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European Technical Assessment

**ETA 13/0787
of 28/02/2017**

General part

**Technical Assessment Body issuing the
ETA:**

**Technický a zkušební ústav stavební Praha,
s. p.**

Trade name of the construction product

Hold-downs, types:

340, , 440,
540, , 620

with washer plates

**Product family to which the construction
product belongs**

Three-dimensional nailing plates

Manufacturer

Manufacturing plant

**This European Technical Assessment
contains**

20 pages including Annexes A and B which form an integral part of this assessment. Annex C contains Control Plan with confidential information and is not included in the European Technical Assessment when that assessment is publicly disseminated.

**This European Technical Assessment is
issued in accordance with regulation (EU)
No 305/2011, on the basis of**

ETAG 015, edition November 2012, used as European Assessment Document (EAD) according to Article 66 (3) of the Regulation (EU) No. 305/2011

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Specific part

1 Technical description of the product

ADVECO hold-downs 340, 440, 540, 540.22, 620 and 620.26, basic dimensions 340x60x62x3, 440x60x62x3, 540x60x62x3, 620x80x82x3 mm, respectively, are face-fixed, nailing and bolting, three-piece, welded, zinc coated, steel angle brackets. They may be completed with massive rectangular washer plates of dimensions 50x60x10 and 70x80x20 mm.

The hold-downs are made of steel that complies with grade S355 according to EN 10025-2:2004 with $R_{eH} \geq 355$ MPa, R_m between 470 and 630 MPa and $A \geq 22\%$. The washer plates are made of steel grade S275 with $R_{eH} \geq 275$ MPa. The source materials are flat hot-rolled products with tolerances that correspond to the requirements of EN 10025-1:2004. Both the hold-downs and the washer plates are either hot dip galvanized according to EN ISO 1461:2009 with a minimum zinc coating mass of Z275 or with equivalent electroplated zinc coating Fe/Zn 12c according to EN ISO 2081:2008.

Dimensions of the products are given in Annex A.

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

ADVECO hold-downs are intended for timber-to-concrete perchance for timber-to-steel connections fastened by a range of nails and bolts or metal anchors.

The hold-downs are used for connecting load bearing elements, as for instance in connections of timber post to concrete base, where requirements for mechanical resistance and stability and safety in use in the sense of the Basic Requirements for Construction Works 1 and 4 of Annex I in Regulation (EU) No. 305/2011 (CPR), as amended, shall be fulfilled.

The connection may be with a single hold-down or with a hold-down on each side of the fastened timber member.

The wood members can be of solid timber, glued laminated timber and similar glued members, or wood-based structural products with a characteristic density between 290 and 420 kg/m³.

This requirement to the material of the wood members can be fulfilled by using the following materials:

- Solid timber classified to C14-C40 according to EN 338 / EN 14081
- Glued members of timber classified to C14-C40 according to EN 338 / EN 14081 when structural adhesives are used
- Glued laminated timber classified to GL24c or better according to EN 14080
- Solid Wood Panels, SWP according to EN 13353+A1
- Laminated Veneer Lumber LVL according to EN 14374
- Plywood according to EN 636+A1

2.1 Specifications on design of works

In Annex B there are stated characteristic load-bearing capacities of the connections with the hold-downs in question and resisting uplift force F_{hd} . For all the types the

load bearing capacities are given for hold-downs with and without the corresponding washer plate.

The stated characteristic load-bearing capacities are moreover conditioned by the use of the fasteners, support conditions of the connected members and the other conditions as summarized in Annexes A and B.

Namely, it is presumed that no rotation of the connected wood member occurs. The rotation shall be hindered by other structural links.

The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code in part related to the assessment of the failure modes governed by wood including nails. The connection to concrete with a metal anchor or a bolt perchance connection to a steel member shall be assessed in line with CEN/TS 1992-4-1 *Design of fastenings for use in concrete* perchance in line with EN 1993-1-8. The reliability management of design and execution of the timber structure shall comply with the requirements stipulated in Cl. 2.2 of EN 1990.

The minimum thickness of the wood members shall be larger than the penetration depth of the fasteners. Where overlapping of fasteners occurs the respective rule stipulated in Cl. 8.3.1.1 of EN 1995-1-1:2004/A1+A2 applies.

Where relevant, possible splitting of the wood member by the tensile force component perpendicular to grain and block shear or plug shear failure shall be assessed.

The intended use of the hold-downs is for connections subjected to static or quasi-static loading.

Their inherent corrosion resistance conforms to the use in timber structures subjected to the dry, internal conditions defined by service class 1 and 2 of Eurocode 5.

The hold-downs can also be used in the connections of outdoor timber structures, service class 3, provided these are adequately protected against corrosion as stipulated in Eurocode 5.

2.2 Specifications on installation of the products on site

The following provisions concerning installation apply:

- *Fasteners*

The minimum number of fasteners used are specified in Annex B. The fasteners shall comply with the specification in Annex A of this ETA. The minimum spacing and edge and end distances shall comply with the requirements of the respective Timber Code.

- *Support conditions*

The members connected by the hold-downs shall be prevented from rotation.

- *Wood members*

Strength class C14 as a minimum, see above. There is no wane in the region of the connection and splits, knots or other defects are limited such that the load-bearing capacity of the connection is not affected. If single hold-down per connection is used the members shall have thickness greater than the penetration depth of the nails. In case double hold-down connection is used overlapping of the nails shall comply with 8.3.1.1 (7) in EN 1995-1-1:2004/A1+A2.

