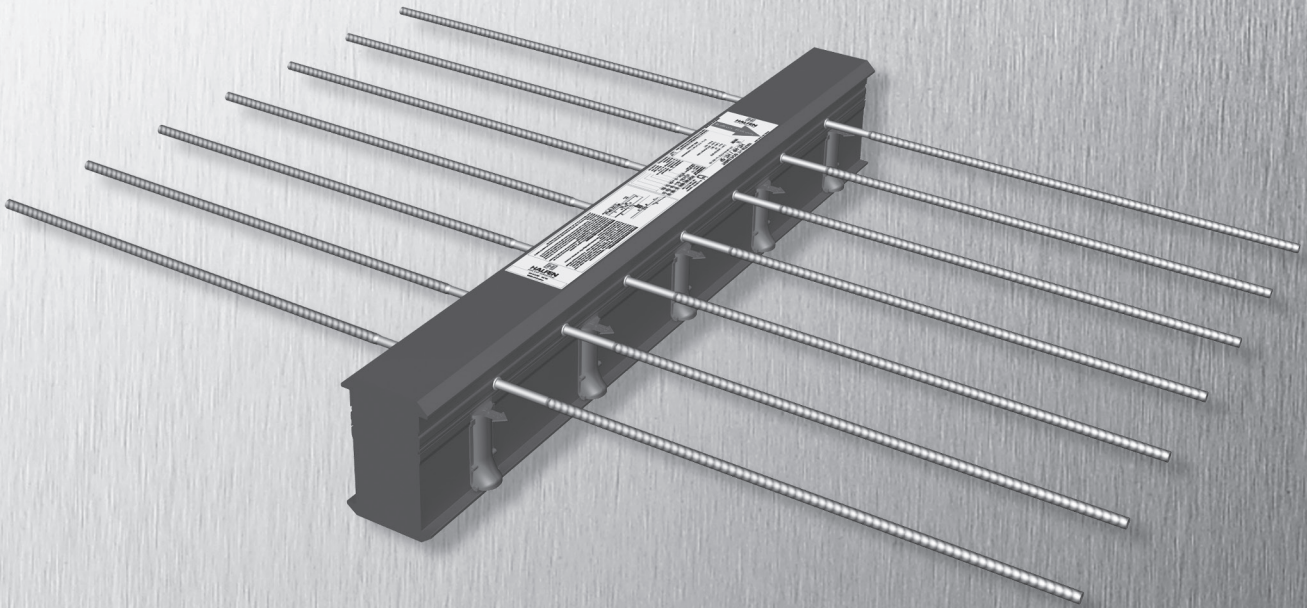


HALFEN HIT INSULATED CONNECTION

EUROPEAN TECHNICAL APPROVAL ETA-13/0546



HALFEN HIT INSULATED CONNECTION

ETA_HIT-HP-SP 06/13-E

CONCRETE



HALFEN
YOUR BEST CONNECTIONS

HALFEN HIT INSULATED CONNECTION

General note

Use of third-party products

This approval only applies to original HALFEN products manufactured by HALFEN.
The specifications in this approval are not transferable to other products.
Users are fully liable for personnel injuries and material damage caused by third-party products used instead of HALFEN products.



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OiB
Member of EOTA

European technical approval

ETA-13/0546

English translation, the original version is in German

Handelsbezeichnung

Trade name

Halfen Iso Element – HIT-HP MV, HIT-SP MV, HIT-HP ZV und HIT-SP ZV

Halfen Insulated Connection – HIT-HP MV, HIT-SP MV, HIT-HP ZV, and HIT-SP ZV

Zulassungsinhaber

Holder of approval

**Halfen GmbH
Liebigstraße 14
40764 Langenfeld
Deutschland**

Zulassungsgegenstand und Verwendungszweck

Generic type and use of construction product

Tragende wärmedämmende Elemente für die thermische Trennung von Bauteilen aus Stahlbeton

Load bearing thermal insulation elements for thermal break of reinforced concrete members

Geltungsdauer vom

*Validity from
bis zum
to*

29.06.2013

28.06.2018

Herstellwerke

Manufacturing plants

**Halfen GmbH
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06556 Artern
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Poland**

Diese Europäische technische Zulassung umfasst

This European technical approval contains

66 Seiten einschließlich 12 Anhängen

66 Pages including 12 Annexes



European Organisation for Technical Approvals
Europäische Organisation für Technische Zulassungen
Organisation Européenne pour l'Agrément Technique

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I LEGAL BASES AND GENERAL CONDITIONS

- 1 This European technical approval is issued by Österreichisches Institut für Bautechnik in accordance with:
 1. 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 – Construction Products Directive (CPD) –, amended by the Council Directive 93/68/EEC of 22 July 1993², and Regulation (EC) 1882/2003 of the European Parliament and of the Council of 29 September 2003³;
 2. *dem Gesetz über Bauprodukte und die Akkreditierung von Prüf-, Überwachungs- und Zertifizierungsstellen für Bauprodukte in Wien (Wiener Bauprodukte- und Akkreditierungsgesetz – WBAG) LGBl. Nr. 30/1996, in der Fassung LGBl. Nr. 71/2001, LGBl. Nr. 36/2007, LGBl. Nr. 24/2008 und LGBl. Nr. 8/2012;*
the Viennese law on construction products and the accreditation of testing, inspection, and certification bodies for construction products (Viennese construction products and accreditation law – WBAG), LGBl. № 30/1996, amended by LGBl. № 71/2001, LGBl. № 36/2007, LGBl. № 24/2008 and LGBl. № 8/2012;
 3. 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 Österreichisches Institut für Bautechnik 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, or manufacturing plants other than those indicated on Page 1 of this European technical approval.
- 4 This European technical approval may be withdrawn by Österreichisches Institut für Bautechnik, in particular pursuant to information by the Commission according to Article 5 (1) of Council Directive 89/106/EEC.
- 5 Reproduction of this European technical approval including transmission by electronic means shall be in full. However, partial reproduction may be made with the written consent of Österreichisches Institut für Bautechnik. 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 The European technical approval is issued by the Approval Body in its official language. This version corresponds to the version circulated within EOTA. Translations into other languages have to be designated as such.

¹ Official Journal of the European Communities № L 40, 11.02.1989, page 12

² Official Journal of the European Communities № L 220, 30.08.1993, page 1

³ Official Journal of the European Union № L 284, 31.10.2003, page 1

⁴ Official Journal of the European Communities № L 17, 20.01.1994, page 34

II SPECIFIC CONDITIONS OF THE EUROPEAN TECHNICAL APPROVAL

1 Definition of product and intended use

1.1 Definition of product

The European technical approval (ETA) applies to a product, the

**Halfen Insulated Connection – HIT-HP MV,
Halfen Insulated Connection – HIT-SP MV,
Halfen Insulated Connection – HIT-HP ZV and
Halfen Insulated Connection – HIT-SP ZV.**

The Halfen Insulated Connection HIT-HP and -SP consists of 80 mm (HIT-HP) or 120 mm (HIT-SP) thick insulating layer made of mineral wool and of a statically effective system made of steel tension bars, steel shear bars and compression shear bearings made of ultra high-strength fibre reinforced mortar.

The installed product with the range of applications and the product as delivered are shown in the Annexes 1 and 2.

1.2 Intended use

The Halfen Insulated Connection HIT-HP and -SP is intended for applications in construction works for which requirements regarding mechanical resistance and stability and safety in use in the sense of the Essential Requirements 1 and 4 shall be fulfilled and where failure of the connection will result in a risk to life and health of humans and/or will have significant economic consequences.

The intended use of the product is in particular the connection of external slab-like members of reinforced concrete with internal slab-like members, e.g. floor slabs of reinforced concrete in buildings. The external and internal slab-like members are not part of the product.

NOTE As external slabs also vertical members like balustrades or parapets can be connected with the product.

The Halfen Insulated Connection HIT-HP and -SP is intended as a load-bearing, thermal insulating connection element between slabs with a thickness of 16 to 35 cm, made of reinforced concrete of normal concrete with a strength class of at least C20/25 according to EN 206⁵.

The connection is intended to transfer moments, shear forces or a combination of moments and shear forces. The forces will be transferred to the adjacent components through bond or surface contact.

Specifically the product is intended to be used

- to minimise thermal bridges in buildings
- to transfer static and quasi-static bending moments and shear forces

NOTE Also tension and compression forces may be transferred by the product. These are, however, not intended to be the major part of the transferred load.

- included are members subject to fire regulation
- for non-dissipative structures in seismic areas
- in the building the thermal insulation shall be covered resistant to driving rain

⁵ Standards and other documents referred to in the European technical approval are listed in Annex 12.

1.3 Intended working life

The provisions made in the European technical approval are based on an assumed intended working life of the connection of 50 years, provided that the products are subject to appropriate installation, use and maintenance. The indications given on the working life of the Halfen Insulated Connection HIT-HP and -SP cannot be interpreted as a guarantee given by the manufacturer or the Approval Body, but are to be regarded only as a means for selecting the appropriate product in relation to the expected, economically reasonable working life of the construction works.

"Assumed working life" means 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. The real working life time of a product incorporated in a specific construction depends on the environmental conditions to which that construction is subject and the particular conditions of the design, execution, use and maintenance of that construction. Therefore, it cannot be excluded that there are cases in which the real working life time of the product may also be shorter than the assumed working life.

2 Characteristics of the product and methods of verification

2.1 Characteristics of the product

2.1.1 General

The slab connection shall correspond to the Annexes 1 to 10. The characteristic material values, dimensions and tolerances of the slab connection not indicated in the Annexes shall correspond to respective values laid down in the technical documentation⁶ of the European technical approval.

2.1.2 Safety in case of fire – Reaction to fire

Regarding the requirements concerning safety in case of fire the steel tension bars, steel shear bars and compression shear bearings of the connection meet the requirements of Euroclass A1 in relation to reaction to fire in accordance with Commission Decision 96/603/EC, as amended.

The thermal insulating material – mineral wool – shall be classified as Euroclass A1 in relation to reaction to fire according to EN 13501-1.

2.1.3 Protection against noise – Energy economy and heat retention

The connection acts as a thermal break to reduce thermal bridges and to enhance impact sound insulation in buildings.

2.1.4 Hygiene, health and environment – Dangerous substances

Halfen Insulated Connection HIT-HP and -SP does not contain dangerous substances according to Regulation (EC) № 1907/2006, Regulation (EC) № 1272/2008, and as listed in the indicative list of regulated dangerous substances DS 041/051.

A declaration in this respect has been made by the manufacturer.

In addition to the specific clauses relating to dangerous substances in the European technical approval, there may be other requirements applicable to the product falling within their 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 also need to be complied with, when and where they apply.

⁶ The technical documentation of the European technical approval is deposited at Österreichisches Institut für Bautechnik and, as far as relevant to the tasks of the approved body involved in the attestation of conformity procedure, is handed over to the approved bodies.

2.1.5 Durability and serviceability

The durability of the Halfen Insulated Connection HIT-HP and -SP elements is in conformity with EN 1992-1-1.

2.1.6 Designation and identification

Each slab connection is marked with the identify mark of the producer and the type designation.

2.2 Method of verification

2.2.1 General

The assessment of the fitness of the slab connection for the intended use with regard to the requirements of mechanical resistance and stability, safety in case of fire, hygiene, health and environment, safety in use, protection against noise, energy economy and heat retention as well as durability and serviceability in the sense of the Essential Requirements 1 to 6 of Council Directive 89/106/EEC has been made in conformity with CUAP 03.01/59 "Load bearing thermal insulation elements which form a thermal break between balconies and internal floors".

2.2.2 Identification

The European technical approval for the Halfen Insulated Connection HIT-HP and -SP is issued on the basis of agreed data, deposited at Österreichisches Institut für Bautechnik, which identifies the Halfen Insulated Connection HIT-HP and -SP that has been assessed and judged. Changes to the manufacturing process of the Halfen Insulated Connection HIT-HP and -SP, which could result in this deposited data being incorrect, should be notified to Österreichisches Institut für Bautechnik before the changes are introduced. Österreichisches Institut für Bautechnik will decide whether or not such changes affect the European technical approval and consequently the validity of the CE marking on the basis of the European technical approval and, if so, whether further assessment or alterations to the European technical approval are considered necessary.

3 Evaluation of conformity and CE marking

3.1 Attestation of conformity system

According to the Commission Decision 97/597/EC of 14 July 1997, the system of attestation of conformity applied to this product shall be that laid down in Council Directive 89/106/EEC of 21 December 1988, Annex III 2 (i), referred to as System 1+. This system of attestation of conformity provides for:

Certification of the conformity of the product by an approved certification body on the basis of

(a) Tasks for the manufacturer

- (1) Factory production control
- (2) Further testing of samples taken at the factory by the manufacturer in accordance with a prescribed test plan⁷

(b) Tasks for the approved body

- (3) Initial type-testing of the product
- (4) Initial inspection of factory and of factory production control
- (5) Continuous surveillance, assessment and approval of the factory production control
- (6) Audit testing of samples taken at the factory

⁷ The prescribed test plan has been deposited at Österreichisches Institut für Bautechnik and is handed over only to the approved body involved in the conformity attestation procedure. The prescribed test plan is also referred to as control plan.

NOTE 1 The approved bodies are also designated "notified bodies".

NOTE 2 In case of System 1+ of attestation of conformity the manufacturer has to issue a declaration of conformity of the product.

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 production within an factory production control system. 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 obtained. This factory production control system shall ensure that the product is in conformity with the European technical approval.

Within the framework of factory production control, the manufacturer shall carry out tests and controls in accordance with the test plan prescribed in the European technical approval. Details of the extent, nature and frequency of testing and controls to be performed within factory production control shall correspond to the prescribed test plan which is part of the technical documentation of the European technical approval.

The results of factory production control are recorded and evaluated. If test results are unsatisfactory, the manufacturer shall take immediate actions to eliminate the deficiencies. Construction products or components which are not in conformity with the requirements shall be removed. After elimination of the deficiencies the respective test – if technically necessary – shall be repeated immediately.

The records of factory production control shall be submitted to the approved body and shall be kept for at least five years time. On request the records shall be presented to Österreichisches Institut für Bautechnik.

3.2.1.2 Other tasks of the manufacturer

The manufacturer shall, on the basis of a contract, involve a body which is approved in the field of connections to undertake the required tasks according to Clause 3.2.2. For this purpose, the prescribed test plan of the European technical approval shall be handed over to the approved body.

When all criteria of the conformity attestation, including certification, are satisfied, the manufacturer shall issue a declaration of conformity, stating that the construction product is in conformity with the European technical approval.

3.2.2 Tasks of the approved bodies

3.2.2.1 General

The approved body involved by the manufacturer shall perform the tasks stated in the clauses below and in accordance with the prescribed test plan of the European technical approval. The characteristics of the product and components shall be documented in a written report, together with the results obtained and conclusions drawn.

When all criteria of conformity attestation are satisfied, the approved certification body shall issue a certificate of conformity of the product, stating the conformity with the European technical approval.

In cases where the specifications of the European technical approval and its prescribed test plan are no longer fulfilled, the certification body shall withdraw the certificate of conformity and inform Österreichisches Institut für Bautechnik without delay.

3.2.2.2 Initial type-testing of the products

For initial type-testing the results of the tests performed as part of the assessment for the European technical approval may be used unless there are changes in the production process or plant. In the case of changes, the necessary initial type-testing shall be agreed between Österreichisches Institut für Bautechnik and the approved body involved.

3.2.2.3 Initial inspection of factory and of factory production control

The approved body shall ascertain that, in accordance with the prescribed test plan, the factory, in particular personnel and equipment, and the factory production control are suitable to ensure a continuous and orderly manufacturing of the Halfen Insulated Connection HIT-HP and -SP in accordance with the specifications defined in Section II as well as in the Annexes of the European technical approval.

3.2.2.4 Continuous surveillance

The approved body shall visit the manufacturer of the product at least once a year for surveillance. It has to be verified that the system of factory production control and the specified manufacturing process are maintained taking account of the prescribed test plan.

On demand the results of product certification and continuous surveillance shall be made available by the approved body to Österreichisches Institut für Bautechnik. In cases where the specifications of the European technical approval and the prescribed test plan are no longer fulfilled, the certification body shall withdraw the certificate of conformity and inform Österreichisches Institut für Bautechnik without delay.

3.2.2.5 Audit testing of samples taken at the factory

During surveillance inspections the approved body shall take samples of components of the Halfen Insulated Connection HIT-HP and -SP for independent testing. Sampling and testing shall be as specified in the prescribed test plan.

3.3 CE marking

The CE marking shall be affixed on each slab connection or each packaging. The initials "CE" shall be followed by the identification number of the approved certification body and shall be accompanied by the following information:

- Name or identification mark and address of the manufacturer
- The last two digits of the year in which the CE marking was affixed
- Number of the European technical approval
- Number of the certificate of conformity
- Type identification of the connection element
- Essential characteristics
 - Dimensions (height and length)
 - Thermal conductivity of the thermal insulation material

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

4.1 Manufacturing

Halfen Insulated Connection HIT-HP and -SP are manufactured in accordance with the specifications of the European technical approval and according to the manufacturing processes as identified in the technical documentation.

4.2 Installation of the product

4.2.1 General

Design and installation shall observe EN 1992-1-1 and the standards and regulations in force at the place of use.

4.2.2 Design of the connection

The fitness of the Halfen Insulated Connection HIT-HP and -SP for the intended use is given under the following conditions.

The design of the slab connection and the connected slabs is based on EN 1992-1-1 and Annexes 1 to 10. If the slabs which are to be jointed with the slab connection are precast elements, Annex 8 shall be considered. Detailing conditions according to Annex 6 shall be observed.

Calculation of internal forces shall be with linear elastic methods only. Methods adopting redistribution, plastic theory and non-linear methods shall not be applied.

The simplified assumption of a rigid support of the supporting component is only permissible if this assumption describes the stiffness ratio of the connected and the supporting components to a sufficiently exact degree. Otherwise varying moments and shear forces along the slab edge shall be taken into account. The slab connections are unsuitable to absorb locally limited torsional moments required for equilibrium. Minor axial forces from constraints in the chords that occur at the end of the line bearings, e.g. next to the free edges or expansion joints, might be neglected for verification. Normal forces from constraint in the direction of the bars of the connections shall be avoided, see example in Annex 7. The forces in the shear force bar shall always be in tension and in the compression shear bearing shall always be in compression and shear. This shall be adhered to, during construction, in the final state, and due to any load combination.

The lattice models shown in Annex 5 shall be used to determine internal forces and detailing of the reinforcement. The internal forces M_{Ed} and V_{Ed} at the section for design shall be used for the calculation of the lattice model. The compression bearing, tension and/or shear force bars shall be verified in accordance with the forces calculated on the basis of the design model according to Annex 5. An analysis shall be provided that the connected forces will be transferred to the adjacent components.

Edge reinforcement according to EN 1992-1-1, Figure 9.8, shall be installed at the edges facing the insulation joint. The splitting tensile forces in the slabs from the load introduction shall be verified according to Annex 5. If the design section is situated outside the area of bearing, supporting reinforcement shall be placed at the edges of the slabs facing the insulation joint, which shall be designed for the entire shear force V_{Ed} . The edge reinforcement may be considered as part of the supporting reinforcement.

Tensile splitting and supporting reinforcement are made by U-shaped links or lattice girders.

Verification of fatigue actions caused by temperature difference has been delivered as part of the assessment for the European technical approval. When the distances of expansion joints in the external slab are limited according to Annex 7 no further verification is required. The respective tests have been performed with a vertical load of about 50 % of the load-bearing capacity.

An additional verification of crack width, according to the joint faced sides of the slab and to the load introduction area is not necessary, insofar as the conditions of the European technical approval are conformed to.

Analysis of the deformation is provided under the quasi-permanent action combination. The elastic deformations of the slab connection as shown in Annex 7 as well as the deformations of the connected slab caused by load and temperature shall be taken into account. An upwards camber of the cantilever slab shall be considered where required.

The slab connection is classified as fire resistance class REI 120. Verification of the adjacent parts of the structure shall be provided independently.

The degree of impact sound pressure level reduction, $\Delta L_{n,w}$, according to Annex 10 may be used as the basis for selected installation situations from Annex 1.

In selected installation situations from Annex 1 the linear thermal transmission coefficient Ψ according to Annex 9 may be applied. A detailed verification can be performed alternatively according to EN ISO 6946 and EN ISO 10211 with the thermal conductivities according to Annex 9 on an individual basis.

4.3 Installation of the slab connection

The slab connection shall be installed according to the manufacturer's assembly instructions, observing the correct orientation of the element with regard to the cantilever slab. Bending of reinforcing steel and misalignment of reinforcing steel and compression bearing shall be avoided.

The elements shall be fixed so that the elements will not be displaced, neither by placing the reinforcement nor during concreting. Before concreting, a final check of the load-bearing thermal insulation element for complete and proper installation shall be performed.

5 Recommendations for the manufacturer

5.1 General

It is the responsibility of the holder of the approval to ensure that all necessary information on design and installation according to the Clauses 1, 2 and 4 as well as to the Annexes of the European technical approval is submitted to those concerned in design and execution of the structures executed with the Halfen Insulated Connection HIT-HP and -SP.

No ambiguous information on the installation of the elements, arrow indicating installation direction, shall be affixed to each element.

An installation instruction, preferably in form of images, shall be enclosed in each packaging unit.

Damaged products shall not be installed.

5.2 Recommendations on packaging, transport and storage

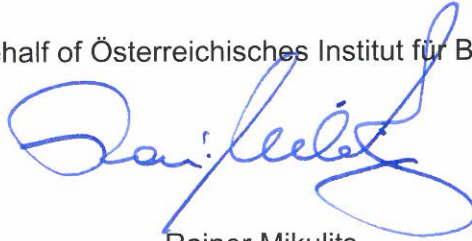
Halfen Insulated Connection HIT-HP and -SP elements shall be protected against any type of damage and damaging effects of humidity during transport and storage. On site the elements shall be stored free from ground, on a rigid, clean surface, to keep them dry and intact.

5.3 Recommendation on use, maintenance and repair of the supporting structures

The assessment of the fitness for the intended purpose is based on the assumption that no maintenance measures will be required during the assumed intended service life.

If repairs prove to be necessary, an assessment shall be performed in each case. In case of a major damage of a connection, immediate measures shall be initiated with regard to the mechanic resistance and stability of the structure.

