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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

MEMBER OF EOTA

European Technical Approval **ETA-13/0794**

Trade name:	BSF beam connections
Holder of approval:	SB Produksjon AS Öran Vest NO-6300 Åndalsnes Norway
Generic type and use of construction product:	Corbel free, load carrying beam connections
Valid from:	29.06.2013
to:	29.06.2018
Manufacturing plant:	SB Produksjon AS Öran Vest NO-6300 Åndalsnes Norway
This European Technical Approval contains:	152 pages including 8 Annexes (142 pages) which form an integral part of the document



European Organisation for Technical Approvals

I LEGAL BASIS AND GENERAL CONDITIONS

- 1 This European Technical Approval is issued by SINTEF Building and Infrastructure, in the following called SINTEF, 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 products¹, modified by the Council Directive 93/68/EEC² and Regulation (EC) N° 1882/2003 of the European Parliament and of the Council³
 - Common Procedural Rules for Requesting, Preparing and the Granting of European technical approvals set out in the Annex of Commission Decision 94/23/EC⁴
- 2 SINTEF is authorised 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 of this European Technical Approval.
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- 6 The European Technical Approval is issued by the approval body in its official language. This version corresponds fully to the version circulated in EOTA. Translations into other languages have to be designated as such.

¹ Official Journal of the European Communities N° L40, 11.2.1989, p. 12

² Official Journal of the European Communities N° L 220, 30.08.1993, p. 1

³ Official Journal of the European Union N° L 284, 31.10.2003, p. 1

⁴ Official Journal of the European Communities N° L17, 20.1.1994, p. 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of the product

BSF is a corbel free, load carrying beam/column connection applicable to precast concrete beams and columns. The connection units are made of structural steel and consists of two parts: a beam unit consisting of a steel box with a sliding knife inside and a column unit which is primarily a thick base plate with a thin steel box on top forming a recess for knife location in the column. The units are moulded into precast concrete beam and column elements. The elements are connected by sliding the knife into the column unit. Access for positioning the knife is through a mounting slot at the upper part of the beam. The sliding knife has a safety notch to lock the connection against the edge of the column unit.

The beam units are equipped with stress-distributing half-round steels at the top front and at the bottom rear beneath the end of the knife in extracted position. These supplementary parts are integrated into and attached by welding to the BSF beam unit. The load bearing end of the knife is made with a small inclination to obtain horizontality towards the steel plate in the column when loaded.

The beam units are to be anchored vertically by specially prescribed reinforcement stirrups with bending diameters fitted to the diameters of the half-round steels. Anchoring of horizontal friction forces is ensured by threaded bars attached to threaded holes in the half round steels. The threaded bars are equipped with nuts and steel plates as end anchors.

The column units transfers the vertical load into the column partly via the base plate and partly via a reinforcement bar butt welded to the bottom of the steel plate. The column unit is anchored horizontally by end anchored threaded bars attached to treaded inserts welded to the main steel plate.

Main dimensions and material properties for BSF units with nominal capacity in the range 225-700 kN are given in Annex 3. Dimensions are also tabulated in Annex 1.

The detailed reinforcement solution for the beam and column varies with the type and dimensions of the connected elements.

The final design of the reinforcement of beam-ends and around the column units are to be carried out by the costumer by application of general design rules and with guidance by the documents developed by the manufacturer.

Annex 1 (fig. A1-1) illustrates the principle of the connections.

1.2 Intended use

The main areas of application for BSF corbel free beam connections are to connect load carrying precast concrete beams and columns. The units may also be used as connections between beam and wall elements, and between wall elements. Standard units are used indoor in dry conditions.

The provisions made in this European technical approval are based on an assumed working life of the BSF corbel free beam connections of 50 years, provided that the conditions laid down in this document are met. The indications given on the working life cannot be interpreted as a guarantee given by the producer, 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.

The assumed intended working life of the BSF corbel free beam connections depends especially on the corrosion protection by the concrete cover.

2 Characteristics of the product and methods of verification

2.1 Mechanical resistance and stability (ER1)

Design of load carrying capacity

The nominal ultimate load carrying capacities of the BSF units are found in Annex 2. The capacities are verified by calculation according to Eurocode 2 and 3 with a specific conservative set of safety parameters (NDP's), The values assume reinforcement around the beam and column units according to the manufacturer's specifications. The values given in Table A2-1 assume that a minimum concrete grade C35/45 is used. The steel units are designed for horizontal friction forces equal to 30 % of the vertical load capacities. Detailed calculation of the steel units is found in Annex 8.

Horizontal load carrying capacity is limited by minimum friction coefficient to about 20 % of the smallest vertical load present at the same time. In case of dynamic loads, the horizontal resistance should always be assumed to be zero. The knife is not designed for torsional moments in combination with vertical shear force. Torsional moments must be taken care of by other means than the torsional capacity of the knife.

The use of BSF connections requires that a complete structural design of the precast concrete elements according to the relevant design standards is carried out case by case. This includes the necessary reinforcement around the connections.

