(54) Title of the Invention: Prefabricated building for use as temporary or semi-permanent housing  
Abstract Title: Building with rain water collecting roof and reservoir in walls

A prefabricated building is supplied in kit form. It comprises a plurality of roof trays (3), each having a base (3c) and upstanding sides (3a, 3b) to provide a collector for rainwater. A set of blocks (2) is stackable, one on top of the other, to form a wall. Blocks for at least an upper section of the wall are adapted to provide a reservoir in a hollow portion of the block for storing rainwater that has been collected by the roof panels. Blocks (2) in a lower section of the wall may be adapted to be loaded with ballast or may be supplied pre-filled with an insulating material. A plurality of trays (25) similar to the roof trays (3) are provided to serve as a floor. The prefabricated building is supplied with solar lamps that slot into holes provided in the roof trays (3).
Prefabricated Building for use as Temporary or Semi-Permanent Housing

The present invention relates to a prefabricated building and to a prefabricated building in kit form. Its primary purpose is for providing emergency shelter and other forms of accommodation in disaster areas. However the present invention is not limited to such accommodation and the prefabricated building has many other applications including non-emergency domestic applications, leisure applications, storage applications, and protection uses, for example as construction site offices and garden rooms.

Emergency shelters of many forms are already known. The shelters need to be made cheaply, erected quickly and transported easily.

One problem identified with tents and other such temporary structures is that they do not provide a long term solution, and at most only provide some shelter against the elements but are ineffective against high winds, heavy rain, mosquitoes and earth tremors. The current temporary solutions only provide a very basic level of accommodation, usually with poor levels of privacy, security and hygiene. They do not offer the person or family that has been made homeless by a disaster with much in the way of a sense of "well-being" and they cannot really be called a home.

The known temporary structures also do not provide a sustainable environment for the occupant. In many instances, the shelters need to be erected where supplies of clean water and electricity are simply not available.

Viewed from a first broad aspect, according to the present invention there is provided a prefabricated building in kit form comprising:

- a set of roof panels that are connectable together to form a roof of the prefabricated building, the roof panels each having a base and upstanding sides to provide a collector for rainwater;

- a set of blocks to form one or more walls of the prefabricated building, the blocks being stackable, one on top of another, to form a wall, wherein blocks intended for an upper section of the wall are adapted to provide a reservoir in a hollow portion of the block for storing rainwater that has been collected by the roof panels.
The prefabricated building of the present invention provides an affordable, sustainable
housing solution that offers temporary and/or semi-permanent housing that meets basic
humanitarian needs. The building can be used as emergency accommodation, as well as
other uses as mentioned above. It can be built easily by two/three people very quickly
indeed, for example in a few hours, and in many situations in less than an hour. It
provides a robust building that is sufficiently watertight and which may be insulated
naturally (or pre-insulated) to provide protection from heat, cold, wind and rain, while
offering security, privacy and dignity to the occupier. Moreover blocks in an upper section
of a wall or the walls (preferably an uppermost section) provide a reservoir for harvested
rain that has been collected by the roof of the building. Thus the building is able to store
rainwater for the occupier(s) as well as providing a shelter.

Preferably the blocks provide a reservoir within the walls of the building that can retain
over 150 litres of rainwater harvested by the roof, per building, more preferably over 250
litres, more preferably still over 350 litres, and in the most preferred embodiments the
reservoir has a capacity of over 450 litres per building. In one embodiment, the entire
upper section of each wall (preferably the top block of each side and rear wall) provides a
reservoir function and over 475 litres of rainwater can be retained per building at full
capacity. The reservoir may be split into different sections, in order to prevent one
becoming contaminated if there is an infection in another. The building preferably
comprises an irrigation system to fill up the rainwater reservoir(s) inside the building. The
rainwater can be used to feed a tap, preferably a tap provided above a sink fitted to the
building, preferably internally of the building. A filter system may be provided in the
irrigation system to keep the water clean for drinking. Preferably it is a special
contaminated water filter system in order to provide clean drinking water. Preferably the
filter system has an anti-bacterial function to keep the harvested water fresh. In one
embodiment pipework is provided to pipe used water from the sink to an external toilet.

Viewed from another aspect, there is provided a building that has been made from
prefabricated sections comprising:

- a roof formed from a plurality of roof panels that are connected together, the roof
  panels each having a base and upstanding sides to provide a collector for rainwater;
- one or more walls formed from blocks which have been stacked, one on top of
  another to form a wall, wherein blocks in an upper section of the wall are adapted to
provide a reservoir in a hollow portion for storing rainwater that has been collected by the roof panels.

Preferably the lower section of the walls, most preferably the lowest section of the walls, but indeed other sections too, are made from blocks that are preferably filled with ballast on site. The blocks are hollow and lightweight, and can be moulded, for example, from plastics or reinforced plastics such as glass reinforced plastics. The ballast provides weight and stability to the structure and may comprise any type of material that is available where the building is constructed. This need not be all the blocks of a lower section, but enough to provide sufficient weight and stability to make the building safe for local weather conditions.

This concept of loading the lower blocks with ballast that is available on-site is inventive in its own right and accordingly the present invention, when viewed from another broad aspect, can be seen to provide a building made from prefabricated sections comprising:

- a roof formed from a plurality of roof panels, preferably in the form of prefabricated trays, each roof panel having a base and upstanding sides, the roof panels being connected together, side by side, to form the roof; and
- one or more walls formed from prefabricated hollow blocks, which are stacked, one on top of another, to form a wall, the blocks in at least a lower section of the wall having been loaded with ballast during construction of the building.

Also, viewed from another aspect, the present invention can be seen to provide a corresponding kit of parts for constructing a prefabricated building, comprising:

- a plurality of roof panels, preferably in the form of prefabricated trays, for forming a roof, each roof panel having a base and upstanding sides, the roof panels being connectable together, side by side, to form the roof; and
- prefabricated hollow blocks for forming one or more walls, the blocks being stackable to form a wall, wherein the blocks intended for a lower section of the wall are provided with an opening for loading ballast during construction of the building.

In these arrangements, the building preferably includes any of the preferred features already previously mentioned, and vice versa, any features mentioned in relation to these arrangements can be used with any of the other arrangements described herein.
Preferably at least half of the available blocks (for example, the available blocks may be the blocks in the lower section corresponding to around one third of the total blocks for the building, and half of these available blocks may be the lower row of a total of two rows in a lower section) are loaded with ballast. More preferably at least 70% of the available blocks (e.g., 70% of the lower section) are filled with ballast, yet more preferably more than 85%. Most preferably all of the available blocks of the building (e.g. all the blocks in a lower section) contain some ballast of one form or another. Blocks of an upper section might also be loaded with ballast too. The ballast may comprise, for example, sand, rubble, gravel, concrete, aggregate, clay, timber, or even liquids such as freshwater (e.g., rainwater) and seawater. Snow or ice could even be used as a ballast in colder climates where available. The blocks could contain a mixture of ballast types depending on what is available. In colder climates, the blocks may be filled with compostable materials that can generate heat for the building.

Cloth or film sacks may be provided for filling with ballast, in order to make filling of the wall cavities easier and, where required, allow the removal of materials to be carried out efficiently when the building is taken down for re-use in another location. Cloth or film sacks are preferably made from recycled materials.

