

STEEL WALL FRAMING SYSTEM

The present invention relates to improvements in structural frameworks; that is frameworks of the kind having a plurality of substantially parallel arranged studs encased at their extremities by plate members. The frameworks of the present invention are primarily used in relation to wall framing systems in domestic housing or partitioning in commercial applications, but can be equally applicable to many different types of applications and to many different types of buildings.

The members of the framework of the present invention are preferably formed by cold forming sheet steel, but the present invention is not limited to that material base.

The invention is further related to the members themselves, in regard to their form, the nature of the joints made between members of the framework, means of effecting connections in the joints made between members of the framework, the method of manufacture of the members themselves, the method of manufacture of the framework having the members and the various methods of construction of the framework.

BACKGROUND TO THE INVENTION

In known frameworks that are of the kind that include stud and plate members, joints between members which are substantially perpendicular are made with a fastening means. Typical fastening means are screws, nails, rivets and the like. Some known systems have integral fastening means, but these systems still require an external or introduced apparatus or tool to effect a nominal connection, such as clinching, spot welding and the like. Another known system has a tab and slot system where lengths of the ends of the stud are removed leaving two tabs that are then inserted into two slots in the mating plate member. The tabs need to be folded over to be able to form a nominal joint and manufacture of such a framework is achieved in the horizontal plane.

OBJECT OF THE INVENTION

It is an object of the present invention to provide a framing system and the method of its assembly, which substantially overcomes or ameliorates the disadvantages with known

systems. At the very least the object of the present invention is to provide an alternative to known systems.

DISCLOSURE OF THE INVENTION

- According to one aspect of the present invention, there is disclosed a framework system including stud members and plate members being adapted to be joined in an abutting relationship with the ends of the stud members abutting against the plate members such that the longitudinal axes of the stud and plate members are substantially perpendicular; each said plate members having at least one flange portion and a web portion with at least one base element and an at least one offset element, said offset element being offset from the base element in the same direction as the flange portion extends therefrom and having aperture means located therein; each said stud member having at least one flange portion and a web portion, said web portion having a cutout portion with tongue means extending thereinto, said cutout portion corresponding to said offset element of said web portion of said plate members with said tongue means being adapted to fit through said aperture means in said offset element when said stud member abuts against said plate member with the ends of the stud members substantially abutting against the base elements of the web portion of said plate member, wherein integral locking means is associated with the tongue and slot, the locking means preventing the removal of the tongue from the slot after it passes through the slot.
- Preferably, the aperture means is a slot and the tongue means is a single tongue adapted to fit therethrough. The slot is preferably formed perpendicularly to the longitudinal axis of the plate member. In other preferred forms, the aperture means takes the form of a number of slots in a number of offset elements with a corresponding number of tongues being adapted to fit therethrough.
- Preferably, the locking means is integral to the tongues and slots and is simply activated by passing the tongue through the slot or it can be activated by using an external tool or the like to deform the tongue(s). The integral locking means can also be used in conjunction with an external tool.
- In the preferred form, the tongue extends only partially into the cutout portion of the web portion of the stud member, however, the tongue can be sized to fit within the constraints

of the offset web elements and base web elements of the plate member. The tongue can extend to the ends of the stud member.

Preferably, the aperture means is a slot extending entirely across the offset web element whereby the cutout portion is formed from a T shaped slot with the tongue means being
5 formed by a pair of tongues extending inwardly towards each other, the edges of the tongues forming the T shaped slot. The tongues are adapted to fit through the slot in the offset web portion. Preferably, the locking means is integral to the tongues and slots and is simply activated by passing the tongue through the slot or it can be activated by using an external tool or the like to deform the tongue(s). The integral locking means can also be
10 used in conjunction with an external tool.

In the preferred form, the tongues are deformed once they pass through the slot and are captured behind the offset portion. Preferably the deformations are in opposite directions.

