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(71) Applicant: **ABULABAN, TARIK, ALI ALGALA' SQUARE, MAIN STREET, ALJAMAL SWEETS BUILDING, 2ND FLOOR DUMIAT CITY EG EG**

(72) Inventor: **ABULABAN, TARIK, ALI ALGALA' SQUARE, MAIN STREET, ALJAMAL SWEETS BUILDING, 2ND FLOOR DUMIAT CITY EG**

(54) **Title:**
REINFORCED LOAD BEARING STRUCTURE

(57) **Abstract:**
A reinforced concrete load bearing structure in the form, of a concrete begin or slab includes a concrete structuralø member and a hollow element swell as a PVC pipe or steel tube extending through the concrete structural member. The load bearing structure also includes a plurality of steel reinforced rods and steel stamps or rivets formed into a cage like skeleton surrounding the hollow element and being encased la the concrete that forms the concrete structural member. In an alternative form a concrete slab or floor having a length, width and thickness with a plurality of parallel load bearing supports is disclosed. Hie integral support has a rectangular or trapezoidal shape that extends downwardly under the floor with a hollow tube surrounded by a case like structure extending through the support member.

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(71) Applicant *(for KM only)*: **FRISCHKNECHT, Harry** [CH/CH]; c/o Isler & Pedrazzini AG, Gotthardstrasse 53, P.O. Box 1772, 8027 Zurich (CH).

(72) Inventor; and
(71) Applicant : **ABULABAN, Tarik, Ali** [JO/EG]; Algala' square, Main street, Aljamal sweets building, 2nd floor, Dumiat city (EG).

(74) Agent: **FRISCHKNECHT, Harry**; Isler & Pedrazzini AG, Gotthardstrasse 53, Postfach 1772, CH-8027 Zürich (CH).

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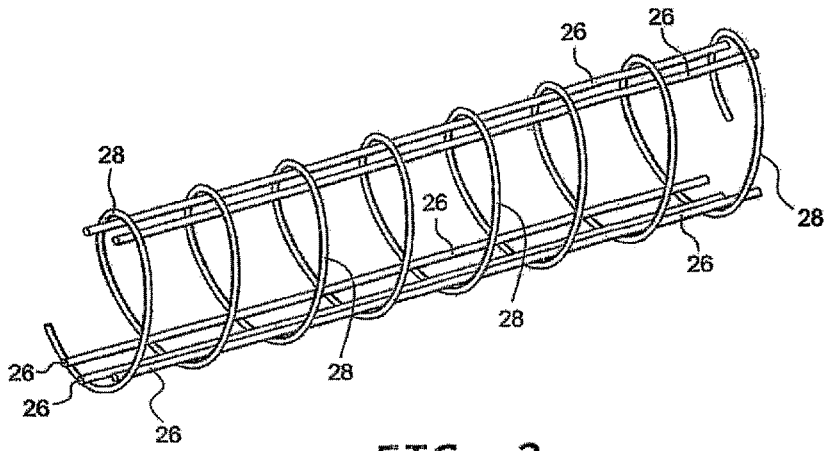

FIG. 2

(57) **Abstract**: A reinforced concrete load bearing structure in the form, of a concrete begin or slab includes a concrete structuralø member and a hollow element swell as a PVC pipe or steel tube extending through the concrete structural member. The load bearing structure also includes a plurality of steel reinforced rods and steel stamps or rivets formed into a cage like skeleton surrounding the hollow element and being encased Ia the concrete that forms the concrete structural member. In an alternative form a concrete slab or floor having a length, width and thickness with a plurality of parallel load bearing supports is disclosed. Hie integral support has a rectangular or trapezoidal shape that extends downwardly under the floor with a hollow tube surrounded by a case like structure extending through the support member.

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REINFORCED LOAD BEARING STRUCTURE

Field of the Invention

This invention relates to a reinforced load bearing structure and more particularly to a concrete load bearing structural member and/or slab with a hollow passageway extending through the structural member or slab.

BACKGROUND FOR THE INVENTION

Reinforced concrete members such as girders, beams and slabs are commonly used in modern buildings. For example, horizontal slabs of steel reinforced concrete typically between 10 and 50 centimeters thick are frequently used to construct floors for buildings. In many industrial buildings, a thick concrete slab supported on a foundation is used to construct the ground floor of a building.

The use of concrete beams, girders and slabs with hollow passages extending therethrough are also known. For example, a U.S. Patent No. 2,938,255 discloses a method for manufacturing beams with longitudinal passages to reduce weight. A more recent apparatus to provide hollow reinforced concrete floors is disclosed in a U.S. Patent of Breuning, No. 5,396,747. The Breuning disclosure utilizes a planar hollow reinforced concrete floor slab with "two dimensional structure" to obtain higher strength and stiffness, less volume of materials, and to obtain a balance between bending forces, shear forces and deformations and reduce the amount of cement.

