ETA-Danmark A/S
Kollegievej 6
DK-2920 Charlottenlund
Tel. +45 72 24 59 00
Fax +45 72 24 59 04
Internet www.etadanmark.dk

MEMBER OF EOTA

Authorised and notified according to Article 10 of the Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products

European Technical Approval ETA-07/0053

This ETA replaces the previous ETA with the same number and validity from 2011-11-17 to 2016-11-17

Trade name:	Simpson Strong-Tie Cantilever Bracket GERB, GERC, GERW, GERG, SC, SCR and LEA
Holder of approval:	SIMPSON STRONG-TIE A/S Hedegaardsvej 4 – 11, Boulstrup DK-8300 Odder Tel. +45 87 81 74 00 Fax +45 87 81 74 09 Internet www.simpsonstrongtie.dk
Generic type and use of construction product:	Three-dimensional nailing plate (timber to timber cantilever bracket)
Valid from: to:	2013-04-18 2018-04-18
Manufacturing plant:	Simpson Strong-Tie A/S Hedegaardsvej 4-11, Boulstrup 8300 Odder Denmark Simpson Strong-Tie ZAC des Quatre Chemins 85400 Sainte Gemme La Plaine France Simpson Strong-Tie Winchester Road Cardinal Point Tamworth Staffordshire B78 3HG United Kingdom
This European Technical Approval contains:	32 pages including 5 annexes which form an integral part of the document

I LEGAL BASIS AND GENERAL CONDITIONS

1 This European Technical Approval is issued by ETA-Danmark A/S in accordance with:

- Council Directive 89/106/EEC of 21 December 1988 on the approximation of laws, regulations and administrative provisions of Member States relating to construction products[1)], as amended by Council Directive 93/68/EEC of 22 July 1993[2)].

- Bekendtgørelse 559 af 27-06-1994 (afløser bekendtgørelse 480 af 25-06-1991) om ikrafttræden af EF direktiv af 21. december 1988 om indbyrdes tilnærmelse af medlemsstaternes love og administrative bestemmelser om byggevarer.

- Common Procedural Rules for Requesting, Preparing and the Granting of European Technical Approvals set out in the Annex to Commission Decision 94/23/EC[3)].

- EOTA Guideline ETAG 015 *Three-dimensional nailing plates*, September 2002 edition.

2 ETA-Danmark A/S is authorized to check whether the provisions of this European Technical Approval are met. Checking may take place in the manufacturing plant. Nevertheless, the responsibility for the conformity of the products to the European Technical Approval and for their fitness for the intended use remains with the holder of the European Technical Approval.

3 This European Technical Approval is not to be transferred to manufacturers or agents of manufacturers other than those indicated on page 1, or manufacturing plants other than those indicated on page 1 of this European Technical Approval.

4 This European Technical Approval may be withdrawn by ETA-Danmark A/S pursuant to Article 5(1) of Council Directive89/106/EEC.

5 Reproduction of this European Technical Approval including transmission by electronic means shall be in full. However, partial reproduction can be made with the written consent of ETA-Danmark A/S. In this case partial reproduction has to be designated as such. Texts and drawings of advertising brochures shall not contradict or misuse the European Technical Approval.

6 This European Technical Approval is issued by ETA-Danmark A/S in Danish.
This version corresponds fully to the version circulated within EOTA. Translations into other languages have to be designated as such.

1) Official Journal of the European Communities N° L40, 11 Feb 1989, p 12.
2) Official Journal of the European Communities N° L220, 30 Aug 1993, p 1.
3) Official Journal of the European Communities N° L 17, 20 Jan 1994, p 34.

II SPECIAL CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

Definition of the product
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 cantilever brackets are made from pre-galvanized steel Grade S 250 GD + Z275 and Grade S 250 + Z800 according to EN 10346, S235JR according to EN10025 or stainless steel 1.4401 or 1.4404 according to EN 10088 or a stainless steel with a minimum characteristic yield stress of 235 N/mm² or a minimum ultimate tensile strength of 330 N/mm². Dimensions and hole positions are shown in Annex D. Steel type are shown in Annex C and typical installations are shown in Annex B.

Intended use
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 89/106/EEC 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 wood members can be of solid timber, glued laminated timber and similar glued members, or wood based structural members with a minimum characteristic density of 290 kg/m^3.
The requirements to the material of the wood members can be fulfilled by using the following materials:

- Solid timber classified to C14-C40 according to EN338 / EN 14081.
- Glued members of timber classified to C14-C40 according to EN338 / EN 14081when structural adhesives are used.
- Glued laminated timber classified to GL24 c or better according to EN 1194 / EN 14080.
- Solid Wood Panels, SWP according to EN 13353.
- Laminated Veneer Lumber LVL according to EN 14374
- Laminated Strand Lumber, e.g. Parallam and Timber Strand
- Plywood according to EN 636.
- Oriented Strand Board, OSB according to EN 300.
- Kreuzbalken with minimum thickness of 80 mm.
- I-beams with web stiffeners in the supported beam. See Annex E.

Annex D states formulas or numbers for the load-carrying capacities of the cantilever brackets.

Where the capacity is expressed by a formula the calculation method is only allowed for a characteristic wood density of up to 460 kg/m^3. Even though the wood based material may have a larger density, this must not be used in the formulas for the load-carrying capacity of the cantilever bracket.

Capacities expressed as numbers (not formulas) e.g. type SC, SCR and GERG are based on a characteristic density of 350 kg/m^3. For timber or wood based material with a lower characteristic density than 350 kg/m^3 the load-carrying capacities shall be reduced by the k_{dens} factor:

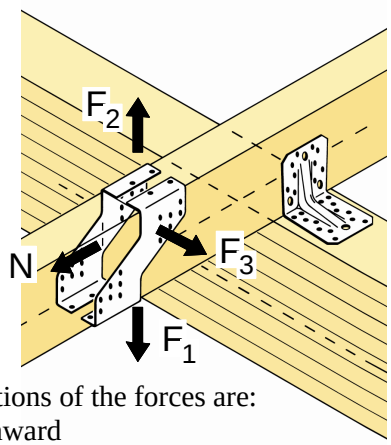
$$k_{dens} = \frac{\rho_k}{350}$$

where ρ_k is the characteristic density of the timber in kg/m^3.

