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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-07/0053 of 2018/04/26

### 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:**

Simpson Strong-Tie Cantilever brackets  
See type numbers in section II.1 of the ETA

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

Three-dimensional nailing plate (Joist hanger for wood to wood connections and wood to concrete or steel connections)

**Manufacturer:**

SIMPSON STRONG-TIE Int. Ltd  
For local branch refer to [www.strongtie.eu](http://www.strongtie.eu)

**Manufacturing plant:**

SIMPSON STRONG-TIE Manufacturing facilities

**This European Technical Assessment contains:**

31 pages including 4 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:**

Guideline for European Technical Approval (ETAG) No. 015 Three Dimensional Nailing Plates, April 2013, used as European Assessment Document (EAD).

**This version replaces:**

The ETA with the same number issued on 2013-04-18 and expiry 2018-04-18

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## II SPECIFIC PART OF THE EUROPEAN TECHNICAL ASSESSMENT

### 1 Technical description of product and intended use

#### Technical description of the product

This ETA covers the following cantilever brackets types: GERB, GERC, GERW, GERG, SC, SCR and LEA.

Simpson Strong-Tie Cantilever Bracket GERB, GERC, GERW, GERG, SC, SCR and LEA are one-piece or two-pieces non-welded, cantilever brackets to be used in timber to timber connections.

The materials for beams can be of solid timber, glued laminated timber or engineered timber products such as LVL or I-joist (fitted with backer blocks if used for the header).

The cantilever brackets are made from pre-galvanized steel Grade S250GD + Z (min Z275) according to EN 10346 or pre-galvanized steel with a minimum characteristic 0.2% yield stress of 250MPa, a minimum ultimate tensile strength of 330MPa and a minimum Elongation of 19%, with tolerances according to EN 10143 except if another material is specified (named "Steel ref 1" in the rest of the document). Material, dimensions and nails positions are detailed in Annex D and typical installations are detailed in Annex B. By default all the products are made out of this material except when specified.

All cantilever brackets can also be produced from stainless steel number 1.4401, 1.4404, 1.4521, 1.4301 or 1.4509 according to EN 10088-2 or a stainless steel with a minimum characteristic 0.2% yield stress of 240 MPa, a minimum 1.0% yield stress of 270 MPa and a minimum ultimate tensile strength of 530 MPa (named "Steel ref 2" in the rest of the document). If no name is clearly specified, product variant made with stainless steel have generally the same name with a S ( as Stainless) at the end.

Cantilever brackets which are hot dipped galvanized according to EN ISO 1461:1999 with a zinc coating thickness of approximately 55 µm (named "Steel ref 3" in the rest of the document) are intended for use in service class 1,2 and 3 according to EN 1995 (Eurocode 5).

In the rest of this document, the steel types will be named as:

Steel ref. 1: S250GD + Z275 acc. to EN10326

Steel ref. 2: Stainless Steel 1.4401, 1.4404, 1.4521

Steel ref. 3: Stainless Steel 1.4301, 1.4509

Steel ref. 4: Stainless Steel 1.4259

Steel ref. 5: S250 + ZM310 according to EN10346:2015

Steel ref. 6: S235JR + hot dip galvanized acc. to EN ISO 1461

Steel ref. 7: S250GD + Z800 acc. to EN10326

### 2 Specification of the intended use in accordance with the applicable EAD

The cantilever brackets are intended for use in making end-grain to end-grain connections between wood based beams (joists or purlins) in a cantilever system, where requirements for mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 of Council Directive (EU) 305/2011 shall be fulfilled.

The static and kinematic behavior of the timber members and the supports shall be as described in Annex C and D.

The cantilever brackets can be installed as connections between wood based members such as:

- Structural solid timber classified to C14-C40 according to EN 338 / EN 14081,
- Glulam classified to GL24-GL36 according to EN 1194 / EN 14080,
- LVL according to EN 14374,
- Parallam PSL,
- Intrallam LSL,
- Duo- and Triobalken,
- Layered wood plates,
- Kreuzbalken with minimum thickness of 80 mm
- I-beams with backer blocks on both sides of the web in the header and web stiffeners in the joist
- Plywood according to EN 636
- Cross Laminated timber according to EN 16351

However, the calculation methods are only allowed for a characteristic wood density of up to 460 kg/m<sup>3</sup>. 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.

When used on CLT , the edge distance and spacing of each fastener (CNA or CSA) must be checked according to the specifications given by the manufacturer of the timber. If nothing is specified, edge distance and spacing must be in accordance to the outer layer of the CLT panels.

Annex C defines the directions of forces and also states the formulas for the characteristic load-carrying capacities of the joist hanger connections. The design of the connections shall be in accordance with Eurocode 5 or a similar national Timber Code.

The cantilever brackets are intended for use for connections subject to static or quasi static loading.

The scope of the cantilever brackets 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 cantilever brackets 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 Characteristics of product and assessment

| Characteristic   | Assessment of characteristic  |
|--|---|
| <b>3.1 Mechanical resistance and stability*) (BWR1)</b>              |   |
| Characteristic load-carrying capacity                                | See <a href="#">Annex D</a>   |
| Stiffness  | No performance assessed (NPA)   |
| Ductility in cyclic testing  | No performance assessed (NPA)   |
| <b>3.2 Safety in case of fire (BWR2)</b>                             |   |
| Reaction to fire   | The cantilever brackets are made from steel classified as Euroclass A1 in accordance with EN 13501-1 and EC decision 96/603/EC, amended by EC Decision 2000/605/EC  |
| <b>3.3 Hygiene, health and the environment (BWR3)</b>                |   |
| Influence on air quality   | The product does not contain/release dangerous substances specified in TR 034, dated March 2012   |
| <b>3.7 Sustainable use of natural resources (BWR7)</b>               |   |
| <b>3.8 General aspects related to the performance of the product</b> | The cantilever brackets 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 class 1, 2 and 3 |
| Identification   | See <a href="#">Annex D</a>   |

\*) See additional information in section 3.9 – 3.12.

### 3.9 Methods of verification

#### Safety principles and partial factors

The characteristic load-carrying capacities are based on the characteristic values of the nail connections and the cantilever brackets. To obtain design values the capacities have to be divided by different partial factors for the material properties, the nail connection 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 nails subjected to shear or the withdrawal capacity of the most loaded nail, respectively) as well as for steel plate failure  $F_{Rk,S}$ . The design value of the load-carrying capacity is the smaller value of both load-carrying capacities.

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

Therefore, for timber failure the load duration class and the service class are included. The different partial factors  $\gamma_M$  for steel or timber, respectively, are also correctly taken into account.

#### 3.10 Mechanical resistance and stability

See [Annex C](#) for characteristic load-carrying capacities of the joist hangers.

The characteristic capacities of the cantilever brackets are determined by calculation assisted by testing or only testing as described in the EOTA Guideline 015 clause 5.1.2. 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 in [Annex C3](#):

The characteristic load-carrying capacities of the products shall be calculated in accordance with the manufacturer's design code, extracts of which are given in [Annex C4](#). The design code has been derived in accordance with ETAG 015 and Eurocode 5 (2008).

The calculated values should be used for designs in accordance with Eurocode 5 or a similar national Timber Code. These values are based on the assumption that there is a maximum gap of 3 mm between the timber members, the members are laterally restrained and wane is not present in the timber at the joint.

The cantilever brackets shall be used with the fasteners specified in [Annex C3](#).

#### Fasteners

The load bearing capacities of the brackets have been determined based on the use of Connector nails CNA or

connector screws CSA in accordance with ETA-04/0013. It is allowed to use other connector nails or connector screws in accordance with the standard EN 14592 with the same or better performance than the used 4,0 mm CNA Connector nails and still achieve the same load-bearing capacity of the connection.

If no calculations are made a reduction factor equal to the ratio between the characteristic withdrawal capacity of the actual used threaded nail and the characteristic withdrawal capacity of the corresponding Connector nail according to ETA-04/0013 is applicable for all load bearing capacities of the connection.

No performance has been determined in relation to the joint's stiffness properties - to be used for the analysis of the serviceability limit state.

No performance has been determined 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.

#### 3.11 Aspects related to the performance of the product

##### 3.11.1 Corrosion protection in service class 1 and 2.

In accordance with ETAG 015 the cantilever brackets have a zinc coating weight of min Z275 (steel ref. 1 and 7) . The steel employed is S250 GD with min Z275 according to EN 10346.

##### 3.11.2 Corrosion protection in service class 3.

In accordance with Eurocode 5 the cantilever brackets are made from stainless steel (steel ref. 2 to 4) number 1.4401, 1.4404, 1.4521, 1.4301 or 1.4509 according to EN 10088-2 or a stainless steel with a minimum characteristic 0.2% yield stress of 240 MPa, a minimum 1.0% yield stress of 270 MPa and a minimum ultimate tensile strength of 530 MPa. The nails or screws shall be produced from stainless steel. Cantilever brackets coated with hot dip galvanisation or with ZM310 (steel ref. 5 and 6) can also be used in service class 3 according to Eurocode 5

#### 3.12 General aspects related to the use of the product

Simpson Strong-Tie cantilever brackets types GERB, GERC, GERW, GERG, SC, SCR and LEA 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.

