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GB 2503975 A **GB 2084511 A**
GB 2052471 A **GB 1386752 A**
ES 002244318 A **US 5934040 A**
US 3605356 A
GB190022941

(58) Field of Search:
INT CL **E04B, E04C, E04F, E06B**
Other: **EPODOC, TXTE, WPI**

(54) Title of the Invention: **Prefabricated building element**
Abstract Title: **Prefabricated building element manufactured with a plastic resin shell and expanded foam core**

(57) A prefabricated building element, preferably a window sill or cill, lintel or quoin, comprising an outer shell 12 having at least an upper surface 16, a lower surface 18, a front surface 20, a rear surface 22 and first and second end surfaces (24, 26 Fig 1), the shell is made from a composite of a plastics resin mixed with either crushed marble or crushed glass and the shell is filled with an expanded plastics foam. Preferably the resin is a polyester resin, more preferably an isophthalic neopentyl unsaturated polyester resin that uses a methyl ethyl ketone peroxide catalyst to help it set. The foam may be a liquid polyisocyanate mixed with a polyol. The foam may be sprayed into the shell during manufacture through one or two apertures located in the shell. There may be a reinforcement 44 made of steel, carbon fibre or engineered plastics. The marble or glass gives a more aesthetic quality whilst the insulating expanded foam makes the element lighter in weight.

Fig 1a

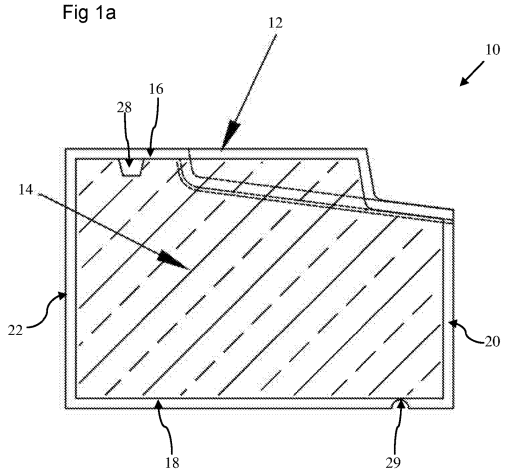
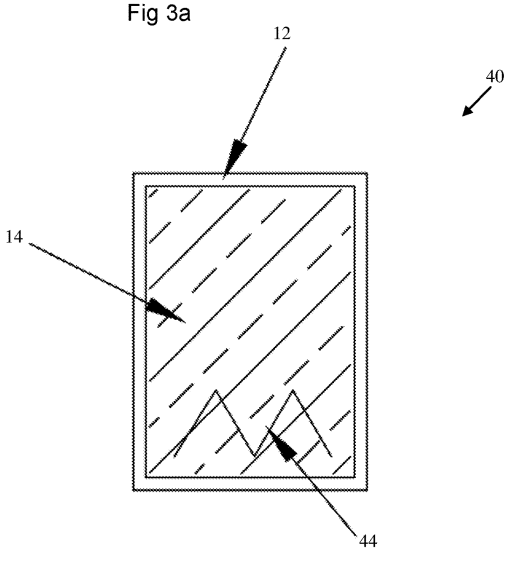