- *Gap size between members*

It is supposed the hold-downs are face fixed in full contact with surfaces of the connected members. The gap between connected members does not exceed 3 mm.

- *Contact with preservative-treated timbers*

If preservative treated timber is used it shall comply with EN 15228. The preservative used shall be compatible with the corrosion protection coating of the connector and fasteners. Note: Protection by zinc coating Z275 or the equivalent Fe/Zn 12c is normally considered as sufficient when copper salts or organic substances are used as treatment in service classes 1 and 2.

- *Additional conditions*

The execution of the connection shall comply with the ETA holder's technical instructions.

2.3 Assumed working life

The assumed working life for the intended use, as foreseen period of time throughout which the construction product, as installed into a construction work, will keep its performances allowing the construction work, behaving under predictable actions and with normal maintenance, to meet the basic requirements for construction works, is 50 years.

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

Basic Requirement for the construction work	EAD: ETAG 015, section:	Essential Characteristic	Performance
Mechanical resistance and stability (BWR 1)			For details of assessment procedure refer to section 3.1.1 of this ETA
	2.4.1.2.1	Strength	Refer to Annex B in this ETA
	2.4.1.2.2	Stiffness	<i>No performance assessed</i>
	2.4.1.2.3	Ductility in cyclic testing	<i>No performance assessed</i>
Safety in case of fire (BWR 2)			
	2.4.2.1	Reaction to fire	The hold-downs are made of steel classified as Euroclass A1 in accordance with EN 13501-1+A1 and EC Decision 96/603/EC, as amended
	2.4.2.2	Fire resistance	<i>No performance assessed</i> Fire resistance would be determined for the complete structural element with associated finishes, not for a separate connector. Therefore no performance has been assessed.
Hygiene, health and environment (BWR 3)			
	2.4.3	Content and/or release of dangerous substances	<i>No performance assessed</i> – additional assessment is necessary regarding the use category - refer to section 3.1.2 of this ETA
Safety and accessibility in use (BWR 4)			<i>No performance assessed</i> Note: specific aspects of BWR 4 related to mechanical resistance are assessed under BWR 1
Sustainable use of natural resources (BWR 7)			<i>No performance assessed</i> Note: specific aspects of BWR 7 – durability and environmental compatibility are assessed under BWR 3 and the following General aspects
		General aspects relating to intended use (durability, serviceability and identification)	
	2.4.7	Durability, resistance to corrosion and deterioration	Refer to section 3.1.3 of this ETA
	2.4.8	Dimensional stability	Refer to section 3.1.4 of this ETA
		Serviceability	The hold-downs 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 dry internal conditions defined by service class 1 and 2
	5.1, 5.2	Identification of the product	Refer to Annex A in this ETA

3.1 Methods of assessment

3.1.1 Mechanical resistance and stability

For determining the load-bearing capacities of hold-downs method calculation assisted by testing, as described in the EOTA Guideline 015 clause 2.4.1.1.2, was used.

Numerical values of the characteristic load-bearing capacities as given in Annex B were calculated using the verified calculation model considering characteristic yield strength of steel stated above and the characteristic load-bearing capacities (thick steel plate assumed) of the fasteners determined according to Eurocode 5 in conjunction with EN 14592, as amended.

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.

No performance has been determined in relation to the stiffness properties of the connections.

3.1.2 Content and/or release of dangerous substances

In case of three-dimensional nailing plates the release scenarios of dangerous substances shall be considered as relevant that correspond to the use categories IA1, IA2 and IA3 according to EOTA TR 034, edition 10/2015, which stand for conditions pertaining to the *Products with direct contact to indoor air*, *Product with no direct contact to (e.g. covered products) but possible impact on indoor air* and *Product with no contact to and no impact on indoor air*, respectively. With zinc coated steel products it is basically the relative content of cadmium (Cd) and lead (Pb) in zinc coating that is a matter of concern depending on the release scenario/use category and the notified regulations relevant for the place of use.

According to the chemical constitution and composition of the materials and components of the product submitted by the ETA-holder to the TAB it is to be stated that coating of primary zinc to EN 1179 or of secondary zinc to EN 13283 may be used regarding the use category, place of the use and the relevant regulatory requirements.

In addition to the specific clauses relating to dangerous substances contained in this European Technical Assessment, there may be other requirements applicable to the products falling within its scope (e.g. transposed European legislation and national laws, regulations and administrative provisions). In order to meet the provisions of the Construction Products Regulation, these requirements need also to be complied with, when and where they apply.

It is stated that the ETA holder will meet the requirements for information about dangerous substances when declaring the relative content of lead and cadmium in the zinc coating.

3.1.3 Durability, resistance to corrosion and deterioration

As a minimum, the respective characteristics of the materials employed are that of S355JR (hold down) and S275JR (washer plate) with corrosion protection Z275 or Fe/Zn 12c.

The corrosion protection of the hold-downs complies with requirements for service classes 1 and 2.

3.1.4 Dimensional stability

This property has been assessed during assessment of mechanical resistance and stability. It is stated that there is a negligible risk of a zipper-like failure when the long alignment goes parallel to the grain as is the normal case with connections of hold-downs and timber posts.

