

Beam Construction in Walls and Ceilings of Clean Air Rooms

Introduction

The present invention relates to a beam construction for walls and ceilings in clean rooms, comprising first and second beams, which are arranged essentially perpendicular to each other and essentially in parallel with the plane of extension of the wall and the ceiling, respectively, the first and the second beams comprising elongate
5 flanges with supporting surfaces, which are essentially parallel with the plane of extension of the wall/ceiling, the wall/ceiling comprising wall and ceiling elements, respectively, which abut against the supporting surfaces.

10 The invention is particularly well suited for construction and mounting of accessible clean room ceilings, where quick and flexible mounting is important.

Background Art

Clean rooms are increasingly used in, for instance, the production of electronic components and as surgical operating theatres. As a rule, the clean room is erected inside
15 an existing room in a building. The clean room is shut off from the existing room by means of special walls, ceiling and floor.

Each wall often comprises a plurality of vertical and horizontal beams, which are
20 interconnected to form a rectangular grid. At the long sides of the beams that are directed inwards to the room, projecting flanges are arranged on each side of the beam. The flanges comprise supporting surfaces, which are parallel with the plane of the wall and face away from the room. In this grid, wall elements, for instance in the form of flat rectangular panels, are arranged in such a manner that each wall element,
25 along its circumference and with its surface facing the room, abuts against the supporting surfaces.

Correspondingly, the ceiling comprises a rectangular grid of horizontal beams arranged perpendicular to each other. The beams are usually suspended by means of wires
30 from the ceiling of the existing room. At the lower long side of the beams, a flange is arranged on each side of the beam. Each flange has a horizontal supporting surface directed upwards, away from the room. Ceiling elements, which may consist of flat rectangular panels, are placed in the grid in such a manner that, along their circumference and with the surface facing the room, they abut against the supporting surfaces.

This construction results in walls and ceiling which, seen from the interior of the clean room, have a smooth surface which is relatively free from irregularities and dirt traps.

- 5 FR 2,173,078 discloses a beam construction which to some extent is suitable for this type of ceiling and walls. The construction comprises beams with a cross-section which has the general shape of an inverted T. The horizontal projecting parts of the beams constitute the flanges on which the supporting surfaces are arranged. That part of the beam cross-section which is perpendicular to the flanges constitutes the sup-
10 porting part of the beam. This supporting part is along its sides formed with longitudinal grooves for receiving connecting means. When building, for instance, a ceiling, the beams can be interconnected to form a rectangular grid. A plurality of first beams are suspended in parallel in one direction. These first beams are linked to each other by a plurality of second beams, which are parallel with each other and perpendicular
15 to the first beams. The transverse second beams are connected to the first beams, such that the ends of the second beams face the long sides of the first beams. In this fashion, a grid or screen forms, which comprises longitudinal and transverse beams, which with their supporting surfaces arranged on the flanges encompass rectangular openings. The ceiling is completed by placing rectangular flat ceiling panels in the
20 screen so as to abut against the supporting surfaces.

Problems

- The construction according to FR 2,173,078, however, causes problems in respect of the connecting of the longitudinal and transverse beams. In particular, the construc-
25 tion implies that each connecting point constitutes a weakening, which considerably reduces the strength of the entire ceiling construction.

- Since the supporting surfaces arranged on the flanges also constitute sealing surfaces, it is important for them to be positioned in one and the same plane. When a transverse
30 beam is to be mounted perpendicular to a longitudinal beam, the end of the transverse beam will therefore abut merely against the thin long side of the projecting flange of the longitudinal beam. The common abutment surface of the two beams will therefore be very small and, besides, is arranged at a distance corresponding to the width of the flange from the supporting part of the longitudinal beam. To keep the two beams
35 together, use is therefore made of special connecting means, which are arranged in the grooves in the supporting parts of the transverse and longitudinal beams. The connecting means are adapted to bridge the space arising between the end surface of the

transverse beam and the long side of the supporting part of the longitudinal beam. This fairly complicated connecting operation entails a considerable amount of work, a great number of components and a weak ceiling or wall construction. The insufficient strength is particularly inconvenient in the cases where the clean room ceiling has to carry heavy filters, electric fittings and the like and where it must be possible to walk on the ceiling to enable repairs and maintenance.