The preferred embodiments of the present invention provide a framework joint that is self locking due to a deformed tongue in the stud member to form a nominal connection. When
15 the joint is made the tongue remains substantially collinear to the longitudinal axis of the stud member. A higher strength connection can be made by using a special tool which rotates the free sides of the tongue to substantially right angles to the longitudinal axis of the slot. The tongue is preferably formed within the nominal length of the stud member and the length of the tongue can be sized to fit within the constraints of the offset web and
20 base web elements of the plate member. The minimum length of the tongue is that which supports a required nominal joint capacity and / or ease of assembly. Where nominal joint capacities suffice, a framework can be manufactured insitu in a vertical position.

Preferably, the invention is concerned with a single slot formed in a plate web element that is offset from its base web elements such that a tongue formed within a mating stud
25 member causes a nominal joint to be made. The base web elements abut the end of the mating stud member with the slot being formed substantially perpendicular to the longitudinal axis of the plate member. It is within the scope of this invention to have a plurality of slots and / or offset web elements and corresponding stud tongues and to have other integral means of locking via barbs, tangs and the like formed at the edges or in the
30 face of the tongue, singly or in plurality.

One embodiment of the present invention has a slot formed entirely across the offset web element and the entire depth of the side elements such that a plain Cee channel can be installed as the stud member without any notching, tagging or otherwise. In this embodiment, fastening means, preferably nails can be installed from either side of the framework. Alternatively, the ends of such stud members can be notched in a Tee arrangement with two tags that are deformed in opposing directions.

In the latter case above, this embodiment of the present invention provides a framework joint that is self locking due to the deformed tags in the stud member to form a nominal connection. When the joint is made the tags remain substantially collinear to the longitudinal axis of the stud member. A higher strength connection can be made by using a special tool which rotates the free sides of the tongue to be at substantially right angles to the longitudinal axis of the slot. The tongue is formed within the nominal length of the stud member and the length of the tongue can be sized to fit within the constraints of the offset web and base web elements of the plate member. The minimum length of the tongue is that which supports a required nominal joint capacity and / or ease of assembly. Where nominal joint capacities suffice a framework can be manufactured insitu in a vertical position.

The method of manufacture of the present invention can be achieved by rolling or a continuous process of pressing, stamping and the like of the tags that protrude through the offset web portion of the plate member. It is within the scope of this invention to cover any such fabrication method in terms of connections of any sort of tagged stud member made with a plate member that has an offset web element, or central channel portion or plurality thereof.

It is also within the scope of the present invention to also provide a joint formed by installing a fastening means, preferably nailing, through the tags when they are folded against the sides of the offset web portion. The folded tags of this instance can be on the inside or the outside of the offset web element to suit installation of the fastening means.

A method of manufacture of the preferred embodiments of present invention, is to pass the wall frame through rollers or the like that are contained or protrude into the offset web portion of the plate members in order to flatten the tongues or tags as appropriate, hence locking the joint. In the case of the preferred form of the present invention disclosed herein,

the tags are folded in such a process against the side portions of the offset web element of the stud of the preferred form.

The typical embodiment of the cold-formed steel structural members of the preferred embodiments of this invention are members of nominal 70 x 35 mm and 90 x 35 mm in gauges ranging from 0.35 to 4.0 mm, however this by no means limits the claims on these structural members ability to perform in a similar way in other sizes or in other base materials.

BRIEF DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the present invention will now be described with reference to the drawings in which;

Fig. 1 is a perspective view of a preferred embodiment of the stud showing a formed tongue;

Fig. 2 is a section view A-A of the stud member of the preferred embodiment of Fig. 1 showing the preferred opposing deformation of the edges of the tongue;

Fig. 3 is a plan view, and corresponding end view, of the stud member to plate member joint of the preferred embodiment of Fig. 1 showing a nominal joint of and a high strength joint of the preferred form;

Fig. 4 is a perspective view of a joint of the preferred embodiment as seen in Fig. 3 with the stud tongue folded out and hold-down fastening device installed through the tongue and offset web element;

