

TECHNICAL INFORMATION – FEBRUARY 2022

# Tronsole® – systematic impact sound insulation



System solution for effective impact sound insulation in staircases with the highest levels of sound insulation.



## Planning and consulting service

The engineers of Schöck's application engineering department would be very happy to advise you on static, structural and building-physics questions and will produce for you proposals for your solution with calculations and detailed drawings. For this please send your planning documentation (general arrangements, sections, static data) with the address of the building project to:

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## Notes | Symbols

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### **Elodur® elastomer support**

Depending on the static level of usage a deflection of the Elodur® elastomer support of some 3 mm, but maximum 5 mm, is allowed. In addition, diagrams and notes on the deflection in this Technical Information are to be observed

## Tags

### **Hazard note**

The yellow triangle with the exclamation mark indicates a hazard note. This means there is a danger to life and limb if compliance is not observed.

### **Info**

The square with “i” indicates important information which must be read in conjunction with the design.

### **Check list**

The square with tick indicates the check list. Here the essential points of the design are summarised.

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T

F

Q

P

Z

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D

L

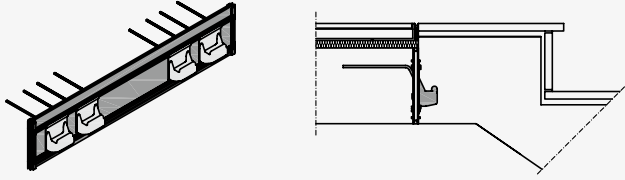
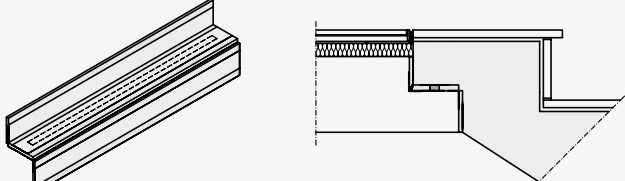
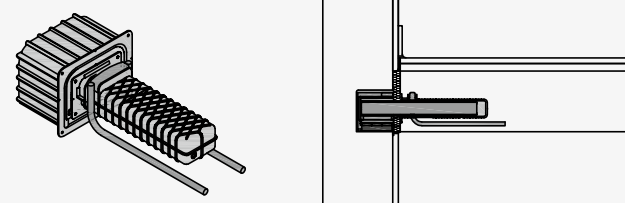
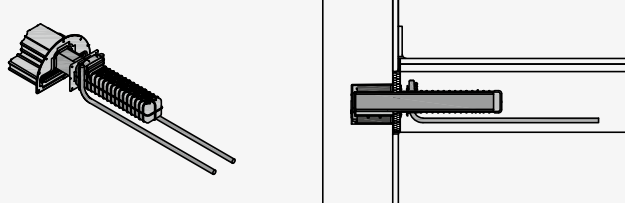
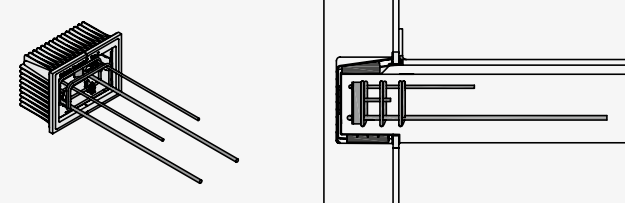
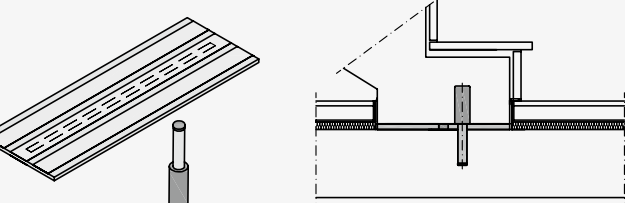


## Summary of types

| Connection      | to         | Construction method  | Type  |
|-----------------|------------|--|-------|
| Straight flight | Landing    | In-situ concrete or precast stair flight; for acoustic insulation in the stair flight/landing joint without cantilever support | T     |
|                 |            | Precast flight; for acoustic insulation in the joint stair flight/landing with cantilever support                              | F     |
|                 | Floor slab |  | B, D  |
|                 | Wall       |  | L     |
| spiral flight   | Landing    | In-situ concrete or precast stair flight; for acoustic insulation in the stair flight/landing joint without cantilever support | T     |
|                 |            | Precast flight; for acoustic insulation in the joint stair flight/landing with cantilever support                              | F     |
|                 | Floor slab |  | B, D  |
|                 | Wall       |  | Q + L |
| Landing         | Wall       | In-situ concrete or precast landings; for sound insulation in landing/wall expansion joints without corbels                    | P + L |
|                 |            | In-situ concrete or precast landings; for sound insulation in landing/wall expansion joints with corbels                       | Z + L |

|        |
|--------|
| T      |
| F      |
| Q      |
| P      |
| Z      |
| B<br>D |
| L      |

## Summary of types

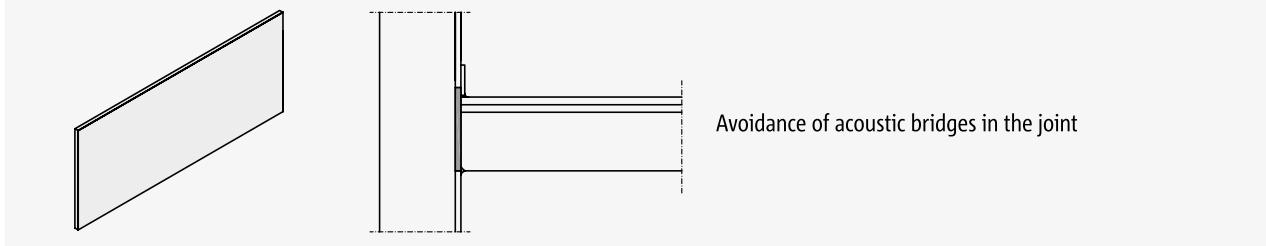
|   |  |
|---|--|
| Schöck Tronsole® type T   | Page 36  |
|    | <p>T-V8: <math>\Delta L_{n,w}^* \geq 29</math> dB; T-V2: <math>\Delta L_{n,w}^* \geq 33</math> dB;<br/>                     T-V8: <math>\Delta L_{w,flight}^* \geq 25</math> dB; T-V2: <math>\Delta L_{w,flight}^* \geq 28</math> dB;<br/>                     DIBt approval; fire-resistance class R 90</p> |
| Schöck Tronsole® type F   | Page 68  |
|    | <p>F-V2: <math>\Delta L_{n,w}^* \geq 30</math> dB; F-V1: <math>\Delta L_{n,w}^* \geq 32</math> dB;<br/>                     F-V2: <math>\Delta L_{w,flight}^* \geq 26</math> dB; F-V1: <math>\Delta L_{w,flight}^* \geq 28</math> dB;<br/>                     fire-resistance class R 90</p>                |
| Schöck Tronsole® type Q   | Page 90  |
|   | <p><math>\Delta L_{n,w}^* \geq 30</math> dB; <math>\Delta L_{w,landing}^* \geq 28</math> dB; DIBt approval; fire-resistance class R 90; rotating supporting member</p>   |
| Schöck Tronsole® Type P   | Page 126   |
|  | <p><math>\Delta L_{n,w}^* \geq 31</math> dB; <math>\Delta L_{w,landing}^* \geq 27</math> dB; DIBt approval; fire-resistance class R 90</p>   |
| Schöck Tronsole® type Z   | Page 166   |
|  | <p><math>\Delta L_{n,w}^* \geq 27</math> dB; <math>\Delta L_{w,landing}^* \geq 24</math> dB; fire-resistance class R 90</p>  |
| Schöck Tronsole® type B, D  | Page 190   |
|  | <p>B-V2: <math>\Delta L_{n,w}^* \geq 30</math> dB; B-V1: <math>\Delta L_{n,w}^* \geq 32</math> dB;<br/>                     B-V2: <math>\Delta L_{w,flight}^* \geq 26</math> dB; B-V1: <math>\Delta L_{w,flight}^* \geq 28</math> dB;<br/>                     optional dowel for structural stability</p>   |



## Summary of types

Schöck Tronsole® type L

Page 214



T

F

Q

P

Z

B  
D

L

## Soundproofing systems with Schöck Tronsole®

With the Schöck Tronsole® types, various soundproofing systems can be realised depending on the design requirement. The installation of the Schöck Tronsole® enables freedom from acoustic bridges over all subsections from the shell up to the completion of the building.

The diagram below shows examples of different variants:

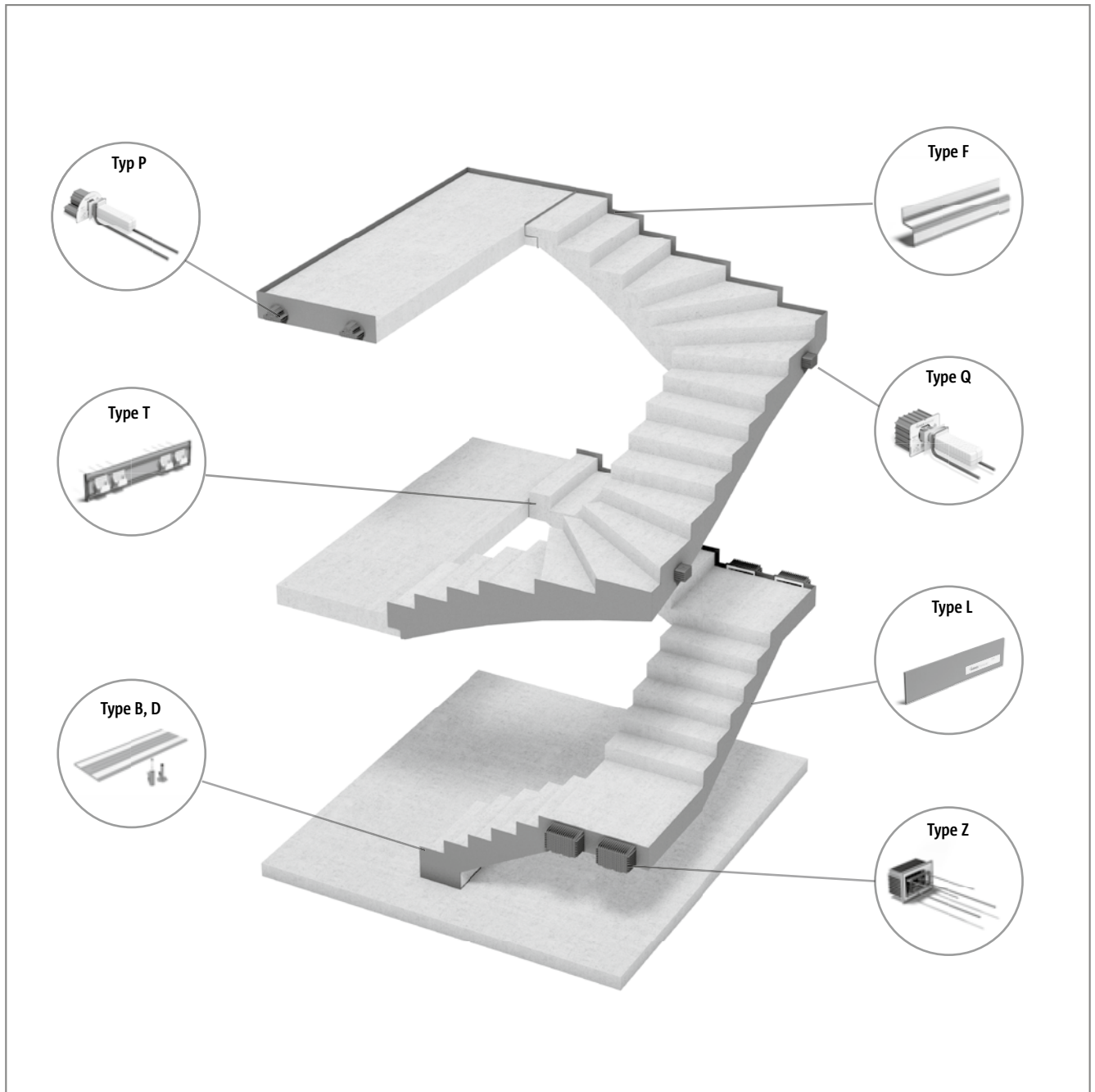


Fig. 1: Sound-insulation system made using Schöck Tronsole®

## Soundproofing systems with Schöck Tronsole®

### Soundproofing system for stair flights using Schöck Tronsole® types T, L and Q

Spiral stairs between the main landings are supplemented through the combination of the Schöck Tronsole® types T, L and Q into a soundproofing system, which realises the sound insulation of the stair flights without intermediate landing. At storey height the Tronsole® type T enables the sound insulation and force transmission in the stairs/main landing joint without concrete cantilever support. With the use of precast stairways and concrete cantilever supports on the main landings, the Tronsole® type T can be replaced by the type F.

A floating floor screed is planned as impact soundproofing measure on the foundation slab and main landings.

Acoustic bridge-free through separation:

- ▶ Flight support/wall using type Q
- ▶ Flight support/wall using type T

Structure sound bridges in form of small stones, concrete or mortar residues in the joint can be avoided through separation:

- ▶ Flight/wall using type L

### Sound-insulation system for precast concrete flights of stairs using Schöck Tronsole® Types B, D, L, P and F

This system uses a combination of Schöck Tronsole® Types B, D, L, P and F to acoustically decouple stairs and intermediate landings with straight flights of stairs between main and intermediate landings. The stairs are mounted on elastic bearings on the intermediate landings (optional: Tronsole® Type F). The intermediate landings are precast units that are decoupled acoustically and statically and installed using Tronsole® Type P. At floor height, Tronsole® Type F is used for acoustic decoupling and force transfer in the stair/main landing expansion joint with concrete corbel supports. Alternatively, Tronsole® Type F can be replaced by type T for the main landing. This alters the construction sequence because type T is concreted into the main landing. The concrete corbel bearings are no longer needed.

A floating screed is installed on the floor slab and main landing as an insulation measure to prevent the propagation of impact sound. Alternatively, the main landings can be decoupled using Tronsole® Type P, meaning that a floating screed is no longer needed.

Decoupled joints free from acoustic bridges:

- ▶ Stair/floor slab using Type B (optional: Type D)
- ▶ Landing support/wall using Type P
- ▶ Stair/main landing using Type F

Decoupling prevents the formation of structure-borne sound bridges in the form of small stones, concrete or mortar residues in the joints:

- ▶ Stair/wall and landing/wall using Type L

### **Sound-insulation system for precast concrete stairs with Schöck Tronsole® Types B, D, L, P and F**

This system uses a combination of Schöck Tronsole® Types B, D, L, Z and F to acoustically decouple stairs and intermediate landings with straight flights of stairs between main and intermediate landings. The stair flights and landings are monolithic. At floor height, Tronsole® Type F is used for acoustic decoupling and force transfer in the stair/main landing expansion joint with concrete corbel supports. Alternatively, Tronsole® Type F can be replaced by type T for the main landing. This alters the construction sequence because type T is concreted into the main landing. The concrete corbel bearings are no longer needed.

A floating screed is installed on the floor slab and main landing as an insulation measure to prevent the propagation of impact sound. Alternatively, the main landings can be decoupled using Tronsole® Type Z, meaning that a floating screed is no longer needed.

Decoupled joints free from acoustic bridges:

- ▶ Stair/floor slab using Type B (optional: Type D)
- ▶ Landing support/wall using Type Z
- ▶ Stair/main landing using Type F

Decoupling prevents the formation of structure-borne sound bridges in the form of small stones, concrete or mortar residues in the joints:

- ▶ Stair/wall and landing/wall using Type L

## Tronsole® building acoustics



## Impact sound protection parameters

|  |  |
|--|--|
| $L_{n,w}$  | Rated standard impact sound pressure level: Single-number ratings of the impact sound pressure level in the test rig, without flanking sound transmission paths, based on a reference absorption area of $A_0 = 10 \text{ m}^2$ . Stated in decibels   |
| $L'_{n,w}$                                       | Rated standard impact sound pressure level in the building: Single-number ratings of the impact sound pressure level of a floor in the building, taking into account all possible sound transmission paths, based on a reference absorption area of $A_0 = 10 \text{ m}^2$ . Stated in decibels  |
| $L'_{nT,w}$                                      | Rated standard impact sound pressure level in the building: Single-number ratings of the impact sound pressure level of a floor in the building, based on the results of measurements in 1/3 octave band and the determined standard impact sound pressure level over a reference reverberation time of $T_0 = 0.5 \text{ s}$ . Stated in decibels |
| $L_{n,eq,0,w}$                                   | Equivalent rated standard impact sound pressure level. Stated in decibels  |
| $\Delta L_{w,DIN7396}^*$                         | Rated impact sound pressure level difference according to DIN 7396. Stated in decibels   |
| $\Delta L_{n,w}^*$                               | Rated impact sound pressure level difference tested according to DIN 7396: impact sound insulation improvement achieved by an impact sound insulating element. Stated in decibels  |
| $\Delta L_{w,Landing}^* / \Delta L_{w,flight}^*$ | Rated impact sound pressure level difference tested according to DIN 7396: impact sound insulation improvement achieved by an impact sound insulating element. Stated in decibels  |
| $\Delta L_{w,Landing} / \Delta L_{w,flight}$     | Rated impact sound pressure level decrease according to DIN 7396: overall impact sound insulation improvement of the stair landing/flight using an impact sound insulation element and taking into account the junction of the landing to the wall or of the stair to the landing. Stated in decibels  |
| $k$  | Coverage factor according to DIN 4109-2  |
| $u_{Prog}$                                       | Safety factor regarding the uncertainty of the prediction (DIN 4109, January 2018). Stated in decibels   |
| $L_{n,w,Landing}$                                | Rated standard landing impact sound pressure level of the decoupled stair landing: impact sound pressure level determined by a standard measurement taken in the room in question when the stair landing connected with the wall is stimulated. Stated in decibels   |
| $L_{n,w,flight}$                                 | Rated standard stair impact sound pressure level of the decoupled stair flight: impact sound pressure level determined by a standard measurement taken in the room in question when the stair flight connected with the landing is stimulated. Stated in decibels  |
| $L_{n0,w,wall}$                                  | Rated standard wall impact sound pressure level of the wall: impact sound pressure level determined by a standard measurement taken in the room in question when the wall is stimulated. Stated in decibels  |
| $L_{n0,w,Landing}$                               | Rated standard landing impact sound pressure level of the stair landing set in concrete: impact sound pressure level determined by a standard measurement taken in the room in question if the stair landing is rigidly set in concrete in the wall and is stimulated. Stated in decibels  |

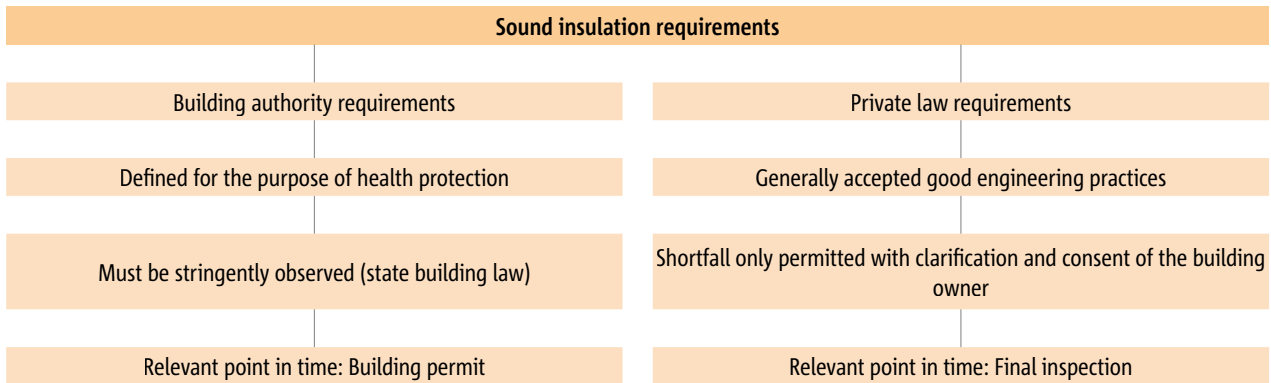
$L_{n0,w,flight}$ 

Rated standard stair impact sound pressure level of the stair flight set in concrete: impact sound pressure level determined by a standard measurement taken in the room in question if the stair flight is rigidly set in concrete in the wall and is stimulated. Stated in decibels

# Requirements

## Impact sound insulation requirements

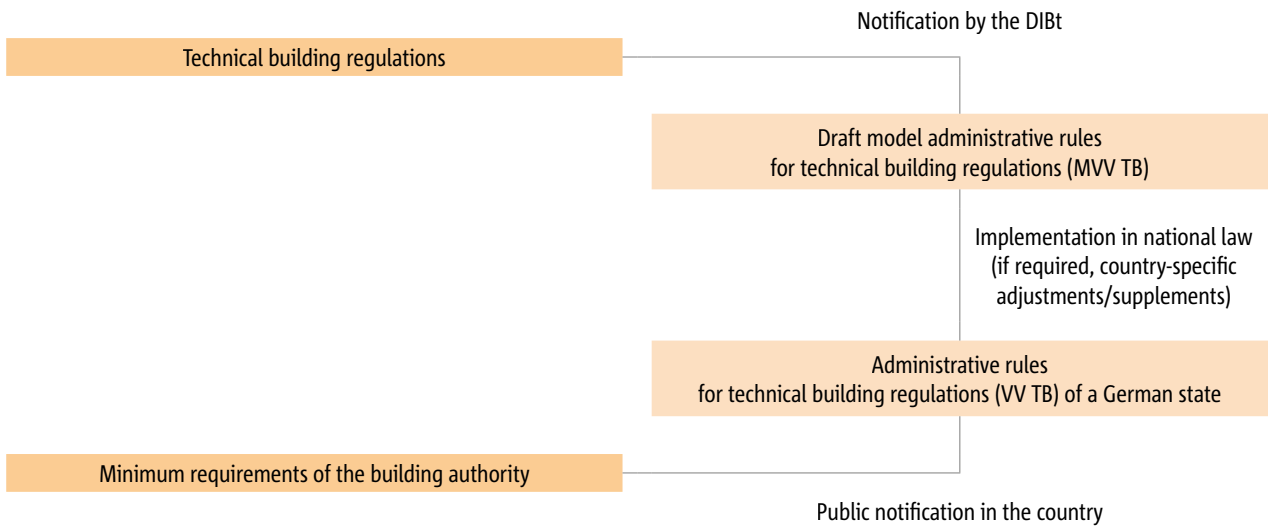
The structural designs of buildings must meet specific acoustic insulation requirements. This is intended to protect the residents from harmful noise levels, for example in areas adjacent to stairwells in apartment buildings.



Summary of sound insulation requirements

## Building authority requirements

Building authorities issue minimum approval requirements to protect residents from harmful noise and these must always be complied with. These are defined in DIN 4109 “Sound insulation in building construction”. They ensure that the occupants are protected from unacceptable conditions due to noise transmission when inside the building. These requirements must not be fallen short of even if the building owner were to be in agreement. The observation of the building authority requirements is prerequisite for the building permit being issued.



Development of technical building regulations concerning minimum requirements for general building authority approval



# Requirements

## Private law requirements

Private law requirements must also be complied with in addition to the building authority requirements. These are the responsibility of the building owner. They require no explicit agreement and are automatically applicable. [2]

Regarding the private law requirements, the German Federal Court of Justice (BGH) writes: “The requisite sound insulation is determined by the interpretation of the contract” [1] [2]. “The expectations regarding sound insulation quality expressed in the contract are applicable” [2]. The fact that building owners usually have no knowledge of sound insulation measures and their significance must be taken into account. Therefore, the quality requirements are not only determined by the contractual text, but also by explanatory and defining statements, other contractually agreed circumstances, specific proportions and circumstances of the building, layout quality, architectural aspirations and the assigned purpose of the building. These frequently result in requirements that clearly exceed the minimum requirements and it is reasonable to assume a higher level of sound insulation than those stipulated by DIN 4109. [2]

If the user can expect a usual standard of quality and comfort and has also agreed these, they can also expect the same from the sound insulation employed. [2]

According to a judgement of the German Federal Supreme Court (BGH), sound insulation, as recognised rule of engineering, must be considered a usual comfort. In the view of the BGH, this corresponds to a sound insulation quality that generally provides the residents with peace and quiet. However, there is currently still no conclusive judgement stipulating the precise values legally required by generally accepted good engineering practices. Nevertheless, guidelines are available.

In October 2016, the German Federal Gazette (Bundesanzeiger) wrote that many BGH judgements confirm that DIN 4109, compiled in 1989, no longer represents the generally accepted good engineering practices for sound insulation in residential buildings and that supplement 2 of DIN 4109 must be adhered to as a minimum requirement. In addition, the Federal Gazette points out that the requirements stipulated in DIN 4109, compiled in 2016, only apply in simple and inexpensive housing (student hostels, refugee accommodation and housing for socially deprived tenants). In this case, to protect the contractor, an appropriate note must be incorporated in the building contract stating that “only the minimum sound insulation according to DIN 4109 is required and this falls short of the usual quality, such as those used in normal owner-occupied buildings”. Furthermore, the building documents must be checked by the contractor and any concerns reported in case of doubt. The notification of concerns secures the contractor against liability claims as the transition between lower-quality and upscale residential construction is fluid.

As the generally accepted good engineering practices for approval of the construction work are not known at the time of planning, it is advisable for the level of sound insulation desired by the building owner to be agreed contractually between building owner and planner. To cover this difference, the agreement must be more stringent than the generally accepted good engineering practices recognised on the day. If no contractual agreement for sound insulation is in place, the generally accepted good engineering practices are the minimum requirement under private law.

Various directives are available as a basis for contractual agreements of desired sound insulation (such as DIN 4109-5, supplement 2 to DIN 4109, VDI 4100 and DEGA sound insulation certificate). Even with sound insulation regulated in this way, the generally accepted good engineering practices may only be fallen short of in exceptional cases and only following detailed explanation of the consequences by the building owner.

The requirements for upscale residential construction are higher than the generally accepted good engineering practices. A discernible improvement is expected. In a judgement, the BGH defined a discernible improvement as being a marked enhancement of sound insulation amounting to multiple decibels [2]. It is assumed that in such cases the requirements are heading towards sound-insulation level III stipulated by the VDI 4100 regulation.

- ▶ [1] BGH judgement dated 14 May 1998 - VII ZR 184/97
- ▶ [2] BGH judgement dated 14 June 2007 - VII ZR 45/06

## Requirements

### Private law requirements in comparison

The following tables show an overview of feasible sound insulation levels for stairs in apartment buildings, terraced houses and semi-detached houses that can be contractually agreed in line with current directives. The minimum technical requirements are also given for reasons of comparison.

| $L'_{n,w}$   | DEGA              |                        | VDI 4100                   |                            | DIN 4109-1/-5                         | DIN 4109 supplement 2 (1989) |
|--------------|-------------------|------------------------|----------------------------|----------------------------|---------------------------------------|------------------------------|
|              | Class             | Walking noises are ... | Class                      | Walking noises are ...     |                                       |                              |
| $\leq 33$ dB | A*                | Inaudible              |                            |                            |                                       |                              |
| $\leq 39$ dB | A ( $\leq 38$ dB) | Inaudible              | Sound insulation level III | Not intrusive              |                                       |                              |
| $\leq 43$ dB | B                 | Still audible          |                            |                            |                                       |                              |
| $\leq 46$ dB | C ( $\leq 48$ dB) | Audible                | Sound insulation level II  | Generally not intrusive    | Stricter requirements ( $\leq 47$ dB) | Stricter requirement         |
| $\leq 53$ dB | D                 | Clearly audible        | Sound insulation level I   | Generally barely intrusive | Minimum requirement                   |                              |
| $\leq 58$ dB |                   |                        |                            |                            |                                       |                              |

Sound-insulation levels for stairs in apartment buildings

| $L'_{n,w}$   | DEGA              |                        | VDI 4100                  |                        | DIN 4109-1/-5                         | DIN 4109 supplement 2 (1989) |
|--------------|-------------------|------------------------|---------------------------|------------------------|---------------------------------------|------------------------------|
|              | Class             | Walking noises are ... | Class                     | Walking noises are ... |                                       |                              |
| $\leq 33$ dB | A*                | Inaudible              | SSt III ( $\leq 32$ dB)   | No details             |                                       |                              |
| $\leq 39$ dB | A ( $\leq 38$ dB) | Generally inaudible    | Sound insulation level II | No details             |                                       |                              |
| $\leq 43$ dB | B                 | Still audible          |                           |                        | Stricter requirements ( $\leq 41$ dB) |                              |
| $\leq 46$ dB | C ( $\leq 48$ dB) | Audible                | Sound insulation level I  | No details             | Minimum requirement                   | Stricter requirement         |
| $\leq 53$ dB |                   |                        |                           |                        |                                       |                              |

Sound-insulation levels for stairs in terraced and semi-detached housing

### **i** Note:

The requirements for stairs in semi-detached and terraced houses in line with VDI 4100 are taken from the 2012 edition. In this edition of the guideline, the requirements are given as rated standard impact sound pressure levels. To simplify the table, the rated standard impact sound pressure level was taken to be the same as the rated standard impact sound pressure level. This is true for a reception room with a volume of approx. 32 m<sup>3</sup>. Therefore, the application of VDI 4100 to semi-detached and terraced houses must be examined on a case-by-cases basis.

## Requirements

### **DIN 4109-5 “Sound insulation in building construction– Part 5: Increased requirements”**

DIN 4109-5:2020-08 defines the stricter sound insulation requirements and replaces DIN 4109 supplement 2:1989-11 and DIN SPEC 91314:2017-01.

Part 5 stipulates a rated standard impact sound pressure level of  $L'_{n,w} \leq 47$  dB for stairs in apartment buildings. This is only a minor change when compared to supplement 2. On the other hand, the requirements for stairs in semi-detached and terraced houses are tightened by 5 dB to  $L'_{n,w} \leq 41$  dB. This increase means that the requirements are again more stringent, being perceptibly better than the minimum requirements ( $L'_{n,w} \leq 46$  dB).

## Testing according to DIN 7396

### Test procedures according to DIN 7396

DIN 7396 describes the test procedure of the “Tests in building acoustics – Test methods for the acoustical characterization of isolating elements for heavy stairs”. In Europe it is the first standard which defines a measurement procedure for impact sound insulation elements and enables a comparability of products. The checks take place using standard building loads and stair geometry. In addition, complete stair flights and landings are checked so that noise transfer via the load-bearing elements and also via the joints is taken into account. With this the system “Stairs” is checked and is comparable with the installed situation in the building. In the system the transmission via the joint panels is also taken into account. If this is forgotten with the check, this can cause an audible deterioration in the building.

In the procedure according to DIN 7396 three characteristic values are determined per impact sound insulation element:

- ▶ Landing or flight impact sound pressure difference level  $\Delta L_{\text{Landing}}^*$  or  $\Delta L_{\text{Flight}}^*$
- ▶ Landing or flight impact sound pressure level reduction  $\Delta L_{\text{Landing}}$  or  $\Delta L_{\text{Flight}}$
- ▶ Weighted standard impact sound pressure level in the receiving room  $L_{n,w}$

The impact sound insulation is determined with various load cases as the sound insulating elastomer support changes its acoustic characteristic under load.

### Test setup according to DIN 7396

The test setup is described in DIN 7396. The standard provides for a landing and flight width of  $1000 \text{ mm} \pm 10 \text{ mm}$ . Thus, according to DIN 7396, the products for the insulation of the flight with a width of 1000 mm are to be tested. For further widths the testing is possible on this basis, under the otherwise same constraints.

### Determination of $L_{n,w}$

The weighted standard impact sound pressure level  $L_{n,w}$  in the receiving room arises as a result of the stimulation, using a standard tapping machine, of the reference landing respective stairs flight in the source room.

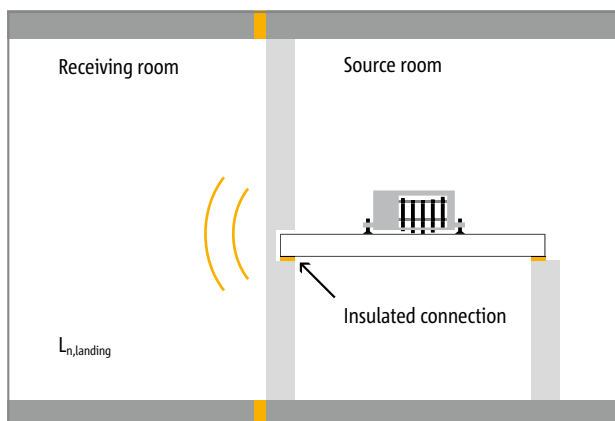


Fig. 2: Determination of the standard landing impact sound pressure level  $L_{n,landing}$  of the reference landing with the impact sound insulation element to be checked

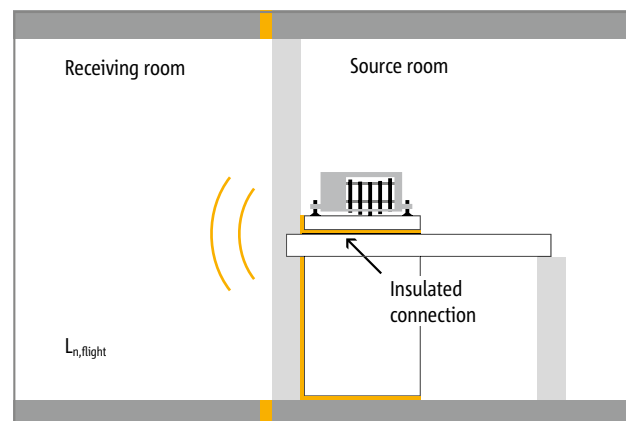


Fig. 3: Determination of the standard flight impact sound pressure level  $L_{n,flight}$  of the reference stair flight with the impact sound insulation element to be checked

## Test procedures according to DIN 7396

### Determination of $\Delta L_{\text{Landing}}^*$

$\Delta L_{\text{Landing}}^*$  is determined as follows:

$$\Delta L_{\text{Landing}}^* = L_{n0,\text{landing}} - L_{n,\text{landing}}$$

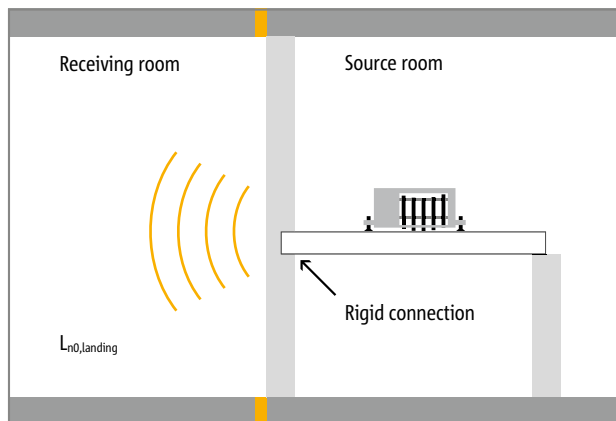


Fig. 4: Determination of the standard landing impact sound pressure level  $L_{n0,\text{landing}}$  of the reference landing without the impact sound insulation element

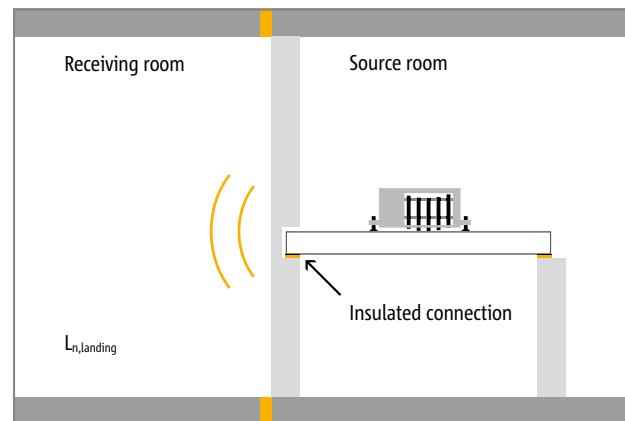


Fig. 5: Determination of the standard landing impact sound pressure level  $L_{n,\text{landing}}$  of the reference landing with the impact sound insulation element to be checked

### Determination of $\Delta L_{\text{Flight}}^*$

$\Delta L_{\text{Flight}}^*$  is determined as follows:

$$\Delta L_{\text{Flight}}^* = L_{n0,\text{flight}} - L_{n,\text{stairs}}$$

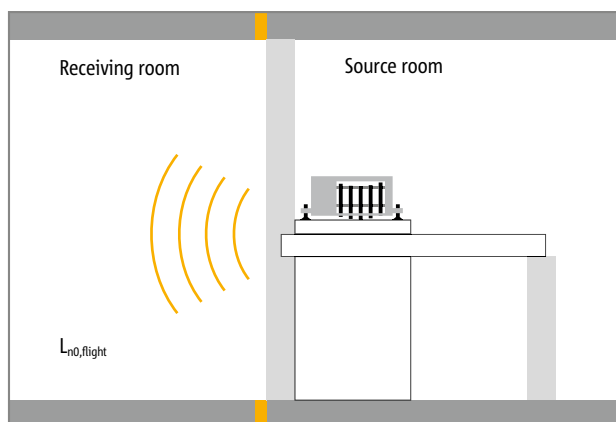


Fig. 6: Determination of the standard flight impact sound pressure level  $L_{n0,\text{flight}}$  of the reference stair flight without the impact sound insulation element

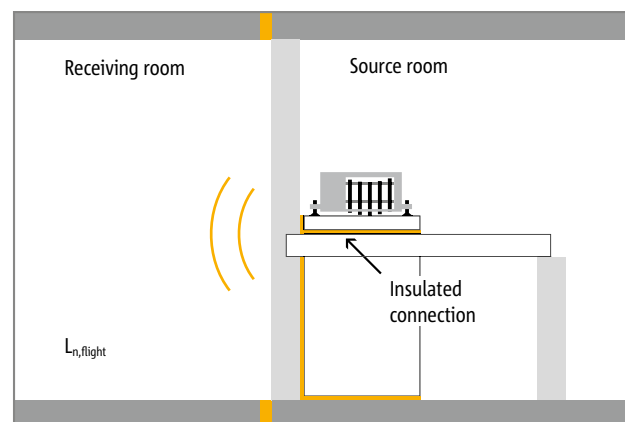


Fig. 7: Determination of the standard flight impact sound pressure level  $L_{n,\text{flight}}$  of the reference stair flight with the impact sound insulation element to be checked

Determination of  $\Delta L_{w,\text{flight}}^*$  and  $\Delta L_{w,\text{landing}}^*$  as described above, the differences are formed in third octave manner and finally evaluated according to ISO 717-2 "Acoustics - Rating of sound insulation in buildings and of building elements - Part 2: Impact sound insulation".

The impact sound parameters determined in this way can be used as input data for calculating the standard impact sound pressure level in rooms adjoining acoustically decoupled landings and stairways according to DIN 4109-2:2016-07 or 2018-01.

### Determination of $\Delta L_{n,w}^*$

For simplification and comparability in practice the product characteristic values  $\Delta L_{n,w}^*$  are introduced. With this value one is concerned with the difference of the weighted standard impact sound pressure level of the rigid and insulated connection. It is to be noted that the standard impact sound pressure level of the rigid and insulated connection, measured according to DIN 7396, is assessed first and then the difference is formed from the individual values.

It applies:

$$\Delta L_{n,w}^* = L_{n0,w,\text{flight}} - L_{n,w,\text{flight}}$$

$$\Delta L_{n,w}^* = L_{n0,w,\text{landing}} - L_{n,w,\text{landing}}$$

## Test procedures according to DIN 7396

### Determination of $\Delta L_{\text{Landing}}^*$

$\Delta L_{\text{Landing}}$  is determined as follows:

$$\Delta L_{\text{Landing}} = L_{n0,\text{wall}} - L_{n,\text{landing}}$$

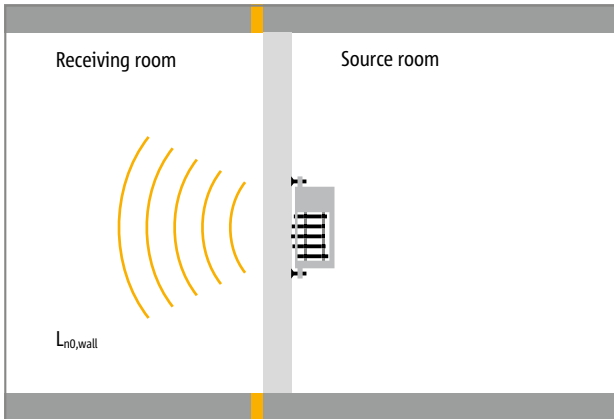


Fig. 8: Determination of the standard wall impact sound pressure level  $L_{n0,\text{wall}}$  the reference wall on a test bench

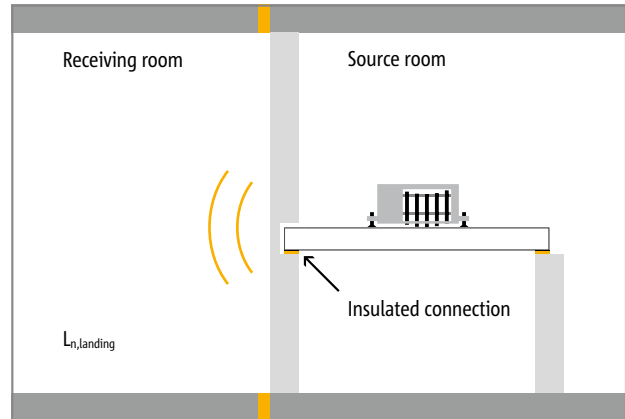


Fig. 9: Determination of the standard landing impact sound pressure level  $L_{n,\text{landing}}$  of the reference landing with the impact sound insulation element to be checked

### Determination of $\Delta L_{\text{Flight}}^*$

$\Delta L_{\text{Flight}}$  is determined as follows:

$$\Delta L_{\text{Flight}} = L_{n0,\text{landing}} - L_{n,\text{flight}}$$

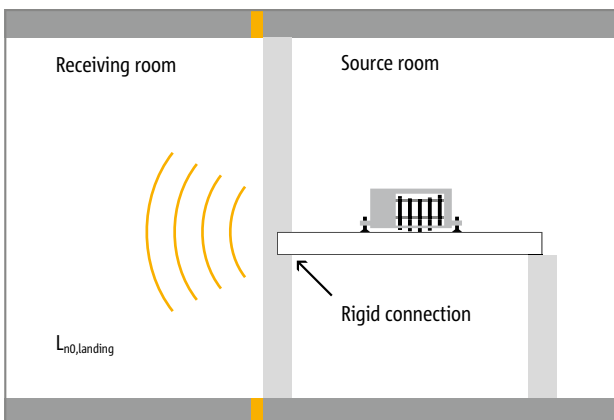


Fig. 10: Determination of the standard landing impact sound pressure level  $L_{n0,\text{landing}}$  of the reference landing without the impact sound insulation element

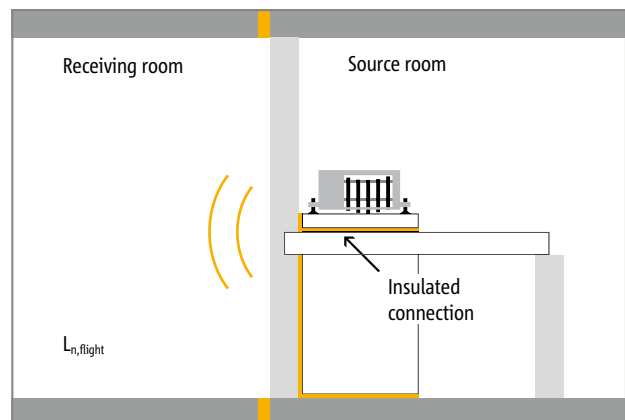


Fig. 11: Determination of the standard flight impact sound pressure level  $L_{n,\text{flight}}$  of the reference stair flight with the impact sound insulation element to be checked

The impact sound parameters determined in this way can be used as input data for calculating the standard impact sound pressure level in rooms adjoining acoustically decoupled stair landings and stairways according to BS EN ISO 12354-2:2017-11.

## Forecasting method

### DIN 4109-2: Safety factor $u_{\text{prog}}$

DIN 4109 includes a unified safety concept to allow prediction uncertainties to be factored in to the sound insulation certification process. This concept includes the use of the safety factor  $u_{\text{prog}}$ . The following is estimated for impact sound insulation:

$$u_{\text{prog}} = 3 \text{ dB}$$

Thus, the following applies to impact sound insulation certification:

$$L'_{n,w} + 3 \text{ dB} \leq \text{permiss. } L'_{n,w} \text{ [dB]}$$

In addition to the safety factor  $u_{\text{prog}}$ , the coverage factor of uncertainty  $k$  can also be applied, for example when calculating stricter impact sound insulation requirements:

$$L'_{n,w} + k \cdot u_{\text{prog}} \leq \text{permiss. } L'_{n,w} \text{ [dB]}$$

Coverage factor  $k$  is specified with a factor of 1 for the range of applications regulated by DIN 4109. However, it can be adjusted for individual cases if so required by the planner.

### DIN 4109: Blanket verification

DIN 4109 provides examples of stairs installed on elastic bearings to assist in the implementation of sound insulation certification. These stair designs achieve a standard impact sound level of  $L'_{n,w} \leq 50 \text{ dB}$ .

The minimum requirements of the building authorities are satisfied in line with DIN 4109 when the safety coefficient  $u_{\text{prog}} = 3 \text{ dB}$  is factored in to impact sound insulation for stairs.

$$L'_{n,w} + u_{\text{prog}} = 50 \text{ dB} + 3 \text{ dB} \leq 53 \text{ dB (permiss. } L'_{n,w})$$

This only incorporates a prediction uncertainty factor but no margin for error during construction.

## Forecasting method

### DIN 4109: Certification with parameters according to DIN 7396

Sound insulation certification of solid stairs is carried out by the building authority according to DIN 4109-2. Blanket certification with execution examples according to Part 32 is sufficient to meet building authority minimum requirements. If requirements for stairs more stringent than the minimum must be achieved, DIN 4109-2 recommends employing test results that have been determined using representative test set-ups. "A laboratory test procedure with mandatory provisions for testing is described in DIN 7396." (DIN 4109-32, section 4.9.4)

DIN 4109 part 2 does not explain how to demonstrate that impact sound insulation elements have characteristic values in line with DIN 7396. For this reason Dr Jochen Scheck, HFT (Technical University) Stuttgart, describes the certification procedure in the publication Bauphysik-Kalender 2020. The certification of impact sound insulation elements is based on the DIN 4109-2 certification procedure for solid stairs on solid single-shell and double-shell stair walls. Chapter 4.3.2.3 differentiates between stairs (landing or flight) without or with additional impact sound insulating coverings or floating screed. Many years of research and investigation have shown that impact sound insulating elements for solid stairs can be considered in the same way as floating screeds. For this reason, certification can be carried out in the same way.

### Stairs (landing or flight) with floating screed floors according to DIN 4109-2 4.3.2.3.:

$$L'_{n,w} = L_{n,eq,0,w} - \Delta L_w$$

$L'_{n,w}$ : rated standard impact sound level for rooms located one above the other, stated in decibels

$L_{n,eq,0,w}$ : equivalent rated standard impact sound, stated in decibels

$\Delta L_w$ : rated impact sound reduction of a floating screed floor, stated in decibels

### Stairs (landing or flight) acoustically decoupled by an impact sound insulation element:

$$L'_{n,w} = L_{n,eq,0,w} - \Delta L_{w,DIN7396}^*$$

$L'_{n,w}$ : rated standard impact sound level of the landing or the flight, stated in decibels

$L_{n,eq,0,w}$ : equivalent rated impact sound level, stated in decibels

$\Delta L_{w,DIN7396}^*$ : rated impact sound level difference according to DIN 7396, stated in decibels

The rated impact sound level difference according to DIN 7396 is calculated from the . The name of the standard deviates slightly and a distinction must be made between landings and flights. The improvement achieved by impact sound level insulation for landings is described by the rated landing impact sound level difference  $\Delta L_{w,landing}^*$  applies in the same way.

The following applies to certification:

$$\Delta L_{w,DIN7396}^* = \Delta L_{w,Podest}^*$$

$$\Delta L_{w,DIN7396}^* = \Delta L_{w,Rama}^*$$

$\Delta L_{w,landing}^*$ : rated landing impact sound level difference according to DIN 7396 stated in decibels

$\Delta L_{w,flight}^*$ : rated flight impact sound level difference according to DIN 7396 stated in decibels



## Forecasting method

The equivalent rated standard impact sound level  $L_{n,eq,0,w}$  can be found in DIN 4109-32: Data for mathematical verification of sound insulation (component catalogue) - Solid construction, Table 6. This differentiates between various designs of solid landings and flights taking the formation of the stairwell wall into account.

| Stairs and stairwell wall  | $L_{n,eq,0,w}$       | $L'_{n,w}$           |
|--|----------------------|----------------------|
| Stair landing <sup>1)</sup> , firmly attached to a single shell, rigid stairwell wall (area-related mass $\geq 380 \text{ kg/m}^2$ )                             | 63 dB                | 67 dB                |
| Flight of stairs <sup>1)</sup> , firmly attached to a single-shell, rigid stairwell wall (area-related mass $\geq 380 \text{ kg/m}^2$ )                          | 63 dB                | 67 dB                |
| Flight of stairs <sup>1)</sup> , detached from a single-shell, rigid stairwell wall  | 60 dB                | 64 dB                |
| Stair landing <sup>1)</sup> , firmly attached to a stairwell wall, and continuous building joint according to 4.3.3.2  | $\leq 50 \text{ dB}$ | $\leq 47 \text{ dB}$ |
| Flight of stairs <sup>1)</sup> detached from the stairwell wall and with a continuous building joint according to 4.3.3.2  | $\leq 43 \text{ dB}$ | $\leq 40 \text{ dB}$ |
| Flight of stairs <sup>1)</sup> detached from the stairwell wall with a continuous building joint according to 4.3.3.2 mounted on elastic bearings on the landing | 35 dB                | 39 dB                |

1) Applies to reinforced concrete landings or stair flights  $\geq 120 \text{ mm}$  thick.

Acoustically decoupled landings:

$$L'_{n,w} = L_{n,eq,0,w} - \Delta L_{w,landing}^* = 63 \text{ dB} - \Delta L_{w,landing}^*$$

Acoustically decoupled flights:

$$L'_{n,w} = L_{n,eq,0,w} - \Delta L_{w,flight}^* = 60 \text{ dB} - \Delta L_{w,flight}^*$$

The acoustic characteristic values of Schöck Tronsole® Types have been inspected in line with DIN 7396 and are available for use in certification procedures according to DIN 4109-2.

### **i** Note

The rated landing or flight impact sound level difference with the maximum allowable load as per DIN 7396 must be used when certifying impact sound insulation elements in line with DIN 4109-2. Only then can the calculations be reliably transferred to the building. Testing with the maximum permissible load is part of the DIN 7396 test procedure.

Further information can be found in the impact sound portal:

[www.schoeck.com/de/trittschall](http://www.schoeck.com/de/trittschall)

## Forecasting method

### ISO 12354-2: Simplified procedure

In the ISO 12354-2 a further verification process for solid stairs is explained. This verification takes into account the individual transmission paths via the separating structural component, and also via the flanking structural components. Thus this verification leads to more accurate values. In addition to the detailed process ISO 12354-2 also offers a simplified process. The impact sound transmission of stair flights and of landings is differentiated.

### Soundproofing verification for landings (simplified procedure)

For landings the following applies:

$$L_{n,w,landing} = L_{n0,w,wall} - \Delta L_{w,landing}$$

### Soundproofing verification for landings (simplified procedure)

For stair flights the following applies:

$$L_{n,w,flight} = L_{n0,w,landing} - \Delta L_{w,flight}$$

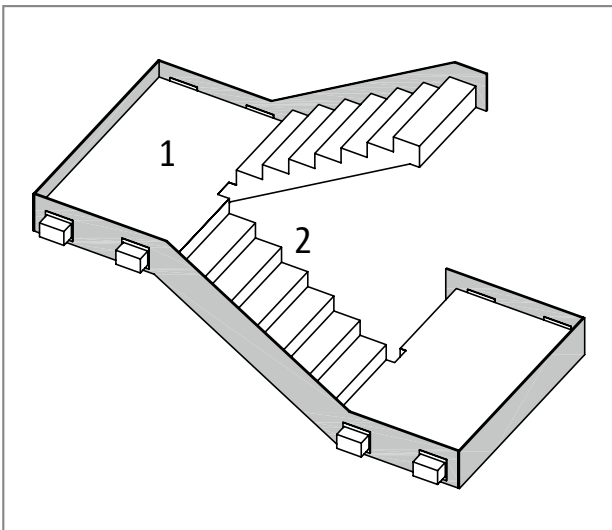


Fig. 12: Representation according to ISO 12354-2 of a landing separated from the walls

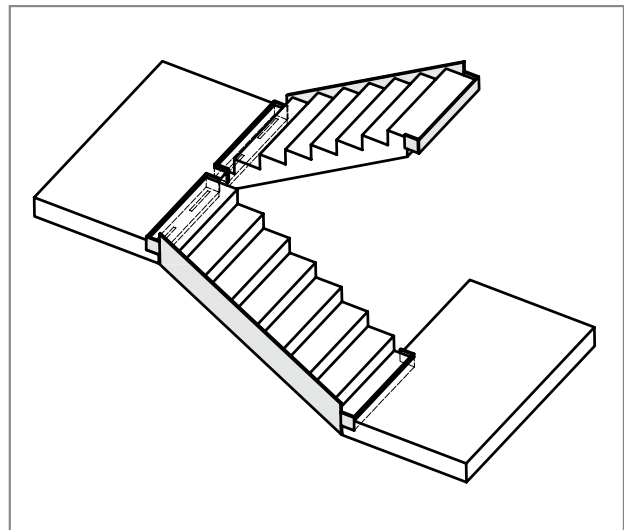


Fig. 13: Representation according to ISO 12354-2 of a flight of stairs separated from the landing and the floor

## Characteristic values of the impact soundproofing

The acoustic characteristic values of the Schöck Tronsole® types have been determined in the test facility in accordance with DIN 7396. In addition, the expected weighted standard impact sound pressure level  $L'_{n,w}$  for a building with a single-leaf, rigid stairwell wall (e.g. in apartment blocks) has been calculated and arranged in the table below, taking into account the respective Schöck Tronsole using the verification method for stairs according to DIN 4109-2.

The values of the table have been checked in accordance with DIN 7396 under maximum permitted dead load of the connected stair structural components and thus represent values on the safe side. The acoustic characteristic values of the Schöck Tronsole® types were all measured in combination with the Schöck Tronsole® type L joint panel. If joint materials alien to the system are combined with the Schöck Tronsole® sound insulation element, due to the possibly higher impact sound transmission via the flanking joint material, in general worse impact soundproofing values arise. The given characteristic values are in these cases no longer ensured. The formation of an air joint is possible, if it is larger than 5 cm, so that no acoustic bridges can form either through dirt or through grout.

DIN 7396 only refers to a test set-up with a flight width of 1000 mm. In practice, however, wider stairs are also common. For this reason, tests are also conducted for elements up to 1500 mm wide in addition to elements that are 1000 mm wide. You are always on the safe side if you use the tested Schöck Tronsole® characteristic values in line with DIN 7396, either for sound insulation certification calculations or when taking sound measurements on building sites.

Schöck Tronsole® characteristic values assume the worst case (maximum load). For this reason, the verified characteristic values in the test report are better than the characteristic values presented in the following table.

With this table attention must be paid that  $L'_{n,w}$  represents an impact sound level and thus, with lower value, expresses a better soundproofing capability. The value  $\Delta L^*_{n,w}$  on the other hand, describes the direct impact soundproofing effect, therefore a lower value here describes a poorer sound proofing.

| Schöck Tronsole® | Load-bearing level | $L_{n,w}$ [dB]<br>test bench value<br>according to DIN 7396 | $\Delta L^*_{n,w}$ [dB]<br>tested according to DIN<br>7396 | $\Delta L^*_{w,landing} / \Delta L^*_{w,flight}$ [dB]<br>test bench value<br>according to DIN 7396 | $L'_{nT,w}$ [dB]<br>calculation according to<br>BS EN ISO 12354-2 |
|------------------|--------------------|---|--|--|---|
| Type F           | V1                 | $\leq 35^{1)}$  | $\geq 32^{1)}$   | $\geq 28^{1)}$   | $\leq 34$   |
|                  | V2                 | $\leq 37^{1)}$  | $\geq 30^{1)}$   | $\geq 26^{1)}$   | $\leq 36$   |
| Type B           | V1                 | $\leq 35^{1)}$  | $\geq 32^{1)}$   | $\geq 28^{1)}$   | $\leq 33$   |
|                  | V2                 | $\leq 37^{1)}$  | $\geq 30^{1)}$   | $\geq 26^{1)}$   | $\leq 35$   |
| Type T           | V2                 | $\leq 34$   | $\geq 33$  | $\geq 28$  | $\leq 33$   |
|                  | V4                 | $\leq 36$   | $\geq 31$  | $\geq 27$  | $\leq 35$   |
|                  | V6                 | $\leq 38$   | $\geq 29$  | $\geq 25$  | $\leq 37$   |
|                  | V7                 | $\leq 38^{2)}$  | $\geq 29^{2)}$   | $\geq 25^{2)}$   | $\leq 37$   |
|                  | V8                 | $\leq 38^{1)}$  | $\geq 29^{1)}$   | $\geq 25^{1)}$   | $\leq 37$   |
| Type Q           |                    | $\leq 38$   | $\geq 30$  | $\geq 28$  | $\leq 36$   |
| Type P           | V+V                | $\leq 38^{3)}$  | $\geq 31^{3)}$   | $\geq 27^{3)}$   | $\leq 37$   |
|                  | VH+VH              | $\leq 38$   | $\geq 31$  | $\geq 27$  | $\leq 37$   |
| Type Z           | V                  | $\leq 41^{3)}$  | $\geq 27^{3)}$   | $\geq 24^{3)}$   | $\leq 39^{3)}$  |
|                  | V+V                | $\leq 41^{3)}$  | $\geq 27^{3)}$   | $\geq 24^{3)}$   | $\leq 39^{3)}$  |
|                  | VH+VH              | $\leq 41$   | $\geq 27$  | $\geq 24$  | $\leq 39$   |

- ▶ 1) Characteristic values for element widths > 1000 mm have been checked based on DIN 7396.
- ▶ 2) Type T-V7: Characteristic values are adopted from the Tronsole® type T-V8.
- ▶ 3) Type P and Type Z: Characteristic values of the load-bearing level VH+VH have been assumed.
- ▶  $L'_{nT,w}$  determined according to EN ISO 12354-2 for a typical apartment building staircase including a 3 dB safety margin (stairwell wall in 24-cm sand-lime brick masonry with bulk density class 2.2, flanking reception room walls in 17.5-cm sand-lime brick with masonry bulk density class 2.0).

For certification according to DIN 4109-2, Schöck Tronsole® not only meets the increased requirements stipulated by DIN 4109-5 or supplement 2 to DIN 4109, it also fulfils DEGA Class B and sound insulation level II or III according to VDI 4100. In some cases, even DEGA Class A can be achieved. Detailed evidence in line with BS EN ISO 12354-2 must be provided to certify all products in line with sound insulation level III.

## Tronsole® fire protection



## Fire protection regulations

### Building component classification

Building components are categorised into various fire-resistance classes according to their fire-resistance rating. Building components can be classified according to the German fire-protection standard DIN 4102-2 (F-classification) or the European standard BS EN 13501-2 (R-classification). However, the German classification does not indicate whether a component meets the separating criterion or not, for example.

BS EN 13501-2 contains an extended classification system. The criteria are:

- ▶ R - load-bearing capability
- ▶ E - separation
- ▶ L - thermal shielding under exposure to fire

Example: A building component with REI 120 is load bearing for 120 min, seals off a space for 120 min and shields the room above or adjacent from the heat for 120 min.

Classification according to DIN 4102 or BS EN13501 can be applied to certify the fire performance of building components. In Germany, both classification systems are of equal importance.

The MVV TB and the VV TBs of the Federal German States regulate which classification of building components conform with the requirements (fire-retardant, highly fire-retardant and fire-proof).

The following segments all refer to the MBO (Model Building Code) and MVV TB. Individual LBOs (German federal state building ordinances) can deviate from the requirements stated here.

### Building material classification

DIN 4102-1 makes a basic distinction between the building material classes: non-combustible (A) and combustible (B). Further distinctions are made within these classes: not easily flammable B1, flammable B2, easily flammable B3.

BS EN 13501-1 also differentiates between building material classes A1, A2, B, C, and E. It also classifies smoke development *s* (smoke) and flaming droplet *d* (drop) production. Floor coverings must be classified separately in line with BS EN 13501-1, Table 2. The building material classes of floor coverings are indicated by the index *fl* (floor coverings).

MVV TB Appendix 4, Tables 1.1 and 1.2 make the following classifications:

### Building authority requirements and building material classes according to MVV TB Table 1.1 and Table 1.2

| Comparison of building material classification DIN 4102 and BS EN 13501                          |   |   |
|--|---|---|
| Building authority requirement   | Minimum required building material classes as per DIN 4102-1:1998-05 according to Table 1.1 | Minimum requirements for building products and their components as per harmonised technical specifications (BS EN 13501-1) according to Table 1.2 |
| Non-combustible  | A2  | A2 – s1,d0  |
| Limited combustibility   | B1  | C – s2,d2   |
| Limited combustibility and no production of flaming particles/droplets                           | B1  | C – s2,d0   |
| Limited combustibility and slight smoke development  | B1  | C – s1,d2   |
| Limited combustibility and no production of flaming particles/droplets, slight smoke development | B1  | C – s1,d0   |
| Normal combustibility and no production of flaming particles/droplets                            | B2  | E   |
| Normal combustibility  | B2  | E – d2  |

*If necessary, additional requirements regarding melting points > 1000°C or smouldering behaviour can be stipulated.*

## Fire protection in stairwells

### Staircases as necessary stairwells

- ▶ Every storey above ground level and the usable roof space of a building must be accessible via at least one necessary staircase (MBO§34).
- ▶ Every necessary staircase must be located in a separate continuous stairwell (necessary stairwell) that provides an emergency escape route to the outside. Buildings intended for human occupancy require two independent emergency escape routes. They must also be arranged and designed to ensure that they can be used in case of fire for a sufficiently long period of time (MBO§35).
- ▶ Special provisions apply to necessary staircases and stairwells with regard to accessibility, smoke density, smoke extraction, stair geometry etc. Their configuration depends on the building class according to MBO §2.

No necessary stairwell is required:

- ▶ In buildings of building classes 1 and 2
- ▶ To connect no more than two storeys within the same designated building unit of no more than 200 m<sup>2</sup> in total if another emergency escape route can be accessed on each storey.
- ▶ If external stairs are provided and if using them is sufficiently safe and does not pose a hazard in case of fire.

### Stairs in necessary stairwells

BS EN 13501-2:2010-02 (1a) classifies flights of stairs as load-bearing components without a space-enclosing function. In addition to further requirements (e.g. clearance width, handrail height, landing arrangement), the MBO §35(4) stipulates requirements on the load-bearing function of the stairs in the necessary stairwells in case of fire.

The MBO combines requirements for the classification of load-bearing building components and requirements for the classification of building materials for load-bearing components. Appendix 4 Tables 4.3.1 and 4.2.4 of the MVV TB regulates these building authority requirements as follows:

| Minimum requirements for load-bearing components of stairs in necessary stairwells |  |  |   |
|--|--|--|---|
| MBO §2 Building class  | MBO §34(4) stairs                                    | MVV TB Appendix 4 Table 4.3.1<br>(BS EN 13501-2) Fire resistance  <br>Fire behaviour | MVV TB Appendix 4 Table 4.2.4<br>(DIN 4102-2) |
| 3  | Fire-retardant or non-combustible building material  | R 30 or A2 – s1,d0   | F 30-B or building material class A           |
| 4  | Non-combustible building material                    | A2 – s1,d0   | Building material class A                     |
| 5  | Fire-retardant or non-combustible building materials | R 30 and A2 – s1,d0  | F 30-A  |

## Fire protection in stairwells

### Walls of necessary stairwells

BS EN 13501-2:2010-02 (1b) classifies walls as load-bearing building components with a space-enclosing function. The MBO §35(4) imposes certain requirements if the enclosed space is in a necessary staircase.

Appendix 4 Tables 4.3.1 and 4.2.4 of the MVV TB regulates the building authority requirements as follows:

| Requirement for staircase walls in necessary stairwells |   |  |   |
|---|---|--|---|
| MBO §2 Building class                                   | MBO §35(4) Walls  | MVV TB Appendix 4 Table 4.2.4 (BS EN 13501-2) Fire resistance   Fire behaviour | VV TB Appendix 4 Table 4.3.1 (DIN 4102-2) |
| 3   | Space-enclosing, fire-retardant   | REI 30, E-d2   | F 30-B                                    |
| 4   | Space-enclosing, also under additional load, highly fire-retardant                            | F 60-B,m   | REI 60,m                                  |
| 5   | Space-enclosing, fire wall type (impact load, exclusively non-combustible building materials) | REI 90-M, A2-s1,d0   | F 90-A,m                                  |

### Building materials in necessary stairwells

Requirements are also stipulated for the building materials used in necessary stairwells. The following table summarises the requirements of §35(5) MBO and the rules of MVV TB Appendix 4 Tables 1.1, 1.2 and 4.2.2.

Please note that the fire load introduced into the staircase by the building material is relevant. Usually, building materials of which only narrow edges are exposed do not contribute significantly to the fire load. However, this must be checked on a case-by-case basis.

| Minimum requirements for building materials in necessary stairwells |  |   |  |
|---|--|---|--|
| MBO §2 Building class   | MBO §35(5)   | MVV TB Appendix 4 Table 1.2 (BS EN 13501-1) | MVV TB Appendix 4 Table 1.1 (DIN 4102-2) |
| 3, 4 and 5  | Linings, plasters, insulating materials, ceilings, fixtures made from non-combustible building materials | ≥ A2 – s1,d0                                | ≥ A2                                     |
|   | Walls and floors made from combustible building materials with non-combustible cladding                  | ≥ A2 – s1,d0                                | ≥ A2                                     |
|   | Floor coverings with limited combustibility  | C <sub>fl</sub> – s1                        | B1, limited smoke development            |



## Fire protection configuration

### Schöck Tronsole® in stairs (Type T, Type F and Type B)

Schöck Tronsole® Type T is equipped with fire protection strips. It is rated with fire-resistance class R 90 according to the DIBt approval Z-15.7-310.

Load transfer via the elastomeric bearing of Schöck Tronsole® Type F and Type B has no effect on certification for the ultimate limit state in case of fire.

Basically, Schöck Tronsole® Type T, Type F and Type B employed in flights of stairs can at best achieve the same fire-protection class as the adjacent load-bearing and stiffening building components. (Advisory opinion iBMB [Institute for building materials, solid construction and fire protection] Brunswick, Germany 16503/2013 and 19395/2013)

The joint width of Schöck Tronsole® Type T, Type F and Type B is  $\leq 30$  mm. Therefore, flights of stairs and landings form a single unit with regard to heating as per DIN 4102-4, section 3.2.4.7. For this reason, the concrete covering stipulated in DIN 1045 must only be observed over joints. (iBMB Braunschweig advisory opinion 16503/2013)

Further requirements concerning adjacent building components are given in the product chapter Schöck Tronsole® Type F. See page 84.

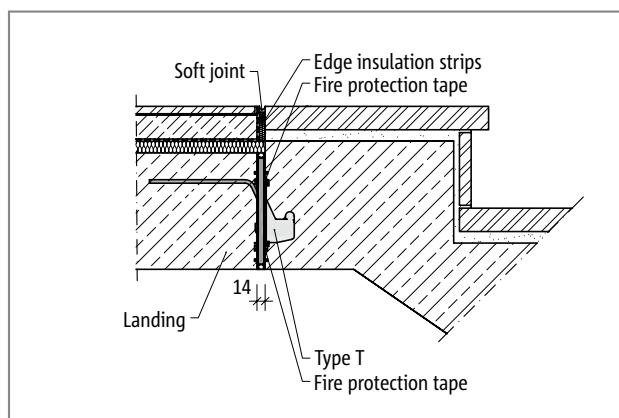


Fig. 14: Schöck Tronsole® Type T: Fire-protection version

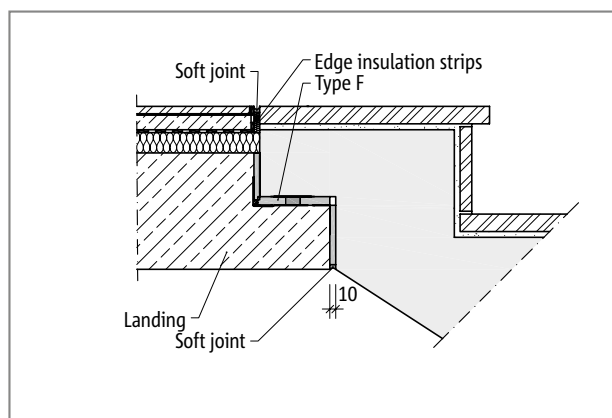


Fig. 15: Schöck Tronsole® Type F: Fire-protection version

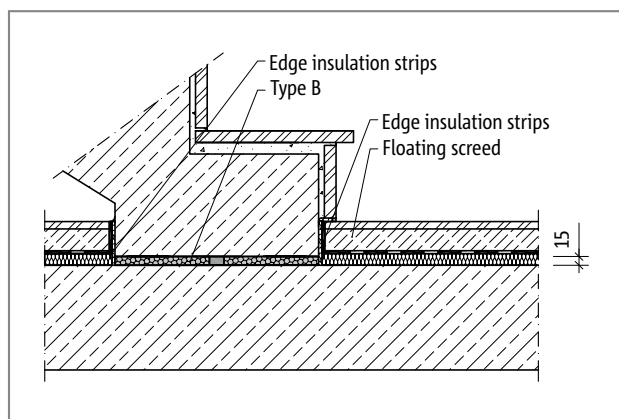


Fig. 16: Schöck Tronsole® Type B: Fire-protection version

## Fire protection configuration

### Schöck Tronsole® in staircase walls (Type Q, Type P and Type Z)

Schöck Tronsole® Type Q, Type P and Type Z and their wall elements do not negatively affect the fire-resistance class of the wall construction if the following is observed: the adjacent floor is set in concrete on the side facing away from the stairwell or it is implemented with a back lining of masonry blocks at least 40 mm thick (each  $\geq 40$  mm). A mineral rendering can count towards the thickness. (Advisory Opinion MFPA [Material research and testing institute] Leipzig GS 3.2-390-1 and GS 3.2-390-2)

A fire-protection set is available for Schöck Tronsole® Type Q and Type P. This guarantees fire-resistance class R 90 in line with BS EN 13501-2. The required number of fire-protection collars depends on the joint width (see page 109 and page 150). Fire-resistance class R 90 can be achieved for joint widths  $\leq 65$  mm (Type Q) and  $\leq 50$  mm (Type P).

The minimum panel thickness depends on the selected product and the building component (see page 109 and page 150).

The load-bearing element of Schöck Tronsole® Type Z is set in concrete with a monolithic connection to the landing. The adjacent landing must be designed so that a centre distance of the load-bearing reinforcement to the building component surface  $u \geq 35$  mm is maintained (mineral floor covering can count towards the thickness). This achieves fire-resistance class R 90 as per BS EN 13501-2.

The employment of combustible building materials for Schöck Tronsole® Type Q, Type P and Type Z (wall element) does not have a negative effect on the fire-resistance class. This is because any exposed edges make no significant contribution to the fire inside the staircase (MFPA Leipzig advisory opinion 3.2-390-1 and 3.2-390-2).

The thickness of the nail edge and/or the connecting frame of the respective wall element is 15 mm maximum and is usually covered by the staircase cladding or the fire-protection set.

Basically, Schöck Tronsole® Type Q, Type P and Type Z can at best achieve the same fire-resistance class as the adjacent, load-bearing and stiffening building components (MFPA Leipzig advisory opinion 3.2-390-1 and 3.2-390-2).

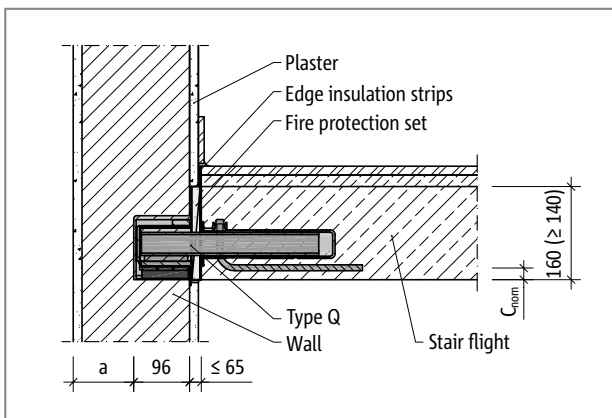


Fig. 17: Schöck Tronsole® type Q: Fire protection configuration

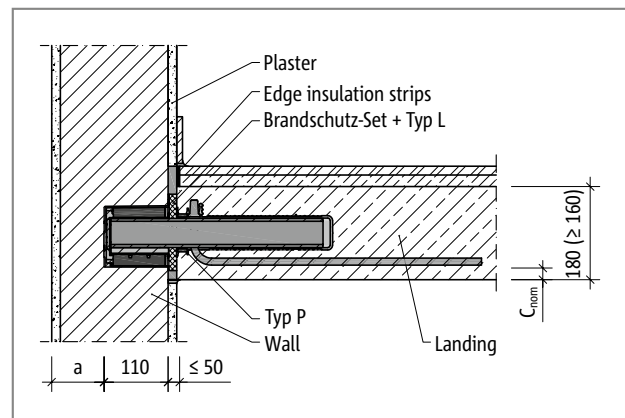


Fig. 18: Schöck Tronsole® Type P: Fire-protection version

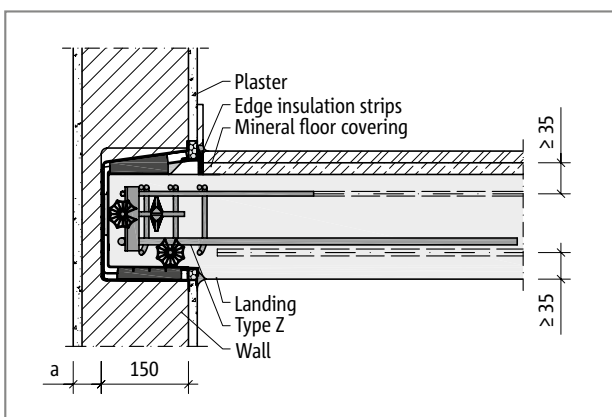


Fig. 19: Schöck Tronsole® type Z: Fire protection configuration

## Fire protection configuration

### Schöck Tronsole® in joints between stairs/landings and walls (Type L)

Schöck Tronsole® Type L is not a cladding panel, mounting panel or insulating material as stated in the MBO. Even if the joint is exposed, the tiny size of the joint compared to the component size means that fire contribution is minimal and is safe in terms of fire protection. Generally, they are even plastered over.

Schöck Tronsole® Type L has also been tested in joints and classified as building material Class B1 (flame resistant). Therefore, it meets the requirements for floor coverings as per MBO §35(5).3 that can be employed in emergency escape routes. Employing this component has no negative impact on the overall fire-resistance class of the stairs. This is because any exposed edges make no significant contribution to formation of fire and smoke inside the staircase.

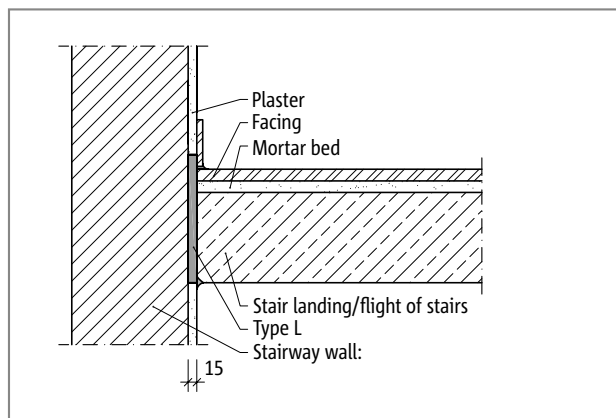


Fig. 20: Schöck Tronsole® Type L: Fire-protection version

## Fire-resistance classes | Building material classes | Fire protection classes

### Fire-resistance classes

The following fire-resistance classes are achieved under these conditions:

- ▶ The adjacent load-bearing and stiffening building components have at least the same fire-resistance class.
- ▶ The wall element of Schöck Tronsole® Type Z, Type P and Type Q is back-lined (each  $\geq 40$  mm).
- ▶ The centre distance of the load-bearing reinforcement to the building component surface is  $u \geq 30$  mm (Type Z).

| Schöck Tronsole® type | T, P and Q with fire-protection collar, Z | F, B, L   |
|-----------------------|---|---|
| Fire resistance class | R 90                                      | Fire-resistance class of the adjacent building components |

### Building material classes

Schöck Tronsole® Types are not linings, insulating materials or fixtures as stipulated in the MBO as these elements are not located on the surface but rather always within stair components. Fire can only take hold of the joint, which is tiny compared to the component and is safe in terms of fire protection.

According to MBO §35(5)3, floor coverings in necessary stairwells must be made from building materials with a minimum rating of B1 (limited combustibility). The joint panel Tronsole® Type L also fulfils this requirement.

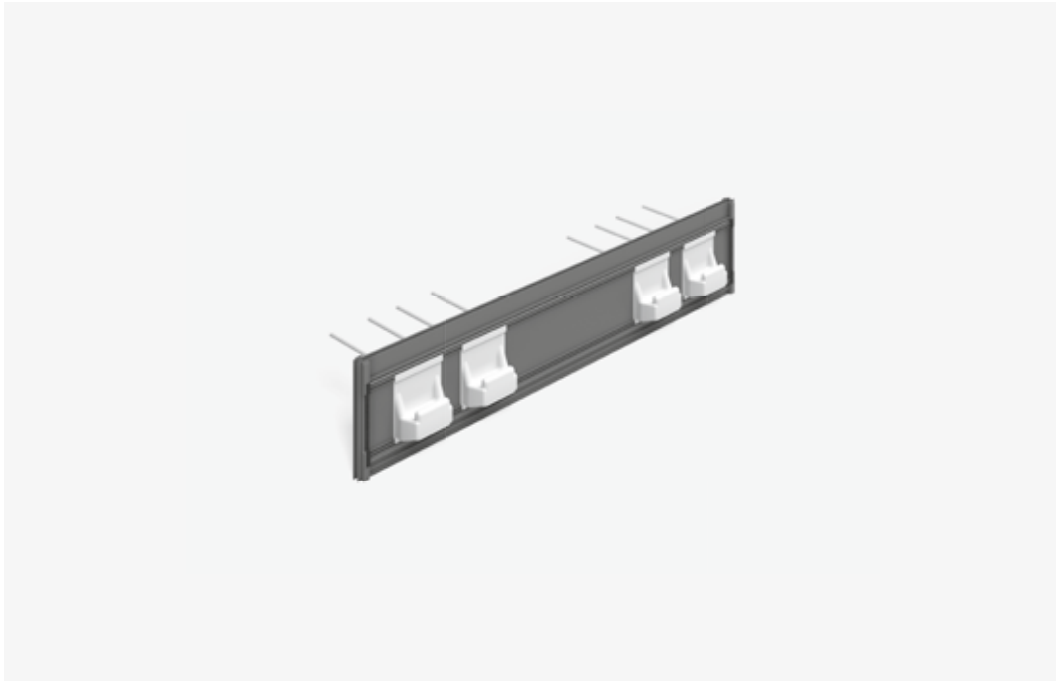
The use of flammable building materials for Schöck Tronsole® Types does not have a negative impact on the overall assessment of the fire-resistance class of the stairs or of the stairwell. This is because any exposed edges make no significant contribution to formation of fire and smoke inside the staircase.

With regard to fire protection, there are no objections to using Schöck Tronsole® Types F, B, L in staircases (advisory opinion on the employment of Schöck Tronsoles in stairwells; EBB 150003-1, Technical University (TU) Kaiserslautern).

| Schöck Tronsole® type   | F, B |
|-------------------------|------|
| Building material class | E    |

| Schöck Tronsole® type   | L  |
|-------------------------|----|
| Building material class | B1 |

## Schöck Tronsole® type T



T

### **Schöck Tronsole® type T**

Serves the sound insulation of stair flight and landing. The stair flight can be manufactured in in-situ concrete or as fully precast component. The landing can be manufactured both in in-situ concrete as well as in semi-precast construction with screed.

## Product characteristics | Product design

### **i** Product characteristics

- ▶ Rated flight impact sound level difference  $\Delta L_{w,flight}^* \geq 25$  dB with type T-V8;  $\Delta L_{w,flight}^* \geq 28$  dB with type T-V2, tested according to DIN 7396 with maximum load; test reports no. 91386-07 and 91386-08; (for an explanation of the value  $\Delta L_{w,flight}^*$ , see page 13)
- ▶ Elodur® elastomer support in the support corbels for sound insulation
- ▶ With DIBt general building supervisory approval No. Z-15.7-310
- ▶ Fire resistance class R90
- ▶ Simpler, more rapid and safer installation using nail battens enables a straight joint pattern

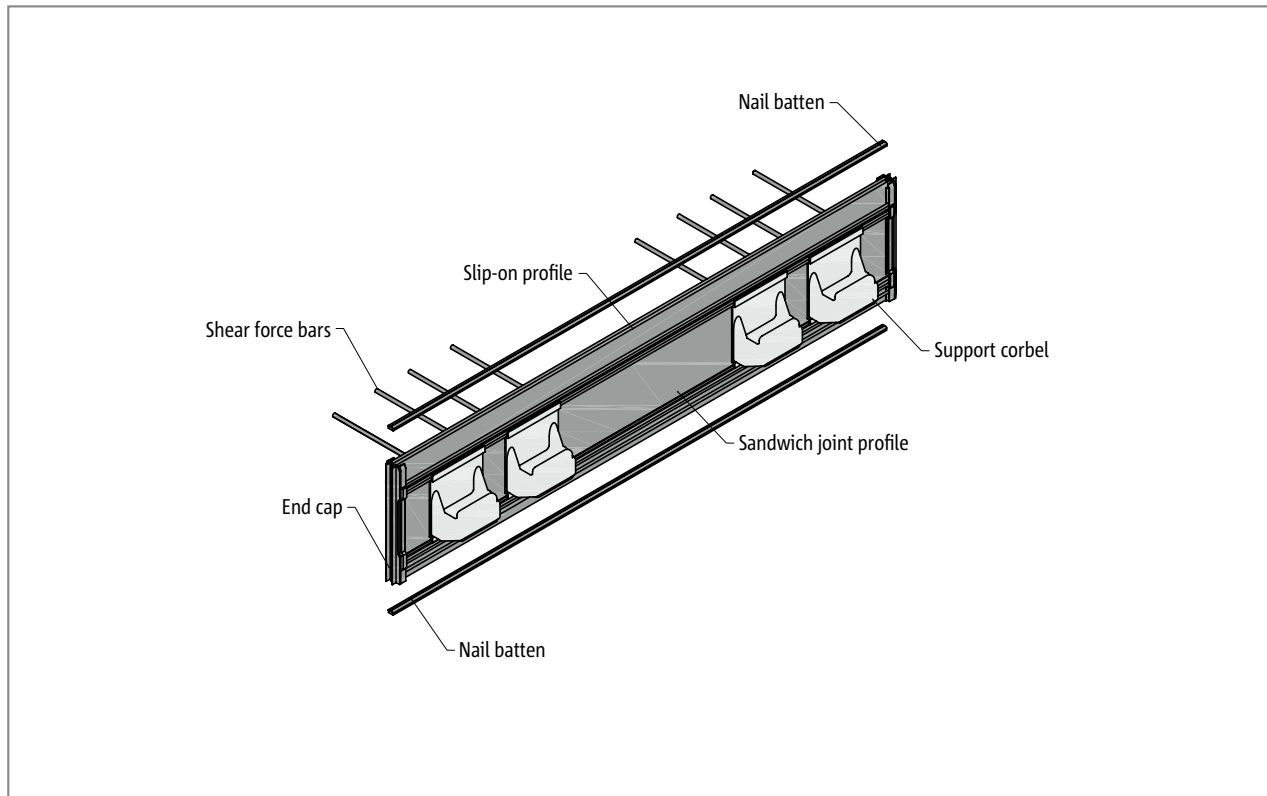


Fig. 21: Schöck Tronsole® type T

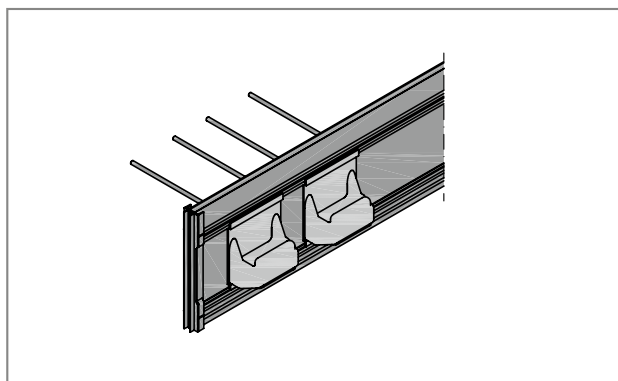


Fig. 22: Schöck Tronsole® type T : Detail support bracket positive fabrication

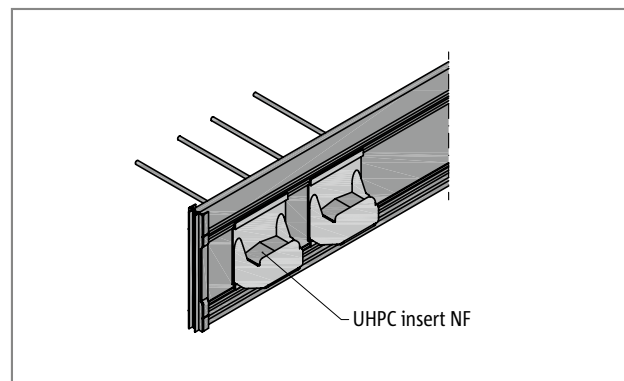


Fig. 23: Schöck Tronsole® type T: Detail support bracket negative fabrication

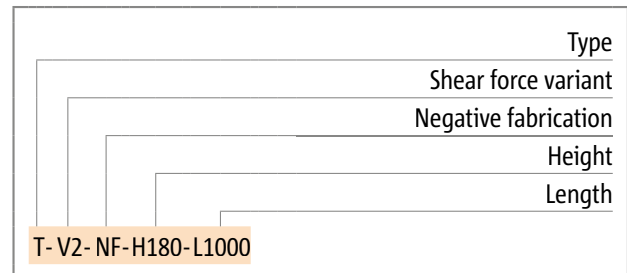
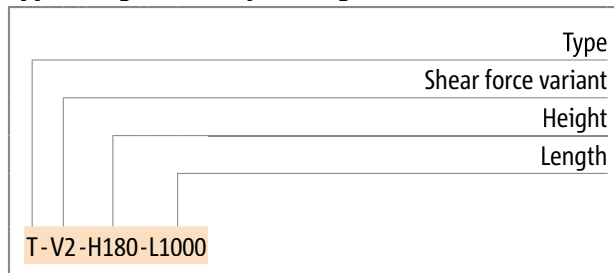
## Product selection | Type designations

### Schöck Tronsole® type T variants

The design of the Schöck Tronsole® type T can vary as follows:

- ▶ Shear force load-bearing level:  
V2 to V8
- ▶ Production type in the prefabricating plant:  
without addition                      positive fabrication and lateral fabrication  
NF    negative fabrication (= reverse fabrication)
- ▶ Height:  
H = 160–320 mm
- ▶ Length:  
Shear force load-bearing level V2: L = 700–1300 mm  
Shear force load-bearing level V4: L = 700–2000 mm  
Shear force load-bearing level V6: L = 1000–2000 mm  
Shear force load-bearing level V7: L = 1150–1450 mm  
Shear force load-bearing level V8: L = 1300–2000 mm

### Type designation in planning documents



T

## Installation cross section

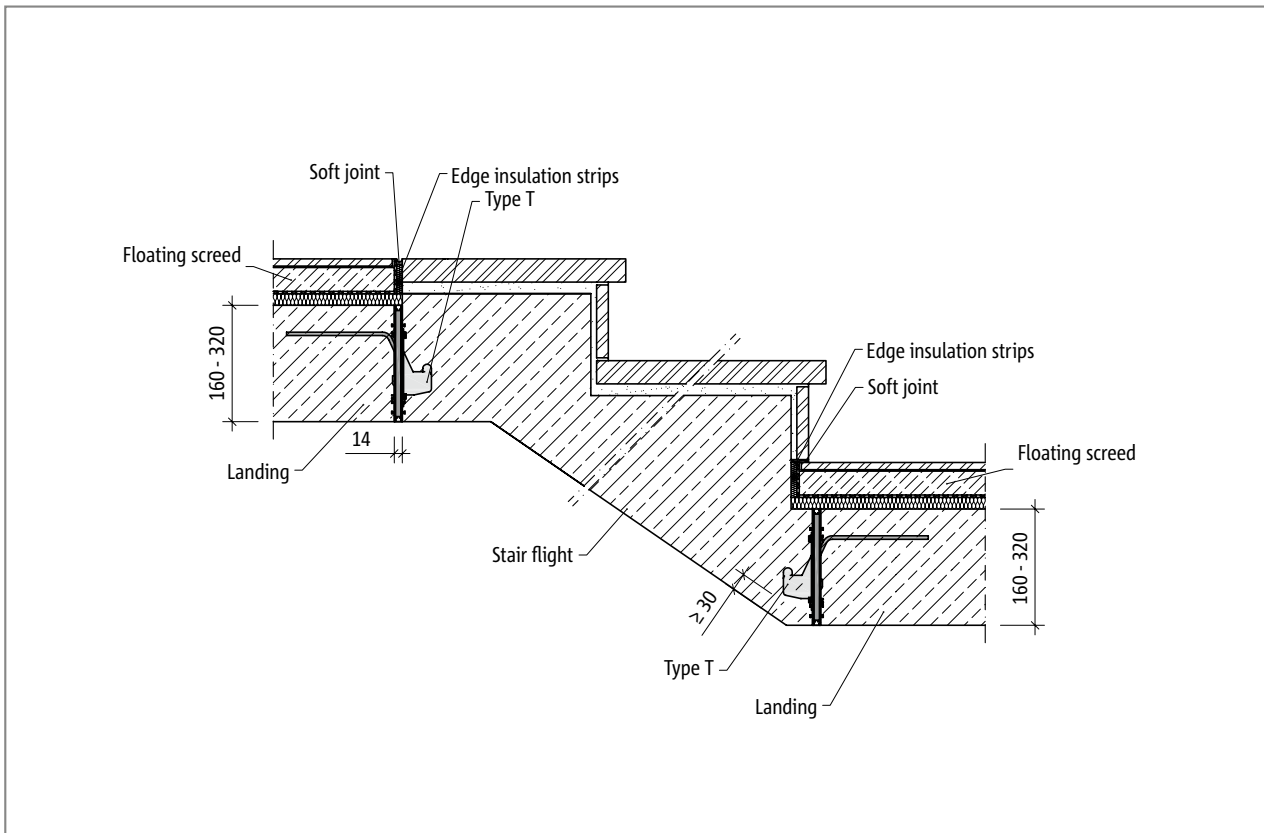


Fig. 24: Schöck Tronsole® type T: Installation cross-section

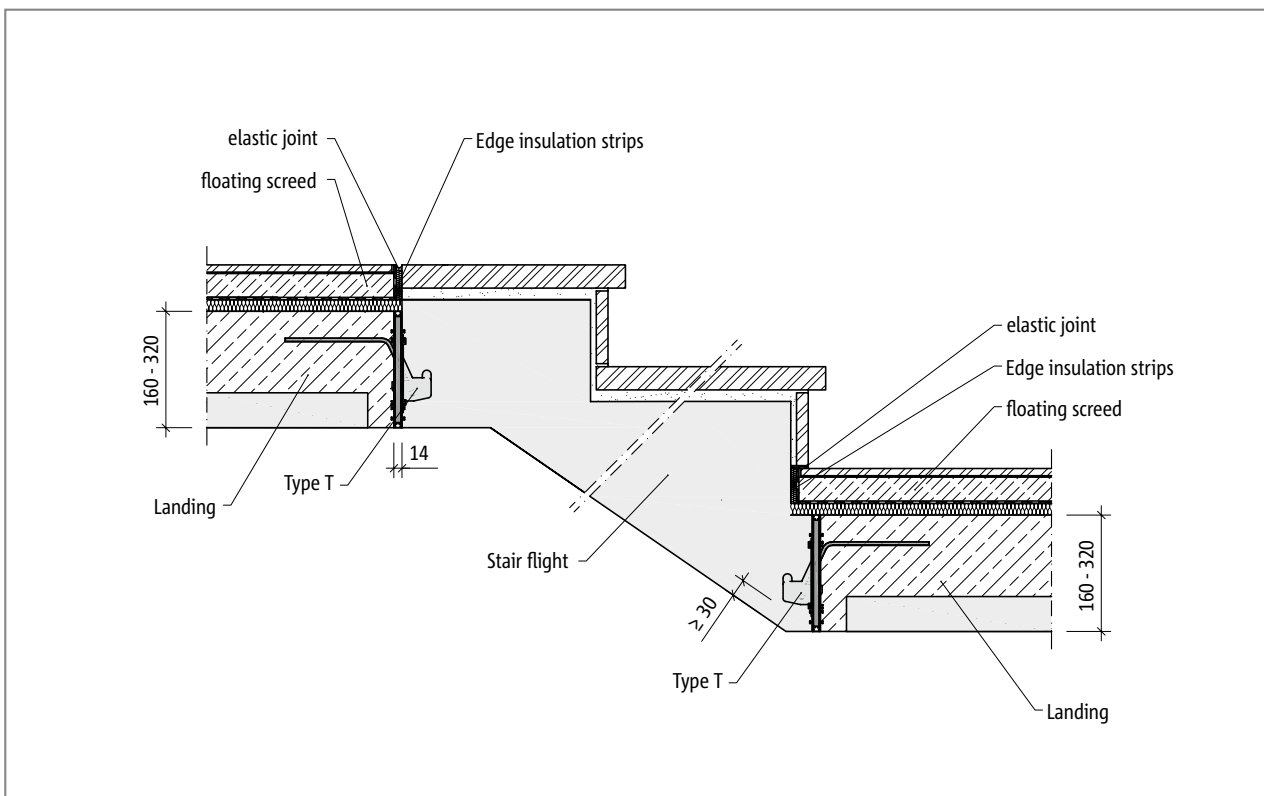


Fig. 25: Schöck Tronsole® type T: Installation cross-section precast stairs with semi-precast landing



## Element arrangement

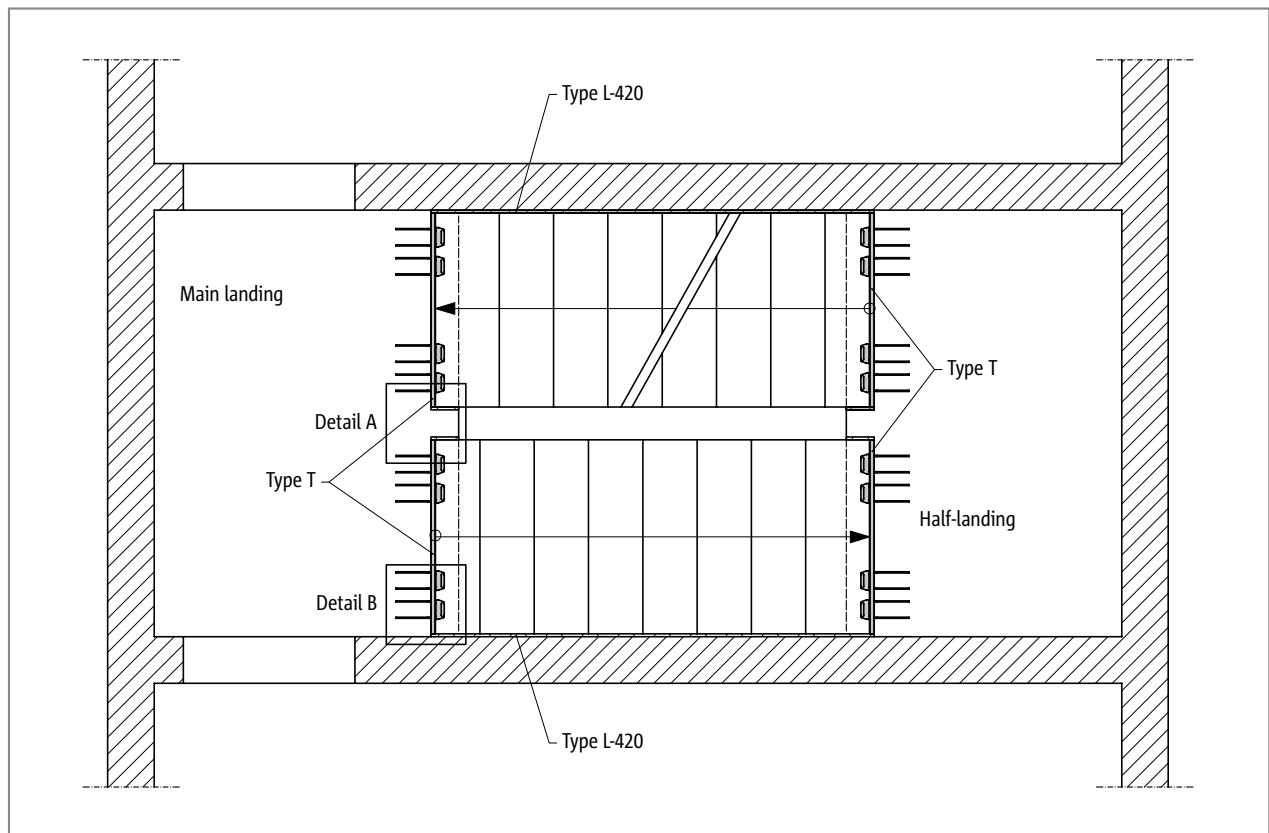


Fig. 26: Schöck Tronsole® type T: Element configuration in plan view

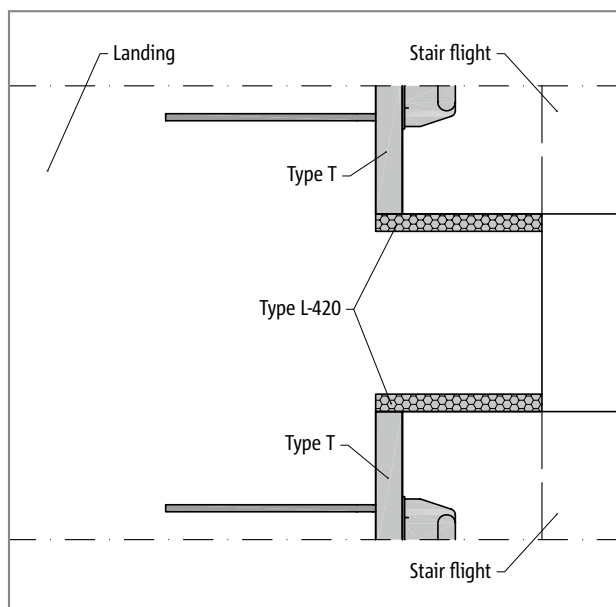


Fig. 27: Schöck Tronsole® type T: Element configuration Detail A

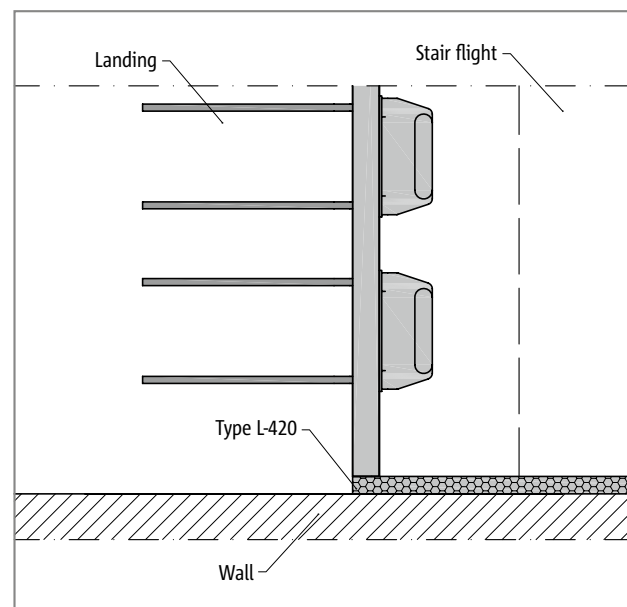


Fig. 28: Schöck Tronsole® type T: Element configuration Detail B

### **i** Notes on combination possibilities

- ▶ The given acoustic insulation values apply in combination with the Tronsole® type L-420 or with a sufficiently wide air joint (50 mm).
- ▶ The connection of the stair flights to the floor slab using the Tronsole® type B.
- ▶ With stair flights, which are wider than 2 m, several elements of the Tronsole® type T can be strung together and, if required, shortened.

