

TITLE

PRECAST CONCRETE PANEL WITH A PLASTIC CLADDING, METHOD FOR MAKING
THE PRECAST CONCRETE PANEL, PRECAST CONCRETE PANEL WITH LATERAL
5 HOLLOWES AND METHOD FOR MAKING IT

FIELD OF TECHNOLOGY

The present application relates to a precast concrete panel and to a method for making the
10 precast concrete panel.

BACKGROUND

Modern construction methods can use wall panels. These precast wall panels can have
15 lightweight and can have desirable physical properties of high strength, water resistance,
rigidity, heat insulation, and flame retardant. For wide adoption of the precast wall panels,
the wall panels should have a low cost.

SUMMARY

20 It is an object of the application to provide a precast wall panel with high manufacturing effi-
ciency at a low cost.

The application provides a concrete product or slab. The concrete product includes a con-
25 crete mixture and one or more claddings.

An extruding process or a slip forming process provides the concrete mixture whilst the
claddings are provided on one or more surfaces of the concrete mixture. The claddings in-
clude one or more continuous plastic layers and one or more anchoring studs. The studs
30 are attached to the plastic layers and they extend from the plastic layers to interior areas of
the concrete mixture for mechanically bonding the plastic layers to the concrete mixture.

The claddings allow the concrete product to hold or contain fluids, such as gas or liquid.
The plastic layers provide the concrete mixture with a non-porous covering whilst the con-
35 crete mixture provides mechanical strength and stability.

In practice, the continuous plastic layer can include two or more smaller plastic layers that are joined by a means, such as thermoplastic welding, to form the larger continuous plastic layer.

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The studs often have a shape that widens out towards the concrete mixture from the plastic layers for providing a positive locking between the plastic layers and the concrete mixture.

10 The plastic layers and the studs can be produced in different ways. They can be produced as one integrated part for high reliability or they be produced as separate parts that are later joined to form one part for easier production.

15 In a special case, the plastic layers can include one or more openings for monitoring purposes. The openings allow monitoring sensors to access contents that the concrete product is holding.

20 The concrete product can also include one or more reinforcement structures, such as a wire or netting for taking up or for absorbing tensile stress of the concrete product. Moreover, the concrete mixture can also have one or more lightweight materials. The lightweight materials are often able to provide lower cost beside ease of use.

25 The application also provides a concrete panel. The concrete panel includes a portion of the above concrete product. The concrete product is often sawed after it is dried to form the concrete panel. The concrete panel can be used as a wall panel.

The application provides different methods of producing the concrete product are provided below.

30 The application provides a first method of producing the concrete product. The method includes a step of providing one or more claddings on an elongated casting bed. The claddings include one or more plastic layers and one or more studs that are attached to the plastic layers and that extend from the plastic layers.

35 A wet concrete mixture is then deposited onto the plastic layers and onto the studs. The concrete mixture is provided using an extruder or a slip-former. The casting bed then casts

or moulds the concrete mixture to form a concrete product whilst the concrete mixture to wrap around the studs for bonding the plastic layers onto the concrete mixture.

The application also provides a second method of producing a concrete product. The method comprises a step of depositing a wet concrete mixture onto an elongated casting bed using an extruder or a slip-former. The casting bed moulds or shapes the concrete mixture.

After the concrete mixture is dried, a layer of wet concrete is provided an external surface of the concrete mixture. One or more claddings are afterward provided on the deposited concrete layer. The claddings include one or more plastic layers and one or more studs that are attached to the plastic layers and that extend from the plastic layers. The layer of concrete mixture wraps around the studs for bonding or for attaching the plastic layers onto the concrete mixture.

The above two methods can include a step of providing a layer of adhesive onto a harden surface of the concrete mixture. One or more further claddings are then attached onto the layer of adhesive.

The first claddings and the second claddings are often provided on opposite surfaces of the concrete mixture. The first claddings can provide a non-porous covering that is able to withstand chemical or waste whilst the second claddings can provide protection such that the concrete product is suitable for outside use. In a general sense, other types of claddings are possible. For example, the cladding can include a fibre-reinforced board.

The application provides a concrete product. The concrete product includes a concrete mixture that is provided by an extruding process or that is provided by a slip-forming process. The concrete mixture includes one or more hollow volume areas that are formed by one or more filler elements.

The hollow volume areas is intended for housing a utility line, such as a electrical cable or a water pipe, although other uses are also possible. The hollow volume areas with the filler elements removed can be viewed as compartments for the utility line. The filler elements are often produced from a material that is able to form the hollow volume areas and yet can be removed easily.

In one implementation, the filler elements include a material with a density that is lighter than a density of the concrete mixture. An example of such material is polystyrene foam, which can be easily removed for accessing the hollow volume areas.

- 5 In another implementation, the filler elements have an outer layer of oil that provides an easy release from the concrete mixture.

The filler element often has a hollow structure. A part of the hollow structure can be removed for accessing the hollow part of the structure. An example of such filler element is a
10 plastic or metal hollow tube.

In a special case, the filler element comprises two-filler sections. The filler sections are arranged in a straight line and are separated from each other. This especially useful when the concrete product has a hollow core that can be placed between the filler sections. The hol-
15 low core can be formed with interrupting with the filler sections.

The hollow volume areas are often provided in a lateral direction or in a longitudinal direction of the concrete product, although they can also be provided in other directions. This provides for easy of design of the concrete product.

20 The hollow volume areas can be provided inside the concrete mixture or on external surfaces of the concrete mixture for easy of implementation depending on user requirements.