Fig 3a



GB 2522681 A

Fig 1

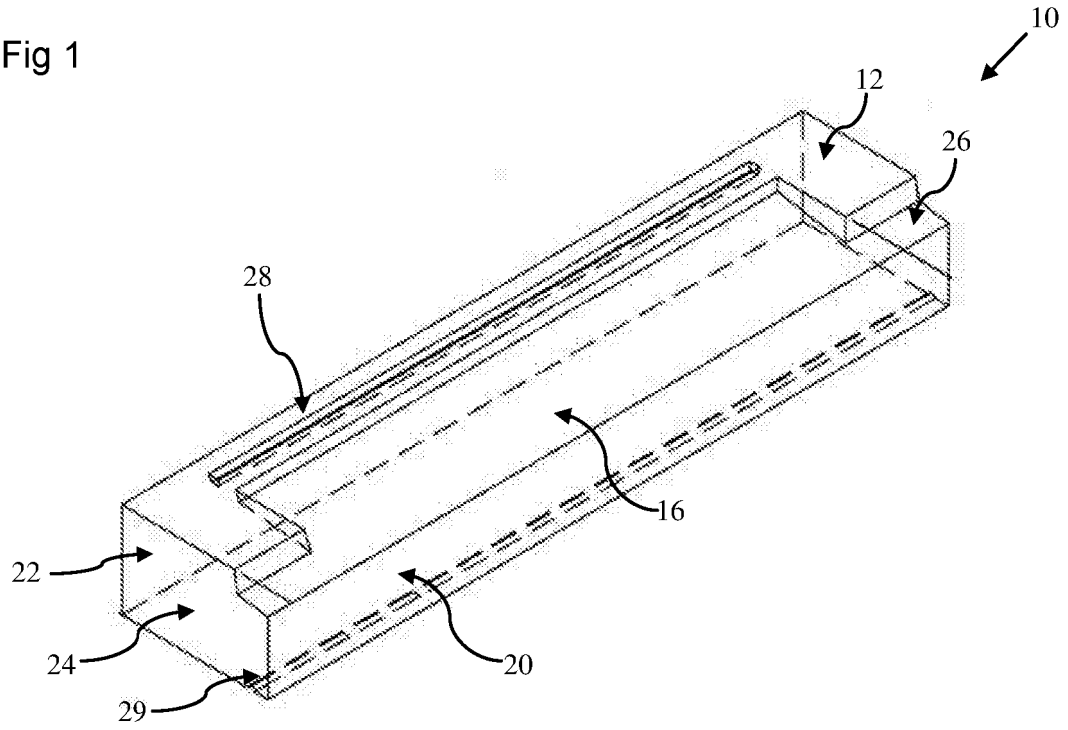


Fig 1a

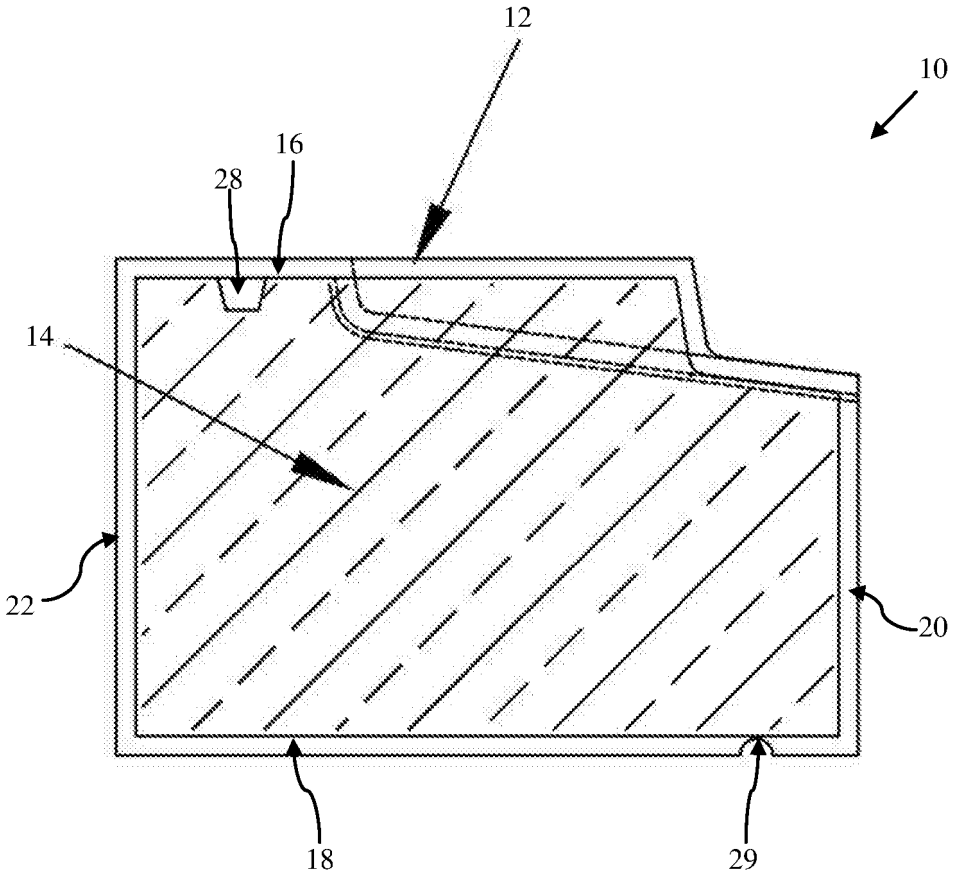


Fig 2