## Product description

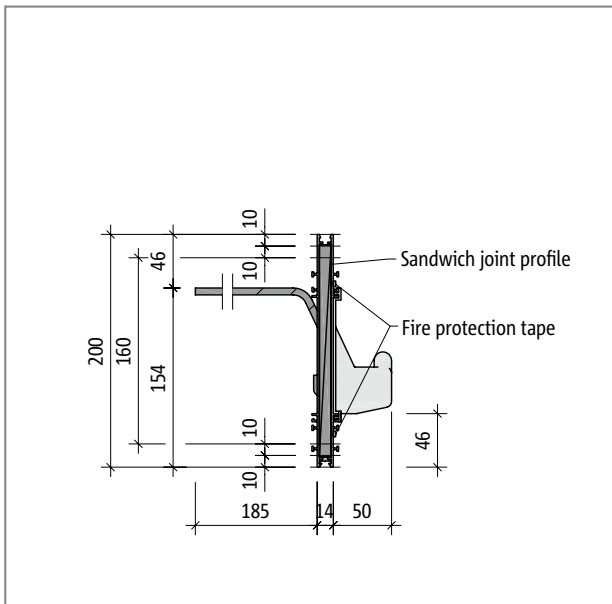


Fig. 29: Schöck Tronsole® Type T: Product section with sandwich joint profile in the basic version

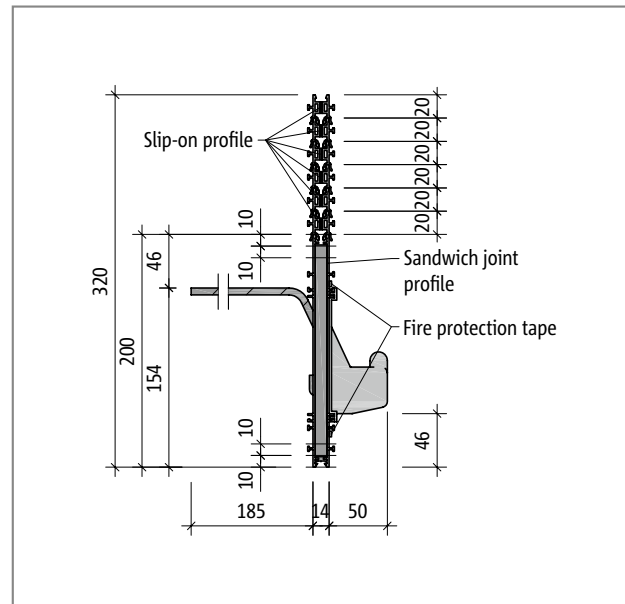


Fig. 30: Schöck Tronsole® type T: Product cross-section with sandwich joint profile and slip-on profiles.

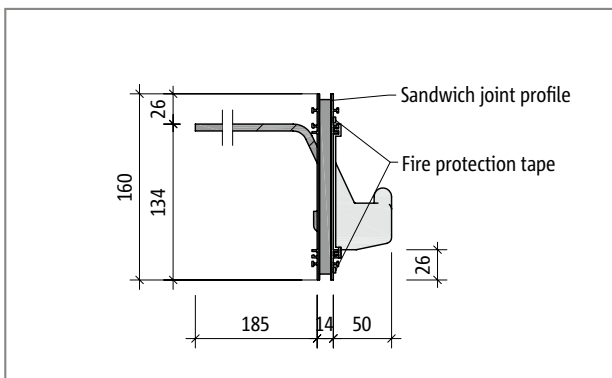


Fig. 31: Schöck Tronsole® type T: Product section T...-H160

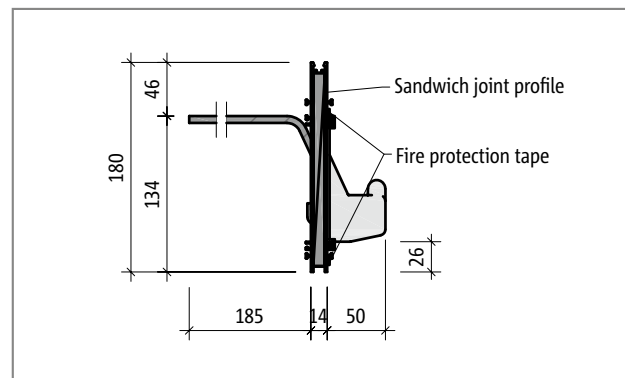


Fig. 32: Schöck Tronsole® type T: Product section T...-H180

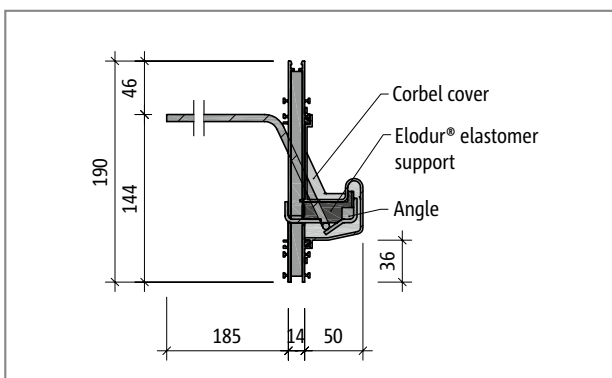


Fig. 33: Schöck Tronsole® type T: Product section T...-H190 through the support bracket

## Product description

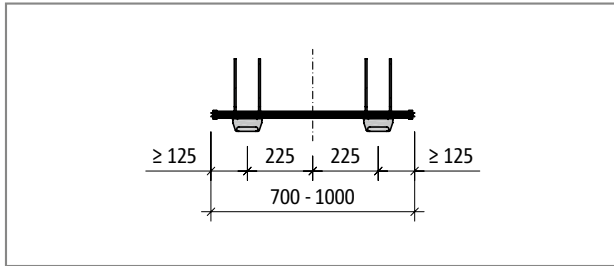


Fig. 34: Schöck Tronsole® type T-V2-H...-L700 to L1000: Product layout

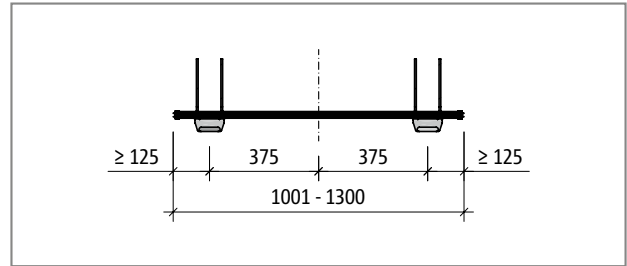


Fig. 35: Schöck Tronsole® type T-V2-H...-L1001 to L1300: Product layout

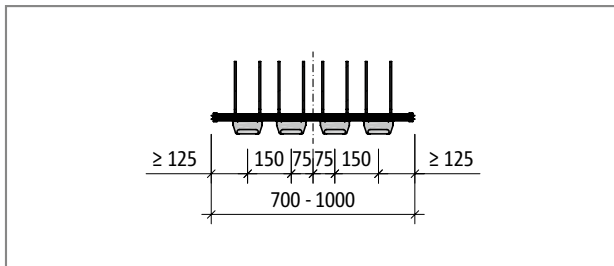


Fig. 36: Schöck Tronsole® type T-V4-H...-L700 to L1000: Product layout

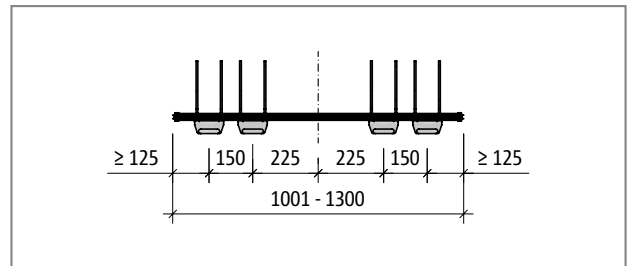


Fig. 37: Schöck Tronsole® type T-V4-H...-L1001 to L1300: Product layout

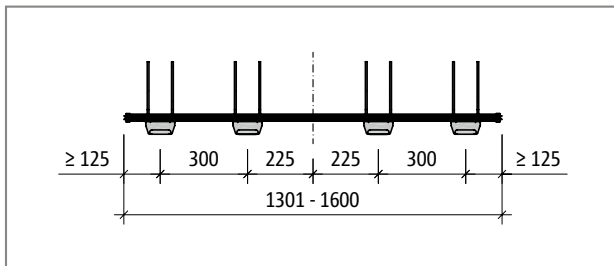


Fig. 38: Schöck Tronsole® type T-V4-H...-L1301 to L1600: Product layout

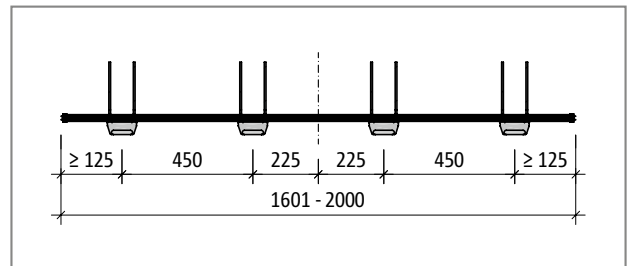


Fig. 39: Schöck Tronsole® type T-V4-H...-L1601 to L2000: Product layout

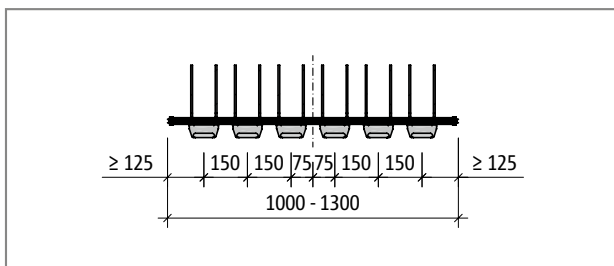


Fig. 40: Schöck Tronsole® type T-V6-H...-L1000 to L1300: Product layout

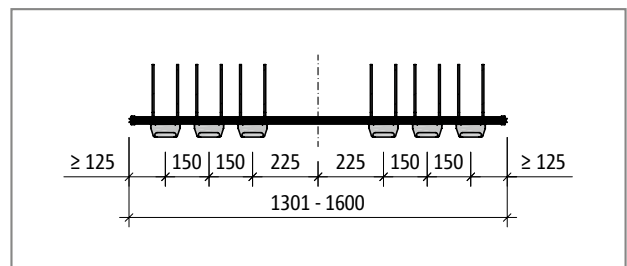


Fig. 41: Schöck Tronsole® type T-V6-H...-L1301 to L1600: Product layout

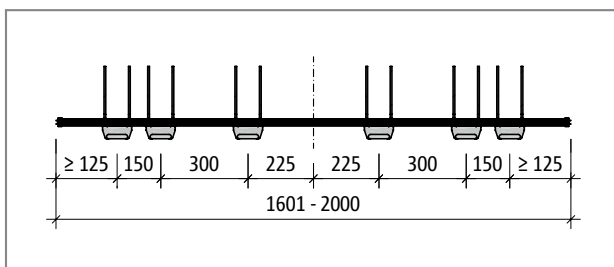


Fig. 42: Schöck Tronsole® type T-V6-H...-L1601 to L2000: Product layout

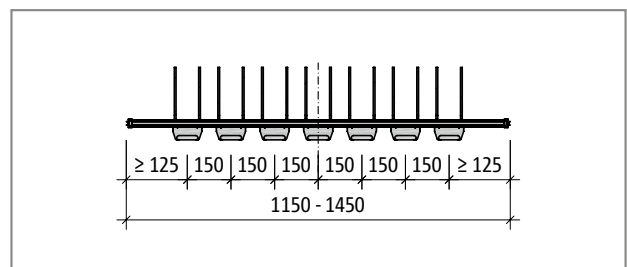


Fig. 43: Schöck Tronsole® type T-V7-H...-L1150 to L1450: Product layout

## Product description

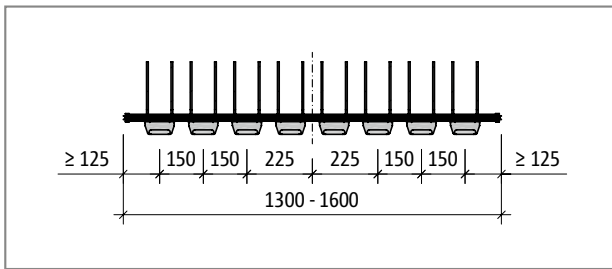


Fig. 44: Schöck Tronsole® type T-V8-H...-L1300 to L1600: Product layout

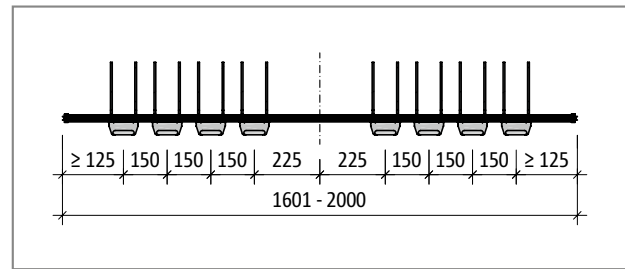


Fig. 45: Schöck Tronsole® type T-V8-H...-L1601 to L2000: Product layout

### **i** Product information

- ▶ The edge distance of the edge of the structural element of the stair flight from the centre to the outer support bracket is  $\geq 125$  mm. Thus a sufficient concrete covering of the on-site reinforcement is ensured.
- ▶ The overall length presented of the Tronsole® includes the end caps.
- ▶ The diameter of the shear force bar is  $d = 6$  mm.

## Design

### Design positive fabrication

| Schöck Tronsole® type   | T-V2                                  | T-V4      | T-V6      | T-V7      | T-V8      |
|-------------------------|---------------------------------------|-----------|-----------|-----------|-----------|
| Design values with      | Concrete strength class $\geq$ C20/25 |           |           |           |           |
| Tronsole® height H [mm] | $V_{Rd,z}$ [kN/element]               |           |           |           |           |
| 160–170                 | 14.3                                  | 28.6      | 42.9      | 50.1      | 57.2      |
| 180–320                 | 17.4                                  | 34.8      | 52.2      | 60.9      | 69.6      |
|                         | $V_{Rd,y}$ [kN/element]               |           |           |           |           |
| 160–320                 | $\pm 1.6$                             | $\pm 3.3$ | $\pm 5.0$ | $\pm 5.8$ | $\pm 6.6$ |

### Design negative fabrication

| Schöck Tronsole® type        | T-V2-NF   | T-V4-NF   | T-V6-NF   | T-V7-NF   | T-V8-NF   |
|------------------------------|---|-----------|-----------|-----------|-----------|
| Design values with           | Concrete strength landing $\geq$ C20/25, stair flight $\geq$ C30/37 |           |           |           |           |
| Tronsole® height H [mm]      | $V_{Rd,z}$ [kN/element]   |           |           |           |           |
| 160–170 ( $h_A \geq 180$ mm) | 14.3  | 28.6      | 42.9      | 50.1      | 57.2      |
| 180–320                      | 17.4  | 34.8      | 52.2      | 60.9      | 69.6      |
|                              | $V_{Rd,y}$ [kN/element]   |           |           |           |           |
| 160–320                      | $\pm 1.6$   | $\pm 3.3$ | $\pm 5.0$ | $\pm 5.8$ | $\pm 6.6$ |

| Schöck Tronsole® type      | T-V2     | T-V4     | T-V6      | T-V7      | T-V8      |
|----------------------------|----------|----------|-----------|-----------|-----------|
| Tronsole® height H [mm]    | 160–320  |          |           |           |           |
| Tronsole® length L [mm]    | 700–1300 | 700–2000 | 1000–2000 | 1150–1450 | 1300–2000 |
| Tronsole® thickness t [mm] | 14       |          |           |           |           |

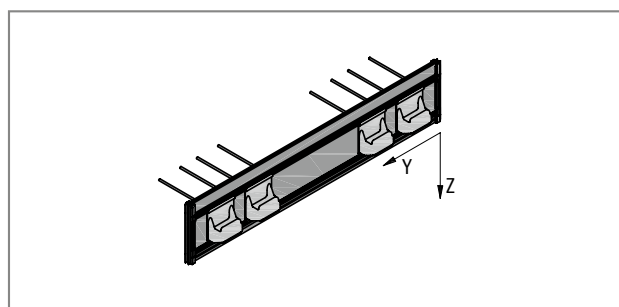


Fig. 46: Schöck Tronsole® type T: Sign rule for the design

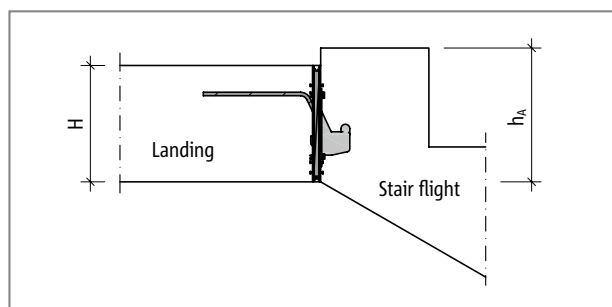


Fig. 47: Schöck Tronsole® type T: Connection height  $h_A$

### **i** Notes on design

- ▶ Area of application of the Schöck Tronsole® type T: Stair flight and landing slabs with mainly quiescent effects
- ▶ A structural calculation is to be produced for the reinforced concrete structural elements adjacent on both sides of the Schöck Isokorb® type T. For the determination of the reinforcement a flexible support is to be assumed as only vertical shear forces and shear forces parallel to the joints can be transmitted through the Tronsole® type T
- ▶ With standard buildings above ground, there are no qualms with regard to the stability as stair support, on the employment of the Schöck Tronsole® type T in earthquake zones of the Federal Republic of Germany. This statement includes buildings in earthquake zone 3 in accordance with DIN 4149.
- ▶ The connection height  $h$  on the flight side  $h_A$  must be at least as great as the Tronsole® height  $H$ .
- ▶ With the use of the Schöck Tronsole® type T-V-NF, for fabrication the flight side connection  $h_A$  is to be selected  $\geq 180$  mm.

## On-site reinforcement - in-situ concrete construction

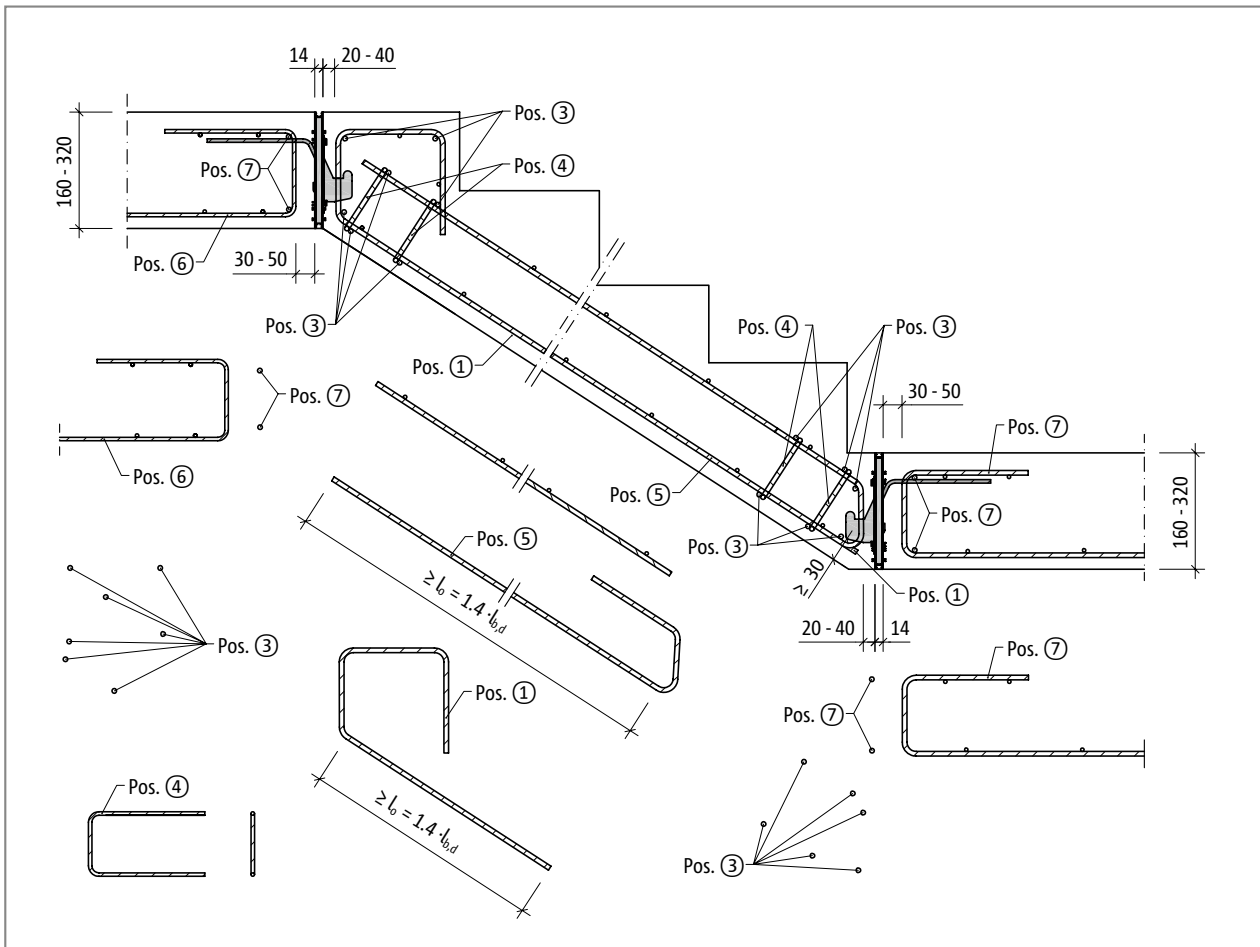


Fig. 48: Schöck Tronsole® type T: On-site reinforcement

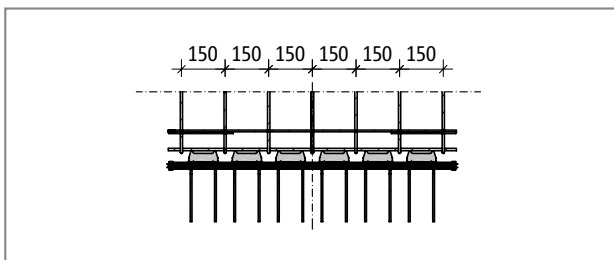


Fig. 49: Schöck Tronsole® type T: Laying pattern of the reinforcement with uneven number of support corbels on the Tronsole®

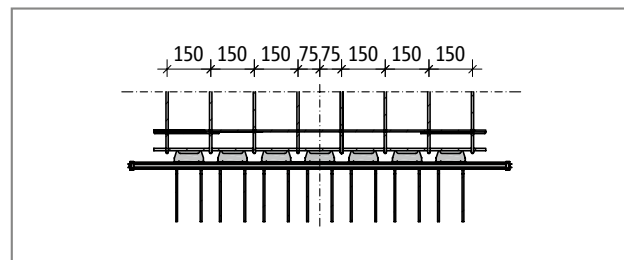


Fig. 50: Schöck Tronsole® type T: Displaced laying pattern of the reinforcement with uneven number of support corbels on the Tronsole®

## On-site reinforcement - in-situ concrete construction

| Schöck Tronsole® type  |                     | T                                     |
|--|---------------------|---------------------------------------|
| On-site reinforcement  | Location            | Concrete strength class $\geq$ C20/25 |
| <b>Pos. 1 slip-in stirrup or stirrup mesh as suspended reinforcement</b> |                     |                                       |
| Pos. 1   | on the flight side  | H8@150 mm                             |
| <b>Pos. 2 closed stirrups</b>  |                     |                                       |
| Pos. 2   | on the flight side  | H8@150 mm                             |
| <b>Pos. 3 steel rods in transverse direction of the stairs</b>           |                     |                                       |
| Pos. 3   | on the flight side  | 15 · H8                               |
| <b>Pos. 4 Ties for the securing of the stair strings</b>                 |                     |                                       |
| Pos. 4   | on the flight side  | 2 · 4 · H8                            |
| <b>Pos. 5 Ties or stirrup mesh as suspended reinforcement</b>            |                     |                                       |
| Pos. 5   | on the flight side  | H8@150 mm                             |
| <b>Pos. 6 ties or stirrup mesh as edging</b>                             |                     |                                       |
| Pos. 6   | on the landing side | H8@150 mm                             |
| <b>Pos. 7 steel rods in transverse direction of the stairs</b>           |                     |                                       |
| Pos. 7   | on the landing side | 2 · H8                                |
| <b>Pos. 8 Ties or stirrup mesh as edging</b>                             |                     |                                       |
| Pos. 8   | on the landing side | H8@150 mm                             |
| <b>Pos. 9 steel rods in transverse direction of the stairs</b>           |                     |                                       |
| Pos. 9   | on the landing side | 2 · H8                                |

### **i** Notes

- ▶ The bending tension reinforcement of the stair flight is to be determined by the structural engineer.
- ▶ A suspended reinforcement dimensioned for the maximum shear force is to be positioned at both ends of the stair flight (Pos. 1, Pos. 5). Normally this is achieved by the running up of the lower reinforcement. A sufficient anchoring is to be ensured.
- ▶ The support corbels of the Schöck Tronsole® type T are arranged in a structural module, which is 150 mm resp. a multiple of 150 mm. Due to the even number of support corbels and their centre line symmetrical arrangement the longitudinal axis of the stair flight agrees with the centre of the Tronsole® and with the origin of the laying grid of the longitudinal reinforcement.
- ▶ The odd number of support brackets (7 pc) requires a displacement of the laying grid of the stair reinforcement of 75 mm in the transverse direction, as the centre of the Tronsole® type T-V7 is occupied by a support bracket. The gaps between the support corbels are to be found 75 mm left and right of the centre of this product variant.

## On-site reinforcement - precast construction

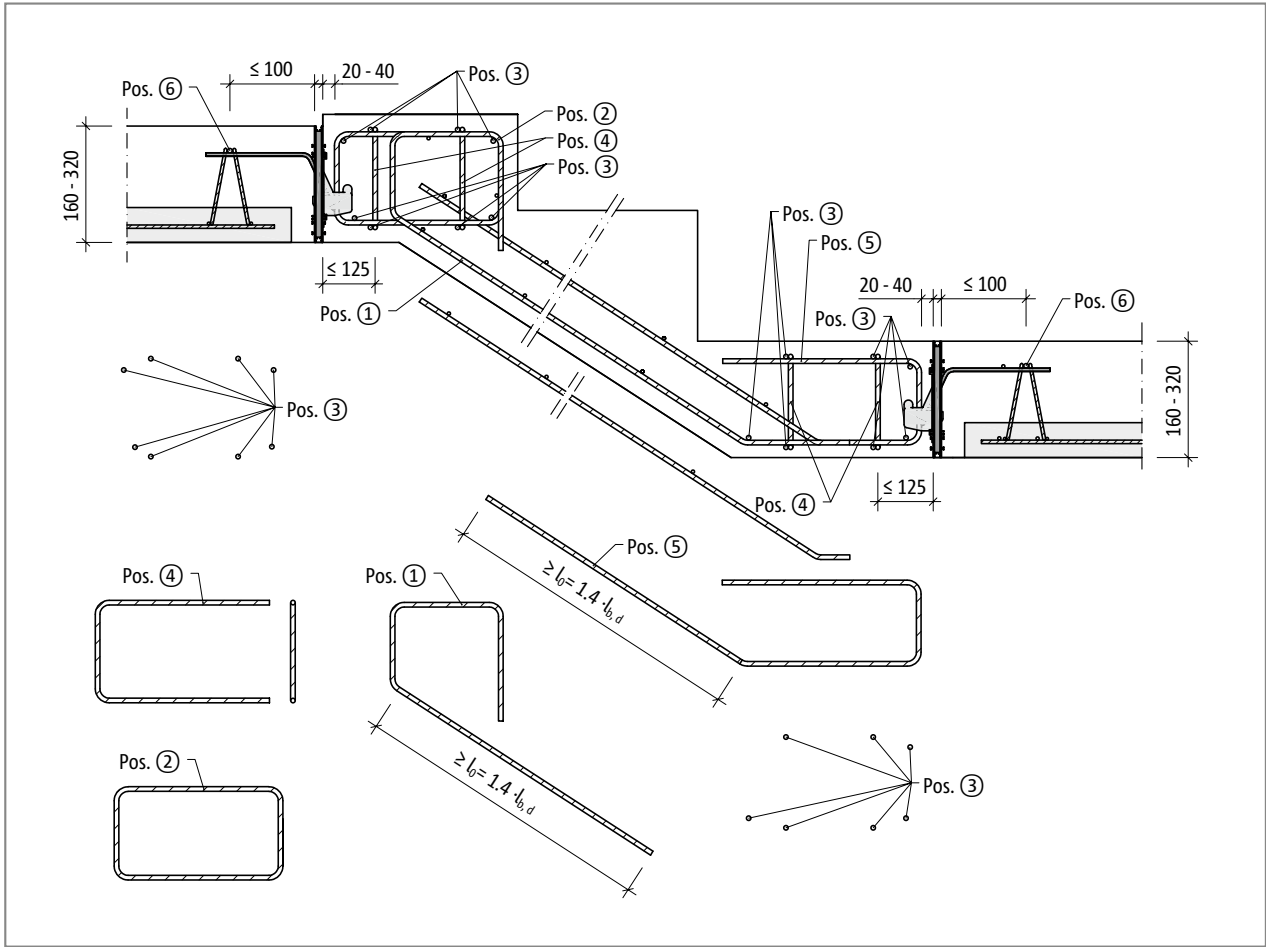


Fig. 51: Schöck Tronsole® type T: On-site reinforcement with precast landing

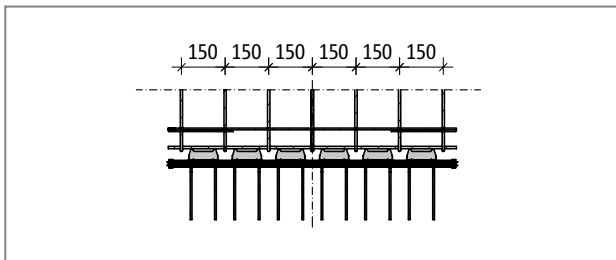


Fig. 52: Schöck Tronsole® type T: Laying pattern of the reinforcement with uneven number of support corbels on the Tronsole®

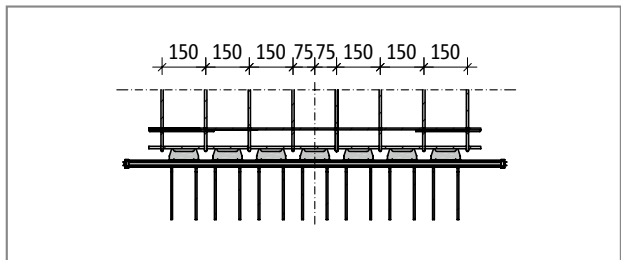


Fig. 53: Schöck Tronsole® type T: Displaced laying pattern of the reinforcement with uneven number of support corbels on the Tronsole®



## On-site reinforcement - precast construction

| Schöck Tronsole® type  |                     | T   |
|--|---------------------|---|
| On-site reinforcement  | Location            | Concrete strength class $\geq$ C20/25             |
| <b>Pos. 1 slip-in stirrup or stirrup mesh as suspended reinforcement</b> |                     |   |
| Pos. 1   | on the flight side  | H8@150 mm   |
| <b>Pos. 2 closed stirrups</b>  |                     |   |
| Pos. 2   | on the flight side  | H8@150 mm   |
| <b>Pos. 3 steel rods in transverse direction of the stairs</b>           |                     |   |
| Pos. 3   | on the flight side  | 15 · H8   |
| <b>Pos. 4 Ties for the securing of the stair strings</b>                 |                     |   |
| Pos. 4   | on the flight side  | 2 · 4 · H8  |
| <b>Pos. 5 Ties or stirrup mesh as suspended reinforcement</b>            |                     |   |
| Pos. 5   | on the flight side  | H8@150 mm   |
| <b>Pos. 6 Lattice girders as edging</b>                                  |                     |   |
| Pos. 6   | on the landing side | equivalent to H8@150 mm = 3.35 cm <sup>2</sup> /m |

### **i** Notes

- ▶ The bending tension reinforcement of the stair flight is to be determined by the structural engineer.
- ▶ A suspended reinforcement dimensioned for the maximum shear force is to be positioned at both ends of the stair flight (Pos. 1, Pos. 5). Normally this is achieved by the running up of the lower reinforcement. A sufficient anchoring is to be ensured.
- ▶ The support corbels of the Schöck Tronsole® type T are arranged in a structural module, which is 150 mm resp. a multiple of 150 mm. Due to the even number of support corbels and their centre line symmetrical arrangement the longitudinal axis of the stair flight agrees with the centre of the Tronsole® and with the origin of the laying grid of the longitudinal reinforcement.
- ▶ The odd number of support brackets (7 pc) requires a displacement of the laying grid of the stair reinforcement of 75 mm in the transverse direction, as the centre of the Tronsole® type T-V7 is occupied by a support bracket. The gaps between the support corbels are to be found 75 mm left and right of the centre of this product variant.

T

## Compression joints

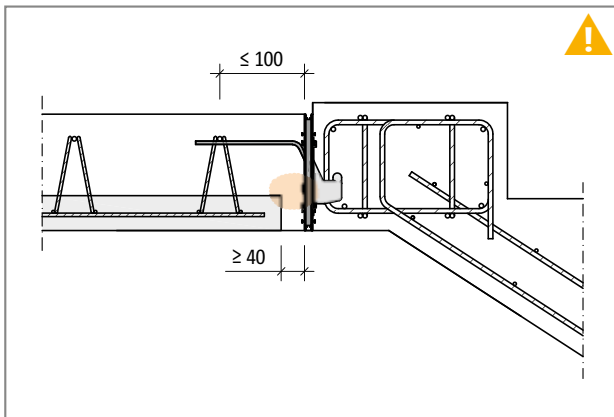


Fig. 54: Schöck Tronsole® type T: Installation in combination with prefabricated floors, compression joint on floor side

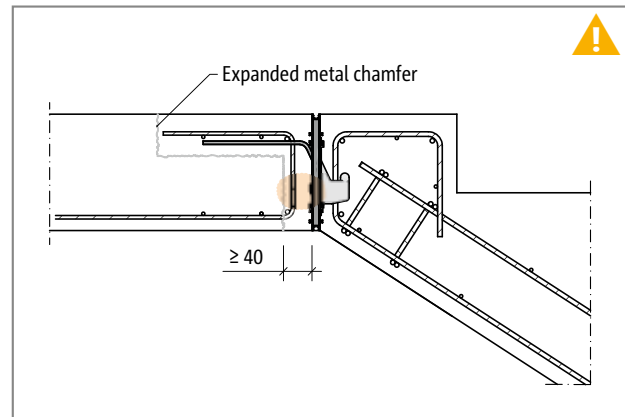


Fig. 55: Schöck Tronsole® type T: Installation in combination with construction joints at floor edge, compression joint on floor side

### ⚠ Hazard note compression joints

Compression joints are joints which, with unfavourable loading combination, remain completely overpressured (DIN EN 1992-1-1 / NA, NCI to 10.9.4.3(1)). The products own stainless steel supporting angle of the Schöck Tronsole® type T transmits a horizontal compression force to the floor front face. With construction joints at the floor edge or with prefabricated floors then the definition in the standard is also effective.

- ▶ Compression joints are to be marked in framework and reinforcement plans.
- ▶ Compression joints between precast elements are always to be grouted using in-situ concrete. This also applies for compression joints with the Schöck Isokorb® type T!
- ▶ For compression joints with the Schöck Isokorb® type T, an in-situ concrete and/or poured strips of  $\geq 40$  mm width must be implemented. This is to be entered in the working drawings.

## Deflection

### Deformation of the Elodur® elastomer support of the Tronsole® type T

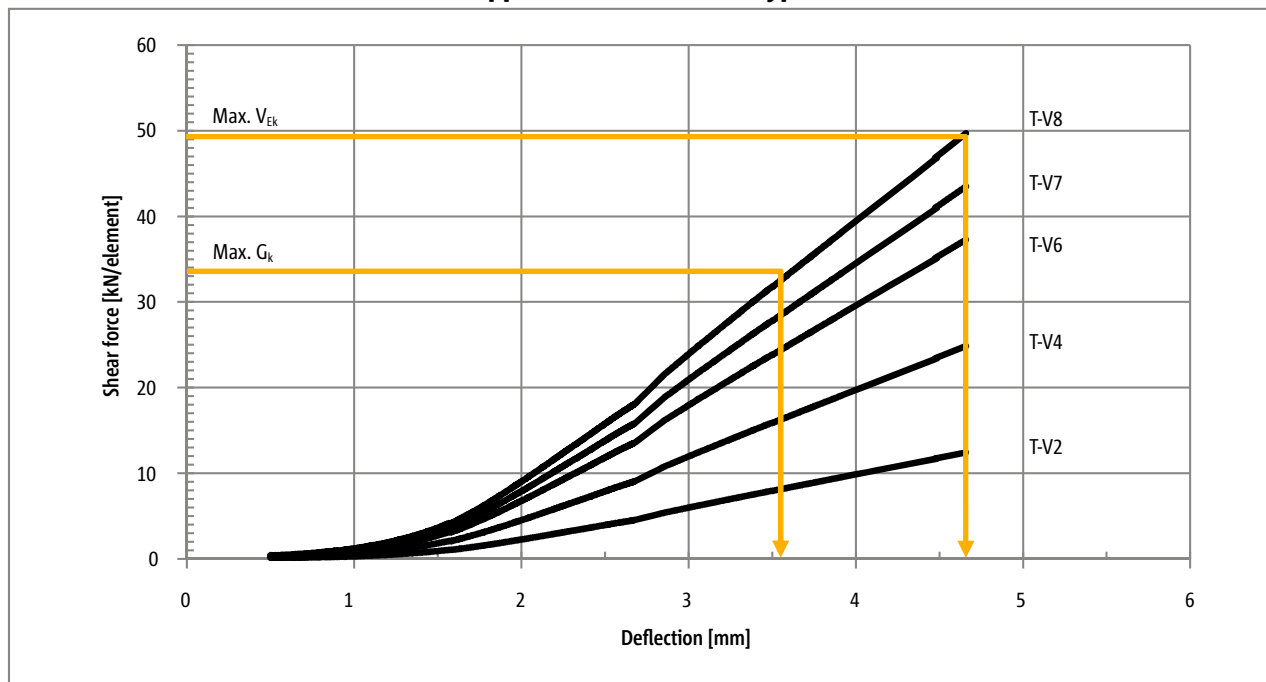


Fig. 56: Schöck Tronsole® type T: Deformation of the Elodur® elastomer support

#### **i** Notes on deformation

- ▶ Deflection is the vertical deformation of the Elodur® elastomer support under vertical shear force load.
- ▶ Creep is additionally to be taken into account with 50 % of the deflection from the constant load  $G_k$ .
- ▶  $\text{Max. } V_{Ek} = \text{Max. } V_{Ed} / \gamma$ , whereby  $\gamma = 1.4$
- ▶  $\gamma = 1.4$  applies under the assumption that  $\text{Max. } V_{Ed}$  is made up of two thirds from own weight and one third from live load.
- ▶ Thus  $\text{Max. } V_{Ek}$  is the maximum service load and the maximum own weight is  $\text{Max. } G_k = 2/3 \cdot \text{Max. } V_{Ek}$ .

## Deflection | Precast construction

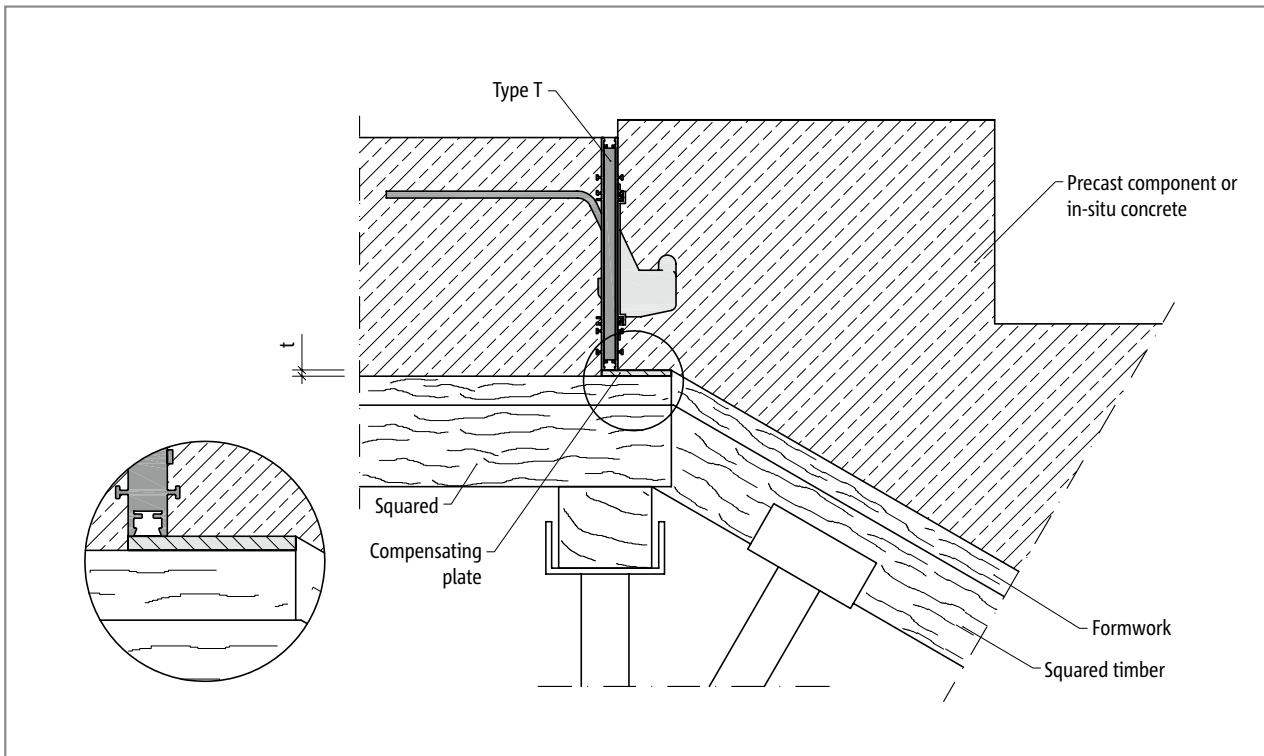


Fig. 57: Schöck Tronsole® type T: Taking into account the deflection of the stair flight by means of on-site compensating plate of thickness  $t$

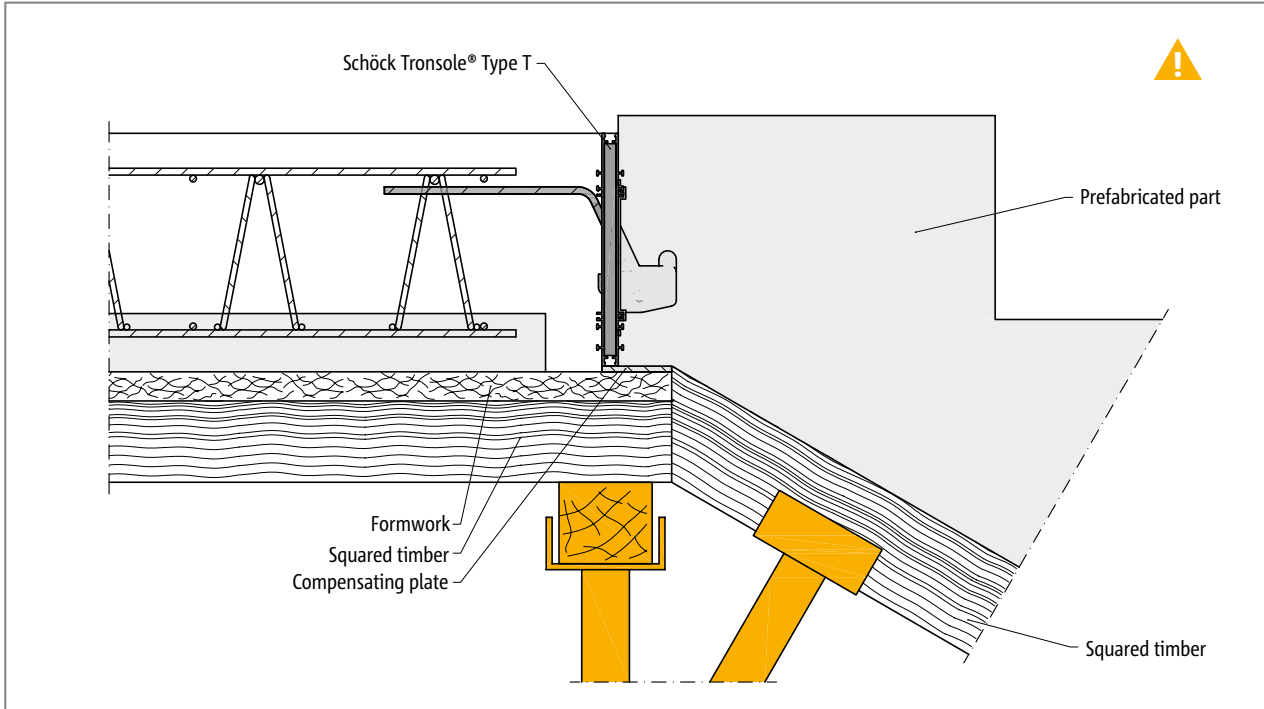


Fig. 58: Schöck Tronsole® Type T: Supports coloured yellow

### ⚠ Hazard warning - missing supports during construction

- ▶ Precast stairs will collapse without support during construction.
- ▶ During construction, precast stairs must be supported using supports of suitable dimensions.
- ▶ Temporary supports are only permitted to be removed after approval by site management.

## Fire protection | Materials | Installation

### **i** Fire protection

- ▶ The neighbouring structural elements must satisfy the same building supervisory requirements on the fire resistance capability as the connection area itself.
- ▶ Schöck Tronsole® type T is equipped with fire protection tapes. They have been classified in the fire resistance class R 90 in accordance with DIBt Approval Z-15.7-310.

### Materials and construction materials

| Schöck Tronsole® type T | Material                               |
|-------------------------|--|
| PE foam panel           | PE foam according to DIN EN 14313      |
| Plastic profile         | PVC-U according to DIN EN 13245-1      |
| Shear force bars        | B500A NR, Material No. 1.4362          |
| Angle                   | Material No. 1.4301 or 1.4404          |
| Elastomer support       | Polyurethane according to DIN EN 13165 |
| Corbel cover            | Polystyrene                            |
| Slip-on profile         | PVC-U according to DIN EN 13245-1      |
| Nail batten             | PVC (Regrind)                          |

### **i** Installation

- ▶ With the use of in-situ concrete the Tronsole® is secured by means of a nail batten stuck on the base of the formwork and, at the top, with the aid of a second nail batten and a wooden strip. In the case that it is concreted on one side only the Tronsole® must additionally be supported at least three points per linear meter distributed evenly over the length.
- ▶ With prefabricated construction the Tronsole® type T is used in any case as formwork with concreting of the stair flight. With concreting in a lateral position to the stairs, the Tronsole® must be supported along its length, in order to withstand the concreting pressure.
- ▶ With negative fabrication please install the Schöck Tronsole® type T for negative construction (NF.)
- ▶ The nail batten is to be removed after stripping.

### **!** Hazard note

- ▶ The rods of the Schöck Tronsole® type T bent in the factory may not be subsequently bent, bent back or shortened. Otherwise in such cases our warranty ceases.

## Customisation options

The Schöck Tronsole® type T can be ordered in centimetre steps. Should it nevertheless be necessary to cut the Schöck Tronsole® type T to length, this is possible. Depending on the initial length it can be trimmed symmetrically. The minimum length is to be taken from the product description (p. 42). After trimming the end caps are to be reassembled

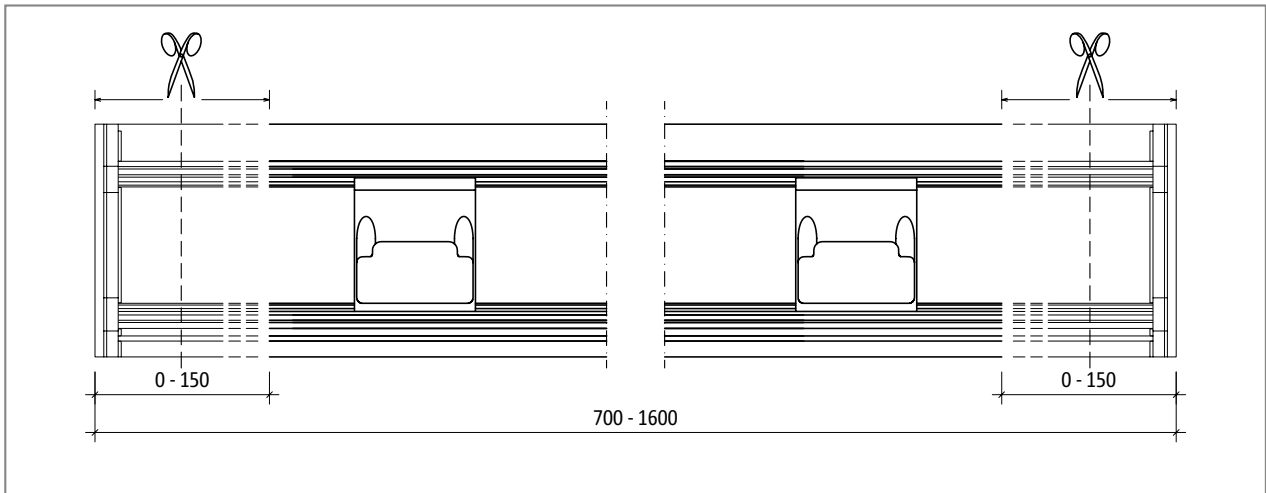


Fig. 59: Schöck Tronsole® type T: Customisation option

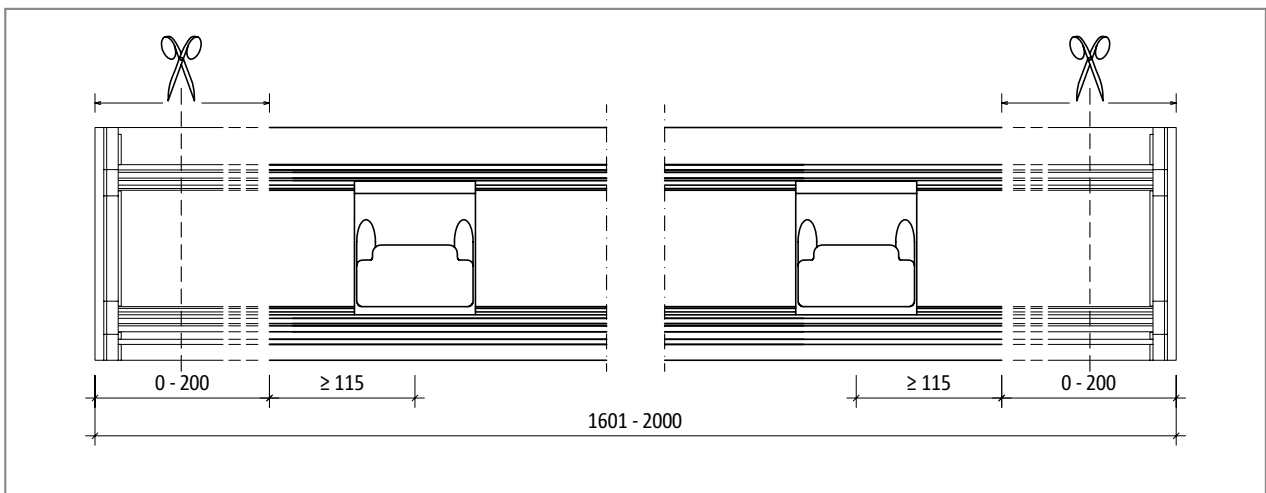


Fig. 60: Schöck Tronsole® type T: Customisation option

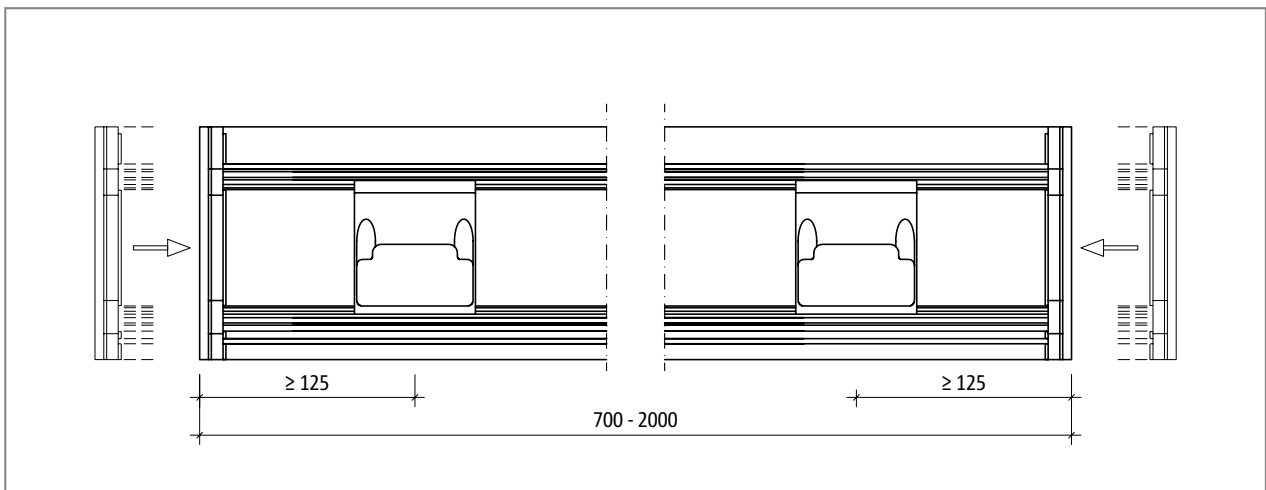
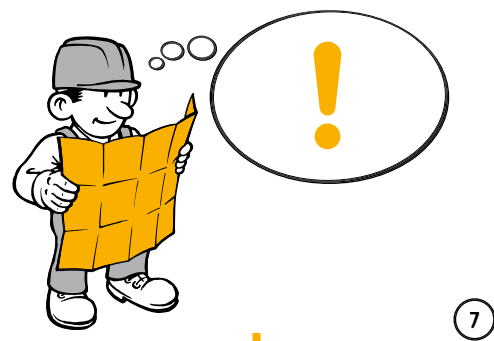
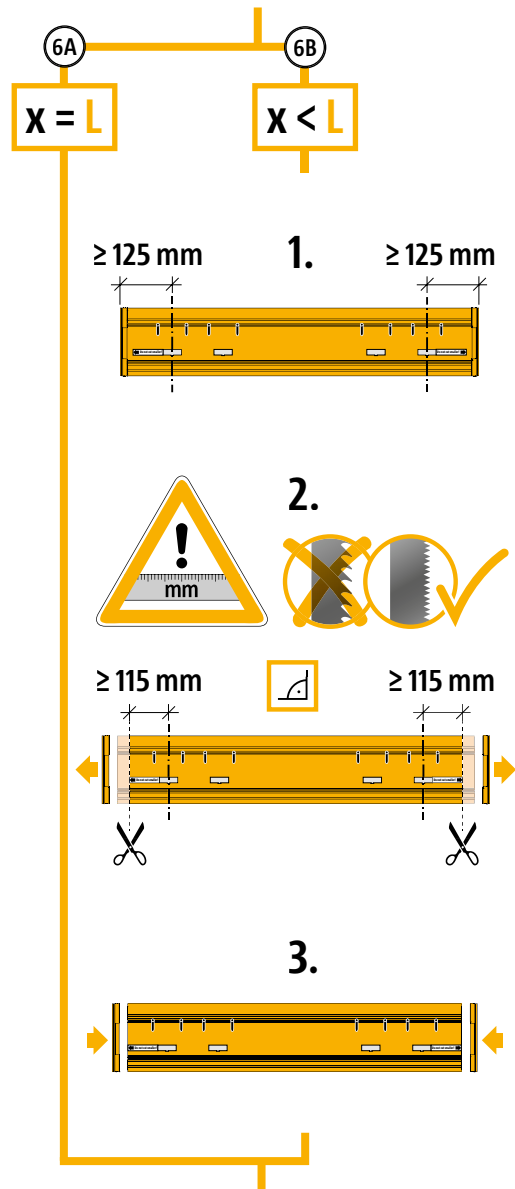
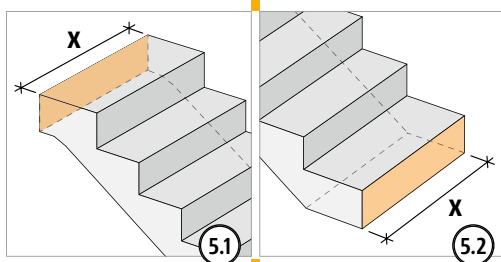
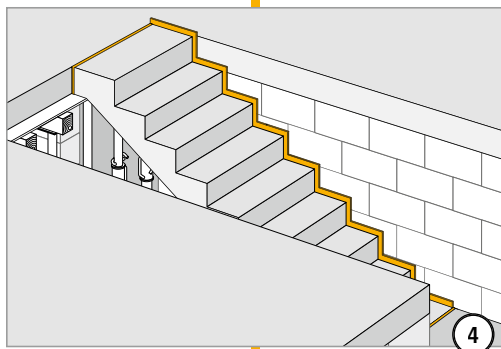
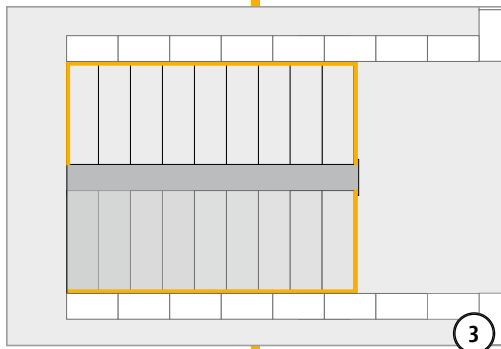
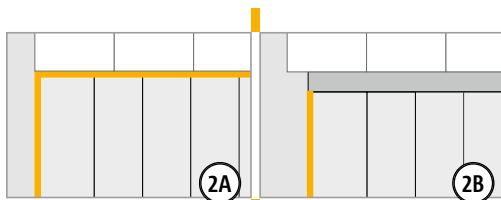
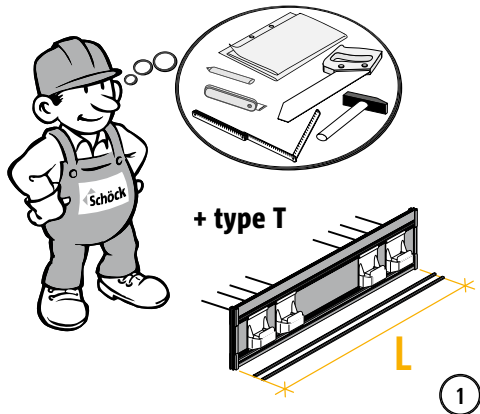
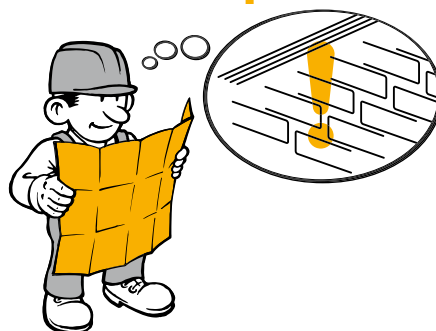
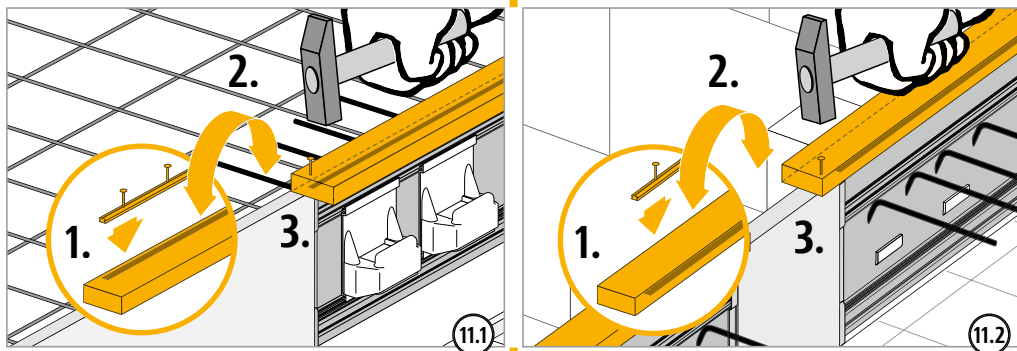
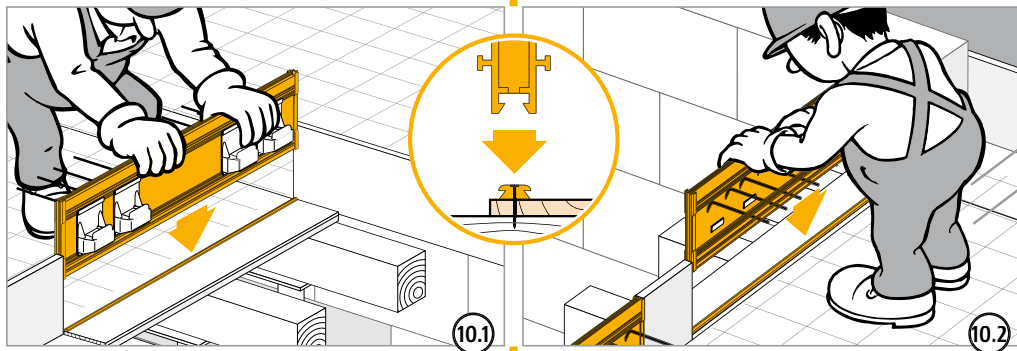
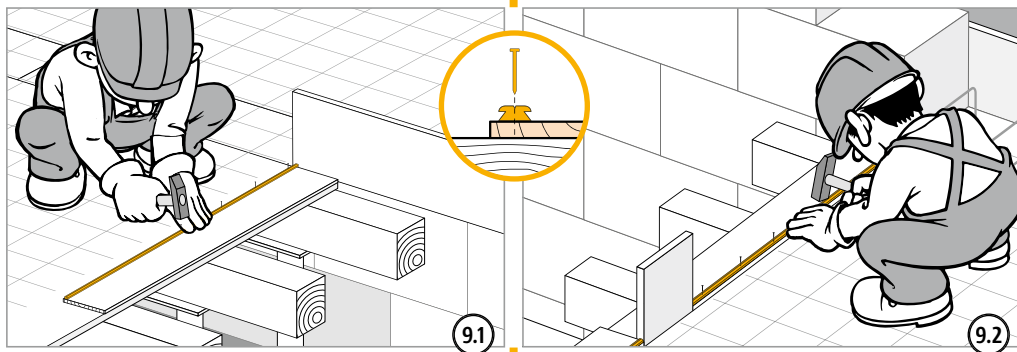
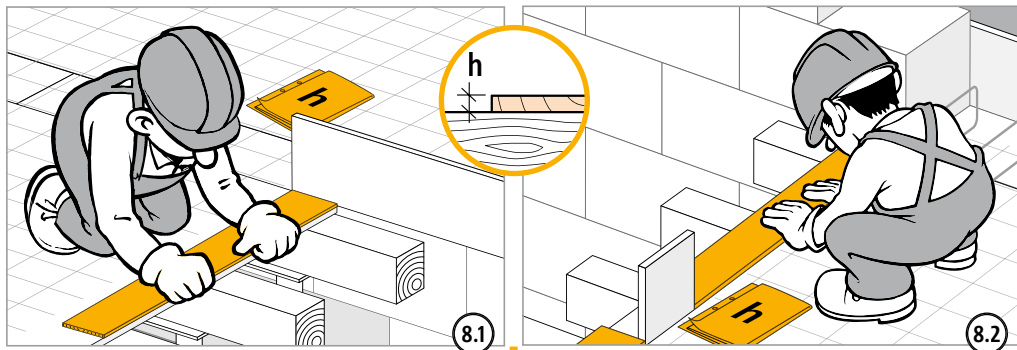


Fig. 61: Schöck Tronsole® type T: Assemble end caps after cutting to length

# Installation instructions building site in-situ concrete

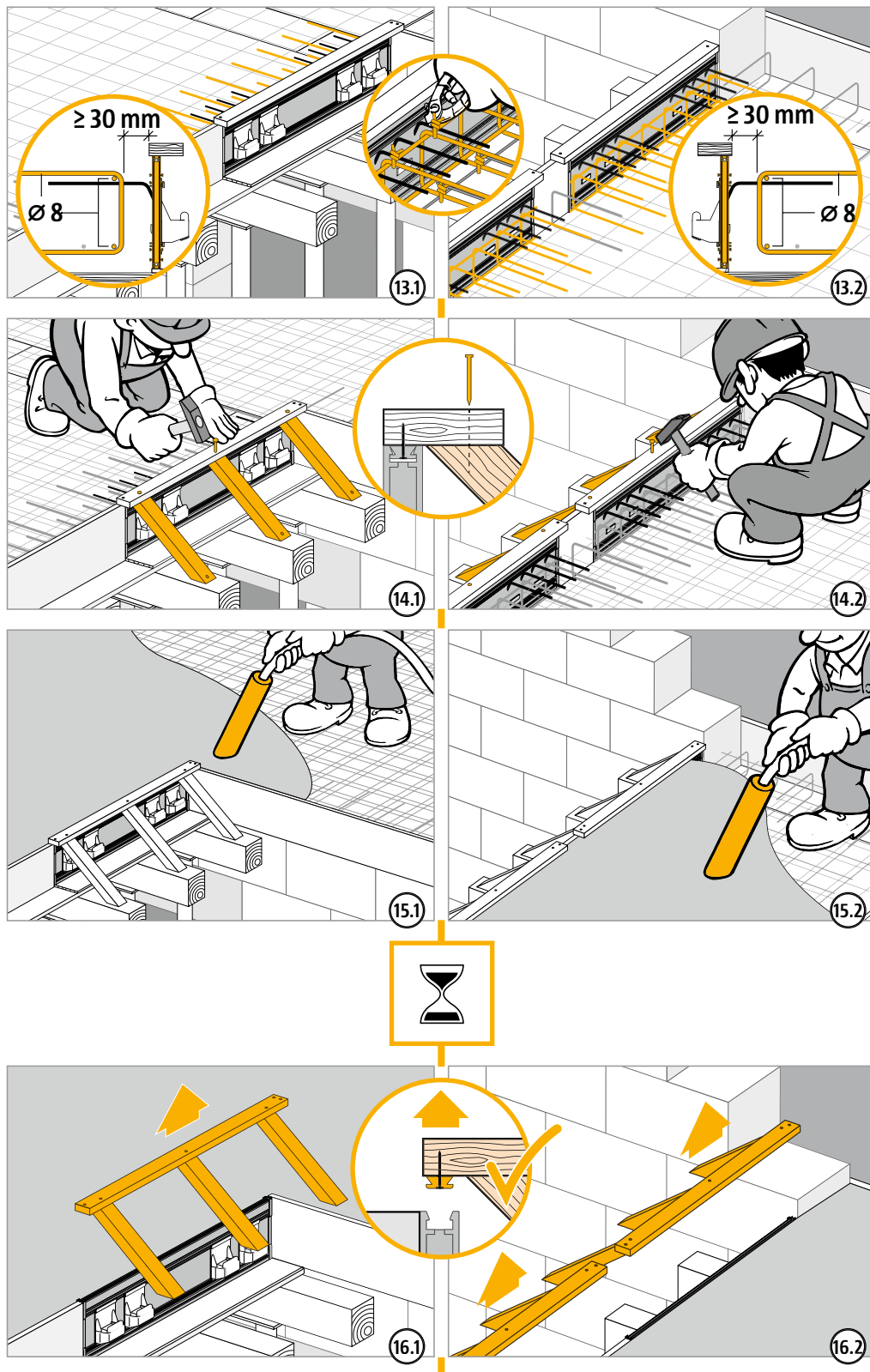


## Installation instructions building site in-situ concrete



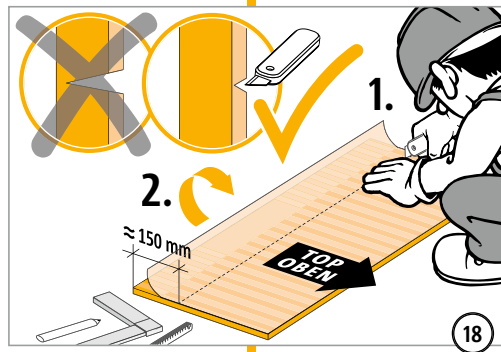
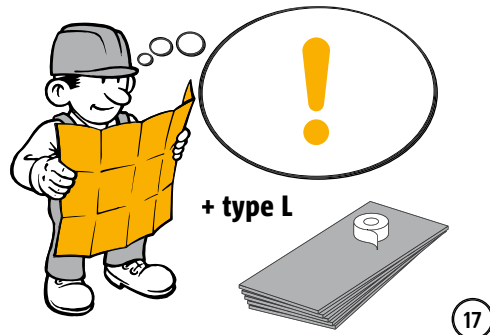


## Installation instructions building site in-situ concrete



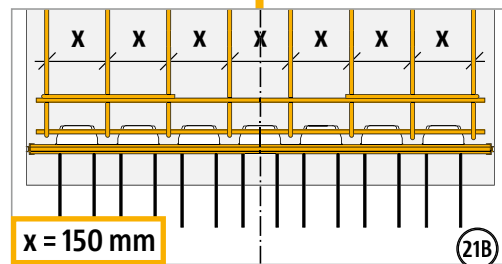
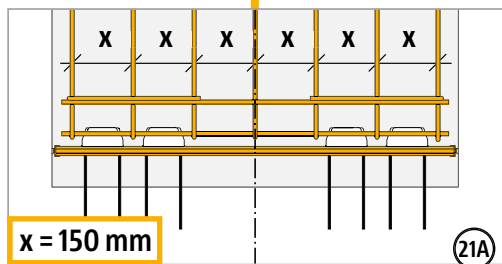
T

# Installation instructions building site in-situ concrete

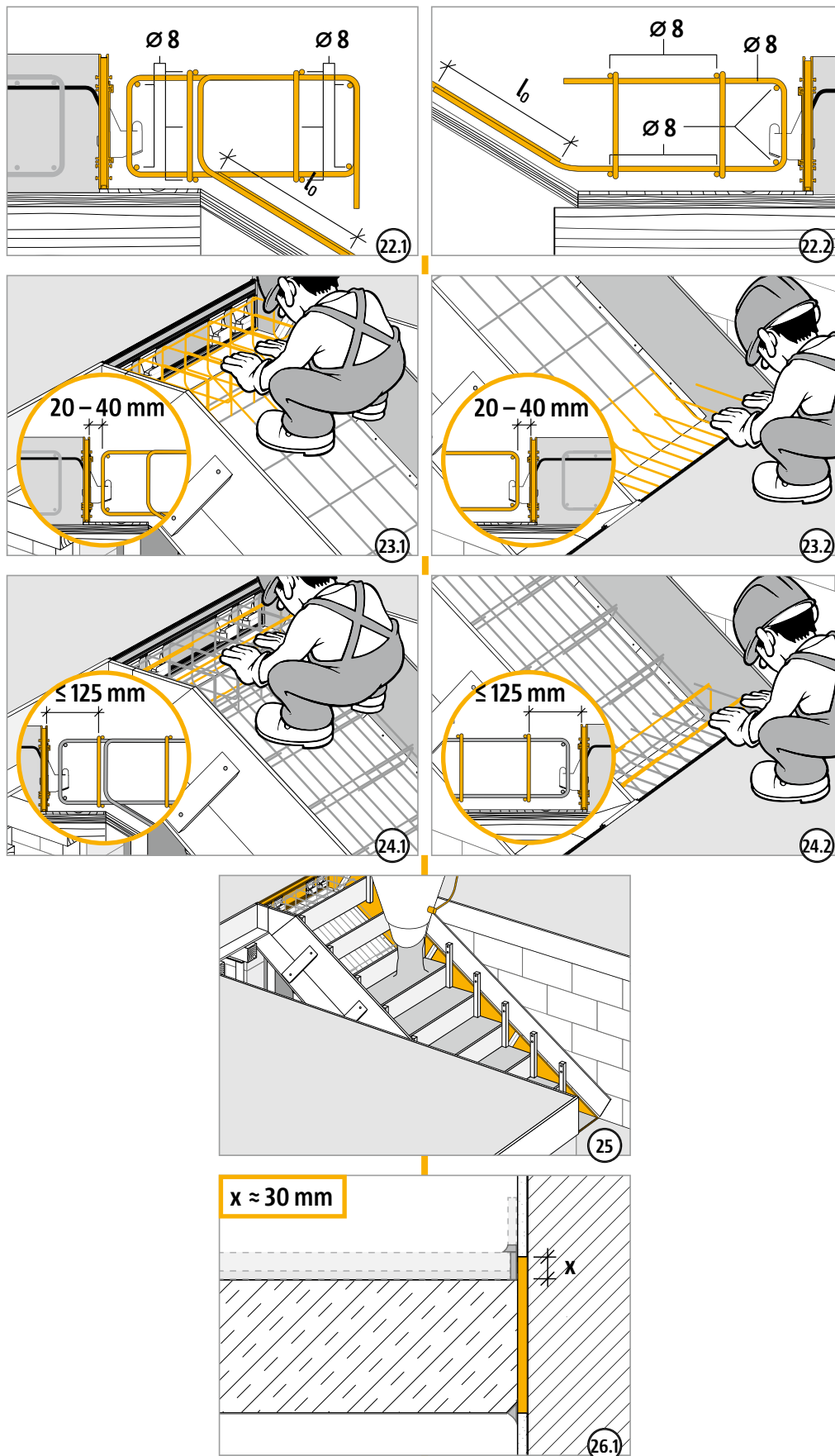


type T-V2, V4, V6, V8, ...

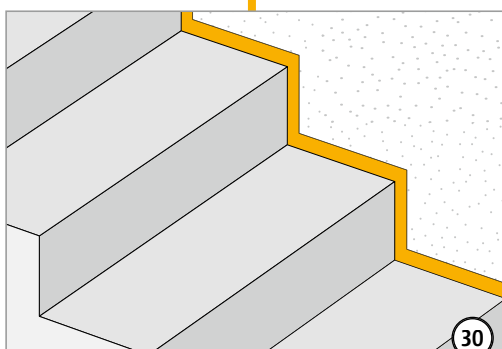
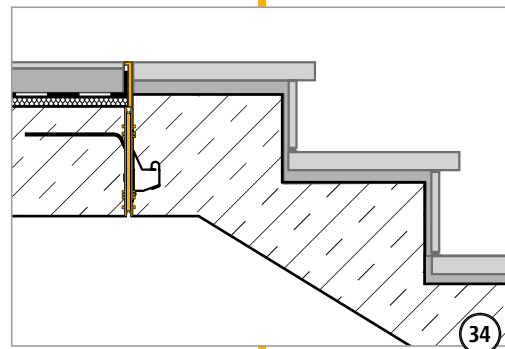
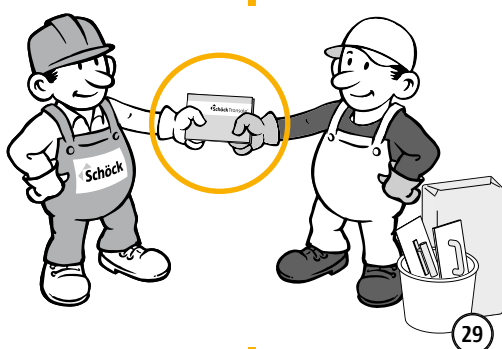
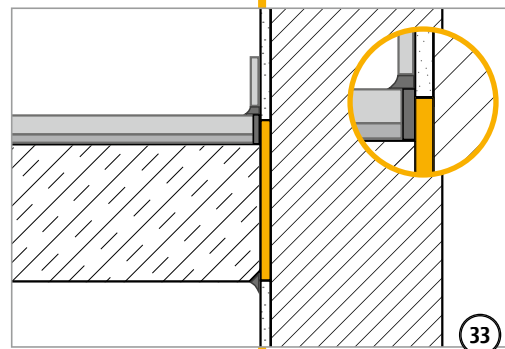
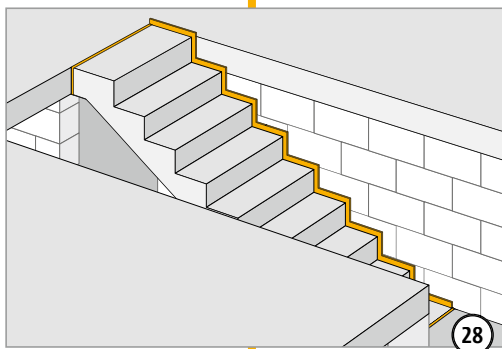
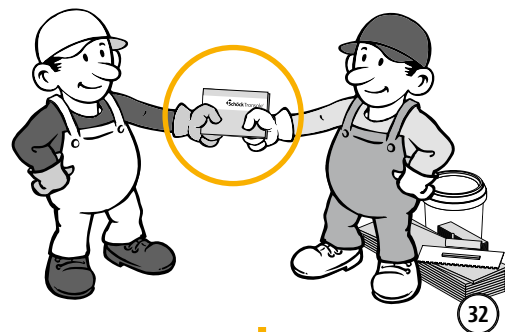
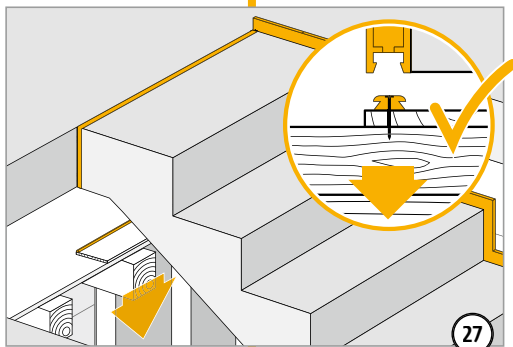
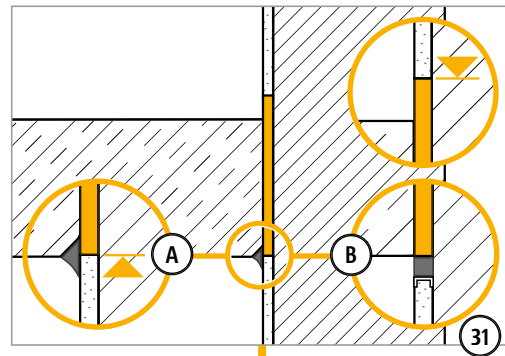
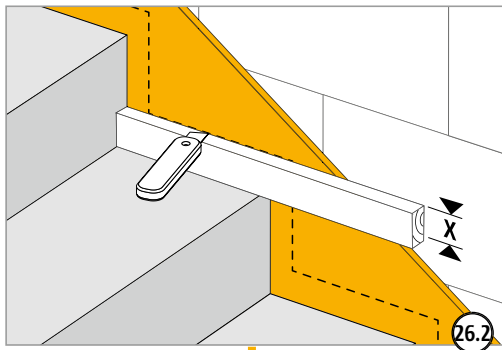
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## Installation instructions building site in-situ concrete

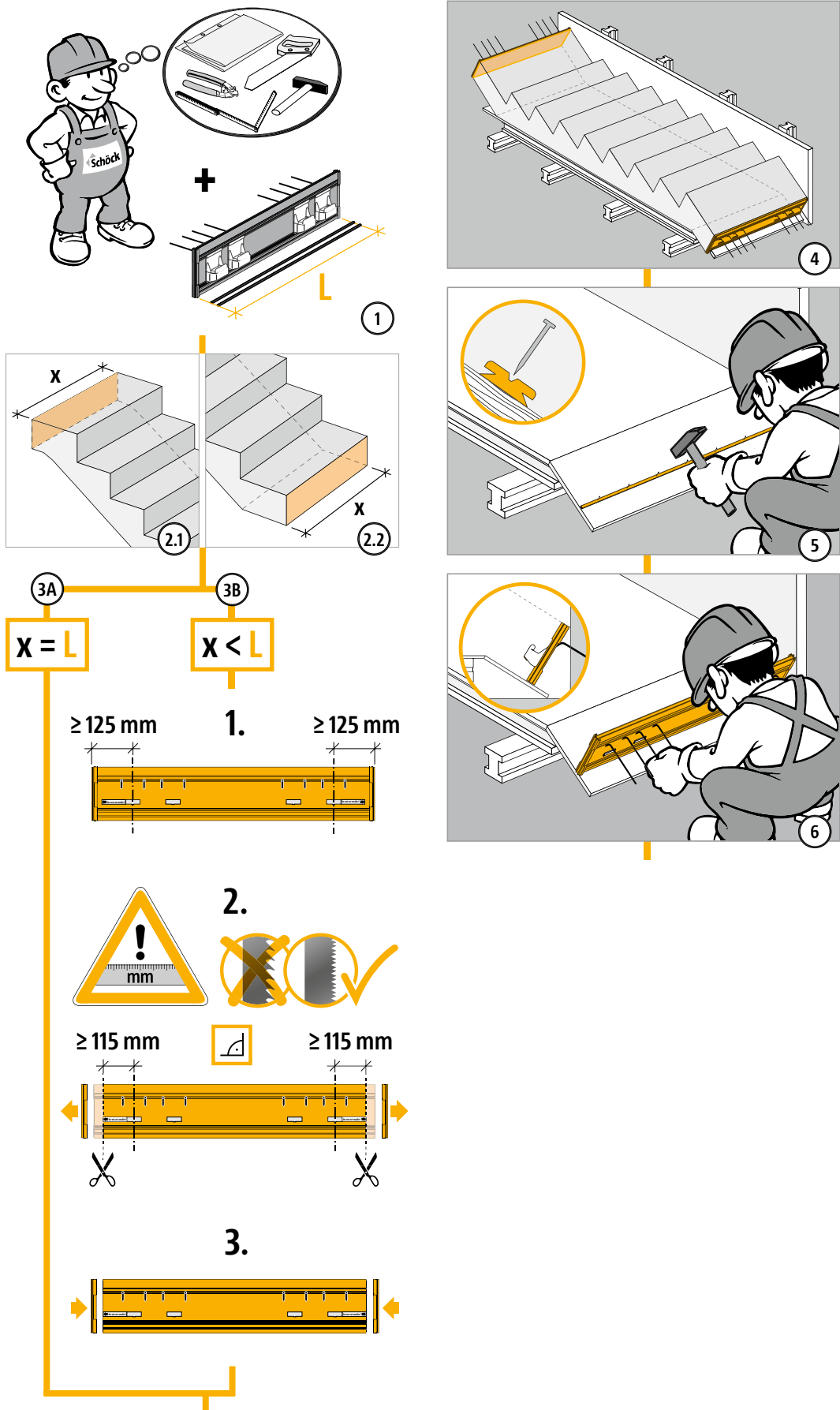


## Installation instructions building site in-situ concrete



T

# Installation instructions for prefabricating plant



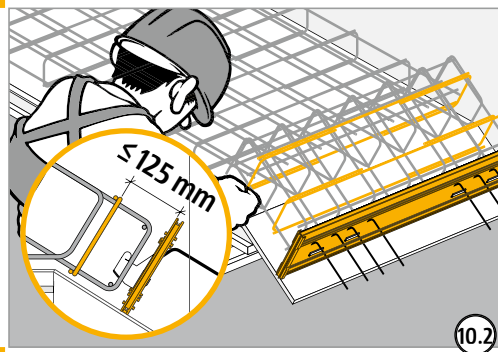
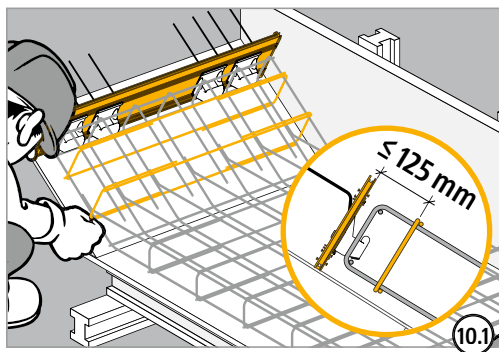
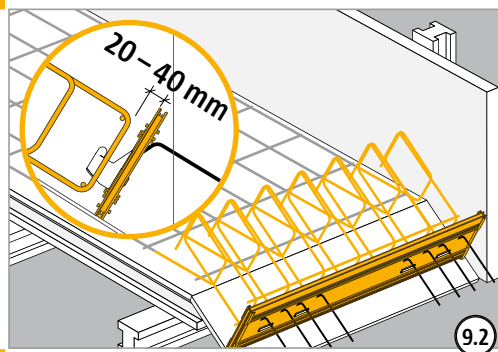
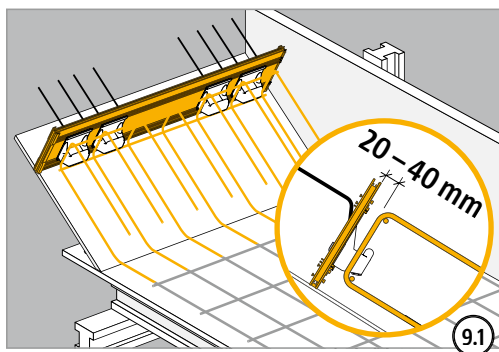
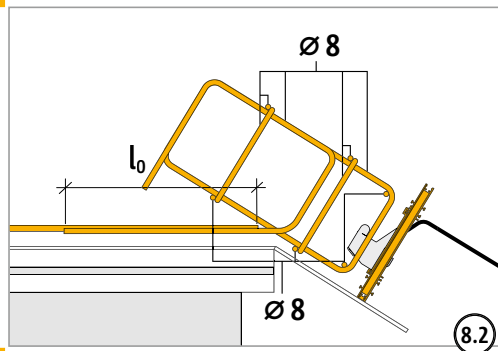
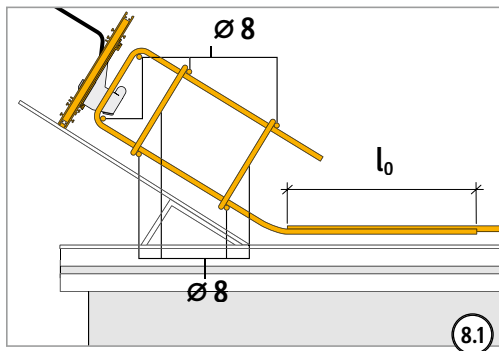
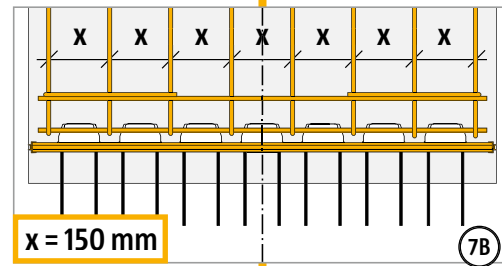
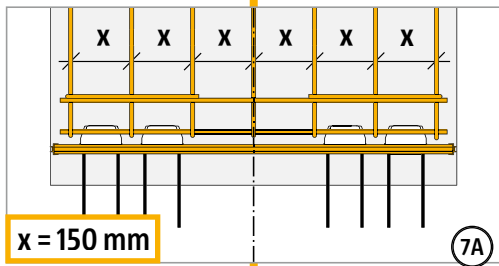
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# Installation instructions for prefabricating plant



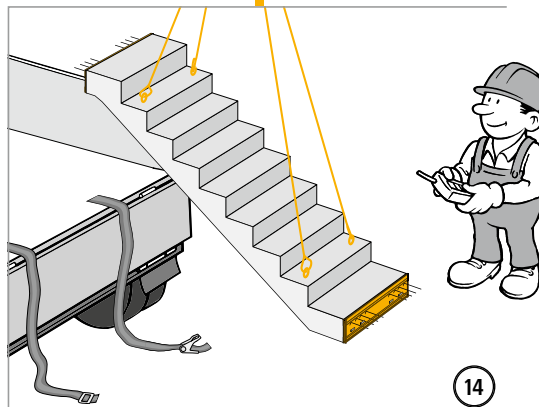
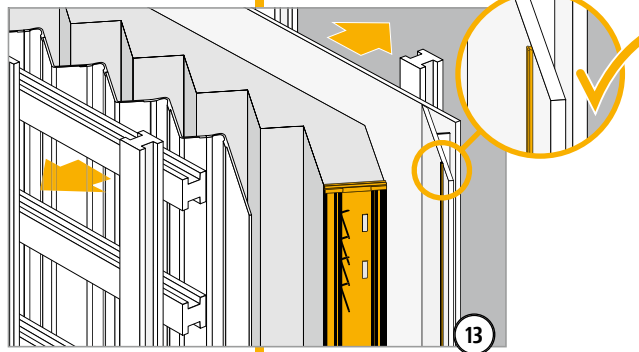
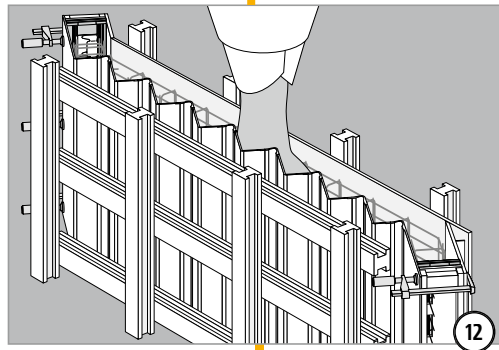
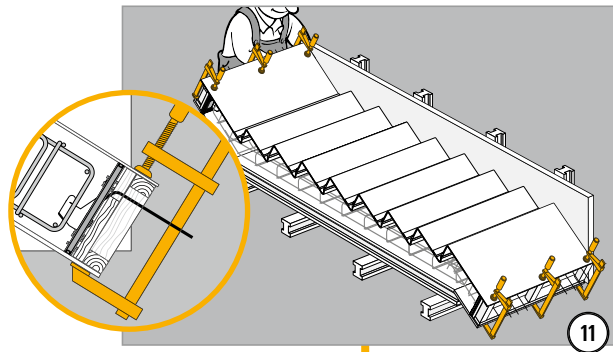
type T-V2, V4, V6, V8, ...

type T-V7



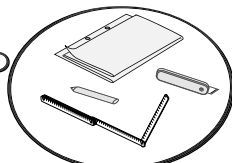
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## Installation instructions for prefabricating plant

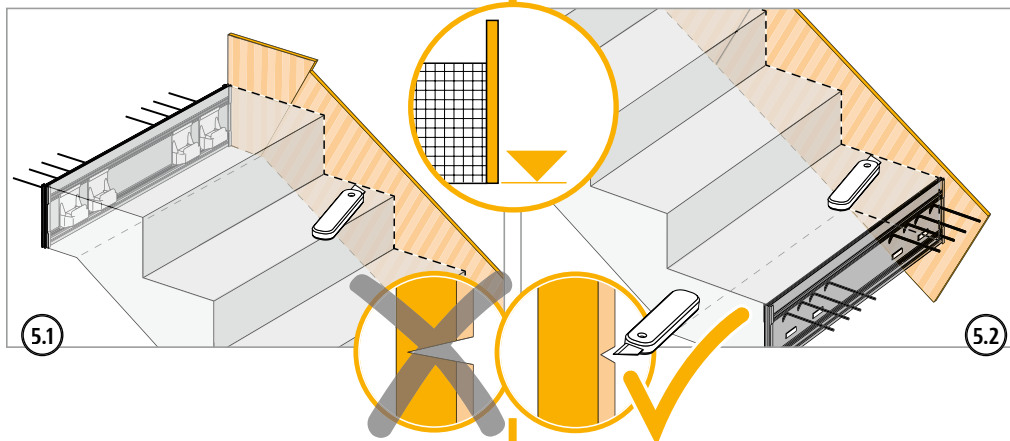
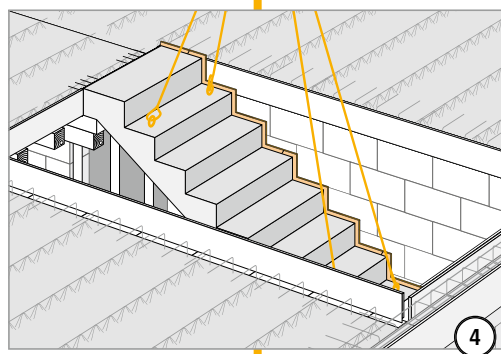
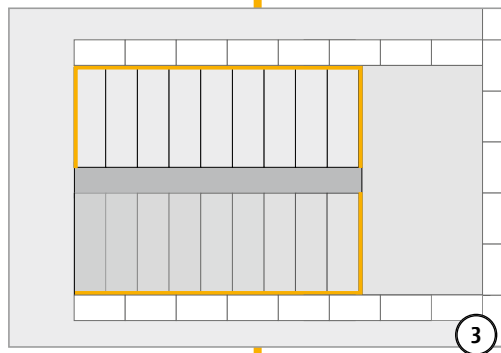
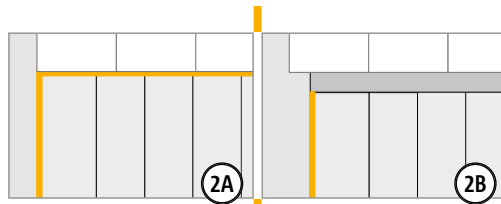
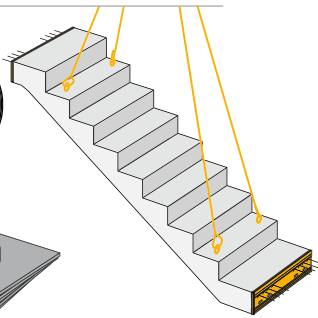
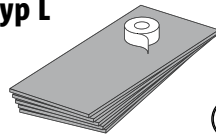


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# Installation instructions building site precast components



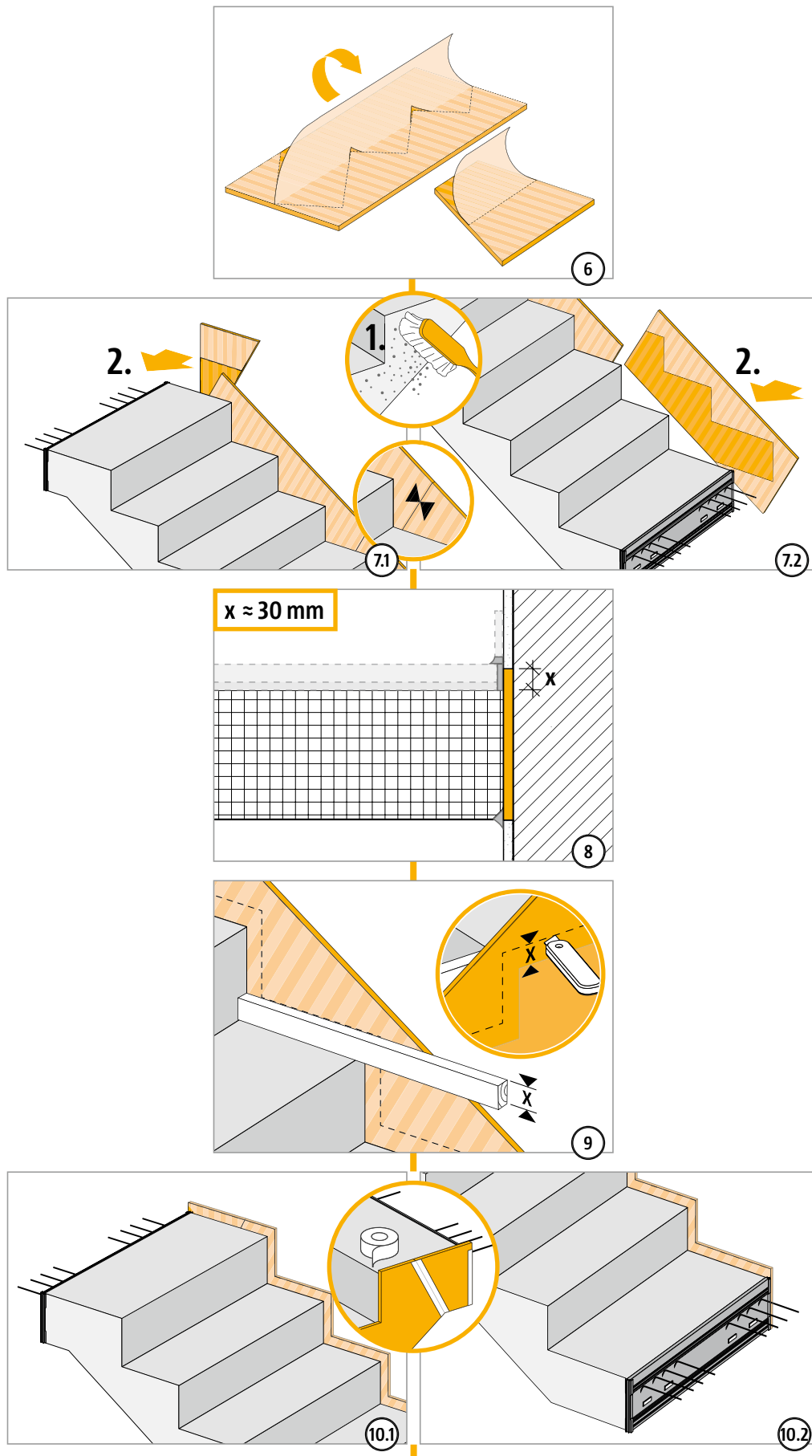
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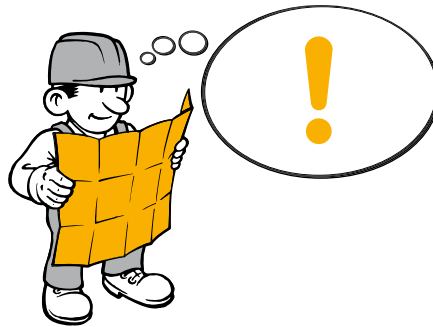
T



## Installation instructions building site precast components



# Installation instructions building site precast components



T

11

$\leq 100 \text{ mm}$

$\geq 40 \text{ mm}$

(12.1)

$\leq 100 \text{ mm}$

$\geq 40 \text{ mm}$

(12.2)

(13.1)

(13.2)

(14)

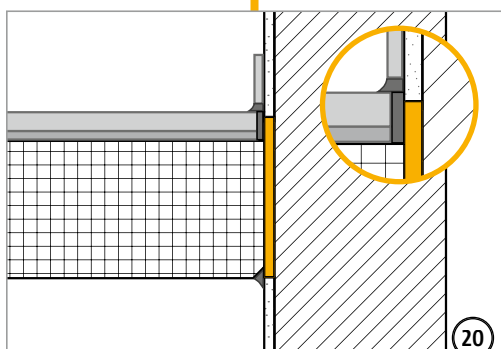
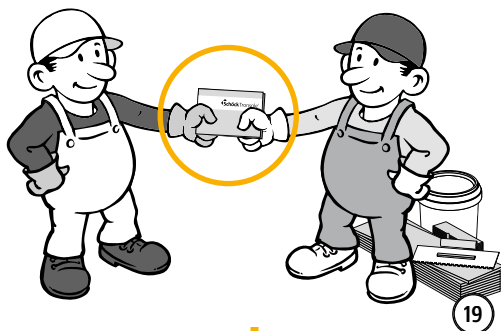
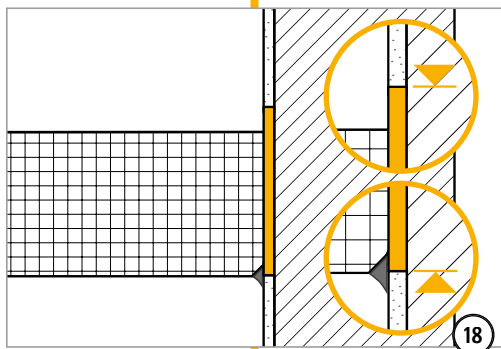
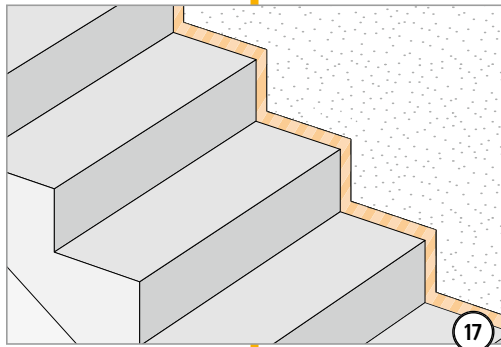
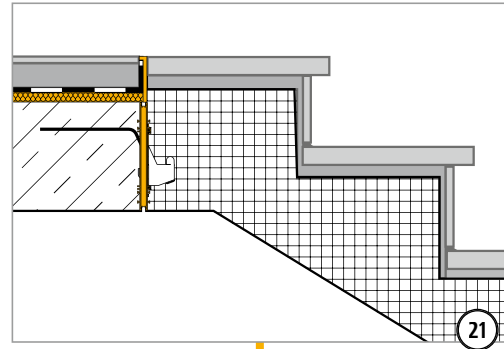
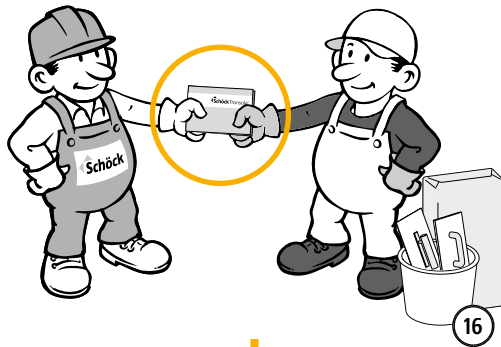
**⚠ WARNING**

**Hazard due to falling structural components with missing support. Secure stairs against falling up to the safe load-bearing capacity of the Tronsole®!**

(15.1)

(15.2)

# Installation instructions building site precast components



## Check list

- Are the dimensions of the Schöck Tronsole® type T adjusted to the structural components which are to be insulated?
- Have the effects on the Schöck Isokorb® connection been specified at design level?
- Is the minimum concrete strength  $\geq$  C20/25 taken into account with the Schöck Tronsole® type T (C30/37 with prefabricated flights of stairs with negative fabrication)?
- Have the requirements with regard to fire protection been cleared and announced?
- Are planned existing horizontal loads, which can be conducted away via the Schöck Tronsole® type T, taken into account?
- Is the Schöck Tronsole® type T-NF scheduled with a planned negative fabrication in the prefabrication plant?

