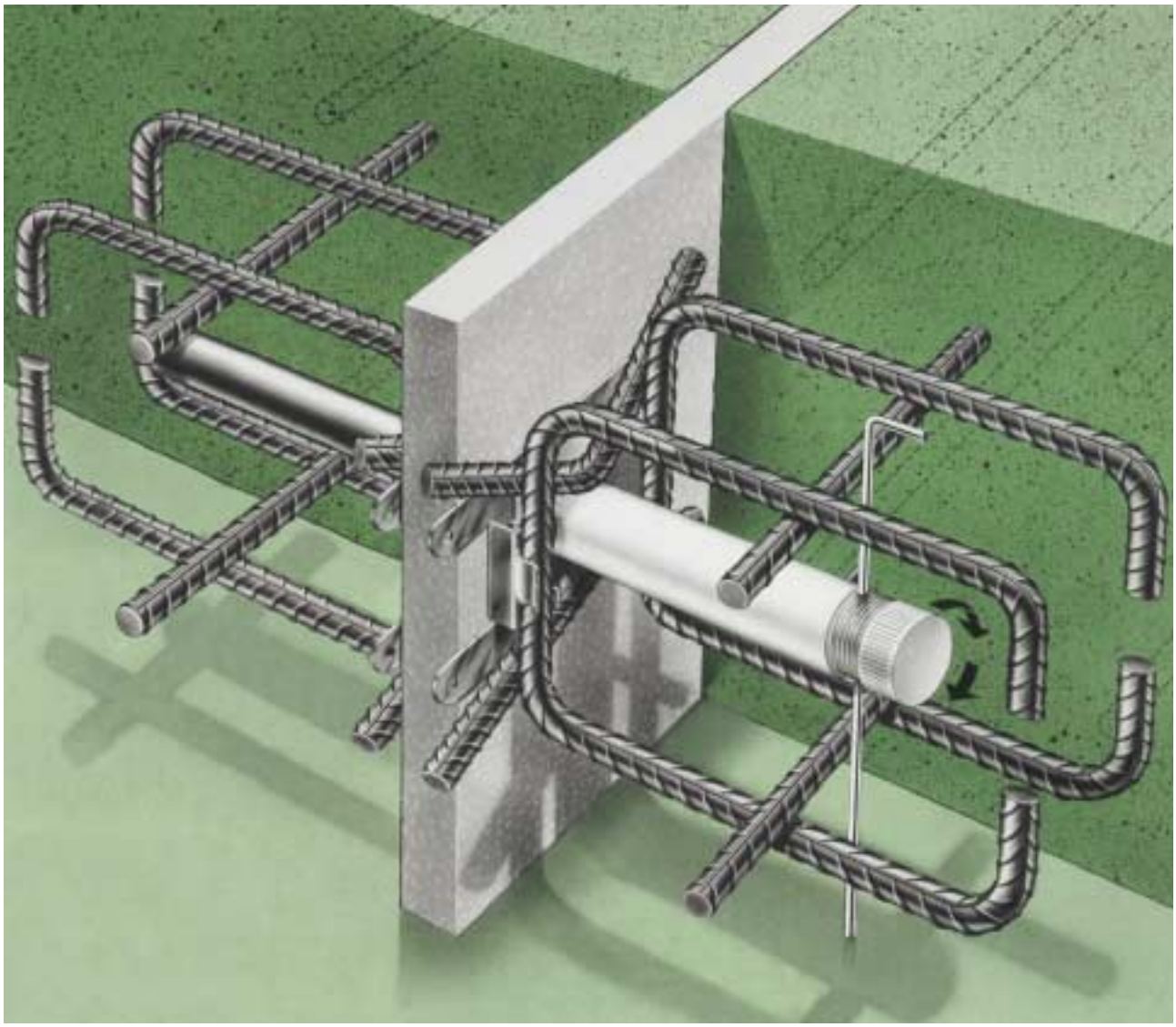
Titan

Titan dowels

The Titan transverse force dowel system guarantees that transverse forces at expansion joints are transmitted without impeding the horizontal movement of each component.



The Titan transverse force dowel system is designed to be simple and functional.

The system consists of two multi-purpose flanges, gliding sleeve, centering flange, adjusting pin and two reinforcement cages.

It allows continuous formwork and therefore the placement of the dowel in the second concrete pour.

Exact horizontal dowel positioning is ensured by the use of the adjusting pin.

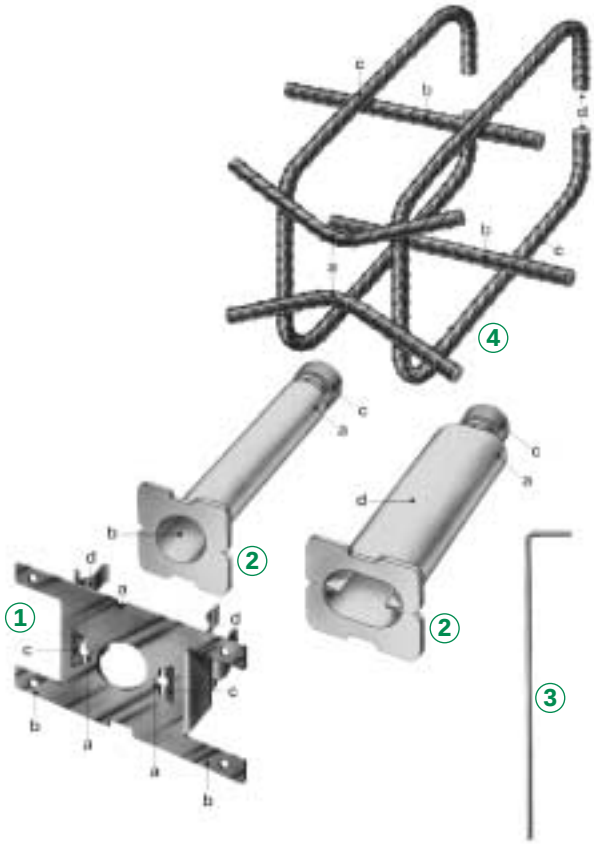
This guarantees precise and stable fixing of the gliding sleeve during the concrete pour.

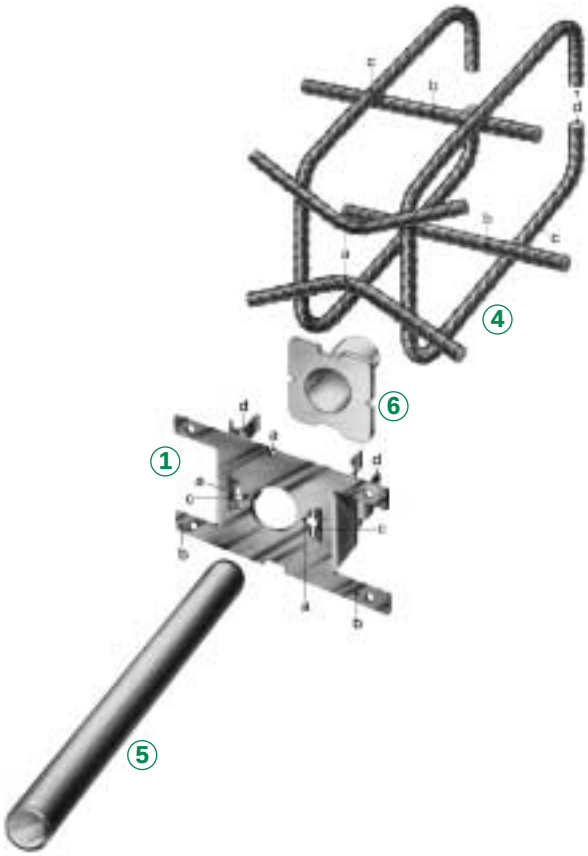
Approved by:

SOCOTEC

Titan dowels

The patented Titan system offers an unprecedented level of stability and guarantees simple and site-suited fixing.