Swedish Patent 8700746-4 discloses a beam construction which allows a considerably more stable connection of longitudinal and transverse beams. In this construction, the beams are hollow such that their general cross-section is box-shaped. The beam part closest to the room is formed with a hollow flange projecting on each side of the central part of the beam. Supporting surfaces are arranged on the flange surfaces facing away from the room. Inside the hollow flange on the transverse beam there is arranged a locking means in the vicinity of the beam end. The longitudinal and transverse beams are kept together by the box-shaped cross-section of the transverse beam abutting against the long side of the longitudinal beam and by the locking means in the transverse beam engaging in locking grooves on the long side of the longitudinal beam. This construction results in a considerably larger abutment surface between the longitudinal and transverse beams and therefore is more stable.

The last-described construction, however, causes deficiencies in respect of appearance and function of the inside of the ceiling or wall. For assembly reasons and to utilise gravitation when securing the wall and ceiling elements, the supporting surfaces must face away from the clean room. Therefore, after assembly, the flange will be placed inside the supporting surface and, thus, inside the wall and ceiling elements. This means that the flange is visible and accessible from the inside of the room. The beam construction according to SE 8700746-4 results in the flange having a considerable thickness since it has to accommodate the locking means and since its cross-section should constitute a sufficiently large supporting surface. This results in a wall or ceiling, the inner surface of which is not smooth but cluttered with significantly projecting vertical and horizontal flanges. In addition to these elements being unaesthetical, they cause difficulties when things are to be hung on the walls. Moreover, they disturb the air flow in the room.

With a view to obtaining as smooth an inner surface as possible, it has therefore been suggested that the beams be formed with a hollow supporting part, whose cross-section is box-shaped, and with a thin flange comprising the supporting surface. The sup-

- porting part should, in its mounted state, be arranged outside the flange with the supporting surface, seen from inside the room. Just like in SE-8700746-4, a transverse beam is connected to a longitudinal beam by the end surface of the hollow section of the transverse beam abutting against the long side of the longitudinal beam. In the
- 5 hollow section of the transverse beam, a locking means is also arranged so as to cooperate with locking grooves on the long side of the longitudinal beam. The suggested construction offers a stable structure, but involves essential problems in the mounting of the clean room.
- 10 With this known construction, each transverse beam must in fact be specially worked before mounting. Since both the longitudinal and the transverse beam are provided with projecting flanges, these flanges will prevent the box-shaped cross-section of the supporting part of the transverse beam from abutting against the long side of the longitudinal beam. Before mounting, a part of the flange either of the longitudinal beam
- 15 or of the transverse beam must therefore be removed. In practice, mounting takes place by first cutting the transverse beam such that its longitudinal dimension corresponds to the distance between the two long sides, facing each other, of the supporting sections of the parallel longitudinal beams. Subsequently, that part of the flange on the transverse beam which prevents contact between the supporting parts of the
- 20 two beams is milled off. This milling operation must be carried out in both ends of the transverse beam. After the cutting and milling operations, the transverse beam is mounted between the two longitudinal beams by a locking means at each end of the transverse beam being engaged with and tightened in the two longitudinal beams.
- 25 The milling operations that are necessary cause considerable difficulties during mounting. The milling operations require that a milling tool be brought along and be available at the mounting site. Moreover, the operation, of course, involves additional and time-consuming stages. Besides, any mistake during milling makes it necessary to reject the entire transverse beam.
- 30 The object of the present invention therefore is a beam construction for ceiling and walls, especially in clean rooms, which results in significantly simplified mounting when connecting the ceiling and the walls.
- 35 Solution
- According to the invention, this object is achieved by a beam construction of the kind stated by way of introduction, which is characterised in that at least the second beams

comprise an elongate flange means formed with one or more supporting surfaces, and an elongate supporting means, that the flange means and the supporting means, at least before mounting, are separable and/or axially displaceable relative to each other, and that the supporting means, after mounting, is longer than the flange means and arranged so as to extend at both ends axially beyond the ends of the flange means.

