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(54) BUILDING FRAME STRUCTURAL ELEMENTS AND FIXING MEMBERS THEREFOR

(71) We, PROFILES ET TUBES DE L'EST, a French Body Corporate of 57 Rue de Villiers, 92203 Neuilly Sur Seine, France and CENTRE DE RECHERCHE D'ARCHITECTURE D'URBANISME ET DE CONSTRUCTION RAUC, a French Body Corporate of 27 Rue Dumont d'Urville, 75116, Paris, France, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to building frame structural elements and fixing members therefor, and to building frames including the structural elements secured by the fixing members.

According to the invention there is provided, in combination, a building frame elongate structural element and a fixing member therefor, the structural element having at least one cavity, which as seen in transverse section has a mouth permitting access to the cavity defined by a pair of opposed flanges which have first portions extending towards each other and second portions extending inwardly of the cavity from said first portions and terminating at free edges so as to leave to each side of the mouth an undercut space which is behind the first portion and laterally outside the second portion at that side, the said second portions of the flanges being deformable; and the fixing member having a body and a cap which can be urged together in a clamping movement and which incorporate cooperating clamping die surfaces consisting of at least one protrusion on one die surface which fits into a corresponding recess on the other die surface, the arrangement being such that the cap can be fitted into the cavity of the structural element and located in a position where its die surfaces lie behind the second

portions of the flanges of the structural element, so that when the cap and the body are urged together in a clamping movement, the second portions of the flanges are locally deformed and clamped between the die surfaces of the cap and the body. The body and the cap may have further mutually opposed clamping surfaces which, after a clamping movement, sandwich between them the first portions of the flanges of the structural element.

According to a preferred form of the invention the cap is dimensioned so that it can be fitted into the mouth and subsequently rotated into the position where its said die surfaces lie behind the second portions of the flanges of the structural element.

The body of the fixing member preferably has two said caps which can be urged towards the body in respective directions which are at right angles to each other. Suitably at least the body of the fixing member is a cast part.

Preferably the structural element is of profiled steel. It may be thin and light and yet of sufficient strength.

The components of the combination of structural element and fixing member are within the invention whether assembled together or otherwise.

Also according to the invention there is provided a building frame having a plurality of the structural elements secured together by the fixing members of the combination of the invention.

Embodiments of the invention will now be described by way of example with reference to the accompanying drawings, in which:—

Figure 1 shows in end view a simple profiled structural element constituting part of an embodiment of the invention having a C-shaped throat;

Figures 2 to 5 are respective end views

of various profiled structural elements useful in embodiments of the invention obtained by direct or indirect assembly of simple profiled elements as shown in Figure 1;

Figure 6 is a side view of a fixing member useful in embodiments of the invention;

Figures 7, 9 and 11 are side views showing the fixing member of Fig. 6 in various stages during its attachment in the throat of the structural element of Fig. 1;

Figures 8, 10 and 12 are sectional views transversely of the structural element showing stages in the attachment of the fixing member of Fig. 6, correspondingly respectively to the positions of Figs. 7, 9, and 11;

Figure 13 is a perspective of a second fixing member useful in embodiments of the invention, used for bracing;

Figure 14 illustrates a mode of assembly of two structural elements by means of two fixing members embodying the invention;

Figures 15 and 16 are perspectives showing two assemblies embodying the invention; and

Figure 17 is a diagrammatic view of a frame of a building embodying the present invention.

A simple elongate profiled steel structural element is shown in Figure 1. It has a cavity or throat 2, which, in transverse section, has the shape of a C whose facing extremities are made up of two flanges having first portions 3, 4 directed towards each other and mutually parallel second portions 5, 6 at 90° to the first portions. The second portions are parallel and directed towards the inside of the throat, where they terminate at free edges. These two flanges define between them the opening or mouth of the throat and it can be seen that an undercut space is provided behind the first portions 3, 4. The second portions are deformable as discussed below.

