Title of the Invention: **A prefabricated wall panel**

Abstract Title: **A prefabricated wall panel with a structural support frame comprising concrete.**

The wall panel 1 has a frame 2 comprising concrete and is suitable for being part of either a structural or non structural wall. The frame may be reinforced by glass fibre or be pre-stressed and may be formed from several frame members joined together or instead be a monolithic frame. The frame is preferably filled with either bricks, blocks or insulation 6. The surfaces of the panel are preferably covered or sheathed in sheeting such as plasterboard or expanded metal reinforcement, the latter for supporting a coat of plaster. The panel may also comprise a breathable membrane on an outer sheathing 14 which may be plywood, oriented strand board (OSB) or cement board. The panel may form the inner leaf of a cavity wall. Also claimed is a kit of parts including studs and couplings for creating said wall panel.
A PREFABRICATED WALL PANEL

The present invention relates to a prefabricated wall panel and in particular to a prefabricated wall panel for the building industry.

A wide range of methods and products are currently available for constructing buildings including blocks and mortar and existing wall panel arrangements such as timber frame wall panels and steel frame wall panels. Timber frame panels are generally provided by timber studs nailed together to form a timber frame. Plywood sheets or oriented strand boards OSB are attached to the main opposing surfaces of the timber frame to form the panel. These timber frame panels can be efficiently constructed offsite and have good thermal values, energy efficiency and accuracy. However, the timber frame panel’s fire rating is dependent on plasterboard being fixed to the panel. Furthermore, upper floors are normally constructed with timber or steel web joists and additional floating floor materials are required in apartments to meet current building regulations. Whilst providing a reasonable solution, the timber floors, engineered I joists, metal or timber webbed joists have limitations and Noise transmission, fire regulations and shrinkage can also be a problem.

The steel frame wall panels are made from light gauge steel studs either offsite or onsite and can be sheathed in a similar manner to the timber frame panels. These type of panels are regularly used for internal partitions in office buildings and have no shrinkage issues. However, the steel frame wall panels can be more expensive and again require plasterboard attached to the steel frame to afford the panel sufficient fire protection. Structural insulated panels SIP are another arrangement of wall panel currently available generally comprising a polyisocyanurate PIR insulation layer sandwiched between two OSB boards. These SIP panels have very good thermal values and better fire ratings than timber frame wall panels. However, these panels are more expensive in comparison to timber frames and do not adequately address the fire issues associated with structural timber wall panels.

The traditional blocks and mortar building technique will allow concrete floors to be laid for upper floors and there are no issues with shrinkage, fire or sound proofing. However,
the thermal values are low and the building process is labour intensive and more difficult to manage than panel systems. The blocks and mortar approach is also struggling to meet new government codes for sustainable homes.

It is an object of the present invention to obviate or mitigate the problems of alternative building products outlined above.

Accordingly, the present invention provides a prefabricated wall panel for building walls having a structural support frame comprising concrete.

Use of the term concrete encompasses any type of building material having a binder such as cement for bonding aggregates to form a strong building material which is durable in the face of normal environmental effects. Recent terms describing specific forms of concrete such as limecrete and hemcrete are included within the term concrete.

Preferably, the structural support frame extends along the periphery of the prefabricated wall panel.

Ideally, the structural support frame is reinforced.

Preferably, the structural support frame is pre-stressed.

Advantageously, the structural support frame of reinforced or pre-stressed concrete is structurally capable of supporting concrete floors to be used for upper floors.

Furthermore, this type of prefabricated wall panel provides the builders with the convenience of a prefabricated building whilst maintaining a good fire rating and sound insulation which are also problems for the building panel arrangements described above. Advantageously, this construction of prefabricated wall panel will combine the benefits of speed and accuracy of prefabricated panels with greater structural capabilities.

Ideally, the prefabricated wall panel is suitable for forming structural support walls. Advantageously, the wall panel can be used as part of the main outer support wall of a building.