On behalf of Österreichisches Institut für Bautechnik



Rainer Mikulits
Managing Director

Type HIT-HP/-SP MV

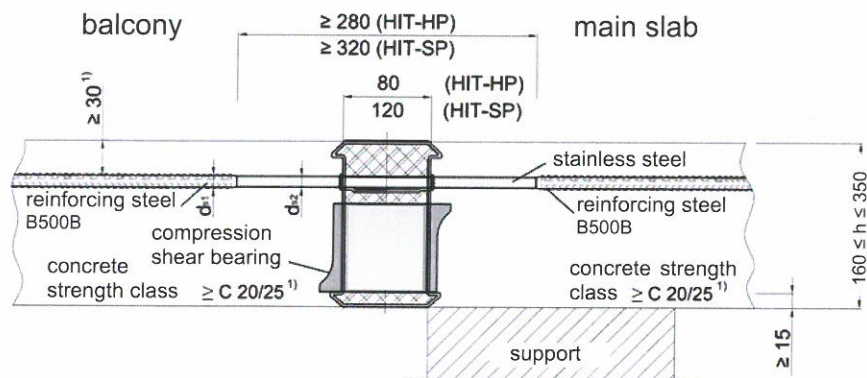


Figure 1: Halfen Insulated Connection **HIT-HP/-SP MV** REI 120 in the built-in state

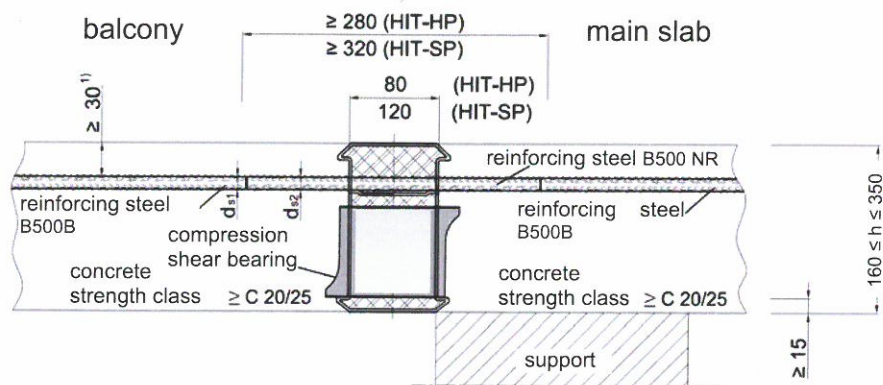


Figure 2: Halfen Insulated Connection **HIT-HP/-SP MV** REI 120 in the built-in state

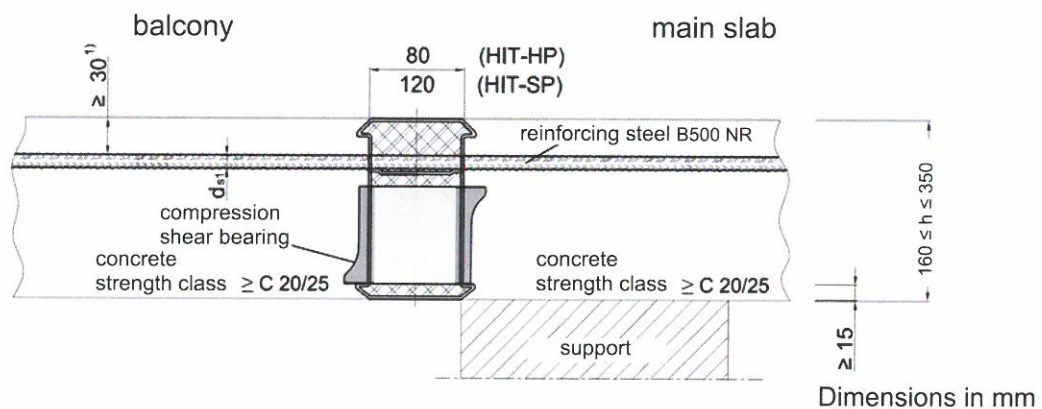


Figure 3: Halfen Insulated Connection **HIT-HP/-SP MV** REI 120 in the built-in state

¹⁾ EN 1992-1-1, Chapter 4 also applies for the minimum concrete strength class and the minimum concrete cover.

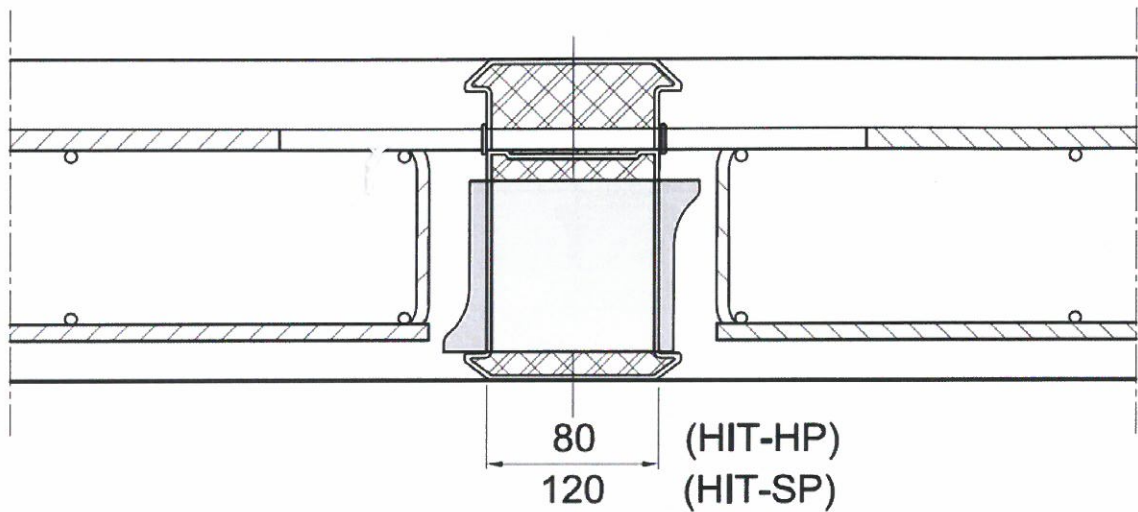


Figure 4: Halfen Insulated Connection **HIT-HP/-SP MV REI 120** in the built-in state (example of indirect support)

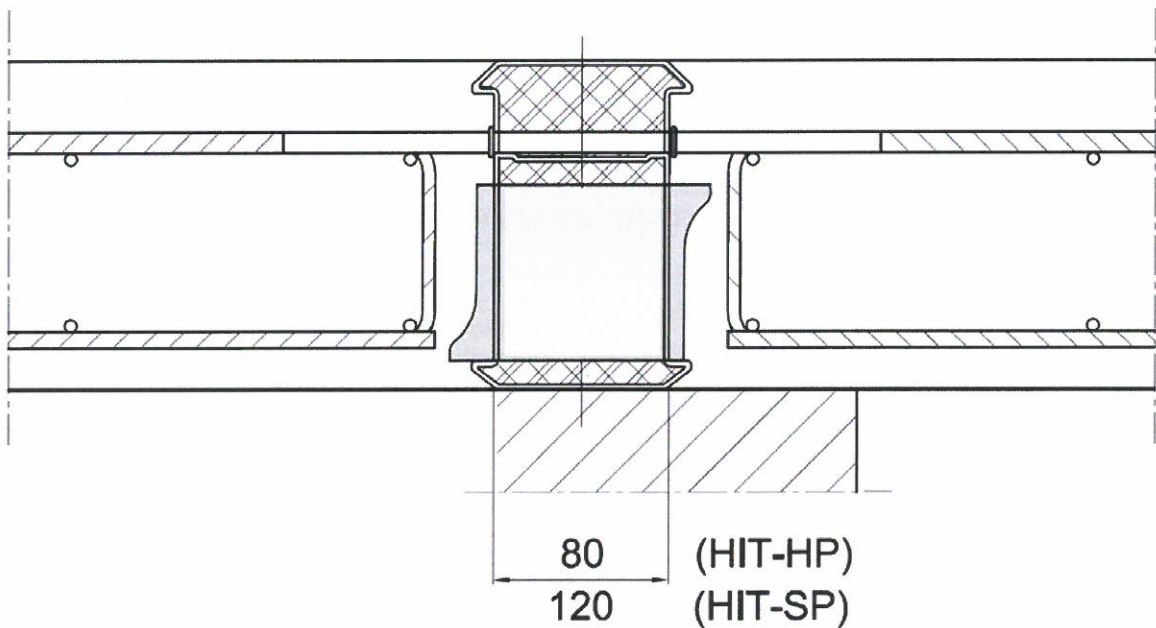


Figure 5: Halfen Insulated Connection **HIT-HP/-SP MV REI 120** in the built-in state (example of direct support)

Dimensions in mm

Types HIT-HP/-SP MV-...-OD/-OU/-WD/-WU

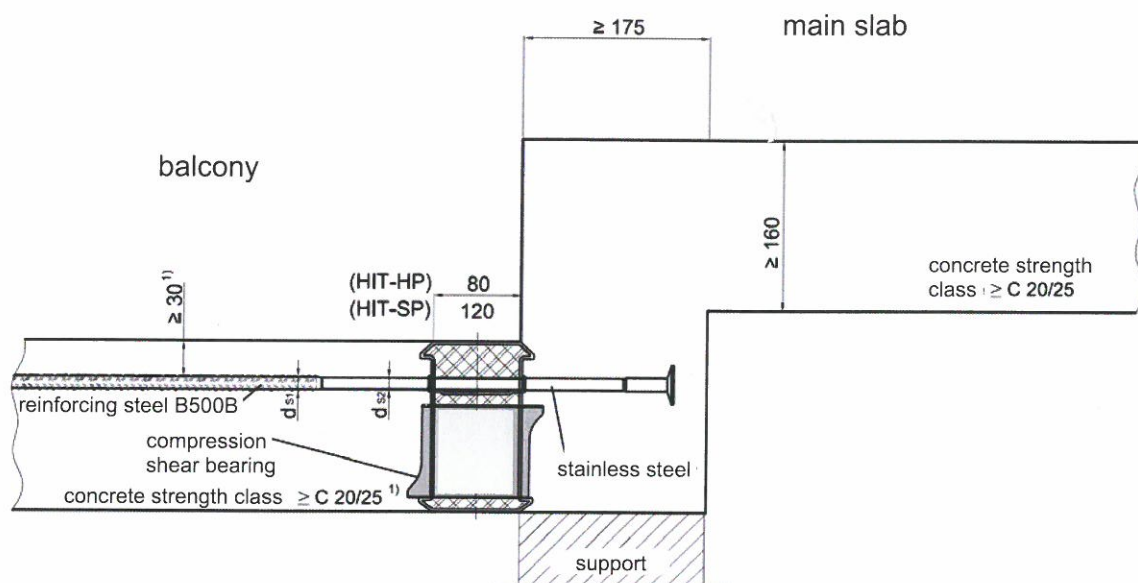
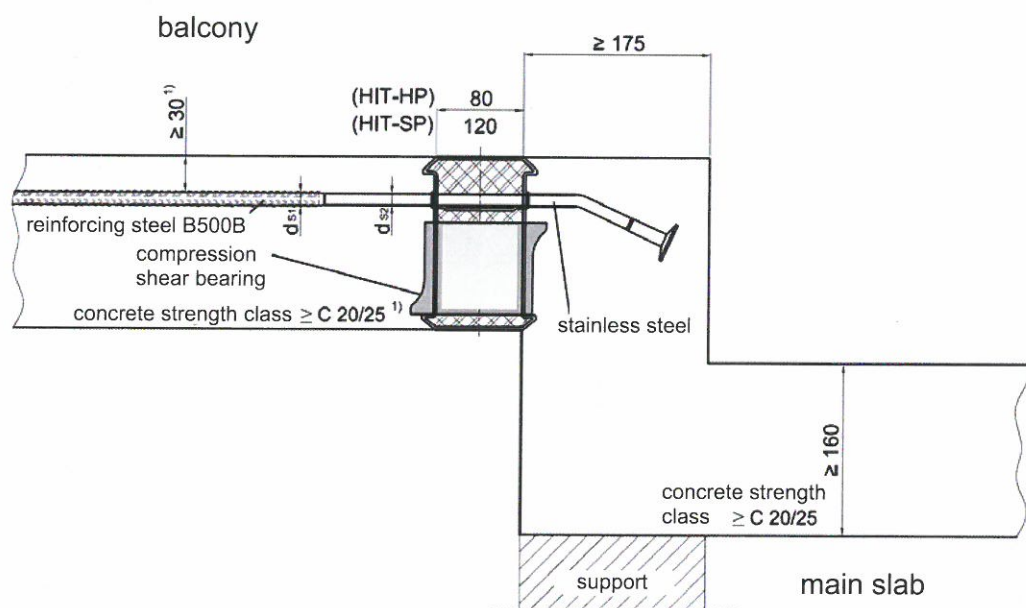


Figure 6: Halfen Insulated Connection **HIT-HP/-SP MV-...-OD** REI 120 in the built-in state



Dimensions in mm

Figure 7: Halfen Insulated Connection **HIT-HP/-SP MV-...-OU** REI 120 in the built-in state

¹⁾ EN 1992-1-1, Chapter 4 also applies for the minimum concrete strength class and the minimum concrete cover.

Halfen Insulated Connection HIT-HP and -SP

Built-in state

Annex 1

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of European technical approval

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Types HIT-HP/-SP MV-...-OD/-OU/-WD/-WU

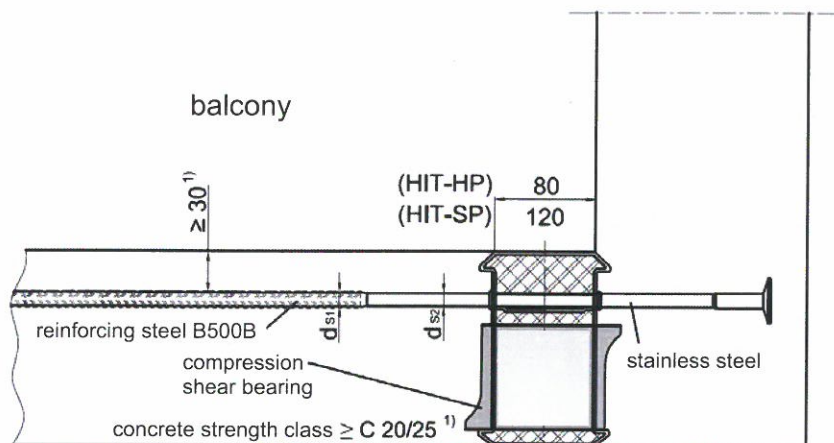
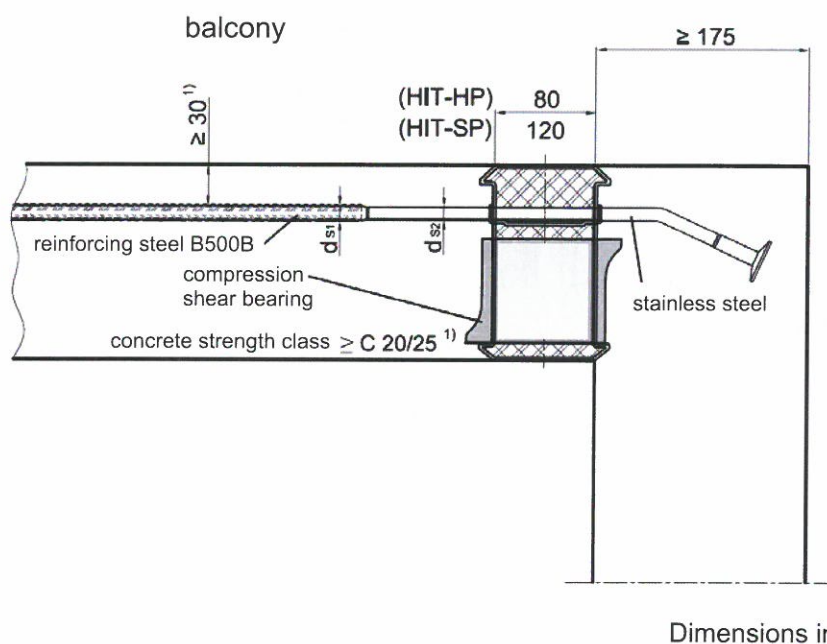


Figure 8: Halfen Insulated Connection **HIT-HP/-SP MV-...-WD** REI 120 in the built-in state



Dimensions in mm

Figure 9: Halfen Insulated Connection **HIT-HP/-SP MV-...-WU** REI 120 in the built-in state

¹⁾ EN 1992-1-1, Chapter 4 also applies for the minimum concrete strength class and the minimum concrete cover.

Halfen Insulated Connection HIT-HP and -SP

Built-in state

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Type HIT-HP/-SP ZV

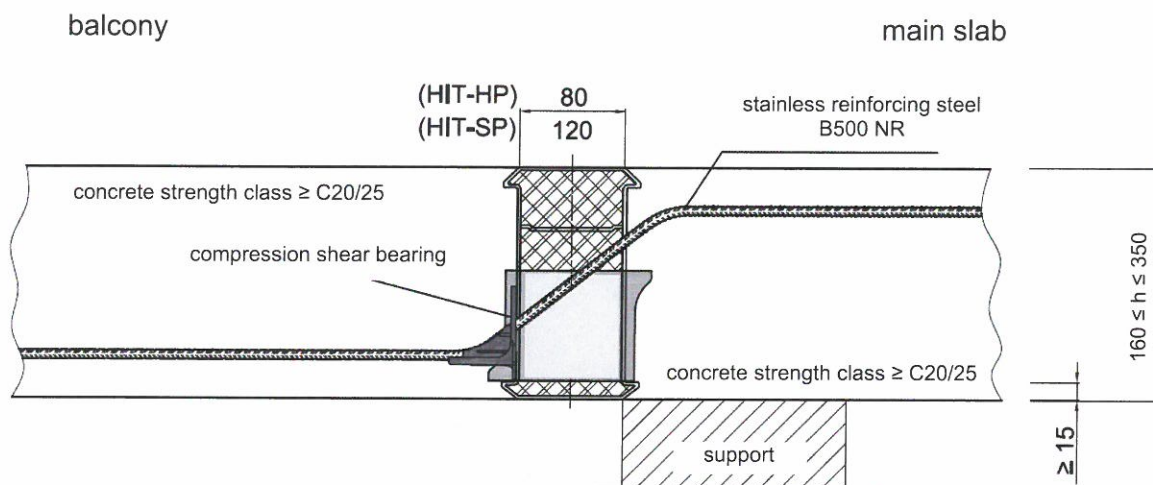
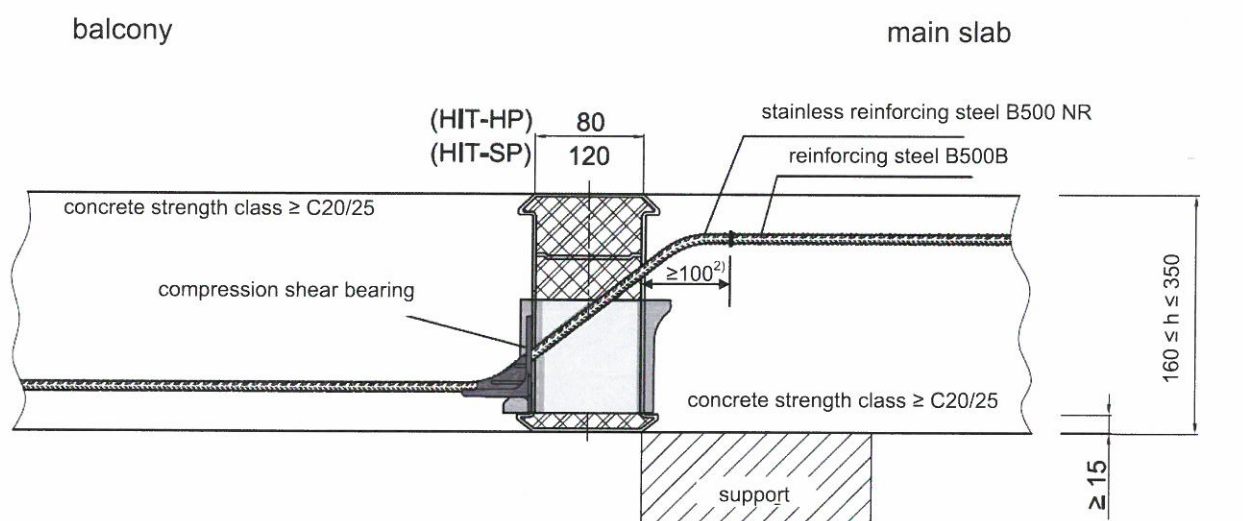


Figure 10: Halfen Insulated Connection **HIT-HP/-SP ZV** REI 120 in the built-in state



Dimensions in mm

Figure 11: Halfen Insulated Connection **HIT-HP/-SP ZV** REI 120 in the built-in state

²⁾ Embedment length of B500 NR of 100 mm in the adjacent concrete

Halfen Insulated Connection HIT-HP and -SP

Built-in state

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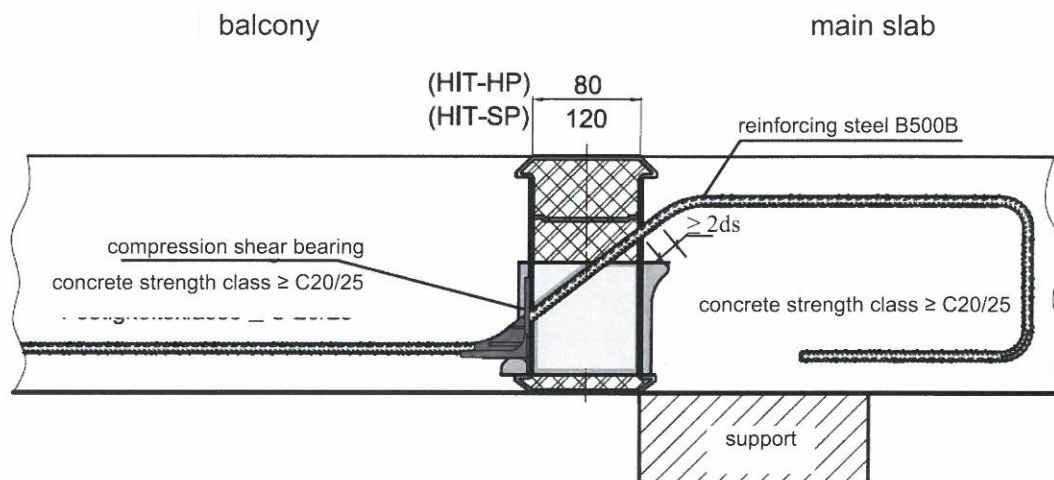


Figure 12: Halfen Insulated Connection **HIT-HP/-SP ZV REI 120** in the built-in state with a loop according to EN 1992-1-1

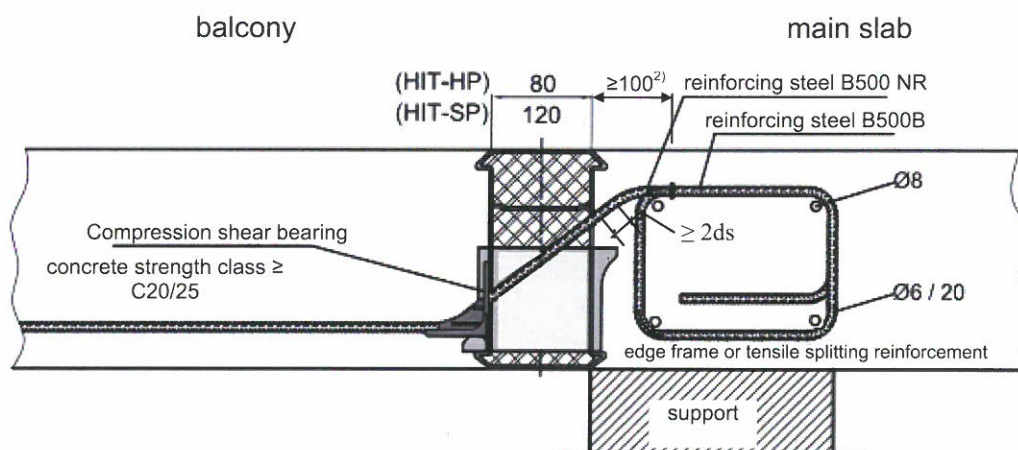


Figure 13: Halfen Insulated Connection **HIT-HP/-SP ZV REI 120** in the built-in state with a shortened loop