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

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 cantilever bracket connection are the following F_1, F_2, F_3 and N, as shown in the figure below. The forces shall act in the middle of the cantilever bracket. It is assumed that the forces F_1, F_2 and F_3 are acting right at the end of each beam.



The directions of the forces are:
F_1 Downward
F_2 Upward
F_3 Laterally – horizontal
N Axial in the middle of the beam

The cantilever brackets with a zinc coating Z275 or Z800 and brackets with a zinc coating of 55 µm are for use in timber structures subject to dry, internal conditions defined by the service classes 1 and 2 of EN 1995-1-1:2004, (Eurocode 5).

The cantilever brackets made from stainless steel are intended for use in more corrosive environments defined by service class 3 of EN 1995-1-1:2004, (Eurocode 5).
The nails and screws to be used in combination with stainless steel brackets shall be made from suitable stainless material.

Assumed working life
The assumed intended working life of the cantilever brackets for the intended use is 50 years, provided that they are subject to appropriate use and maintenance.

The information on the working life should not be regarded as a guarantee provided by the manufacturer or ETA-Danmark A/S. An “assumed intended working life” means that it is expected that, when this working life has elapsed, the real working life may be, in normal use conditions, considerably longer without major degradation affecting the essential requirements.

2 Characteristics of product and assessment

ETAG para.	Characteristic	Assessment of characteristic
	2.1 Mechanical resistance and stability*)	
6.1.1	Characteristic load-carrying capacity	See Annex D
6.1.2	Stiffness	No performance determined
6.1.3	Ductility in cyclic testing	No performance determined
	2.2 Safety in case of fire	
6.2.1	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
	2.3 Hygiene, health and the environment	
6.3.1	Influence on air quality	No dangerous materials **)
	2.4 Safety in use	Not relevant
	2.5 Protection against noise	Not relevant
	2.6 Energy economy and heat retention	Not relevant
	2.7 Related aspects of serviceability	
6.7.1	Durability	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
6.7.2	Serviceability	
6.7.3	Identification	See Annex D

*) See page 8 of this ETA

**) In accordance with http://europa.eu.int-/comm/enterprise/construction/internal/dangsub/dangmain.htm In addition to the specific clauses relating to dangerous substances contained in this European Technical Approval, 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 EU Construction Products Directive, these requirements need also to be complied with, when and where they apply.

2. Safety principles and partial factors

2.1 Mechanical resistance and stability

See annex D for characteristic load-carrying capacities of the cantilever brackets.

The characteristic capacities of the cantilever brackets are determined by calculation assisted by 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.

Connector nails and screws in accordance to ETA-04/0013
The formulas for the load-carrying capacities of the cantilever bracket have been determined based on the use of connector nails or connector screws in accordance with ETA-04/0013.

The load-carrying capacities stated as numbers have been determined based on the use of connector nails with a diameter of 4.0 mm according to ETA-04/0013. To obtain these values it is also allowed to use connector nails with a diameter of 4.2 mm or connector screws with a diameter of 5 mm according to ETA-04/0013 with similar or better performance than connector nails with a diameter of 4.0 mm.

Threaded nails in accordance to prEN 14592
The design model on which the formulas for load-carrying capacity are based, also allows the use of threaded nails in accordance to prEN 14592 with a diameter in the range 4,0 – 4,2 mm and a minimum length of 35 mm, assuming a thick steel plate when calculating the lateral nail load-carrying capacity. For the load-carrying capacities stated as numbers a reduction factor equal to the ratio between the characteristic lateral capacity of the actual used threaded nail and the characteristic lateral capacity of the corresponding connector nail according to table B1 in ETA-04/0013 is applicable.

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.

No performance has been determined in relation to the stiffness of the joints to be used for the analysis of the serviceability limit state.

2.7 Related aspects of serviceability

2.7.1 Corrosion protection in service class 1 and 2.
In accordance with ETAG 015 the cantilever brackets shall have a zinc coating weight of minimum Z275 or Z800. The steel employed is S250 GD with Z275 or Z800 according to EN 10326:2004 or S235 JR according to EN10025:2004 with a zinc coating of 55 µm.

2.7.2 Corrosion protection in service class 3.
In accordance with Eurocode 5 the cantilever brackets are made from stainless steel 1.4401or 1.4404 according to EN 10088 and the nails or screws shall be produced from stainless steel.

3 Attestation of Conformity and CE marking

3.1 Attestation of Conformity system

The system of attestation of conformity is 2+ described in Council Directive 89/106/EEC (Construction Products Directive) Annex III.

a) Tasks for the manufacturer:

(1) Factory production control,
(2) Initial type testing of the product,

b) Tasks for the notified body:

(1) Initial inspection of the factory and the factory production control,
(2) Continuous surveillance

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

The manufacturer has a factory production control system in the plant and exercises permanent internal control of production. All the elements, requirements and provisions adopted by the manufacturer are documented in a systematic manner in the form of written policies and procedures. This production control system ensures that the product is in conformity with the European Technical Approval.

The manufacturer shall only use raw materials supplied with the relevant inspection documents as laid down in the control plan[1]. The incoming raw materials shall be subject to controls and tests by the manufacturer before acceptance. Check of materials, such as sheet metal, shall include control of the inspection documents presented by suppliers (comparison with nominal values) by verifying dimension and determining material properties, e.g. chemical composition, mechanical properties and zinc coating thickness.

The manufactured components are checked visually and for dimensions.

The control plan, which is part of the technical documentation of this European Technical Approval, includes details of the extent, nature and frequency of testing and controls to be performed within the factory production control and has been agreed between the approval holder and ETA-Danmark A/S.

The results of factory production control are recorded and evaluated. The records include at least the following information:

- Designation of the product, basic material and components;
- Type of control or testing;
- Date of manufacture of the product and date of testing of the product or basic material and components;
- Result of control and testing and, if appropriate, comparison with requirements;
- Signature of person responsible for factory production control.