Preferably, the prefabricated wall panel is suitable for forming non structural support walls. Advantageously, the wall panel can be used to provide walls such as internal divider walls.
Preferably, the structural support frame has a generally quadrangular construction.

Ideally, the structural support frame is a monolithic frame. Advantageously, the structural support frame is formed in a bespoke mould.

In an alternative arrangement, the structural support frame comprises a plurality of discrete precast frame members mechanically fixed together by approved mechanical fixings.

Ideally, the inner space of the frame is filled with an insulation means. Any type of insulation suitable for the construction industry can be used.

Alternatively, the inner space of the frame is filled with building components such as bricks or blocks. Advantageously, these building components can be plastered like a normal block wall.

Preferably, one main surface of the prefabricated wall panel has a sheet of plasterboard attached thereto.

Ideally, an internal sheathing member of the prefabricated wall panel is a sheet of plasterboard. Alternatively, an expanded metal reinforcement is attached to the structural support frame for supporting a coat of plaster.

Ideally, the other main surface of the prefabricated wall panel comprises an outer sheathing member.

Preferably, the outer sheathing member provides additional support to the prefabricated wall panel.

Ideally, the outer sheathing members is provided by plywood, osb, or cement boards.

Preferably, the outer sheathing member has a breather membrane.

Preferably, the prefabricated wall panel forms the inner leaf of a cavity wall.

Ideally, the prefabricated wall panel is restrained to the outside leaf of the cavity wall or to the lower inside leaf by a metal restraint fixing.

Preferably, the structural support frame of the prefabricated wall panel comprises four main reinforced or pre-stressed studs mechanically fixed together at their joints by fixing members.
Ideally, the fixing members comprise approved fixings.

Preferably, the fixing means are suitable to be drilled, shot fired or chemically fixed.

Preferably, one or more divider means are provided within the structural support frame. Advantageously, the divider means are provided for defining window and door openings within the structural support frame of the prefabricated wall panel.

Ideally, the divider means are provided by studs manufactured from concrete.

Preferably, the divider means are provided by wooden stud frame members.

Ideally, the divider means are mechanically fixed to the structural support frame.

Preferably, the divider means are mechanically fixed to the structural support frame using any suitable mechanical connection.

Preferably, at least part of one or more precast frame members and/or studs of the structural support frame has a cavity, preferably central and preferably elongate axially.

Advantageously, the cavity is filled with an insulation material.

Ideally, at least one stud has a cavity. Advantageously, the cavity is filled with an insulation material.

Preferably, the vertical studs have a cavity.

Ideally, the vertical studs comprise glass fibre reinforced concrete.

Preferably, a glass fibre reinforced concrete is used for at least part of the structural support frame.

Ideally, the glass fibre reinforced concrete material is used for at least part of one or more of the precast frame members or studs of any embodiment of the invention.

Accordingly, the present invention provides a kit of parts for assembling a prefabricated wall panel comprising a plurality of discrete concrete studs and fixing means for mechanically coupling the plurality of concrete studs together into a prefabricated wall panel. Advantageously, all of the embodiments described above other than the prefabricated monolithic frame can be delivered to the construction site in this kit of parts and assembled at the building site. Advantageously, all of the additional features described in relation to the prefabricated wall panel above can also be used with the kit of parts.
The invention will now be described with reference to the accompanying drawings which show by way of example only seven embodiments of a prefabricated wall panel in accordance with the invention. In the drawings:-

Figure 1 is a partial perspective view of a wall panel;

Figure 2 is a partial section view of the wall panel of Figure 1 built into an external wall of a building;

Figure 3 is a partial perspective view of Figure 2;

Figure 4 is a partial perspective view of a second embodiment of prefabricated wall panel;

Figure 5 is a perspective view of a second embodiment of prefabricated wall panel;

Figure 6 is a perspective view of a first embodiment of structural support frame of a prefabricated wall panel;

