Embodiments of the invention comprise apparatuses and methods of manufacturing and installing reinforced concrete structures. The reinforced concrete structures utilize trusses and rebar to form a support structure. A screed guide bar is removably coupled to the support structure. Concrete is supplied to the support structure, and screeding occurs to form the reinforced concrete structure from the support structure (e.g., rebar mats and trusses) and concrete. The use of trusses and the screed guide bar allow for the formation of a reinforced concrete structure without the need for using spacers and standees to position the mats, or performing position checks to determine the position of the concrete during screeding. The screed bar guide allows workers to quickly form the desired surface of the reinforced concrete structure, remove the screed bar, and fill any void left by the screed bar, as necessary.
FIG. 1

1. RECEIVING THE REQUIREMENTS FOR THE SUPPORT STRUCTURE

2. DETERMINING THE TRUSSES NEEDED FOR THE REBAR SUPPORT STRUCTURE BASED ON THE SUPPORT STRUCTURE REQUIREMENTS

3. MANUFACTURING THE TRUSSES FOR THE REBAR SUPPORT STRUCTURE BASED ON THE TYPES AND NUMBER DETERMINED

4. SHIPPING THE TRUSSES TO THE CUSTOMER ON SITE.

5. INSTALLING THE TRUSSES ON SITE

6. INSTALLING THE REBAR MATTS ON THE TRUSSES

7. PLACING THE CONCRETE AROUND THE TRUSS AND REBAR SUPPORT STRUCTURE

8. SCREEDING THE CONCRETE USING THE SCREED BAR AS A GUIDE
FIG. 3C
TRUSS AND REBAR REINFORCED CONCRETE STRUCTURES

CLAIM OF PRIORITY UNDER 35 U.S.C. §119

[0001] The present application for a patent claims priority to Provisional Application No. 61/505,939 entitled “Truss and Rebar Reinforced Concrete Structures” filed Jul. 8, 2011 and assigned to the assignees hereof and hereby expressly incorporated by reference herein.

BACKGROUND

[0002] Reinforced concrete is used in many different applications for supporting various types of loads. The reinforced concrete typically utilizes rebar structures on which concrete is poured to form the concrete structures. The present invention relates to apparatuses and methods that have improvements over the typical reinforced concrete structures and methods of installing the typical reinforced concrete structures.

BRIEF SUMMARY OF THE INVENTION

[0003] This invention relates generally to support structures, and more particularly embodiments of the invention relate to truss and rebar configurations utilized in reinforced concrete structures for various support applications and methods of manufacturing and assembling such reinforced concrete structures.

[0004] Reinforced concrete is used in many different applications for supporting various types of loads, such as but not limited to towers, bridge abutments, bridge girders, deep footings for elevator pits, building supports, water tank tower supports, tower crane pads, wind tower pads, etc. In these applications rebar is connected together to form a rebar structure and concrete is poured in and around the rebar structure to form the support structures. In some applications the rebar structures comprise layers of rebar called mats spaced apart by standees. The mats may be crossed patterns of rebar (i.e., rectangular lattice, woven, etc.) that are connected through the use of wire or plastic ties, welded, clamped, glued, screwed, etc. The mats may be generally planar (i.e., two-dimensional), kinked, bent, curved, or the like, and generally shaped as circles, squares, rectangles, ovals, or other like shapes as needed based on the load and space requirements for the support application. In some embodiments the mats may have sections that are angled or bent, or may be bowed to create a rounded surface. All or most of the mats within applications may be of the same shape and size, however, in other applications the mats may be in a carved configuration such that the lower mats span a wider area and the size of the mats may be reduced the taller the support structure becomes (or vice versa in other embodiments). In applications where there are two or more mats that are spaced apart, standees are typically used to support a higher mat apart from a lower mat before the concrete can be poured. Standees are support elements that are usually bars bent in multiple planes and are specially fabricated pieces based on the applications in which they are used. The standees may be made from rebar or other types of bar. Within a typically support structure there may be one or more levels of mats with standees placed in between based on the depth of the support structure necessary for the application.

[0005] While rebar structures made from mats and standees usually have low material costs in most applications, there are a number of issues associated with the using these types of rebar structures, such as large tolerances, dangerous configurations, lack of conformability, quality assurance issues, high labor costs, and potential increased material costs in large applications, etc.

