

New Building Systems for Modular Construction of High-Rise Residential Buildings

Using Prefabricate Prefinished Volumetric Units

“Residential” – Buildings intended for permanent occupation by people, such as high-rise houses, senior citizen housing, student housing, and rental housing.

A. Properties of the building system submitted for evaluation:

Building systems designed for modular construction using prefabricated 3D units share several similar characteristics but differ in their specific details according to their materials, structural system, and façade system. In order to identify the building system submitted for evaluation, its characteristics should be listed by choosing the applicable options from the following list.

Maximum number of floors in buildings constructed using this building system:

Constraints that apply to said structures or buildings must be defined, in terms of their designation, size, number of floors, predicted foundation conditions, and possible site conditions, as well as in terms of ensuring the resistance of the structures or buildings to wind loads, seismic loads and/or any other applicable load.

The building material of the modular units’ structure is:

- Concrete;
- Steel;
- Wood;
- Other, specify

The units are intended to be:

- Stacked with no additional cast-in-place structural core aside from the podium;
- Stacked on a cast-in-place podium and attached to a cast in-place concrete structural core;
- Inserted into and attached to a main structural skeleton executed on site, whereby the structural skeleton of the units is load bearing and constitutes part of the building’s overall structural skeleton;
- Inserted into and attached to a main structural skeleton executed on site, whereby the units do not bear loads other than those acting directly on them, and do not constitute part of the building’s overall structural skeleton.
- Other. Specify

The structure of the units and force transfer are based on:

- Forces are imposed/transferred by discrete supports;
- The unit walls function as load bearing walls and forces are imposed/transferred by full leaning support and attachments along the entire length of the wall;

The apartment security spaces, according to the building system submitted for evaluation, are:

- Prefabricated in compliance with Home Front Command requirements and are delivered to the site as separate 3D units;
- Prefabricated in compliance with Home Front Command requirements and constitute part of the structure of a larger unit;
- Cast on site as a separate core using conventional construction methods;
- Built on site as part of the cast-in-place central core (using conventional construction methods);
- Other. Specify

The structural system of the entire building constructed using this building system is based on:

- A set of units stacked upon a cast podium, **without a cast-in-place central core**. Both vertical and horizontal loads are transferred only by the units' structural skeleton and their inter-connections; (Such systems are denoted also as: Stand alone).
- A set of units stacked upon a cast podium, **without a cast-in-place central core**. The vertical loads are transferred only by the units' structural skeleton and their inter-connections. The horizontal loads are transferred by the units' structural skeleton, their inter-connections, and an additional stiffening system that is executed on site;
- A set of units stacked upon a cast podium, with a cast-in-place central core. The vertical loads within the area of the units are transferred only by the units' structural skeleton and their inter-connections. The horizontal loads are transferred by the units' structural skeleton and their inter-connections, to the structure of the core;
- The set of units is stacked upon a podium and is attached to a stiffening structure that is attached to the central core. The vertical and horizontal loads within the area of the units are transferred by the units' structural skeleton, their inter-connections, and the stiffening structure;
- The set of units is inserted into a stiffening structure within the area of the complete building, which is attached to a cast-in-place central core. The units are attached to the stiffening structure and participate in the transfer of loads;
- The set of units is inserted into a stiffening structure within the area of the complete building, which is attached to a cast-in-place central core. The units are connected to the stiffening structure to prevent shifting and extraction but they do not take part in the transfer of loads;
- Other. Specify

B. Description of the prefabrication process and on-site execution of a typical building using the building system submitted for evaluation:

Building systems intended for modular construction include 3D units that are prefabricated and prefinished, and are delivered to the site for assembly and finishing only. The on-site works are few and usually include the interconnecting of units, attaching units to elements executed on site, interfacing works at passage openings between units or between units and spaces executed on site (e.g. floor lobbies, apartment security spaces, etc.), finishing of various kinds of seals, finishing of fire and smoke barriers, finishing of thermal insulation, interfacing systems in different units, interfacing systems installed in units to common systems, etc. Some systems of this kind are delivered to the site with finished façades, and others come with façades whose cladding systems are partially or fully completed on site.

