

Shuttering element for limiting a trench wall section, shuttering part and method for producing a trench wall in the ground

The present invention relates in a first aspect to a shuttering element for limiting a trench wall section of a trench wall.

In another aspect the invention relates to a shuttering part which is in particular adapted to form a shuttering element according to the invention.

Finally, the invention relates to a method for producing a trench wall in the ground, in which trench wall sections lying next to each other are formed in the ground by means of a trench wall device, in particular by a trench wall cutter, wherein at least one trench wall section is limited by an introduced shuttering element.

A generic shuttering element and a generic method are known for instance from DE 90 01 679 U1.

It is known to employ shuttering elements, such as e.g. stop-end tubes made of steel, in order to limit sections of a trench wall that are to be produced of concrete. The width or diameter of such shuttering elements that are lowered into the construction joint prior to concreting corresponds to the thickness of the trench wall. Following the setting of the concrete these shuttering elements have to be removed, for example by being drawn vertically upwards out of the construction joint by means of hydraulic devices. As it proves to be quite difficult to determine the point of setting of the concrete that is most favourable for withdrawal this frequently leads to situations in which the concrete has set either to an insufficient degree or else has hardened too much. In the first case parts of the freshly concreted trench wall cave in during withdrawal of the shuttering elements and in the second case withdrawal of the shuttering elements is considerably difficult and, in some cases, even impossible.

In order to avoid these difficulties prefabricated elements are also used in prior art for limiting trench wall sections which remain in the ground after concreting the respective trench wall sections. Such prefabricated elements can be made of steel or concrete for example. In larger trench wall depths, however, such components are extremely bulky due to their weight. In addition, in the case of shuttering elements made of concrete these must have hardened very well so as to avoid damages, which results in a very long storage time. Due to the sensitivity of concrete in regard to tensile loads are concerned, such shuttering components of concrete typically need to have hardened for approximately four weeks.

The **o b j e c t** of the invention is to provide a shuttering element which is especially easy to install. Furthermore, a method for producing a trench wall in the ground is to be provided with which it is possible to limit a trench wall section in an uncomplicated manner.

In a first aspect of the invention the object is solved by the shuttering element having the features of claim 1 and by the shuttering part having the features of claim 8.

As far as the method is concerned the object is solved by the method having the features of claim 12.

Preferred embodiments of the shuttering element according to the invention and the shuttering part according to the invention are subject of the dependent claims.

In accordance with the invention the shuttering element of the above-stated kind comprises a plurality of shuttering parts which have a plate-shaped base body, consisting of concrete in particular, and are connected to one another at their adjoining horizontal front faces.

The shuttering part according to the invention, which is adapted in particular to form a shuttering element in accordance with the invention, has a plate-shaped base body, consisting of concrete in particular, wherein on at least one horizontal front face of the base body a connecting device is arranged for connecting a further shuttering part.

According to the invention the method of the above-stated kind is developed further in that the shuttering element is composed of individual shuttering parts that are intro-

duced successively into the trench and connected to one another at their horizontal front faces.

The central idea of the invention can be seen in the fact that the shuttering element no longer consists of one part, as is the case in prior art, but is composed of several shuttering parts or shuttering segments.

A first considerable advantage resides in this connection in the fact that these shuttering parts are much smaller for example as shuttering elements for trench walls of very large depths. This brings about substantial advantages with regard to handling and processing of the shuttering elements and shuttering parts.

According to another central idea of the invention the shuttering parts according to the invention have suitable connecting devices at their horizontal front faces so that single shuttering parts can be connected to one another.

Another advantage of the invention can be seen in the fact that due to their smaller size the shuttering parts are exposed to a considerably lower amount of stress during assembly as well as during movement and transport prior to the assembly as compared to a large shuttering element consisting of one piece. If the shuttering parts are produced of concrete, noticeably shorter hardening times are already sufficient. First tests have shown that in shuttering parts having a length of approximately 6 m the concrete has hardened to a sufficient degree even after two days.

Finally, an advantage of the invention resides in the fact that it is possible to divide trench walls with different depths with the same shuttering parts. Therefore, the production of shuttering elements matching the trench wall depth demanded in each case is no longer required.

In principle, the shuttering parts can be produced of any chosen kind of material that has the properties suitable with regard to permanent presence in the trench wall. For example the shuttering parts can consist of steel. However, it is especially preferred that the base bodies of the shuttering parts are produced of concrete.