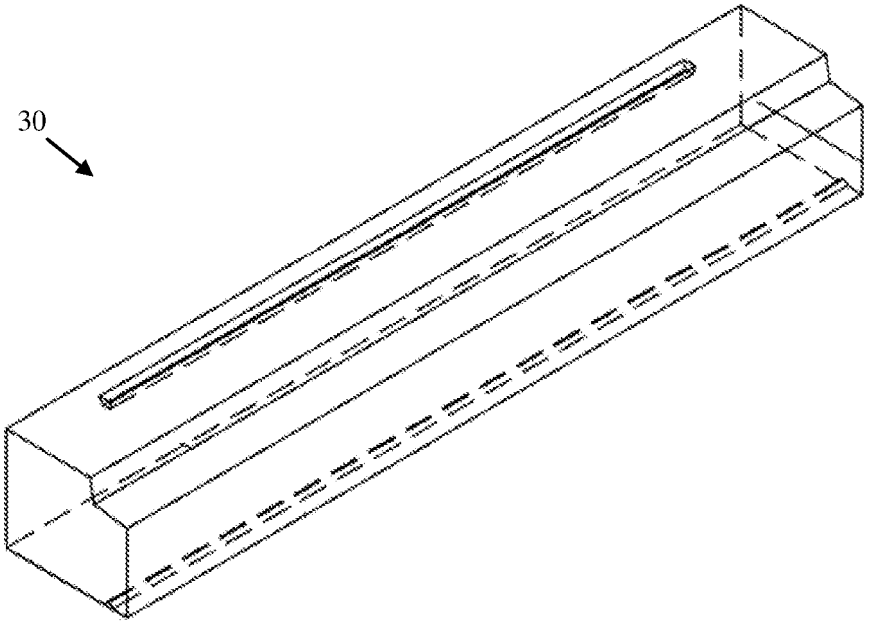


Fig 2a

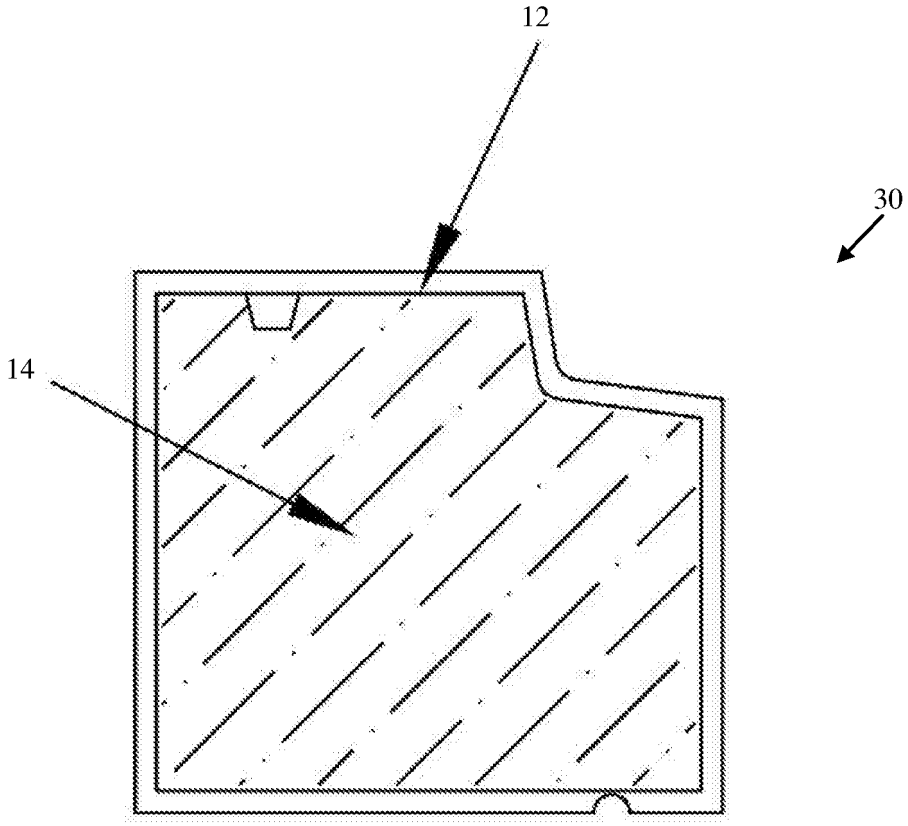


Fig 3

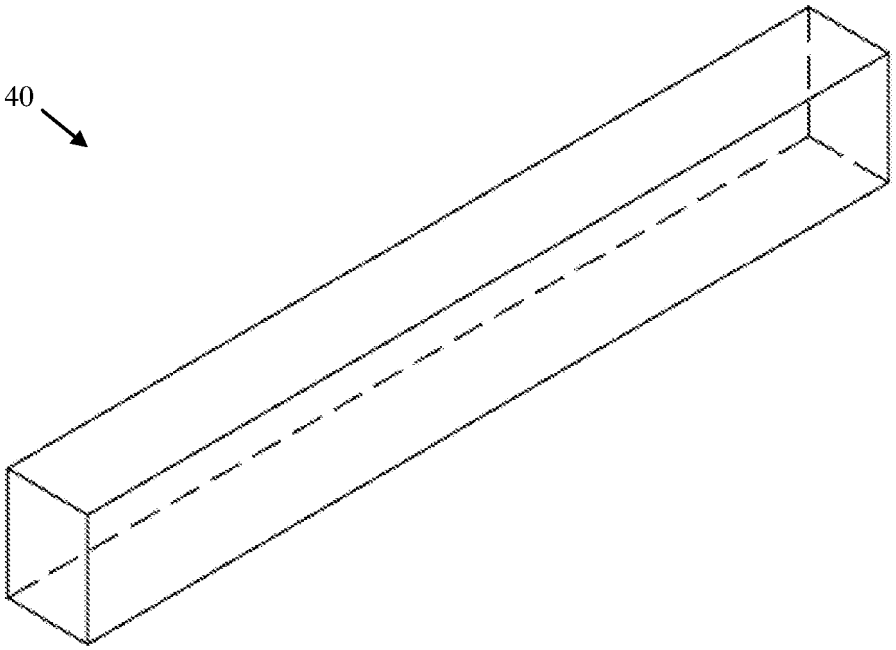


