Abstract: A shelving system and method including a plurality of columns (100) to which a cross beam (200) is attached at one end thereof. A retaining element (300) is inserted through a retaining element recess created by the overlap of an aperture (110) of the column (100) and an opening (224) of the cross beam (200).
SHELVING SYSTEM AND METHOD

Field of the Invention
The present invention relates to improvements in a shelving system. This invention has particular but not exclusive application to a shelving system for storage or display. For illustrative purposes reference will be made to such applications. However, it is to be understood that this invention could be used in other applications, such as shelving systems generally.

Background of the Invention
Domestic and light industrial shelving may be fabricated from metal stock, but in general takes the form of one of many systems with upright stanchions having a selection of shelf support positions defined on them, interconnected by sets of longitudinal and transverse shelf supporting members to define the basic shelf supports. Some have all necessary bracing; other systems require diagonal end braces or strapping. Shelves may be integral with the interconnecting members or may be loose laid on or otherwise assembled to the interconnecting members.

Conventional industrial standard systems are heavily engineered and may be too expensive for some light industrial, public-warehouse retailing or private applications. Domestic-oriented systems are simply not robust enough against transient loads such as pulling outward on one of the long shelf supports, or parallelogram-loads on the short end panels in assembly. Accordingly, there is a need for a crossover system that combines good load bearing capacity and strength with low cost and ease of transport.

Summary
The present invention in one preferred aspect includes a method of assembling a shelving unit, comprising: positioning at least two columns in a substantially vertical orientation; attaching a cross beam to two of the columns; and locking the cross beam to one of the columns with a plurality of retaining elements.
In another preferred aspect, the present invention includes a method of assembling a shelving unit, comprising: positioning at least two columns in a substantially vertical orientation, each column having a plurality of apertures oriented along a portion of the height of the column; positioning a cross beam having a length and an opening so that a portion of the opening of the cross beam overlaps a portion of one of the apertures of one of the columns to create a retaining recess through the cross beam and the column, the retaining recess having a central longitudinal axis; and moving a retaining element through the retaining recess to lock the cross beam to the column.

In yet another preferred aspect, the present invention includes a shelving system, comprising: a plurality columns, each column having a top, a bottom and a height from the top to the bottom, each column having a plurality of apertures oriented along at least a portion of the height; a cross beam having a pair of ends and a flange at each end for connecting the cross beam to two of the columns, the flange including an opening, the opening of the flange and the aperture of the column defining a retaining recess when the flange of the cross beam is placed against the column; and a retaining element insertable into the retaining recess for securing the cross beam to the column, the retaining element having an insertion end and a trailing end, the trailing end having a maximum height when the retaining element is in a fully engaged position relative to the cross beam and the column, a portion of the insertion end extending beyond at least one of the upper and lower bounds of the maximum height of the trailing end.

In a further preferred aspect, the present invention resides broadly in a shelving apparatus including end frames with spaced, metal stanchions or columns interconnected by at least upper and lower struts and at least one diagonal brace, the columns having respective opposed channels into which the struts and brace are fixed and a plurality of engagement apertures spaced along the column on the opposite face to the channel; shelf supports or cross beams extending between respective columns of a pair of spaced end frames and having a flange adapted to extend over the opposite face, the flange having at least one engagement tab.
engaging a respective aperture to secure the support to the column; and a shelf supported between respective opposed cross beams.

A plurality of engagement apertures spaced along the column on the opposite face to the channel may be formed by any means permitted by the choice of column form. For example in the case of roll formed metal columns the engagement apertures may be punched through the sheet metal stock either before or during forming up of the columns. The columns may be provided with two rows of apertures on the face, whereby the shelving system may be extended without the need for butting up independent columns. The columns may be provided with apertures on two or more of its surfaces, whereby the shelving may extend about a corner.

In a yet further aspect this invention resides broadly in shelving apparatus including: columns with a side face having a plurality of engagement openings spaced thereon; cross beams extending between respective columns and having end brackets each comprising an engagement flange adapted to extend over the side face and an abutment flange bearing against its respective column, the engagement flange extending along the side face in use and having at least two vertically spaced engagement tabs engaging respective apertures to secure the support to the column; and a shelf supported between respective opposed cross beams.

