

Interconnectors and Interconnection Systems

Field of description

5 The present description relates to
interconnection systems for connecting
individual building modules to one another
within a building structure, and to
interconnectors for use in the interconnection
10 systems .

In one form the present description relates to
building structures formed from multiple
interconnected individual building modules which
15 are interconnected together by one or other or
more forms of interconnectors to form an array
or assembly of modules, including an array or
assembly of modules for forming a building
structure.

20 In one form the present description relates to
methods of interconnecting two or more
individual building modules to form an array or
assembly of such modules using one or other form
25 or forms of the interconnectors for
interconnecting the individual building modules
to one another to form the building structure.

In one form the present description relates to methods of constructing building structures from multiple individual building modules using one
5 or other forms of the interconnectors to interconnect individual building modules to one another to form the building structure.

In one form the present description relates to
10 individual building modules for use in lightweight prefabricated pre-finished volumetric constructions, and to methods of constructing building structures from the individual building modules to form the light
15 weight prefabricated prefinished volumetric constructions using interconnectors for interconnecting such individual building modules together in which the methods include a sequence or sequences of steps including positioning one
20 building module with respect to another building module and interconnecting the modules together using the interconnectors.

In one form the present description relates to
25 interconnectors for use in interconnecting one building module to another building module in which the interconnectors extend between one or

more adjacent modules.

In one form the present description relates to individual building modules having support
5 members, including pairs of support members, which form part of the interconnection system by the interconnectors cooperatively interacting with pairs of support members, including columns, beams, or the like of individual
10 building modules.

Although the present description is directed to specific embodiments of components of a building structure including individual building modules
15 and their components and constituent parts, forms of connectors, interconnectors, fittings, fixtures and accessories therefore, and to methods of using such components generally to construct building structures from the
20 individual modules, it is to be noted that the scope of protection is not restricted to the described embodiments only, but rather the scope of protection is more extensive so as to include other forms, variations and modifications of the
25 building modules, their components and constituent parts, the connector, the interconnector and the building structures, and

to methods of installing building modules using sequences of steps or stages and auxiliary components, parts and accessories to form the building structure from the individual building modules other than specifically described herein.

Background

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One problem or shortcoming of using individual building modules in constructing building structures in the form of prefabricated prefinished volumetric constructions (PPVC), particularly multi-story or multi-level PPVC structures, and more particularly high-rise building structures, relates to the manner of interconnection of the modules not only to other adjacent modules but also to parts of the building, such as for example, structural parts of the building typically made from reinforced concrete, including the core structure of the building structure from which the strength and rigidity of the building structure is principally derived. In PPVC building constructions, particularly lightweight PPVC building constructions of the type using light

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weight infill panels for the walls of the individual modules, it is desirable that a building module when connected to other adjacent building modules be restrained or prevented from movement, including both lateral movement horizontally from side to side relative to adjacent modules at the same level in various directions, and vertical movement between upper and lower building modules, relative to adjacent contiguous upper and/or lower modules, when the building modules are located in stacked aligned relationship one upon the other at different levels to form the building structure. Accordingly, there is a need for a connection system which prevents, inhibits or restrains relative movement of one building module with respect to one or more or all of the adjacent building modules, including building modules located in side by side relationship to the one building module or building modules located at different vertical levels, such as for example, building modules located above and below the one building module when the building modules are arranged in stacked relationship to each other to form the building structure in accordance with the overall design required of the building structure.

A shortcoming of existing interconnection systems for interconnecting individual building modules in PPVC constructions relates to
5 unwanted movement of individual building modules with respect to one another, owing to the lack of control of transmission of forces and loadings through the interconnections of individual modules forming the building
10 structure sufficient to prevent the unwanted movement of one module with respect to an adjacent module to maintain the strength and rigidity of the building structure.

15 In many cases the PPVC building requires a core structure of reinforced concrete centrally located within the building to form an anchoring structure of the building to provide the necessary strength and rigidity of the building
20 structure. Owing to all of the individual modules being either directly or indirectly connected to the reinforced concrete core, there is little or no unwanted movement of one module with respect to an adjacent module since all of
25 the forces and loadings are transmitted to the reinforced concrete core irrespective of the placement of the individual module. However the

need for a reinforced concrete core adds to the cost of the building structure, and to the time taken to construct the building structure.

5 Additionally, the need for a reinforced concrete core restricts the flexibility of the aesthetically design of the building structure since the location and type of reinforced concrete core dictates to some extent the
10 overall design of the building structure. Therefore, if the core of the building structure did not need to be present within the building structure to provide inherent strength and rigidity to prevent unwanted movement of the
15 building modules, there would be greater flexibility and options when designing the building aesthetically, as well as there being a reduction in the cost of construction of the building and the time needed to construct the
20 building, such as for example, the delay caused by allowing the reinforced concrete core to cure to achieve the necessary strength to complete construction of the building structure. However, doing away with the central reinforced
25 core of the building structure is not always possible using currently available interconnection systems due to the need to

prevent unwanted relative movement of the building modules with respect to each another, and to retain adequate inherent rigidity and strength of the joint between the individual building modules, so that forces and loadings are adequately transmitted to and by the individual modules through the interconnection system and through the interconnectors used in the joints to interconnect the adjacent individual building modules to one another.

Surprisingly, it has been discovered that using a new type of joint between individual building modules provides the force and loading transmission through the joint necessary to maintain the strength and rigidity of the building structure, thereby obviating the requirement for the building structure to have a reinforced concrete core or similar.

Accordingly, it is an aim of embodiments of the connector, interconnector and/or interconnection system of the present description to provide a secure interconnection between adjacent building modules to enhance the inherent strength and rigidity of the building structure.

Accordingly, it is an aim of embodiments described in the present description to provide secure interconnection of neighbouring modules using interconnectors having one, two, three, four or more individual connectors or pairs of connectors for securely locating and maintaining multiple building modules with respect to each other.

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Accordingly, it is an aim of embodiments of the present description to provide a method of interconnecting two or more individual building modules to one another using interconnectors having separate connectors or pairs of connectors for engaging with one or more of the neighbouring building modules.

Accordingly, it is an aim of embodiments of the present description to provide methods of constructing a building structure from individual building modules using improved joints and connectors between the individual modules.

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Accordingly, it is an aim of embodiments of the present description to provide methods of

constructing a building structure from individual building modules using predetermined sequence or sequences of steps or stages of installing individual building modules within
5 the building structure to maintain the integrity of the joint and hence the strength and rigidity of the building structure.

Accordingly, it is an aim of embodiments of the
10 present description to provide enhanced strength interconnectors having connectors of one or more combination or combinations of mechanical components and chemical components to provide enhanced secure interconnection of individual
15 building modules to one another in a manner to prevent, inhibit, or reduce unwanted relative movement of one building module with respect to an adjacent or contiguous building module.

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Summary

According to one form of the present invention there is provided an interconnector for
25 interconnecting at least a first building module having a first receiver and a second building module having a second receiver to form an array

or assembly or part an array or assembly of building modules,

the interconnector comprising

5 a first connector in the form of a first projection for being received in the first receiver, and

a second connector in the form of a second projection for being received in the second receiver,

10 the first connector and the second connector being arranged with respect to each other so that when the first connector is received within the first receiver and the second connector is received within the second receiver, the first
15 module and the second module are interconnected to one another in alignment with one another wherein the interconnector further comprises a chamber for containing a flowable material therein,

20 the chamber having an inlet for admitting the flowable material to the interconnector and an outlet for discharging the flowable material from the interconnector,

25 the flowable material when cured for enhancing the strength of the joint between the individual building modules to assist in transferring forces and/or loading between the

individual building modules in the building structure.