As a result, it is possible, when mounting clean rooms, to cut the flange means separately and the supporting means of the beam separately. In this manner, the need for milling operations is fully eliminated. Besides, the invention allows that the length of the second beams is adjusted by performing a single cutting operation. The cutting and double milling operations that were necessary according to prior art are thus replaced, in a beam construction according to the invention, with a single cutting operation.

The flange means can be connected to the supporting means by means of projections which are arranged on the one means and which cooperate with grooves formed in the other means. When the two means have been cut separately to suitable length, they are simply interconnected by the means provided with projections being inserted into the means provided with grooves.

Also after mounting, the flange means can be connected to the supporting means with the aid of separate connecting means. Thus, the flange means can be, for instance, screwed, riveted or glued to the supporting means. It is also possible that first the means are connected by means of grooves and projections and then separate connecting means are arranged.

Moreover the supporting surfaces can be arranged in such a manner that, after mounting, they are directed away from the room. This embodiment permits easy outside mounting of wall and ceiling elements against the supporting surfaces. In respect of the ceiling, this embodiment makes it possible to use gravitation to fix the ceiling element to the beam grid.

The flange means and/or the supporting means may consist of extruded sectional elements. This makes it possible to use, at relatively low cost, beams, whose cross-sectional geometries are specially adapted to different needs.

The flange means and/or the supporting means can also be made of light metal. One example is aluminium which combines good mouldability with high strength and low weight.

- 5 According to an embodiment of the invention, it is possible to make the first and the second beams with identical cross-sections. Then both the first and the second beams comprise identical flange means and identical supporting means. The advantage of this embodiment is that one and the same type of beam can be used for both the longitudinal and the transverse beams. In mounting, only the length of the flange means
10 and the supporting means of the various beams is to be adjusted.

Description of the Figures

Exemplifying embodiments of the invention will be described below with reference to the accompanying drawings.

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Fig. 1 is a schematic perspective view of a beam construction for clean room ceilings according to an embodiment of the invention.

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Fig. 2 is a part-sectional enlargement of a portion of the perspective view shown in Fig. 1.

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Fig. 1 shows the composition of part of a ceiling for clean rooms. The ceiling comprises a beam construction 1. The beam construction comprises a plurality of first beams 2, which are horizontally suspended with the aid of suspension means 3 from the ceiling of the existing room, in which the clean room is accommodated. Alternatively, the beam construction can be suspended from a separate supporting frame structure (not shown). The first beams 2 are suspended in parallel and their longitudinal axes extend in a direction which below is referred to as the longitudinal direction.

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Between the first beams 2, a plurality of second beams 4 are arranged. The second beams 4 are arranged horizontally, in parallel with each other and perpendicular to the longitudinal first beams 2. Moreover, the second beams 4 are at their ends 5 fixedly connected to the long sides 6 of the longitudinal first beams 2.

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The beam construction 1 forms a grid or a screen, in which the first 2 and the second 4 beams define the circumference of rectangular openings 7. The rectangular openings

7 are covered with rectangular ceiling elements 8. The ceiling elements 8 rest on supporting surfaces 9, which are arranged on the first 2 and the second 4 beams. The supporting surfaces 9 also constitute sealing surfaces, which sealingly cooperate with corresponding sealing surfaces (not shown) of the ceiling elements 8. Separate sealing means (not shown), for instance in the form of seals or a sealing compound, can be arranged between the supporting surfaces 9 and the ceiling elements 8. In order to obtain a reliable seal, it is important for the supporting surfaces 9, which surround an opening 7, to be arranged essentially in one and the same plane. The Figure also indicates that all supporting surfaces 9 of the entire beam construction 1 are arranged essentially in one and the same plane. Exceptions may, of course, occur, for instance if the clean room ceiling has to be built on different levels.