The ballast also provides thermal mass insulation in addition to weight. Low U values, which are the overall heat transfer coefficient of a given material, can be achieved using substances like sand, soil, concrete and even water. For example, sand and concrete in the thicknesses proposed are reported to have U values of around 0.8 W/m²K and water a U value of around 0.93 W/m²K. Accordingly, in preferred embodiments of the present invention, the U value of the building, or the blocks at least, is less than 2 W/m²K, more preferably less than 1.5 W/m²K, and most preferably is approaching a value of 1 W/m²K or lower.

Section(s) other than the lower section of the walls (or indeed also including blocks from a lower section) may be filled with a lightweight material providing high insulating properties, such as a gel or foam, e.g. a soya foam. Other materials could also be possible such as plant products such as straw or hay, lightweight wood such as balsa, cane fibres, animal products such as wool, hair or fur, or even bird feathers or down where available. Alternatively a man-made product such as an expandable plastics foam could be such, for example, polystyrene or polyurethane.
A heat reflective film or membrane could be incorporated into the block (e.g., inserted in the cavity) to provide additional insulation. In one embodiment, the block is provided with a panel of insulating material. This could be a panel of insulating material that is sandwiched between heat reflecting films applied to the main surfaces of the panel. The blocks could be fitted with insulating material either on-site or during prefabrication. The block may be provided with an end cap to close off an access opening or could be supplied as a sealed block with the insulating material already in place. The building comprising blocks filled with insulating material, for example, in the form of panels with heat reflective films, preferably incorporates the harvested rainwater reservoir of the first arrangement. The building may also include some blocks filled with ballast to provide the building with some mass to resist strong winds. The building may also be tethered to the ground as necessary, for example through one or more ground anchors that secure the building to the ground via the floor structure. Metal plates, for example steel plates, may be fixed under the floor structure in the corners and coupled to the corner posts to assist with securing the building to the ground with such anchors.

The building preferably also comprises a framework of struts arranged to tie the blocks together and to interconnect wall panels formed by the blocks. Preferably a strut (post) is provided at each corner of the building and a further strut (beam) is provided along the top of each wall. A further strut (beam) may be provided along the base of the building and/or additional struts (posts) may be provided at intermediate positions within a wall panel or within the building. The framework of struts provides a structural cage for the building comprising a ring beam around the top and bottom perimeters of the building, that the roof and preferably a floor, which is/are structural elements in their own right, can be fixed to. The two ring beams are held spaced apart by the series of vertically extending posts. Preferably the posts extend substantially vertically, though conceivably arrangements would be possible where the posts are inclined towards one another to provide triangulation to the structure. The framework of struts also ties the blocks of the wall together to prevent them separating and to hold them securely in place. The struts may be connected to each other with bolts or any suitable fastener. The struts can be made by extrusion, but most preferably formed by pultrusion or moulding to keep the tooling costs as low as possible.
If required, the building can be dismantled within hours and re-used again and again. When empty of ballast the building can be neatly packed away and carried by two or more people. The prefabricated building is a lightweight construction. Even blocks that are sealed with a lightweight insulating material inside will still be lightweight and relatively easy to carry. Preferably the prefabricated building is made of plastics, in particular recycled plastics, and in the most preferred embodiments, 100% recycled plastics from landfill waste. The mixture of plastics is preferably chosen so that it is 100% recyclable. With a careful choice of materials and features, it is possible to make the building properly "zero carbon". For example, it is possible to use 100% recycled plastics that are in turn capable of being 100% recycled, with the buildings using only natural resources, for example, sun, rain and available thermal mass insulation to provide the sustainable home. Preferably the plastics are flame retardant. The plastics materials can also be reinforced with fibres or particles. One preferred class of materials is glass reinforced plastics (GRP). Preferably the chosen materials, for example, the different plastics for the trays, blocks and struts, are operational through a temperature range of -20°C to +40°C and have a service life in excess of 20 years. The plastics structure has the advantage that it can also be cleaned and sterilised easily to help prevent spread of disease.

The building is fast and easy to assemble, requiring a minimum of tools on site. There is also only a minimum of on-site ground works required. The ground needs to be levelled as far as possible, but material from the site can be used to fill the hollow blocks as ballast. If required, shims may be provided or formed on site from timber or other suitable material, in order to provide a level base. The building may have an earth floor, but more preferably the building is provided with a raised floor (e.g., flat floor panels supported on beams) to provide insulation, and more preferably it is provided in the form of a raised modular floor.

Preferably the roof panels are prefabricated trays, having a base, preferably a rectangular base, most preferably an elongate rectangular base (e.g., a length greater than twice the width), and upstanding sides, preferably around the entire perimeter of the tray. The base may be provided with a non-slip surface or areas. The upstanding sides provide rigidity to the roof panels. When two trays are connected together a vertical strut is created of double thickness material that is arranged perpendicularly to the base of the roof. The upstanding sides are preferably greater than 100 mm tall, more preferably
equal to or greater than 150 mm tall, and in the most preferred arrangements are between 160 and 200 mm tall or taller. This provides the capacity to collect a substantial amount of rainwater during a downpour, but the roof must also have the strength not to collapse under the weight of the collected water. Preferably the roof has two or more panels (trays) arranged side by side, more preferably three panels (trays). In such an embodiment, the vertical struts created by the joined upstanding sides are provided at one third and two thirds the way across the roof. It would also be possible to have more than three panels (trays) depending on the relative dimensions of the trays and the dimensions of the rest of the building, for example, for larger buildings.

Other arrangements of trays are also possible and may have applications for certain types of building. For example, one or more of the roof trays could be arranged the other way up to adjacent trays. One embodiment is envisaged where the roof comprises three trays, two arranged the normal way up for use as rainwater collectors, the other arranged between them the other way up. This arrangement of trays allow the sides to project from the base at an angle that is inclined steeply to it rather than being substantially perpendicular to the base. In order to facilitate release from a mould, it is likely that the tray sides will be inclined slightly in any event, e.g., a few degrees. However with the alternating arrangement it allows the sides to be inclined more steeply e.g., opening the possibility for the trays to nest one inside the other for transportation, while at the same time ensuring that the sides will butt up to and against each other (with a side of one tray flat against the side of the adjacent tray), to give rigidity to the roof. Arranging the trays in an alternating manner also enables the sides of the tray to lie easily against each other without leaving gaps. The upturned tray would also increase the headroom within the building underneath the tray. A disadvantage is that there would be less rainwater capture area.

With the ability to support such a weight of rainwater, the reinforced roof structure is also able to provide a platform for the building occupier(s) to seek escape from rising flood waters. A ceiling hatch may be provided to give an emergency exit.

A tray shape for each roof panel is naturally suited to collecting rainwater and provides many other advantages as will be elaborated on below. However the tray need not have upstanding sides around its entire perimeter. For example, where it is incorporated into a building having a pitched roof, a higher upstanding side need not be present for the panel
to collect rainwater though would preferably be present for strength. In one embodiment
the roof panel is a tray that has more of a box shape through the provision of slats or an
additional upper surface with a set of holes that allow rainwater to penetrate and to collect
on the base surface.

Preferably the roof is fitted with one or more solar powered lamps. Most preferably, one
or more (preferably circular) holes are cut in each roof panel and a solar powered lamp is
inserted therein. Preferably each lamp has its own solar cell.

