SAFELY TRANSPORT TWIN WALL PANELS

KE ANCHORS
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It is our mission not only to provide the very latest building technology, but to also be one crucial step ahead of the game at all times. That is why we are constantly undertaking pioneering work in all product areas. Our employees consistently put their extensive practical experience and creativity to use in the interests of our customers. In constant dialogue with our target groups on a partnership basis, we are already developing the products today that will be needed tomorrow. Our momentum continues to set new benchmarks in structural engineering – yesterday, today and tomorrow, too. This is what we mean by “forward constructing”.
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16 Service & contact
  We are always there for you.
  We will be wherever you are.
KE transport anchors

SAFELY TRANSPORT TWIN WALL PANELS

THE PRODUCT
The design of the KE transport anchor enables it to be easily integrated into the production process. It can be assembled with the reinforcement girder in any position. This ensures versatility to accommodate different panel designs and cost efficiency.

ADVANTAGES
- CE mark
- Quality-monitored
- Two ranges of anchors enable cost-effective product selection to meet the required load performance.

APPLICATION AREA
KE transport anchors are used to rotate, transport and position element walls throughout the entire manufacturing and installation process, whether it be in the pre-cast factory or the building site. Due to the diversity and design of KE transport anchors, these products are unique in terms of their technical, economic and safety characteristics.
In order to ensure the highest possible levels of safety and reliability, KE anchors are subject to exhaustive testing and quality monitoring. The range of versions available enable cost-effective matching of products to the required load-bearing capacity.

The KE transport anchor is divided into load ranges III and IV. These products are manufactured using ductile smooth steel and without welds. This ensures no weld embrittlement of the material in areas that are subject to load, and reliable load transfer over the entire length of the anchor.

**KE TRANSPORT ANCHORS**

- CE marking
- Quality-monitored and certified in accordance with VDI/BV-BS 6205 and the Machinery Directive 2006/42/EC
- Anchor made of S355 smooth steel
- Technically approved braces made of laminated veneer lumber
- Anchor hoop made of B500B
- Two load ranges
- Anchor widths of 130–350 mm

**KE III**

**KE IV**

In accordance with guideline VDI/BV-BS 6205, the transport anchors are divided into load ranges III and IV. The KE III anchor is designed for loads associated with normal component sizes and transport conditions. The KE IV anchor is used for particularly heavy components.
APPLICATION

LOADING
When discussing loads, it is important to distinguish between the tension and shear loads associated with handling pre-cast components

Load types:

TENSION LOADS

Axial pull, $\beta = 0^\circ$

Diagonal pull, $0^\circ \leq \beta \leq 45^\circ$

TRANSVERSE SHEAR LOADS

Transverse pull, $\beta = 0^\circ$

Diagonal transverse pull, $0^\circ \leq \beta \leq 45^\circ$

TURNING

90° transverse pull

ANCHOR SPACING AND EDGE DISTANCES

Installation away from edges

- KE III
  - $a_w \geq 200$ mm
  - $a_h \geq 200$ mm
- KE IV
  - $a_w \geq 400$ mm
  - $a_h \geq 400$ mm

Installation close to edges

- KE III
  - $a_w \geq 125$ mm
  - $a_h \geq 125$ mm
  - $h_{w} \geq 200$ mm

NOTE

- The concrete area above the opening is subject to compression loads under diagonal pull and diagonal transverse pull. It must be checked with reference to these loads.
- In the event of applications requiring reduced edge distances, please contact our technical department
**APPLICATION**

