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H BAU TECHNIK

KE double wall transport anchors

The safe transport anchor for double walls

KE Ttransport anchors - Transport double walls securely

www.h-bau.de

Contact

H-BAU TECHNIK GMBH
Am Güterbahnhof 20
79771 Klettgau
Germany
Phone +49 (0) 77 42 | 92 15-20
Telefax +49 (0) 77 42 | 92 15-90
info.klettgau@h-bau.de
www.h-bau.de
www.jp-bautechnik.de

PRODUCTION AND DELIVERY NORTH-EAST
Brandenburger Allee 30
14641 Nauen OT Wachow
Germany
Phone +49 (0) 3 32 39 | 7 75-20
Telefax +49 (0) 3 32 39 | 7 75-90
info.berlin@h-bau.de

PRODUCTION CHEMNITZ
Beyerstraße 21
09113 Chemnitz
Germany
Phone +49 (0) 371 | 400 41 - 0
Telefax +49 (0) 371 | 400 41 - 99

SOUTH
Paul Rieger
Phone +49 (0) 77 42 | 92 15-21
Telefax +49 (0) 77 42 | 92 15-93
Mobile +49 (0) 171 | 864 72 61
paul.rieger@h-bau.de

NORTH – EAST
Rudolf Till
Phone +49 (0) 332 39 | 775-24
Telefax +49 (0) 332 39 | 775-90
Mobile +49 (0) 172 | 993 70 50
rudolf.till@h-bau.de

SOUTH – WEST
Oliver Etzrodt
Phone +49 (0) 70 82 | 41 39 63
Telefax +49 (0) 70 82 | 79 33 00
Mobile +49 (0) 171 | 864 72 60
oliver.etzrodt@h-bau.de

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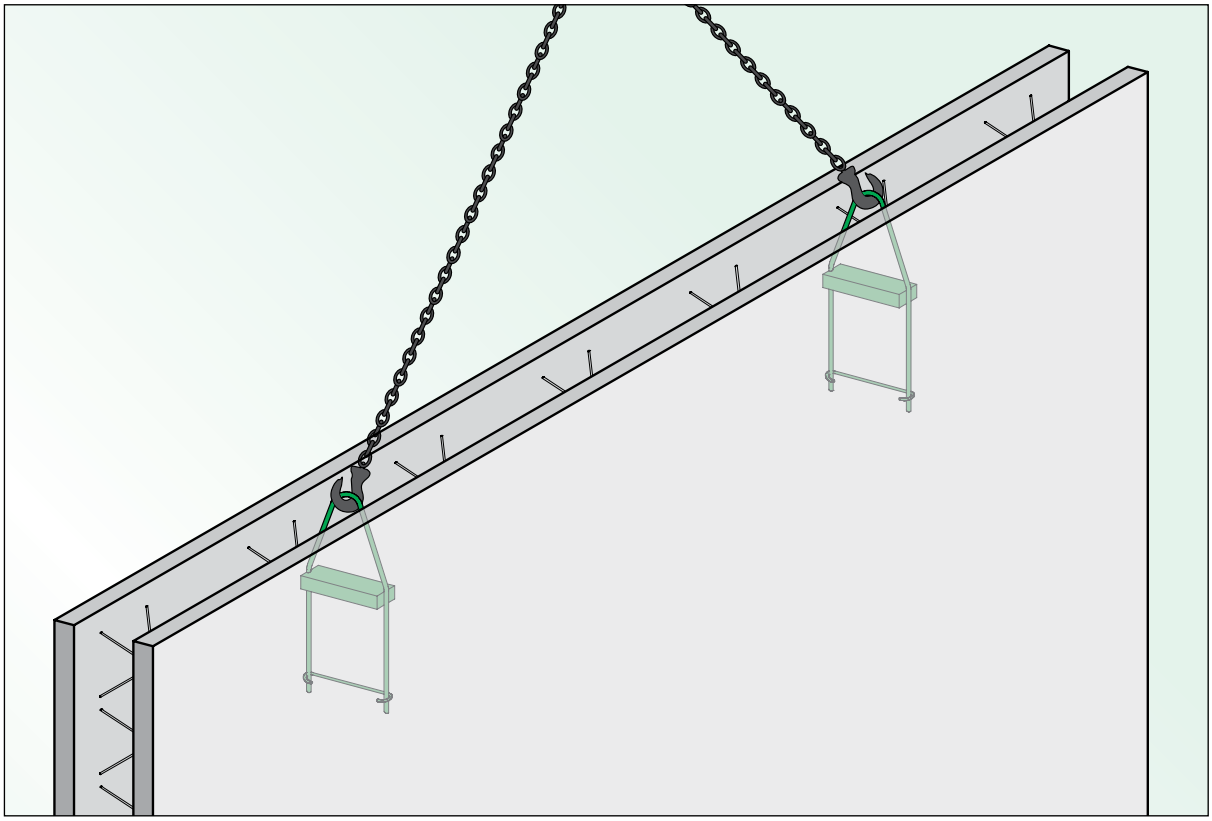
KE transport anchors - Transport double walls more securely



The Product

KE transport anchors are used to erect and transport wall sections both during the production of the prefabricated part and at the site of construction.