#### Cantilever brackets connections

**Cantilever brackets** shall be installed on the basis of a specific structural design for each installation, using the load-bearing capacities derived from the formulas given in [Annex D](#), applying the appropriate  $k_{mod}$  factor depending on the relevant service class / duration of load and the appropriate National partial safety factor for

materials.

The fixing of cantilever brackets to the support shall use the appropriate nails or screws in case of solid wood or wood-based support,. The load bearing capacities which can be derived from [Annex C](#) are given provided that the fixing device has been appropriately designed and installed.

**Cantilever brackets** shall be installed by appropriately qualified personnel, following an installation plan and relevant construction details worked out for each individual building project. The installation plan shall be based on the manufacturers general guide and provisions for installing SIMPSON Strong-Tie connections.

A cantilever brackets connection is deemed fit for its intended use provided:

### **Wood to wood connections**

- **Cantilever brackets** can be fastened to wood-based members by nails or screws.
- There shall be nails or screws in all holes or a partial nailing pattern as prescribed in [Annex B](#) can be used.
- The characteristic capacity of the cantilever brackets connection is calculated according to the manufacturer's technical documentation.
- The cantilever brackets connection is designed in accordance with Eurocode 5 or an appropriate national code.
- The gap between the beams shall be maximum 3 mm.
- The cross section of the beams at the cantilever brackets connection shall have sharp edges at the lower side against the bottom plate and or sharp edges at the top side against the top plate, i.e. it shall be without wane.
- The width  $B$  of the beam shall correspond to that of the cantilever bracket.  $B$  shall not be smaller than  $A-3$  mm, where  $A$  is the inner width of the cantilever bracket.
- Cantilever brackets made from stainless steel should only be fastened with fasteners made from

suitable stainless steel. Zinc-coated joist hangers shall not be fastened with fasteners of stainless steel.

- Nails or screws to be used shall have a diameter, which fits the holes of the joist hangers. Round nails shall have a diameter which is not smaller than the diameter of the hole minus 1 mm.



## **4 Assessment and verification of constancy of performance (AVCP)**

### **4.1 AVCP system**

According to the decision 97/638/EC of the European Commission<sup>1</sup>, 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 foreseen 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 2018-04-26 by



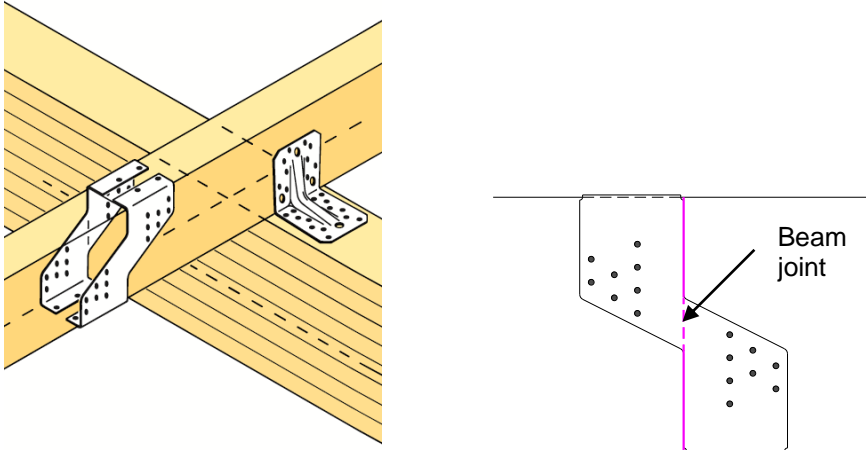
Thomas Bruun  
Manager, ETA-Danmark

## ANNEX A REVISION HISTORY

| <i>Modifications and additions to the previous versions of ETA-07/0053</i> |   |
|--|---|
| Issue No.  | Update  |
| 1.0  | First release   |
| 2.0  | change of the product names   |
|  | added size of GERW  |
|  | added type LEA  |
|  | modify the values for SC and SCR  |
| 3.0  | Introduction of steel grade S250 + Z800                                   |
| 4.0  | Adjustment from “approval” to “assessment                                 |
|  | Added uplift capacities for LEA   |
|  | GERB150, GERC150: modified size E   |
|  | GERW: added option for peed-hole position, additional holes, “half” holes |
|  | Adjustment of steel references, additional coating Z800 and ZM310         |

## ANNEX B TYPICAL INSTALLATIONS

### B1 Cantilver bracket



Conditions for using I-beam joists.

When an I-beam is used as a beam it is a condition for obtaining the stated load-carrying capacity, that 2 web stiffeners are nailed to the web of the beam, one on each side.

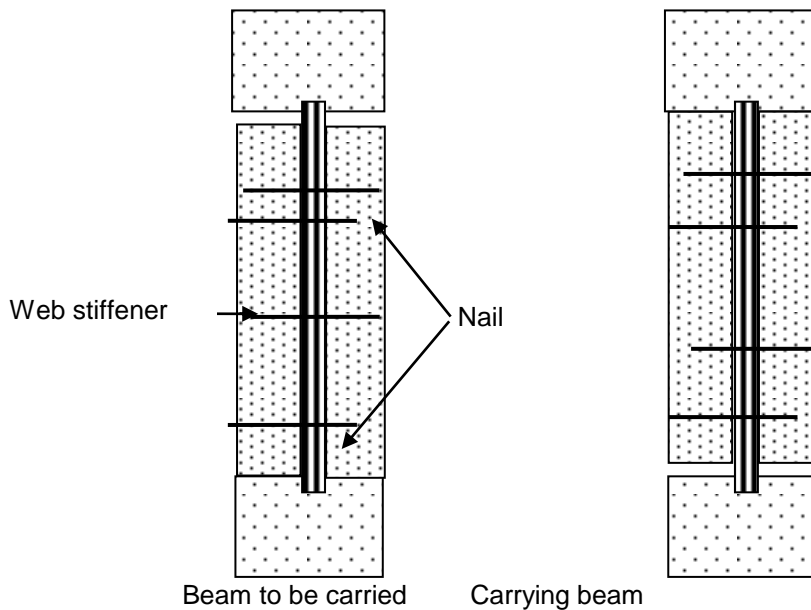


Figure C-1. Web stiffeners on the beam at the cantilever bracket. The web stiffener shall fit to the bottom flange and have a width of 2/3 of the height between the inner sides of the flanges.

The surface of the web stiffeners shall be flush with the side of the flange of the beam and shall fit tight to the lower flange and shall be nailed with sufficient nails to secure, that the web stiffeners and the web functions as one piece of solid timber. So, the number of nails in each web stiffener shall be:

$$n_{nail,web-stif} = n_{joist}$$

where  $n_{joist}$  is the total number of nails from the cantilever bracket into the beam.

## B2 Installation

### Cantilever bracket connections

A cantilever brackets connection is deemed fit for its intended use under following conditions:

- Cantilever brackets can be fastened to wood-based members by nails or screws.
- There shall be nails or screws in all holes or a partial nailing pattern as shown and prescribed in Annex D.
- The gap between the end of the beams, where contact stresses can occur during loading shall be limited. This means that the gap between the ends of the beams connected shall be maximum 3 mm.
- The thickness of the beam shall be at least  $l+4d$ , where  $l$  is the length of the nails in the beam and  $d$  the diameter. This is in accordance with Eurocode 5.
- For all types of cantilever brackets except GERW:  
The cross section of the beam to be carried shall have sharp edges at the lower side against the bottom plate, i.e. it shall be without wane.
- For Cantilever Bracket GERB:  
The cross section of the carrying beam shall have sharp edges at the top side against the top plate, i.e. it shall be without wane.
- For Cantilever Bracket GERG, SC and SCR the width  $B_b$  of the beam shall correspond to that of the cantilever bracket.  $B_b$  shall not be smaller than  $B-3$  mm, where  $B$  is the inner width of the cantilever bracket.
- The depth of the beam shall be so large that the top of the beam is at least 20 mm above the upper nail in the side of the beam.
- Cantilever brackets made from stainless steel shall only be fastened with fasteners made from suitable stainless steel. Zinc-coated cantilever brackets shall not be fastened with fasteners of stainless steel.
- Nails or screws to be used shall have a diameter, which fits the holes of the cantilever brackets. They shall have a diameter which is not smaller than the diameter of the hole minus 1 mm.
- The execution of the connection shall be in accordance with the approval holder's technical literature.