The end brackets may formed of sheet metal to form an angle piece to be welded to the ends of roll formed metal cross beams. The two engagement tabs may be spaced to engage adjacent apertures. Alternatively the engagement tabs may bridge over an adjacent aperture or apertures to engage apertures one or more removed, in order to make for finer adjustment of shelf position. There may be sufficient engagement tabs of sufficient spacing to adequately brace the interconnection and keep it square in use. The engagement tabs and engagement apertures in combination may be configured to engage dynamically
whereby the abutment flange is urged into static engagement with the column, to make the assembly rigid.

In a yet further aspect this invention resides broadly in shelving apparatus including: sheet-metal formed columns with side faces having a plurality of vertically-elongate engagement openings formed thereon; cross beams extending between respective columns and having an engagement flange adapted to extend over the side face and extending along the side face in use and having at least two engagement hook tabs adapted to engage the top of respective apertures and drop down to secure the support to the column; and a shelf supported between respective opposed cross beams.

In a yet further aspect this invention resides broadly in shelving apparatus including: sheet-metal formed columns with side faces having a plurality of substantially vertically-elongate engagement openings formed thereon; cross beams extending between respective columns and having end brackets each comprising an engagement flange adapted to extend over the side face and an abutment flange bearing against its respective column, the engagement flange extending along the side face in use and having at least two engagement hook tabs adapted to engage the top of respective apertures and drop down to secure the support to the column, the engagement openings being inclined to provide a cam action to urge the abutment flange against the column; and a shelf supported between respective opposed cross beams.

In a yet further aspect the present invention resides broadly in a column and rail joining method including the steps of roll forming a steel column having a plurality of substantially vertical, elongate engagement openings spaced along at least one face thereof, the openings having an enlarged portion at its lower end; forming a rail end bracket comprising an engagement flange adapted to extend over one the face and an abutment flange bearing against an adjacent face of the column, and forming at least two engagement hook tabs on the engagement flange which are adapted to engage the top of respective apertures and drop
down to secure the bracket to the column, the engagement openings being
inclined to provide a cam action to urge the abutment flange against the adjacent
face; the engagement hook tabs being formed from a D-punching whereby a
portion of the open D overlies the enlarged portion in use to provide for insertion
of a retaining element preventing disengagement of the bracket from the column;
and fabricating a rail to the rail end bracket.

The retaining element may comprise a punched-metal gravity retainer having an
insertion tail, a hook portion and an upper stop portion, whereby the tail is
inserted through the indexed D punching and enlarged portion. The hook portion
is dropped over the lower edges of the indexed portion of the indexed D punching
and enlarged portion. Gravity rotates the retainer such that the upper stop portion
passes under the upper edge of the enlarged portion and a shoulder formed on
the retainer passes over the lower edge of the D punching.

**Brief Description of the Figures**

Fig. 1 is a partial front perspective view of a portion of a cross beam attached to a
portion of a column in accordance with a preferred embodiment of the present
invention.

Fig. 2 is a partial rear perspective view of a portion of the cross beam of Fig. 1
attached to another column.

Fig. 3 is a partial perspective view of a pair of braces and a cross member
attached to a column in accordance with a preferred embodiment of the present
invention.

Fig. 4A is a side elevation view of a retaining element for use in locking the cross
beam and column of Fig. 1.

Fig. 4B is a perspective view of the retaining element of Fig. 4A.
Fig. 5A is a partial perspective view of a portion of a cross beam attached to a portion of the column of Fig. 2.

Fig. 5B is a partial perspective view of a portion of the cross beam of Fig. 1 attached to a portion of the column of Fig. 2 with the retaining element of Fig. 4A being positioned relative to the cross beam and column.

Fig. 5C is a partial perspective view of the cross beam, column and retaining element of Fig. 5B with the retaining element partially engaged with the cross beam and column.