Fig. 5 is a perspective view of a stud member with another preferred form of the tongue;

Fig. 6 is an elevation view of the stud member of the form of Fig. 5;

Fig. 7 is a plan view, and corresponding end view, of the stud member to plate member joint of the form of Fig. 5 showing a nominal joint;

Fig. 8 is a section view B-B showing the slots in the plate member of Fig. 7;

Fig. 9 is a perspective view of a stud member with another preferred form of the tongue;

Fig. 10 is an elevation view of the stud member of the form of Fig. 9;

Fig. 11 is a section view C-C of the stud of Fig. 10 showing preferred barbs in the tongue of this form;

- 5 Fig. 12 is a plan view, and corresponding end view, of the stud member to plate member joint of the form of Fig. 9 showing a nominal joint,;

Fig. 13 is a section view D-D of the preferred form of the slot of the plate form of Fig. 12;

- Fig. 14 is an exploded perspective view of a joint of another preferred embodiment of the present invention showing a slot in an offset web element and sides thereof, and notched
10 end of the mating stud member;

Fig. 15 is a plan view, and corresponding end view, of the stud member to plate member joint of the preferred form showing a nominal joint of the preferred form and a high strength joint of the preferred form; and,

- Fig. 16 is a section view E-E of Fig. 15 with the stud member of the preferred form of Fig.
15 14 showing the preferred opposing deformation of the edges of the tongue as in the case of a nominal joint;

Fig. 17 is a section view F-F of Fig. 16;

Fig. 18 is a plan view of a plate member of another preferred embodiment;

Fig. 19 is a detail view of the end of the plate of Fig. 18;

- 20 Fig. 20 is a sectional view G-G of Fig. 18;

Fig. 21 is a plan view of a stud member of another preferred embodiment;

Fig. 22 is a detail view of the slot of the stud of Fig. 21;

Fig. 23 is a sectional view H-H of Fig. 21;

Fig. 24 is a sectional view showing the profile of another preferred embodiment of a stud member;

Fig. 25 is a plan view showing the end detail of the stud member of Fig. 24;

Fig. 26 is a plan view showing the end detail of another variation of the stud member of
5 Fig. 24;

Fig. 27 is a sectional view I-I of Fig. 26;

Fig. 28 is a sectional view J-J of Fig. 26;

Fig. 29 is a plan view of a connector plate member of a preferred embodiment;

Fig. 30 is a detail view of a corner of the connector plate of Fig. 29;

10 Fig. 31 is a sectional view of stud members in a wall frame junction with a connector plate connecting same;

Fig. 32 is a detailed view of the connection between a stud and a connector plate of one variation;

Fig. 33 is a detailed view of the connection between a stud and a connector plate of a
15 another variation;

Fig. 34 is a plan view of a connector bracket of a preferred embodiment;

Fig. 35 is a sectional view K-K of the bracket of Fig. 34;

Fig. 36 is a cutaway perspective view of a junction between plate members and stud members of a preferred arrangement;

20 Fig. 37 is a cutaway perspective view of a junction between plate members and stud members of another preferred arrangement;

Fig. 38 is a cutaway perspective view of a junction between plate members and rafters or truss chords of a preferred arrangement;

Fig. 39 is a cutaway side view of a wall frame showing detail of a door assembly;

Fig. 40 is a sectional view L-L of Fig. 39 showing the jamb profile;

Fig. 41 is a sectional view M-M of Fig. 39 showing the profile of back to back stud members;

5 Fig. 42 is a view of a series of connector lug of a preferred arrangement;

Fig. 43 is a cutaway side view of a wall frame showing detail of a window assembly;

Fig. 44 is a cutaway perspective view of the junction between a stud member and a head plate member;

10 Fig. 45 is a cutaway perspective view of the junction between a stud member and a sill plate member;

Fig. 46 is a perspective view of a general purpose tool used in the formation of the wall frame according to preferred embodiments;

Fig. 47 is a side view of a cold chisel insert for the tool of Fig. 46; and

Fig. 48 is a side view of the tool of Fig. 46 with the cold chisel insert therein.