According to one form of the present invention
5 there is provided an interconnector for
interconnecting at least a first building
module, a second building module and a third
building module to form a building structure
including an array or assembly or part of an
10 array or assembly of building modules,

the interconnector comprising a first
connector in the form of a first projection, a
second connector in the form of a second
projection and a third connector in the form of
15 a third projection,

the first projection for being received
within a first receiver provided on the first
module, the second projection for being received
within a second receiver provided on the second
20 module, and the third projection for being
received within a third receiver provided on the
third module,

the first projection being in collinear
alignment with the second projection,

25 the third projection having a first part and
a second part,

the first part of the third projection being

connected to either the first projection or the second projection,

the second part of the third projection being spaced apart from the first projection or
5 the second projection,

wherein when the first module is in aligned relationship with the second module with the first projection being received within the first receiver and the second projection being
10 received within the second receiver to securely interconnect the first and second modules in aligned relationship with each other,

the third projection is received within the third receiver to securely connect the third
15 module to the first and second modules in contiguous relationship to the first and second modules to form the building structure

and wherein the first receiver and the second receiver form a chamber for containing a
20 flowable material therein which flowable material when cured enhances the strength of joint between the individual building modules to assist in transferring forces and/or loading between the individual building modules in the
25 building structure.

According to one form of the present invention

there is provided an interconnection system for interconnecting multiple individual building modules to form an array or assembly or part of an array or assembly of a building structure,

5 the interconnection system including at least one interconnector for interconnecting the building modules,

 each individual module having at least one hollow tube and at least one interconnector
10 having two or more stems for engaging respective one ends of hollow tubes of adjacent modules, so that when the individual modules are in alignment with each other the stems are received within the respective hollow tubes facilitating
15 secure interconnection of the adjacent individual modules to one another to restrain respective movement of one module with respect to the other module.

20 According to one form of the present invention there is provided an interconnector for interconnecting two individual building modules to one another to form an assembly of a building structure, the interconnector comprising

25 a lower end for being received in an upper open end of a hollow support member of a lower module,

a second end being an upper end for being received in the lower open end of a hollow support member of an upper module to interconnect the upper module and lower module
5 when the upper module and the lower module are in stacked aligned relationship one on top of the other to form the assembly of the module.

According to one form of the present invention
10 there is provided an interconnector for interconnecting individual modules to one another to form an assembly of modules of a building structure, the interconnector comprising

15 a first connector and a second connector
the first connector including a lower end for being received in a receiver of a first lower module and an upper end for being received in a receiver of a first upper module,

20 the lower end and upper end of the first connector being collinear to interconnect the upper module and lower module to one another when the first upper module and first lower module are in aligned stacked relationship one upon the
25 other,

the second connector including a lower end for being received in a receiver of a second

lower module and an upper end for being received in a receiver of a second upper module and a central bridging section located intermediate the lower end and the upper end,

5 the central bridging section extending intermediate the first connector and second connector,

 wherein when the second upper module and second lower module are in aligned stacked
10 relationship one above the other the second connector extends between the second upper module and second lower module to interconnect the first upper module, the second upper module, the first lower module and the second lower
15 module together.

According to one form of the present invention there is provided an interconnector for interconnecting a first module and a second
20 module in side by side relationship to one another,

 the interconnector comprising a first part for being received within a receiver of the first module, a second part for being received within
25 a receiver of the second module and a third part being a bridging section extending between the first part and the second part to retain the

second part in spaced apart relationship to the first part wherein when the first module and second module are in aligned side-by-side relationship to one another the interconnector
5 interconnects the first and second modules to one another.

According to one form of the present invention there is provided an interconnection system for
10 interconnecting at least two individual building modules of a building structure,

the interconnection system including an interconnector having a first projection, a second projection and a bridging section located
15 intermediate the first projection and the second projection,

the first projection for engaging with a part of a first module, the second projection for engaging with a part of a second module, the
20 bridging section extending between the first projection and the second projection,

wherein when the first module is aligned with respect to the second module the first projection is engaged with the first module and
25 the second projection is engaged with the second module to interconnect the first module and the second module and the first projection extends

in aligned spaced apart relationship with respect to the second projection which is maintained by the bridging section.

5 According to one form of the present invention there is provided a building module comprising at least one support member having a first barrier spaced apart from a second barrier,

a first conduit extending between the first
10 barrier and the second barrier,

the first conduit having a first open end located at or towards the first barrier for admitting a flowable material into the first conduit,

15 the first conduit having a second open end for discharging flowable material therefrom,

the second open end extending through the second barrier,

a second conduit extending between the first
20 barrier and the second barrier,

the second conduit having a first open end located at or towards the first barrier for discharging the flowable material from the support member,

25 the second conduit having a second open end located at or towards the second barrier for receiving flowable material into the second

conduit,

wherein flowable material introduced into the first open end of the first conduit flows through the first conduit into the second conduit for discharge from the second conduit to provide a visual indication of the flowable material being discharged from the second open end of the first conduit to assist in secure interconnection of a first building module to a second building module when in stacked relationship one upon the other.

According to one form of the present the invention there is provided a substantially elongate hollow support member of an individual building module,

the support member having a first barrier located internally therein spaced apart from a second barrier located internally therein,

a first conduit extending between the first barrier and the second barrier internally within the support member,

the first conduit having a first open end located at or towards the first barrier for admitting a flowable material into the first conduit,

the first conduit having a second open end

for discharging flowable material therefrom,

the second open end extending through and beyond the second barrier for engagement with an interconnector for use in interconnecting the building module,

a second conduit located internally within the support member extending between the first barrier and the second barrier,

the second conduit having a first open end located at or towards the first barrier for discharging the flowable material from the second conduit,

the second conduit having a second open end located at or towards the second barrier for receiving flowable material into the second conduit from the interconnector,

wherein flowable material introduced into the first open end of the first conduit flows through the first conduit into the interconnector and the second conduit for discharge from the second conduit to provide an indication of the flowable material being received within the interconnector to assist in the interconnector securely interconnecting the building module to another building module when the building modules are in stacked relationship one upon the other.

Brief description of embodiments

5 Interconnectors.

In PPVC building structures interconnectors are used to join one building module to another building module of the PPVC within the building structure, including joining one individual building module to one or more neighbouring, adjacent, abutting, or contiguous building modules at the same level, and/or at different levels, including one above the other in vertically stacked relationship or vertically offset relationship.

The interconnectors can be a separate or discrete component, fitting or fixture or similar or can be part of one or more of the support elements of the lightweight PPVC building module, including part of one or more of the columns of the building module and/or part of one or more of the beams of the building module, or can be attached to the building module at some other location within the module.

In one form the interconnector is a mechanical interconnector whereas in other forms, the interconnector is a combined mechanical and chemical connector, such as for example, a
5 combination of a curable flowable chemical material surrounding or encasing a mechanical structure or component, such as for example, in the form of a grouted or cemented metallic tube.

10 In one form the interconnector is provided with one or more individual connectors. Typically, the connectors are projections, typically elongate projections, such as in the form of stems, stubs or similar lengthwise extending
15 protrusions extending outwardly from a central body portion of the interconnector. Typically, the projections are hollow or are provided with an internal cavity, chamber, void channel or similar. In one form the projections include
20 one or more connectors, more typically two or more connectors arranged to extend either collinearly or in substantially parallel spaced apart relationship to one another. Typically, each interconnector is provided with a least one
25 pair of projections or connectors extending collinearly in opposite directions from each other. In one form the interconnector is a spigot

or similar having a plurality or multitude of outwardly extending projections in the form of fingers or extensions, arranged in pairs. Preferably, the spigot is hollow or
5 substantially hollow having an internal cavity, void, space, channel or similar located therein for receiving and/or containing the flowable material.