Accessories for the 1st phase

① Multi-purpose flange for all diameters

a) Centering notch
b) Nail tabs
c) Sleeve guide
d) Clips for reinforcing cage

② Gliding sleeves

a) Expansion space
b) Colour coding for the different diameters
c) Fixing cap for adjusting pin
d) Sleeve for lateral displacement

③ Horizontal adjusting pin

Accessories for the 2nd phase

④ Reinforcing cage for 1st or 2nd concrete pour

a) Tension distribution bars
b) Transverse rebar
c) Tension stirrup
d) Opening for placing edge reinforcement

⑤ Dowel

⑥ Centering flange for 2nd concrete pour

Titan
Transverse force dowels

The Titan dowel system simplifies both the conception and the implementation of certain concrete works such as corbels with sliding bearings or bases with expansion joints etc.

Various tests on original parts which have been carried out in official testing laboratories and which are mathematically verifiable now enable us to guarantee the transmission of stated loads taking into account realistic safety factors. Thanks to an integrated system we have been able to optimise the application stability despite various application fields.

Fixing
One metal flange for Ø 20 to 30 mm and a further flange for Ø 40 mm enable the sleeve and the reinforcing cage to be centered and fixed.

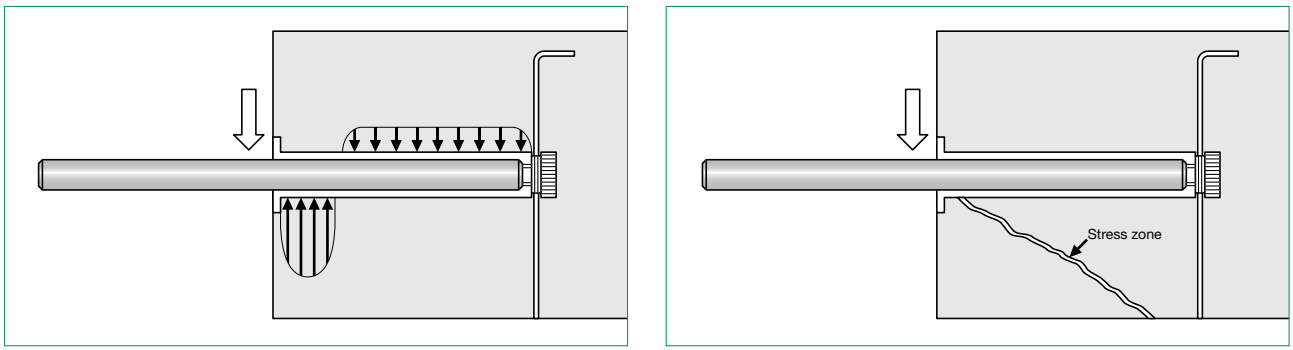
Gliding and expanding
The sleeves made of self-lubricating Polyethylene are provided with expansion space and are shock and frost resistant. Each diameter is identified by its particular colour.

Stiffening reinforcement
Other systems require the installation of additional stirrups which are often difficult to fix and can easily be forgotten. The Titan reinforcing cage rules this out, because it is welded and therefore compact. It is clipped onto the flange and is therefore always fixed in the right location ensuring an even and definitely determinable load distribution.

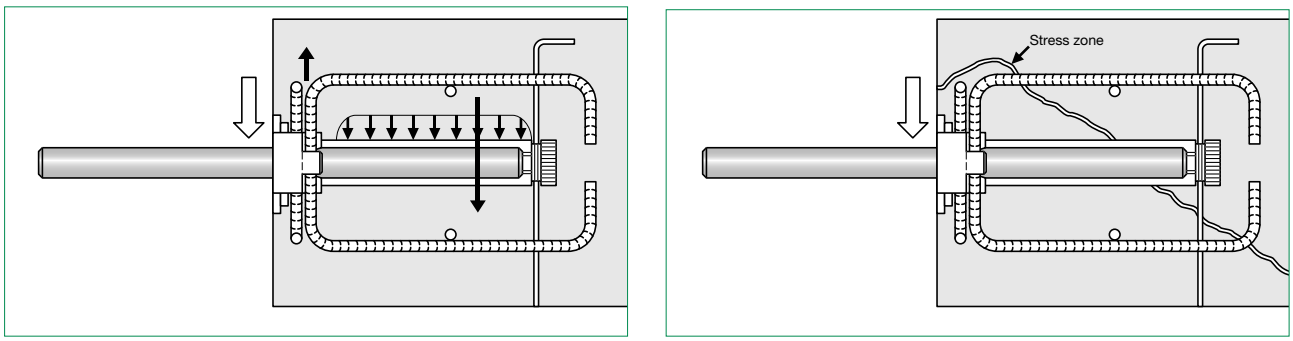
Fixing the horizontal position
It is imperative that the horizontal positioning of the sleeve is correct so that the dowel's ability to slide is guaranteed. The adjusting pin allows any accidental displacement of the sleeve to be corrected even after the reinforcement has been fixed and then to fix it permanently.

Dowels
For every requirement various bar diameters, finishes and material combinations can be supplied.

Stress and fracture lines for a dowel without reinforcement



Stress and fracture lines for a dowel with reinforcement



Titan

Types of transverse force dowels

Conventional dowels

Article number	Type	Ø mm	Steel	L mm	Yielding point N/mm²	Failure load N/mm²
TQDG201	G-20-1	20	St 37	320	235	370
TQDG200	G-20-0	20	42Cr Mo 4 v	320	815	980
TQDG220	G-22-0	22	42Cr Mo 4 v	340	815	980
TQDG250	G-25-0	25	42Cr Mo 4 v	390	815	980
TQDG300	G-30-0	30	42Cr Mo 4 v	470	815	980
TQDG400	G-40-0	40	42Cr Mo 4 v	570	815	980
TQDI200	I-20-0	20	Uranus 45N	320	450	680
TQDI220	I-22-0	22	Uranus 45N	340	450	680
TQDI250	I-25-0	25	Uranus 45N	390	450	680
TQDI300	I-30-0	30	Uranus 45N	470	450	680
TQDI400	I-40-0	40	Uranus 45N	570	450	680
TQD2A	2-A	20	BSt 500 S	380	500	550
TQD2B	2-B	25	BSt 500 S	480	500	550

Dowels of Type G
are hot-dip galvanized.

Dowels of Type G-20-1 are used for low loadings.

Dowels of Types G-20-0, G-22-0, G-25-0, G-30-0 and G-40-0 are used for higher loadings and are recommended for most applications.

Dowels of Type I
are made of stainless special steel.

Dowels of Types I-20-0, I-22-0, I-25-0, I-30-0 and I-40-0 are made of stainless Duplex special steel and exhibit double the mechanical strength of dowels made of conventional stainless steel. In addition they have a very high corrosion resistance (especially stress corrosion).

Dowels of Type 2
are made of high strength ribbed steel (BSt 500 S).

An epoxy resin coating in the middle section gives the dowel a high-quality corrosion protection.
These dowels are merely for the use in rigid joints and are not suitable for sliding in sleeves.
These dowels cannot be used in expansion joints.