Fig 3a

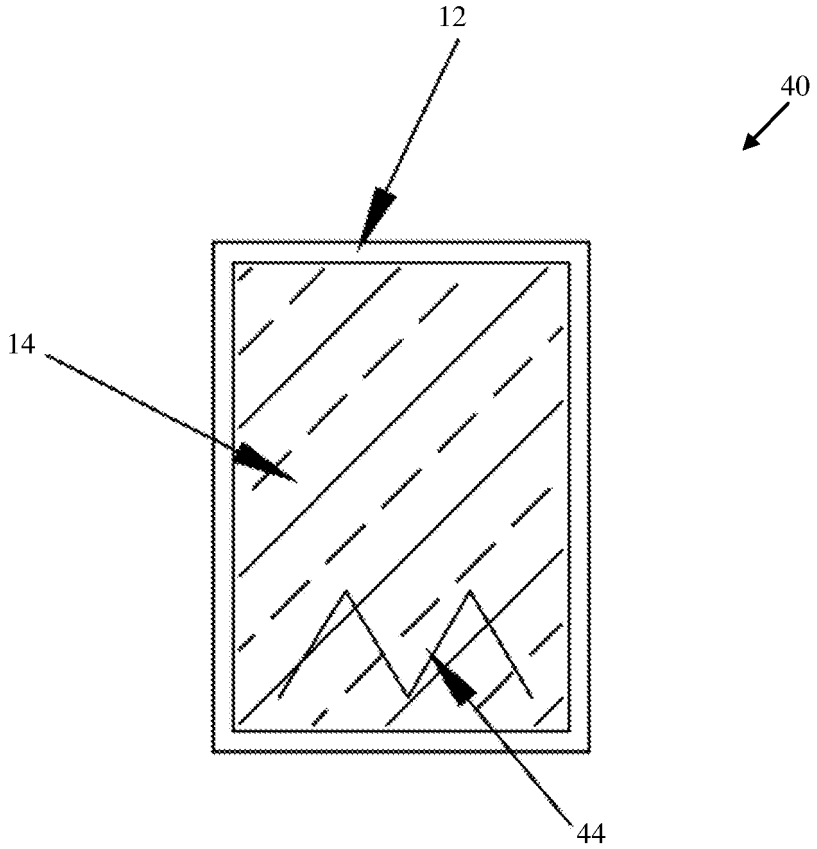


Fig 4

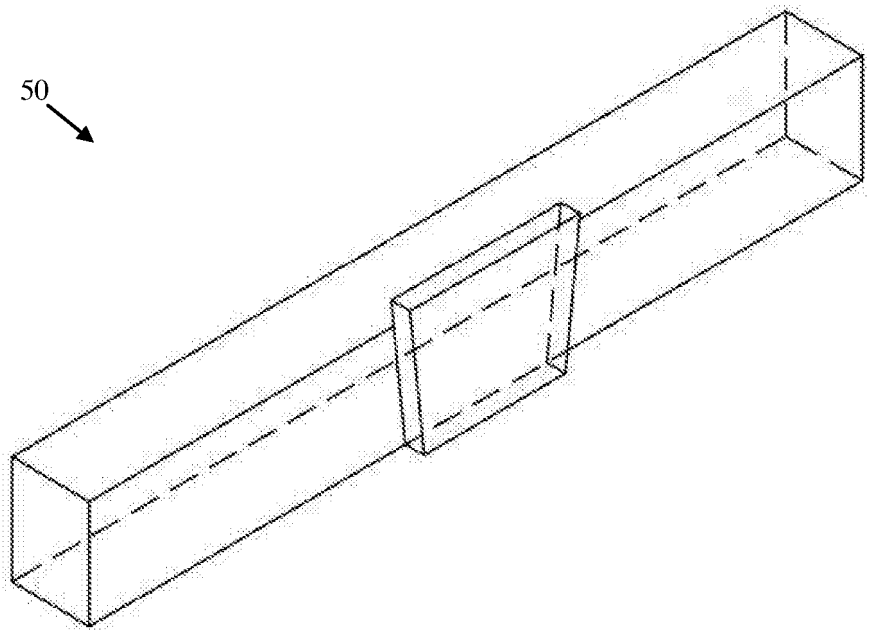
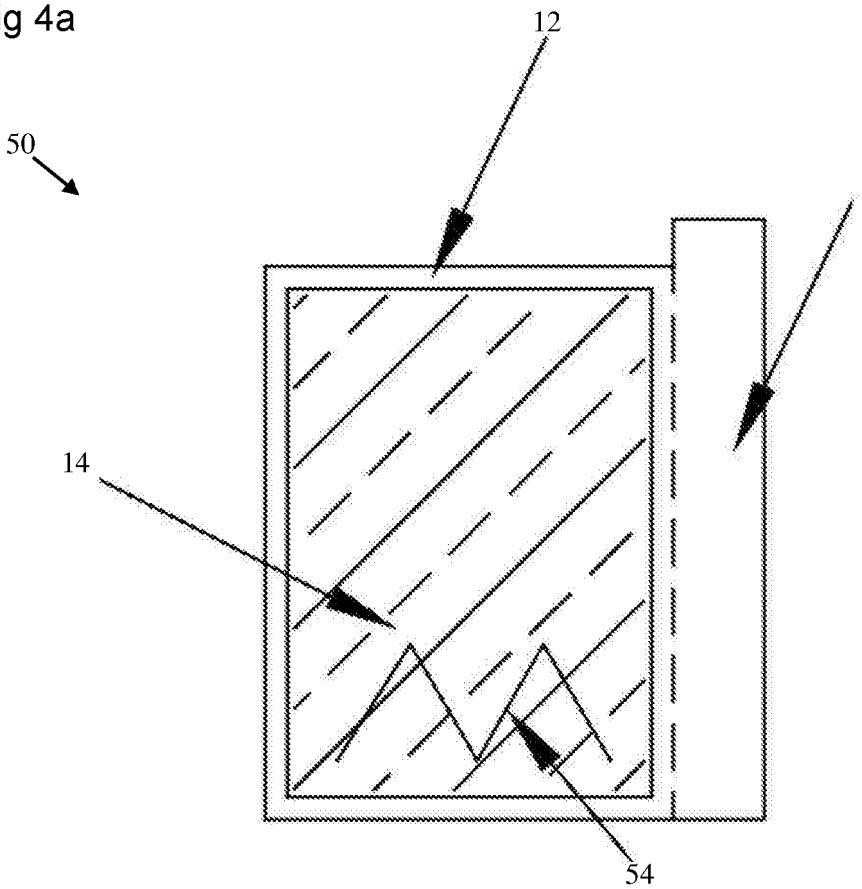


