Implementation of rigid prefabricated column joints

Analyzing the static schemes of transverse frames used in current construction practice, we see the dominance of the scheme in which the connection of the columns to the foundation is realized as a rigid joint. This is a key connection for the stability of the object, which can be realized in many ways. However, the standard here is becoming the use of system bolted connectors.

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In virtually every prefabricated frame construction project, the priority is a rigid joint connecting the column with the foundation. In practice, it can be made using various systems: by placing the column in the foundation socket, connecting the footing to the column in a prefabrication plant (footing column), using reinforcing bars anchored in channels created in the column (so-called starter bars) or using system bolted connectors. This last method, due to its numerous advantages, is replacing other systems on the market, meeting the expectations of participants in the construction process.

An example of a bolted connector system is the **PFEIFER PCC column support system**. It consists of a column support concreted into the column and a **PFEIFER PGS** foundation anchor with a protruding external thread, embedded in a monolithic footing or foundation slab. The connection is made by bolting using nuts. Using a set of two washers and nuts allows for precise rectification of the column and ensures sufficient fixing already at the assembly stage (unlike the “starter bar” solution, which requires additional struts to protect the column from tipping over). After the high-strength mortar has set, filling the space between the column and the foundation, we obtain a fully load-bearing joint and the possibility of installing subsequent building structure elements.

Thanks to the simplicity of this a quick and safe connection, the time required to complete the core construction is significantly shortened, and the precise assembly of the posts is carried out without unnecessary downtime, regardless of weather conditions.

The popularity of the **PFEIFER PCC** system is influenced not only by the obvious benefits for installers, but also by other advantages of the system, including optimal support geometry, minimization of eccentricities and favorable position of the screw axis. Designers can easily select a proven connection that takes into account assembly tolerances and is cost-effective. The lack of standardized guidelines for calculations and documents permitting the use of "starter bar" connections, as well as the lack of certainty as to the subsequent correct execution of the joint on the construction site mean that the design of bolted connections has gained a great advantage. **PFEIFER PGS** foundation anchors with the load-bearing capacity specified in the catalogues can also be successfully used for screwing steel columns (fixed or articulated to the foundation).

The growing requirements for storage facilities mean that, in addition to the increasing usable area, these buildings are also getting higher every year, which in turn – due to transport, production and assembly limitations – necessitates the division of prefabricated columns at height. The connection formed at the point of joining the columns must be rigid. To implement it, you can use column supports embedded in the upper column and rod anchors concreted in the head of the lower column.