Fig. 5D is a partial perspective view of the cross beam, column and retaining element of Fig. 5B with the retaining element fully engaged with the cross beam and column.

Fig. 6 is a partial cross sectional side view showing the engagement of the retaining element, cross beam and column when the retaining element is in the fully engaged position.

Fig. 7 is a perspective view of a shelving unit including the columns and cross beam of Figs. 1 and 2.

**Detailed Description of the Drawings**

Alternative embodiments of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. It is intended that the specification and examples be considered as exemplary only, with a true scope and spirit of the invention being indicated by the claims which follow. References to "front," "rear" and "centre" are for illustrative convenience only as would be appreciated by a person skilled in the art.

Figs. 1 to 4B and 7 show a preferred embodiment of a shelving system 10 having one or more braces 20, cross members 30, shelves 40, columns 100, cross
beams 200 and retaining elements 300. The preferred elements of the shelving system and their interrelationship are described below.

As shown in Figs. 1-3 and 7, there is provided a shelving apparatus including rigid end frames preferably welded together from roll formed stanchions or columns 100, braces 20 and RHS cross members 30. Columns 100 include a front 102, a rear 104, an inwardly facing side 106 and an outwardly facing side 108. The columns 100 are provided with two rows of engagement apertures 110 comprising elongate, substantially vertical slot portions 112 and an enlarged base portion 114. The slot portions 112 are preferably slightly inclined with the bottom toward the centreline of the column. As shown in Fig. 1, apertures 110 are each preferably generally "L" shaped. Preferably the rows of apertures are arranged as mirror images of one another along the height of the column. The roll formed columns 100 are preferably form stiffened by ridging at 116 and are formed into a channel 118 with stiff rolled edges 120. The end frames are preferably painted post-fabrication.

Columns 100 may be provided with integral or separable upper and or lower feet or caps. The feet may be provided with means for enabling the shelving apparatus to be bolted down. The feet and/or caps may be adapted to permit stacking of the shelving apparatus.

Referring to Figs. 1 and 2, shelf supports or cross beams 200 include a body 202, a first end 204, a second end 206, a front 208 and a rear 210. Front 208 of cross beam 200 preferably includes a roll-formed section 212 while rear 210 preferably has formed therein a shoulder 214 adapted to support a shelf 40 of folded sheet metal. A vertical face 216 defines the edge of the shoulder 214 and is of a depth equal to the thickness of the shelf edge to result in a surface 218 of cross beam 200 which is substantially flush with the surface of the shelf 40. The vertical retaining portion formed by shoulder 214 and vertical face 216 may be selected to be substantially as deep as the thickness of the shelf in order that the shelf is essentially stepless in use from edge to edge.
Shelf 40 may be any suitable material including wood, wood composite, polymer composite or metal, with metal shelving being selected from open (such as mesh) surfaces and closed (such as sheet metal) surfaces. Sheet metal shelves may be configured for form stiffness such as by rolling or forming the edges and/or the bulk surface of the sheet.

A bracket 220 is welded to the end of cross beam 200 and comprises a bearing flange 221 and an engagement flange 222. Engagement flange 222 preferably has three vertical-barred D punchings or openings 224 at the same centres as apertures 110. Openings 224 preferably include an upper portion 226 and a base portion 228 having a notch 230. Flange 222 preferably includes a retained hook tab 232 which is bent into the plane of flange 222 and is adapted to pass into slot 112 and drop down the engage the bracket with the column at three positions. The inclination of slots 112 cams the bearing flange 221 into engagement with the column to stabilize the join.

Cross beams 200 may be formed of solid, hollow, roll formed or other section. Preferably cross beams 200 are roll formed metal and have the flange adapted to extend over the opposite face affixed to the end of the section by welding. The at least one engagement tab 232 may be formed by any suitable means such as by fabrication to the flange or by stamping and folding it from the flange material per se.

