

## Installation of HPKM® Column Shoe

### INSTALL THE PRODUCT – PRECAST FACTORY

#### Identification of the product

HPKM® Column Shoes are available in standard models (16, 20, 24, 30 and 39) analogous to M-thread sizes of the HPM® Rebar Anchor Bolts. The model of column shoe can be identified by the name on the label on the product and according to the color of the product. The color codes are shown in the table below. The color codes of recess boxes correspond to the color codes of HPKM® Column Shoes.

*HPKM® Column Shoe with corresponding recess box..*

Column Shoe	Rebar Anchor Bolt	Corner Recess	Middle Recess	Color code
HPKM 16 ACI	HPM 16 ACI	HPKM 16 CBOX	HPKM 16 MBOX	Yellow
HPKM 20 ACI	HPM 20 ACI	HPKM 20 CBOX	HPKM 20 MBOX	Blue
HPKM 24 ACI	HPM 24 ACI	HPKM 24 CBOX	HPKM 24 MBOX	Gray
HPKM 30 ACI	HPM 30 ACI	HPKM 30 CBOX	HPKM 30 MBOX	Green
HPKM 39 ACI	HPM 39 ACI	HPKM 39 CBOX	HPKM 39 MBOX	Orange

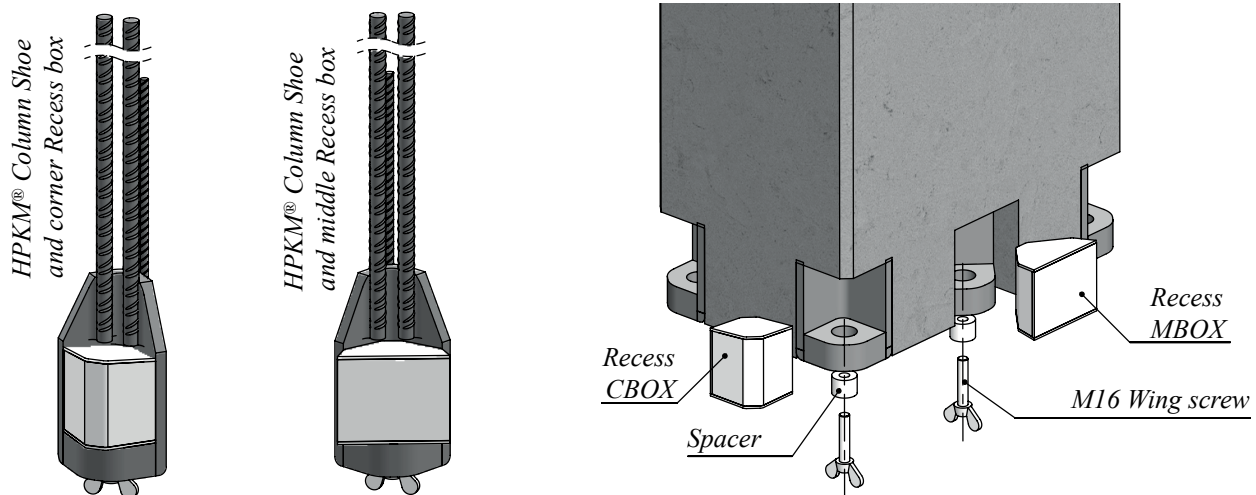
#### Installation of column shoes

The HPKM® Column Shoes are placed into the reinforcement of the column and fixed through their base plates to the end plate of the mold with recess boxes. The installation tolerance of column shoes in the crosswise direction of the column is  $\pm 2$  mm ( $\pm \frac{1}{16}$ "). Supplementary reinforcement must be placed in the area of the column base according to drawings (Technical Manual Annex A). After casting the column, the boxes are removed from the shoes and the voids are checked to ensure that they are free of concrete.

Recess boxes are fixing accessories used to form pockets in concrete column for anchor bolts. There are separate recess boxes available for all types of column shoes, depending on the position of the column shoe in the column's cross-section:

- CBOX is used with column shoes fixed at the corner of the column.
- MBOX is used with column shoes fixed in the middle of the column.

Recess boxes enable the shoes to be fastened and positioned to the end plate of the mold. The M16 wing screw, which comes with a spacer equal to the size of the column shoe's bolt hole, is used for fixing. With the help of the spacer, the shoe can be fixed to the correct place in the end plate. Environmentally friendly formers are very durable and re-usable. It is recommended that they be maintained to achieve a long operating life.