The records shall be presented to ETA-Danmark A/S on request

3.2.1.1 Initial type testing of the product

For initial type-testing the results of the tests performed as part of the assessment for the European Technical Approval shall be used unless there are changes in the production line or plant. In such cases the necessary initial type testing has to be agreed between ETA-Danmark A/S and the notified body

3.2.2. Tasks of notified bodies

3.2.2.1 Initial inspection of the factory and the factory production control

The approved body should ascertain that, in accordance with the control plan, the factory, in particular the staff and equipment, and the factory production control, are suitable to ensure a continuous and orderly manufacturing of the cantilever bracket with the specifications given in part 2.

1 The control plan has been deposited at the ETA-Danmark A/S and is only made available to the approved bodies involved in the conformity attestation procedure.

3.2.2.2 Continuous surveillance

The approved body shall visit the factory at least twice a year for routine inspections. It shall be verified that the system of factory production control and the specified manufacturing processes are maintained, taking account of the control plan.

The results of product certification and continuous surveillance shall be made available on demand by the certification body to ETA-Danmark A/S. Where the provisions of the European Technical Approval and the control plan are no longer fulfilled, the certificate of conformity shall be withdrawn by the approved body.

3.3 CE marking

The CE marking shall be affixed on each packaging of connectors. The initials "CE" shall be accompanied by the following information:

- The identification number of the notified body.
- Name or identifying mark of the manufacturer.
- The last two digits of the year in which the marking was affixed.
- Number of the European Technical Approval.
- Name and size of product.
- Number of the EC certificate of conformity.
- Number of the ETA Guideline (ETAG no. 015).

4 Assumptions under which the fitness of the product for the intended use was favourably assessed

4.1 Manufacturing

Simpson Strong-Tie Cantilever Bracket B, C, G, W, SC and SCR are manufactured in accordance with the provisions of this European Technical Approval using the manufacturing processes as identified in the inspection of the plant by the notified inspection body and laid down in the technical documentation.

4.2 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 in Annex A and prescribed in Annex B can be used.
- The characteristic capacity of the cantilever bracket connection is calculated according to the manufacturer's technical documentation, dated 20-12-2006.
- The cantilever bracket connection is designed in accordance with Eurocode 5 or an appropriate National Code.
- 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 W: 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 B: 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 G, 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.

4.3 Maintenance and repair

Maintenance is not required during the assumed intended working life.

Should repair prove necessary, it is normal to replace the cantilever bracket.

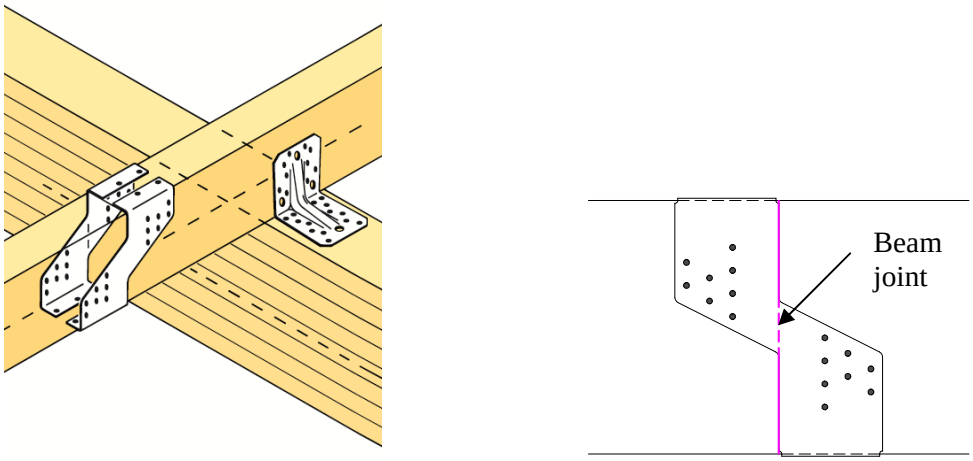
Thomas Bruun
Manager, ETA-Danmark A/S

Annex A Revision History

Revison History	
Issue	update
2	change of the product names added size of GERW added type LEA modify the values for SC and SCR
3	Introduction of steel grade S250 + Z800

Annex B Typical Installation

Cantilever Bracket



- **Figure B-1: Typical installation**

- **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

Annex C1 Basis of Design

Characteristic capacities of the cantilever bracket connections with nails or screws only

The formulas are applicable for connectors made from stainless steel with a characteristic yield stress of at least 235 N/mm² or a characteristic ultimate tensile strength of at least 330 N/mm² as for ordinary steel of the quality S250GD + Z275 and S250 + Z800 according to EN 10346 or S235JR according to EN10025.

- The characteristic capacity of the cantilever bracket connection is calculated according to the manufacturer's technical documentation, dated 20-12-2006.
- The cantilever bracket connection is designed in accordance with Eurocode 5 or an appropriate National Code.

The capacities and formulas stated in annex D gives characteristic capacities (R_k). The design capacities are obtained according to the following formula with the material safety factor γ_M for timber:

$$R_d = \frac{R_k \cdot k_{\text{mod}}}{\gamma_M}$$

Combined forces

For practical purposes the strength verification is always carried out for design forces and design capacities. For combinations of forces – but not axial force – the following inequalities shall be fulfilled:

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

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

When axial force N acts together with the other forces F_1, F_2 or F_3 the following inequalities shall be fulfilled:

$$\left(\frac{F_{1,d}}{R_{1,d}}\right)^{1,25} + \left(\sqrt{\left(\frac{F_{3,d}}{R_{3,d}}\right)^2 + \left(\frac{N_d}{R_{N,d}}\right)^2}\right)^{1,25} \le 1{,}0$$

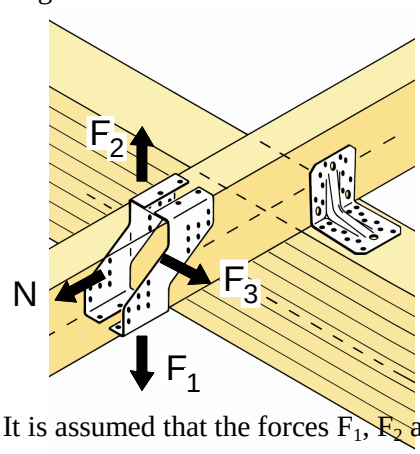
$$\left(\frac{F_{2,d}}{R_{2,d}}\right)^{1,25} + \left(\sqrt{\left(\frac{F_{3,d}}{R_{3,d}}\right)^2 + \left(\frac{N_d}{R_{N,d}}\right)^2}\right)^{1,25} \le 1{,}0$$

Annex C2 – Definition of forces direction

The characteristic load-carrying capacities are for the following force directions:

The directions of the forces are:

F_1	Downward
F_2	Upward
F_3	Laterally – horizontal
N	Axial in the middle of the beam



The forces shall act in the middle of the cantilever bracket. It is assumed that the forces F_1, F_2 and F_3 are acting right at the end of each beam.