15 BEST MODE OF CARRYING OUT THE INVENTION

One embodiment is illustrated with respect to Figs. 1 to 4 of the drawings where joints of a partially illustrated framework system 10 are illustrated. The framework system generally referenced as 10 includes studs 11 and mating plates 12 in nominal joints 13 and high strength joints 14. The studs 11 are formed as a lipped Cee-section with a web 15 and two lipped flanges 16. The plates 12 are formed as a double U section with a web 17 and two flanges 18, the web 17 having a centrally located offset element 19 and two spaced apart base elements 20 adjacent the flanges 18. The offset element 19 has a rectangular profile and corresponds and mates with a cutout portion 21 in the web 15 at ends 22 of the studs 11 when the ends 22 of the studs 11 abut against the plates 12 in the perpendicular manner shown in the drawings.

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Each stud 11 has a tongue 23 protruding into the cutout portion 21 while the plates 12 have a number of slots 24 located in the offset element 19 of the web 17. To form the nominal joints 13, the tongue 23 is fitted through one of the slots 24 such that the ends 22 of the studs 11 abut against webs 17 of the plates 12 with the flanges 16 and 18 also abutting. It is seen that the studs 11 nest in the plates 12 when the tongues 23 are inserted into the slots 24 as the distance G across the cutout portion 21 is substantially the same as the distance H across the offset element 19, while the length I of the tongue 23 is less than the depth J of the offset element 19.

The tongues 21 of this embodiment have deformed edges 25 which lock under the offset web element 19 after insertion through the slots 24. The deformed edges 25 are flexible and are preferably offset such that they deform either side of the slot 24 when inserted to form the nominal joints.

To form the high strength joints 14, the deformed edges 25 are bent further under the offset element 19 by a suitable hand tool (not illustrated).

Hold-down of the stud 12 into concrete, timber or the like as shown in Fig. 4 can be effected with masonry anchors 26 through holes 27 in the tongues 23 whereby the tongues 23 are bent at right angles to abut against the offset element 19. This method of hold-down can be applied to all forms of the present invention.

In the embodiment illustrated in Figs. 5 to 8, which is basically the same as described with respect to Figs. 1 to 4, the tongue 23 formed in the cutout portion 21 which in this embodiment is non-rectangular, has a pair of barbs 28 which lock into side slots 29 formed in the sides 30 of the offset element 19 of the web 17 of the plate 12. In this embodiment the slot 24 extends into the sides 30 and the slots 29 are formed lower in the sides 30 as seen in Fig. 8. In forming the nominal joint 13, the tongue 23 is inserted through the slot 24 and the barbs 28 then fit through and lock behind the slots 29.

Similarly, in the embodiment illustrated in Figs. 9 to 13, which is similar to the other embodiments, the slot 24 is deformed as best seen in Fig. 13 and barbs 28 on the tongue 23 interact to form the locking mechanism. Once again the nominal joints 13 and high strength joints 14 are formed in a similar manner to the other embodiments.

In the embodiment shown in Figs. 14 to 17, the slot 24 extends around the offset element 19 and the tongue 23 which are inserted therethrough consist of a pair of tongues extending from the side of the cutout portion 21 which in this embodiment is seen to take the form of a T-shaped slot. The pair of tongues are the deformed edges 25 which lock under the offset
5 element 19. To form the nominal joint 13 of this form the tongues or tags 23 are inserted into the slot 24 in the offset web element 19 of the mating plate 12. The deformed edges 25 of the tags 23 lock under the offset web element 19 of the plate 12. To form a high strength joint 14 of this form, the deformed edges 25 of the tags 23 are bent around further under the offset web element 19 by suitable means and can be folded flat against the sides
10 of the offset web portion. This description applies to each end of the stud member in a framework. The maximum depth of the tags 23 corresponds to the depth of the offset web element 19 of the plate 12.