²⁾ Embedment length of B500 NR of 100 mm in the adjacent concrete

Halfen Insulated Connection HIT-HP and -SP

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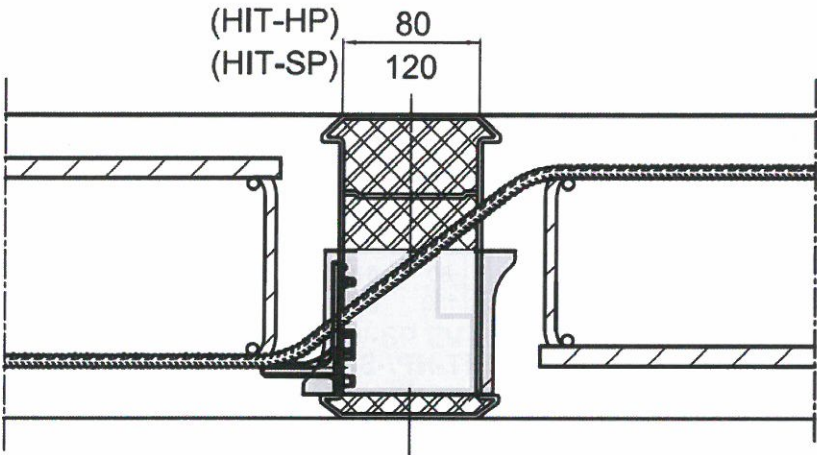
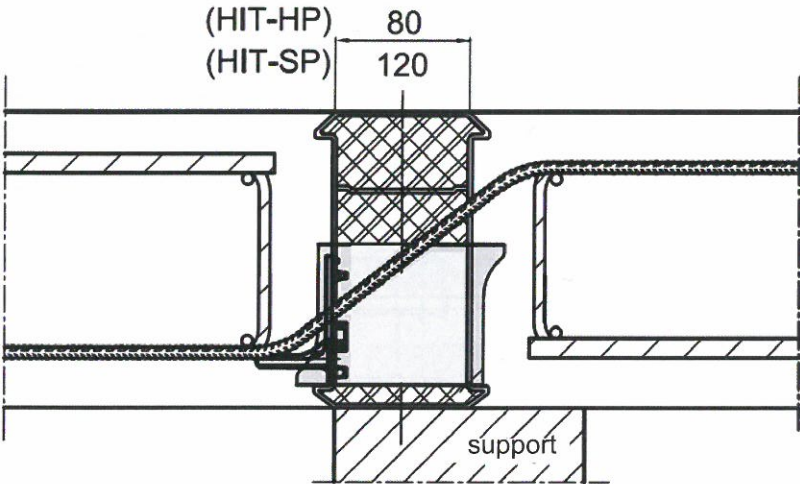


Figure 14: Halfen Insulated Connection **HIT-HP/-SP ZV REI 120** in the built-in state (example of indirect support)



Dimensions in mm

Figure 15: Halfen Insulated Connection **HIT-HP/-SP ZV REI 120** in the built-in state (example of direct support)

Halfen Insulated Connection HIT-HP and -SP Built-in state	Annex 1 Page 7/7 of European technical approval ETA-13/0546
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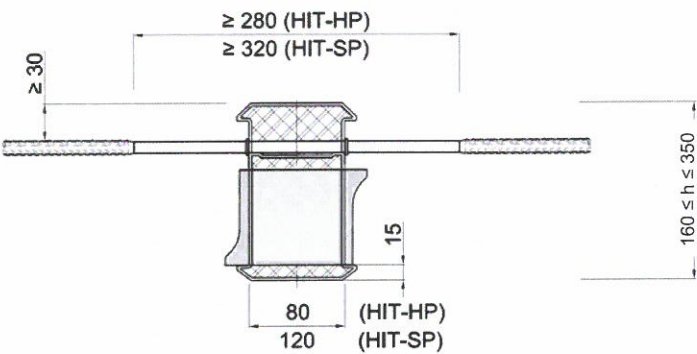


Figure 16: Halfen Insulated Connection **HIT-HP/-SP MV REI 120** – completed execution variation

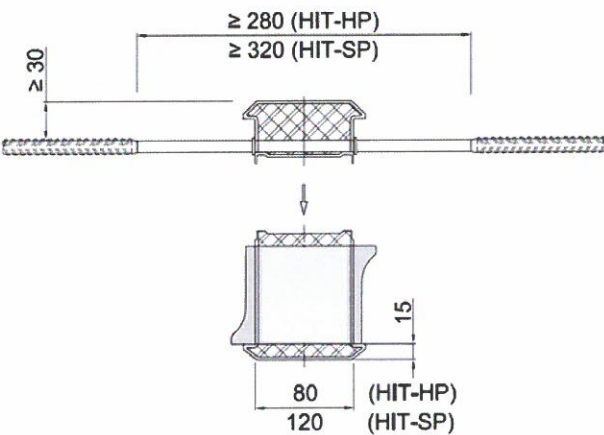


Figure 17: Halfen Insulated Connection **HIT-HP/-SP MV REI 120** – separated execution variation

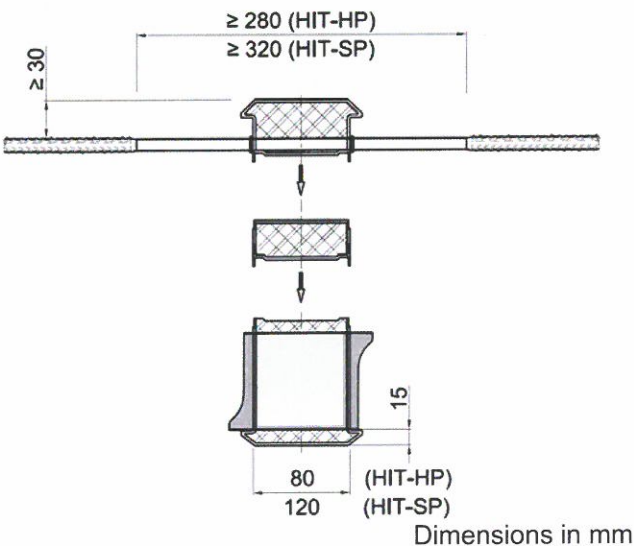


Figure 18: Halfen Insulated Connection **HIT-HP/-SP MV REI 120** – multi-part execution variation

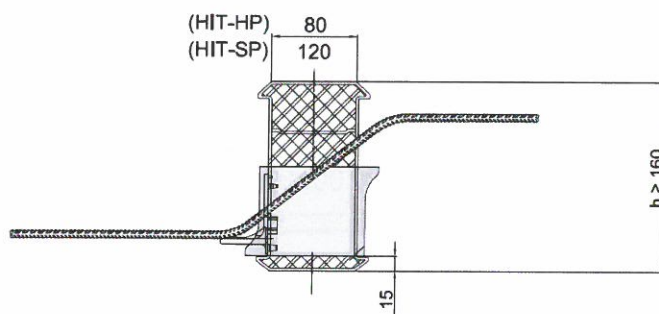


Figure 19: Halfen Insulated Connection **HIT-HP/-SP ZV REI 120** – completed execution variation

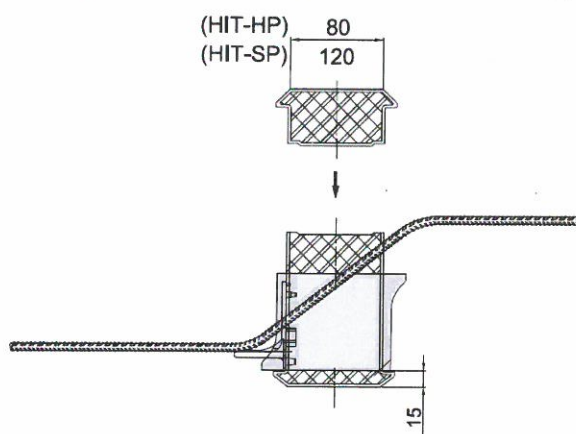
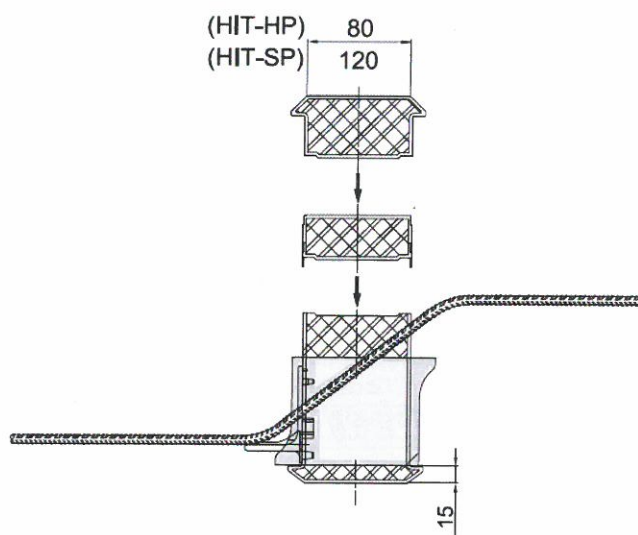


Figure 20: Halfen Insulated Connection **HIT-HP/-SP ZV REI 120** – separated execution variation



Dimensions in mm

Figure 21: Halfen Insulated Connection **HIT-HP/-SP ZV REI 120** – multi-part execution variation

Halfen Insulated Connection HIT-HP and -SP

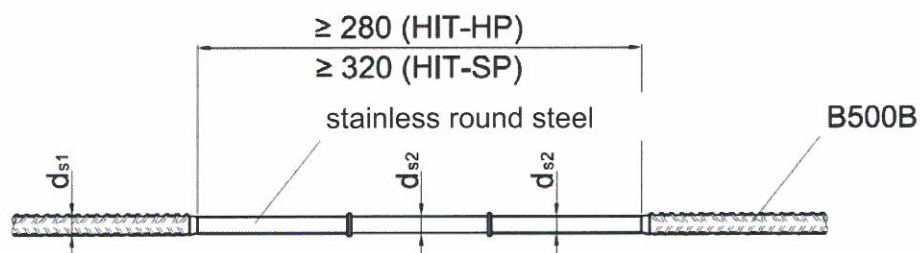
Delivery variations

Annex 2

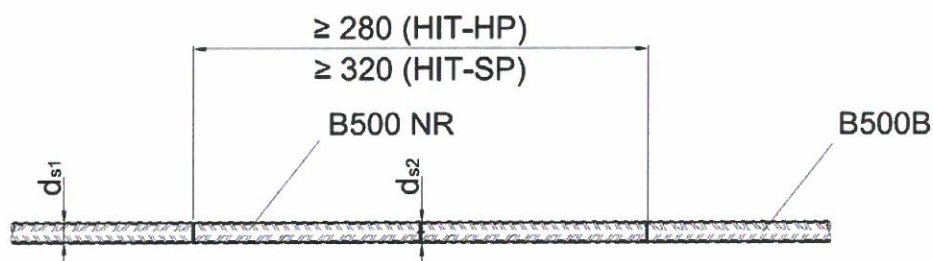
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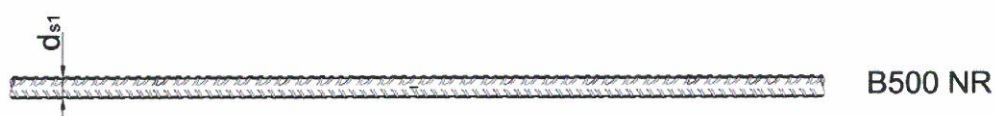
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a) Execution with stainless round steel S460 or S690 with B500B



b) Execution with stainless reinforcing steel B500 NR with B500B



c) Execution with stainless reinforcing steel B500 NR

Figure 22: Tension bar variations Halfen Insulated Connection **HIT-HP/-SP** REI 120

d_{s1} (B500B, B500 NR)	d_{s2} (stainless round steel S690)	d_{s2} (stainless round steel S460, B500 NR)
6 mm	—	6 mm
8 mm	≥ 7 mm	8 mm
10 mm	≥ 8.5 mm	10 mm
12 mm	≥ 10.5 mm	12 mm
14 mm	—	14 mm
16 mm	—	16 mm
20 mm	—	20 mm

Table A1: Diameter combinations of HIT-HP/-SP tension bars

Halfen Insulated Connection HIT-HP and -SP

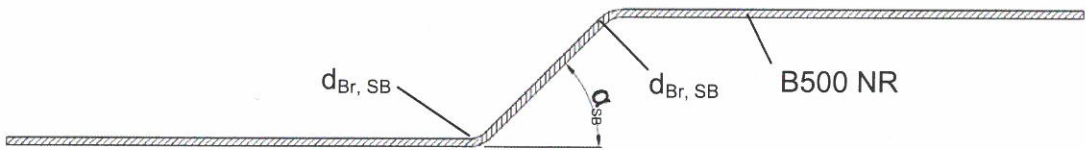
Tension and shear bar variations

Annex 3

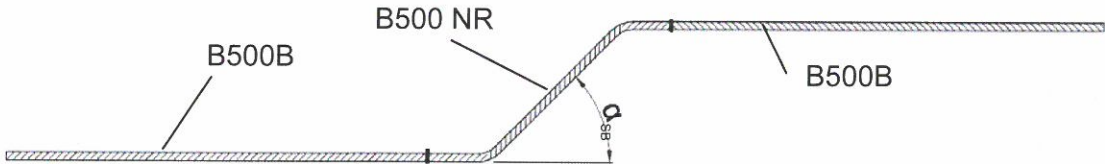
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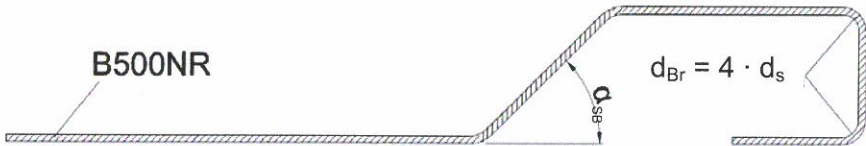
ETA-13/0546



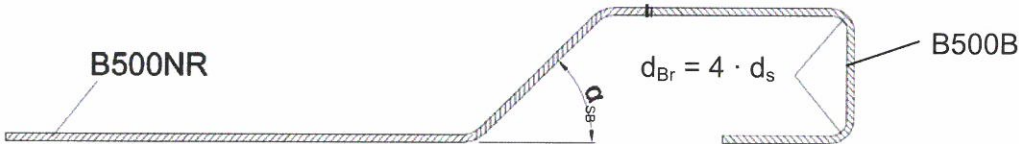
a) Execution with stainless reinforcing steel B500 NR



b) Execution with stainless reinforcing steel B500 NR in combination with B500B (embedment length of B500 NR of 10 cm in the adjacent concrete)



c) Execution with stainless reinforcing steel B500 NR, upper leg of shear bar carried out as loop



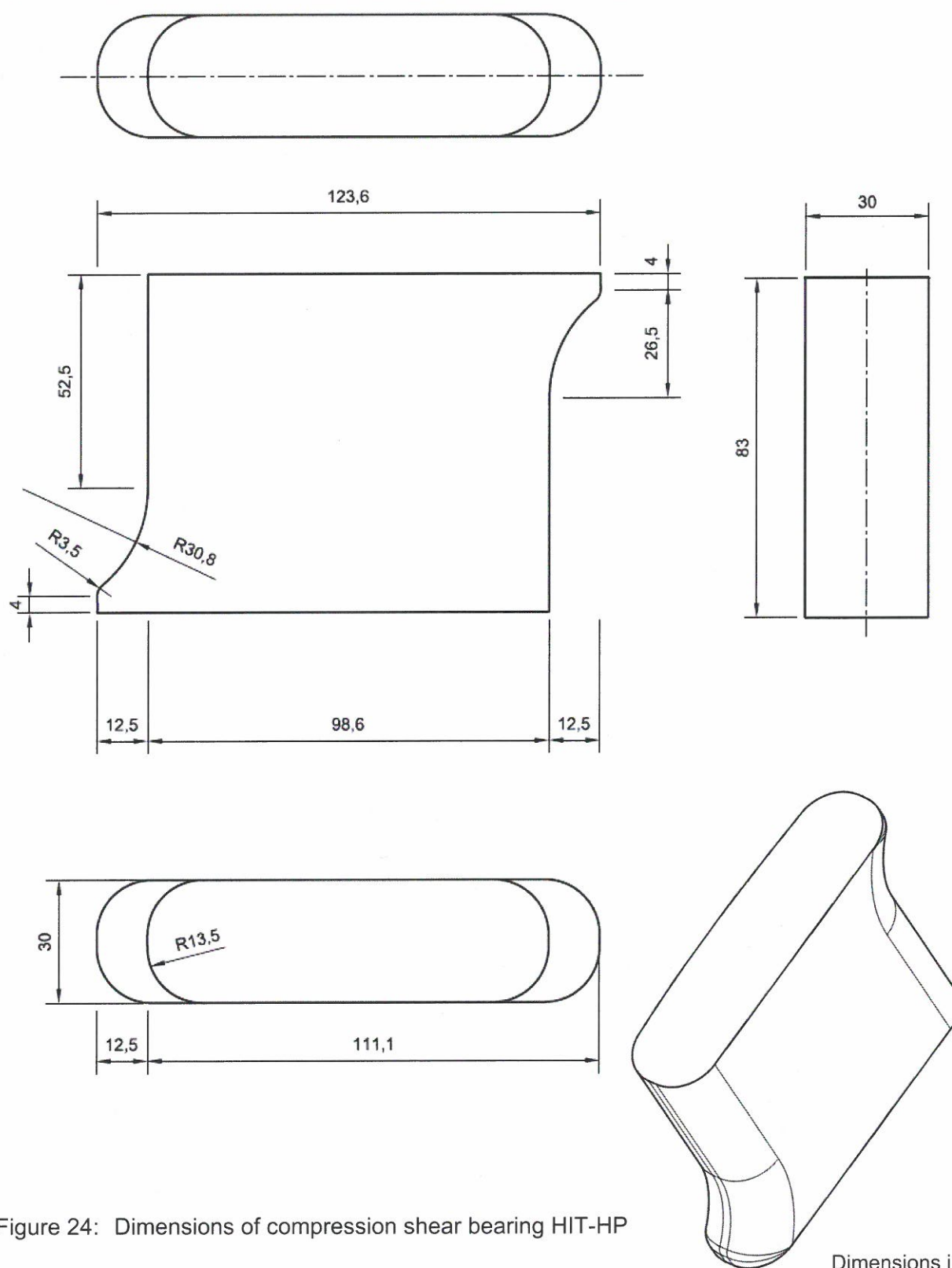
d) Execution with stainless reinforcing steel B500 NR, upper leg of shear bar carried out as loop made of B500B (embedment length of B500 NR of 10 cm in the adjacent concrete)

Figure 23: Shear bar variations Halfen Insulated Connection **HIT-HP/-SP**

d_{SB} (B500B, B500 NR)	$d_{Br, SB}$ bending diameter	α_{SB}
6 mm	$6 \cdot d_s$	$30^\circ - 60^\circ$
8 mm		
10 mm		
12 mm		

Table A2: Execution variations HIT-HP/-SP shear bars

Halfen Insulated Connection HIT-HP and -SP Tension and shear bar variations	Annex 3 Page 2/2 of European technical approval ETA-13/0546
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Halfen Insulated Connection HIT-HP and -SP
Compression shear bearing

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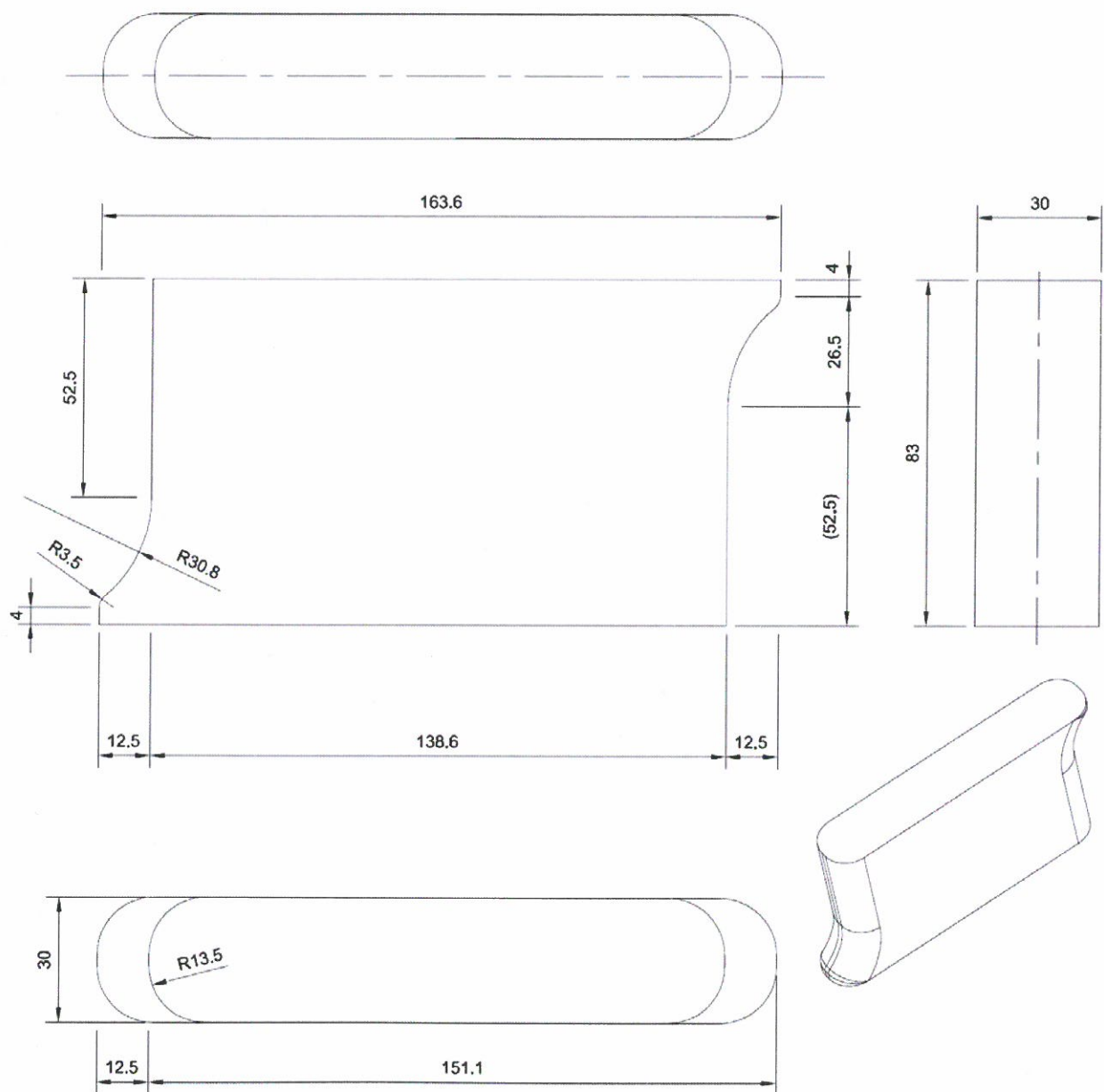


