A tie system and method for forming a wall from a hardenable building material. In one embodiment, the tie system includes multiple wall ties configured to be directly interconnected to form a wall tie stack such that multiple wall tie stacks are positioned between first and second panel structures. Each wall tie stack defining a first wall portion and a second wall portion with an intermediate portion extending therebetween. The first and second wall portions define a first planar surface and a second planar surface, the first and second planar surfaces being outer most surfaces of the wall tie stack to define a wall tie width. The first planar surface is configured to be directly fastened to the inner surface of the first panel structure and the second planar surface is configured to be directly fastened to the inner surface of the second panel structure.
FIG. 1
WALL FORMING SYSTEM AND KIT THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS


TECHNICAL FIELD

[0002] The present invention relates generally to wall forming systems. More specifically, the present invention relates to a tie system and a kit for forming walls and the like.

BACKGROUND

[0003] Many residential and light commercial structures are built on concrete foundation walls which are formed by pouring concrete into a system of forms that have been erected on a previously poured concrete footing. After the concrete has cured sufficiently, the forms are stripped from the concrete and in most cases is back filled on the exterior side of the concrete wall. Typically, the base of each foundation wall is supported on a concrete footing, which is wider than the thickness of the wall itself. Ideally, the center-line of the wall is aligned with the centerline of the footing. The footing spreads the load of the structure over a greater area and prevents uneven loading of the foundation wall.

[0004] As set forth, once the footing is in place and hardened, a system of forms are constructed over the footing. Such systems of forms have typically been constructed using expensive and reusable forms. These forms are typically made of metal and are, thus, very heavy and extremely labor-intensive to assemble and remove after pouring the concrete. Further, due to the significant investment of reusable metal forms, concrete laborers will typically pass the cost on to others for their services. As a result, various other concrete form systems for cement walls have been proposed as alternatives to the heavy metal forms.

[0005] One recent development in this field is the use of expanded polystyrene panels, known as insulated concrete forms. These newer form systems utilize pairs of horizontally extending foam panels which are connected in parallel with a series of rigid plastic ties. Complete wall form systems are typically created by vertically stacking these horizontally extending paired foam panels into larger arrays. Concrete is then poured between the panels of the completed foam wall form system. The thickness of the poured concrete walls can be adjusted by the selection and utilization of form ties of appropriate size. Subsequent to concrete hardening these foam panels are left in place to serve as insulation.

[0006] Although such insulated concrete forms are lighter than the conventional metal form systems, the forms are bulky and, therefore, the cost for shipping such forms can be expensive. Further, due to the bulky and cumbersome nature of these forms, they are highly susceptible to the inherent risk of damage during transportation and even during installation. Another problem with the insulated concrete forms is the requirement for numerous different types of parts to fit the variations of the footprint of both residential and commercial construction. Due to these numerous different parts and sizes, the insulated concrete forms are high in cost to manufacture and therefore, such high cost is passed on to the consumers and builders. Furthermore, the numerous different types of parts in the insulated concrete forms are complicated to construct and require skilled laborers who understand the complexities for such construction. In addition, another inherent problem with the insulated concrete forms is the difficulty to match such forms to the predetermined required lengths along the footing usually evident at corners and ends, in which shortening the forms by cutting and then adhesively repairing the forms is required, often leaving the forms in a damaged state with reduced structural integrity. Such problem further increases the complexity and time required to build the forms in preparation to pour the concrete.

[0007] Another problem with prior art systems, particularly conventional metal forms, involves the installation of rebar, wire mesh, or other reinforcing members between the parallel panels that are to be embedded within the finished foundation wall. The techniques employed typically involve various means and methods for suspending rebar haphazardly between the panels with wire ties. Although such wire ties have been used for years, inaccurate placement of the rebar is common, often resulting in unsatisfactory reinforcement of the foundation walls. Further, such wire tying techniques are labor intensive, time consuming and a tedious process.

[0008] Further, often it is desired to have walls with a radius; however, conventional metal or steel forms are not made to provide a wall with a constant radius. Rather, the best the conventional metal or steel forms can implement is segmenting a wall with multiple flat faced portions at different orientations at the dimension of the form itself. There are specialized aluminum forms that are specifically made to form curved walls, but such specialized aluminum forms are extremely expensive and are limited by the fixed radial dimensions of the form itself.

[0009] Based on the foregoing, it would be advantageous to provide a concrete form system that is low in cost for builders and, thus, the home owner, minimizes the waste of form materials, provides a non-complicated system with less part types and that inherently can be adjusted to any required lengths for ends and corners or overall footprints required for the foundation walls. Further, it would be advantageous to provide a concrete form system that is less labor intensive, lightweight and compact and, further, provides for ready and precise assembly of reinforcing rebar materials to be placed in concrete forms. Even further, it would be advantageous to provide a concrete form system that readily facilitates forming walls with a radius that is low in cost and is not limited by the dimension of the forms.
BRIEF SUMMARY OF THE INVENTION

[0010] Embodiments of the present invention are directed to a wall forming system configured to form a wall structure from a hardenable pourable building material are provided. In accordance with one embodiment of the present invention, the wall forming system includes first and second panel structures and multiple wall ties. The first and second panel structures each include an inner surface and an outer surface, the first and second panel structures configured to be positioned parallel to each other so that the inner surface of the first panel structure faces the inner surface of the second panel structure. The multiple wall ties are configured to be directly interconnected to form a wall tie stack such that multiple wall tie stacks are configured to be positioned between the first and second panel structures in a spaced arrangement. Each wall tie stack defines a first wall portion and a second wall portion with an intermediate portion extending between the first wall portion and the second wall portion. The first wall portion defines a first planar surface and the second wall portion defines a second planar surface, the first planar surface facing away from and directly opposite the second planar surface. The first planar surface and the second planar surface are outer most surfaces of the wall tie stack to define a wall tie width such that the first planar surface is configured to be directly fastened to the inner surface of the first panel structure and the second planar surface is configured to be directly fastened to the inner surface of the second panel structure.

[0011] In one embodiment, the wall tie stack includes multiple vertically stacked wall ties. In another embodiment, the wall tie stack includes multiple wall ties coupled together horizontally with wall tie fasteners. In another embodiment, the intermediate portion extends rigidly between the first wall portion and the second wall portion. In another embodiment, each wall tie of the multiple wall ties includes a first elongated wall portion and a second elongated wall portion with a cross-member portion extending therebetween.

[0012] In another embodiment, the wall forming system further includes conduit portions, the conduit portions configured to be positioned over and along the intermediate portion of adjacent spaced wall tie stacks. In another embodiment, the wall forming system further includes one or more housing components, the one or more housing components configured to be coupled to conduit, the housing components including a surface configured to be directly coupled to an inner surface of one of the first and second panel structures.

[0013] In still another embodiment, the wall forming system further includes panel support structures, the panel support structures configured to couple adjacent positioned first panel structures and adjacent positioned second panel structures. In a further embodiment, at least one of the adjacent positioned first panel structures and the adjacent positioned second panel structures are positioned relative to the respective first and second panel structures to extend vertically or horizontally. In still another embodiment, at least one of the adjacent positioned first panel structures and the adjacent positioned second panel structures are positioned relative to the respective first and second panel structures to extend at an angle. In another embodiment, the first and second panel structures extend with a curve so that the wall structure extends with a corresponding curvature.

[0014] In accordance with another embodiment of the present invention, a kit for forming a concrete wall structure is provided. The kit includes first and second panel structures and multiple wall ties. The first and second panel structures are configured to be positioned parallel relative to each other. Each of the first and second panel structures includes an inner surface and an outer surface extending to define a periphery. Further, each of the first and second panel structures are formed with pre-determined sizes, at least one of the first and second panel structures including a pre-cut opening defined therein. The pre-cut opening is sized and positioned at a pre-determined location in the at least one of the first and second panel structures. Each of the wall ties include outer most planar surfaces defining a tie width. The outer most planar surfaces of each of the wall ties are configured to be positioned and fastened directly against the inner surface of one of the first panel structures and the inner surface of one of the second panel structures so that opposing ones of the first and second panel structures extend parallel relative to each other.

[0015] In one embodiment, the kit further includes conduit configured to be supported by and positioned along the wall ties and between the first and second panel structures and configured to extend through the pre-cut opening of the first and second panel structures. In another embodiment, the kit further includes one or more housing components, the one or more housing components including a surface configured to be directly coupled to the inner surface of one of the first and second panel structures. In another embodiment, the kit further includes fasteners, the fasteners configured to couple the first panel structures to first wall portions of the wall ties and the fasteners configured to couple the second panel structures to second wall portions of the wall ties. In still another embodiment, the kit further includes panel support structures, the panel support structures configured to directly couple adjacent positioned first panel structures and adjacent positioned second panel structures. In another embodiment, the kit further includes clips, the clips configured to couple wall ties together horizontally between at least one of the first panel structures and at least one of the second panel structures. In still another embodiment, the kit further includes instructions for assembling the first and second panel structures and wall ties. In a further embodiment, the instructions further include instructions for assembling conduit and/or one or more housing components relative to the first and second panel structures.

[0016] In another embodiment, the wall ties are configured to be vertically stacked and coupled to form a wall tie stack, the wall tie stack configured to be fastened between the first and second panel structures.

[0017] In accordance with another embodiment of the present invention, a method for assembling a preformed wall forming tie system is provided. The method includes providing first and second panel structures, each of the first and second panel structures being pre-cut with pre-determined sizes and at least one of the first and second panel structures including a pre-cut opening defined therein; and coupling wall ties between the first and second panel structures, each of the wall ties including outer most planar surfaces defining a tie width, the outer most planar surfaces of each of the wall ties configured to be positioned and fastened directly against an inner surface of one of the first panel structures and an inner surface of one of the second panel structures so that opposing ones of the first and second panel structures extend parallel relative to each other.

[0018] In one embodiment, the method further includes extending conduit along the wall ties and between the first and
second panel structures and extending conduit through the pre-cut opening of the first and second panel structures. In still another embodiment, the method further includes coupling one or more housing components to one of the first and second panel structures such that a surface of the one or more housing components is directly coupled to the inner surface of one of the first and second panel structures.

[0019] In accordance with another embodiment of the present invention, a tie system includes a first panel structure, a second panel structure, and multiple ties. The first and second panel structures each including an inner surface and an outer surface such that the first and second panel structures are configured to be positioned parallel to each other so that the inner surface of the first panel structure faces the inner surface of the second panel structure. The multiple wall ties are configured to be directly interconnected to form a wall tie stack such that multiple wall tie stacks are configured to be positioned between the first and second panel structures in a spaced arrangement. Each wall tie stack defines a first wall portion and a second wall portion with an intermediate portion extending between the first wall portion and the second wall portion. In addition, the first wall portion defines a first planar surface and the second wall portion defines a second planar surface, the first planar surface facing away from and directly opposite the second planar surface. The first planar surface and the second planar surface are outer most surfaces of the wall tie stack to define a wall width. With this arrangement, the first planar surface is configured to be directly fastened to the inner surface of the first panel structure and the second planar surface is configured to be directly fastened to the inner surface of the second panel structure.

[0020] In one embodiment, the wall tie stack includes multiple vertically stacked wall ties. In another embodiment, the wall tie stack includes multiple wall ties coupled together horizontally with wall tie fasteners. In a further embodiment, the wall tie fasteners are in the form of a clip.

[0021] In another embodiment, the intermediate portion extends rigidly between the first wall portion and the second wall portion. In still another embodiment, each wall tie of the multiple wall ties includes a first elongated wall portion and a second elongated wall portion with a cross-member portion extending therebetween.

[0022] In another embodiment, the tie system further includes conduit portions, the conduit portions configured to be positioned over and along the intermediate portion of adjacent spaced wall tie stacks. In still another embodiment, the tie system further includes one or more housing components, the one or more housing components configured to be coupled to conduit, the housing components including a surface configured to be directly coupled to an inner surface of one of the first and second panel structures.

[0023] In another embodiment, the tie system further includes panel support structures, the panel support structures configured to couple adjacent panel structures and adjacent panel structures. In a further embodiment, at least one of the adjacent panel structures and the adjacent panel structures are positioned relative to the respective first and second panel structures to extend vertically or horizontally. In another embodiment, the tie system further includes, at least one of the adjacent panel structures and the adjacent panel structures are positioned relative to the respective first and second panel structures to extend at an angle. In another embodiment, the first and second panel structures extend with a curvature so that the wall structure extends with a corresponding curvature.

[0024] In accordance with another embodiment of the present invention, a kit for forming a concrete wall structure is provided. The kit includes first and second panel structures, multiple wall ties, and conduit. The first and second panel structures are configured to be positioned parallel relative to each other such that each of the first and second panel structures include an inner surface and an outer surface extending to define a periphery. Each of the wall ties include outer most planar surfaces defining a tie width such that the outer most planar surfaces of each of the wall ties are configured to be positioned and fastened directly against the inner surface of one of the first panel structures and the inner surface of one of the second panel structures so that opposing ones of the first and second panel structures extend parallel relative to each other. The conduit is configured to be supported by and positioned along the wall ties and between the first and second panel structures.

[0025] In one embodiment, the wall ties are configured to be vertically stacked and coupled to form a wall tie stack, the wall tie stack configured to be fastened between the first and second panel structures.

[0026] In another embodiment, the kit further includes fasteners, the fasteners configured to couple the first panel structures to first wall portions of the wall ties and configured to couple the second panel structures to second wall portions of the wall ties. In another embodiment, the kit further includes one or more housing components, the one or more housing components including a surface configured to be directly coupled to the inner surface of one of the first and second panel structures.

[0027] In another embodiment, the kit further includes panel support structures, the panel support structures configured to directly couple adjacent positioned first panel structures and adjacent positioned second panel structures. In another embodiment, the kit further includes clips, the clips configured to couple wall ties together horizontally between at least one of the first panel structures and at least one of the second panel structures.