The profiled structural elements within the scope of the present invention include simple profiled elements such as shown in Figure 1 and complex profiled elements obtained by direct or indirect assembly of these simple elements so that the mouths of the respective cavities face in different directions. Figures 2 and 3 respectively show profiled elements 7 and 8 obtained by the assembly of two and four simple profiled elements. Profiled elements such as those in Figures 1, 2 and 3 are especially intended for use as frame uprights, and therefore have longitudinally extending throats.

Figures 4 and 5 show indirect assemblies of simple profiled elements. In Figure 4, two simple profiled elements 9 and 10 are

secured by welding to a rectangular intermediate core 11 (which as shown in Figs. 14 to 16 may be two plane sheets) while in Figure 5 the two simple profiled elements 9 and 10 are secured by welding to an X-shaped intermediate core 12. Profiled elements such as shown in Figs. 4 and 5 are especially intended for use as frame girders. These girders are thus furnished at each side with a longitudinal throat. The invention is not however limited to a particular shape of core between the simple elements and shapes such as 11 and 12 are given only by way of preferred examples.

Figure 6 is a view of a typical fixing member of the present invention. This part is made up of body 13 having two legs 14, 15 at a right-angle, each leg 14, 15 having an aperture 16, 17 and receiving on its external face a cap 18, 19 which has a screw-threaded aperture for the passage of a bolt 20 which passes also through the aperture 16, 17 in the body. Caps 18, 19 are C-shaped and have dimensions so that in one position (Figures 7 and 8) the cap, in this case the cap 18, can be inserted at any desired place in the throat 2 of a profiled element 1 and, after rotation through about 90° relative to its position of introduction into the throat, can be caused to come into abutment by the tightening of the bolt 20, with the first portions 3, 4 of the flanges of the structural element, clamping them directly against the body 13 after having caused a progressive deformation of the second portions 5, 6 of the throat. By deformation of the flanges, the fixing member is secured in a positive manner, i.e. slippage along the structural member can be for practical purposes prevented.

In order to obtain this deformation, the outer surfaces of the body 13 against which the cap 18 is held have two reaction points 21, 22 for the first portions 3, 4 and recesses 23, 24 adapted to co-operate with corresponding protrusions 25, 26 of the cap 18 to make up cooperating die surfaces adapted to cause the deformation of the flanges during tightening of the bolt 20. The surfaces acting to cause the deformation are for example pairs of complementary V surfaces as best seen in Figure 6, which shows two surfaces 23 which the leg 14 of the body 13 has on one side. The opposite side of the body 13 is provided with two similar surfaces 24. The cap 18 has protrusions corresponding in shape to that of the recesses 23 on the leg of the body. The other leg of the body 13 co-operates in like fashion with the other cap 19. The caps 18, 19 thus constitute gripping clamps.

Various stages in the positioning of a fixing member on a profiled element are

shown in Figures 7 to 12.

In Figures 7 and 8, the cap 18 is in its first position ready for introduction into the throat 2 of a profiled element 1. It can be seen that the width of the cap is smaller than the gap between the flanges 5 and 6 of the throat, which allows the cap to enter right into the throat. In Figures 9 and 10, the cap 18 has been turned through 90° relative to its position when introduced and, in this second position, is in the bottom of the throat, substantially conforming to the shape of this bottom. In Figures 11 and 12, is shown the final assembly position in which the cap has been brought towards and tightened onto the leg of the body 13 by means of the bolt 20, thus clamping and deforming the second portions 5, 6.

In the example given, the head of the bolt 20 is housed in a suitable recessed portion 27 of the leg 14 of the body 13. The cap 18 is like a nut for the bolt captured in the throat. In a variant, the bolt could in effect be provided with a nut which would be held in a housing in the cap and which would be constrained against rotation in that housing. Of course, the bolt can be replaced by any element capable of fulfilling the same function of urging together the elements 14 and 18.

Figure 13 shows a particular form of body 13 of the fixing member in which the legs 14 and 15 are complemented by a leg 28 which is orthogonal to the legs 14 and 15 and which is provided with means for fixing a bracing link or strainer. In the example given, this means for fixing is made up of one or more apertures 29 which can receive bolts or pins for the mounting of the end of a strainer or link.