[0006] The tolerances issues associated with producing the standees (e.g. plus or minus an inch) are such that additional spacers may be necessary in order to secure the standees to the mats at the proper heights and to allow the mats to rest at the required positions to produce the desired surfaces of the reinforced concrete structure after the concrete is poured. Therefore, in order to determine where the spacers are needed during installation the locations of various points of the mats or standees are checked. The workers then added the spacers to make sure the mats are located at the proper level points. These steps increase the labor costs associated with positioning the mats in the required locations. Furthermore, while standees are typically used in applications in which they are less than four feet tall, in applications that require standees that are greater than four feet tall the tolerances issues may be amplified. Therefore, engineers are often required to design and approve the mats and standees that are used when the standees are greater than four feet tall, which again increases the costs.

[0007] Alternatively, or in addition to using spacers, workers may try to correct any tolerance issues when screeding the concrete. Screeding concrete relates to using a tool (e.g., often an elongated flat board) on the surface of the concrete to make sure the surface is level and in the proper orientation. Thus, in some embodiments, great care must be taken to add spacers to make sure the mats are in the correct locations and level before placing the concrete into the rebar structure, and to make sure that the concrete is properly screeded after the concrete is placed. The location of the concrete is checked using a laser level or other leveling device. The additional labor intensive processes of checking the position of the concrete during screeding, in order to compensate for tolerance issues in the standees, also results in higher labor costs associated with creating reinforced concrete structures.

[0008] Moreover, dangerous rebar configurations may occur in applications where the standees are greater than 4 feet. Lateral and twisting movement loads may be dangerous when the distance between mats (e.g., a top and bottom mat) is greater than approximately four (4) feet, such as for example when mats are six (6) feet apart. If standees are used in these configurations, the standees may buckle under loading during assembly or placement of the concrete and/or the standees may not be able to support the loads of the structure after the final structure is assembled. Therefore, great care must be taken to consider all forces acting on the standees. Standee spacing must be carefully determined to support the dead loads and the bracing must be adequate to handle all lateral forces. In the case of applications that are deeper than four feet, or with multiple layers of mats that are more than four feet apart, the number of standees used is increased in order to provide additional support. The additional design, the additional material, and the additional labor to assemble the multiple layers and standees may all result in increased costs. Furthermore, some applications may not be able to use standees or may require some other kind of support.

[0009] Conformability of the traditional rebar structures may also be an issue in applications that incorporate standees. Of particular importance, in applications that are repeatable such as multiple towers, multiple bridge supports, multiple
building foundations, or the like, the use of rebar mats and standees in structural supports incorporate inherent tolerance issues that may cause conformity issues between two or more of the same support structures. In many of these applications, the rebar standees and mats must be made and assembled specifically for each individual support structure. The lack of interchangeability of the structural rebar within the supports increases the material and labor costs when assembling the rebar support structures on site. As previously described workers must add spacers and check the positions of the mats before the additional layers may be built on top of the lower layers. This process has to be repeated for each support structure or layer even if the support structure or layer in the support structure has the same dimensions. Therefore, even if rebar is the cheapest material to produce and use in structural supports applications, the increased costs associated with installation and lack of interchangeability in repeatable support structures drives up the costs associated with building multiple similar or redundant support structures.

[0010] Quality assurance can also be an issue in the structural supports made of rebar mats and standees. For example, since most or all of the rebar is assembled together on site through the use of metal or plastic ties, welded, wired, etc., each joint may need to be examined, and again workers may need to check the height and plane orientations of the standees, mats, and concrete surfaces before and after placing the concrete in order to make sure the rebar structure and finished support structure is assembled properly to support the required loads. The quality assurance issues lead to increased labor costs.

[0011] The number of standees necessary in a support structure is dictated by the depth and width of the support structure, as well as the structure being supported by the support structure. The larger the upper rebar mats and the greater distance between the bottom and top mats, the larger the standees and/or the more standees between the mats are necessary. In some embodiments there may be two or more layers of mats in order to provide enough structural support in support structures that require a large depth. As the standees increase in number and size within a support structure the greater the chance is that one or more the issues described above will occur.

[0012] In addition to the issues described above, the standees only provide support at a specific point under the mat, and thus, the rebar in the mat may sag in areas where it is not directly supported by a standee, which increases the error in the positional tolerances of the rebar mats. This again increase the costs associated with screeding the concrete to the proper positions required by the reinforced concrete structure.