Accordingly, the invention relates to a shuttering element for limiting a trench wall section, wherein the shuttering elements consist of individual sections that can be connected to one another by threaded bars. The connecting surfaces located at the front

face can be designed as steel plates in order to ensure an axially precise connection of the individual parts and allow for the installation of sealing elements. For this purpose a vertical sealing tape or joint-sealing tape can also be placed in an overlapping manner at points of contact of the shuttering element sections and can be connected to one another. After a short storage time when the concrete has gained sufficient stability the shuttering elements can be placed vertically into the trench, and in doing so they can first be retained on the guiding wall by means of an axis running through a transverse borehole so as to establish a connection to the next shuttering part and seal the points of contact.

Through the invention a shuttering element is provided that can remain in the trench wall and yet requires a very short production time until the concrete has the stability needed. Moreover, through the shuttering element according to the invention assurance is made that in the case of a small trench wall width and a large trench depth the shuttering element does not deform, as is commonly with steel boards, so that sufficient sealing cannot be ensured.

In all, the shuttering element according to the invention permits a better and more precise sealing at a smaller trench width. The shuttering element remains in the trench and does not have to be cleaned after each use as is common for steel boards.

For best suitability connecting devices are arranged in the portion of the front faces of the shuttering parts, by which the shuttering parts can be connected to one another in a fixed manner. These connecting devices can each comprise screw connections for example. To this end suitable recesses can be formed in the concrete base body. By the connecting devices a safe mechanical connection of the shuttering parts amongst themselves is ensured.

For a great number of applications, for example when trench walls have to be installed below ground-water level, the trench wall needs to be watertight in its entirety. To this end special care is to be taken to ensure that the transition area between the shuttering element according to the invention that has already hardened and the later hardening concrete in the adjoining trench wall section is sealed.

For this purpose a joint-sealing tape can be arranged along at least one longitudinal side of the shuttering parts which is directed towards the limiting trench wall section.

In order to also ensure a reliable sealing of the portion in which the joint-sealing tapes of adjoining shuttering parts make contact the joint-sealing tapes of adjoining and mutually connected shuttering parts are preferably connected to each other in a tight manner by means of connecting pieces.

In a simple variant the connecting pieces can be designed as metal clamps, and in particular they can be metal plates that are arranged on opposite sides of the joint-sealing tapes and are connected to each other in a suitable way, for example by being screwed to each other.

Finally, if the trench wall is to be watertight in its entirety, the portion in which the horizontal front faces of two adjoining shuttering parts make contact on each other equally needs to be sealed. To this end the portions between adjoining shuttering parts, in particular also any connecting pieces that are possibly present, can be filled on the one hand with a sealing compound. This compound can be applied to the respective front faces just before two shuttering parts are placed on top of each other and tied together.

However, in especially preferred embodiment variants a sealing is provided on at least one horizontal front face of the shuttering part for sealing with respect to a subsequent shuttering part.

For example such a sealing can be formed by a steel plate and a rubber plate fixed thereon. The steel plate can be welded to a steel reinforcement of the concrete base body.

Moreover, in another particularly preferred variant a holding device, in particular a horizontal break-through, is provided in the shuttering part according to the invention. By such a holding device the handling, i.e. the transport and manipulation of the shuttering part according to the invention is facilitated.

Further advantages and features of the invention are described in the following with reference to the accompanying schematic Figure, wherein:

Fig. 1 shows an embodiment of a shuttering element according to the invention with several shuttering parts according to the invention; and

Fig. 2 shows a detail of a connecting portion of two adjoining shuttering parts.

The shuttering element 10 shown in Fig. 1 in the assembly phase is composed of a plurality of shuttering parts 20, one of which is shown completely in Fig. 1 while the shuttering parts adjoining above and below are shown partly. The length of a shuttering part 20 amounts to approximately 6 m.

The shuttering parts 20 each comprise a base body 30 having a substantially wall-like or plate-shaped form. At the horizontal front faces 32 of the base bodies 30 of the shuttering parts 20 connecting devices 50 are provided in accordance with the invention that serve for the connection of the following shuttering part 20 respectively. In the illustrated example the connecting devices 50 are screw connections that are not shown in detail and are arranged in recesses 56 in the concrete base body 30. Through openings 54 the screw connections reach to the adjoining shuttering parts 20 respectively. The recesses 56 are limited at the front faces 32 of the shuttering parts 20 by metal plates 58. The outer contour of these metal plates 58 corresponds to the profile of the base body 30. By particular preference the metal plates 58 are already welded to a steel reinforcement of the respective base body 30. The metal plates 58 serve in particular for fixing further sealing devices, as for example rubber plates.

The two lower shuttering parts 20 in Fig. 1 are already connected to each other in a fixed manner, whereas the upper shuttering part 20 shown partly only is about to be placed onto the shuttering part 20 located in the centre.