The KE III model is designed for popular panel sizes and the KE IV model for panels with specific requirements.

The variety of dimensions and the novel design make the KE transport anchor an unrivalled product technically, economically and in relation to safety that clearly increases flexibility during the construction of prefabricated parts.

Features

- GS mark (KE III) – for maximum possible safety
- Graduated bearing loads – for economic planning
- Quicker and simpler to install – for a problem-free production process
- Position can be planned independent of the formwork girders – for optimum solutions technically and economically

Additional comments

The KE III is produced from 14 mm diameter steel and the KE IV from 16 mm diameter steel. The anchors can be supplied in widths of 120 to 360 mm.

The minimum concrete covering on the inside side of the shuttering is 10 mm for the KE III models and on the outside 20 mm. For KE IV transport anchors a minimum concrete covering of 20 mm inside and outside must be maintained.

KE transport anchors

Product range

KE transport anchors – the more secure and economic way to transport or erect wall sections during the production of the prefabricated part and at the site of construction.
Two designs are available for different installation types:

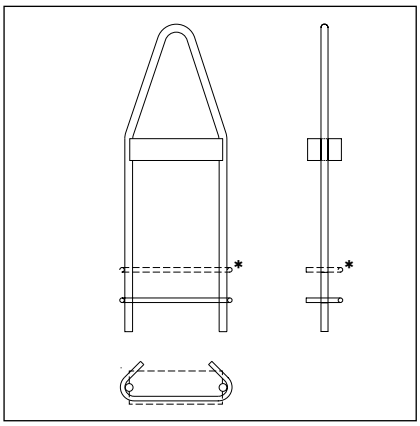
KE transport anchor model A

The standard design. Positioned at the centre of gravity of the wall panels.

Suitable for stationary productions/systems.

Available as KE III and IV.

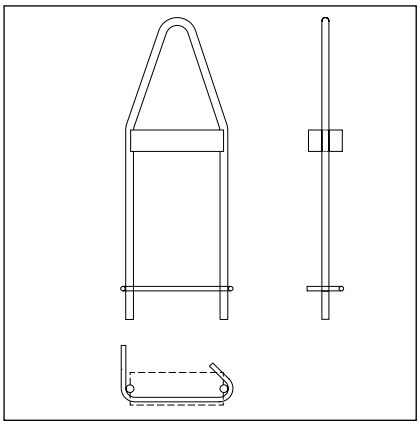
* KE IV is designed with 2 stirrups



KE transport anchor model B

For quick locking into the formwork girder The 90° stirrup leg makes it easier to secure the transport anchor to the formwork girder e.g. by means of spring steel binders. Can also be inserted at the point of gravity. Suitable for use in rotating systems.

Available as KE III.