[0013] The use of standees results in the issues discussed above (e.g. increased tolerances, dangerous configurations, conformity issues, quality assurance problems, or the like), which all may contribute in increasing the overall costs associated with using standees in support structure applications.

[0014] The following presents a simplified summary of one or more embodiments of the present invention in order to provide a basic understanding of such embodiments. This summary is not an extensive overview of all contemplated embodiments, and is intended to neither identify key or critical elements of all embodiments nor delineate the scope of any or all embodiments. Its sole purpose is to present some concepts of one or more embodiments in a simplified form as a prelude to the more detailed description that is presented later.

[0015] Embodiments of the present invention utilize trusses in place of standees for rebar support structures used in building reinforced concrete structures. There are a number of benefits associated with utilizing trusses as opposed to standees when building support structures. For example, the trusses can be manufactured with tolerances that are tighter than the standees. The improved tolerances allow the support structure to easily conform to the dimensional requirements during installation, and also allow even screeding of the concrete without the need to check the position of the concrete surfaces using a laser level or other leveling device. The trusses also provide continuous support under the mat at a constant height, and thus, as a result can be spaced further apart when compared to standees, which require placement at closer intervals under the mat. The use of truss configurations instead of standees reduce the uneven stresses and deflections that could be placed on the structure when using standees, prevent the need for spacers or additional screeding in order to make sure the reinforced concrete structure is level, reduce the labor costs associated with assembling the rebar structure, etc. Furthermore, the trusses improve the conformability of the support structures in that the trusses may be interchangeable throughout various similar support structures. Therefore, the rebar support structure may be assembled faster, using less labor, with more accuracy, in a repeatable process. These benefits all reduce the costs associated with installing the support structures on site. Trusses, unlike the standees, can be assembled in sections, which reduces the number of necessary joints, and thus, improves quality assurance issues caused when using the individual standees. Moreover, since the trusses provide a continuous support element for the mats the trusses are more stable, more structurally sound, and less susceptible to lateral and twisting loading than the standees, and thus, are less dangerous than the standees.

[0016] One embodiment of the invention is a support apparatus, wherein the support apparatus comprises one or more mats, one or more trusses operatively coupled to the one or more mats to form a support structure, and wherein the support structure is at least partially surrounded by concrete to form a reinforced concrete support.

[0017] In another embodiment of the invention, the support apparatus, further comprises a screed guide bar operatively coupled to the support structure, and wherein the screed guide bar is used as a positioning device to screed the concrete.

[0018] In yet another embodiment of the invention, the screed guide bar is removeably coupled to the support structure such that it can be removed from the support structure after screeding. In still another embodiment of the invention, a void left by the removal of the screed guide bar is at least partially filled with concrete.

[0019] In further accord with an embodiment of the invention, the screed guide bar is used as the positioning device to screed the concrete, such that no additional positioning devices are required to determine a position of the concrete during screeding.

[0020] In another embodiment of the invention, the one or more mats comprise a bottom mat, a top mat, and an intermediate mat, and wherein one of the one or more trusses are operatively coupled between the bottom mat and the intermediate mat, and another of the one or more trusses are operatively coupled between the intermediate mat and the top mat.
In yet another embodiment of the invention the one or more trusses are operatively coupled to the one or more mats, such that no additional positioning of the mats with spacers is required. In still another embodiment of the invention the support apparatus, further comprises cross bracing between two or more trusses to provide additional support in the reinforced concrete structure.

Another embodiment of the invention is an apparatus comprising a screed guide bar removably coupled to a support structure, wherein the support structure comprises at least one rebar mat and at least one truss, and wherein the screed guide bar is used during screeding, after concrete covers at least a portion of the support structure, to position a level of the concrete using at least a portion of the screed guide bar as a guide.

In another embodiment of the invention, a void left by the removal of the screed guide bar after screeding is at least partially filled with concrete.

In still another embodiment of the invention, the screed guide bar is used as the positioning device to screed the concrete, such that no additional positioning devices are required to position the level of the concrete during screeding.

Further accord with an embodiment of the invention, the support structure comprises a bottom mat, a top mat, and an intermediate mat, and wherein trusses are operatively coupled between the bottom mat and the intermediate mat, and trusses are operatively coupled between the intermediate mat and the top mat.

