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Williams

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[54] **APPARATUS FOR SUPPORTING MASONRY WALLS AGAINST WIND DAMAGE DURING CONSTRUCTION**

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[52] **U.S. Cl.** .... **52/122,** 52/149, 52/747, 52/749, 248/354 R

[51] **Int. Cl.** **E04g 21/02**

[58] **Field of Search** .... 52/745, 747, 749, 122, 52/127, 146, 149, 168, 314; 248/354 S, 354 R, 354 P, 354 C

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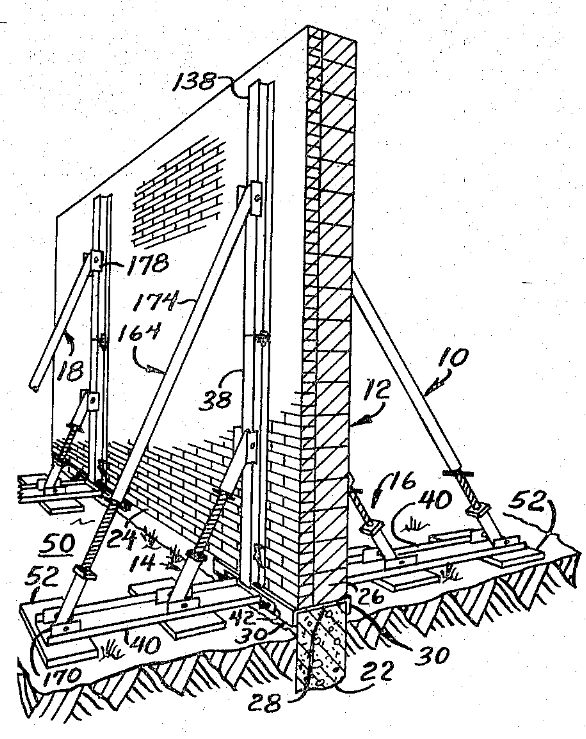
[57] **ABSTRACT**

Bracing system for supporting masonry walls during construction utilizes metal braces arranged in opposed relation on opposite sides of the wall at spaced locations. Vertical support members are placed against each side of the wall and held tightly together by snap-tie members which are placed in the wall near its bottom during construction. Horizontal members extend outwardly from each vertical member and rest on the ground or on boards laid on the ground but are not anchored to the ground. Adjustable diagonal members connect the horizontal and vertical members to form a triangular brace on each side of the wall. The diagonal members are adjusted until the vertical members are pressed tightly against the wall adjacent their upper connections to the diagonal members. The weight of the braces are carried by the foundation, preferably by removable angle members laid over the edge of the foundation during construction. The angles include studs to which the horizontal members are attached. When building high walls, the wall is preferably supported as it reaches a height of about 10 or 12 feet. When the wall reaches a height of 20–24 feet, additional vertical members are linked to the previously positioned vertical members and pressed against the wall by additional diagonal members attached to the same horizontal members. The system permits the wall to resist moments as if it were supported as its top and bottom rather than as a cantilever and causes wind loads to be transferred through the masonry wall, into the brace, into the foundation wall and then into the ground. The system is quickly assembled and, except for the snap ties which are broken off inside the wall and covered over, reusable indefinitely.

