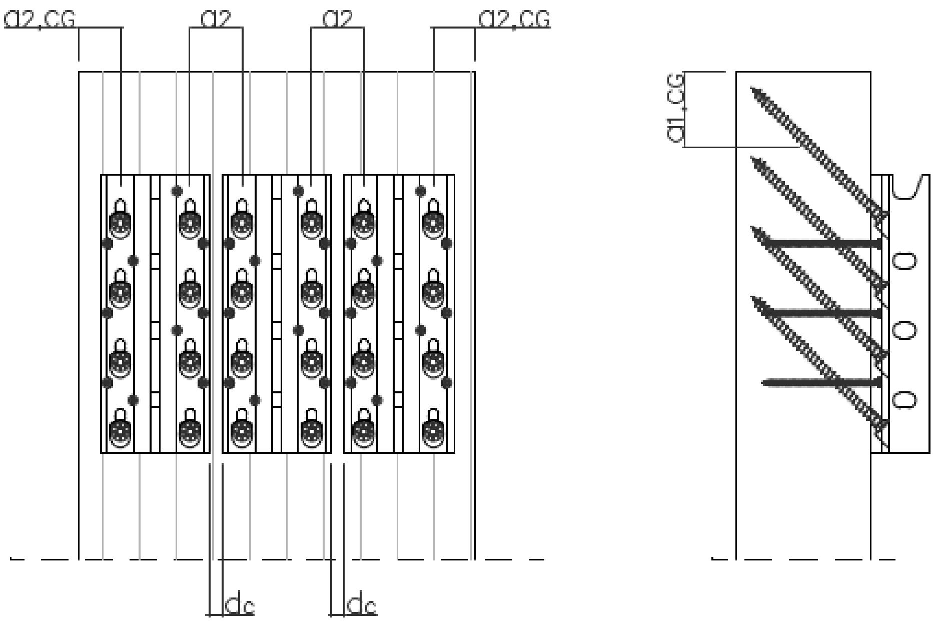
For all other minimum spacing and distance requirements see ETA-11/0030.

Minimum clear spacing d_c:

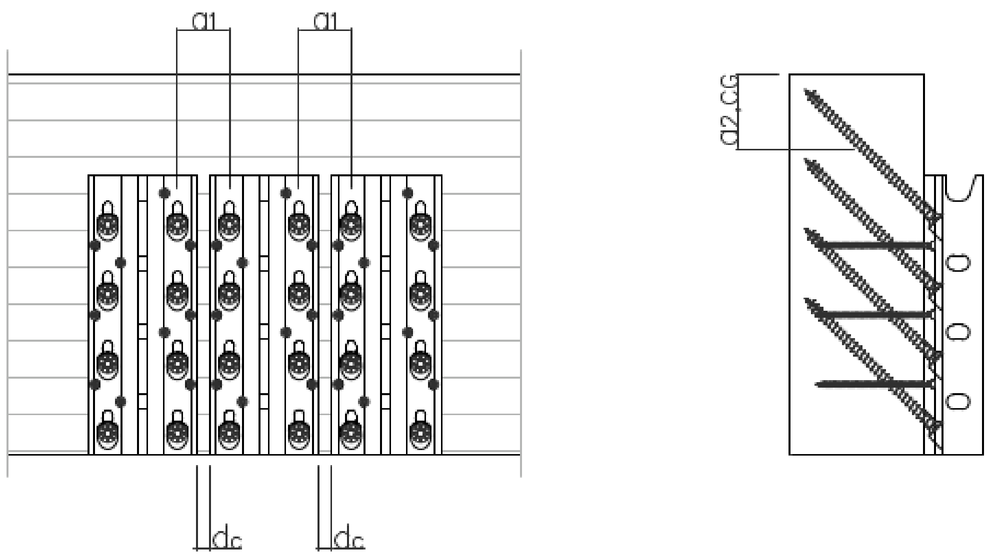
- Load direction F_1:
  - ALUMEGA HP column: d_c = 22 mm
  - ALUMEGA HP header: d_c = 42 mm
  - ALUMEGA HV or JV, $\rho_k \leq 420$ kg/m³: d_c = 10 mm
  - ALUMEGA HV or JV, $\rho_k \leq 500$ kg/m³: d_c = 28 mm
- Load direction F_2:
  - ALUMEGA HP, $\rho_k \leq 420$ kg/m³: d_c = 22 mm
  - ALUMEGA HP, $\rho_k \leq 500$ kg/m³: d_c = 42 mm
  - ALUMEGA HV column d_c = 10 mm
  - ALUMEGA HV header d_c = 10 mm
  - ALUMEGA JV d_c = 10 mm
- Load direction F_3:
  - ALUMEGA HP column: d_c = 22 mm
  - ALUMEGA HP header: d_c = 42 mm
  - ALUMEGA HV or JV, $\rho_k \leq 420$ kg/m³: d_c = 10 mm
  - ALUMEGA HV or JV, $\rho_k \leq 500$ kg/m³: d_c = 28 mm
- Load direction F_{45}:
  - ALUMEGA HP column, $\rho_k \leq 420$ kg/m³: d_c = 22 mm
  - ALUMEGA HP column, $\rho_k \leq 500$ kg/m³: d_c = 42 mm
  - ALUMEGA HP header, $\rho_k \leq 420$ kg/m³: d_c = 92 mm
  - ALUMEGA HP header, $\rho_k \leq 500$ kg/m³: d_c = 122 mm
  - ALUMEGA HV column or JV, $\rho_k \leq 420$ kg/m³: d_c = 10 mm
  - ALUMEGA HV column or JV, $\rho_k \leq 500$ kg/m³: d_c = 28 mm
  - ALUMEGA HV header, $\rho_k \leq 420$ kg/m³: d_c = 73 mm
  - ALUMEGA HV header, $\rho_k \leq 500$ kg/m³: d_c = 100 mm