Fig 4a



PREFABRICATED BUILDING ELEMENT

The invention relates to a prefabricated building element and particularly but not exclusively to a prefabricated building element having a high thermal insulation value for use in properties with an external insulation system applied.

BACKGROUND TO THE INVENTION

Solid wall buildings with no insulation are estimated to lose around 38% of their heat through the walls in winter. In the UK and other European states, governments are introducing targets to reduce the thermal loss from property, in order to try and reduce energy consumption and greenhouse gases created in energy generation.

It is now common practice to apply insulation materials, such as Expanded Polystyrene (EPS) provided in panels, to the exterior of a building in order to reduce thermal loss from the building. It is common to fix the panels to the building, sometimes with reinforcing, and then to apply render or brick/stone effect slip panels over the insulation to weatherproof it. Typically, render is applied in layers, with the base layer being reinforced with a plastics mesh.

The problems in applying these systems arise at openings, such as windows and doors, where cold bridges can occur between the inner walls of the building and exterior, ie where there is no insulation. The invention is directed primarily to sills, but also has application in lintels, quoins, band-strips and cladding. Currently, the practice with sills, where there is an external insulation system, is to apply an oversill to an existing stone or concrete sill, to try and improve the thermal value of the sill. Such oversills are well known and an example is disclosed, for example, in GB 2500924 A1.

Oversills typically have very little strength, either in bending or compression. They are often manufactured using expanded polystyrene (EPS) and coated on one or two sides with a resin. Examples currently on the market have styrene in the resin, which is acidic and tends

to attack the EPS, leading to long term degradation of the EPS and a reduction in the thermal insulation provided by the oversill.

Sometimes oversills are manufactured with EPS insulation covered with a metal skin. This overcomes any problems of acid degredation of the insulation material, but reduces the insulation value of the oversill, because the metal skin is an effective heat conductor and goes some way to mitigating the thermal benefit of the oversill, ie the metal is a thermal bridge. The metal skins are typically painted steel or aluminium extrusions, which are sharp to handle during installation. A complete sill may be manufactured from an open metal extrusion filled with foam insulation, as disclosed in US 2008282626 A1, but again the metal forms a thermal bridge. Also, metal is not an attractive material for most domestic buildings and tends to be used more in commercial and industrial applications.

On new build projects, sills also cause handling problems. In the UK, for example, a site worker is only allowed to lift up to 58kg without assistance. Cast stone, stone or concrete sills are often purchased to fit a particular aperture and maybe long. This being the case, they often weigh well in excess of the 58kg limit and require two people or more to carry them to the position where they need to be built in. They also have little or no thermal insulation qualities and form cold bridges when installed, which must be covered with oversills to match the insulation values of external insulation systems. A 25mm strip of EPS may be bedded onto the bottom and inner faces of stone sills to provide some insulation, but it is generally inadequate for purpose. Similar problems apply to both lintels and quoins.