Figure 25: Dimensions of compression shear bearing HIT-SP

Dimensions in mm

Halfen Insulated Connection HIT-HP and -SP
Compression shear bearing

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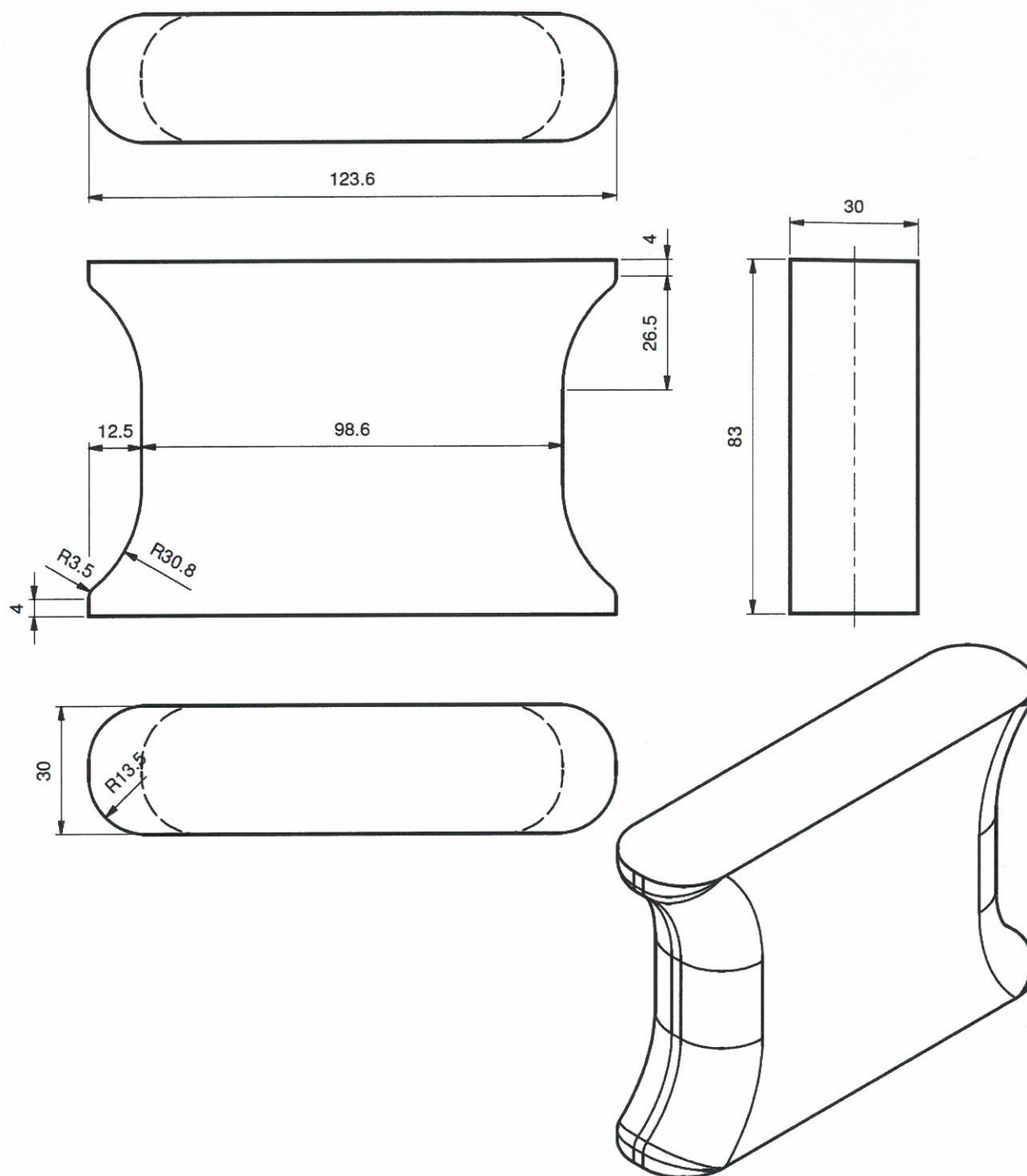


Figure 26: Dimensions of double-symmetric compression shear bearing HIT-HP

Dimensions in mm

Halfen Insulated Connection HIT-HP and -SP
 Compression shear bearing

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Strut-and-tie model of Halfen Insulated Connection HIT-HP/-SP MV (general)

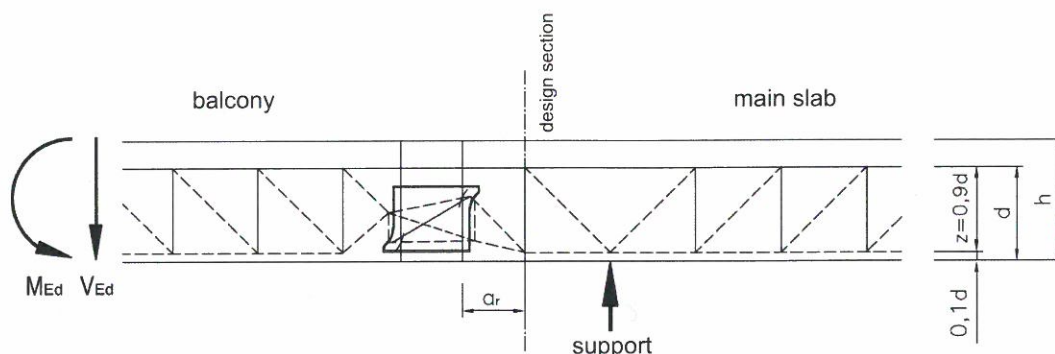


Figure 28: Strut-and-tie model and design section **HIT-HP/-SP MV** with compression shear bearing

Strut-and-tie model Halfen Insulated Connection HIT-HP/-SP MV-...-OD/-WD/-OU/-WU (Height offset)

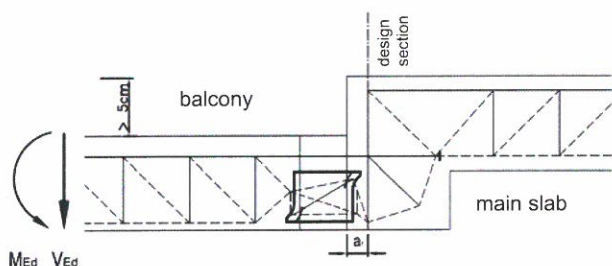


Figure 29: Strut-and-tie model **HIT-HP/-SP MV-...-OD**

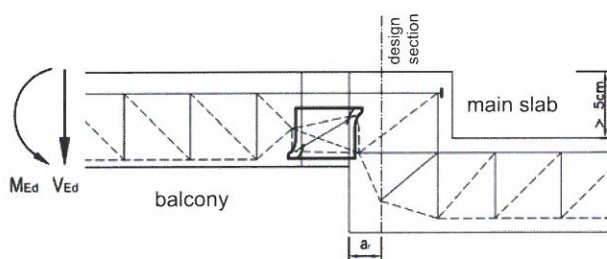


Figure 30: Strut-and-tie model **HIT-HP/-SP MV-...-OU**

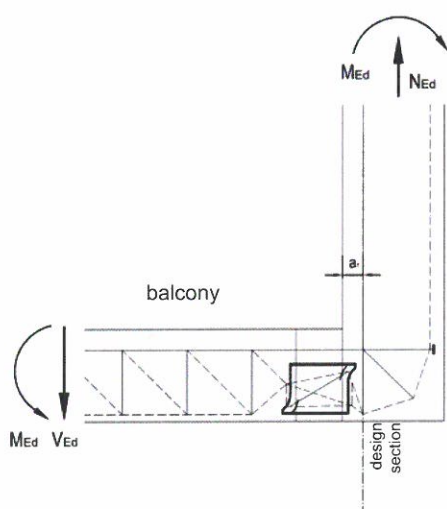


Figure 31: Strut-and-tie model **HIT-HP/-SP MV-...-WD**

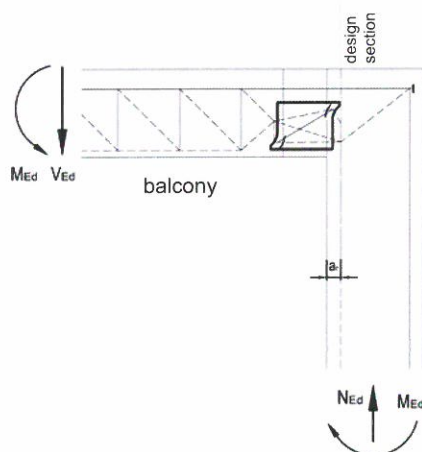


Figure 32: Strut-and-tie model **HIT-HP/-SP MV-...-WU**

Halfen Insulated Connection HIT-HP and -SP

Design model

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Distance between design section and component edge HIT-HP/-SP MV

$$a_r = 96 \text{ mm} - 0.1 \cdot d \quad (a_r \approx 80 \text{ mm})$$

$$d = h - c_{\text{nom}} - d_{s1, \text{HIT}} / 2 \quad \text{Effective depth HIT-HP/-SP MV in (mm)}$$

In the ultimate limit state a ratio between bending moment M_{Ed} and shear force V_{Ed} of at least $\frac{M_{\text{Ed}}}{V_{\text{Ed}}} \geq 0.15$ shall be adhered to.

Determination of actions HIT-HP/-SP MV

$$E_d = \gamma_G \cdot E_{\text{GK}} + \gamma_Q \cdot E_{\text{QK}}$$

Determination of internal forces resulting from moment/shear force interaction

Concrete compression zone height of compression shear bearings (units in N and mm):

$$x_c = \text{Max} \left\{ \begin{array}{l} (d-15) - \sqrt{(d-15)^2 - \frac{|M_{\text{Ed}}|}{\beta_{c1,M} \cdot n_{\text{CSB}}}} \\ 41.5 - \sqrt{41.5^2 - \frac{|V_{\text{Ed}}|}{\beta_{c2,V} \cdot n_{\text{CSB}}}} \end{array} \right. \leq 83 \text{ [mm]}$$

Concrete compressive force F_{cd} (negative) und steel tensile force F_{sd} (positive):

$$-F_{\text{cd}} = F_{\text{sd}} = 2 \cdot x_c \cdot n_{\text{CSB}} \cdot \beta_{c1,M} \quad (\text{units in N and mm})$$

where: n_{CSB} Number of compression shear bearings

$\beta_{c1,M}$ and $\beta_{c2,V}$ According to Table A3

HIT unit	HIT-HP/-SP	HIT-HP	HIT-SP
concrete strength class	$\beta_{c1,M}$ in (N/mm)	$\beta_{c2,V}$ in (N/mm ²)	$\beta_{c2,V}$ in (N/mm ²)
C20/25	680	12.5	9.1
$\geq$ C25/30	797	14.5	10.6

Table A3: Parameters for design of **HIT-HP/-SP** with compression shear bearings

Maximum transferable shear force V_{Rd} in the design section:

$$V_{\text{Rd}} = \text{Min} \left\{ \begin{array}{l} n_{\text{CSB}} \cdot 16 \text{ [kN]} \\ |F_{\text{cd}}| \cdot \frac{(83 \text{ mm} - x_c)}{a_{\text{CSB}}} \end{array} \right.$$

where: n_{CSB} Number of compression shear bearings

a_{CSB} = 110 mm for HIT-HP MV
= 150 mm for HIT-SP MV

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Verifications of the ultimate limit state of HIT-HP/-SP MV

Shear load: $|V_{Ed}| \leq V_{Rd}$

Moment load: $M_{Ed} \leq M_{Rd}$

Verification of required tension bar reinforcement:

$$A_{s, req} = \frac{F_{sd}}{f_{yd}} \leq A_{s, prov}$$

Verification of concrete edge failure HIT-HP/-SP MV

Actions in the design section:

$$F_{c, Ed} = 0.25 \cdot |F_{cd}| + |V_{Ed}|$$

Bearing resistance:

$$F_{c, Rd} = a_{Rd} \cdot (f_{ck})^{\frac{1}{4}} \cdot b_{eff} \cdot \psi_{BK}$$

where:

b_{eff}	$= n_{CSB} \cdot (137 \text{ mm}) \leq b_{Unit}$
a_{Rd}	$= 132$ for HIT-HP MV $= 120$ for HIT-SP MV
n_{CSB}	Number of compression shear bearings per unit
b_{Unit}	Width of Halfen Insulated Connection HIT-HP/-SP MV in (mm)
f_{ck}	Characteristic cylinder compressive strength of the concrete in (N/mm ²)
$\psi_{BK} = 1.0$	Applicable to HIT-HP/-SP MV (general) and to HIT-HP/-SP MV-...-OU/-WU, height offset , balcony up , see Annex 1, Pages 3 and 4, Figures 7 and 9
$\psi_{BK} = 0.7$	Applicable to HIT-HP/-SP MV-...-OD/ -WD, height offset , balcony down , see Annex 1, Pages 3 and 4, Figures 6 and 8

Verification:

$$F_{c, Ed} \leq F_{c, Rd}$$

Halfen Insulated Connection HIT-HP and -SP

Design model

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When designing the adjacent slabs of HIT-HP/-SP MV, the following loads shall be considered:

Main slab:
$$M_{Ed,slab} = \text{Max} \left\{ \begin{array}{l} M_{Ed} \\ F_{cd} \cdot z_1 \end{array} \right. \text{ in the design section}$$

where $z_1 = d - \frac{1}{2} \cdot x_c - 15 \text{ mm}$

M_{Ed} in the design section

Balcony slab:
$$M_{Ed,balcony} = M_{Ed,slab} - |V_{Ed}| \cdot a_{CSB}$$

where

$a_{CSB} = 110 \text{ mm}$ for HIT-HP MV

$= 150 \text{ mm}$ for HIT-SP MV

V_{Ed} in the design section

Design of the tensile splitting reinforcement

- Horizontal tensile splitting reinforcement (2 longitudinal bars, $d_s \geq 8 \text{ mm}$, or alternatively lattice girder)

$$F_{Sp,h} = \frac{|F_{cd}|}{4 \cdot n_{CSB}} \cdot \left(1 - \frac{30 \text{ mm}}{e} \right)$$

where:

$$e = \begin{cases} e_{\max,CSB} & \text{centre distance of the compression shear bearings in [mm]} \\ 2 \cdot e_{CSB,edge} & \text{centre distance between CSB and component edge in [mm]} \end{cases} \leq 120 \text{ mm}$$

- Vertical tensile splitting reinforcement ³⁾ (U-bars $d_s \geq 6 \text{ mm}$, $s \leq 25 \text{ cm}$ or alternatively lattice girder)

$$F_{Sp,v} = \frac{|F_{cd}|}{4} \cdot \left(1 - \frac{x_c}{x_c + 30 \text{ mm}} \right)$$

Required tensile splitting reinforcement

$$A_s = \frac{F_{Sp,h,v}}{f_{yd}} \text{ where } f_{yd} \leq 435 \text{ N/mm}^2$$

³⁾ If the design section is situated outside the area of support (indirect support), an additional vertical suspension reinforcement shall be placed.

Strut-and-tie model of Halfen Insulated Connection HIT-HP/-SP ZV

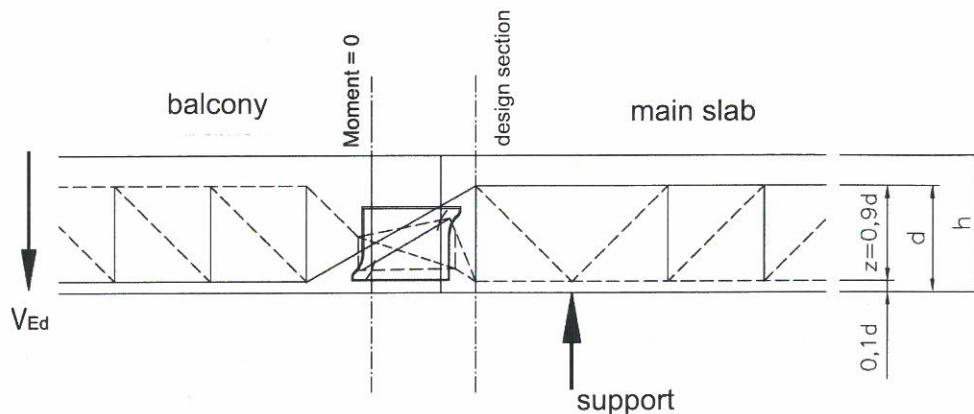


Figure 33: Strut-and-tie model and design section **HIT-HP/-SP ZV** with compression shear bearings

The design action V_{Ed} is to be calculated at the defined position of the joint (Moment = 0), the verification has to be performed at the design section.

Determinations of actions HIT-HP/-SP ZV

$$E_d = \gamma_G \cdot E_{Gk} + \gamma_Q \cdot E_{Qk}$$

Concrete compression zone height of compression shear bearings (units in N and mm)

$$x_c = \text{Max} \left\{ \begin{aligned} & \left(41.5 + \frac{a_{CSB}}{2} \cdot \tan \alpha_{SB} \right) - \sqrt{\left(41.5 + \frac{a_{CSB}}{2} \cdot \tan \alpha_{SB} \right)^2 - \frac{|V_{Ed}|}{\beta_{c2,V} \cdot n_{CSB}}} \\ & \frac{(V_{Ed} - n_{CSB} \cdot V_{CSB,d})}{2 \cdot n_{CSB} \cdot \beta_{c1,M} \cdot \tan \alpha_{SB}} \end{aligned} \right. \leq 83 \text{ mm}$$

Concrete compressive force F_{cd} (negative):

$$-F_{cd} = 2 \cdot x_c \cdot n_{CSB} \cdot \beta_{c1,M} \text{ (units in N and mm)}$$

where: a_{CSB} = 110 mm for HIT-HP
= 150 mm for HIT-SP

α_{SB} Angle of shear bars

n_{CSB} Number of compression shear bearings

$\beta_{c1,M}$ and $\beta_{c2,V}$ According to Table A3

$V_{CSB,d}$ = 16 kN

Halfen Insulated Connection HIT-HP and -SP

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Verifications of the ultimate limit state of HIT-HP/-SP ZV

Verification of required shear bar reinforcement

$$A_{s,SB,erf} = \frac{F_{SB,d}}{f_{y,d}} \quad \text{where: } F_{SB,d} = \frac{-F_{cd}}{\cos \alpha_{SB}}$$

Verification of concrete edge failure HIT-HP/-SP ZV

Actions of the design section:

$$F_{c,Ed} = 0.25 \cdot |F_{cd}| + |V_{Ed,CSB}|$$

$$\text{where: } V_{Ed,CSB} = |F_{cd}| \cdot \frac{\max(41.5; 83 - x_c)}{a_{CSB}}$$

Bearing resistance:

$$F_{c,Rd} = a_{Rd} \cdot (f_{ck})^{\frac{1}{4}} \cdot b_{eff}$$

where:

$$b_{eff} = n_{CSB} \cdot (137 \text{ mm}) \leq b_{Unit}$$

$$a_{Rd} = 132 \text{ for HIT-HP MV}$$

$$= 120 \text{ for HIT-SP MV}$$

$$n_{CSB} \quad \text{Number of compression shear bearings per unit}$$

$$b_{Unit} \quad \text{Width of Halfen Insulated Connection HIT-HP/-SP ZV in (mm)}$$

$$f_{ck} \quad \text{Characteristic cylinder compressive strength of the concrete in (N/mm}^2\text{)}$$

Verification:

$$F_{c,Ed} \leq F_{c,Rd}$$

Halfen Insulated Connection HIT-HP and -SP

Design model

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Capacity of concrete strut of the connected slabs

$$V_{Ed} \leq V_{Rd,CSB} + \frac{1}{3} \cdot V_{Rd,max}$$

where: $V_{Rd,max}$ according to EN 1992-1-1, Chapter 6.2.3 with $\Theta = 45^\circ$

$$V_{Rd,CSB} = \text{Min} \left\{ \begin{array}{l} n_{CSB} \cdot 16 \text{ [kN]} \\ |F_{cd}| \cdot \frac{(83 \text{ mm} - x_c)}{a_{CSB}} \end{array} \right.$$

Additional design force for the verification of the main slab (moment of displacement) HIT-HP/-SP ZV

$$M_{Ed, slab} = V_{Ed} \cdot t_{joint}$$

where: t_{joint} Width of the joint

Design of the tensile splitting reinforcement

See Annex 5, Page 4.