## Schöck Tronsole® type F



F

### **Schöck Tronsole® type F**

Serves the sound insulation of precast stair flight and landing with formation of support. The landing can be produced both in in-situ concrete as well as semi- or fully prefabricated.

## Product characteristics | Product design

### **i** Product characteristics

- ▶ Rated flight impact sound level difference  $\Delta L_{w,flight}^* \geq 26$  dB for Type F-V2;  $\Delta L_{w,flight}^* \geq 28$  dB for Type F-V1, tested according to DIN 7396 with maximum load; test reports no. 91386-01 to 91386-03; (for an explanation of the value  $\Delta L_{w,flight}^*$ , see page 13)
- ▶ High value and efficient Elodur® elastomer support for linear connection
- ▶ Planning certainty through structural component statics
- ▶ Fire resistance class of the adjoining structural component (up to R90) in accordance with fire protection inspection report No. 16503/2013 iBMB Braunschweig
- ▶ Firm attachment to precast stair flight using adhesive assembly tape
- ▶ Length easy to shorten by 100 mm
- ▶ Simple and rapid installation through bracing clip joint

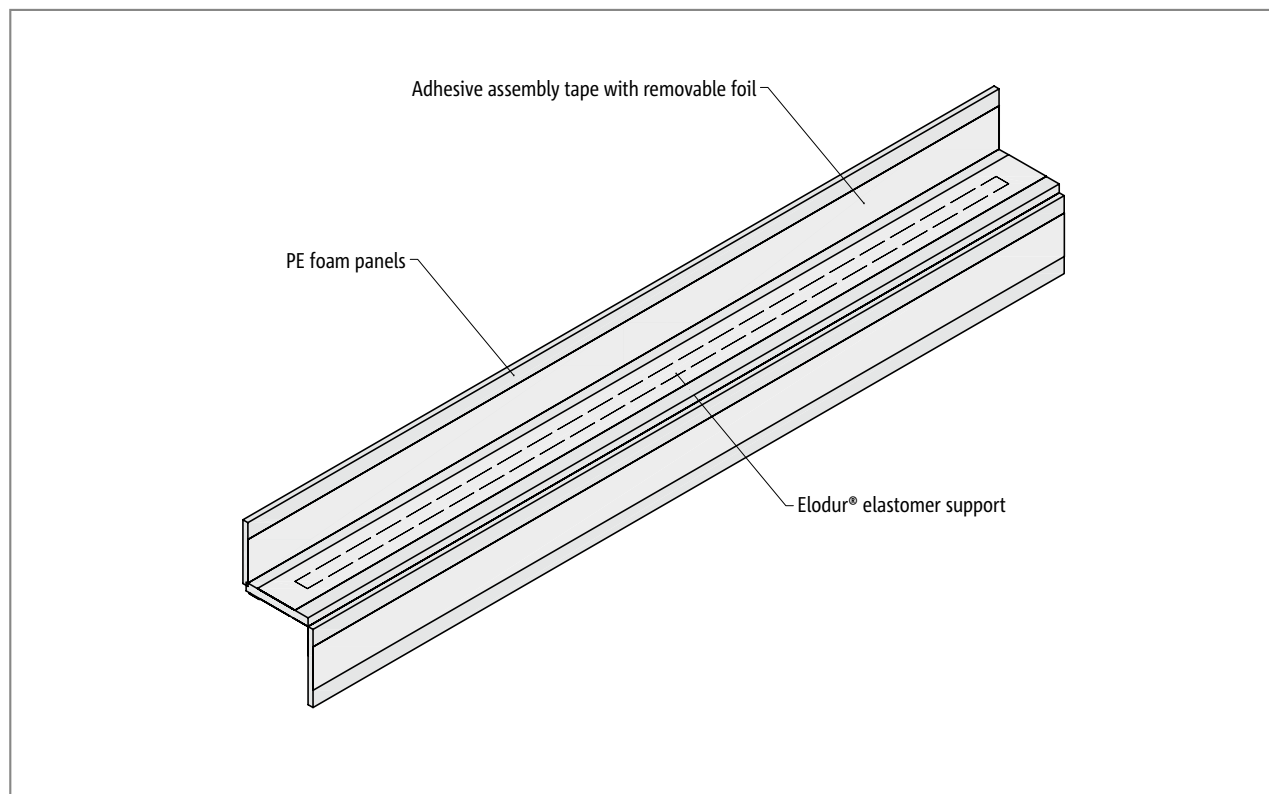


Fig. 62: Schöck Tronsole® type F

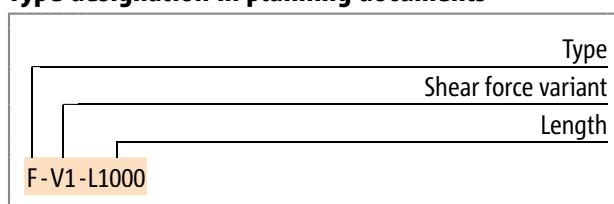
# Product selection | Type designations | Special designs | Configuration variants

## Schöck Tronsole® type F variants

The design of the Schöck Tronsole® type F can vary as follows:

- ▶ Shear force load-bearing level:
  - Type F-V1, shear force load-bearing level 1, elastomer support width  $b = 25$  mm or
  - Type F-V2, shear force load-bearing level 2, elastomer support width  $b = 35$  mm
  - Type FS-V3, shear force load-bearing level 3, elastomer support width  $b = 2 \times 25$  mm (special type on request)
- ▶ Length:
  - $L = 1000$  mm,  $1100$  mm,  $1200$  mm,  $1300$  mm and  $1500$  mm
- ▶ Corbel depth:
  - $130 - 160$  mm

## Type designation in planning documents



## **i** Special designs

The Schöck Tronsole® type F can be cut to length on site. Furthermore, the special dimensions of the Tronsole®, which differ from the standard product variants presented in the information, can be requested from Schöck Application Technology.

## Configuration of various types of connection

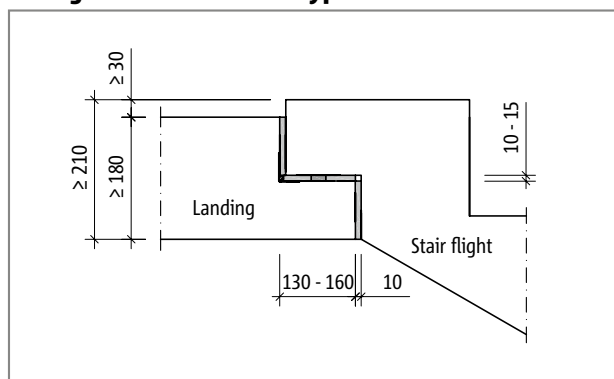


Fig. 63: Schöck Tronsole® type F: Design variant superelevated stair connection

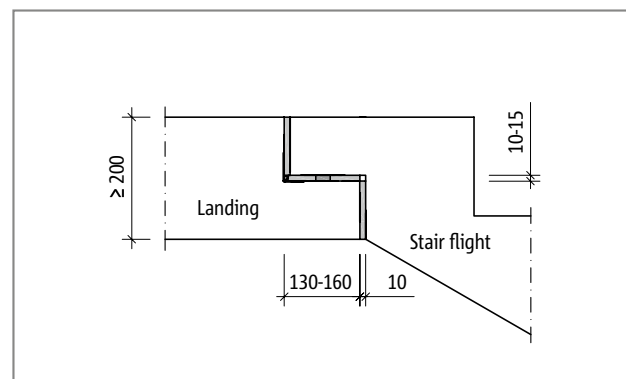


Fig. 64: Schöck Tronsole® type F: Design variant flush stair connection

## **i** Configuration variants

- ▶ Type of connection:
  - The Schöck Tronsole® type F enables the formation of a flush or a superelevated connection on the stair flight side
- ▶ Height:
  - A connection height of  $h$  with flush connection type<sub>A</sub>  $\geq 200$  mm possible.
  - A height offset of at least 30 mm is assumed with superelevated connection on the stair side. This is found in the assumed minimum height for the impact soundproofing on the landing and leads to a total height of the connection of  $h_A \geq 210$  mm with a landing slab thickness of  $h \geq 180$  mm.
- ▶ Corbel depth:
  - Corbel depths are possible between  $K_T \geq 130$  mm and  $K_T = 160$  mm, because for corbel depths in this area the smallest possible anchoring length of the corbel reinforcement according to DIN EN 1992-1-1 can be verified.
- ▶ Depending on the static utilisation rate, we can reckon with a deflection of the Elodur® elastomeric bearing of some 3 mm and a maximum of 5 mm. See the diagram on page 83.

## Installation cross section

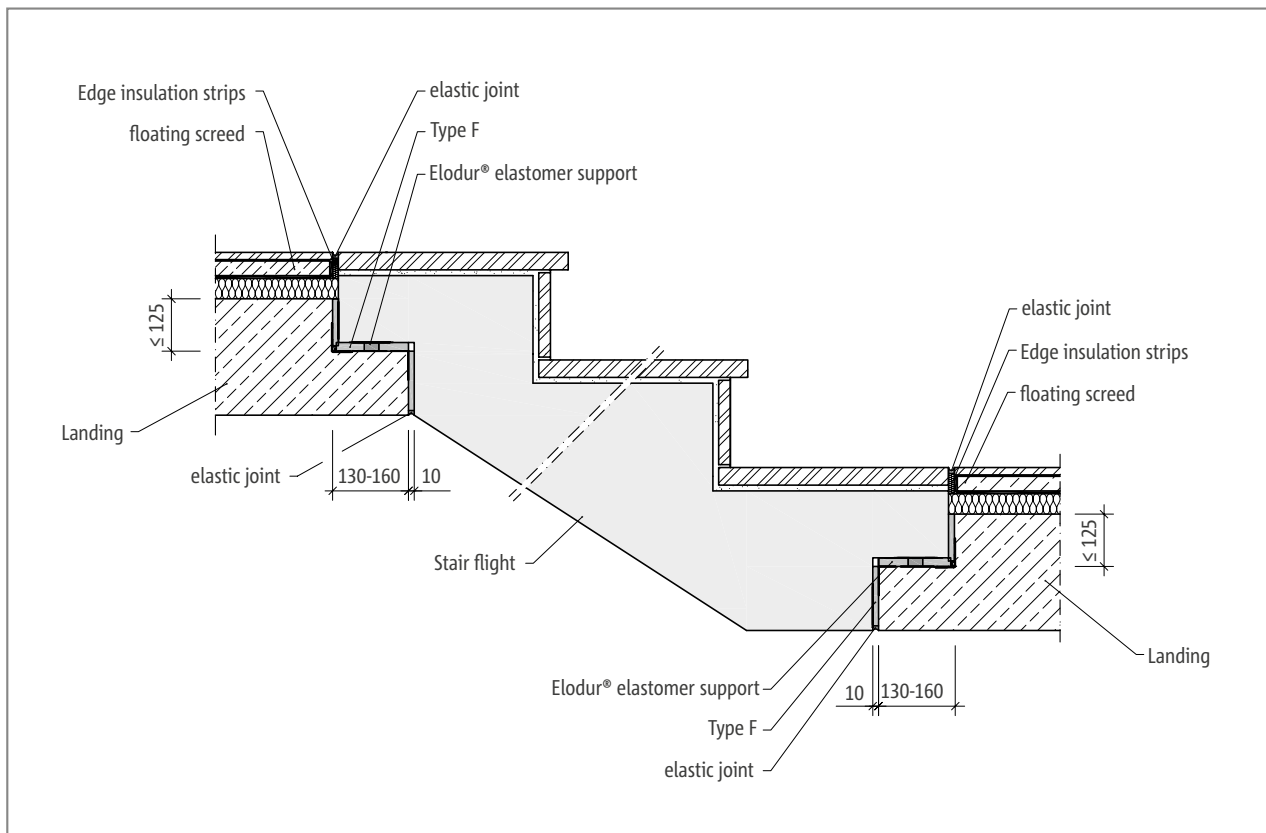


Fig. 65: Schöck Tronsole® type F: Installation cross section

### **i** Information on installation cross-section

- ▶ If the difference between the corbel height of the landing  $h_{k,p}$  and the landing slab thickness  $h$  is greater than 125 mm, the upper end of the soundproofing joint between landing and stairs is closed using additional elastic joint material.



## Element arrangement

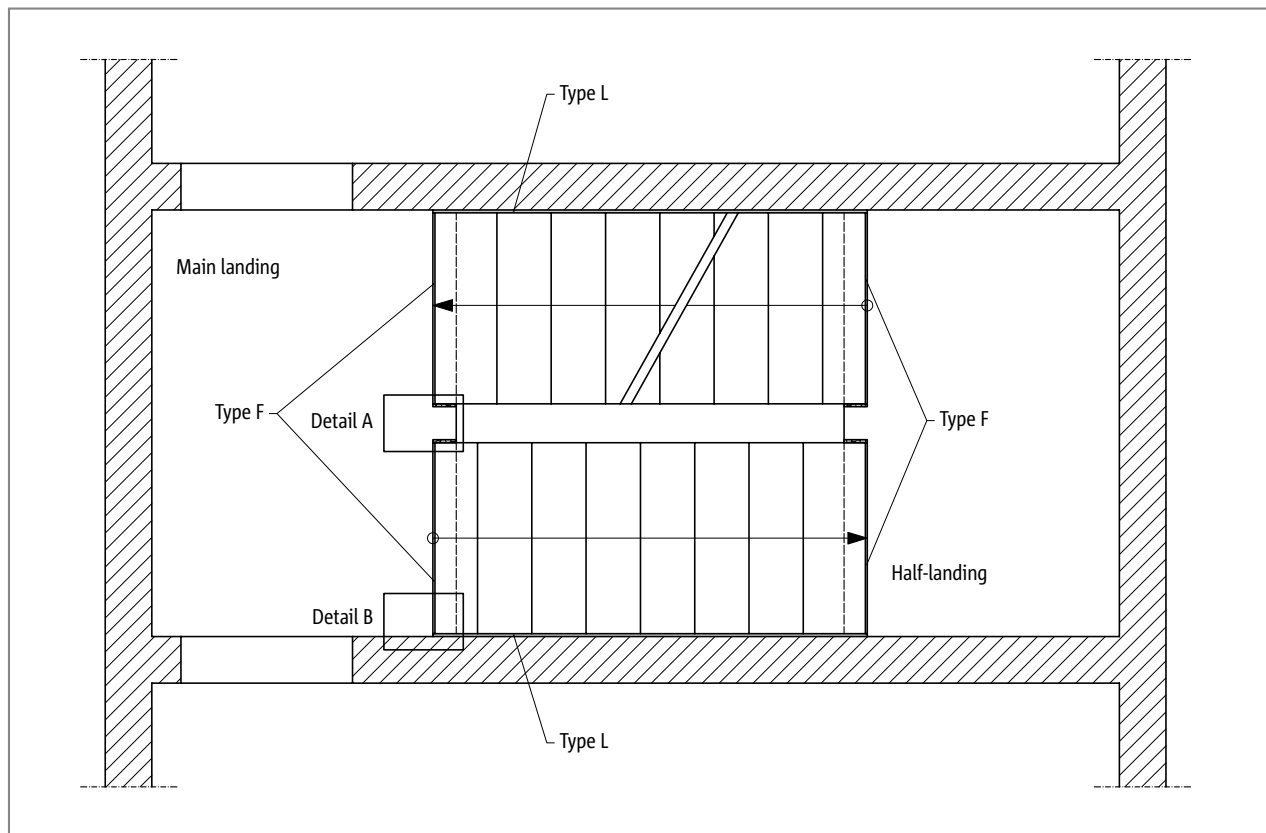


Fig. 66: Schöck Tronsole® type F: Element configuration in plan view

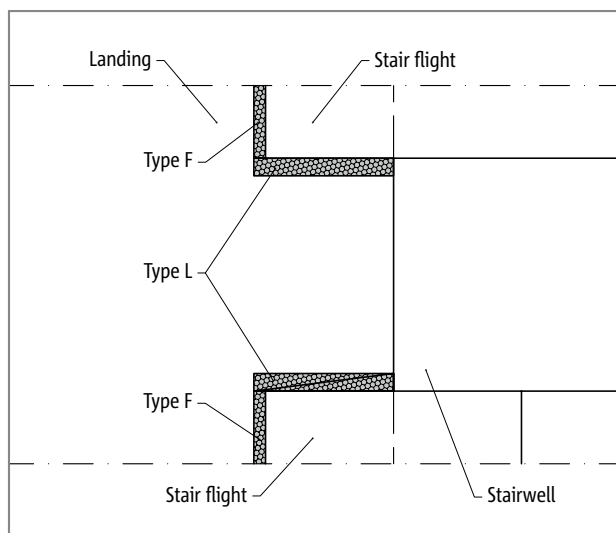


Fig. 67: Schöck Tronsole® type F: Element configuration, Detail A

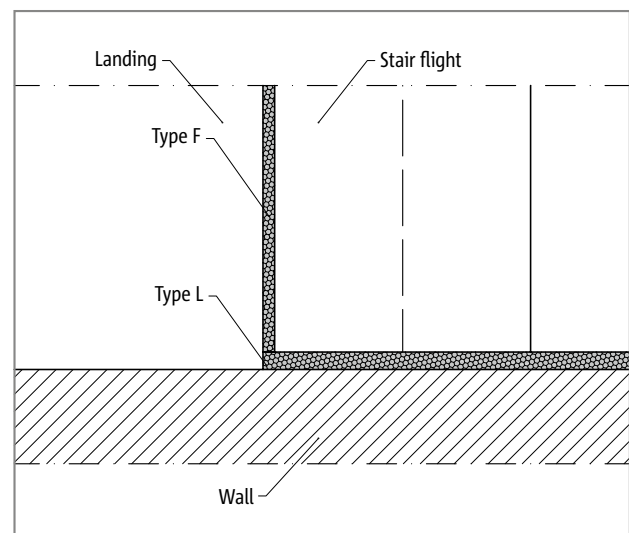


Fig. 68: Schöck Tronsole® type F: Element configuration, Detail B

### **i** Notes on element configuration

- ▶ For the avoidance of acoustic bridges between staircase wall and stair flight it is recommended that the Schöck Tronsole® type F is combined with type L-420. The Tronsole® type L-420 closes the joint between stair string and wall, maintaining a joint width of 15 mm.
- ▶ The use of the Schöck Tronsole® type B is suitable for the sound insulation of stair flight and floor slab. Tronsole® type B. The Tronsole® type F and B can be used combined.

## Product description

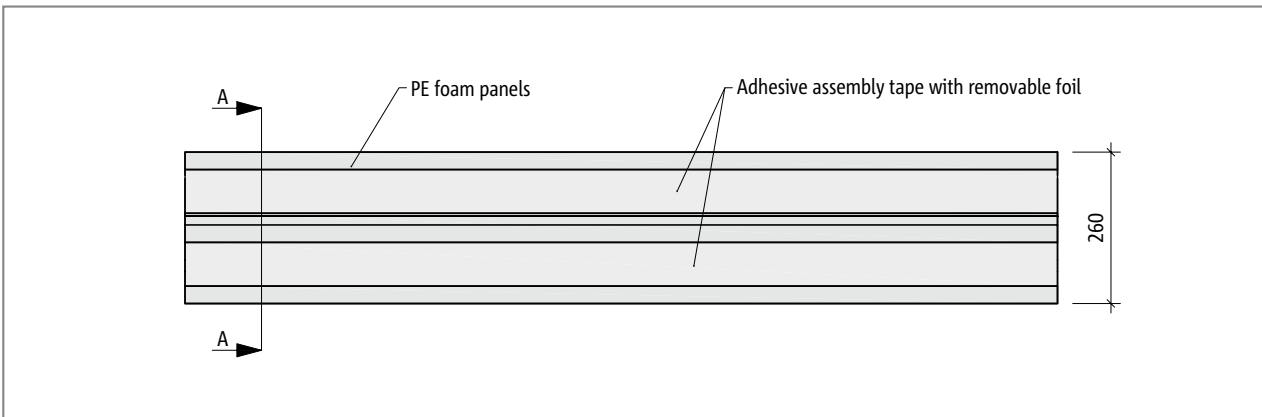


Fig. 69: Schöck Tronsole® type F: Elevation

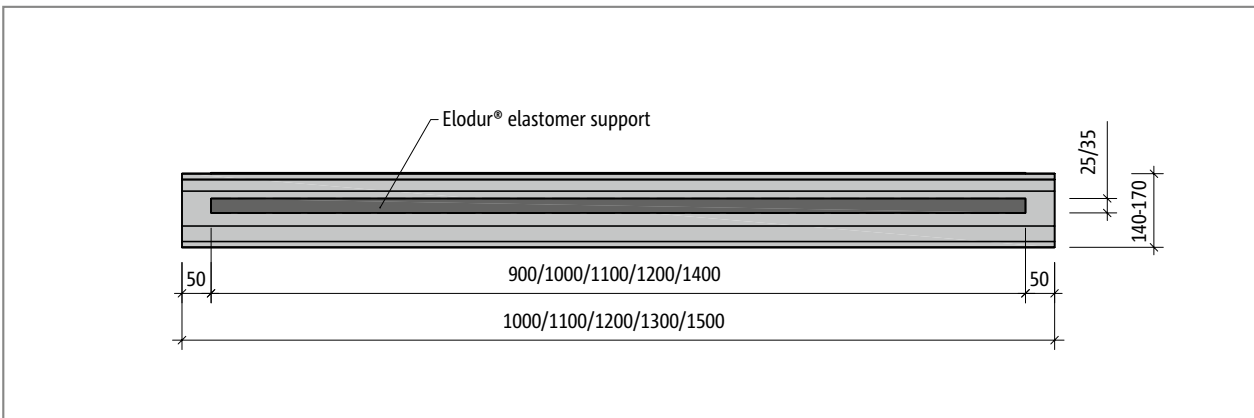


Fig. 70: Schöck Tronsole® type F: Layout

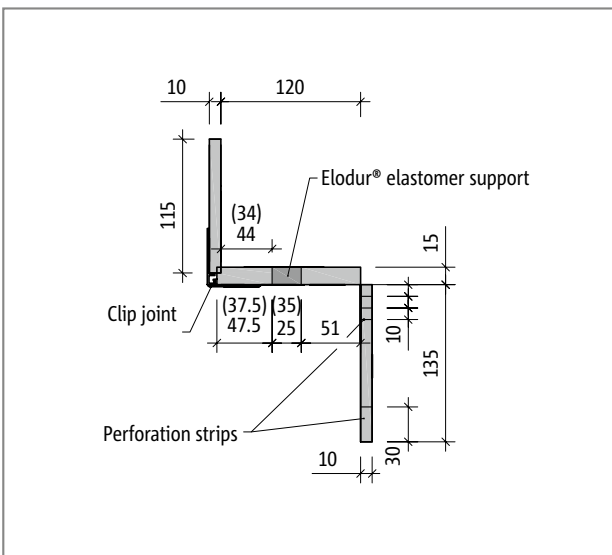


Fig. 71: Schöck Tronsole® type F-V1, (-V2): Product model, cross-section A-A, with adjustment to the minimum corbel depth

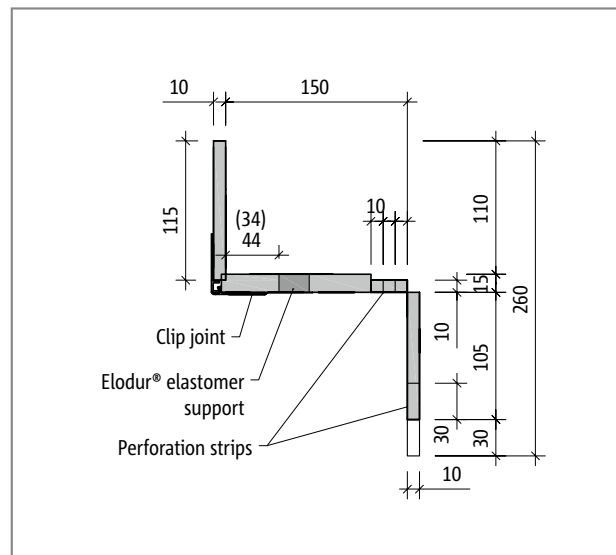


Fig. 72: Schöck Tronsole® type F-V1, (-V2): Product model with adjustment to the maximum corbel depth

## Design Tronsole®

| Schöck Tronsole® type | F-V1 | F-V2 |
|-----------------------|------|------|
| $v_{Rd,z}$ [kN/m]     | 42.4 | 59.3 |
| $v_{Rd,x}$ [kN/m]     | ±3.8 | ±3.8 |
| $v_{Rd,y}$ [kN/m]     | ±3.8 | ±3.8 |

| Schöck Tronsole® type                        | F-V1                         | F-V2 |
|--|------------------------------|------|
| Tronsole® length L [mm]                      | 1000, 1100, 1200, 1300, 1500 |      |
| Tronsole® Thickness [mm]                     | 15                           |      |
| Elodur® elastomer support, length $L_E$ [mm] | L - 100                      |      |
| Elodur® elastomer support, thickness [mm]    | 15                           |      |
| Elodur® elastomer support, width [mm]        | 25                           | 35   |

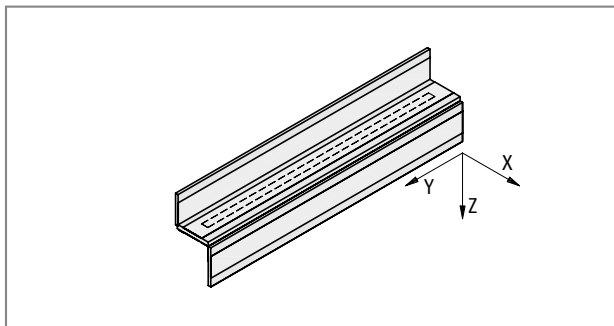


Fig. 73: Schöck Tronsole® type F: Sign rule for the design

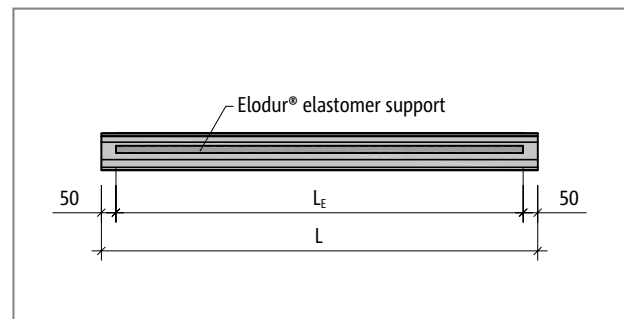


Fig. 74: Schöck Tronsole® type F: Representation of lengths L and  $L_E$ ; the length of the Elodur® elastomer support is always 10 cm shorter than the length of the Tronsole®.

### **i** Notes on design

- ▶ The load-bearing capacity of the corbel area of the stair structural components is to be verified by the structural engineer, so far as the dimensioning does not take place according to type statics for the Tronsole® type F.
- ▶ The acceptable shear force of the elastomer support is limited by the impact sound reduction.

# Corbel dimensioning according to type-tested structural standards | Design

Deviating from the corbel dimensioning according to type statics, any corbel dimensions can be selected, so far as for this a valid static verification is carried out by the responsible structural engineer.

## Landing

| Schöck Tronsole® type                | F-V1  |            |            | F-V2      |            |            |
|--------------------------------------|---|------------|------------|-----------|------------|------------|
| Design values<br>Corbel landing with | Fire resistance class R0<br>Concrete strength landing $\geq$ C20/25 |            |            |           |            |            |
| Corbel height landing $h_{k,p}$ [mm] | $\geq 90$   | $\geq 100$ | $\geq 110$ | $\geq 90$ | $\geq 100$ | $\geq 110$ |
| Corbel depth $K_T$ [mm]              | $v_{Rd,z}$ [kN/m]   |            |            |           |            |            |
| 130                                  | 39.8  | 42.4       | 42.4       | 49.5      | 57.1       | 59.3       |
| 140                                  | 42.4  | 42.4       | 42.4       | 57.0      | 59.3       | 59.3       |
| 150–160                              | 42.4  | 42.4       | 42.4       | 59.3      | 59.3       | 59.3       |
| Corbel depth $K_T$ [mm]              | $v_{Rd,y}$ [kN/m]   |            |            |           |            |            |
| 130–160                              | $\pm 3.8$   |            |            |           |            |            |
| Corbel depth $K_T$ [mm]              | $v_{Rd,x}$ [kN/m]   |            |            |           |            |            |
| 130–160                              | $\pm 3.8$   |            |            |           |            |            |

## Stair flight

| Schöck Tronsole® type                      | F-V1   |            |            | F-V2      |            |            |            |            |
|--|--|------------|------------|-----------|------------|------------|------------|------------|
| Design values<br>Corbel stair flight with  | Fire resistance class R0<br>Concrete strength class stair flight $\geq$ C30/37 |            |            |           |            |            |            |            |
| Corbel height stair flight $h_{item}$ [mm] | $\geq 90$  | $\geq 100$ | $\geq 110$ | $\geq 90$ | $\geq 100$ | $\geq 110$ | $\geq 120$ | $\geq 130$ |
| Corbel depth $K_T$ [mm]                    | $v_{Rd,z}$ [kN/m]  |            |            |           |            |            |            |            |
| 130  | 42.4   | 42.4       | 42.4       | 50.0      | 57.0       | 59.3       | 59.3       | 59.3       |
| 140  | 28.2   | 42.4       | 42.4       | 28.2      | 51.7       | 58.1       | 59.3       | 59.3       |
| 150  | 28.2   | 33.6       | 42.4       | 28.2      | 33.6       | 53.1       | 59.0       | 59.3       |
| 160  | 28.2   | 33.6       | 42.4       | 28.2      | 33.6       | 39.0       | 54.4       | 59.3       |
| Corbel depth $K_T$ [mm]                    | $v_{Rd,y}$ [kN/m]  |            |            |           |            |            |            |            |
| 130–160                                    | $\pm 3.8$  |            |            |           |            |            |            |            |
| Corbel depth $K_T$ [mm]                    | $v_{Rd,x}$ [kN/m]  |            |            |           |            |            |            |            |
| 130–160                                    | $\pm 3.8$  |            |            |           |            |            |            |            |

### **i** Notes on design

- ▶ The acceptable shear force of the corbels can only be verified with the on-site reinforcement presented in this section
- ▶ According to DIN EN 1992-1-1 (EC2) and DIN EN 1992-1-1/NA with exposure class XC1 the following nominal concrete cover results:
  - In-situ concrete landing  $c_{nom} = 20$  mm
  - Prefabricated stairway:  $c_{nom} = 15$  mm
- ▶ For the fire resistance class R90 a higher concrete cover according to DIN EN 1992-1-2 is necessary. See page 84
- ▶ With the predefined concrete strengths one is concerned with minimum requirements which are based on the design.
- ▶ The verification of the shear force in the slabs is to take place through the structural engineer, whereby  $V_{Rd,max}$  according to DIN EN 1992-1-1 (EC2), Gl. (6.9) for  $\theta = 45^\circ$  and  $\alpha = 90^\circ$  is to be determined.
- ▶ The PE foam panel of the Schöck Tronsole® type specifies the position of the elastomer support. The position of the elastomer support is relevant for the dimensioning of the corbel. Schöck Tronsole® is to be installed fitting exactly to the corbel.

## Corbel design according to structural calculations - raised connection

On the following pages, combinations of corbel and landing height are calculated as examples.

### Superelevated connection

| Schöck Tronsole® type                      | F-V1, F-V2                                |       |       |       |
|--|---|-------|-------|-------|
| Connection geometry with                   | Fire resistance class R 0                 |       |       |       |
|  | Stair flight connection height $h_A$ [mm] |       |       |       |
|  | ≥ 210                                     | ≥ 230 | ≥ 250 | ≥ 270 |
| Corbel height landing $h_{k,p}$ [mm]       | ≥ 90                                      | ≥ 100 | ≥ 110 | ≥ 120 |
| Corbel height stair flight $h_{item}$ [mm] | ≥ 110                                     | ≥ 120 | ≥ 130 | ≥ 140 |

Schöck Tronsole® type F, table: Flush connection geometry with R0

| Schöck Tronsole® type                      | F-V1, F-V2                                |       |       |       |
|--|---|-------|-------|-------|
| Connection geometry with                   | Fire resistance class R90                 |       |       |       |
|  | Stair flight connection height $h_A$ [mm] |       |       |       |
|  | ≥ 240                                     | ≥ 260 | ≥ 280 | ≥ 300 |
| Corbel height landing $h_{k,p}$ [mm]       | ≥ 100                                     | ≥ 110 | ≥ 120 | ≥ 130 |
| Corbel height stair flight $h_{item}$ [mm] | ≥ 130                                     | ≥ 140 | ≥ 150 | ≥ 160 |

Schöck Tronsole® type F, table: Flush connection geometry with R90

| Schöck Tronsole® type     | F-V1   |       |       |       | F-V2  |       |       |       |
|---------------------------|--|-------|-------|-------|-------|-------|-------|-------|
| Design values with        | Concrete strength landing ≥ C20/25, stair flight ≥ C30/37  |       |       |       |       |       |       |       |
|                           | Connection height $h_A$ [mm] with superelevated stair head |       |       |       |       |       |       |       |
| Fire resistance class R 0 | ≥ 210  | ≥ 230 | ≥ 250 | ≥ 270 | ≥ 210 | ≥ 230 | ≥ 250 | ≥ 270 |
| Fire resistance class R90 | ≥ 240  | ≥ 260 | ≥ 280 | ≥ 300 | ≥ 240 | ≥ 260 | ≥ 280 | ≥ 300 |
| Corbel depth $K_T$ [mm]   | $v_{rd,z}$ [kN/m]  |       |       |       |       |       |       |       |
| 130                       | 39.8   | 42.4  | 42.4  | 42.4  | 49.5  | 57.1  | 59.3  | 59.3  |
| 140                       | 42.4   | 42.4  | 42.4  | 42.4  | 57.0  | 59.3  | 59.3  | 59.3  |
| 150                       | 42.4   | 42.4  | 42.4  | 42.4  | 53.1  | 59.0  | 59.3  | 59.3  |
| 160                       | 39.0   | 42.4  | 42.4  | 42.4  | 39.0  | 54.4  | 59.3  | 59.3  |
| Corbel depth $K_T$ [mm]   | $v_{rd,y}$ [kN/m]  |       |       |       |       |       |       |       |
| 130–160                   | ±3.8   |       |       |       |       |       |       |       |
| Corbel depth $K_T$ [mm]   | $v_{rd,x}$ [kN/m]  |       |       |       |       |       |       |       |
| 130–160                   | ±3.8   |       |       |       |       |       |       |       |

Schöck Tronsole® type F, table: Dimensioning with superelevated connection

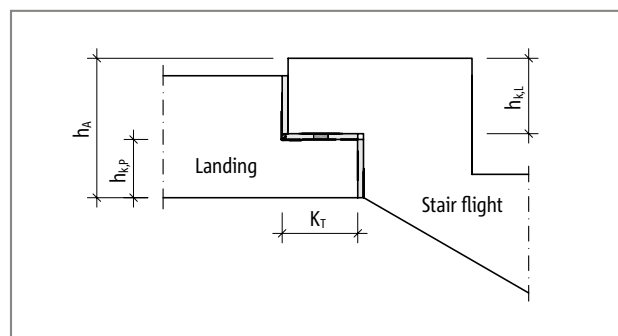


Fig. 75: Schöck Tronsole® type F: Design

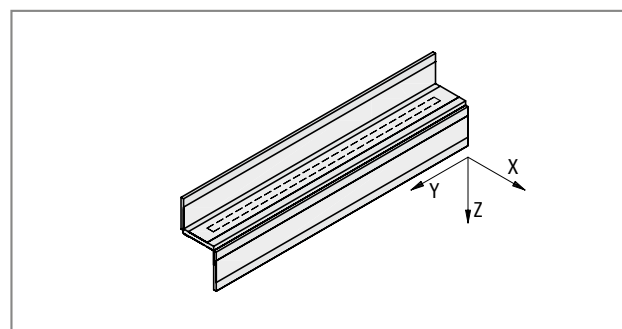


Fig. 76: Schöck Tronsole® type F: Sign rule for the design

# On-site reinforcement according to type-tested structural standards - Superelevated connection

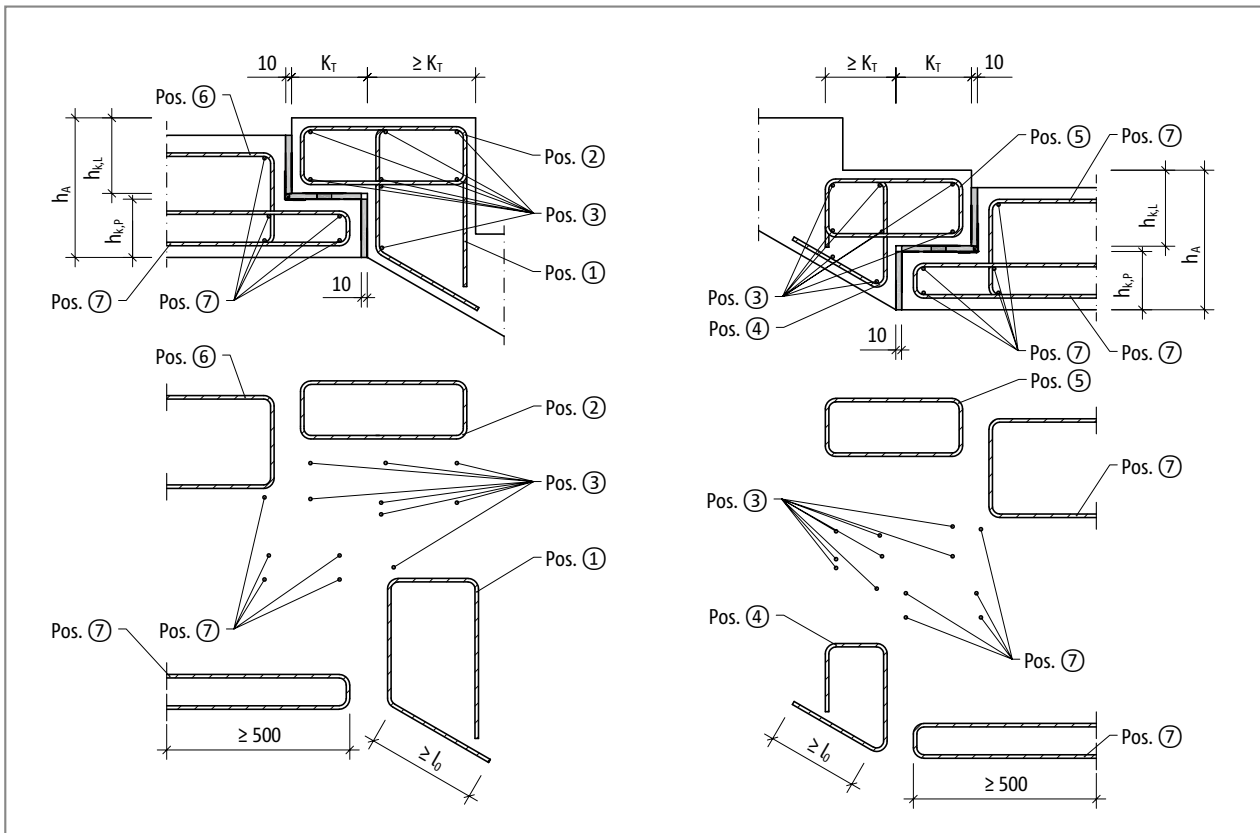


Fig. 77: Schöck Tronsole® type F: On-site reinforcement with superelevated connection

## On-site reinforcement according to type-tested structural standards - Superelevated connection

| Schöck Tronsole® type  |                     | F-V1, F-V2  |
|--|---------------------|---|
| On-site reinforcement  | Location            | Landing (XC1) concrete strength class $\geq$ C20/25<br>Stair flight (XC1) concrete strength class $\geq$ C30/37 |
|  |                     | $210 \leq h_A$ [mm] (R 0)   |
|  |                     | $240 \leq h_A$ [mm] (R 90)  |
| <b>Pos. 1 open stirrup (vertical tensile reinforcement)</b>      |                     |   |
| Pos. 1   | on the flight side  | H8@150 mm   |
| <b>Pos. 2 closed stirrups (horizontal tensile reinforcement)</b> |                     |   |
| Pos. 2   | on the flight side  | $\varnothing$ 8/100 mm  |
| <b>Pos. 3 Steel bars along the support joint</b>                 |                     |   |
| Pos. 3   | on the flight side  | 2 · 2 · H8  |
| <b>Pos. 4 open stirrups (vertical tensile reinforcement)</b>     |                     |   |
| Pos. 4   | on the flight side  | H8@150 mm   |
| <b>Pos. 5 closed stirrups (horizontal tensile reinforcement)</b> |                     |   |
| Pos. 5   | on the flight side  | $\varnothing$ 8/100 mm  |
| <b>Pos. 6 ties (vertical tensile reinforcement)</b>              |                     |   |
| Pos. 6   | on the landing side | H8@150 mm   |
| <b>Pos. 7 ties (horizontal tensile reinforcement)</b>            |                     |   |
| Pos.7  | on the landing side | $\varnothing$ 8/100 mm  |
| <b>Pos. 8 Steel bars along the support joint</b>                 |                     |   |
| Pos. 8   | on the landing side | 5 · H8  |
| <b>Pos. 9 ties (vertical tensile reinforcement)</b>              |                     |   |
| Pos. 9   | on the landing side | H8@150 mm   |
| <b>v 10 ties (horizontal tensile reinforcement)</b>              |                     |   |
| Pos. 10  | on the landing side | $\varnothing$ 8/100 mm  |
| <b>Pos. 11 Steel bars along the support joint</b>                |                     |   |
| Pos. 11  | on the landing side | 5 · H8  |

### **i** On-site reinforcement

- ▶ The height of the reinforcement stirrup in the corbel varies with the various corbel heights of the Tronsole® type F, in order to achieve the greatest possible internal lever arm for the different load-bearing levels.
- ▶ The on-site stirrup reinforcement is to be led as closely as possible to the respective vertical edge of the structural component taking into account the required concrete cover.
- ▶ In order to keep the manufacturing tolerances with the laying of the reinforcement and the structural component dimensions as small as possible, attention is to be paid to correct implementation.
- ▶ Pos. 1 and Pos. 4 with the slab reinforcement of the stair flight form an overlap connection. With this, a sufficient overlap length  $l_0$  is to be ensured.
- ▶ Pos. 1 and Pos. 4 can be implemented as closed stirrup if, with this, a sufficient overlap length  $l_0$  can be realised.
- ▶ In order to be able to realise the smallest possible anchoring length  $l_{b,min} = \max(6.7 \phi_s; 0.3 l_{b,rqd})$ , in the cases presented here for the corbels, more than the 2 to 3 times the statically required tensile reinforcement has been selected.

## Corbel design according to structural calculations - flush connection

On the following pages, combinations of corbel and landing height are calculated as examples.

Deviating from the corbel dimensioning according to type statics, any corbel dimensions can be selected, so far as for this a valid static verification is carried out by the responsible structural engineer.

### Flush connection

| Schöck Tronsole® type                      | F-V1, F-V2                                |       |       |       |
|--|---|-------|-------|-------|
| Connection geometry with                   | Fire resistance class R 0                 |       |       |       |
|  | Stair flight connection height $h_A$ [mm] |       |       |       |
|  | ≥ 200                                     | ≥ 220 | ≥ 240 | ≥ 260 |
| Corbel height landing $h_{k,p}$ [mm]       | ≥ 100                                     | ≥ 110 | ≥ 120 | ≥ 130 |
| Corbel height stair flight $h_{item}$ [mm] | ≥ 90                                      | ≥ 100 | ≥ 110 | ≥ 120 |

Schöck Tronsole® type F, table: Flush connection geometry with R0

| Schöck Tronsole® type                      | F-V1, F-V2                                |       |       |       |
|--|---|-------|-------|-------|
| Connection geometry with                   | Fire resistance class R90                 |       |       |       |
|  | Stair flight connection height $h_A$ [mm] |       |       |       |
|  | ≥ 230                                     | ≥ 250 | ≥ 270 | ≥ 290 |
| Corbel height landing $h_{k,p}$ [mm]       | ≥ 110                                     | ≥ 120 | ≥ 130 | ≥ 140 |
| Corbel height stair flight $h_{item}$ [mm] | ≥ 110                                     | ≥ 120 | ≥ 130 | ≥ 140 |

Schöck Tronsole® type F, table: Flush connection geometry with R90

| Schöck Tronsole® type     | F-V1  |       |       |       | F-V2  |       |       |       |
|---------------------------|---|-------|-------|-------|-------|-------|-------|-------|
| Design values with        | Concrete strength landing ≥ C20/25, stair flight ≥ C30/37 |       |       |       |       |       |       |       |
|                           | Stair flight connection height $h_A$ [mm]                 |       |       |       |       |       |       |       |
| Fire resistance class R 0 | ≥ 200   | ≥ 220 | ≥ 240 | ≥ 260 | ≥ 200 | ≥ 220 | ≥ 240 | ≥ 260 |
| Fire resistance class R90 | ≥ 230   | ≥ 250 | ≥ 270 | ≥ 290 | ≥ 230 | ≥ 250 | ≥ 270 | ≥ 290 |
| Corbel depth $K_T$ [mm]   | $v_{Rd,z}$ [kN/m]   |       |       |       |       |       |       |       |
| 130                       | 42.4  | 42.4  | 42.4  | 42.4  | 50.0  | 57.0  | 59.3  | 59.3  |
| 140                       | 28.2  | 42.4  | 42.4  | 42.4  | 28.2  | 51.7  | 58.1  | 59.3  |
| 150                       | 28.2  | 33.6  | 42.4  | 42.4  | 28.2  | 33.6  | 53.1  | 59.0  |
| 160                       | 28.2  | 33.6  | 39.0  | 42.4  | 28.2  | 33.6  | 39.0  | 54.4  |
| Corbel depth $K_T$ [mm]   | $v_{Rd,y}$ [kN/m]   |       |       |       |       |       |       |       |
| 130–160                   | ±3.8  |       |       |       |       |       |       |       |
| Corbel depth $K_T$ [mm]   | $v_{Rd,x}$ [kN/m]   |       |       |       |       |       |       |       |
| 130–160                   | ±3.8  |       |       |       |       |       |       |       |

Schöck Tronsole® type F, table: Dimensioning with flush connection

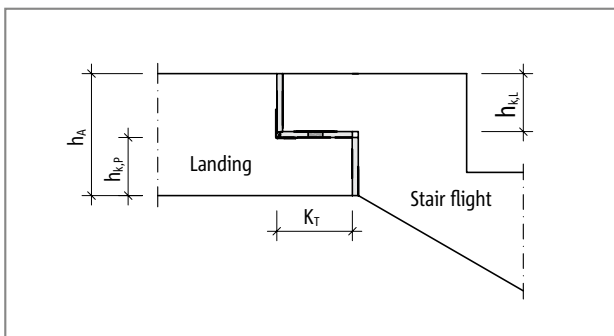


Fig. 78: Schöck Tronsole® type F: Design

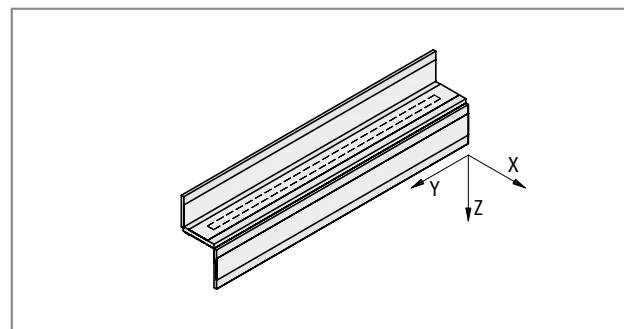


Fig. 79: Schöck Tronsole® type F: Sign rule for the design



## Design

### **i** Notes on design

- ▶ The acceptable shear force of the corbels can only be verified with the on-site reinforcement presented in this section
- ▶ According to DIN EN 1992-1-1 (EC2) and DIN EN 1992-1-1/NA with exposure class XC1 the following nominal concrete cover results:
  - In-situ concrete landing  $c_{nom} = 20 \text{ mm}$
  - Prefabricated stairway:  $c_{nom} = 15 \text{ mm}$
- ▶ With the predefined concrete strengths one is concerned with minimum requirements which are based on the design.
- ▶ The verification of the shear force in the slabs is to take place through the structural engineer, whereby  $V_{Rd,max}$  according to DIN EN 1992-1-1 (EC2), Gl. (6.9) for  $\theta = 45^\circ$  and  $\alpha = 90^\circ$  is to be determined.
- ▶ The PE foam panel of the Schöck Tronsole® type specifies the position of the elastomer support. The position of the elastomer support is relevant for the dimensioning of the corbel. Schöck Tronsole® is to be installed fitting exactly to the corbel.

# On-site reinforcement according to type-tested structural standards - Flush connection

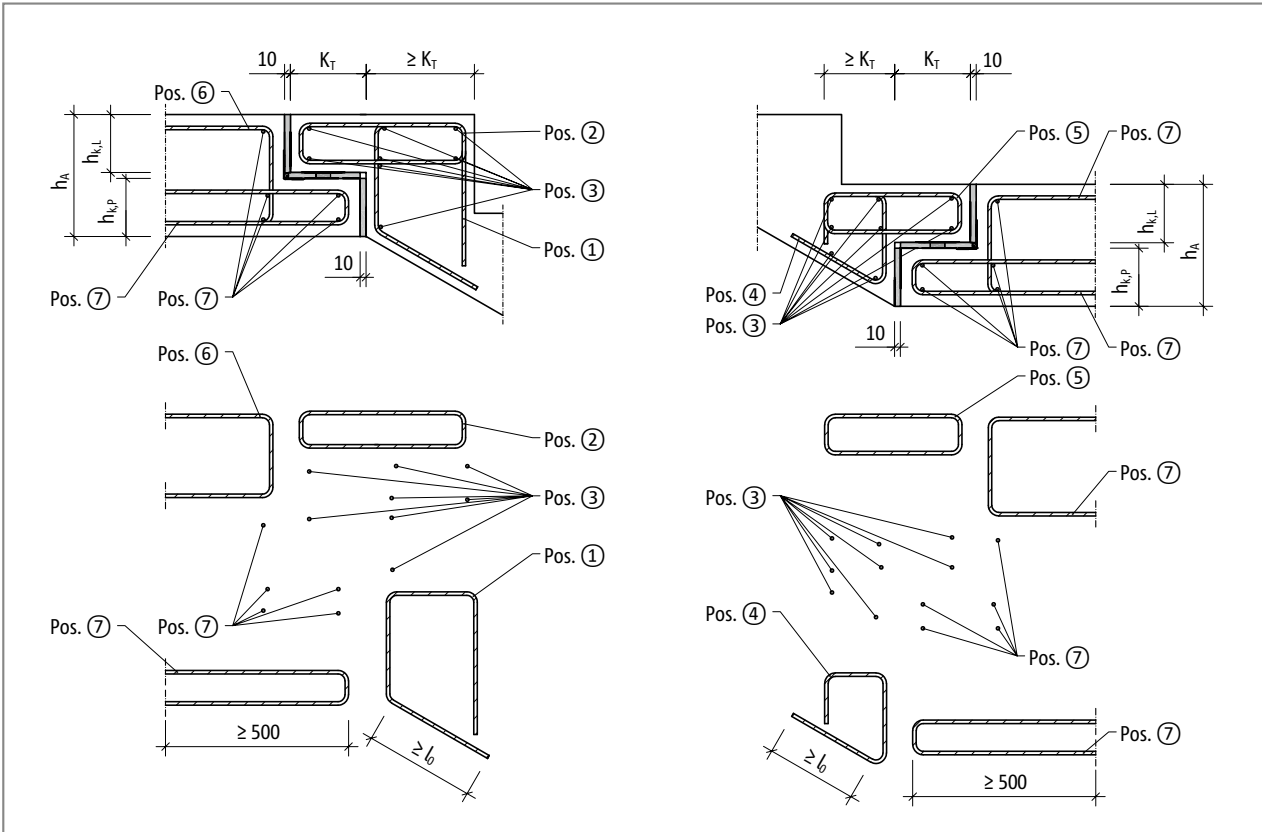


Fig. 80: Schöck Tronsole® type F: On-site reinforcement with flush connection

## On-site reinforcement according to type-tested structural standards - Flush connection

| Schöck Tronsole® type  |                     | F-V1, F-V2  |
|--|---------------------|---|
| On-site reinforcement  | Location            | Landing (XC1) concrete strength class $\geq$ C20/25<br>Stair flight (XC1) concrete strength class $\geq$ C30/37 |
|  |                     | $200 \leq h_A$ [mm] (R0)  |
|  |                     | $230 \leq h_A$ [mm] (R90)   |
| <b>Pos. 1 open stirrup (vertical tensile reinforcement)</b>      |                     |   |
| Pos. 1   | on the flight side  | H8@150 mm   |
| <b>Pos. 2 closed stirrups (horizontal tensile reinforcement)</b> |                     |   |
| Pos. 2   | on the flight side  | $\varnothing$ 8/100 mm  |
| <b>Pos. 3 Steel bars along the support joint</b>                 |                     |   |
| Pos. 3   | on the flight side  | 2 · 2 · H8  |
| <b>Pos. 4 open stirrups (vertical tensile reinforcement)</b>     |                     |   |
| Pos. 4   | on the flight side  | H8@150 mm   |
| <b>Pos. 5 closed stirrups (horizontal tensile reinforcement)</b> |                     |   |
| Pos. 5   | on the flight side  | $\varnothing$ 8/100 mm  |
| <b>Pos. 6 ties (vertical tensile reinforcement)</b>              |                     |   |
| Pos. 6   | on the landing side | H8@150 mm   |
| <b>Pos. 7 ties (horizontal tensile reinforcement)</b>            |                     |   |
| Pos.7  | on the landing side | $\varnothing$ 8/100 mm  |
| <b>Pos. 8 Steel bars along the support joint</b>                 |                     |   |
| Pos. 8   | on the landing side | 5 · H8  |
| <b>Pos. 9 ties (vertical tensile reinforcement)</b>              |                     |   |
| Pos. 9   | on the landing side | H8@150 mm   |
| <b>v 10 ties (horizontal tensile reinforcement)</b>              |                     |   |
| Pos. 10  | on the landing side | $\varnothing$ 8/100 mm  |
| <b>Pos. 11 Steel bars along the support joint</b>                |                     |   |
| Pos. 11  | on the landing side | 5 · H8  |

Schöck Tronsole® type F, table: On-site reinforcement with flush connection

### **i** On-site reinforcement

- ▶ The height of the reinforcement stirrup in the corbel varies with the various corbel heights of the Tronsole® type F, in order to achieve the greatest possible internal lever arm for the different load-bearing levels.
- ▶ The on-site stirrup reinforcement is to be led as closely as possible to the respective vertical edge of the structural component taking into account the required concrete cover.
- ▶ In order to keep the manufacturing tolerances with the laying of the reinforcement and the structural component dimensions as small as possible, attention is to be paid to correct implementation.
- ▶ Pos. 1 and Pos. 4 with the slab reinforcement of the stair flight form an overlap connection. With this, a sufficient overlap length  $l_0$  is to be ensured.
- ▶ Pos. 1 and Pos. 4 can be implemented as closed stirrup if, with this, a sufficient overlap length  $l_0$  can be realised.
- ▶ In order to be able to realise the smallest possible anchoring length  $l_{b,min} = \max(6.7 \phi_s; 0.3 l_{b,reqd})$ , in the cases presented here for the corbels, more than the 2 to 3 times the statically required tensile reinforcement has been selected.

## Deflection

### Deformation of the Elodur® elastomer support of the Tronsole® type F-V1

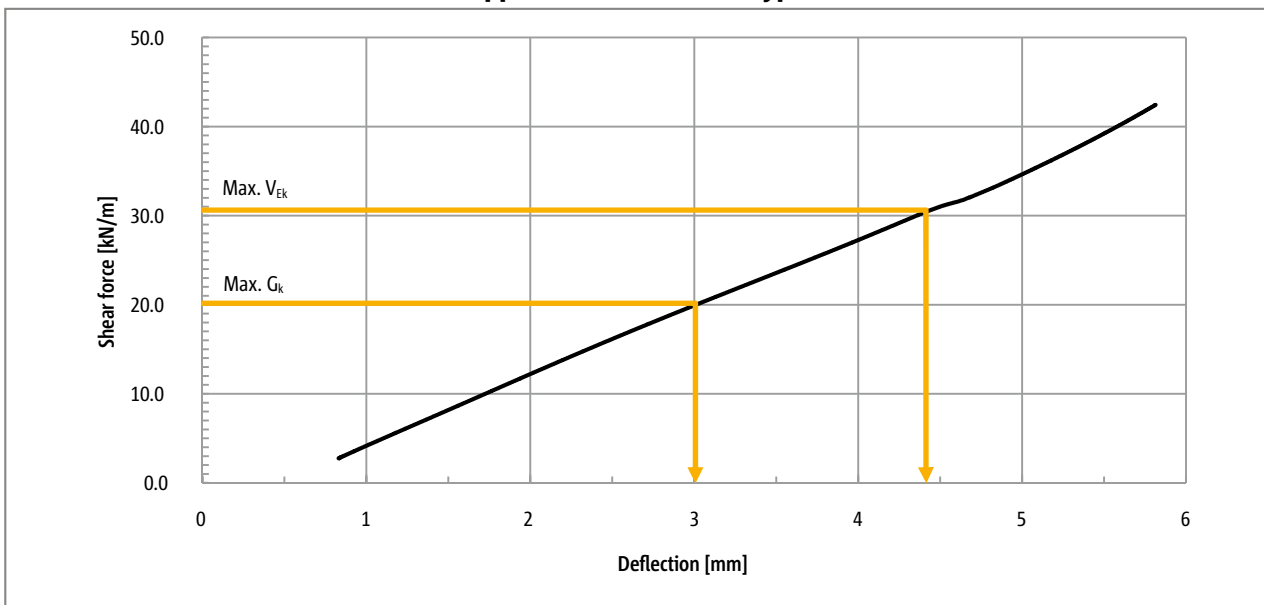


Fig. 81: Schöck Tronsole® type F-V1: Deformation of the Elodur® elastomer support

### Deformation of the Elodur® elastomer support of the Tronsole® type F-V2

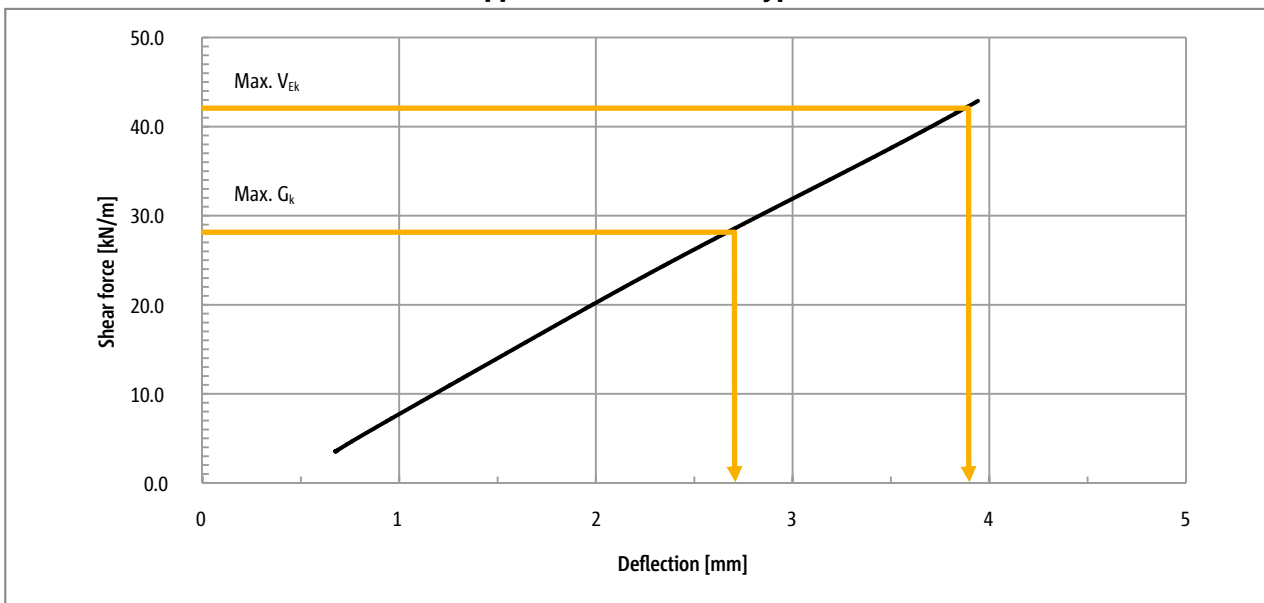


Fig. 82: Schöck Tronsole® type F-V2: Deformation of the Elodur® elastomer support

#### **i** Notes on deformation

- ▶ Deflection is the vertical deformation of the Elodur® elastomer support under vertical shear force load.
- ▶ Creep is additionally to be taken into account with 50 % of the deflection from the constant load  $G_k$ .
- ▶  $\text{Max. } V_{Ek} = \text{Max. } V_{Ed} / \gamma$ , whereby  $\gamma = 1.4$
- ▶  $\gamma = 1.4$  applies under the assumption that  $\text{Max. } V_{Ed}$  is made up of two thirds from own weight and one third from live load.
- ▶ Thus  $\text{Max. } V_{Ek}$  the maximum service load and the maximum own weight is  $\text{Max. } G_k = 2/3 \cdot \text{Max. } V_{Ek}$ .
- ▶ From the deflection of the Elodur® elastomer support there results the following rule of thumb for the connection height  $h_A$ :  
Connection height  $h_A = \text{Corbel height landing } h_{k,p} + \text{Corbel height stair flight } h_{k,L} + 10 \text{ mm}$

## Fire protection | Materials | Installation

### Fire protection

For the use of the Schöck Tronsole® type F the connection range of the notched slab edges in accordance with Fire protection Report No. 16503/2013 iBMB Braunschweig can be classified in the fire resistance class R 90. For this, however, the maintaining of the following conditions is prerequisite:

Attention is to be paid to the required nominal concrete cover according to DIN EN 1992-1-2 in combination with DIN EN 1992-1-2/NA. With a joint width  $a \leq 30$  mm between stairs and landing these reinforced structural components, with regard to fire protection according to DIN 4102-4, are considered as single unit, i.e. as a monolithic connection.

From this, it results that the required concrete cover at the corbel joint itself does not have to be increased due to fire protection requirements. Consequently, the on-site stirrup reinforcement in the area of the corbel connection in the case of a fire protection requirement  $c_{nom,L}$  and  $c_{nom,P}$  is to be brought up to the impact soundproofing joint just as tight as in the case without fire protection requirement.

Nevertheless, a vertical minimum centre-to-centre distance of the reinforcement from the horizontal structural component edge on the room side of  $u = 35$  mm is necessary. This requirement would naturally also exist with a monolithic connection. The vertical centre-to-centre distance is measured respectively from the lower to the upper edge of the structural component. The neighbouring reinforced concrete structural components must satisfy the same building supervisory requirements on fire resistance capability as the connection area itself.

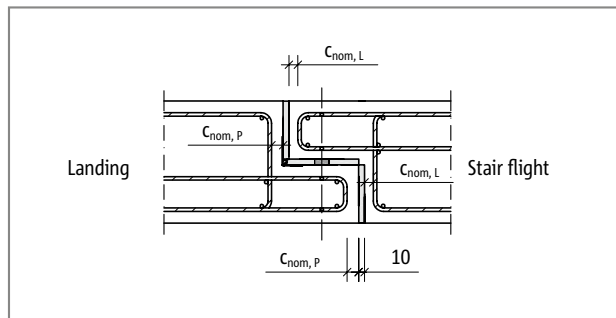


Fig. 83: Schöck Tronsole® type F: Vertical section along the stairs in the area of the corbel support; depiction of the concrete cover  $c_{nom,L}$  and  $c_{nom,P}$

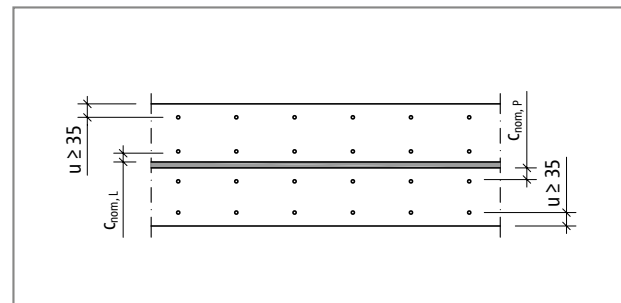


Fig. 84: Schöck Tronsole® type F: Vertical section transverse to the stairs in the area of the corbel support; depiction of the concrete cover  $c_{nom,L}$ ,  $c_{nom,P}$  and the minimum centre-to-centre distance  $u$  of the reinforcement

### i Fire protection

- ▶ The Tronsole® type F conforms with building materials class B2 according to DIN 4102.

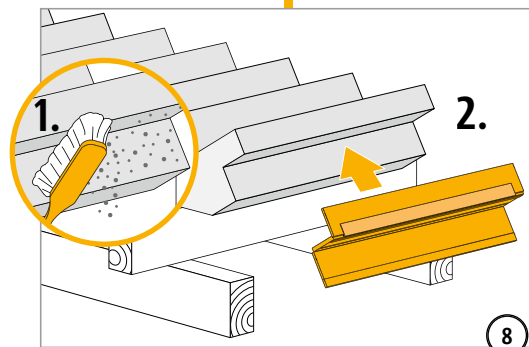
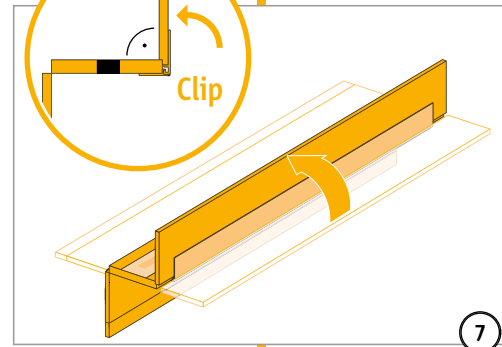
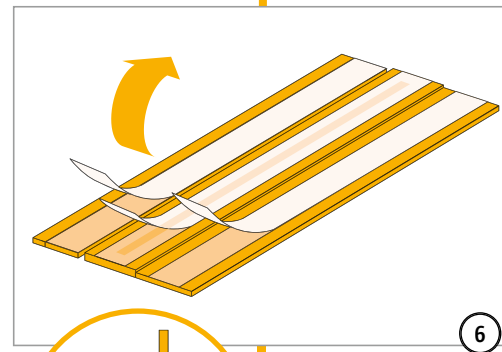
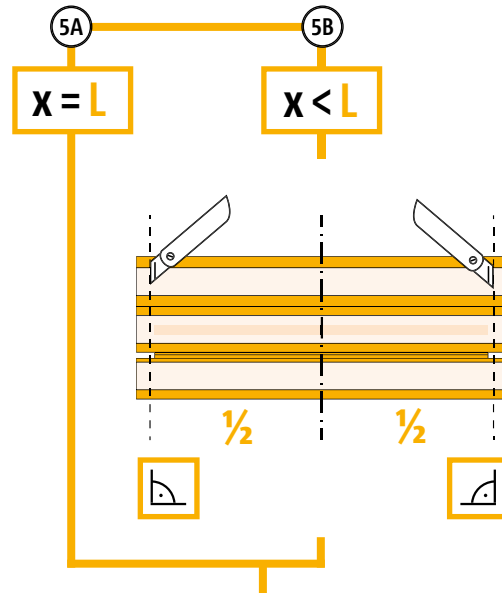
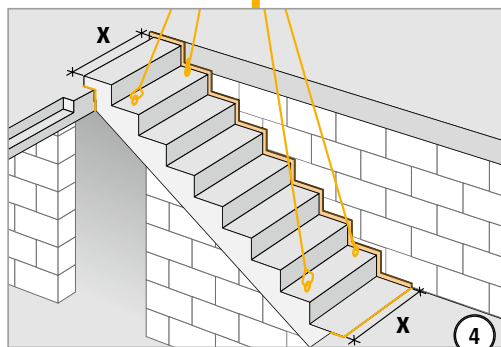
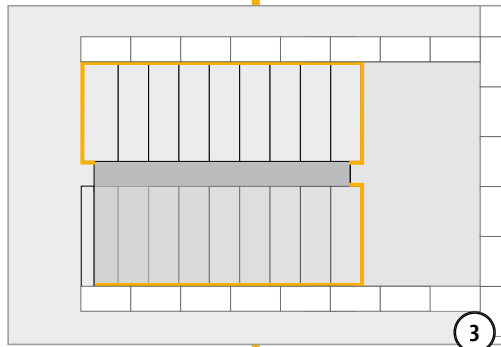
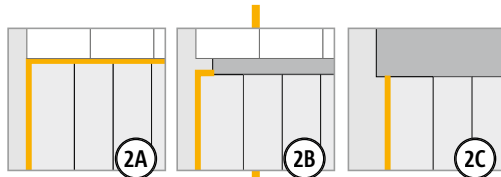
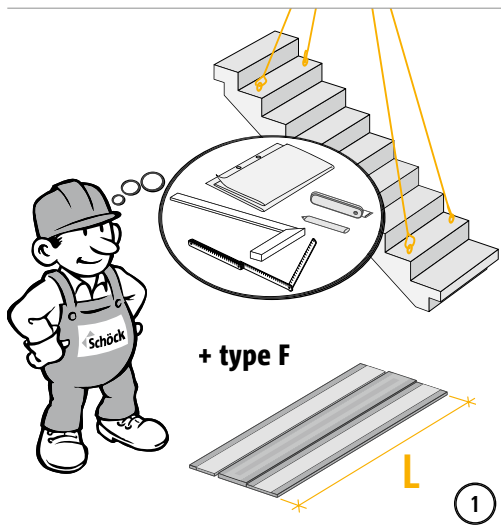
### Materials and construction materials

| Schöck Tronsole® type F | Material                               |
|-------------------------|--|
| PE foam panel           | PE foam according to DIN EN 14313      |
| Plastic profile         | PVC-U according to DIN EN 13245-1      |
| Elastomer support       | Polyurethane according to DIN EN 13165 |

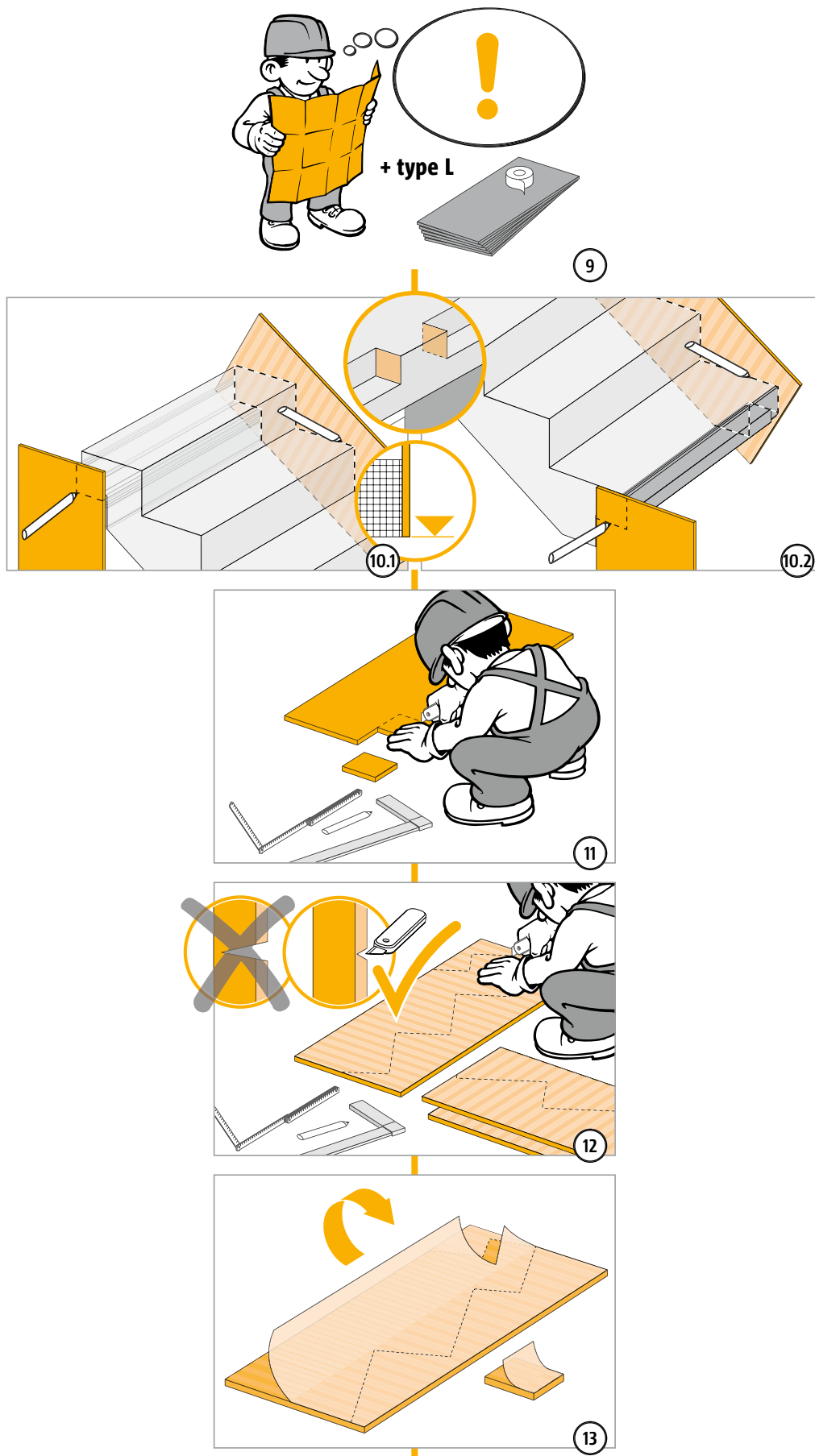
### i Installation

- ▶ The Schöck Tronsole® type F is bonded to the dry precast stair flight with the aid of an own-product assembly adhesive tape. Through the bracing clip hinge it is also suitable as alternative for positioning in the landing corbel.
- ▶ The PE foam panels can be cut by hand using a simple cutting tool. As the PE foam panel at both ends of the linear elastomer support projects by 50 mm, the Tronsole® type F can be easily shortened without interfering with the elastomer support.
- ▶ With the cutting to length of the Tronsole® type F care is to be taken that the projection of the PE foam panels over the elastomer support is shortened to the same length on both sides, in order to retain the central position of the elastomer support.

# Installation instructions building site precast components

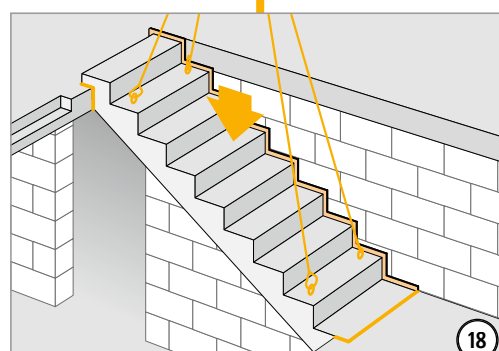
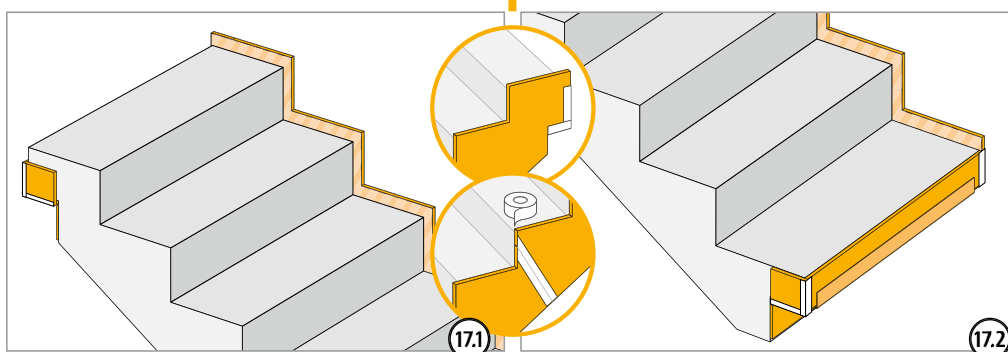
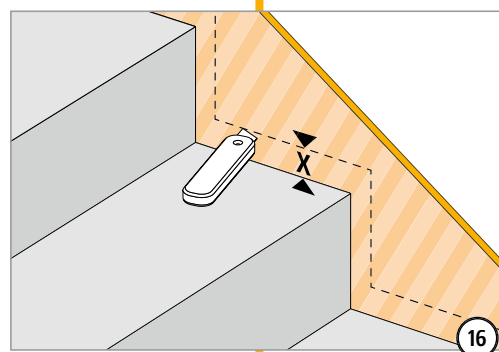
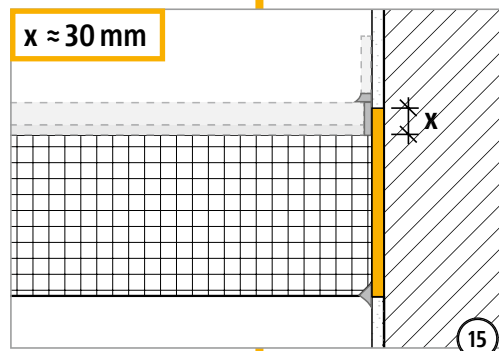
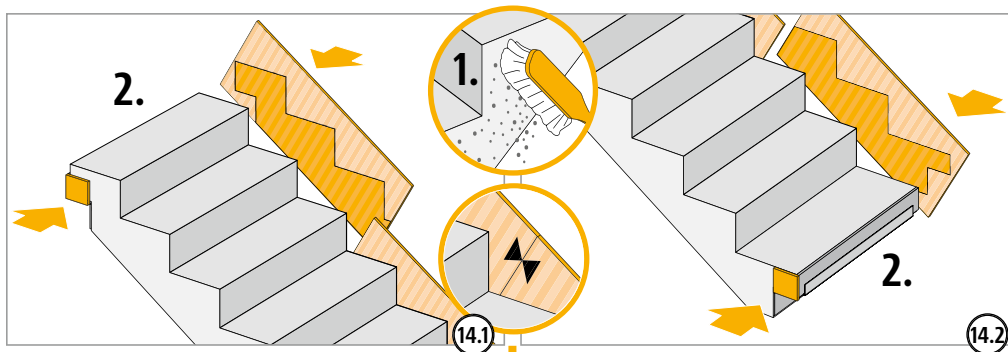


## Installation instructions building site precast components



F

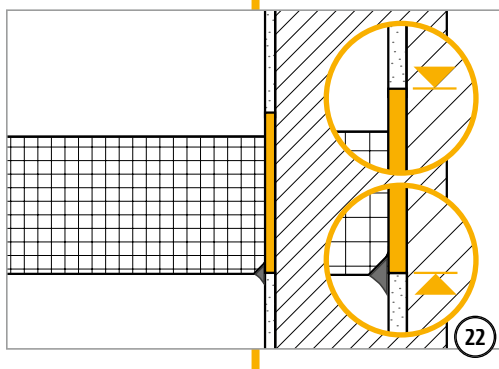
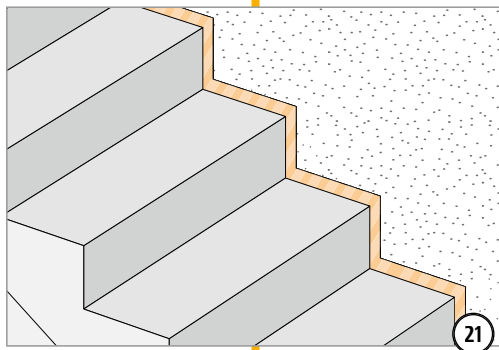
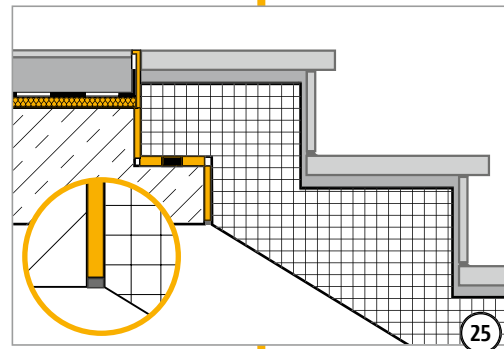
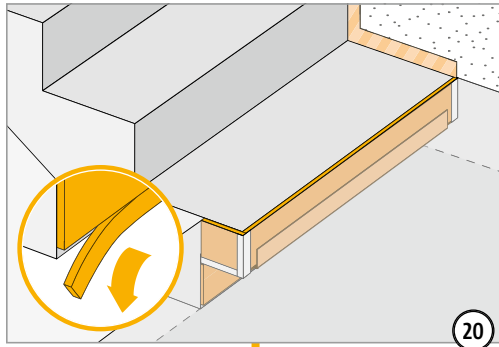
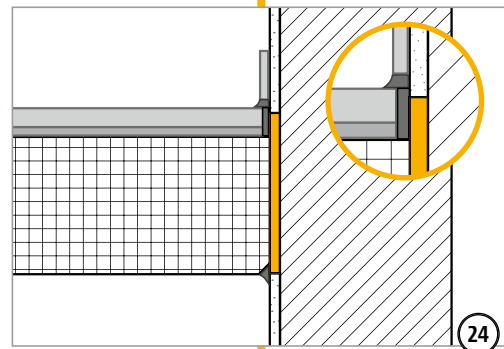
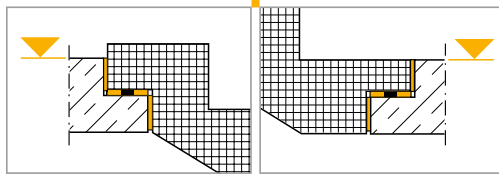
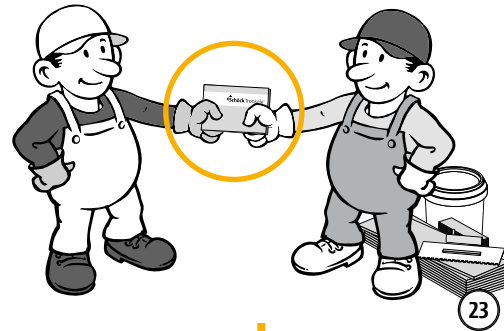
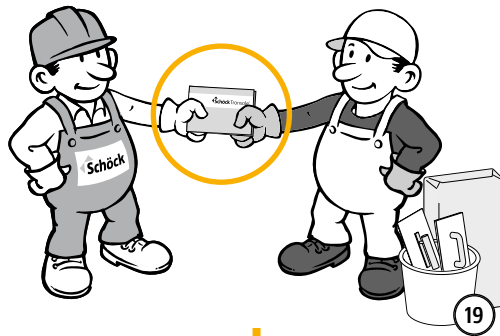
## Installation instructions building site precast components



F



# Installation instructions building site precast components



F

## ✓ Check list

- Are the dimensions of the Schöck Tronsole® matched to the geometry of the structural components which are to be insulated?
- Have the effects on the Schöck Isokorb® connection been specified at design level?
- With type F are the minimum concrete strengths for the landing  $\geq C20/25$  and the stair flight  $\geq C30/37$  taken into account?
- With type F is the stair flight designed as prefabricated element with exposure class XC1, a concrete cover of  $c_{nom} = 15$  mm and fire resistance class R 0?
- With type F is the landing planned as prefabricated element with exposure class XC1, a concrete cover of  $c_{nom} = 20$  mm and fire resistance class R 0?
- Have the requirements with regard to fire protection been cleared and announced?
- Due to a fire protection requirement are larger concrete covers and larger structural component heights taken into account?
- Is the corbel depth defined within a range between 130 mm and 160 mm?
- With  $V_{Ed}$  is the respective limiting value of the slab load-bearing capacity checked on the non-notched slab side of the landing or of the stair flight?
- Are planned existing horizontal loads, which can be conducted away via type T, taken into account?

## Schöck Tronsole® type Q



### **Schöck Tronsole® Type Q**

Serves as point bearing for acoustic decoupling of spiral flights of stairs and staircase walls. The flight of stairs can be manufactured in in-situ concrete or as fully precast component. The staircase wall can be made of reinforced concrete or masonry.

Q

## Product characteristics

### i Product characteristics

- ▶ Rated landing impact sound level difference  $\Delta L_{w,landing}^* \geq 28$  dB, tested according to DIN 7396 with maximum load: test report no. 91386-10 and 91386-11: (for an explanation of the value  $\Delta L_{w,landing}^*$ , see page 13)
- ▶ High quality and efficient Elodur® elastomer support for point connection
- ▶ With general building authority approval (in Germany DIBt under no. 15.7-311)
- ▶ Fire-resistance class R 90 up to max. 65 mm joint width can be achieved using the optional fire-protection set (fire protection advisory opinion no. 3.2/13-390-1)
- ▶ Joint widths to maximum 100 mm can be realised
- ▶ Rotatable load-bearing component enables the alignment of the sliding sleeve parallel to the stair reinforcement

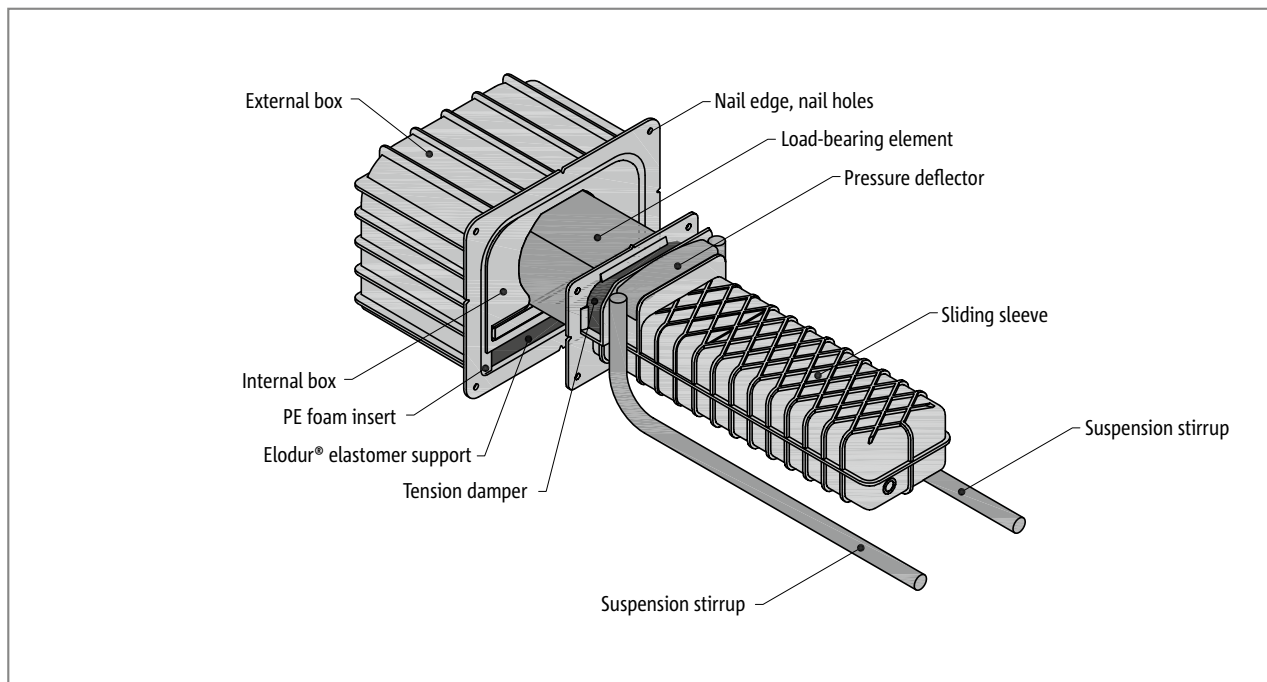


Fig. 85: Schöck Tronsole® Type Q: Wall element, load-bearing element and sliding sleeve with details of important components

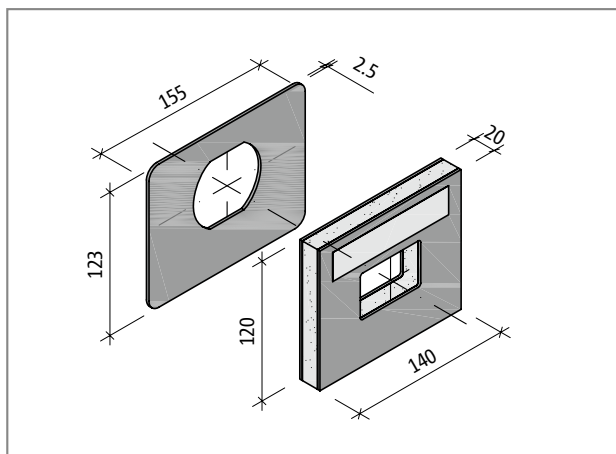


Fig. 86: Schöck Tronsole® type Q: Fire protection set consisting of fire protective cover ( $t = 2.5$  mm) and fire protective collar(s)

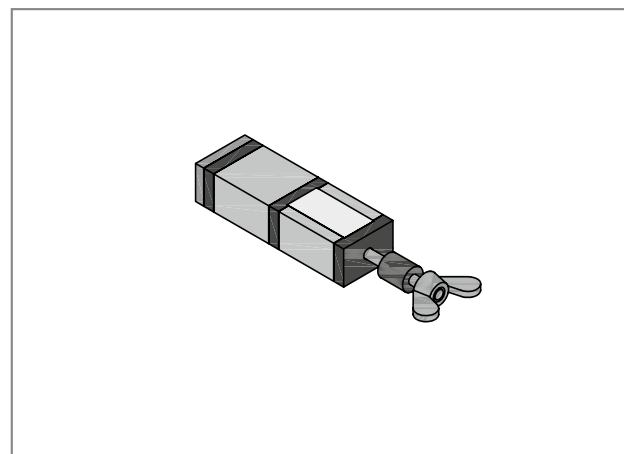


Fig. 87: Schöck Tronsole® type Q: Assembly element

## Product selection | Type designations

### Schöck Tronsole® Type Q variants

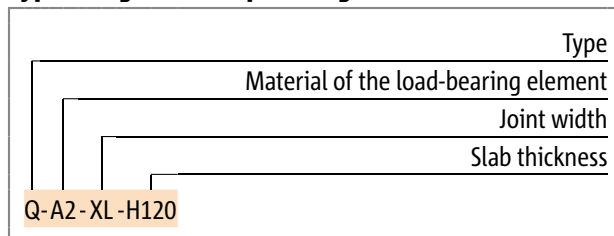
The configuration of Schöck Tronsole® Type Q can be varied as follows:

- ▶ Material of the load-bearing element:
  - Type Q-FV: Load-bearing element made from galvanised construction steel
  - Type Q-A2: Load-bearing element made of stainless steel
- ▶ Joint width:
 

XL indicates a joint width range between 51 mm and 100 mm. The long version of the load-bearing element is required for this range. The designation XL is omitted for smaller joint widths. In this case, the short version of the load-bearing element should be selected.
- ▶ Slab thickness:
 

H120 indicates a sliding sleeve design with an 8-mm-diameter suspension bracket. It is used for waist slabs with thicknesses  $h = 120$  mm or  $h = 130$  mm. For greater slab thicknesses, the designation H120 is no longer required.

