

SEMI PRECAST METHOD OF CONSTRUCTION OF MULTI-STOREY BUILDINGS

This invention relates to a method of construction of multi-storey buildings using precast facade panels and precast floor panels in a manner so as to eliminate water seepage through joints and to substantially reduce time to complete construction of the multi-storey building.

The traditional method of construction of multi-storey buildings using precast concrete facade involves the erection of structural walls first. Once the structural walls are in place the floor is then laid on top. The walls require formwork to be erected around reinforcement, into which concrete can be poured. The floor requires formwork, which may consists of plywood or timber batons, to be erected and this formwork has to be supported by a system of framework. Steel reinforcements are laid on the formwork and concrete is then placed on to the formwork to cast the floor. Once the concrete has set the formwork and the supporting framework can be removed. This has to be carried out from the floor below. Table formwork can be used in place of plywood or timber batons to cast the floor above. The disadvantage with the use of table formwork is that in order for the formwork to be removed, once the floor has set the unit must have a suitable opening. Therefore the facade cannot be erected until the table formwork has been removed from the unit.

Once the cross walls and floor have been cast, precast facade units are then lifted into place and attached to the superstructure by mechanical



means at the appropriate place. This can be in the form of brackets and bolts connection or interlocking of reinforcement encased by grout or concrete. The joint between the facade unit and the superstructure is filled with grout or concrete and is sealed with rubber strips between the facade and the superstructure and finally mastic pointing is provided to provide a waterproof seal. Once the facade has been put into place only then can the internal and external finishing work commence.

The problem inherent with this method of construction is water seepage through the joint where the facade is joined to the superstructure. In addition this method requires external scaffolding to be erected around the superstructure, to enable the facade panels to be fitted and grouted and also internal framework to be erected to support formwork for the floor panels. As a result more workers are required at the construction site and completion times are longer. The necessity to erect formwork requires a large supply of plywood and timber beams and the erection of the formwork for the floor takes time.

The internal and external finishing work cannot be commenced until the facade unit has been put into place and the formwork, together with supporting framework for the floor panel, removed.

The semi-precast method of construction overcomes the problems inherent with the traditional method of construction. It is an object of the present invention to eliminate water seepage through the joint where the facade is attached to the superstructure by eliminating all external joints.

In addition the semi-precast method of construction eliminates the need for external scaffolding around the building as well as the need for formwork for floor slabs. Further the need for internal supporting framework to support the floor of the unit vertically above is minimized.

Unlike the traditional method of construction with the present method a precast facade is erected first. This is followed by the construction of the structural cross walls, which are cast into the facade so as to embed the edges of the facade and thereby support and hold the facade. Once the facade and the cross walls have been erected the precast floor slabs are placed on the top of the cross walls. The precast floor slab is then topped with concrete to form the floor of the unit above.

The present method of construction significantly reduces the time required to complete the construction compared to the traditional method of construction. In addition this method of construction requires fewer workers as the need for external scaffolding and external grouting are eliminated. The absence of external scaffolding also increases safety at the construction site. Further the need for internal supporting framework is minimized.

The semi-precast method of construction consists of several distinct steps. These steps will be now be described in detail.

Precast facade construction and design

Each semi-precast facade unit is constructed by the use of suitably designed moulds. Window frames are cast in situ in the mould i.e. they are fixed into the mould at the appropriate place and reinforcement is placed in the mould. Concrete is then poured into the mould and is finished off. Once the concrete is set the mould and the precast facade is then covered and steam cured to ensure a better quality of final product.

The width of the facade is wider than the internal width of the unit it covers and the sides of the facade are then embedded into the cross walls during construction.

The height of the facade is such that it may be of the same height as the opening it covers, or it may have an overhang on the outer face of the facade, which overhangs and may partly or wholly cover the outer face of the concrete floor of the unit, covered by the facade.

Vertically disposed brackets, which may be made of steel, are cast into either side of the facade at the top edge and project above the height of the facade and horizontally disposed steel brackets are cast into either side of the facade at the bottom edge. The disposition of these brackets is such that the vertically disposed brackets at the top of the facade unit interconnect with the horizontally disposed brackets at the bottom edge of the facade unit which is located directly above i.e. vertically adjacent. These interconnected brackets are mechanically locked together. These brackets also provide support to the facade during the installation process and they are cast into the structural cross walls.

The facade itself may be of the same height as the opening that it covers, or the facade may have an overhang on the bottom of the outer face, so that it overhangs the size of the opening that it covers.