[0028] In accordance with another embodiment of the present invention, a kit for forming a concrete wall structure is provided. The kit includes first and second panel structures, multiple wall ties, and one or more housing components. The first and second panel structures are configured to be positioned parallel relative to each other such that each of the first and second panel structures include an inner surface and an outer surface extending to define a periphery. Each of the wall ties include outer most planar surfaces defining a tie width such that the outer most planar surfaces of each of the wall ties are configured to be positioned and fastened directly against the inner surface of one of the first panel structures and the inner surface of one of the second panel structures so that opposing ones of the first and second panel structures extend parallel relative to each other. The one or more housing components are configured to be coupled to conduit, the one or more housing components including a surface configured to be positioned at least partially against the inner surface of one of the first and second panel structures.

[0029] In one embodiment, the wall ties are configured to be vertically stacked and coupled to form a wall tie stack, the wall tie stack configured to be fastened between the first and second panel structures.
In another embodiment, the kit further includes fasteners, the fasteners configured to couple the first panel structures to first wall portions of the wall ties and configured to couple the second panel structures to second wall portions of the wall ties. In another embodiment, the kit further includes panel support structures, the panel support structures configured to directly couple adjacent fasteners of the first panel structures and adjacent panel structure second panel structures.

In another embodiment, the kit further includes conduit portions, the conduit portions configured to be supported by and positioned along the wall ties and between the first and second panel structures. In still another embodiment, the kit further includes clips, the clips configured to couple wall ties horizontally between at least one of the first panel structures and at least one of the second panel structures.

In accordance with another embodiment of the present invention, a kit for forming a concrete wall structure is provided. The kit includes first and second panel structures, the first and second panel structures configured to be positioned parallel relative to each other, each of the first and second panel structures including an inner surface and an outer surface extending to define a periphery, at least one of the first and second panel structures including pre-cut portions; multiple wall ties, each of the wall ties configured to be positioned and fastened between the first and second panel structures so that the first and second panel structures extend parallel relative to each other; and one or more housing components coupled to conduit, the one or more housing components including a surface configured to be positioned at least partially against the inner surface of one of the first and second panel structures.

In accordance with another embodiment of the present invention, a kit for forming a concrete wall structure is provided. The kit includes first and second panel structures, the first and second panel structures configured to be positioned parallel relative to each other, each of the first and second panel structures including an inner surface and an outer surface extending to define a periphery, at least one of the first and second panel structures including pre-cut portions; multiple wall ties, each of the wall ties configured to be positioned and fastened between the first and second panel structures so that the first and second panel structures extend parallel relative to each other; and conduit configured to be supported by and positioned along the wall ties and between the first and second panel structures. In another embodiment, at least a portion of the conduit is configured to extend through a pre-cut portion of the at least one of the first and second panel structures.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

To further clarify the above and other advantages and features of the present invention, a more particular description of the invention will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. It is appreciated that theses drawings depict only typical embodiments of the invention and are therefore not to be considered limiting of its scope. The invention will be described and explained with additional specificity and detail through the use of the accompanying drawings in which:

FIG. 1 is a perspective view of an assembled tie system and concrete wall with portions removed, according to one embodiment of the present invention;

FIG. 2 is a perspective view of an unassembled base tie and wall tie, according to an embodiment of the present invention;

FIG. 2A is a top view of a first end portion of the base tie, according to the present invention;

FIG. 2B is a perspective view, from a right rearward side of a lower attachment portion of the wall tie depicted in FIG. 2, according to the present invention;

FIG. 3 is a perspective view of an assembled base tie and wall tie, according to the present invention;

FIG. 3A is a cross-sectional view, taken along line A, of an interconnection between the base tie and the wall tie, according to the present invention;

FIG. 4 is a perspective view of a typical concrete footing with base ties positioned thereon, according to one embodiment of the present invention;

FIG. 5 is a perspective view of the footing with a first course of wall ties attached to base ties on the footing with horizontal rebar positioned over the wall ties, according to the present invention;

FIG. 6 is a perspective view of the footing with multiple tie stacks and horizontal rebar therewith, according to an embodiment of the present invention;

FIG. 7 is a perspective view of the footing with panel structures secured to the wall tie stacks and positioned between base ties and a finish ties, according to an embodiment of the present invention;

FIG. 8 is a perspective view of the top tie with an anchor bolt coupled thereto, according to one embodiment of the present invention;

FIG. 9 is a perspective view of the tie system, depicting additional support structure for such system, according to an embodiment of the present invention;

FIG. 10 is a side view of the additional support structure for the tie system depicted in FIG. 9, illustrating an additional top wall tie integrated with the tie system, according to another embodiment of the present invention;

FIG. 11 is a perspective view of another embodiment of additional support structure for a wall end, according to the present invention;

FIG. 12 is a perspective view of additional support structure for a wall corner, according to one embodiment of the present invention;

FIG. 13 is a perspective view of additional support structure for a wall corner, according to another embodiment of the present invention;

FIG. 14 is a perspective view of an exposed concrete wall after the panel structures are removed, depicting a covering and coating process of an exposed portion of the wall ties, according to an embodiment of the present invention;

FIG. 15 is a perspective view of the tie system being utilized over traditional metal concrete forms, depicting a clip member interconnecting the metal concrete forms to the tie system, according to an embodiment of the present invention;

FIG. 16 is cross-sectional view, taken along line A, of the tie clip member and a portion of the base tie, depicting the clip member fastened to metal concrete forms, according to the present invention;

FIG. 17 is a perspective view of a tie system between panel structures, with portions removed, for forming a wall for a swimming pool, depicting the tie system being used along a curved footing to form a curved wall, according to one embodiment of the present invention;
FIGS. 18 and 19 are respective exploded and assembled perspective views of some of the components of the tie system, according to another embodiment of the present invention;

FIG. 20 is a top view of a footing with a radius, depicting multiple base members and wall ties positioned on the footing, according to another embodiment of the present invention;

FIG. 20A is a cross-sectional view taken from segment 20A of FIG. 20, depicting one of the base portions being bendable over a side of the curved footing, according to another embodiment of the present invention;

FIG. 21 is a perspective view of a base member for a tie system, depicting base portions and a wall tie having a unitary seamless structure, according to another embodiment of the present invention;

FIG. 22 is a perspective view of a base member for a tie system, depicting the base tie and wall tie of FIG. 3 having a unitary seamless structure, according to another embodiment of the present invention;

FIG. 23 is a perspective view of a tie system between panel structures, with portions removed, for forming a wall with a radius, according to one embodiment of the present invention;

FIG. 24 is a partial cross-sectional side view of a tie system secured to a building structure, depicting a wall tie stack positioned above an existing concrete wall, according to another embodiment of the present invention;

FIG. 24A is a side view of a wall tie stack, depicting some wall ties coupled together and some wall ties prior to being coupled together, according to another embodiment of the present invention;

FIG. 25 is a partial cross-sectional side view of a tie system secured to framing of a building structure, depicting a juncture between an upper portion of a wall tie stack extending vertically, an eave portion, and a lower portion of a wall tie stack extending transversely for forming a roof structure, according to another embodiment of the present invention;

FIG. 26 is a partial cross-sectional side view of a concrete portion of a building structure formed with the tie system, according to another embodiment of the present invention;

FIG. 27 is a partial cross-sectional side view of a tie system secured to an existing building structure, depicting a wall tie stack between panel structures coupled alongside an existing foundation wall, according to another embodiment of the present invention;

FIG. 28 is a perspective view of another embodiment of a tie system, depicting the tie system assembled with lower and upper tie assemblies configured to form a hot tub or spa, according to the present invention;

FIG. 29 is a top view of the tie system of FIG. 28, according to another embodiment of the present invention;

FIG. 30 is a perspective view of a wall tie stack, depicting vertically coupled wall ties and clips disengaged for coupling horizontally positioned wall ties, according to another embodiment of the present invention;

FIG. 30A is an enlarged perspective view of one of the clips, according to another embodiment of the present invention;

FIG. 31 is an exploded perspective view of components of a lower wall tie form, according to another embodiment of the present invention;

FIG. 32 is an exploded perspective view of four assembled lower wall tie forms, according to another embodiment of the present invention;

FIG. 33 is a perspective view of the lower tie assembly, depicting each of the four lower wall tie forms fastened together, according to another embodiment of the present invention;

FIG. 34 is a perspective view of the lower tie assembly, depicting housing components and conduit portions positioned with the lower tie assembly, according to another embodiment of the present invention;

FIG. 35 is a perspective view of a portion of the tie system, depicting the lower tie assembly with a first upper wall tie form fastened to the lower tie assembly, according to another embodiment of the present invention;

FIG. 36 is a perspective view of a portion of the tie system, depicting the lower tie assembly with first and second wall tie forms fastened together to and the lower tie assembly, according to another embodiment of the present invention;

FIG. 37 is a perspective view of the upper tie assembly fastened to the lower tie assembly, according to another embodiment of the present invention;

FIG. 38 is a perspective view of a hardened pourable material formed into a wall structure, depicting the panel structures removed from the tie system to expose the wall structure, according to another embodiment of the present invention;

FIG. 39 is a front perspective view of corner portions of a tie system configured to form a swim pool, depicting disengaged lower and upper corner portions of the tie system, according to another embodiment of the present invention;

FIG. 40 is a front perspective view of the lower and upper corner portions of the tie system fastened together, according to another embodiment of the present invention;

FIG. 41 is a rear perspective view of the lower and upper corner portions of the tie system of FIG. 40, according to another embodiment of the present invention;

FIG. 42 is a perspective view of a lower wall portion and a feature of the tie system for the swimming pool, according to another embodiment of the present invention;

FIG. 43 is a perspective view of an upper wall portion fastened to the lower wall portion, according to another embodiment of the present invention; and

FIG. 44 is a perspective view of a hardened pourable material formed into a portion of a wall structure, depicting the panel structures removed from the tie system to expose the wall structure, according to another embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring first to FIG. 1, there is disclosed a partial view of a tie system 20, according to the present invention. The primary components of the tie system 20 comprise a base tie 30 and a wall tie 90. As will be set forth herein, the base tie 30 and wall tie 90 are utilized as support structure in conjunction with panel structures 150, such as typical plywood or Form ply, to build concrete forms for forming concrete walls for various residential and commercial buildings.

Such a tie system 20 includes multiple base ties 30 and multiple wall ties 90. The base ties 30 are placed and secured, in a spaced apart arrangement, to a concrete footing 10. Each base tie 30 receives a stack of wall ties 90 configured to extend in a vertical arrangement to form a tie stack 160.
Each of the wall ties 90, within a stack, are configured to be directly interconnected together and configured to extend vertically, one above another. After running a first course of wall ties 90, horizontal rebar 162 can be run along a cross-member 110 of the wall ties 90, after which, additional courses of wall ties 90 can be built upon each other, running horizontal rebar 162 as needed, until the tie stacks 160 are built to the desired height. Once the tie stacks 160 are complete, panel structures 150 can be placed along each side of the tie stacks 160 in a parallel fashion and secured thereto. In addition, a finish tie 170 is provided to be positioned over the panel structures 150. Concrete can then be poured between the parallel panel structures 150 and into the tie system 20. Once the concrete wall 17 has set, the panel structures 150 can then be removed and utilized for another tie system or for other purposes for the structure being built upon the concrete foundation. As readily understood by one of ordinary skill in the art, the tie system 20 of the present invention provides advantages of being low in material cost and is time efficient for forming concrete walls for both residential and commercial dwellings.

It should be noted that the tie system is described herein as a concrete wall forming system due to concrete typically being used in the art for foundation walls. However, the tie system of the present invention is not limited to concrete, but rather, the tie system can be employed with any hardenable liquid building material, including but not limited to, typical concrete, various cement and/or concrete composites, (i.e., fiber reinforced cements, polymer composite cements), lightweight type cements or concrete, or any other suitable pourable and curable building material known in the art that will meet the structural integrity requirements for a given structure. Furthermore, as can be appreciated by one of ordinary skill in the art, the tie system of the present invention can be employed to form above ground level walls as well as foundation walls. In addition, it is intended that the term footing can mean any stable structure the base tie of the present invention can be mounted or secured to, such as, a concrete footing or even traditional concrete forms.

Now referring to FIG. 2, there is disclosed an enlarged unassembled view of the base tie 30 and the wall tie 90, according to an embodiment of the present invention. Such a base tie 30 and wall tie 90 include structural features that allow the tie system to be placed under maximum loads while pouring the concrete while still maintaining the structural integrity within the tie system. The base tie 30 and wall tie 90 are ideally made from a semi-rigid or substantially rigid polymeric material, such as high density polyethylene. Other polymeric materials can also be used, such as, polypropylene, polycarbonate, acrylonitrile butadiene styrene or polyamide or any other suitable polymeric material known to one of ordinary skill in the art. Further, such base tie 30 and wall tie 90 can be manufactured using molds with an injection molding process, or any other suitable manufacturing method, such as mold casting or machining, as known in the art.

First referring to the base tie 30, such a base tie can include an upper side 32, a bottom side 33, a front side 34, a back side 35, a left side 36 and a right side 37, the upper side 32 configured to face upward and the bottom side 33 configured to be positioned, face down, against a top surface of a concrete footing 10 (FIG. 1). The base tie 30 can include a first end portion 50 and a second end portion 52 with an intermediate portion 40 extending therebetween. In one embodiment, the first end portion 50 and the second end portion 52 can each be an extension of the intermediate portion 40, on opposite sides thereof, along a longitudinal length of the base tie 30. Furthermore, the intermediate portion 40 can be a generally elongated portion in comparison to the first end portion 50 and the second end portion 52. The intermediate portion 40 can also include rails 42 extending upward at the upper side 32 of the intermediate portion 40 to, thereby, define a recess 44 in the upper side 32 of the intermediate portion 40. The rails 42 can extend longitudinally along the length of the upper side 32 of the intermediate portion 40, of which the rails can define the front side 34 and back side 35 of the intermediate portion 40. The bottom side 33 of the base tie 30 is preferably substantially planar or flat since, as previously set forth, the bottom side 33 is sized and configured to be secured to the top surface of the concrete footing.