### Type designation in planning documents



## Installation variants

### Installation with different inclination angles of the stair flight

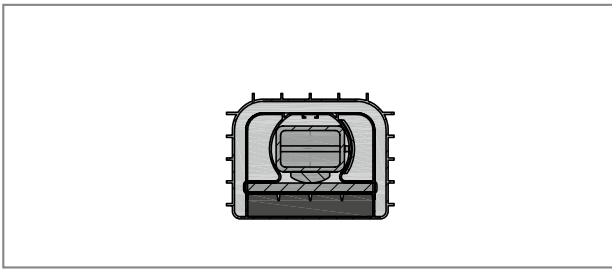


Fig. 88: Schöck Tronsole® type Q: Installation variant horizontal installation of the load-bearing element

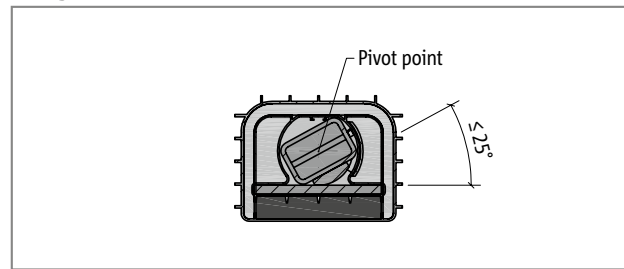


Fig. 89: Schöck Tronsole® type Q: Installation variant inclined installation of the load-bearing element

### Installation with different joint widths

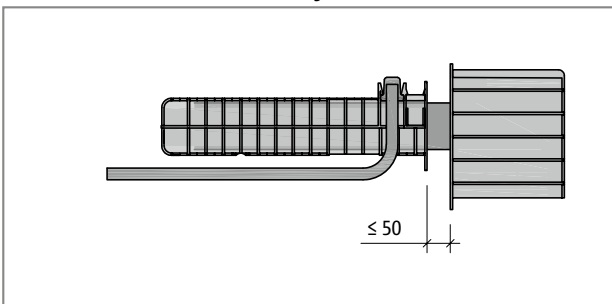


Fig. 90: Schöck Tronsole® type Q: Installation variant joint width  $\le 50$  mm

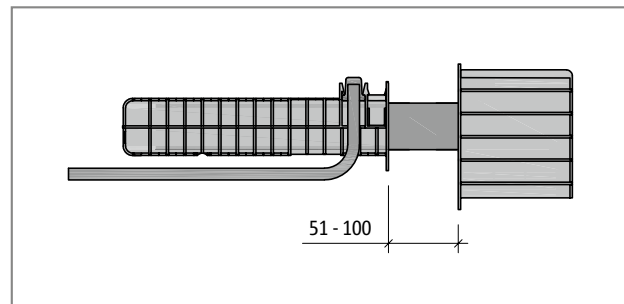


Fig. 91: Schöck Tronsole® type Q...-XL: Installation variant joint width 51-100 mm

### Installation with different slab thicknesses

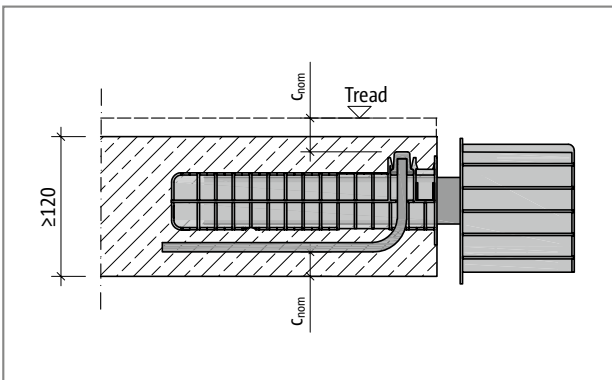


Fig. 92: Schöck Tronsole® type Q: Installation with slab thickness  $h = 120$  mm requires the inclusion of the concrete of the tread for the enabling of the concrete cover  $c_{nom}$

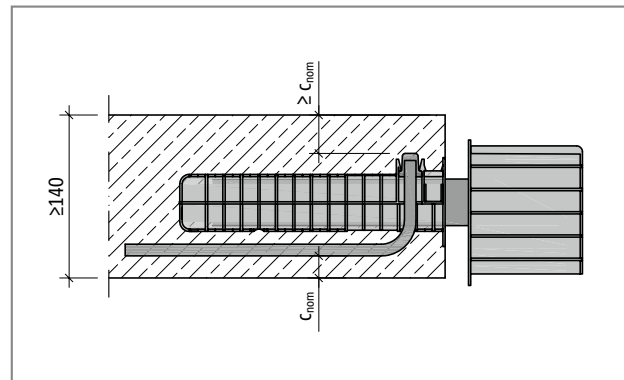


Fig. 93: Schöck Tronsole® type Q: Installation with slab thickness  $h \ge 140$  mm taking note of the concrete cover  $c_{nom}$

### **i** Installation variants

- ▶ The rotatability of the load-bearing component of the Schöck Tronsole® type Q enables the alignment of the sliding sleeve parallel to the level of the reinforcement in the stair flight. In this way a matching of the sliding sleeve and the load-bearing component to the pitch of the stairs takes place.
- ▶ Two different lengths of the load-bearing component allow joint widths up to 50 mm resp. between 51 and 100 mm. With the use of the Tronsole® type L for the avoidance of acoustic bridges between the stair string and the stairwell wall there results a minimum joint width of 15 mm, to which the given soundproofing values refer.
- ▶ The minimum slab thickness of a stair flight with Tronsole® type Q lies at  $h = 120$  mm.

## Installation cross sections

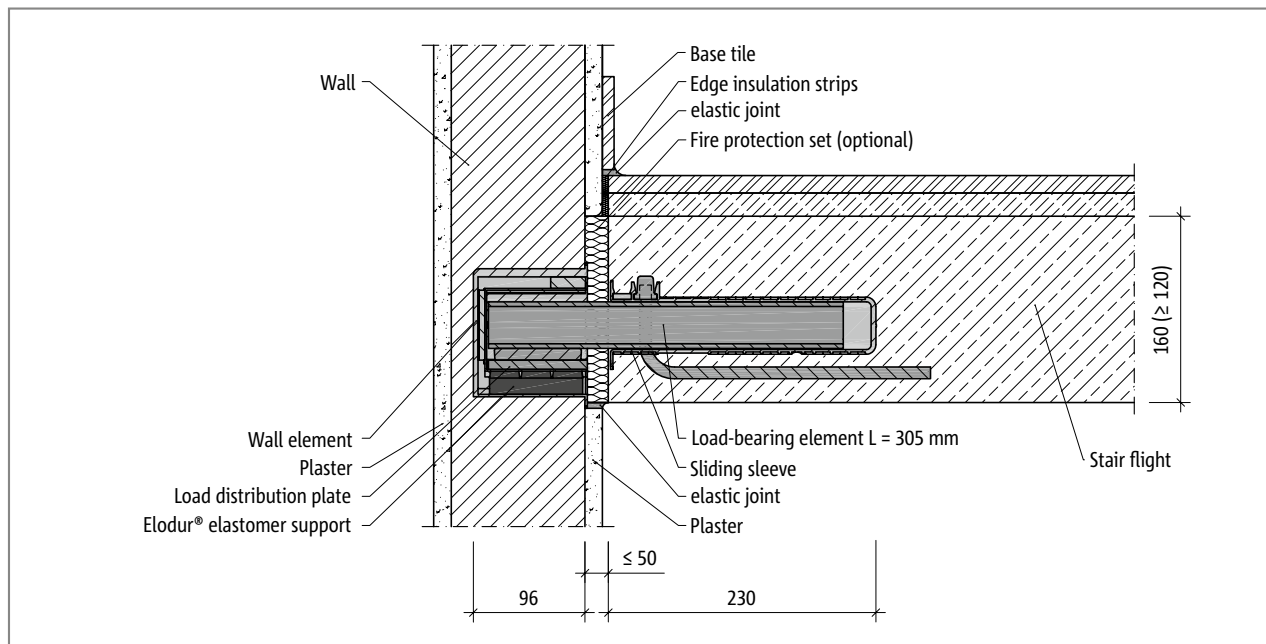


Fig. 94: Schöck Tronsole® type Q-FV or Q-A2: Installation cross-section wall thickness 11.5 cm

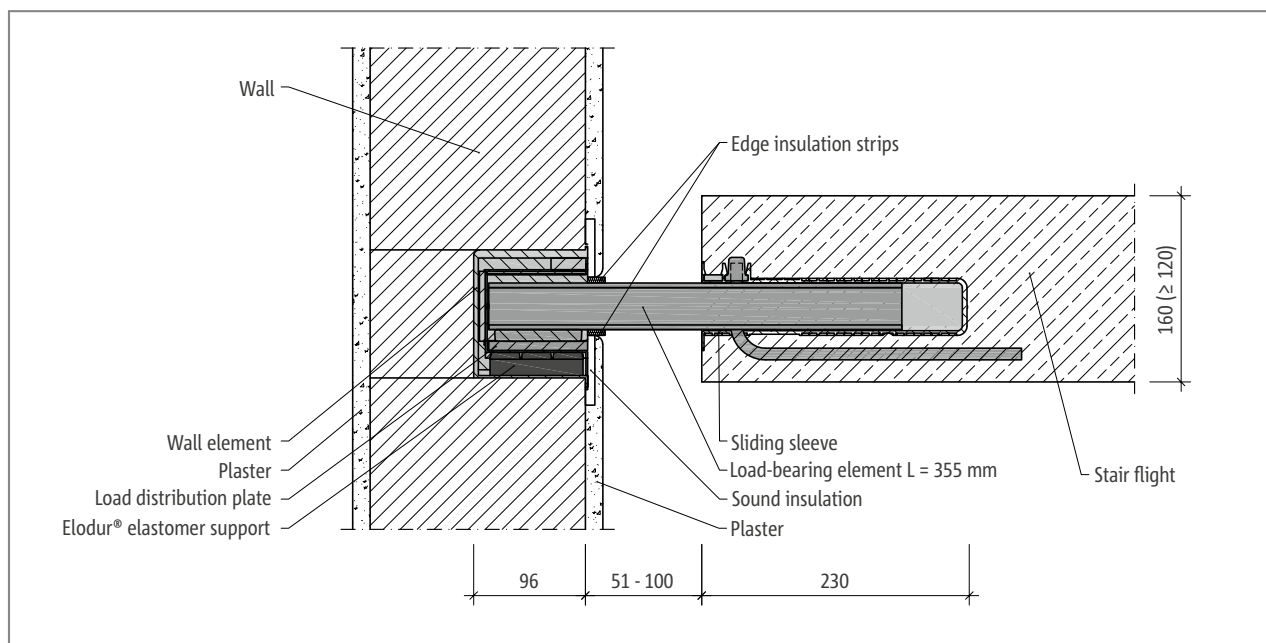


Fig. 95: Schöck Tronsole® type Q-FV-XL or Q-A2-XL: Installation cross-section

## Installation cross sections

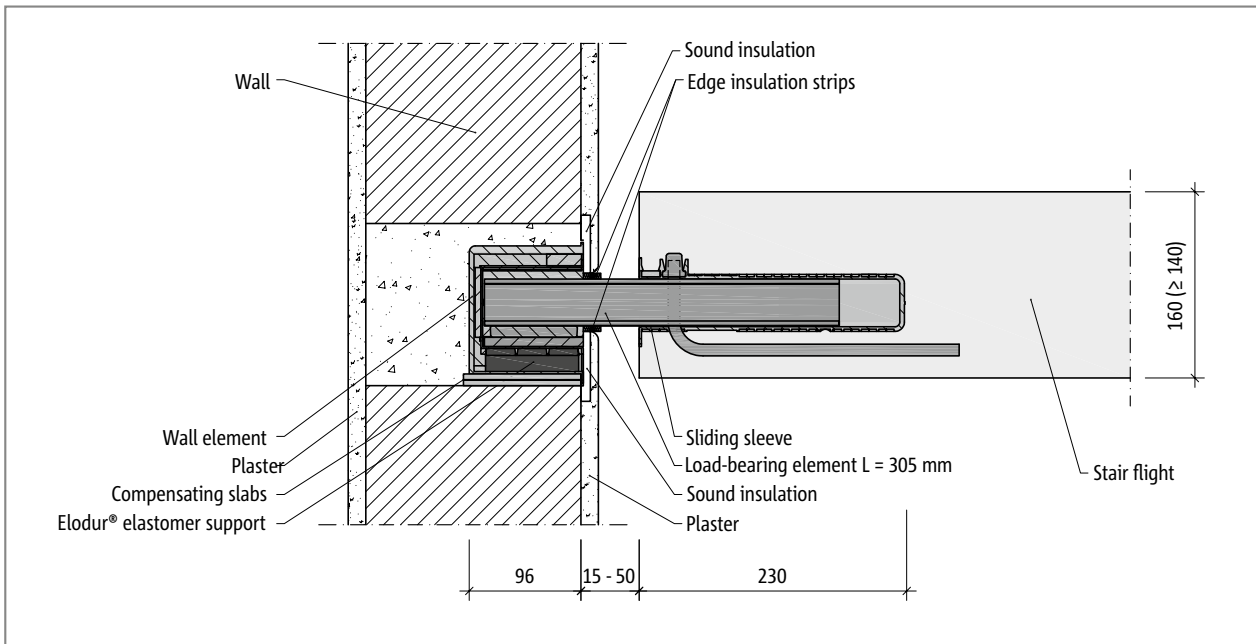


Fig. 96: Schöck Tronsole® type Q-FV or Q-A2: Installation cross-section with precast stairs flight

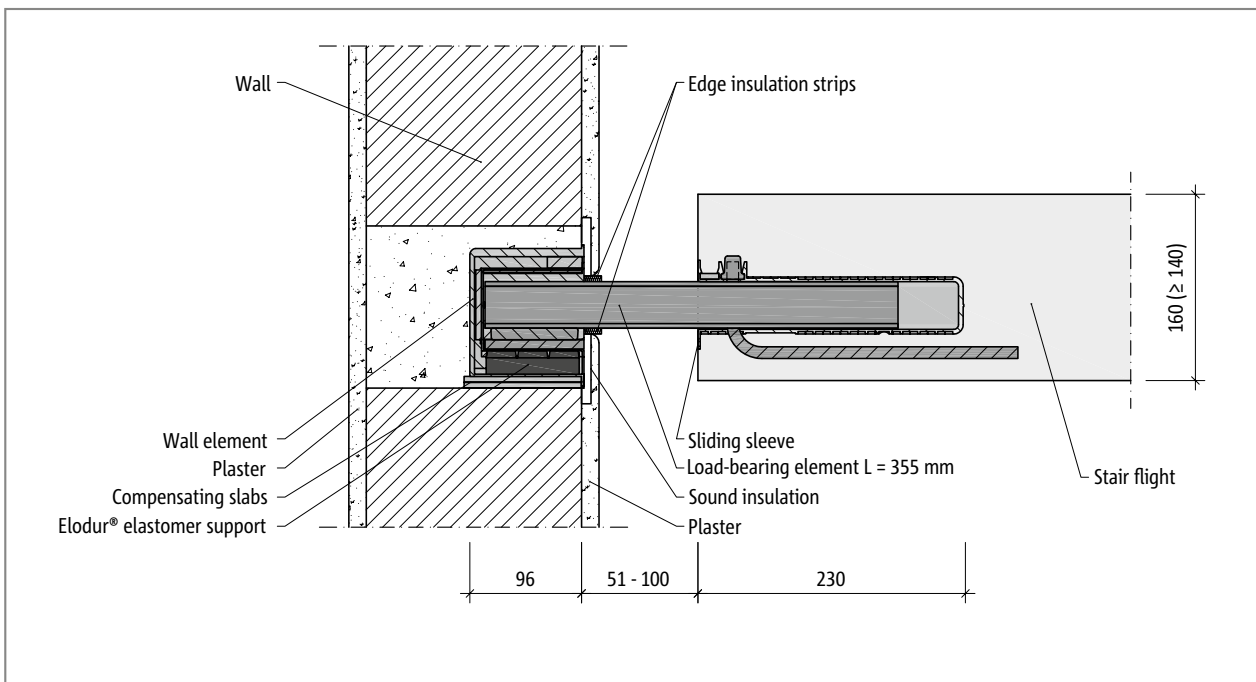


Fig. 97: Schöck Tronsole® type Q-FV-XL or Q-A2-XL: Installation cross-section with precast stairs flight



## Element arrangement

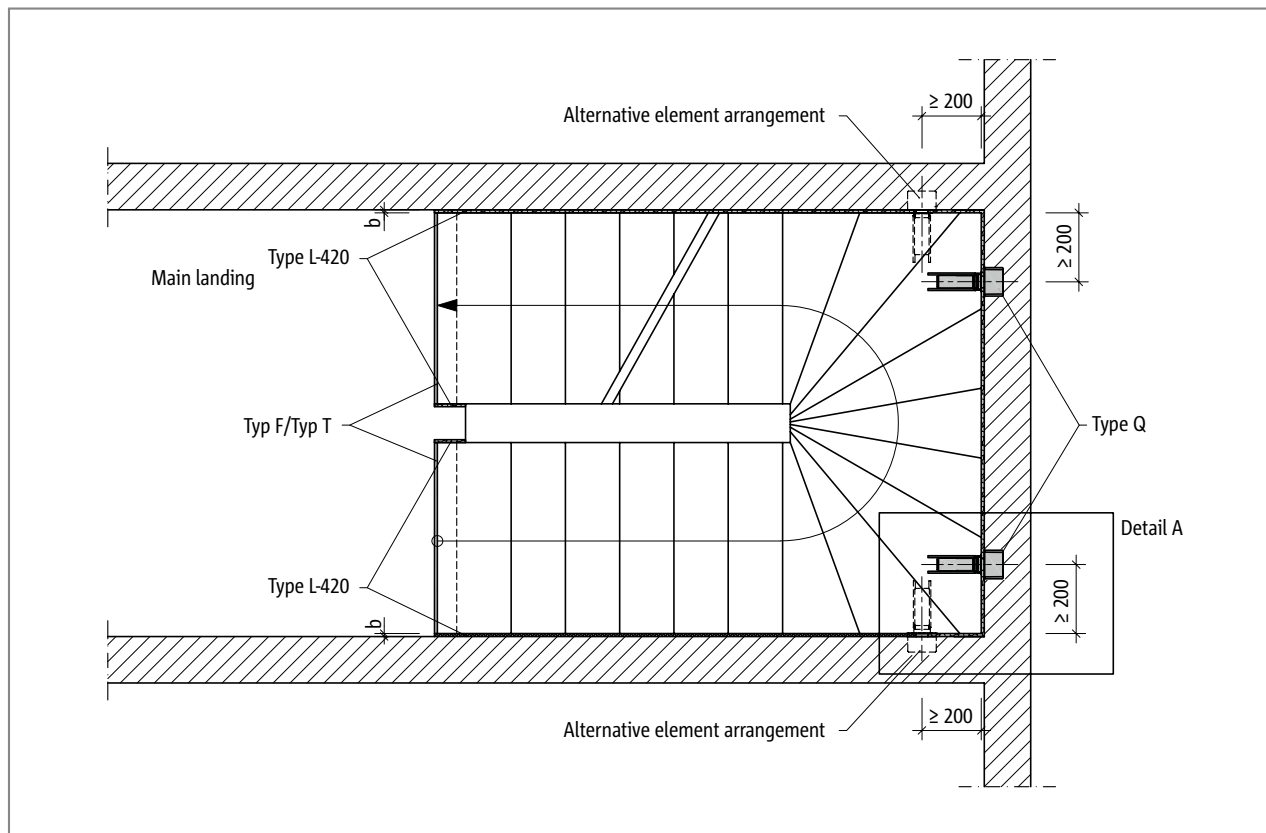


Fig. 98: Schöck Tronsole® type Q: Component arrangement in the layout using the Tronsole® type L

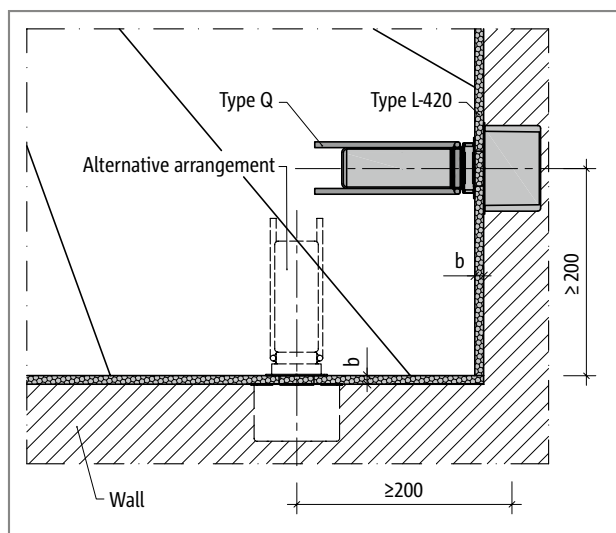


Fig. 99: Schöck Tronsole® type Q: Component arrangement, Detail A, joint width  $b = 15 \text{ mm}$  with in-situ concrete, with precast stair flights the necessity of an additional installation tolerance is to be checked by the planner

## Element arrangement

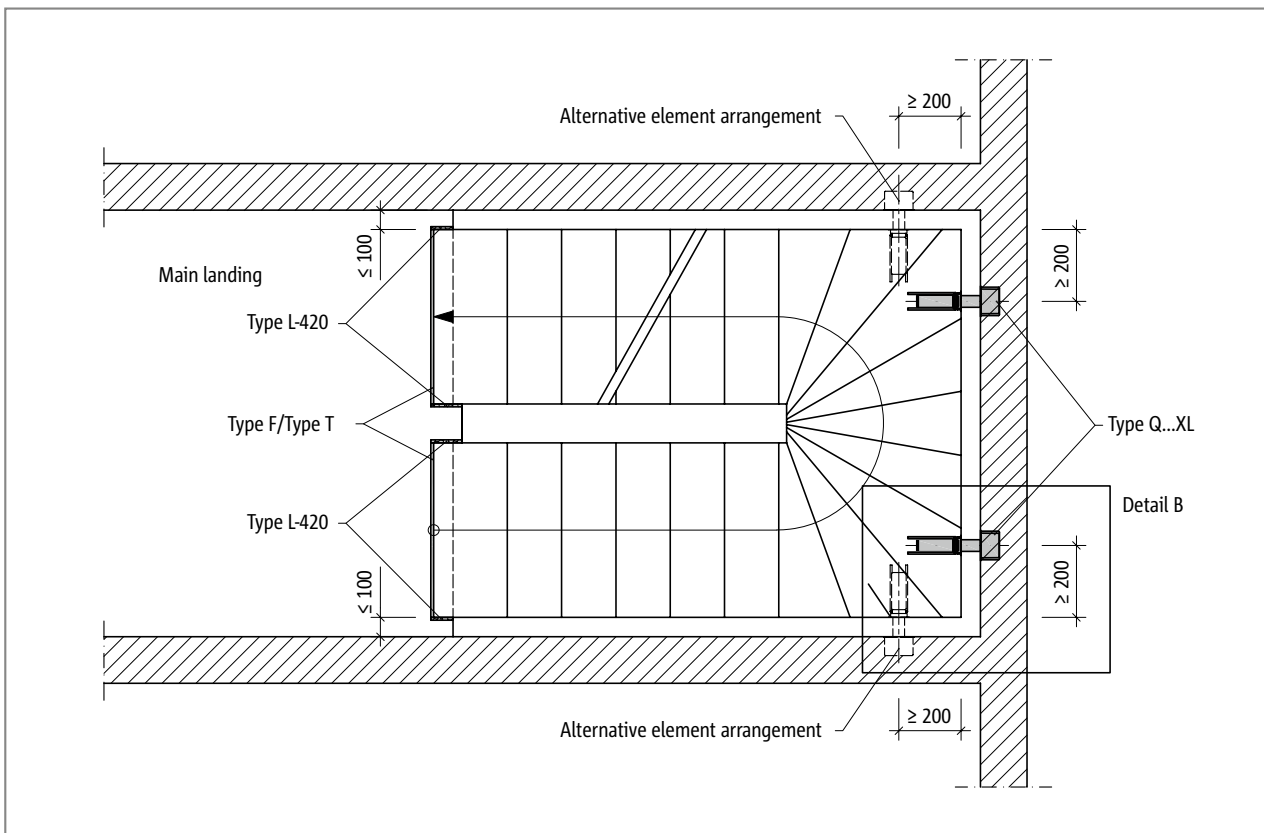


Fig. 100: Schöck Tronsole® type Q...-XL: Component arrangement in the layout with a joint width of maximum 100 mm

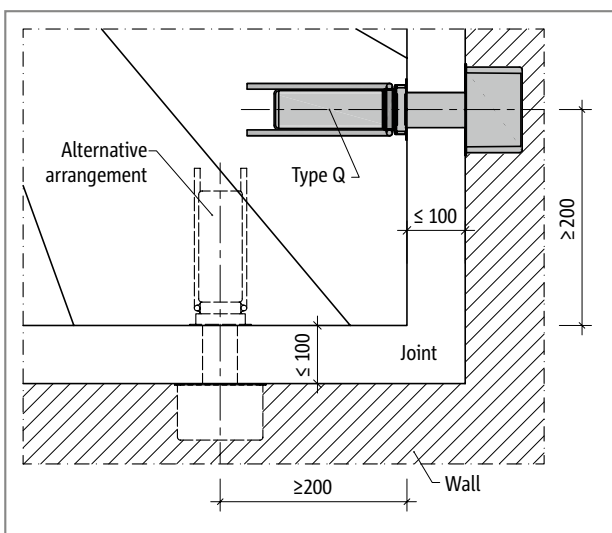


Fig. 101: Schöck Tronsole® type Q: Component configuration, Detail B

### **i** Combination possibilities

- ▶ The given acoustic insulation values are only achieved in combination with the Tronsole® type L-420 or with a sufficiently wide air joint (50 mm). For prefabricated construction with regard to installation tolerances the explanation for the Tronsole® type L on page 219 is to be noted.
- ▶ The use of the Schöck Tronsole® type B is suitable for the sound insulation of stair flight and floor slab. The Tronsole® type Q and type B can be combined.
- ▶ The employment of the Schöck Tronsole® type F or type T is suitable for the sound insulation of the stair-head and/or stair-foot and landing slab or floor. Tronsole® type F is suitable for precast stairs, while type T is used for in-situ concrete and fully pre-fabricated stair flights.

## Product description

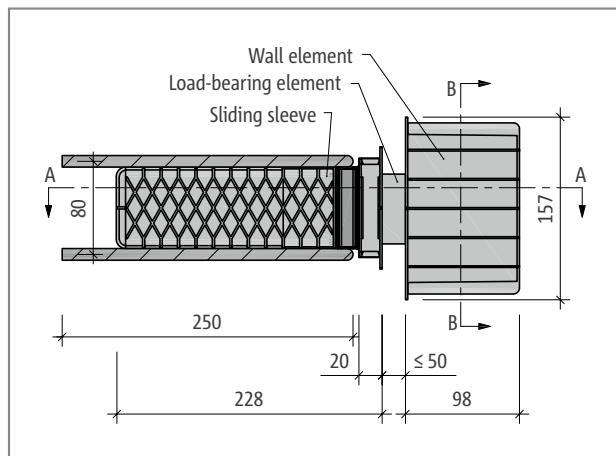


Fig. 102: Schöck Tronsole® type Q: Product layout

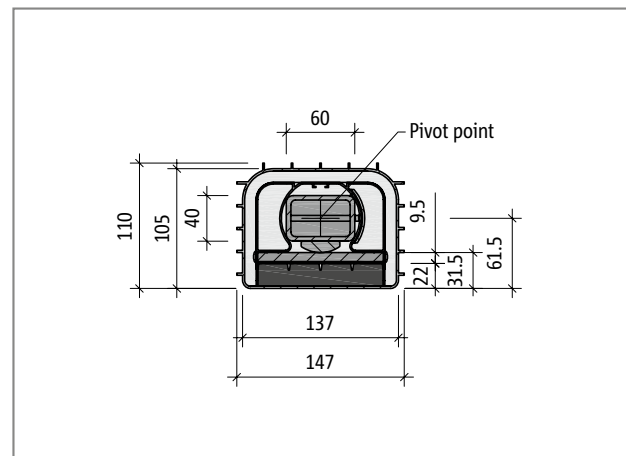


Fig. 103: Schöck Tronsole® type Q: Product cross-section B-B with horizontal load-bearing element

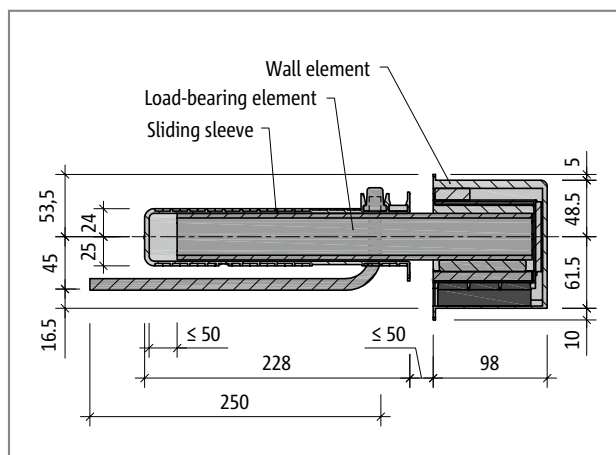


Fig. 104: Schöck Tronsole® type Q: Product section A-A

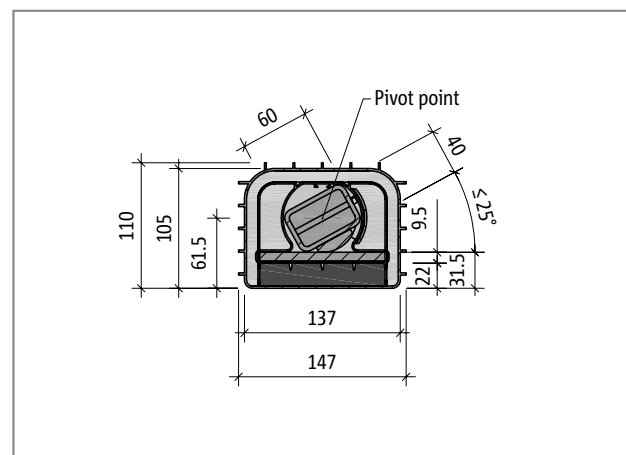


Fig. 105: Schöck Tronsole® type Q: Product cross-section with rotated load-bearing element

### **i** Product information

- ▶ For slab thicknesses  $h = 120$  mm and  $h = 130$  mm, a suspension bracket 8 mm in diameter and 210 mm long in the top view is supplied for the sleeve of Schöck Tronsole® Type Q.
- ▶ For slab thicknesses  $h \geq 140$  mm, the rod diameter of the suspension bracket is enlarged to 10 mm in the top view.
- ▶ Due to its approval, Schöck Tronsole® Type Q must always be used as a set along with the wall element, load-bearing element and sliding sleeve.

## Design

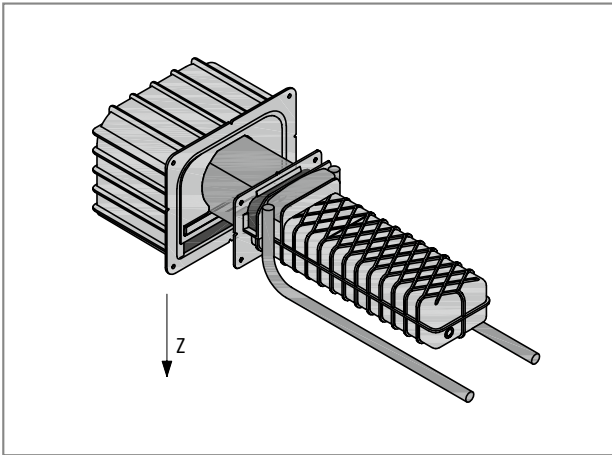


Fig. 106: Schöck Tronsole® type Q: 3D view with centre line designation

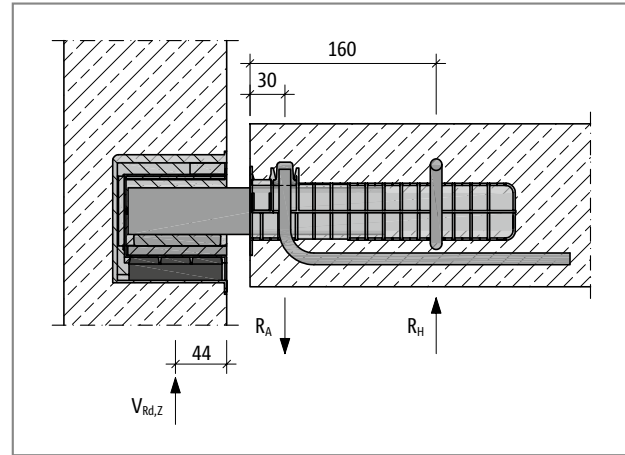


Fig. 107: Schöck Tronsole® type Q: Static system

### Design

For the bearing surface of the Tronsole® at least the compression strength class 20 in combination with mortar group III is required as masonry. With lower compression strength classes a concrete pressure pad under the wall element can be used, with which the permitted pressing is observed.

#### **i** Notes on design

- ▶ The shear force  $V_{Ed,z}$  is transferred into the wall element of Tronsole® Type Q via the Elodur® elastomeric bearing with an area of 110 mm × 80 mm.
- ▶ The stress impacting the masonry is calculated as follows:  $\sigma_{Ed} = V_{Ed} / (110 \cdot 80) \text{ mm}^2$ . With the maximum utilisation of 40.1 kN  $\sigma_{isEd} = 4.5 \text{ N/mm}^2$ .
- ▶ Listed in the design tables are the  $V_{Rd,z}$  values for various joint widths. Intermediate values may be interpolated linearly.
- ▶ The application range of the Schöck Tronsole® type Q stretches exclusively on structural components with mainly static loading according to DIN EN 1991-1-1 (EC1) and DIN EN 1991-1-1/NA.
- ▶ The verification of the shear force in the stair flight and in the landing slab must be carried out by the structural engineer.
- ▶ With the predefined concrete strengths it is a matter of the minimum requirements, which are the basis for the design.
- ▶ For stair flights exposure class XC1 is assumed.
- ▶ According to DIN EN 1992-1-1 (EC2) and DIN EN 1992-1-1/NA, with exposure class XC1, the following nominal concrete cover results:
 

|                                |                             |
|--------------------------------|-----------------------------|
| In-situ concrete stair flight: | $c_{nom} = 20 \text{ mm}$ . |
| Prefabricated stair flight:    | $c_{nom} = 15 \text{ mm}$ . |
- ▶ When using Tronsole® Type Q with a waist slab thickness of  $h = 120 \text{ mm}$  and  $h = 130 \text{ mm}$ , the product designation H120 must be taken into account as the product's own suspension bracket must be adjusted to the lower height in these cases.
- ▶ With configuration of the 120 mm thick stair slabs with the Schöck Tronsole® type Q, the required upper concrete cover is achieved through the concrete of the tread.
- ▶ With the installation of several elements of the Tronsole® type Q, the minimum separation of Tronsole® to Tronsole® is 400 mm.

## Design

| Schöck Tronsole® type |                  | Q-FV                                  | Q-FV-XL | Q-A2 | Q-A2-XL |
|-----------------------|------------------|---------------------------------------|---------|------|---------|
| Design values with    |                  | Concrete strength class $\geq$ C20/25 |         |      |         |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]               |         |      |         |
| 120, 130              | 15               | 28.3                                  | -       | 28.3 | -       |
|                       | 20               | 27.6                                  | -       | 27.6 | -       |
|                       | 30               | 26.4                                  | -       | 26.4 | -       |
|                       | 40               | 25.3                                  | -       | 25.3 | -       |
|                       | 50               | 24.3                                  | 24.3    | 24.3 | 24.3    |
|                       | 60               | -                                     | 23.4    | -    | 23.4    |
|                       | 70               | -                                     | 22.6    | -    | 21.9    |
|                       | 80               | -                                     | 21.8    | -    | 20.5    |
|                       | 90               | -                                     | 21.0    | -    | 19.3    |
|                       | 100              | -                                     | 20.3    | -    | 18.2    |
| $\geq 140$            | 15               | 38.4                                  | -       | 34.2 | -       |
|                       | 20               | 36.6                                  | -       | 32.5 | -       |
|                       | 30               | 33.5                                  | -       | 29.7 | -       |
|                       | 40               | 30.8                                  | -       | 27.3 | -       |
|                       | 50               | 28.3                                  | 33.0    | 25.3 | 25.3    |
|                       | 60               | -                                     | 30.5    | -    | 23.5    |
|                       | 70               | -                                     | 28.4    | -    | 21.9    |
|                       | 80               | -                                     | 26.6    | -    | 20.5    |
|                       | 90               | -                                     | 24.9    | -    | 19.3    |
|                       | 100              | -                                     | 23.5    | -    | 18.2    |

| Schöck Tronsole® type |                  | Q-FV                                  | Q-FV-XL | Q-A2 | Q-A2-XL |
|-----------------------|------------------|---------------------------------------|---------|------|---------|
| Design values with    |                  | Concrete strength class $\geq$ C25/30 |         |      |         |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]               |         |      |         |
| 120, 130              | 15               | 30.2                                  | -       | 30.2 | -       |
|                       | 20               | 29.5                                  | -       | 29.5 | -       |
|                       | 30               | 28.2                                  | -       | 28.2 | -       |
|                       | 40               | 27.1                                  | -       | 27.1 | -       |
|                       | 50               | 26.0                                  | 26.0    | 25.3 | 25.3    |
|                       | 60               | -                                     | 25.0    | -    | 23.5    |
|                       | 70               | -                                     | 24.1    | -    | 21.9    |
|                       | 80               | -                                     | 23.2    | -    | 20.5    |
|                       | 90               | -                                     | 22.5    | -    | 19.3    |
|                       | 100              | -                                     | 21.7    | -    | 18.2    |
| $\geq 140$            | 15               | 38.4                                  | -       | 34.2 | -       |
|                       | 20               | 36.6                                  | -       | 32.5 | -       |
|                       | 30               | 33.5                                  | -       | 29.7 | -       |
|                       | 40               | 30.8                                  | -       | 27.3 | -       |
|                       | 50               | 28.3                                  | 33.0    | 25.3 | 25.3    |
|                       | 60               | -                                     | 30.5    | -    | 23.5    |
|                       | 70               | -                                     | 28.4    | -    | 21.9    |
|                       | 80               | -                                     | 26.6    | -    | 20.5    |
|                       | 90               | -                                     | 24.9    | -    | 19.3    |
|                       | 100              | -                                     | 23.5    | -    | 18.2    |

## Design

| Schöck Tronsole® type |                  | Q-FV                            | Q-FV-XL | Q-A2 | Q-A2-XL |
|-----------------------|------------------|---------------------------------|---------|------|---------|
| Design values with    |                  | Concrete strength $\geq$ C30/37 |         |      |         |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]         |         |      |         |
| 120, 130              | 15               | 32.0                            | -       | 32.0 | -       |
|                       | 20               | 31.3                            | -       | 31.3 | -       |
|                       | 30               | 29.9                            | -       | 29.7 | -       |
|                       | 40               | 28.7                            | -       | 27.3 | -       |
|                       | 50               | 27.6                            | 27.6    | 25.3 | 25.3    |
|                       | 60               | -                               | 26.5    | -    | 23.5    |
|                       | 70               | -                               | 25.6    | -    | 21.9    |
|                       | 80               | -                               | 24.7    | -    | 20.5    |
|                       | 90               | -                               | 23.8    | -    | 19.3    |
|                       | 100              | -                               | 23.0    | -    | 18.2    |
| $\geq 140$            | 15               | 38.4                            | -       | 34.2 | -       |
|                       | 20               | 36.6                            | -       | 32.5 | -       |
|                       | 30               | 33.5                            | -       | 29.7 | -       |
|                       | 40               | 30.8                            | -       | 27.3 | -       |
|                       | 50               | 28.3                            | 33.0    | 25.3 | 25.3    |
|                       | 60               | -                               | 30.5    | -    | 23.5    |
|                       | 70               | -                               | 28.4    | -    | 21.9    |
|                       | 80               | -                               | 26.6    | -    | 20.5    |
|                       | 90               | -                               | 24.9    | -    | 19.3    |
|                       | 100              | -                               | 23.5    | -    | 18.2    |

| Schöck Tronsole® type |                  | Q-FV                            | Q-FV-XL | Q-A2 | Q-A2-XL |
|-----------------------|------------------|---------------------------------|---------|------|---------|
| Design values with    |                  | Concrete strength $\geq$ C35/45 |         |      |         |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]         |         |      |         |
| 120, 130              | 15               | 33.9                            | -       | 33.9 | -       |
|                       | 20               | 33.1                            | -       | 32.5 | -       |
|                       | 30               | 31.7                            | -       | 29.7 | -       |
|                       | 40               | 30.4                            | -       | 27.3 | -       |
|                       | 50               | 28.3                            | 29.2    | 25.3 | 25.3    |
|                       | 60               | -                               | 28.1    | -    | 23.5    |
|                       | 70               | -                               | 27.0    | -    | 21.9    |
|                       | 80               | -                               | 26.1    | -    | 20.5    |
|                       | 90               | -                               | 24.9    | -    | 19.3    |
|                       | 100              | -                               | 23.5    | -    | 18.2    |
| $\geq 140$            | 15               | 38.4                            | -       | 34.2 | -       |
|                       | 20               | 36.6                            | -       | 32.5 | -       |
|                       | 30               | 33.5                            | -       | 29.7 | -       |
|                       | 40               | 30.8                            | -       | 27.3 | -       |
|                       | 50               | 28.3                            | 33.0    | 25.3 | 25.3    |
|                       | 60               | -                               | 30.5    | -    | 23.5    |
|                       | 70               | -                               | 28.4    | -    | 21.9    |
|                       | 80               | -                               | 26.6    | -    | 20.5    |
|                       | 90               | -                               | 24.9    | -    | 19.3    |
|                       | 100              | -                               | 23.5    | -    | 18.2    |

# On-site reinforcement

## Required on-site reinforcement

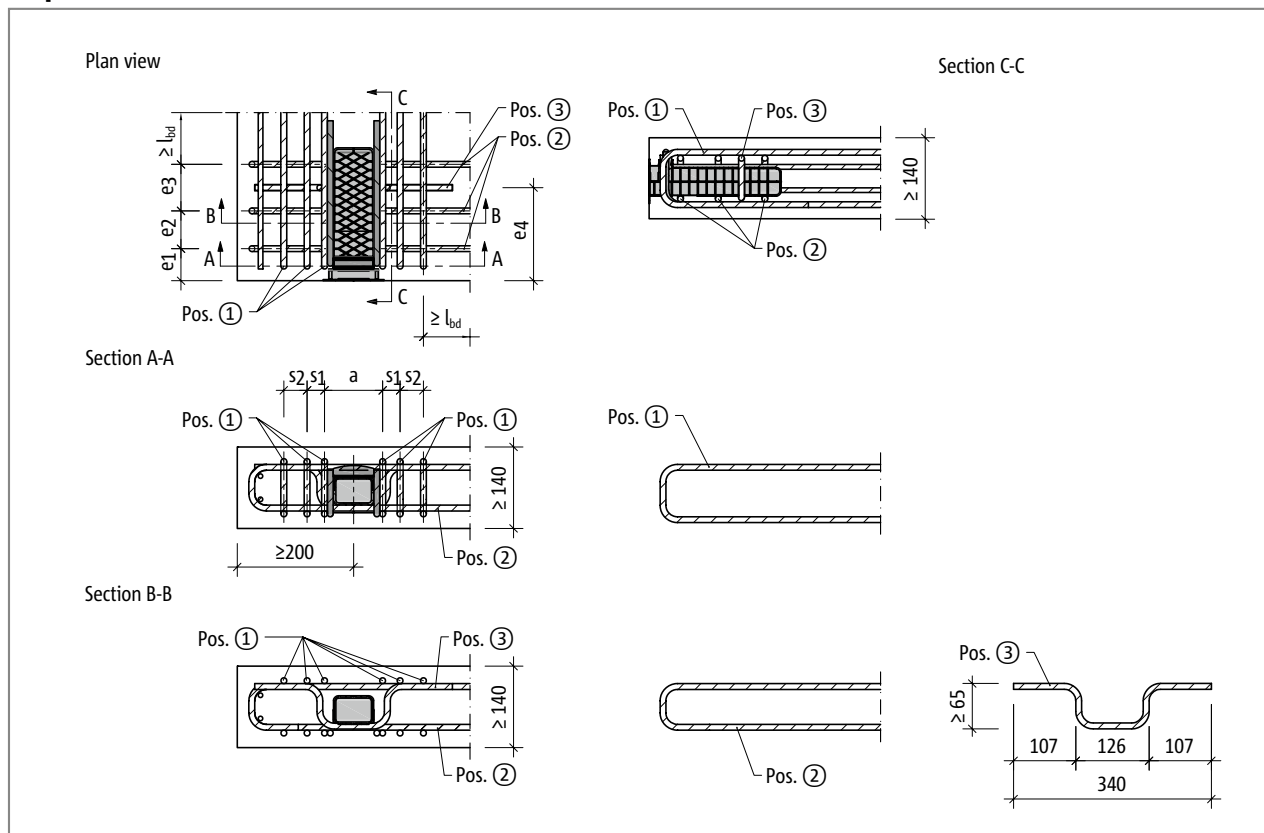


Fig. 108: Schöck Tronsole® type Q: On-site reinforcement

| Schöck Tronsole® type   |                     | Q               |     |                                       |
|---|---------------------|-----------------|-----|---------------------------------------|
| On-site reinforcement   | Slab thickness [mm] | Separation [mm] |     | Concrete strength class $\geq$ C20/25 |
| <b>Pos. 1 tie, <math>A_{sx}</math></b>                              |                     |                 |     |                                       |
| Pos. 1  | 120, 130            | a               | 100 | 6 • H8                                |
|   |                     | $s_1$           | 30  |                                       |
|   |                     | $s_2$           | 30  |                                       |
| Pos. 1  | $\geq 140$          | a               | 100 | 6 • H10                               |
|   |                     | $s_1$           | 30  |                                       |
|   |                     | $s_2$           | 30  |                                       |
| <b>Pos. 2 ties as transverse reinforcement, <math>A_{sy}</math></b> |                     |                 |     |                                       |
| Pos. 2  | 120, 130            | $e_1$           | 50  | 3 • H8                                |
|   |                     | $e_2$           | 70  |                                       |
|   |                     | $e_3$           | 80  |                                       |
| Pos. 2  | $\geq 140$          | $e_1$           | 55  | 3 • H10                               |
|   |                     | $e_2$           | 65  |                                       |
|   |                     | $e_3$           | 80  |                                       |
| <b>Pos. 3 hat brackets</b>  |                     |                 |     |                                       |
| Pos. 3  | 120, 130            | $e_4$           | 160 | 1 • H8                                |
| Pos. 3  | $\geq 140$          |                 |     | 1 • H10                               |

Schöck Tronsole® Type Q: On-site reinforcement

## On-site reinforcement

### **i** On-site reinforcement

- ▶ The height of the on-site hat bracket (Pos. 3) depends on the slab thickness  $h$ . It should be so selected that the hat bracket can be fed around the underside of the sleeve and its ends are in the 2nd position of the slab reinforcement.
- ▶ The underside of the sliding sleeve of the Tronsole® type Q is for the force transmission to the on-site hat bracket (Pos. 3) is fitted with a notch on the contact side.
- ▶ If the U-shaped brackets,  $A_{sx}$  (item 1) are sufficiently long, they can count towards the structurally required slab reinforcement  $A_{sx}$  that must be verified by the structural engineer.
- ▶ If the impacting shear force  $V_{Ed,z}$  with slab thickness 140 is smaller or equal to the acceptable shear force  $V_{Rd,z}$  with slab thickness 120, 130, then the on-site reinforcement can be selected analogue to the slab thickness 120, 130.



## Application example spiral staircase

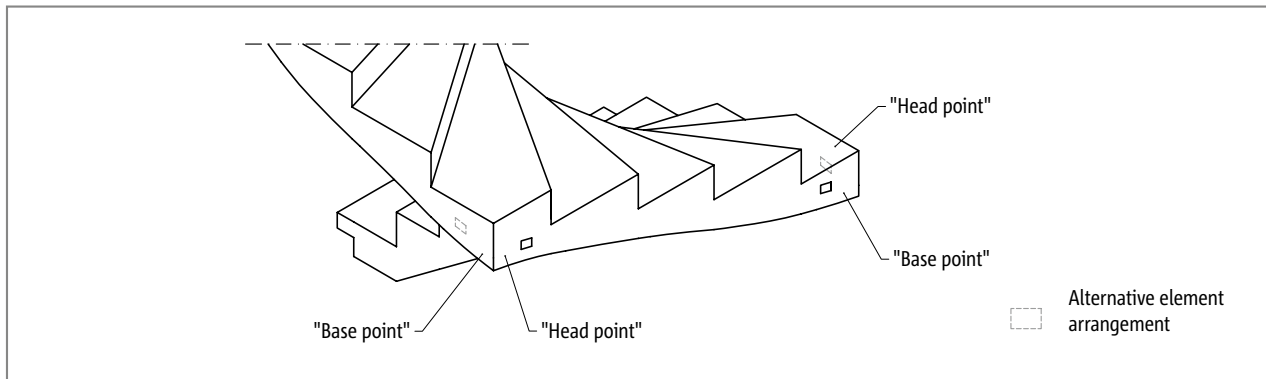
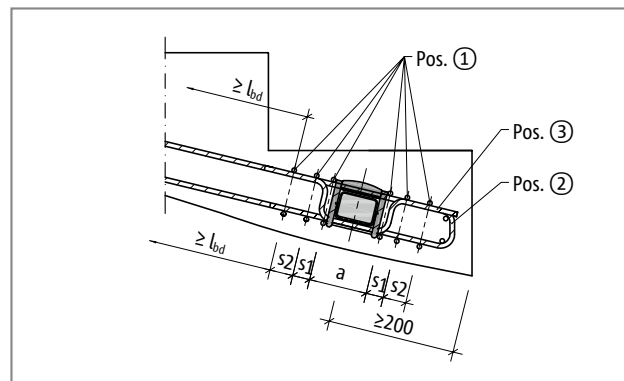
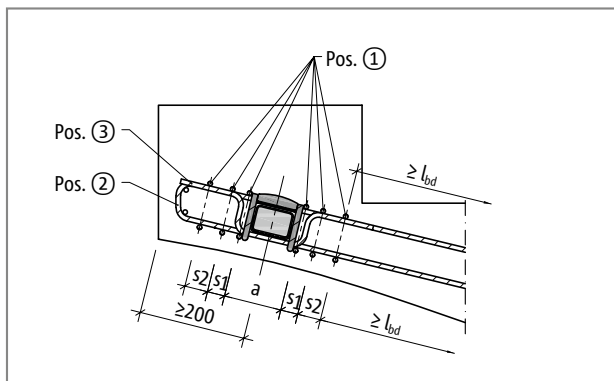
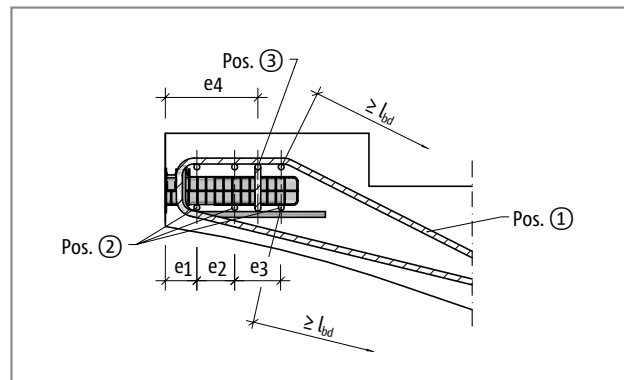
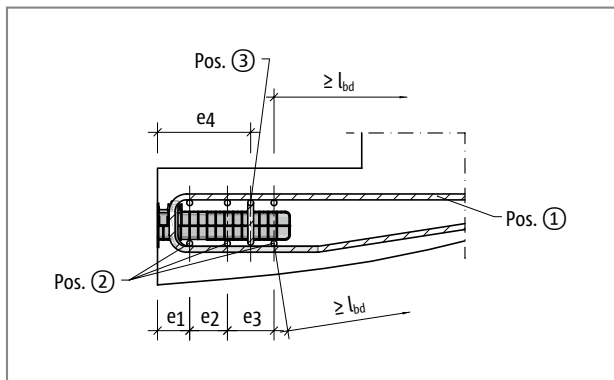
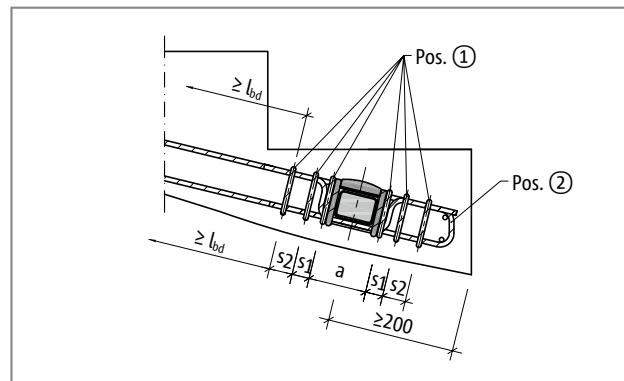
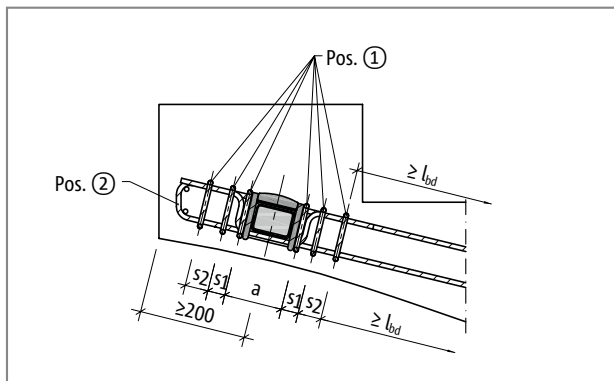


Fig. 109: Schöck Tronsole® type Q: Attachment point in "head point" and "base point"

### Cross-sectional views



## Deflection

### Deformation of the Elodur® elastomer support

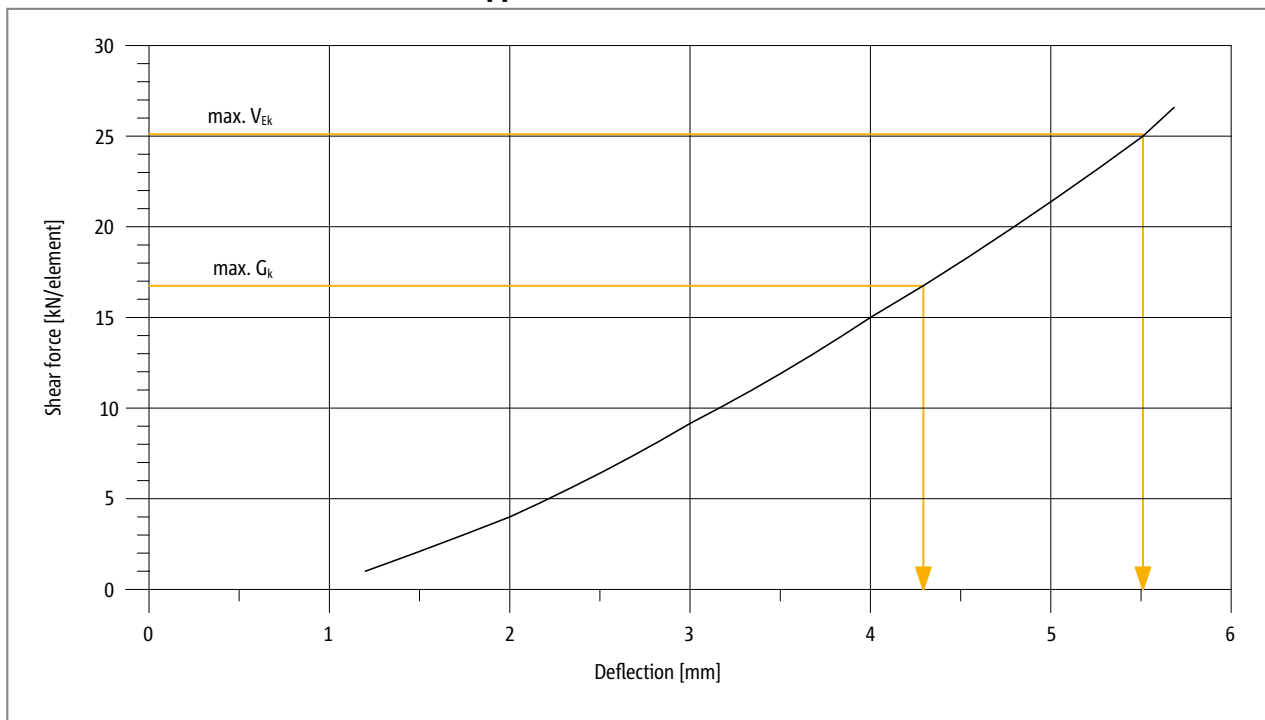


Fig. 110: Schöck Tronsole® type Q: Deformation of the Elodur® elastomer support

#### **i** Notes on deformation

- ▶ With deflection, it is understood to be the vertical deformation of the Elodur® elastomer support under vertical shear force load.
- ▶  $\text{Max. } V_{Ek} = \text{Max. } V_{Ed} / \gamma$ , whereby  $\gamma = 1.4$
- ▶  $\gamma = 1.4$  applies under the assumption that  $\text{Max. } V_{Ed}$  is made up of two thirds from own weight and one third from live load.
- ▶ Thus  $\text{Max. } V_{Ek}$  is the maximum service load and the maximum own weight is  $\text{Max. } G_k = 2/3 \cdot \text{Max. } V_{Ek}$ .

## On-site hat bracket

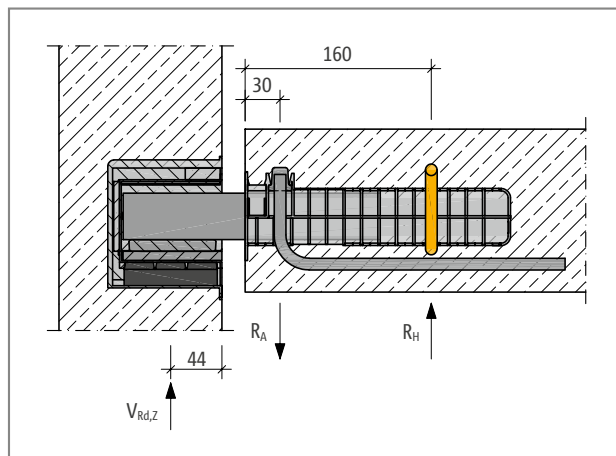


Fig. 111: Schöck Tronsole® type Q: Here: On-site hat bracket coloured orange

### **i** Hat-shaped bracket required for forming the structural system

The sliding sleeve of Schöck Tronsole® Type Q contains a suspension bracket. A hat-shaped bracket must be added on site to form the structural system as expected in the calculations. The suspension bracket and the hat-shaped bracket form a force couple that is required to clamp the Tronsole® in the reinforced concrete building component.

### **!** Hazard warning - missing hat-shaped bracket

- ▶ For the given load-bearing capacity of the Schöck Tronsole®, the on-site hat bracket (Pos. 3) is absolutely necessary.
- ▶ The hat bracket must be planned as part of the on-site reinforcement and integrated in the planned notch on the underside of the carrier sleeve.

## Load-bearing element

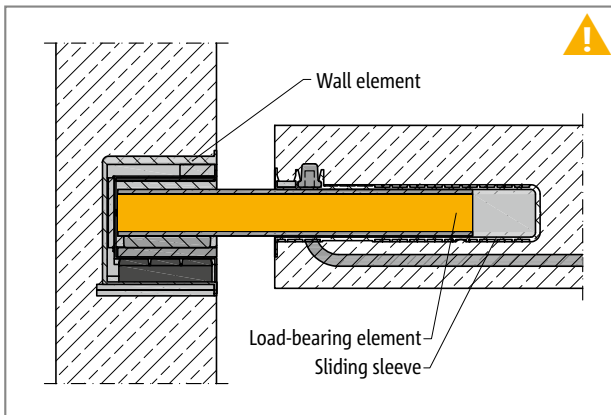


Fig. 112: Schöck Tronsole® type Q: Multi-part product (wall component, load-bearing component, sliding sleeve); load-bearing element (yellow) must be installed on the building site.

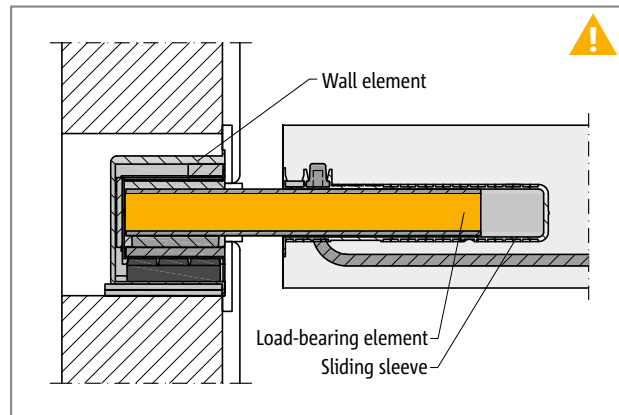


Fig. 113: Schöck Tronsole® type Q: Multi-part product (wall component, load-bearing component, sliding sleeve); load-bearing element (yellow) must be installed on the building site.

### **i** Load-bearing element required to transfer shear force

Schöck Tronsole® Type Q consists of a wall element, sliding sleeve and load-bearing element. The load-bearing element must be installed on the construction site. The wall element is installed on the construction site. The sliding sleeve can be installed either in the precast factory or on the construction site in in-situ concrete. Each sliding sleeve must be allocated a load-bearing element.

### **!** Hazard warning - missing load-bearing element

- ▶ The stairs will collapse without the load-bearing element.
- ▶ The load-bearing element must be installed on the construction site.

## Precast construction

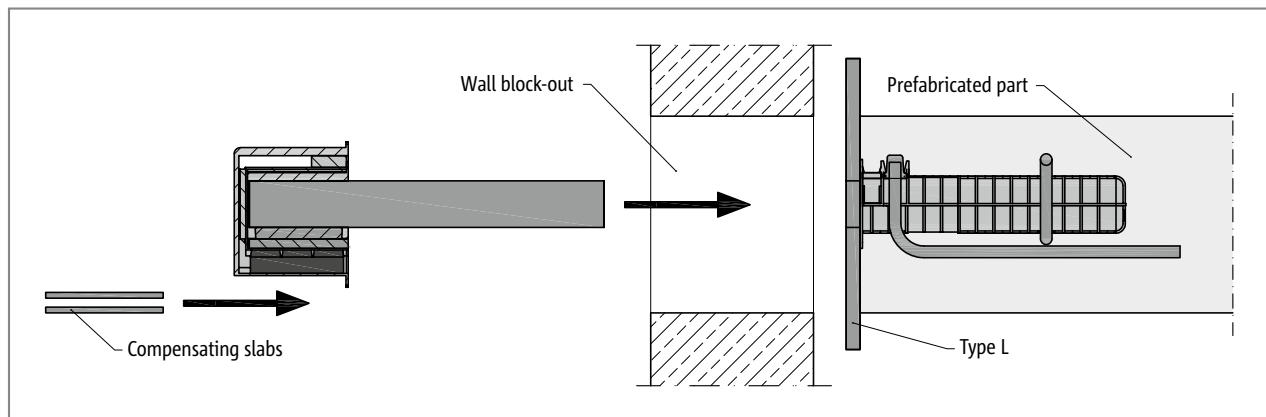


Fig. 114: Schöck Tronsole® type Q: Wall recess with prefabricated construction

### **i** Precast part construction

- ▶ The wall element of the Schöck Tronsole® type Q lies on a level full-faced support. Configuration of the support: Compressive strength class 20 and mortar group III,
- ▶ The stress impacting the masonry is calculated as follows:  $\sigma_{Ed} = V_{Ed} / (110 \cdot 80) \text{ mm}^2$ . With the maximum utilisation of 40.1 kN  $\sigma_{isEd} = 4.5 \text{ N/mm}^2$ .
- ▶ Schöck Tronsole® Type Q is inserted through the staircase wall afterwards. A full-length wall slot must be present in the staircase wall.
- ▶ When installing the stairs, it may be necessary to adjust the height of the stairs under the wall element using pressure-resistant compensating plates (e.g. made from steel, minimum size 160 mm × 110 mm). The compensating plate must support the complete bearing surface of the wall element.

## Fire protection | Materials

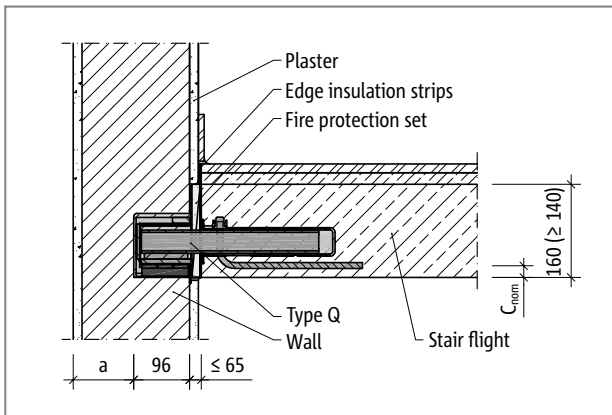


Fig. 115: Schöck Tronsole® type Q: Fire protection configuration

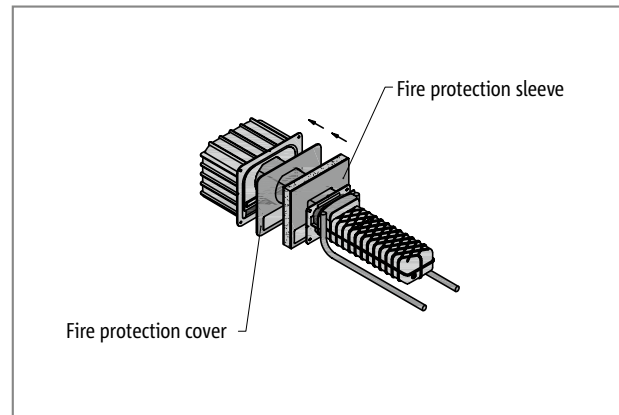


Fig. 116: Schöck Tronsole® type Q: 3D view of the product with two-part fire protection set

### **i** Fire protection

- ▶ The fire protection classification of the staircase wall is not disturbed by the wall element if a backing of at least 40 mm masonry blocks ( $a \geq 40$  mm) is carried out. A mineral render may be added to the thickness.
- ▶ A minimum centre distance of  $u \geq 35$  mm must be observed between the Tronsole® Type Q suspension bracket and the building component surface.
- ▶ Using Schöck Tronsole® Type Q, an R 90 fire-resistance class can be achieved for the surrounding building components up to a maximum joint width of 65 mm.
- ▶ R 90 landings can be achieved using Tronsole® Type Q with a minimum slab thickness of  $h = 160$  mm.
- ▶ R 90 waist slabs can be achieved using Tronsole® Type Q with a minimum slab thickness of  $h = 140$  mm if the concrete steps are provided as the required concrete covering.
- ▶ An optional fire-protection set is required for Tronsole® Type Q to achieve fire-protection class R 90. This set consists of a fire-protection covering and two or three fire-protection collars depending on the joint width.
- ▶ The wall element of Tronsole® Type Q must be protected by the fire-protection covering. The covering is secured to the adhesive tape of the wall element using the product's built-in adhesive surface.
- ▶ The load-bearing element is protected by the fire-protection collar(s).
- ▶ Joint width  $\leq 25$  mm: 1 fire-protection set
- ▶ Joint width 26 mm to 45 mm: 1 fire-protection set + 1 additional fire-protection collar
- ▶ Joint width 46 mm to 65 mm: 1 fire protection set + 2 additional fire-protection collars

### Materials and construction materials

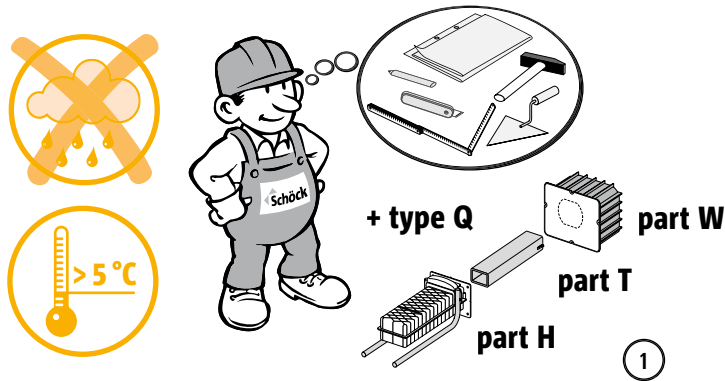
| Schöck Tronsole® type Q | Material  |
|-------------------------|---|
| External box            | Polystyrene   |
| Internal box            | Polystyrene   |
| PE foam insert          | PE foam according to DIN EN 14313   |
| Elastomer support       | Polyurethane according to DIN EN 13165                                      |
| Load distribution plate | Fine-grain construction steel S460 according to DIN EN 10025                |
| Load-bearing element    | FV: S355 JO; A2: S355, corrosion protection class. II according to Z-30.3-6 |
| Sleeve                  | Polystyrene   |
| Suspension bracket      | Reinforcing steel B500B according to DIN 488-1                              |
| Pressure deflector      | Construction steel S355 JO according to DIN EN 10025                        |
| Tension damper          | Polyurethane according to DIN EN 13165                                      |

## Installation

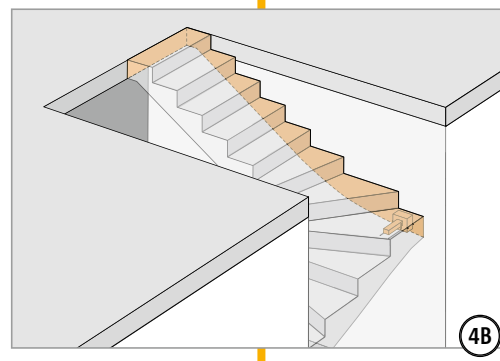
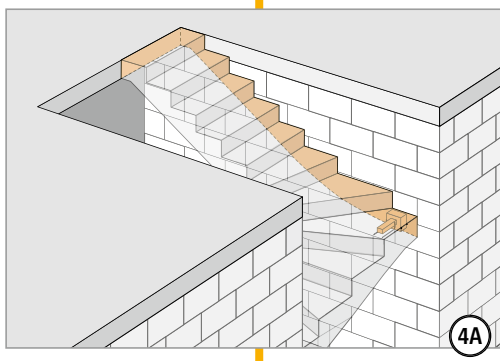
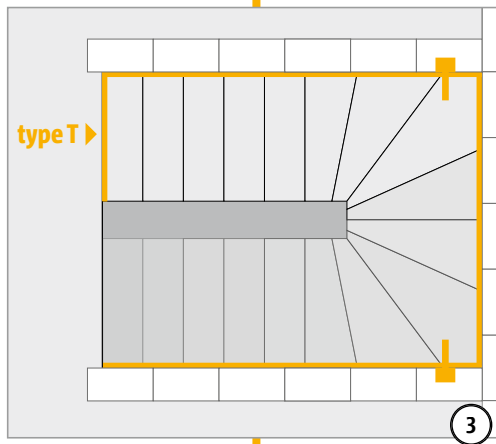
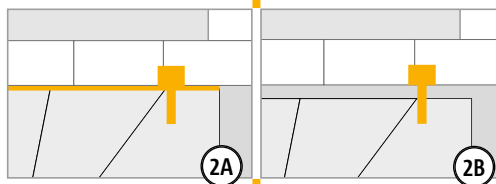
### **i** Installation

- ▶ The wall element of the Schöck Tronsole® type Q lies on a level full-faced support. Configuration of the support: Compressive strength class 20 and mortar group III,
- ▶ The stress impacting the masonry is calculated as follows:  $\sigma_{Ed} = V_{Ed} / (110 \cdot 80) \text{ mm}^2$ . With the maximum utilisation of 40.1 kN  $\sigma_{is_{Ed}} = 4.5 \text{ N/mm}^2$ .
- ▶ When installing the stairs, it may be necessary to adjust the height of the stairs under the wall element using pressure-resistant compensating plates (e.g. made from steel, minimum size 160 mm × 110 mm). The compensating plate must support the complete bearing surface of the wall element.

# Installation instructions building site in-situ concrete



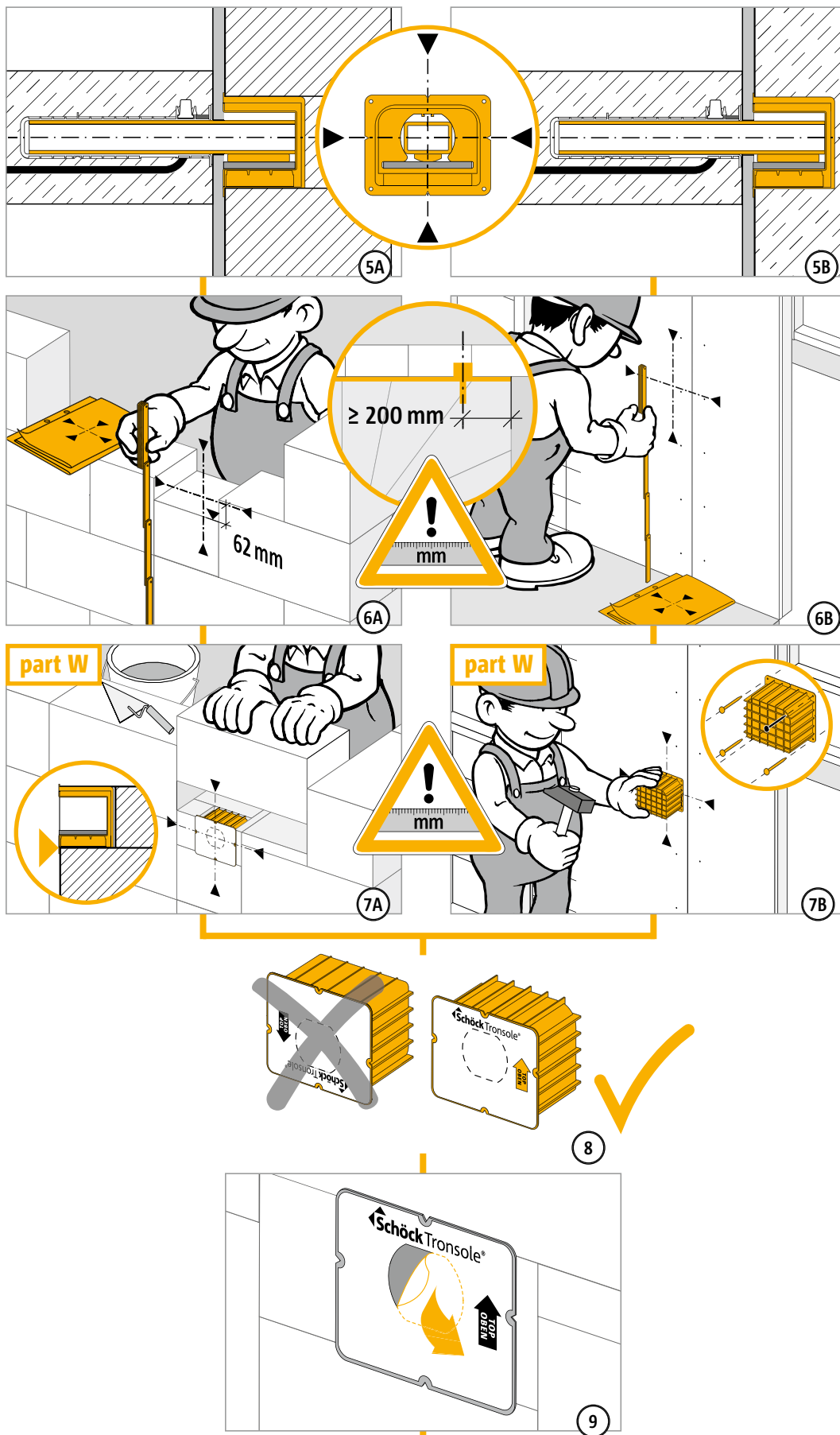
**⚠ WARNING**  
 Hazard due to falling structural components with incomplete installation. All parts of the Tronsole® type Q (Part W + T + H) must be used.



Q

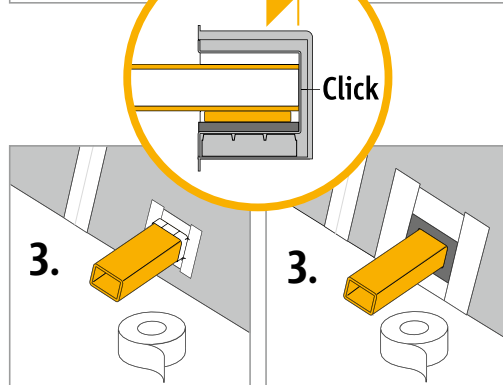
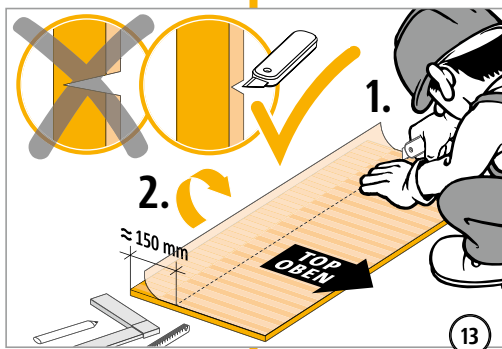
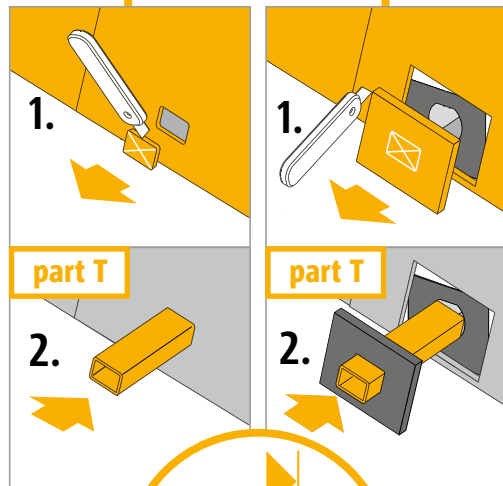
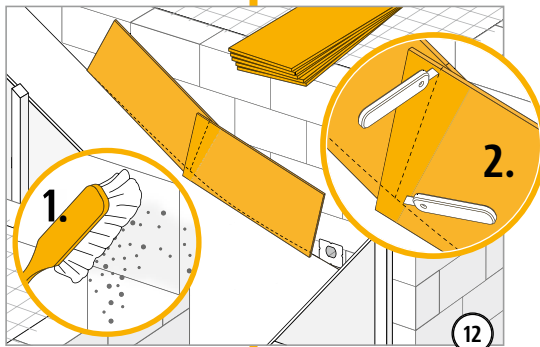
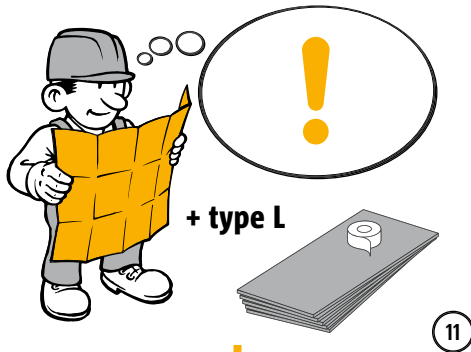
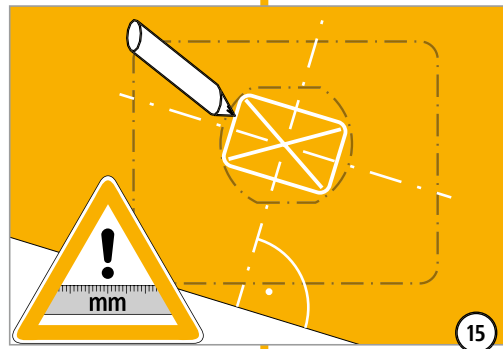
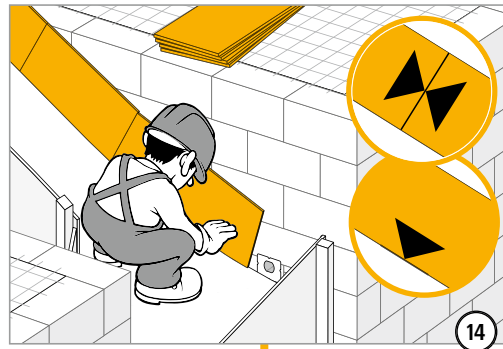
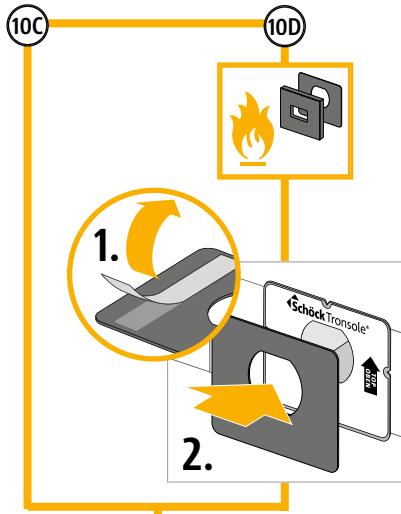


## Installation instructions building site in-situ concrete

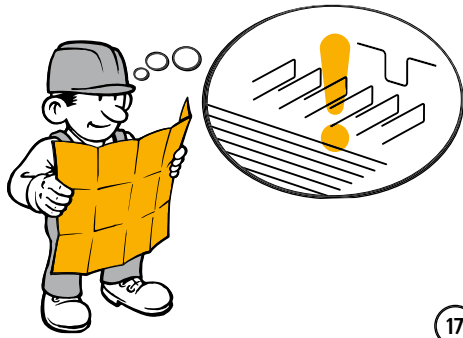


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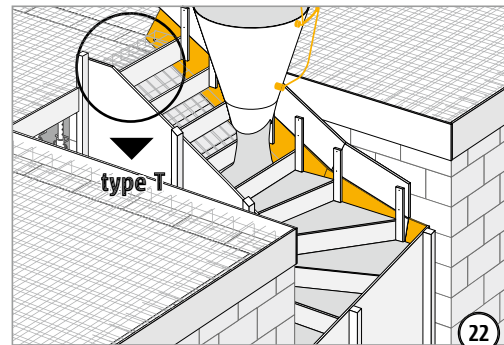
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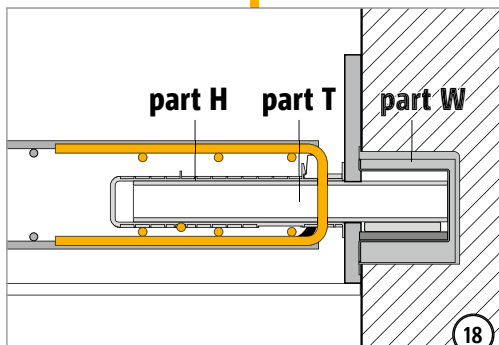
# Installation instructions building site in-situ concrete



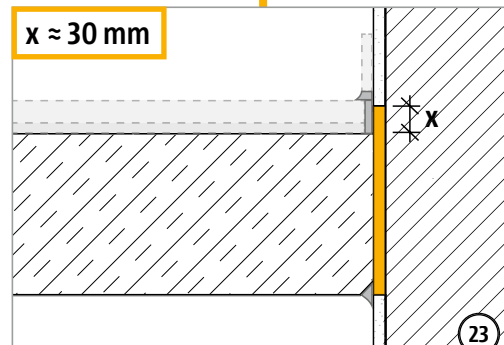
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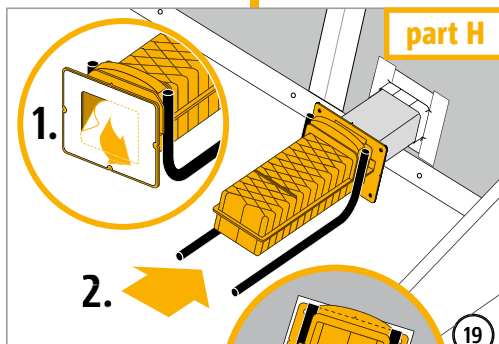
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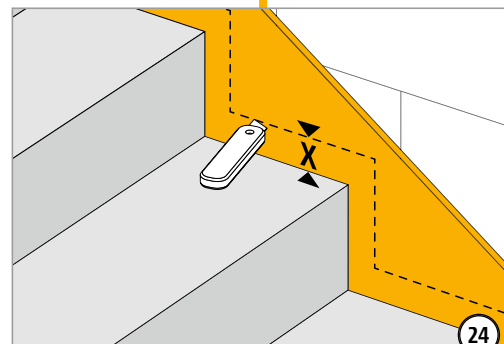
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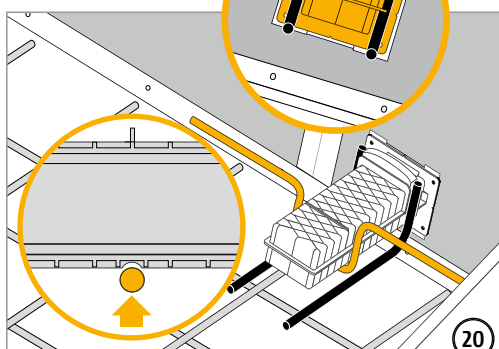
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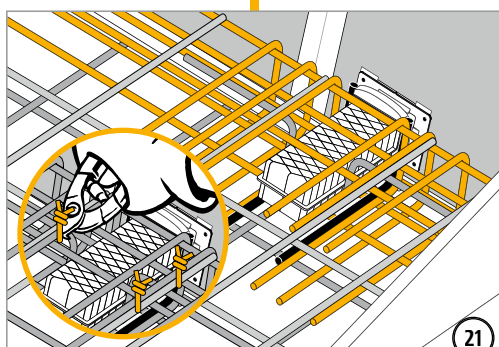
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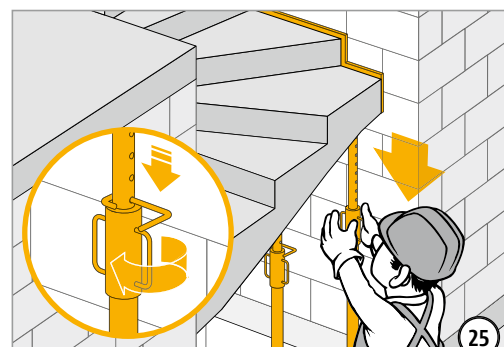
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**WARNING**

Hazard due to falling structural components with missing support. Turn down all construction supports slowly. Remove only load-free supports.