Wane

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.

Additional conditions

Additionally the following conditions apply:

There shall be nails or screws in all holes or a partial nailing pattern as described in Annex D can be used.
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.

Annex C3 – Fasteners specification and capacities

Fastener type	Diameter [mm]	Length [mm]	According to
Connector nail	4,0 and 4,2	L	ETA-04/0013
Connector screw	5,0	L	ETA-04/0013
Threaded nail	4,0-4,2	L	EN 14592

When the capacity of a cantilever bracket is calculated from a formula all of the above stated nails can be used.
When the load bearing capacities of the cantilever brackets are based on the use of Connector nails CNA4,0x50 in accordance with ETA-04/0013 it is allowed to use connector nails, connector screws according to ETA-04/0013 with the same or better performance than the used CNA4,0x50 Connector nails and still achieve the same load bearing capacity of the connection. If the capacities are stated for more sizes of nails or screws it is always allowed to interpolate between two sizes.

Annex C4 – Characteristic capacity modification method for different timber types

Annex D states the load bearing carrying capacities of the cantilever bracket connections for a characteristic density of 350 kg/m^3.
For timber or wood based material with a lower characteristic density than 350 kg/m^3 the load carrying capacities shall be reduced by the k_{dens} factor:

$$k_{dens} = \frac{\rho_k}{350}$$

Where ρ_k is the characteristic density of the timber in kg/m^3.

Annex D - Product definition and capacities

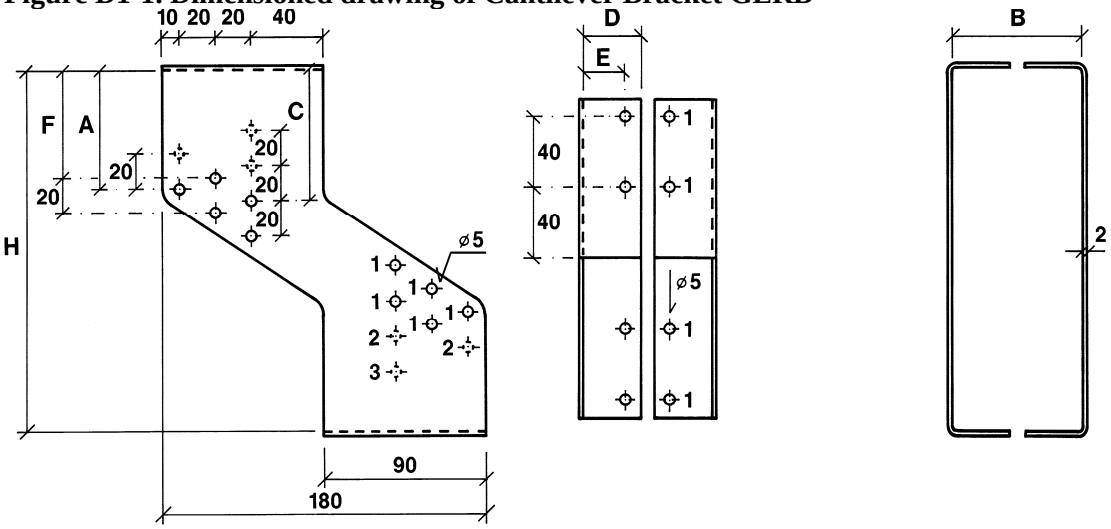
Annex D1 - GERB

Product name

Product Name	Alternative names			
	UK	France	Denmark	Germany
GERB	-	-	-	B

Drawing

Figure D1-1. Dimensioned drawing of Cantilever Bracket GERB



From the side From the end From the top

Table D1-1. Size specification

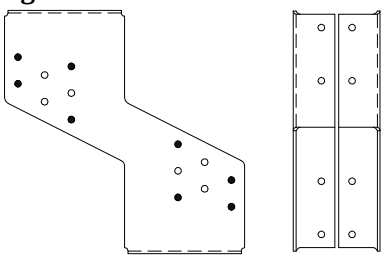
Type	size [mm]							Holes Ø5mm	Total number in a pair
	A	B_{min}	C	D	E	F	H		
GERB125	28	56	35	27	19	21,5	128,5	1	28
GERB140	35	62	42,5	30	22	28,5	140	1	28
GERB150	42	60	49,5	29	21	35,5	154	1+2	36
GERB160	45	62	52,5	30	22	38,5	160	1+2	36
GERB175	54,5	68	61	33	25	48	179	1+2	36
GERB180	55	68	62,5	33	25	48,5	180	1+2	36
GERB200	67,5	68	74	33	25	61	205	1+2+3	40
GERB220	75	70	81,5	34	26	68,5	220	1+2+3	40

Material

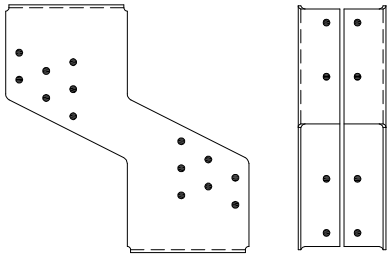
Table D1-2. Material Specification

Material thickness	Material Grades	Coating specification
2	S250 GD	Z275 or Z800
2	S235 JR	hot-dip galvanized 55 µm
2	stainless steel as described	

Nail pattern
Figure D1-2.

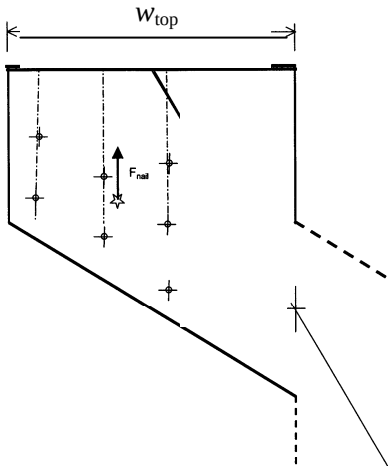


Nails in corners



Full nailing in both sides, bottom and top

Characteristic capacities
Figure D1-3. Downward load F_1



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

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

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 D1-3
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 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 D1-3

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 D1-3.