The recess 44 defined in the upper side 32 of the intermediate portion 40 can include various openings, including a center hole 46, extending through the upper side 32 to the bottom side 33 of the intermediate portion 40. The center hole 46 can be sized and configured to secure the base tie 30 to the concrete footing 10 (FIG. 1). The other openings can be utilized for minimizing the material required while maintaining structural integrity in the base tie as well as for other purposes set forth more fully herein. In one embodiment, the intermediate portion 40 also can include a bulge 48, defined in part by the rails 42, at a central portion thereof sized and configured to maintain the structural integrity of the base tie 40 as well as allow for a hammer head to nail a concrete nail through center hole 46 to minimize potentially hitting the rails while hammering such concrete nail. As such, the bulge 48 is sized and configured larger than the typical hitting surface of a hammer head.

Referring now to FIGS. 2 and 2A, as previously set forth, the first end portion 50 and the second end portion 52 can extend from the intermediate portion 40 of the base tie 30. The first end portion 50 can be substantially identical or similar to the second end portion 52. In particular, such end portions can each include an attachment portion 54 and a support wall 70. The attachment portion 54 and support wall 70 both extend upward at the upper side 32 of the base tie 30 and define a channel 80 therebetween. Each attachment portion 54 can include a first attachment portion 60 and a second attachment portion 62 that extend upward and laterally between the front side 34 and back side 35 of the base tie 30. The first attachment portion 60 can be closer to the end or right side 37 of the base tie 30 than the second attachment portion 62. Likewise, the first attachment portion 60 on the left side 36 of the base tie 30 can be closer to the left side 36 than the second attachment portion 62. Further, the attachment portion 54 can be unitary in structure with a mid portion 64 interconnecting the first attachment portion 60 and the second attachment portion 62, of which the mid portion 64 extends longitudinally with the base tie 30. As such, the first attachment portion 60 and the second attachment portion 62 extend laterally across each of the first and second end portions 50 and 52 in an offset manner with the mid portion 64 extending longitudinally therebetween.

In addition, each attachment portion 54 can include one or more protrusions 66 sized and configured to lock or attach to the wall tie 90. In one embodiment, the attachment portion 54 on the right side 37 can include a protrusion 66 on the inner surface of the first attachment portion 60 and a protrusion 66 on the outer surface of the second attachment portion 62. Likewise, on the left side 36 of the base tie 30, the
first attachment portion 54 can include a protrusion 66 on the inner surface and a protrusion 66 on the second attachment portion 62 on the outer surface of the attachment portion 54. Such protrusions 66 on the attachment portion 54 are sized and configured to interconnect and removably lock with the wall tie 90, of which further explanation will be provided for the interconnection hereafter.

[0092] Each of the first end portion 50 and the second end portion 52 can also include a support wall 70. The support wall 70 can include an inner surface 72 and an outer surface 74, extending upward and between the front side 34 and back side 35 of the base tie 30. The support wall 70 can include additional supports 76 extending from the outer surface 74 of the support wall to provide additional structural integrity to the support wall. Such additional supports can extend, for example, from an intermediate height of the outer surface 74 of the support wall 70, angling downward toward a corresponding end of the first end portion 50 and the second end portion 52. Further, the additional supports 76 can define a portion of the front side 34 and back side 35 of each of the respective first and second end portions 50 and 52 of the base tie 30. As previously set forth, the upward extension of the both the support wall 70 and the attachment portion 54 define a channel 80 in each of the first end portion 50 and the second end portion 52. Such a channel 80 extends (lateral to the longitudinal length of the base tie 30) between the front side 34 and back side 35 of the base tie 30 at each of the first end portion 50 and the second end portion 52. Further, the channel 80 is sized and configured to receive and support a panel structure 150 (FIG. 1), such as plywood or Form ply, as previously set forth. Furthermore, the support wall 70 can define a channel slot 81, extending through the support wall 70, sized and configured to receive a fastener therethrough. In other words, such channel slot 81 can be configured to facilitate fastening the panel structure within the channel 80 and, thus, to the base tie 30.

[0093] Now with reference to the wall tie 90 of the tie system 20, the wall tie 90 includes an upper side 92, bottom side 93, a front side 94, a back side 95, a right side 96 and a left side 97. Further, such a wall tie 90 can include a first elongated wall portion 100 and a second elongated wall portion 102 with a cross-member 110 extending therebetween. The first elongated wall portion 100 includes an outer surface 104 and an inner surface 105, the outer surface 104 defining, at least in part, the right side 96 of the wall tie 90. Likewise, the second elongated wall portion 102 includes an outer surface 106 and an inner surface 107 with the outer surface 106 defining, at least in part, the left side 97 of the wall tie 90. The outer surfaces of the first and second elongated wall portions 100 and 102 can be substantially flat and sized and configured to be positioned against and secured to the panel structure 150, the panel structure also being positioned in the channel 80 of the base tie 30, as previously set forth.

[0094] Furthermore, the first and second elongated wall portions 100 and 102 include an intermediate wall portion 108 with an inner surface that can be raised. Such raised surface can be thicker than the remaining portions of both the first and second elongated wall portions 100 and 102. Further, such intermediate wall portion 108 is sized and configured to be secured to the panel structures with fasteners and is, therefore, configured to be thicker to increase the structural integrity for such attachment. In addition, the intermediate wall portion 108 for each of the first and second elongated wall portions 100 and 102 can include and define holes 109 extending between the front side 94 and back side 95 of the wall tie 90. Such holes 109 defined in each intermediate wall portion 108 of the wall tie 90 limits the amount of material necessary for the structural integrity of the wall tie while also adding structural thickness for being secured to the panel structures.

[0095] As previously set forth, the first and second elongated wall portions 100 and 102 are interconnected by a cross-member 110. The cross-member 110 can extend from respective inner surfaces of the first and second elongated wall portions 100 and 102 at one or more locations. In particular, the cross-member 110 can include upper beams 112, a mid beam 114 and a lower beam 116 with multiple struts 118 interconnecting such upper, mid and lower beams. The upper beams, mid beam and lower beam can extend from respective upper, mid and lower portions of the inner surface of the intermediate wall portion 108 of both the first and second elongated wall portions 100 and 102. According to this arrangement, the cross-member 110, including the multiple beams and struts, are sized and configured to provide the structural integrity necessary to withstand the concrete loads placed thereon.

[0096] Furthermore, the cross-member 110 can include multiple rebar holders. In particular, the cross-member 110 can include a center rebar holder 120 with a right rebar holder 122 and a left rebar holder 124 positioned above the center rebar holder 120. The center rebar holder 120 is defined at a juncture between the upper beams 112 of the cross-member 110 with a u-shaped configuration. The upper beams can include cross-member extensions 126, extending upward, to define each of the center, right and left rebar holders 120, 122 and 124 each having a u-shaped configuration. Of course, such rebar holders can include other configurations with means for maintaining rebar. With such an arrangement, rebar can be readily placed within one or more of the u-shaped configurations for substantially exact rebar placement and positioned in a time efficient manner. Each of the center rebar holder 120 and right and left rebar holders 122 and 124 can be configured with structure to attach and hold the rebar, with an interference type fit, in position or can be configured to allow the rebar to rest within the various u-shaped configurations.

[0097] In addition, the center rebar holder 120 can be sized and configured to receive both ½" diameter and 5/8" diameter rebar, the ½" diameter rebar held in a lower portion of the center rebar holder and the 5/8" diameter rebar held in an upper portion with a ridge 121 defined therebetween. That is, the ridge 121 defines an upper edge of the lower portion sized for the ½" diameter rebar and the ridge 121 defines a lower edge of the upper portion sized for the 5/8" diameter rebar. Further, the center rebar holder 122 can include a rebar groove 123 defined at a bottom of the center rebar holder 122. Such rebar groove 123 is sized and configured to receive a raised seam on the periphery of rebar and, in this case, the ½" diameter rebar. The right and left rebar holders 122 and 124 are sized and configured to receive ½" diameter rebar therein each including a rebar groove defined therein.

[0098] According to an important aspect of the present invention, each of the first and second elongated wall portions 100 and 102 can include a lower attachment portion 130 and an upper attachment portion 140. The lower attachment portion 130 of the wall tie 90, located at a lower portion of each of the first and second elongated wall portions 100 and 102, can be sized and configured to attach and interconnect or interlock (in a removable manner) to the attachment portion
of a respective and corresponding first and second end portion 50 and 52 of the base tie 30. The upper attachment portion 140 of each of the first and second elongated wall portions 100 and 102 can be sized and configured to substantially mimic the attachment portion 54 of the base tie 30 so that additional wall ties 30 can be stacked vertically upon each other to, thereby, build the wall ties 30 to the approximate desired height for the concrete wall form.

With respect to FIGS. 2 and 2B, there is disclosed the lower attachment portion 130 of the wall tie 90. Each lower attachment portion 130, extending from the first and second elongated wall portions 100 and 102, can include a first lower attachment portion 132 and a second lower attachment portion 134. The first and second lower attachment portions 132 and 134 can be configured to extend downward from the respective elongated wall portion and define a gap 136 therebetween. Further, the first lower attachment portion 132 can be laterally offset with respect to the second lower attachment portion 134 sized and configured to correspond with the offset arrangement of the attachment portion 54 of the base tie 30 (See also, FIG. 2A). Further, the first lower attachment portion 132 for both the first and second elongated wall portions 100 and 102 can include a groove 138 that extends laterally within the outer surface of the first lower attachment portion 132. Similarly, the second lower attachment portion 134 for both the first and second elongated wall portions 100 and 102 also can include a groove 138 that extends laterally within the inner surface of the second lower attachment portion 134. In addition, each of the first and second lower attachment portions 132 and 134 can include a tapered free end 142 so as to allow ready insertion and attachment of the wall tie 90 to the base tie 30.

With reference now to FIGS. 3 and 3A, there is illustrated the wall tie 90 assembled with the base tie 30. More particularly, the first and second lower attachment portion 132 and 134 of each of first and second elongated wall portions 100 and 102 are sized and configured to mate and interconnect with a respective one of each of the first and second attachment portions 60 and 62 of each of first and second end portion 50 and 52 of the base tie 30. Further, the groove 138 within the first and second lower attachment portion 132 and 134 is sized and configured to mate and interconnect with the protrusion 66 of the first and second attachment portion 60 and 62 of the base tie 30 to, thereby, provide a locking arrangement. In this manner, the offset and gapped arrangement between the first and second lower attachment portion 132 and 134 of the wall tie 90 readily interconnects and attaches to the offset and unitary arrangement of the attachment portion 54 (having a respective first and second attachment portion 60 and 62) of the base tie 30. As such, the wall tie 90 is configured to attach and interconnect with the base tie 30.

Further, as previously set forth, the wall tie 90 includes an upper attachment portion 140 that mimics the structure of the attachment portions 54 of the base tie 30. As such, the lower attachment portions 130 of a second wall tie 90 can attach and interconnect with the upper attachment portion 140 of a lower wall tie 90 therebelow to, thereby, facilitate vertically building a stack of wall ties 90 upon a single base tie 30 to the desired height of the concrete wall form (See FIG. 1).

Based on the foregoing, the tie system of the present invention is advantageous in comparison to the prior art concrete form systems due to the tie system comprising primarily two components, the base tie and the wall tie. Such two components in the tie system inherently provides advantages of being compact for shipping purposes, minimizing the risk of damaging the components during shipping and even while building the concrete forms. Further, due to the compact and light nature of the tie system with primarily two components, installing the tie system to build the concrete forms is less laborious than prior art concrete form systems with minimized complexity. Moreover, the tie system of the present invention includes greater cost and time efficiency in regard to manufacturing, shipping and assembling such tie system.

With respect to FIGS. 4 through 14, the process and method for assembling the tie system to build concrete forms, according to an embodiment of the present invention, will be now be described. Referring first to FIG. 4, there is disclosed a step for securing the base tie to a concrete footing 10 with a corner. The footing 10 can first be marked with a chalk line on a top surface 12 thereof, marking the position for an outside perimeter 152 and inside perimeter 154 of the concrete wall. Such marked chalk line should correspond with the desired concrete wall thickness 156. Likewise, the base ties and wall ties employed should correspond with the desired concrete wall thickness, sized, but not limited to, according to the most typical concrete wall thicknesses of about 8", 6" or 4" thick concrete walls. Once the chalk lines are marked, placement of the first base tie 30 can be measured a first length L1 from the inside corner chalk line for the concrete wall. Such first length L1 can be preferably about 3" from the inside corner chalk line. Placement of the other base ties 30 along the length of the footing 10 can be spaced a second length L2, separate and distinct from each other. The last base tie 30 along the length of the footing 10, whether at an end or a corner, can be measured the first length L1 (approximately 3") from such end or corner. The same procedure can be followed along the other length of footing 10 from the inside corner chalk line, as depicted.

The second length L2 in which the base ties 30 are spaced can vary upon parameters, namely (but not limited to), the thickness of the panel structure and the height of the concrete wall. The thickness of a panel structure that can be employed with the present invention can include, but is not limited to, 1/4", 1/2", 5/8", 3/4", 3/8" or 1" thickness. When using typical plywood, the preferred parameters are as follows: For a one to two foot concrete wall height utilizing a plywood thickness between 1/4" to 1/2" thick, the spacing for the second length L2 is preferably a maximum of about twenty-four inches. If the wall height is 2 1/2 feet, the spacing for the second length L2 is a maximum of about nineteen inches utilizing plywood at 1/4" or 1/2" thick and a maximum of about twenty-four inch spacing for plywood 5/8" through 1 1/4" thick. Further, if the wall height is three feet, the spacing for the second length L2 is a maximum of about sixteen inches with a 1/4" or 1/2" thick plywood and a maximum of about twenty-four inch spacing for 5/8" through 1 1/4" thick plywood. If the wall height is 3 1/2 feet, the spacing for the second length L2 is a maximum of about twelve inches utilizing plywood at 1/4" or 1/2" thick, and a maximum of about a 19 inch spacing for plywood at 1/4" or 5/8" thick, and about a maximum of about twenty-four inch spacing using plywood at 1 1/4" through 1 1/8" thick. For a wall height of four feet, the spacing for the second length L2 is a maximum of about sixteen inches with 1/4" or 1/2" thick plywood and a maximum of about twenty-four inch spacing using 1 1/4" through 1 1/8" thick plywood. Further, it should be noted that it is preferred to utilize typical plywood having a thickness greater than 1/2"
for a wall height of four feet. Again, as set forth, the above-indicated parameters relate to the panel structure being typical plywood. When using Form ply, it is preferred to utilize 1/2" thick panels for any wall height up to ten feet. The preferred panel structures employed that are rated as Form ply are typically high density overlay ("HDO") plywood or medium density overlay ("MDO") plywood. Other suitable panel structures, as known to one of ordinary skill in the art, can also be employed with the tie system of the present invention.

