

A suspension shoe, a climbing unit and method for erecting a building

The invention relates to a suspension shoe for use in a climbing unit having a first climbing component, which is in particular a climbing rail, and a second climbing component, which is in particular a climbing carriage movable along the climbing rail, the suspension shoe comprising:

- an anchor for anchoring in a concreting portion of a building, and

- a suspension part connected to the anchor.

Furthermore, the invention relates to a climbing unit for arrangement on a building, comprising:

- a first suspension shoe for anchoring to a concreting portion of the building,

- a climbing rail,

- a climbing carriage.

Furthermore, the invention relates to a climbing device comprising:

- two climbing units, which are arranged next to one another other at a horizontal distance.

The invention further relates to a climbing system comprising:

- a climbing unit,

- a building having a concreting portion, wherein the anchor of the suspension shoe is anchored within the concreting portion of the building.

Finally, the invention relates to a method for erecting a building from concreting portions arranged one above the other.

It is known from EP 3 440 283 B1 to use a different type of self-climbing unit in the construction of building cores. The self-climbing unit is provided with a working platform and can be converted from a lower, completed concrete wall section to a further concrete wall section placed above another without the need of a crane. For such a climbing process, lifting cylinders are used, which are supported on climbing brackets, which are each releasably anchored in anchoring points of a lower concrete wall section. The working platform and the concrete formwork elements

are attached to work brackets, which are anchored to the concrete component above the climbing brackets. For fastening the work and climbing brackets in the concreting portions, anchor bolts are used, which are introduced into the respective concreting portion. EP 3 440 283 B1 addresses the problem that the concrete wall anchors must be arranged in predetermined positions, but they may collide with the reinforcement steel rods to be embedded there. Therefore, the reinforcing steel rods must be partially guided around the anchoring points. However, this can lead to a structural weakening of the concrete body. The number of anchoring points in the concrete should be kept as low as possible. To achieve this goal, EP 3 440 283 B1 proposes an embodiment with climbing brackets and working brackets. The climbing brackets have first anchor receiving arrangements on a first concreting portion, and the working consoles have second anchor receiving arrangements on a second concreting portion, which correspond in their pattern with respect to their relative positions. In this way, after anchoring the working brackets in anchor holes at third anchoring points of a third concrete wall section, the climbing brackets can be moved by a return stroke movement of the climbing cylinders to the second anchor points of the second concrete wall section and anchored in the anchor holes, which have become free in the meantime, of the second anchor points of the second concrete wall section. This allows the number of anchor holes to be halved.

A disadvantage of this state of the art, however, is that the self-climbing unit requires three concreting portions for anchoring to the concrete body for each climbing process (anchoring the climbing brackets in the first concreting portion - climbing the working brackets upwards with the working platform from the second into the third concreting portion - anchoring the working brackets in the third concreting portion - pulling the climbing brackets from the first into the second concreting portion). This requires a very complex and high-level design of the self-climbing unit. Furthermore

it is disadvantageous in that the state of the art provides working and climbing brackets with receiving openings for the concrete wall anchors. However, this leads to unfavourable tensile loads at the anchoring points. In addition, the state of the art is only designed for the erection of a building core, wherein the self-climbing unit is supported between opposite wall sections. For this purpose, two support columns are connected to each other at their upper ends via a support frame with cross members. This state of the art would be unsuitable for use on the outside of a building, without support between opposite wall sections.

Furthermore, suspension shoes for climbing formwork are known in the state of the art. From these suspension shoes, a single climbing component, in particular a climbing rail, is suspended. A working platform can be mounted on the climbing rail. For climbing upwards to the next floor, cylinder-piston drives can be used, which are supported on the building or on the suspension shoe fastened to it. The lifting is carried out gradually, i.e. with short forward and backward movements of the cylinder-piston drive. Examples of this are shown in EP 1 899 549 B1 and WO 2008/061922 A1.

Accordingly, the object of the invention is to mitigate or eliminate at least individual drawbacks of the state of the art. This object is achieved with a suspension shoe according to claim 1, a climbing unit according to claim 8, a climbing device according to claim 22 and a method according to claim 26. Preferred embodiments are given in the dependent claims.

The invention provides a suspension shoe in which the suspension part has a first mount for releasably holding the first climbing component of the climbing unit, in particular the climbing rail, and a second mount for releasably holding the second climbing component of the climbing unit, in particular the climbing carriage.

With the first and the second mount, the suspension shoe has two fastening points at which, depending on the application and phase of the climbing process, one of the first and the second climbing components can be suspended, or the first and the second climbing components can be suspended at the same time. The first and the second climbing components can be moved relative to one another in the climbing or height direction when repositioning the climbing unit. The first and the second mounts are spaced from each other. If the suspension shoe has a single anchor for anchoring in the concrete, the number of anchoring points in the concrete can be reduced accordingly. A significant advantage over the state of the

art is thus that two fastening points are created per anchor. Thus, the suspension shoe only needs a single anchoring point in the concrete. In a preferred embodiment, the first and the second mounts are used for selectively suspending the climbing rail and the climbing carriage. For example, the climbing rail may first be suspended from the first mount of the suspension shoe before the climbing carriage climbs upwards and is suspended from the second mount of the same suspension shoe. With the suspension shoe according to the invention, two independent fastening or suspension points are created by the first and the second mount. The suspension shoe according to the invention (or a plurality of such suspension shoes) may be part of a climbing unit during the cyclical erection of the building from concreting portions. It is advantageous that when moving from one concreting portion to the next, no more than two concreting portions arranged one above the other are required for anchoring in the concrete. In contrast to the state of the art, it is not absolutely necessary to temporarily suspend the climbing unit from a third concreting portion when climbing upwards to the next floor.

For the purposes of this disclosure, the location and direction indications, such as "horizontal," "vertical," "one above the other," "next to one another," refer to the intended use of the suspension shoe, the climbing unit, and the climbing device in the mounted state on a building having a vertical concreting portion. Depending on the design, concreting portions inclined to the vertical may also be produced with the suspension shoe, the climbing unit and the climbing device, in which case the location and direction indications can then be transmitted accordingly.

In a first climbing position, i.e. when climbing from one concreting portion to the next, the first climbing component, in particular the climbing rail, can be fixed in its respective height position relative to the suspension shoe by the suspension on the first mount of the suspension shoe. Thus, in this embodiment, the first climbing component, in particular the climbing rail, is secured in the first climbing position not only against a downward movement, but also against an upward movement. The load of the climbing unit is transmitted to the suspension shoe via the first climbing component and diverted from the suspension shoe into the concreting portion of the building. In the first climbing position,

the second climbing component, in particular the climbing carriage, may be detached from the second mount of the suspension shoe to allow the second climbing component to climb upwards by a displacement relative to the first climbing component.