13 Claims, 8 Drawing Figures



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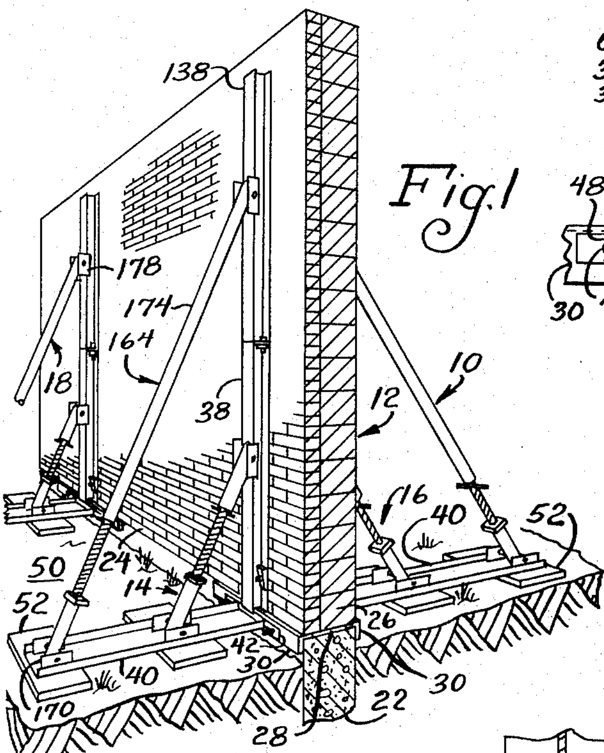