[0104] For accurate placement and alignment, the base tie 30 can include a notch 82 at the inside edge of each channel (See FIG. 2A). Such notch 82 is configured to be aligned and correspond with the inside perimeter 152 and outside perimeter 154 chalk lines marked on the footing 10. Once the base ties 30 are placed with their respective notches 82 aligned with the chalk lines and at the correct spacing as set forth above, such base ties 30 should be secured to the footing preferably with a 1-1/2" concrete nail 158. Such nail 158 can be nailed through the center hole 46 in the base ties 30. If desired, additional concrete nails can be run through other portions, preferably within an interior portion, of the base tie 30 to ensure securing the base tie to the footing 10 while also making sure the notches remain aligned with the chalk lines with the base tie extending perpendicular to the chalk lines.

[0105] With reference to FIGS. 5 and 6, there is disclosed a step for building tie stacks 160 of the tie system 20 on the concrete footing 10 with horizontal rebar 162, according to the present invention. In particular, once the base ties 30 are properly secured, a first course of wall ties 90 can be attached to the base ties 30. Such attachment is readily employed by mating the lower attachment portions 130 of a given wall tie 90 with the attachment portion 54 of the base tie 30, as previously set forth herein (See FIGS. 2 and 3). After attachment of the first course of wall ties 90 is complete, it is necessary to determine the desired height for horizontal rebar 162 placement. Typically, it is advantageous and required by code to run a lower level of horizontal rebar 162. As such, once the first course of wall ties 90 are placed, horizontal rebar 162 can be run by placing the rebar within the center rebar holder 120. Each of the rebar holders are sized and configured to maintain the rebar, with accurate positioning and with an interference fit. At the center rebar holder 120 level, the horizontal rebar will be approximately 2-1/2" above the footing. If a slightly different height is required, rebar can be placed along the right or left rebar holders 122 and 124 in each wall tie 90 or rebar can be tied off at different heights along the various portions of the wall tie or tied to the vertical rebar 14. If the design requirements call for two horizontal rebar, such rebar can be positioned in both the right and left rebar holders 122 and 124.

[0106] Once the horizontal rebar 162 is positioned along the first course of wall ties, additional wall ties can be added to each stack to the height necessary for running another length of horizontal rebar 162. In other words, depending on the required vertical spacing of the horizontal rebar, the appropriate number of wall ties 90 can be pre-assembled to achieve the desired vertical spacing of such horizontal rebar 162. For example, each wall tie 90 can represent about six inches of vertical height. If your intended rebar spacing between horizontal rebar is twenty-four inches apart, then pre-assemble four wall ties and attach such pre-assembled wall ties to each tie stack before running a second length of horizontal rebar 162. Once such rebar is positioned as desired, additional wall ties 90 can be stacked vertically for each tie stack to the desired height. It should be noted that tie stacks are complete within about five inches of the intended height of the concrete wall. For example, for an intended wall height of three feet, a total of five wall ties will make a complete tie stack 160 with the base tie 30 at the bottom (representing about one inch) providing about five inches below the intended wall height of three feet. As will be readily understood by one of ordinary skill in the art, the ability to internally build the tie stacks 160 with the horizontal rebar 162 prior to positioning the panel structures thereto, as set forth above, provides for quick and ready assembly of the tie system 20, and therefore provides advantages over the prior art in reducing complexity to, thereby, be more time and cost efficient.

[0107] Referring now to FIG. 7, there is disclosed a step for attaching the panel structures 150 of the tie system 20 with a finish tie 170, according to the present invention. In particular, panel structures 150 can now be placed within the channel 80 on each side of the base ties 30 so that the panel structures run parallel to each other with each tie stack 160 substantially oriented perpendicular to the panel structures 150, as illustrated. As previously set forth, to ensure optimal concrete walls, i.e., plum and straight, it is important that the thickness and the type of panel structures 150 correspond with the intended wall height and the spacing of the tie stacks, as previously set forth. Further, it is necessary to make sure the seams 164 or butt joints between the plywood panel structures 150 do not correspond with the tie stacks 160. Once such panel structures 150 are placed, base ties can be inverted and placed over a top portion 166 of the panel structures 150 with such top portion 166 positioned and received within the channels of each inverted base tie. The inverted base tie is referred to herein, according to one embodiment, as a finish tie 170. Such finish tie 170 can be configured to interconnect directly to the panel structure 150.

[0108] With reference to FIGS. 7 and 8, the finish tie 170 includes various sized holes extending through the intermediate portion 174 of such finish tie 170. In particular, there is a pair of 3/8" diameter holes 176 and a pair of 5/8" diameter holes 178. These holes can be configured to receive and hold an anchor bolt 180. As shown, the anchor bolt 180 can be positioned within one of the holes and secured for subsequent anchoring structure to the top surface of the concrete wall (not shown). For concrete walls having a thickness of 8", the outer holes are center line placement for 2x4 plates and the inner holes are center line placement for 2x6 plates. As such, employing the anchor bolt 180 with the finish tie 170 will provide substantially perfect placement of the anchor bolts 180.

[0109] Like the base tie 30, the finish tie 170 can include a first end portion 175 and a second end portion 177 with the intermediate portion 174 extending therebetween. Each of the end portions can define channels 172 therein sized and configured to be positioned over and receive the panel structures 150. Further, channel slots 182 defined in each of the end portions can be employed to fasten the finish tie 170 to the panel structures 150. It should be noted that it is not required to fasten the finish tie 170 to the panel structures 150.

[0110] Once the panel structures 150 are positioned within the channels 80 of the base ties 30 and further, the channels 172 of the finish ties 170 are also positioned over the panel structures 150, fasteners 184, such as screws, can be inserted through the panel structures 150 and through the wall ties 90.
Placement of such fasteners should correspond with the first and second elongated wall portions 100 and 102 of each wall tie 90 and, more specifically, the intermediate wall portion 108 (See FIG. 2) where the wall tie 90 is thicker than other portions of the wall tie. For more accurate and efficient screw placement, it is preferred to make a template or tool to mark the position for placing screws in the plywood panel structure 150. As depicted in FIG. 7, it is preferred to place two screws through the panel structure 150 and within each side or intermediate wall portion 108 of the wall tie 90. In addition, at the seams 164 or butt joints of the plywood panel structure 150, additional reinforcement should be employed by fastening a scrap piece 186 of plywood over the seam 164 and securing such scrap piece 186 with two vertical rows of screws with about six inches on-center on each side of the seam 164.

FIGS. 9 through 13 disclose additional supporting structures that can be built around the form of the tie system 20 of the present invention. Such additional support structures can be built-up around seem, potential weak portions in the forms or portions that will receive greater loads to ensure the forms will maintain their structural integrity when loaded with the concrete. Further, it is preferred to employ additional supporting structure for any wall height and is required for wall heights three feet and higher.

Referring to FIGS. 9 and 10, there is disclosed a lag whaler arrangement in conjunction with the tie system 20 of the present invention. In particular, a 2x4 whaler 190 extends along a bottom portion of both sides of the panel structures 150 with, for example, several ½" x 15" screws 192 extending laterally through both whalers 190. Such lag whaler arrangement provides additional support to the tie system 20 of the present invention where the forms receive the greatest load pressure, such as, while pouring the concrete with the use of a hydraulic pumping system, to ensure the width of the forms will remain substantially constant and stationary. Once the concrete is poured within the forms, it is important to remove the screws within one to three hours. Removing the lag whaler screws 192 after three hours can make such removal time consuming.

With reference to FIG. 10, there is disclosed additional supporting structure that is internal and integrated with the wall ties in the tie system 20 of the present invention. In particular, in one embodiment, the tie stack can include a top wall tie 290. Such top wall tie 290 is sized and configured to be positioned and attached to a lower wall tie 90 and is configured to be the highest tie that is directly interconnected to other ties in the tie stack in the tie system 20. The top wall tie 290 can include a similar profile as the wall tie 90, except the top wall tie 290 can extend approximately three to four inches in vertical height, rather than the six inches of the wall ties 90. As such, the top wall tie 290 can include a first elongated wall portion 292 and a second elongated wall portion 294 with a cross-member 296 extending therebetween. Further, the top wall tie 290 can include a lower attachment portion 298 at a lower end of each of the first elongated wall portion 292 and the second elongated wall portion 294. The lower attachment portion 298 of the top wall tie 290 is sized and configured to attach to the upper attachment portion 140 of the wall tie 90 (See FIG. 2). Such top wall tie 290 can provide internal support, in addition to the finish tie 170, to the tie system 20 at an upper portion of the panel structures 150. Similar to the wall ties, the top wall tie 290 is sized and configured to be disposed between the panel structures 150 and is configured to be fastened to and between the panel structures.

FIG. 11 discloses an end portion 22 of the tie system 20, according to another aspect of the present invention. Additional supporting structure can be built for end portions 22 by simply having an end sheet 194 of plywood be cut wider, such as about three inches wider, than a width 196 of the parallel plywood panel structures 150 and securing two 2x4 beams 198 vertically to an inside edge 202 of the wider end sheet 194, as depicted.

Referring now to FIG. 12, additional supporting structure can also be employed for outside corners 24 of the tie system 20, according to the present invention. In particular, for an outside corner 24, one of the panel structures can extend a longer length 204, such as about three inches, and then fasten a 2x4 beam 206 vertically to both intersection panel structures 150, as depicted. If one cannot extend the plywood panel structure 150 longer a given distance, the corner can be wrapped with two 2x4 beams 208 extending vertically, as depicted in the outside corner 24 of the tie system 20 in FIG. 13. For inside corners, no additional support is needed up to a three foot wall height. For inside corners taller than three feet, the outside corner detail can be inverted by fastening a 2x4 beam vertically to the two intersecting inside corner panels.

FIG. 13 also discloses another embodiment for attaching additional supporting structure along a length of an upper portion of the tie system 20 to keep the wall straight and plumb, according to another aspect of the present invention. In particular, additional support structure can be provided to the concrete form by securing 2x4 beams 210 horizontally along an upper portion of the concrete forms and positioning beams 212 to extend between the ground and the horizontally extending beams in a diagonal manner, as depicted.

Referring now to FIG. 14, there is disclosed a step for covering and coating an exposed portion of the wall ties in an exposed and hardened concrete wall 17, according to another aspect of the present invention. Once the forms have been built and provided the proper supporting structure, the concrete can be poured between the forms and left to set, and, as previously set forth, within one to three hours, the screw from the lag whaler arrangement can be removed from the forms. Once the concrete is completely set, the forms can be removed, including the additional support structure, the panel structures and the finish ties. According to another advantageous aspect of the present invention, the panel structures and finish ties can then be re-used for another tie system or the panel structures can be employed for other portions of the residential or commercial building, such as for the roof or sub-floor. Therefore, the tie system of the present invention limits the waste of lumber and maximizes the use of materials.

As shown, a top portion 19 of the hardened concrete wall 17 can include an exposed portion of the anchor bolts 180 ready to receive the bottom portion of the structure (not shown) to be built thereon. Also, once the panel structures are removed, the outer surface of the wall ties 90 will be exposed on the concrete wall 17 along with a portion of the end portions of the base tie 30. To cover this exposed portion of the wall tie 90, a self-adhesive tape 222 can be applied thereto, such as a mesh tape. The self-adhesive tape 222 can then receive a base coat product 224. The base coat product can be any suitable exterior insulation finishing system ("E.I.F.S.")
type product, such as, DRYVIT, PAREX, SYNERGY or FINESTONE products. This will provide a bridge over the exposed wall ties that provides a surface that can be plastered over or receive a water proofing product as typically employed on foundation walls.

Furthermore, in another aspect of the present invention, once the panel structures are removed from the hardened concrete wall 17, the exposed portion of the wall ties 90 can be used as anchoring points for other building materials. In particular, such exposed portion of the wall ties 90 in the concrete wall can be employed as a substrate to anchor a polymeric insulation building material thereto. The portion best suited to anchor into is the intermediate wall portion 108 being sized and configured thicker than other portions of the elongated wall portions (See FIG. 2). Polymeric building materials can include, but are not limited to, high density polyurethane foam, or any other suitable polymeric foam or building material typical to that used in insulation concrete forms. Of course, the exposed portion of the wall ties 90 can also be used to anchor other types of materials as well. In this manner, the tie system of the present invention can be employed to form concrete walls and obtain the advantages of an insulated wall without the high cost of the insulation concrete form systems.

FIGS. 15 and 16 disclose another embodiment of the tie system 20 in conjunction with a clip member 250, according to the present invention. In particular, there is disclosed a clip member 250 that can be integrated with the base tie 30 of the present invention and attach to a top surface 242 of traditional metal forms 240. Such a clip member 250 can be employed with the tie system 20 of the present invention for increasing the height for a concrete wall than that which is available for a given metal form system.

The clip member 250 can include a form attachment portion 252 and a tie attachment portion 254. The form attachment portion 252 is sized and configured to attach to a portion, such as a top surface 242, of the metal forms 240. The form attachment portion 252 can include a first extension portion 262, a wrap portion 264 and a free end 266. The first extension portion 262 can be configured to extend outward from the tie attachment portion 254 to the wrap portion 264. The wrap portion 264 can be sized and configured to wrap around an edge 244 at the top surface 242 of the metal form 240. The free end 266 extends from the wrap portion 264 and can include a tapered lip 268. At an underside of the first extension portion 262, there is defined a recess 269 or groove configured to receive the edge 244 of the metal form 240 in conjunction with the wrap portion 264. With this arrangement, the clip member 250 can be ready attached to the edge 244 of the metal form by pulling and sliding the tapered free end 266 under the edge 244 and into the wrap portion 264 until the recess 269 of the first extension portion 262 engages such edge 244.