*Recess boxes for corner and middle positions of HPKM® Column Shoe.*

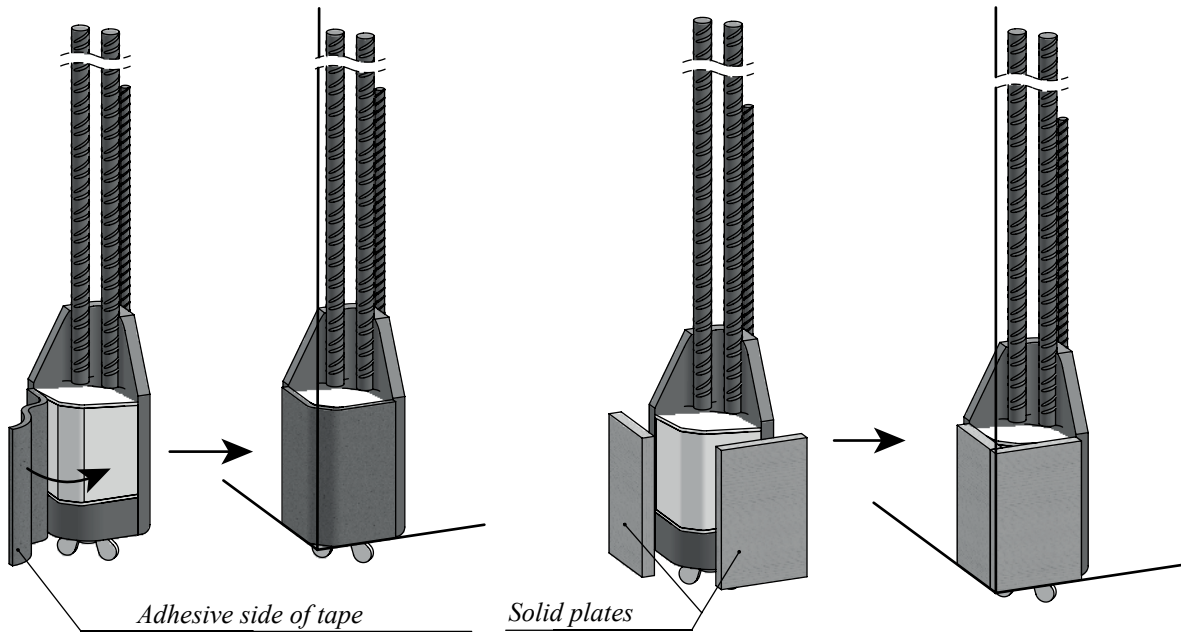
To ensure higher values of concrete cover thicknesses of main anchor bars in accordance with section 1.2.3 of the technical

manual, follow these instructions for increased values  $\Delta_c$  of concrete cover:

- If  $\Delta_c < 5 \text{ mm}$ , there is no special requirement for recess boxes; instructions are the same as for standard concrete cover of column shoes. The gap is too small to be filled up with concrete. However, if the gap is filled or partially filled, the concrete shell can be easily crushed after removing the mold.
- If  $5 \text{ mm} \leq \Delta_c \leq 10 \text{ mm}$ , self-adhesive foam tape or equivalent can be used to prevent the gap from filling up. Foam tape of corresponding thickness  $\Delta_c$  is fixed on two sides of the recess box.
- If  $\Delta_c > 10 \text{ mm}$ , to prevent concrete from filling up the gap, it is recommended that a solid plate be used such as plywood or hardened polystyrene of corresponding thickness  $\Delta_c$ . These plates can be fixed to the surface of the mold.

*Use of **self-adhesive foam tape** to prevent the gap from filling up with concrete.*

*Use of **solid plates** to prevent the gap from filling up with concrete.*



*Ensure thicker concrete cover if using self-adhesive foam tape or solid plates*



*HPKM® Column Shoe before and after casting.*

## INSTALL THE PRODUCT – CONSTRUCTION SITE

### Identification of the product

HPKM® Column Shoes are available in standard models (16, 20, 24, 30 and 39) analogous to M-thread sizes of the HPM® Rebar Anchor Bolts. Firstly, precast concrete columns assembly must be done according to project. The model of column shoe can be identified by the name on the label on the product and according to the color of the product. The color codes are shown in the table below.

*HPKM® Column Shoe color identification.*

Column Shoe	Color code	Anchor Bolt	Installation template
HPKM 16 ACI	Yellow	HPM 16 ACI	PPL 16
HPKM 20 ACI	Blue	HPM 20 ACI	PPL 20
HPKM 24 ACI	Gray	HPM 24 ACI	PPL 24
HPKM 30 ACI	Green	HPM 30 ACI	PPL 30
HPKM 39 ACI	Orange	HPM 39 ACI	PPL 39

### Erection of precast column

#### 1. Levelling a precast concrete column

Before erecting the column, the upper nuts and washers are removed from the anchor bolts. The lower nuts and washers are adjusted to the correct level. The column is erected directly on the pre-levelled washers and nuts.