The method of joining the studs 11 and plates 12 without any fasteners or expensive tools as described facilitates low cost housing, particularly in developing countries that utilise
15 low skilled fabrication and construction labour.

The nominal framing joints 13 are made simply by inserting the studs 11 into the plates 12 and by using one simple and inexpensive hand tool 40 as seen in Figs. 46 to 48, the high strength joints 14 are made. The frames 10 which are formed from the studs 11 and the plates 12 are joined using the same technology during construction, without the need for
20 conventional joining methods such as welding, riveting and screwing. The joining technology extends beyond the wall framing to panelised floor and roof framing, such that its application covers an entire building structure. The entire structure can be assembled and erected using the one hand tool 40. Onsite power is not required.

Other embodiments of the studs 11 and plates 12 are shown in Figs. 18 to 45. The plates
25 12 as seen in Figs. 18 to 20 are seen to have the profile as described previously and has the slots 24 for locating the studs 11. The plates 12 for the framework 10 are preferably identified and have plate identification numbers 41 for their location within the frame 10, have embossed symbols 42 to indicate stud orientation thereto and service holes 43 punched in the plates 12, while the embodiments of the studs 11 as seen in Figs. 21 to 28
30 are standardised in that they are all symmetrical and all have service holes 44. There is no need to have smart studs which are specific to a particular location in the plates 12. The

service hole 43 in the plates 12 are generally only punched in the top plate 12 but in the bottom plate 12 they can be used to received anchors (not illustrated) in core filled walls. The plate 12 as seen in Fig. 18 has pre cut grooves 45 so that part of the bottom plate 12 can be removed for the door opening by using a cold chisel or the like. The tongues 23 have deformed edges 25 and connect through the slots 24 in a similar manner to the
5 embodiments already described.

A connector plate 46 as seen in Figs. 29 to 33 is used to connect adjacent studs 11 in a wall frame junction as best seen in Fig. 31. The connector plate 46 is generally rectangular with the four corners forming tongues 47 which are inserted through slots 48 in the studs 11.
10 The tongues 47 are either bent after being inserted in the slot 48 as seen in Fig. 32 or is twisted with deformed edges 49 as seen in Fig. 33 which means that the tongue operates similarly to the other described tongues with deformed edges.

A connector bracket 50 as seen in Figs. 34 to 38 is used to connect adjacent top plates 12 in a perpendicular arrangement with the stud 11 located within the adjacent plate 12. The
15 bracket 50 has portion 51 which is profiled the same as the base elements 20 of the plate 12 with pre-punched holes 52 therein. Screws 53 or nails are used to secure the portion 51 to the plate 12 while a free end 54 of the bracket 50 is able to be folded or bended and inserted through one of the slots 24 of the adjacent plate 12.

The connector bracket 50 is also used to connect wall frames 10 of adjacent storeys of a
20 building as seen in Fig. 37 in a wall frame, floor hold down arrangement whereby the connector brackets 50 are used to connect the top and bottom plates 12 of adjacent storeys with a side plate 12 being used to receive the floor panel 55 and floor sheeting 56 therein. The bracket 50 is also used to hold down a rafter or truss chord 57 as seen in Fig. 38.

A door assembly 58 is shown in the wall frame in Figs. 39 to 41 where the assembly has
25 top and bottom plates 12, standard studs 11, a head plate 12A with overs between the top plate 12 and the head plate 12A. The jamb profile is shown in Fig. 40 while the back to back stud connections are shown in Fig. 41 where connector lugs 59 are used for the connection with the lugs 59 being inserted into the slots 48 in the studs 11. A series of connector lugs 59 are shown in Fig. 42 in strip form where they are able to be broken away
30 for individual use as required.