Figure 7 is a perspective view of a second embodiment of structural support frame of a prefabricated wall panel;

Figure 8 is a perspective view of a third embodiment of structural support frame of a prefabricated wall panel;

Figure 9 is a perspective view of a fourth embodiment of structural support frame of a prefabricated wall panel;

Figure 10 is a perspective view of a fifth embodiment of structural support frame of a prefabricated wall panel;

Figure 11 is a perspective view of a sixth embodiment of structural support frame of a prefabricated wall panel; and

Figure 12 is a perspective view of a seventh embodiment of structural support frame of a prefabricated wall panel.

In the drawings, there is shown a prefabricated wall panel indicated generally by the reference numeral 1 for building walls comprising a structural support frame 2 see especially Figures 6 to 12 of concrete which can be reinforced or pre-stressed. Advantageously, the
structural support frame 2 of the prefabricated wall panel 1 allows concrete floors to be used for upper floors. This is in contrast to the alternative arrangement of prefabricated building panels outlined above where timber floors are normally installed for upper floors. Furthermore, this type of wall panel 1 provides the builders with the convenience of a prefabricated building whilst maintaining a good fire rating and sound insulation which are also problems for the building panel arrangements described above. Advantageously, this construction of wall panel 1 will combine the benefits of speed and accuracy of prefabricated panels with greater structural strength in combination with a sheathing material and internal divider studs.

The prefabricated wall panel 1 is suitable for forming structural support walls, see especially Figure 2. Advantageously, the wall panel 1 can be used as part of the main outer support structure of a building see especially Figures 2 and 3. The prefabricated wall panel 1 is also suitable for forming non structural support walls. Advantageously, the wall panel 1 can be used to provide walls such as internal divider walls. The inner space 5 of the structural support frame 2 can be filled with any suitable insulation 6. Figure 4 shows an alternative embodiment of prefabricated wall panel 1 where the inner space 5 is filled with building blocks 13 suitable for use as internal walls or party walls between dwellings.

One main surface of the wall panel 1 has a sheet of plasterboard 8 attached thereto. Generally, the sheet of plasterboard 8 provides the internal layer of the wall. The sheet of plasterboard 8 has a vapour control layer 11 which is provided by a polythene vapour barrier.

The other main surface of the wall panel 1 has an outer sheathing member 14 provided by a sheathing board 14. The outer sheathing member 14 also has a breather membrane 15 attached on the outer face 16 of the outer sheathing member 14 when it comprises a wooden based material.

Referring particularly to Figures 2 and 3, the prefabricated wall panel 1 forms the inner leaf 21 of a cavity wall indicated generally by reference numeral 22. A horizontal bottom rail 19 of the prefabricated wall panel 1 is mounted on foundations 20 of the building and the prefabricated wall panel 1 is restrained to the outside leaf 23 of the cavity wall 22 by
a strap member 24. The strap member 24 is built into a mortar joint 25 between courses of
bricks 26 or blocks and the other end of the strap member 24 is fixed to the prefabricated
wall panel 1. Figure 5 shows an alternative construction of vertical studs 31 manufactured in
the form of I-beams and generally spaced at 600 mm, which spacing is applicable to all
embodiments. Figure 5 also highlights the requirement for overlapping of the vapour barrier
15 in alignment with the studs 31 at location A by a minimum of 100 mm.

Referring to the drawings and now to Figures 6 to 12, the structural support frame 2
has a generally quadrangular construction. Figure 6 shows the most basic form of structural
support frame 2 which is provided by a rectangular frame 31. Figure 7 shows a second
embodiment of structural support frame 2 which is provided by a substantially square outer
frame 32 with a single vertical divider member 33 splitting the internal space of the structural
support frame 2 into two equal rectangular areas 34, 35. It will of course be appreciated that
the divider member 33 can be set anywhere along the length of the structural support frame
2 to divide the internal area up as required. The divider member 33 can be provided by
using any of the materials used in the structural support frame 2 or using an alternative
material such as timber studs.