Alternatively, shims are placed between the anchor bolts and adjusted to the correct level. The lower levelling nuts must be levelled to at least 5 mm ( $\frac{3}{16}$ " ) below the top level of the shims to ensure that the column will rest first on the shims. This method is recommended for heavier columns for easier and faster alignment of the column.

#### 2. Aligning a precast concrete column

The upper nuts and washers are screwed onto the bolts and the attachment is aligned in the vertical position using levelling nuts. It is practical to use two theodolites from different directions to ensure verticality. After initial tightening (between 20 to 30% of verification torque), the nuts should be turned to the required nut rotation specified in the Table below. Subsequently a torque wrench should be used to verify that a torque at least equal to the  $T_v$  is required to additionally tighten the nuts. Detailed information about nut tightening procedure and sequence of the steps can be found in Steel design guide 1, 2nd edition / Base plate and anchor rod design, Appendix A, section A2.1.

*Recommended minimum  $T_{min}$  and maximum  $T_{max}$  torque values of nuts.*

Anchor Bolt	Nut Rotation	$T_v$ [Nm]
HPKM 16 ACI	$\frac{1}{3}$ Turn	95 N/m ; 70 lbs/ft
HPKM 20 ACI	$\frac{1}{3}$ Turn	165 N/m ; 125 lbs/ft
HPKM 24 ACI	$\frac{1}{3}$ Turn	395 N/m ; 300 lbs/ft
HPKM 30 ACI	$\frac{1}{3}$ Turn	795 N/m ; 575 lbs/ft
HPKM 39 ACI	$\frac{1}{6}$ Turn	1365 N/m ; 1,000 lbs/ft



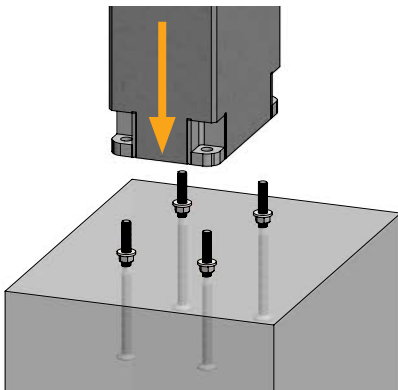
### 3. Grouting the joint and recesses

Before loading the column with any other structures such as beams or columns, the joint underneath the column and bolt recesses must be grouted following the instructions of the grout supplier. The grout must be non-shrink grade with strength according to the plans. To avoid air being trapped in the joint, it is recommended that grout be poured from one side of the column only. Grouting formwork is made so that adequate concrete cover for column shoes and anchor bolts is achieved.

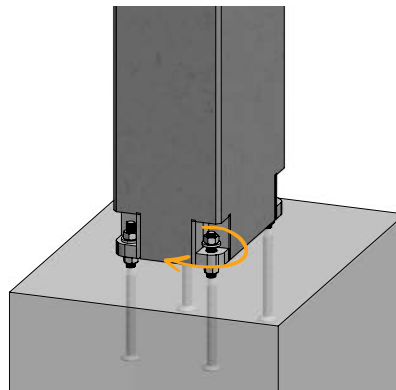
After grout has reached sufficient strength, the connection is finalized and joining structures may be erected onto the column.

#### Erection of a precast concrete column step by step

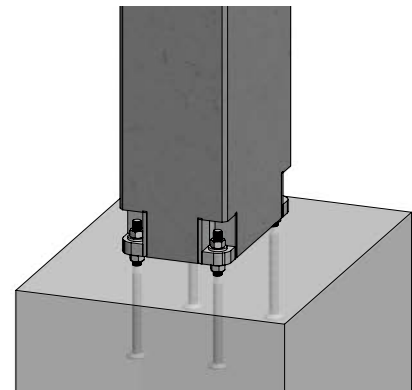
*The column is installed directly on the pre-leveled washers and nuts.*



*The upper nuts and washers are screwed onto the bolts.*



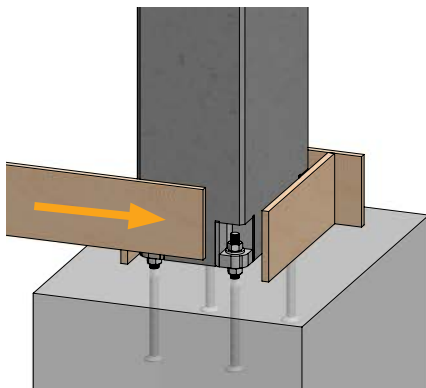
*After the nuts are tightened, the crane can be released.*