Preferably the solar powered lamp comprises a housing that, when fitted, penetrates
through a roof panel of the building, the housing having an electricity generating portion at
a head end that incorporates a solar cell and sits on an upper surface of the roof panel,
and a light generating portion incorporating one or more lamps at a tail end that extends
below the roof panel into the interior space of the building. The solar powered lamp may
incorporate flanges to seal against both sides of the roof panel and these may be
clamped together against the respective surface of the roof panel using fasteners, such
as nuts and bolts. In another arrangement, the housing comprises a threaded neck and a
locking ring is provided that screws onto the neck below the roof panel to clamp the head
end against the upper surface of the roof panel. The lamp preferably has a set of LEDs
at its tail end to illuminate the room. Depending on the componentry within the solar
lamps, preferably the lamps are configured to provide illumination within the building for at
least 4 to 6 hours, more preferably longer.

The building preferably further comprises a floor comprising a plurality of floor panels.
Preferably these floor panels are trays similar to or identical to those of the roof, e.g., of
the same shape and dimensions. They are instead used in an inverted configuration with
the base of the trays providing a raised floor surface. This gives insulation to the floor of
the building and rigidity to the structure. The floor panels are preferably provided with a
non-slip surface on their top surface. The downwardly extending sides (the upstanding
sides of the trays) help to reinforce the floor to an adequate extent. Preferably the roof
trays and the floor trays are made from the same or identical mould.

Some of the blocks may be made of a translucent or light permeable material. In this
way, depending on the material provided in the block, it can allow light from outside to
enter the building. Similarly light provided within the building can also pass through the
block to provide light for the area around the building, for example, providing a low
ambient light for a camp of buildings.

The blocks in the lower section for retaining ballast or other higher performance insulating
material may be made of the same material as the ones in the upper section providing the
reservoir. All the blocks are preferably made from the same or identical mould in order to
minimise tooling. The only difference may be an opening provided in the ballast filled
blocks to allow loading of ballast, which may be formed by a blanking plate during
moulding or may be cut out at the factory or on site.

Preferably the building has a square or rectangular footprint. Other footprint shapes are
possible, e.g., other polygonal shapes such as hexagonal, but a square footprint has
other advantages in terms of how the prefabricated building sections and components
can fit together when stowed making it easier to ship to where it is needed. Preferably
the building has a flat roof too, as this simplifies construction and allows the blocks
forming the walls to be all the same shape as the tops of the walls will be flat too. The
blocks may be of any size, though preferably they are of a height such that they can be
stacked three high to form a wall, preferably a wall of around 2.0 m to 2.5 m high,
allowing the two lower blocks to be filled with ballast or an insulating material and the top
block to be used as a reservoir. In one preferred embodiment a wall (e.g., for the sides or
rear of the building) comprises six blocks: two stacks of three arranged side by side as
two half wall sections. Preferably three out of four walls of the building are formed in this
way. Other block arrangements are also envisaged where the wall is made of a different
number of blocks stacked on top of each other (e.g., two, four, five, six etc.,) or arranged
side by side (e.g., three, four, etc.,). The blocks preferably have flat sides to allow flat-
packing. They may be moulded in two parts which are welded or joined together at the
factory or on site. They are also preferably quite shallow from front to back, e.g. 0.1m
deep or less.

In one embodiment, the blocks may be filled with bullet-proof material or indeed the
blocks may be made from or lined with bullet proof material for use in dangerous areas,
e.g. by defence forces.

A seal is preferably provided at the interconnections (e.g., block to block and/or block to
strut, and/or strut to strut, and/or block to tray, and/or strut to tray, and/or tray to tray),
such that the walls are watertight, the roof is watertight, and the floor is watertight for normal weather conditions and a range of more extreme weather conditions. Interconnections between the blocks and struts and between the blocks themselves may comprise a combination of tongue and groove joints. For example, a vertical strut may be provided with a vertical tongue and a block may be provided with a vertical groove that interlocks with the tongue. A horizontal strut may be provided with a horizontal groove that interlocks with a horizontal tongue of a block. A block may have a horizontal tongue or groove to interlock with a corresponding groove or tongue of another block. Particularly for the horizontal interconnections, the tongue and groove joint may be staggered with a higher internal lip than the external lip, to reduce water ingress from the outside to the inside of the building. In another embodiment, the vertical and horizontal struts have a U-shaped channel or profile providing a groove for engagement with an edge of a block.

One wall, for example, the front wall of the building, may comprise a door to allow access into the building. In one embodiment, a half wall section is provided by the door, a small over door block and a vertical fill-in block extending the full floor to ceiling height (or three smaller blocks could be used). The other half wall section may comprise three stacked blocks. The building is preferably also provided with a window. The window and door may be preferably provided with water resistant seals to prevent water penetration into the building at times of flooding. To further prevent ingress of water during times of flooding, the door may open outwardly to resist the pressure from flood water. Where this is not a significant risk, the door can be fitted to open inwardly in the same way as a conventional building door.

In some embodiments, more than one window is provided. This is particularly the case where the building is being used for applications other than emergency housing, e.g. as site offices, garden rooms and other non-emergency domestic and leisure applications. Windows may for example be provided in each wall of the building, or even an entire wall(s) may be replaced with a window. For example, a wall may be replaced with full height sliding windows (patio doors) to provide access to the building, and in this case, a door may not be provided. In these applications the window(s) are preferably made of glass.
The building should include at least one ventilation device, preferably two ventilation devices, in addition to any window, the ventilation device(s) being provided in an upper section of a wall for ventilating the interior of the building. Where risk of flooding is less significant, one of the ventilation devices may be provided in a lower section of the wall.

In some embodiments, a ventilation and cooling system is provided. Preferably, this is located, at least in part, under the floor trays. Systems that utilise temperature differences to circulate air through the building (rather than needing power) are preferred. Vents may be provided in the floor trays as desired.

One advantage of the building is that it is possible to flat pack the structure for easy transportation. The blocks of the walls can fit inside the panels or trays of the roof sections. In preferred embodiments the panels or trays for the roof are rectangular, having an elongate rectangular base and upstanding sides that are part of the tray. The blocks for the walls are preferably square or rectangular for ease of building assembly, more preferably they are rectangular and/or elongate to provide a long wall section that can fit within a roof panel or tray but at the same time maximise the wall area that it can offer. Preferably the building includes trays for the floor as described above, and the blocks stow within pairs of (roof/floor) trays for transporting the building.

Thus according to a further aspect of the present invention, there is provided a prefabricated building in kit form comprising:

- a set of trays to form a roof of the prefabricated building, each tray having a rectangular base and upstanding sides, the trays being connectable together, side by side, to form the roof;

- a further set of rectangular trays, of substantially the same shape and size as the roof trays, that are provided to form a floor of the prefabricated building, the trays being connectable together, side by side, in an inverted configuration;

- a set of hollow blocks, which are stackable, one on top of another, to form one or more walls of the prefabricated building, wherein the blocks are: adapted to be loaded with ballast during construction of the building, to be filled with an insulating material, or adapted for use as a reservoir in the constructed building;

wherein the prefabricated building is supplied as a kit in which the blocks of the walls are laid within pairs of oppositely arranged trays.
According to another aspect there is provided a building made from prefabricated sections comprising:

- a roof formed from a plurality of prefabricated trays, each tray having a rectangular base and upstanding sides, the trays being connected together, side by side, to form the roof;
- a floor formed from a plurality of prefabricated rectangular trays of substantially the same shape and size as the roof trays, the trays being connected together, side by side, in an inverted configuration to form the floor;
- one or more walls formed from prefabricated hollow blocks, which are stacked, one on top of another, to form the walls, the blocks having been loaded with ballast during construction of the building, filled with an insulating material, or adapted to provide a reservoir for collected rainwater in the constructed building;
- wherein the blocks of the wall are sized for fitting within oppositely arranged pairs of trays for transporting.