Basic List of Technical Documents Required for the Evaluation of a Given Method

A full and detailed verbal technical description of the typical prefabricated and prefinished units as well as of the on-site works, including reference to drawings that clarify the details described in the specifications, as specified below:

1. Detailed description of the typical prefabricated units

When the system includes several different types of units, each type will be described separately. The description will include the structure of the unit and all its elements (including reference to typical vertical and horizontal cross sections), and will specify, in full, all of the materials used in the elements, the standards with which the materials comply, and if needed, treatments given to ensure that compliance, etc.

The description will address in detail the structure of the unit's skeleton, including all components designed to receive vertical and horizontal forces and transfer them to the supports, as well as the additional non loadbearing elements (floor, ceiling, unit's perimeter walls, partitions within the unit, passage openings to other units or to other spaces built on site, openings for windows in external walls, etc.) including all of their components, systems that pass through the unit, and all additional details executed at the factory such as fire protection, thermal and acoustic insulation, seal details, flooring, finishing details, etc.

2. Drawings for typical prefabricated units

When the system includes several different types of units, a separate set of drawings must be submitted for each type.

Every drawing will be drawn to a scale that is appropriate for the thickness of the different materials, so as to enable to distinguish between the skeleton materials, building materials, sealing materials, insulation, connections, etc.

2.1 Detailed drawings of the structure (skeleton) of the unit, including all interior connections. Preparations for on-site connections to other parts of the skeleton will be specified as well.

2.2 Typical horizontal cross sections through the unit walls, including:

2.2.1 Cross sections of the unit's corners presenting full typical cross sections of the two walls that meet at the corner as well as the corner detail. Corner details will be presented for every typical corner (exterior-exterior, exterior-interior, interior-interior).

2.2.2 Cross section through an exterior wall at the opening of an exit door to a balcony;

2.2.3 Cross section through an exterior wall at a window opening;

2.2.4 Cross section through an interior partition and its connection to the unit wall.

2.3 Typical vertical cross sections through the unit walls, including:

2.3.1 Typical cross section through an exterior wall and through an interior wall at joints with the unit's ceiling and floor, showing the typical cross section of the elements at the joint (wall, ceiling, and floor) as well as corner details. Corner details will be presented for every typical joint (exterior wall-ceiling, exterior wall-floor, interior wall-ceiling, interior wall-floor);

2.3.2 Cross section through an exterior wall at a lintel and threshold of an exit door to a balcony;

2.3.3 Cross section through an exterior wall at a window lintel (including shutter box if exists);

2.3.4 Cross section through an interior partition and its connection to the unit's floor and ceiling.

2.4 As applicable (when the installation of the systems is not conventional and constitutes a new component in the building system), drawings that specify the installation method of the electrical, communications, water, wastewater, and sewage piping, and of sanitary fixtures.

3. Detailed description of the transport/delivery process of the units from factory to site:

This section will detail the protection of the units against excessive deformations, mechanical damage, and water penetration from the time they leave the factory until they are installed in the building.

Every binding detail pertaining to the course of transport and transfer from place to place will be specified, including the method of connecting the means of transport, lifting, etc.

4. Detailed description of the assembly process and the other on-site works:

The on-site assembly process will be described in full detail, including the operations carried out on site, which will be described in chronological order. First it is necessary to specify the preliminary works required within the part constructed on site using conventional methods, that are required in preparation for the receipt of the modular units. All details and components required as part of these preparations will be listed, such as anchoring and preparing connection accessories, nature of the support/stiffening

structure when using inserted units, etc. (Details of conventional works that are not a consequence of the modular construction need not be included). Then, works that are executed and details that require overseeing during the connection of the lifting means, during the lifting itself, when positioning, when lowering into place and assembling on the podium, and when assembling upon previous unit, etc. will be specified. Details of attaching to podium, to cast-in-place structural parts (central core, etc.), to support/stiffening system (when using inserted units), to previous unit, etc. will also be specified.