To mount a girder 30 on an upright 31 (Figure 14), the girder being for example of the type shown in Figure 5 and the upright for example of the type shown in Figure 3, the following method can be used:—

A fixing member 32 is placed in the throat 35 of the upright 31 at the desired place for positioning the lower edge of the girder. Another fixing member 33 is placed in the upper throat 34 of the girder 30. The girder is brought up to the upright until at the same moment the upper cap 36 of the fixing member 32 comes into the lower throat of the girder and the front cap 37 of the fixing member 33 comes into the throat 35 of the upright 31. All that needs to be done then is to secure the assembly by rotating and tightening the two caps.

Figure 15 is a part view showing the mounting of several girders 38 of the type shown in Figure 4 on an upright 39 of the type shown in Figure 3.

Figure 16 shows a modified mounting in

which certain of the fixing members used, such as fixing member 40, are staying fixing members of the type shown in Figure 13. The end of a strainer 41 can be seen fixed to this fixing member 40.

Finally, Figure 17 is a standard diagram, given solely by way of example, of a frame made up of uprights 42 and girders 43 of the present invention assembled by means of fixing devices of the present invention.

WHAT WE CLAIM IS:—

1. In combination, a building frame elongate structural element and a fixing member therefor, the structural element having at least one cavity, which as seen in transverse section has a mouth permitting access to the cavity defined by a pair of opposed flanges which have first portions extending towards each other and second portions extending inwardly of the cavity from said first portions and terminating at free edges so as to leave to each side of the mouth of an undercut space which is behind the first portion and laterally outside the second portion at that side, the said second portions of the flanges being deformable; and the fixing member having a body and a cap which can be urged together in a clamping movement and which incorporate cooperating clamping die surfaces consisting of at least one protrusion on one die surface which fits into a corresponding recess on the other die surface, the arrangement being such that the cap can be fitted into the cavity of the structural element and located in a position where its die surfaces lie behind the second portions of the flanges of the structural element, so that when the cap and the body are urged together in a clamping movement, the second portions of the flanges are locally deformed and clamped between the die surfaces of the cap and the body.

2. A combination according to claim 1 wherein the body and the cap have further mutually opposed clamping surfaces which, after a clamping movement, sandwich between them the first portions of the flanges of the structural element.

3. A combination according to claim 1 or claim 2, wherein the cap is dimensioned so that it can be fitted into the mouth and subsequently rotated into the position where its said die surfaces lie behind the second portions of the flanges of the structural element.

4. A combination according to any one of the preceding claims in which the said die surfaces of the cap and the body comprise pairs of complementary V-surfaces.

5. A combination according to any one of the preceding claims wherein the body and the cap each have an aperture receiving a bolt constituting means for urging

shown in Figures 7 to 12.

In Figures 7 and 8, the cap 18 is in its first position ready for introduction into the throat 2 of a profiled element 1. It can be seen that the width of the cap is smaller than the gap between the flanges 5 and 6 of the throat, which allows the cap to enter right into the throat. In Figures 9 and 10, the cap 18 has been turned through 90° relative to its position when introduced and, in this second position, is in the bottom of the throat, substantially conforming to the shape of this bottom. In Figures 11 and 12, is shown the final assembly position in which the cap has been brought towards and tightened onto the leg of the body 13 by means of the bolt 20, thus clamping and deforming the second portions 5, 6.

In the example given, the head of the bolt 20 is housed in a suitable recessed portion 27 of the leg 14 of the body 13. The cap 18 is like a nut for the bolt captured in the throat. In a variant, the bolt could in effect be provided with a nut which would be held in a housing in the cap and which would be constrained against rotation in that housing. Of course, the bolt can be replaced by any element capable of fulfilling the same function of urging together the elements 14 and 18.

Figure 13 shows a particular form of body 13 of the fixing member in which the legs 14 and 15 are complemented by a leg 28 which is orthogonal to the legs 14 and 15 and which is provided with means for fixing a bracing link or strainer. In the example given, this means for fixing is made up of one or more apertures 29 which can receive bolts or pins for the mounting of the end of a strainer or link.