KE transport anchors

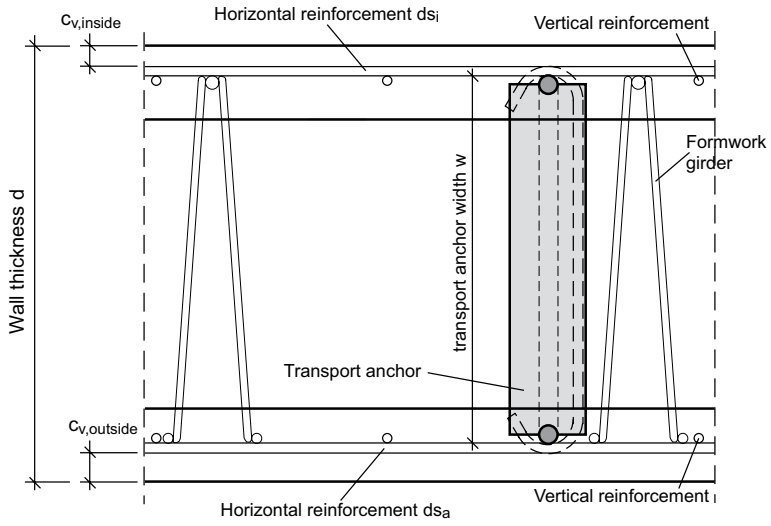
Dimensions

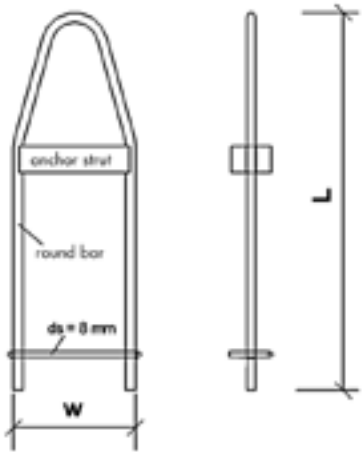
Dimensions KE transport anchors

Type	KE III		KE IV#	
	Dimensions [mm]		Dimensions [mm]	
	b	l	b	l
120	120	515	120	750
130	130	515	130	750
140	140	515	140	750
150	150	515	150	750
160	160	515	160	750
170	170	515	170	750
180	180	565	180	800
190	190	565	190	800
200	200	565	200	800
210	210	565	210	800
220	220	565	220	800
230	230	565	230	800

Type	KE III		KE IV#	
	Dimensions [mm]		Dimensions [mm]	
	b	l	b	l
240	240	565	240	800
250	250	615	250	850
260	260	615	260	850
270	270	615	270	850
280	280	615	280	850
290	290	615	290	850
300	300	615	300	850
310	310	645	310	880
320	320	645	320	880
330	330	645	330	880
340	340	645	340	880
350	350	645	350	880

Determining the necessary anchor width w





Determining the necessary anchor width w

$$w = d - cv,i - cv,a - dsi - dsa$$

Key:
w = Transport anchor width
d = wall thickness
$c_{v,i}$ = concrete covering inside
$c_{v,a}$ = concrete covering outside
d_{si} = Horizontal reinforcement inside
d_{sa} = Horizontal reinforcement outside

The determining is applicable if:
The horizontal reinforcement is on the outside of the wall panel (1st position) if the horizontal reinforcement is inside (2nd position), the vertical reinforcement must be additionally removed.
In general the following applies: anchor width w = formwork girder height FGH

The KE IV transport anchor is not a part of the GS mark.

KE transport anchors

Dimensional design values

for better solutions ...

Transport anchor bearing load

	KE III		KE IV#	
Concrete strength fc [N/mm²]	25	35#	25	35
Central pull1) Fred [kN]	29,0	35,0	50,0	65,0
Diagonal pull)* Fred [kN]	29,0	35,0	50,0	65,0
Transverse pull2)* Fred [kN]	16,8	20,0	20,0	20,0
Diagonal pull 90°1) Fred [kN]	29,0	29,0	40,0	40,0

Installation tolerance: -10 mm formwork girder height

1) Safety factor: g = 3.0

2) Safety factor: g = 2.0; c_{nom} = 30 mm ; for the orderly erecting of horizontal panels g = 3.0.

3) The admissible load capacities in dependence on the basic conditions such as concrete strength, concrete covering and transport variants are to be found in the assembly instructions approved by the Professional Trade Association for Building and Allied Trades

* With diagonal and transverse pull there is increased load on the anchors (see p. 7 point 5)

** Use square timber as erection aid (see Figure 3)

Additional geometric conditions

Concrete covering on the outside c_{nom} [mm]	Concrete covering on the inside c_{innen} [mm]	Minimum shuttering thickness min s* [mm]
20	≥ 10 mm ≥ 20 mm 4)	50
25		55
30		60

4) 4) Only applies to KE IV transport anchors with 200 mm widths per side in the anchor region.

Installation

The transport anchor installation position is shown in Figures 1 and 2. The transport anchor must be secured in its position for the concreting process. This can be effected by securement to the bottom transverse reinforcement and a corresponding mounting iron at the top (see Figure 2).