Fig. 2 shows in greater detail how a first longitudinal beam 2 is connected to a second transverse beam 4. The first longitudinal beam 2 is an extruded sectional element of aluminium. The beam 2 is essentially box-shaped in cross-section, with a vertical symmetry axis. A first axial T groove 10 is formed in the upwardly directed long side 11 of the beam. This first T groove 10 is used to attach the suspension means 3 (Fig. 1). In its downwardly directed long side 12, the beam 2 has a second T groove 13. This second T groove 13 is used to fix, from the interior of the clean room, components in the clean room ceiling. The parts of the second T groove 13 which are not used can, for aesthetical and cleaning purposes, be covered with a cover strip 14 which is inserted or snapped into this second T groove 13. Moreover two flanges 15a, 15b are arranged on the downwardly directed long side 12. The flanges 15a, 15b project perpendicularly in separate directions from the vertical symmetry plane of the beam 2. The downwardly directed surfaces of the flanges 15a, 15b are on a level with and constitute part of the downwardly directed long side 12 of the beam. When the cover strip 14 is arranged in the lower T groove 13, the first beam 2 thus has, downwards, towards the clean room, a flat and smooth surface. The two flanges 15a, 15b project horizontally from the respective vertical long sides 6a, 6b of the beam 2. The two vertical long sides 6a, 6b are each provided with a locking groove 16a, 16b. Also these locking grooves 16a, 16b are designed as T grooves. The upwardly directed surfaces of the flanges 15a, 15b constitute the supporting surfaces 9 against which the ceiling elements 8 (Fig. 1) abut. The vertical thickness of the flanges 15a, 15b is relatively small, about 2-5 mm. Their horizontal width is dimensioned to constitute a perfect sealing surface and may, in the normal case, be about 15-50 mm.

The second transverse beam 4 is arranged perpendicular to the first longitudinal beam 2. The second beam 4 is made up of two different elongate sectional elements 17, 18. The first sectional element 17 is a flange means and comprises a downwardly directed flat side 19. An upwardly directed flat side 20 is arranged opposite the downwardly directed side 19. Elongate projections 21 are arranged on the upwardly directed side 20 in parallel with the longitudinal axis of the flange means 17.

The second sectional element 18 is the supporting means and consists of a square beam which is symmetrical about a vertical and a horizontal longitudinal symmetry plane. Each of the long sides 22a, 22b, 22c, 22d of the square beam has a flat surface, in which a T groove 23a, 23b, 23c, 23d, respectively, is arranged. A longitudinal cavity 24 extends centrally through the square beam 18. A locking means 25 with hooks 25a is arranged at each end of the square beam 18, partially within it and with the hooks 25a projecting from the cavity 24.

As is evident from Fig. 2, the flange means 17 and the square beam 18 are interconnected by the elongate projections 21 engaging in the T groove 23d which is arranged in the downwardly directed long side 22d of the square beam 18. This engagement is effected by the projections 21 of the flange means 17 being inserted axially into the T groove 23d.

The thus interconnected sectional elements 17, 18 constitute the second transverse beam 4. The supporting surfaces 7 of this beam 4 are formed of the parts of the upwardly directed side 20 of the flange means 17 which project beyond the downwardly directed long side 22d of the square beam 18. The square beam 18 is longer than the flange means 17 and therefore extends, with both ends, beyond the ends of the flange means 17. The end of the flange means 17 abuts against the long side of the flange 15a of the first longitudinal beam 2. The square beam 18, however, extends beyond the flange 15a of the first beam 2 with supporting surface 9 and abuts against the vertical long side 6a of the first beam 2. The transverse beam 2 is connected to the longitudinal beam 2 by the hooks 25a of the locking means 25 engaging in the locking grooves 16a of the first beam 2.

When mounting a beam construction for a clean room ceiling, first the first longitudinal beams 2 are suspended in parallel and at a suitable distance from each other. The centre distance between the first beams 2 is preferably selected between 500 and 1500 mm, especially between 600 and 1200 mm. Then the length of the transverse

second beams 4 is adjusted to the selected distance. The square beam 18 is cut such that its length corresponds to the distance between the two vertical long sides 6a and 6b, facing each other, of the first longitudinal beams 2. The flange means 17 is cut such that its length corresponds to the length of the square beam minus twice the width of the flange 15 of the longitudinal beam 2. This can be carried out by two cutting operations with the flange means 17 and the square beam 18 separated.