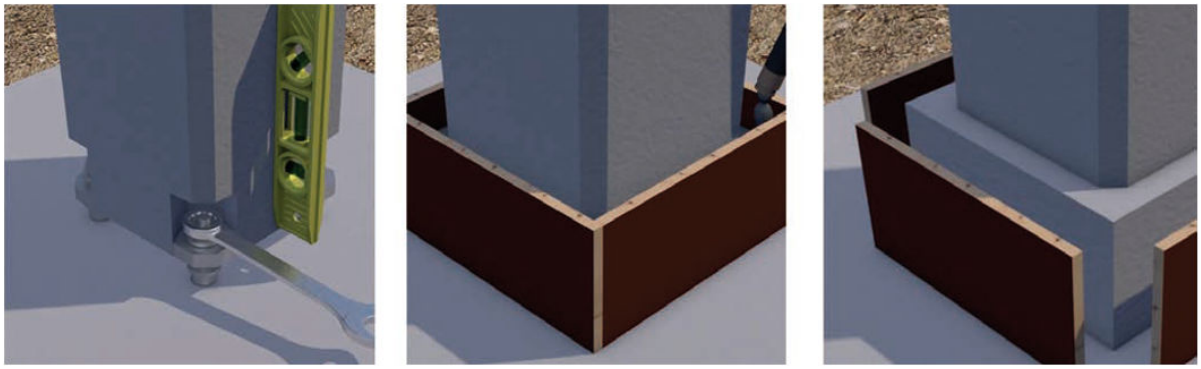

Fig. 1. Rectification and grouting of a prefabricated column

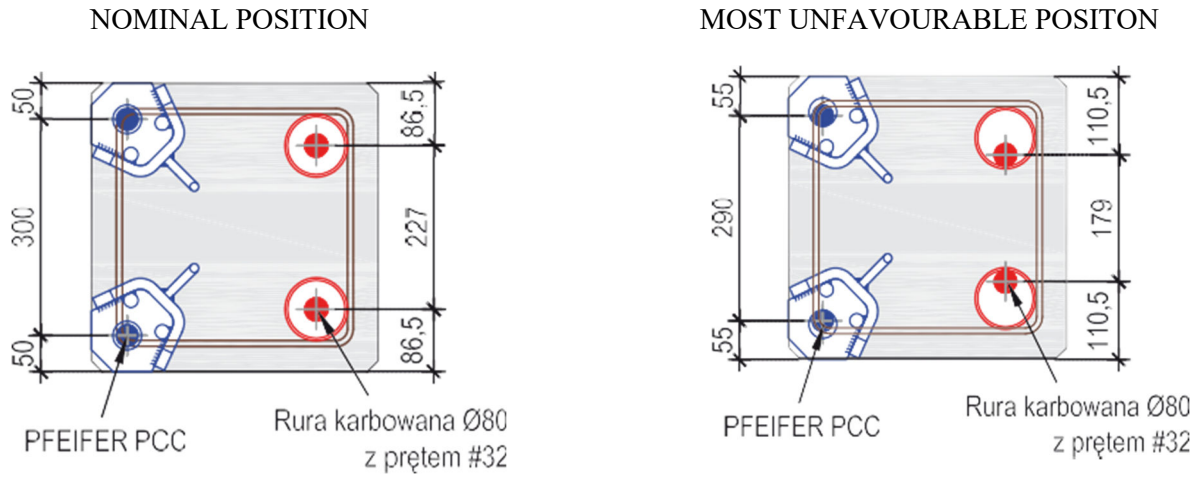

Fig. 2. Comparison of the moment transfer arm for PFEIFER PCC supports and the "starter bar" connection at the nominal and most unfavourable position (for a 40 x 40 cm column)

The use of system accessories built into prefabricated elements gives construction almost unlimited possibilities for creating the most complex rigid connections. This is particularly necessary in the structures of tall buildings, where each additional rigid connection affects the limitation of displacements. Connecting a beam to an external column, continuing beams along their length, continuing beams or beam-walls at the location of multi-storey columns are examples of connections that can be implemented as rigid ones, using the advantages of bolted connections. Each connection requires an individual design analysis and selection of the most appropriate connection system.

To make it easier for the designer to select the correct connectors for connecting a column to a foundation or a column to a column at a height, PFEIFER has made available a new, free calculation program "**PFEIFER Column Supports**". Intuitive to use, with a well-prepared interface, it allows you to select the appropriate size of the **PFEIFER PCC** column support and the appropriate model and size of the **PFEIFER PGS** anchor. A wide range of foundation

anchors, which can be briefly divided into two groups ensuring shallow and deep anchoring, allows for optimal adjustment to the specific installation situation. The program performs separate calculations for three situations/phases of making a connection. Calculations and selection of system connectors are checked for the assembly phase (without grouting), the final phase (operational) and the fire situation. Designers can enter basically any geometric and material parameters characterizing the construction of the connected elements. To check the assembly phase, the following are necessary: correct determination of the actual height of the pole and data necessary to determine the effect of wind on the pole (wind zone, terrain category, height of the connection above ground level). For the final (operational) and fire phases, it is required to provide a set or sets of forces loading the connection (normal force, transverse forces and moments in two directions). In the event of a fire, **PFEIFER PCC** column supports are fire resistant without the need to use additional protective materials. The program allows for calculation of connections in classes from R30 to R240. The favorable value of the load-bearing capacity reduction factor of the column support in a fire situation means that it is usually not necessary to increase the size of the connector, and the calculations and selection of connectors in a normal situation are reliable. After analyzing all cases and entering data, a comprehensive calculation report is generated. The printout includes a list of selected column supports, foundation anchors and necessary accompanying accessories that facilitate installation and assembly.

The design process is safe and transparent thanks to the program. It eliminates the need for the designer to focus on the individual design of welded or bolted joints. The standard **PFEIFER PCC** connector sets are able to implement his intentions, guaranteeing efficiency and reliability.

PFEIFER can boast many years of experience in the field of prefabricated element connections. All PFEIFER systems meet the most important assumptions of prefabricated construction to the highest degree: reliability, speed of implementation, economy, quality and safety. The same applies to the PFEIFER column supports and PFEIFER foundation anchors described above, which are an excellent choice for connections in prefabricated reinforced concrete structures – especially the rigid nodes known from monolithic structures.

Photo: Steel structure of the stadium roof attached using the PGS PFEIFER system

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