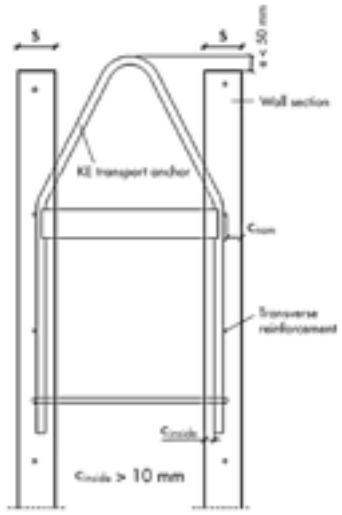


Figure 1. Installation position in section

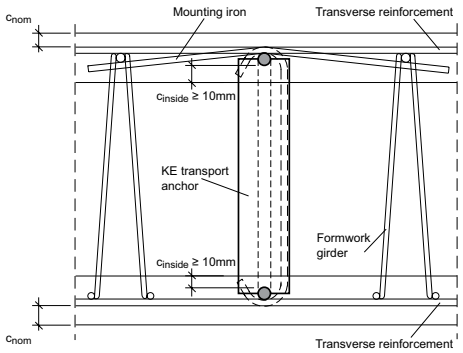


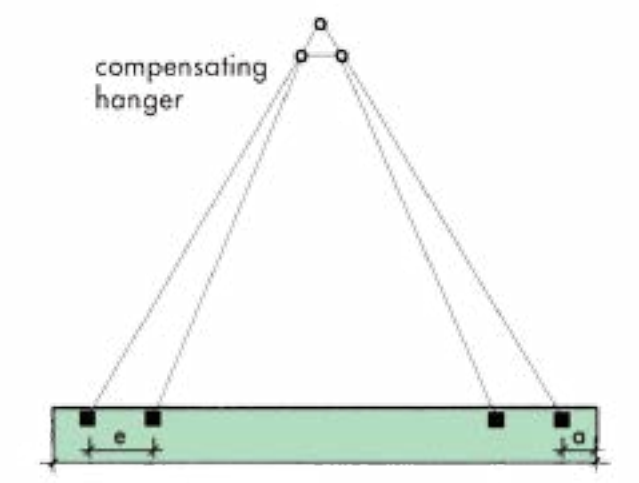
Figure 2. Installation position horizontal projection

The KE IV transport anchors and the concrete strength 35 N/mm² are not part of the GS.

KE transport anchors

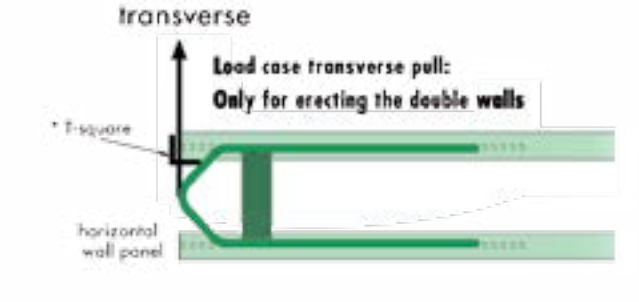
Planning

If more than two anchors are provided a compensating hanger or similar load distributing device must be used.

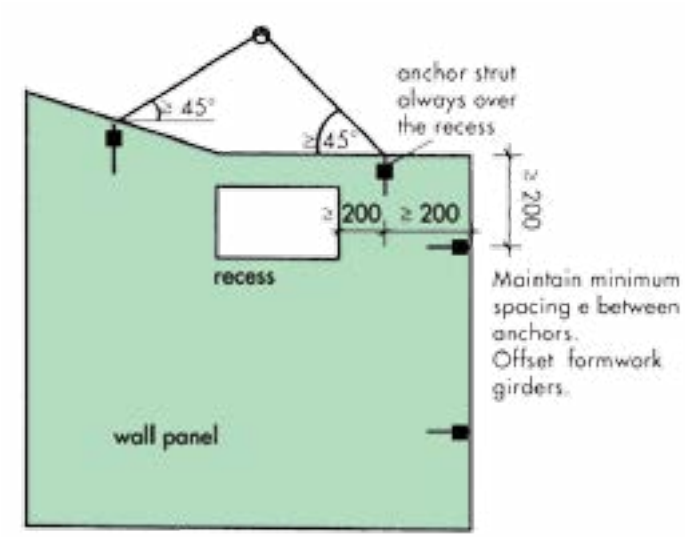


The anchor spacings must be planned so that the wall can be lifted at its centre of gravity:

- Distance between centers KE III: e ≥ 300 mm
- Distance between centers KE IV: e ≥ 600 mm
- Distance to edge KE III: a ≥ 200 mm
- Distance to edge KE IV: a ≥ 400 mm



For transport reasons, sections in excess of 3.00 m in height must in practice be turned at the site of construction. To this end the sections are to be put down flat and then raised to the upright position. The design criteria can be found in the assembly and usage instructions approved in the design specifications. Mounting reinforcement must be verified.



The wall panels must be designed with a minimum reinforcement of Ø 6 / 250 mm in the anchor region.
For the load case transverse pull, sufficient edging must be provided between the free edge and the transport anchor or a formwork girder in the anchor region.

* The transverse pull load of the KE III transport anchor can be increased to 20 kN (concrete strength f_c 25 N/mm²) if a 100 x 100 x 10 mm T-square is positioned on a width of 1.00 m per anchor. The square must be covered by an elastomer strip or shaft bearing.
The steel section must be secured against falling (e.g. weld the steel stirrup and secure to crane hooks with cable).
A square timber can also be used to protect the edge against damage caused by the crane hangers. This means a load increase can only be obtained in a limited manner.