Guidance documents for design of the beam-end reinforcement and local column reinforcement is developed by the manufacturer. The document in Annex 4 – BSF units – Design of reinforcement contains a general part outlining the design procedures, as well as example calculations for each unit. The example calculations are based on a selected set of national determined parameters (NDP's) and minimum beam dimensions. Examples of reinforcement layout are developed for each of the units based on the calculation. The examples of beam-end reinforcement are given in Annex 5, while examples on local reinforcement pattern in the column are found in Annex 6.

The detailed calculation shall be in accordance with the calculation method indicated in the model calculations, presented in Annex 4.

Beam and column dimensions

Approximately minimum beam dimensions and column widths are given in Annex 2, Table A2-1 and A2-2. Final evaluations on beam/column dimensions has to be done on a case to case basis.

Reference levels

In order to secure correct positioning of the units in the concrete elements the manufacturer has prepared drawings with positioning points for each type of connection. It is important that all the reference points are specified on all the production drawings to obtain a correct position. Annex 3 gives the reference levels.

Position tolerances

The steel units must be positioned in the precast concrete elements with a high degree of accuracy consistent with the required tolerances for the final structure. Of special importance for the performance of the connection is the alignment of the vertical axes of the steel units and the beam/column elements. Fixing the position by bolts through the mould and the prepared holes in the half round steel are recommended for the beam unit. Annex 3 gives the tolerances on the joint width and the position of the suspension reinforcement stirrups.

2.2 Safety in case of fire (ER2)

2.2.1 Reaction to fire

The BSF beam connections satisfy Class A1 of EN 13501-1 in accordance with the provisions of EC Decision 96/603/EC (as amended) without the need for testing on the basis of the listing in that Decision.

2.2.2 Resistance to fire

The method of verification of the fire resistance of the concrete element may be taken from Eurocode 2, Part 1-2 Structural fire design. The structural steel part of the connection will be encased by mortar fill in the support pocket and by concrete in the element, see Annex 7. The joint between the beam and support will be filled with a cement based mortar. The necessary thickness of the insulating concrete cover in the required fire resistance class may be estimated by the relevant part of Eurocode 4, Design of composite steel and concrete structures Part 1-2 Structural fire design.

2.3 Hygiene, health and environment (ER 3)

No special environmental declaration has been worked out for BSF connections. The products do not contain any chemical substances listed on the Norwegian environmental authorities' observation list of compounds hazardous to human health or the environment, and are not regarded as emitting any particles, gases or radiation that have a perceptible impact on the indoor climate or that have any significant impact on health.

Note: 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 Construction Products Directive, these requirements need also to be complied with, when and where they apply.

Steel parts and concrete elements may be recycled under given circumstances. Alternatively they may be delivered to a public waste deposit site at the end of the working life. There is no cadmium in the steel details.

2.4 Safety in use (ER 4)

The sliding knife has a safety notch to lock the connection against the edge of the column unit.

2.5 Protection against noise (ER 5)

Not relevant.

2.6 Energy economy and heat retention (ER 6)

Not relevant.

2.7 Aspects of durability, serviceability and identification

Concrete cover normally gives a sufficient resistance against corrosion. However, the manufacturer recommends to treat the external surfaces and the knife with a protective paint in order to prevent stain and rust during storage. The units may be delivered with galvanized or stainless steel for special cases. Stainless steel normally gives an approx. 20 % reduction of the load carrying capacity.

2.8 Special conditions for use and installation

Special design considerations

Special connection designs and installation systems are required when the connections shall serve as expansion joints, be attached to circular columns, used for skewed connections, or used in prestressed concrete elements.

Installation on site

The beams must hang horizontally in the lifting device. The lifting points must be in line with the centre of gravity for beams with unsymmetrical cross sections, or horizontality may be achieved by other means. The internal clearance between the knife and the steel box is 5 mm horizontally and 3 mm vertically. Torsional moments on the beam must be avoided during installation.

Before hoisting the beam into position the knives are retracted inside the beam unit. When the beam is in the correct position, the knives are pushed out of the beam and into the column units by means of a crowbar in the mounting slot. The knife shall always be pushed out until the vertical end of the knife bottoms against the backside of the recess in the column, see Annex 7 fig A7-1. The beam is then lowered carefully to the supported position, making sure that the slots on the underside of the knives are hooked over the safety bar in the column unit. Before releasing the lifting device the joint width shall be checked. Normal joint width is 15 - 20 mm. Maximum allowable gap is 30 mm when utilizing the full load capacity. A final control of correct positioning of the knife is ensured by measuring the visible length of the slot at the bottom of the knife in front of the column edge. This visible length of the slot shall be 5 mm for all of the units when the knife bottoms against the rear side of the recess in the column, see Annex 7, fig A7-1.

The joint between beam and column is normally filled with a low shrinkage quick setting concrete based mortar to protect the connection against fire as shown in Annex 7.