Generally, the effect of long alignments with rows of nails parallel to grain is taken into account by considering reduced (effective) number of nails n_{ef} according to the clause 8.3.1.1 (8) in EN 1995-1-1, refer to Annex B

When possibly the hold-down is oriented perpendicular to the grain of solid wood or similar wood member situated in service class 1 or 2 and the length of fastener alignment is less than 600 mm, as is the case of the ADVECO hold-downs, the risk of the zipper-like failure due to varying moisture content and induced shrinkage and swelling is also negligible.

If in a specific case the conditions of use of a hold-down fall beyond the scope specified above the possible impact of moisture induced deformations on uneven distribution of lateral force among fasteners shall be taken into account in the design.

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

According to Decision 97/638/EC of the Commission of 1 October 1997, published in the Official Journal of the European Communities L 268/36 of 1/10/1997, the system of assessment and verification of constancy of performance (see Annex V to Regulation (EU) No 305/2011, as amended) given in the following table applies.

Product	Intended use	Level or class	System
Three-dimensional nailing plates (with fasteners specified)	For structural timber products	Reaction to fire class and resistance to fire classes according to EN 13501-2	2+

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

5.1 Tasks of the manufacturer

The manufacturer may only use initial and constituent materials stated in the technical documentation of this European Technical Assessment.

The European Technical Assessment is issued for the product on the basis of agreed data, deposited with TZÚS Praha, s. p., which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data being incorrect, shall be notified to TZÚS Praha, s. p., before the changes are introduced. TZÚS Praha, s. p., will decide whether or not such changes affect the assessment.

Welds connecting parts of the hold-downs have been identified as structural link significant for the structural behaviour of the connectors thus affecting the load-

bearing capacity of the connection. Hence, welding shall be considered as critical process during manufacturing the connectors and shall be in line with the requirements of EN ISO 3834-3.

The process of cold-forming parts of above stated structural steel is critical to reliable ductile behaviour of structural elements in question. The process shall meet the requirements of EN 1090-2 Cl. 6.5.4 in line with EN 10025-2 Cl. 7.4.2.2.

Similarly, the process of zinc coating shall meet the requirements of EN ISO 14713, and EN ISO 1461 or EN ISO 2081

Apart from marking and performance information of the products as required in EAD, the manufacturer shall provide technical instructions on design and installation of the products in works complying with the conditions stipulated in this ETA. These shall be made available, e. g. in accompanying documents to the products.

5.2 Factory production control

The manufacturer shall exercise permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer shall be documented in a systematic manner in the form of written policies and procedures, including records of results performed. This production control system shall ensure that the product is in conformity with this European Technical Assessment.

The factory production control shall be in accordance with the "Control plan to ETA 13/0787, hold-downs with washer plates", version 2 that is a part of the technical documentation of this European Technical Assessment. The control plan is laid down in the context of the factory production control system operated by the manufacturer and deposited with TZÚS Praha, s. p.¹

Issued in Prague on 28.02.2017



By **Ing. Maria Schaan**

Head of the Technical Assessment Body

¹ The control plan is a confidential part of the European Technical Assessment and only handed over to the notified body or bodies involved in the procedure of Assessment and Verification of Constancy of Performance of the products.

Annex A
Product details and definitions

Table A.1 Dimensions and parent material specifications

Hold-down /washer plate Code No.	Type dimensions (mm)	Thickness (mm)	Steel specification	Coating specification
340	340x60x62	3.0	S355	Z275 or Fe/Zn 12c
440	440x60x62	3.0	S355	Z275 or Fe/Zn 12c
540	540x60x62	3.0	S355	Z275 or Fe/Zn 12c
540.22	540x60x62	3.0	S355	Z275 or Fe/Zn 12c
620	620x80x82	3.0	S355	Z275 or Fe/Zn 12c
620.26	620x80x82	3.0	S355	Z275 or Fe/Zn 12c
10	50x60x10	10.0	S275	Z275 or Fe/Zn 12c
10.22	50x60x10	10.0	S275	Z275 or Fe/Zn 12c
20	70x80x20	20.0	S275	Z275 or Fe/Zn 12c
20.26	70x80x20	20.0	S275	Z275 or Fe/Zn 12c

Table A.2 Tolerances

Connector	Lengths (mm)	Hole position and spacing (mm)	Hole diameter (mm)
All types	±1	±1	±0.2

Table A.3 Fastener specification

Nail type	Nail size (mm)		Finish
	Diameter	Length	
According to EN 14592 Threaded nail with truncated cone under the head	4.0	60	Zinc-coated
<p>The capacities for threaded (ring shank) nails calculated from the formulas of Eurocode 5, are used assuming a thick steel plate when calculating the nail lateral load-bearing capacity. The characteristic withdrawal capacity of the nails was determined by calculation according to the respective formula from paragraph 8.3.2 of EN 1995-1-1:2004/A1+A2:</p> $F_{ax,Rk} = f_{ax,k} \cdot d \cdot t_{pen}$ <p>$f_{ax,k}$ is the characteristic withdrawal strength, in N/mm² d nail diameter, in mm t_{pen} penetration length of the threaded part of shank, in mm</p> <p>The characteristic withdrawal strength is calculated as:</p> $f_{ax,k} = 50 \cdot 10^{-6} \cdot \rho_k^2$			

Bolt or Metal anchor diameter (mm)	Corresponding nut dimension (mm)	Type
16	24	According to the specification of the manufacturer
20	30	According to the specification of the manufacturer
24	36	According to the specification of the manufacturer