**TENSION LOADS**
- Axial pull
- Diagonal pull

**TRANSVERSE SHEAR LOADS**
- Transverse pull
- Diagonal transverse pull

**LOAD CAPACITY OF ANCHORS LOCATED AWAY FROM EDGES**

<table>
<thead>
<tr>
<th>Vertical load proportion per anchor $F_{zv}$ [kN]</th>
<th>Load angle</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>KE III Concrete strength $f_{c,\text{cube}}$150 [N/mm²]</th>
<th>KE IV Concrete strength $f_{c,\text{cube}}$150 [N/mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tension loads $\beta = 0^\circ$</td>
<td></td>
<td>22.5</td>
<td>25.9</td>
<td>29.0</td>
<td>15</td>
<td>20</td>
</tr>
<tr>
<td>$\beta = 30^\circ$</td>
<td></td>
<td>19.5</td>
<td>22.4</td>
<td>25.1</td>
<td>38.2</td>
<td>44.1</td>
</tr>
<tr>
<td>$\beta = 45^\circ$</td>
<td></td>
<td>15.9</td>
<td>18.3</td>
<td>20.5</td>
<td>31.2</td>
<td>36.0</td>
</tr>
<tr>
<td>Transverse shear loads $\beta = 0^\circ$</td>
<td></td>
<td>8.7</td>
<td>10.0</td>
<td>11.2</td>
<td>10.6</td>
<td>12.2</td>
</tr>
<tr>
<td>$\beta = 30^\circ$</td>
<td></td>
<td>7.5</td>
<td>8.7</td>
<td>9.7</td>
<td>9.2</td>
<td>10.6</td>
</tr>
<tr>
<td>$\beta = 45^\circ$</td>
<td></td>
<td>6.2</td>
<td>7.1</td>
<td>7.9</td>
<td>7.5</td>
<td>8.6</td>
</tr>
<tr>
<td>Turning $\beta = 90^\circ$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16.1</td>
<td></td>
</tr>
</tbody>
</table>

*If transport anchors are installed in twin wall panels under plant specific and continuous inspection the table values can be increased with factor $3.0/2.5 = 1.2$ (see guideline VDI/BV-BS 6205 chapter 8.2.2.3.2). In this case, no dynamic factors smaller than 1.3 may be used (see page 14 – 15).*

**LOAD CAPACITY OF ANCHORS LOCATED CLOSE TO EDGES**

<table>
<thead>
<tr>
<th>Vertical load proportion per anchor $F_{zv}$ [kN]</th>
<th>Load angle</th>
<th>15</th>
<th>20</th>
<th>25</th>
<th>KE III Concrete strength $f_{c,\text{cube}}$150 [N/mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tension loads $0^\circ \leq \beta \leq 45^\circ$</td>
<td></td>
<td>12.5</td>
<td>14.0</td>
<td>15.5</td>
<td></td>
</tr>
</tbody>
</table>

**NOTE**
- The tables relate to the vertical load capacity $F_{ZV}$ of a single anchor.
- When applying the load values, please also check the applicable factors and recommendations shown on pages 13, 14 and 15.
- When anchors are installed close to edges, the anchors should not be subjected to transverse shear loads. The precast units should be rotated to the vertical position using a tilting table before using the anchors to lift them.
- The specified anchor loads apply to undamaged components. For this reason, the components must be inspected for damage prior to every lifting process.
# PRODUCT DETAILS

## DIMENSIONS

<table>
<thead>
<tr>
<th>Type</th>
<th>KE III</th>
<th>KE IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dimensions [mm]</td>
<td>Dimensions [mm]</td>
</tr>
<tr>
<td>b</td>
<td>l</td>
<td>l₀</td>
</tr>
<tr>
<td>120</td>
<td>120</td>
<td>515</td>
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<tr>
<td>130</td>
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<td>645</td>
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<tr>
<td>350</td>
<td>350</td>
<td>645</td>
</tr>
</tbody>
</table>
USE

CALCULATING THE REQUIRED ANCHOR WIDTH:

The required anchor width (b) depends on the structure of the panel.

INSTALLATION OF THE TRANSPORT ANCHOR PARALLEL TO THE REINFORCEMENT GIRDER

Calculating the required anchor width:

\[ b = d - c_{va,1} - c_{va,2} - d_{s,hi} - d_{s,ha} \]

- \( b \) = Transport anchor width
- \( d \) = Wall width
- \( c_{va,1} \) = Reinforcement concrete cover in internal leaf
- \( c_{va,2} \) = Reinforcement concrete cover in external leaf
- \( d_{s,hi} \) = Horizontal reinforcement diameter in internal leaf
- \( d_{s,ha} \) = Horizontal reinforcement diameter in external leaf