Now with reference to the tie attachment portion 254 of the clip member 250, such tie attachment portion 254 can be sized and configured to attach to a clip hole 53 in an end portion 51 of the base tie 30. The tie attachment portion 254 can include a second extension portion 270 with a clipping portion 274 extending upward therefrom and a lower portion 272. The second extension portion 270 is sized and configured to be disposed between a top surface 242 of the metal forms 240 and below the base tie 30. The clipping portion 274 can be sized and configured to extend through the clip hole 53 defined in the end portion 51 of the base tie 30. The lower portion 272 below the second extension portion 270 can be disposed within a hole 246 defined in the top surface 242 of the metal forms 240. The clipping portion 274 can include two upward extending portions 276 each with a tapered free end 278 and a back-stop 279. As such, once the clip member 250 is properly positioned and attached to the metal forms 240, the base tie 30 can be aligned such that the clipping portion 274 is inserted through the clip hole 53 in the base tie 30. As such insertion takes place, the tapered free ends 278 of the upward extending portion 276 squeeze or move together until the clipping portion 274 is fully inserted. The back-stop portion 279 of each upward extending portion 276 maintains the base tie 30 in proper position. Another clip member 250 should also be employed, as previously set forth, for the opposite side of the base tie 30 and each base tie 30 along the length of the metal forms 240. In this manner, the clip member 250 can be utilized with the tie system 20 to achieve greater concrete wall heights than that which is available for a given metal form 240. It should be noted that the base tie, in this aspect of the present invention, is positioned over the concrete footing (not shown) and, more specifically, is positioned over and above the concrete footing while being secured to the metal forms 240.

Furthermore, the tie system of the present invention can also be employed over a top portion of traditional wood forms, similar to that depicted in the previous embodiment. However, according to another embodiment, the base tie 30 can be positioned over (and above) the footing and fastened to the top surface of traditional wood forms via a base securing hole 83 defined in each of the channels 80 of the first end portion 50 and the second end portion 52 of the base tie 30, as depicted in FIGS. 2 and 2A. As will be readily understood by one of ordinary skill in the art, the base tie 30 can be positioned and secured on the top surface of the traditional wood forms via base securing hole 83 and, then built upon with the tie system, as set forth herein.

With respect to FIG. 17, another embodiment of a tie system 320 utilized for forming a concrete wall 302 on a footing 304 made, for example, a swimming pool is shown. The tie system 320 of this embodiment may be employed in conjunction with a water stop 310. The water stop 310 may be positioned within a top surface 366 of the footing 304, extending lengthwise along a curvature of the footing 304 or along a linear footing, as the case may be. The water stop 310 may be positioned and embedded into the footing 304 before the footing is hardened and provides one means for preventing water from seeping between the footing 304 and the finished concrete wall 304. The water stop 310 may be about six to eight inches in height, but is not limited to such, with about half the height embedded into the footing 304. As such, the tie system 320 of this embodiment may be employed for walls where the water stop 310 is preferred, such as for forming walls of a swimming pool, a storm drain, or any other wall structure made to hold a liquid. Furthermore, it should be noted that the tie system 320 of this embodiment, as well as the tie system of the previous embodiments, such as the tie system depicted in FIG. 1, may be employed along a footing with a radius to form walls with a corresponding wall radius.

Similar to the previous embodiments, the tie system 320 may include base members 322 and wall ties 322 interconnected together to form multiple tie stacks 326 that are spaced apart and secured to and along the footing 304. The tie stacks 326 can be built in levels to readily facilitate laying or positioning rebar 329 over appropriate levels within the tie
stacks 326. With multiple tie stacks 326 secured to the footing 304, panel structures 328 can be secured to the tie stacks 326 and finish ties 330 may be secured to an upper end 332 of the panel structures 328. The panel structures 328, in the case of the curved footing, may be positioned and secured to the tie stacks 326 by bending or bowing the panel structures 328 as they are secured to the tie stacks 326. The panel structures 328 employed with the curved footing may be bendable plywood, masonite or plastic panels that will provide sufficient strength to act as a temporary form, but also may readily bow or bend, as known to one of ordinary skill in the art. At this stage, the hardenable building material, such as concrete or any other hardenable building material, can be poured between the panel structures 328. Once the hardenable building material has cured sufficiently, the panel structures 328 and finish ties 330 can be removed, leaving the newly formed concrete wall 302.

[0126] Referring now to FIGS. 18 and 19, some of the components of the tie system 320 depicted in FIG. 17 are shown in respective exploded and assembled views. This embodiment is similar, in most respects, to the embodiment depicted in FIG. 2, but with different base members 322. In one embodiment, the base members 322 may facilitate the tie system 320 being secured to the footing and assembled over the water stop 310 embedded in the footing 304 (see FIG. 17). Such base members 322 may include a first base portion 334 and a second base portion 336 and multiple wall ties 324. Also, the tie system 320 may include intermediate adapters 338.

[0127] The first base portion 334 and the second base portion 336 may be separate and discrete components from each other. That is, the first base portion 334 and the second base portion 336 may be discrete structures in the unassembled form, but may be configured to be interconnected once the wall tie 324 is attached to the first and second base portions 334, 336. Each of the first base portion 334 and the second base portion 336 may include a base extension 340 and one or more upstanding attachment portions 342 and a support wall 344. The base extension 340 may be configured to be secured to a footing and configured to extend horizontally against the footing with the upstanding attachment portions 342 and support wall 344 extending vertically from and relative to the footing and base extension 340. Such first and second base portions 334, 336 may be secured to the footing via concrete fasteners at the multiple holes 346 extending through the base extension 340.

[0128] The upstanding attachment portions 342 of the first and second base portions 334, 336 may be configured to connect or mate with the respective end portions of the wall tie 324, similar to previous embodiments. The support wall 344 may extend upward to the height of the upstanding attachment portion 342 or to a height beyond the upstanding attachment portion 342. The upstanding attachment portion 342 and the support wall 344 may define a channel 348 therebetween, the channel 348 sized and configured to receive a bottom end of the panel structures 328 (FIG. 17).

[0129] The wall tie 324 may be similar to the wall ties described in earlier embodiments, though, in part, interconnected differently. For example, in this embodiment, the wall tie 324 may be interconnected to the first and second base portions 334, 336 in an inverted manner such that two end portions 350 of the wall tie 324 mate with the respective upstanding attachment portions 342 of the first and second base portions 334, 336. As in the previous embodiments, the wall tie 324 may include a first elongated wall portion 352 and a second elongated wall portion 354 with a cross-member portion 356 extending therebetween. The end portions 350, of both an upper end and lower end of the wall tie 324, of each of the first and second elongated wall portions 352, 354 may be sized and configured to mate or interconnect with at least one of the first and second base portions 334, 336, another wall tie 324 and the intermediate adapter 338. In this embodiment, the wall tie 324 may be inverted such that the corresponding end portions 350 of the first and second elongated wall portions 352, 354 mate and attach with the attachment portions 342 of the first and second base portions 334, 336.

[0130] The intermediate adapters 338 may be connected to the end portions 350, on the upper end, of the first and second elongated wall portions 352, 354 of the inverted wall tie 324. Such intermediate adapters 338 may be employed to facilitate an additional wall tie 324 to be interconnected thereto, attachable in a non-inverted or upright manner. In this manner, additional wall ties 324 may be attached and stacked in an upright non-inverted orientation to vertically build the tie stack 326 to the height desired.

[0131] As in the previous embodiments, each tie stack 326 may include multiple wall ties 324, with the inverted bottom wall tie 324 secured to one or more base members 322 or, more specifically, the first and second base portions 334, 336. Each tie stack 326 extends vertically relative to the footing, curved or linear, with the first and second elongated wall portions 352, 354 for each wall tie 324 including a first flat surface 358 and a second flat surface 360, the first flat surface 358 facing directly opposite the second flat surface 360. Further, the first flat surface 358 and the second flat surface 360 of respective first and second elongated wall portions 352, 354 extend longitudinally vertical and perpendicular relative to the base members 322. It should also be noted that the intermediate adapters 338, interconnected between the inverted wall tie 324 and another wall tie that is upwards, also are configured to include a flat outward facing surface that may be flush and correspond with the first and second flat surfaces 358, 360 of the tie stack 326 may be configured to be directly secured to the panel structures 328, as depicted in FIG. 17. With this arrangement, the panel structures 328, secured to the first and second flat surfaces 358, 360 of each tie stack 326, provides the forms for pouring the hardenable building material, such as concrete, over the tie system 320 securing the panel structures 328, or forms, in position.

[0132] With respect to FIGS. 20 and 20A, multiple base members 322 and wall ties 324 positioned over a footing 304 with a radius 305 are depicted. The multiple base members 322 or first and second base portions 334, 336 of the tie system 320 are positioned in a spaced apart arrangement and oriented lengthwise to extend along and substantially align with the radius 305 of the footing 304. Further, the first and second base portions 334, 336 may be secured to the footing and spaced a distance from each other so that the attachment portion 342 can mate with the end portions 350 of the wall tie 324. To ensure appropriate spacing between the first and second base portions 334, 336, the inverted wall tie 324 may be attached to such base portions as the base portions 334, 336 are secured to the footing. Further, the first base portions 334 may be positioned such that the attachment portion 342 is adjacent to or aligns with an edge 307 of the footing 304 such that the channel 348 may partially extend over the edge 307 of.
the footing 304. In addition, the second base portion 336 may be aligned with the first base portion 334 a specific distance such that the attachment portions 342 will correspond with the end portions 350 of the wall tie 324. Further, the first base portion 334 and the second base portion 336 may be positioned on the footing such that the water stop 310 extends therebetween with the inverted wall tie 324 providing the clearance for the water stop 310. More specifically, in instances where the tie system 320 is utilized for forming walls for a swimming pool or the like, the water stop 310 may be positioned and embedded within the footing 304 with the first and second base portions 334, 336 on an inner and outer side of the water stop 310 so that each tie stack 326 is positioned over the water stop 310 (also seen in FIG. 17).

[0133] In another embodiment, the first base portion 334, as previously indicated, may hang over the edge 307 of the footing 304. The first base portion 334 may include a thinned portion 364. The thinned portion 364 may readily allow the over-hanging portion of the first base portion 334 to be bendable or moveable against a side wall 309 (or sloping surface) of the footing 304 and to be secured thereto, as shown by arrow 366. In this manner, the bottom end of the panel structures 328, as shown in FIG. 17, can be positioned substantially adjacent and flush with the edge 307 of the footing 304 and against the first and second elongated wall portions 352, 354 of the wall ties 324 so that the wall formed between the panel structures 328 sits flush and extends to the edge 307 of the footing 304.

[0134] Referring now to FIGS. 17, 19 and 20, each of the cross-member portions 356 of the tie stack 326 may extend generally in a common plane 368. Such common plane 368 of the cross-member portions 356 may be configured to be substantially perpendicular to the top surface 306 of the footing 304 (as well as the base extension 340 of each of the first and second base portions 334, 336) and substantially perpendicular to the first and second flat surfaces 358, 360 of the first and second elongated wall portions 352, 354 of the wall ties 324. With this arrangement, the substantially perpendicular relationship of the cross-member portions 356 (being generally in a common plane) in each tie stack 326 relative to the first and second flat surfaces 358, 360 and the top surface 306 of the footing 304 or base extensions 322 may maximize the structural integrity of the tie stack 326 when receiving the weight associated with the hanger building material, or concrete, between the panel structures 326.

[0135] With respect to FIG. 21, another embodiment of a base member 380 for a tie system is shown. In particular, the base member 380 of this embodiment includes a first base portion 382, a second base portion 384 and a wall tie portion 386, each integrally formed together in a unitary and seamless arrangement. Other wall ties and/or intermediate adapters (not shown), such as the upright wall tie and intermediate adapters depicted in FIG. 18, may then be attached to upper end portions 388 of the wall tie portion 386. With this arrangement, the base member 380 may be positioned and secured over a concrete footing (not shown) to establish a base for a tie stack, then additional wall ties may be attached to the base member and vertically stacked to the height desired to form a tie stack, as set forth in previous embodiments.

[0136] With respect to FIG. 22, another embodiment of a base member 390 for a tie system is depicted. This embodiment is similar to the base tie and wall tie depicted in FIG. 3, except in this embodiment, a base tie 392 and a wall tie portion 394 may be integrally formed together in a unitary seamless structure. Similar to the previous embodiment, the base member 390 may be positioned and secured to a footing (not shown), after which, additional wall ties may be attached to the end portions 396 of the wall tie portion 394 and vertically stacked to the height desired for a tie stack. Multiple tie stacks may be positioned and secured to the footing for securing panel structures thereto to act as forms for pouring a concrete wall (not shown).

[0137] With reference to FIG. 23, another embodiment of a tie system 420 is shown. In this embodiment, the tie system 420 may be the same or similar to the tie system depicted in FIG. 1, except the tie system 420 is employed for supporting panel structures 428 over a footing 404 with a radius or curved footing. Similar to that set forth with respect to FIG. 1, the tie system 420 of this embodiment may be best suited for forming walls for a home, or the like, which may be used for straight walls or walls where a radius is desired. The tie system 420 over the curved footing 404 may include multiple tie stacks 426. Each tie stack 426 may include a base member 422 or base tie and one or more wall ties 424. The panel structures 428 employed with the curved footing may be bendable plywood, masonite or plastic panels that will provide sufficient strength to act as a temporary form, but also may be readily bow or bend. In this manner, the tie system 420 as previously depicted in FIG. 1 may also be utilized over the curved footing 404 to provide a corresponding radius for a wall 402.