When describing the order of operations, the chronological order will include all details of on-site finishing works executed on fire barriers, various seals, connection of systems, finishing works in passages (around the entire perimeter of openings: between units, between units and the central core space, between units and apartment security spaces in other units or in the core, etc.), and finishing works on the building's envelope. If the method includes a façade that is executed on site, all operations needed in order to assemble the façade will be specified, including all its components, finishing around window openings, and fire barriers executed around windows and at ceiling level.

4.1 The description will be accompanied by the following drawings:

- 4.1.1 In units with discrete supports: details of assembly and connection of the various types of discrete support (between unit and podium, and between two units);
- 4.1.2 In units with load bearing walls: details of propping and connections using a continuous support (between unit and podium, and between two units);
- 4.1.3 When units are attached to an external stiffening system: details of connecting the unit and the stiffening system;
- 4.1.4. When units are attached to a cast-in-place core: details of connectin the unit and the core;
- 4.1.5 Details of the interface between the unit's service systems and the common service system and/or a service system in another unit;
- 4.1.6 Vertical cross section through an exterior wall of a unit at the joint with the podium, showing the joint between the unit and podium, including protection against thermal bridging, water penetration, etc. (The cross section will show the podium in a schematic manner, and present a typical detail of the unit at the corner joint between the exterior wall and the floor, as well as all of the additional materials applied on site.
- 4.1.7 Vertical cross section through the exterior walls of two units, positioned one above the other, showing the joint between the units, including protection against thermal bridging, water penetration, etc. (The cross section will show, for the bottom unit, a typical detail at the corner joint between an exterior wall and the ceiling and, for the unit above, a typical detail at the corner joint between an exterior wall and the floor, as well as all of the additional materials applied on site). When building with an exterior façade executed on site, the cross section will also show the details of the finishing works required around the window and the fire barriers around the window and at ceiling level;
- 4.1.8 Vertical cross section through the building's roof including at joints between the units' interior and exterior walls, as well as at the joint between the unit and cast-in-

place parts (such as a shaft or central core), showing the protection against thermal bridging, water penetration, etc. (The cross section will present a typical detail at the corner joint between an exterior wall and the ceiling, and between an interior wall and the ceiling, as well as all of the additional materials applied on site.);

- 4.1.9 If the units are intended for staggered assembly in which part of the unit's ceiling is exposed to the exterior and constitutes a roof or balcony (i.e., the upper unit is recessed in relation to the façade of the unit beneath it): Vertical cross section through the step formed by the two units, showing the joint between them, including the protection against thermal bridging, water penetration, etc. (The cross section will show, for the bottom unit, a typical detail of the unit's ceiling, part of which is an interior ceiling and part of which is a roof, and for the upper unit, it will show a typical detail of the joint between the exterior wall and the unit's floor, as well as all of the additional materials applied on site.);
- 4.1.10 If the units are intended for staggered assembly in which the façade of the upper unit overhangs the façade of the unit beneath it: Vertical cross section through the step formed by the two units, showing the joint between them, including the protection against thermal bridging, water penetration, etc. (The cross section will show, for the bottom unit, a typical detail of the corner joint between an exterior wall and the unit's ceiling, and for the upper unit, it will show a typical detail of the unit's floor, part of which is an interior floor and part of which is a floor above an exterior space, as well as all of the additional materials applied on site.);
- 4.1.11 Vertical cross section in the passage opening between two units, showing the joint between the units, including the protection against the spread of fire and smoke, water penetration, travel of noise, etc. through the spaces around the opening. (The cross section will show, for each of the units, a typical detail between the interior wall and the unit's ceiling, the joint between the lintels in the two units, the joint between the floors of the units, as well as all of the additional materials applied on site.);
- 4.1.12 Vertical cross section in the passage opening between a unit and a space in a cast-in-place part of the building (central core, apartment security space, etc), showing the above-mentioned joint including protection against the spread of fire and smoke, water penetration, travel of noise, etc. through the spaces around the opening. (The cross section will present a schematic detail of the cast-in-place part and, for the unit, typical details of the joint between the interior wall and the unit's ceiling, the unit's lintels and the cast-in-place part, the joint between the unit's floor and the floor of the cast-in-place part, as well as all of the additional materials applied on site.);
- 4.1.13 Horizontal cross section through exterior walls of two adjacently assembled units whose façades are on the same plane, showing the joint between the two units, including protection against thermal bridging, water penetration, etc. (The cross section will show, for each unit, a typical detail at the corner joint between an exterior wall and an interior wall, as well as all of the additional materials applied on site). When the exterior façade is executed on site, the cross section will also show the details of the required finishing works and fire barriers around the window;
- 4.1.14 Horizontal cross section through exterior walls of two adjacently assembled units with staggered façades (such that the façades of the two units are not on the same plane), showing the joint between the two units, including protection against thermal bridging, water penetration, etc. (The cross section will show, for one unit, a typical