Figure 8 shows a third embodiment of structural support frame 2 which is provided by
a substantially square outer frame 32 with two vertical divider members 33 spaced apart
splitting the internal space of the structural support frame 2 into three equal rectangular
areas 34, 35 and 36. Two additional horizontal divider members 37, 38 are mounted
between the two vertical divider members 33 creating an aperture suitable for supporting a
window, not shown. It will of course be appreciated that the vertical divider members 33 and
the horizontal divider members 37, 38 can be set anywhere along the length and height
respectively of the structural support frame 2 to divide the internal area up as determined by
the design of the building. The divider members 33, 37 and 38 can be provided by using any
material used for the structural support frame 2 or an alternative material such as timber
studs.
Figure 9 shows a fourth embodiment of structural support frame 2 which is provided by a substantially square outer frame 32 with two vertical divider members 33 spaced apart splitting the internal space of the outer frame 2 into two substantially equal rectangular areas 34, 35 and a third larger central area 36. One additional horizontal divider members 37 is mounted between the two vertical divider members 33 creating an aperture 36 suitable for supporting a door, not shown. It will of course be appreciated that the vertical divider members 33 and the horizontal divider member 37 can be set anywhere along the length and height respectively of the structural frame 2 to divide the internal area up as determined by the design of the building. The divider members 33 and 37 can be provided by using any material used for the structural support frame 2 or an alternative material such as timber studs.

Figure 10 shows a fourth embodiment of structural support frame 41 which is provided by a trapezium shaped outer frame 42 with two vertical divider members 43 splitting the internal space of the outer frame 2 into three trapezium shaped areas 44, 45 and 46. Two additional horizontal divider members 47, 48 are mounted between the two vertical divider members 43 creating an aperture 49 suitable for supporting a window, not shown. It will of course be appreciated that the vertical divider members 43 and the horizontal divider members 47, 48 can be set anywhere along the length and height respectively of the structural frame 41 to divide the internal area up as required. The divider members 43, 47 and 48 can be provided by using any material used for the structural support frame 41 or using an alternative material such as timber studs. This prefabricated wall panel 1 is suitable in areas where non-uniform walls are required to be built such as the gable of a wall construction.

Figure 11 shows a fifth embodiment of structural support frame 51 which is provided by a trapezium shaped outer frame 52 with two vertical divider members 53 splitting the internal space of the structural support frame 2 into three unequal trapezium shaped areas 54, 55 and 56. It will of course be appreciated that the divider members 53 can be set anywhere along the length of the structural support frame 51 to divide the internal area up as
required. The divider members 53 can be provided by using any material in the structural support frame 51 or using an alternative material such as timber studs. This prefabricated wall panel 1 is suitable in areas where non uniform walls are required to be built such as the side panels for dormer windows.

In all of the embodiments shown, the structural support frame 2, 41, 51 is provided by a monolithic frame which can be pre-stressed or reinforced. Advantageously, the structural support frame 2, 41, 51 is formed in a bespoke mould. In an alternative arrangement, the structural support frame 2, 41, 51 comprises a plurality of discrete reinforced or pre-stressed stud members 31 mechanically fixed together.

In this alternative arrangement, the structural support frame 2, 41, 51 comprises four main reinforced or pre-stressed studs 31 mechanically fixed together at their joints by fixing members. The fixing members comprise fixings which can be drilled, shot fired or chemically fixed. The divider members 33, 37, 38, 43, 47, 48, 53 are mechanically fixed to the structural support frame 2, 41, 51 using any suitable approved fixings.

Referring to the drawings and now to Figure 12, there is shown a seventh embodiment of structural support frame where the studs 61 have a central cavity which is hollow or alternatively is filled with an insulation material 62. A further insulation material 63 is provided between the studs 61 and an external sheathing member 64 is connected to the studs 61.