Another problem of stone, cast stone and concrete sills is that they can easily be damaged in storage or transit, on or off site, and repairs are often inadequate and unsightly. Stone is porous and is prone to water damage, particularly in frost conditions, over time. There is also a significant turnaround time from order to delivery, which can delay a build, with consequent penalty costs.

It is an object of the invention to provide an improved building element which substantially mitigates the abovementioned problems and which is for general use in the construction of new build property and renovation of existing property.

STATEMENT OF INVENTION

According to the present invention, there is provided a prefabricated building element comprising an integral outer shell having at least an upper surface, a lower surface, a front surface, a rear surface and first and second end surfaces, the shell being made from a composite of a plastics resin mixed with either crushed marble or crushed glass; the shell being filled with an expanded plastics foam.

The building element of the invention is highly advantageous because it can take the appearance of stone due to the addition of crushed stone or marble with the resin, but it has an extremely high U-value, since the whole body of the building element is filled with an insulation material.

The integral outer shell is formed in a silicone mould, as explained below, and has a very high strength to weight ratio, both in compression and bending. A 2m length weighs well under the 58kg lifting limit for a single site worker, and so is easy to handle.

The resin is preferably a polyester resin, more preferably an isophthalic neopentyl glycol unsaturated polyester resin, more preferably including a catalyst, causing the resin to set.

The catalyst may be a methyl ethyl ketone peroxide. Unlike other resin composites, the resin described can withstand thermal shock, for example in ambient weather extremes. It is also impervious to water.

The outer shell may be between 1mm and 6mm in thickness. A preferred thickness of the outer shell is substantially 6mm in thickness.

It has been found that a shell of this thickness will resist a hammer blow with little or no marking and so is less vulnerable to damage on site and in transit.

At least one aperture may be provided in the shell for injecting the expanded plastics foam. Ideally two apertures are provided and more apertures may be provided if the sill is very long, for example several metres. The foam is injected in metered shots or batches to minimise waste and to guarantee a perfect fill of the shell each time.

The aperture(s) may be provided through the upper surface of the building element. Alternatively, the apertures may be positioned on a lower or rear surface, but should be in a position not exposed to weather, or to detract from the appearance of the building element.

The expanded plastics foam may be expanded polyurethane and may be composed of a liquid polyisocyanate and a polyol which is mixed in a nozzle on injection, generally known as a Bio Foam. Advantageously, the expanded polyurethane has no VOCs, CFCs, HFCs or urea. The density of the foam can be controlled to produce a required insulation value, as required.

Alternatively, the expanded plastics foam may be of the type commercially known as Iceynene.

Reinforcing may be disposed inside the shell, which may be of steel, carbon fibre or engineered plastics. Reinforcing may be advantageous where the building element is to be used as a lintel and significant loads are to be applied.

The prefabricated building element may be formed as a window sill, for example, with an elongate recess provided along the lower surface of the shell for serving as a drip bead. A portion of the upper surface may be sloped downwardly towards one side of the sill in conventional manner to take water away from a building, when in situ.

Alternatively, the prefabricated building element may be a lintel, and may have a decorative element integrally formed in resin on a side surface of the lintel. In another alternative the prefabricated building element may be a quoin.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention, and to show more clearly how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows a perspective view of a first embodiment of building element in the form of a sill;

Figure 1A shows a cross section through the sill of Figure 1;

Figure 2 shows a perspective view of an alternative embodiment of sill;

Figure 2A shows a cross section through the sill of Figure 2;

Figure 3 shows a perspective view of a third embodiment of building element in the form of a lintel;

Figure 3A shows a cross section through the lintel of Figure 3;

Figure 4 shows a perspective view of an alternative embodiment of lintel; and

Figure 4A shows a cross section through the lintel of Figure 4.

DESCRIPTION OF PREFERRED EMBODIMENT(S)

Referring firstly to Figures 1 and 1A, a first embodiment of building element in the form of a sill is indicated generally at 10. The sill has an outer shell 12 and an expanded foam inner 14. In the embodiment shown, the sill is a stooled sill, which is a well known design shape of sill. The outer shell 12 has an upper surface 16, a lower surface 18, a front surface 20, a rear surface 22 and first and second end surfaces 24,26. A front area of the upper surface 16 is effectively cut away and slopes downwardly to allow water to run off in conventional manner. A longitudinally extending groove or recess 28 is provided in the upper surface 16 of the sill to provide a key for mortar. Also, a longitudinally extending groove or recess 29 is

provided on the lower surface 18 of the shell 12, providing a drip bead. Grooves of this nature are conventional in the field.

The outer shell 12 is made from polyester resin in a silicone mould. The mould itself is made from catalysed liquid silicone with silicone thickener. Glass fibre and burlap is used to strengthen the mould as the layers of silicone are laid down, which add both elasticity and strength. The layers of silicone are brushed on evenly by hand and allowed to dry between coats.