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

Type	Downward load $k_{B,1}$		Uplift $k_{B,2}$		Lateral force Full side nails	
	Full side nails	Nails in corners	Full side nails	Nails in corners	$k_{C,3,ax}$	$k_{C,3,lat}$
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:

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

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

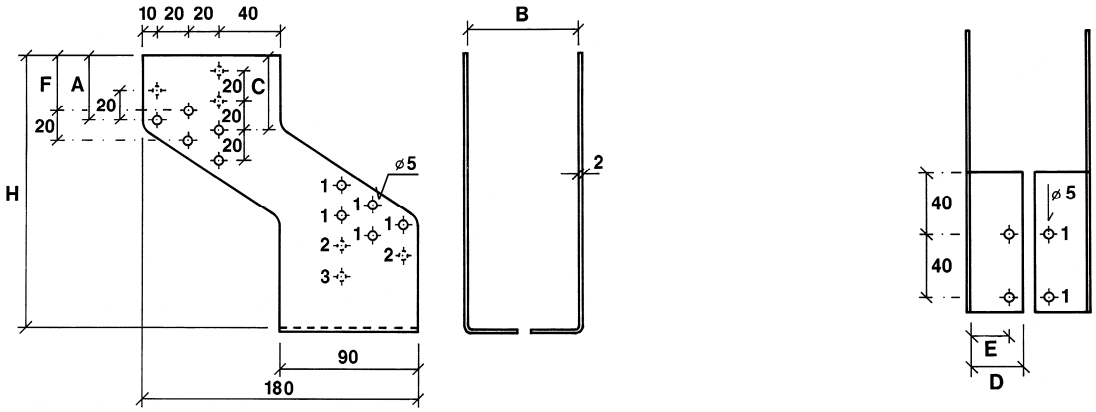
Annex D2 - GERC

Product name

Product Name	alternative names			
	UK	France	Denmark	Germany
GERC	-	-	-	C

Drawing

Figure D2-1. Dimensioned drawing of Cantilever Bracket GERC



From the side From the end From the top

Table D2-1. Size specification

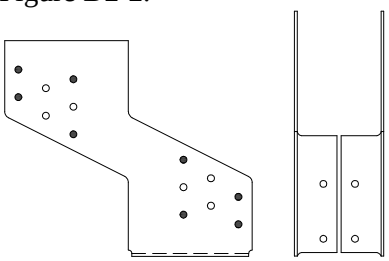
Type	size [mm]							Holes Ø5mm	Total number in a pair
	A	B_{min}	C	D	E	F	H		
GERC125	16,5	58	23	27	19	10	117	1	24
GERC150	30,5	60	38,5	29	21	24,5	143	1	32
GERC175	30,5	68	38,5	33	25	24,5	155	1+2	32
GERC200	42,5	68	50	33	25	37	181	1+2+3	36
GERC225		68		33	25		212	1+2	36

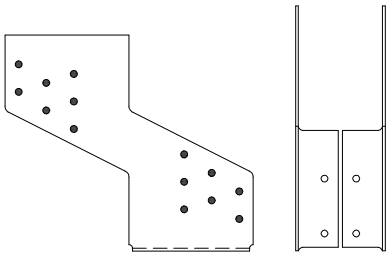
Material

Table D2-2. Material specification

Material thickness	Material Grades	Coating specification
2	S250 GD	Z275 or Z800
2	stainless steel as described	

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 3.3.

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

Type	Downward load, $k_{C,1}$		Uplift $k_{C,2}$		Lateral force Full side nails	
	Full side nails	Nails in corners	Full side nails	Nails in 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