The application also provides a further concrete product. The product comprises a concrete
25 mixture that is provided by one of an extruding process or of a slip-forming process. The concrete mixture comprises one or more hollow volume areas that are provided on one or more external surface areas of the concrete mixture. The hollow volume areas are formed by a sawing device and by a suction device. This concrete product allows its design to be changed quickly. The position, width, and depth of the hollow volume areas can be adjusted
30 easily during its production.

These hollow volume areas can be provided in a lateral or a horizontal direction of the concrete product for flexible implementation. Alternatively, they can be provided inside the concrete mixture, wherein the hollow volume area is separated from an outer surface of the
35 concrete mixture by a thin layer of concrete.

One or more claddings can be provided on one or more surfaces of the concrete mixture and can be used to cover and protect the exposed hollow volume areas.

5 The above concrete products can also include one or more other longitudinal hollow areas that are provided by an extruding process or by a slip-forming process. These longitudinal hollow areas are usually provided inside the concrete product and can also be used to house electrical cables or pipes.

10 The concrete mixture can also include one or more lightweight materials to reduce weight for ease of handling as well as to reduce cost.

The application also provides a concrete panel. The concrete panel comprises a portion of the said concrete product. The concrete product is usually separated by a sawing mechanism to form several concrete panels.

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The application provides different methods of producing a concrete product.

The application provides a first method of producing a concrete product. The method includes a step of providing one or more filler elements on an elongated casting bed. A concrete mixture is then deposited on the filler elements and on the casting bed using an extruder or a slip-former. The casting bed moulds the concrete mixture to form the concrete panel whilst the filler elements cast or moulds the concrete mixture to form one or more hollow volume areas.

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25 The casting bed is usually provided with a layer of oil before the concrete mixture is deposited on the casting bed to allow for easy release of the concrete mixture from the casting bed.

30 The method can include a step of attaching one or more claddings onto the dried deposited concrete mixture. The claddings can be used to cover the hollow volume areas that are exposed or to provide a covering for an external surface of the concrete mixture.

The application provides a second method of producing a concrete product. The method comprises a step of providing one or more claddings on an elongated casting bed. One or

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more filler elements are then provided on the claddings. After this, a wet concrete mixture is deposited on the filler elements and on the claddings using an extruder or a slip-former. The casting bed moulds the concrete mixture to form the concrete product whilst the filler elements cast or mould the concrete mixture to form one or more hollow volume areas.

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The method can also include a step of removing a layer of concrete to access the filler element, when the filler element is separated from an outer surface of the concrete product by the concrete layer.

10 In one implementation, the filler elements of the above two methods are positioned next to the casting bed such that hollow volume areas are formed on outer surfaces of the concrete mixture. In another implementation, the filler elements of the above two methods are positioned above the casting bed. This allows the hollow volume areas to be formed inside the concrete mixture. In this case, the hollow volume areas are separated from an external surface of the concrete mixture by a thin layer of concrete.

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The application provides another method for producing a concrete product. The method includes a step of one of an extruder or of a slip-former depositing a wet concrete mixture on a casting bed. A portion of the wet concrete mixture is then separated using a sawing device to form two slots on the concrete mixture. After this, a portion of the wet concrete mixture that is between the two slots is removed using sucking device to form a hollow volume area on the concrete product. This method provides another way of producing the hollow volume area.

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25 The application provides a method of using the above said concrete product. The concrete product is often separated into several smaller concrete panels by a sawing mechanism before the concrete product is used.

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The method has a step of providing a utility line, such as an electrical wire or a pipe, in a hollow volume area of the concrete product. The hollow volume area is then covered, for example, using plaster or mortar.

A part of a filler element of the hollow volume area can be removed from a concrete mixture to provide space for the utility line.

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BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

- Fig. 1 illustrates a side view of an embodiment of a lightweight concrete slab,
Fig. 2 illustrates a top view of the lightweight concrete slab of Fig. 1,
5 Fig. 3 illustrates a step of installing a further lightweight concrete wall panel that is produced from the concrete slab of Fig. 1,
Fig. 4 illustrates a front view of the installed concrete wall panel of Fig. 3,
Fig. 5 illustrates a wall bracket for installing the concrete wall panel of Fig. 4,
Fig. 6 illustrates a front view of the installed concrete wall panels of Fig. 4 that is
10 equipped with an electrical power outlet,
Fig. 7 illustrates a side view of the installed concrete wall panels of Fig. 6,
Fig. 8 illustrates an embodiment of the concrete slab of Fig. 1 that is reinforced with wires,
Fig. 9 illustrates a further embodiment of the concrete slab of Fig. 1,
15 Fig. 10 illustrates a top view of a casting bed that is used for producing the concrete slab of Fig. 9,
Fig. 11 illustrates a side view of the casting bed of Fig. 10,
Fig. 12 illustrates an embodiment of producing the concrete slab of Fig. 1,
Fig. 13 illustrates an embodiment of the lightweight concrete slab of Fig. 2,
20 Fig. 14 illustrates a cross-sectional view of the concrete slab of Fig. 13.
Fig. 15 illustrates an embodiment of a cladding for a concrete slab,
Fig. 16 illustrates an embodiment of the cladding of Fig. 15,
Fig. 17 illustrates a container that is constructed using concrete slabs that have the claddings of Fig. 15 or 16,
25 Fig. 18 illustrates a cutout view of a concrete slab that is equipped with the cladding of Fig. 15 or 16,
Fig. 19 illustrates a cross-sectional view of part of the container of Fig. 17,
Fig. 20 illustrates two claddings of Fig. 15 or 16 that are joined together, and
Fig. 21 illustrates a cross-sectional view of an embodiment of a concrete slab that
30 uses the cladding of Fig. 15.