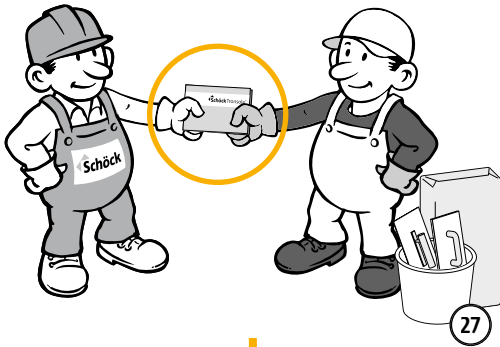
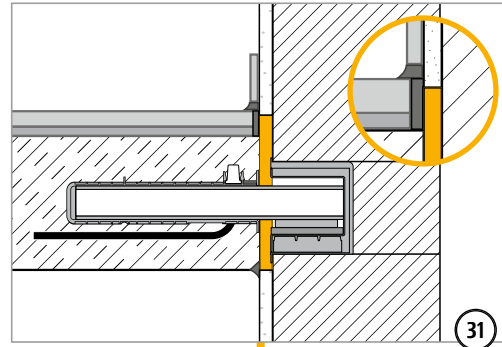
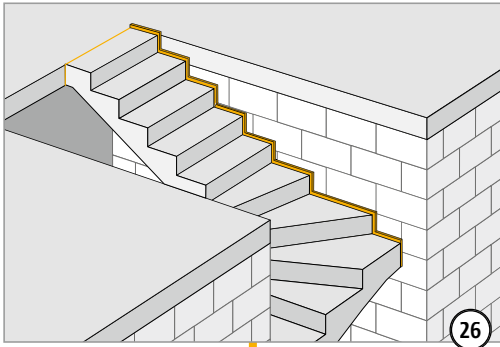
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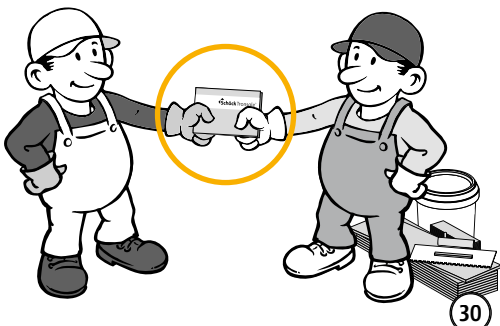
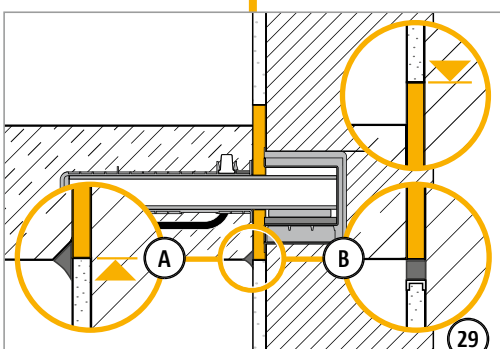
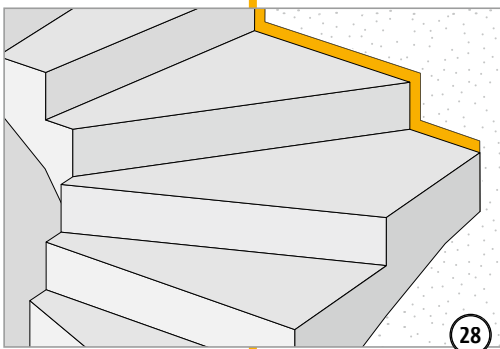
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Q

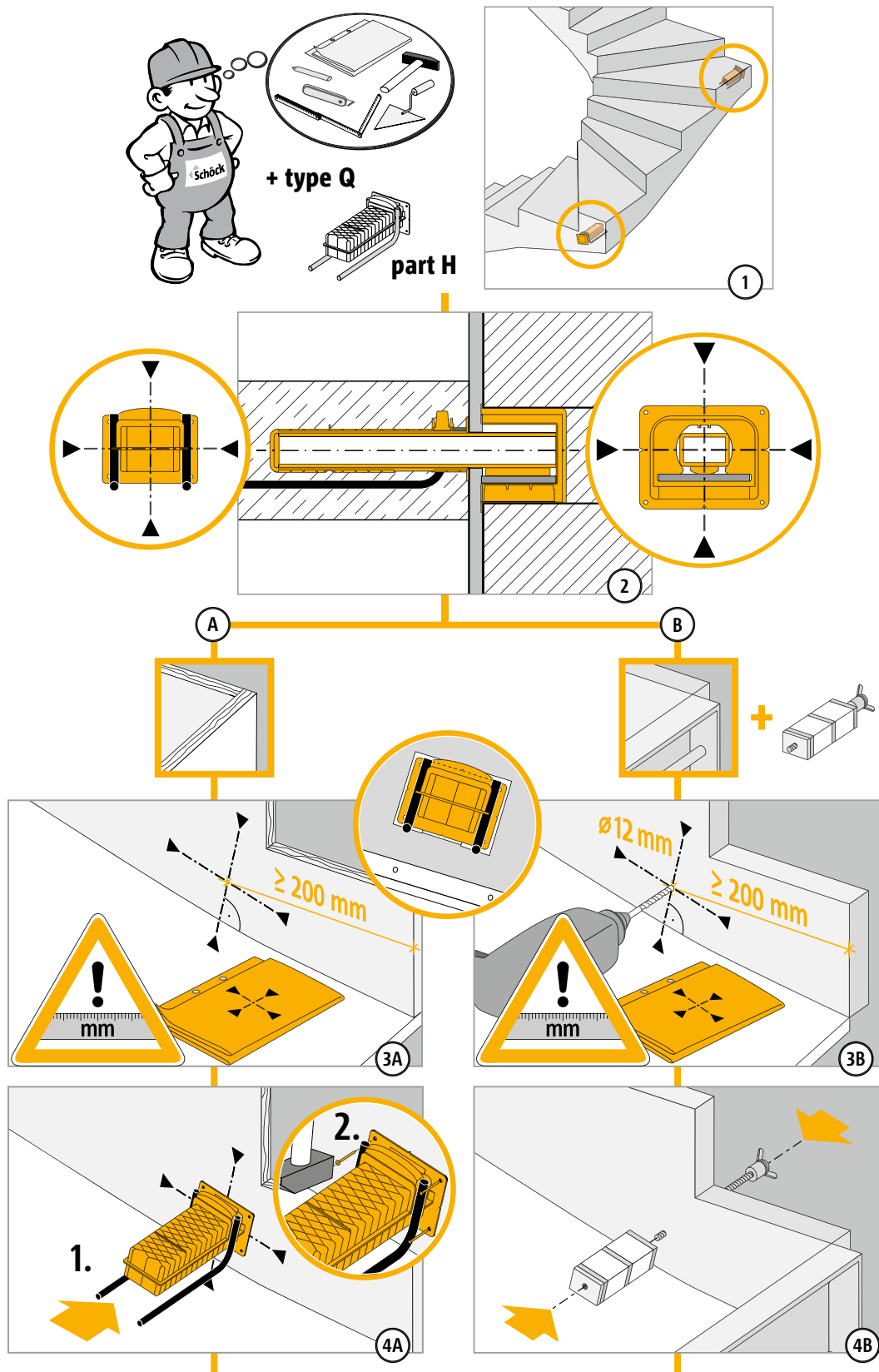
## Installation instructions building site in-situ concrete



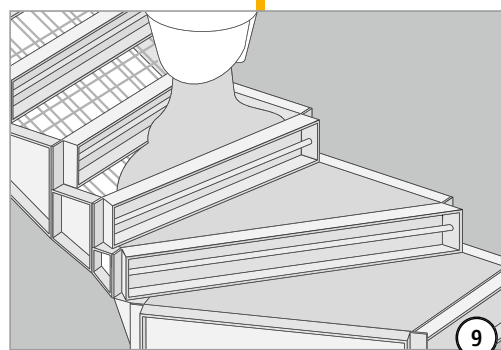
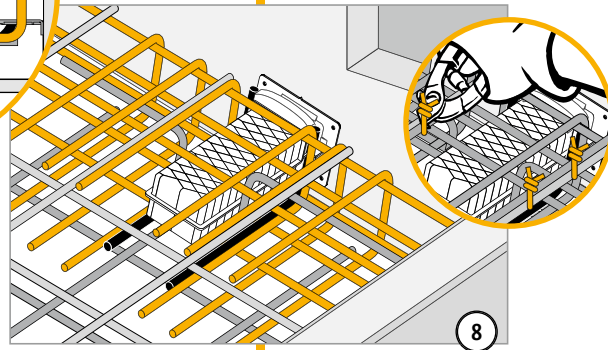
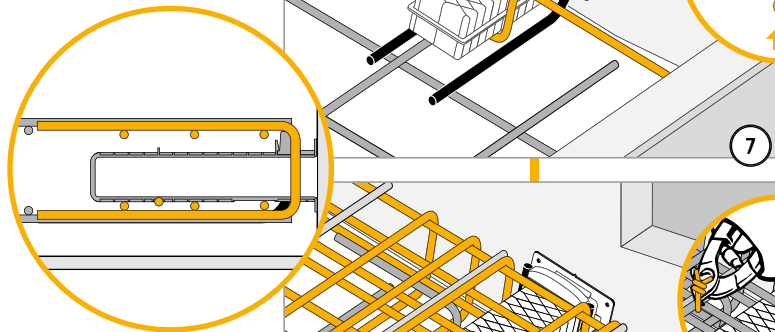
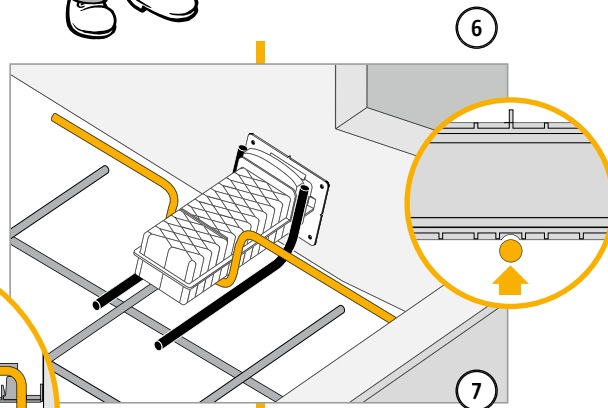
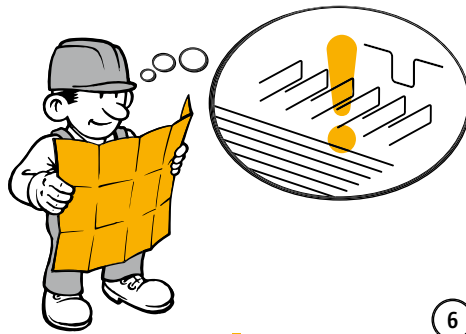
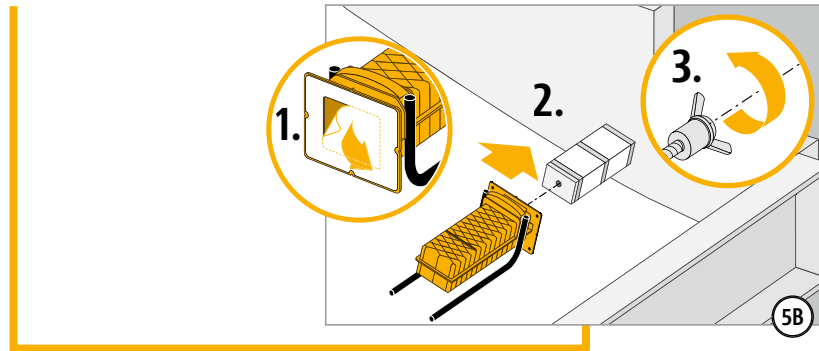
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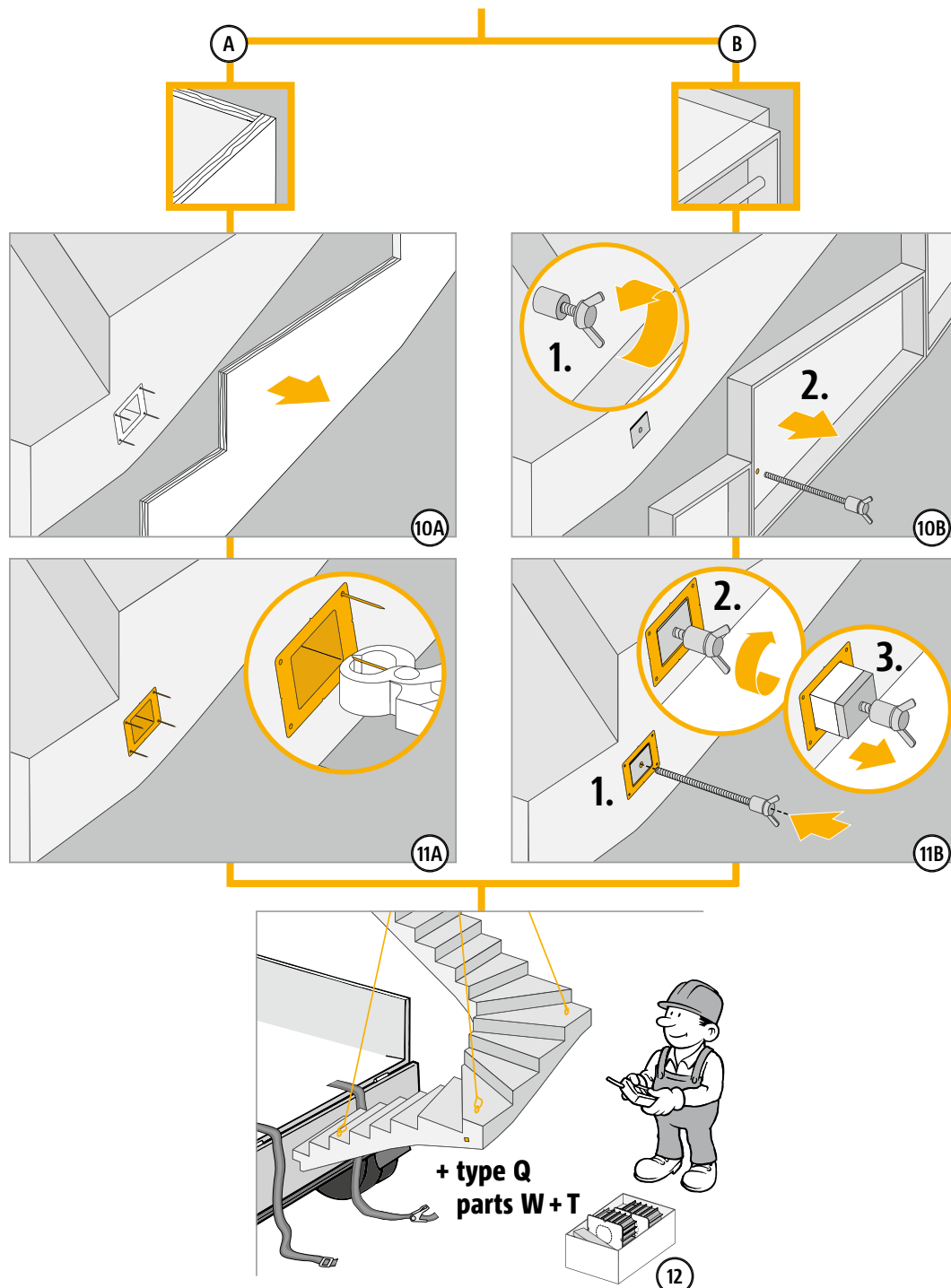
# Installation instructions for prefabricating plant



## Installation instructions for prefabricating plant

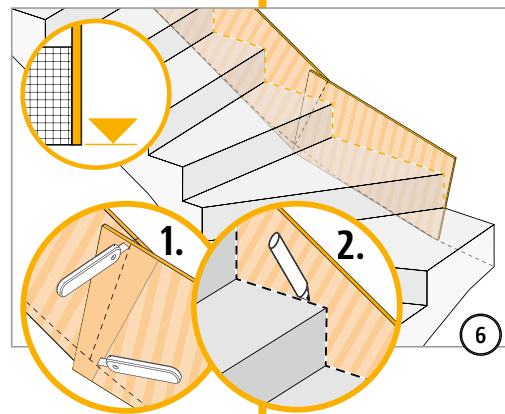
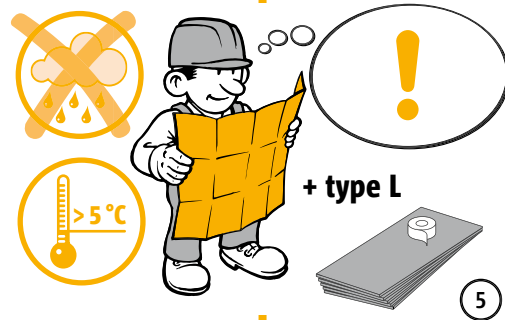
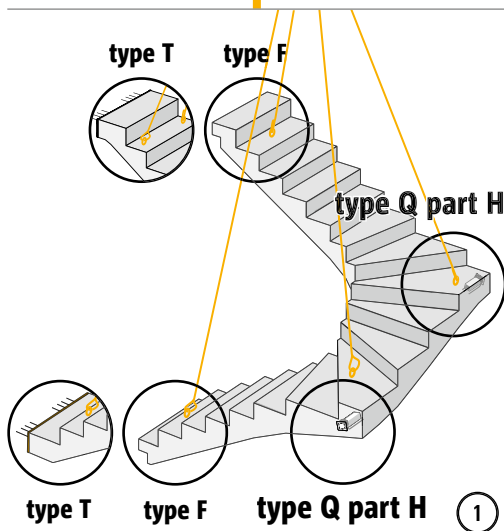
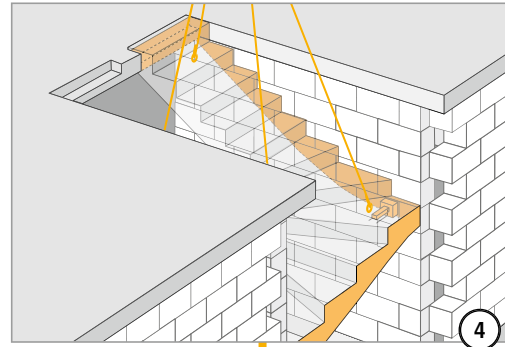
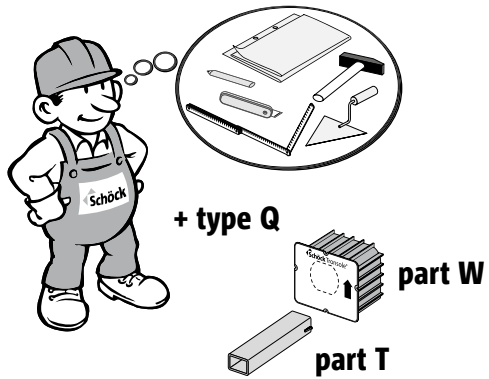


## Installation instructions for prefabricating plant



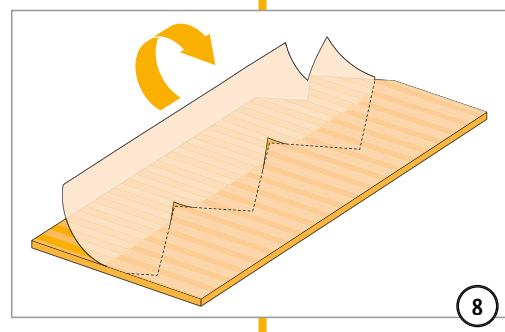
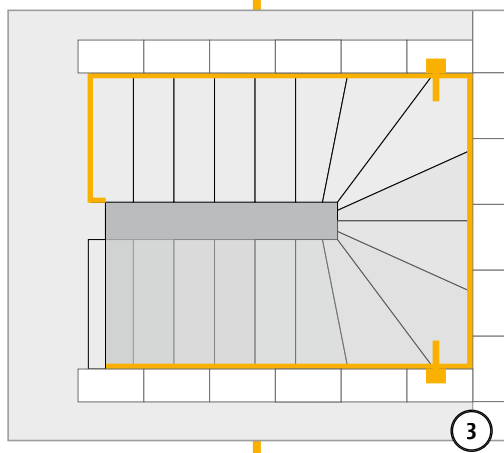
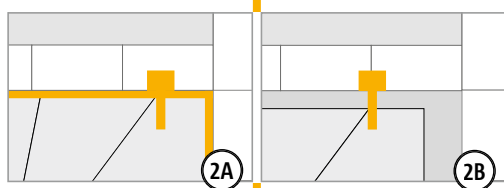
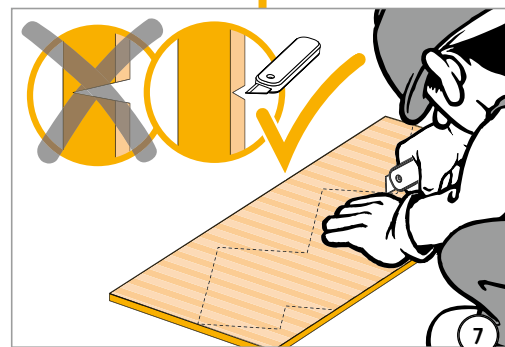
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# Installation instructions building site precast components



**WARNING**  

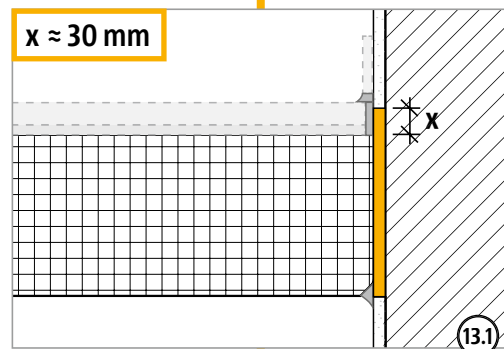
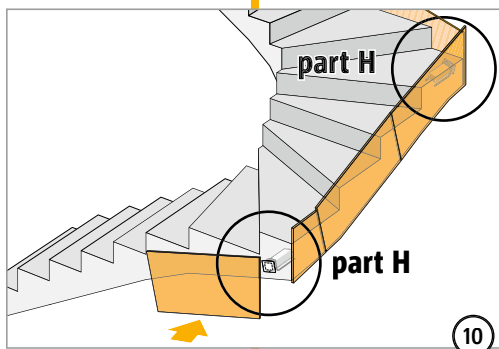
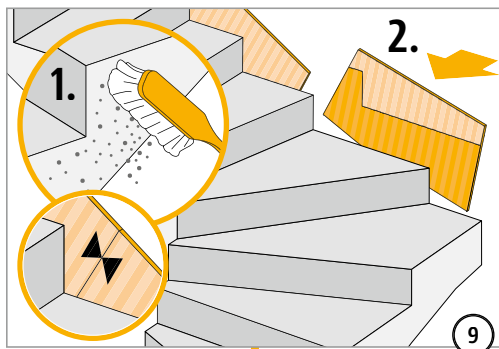
 Hazard due to falling structural components with incomplete installation. All parts of the Tronsole® type Q (part W + T) must be used.



Q

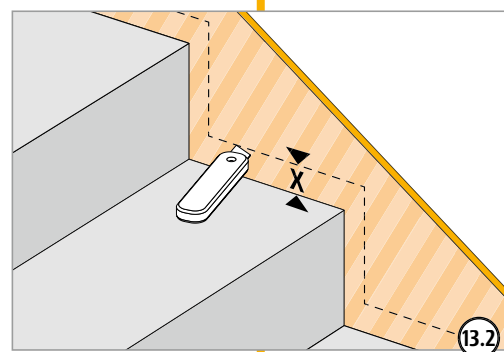
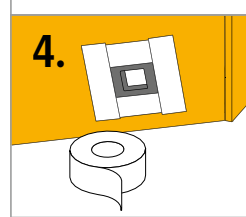
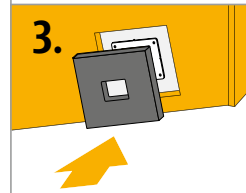
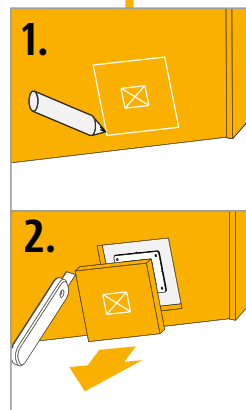
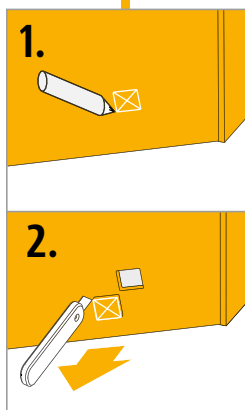
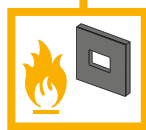


# Installation instructions building site precast components



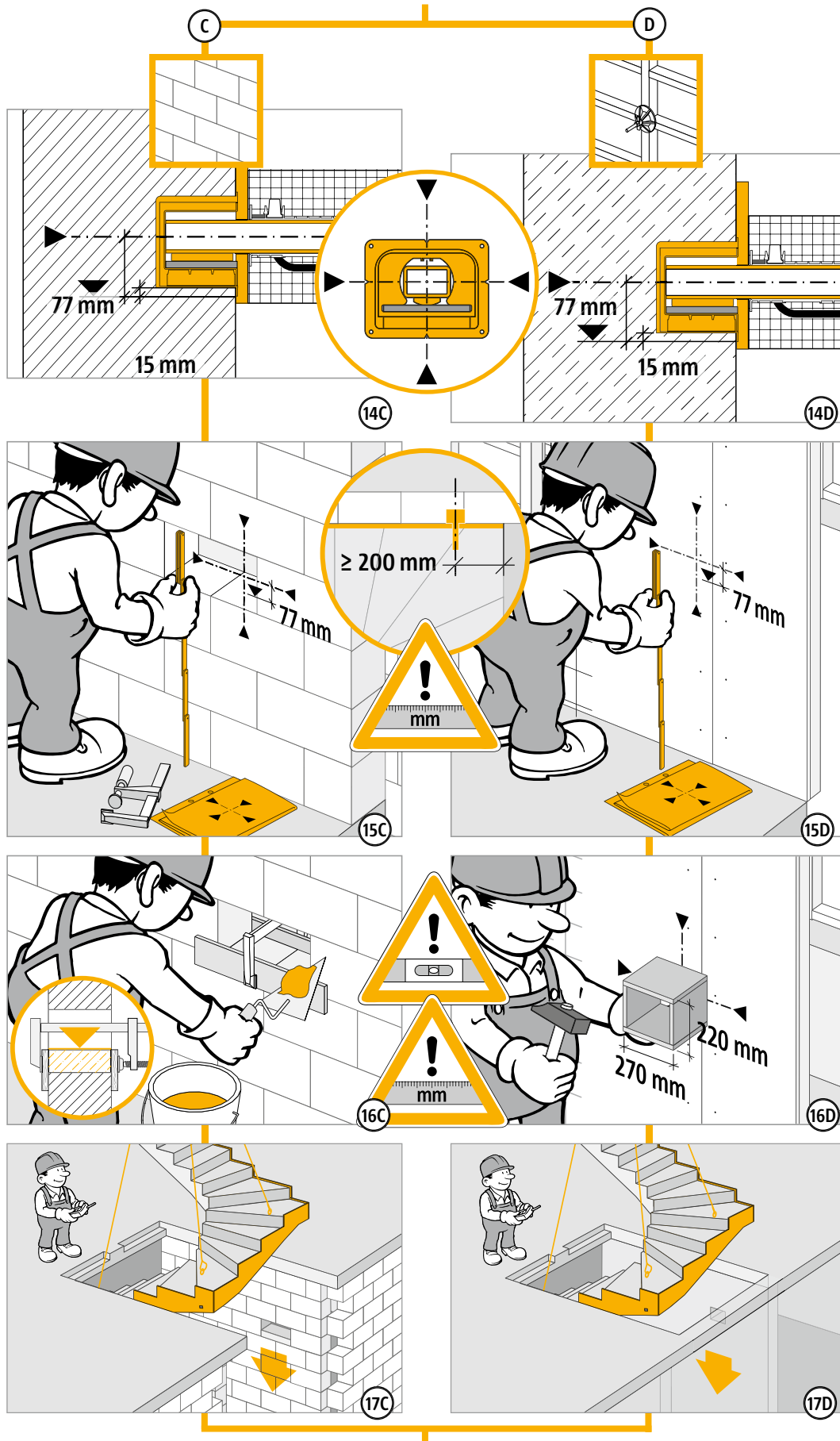
11A

11B



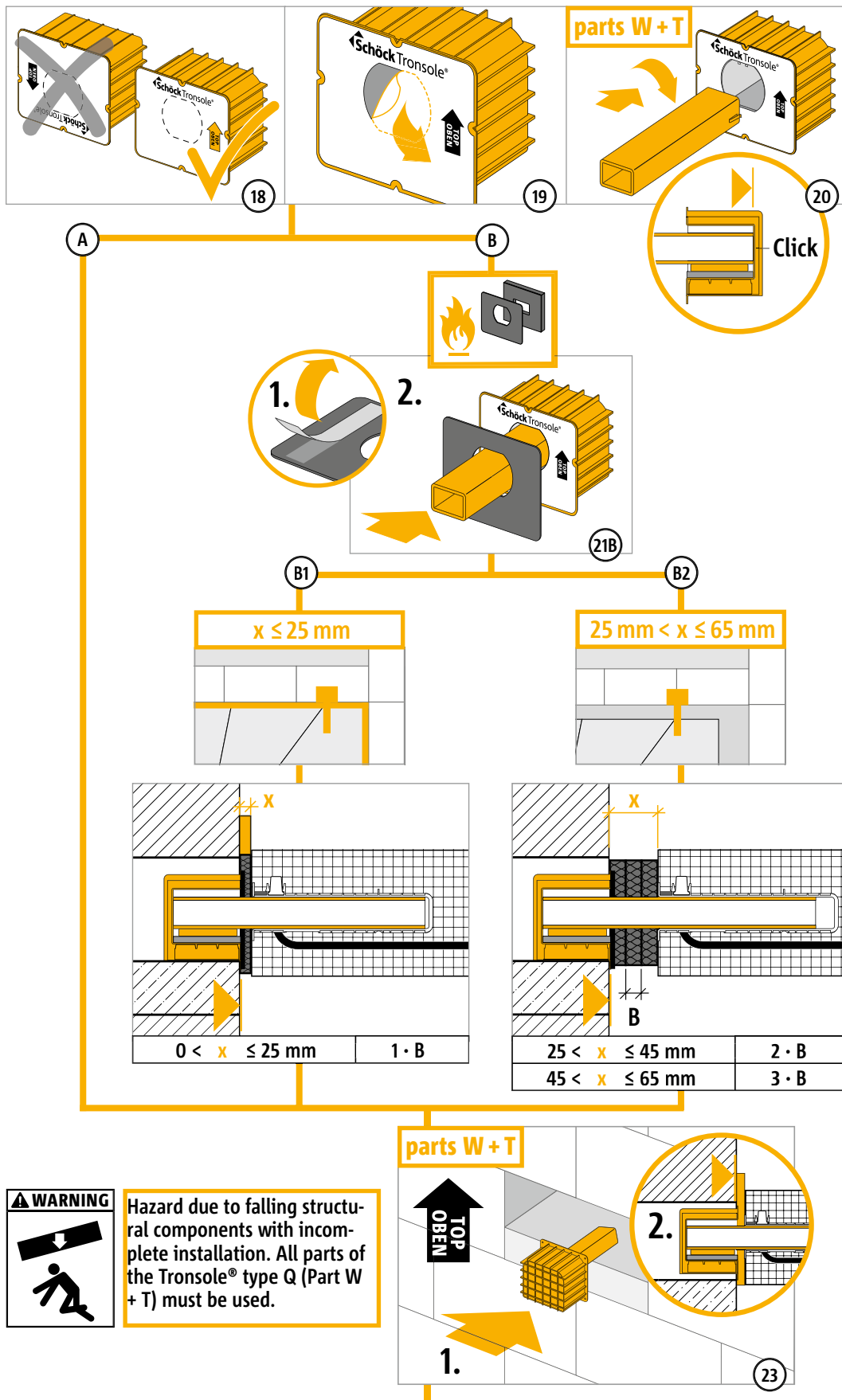
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## Installation instructions building site precast components

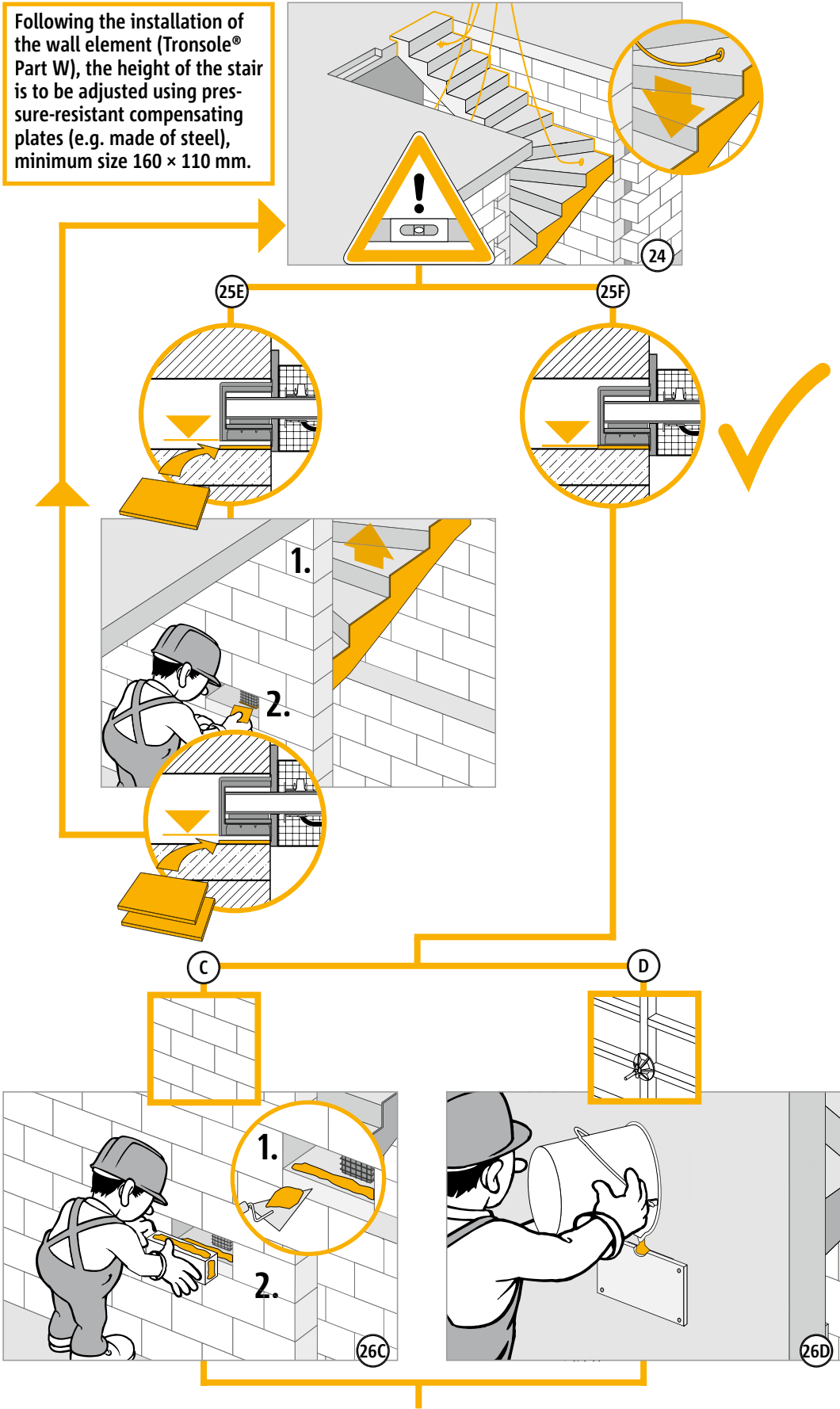


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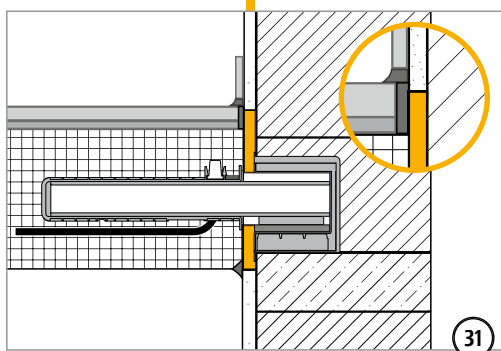
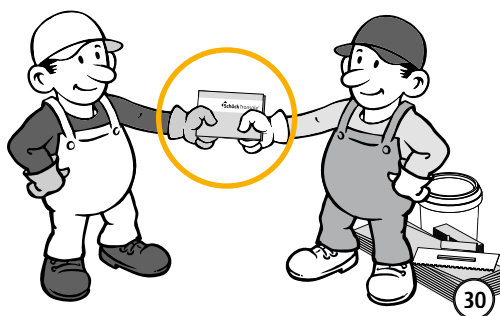
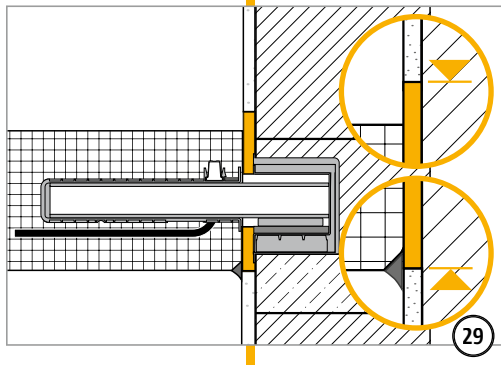
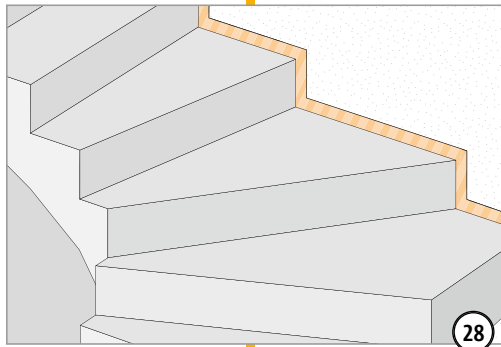
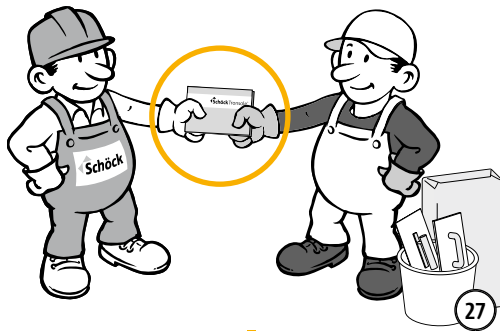
# Installation instructions building site precast components



## Installation instructions building site precast components



## Installation instructions building site precast components



## Check list

- Is the geometry of the structural component to be sound insulated matched to the measurements of the Schöck Tronsole® type Q?
- Have the effects on the Schöck Isokorb® connection been specified at design level?
- With the Tronsole® type Q is the minimum concrete strength taken into account according to the design table?
- Have the requirements with regard to fire protection been cleared and announced?
- Due to an R 90 requirement are larger concrete covers and the resultant larger structural component heights taken into account?
- With  $V_{Ed}$  at the slab edge of the landing, is the limiting value of the slab load-bearing capacity checked?
- Is the required on-site reinforcement, including the hat brackets, taken into account?

## Schöck Tronsole® Type P



### **Schöck Tronsole® Type P**

Serves as point bearing for acoustic decoupling of landings and staircase walls. The landings can be produced in in-situ concrete or as completely precast components. The staircase walls can consist of reinforced concrete or masonry.

P

## Product characteristics

### **i** Product characteristics

- ▶ Rated landing impact sound level difference  $\Delta L_{w,landing}^* \geq 27$  dB, tested in accordance with DIN 7396 with maximum load: test report no. 91386-20; (for an explanation of the value  $\Delta L_{w,landing}^*$ , see page 13)
- ▶ High quality and efficient Elodur® elastomer support for point connection
- ▶ With general building authority approval (in Germany DIBt under no. 15.7-349)
- ▶ Fire-resistance class up to R 90 by using optional fire-protection set (fire protection expert report no. BB-20-036-2)
- ▶ Joints can be up to 50 mm wide

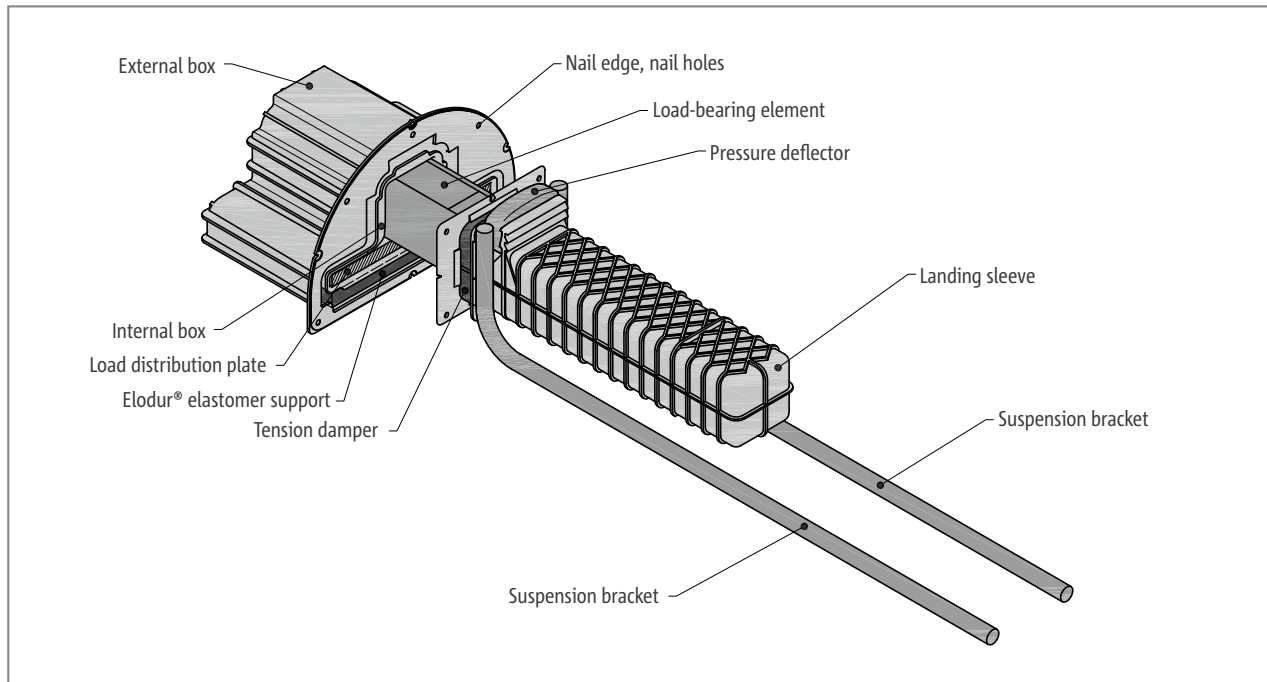


Fig. 117: Schöck Tronsole® Type P: Wall element, load-bearing element and landing sleeve with details of important components

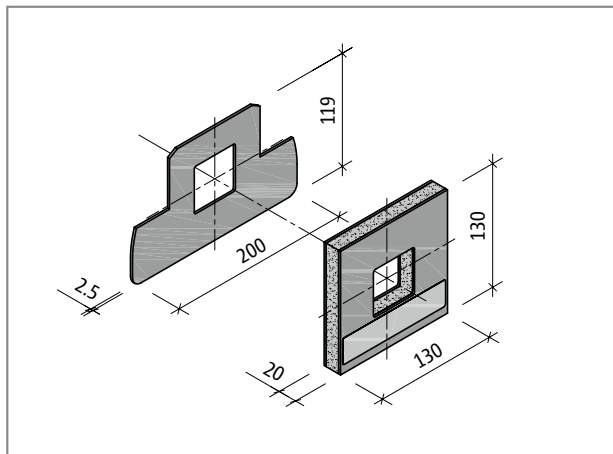


Fig. 118: Schöck Tronsole® Type P: Fire-protection set consisting of fire-protection covering ( $t = 2.5$  mm) and fire-protection collar(s)

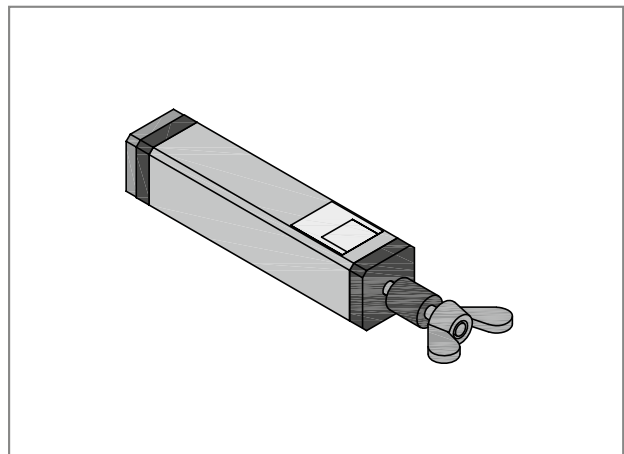


Fig. 119: Schöck Tronsole® type P: Assembly element



## Product selection | Type designations

### Schöck Tronsole® Type P variants

The configuration of Schöck Tronsole® Type P can be varied as follows by using different Elodur® elastomer supports:

► Load path:

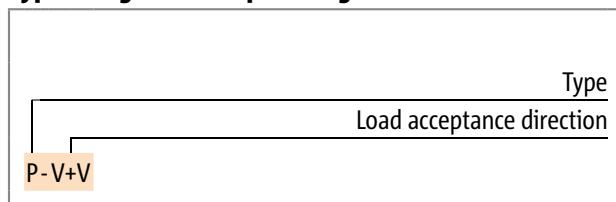
Wall element Type P-V+V absorbs positive and negative shear forces  $V_{Ed,z}$ .

The Elodur® elastomeric bearings are located at the bottom and top of the wall element in Tronsole® Type P-V+V .

The wall element Type P-VH+VH absorbs both shear forces  $\pm V_{Ed,z}$  and lateral horizontal forces  $\pm V_{Ed,y}$ .

The Elodur® elastomeric bearing is located at the bottom, top and sides of the wall element in Tronsole® Type P-VH+VH.

### Type designation in planning documents



## Installation sections in masonry

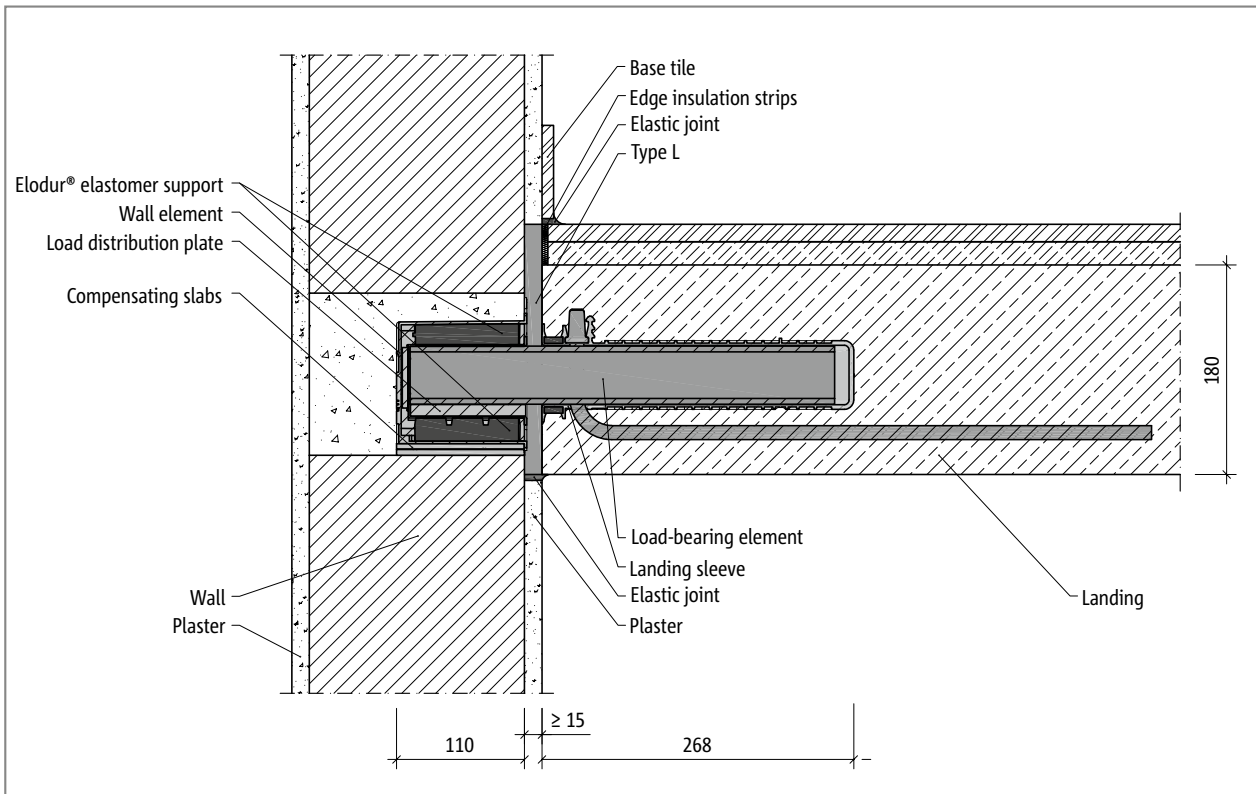


Fig. 120: Schöck Tronsole® Type P: with in-situ concrete landing and Tronsole® Type L

P

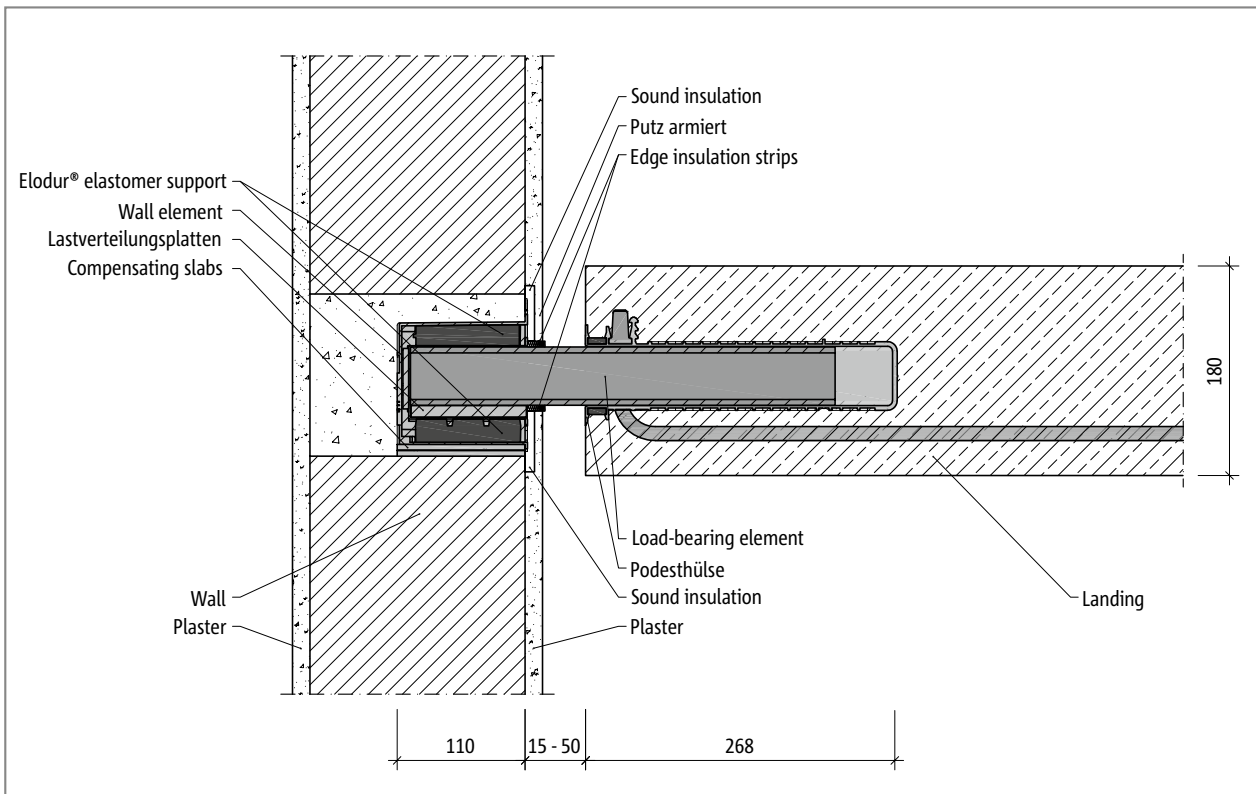


Fig. 121: Schöck Tronsole® Type P: Installation section with in-situ concrete landing and air gap

# Installation sections in exposed concrete

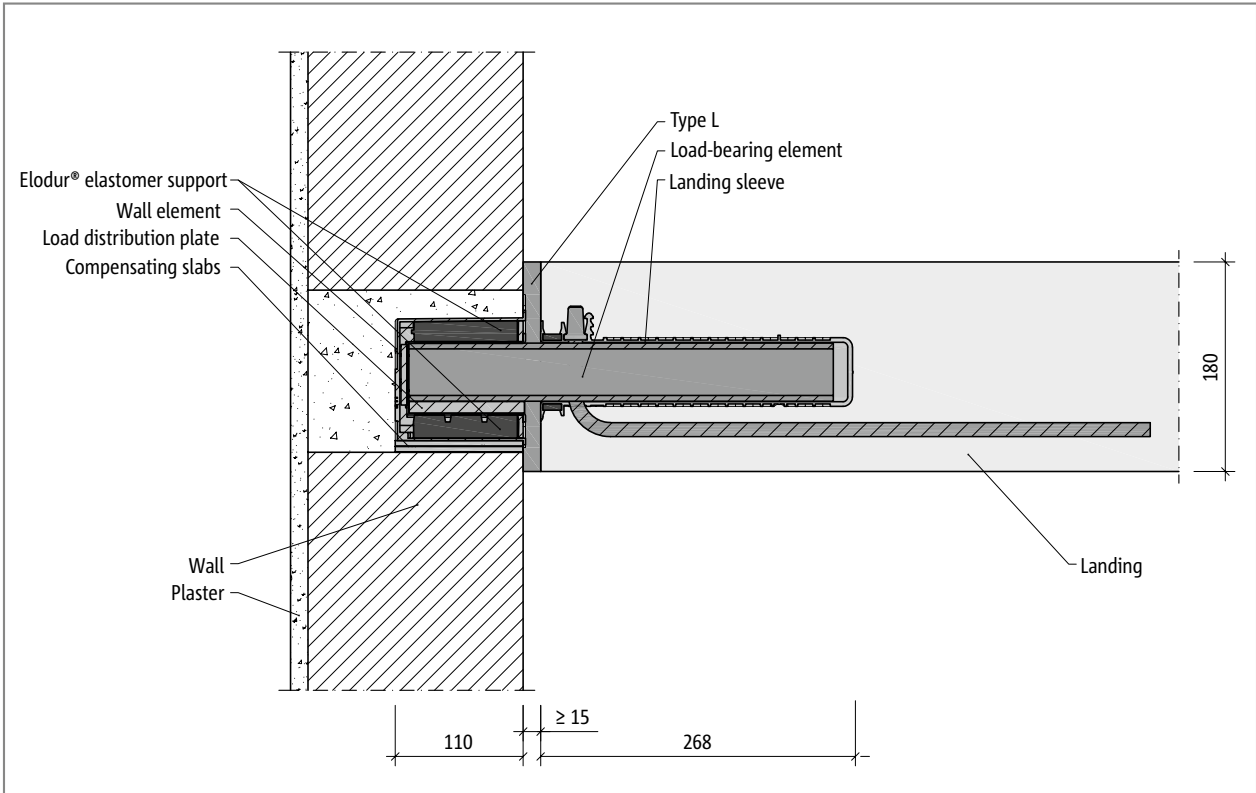


Fig. 122: Schöck Tronsole® Type P: Installation section with precast landing and Tronsole® Type L

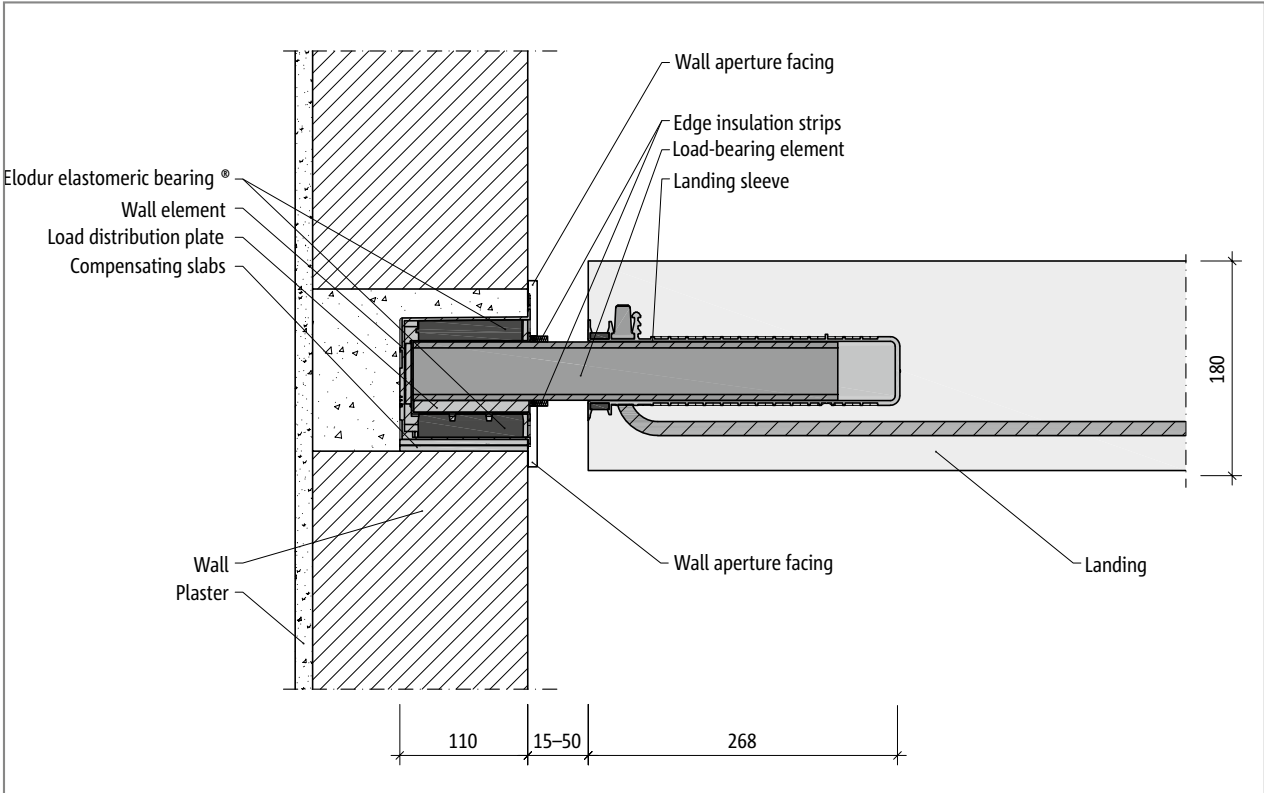


Fig. 123: Schöck Tronsole® Type P: Installation section with precast landing and air gap

P

## Element arrangement

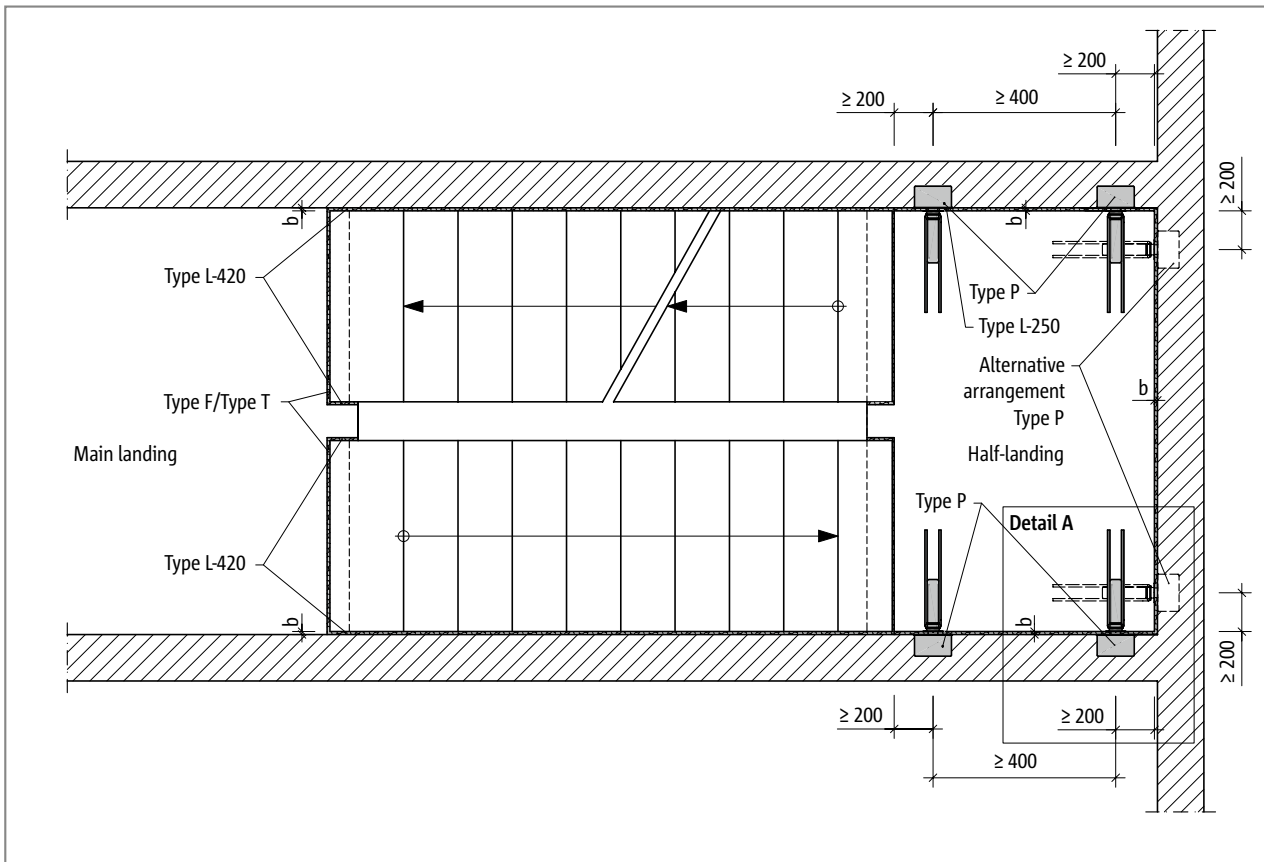


Fig. 124: Schöck Tronsole® Type P: Element arrangement in plan view using Tronsole® Type L

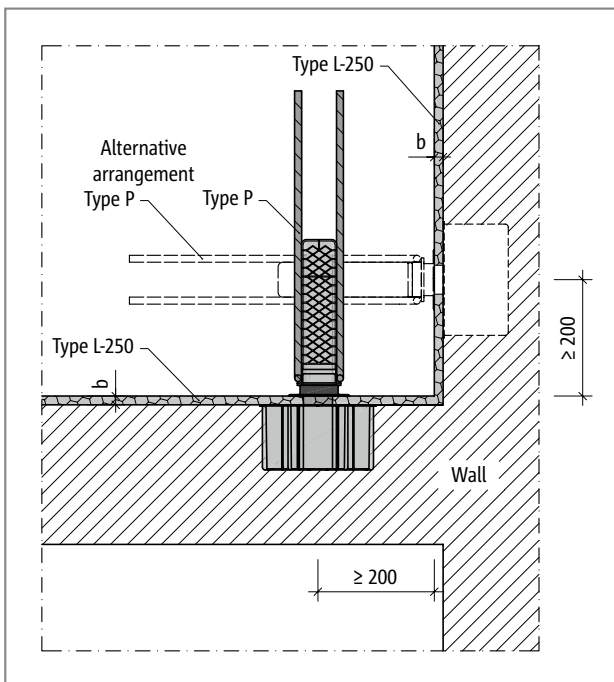


Fig. 125: Schöck Tronsole® Type P: Element arrangement, detail A, joint width  $b= 15$  mm for in-situ concrete. When using precast flights of stairs, the planner must check whether additional installation tolerance is required

# Element arrangement

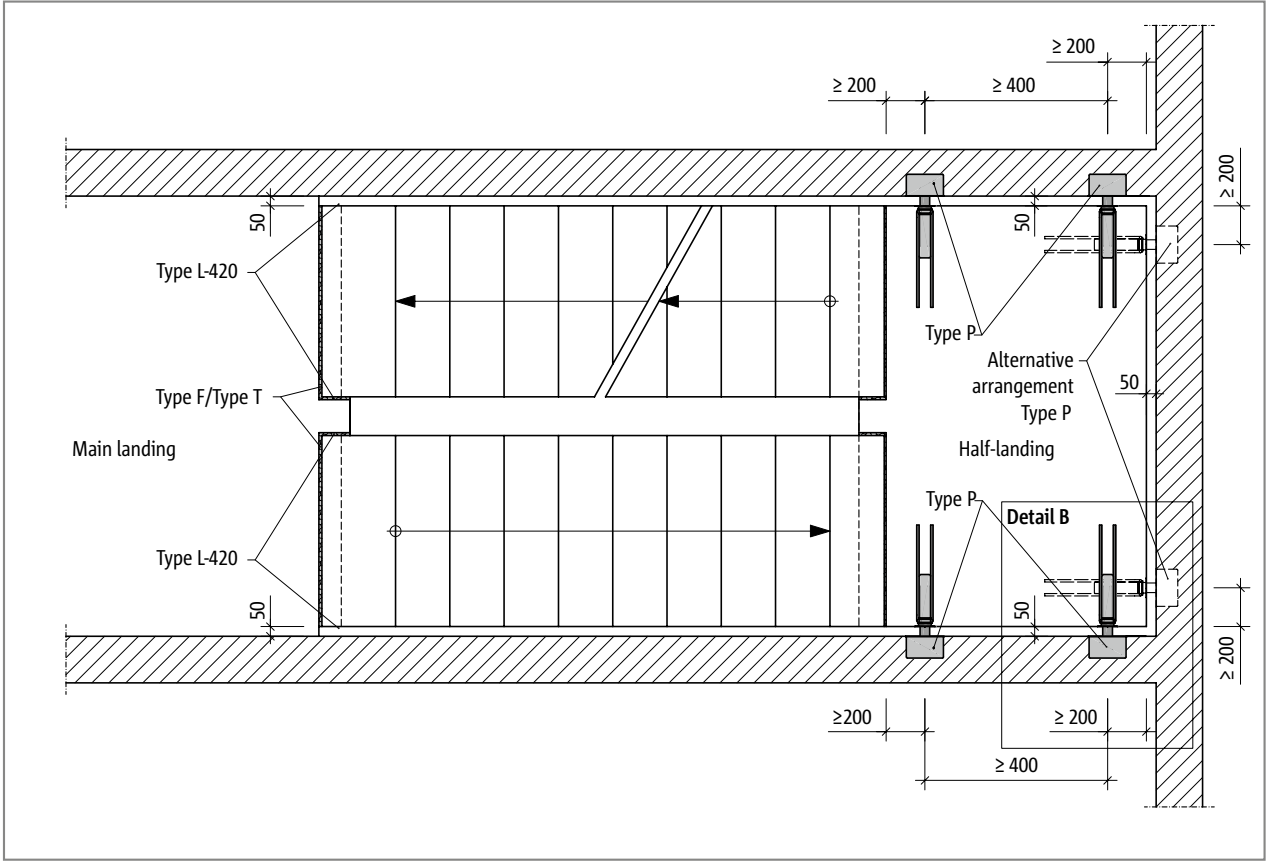


Fig. 126: Schöck Tronsole® Type P: Element arrangement in plan view with a joint width of 50 mm

P

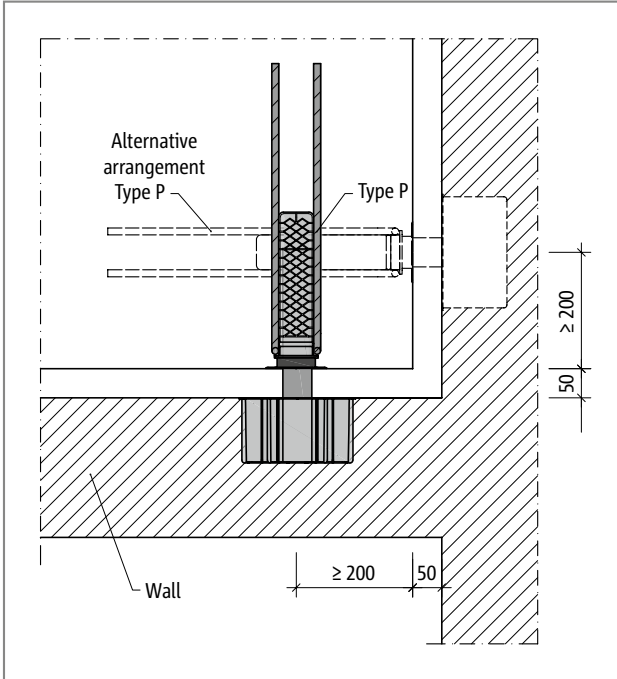


Fig. 127: Schöck Tronsole® Type P: Element arrangement, detail B

## Element arrangement

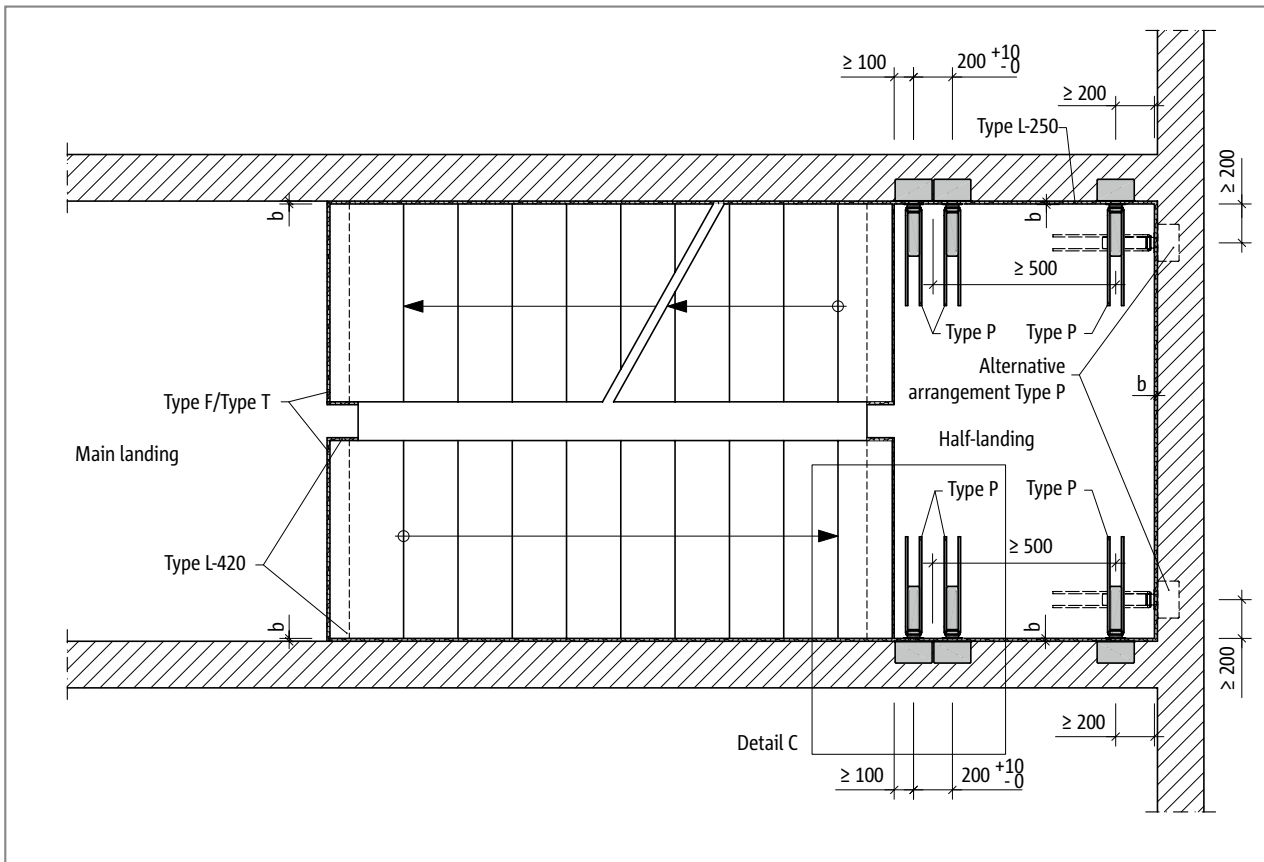


Fig. 128: Schöck Tronsole® Type P: Element arrangement in plan view using Tronsole® Type L

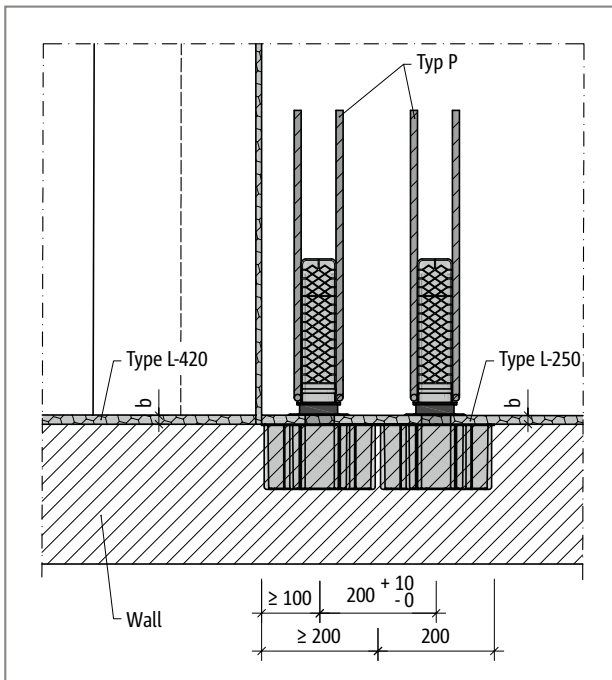


Fig. 129: Schöck Tronsole® Type P (arranged in pairs): Element arrangement, detail C, joint width  $b= 15$  mm for in-situ concrete. When using precast flights of stairs, the planner must check whether additional installation tolerance is required

## Element arrangement

### **i** Combination options

- ▶ If greater shear forces  $V_{Ed,z}$  are applied to the front area of the landing, Schöck Tronsole® Type P can optionally be arranged in pairs. This variant must be calculated separately. See the information on calculations for arrangement in pairs on page 139.
- ▶ The stated sound-insulation values can only to be achieved in combination with Schöck Tronsole® Type L-250 and/or Type L-420 or by using a sufficiently wide air gap (50 mm). When using precast construction, please read the comment concerning installation tolerances for Tronsole® Type L on page 219 .
- ▶ Schöck Tronsole® Type B is suitable for the acoustic decoupling of stair flights and base plates. Tronsole® Type P, Type F and Type B can be used in combination.
- ▶ The employment of the Schöck Tronsole® type F or type T is suitable for the sound insulation of the stair-head and/or stair-foot and landing slab or floor. Tronsole® type F is suitable for precast stairs, while type T is used for in-situ concrete and fully pre-fabricated stair flights.

## Product description

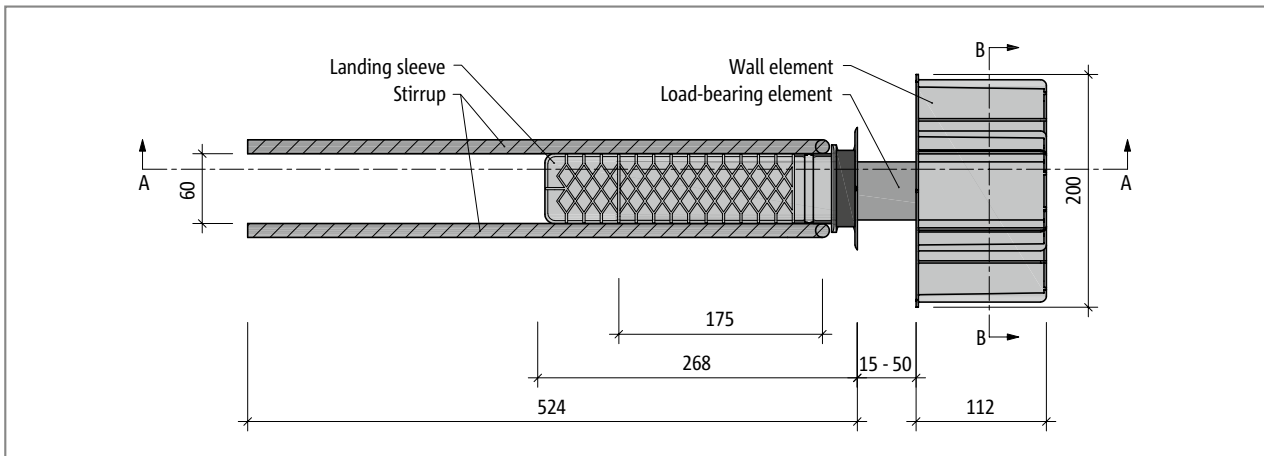


Fig. 130: Schöck Tronsole® Type P: Product plan

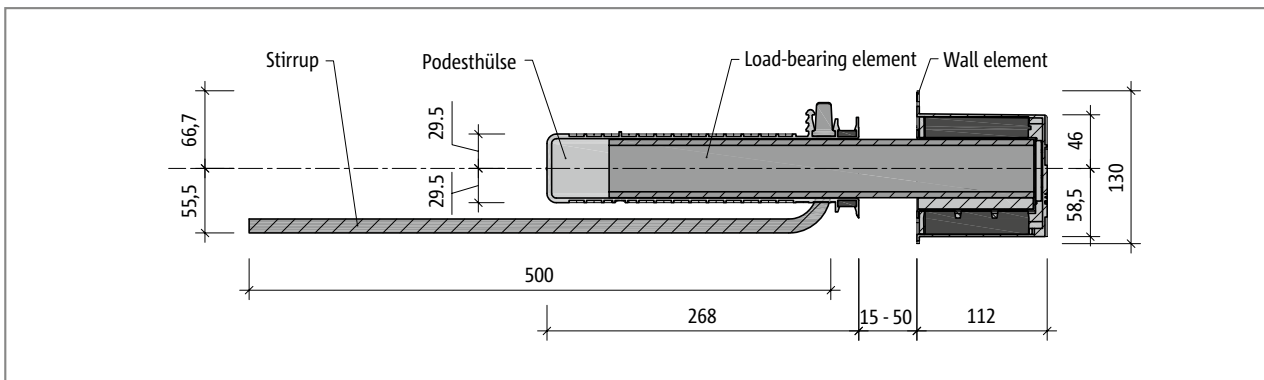


Fig. 131: Schöck Tronsole® Type P: Product section A-A

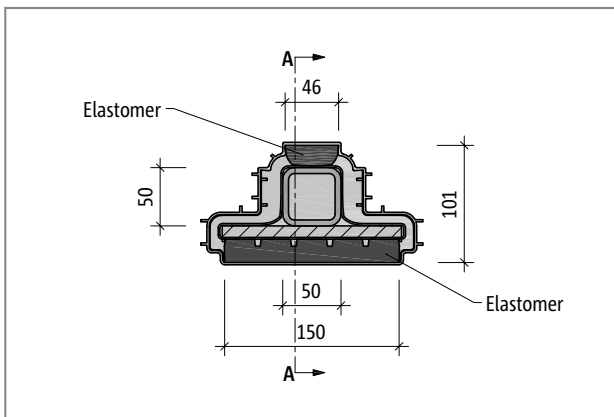


Fig. 132: Schöck Tronsole® Type P-V+V: Product cross-section B-B

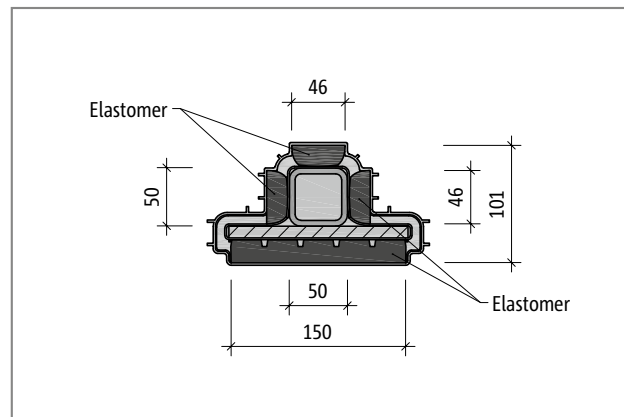


Fig. 133: Schöck Tronsole® Type P-VH+VH: Product cross-section B-B

### **i** Product information

- ▶ Due to its approval, Schöck Tronsole® Type P must always be used as a set along with the wall element, load-bearing element and landing sleeve.



## Design

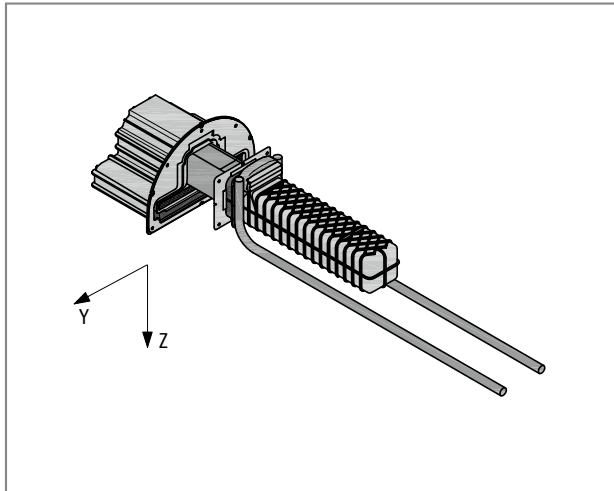


Fig. 134: Schöck Tronsole® Type P: 3D view showing axis labels

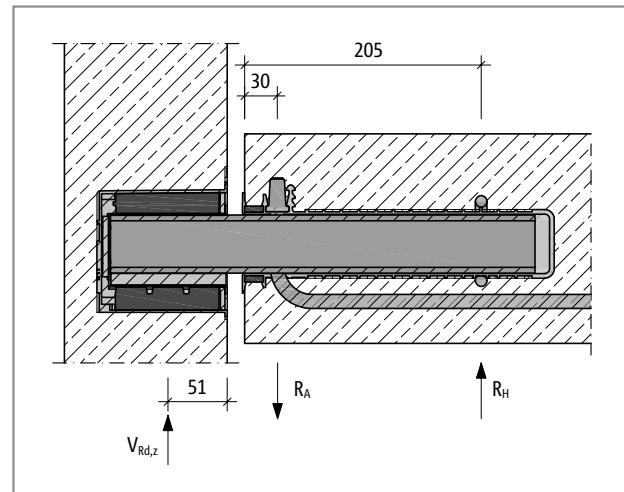


Fig. 135: Schöck Tronsole® Type P: static system

### Calculation

Masonry used to support the Tronsole® must be made from bricks of density class 20 combined with mortar group III as a minimum requirement. If bricks of a lower density class are employed, a concrete pad can be added under the wall element to ensure adherence to the permitted compressions.

### **i** Notes on design

- ▶ The shear force  $V_{Ed,z}$  is transferred via the Elodur® elastomeric bearing to the wall element of Tronsole® Type P with a base area of 150 mm × 90 mm.
- ▶ The shear force  $V_{Ed,y}$  is transferred via the lateral Elodur® elastomeric bearing to the wall element of Tronsole® Type P with a base area of 46 mm × 90 mm.
- ▶ In Tronsole® Type P, the  $V_{Rd,z}$  values along with the joint width also depend on the exerted horizontal force  $V_{Ed,y}$ . The calculation tables list the  $V_{Rd,z}$  values for the various joint widths depending on the exerted horizontal force  $V_{Ed,y}$ . Intermediate values can be interpolated in a linear manner.
- ▶ If greater shear forces  $V_{Ed,z}$  are applied to the front area of the landing, Schöck Tronsole® Type P can optionally be arranged in pairs. This variant must be calculated separately. See the information on calculations for arrangement in pairs on page 139.
- ▶ The scope of applications for Schöck Tronsole® Type P exclusively covers components with mainly static loading according to BS EN 1991-1-1 (EC1) and BS EN 1991-1-1/NA.
- ▶ The structural engineer must verify the shear forces in the landing slab.
- ▶ The stated concrete strengths are minimum requirements that are used as the basis for structural calculations.
- ▶ Exposure class XC1 is assumed for landings.
- ▶ According to BS EN 1992-1-1 and BS EN 1992-1-1/NA, elements with exposure class XC1 require the following nominal concrete covering:
  - In-situ concrete landing:  $c_{nom} = 20$  mm.
  - Precast landing:  $c_{nom} = 15$  mm.
- ▶ If multiple Tronsole® Type P elements are installed, the minimum centre distance of Type P to Type P is 400 mm. When arranged in pairs, a centre distance of 200 mm must be observed within each pair and a centre distance of 500 mm to other Tronsole® Type P.

## Design

### Calculation for concrete strength class C20/25

| Schöck Tronsole® type |                  | P-V+V                           | P-VH+VH    |            |            |
|-----------------------|------------------|---------------------------------|------------|------------|------------|
| Design values with    |                  | Concrete strength $\geq$ C20/25 |            |            |            |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]         |            |            |            |
|                       |                  | At $V_{Ed,y}$ [kN/element]      |            |            |            |
|                       |                  | 0                               | $\pm 5$    | $\pm 10$   | $\pm 15$   |
| 160/180               | 15               | 57.0/-15.0                      | 57.0/-15.0 | 57.0/-15.0 | 57.0/-15.0 |
|                       | 20               | 56.0/-15.0                      | 56.0/-15.0 | 56.0/-15.0 | 55.7/-15.0 |
|                       | 30               | 54.0/-15.0                      | 53.8/-15.0 | 52.6/-15.0 | 50.7/-15.0 |
|                       | 40               | 52.1/-15.0                      | 49.6/-15.0 | 48.4/-15.0 | 46.4/-15.0 |
|                       | 50               | 48.1/-15.0                      | 46.0/-15.0 | 44.7/-15.0 | 42.6/-15.0 |
| $\geq 200$            | 15               | 63.6/-15.0                      | 61.2/-15.0 | 60.2/-15.0 | 58.5/-15.0 |
|                       | 20               | 62.1/-15.0                      | 58.5/-15.0 | 57.5/-15.0 | 55.7/-15.0 |
|                       | 30               | 56.8/-15.0                      | 53.8/-15.0 | 52.6/-15.0 | 50.7/-15.0 |
|                       | 40               | 52.1/-15.0                      | 49.6/-15.0 | 48.4/-15.0 | 46.4/-15.0 |
|                       | 50               | 48.1/-15.0                      | 46.0/-15.0 | 44.7/-15.0 | 42.6/-15.0 |

### Calculation for concrete strength class C25/30

| Schöck Tronsole® type |                  | P-V+V                                 | P-VH+VH    |            |            |
|-----------------------|------------------|---------------------------------------|------------|------------|------------|
| Design values with    |                  | Concrete strength class $\geq$ C25/30 |            |            |            |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]               |            |            |            |
|                       |                  | At $V_{Ed,y}$ [kN/element]            |            |            |            |
|                       |                  | 0                                     | $\pm 5$    | $\pm 10$   | $\pm 15$   |
| 160/180               | 15               | 60.4/-15.0                            | 60.0/-15.0 | 59.5/-15.0 | 58.5/-15.0 |
|                       | 20               | 59.3/-15.0                            | 58.5/-15.0 | 57.5/-15.0 | 55.7/-15.0 |
|                       | 30               | 56.8/-15.0                            | 53.8/-15.0 | 52.6/-15.0 | 50.7/-15.0 |
|                       | 40               | 52.1/-15.0                            | 49.6/-15.0 | 48.4/-15.0 | 46.4/-15.0 |
|                       | 50               | 48.1/-15.0                            | 46.0/-15.0 | 44.7/-15.0 | 42.6/-15.0 |
| $\geq 200$            | 15               | 63.6/-15.0                            | 61.2/-15.0 | 60.2/-15.0 | 58.5/-15.0 |
|                       | 20               | 62.1/-15.0                            | 58.5/-15.0 | 57.5/-15.0 | 55.7/-15.0 |
|                       | 30               | 56.8/-15.0                            | 53.8/-15.0 | 52.6/-15.0 | 50.7/-15.0 |
|                       | 40               | 52.1/-15.0                            | 49.6/-15.0 | 48.4/-15.0 | 46.4/-15.0 |
|                       | 50               | 48.1/-15.0                            | 46.0/-15.0 | 44.7/-15.0 | 42.6/-15.0 |

#### **i** Fire protection

The design values shown here are required to fulfil fire protection rating R 30 starting from a landing thickness of 180 mm. This requirement is sufficient up to building class 5 in line with the MBO. The directions on page 149 and 150 must be complied with. Landings with slabs 160 mm fulfil the requirements for fire protection rating R 0.

## Design

### Calculation for concrete strength class C30/37

| Schöck Tronsole® type |                  | P-V+V                           | P-VH+VH    |            |            |
|-----------------------|------------------|---------------------------------|------------|------------|------------|
| Design values with    |                  | Concrete strength $\geq$ C30/37 |            |            |            |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]         |            |            |            |
|                       |                  | At $V_{Ed,y}$ [kN/element]      |            |            |            |
|                       |                  | 0                               | $\pm 5$    | $\pm 10$   | $\pm 15$   |
| 160/180               | 15               | 63.6/-15.0                      | 61.2/-15.0 | 60.2/-15.0 | 58.5/-15.0 |
|                       | 20               | 62.1/-15.0                      | 58.5/-15.0 | 57.5/-15.0 | 55.7/-15.0 |
|                       | 30               | 56.8/-15.0                      | 53.8/-15.0 | 52.6/-15.0 | 50.7/-15.0 |
|                       | 40               | 52.1/-15.0                      | 49.6/-15.0 | 48.4/-15.0 | 46.4/-15.0 |
|                       | 50               | 48.1/-15.0                      | 46.0/-15.0 | 44.7/-15.0 | 42.6/-15.0 |
| $\geq 200$            | 15               | 63.6/-15.0                      | 61.2/-15.0 | 60.2/-15.0 | 58.5/-15.0 |
|                       | 20               | 62.1/-15.0                      | 58.5/-15.0 | 57.5/-15.0 | 55.7/-15.0 |
|                       | 30               | 56.8/-15.0                      | 53.8/-15.0 | 52.6/-15.0 | 50.7/-15.0 |
|                       | 40               | 52.1/-15.0                      | 49.6/-15.0 | 48.4/-15.0 | 46.4/-15.0 |
|                       | 50               | 48.1/-15.0                      | 46.0/-15.0 | 44.7/-15.0 | 42.6/-15.0 |

### Calculation for concrete strength class $\geq$ C35/45

| Schöck Tronsole® type |                  | P-V+V                           | P-VH+VH    |            |            |
|-----------------------|------------------|---------------------------------|------------|------------|------------|
| Design values with    |                  | Concrete strength $\geq$ C35/45 |            |            |            |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]         |            |            |            |
|                       |                  | At $V_{Ed,y}$ [kN/element]      |            |            |            |
|                       |                  | 0                               | $\pm 5$    | $\pm 10$   | $\pm 15$   |
| 160/180               | 15               | 65.0/-15.0                      | 61.2/-15.0 | 60.2/-15.0 | 58.5/-15.0 |
|                       | 20               | 62.1/-15.0                      | 58.5/-15.0 | 57.5/-15.0 | 55.7/-15.0 |
|                       | 30               | 56.8/-15.0                      | 53.8/-15.0 | 52.6/-15.0 | 50.7/-15.0 |
|                       | 40               | 52.1/-15.0                      | 49.6/-15.0 | 48.4/-15.0 | 46.4/-15.0 |
|                       | 50               | 48.1/-15.0                      | 46.0/-15.0 | 44.7/-15.0 | 42.6/-15.0 |
| $\geq 200$            | 15               | 65.0/-15.0                      | 61.2/-15.0 | 60.2/-15.0 | 58.5/-15.0 |
|                       | 20               | 62.1/-15.0                      | 58.5/-15.0 | 57.5/-15.0 | 55.7/-15.0 |
|                       | 30               | 56.8/-15.0                      | 53.8/-15.0 | 52.6/-15.0 | 50.7/-15.0 |
|                       | 40               | 52.1/-15.0                      | 49.6/-15.0 | 48.4/-15.0 | 46.4/-15.0 |
|                       | 50               | 48.1/-15.0                      | 46.0/-15.0 | 44.7/-15.0 | 42.6/-15.0 |

#### **i** Fire protection

The design values shown here are required to fulfil fire protection rating R 30 starting from a landing thickness of 180 mm. This requirement is sufficient up to building class 5 in line with the MBO. The directions on page 149 and 150 must be complied with. Landings with slabs 160 mm fulfil the requirements for fire protection rating R 0.

## Design

### Calculation for horizontal load-bearing capacity

| Schöck Tronsole® type |                  | P-V+V                           | P-VH+VH    |
|-----------------------|------------------|---------------------------------|------------|
| Design values with    |                  | Concrete strength $\geq$ C20/25 |            |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,y}$ [kN/element]         |            |
| $\geq 160$            | 15               | 0.0                             | $\pm 15.0$ |
|                       | 20               | 0.0                             | $\pm 15.0$ |
|                       | 30               | 0.0                             | $\pm 15.0$ |
|                       | 40               | 0.0                             | $\pm 15.0$ |
|                       | 50               | 0.0                             | $\pm 15.0$ |

### Calculation for arrangement in pairs

| Schöck Tronsole® type |                  | P-V+V                           | P-VH+VH |          |          |
|-----------------------|------------------|---------------------------------|---------|----------|----------|
| Design values with    |                  | Concrete strength $\geq$ C40/50 |         |          |          |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/pair]            |         |          |          |
|                       |                  | At $V_{Ed,y}$ [kN/pair]         |         |          |          |
|                       |                  | 0                               | $\pm 5$ | $\pm 10$ | $\pm 15$ |
| 180                   | 15               | 80.1                            | 80.1    | 80.1     | 80.1     |
|                       | 20               | 77.4                            | 77.4    | 77.4     | 77.4     |
|                       | 30               | 70.4                            | 70.4    | 70.4     | 70.4     |
|                       | 40               | 64.6                            | 64.6    | 64.6     | 64.6     |
|                       | 50               | 59.6                            | 59.6    | 59.6     | 59.6     |
| $\geq 200$            | 15               | 91.8                            | 91.8    | 91.8     | 91.8     |
|                       | 20               | 88.7                            | 88.7    | 88.7     | 88.7     |
|                       | 30               | 80.7                            | 80.7    | 80.7     | 80.7     |
|                       | 40               | 74.0                            | 74.0    | 74.0     | 74.0     |
|                       | 50               | 68.4                            | 68.4    | 68.4     | 68.4     |

### **i** Fire protection

The design values shown here are required to fulfil fire protection rating R 30 starting from a landing thickness of 180 mm. This requirement is sufficient up to building class 5 in line with the MBO. The directions on page 149 and 150 must be complied with.

# On-site reinforcement

## Required on-site reinforcement

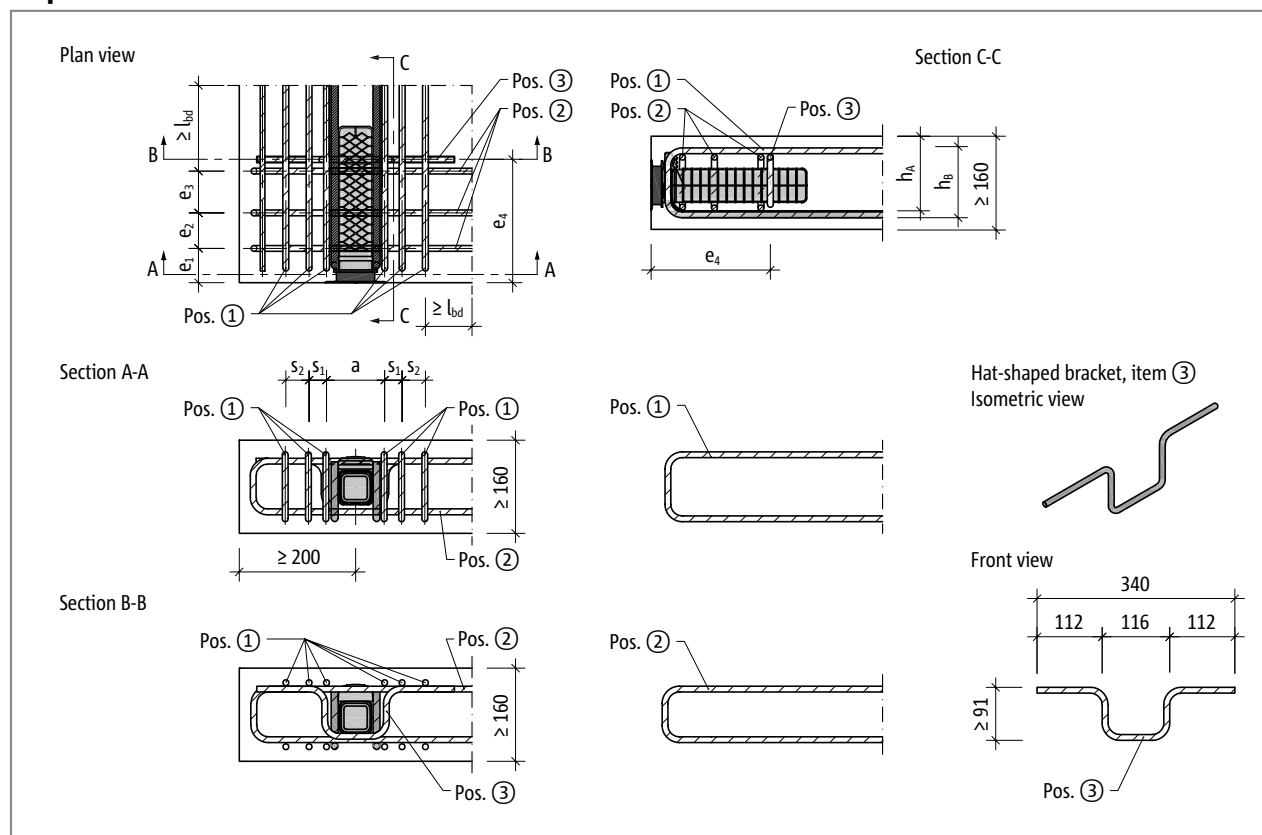


Fig. 136: Schöck Tronsole® Type P: On-site reinforcement

| Schöck Tronsole® type   |                     | P               |                                       |                    |
|---|---------------------|-----------------|---------------------------------------|--------------------|
| On-site reinforcement   | Slab thickness [mm] | Separation [mm] | Concrete strength class $\geq$ C20/25 |                    |
| <b>Distances</b>  |                     |                 |                                       |                    |
| Edge distance   | $\geq 160$          | $a_R$           | $\geq 200$                            | -                  |
| Centre distance   |                     | $a_T$           | $\geq 400$                            |                    |
| Distance of the suspension reinforcement from the loaded edge |                     | $h_A$           | $\geq 128$                            |                    |
| Required height of the bracket reinforcement (item 1)         |                     | $h_B$           | $\geq 120$<br>$\geq 140$              |                    |
| <b>Pos. 1 tie, <math>A_{sx}</math></b>                        |                     |                 |                                       |                    |
| Pos. 1  | $\geq 160$          | $a$             | 100                                   | $6 \varnothing 10$ |
|   |                     | $s_1$           | 30                                    |                    |
|   |                     | $s_2$           | 30-40                                 |                    |
| <b>Item 2 Lateral reinforcement, <math>A_{sy}</math></b>      |                     |                 |                                       |                    |
| Pos. 2  | $\geq 160$          | $e_1$           | 55                                    | $3 \varnothing 10$ |
|   |                     | $e_2$           | 55                                    |                    |
|   |                     | $e_3$           | 80                                    |                    |
| <b>Pos. 3 hat brackets</b>                                    |                     |                 |                                       |                    |
| Pos. 3  | $\geq 160$          | $e_4$           | 205                                   | $1 \varnothing 10$ |

Schöck Tronsole® Type P: On-site reinforcement

## On-site reinforcement

### **i** On-site reinforcement

- ▶ The height of the on-site hat-shaped bracket (item 3) depends on slab thickness  $h$ . The height must be chosen so that the hat-shaped bracket can be laid around the lower side of the landing sleeve with its ends in the second layer of the upper slab reinforcement.
- ▶ The underside of the Tronsole® Type P landing sleeve has a groove at the contact point for transferring forces to the on-site hat-shaped bracket (item 3).
- ▶ If the U-shaped brackets,  $A_{sx}$  (item 1) are sufficiently long, they can count towards the structurally required slab reinforcement  $A_{sx}$  that must be verified by the structural engineer.
- ▶ If the shear force  $V_{Ed, z}$  exerted on a slab  $\geq 200$  mm thick is lower or equal to the shear force  $V_{Rd, z}$  that can be absorbed by a slab 180 mm thick, the on-site reinforcement can be selected as if the slab were 180 mm thick.

# On-site reinforcement

## Required on-site reinforcement for arrangement in pairs

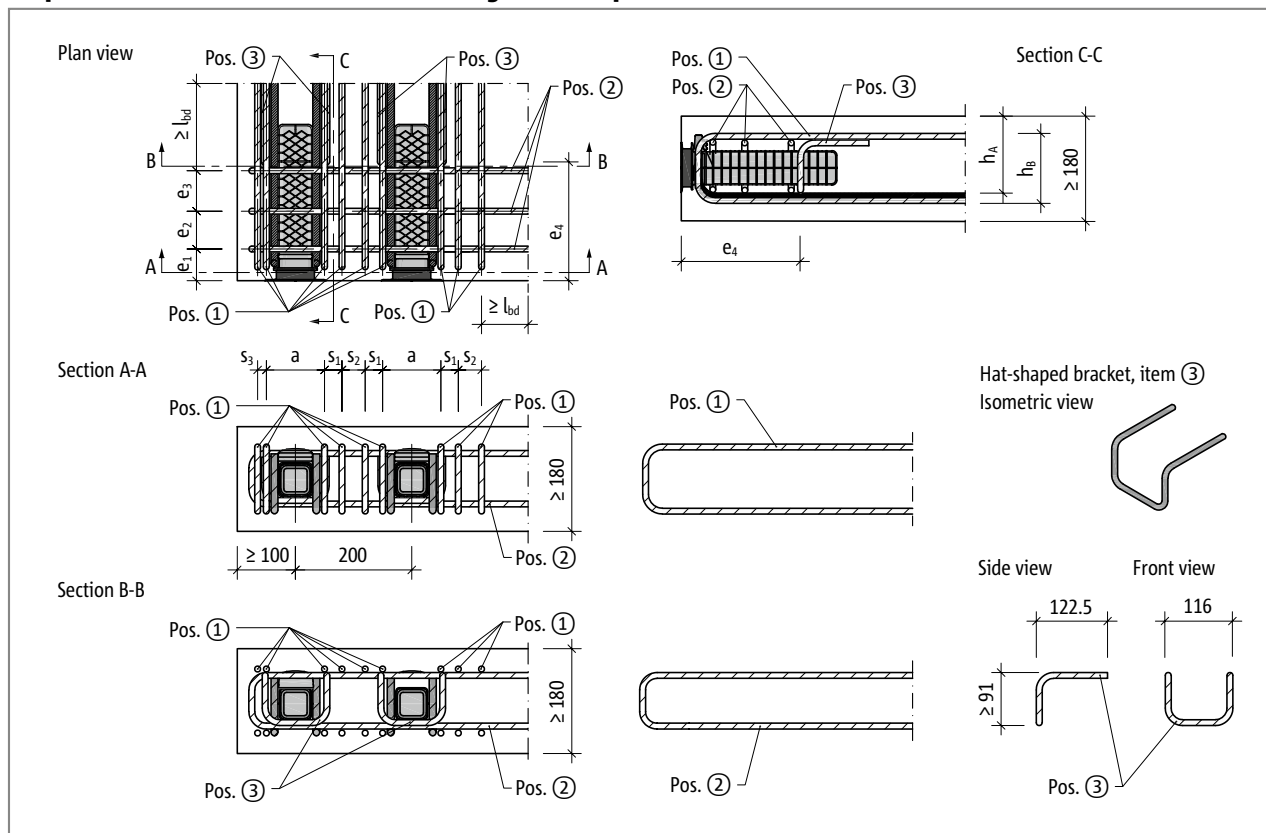


Fig. 137: Schöck Tronsole® Type P: On-site reinforcement for arrangement in pairs

| Schöck Tronsole® type   |                     | P (arranged in pairs) |                          |                                 |
|---|---------------------|-----------------------|--------------------------|---------------------------------|
| On-site reinforcement   | Slab thickness [mm] | Separation [mm]       |                          | Concrete strength $\geq$ C40/50 |
| <b>Distances</b>  |                     |                       |                          |                                 |
| Edge distance   | $\geq 180$          | $a_R$                 | $\geq 100$               | -                               |
| Centre distance   |                     | $a_T$                 | $\geq 500$               |                                 |
| Distance of the suspension reinforcement from the loaded edge |                     | $h_A$                 | $\geq 138$               |                                 |
| Required height of the bracket reinforcement (item 1)         |                     | $h_B$                 | $\geq 120$<br>$\geq 140$ |                                 |
| <b>Pos. 1 tie, <math>A_{sx}</math></b>                        |                     |                       |                          |                                 |
| Pos. 1  | $\geq 180$          | $a$                   | 100                      | 9 $\varnothing$ 10              |
|   |                     | $s_1$                 | 30                       |                                 |
|   |                     | $s_2$                 | 40                       |                                 |
|   |                     | $s_3$                 | 15-40                    |                                 |
| <b>Item 2 Lateral reinforcement, <math>A_{sy}</math></b>      |                     |                       |                          |                                 |
| Pos. 2  | $\geq 180$          | $e_1$                 | 55                       | 3 $\varnothing$ 10              |
|   |                     | $e_2$                 | 55                       |                                 |
|   |                     | $e_3$                 | 80                       |                                 |
| <b>Pos. 3 hat brackets</b>                                    |                     |                       |                          |                                 |
| Pos. 3  | $\geq 180$          | $e_4$                 | 205                      | 2 $\varnothing$ 10              |

Schöck Tronsole® Type P: On-site reinforcement for arrangement in pairs

## On-site reinforcement

### **i** On-site reinforcement

- ▶ The height of the on-site hat-shaped bracket (item 3) depends on slab thickness  $h$ . The height must be chosen so that the hat-shaped bracket can be laid around the lower side of the landing sleeve with its ends in the second layer of the upper slab reinforcement.
- ▶ The underside of the Tronsole® Type P landing sleeve has a groove at the contact point for transferring forces to the on-site hat-shaped bracket (item 3).
- ▶ If the U-shaped brackets,  $A_{sx}$  (item 1) are sufficiently long, they can count towards the structurally required slab reinforcement  $A_{sx}$  that must be verified by the structural engineer.
- ▶ If the shear force  $V_{Ed, z}$  exerted on a slab  $\geq 200$  mm thick is lower or equal to the shear force  $V_{Rd, z}$  that can be absorbed by a slab 180 mm thick, the on-site reinforcement can be selected as if the slab were 180 mm thick.