Precast floor slabs

Each precast floor slab unit is constructed by the use of suitably designed moulds. Steel reinforcement is laid along the mould and concrete is then poured on to the mould to cover the reinforcement. The concrete is then compacted by vibration. The floor-panel is then lifted together with the mould and transferred to a steam curing chamber where it is cured. Once the floor slab panels have been steam cured they are removed from the curing chamber and stacked on site until required for use.

Construction

As stated previously in the traditional method of construction the structural walls are erected primarily and the floor unit is laid on top of this. With the semi-precast method of construction the precast facade unit is erected first, before the structural cross walls are constructed.

The facade is initially lifted into place. The facade is supported temporarily during the installation by the brackets built into the facade and this allows the facade to be placed into position.



During the installation process the vertically disposed brackets, located at the top of the facade on either side, from the facade unit below, interconnect with the horizontally disposed brackets, located at the bottom of the facade on either side, from the facade unit above, and are mechanically locked together.

Once the facade has been installed into place the structural cross walls are cast. Steel reinforcement is erected for the cross walls and this is interlinked with the reinforcement from the facade. The reinforcement is then encased in formwork and concrete is then poured into the formwork to cast the cross walls. The width of the facade is greater than the width between the cross walls and as a result the structural cross walls are cast into the facade i.e. the projecting edges of the facade are embedded in the concrete of the cross walls. This creates a concrete to concrete construction joint which is water tight. There are thus no joints between the supporting cross walls and the facade. Water seepage is thus eliminated.

The brackets in the facade units are cast into the cross wall and the facade is itself supported and held in place by the cross walls. The height of the cross walls is the same as the height of the facade and as a result the vertically disposed brackets at the top edges of the facade project out vertically from the cross wall. The horizontally disposed brackets, at the bottom edges of the facade, from the facade unit above, interlock with the vertically disposed brackets projecting vertically from the facade unit below. The interlocked brackets are locked mechanically and the locked brackets are fully embedded in the cross walls.

Once the facade has been cast into the cross walls, supporting frames are inserted between the cross walls. A precast floor panel is then lowered on to the supporting frames. The size of the floor slab is such that it overlaps the structural cross walls and rests thereon. Slab reinforcement is then laid on top of the precast floor slab unit and concrete is poured around the reinforcement. The concrete is then compacted by vibration and the surface is smoothed. This then forms the basis for the floor of the unit above. The precast floor slabs eliminate the need for formwork to be erected inside the structure to support the floor above and minimizes the need for internal supporting framework. The precast floor slab acts as the formwork on which the floor for the unit above is cast by supporting the slab reinforcement and the concrete for the floor above.

In this manner no table formwork or internal supporting framework is required in order to lay the floor. As a result internal works in the unit can commence after the precast floor slab has been laid.

In order that the semi-precast method of construction may be more fully understood it will now be described by reference to the drawings.

Fig 1. Is a perspective view of the precast facade unit with vertically and horizontally disposed steel brackets on either side of the facade.

Fig 2. Is a perspective view of a completed unit illustrating the cross walls, precast floor slab and the facade.

Fig 3. Is a perspective view of two vertically adjacent units illustrating the cross walls, precast floor slabs and the facade units.

Fig 4. Is a plan view of the facade unit cast into the cross walls.

Fig 4A. Is a detailed view of the interlinking of the reinforcement of the facade and the cross walls.

Fig 5. Is a cross section of the floor slabs cast into the cross walls.

Fig 6. Is a detailed cross-sectional view of the joint between the precast floor slab and the facade unit of two vertically adjacent units.

The vertically (4) and horizontally (5) disposed brackets on either side of the top and bottom of the facade unit (1) are illustrated in Fig. 1 as is the overhang (13) on the outer face of the facade. From this illustration the window frames cast into the facade is also clearly seen.

The overall arrangement of two completed vertically adjacent units can be seen in Fig. 3 which clearly shows the relationship between the precast facade (1), cross walls (2), precast floor slabs (3), the vertically disposed brackets (4) located at the top edge of the facade and the horizontally disposed brackets (5) located at the bottom edge of the facade. Fig. 3 further shows the interconnection of the vertically disposed bracket from the facade unit below with the horizontally disposed bracket of the facade unit above (6) and further shows the disposition of the vertically disposed

bracket once it has been embedded in the cross wall (4A).

