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Title: System for constructing buildings

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Field of the invention

The present invention relates to a system for constructing buildings, a method for connecting frames to a box, and boxes to a building, and a connector for connecting frames, according to the preamble of the independent claims.

Background of the invention

Construction of buildings is very traditional, even modular houses are based on traditional thinking. Construction is time consuming, even when the modules are prefabricated. Further, constructing buildings often requires use of special tools and large cranes.

In some areas the accessibility to the necessary tools are not possible, for instance in an area without an access road, an area with natural disaster or in developing countries. Even if the tools are available, there might be a need to construct the buildings quickly, for instance within weeks, or even days.

Further, it is time consuming and expensive to expand a traditional building. The adjacent parts of the structure may be affected by and unavailable during construction of the addition.

Modular building construction has been widely available for some time, but the modules are designed to fit into a particular predetermined structure. If the entrepreneur or buyer wants changes in room layouts or sizes, to add more space, to increase/decrease the utility floor space, to extend the building, et cetera, it may require replanning of the whole building, which may involve unexpected costs and consume a lot of time.

Perhaps it may be desirable to dismantle buildings for relocation or for sale. Usually this will not be profitable, due to the complexity and time consumption involved in dismantling a structure. Building elements are often fastened together using screws and sealants. This may damage the building elements and the framing during disassembly.

In addition, the dismantled items can be large and difficult to transport, and it can be challenging to remember how the elements fit together when reassembling. In other cases, for example, the replacement or relocation of windows and doors is usually not a quick operation.

In known modular buildings, such as described in patent publication US 2012/102871 and WO 2004/076762 different solutions for solving the above stated problems are given. However, all of the described solutions require a large number of means of fastening, and thus are time consuming to build, disassemble and modify. Furthermore, the known modular buildings are made of a wide variety of modules that have mutual affinity, and therefore the modules must be produced for a given building.

Patent publication US 8231185 discloses a multi-purpose assembly of frame boxes with the capability of assembling and disassembling. However the frame assembly does not have the same structural strength compared to a frame assembly comprising of rectangular prefabricated frames, which could be a critical factor in order to support loads in buildings. In addition the frame boxes don’t have connectors at the corners which makes it possible to connect an unlimited number of additional frame boxes to each other.

Patent publication KR 20110060612 discloses an assembly of hollow tubular components and corner connectors, assembled into a frame box structure, with the possibility of adding a ceiling frame. Still, the connectors at the corners don’t have the possibility to connect to an unlimited number of additional frame boxes.

Other patent publications; WO 2015/164975 which discloses a connector assembly, and EP 0834974 which discloses a corner junction and a corresponding framework.

Objects of the present invention

One object of the invention is to provide a system for constructing a building, which may be built rapidly, but still be stable and fulfill the expectations of a new and modern building. Further it is an object that it should be possible to expand, and even move the building. Yet another object is that the building should be constructed with as few different parts as possible.

Summary of the invention

The above stated objects are met by a system, a method and a connector according to the characterization of the independent claims. Further advantages and features are stated in the corresponding independent claims.

The present invention is related to a system for constructing buildings, wherein the building is comprised of mounting a number of square frames to each other. The frames may be mounted in any suitable manner, and constitute the framework of walls, floors and ceiling/roof of the building. The arrangement of the frames in relation to each other will determine the shape of the building. In a preferred embodiment the building is made of a limited variety of different frames, and even more preferred, of identical frames, arranged as desired by the builder. The building may be comprised of several floors by mounting frames on top of each other, keeping a constant height between the floor and ceiling.

Each frame to be used in relation to the invention has a planar, square, shape and four sides which are fastened to each other in a prefabricated process. The sides are perpendicular to each other, and by "square" it is herein meant both rectangular and quadratic. The fastening of the sides to each other must be sufficiently strong, as the assembled frames constitute the framework of the building, and may be performed in any way which will be obvious to a person skilled in the art.