[0138] Now referring to FIGS. 24-26, another embodiment of a tie system 500 is provided. In this embodiment, the tie system 500 may employ multiple wall ties 542 coupled together to form wall tie stacks 544 for supporting first and second panel structures 510, 512 above an existing concrete wall 514, such as a foundation wall or any hardened concrete wall. The wall tie stacks 544 may be individually spaced in a separate and discrete manner, extending between the first and second panel structures 510, 512 similar to that depicted in previous embodiments (see FIGS. 1, 6, and 7), except, in this embodiment, the wall tie stacks 544 may be employed without utilizing the base tie 30 as described above (see FIGS. 2, 4, and 5). The wall tie stacks 544 coupled to the first and second panel structures 510, 512 may be secured vertically to form a vertically extending concrete wall 516 as a vertical extension or continuation of the existing concrete wall 514. Further, the wall tie stacks 544 and first and second panel structures 510, 512 may be positioned and secured transversely relative to the vertically extending existing concrete wall 514 so as to be secured to, for example, trusses to form a concrete roof structure 518 of a building structure 520. With this arrangement, such tie system 500 and first and second panel structures 510, 512 may receive a pourable and hardenable building material, such as concrete or cellular concrete or the like, which may be poured in one or more stages. Once the pourable material is hardened, the outer panel structures or second panel structures 512 may be removed to expose the concrete wall 516 and concrete roof structure 518 so as to permit an extension of the footing 522 and/or the existing concrete wall 514. In another embodiment, the second panel structures 512 may be maintained to at least one of the concrete wall 516 and the concrete roof structure 518. Such vertically extending concrete wall 514 may include wall surfaces extending parallel relative to a central plane 515 defined by the existing concrete wall 514. Further, the concrete roof structure 518 may include wall surfaces extending transverse,
alongside a roof structure central plane 517, relative to the central plane 515 of the existing concrete wall 514.

[0139] With respect to FIGS. 24, 24A and 25, detail relating to various steps that may be utilized for employing the tie system 500 over an existing concrete wall 514 will now be provided. Referring to FIG. 24A first, for example, each of the wall tie stacks 544 may be formed by coupling together multiple wall ties 542. Each wall tie 542 may be substantially similar to the wall ties previously described in detail herein, such as described in FIG. 2 (i.e., wall tie 90). In summary, each wall tie 542 may include a first elongated wall portion 546 and a second elongated wall portion 548 with a cross-member portion 550 rigidly fixed, connected and extending therebetween. Such cross-member portion 550 may include one or more rebar holder portions 560 defined therein. The first elongated wall portion 546 and the second elongated wall portion 548 includes a first planar surface 552 and a second planar surface 554, respectively, such that the first planar surface 552 faces directly opposite from the second planar surface 554. Further, the first and second planar surfaces 552, 554 define planes that are parallel to each other. Furthermore, each wall tie 542 may include lower attachment portions 556 and upper attachment portions 558 at respective lower and upper ends of the first elongated wall portion 546 and the second elongated wall portion 548 so that the upper attachment portions 558 may be configured to mate and couple to the lower attachment portions 556 of another wall tie 542 (as indicated by arrows 555) to thereby facilitate building each wall tie stack 544. In this manner, multiple wall tie stacks 544 may be formed with an appropriate number of wall ties 542 depending on the desired length or height needed for a particular wall tie stack 544.

[0140] Now with reference to FIGS. 24 and 24A, once the wall tie stacks 544 have been formed, the wall tie stacks 544 may be positioned and secured to the first panel structure 510. For example, the first panel structure 510 may include a plywood sheet and, further, may include framework studs 524, such as typical two-by-four framework studs, coupled to an outer surface of the first panel structure 510. The wall tie stacks 544 may be secured directly to an inner surface of the first panel structure 510 such that the first planar surface 552 directly abuts against an inner surface of the first panel structure 510. The wall tie stacks 544 may be secured by employing a nail gun, screw fasteners, or any other suitable fastening method and means, such as utilizing an adhesive. The wall tie stacks 544 may be secured to the first panel structure 510 as the first panel structures 510 are in the horizontal orientation, which may result in its being pre-secured to the frame work studs 524 laying in the horizontal orientation, or the wall tie stacks 544 may be secured to the first panel structures 510 after the frame work studs 524 and first panel structures 510 are moved and secured to the floor of the building structure 520 in the vertical orientation. In either case, once the first panel structures 510 are positioned in the vertical orientation with the wall tie stacks 544 coupled thereto, additional first panel structures 510, such as a lower first panel structure 526, to then couple additional wall ties 542 and extend the wall tie stacks 544 toward an upper surface 528 of the existing concrete wall 514. The lower first panel structure 526 may overlap and be secured to a first side wall surface 530 of an upper portion of the existing concrete wall 514. Once the additional wall ties 542 are added and secured to the wall tie stacks 544 and also secured to the first panel structures 510, the appropriate horizontal lying rebar 534 may be added to extend across the wall ties 542 and through the vertically extending wall tie stacks 544 within the rebar holder portions 560 of the cross-member portions 550 of the wall ties 542 as well as appropriately positioning vertically extending rebar 534.

[0141] At this juncture, the second panel structures 512 may be positioned against the wall tie stacks 544 such that the second planar surface 554 of the wall ties 542 in the wall tie stacks 544 directly abuts and is secured against the inner surface of the second panel structure 512. Also, the second panel structures 512 may extend beyond the upper surface of the existing concrete wall 514 so as to abut against and be secured to an outer or a second side wall surface 532 of the upper portion of the existing concrete wall 514. Similar to the first panel structures 510, the second panel structure 512 may be secured utilizing a nail gun, screw fasteners or the like. Further, by overlapping the first and second panel structures 510, 512 over the respective first and second side wall surfaces 530, 532 of the existing concrete wall 514, the wall tie stacks 544 do not necessarily require being positioned and coupled to a base tie, as previously set forth. In this manner, due to overlapping the first and second panel structures 510, 512 over the upper portion of the existing concrete wall 514, the tie system 500 may be employed for forming a continuation of the existing concrete wall 514 with the same width or thickness. In another embodiment, in instances where the existing concrete wall 514 is wider or thicker than what is desired for a continued concrete wall vertically extending therefrom, a user may implement a base tie to be secured to the upper surface 528 of the existing concrete wall 514 similar to that described and depicted in previous embodiments.

[0142] Now with reference to FIGS. 24 and 25, once the tie system 500 with the tie stacks and first and second panel structures has extended vertically to the desired height, the roof structure may be added to the wall framework studs 524, as known by one of ordinary skill in the art. For example, a roof truss system 536 may be coupled to the wall framework studs 524. The roof truss system 536 may then receive the first panel structures 510, such as plywood, to the slanted top surface of the roof truss system 536. The building structure 520 may also include forms for forming an eave portion 570 to be formed of concrete as an extension or juncture of the vertically and transversely extending tie systems 500. Such may be accomplished by, for example, positioning a horizontal eave form 572 with one end positioned over an upper end of the second panel structures 512 and the other end supported by a cross-brace 574 extending between the horizontal eave form and the second panel structures 510. The eave portion 570 of the building structure 520 may also include an end eave form 576 extending upward from the horizontal eave form 572.

[0143] At this juncture, multiple wall ties 542 may be coupled together to form multiple wall tie stacks 544 that may be secured to an upper or the inner surface of the first panel structures 510 that are secured to the roof truss system 536 such that the first planar surface 552 of the wall ties 542 is directly fastened to the inner surface of the first panel structures 510. The appropriate rebar 534 may be added through the wall tie stacks 544, after which, the second panel structures 512 may be secured to the wall tie stacks 544 such that the second planar surface 554 of the wall ties 542 is directly fastened to the inner surface of the second panel structures 512. Initially, for purposes of pouring the concrete, the second panel structures 512 may extend only over the wall tie stacks 544 that are positioned over the roof truss system 536, but...
ultimately, additional second panel structures 512 will be positioned and secured to extend over the eave portion 570 and further secured to the end eave portion 576.

[0144] Now with reference to FIGS. 25 and 26, a hardenable material, such as typical concrete or cellular concrete, may then be poured between the first and second panel structures 510, 512 of the vertically and transversely extending tie systems 500 of the building structure 520. Such may be accomplished in stages by first pouring the hardenable material between the first and second panel structures 510, 512 of the vertically extending tie system 500 and up to a portion of the eave portion 570 of the building structure 520, as indicated by dotted line 582. Once sufficiently hardened, a remaining portion 512r of the second panel structures 512 over the wall ties stacks 544 at the roof truss system 536 may then be added to cover the eave portion 570. Once the hardenable material has sufficiently set and hardened to form the concrete wall 516, the hardenable material may then be poured at the pitch of the roof through an opening (not shown) to fill the transversely extending first and second panel structures 510, 512 of the tie system 500 over the roof truss system 536. Once the hardenable material has sufficiently set and hardened over the roof truss system 536, the second panel structures 512 may be removed from the building structure 520. In some instances, it may be desired to maintain the second panel structures 512 to the building structure 520 to provide a ready surface to secure the exterior of the building structure, such as roof shingle system, aluminum siding, stucco or other typical home exterior facades.

[0145] With the tie system 500 set forth herein, such wall ties 542 and wall tie stacks 542 provide a cost efficient means for forming continuous concrete walls 516 and concrete roof structures 518 for one’s home or other building structure. Such continuous concrete wall 516 and roof structure 518 may provide enhanced insulation to one’s home or building. Further, the continuous concrete wall and roof structure may provide enhanced resistance and stability in the event of tornado and hurricane disasters, or other type of disasters, such as fire.

[0146] Now with reference to FIG. 27, another embodiment for implementing the wall tie system 500 is provided. In the event it is desired to transform one’s existing home or other building structure 588 to include a continuous concrete wall and roof structure similar to that previously set forth, the wall tie system 500 may be employed over the existing walls 586 and roof (not shown) of one’s home or other building structure. In this embodiment, the wall tie system 500 may be employed similarly to that described in the previous embodiment, except the wall tie system 500 extends above the existing concrete wall 514 with a portion along-side an upper portion of, for example, a foundation wall. For example, one may first remove some of the earth from the existing concrete wall 514 of the building structure 588 to expose an outer surface of the upper portion of the existing concrete wall 514. Next, holes may be drilled into the exposed outer surface to insert and secure rebar 590 in the upper portion of the existing concrete wall 514 such that the rebar 590 would extend horizontally into the existing concrete wall 514 and then be bent to extend upward and vertically alongside the existing concrete wall 514. Next, multiple wall ties 542 may be coupled together to form wall tie stacks 544, which then may be secured to first panel structures 510. The first panel structures 510 may be secured to the upper portion of the existing concrete wall and the existing walls 586 of the building structure 588 prior to securing the wall tie stacks 544 thereto or subsequent to securing the wall tie stacks 544 to the first panel structures 510. Appropriate rebar 590 may be provided along the tie stacks, vertically and horizontally, as known by one of ordinary skill in the art, after which, the second panel structures 512 may be secured to the wall tie stacks 544. In this manner, one may continue securing the wall tie stacks 544 between first and second panel structures 510, 512 over the existing walls 586 and existing roof (not shown) of the existing home or building structure 588, similar to that described in the previous embodiment, and then filling the panel structures with concrete, such as regular concrete or cellular concrete, to form a continuous and integral concrete wall and roof structure over an existing building structure 588. One may then provide a new exterior to the concrete structure as desired. In this manner, the tie system 500 of the present invention may be employed with an existing building structure 588 to form a concrete structure over the existing building structure to, thereby, provide enhanced insulation and enhanced stability and resistance to various potential disasters, such as wild fires, tornadoes, and hurricanes.

[0147] Now with reference to FIGS. 28-29, another embodiment of a tie system 600 for forming a wall structure 601 (FIG. 38). Wall structure 601 may be defined herein as any hardenable, pourable building material, such as cement or the like, and may extend vertically or at an angle relative to the vertical. In one embodiment, the tie system 600 may be formed from a kit with unassembled components pre-formed in the kit for assembling the tie system 600 with its panel structures to form, for example, a monolithic structure (such as a cement structure or the like) to hold water to be employed as a hot-tub or spa. The tie system 600 of the kit may include a variety of configurations, tiers, shapes (including curved walls) and sizes. Further, the panel structures provided in the kit may include pre-cut holes and preformed panel structure dimensions to correspond with the features desired in a wall structure as well as to provide various forms of functionality.

[0148] For example, in one embodiment, the tie system 600 of the kit may be formed, in its assembled state, with a square shaped periphery with portions configured to form a seat structure 603 and a step structure 605 as part of the wall structure 601 (see FIG. 38), as well as various other components, discussed further herein. The tie system 600 may include a lower tie assembly 602 and an upper tie assembly 604, the upper tie assembly 604 positioned on or over the lower tie assembly 602. The lower tie assembly 602 may include a first lower wall form 606, a second lower wall form 608, a third lower wall form 610, and a fourth lower wall form 612. Further, each lower wall form may include one or more first panel structures 614 and one or more second panel structures 616, the one or more first and second panel structures 614, 616 positioned to extend parallel relative to each other. Furthermore, each first and second panel structures 614, 616 may include an inner surface 618 and an outer surface 620, the first and second panel structures 614, 616 positioned so that the inner surface 618 of the first panel structure 614 faces the inner surface 618 of the second panel structure 616. Each lower wall form may include multiple wall ties 622 formed in wall tie stacks 624 spaced and fastened between the first and second panel structures 614, 616, discussed in further detail herein. With this arrangement, each of the lower wall forms may be connected between two other lower wall forms at their respective ends of the first and second panel structures 614, 616 to form a four sided, square outer periphery.
Similarly, the upper tie assembly 604 may include a first upper wall form 626, a second upper wall form 628, a third upper wall form 630, and a fourth upper wall form 632, each also including first and second panel structures 634, 636 with wall tie stacks 638 positioned between the first and second panel structures 634, 636. The upper wall forms of the upper tie assembly 604 may include an upper width 640 between the first and second panel structures 634, 636 that is smaller than a lower width 642 of the lower wall forms of the lower tie assembly 602 between each of the first and second panel structures 614, 616. With this arrangement, the upper tie assembly 604 may be coupled to the lower tie assembly 602 with the respective first panel structures 614, 634 or exterior panels of the upper and lower tie assembly 602, 604 coupled to each other so that the second panel structures 636 of the upper tie assembly 604 are positioned above wall tie stacks 624 of the lower tie assembly 602. In this manner, the lower tie assembly 602 and upper tie assembly 604 may form a seat structure 603 with additional features in the upper tie assembly 604 to form a step structure 605 (see FIG. 38).