In yet another embodiment of the invention, the truss is operatively coupled to the mats, such that no additional positioning of the mats with spacers is required.

Another embodiment of the invention comprises a method for forming a reinforced concrete structure. The method comprises installing trusses; installing mats wherein the mats are operatively coupled to the trusses to form a support structure; installing a screed guide bar, wherein the screed guide bar is operatively coupled to the support structure; supplying concrete to the support structure; and screeding the concrete into a proper position using a screed bar and at least a portion of the screed guide bar as a guide.

In another embodiment of the invention, the screed guide bar is removably coupled to the support structure such that after screeding at least a portion of the concrete, the method further comprises removing the screed guide bar from the support structure, and filling at least a portion of a void left by the screed guide bar with concrete.

In still another embodiment of the invention, the screed guide bar is used as a positioning device to screed the concrete, such that no additional positioning devices are required to determine the proper position of the concrete during screeding.

In yet another embodiment of the invention, the mats are operatively coupled to the trusses such that no additional positioning of the mats with spacers is required.

In further accord with an embodiment of the invention, installing the trusses comprises installing at least partially pre-assembled trusses at the installation site.

In another embodiment of the invention, installing the trusses comprises installing cross bracing between two or more trusses to provide additional support in the reinforced concrete structure.

In still another embodiment of the invention, installing the mats comprises assembling rebar in cross-patterns.

To the accomplishment the foregoing and the related ends, the one or more embodiments comprise the features hereinafter fully described and particularly pointed out in the claims. The following description and the annexed drawings set forth detail certain illustrative features of the one or more embodiments. These features are indicative, however, of but a few of the various ways in which the principles of various embodiments may be employed, and this description is intended to include all such embodiments and their equivalents.

BRIEF DESCRIPTION OF THE DRAWINGS

Having thus described embodiments of the invention in general terms, reference will now be made to the accompanying drawings, wherein:

FIG. 1 illustrates a flow diagram for a process of manufacturing and installing the trusses, in accordance with one embodiment of the present invention;

FIG. 2 illustrates a cross sectional planar view of an installed reinforced concrete structure, in accordance with one embodiment of the present invention;

FIG. 3A illustrates a planar view of the installed trusses in a reinforced concrete structure, in accordance with one embodiment of the present invention;

FIG. 3B illustrates a top view of the installed trusses and cross-bracing in a reinforced concrete structure, in accordance with one embodiment of the present invention;

FIG. 3C illustrates a side view of the installed trusses and cross-bracing in a reinforced concrete structure, in accordance with one embodiment of the present invention;

FIG. 4A illustrates a planar view of the end of a truss with a screed guide holder and screed guide bar, in accordance with one embodiment of the present invention;

FIG. 4B illustrates a front view of the truss, rebar mat, screed guide holder, and screed guide bar, in accordance with one embodiment of the present invention;

FIG. 5 illustrates a cross-sectional view of a footing structure with the rebar mats and trusses surrounded with concrete, in accordance with one embodiment the present invention;

FIG. 6 illustrates a top view of another rebar reinforced concrete structure configuration, in accordance with one embodiment of the present invention;

FIG. 7A illustrates a side view of a truss for the rebar reinforced concrete structure configuration, in accordance with one embodiment of the present invention; and

FIG. 7B illustrates a side view of a truss for the rebar reinforced concrete structure configuration, in accordance with one embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Embodiments of the present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all, embodiments of the invention are shown. Indeed, the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

As illustrated by block 10 in FIG. 1, the manufacturing and installation process 1 comprises receiving requirements for a reinforced concrete structure. The requirements
may be, but not limited to, the dimensions of the reinforced concrete structure, such as the surface contours (e.g., bends, curved surfaces), the load forces, the locations of loading, etc. For example, in one embodiment of the invention the reinforced concrete structure may be a bridge abutment or girder. In other embodiments the reinforced concrete structure may be a tower footing support. In still other embodiments of the invention, the reinforced concrete structure may be building foundation pads. In the embodiment illustrated herein the reinforced concrete structure may be a base footing support for a tower, such as a wind tower, as illustrated in FIGS. 2 through 7B.