Each side of the frame may be made of a balk, beam or tube whichever provides sufficient strength, but at least one of the ends of each tube must be hollow, and one hollow end must be exposed in each corner of the frame. When a number of frames are connected, the frames must be arranged such that exposed hollow ends must be

perpendicular to each other in the common corner. If the frame is made of tubes having two hollow ends, two hollow ends will be exposed at each corner, and it may be easier to arrange the frames in relation to each other.

The sides may also be made of a balk, beam, tube or similar, the entire length of which is hollow. Further, the frame should be easy to produce, transport and store. In a preferred embodiment the frame is made of metal tubes, and even more preferred of metal tubes with a square cross section.

Once the frames are arranged for the desired layout of the building, modules for floors, walls, including doors and windows or openings for doors and windows, and ceilings and/or roofs are added to the frames. The modules may be made to reflect different rooms such as kitchen, bathroom etc. Thus, the construction of a building when using a system according to the present invention is fast, secure and easy, while also allowing for a high level of customization.

The invention is further comprised of a connector for connecting the above stated square frames. The connector has three members protruding perpendicular to each other from a common center, and each member has a through-passage to accommodate a locking element. When the connector is used to connect three frames, the locking element runs through a passage in the connector and into the hollow end of a tube of the frame.

Each protruding member has a transverse through-passage, wherein its longitudinal axis is running perpendicularly past each of the other two corresponding through-passages axes.

The hollow ends of the tubes constituting the frame, the passage through each member of the connector, the members of the connector, the center of the connector and the locking elements may all have square cross section. The square cross section will prevent rotation between the connector and the locking element, and between the locking element and the tubes. It will also prevent rotation of the different frames connected to each other.

The outer cross section of each member, and preferably the center of the connector, may be equal or even identical to the outer cross section of the tubes constituting the frames. Having equal or corresponding cross section allows for more compact arrangement of connectors and frames, and minimal movement between the frames.

The inner cross section of each of the passages of the connector may be equal or identical to the inner cross section of the hollow ends of the tubes. When the cross sections are equal or even corresponding, the locking element may have equal cross section along its length, and mounting will be easier. The outer cross section of the locking element should be slightly smaller than the inner cross section of the passages in such a way that the fastening between the connector and the frames, and the fastening between the frames, will be compact, allowing little or no movement and/or rotation between the frames.

The invention also relates to a method for connecting three square frames of tubes, wherein at least one end of each tube is hollow and at least one hollow end is exposed in each corner of each frame. The method comprises the following steps:

- arranging the frames perpendicular to each other and arranging the connector (as described above) at the intersecting corners of the frames,
- inserting a first locking element through a first passage of the connector and into a hollow end of a tube of the first frame, and locking the element to the frame,
- inserting a second locking element through a second passage of the connector and into a hollow end of a tube of the second frame, and locking the element to the frame, and
- inserting a third locking element through a third passage of the connector and into a hollow end of a tube of the third frame, and locking the element to the frame.

The method further comprises steps for adding more frames, until six frames constitute a cube or rectangular box, having a connector in each corner.

A locking element to be used according to the invention must have an outer cross section corresponding to the inner cross section of the passage of the connector and the inner cross section of the hollow end of the tube being part of the frame, as discussed above.

The locking element must be sufficiently strong to prevent forces acting on the framework of the building, including vertical, horizontal and torsion forces. The locking element may be compact or hollow, and of any suitable material which will be obvious to a person skilled in the art. In a preferred embodiment, the locking element is hollow and made of metal, such as iron or steel.

When the locking element is inserted into the connector and the frame, the locking element should be locked to the frame, at the desired position. The locking may be performed in many ways, which will be obvious to a person skilled in the art. When frames in three dimensions are connected to the connector, the connector is prevented from moving in relation to the locking element, and thus the frame, the connector and the locking element will be securely fixed to each other.