## ANNEX C BASIS OF DESIGN

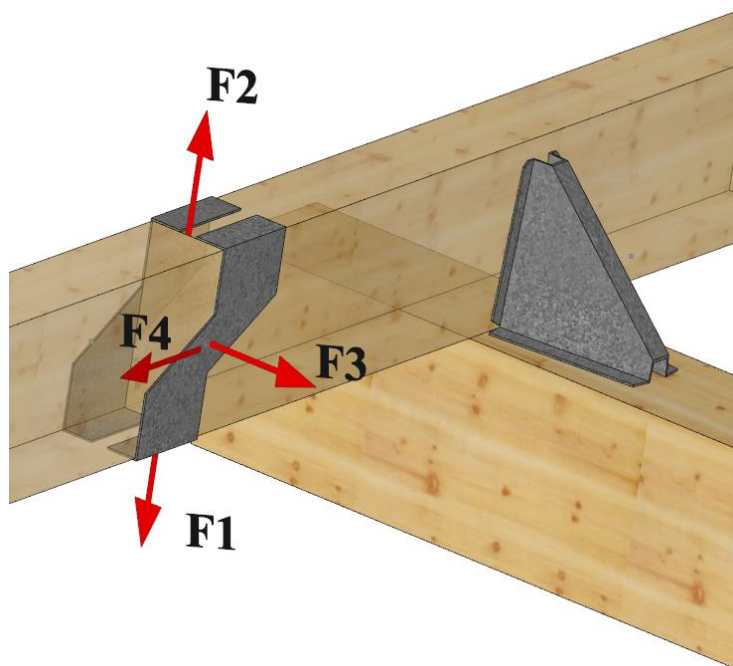
### C0 Symbols used in the ETA-07/0053

For the purpose of ETA-07/0053, the following symbols apply.

|              |   |
|--------------|---|
| $f_{c,90,k}$ | characteristic compression strength perpendicular to grain of the timber                    |
| $f_{y,k}$    | characteristic yields stress of the steel   |
| $k_{dens}$   | modification factor for density   |
| $k_{i,j}$    | is a factor considering the capacity of the nails and/or load directions                    |
| $n_{flange}$ | is the number of nails in the top or bottom in one bracket                                  |
| $n_{nails}$  | is the number of nails in each end of the cantilever bracket (for type GERW)                |
| $n_{strip}$  | is the number of 20 mm wide horizontal strips with 2 or 3 nails in each end (for type GERW) |
| $R_{ax,k}$   | Characteristic axial load-carrying capacity of the nails                                    |
| $R_{lat,k}$  | Characteristic lateral load-carrying capacity of the nails                                  |
| $t$          | thickness of the steel plate  |
| $w_{top}$    | is the width of the top of the connector ( $w_{top} = 90$ mm).                              |
| $\rho_k$     | Characteristic density of header or joist material ( $\text{kg/m}^3$ )                      |

### C1 Definition of Force Directions

It is assumed that the forces acting on the cantilever brackets connection are the following  $F_1$ ,  $F_2$ ,  $F_3$  and  $F_4$ , as shown in the figure below. The forces shall act in the middle of the beams.



## C2 Characteristic Capacity Modification Methods

Capacities expressed as numbers (not formulas) are based on a characteristic density of 350 kg/m<sup>3</sup>. For timber or wood based material with a lower density than 350 kg/m<sup>3</sup> the load carrying capacities shall be reduced by the  $K_{dens}$  factor:

$$k_{dens} = (\rho_k / 350)^2$$

## C3 Fastener Specification and Capacities

### Fastener types and sizes

| NAILS diameter | Length Min – max | Nail type  |
|----------------|------------------|--|
| 4.0            | 35 - 100         | Connector nails in accordance with ETA-04/0013           |
| 4.2            | 35 - 60          | Connector nails in accordance with ETA-04/0013           |
| 4.0            | 35 - 100         | connector nails in accordance with the standard EN 14592 |

| SCREW diameter | Length Min – max | Screw type                                      |
|----------------|------------------|---|
| 5.0            | 35 - 50          | Connector screws in accordance with ETA-04/0013 |
| 5.0            | 35 – 80          | connector screws in accordance with EN 14592    |

### Nail Capacity

See relevant ETA / EN 14592

### C4.3 Load combination

For a combination of forces in the vertical direction and in the lateral direction the following inequalities shall be fulfilled.

$$\sum \left( \frac{F_{i,d}}{R_{i,d}} \right)^2 \leq 1$$



## **ANNEX D**

### **PRODUCT DEFINITION AND CAPACITIES**



## D1 GERB

| Product Name | Material reference acc. to clause II-1 | Alternative Names |
|--------------|--|-------------------|
| GERB         | <a href="#">Steel ref 1</a> to 7       | -                 |

Drawing

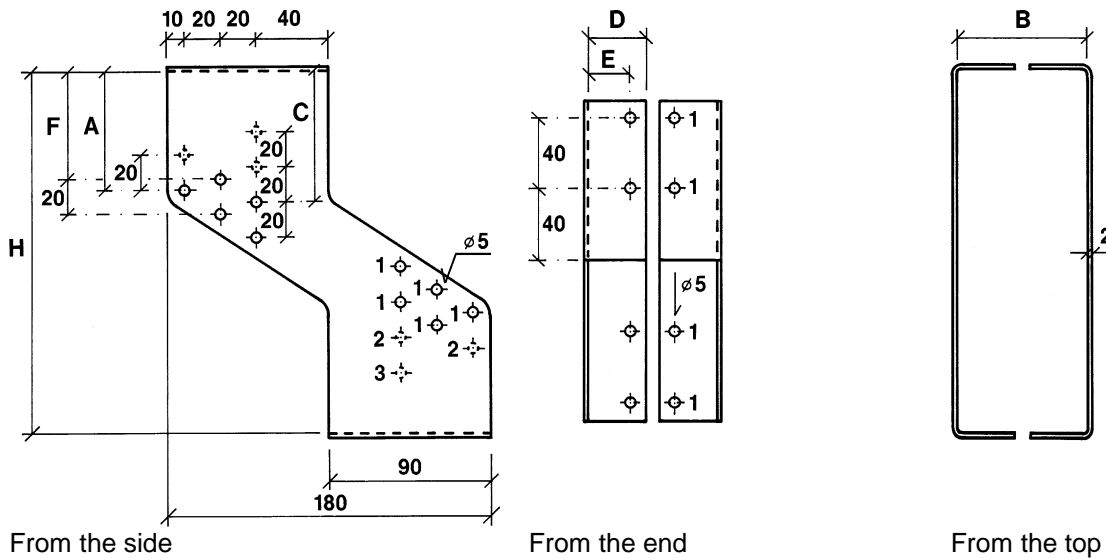
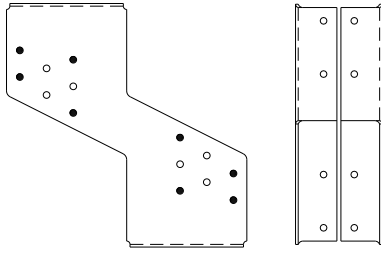


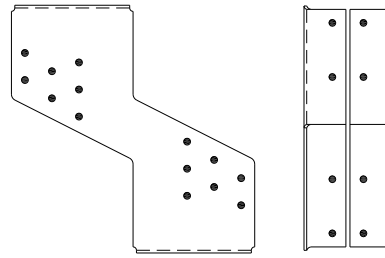
Table D1-1. Dimensions

| Type    | size [mm] |                  |      |    |    |      |       | Holes $\phi 5$ mm | Total number in a pair |
|---------|-----------|------------------|------|----|----|------|-------|-------------------|------------------------|
|         | A         | B <sub>min</sub> | C    | D  | E  | F    | H     |                   |                        |
| GERB125 | 28        | 56               | 35   | 27 | 19 | 21,5 | 128,5 | 1                 | 28                     |
| GERB140 | 35        | 62               | 42,5 | 30 | 21 | 28,5 | 140   | 1                 | 28                     |
| GERB150 | 42        | 60               | 49,5 | 29 | 19 | 35,5 | 154   | 1+2               | 36                     |
| GERB160 | 45        | 62               | 52,5 | 30 | 22 | 38,5 | 160   | 1+2               | 36                     |
| GERB175 | 54,5      | 68               | 61   | 33 | 25 | 48   | 179   | 1+2               | 36                     |
| GERB180 | 55        | 68               | 62,5 | 33 | 25 | 48,5 | 180   | 1+2               | 36                     |
| GERB200 | 67,5      | 68               | 74   | 33 | 27 | 61   | 205   | 1+2+3             | 40                     |
| GERB220 | 75        | 70               | 81,5 | 34 | 26 | 68,5 | 220   | 1+2+3             | 40                     |

Nail pattern  
Figure D1-2.