The outer shell 12 is cast as a closed casting in a rotational casting machine. Resin, preferably a polyester resin and more preferably an isophthalic neopentyl glycol unsaturated polyester resin, sold under the trade name CRYSTIC 935PAHR is mixed with a catalyst of methyl ethyl ketone peroxide, and a quantity of crushed marble or glass. The crushed marble or glass may take the consistency of a powder. The resin of the outer shell 12 is allowed to cure, initially at room temperature for around 24 hours, and is then heated to 60 degrees Celsius for around four hours. The heating accelerates the curing process, which at 15 degrees Celsius would take twenty eight days for an equivalent cure hardness. On removal from the silicone mould, the outer shell 12 has the appearance of a solid casting, but in fact is hollow.

The ideal wall thickness of the outer shell 12 has been found to be around 6mm. However, wall thicknesses between 1mm and 6mm are contemplated for different applications and subject to controlled testing.

Two small holes (not shown) are provided in the top of the outer shell 12, towards respective ends, on the upper surface 16 towards the rear surface 22. The expanded foam insulation 14 is injected through these holes simultaneously to fill the outer shell 12. The expanded plastics foam is expanded polyurethane and is composed of a liquid polyisocyanate and a polyol which is mixed in the injection nozzle(s) on injection. It falls within the class of substances, generally known as a Bio Foams. Advantageously, the expanded polyurethane has no VOCs, CFCs, HFCs or urea. The density of the foam can be controlled to produce a required insulation value, as required. The foam has an r-value of

0.025. If the density of the foam is increased, the strength of the building element in both compression and bending can be improved. The foam has no food value for rodents or insects and is self bonding. It is also envisaged that expanded plastics foam of the type commercially known as Iceynene is suitable in the same way as expanded polyurethane.

A key factor in the choice of the resin and foam, is that they must not react together and degenerate in any way, for example, the resin must not break down bonds in the foam causing it to effectively dissolve.

The building element may also be provided as a standard non-stooled sill, indicated at 30 in Figures 2 and 2A; a lintel as indicated at 40 in Figures 3 and 3A (also usable as a quoin) and a decorated lintel as indicated at 50 in Figures 4 and 4A. The decorated lintel 50 includes an integral keystone member 52 disposed on the front surface of the lintel. It will be appreciated that in view of the manufacturing process of the building element, decorative features can be added as desired, a long as they can be moulded effectively. It is also to be noted in Figures 3A and 4A, that reinforcing 44, 54 is set into the foam 14. The shell can be moulded around the reinforcing, which may be steel, carbon fibre or engineered plastics and the foam then injected around the reinforcing. High density polyurethane foam can also be reinforced with strands of fibreglass to make structurally reinforced foam. The reinforcement is generally required when the building element is used as a lintel.

It will be appreciated that the building elements described are extremely strong, light to handle, do not have sharp edges, can withstand all weather conditions, have the appearance of stone and most importantly, can be used with or without external insulation systems to meet required insulation standards. By the use of plastics, cold bridges are entirely avoided.

The embodiments described above are provided by way of example only, and various changes and modifications will be apparent to persons skilled in the art without departing from the scope of the present invention as defined by the appended claims.

CLAIMS

1. A prefabricated building element comprising an outer shell having at least an upper surface, a lower surface, a front surface, a rear surface and first and second end surfaces, the shell being made from a composite of a plastics resin mixed with either crushed marble or crushed glass; the shell being filled with an expanded plastics foam.

2. A prefabricated building element as claimed in claim 1, in which the resin is a polyester resin.

3. A prefabricated building element as claimed in claim 1 or claim 2, in which the resin is an isophthalic neopentyl glycol unsaturated polyester resin.

4. A prefabricated building element as claimed in claim 3, in which the resin includes a catalyst, causing the resin to set.

5. A prefabricated building element as claimed in claim 4, in which the catalyst is a methyl ethyl ketone peroxide.

6. A prefabricated building element as claimed in any preceding claim, in which the outer shell is between 1mm and 6mm in thickness.

7. A prefabricated building element as claimed in any one of claims 1 to 5, in which the outer shell is substantially 6mm in thickness.

8. A prefabricated building element as claimed in any preceding claim, in which at least one aperture provided in the shell for injecting the expanded plastics foam.

9. A prefabricated building element as claimed in claim 8, in which two apertures are provided in the sill for injecting the expanded plastics foam.

10. A prefabricated building element as claimed in claim 9, in which the apertures are provided through the upper surface of the building element.

11. A prefabricated building element as claimed in any preceding claim, in which the expanded plastics foam is polyurethane.

12. A prefabricated building element as claimed in claim 11, in which the polyurethane is composed of a liquid polyisocyanate and a polyol which is mixed in a nozzle on injection.

13. A prefabricated building element as claimed in any preceding claim, in which the expanded plastics foam is Iceynene.

14. A prefabricated building element as claimed in any preceding claim, in which reinforcing is disposed inside the shell.

