A modular steel-framed building unit according to the invention comprises a lift shaft (elevator shaft) and staircase extending for the height of a single storey of a multistorey building and intended to be built up as a stack of identical units to create the multi-storey lift shaft and staircase of the finished building. The unit comprises a metal outer frame (1) formed from cold-formed structural steel sections and a metal inner frame (2) formed from cold-formed structural steel sections. The inner frame defines the lift shaft in the finished building. A three-flight staircase (3) extends between the inner and outer frames (1) and (2) on three sides of the inner frame (2), each flight (3a, 3b, 3c) of the staircase being formed from folded sheet metal joined at one edge to the inner frame (2) and at an opposite edge to the outer frame (1), with a flat sheet metal landing (6) being secured between successive flights of the staircase (3) so that each flight runs at 90° to the preceding flight. The unit has sufficient structural integrity that it can be manufactured off-site and transported to the building site where a number of such units can be stacked one over the next and connected together to build a structurally stable and accurate lift shaft and staircase.
TITLE
Modular Lift Shaft and Staircase

DESCRIPTION
5 Field of the Invention
The invention relates to a modular steel framed building unit comprising a single storey lift shaft and staircase.

Background Art
10 Prefabricated building systems are known in which buildings are created from either prefabricated panels or prefabricated room units. In the panel system of construction, rooms and corridors, and internal and external walls of the building, are created by securing prefabricated panels together at their edges, or by securing such prefabricated panels to a lattice work of steel girders pre-erected as the structural frame of the building. In both building methods there is a need for a rapid and reliable method of creating the lift shafts or elevator shafts which service the upper floors of a high rise building. A very high standard of accuracy is needed for the construction of those lift shafts, since a working tolerance of at most about 1 mm per four storeys is called for to ensure that in the final building the lift or elevator runs smoothly. For that reason even in modular assembly buildings, the lift shaft is generally something that is created on-site, where the necessary tolerances can be observed over a number of storeys, as opposed to being formed from prefabricated components. That slows down the construction work, and adds significantly to the cost of the finished building.

The Invention
The invention provides a modular steel-framed building unit comprising a single storey lift shaft and staircase, as defined in claim 1 herein. By constructing the lift shaft and staircase as an integrated sub-assembly the lift shaft can derive its structural and dimensional integrity from the staircase which surrounds it on three sides, with the result that an extremely accurately
dimensioned and dimensionally stable building unit can be created in factory conditions, before being transported to the building site. During that transportation the dimensional stability is maintained, and it has been found that in a finished building, even a high rise building of twelve or more storeys, the lift shaft created by arranging a number of such modular units one over the other has a dimensional accuracy well within the tolerances laid down by the appropriate building regulations for lift shafts. Typically a dimensional tolerance of ±0.1 mm per storey is achievable.

The building unit of the invention derives its dimensional rigidity and stability from the way in which the three flights of the staircase, which respectively lie on different sides of the inner frame defining the lift shaft, link together the inner and outer metal frames in a totally dimensionally stable manner. The risers and treads of the individual stairs are made from sheet metal, but that can be covered with board, cladding or other sound-insulating material to reduce sound transmission, and is an excellent thermal barrier against any building fire which might otherwise try to spread upwardly through the stairwell.

Drawings

Figure 1 is a perspective view of the principal components only of a metal framework of a unit according to the invention, comprising a metal outer frame and a metal inner frame, before the incorporation of the stairs;

Figure 2 is a schematic perspective view illustrating very generally the three flights of staircase and two landings which according to the invention are provided between the metal outer frame and the metal inner frame of Figure 1;

Figure 3 is a perspective view of one of the flights of stairs shown schematically in Figure 2; and
Figure 4 is an enlarged detail of the portion shown encircled as A in Figure 3.

Referring first to Figure 1, the modular steel framed building unit of the invention is shown in the form of only its most basic structural components. A metal outer frame 1 of parallelepipedal shape is shown as comprising four corner posts 1a linked together at their tops and bottoms by horizontal spacers 1b and 1c. A metal inner frame 2 is also of parallelepipedal shape, comprising four corner frame members 2a linked together at their tops and bottoms by horizontal cross members 2b and 2c.

All of the structural members of the module skeleton shown illustrated in Figure 1 are formed from cold-formed structural steel sections. These are preferably C-sections, but may be formed of any other cross section commonly used in the fabrication of modules for prefabricated building constructions. The individual sections may be joined together at their corners by any known method, including welding, brazing, screwing or bolting. Figure 1 illustrates only the basic components which will be used to make up such a steel shell. Of course, additional vertical uprights or horizontal cross members or diagonal braces could be used as appropriate to comply with building regulations and best building practice, including the usual filler bars from which internal or external wall panels can be suspended. Figure 1 omits such additional structural members purely in the interest of clarity.

Figure 2 illustrates, only very schematically, a three-flight staircase used in conjunction with the framework of Figure 1 to create a single building module according to the invention. Figure 2 illustrates a staircase 3 comprising three individual flights of stairs 3a, 3b and 3c each of which as illustrated comprises three stairs only. It will of course be understood that each individual flight of stairs can comprise some other number of individual stairs, or even one more or one less stair tread than the stair risers. Flight 3a is connected to flight 3b in Figure 2 through a steel plate 6 which serves as the landing as the
staircase turns through 90°, and similarly stair flights 3b and 3c are connected together by a steel plate 6 which serves as a second landing.