DETAILED DESCRIPTION

In the following description, details are provided to describe the embodiments of the application. It shall be apparent to one skilled in the art, however, that the embodiments may be practised without such details.

- 5 Figures below have similar parts. The similar parts have the same part numbers or the same names. The description of the similar parts is hereby incorporated by reference, where appropriate, thereby reducing repetition of text without limiting the disclosure.

10 For sake of shortness, the embodiments of WO 2010/055497 A2 with its alternatives and implementations are included here as a reference. The embodiments are shown at:

- page 18, line 14 to page 31, line 21 together with Figs. 1 to 7 of WO 2010/055497 A2 with its alternatives and implementations relates to an embodiment of a casting machine for producing concrete slabs and to a method of producing concrete slabs,
- 15 - page 31, line 26 to page 32, line 26 together with Figs. 8 to 11 of WO 2010/055497 A2 with its alternatives and implementations relate to embodiments of a wall panel,
- page 32, line 28 to page 34, line 6 together with Figs. 12 to 14 of WO 2010/055497 A2 with its alternatives and implementations relate to applying a different top layers of a concrete slab,
- 20 - page 34, line 11 to page 35, line 15 together with Figs. 15 to 16 of WO 2010/055497 A2 with its alternatives and implementations relate to supporting rollers of a casting machine,
- page 35, line 19 to page 37, line 9 together with Figs. 17 to 19 of WO 2010/055497 A2 with its alternatives and implementations relate to a method of treating polystyrene beads,
- page 37, line 13 to page 38, line 31 together with Fig. 20 of WO 2010/055497 A2 with its
- 25 alternatives and implementations relate to an embodiment of a casting machine,
- page 39, line 1 to page 40, line 8 together with Figs. 21 to 23 of WO 2010/055497 A2 with its alternatives and implementations relate to a wall panel that is produced by a casting machine,
- page 40, line 12 to page 44, line 10 together with Figs. 24 to 30 of WO 2010/055497 A2
- 30 with its alternatives and implementations relate to different precast wall panels, to a possible method of producing the wall panel, and to a method of using the wall panels,
- page 44, line 14 to page 48, line 20 together with Figs. 31 to 39 and with Fig. 41 of WO 2010/055497 A2 with its alternatives and implementations relate to an embodiment of a casting machine and to a method of using the casting machine,

- page 48, line 22 to page 49, line 17 together with Fig. 40 of WO 2010/055497 A2 with its alternatives and implementations relate to an embodiment of shoes and of tubes of the casting machine,

- page 49, line 21 to page 53, line 33 together with Figs. 42 to 45 of WO 2010/055497 A2

5 with its alternatives and implementations relate to an embodiment of a casting machine and to a method of using of the casting machine,

- page 54, line 5 to page 71, line 6 together with Figs. 46 to 51 relate to embodiments of the wall panel that may be produced by a slip-former and to possible lightweight concrete mixtures,

10 - page 71, line 10 to page 74, line 2 together with Fig. 52 of WO 2010/055497 A2 with its alternatives and implementations relate to a flow chart of a method for optimizing the production costs of a concrete mixture for use by a casting machine, and

- page 74, line 4 to page 77, line 3 together with Fig. 53 of WO 2010/055497 A2 with its alternatives and implementations relate to a flow chart of a method of optimizing the density
15 of a concrete mixture for use by a casting machine.

Figs. 1 and 2 show a side view and a top view respectively of a production 600 of a lightweight concrete slab 601.

20 A bottom surface 603 of the concrete slab 601 is supported by a plurality of fibre-reinforced boards 604 whilst the fibre-reinforced boards 604 are placed above an elongated casting bed 605.

The fibre-reinforced boards 604 are placed next to each other such that top surfaces of the
25 fibre-reinforced boards 604 are positioned next to the bottom surface 603 the concrete slab 601. Fig. 2 shows edges of the fibre-reinforced boards 604 being adjacent to separation lines 612.

The concrete slab 601 has lateral hollow channels 606 and a longitudinal hollow core 608.

30 One side of the concrete slab 601 has a longitudinal groove 609 whilst an opposite side of the concrete slab 601 has a longitudinal tongue 610.

The hollow channels 606 are provided on the bottom surface 603 of the concrete slab 601.

A plurality of polystyrene tubes or polystyrene cores 607 are placed within the hollow channels 606. The polystyrene cores 607, as provided here, connect to the hollow core 608. In
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other words, the polystyrene cores 607 are in contact with the hollow core 608. Polystyrene is also called Styrofoam. Both the hollow channels 606 and the polystyrene cores 607 have the same rectangular profile. Positions of the hollow core 608 as well as positions of the polystyrene cores 607 are indicated by marking on the fibre-reinforced boards 604 for easy
5 locating of the hollow core 608 and the polystyrene cores 607.

In a generic sense, the concrete slab 601 can have one or more longitudinal hollow cores. Wood, plastic foam, fibreboard, brick, or other similar material can replace the polystyrene cores 607. Instead of the hollow core 608 being connected to the polystyrene cores 607,
10 the hollow core 608 can also be separated from the polystyrene tubes 607 by a layer of concrete.

Functionally, the fibre-reinforced boards 604 serve as claddings or coverings for the concrete slab 601. The hollow core 608 and the channels 606 act as passageways for electrical
15 wires or pipes.