In a second climbing position, the second climbing component, in particular the climbing carriage, can be fixed by the suspension on the second mount of the suspension shoe in its respective height position relative to the suspension shoe and thus to the building. Thus, in this embodiment, the first second climbing component, in particular the climbing carriage, is secured in the second climbing position not only against a downward movement, but also against an upward movement. The load of the climbing unit is transmitted to the suspension shoe via the second climbing component and diverted from the suspension shoe into the concreting portion of the building. In the second climbing position, the first climbing component, in particular the climbing rail, may be detached from the first mount of the suspension shoe to allow the first climbing component to climb upwards by a displacement relative to the second climbing component.

In addition, in a holding position, the first climbing component may be attached to the first mount and the second climbing component may be attached to the second mount. In an application as climbing formwork, the holding position may be a concreting position when concreting a concreting portion.

In a preferred embodiment, the first mount has a first holding opening for the passage of a first holding bolt and/or the second mount has a second holding opening for the passage of a second holding bolt. As a result, the suspension of the first and the second climbing components can be provided and released quickly and reliably, depending on the phase of the climbing process. In the mounted state on the building, the first and/or the second holding bolt preferably extends substantially perpendicular to the main plane of the suspension part, in particular substantially perpendicular to a base plate of the suspension part. With respect to a neutral position of the suspension part, the first and/or the second holding bolt therefore preferably extends substantially perpendicular to the outer side of the concreting portion facing the suspension part.

As the first and/or second holding bolt, a plug bolt or a threaded screw bolt can be provided in each case.

In order to arrange the fastening points for the suspension of the climbing components in an easily accessible way, the first and the second mounts are preferably provided at substantially the same height on both sides of the anchor.

In order to achieve load or tolerance compensation, it is advantageous if the suspension part is connected to the anchor such that it can be tilted, in particular about a horizontal axis. The maximum tilt angle with respect to a substantially vertical starting position of the suspension part is preferably at least 5° in both tilting directions, i.e. at least $\pm 5^\circ$ with respect to the substantially vertical starting position of the suspension part.

In a preferred embodiment, the anchor comprises a ball element and the suspension part comprises a ball socket, wherein

the ball element of the anchor is tiltably arranged in the ball socket of the suspension part. This embodiment has the advantage, on the one hand, that an effective force transmission is achieved by reducing the tensile forces. The suspension part can be held directly by the (wall) anchor via the ball joint formed from the ball socket and the ball element. In the mounted state on the building, the suspension part is spaced from the outside of the concreting portion facing the suspension part in order to release the tiltability of the suspension part with respect to the anchor. Since the suspension part, unlike in the state of the art, is not supported on the concrete, the tensile forces of the anchor can be significantly reduced. As a result, the weight of the suspension shoe can be significantly reduced. This embodiment is also particularly advantageous when two such suspension shoes are used in pairs, which in particular can be arranged next to one another at essentially the same height in order to guide the first climbing component, in particular the climbing rail, between the two suspension shoes. Since the ball socket is freely rotatable, tolerance compensation of the anchors of the two suspension shoes in the concrete can be obtained. The two ball sockets can be precisely aligned with each other, so that the climbing components have a common axis of rotation, whereby the two concrete anchors receive essentially the same load. Thus, a type of balance beam can be realised.

For the secure suspension of the climbing components, it is advantageous if the suspension part has a receiving groove, in particular extending in the horizontal direction, for receiving a first coupling strip on the first climbing component and/or a second coupling strip on the second climbing component.

With regard to a stable yet lightweight design, the suspension part preferably has a base plate, in which the receiving groove and/or the ball socket are preferably integrated. For example, the base plate may be designed as a milled part. Preferably, the base plate has one respective recess for the receiving groove and/or the ball socket. Preferably, the suspension part with the base plate in the mounted state on the building is spaced apart from the outside of the concreting portion facing the suspension part, in order to reduce the tensile forces of the anchor and thus enable a particularly weight-saving design. With respect to the neutral position, the main plane of the base plate in the mounted state on the building preferably extends substantially parallel to the planar outer side of the concreting portion.

The climbing unit according to the invention for arrangement on a building, has at least:

- a first suspension shoe for anchoring to a concreting portion of the building,
- a climbing rail,
- a climbing carriage,

wherein the first suspension shoe is designed according to one of the above-described embodiments,

wherein, in a first climbing position of the climbing unit, a holding device on the climbing carriage is connected to the second mount of the first suspension shoe, and a fastening device on the climbing rail is released from the first mount of the first suspension shoe, so that the climbing rail is movable along the first suspension shoe,

wherein in a second climbing position, the fastening device on the climbing rail is connected to the first mount of the first suspension shoe, and the holding device on the climbing carriage is released from the second mount of the first suspension shoe, so that the climbing carriage is movable along the climbing rail.

Thus, a climbing bracket and a working bracket as in the state of the art can be dispensed with. Instead, a suspension shoe with a suspension part is provided, on which, in one phase of the climbing process when moving to the next floor, the climbing carriage, but not the climbing rail, can be suspended, and in a second phase, the climbing rail, but not the climbing carriage, can be suspended from the suspension shoe.

In an embodiment variant, in particular for climbing on an outside of the building, i.e. during façade climbing, the holding device is arranged at the upper end of the climbing rail. In another embodiment variant, in particular for climbing between opposite wall sections of a shaft, the holding device can be arranged on a central longitudinal section, between the opposite ends.

In a holding position, in particular a concreting position, the holding device on the climbing carriage can be connected to the second mount of the first suspension shoe and the fastening device on the climbing rail can be connected to the first mount of the first suspension shoe.

For a quick and stable connection, the fastening device connected to the climbing rail preferably has a fastening opening for arranging the first holding bolt and/or the holding device connected to the climbing carriage has a suspension opening for arranging the second holding bolt. The suspension opening of the holding device and the second holding opening of the suspension shoe can be arranged in alignment, wherein the second holding bolt

passes through the suspension opening and the second holding opening for connection. Accordingly, the fastening opening of the fastening device and the first holding opening of the suspension shoe can be arranged in alignment, wherein the first holding bolt passes through the fastening opening and the first holding opening for connection.

For stable and secure suspension, the fastening device on the climbing rail has a first coupling strip and/or the holding device on the climbing carriage has a second coupling strip, in each case for preferably substantially precisely fitting arrangement in the receiving groove of the first suspension shoe. If the suspension part is tiltably arranged on the anchor, undesired rotation of the suspension part about the longitudinal axis of the anchor can also be prevented by the engagement of the first or second coupling strip in the receiving groove of the first suspension shoe.

In a preferred embodiment, a second suspension shoe, which is designed according to one of the embodiments of the suspension shoe described above, is provided for anchoring to the same concreting portion.

In the first climbing position, the holding device on the climbing carriage is connected in each case to the second mount of the first and the second suspension shoes, the fastening device on the climbing rail being released in each case from the second mount of the first and the second suspension shoes. This allows the climbing rail to be moved along the first and the second suspension shoes.

In the second climbing position, the fastening device on the climbing rail is connected to the first mount of the first and the second suspension shoes, respectively, the holding device on the climbing carriage being detached from the second mount of the first and the second suspension shoes, respectively. This allows the climbing carriage to be moved along the climbing rail.