In a preferred embodiment, the hollow end of a tube of the frame and the locking element are provided with holes, and when the locking element is inserted at the desired position of the frame, the holes will be corresponding and a locking bolt may be inserted into the holes. In another embodiment, the locking element comprises knobs or similarly which will protrude outwards from the surface, wherein the knobs may be pressed into the locking element when the locking element is inserted into the frame, and which will protrude through the hole in the frame when the locking element is at the desired position. In such an embodiment, the knob must be pressed into the locking element again before the locking element may be released from the frame. Such systems are well known to a person skilled in the art, and are thus not described further here.

The locking element may preferably comprise two, three or more holes or knobs, one first hole/knob for locking the element in the first position when three frames are fastened to the same connector and thus to each other. The remaining holes/knobs should preferably be used when one locking element is inserted into two frames.

The invention relates to a system for constructing buildings of frames, by fastening six frames to a box by a method described above. Then further frames may be attached to the box, either as a preassembled box of six frames, or the frames of the

next box are attached to the first box frame by frame. In a preferred embodiment a desired number of boxes are arranged in relation to each other, and the adjacent boxes are attached to each other. The attachment is performed by locking elements protruding from inside a tube of a frame of the first box, through a first passage of a first connector, through a first passage of a second connector and into a hollow end of a tube of a frame of the second box.

When two adjacent boxes are connected, the locking element inserted into one of the adjacent connectors, is released and removed, and the locking element inserted in the other connector is released and replaced to extend from a tube of a frame of the first box to a tube of a frame of the second box.

A connector according to the invention may also be used to connect three tubes having hollow ends, perpendicular to each other. A method for such connection will comprise the following steps:

- arranging a connector according to the invention at the hollow ends of the tubes,
- inserting a first locking element through a first passage of the connector and into the end of the first tube, and inserting locking bolts through corresponding holes of the tube and the locking element,
- inserting a second locking element through a second passage of the connector and into an end of the second tube, and inserting locking bolts through corresponding holes in the tube and the element, and
- inserting a third locking element through a third passage of the connector and into an end of the third tube, and inserting locking bolts through corresponding holes in the tube and the element.

If the distal end of one or more of the tubes is free, a locking bolt should preferably also be arranged between the connector and the locking element, in order to prevent that the locking element may be withdrawn from the connector together with the tube. A person skilled in the art would know how to arrange such a locking bolt.

Description of preferred embodiments of the invention

The invention will now be described with the help of the enclosed figures, showing a connector, locking element, frame and framework of a building according to the present invention. The different parts of the figure are not necessarily in scale to each other, as the figure is merely for illustrating the invention.

The following description of an exemplary embodiment refers to the drawing, and the following detailed description is not meant or intended to limit the invention. Instead, the scope of the invention is defined by the appended claims.

Reference throughout the specification to “one embodiment” or “an embodiment” means that a particular feature, structure, or characteristic described in connection with an embodiment is included in at least one embodiment of the subject matter disclosed. Thus, the appearance of the phrases “in one embodiment” or “in an embodiment” in various places throughout the specification is not necessarily referring to the same embodiment. Further, the particular features, structures or characteristics may be combined in any suitable manner in one or more embodiments.

Embodiments of the present invention will now be described, by way of example only, with reference to the following figures wherein:
Figure 1A and B show a connector according to the invention,
Figure 2 shows a locking element according to the invention,
Figure 3 shows a frame as used by the present invention, and
Figure 4 shows a framework of a building constructed by a method according to the invention.

Figure 1A and 1B shows a connector 1 according to the invention, wherein the connectors are laterally reversed to each other. When connecting six frames to a cube, four connectors according to Figure 1A and four connectors according to Figure 1B are needed. Each connector 1 has three members 2, 3, 4 protruding perpendicular from each other from a common center 5, and each member has a through passage 6, 7, 8, to accommodate a locking element 9. In the shown

embodiment, and provided the following members 2, 3, 4 are projecting from the center point 5, the member 2 protrudes parallel along the horizontal plane with a transverse passage 6 in the vertical direction, the member 3 protrudes parallel along the vertical plane with a transverse passage 7 in the horizontal direction perpendicularly to passage 6, the member 4 protrudes parallel along the horizontal plane with a transverse passage 8 in the horizontal direction perpendicularly to both passages 6 and 7. The passages 6, 7, 8, the members 2, 3, 4 all have square cross section, wherein all sides are equally long.