10 An interconnector can have an even number of individual connectors, such as, one pair of connectors, two pairs of connectors, three pairs of connectors or four pairs of connectors, depending upon the precise location within the
15 building structure at which the interconnector is to be installed to join adjacent building modules to one another. Additionally, an interconnector can be provided with an odd number of connectors, such as for example, two
20 pairs of connectors and a single connector arranged in side by side parallel relationship, in which some of the connectors extend in a direction opposite to the direction of extension of other of the connectors.

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In one form the interconnector has a single pair of two connectors in the form of projections

which are arranged to extend in opposite directions to one another such that one of the connectors extends outwardly from a central portion of the interconnector in a first direction which is 180° to the direction of extension of the second connector extending from the other side of the central portion. Typically, the two connectors are arranged collinearly and extend from the central portion to substantially the same extent in opposite directions, typically one projection extends upwardly in use whilst the other projection extends downwardly in use.

In one form the interconnector has four individual connectors arranged as two pairs of connectors or projections in which one pair is arranged in side by side substantially spaced apart parallel relationship to the other pair of connectors or projections. Typically, the first connector of one pair of connectors extends in the opposite direction to the other connector of the same pair of connectors and also the two connectors of the second pair of connectors extend in opposite directions to each other. Further, the first connector of each pair of connectors extend in the same direction in

spaced apart parallel relationship to each other
in one direction and the second connector of each
pair of connectors extend in spaced apart
parallel relationship to each other in a second
5 direction which is the opposite direction to the
first direction. Thus, all first connectors of
the pairs extend in the same direction and all
second connectors of the pairs extend in the same
direction, being the opposite direction to the
10 direction of extension of the first connectors.

In one form the interconnector has five
connectors, being in the form of two pairs of
oppositely directed connectors and a single
15 connector extending in parallel spaced apart
relationship to the same connectors of each pair
of connectors. Typically, three of the
connectors extend in the same direction, more
typically in an upwards direction in use, and
20 two connectors extend in the same direction,
typically in a downwards direction in use. The
three upwardly extending connectors are arranged
in substantially parallel spaced apart
relationship to one another whereas the two
25 downwardly extending connectors are arranged in
substantially parallel spaced apart relationship
to one another which is in the opposite direction

to the direction of extension of the three connectors.

In one form the interconnector is provided with
5 four pairs of connectors comprising eight individual connectors in which four connectors, one from each pair of connectors, extend substantially vertically upwards in use and four
10 connectors, one from each pair of connectors, extend substantially vertically downwards in use.

In one form each connector has a proximal end and a distal end separated by a central portion.
15 Forms of the central portion include a central bridging portion which is located intermediate the distal end and proximal end of each of the connectors. Typically, the central bridging portion is a plate. More typically, the proximal
20 ends of two or more connectors of the same interconnector are joined to one another by the central bridging section. In one form the bridging section is located centrally of the longitudinally extending axes of each of the
25 connectors of the one interconnector.

Typically, the central portion being a bridging

section is a plate, collar, bracket, web, or similar. More typically, the plate is a shear plate. In forms of the interconnectors the lengthwise extending axis of the central
5 section, typically in the form of a plate, is substantially perpendicular to the longitudinal axis of the connectors.

In one form the plate is provided with one or
10 more apertures, holes, voids, cavities or similar. In one form the number of apertures corresponds to the number of the pair of connectors or projections of the interconnector. It is to be noted that the central bridging
15 section provides strength and rigidity to the interconnector as well as joining all of the pairs of connectors to one another to form a stable rigid strong interconnector. Further, the shear plate is connected to the support
20 members of adjacent building modules, such as by suitable fasteners, including bolts, nuts, high tension bolts and similar, when joining the individual building modules and forming the building structure.

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In one form the distal end of each connector or projection is tapered, bevelled, or provided

with an inclined surface, ramp, or similar for facilitating insertion of the tapered end of the connector or projection into the receiving portion or receiving part of the support member, typically in the form of a hollow column, preferably a square section or rectangular section tube or other similar hollow part of the receiving portion of a post, column or vertical element or framework member of an adjacent building module when two or more separate building modules are aligned and connected to each other.

Interconnectors comprising a single pair of connectors or projections extending in opposite directions facilitates interconnection of two individual modules in an aligned vertical stacked relationship.

Interconnectors comprising two pairs of connectors or projections extending in opposite directions facilitates interconnection of two or four individual building modules arranged in side by side relationship and vertically stacked one upon to one another.

Interconnectors comprising four pairs of

connectors or projections extending in opposite directions facilitates interconnection of four individual building modules in both side-by-side and stacked relationship to one another to form
5 the array or assembly of modules within the building structure.

Connectors

10 Forms of the individual interconnectors are adapted to cooperate with suitable flowable materials when cured to securely interconnect two individual building modules to one another by the flowable material being injected into the
15 interior of the interconnector, more particularly into the interior of the connectors of the interconnector, and even more particularly, to surround or envelop the projections of the interconnectors when located
20 within the hollow support members, particularly the hollow square section or rectangular section tubes forming the columns of individual building modules, and typically in the form of a spigots.

25 Forms of the support members of the individual building module, typically in the form of vertical columns, are provided with internal

dividers, partitions or barriers to subdivide the columns into individual sections, chambers, compartments or similar. Typically, each column, particularly columns located at the corners or edges of the individual building modules, are provided with three individual sections, chambers or compartments, the first being an open ended upper section, typically in the form of a receiver for a projection, or typically a lower projection, of the interconnector, the second being an open ended lower section, typically in the form of a receiver for a projection of the interconnector, typically an upper projection, and the third being a closed central section located intermediate the open-ended upper section and open-ended lower section.

In forms, the closed central section is provided with a pair of conduits or similar, typically in the form of tubes, pipes, hoses, channels, bores, or the like allowing fluid communication between the upper open-ended section and the lower open-ended section. Preferably, the conduits are in the form of cylindrical tubes or pipes.

In forms, the pair of conduits are arranged in spaced apart side-by-side substantially parallel relationship to each other. One conduit, namely the first conduit, typically in the form of an inlet tube, or grouting duct, extends from one of the dividers or barriers, being in the form of an upper transverse partition or wall, more typically an upper grout plate, located near to the top of the column through the interior of the hollow column towards a second divider or barrier, being in the form of a lower transverse barrier or wall, typically a lower grout plate, located near to the open-ended base of the column. The other of the pair of conduits, namely the second conduit, typically in the form of an outlet tube, or air/grout bleed duct extends from the upper transverse plate through the interior of central section of the hollow column to the lower transverse plate.

The first conduit or inlet tube or grout duct extends lengthwise through the lower transverse plate or wall so as to extend into and through the lower open ended portion at the base of the column to protrude through the opening at the base of the column from the open lower end of the column for engagement with an upwardly

extending connector of the interconnector located intermediate the upper building module and lower building module.

5 The second conduit or outlet tube or air/grout bleed duct, referred to as a bleed duct in this description, extends between the upper transverse grout plate and the lower transverse grout plate terminating in the openings in the
10 respective barriers, and being of a length corresponding to the spacing between the upper and lower transverse grout plates or the length of the central section of the column.

15 Thus, the length of the first conduit or inlet tube or grout duct extending from the upper transverse grout plate to beyond the lower end or space of the column is greater than the length of the second conduit or outlet tube or bleed
20 duct which extends between the upper transverse grout plate and the lower transverse grout plate only terminating at either end thereof at the respective transverse barriers.

25 One form of the grout plate is a grout stopper, typically in the form of a grout stopper plate transversely oriented with respect to the

lengthwise extending axis of the column. Typically, the transverse grout plate is provided with a pair of openings, apertures, holes, perforations, rims, or similar arranged
5 in spaced apart side by side relationship corresponding to the dimensions and orientation of the pair of conduits.