In one embodiment, the kit may include additional components, such as housing components 644 and conduit portions 646. For example, the kit may include conduit portions 646 configured to circulate water through the hot tub or spa and/or configured to extend electrical wire therethrough. The conduit portions 646 and housing components 644 depicted in FIG. 29 are only shown as an example, in a simplistic manner, and may extend through the lower and upper tie assemblies 602, 604 with various other configurations and include additional conduit portions 646 than that which is depicted. Such conduit portions 646 may include tubular structures and may be coupled together with conduit connectors 648 that may be sized and configured to be at least partially encapsulated in a hardenable and pourable building material, such as cement. The conduit portions 648 may be a polymeric material, such as polynvinyl chloride ("PVC") material, or any other suitable conduit material. The conduit portions 646 may be interconnected to functional components, such as jets, water returns, drains, etc. or to run electrical wire for lighting, spa controller, or for any other suitable purposes desired in the hot tub or spa.

As set forth, the kit may include housing components 644. For example, for a hot tub or spa, the housing components 644 may include a skimmer 650, a water leverer 652, etc. The housing components 644 may include a side or surface 654 that, upon positioning between the first and second panel structures 634, 636 of the upper tie assembly 604, the surface 654 may be secured with fasteners against one of the first and second panel structures 634, 636. In the case of a hot tub or spa, the surface 654 may be positioned and secured against the interior panel or the second panel structure 636 of the upper tie assembly 604, discussed in further detail herein.

The kit may include the first and second panel structures for each of the lower and upper tie assemblies 602, 604, each panel structure being sized with the appropriate predetermined dimensions as well as include pre-cut holes, notches, and openings or voids sized and configured to meet the requirements of the tie system 600. In one embodiment, the dimensioned first and second panel structures may be pre-cut with the holes, notches, and openings or voids with computer numerical control or CNC machining or the like or other suitable machining processes and techniques. The kit may also include various panel support structures 656. The panel support structures 656 may include straps 658, strips 660, and vertical supports 662 sized and configured to couple the appropriate panel structures together. In addition, the kit may include fasteners 664, such as screws, for fastening the tie stacks 624, 638 to the panel structures. Further, the fasteners 664 may be utilized to couple the straps 668 and strips 660 to adjacent panel structures of the tie system 600. The straps 658 may be a bendable material or a rigid material that may be positioned over outer corners at the periphery of the lower and upper tie assemblies 602, 604 to assist in coupling the lower and upper wall forms together. The strips 660 may be plywood sheet material, or the like, that may be positioned over lower and upper edge lengths of the respective lower and upper assemblies 602, 604 along the outer periphery thereof. In one embodiment, the kit may include clips 666 (FIG. 30) for coupling wall ties together in a horizontal manner, which facilitates enlarging a width or depth of a wall structure, described in further detail hereafter.

The kit may initially be in an unassembled state or a partially unassembled state. For example, the kit may include each of the first and second panel structures of the lower and upper tie assemblies 602, 604, wall ties 622, and panel support structures 656. In this embodiment, the kit may also include the clips 666, the clips 666 being pre-coupled to the wall ties 622 or left separate to employ during the assembly process. In addition, in one embodiment, the kit may include the housing components 644 and/or the conduit portions 646 and their conduit connectors 648.

With respect to FIGS. 30 through 37, description of the assembly of the tie system will now be provided. With respect to FIGS. 30 and 30A, the wall ties 622 may be assembled into multiple wall tie stacks 624. As set forth in previous embodiments, the wall ties 622 can be vertically stacked via upper and lower attachment portions of the wall ties 622, as detailed. As depicted, in the wall tie stack 624, the lower attachment portions of the lower wall ties and the upper attachment portions of the upper wall ties may be removed. In this embodiment, for the lower tie assembly 602, the wall tie stacks 624 may include three partial wall tie stacks of vertically stacked wall ties 622 that may be coupled together, side-to-side or in a horizontal manner. In other words, such three partial wall tie stacks may be coupled in a horizontal manner with the clips 666 such that the planar surface of one wall tie 622 may be clamped against the planar surface of another wall tie 622. As set forth in previous embodiments, the wall ties 622 may come in different horizontal widths, for example, four, six, eight, and ten inch widths. In this embodiment, the two outer wall ties 622 may be eight inches and the middle wall tie 622 may be ten inches, coupled together to form a width 690 of the wall tie stack 624.

Each clip 666 may be sized and configured to be inserted within elongated holes 668 defined within first and second elongated wall portions 670, 672 to couple horizontally positioned wall ties 622, as depicted. Each clip 666 may include a U-shaped cross-section to exhibit a base span 674 with two leg spans 676 extending from opposing ends of the base span 674. The two leg spans 676 may extend parallel relative to each other and the leg spans 676 may extend substantially perpendicular relative to the base span 676. Further, the leg spans 676 may include one or more spikes 678 extending therefrom, the spikes 678 sized and configured to grab structure defined within the elongated holes 668 of the first and second elongated wall portions 670, 672. The clips 666 may be a rigid material made from metal, such as spring steel, or any other suitable material, such as a polymeric...
material. With this arrangement, the clips 666 may be employed to connect the wall ties 622 in a horizontal manner. The wall ties 622 may also be built in a vertical manner, as depicted, to fully assemble the wall tie stack 624.

[0156] Each wall tie stack 624, formed of the multiple wall ties 622, may define a first wall portion 680 and a second wall portion 682 with an intermediate portion 684 extending therebetween. The first and second wall portions 680, 682 may extend the height of the wall tie stack 624. The intermediate portion 684 may be rigid relative to the first and second wall portions 680, 682. The first wall portion 680 and the second wall portion 682 may define a first planar surface 686 and a second planar surface 688, respectively. The first planar surface 686 and the second planar surface 688 may be the outermost surfaces of the wall tie stack 624 so as to define the width 690 of the wall tie stack 624. The width 690 of the wall tie stack 624 corresponding with the lower width 642 defining the distance between the first and second panel structures 614, 616 of the lower tie assembly 602 (see FIG. 29). Further, the first planar surface 686 and the second planar surface 688 of the wall tie stack 624 may face away and directly opposite from each other. With this arrangement, the first planar surface 686 may be configured to be directly fastened to the first panel structure 614 and the second planar surface 688 may be configured to be directly fastened to the second panel structure 616.

[0157] With respect to FIGS. 31 and 32, upon each of the wall tie stacks 624 being assembled, the first, second, third, and fourth lower wall forms 606, 608, 610, 612 may be prepared for assembly, each of which may be assembled in a substantially similar manner. For example, the first lower wall form 606 may include the first and second panel structures 614, 616 and the multiple wall tie stacks 624. Each of the first and second panel structures 614, 616 may include an inner surface 618 and an outer surface 620 extending to and defining a peripheral edge. Similar to previous embodiments, the first planar surface 686 of each wall tie stack 624 may be directly fastened with fasteners to the inner surface 618 of the first panel structure 614. Further, each wall tie stack 624 may be substantially evenly spaced relative to adjacent positioned wall tie stacks 624 along a portion of a length of the first panel structure 614. The second panel structure 616 may then be fastened with fasteners to the spaced wall tie stacks 624 such that the second planar surface 688 of each of the wall tie stacks 624 is directly fastened to the inner surface 618 of the second panel structure 616, as depicted in FIG. 32. At this juncture, the panel support structures 656 may be coupled to the first and second panel structures 614, 616. For example, the strip 660 may be coupled to the outer surface 620 of the first panel structure 614 so that the strip 660 extends horizontally along the outer surface 620 and above the upper edge of the first panel structure 614. Further, in the event the first panel structure requires additional length, an additional first panel structure 692 may be coupled to an end of the first panel structure 614 with a vertical strip 694. In addition, vertical supports 662 may be fastened to the outer surface 620 and along opposing ends of the first panel structure 614. Once the panel support structures 656 are fastened to the first and second panel structures 614, 616, an appropriate amount of rebar 696 may be fed through the intermediate portion 684 of each of the wall tie stacks 624 as known by one of ordinary skill in the art. The drawings depict a limited amount of rebar 696 for simplistic purposes. With this arrangement, the first lower wall form 606 may be assembled. The second, third, and fourth lower wall forms 608, 610, 612 may be similarly assembled, as depicted in FIG. 32.

[0158] With respect to FIGS. 32 and 33, upon assembling each of the lower wall forms, the lower wall forms may then be coupled to each other to form the lower tie assembly 602. Such coupling of the lower wall forms may be employed with the before described strips 658. The strips 658 may act as an L-bracket or the like and be fastened onto the outer surface 620 of each of the first panel structures 614 to couple each of the lower wall forms together, as depicted in FIG. 33. Further, the second panel structures 616 of each lower wall form may couple to an adjacent second panel structure 616 via the vertical supports 662. In addition, additional rebar 696, such as corner rebar, may be positioned to extend adjacent the corners of the coupled lower wall forms, which may be supported by the intermediate portion 684 of the wall tie stacks 624 of adajcently positioned lower wall forms.

[0159] With respect to FIG. 34, in one embodiment, the tie system 600 and kit may include the housing components 644 and conduit portions 646, as previously described. At this juncture of each of the first, second, third and fourth lower wall forms 606, 608, 610, 612 being coupled together, one or more housing components 644 and/or various conduit portions 646 may be positioned along portions of the lower tie assembly 602. For example, the housing components 644 with conduit portions 646 extending therefrom may be positioned such that the housing components 644 may be positioned between and above the first and second panel structures 614, 616 of the lower tie assembly 602, extending above the lower tie assembly 602 to later be supported and fastened to the upper assembly (not shown). As previously set forth, the housing components 644 may include the water leveler 652, the skimmer 650, light fixtures (not shown), or any other suitable housing component for a hot tub, spa, or the like. Depending on the tie system 600, the housing components 644 may house light fixtures, electrical outlets, control systems or the like, or any other housing component that may be assembled with a tie system 600 for forming a wall structure. In this embodiment, each of the housing components 644 may include conduit portions 646 extending downward and/or horizontally from the housing components 644, which may be assembled and positioned within the lower tie assembly 602.

[0160] Further, additional conduit portions 646 may be assembled and positioned to be supported within the lower tie assembly 602 along the intermediate portion 684 of the wall tie stacks 624. For example, the lower tie assembly 602 (and upper tie assembly) may house and support conduit portions 646 that may extend linear and with bends as required for a hot tub or spa. The conduit portions 646 may be inserted to extend between the cross-member portions of wall ties 622 such that the conduit portions 646 may be assembled within the lower tie assembly 602 with some conduit portions 646 extending to where the upper tie assembly 604 will be assembled, described herein. Further, some of the conduit portions 646 may extend horizontally to a central portion of the lower tie assembly 602 with vertical portions that will act as housing for drains. The conduit portions 646 may be employed to facilitate various jets, blowers, return lines, suction lines, drains, and/or electrical lines, or any other suitable purpose necessary for a spa or hot tub or the like or that may be useful for the particular purpose of the wall structure being formed. In this manner, housing components 644 and conduit portions 646 may be assembled with the tie system 600 and may be provided with the kit.
With reference to FIGS. 28 and 35, similar to assembling the lower tie assembly 602, the first, second, third, and fourth upper wall forms 626, 628, 630, 632 may be assembled with vertically stacked wall ties 622 to form multiple wall tie stack 638 and positioning the wall tie stacks 638 between the first and second panel structures 634, 636, and then fastening the wall tie stacks 638 between the first and second panel structures 634, 636. As indicated, assembling each of the upper wall forms may be employed in a similar manner as described for assembling the lower wall forms, except the wall tie stacks 638 may not include horizontally clipping ties together with the clip 666 (FIG. 30), but rather, may only require vertically stacking upon a single tie to form or assemble the wall tie stacks 638 for each of the upper wall forms. Further, the width 640 of each of the first and second panel structures 634, 636 may be substantially the same in each of the upper wall forms.

Now with reference to FIGS. 35 and 36, upon assembling each of the upper wall forms, the first upper wall form 626 may be assembled or fastened to the lower tie assembly 602. Such may be accomplished by fastening the first panel structure 634 of the first upper wall form 626 to the strip 660 previously fastened along the outer surface 620 to extend above the upper edge of each of the lower wall forms. Similarly, the second upper wall form 628 may be attached and fastened to the strip 660 extending above the second lower wall form 608. The first and second upper wall forms 626, 628 may then receive a step form 698, the ends of the step form 698 fastened to vertical supports 662 of the first and second upper wall forms 626, 628. The second panel structures 636 of each of the first and second upper wall forms 626, 628 may define a step opening 702 so that the step opening 702 may be adjacent other upon assembling the first and second upper wall forms 626, 628 to the respective first and second lower wall forms 606, 608. Such step form of 698 along with the step opening 702 defined in the second panel structure 636 may provide structure for forming the step structure 605 (FIG. 38).

With respect to FIG. 37, similar to that described relative to FIGS. 35 and 36, the third and fourth upper wall forms 630, 632 may be fastened to the strips 660 extending above the respective third and fourth lower wall forms 610, 612. At each outer corner of the outer periphery of the adjacent upper wall forms, the strips 658 in the form of an L-shape may be fastened to provide support between the adjacent upper wall forms. Likewise, the vertical supports 662 may be employed for supporting the inner corners of the inner periphery of the adjacent upper wall forms.

Now with reference to FIGS. 29 and 37, once each of the panel support structures 656 are fastened to adjacent positioned upper and lower wall forms, the housing components 644 may be directly fastened to the inner surface 618 of the second panel structures 636. For example, the first housing component 644 or skimmer 650 (see FIG. 34) may be directly fastened to the inner surface 618 of the second panel structure 636 of the first upper wall form 626. Similarly, the water leveler 652 may be directly fastened to the inner surface 618 of the second panel structure 636 of the second upper wall form 628. With this arrangement, a surface 654 on each of the housing components 644 directly abuts and is fastened to the inner surface 618 of one of the second panel structures 616 so that there is a seal (or close to a seal) so as to not allow cement to move past the surface abutted against the inner surface 618 of the second panel structure 636.