In order to fix the climbing rail and the climbing carriage in their respective height positions depending on the phase of the climbing process or to release the climbing upwards, the first and the second suspension shoes are preferably arranged substantially at the same height on both sides of the climbing rail. In this embodiment, the first and the second suspension shoes are located

adjacent to the opposite longitudinal sides of the climbing rail. In the second climbing position, the climbing rail can be guided upwards between the first and the second suspension shoes relative to the climbing carriage.

Preferably, the first mounts of the first and the second suspension shoes are located on the side of the climbing rail, relative to the vertical plane through the longitudinal axis of the anchor, and the second mounts of the first and the second suspension shoes are located, again relative to the vertical plane through the longitudinal axis of the anchor, on the side facing away from the climbing rail. This makes it possible to create structurally simple suspensions for the climbing rail and the climbing carriage.

In a preferred embodiment, the climbing carriage has a holding fork with two fork elements on both sides of the climbing rail, wherein the two fork elements, in particular at their free ends, each carry a holding element, in particular a holding plate, of the holding device, which in the first climbing position, in particular via the second holding bolt, are connected to the second mounts of the first and the second suspension shoes. Due to the holding fork, the two holding elements of the holding device can be reversibly detachably connected to the second mounts of the first and the second suspension shoes on both sides of the climbing rail. Preferably, a vertical centre plane of the holding fork between the two fork elements contains the longitudinal axis of the anchor of the suspension shoe.

In order to achieve reliable guidance during climbing upwards, in a preferred embodiment, the climbing carriage has a guide shoe for guiding along the climbing rail, in particular for gripping around a climbing profile of the climbing rail.

Preferably, a horizontal central axis of the guide shoe extends substantially along a vertical central plane of the climbing rail perpendicular to the adjacent concreting portion of the building. When the climbing carriage has the holding fork, the horizontal central axis of the guide shoe extends substantially centrally between the two fork elements. As a result, a particularly favourable load transfer between anchoring points arranged one above the other can be achieved.

In order to suspend the climbing rail in the second climbing position, in a preferred embodiment, the fastening device has a fastening plate with a bearing section and two fastening sections on both sides of the bearing section, wherein the bearing section is connected to the climbing rail, preferably via a bearing journal, and the fastening sections are connected to the first mounts of the first and the second suspension shoes, preferably via the two first holding bolts, in the second climbing position.

Preferably, the climbing carriage has a pivot axis about which the holding fork can be pivoted. This pivot axis is preferably arranged substantially in line with the longitudinal axis of the bearing journal, which allows the fastening plate to pivot. The holding fork can thus be pivoted together with the fastening plate on the climbing rail, for example, in order to compensate for anchoring points in the concrete of the first and the second suspension shoes that are not exactly arranged in the horizontal. As a result, a uniform load transfer in the anchoring points in the concrete is achieved.

Preferably, the longitudinal axis of the bearing journal extends along the vertical centre plane of the guide shoe.

In a preferred embodiment, a support part for support on the outside of the building, in particular on the lower end of the climbing rail, is connected to the climbing rail.

In a preferred embodiment, in particular for an embodiment when climbing on the outside of the building, a climbing scaffold is provided with the climbing carriage.

In this embodiment, the climbing scaffold may have a preferably vertical column element, which preferably extends substantially parallel and preferably at a horizontal distance perpendicular to the vertical outer side of the building to the climbing rail. This embodiment is particularly suitable for climbing on the outside of the building.

In addition, the climbing scaffold preferably has a supporting element for support on the outside of the building. The support element is preferably arranged on a horizontal beam. The horizontal beam is preferably attached to the lower end of the column element.

In a preferred embodiment, the climbing scaffold has a guide element for guiding along the climbing rail, the guide element preferably being arranged below the guide shoe. The guide element can engage around a flange of a climbing profile of the climbing rail. Furthermore, it is advantageous if the guide element is connected to the column element of the climbing scaffold via a support element.

For climbing upwards into the next concreting portion, it is advantageous if the climbing unit has a self-climbing drive, in particular with a cylinder-piston drive, for displacing the climbing carriage relative to the climbing rail and vice versa. The self-climbing drive is configured for power transmission between the climbing rail and the climbing carriage, so that an actuation of the self-climbing drive in the first climbing position moves the climbing rail upwards, in particular by a single stroke of the cylinder-piston drive, i.e. by a single retraction or extension of the piston, and a further actuation of the self-climbing drive in the second climbing position moves the climbing carriage upwards, by a single stroke of the cylinder-piston drive.

Preferably, the longitudinal axis of the cylinder-piston drive is arranged substantially vertically to allow a maximum stroke.

In a preferred embodiment, in particular for climbing on the outside of the building, a boom is provided, which extends from the climbing rail, in particular from the lower end of the climbing rail, to the rear, i.e. away from the adjacent concreting portion of the building.

In a preferred embodiment, the self-climbing drive, in particular the first longitudinal end of the cylinder-piston drive, is connected to the boom.

In a preferred embodiment, in particular for climbing on the outside of the building, the climbing scaffold has the column element to which the self-climbing drive is connected. With this embodiment, the power of the self-climbing drive can be effectively transferred to the climbing scaffold to allow the climbing scaffold to climb upwards.

In an alternative embodiment, a crane for raising the climbing unit is provided instead of the self-climbing drive.

In a preferred embodiment, the climbing scaffold has a further column element, wherein a strut truss is preferably provided between the column element and the further column element. In use, the further column element preferably extends at a horizontal distance perpendicular to the vertical outer side of the building behind the column element.

For purposes of this disclosure, "forward" means closer to the building and "rearward" means facing away from the building.

It is particularly preferred if the climbing rail, the column element, and the further column element are arranged along a vertical plane perpendicular to the outside of the building. In this embodiment, the climbing unit is designed as a substantially two-dimensional climbing pulley. This embodiment is particularly suitable for use as part of a climbing device described in more detail below, having a plurality of climbing units arranged at a horizontal distance in the direction parallel to the outside of the building.

The climbing unit preferably has at least one further climbing shoe, in particular a pair of further climbing shoes arranged next to one another, above the first suspension shoe (and optionally the second suspension shoe), in particular on an overlying concreting portion.

The climbing device according to the invention has at least:

two climbing units, which are formed according to one of the embodiments of the climbing unit described above, the two climbing units being arranged next to one another at a horizontal distance on the same concreting portion.

The climbing device preferably has at least one working platform. The working platform preferably has individual platform supports, which can extend in the horizontal direction parallel to the outside of the building. A working platform flooring can be arranged on the platform supports.

In one embodiment, in particular for climbing on the outside of the building, the working platform is connected to the climbing

scaffolds having the climbing carriages. In this embodiment, the working platform is moved together with the climbing scaffolds at the level of the next concreting portion.

In another embodiment, in particular for climbing within a shaft, the working platform is connected to the climbing rails of the climbing units, so that the working platform is moved together with the climbing rails at the level of the next concreting portion. In a preferred application of the climbing device, a formwork, in particular a wall formwork, is provided. The formwork has at least one formwork element, in particular a wall formwork element, which is movable between a forming position and a stripping position, in particular at least in the horizontal direction perpendicular to the outside of the building.