The inlet tube conduit or grout duct extends from
10 the upper transverse grout stopper plate located near to the top of the column to the lower transverse grout stopper plate located near to the base of the column. The outlet tube conduit or bleed duct extends from the upper transverse
15 grout stopper through the interior of the hollow column to the lower transverse grout stopper plate.

In use, when an upper building module is aligned
20 in stacked relationship one upon the other with a lower building module and a spigot located intermediate the corresponding columns of the upper and lower building modules, the flowable material in the form of a grout is injected into
25 the open upper end of the inlet conduit and forced under pressure to flow through the entire length of the inlet tube for discharge into the

interior of the spigot located between the corresponding columns of the upper and lower building modules to fill the chamber formed from the upper section of the lower column and the lower section of the upper column to completely fill, surround and embed the spigot, whereupon the grout flows into the lower opening of the outlet tube, through the entire length of the outlet tube for discharge into the upper section of the column of the upper module, whereupon it emerges from the upper grout plate to provide a visual indication that the joint between the two building modules is completely filled with grout to enhance the strength and rigidity of the joint by encasing the spigot within the two columns now filled with grout when the grout is allowed to set or cure. In one form the grout is a high strength high flow grout, typically of a type similar to the type used in post tensioned concrete structures for filling the post tensioned cable ducts.

Brief description of drawings

Embodiments of components of the interconnection systems of the present description will now be

described by way of example with reference to the accompanying drawings in which

Figure 1a is an in situ schematic perspective
5 view of one form of the interconnector having two connectors in which one connector is received in one end of a column, the other end of the connector being exposed,

10 Figure 1b is an in situ schematic perspective view of one form of the interconnector having four individual connectors when in one orientation in which one of the connectors is received within one end of a column,

15 Figure 1c is an in situ schematic perspective view of one form of the interconnector having four individual connectors when in another orientation in which one of the connectors is
20 received within one end of a column,

Figure 1d is an in situ schematic perspective view of one form of the interconnector having six individual connectors in which one connector
25 is received within one end of a column,

Figure 1e is an in situ schematic perspective

view of one form of the interconnector having eight individual connectors in which one connector is received within one and of a column,

5 Figure 2 is a schematic top perspective view of one form of an assembly of individual building modules arranged in side by side and vertically stacked relationship showing the form and location of individual interconnectors having
10 different numbers of connectors,

Figure 3 is a schematic side perspective view of an array of individual building modules showing insertion of interconnectors into the tops of
15 columns preparatory to installing additional building modules in vertical stacked relationship to the existing level of building modules.

20 Figure 4 is a schematic side view of two interconnected columns in which an interconnector is inserted intermediate the columns at their interface to join two individual modules in vertical stacked
25 relationship to one another.

Figure 5 is a schematic vertical cross section

view of one form of interconnector having two opposed connectors forming a joint between an upper and lower building module in which the joint is embedded within grout.

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Figure 6 is a schematic top plan view of one form of a grout stopper plate having a pair of openings shown in isolation.

10 Figure 7 is a schematic top plan view of one form of a cap plate having four grout holes and a single central aperture shown in isolation.

15 Figure 8 is a schematic enlarged phantom view of the interconnector of figure 5 in the form of a spigot in situ interconnecting upper and lower building modules prior to injection of grout.

20 Figures 9(a) to 9(f) are a series of top perspective views of one form of a building structure showing the different positions of installation of various individual building modules interconnected by forms of the interconnector of figure 5.

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Figure 10 is a partial side elevation view and partial cross section view of one form of

interconnector located intermediate two aligned columns for interconnecting building modules in vertical stacked relationship to one another in which the shear plate is fixed to the modules.

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Figure 11 is a schematic top perspective view of the connector of figure 10 mounted at the top of a column of a building module.

10 Figure 12 is a schematic underneath view of the interconnector of figure 11 showing the lower connector received within the column of the building module.

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Detailed description of embodiments

The interconnection system, including
20 interconnectors, connectors, components and parts, fittings and internals thereof of embodiments in accordance with the present description will now be described.

25 Interconnectors

With particular reference to figure 1a, there is

shown one form of an interconnector, generally denoted as 10, and generally referred to as a spigot. It is to be noted that interconnector and spigot will be used interchangeably in the description for clarity of expression. Interconnector or spigot 10 has two separate projections in the form of connectors 12, 14, located one at either end thereof. Connector 12 extends upwardly from the upper open end of column 16 whereas connector 14 is received fully within the upper open end of column 16, (obscured in figure 1a), particularly within upper section 18 (to be described in more detail later) to securely mount interconnector 10 at the top of column 16. It is to be noted that connector 12 and connector 14 can be the same, identical, substantially similar or different to one another. For ease of understanding and clarity of expression the exposed connector 12 only will be described in detail. It is to be noted that connector 14 is substantially the same as connector 12 apart from having a substantially inverted orientation being received within top section 18 of column 16.

Column 16 is one of the columns of an individual building module, generally denoted as 20,

typically a corner column which is located at the corner or edge of the building module which corner column when the building module is installed within a building structure abuts
5 against the corner column of a neighbouring building module, such as for example, adjacent modules at the same level as the module having column 16, and as shown more clearly in figures 2 and 3.

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Connector 12 which is substantially hollow being provided with an internal cavity or similar extends upwardly from the open upper end of column 16 and is of a generally square cross
15 section having rounded edges or corners. Connector 12 can have any suitable, desirable or convenient length, dimensions, size and be made from any suitable material, typically steel.

20 In one form interconnector 10 is provided with an intermediate body portion 22 formed intermediate connector 12 and connector 14 and forming the central section of interconnector 10. Central body portion 22 is provided for
25 joining the respective columns of the upper and lower building modules when interconnector 10 is received within the receiving parts of both

columns and for correctly and securely locating interconnector 10 in place.

In one form a plate or similar, in the form of
5 a shear plate 24, is connected to the central
body portion 22 of spigot 10 in which body
portion 22 is received within the opening of
shear plate 24, so that the body portion 22 of
connector 12 extends upwardly in use from the
10 top of column 16 and body portion 22 of connector
14 is received within the top open section of
column 16 when interconnector 10 is located
securely in place to join the respective columns
of the upper and lower building modules. In this
15 position shear plate 24 is located against the
rim of the upper open end of column 16.

Connector 12 has a tapered or tapering distal
end 26 terminating in a flat section 28 provided
20 with an opening allowing access internally
within connector 12, and hence within spigot 10,
to the internal cavity formed within connector
12. Optionally, in one form of spigot, a lifting
ring 30 extends upwardly from flat section 28.
25 Typically, optional lifting ring 30 is
optionally removable after installation of the
building module at the required location within

the building structure. Ring 30 allows interconnector 10 together with column 16, if required, and/or building module 20, to be lifted by a suitable lifting means such as a hoist, typically a hook located at the end of a chain of the hoist to lift and place building module 20 with column 16 in the required orientation at the correct location within the building structure.

10

First Embodiments of interconnectors.

In one embodiment of spigot 10, there is an optional aperture 32 provided in one of the walls of the body portion 22 of connector 12. A movable latch 34 is spring mounted within the interior of body portion 22 to be resiliently biased to extend outwardly through aperture 32 for securely engaging with a corresponding aperture of another column of a further building module to assist in securely interconnecting the two building modules to one another and retaining the two building modules in place with respect to each other. Movable latch 34 when at rest is spring biased to extend outwardly from the surface of the wall of body portion 22 of connector 12. Latch 34 is provided with a

sloping, tapered or bevelled surface or inclined surface to facilitate retraction of the latch internally into the body portion 22 of connector 12 when being received within an open end of
5 column 16.

Connector 14 is welded in place at the top of hollow section 18 of column 16 with shear plate 24 abutting against the rim of the open end of
10 column 16 and connector 12 extending outwardly from column 16 to securely attach interconnector 10 to the building module.