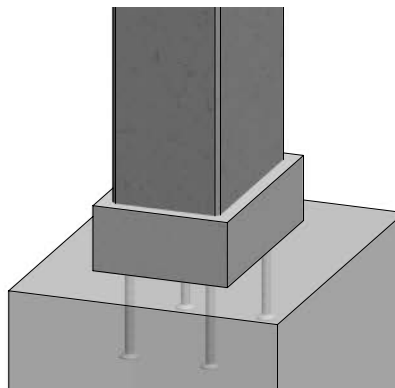
#### NOTE!

The open joint must be grouted, and the grout has to reach its designed strength before the column is loaded by other structures.

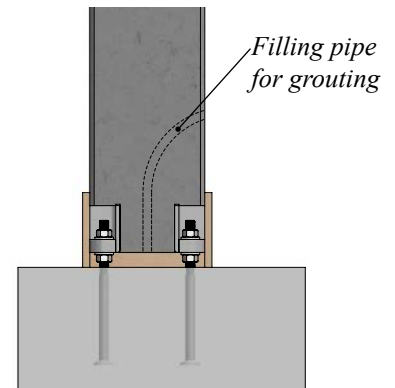
*Formwork for grouting the joint and recesses.*



*Finalized connection after grouting has hardened.*

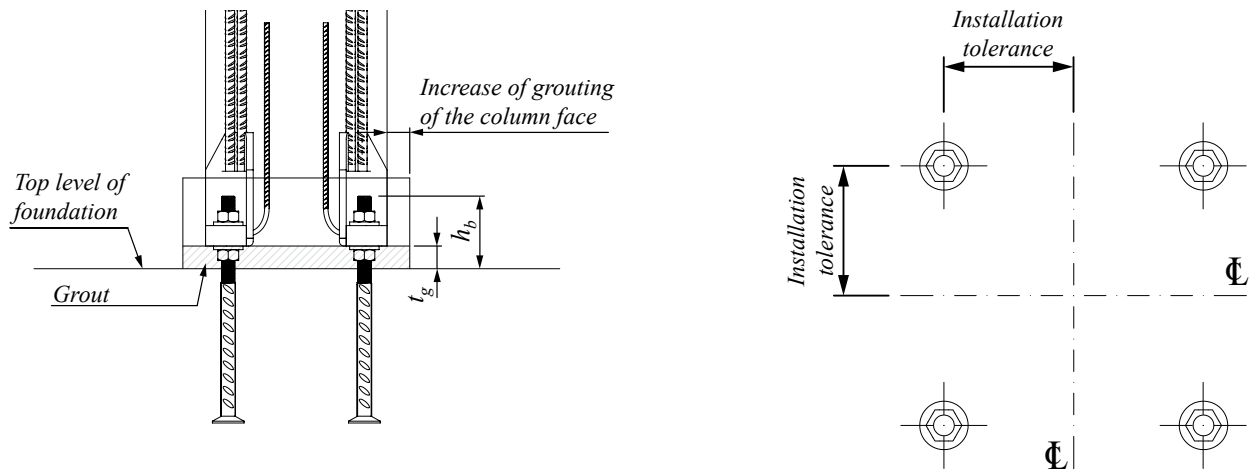


*Alternative where grouting is aligned with column face.*



In column-to-foundation connections, wider grouting can be provided to ensure higher concrete cover if it is required. It is recommended that the cover be increased in aggressive environments.

Installation tolerances and the anchor bolt's protrusion from the surface of concrete when HPKM® Column Shoes are used.



Column Shoe	HPKM 16 ACI	HPKM 20 ACI	HPKM 24 ACI	HPKM 30 ACI	HPKM 39 ACI
Anchor Bolt	HPM 16 ACI	HPM 20 ACI	HPM 24 ACI	HPM 30 ACI	HPM 39 ACI
Thickness of grouting $t_g$ [mm]	50 mm 2"	50 mm 2"	50 mm 2"	50 mm 2"	50 mm 2"
Protrusion of bolt $h_b$ [mm]	105 mm 4-1/8"	115mm 4-1/4"	130mm 5-1/8"	150mm 5-7/8"	180mm 7-1/8"
Installation tolerance for the bolt [mm]	± 3 mm ± 1/8"	± 3 mm ± 1/8"	± 3 mm ± 1/8"	± 3 mm ± 1/8"	± 3 mm ± 1/8"