Again, in these arrangements, the building (and the kit) preferably includes any of the preferred features already previously mentioned, and vice versa, any features mentioned in relation to these arrangements can be used with any of the other arrangements described herein. Thus in one embodiment the blocks are rectangular and preferably elongate, having a length of over twice the height measurement. The packaged up building as a stack of oppositely arranged trays houses all or a majority of the additional components such as struts, fasteners, solar lamps, etc for the fully constructed building. In one embodiment the overall package size is around 5m long, around 1.7m wide and around 1.4m high. This is of a size that can be handled easily by a team of people or transported easily on the back of a lorry.

For shipping large quantities of the flat-packed homes, it would be possible to stack the components in different ways to maximise the contents of a sea container. For example like components from different homes can be stacked together. However ideally all the components required to build the set of homes are included in the one container, so that there is no problem with parts being delayed through being in a different container. In this way it is possible to fit 6 or more flat-packed buildings within a 40 foot sea container, e.g., for shipping, more preferably 8 or more buildings, yet more preferably 10 or more buildings, and where possible 12 or more. Depending on the type of container, e.g.,
standard or high cube, dimensions of the buildings can be altered slightly to optimise the packing.

One advantage of the use of all plastic components is that the parts are not affected by the weather. As a result it is not necessary to carry the units in a watertight container, and instead they could be loaded on an open pallet with less stringent external dimensions, e.g., for carrying on a ship or lorry, or carried under a helicopter.

An option may be provided to add on additional rooms, by providing a bolt on facility. In this way, a building complex can be constructed, which is strengthened and stabilised by the additional building modules, for example, buildings joined corner to corner. Blocks and/or walls can be removed in buildings or modules that are joined side by side, in order to provide larger buildings, which might function as a larger home, as a school, as an office, as a storage facility, as a hospital, as a church or indeed any other type of building.

In one embodiment, buildings may be stacked on top of each other to provide a multi-storey arrangement. An external staircase may be provided to allow access to the upper levels.

The prefabricated building is preferably supplied with a set of bags for filling with ballast. In one embodiment the bags are substantially cylindrical in shape and elongate, having a diameter measurement and a length measurement that are in the ratio of at least 1:5, more preferably 1:7, yet more preferably 1:10, in order to provide a long thin "sausage" of ballast material when filled, as compared to a conventional sandbag shape.

The prefabricated building may further comprise an extendable shade device, preferably a fabric shade device, attached to a side of the building. The shade device may be removable. Most preferably this is provided at the front of the building where the door is provided. Such a shade provides useful protection from the sun and rain as well as extending the living space, e.g., providing cover for cooking outside. Optional flat-packed internal wall dividers and furniture could be included within the building kit.

As protection from flooding, the floor panels could also be fitted with buoyancy, for example inflatable or foam pads. A tether could also be provided for the structure. In the event of flooding, the roof of the building may, to an extent, provide a floating platform for
the occupier until the waters subside or the occupier is rescued. Foam pads under the floor area would further help to insulate the building.

The building also has a range of other possible uses beyond emergency shelters. It could provide key worker accommodation, accommodation for military personnel (for example, including bullet-proofing within the blocks and/or additional bullet-proof walls within the building), accommodation for leisure pursuits such as mountain rescue huts or wildlife hides, accommodation or support buildings such as toilet blocks and storehouses for festivals, accommodation in campsites, accommodation for private residents, garden rooms, temporary offices such as construction site offices, shops and classrooms, beach huts, with any of these being on a buy or rent basis. The building is not just suitable for housing humans, but also could be used to provide accommodation for animals, for example, as a stables, hutch, pen, aviary or other such enclosure. Drinking water for the animals or birds can be provided on site by the harvested rainwater. The water also allows the farmer or carer to wash their hands after tending to the animals or birds.

One key area where the building can be used is as a garden or allotment shed. The building is quick and easy to construct and provides an integral means for storing rainwater which avoids the need for unsightly water-butts that take up valuable room in the garden or allotment. An external tap may be provided for dispensing the rainwater. Lighting can be provided by solar lamps as described above. The shed might be of much smaller proportions than the emergency accommodation described above and may only have a single roof tray.

Thus in a further aspect of the present invention there is provided a prefabricated shed in kit form comprising:

- a prefabricated tray for forming a roof, the tray having a base and upstanding sides; and
- prefabricated hollow blocks for forming three or more walls, the blocks being stackable to form a wall, wherein blocks intended for an upper section of the wall are adapted to provide a reservoir for rainwater collected by the roof.

Preferably blocks intended for a lower section of the wall are provided with an opening for loading ballast during construction of the building though this need not always be the case.
The prefabricated building of the present invention need not utilise ballast for filling the blocks of the lower sections. In some applications a material with particularly strong insulating properties and/or a lightweight material may be desired. Furthermore an alternative material may be required for locations where a suitable ballast is not available.

Viewed from another aspect, the present invention provides a building made from prefabricated sections comprising:

- a roof formed from a plurality of prefabricated trays, each tray having a base and upstanding sides, the trays being connectable together, side by side, to form the roof; and
- one or more walls formed from prefabricated hollow blocks, which are stacked, one on top of another, to form a wall, the blocks in at least a lower section of the wall having been loaded with material during construction of the building.

Also provided is a corresponding kit of parts for constructing a prefabricated building, comprising:

- a plurality of prefabricated trays for forming a roof, each tray having a base and upstanding sides, the trays being connectable together, side by side, to form the roof; and
- prefabricated hollow blocks for forming one or more walls, the blocks being stackable to form a wall, wherein the blocks intended for a lower section of the wall are provided with an opening for loading material during construction of the building.

Preferred embodiments of the present invention will now be described by way of example only and with reference to the accompanying drawings, in which:

- Figure 1 illustrates a prefabricated building according to a first embodiment of the invention;
- Figure 2 is an exploded view of the component parts of the prefabricated building of the first embodiment of the invention of Figure 1;
- Figure 3 is a side view of one of the side walls of the first embodiment;
- Figure 4 is a plan view of the roof of the first embodiment;
- Figure 5 illustrates a hollow block from which the side walls of the first embodiment are made;
- Figure 6 is a top view of the block in Figure 5;
- Figure 7 is a side cross-sectional view of the hollow block of Figure 5;
Figure 8 illustrates a prefabricated building according to a second embodiment of the invention;
Figure 9 is a side view of a side wall of the second embodiment;
Figure 10 illustrates a prefabricated building kit according to the second embodiment of the invention;
Figure 11 is a perspective view of an example packing layout for ten buildings in a 40 foot High Cube container;
Figure 12 is a perspective view of a third embodiment of the building;
Figure 13 is an end view of a preferred strut;
Figure 14 is a perspective view of a preferred beam;
Figure 15 is a perspective view of a preferred block; and
Figure 16 is a cross-sectional view through a fixing of a preferred roof tray to a beam.

In the description that follows, a number of examples will be described. Where similar features are present the same reference numbers have been used. Any description of preferred features in conjunction with an example can apply equally to other examples and is not necessarily limited to that specific example. Similarly, preferred features mentioned in a general context in relation to the present invention can also apply to the specific examples and vice versa; preferred features described herein in connection with a specific example can apply to the present invention in a general context too.