## Deflection

### Deformation with positive and negative shear force load

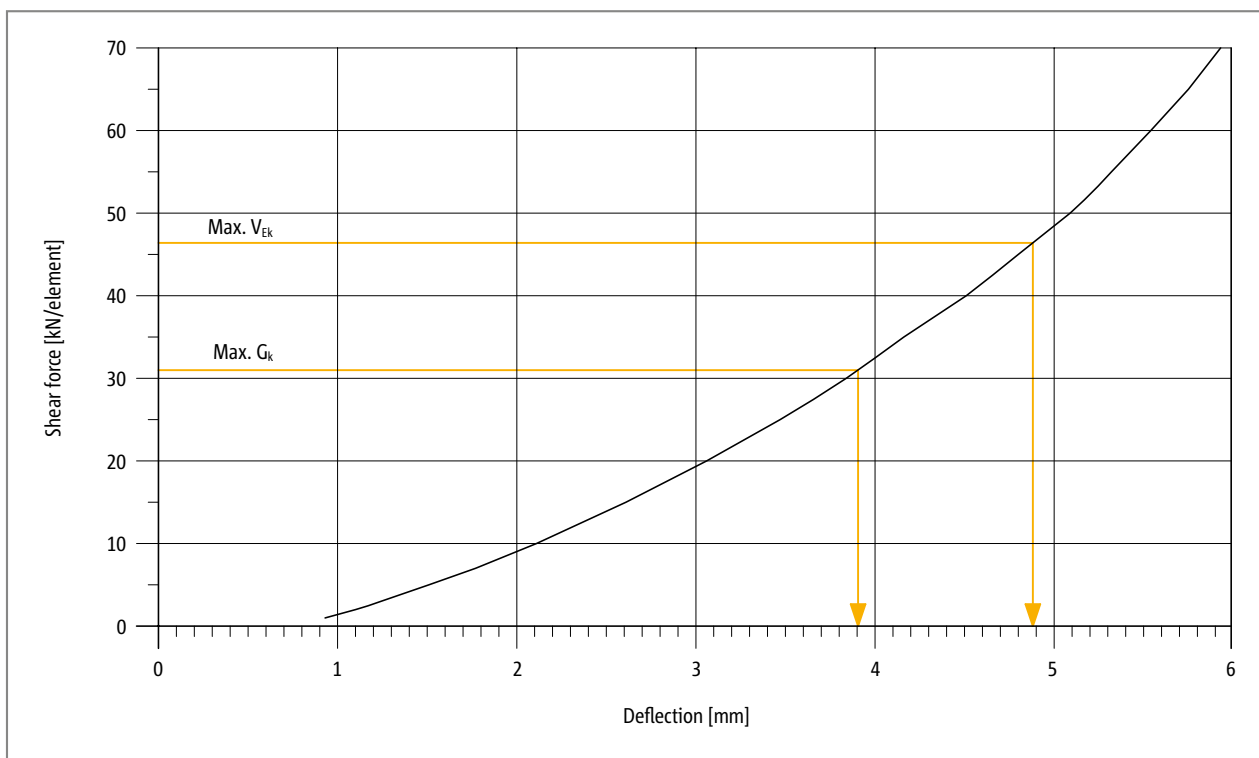


Fig. 138: Schöck Tronsole® Type P: Deformation of the Elodur® elastomeric bearing with a positive  $V_{Ek,z}$

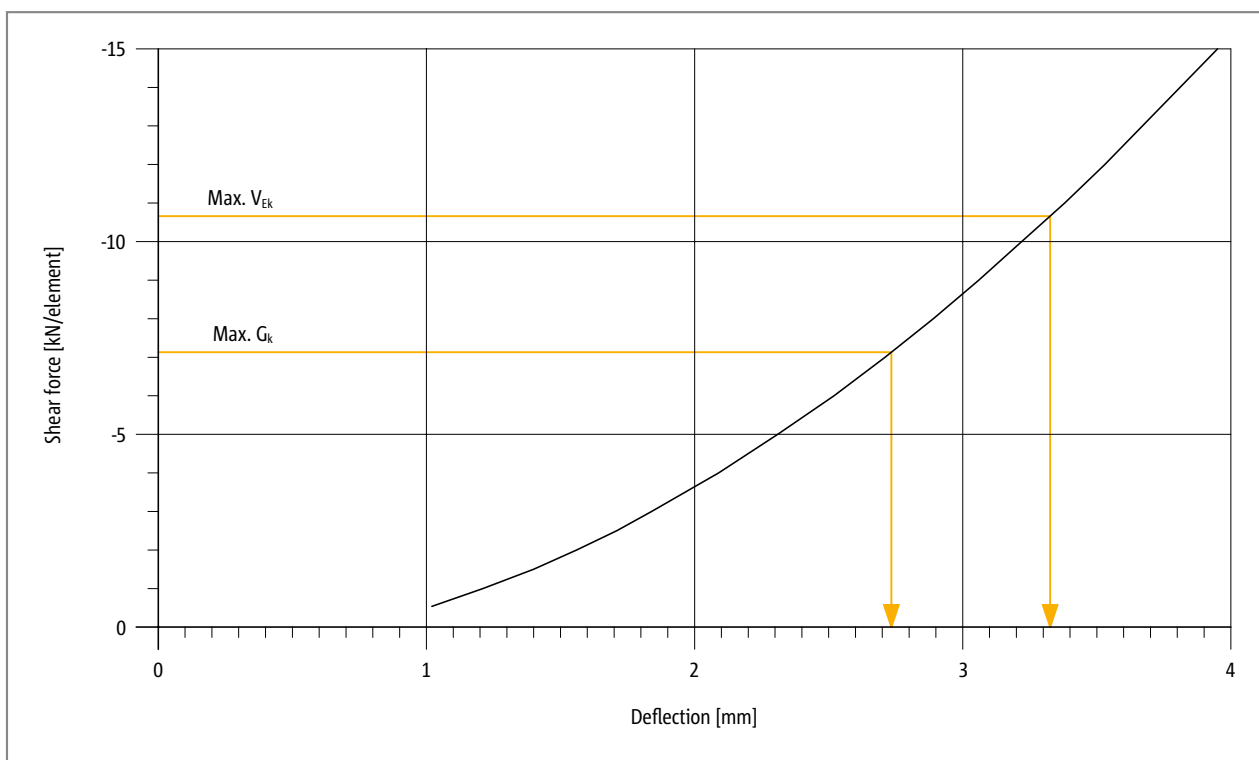


Fig. 139: Schöck Tronsole® Type P: Deformation of the Elodur® elastomeric bearing with a negative  $V_{Ek,z}$

## Deflection

### Deformation with positive shear force load when arranged in pairs

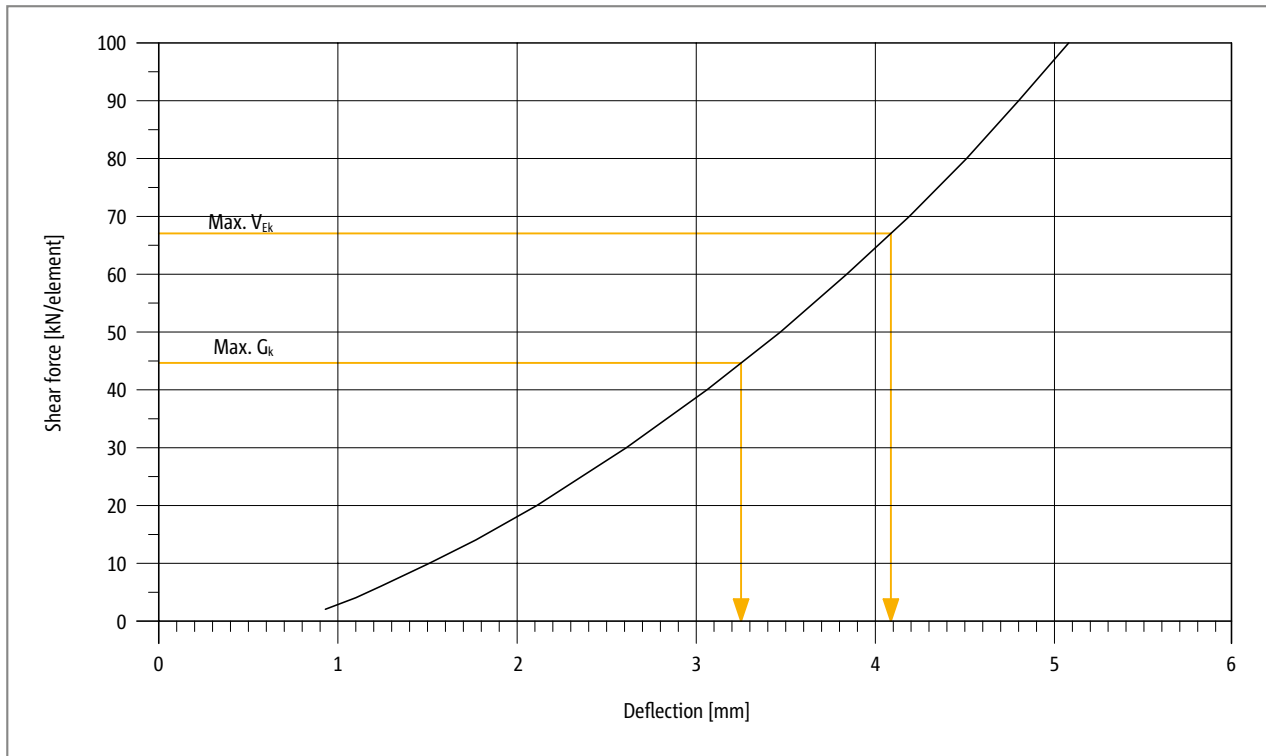


Fig. 140: Schöck Tronsole® Type P: Deformation of the Elodur® elastomeric bearing under a vertical load  $V_{Ek,z}$  when arranged in pairs

P

#### **i** Notes on deformation

- ▶ Deflection means the vertical deformation of the Elodur® elastomeric bearing under vertical shear force load.
- ▶  $\text{Max. } V_{Ek} = \text{Max. } V_{Ed} / \gamma$ , where  $\gamma = 1.4$
- ▶  $\gamma = 1.4$  applies under the assumption that  $\text{max. } V_{Ed}$  is made up of two thirds dead weight and one third live load.
- ▶ Thus  $\text{max. } V_{Ek}$  is the maximum working load and the maximum dead weight is  $\text{max. } G_k = 2/3 \cdot \text{max. } V_{Ek}$ .

## On-site hat bracket

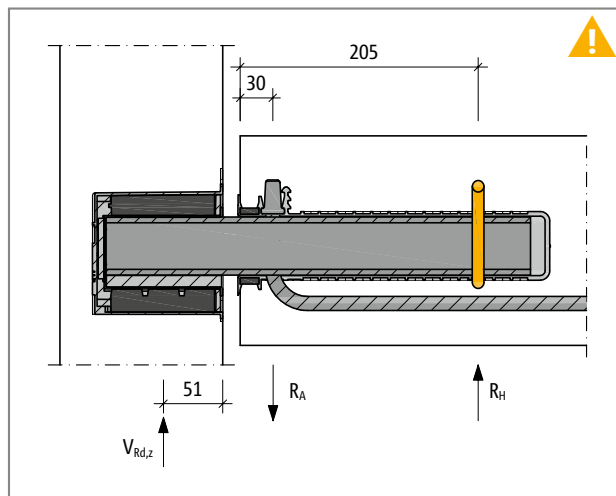


Fig. 141: Schöck Tronsole® Type P: Here: On-site hat-shaped bracket coloured orange

### **i** Hat-shaped bracket required for forming the structural system

The landing sleeve of Schöck Tronsole® Type P contains a suspension bracket. A hat-shaped bracket must be added on site to form the structural system as expected in the calculations. The suspension bracket and the hat-shaped bracket form a force couple that is required to clamp the Tronsole® in the reinforced concrete building component.

### **!** Hazard warning - missing hat-shaped bracket

- ▶ For the given load-bearing capacity of the Schöck Tronsole®, the on-site hat bracket (Pos. 3) is absolutely necessary.
- ▶ The hat-shaped bracket must be planned as part of the on-site reinforcement and installed in the groove provided on the underside of the landing sleeve.

## Load-bearing element

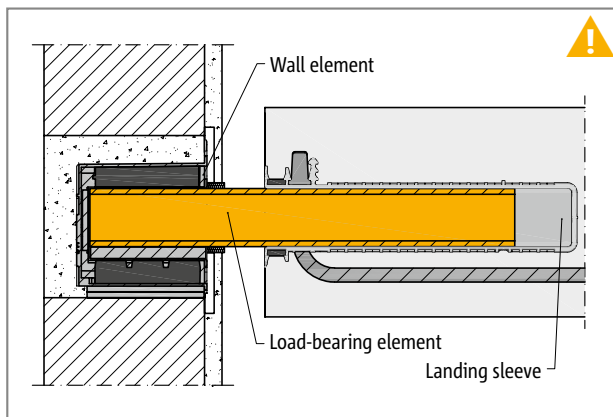


Fig. 142: Schöck Tronsole® Type P: Multi-part product (wall element, load-bearing element, landing sleeve); load-bearing element (yellow) must be installed on the building site.

### **i** Load-bearing element required to transfer shear force

Schöck Tronsole® Type P is made up of a wall element, landing sleeve and load-bearing element. The load-bearing element must be installed on the construction site. The wall element is installed on the construction site. The landing sleeve can be installed either in the precast factory or on the construction site in in-situ concrete. Every landing sleeve must be allocated a load-bearing element.

### **!** Hazard warning - missing load-bearing element

- ▶ The landing will collapse without the load-bearing element.
- ▶ The load-bearing element must be installed on the construction site.

## Precast construction

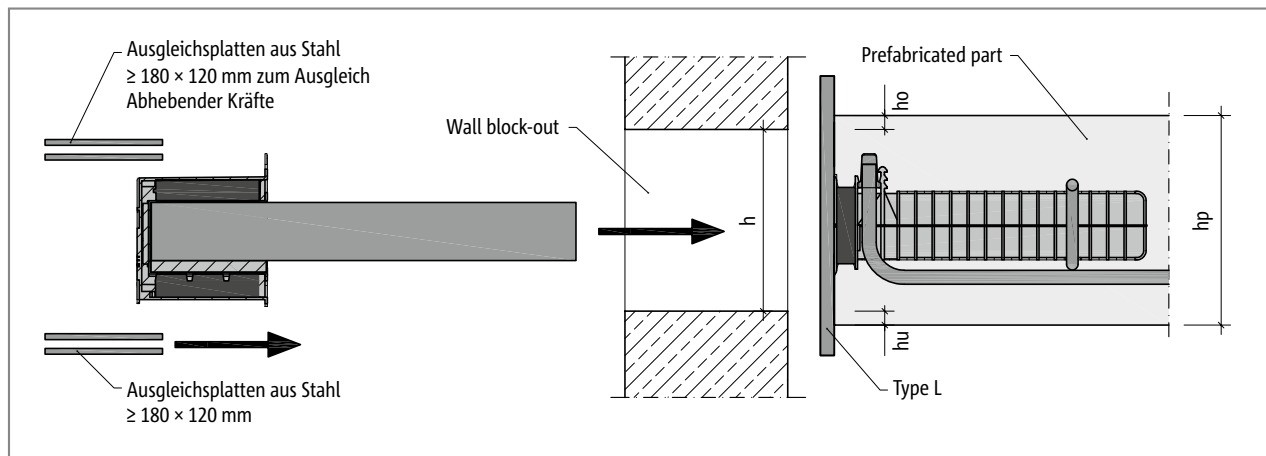


Fig. 143: Schöck Tronsole® Type P: Wall slot for precast construction

### i Precast part construction

- ▶ The wall element of Schöck Tronsole® Type P must lie on a level, full-surface bearing. Bearing design: brick density class 20 and mortar group III.
- ▶ Schöck Tronsole® Type P is inserted through the staircase wall afterwards. A full-length wall slot must be present in the staircase wall.
- ▶ When installing the landing, it may be necessary to adjust the height of the landing under the wall element using pressure-resistant compensating plates, (e.g. made of steel, minimum size 180 mm x 120 mm). The compensating plate must support the complete bearing surface of the wall element.
- ▶ When installed in exposed concrete, the size of the wall slot is calculated as follows:  $h = h_p - h_o - h_u$ . See the following table for recommended values.

| Schöck Tronsole® type | P                   |       |
|-----------------------|---------------------|-------|
| Wall slot for         | Landing height [mm] |       |
|                       | 160                 | ≥ 180 |
| h [mm]                | 140                 | ≥ 150 |
| h <sub>u</sub> [mm]   | 10                  | ≥ 15  |
| h <sub>o</sub> [mm]   | 10                  | ≥ 15  |
| b mm][                | 270                 | 270   |

P

## Fire protection

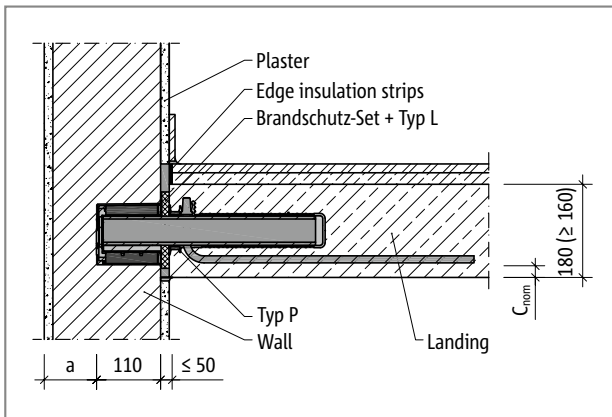


Fig. 144: Schöck Tronsole® Type P: Fire-protection version

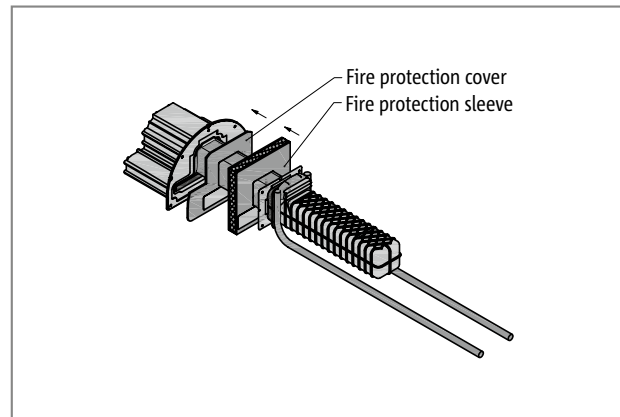


Fig. 145: Schöck Tronsole® Type P: 3D view of the product with two-part fire-protection set

### **i** Fire safety design

- ▶ Tronsole® Type P fulfils the R 30 requirement starting from a slab thickness of 180 mm. The design values stated on pages 137–149 apply.
- ▶ For specialist requirements (e. g. special structures), design values in line with the following tables can be achieved using Tronsole® Type P for a R 90 rating. The respective minimum slab height must be taken into account. The values apply to variants P-V+V and P-VH+VH and can be employed independently of the  $V_{Ed,y}$  force.

| Schöck Tronsole® type |                  | P                          |            |            |            |            |
|-----------------------|------------------|----------------------------|------------|------------|------------|------------|
| Design values with    |                  | Fire-protection class R 90 |            |            |            |            |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]    |            |            |            |            |
|                       |                  | C20/25                     | C25/30     | C30/37     | C35/45     | C40/50     |
| 210                   | 15               | 42.5/-15.0                 | 45.0/-15.0 | 47.6/-15.0 | 50.2/-15.0 | 52.7/-15.0 |
|                       | 20               | 27.8/-15.0                 | 29.5/-15.0 | 31.2/-15.0 | 32.8/-15.0 | 34.5/-15.0 |
|                       | 30               | 26.8/-15.0                 | 28.4/-15.0 | 30.1/-15.0 | 31.7/-15.0 | 33.3/-15.0 |
|                       | 40               | 25.9/-15.0                 | 27.5/-15.0 | 29.1/-15.0 | 30.6/-15.0 | 32.2/-15.0 |
|                       | 50               | 25.1/-15.0                 | 26.6/-15.0 | 28.1/-15.0 | 29.6/-15.0 | 31.1/-15.0 |

| Schöck Tronsole® type |                  | P                          |            |            |            |            |
|-----------------------|------------------|----------------------------|------------|------------|------------|------------|
| Design values with    |                  | Fire-protection class R 90 |            |            |            |            |
| Slab thickness [mm]   | Joint width [mm] | $V_{Rd,z}$ [kN/element]    |            |            |            |            |
|                       |                  | C20/25                     | C25/30     | C30/37     | C35/45     | C40/50     |
| ≥ 230                 | 15               | 65.0/-15.0                 | 65.0/-15.0 | 65.0/-15.0 | 65.0/-15.0 | 65.0/-15.0 |
|                       | 20               | 41.7/-15.0                 | 44.2/15.0  | 46.8/-15.0 | 49.3/-15.0 | 51.7/-15.0 |
|                       | 30               | 40.3/-15.0                 | 42.7/-15.0 | 45.1/-15.0 | 47.5/-15.0 | 49.9/-15.0 |
|                       | 40               | 38.9/-15.0                 | 41.2/-15.0 | 43.6/-15.0 | 45.9/-15.0 | 48.3/-15.0 |
|                       | 50               | 37.6/-15.0                 | 39.9/-15.0 | 42.2/-15.0 | 44.4/-15.0 | 46.7/-15.0 |

## Fire protection | Materials | Installation

### **i** Fire protection

- ▶ The fire protection classification of the staircase wall is not affected by the wall element if it is given a back lining of masonry blocks at least 40 mm thick (each  $\geq 40$  mm). A mineral rendering can count towards the thickness.
- ▶ A minimum distance of  $C_{nom} \geq 30$  mm must be observed between the suspension bracket of Tronsole® Type P and the building component surface.
- ▶ An optional fire-protection set is required for Tronsole® Type P to achieve fire-protection class R 30 or R 90. This set consists of a fire-protection covering and two or three fire-protection collars depending on the joint width.
- ▶ The wall element of Tronsole® Type P must be protected by the fire-protection covering. The covering is secured to the adhesive tape of the wall element using the product's built-in adhesive surface.
- ▶ Joint width  $\leq 25$  mm: 1 fire-protection set
- ▶ Joint width 26 mm to 45 mm: 1 fire-protection set + 1 additional fire-protection collar
- ▶ Joint width 46 mm to 50 mm: 1 fire protection set + 2 additional fire-protection collars

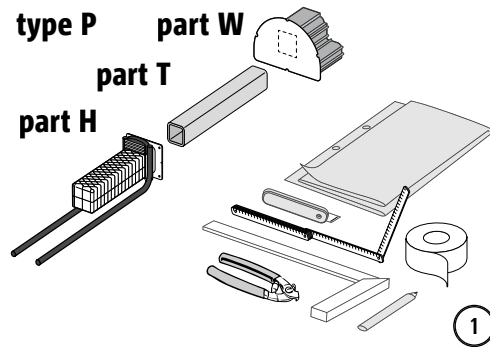
### Materials and construction materials

| Schöck Tronsole® Type P | Material   |
|-------------------------|--|
| External box            | Polystyrene                                      |
| Internal box            | Polystyrene                                      |
| PE foam insert          | PE foam according to DIN EN 14313                |
| Elastomer support       | Polyurethane according to DIN EN 13165           |
| Load distribution plate | S355 according to BS EN 10025                    |
| Load-bearing element    | S460, galvanised as per DIN 1461                 |
| Landing sleeve          | Polystyrene                                      |
| Suspension bracket      | Reinforcing steel B500B according to DIN 488-1   |
| Pressure deflector      | Construction steel S460 according to BS EN 10025 |
| Tension damper          | Polyurethane according to DIN EN 13165           |
| Sealing                 | PE foam according to DIN EN 14313                |

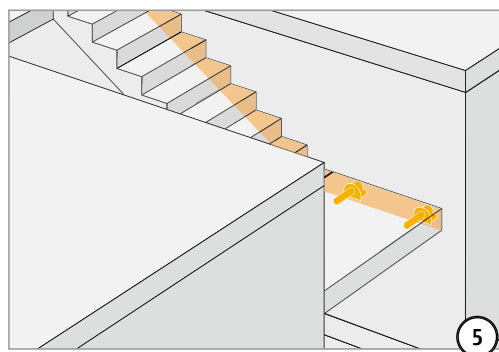
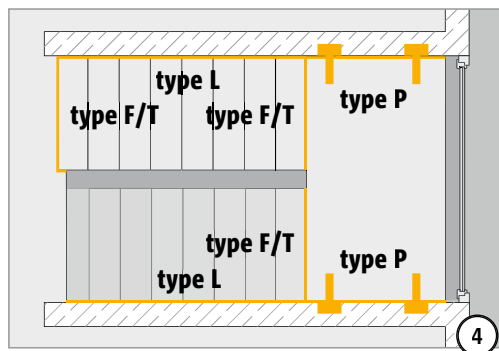
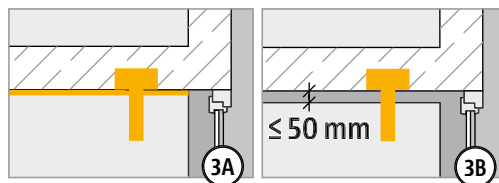
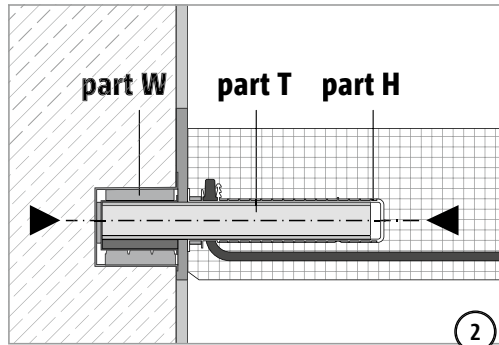
### **i** Installation

- ▶ The wall element of Schöck Tronsole® Type P must lie on a level, full-surface bearing. Bearing design: brick density class 20 and mortar group III.
- ▶ When installing the landing, it may be necessary to adjust the height of the landing under the wall element using pressure-resistant compensating plates, (e.g. made of steel, minimum size 180 mm x 120 mm). The compensating plate must support the complete bearing surface of the wall element.

## Installation instructions for building site in-situ concrete

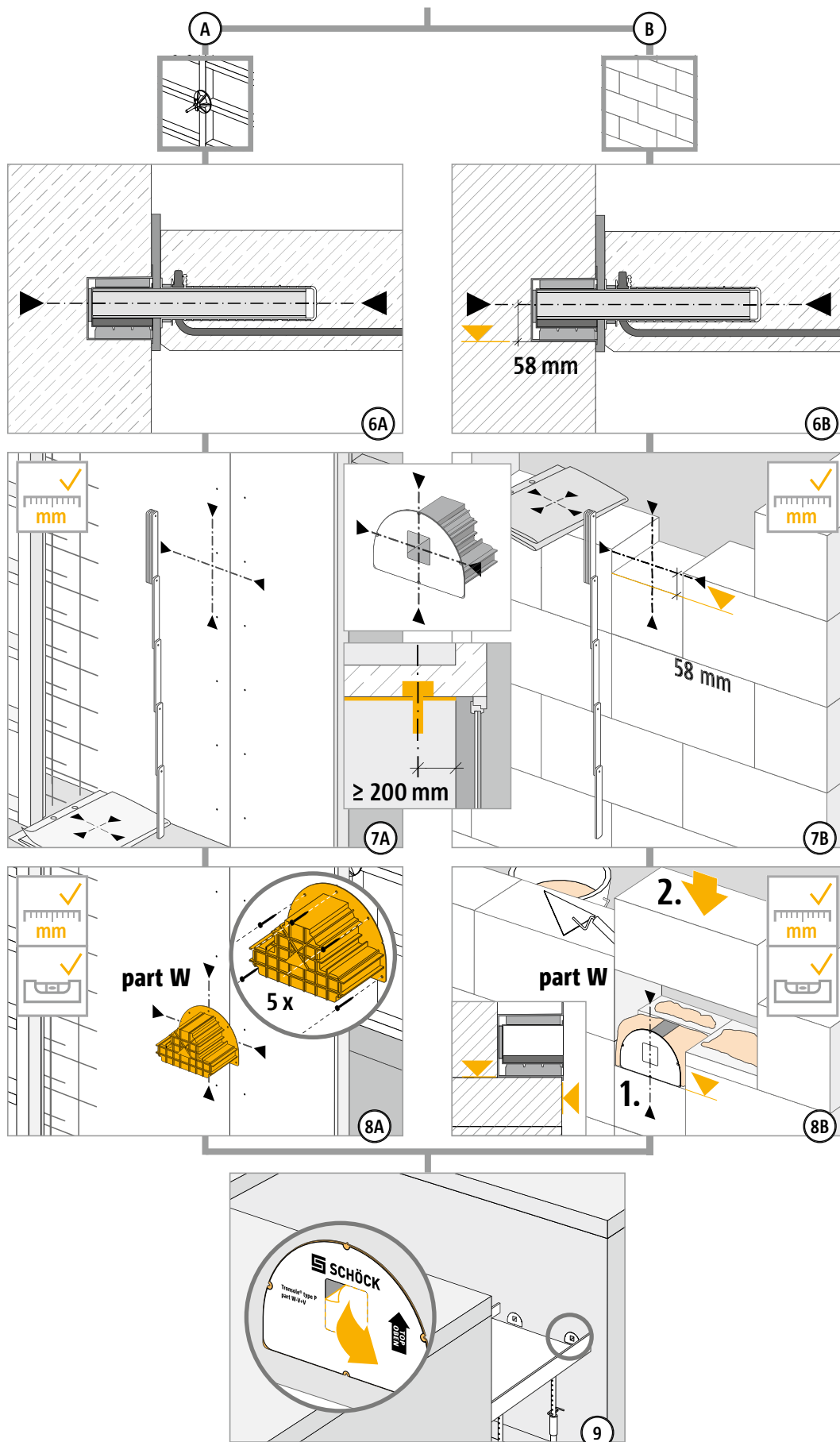


**⚠ WARNING** Hazard due to falling structural components with incomplete installation. All parts of the Tronsole® type P (Part W + T + H) must be used.

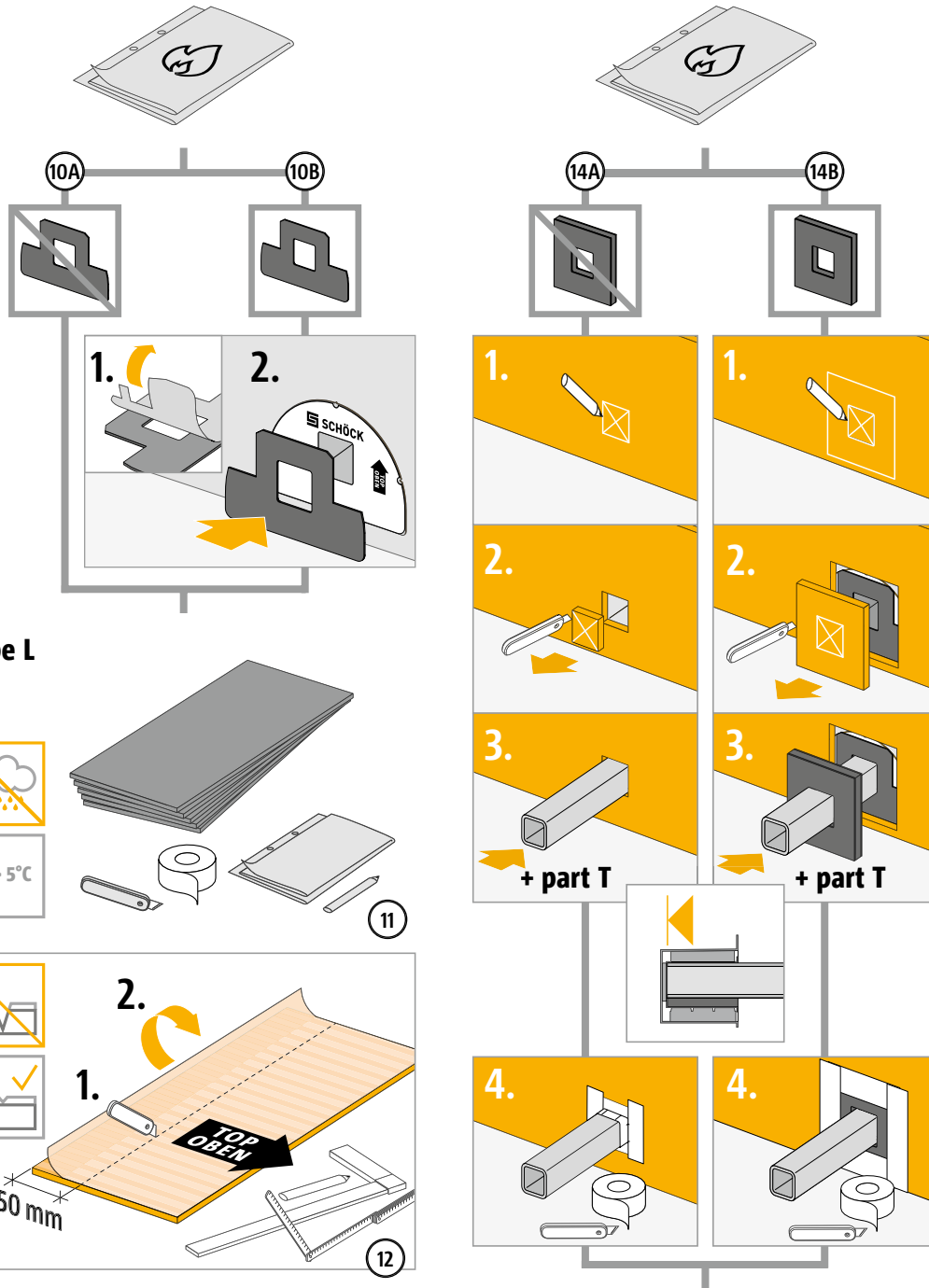




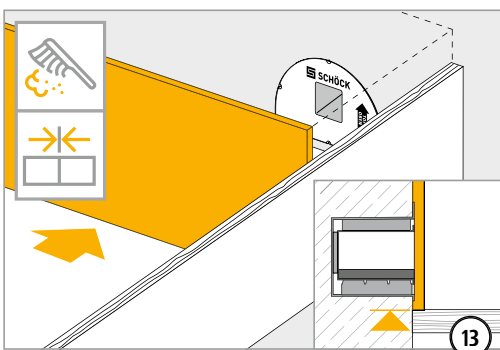
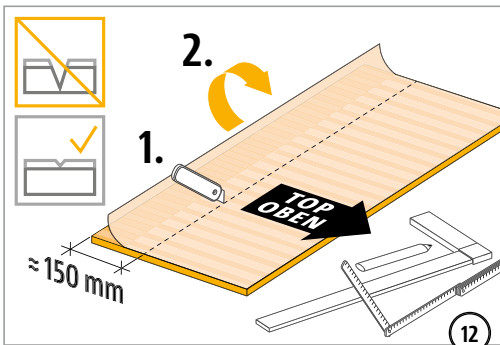
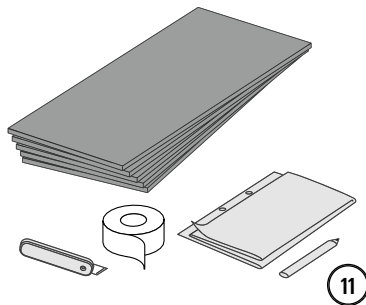
## Installation instructions for building site in-situ concrete



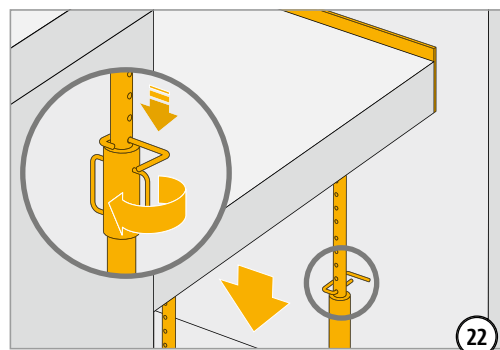
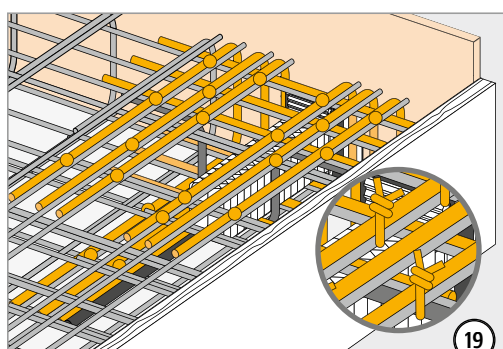
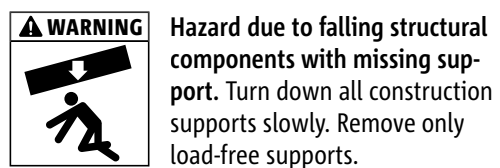
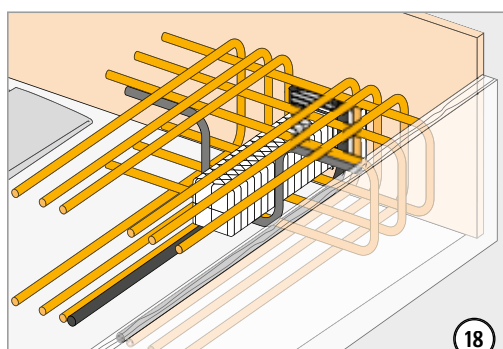
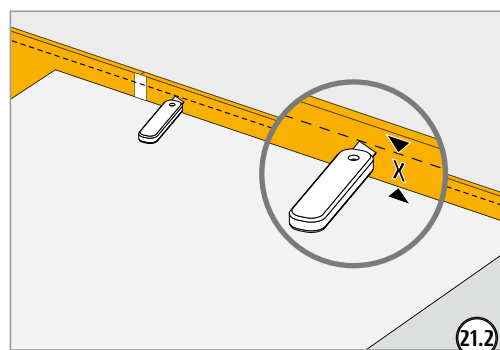
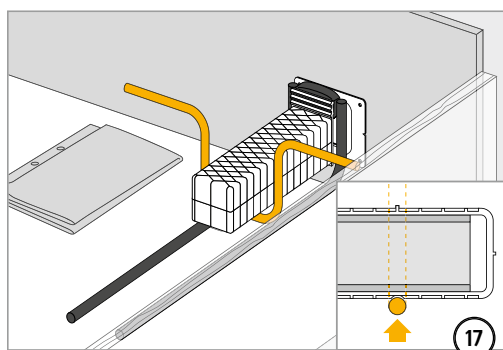
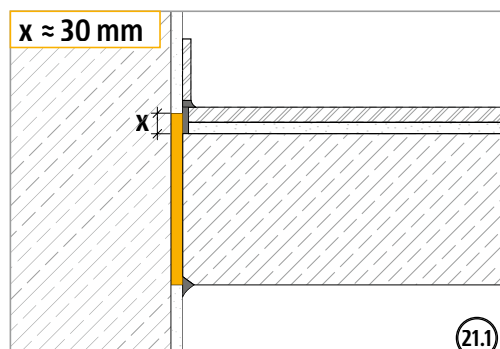
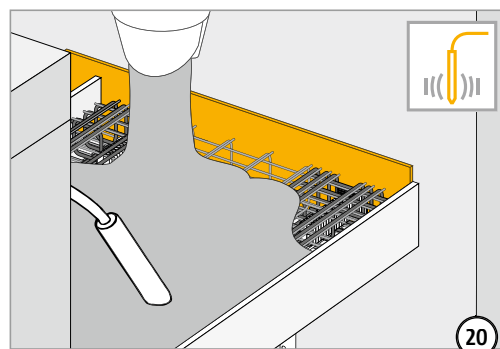
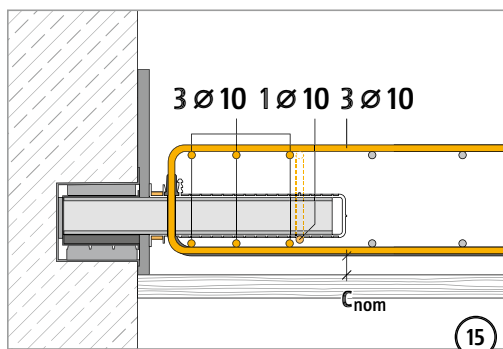
# Installation instructions for building site in-situ concrete



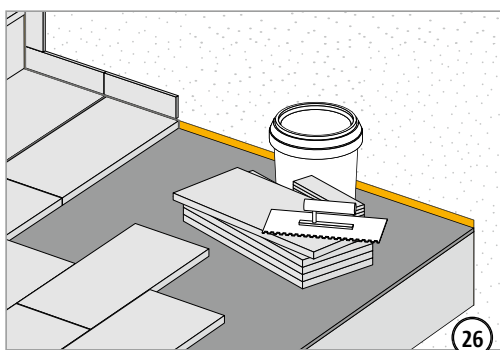
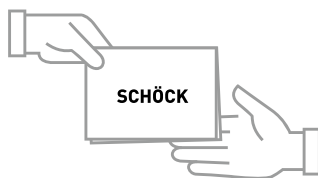
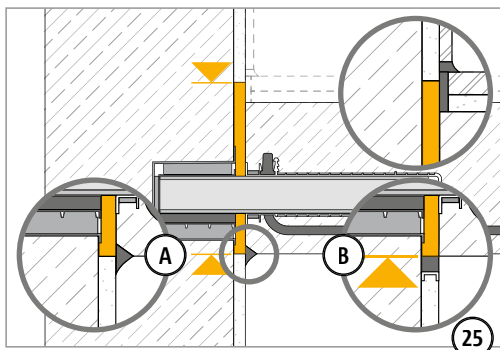
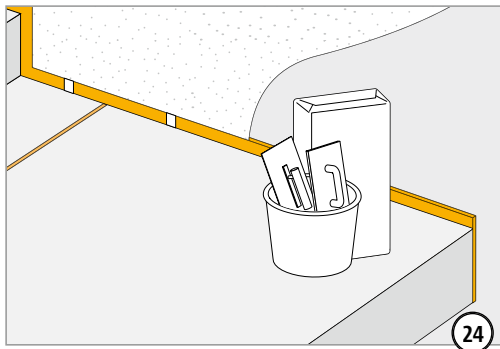
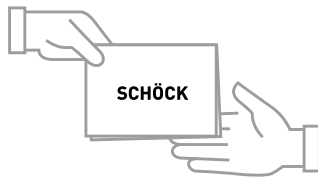
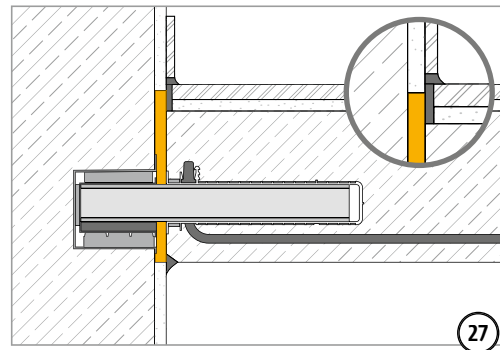
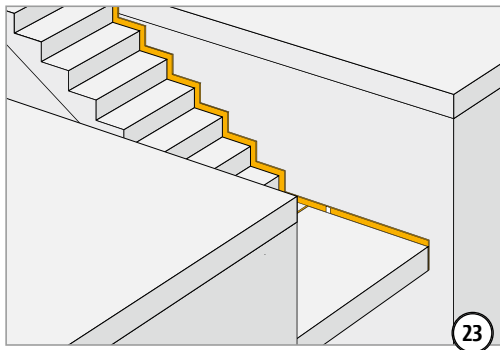
type L



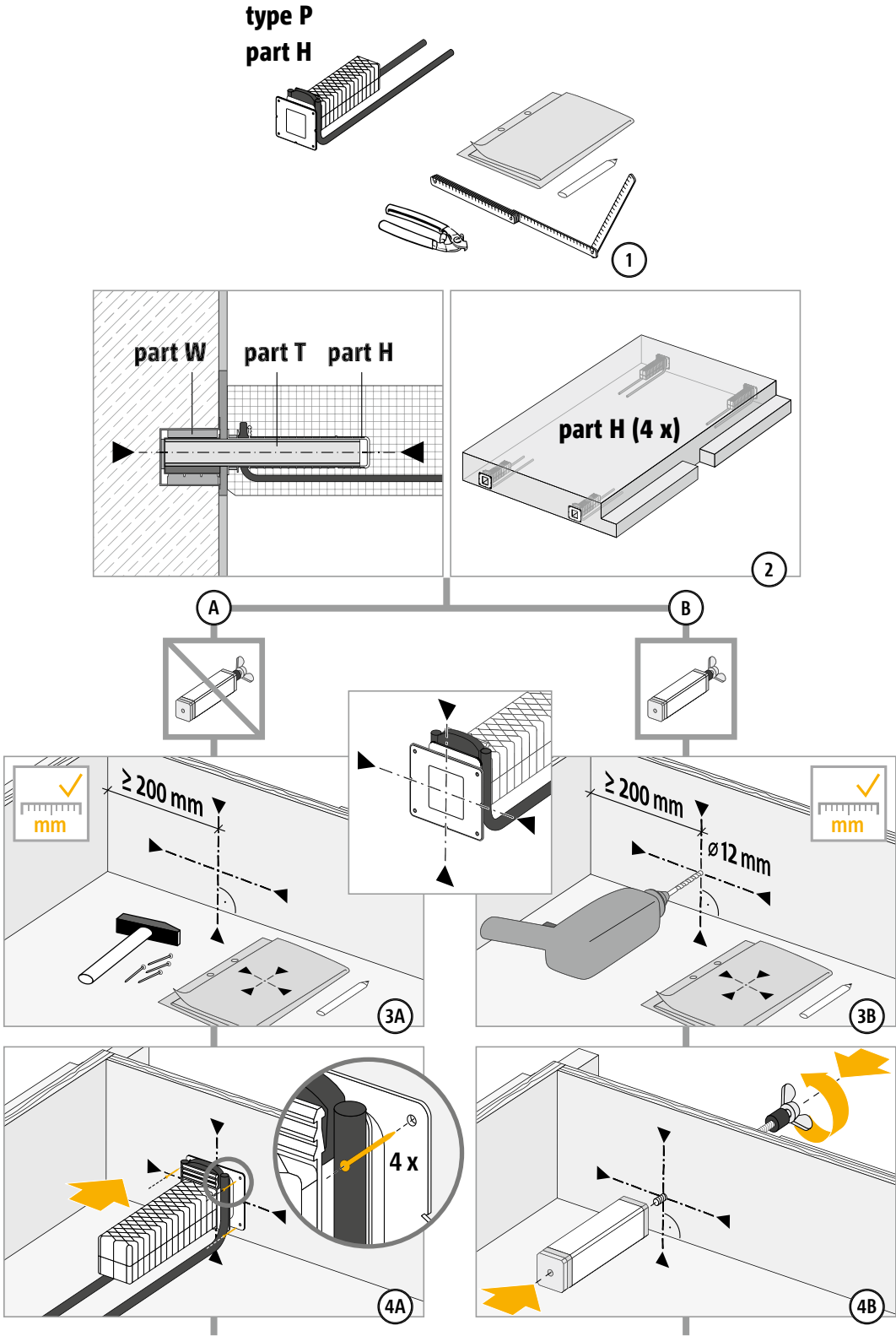
## Installation instructions for building site in-situ concrete



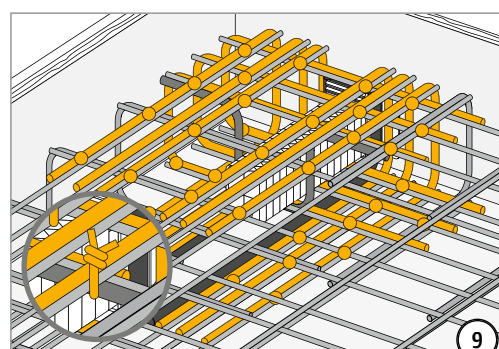
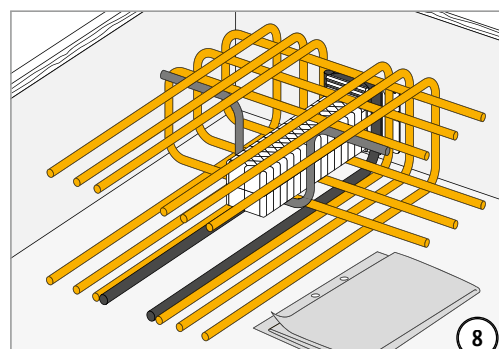
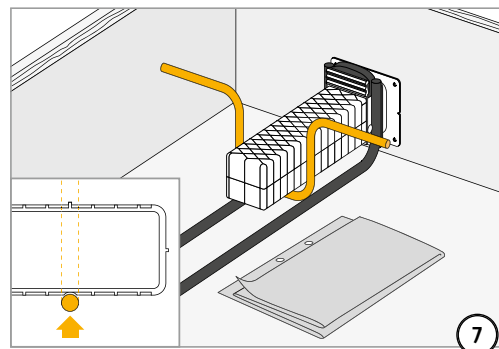
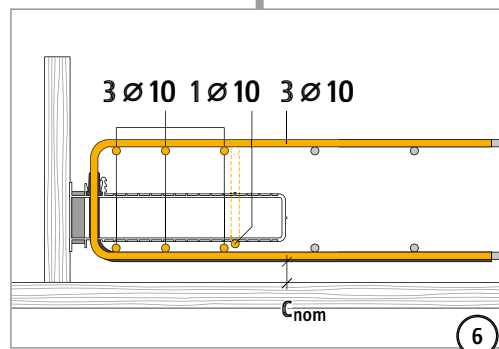
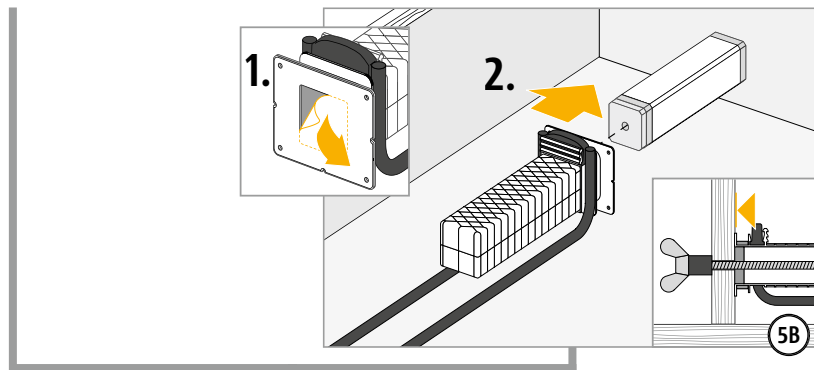
## Installation instructions for building site in-situ concrete



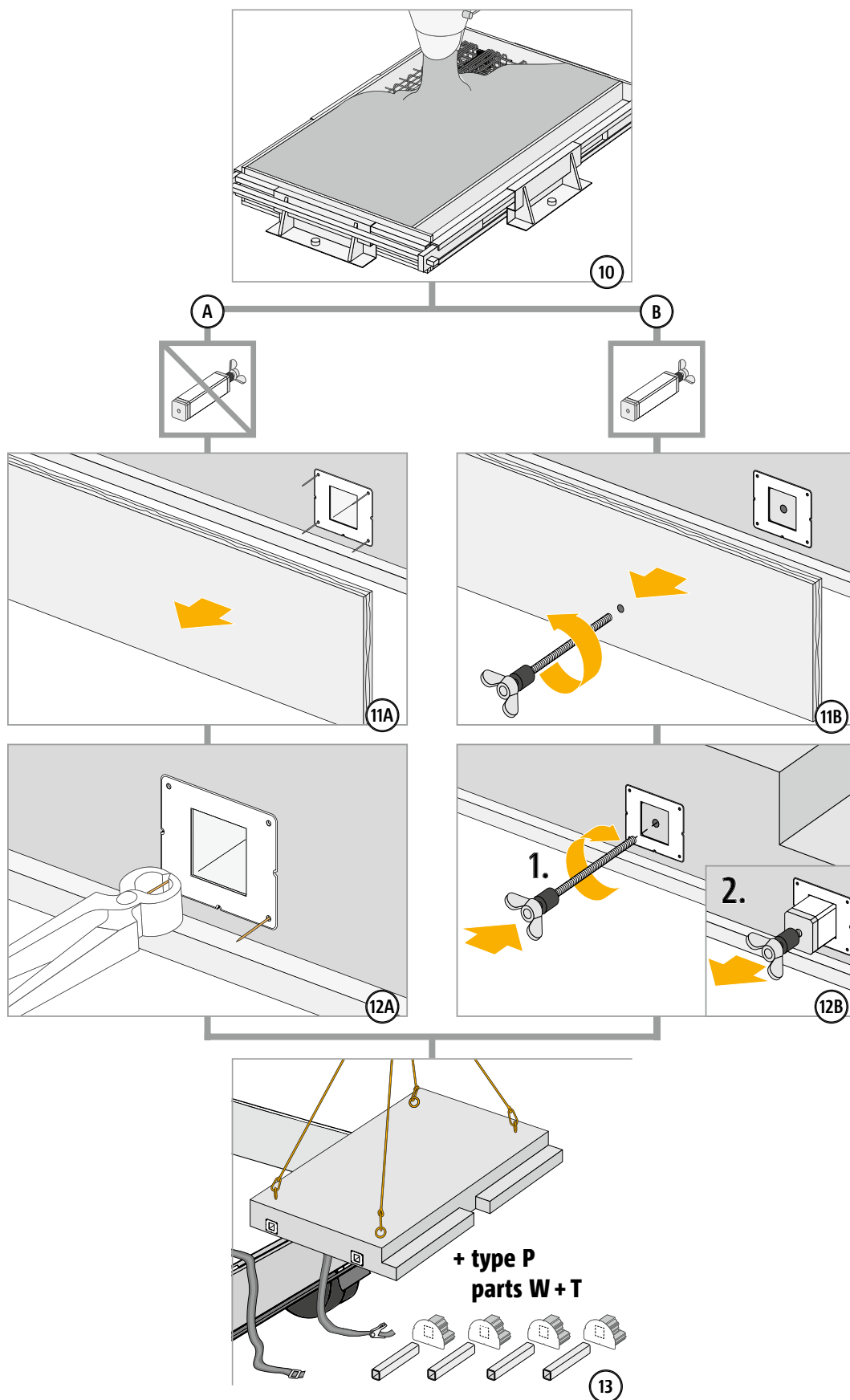
# Installation instructions for prefabricating plant



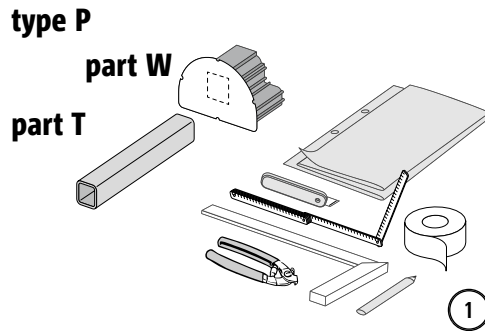
## Installation instructions for prefabricating plant



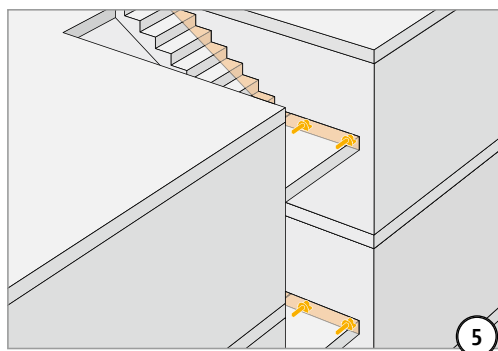
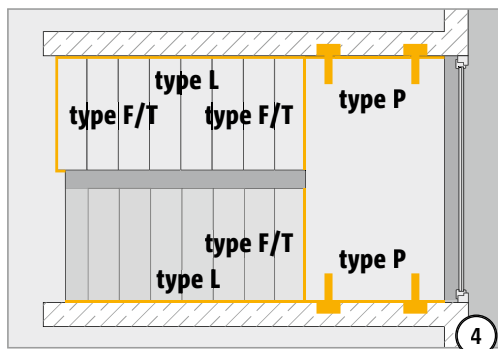
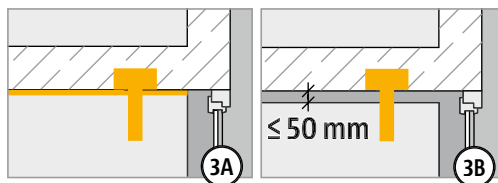
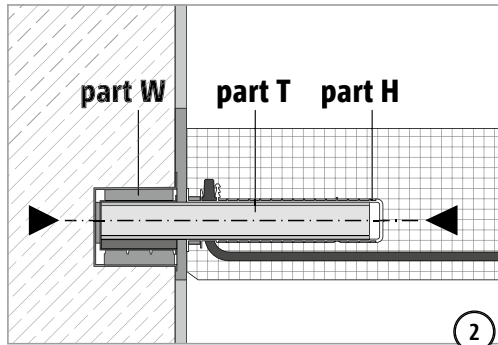
## Installation instructions for prefabricating plant



# Installation instructions building site precast components



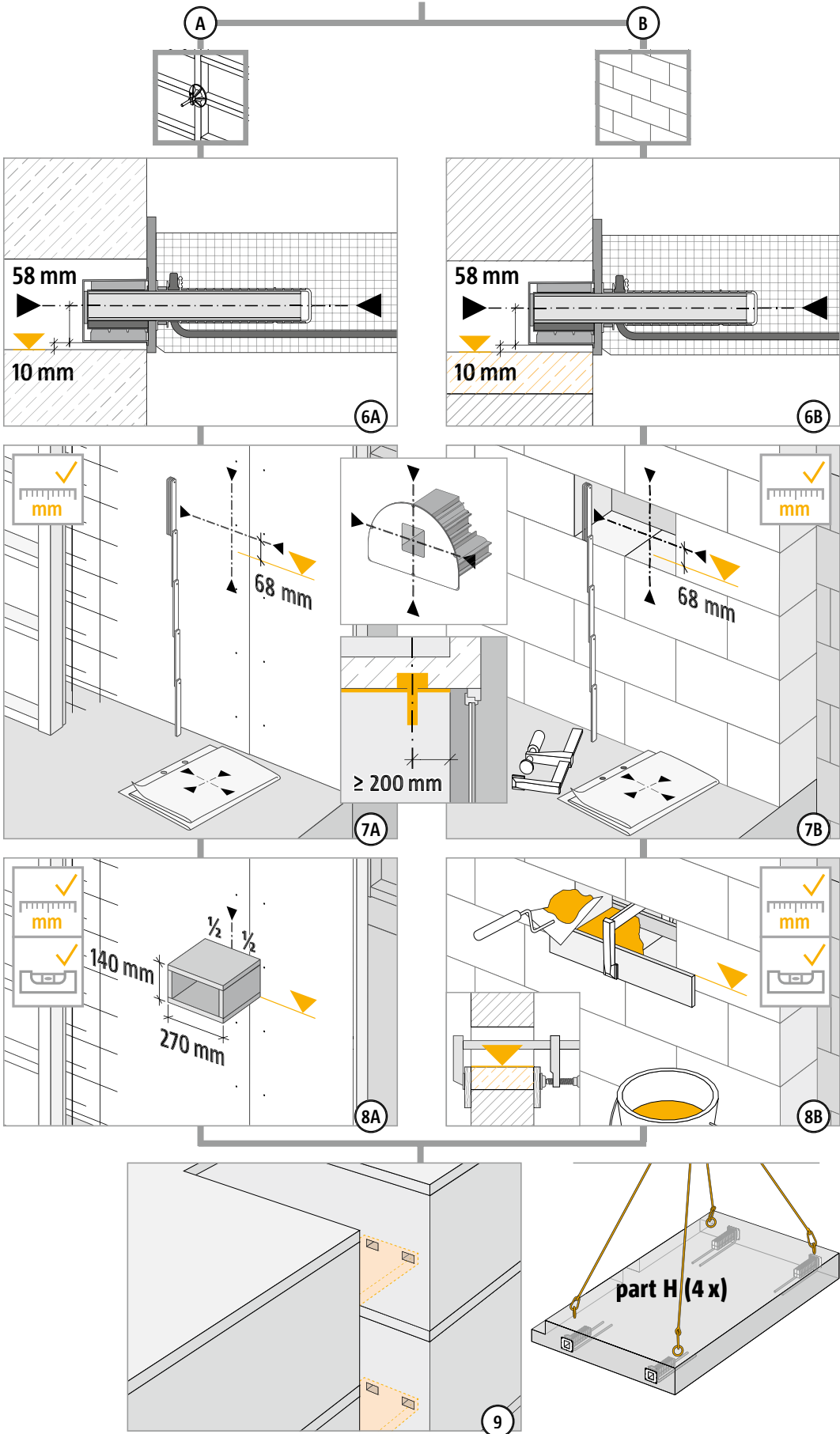
**⚠ WARNING** Hazard due to falling structural components with incomplete installation. All parts of the Tronsole® type P (Part W + T) must be used.



P

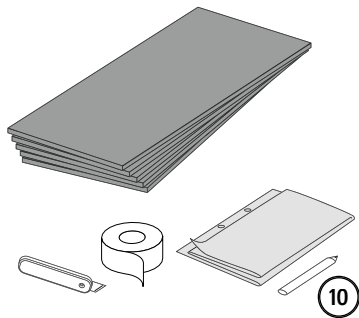


# Installation instructions building site precast components

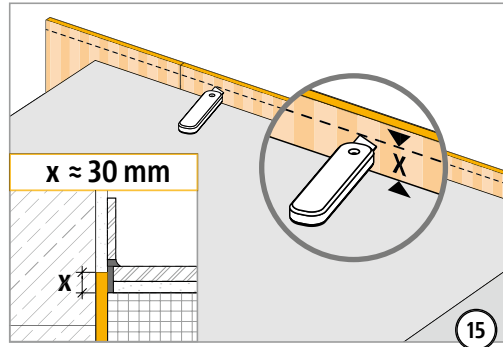


# Installation instructions building site precast components

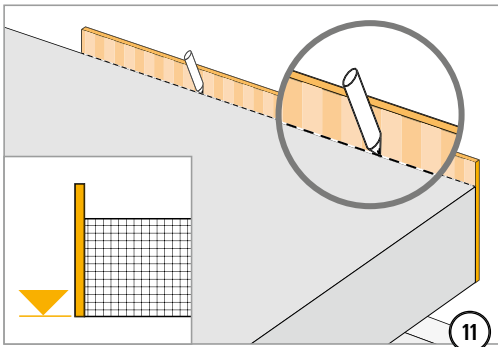
type L



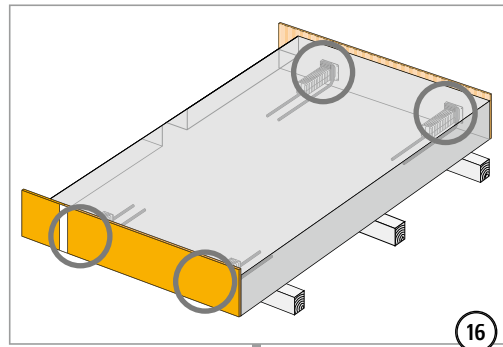
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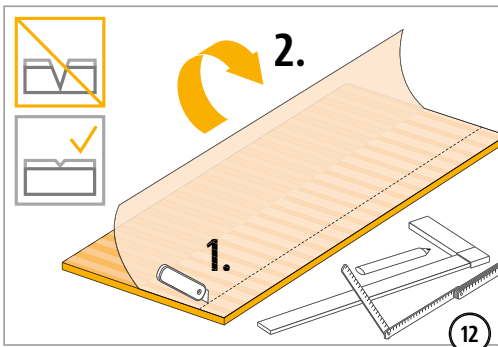
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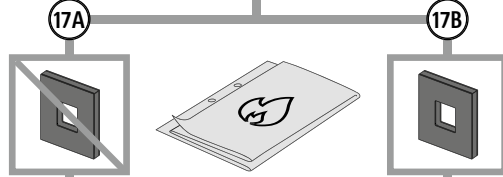
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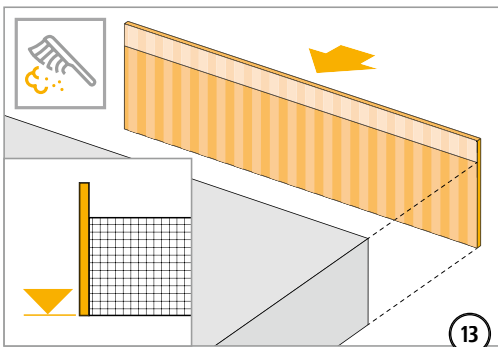


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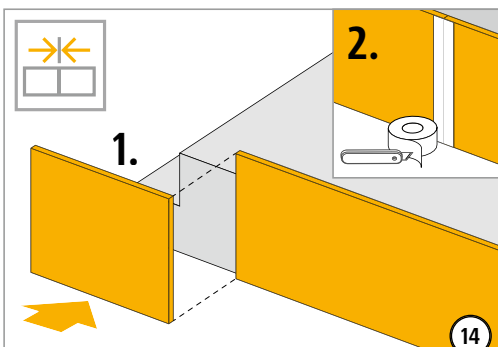
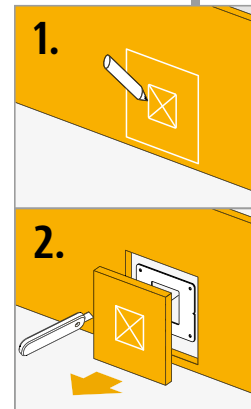
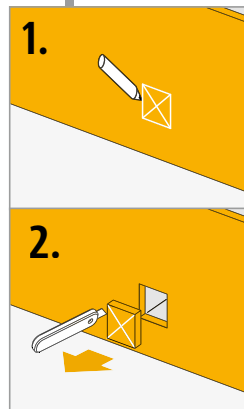


17A

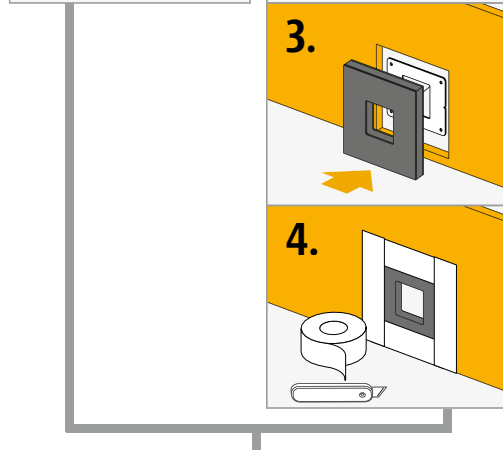
17B



13

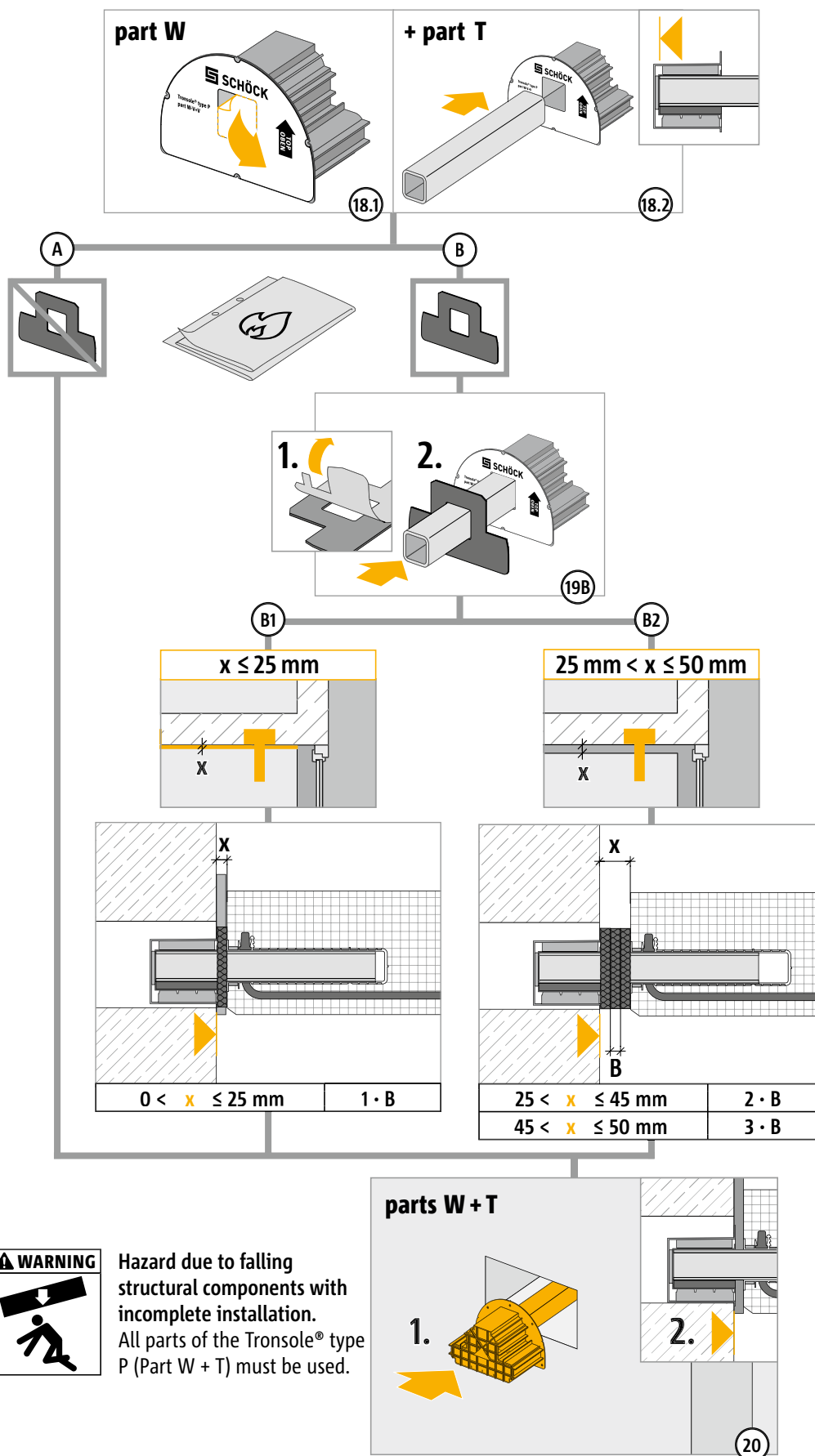


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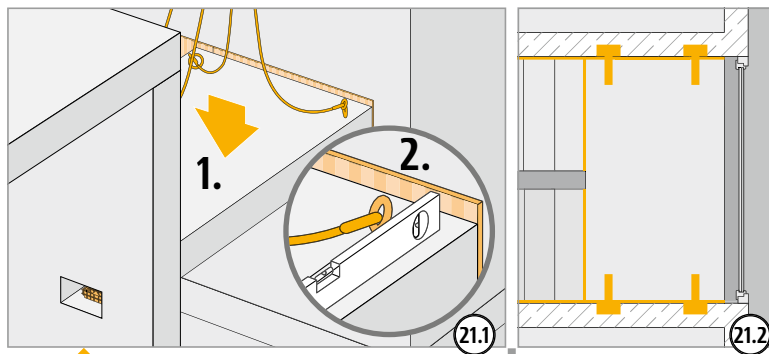
P

# Installation instructions building site precast components

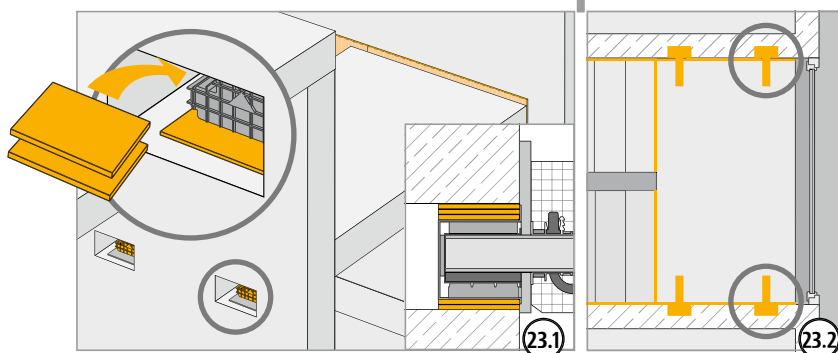
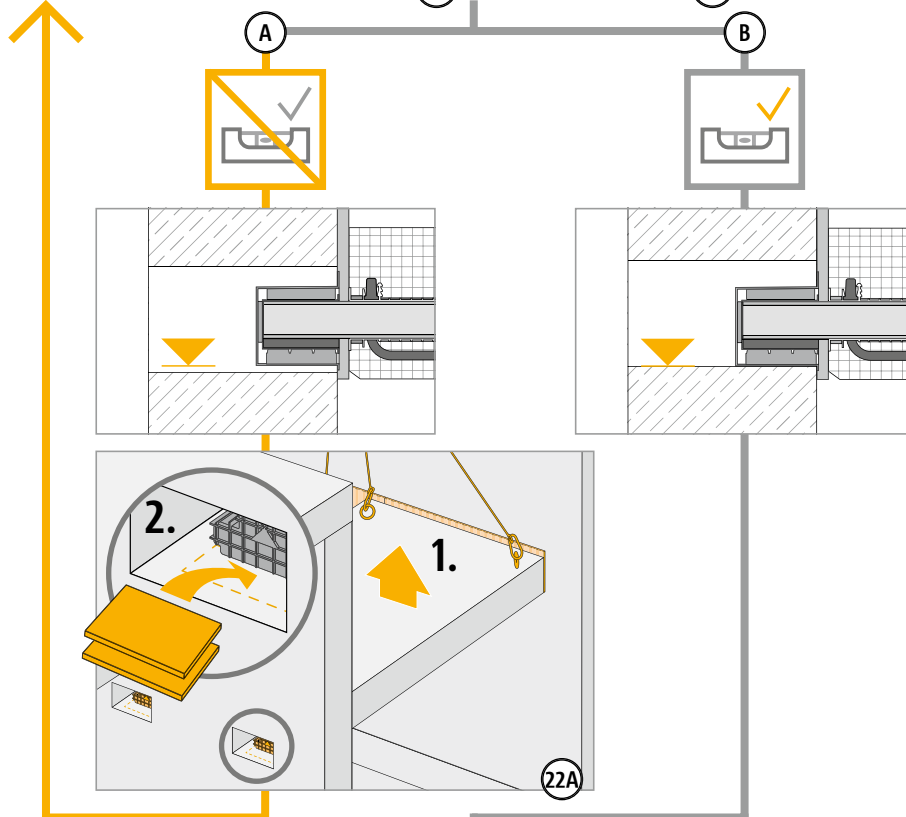


P

## Installation instructions building site precast components

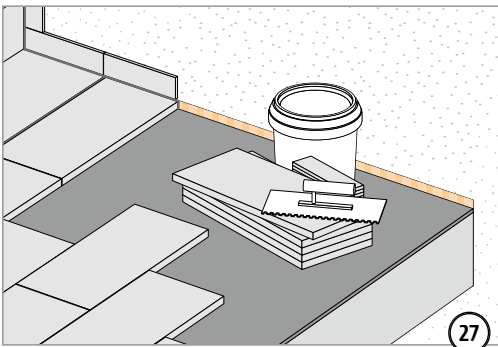
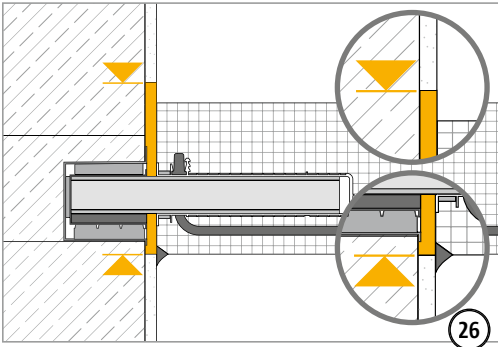
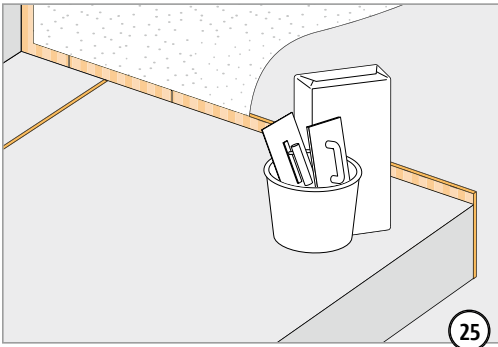
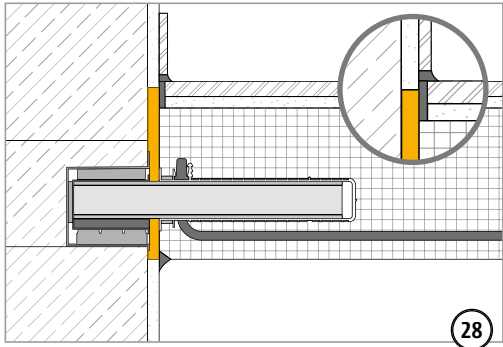
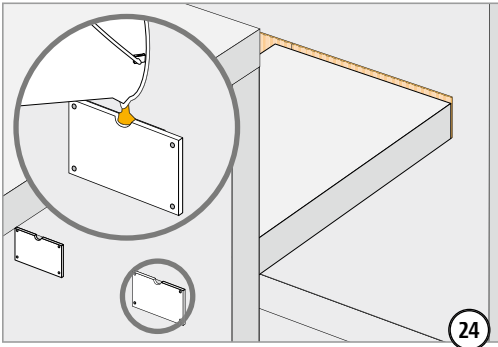


After installing the wall element of Tronsole® type P part W, the height of the landing is to be adjusted using pressure-resistant **compensating plates** (e.g. made of steel, minimum size 180 × 120 mm).



Check: Use of pressure-resistant **compensation plates** (e.g. steel, minimum size 180 × 120 mm) on top of the wall element Tronsole® type P Part W, to secure against lifting of the platform.

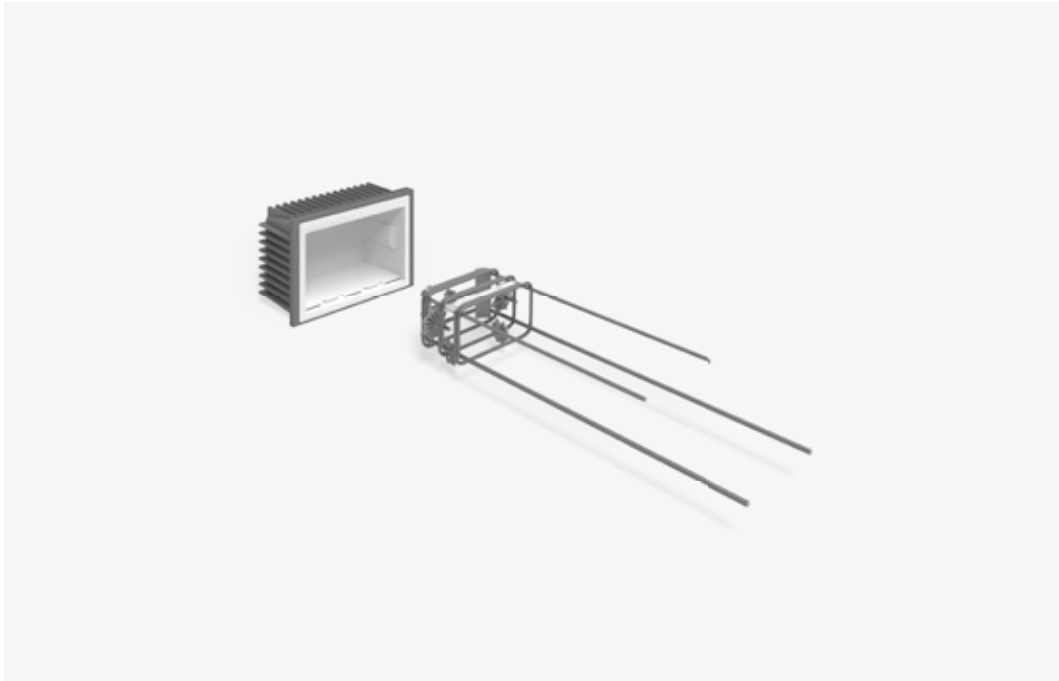
# Installation instructions building site precast components



## Check list

- Is the geometry of the building component being acoustically decoupled suitable for the dimensions of Schöck Tronsole® Type P?
- Have the effects on the Schöck Isokorb® connection been specified at design level?
- When using Schöck Tronsole® Type P, has the minimum concrete strength as stipulated in the calculation table been taken into account?
- Have the requirements with regard to fire protection been cleared and announced?
- Have any larger concrete coverings (as a consequence of R 30 or R 90 ratings) and the resulting increase in component heights been taken into account?
- With  $V_{Ed}$  at the slab edge of the landing, is the limiting value of the slab load-bearing capacity checked?
- Is the required on-site reinforcement, including the hat brackets, taken into account?

## Schöck Tronsole® type Z



### Schöck Tronsole® type Z

Serves the sound insulation of landings and staircase walls. Here, the landings can be implemented in in-situ concrete or as fully precast components. The staircase wall can be either masoned or concreted.

Z

## Product characteristics

### **i** Product characteristics

- ▶ Rated landing impact sound level difference  $\Delta L_{w,landing}^* \geq 24$  dB, tested in accordance with DIN 7396 with maximum load: test report no. 91386-09; (for an explanation of the value  $\Delta L_{w,landing}^*$ , see page 13)
- ▶ High quality and efficient Elodur® elastomer support for point connection
- ▶ Type-tested load-bearing element in accordance with type test report no. S-N/130257; bracket calculation can be dispensed with
- ▶ Load-bearing element in accordance with type approval report No. S-N/130257
- ▶ One element height for all landing heights
- ▶ Fire resistance class R 90 in accordance with Fire Protection Report GS 3.2/13-390-2
- ▶ Light load-bearing element including spacer for simple assembly optional

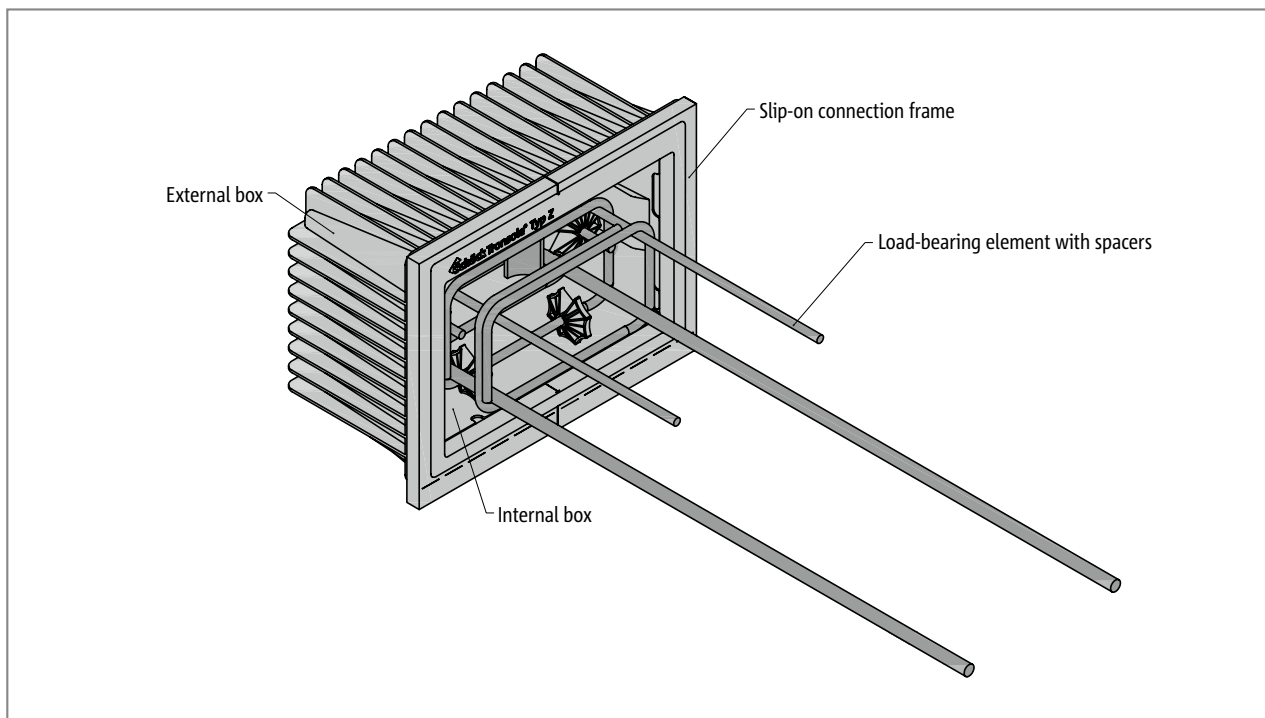
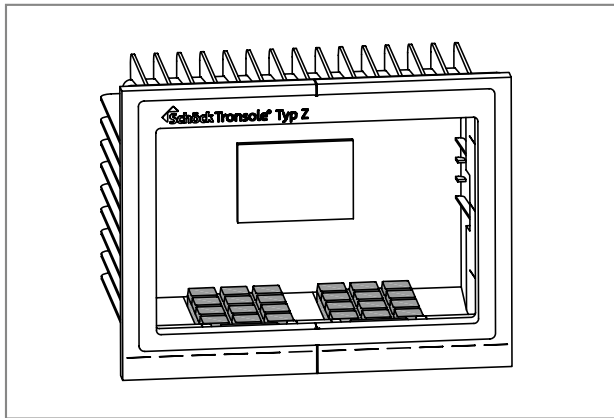


Fig. 146: Schöck Tronsole® type Z: Wall element, consisting of outer box, inner box, connection framework and integrated Elodur® elastomer, which are not visible in the diagram. The load-bearing element can be obtained optionally and is concreted into the landing.

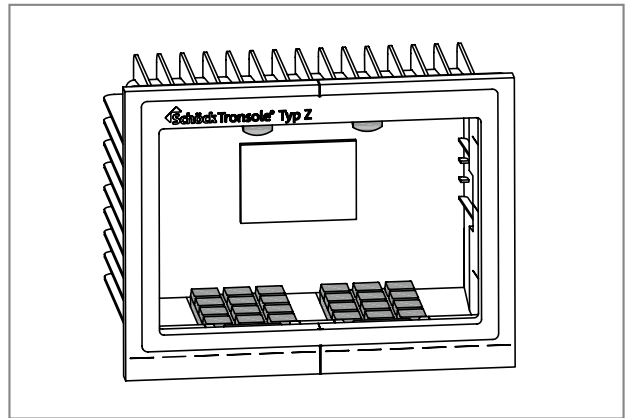


## Product selection | Type designations

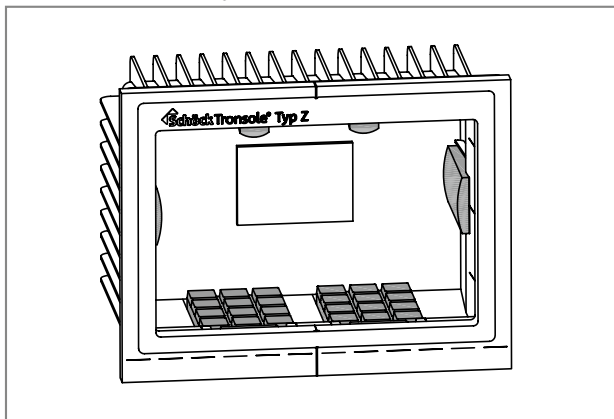
Schöck Tronsole® type Z-V



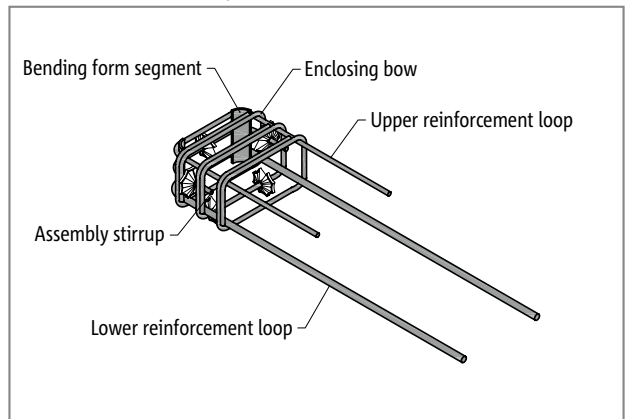
Schöck Tronsole® type Z-V+V



Schöck Tronsole® type Z-VH+VH



Schöck Tronsole® type Z part T



### Schöck Tronsole® type Z variants

The design of the Schöck Tronsole® type Z can vary as follows due to different placement with Elodur® elastomer supports:

► Load acceptance direction:

The type Z-V wall element receives a positive shear force  $V_{Ed,z}$ .

The Elodur® elastomer support is located in the wall element of the Tronsole® type Z-V below.

The wall element type Z-V+V receives positive and negative shear forces  $V_{Ed,z}$ .

The Elodur® elastomer support is located in the wall element of the Tronsole® type Z-V+V below and above.

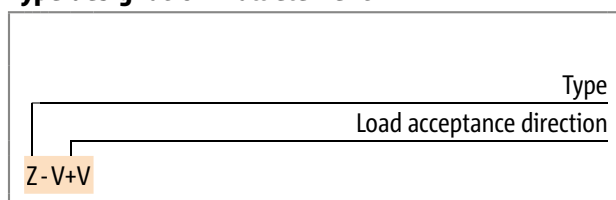
The wall element type Z-Vh+Vh, along with shear forces  $\pm V_{Ed,z}$  also receives lateral horizontal forces  $\pm V_{Ed,y}$ .

The Elodur® elastomer support is located in the wall element of the Tronsole® type Z-Vh+Vh below, above and laterally.

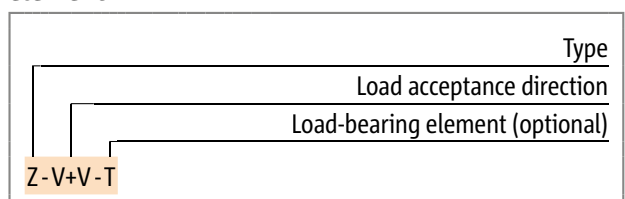
► Load-bearing element:

The type-approved load-bearing element Schöck Tronsole® type Z part T is optionally available.

### Type designation wall element



### Type designation wall element with load-bearing element



## Manufacturing variants

### Manufacturing variant wall element as stay-in-place formwork

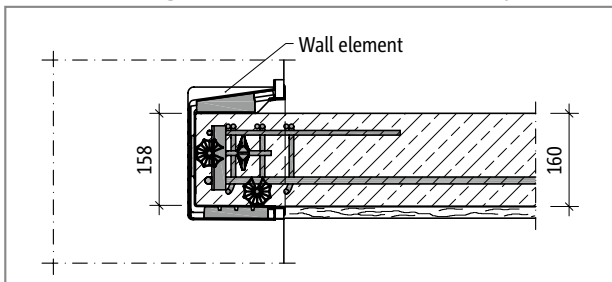


Fig. 147: Schöck Tronsole® type Z: Wall element as stay-in-place formwork

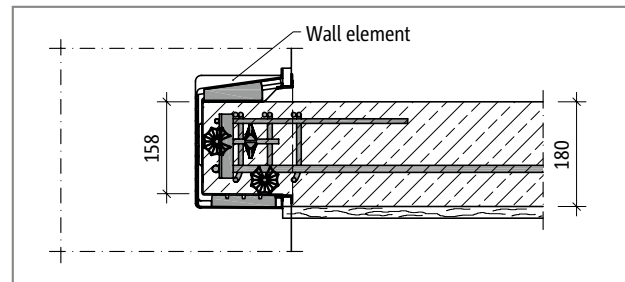


Fig. 148: Schöck Tronsole® type Z: Wall element as stay-in-place formwork; underside of the landing flush with the connection frame of the wall element

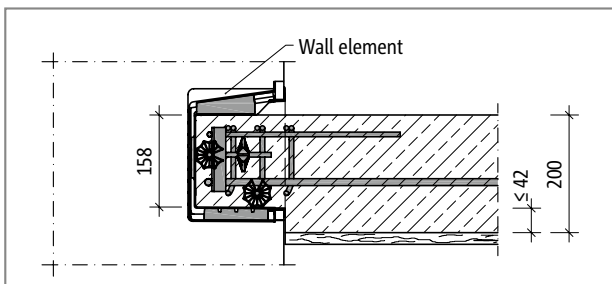


Fig. 149: Schöck Tronsole® type Z: Wall element as stay-in-place formwork; underside of the landing lower than the connection frame of the wall element

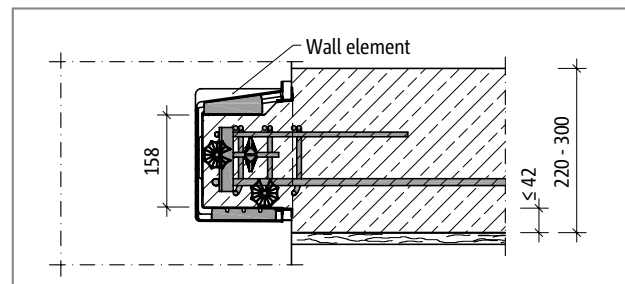


Fig. 150: Schöck Tronsole® type Z: Wall element as stay-in-place formwork; underside of the landing lower than the connection frame of the wall element

### Manufacturing variant formwork construction in the prefabricating plant

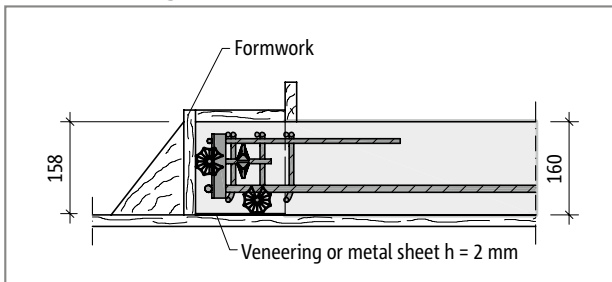


Fig. 151: Schöck Tronsole® type Z: Production of a support corbel on the fully precast landing; landing slab thickness  $h = 160$  mm

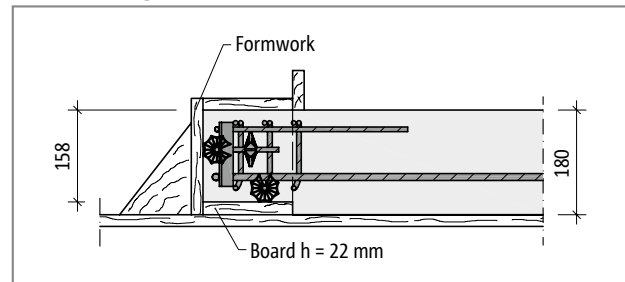


Fig. 152: Schöck Tronsole® type Z: Production of a corbel bracket on the fully precast landing; landing slab thickness  $h = 180$  mm

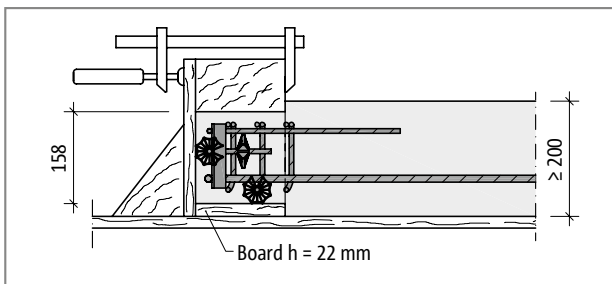


Fig. 153: Schöck Tronsole® Type Z: Constructing a support bracket on a fully precast landing; slab thickness  $h \geq 200$  mm

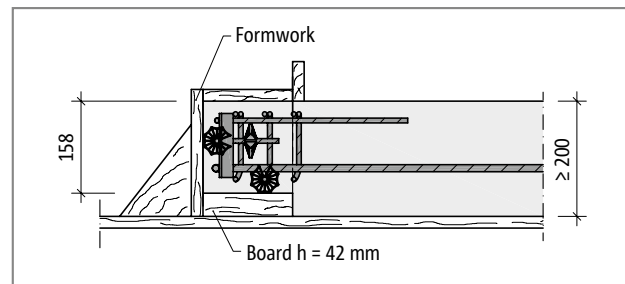


Fig. 154: Schöck Tronsole® Type Z: Constructing a support bracket on the fully precast landing with maximum height difference between the lower edge of the landing and the bracket; landing slab height  $h \geq 200$  mm

### Manufacturing variants

The Schöck Tronsole® type Z is used both for in-situ concrete as well as for fully precast landings. With in-situ concrete landings the wall element of the Tronsole® is used as stay-in-place formwork. With fully precast landings the corbel bracket of the landing is manufactured according to the dimensions presented in this technical information in order, following the hardening of the concrete, to be able to insert it into the wall element of the Tronsole®.