As shown in Figs. 4A and 4B, a retaining element or gravity retainer 300 includes an insertion end 302 and a trailing end 304 having a height H with an upper bound UB and a lower bound LB. Trailing end 304 preferably includes a finger engagement area 306. Retainer 300 preferably forms a neck 308 distal to trailing end 304, and an upper land 310 diagonal from neck 308 for placement against a portion of opening 110 when engaged therewith. Retainer 300 is preferably of mass enough to rotate about a support point at 312, which defines the bight of a hook at neck 308. Retainer 300 preferably includes a lower land 314 proximate
one end of neck 308. Insertion end 302 preferably includes a tail 316 with a tip 318 at the most distal point thereof.

Preferably, insertion end 302 has a maximum dimension less than the minimum cross sectional dimension of aperture 110 of column 100.

Having described the preferred components of the system, a preferred method of use will now be described with reference to Figs. 5A to 6. At least two, more preferably four columns 100 are positioned in a substantially vertical orientation relative to one another. As shown in Fig. 5A, cross beam 200 is attached to one of columns 100 by placing bracket 220 against column 100 and positioning openings 224 to overlap portions of apertures 110 of column 100 to create a retaining recess through cross beam 200 and column 100. Tabs 232 of flange 222 are inserted into corresponding apertures 110 of column 100 at a height desired by the user. When tabs 232 are engaged with openings 110, they form a portion of the retaining recess. The retaining recess formed by the overlap of opening 224 with opening 110 of column 100 preferably has a maximum cross sectional dimension that is less than the maximum cross sectional dimension of either aperture 110 or opening 224.

Referring to Fig. 5B, retaining element 300 is moved towards the retaining recess created by the overlap of aperture 110 and opening 224 to lock cross beam 200 to column 100. As shown in Figs. 5C and 5D, insertion of the tail 316 into the index between the enlarged base portion 114 of column 100 and the "D" section of opening 224 allows the support point 312 to settle on the lower edge of the index. Releasing retaining element 300 enables the retaining element to rotate about the lower edge 114 until an upper land 310 is trapped beneath the upper edge of the enlarged base portion 114 of column 100 and a lower land 314 rests above the lower edge notch 230 of opening 224, thus retaining the bracket in engagement with the column.
As shown in Figs. 4A and 6, while the retaining element is in the fully engaged position relative to column 100 and cross beam 200, a portion of insertion end 302 extends beyond the lower bound LB of the height H of trailing end 304. More preferably, tip 318 extends a distance greater than the maximum height of trailing end 304 (i.e., more than 2 x H). In this orientation, insertion end 302 depends in an entirely downward direction from trailing end 304. As shown in Fig. 6, when retainer 300 is in the fully engaged position, a majority of the length of retainer 300 has passed through the retainer recess to lock cross beam 200 to column 100.

It will be appreciated that certain steps described above may be performed in a different order, varied, or omitted entirely without departing from the scope of the present invention.

The components of the system may be made from a variety of materials. For example only, any one of columns 100, cross beams 200 and/or retainers 300 may be made of plastic, metal or wood. Preferably the components are made from a metal such as steel.

Fig. 7 shows shelving system 10 with end frames formed by columns 100, braces 20 and cross members 30. The end frames may be formed from roll-formed columns of steel, aluminium or other sheet metal. Preferably the columns are formed of steel and are coated or treated for corrosion protection such as by galvanizing, powder coating or painting. The roll form may comprise a substantially U or C-shaped rolled section, with the channels defined by the open face of the U or C. The webs may be further profiled for form stiffness. The upper and lower struts and at least one diagonal brace may be respectively of solid or roll formed or other section. The upper and lower struts and at least one diagonal brace may be secured in the channels by any suitable means. In the case of the steel columns and steel upper and lower struts and at least one diagonal brace, the assembly of the end frames is preferably by welding.
The foregoing description is by way of example only, and may be varied considerably without departing from the scope of the present invention. For example only, with regards to the column, the column may have any cross section suitable for the intended purpose. For example, there may be more or less than four sides. The column may have a rounded or circular cross section. Apertures may be arranged along more than one side of the column. There may be only a single row of apertures, or more than two rows of apertures along the height of the column. The apertures of the column may be positioned and shaped in a variety of ways as needed or desired.