A further form of the interconnector, being
15 interconnector 110, is illustrated in figure 1b in which interconnector 110 is provided with two pairs of connectors comprising four individual projections.

20 Interconnector 110 has four individual connectors or projections, denoted as 112, 114, 142 and 144 in which connector 114 is welded to the top of column 116 to securely locate interconnector 110 at the top of the building
25 module. Connector 114 is substantially the same as connector 14 and is obscured by the top of column 116 in Figure 1b similarly to connector

14 as previously described. Connector 112 extends upwardly from the top of column 116 and is substantially the same as previously described connector 12. Connector 142 extends
5 upwardly in spaced apart parallel relationship to connector 112 and connector 144 extends downwardly in spaced apart parallel relationship to connector 114. Connectors 142 and 144 are arranged to extend collinearly in opposite
10 directions to one another and are connected to connectors 112/114 by shear plate 124 extending therebetween as shown in figure 1b. Both connectors 142 and 144 are provided with movable latches 134,136 which are both similar to one
15 another and similar to spring biased latch 34 of interconnector 10. As well as connector 114 being securely welded to column 116 to locate interconnector 110 at the top of column 116, connector 112 is received within the lower end
20 of a column of an upper building module immediately above the building module having column 116 when the two building modules are in aligned stacked relationship one upon the other. Also connector 144 is received within the open
25 top of a column of a building module contiguous with the building module having column 116 located in side by side relationship to one

another at the same level within the building structure formed by the array or assemblage of building modules. Additionally, connector 144 is received within the lower open end of a column
5 of a building module located immediately above the level of the building module having column 116 but located to one side of the building module. Thus, interconnector 110 interconnects four individual building modules with connectors
10 112, 114, 142 and 144 engaging with a single column of each of the respective modules.

With particular reference to figure 1c, interconnector 110 is located in a different
15 orientation to the orientation of connector 110 as illustrated in figure 1b. Further, it is to be noted that interconnector 110 shown in figure 1b has been rotated through 90° to adopt the orientation as shown in figure 1c.

20 A further form of the interconnector of the present description is illustrated in figure 1d in which this form of interconnector, generally denoted as 210, is provided with six individual
25 connectors or projections, namely connector 212, connector 214, connector 242, connector 244, connector 246 and connector 248, not all of which

are visible in figure 1d as some are obscured by being received within the top of the column 216, namely connector 214 or are obscured by other parts of interconnector 210, namely connector 244. Connector 212 extends upwardly from the top of column 216 whereas connector 214 is received within the top open end of column 216. Other connectors are the upper connector 242, the lower connector 244, the further upper connector 246 and the further lower connector 248. Plate 234 surrounds each of the six connectors to interconnect all six connectors to one another in spaced apart substantially parallel relationship to each other. Connector 212 is the same as connector 12 and connector 214 is the same as connector 14 whereas each of connectors 242, 244, 246, and 248 are the same as the corresponding connectors 142, 144 as previously described apart from having perhaps different orientations within the respective interconnector.

A further form of the interconnector is illustrated in figure 1e which has eight separate connectors arranged in four pairs of connectors in which each one of the connectors of the pairs extend in opposite directions.

Interconnector 260 includes four separate upwardly extending connectors 262, 264, 266 and 268 and four separate downwardly extending connectors 272, 274, 276 and 278 in which
5 connector 272 is received within the hollow top of column 280 and is obscured in Figure 1e. Shear plate 282 is located centrally to bridge all eight connectors arranged in four pairs in substantially parallel spaced apart relationship
10 to each other for location at the intersection of four individual building modules when in aligned side-by-side and vertically stacked relationship to each other.

15 Methods

Methods of assembling building structures from individual building modules using various forms of interconnectors will now be described.

20

A building module is prefabricated off-site from the location of the building structure, such as for example, in a factory or other manufacturing facility where the module is prefabricated and
25 prefinished to contain all of the contents required of the particular module, such as for example, all of the fittings and fixtures if the

module is a bathroom. The building module comprises a multitude of vertical columns, typically in the form of posts located at corners of the module or locations along sides of the module in spaced apart relationship to one another, typically in the form of columns 16, 116, and 216, and a multitude of horizontal beams 40, typically in the form of ceiling and/or flooring joists or rafters, located along the upper edges and lower edges of the building module.

A suitable interconnector, having two or more individual connectors is located at the top of selected posts of the module so that the lower connector is securely received within the open bore at the top of the post. During installation of an upper module, the base of the column of the upper module is aligned with the top of the column of the lower module so that the upwardly extending connector fixedly located to the column of the lower module is received within the open hollow base of the column of the upper module to securely interconnect both modules to one another in vertical stacked relationship. One sequence of steps or stages in the installation and assembly of modules to form a

building structure is illustrated with reference to figures 9a to 9f which illustrate the placing of successive upper modules on the top surface of existing modules when previously installed.

5

Second Embodiments of the interconnectors.

The second embodiment of the inter-connector includes both a mechanical component and a
10 chemical component for enhancing the strength and rigidity of the joint between two adjacent building modules for transmitting forces and loadings there through. Forms of the combined mechanical and chemical joint structure will now
15 be described with reference to figures 5 to 9.

In the interests of ease of understanding and clarity of expression interconnectors having a combination of mechanical and chemical joint
20 structure will be referred to as grouted interconnectors or grouted spigots herein.

One form of grouted interconnector or spigot, generally denoted as 310, for forming a grouted
25 joint interconnecting an upper building module 302 containing column 316 and a lower building module 304 containing column 318 is illustrated

in figure 5. Interconnector 310 includes upper connector 312 having aperture 313 in the distal end thereof and lower connector 314 having aperture 315 in a distal end thereof separated
5 by a suitable fitting in the form of a shear plate, collar, ring, bridging plate or similar. In one form the shear plate is a square or rectangular shaped plate in the form of a cap plate 340 having an outer part provided with four
10 spaced apart holes and an inner part provided with a single central hole (to be described in more detail later).

When the upper and lower building modules 302,
15 304 are in aligned stacked relationship one upon the other, columns 316, 318 are in vertical alignment with each other with interconnector or spigot 310 located intermediate the columns to join the columns to each other. Both columns
20 316, 318 are substantially identical and each is provided with three distinct sections.

Column 316 includes upper hollow section 320, lower hollow section 322 and intermediate
25 central hollow section 324 being located between upper section 320 and lower section 322. Column 318 includes upper hollow section 326, lower

hollow section (not shown in figure 5) and central intermediate section 328 located between upper section 326 and the lower section.

5 A first barrier or divider, typically in the form of a stopper wall or plate, more typically an upper grout stopper plate 330, is provided at the interface of upper section 320 and intermediate section 324 of column 316. Plate
10 330 extends transversely through the cross section of column 316 to seal column 316. Plate 330 has two apertures or openings 329, 331 in side by side relationship to one another, as shown in figure 6.

15 A second barrier or divider, typically in the form of a stopper wall or plate, more typically a lower grout stopper plate 332, is provided at the interface of intermediate section 324 and
20 lower section 322 of column 316. Plate 332 extends transversely through the cross section of column 316 to seal column 316. Plate 332 has two apertures or openings 333, 335 in side by side relationship to one another, as shown in
25 figure 6. It is to be noted that upper grout stopper plate and lower grout stopper plate are substantially identical.

A first conduit in the form of an inlet tube or grout duct 334 extends from opening 329 in upper grout stopper plate 330 downwardly through
5 corresponding aperture 333 in lower grout stopper plate 332 and into lower hollow section 322 of column 316 and into upper hollow section 326 of column 318. Thus, grout duct 334 extends from the top of column 316 to the top of column
10 318.