Halfen Insulated Connection HIT-HP and -SP

Design model

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HIT-HP/-SP MV (general)

Ratio between height/width of the adjacent components:	$< 1/3$ (otherwise a verification of lateral tension strength shall be performed)
Number of compression shear bearings:	$n_{CSB} \geq 4 / m$
Concrete cover of the compression shear bearings:	$c_{nom, CSB} \geq 15 \text{ mm}$
Axial distance of the compression shear bearings from the component edge (edge distance):	$\geq 80 \text{ mm}$
Axial distance of the compression shear bearings:	$\geq 75 \text{ mm}$
Edge distance of the tension bars:	$\geq 50 \text{ mm}$

For HIT-HP/-SP MV (-OD/-WD/-OU/-WU)

Embedment depth of the anchor head:	$l_d \geq 145 \text{ mm}$, (Distance of the anchor head to the edge of the component); The anchor heads shall always be positioned in the back vertical edge beam reinforcement. (compare Figures 34a and 34b).
Concrete cover of the anchor head:	$\geq 60 \text{ mm}$ (measured to the center of gravity of the anchor); Bending of the tension bars with a bending diameter of $4 \cdot d_s$ is allowed. The bending of the tension bars shall be in the region of the edge beam. A minimum distance of the HIT element to the beginning of the bent of $2 \cdot d_{s1}$ shall be observed.
Minimum transverse reinforcement:	Directly at the anchor head at least one reinforcing bar $\varnothing 12 \text{ mm}$ shall be arranged at the edge of the component.
Minimum number of stirrups:	$n_{stirrups} \geq n_{TB} + 1$, with $A_{stirrups} \geq \frac{\pi}{4} \cdot d_{s,1}^2 \cdot (n_{TB} + 1)$ In the edge beam shall always be positioned between two tension bars as well as on the outer edges of at least one stirrup. The stirrups may be used for the static proof of the edge beam.
Bending diameter:	The stirrups in the edge shall be bent with a bending diameter of $d_{br} \geq 4 \cdot d_s$ (up to stirrup diameter 12 mm).
Size of the anchor heads:	$d_k \geq 3 \cdot d_{s1}$
Diameter of the tension bars:	$d_{s1} \leq 12 \text{ mm}$ (see Annex 3)
Number of tension bars per metre:	$4 \leq n_{TB} \leq 12$
Lateral concrete cover:	$\geq 60 \text{ mm}$ (measured to the shank of the anchor)

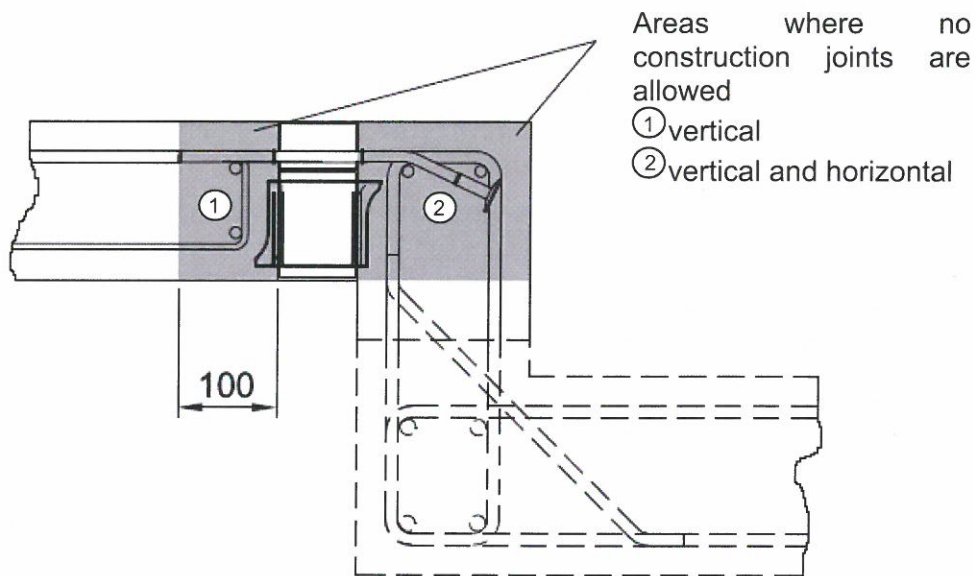


Figure 34a: Reinforcement layout for HIT-HP/-SP MV-OU/-WU

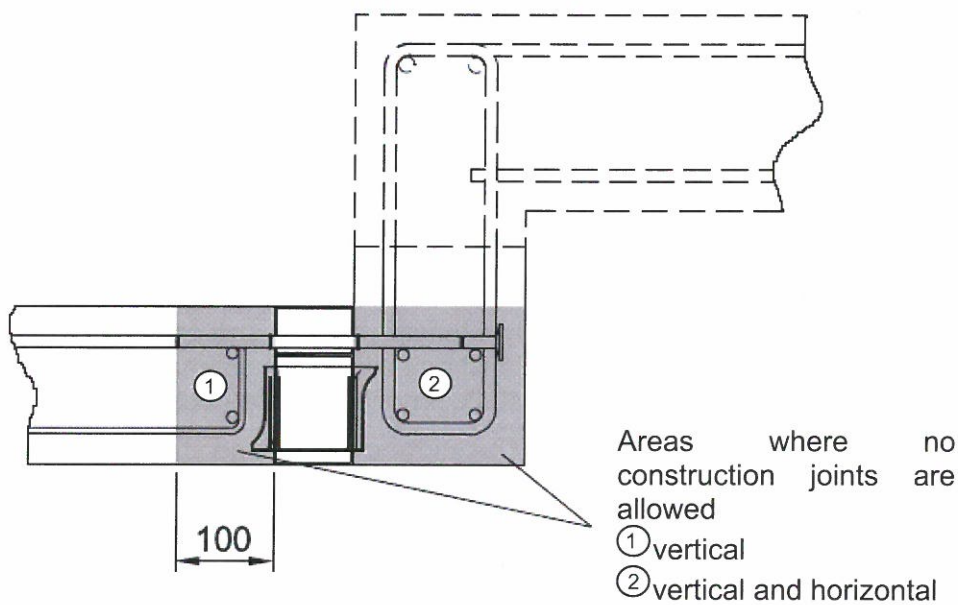


Figure 34b: Reinforcement layout for HIT-HP/-SP MV-OD/-WD

Dimensions in mm

HIT-HP/-SP ZV

Number of CSB per metre:	$3 \leq n_{\text{CSB}} \leq 12$
Concrete cover of the CSB:	$c_{\text{nom, CSB}} \geq 15 \text{ mm}$
Axial distance of the CSB from the component edge:	$\geq 80 \text{ mm}$
Axial distance of the CSB:	$\geq 75 \text{ mm}$
Diameter of the shear bars:	$d_{\text{SB}} \leq 12 \text{ mm}$
Number of shear bars per metre:	$n_{\text{SB}} \geq 2$ ($d_{\text{SB}} \leq 8 \text{ mm}$) resp. $n_{\text{SB}} \geq 4$ ($d_{\text{SB}} > 8 \text{ mm}$)
Bending diameter:	$d_{\text{Br, SB}} \geq 6 \cdot d_{\text{SB}}$ ($d_{\text{SB}} \leq 12 \text{ mm}$)
Edge distance of the shear bars:	$\geq 6 \cdot d_{\text{SB}}$
Axial distance of the shear bars	$\geq 6 \cdot d_{\text{SB}}$ (average) and $\geq 4 \cdot d_{\text{SB}}$ (minimum)
Angle of the shear bars:	$30^\circ \leq \alpha_{\text{SB}} \leq 60^\circ$
Vertical distance between shear bars and longitudinal reinforcement:	$s_{\text{SB}} \leq 100 \text{ mm}$

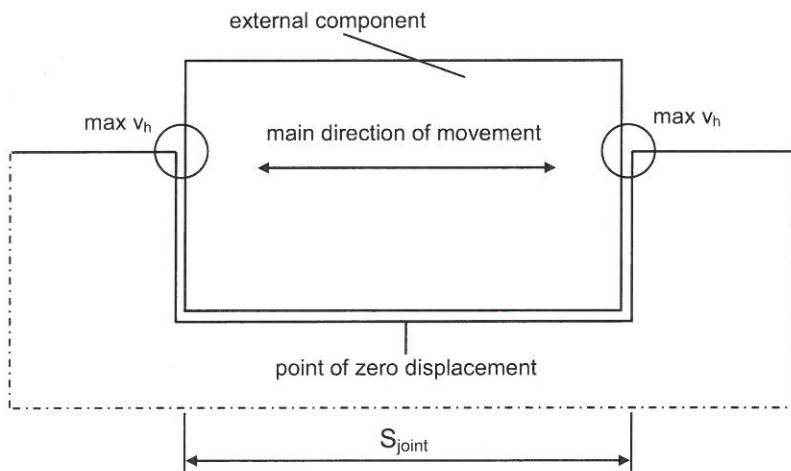
Halfen Insulated Connection HIT-HP and -SP

Structural conditions

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Tension bar diameter d_{s1} in the insulating joint in (mm)	Permissible joint distances s_{joint} in (m)
≤ 12	11.3
14	10.1
16	9.2
20	8.0

Table A4: Joint distances of HIT-HP/-SP

Figure 35: Assembly situation with supports on opposite sides

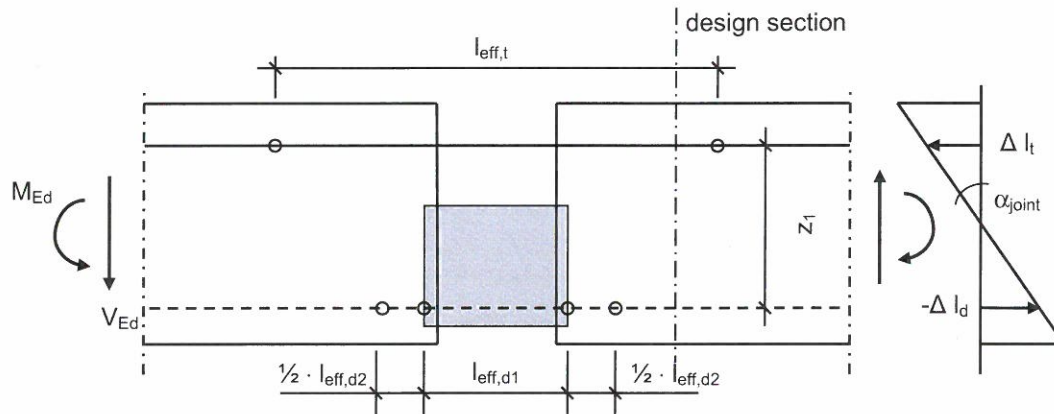


Figure 36: Model to determine the bending deformations in the joint

Angle of rotation in the joint:

$$\tan \alpha_{joint} = \frac{\Delta l_t - \Delta l_{d1} - \Delta l_{d2}}{z_1} = \frac{\Delta l_t - \Delta l_d}{z_1}$$

Internal lever arm HIT-HP/-SP MV:

$$z_1 = d - \frac{x_c}{2} - 15 \text{ mm}$$

Tension bar strain for $d_{s1} = d_{s2}$:

$$\Delta l_t = \varepsilon_t \cdot l_{eff,t} = \frac{\sigma_{s,t}}{E_s} \cdot l_{eff,t}$$

Tension bar strain for $d_{s1} > d_{s2}$:

$$\Delta l_t = \varepsilon_{t,ds1} \cdot l_{eff,t,ds1} + \varepsilon_{t,ds2} \cdot l_{eff,t,ds2}$$

$$= \frac{\sigma_{s,t,ds1}}{E_{s,ds1}} \cdot l_{eff,t,ds1} + \frac{\sigma_{s,t,ds2}}{E_{s,ds2}} \cdot l_{eff,t,ds2}$$

where:

$$l_{eff,t,ds1} = 20 \cdot d_{s1} \text{ and } l_{eff,t,ds2} = 280 \text{ mm for HIT-HP MV}$$

$$l_{eff,t,ds1} = 20 \cdot d_{s1} \text{ and } l_{eff,t,ds2} = 320 \text{ mm for HIT-SP MV}$$

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Determination of deformation

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Compression strain of the compression shear bearing: $\Delta l_{d1} = -\varepsilon_{d1} \cdot l_{\text{eff},d1}$

Compression strain of the adjacent slab concrete: $\Delta l_{d2} = -\varepsilon_{d2} \cdot l_{\text{eff},d2} = \frac{-\alpha_{l,d2}}{E_{\text{cm}}}$

Δl_d according to Table A5

Concrete strength class	C20/25	C25/30	C30/37
Δl_d in (mm) for HIT-HP MV	0.228	0.258	0.251
Δl_d in (mm) for HIT-SP MV	0.276	0.315	0.308

Table A5: Coefficients Δl_d to calculate the deformation of HIT-HP/-SP MV with compression shear bearings

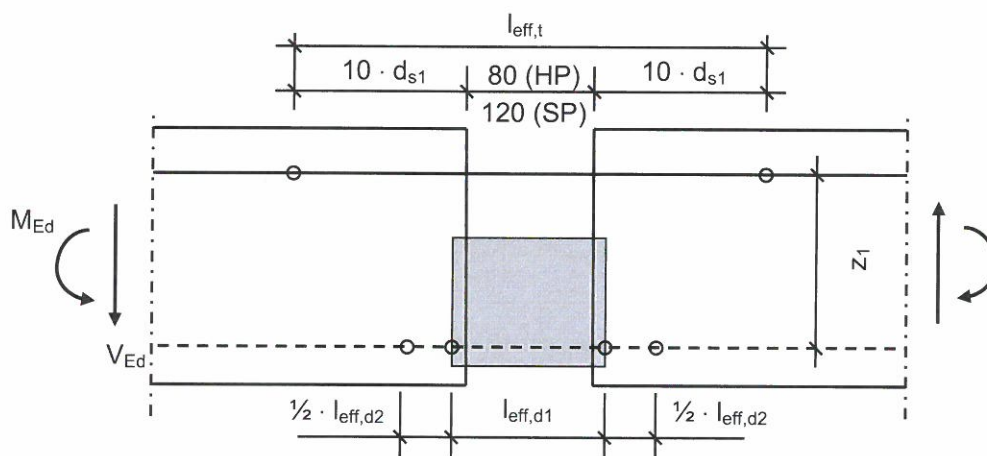


Figure 37: l_{eff} for reinforcing steel B500 NR

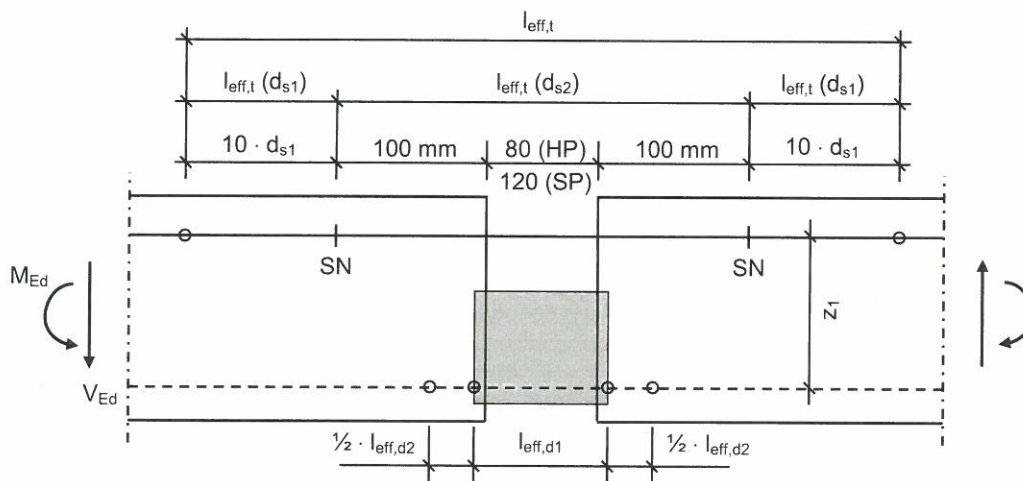


Figure 38: l_{eff} for stainless round steel S460 and S690 according to data sheet

Dimensions in mm

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Determination of deformation

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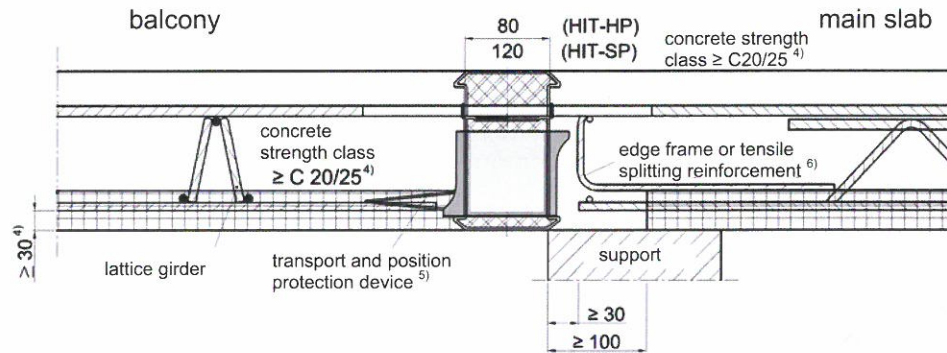


Figure 39: Example of the connection **HIT-HP/-SP MV REI 120** to element slabs with statically effective in-situ concrete layer

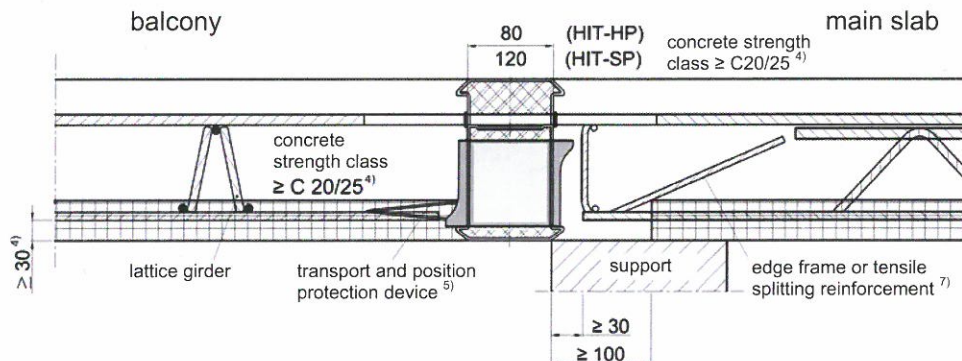
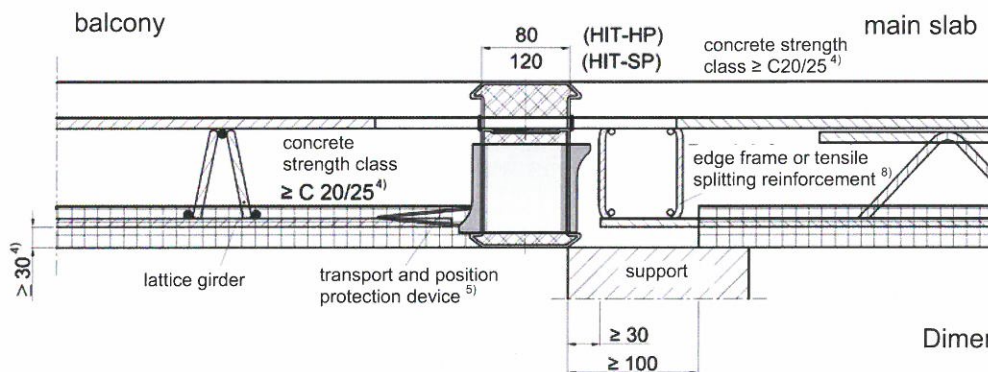


Figure 40: Example of the connection **HIT-HP/-SP MV REI 120** to element slabs with statically effective in-situ concrete layer



Dimensions in mm

Figure 41: Example of the connection **HIT-HP/-SP MV REI 120** to element slabs with statically effective in-situ concrete layer

⁴) EN 1992-1-1, Chapter 4 is also valid for the minimum concrete strength class and cover.

⁵) Transport and position protecting device for the assembly state in the form of a U-shaped holding clamp $\varnothing$ 2 mm made of cold drawn steel S235 with a length of about 100 mm and a width of about 40 mm. The holding clamp is connected to the plastic casing of the compression shear bearing.

⁶) The U-bars of the edge frame or of the vertical tensile splitting reinforcement shall be directly placed either on the element slabs or, preferably, be integrated into the element slabs at the height of the main reinforcement of the element slabs.

⁷) To ⁶) alternative design by bending up the lower leg of the U-bar

⁸) To ⁶) alternative design by placing an edge beam instead of the U-bars

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Connection of element slabs

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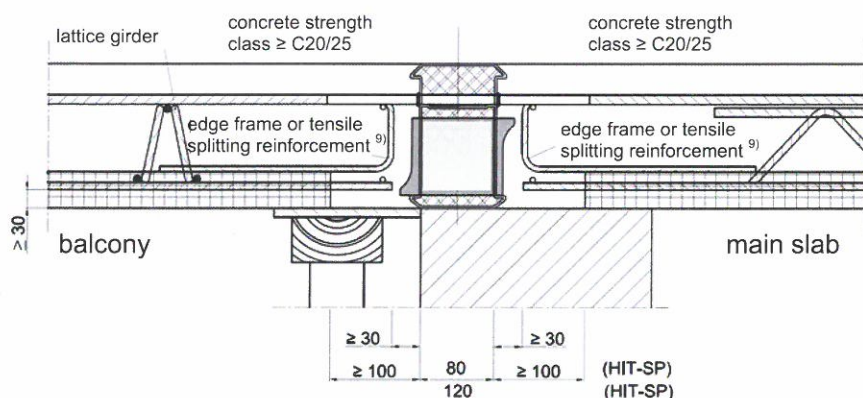


Figure 42: Example of the connection **HIT-HP/-SP MV REI 120** to element slabs with statically effective in-situ concrete layer

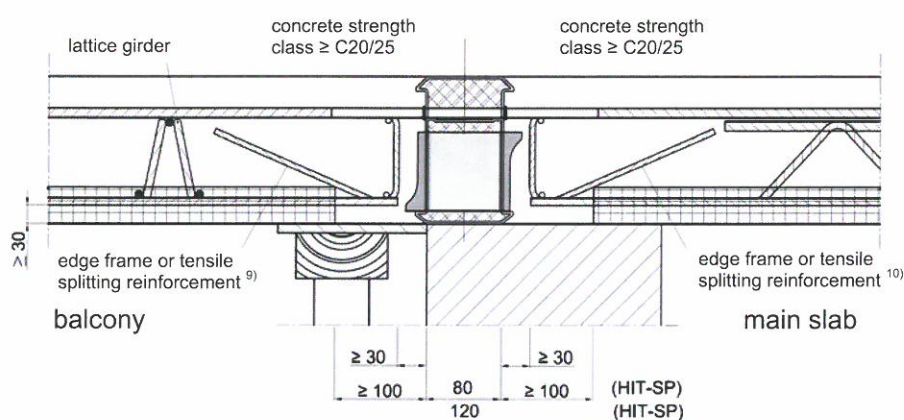
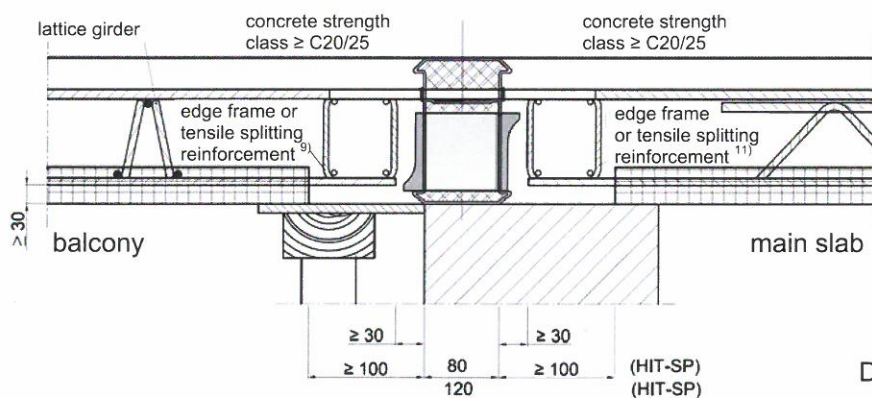


Figure 43: Example of the connection **HIT-HP/-SP MV REI 120** to element slabs with statically effective in-situ concrete layer



Dimensions in mm

Figure 44: Example of the connection **HIT-HP/-SP MV REI 120** to element slabs with statically effective in-situ concrete layer

⁹⁾ The U-bars of the edge frame or of the vertical tensile splitting reinforcement shall be placed either directly on the element slabs or, preferably, be integrated into the element slabs at the height of the main reinforcement of the element slabs.