It will of course be appreciated that glass fibre reinforced concrete can be used with all or a part of the precast frame members and/or the studs or the monolithic frame of any embodiment of the invention. In one specific embodiment, 80 kg of glass fibre is mixed with 2400 kg of concrete as an example only.

The features disclosed in the foregoing description or the following drawings, expressed in their specific forms or in terms of a means for performing a disclosed function, or a method or a process of attaining the disclosed result, as appropriate, may separately, or in any combination of such features be utilised for realising the invention in diverse forms thereof as defined in the appended claims.
CLAIMS

1. A prefabricated wall panel for building walls having a structural support frame comprising concrete.

2. A prefabricated wall panel as claimed in claim 1, wherein the structural support frame extends along the periphery of the prefabricated wall panel.

3. A prefabricated wall panel as claimed in claim 1 or claim 2, wherein the structural support frame is reinforced.

4. A prefabricated wall panel as claimed in claim 1 or claim 2, wherein the structural support frame is pre-stressed.

5. A prefabricated wall panel as claimed in any one of the preceding claims, wherein the prefabricated wall panel is suitable for forming structural support walls.

6. A prefabricated wall panel as claimed in any one of the preceding claims, wherein the prefabricated wall panel is suitable for forming non structural support walls.

7. A prefabricated wall panel as claimed in any one of the preceding claims, wherein the structural support frame has a generally quadrangular construction.

8. A prefabricated wall panel as claimed in any one of the preceding claims, wherein the structural support frame is a monolithic frame.

9. A prefabricated wall panel as claimed in any one of claim 1 to 7, wherein the structural support frame comprises a plurality of discrete precast frame members mechanically fixed together by mechanical fixings.

10. A prefabricated wall panel as claimed in any one of the preceding claims, wherein the inner space of the frame is filled with an insulation means.

11. A prefabricated wall panel as claimed in any one of claims 1 to 9, wherein the inner space of the frame is filled with building components such as bricks or blocks.

12. A prefabricated wall panel as claimed in any one of the preceding claims, wherein one main surface of the prefabricated wall panel has a sheet of plasterboard attached thereto.
13. A prefabricated wall panel as claimed in any one of the preceding claims, wherein an internal sheathing member of the prefabricated wall panel is a sheet of plasterboard.

14. A prefabricated wall panel as claimed in any one of the preceding claims, wherein an expanded metal reinforcement is attached to the structural support frame for supporting a coat of plaster.

15. A prefabricated wall panel as claimed in any one of the preceding claims, wherein another main surface of the prefabricated wall panel comprises an outer sheathing member.

16. A prefabricated wall panel as claimed in claim 15, wherein the outer sheathing member provides additional support to the prefabricated wall panel.

17. A prefabricated wall panel as claimed in claim 15 or 16, wherein the outer sheathing member is provided by plywood, osb, or cement boards.

18. A prefabricated wall panel as claimed in any one of claims 15 to 17, wherein the outer sheathing member has a breather membrane.

19. A prefabricated wall panel as claimed in any one of the preceding claims, wherein the prefabricated wall panel forms the inner leaf of a cavity wall.

20. A prefabricated wall panel as claimed in any one of the preceding claims, wherein one or more divider means are provided within the structural support frame.

21. A prefabricated wall panel as claimed in any one of the preceding claims, wherein at least part of one or more precast frame members and/or studs of the structural support frame has a cavity.

22. A prefabricated wall panel as claimed in any one of the preceding claims, wherein glass fibre reinforced concrete is used for at least part of one or more of the precast frame members or studs of the structural support frame.

23. A kit of parts for assembling a prefabricated wall panel comprising a plurality of discrete concrete studs and fixing means for mechanically coupling the plurality of concrete studs together into a prefabricated wall panel.
24. A prefabricated wall panel substantially as hereinbefore described with reference to
and/or as shown in the accompanying drawings.
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:\(^{X}\):

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