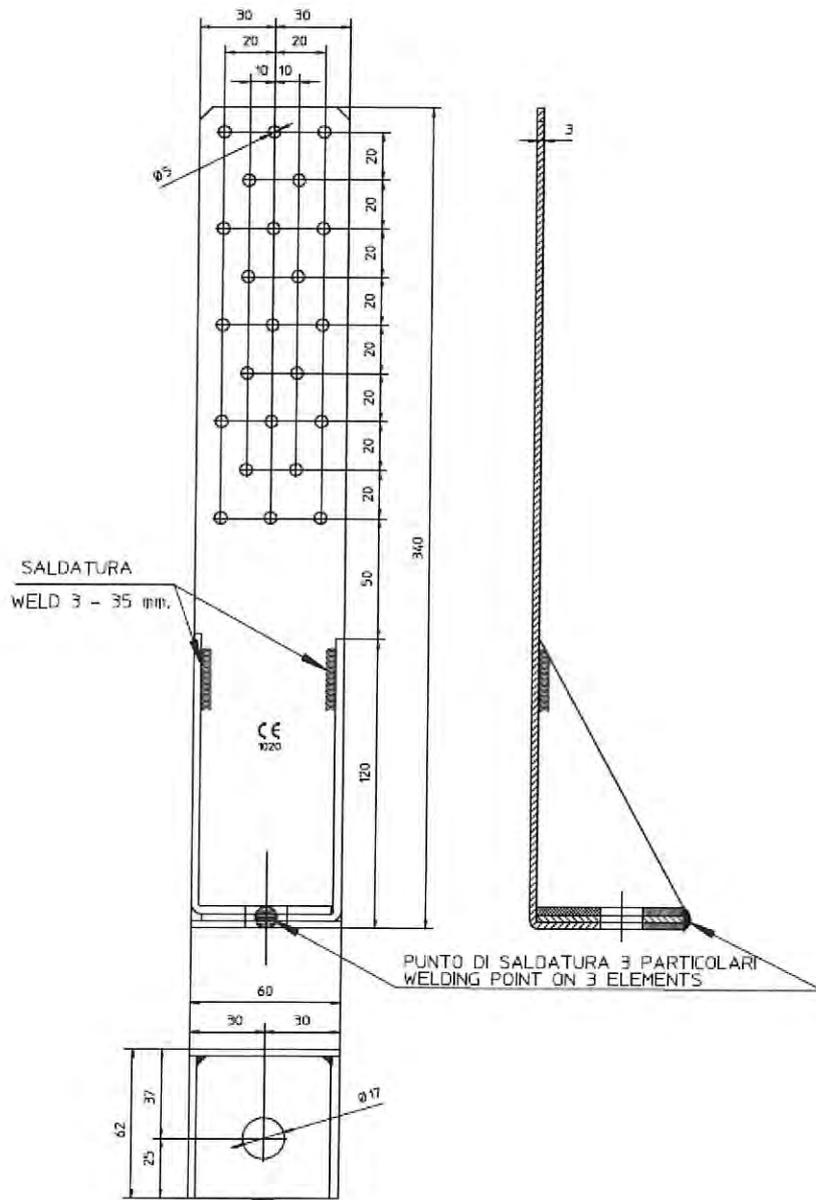


Fig. A.1

340

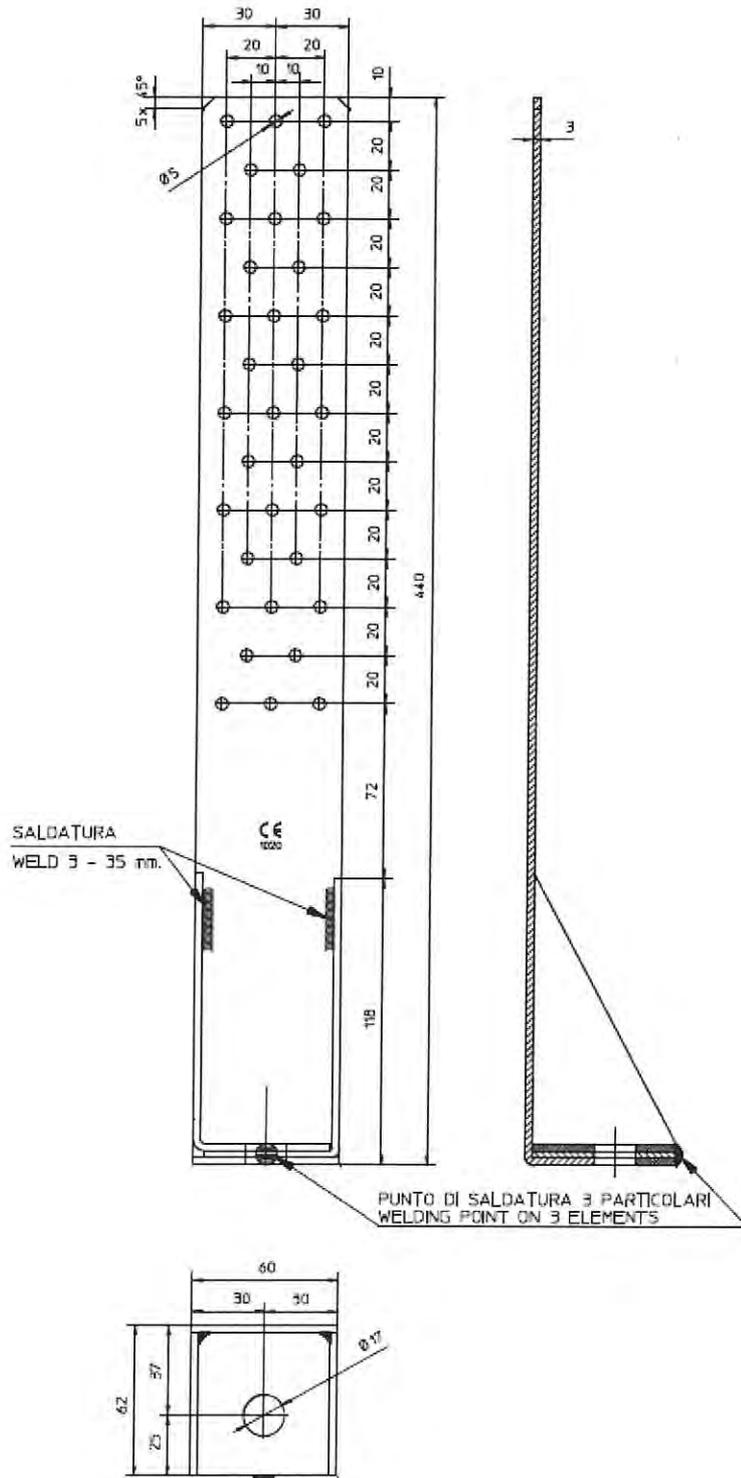


Fig. A.2 [440

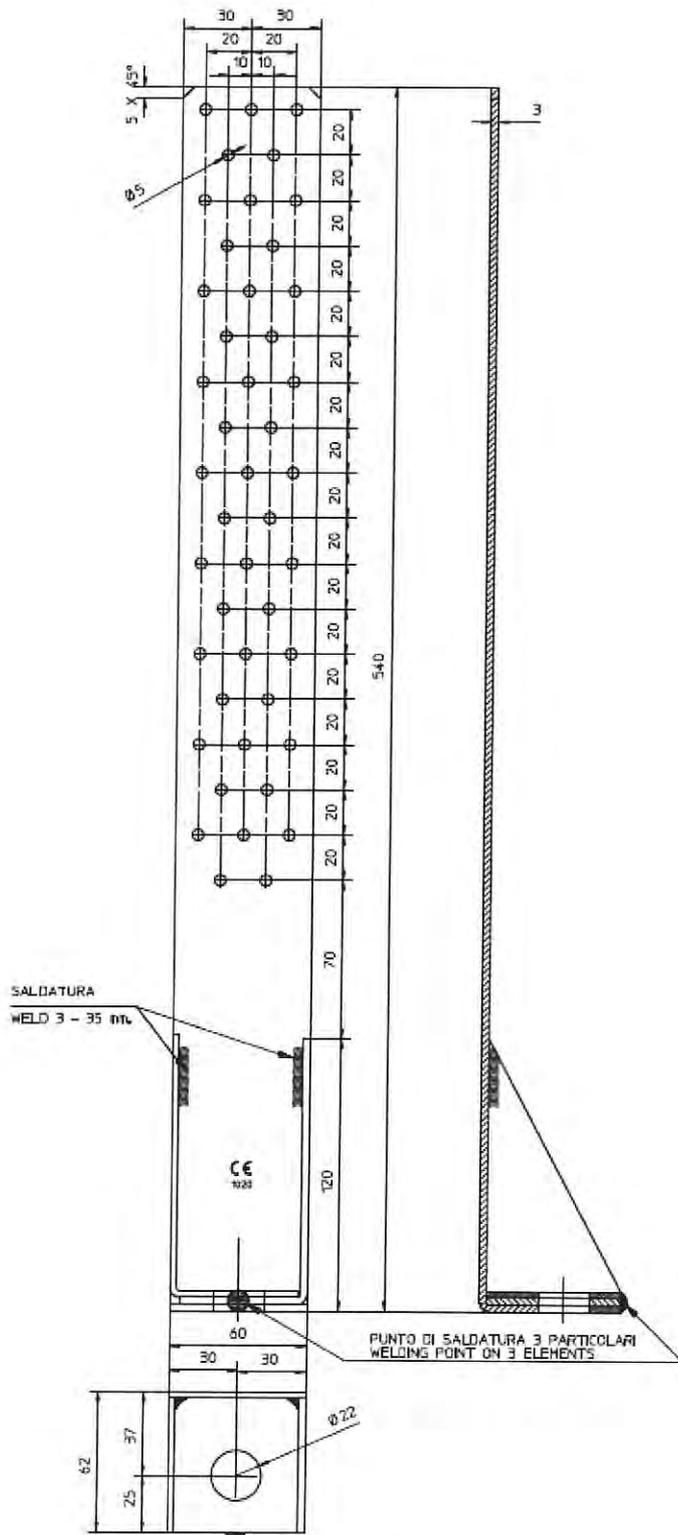


Fig. A.4

540.22

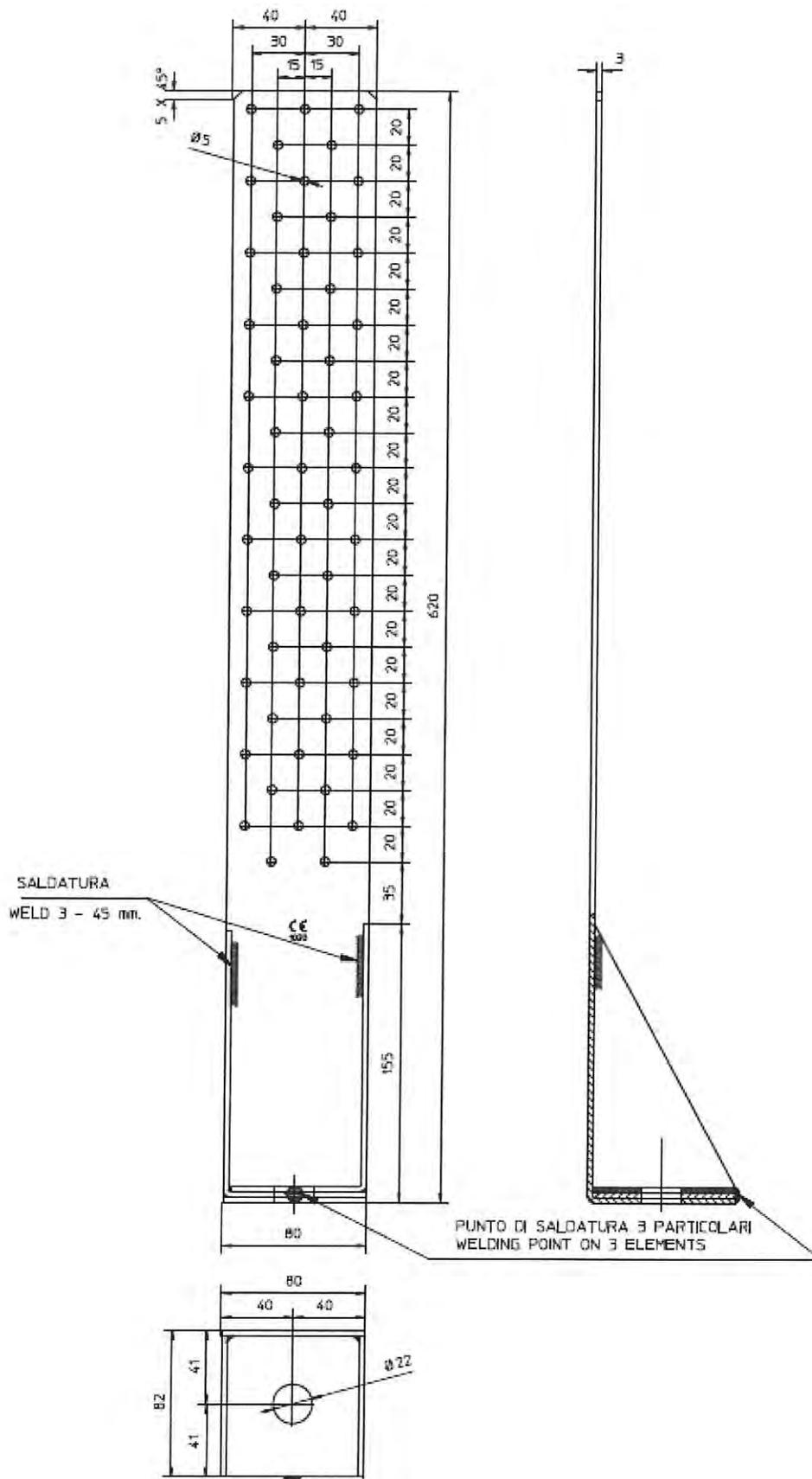


Fig. A.5 620

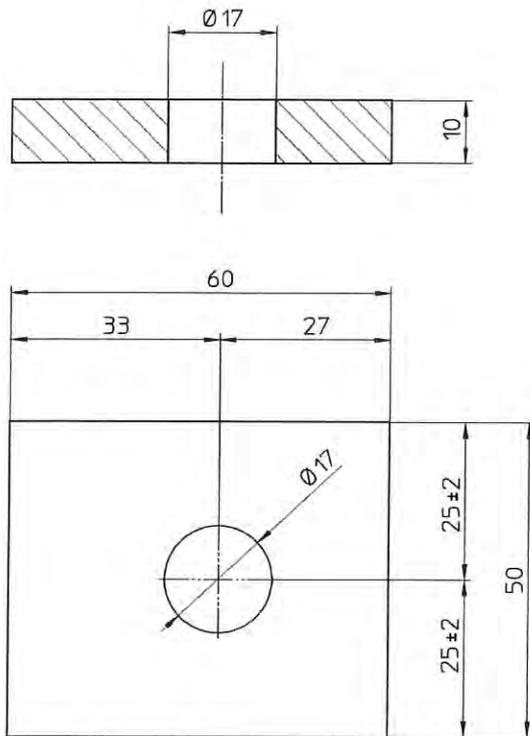


Fig. A.7 10

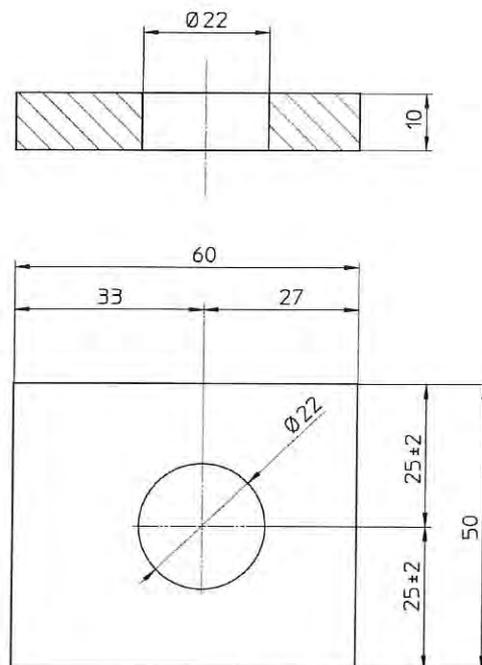


Fig. A.8 10.22

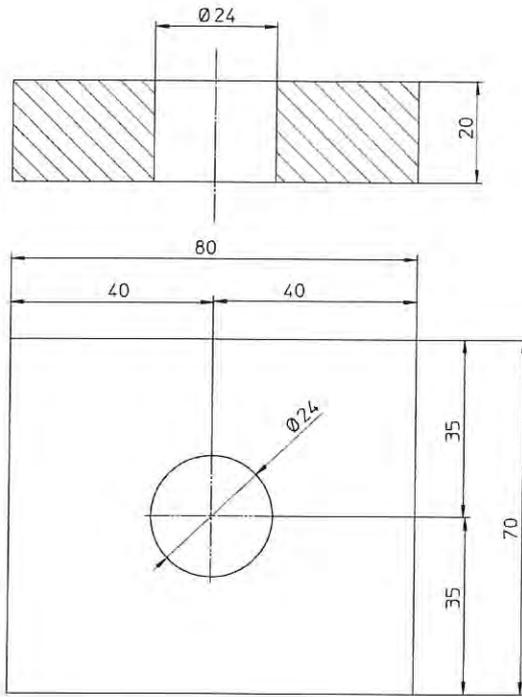


Fig. A.7 20

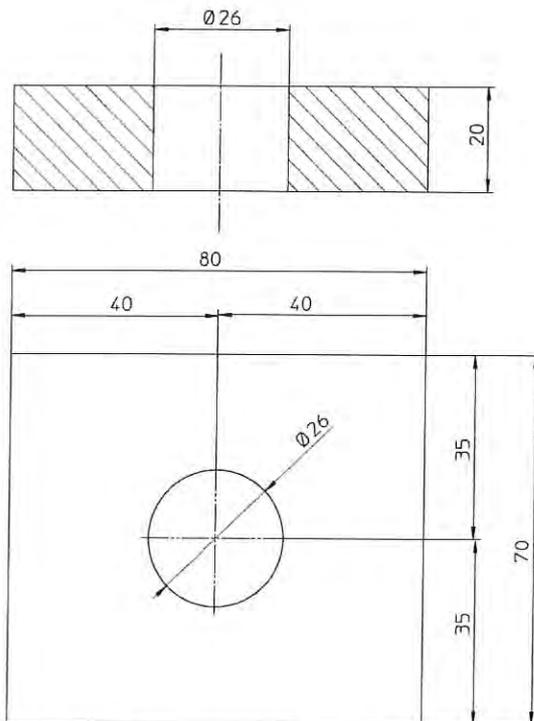


Fig. A.8 20.26

Annex B

Load-bearing capacities of hold-downs type _____ with and without washer plates type _____