Annex D3 - GERW

Product name

	alternative names			
Product Name	UK	France	Denmark	Germany
GERW	-	-	-	W

Drawing

Figure D3-1. Dimensioned drawing of Cantilever Bracket GERW

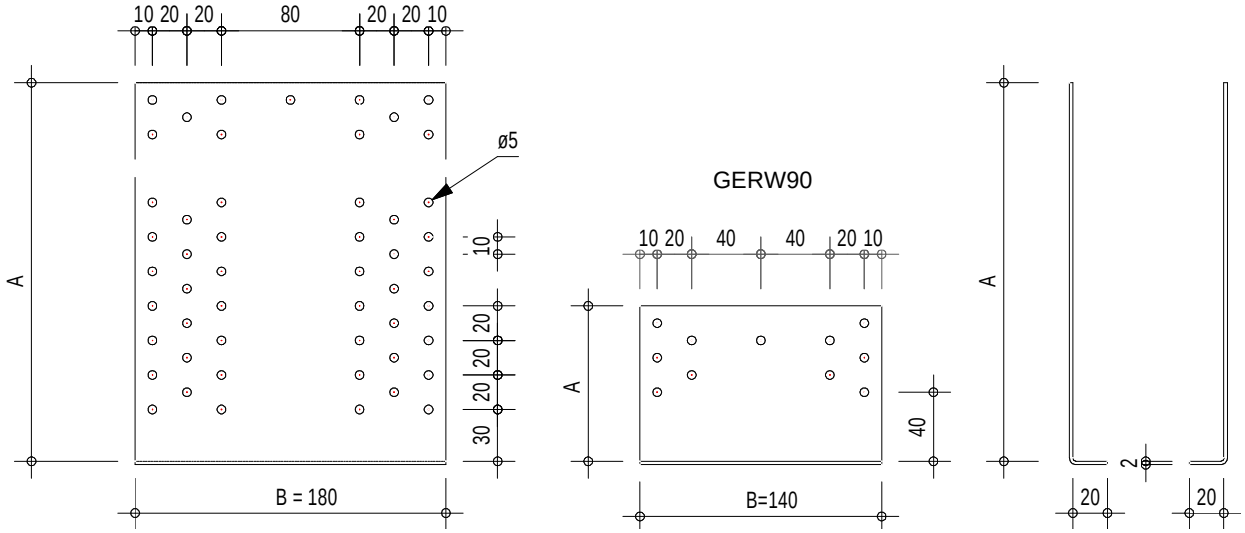


Table D3-1: Size specification

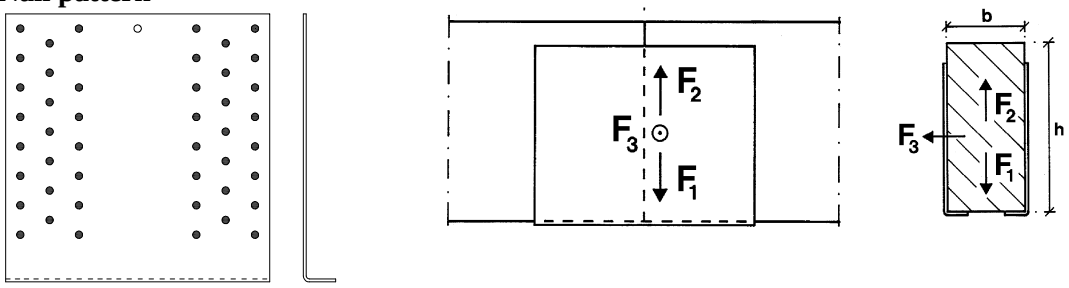
Type	A [mm]	B [mm]	no of nails / screws	
			Full nailing	Partial nailing
GERW90	90	140	20	12
GERW120	120	180	56	36
GERW140	140		68	44
GERW160	160		80	52
GERW180	180		92	60
GERW200	200		104	68
GERW220	220		116	76
GERW240	240		128	84
GERW260	260		140	92
GERW280	280		152	100
GERW300	300		164	108
GERW320	320		176	116
GERW340	340		188	124
GERW360	360		200	132
GERW380	380		212	140
GERW400	400		224	148
GERW420	420		236	156

Material

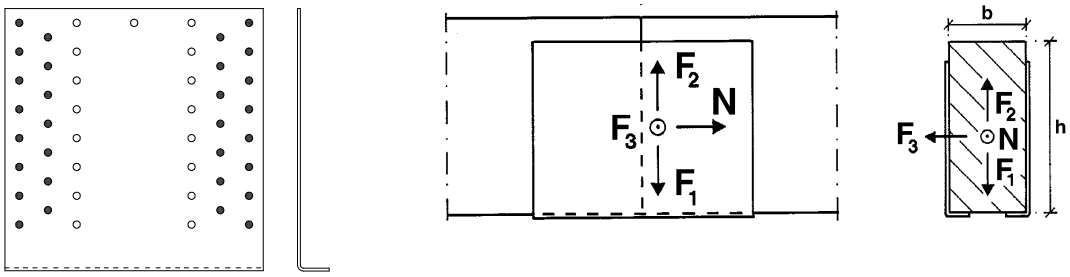
Table D3-2. Material specification

Material thickness	Material Grades	Coating specification
2	S 250 GD	Z275 or Z800
2	S 235 JR	hot-dip galvanized 55 µm
2	stainless steel as described	

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:

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

where $k_{w,1\text{-}2}$ 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 15*d*, 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.

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

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 *N*

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

$$R_{N,k} = 2 \cdot n_{nail} R_{lat,k}$$

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

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

	Downward or uplift load, $k_{W,1-2}$				Lateral force			
Type	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

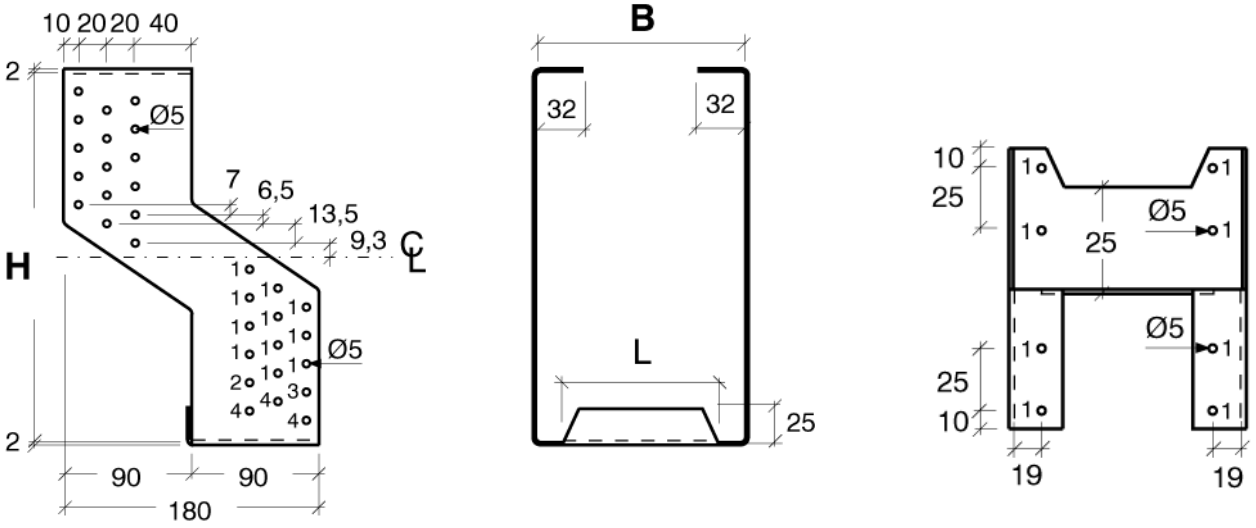
Annex D4 - GERG

Product name

Product Name	alternative names			
	UK	France	Denmark	Germany
GERG	-	-	-	G

Drawing

Figure D4-1. Dimensioned drawing of Cantilever Bracket GERG



From the side From the end From the top

Table D4-1. Size Specification

Type	size [mm]			Holes Ø5mm	Total number in 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

Material

Table D4-2. Material Specification

Material thickness	Material Grades	Coating specification
2	S250 GD	Z275 or Z800
2	stainless steel as described	

Characteristic capacity

Table D4-3. 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 140x200	120x220 140x220 160x220	120x240 140x240 160x240	120x260 140x260 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 D4-4. Factors $k_{G,3,ax}$ and $k_{G,3,lat}$ for calculating the characteristic lateral capacity