One possible method of producing the concrete slab 601 includes a step of attaching the polystyrene tubes 607 onto the fibre-reinforced boards 604 via glue. The fibre-reinforced boards 604 are then placed on the casting bed 605. The fibre-reinforced boards 604 are
20 arranged such that one fibre-reinforced board 604 is located next to another fibre-reinforced board 604 and such that an axis of the polystyrene tubes 607 is extending in a lateral direction of the concrete slab 601.

Following this, wet concrete mixture is deposited over the fibre-reinforced boards 604 and
25 over the polystyrene tubes 607 to form the concrete slab 601. The polystyrene tubes 607 form the hollow channels 606 within the concrete slab 601.

After the concrete mixture is dried, a sawing mechanism separates the lightweight concrete slab 601 into two or more lightweight concrete wall panels 615. These concrete wall panels
30 615 can be used later to form a wall of a room.

Fig. 3 shows possible steps of installing the lightweight concrete wall panels 615 to form a wall. The wall panel 615 has a longitudinal hollow-core 623 as well as two horizontal hollow-tubes 607, as illustrated in Fig. 4.

The installation includes a step of equipping the wall panel 615 with a wall bracket 622 for mounting the wall panel 615 onto the ceiling 618. The wall bracket 622 is illustrated in Fig, 5. A “v” shape portion of the wall bracket 622 is later inserted into an upper end of the hollow core 623.

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An upper wooden guide 617 and a lower wooden guide 620 are afterward mounted respectively onto a ceiling 618 and a floor 621 of the room. Wet mortar 626 is later placed onto an upper edge 625 of the wall panel 615. After this, the wall panel 615 is positioned such that the wall panel 615 touches the upper and the lower guides 617 and 620. The wall panel 615 is then lifted with a lever so that the mortar 626 is squeezed out from a gap 627 that is situated between the upper edge 625 of the wall panel 615 and the ceiling 618.

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Wedges 629 are then put into a gap 632 that is situated between a lower edge 631 of the lifted wall panel 615 and the floor 621. The gap 632 is later stuffed with wet mortar 626. The wall bracket 622 is also then fixed to the ceiling 618 with a screw or a rivet. A front view of the installed wall panel 615 is illustrated in Fig. 4. Later, the mortar 626, which hardens and the wall bracket 622 keeps the wall panel 615 in place and keeps it from shifting.

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In a generic sense, the mortar 626 can be replaced with foam glue or with construction foam that may grow after applying.

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The installed wall panels 615 can then be equipped with electrical outlets, such as an electrical power socket, as well as associated connected electrical cables or wires.

An example of such equipping is shown in Figs. 6 and 7. Figs. 6 and 7 show the installed concrete wall panels 615 that are equipped with an electrical power socket and an associated electrical cable.

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The concrete wall panels 615 have a first opening 635 and a second opening 637. The openings 635 and 637 are used for installing electrical power sockets. The first opening 635 is positioned next to a portion of the hollow core 608 and is contact with the hollow core 608. The opening 637 that is situated a short distance away from the hollow core 608 and is connected to the hollow core 608 via a hollow channel 639.

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One method of the equipping the wall panels 615 comprises opening the upper lateral channel 606 by cutting away a part of the fibre-reinforced board 604 that is next to edges of the one polystyrene core 607. After this, the exposed part of the polystyrene core 607 is removed. The removal is such that a passage to a part of the hollow core 608, which lies next to the exposed lateral channel 606, is created.

The method can include a step of removing a thin layer of concrete if the lateral channel 606 is separated from the hollow core 608 by this thin layer of concrete.

Following this, the opening 635 is created on the wall panel 615 with a drill saw for installing the electrical power socket. The opening 635 provides direct access to a part of the hollow core 608. A cable 636 is then inserted in the hollow core 608 via the opening 635 to the exposed lateral channel 606, as illustrated in Figs. 6 and 7. After this, mortar or thin plaster is applied to close or cover the opening 635 and the exposed lateral channel 606.

The opening 637 is later created on the wall panel 615 for installing the electrical power socket. The channel 639 is created with a drill saw to connect the opening 637 to the hollow core 608. A cable 637 is afterward inserted in the hollow core 608 via the opening 637 and via the channel 639 to the exposed lateral channel 606. Mortar or thin plaster is then applied close the opening 637, the channel 639, and the exposed lateral channel 606.

Fig. 8 shows an embodiment of the concrete slab of Fig. 1. Fig. 8 depicts a lightweight concrete slab 640.

The concrete slab 640 has a longitudinal hollow core 642 and lateral hollow channels 646. A plurality of reinforcing wires 650 is provided within the concrete slab 640. A plurality of fibre-reinforced boards 643 is attached to an external surface of the concrete slab 640.

The hollow channels 646 are provided on a bottom surface 645 of the concrete slab 640.

Polystyrene tubes 647 are provided within the hollow channels 646. The polystyrene tubes 647 contacts the hollow channels 646. Both the hollow channels 646 and the polystyrene tubes 647 have the same profile. The wires 650 are provided next to the polystyrene tubes 647.

The wires 650 reinforce the concrete slab 640 for enabling the concrete slab 640 to bear a greater mechanic load by taking up tensile forces. The wires 650 can be pre-stressed and it is also possible to provide a metal wire mesh, such as rabbit fence, together with the wires 650 or in place of the wires 650.

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In a general sense, the concrete slab 640 can also work without the fibre-reinforced boards 643. The wires 650 can provide enough stability to resist compressing, bending, and tensioning actions for the concrete slab 640 such that the concrete slab 640 does not need the fibre-reinforced boards 643 to provide the stability.