Example 1
A prefabricated building 1 according to a first embodiment of the invention is shown in Figure 1. The prefabricated building 1 comprises three side walls 35 each having two side sections 36. Each side section 36 is made from three stacked hollow blocks 2, a top block 2a, a middle block 2b and a lower block 2c. Top block 2a is arranged to receive rainwater that has been collected by the roof 11, and middle and lower blocks 2b and 2c contain ballast that has been inserted into a hollow portion of the blocks during assembly. The ballast in the middle and lower blocks 2b, 2c add weight to the structure to provide stability. It also gives a degree of insulation. The rainwater in the top blocks 2a creates a valuable source of water for the occupier. The fourth side wall comprises one side section 36 where a portion has been cut from the middle block 2b and a window has been inserted. It also includes a door panel 7 having a door 8 therein. The prefabricated
building 1 has a roof 11 comprising three roof trays 3 having upstanding sides 4 for retaining rainwater. Two solar powered lamps 10 are located in each roof tray 3.

The building is held together by a framework of struts that provides a structural "cage" comprising two rings of lateral beams 5a, 5b extending around the top and bottom perimeters of the side walls respectively, that are held connected together at points by a series of posts, for example, corner posts 6 at each corner of the building and intermediate posts 37 midway along the side of each side wall 35. The lateral beams 5a, 5b and posts 6 are bolted together to form the framework of struts that ties the building together and provides the structural cage to retain the blocks as wall sections 36.

The prefabricated building 1 can be seen in exploded view in Figure 2. Each hollow block 2 has an interlock portion on each of its edges, for example, a tongue along the top edge and a groove along the bottom edge such that the blocks 2 can fit together in an interlocking manner. The upper lateral beams 5a may have a groove for receiving the tongue of the top hollow blocks 2a. The groove (not shown) could be part of the beams' cross-sectional profile, or could be formed by two additional longitudinal battens attached to the lateral beams 5 providing a groove therebetween. The lower lateral beams 5b may have a tongue for fitting within the groove of the lower hollow blocks 2c, which could be part of the profile, or more preferably is formed by an additional longitudinal batten attached to the surface of the beam.

The side wall containing the door 8 is shown in more detail in Figure 3. The door has a watertight seal around the edges (not shown). The door 8 is arranged to open outwards in order to improve its sealing ability in the event of flooding. The building may be constructed to avoid the penetration of flood water in depths of up to 1 m, and preferably deeper. Window 9 is made from clear perspex (though could be of glass), and has a watertight seal 39 around the edges. Holes 40 for bolts can also be seen in Figure 3. These allow the beams 5a, 5b and blocks 2 to be joined to the posts 6, 37. They also allow multiple buildings 1 to be joined together as modules to form a larger, more stable, collection of buildings, or a building with a larger internal space.

Figure 4 is a plan view of the roof 11 of the prefabricated building 1. The three trays 3 are identical and are of an elongate rectangular shape with upstanding sides 4 along each straight edge 3a, 3b of the rectangular base 3c. They are arranged side by side and are
bolted together at adjacent upstanding sides 4. Rainwater accumulates in the trays 3 and
drains to drainage points provided in the edges of the trays. The harvested rainwater is
directed into the top blocks 2a which act as a reservoir to store the rainwater. Inside the
building, pipework (not shown) is provided to supply a tap inside the building with water.
A filtration system (not shown) filters the water before supplying it to the tap.

The trays 3 are preferably of a length greater than 2 m, more preferably greater than 3 m,
more preferably equal to or greater than 4 m (e.g., for a 4 m x 4 m building). For larger
buildings the trays may be around 4.5 m or longer, for example around 5 m in length
(e.g., for a 5 m x 5 m building). The trays are preferably elongate having a length of over
twice its width. The trays 3 may be between 1 and 2 m wide. For example a preferred
width is 1.65 m as three trays connected together side by side will span a width of 5 m.
Another preferred width is 1.5 m as three trays connected together side by side would
span a width of 4.5 m (e.g., for a 4.5 m x 4.5 m building). Another preferred width is 1.33
m as three trays connected together side by side would span a width of 4 m.

Preferably the sides 4 of the trays 3 are higher than 100 mm, more preferably higher than
150 mm and most preferably around 200 mm, in order to provide the reinforcement
properties and water collection ability required. In a most preferred embodiment, the tray
3 has external dimensions of 5000 x 1655 x 200 mm. In the three roof tray embodiment,
this would provide a building with a footprint of 25 m².

Other tray sizes are possible for smaller buildings and two particularly preferred sizes are
4500 x 1500 x 200 mm for a building with a footprint of just over 20 m² and 4000 x 1333 x
200 mm for a building with a footprint of 16 m². One preferred embodiment of a smaller
building or garden shed has roof dimensions of 2m x 2m, i.e. 4 m². A single roof tray of
2m x 2m could be provided, or for example two trays of 2m x 1m, or indeed three trays of
2m x 0.67m.

The trays are preferably made from a type of plastics (including GRP) which is able to
operate well in a temperature range of -20 to +40°C and in particular not become too soft
at higher temperatures since the roof will be directly exposed to midday sun. It should
also have good properties in tension and compression as the trays 3 provide resistance
to torsion for the building 1.
Figure 5 shows a hollow block 2a, 2b, 2c. A tongue 16 is provided along the top edge of the block for interlocking with an adjacent block 2a, 2b, or an upper lateral beam 5a. A groove 17 is provided along the bottom edge of the block 2b, 2c for interlocking with an adjacent block 2a, 2b, 2c or a lower lateral beam 5b.

A plan view of a block 2a, 2b, 2c is shown in Figure 6. The block has a hollow portion 12 which contains water or ballast. Each side edge of the block has a groove 19 extending between side flanges 18, for interlocking with a tongue of a post 6, 37. The tongue 23 is preferably continuous along the length of the post but could be present as sections. The tongue 23 could be formed integrally with the post 6, 37, but is more preferably formed as a separate member, for example, as a batten that attaches to the post 6, 37.

Figure 7 is a side cross-sectional view of a middle or lower hollow block 2b, 2c. During construction, sausage-shaped sacks 13 are filled with ballast and inserted one on top of the other within the hollow portion 12 (shown hatched in the drawing) of the block 2b, 2c via opening 15 in a side edge 14a of the block 2b, 2c. The opposite side edge 14b has no opening. In the case of a hollow block 2a for containing water, there is no opening 15 and instead both ends have sealed side edges 14a, 14b.

The block 2 has an elongate form, having a length over twice as long as its height. Preferably the blocks 2 are over 1.5 m in length, for example, around 2.3 m in length for a square building having a 5 m perimeter dimension. They are preferably over 0.5 m high, more preferably over 0.7 m high, and may be around 0.8 m high. The blocks 2 are preferably at least 50 mm thick, more preferably greater than 75 mm thick and most preferably around 80 mm to 100 mm thick. Shorter blocks could be used for smaller buildings with shorter perimeter dimensions, for example, a length of around 2.1 m for a building of 4.5 m perimeter dimension or 1.8 m for a building of 4 m perimeter dimension. For buildings with a lower ceiling height, the height of the block can be modified accordingly. For example, a building with a ceiling height of 2.4 m might have a block of 800 mm tall, a building of 2.3 m might have a block of 766 mm tall, and a building of 2.2 m might have a block of 733 mm tall. Where beams extend between top and/or bottom surfaces of the wall, these sizes can be reduced by the beam(s) cross-sectional dimension (e.g., 142 mm) to provide the desired ceiling height. The thickness of the
material (e.g. plastic or GRP) making the outer "skin" of the blocks is preferably around 2mm to 5mm thick, most preferably 3mm thick.