Figure 2 shows the locking element 9 to be inserted into a connector 1 as shown in Figure 1A or 1B, and into a frame 10 of hollow tubes, wherein the ends of each tube is exposed at the corners, as shown in Figure 3. The shown locking element 9 is hollow and has an outer cross section slightly smaller than the cross section of the passages 6, 7, 8 and the exposed openings of the tubes of the frame 10. The shown locking element has three through holes 11, 12, 13 for accommodating a locking bolt (not shown). When the connector 1 and locking element 9 is used to connect three frames 10, just one of the holes 13 is necessary to lock the locking element at the desired place. When the locking element 10 is running from one frame to another frame the other holes 11, 12 are used, securing the locking element to both frames.

The shown frame 10 of Figure 3 is made of four hollow tubes, which are fixed perpendicular and planar to each other, for instance by welding. The hollow ends of each tube are exposed at the corners, and each end of each tube is provided with a through hole 14 for accommodating a locking bolt to fastened the locking element to the frame.

In figure 4 the frames 10, locking elements 9 and connectors 1 are used to build a framework of a building. The left hand side of the figure is shown in exploded view. Two cubes each of six frames 10, are arranged adjacent to each other and fastened by connectors and fastening elements. A similar cube is arranged on top of one of them, and these three cubes may constitute a building having first floor or level being double the size of the second floor. On the left hand side, shown in exploded view,

a cube of smaller size may be added to the two cubes. The locking elements of the adjacent existing or smaller cube are removed, and the remaining locking element is released and inserted into both a frame of the smaller cube, and a frame of the existing cube. Thus expansion of an existing building is easy.

The invention as described above may be embodied in many different forms and should not be construed as limited to any specific structure or function presented throughout this disclosure. Rather, these aspects are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the disclosure to those skilled in the art. Based on the teachings herein one skilled in the art should appreciate that the scope of the disclosure is intended to cover any aspect of the disclosure disclosed herein, whether implemented independently of or combined with any other aspect of the disclosure. Further, the example above and the Figures are given to illustrate the invention, and should not be used to confine the invention as defined in the claims.

Claims

1. Connector (1) for interconnecting square frames (10) within a supporting structure for buildings wherein each frame (10) is prefabricated, -square, -planar, -consisting of four hollow tubes which are attached perpendicular to each other, where at least one hollow tube end is exposed open in each corner of the frame (10), and furthermore the said frames (10) are interconnected perpendicular to each other by using the said connector (1) which comprises three diced members (2, 3, 4) projecting perpendicular from each other from a common center (5), wherein each member (2, 3, 4) has a hollow through passage (6, 7, 8) which is passing transverse to the member's (2, 3, 4) projecting direction, **characterized** in that all three through passages (6, 7, 8) are mutually aligned to freely cross perpendicular past each other, wherein the first through passage (6) runs upwards along a vertical plane which cross perpendicularly past the second passage (7) running along a horizontal plane which cross perpendicularly above the third passage (8) running along an underlying horizontal plane which cross perpendicularly past the first passage (6) along the vertical plane, and further by locking the connector (1) to the frame (10) by using a locking element (9) which is running through the passage (6, 7, 8) and through the hollow corner at the adjacent said frame (10) and partly inside one of the frame's (10) hollow tubes.

2. Connector (1) according to claim 1, where all three through passages (6, 7, 8) cross perpendicularly past each other, held up to a three dimensional Cartesian coordinate system wherein three mutual perpendicular axis; x, y, z, meet in a common point (origin) and forming an inside corner with three mutually perpendicular sides, and further wherein the said connector (1), by comparison, is positioned outside of the said corner where the connector's (1) three members (2, 3, 4) protrude beyond each of the sides of the said corner **characterized** by each of the members (2, 3, 4) through passages (6, 7, 8) are oriented in that each passage (6, 7, 8) runs outside along each of the three said sides and also wherein each passage (6, 7, 8) runs parallel offset along the said projecting corner axis; x, y, z, wherein said parallel offset distance is at least equivalent to the width of the cross section of the respective passage (6, 7, 8) or member (2, 3, 4), which means that all through passages (6, 7, 8) will run past each other at the region where they cross each others directions.