Installation under winter conditions

The openings in the beam and column units must be completely free from water, ice and snow before installation. Ice in the openings must be removed with e.g. a heat blower. Frost resistant mortar shall be used for filling the slot in the beam unit and the joint between beam and column. Postponing the installation may be necessary at very low temperatures. If heating is applied the temperature must be kept sufficient high until the mortar has hardened.

2.9 Further technical information

Further technical information can be found at the ETA holders home site:
<http://invisibleconnection.no>

3 Evaluation and attestation of conformity and CE marking

3.1 System of attestation of conformity

According to Decision 97/597/EC of 02.09.1997 the European Commission has decided that System 2+ of attestation of conformity applies. This system of attestation of conformity is defined as follows:

Certification of the conformity of the product by a notified certification body on the basis of:

- (a) Tasks for the manufacturer:
 - (1) initial type testing of the product;
 - (2) factory production control;
 - (3) testing of samples taken at the factory in accordance with a prescribed test plan.
- (b) Tasks for the approved body:
 - (4) certification of factory production control on the basis of:
 - initial inspection of factory and of factory production control;
 - continuous surveillance, assessment and approval of factory production control

3.2 Responsibilities

3.2.1 Tasks of the manufacturer

3.2.1.1 Factory production control

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

The manufacturer may only use constituent materials stated in the technical documentation of this European technical approval.

The factory production control shall be in accordance with the Control Plan for BSF beam connections relating to the this European technical approval. The Control Plan is part of the technical documentation of this European technical approval, and is laid down in the context of the factory production control system operated by the manufacturer. The Control Plan is deposited at SINTEF.⁵

The results of factory production control shall be recorded and evaluated in accordance with the provisions of the Control Plan.

3.2.1.2 Other tasks of manufacturer

The manufacturer shall, on the basis of a contract, involve a body (bodies) which is (are) notified for the tasks referred to in section 3.1 in the field of reinforcement steel products in order to undertake the actions laid down in section 3.2.2. For this purpose, the Control Plan referred to in sections 3.2.1.1 and 3.2.2 shall be handed over by the manufacturer to the notified body or bodies involved.

⁵ The "control plan" is a confidential part of the European technical approval and only handed over to the notified body or bodies involved in the procedure of attestation of conformity. See section 3.2.2.

3.2.2 Tasks of the notified body

The approval body (bodies) shall perform the

- initial inspection of factory and of factory production control
- continuous surveillance, assessment and approval of factory production control

in accordance with the provisions laid down in the Control Plan relating to this European technical approval ETA.

The approval body (bodies) shall retain the essential points of its (their) actions referred to above and state the results obtained and conclusions drawn in written reports.

The approved certification body involved by the manufacturer shall issue an EC certificate of conformity of the factory production control stating the conformity with the provisions of this European technical approval.

In cases where the provisions of the European technical approval and its Control Plan are no longer fulfilled the certification body shall withdraw the certificate of conformity and inform SINTEF without delay.

3.3 CE marking

The CE marking shall be affixed to the packaging or accompanying commercial documents. The letters „CE“ shall be followed by the identification number of the notified certification body and be accompanied by the following additional information:

- the name and address of the producer (legal entity responsible for the manufacture),
- the last two digits of the year in which the CE marking was affixed,
- the number of the EC certificate for the factory production control
- the number of the European technical approval,
- identification of the product

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

4.1 Manufacturing

The European technical approval is issued for BSF connections on the basis of agreed data/information deposited with SINTEF, which identifies the product that has been assessed and judged. Changes to the product or production process, which could result in this deposited data/information being incorrect, should be notified to SINTEF before the changes are introduced. SINTEF will decide whether or not such changes affect the ETA and consequently the validity of the CE marking on the basis of the ETA, and if so whether further assessment or alterations to the ETA is necessary.

4.2 Installation

The BSF connections shall be installed in accordance with detailed construction drawings worked out for the individual works, based on the structural design for the works according to applicable design standards.

5 Indications to the manufacturer and supplier

5.1 Packaging, transport and storage

The BSF connections must be transported and stored in such a way that the material is protected against salt and other harmful chemicals due to the risk of corrosion.

During outdoor storage all openings in the beam and column units must be covered in order to prevent water or ice to enter the connections.

On behalf of
SINTEF Building and Infrastructure
Trondheim, 29.06.2013



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Annex 1: Product description

Annex 2: BSF – Nominal capacities and approximate minimum beam and column dimensions (Memo 501)

Annex 3: Main dimensions, material properties, tolerances and reference levels in design. (Memo 502,503 and 504)

Annex 4: Design of reinforcement for BSF225-300-450-700 (Memo 521)

Annex 5: Example – reinforcement in beam end (Memo 522a-d)

Annex 6: Example – reinforcement pattern in column (Memo 523)

Annex 7: Assembling of the BSF units and fire protection of the joint.

Annex 8: BSF - Design of steel units