A more recent concrete floor system and method of making floor components is described in a U.S. Patent No. 7,024,831 of Clark et al. As disclosed therein, the concrete floor system includes a plurality of parallel concrete beams made up of hollow concrete blocks for reducing weight and receiving a tension cable therethrough. Opposite ends of the cable are held on end plates inside recessed ends of each hollow beam. The ends of the beams are adapted for mounting next to the inside of the sides of a foundation wall. A top portion of each parallel beam is adaptive to receive a plurality of angularly shaped floor panels. The floor panels interlock next to the top portion of the beam.

Notwithstanding the above, it is presently believed that there is a need and a potential commercial market for an improved reinforced concrete load bearing structure in accordance with the present invention. There should be a potential market for such structures because the volume of the hollow portions can be tailored for specific applications by using different shapes and materials such as Styrofoam, P.V.C. pipes and steel pipes. For example, the type and shape of materials varies depending on load, span and depth of a beam. In a case where the beam depth is restricted it may be appropriate to use steel pipes or tubes to increase the carrying capacity of a beam.

The improved reinforced load bearing structures in accordance with the present invention can also be used with the following advantages; reducing the weight of the concrete member due to the hollow area to thereby reduce the flexural movement due to the weight. This also means a reduction in cement and steel reinforcement, and increasing the moment of inertia for the member due to the added moment of inertia for the inserted pipe or tube that will lead to a reduction in deflection. The pipe or tube will carry part of the flexural moment and this depends on the pipe material and thickness. The result of applying this approach will provide less slag weight, less steel reinforcement and less cost. Further, the system in accordance with the present invention eliminates the drop beams and makes it possible to prepare and fix the reinforcement steel on the pipes before preparing the slabs and this will reduce the time and cost for workers.

BRIEF SUMMARY OF THE INVENTION

A reinforced load bearing structure in accordance with the present invention includes an outer longitudinally extending concrete load bearing structural member and an inner longitudinally extending hollow element encased within the outer longitudinally extending load bearing structural member. A plurality of reinforcement rods extend through the outer longitudinally extending concrete load bearing structural member and a plurality of stirrups are spaced longitudinally along the inner longitudinally extending hollow element and around

the element. The plurality of stirrups are in contact with the reinforcing rods and encased by the cement or concrete in the outer longitudinally extending load bearing structural member.

In a preferred embodiment of the invention a reinforced load bearing structure includes steel reinforcing rods and steel stirrups that are welded together at their points of contact to form a cage like structure that is spaced from the hollow element.

The invention will now be described in connection with the following figures wherein like reference numerals have been used to designate like parts.

DESCRIPTION OF THE DRAWINGS

Figure 1 is a cross-sectional view of a concrete beam in accordance with a first embodiment of the invention;

Figure 2 is a perspective view of a reinforcement including steel reinforcing rods and steel stirrups as used in the first embodiment of the invention;

Figure 3 is a cross-sectional view of a concrete beam in accordance with a second embodiment of the invention;

Figure 4 is a cross-sectional view of a concrete beam in accordance with a third embodiment of the invention;

Figure 5 is a cross-sectional view of a concrete beam in accordance with a fourth embodiment of the invention; and

Figure 6 is a cross-sectional view of a concrete slab or floor structure in accordance with a fifth embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS OF THE INVENTION

A first embodiment of the invention will now be described in connection with figures 1 and 2. As shown, a longitudinally extending concrete beam 20 includes a longitudinally extending passageway 22 defined by a pipe or tube 23 extending through the beam 20 along its length. The beam 20 also includes a mass of concrete 24 surrounding the tube 23 and in contact therewith. As shown, the beam 20 has a generally rectangular cross-section, however, other shapes may be used for specific applications.

In a preferred embodiment of the invention, a plurality of steel reinforcing rods 26 extend along the length of the beam 20. For example, three longitudinally extending reinforcing rods 26 are provided on a lower side of the beam 20 and two reinforcing rods 26 are provided on an upper side thereof. As shown more clearly in figure 2, a plurality of steel stirrups 28 or rings are spaced apart along the length of the beam 20 and separated from the pipe or tube 23 by a portion of the concrete 24. As shown in figure 2, the steel reinforcing rods and steel stirrups are welded together at their points of contact to form a cage or skeleton.

A second embodiment of the invention is illustrated in figure 3 and is similar to the first embodiment of the invention. For example, the concrete beam 20 has a generally rectangular cross-section and a hollow passageway such as a polyvinyl chloride (PVC) pipe 23 extending through the length of the beam 20. However, in this embodiment of the invention the steel stirrups 38 have a rectangular shape as opposed to the circular stirrups 28 in the first embodiment of the invention. The second embodiment of the invention also includes five longitudinally extending steel reinforcing rods 26 with two of the reinforcing rods disposed in an upper portion of the beam 20 and three reinforcing rods in a lower portion thereof. As illustrated the reinforcing rods 26 are disposed with one reinforcing rod in each corner of the rectangular ring or stirrup 38 and an additional rod 26 is disposed in the bottom portion between the other two steel rods 26 on the lower portion.