¹⁰⁾ To ⁹⁾ (see Annex 8, Page 1) alternative design by bending up the lower leg of the U-bar

¹¹⁾ To ⁹⁾ (see Annex 8, Page 1) alternative design by placing an edge beam instead of the U-bars

Halfen Insulated Connection HIT-HP and -SP

Connection of element slabs

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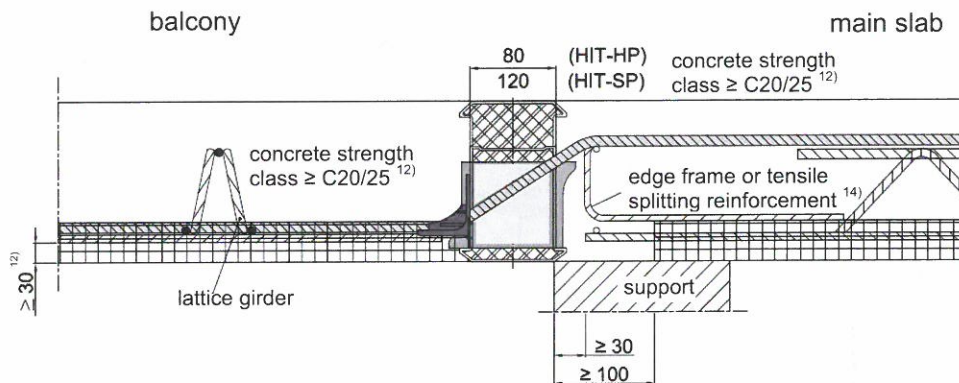


Figure 45: Example of the connection **HIT-HP/-SP ZV REI 120** to element slabs with statically effective in-situ concrete layer

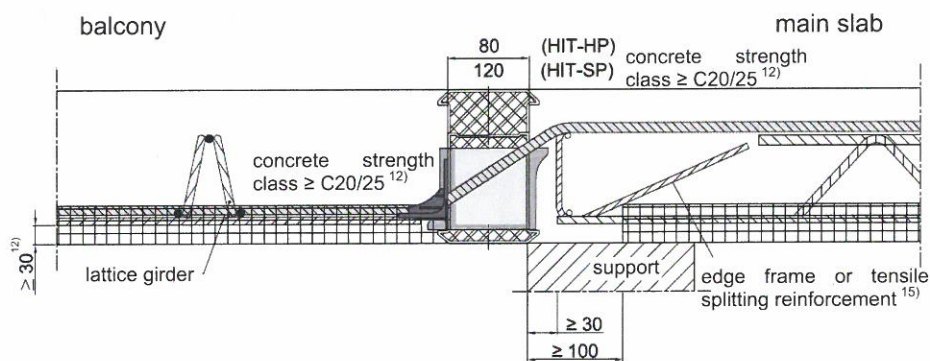
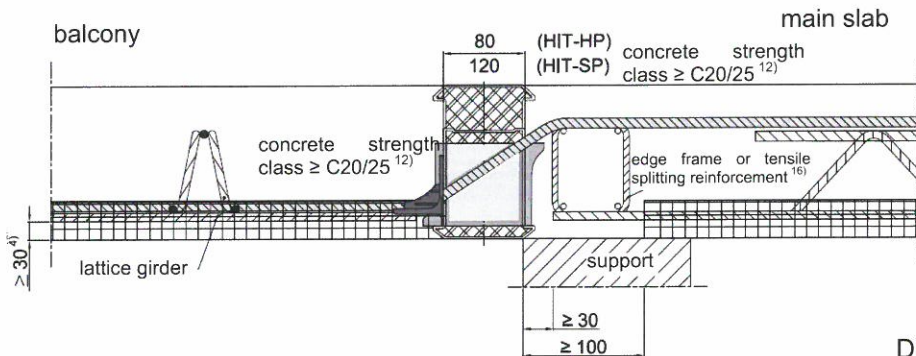


Figure 46: Example of the connection **HIT-HP/-SP ZV REI 120** to element slabs with statically effective in-situ concrete layer



Dimensions in mm

Figure 47: Example of the connection **HIT-HP/-SP ZV REI 120** to element slabs with statically effective in-situ concrete layer

¹²⁾ EN 1992-1-1, Chapter 4 is also valid for the minimum concrete strength class and cover

¹³⁾ Transport and position protecting device for the assembly state in the form of a U-shaped holding clamp $\varnothing$ 2 mm made of cold drawn steel S235 with a length of about 100 mm and a width of about 40 mm. The holding clamp is connected to the plastic casing of the compression shear bearing.

¹⁴⁾ The U-bars of the edge frame or of the vertical tensile splitting reinforcement shall be directly placed either on the element slabs or, preferably, be integrated into the element slabs at the height of the main reinforcement of the element slabs.

¹⁵⁾ to ¹⁴⁾ alternative design by bending up the lower leg of the U-bar

¹⁶⁾ to ¹⁴⁾ alternative design by placing an edge beam instead of the U-bars

Thermal resistance

The thermal resistances were calculated for several application conditions of the insulated connection HIT-HP MV and HIT-SP MV. The linear thermal transmittance Ψ and the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi} are carried out for masonry walls insulated at the outside with an external thermal insulation composite system (ETICS), see Tables A6 to A11 and for monolithic masonry (not insulated), see Tables A12 to A17. The given values are valid for the wall situations shown in Figure 48. The variations are given as a function of the wall construction (heat transition coefficient of the wall), bearing capacity of HIT-HP/-SP MV and the thickness of the insulation joint. (Standard "Exterior wall" section)

The values were determined at the basis of the following relationships and boundary conditions according to EN ISO 10211:

- Linear thermal transmittance Ψ :
$$\Psi = \frac{\Phi - A(\theta_i - \theta_e)U}{(\theta_i - \theta_e) \cdot l}$$
- Temperature-factor f_{Rsi} :
$$f_{Rsi} = \frac{\theta_{si, min} - \theta_e}{\theta_i - \theta_e}$$
- Boundary conditions to calculate the linear thermal transmittance Ψ :
 - Inner temperature: $\theta_i = 20 \text{ °C}$
 - Inner heat transfer resistance: $R_{si} = 0.13 \text{ (m}^2\cdot\text{K)/W}$
 - Outside temperature: $\theta_e = 0 \text{ °C}$
 - Exterior heat transfer resistance: $R_{se} = 0.04 \text{ (m}^2\cdot\text{K)/W}$
- Boundary conditions to calculate the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the temperature-factor f_{Rsi} :
 - Inner temperature: $\theta_i = 20 \text{ °C}$
 - Inner heat transfer resistance: $R_{si} = 0.25 \text{ (m}^2\cdot\text{K)/W}$
 - Outside temperature: $\theta_e = -5 \text{ °C}$
 - Exterior heat transfer resistance: $R_{se} = 0.04 \text{ (m}^2\cdot\text{K)/W}$

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Thermal resistance
Basis

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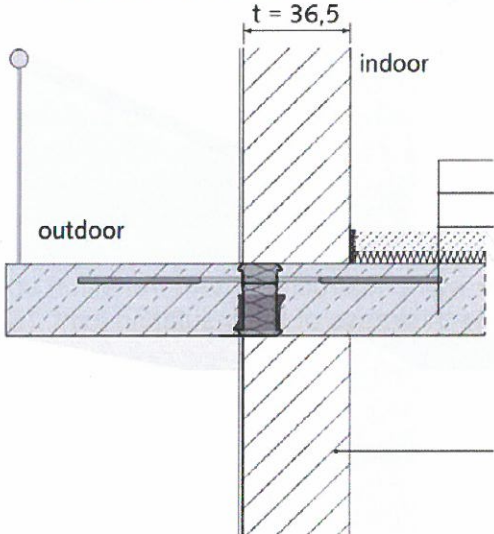
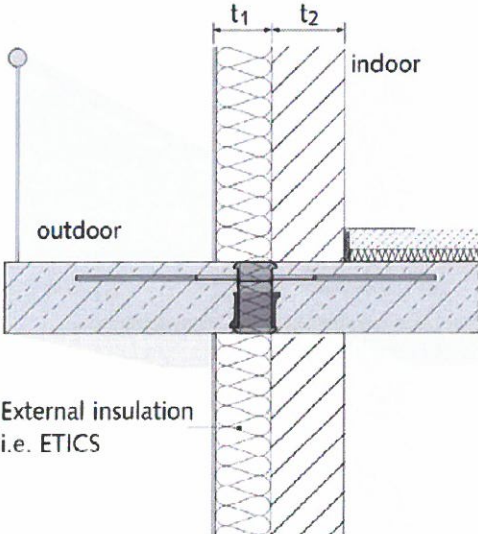
Monolithic masonry	
	Screed 5 cm ($\lambda = 1.35 \text{ W/(mK)}$) Foot-fall insulation 3 cm ($\lambda = 0.035 \text{ W/(mK)}$) Reinforced concrete slab 18 cm ($\lambda = 2.3 \text{ W/(mK)}$) with an edge insulation 1 cm ($\lambda = 0.14 \text{ W/(mK)}$) Exterior wall (Monolithic)
Heat transition coefficient (exterior wall)	Thermal conductivity of monolithic masonry
$U = 0.455 \text{ W/(m}^2\text{K)}$	$\lambda = 0.18 \text{ W/(mK)}$
$U = 0.311 \text{ W/(m}^2\text{K)}$	$\lambda = 0.12 \text{ W/(mK)}$
$U = 0.211 \text{ W/(m}^2\text{K)}$	$\lambda = 0.08 \text{ W/(mK)}$
Masonry with (ETICS) external thermal insulation composite system	
	- Exterior wall (lime-stone brick): thickness $t_2 = 24 \text{ cm}$ ($\lambda = 0.99 \text{ W/(mK)}$) - Screed 5 cm ($\lambda = 1.35 \text{ W/(mK)}$) - Foot-fall insulation 3 cm ($\lambda = 0.035 \text{ W/(mK)}$) - Reinforced concrete slab 18 cm ($\lambda = 2.3 \text{ W/(mK)}$) with an edge insulation 1 cm ($\lambda = 0.14 \text{ W/(mK)}$) External insulation i.e. ETICS
Heat transition coefficient (exterior wall)	Thickness t_1 of exterior wall insulation (ETICS) ($\lambda = 0.035 \text{ W/(mK)}$)
$U = 0.227 \text{ W/(m}^2\text{K)}$	$t_1 = 140 \text{ mm}$
$U = 0.149 \text{ W/(m}^2\text{K)}$	$t_1 = 220 \text{ mm}$
$U = 0.111 \text{ W/(m}^2\text{K)}$	$t_1 = 300 \text{ mm}$

Figure 48: Application conditions monolithic masonry and masonry with ETICS

Dimensions in cm

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Thermal resistance
Basis

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Thermal resistance for masonry with ETICS ($t_1 = 140 \text{ mm}$), HIT-HP MV

Type	Ψ in (W/(m·K))	$\theta_{si, \min}$ in (°C)	f_{Rsi} in (–)
HIT-HP MV-0404-18-100-35	0.168	17.80	0.912
HIT-HP MV-0504-18-100-35	0.175	17.76	0.910
HIT-HP MV-0604-18-100-35	0.181	17.73	0.909
HIT-HP MV-0804-18-100-35	0.194	17.66	0.906
HIT-HP MV-0505-18-100-35	0.194	17.64	0.906
HIT-HP MV-0705-18-100-35	0.207	17.57	0.903
HIT-HP MV-0805-18-100-35	0.213	17.54	0.902
HIT-HP MV-0506-18-100-35	0.212	17.53	0.901
HIT-HP MV-0606-18-100-35	0.219	17.49	0.900
HIT-HP MV-0706-18-100-35	0.225	17.46	0.898
HIT-HP MV-0906-18-100-35	0.238	17.39	0.896
HIT-HP MV-1006-18-100-35	0.244	17.36	0.894
HIT-HP MV-1106-18-100-35	0.249	17.33	0.893
HIT-HP MV-0607-18-100-35	0.236	17.38	0.895
HIT-HP MV-0707-18-100-35	0.243	17.35	0.894
HIT-HP MV-0907-18-100-35	0.255	17.29	0.891
HIT-HP MV-1007-18-100-35	0.261	17.26	0.890
HIT-HP MV-1107-18-100-35	0.267	17.23	0.889
HIT-HP MV-1207-18-100-35	0.272	17.20	0.888
HIT-HP MV-1407-18-100-35	0.283	17.14	0.886
HIT-HP MV-0408-18-100-35	0.239	17.35	0.894
HIT-HP MV-0708-18-100-35	0.259	17.25	0.890
HIT-HP MV-0808-18-100-35	0.265	17.22	0.889
HIT-HP MV-1008-18-100-35	0.277	17.16	0.886
HIT-HP MV-1208-18-100-35	0.289	17.10	0.884
HIT-HP MV-1308-18-100-35	0.294	17.07	0.883
HIT-HP MV-1309-18-100-35	0.309	16.98	0.879
HIT-HP MV-0610-18-100-35	0.283	17.09	0.884
HIT-HP MV-0910-18-100-35	0.301	17.00	0.880
HIT-HP MV-1010-18-100-35	0.307	16.97	0.879
HIT-HP MV-1210-18-100-35	0.318	16.92	0.877
HIT-HP MV-1412-18-100-35	0.356	16.70	0.868

Table A6: Thermal resistance for HIT-HP MV at application condition masonry with ETICS ($t_1 = 140 \text{ mm}$), acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, \min}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Masonry with ETICS ($t_1 = 140 \text{ mm}$)

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Thermal resistance for masonry with ETICS ($t_1 = 140$ mm), HIT-SP MV

Type	Ψ in (W/(m·K))	$\theta_{si, min}$ in (°C)	f_{Rsi} in (–)
HIT-SP MV-0404-18-100-35	0.115	18.12	0.925
HIT-SP MV-0504-18-100-35	0.121	18.09	0.924
HIT-SP MV-0604-18-100-35	0.126	18.06	0.922
HIT-SP MV-0804-18-100-35	0.137	18.00	0.920
HIT-SP MV-0505-18-100-35	0.137	17.99	0.919
HIT-SP MV-0705-18-100-35	0.148	17.92	0.917
HIT-SP MV-0805-18-100-35	0.154	17.89	0.916
HIT-SP MV-0506-18-100-35	0.153	17.89	0.916
HIT-SP MV-0606-18-100-35	0.158	17.86	0.914
HIT-SP MV-0706-18-100-35	0.164	17.83	0.913
HIT-SP MV-0906-18-100-35	0.175	17.77	0.911
HIT-SP MV-1006-18-100-35	0.180	17.74	0.910
HIT-SP MV-1106-18-100-35	0.186	17.71	0.908
HIT-SP MV-0607-18-100-35	0.174	17.76	0.910
HIT-SP MV-0707-18-100-35	0.179	17.73	0.909
HIT-SP MV-0907-18-100-35	0.190	17.67	0.907
HIT-SP MV-1007-18-100-35	0.196	17.65	0.906
HIT-SP MV-1107-18-100-35	0.201	17.62	0.905
HIT-SP MV-1207-18-100-35	0.206	17.59	0.904
HIT-SP MV-1407-18-100-35	0.216	17.54	0.902
HIT-SP MV-0408-18-100-35	0.177	17.73	0.909
HIT-SP MV-0708-18-100-35	0.194	17.64	0.906
HIT-SP MV-0808-18-100-35	0.199	17.61	0.905
HIT-SP MV-1008-18-100-35	0.210	17.56	0.902
HIT-SP MV-1208-18-100-35	0.220	17.50	0.900
HIT-SP MV-1308-18-100-35	0.226	17.48	0.899
HIT-SP MV-1309-18-100-35	0.239	17.39	0.896
HIT-SP MV-0610-18-100-35	0.216	17.50	0.900
HIT-SP MV-0910-18-100-35	0.232	17.42	0.897
HIT-SP MV-1010-18-100-35	0.237	17.39	0.896
HIT-SP MV-1210-18-100-35	0.248	17.34	0.893
HIT-SP MV-1412-18-100-35	0.283	17.13	0.885

Table A7: Thermal resistance for HIT-SP MV at application condition masonry with ETICS ($t_1 = 140$ mm), acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi}

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Thermal resistance
Masonry with ETICS ($t_1 = 140$ mm)

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Thermal resistance for masonry with ETICS ($t_1 = 220$ mm), HIT-HP MV

Type	Ψ in (W/(m·K))	$\theta_{si, min}$ in (°C)	f_{Rsi} in (–)
HIT-HP MV-0404-18-100-35	0.187	18.08	0.923
HIT-HP MV-0504-18-100-35	0.193	18.05	0.922
HIT-HP MV-0604-18-100-35	0.199	18.02	0.921
HIT-HP MV-0804-18-100-35	0.211	17.95	0.918
HIT-HP MV-0505-18-100-35	0.211	17.94	0.918
HIT-HP MV-0705-18-100-35	0.223	17.87	0.915
HIT-HP MV-0805-18-100-35	0.229	17.84	0.914
HIT-HP MV-0506-18-100-35	0.228	17.83	0.913
HIT-HP MV-0606-18-100-35	0.234	17.80	0.912
HIT-HP MV-0706-18-100-35	0.240	17.77	0.911
HIT-HP MV-0906-18-100-35	0.251	17.71	0.908
HIT-HP MV-1006-18-100-35	0.257	17.68	0.907
HIT-HP MV-1106-18-100-35	0.262	17.65	0.906
HIT-HP MV-0607-18-100-35	0.249	17.70	0.908
HIT-HP MV-0707-18-100-35	0.255	17.67	0.907
HIT-HP MV-0907-18-100-35	0.267	17.61	0.904
HIT-HP MV-1007-18-100-35	0.272	17.58	0.903
HIT-HP MV-1107-18-100-35	0.278	17.56	0.902
HIT-HP MV-1207-18-100-35	0.283	17.53	0.901
HIT-HP MV-1407-18-100-35	0.293	17.48	0.899
HIT-HP MV-0408-18-100-35	0.252	17.68	0.907
HIT-HP MV-0708-18-100-35	0.270	17.58	0.903
HIT-HP MV-0808-18-100-35	0.276	17.55	0.902
HIT-HP MV-1008-18-100-35	0.287	17.49	0.900
HIT-HP MV-1208-18-100-35	0.297	17.44	0.898
HIT-HP MV-1308-18-100-35	0.302	17.41	0.897
HIT-HP MV-1309-18-100-35	0.316	17.33	0.893
HIT-HP MV-0610-18-100-35	0.292	17.44	0.898
HIT-HP MV-0910-18-100-35	0.308	17.35	0.894
HIT-HP MV-1010-18-100-35	0.314	17.33	0.893
HIT-HP MV-1210-18-100-35	0.324	17.28	0.891
HIT-HP MV-1412-18-100-35	0.357	17.08	0.883

Table A8: Thermal resistance for HIT-HP MV at application condition masonry with ETICS ($t_1 = 220$ mm), acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Masonry with ETICS ($t_1 = 220$ mm)

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Thermal resistance for masonry with ETICS ($t_1 = 220$ mm), HIT-SP MV

Type	Ψ in (W/(m·K))	$\theta_{si, min}$ in (°C)	f_{Rsi} in (-)
HIT-SP MV-0404-18-100-35	0.134	18.40	0.936
HIT-SP MV-0504-18-100-35	0.140	18.37	0.935
HIT-SP MV-0604-18-100-35	0.145	18.34	0.934
HIT-SP MV-0804-18-100-35	0.156	18.28	0.931
HIT-SP MV-0505-18-100-35	0.155	18.27	0.931
HIT-SP MV-0705-18-100-35	0.166	18.21	0.929
HIT-SP MV-0805-18-100-35	0.171	18.19	0.927
HIT-SP MV-0506-18-100-35	0.170	18.18	0.927
HIT-SP MV-0606-18-100-35	0.176	18.15	0.926
HIT-SP MV-0706-18-100-35	0.181	18.12	0.925
HIT-SP MV-0906-18-100-35	0.191	18.07	0.923
HIT-SP MV-1006-18-100-35	0.196	18.04	0.922
HIT-SP MV-1106-18-100-35	0.201	18.01	0.921
HIT-SP MV-0607-18-100-35	0.190	18.06	0.922
HIT-SP MV-0707-18-100-35	0.195	18.03	0.921
HIT-SP MV-0907-18-100-35	0.205	17.98	0.919
HIT-SP MV-1007-18-100-35	0.210	17.95	0.918
HIT-SP MV-1107-18-100-35	0.215	17.93	0.917
HIT-SP MV-1207-18-100-35	0.220	17.90	0.916
HIT-SP MV-1407-18-100-35	0.229	17.85	0.914
HIT-SP MV-0408-18-100-35	0.192	18.04	0.921
HIT-SP MV-0708-18-100-35	0.208	17.95	0.918
HIT-SP MV-0808-18-100-35	0.214	17.92	0.917
HIT-SP MV-1008-18-100-35	0.224	17.87	0.915
HIT-SP MV-1208-18-100-35	0.233	17.82	0.913
HIT-SP MV-1308-18-100-35	0.238	17.79	0.912
HIT-SP MV-1309-18-100-35	0.251	17.72	0.909
HIT-SP MV-0610-18-100-35	0.229	17.82	0.913
HIT-SP MV-0910-18-100-35	0.244	17.74	0.910
HIT-SP MV-1010-18-100-35	0.249	17.71	0.909
HIT-SP MV-1210-18-100-35	0.258	17.67	0.907
HIT-SP MV-1412-18-100-35	0.290	17.48	0.899

Table A9: Thermal resistance for HIT-SP MV at application condition masonry with ETICS ($t_1 = 220$ mm), acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Masonry with ETICS ($t_1 = 220$ mm)

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Thermal resistance for masonry with ETICS ($t_1 = 300$ mm), HIT-HP MV

Type	Ψ in (W/(m·K))	$\theta_{si, min}$ in (°C)	f_{Rsi} in (–)
HIT-HP MV-0404-18-100-35	0.194	18.25	0.930
HIT-HP MV-0504-18-100-35	0.200	18.21	0.929
HIT-HP MV-0604-18-100-35	0.206	18.18	0.927
HIT-HP MV-0804-18-100-35	0.217	18.12	0.925
HIT-HP MV-0505-18-100-35	0.216	18.11	0.924
HIT-HP MV-0705-18-100-35	0.228	18.05	0.922
HIT-HP MV-0805-18-100-35	0.233	18.02	0.921
HIT-HP MV-0506-18-100-35	0.231	18.02	0.921
HIT-HP MV-0606-18-100-35	0.237	17.99	0.919
HIT-HP MV-0706-18-100-35	0.243	17.96	0.918
HIT-HP MV-0906-18-100-35	0.253	17.90	0.916
HIT-HP MV-1006-18-100-35	0.258	17.87	0.915
HIT-HP MV-1106-18-100-35	0.263	17.85	0.914
HIT-HP MV-0607-18-100-35	0.251	17.90	0.916
HIT-HP MV-0707-18-100-35	0.257	17.87	0.915
HIT-HP MV-0907-18-100-35	0.267	17.81	0.912
HIT-HP MV-1007-18-100-35	0.272	17.79	0.911
HIT-HP MV-1107-18-100-35	0.277	17.76	0.910
HIT-HP MV-1207-18-100-35	0.282	17.73	0.909
HIT-HP MV-1407-18-100-35	0.292	17.68	0.907
HIT-HP MV-0408-18-100-35	0.253	17.87	0.915
HIT-HP MV-0708-18-100-35	0.270	17.79	0.911
HIT-HP MV-0808-18-100-35	0.275	17.76	0.910
HIT-HP MV-1008-18-100-35	0.285	17.70	0.908
HIT-HP MV-1208-18-100-35	0.295	17.65	0.906
HIT-HP MV-1308-18-100-35	0.300	17.63	0.905
HIT-HP MV-1309-18-100-35	0.312	17.55	0.902
HIT-HP MV-0610-18-100-35	0.289	17.66	0.906
HIT-HP MV-0910-18-100-35	0.304	17.58	0.903
HIT-HP MV-1010-18-100-35	0.309	17.56	0.902
HIT-HP MV-1210-18-100-35	0.319	17.51	0.900
HIT-HP MV-1412-18-100-35	0.349	17.33	0.893

Table A10: Thermal resistance for HIT-HP MV at application condition masonry with ETICS ($t_1 = 300$ mm), acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Masonry with ETICS ($t_1 = 300$ mm)

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Thermal resistance for masonry with ETICS ($t_1 = 300$ mm), HIT-SP MV