The cross beam may include engagement projections along the same general direction as the length of the cross beam to engage the cross beam to the column. For example, instead of or in addition to side tabs insertable into apertures along the front of the column, the bracket of the cross beam may include bent tabs insertable into corresponding apertures on the inwardly facing side of the column in a manner described with respect to the tab and aperture arrangement described above. The cross beam may include a multi-sided frame for engagement with more than two columns. The bracket may be omitted if desired and replaced with one or more engagement projections extending from the end of the cross beam for engagement with the column. Flange 222 (Fig. 1) may include only one or two openings 224 and/or tabs 232 if desired. Alternatively, flange 222 may include three or more openings 224 and/or tabs 232 if desired for engagement with corresponding apertures on the column. The shape of the bracket may be configured to substantially conform to the shape of the column. For example, the bracket may be curved to fit with a curved column.

The shape of the openings of the flange of the cross beam may be varied. Preferably opening 224 is larger in cross sectional area than a corresponding aperture 110 of the column. Notch 230 is preferably configured for engagement with trailing end 304 of retainer 300 so that when retainer 300 is in the fully engaged position, the height of retainer 300 engages with notch 230 and upper
portion 226 of opening 224 to substantially prevent vertical movement of the cross beam relative to the column.

The retaining element may be shaped in a variety of ways. For example only, the height of the trailing end may be varied to match the distance between the upper portion and base of the opening on the flange of the cross beam. It will be appreciated that the retaining element may be configured to have an insertion end portion extending in an upwardly direction if desired. The retaining element is preferably longer than wide with substantially flat side surfaces. The retaining element may be configured so as to have rounded or circular surfaces if desired.

The retaining element may be used as the primary attachment means if desired. For example, the retaining element may be inserted through the retaining recess without the presence of a tab.

The shelf system may be modified to include additional components such as adjoining racks of shelves of different height. Other examples of components include racks of baskets or other storage components. The system may include intermediate columns that have cross beams connected on both sides of the column.

The features described with respect to one embodiment may be applied to other embodiments, or combined with or interchanged with the features other embodiments, as appropriate, without departing from the scope of the present invention.

The present invention in a preferred form provides the advantages of a more secure racking system that is relatively easy to assemble. The inclusion of a retaining element provides a secondary attachment means that locks the cross beam to the column and substantially prevents vertical movement between the cross beam and associated column. The trailing end of the retainer is advantageously shaped to permit a user to disengage the retaining element with
little difficulty so that the cross beam may be repositioned at a different height if
desired. Additional advantages of preferred embodiments of the present
invention include considerable load bearing capacity, readily transportable, and
ability to be assembled in a range of configurations.

It will of course be realised that the above has been given only by way of
illustrative example of the invention and that all such modifications and variations
thereto as would be apparent to persons skilled in the art are deemed to fall within
the broad scope and ambit of the invention as herein set forth.
The claims defining the invention are as follows:

1. A method of assembling a shelving unit, comprising:
   positioning at least two columns in a substantially vertical orientation;
   attaching a cross beam to two of the columns; and
   locking the cross beam to one of the columns with a plurality of retaining elements.

2. The method of claim 1, wherein the step of attaching includes attaching a cross beam having a bracket with a plurality of projections configured for insertion into a corresponding number of apertures in the column.

3. The method of claim 2, wherein the projections are tabs.

4. The method of claim 1, wherein the step of locking includes inserting each of the retaining elements into a corresponding opening in the cross beam.

5. The method of claim 4, wherein the step of locking further includes inserting each of the retaining elements into a corresponding aperture in column to which the cross beam is locked.

6. A method of assembling a shelving unit, comprising:
   positioning at least two columns in a substantially vertical orientation, each column having a plurality of apertures oriented along a portion of the height of the column;
   positioning a cross beam having a length and an opening so that a portion of the opening of the cross beam overlaps a portion of one of the apertures of one of the columns to create a retaining recess through the cross beam and the column, the retaining recess having a central longitudinal axis; and
   moving a retaining element through the retaining recess to lock the cross beam to the column.