In one embodiment, in particular for climbing on the outside of the building, the formwork is supported on a scaffolding part of the climbing scaffold from below and/or is suspended from a cantilever part of the climbing scaffold from above.

In another embodiment, in particular for climbing within a shaft, a bridging frame is connected to the climbing rail, wherein the formwork is suspended from the bridging frame.

The climbing system according to the invention comprises at least:

- a climbing unit of any of the above-described embodiments,
- a building having a first concreting portion, wherein the anchor of the first suspension shoe is anchored within the first concreting portion of the building.

Preferably, the climbing system comprises a climbing device having a plurality of climbing units of one of the embodiments described above, the anchors of the first suspension shoes of the climbing units each being anchored within the same concreting portion of the building.

Preferably, the climbing system comprises at least one further suspension shoe, in one of the embodiments described above, which is anchored to a second concreting portion above the first concreting portion. Upon completion of the climbing process, the first suspension shoes (or parts of the first suspension shoes)

can be recovered and used when erecting a concreting portion higher up.

In the method according to the invention for erecting a building from concreting portions arranged one above the other, at least the following steps are carried out, preferably in the order indicated:

- i. providing a climbing unit of any of the above-described embodiments,
- ii. anchoring the first suspension shoe to a first concreting portion of the building,
- iii. arranging the climbing unit in the first climbing position on the first suspension shoe, wherein the holding device on the climbing carriage is connected to the second mount of the first suspension shoe and the fastening device on the climbing rail is released from the first mount of the first suspension shoe,
- iv. anchoring a further suspension shoe to a second concreting portion,
- v. moving the climbing rail along the first suspension shoe,
- vi. arranging the climbing unit in the second climbing position on the further suspension shoe, wherein the fastening device on the climbing rail is connected to the first mount of the further suspension shoe and the holding device on the climbing carriage is released from the second mount of the first suspension shoe,
- vii. moving the climbing carriage upwards along the climbing rail.

The method preferably also comprises the step of:

- viii. arranging the climbing unit in a holding position on the further suspension shoe, wherein the holding device on the climbing carriage is connected to the second mount of the further suspension shoe and the fastening device on the climbing rail is connected to the first mount of the further suspension shoe.

If the method is used for climbing formwork, the method can be extended by additional steps. In this embodiment, the following steps can also be carried out, in particular in a holding position of the climbing unit:

- ix. arranging a formwork, in particular a wall formwork, in a forming position,
- x. concreting the third concreting portion,
- xi. arranging the formwork in a stripping position, wherein the formwork is preferably moved in a horizontal direction perpendicular to the second concreting portion away from the second concreting portion.

The stripping position is configured to release the movement of the climbing rail into a fourth concreting portion (i.e. into a position overlapping with the third concreting portion).

Depending on the number of floors, the preceding steps can be repeated as often as desired.

In a preferred embodiment, the movement of the climbing rail along the first suspension shoe, i.e. step v. above, and/or the movement of the climbing carriage along the climbing rail, i.e. step vii. above, in particular by the height of the first or second concreting portion, is effected in each case by a single stroke (i.e. by a single extension or a single retraction) of a cylinder-piston drive of a self-climbing drive.

In a first embodiment, when climbing along an outside of the building, the method is performed with a climbing device having a plurality of climbing units, wherein the climbing scaffolds and the climbing rails of the climbing units are each moved substantially parallel and at the same height.

In a second embodiment, the method is performed while climbing between opposing wall portions of a shaft of the building.

The present disclosure also relates to a self-climbing device, particularly a self-climbing formwork, as follows.

A self-climbing device, in particular a self-climbing formwork, comprising:

- a suspension shoe for anchoring to a concreting portion of a building,
- a climbing rail for guiding along the suspension shoe,
- a climbing scaffold with a climbing carriage, which is movable along the climbing rail,

a self-climbing drive, which acts between the climbing rail and the climbing scaffold.

In this embodiment, the suspension shoe can be designed according to one of the embodiments described above. However, another embodiment of the suspension shoe, in particular with only one fastening point for the climbing rail or the climbing scaffold, may also be provided. The climbing rail, the climbing scaffold, the self-climbing drive, and optionally other components of the self-climbing device may be configured as in the embodiments of the climbing device described above.

On the one hand, façade climbing formworks with climbing rails, which are guided on climbing shoes on the façade, are known in the state of the art. However, the climbing drive is supported on the building or suspension shoe and must be activated in short strokes. On the other hand, the state of the art according to EP 3 440 283 B1 is not designed for climbing on the outside of the building. The self-climbing device in the above embodiment combines the advantages of known façade climbing systems with an efficient self-climbing drive, with which the climbing scaffold and the climbing rail can be quickly and easily moved into the next concreting portion, in particular by a single stroke of a cylinder-piston drive.

The invention will be further discussed below with reference to a preferred exemplary embodiment.

Figure 1 shows a diagrammatic climbing formwork according to the invention during the erection of a building consisting of individual concreting portions arranged one above the other.

Figures 2 to 4 show side views of the climbing formwork in different phases of the climbing process.

Figure 5 shows a front view of a suspension shoe according to the invention with own fastening points for a climbing carriage and a climbing rail of the climbing formwork.

Figure 6 shows a side view of the suspension shoe, wherein an anchor concreted into the concreting portion and a suspension part arranged tiltably thereon with the fastening points for the climbing carriage and the climbing rail can be seen.

Figure 7 shows the suspension shoe to which the (partially visible) climbing carriage has been detachably attached.

Figure 8 shows a detailed view of a climbing unit of the climbing formwork, wherein a first and a second suspension shoes are arranged on opposite sides of the climbing rail.

Figure 9 shows a view corresponding to Figure 7 in an untilted neutral position of the suspension part.

Figure 10 shows a diagrammatic view of a detail of the climbing unit in a position in which both the climbing rail and the climbing carriage are fixed relative to the first and the second suspension shoes.

Figure 11 shows another embodiment of the climbing formwork between opposing wall portions of a shaft.

Figures 12 to 14 show the procedure when climbing the climbing formwork of Figure 11 within the shaft.

In Figures 1 to 4, a climbing system 1 is shown, which is formed from a climbing device 2 and a building 3 (only partially visible). The climbing device 2 is temporarily connected to the building 3 during the erection of the building 3. Shown is an embodiment of the climbing device 2 for climbing on a façade, i.e. on the outside, of the building 3

In the embodiment shown, the climbing device 2 is designed as a climbing formwork, on which a formwork 4, in this case a wall formwork, is arranged. With the aid of the climbing formwork, individual concreting portions 5 are produced in temporally successive concreting operations, which are arranged one above the other in a vertical arrangement.

In an alternative application, the climbing device 2 has a protective shield for securing an edge region of a floor of the building 3.