[0049] As illustrated in block 20, the trusses 210 designed for the reinforced concrete structure are determined based on the reinforced concrete structure requirements identified in block 10. For example, the number of trusses 210 used in a structure may be determined based on the load required for the reinforced concrete structure, the size of the component structure footprint, the depth of the reinforced concrete structure, etc. In some embodiments, a number of different truss sizes are needed for a reinforced concrete structure. In other embodiments of the invention, the same trusses 210 can be used throughout the reinforced concrete structure. FIG. 2 illustrates a perspective cross-sectional view of a wind tower base support 200 without the concrete, which is provided as an example of a support structure used in a reinforced concrete structure. The base support 200 comprises a bottom rebar mat 202 and top rebar mat 204. The mats may be made of one or more independent sections of rebar in a crossed pattern. The rebar used to make mats may be the same size or may be various sizes. For example, as illustrated by the bottom rebar mat 202 and the top rebar mat 204 the rebar is laid in a crossed square pattern. In other embodiments of the invention the rebar may be crossed in other types of patterns. In some embodiments of the invention the mat may be planar as illustrated by the bottom mat 202 or the mat may have bends or kinks, such as the top mat 204. In still other embodiments of the invention the mat may have a radius that would result in a curved surface in the reinforced concrete structure. The top mat 204 should generally conform to the upper surface of the concrete and maintain the required clearance based on the final dimensions of the reinforced concrete structure. In some embodiments, the reinforced concrete structure may have one or more intermediate mats located between the top mat 204 and the bottom mat 202. In still other embodiments, the top mat 204 and/or bottom mat 202 may not be used and instead only intermediate mats are used in the reinforced concrete structure.

[0050] FIG. 3A illustrates a support structure for a reinforced concrete structure without illustrating the bottom mat 202 and the top mat 204, in order to provide a clearer view of the trusses 210. As previously discussed, the trusses 210 in the reinforced concrete structure may have one or more trusses 210 that are same size or may have one or more trusses 210 that are different sizes, such as the interior trusses 212 and exterior trusses 214 illustrated in FIG. 3A. FIG. 3A also illustrates that the trusses 210 may be utilized with other types of supports, such as an anchor bolt cage support 310 illustrated in FIG. 3A. The anchor bolt cage 310 or other type of support may be used to secure other portions of a support structure (e.g., a tower) to the base of the reinforced concrete structure.

[0051] In some embodiments of the invention the trusses 210 may have the ability to receive a screed guide bar 400. A screed is a flat board, an aluminum tool, or other like tool used to smooth concrete after it has been placed on a surface. Manual screeds may be simple bars or may be coupled to a tool to aid in screeding the concrete. Power screeds may be up to forty (40) feet long or more, and may be attached to an engine that vibrates the screed to settle the concrete in the structure and remove air bubbles in the concrete.

[0052] As illustrated by FIG. 4A, a screed guide bar 400 may be located above the trusses 210 and utilized to help level the top of the reinforced concrete support surface in line with the screed guide bar 400. The trusses 210 in the present invention may be manufactured to within approximately one-eighth (1/8) of an inch or less (or in some embodiments within larger tolerances that are greater than 1/8 of an inch). Due to the tight tolerances of the trusses 210 the reinforced concrete structures are more likely to be built to the dimensional and load limits that the engineers originally designed for a reinforced concrete structure, as opposed to reinforced concrete structures built using standees. The use of trusses 210 instead of standees increases the support provided by the support structure and results in reinforced concrete structures that are within tolerances ranges. In using trusses 210 instead of standees workers are not required to monitor the position of the concrete at all, or as often, as they would have been required to do when using standees. The use of trusses 210 increases the likelihood that the reinforced concrete structure meets the dimensional and load requirements designed by the engineers.

[0053] The screed guide bar 400 may be placed on top of screed guide holders 410 that are operatively coupled to the trusses 210 through the use of any means known in the art, such as but not limited to welded, screwed, clamped, glued, etc. In one embodiment of the invention the screed guide holders 410 are v-shaped (as shown) or u-shaped and are capable of receiving tubular (as shown), square, rectangular, etc. shaped guide bars 400. Due to the tight tolerances of the trusses 210 the position of the surfaces of the reinforced concrete structure may be accurately formed during assembly without needing the additional labor hours it usually takes to determine if the concrete surface and reinforcing mats meet the specific positional requirements when using standees in the traditional structural support members, as explained in further detail later.