Figure 2 is purely illustrative, and Figure 3 shows in greater detail one individual stair flight, which may be 3a, or 3b, or 3c. The stair flight of Figure 3 comprises a folded sheet of metal 4, folded into alternating stair risers and stair treads. It will be understood that the risers and treads of the complete flight of stairs 3a (or 3b or 3c) shown in Figure 3 can be formed from a single sheet of folded metal 4, or alternatively individual stairs comprising one riser and one stair tread can each be welded to the next, so that the flight of stairs 4 is surfaced with sheet steel formed with a combination of folds and welds.

Welded to each side of the metal sheet 4 are stair sides 5 which give the individual stair flights structural integrity. Figure 4 shows a detail of the edge connection between the side panels 5 and the folded metal panel 4. Each edge is laser-cut into a crenellated formation, with the crenellations interfitting one with the other. The edge connection is then completed by either a running weld or a series of spot welds between the underside of the stair tread and the inside face of the side panel 5. The same system of edge joining by welding over a series of interfitting crenellations can be used down the edges of the riser portions of the folded metal sheet 4 and the side plates 5, and for the junctions between each flight of stairs and its associated landing 6.

The stairs are incorporated, one flight at a time, into the steel framed building module of Figure 1, and rigidly secured by welding, brazing, screwing or bolting to the structural C-section members of Figure 1. If additional structural members are used for the construction of the module of Figure 1, other than the most basic components of the metal outer and inner frames illustrated in Figure 1, then the staircases are preferably secured to those additional structural members also, further to enhance the structural integrity of the finished module.
In the finished module, all walls which will become solid walls in the final building are preferably clad with suitable cladding panels before the module is transported to the building site for incorporation into the finished building. The module itself can be assembled in factory conditions, preferably building it around an assembly jig that has been created to very precise dimensional tolerances. Once assembled, the staircase which extends around three sides of each storey height of the lift shaft that is defined by the metal inner frame 2 creates exceptional structural and dimensional stability to a finished module. Successive modules can be built up one on top of the other, preferably with factory-installed location means (not shown) which ensure positive location between successive building units as the overall height of the lift shaft increases during building.

The modular building unit of the invention is expected to reduce quite significantly the overall time spend in constructing accurate lift shafts on-site, with a corresponding reduction in building costs over current practices.
CLAIMS:
1. A modular steel-framed building unit comprising a single storey lift shaft and staircase, comprising:
   - a metal outer frame formed from cold-formed structural steel sections;
   - a metal inner frame formed from cold-formed structural steel sections and defining a lift shaft for the vertical passage therein of a lift (elevator) in a finished building which incorporates a number of such units arranged one over the other; and
   - a three-flight staircase extending between the inner and outer frames on three sides of the inner frame, each flight of the staircase being formed from folded sheet metal joined at one edge to the inner frame and at an opposite edge to the outer frame, with a flat sheet metal landing being secured between successive flights of the staircase so that each flight runs at 90° to the preceding flight.

2. A building unit cording to claim 1, wherein each flight of the three-flight staircase comprises stair treads and stair risers formed by folding a sheet of metal which extends continuously across the width of the stair flight.

3. A building unit according to claim 2, wherein all the treads and all the risers of each flight of stairs are formed from a single sheet of metal by folding.

4. A building unit according to any preceding claim, wherein each flight of the three-flight staircase comprises three or more individual stairs, with the flight starting with either a stair tread or a stair riser and finishing with either a stair tread or a stair riser.

5. A building unit according to any preceding claim, wherein each flight of stairs comprises riser and tread areas formed by folding, having at their opposite edges a crenellated formation which interfits with a cooperating crenellated formation in a pair of side plates, the risers and treads being
further connected to the side plates by a running weld or by a series of spot welds along the internal join therebetween.

6. A building unit according to claim 5, wherein each individual flight of the three-flight staircase is secured to each of the metal outer frame and the metal inner frame by bolting, screwing, welding or brazing the side plates to the respective outer and inner frames.
Application No: GB0703638.7
Claims searched: 1-6

Examiner: Mrs Judith Peake
Date of search: 24 July 2007

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 of document or figure of particular relevance</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>-</td>
<td>DE20002775 U1 (MUELLER) See abstract number 2000-573348 [54] and Figs 2 and 10, showing independent stackable building module featuring staircase surrounding the lift shaft.</td>
</tr>
<tr>
<td>A</td>
<td>-</td>
<td>US5644871 A (COHEN et al) Modular, single storey unit with lift shaft and separate staircase</td>
</tr>
<tr>
<td>A</td>
<td>-</td>
<td>FR2313523 A1 (ASPELIN) See abstract number 1977-C4132Y [04] and Figs 4 and 6 showing prefabricated central column type lift shaft.</td>
</tr>
<tr>
<td>A</td>
<td>-</td>
<td>GB2279378 A (COLLMAIN CUSTOMER SERVICES LTD) Prefabricated metal framework for lift shaft of multiple storey build</td>
</tr>
</tbody>
</table>

Categories:

<table>
<thead>
<tr>
<th>X</th>
<th>Document indicating lack of novelty or inventive step</th>
</tr>
</thead>
</table>
| 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:

EID
Worldwide search of patent documents classified in the following areas of the IPC
E04B; E04F; E04H
The following online and other databases have been used in the preparation of this search report
Online: EPDOC, WPI, Full text databases

International Classification:

<table>
<thead>
<tr>
<th>Subclass</th>
<th>Subgroup</th>
<th>Valid From</th>
</tr>
</thead>
<tbody>
<tr>
<td>E04B</td>
<td>0001/34</td>
<td>01/01/2006</td>
</tr>
<tr>
<td>E04B</td>
<td>0001/343</td>
<td>01/01/2006</td>
</tr>
</tbody>
</table>