For combinations of load directions, the maximum value governs.

ALUMEGA HVG SIDE-BY-SIDE

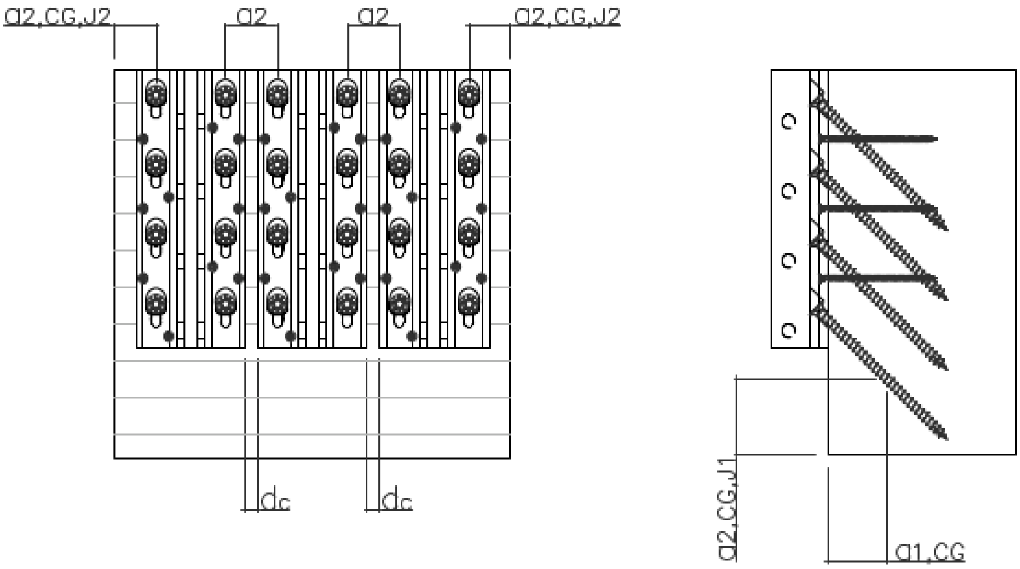


ALUMEGA HVG FULL PATTERN
FIXED TO COLUMN



ALUMEGA HVG FULL PATTERN
FIXED TO HEADER

ALUMEGA JVG SIDE-BY-SIDE

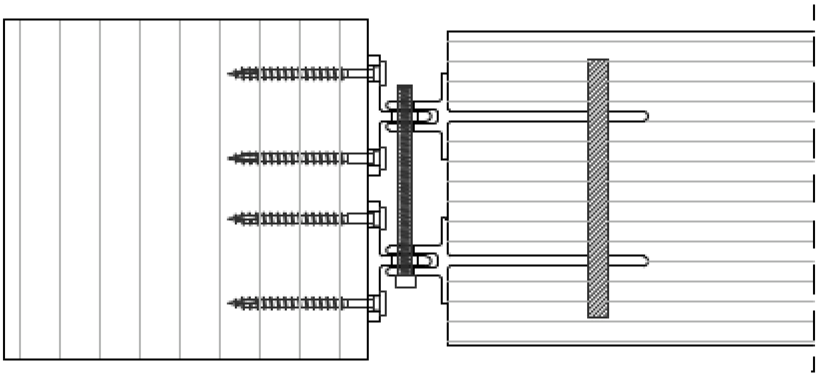


ALUMEGA JVG FULL PATTERN
FIXED TO JOIST

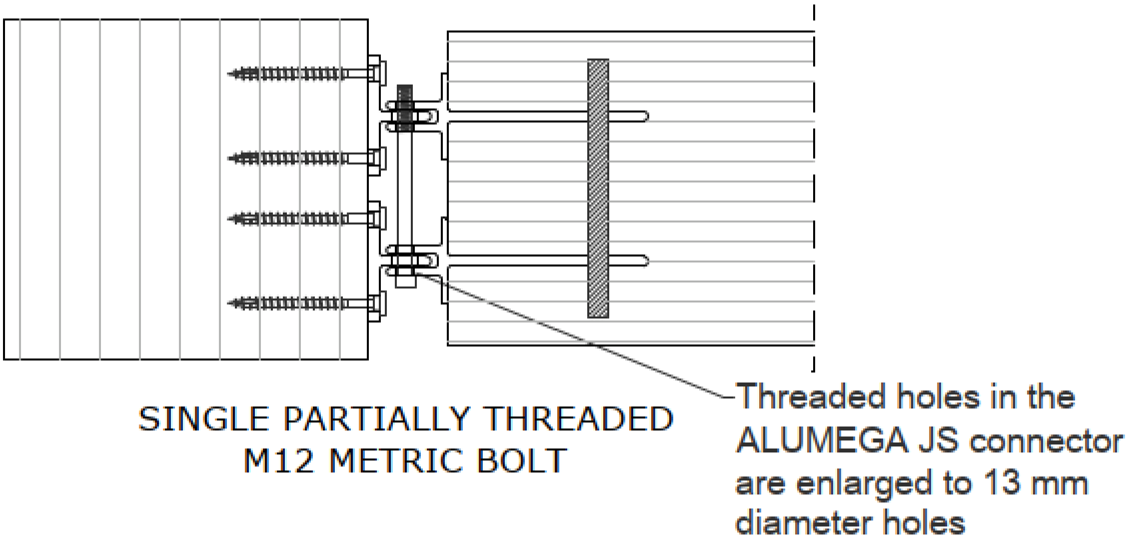
Minimum clear spacing d_c:	**LBS/LBSH Pattern 1 or 2**	**LBS/LBSH Pattern 3**
• Load direction F_1:		
○ ALUMEGA HVG or JVG, $\rho_k \leq 420$ kg/m³:	d_c = 13* mm	d_c = 10 mm
○ ALUMEGA HVG or JVG, $\rho_k \leq 500$ kg/m³:	d_c = 28 mm	d_c = 28 mm
• Load direction F_2:		
○ ALUMEGA HVG or JVG, $\rho_k \leq 420$ kg/m³:	d_c = 10 mm	d_c = 10 mm
○ ALUMEGA HVG or JVG, $\rho_k \leq 500$ kg/m³:	d_c = 23 mm	d_c = 10 mm
• Load direction F_3:		
○ ALUMEGA HVG or JVG, $\rho_k \leq 420$ kg/m³:	d_c = 13 mm	d_c = 10 mm
○ ALUMEGA HVG or JVG, $\rho_k \leq 500$ kg/m³:	d_c = 28 mm	d_c = 28 mm
• Load direction F_{45}:		
○ ALUMEGA HVG column or JVG, $\rho_k \leq 420$ kg/m³:	d_c = 13 mm	d_c = 10 mm
○ ALUMEGA HVG column or JVG, $\rho_k \leq 500$ kg/m³:	d_c = 28 mm	d_c = 28 mm
○ ALUMEGA HVG header, $\rho_k \leq 420$ kg/m³:	d_c = 73 mm	d_c = 73 mm
○ ALUMEGA HVG header, $\rho_k \leq 500$ kg/m³:	d_c = 100 mm	d_c = 100 mm