Determining the transport anchor load

When carrying out the planning, the regulations in the assembly and usage instructions approved by the Professional Trade Association for Building and Allied Trades must be observed and maintained.

When determining the loads working on the transport anchors, the following must be observed whilst taking possible load overlap into consideration:

1. Dead weight of the prefabricated part
2. Adhesion in the shuttering on lifting out
3. Impact loads
4. Number and arrangement of the transport anchors
5. Direction of force from means

1. Dead weight:
To determine the dead weight of the wall section, the load of the total volume of the shuttering is taken as 25.0 kN/m3. Additional mounting parts must be considered separately.

2. Adhesive forces:
When raising the wall section out of the shuttering, consideration must be given to adhesive forces, the extent of which depends on the type and composition of the skin used. The following forces occur for conventional materials:

Oiled shuttering:	q = 1.0 kN/m²
Painted shuttering:	q = 2.0 kN/m²
Rough timber shuttering:	q = 3.0 kN/m²

An adhesive force of q = 1.0 kN/m2 has already been taken into consideration in the KE transport anchor load capacity tables.

3. Impact loads:
When lifting, depositing and transporting wall sections impact stresses can occur. Their extent depends substantially on the type of hoisting equipment used and can be a multiple of the panel weight. The cranes used in the prefabrication process and also modern truck-mounted cranes have precision lifting equipment. Lifting load factors of f = 1.1 to 1.3 are to be applied here. A lifting load factor of f = 1.3 has already been taken into consideration in the KE transport anchor load capacity tables.
To determine the lifting load coefficient under other basic conditions, the values must be determined according to DIN 1501 8-1: 1984-11.

4. Number and arrangement of the transport anchors
Prefabricated concrete parts do not always have the ideal geometry of a rectangular panel with no recesses. Asymmetrical wall geometry and/or openings in the section produce different loads for the installed transport anchors. In this case, the distances from the centers of the KE anchors to the wall section point of gravity are incorporated into the determining of the respective anchor load. Where there are more than two transport anchors, the mounting arrangement is statistically undefined. In this case, a roller compensation hanger is to be used. The higher number of anchors must not be used for the dimensional design without this measure.

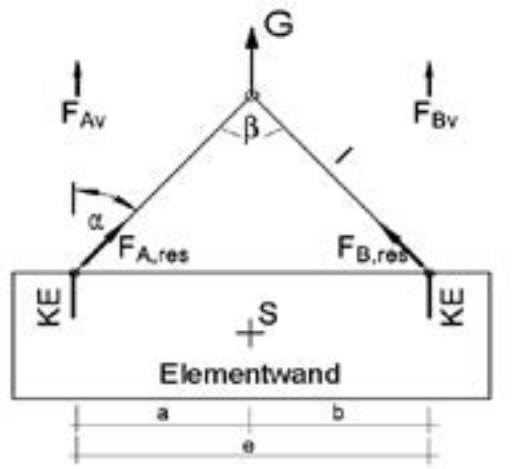
5. Direction of force from the lifting means (diagonal pull)
If hangers are not used for transport, there is increased tensile load on the transport anchors. The maximum admissible angle of inclination α between the vertical and the lifting means is 45 degrees. The length of the lifting means is to be selected accordingly. This angle α = 45° has already been taken into consideration in the KE transport anchor load capacity tables. The maximum admissible panel weight alters with the angle of inclination.

KE transport anchors

Dimensional design

Dimensional design of transport anchor systems

When planning, the regulations in the assembly instructions must be observed and maintained. Transport anchors for double walls must be dimensioned by an engineer for the forces actually occurring in practice. The loads to be taken into consideration are as follows:



α = angle of inclination
β = angle of spead
S = centre of gravity
KE = KE transport anchor
l = lifting means length

The angle of inclination α must not exceed 45°. To this end, the length of the lifting means is to be l ≥ e/1 .41.

- Central pull = load in axial direction of the anchor
- Diagonal pull = load distribution under the angle of inclination α relative to the vertical
- Transverse pull = load distribution at the end face when double wall is set upright. Extreme case 90°

1. Dead weight of the wall section

$G = \rho \times V$

ρ = concrete gross density 25 kN/m³
V = concrete volume of the two shutterings

2. Adhesion of the concrete part in the shuttering

$Ha = ha \times A$

A = adhering shuttering face

The shuttering adhesion Ha is absorbed by the transverse pull load capacity of the anchor F_{red}. Where the shuttering is coarsely structured, the adhesive force increases considerably. An adhesive force of q = 1.0 kN/m² has already been taken into consideration in the KE transport anchor load capacity tables.

