

Title: Anchor DowelDescription

The invention relates to an anchor dowel which is provided for being cast into a castable, hardening mass, said anchor dowel having a receiving portion for a member to be held by means of the anchor dowel.

Anchor dowels of the aforementioned type are known in the prior art. Such anchor dowels are used, *inter alia*, for erecting walls, in particular double walls. A double wall is a usually prefabricated wall construction manufactured at a factory and usually transported horizontally to a building site by a truck, where it is raised and moved into its installation position. The shells of the double wall are mostly made of concrete and are interconnected by lattice girders and have a cavity which is filled with concrete at the building site. An advantage of double walls is that a formwork is not required for the construction of walls at a building site. A further advantage is that owing to these being manufactured at the factory, the surface quality of the double walls is very good. Double walls include, for example, double walls, thermal walls, cavity walls and filigree walls. To be able to load and to move the double wall at the building site, transport anchors are incorporated during manufacture of the double wall.

To erect corresponding walls, these walls are often supported by struts anchored both to the respective wall and the other component.

The other component can be another wall or a component substantially perpendicular to the wall, for example in a floor or in a ceiling. High forces can act on the walls to be held, for example due to wind pressure or forces resulting from construction such as stabilizing loads or supporting loads. The forces are deflected to the other component via the struts. The forces can be tensile forces or compressive forces.

It has been shown that the anchorages, especially in thin shells of element walls, can only absorb certain, relatively not particularly high, forces. When exceeding a certain maximum force, particularly in the tensile direction, the concrete is damaged and the anchorage is possibly torn out of the concrete. Tests have shown that the tear-out is mostly irregular. Thereafter, the concrete is usually heavily damaged. However, when a crack forms, the maximum load capacity of the connection is reached and there is a sudden loss of load capacity. In such an event, the wall could immediately fall down and constitute a danger.

Therefore, the object is to further develop an anchor dowel of the aforementioned type to the effect that it can absorb higher forces than anchor dowels known so far.

This object is solved by an anchor dowel according to claim 1 as well as by a concrete component according to the independent claim 9. Further embodiments of the invention are the subject matter of the dependent claims.

An anchor dowel according to the invention is used for the insertion into a castable, hardening mass. For example, concrete can be such a castable, hardening mass. Other castable, hardening masses, for example synthetic materials, can also be used with the anchor dowel according to the invention.

The anchor dowel comprises a receiving portion for a member to be held by means of the anchor dowel, in particular a joining member. Such a joining member can be, *inter alia*, a bolt, a screw, a threaded bore or the like. The member can be fixed in the anchor dowel by means of the receiving portion. The member can be an object to be held or a connection, e.g. a bolt, for example, to a strut or the like.

According to the invention, it is provided that the anchor dowel has a surface facing in a tensile force direction, which is essentially concavely curved. Such a configuration of the surface facing in the tensile force direction causes forces that are introduced via the member into the anchor dowel and the mass surrounding the anchor dowel, for example concrete, to be distributed over a large surface. This reduces stress peaks and thus local overloads of the material surrounding and holding the anchor dowel such that the material, particularly when it is brittle, will not start to selectively burst. Instead, the introduced tensile force is distributed over the surface. Therefore, the force deflection is more homogeneous than in known anchor dowels.

In particular, the tensile force direction can coincide with the surface normal of the mass, into which the anchor dowel is inserted.

According to a first possible further embodiment of the anchor dowel, the concave curvature can be realized by a conic section, in particular a parabolic or a hyperbolic contour.

According to a possible further embodiment of the anchor dowel, the surface facing in the tensile force direction can be essentially rotationally symmetrical. Due to such a rotationally symmetrical surface, a rotationally symmetrical compressive stress ring is formed when

there is a tensile force. As a result, the tensile stresses resulting from the tensile load are partly prestressed. As a consequence, the combination of a rotationally symmetrical surface and the concave curvature results in a higher load capacity of the anchor dowel than in known anchor dowels.

The tensile force direction can coincide in particular with the symmetry axis of the anchor dowel according to the invention.

A further aspect of the anchor dowel according to the invention is that the anchor dowel consists essentially of a synthetic material. As opposed to other possible materials such as metal, synthetic material has a higher elasticity, by which pressure differences can be balanced in the case of load. Furthermore, synthetic material has a more pliant surface than metal such that pressure differences and stress peaks can be better reduced than when using metal. On the other hand, synthetic material is usually more resistant than many other materials to the conditions prevailing in the mounted state. In addition, a synthetic material component with a concave surface can be produced cost-effectively, for example by injection molding processes.

Furthermore, the receiving portion in the anchor dowel according to the invention can be configured such that it has a through-hole. This allows a largest possible insertion depth of the member to be held, which results in a high stability transversely to the tensile force direction.

A further aspect of the present invention relates to the provision of an internal thread in the receiving portion. The member, in particular the joining member, can be screwed into the anchor dowel with the help of the internal thread. The internal thread can be used to receive a nailing plate. Hence, the anchor can be fixed to a formwork, for example a steel formwork. Nailing plates are standard products in the manufacture of precast concrete parts and found in any precast factory. Nailing plates can be used to fix the anchor to the formwork and to ensure that no concrete passes into the through-hole during formwork manufacture.

According to a further possible embodiment, it can be provided that the internal thread is part of a nut arranged on a surface facing away from the tensile force direction. Thus, the internal thread can be made of a different material than the rest of the anchor dowel. By arranging the nut on the surface facing away from the tensile force direction, forces applied via the nut are transferred into the anchor dowel and distributed therein.

The provision of a nut is particularly useful when the anchor dowel is made of a synthetic material. The nut can be made of e.g. a metal, in particular a precious metal, which has a higher shear resistance than does synthetic material. Moreover, by providing different nuts with different characteristics, different joining members can be taken into account. The nut can be cast, for example, into the anchor dowel or can be inserted therein. The nut can be held in a form-fitting manner, frictionally engaged or in a firmly bonded manner.

As an alternative to a nut, a bolt, for example a threaded bolt, can be inserted into the anchor dowel according to the invention, which is used for fixation of the components to be connected. The thread of the threaded bolt can be an internal thread or an external thread. Another variant is the use of tilting dowels or bolts having a tilting dowel function.

A further aspect of the anchor dowel according to the invention pertains to the arrangement of a guide sleeve in the receiving portion. Such a guide sleeve can consist of a different material than the receiving portion. Just as with the rest of the anchor dowel, the receiving portion can consist of a synthetic material. The sleeve can be made of a more solid material than the anchor dowel, for example of a harder synthetic material or metal. Transverse forces, i.e. forces perpendicular to the tensile force direction, can be better distributed in the anchor dowel by means of such a sleeve such that local wear of the anchor dowel is reduced in highly loaded areas.

According to a further aspect of the invention, at least one recess is provided in the surface for abutting a reinforcement. Abutting a reinforcement allows an additional application of force via the reinforcement and thus an increase of the maximum tensile force to be absorbed as well as a more ductile load behavior such that there is still the load capacity even after initial crack formation in the concrete.

A first independent subject matter of the present invention relates to a concrete component having at least one anchor dowel according to one of the preceding claims. A corresponding concrete component is suitable for absorbing higher tensile forces than a concrete component with anchor dowels other than those according to the invention. This increases the load-bearing capacity of the connection. A corresponding concrete component can be, for example, a concrete wall.

A first further concept of the concrete component according to the invention provides that one face of the anchor dowel is flush with the concrete component, or the anchor dowel is recessed in the concrete component. A flush ending or recessed arrangement allows a

homogeneous mounting of the member to be held to the anchor dowel, and therefore the concrete can be used as a support around the face.

A further independent aspect of the present invention relates to a method for the manufacture of a concrete component, in which an anchor dowel according to the invention is positioned in a formwork, the formwork being subsequently filled with concrete.

A further aspect of the present invention relates to a method according to the preceding paragraph, with a reinforcement being abutted to the anchor dowel prior to positioning of the anchor dowel or between positioning the anchor dowel and casting.

A further aspect of the present invention relates to a method according to the two preceding paragraphs, the anchor dowel being positioned by means of a nailing plate.

A further aspect of the present invention relates to a method for the manufacture of a concrete component according to the invention described above. The anchor dowel is positioned here in a formwork. The formwork can be provided for example by a cladding. Subsequently, the formwork is filled with concrete. After hardening of the concrete, the concrete component is ready for use, and the anchor dowel can be used.

A further aspect provides that after positioning and before casting, a reinforcement is abutted to the anchor dowel. The reinforcement can abut the concave surface. When there is a load, the reinforcement can absorb some of the forces and cause a more ductile load behavior of the anchor dowel.

A further aspect of the method provides that the essentially concavely curved and in particular rotationally symmetrical surface is aligned in the direction of a surface normal of a surface of the concrete component to be cast. In this way, uniform force distribution can be achieved when there is a tensile force as well as a high load-bearing capacity.

In a possible further development of the method, the anchor dowel can be positioned in the formwork by means of a nailing plate. The nailing plate can be removed after casting of the concrete component.

Further objectives, advantages, features and use possibilities of the present invention can be derived from the following description of an embodiment example by the drawing. All of the described and/or illustrated features, both *per se* and in any meaningful combination,

constitute the subject matter of the present invention, also irrespective of their compilation in the claims or their dependency.