[0054] As illustrated by block 30 in FIG. 1 of the reinforced concrete structure manufacturing and installation process 1, the trusses 210 that were designed based on the requirements of the reinforced concrete structure in blocks 10 and 20 are manufactured to the required tolerances of the reinforced concrete structure. In the illustrated embodiment of the wind tower base support 200 of FIG. 3A, there are three interior trusses 212 and two exterior trusses 214. Like trusses 210 may be manufactured as interchangeable trusses 210 such that they are useable within any position in or between any of the multiple tower base supports 200 being installed.

[0055] The trusses 210 may be shipped to the customer on site for assembly as illustrated by block 40 of FIG. 1. In some embodiments, the trusses 210 may be pre-assembled before shipment or shipped in pieces and assembled on site. The assembled trusses 210 may be installed to form the support structure in the reinforced concrete structure as illustrated by block 50 in FIG. 1. During installation the trusses 210 are operatively coupled to the mats in the reinforced concrete structure. The trusses 210 can be secured to the mat in a number of different ways, such as but not limited to, through...
the use of metal or plastic ties, tire wire, welds, clamps, etc. In some embodiments of the invention cross-bracing 220, such as additional chords or web elements may be utilized to stand and/or position the trusses 210 in the vertical position on top of the rebar mats (e.g., bottom mat 202), as illustrated in FIGS. 3B and 3C. Furthermore, in some embodiments dobies may be used below the rebar mats (e.g., bottom mat 202) and/or trusses 210 to prevent displacement of the rebar mats and/or trusses 210 during concrete placement. In the illustrated embodiment used as an example herein, the trusses 210 and cross-bracing 220 are operatively coupled to each other and/or the rebar mats 202, 204 through the use of tie wire.

Once the trusses 210 are in place additional rebar mats (e.g., top mat 204 or intermediate mats) may be placed on top the trusses 210, as illustrated by block 60 in FIG. 1. The rebar mats being placed on top of the trusses 210 may be installed as one or more sections of assembled mats in stages, or as single bars one at a time. The rebar in the mats may be operatively coupled to the trusses 210 as previously discussed herein (e.g., through the use of metal or plastic ties, tie wires, welded, or the like). In the illustrated embodiment of a wind tower base support 200 described herein, the top rebar mat 204 is operatively coupled to the top chord of the trusses 210 to form a single support structure with a bottom rebar mat 202, trusses 210, cross-bracing 220, and a top rebar mat 204. The installed mats, trusses, and cross bracing maintain the support structure positioning while the concrete is placed and cured to form the reinforced concrete structure. In other reinforced concrete structures additional layers of trusses 210 and mats may be placed on top of the first layer if it is required due to the depth of the reinforced concrete structure necessary to support the final load of the finished structure. The mats and trusses 210 of additional layers may be assembled to each other as described throughout this specification.

As illustrated by FIG. 4B, in some embodiments of the invention after the top mat 204 is secured to the top chord of the trusses 210, a screed guide bar 400 may be operatively coupled to the trusses 210. The screed guide bar 400 provides a defined plane on the surface of the reinforced concrete structure to which a worker screeding the concrete has a reference for leveling the surface of the concrete.

The reinforced concrete structure illustrated in FIGS. 2 and 3 is formed using three interior trusses 212 and two exterior trusses 214, with cross bracing. If the reinforced concrete structure was installed in the traditional way utilizing standees the same type of reinforced concrete structure would require approximately five (5) different types of standees for a total of approximately one-hundred (100) standees. Therefore, installing five (5) trusses with cross-bracing, which does not require extensive screeding, is much less costly then assembling one-hundred (100) standees, which requires extensive positioning using spacers and/or screeding in order to make sure the support structure has the proper surface dimensions. Therefore, utilizing the trusses 210 instead of standees reduces the costs of installing reinforced concrete structures.

The concrete may be poured in and around the assembled support structure of mats and trusses 210, as illustrated in block 70 of FIG. 1. In some embodiments of the invention the concrete is poured into the support structure all at once, however, in other embodiments of the invention the concrete may be poured into different sections of the support structure at different times, such as in the bottom layer, then allowed to cure, then in the second layer built on top of the bottom layer, etc. The concrete surface is defined using a screed device (e.g., manual screed, power screed, or the like) and the screed guide bar 400 as a guide for leveling off of the concrete surface as described in block 80 of FIG. 1. In various embodiments of the invention, either before, during, or after the concrete is curing the screed guide bar is removed, and thereafter in some embodiments additional concrete is placed into the resulting void left by the removal of the screed guide bar 400. Use of the term concrete herein may include the traditional use of the term concrete, which is a mixture of a cementing material, aggregate, and water, or otherwise refer to cement only, or other hardening material used in a support structure to create a reinforced support structure.