7. The method of claim 6, wherein the step of moving includes moving a portion of the retaining element in a direction away from the central longitudinal axis of the retaining recess.

8. The method of claim 7, wherein the step of moving includes moving the retaining element along the central longitudinal axis of the retaining recess, then
moving an insertion end portion of the retaining element away from the central longitudinal axis of the retaining recess.

9. The method of any one of claims 6 to 8, further comprising moving a second retaining element through the same cross beam and column.

10. The method of claim 9, wherein the second retaining element is moved through a second retaining recess created by the overlap of a second opening of the cross beam with another of the apertures of the column.

11. The method of any one of claims 6 to 10, wherein the step of positioning the cross beam includes creating the retaining recess to have a cross sectional area less than the cross sectional area of either the aperture or the opening used to create the retaining recess.

12. The method of any one of claims 6 to 11, wherein the step of moving includes moving a majority of the retaining element through the retaining recess.

13. A shelving system, comprising:

   a plurality columns, each column having a top, a bottom and a height from the top to the bottom, each column having a plurality of apertures oriented along at least a portion of the height;

   a cross beam having a pair of ends and a flange at each end for connecting said cross beam to two of said columns, said flange including an opening, the opening of said flange and the aperture of said column defining a retaining recess when said flange of said cross beam is placed against said column; and

   a retaining element insertable into said retaining recess for securing said cross beam to said column, said retaining element having an insertion end and a trailing end, said trailing end having a maximum height when said retaining element is in a fully engaged position relative to said cross beam and said column, a portion of said insertion end extending beyond at least one of the upper and lower bounds of the maximum height of said trailing end.

14. The system of claim 13, wherein said retaining element is adapted to prevent substantial vertical movement of said cross beam relative to said column.

15. The system of either claim 13 or 14, wherein said cross beam further comprises an integral projection adapted to engage said aperture of said column.
16. The system of claim 15, wherein said projection defines a portion of said opening of said flange.
17. The system of either claim 15 or 16, wherein said projection is a tab.
18. The system of any one of claims 13 to 17, wherein said retaining element includes at least one flat side when in the fully engaged position.
19. The system of any one of claims 13 to 18, wherein said insertion end of said retaining element includes a tip, said tip extending a distance beyond at least one of the upper and lower bounds of the maximum height, the distance being greater than the maximum height of said trailing end.
20. The system of any one of claims 13 to 19, wherein the insertion end has a maximum dimension less than the minimum cross sectional dimension of said aperture of said column.
21. The system of any one of claims 13 to 20, wherein said insertion end depends in an entirely downward direction from said trailing end when in the fully engaged position.
22. The system of any one of claims 13 to 21, wherein said apertures of said columns each include a base portion and a top portion, the base portion being wider than the top portion.
23. The system of any one of claims 13 to 22, wherein said apertures are generally L-shaped.
24. The system of any one of claims 13 to 23, wherein said retaining recess through said cross beam and said column has a maximum cross sectional dimension that is less than the maximum cross sectional dimension of either said opening of said cross beam or said aperture of said column.
25. The system of any one of claims 13 to 24, wherein said retaining element has a length, a majority of the length of said retaining element being configured to pass through said aperture of said column to lock said cross beam to said column.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.

A47B 47/02 (2006.01) A47B 57/10 (2006.01)
A47B 47/03 (2006.01) A47B 57/22 (2006.01)

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DWPI, A47B 47/02, 47/03, 57/10, 57/22, 57/34, 57/50, 96/14 key words OPENING+, HOLE+, APERTUR+, SLOT+, TAB+, TONGUE+, PROJECTION+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>US 2005/01 11912 A (BRAIN et al.) 26 May 2005 Whole document (pi refer to figs 1 &amp; 2)</td>
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* Special categories of cited documents
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Date of the actual completion of the international search

11 March 2008

Date of mailing of the international search report

9 MAR 2008

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX