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(54) **FIRE RESISTING WALL**

FEUERFESTE WAND

MUR RESISTANT AU FEU

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DE-U- 29 505 833 **GB-A- 2 053 779**
US-A- 3 305 993

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Description

[0001] This invention relates to fire resisting wall structure comprising a row of spaced vertical studs covered by respective facing layers of fire resisting building boards secured to the studs.

[0002] Fire resisting walls have been designed to survive a fire duration with no loss of integrity or insulation performance. This has led to a design where a wall consists of metal studs with boards attached to each side and occasionally insulation in the cavity. As the fire test progresses the layers of boards fall away until finally the wall fails either by heat transfer or through loss of integrity.

[0003] Such walling is shown in DE-U-295 05 833, in which the structure is provided on both sides with planking which comprises sheet steel plates riveted to support sections, or studs, and multilayered gypsum board planking screwed thereover.

[0004] Particularly useful in fire resisting partitions are boards made in accordance with our Patent GB-B-2 053 779, which consist of a set cementitious (usually gypsum) core, preferably reinforced with chopped inorganic fibre, and a surface layer on at least one face comprising an inorganic fibre sheet embedded in the gypsum surface so that the material of the core extends in a continuous film over the web outer surface of the sheet. This board affords good resistance to spread of flame, owing to its wholly inorganic surface, but also has a high degree of inherent fire resistance arising from the behaviour of the core materials when the board is exposed to fire.

[0005] When a gypsum surface is exposed to fire, the combined water of crystallisation is gradually released in the form of water vapour in two stages, both of which are endothermic, while a covering of calcined gypsum remains strongly adherent to the uncalcined material, retarding the dehydration process, which becomes progressively slower as the thickness of the calcined layer increases. While this continues, the temperature behind the plane of calcination remains only slightly above 100°C so that, until all the water of crystallisation in the board has been expelled, the temperature of materials in contact with or adjacent to the unexposed side of the board should not exceed 100°C. This is well below the ignition temperature of most materials that are either used in building or stored in buildings.

[0006] Once the gypsum content of the board is completely calcined, the residue (Calcium sulphate) continues to act as an insulating barrier for as long as it remains intact. Inorganic fibre webs and core fibre reinforcement help to ensure the integrity of the board and to maintain a barrier to the fire for some considerable time after calcination.

[0007] With this design of partition the metal framework of the wall is at temperature of around 1000°C at the point of failure for the wall, as all the boards on the exposed face have fallen away. This presents a problem

when a wall of extended height is required, as at elevated temperatures steel suffers loss of strength. This strength loss means that the wall will not remain stable and consequently will not support the boards on the unexposed face of the metal. To make matters worse, when steel is heated differentially it undergoes thermal bowing which means that the weight of the wall itself is acting eccentrically. For this reason, fire resistant partitions of considerable height, for example up to 20m, have only been achieved by the use of load-bearing structural frameworks, which enable the partition to be subdivided into smaller areas affording the desired resistance.

[0008] It is an object of the present invention to provide an easily erected partition wall structure which can offer four fire resistance at considerable heights, for example up to 20m, without the use of a load-bearing structural framework.

[0009] In accordance with this invention, such a fire resisting wall structure is characterised in that the structure comprises two spaced rows of studs, and that the rows of studs are separated by a central layer of fire resisting building board to which the studs of both rows are secured, the thickness of the central layer being greater than that of either of the facing layers. The studs or supports of fire resisting material are preferably of metal, such as steel. The preferred board is inorganic fibre reinforced gypsum board, for example of the kind discussed above.

[0010] The invention achieves its object by providing support to the boards for the duration required. Of the two metal frames separated by the board core, the frame closest to the fire is sacrificial whilst the second frame remains cool and consequently has the strength to keep the wall standing for the required duration. The thicker core continues to be supported by the surviving frame.

[0011] To attain greater fire resistance, each layer of board is preferably made up of several thicknesses of board. The desired thickness of the central layer can be obtained by employing at least two thicknesses of board while the facing layers may consist of fewer thicknesses of board.