Transverse force dowels are used to transmit load at movement joints.

The following requirements must be met:	The solution is:
■ Unimpeded horizontal movement of the component	The self-lubricating Polyethylene sleeve with expansion space allows the dowel to glide freely.
■ Protection of the dowel from corrosion	The dowels can be supplied either galvanized or in stainless special steel.
■ Exact horizontal dowel position	Adjusting pin at sleeve end
■ Secure load transmission into the building component	Prefabricated reinforcing cage at predetermined fixing location
■ Simple, site-suited fixing	The sleeve is fixed to the first concrete pour formwork using the multi-purpose flange as a locator. Continuous formwork is possible without drilling.

Titan
Selection criteria

1. Type of corrosion protection

The selection is made to suit site conditions.

- The hot-dip galvanized dowels can be used in many different applications. Your benefits: They do not become brittle even under corrosive conditions.

- If stainless steel is specified, it is important to determine which materials could come into contact with the dowels.

2. Corrosion types

- **Surface corrosion**
  This type of corrosion occurs on non-alloyed steel in connection with air humidity and oxygen under the influence of aggressive environmental influences. Stainless steel types are less sensitive to this type of corrosion in comparison to untreated steels.

- **Stress corrosion**
  Stress corrosion occurs in austenitic stainless steel under stress which is also subjected to chlorides, even in low quantities. This type of corrosion is particularly dangerous as it is invisible and can lead to sudden failure in the structure under load.
  Under corrosive conditions it is therefore imperative that a stainless steel (I-) which is specially made to be resistant to this type of corrosion or an electroplated steel (G-) is used.

- **Intercrystalline corrosion**
  This type of corrosion occurs frequently at the boundary between two different metal structures. It is the main characteristic of stainless steels, especially as a result of incorrect heat treatment or bad quality welding. The Titan transverse force dowel is not welded.

- **Corrosion due to pitting**
  Metals which form passive layers (e. g. stainless special steel) can be especially affected. The passive layer is normally a very thin oxide layer which prevents further corrosion. Pitting corrosion appears as soon as the passive layer is damaged by mechanical loading or by specific substances such as chlorides, bromic salts or iodides (chemical or petrochemical industries). This takes place very rapidly in the affected areas.

3. Loading characteristics

This description of our dowels is based on fracture and live loads (according to Article A.3.3.3 BAEL regulations).

The main characteristics for the determination of loads are:

- Concrete quality
  Concrete compression strength β_{28} = 35 N/mm^2 (cube crushing strength)

- Distance between dowels
  The loads stated in the description are applicable to spacing between the individual dowels ≥ 60 cm. If the dowel spacing is < 60 cm, then an additional reinforcement is necessary.

- Size of expansion joint
  For safety reasons the expansion joint dimension “a“ as specified in the drawings must be increased by the value “δ_a“ in order to compensate for negative effects such as shrinkage, change in length due to temperature changes etc. The safety allowance “δ_a“ is 5 mm.

- The reinforcing cage allows a considerable increase in the permissible shear forces.
  The reinforcing cage is constructed in high-quality, guaranteed weldable steel (BSt 500 S).

Titan

Sample specification

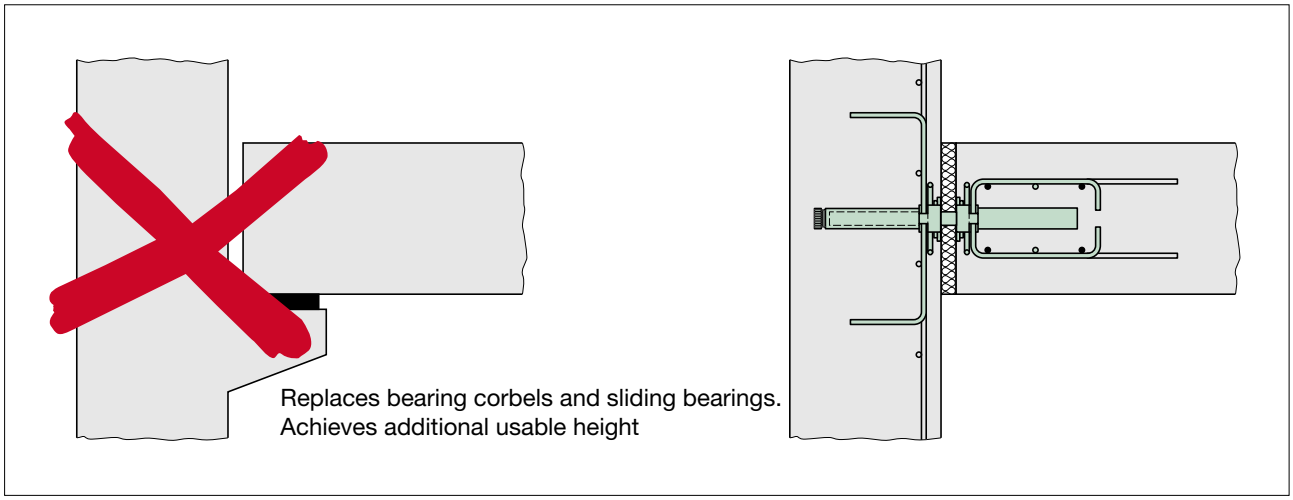
Tender text: “Formwork aids for threaded steel couplers“

Item	Qty. (lin. m)	Specification	Price per unit	Total price
		Transverse force dowels – for the transmission of transverse forces at expansion joints. Deliver dowel in either galvanized (G-) or stainless steel (I-) version depending on the corrosion loading with fixing materials incl. reinforcement cages and fix it in accordance with the drawings and the manufacturer's information. Manufacturer: FRANK Titan dowel as above mentioned. Type _____		

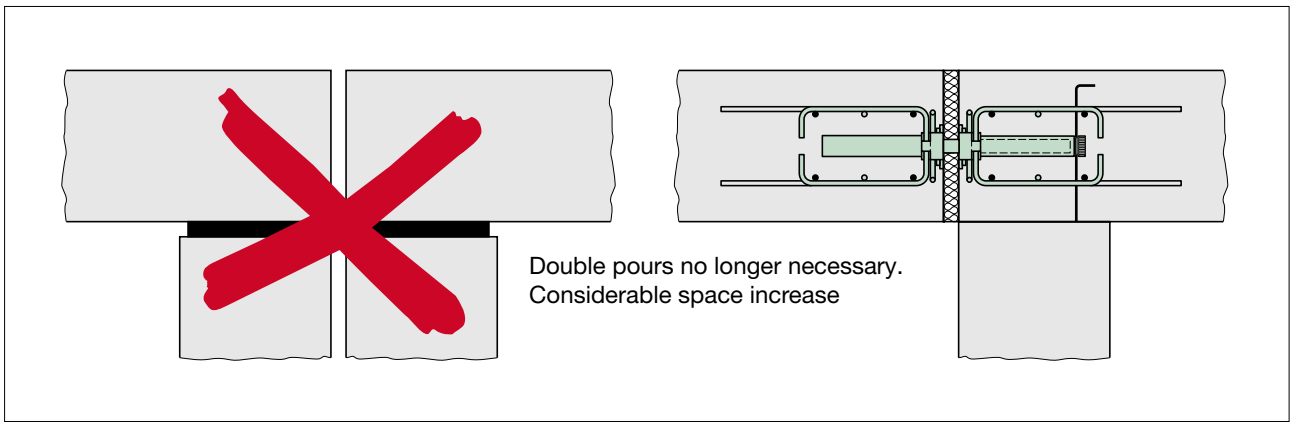
Titan dowel system:
The secure method having been tested for many years