Fig. 1

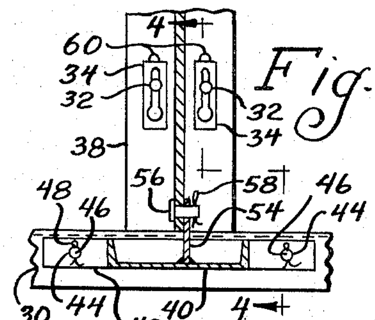

Fig. 3

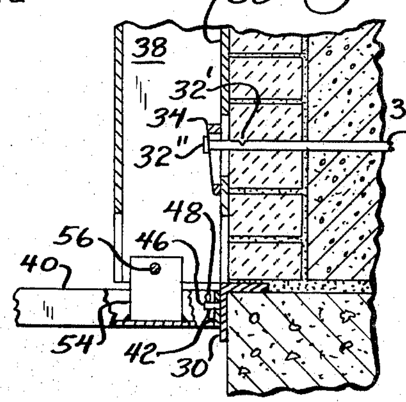

Fig. 4

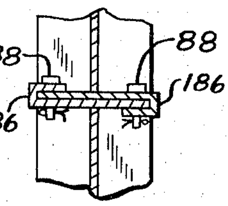

Fig. 6

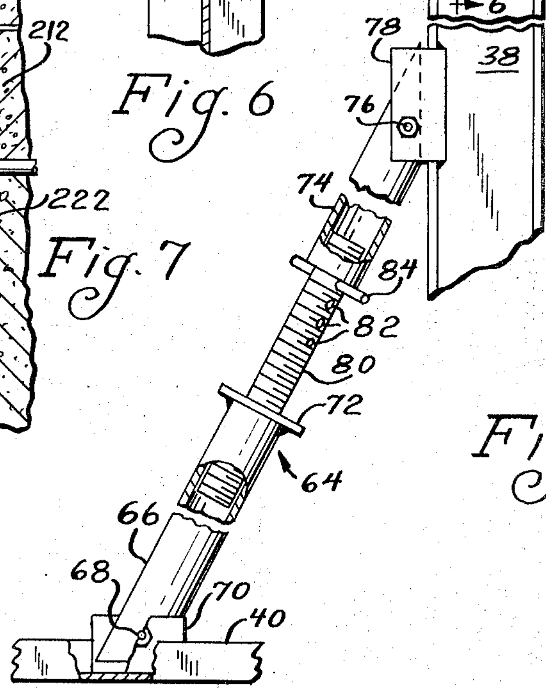

Fig. 5

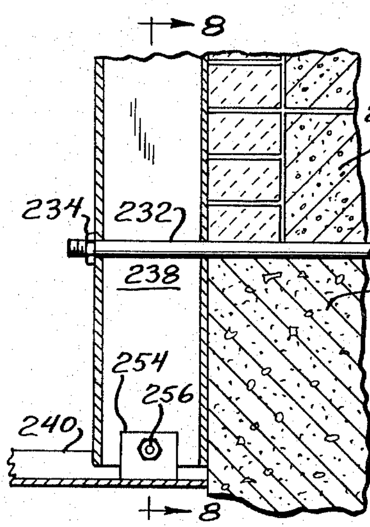

Fig. 7

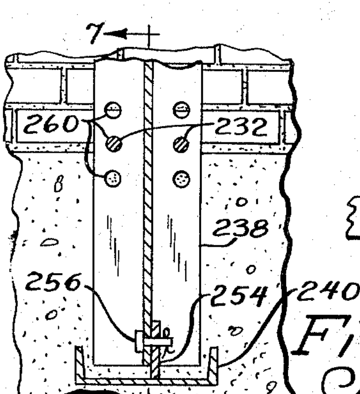

Fig. 8

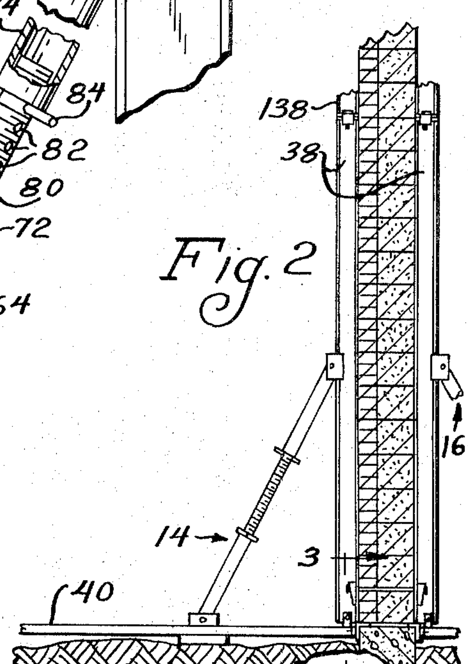

Fig. 2

APPARATUS FOR SUPPORTING MASONRY WALLS AGAINST WIND DAMAGE DURING CONSTRUCTION

BACKGROUND OF THE INVENTION

During construction, masonry walls are very vulnerable to failure due to wind forces. Most walls are designed to span from the base, usually a foundation wall, to a support at the top, either a floor or roof. The design moment used for this type wall is W L/8 (where W is the load and L is the length between supports.) During construction, the wall only has a support at the base and the moment to be resisted is W L/2. It is obvious that the wall during construction must resist four times more moment than the wall is designed for. To resist these moments during erection, common practice is to prop wooden members, a 2 × 8 or 2 × 12, against the wall and fasten the other end to a stake driven into the ground. The horizontal spacing of these members varies greatly with individual contractors. In many instances, the stakes are driven very loosely into the ground by laborers who do not take the trouble to drive the stakes firmly or want to assure their easy removal. Extensive rain can also loosen the prop anchors. The wooden props, assembled in their usual manner, can resist very little wind loading and are mainly used to satisfy insurance requirements that bracing be used.

Obviously, when a wall blows over during construction there is a tremendous loss involved with respect to time and materials. Time must be spent in clearing away the debris. Also, if an additional supply of the building facing material is not readily available, the finishing of the construction, and the work of other trades, is delayed, and increased in cost, to an extent much greater than the value of the time and materials required to rebuild the wall. Although most walls are insured against wind damage, the cost of the insurance must of course be high enough to cover the risk involved. Naturally, the cost of insurance must be included in the cost of construction and causes building costs to be higher than they would be if the risk of falling walls was lower. Although insurance companies are concerned about walls blowing over during construction and usually require that bracing be used, the only bracing system currently being used is the wooden prop system previously described.

There are many prior art patents disclosing support devices for holding forms in place during construction and aligning door and window frames or other members. None of these patents, including U.S. Pat. Nos. Re 21,905, 1,779,007, 2,510,717, 2,514,397, 2,814,459, 3,006,592, 3,154,833, 3,444,659, 3,468,094 and 3,574,981 is concerned with supporting a modular wall against wind damage during construction. Most of the patents require that the horizontal or vertical support be anchored to the ground or a floor at its outer end and thus have the same problem as the conventional wooden prop system. Since walls go up so fast it is impossible for insurance investigators to check all bracing being used. Furthermore, after a wall has fallen it is impossible to determine how it was supported. Thus, it would be most desirable to have a wall support system which not only provides excellent support but which performs its function somewhat independently of the degree of care exercised by the workers installing the supports.