Now with reference to FIGS. 37 and 38, once the tie system 600 is completely assembled, the installer should ensure that all housing components 644 and conduit portions 646 are properly positioned and assembled within the tie system 600. Further, ends of the conduit portions 646 should be placed through conduit openings 704 defined in the second panel structures 636 of the lower and upper tie assemblies 602, 604 to make sure such conduit portions 646 are appropriately positioned. The conduit openings 704 may be placed in the second panel structures 636 after fastening to the tie system 600 or, such conduit openings 704 may be pre-formed and be provided in the second panel structures 616, 636 in the kit. Similarly, conduit openings 704 of the first panel structures 614, 634 may be pre-formed or formed or drilled in the first panel structures during assembly of the tie system 600.

Once the installer is satisfied with the positioning of the conduit portions 646 with the tie system 600, the tie system 600 is ready to receive a hardenable, pourable building material, such as cement. As depicted, the second panel structures 616 of the lower tie assembly 602 may be suspended above ground level. With this arrangement, as the pourable building material is poured through the upper tie assembly 604, between each of the first and second panel structures 614, 616, the pourable building material flows through the lower tie assembly 602 and inward under the suspended second panel structures 616 of the lower tie assembly 602 to form the cement floor. The installer may also pour cement directly onto the floor portion or inward of the lower tie assembly 602. As the floor portion sets, the installer may pour the pouring building material between the first and second panel members 614, 616 of the lower tie assembly 602 to form the seat structure 603 and as the seat structure 603 sets, the installer may pour and fill the pourable material between the first and second panel structures 634, 636 of the upper tie assembly 604 as well as the step structure 605 extending between the first and second upper wall forms 626, 628. Once the pourable building material has hardened and cured, all the panel structures as well as the panel support structures may be removed to fully expose the wall structure 601 with the seat structure 603 and step structure 605 in the form of a spa, as depicted in FIG. 38.

As depicted in FIG. 38, the surface 654 of the one or more housing components 644, such as the skimmer 650 and water leveler 652, may advantageously be flush with the exposed wall structure 601, the one or more housing components 644 being encased and fixed within the wall structure 601. Such flush position of the one or more housing components 644 relative to a surrounding outer surface of the wall structure 601 may be employed upon the surface 654 being directly fastened to the inner surface of the second panel structure, as previously set forth.

At this juncture, the installer may provide a water proofing material over ties of the interior of the wall structure, such as adhesively attached fiber glass mesh with acrylic modified cement thereover, over the exposed planar surfaces of the wall ties 622. Further, the other surfaces may then receive various coating and finishing structures, such foundation plaster, pool finishes, paints, plastics, water proof coatings, tile/finishing to finalize the wall structure 601. In addition, various pumps, controllers, light fixtures, jet nozzles, etc. may also be coupled to the exposed conduit portions 646, as known to one of ordinary skill in the art, so that, upon filling the wall structure with water, the wall structure may function as a hot tub or spa.
Now with reference to FIGS. 39 through 44, another embodiment of a tie system 720 for forming a wall structure 721 in the form of a swimming pool is provided. As in the previous embodiment, the tie system 720 may be provided as a kit with wall ties 722 and first and second panel structures 724, 726 and various panel support structures 728 in an unassembled state. Further, each of the first and second panel structures 724, 726 may include various openings and notches defined therein as well as the panel structures having various dimensions, each of which may be pre-formed and provided in the kit.

With respect to FIG. 39, a portion of the tie system 720, namely, a lower corner portion 730 and an upper corner portion 732, is provided. The lower corner portion 730 may include a first lower portion 734 and a second lower portion 736, each of which may be fastened together to form the lower corner portion 730. The first lower portion 734 may be assembled with, for example, two wall tie stacks 738 spaced and positioned between the first and second panel structures 724, 726. The second lower portion 736 may be similarly assembled. The second panel structure 726 may be fastened to the wall tie stacks 738 so that the second panel structure 726 is suspended above the ground level a predefined distance. As such, the second panel structure 726 may be sized and configured to include a second width 740 that is smaller than a width 742 of the first panel structure 724. The predefined distance of the second panels structure being disposed above ground level is a space for the pourable building material, such as cement, to flow through to form a floor 723 of the swimming pool. In this manner, the tie system 720 may be sized and configured to form the wall structure 721 and floor 723 of the swimming pool as a continuous, monolithic structure.

The upper corner portion 732 may be assembled in a similar manner as the lower corner portion 730. The upper corner portion 732 may include the first upper portion 744 and the second upper portion 746 both of which may be assembled with tie stacks 738 and first and second panel structures 724, 726 and fastened together with panel structure supports 728. The upper corner portion 732 may include the same components of the lower corner portion 730, except the second panel structure 726 of the upper corner portion 732 includes a similar width as the first panel structure 724 of the upper corner portion 732. Once the lower and upper corner portions 730, 732 are fully assembled, the upper corner portion 732 may be fastened to the lower corner portion 730 with strips 748, as depicted in FIGS. 40 and 41. The strips 748 may be positioned over the top and bottom edges of the first panel structure 724 of the respective lower and upper corner portions 730, 732. Further, vertically extending strips 748 may be positioned over ends of the first and second panel structures 724, 726 of each of the lower and upper corner portions 730, 732 to be fastened to additional first and second panel structures of lower and upper tie assemblies to continue the wall forms, as indicated by arrows 750, to another corner of the wall tie system 720 for the swimming pool. The other corners of the tie system 720 may be similarly assembled to that described in FIGS. 39 and 40. In this manner, a tie system 720 may be provided as a kit to form the wall structure 721 and floor 723 (FIG. 44) of a swimming pool. In addition, the tie system 720 of this embodiment may include various housing components (not shown), such as a skimmer and water leveler, and various conduit portions for circulating and advancing water that may be positioned and supported within the tie system 720 and between the first and second panel structures 724, 726 in a similar manner as that described for the hot tub or spa.

Now with reference to FIGS. 42 through 44, in one embodiment, the tie system 720 may include a shelf feature 752 for a swimming pool, the feature known as a “jalapa” shelf. The shelf feature 752 may be a raised portion of the pool that holds shallower water with an edge that drops off to define a wall with substantially deeper water of the swimming pool. The shelf feature 752 may be integrated into the tie system 720 along, for example, one side of the tie system 720 between two opposing walls (not shown) of the tie system 720.

With respect to FIG. 42, tie system 720 may be assembled with a lower tie assembly 754 and a shelf tie assembly 756. The lower tie assembly 754 may define a perimeter of the swimming pool. In one embodiment, the lower tie assembly 754 may include a first length 758 and a second length 760, each of the first length 758 and the second length 760 of the lower tie assembly 754 extending further than that which is depicted in FIG. 42, as indicated by respective arrows 762, 764. As in previous embodiments, the lower tie assembly 754 may include multiple wall tie stacks 738 fastened and directly connected between inner surfaces 766 of first and second panel structures 724, 726.

The shelf tie assembly 756 may include multiple wall tie stacks 738 fastened and directly connected between inner surfaces 766 of first and second panel structures 724, 726. Opposing ends of the shelf tie assembly 756 may be fastened to the lower tie assembly 754, only one end of the shelf tie assembly 756 being depicted, but may extend further as indicated by arrow 768. Further, the second panel structure 726 of the shelf tie assembly 756 may extend higher than the first panel structure 724 of the shelf tie assembly 756. The tie system 720 may be formed to surround a shelf region 770 and a deeper pool region 772.

The panel structures or second panel structures 726 extending along the deeper pool region 772 may be suspended above ground level along the wall tie stacks 738 so that a pourable building material (not shown) may flow between the first and second panel structures 724, 726 and extend through the void defined by the suspended second panel structures 726 so that the pourable building material can flow and extend to form a floor of the swimming pool. The panel structures surrounding the shelf region 770 may extend to the ground level. Within the shelf region 770, a filler material (not shown) may be provided to fill the shelf region to about a height of the first panel structure 724 of the shelf tie assembly 756.

Now with reference to FIG. 43, an upper tie assembly 774 may be fastened to the lower tie assembly 754 with panel support structures, similar to previous embodiments. As in previous embodiments, the upper tie assembly may include the multiple wall tie stacks 738 fastened between the first and second panel structures 724, 726. Along the shelf region 770, the second panel structures 726 of the upper tie assembly 774 may be sized and configured to define a shelf opening 776 along a bottom portion of the second panel structures 726 and defined by a top edge of the second panel structures 726 of the lower tie assembly 754. Although FIG. 43 only depicts a portion of the tie system 720, the lower and upper tie assemblies 754, 774 may continue and extend to
opposite sides, and extend past lower and upper corner portions 730, 732 (FIG. 40) to form a complete tie system 720 for the swimming pool.

[0177] With respect to FIGS. 43 and 44, upon completing the tie system 720, the installer can ensure that all housing components and conduit portions are properly positioned between the first and second panel structures 724, 726, similar to that previously depicted and described relative to the hot tub or spa. At this point, the tie system 720 is ready to receive the hardenable, pourable building material between the first and second panel structures 724, 726 to flow through the void below the second panel structures 726 to fill-in the floor 723 in the deeper pool region 772 and to fill the space between the first and second panel structures 724, 726. At the shelf region 770, the pourable building material flows between the first and second panel structures 724, 726 and through the shelf opening 776 and over the filler material (not shown) to form the shelf floor 775. Further, the pourable building material may extend to form the shelf floor 775 and extend between the first and second panel structures 724, 726 of the shelf tie assembly 756 and to the floor 723 of the deeper pool region 772. Once the pourable building material has hardened and cured, the first and second panel structures 724, 726 are removed to expose the wall structure 721 of the pool region 772 and shelf region 770. In this manner, the tie system 720 may be employed to form a swimming pool, and a swimming pool with a shelf feature 752.

[0178] While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the invention includes all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the following appended claims.

What is claimed is:

1. A wall forming system configured to form a wall structure from a hardenable pourable building material, the tie system comprising:
   a first panel structure and a second panel structure, the first and second panel structures each including an inner surface and an outer surface, the first and second panel structures configured to be positioned parallel to each other so that the inner surface of the first panel structure faces the inner surface of the second panel structure; and multiple wall ties configured to be directly interconnected to form a wall tie stack such that multiple wall tie stacks are configured to be positioned between the first and second panel structures in a spaced arrangement, each wall tie stack defining a first wall portion and a second wall portion with an intermediate portion extending between the first wall portion and the second wall portion, the first wall portion defining a first planar surface and the second wall portion defining a second planar surface, the first planar surface facing away from and directly opposite the second planar surface, the first planar surface and the second planar surface being outer most surfaces of the wall tie stack to define a wall tie width, the first planar surface configured to be directly fastened to the inner surface of the first panel structure and the second planar surface configured to be directly fastened to the inner surface of the second panel structure.

2. The wall forming system of claim 1, wherein the wall tie stack comprises multiple vertically stacked wall ties.

3. The wall forming system of claim 1, wherein the wall tie stack comprises multiple wall ties coupled together horizontally with wall tie fasteners.

4. The wall forming system of claim 1, wherein the intermediate portion extends rigidly between the first wall portion and the second wall portion.

5. The wall forming system of claim 1, wherein each wall tie of the multiple wall ties comprises a first elongated wall portion and a second elongated wall portion with a cross-member portion extending therebetween.

6. The wall forming system of claim 1, further comprising conduit portions, the conduit portions configured to be positioned over and along the intermediate portion of adjacent spaced wall tie stacks.

7. The wall forming system of claim 1, further comprising one or more housing components, the one or more housing components configured to be coupled to conduit, the housing components including a surface configured to be directly coupled to an inner surface of one of the first and second panel structures.

8. The wall forming system of claim 1, further comprising panel support structures, the panel support structures configured to couple adjacent positioned first panel structures and adjacent positioned second panel structures.

9. The wall forming system of claim 8, wherein at least one of the adjacent positioned first panel structures and the adjacent positioned second panel structures are positioned relative to the respective first and second panel structures to extend vertically or horizontally.

10. The wall forming system of claim 8, wherein at least one of the first and second panel structures extend with a curvature so that the wall structure extends with a corresponding curvature.

11. A kit for forming a concrete wall structure, the kit comprising:
   first panel structures and second panel structures, the first and second panel structures configured to be positioned parallel relative to each other, each of the first and second panel structures including an inner surface and an outer surface extending to define a periphery formed with pre-determined dimensions, at least one of the first and second panel structures including a pre-cut opening defined therein, the pre-cut opening sized and positioned at a pre-determined location in the at least one of the first and second panel structures; and multiple wall ties, each of the wall ties including outer most planar surfaces defining a tie width, the outer most planar surfaces of the wall ties configured to be positioned and fastened directly against the inner surface of one of the first panel structures and the inner surface of one of the second panel structures so that opposing ones of the first and second panel structures extend parallel relative to each other.

12. The kit of claim 11, further comprising conduit configured to be positioned along the wall ties and between the first and second panel structures and configured to extend through the pre-cut opening of one of the first and second panel structures.
14. The kit of claim 12, further comprising one or more housing components, the one or more housing components including a surface configured to be directly coupled to the inner surface of one of the first and second panel structures.

15. The kit of claim 12, further comprising fasteners, the fasteners configured to couple the first panel structures to first wall portions of the wall ties and the fasteners configured to couple the second panel structures to second wall portions of the wall ties.

16. The kit of claim 12, further comprising panel support structures, the panel support structures configured to directly couple adjacent positioned first panel structures and adjacent positioned second panel structures.

17. The kit of claim 12, further comprising clips, the clips configured to couple wall ties together horizontally between at least one of the first panel structures and at least one of the second panel structures.

18. A method for assembling a pre-formed wall forming tie system, comprising:

- providing first and second panel structures, each of the first and second panel structures being pre-cut with predetermined dimensions and at least one of the first and second panel structures including a pre-cut opening defined therein;
- coupling wall ties between the first and second panel structures, each of the wall ties including outer most planar surfaces defining a tie width, the outer most planar surfaces of each of the wall ties configured to be positioned and fastened directly against an inner surface of one of the first panel structures and an inner surface of one of the second panel structures so that opposing ones of the first and second panel structures extend parallel relative to each other.

19. The method according to claim 18, further comprising extending conduit along the wall ties and between the first and second panel structures and extending conduit through the pre-cut opening of the first and second panel structures.

20. The method according to claim 18, further comprising coupling one or more housing components to one of the first and second panel structures such that a surface of the one or more housing components is directly coupled to the inner surface of one of the first and second panel structures.