Shuttering type:	ha
Oiled shuttering	1 kN/m²
Smooth timber shuttering	2 kN/m²
Coarse timber shuttering	3 kN/m²

3. Impact load/lifting load factors

$F_{red} = F_{admi} / f$

	Lifting Gear	Lifting load factor f
	Tower crane for construction	1.3
	Truck-mounted crane	1.3
	Loading bridges, gantry crane	1.3
	Excavator, depending on the driving operation	2.0 - 2.5

The reduced anchor resistance F_{red} includes the reduction through lifting load factors of a conventional tower crane, truck-mounted crane or gantry crane. If other lifting means are used, the lifting load factors will be higher. These are to be determined to DIN 15018-1: 1984-11.

A lifting load factor of f =1.3 has already been taken into consideration in the KE transport anchor load capacity tables.

4. Number and arrangement of the transport anchors

$F_{Av} = G \times b / (a + b)$

$F_{Bv} = G - FA$

Openings in the wall section or an asymmetrical geometry produce different loads on the anchors.

F_{Av} = Vertical force portion at anchor A
F_{Bv} = Vertical force portion at anchor B
G = Weight of double wall at point of gravity
a = Distance from centre anchor A to the point of gravity*
b = Distance from centre anchor B to the point of gravity *

5. Direction of force from the lifting means

$Fres = F_V / \cos \alpha$

$FV = G / c$

Through the inclinedly engaging hangers, the force F resulting at the anchor, load-absorbing means and lifting means is increased in relation to the pure vertical force F_V in dependence on the angle of inclination α of the force engagement. (The vertical force F_V is produced from the weight, the arrangement of the anchors, the number of load-bearing anchors c and the acceleration forces etc.)

An angle of inclination $0 \leq \alpha \leq 45°$ has already been taken into consideration in the KE transport anchor load capacity tables. The max. admissible panel weight alters in dependence on the angle α.

G = weight
F_V = vertical force portion per anchor
F_{res} = resulting force per anchor
c = number of load-bearing anchors
cos a = factor for diagonal pull

6. Verification for each load case and anchor

$F_{erf} \leq F_{admi}$

F_{erf} = resulting force from dimensional design per anchor
F_{admi} = bearing load per anchor

Transport without setting upright using lifting means

Basic conditions:

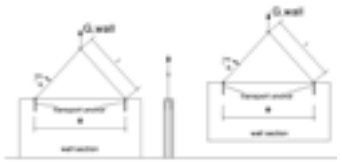
Number of anchors: 2 items

Concrete strength at the time of the transport: $f_c \geq 25$ N/mm²

Shuttering density: 60 mm

Concrete covering: $c_{nom} = 20$ mm

Trasnport means lifting means: $\alpha = 45°$



KE III transport anchor bearing load

Concrete strength f_c [N/mm²]	Central pull F_{red} [kN]	Diagonal pull F_{red} [kN]	Transverse pull F_{red} [kN]
25	29.0	29.0	16.8
35	35.0	35.0	20.0

Safety coefficients γ according to Professional Trade Association Regulations for Building and Allied Trades for the present load case:

Central pull/diagonal pull: $g = 3.0$

Transverse pull (no setting upright): $\gamma_{no\ setting\ upright} = 2.0$

Determining the admissible panel weight:

$$\text{admin } G_{Wall} \leq \begin{matrix} 2 * \text{admin F} * \cos\alpha / 10\ [\text{to}] = 2 * 29.0 * \cos 45/10 = 4.10\ \text{to} \\ \rightarrow \text{admin } G_{Wall} = 4.10\ \text{to} \\ 4 * \text{admin Q} / 10\ [\text{to}] = 4 * 16.8/10 = 6.72\ \text{to} \end{matrix}$$

where:

admi F admissible central tensile load according to Table KE III in kN

α angle according to diagram - load case

admi. Q admissible transverse tensile load according to Table KE III in kN

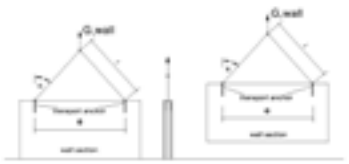
To make things easier, the admissible loading capacities are specified in the assembly and usage instructions according to the type of stress – see extract from the assembly and usage instructions:
Special load case B – Transport without setting upright

Extract from the assembly iand usage Instructions

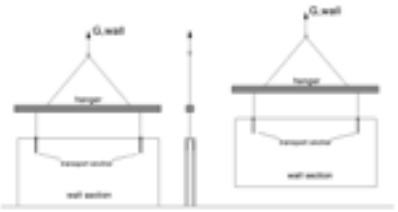
Special load case B - Transport without setting upright

Where this special load case is used, along with the specific accuracy and attention in planning and design, it must be ensured that the basic conditions set out in Chapter 3.1 are implemented in an unrestricted manner.