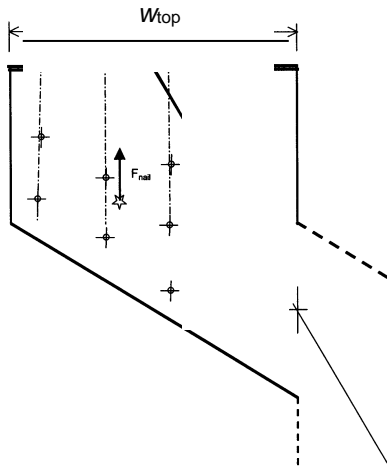
Nails in corners



Full nailing in both sides, bottom and top

Characteristic capacities

Figure D1-3. Downward load  $F_1$



The characteristic load-carrying capacity  $F_1$  of a pair of cantilever brackets is calculated as:

$$R_{1,k} = 2,1 \left( w_{top} \sqrt{0,5 t^2 f_{y,k} f_{c,90,k}} + k_{B,1} R_{lat,k} + 0,4 n_{flange} R_{lat,k} \right)$$

where

- $f_{c,90,k}$  characteristic compression strength perpendicular to grain of the timber
- $f_{y,k}$  characteristic yields stress of the steel
- $k_{B,1}$  is a factor considering the capacity of the nails in the side of the bracket, see table D1-2
- $n_{flange}$  is the number of nails in the top or bottom in one bracket
- $R_{lat,k}$  characteristic lateral load-carrying capacity of the nails
- $t$  thickness of the steel plate
- $w_{top}$  is the width of the top of the connector ( $w_{top} = 90$  mm).

Uplift capacity  $F_2$

The characteristic load-carrying capacity of a pair of cantilever brackets is calculated as:

$$R_{2,k} = k_{B,2} \cdot R_{lat,k}$$

where  $k_{B,2}$  is stated in table D1-2

Lateral load  $F_3$ 

The characteristic load-carrying capacity of a pair of cantilever brackets is calculated as the minimum value of the following two formulas:

$$R_{3,ax} = k_{B,3,ax} \cdot R_{ax,k}$$

$$R_{3,lat} = k_{B,3,lat} \cdot R_{lat,k}$$

Where the factors  $k_{B,3,ax}$  and  $k_{B,3,lat}$  are stated in table D1-2.

Table D1-2. Factors  $k_{B,1}$ ,  $k_{B,2}$  and  $k_{B,3}$  for a pair of Cantilever Bracket GERB

| Type    | F <sub>1</sub><br>$k_{B,1}$ |                  | F <sub>2</sub><br>$k_{B,2}$ |                  | F <sub>3</sub><br>Full side nails |               |
|---------|-----------------------------|------------------|-----------------------------|------------------|-----------------------------------|---------------|
|         | Full side nails             | Nails in corners | Full side nails             | Nails in corners | $k_{B3,ax}$                       | $k_{B,3,lat}$ |
| GERB125 | 2,03                        | 2,01             | 2,5                         | 2,24             | 4                                 | 2,1           |
| GERB140 | 2,08                        | 2,06             | 2,5                         | 2,24             | 4                                 | 2,1           |
| GERB150 | 3,2                         | 1,85             | 4,01                        | 2,35             | 6                                 | 3,5           |
| GERB160 | 3,23                        | 1,87             | 4,01                        | 2,35             | 6                                 | 3,5           |
| GERB175 | 3,44                        | 1,97             | 4,01                        | 2,35             | 6                                 | 3,5           |
| GERB180 | 3,44                        | 1,97             | 4,01                        | 2,35             | 6                                 | 3,5           |
| GERB200 | 3,8                         | 1,86             | 5,04                        | 2,55             | 6                                 | 4,2           |
| GERB220 | 3,84                        | 1,88             | 5,04                        | 2,55             | 6                                 | 4,2           |

## Combined forces

For practical purposes the strength verification is always carried out for design forces and design capacities.

For combinations of forces the following inequalities shall be fulfilled:

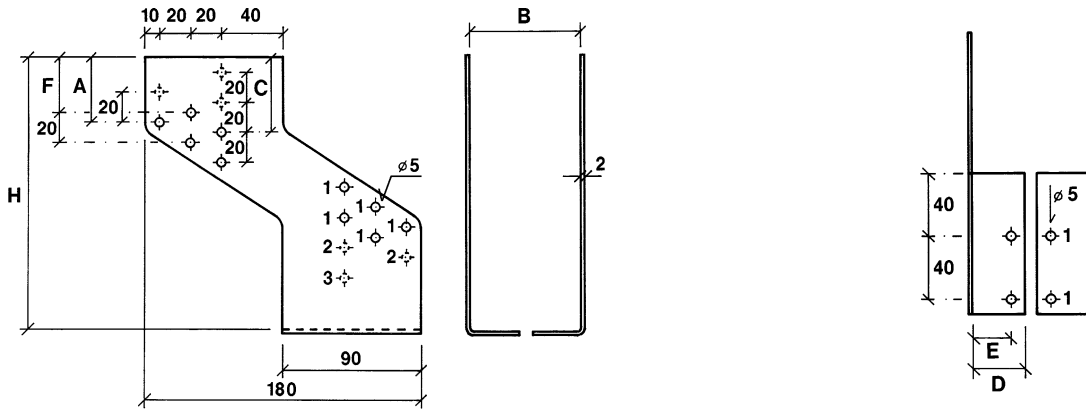
$$\left( \frac{F_{1,d}}{R_{1,d}} \right)^2 + \left( \frac{F_{3,d}}{R_{3,d}} \right)^2 \leq 1,0$$

$$\left( \frac{F_{2,d}}{R_{2,d}} \right)^2 + \left( \frac{F_{3,d}}{R_{3,d}} \right)^2 \leq 1,0$$

## D2 GERC

| Product Name | Material reference acc. to clause II-1 | Alternative Names |
|--------------|--|-------------------|
| GERC         | <a href="#">Steel ref 1</a> to 7       | -                 |

Drawing



From the side

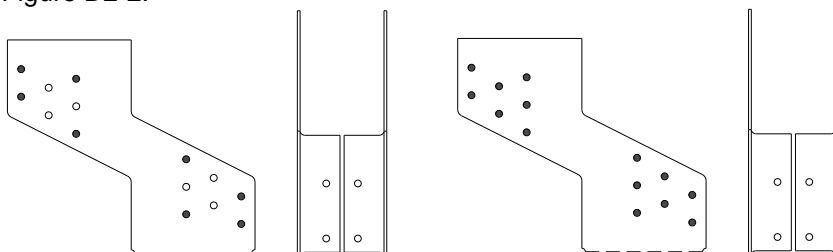
From the end

From the top

Table D2-1. Size specification

| Type    | size [mm] |                  |      |    |    |      |     | Holes<br>Ø5mm | Total<br>number<br>in a pair |
|---------|-----------|------------------|------|----|----|------|-----|---------------|------------------------------|
|         | A         | B <sub>min</sub> | C    | D  | E  | F    | H   |               |                              |
| GERC125 | 16,5      | 58               | 23   | 27 | 19 | 10   | 117 | 1             | 24                           |
| GERC150 | 30,5      | 60               | 38,5 | 29 | 19 | 24,5 | 143 | 1             | 32                           |
| GERC175 | 30,5      | 68               | 38,5 | 33 | 25 | 24,5 | 155 | 1+2           | 32                           |
| GERC200 | 42,5      | 68               | 50   | 33 | 25 | 37   | 181 | 1+2+3         | 36                           |
| GERC225 |           | 68               |      | 33 | 25 |      | 212 | 1+2           | 36                           |

Nail pattern  
Figure D2-2.



Nails in corners

Full side nails

Characteristic capacities

Downward load  $F_1$

The characteristic load-carrying capacity of a pair of cantilever brackets is calculated as:

$$R_{1,k} = k_{C,1} \cdot R_{lat,k}$$

where  $k_{C,1}$  is a factor considering the capacity of the nails in the side of the bracket.

Uplift  $F_2$

The characteristic load-carrying capacity of a pair of cantilever brackets is calculated as:

$$R_{2,k} = k_{C,2} \cdot R_{lat,k}$$

where  $k_{C,2}$  is a factor considering the capacity of the nails in the side of the bracket.