SUMMARY

It is an object of this invention to provide a masonry support system which will permit a wall being constructed to resist wind loads of a magnitude equal to the design load of the finished wall (usually 15 pounds per square foot).

It is an additional object of the invention to provide a support system which can be used indefinitely, is economical, and which can be assembled and disassembled by unskilled workers in a few minutes.

Yet another object of the invention is to provide a wall support system which does not require that anchor members be driven into the ground adjacent the wall.

The preceding and other objects are attained by the present invention relating to a method and apparatus for supporting a masonry wall during construction. In a preferred embodiment, a 40 foot long, 20 foot high, 12 inch thick wall section is constructed and supported in the following manner: As the mortar is placed on the top of the foundation wall, a 3 inch × 2 inch × three-eighths inch ×2 feet long steel angle member is laid over opposing side edges of the foundation at positions 16 feet apart and 4 feet from each end of the wall. After three courses of face brick for the outer surface and one course of concrete block for the inner surface have been laid, a pair of snap tie members capable of resisting a 5,000 pound tension load are inserted in the motar so that each snap tie extends horizontally from each side of the wall. The snap ties have enlarged ends for a purpose to be described.

After the wall has been constructed to a height of about 10 feet, a horizontal support member such as a 10 feet length of 8 inch channel having a double apertured plate welded to one end is positioned with its inner end in contact with the angle member on the foundation edge so that a pair of studs welded to the angle member will pass through the apertures and be retained by cotter pins. The outer end of each horizontal channel member is permitted to rest on the earth, or preferably, against a pair of planks, 2 inches × 10 inches × 6 feet, for example, or other form of mudsills which serve to distribute downward loading of the channel to the face of the earth. A vertical support member, which may comprise a 10 foot length of 6 inch I-beam is placed against each side of the wall and pinned to a flange extending upwardly from the horizontal channel at a location near the foundation. A pair of elongated slots in the wall engaging flange of the I-beam are placed over the extending ends of the snap tie members and the opposing I-beams on each side of the wall are drawn toward the wall and each other by hammering wedge-like locking members between the inner flanges and the enlarged ends of the snap tie members. A diagonal member, consisting principally of 3 inch pipe sections is pivotally connected to the horizontal channel member at a location about 3 feet to 4 inches out from the wall, and to the vertical member at a point 5 feet above its lower end. The pipe portions of the diagonal members are spaced from each other to permit the diagonal member to be adjusted in length for the purpose of forcing the vertical I-beam against the wall and the horizontal channel against the ground. This is accomplished by welding a threaded nut member to the free end of one of the pipe sections. The nut member is threadingly engaged with a 2 inch threaded rod member which is telescopically received within the adjacent inner ends of the two spaced pipe sections. The threaded rod member is preferably transversely apertured at several positions along its length to permit the length of the diagonal member to be rapidly adjusted. A pin is placed in whichever aperture which will require the least amount of rotation of the rod to move the pin into engagement with the pipe section which does not carry the nut member. The rod is rotated by placing a bar through one of the unused apertures and using it as a handle to rotate the rod until the diagonal member is extended sufficiently to force the I-beam into tight contact with the wall. It should be understood that the diagonal members on each side of the wall are extended so that the pressure applied against each side of the wall will be relatively uniform. After the diagonal members are tightened, the diagonal members are in compression while the horizontal and vertical members are in tension. The rigid support applied to the upper portion of the wall by the vertical I-beam members causes the wall to behave relative to wind loads in substantially the same manner it behaves after a pair of spaced walls are joined together by a roof or floor structure. Thus, when supported by my improved bracing system, the wall is able to resist approximately four times the moment it could resist if it was a free-standing cantilever.