Type	Ψ in (W/(m·K))	$\theta_{si, min}$ in (°C)	f_{Rsi} in (–)
HIT-SP MV-0404-18-100-35	0.145	18.54	0.942
HIT-SP MV-0504-18-100-35	0.150	18.51	0.941
HIT-SP MV-0604-18-100-35	0.155	18.48	0.939
HIT-SP MV-0804-18-100-35	0.165	18.43	0.937
HIT-SP MV-0505-18-100-35	0.164	18.42	0.937
HIT-SP MV-0705-18-100-35	0.175	18.37	0.935
HIT-SP MV-0805-18-100-35	0.179	18.34	0.934
HIT-SP MV-0506-18-100-35	0.178	18.34	0.933
HIT-SP MV-0606-18-100-35	0.183	18.31	0.932
HIT-SP MV-0706-18-100-35	0.188	18.28	0.931
HIT-SP MV-0906-18-100-35	0.198	18.23	0.929
HIT-SP MV-1006-18-100-35	0.203	18.20	0.928
HIT-SP MV-1106-18-100-35	0.207	18.18	0.927
HIT-SP MV-0607-18-100-35	0.196	18.23	0.929
HIT-SP MV-0707-18-100-35	0.201	18.20	0.928
HIT-SP MV-0907-18-100-35	0.211	18.15	0.926
HIT-SP MV-1007-18-100-35	0.215	18.12	0.925
HIT-SP MV-1107-18-100-35	0.220	18.10	0.924
HIT-SP MV-1207-18-100-35	0.225	18.08	0.923
HIT-SP MV-1407-18-100-35	0.233	18.03	0.921
HIT-SP MV-0408-18-100-35	0.198	18.21	0.928
HIT-SP MV-0708-18-100-35	0.213	18.12	0.925
HIT-SP MV-0808-18-100-35	0.218	18.10	0.924
HIT-SP MV-1008-18-100-35	0.228	18.05	0.922
HIT-SP MV-1208-18-100-35	0.237	18.00	0.920
HIT-SP MV-1308-18-100-35	0.241	17.98	0.919
HIT-SP MV-1309-18-100-35	0.253	17.90	0.916
HIT-SP MV-0610-18-100-35	0.232	18.00	0.920
HIT-SP MV-0910-18-100-35	0.246	17.93	0.917
HIT-SP MV-1010-18-100-35	0.250	17.91	0.916
HIT-SP MV-1210-18-100-35	0.259	17.86	0.914
HIT-SP MV-1412-18-100-35	0.288	17.69	0.908

Table A11: Thermal resistance for HIT-SP MV at application condition masonry with ETICS ($t_1 = 300$ mm), acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Masonry with ETICS ($t_1 = 300$ mm)

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Thermal resistance for monolithic masonry ($\lambda = 0.18 \text{ W/(m}\cdot\text{K)}$), HIT-HP MV

Type	Ψ in ($\text{W/(m}\cdot\text{K)}$)	$\theta_{\text{si, min}}$ in ($^{\circ}\text{C}$)	f_{Rsi} in (-)
HIT-HP MV-0404-18-100-35	0.168	15.49	0.819
HIT-HP MV-0504-18-100-35	0.173	15.45	0.818
HIT-HP MV-0604-18-100-35	0.178	15.41	0.817
HIT-HP MV-0804-18-100-35	0.188	15.35	0.814
HIT-HP MV-0505-18-100-35	0.186	15.31	0.813
HIT-HP MV-0705-18-100-35	0.196	15.25	0.810
HIT-HP MV-0805-18-100-35	0.201	15.21	0.809
HIT-HP MV-0506-18-100-35	0.198	15.19	0.807
HIT-HP MV-0606-18-100-35	0.203	15.15	0.806
HIT-HP MV-0706-18-100-35	0.208	15.12	0.805
HIT-HP MV-0906-18-100-35	0.217	15.06	0.802
HIT-HP MV-1006-18-100-35	0.222	15.03	0.801
HIT-HP MV-1106-18-100-35	0.226	15.00	0.800
HIT-HP MV-0607-18-100-35	0.214	15.03	0.801
HIT-HP MV-0707-18-100-35	0.219	15.00	0.800
HIT-HP MV-0907-18-100-35	0.228	14.94	0.797
HIT-HP MV-1007-18-100-35	0.233	14.91	0.796
HIT-HP MV-1107-18-100-35	0.237	14.88	0.795
HIT-HP MV-1207-18-100-35	0.242	14.85	0.794
HIT-HP MV-1407-18-100-35	0.250	14.80	0.792
HIT-HP MV-0408-18-100-35	0.215	14.99	0.799
HIT-HP MV-0708-18-100-35	0.230	14.89	0.795
HIT-HP MV-0808-18-100-35	0.234	14.85	0.794
HIT-HP MV-1008-18-100-35	0.243	14.80	0.792
HIT-HP MV-1208-18-100-35	0.252	14.74	0.790
HIT-HP MV-1308-18-100-35	0.256	14.72	0.789
HIT-HP MV-1309-18-100-35	0.266	14.61	0.784
HIT-HP MV-0610-18-100-35	0.245	14.71	0.788
HIT-HP MV-0910-18-100-35	0.259	14.62	0.785
HIT-HP MV-1010-18-100-35	0.263	14.59	0.784
HIT-HP MV-1210-18-100-35	0.272	14.54	0.782
HIT-HP MV-1412-18-100-35	0.297	14.32	0.773

Table A12: Thermal resistance for HIT-HP MV at application condition monolithic masonry, $\lambda = 0.18 \text{ W/(m}\cdot\text{K)}$ acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{\text{si, min}}$ and the corresponding temperature-factor f_{Rsi}

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Thermal resistance
Monolithic masonry ($\lambda = 0.18 \text{ W/(m}\cdot\text{K)}$)

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Thermal resistance for monolithic masonry ($\lambda = 0.18 \text{ W/(m}\cdot\text{K)}$), HIT-SP MV

Type	Ψ in ($\text{W/(m}\cdot\text{K)}$)	$\theta_{\text{si, min}}$ in ($^{\circ}\text{C}$)	f_{Rsi} in (-)
HIT-SP MV-0404-18-100-35	0.132	15.86	0.835
HIT-SP MV-0504-18-100-35	0.136	15.83	0.833
HIT-SP MV-0604-18-100-35	0.141	15.80	0.832
HIT-SP MV-0804-18-100-35	0.149	15.74	0.830
HIT-SP MV-0505-18-100-35	0.148	15.71	0.828
HIT-SP MV-0705-18-100-35	0.156	15.65	0.826
HIT-SP MV-0805-18-100-35	0.161	15.62	0.825
HIT-SP MV-0506-18-100-35	0.158	15.59	0.824
HIT-SP MV-0606-18-100-35	0.163	15.56	0.823
HIT-SP MV-0706-18-100-35	0.167	15.53	0.821
HIT-SP MV-0906-18-100-35	0.175	15.48	0.819
HIT-SP MV-1006-18-100-35	0.180	15.45	0.818
HIT-SP MV-1106-18-100-35	0.184	15.42	0.817
HIT-SP MV-0607-18-100-35	0.173	15.45	0.818
HIT-SP MV-0707-18-100-35	0.177	15.42	0.817
HIT-SP MV-0907-18-100-35	0.186	15.37	0.815
HIT-SP MV-1007-18-100-35	0.190	15.34	0.814
HIT-SP MV-1107-18-100-35	0.194	15.32	0.813
HIT-SP MV-1207-18-100-35	0.198	15.29	0.812
HIT-SP MV-1407-18-100-35	0.206	15.24	0.810
HIT-SP MV-0408-18-100-35	0.174	15.41	0.816
HIT-SP MV-0708-18-100-35	0.187	15.32	0.813
HIT-SP MV-0808-18-100-35	0.191	15.29	0.812
HIT-SP MV-1008-18-100-35	0.200	15.24	0.810
HIT-SP MV-1208-18-100-35	0.208	15.19	0.807
HIT-SP MV-1308-18-100-35	0.212	15.16	0.807
HIT-SP MV-1309-18-100-35	0.221	15.07	0.803
HIT-SP MV-0610-18-100-35	0.201	15.15	0.806
HIT-SP MV-0910-18-100-35	0.214	15.07	0.803
HIT-SP MV-1010-18-100-35	0.218	15.05	0.802
HIT-SP MV-1210-18-100-35	0.226	15.00	0.800
HIT-SP MV-1412-18-100-35	0.250	14.78	0.791

Table A13: Thermal resistance for HIT-SP MV at application condition monolithic masonry, $\lambda = 0.18 \text{ W/(m}\cdot\text{K)}$ acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{\text{si, min}}$ and the corresponding temperature-factor f_{Rsi}

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Thermal resistance
Monolithic masonry ($\lambda = 0.18 \text{ W/(m}\cdot\text{K)}$)

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Thermal resistance for monolithic masonry ($\lambda = 0.12 \text{ W/(m}\cdot\text{K)}$), HIT-HP MV

Type	Ψ in ($\text{W/(m}\cdot\text{K)}$)	$\theta_{\text{si, min}}$ in ($^{\circ}\text{C}$)	f_{Rsi} in (-)
HIT-HP MV-0404-18-100-35	0.180	15.91	0.836
HIT-HP MV-0504-18-100-35	0.185	15.86	0.834
HIT-HP MV-0604-18-100-35	0.190	15.82	0.833
HIT-HP MV-0804-18-100-35	0.200	15.74	0.829
HIT-HP MV-0505-18-100-35	0.199	15.70	0.828
HIT-HP MV-0705-18-100-35	0.209	15.62	0.825
HIT-HP MV-0805-18-100-35	0.214	15.58	0.823
HIT-HP MV-0506-18-100-35	0.212	15.55	0.822
HIT-HP MV-0606-18-100-35	0.217	15.50	0.820
HIT-HP MV-0706-18-100-35	0.222	15.46	0.819
HIT-HP MV-0906-18-100-35	0.232	15.39	0.816
HIT-HP MV-1006-18-100-35	0.236	15.35	0.814
HIT-HP MV-1106-18-100-35	0.241	15.32	0.813
HIT-HP MV-0607-18-100-35	0.229	15.36	0.814
HIT-HP MV-0707-18-100-35	0.234	15.33	0.813
HIT-HP MV-0907-18-100-35	0.244	15.25	0.810
HIT-HP MV-1007-18-100-35	0.249	15.22	0.809
HIT-HP MV-1107-18-100-35	0.253	15.18	0.807
HIT-HP MV-1207-18-100-35	0.258	15.15	0.806
HIT-HP MV-1407-18-100-35	0.266	15.09	0.803
HIT-HP MV-0408-18-100-35	0.230	15.31	0.812
HIT-HP MV-0708-18-100-35	0.246	15.19	0.808
HIT-HP MV-0808-18-100-35	0.251	15.16	0.806
HIT-HP MV-1008-18-100-35	0.260	15.09	0.803
HIT-HP MV-1208-18-100-35	0.269	15.02	0.801
HIT-HP MV-1308-18-100-35	0.273	14.99	0.800
HIT-HP MV-1309-18-100-35	0.284	14.87	0.795
HIT-HP MV-0610-18-100-35	0.262	14.98	0.799
HIT-HP MV-0910-18-100-35	0.276	14.88	0.795
HIT-HP MV-1010-18-100-35	0.281	14.85	0.794
HIT-HP MV-1210-18-100-35	0.290	14.79	0.792
HIT-HP MV-1412-18-100-35	0.316	14.53	0.781

Table A14: Thermal resistance for HIT-HP MV at application condition monolithic masonry, $\lambda = 0.12 \text{ W/(m}\cdot\text{K)}$ acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{\text{si, min}}$ and the corresponding temperature-factor f_{Rsi}

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Thermal resistance
Monolithic masonry ($\lambda = 0.12 \text{ W/(m}\cdot\text{K)}$)

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Thermal resistance for monolithic masonry ($\lambda = 0.12 \text{ W/(m}\cdot\text{K)}$), HIT-SP MV

Type	Ψ in ($\text{W/(m}\cdot\text{K)}$)	$\theta_{\text{si, min}}$ in ($^{\circ}\text{C}$)	f_{Rsi} in (-)
HIT-SP MV-0404-18-100-35	0.142	16.33	0.853
HIT-SP MV-0504-18-100-35	0.147	16.30	0.852
HIT-SP MV-0604-18-100-35	0.151	16.26	0.850
HIT-SP MV-0804-18-100-35	0.160	16.18	0.847
HIT-SP MV-0505-18-100-35	0.159	16.15	0.846
HIT-SP MV-0705-18-100-35	0.168	16.08	0.843
HIT-SP MV-0805-18-100-35	0.172	16.04	0.842
HIT-SP MV-0506-18-100-35	0.170	16.02	0.841
HIT-SP MV-0606-18-100-35	0.175	15.98	0.839
HIT-SP MV-0706-18-100-35	0.180	15.94	0.838
HIT-SP MV-0906-18-100-35	0.188	15.87	0.835
HIT-SP MV-1006-18-100-35	0.193	15.84	0.834
HIT-SP MV-1106-18-100-35	0.197	15.81	0.832
HIT-SP MV-0607-18-100-35	0.186	15.85	0.834
HIT-SP MV-0707-18-100-35	0.191	15.81	0.833
HIT-SP MV-0907-18-100-35	0.199	15.75	0.830
HIT-SP MV-1007-18-100-35	0.204	15.71	0.829
HIT-SP MV-1107-18-100-35	0.208	15.68	0.827
HIT-SP MV-1207-18-100-35	0.212	15.65	0.826
HIT-SP MV-1407-18-100-35	0.220	15.59	0.824
HIT-SP MV-0408-18-100-35	0.187	15.80	0.832
HIT-SP MV-0708-18-100-35	0.201	15.69	0.828
HIT-SP MV-0808-18-100-35	0.206	15.66	0.826
HIT-SP MV-1008-18-100-35	0.214	15.60	0.824
HIT-SP MV-1208-18-100-35	0.222	15.53	0.821
HIT-SP MV-1308-18-100-35	0.226	15.50	0.820
HIT-SP MV-1309-18-100-35	0.236	15.39	0.816
HIT-SP MV-0610-18-100-35	0.216	15.50	0.820
HIT-SP MV-0910-18-100-35	0.229	15.40	0.816
HIT-SP MV-1010-18-100-35	0.234	15.37	0.815
HIT-SP MV-1210-18-100-35	0.242	15.31	0.813
HIT-SP MV-1412-18-100-35	0.267	15.06	0.802

Table A15: Thermal resistance for HIT-SP MV at application condition monolithic masonry, $\lambda = 0.12 \text{ W/(m}\cdot\text{K)}$ acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{\text{si, min}}$ and the corresponding temperature-factor f_{Rsi}

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Thermal resistance
Monolithic masonry ($\lambda = 0.12 \text{ W/(m}\cdot\text{K)}$)

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Thermal resistance for monolithic masonry ($\lambda = 0.08 \text{ W/(m}\cdot\text{K)}$), HIT-HP MV

Type	Ψ in ($\text{W/(m}\cdot\text{K)}$)	$\theta_{\text{si, min}}$ in ($^{\circ}\text{C}$)	f_{Rsi} in (–)
HIT-HP MV-0404-18-100-35	0.186	16.21	0.848
HIT-HP MV-0504-18-100-35	0.192	16.15	0.846
HIT-HP MV-0604-18-100-35	0.197	16.10	0.844
HIT-HP MV-0804-18-100-35	0.207	16.01	0.840
HIT-HP MV-0505-18-100-35	0.207	15.97	0.839
HIT-HP MV-0705-18-100-35	0.217	15.88	0.835
HIT-HP MV-0805-18-100-35	0.222	15.83	0.833
HIT-HP MV-0506-18-100-35	0.220	15.80	0.832
HIT-HP MV-0606-18-100-35	0.226	15.75	0.830
HIT-HP MV-0706-18-100-35	0.231	15.70	0.828
HIT-HP MV-0906-18-100-35	0.241	15.62	0.825
HIT-HP MV-1006-18-100-35	0.246	15.58	0.823
HIT-HP MV-1106-18-100-35	0.251	15.54	0.821
HIT-HP MV-0607-18-100-35	0.239	15.59	0.824
HIT-HP MV-0707-18-100-35	0.244	15.55	0.822
HIT-HP MV-0907-18-100-35	0.254	15.46	0.818
HIT-HP MV-1007-18-100-35	0.259	15.42	0.817
HIT-HP MV-1107-18-100-35	0.263	15.38	0.815
HIT-HP MV-1207-18-100-35	0.268	15.35	0.814
HIT-HP MV-1407-18-100-35	0.277	15.27	0.811
HIT-HP MV-0408-18-100-35	0.240	15.53	0.821
HIT-HP MV-0708-18-100-35	0.256	15.40	0.816
HIT-HP MV-0808-18-100-35	0.261	15.35	0.814
HIT-HP MV-1008-18-100-35	0.271	15.28	0.811
HIT-HP MV-1208-18-100-35	0.280	15.20	0.808
HIT-HP MV-1308-18-100-35	0.284	15.17	0.807
HIT-HP MV-1309-18-100-35	0.295	15.04	0.801
HIT-HP MV-0610-18-100-35	0.273	15.16	0.807
HIT-HP MV-0910-18-100-35	0.288	15.05	0.802
HIT-HP MV-1010-18-100-35	0.292	15.01	0.801
HIT-HP MV-1210-18-100-35	0.301	14.94	0.798
HIT-HP MV-1412-18-100-35	0.329	14.66	0.786

Table A16: Thermal resistance for HIT-HP MV at application condition monolithic masonry, $\lambda = 0.08 \text{ W/(m}\cdot\text{K)}$ acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{\text{si, min}}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Monolithic masonry ($\lambda = 0.08 \text{ W/(m}\cdot\text{K)}$)

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Thermal resistance for monolithic masonry ($\lambda = 0.08 \text{ W/(m}\cdot\text{K)}$), HIT-SP MV

Type	Ψ in ($\text{W/(m}\cdot\text{K)}$)	$\theta_{\text{si, min}}$ in ($^{\circ}\text{C}$)	f_{Rsi} in (–)
HIT-SP MV-0404-18-100-35	0.147	16.69	0.868
HIT-SP MV-0504-18-100-35	0.152	16.64	0.866
HIT-SP MV-0604-18-100-35	0.157	16.60	0.864
HIT-SP MV-0804-18-100-35	0.166	16.51	0.860
HIT-SP MV-0505-18-100-35	0.165	16.48	0.859
HIT-SP MV-0705-18-100-35	0.175	16.39	0.856
HIT-SP MV-0805-18-100-35	0.179	16.35	0.854
HIT-SP MV-0506-18-100-35	0.178	16.32	0.853
HIT-SP MV-0606-18-100-35	0.182	16.28	0.851
HIT-SP MV-0706-18-100-35	0.187	16.24	0.849
HIT-SP MV-0906-18-100-35	0.196	16.16	0.846
HIT-SP MV-1006-18-100-35	0.201	16.12	0.845
HIT-SP MV-1106-18-100-35	0.205	16.08	0.843
HIT-SP MV-0607-18-100-35	0.194	16.13	0.845
HIT-SP MV-0707-18-100-35	0.199	16.09	0.844
HIT-SP MV-0907-18-100-35	0.208	16.01	0.841
HIT-SP MV-1007-18-100-35	0.212	15.98	0.839
HIT-SP MV-1107-18-100-35	0.216	15.94	0.838
HIT-SP MV-1207-18-100-35	0.221	15.90	0.836
HIT-SP MV-1407-18-100-35	0.229	15.84	0.833
HIT-SP MV-0408-18-100-35	0.196	16.08	0.843
HIT-SP MV-0708-18-100-35	0.210	15.96	0.838
HIT-SP MV-0808-18-100-35	0.214	15.92	0.837
HIT-SP MV-1008-18-100-35	0.223	15.84	0.834
HIT-SP MV-1208-18-100-35	0.232	15.77	0.831
HIT-SP MV-1308-18-100-35	0.236	15.74	0.830
HIT-SP MV-1309-18-100-35	0.246	15.61	0.825
HIT-SP MV-0610-18-100-35	0.226	15.73	0.829
HIT-SP MV-0910-18-100-35	0.239	15.63	0.825
HIT-SP MV-1010-18-100-35	0.244	15.59	0.824
HIT-SP MV-1210-18-100-35	0.252	15.53	0.821
HIT-SP MV-1412-18-100-35	0.279	15.24	0.810

Table A17: Thermal resistance for HIT-HP MV at application condition monolithic masonry, $\lambda = 0.08 \text{ W/(m}\cdot\text{K)}$ acc. to Figure 48, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{\text{si, min}}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Monolithic masonry ($\lambda = 0.08 \text{ W/(m}\cdot\text{K)}$)

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Application condition for masonry walls (Figure 49)

Linear thermal transmittance standard „Exterior wall“ section

- $U = 0.227 \text{ W}/(\text{m}^2 \cdot \text{K})$ for insulation thickness t_1 of ETICS of 14 cm
- $U = 0.149 \text{ W}/(\text{m}^2 \cdot \text{K})$ for insulation thickness t_1 of ETICS of 22 cm
- $U = 0.111 \text{ W}/(\text{m}^2 \cdot \text{K})$ for insulation thickness t_1 of ETICS of 30 cm
- Insulation of exterior wall: Thickness $t_1 = 14, 22 \text{ or } 30 \text{ cm}$ ($\lambda = 0.035 \text{ W}/(\text{m} \cdot \text{K})$)
- Exterior wall (lime stone brick): Thickness $t_2 = 24 \text{ cm}$ ($\lambda = 0.99 \text{ W}/(\text{m} \cdot \text{K})$)
- Floor construction (indoor):
 - a) Reinforced concrete slab $h = 16 \text{ cm}$ ($\lambda = 2.3 \text{ W}/(\text{m} \cdot \text{K})$) for shear bars $\varnothing 6$ and $\varnothing 8 \text{ mm}$,
reinforced concrete slab $h = 18 \text{ cm}$ ($\lambda = 2.3 \text{ W}/(\text{m} \cdot \text{K})$) for shear bars $\varnothing 10$ and $\varnothing 12 \text{ mm}$
 - b) Foot-fall insulation 3 cm ($\lambda = 0.035 \text{ W}/(\text{m} \cdot \text{K})$)
 - c) Screed 5 cm ($\lambda = 1.35 \text{ W}/(\text{m} \cdot \text{K})$)
 - d) Edge insulation 1 cm ($\lambda = 0.14 \text{ W}/(\text{m} \cdot \text{K})$)

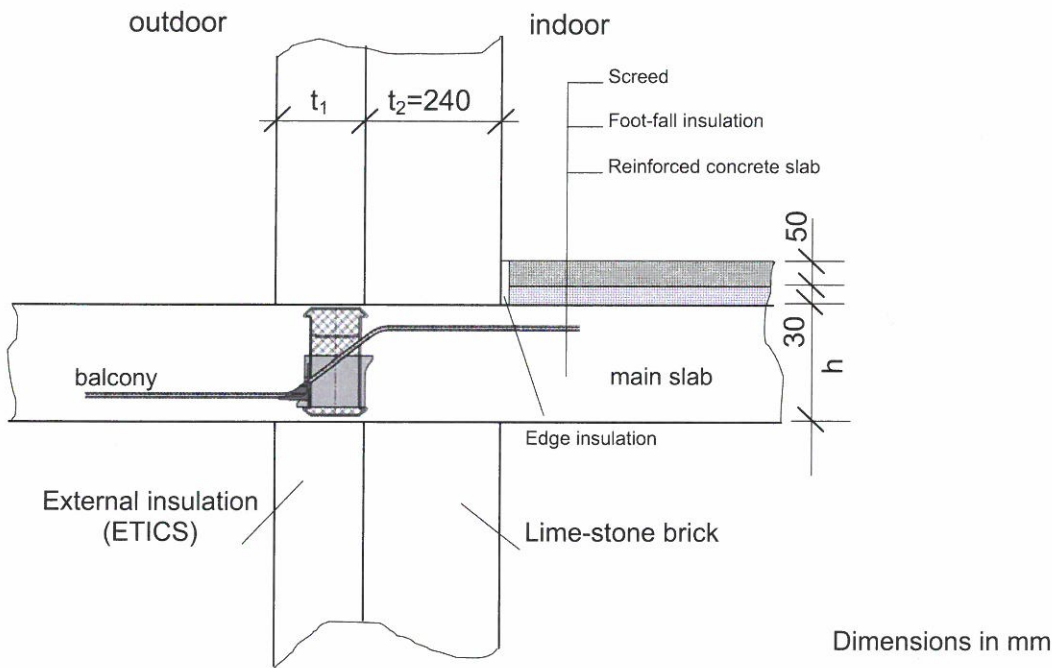


Figure 49: Application condition masonry walls with ETICS

The thermal values of Tables A18 to A20 are valid exclusively for the given application condition, thicknesses and linear thermal transmittances of the construction materials (linear thermal transmittance standard „Exterior wall“ section). Other conditions cause other values.