The climbing device 2 has (at least) two identical climbing units 6, which are arranged essentially at the same height at a horizontal distance parallel to the vertical outer side of the building 3 (cf. Figure 1). The climbing units 6 each have an

elongated climbing rail 7, which extends over more than the height of one concreting portion 5, in this case over more than the total height of two concreting portions 5 of equal height. In addition, the climbing units 6 each have a climbing carriage 9, which in the embodiment of Figures 1 to 10 is designed as a scaffolding carriage of a climbing scaffold 8. The climbing scaffold 8 is moved as a unit along the climbing rail 7 when climbing upwards. The climbing device 2 also has at least one working platform 10, which in the embodiment of Figures 1 to 10 is carried by the climbing scaffolds 8 of the climbing units 6. The working platform has horizontal platform supports 10A on which a working platform flooring 58 is arranged.

For load transfer into the building 3, each climbing unit 6 has at least one first suspension shoe 11, which is anchored in the concrete of the building 3.

As can be seen in detail from Figures 5 to 9, the suspension shoe 11 has a wall anchorage in the form of an anchor 12 for anchoring in the respective concreting portion 5. The anchor 12 has a locking part, also referred to as a locking anchor 13, a suspension cone 14 and a ball stud 15. The locking anchor 13 can remain in the concrete of the building 3, the suspension cone 14 and the ball stud 15 connected, for example screwed, to the locking anchor 13 can be recovered after climbing upwards and used for an overlying concreting portion 5. In the mounted state of the suspension shoe 11, the anchor part 15 projects rearward from the outside of the building 3. Arranged on the anchor part 15 is a suspension part 16, on which the climbing rail 7 or the climbing carriage 9 can be suspended.

In the embodiment shown, the suspension part 16 has a first mount 17 for reversibly releasably holding the climbing rail 7 and a second mount 18 for reversibly releasably holding the climbing carriage 9 of the climbing scaffold 8. The first mount 17 has a first holding opening 19 for the passage of a first holding bolt 20 (cf. Figure 8). Correspondingly, the second mount 18 has a second holding opening 21 for the passage of a second holding bolt 22 (cf. Figure 8). The first 17 and the second mount 18 are located, in relation to the mounted state of use on the building 3, substantially at the same height, i.e. substantially at the same vertical position, on opposite sides with respect to a vertical

plane (corresponding to the section line VI-VI in Figure 5) through a longitudinal axis 23 (cf. Figure 6) of the anchor 12. In the embodiment shown, the centres of the first 19 and the second holding openings 21 are arranged substantially at the same horizontal distance from the vertical plane through the longitudinal axis 23 of the anchor 12.

In the embodiment shown, the suspension part 16 is mounted on the anchor 12 such that it can be tilted (at least) about a tilting axis running in the horizontal direction parallel to the outside of the adjacent concreting portion 5. To this end, the anchor 12 has a ball element 24 and the suspension part 16 has a ball socket 25. The ball element 24 is arranged within the ball socket 25 in such a way that the suspension part 16 can be tilted relative to the anchor 12. In addition, the ball socket 25 is elongated in the vertical direction (cf. Figure 5), so that the suspension part 16 is movable in the vertical direction with respect to the anchor 12 in order to facilitate mounting.

In the embodiment shown, the suspension part 16 also has a receiving groove 26, which extends in an upper region of the suspension part 16 on the front side facing the climbing rail 7 in the horizontal direction parallel to the outside of the adjacent concreting portion 5. This receiving groove 23 makes it possible to positively receive a first coupling strip 27 on the climbing rail 7 and a second coupling strip 28 on the climbing carriage 9 (cf. Figure 8). In the example shown, the suspension part 16 has a base plate 29, in which the receiving groove 26 and the ball socket 25 are designed as recesses, in particular as milled cut-outs.

As can be seen from Figure 8 and Figure 10, each climbing unit 6 in the embodiment shown has a second suspension shoe 30, which is identical to the first suspension shoe 11. The first 11 and the second suspension shoes 30 are arranged at substantially the same height on both sides of the climbing rail 7 on the same concreting portion 5.

In the embodiment shown, the climbing carriage 9 has a holding fork 31 with two fork elements 32 on both sides of the climbing rail 7. At their free ends, the two fork elements 32 each carry a holding element 33, in this case a vertical holding plate, of a

holding device 34. The holding elements 33 have suspension openings 35 (cf. Figure 9) for connection to the second holding openings 21 of the second mounts 18 by arranging the second holding bolts 22. In addition, the holding elements 33 each have a second coupling strip 28 for a substantially precisely fitting arrangement in the receiving groove 26 of the first 11 or the second suspension shoes 30.

In the embodiment shown, the climbing carriage 9 also has a guide shoe 9A for gripping and sliding along a rear flange 36 of a climbing profile 37 of the climbing rail 7. The climbing carriage 9 and thus the entire climbing scaffold 8 are guided by means of the guide shoe 9A when climbing upwards.

In the embodiment shown, a fastening device 38 can be reversibly detachably connected to the climbing rail 7 (cf. Figure 8). The fastening device 38 has a fastening plate 39 with a bearing section 40 and two fastening sections 41 on both sides of the bearing section 40. The bearing section 40 is connected to the climbing rail 7 via a bearing journal 42. The fastening sections 41 each have a fastening opening 43 for connection to the first holding openings 19 of the first mounts 17 of the first 11 or second suspension shoe 30 by arranging the first holding bolts 20.

In the embodiment shown, the fastening plate 39 also has the first coupling strip 27 for substantially precisely fitting arrangement in the receiving groove 26 of the first 11 and the second suspension shoes 30, respectively.

In Figures 2 to 4, the process of climbing up the climbing device 2 is illustrated. Depending on the height of the building 3 to be erected, this sequence can be repeated as often as desired.

According to Figure 2, the first 11 and the second suspension shoes 30 are anchored to a first concreting portion 5A adjacent to the upper end of the climbing rail 7, two lower concreting portions 5 having already been produced below the first concreting portion 5A in the example shown. The formwork 4 is in the forming or concreting position, with which a second concreting portion 5B is produced directly above the first concreting portion 5a. The climbing unit 6 (and correspondingly the further climbing unit 6 arranged in parallel) is arranged in the holding position, in which

the holding device 34 on the climbing carriage 9 is connected to the second mount 18 of the first 11 and the second suspension shoes 30, respectively, and the fastening device 38 on the climbing rail 9 is connected to the first mount 17 of the first 11 and the second suspension shoes 30, respectively. The climbing rail 7 is arranged completely below the lower end of the second concreting portion 5B.

According to Figure 3, the formwork 4 is retracted to the stripping position. The fastening device 38 connected to the climbing rail 7 is released from the first mount 17 of the first 11 and the second suspension shoes 30, respectively. In this position, the climbing rail 7 can be moved upwards along the first 11 and the second suspension shoes 30 up to the upper end of the second concreting portion 5B. During the climbing up the climbing rail 7, the climbing scaffold 8 is held by the first 11 and the second suspension shoes 30. Arranged at the upper end of the second concreting portion 5b is a pair of further suspension shoes 44, which are formed and arranged in correspondence with the first 11 and the second suspension shoes 30. The fastening device 38 at the upper end of the climbing rail 7 is connected to the first mount 17 of the further pair of suspension shoes 44 on the second concreting portion 5B. The climbing rail 7 of the other climbing unit 6 is pulled upwards simultaneously and in parallel and is also held with a pair of further suspension shoes 44.