Lateral load  $F_3$

The characteristic load-carrying capacity of a pair of cantilever brackets is calculated as the minimum value of the following two formulas:

$$R_{3,ax} = k_{C,3,ax} \cdot R_{ax,k}$$

$$R_{3,lat} = k_{C,3,lat} \cdot R_{lat,k}$$

where the factors  $k_{C,3,ax}$  and  $k_{C,3,lat}$  are stated in table D2-2

Table D2-2. Factors  $k_{C,1}$ ,  $k_{C,2}$  and  $k_{C,3}$  for a pair of Cantilever Bracket GERC

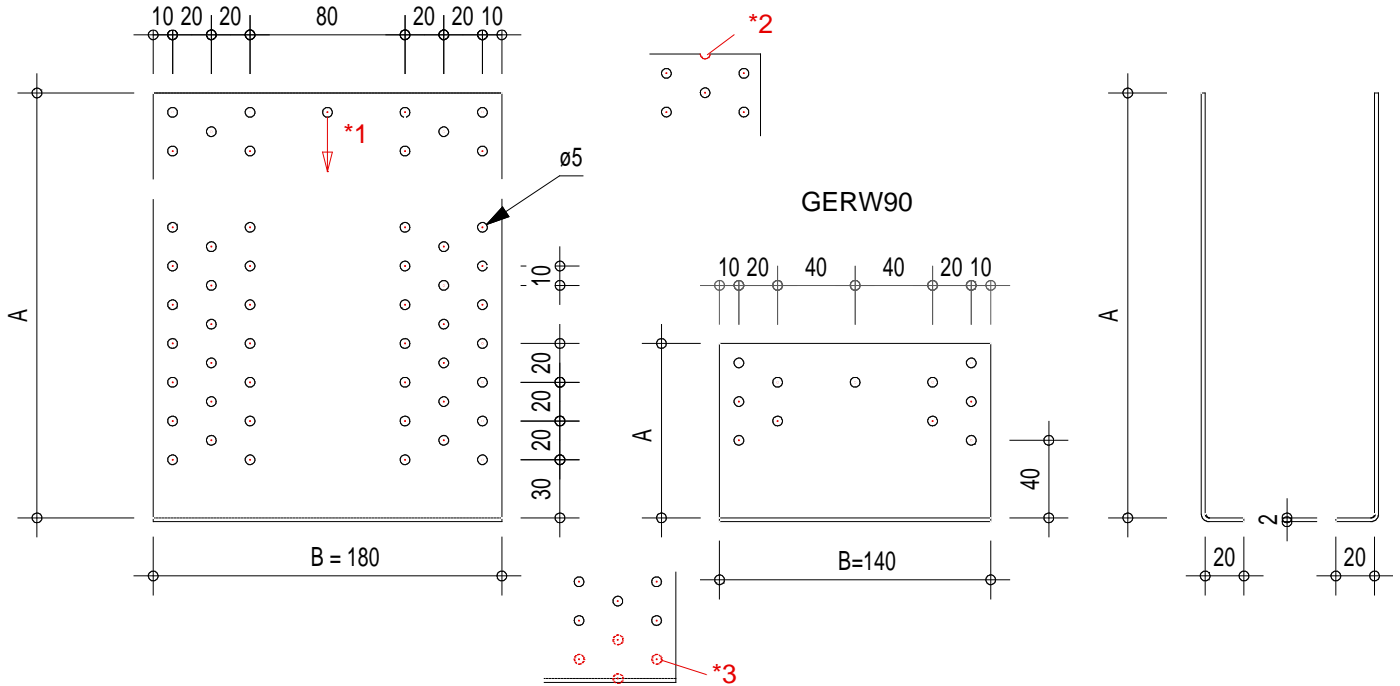
| Type    | Downward load,<br>$k_{C,1}$ |                     | Uplift<br>$k_{C,2}$ |                     | Lateral force<br>Full side nails |               |
|---------|-----------------------------|---------------------|---------------------|---------------------|----------------------------------|---------------|
|         | Full side<br>nails          | Nails in<br>corners | Full side<br>nails  | Nails in<br>corners | $k_{C,3,ax}$                     | $k_{C,3,lat}$ |
| GERC125 | 7,1                         | 5,7                 | 2,5                 | 2                   | 4                                | 2,1           |
| GERC150 | 9,9                         | 5,7                 | 4                   | 2,4                 | 6                                | 3,5           |
| GERC175 | 9,6                         | 5,5                 | 4                   | 2,4                 | 6                                | 3,5           |
| GERC200 | 10,5                        | 5,3                 | 5,1                 | 2,5                 | 6                                | 4,2           |
| GERC225 | 9,2                         | 5,3                 | 4                   | 2,4                 | 6                                | 3,5           |

### D3 GERW

| Product Name | Material reference acc. to clause II-1 | Alternative Names |
|--------------|--|-------------------|
| GERW         | <a href="#">Steel ref 1</a> to 7       | -                 |

Drawing

Figure D3-1. Dimensioned drawing of Cantilever Bracket GERW



\*1 the peep hole can be placed also in vertical direction on another place

\*2 holes on the border can be also be “cut” as half holes,

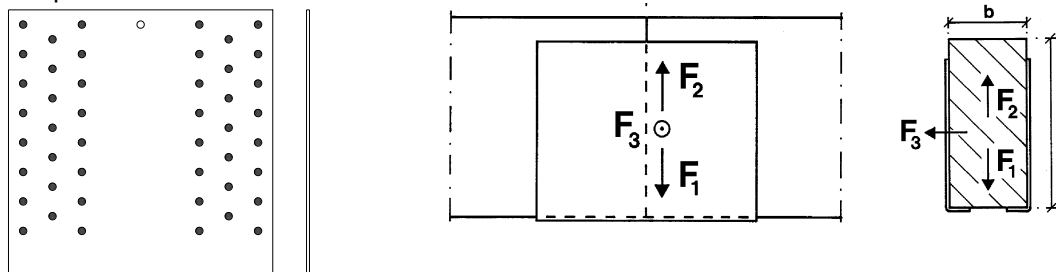
\*3 additional holes may be possible, also in the bended 20mm flange. These holes are not for nailing.

Table D3-1: Size specification

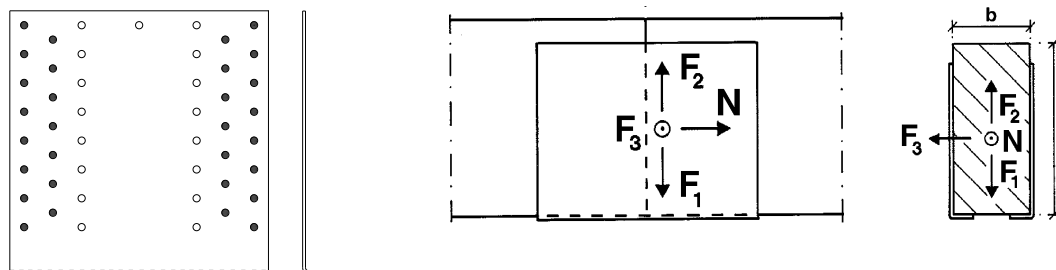
| Type    | A<br>[mm] | B<br>[mm] | no of nails / screws |                 |
|---------|-----------|-----------|----------------------|-----------------|
|         |           |           | Full nailing         | Partial nailing |
| GERW90  | 90        | 140       | 20                   | 12              |
| GERW120 | 120       | 180       | 56                   | 36              |
| GERW140 | 140       |           | 68                   | 44              |
| GERW160 | 160       |           | 80                   | 52              |
| GERW180 | 180       |           | 92                   | 60              |
| GERW200 | 200       |           | 104                  | 68              |
| GERW220 | 220       |           | 116                  | 76              |
| GERW240 | 240       |           | 128                  | 84              |
| GERW260 | 260       |           | 140                  | 92              |
| GERW280 | 280       |           | 152                  | 100             |
| GERW300 | 300       |           | 164                  | 108             |
| GERW320 | 320       |           | 176                  | 116             |
| GERW340 | 340       |           | 188                  | 124             |
| GERW360 | 360       |           | 200                  | 132             |

|         |     |  |     |     |
|---------|-----|--|-----|-----|
| GERW380 | 380 |  | 212 | 140 |
| GERW400 | 400 |  | 224 | 148 |
| GERW420 | 420 |  | 236 | 156 |

Nail pattern



Nails in all holes applicable for shear forces  $F_1$ ,  $F_2$ ,  $F_3$  only.



Nails in 2 end columns applicable for shear forces  $F$  combined with normal force  $N$

Characteristic capacities

Downward load  $F_1$  and uplift  $F_2$

The characteristic load-carrying capacity of a pair of cantilever brackets can be determined from:

$$R_1 = R_2 = k_{w,1-2} \cdot R_{lat,k}$$

where  $k_{w,1-2}$  is stated in table D3-3.

In the case where the Cantilever Bracket GERW are subjected to an axial force  $N$  shall the nails have a minimum distance to end grain of at least  $15d$ , where  $d$  is the diameter of the nails, here 4,0 mm. Consequently, in this case only the 2 nail hole columns nearest each end of the bracket can be used, however, not type 90.

Lateral load  $F_3$

For every 20 mm wide horizontal strip with 3 nails in each end 1 nail is subjected to axial withdrawal and 2 nails to lateral load. For the type W 90 and for connections subjected to an axial tensile force there is only 2 nails per strip so 1 nail is subjected to axial withdrawal and 1 nail to lateral load. So the characteristic load-carrying capacity of a pair of cantilever brackets is calculated as the minimum value of the following two formulas.