For combinations of load directions, the maximum value governs.
*d_c = 10 mm if the contribution of LBS/LBSH is not taken into account in B.1 and B.4.

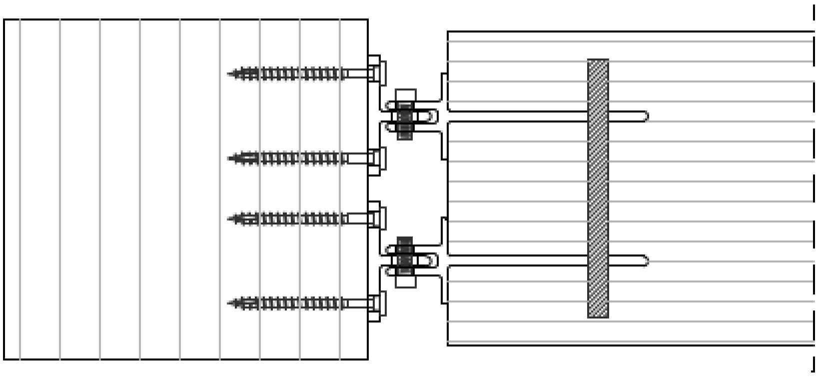
FIXING OPTIONS
M12 METRIC STEEL BOLT



SINGLE FULLY THREADED