According to Figure 4, the holding device 34 on the climbing carriage 9 was first released from the second mount 18 of the first 11 and the second suspension shoes 30, respectively. The climbing scaffold 8 can then be moved upwards along the climbing rail 7 via the climbing carriage 9 until the formwork 4 is arranged at the level of the third concreting portion (to be produced). Thereafter, the holding elements 33 of the holding device 34 on the climbing carriage 9 are connected to the second mounts 18 of the further suspension shoes 44 on the second concreting portion 5B. Finally, the formwork 4 can be brought into the forming or concreting position shown in Figure 4 in order to produce the third concreting production (not yet present in the illustration of Figure 4) above the second concreting portion 5B.

In the embodiment shown, a support part 45 is provided for support on the outside of the building (cf. e.g. Figure 2). When climbing

up the climbing rail 7, the supporting part 45 slides on the outside of the building 3. In the embodiment shown, the support part 45 is attached to the lower end of the climbing rail 7.

In the embodiment shown, a boom 46 is also mounted on the lower end of the climbing rail (see, e.g., Figure 2). The boom 46 extends horizontally to the rear, i.e. away from the outside of the building 3.

Depending on the embodiment, the climbing up the climbing device 2 can be accomplished with a crane (not shown) or with a self-climbing drive 47 (as shown). In the embodiment shown, the self-climbing drive 47 has, for example, a hydraulic cylinder-piston drive 48 for moving the climbing scaffold relative to the climbing rail (and vice versa) (see, e.g., Figure 2).

In the embodiment shown, the climbing scaffold 8 has a vertically oriented column element 49 (when the climbing unit 6 is used on a building 3 comprising vertical concreting portions 5), which extends parallel to the climbing rail 7. In addition, the climbing scaffold 6 has a supporting element for support on the outside of the building. The support element is provided at the front end of a horizontal beam 61 mounted at the lower end of the column element 49.

The cylinder-piston drive 48 is connected, at one longitudinal end, to the rear end of the boom 46 and, at the other longitudinal end, to the column element 49. In the retracted state, the cylinder-piston drive is arranged substantially entirely within the column element 49 (cf. Figure 3 and Figure 4).

In the embodiment shown, the climbing scaffold 8 has a supporting element 56 for support on the outside of the building 3. The support element 56 is provided at the front end of a horizontal beam 57 at the lower end of the column element 49.

In the exemplary embodiment shown, the climbing carriage 9 is connected to the column element 49 via a further boom 50 (cf. e.g. Figure 2).

In addition, the climbing scaffold 8 has a guide element 51, in particular a further guide shoe, for guiding along the rear flange 36 of the climbing rail 7 below the guide shoe of the climbing

carriage 8. The guide element 51 engages around the rear flange 36 of the climbing rail 7 in order to slide along the climbing rail 7 when climbing up the climbing scaffold 8. The guide element 51 is connected to the column element 49 of the climbing scaffold 8 via a support element 52.

In the exemplary embodiment shown, the climbing scaffold 8 has a further column element 53, which is arranged substantially parallel to and at a horizontal distance perpendicular to the outer side of the building from the column element 49. The further column element 53 is connected to the column element 49 via a strut truss 54 (cf. e.g. Figure 2).

In the exemplary embodiment shown, the climbing scaffold 8 has a cantilever part 55 at the upper ends of the column element 49 and of the further column element 53, from which the formwork 4 is suspended.

Thus, the following method for erecting the building 3 from concreting portions 5 arranged one above the other can be carried out:

- i. providing the climbing device 2,
- ii. anchoring each of the first 11 and the second suspension shoes 30 of the climbing units 6 at substantially the same height to the first concreting portion 5A of the building 3,
- iii. arranging the climbing units 6 respectively in the holding position on the first 11 and the second suspension shoes 30, wherein the holding devices 34 on the climbing carriage 9 of the climbing units 6 are respectively connected to the second mounts 18 of the first 11 and the second suspension shoes 30 and the fastening devices 38 on the climbing rails 7 are respectively connected to the first mounts 17 of the first 11 and the second suspension shoes 30,
- iv. arranging the formwork 4 in the forming or concreting position,
- v. concreting the second concreting portion 5B directly above the first concreting portion 5A,
- vi. arranging the formwork 4 in the stripping position behind the rear end of the climbing rail 7,

- vii. anchoring two further suspension shoes 44 per climbing unit 6 in each case at the upper end of the second concreting portion 5B substantially at the same height and releasing the fastening devices 38 on the climbing rails 7 in each case from the first mounts 17 of the first 11 and the second suspension shoes 30,
- viii. moving the climbing rails 7 by actuating the self-climbing drives 47 along the first 11 and the second suspension shoes 30 until the upper ends of the climbing rails 7 reach the upper end of the second concreting portion 5B,
- ix. connecting the fastening devices 38 on the climbing rails 7 to the first mounts 17 of the further suspension shoes 44,
- x. releasing the holding devices 34 on the climbing carriage 9 from the second mounts 18 of the first 11 and the second suspension shoes 30,
- xi. shifting the climbing scaffolds 8 upwards by means of the climbing carriages 9 by actuating the self-climbing drive 47 along the climbing rails 7 until the formwork 4 is arranged at the level of the third concreting portion to be produced in the next concreting operation.

Figures 11 to 14 show an embodiment of the climbing device 2 that is configured for climbing between opposite wall sections 59 of a shaft. For this purpose, two climbing units 6 are arranged on each of the opposite wall sections 59. Figures 12 to 14 each show only one half of this arrangement in a side view.

In this embodiment, a bridging frame 60, a so-called gantry, can be provided, which in each case connects the upper ends of the climbing rails 7 to one another. In the embodiment of Figures 11 to 14, the climbing rail 7 is column-shaped. As in the embodiment of Figures 1 to 10, the climbing carriage 9 is slidable along the climbing rail 7. For this purpose, the climbing carriage 9 has the guide shoe 9A, which engages around a section of the climbing rail 7. Mounted on the front side of the climbing carriage 9 is the holding device 34, by means of which the climbing carriage 9, as in the embodiment of Figures 1 to 10, can be suspended from the second mount 18 of the first 11 and the second suspension shoes 30, respectively. The first 11 and the second suspension shoes 30 of each climbing unit 6 are configured according to Figures 1 to

10. In addition, the fastening device 38 is mounted on a central longitudinal section of the climbing rail 7, by means of which the climbing rail 7, likewise as in the embodiment of Figures 1 to 10, can be suspended from the first mount 17 of the first 11 and the second suspension shoes 30, respectively. In contrast to the preceding embodiment, the working platform 10 is connected to the climbing rail 7, so that the working platform 10, and also the bridging frame 60 with the formwork 4 suspended therefrom, is moved together with the climbing rail 7 at the level of the next concreting portion. The self-climbing drive 47 has the above-described cylinder-piston drive 48, which acts between the climbing carriage 9 and the climbing rail 7 in order to bring the climbing rail 7 or the climbing carriage 9 to the level of the next concreting portion, depending on the phase of the climbing process.