For lateral load should all nail holes in the cantilever brackets be used. The factors in the following formulas are determined under this assumption.

$$R_{3,ax} = n_{strip} \cdot k_{W,3,ax} \cdot R_{ax,k}$$

$$R_{3,lat} = n_{strip} \cdot k_{W,3,lat} \cdot R_{lat,k}$$

Where  $n_{strip}$  is the number of 20 mm wide horizontal strips with 2 or 3 nails in each end (only 2 nails for Cantilever Bracket GERW 90). The factors  $k_{W,3,ax}$  and  $k_{W,3,lat}$  are for nails in either 2 columns in each end or in all holes as stated in table 3.4.

Axial force  $F_4$

The characteristic axial tensile capacity of a pair of cantilever brackets can be determined from the following formula:

$$R_{4,k} = 2 \times n_{nails} \times R_{lat,k}$$

where  $n_{nail}$  is the number of nails in each end of the cantilever bracket. The nails shall be positioned at least  $15d$  from the end grain of the timber member.

Table D3-2. Factors  $k_{w,1-2}$  and  $k_{w,3}$  for a pair of Cantilever Bracket GERW

| Type    | Downward or uplift load, $k_{w,1-2}$ |             |                    |             | Lateral force          |               |                    |               |
|---------|--------------------------------------|-------------|--------------------|-------------|------------------------|---------------|--------------------|---------------|
|         | Nails in 2 end columns               |             | Nails in all holes |             | Nails in 2 end columns |               | Nails in all holes |               |
|         | No. 2x                               | $k_{w,1-2}$ | No. 2x             | $k_{w,1-2}$ | $k_{w,3,ax}$           | $k_{w,3,lat}$ | $k_{w,3,ax}$       | $k_{w,3,lat}$ |
| GERW90  | 4                                    | 2,0         |                    |             | 2                      | 0,5           | 2                  | 0,7           |
| GERW90  | 5                                    | 2,7         | 5                  | 2,7         | 2                      | 0,5           | 2                  | 1,4           |
| GERW120 | 9                                    | 5,6         | 14                 | 11,4        | 2                      | 0,5           | 2                  | 1,4           |
| GERW140 | 11                                   | 8,2         | 17                 | 15,6        | 2                      | 0,5           | 2                  | 1,4           |
| GERW160 | 13                                   | 11,0        | 20                 | 20,3        | 2                      | 0,5           | 2                  | 1,4           |
| GERW180 | 15                                   | 14,2        | 23                 | 25,4        | 2                      | 0,5           | 2                  | 1,4           |
| GERW200 | 17                                   | 17,6        | 26                 | 30,9        | 2                      | 0,5           | 2                  | 1,4           |
| GERW220 | 19                                   | 21,3        | 29                 | 36,7        | 2                      | 0,5           | 2                  | 1,4           |
| GERW240 | 21                                   | 25,1        | 32                 | 42,7        | 2                      | 0,5           | 2                  | 1,4           |
| GERW260 | 23                                   | 29,1        | 35                 | 48,8        | 2                      | 0,5           | 2                  | 1,4           |
| GERW280 | 25                                   | 33,3        | 38                 | 55,1        | 2                      | 0,5           | 2                  | 1,4           |
| GERW300 | 27                                   | 37,2        | 41                 | 61,2        | 2                      | 0,5           | 2                  | 1,4           |
| GERW320 | 29                                   | 41,4        | 44                 | 67,5        | 2                      | 0,5           | 2                  | 1,4           |
| GERW340 | 31                                   | 45,6        | 47                 | 73,7        | 2                      | 0,5           | 2                  | 1,4           |
| GERW360 | 33                                   | 49,8        | 50                 | 80,0        | 2                      | 0,5           | 2                  | 1,4           |
| GERW380 | 35                                   | 52,3        | 53                 | 84,5        | 2                      | 0,5           | 2                  | 1,4           |
| GERW400 | 37                                   | 56,1        | 56                 | 90,3        | 2                      | 0,5           | 2                  | 1,4           |
| GERW420 | 39                                   | 59,8        | 59                 | 96,1        | 2                      | 0,5           | 2                  | 1,4           |



## D4 GERG

| Product Name | Material reference acc. to clause II-1 | Alternative Names |
|--------------|--|-------------------|
| GERG         | <a href="#">Steel ref 1</a> to 7       | -                 |

Drawing

Figure D4-1. Dimensioned drawing of Cantilever Bracket GERG

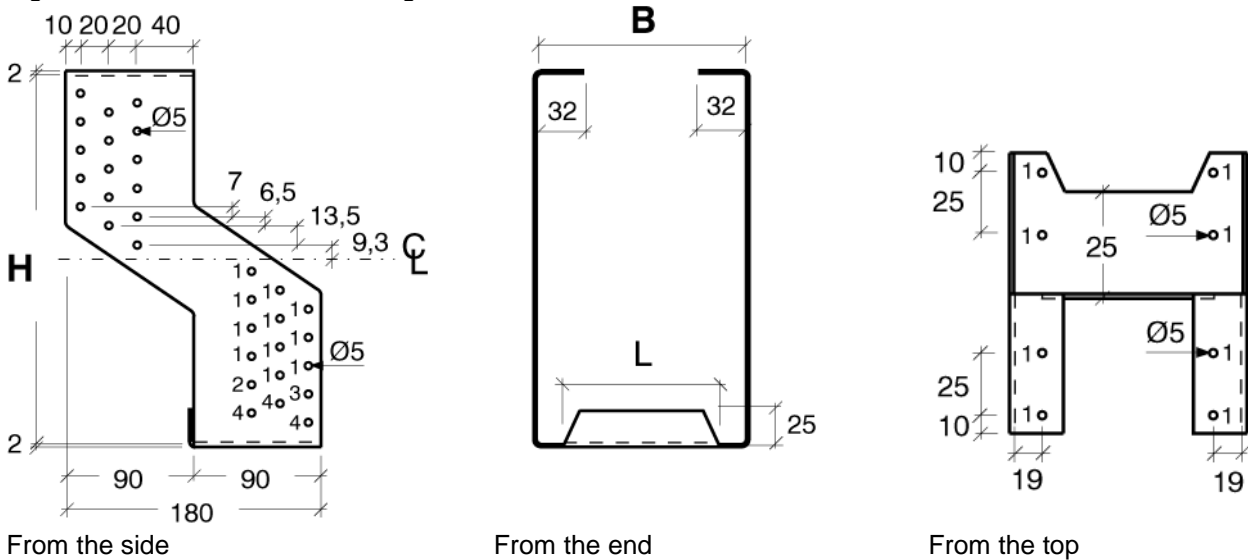


Table D4-1. Size Specification

| Type        | size [mm] |     |     | Holes<br>Ø5mm | Total<br>number in<br>a pair |
|-------------|-----------|-----|-----|---------------|------------------------------|
|             | B         | H   | L   |               |                              |
| GERG120x180 | 122       | 182 | 69  | 1             | 52                           |
| GERG120x200 | 122       | 202 | 69  | 1+2           | 56                           |
| GERG120x220 | 122       | 222 | 69  | 1+2+3         | 60                           |
| GERG120x240 | 122       | 242 | 69  | 1+2+3         | 60                           |
| GERG120x260 | 122       | 262 | 69  | 1+2+3+4       | 72                           |
| GERG140x200 | 142       | 202 | 89  | 1+2           | 56                           |
| GERG140x220 | 142       | 222 | 89  | 1+2+3         | 60                           |
| GERG140x240 | 142       | 242 | 89  | 1+2+3         | 60                           |
| GERG140x260 | 142       | 262 | 89  | 1+2+3+4       | 72                           |
| GERG160x220 | 162       | 222 | 109 | 1+2+3         | 60                           |
| GERG160x240 | 162       | 242 | 109 | 1+2+3         | 60                           |
| GERG160x260 | 162       | 262 | 109 | 1+2+3+4       | 72                           |

Interim sizes for H are possible, by using the hole pattern and capacities of the next lower full size.

## Characteristic capacity

Table D4-2. Characteristic load-carrying capacity of Cantilever Bracket GERG for downward force  $F_1$  and uplift force  $F_2$ . The bracket shall have nails 4,0x50 mm in all holes

| Type            | 120x180 | 120x200 | 120x220            | 120x240            | 120x260            |
|-----------------|---------|---------|--------------------|--------------------|--------------------|
|                 |         | 140x200 | 140x220<br>160x220 | 140x240<br>160x240 | 140x260<br>160x260 |
| Down: $R_{1,k}$ | 22,3    | 25,1    | 31,4               | 34,5               | 41,5               |
| Up: $R_{2,k}$   | 9,1     | 10,3    | 13,8               | 15,3               | 19,3               |

Lateral load  $F_3$ 

The characteristic load-carrying capacity of a cantilever bracket is calculated as the minimum value of the following two formulas:

$$R_{3,ax} = k_{G,3,ax} \cdot R_{ax,k}$$

$$R_{3,lat} = k_{G,3,lat} \cdot R_{lat,k}$$

where the factors  $k_{G,3,ax}$  and  $k_{G,3,lat}$  are stated in table 3.5.2.