## Installation cross section

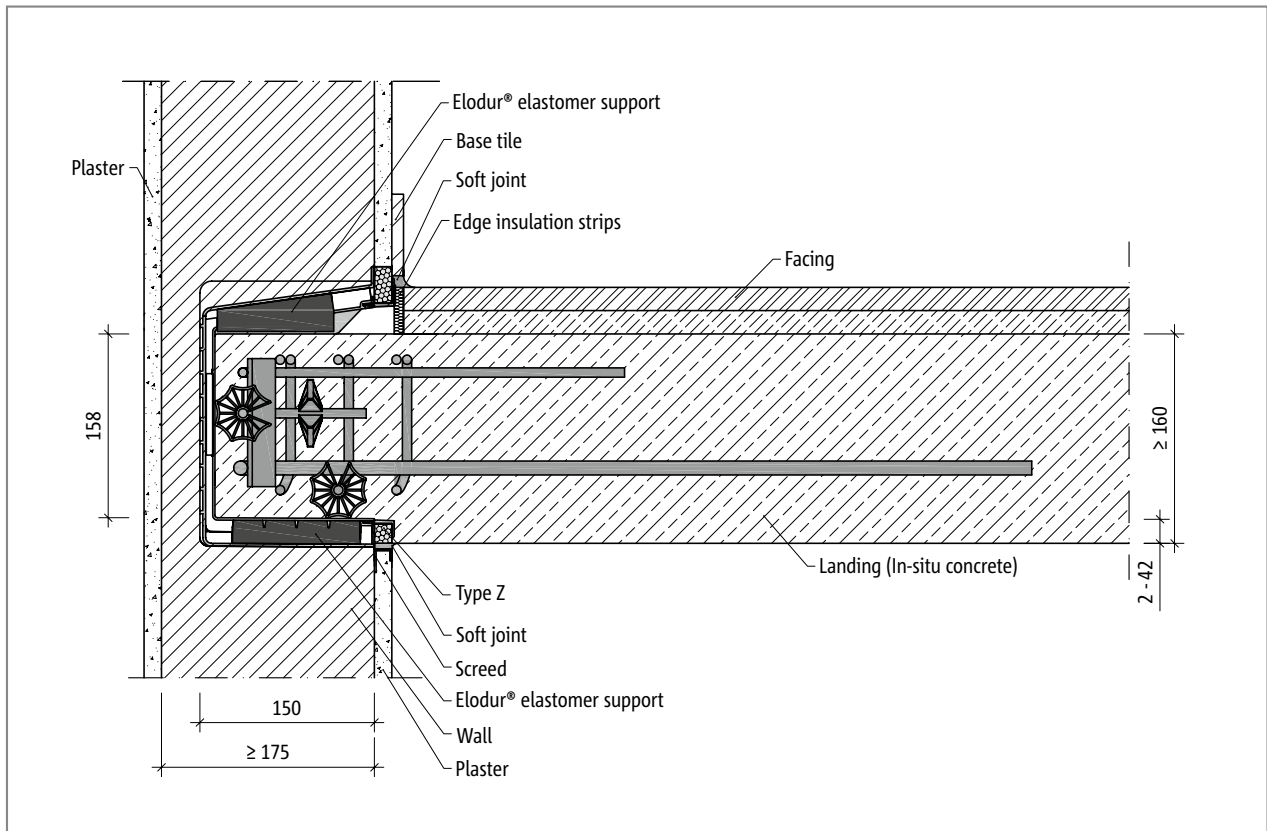


Fig. 155: Schöck Tronsole® type Z-V+V-T: Installation cross-section in-situ concrete landing

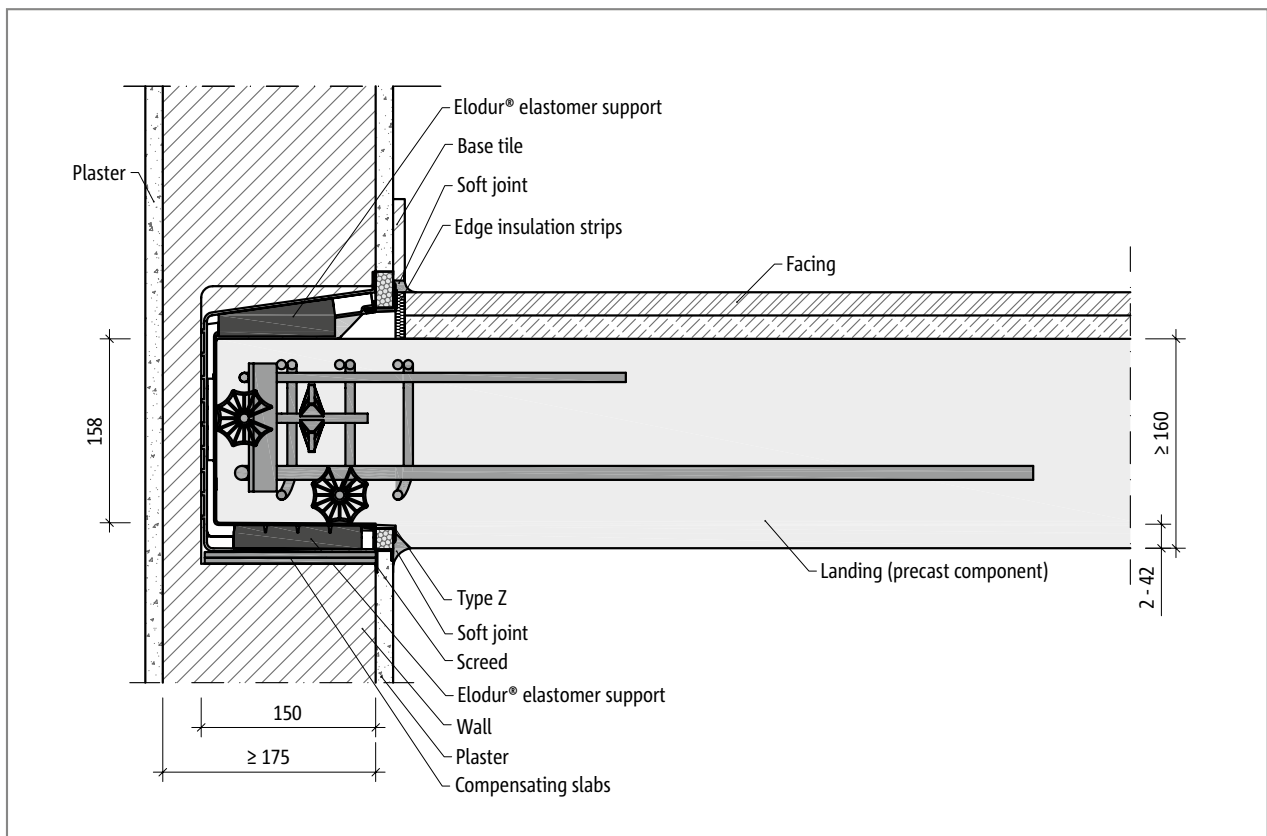


Fig. 156: Schöck Tronsole® type Z-V+V-T: Installation cross-section precast landing

## Element arrangement

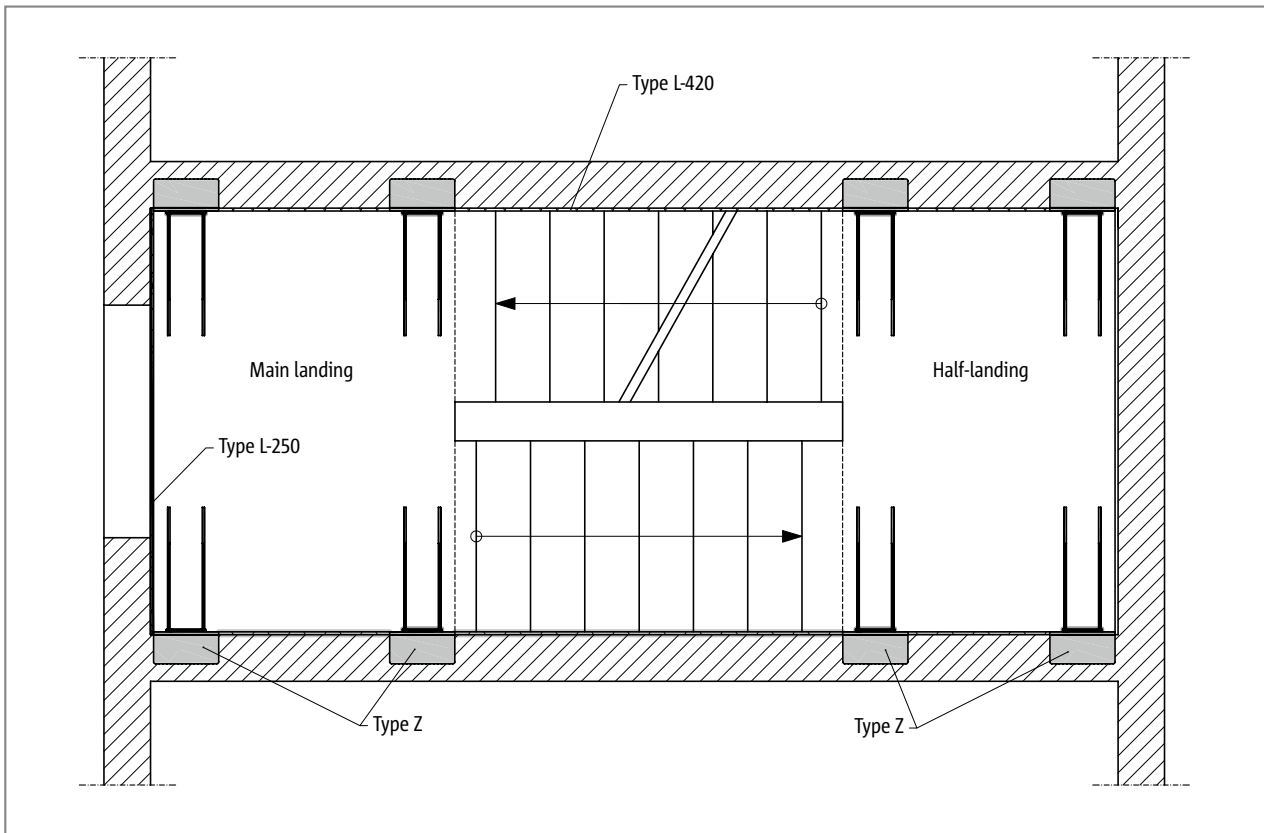


Fig. 157: Schöck Tronsole® type Z: Element configuration in plan view

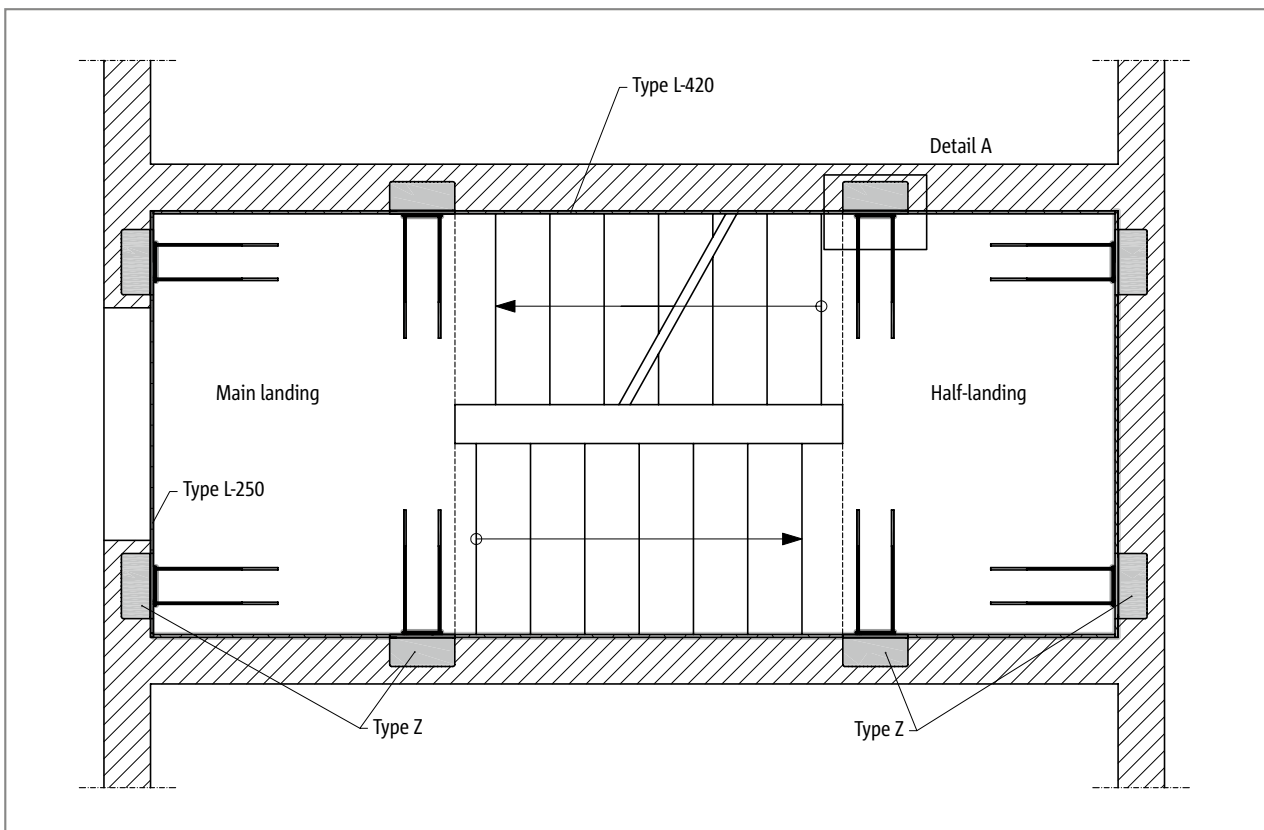


Fig. 158: Schöck Tronsole® type Z: Alternative element configuration in plan view

## Element arrangement

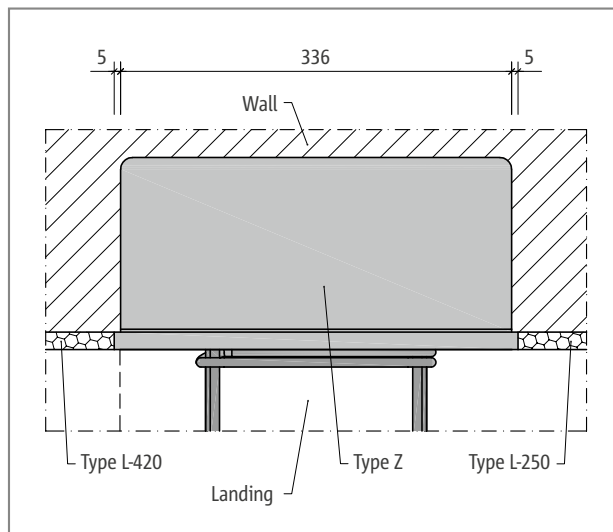


Fig. 159: Schöck Tronsole® type Z: Element configuration, Detail A

### **i** Element arrangement

- ▶ It is advisable to install a 4-point support for the landing on two opposite sides or on three sides to achieve a favourable distribution of the bearing forces.
- ▶ Take note of the external dimensions of Schöck Tronsole® Type Z. See the diagram.
- ▶ For further product dimensions and dimensions of the concrete bracket, see the product description page 173.

### **i** Combination possibilities

- ▶ The given acoustic insulation values apply in combination with the Tronsole® type L-420 or with a sufficiently wide air joint (50 mm).

## Product description

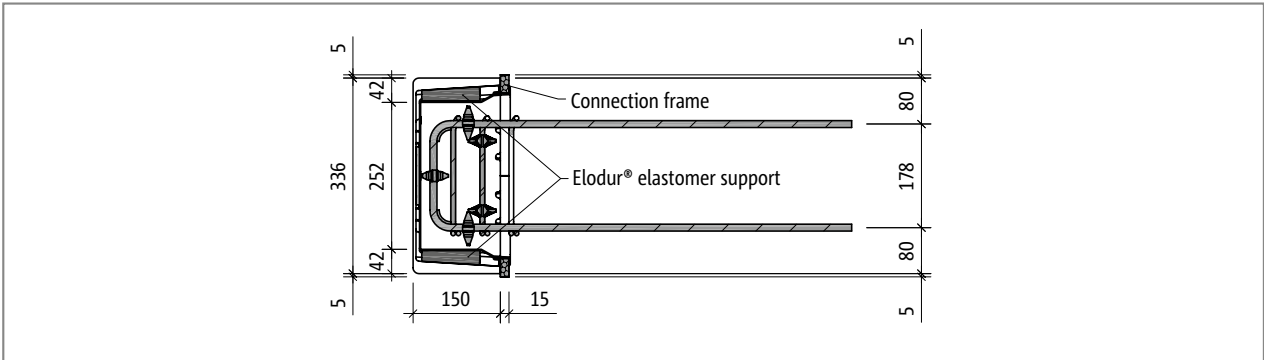


Fig. 160: Schöck Tronsole® type Z-VH+VH-T: Horizontal cross-section

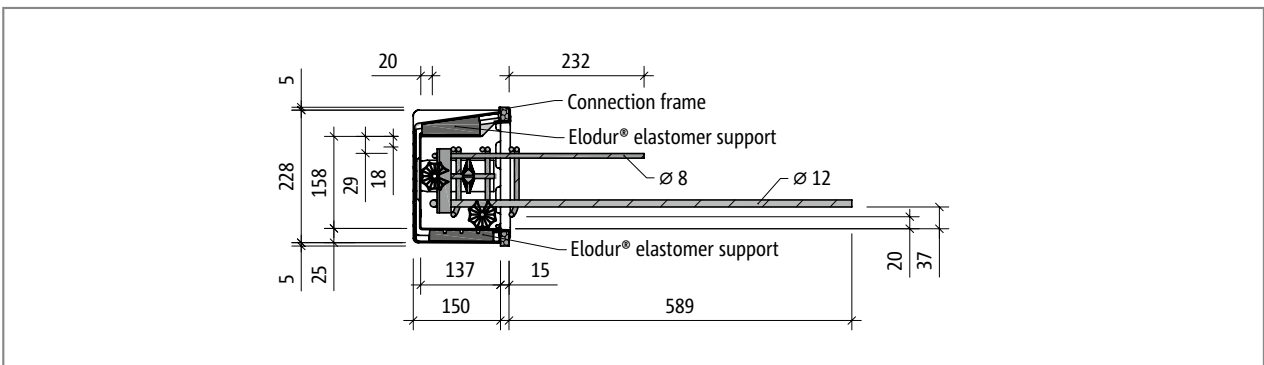


Fig. 161: Schöck Tronsole® type Z-V+V-T respectively type Z-VH+VH-T: Vertical cross-section

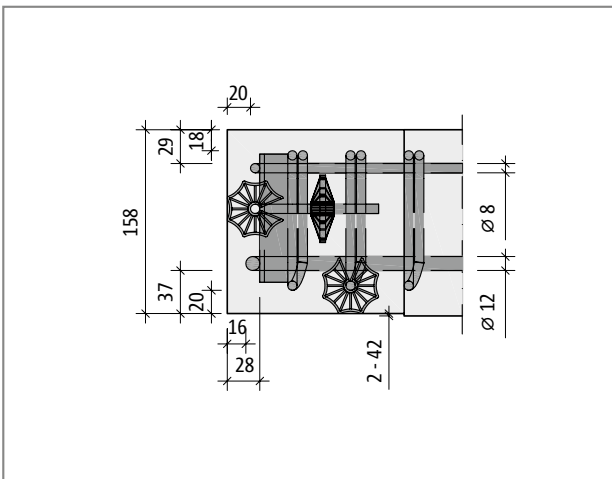


Fig. 162: Schöck Tronsole® type Z: Side view of a concrete landing with integrated load-bearing element

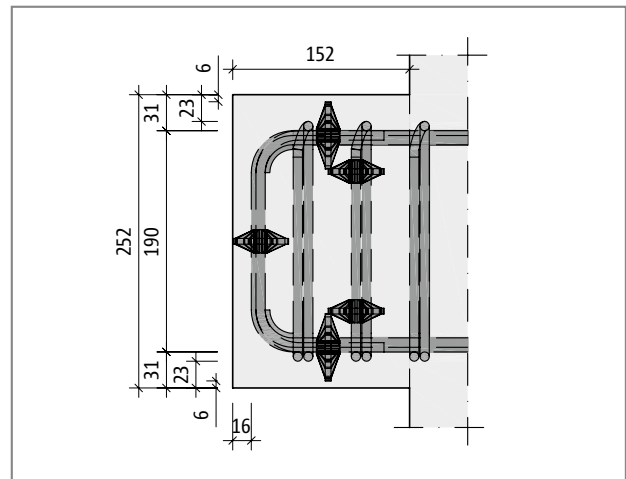


Fig. 163: Schöck Tronsole® type Z: Plan view of a concrete landing with integrated load-bearing element

### **i** Product information

- ▶ The connecting frame of the wall element of the Tronsole® type Z is a plug-on type.

## Design | On-site reinforcement

| Schöck Tronsole® type   | Z-V                                   | Z-V+V      | Z-VH+VH    |
|-------------------------|---------------------------------------|------------|------------|
| Design values with      | Concrete strength class $\geq$ C20/25 |            |            |
| $V_{Rd,z}$ [kN/element] | 75.0                                  | 75,0/-15,0 | 75,0/-15,0 |
| $V_{Rd,y}$ [kN/element] | -                                     | -          | $\pm$ 15.0 |

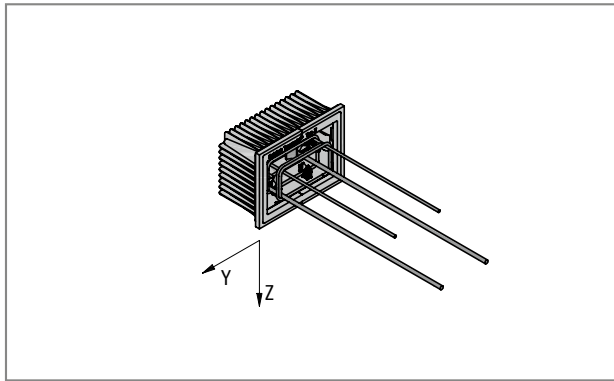


Fig. 164: Schöck Tronsole® type Z: Sign rule for the design

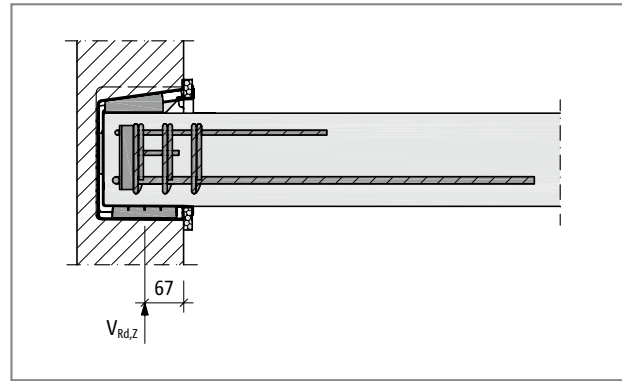


Fig. 165: Schöck Tronsole® type Z: Representation of the active line of the reaction force in the wall

### Design

The reinforcement cage-like load-bearing element of the Schöck Tronsole® type Z is concreted into the landing and transmits shear forces to the staircase walls via the concrete corbel and the therefrom resultant offset moments.

For the bearing surface of the Tronsole®, with the maximum loading of 75 kN, at least the compression strength class 20 in combination with mortar group III ( $f_k = 6.0 \text{ N/mm}^2$ ) is required as masonry. With lower compression strength classes a concrete pressure pad under the wall element can be used, with which the permitted pressing is maintained.

The positive shear force  $V_{Ed,z}$  is transmitted via two Elodur® elastomer supports into the wall element of the Tronsole® type Z with a surface area of  $110 \text{ mm} \times 80 \text{ mm}$ .

A structural verification is to be produced for the reinforced concrete structural elements adjacent on both sides of the Schöck Isokorb®. The shear force resistance of the (landing) slab is to be verified. With a connection using Schöck Isokorb® type Z a freely rotatable support (moment joint) is to be assumed as static system.

### i Notes on design

- ▶ The stress impacting the masonry is calculated as follows:  $\sigma_{Ed} = V_{Ed} / (2 \cdot 110 \cdot 80) \text{ mm}^2$ . With the maximum utilisation of 75 kN  $\sigma_{Ed} = 4.26 \text{ N/mm}^2$ .
- ▶ With the predefined concrete strengths h consider the minimum requirements based on the design.
- ▶ Exposure class XC1 is assumed for the landing.
- ▶ According to DIN EN 1992-1-1 and DIN EN 1992-1-1/NA with exposure class XC1 the following nominal concrete cover results:  
In-situ concrete landing:  $c_{nom} = 20 \text{ mm}$ .  
Prefabricated landing:  $c_{nom} = 15 \text{ mm}$ .
- ▶ Using the load-bearing element with in-situ concrete the following applies for the concrete cover in the area of the corbel  $c_{nom} = 15 \text{ mm}$ .
- ▶ The Schöck Tronsole® type Z supports under mainly static loading.
- ▶ Under both lower Elodur® elastomer supports of the Tronsole® type Z one can assume a uniform support pressing.
- ▶ The height offset between the lower edges of the landing and the concrete corbel is limited to a maximum 42 mm in order, in any case, to enable the formation of an overlap connection of the load-bearing element with the lower landing reinforcement.

### i On-site reinforcement

- ▶ The tensile reinforcement of the load-bearing element is to overlap with the on-site reinforcement in adjacent landing.
- ▶ With this the overlap length starts at the transition of the corbels for the landing.
- ▶ The free edges on the landing at both sides of the Tronsole® type Z are to be secured using ties.

## Deflection

### Deformation of the Elodur® elastomer support of the Tronsole® type Z

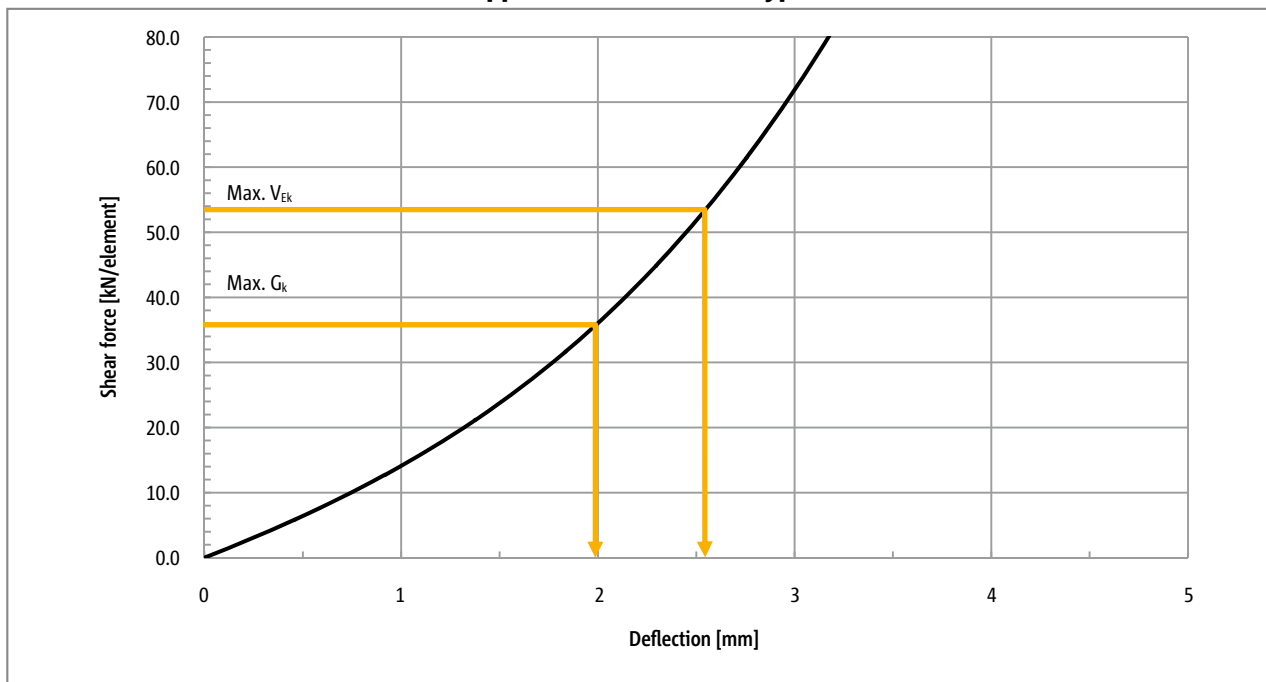


Fig. 166: Schöck Tronsole® type Z: Deformation of the Elodur® elastomer support

#### **i** Notes on deformation

- ▶ With deflection, it is understood to be the vertical deformation of the Elodur® elastomer support under vertical shear force load.
- ▶  $\text{Max. } V_{Ek} = \text{Max. } V_{Ed} / \gamma$ , whereby  $\gamma = 1.4$
- ▶  $\gamma = 1.4$  applies under the assumption that  $\text{Max. } V_{Ed}$  is made up of two thirds from own weight and one third from live load.
- ▶ Thus  $\text{Max. } V_{Ek}$  is the maximum service load and the maximum own weight is  $\text{Max. } G_k = 2/3 \cdot \text{Max. } V_{Ek}$ .



## Precast construction

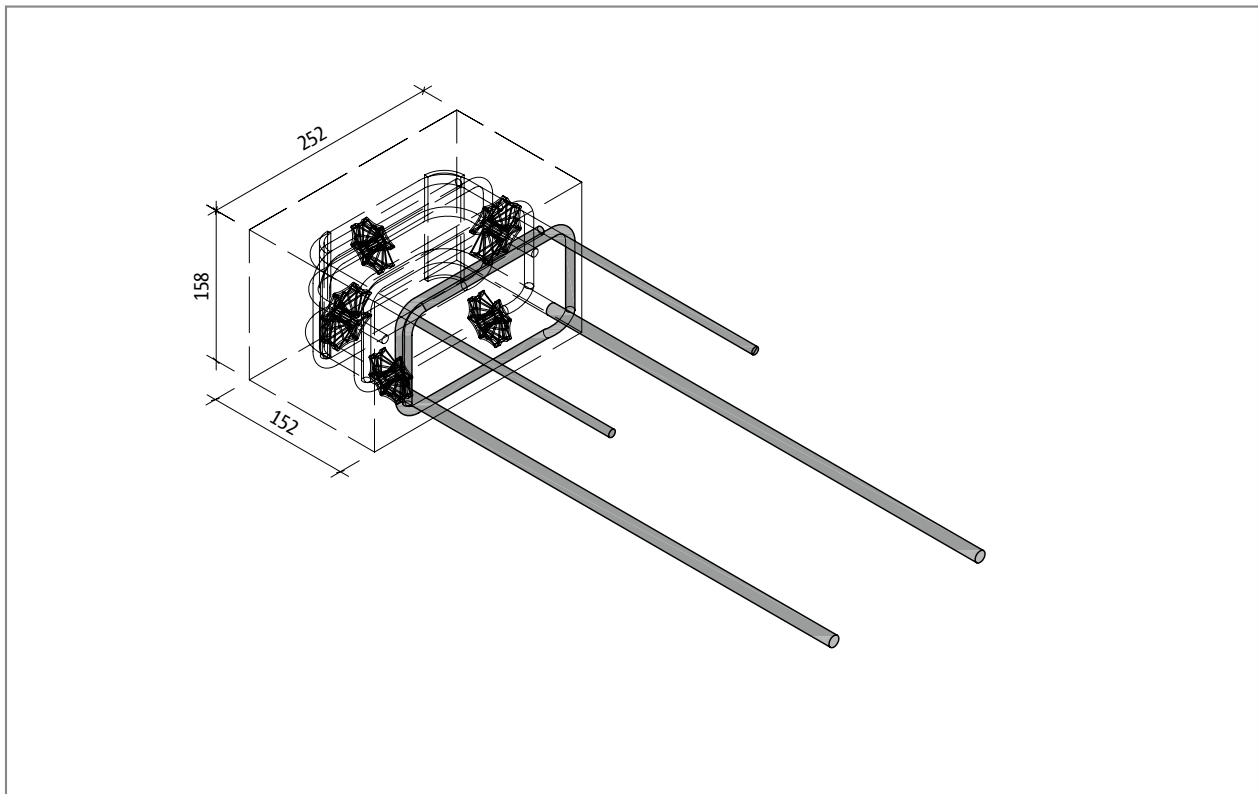


Fig. 167: Schöck Tronsole® type Z: Dimensions of the corbel support to be manufactured in the prefabrication plant

### **i** Precast part construction

- ▶ The limit deviations of the prefabricated support bracket for the acceptance of the wall element of the Tronsole® type Z are subject to the general tolerances according to DIN ISO 2768 - c.
- ▶ The corbel depth of 152 mm takes into account a 15 mm wide joint between wall and landing alongside the corbel brackets.
- ▶ With negative fabrication of landings using the load-bearing element of the Tronsole® type Z on-site spacers are required in order to achieve the necessary concrete cover on the concrete corbel.
- ▶ When installing the stairs, it may be necessary to adjust the height of the stairs under the wall element using pressure-resistant compensating plates (e.g. made from steel, minimum size 160 mm × 110 mm). The compensating plate must support the complete bearing surface of the wall element.

## Fire protection configuration | Materials

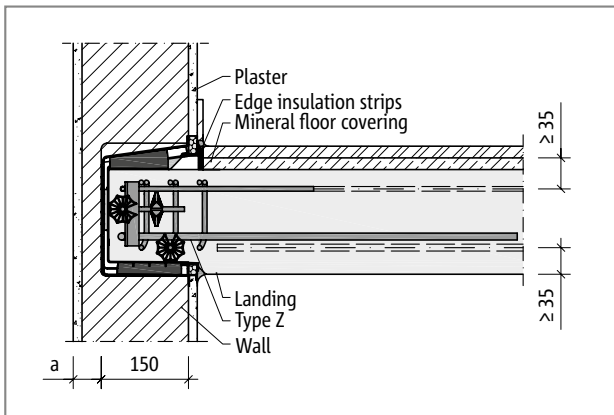


Fig. 168: Schöck Tronsole® type Z: Fire protection configuration

### Fire protection

According to DIN 4102-4, Table 5, joints between the structural components  $\leq 30$  mm are not taken into account. The structural component surfaces of the landing in the area of the neighbouring wall are considered as not flame treated as the corbel support with the staircase wall thermotechnically forms one unit

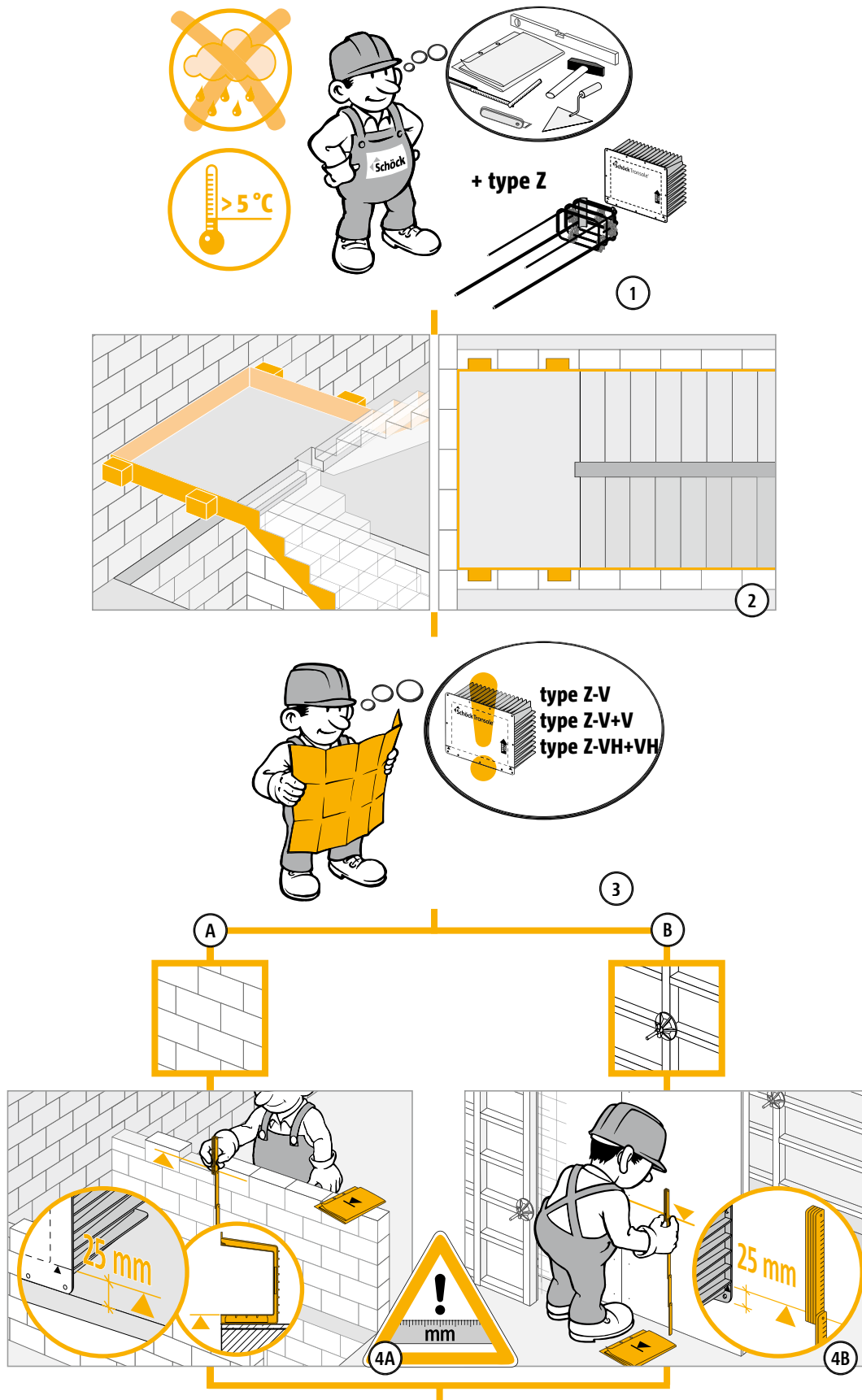
#### **i** Fire protection

- ▶ A minimum centre distance of  $u = 35$  mm must be observed for the lower load-bearing reinforcement when using the Tronsole® Type Z  $c_{v,l} \geq 37 + 12/2 = 43$  mm load-bearing element.
- ▶ The neighbouring structural elements must satisfy the same building supervisory requirements on the fire resistance capability as the connection area itself.
- ▶ For fire protection dimensioning of the reinforced concrete slabs DIN EN 1992-1-2 together with DIN EN 1992-1-2/NA is to be applied.
- ▶ The fire protection classification of the staircase wall is not disturbed by the wall element if a backing of at least 40 mm masonry blocks ( $a \geq 40$  mm) is carried out. A mineral render may be added to the thickness.

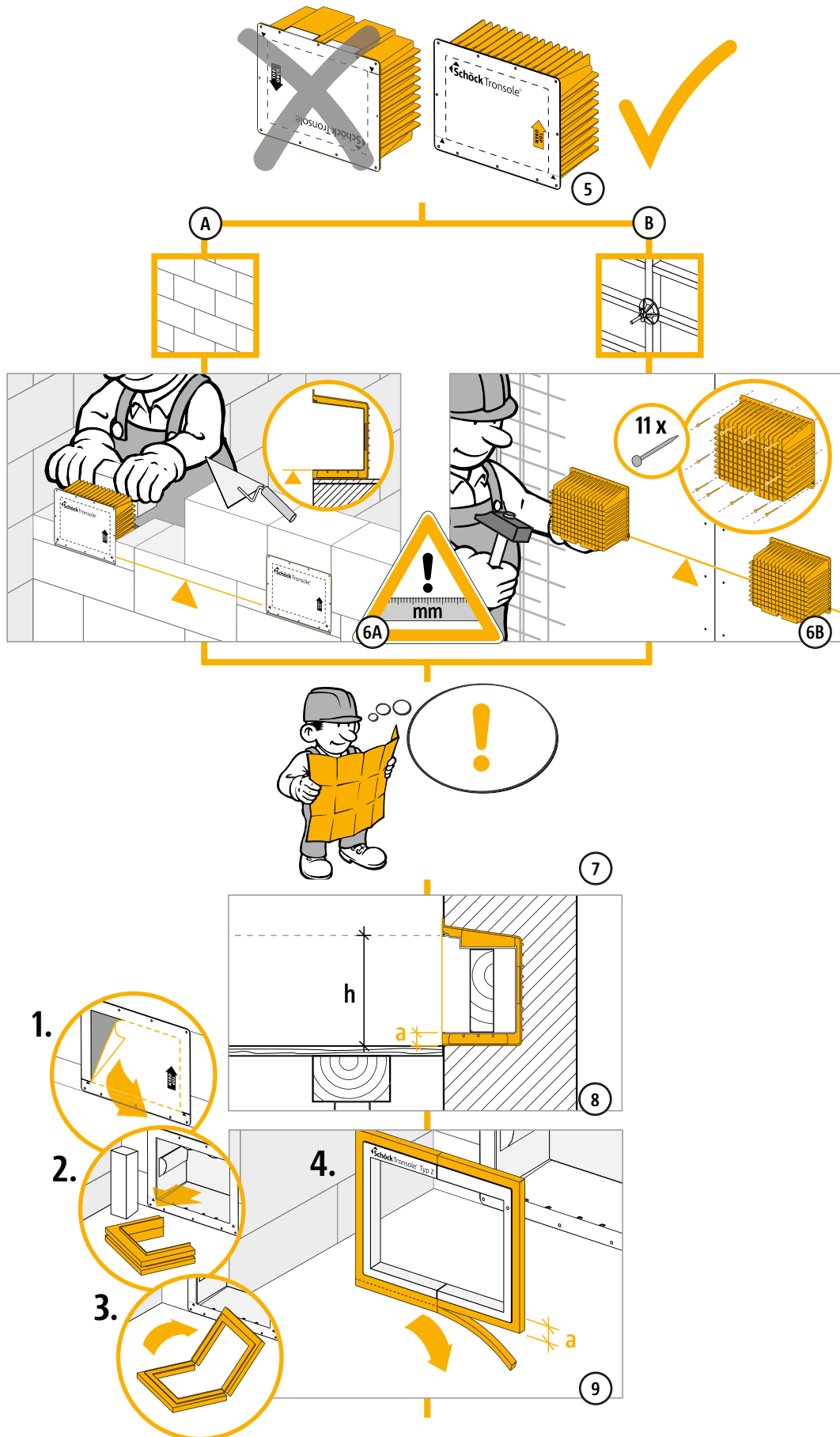
### Materials and construction materials

| Schöck Tronsole® type Z                   | Material                                       |
|---|--|
| External box                              | Polystyrene                                    |
| Internal box                              | Polystyrene                                    |
| PE foam insert                            | PE foam according to DIN EN 14313              |
| Hinged plastic profile                    | ABS according to DIN EN ISO 2580-1             |
| Connection frame                          | PE foam according to DIN EN 14313              |
| Elastomer support                         | Polyurethane according to DIN EN 13165         |
| Reinforcement of the load-bearing element | Reinforcing steel B500B according to DIN 488-1 |
| Bending form segment                      | S 235 JR                                       |

## Installation instructions building site in-situ concrete

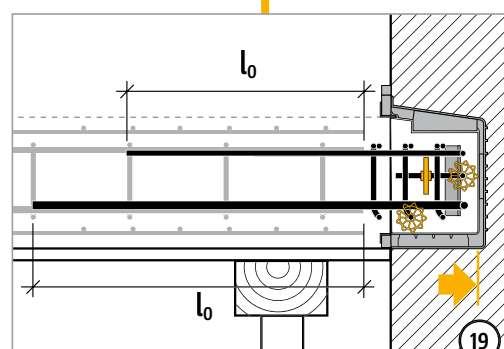
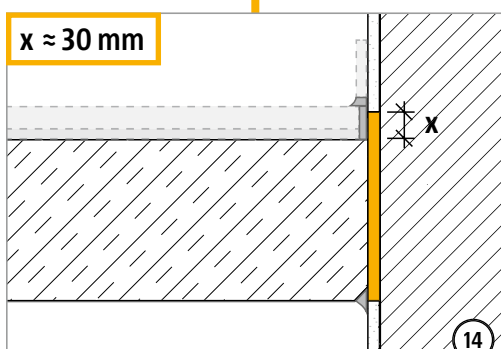
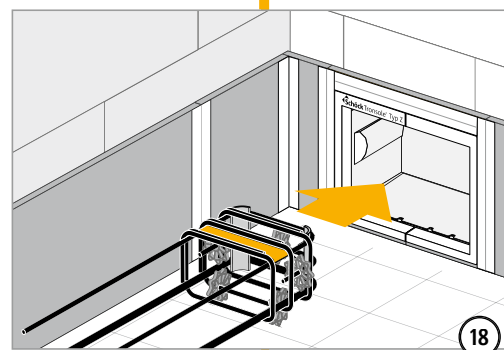
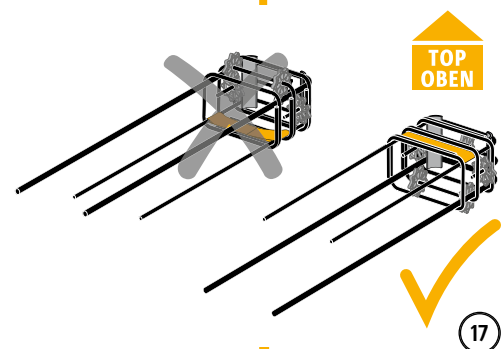
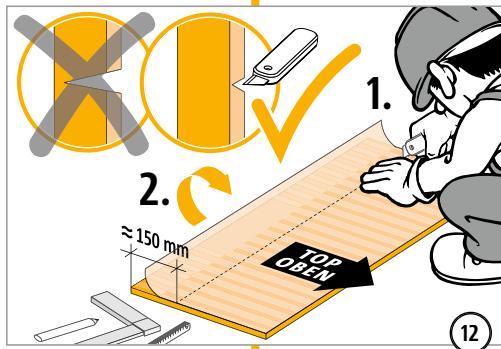
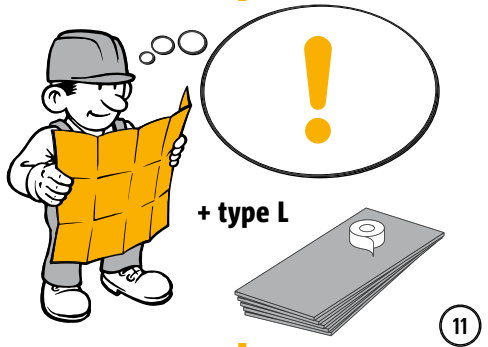
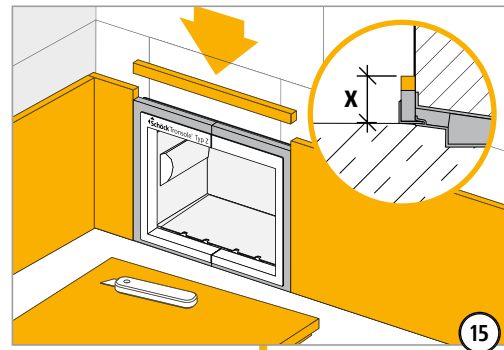
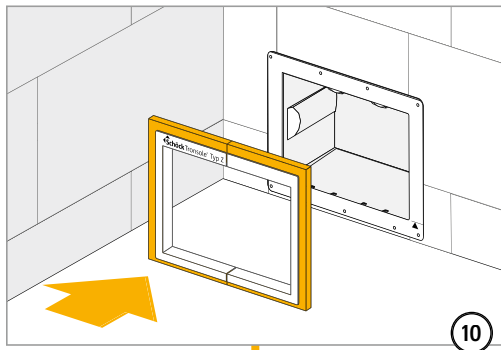


# Installation instructions building site in-situ concrete



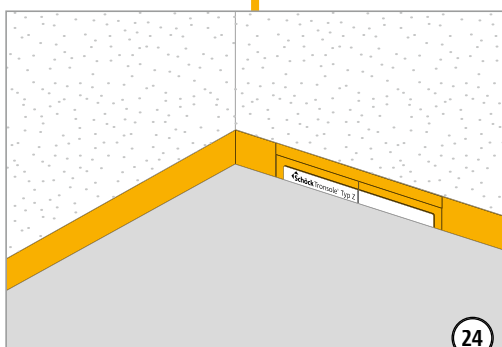
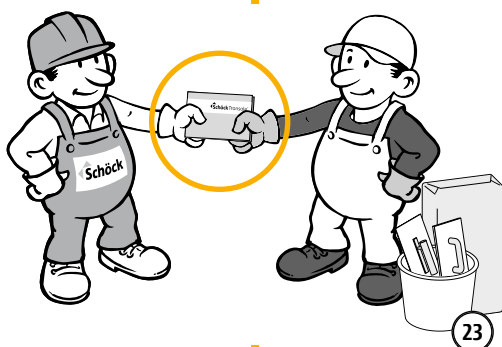
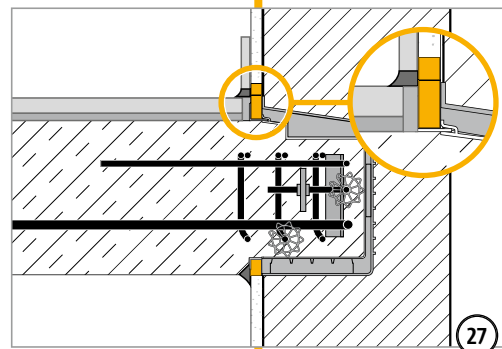
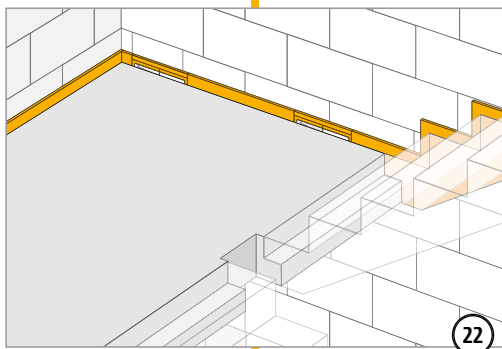
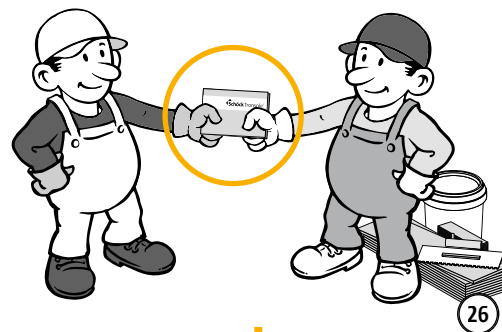
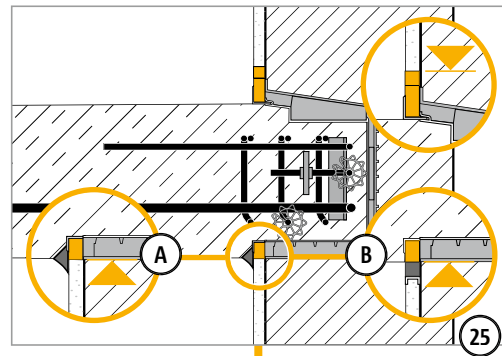
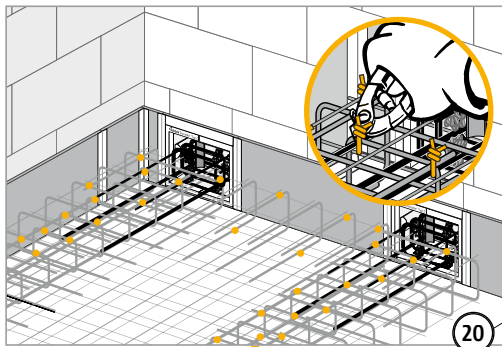
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# Installation instructions building site in-situ concrete



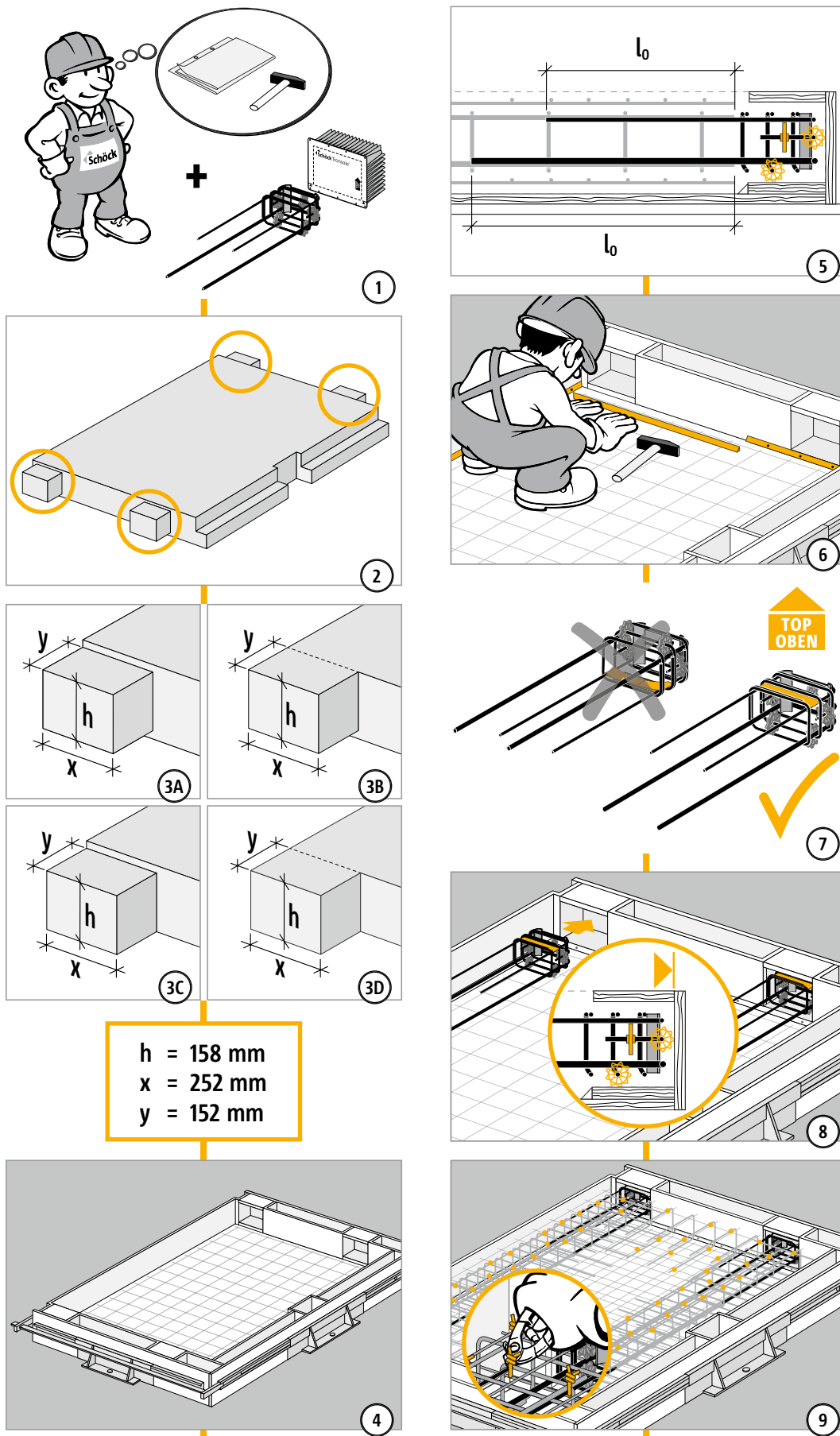
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## Installation instructions building site in-situ concrete



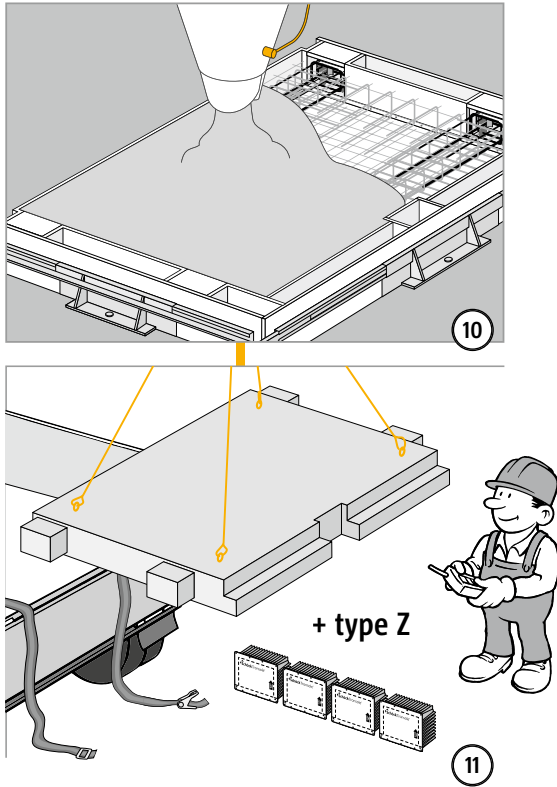
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# Installation instructions for prefabricating plant



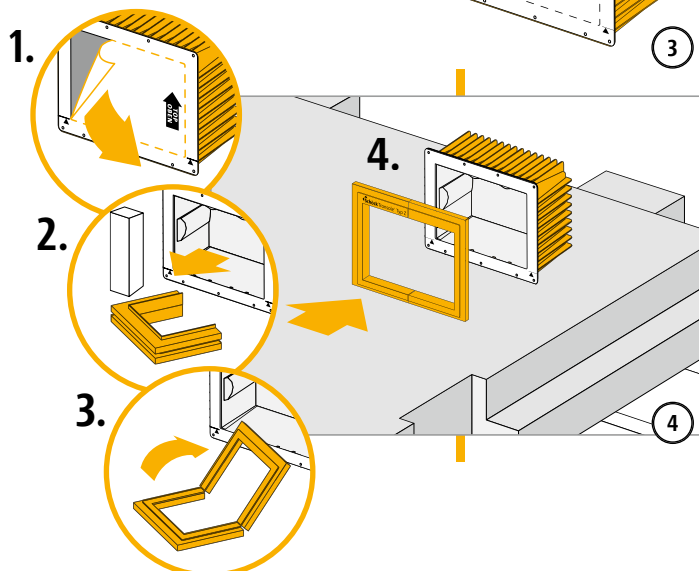
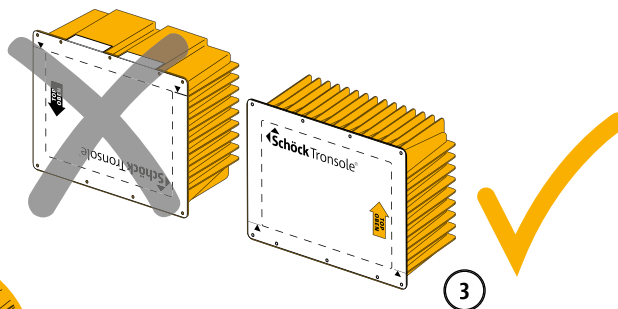
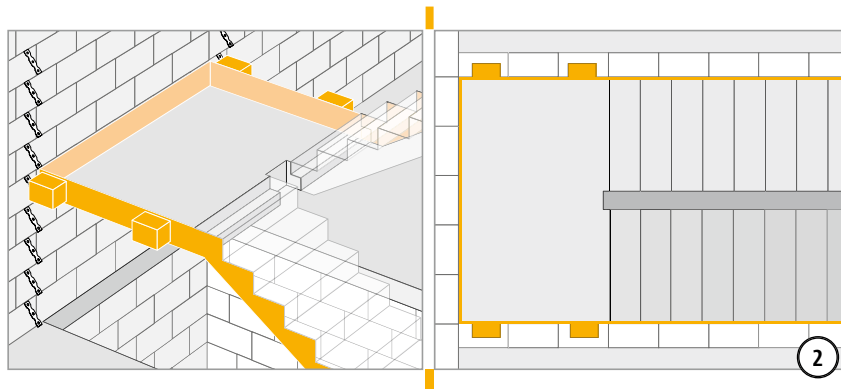
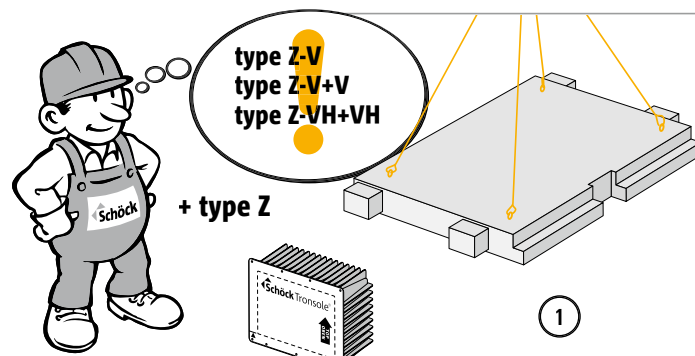
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## Installation instructions for prefabricating plant

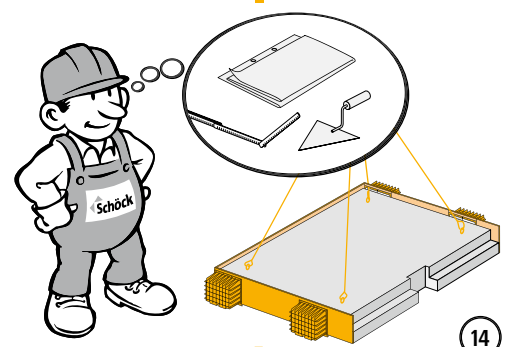
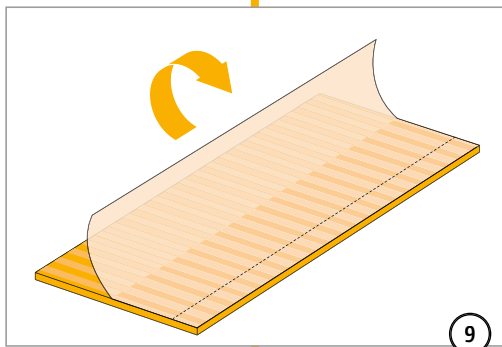
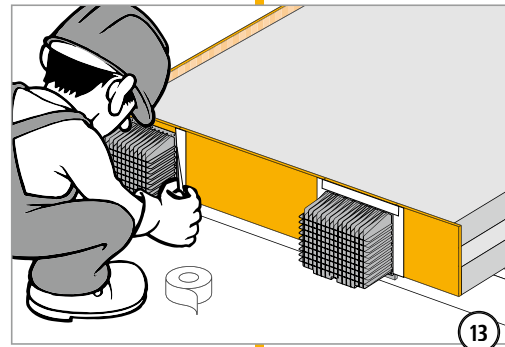
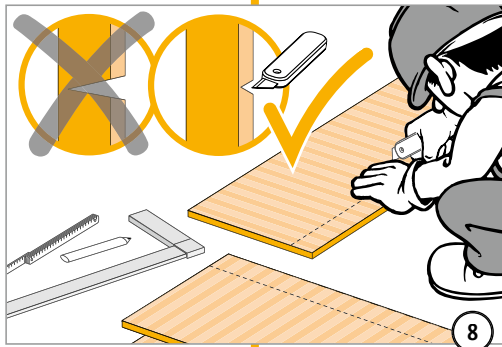
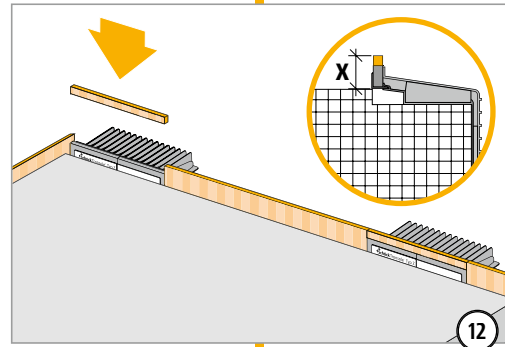
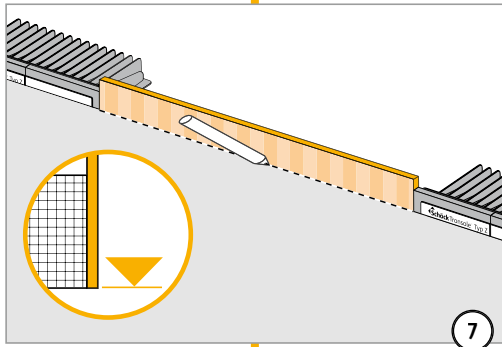
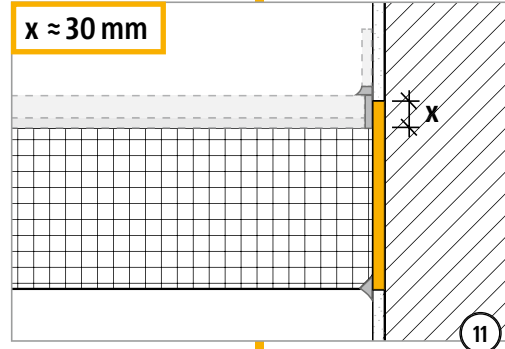
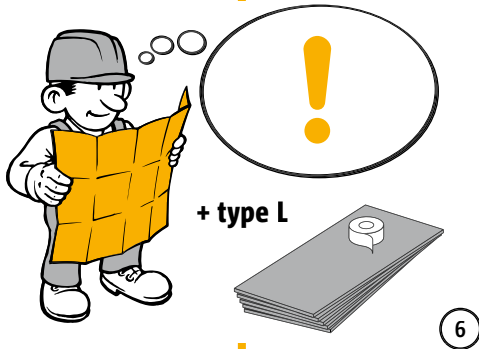
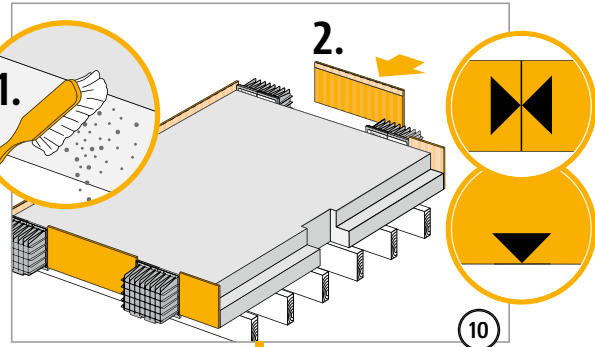
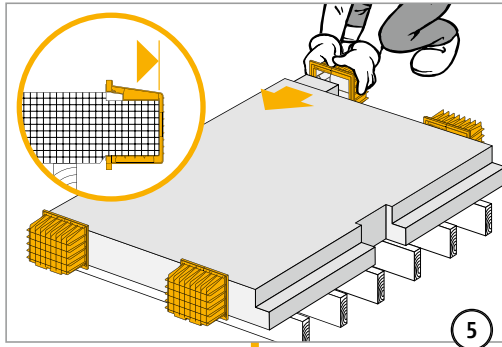




## Installation instructions building site precast components

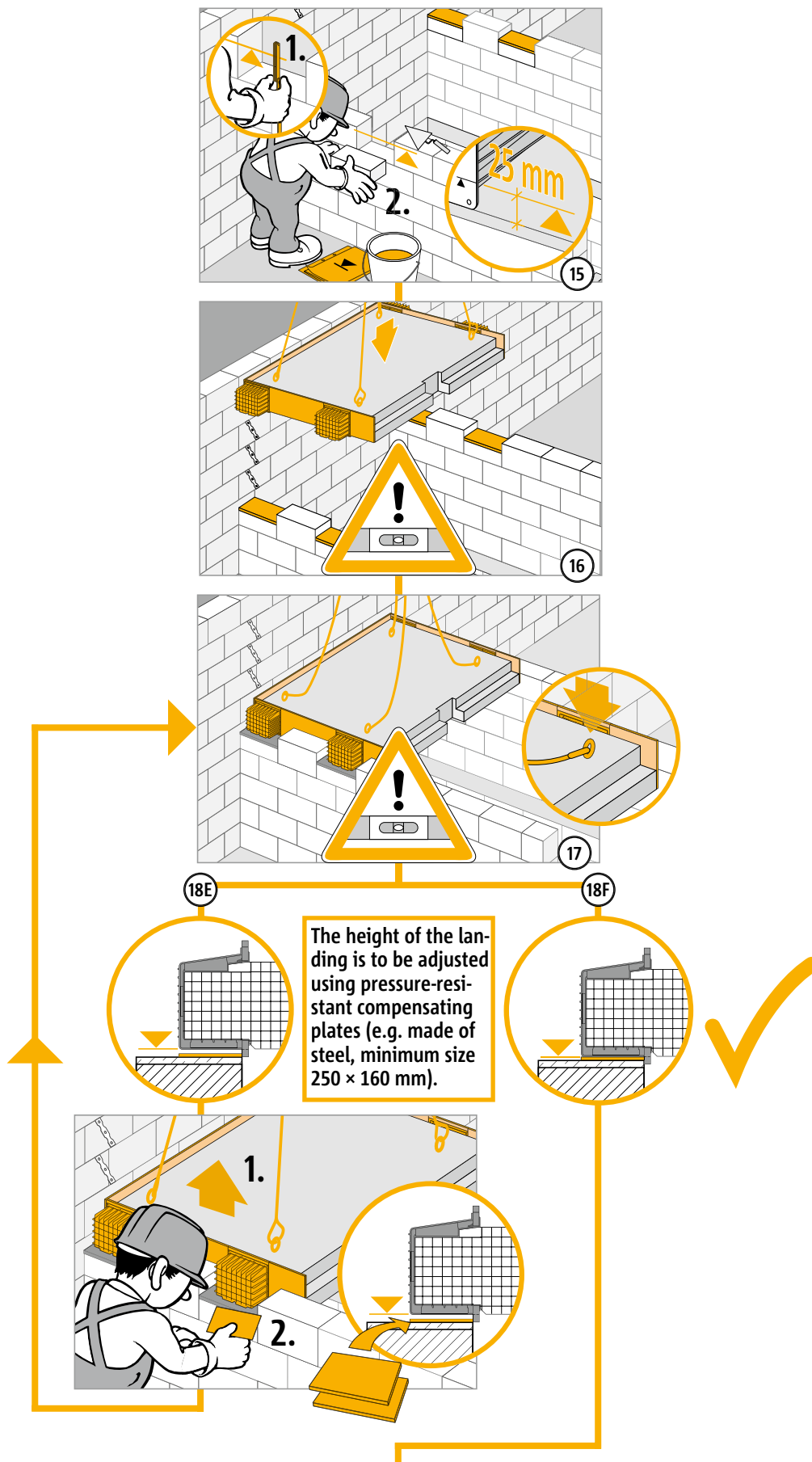


# Installation instructions building site precast components

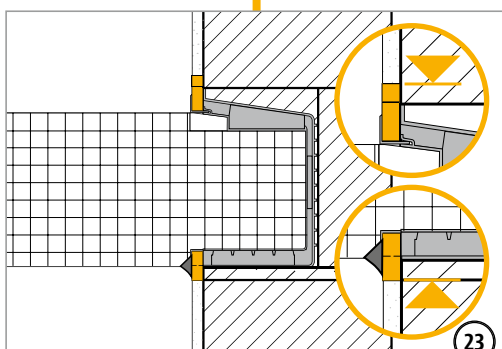
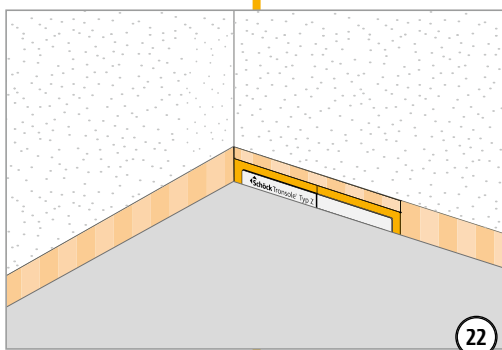
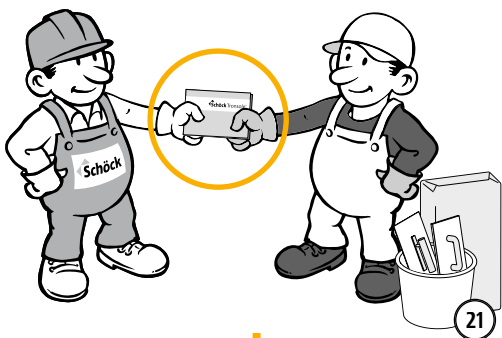
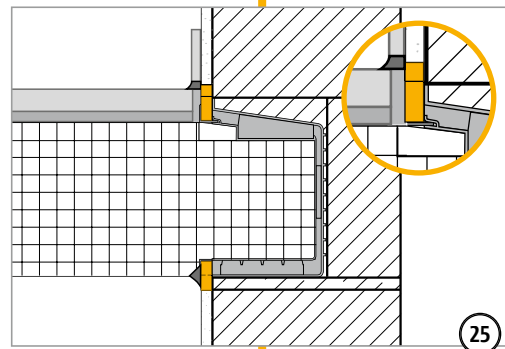
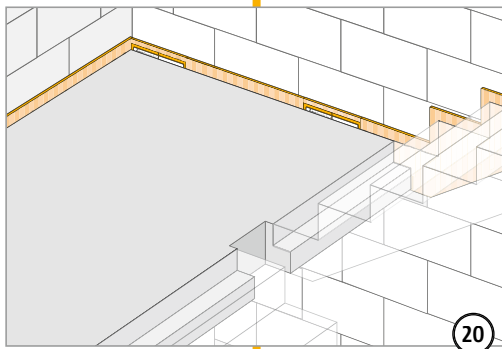
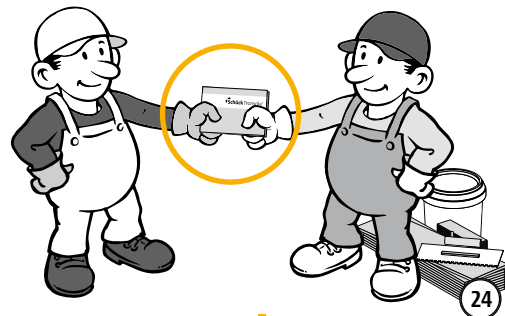
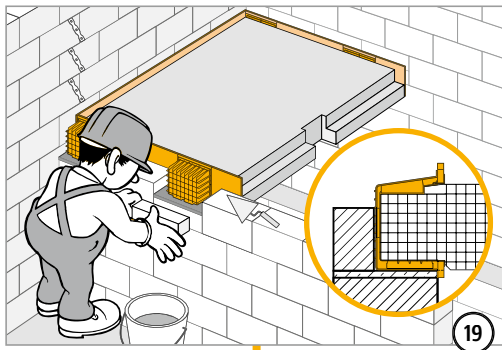


Z

## Installation instructions building site precast components



## Installation instructions building site precast components



## ✓ Check list

- Is the geometry of the structural component to be sound insulated matched to the measurements of the Schöck Tronsole® type Z?
- Have the effects on the Schöck Isokorb® connection been specified at design level?
- Is the minimum concrete strength  $\geq C20/25$  taken into account with the use of the load-bearing element of the Schöck Tronsole® type Z?
- Have the requirements with regard to fire protection been cleared and announced?
- With the use of the Schöck Tronsole® type Z and concurrent fire protection requirements on the room closure is a minimum wall width (including exterior rendering) of 160 mm met?
- With  $V_{ed}$  at the slab edge of the landing, is the limiting value of the slab load-bearing capacity checked?
- Are planned existing horizontal loads resp. lifting forces, which can be conducted away via the Schöck Tronsole® type Z, taken into account?



## Schöck Tronsole® type B with type D



### **Schöck Tronsole® Type B with Tronsole® Type D**

Schöck Tronsole® Type B acoustically decouples flights of stairs and base slabs. Optionally, Tronsole® Type D can be employed for structural stability. The flight of stairs can be constructed either in in-situ concrete or in precast concrete.

## Product characteristics | Product design

### **i** Product characteristics Tronsole® type B

- ▶ Rated flight impact sound level difference  $\Delta L_{w,flight}^* \geq 26$  dB with Type B-V2;  $\Delta L_{w,flight}^* \geq 28$  dB with Type B-V1, tested according to DIN 7396 with maximum load; test reports no. 91386-04 to 91386-06; (for an explanation of the value  $\Delta L_{w,flight}^*$ , see page 13)
- ▶ High quality and efficient Elodur® elastomer support for linear connection
- ▶ Firm attachment to prefabricated stair flight using adhesive assembly tape
- ▶ High quality and easily cut PE foam panel

### **i** Product characteristics Tronsole® type D

- ▶ Influence on the impact soundproofing is already contained in the acoustic characteristic value of type B
- ▶ Dowel for structural positional security between stair flight and floor slab
- ▶ Made of high-quality stainless steel with elastomer cap.
- ▶ Optional installation sleeve

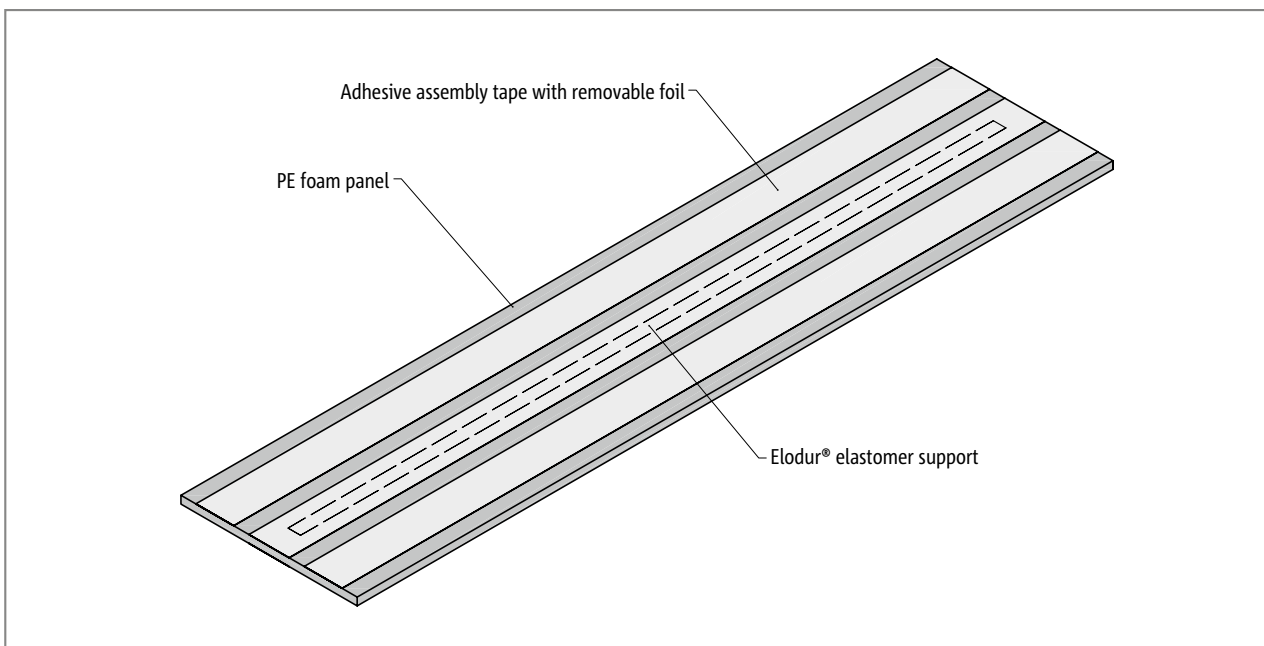


Fig. 169: Schöck Tronsole® type B

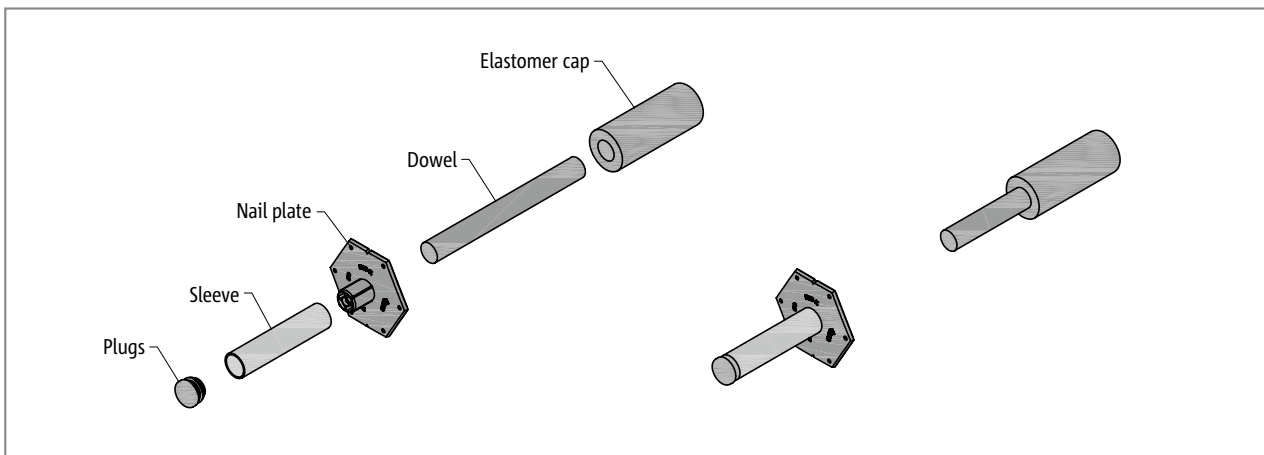


Fig. 170: Schöck Tronsole® type D-H:



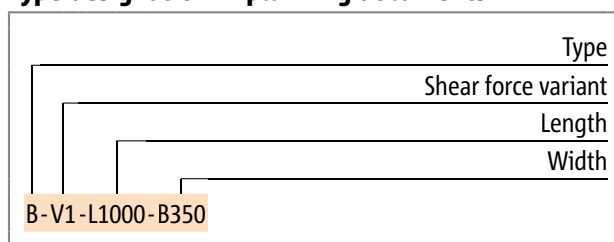
## Product selection | Type designations | Special designs

### Schöck Tronsole® Type B variants

The configuration of Schöck Tronsole® Type B can be varied as follows:

- ▶ Shear force bearing level:
  - Type B-V1, shear force bearing level 1, elastomeric bearing width  $b = 25$  mm
  - Type B-V2, shear force bearing level 2, elastomeric bearing width  $b = 35$  mm
  - Type BS-V3, shear force bearing level 3, elastomeric bearing width  $b = 2 \times 25$  mm (special type on request)
- ▶ Length:
  - Type B-V1: Length  $L = 1000$  mm, 1100 mm, 1200 mm, 1300 mm and 1500 mm
  - Type B-V2: Length  $L = 1000$  mm, 1100 mm, 1200 mm and 1500 mm
- ▶ Width:
  - Type B: Width  $B = 350$  mm and 600 mm

### Type designation in planning documents

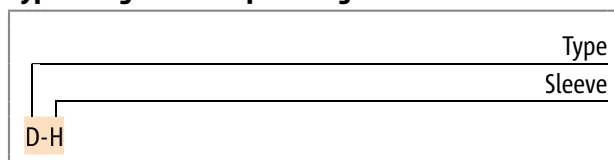


### Schöck Tronsole® type D variants

The design of the Schöck Tronsole® type D can vary as follows:

- ▶ Sleeve:
  - Schöck Tronsole® type D is offered optionally with a sleeve.:

### Type designation in planning documents



### **i** Special designs

The Schöck Tronsole® type B can be cut to length on site. Furthermore, the special dimensions of the Tronsole®, which differ from the standard product variants presented in the information, can be requested from Schöck Application Technology.

## Installation cross section

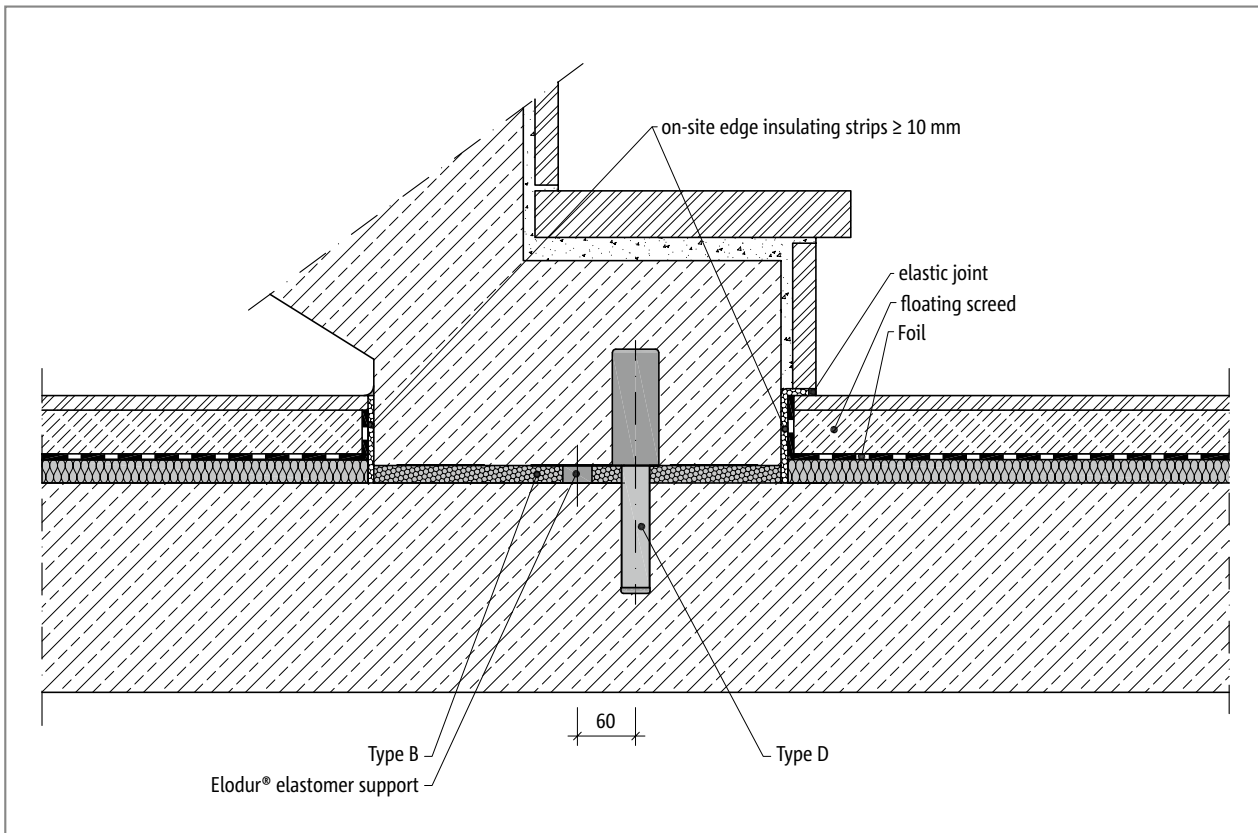


Fig. 171: Schöck Tronsole® Type B + type D: Installation cross-section

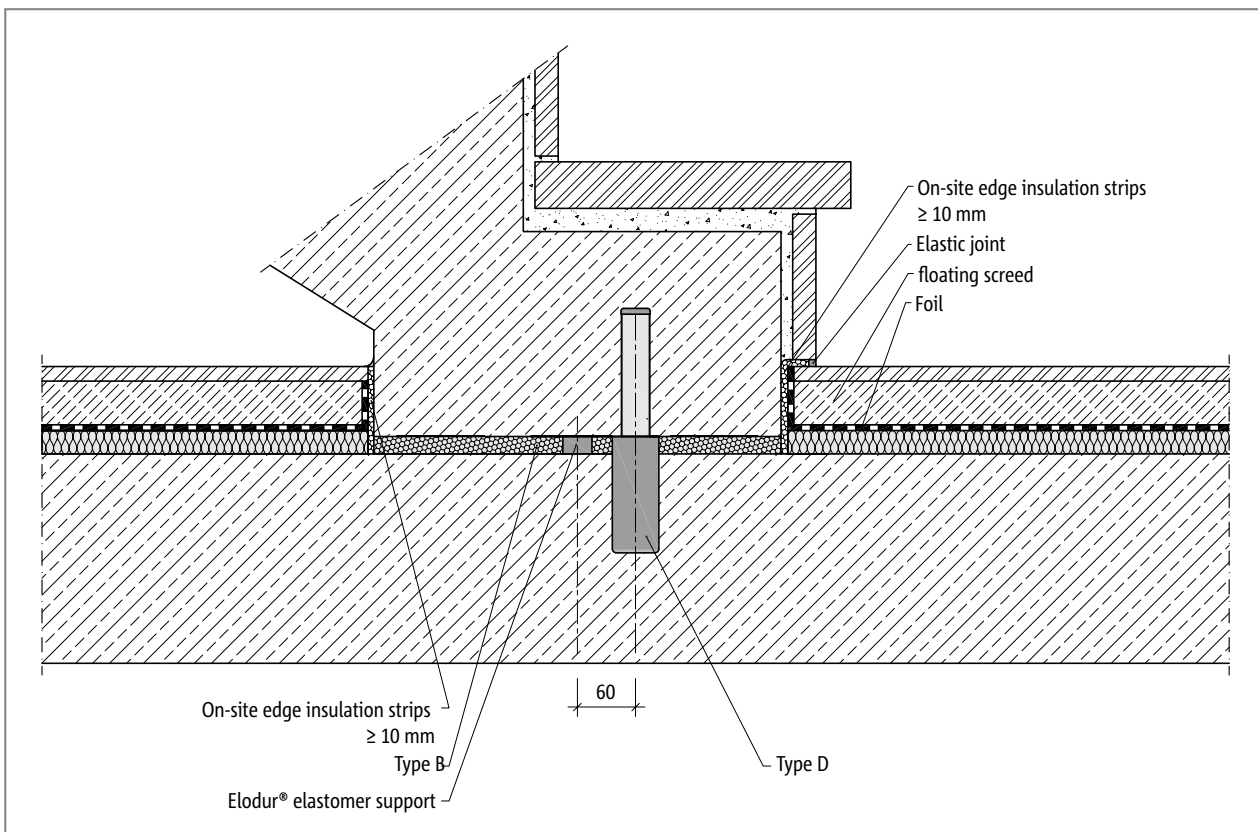


Fig. 172: Schöck Tronsole® type B + type D: Alternative installation

## Element arrangement

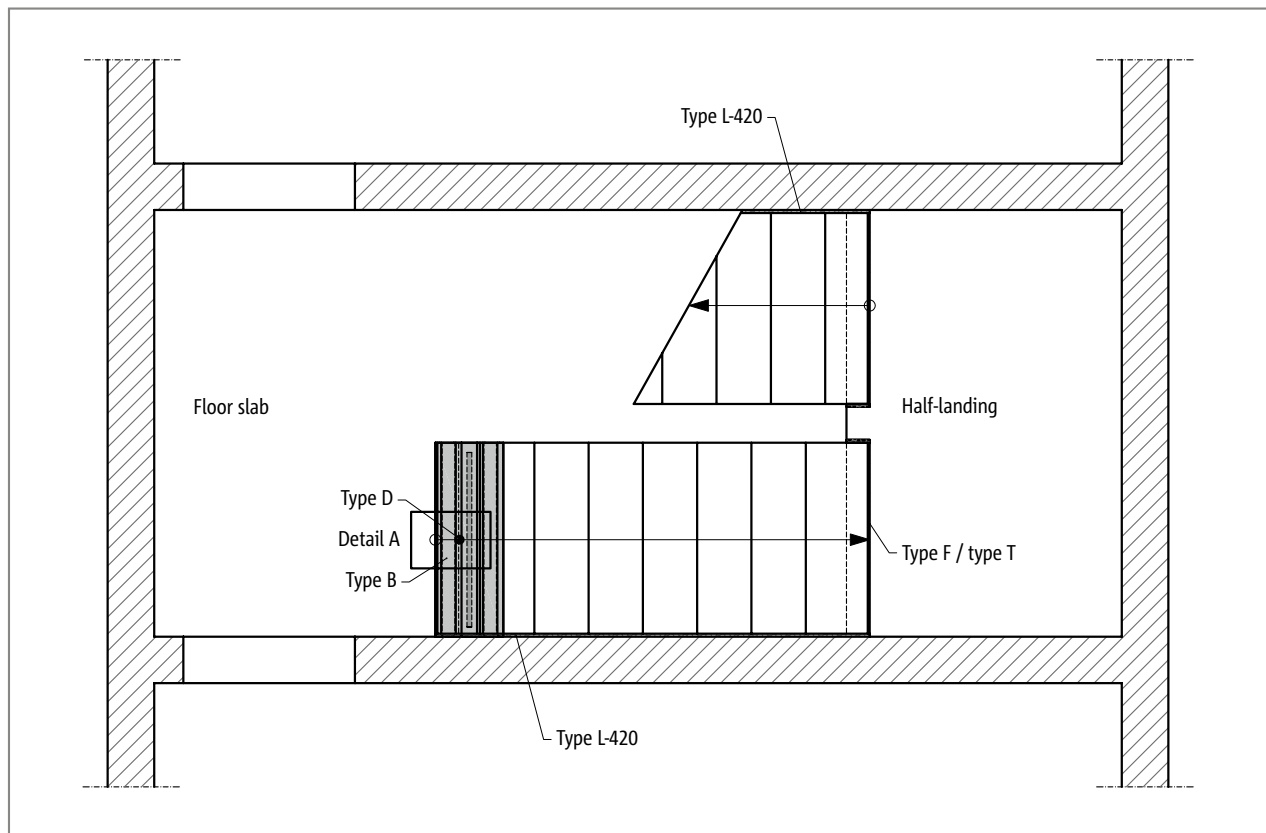


Fig. 173: Schöck Tronsole® Type B + type D: Element configuration in plan view

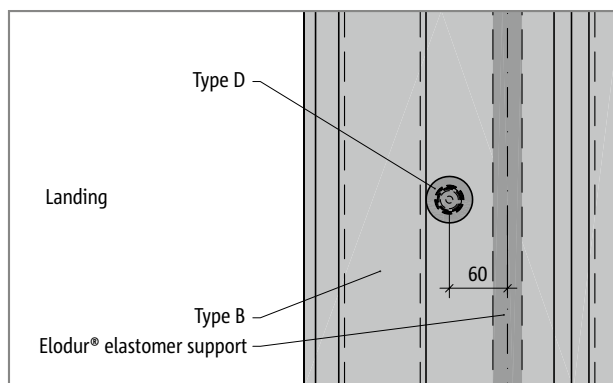


Fig. 174: Schöck Tronsole® Type B + type D: Detail A

### **i** Element arrangement

- ▶ The given acoustic insulation values apply in combination with the Tronsole® type L-420 or with a sufficiently wide air joint (50 mm).
- ▶ The use of the Schöck Tronsole® type T or with corbel formation using Type F is suitable for the sound insulation of stair flight and landing/ floor slab. The Tronsole® type F, T and B can be combined on a stair flight.
- ▶ The Schöck Tronsole® type D offers structural positional security of the bottom of the stairs. It is combined with the Schöck Tronsole® type B.

## Product description

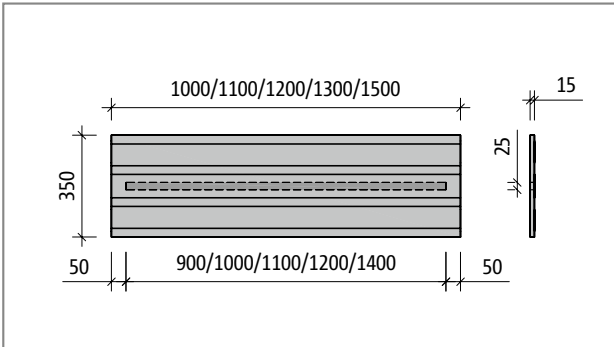


Fig. 175: Schöck Tronsole® type B-V1-L...-B350: Product layout

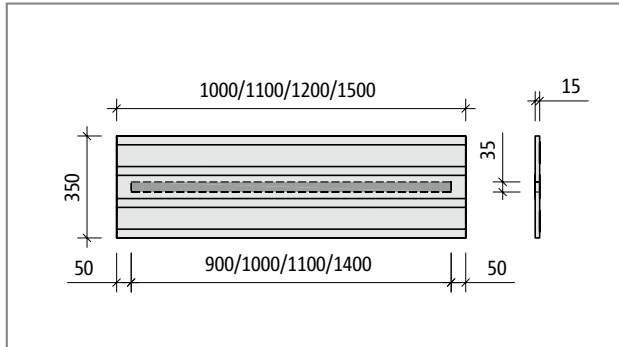


Fig. 176: Schöck Tronsole® type B-V2-L...-B350: Product layout

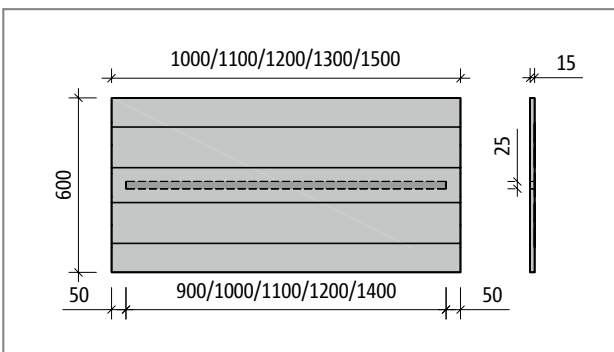


Fig. 177: Schöck Tronsole® type B-V1-L...-B600: Product layout

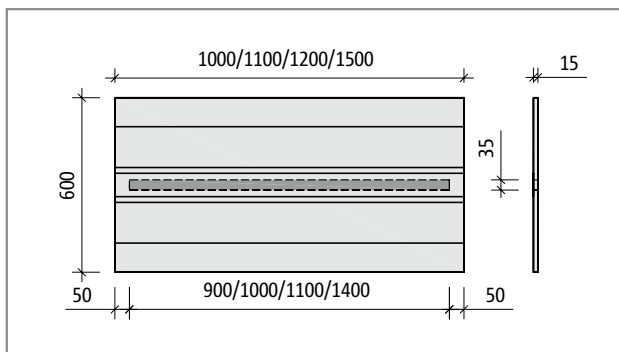


Fig. 178: Schöck Tronsole® type B-V2-L...-B600: Product layout

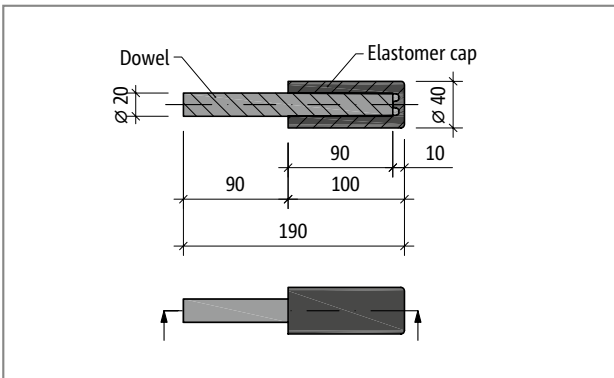


Fig. 179: Schöck Tronsole® type D: Product layout

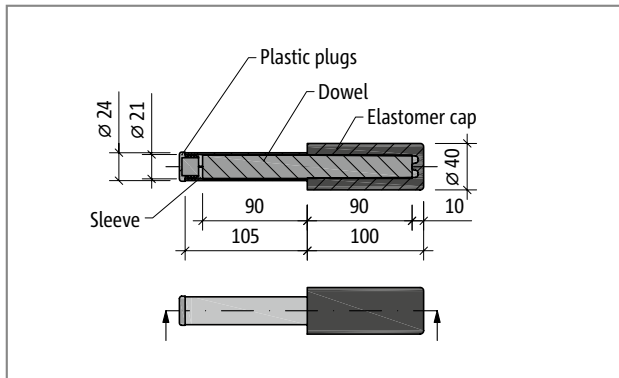


Fig. 180: Schöck Tronsole® type D-H: Product layout

B  
D

# Design

## Design table

| Schöck Tronsole® type | B-V1 | B-V2 |
|-----------------------|------|------|
| $v_{Rd,z}$ [kN/m]     | 42.4 | 59.3 |
| $v_{Rd,x}$ [kN/m]     | ±3.8 | ±3.8 |
| $v_{Rd,y}$ [kN/m]     | ±3.8 | ±3.8 |

| Schöck Tronsole® type                        | B-V1                         | B-V2                   |
|--|------------------------------|------------------------|
| Tronsole® length L [mm]                      | 1000, 1100, 1200, 1300, 1500 | 1000, 1100, 1200, 1500 |
| Tronsole® Thickness [mm]                     | 15                           |                        |
| Elodur® elastomer support, length $L_E$ [mm] | L - 100                      |                        |
| Elodur® elastomer support, thickness [mm]    | 15                           |                        |
| Elodur® elastomer support, width [mm]        | 25                           | 35                     |

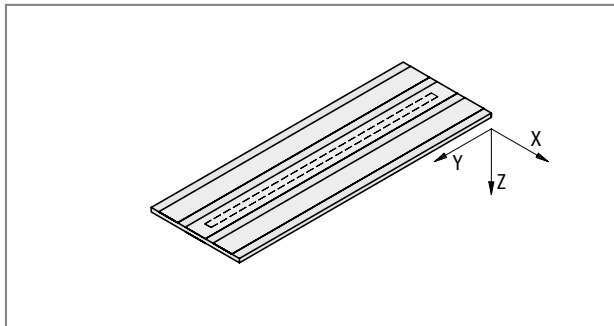


Fig. 181: Schöck Tronsole® type B: Sign rule for the design

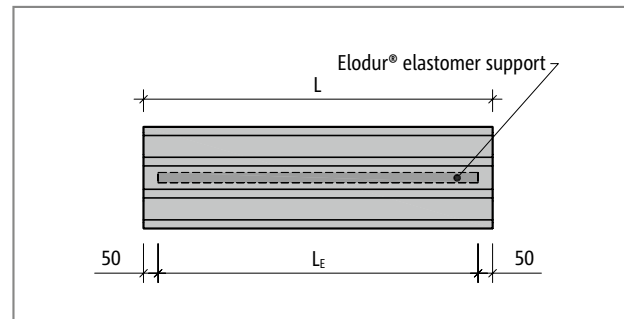


Fig. 182: Schöck Tronsole® type B Representation of lengths L and  $L_E$ ; the length of the Elodur® elastomer support is always 10 cm shorter than the length of the Tronsole®.