Transport with lifting means – without setting the panel upright ($0 < \alpha \leq 45°$)



Transport with hanger – without setting the panel upright ($\alpha = 0°$)



Angle a [degrees]	admi. load capacity1)[1] G_{Wall} [to]								
	Concrete compressive strength at time of transport $f_c \geq 15$ N/mm²			Concrete compressive strength at time of transport $f_c \geq 20$ N/mm²			Concrete compressive strength at time of transport $f_c \geq 25$ N/mm²		
	c_{nom}[2] = 20 mm	c_{nom}[2] = 25 mm	c_{nom}[2] = 30 mm	c_{nom}[2] = 20 mm	c_{nom}[2] = 25 mm	c_{nom}[2] = 30 mm	c_{nom}[2] = 20 mm	c_{nom}[2] = 25 mm	c_{nom}[2] = 30 mm
	s ≥ 50mm	s ≥ 55mm	s ≥ 60mm	s ≥ 50mm	s ≥ 55mm	s ≥ 60mm	s ≥ 50mm	s ≥ 55mm	s ≥ 60mm
a = 0° (hanger)	4.1	4.5	4.5	4.7	5.2	5.2	5.2	5.8	5.8
a ≤ 45°	3.2	3.2	3.2	3.7	3.7	3.7	4.1	4.1	4.1

[1] Already taken into consideration are:
- lifting load factor - $\psi = 1.3$
- direction of force from lifting means
- adhesive forces - q = 1.0 kN/m2 (oiled steel shuttering)

[2] With different shuttering thicknesses s, concrete coverings cnom and shuttering strengths fc , the smaller load capacity produced is decisive for the dimensional design.

Minimum requirements:
- two anchors per panel
- shuttering thickness in the region of the transport anchor: $50 \leq s \geq c_{nom} + 30$
- lifting cable length: $l \geq e/1.41$

where e = distance between centres of the transport anchors,
α - design angle from direction of force of the lifting means – see drawing

Note: Details in Sections 3 and 4 in particular are to be observed in the planning stage

Transport with setting upright using hanger

Basic conditions:

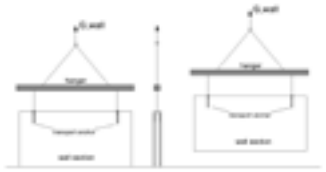
Number of anchors: 2 items

Concrete strength at the time of the transport: $f_c \geq 25$ N/mm²

Shuttering density: 60 mm

Concrete covering: $c_{nom} = 30$ mm

Trasnport means lifting means: $\alpha = 0°$



KE III transport anchor bearing load

Concrete strength f_c [N/mm²]	Central pull F_{red} [kN]	Diagonal pull F_{red} [kN]	Transverse pull F_{red} [kN]
25	29,0	29,0	16,8
35	35,0	35,0	20,0

Safety coefficients γ according to Professional Trade Association Regulations for Building and Allied Trades for the present load case:

Central pull/diagonal pull: $\gamma = 3.0$

Transverse pull (with setting upright): $\gamma_{\text{with setting upright}} = 3.0$

Determining the admissible panel weight:

$$\text{admin } G_{Wall} \leq \begin{matrix} 2 * \text{admin F} * \cos\alpha / 10 \text{ [to]} = 2 * 29.0 * \cos 0/10 = 5.8 \text{ to} \\ 4 * \text{admin Q} / 10 \text{ [to]} = 4 * 16.8\ (2.0/3.0)/10 = 4.5 \text{ to} \end{matrix} \rightarrow \text{admin } G_{Wall} = 4.5 \text{ to}$$

where:

admi F admissible central tensile load according to Table KE III in kN

α angle according to diagram - load case

admi. Q admissible transverse tensile load corrected according to Table KE III with the factor of the safety $\gamma_{\text{with no setting upright}} / \gamma_{\text{with setting upright}} = 2.0/3.0$ in kN

To make things easier, the admissible loading capacities are specified in the assembly and usage instructions according to the type of stress – see extract from the assembly and usage instructions:
Special load case A – Transport with setting upright

Extract from the assembly iand usage Instructions

Special load case A - Transport with setting upright

Where this special load case is used, along with the specific accuracy and attention in planning and design, it must be ensured that the basic conditions set out in Chapter 3.1 are implemented in an unrestricted manner.