In order to carry the shuttering parts 20 these have a horizontal break-through 62 that can serve as a holding device 60.

In the central shuttering part 20 a schematically illustrated holding bar 64 is inserted into the break-through 62, which can be used for transporting and handling the shuttering part 20.

To ensure reliable sealing of the joints between the concrete of the shuttering parts 20 that has hardened already and the concrete of the respective trench wall section that still needs to harden a joint-sealing tape 40 is present on the longitudinal sides 34 of the shuttering parts which is cast into the base body 30.

Moreover, to additionally ensure sealing in those portions where the joint-sealing tapes 40 of adjoining shuttering parts 20 make contact these portions are connected to each other in a tight manner by connecting pieces 44, as shown schematically in Fig. 1. In the

depicted example the connecting pieces 44 are metal clamps 46 that are connected to one another by means of suitable fixing means, such as e.g. screw connections.

To seal the portions between the horizontal front faces 32 of adjoining shuttering parts 20 these portions can be filled with a sealing compound, e.g. prior to the tightening of the connecting devices 50. However, it is particularly preferred that the shuttering parts 20 are provided with sealings at the horizontal front faces 32. The sealings that are not depicted in Fig. 1 can be a rubber plate in particular that is fixed onto the metal plates 58, for example by being screwed to the metal plates 58.

Basically, it is sufficient if a metal plate 58 is provided on the horizontal front face 32 of one shuttering part 20 only.

In illustration 2 a detail of a connecting portion between two adjoining shuttering parts 20 with base bodies 30 is shown. The connecting devices 50 shown there in further detail have a substantially cuboid metal box 57 that is welded on the one hand to the respective metal plates 58 and on the other hand to an internally disposed reinforcement cage of the base body 30. In a recess 56 formed by the metal box 57 a threaded bar 90 with nuts 92 is accommodated that is accessible from the outside. The threaded bar is inserted through the openings 54 shown in Fig. 1.

Mutually corresponding components are provided with the same reference signs in Figs. 1 and 2.

By the present invention a novel shuttering element composed of a plurality of shuttering parts as well as a novel method for producing a trench wall in the ground are provided, which allow for considerable simplifications in the production of individual trench wall sections.

CLAIMS

1. Shuttering element for limiting a trench wall section of a trench wall,
having

a plurality of shuttering parts which have a plate-shaped base body consisting of concrete and are connected to one another at their adjoining horizontal front faces by means of connecting devices, wherein at the front faces of the shuttering parts metal plates are arranged, and for arranging the connecting devices in the base body recesses are provided, the recesses being limited at the front faces by the metal plates.
2. Shuttering element according to claim 1,

wherein in the portion of the front faces of the shuttering parts the connecting devices are arranged.
3. Shuttering element according to claim 1,

wherein the connecting devices include screw connections.
4. Shuttering element according to claim 1,

wherein a joint-sealing tape is arranged along at least one longitudinal side of the shuttering parts, which is directed towards the limiting trench wall section.
5. Shuttering element according to claim 4,

wherein the joint-sealing tapes of adjoining and mutually connected shuttering parts are connected to each other in a tight manner by means of connecting pieces.
6. Shuttering element according to claim 5,

wherein the connecting pieces are designed as metal clamps.

7. Shuttering element according to claim 1,
wherein portions between adjoining shuttering parts are filled with a sealing compound.
8. Shuttering part, in particular for forming a shuttering element according to claim 1, comprising a plate-shaped base body consisting of concrete, wherein on at least one horizontal front face of the base body a connecting device is arranged for connecting a further shuttering part,
wherein
 - a metal plate is arranged on the at least one front face for connecting a further shuttering part and
 - for arrangement of the connecting device recesses are provided in the base body which are limited at the front face by the metal plate.
9. Shuttering part according to claim 8,
wherein a holding device, in particular a horizontal break-through, is provided.
10. Shuttering part according to claim 8,
wherein on at least one horizontal front face a sealing is provided for sealing with respect to a subsequent shuttering part.
11. Shuttering part according to claim 10,
wherein the sealing is formed by the metal plate and a rubber plate fixed thereon.
12. Method for producing a trench wall in the ground, in which trench wall sections lying next to each other are formed in the ground by means of a trench wall device, in particular by a trench wall cutter, wherein at least one trench wall section is limited by an introduced shuttering element, the shuttering element is composed of individual shuttering parts that are introduced successively into the trench and

connected to one another at their horizontal front faces by means of connecting devices,

wherein

at the front faces of the shuttering parts metal plates are arranged, and the connecting devices are arranged in the base body in recesses, which are limited at the front faces by the metal plates.