A second conduit in the form of an outlet tube or air bleed duct, generally called bleed duct 338 extends from opening 331 in upper grout
15 stopper plate 330 downwardly to corresponding aperture 335 in lower grout stopper plate 332 to terminate at plate 332 of column 316. Thus, bleed duct 338 extends from opening 331 at one end of central section 324 to opening 335 at the
20 other end of central section 324.

Interconnector or spigot 310 is located at the interface of upper building module 302 and lower building module 304 so that connector 312 is
25 received within hollow lower section 322 of column 316 and connector 314 is received within hollow upper section of column 318. Thus, column

316 is sealed by upper grout stopper 330, lower grout stopper 332 and cap plate 340, and column 318 is sealed by upper grout stopper 330 and cap plate 340.

5

Cap plate 340, which is substantially square or rectangular having dimensions corresponding to the internal dimensions of column 316, includes a generally square or rectangular solid outer
10 apron 342 having four regularly spaced apart grout holes 344, one in each of the four sides of apron 342, surrounding a solid square or rectangular centre 346 having a single centrally located aperture 348 of a size corresponding to
15 the size of grout duct 330 allowing grout duct 330 to pass through cap plate 340.

In operation, grout after being injected into connector 314 passes through aperture 348 of
20 plate 340 via grout duct 330 in a downwards direction and grout exiting connector 314, is forced through grout holes 344 of plate 340 in the opposite direction to flow upwardly into and through connector 312 before being squeezed into
25 and through bleed duct 332 to exit in upper section 320 of column 316 to provide a visual indication of the correct amount of grout having

been added to the grouted spigot 310 as will be described in more detail below.

In operation of spigot 310 to interconnect upper
5 building module 302 and lower building module
304, after the lower building module is
installed in the correct position, spigot 310 is
located within upper section 326 of column 318
with lower connector 314 being received within
10 upper section 326. Lower connector 312 extends
upwardly from the upper open end of column 318
at the top of the lower building module. The
upper building module is then placed upon the
lower building module with columns 316 and 318
15 in vertical alignment with each other so that as
the upper building module is lowered into
position upper connector 312 is received within
lower section 322 of column 310.

20 With the upper and lower building modules 302,
304 in the final installed position within the
building structure, a flowable material in the
form of a grout or cement is then introduced into
the columns 316, 318 to enhance the strength and
25 rigidity of the joint between the modules by the
joint being a combination of a mechanical joint
and a chemical joint when the grout sets or

cures. Grout is then introduced into the opening of upper grout duct 334 through the inlet opening 329 located in upper grout stopper plate 330 to flow into and through the entire length of grout duct 334 to be discharged from the lower end of grout duct 334 into a cavity formed by the hollow interior of connector 314. As more grout is injected into grout duct 334, the grout is forced to flow through the cavity of connector 314 to exit from aperture 315 at the distal end of connector 314 to flow in the opposite direction around the outside of connector 314 between the internal walls of upper section 326 of column 318 to fill upper section 326 as indicated by arrows "A" of figure 5.

Thereafter grout flows through grout holes 344 of cap 340 into lower section 322 of column 316 to fill section 322, as well as the internal cavity of connector 312 of spigot 310 and then to enter the aperture, 335 in lower grout stopper plate 332 to flow through air bleed duct 324 until exiting through aperture 331 in upper grout stopper plate 330. As grout exiting through grout stopper plate 330 is visible from above by looking down into column 316, the presence of grout in upper section 320 provides

a visual indication that spigot 310 is completely encased within grout thereby forming a grouted spigot enhancing the strength and rigidity of the joint between columns 316 and 318 when the grout cures and hence, between upper and lower building modules 302, 304 for allowing greater transmission of forces and loadings through the joint leading to a more stable and rigid building structure without the need to have a reinforced concrete core or other substrate.

The procedure of locating a lower building module in the correct final position, inserting a spigot into the open end of the column of the lower building module, and then locating the upper building module in alignment with the lower building module so that the upper connector of the spigot is received within the lower hollow section of the column of the upper building module and filling the cavities formed by the respective columns being in alignment with each other and the spigot with grout to form the grouted joint between the modules is repeated as many times as required in accordance with the installation of each new building module in the building structure, including

having multiple joints between the same upper and lower building modules, such as for example at each of the corners or edges of the modules.

5 **Third embodiments of the interconnectors**

With particular reference to figure 10, another form of interconnector, generally denoted as spigot 410, will now be described. First upper
10 building module 402 includes a floor beam 406 and column 416 in which column 416 is located at the corner of module 402. First lower building module 404 includes a ceiling beam 408 and column 418 in which column 418 is located at the corner
15 of module 404. First upper building module 402 is located vertically above first lower building module 404 and in vertical alignment there with. Second upper building module 403 is located adjacent first upper building module 402 and
20 second lower building module 405 is located adjacent first lower building module 404. Second upper building module 403 is located vertically above second lower building module 405 and in vertical alignment there with.

25

A cap plate 420 is fixed in place at the top of column 418, such as for example, by welding or

similar, to close the open upper end of column 418. Interconnector or spigot 410 is fixedly connected to cap plate 420 at the top of column 418 of module 404 to extend vertically upwards in which connector 412 of spigot 410 is exposed to extend substantially vertically upwards to be received in the base of open lower section of column 416. Although one form of spigot is shown in figure 10, the spigot can be of any suitable or convenient form or type.

A top generally L-shaped bracket 421 having upright 422 and shelf 424, is fixedly mounted to one side wall of the top of rectangular or square column 418 by suitable mounting means, such as for example, by welding or similar. Upright 422 is mounted flush with the external wall of column 418 whereas shelf 424 extends outwardly substantially perpendicularly to the lengthwise extending axis of column 418. Shelf 424 is provided with a pair spaced apart apertures for use in retaining ceiling beam 408 of an adjacent building module in place connected to column 418.

A bridging plate in the form of a shear plate 430 is located intermediate the base of column

416 and the top of column 418. Shear plate 430 includes an aperture of a size and shape corresponding to the size and shape of connector 412 of spigot 410 so that connector 412 is received through the aperture when shear plate 430 is located on the top of column 418 for use to interconnect the various individual building modules. Shear plate 430 has a first side extension 432 extending on the same side as bracket 420 and having two spaced apart apertures with spacing, size and orientation corresponding to the spacing, size and orientation of the pair of apertures of shelf 424, enabling a pair of bolts 433 to be received there through when in alignment to connect beam 408 of an adjacent individual building module. Shear plate 430 also includes a second side extension 434 extending on the opposite side to that of first side extension and is also provided with a pair of apertures for receiving there through a pair of bolts 435 to connect shear plate 430 to beam 408 of module 404.

A lower generally L-shaped bracket 440, having upright 442 and shelf 444 is fixedly mounted to one side or wall of the base of rectangular or square column 416 by suitable mounting means,

such as for example, by welding or similar. Upright 442 is mounted flush with the external wall of column 416 whereas shelf 444 extends outwardly substantially perpendicularly to the lengthwise extending access of column 416. Shelf 444 is provided with a pair of spaced apart apertures for use in securing upper module 402 to lower module 404. It is to be noted that the size and spacing of apertures of shelf 444 is the same as the size and spacing of the apertures in extension 432 of shear plate 430 for receiving there through bolts 433 to assist in connecting beam 408 of an adjacent lower building module.

A cap plate 448 is provided at the open lower end of column 416 to close the open end thereof. Cap plate 448 includes a central aperture of a shape and size corresponding to the shape and size of connector 412 of spigot 410 for receiving connector 412 there through to be received internally in the lower end of column 416 to assist in interconnection of upper module 402 to lower module 404.