Titan
Applications

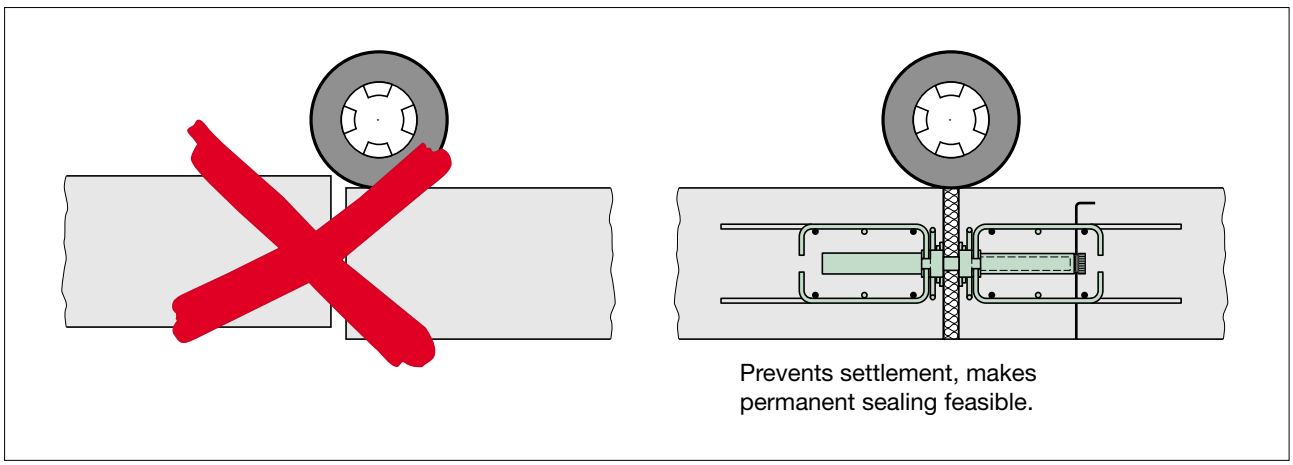
Slab on corbel



Slab on double-skinned wall



Floor slab



Titan
Applications

Application at outside ends of beams and wall sections

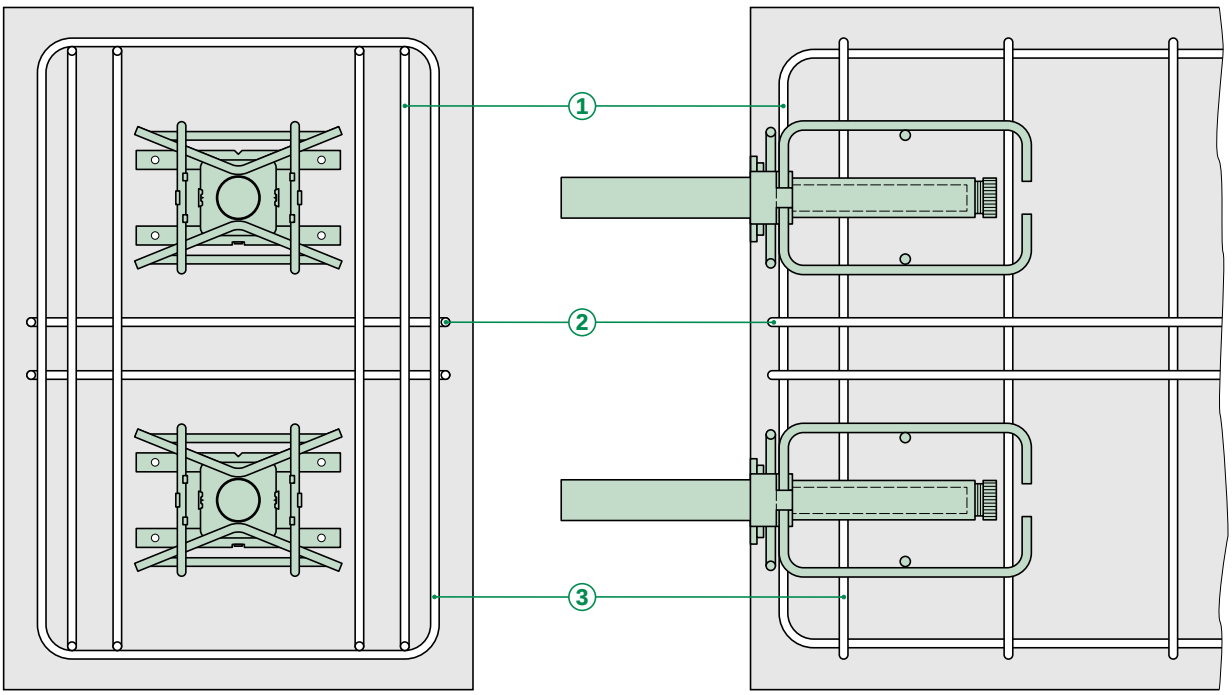
All Titan dowels can be used at the outside ends of beams or walls. If several dowels are necessary, they are mostly placed above each other in such a manner that they do not impede the normal reinforcement outside on the beam.

The distance between the dowels depends on the height of the reinforcement cages to be found there. The reinforcement pins to be located between the dowels must be taken into account, however.

The minimum width of the beam or wall is determined by the reinforcement and its concrete cover.

The reinforcement at the end of the beam or wall must be designed to suit the concentrated load.

The following diagram is only intended as an example and to show the principles involved.



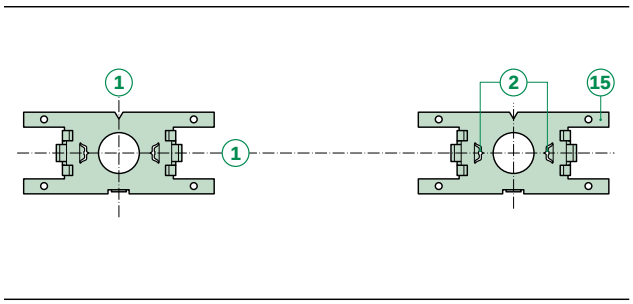
① The transverse reinforcement is to be designed so that it can withstand the total loading alone. It is concentrated on the outside end of the beam or wall and must be anchored accordingly.

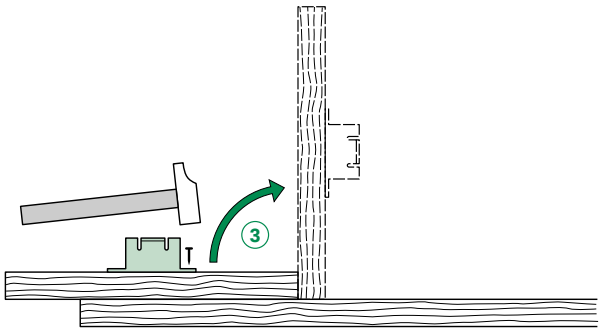
② The reinforcement pins are located horizontally between the dowels. The section used must not be smaller than 2 cm^2.