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Basis

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Thermal resistance for masonry with ETICS ($t_1 = 140$ mm), HIT-HP/-SP ZV

Type	Ψ in (W/(m·K))	$\theta_{si, min}$ in (°C)	f_{Rsi} in (–)
HIT-SP ZV-0404-16-100-30-06	0.095	18.229	0.929
HIT-SP ZV-0604-16-100-30-06	0.099	18.183	0.927
HIT-SP ZV-0804-16-100-30-06	0.103	18.183	0.927
HIT-SP ZV-0404-16-100-30-08	0.101	18.191	0.928
HIT-SP ZV-0604-16-100-30-08	0.108	18.110	0.924
HIT-SP ZV-0804-16-100-30-08	0.115	18.110	0.924
HIT-SP ZV-0404-18-100-30-10	0.109	18.143	0.926
HIT-SP ZV-0604-18-100-30-10	0.119	18.021	0.921
HIT-SP ZV-0804-18-100-30-10	0.129	18.021	0.921
HIT-SP ZV-0404-18-100-30-12	0.117	18.101	0.924
HIT-SP ZV-0604-18-100-30-12	0.132	17.939	0.918
HIT-SP ZV-0804-18-100-30-12	0.147	17.939	0.918
HIT-HP ZV-0404-16-100-30-06	0.148	17.906	0.916
HIT-HP ZV-0604-16-100-30-06	0.152	17.849	0.914
HIT-HP ZV-0804-16-100-30-06	0.157	17.849	0.914
HIT-HP ZV-0404-16-100-30-08	0.155	17.860	0.914
HIT-HP ZV-0604-16-100-30-08	0.163	17.761	0.910
HIT-HP ZV-0804-16-100-30-08	0.171	17.761	0.910
HIT-HP ZV-0404-18-100-30-10	0.161	17.823	0.913
HIT-HP ZV-0604-18-100-30-10	0.175	17.651	0.906
HIT-HP ZV-0804-18-100-30-10	0.190	17.651	0.906
HIT-HP ZV-0404-18-100-30-12	0.171	17.774	0.911
HIT-HP ZV-0604-18-100-30-12	0.190	17.562	0.902
HIT-HP ZV-0804-18-100-30-12	0.209	17.562	0.902

Table A18: Thermal resistance for HIT-HP/-SP ZV at application condition masonry with ETICS ($t_1 = 140$ mm), acc. to Figure 49, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Masonry with ETICS ($t_1 = 140$ mm)

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Thermal resistance for masonry with ETICS ($t_1 = 220$ mm), HIT-HP/-SP ZV

Type	Ψ in (W/(m·K))	$\theta_{si, min}$ in (°C)	f_{Rsi} in (–)
HIT-SP ZV-0404-16-100-30-06	0.120	18.473	0.939
HIT-SP ZV-0604-16-100-30-06	0.124	18.424	0.937
HIT-SP ZV-0804-16-100-30-06	0.128	18.424	0.937
HIT-SP ZV-0404-16-100-30-08	0.127	18.433	0.937
HIT-SP ZV-0604-16-100-30-08	0.134	18.348	0.934
HIT-SP ZV-0804-16-100-30-08	0.141	18.348	0.934
HIT-SP ZV-0404-18-100-30-10	0.136	18.377	0.935
HIT-SP ZV-0604-18-100-30-10	0.142	18.307	0.932
HIT-SP ZV-0804-18-100-30-10	0.148	18.307	0.932
HIT-SP ZV-0404-18-100-30-12	0.145	18.331	0.933
HIT-SP ZV-0604-18-100-30-12	0.155	18.227	0.929
HIT-SP ZV-0804-18-100-30-12	0.165	18.227	0.929
HIT-HP ZV-0404-16-100-30-06	0.161	18.223	0.929
HIT-HP ZV-0604-16-100-30-06	0.172	18.090	0.924
HIT-HP ZV-0804-16-100-30-06	0.183	18.090	0.924
HIT-HP ZV-0404-16-100-30-08	0.168	18.181	0.927
HIT-HP ZV-0604-16-100-30-08	0.182	18.005	0.920
HIT-HP ZV-0804-16-100-30-08	0.197	18.005	0.920
HIT-HP ZV-0404-18-100-30-10	0.180	18.109	0.924
HIT-HP ZV-0604-18-100-30-10	0.201	17.861	0.914
HIT-HP ZV-0804-18-100-30-10	0.222	17.861	0.914
HIT-HP ZV-0404-18-100-30-12	0.189	18.061	0.922
HIT-HP ZV-0604-18-100-30-12	0.215	17.775	0.911
HIT-HP ZV-0804-18-100-30-12	0.240	17.775	0.911

Table A19: Thermal resistance for HIT-HP/-SP ZV at application condition masonry with ETICS ($t_1 = 220$ mm), acc. to Figure 49, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Masonry with ETICS ($t_1 = 220$ mm)

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Thermal resistance for masonry with ETICS ($t_1 = 300$ mm), HIT-HP/-SP ZV

Type	Ψ in (W/(m·K))	$\theta_{si, min}$ in (°C)	f_{Rsi} in (-)
HIT-SP ZV-0404-16-100-30-06	0.137	18.576	0.943
HIT-SP ZV-0604-16-100-30-06	0.143	18.507	0.940
HIT-SP ZV-0804-16-100-30-06	0.149	18.507	0.940
HIT-SP ZV-0404-16-100-30-08	0.144	18.536	0.941
HIT-SP ZV-0604-16-100-30-08	0.153	18.428	0.937
HIT-SP ZV-0804-16-100-30-08	0.162	18.428	0.937
HIT-SP ZV-0404-18-100-30-10	0.153	18.482	0.939
HIT-SP ZV-0604-18-100-30-10	0.165	18.339	0.934
HIT-SP ZV-0804-18-100-30-10	0.177	18.339	0.934
HIT-SP ZV-0404-18-100-30-12	0.163	18.430	0.937
HIT-SP ZV-0604-18-100-30-12	0.180	18.245	0.930
HIT-SP ZV-0804-18-100-30-12	0.196	18.245	0.930
HIT-HP ZV-0404-16-100-30-06	0.168	18.384	0.935
HIT-HP ZV-0604-16-100-30-06	0.185	18.187	0.927
HIT-HP ZV-0804-16-100-30-06	0.201	18.187	0.927
HIT-HP ZV-0404-16-100-30-08	0.174	18.346	0.934
HIT-HP ZV-0604-16-100-30-08	0.195	18.102	0.924
HIT-HP ZV-0804-16-100-30-08	0.215	18.102	0.924
HIT-HP ZV-0404-18-100-30-10	0.187	18.272	0.931
HIT-HP ZV-0604-18-100-30-10	0.211	17.993	0.920
HIT-HP ZV-0804-18-100-30-10	0.235	17.993	0.920
HIT-HP ZV-0404-18-100-30-12	0.196	18.230	0.929
HIT-HP ZV-0604-18-100-30-12	0.224	17.907	0.916
HIT-HP ZV-0804-18-100-30-12	0.253	17.907	0.916

Table A20: Thermal resistance for HIT-HP/-SP ZV at application condition masonry with ETICS ($t_1 = 300$ mm), acc. to Figure 49, linear thermal transmittance Ψ , the lowest temperature at the inner surface of the construction $\theta_{si, min}$ and the corresponding temperature-factor f_{Rsi}

Halfen Insulated Connection HIT-HP and -SP

Thermal resistance
Masonry with ETICS ($t_1 = 300$ mm)

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Impact sound insulation according to EN ISO 10140

HIT unit	Weighted normalized impact sound pressure level difference $\Delta L_{n,w}$ in (dB)
HIT-HP MV-0504-18-100-35	12
HIT-HP MV-0705-18-100-35	11
HIT-HP MV-1207-18-100-35	11
HIT-SP MV-0504-18-100-35	14
HIT-SP MV-0705-18-100-35	15
HIT-SP MV-1208-18-100-35	10

Table A21: Weighted normalised impact sound pressure level difference $\Delta L_{n,w}$ in (dB) derived from laboratory tests

HIT unit	Weighted normalized impact sound pressure level difference $\Delta L_{n,w}$ in (dB)
HIT-HP ZV-0504-18-100-30-12	12
HIT-HP ZV-0705-18-100-30-12	11
HIT-HP ZV-1207-18-100-30-12	11
HIT-SP ZV-0504-18-100-30-12	14
HIT-SP ZV-0705-18-100-30-12	15
HIT-SP ZV-1208-18-100-30-12	10

Table A22: Weighted normalised impact sound pressure level difference $\Delta L_{n,w}$ in (dB) derived from laboratory tests

Halfen Insulated Connection HIT-HP and -SP

Impact sound insulation

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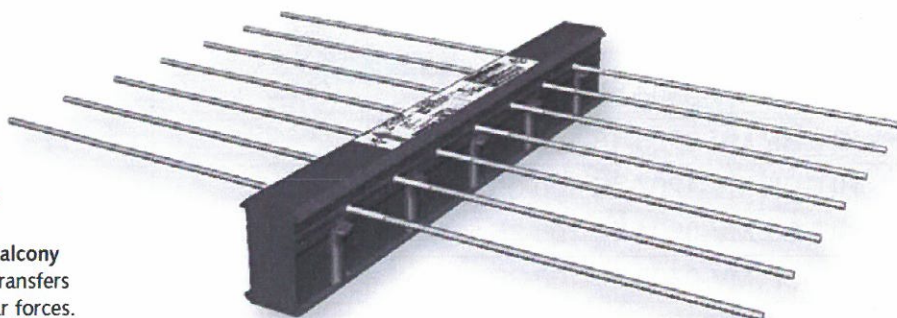
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HIT-HP MV/HIT-SP MV

One-piece type

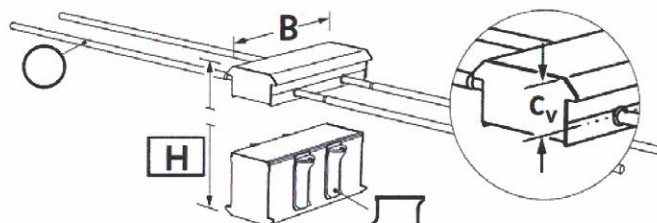
HIT-HP MV and HIT-SP MV
 Insulated Connections.
 For cantilevered concrete balcony
 and corner balcony slabs, transfers
 bending moments and shear forces.



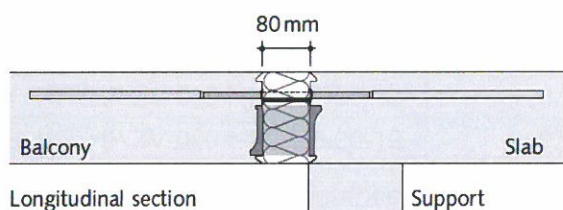
HIT-HP MV-ES/HIT-SP MV-ES

Multiple-part type

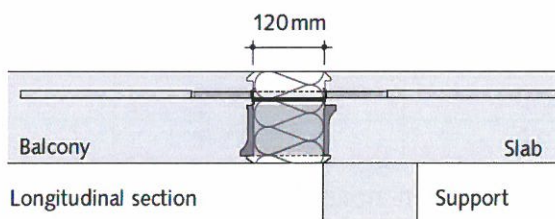
HIT unit for cantilevered balcony and corner balcony slabs designed as element slab,
 transfers bending moments and shear forces.



HIT-HP MV – High Performance



HIT-SP MV – Superior Performance



Example of an order:

HIT-HP MV - 06 04 - 20 - 100 - 35

Type _____
 Load type _____
 No. of tension bars _____
 No. of compression shear bearings _____
 Element height [cm] _____
 Element width [cm] _____
 Concrete cover [mm] _____

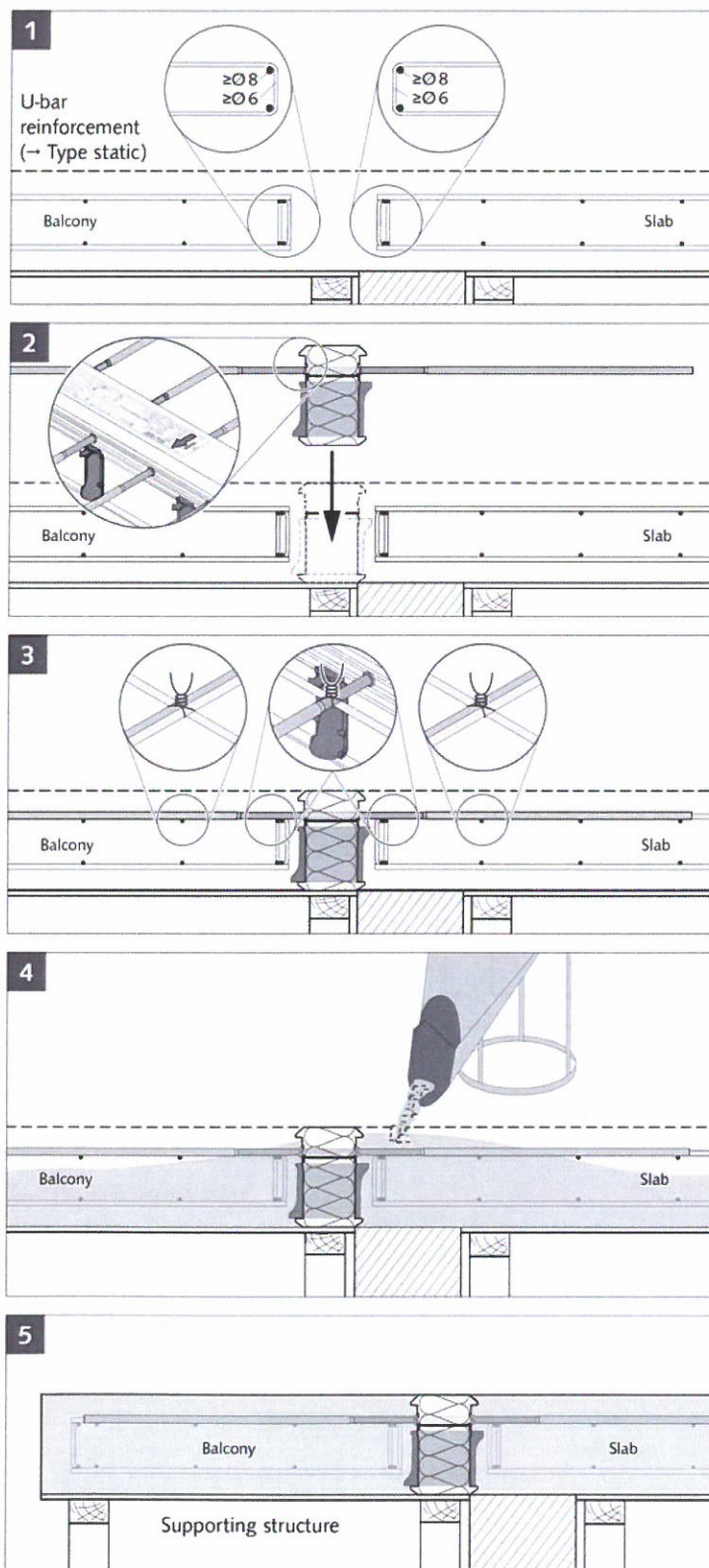
Halfen Insulated Connection HIT-HP and -SP

Assembly instructions

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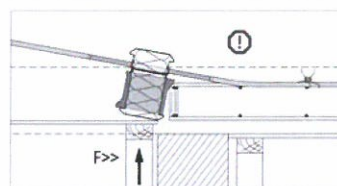


1 Installation of on-site reinforcement

⚠ The on-site reinforcement must be placed as specified by the structural engineer.

2 Installation of HIT unit from top

⚠ Check that the red arrows on the HIT labels and the compression shear bearings are pointing towards the balcony.



⚠ Correct position of formwork should be respected!

3 Fixing of HIT tension bars to on-site reinforcement using tying wire

4 Pouring the concrete

⚠ To ensure the HIT units are not displaced, pour and compact the concrete evenly. Ensure all HIT elements are securely positioned.

5 Freshly concreted balcony slab on supporting structure

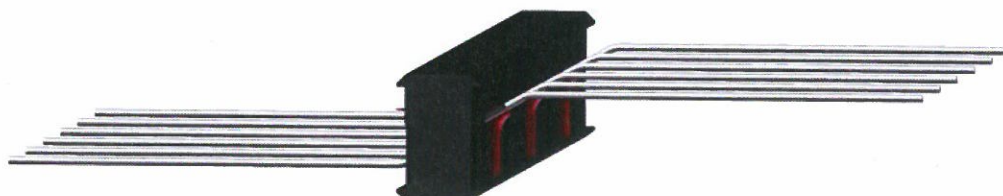
Dimensions in mm

Halfen Insulated Connection HIT-HP and -SP
Assembly instructions

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HIT-HP ZV/HIT-SP ZV

The slab connection Halfen Insulated Connection HIT-HP ZV/HIT-SP ZV serves to transfer only shear forces.



Example of an order:

HIT-HP ZV-0604-20-100-30-08

Type	_____
Load type	_____
No. of shear bars	_____
No. of compression shear bearings	_____
Element height [cm]	_____
Element width [cm]	_____
Concrete cover [mm]	_____
Diameter of the shear bars	_____

Halfen Insulated Connection HIT-HP and -SP

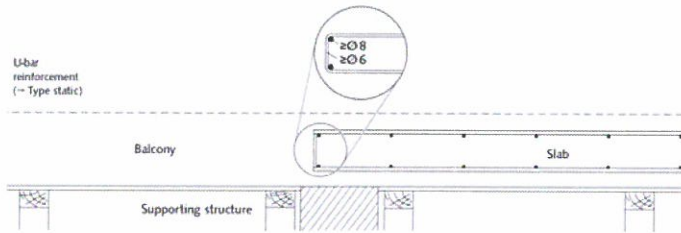
Assembly instructions

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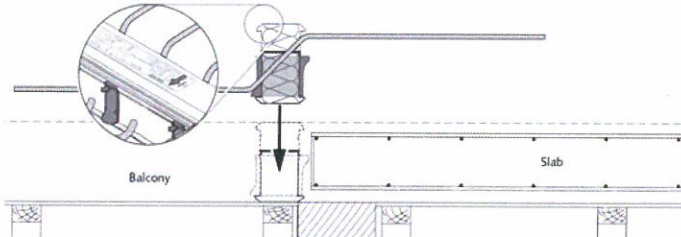
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1. Installation of on-site reinforcement of the main slab



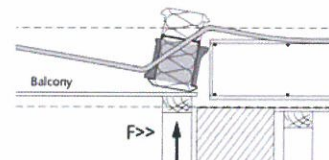
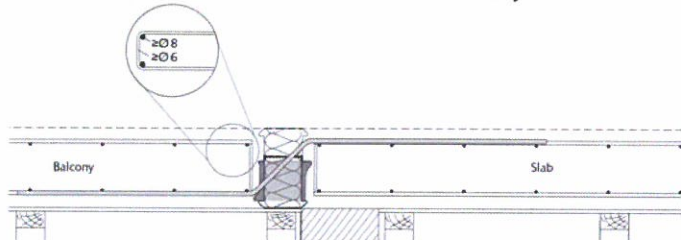
! The on-site reinforcement must be placed as specified by the structural engineer.

2. Installation of the HIT



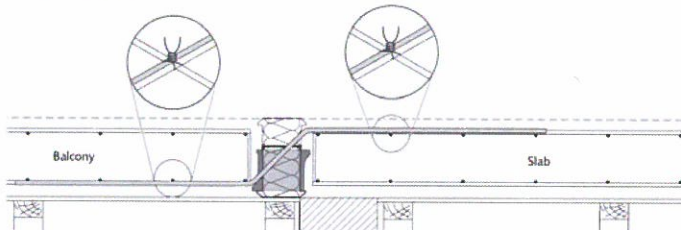
! Check that the red arrows on the HIT labels and the compression shear bearings are pointing towards the balcony.

3. Installation of on-site reinforcement of the balcony

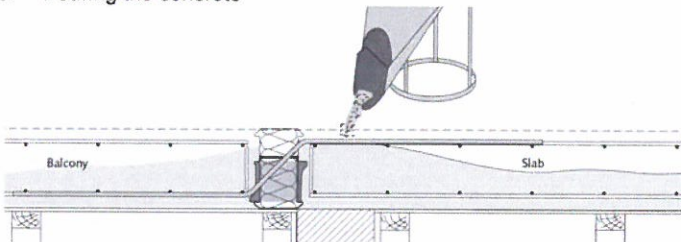


! Correct position of formwork should be respected!

4. Fixing of HIT diagonal tension bars to on-site reinforcement using tying wire

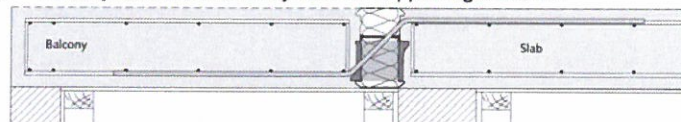


5. Pouring the concrete



! To ensure the HIT units are not displaced, pour and compact the concrete evenly. Ensure all HIT elements are securely positioned.

6. Freshly concreted balcony slab on supporting structure



Dimensions in mm

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CUAP 03.01/59, 2013	Load bearing thermal insulation elements which form a thermal break between balconies and internal floors		
EN 206-1, 2000 EN 206-1/A1, 2004 EN 206-1/A2, 2005	Concrete – Part 1: Specification, performance, production and conformity		
EN 1992-1-1, 2004 EN 1992-1-1/AC, 2010	Eurocode 2 – Design of concrete structures – Part 1-1: General rules and rules for buildings		
EN 13501-1+A1, 2009	Fire classification of construction products and building elements – Part 1: Classification using data from reaction to fire tests		
EN ISO 6946, 2007	Building components and building elements – Thermal resistance and thermal transmittance – Calculation method (ISO 6946:2007)		
EN ISO 10140	Acoustics – Laboratory measurement of sound insulation of building elements		
EN ISO 10211, 2007	Thermal bridges in building construction – Heat flows and surface temperatures – Detailed calculations (ISO 10211:2007)		
<table border="1"> <tr> <td> Halfen Insulated Connection HIT-HP and -SP Reference documents </td><td> Annex 12 Page 1/1 of European technical approval ETA-13/0546 </td></tr> </table>		Halfen Insulated Connection HIT-HP and -SP Reference documents	Annex 12 Page 1/1 of European technical approval ETA-13/0546
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