3. Connector (1) according to claim 1 or 2, **characterized** in that the hollow corners of the frame, the members (2, 3, 4) of the connector (1), the locking elements (9) and the passage (6, 7, 8) through each member of the connector, all have square cross section.

4. Connector (1) according to claim 1 or 2, **characterized** in that the outer cross section of each member (2, 3, 4) and the center (5) is identical to the outer cross section of the tubes that constitute the frames (10).

5. Connector (1) according to any one of the preceding claims **characterized** in that the inner cross section of the passage (6, 7, 8) is identical to the inner cross section of the hollow ends of the tubes of the frames (10).

6. Method of connecting three mutually perpendicular square frames (10) which has hollow corners, where the said frames (10) are arranged together so they meet each other in a common corner where they are locked in perpendicular positions to each other by applying the connector (1) according to claims 1-5, in addition to applying the locking elements (9), **characterized** by performing the following steps:

- inserting the first locking element (9) through the first passage (6) of the connector (1) and into a hollow end of the first frame, and locking the element to the first frame,
- inserting the second locking element (9) through the second passage (7) of the connector (1) and into a hollow end of the second frame, and locking the element to the second frame, and
- inserting the third locking element (9) through the third passage (8) of the connector and into a hollow end of the third frame, and locking the element to the third frame.

7. Method according to claim 6, **characterized** in that the locking element (9) is locked to a frame (10) by inserting a locking bolt through corresponding holes (14; 11, 12, 13) in the frame and the locking element.

8. Method according to claim 6, wherein each locking element (9) comprises knobs or something similar protruding outwards from the surface, **characterized** by comprising a further step for pressing the knob into the locking element before the element is inserted into the passage (6, 7, 8), and inserting the element into a hollow end of the tube of the frame (10) until the knob protrudes through a corresponding hole (14) of the frame, locking the element to the frame.

9. System for constructing buildings, through arranging six above said frames (10) to shape a frame box, wherein the frames (10) are interconnected by the method of claim 6-8 at each corner of the frame box, and further execute repetitive compositions to erect a desired number of boxes, then placing them together in the desired order, whereafter the adjacent boxes are connected to each other, **characterized** by inserting the locking element (9) into a hollow corner of the frame (10) on the first box, through the first passage (6) of the first connector (1) and through the first passage of the second connector and into a hollow corner of the frame on the second box.

10. System according to claim 9, **characterized** in that the locking element (9) inserted into one of the adjacent connectors (1), is removed, and the other locking element is released and replaced to extend from a frame of the first box, through a first passage of a first connector and through a first passage of a second connector and into a hollow end of a tube of a frame of the second box.

11. System according to claim 9 or 10, **characterized** in that the locking element (9) is locked to the frame (10) by inserting locking bolts through corresponding holes (14; 11,12, 13) in the frame and the locking element.

Abstract

The invention relates to connecting square frames (10) made of tubes with a connector (1) having three perpendicular members (2,3,4) that accommodate a locking element (9) which runs through a connector passage (6,7,8) into a hollow tube of the frame (10).

The invention further relates to a method for connecting such frames (10) as follows:

- arranging three frames (10) perpendicular to each other and arranging the connector (1) at the intersecting corners of the frames (10),
- inserting the locking elements (9) through connector passages (6,7,8) and into tubes in the frames (10).

The invention also relates to a system for constructing buildings, wherein six such frames (10) are connected to form a box by the method of the invention, and further arranging, connecting and locking a desired number and configuration of boxes, to each other, by such locking element (9) joint in each adjacent corner.