M12 METRIC BOLT

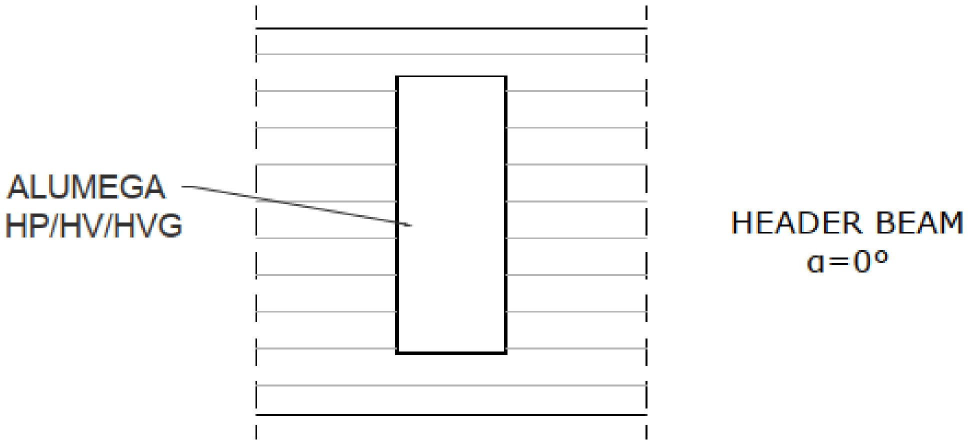


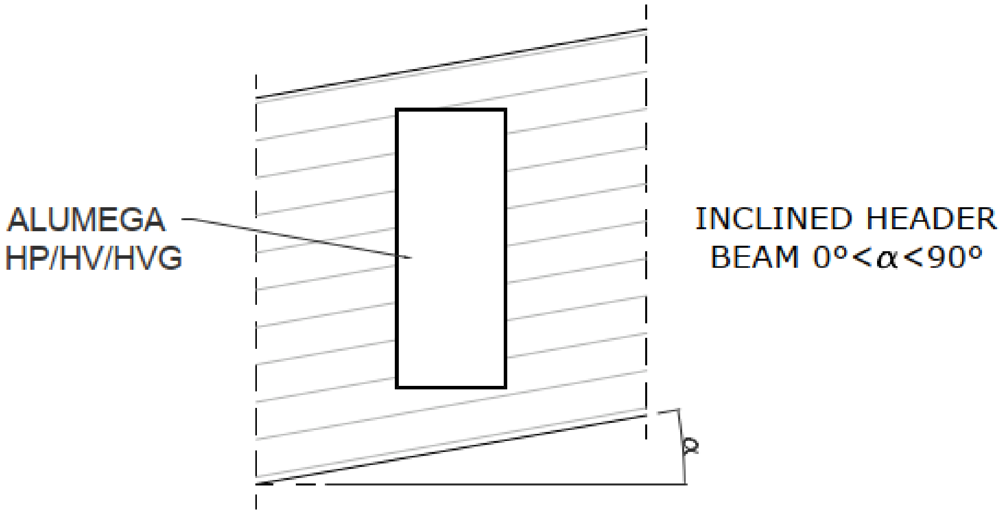
SINGLE PARTIALLY THREADED
M12 METRIC BOLT

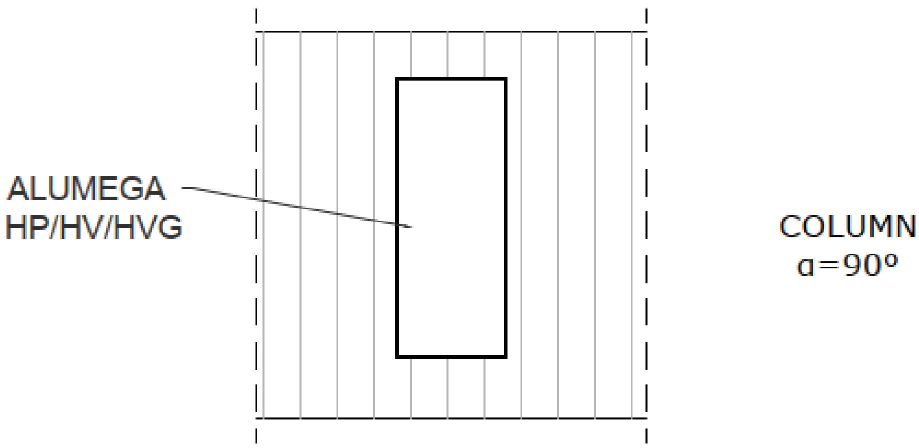


TWO SINGLE PARTIALLY
THREADED M12 METRIC BOLTS

PRIMARY MEMBER INCLINATION