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The concrete slab 640 is later cut into several panels, which is not shown here.

One method of producing the concrete slab 640 is described below. The fibre-reinforced board 643 has a wide first surface and a wide second surface that is opposite to the first surface. The polystyrene tubes 647 are initially attached to the first surface via glue.

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The second surface is then placed on a flat elongated steel casting bed such that the polystyrene tubes 647 are positioned above the fibre-reinforced board 643. After this, the wires 650 are placed on and above the polystyrene tubes 647. Wet concrete mixture is then deposited on the fibre-reinforced board 643 to form the concrete slab 640. The wet concrete mixture covers the polystyrene tubes 647 and the wires 650.

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In a special embodiment, the concrete slab 640 does not have the fibre-reinforced board. To produce this concrete slab, the polystyrene tubes 647 provided directly onto the steel casting bed, for example, by gluing the polystyrene tubes 647 directly onto the steel casting bed. The casting bed is then coated with a layer of oil. The wires are later placed on the polystyrene tubes 647. After this, the wet concrete mixture is deposited onto the oiled casting bed and onto the polystyrene tubes 647 to form the concrete slab 640. After drying, the layer of oil allows the concrete slab 640 to be released easily from the casting bed.

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In a generic sense, the lateral polystyrene tubes can be replaced with different types of tubes.

Fig. 9 shows a further embodiment of the concrete slab of Fig. 1. Fig. 9 shows a concrete slab 655 with a circular hollow plastic tube 658 and a rectangular hollow metal tube 660,

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which are placed within the concrete slab 655. A fibre-reinforced board 657 is attached to an external surface of the concrete slab 655.

The metal tube 660 is provided on one a bottom surface 662 of the concrete slab 655 such that one surface of the metal tube 660 is flush or flat with the bottom surface. In contrast, the plastic tube 658 is provided with in the concrete slab 655 and is placed at a small distance above the bottom surface 662. The fibre-reinforced board 657 has marking to indicate positions of the hollow plastic tube 658 and the rectangular hollow metal tube 660 for easy locating.

The rectangular hollow metal tube 660 is intended for holding a utility line, such as an electrical wire or a water pipe. The metal tube 660 can be easily drilled for providing an access to its hollow for placing the utility line.

The hollow plastic tube 658 is also intended for holding the utility line. The hollow plastic tube 658 is separated from the fibre-reinforced board 657 by a layer of concrete, which can be removed to expose the plastic tube 658. A part of the plastic tube 658 can be removed for placing the utility line.

Fig. 10 shows a set-up that is used for producing the concrete slab 655 with the plastic tube 658. Fig. 10 depicts an elongated casting bed 660 that is provided on a flat concrete floor 661. Tracks or rails 663 for an extruder and support 664 for rods 665 are placed on both longitudinal sides of the casting bed 660. The rod 665 is inserted into the tube 658, as illustrated in Figs. 10 and 11.

To produce the said concrete slab, an extruder moves using the rails 663 over the casting bed 660 to deposit wet concrete mixture onto the casting bed 660. The concrete mixture covers the plastic tubes 658. The rods 665 keep the plastic tubes 658 from moving or from bending during the said deposition of the wet concrete mixture. The concrete mixture later dries to form the concrete slab 655. After this, the rods 665 are removed from the tubes 658.

Fig. 12 shows an embodiment of producing the concrete slab of Fig. 1. Fig. 12 shows a production 710 of a lightweight concrete slab 712. The concrete slab 712 has a wet concrete mixture 735.

An elongated casting bed 715 supports a bottom surface 717 of the wet concrete mixture 735. A top surface 718 of the wet concrete mixture 735 has two parallel slots 719 and 720 that are positioned a lateral direction of the concrete slab 712. A sucking device 723 is placed above the slots 719 and 720. Two guiding plates 725 and 726 are also positioned on the top surface 718 and are placed next to the slots 719 and 720 respectively.

The slots 719 and 720 extend from the top surface 718 to an inner portion of the concrete slab 712. The slots 719 and 720 also extend from one longitudinal side to another longitudinal side of the concrete slab 712.

The concrete mixture 735, as provided here, is in a semi-dry or wet state. The guiding plates 725 and 726 are used for guiding a saw for cutting the wet concrete mixture 735 to form the slots 719 and 720. The saw is not shown in the Fig. 12. The slots 719 and 720 are used for defining sides of a lateral hollow channel, which can be used to house a utility line, such as an electrical cable or a water pipe.

The suction device 723 is intended for removing a portion 732 of the concrete mixture 735 to form the lateral hollow channel on the concrete slab 712. The portion 732 is positioned between the slots 719 and 720, as illustrated in Fig. 12. An opening 730 of the suction device 723 is intended for placing near to the slots 719 and 720 and it is used for taking the portion 732, which is positioned between the slots 719 and 720, away from the concrete mixture 735. The removal forms the hollow channel.

Moreover, the guiding plates 725 and 726 also serve to shield parts of the wet concrete mixture 735 from the suction device 723. The shielded parts are positioned next to the slots 719 and 720 and are not required to be removed for forming the hollow channel.

One method of producing the lateral hollow channel is described below. The method includes a step of depositing the wet concrete mixture 735 on the casting bed 715 by an extruding process or by a slip-forming process to form the concrete slab 712.