detail at the corner joint between an exterior wall and an interior wall, and for the second unit, a typical section of a wall that is partly interior and partly exterior, as well as all of the additional materials applied on site.);

- 4.1.15 Horizontal cross section at the passage opening between two units, showing the joint between the two units, including protection against the spread of fire and smoke, travel of noise, etc. through the spaces around the opening. (The cross section will show, for each of the two units, a typical detail of the interior wall, the joint between the vertical lintels in both units, as well as all of the additional materials applied on site.);
- 4.1.16 Horizontal cross section at the passage opening between a unit and a space in a cast-in-place part of the building (central core, apartment security space, etc.), showing the joint including protection against the spread of fire and smoke, travel of noise, etc. through the spaces around the opening. (The cross section will show, for each of the units, a typical detail of the interior wall, the joint between the vertical lintels of both units, as well as all of the additional materials applied on site.);
- 4.1.17 Vertical cross section at the passage opening between a unit and a space in a cast-in-place part of the building (central core, apartment security space, etc.), showing the joint, including protection against the spread of fire, water penetration, etc. through the spaces around the opening. (The cross section will present a schematic detail of the cast-in-place part and, for the unit, it will show a typical detail of the interior wall, the joint between the vertical lintels of the unit and the cast-in-place part, as well as all of the additional materials applied on site).

5. Additional required documents:

- 5.1 Static schemes for a **typical unit** showing lifting and transport states, intermediate states, and the final state in the completed structure;
- 5.2 Characteristic static scheme of a complete structure built using the evaluated building system describing the method of transferring forces to the central core and/or to the foundation system, upon action of vertical and horizontal loads, including reference to schemes pertaining to intermediate stages of assembly;
- 5.3 Sample calculation for a representative building, with the maximal number of floors, under the action of the most severe instances of all vertical and horizontal loads, such as seismic loads, wind loads, etc., that are expected to act on such a building according to the applicable Israeli standards.

- 5.4 Details on the quality assurance and quality control at both the factory and on site, including a list of the kinds of tests performed during unit fabrication, upon receiving units on site, during assembly and execution of works on site, and required repair works. Attention will be given to execution tolerances aimed at ensuring erection accuracy in general, and specifically, accuracy of the stacking and assembly of the units, accuracy of façade planarity (with an emphasis on this issue when no additional exterior façades are executed on site), and insertion accuracy of units inserted into a support/stiffening structure (the impact of the deformations must be taken into account in determining the tolerances).
- 5.5 All test reports and/or test certificates regarding tests performed by authorized laboratories in Israel or abroad, pertaining to the proposed system and/or its components.
- 5.6 For system that are imported from outside of Israel: Copies of applicable standards pertaining to said building system.
- 5.7 All drawings mentioned in all of the above sections will be drawn to a respective scale that is appropriate for the full description of the details of the connections, sealing, finishing, cladding, insulation, etc. Each material and component will be clearly identifiable. All of the above documents will be prepared in Hebrew or English only. It is hereby emphasized that the technical material submitted to the Unit may not include any commercial or publicity-oriented material pertaining to the proposed building system, and will consist only of relevant technical material, based on the above basic list.

Miscellaneous:

Submission of the materials and the evaluation are, by nature, an interactive process. The Unit will, therefore, provide the applicant with its initial feedback within approximately 4 weeks of the submission of the material in full. Subsequent feedback will be provided within approximately two weeks from the receipt of any new material.