The principal function of my temporary wall support system is to change the direction of span of the wall from a vertical cantilever to a simple horizontal span. Although a four foot section at each end of the wall is still a cantilever, such a small section is of no concern since the wall is 12 inches thick. The loading of the wall can be described as follows: The wind loads are transferred from the masonry to the vertical brace member on the down-wind side through bending. This member is designed to resist these loads and transmit them to the diagonal member. The diagonal transfers the load to the horizontal channel which rests on a mudsill on the ground. This channel is a tension member, and transfers the loads back to the vertical. Since the vertical members on either side of the wall are fastened together by means of bolting or steel rods located 8 inches to 24 inches above the foundation, the load is transferred through the rods to the brace on the opposite, i.e., windward side of the wall. This brace pushes against the masonry and the load is transferred to the foundation wall through friction between the masonry and concrete. In addition, when the diagonal member is subjected to the above action, it tends to slide the vertical member up on the face of the wall. This is resisted by the angle member fastened to the vertical and embedded into the base of the wall, thus utilizing the entire weight of the wall to resist the force.

If the supported wall is to be extended to a final height of 20–24 feet, the wall is constructed upwardly after it is supported at the 10–12 foot level without embedding any additional elements in it. An upper vertical member is then pinned to the lower vertical member to form an extension thereof and held against the upper section of the wall by an outer diagonal member pinned to the outer end of the horizontal channel member and to the center of the upper vertical member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of a modular wall section supported by two opposed pairs of bracing members in accordance with the invention;

FIG. **2** is a fragmentary end elevational view of a wall with the support system in place;

FIG. **3** is a sectional view taken on the line **3—3** of FIG. **2**;

FIG. **4** is a sectional view taken on the line **4—4** of FIG. **3**;

FIG. **5** is a fragmentary, partially sectioned view of the diagonal brace member of the invention and its connection to the horizontal and vertical members;

FIG. **6** is a sectional view of the vertical member coupling taken on line **6—6** of FIG. **5**;

FIG. **7** is a sectional side view, somewhat similar to FIG. **4**, showing a modification of the invention, the section being taken on line **7—7** of FIG. **8**; and

FIG. **8** is a sectional view taken on line **8—8** of FIG. **7** showing a modification of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. **1**, my improved bracing system is indicated generally at **10** in supporting relationship with a section of masonry wall **12**. The bracing system **10** includes a pair of bracing structures **14, 16** positioned on opposite sides of the wall. Spaced along the wall **12** is a second pair of bracing structures, only one of which, **18**, is visible. The spaced pairs of opposed bracing structures cooperate with each other and with the wall **12** to cause wind loads which impinge upon either side of the wall **12** before it is tied into a roof or floor structure (not shown) to be resisted as hereinbefore described. The wall **12** is constructed on top of foundation wall **22** which is preferably of poured concrete construction. Before the first course of bricks **24** and blocks **26** are laid into a bed of mortar **28**, a pair of metal angle pieces **30, 30** are laid along the top side edges of the foundation wall **22**. A pair of high tensile strength snap tie members **32, 32** are then embedded in the wall as it is being constructed at a location spaced no further than about 2 or 3 feet above the foundation **22** and preferably at a height of about 8 inches or less above the foundation. The snap tie **32** includes notches **32'** near each end which permit the ties to be broken off inside the wall **12** after use. The resultant openings left in the wall by the breaking off of ties **32** and the prying out of angles **30** are easily covered with mortar. The ties **32** also have enlarged ends **32''** which are contacted by wedge members **34** for tensioning the ties **32** and forcing the vertical members **38** against the wall.