According to Figure 12, the first 11 and the second suspension shoes 30 are each anchored to the first concreting portion 5A, wherein in the example shown, two lower concreting portions 5 have already been produced below the first concreting portion 5A. The formwork 4 is in the forming or concreting position, with which the second concreting portion 5B is produced directly above the first concreting portion 5a. The climbing units 6 are each arranged on the opposite wall sections 59 of the shaft, i.e. spaced apart from one another in the horizontal direction perpendicular to the wall planes, in the holding position in which the holding device 34 on the climbing carriage 9 is connected to the second mount 18 of the first 11 and the second suspension shoes 30, respectively, and the fastening device 38 on the climbing rail 9 is connected to the first mount 17 of the first 11 and the second suspension shoes 30, respectively. The climbing rail 7 extends beyond the upper end of the second concreting portion 5B, wherein the formwork 4 is suspended from the bridging frame 60.

According to Figure 13, the fastening device 38 connected to the climbing rail 7 is released from the first mount 17 of the first 11 and the second suspension shoes 30, respectively. In this position, the climbing rail 7 together with the working platform 10, the bridging frame 60 and the formwork 4 can be displaced along the first 11 and the second suspension shoes 30 upwards beyond the upper end of the third concreting portion (to be produced next).

Climbing up the climbing rail 7 is achieved by a single stroke of the self-climbing drive 47 (i.e., not incrementally with multiple forward and backward movements of the piston). During the climbing up the climbing rail 7, the climbing carriage 9 is held by the first 11 and the second suspension shoes 30. Arranged at the upper end of the second concreting portion 5b is a pair of further suspension shoes 44, which are formed and arranged in correspondence with the first 11 and the second suspension shoes 30. The fastening device 38 on the central longitudinal section of the climbing rail 7 is connected to the first mount 17 of the further pair of suspension shoes 44 on the second concreting portion 5B. The climbing rail 7 of the climbing unit 6 on the opposite wall section 59 is pulled upwards simultaneously and in parallel and is held on the opposite wall section 59 with a pair of further suspension shoes 44.

According to Figure 14, the holding device 34 on the climbing carriage 9 was first released from the second mount 18 of the first 11 and the second suspension shoes 30, respectively. The climbing carriage 9 can then be moved along the climbing rail 7 by a single stroke of the cylinder-piston drive 48 of the self-climbing drive 47 at the level of the next concreting portion, here at the level of the second concreting portion 5B. Thereafter, the holding device 34 on the climbing carriage 9 is connected to the second mounts 18 of the further suspension shoes 44 on the second concreting portion 5B. Thus, the climbing unit 6 is arranged in the holding position, in which the third concreting portion can be produced above the second concreting portion 5B.

List of reference numbers:

- 1 climbing system
- 2 climbing device
- 3 building
- 4 formwork
- 5 concreting portion
- 6 climbing unit
- 7 climbing rail
- 8 climbing scaffold
- 9 climbing- or scaffold-carriage
- 9A guide shoe
- 10 working platform

10A platform support
11 first suspension shoe
12 anchor
13 locking anchor
14 suspension cone
15 anchor part
16 suspension part
17 first mount
18 second mount
19 first holding opening
20 first holding bolt
21 second holding opening
22 second holding bolt
23 longitudinal axis
24 ball element
25 ball socket
26 receiving groove
27 first coupling strip
28 second coupling strip
29 baseplate
30 second suspension shoe
31 holding fork
32 fork elements
33 holding elements
34 holding device
35 suspension openings
36 flange
37 climbing profile
38 fastening device
39 fastening plate
40 bearing portion
41 fastening portions
42 bearing journals
43 fastening opening
44 additional suspension shoes
45 support part
46 boom
47 self-climbing drive
48 cylinder-piston drive
49 column element
50 additional booms

- 51 guide element
- 52 support element
- 53 additional column element
- 54 strut truss
- 55 cantilever part
- 56 support element
- 57 horizontal beam
- 58 working platform flooring
- 59 opposite wall portions of the shaft
- 60 bridging frame
- 61 horizontal beam

Claims:

1. A suspension shoe (11, 30, 44) for use in a climbing unit (6) having a first climbing component, which is in particular a climbing rail (7), and a second climbing component, which is in particular a climbing carriage (9) movable along the climbing rail (7), the suspension shoe comprising:

an anchor (12) for anchoring in a concreting portion (5; 5A, 5B) of a building (3),

a suspension part (16) connected to the anchor (12),
characterised in that

the suspension part (16) has a first mount (17) for releasably holding the first climbing component of the climbing unit (6), in particular the climbing rail (7), and a second mount (18) for releasably holding the second climbing component of the climbing unit (6), in particular the climbing carriage (9).

2. The suspension shoe (11, 30, 44) according to claim 1, characterised in that the first mount (17) has a first holding opening (19) for the passage of a first holding bolt (20) and/or the second mount (18) has a second holding opening (21) for the passage of a second holding bolt (22).

3. The suspension shoe (11, 30, 44) according to claim 1 or 2, characterised in that the first (17) and the second mounts (18) are provided substantially at the same height on both sides of the anchor (12).

4. The suspension shoe (11, 30, 44) according to any of claims 1 to 3, characterised in that the suspension part (16) is tiltably connected to the anchor (12), in particular about a horizontal axis.

5. The suspension shoe (11, 30, 44) according to claim 4, characterised in that the anchor (12) comprises a ball element (24) and the suspension part comprises a ball socket (25), wherein the ball element (24) of the anchor (12) is tiltably arranged in the ball socket of the suspension part (16).

6. The suspension shoe (11, 30, 44) according to any of claims 1 to 5, characterised in that the suspension part (16) has a receiving groove (26), in particular extending in the horizontal

direction, for receiving a first coupling strip (27) on the climbing rail and/or a second coupling strip (28) on the climbing carriage (9).

7. The suspension shoe (11, 30, 44) according to any one of claims 1 to 6, characterised in that the suspension part (16) has a base plate (29), in which the receiving groove (26) and/or the ball socket (25) are preferably integrated.

8. A climbing unit (6) for arrangement on a building (3), comprising:

- a first suspension shoe (11) for anchoring to a concreting portion (5; 5A, 5B) of the building (3),

- a climbing rail (7),

- a climbing carriage (9) which is movable along the climbing rail (7),

- characterised in that

- the first suspension shoe (11) is designed according to any one of claims 1 to 7,

- wherein, in a first climbing position of the climbing unit (6), a holding device (34) on the climbing carriage (9) is connected to the second mount (18) of the first suspension shoe (11), and a fastening device (38) on the climbing rail (7) is released from the first mount (17) of the first suspension shoe (11), so that the climbing rail (7) is movable along the first suspension shoe (11),

- wherein in a second climbing position, the fastening device (38) on the climbing rail (7) is connected to the first mount (17) of the first suspension shoe (11), and the holding device (34) on the climbing carriage (9) is released from the second mount (18) of the first suspension shoe (11), so that the climbing carriage (9) is movable along the climbing rail (7).

9. The climbing unit (6) according to claim 8 with claim 2, characterised in that the fastening device (38) on the climbing rail (7) has a fastening opening (43) for arranging the first holding bolt (20) and/or the holding device (34) on the climbing carriage (9) has a suspension opening (35) for arranging the second holding bolt (22).

10. The climbing unit (6) according to claim 8 or 9 with claim 6, characterised in that the fastening device (38) on the climbing

rail (7) has a first coupling strip (27) and/or the holding device (34) on the climbing carriage (9) has a second coupling strip (38), in each case for preferably substantially precisely fitting arrangement in the receiving groove (26) of the first suspension shoe (11).

11. The climbing unit (6) according to any one of claims 8 to 10, characterised in that

a second suspension shoe (30) according to any one of claims 1 to 7 is provided for anchoring to the concreting portion (5),

wherein, in the first climbing position, the holding device (34) on the climbing carriage (9) is respectively connected to the second mount (18) of the first (11) and the second suspension shoes (30), and the fastening device (38) on the climbing rail (7) is respectively released from the second mount (18) of the first (11) and the second suspension shoes (30), so that the climbing rail (7) is movable along the first (11) and the second suspension shoes (30),

wherein in the second climbing position, the fastening device (38) on the climbing rail (7) is respectively connected to the first mount (17) of the first (11) and the second suspension shoes (30), and the holding device (34) on the climbing carriage (9) is respectively released from the second mount (18) of the first (11) and the second suspension shoes (30), so that the climbing carriage (9) is movable along the climbing rail (7).

12. The climbing unit (6) according to claim 11, characterised in that the first (11) and the second suspension shoes (30) are arranged substantially at the same height on both sides of the climbing rail (7).

13. The climbing unit (6) according to claim 11 or 12, characterised in that the climbing carriage (9) comprises a holding fork (31) with two fork elements (32) on both sides of the climbing rail (7), wherein the two fork elements (32), in particular at their free ends, each carry a holding element (33), in particular a holding plate, of the holding device (34), which in the first climbing position, in particular via the second holding bolt (22), are connected to the second mounts (18) of the first (11) and the second suspension shoes (30).

14. The climbing unit (6) according to any of claims 8 to 13, characterised in that the climbing carriage (9) has a guide shoe (9A) for guiding along the climbing rail (7), in particular for engaging around a climbing profile (37) of the climbing rail (7), wherein preferably a horizontal central axis of the guide shoe (9A) lies substantially in a vertical central plane of the climbing rail (7).

15. The climbing unit (6) according to any of claims 11 to 14, characterised in that the fastening device (38) comprises a fastening plate (39) having a bearing portion (40) and two fastening portions (41) on both sides of the bearing portion (40), wherein the bearing portion (40) is connected to the climbing rail (7), preferably via a bearing journal (42), and the fastening portions (41) are connected to the first mounts (17) of the first (11) and the second suspension shoes (30), preferably via the two first holding bolts (20), in the second climbing position.

16. The climbing unit (6) according to any of claims 8 to 15, characterised in that a support part (45) is provided for support on the outside of the building (3), in particular on the lower end of the climbing rail (7).

17. The climbing unit (6) according to any one of claims 8 to 16, characterised by

a self-climbing drive (47), in particular with a cylinder-piston drive (48), for moving the climbing carriage (9) relative to the climbing rail (7) and vice versa.

18. The climbing unit (6) according to claim 17, characterised in that a boom (46), in particular at the lower end of the climbing rail (7), is provided, to which the self-climbing drive (47) is connected.

19. The climbing unit (6) according to claim 17 or 18, characterised in that a climbing scaffold (8) having the climbing carriage (9) also has a preferably vertical column element (49), to which the self-climbing drive (47) is connected.

20. The climbing unit (6) according to claim 19, characterised in that the climbing scaffold (8) has a further column element (53) parallel to the column element (49), wherein a strut truss (54) is

preferably provided between the column element (49) and the further column element (53).

21. The climbing unit (6) according to any of claims 8 to 20, characterised in that a further climbing shoe (44), in particular a pair of further climbing shoes (44), is provided above the first climbing shoe (11).

22. A climbing device (2) comprising:

two climbing units (6) each according to any of claims 8 to 21, which are arranged next to one another at a horizontal distance.

23. The climbing device according to claim 22, characterised in that at least one working platform (10) is provided.

24. The climbing device according to claim 22 or 23, characterised in that a formwork (4), in particular a wall formwork, is provided.

25. A climbing system (1) comprising:

a climbing unit (6) according to any of claims 8 to 21, a building (3) having a concreting portion (6), wherein the anchor (12) of the suspension shoe (11) is anchored within the concreting portion (5) of the building (3).

26. A method for erecting a building (3) from concreting portions (5) arranged one above the other, comprising the steps of:

- i. providing a climbing unit (6) according to any of claims 8 to 21,
- ii. anchoring the first suspension shoe (11) to a first concreting portion (5A) of the building (3),
- iii. arranging the climbing unit (6) in the first climbing position on the first suspension shoe (11), wherein the holding device (34) on the climbing carriage (9) is connected to the second mount (18) of the first suspension shoe (11) and the fastening device (38) on the climbing rail (7) is released from the first mount (17) of the first suspension shoe (11),
- iv. anchoring a further suspension shoe (44) to a second concreting portion (5B),
- v. moving the climbing rail (7) along the first suspension shoe (11),

- vi. arranging the climbing unit (6) in the second climbing position on the further suspension shoe (44), wherein the fastening device (38) on the climbing rail (7) is connected to the first mount (17) of the further suspension shoe (44) and the holding device (34) on the climbing carriage (9) is released from the second mount (18) of the first suspension shoe (11),
- vii. moving the climbing carriage (9) upwards along the climbing rail (7).

27. The method according to claim 26, characterised by the further step of:

- viii. arranging the climbing unit (6) in a holding position on the further suspension shoe (44), wherein the holding device (34) on the climbing carriage (9) is connected to the second mount (18) of the further suspension shoe (44) and the fastening device (38) on the climbing rail (7) is connected to the first mount (17) of the further suspension shoe (44).

28. The method according to claim 27, characterised by the further steps of:

- ix. arranging a formwork (4), in particular a wall formwork, in a forming position,
- x. concreting the third concreting portion,
- xi. arranging the formwork (4) in a stripping position, wherein the formwork (4) is preferably moved in a horizontal direction perpendicular to the second concreting portion (5B) away from the second concreting portion (5B).

29. The method according to any of claims 26 to 28, characterised in that the movement of the climbing rail (7) along the first suspension shoe (11) and/or the movement of the climbing carriage (9) along the climbing rail (7), in particular by the height of one of the concreting portions (5A, 5B), is effected in each case by a single stroke of a cylinder-piston drive (48) of a self-climbing drive (47).