ADVANTAGES

One or more embodiments of the interconnection system and of the interconnector include one or more of the following:

- 5 Building structures made in accordance with embodiments of the present description do not require a concrete core or centralised concrete core, nor do they require shear walls.
- 10 Building structures made in accordance with embodiments of the present description allow lift shafts and stair shafts to be installed as individual building modules concurrently with the installation of other individual building
15 modules.

In embodiments modules slide inside each other with a 10 mm gap at their interface in such a manner to minimise the party wall thicknesses.

- 20 The speed of construction of building structures is increased due to there being no delay for the formation of reinforced concrete core structures within the building structure since the
25 formation of the concrete core structures is time consuming both in preparation for pouring the concrete to form the core and allowing the

concrete to cure to a sufficient strength to allow installation of the individual modules to form the building structure to commence.

- 5 In the past for low to medium rise structures, all core and shear walls are cast/poured as each level progresses, which delays and interferes with the installation of the modules. By introducing fixed connections between modules in
- 10 conjunction with steel wall bracing within the modules lateral forces will be resisted thereby eliminating the requirement to provide the concrete core and shear walls.

The claims defining the invention are as follows:

- 5 1. An interconnector for interconnecting at least a first building module having a first receiver and a second building module having a second receiver to form an array or assembly or part of an array or assembly of building modules,
10 the interconnector comprising
a first connector in the form of a first projection for being received in the first receiver, and
a second connector in the form of a
15 second projection for being received in the second receiver,
the first connector and the second connector being arranged with respect to each other so that when the first connector is received within the
20 first receiver and the second connector is received within the second receiver, the first module and the second module are interconnected to one another in alignment with one another
the interconnector further comprising a chamber
25 for containing a flowable material therein,
the chamber having an inlet for admitting the flowable material to the interconnector and

an outlet for discharging the flowable material from the interconnector,

the flowable material when cured for enhancing the strength of the joint between the individual building modules to limit relative movement of the individual modules with respect to one another.

2. An interconnector for interconnecting at least a first building module, a second building module and a third building module to form a building structure of an array or assembly or part of an array or assembly of building modules,

the interconnector comprising a first connector in the form of a first projection, a second connector in the form of a second projection and a third connector in the form of a third projection,

the first projection for being received within a first receiver provided on the first module, the second projection for being received within a second receiver provided on the second module, and the third projection for being received within a third receiver provided on the third module,

the first projection being in collinear alignment with the second projection,

the third projection having a first part and a second part,

the first part of the third projection being connected to either the first projection or the
5 second projection,

the second part of the third projection being spaced apart from the first projection or the second projection,

wherein when the first module is in aligned
10 relationship with the second module with the first projection being received within the first receiver and the second projection being received within the second receiver to securely interconnect the first and second modules in
15 aligned relationship with each other, the third projection is received within the third receiver to securely connect the third module to the first and second modules in contiguous relationship to the first and second modules to form the building
20 structure wherein the first receiver and the second receiver form a chamber for containing a flowable material therein which flowable material when cured enhances the strength of joint between the individual building modules to
25 limit relative movement of the modules with respect to one another.

3. An interconnection system for interconnecting multiple individual building modules to form an array or assembly or part of an array or assembly of a building structure,

5 the interconnection system including at least one interconnector for interconnecting the building modules to one another,

each individual module having at least one hollow tube and at least one interconnector
10 having two or more projections for engaging respective one ends of receivers of adjacent modules, so that when the individual modules are in alignment with each other the projections are received within the respective receivers
15 facilitating secure interconnection of the adjacent individual modules to one another to restrain respective movement of one module with respect to another module.

20 4. An interconnector for interconnecting two individual building modules to one another to form an assembly of a building structure, the interconnector comprising

a lower end for being received in an upper
25 open end of a hollow support member of a lower building module,

a second end being an upper end for being

received in the lower open end of a hollow support member of an upper building module to interconnect the upper module and lower module when the upper module and the lower module are
5 in stacked aligned relationship one on top of the other to form the assembly of modules.

5. An interconnector for interconnecting individual modules to one another to form an
10 assembly of modules of a building structure, the interconnector comprising

a first connector and a second connector
the first connector including a lower end for being received in a receiver of a first lower
15 module and an upper end for being received in a receiver of a first upper module,

the lower end and upper end of the first connector being collinear to interconnect the upper module and lower module to one another when
20 the first upper module and first lower module are in aligned stacked relationship one upon the other,

the second connector including a lower end for being received in a receiver of a second
25 lower module and an upper end for being received in a receiver of a second upper module,
the interconnector further comprising a central

bridging section located intermediate the lower end and the upper end,

wherein when the second upper module and second lower module are in aligned stacked relationship

5 one above the other the second connector extends between the second upper module and second lower module to interconnect the first upper module, the second upper module, the first lower module and the second lower module to each other.

10

6. A building module comprising at least one support member having a first barrier spaced apart from a second barrier,

15 a first conduit extending between the first barrier and the second barrier,

the first conduit having a first open end located at or towards the first barrier for admitting a flowable material into the first conduit,

20 the first conduit having a second open end for discharging flowable material therefrom,

the second open end extending through the second barrier,

25 a second conduit extending between the first barrier and the second barrier,

the second conduit having a first open end located at or towards the first barrier for

discharging the flowable material from the support member,

the second conduit having a second open end located at or towards the second barrier for receiving flowable material into the second conduit,

wherein flowable material introduced into the first open end of the first conduit flows through the first conduit into the second conduit for discharge from the second conduit to provide a visual indication of the flowable material being discharged from the second open end of the first conduit to assist in secure interconnection of a first building module to a second building module when in stacked relationship one upon the other.

7. A connector comprising a substantially elongate hollow support member of an individual building module, the support member having a first barrier located internally therein spaced apart from a second barrier located internally therein,

a first conduit extending between the first barrier and the second barrier internally within the support member,

the first conduit having a first open end

located at or towards the first barrier for admitting a flowable material into the first conduit,

the first conduit having a second open end
5 for discharging flowable material therefrom,

the second open end extending through and beyond the second barrier for engagement with an interconnector for use in interconnecting the building module,

10 a second conduit located internally within the support member extending between the first barrier and the second barrier,

the second conduit having a first open end located at or towards the first barrier for
15 discharging the flowable material from the second conduit,

the second conduit having a second open end located at or towards the second barrier for receiving flowable material into the second
20 conduit from the interconnector,

wherein flowable material introduced into the first open end of the first conduit flows through the first conduit into the interconnector and the second conduit for
25 discharge from the second conduit to provide an indication of the flowable material being received within the interconnector to assist in

the interconnector securely interconnecting the building modules to another when the building modules are in stacked relationship one upon the other.

5

8. An interconnection system or interconnector according to any preceding claim in which the interconnector is a mechanical interconnector or a combined mechanical and chemical interconnector in which the combined mechanical and chemical interconnector comprises a curable flowable chemical material surrounding, enveloping or encasing a mechanical connector to form a grouted or cemented joint.

15

9. An interconnection system or interconnector according to any preceding claim in which the interconnector is provided with one or more individual connectors in the form of elongate projections extending outwardly from a central body portion of the interconnector in different directions to one another.

20

10. An interconnection system or interconnector according to any preceding claim in which the projections are hollow or are provided with an internal cavity, chamber, void, channel, gap or

25

space.

11. An interconnection system or interconnector according to any preceding claim in which the
5 projections include one or more connectors arranged to extend either collinearly or in substantially parallel spaced apart relationship to one another.

10 12. An interconnection system or interconnector according to any preceding claim in which the interconnector is a spigot or similar having a plurality or multitude of outwardly extending
15 projections in the form of fingers or extensions arranged in pairs in which the spigot is hollow or substantially hollow having an internal cavity, void, space, channel or gap located therein for receiving and/or containing the flowable material.