[0012] An advantage of the invention is its economy in the quantity of building board required for a given degree of fire resistance. This follows from the location of the majority of the boards, that is, the greater amount of fire resistant material, in the centre layer, where it is protected by the sacrificial outer layers. This centre-weighted or symmetrical design enables thinner facing layers to be used than if each facing layer itself had to constitute the main defence against the transmission of fire, which might attack either side. The facing layers, or at least the layer on that face exposed to a known fire risk, preferably incorporates a material of high fire resistance and integrity, for example a metal (e.g. steel) sheet; this can be used to maximise the potential of the air cavity or may serve to reduce the number of thicknesses of

board employed in the outer layers.

[0013] This wall is designed to maintain 4 hours fire resistance at extended heights and consequently when tested at 3m height achieves 5 hours fire resistance. However, the traditional failure criteria do not apply, and the critical factor is the temperature of the cold metal frame at 4 hours duration. The cold metal frame has a temperature of approx. 100°C with a small temperature differential over the stud at the four hour duration, which allows the design to be used at extended heights.

[0014] Preferred embodiments of the invention will now be described, by way of example, with reference to the accompanying drawing which is a horizontal section through a wall in accordance with the invention.

[0015] In erecting the partition shown in the drawing, a first framework includes a metal head channel and base channel which are fixed at 600mm centres to the adjacent floor and ceiling surfaces respectively. Strips of inorganic fibre reinforced gypsum board 72mm wide and 25mm thick are interposed between the channels and the surfaces to which they are fixed. Metal studs 10 are then positioned at 600mm centres between the head and base channels. The end studs at the sides of the partition are fixed to the adjacent wall at 600mm centres through another strip of inorganic fibre reinforced gypsum board.

[0016] Three thicknesses of inorganic fibre reinforced gypsum board, arranged in abutting vertical lengths, are fixed by screws to the faces of the studs 10 which are to constitute the inner face in the finished partition. A first layer 11 of 15mm board is fixed by 25mm screws at 300mm centres to all metal framing, a second layer 12 of 25mm board by 42mm screws at 300mm centres and the third layer 13 of 15mm board by 75mm screws at similar spacing. The joints between the boards are staggered with respect to adjacent layers, with a full board at the fixed edge.

[0017] A second similar metal stud framework (but using 50mm thick strips of board at the head, base and sides) is constructed alongside and in contact with the three layers of board. The studs 14 in the second framework are staggered by 300mm with respect to the studs 10 in the first framework, and the second framework is fixed to the three layers of board 11-13 using 75mm screws.

[0018] The external face of each framework is then lined with 0.7mm steel sheet 15 fixed at 300mm centres with 13mm wafer head screws. A layer of 25mm board 16 is fixed to the steel sheet using 25mm screws at 150mm centres round the perimeter and down the centre of the boards, and an outer layer of 15mm board 17 is fixed through to the steel sheet at 300mm centres using 42mm screws round the perimeter and down the centre of the boards. The vertical joints between the boards in the outer layers are positioned such that no joint is in alignment with the position of a stud. All joints are taped and filled, and screwheads spotted, with a conventional joint filler.

[0019] In a typical example, the channels and studs are of cold formed hot dipped galvanised steel in accordance with BS 2989 (EN 10142), and the boards are glass fibre reinforced gypsum board in accordance with UK Patent GB-B-2 053 779, preferably as sold under the designation 'Glasroc S'.

[0020] In a test conducted on a partition 3m high and 3m wide, constructed in a concrete lined steel restraint frame having an opening of this size, the partition demonstrated fire resistance of five hours when tested in accordance with BS476: Part 22: 1987.

Claims

1. A fire resisting wall structure comprising a row of spaced vertical studs (10) covered by respective facing layers of fire resisting building boards (16-17) secured to the studs, **characterised in that** the structure comprises two spaced rows (10, 14) of studs, and that the rows of studs are separated by a central layer of fire resisting building board (11-13) to which the studs of both rows are secured, the thickness of the central layer being greater than that of either of the facing layers (16-17).
2. A wall structure according to claim 1 in which the central layer of building board (11-13) comprises at least two thicknesses of inorganic fibre reinforced gypsum board.
3. A wall structure according to claim 1 or 2 in which the facing layers each comprise two thicknesses of board (16, 17) and the central layer comprises at least three thicknesses of board (11, 12, 13).
4. A wall structure according to claim 1, 2 or 3 in which at least one outer facing layer includes a layer of sheet steel (15), preferably as the innermost layer at the outer face and secured directly to the underlying stud (10 or 14).
5. A wall structure according to claim 3 or 4 in which the facing layers each comprise thicker board (16) nearer the studs and thinner board (17) on the outer face, and the central layer comprises a layer of thicker board (12) between respective layers of thinner board (11, 13).