A window assembly 60 is shown in the wall frame in Figs. 43 to 45 where the assembly has top and bottom plates 12, standard studs 11, a head plate 12A with overs 11A between the top plate 12 and the head plate 12A and a sill plate 12B with unders 11B between the sill plate 12B and the bottom plate 12. The connector bracket 50 is once again used to
5 connect the sill and head plates 12A and B to the adjacent stud as seen in Figs 44 and 45. In this arrangement the connector portion 51 abuts against the lips of the stud 11, while the free end 54 is bent and folded through slots 48.

The hand tool 40 as seen in Figs. 46 to 48 is basically shaped as a hammer with a hammer head 61 and handle 62 with slots 63 being provided to facilitate twisting of the various
10 tongues and the like. A cold chisel insert 64 is secured by suitable means such as a screw thread, a pin clip etc is used to cut the studs 11 and plates as required, as in to remove the bottom plate 12 from door openings.

The benefits of the framing system 10 of the embodiments of the present invention which use coated light gauge light weight steel sections include a high volume production
15 upwards of 60 metres per minute for studs and 30 metres per minute for plates. This high volume production from rollformers results in bundles of studs and bundles of plates which means that up to 20 "knocked-down" house frames can be transported to building sites in a single trip. This is important in transversing densely populated areas with underdeveloped road systems. Conversely, a single house unit can be transported easily by a small vehicle
20 or cart.

The system does not require to be fabricated in a factory using jigs and therefore there are no additional costs of inefficient transportability.

The system is able to be assembled and erected using a hand tool on site with minimal instructions and supervision. All instructions are visible on the plates and studs are
25 standardised. The roof and floor structures are panelised and are fabricated and installed in a similar manner to the walls. The frames can be nailed to concrete foundations using in-built hammer heads on the hand tool which is robust and inexpensive to manufacture and can have ongoing uses for general handyman work.

The foregoing describes only some embodiments of the present invention, and modifications obvious to those skilled in the art can be made thereto without departing from the scope of the present invention.

CLAIMS

1. A framework system including stud members and plate members being adapted to be joined in an abutting relationship with the ends of the stud members abutting against the plate members such that the longitudinal axes of the stud and plate members are substantially perpendicular; each said plate members having at least one flange portion and a web portion with at least one base element and an at least one offset element, said offset element being offset from the base element in the same direction as the flange portion extends therefrom and having aperture means located therein; each said stud member having at least one flange portion and a web portion, said web portion having a cutout portion with tongue means extending thereinto, said cutout portion corresponding to said offset element of said web portion of said plate members with said tongue means being adapted to fit through said aperture means in said offset element when said stud member abuts against said plate member with the ends of the stud members substantially abutting against the base elements of the web portion of said plate member, wherein integral locking means is associated with the tongue and slot, the locking means preventing the removal of the tongue from the slot after it passes through the slot.
2. The framework system according to claim 1, wherein the aperture means is a slot and the tongue means is a single tongue adapted to fit therethrough.
3. The framework system according to claim 2, wherein the slot is formed perpendicularly to the longitudinal axis of the plate member.
4. The framework system according to claim 1, wherein the aperture means takes the form of a number of slots in a number of offset elements with a corresponding number of tongues being adapted to fit therethrough.
5. The framework system according to claim 1, wherein the locking means is integral to the tongues and slots and is simply activated by passing the tongue through the slot or it can be activated by using an external tool or the like to deform the tongue(s).

21 MAY 2004

6. The framework system according to claim 1, wherein the integral locking means is used in conjunction with an external tool.
7. The framework system according to claim 2, wherein the tongue extends only partially into the cutout portion of the web portion of the stud member.
- 5 8. The framework system according to claim 2, wherein the tongue extend to the ends of the stud member.
9. The framework system according to claim 1, wherein the aperture means is a slot extending entirely across the offset web element whereby the cutout portion is formed from a T shaped slot with the tongue means being formed by a pair of tongues extending
- 10 inwardly towards each other, the edges of the tongues forming the T shaped slot.
10. The framework system according to claim 9, wherein the tongues are deformed once they pass through the slot and are captured behind the offset portion.
11. The framework system according to claim 10, wherein the tongues the deformations are in opposite directions.