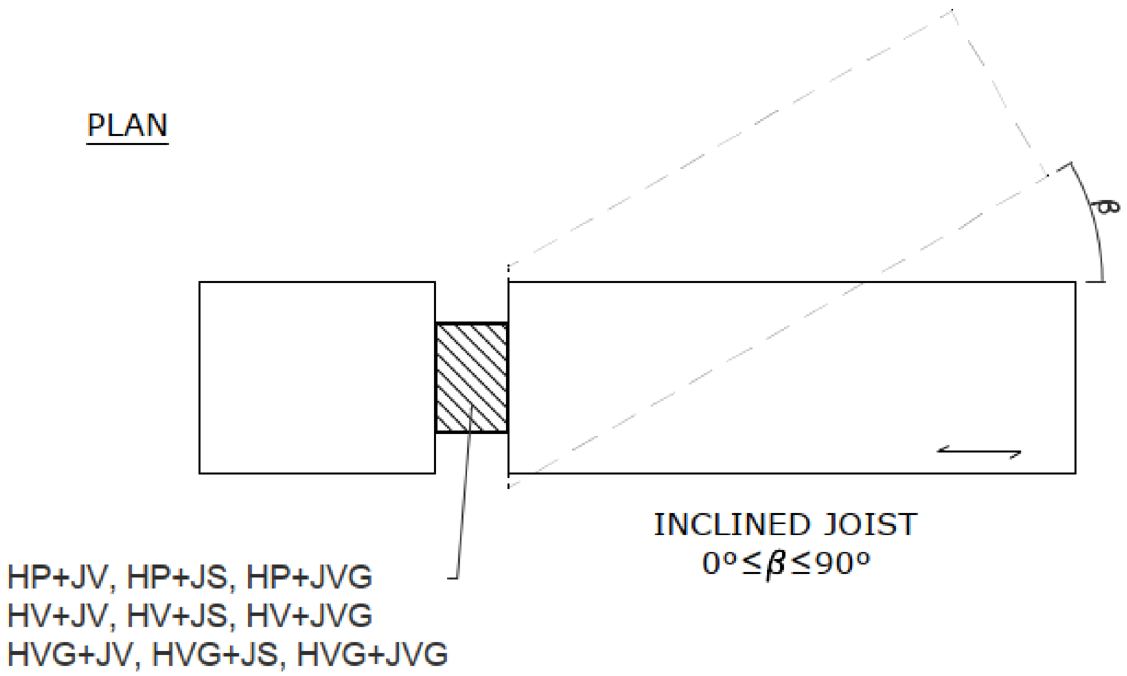




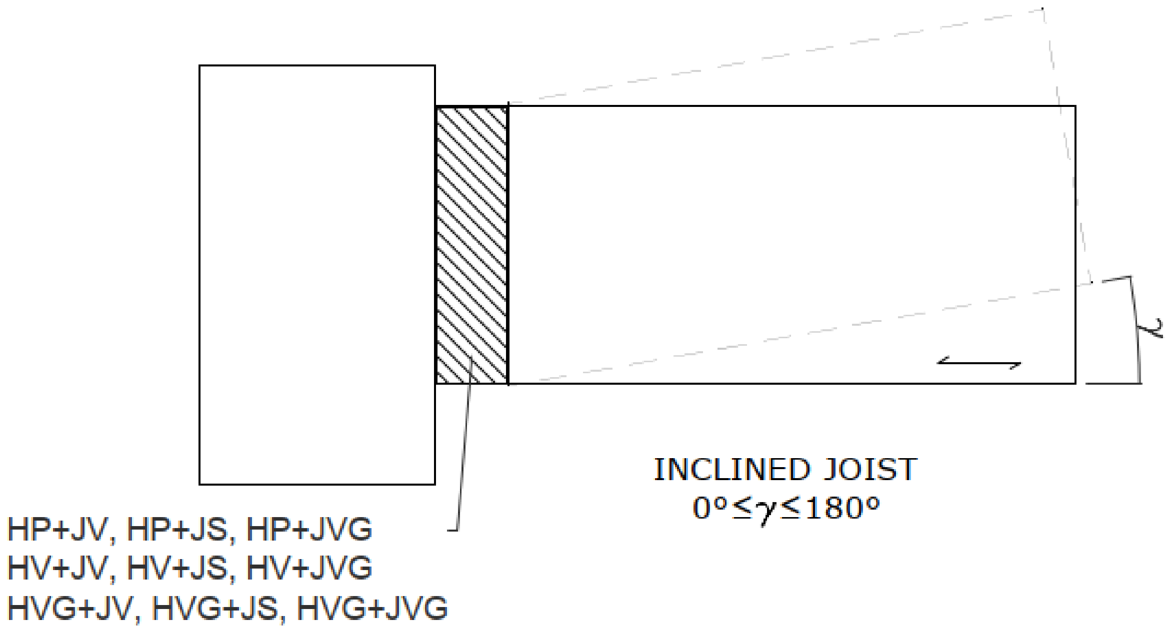


JOIST INCLINATION

PLAN

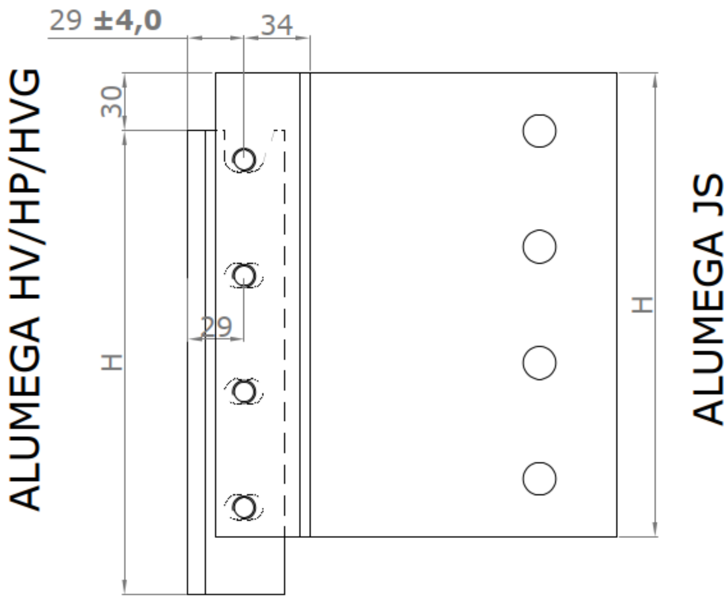


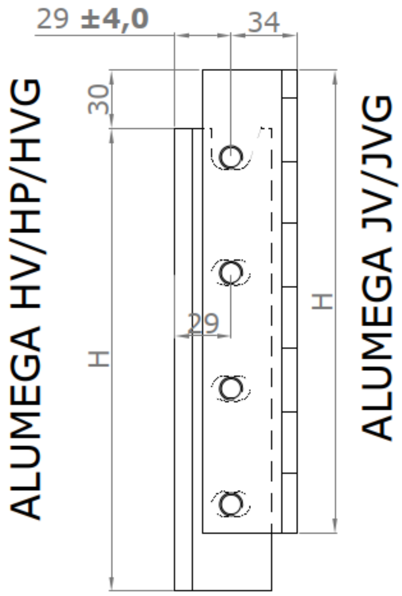
ELEVATION

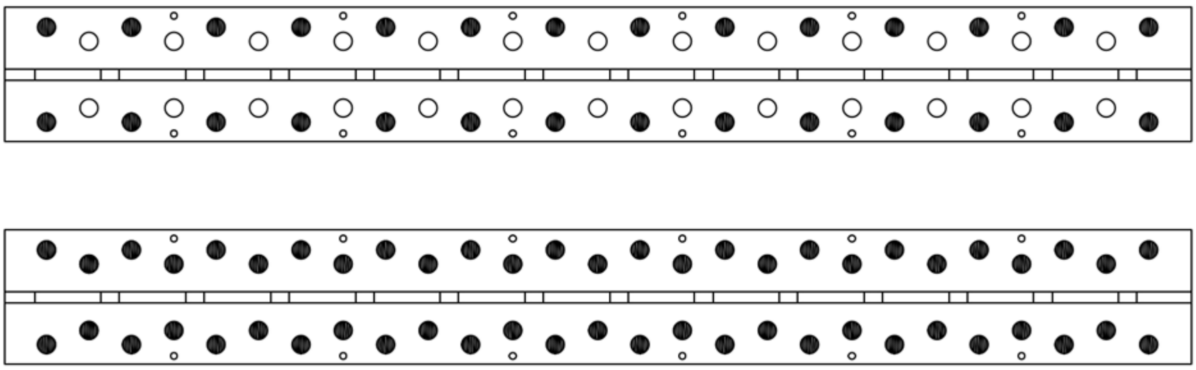


All fasteners must be fully embedded in the timber members and the minimum spacing and end or edge distances of each fastener must be observed

ASSEMBLY AND INSTALLATION TOLERANCE







Partial (top) and full (bottom) fastener pattern for ALUMEGA 840 HP.