In general, the transport anchor width is equal to the braced girder height

INSTALLATION OF THE TRANSPORT ANCHOR PERPENDICULAR TO REINFORCEMENT GIRDER

Calculating the required anchor width:

\[ b = d - c_{va,1} - c_{va,2} - d_{s,vi} - d_{s,va} \]

- \( b \) = Transport anchor width
- \( d \) = Wall width
- \( c_{va,1} \) = Reinforcement concrete cover in internal leaf
- \( c_{va,2} \) = Reinforcement concrete cover in external leaf
- \( d_{s,vi} \) = Vertical reinforcement diameter in internal leaf
- \( d_{s,va} \) = Vertical reinforcement diameter in external leaf
USE

BOUNDARY CONDITIONS

Installation position of the KE transport anchors

Concrete embedment:
The red marking must be completely encased in concrete.

Concrete embedment:
The red marking must be completely encased in concrete.

Minimum concrete cover:
KE III: $c_v \geq 10 \text{ mm}$, $c_{va} \geq c_{nom} \geq 20 \text{ mm}$
KE IV: $c_v \geq 18 \text{ mm}$, $c_{va} \geq c_{nom} \geq 20 \text{ mm}$
USE

BOUNDARY CONDITIONS

Twin wall requirements

Leaf thickness:
KE III: $s \geq 50$ mm
KE IV: $s \geq 60$ mm

Minimum reinforcement:
Dia. 6/20

Tension lifts

Anchors located away from edges:
Horizontal edge reinforcement diameter $d \geq 10$ mm, reinforcement girder to outside of anchor position

Anchors located close to edges:
Horizontal and vertical edge reinforcement diameter $d \geq 10$ mm, reinforcement girder placed between opening and anchor position

Transverse lifts

Anchors located away from edges:
For transverse lifts position the reinforcement girder between the anchor and the edge of the panel

Anchors located close to edges:
For transverse lifts position the reinforcement girder between the anchor and the edge of the panel and also between the anchor and any interior opening
USE

BOUNDARY CONDITIONS

Number and position of the KE transport anchors

- Anchors located away from edges
  Distance from edge KE III:  \( a \geq 200 \text{ mm} \)
  Distance from edge KE IV:  \( a \geq 400 \text{ mm} \)

- Anchors located close to edges
  Distance from edge KE III:  \( a \geq 125 \text{ mm} \)
  See also information on page 6

- The load must be equally distributed across the anchors

- Minimum edge distances
  Distance from edge KE III:  \( a \geq 200 \text{ mm} \)
  Distance from edge KE IV:  \( a \geq 400 \text{ mm} \)

- Minimum spacing dimensions
  Distance from centre KE III:  \( e \geq 300 \text{ mm} \)
  Distance from centre KE IV:  \( e \geq 600 \text{ mm} \)

- The load must be equally distributed across the anchors

- When using 4 anchors per panel, the anchor loads provided on page 7 must be multiplied by the safety factor \( \Psi_4 \approx 0.75 \).

NOTE

- Minimum concrete strength at the time of initial lifting \( f_{cub,150} \geq 15 \text{ N/mm}^2 \).
- Two or four transport anchors must be used for each pre-cast component.
- Minimum internal spacing between anchors 900 mm
- The transport anchors must be installed so that they are symmetrical in relation to the centre of gravity in order to ensure even load distribution.
- If the transport anchors are subject to unequal loads, the different effects of the loads must be taken into account.
DIMENSIONING

CALCULATING THE LOADS

To determine the relevant loads on the transport anchor, the entire production, storage, transportation and assembly process must be considered and all relevant stresses must be taken into account. The relevant stresses may differ depending on the component geometry, transportation conditions and boundary conditions, and for this reason, the transport anchors must be designed separately for each project and each component.

The parameters of static system, weight, formwork adhesion, dynamic effects and the position and number of transport anchors must be determined. Additional stresses may occur in relation to specific panel designs, and in these cases must also be taken into account.