The following is shown schematically:

- Fig. 1A a plan view of an anchor dowel according to the invention in a first embodiment;
- Fig. 1B a sectional view along the sectional line A-A of the anchor dowel from Fig. 1A;
- Fig. 2A a plan view of an anchor dowel according to the invention in a second embodiment;
- Fig. 2B a sectional view along the sectional line A-A of the anchor dowel from Fig. 2A;
- Fig. 3 a side view of a wall construction in which an anchor dowel according to the invention can be used;
- Fig. 4 an enlarged sectional view through the wall construction from Fig. 3 with the anchor dowel according to the invention in a first embodiment;
- Fig. 5 an enlarged sectional view through the wall construction with the anchor dowel according to the invention in a second embodiment; as well as
- Figs. 6A to 6D phases of manufacturing a concrete component according to the invention.

For better readability, identical or equally effective components are provided with the same reference numerals in the following figures.

Fig. 1A shows a plan view of an anchor dowel 2 according to the invention. The view direction runs counter to a tensile force direction Z. The tensile force direction Z therefore points into the illustration plane.

A surface 4 of the anchor dowel 2 is also rotationally symmetrical. The anchor dowel 2 has a receiving portion 6. The receiving portion 6 is arranged centrally, i.e. also rotationally symmetrically with respect to the same symmetry axis.

The receiving portion 6 is configured as a through-hole. A nut 8 is arranged on the bottom side, i.e. the side opposite the surface 4. The nut 8 serves to tightly screw a joining member.

The anchor dowel 2 is made of a synthetic material, in particular a glass fiber reinforced synthetic material. A possible suitable material can be PA6 GF30, i.e. polyamide 6 with 30 % glass fiber.

Fig. 1B shows a cross section through the anchor dowel 2 along the sectional line A-A according to Fig. 1.

The surface 4 aligned in the tensile force direction Z is convexly curved. If a tensile force occurs in the tensile force direction Z, the convex curvature causes a rotationally symmetrical and even load on the surrounding concrete in that a rotationally symmetrical compressive stress ring is formed. Tensile stress resulting from the tensile load is in part prestressed, and a higher load capacity of the anchor dowel 2 is achieved.

The nut 8 is arranged from a bottom side 10 aligned opposite the tensile force direction Z. For this purpose, a depression 12 is configured in the surface 10, into which the nut 8 has been inserted. Alternatively, the nut can be completely embedded in the anchor dowel 2.

The anchor dowel 2 has a face 14 which can be installed with the concrete in a flush-mounted or recessed manner.

Fig. 2A shows a plan view of an anchor dowel 2' according to the invention in a second embodiment.

In addition to the anchor dowel 2 according to Figs. 1A and 1B, two recesses 9 are configured in the surface 4, which are provided for abutting a reinforcement.

Fig. 2B shows a sectional view along the sectional line A-A of the anchor dowel 2' from Fig. 2A.

In the figure, a reinforcement 38 is arranged in the recesses 9.

Fig. 3 shows a side view of a wall construction 20 which is constructed by means of an anchor dowel 2 according to the invention.

The wall construction has a double wall 22 which stands on a concrete component 24. The concrete component 24 can be a bottom plate, a foundation or a ceiling. However, horizontal supports against other components are also possible. For this purpose, a strut is horizontally mounted to the anchor dowel 2 according to the invention.

The double wall 22 is supported by means of a strut 26. In the present case, the strut 26 is not held as described in the previous paragraph, but it is held in the double wall 22 by means of a top anchorage 28 and in the concrete component 24 by means of a base anchorage 30. The top anchorage 28 is fixed to an anchor dowel 2 which cannot be seen in Fig. 3 but which corresponds to Figs. 1 and 2 according to the embodiment.

Fig. 4 shows an enlarged sectional view through the wall construction from Fig. 3 with an anchor dowel 2 according to the invention in the first embodiment.

The double wall 22 in which the anchor dowel 2 is mounted corresponds to a generally known structure with two concrete shells forming a cavity, with it being possible that a core insulation is accommodated in the cavity. Here, the core insulation is in contact with the shell which later forms the outer shell of a building wall. Until the double wall or also the thermal wall is moved, a clearance can remain between the core insulation and the shell that later forms the inner shell of a building wall, which is filled with cast-*in-situ* concrete on the construction site.

The strut 26 is shown in two different positions. As shown in Fig. 3, the strut 26 can be guided diagonally downwards to a base anchorage, or it can be supported horizontally at a different wall. Due to the horizontal support, plural walls can be supported with a smaller number of required struts.

The strut 26 is fixed to the anchor dowel 2 by means of a joining member 34. The joining member 34 has a plate 34.1 with a through-hole 34.2, through which a screw 36 can be screwed into the nut 8 of the anchor dowel 2. The strut is fixed to a flange 34.3 attached to the plate 34.1.