After this, the guiding plates 725 and 726 are positioned on the top surface 718. A user then uses the guiding plates 725 and 726 to guide a saw for cutting the wet concrete mixture 735 to form the slots 719 and 720. The suction device 723 later removes the portion 732 of the

wet concrete mixture 735, which is positioned between the slots 719 and 720, by a sucking action. The removing forms the lateral hollow channel on the concrete slab 712. During the removal, the guiding plates 725 and 726 shield parts of the wet concrete mixture 735, which does not need to be removed for forming the hollow channel.

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This implementation has the advantage of flexible formation of the lateral hollow channel. Positions of the hollow channel can be easily changed as needed. Width and depth of the hollow channel can also be easily adjusted as required.

10 In a generic sense, the hollow channel can positioned in a lateral or in a longitudinal direction of the concrete slab 712 although in other directions are also possible. A cladding can be provided on the surface of the concrete slab 712 for covering the hollow channel. The concrete slab 712 can also have a hollow core that is formed by an extruding process or by a slip-forming process. The concrete mixture 735 can include one or more lightweight materials.

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Figs. 13 and 14 show a special embodiment of Fig. 1. Figs. 13 and 14 include parts of the Fig. 1. The polystyrene tube 607 comprises two polystyrene sections 740 rather than one section.

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The two polystyrene sections 740 are placed along a straight line. Inner ends of the two polystyrene sections 740 are separated from each other by a short distance and are positioned near to the hollow core 608. The hollow core 608 is separated from exterior surfaces of the concrete slab 601 and the separation does not include the polystyrene sections 740.

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This special embodiment is used especially when the separation of the hollow core 608 from the exterior concrete slab surface so thin that the separation does not have space for the polystyrene tube 607. In certain extruding process implementations, the separation can be as thin as 5 millimetres. Placing the polystyrene tube 607 then at the separation area

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can result in the polystyrene tube 607 interrupting with a formation of the hollow core 608.

Fig. 15 shows an embodiment of a cladding for a lightweight concrete slab. Fig. 15 shows a cladding 870 that comprises a thin sheet 872 and a plurality of anchoring studs 873 that is attached to the sheet 872. The sheet 872 and the anchoring studs 873 comprise plastic,

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such as high heat stabilized polypropylene or high-density polyethylene material.

The sheet 872 is intended for attaching to a lightweight concrete slab 874 via the anchoring studs 873. The anchoring studs 873 are used for sticking into or embedding into the concrete slab 874, as illustrated in Fig. 18. The material of the sheet 872 and the anchoring studs 873 are chosen such that they are non-porous and that they can resist corrosion due to chemicals, water, or gas. The concrete slab 874 with the cladding 870 can be used to build liquid or gas tight containers.

In a generic sense, the sheet 872 and the anchoring studs 873 can be provided as separate parts that are joined together at a later step or they can be provided as one integral part, as illustrated in Fig. 16.

One concrete slab or wall can have one single cladding 870. It can also have two or more claddings 870, wherein the claddings 870 are joined together by means, such as welding, to form one cladding. One example of this is illustrated in Fig. 20.

Fig. 17 shows a tank or container 877 that is constructed using the concrete panels 874, which have the claddings 870 of Fig. 15.

The concrete panels 874 are joined to each other via mortar to form walls of the container 877. The claddings 870 are joined to each other via plastic welds 879 to form an interior wall surface of the container 877. The plastic welds 879 are also called welding seams. A reinforcement steel ring bracket 876 surrounds the concrete panels 874.

The claddings 870 act an anti-corrosive layer. The welds 879 close gaps between adjacent claddings 870. The reinforcement steel bracket 876 forces the concrete panels 874 together such that the concrete panels 874 can withstand greater internal pressure.

One method of building the container 877 includes a step of erecting the concrete panels 874 vertically to form the walls of the container 877.

The concrete panels 874 are arranged on a floor 875 such that the inside surface of the container 877 has the cladding 870 whilst the outside surface of the container 877 has a concrete surface, as illustrated in Fig. 19. The panels 874 are also connected to each other

by a tongue and groove mechanism. The tongue and groove connection is then filled with a concrete mortar. The panels 874 can be secured to the floor 875 by brackets 878.

Following this, concrete mixture 880 is poured inside the container 877 and over the floor 875 of the container 877, as illustrated in Fig. 19. A sheet of a cladding 882 that has anchoring studs 884 is afterward rolled over the wet concrete mixture. The concrete mixture 880 flows around and wraps around the anchoring studs 884. In this manner, the sheet 882 bonds with the concrete mixture 880.

Thermoplastic welding is then performed on the wall claddings 870 and the floor cladding 882 such that they can hold water. This process is similar to steel welding. Surfaces for welding are firstly cleaned such that they are free of dirt, oil, or water. A thermoplastic gun is then used to heat up the welding areas. A rod of anticorrosive material is later used to form welding seams 879 for closing any gaps between the adjacent claddings 870 and any gaps between the adjacent walling cladding 870 and the floor cladding 882.

For additional reinforcement to withstand any internal pressure of the container 877, the steel bracket 876 is wrapped around the container 877.

In a generic sense, a concrete product, such as the concrete panels 874, can replace the floor 875. The cladding 882 can then be attached to the concrete product by the concrete mixture 880. The concrete mixture 880 wraps around the studs 884 to attach the cladding 882 onto the concrete product.

Several alternatives of the cladding 870 are possible.

In one alternative, the cladding 870 includes a single-ply, mechanically anchored thermoplastic lining.

In a second alternative, the cladding 870 includes an aluminium film in its middle part.

In a further alternative, the cladding 870 includes a lining that has openings to serve as a monitoring space.

In another alternative, the cladding 870 includes a polyethylene material that is resistant to acids and lyes. The material can be electrically conductive and can be physiologically safe.