1. Weight
When determining the self-weight, the relevant concrete volume with a density of 25 kN/m³ must be used. Any additional loads must be taken into account accordingly.

\[
F_{G} = 25 \text{ kN/m}^3 \cdot V + Z
\]

\( V = \) Concrete volume of the pre-cast component in m³
\( Z = \) Additional loads in kN

2. Formwork adhesion
When pre-cast components are lifted from the formwork, they are acted on by adhesion forces differing in strength depending on the formwork shell used. The following reference values are specified in the guideline VDI/BV-BS 6205 as examples:

\[
F_{adh} = q_{adh} \cdot A_f
\]

\( q_{adh} = \) Basic value of the formwork adhesion in kN/m²
\( A_f = \) Contact surface between the concrete and formwork in m²

<table>
<thead>
<tr>
<th>Formwork type</th>
<th>( q_{adh} ) [kN/m²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oiled steel or plastic formwork</td>
<td>≥ 1.0</td>
</tr>
<tr>
<td>Lacquered wood formwork</td>
<td>≥ 2.0</td>
</tr>
<tr>
<td>Bare wood formwork</td>
<td>≥ 3.0</td>
</tr>
</tbody>
</table>

3. Dynamic loads
When pre-cast components are lifted, transported and set down, they are subject to shock stresses. The magnitude of these stresses is determined by the type of lifting device used and is taken into account using the dynamic factor \( \Psi_{dyn} \). It is also possible for a variety of lifting devices to be used over the course of the transportation chain. The relevant dynamic factor must be determined. The calculated loads must be multiplied by this factor. The following reference values are specified in the guideline VDI/BV-BS 6205 as examples:

\[
F_{G} = 25 \text{ kN/m}^3 \cdot V + Z
\]

\( V = \) Concrete volume of the pre-cast component in m³
\( Z = \) Additional loads in kN

\[
F_{adh} = q_{adh} \cdot A_f
\]

\( q_{adh} = \) Basic value of the formwork adhesion in kN/m²
\( A_f = \) Contact surface between the concrete and formwork in m²

<table>
<thead>
<tr>
<th>Lifting device</th>
<th>( \Psi_{dyn} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotating tower crane</td>
<td>1.3</td>
</tr>
<tr>
<td>Truck-mounted crane</td>
<td>1.3</td>
</tr>
<tr>
<td>Gantry crane</td>
<td>1.3</td>
</tr>
<tr>
<td>Transportation on even terrain</td>
<td>2.5</td>
</tr>
<tr>
<td>Transportation on uneven terrain</td>
<td>≥ 4</td>
</tr>
</tbody>
</table>
DIMENSIONING

VERIFICATION

The following must be checked:

- \( F_{Rd} \geq F_{Ed} \)
  - Rated load that can be accommodated by the anchor
- \( F_{Rd} \)
  - Applied rated load

**NOTE:**
The load capacity of the anchors will vary according to the different types of load applied during the installation and manufacturing process. Please refer to pages 6 and 7 for details of these capacities.

The rated load that can be accommodated is calculated as follows:

- \( F_{Rd} = n \cdot F_{2v} \cdot \Psi_n \)
  - Load in accordance with the information on page 7
  - \( F_{2v} \)
  - Number of anchors used per panel (two or four anchors)
  - \( \Psi_n = \Psi_3 = 1.0 \)
  - When using two anchors
  - \( \Psi_n = \Psi_4 = 0.75 \)
  - When using four anchors

The rated load that is applied is calculated as follows:

**Transverse shear**

- \( F_{Ed} = \left( \frac{F_G}{2} + F_{adh} \right) \cdot \Psi_{dyn} \)
  - Weight of the pre-cast component in accordance with the information on page 14
  - Load from formwork adhesion in accordance with the information on page 14
  - Dynamic factor in accordance with the information on page 14

**Tension**

- \( F_{Ed} = F_G \cdot \Psi_{dyn} \)
  - Load in accordance with the information on page 14
  - Dynamic factor in accordance with the information on page 14

**Turning**

- \( F_{Ed} = \frac{F_G}{2} \cdot \Psi_{dyn} \)
  - Weight of the pre-cast component in accordance with the information on page 14
  - Dynamic factor in accordance with the information on page 14
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