To mount a girder 30 on an upright 31 (Figure 14), the girder being for example of the type shown in Figure 5 and the upright for example of the type shown in Figure 3, the following method can be used:—

A fixing member 32 is placed in the throat 35 of the upright 31 at the desired place for positioning the lower edge of the girder. Another fixing member 33 is placed in the upper throat 34 of the girder 30. The girder is brought up to the upright until at the same moment the upper cap 36 of the fixing member 32 comes into the lower throat of the girder and the front cap 37 of the fixing member 33 comes into the throat 35 of the upright 31. All that needs to be done then is to secure the assembly by rotating and tightening the two caps.

Figure 15 is a part view showing the mounting of several girders 38 of the type shown in Figure 4 on an upright 39 of the type shown in Figure 3.

Figure 16 shows a modified mounting in

which certain of the fixing members used, such as fixing member 40, are staying fixing members of the type shown in Figure 13. The end of a strainer 41 can be seen fixed to this fixing member 40.

Finally, Figure 17 is a standard diagram, given solely by way of example, of a frame made up of uprights 42 and girders 43 of the present invention assembled by means of fixing devices of the present invention.

WHAT WE CLAIM IS:—

1. In combination, a building frame elongate structural element and a fixing member therefor, the structural element having at least one cavity, which as seen in transverse section has a mouth permitting access to the cavity defined by a pair of opposed flanges which have first portions extending towards each other and second portions extending inwardly of the cavity from said first portions and terminating at free edges so as to leave to each side of the mouth of an undercut space which is behind the first portion and laterally outside the second portion at that side, the said second portions of the flanges being deformable; and the fixing member having a body and a cap which can be urged together in a clamping movement and which incorporate cooperating clamping die surfaces consisting of at least one protrusion on one die surface which fits into a corresponding recess on the other die surface, the arrangement being such that the cap can be fitted into the cavity of the structural element and located in a position where its die surfaces lie behind the second portions of the flanges of the structural element, so that when the cap and the body are urged together in a clamping movement, the second portions of the flanges are locally deformed and clamped between the die surfaces of the cap and the body.

2. A combination according to claim 1 wherein the body and the cap have further mutually opposed clamping surfaces which, after a clamping movement, sandwich between them the first portions of the flanges of the structural element.

3. A combination according to claim 1 or claim 2, wherein the cap is dimensioned so that it can be fitted into the mouth and subsequently rotated into the position where its said die surfaces lie behind the second portions of the flanges of the structural element.

4. A combination according to any one of the preceding claims in which the said die surfaces of the cap and the body comprise pairs of complementary V-surfaces.

5. A combination according to any one of the preceding claims wherein the body and the cap each have an aperture receiving a bolt constituting means for urging



the body and the cap together.

6. A combination according to any one of the preceding claims wherein the body of the fixing member has two said caps which can be urged towards the body in respective directions which are at right angles to each other, so that the fixing member can secure two structural members to each other.

7. A combination according to claim 6 having means for attaching a staying link or strainer.

8. A combination according to any one of the preceding claims wherein the said first portions of the flanges are coplanar and the said second portions are mutually parallel and are at 90° to the first portions.

9. A combination according to any one of the preceding claims wherein the structural element is of profiled steel.

10. A combination according to any one of the preceding claims wherein the structural element is comprised of two or more unitary parts each having a said cavity, the parts being connected directly to each other or through an intermediate

member or members, the mouth of the respective cavities facing in different directions.

11. A combination according to claim 10 wherein the said unitary parts are connected through an intermediate connection which is rectangular or is generally X-shaped in transverse section.

12. Building frame elongate structural element substantially as herein described with reference to and as shown in any one of Figs. 1 to 5 of the accompanying drawings in combination with fixing member for structural element substantially as herein described with reference to and as shown in Figs. 6 to 12 or Fig. 13 of the accompanying drawings.

13. Building frame having a plurality of structural elements and fixing members according to any one of the preceding claims, with the structural elements secured together by the fixing members.

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