Table D4-3. Factors  $k_{G,3,ax}$  and  $k_{G,3,lat}$  for calculating the characteristic lateral capacity

| Type          | 120x180 | 120x200 | 120x220            | 120x240            | 140x260 |
|---------------|---------|---------|--------------------|--------------------|---------|
|               |         | 140x200 | 140x220<br>160x220 | 140x240<br>160x240 | 160x260 |
| $k_{G,3,ax}$  | 6,0     | 6,0     | 6,0                | 6,0                | 6,0     |
| $k_{G,3,lat}$ | 4,2     | 4,9     | 5,6                | 5,6                | 6,3     |

## D5 SC

| Product Name | Material reference acc. to clause II-1 | Alternative Names |
|--------------|--|-------------------|
| SC           | <a href="#">Steel ref 1</a> to 7       | -                 |

### Drawing

Figure D5-1. Dimensioned drawing of Cantilever Bracket SC

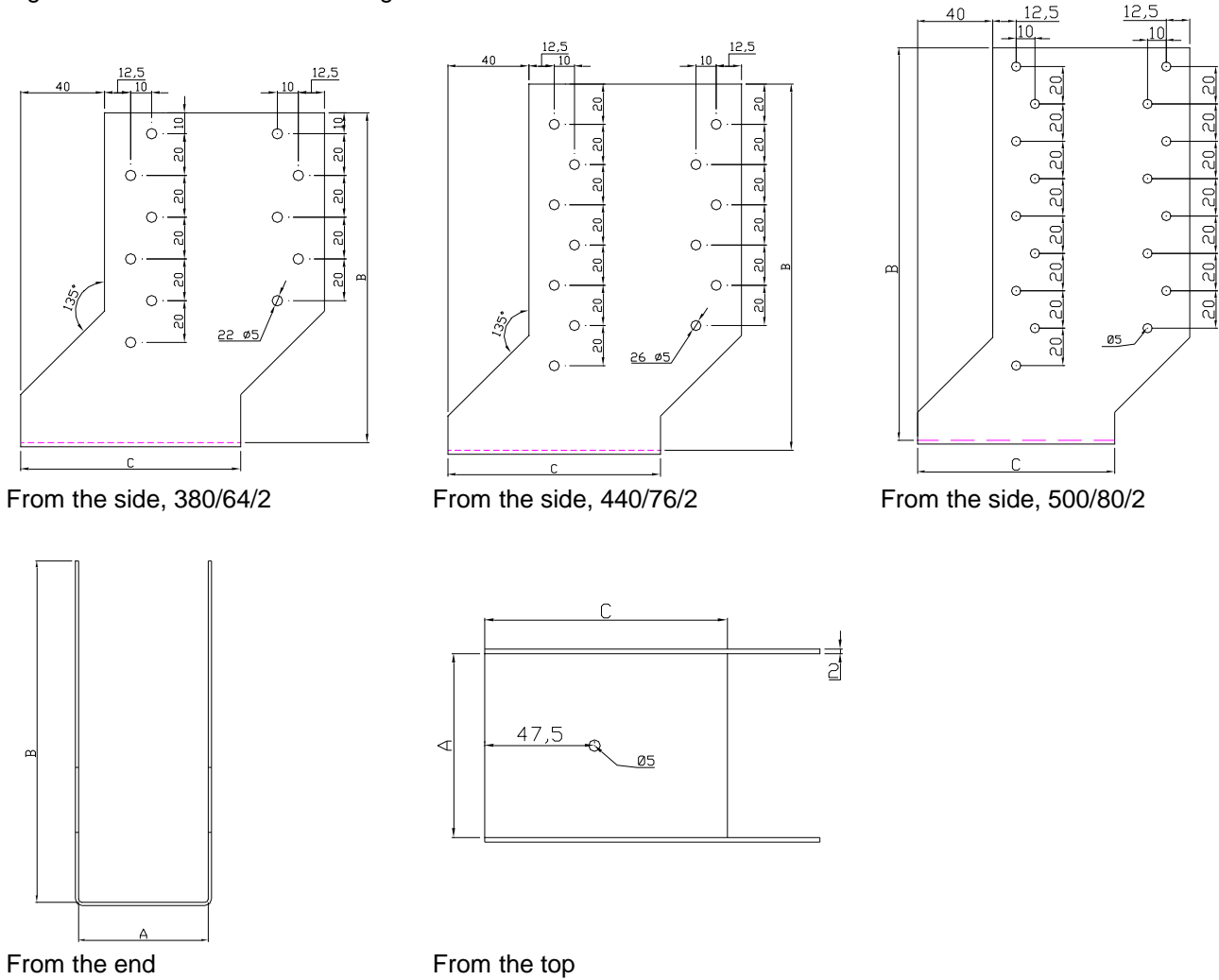
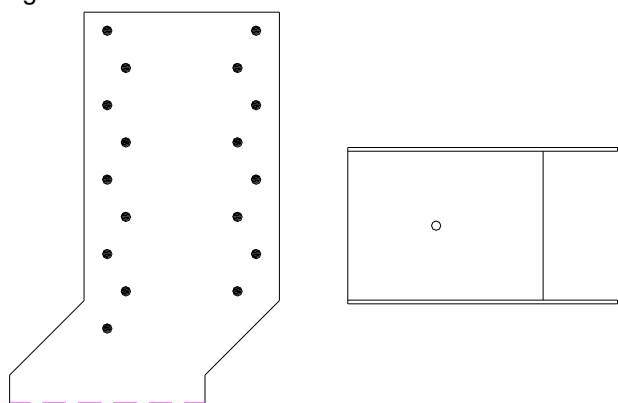


Table D5-1. Size Specification

| Type        | size [mm] |     |     | Holes<br>Ø5mm |
|-------------|-----------|-----|-----|---------------|
|             | B         | H   | L   |               |
| SC 380/64/2 | 64        | 158 | 105 | 10+12+1       |
| SC 440/76/2 | 76        | 182 | 105 | 12+14+1       |
| SC 500/80/2 | 80        | 210 | 105 | 16+18+1       |

Nail pattern  
Figure D5-2.



Full side nails

Characteristic capacity

Table D5-2. Characteristic load-carrying capacity of Cantilever Bracket SC for downward force  $F_1$  with CNA4,0x50 nails

| Type            | SC 380 | SC 440 | SC 500 |
|-----------------|--------|--------|--------|
| Down: $R_{1,k}$ | 15,6   | 18,7   | 24,2   |

## D6 SCR

| Product Name | Material reference acc. to clause II-1 | Alternative Names |
|--------------|--|-------------------|
| SCR          | <a href="#">Steel ref 1</a> to 7       | -                 |

### Drawing

Figure D6-1. Dimensioned drawing of Cantilever Bracket SCR

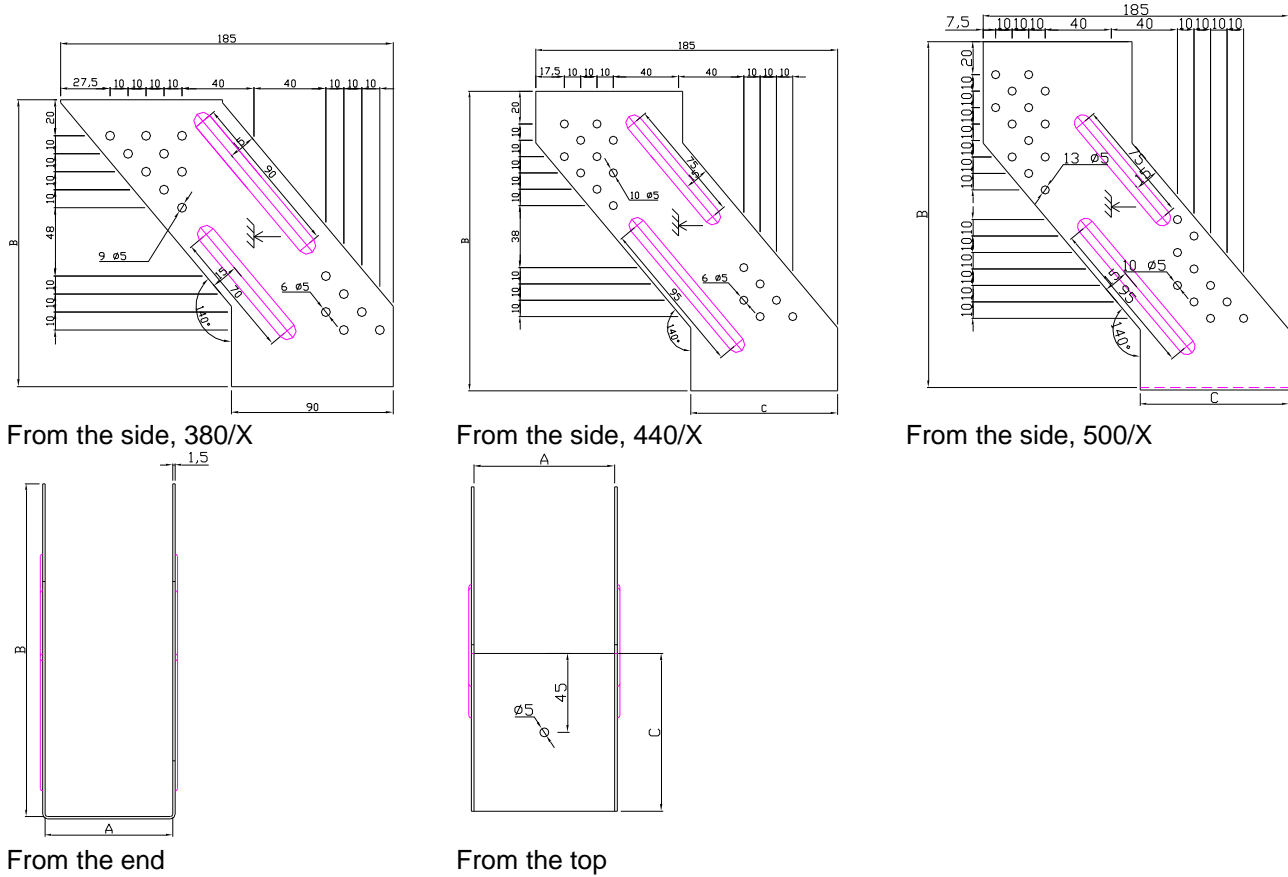
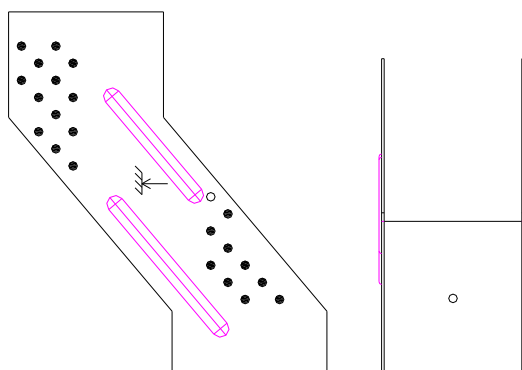