20 13. An interconnection system or interconnector according to any preceding claim in which the interconnector has an even number of individual connectors including one pair of connectors, two
25 pairs of connectors, three pairs of connectors or four pairs of connectors, depending upon the precise location within the building structure

at which the interconnector is to be installed to join adjacent building modules to one another or the interconnector has an odd number of connectors including two pairs of connectors and
5 a single connector arranged in side by side parallel relationship in which selected connectors extend in a direction opposite to the direction of extension of other of the connectors.

10

14. An interconnection system or interconnector according to any preceding claim in which the interconnector further comprises a central section and the interconnector has a single pair
15 of two connectors in the form of projections which are arranged to extend in opposite directions to one another such that one of the connectors extends outwardly from the central portion of the interconnector in a first
20 direction which is about 180° to the direction of extension of the second connector extending from the other side of the central portion wherein the two connectors are arranged collinearly and extend from the central portion
25 to substantially the same extent in opposite directions from each other.

15. An interconnection system or interconnector according to any preceding claim in which the interconnector has four individual connectors arranged as two pairs of connectors or
5 projections in which one pair is arranged in side by side substantially spaced apart parallel relationship to the other pair of connectors or projections wherein the first connector of one pair of connectors extends in the opposite
10 direction to the direction of extension of the other connector of the same pair of connectors and also the two connectors of the second pair of connectors extend in opposite directions to each other wherein the first connector of each
15 pair of connectors extends in the same direction in spaced apart parallel relationship to each other in one direction and the second connector of each pair of connectors extends in spaced apart parallel relationship to each other in a
20 second direction which is the opposite direction to the first direction such that all first connectors of the pairs extend in the same direction as each other and all second connectors of the pairs extend in the same
25 direction as each other, being the opposite direction to the direction of extension of the first connectors.

16. An interconnection system or interconnector according to any preceding claim in which the interconnector has five connectors comprising
5 two pairs of oppositely directed connectors and a single connector extending in parallel spaced apart relationship to a selected one of each of the pairs of connectors such that three of the connectors extend in the same direction as each
10 other being a generally upwards direction and two connectors extend in the same direction as each other being a generally downwards direction wherein the three upwardly extending connectors are arranged in substantially parallel spaced
15 apart relationship to one another and the two downwardly extending connectors are arranged in substantially parallel spaced apart relationship to one another.

20 17. An interconnection system or interconnector according to any preceding claim in which the interconnector is provided with four pairs of connectors comprising eight individual
connectors in which four connectors, one from
25 each pair of connectors, extend substantially vertically upwards in use and four connectors, one from each pair of connectors, extend

substantially vertically downwards in use.

18. An interconnection system or interconnector according to any preceding claim in which each
5 connector has a proximal end and a distal end separated by a central portion being a central bridging portion which is located intermediate the distal end and proximal end of each of the connectors wherein the proximal ends of two or
10 more connectors of the same interconnector are joined to one another by the central bridging section.

19. An interconnection system or interconnector
15 according to any preceding claim in which the bridging section is a plate, collar, bracket, web, or flange wherein the lengthwise extending axis of the central section is substantially perpendicular to the longitudinal axis of the
20 connectors.

20. An interconnection system or interconnector according to any preceding claim in which the plate is provided with one or more apertures,
25 holes, voids, cavities or bores wherein the number of apertures corresponds to the number of the pair of connectors or projections of the

interconnector.

21. An interconnection system or interconnector according to any preceding claim in which the
5 distal end of each connector or projection is tapered, bevelled, or provided with an inclined surface, ramp, or sliding surface for facilitating insertion of the tapered end of the connector or projection into the receiving
10 portion or receiving part of the support member, post, column or vertical element or framework member of an adjacent building module when two or more separate building modules are aligned and connected to each other.

15 22. An interconnection system or interconnector according to any preceding claim in which support members of the individual building module are provided with internal dividers,
20 partitions or barriers to subdivide the support members into individual sections, chambers, compartments, spaces or voids.

23. An interconnection system or interconnector
25 according to any preceding claim in which the support members are provided with three individual sections, chambers or compartments,

the first being an open ended upper section, in the form of a receiver for a downwardly depending lower projection or connector, the second being an open ended lower section in the form of a receiver for a projection of the interconnector in the form of an upwardly extending projection or connector, and the third being a closed central section located intermediate the open-ended upper section and open-ended lower section.

24. An interconnection system or interconnector according to any preceding claim in which the closed central section is provided with a pair of conduits, in the form of tubes, pipes, hoses, channels, bores, or ducts allowing fluid communication between the upper open-ended section and the lower open-ended section.

25. An interconnection system or interconnector according to any preceding claim in which the pair of conduits includes a first conduit and a second conduit arranged in spaced apart side-by-side substantially parallel relationship to each other in which the first conduit, being an inlet tube, or grouting duct, extends from one of the dividers or barriers, being an upper transverse

partition or wall, forming an upper grout plate,
located near to the top of the column, through
the interior of the hollow column towards a
second divider or barrier, being a lower
5 transverse barrier or wall, forming a lower
grout plate, located near to the open-ended base
of the column in which the second conduit, in
the form of an outlet tube or air/grout bleed
duct extends from the upper transverse plate
10 through the interior of central section of the
hollow column to the lower transverse plate.

26. An interconnection system or interconnector
according to any preceding claim in which the
15 first conduit or inlet tube or grout duct extends
lengthwise through the lower transverse plate or
wall so as to extend into and through the lower
open ended portion at the base of the column to
protrude through the opening at the base of the
20 column from the open lower end of the column for
engagement with an upwardly extending connector
of the interconnector located intermediate the
upper building module and lower building module
and the
25 second conduit or outlet tube or air/grout bleed
duct, extends between the upper transverse grout
plate and the lower transverse grout plate

terminating in the openings in the respective barriers, and being of a length corresponding to the spacing between the upper and lower transverse grout plates or the length of the
5 central section of the column.

27. An interconnection system or interconnector according to any preceding claim in which the length of the first conduit or inlet tube or
10 grout duct extending from the upper transverse grout plate to beyond the lower end or space of the column is greater than the length of the second conduit or outlet tube or bleed duct which extends between the upper transverse grout plate
15 and the lower transverse grout plate only terminating at either end thereof at the respective transverse barriers.

28. An interconnection system or interconnector
20 according to any preceding claim in which the grout plate is a grout stopper, in the form of a grout stopper plate transversely oriented with respect to the lengthwise extending axis of the column wherein the transverse grout plate is
25 provided with a pair of openings, apertures, holes, perforations, rims, or similar arranged in spaced apart side by side relationship

corresponding to the dimensions and orientation of the pair of conduits.

29. An interconnection system or interconnector
5 according to any preceding claim in which the
inlet tube conduit or grout duct extends from
the upper transverse grout stopper plate located
near to the top of the column to the lower
transverse grout stopper plate located near to
10 the base of the column and the outlet tube
conduit or bleed duct extends from the upper
transverse grout stopper through the interior of
the hollow column to the lower transverse grout
stopper plate.

15

30. An interconnection system or interconnector
according to any preceding claim in which when
an upper building module is aligned in stacked
relationship upon a lower building module with
20 a spigot located intermediate the respective
columns of the upper and lower building modules
extending therebetween, the flowable material in
the form of a grout injected into the open upper
end of the inlet conduit and forced under
25 pressure to flow through the entire length of
the inlet tube for discharge into the interior
of the spigot flows into the chamber formed from

the upper section of the lower column and the lower section of the upper column to completely fill, surround and embed the spigot after which the grout flows into the lower opening of the outlet tube, through the entire length of the outlet tube for discharge into the upper section of the column of the upper module to emerge from the upper grout plate to provide a visual indication that the chamber between the two building modules is completely filled with grout to enhance the strength and rigidity of the joint by encasing the spigot within the two columns now filled with grout when the grout is allowed to set or cure.