Values of maximum characteristic load-bearing capacities for uplift stated in Table B.1 are given for one hold-down and are valid on condition that:

- it shall be distinguished whether the hold-down is or is not equipped with the respective type of washer plate. It is to be noted that the load-bearing capacities of hold-downs without washer plates are considerably lower as compared with those completed with the washer plates
- the hold-downs are affixed by fastener types as specified in Annex A with minimum number as determined below
- there is no wane in the region of the connection and splits, knots or other defects are limited so that the capacity is not reduced
- the connected wood member is prevented from rotation by other structural links
- the possibility of splitting the wood member and block or plug shear shall be checked, see 8.1.4 and Annex A in EN 1995-1-1
- the possibility of dimensional instability of the wood member shall be taken into account where relevant, refer to clause 3.1.4 of this ETA
- connection to concrete or other base material with a metal anchor or a bolt shall be assessed in line with CEN/TS 1992-4-1 *Design of fastenings for use in concrete* per chance in line with EN 1993-1-8. Namely, the effect of prying force in base connection shall be accounted for taking into account the stiffness and strength of the base material and the anchor/bolt. It shall be noted that the capacities given in Table B.1 may only develop if no substantial rotation in fixing to the base occurs which means that neither the base material nor the anchor/bolt fails or undergoes excessive plastic deformations before the load-bearing capacity of either the nails or of the steel hold-down is attained.