Type	120x180	120x200 140x200	120x220 140x220 160x220	120x240 140x240 160x240	140x260 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

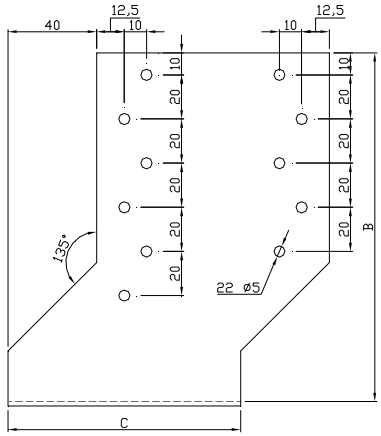
Annex D5 - SC

Product name

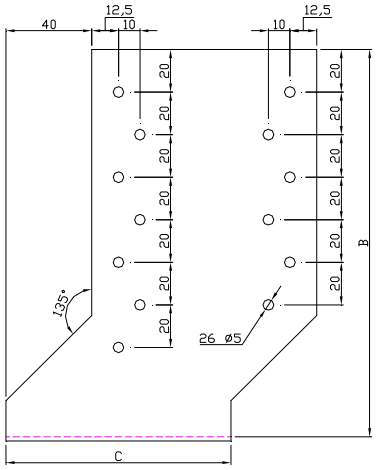
Product Name	alternative names			
	UK	France	Denmark	Germany
SC	-	-	-	-

Drawing

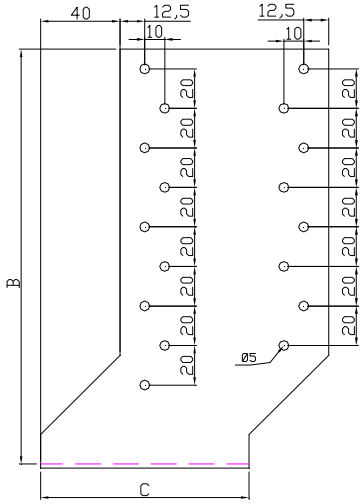
Figure D5-1. Dimensioned drawing of Cantilever Bracket SC



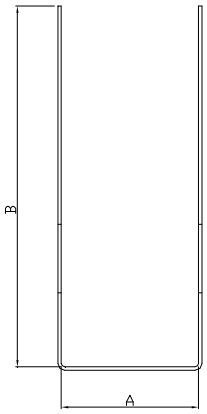
From the side, 380/64/2



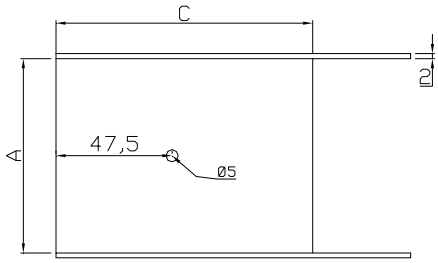
From the side, 440/76/2



From the side, 500/80/2



From the end



From the top

Table D5-1. Size Specification

Type	size [mm]			Holes 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

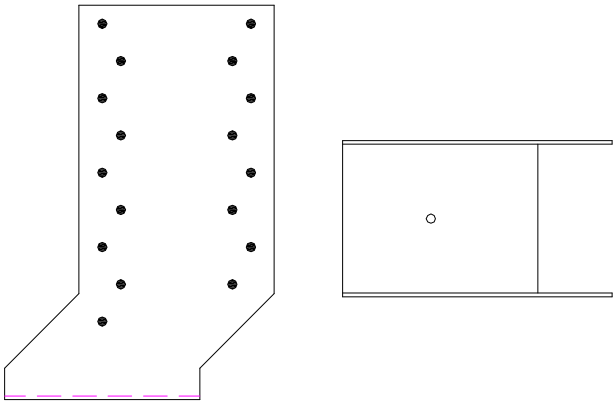
Material

Table D5-2. Material Specification

Material thickness	Material Grades	Coating specification
2	S250 GD	Z275 or Z800
2	stainless steel as described	

Nail pattern

Figure D5-2.



Full side nails

Characteristic capacity

Table D5-3. 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

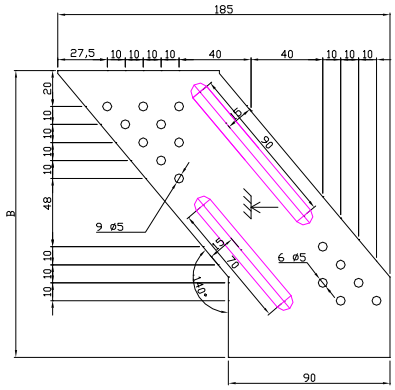
Annex D6 - SCR

Product name

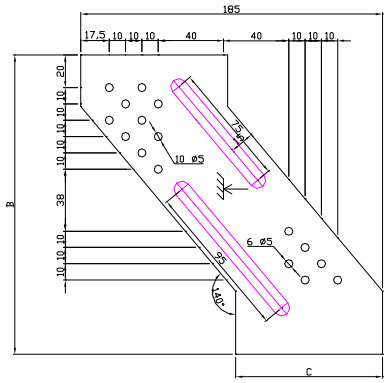
Product Name	alternative names			
	UK	France	Denmark	Germany
SCR	-	-	-	-

Drawing

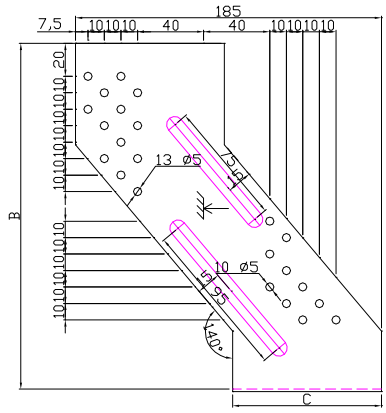
Figure D6-1. Dimensioned drawing of Cantilever Bracket SCR