③ Surrounding stirrups

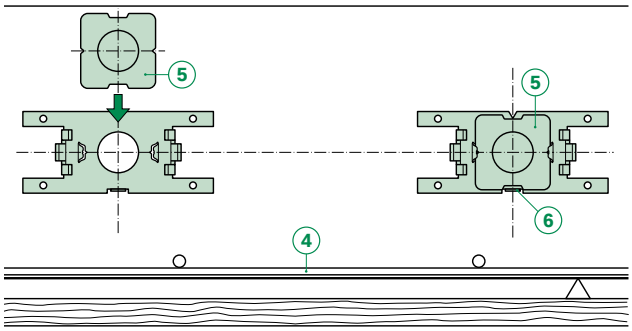
Titan
Fixing instructions

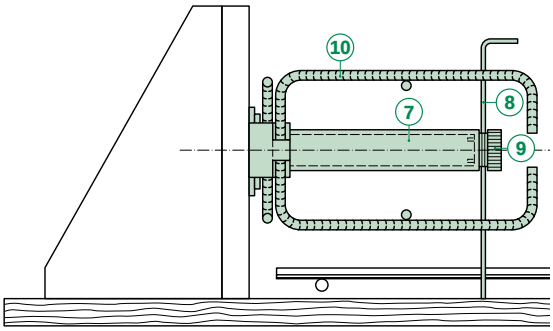
1st stage





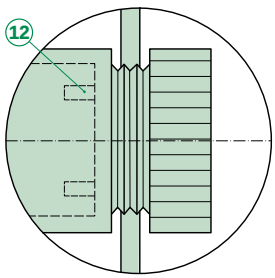
- Determine the axis (1) and nail the multi-purpose flange (15) onto the face shutter to the centering marks (2) while it is lying down.
- Erect and fix the face shutter (3).

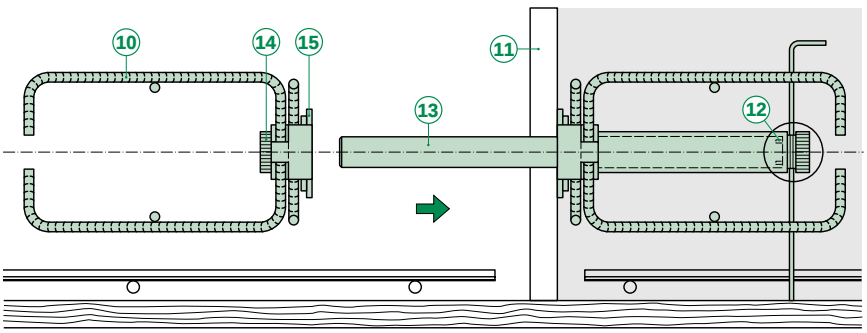




- Fix the bottom reinforcement layer (4).
- Push the gliding sleeves (5) (without removing the label) into the flange gliding rails all the way to the stop (6).
- Check that the gliding sleeve (7) is horizontally and properly fixed using the adjusting pin (8) which is clamped in place by the threaded cap (9).
- If necessary, clip the reinforcing cage (10) onto the flange.
- Fix the top reinforcement layer and concrete the first pour.

2nd stage





- Remove the face shutters and fix the joint lining in place (11).
- Fix the bottom reinforcement.
- Push the Titan dowel (13) in as far as the stop (12).
- If necessary, push the centering flange (14) into the multi-purpose flange gliding rail (15) as far as the stop.
- If necessary, clip the reinforcing cage (10) onto the flange.
- Fix the remaining reinforcement.
- Tie the reinforcing cage to the main reinforcement.

Titan
Accessories

Reinforcement cages are used to encrease the load transmission.

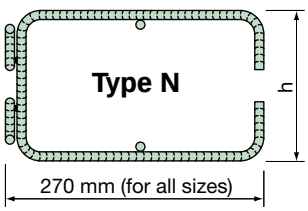
The reinforcing cage

- is welded and constructed compactly;
- ensures a clearly determinable load distribution;
- allows a considerable increase in the permissible shear forces;
- guarantees exact location due to the fixing on multi-purpose flange.

◀ Tension distribution bars made of stainless steel

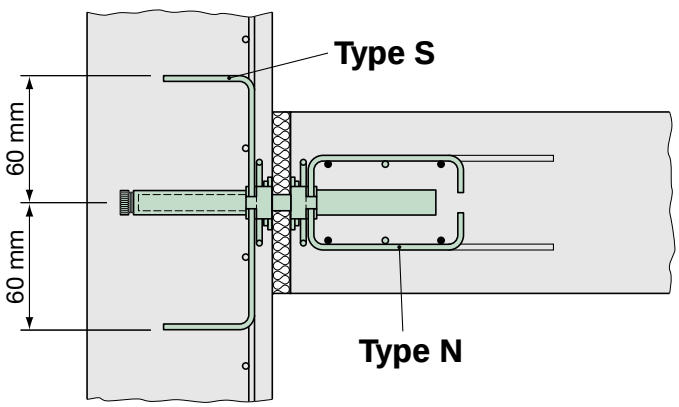
There are two different cage versions depending on your requirements.
The tabular values apply to both versions without restrictions.

Reinforcing cage type N incl. fixing materials (for slabs and beams)

	Article number	Ø mm	Height h in mm	Weight kg/item
	TQDB20	20	120	2.3
	TQDB22	22	120	2.3
	TQDB25	25	140	2.4
	TQDB30	30	180	3.2
	TQDB40	40	180 – reinforced	4.2

The reinforcing cage standard height h is determined by the slab thickness and the dowel used.
Other measurements are available on request.

Special reinforcing cage type S for walls whose thickness must not be less than 15 cm.



If necessary, the sleeve and dowel can be shortened to take the wall thickness into account.

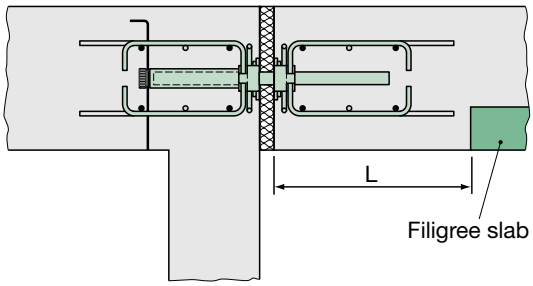
Please contact our technical advisory service for further information, if required.

Titan
Accessories

Applications with filigree slabs

If an application without reinforcing cage is required, no particular problems are caused:

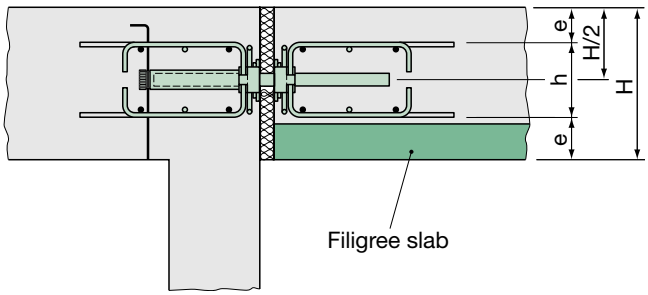
- The filigree slab stops at a distance L from the expansion joint. The remaining section is cast in the in-situ concrete. The loads to be taken into account are identical to those in an in-situ concrete slab from the stability point of view.



- The prefabricated slab stops directly at the expansion joint. You will have to calculate a dummy slab height for this application.

  H = h + 2 e

  where: H = dummy slab height
  h = reinforcing cage height
  e = concrete cover



Attention: Bonding between filigree slab and in-situ concrete must be ensured!

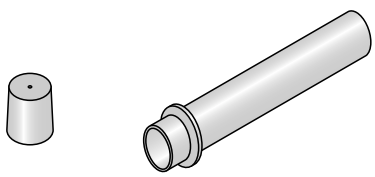
Special gliding sleeves

for two-dimensional movement, incl. fixing flange and adjusting pin

	Article number	Ø mm	Weight kg/item
	TQGHS20	20	0.48
	TQGHS22	22	0.48
	TQGHS25	25	0.73
	TQGHS30	30	0.79
	TQGHS40	40	1.47

The oval sleeves can be easily combined with all reinforcement cages.