### **i** Notes on design

- ▶ The Elodur® elastomer support serves exclusively for the transmission of vertical forces and small horizontal forces.
- ▶ The PE foam panel of the Tronsole® type B, with correct installation, specifies the central position of the Elodur® elastomer support. The adherence to this position prepares the basis for the design.

## On-site reinforcement

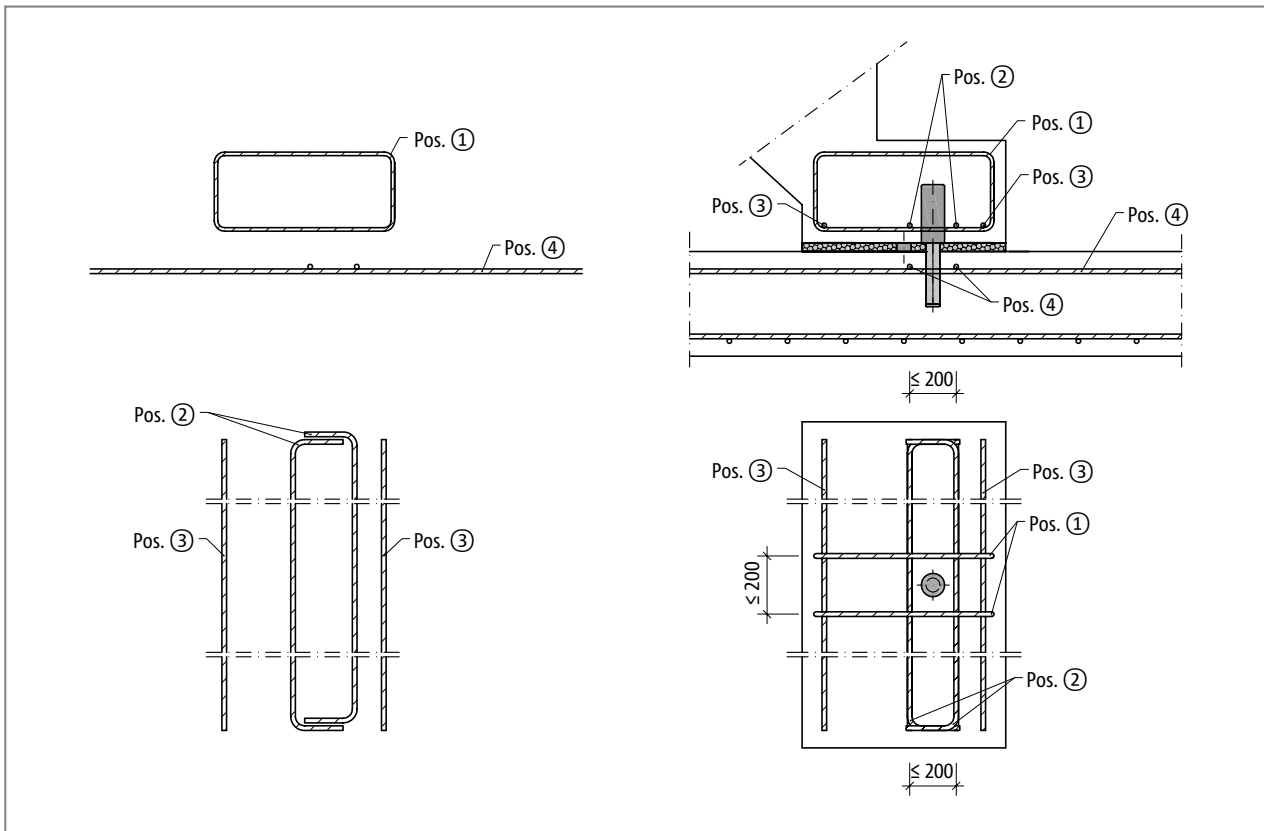


Fig. 183: Schöck Tronsole® type D: On-site reinforcement

| Schöck Tronsole® type   |                   | D   |
|---|-------------------|---|
| On-site reinforcement   | Location          | Exposure class XC1, concrete strength $\geq$ C25/30 |
| <b>Pos. 1 closed stirrup</b>  |                   |   |
| Pos. 1  | on the stair side | 2 · H8  |
| <b>Pos. 2 Transverse reinforcement with end hooks on both sides</b> |                   |   |
| Pos. 2  | on the stair side | 2 · H8  |
| <b>Pos. 3 steel rods in transverse direction of the stairs</b>      |                   |   |
| Pos. 3  | on the stair side | 2 · H8  |
| <b>Pos. 4 Bar steel parallel and transverse to the stair flight</b> |                   |   |
| Pos. 4  | Floor slab, above | 2 · 2 · H8  |

### **i** On-site reinforcement

- ▶ The on-site reinforcement Pos. 1, Pos. 2, as well as Pos. 4 are to be arranged respectively in pairs around the Tronsole® type D. In the layout the separation of the stirrup resp. bar of an item should be maximum 200 mm.
- ▶ An existing upper slab reinforcement can be added to Pos. 4.

## Deflection | Fire protection

### Deformation of the Elodur® elastomer support of the Tronsole® type B-V1

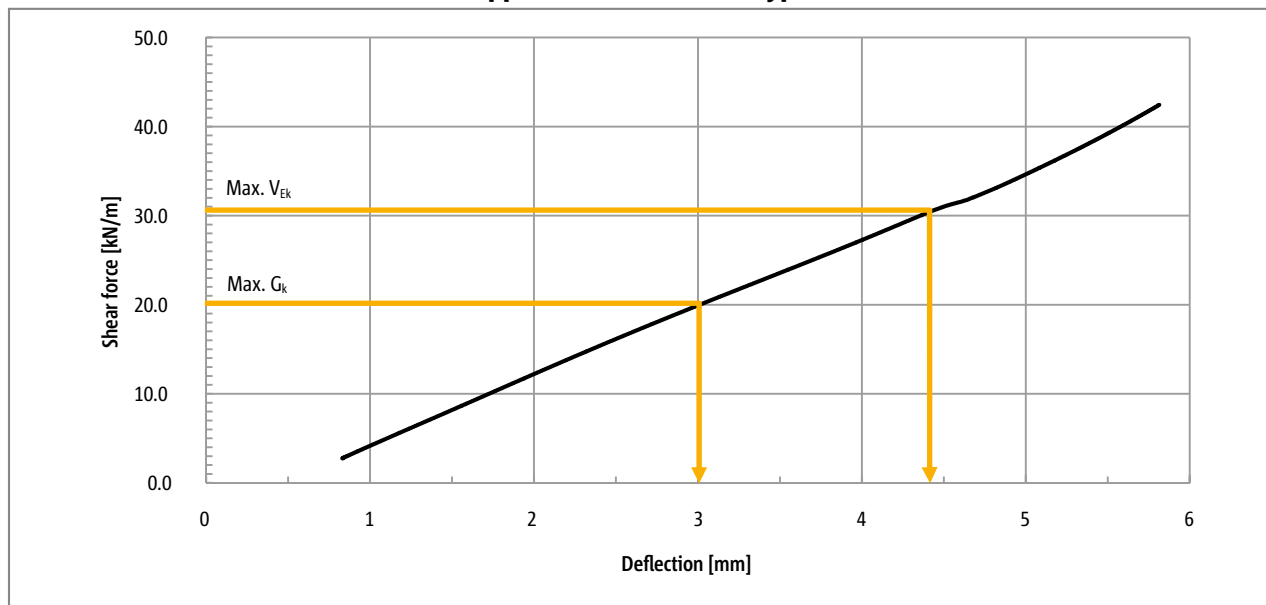


Fig. 184: Schöck Tronsole® type B-V1: Deformation of the Elodur® elastomer support

### Deformation of the Elodur® elastomer support of the Tronsole® type B-V2

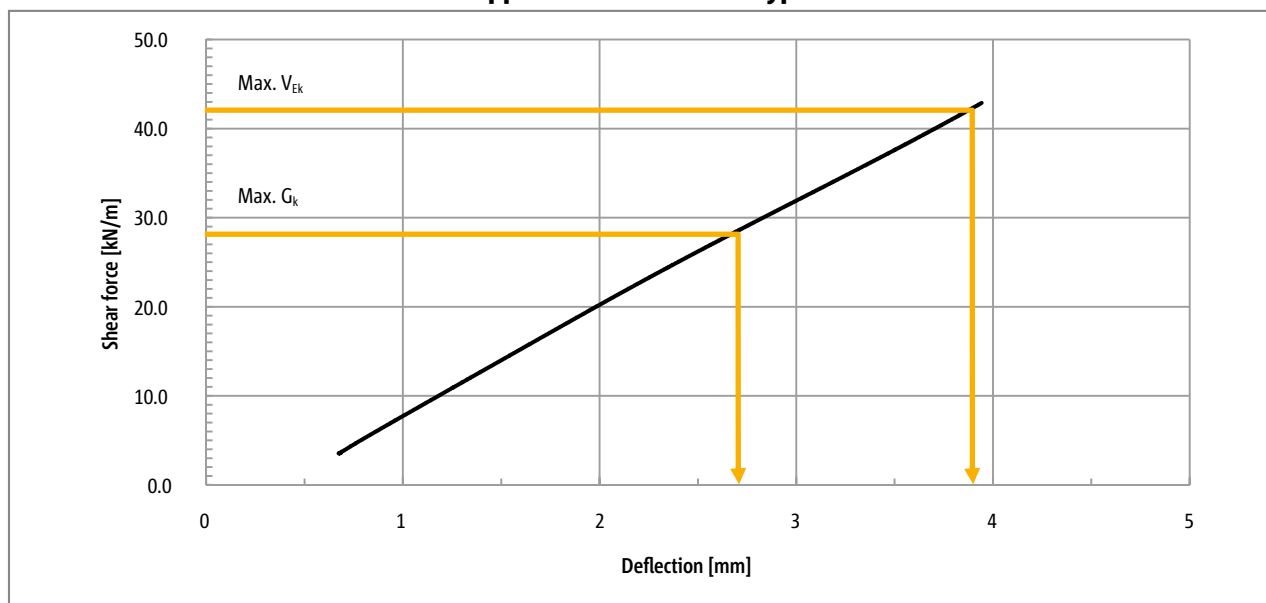


Fig. 185: Schöck Tronsole® type B-V2: Deformation of the Elodur® elastomer support

#### **i** Notes on deformation

- ▶ Deflection is the vertical deformation of the Elodur® elastomer support under vertical shear force load.
- ▶ Creep is additionally to be taken into account with 50 % of the deflection from the constant load  $G_k$ .
- ▶  $\text{Max. } V_{Ek} = \text{Max. } V_{Ed} / \gamma$ , whereby  $\gamma = 1.4$
- ▶  $\gamma = 1.4$  applies under the assumption that  $\text{Max. } V_{Ed}$  is made up of two thirds from own weight and one third from live load.
- ▶ Thus  $\text{Max. } V_{Ek}$  is the maximum service load and the maximum own weight is  $\text{Max. } G_k = 2/3 \cdot \text{Max. } V_{Ek}$ .

#### Fire protection

With the Tronsole® type D one is concerned with a static, non-relevant impact soundproofing element. Therefore the fire resistance class relates to the surrounding reinforced concrete components.

#### **i** Fire protection

- ▶ The Tronsole® type B conforms with building materials class B2 according to DIN 4102.

## Materials | Installation

### Materials and construction materials

| Schöck Tronsole® type B | Material                               |
|-------------------------|--|
| PE foam panel           | PE foam according to DIN EN 14313      |
| Elastomer support       | Polyurethane according to DIN EN 13165 |

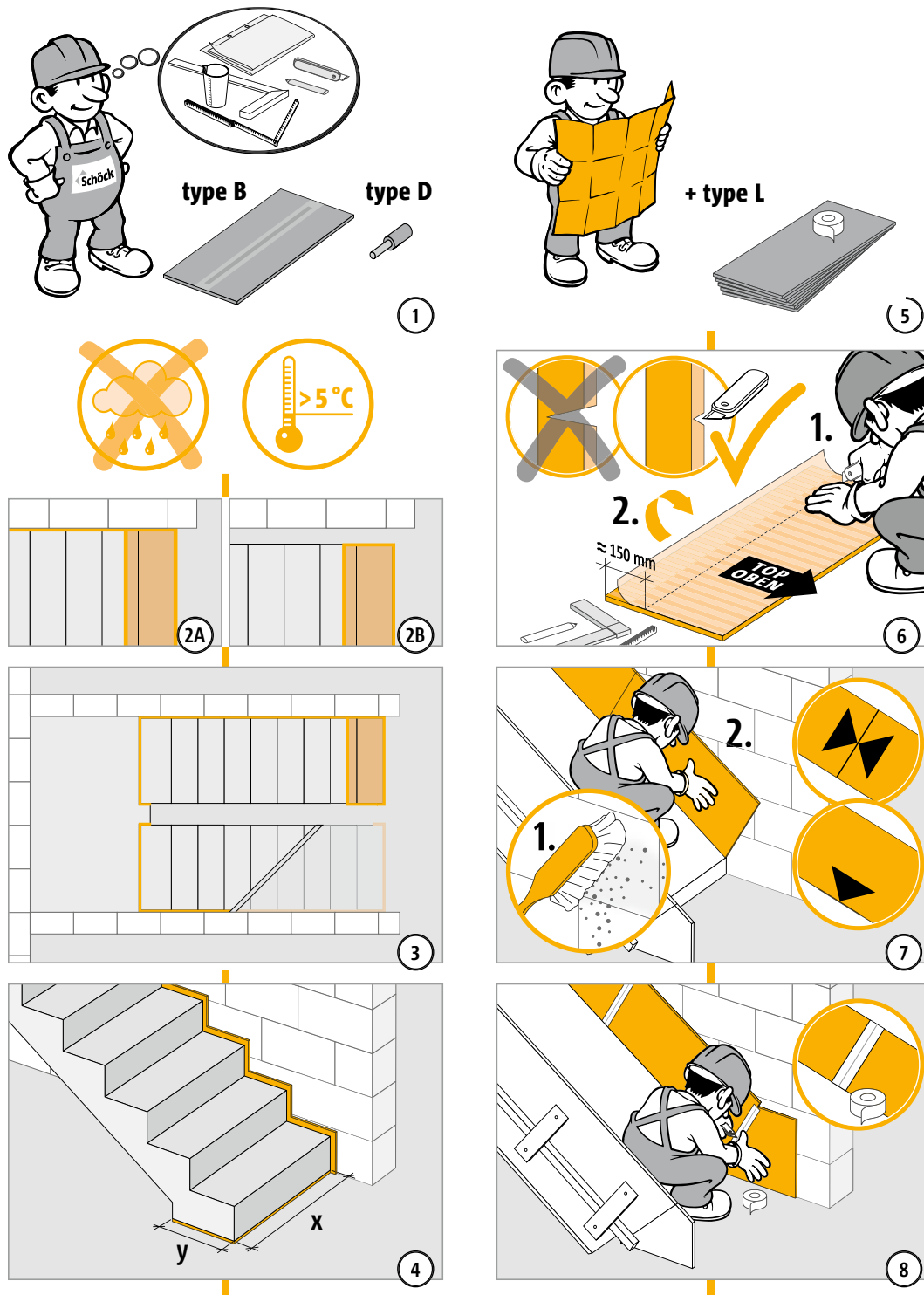
| Schöck Tronsole® type D: | Material                               |
|--------------------------|--|
| Stainless steel dowel    | S690, Material No. 1.4362              |
| Elastomer cap            | Polyurethane according to DIN EN 13165 |
| Sleeve                   | Polypropylene                          |

### **i** Installation

- ▶ The Schöck Tronsole® type B has double-sided assembly adhesive tapes for securing to the bottom of the dry and dust-free precast stair flight.
- ▶ With the employment of in-situ stairs the Tronsole® type B lies on the floor slab between the edge formwork.
- ▶ The PE foam blocks can be cut to size using a simple cutting tool. The PE foam block extends beyond the linear elastomeric bearing by 50 mm at either end, so Tronsole® Type B can be easily trimmed without affecting the elastomeric bearing.
- ▶ With the cutting to length of the Tronsole® type B care is to be taken that the projection of the PE foam panels over the elastomer support is shortened to the same length on both sides, in order to retain the central position of the elastomer support.
- ▶ An acoustic bridge-free configuration limits the employment of on-site edge insulation strips on the sides of the foot of the stairs.
- ▶ The sleeve for the Tronsole® type D, which can be obtained optionally, can be used as stay-in-place formwork in the precast stair flight or in the floor.
- ▶ The Tronsole® type D (without sleeve) requires a block-out or the integration of the dowel in the hardened concrete of the floor slab.

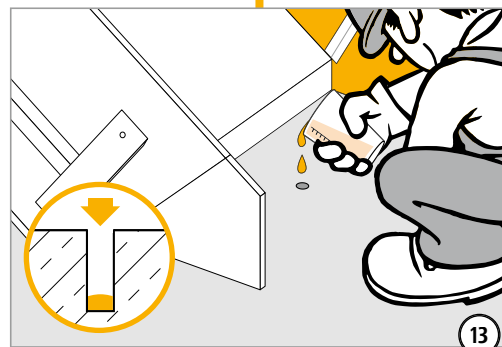
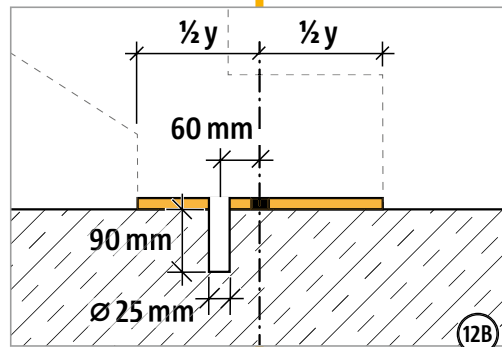
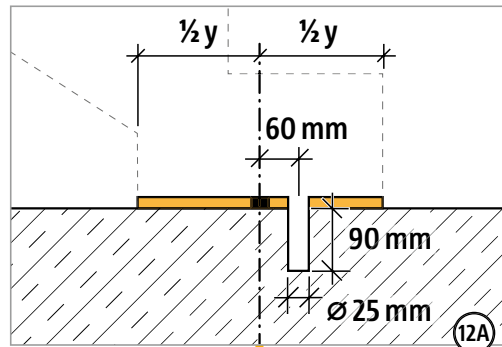
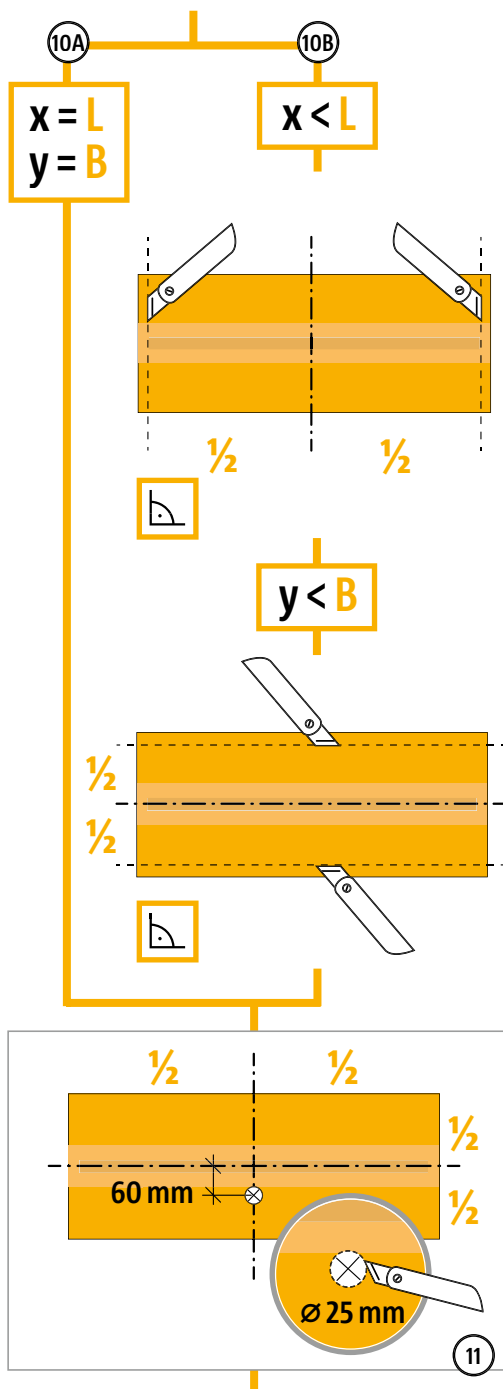
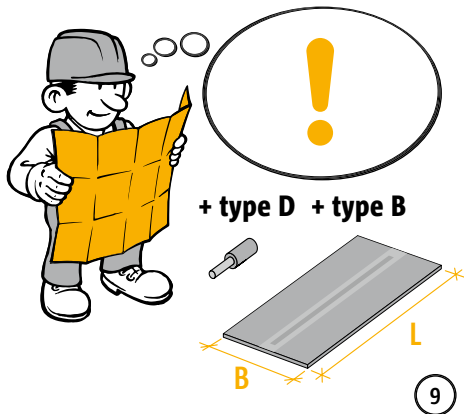


# Installation instructions for building site in-situ concrete

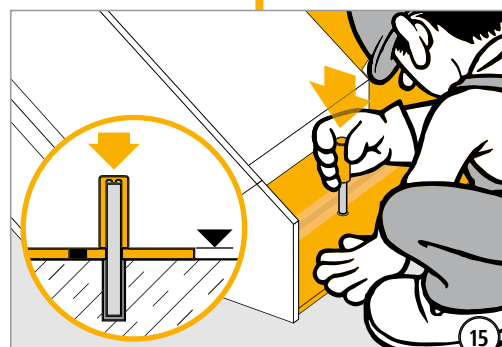


B  
D

# Installation instructions for building site in-situ concrete

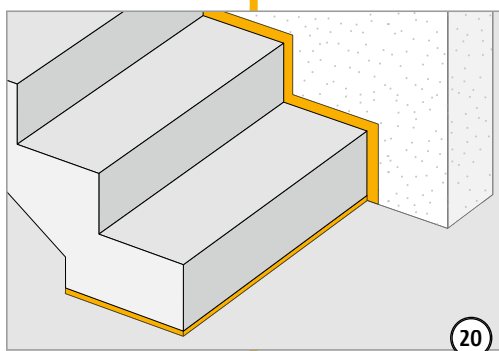
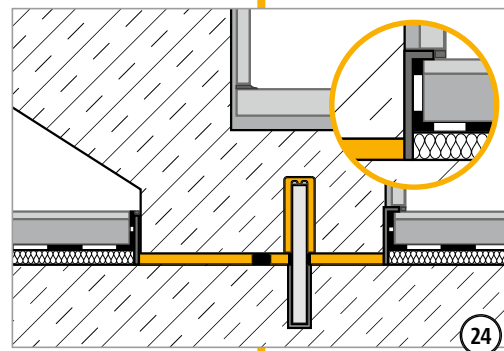
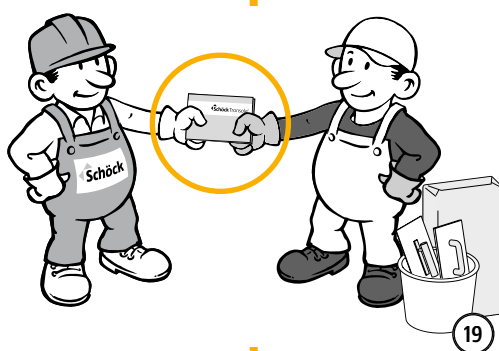
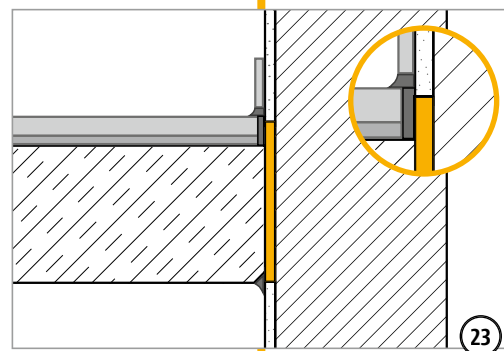
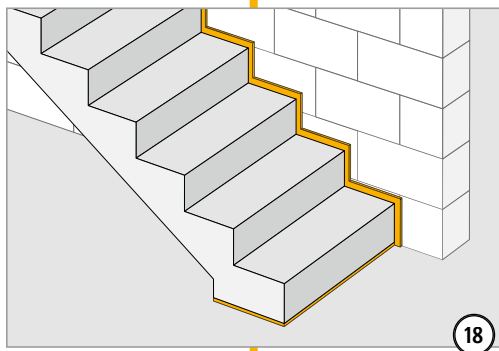
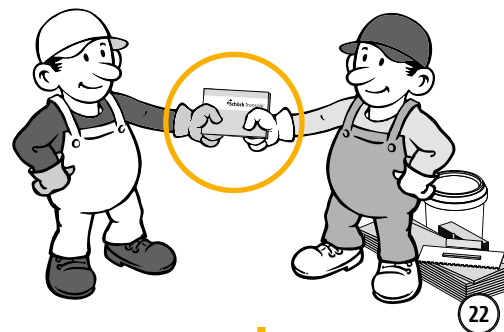
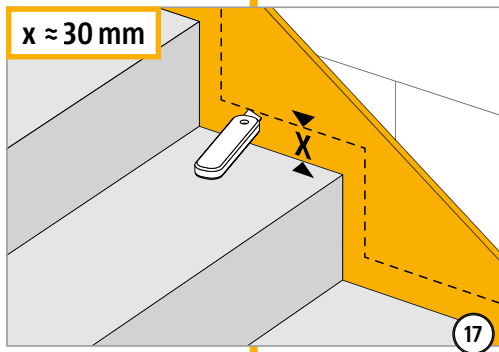
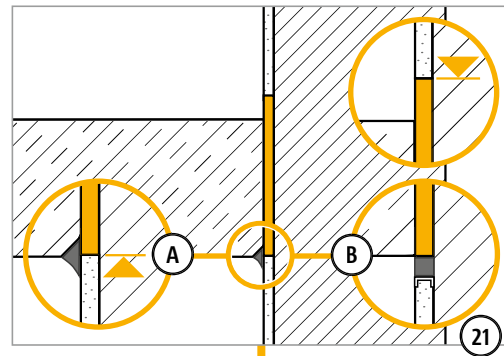
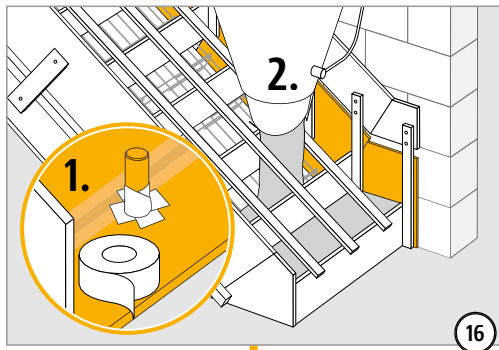


\*Pay attention to sufficiently fluid consistency!



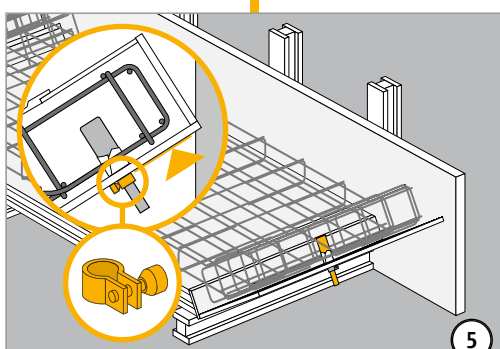
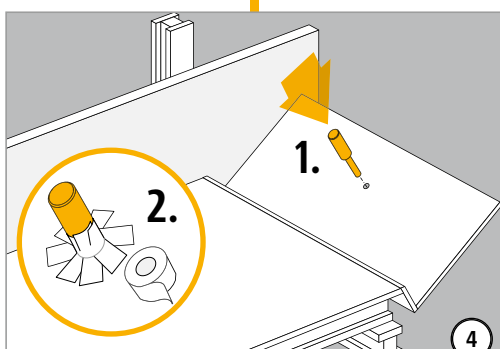
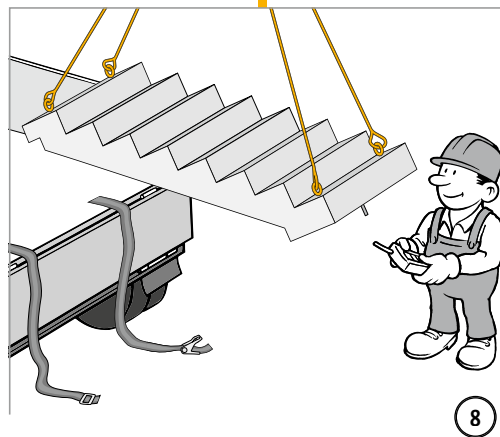
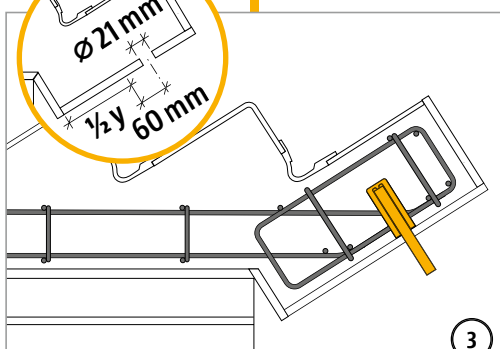
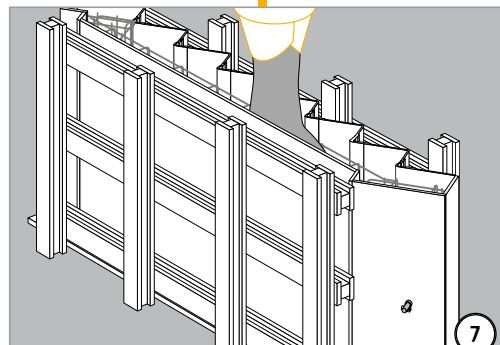
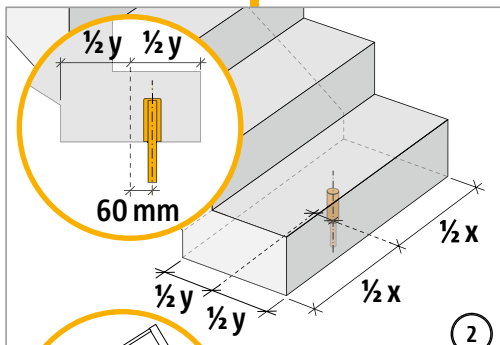
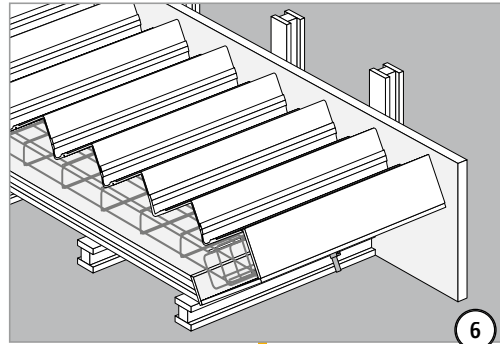
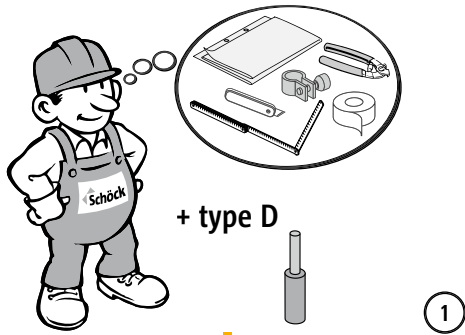
B  
D

## Installation instructions for building site in-situ concrete



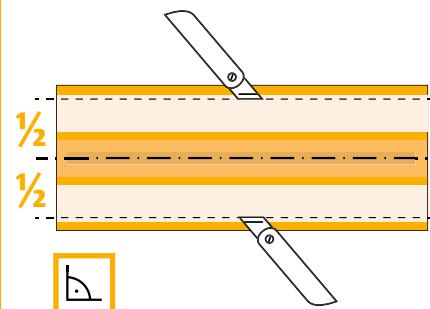
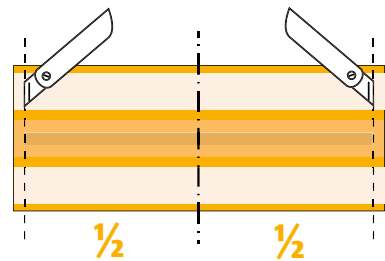
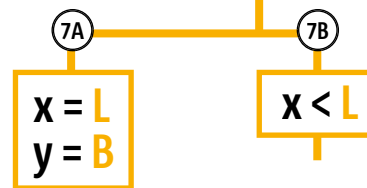
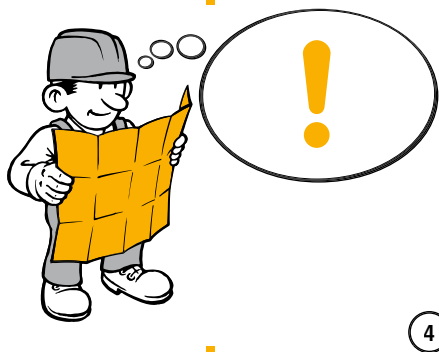
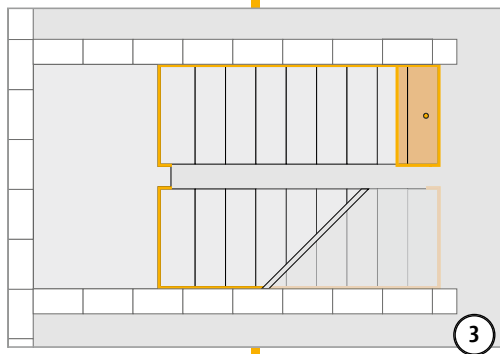
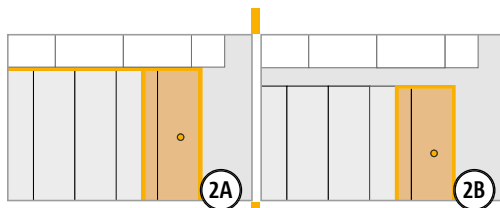
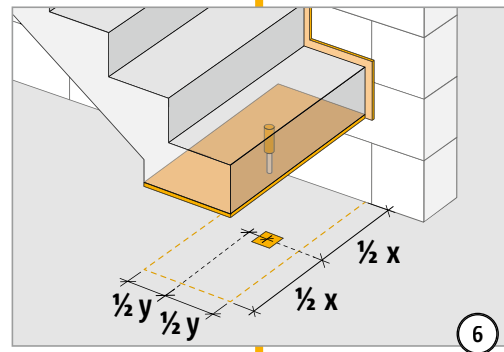
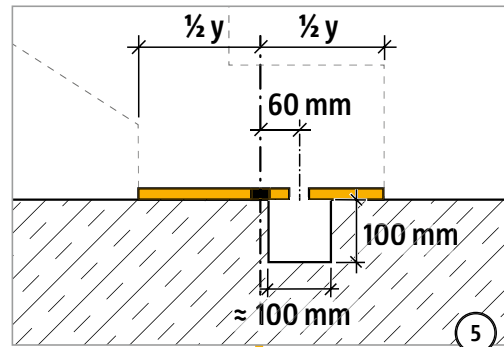
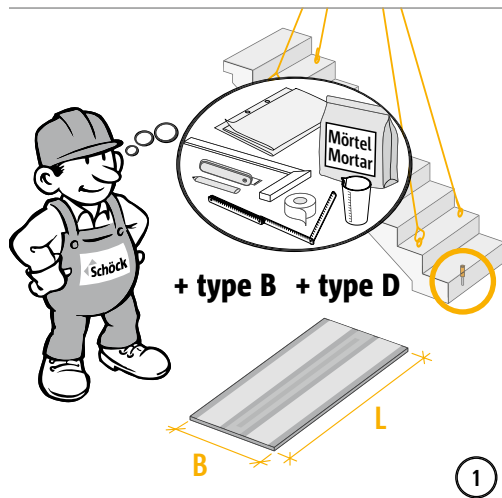
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# Installation instructions for prefabricating plant



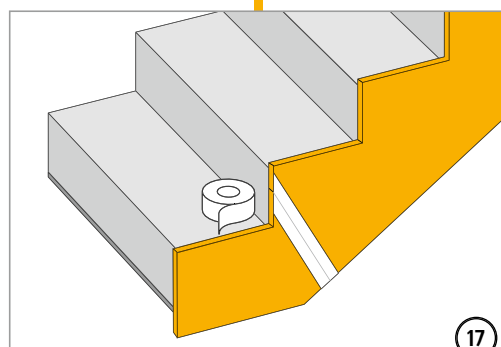
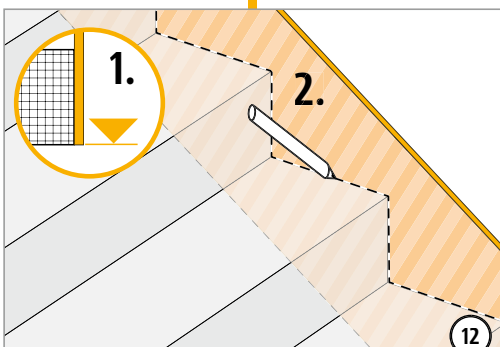
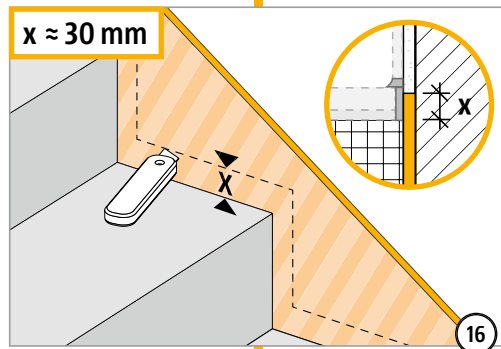
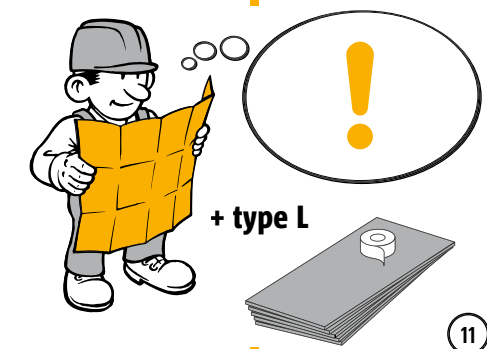
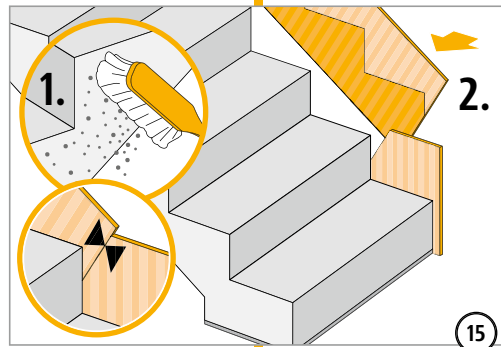
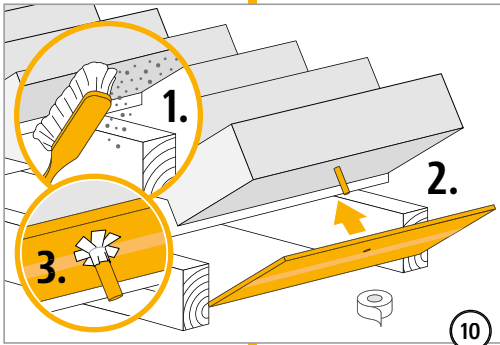
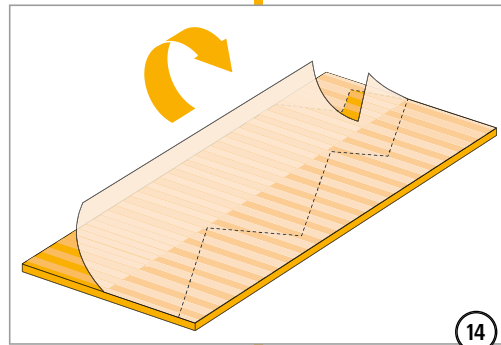
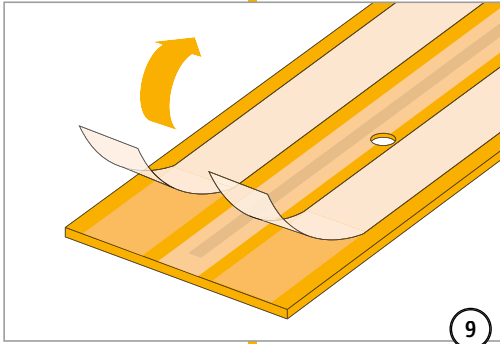
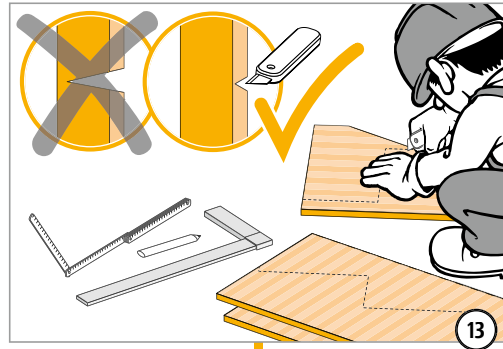
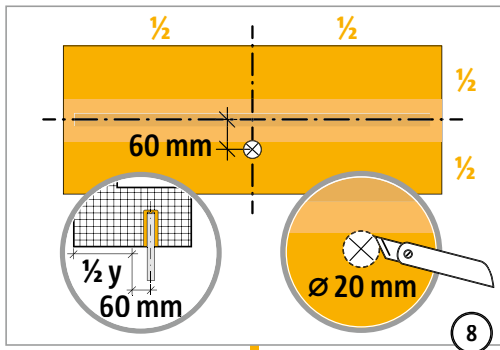
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# Installation instructions building site precast components

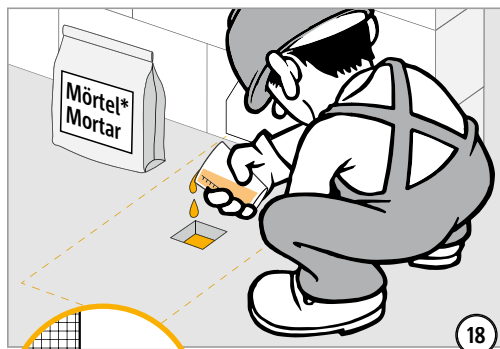


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## Installation instructions building site precast components

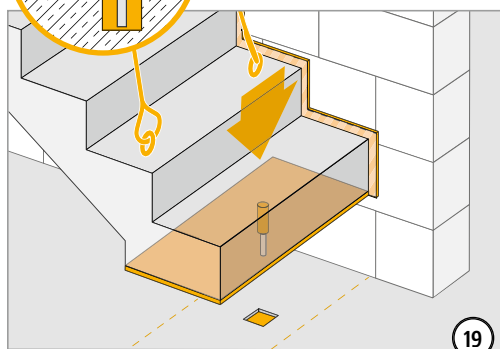


## Installation instructions building site precast components

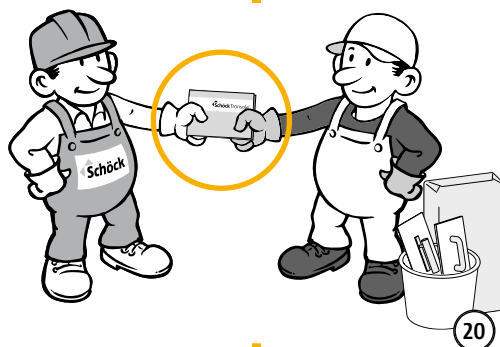


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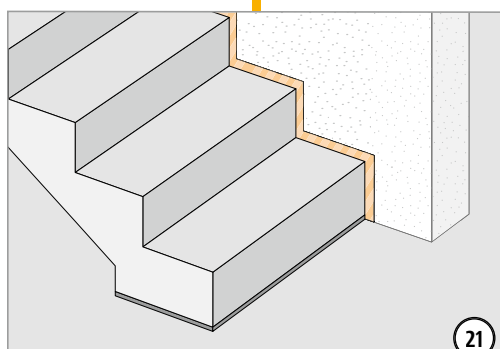
\*Pay attention to sufficiently fluid consistency!



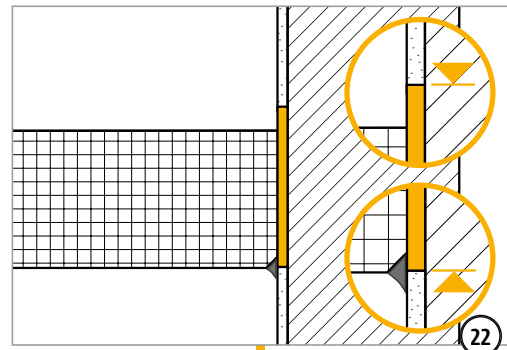
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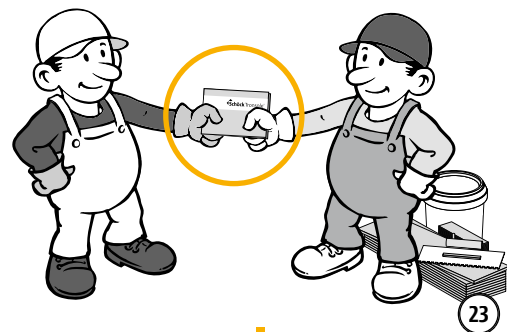
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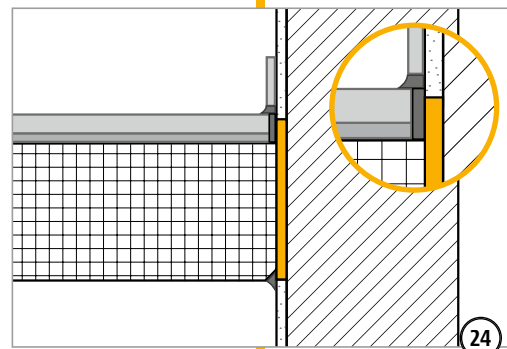
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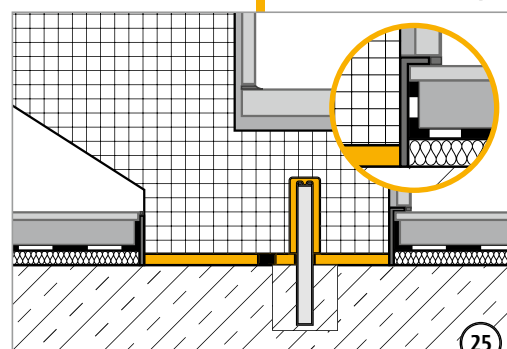
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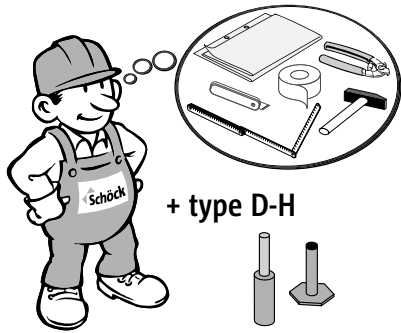
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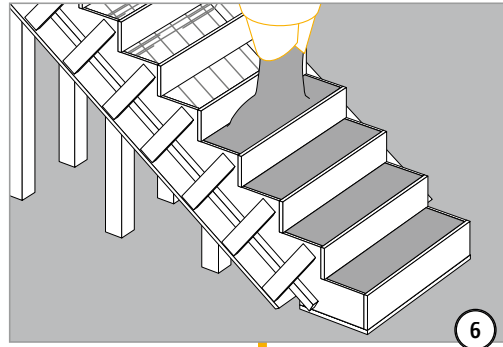
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B  
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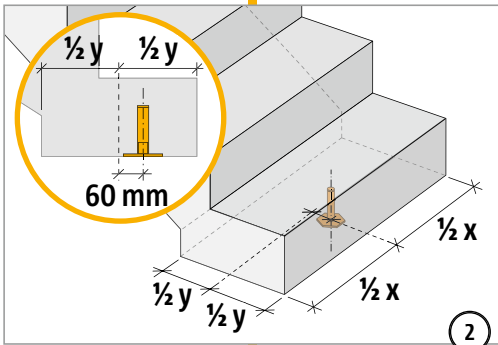
# Installation instructions for prefabricating plant



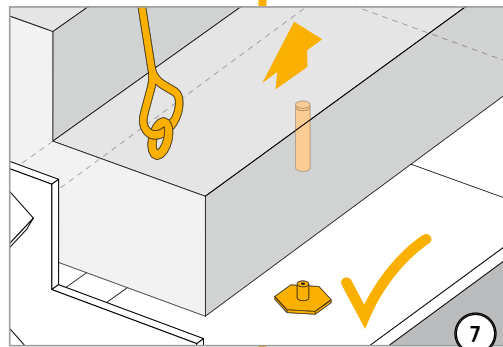
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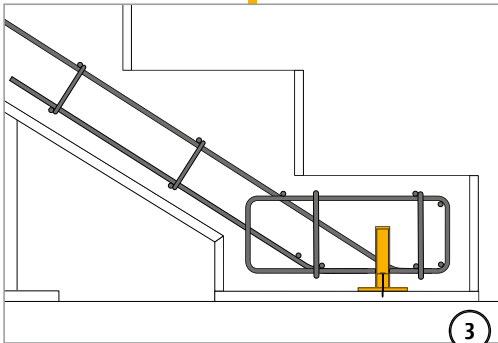
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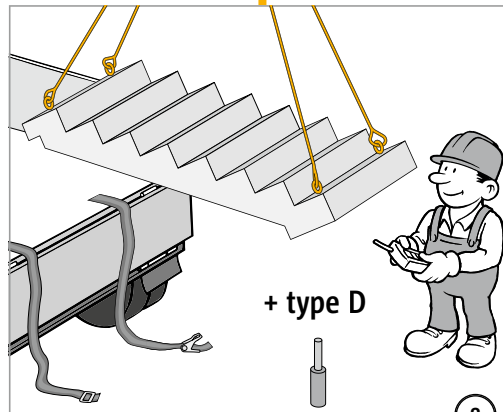
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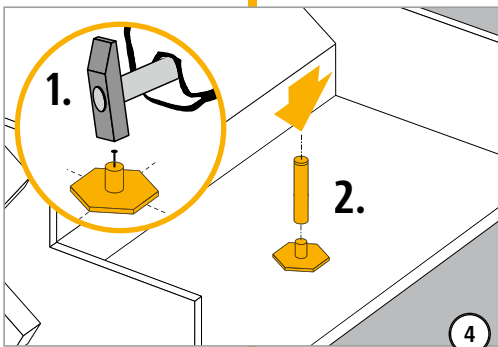
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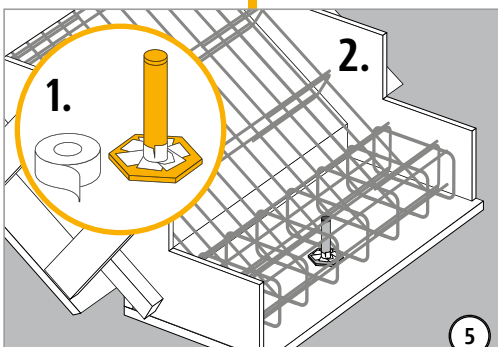
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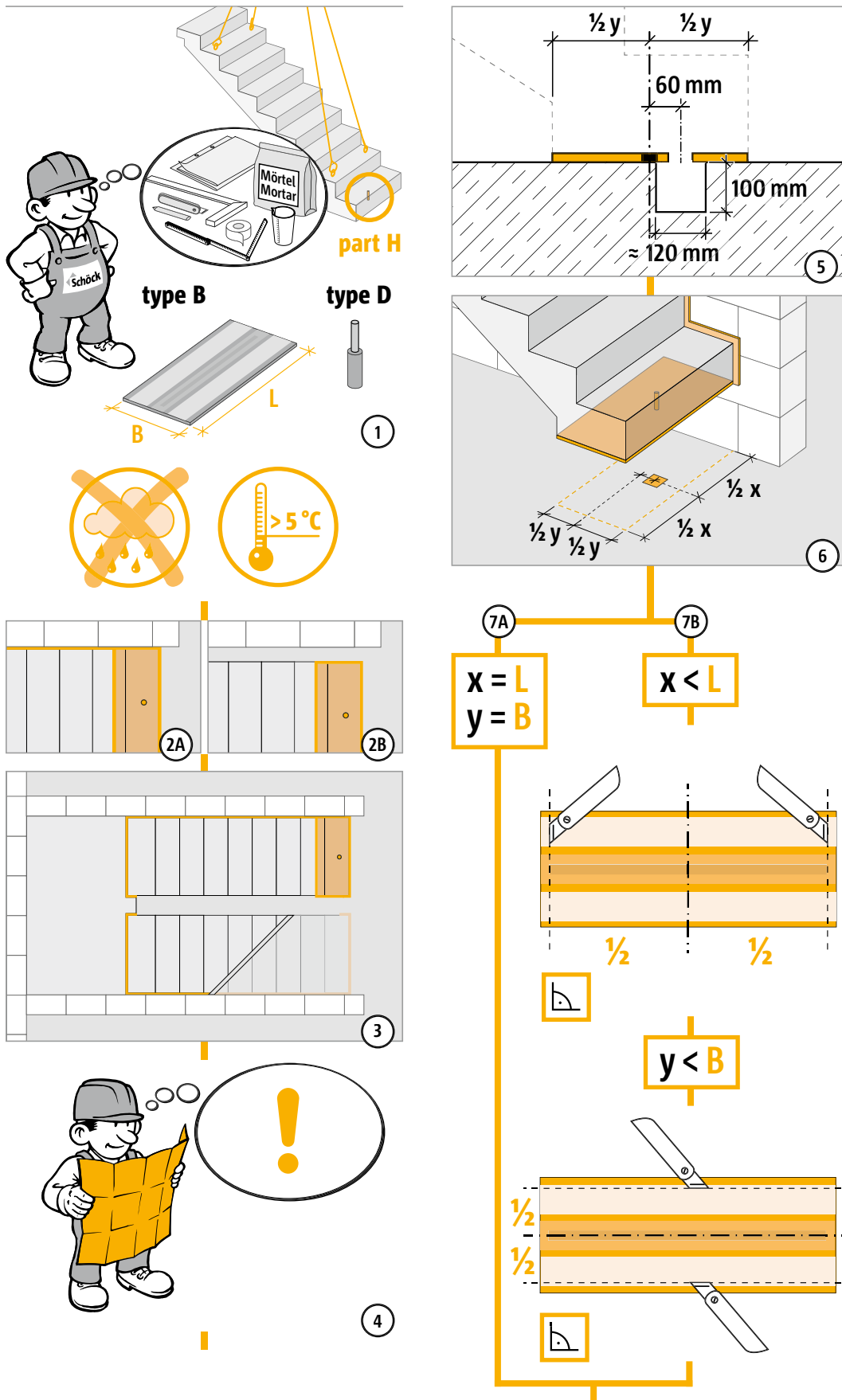


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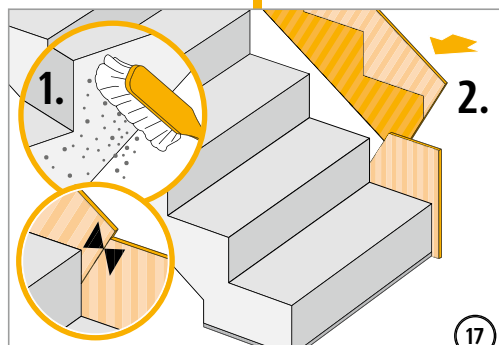
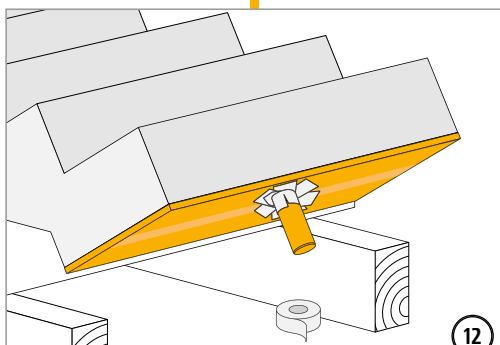
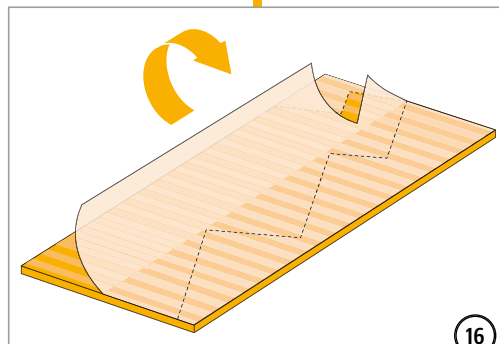
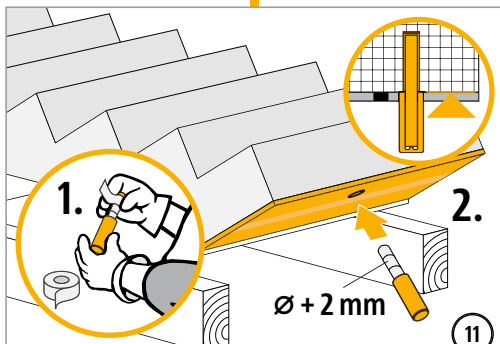
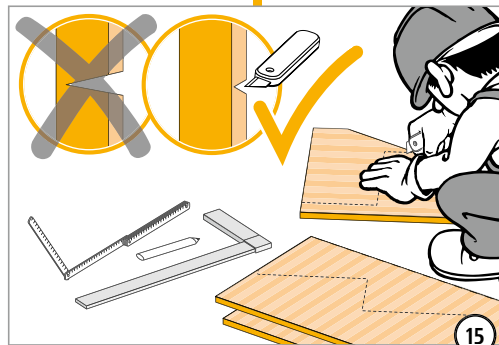
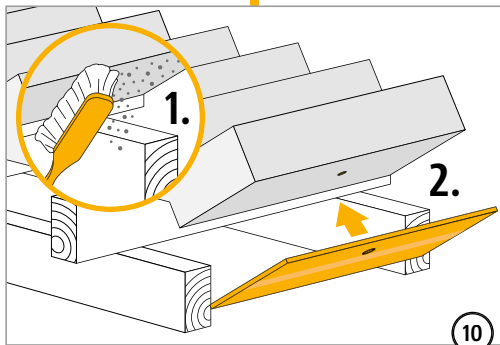
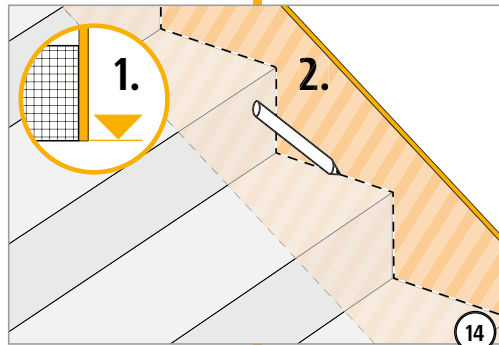
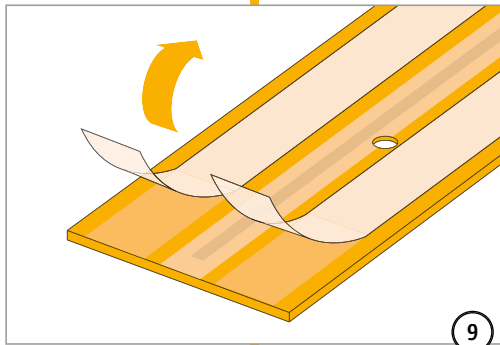
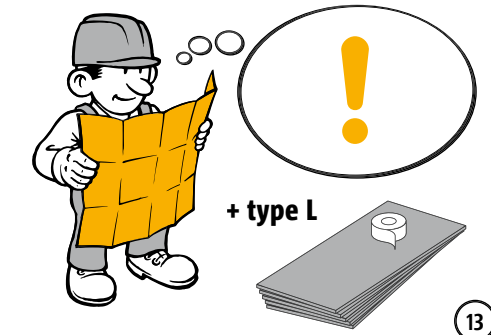
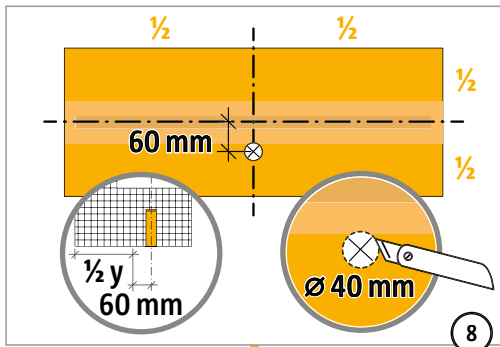
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# Installation instructions building site precast components

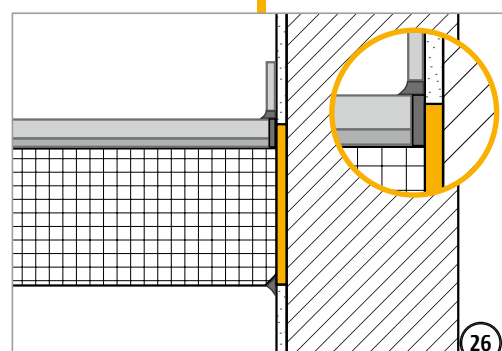
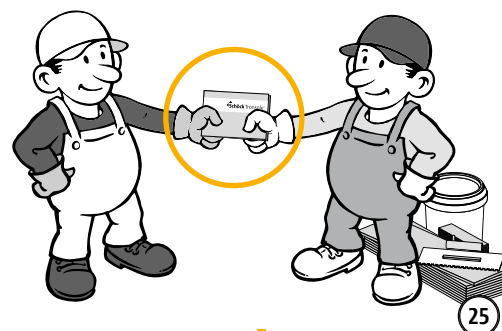
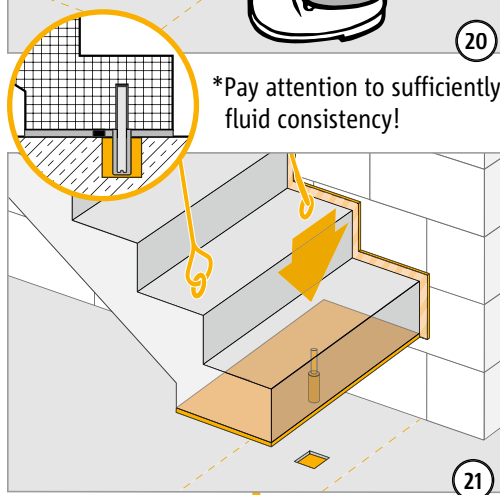
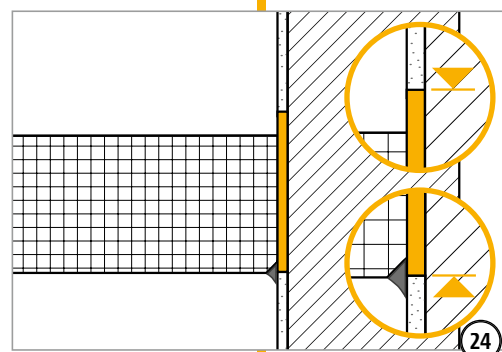
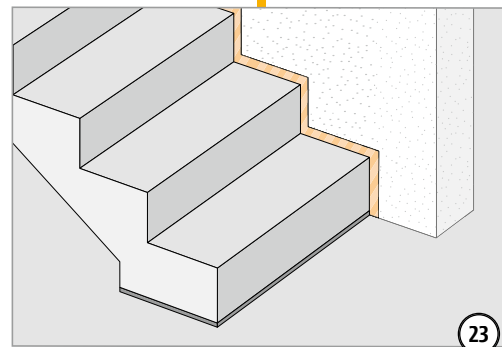
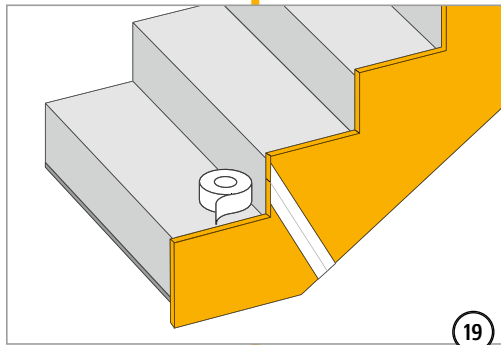
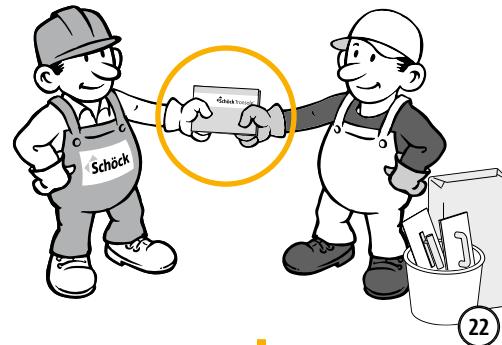
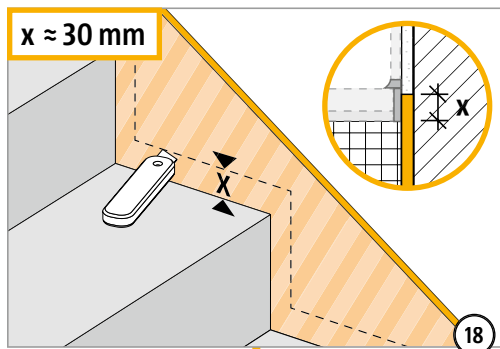


# Installation instructions building site precast components

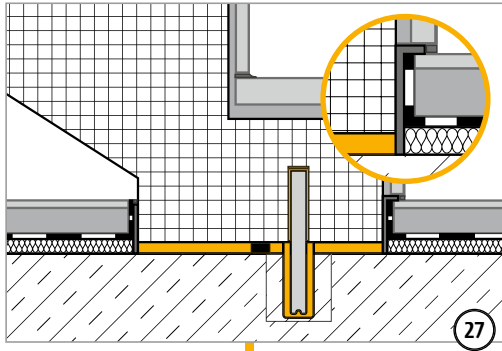


B  
D

## Installation instructions building site precast components



## Installation instructions building site precast components

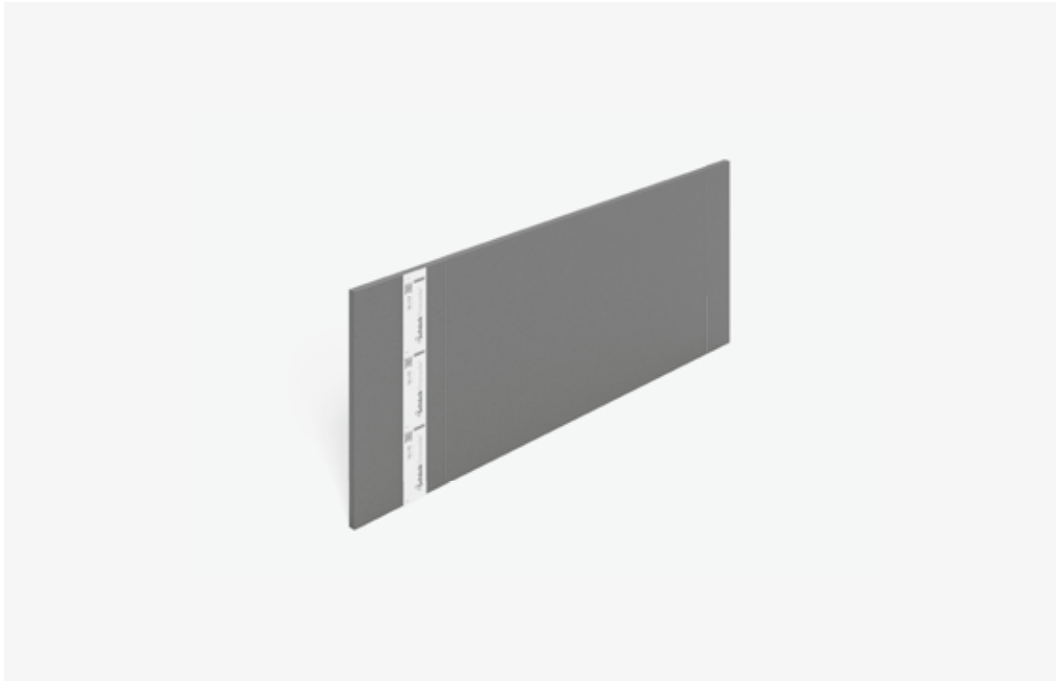


## ✓ Check list

- Are the dimensions of the Schöck Tronsole® matched to the geometry of the structural components which are to be insulated?
- Have the effects on the Schöck Isokorb® connection been specified at design level?
- Have the requirements with regard to fire protection been cleared and announced?
- Are planned existing horizontal loads, which can be conducted away via type B, taken into account?



## Schöck Tronsole® type L



### **Schöck Tronsole® type L (joint formation)**

Serves the acoustic bridge-free formation of the joints between stair flight resp. landing and staircase wall. It can be applied with in-situ concrete as well as prefabricated construction.

The Tronsole® type L is also available in the soundproofing packet (See page 220).

## Product characteristics | Product selection | Type designations

### **i** Product characteristics

- ▶ Optimum impact sound protection through avoidance of acoustic bridges in the area of joints
- ▶ High quality and easily cut PE foam panels
- ▶ Stable material, no damage during construction progress
- ▶ Secure attachment using adhesive assembly tape

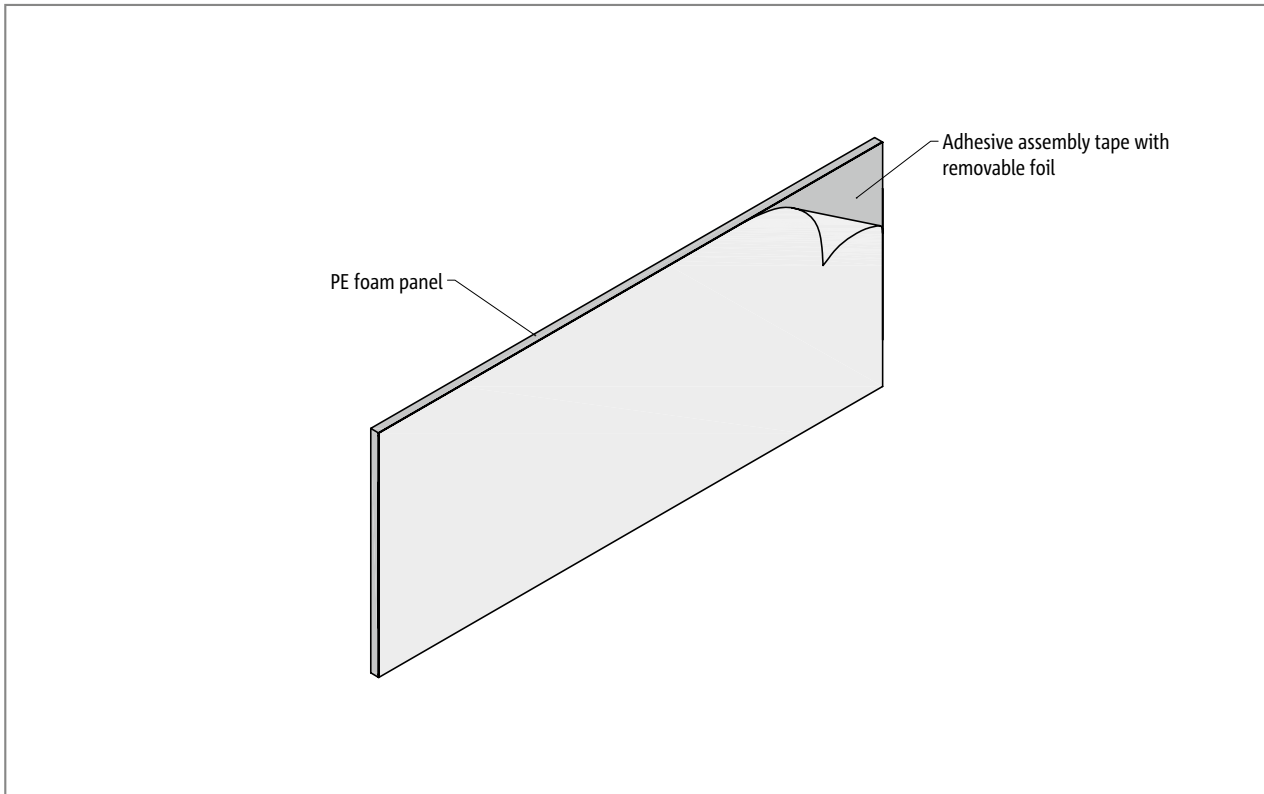


Fig. 186: Schöck Tronsole® type L

### Schöck Tronsole® type L variants

The design of the Schöck Tronsole® type L can vary as follows:

- ▶ Height:  
for landing: H = 250 mm and for stair flights H = 420 mm

### Type designation in planning documents

| Type   |
|--------|
| Height |
| L-250  |



## Installation cross sections

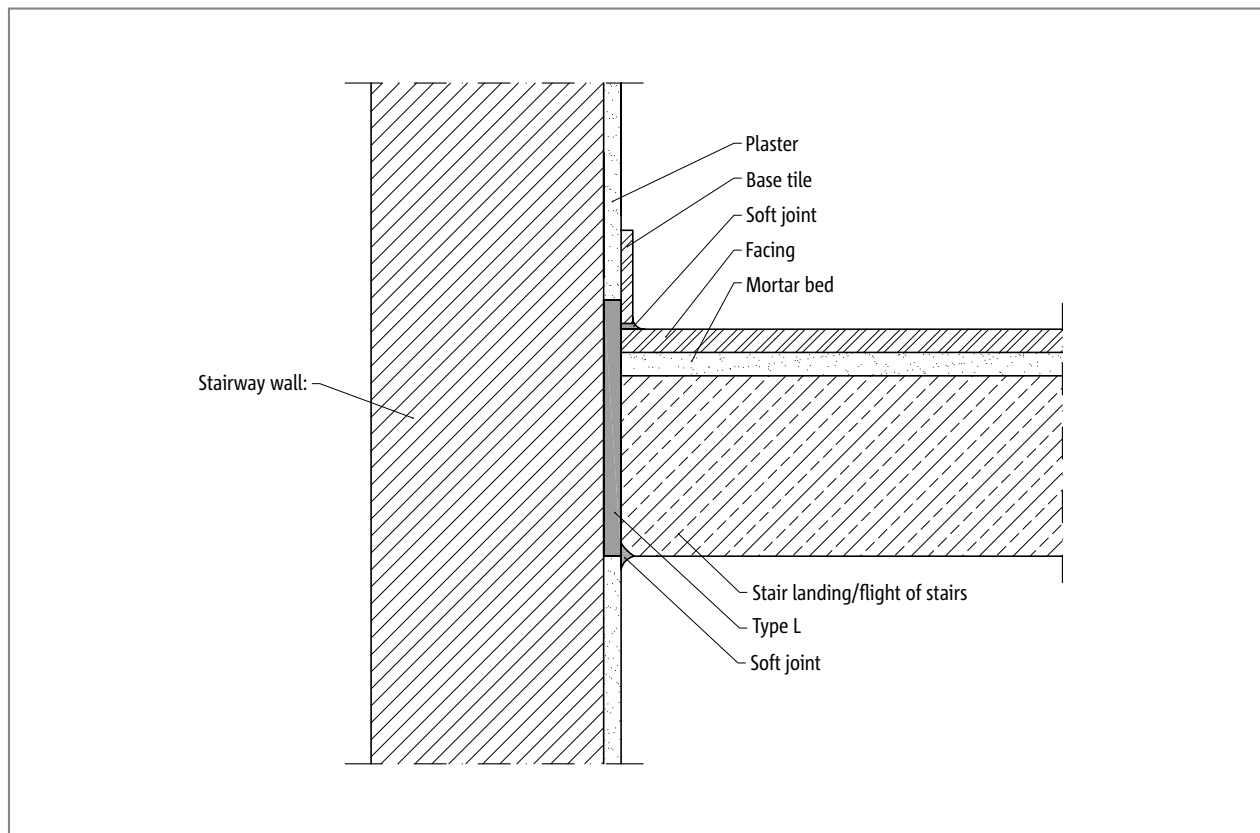


Fig. 187: Schöck Tronsole® type L: Installation cross-section in-situ concrete stairs

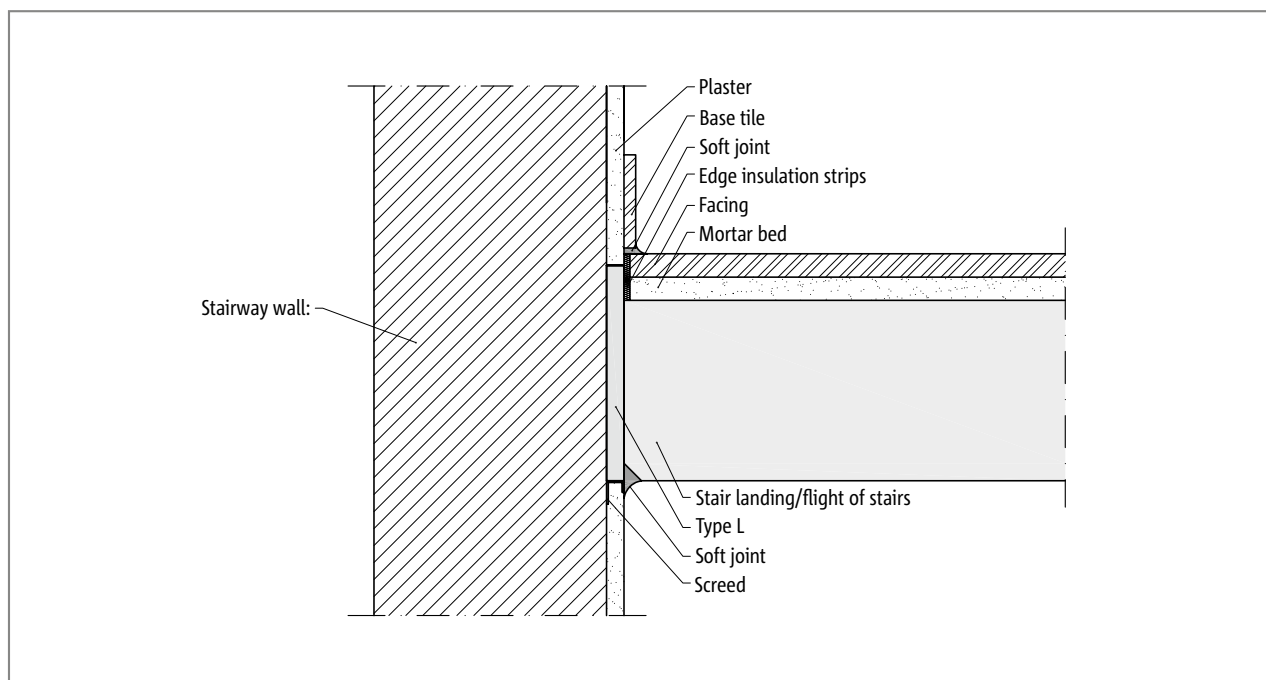


Fig. 188: Schöck Tronsole® type L: Installation cross-section precast landing

## Element arrangement

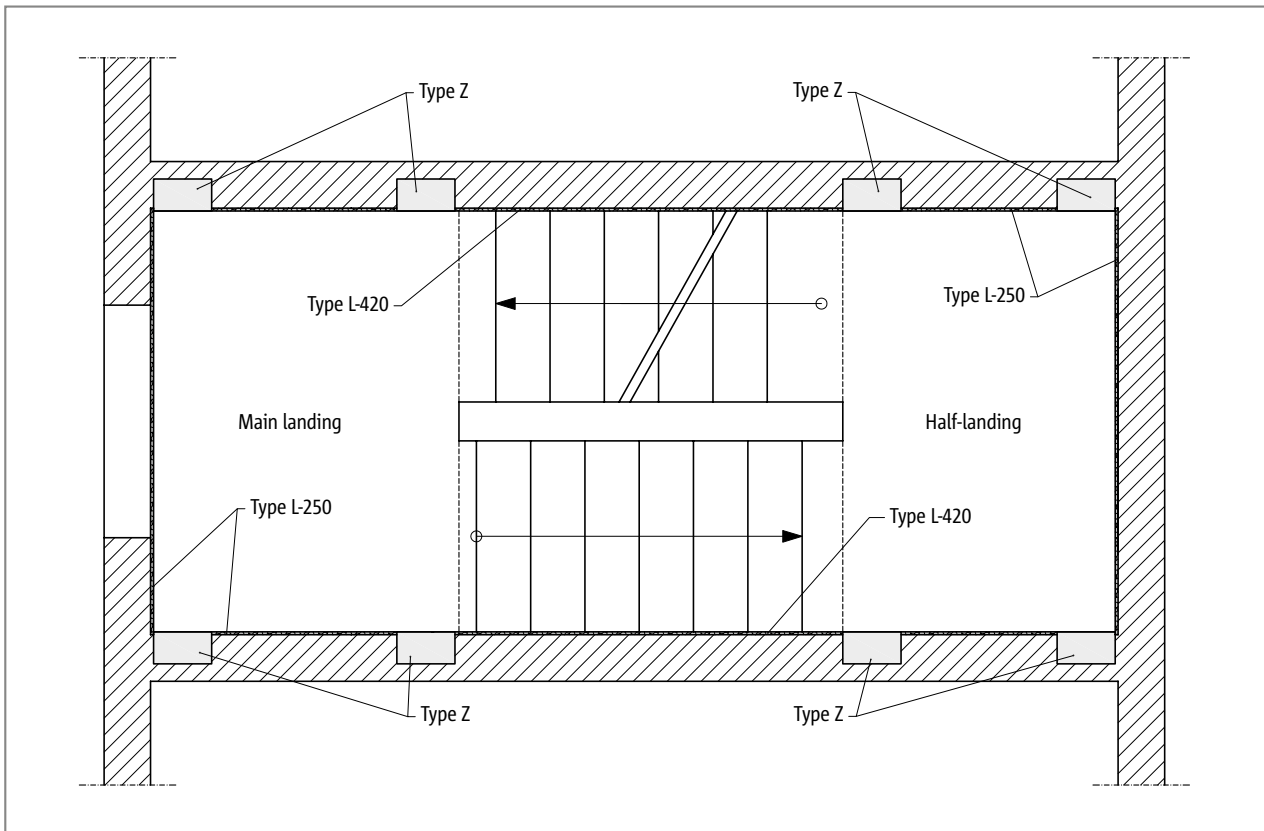


Fig. 189: Schöck Tronsole® type L-250 and type L-420: Soundproofing solution for stair flights and landings with the inclusion of the Tronsole® type Z

### **i** Element arrangement

- ▶ The Schöck Tronsole® type L can be combined with every other Schöck Tronsole® type.

## Element arrangement

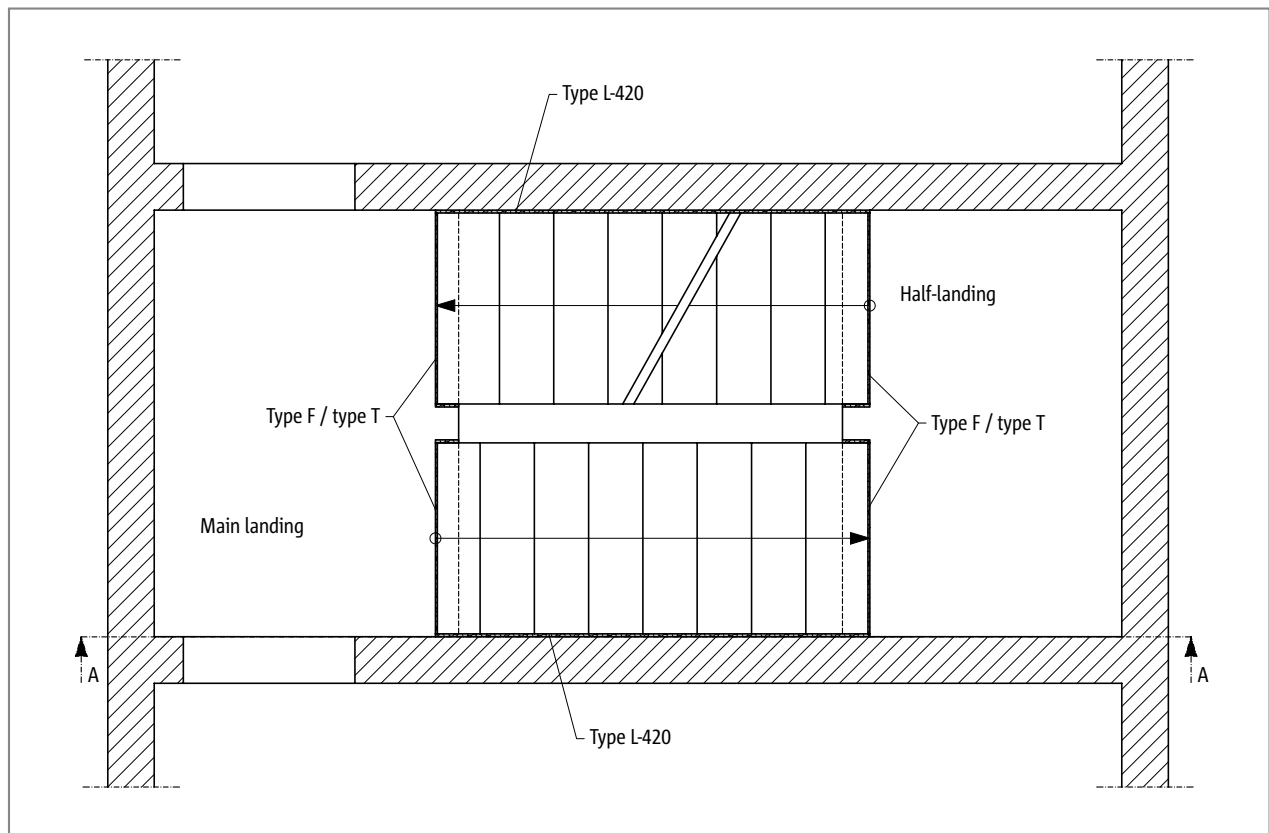


Fig. 190: Schöck Tronsole® type L-420: Soundproofing solution for stair flights with the inclusion of the Tronsole® type F or type T

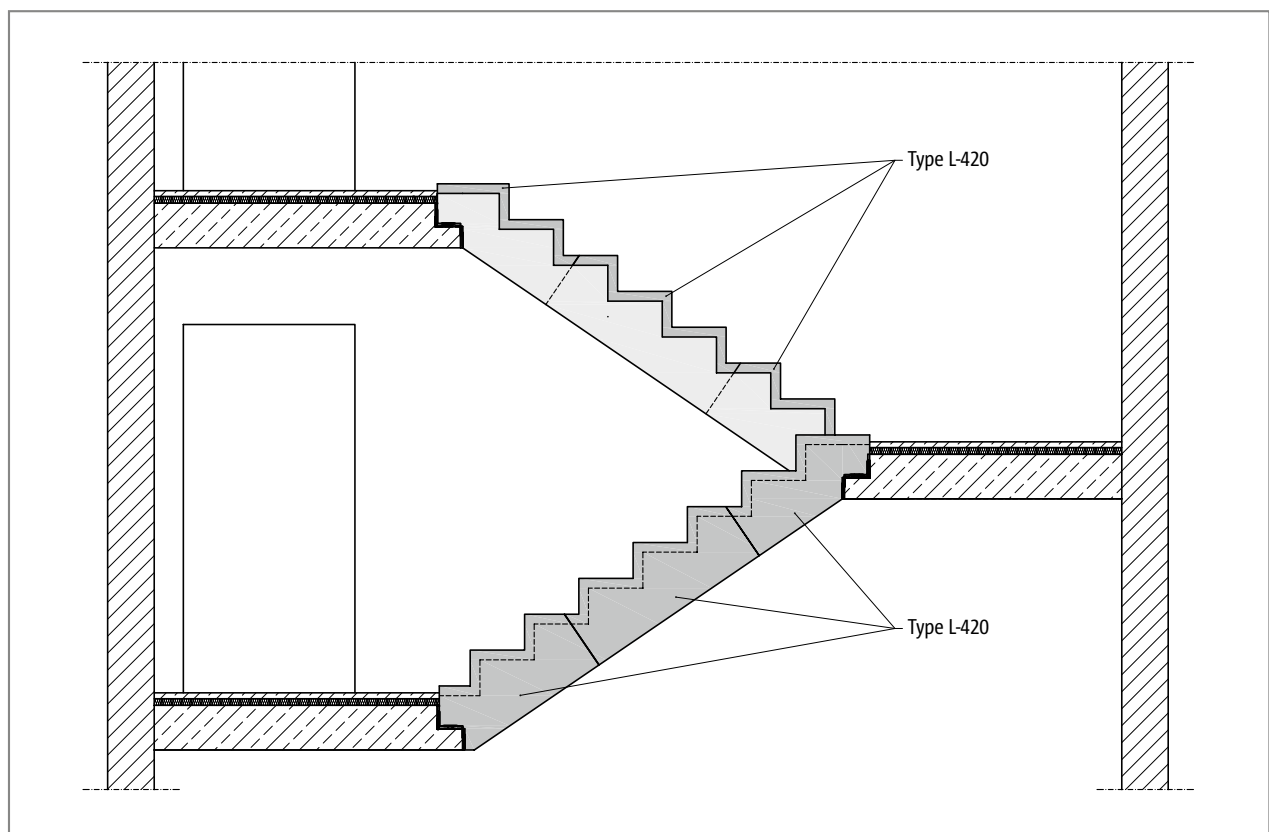


Fig. 191: Schöck Tronsole® type L-420: Element arrangement, Section A-A

## Product description | Precast construction | Fire protection

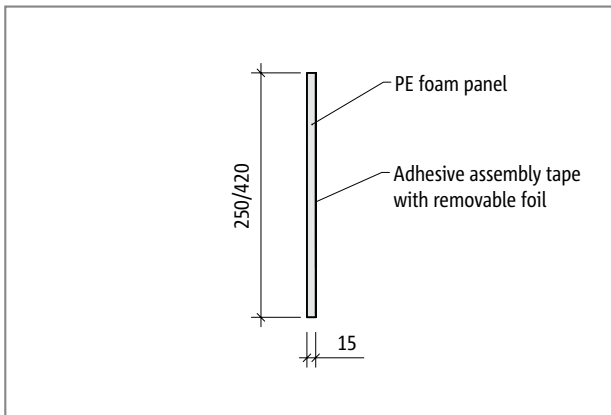


Fig. 192: Schöck Tronsole® type L-250 resp. L-420: Product section

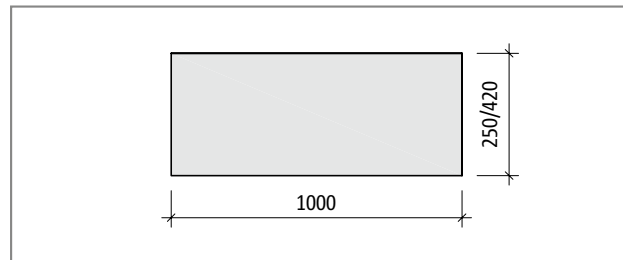


Fig. 193: Schöck Tronsole® type L-250 resp. L-420: Product layout

### **i** Product information

- ▶ The Tronsole® type L is also available as soundproofing packet
- ▶ The Tronsole® type L transmits no statically relevant forces.
- ▶ The Schöck Tronsole® type L is offered with the length  $L = 1000$  mm.

### Precast part construction

If prefabricated stair flights are to be installed between two opposite walls, a dimensional tolerance must be specified by the planner. If, for example, a wall at the site of the stair flight is required, a space of at least 20 mm is to be planned between the stair strings and the enclosing walls, although the Schöck Tronsole® type L is only 15 mm thick. This allows the smooth installation of prefabricated stair flights using affixed Tronsole® type L.

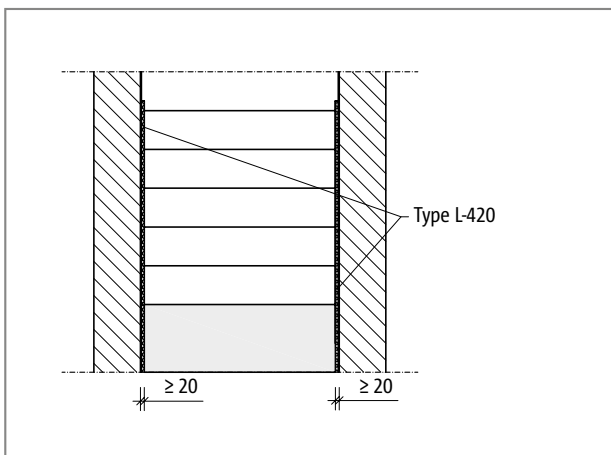


Fig. 194: Schöck Tronsole® type L-420: Taking into account installation tolerances

### Fire protection

With the Tronsole® type L it is a matter of a static, non-relevant, impact soundproofing element.

### **i** Fire protection

- ▶ Tronsole® Type L conforms to building material class B1 according to DIN 4102 (=limited combustibility).

# Materials | Soundproofing packet | Installation instructions | Installation

## Materials and construction materials

| Schöck Tronsole® type L | Material                          |
|-------------------------|-----------------------------------|
| PE foam panel           | PE foam according to DIN EN 14313 |

| Schöck Tronsole® type L                             | Physical properties  |
|---|----------------------|
| Dynamic stiffness in accordance with DIN EN 29052-1 | 90 MN/m <sup>3</sup> |
| Unit weight in accordance with DIN EN ISO 845       | 28 kg/m <sup>3</sup> |
| Water take-up after 7 days                          | < 1 Vol.-%           |

## Soundproofing packet

The soundproofing packet is a coordinated system packet with all necessary installation aids. The supplied adhesive tape for the sealing adhesion of the joint slab butt points simplifies the acoustic bridge-free installation of the Schöck Tronsole® type L. The soundproofing packet completes the impact sound insulation solution in the stair well and is component part of the soundproofing system.

The soundproofing packet consists of:

- ▶ 15 Schöck Tronsole® type L-250 resp. L-420
- ▶ 20 m adhesive tape (1 roll)
- ▶ 1 suitable cutting tool (cutter)
- ▶ 1 pencil
- ▶ 1 installation instruction

## **i** Installation instructions

As the Schöck Tronsole® type L is combined with a force transmitting Tronsole®, the installation instructions for the Tronsole® type L are presented in exemplary combinations in all further product sections.

## **i** Installation

- ▶ The Schöck Tronsole® type L is bonded to the dry and dust-free structural component with the aid of an own-product double-sided assembly adhesive tape. With this, it is matter of a prefabricated stair flight resp. with the staircase wall when it is in-situ concrete stairs.
- ▶ The PE foam panels can be cut by hand using a simple cutting tool.
- ▶ The Tronsole® type L closes the joint between stair string resp. landing and wall maintaining a joint width of 15 mm.

## Check list

- With the planning of prefabricated components is the Tronsole® type L given, is there a sufficiently wide joint between stair flight or landing and staircase wall?
- Are the dimensions of the Schöck Tronsole® matched to the geometry of the structural components which are to be insulated?
- Have the requirements with regard to fire protection been cleared and announced?
- Due to a fire protection requirement are larger concrete covers and larger structural component heights taken into account?

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