15. A prefabricated building element as claimed in claim 14, in which the reinforcing is of steel, carbon fibre or engineered plastics.

16. A prefabricated building element as claimed in any preceding claim, in which the prefabricated building element is a window sill.

17. A prefabricated window sill as claimed in claim 16, in which an elongate recess is provided along the lower surface of the shell for serving as a drip bead.

18. A prefabricated window sill as claimed in claim 16 or claim 17, in which a portion of the upper surface is sloped downwardly towards one side thereof.

19. A prefabricated building element as claimed in any one of claims 1 to 15, in which the prefabricated building element is a lintel.

20. A prefabricated lintel as claimed in claim 19, in which a decorative element integrally formed in resin on a side surface of the lintel.

21. A prefabricated building element as claimed in any one of claims 1 to 15, in which the prefabricated building element is a quoin.

22. A prefabricated building element substantially as described herein with reference to and as illustrated in Figures 1 to 8 of the accompanying drawings.

AMENDMENTS TO CLAIMS HAVE BEEN FILED AS FOLLOWS

CLAIMS

1. A prefabricated building element in the form of a window sill suitable for external use comprising a closed cast outer shell having at least an upper surface, a lower surface, a front surface, a rear surface and first and second end surfaces, the shell being made from a composite of a plastic polyester resin mixed with either crushed marble or crushed glass and a catalyst, causing the resin to set; the shell being filled with an expanded plastics foam.

2. A prefabricated building element as claimed in claim 1, in which the resin is an isophthalic neopentyl glycol unsaturated polyester resin.

3. A prefabricated building element as claimed in claim 1 or 2, in which the catalyst is a methyl ethyl ketone peroxide.

4. A prefabricated building element as claimed in any preceding claim, in which the outer shell is between 1mm and 6mm in thickness.

5. A prefabricated building element as claimed in any one of claims 1 to 3, in which the outer shell is substantially 6mm in thickness.

6. A prefabricated building element as claimed in any preceding claim, in which at least one aperture provided in the shell for injecting the expanded plastics foam.

7. A prefabricated building element as claimed in claim 6, in which two apertures are provided in the sill for injecting the expanded plastics foam.

8. A prefabricated building element as claimed in claim 7, in which the apertures are provided through the upper surface of the building element.

9. A prefabricated building element as claimed in any preceding claim, in which the expanded plastics foam is polyurethane.

10. A prefabricated building element as claimed in claim 9, in which the polyurethane is composed of a liquid polyisocyanate and a polyol which is mixed in a nozzle on injection.

11. A prefabricated building element as claimed in any preceding claim, in which reinforcing is disposed inside the shell.

12. A prefabricated building element as claimed in claim 11, in which the reinforcing is of steel or carbon fibre.

13. A prefabricated window sill as claimed in claim 11, in which an elongate recess is provided along the lower surface of the shell for serving as a drip bead.

14. A prefabricated window sill as claimed in claim 13, in which a portion of the upper surface is sloped downwardly towards one side thereof.

15. A prefabricated building element substantially as described herein with reference to and as illustrated in Figures 1 to 2a of the accompanying drawings.

Application No: GB1401770.1 **Examiner:** Mr Philip Lawrence

Claims searched: . **Date of search:** 26 August 2014

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X,Y	X: 1-13 Y: 16-21	GB2084511 A (DILLON), see Abstract, Figures, Page 1 lines 20-26, 71-79 and Page 2 lines 20-34.
X,Y	1-7 11, 13-15, Y: 16-21	GB1386752 A (ARCHITECTURAL RESEARCH), see Figures, Page 2 lines 3-9 and Page 2 line 100 - Page 3 line 10.
X,Y	X: 1-7, 11, 13 Y: 16-21	ES2244318 A (ASUMENDI et al.), see WPI Abstract Accession No. 2006-300895.
X	1-8, 11-14	US5934040 A (CHEN), see Abstract, Figures and Col. 3 lines 48-59 and table in Col. 4. Note also the discussion of the prior art.
Y	16-20	GB2503975 A (MANTHORPE), see Abstract and Figures.
Y	16-20	US3605356 A (BORDNER), see whole document.
Y	21	GB2052471 A (FIJON), see Abstract.
A	-	GB190022941 A (DOYLE), see whole document.

Categories:

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

Worldwide search of patent documents classified in the following areas of the IPC

E04B; E04C; E04F; E06B

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

EPODOC, TXTE, WPI

International Classification:

Subclass	Subgroup	Valid From
E04C	0001/00	01/01/2006
E04B	0001/12	01/01/2006
E04B	0001/14	01/01/2006
E04B	0001/74	01/01/2006
E04B	0001/76	01/01/2006
E04B	0001/78	01/01/2006
E04C	0002/02	01/01/2006
E04C	0002/20	01/01/2006
E04F	0013/14	01/01/2006
E06B	0001/70	01/01/2006