When the wall **12** has been erected to a height slightly higher than the height of vertical I-beam member **38**, the erection of the lower portions of braces **14, 16** and **18** can commence with the assembly of the channel-shaped horizontal support members **40** to the angle plates **30**. The channels **40** have connecting plates **42** welded to their inner ends. The plates **42** are apertured at **44** (FIG. **3**) so that they can pass over studs **46** which are welded to angles **30**. The plates **42** are retained against movement away from angles **30** by cotter pins **48**. The anchoring of channels **40** to the angles **30** is loose so that the channel may be pivoted up and down 15° or so in each direction to permit the channel to accommodate to the level of the earth **50** adjacent the wall **12.** To permit the loading of the channels **40** to be relatively uniformly distributed to the earth **50,** a pair of mudsills, **52, 52** such as short lengths of wooden planks, are placed under the channel **40.**

After the channels **40** are assembled to the angle member bearing plates **30,** the vertical support members **38** are laid against the wall **12** and pinned to brackets **54** welded to channels **40** by pins **56** which may be held in place by cotter pins **58** (FIGS. **3** and **4**). Opposed pairs of vertical members **38** are then forced toward each other and the wall **12** by slotted wedge members **34** which provide a wedging action between the ends **32''** of the snap tie members **32** and the inner flanges **38'** of the I-beam **38.** The inner flanges **38'** are slotted at **60** to permit the beam to accommodate to a range of vertical positioning of the tie members **32.**

As shown in FIG. **5,** the vertical member **38** and horizontal member **40** form a triangle having one variable length leg when the diagonal support member **64** is connected to them. The diagonal member **64** includes a lower pipe section **66** pivoted by pin **68** to a bracket **70** welded to the channel member **40.** A threaded nut member **72** is welded to the upper end of pipe section **66.** An upper pipe section **74** is pivotally mounted by pin **76** to a bracket **78** welded to the vertical support **38** at about its midpoint. Since the diagonal member **64** is always in compression when it is resisting a wind load on the wall **12** it is made adjustable in length by forcing the pipe sections **66, 74** away from each other. This adjustment is made by rotating threaded member **80** relative to threaded nut **72.** A series of holes **82** are adapted to receive a pin **84** to permit the length of diagonal **64** to be quickly adjusted to a number of predetermined positions. Final adjustment to compress the member **64** and force the vertical member **38** against the wall **12** can then be made by placing an elongated bar (not shown) in one of the unused holes **82** and rotating the threaded member **80.**

After the lower portion of the wall **12** has been supported in the aforementioned manner, the remaining courses of brick and block or other modules can be laid in place. The upper section of the wall is then supported by a vertical support member **138** which may be identical to the lower vertical member **38.** Interlocking, generally J-shaped flanges **86, 186** are welded to one end of each vertical member **38, 138.** When the flanges are interlocked as shown in FIGS. **5** and **6,** and pins **88** placed through them, the vertical members **38, 138** are locked together in a manner in which either tension or compression forces can be transmitted between them. The upper vertical member **138** is forced against the upper section of the wall **12** by a diagonal member **164** which is identical to diagonal **64** except that pipe section **174** is longer. The lower end of diagonal **164** is pivotally connected to welded bracket **170** positioned at the end of channel **40** and the upper end of the diagonal is pivotally connected to the welded bracket **178** at the center of vertical member **138.**

FIGS. **7** and **8** illustrate an alternative embodiment of the invention wherein the means to horizontally tie the vertical support members **238** together and the means to apply the downward loading to the foundation comprise a single set of threaded rod elements **232** rather than the separate snap ties **32** and angled bearing plates **30** shown in the other figures. The rods **232** extend outwardly from each side of the wall through apertures **260** in the vertical members **238** and have nuts **234** on their ends which force the opposed vertical members against the wall **212.** The horizontal member **240** is pinned to the vertical member **238** by a pin **256** which passes through an aperture in the bracket **254** which is welded to channel **240.** The alternative embodiment of FIGS. **7** and **8** is slightly easier to assemble than the preferred embodiment shown in the other figures but is more difficult to disassemble since the rod **232** must be heavier than the rod **32,** preferably about 0.75 in., and is thus thicker than the usual mortar joint. The thickness of the rod prevents its being snapped off and its threads make it difficult to be pulled out of the wall.