Pin gliding sleeves

	Article number	Description	Weight kg/item
	TQNGH20	**Pin gliding sleeve** for 20 mm Ø dowels Push-in depth 160 mm	0.034
	TQNGHH20	**Sleeve holders** for 20 mm Ø pin sliding sleeves	0.004

Other dowels

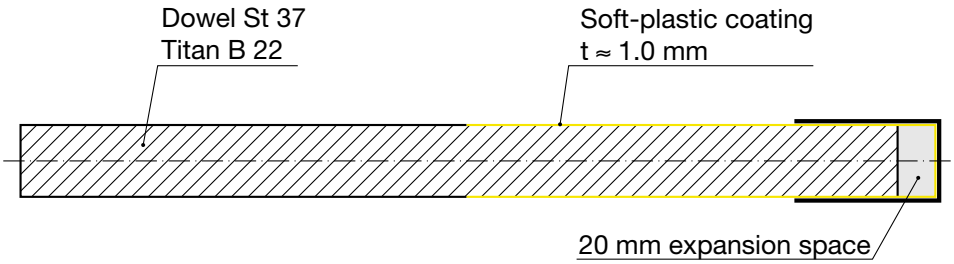
Dowel, galvanized, coated one side

The dowels have various diameters, an expansion space (2 cm) incorporated and are covered with a soft-plastic coating over half their length. This completely new soft-plastic coating is a further development of the well-known bituminous coating and offers an optimum corrosion protection for the dowel. Handling the dowel is made considerably easier, as the soft-plastic coating does not tend to stick the individual dowels together, as this was the case with bituminous coatings.

Article numner	Type	Steel quality	Diameter mm	Length mm	Weight kg/item
TQGHB18500	B 18	Steel St 37 galvanized	18	500	0.999
TQGHB20500	B 20	Steel St 37 galvanized	20	500	1.233
TQGHB22500	B 22	Steel St 37 galvanized	22	500	1.492
TQGHB25500	B 25	Steel St 37 galvanized	25	500	1.926
TQGHB28500	B 28	Steel St 37 galvanized	28	500	2.417

Other lengths and steel qualities on request.

The dowels listed above can also be supplied in a galvanized version, without coating.



◀ Galvanized dowel, coated one side with expansion space. Fixed in floor slab.

Titan
System requirements

The Titan transverse force dowel system is intended for the transmission of transverse forces under mainly stationary loading at expansion joints in reinforced concrete members. The joint formation and distribution of forces in the concrete must be designed and dimensioned by a structural engineer.

The following loading tables should serve as design aids for the various dowels and loading cases.

They were checked and approved by the "Direction Technique de SOCOTEC" (official French testing society) in letter no. DT/SB/92/307/ISB/MB.

The following values can be taken from the drawings/ structural analysis

Slab thickness	200 mm
Concrete class	**B 35**
Loading	30 kN/m
Joint width	20 mm

Determine corrosion protection

galvanized or stainless steel

G **I**

Select diameter (estimate)

e. g. **I - 22 - 0**

Determine safety factor

(suggestion)

for concrete y = 2.0

for steel y = 1.8

Determine perm. loading

		Failure load			Perm. loading
Failure of steel a = 20 + 5		51.4 kN	$\frac{51.4\text{ kN}}{1.8}$	=	28.6 kN
Failure of concrete H = 200 mm B 35	Without reinforcing cage	26.8 kN	$\frac{26.8\text{ kN}}{2.0}$	=	13.4 kN
	With reinforcing cage	98.0 kN	$\frac{98.0\text{ kN}}{2.0}$	=	49.0 kN

Determine the dowel spacing

				Dowel spacing
For the solution without reinforcing cage → limiting loading case → failure of concrete	$\frac{13.4\text{ kN}}{30\text{ kN/m}}$	= 0.466 m	=	45 cm
For the solution with reinforcing cage → limiting loading case → failure of steel	$\frac{28.6\text{ kN}}{30\text{ kN/m}}$	= 0.953 m	=	96 cm

The dowel spacing can be altered by selecting another dowel diameter or another steel quality.

The dowel spacing is determined by:

- On-site requirements
- The dowel diameter
- The dowel material
- The reinforcement

You should aim for dowel spacing of between 60 cm and 100 cm.

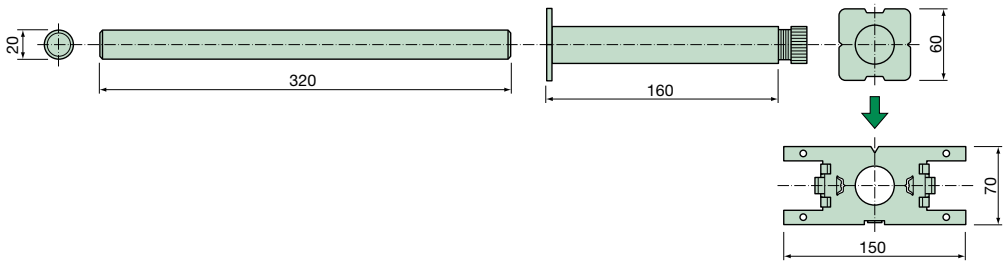
Design verification

Calculation example

Titan
System requirements

Type G-20-1
Dowel in hot-dip galvanized steel St 37

Type G-20-1: Ø 20 mm



Failure load (kN)

F_R (A) failure of steel (kN)						**a = theoret. joint width + 5 mm**
a	**5**	**15**	**20**	**25**	**35**	**45**
G-20-1 Ø 20 mm	38.5	27.5	24.0	21.4	17.5	14.8

F_R (B) failure of concrete (kN)							**H = slab thickness (mm)**
H	**150**	**180**	**200**	**220**	**250**	**300**	**350**
$ß_{w28}$ = 30 N/mm²	14.1	19.6	23.7	28.3	36.0	51.1	68.9
$ß_{w28}$ = 35 N/mm²	16.0	22.1	26.8	32.0	40.7	57.7	77.8

Permissible loads: Safety factors

1) The following values are derived from a and H:
   F_R (A) fracture of steel (kN) and
   F_R (B) fracture of concrete (kN)
   The lower value is decisive.