In general the buildings may comprise wall sections of around 2m. In one embodiment the building has a footprint of 2m x 2m, with the blocks being 2m long (with each wall being one block wide) or 1m long (with each wall being two blocks wide). The buildings may comprise multiples of these sections to form rectangular or square perimeter buildings up to around 8m in a length and/or width dimension.

Preferably all of the blocks in the side sections 36 of the building 1 (for example, in at least three of the four walls 37) are of the same external shape and dimensions and can be made from the same mould. They are preferably made from a type of plastics that is able to operate in a temperature range of -20 to +40°C and which has good properties in tension to resist internal static pressures from loading with ballast or water. It is also preferably able to weld easily, for example, where the blocks are moulded in two halves and welded (or glued) together to form the block 2. In some embodiments it may be possible to provide internal bracing members during fabrication to improve the rupture resistance of a block when it is fully loaded with water or other heavy material.

In a variant of the block (not shown), the tongue 16 is provided on the bottom edge of the block, slightly off-centre, and the adjacent flat surfaces of the edge profile are "staggered" such that where the surfaces abut on the interior surface of the wall is in a higher vertical position to that of the exterior surface of the wall. This staggered arrangement helps prevent water ingress into the building. Other forms of male/female interlock profile would also be possible and are envisaged herein.

The struts 5a, 5b, 6, 37 are preferably over 1.5 m in length, more preferably over 2 m in length, preferably over 2.1 m, more preferably over 2.2 m in length, and more preferably still over 2.3 m in length.

The struts are preferably made from a type of plastics that is able to operate in a temperature range of -20 to +40°C and which has good properties in tension and compression. Preferably all the struts are of the same external shape and dimensions to allow them to be made from the same mould (if necessary, sections could be cut to size). The posts are preferably hollow. Where desired, end caps are used to seal the ends.
Example 2
A prefabricated building according to a second embodiment of the invention is illustrated in Figure 8. Many of the elements of this building are the same as those of the first embodiment, and like elements are designated with like reference numerals and are not described further. The description of those elements above applies equally to this embodiment and vice versa.

The embodiment of Figure 8 additionally has a floor 24 comprising three floor trays 25 that are identical to each other and are of an elongate rectangular shape with sides 29 extending down from all sides. They are arranged side by side and are bolted together at adjacent sides 29. These trays 25 are identical to the roof trays 3, but are used in an upside down configuration. The floor trays 25 are bolted to the lower lateral beams 5b around the perimeter of the floor.

The embodiment of Figure 8 also comprises a fabric, e.g. canvas, canopy 43 which is retractable/detachable from the building 1. An air vent 38 is provided in the top of the door section 7.

As can be seen in Figure 9, the roof trays and upper lateral beams 5a comprise holes 26 through which rainwater collected by the roof 11 can drain into the upper blocks 2a. Overflow holes 27 are also provided in the roof trays, preferably at the rear of the building, to prevent the trays 3 becoming too full of water.

Figure 10 shows the prefabricated building of Figure 8 packaged between pairs of opposing roof/floor trays 3, 25 arranged in a flat packed kit 28. In the example, there are three pairs of roof and floor trays, and a package can be assembled as illustrated in Figure 10. Up to eight hollow blocks 2a, 2b, 2c can be packed between one pair of roof/floor trays and the remaining components are packed in any available spaces and between further pairs of roof/floor trays. The flat pack unit 28 is of between 3 and 7 m in length, more preferably between 4 and 6 m in length, and most preferably around 5 m. The width of the unit 28 is preferably between 1 m and 2 m, more preferably between 1.25 and 1.80 m. The height of the unit 28 is preferably between 1 m and 2 m high, more preferably between 1.2 m and 1.6 m high. In one example, the flat-packed unit 28 has maximum dimensions of 5m length x 1.655m width x 1.399m height. Thus a typical 40
foot (12.2m) high cube sea container used for shipping, which typically has internal
dimensions 12.02 x 2.35 x 2.70 m, can hold around 6 flat pack units 28 (the three pairs of
roof/floor trays can be loaded separately to maximise the contents within a container).
Where required, the parts of up to 10 units 28 can be packed separately into a sea
container. With different component dimensions, for example, buildings having a smaller
footprint than 25 m², a larger number of buildings would be able to fit within a standard or
high cube 40 foot sea container, preferably 12 or more.

Figure 11 is a perspective view of another example layout 50 for packing prefabricated
buildings into a container. In this embodiment the container (not shown) is a 40 foot High
Cube container, and the component parts of ten prefabricated buildings fit within a (l)
12.009m x (h) 2.407m x (w) 2.347m space within the container. As can be seen, in this
embodiment, the component parts of the ten buildings are not packed as separate units
as in Figure 10, instead the parts of the different buildings are mixed up so to be packed
most efficiently. In addition, the height of the building may be reduced such that ten
buildings can be transported in a 40 foot standard container rather than a High Cube
container.

Example 3

Figure 12 shows a perspective view of a third embodiment of the building 1. Many of the
elements of this building are the same as those in the earlier embodiments, and like
elements are designated with like reference numerals and are not described further. The
previous description of those elements above applies equally to this embodiment and vice
versa.

In Figure 12, the profiles of the beams 5a, 5b and posts 6 has been modified to provide
girder sections (e.g., members with I and C-shape cross-sections) that can be formed by
extrusion, by pultrusion, by moulding and by folding sheet material. The tongue and
groove arrangement of the blocks 2 has also been simplified and the blocks 2 no longer
incorporate a groove 19 at the ends because the ends slot into a U-shaped channel
defined by the cross-sectional profile of the posts 6, 37. A second air vent 38 is provided
in a lower section of the door panel 7. The door 8 is arranged to open inwardly. The
construction of the roof trays 3 has also been modified as will be described in more detail
below.
Figure 13 is an end on view of a corner post 6 e.g., from above. It is constructed from a first strut 6a having a C-shaped cross-section and a second strut 6b having an I-shaped cross-section. The struts 6a, 6b are bonded or fastened together to form the corner post 6. In a variant of this, the corner post 6 could be made as a single piece extrusion or pultrusion. A vertical edge of the blocks 2 of one wall section 36 slot into the channel A provided by strut 6a, while a vertical edge of the blocks 2 of a neighbouring wall section 36 slot into another channel B provided by strut 6b. An end cap (not shown) can fit into the channel on the other side of strut 6b to close off the corner post 6, the end cap preferably laying flush with the surface of the strut 6a. Corner brackets (not shown), preferably made of steel, are provided for securing the corner posts 6 to the lateral beams 6a, 6b.

The intermediate posts 37 of this embodiment comprise an I-shaped cross-section, providing a channel on each side for the ends (vertical edges) of adjacent blocks 2 to locate into. The I-shaped cross-section can be formed by a single member or constructed through two C-shaped members arranged back to back and suitably fastened together.

Within the building 1, internal posts (not shown) and rafters (not shown), e.g., of blocks or sheet material supported by an internal post, may be provided as desired to divide up the interior space of the building 1 into rooms or areas. Internal sanitary or kitchen fittings may be provided as desired for the intended use of the building.