Patentansprüche

1. Feuerbeständige Wandkonstruktion, umfassend eine Reihe von voneinander beabstandeten vertikalen Ständern (10), die mit jeweiligen Beplankungslagen aus feuerbeständigen Bauplatten (16-17), die an den Ständern befestigt sind, bedeckt sind, **dadurch gekennzeichnet, dass** die Konstruktion

zwei voneinander beabstandete Reihen (10, 14) von Ständern hat und dass die Reihen von Ständern durch eine zentrale Lage aus feuerbeständigem Bauplattenmaterial (11-13) getrennt sind, an der die Ständer beider Reihen befestigt sind, wobei die Dicke der zentralen Lage größer ist als die von jeder der Beplankungslagen (16-17).

2. Wandkonstruktion nach Anspruch 1, bei der die zentrale Bauplattenlage (11-13) wenigstens zwei Dicken aus mit anorganischer Faser verstärkten Gipsplatten umfasst.

3. Wandkonstruktion nach Anspruch 1 oder 2, bei der die Beplankungslagen jeweils zwei Plattendicken (16, 17) umfassen und die zentrale Lage wenigstens drei Plattendicken (11, 12, 13) umfasst.

4. Wandkonstruktion nach Anspruch 1, 2 oder 3, bei der wenigstens eine äußere Beplankungslage eine Lage aus Stahlblech (15) aufweist, vorzugsweise als die innerste Lage an der äußeren Beplankung und direkt am darunterliegenden Ständer (10 oder 14) befestigt.

5. Wandkonstruktion nach Anspruch 3 oder 4, bei der die Beplankungslagen jeweils näher an den Ständern dickeres Plattenmaterial (16) und an der Außenbeplankung dünneres Plattenmaterial (17) umfassen und die zentrale Lage eine Lage aus dickem Plattenmaterial (12) zwischen jeweiligen Lagen aus dünnerem Plattenmaterial (11, 13) umfasst.

chacune deux épaisseurs de panneau (16, 17) et la couche centrale comprend au moins trois épaisseurs de panneau (11, 12, 13).

4. Structure murale selon la revendication 1, 2 ou 3, dans laquelle au moins une couche de parement extérieure comprend une couche de tôle (15), de préférence en tant que couche la plus intérieure au niveau du parement extérieur et fixée directement au poteau sous-jacent (10 ou 14).

5. Structure murale selon la revendication 3 ou 4, dans laquelle les couches de parement comprennent chacune un panneau plus épais (16) plus près des poteaux et un panneau plus mince (17) sur le parement extérieur, et la couche centrale comprend une couche de panneau plus épais (12) entre des couches respectives de panneau plus mince (11, 13).

Revendications

1. Structure murale résistante au feu comprenant une rangée de poteaux verticaux espacés (10) recouverts de couches de parement respectives de panneaux de construction résistants au feu (16-17) fixées aux poteaux, **caractérisée en ce que** la structure comprend deux rangées espacées (10, 14) de poteaux, et **en ce que** les rangées de poteaux sont séparées par une couche centrale de panneau de construction résistant au feu (11, 13) à laquelle les poteaux des deux rangées sont fixés, l'épaisseur de la couche centrale étant plus grande que celle de l'une ou l'autre des couches de parement (16 -17).

2. Structure murale selon la revendication 1, dans laquelle la couche centrale de panneau de construction (11 - 13) comprend au moins deux épaisseurs de panneau en gypse armé de fibres inorganiques.

3. Structure murale selon la revendication 1 ou 2, dans laquelle les couches de parement comprennent