Instead of using such a joining member 34, the strut can alternatively also be connected to the anchor dowel 2 in another way, for example directly.

Forces acting upon the wall construction 20 are deflected via the strut 26. The forces act in the tensile force direction Z. The counterforces are absorbed by the anchor dowel 2 and the double wall 22. Due to the convex surface 4 of the anchor dowel 2, which lies in the

concrete, the counterforces are distributed in the concrete over a large surface, which is why the maximally absorbable load increases.

Fig. 5 shows a sectional view through the wall construction with an anchor dowel 2' according to the invention in the second embodiment.

In addition to the features already described with regard to Fig. 4, a reinforcement 38 is arranged in the double wall 22 in this embodiment such that it abuts the surface 4 of the anchor dowel 2. A more ductile load deflection behavior can be achieved thereby, and thus the load-bearing capacity of the anchor dowel 2 further increases.

Figs. 6A to 6D show phases of manufacturing a concrete component according to the invention for two different embodiments of the invention.

According to Fig. 6A, an anchor dowel 2 is arranged in a steel formwork 40 by means of a nailing plate 32. The bottom of the steel formwork 40 defines the outside of the concrete component to be cast, and therefore the nailing plate 32 will be arranged in the concrete component in a flush-mounted manner at first. After casting, the nailing plate 32 is removed, and the resulting hole can be filled with a suitable cement.

Fig. 6B shows that the steel formwork 40 is filled with concrete 42. The anchor dowel 2 is dimensioned such that its bottom side 10 protrudes from the concrete 42 so as to prevent the nut 8 from being contaminated with concrete and thus being made unusable. Alternatively or additionally, the nut can be protected from contamination by means of a cover made of adhesive tape, for example.

Figs. 6C and 6D show the manufacturing of a concrete component according to the second embodiment. Before or after positioning the anchor dowel 2' by means of a nailing plate 32, a reinforcement 38 is inserted, which abuts the surface 4 of the anchor dowel 2' in the recesses 9.

After that, concrete 42 is filled in, as is shown in Fig. 6D.

List of Reference Numerals

2, 2'	Anchor dowel
4	Convex surface
6	Receiving portion
8	Nut
9	Recess
10	Bottom side
12	Depression
14	Face
20	Wall construction
22	Double wall
24	Concrete component
26	Strut
28	Top anchorage
30	Base anchorage
32	Nailing plate
34	Joining member
34.1	Plate
34.2	Through-hole
34.3	Flange
36	Screw
38	Reinforcement
40	Steel formwork
42	Concrete
Z	Tensile force direction
F	Surface normal

Patent Claims

1. An anchor dowel provided for being cast into a castable, hardening mass, in particular concrete (42), having a receiving portion (6) for a joining member (34, 36) to be held by means of the anchor dowel (2, 2'), characterized in that the anchor dowel (2, 2') has a surface (4) facing in a tensile force direction (Z), which is essentially concavely curved.
2. The anchor dowel according to claim 1, characterized in that the concave curvature is realized by a conic section, in particular a parabolic or a hyperbolic contour.
3. The anchor dowel according to claim 1 or 2, characterized in that the surface (4) facing in the tensile force direction (Z) is essentially rotationally symmetrical.
4. The anchor dowel according to one of the preceding claims, characterized in that the anchor dowel (2, 2') consists essentially of a synthetic material.
5. The anchor dowel according to one of the preceding claims, characterized in that the receiving portion (6) has a through-hole.
6. The anchor dowel according to one of the preceding claims, characterized in that the receiving portion (6) has an internal thread (8) for screwing with the joining member (36).
7. The anchor dowel according to claim 6, characterized in that the internal thread is part of a nut (8) arranged at a surface (10) facing away from the tensile force direction (Z).
8. The anchor dowel according to one of claims 1 bis 5, characterized in that a bolt, in particular a threaded bolt or a screw (36), is inserted into the receiving portion (6).
9. The anchor dowel according to one of the preceding claims, characterized in that a guide sleeve is inserted into the receiving portion (6).
10. The anchor dowel according to one of the preceding claims, characterized in that at least one recess (9) is provided in the surface (4) for abutting a reinforcement (38).
11. A concrete component having at least one anchor dowel (2, 2') according to one of the preceding claims.

12. The concrete component according to claim 11, characterized in that one face (14) of the anchor dowel (2, 2') is flush with the concrete component (22), or said anchor dowel is recessed in the concrete component (22).
13. The concrete component according to claim 11 or 12, characterized in that a reinforcement (38) abuts the surface (4) of the anchor dowel (2, 2').