The disposition of the precast floor slab in relation to the cross walls and the facade can be seen in Figs. 2 and 3. Fig. 5 shows a cross section across the face of a unit showing the relationship of the precast floor slabs cast into the cross walls. Fig 6 shows cross section detail of the joint between the facade unit, the precast slab and the concrete floor laid on the precast slab. It can be seen from Figs. 2 and 3 that the precast floor slabs rest on, and are supported by, the cross walls of the unit.

The joint between the cross walls and the facade can be seen in Fig. 4. It can be seen that the edges of the facade are embedded into the cross walls. Fig. 4A shows the interlinking of the reinforcement of the facade (11) and the reinforcement of the cross wall (12) surrounded by the concrete of the facade (1) and the concrete of the cross wall (2).

During installation a facade unit (1) is lowered, by suitable lifting means, onto the concrete floor of the unit under construction. The facade is held in place by the vertical (4) and horizontal (5) brackets and is adjusted to a vertical position. The horizontally disposed metal brackets (5), situated at bottom edges of the facade, interconnect with the vertically disposed brackets (4) at the top edges of the facade, from the facade unit below. The interconnected brackets are then locked mechanically.

With the facade in place, steel reinforcement is then erected to form the cross walls. The reinforcement of the cross walls (12) is interlinked with

the reinforcement of the facade unit (11) and the cross wall is then cast, using suitable formwork, so as to embed the edges of the facade (12) and fully embed the interlocked brackets (6) of the vertically adjacent facade units. This creates a concrete construction joint between the cross walls and the facade which is watertight. There is therefore no external joint between the facade and the cross walls. The cross walls support and hold the facade units in place.

The height of the cross walls are level with the height of the facade and as a result the vertically disposed brackets (4) of the facade project out of the cross walls (4A) and can receive the horizontal brackets of the facade unit to be placed vertically adjacent.

A precast floor slab (3) is then lowered on to the top of the cross walls. The precast floor slab is supported by the cross walls. The precast floor slab acts as the formwork on which the floor of the unit vertically adjacent (9) can be cast. Reinforcement is then laid on the precast slab and concrete poured onto the reinforcement to cast the floor of the unit above.



CLAIMS

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1. A method of construction of multi-storey buildings using precast facade panels and precast floor slabs wherein external joints between the precast facade and the superstructure of the building are eliminated and wherein the use of external scaffolding and formwork for floor slabs is eliminated and the need for supporting framework inside the unit to support the floor of the unit above is minimized.
2. A method of construction as claimed above wherein the edges of the precast facade are cast into and embedded in the structural cross walls of each unit in the building thereby creating a concrete construction joint between the facade and the cross walls which is watertight.
3. A method of construction as claimed above wherein the facade is installed on the superstructure first before the structural cross walls are cast and wherein the reinforcement of the cross walls is interlinked with the reinforcement of the facade prior to the cross walls being cast.
4. A method of construction wherein the facade is disposed with brackets cast into either side of the facade at the top and bottom edges and wherein the brackets at the top of the facade are disposed vertically in relation to the side of the facade and which project above the height of the facade and wherein the brackets at the





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bottom of the facade are disposed horizontally in relation to the side of the facade and wherein the said vertical and horizontal brackets are provided with means to lock together.

5. A method of construction as claimed above wherein the vertically disposed brackets of the facade unit interconnect during installation with the horizontally disposed brackets of the facade unit vertically above and wherein the said interconnected vertical and horizontal brackets are mechanically locked together.
6. A method of construction wherein the interlocked brackets at the bottom edge of the facade are fully embedded in the structural cross walls and wherein the vertically disposed brackets at the top edge of the facade is partly embedded in the cross walls and partly projects vertically out of the cross walls so as to interconnect with the horizontally disposed brackets of the facade unit vertically above and wherein the cross walls hold and support the facade unit in place.
7. A method of construction as claimed above wherein the facade may have an overhang on the outer face of the facade which projects below the base of the facade and which overhangs and partly or wholly covers the outer face of the concrete floor of the unit, covered by the facade.
8. A method of construction as claimed above wherein a precast floor slab is laid on top of the cross walls of the unit such that it rests on



top of and is supported by the cross walls and wherein the precast floor slab is made of reinforced concrete and wherein the precast floor slab acts as the formwork for the floor of the unit above thereby minimizing the need for supporting framework within the unit.

9. A method of construction as claimed above wherein reinforcement is laid on top of the precast floor slab and the floor of the unit above is cast on the precast floor slab.