Alternatively, both sectional elements 17, 18 can be cut in one and the same cutting operation. Then the two sectional elements 17, 18 are displaceably interconnected also during the cutting operation. Before cutting, the two sectional elements 17, 18 are displaced axially in relation to each other such that the square beam 18, at the end which is not to be cut, extends beyond the flange means 17 a distance corresponding to twice the width of the flange 15 of the first beam 2. Subsequently the two sectional elements 17, 18 are cut such that the square beam 18 obtains the correct length. After cutting, the flange means 17 is moved back half the previously displaced distance. Now the square beam 18 extends, at each end, beyond the end of the flange means a distance corresponding to the width of the flange 15 of the first longitudinal beam 2.

This technique of adjusting the length of the transverse beams results in a considerable simplification compared with prior art. In known beam constructions, each transverse beam must be adjusted in one cutting and two milling operations, one at each end. With a beam construction according to the present invention, all these operations are replaced by a single cutting operation.

When the length of the second transverse beam 4 thus is adjusted, each end thereof is fixed to the locking means 25 in the locking grooves 16 of the longitudinal beams 2.

It goes without saying that the invention is not limited to the embodiment illustrated and can be varied within the scope of the appended claims.

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That stated above about beam constructions for ceilings in clean rooms is applicable also to beam constructions for walls in clean rooms. The only difference is that some of the directions stated in the above example are adjusted to apply to a vertical wall instead of a horizontal ceiling. The beam construction must also be supplemented with means pressing the wall elements against the supporting surfaces.

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- Furthermore, the ceiling elements consist in the example shown of so-called blank panels, i.e. flat panels, the only purpose of which is to sealingly cover the openings 7. The ceiling elements 8 may, however, in practice also consist of a number of other components, for instance, filter elements for filtering supply air and lighting fittings.
- 5 Such lighting fittings can also be arranged completely outside the clean room, a light-permeable sheet being sealingly arranged on the supporting surfaces in an opening. In beam constructions for walls, the ceiling elements are of course replaced by wall elements. These may consist of, apart from blank panels, e.g. window or door elements.
- 10 When the beam construction is used for ceilings, that part of the second transverse beam which constitutes the supporting means need not extend up to the long side of the first longitudinal beam. Instead the supporting means can supportingly abut against the supporting surface of the first longitudinal beam.

Claims

1. A beam construction (1) for walls and ceilings in clean rooms, comprising first (2)
5 and second (4) beams, which are arranged essentially perpendicular to each other and
essentially in parallel with the plane of extension of the wall or the ceiling, said first
(2) and second (4) beams comprising elongate flanges (15a, 15b, 17) with supporting
surfaces (9) which are essentially parallel with the plane of extension of the wall/ceil-
ing, the wall/ceiling comprising wall/ceiling elements (8), which abut against the sup-
10 porting surfaces (9), **characterised in** that at least the second beams (4) comprise an
elongate flange means (17) provided with one or more supporting surfaces (9), and an
elongate supporting means (18), that the flange means (17) and the supporting means
(18), at least before mounting, are separable and/or axially displaceable relative to
each other, and that the supporting means (18), after mounting, is longer than the
15 flange means (17) and arranged so as to extend at both ends axially beyond the ends
of the flange means (17).

2. A beam construction as claimed in claim 1, **characterised in** that the flange means
(17) is connected to the supporting means (18) by means of projections (21), which
20 are arranged in the one means and cooperate with grooves (23d) formed in the other
means.

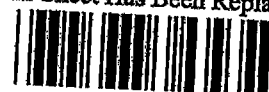
3. A beam construction as claimed in claim 1 or 2, **characterised in** that the flange
means (17), after mounting, is connected to the supporting means (18) with the aid of
25 separate connecting means.

4. A beam construction as claimed in any one of claims 1-3, **characterised in** that the
supporting surfaces (9), after mounting, are directed away from the room that is sur-
rounded by the walls and the ceiling.

30 5. A beam construction as claimed in any one of claims 1-4, **characterised in** that the
flange means (17) and/or the supporting means (18) consists of extruded sectional ele-
ments.

35 6. A beam construction as claimed in any one of claims 1-5, **characterised in** that the
flange means (17) and/or the supporting means (18) is made of light metal, e.g. alumi-
nium.

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7. A beam construction as claimed in any one of claims 1-6, characterised in that the first (2) and second (4) beams are identical in cross-section and are composed of flange means (17) of identical cross-sections and of supporting means (18) of identical cross-sections.

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