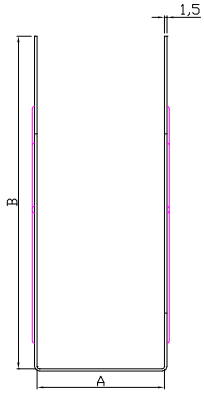
From the side, 380/X



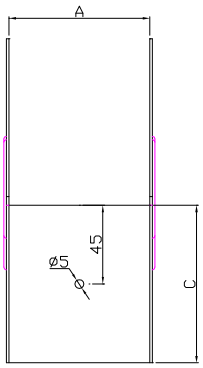
From the side, 440/X



From the side, 500/X



From the end



From the top

Table D6-1: Size Specification

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

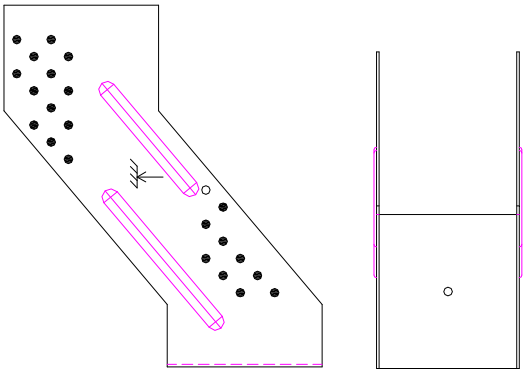
Material

Table D6-2. Material Specification

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

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 D6-3. 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 D6-4. 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

Annex D7 - LEA240/30/70/1.5

Product name

Product Name	alternative names			
	UK	France	Denmark	Germany
LEA	-	-	-	-

Drawing

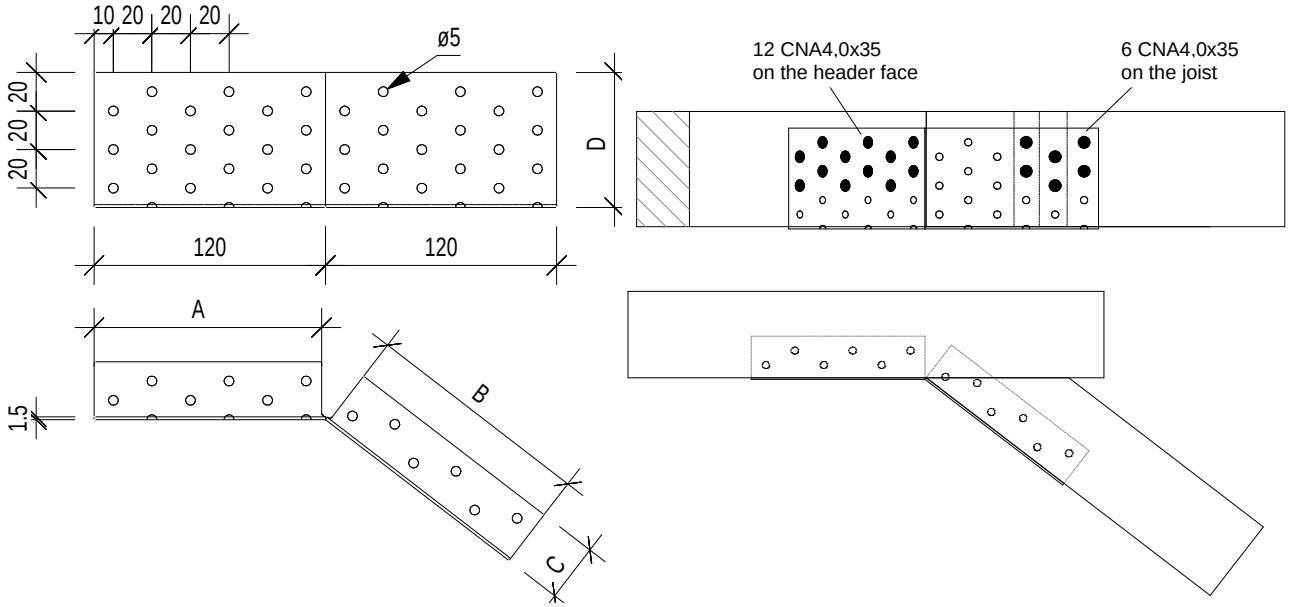


Table D7-1. Size Specification

Type	size [mm]				Holes 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) Downward
	Header	Joist	
LEA240/30/70/1.5	12	6	2.7

Annex E - Installation of cantilever bracket with I-beams

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.

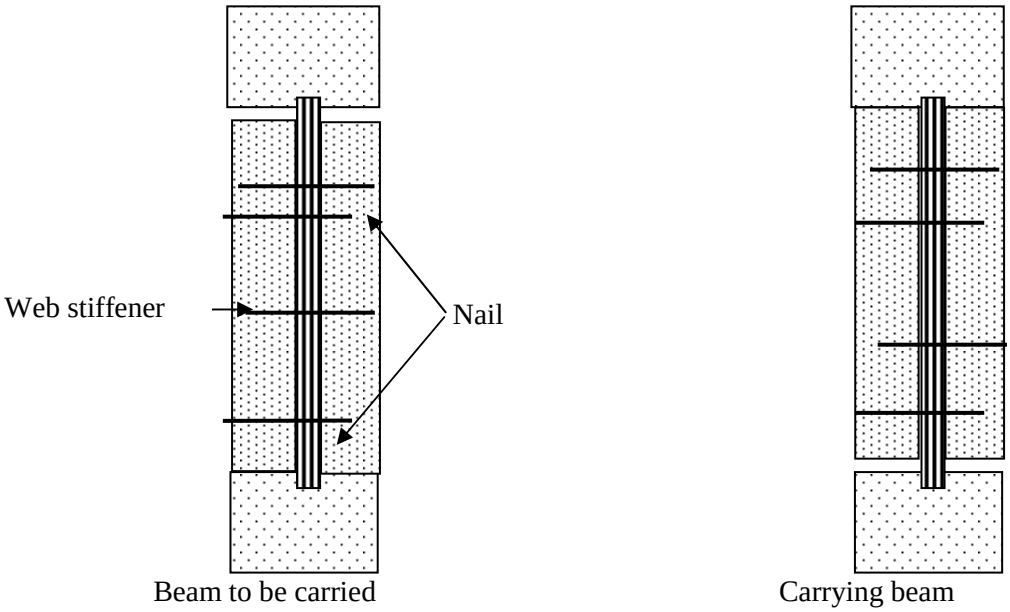


Figure C-1. Web stiffeners on the beam at the cantilever bracket. The web stiffener shall fit to the bottom flange and have a width of 2/3 of the height between the inner sides of the flanges.

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.