Figure 4 shows a third embodiment of the invention wherein the beam 20 has a generally rectangular shape, a rectangular shaped ring or stirrup 38 and a plurality of longitudinally extending reinforcing rods 26 welded at their contacts points to the stirrups 38 in the same manner and positioning as in the third embodiment of the invention. The difference between the second and the third embodiment of the invention resides in the longitudinally extending hollow passageway 32. The hollow passageway 32 is defined by a steel tube 38 with a generally rectangular shaped cross-section as opposed to the PVC pipe in the first and second embodiments of the invention.

A fourth embodiment of the invention is illustrated in figure 5 wherein the beam 20 is basically similar to the third embodiment of the invention. However, in the fourth embodiment of the invention, the hollow passageway is defined by the plastic pipe 22 or steel tube 33 and is replaced by a longitudinally extending light weight solid structure 42 such as a rectangular or round Styrofoam, poly styrene foam element.

A reinforced concrete slab according to a fifth embodiment of the invention is shown in figure 6. The concrete slab 50 defines a concrete base 52 or floor having a first thickness. As shown, the floor or base 52 may include a number of steel reinforcing rods 54 dispersed in a conventional manner as will be well understood by a person of ordinary skill in the art. The slab 50 also includes a plurality of parallel integral support members 60. As shown the support member 60 extend downwardly below the concrete base or floor 52 and have a thickness of about twice the thickness of the floor.

Each of the inner support members 60 includes a longitudinally extending hollow passage 22 as defined by a hollow PVC pipe. As illustrated the support member 60 includes the structure of the second embodiment of the invention. To be more specific, each of the support members 60 include a plurality of longitudinally extending reinforcing rods 26, a rectangular shaped ring or stirrup 38 and a hollow passageway 22 defined by a plastic pipe

23. The concrete slab 50 including the floor 52 and support member 60 are formed in a plastic or wooden mold 65 and rests on a foundation 66 such as a steel girder.

While the invention has been described in connection with its preferred embodiments, it should be recognized that changes and modifications may be made therein without departing from the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A reinforced load bearing structure comprising:

an outer longitudinally extending concrete load bearing structural member and an inner longitudinally extending hollow element encased within said outer longitudinally extending load bearing structural member;

a plurality of reinforcing rods extending through said outer longitudinally extending concrete load bearing structural members; and

a plurality of stirrups spaced longitudinally along said inner longitudinally extending hollow element, and around said element, in contact with said reinforcing rods and encased by said outer longitudinally extending load bearing structural member.

2. A reinforced load bearing structure according to claim 1 in which said reinforcing rods and said stirrups are metal.

3. A reinforced load bearing structure according to claim 2 in which said reinforcing rods and said stirrups are made of steel.

4. A reinforced load bearing structure according to claim 2 in which said plurality of reinforcing rods and said stirrups are joined together at their points of contact.

5. A reinforced load bearing structure according to claim 4 in which said reinforcing rods and said stirrups are welded together at their points of contact.

6. A reinforced load bearing structure according to claim 4 in which said outer longitudinally extending concrete load bearing structural member has a rectangular cross-section.

7. A reinforced load bearing structure according to claim 5 in which said inner longitudinally extending hollow element comprises a steel tube.

8. A reinforced load bearing structure according to claim 5 in which said inner longitudinally extending hollow element is a plastic pipe.

9. A reinforced concrete slab comprising:

a concrete floor having a length, a width and a thickness and a plurality of parallel integral support members or beams running across said floor in a first direction and extending downwardly therefrom with a thickness greater than the thickness of said floor and each of said support members comprising an outer longitudinally extending load bearing structural member and an inner longitudinally extending hollow element encased within said integral support member; and

a plurality of longitudinally extending reinforcing rods extending through said support member and a plurality of stirrups spaced longitudinally along said inner longitudinally extending hollow element around said hollow element and in contact with said reinforcing rods and encased in said support member.

10. A reinforced concrete slab consisting of:

a concrete floor having a length, a width and a thickness and a plurality of parallel integral support members or beams running across and under said floor in a first direction and extending downwardly therefrom with the thickness in the downward direction equal to about two times the thickness of said floor and each of said support members

including an inner longitudinally extending hollow element incased within said support member;
a first plurality of steel reinforcing rods in a planar floor portion and a second plurality of steel reinforcing rods extending longitudinally through said support member and a plurality of stirrups spaced longitudinally along said hollow element and surround said hollow element and each of said stirrups in contact with and welded to said second plurality of steel reinforcing rods to form a cage like structure around said hollow element.

11. A reinforced concrete slab according to claim 10 in which said hollow element is a plastic pipe.

12. A reinforced concrete slab according to claim 10 in which said hollow element is a steel tube.

13. A reinforced concrete slab according to claim 12 in which said hollow element has a rectangular cross-section.

14. A reinforced concrete slab according to claim 10 in which said hollow element is filled with a plastic foam.