Table D6-1: Size Specification

| Type       | size [mm] |         |    |     | Holes<br>Ø5mm |
|------------|-----------|---------|----|-----|---------------|
|            | B         | H       | L  | t   |               |
| SCR 64/158 | 64        | 158     | 90 | 1,5 | 15+15+1       |
| SCR 76/182 | 76        | 182     | 90 | 1,5 | 17+16+1       |
| SCR 80/210 | 80        | 210     | 90 | 1,5 | 23+23+1       |
| SCR 380/X  | 50-80     | 150-165 | 90 | 1,5 | 15+15+1       |
| SCR 440/X  | 50-100    | 170-190 | 90 | 1,5 | 17+16+1       |
| SCR 500/X  | 50-100    | 200-225 | 90 | 1,5 | 23+23+1       |

Nail pattern  
Figure D6-2. Nail pattern



Full side nails

Characteristic capacity

Downward load  $F_1$

The characteristic load-carrying capacity  $R_{1,k}$  of a cantilever bracket nailed in all side holes with 4,0x35 mm or 4,0x50 mm nails in accordance to ETA 04/0013 subjected to a downward force is stated in table D6-3.

Uplift  $F_2$

The characteristic load-carrying capacity  $R_{2,k}$  of a cantilever bracket nailed in all holes with 4,0x35 mm or 4,0x50 mm nails in accordance with ETA 04/0013 subjected to an uplift force is stated in table D6-3.

Table D6-2. Characteristic load-carrying capacity of Cantilever Bracket SCR for downward force  $F_1$  and uplift force  $F_2$ . The bracket shall have nails in all side holes

| Nail type and force direction | SCR64/158 = SCR380 | SCR76/182 = SCR440 | SCR80/210 = SCR500 |
|-------------------------------|--------------------|--------------------|--------------------|
| 4,0x35 mm                     |                    |                    |                    |
| Down: $R_{1,k}$               | 14,6               | 16,7               | 22,7               |
| Up: $R_{2,k}$                 | 4,6                | 5                  | 8,1                |
| 4,0x50 mm                     |                    |                    |                    |
| Down: $R_{1,k}$               | 19,2               | 22,3               | 30,6               |
| Up: $R_{2,k}$                 | 6,3                | 6,8                | 11,2               |

Lateral load  $F_3$

The characteristic load-carrying capacity of a cantilever bracket is calculated as the minimum value of the following two formulas:

$$R_{3,ax} = k_{SCR,3,ax} \cdot R_{ax,k}$$

$$R_{3,lat} = k_{SCR,3,lat} \cdot R_{lat,k}$$

where the factors  $k_{SCR,3,ax}$  and  $k_{SCR,3,lat}$  are stated in table 3.7.2.

Table D6-3. Factors  $k_{SCR,3,ax}$  and  $k_{SCR,3,lat}$  for calculating the characteristic lateral capacity

| Type            | SCR 380 | SCR 440 | SCR 500 |
|-----------------|---------|---------|---------|
| $k_{SCR,3,ax}$  | 5,0     | 5,0     | 6,0     |
| $k_{SCR,3,lat}$ | 2,8     | 2,8     | 5,3     |

## D7 LEA

| Product Name | Material reference acc. to clause II-1 | Alternative Names |
|--------------|--|-------------------|
| LEA          | <a href="#">Steel ref 1</a> to 7       | -                 |

### Drawing

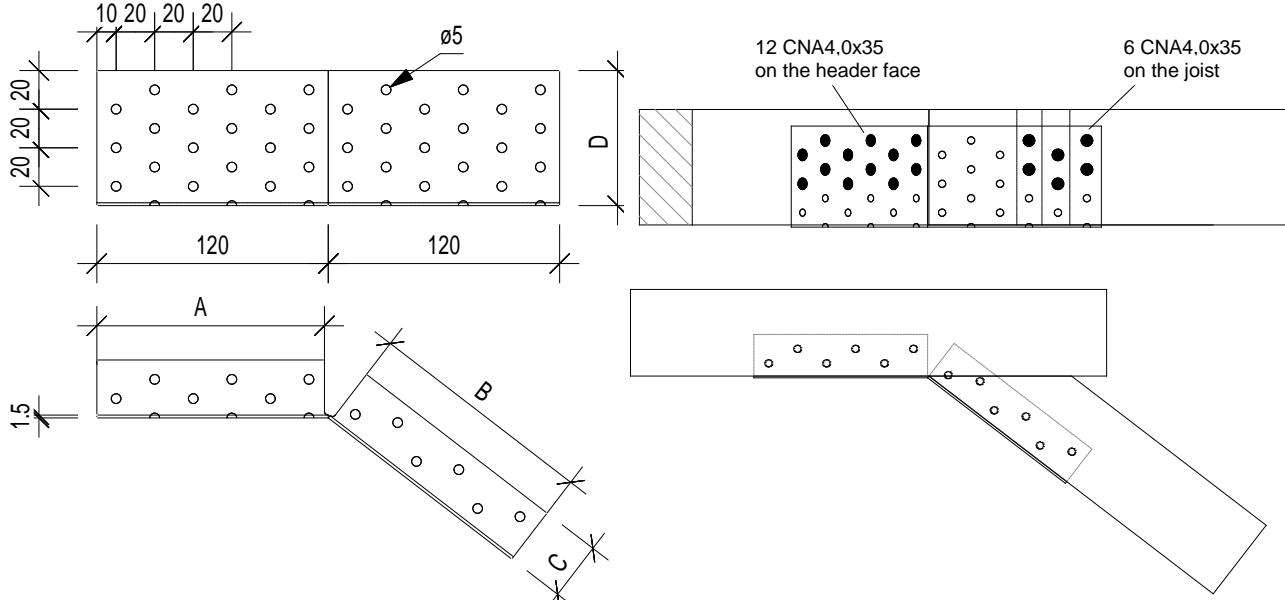


Table D7-1. Size Specification

| Type             | size [mm] |     |    |    | Holes<br>Ø5mm |
|------------------|-----------|-----|----|----|---------------|
|                  | A         | B   | C  | D  |               |
| LEA240/30/70/1,5 | 118       | 118 | 30 | 70 | 18+18+6+6     |

### Material

Table D7-2. Material Specification

| Material thickness | Material Grades              | Coating specification |
|--------------------|------------------------------|-----------------------|
| 1,5                | S250 GD                      | Z275 or Z800          |
| 1,5                | stainless steel as described |                       |

### Characteristic capacity

Table D7-3. Load carrying capacities for CNA 4,0x35

| Hangers          | Number of fasteners |       | Characteristic capacities (kN) |                |
|------------------|---------------------|-------|--------------------------------|----------------|
|                  | Header              | Joist | F <sub>1</sub>                 | F <sub>2</sub> |
| LEA240/30/70/1.5 | 12                  | 6     | 2,7                            | 2,3            |