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(54) A method and an apparatus for casting concrete products

Verfahren und Vorrichtung zum Giessen von Betongegenständen

Procédé et dispositif pour le coulage de produits en béton

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Description

The present invention relates to a method of casting a concrete product by using continuous slide casting, wherein concrete mass is extruded onto a bed and into a space between the bed and a mould, by means of slide casting apparatus travelling along the bed, and the mass is compacted and recesses discontinuous in the casting direction are formed in a surface layer of the product.

The invention also relates to slide casting apparatus for casting a concrete product provided with discontinuous recesses in the casting direction, which apparatus comprises a mould, means for feeding concrete mass into the mould, one or more compacting vibrators for compacting the concrete mass, a driving mechanism for driving the feeding means and vibrators and for transporting the mould along a casting bed, and pressing means having a pressing surface arranged to be stationary, in the casting direction, whilst forming the recesses in a surface layer of the concrete mass.

The surface prepared by means of conventional methods by slide casting is relatively smooth. The surface smoothness is in fact generally a desired property, when the product to be cast acts as such as a visible part of the structure. However, in the building industry, structures are often used in which the entire structure is formed of an element prepared at a plant and of a portion to be joined thereto and prepared on site.

The functioning of such concrete structures in the desired manner requires that the bonding of the element to the portion prepared on site is as strong as possible. For ensuring this, it is advantageous that dowel patterns or recesses are made on the surface of the element. The part to be cast on site then fills these recesses and adheres to the element prepared at the plant. For preventing the mutual sliding of the parts of the structure, the patterns have to be both in the casting direction and in the transverse direction discontinuous, e.g. square or rectangular recesses. A suitable dowel depth is e.g.1-20 mm.

A certain concrete product, in which the dowels are specially important, is a so-called casing, club. The casing slab acts as a mould, on top of which is cast a concrete layer required by the total thickness of the slab. The casing slab remains as part of the structure and the load carrying capacity requires a strong grip between the parts.

The necessary dowel grooves have previously been generally such that the product has not been cast in a slide casting manner but in a mould on site, whose bottom contains bulges. The bulges have formed recesses on the lower surface of the slab. However, a drawback of the method is that one surface of the slab or the upper surface has to be smoothed separately so that a smooth surface could be made visible on the finished slab. This results in an additional working step in the slab casting.

From FI patent publication 61652 is also known a device, by means of which recesses are formed in the sides of the slab by using two successive wheels, whose teeth form the recesses in the side of the slab. Since the concrete mass is compacted between these two wheels, the latter wheel has to be slightly smaller than the wheel operating first, and in addition the speeds of the wheels have to be synchronized by means of a special sliding coupling, which takes into account the changed dimensions of the slab. The device is thus fairly complicated, and it is difficult to make it satisfactorily operative in all conditions.

US patent publication 3 740 176 and FI application 878/71 in turn describe devices, in which the recesses are formed either by means of a flexible belt or one gear wheel. However, problems are caused in both these devices by a deformation caused by the compaction of the slab.

According to a first aspect of the present invention, there is provided a method of casting a concrete product by using continuous slide casting, wherein concrete mass is extruded onto a bed and into a space between the bed and a mould, by means of slide casting apparatus travelling along the bed, and the mass is compacted and, after the compaction, recesses discontinuous in the casting direction are formed in a surface layer of the product by using vibration to cause the surface layer to enter a plastic state and by pressing the recesses into the surface layer thus plasticized, characterized in that the effect of the vibration occurring after the compaction is sufficiently low and directed in such a way that the surface layer is plasticized only to a depth necessary to permit the pressing of the recesses, whilst the main portion of the product remains in its compacted state.

According to a second aspect of the present invention, there is provided slide casting apparatus for casting a concrete product provided with recesses discontinuous in the casting direction, which apparatus comprises a mould, means for feeding concrete mass into the mould, one or more compacting vibrators for compacting the concrete mass, at least one plasticizing vibrator for plasticizing a surface layer of the compacted concrete mass, pressing means having a pressing surface arranged to be stationary, in the casting direction, whilst forming the recesses in the plasticized surface layer, and a driving mechanism for driving the feeding means and vibrators and for transporting the mould along a casting bed, characterized in that the plasticizing vibrator(s) are arranged so that the effect of the vibration occurring after the compaction is sufficiently low and directed in such a way that the surface layer is plasticized only to a depth necessary to permit the pressing of the recesses, whilst the main portion of the product remains compacted.

The recesses are formed by pressing. i.e. without removing any of the concrete mass. The slide casting technique requires the use of a fairly dry concrete mass, since the product has to retain its shape after leaving

the mould. The pressing of sufficient recesses into such a dry mass after compaction requires the bringing of the surface again into a plastic state, but only to a depth just needed, whereby the cohesion of the entire product after leaving the mould is not in danger.

Preferably, when forming dowel grooves during the casting of a concrete slab, they are formed in an upper surface of the horizontal slab. Then, a flat steel plate may be used as a lower surface of the mould and the visible surface of the mould can be made completely smooth.

The invention may also be applied when forming dowels in other concrete products that are prepared by slide casting, such as hollow slabs, beams and pillars.

A non-limiting embodiment of the invention will now be described with reference to the accompanying drawing, which is a side view of slide casting apparatus in accordance with the invention.

A slide casting machine comprises a frame and a driving mechanism 6, which may also be replaced by an external driving device, as well as a funnel and a moulding box 1, via which the concrete mass flows into a slide casting mould.

On the upper surface of the mould is, seen from the funnel 1, first located a moulding beam 2, whereto is fixed one or several vibrators. The vibrating moulding beam 2 improves the flowing of the concrete mass into the mould.

Next is located a compacting beam 3, which is provided with more efficient vibrators than the previous ones. The compacting beam 3 compacts the product to be cast into its final form, except for the dowel grooves.

Next is located a pressure balancing/smoothing beam 4, which is further provided with vibrators, but they are less efficient than those of the compacting beam 3. The smoothing beam 4 has two tasks. It smooths the surface of the product to be prepared, and on the other hand it prevents the surface of the concrete mass from rising after the actual compacting beam 3. When the rising is thus prevented, the pressure needed for the compaction remains under the compacting beam 3.

In the application shown in the drawing, the recesses are formed by means of a cylindrical press roll 5, whose surface has bulges. These bulges press the corresponding recesses into the surface of the product. The cylindrical press roll 5 may be replaced with an endless belt travelling around rollers, to which belt are fixed bulges for pressing the dowel grooves. The roll or the belt is rotated at a speed synchronized with the advancement of the machine e.g. by means of a toothed belt or a chain so that the roll or the belt rolls along the surface of the product to be cast and simultaneously presses a regular dowel pattern into the concrete surface. In this connection, a belt refers, except for an entirely flexible belt, also to a caterpillar type construction, which is comprised of plates joined to each other.

The roll or the belt may also be replaced with a stamp-type press, which may operate by means of cranks or levers or also hydraulically. The press performs in the pressing direction a to-and-fro movement towards the product and away therefrom. In addition, the movement track of the device is such that it does not drag along the surface of the product as the machine advances, so it presses a sharp pattern. This means that on one hand, during the pressing step, the press remains stationary relative to the casting direction on the surface of the product, moving relative to the casting machine, and on the other hand, when it comes off the product, it returns back to the same position relative to the casting machine.

The roll 5 may be vibrated e.g. by vibrating bearing blocks supporting the roll. Similarly, the vibration of the belt is achieved by vibrating the support rollers of the belt. When using a stamp-type press, the vibrator may be placed inside the press itself.

The vibrating effects of both the dowel-making device itself and of the balancing beam 4 have been selected such that they are sufficient for plasticizing again the surface of the slab, but only to such a depth that the dowel patterns may be pressed without endangering the shape of the rest of the slab.

When the method is applied to making dowel grooves in a hollow slab, the upper surface of the slide mould of the hollow-slab machine is replaced with apparatus as described above. In the hollow-slab extruder, the mass flow into the slide mould is arranged by screws as well as by compacting mandrels located after the screws.

Such a machine is described e.g. in Finnish patent publication 70821.

In addition to producing dowel patterns in the upper surface of the concrete product, the method and apparatus of the invention may also produce dowel patterns in the side surfaces of a concrete element by installing corresponding devices on the side walls of the slide cast mould.

Claims

1. A method of casting a concrete product by using continuous slide casting, wherein concrete mass is extruded onto a bed and into a space between the bed and a mould, by means of slide casting apparatus travelling along the bed, and the mass is compacted and, after the compaction, recesses discontinuous in the casting direction are formed in a surface layer of the product by using vibration to cause the surface layer to enter a plastic state and by pressing the recesses into the surface layer thus plasticized, characterized in that the effect of the vibration occurring after the compaction is sufficiently low and directed in such a way that the surface layer is plasticized only to a depth necessary to permit the pressing of the recesses, whilst the main portion of the product remains in its compacted

state.

2. The method according to claim 1, wherein the product is a hollow slab.

3. Slide casting apparatus for carrying out the method of claim 1 for casting a concrete product provided with recesses discontinuous in the casting direction, which apparatus comprises a mould (2, 3), means (1) for feeding concrete mass into the mould one or more compacting vibrators for compacting the concrete mass, at least one plasticizing vibrator (4) for plasticizing a surface layer of the compacted concrete mass, pressing means (5) having a pressing surface arranged to be stationary, in the casting direction, whilst forming the recesses in the plasticized surface layer, and a driving mechanism (6) for driving the feeding means and vibrators and for transporting the mould along a casting bed, characterized in that the plasticizing vibrator(s) are arranged so that the effect of the vibration occurring after the compaction is sufficiently low and directed in such a way that the surface layer is plasticized only to a depth necessary to permit the pressing of the recesses, whilst the main portion of the product remains compacted.

4. Apparatus according to claim 3, wherein the plasticizing vibrators comprise (i) a vibrating wall (4) downstream of the compacting vibrator(s) (3) and (ii) the pressing means (5), which is downstream of the vibrating wall (4) and is arranged to vibrate.

5. Apparatus according to claim 4, wherein the compacting vibrator(s) comprise a compacting wall (3) which is upstream of the vibrating wall (4).

Patentansprüche

1. Verfahren zum Gießen eines Betonproduktes durch kontinuierliches Gleitgießen, bei dem die Betonmasse auf ein Bett und in einen Zwischenraum zwischen dem Bett und einer Form extrudiert wird und zwar mittels einer Gleitgießvorrichtung, die sich entlang des Bettes fortbewegt, und bei dem die Masse verdichtet und nach dem Verdichten in einer Oberflächenschicht des Produktes in Gießrichtung diskontinuierliche Vertiefungen mittels Vibration geformt werden, um die Oberflächenschicht in einen plastischen Zustand zu versetzen und die Vertiefungen in die auf diese Weise plastifizierte Oberfläche zu pressen,
dadurch gekennzeichnet, daß die nach der Verdichtung auftretende Wirkung der Vibration ausreichend gering und so gerichtet ist, daß die Oberflächenschicht nur bis in eine Tiefe plastifiziert wird, die erforderlich ist, um die Vertiefungen einzupressen, während der Hauptbestandteil des Produktes im verdichteten Zustand bleibt.

2. Verfahren nach Anspruch 1,
bei dem das Produkt eine hohle Platte ist.

3. Gleitgießvorrichtung zum Durchführen des Verfahrens nach Anspruch 1, zum Gießen eines Betonproduktes mit in Gießrichtung diskontinuierlichen Vertiefungen, die eine Form (2, 3), Mittel (1) zum Zuführen von Betonmasse in die Form, eine oder mehrere verdichtende Vibratoren zum Verdichten der Betonmasse, zumindest einen plastifizierenden Vibrator (4), zum Plastifizieren einer Oberflächenschicht der verdichteten Betonmasse, Preßmittel (5) mit einer während des Formens der Vertiefungen in der plastifizierten Oberflächenschicht in Gießrichtung stationär angeordneten Preßoberfläche und einen Antriebsmechanismus (6) aufweist, um die Zuführmittel und Vibratoren anzutreiben und die Form entlang des Gußbetts zu transportieren,
dadurch gekennzeichnet, daß die plastisch machenden Vibratoren so angeordnet sind, daß der Effekt der Vibration nach dem Verdichten ausreichend gering und so gerichtet ist, daß die Oberflächenschicht nur bis in eine Tiefe plastifiziert wird, die erforderlich ist, um das Einpressen von Vertiefungen zu erlauben, während der Hauptteil des Produktes verdichtet bleibt.

4. Vorrichtung nach Anspruch 3,
bei der die plastifizierenden Vibratoren (i) eine vibrierende Wand (4) stromabwärts der verdichtenden Vibratoren (3) und (ii) Preßmittel (5) aufweisen, die sich stromabwärts der vibrierenden Wand (4) befinden und zum Vibrieren eingerichtet sind.

5. Vorrichtung nach Anspruch 4,
bei der die verdichtenden Vibratoren eine verdichtende Wand (3) aufweisen, welche sich stromaufwärts der vibrierenden Wand (4) befindet.

Revendications

1. Procédé pour la coulée d'un produit en béton en utilisant une coulée continue par déplacement, où la masse de béton est extrudée sur un lit et dans un espace entre le lit et un moule, au moyen d'un appareil de coulée par déplacement se déplaçant le long du lit, et la masse est compactée, et après le compactage, des évidements discontinus dans la direction de coulée sont formés dans une couche de surface du produit en utilisant des vibrations pour amener la couche de surface à entrer dans un état plastique et en pressant les évidements dans la couche de surface ainsi plastifiée, caractérisé en ce que l'effet des vibrations se produisant après le compactage est suffisamment bas et dirigé de telle

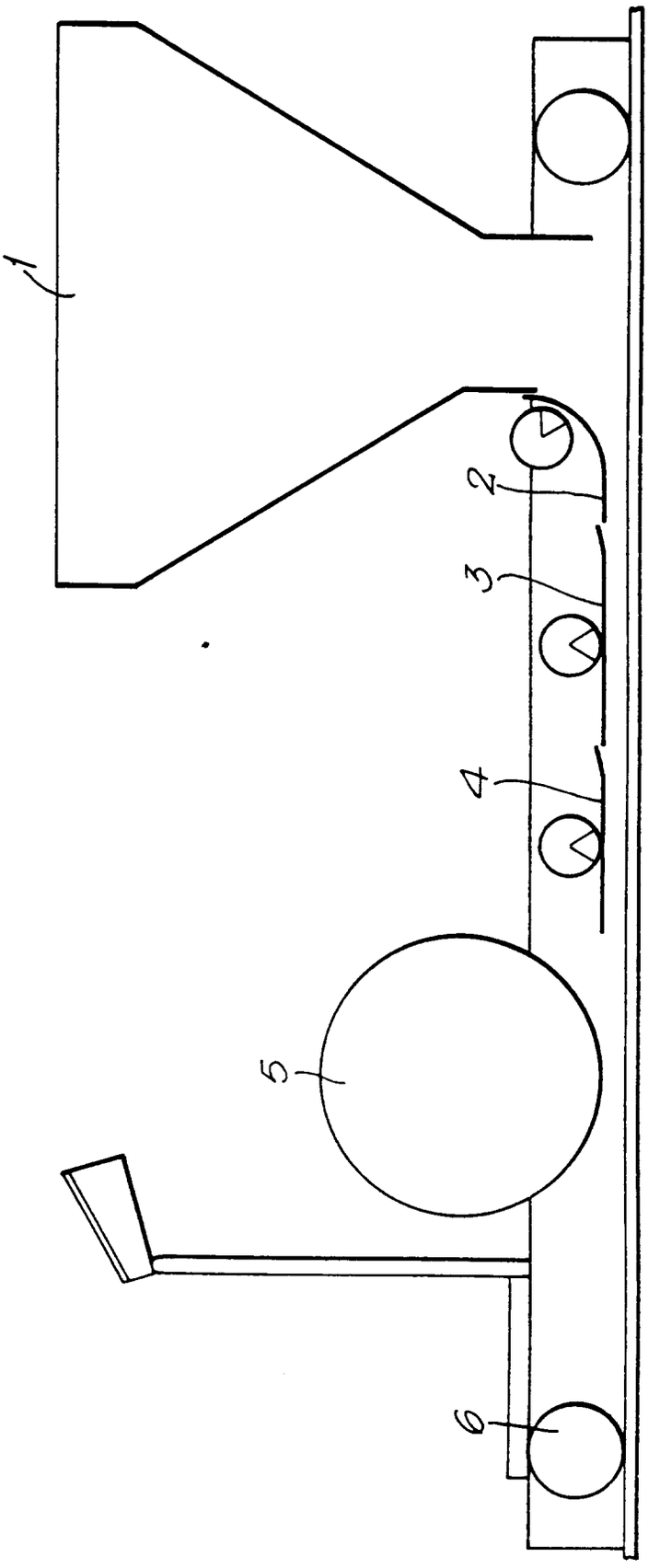
manière que la couche de surface soit plastifiée seulement sur une profondeur nécessaire pour permettre le pressage des évidements alors que la partie principale du produit reste dans son état compacté.

2. Procédé selon la revendication 1, où le produit est une dalle creuse.

3. Appareil de coulée par déplacement pour la mise en oeuvre du procédé selon la revendication 1 pour couler un produit en béton pourvu d'évidements discontinus dans la direction de coulée, cet appareil comporte un moule (2, 3), un moyen (1) pour amener une masse en béton dans le moule, un ou plusieurs vibrateurs de compactage pour compacter la masse en béton, au moins un vibrateur de plastification (4) pour plastifler une couche de surface de la masse de béton compacté, un moyen de pression (5) ayant une surface de pression agencée pour être stationnaire, dans la direction de coulée, tout en formant les évidements dans la couche de surface plastifiée ainsi qu'un moyen d'entraînement (6) pour entraîner le moyen d'amenée et les vibrateurs et pour transporter le moule le long du lit de coulée, caractérisé en ce que le ou les vibrateurs de plastification sont agencés pour que l'effet des vibrations se produisant après le compactage soit suffisamment bas et dirigé de telle manière que la couche de surface soit plastifiée seulement suivant une profondeur nécessaire pour permettre le pressage des évidements alors que la portion principale du produit reste compactée.

4. Appareil selon la revendication 3, où les vibrateurs de plastification comportent (i) une paroi vibrante (4) en aval du ou des vibrateurs de compactage (3) et (ii) le moyen de pression (5) qui se situe en aval de la paroi vibrante (4) et qui est agencé pour vibrer.

5. Appareil selon la revendication 4, où le ou les vibrateurs de compactage comportent une paroi de compactage (3) qui se situe en amont de la paroi vibrante (4).


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