A lower lateral beam 5b is shown in more detail in Figure 14 and comprises three C-shaped members 31, 32 and 33 that have been bonded or fastened together in the configuration shown, for example with bolts (not shown) passing through holes 34a in order to secure a first of the C-shaped members 31 in a back to back arrangement with a second member 32. The girder structure generated by this arrangement helps to transfer and spread the load from the blocks 2, which are located at their base in the C-shaped channel C provided by the third C-shaped member 33, evenly through to the floor trays 25 below. Holes 34b may be provided in the flanges 33a of the third (upper) C-shaped member 33 for securing the corner posts 6 and intermediate post 37. The C-shaped members 31, 32 and 33 could be formed by pultrusion or a similar process such as
extrusion. In a variant of this embodiment, the lateral beam 5b is formed as a single member, for example by extrusion or pultrusion.

Upper lateral beams 5a can be provided in a similar way but with the beam 5b flipped through 180° so that the flanges 33a of channel C fit around the top of the blocks 2 rather than the base. The width of the channel C can be made smaller to fit tightly around the tongue 16, or spacer elements may be provided to pack out the tongue 16 so that the same section can be used.

Figure 15 shows a perspective view of a preferred block 2 having a tongue 16 extending across its top edge and a correspondingly sized groove formed in its lower edge. The block 2 can be moulded with an opening in a side edge 14a that is blocked off with an end cap (not shown) once the block 2 has been filled with ballast or insulation; or it could be formed as a sealed block 2 containing insulation or another material. The blocks generally have a wall thickness in GRP of around 2-5 mm, more preferably 3 mm. Where necessary, the building can be tethered to the ground by means of one or more ground anchors rather than relying on the weight of the materials in the walls, for example, where lightweight insulation-filled blocks are used.

As a way of harvesting the rainwater for the building, a gutter may be secured to a surface of the beam 5a and drainage holes (not shown) may be provided in the trays 3 and beam 5a to allow rainwater to drain from the roof trays 3 into the gutter for distribution into the reservoir provided by an upper layer of blocks 2a. The gutter is preferably located on an external side of the upper lateral beam 5a so that any leaks drain to the exterior of the building 1. In a variant of this embodiment, pipes may be provided below the roof trays 3 to feed the harvested rainwater into the blocks 2.

Figure 16 illustrates the construction of a preferred roof tray 3 in cross-section. The roof tray 3 is formed as upper and lower tray halves that are joined to opposite sides of a panel of insulation during the manufacturing process. The roof tray 3 has a sandwich construction comprising an upper layer 44, which is preferably a 5 mm thick glass reinforced plastics (GRP) formed panel, a lower layer 45, e.g., a 3 mm GRP ceiling panel, and a middle layer of an insulating material 46 that is preferably bonded to the upper and lower layers 44, 45. The upstanding side 4 is provided by the upper layer 44 being formed as a double skinned region, which in the illustrated embodiment also
encapsulates a sandwich of GRP layers 47a and a timber infill layer 47b to provide the roof tray 3 with additional rigidity. A further timber (or GRP or other material) infill 48, e.g. in the form of a batten, may be provided, as and where required within the tray 3 to stiffen the roof tray 3 further.

The roof tray 3 is secured to a flange 52 of the upper lateral beam 5a using a coach bolt 49 or similar fastener that is inserted in a hole which penetrates through the upper layer 44 of the tray 3, through a fixing support block 51, and through the exterior half of the flange 52 of the beam 5. These fastenings can be provided at intervals around the perimeter of the roof tray where it overlies an upper lateral beam 5a.

Where desired a weathering strip (not shown) can be provided over the top of the join between adjacent roof trays to try to prevent rainwater from penetrating between the upstanding sides into the living space below. Other forms of seal or weathering element are also possible.

The floor trays 25 are preferably made and joined together in the same way as the roof trays 3 in order to provide the floor of the building 1. The same system of coach bolts 49 can be used to secure the floor trays 25 to the lower lateral beams 5b, and hence the rest of the building, as the lower beams 5b are preferably the same profile as the upper beams but just the other way up.

Thus as can be seen from the above disclosure, at least in the preferred embodiments, these homes can bring relief and shelter quickly to zones in most need. The product has a minimal impact on global climate change, is robust, re-useable and recyclable at the end of its life, would utilise production and workforces regionally therefore stimulating employment in areas of most need. The profiles can be made to meet all the requirements of EN 13706 with quality and environmental control systems registered to ISO 9001 and E14102, and fire retardant to BS 476.

Thus at least in preferred embodiments, the present invention can be seen to provide a building or a kit of parts respectively in accordance with the following clauses:

- A prefabricated building in kit form comprising:
a set of trays to form a roof of the prefabricated building, each tray having a rectangular base and upstanding sides, the trays being connectable together, side by side, to form the roof;

a further set of rectangular trays, of substantially the same shape and size as the roof trays, that are provided to form a floor of the prefabricated building, the trays being connectable together, side by side, in an inverted configuration;

a set of hollow blocks, which are stackable, one on top of another, to form one or more walls of the prefabricated building, wherein the blocks are adapted to be loaded with ballast during construction of the building, filled with an insulating material or adapted for use as a reservoir in the constructed building.

- A building made from prefabricated sections comprising:
  a roof formed from a plurality of prefabricated trays, each tray having a rectangular base and upstanding sides, the trays being connected together, side by side, to form the roof;
  a floor formed from a plurality of prefabricated rectangular trays of substantially the same shape and size as the roof trays, the trays being connected together, side by side, in an inverted configuration to form the floor;
  one or more walls formed from prefabricated hollow blocks, which are stacked, one on top of another, to form the walls, the blocks having been loaded with ballast during construction of the building, filled with an insulating material, or adapted to provide a reservoir for collected rainwater in the constructed building;
  wherein the hollow blocks of the wall are sized for fitting within oppositely arranged pairs of trays for transporting.

- A prefabricated building in kit form comprising:
  one or more roof panels that are adapted to provide a collector for rainwater;
  a set of blocks to form one or more walls of the prefabricated building, the blocks being stackable, one on top of another, to form a wall, wherein one or more blocks are adapted to provide a reservoir in a hollow portion of the respective block for storing rainwater that has been collected by the one or more roof panels; and
  a set of posts and beams for tying the set of blocks together to form a building.

- A kit of parts for constructing a prefabricated building, comprising:
  three roof trays for forming a roof;
three floor trays for forming a floor;
twenty one hollow blocks that are stackable to form a wall, wherein blocks
intended for a lower section of the wall are provided with an opening for loading with
material or are filled with an insulating material and blocks intended for an upper section
are adapted for use as a reservoir;
a plurality of posts for interconnecting the blocks;
a plurality of beams for interconnecting the blocks with the roof trays;
a plurality of beams for interconnecting the blocks with the floor trays.

- 27 -

• A kit of parts described in the preceding clause further comprising: a door and/or a
window; six or more solar powered lamps; a sink with a tap; an extendable shade device
for attaching to the side of the building; and/or a filtration system for filtering rainwater
collected in the roof trays.

Previously mentioned preferred features can be used in conjunction with any of the
prefabricated buildings or kit of parts mentioned in the above clauses.
Claims

1. A prefabricated building in kit form comprising:
   a set of roof panels that are connectable together to form a roof of the
   prefabricated building, the roof panels each having a base and upstanding sides to
   provide a collector for rainwater;
   a set of blocks to form one or more walls of the prefabricated building, the blocks
   being stackable, one on top of another, to form a wall, wherein blocks intended for an
   upper section of the wall are adapted to provide a reservoir in a hollow portion of the
   block for storing rainwater that has been collected by the roof panels.