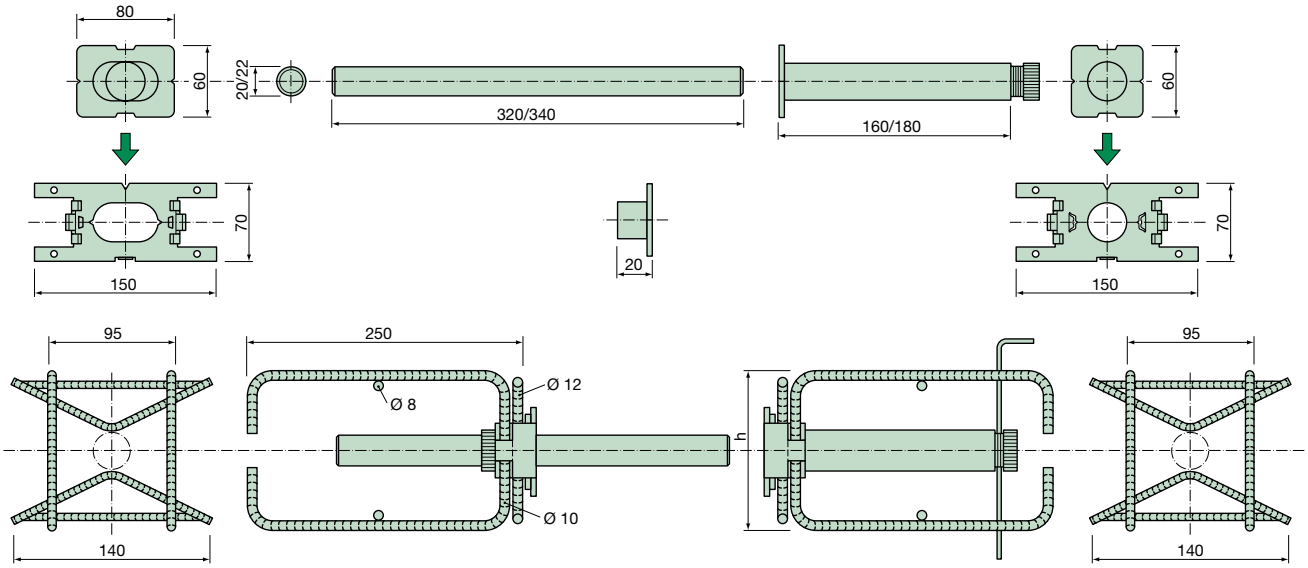
2) Safety factors:
   1.8 with F_R (A) for steel
   2.0 with F_R (B) for concrete

Approved by:

SOCOTEC

Titan
System requirements

Type G-20-0, Type G-22-0, Type I-20-0 and Type I-22-0



Reinforcing cage

- Reinforcing cage: Ø 10 mm – BSt 500 S
- Reinforcing cage height h for dowel Ø 20 mm and 22 mm: 120 mm/cage with two tension stirrups
- Minimum slab thickness: 150 mm

Dowel length for:

- Ø 20 mm: 320 mm
- Ø 22 mm: 340 mm

Failure load (kN)

F_R (A) failure of steel (kN)						**a = theoret. joint width + 5 mm**
a	**5**	**15**	**20**	**25**	**35**	**45**
G-20-0	104.7	74.8	65.4	58.2	47.6	40.3
G-22-0	129.0	94.1	82.9	74.1	61.1	52.0
I-20-0	72.6	51.9	45.4	40.4	33.0	27.9
I-22-0	89.5	65.3	57.5	51.4	42.4	36.1

F_R (B) failure of concrete (kN)														**H = slab thickness (mm)**
H	**150**		**180**		**200**		**220**		**250**		**300**		**350**	
Concrete strength $ß_{w28}$ (N/mm²)	30	35	30	35	30	35	30	35	30	35	30	35	30	35
F_R (B) Without cage	14.1	16.0	19.6	22.1	23.7	26.8	28.3	32.0	36.0	40.7	51.1	57.7	68.9	77.8
F_R (B) With cage	47.3	55.1	68.0	79.4	84.0	98.0	101.6	118.6	131.3	153.1	189.0	220.5	257.3	300.1

Permissible loads: Safety factors

1) The following values are derived from a and H:
F_R (A) fracture of steel (kN) and
F_R (B) fracture of concrete (kN)
The lower value is decisive.

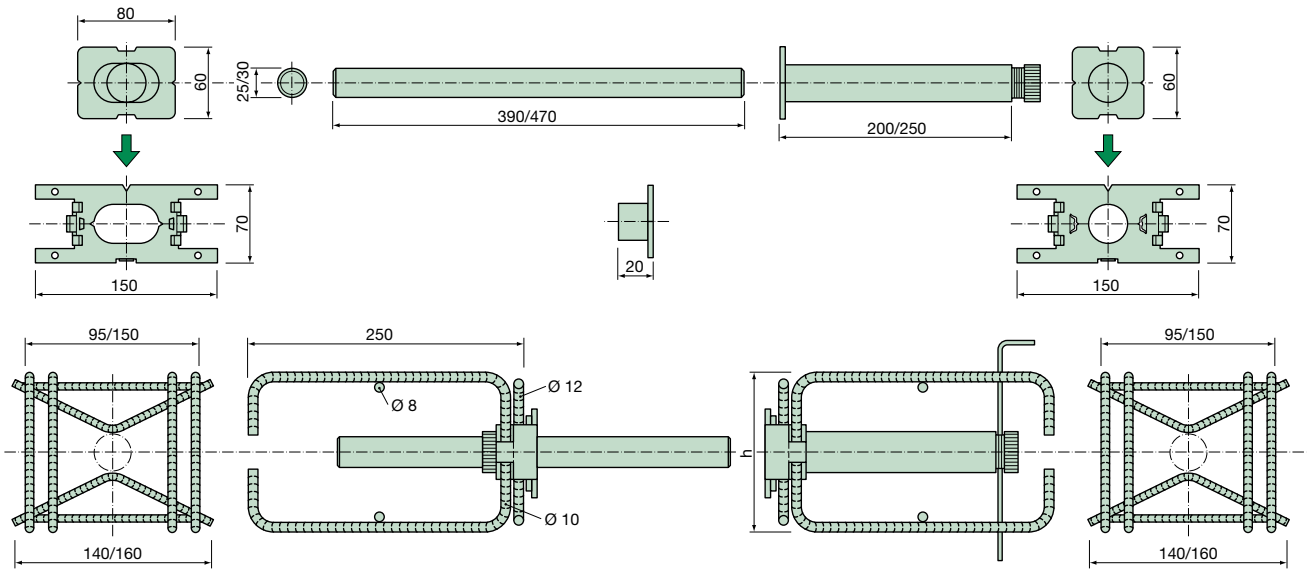
2) Safety factors:
1.8 with F_R (A) for steel
2.0 with F_R (B) for concrete

Approved by:

SOCOTEC

Titan
System requirements

Type G-25-0, Type G-30-0, Type I-25-0 and Type I-30-0



Reinforcing cage

- Reinforcing cage: Ø 10 mm – BSt 500 S
- Reinforcing cage height h for dowel Ø 25 mm: 140 mm/cage with two tension stirrups
- Reinforcing cage height h for dowel Ø 30 mm: 180 mm/cage with four tension stirrups
- Minimum slab thickness: 180 mm

Dowel length for:

- Ø 25 mm: 390 mm
- Ø 30 mm: 470 mm

Failure load (kN)

F_R (A) failure of steel (kN)						a = theoret. joint width + 5 mm
a	**5**	**15**	**20**	**25**	**35**	**45**
G-25-0	170.4	127.8	113.6	102.2	85.2	73.0
G-30-0	252.3	196.3	176.6	160.6	135.9	117.8
I-25-0	118.2	88.7	78.8	70.9	59.1	50.7
I-30-0	175.1	136.2	122.6	111.4	94.3	81.7

F_R (B) failure of concrete (kN)												H = slab thickness (mm)
H	**180**		**200**		**220**		**250**		**300**		**350**	
Concrete strength $ß_{w28}$ (N/mm²)	30	35	30	35	30	35	30	35	30	35	30	35
F_R (B) Without cage	19.6	22.1	23.7	26.8	28.3	32.0	36.0	40.7	51.1	57.7	68.9	77.8
F_R (B) mit Korb	68.0	79.4	84.0	98.0	101.6	118.6	131.3	153.1	189.0	220.5	257.3	300.1

Permissible loads: Safety factors

1) The following values are derived from a and H:
   F_R (A) fracture of steel (kN) and
   F_R (B) fracture of concrete (kN)
   The lower value is decisive.