Transport with lifting means ($0 < \alpha \leq 45°$)

Transport with hanger ($\alpha = 0°$)

Winkel a [Grad]	admi. load capacity1)[1] G_{Wall} [to]								
	Concrete compressive strength at time of transport $f_c \geq 15$ N/mm²			Concrete compressive strength at time of transport $f_c \geq 20$ N/mm²			Concrete compressive strength at time of transport $f_c \geq 25$ N/mm²		
	c_{nom}[2] = 20 mm	c_{nom}[2] = 25 mm	c_{nom}[2] = 30 mm	c_{nom}[2] = 20 mm	c_{nom}[2] = 25 mm	c_{nom}[2] = 30 mm	c_{nom}[2] = 20 mm	c_{nom}[2] = 25 mm	c_{nom}[2] = 30 mm
	s ≥ 50mm	s ≥ 55mm	s ≥ 60mm	s ≥ 50mm	s ≥ 55mm	s ≥ 60mm	s ≥ 50mm	s ≥ 55mm	s ≥ 60mm
a = 0° (Traverse)	2.7	3.1	3.5	3.1	3.6	4.0	3.5	4.0	4.5
a ≤ 45°	2.7	3.1	3.2	3.1	3.6	3.7	3.5	4.0	4.1

[1] Already taken into consideration are:
- lifting load factor - y = 1.3
- direction of force from lifting means
- adhesive forces - q = 1.0 kN/m2 (oiled steel shuttering)

[2] With different shuttering thicknesses s, concrete coverings cnom and shuttering strengths fc , the smaller load capacity produced is decisive for the dimensional design.

Minimum requirements:
- · two anchors per panel
- · shuttering thickness in the region of the transport anchor: $50 \leq s \geq c_{nom} + 30$
- · lifting cable length: $l \geq e/1.41$

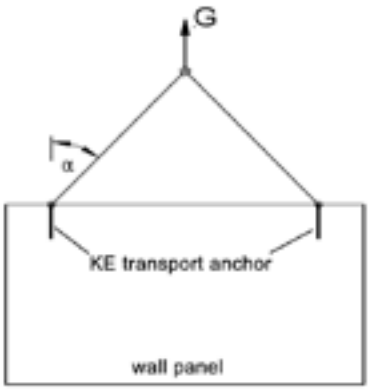
where e = distance between centres of the transport anchors,
α - design angle from direction of force of the lifting means – see drawing

Note: Details in Sections 3 and 4 in particular are to be observed in the planning stage

KE transport anchors

KE IV Dimensional design table

Max. KE IV bearing loads in dependence on the concrete strengths



Angle α [degrees]	admin F α = F_u / 3 · cos α - per anchor -				
Basis: admissible central tensile force/anchor	15 N/mm² [kN]	20 N/mm² [kN]	25 N/mm² [kN]	30 N/mm² [kN]	35 N/mm² [kN]
α = 0° (central pull)	44.1	50.9	56.9	62.3	67.3
Inclined angle of pull, max. panel weight / anchor [kN]					
α = 15°	42.6	49.1	54.9	60.2	65.0
α = 30°	38.2	44.1	49.3	54.0	58.3
α = 45°	31.2	36.0	40.2	44.1	47.6

[1] The following have already been taken into consideration:
- lifting load factor - ψ = 1.3
- direction of force from lifting means
- adhesive forces - q = 1.0 kN/m² (oiled steel shuttering)
- where 4 anchors are used per panel and the distances to the edge and between centers is maintained (see Ch. 3.2, Figure 3), the values specified in the Table can be increased by 50 %.

[2] With different shuttering thicknesses s, concrete coverings cnom and shuttering strengths fc the lower load capacity produced must be used in the dimensional design

Minimum requirements:
· two anchors per panel
· shuttering thickness in the region of the transport anchor: 60 ≤ s ≥ c_{nom} + 30
· lifting cable length: l ≥ e/1.41
where e = distance between transport anchor centers,
α - design angle from direction of force of the lifting means – see drawing

Note: The details in sections 3 and 4 in particular are to be observed in the planning.
Concrete covering on the inside ≥ 20 mm on 200 mm width per side in the anchor region.

Notes

Systematic concreting...

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H-BAU TECHNIK GMBH
Am Güterbahnhof 20
79771 Klettgau
Phone +49 (0) 77 42 | 92 15-20
Telefax +49 (0) 77 42 | 92 15-90
info.klettgau@h-bau.de

PRODUCTION AND DELIVERY NORTH-EAST
Brandenburger Allee 30
14641 Nauen OT Wachow
Phone +49 (0) 3 32 39 | 7 75-20
Telefax +49 (0) 3 32 39 | 7 75-90
info.berlin@h-bau.de

PRODUCTION CHEMNITZ
Beyerstraße 21
09113 Chemnitz
Phone +49 (0) 37 1 | 400 41-0
Telefax +49 (0) 37 1 | 400 41-99

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