2. A building as claimed in claim 1, wherein blocks intended for a lower section of the
   wall are provided with an opening for loading ballast into a hollow portion of the block
   during the construction of the building.

3. A building as claimed in claim 2, wherein the building includes a set of bags, sized
   for fitting within the hollow blocks of the lower section of the wall, for filling with ballast.

4. A building as claimed in claim 2 or 3, wherein the blocks of the lower section of
   the wall are provided with an end cap to close off the opening once they have been filled.

5. A building as claimed in any preceding claim, wherein some or all of the blocks
   intended for a lower section are filled with a lightweight insulating material.

6. A building as claimed in claim 5, wherein the lightweight insulating material is a
   panel of insulating material provided with heat reflective material on its main sides.

7. A building as claimed in any preceding claim, wherein the blocks of the one or
   more wall panels are substantially identical to each other in external form.

8. A building as claimed in claim 7, wherein the building comprises three walls where
   each wall comprises six blocks arranged as two stacks of three side by side.

9. A building as claimed in claim 8 having a fourth wall comprising a door and a
   window.
10. A building as claimed in any preceding claim, further comprising a framework of struts arranged to provide a structural cage that ties the blocks together and provides an interconnection between the blocks and the roof trays.

11. A building as claimed in claim 10, wherein the struts comprise a post at each corner of the building and/or a beam along the top of each wall and/or a beam along the bottom of each wall.

12. A building as claimed in claim 10 or 11, wherein interconnections between blocks and struts and/or between the blocks themselves comprise tongue and groove joints.

13. A building as claimed in any preceding claim, further comprising a floor of a plurality of floor panels.

14. A building as claimed in any preceding claim, wherein the roof panels are in the form of prefabricated trays that are adapted to collect rainwater and direct the collected rainwater to the reservoir in the upper section of the one or more walls.

15. A building as claimed in claim 14, wherein each tray is provided with upstanding sides around its entire perimeter.

16. A building as claimed in claim 15, wherein each tray comprises inner and outer shells that are joined together along the upstanding sides.

17. A building as claimed in claim 16, wherein each tray has a central region sandwiched between the two shells that is filled with an insulating material.

18. A building as claimed in any of claims 14 to 17, wherein the floor panels comprise prefabricated trays substantially identical to the roof trays, arranged in an inverted configuration with the base of the trays providing a raised floor surface.

19. A building as claimed in claim 18, wherein the roof comprises three elongate rectangular roof trays, the floor comprises three elongate rectangular floor trays,
20. A building as claimed in any preceding claim, wherein the building comprises a conduit to direct rainwater collected in the roof panels to a tap inside and/or outside the building.

21. A building as claimed in claim 20, further comprising a filtration system to filter the rainwater before supplying it to the tap.

22. A building as claimed in any preceding claim, wherein one or more solar powered lights are provided to be inserted in the roof.

23. A building as claimed in claim 22, wherein the solar powered lights each comprise a lamp body that is arranged to extend through the roof, having an electricity generating portion at a head end that incorporates a solar cell and in use sits on an upper surface of a roof panel, and a light generating portion incorporating one or more lamps at a tail end that in use extends through the roof panel and into the room below.

24. A building as claimed in claim 23, wherein each solar powered lamp includes a locking ring that engages with a neck of the lamp body to clamp against a lower surface of the roof panel.

25. A building as claimed in any preceding claim, comprising at least one ventilation device in an upper section of the wall.

26. A building as claimed in any preceding claim, further comprising an extendable shade device for attachment to a side of the building.

27. A building as claimed in any preceding claim, wherein the blocks and/or trays and/or struts are made from plastics, preferably reinforced plastics, preferably glass reinforced plastics.

28. A building as claimed in any preceding claim wherein the prefabricated building is supplied as a kit in which blocks for the walls are laid within pairs of oppositely arranged trays.

29. A building that has been made from prefabricated sections comprising:
a roof formed from a plurality of roof panels that are connected together, the roof panels each having a base and upstanding sides to provide a collector for rainwater; one or more walls formed from blocks which have been stacked, one on top of another to form a wall, wherein blocks in an upper section of the wall are adapted to provide a reservoir in a hollow portion for storing rainwater that has been collected by the roof panels.

30. A building as claimed in claim 29, wherein ballast has been loaded into a hollow portion of the blocks of a lower section of the wall during the construction of the building.

31. A prefabricated shed in kit form comprising:
   a prefabricated tray for forming a roof, the tray having a base and upstanding sides; and
   prefabricated hollow blocks for forming three or more walls, the blocks being stackable to form a wall, wherein blocks intended for an upper section of the wall are adapted to provide a reservoir for rainwater collected by the roof.

32. A method of constructing a prefabricated building from a kit of parts, comprising:
   interconnecting a plurality of floor trays, side by side in an inverted configuration to form a raised floor, such that a base of the trays forms a floor surface and sides of the trays are downwardly extending;
   forming a frame of lateral beams around a perimeter of the floor;
   connecting a base region of an array of posts to the frame of lateral beams;
   building a plurality of walls or wall sections by laying loaded blocks in rows, one of top of another, within the posts in at least a lower section of the walls and optionally laying one or more hollow blocks for use as a reservoir in an upper section of the walls;
   coupling the blocks to the posts to connect the walls to adjacent walls;
   assembling a second frame of lateral beams and connecting it to top regions of the array of posts;
   connecting together a plurality of roof trays, side by side, on the top of the building to form a roof, such that a base of the trays forms a roof surface and upwardly extending sides of the trays provide a collector for rainwater.

33. A method as claimed in claim 32 wherein the method includes the step of loading a plurality of hollow blocks with ballast (or lightweight insulating material).
Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

<table>
<thead>
<tr>
<th>Category</th>
<th>Relevant to claims</th>
<th>Identity of document and passage or figure of particular relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>GB2103696 A SKITTRALL see whole document</td>
</tr>
<tr>
<td>A,E</td>
<td>-</td>
<td>GB2470017 A OVE ARUP &amp; PARTNERS</td>
</tr>
<tr>
<td>A</td>
<td>-</td>
<td>AU2008202915 FITZPATRICK see whole document</td>
</tr>
<tr>
<td>A</td>
<td>-</td>
<td>DE19800030 A LUDWIG see figures</td>
</tr>
</tbody>
</table>

Categories:

X Document indicating lack of novelty or inventive step
Y Document indicating lack of inventive step if combined with one or more other documents of same category.
& Member of the same patent family
A Document indicating technological background and/or state of the art.
P Document published on or after the declared priority date but before the filing date of this invention.
E Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC:

E03B; E04C; E04D

The following online and other databases have been used in the preparation of this search report

EPDOC, WPI

International Classification:

<table>
<thead>
<tr>
<th>Subclass</th>
<th>Subgroup</th>
<th>Valid From</th>
</tr>
</thead>
<tbody>
<tr>
<td>E04D</td>
<td>0013/04</td>
<td>01/01/2006</td>
</tr>
<tr>
<td>E03B</td>
<td>0003/02</td>
<td>01/01/2006</td>
</tr>
<tr>
<td>E03B</td>
<td>0003/03</td>
<td>01/01/2006</td>
</tr>
<tr>
<td>E04C</td>
<td>0001/39</td>
<td>01/01/2006</td>
</tr>
</tbody>
</table>