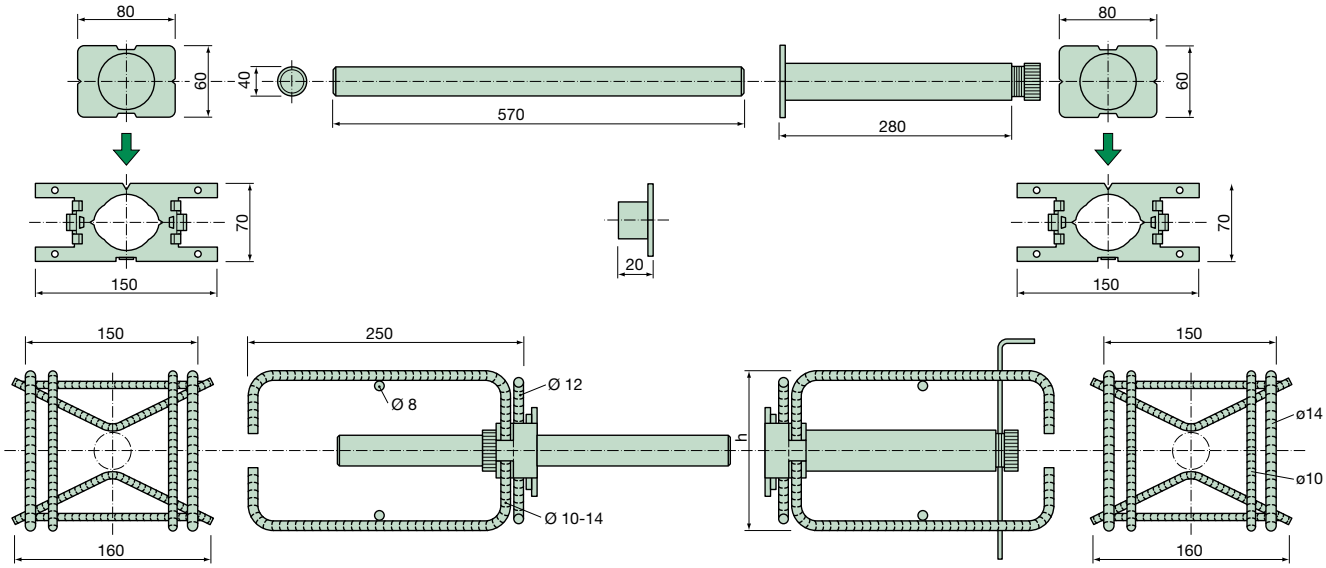
2) Safety factors:
   1.8 with F_R (A) for steel
   2.0 with F_R (B) for concrete

Approved by:

SOCOTEC

Titan
System requirements

Type G-40-0 and Type I-40-0
Dowel Ø 40 mm in stainless Duplex steel WR 1.4462
Dowel Ø 40 mm in hot-dip galvanized steel (42 Cr Mo 4 v)



Reinforcing cage

- Reinforcing cage: Ø 10 mm + Ø 14 mm – BSt 500 S
- Reinforcing cage height h for dowel Ø 40 mm: 180 mm/cage with four tension stirrups
- Minimum slab thickness: 250 mm

Dowel length for:

- Ø 40 mm: 570 mm

Failure load (kN)

F_R (A) failure of steel (kN)						a = theoret. joint width + 5 mm
a	**5**	**15**	**20**	**25**	**35**	**45**
G-40-0	465.2	380.6	348.9	322.1	279.1	246.3
I-40-0	322.8	264.1	242.1	223.5	193.7	170.9

F_R (B) failure of concrete (kN)												H = slab thickness (mm)
H	**250**		**300**		**350**		**400**		**450**		**500**	
Concrete strength $ß_{w28}$ (N/mm²)	30	35	30	35	30	35	30	35	30	35	30	35
F_R (B) Without cage	36.0	40.7	51.1	57.7	68.9	77.8	90.7	100.5	114.3	126.6	140.6	155.8
F_R (B) With cage	131.3	153.1	189.0	220.5	257.3	300.1	336.0	392.0	425.3	496.1	525.0	612.5

Permissible loads: Safety factors

1) The following values are derived from a and H:
F_R (A) fracture of steel (kN) and
F_R (B) fracture of concrete (kN)
The lower value is decisive.

2) Safety factors:
1.8 with F_R (A) for steel
2.0 with F_R (B) for concrete

Approved by:

SOCOTEC

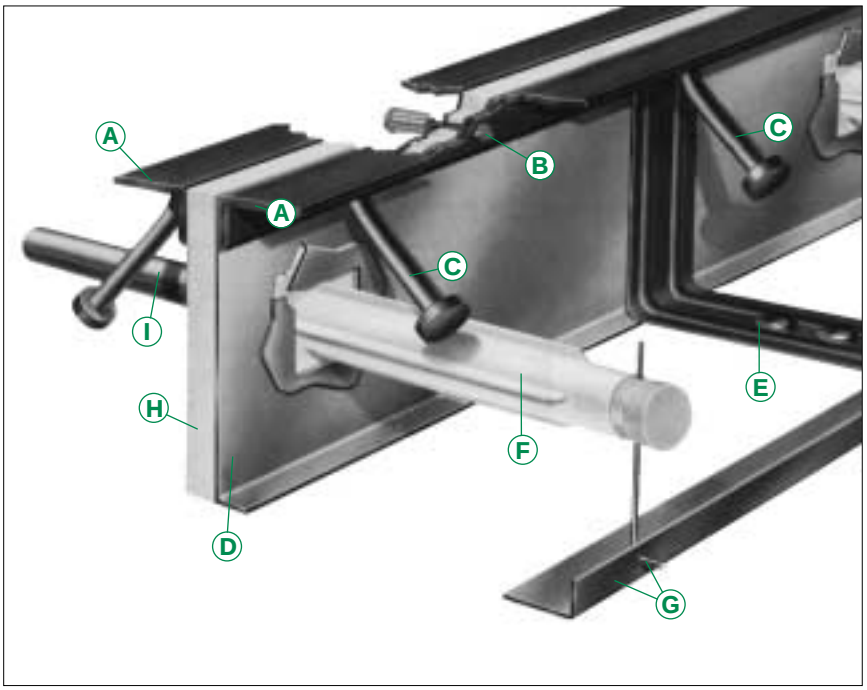
Dilatec

The Dilatec system is used as formwork to movement joints.

If the system is used in floor slabs,we recommend the use of the Titan dowel in connection with Dilatec continuous formwork, because this also supports the joint edges. The system enables simultaneous concreting of both sides.

The dowels are kept parallel. All Titan dowels can be used with Dilatec formwork.

Standard version consisting of:



- (A) Protective angle steel
- (B) Centering bolts
- (C) Anchor bolts
- (D) Formwork and dowel holder
- (E) Stiffening bracket
- (F) Sleeve
- (G) Perforated section and adjusting pin
- (H) Joint material
- (I) Titan dowel

Standard length supplied per element: 3 m

When making price enquiries or ordering the following information is essential:

- Element height
- Joint width (joint material thickness)
- Dowel diameter
- Gliding sleeve spacing

Max Frank GmbH & Co. KG
Accessories for the reinforced concrete construction
Mitterweg 1 · 94339 Leiblfing
Germany

Sales
Phone +49/(0)9427/189-117
Fax +49/(0)9427/189-220
http://www.maxfrank.de
E-mail: info@frank-online.de