In a further alternative, the cladding 870 includes a heat-stabilised polypropylene material.

5 This material offers resistance to aqueous salt solutions, alkalis, and acids as well as long-term temperature resistance.

In another alternative, the cladding 870 includes a material that offers resistant and permeation-tight poly-vinylidene fluoride that is used for chloro-hydrocarbon loads.

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In an alternative, the cladding 870 includes impact-resistant material that possesses chemical resistance and rigidity.

These alternatives allows the cladding 870 to have properties of being non-flammable, impact-resistant, electrically conductive, UV (ultra-violet)-stabilised or being able to withstand UV, or anti-skid.

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Fig. 21 shows a cross-sectional view of a concrete slab 890. The concrete slab 890 includes a concrete mixture 891 as well as a plastic sheet 893 and a fibre-reinforced board 895.

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The plastic sheet 893 is located next to a first surface 896 of the concrete slab 890 whilst the fibre-reinforced board 895 is situated next to a second surface 898 of the concrete slab 890. The first surface 896 faces the second surface 898.

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The plastic sheet 893 has multiple studs 900 that are attached to one side of the plastic sheet 893. The multiple studs 900 extend from the plastic sheet 893 into inner parts of the concrete mixture 891. In comparison, the fibre-reinforced board 895 is separated from the second surface 898 by a thin layer of concrete 902.

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Functionally, the fibre-reinforced board 895 provides a protective layer for the concrete mixture 891. The concrete layer 902 is intended for bonding the fibre-reinforced board 895 onto the second surface 898 of the concrete mixture 891. The studs 900 are used for attaching the plastic sheet 893 onto the first surface 896 of the concrete mixture 891. The plastic

sheet 893 provides a non-porous layer for the concrete mixture 891 such that the concrete slab 890 can be used for containing different types of fluids.

One method of producing the concrete slab 890 is described below.

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The method includes a step of placing the plastic sheet 893 onto an elongated casting bed of an extruder. The plastic sheet 893 is laid on the casting bed such that the studs 900 can receive the concrete mixture 891.

10 The extruder later deposits the wet concrete mixture 891 onto the plastic sheet 893 and onto the studs 900. The concrete mixture 891 wraps or surrounds the studs 900 for bonding the studs 900 with the concrete mixture 891.

15 When the concrete mixture 891 dries and hardens, the layer 902 of wet concrete or plaster is later pasted onto the second surface 898. The fibre-reinforced board 895 is then placed onto the concrete layer 902 for bonding with the concrete mixture 891.

20 Although the above description contains much specificity, these should not be construed as limiting the scope of the embodiments but merely providing illustration of the foreseeable embodiments. Especially the above stated advantages of the embodiments should not be construed as limiting the scope of the embodiments but merely to explain possible achievements if the described embodiments are put into practice. Thus, the scope of the embodiments should be determined by the claims and their equivalents, rather than by the examples given.

PART REFERENCE NUMERALS

	600	production
	601	concrete slab
5	603	bottom surface
	604	fibre-reinforced board
	605	casting bed
	606	channel
	607	polystyrene core
10	608	hollow core
	609	groove
	610	tongue
	612	separation line
	615	wall panel
15	617	upper wooden guide
	618	ceiling
	620	lower wooden guide
	621	floor
	622	wall bracket
20	623	hollow core
	624	side edge
	625	upper edge
	626	mortar
	627	gap
25	629	wedge
	631	lower edge
	632	gap
	635	opening
	636	cable
30	637	opening
	638	cable
	639	channel
	640	concrete slab
	642	hollow core
35	643	fibre-reinforced board

	645	bottom surface
	646	hollow channel
	647	polystyrene tube
	650	reinforcing wire
5	655	concrete slab
	657	fibre-reinforced board
	658	circular hollow plastic tube
	660	rectangular hollow metal tube
	661	flat concrete floor
10	662	bottom surface
	663	rail
	664	support
	665	rod
	710	production
15	712	concrete slab
	715	casting bed
	717	bottom surface
	718	top surface
	719	slot
20	720	slot
	723	suction device
	725	guiding plate
	726	guiding plate
	730	opening
25	732	portion
	735	concrete mixture
	740	section
	870	cladding
	872	thin sheet
30	873	anchoring stud
	874	lightweight concrete panel
	875	floor
	876	reinforcement steel
	877	container
35	878	bracket

	879	weld
	880	concrete mixture
	882	cladding
	884	anchoring stud
5	890	concrete slab
	891	concrete mixture
	893	plastic sheet
	895	fibre-reinforced board
	896	first surface
10	898	second surface
	900	studs
	902	concrete layer

CLAIMS

1. A concrete product (874, 870) comprising
a concrete mixture (874) provided by one of an extruding process or of a slip
forming process and
at least one cladding (870) provided on at least one surface of the concrete
mixture (874),
wherein
the at least one cladding (870) comprises
- at least one plastic layer (872) and
- at least one stud (873) extending from the at least one plastic layer (872) to at
least one interior area of the concrete mixture (874).
2. A concrete product (874, 870) of claim 1, wherein
the at least one stud (873) comprises a shape that widens towards the concrete mix-
ture (874).
3. A concrete product (640) of claim 1 or 2, wherein
the at least one plastic layer (872) and the at least one stud (873) are provided as
one integrated part.
4. A concrete product (640) of one of above-mentioned claims, wherein
the at least one plastic layer (872) comprises at least one opening.
5. A concrete product (640) of one of above-mentioned claims further comprising
at least one reinforcement structure (650).
6. A concrete product (640) of one of above-mentioned claims, wherein
the concrete mixture (874) comprises at least one lightweight material.
7. A concrete panel (615) comprising a portion of a concrete product (601) of one of the
above-mentioned claims.
8. A method for producing a concrete product (874, 870), the method comprising

providing at least one cladding (870) on a casting bed (605), the at least one cladding (870) comprises at least one plastic layer (872) and at least one stud (873) that extends from the at least one plastic layer (872) and

depositing a concrete mixture (874) onto the at least one plastic layer (872) and onto the at least one stud (873) using one of an extruder or of a slip-former such that the concrete mixture (874) wraps around at least one stud (873) for bonding the at least one plastic layer (872) onto the concrete mixture (874).