I claim:

1. Apparatus for temporarily supporting a freestanding modular wall constructed on top of a foundation against wind damage during construction comprising:

a first pair of rigid elongated members adapted to be placed vertically against opposing sides of the wall and in contact therewith throughout their lengths;

means extending between said first pair of members intermediate the ends thereof adapted to be placed in said wall as it is being constructed for tying said first pair of elongated members to each other and to said wall and for transferring the stresses in said members produced by wind loading on the wall to the foundation of the wall; a second pair of rigid elongated members pivotally jointed at corresponding ends thereof to respective ends of said first pair of elongated members and projecting in opposite directions therefrom, said second pair of rigid elongated members being adapted to be supported against downward movement by the ground adjacent said foundation;

a third pair of elongated compression members pivotally connected to each of said first and second pairs of elongated members so as to form a triangular brace on each side of said wall;

one of said pairs of elongated members being adjustable to force said first pair of elongated members towards each other and the wall at the location where said first and third pairs of elongated members are connected to each other.

2. The apparatus of claim **1** wherein said means extending between said first pair of members comprises at least one tie rod member adapted to be placed in the wall at a distance above the foundation and a pair of support plates having portions adapted to lay on top of the foundation and portion extending ourwardly from the foundation, each of said pair of support plates being attached to one of said rigid elongated members for supporting the weight of said one member.

3. The apparatus of claim **2** wherein said at least one tie rod member is sufficiently long to extend through at least a portion of each of said first pair of elongated members and includes enlarged portions at its ends which are adapted to cooperate with wedge type fastening means to force said first pair of elongated members against said wall.

4. The apparatus of claim **2** wherein each of said first pair of rigid elongated members includes at least one elongated aperture therein adapted to receive said at least one tie rod member.

5. The apparatus of claim **1** wherein said means extending between said first pair of members comprises at least one tie rod member adapted to be placed on top of the foundation.

6. The apparatus of claim **1** wherein said third pair of elongated members are adjustable in length.

7. The apparatus of claim **6** wherein said third pair of elongated members comprise a pair of hollow end portions and a threaded center portion telescopically receivable inside said end portions, said threaded center portion engaging a threaded portion of one of said hollow end portions and being adjustably movable relative thereto, and means on said center portion for abuting the free end of the other of said hollow end portions.

8. The apparatus of claim **7** wherein said means for abuting comprises a rod, selectively transversely insertable in a plurality of apertures spaced along the length of said threaded center portion, said center portion being adapted to be rotated and thereby moved axially relative to said threaded hollow end portion by inserting an elongated handle in one of said plurality of spaced apertures.

9. The apparatus of claim **1** wherein each of said first pair of elongated members comprises a first section adapted to be placed against said wall and pivotally connected to said second and third pairs of elongated members when the wall is at less than its final height and a second section adapted to be connected to said first section when said wall is at or at least close to its final height, said first and second sections including integral complementary end portions which interlock with each other to permit tension loading of said first pair of elongated members, and a fourth pair of elongated members pivotally connected to said second pair of elongated members at points remote from said third pair of elongated members and to said second section of said first pair of elongated members at a point spaced upwardly from said end portion.

10. The apparatus of claim **9** wherein said means extending between said first pair of members comprises at least one tie rod member adapted to be placed in the wall at a distance above the foundation and a pair of support plates having portions adapted to lay on top of the foundation and portions extending outwardly from the foundation, each of said pair of support plates being attached to one of said rigid elongated members for supporting the weight of said one member.

11. The apparatus of claim **10** wherein said outwardly extending portions of said support plates engage and retain first end portions of said second pair of elongated members located adjacent the point of connection of said first and second pairs of elongated members, said third and fourth elongated members being connected to said second elongated members at points intermediate the ends thereof and at the ends remote from said first end portions, respectively.

12. The apparatus of claim **1** wherein said means extending between said first pair of members ties said members to each other at locations which are spaced at least about 8 inches above the bottom of said pair of rigid horizontal members.

13. The apparatus of claim **2** wherein said at least one tie rod member ties said first pair of rigid elongated members together at a location between 2 to 36 inches above said support plates.

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