Table B.1 ADVECO hold-downs, characteristic capacities for the uplift force

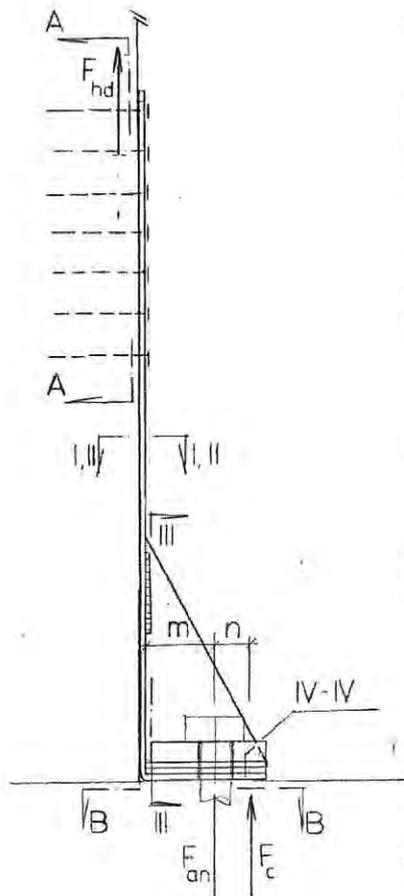
Hold-down Code No.	Washer plate Code No.	Anchor (bolt) diameter (mm)	capacity of the nails (connection to timber) $F_{hd,Rk}$	capacity of the hold-down (steel) $F_{hd,Rk}$ (kN)
340	none	16	$n_{ef} \cdot F_{V,Rk}^{1,2)}$	13.5
440	none	16		13.5
540	none	16		13.5
540.22	none	20		15.7
620	none	20		15.1
620.26	none	24		16.7
340	10	16		45.7
440	10	16		45.7
540	10	16		45.7
540.22	10.22	20		45.7
620	20	20		66.0
620.26	20.26	24		66.0

Note 1: ¹⁾ $F_{V,Rk}$ characteristic load-bearing capacity of one laterally loaded nail, thick plate considered

²⁾ n_{ef} effective (reduced) number of nails in solid timber when the fastener alignment goes parallel to grain, refer to 8.1.2 in EN 1995-1-1

Note 2: The minimum number n of nails to be used is 10. The maximum nail number corresponds to full nailing pertaining to the respective type.

Definitions of forces, eccentricities and critical sections to be considered:



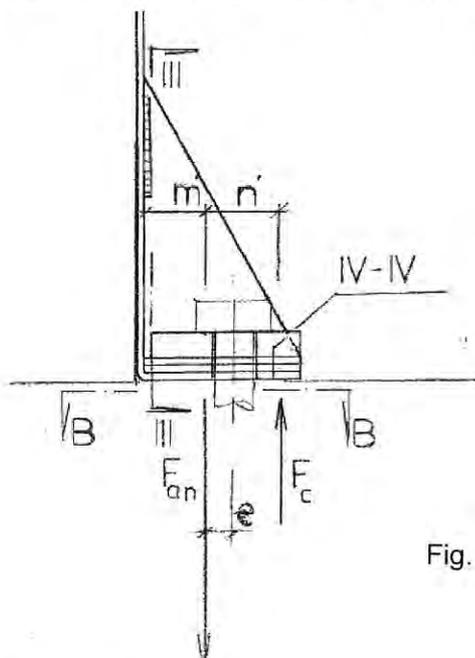
- F_{hd} uplift, lifting force acting parallel to vertical leg of the hold-down
- F_{an} force induced in anchor/bolt
- F_c prying force
- m distance of the anchor axis to vertical leg
- n distance of the anchor axis to centre of prying

Critical sections:

- A-A capacity in this section is given by the capacity of the laterally loaded nails, this capacity is to be determined as shown in Table B.1
- I-I, II-II, III-III, IV-IV critical sections and parts of the hold-down itself, the minimum characteristic capacity of these parts and sections is stated in Table B.1
- B-B capacity in this section shall be assessed in line with CEN/TS 1992-4-1, 2, 3, 4, 5 or possibly in line with EN 1993-1-8

Fig. B.1 Definition of forces and critical sections

In cases the base material is of lower class/strength (e. g. C20/25 and less) the static scheme should be rather considered as depicted in Fig. B.2 – that means due to rotation of the washer plate anchor/bolt head is loaded eccentrically thus inducing bending in the anchor/bolt. Tensile capacity of the anchor/bolt shall be reduced accordingly.



e eccentricity of the force F_{an}

Fig. B.2 Alternative static scheme of loading the anchor/bolt to be considered

Design value of the load bearing capacity of the connection:

To obtain design values the characteristic capacities have to be divided by the respective partial factors for the material properties. Moreover, where the load bearing capacity is governed by wood failure as is normally the case of nails, the coefficient k_{mod} depending on the load duration class and service class shall apply.

$$F_{hd,Rd} = k_{mod} \cdot F_{hd,Rk} / \gamma_M \quad (B.1)$$

- For design value pertain to steel (hold-down) the relation (B.1) applies with values $\gamma_M = \gamma_{M0} = 1.0$. According to EN 1993-1-1 $\gamma_{M0} = 1.0$. (Note: reduction coefficient 0.9 and partial factor γ_{M2} for net cross-section at holes is already accounted for in the characteristic value of $F_{hd,Rk}$). $k_{mod} = 1.0$ applies.
- For design value pertain to nails (timber) the relation (B.1) applies with values $\gamma_M = 1.3$ and k_{mod} depending on the load duration and moisture content, refer to EN 1995-1-1.
- For failure governed by the base connection – anchor/bolt and the base material – partial factors $\gamma_{MS} \geq 1.4$, and $\gamma_{MC} \geq 1.5$ as specified in CEN/TS 1992-4-1, or γ_{M2} and γ_C according to EN 1993-1-1 and EN 1992-1-1, apply. $k_{mod} = 1.0$.

The lowest design value of the three so determined decides.