9. A method for producing a concrete product (874, 870), the method comprising

depositing a concrete mixture (874) onto on a casting bed (605) using one of an extruder or of a slip-former,

providing a layer of concrete (880) on the concrete mixture (874), and

providing at least one cladding (870) on the layer of concrete,

wherein

- the at least one cladding (870) comprises at least one plastic layer (872) and at least one stud (873) that extends from the at least one plastic layer (872) and
- the layer of concrete (880) wraps around at least one stud (873) for bonding the at least one plastic layer (872) onto the concrete mixture (874).

10. A method of claims 8 or 9 further comprising

providing a layer of adhesive onto a surface of the concrete mixture (874) and attaching at least one further cladding onto the layer of adhesive.

11. A concrete product (601, 604) comprising

a concrete mixture (601) provided by one of an extruding process or of a slip-forming process, wherein

the concrete mixture (601) comprises at least one hollow volume area (606) that is formed by at least one filler element (607).

12. A concrete product (601, 604) of claim 11, wherein

the filler element (607) comprises a material with a density that is lighter than a density of the concrete mixture (601).

13. A concrete product (601, 604) of claim 11 or 12, wherein

the filler element comprises a hollow structure.

14. A concrete product (601, 604) of one of claims 11 to 13, wherein
the filler element (607) comprises two filler sections (740), the filler sections are ar-
ranged in a straight line and are separated from each other.

15. A concrete product (601, 604) of claim 14, wherein
a hollow volume area (608) is provided in a longitudinal direction of the concrete
product (601, 604) and in a separation area between the filler sections (740).

16. A concrete product (601, 604) of one of claims 11 to 15, wherein
the at least one hollow volume area (606) is provided inside the concrete mixture
(601).

17. A concrete product (601, 604) of one of claims 11 to 15, wherein
the at least one hollow volume area (606) is provided on at least one surface area
(603) of the concrete mixture (601).

18. A concrete product (712) comprising
a concrete mixture (735) provided by one of an extruding process or of a slip-
forming process, wherein
the concrete mixture (735) comprises at least one hollow volume area that is provid-
ed on at least one surface area (718) of the concrete mixture (735) and is formed by
a sawing device and by a suction device (723).

19. A concrete product (601, 604) of one of claims 11 to 18, wherein
the at least one hollow volume area (606) is provided in a lateral direction of the
concrete product (601, 604).

20. A concrete product (601, 604) of one of claims 11 to 19 further comprising
at least one cladding (604) being provided on at least one surface (603) of the con-
crete mixture (601).

21. A concrete product (601, 604) of claim 20, wherein

the at least one hollow volume area (606) is covered by the at least one cladding (604).

22. A concrete product (601, 604) of one of claims 11 to 21 further comprising
5 at least one further hollow volume area (608) provided by one of an extruding process or of a slip-forming process.

23. A concrete product (601, 604) of one of claims 11 to 22, wherein
10 the concrete mixture (601, 604) comprises at least one lightweight material.

24. A concrete panel (615) comprising a portion of a concrete product (601) of one of
claims 11 to 23.

25. A method for producing a concrete product (601, 604), the method comprising
15 providing at least one filler element (607) on a casting bed (605) and
depositing a concrete mixture (601) on the at least one filler element using
one of an extruder or of a slip-former such that the at least one filler element casts
the concrete mixture (601) to form at least one hollow volume area (606).

20 26. A method of claim 25 further comprising
attaching at least one cladding (604) onto the deposited concrete mixture (601).

27. A method for producing a concrete product (601, 604), the method comprising
providing at least one cladding (604) on a casting bed (605),
25 providing at least one filler element (607) on the least one cladding (604) and
depositing a concrete mixture (601) on the at least one filler element (607)
and on the at least one cladding (604) using one of an extruder or of a slip-former
such that the at least one filler element casts the concrete mixture (601) to form at
least one hollow volume area.

30 28. A method of one of claims 25 to 27 further comprising
removing a part of a filler element (607) of the hollow volume area (606) to provide
space for an utility line.

35 29. A method of claim 25 to 28 further comprising

removing a layer of concrete to access the filler element (607), wherein the filler element is separated from an outer surface of the concrete product by the concrete layer.

- 5 30. A method for producing a concrete product (712), the method comprising
 one of an extruder or of a slip-former depositing a wet concrete mixture (735)
 on a casting bed (715),
 separating a portion of the wet concrete mixture (735) to form two slots (719,
10 720) on the concrete mixture (735), and
 removing a portion (735) of the wet concrete mixture (735) that is between
 the two slots (719, 720) to form a hollow volume area on the concrete product (712).
31. A method of using a concrete product (601, 604) of one of claims 25 to 30, the
 method comprising
15 providing a utility line in a hollow volume area (606) of the concrete product
 (601, 604) and
 covering the hollow volume area (606).