FIG. 5 illustrates a cross-sectional view of the wind tower base support 200 that has been filled with concrete. The base support 200 illustrated as an example herein, has a bottom mat 202, a top mat 204, trusses 210, and cross-bracing 220 that forms the lower base 502 to indirectly support an installed tower, while the anchor bolt cage support 504 directly supports the tower. In the illustrated embodiment, the concrete in the lower base 502 may be formed first, such that the trusses 210 and mats are covered by the concrete and a bottom embedment ring and lower portions of the anchor bolts 506 are incased in the concrete. Thereafter, the anchor bolt cage support 504 concrete is poured into the anchor bolt cage support 504, screed, and left to harden.

Utilizing trusses 210 instead of standees provides a number of benefits to the reinforced concrete structures, such as improved tolerances, continuous support, interchangeability, conformity, structural stability, reduced support weight, etc., which all contribute to reduced material, assembly labor, and screeding labor costs, as well as improved structural stability of the reinforced concrete structure.

The improved tolerances allow the concrete to be screed evenly without the need to check dimensional points using a laser level or other leveling device to make sure the reinforced concrete structure is within the proper tolerances. The continuous support under the mat at a constant height allows for spacing the trusses 210 and creating support locations that are further apart than if standees were used, while at the same time providing increased support to the mats. This configuration improves the tolerances of the positional placement of the rebar mat, reduces the total support weight, and again allows easy screeding of the concrete evenly with reduced labor. The conformability of the reinforced concrete structures allows the manufacturing of standard interchangeable trusses 210 for repeatable reinforced concrete structure elements. The increased conformability reduces the on-site manufacturing and assembly costs since the trusses 210 may be assembled within and between multiple reinforced concrete structures utilizing repeatable processes. The trusses 210 are less dangerous than the standees because they are more stable and more structurally sound, and thus, less susceptible to lateral and twisting loading. The need for fewer trusses 210 in place of the standees and/or fewer layers of mats (e.g. because trusses 210 with heights greater than 4 feet may be used), reduces the labor costs and increases the overall reinforced concrete support.

FIGS. 6, 7A, and 7B illustrate an alternate embodiment of a wind tower base support 600, in accordance with one embodiment of the invention. As illustrated in FIG. 6, the wind tower base support 600, in some embodiments may, utilize trusses 610 that are assembled in a pie or spoke configuration instead of in a horizontal position (as seen in FIGS.
2, 3A, and 3B). The wind tower base support 600 may utilize a first truss 612 and a second truss 614. The first truss 612, in some embodiments, may comprise of a sloped section 620 and a flat section 622, as illustrated by FIG. 7A. The second truss 614, in some embodiments may comprise of only a sloped section 620, as illustrated by FIG. 7B. The trusses 610 in the wind tower base support 600 illustrated in FIG. 6 through 7B may be installed in the same way previously described with respect to FIGS. 2 through 5. For example, the trusses 610 may be operatively coupled to each other using cross bracing, and/or coupled to a top mat and bottom mat utilizing tie wires or other fastening means. The trusses 610 may comprise screed guide bars 400 positioned within tight tolerances that allow workers to easily screed the concrete into the desired surface position without the issues that occur when using standees. Any other type of reinforced concrete structures may also be formed using the apparatuses and methods discussed and described herein.

Specific embodiments of the invention are described herein. Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments and combinations of embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A support apparatus, comprising:
   - one or more mats;
   - one or more trusses operatively coupled to the one or more mats to form a support structure; and
   - wherein the support structure is at least partially surrounded by concrete to form a reinforced concrete support.

2. The support apparatus of claim 1, further comprising:
   - a screed guide bar operatively coupled to the support structure; and
   - wherein the screed guide bar is used as a positioning device to screed the concrete.

3. The support apparatus of claim 2, wherein the screed guide bar is removably coupled to the support structure such that it can be removed from the support structure after screeding.

4. The support apparatus of claim 3, wherein a void left by the removal of the screed guide bar is at least partially filled with concrete.

5. The support apparatus of claim 2, wherein the screed guide bar is used as the positioning device to screed the concrete, such that no additional positioning devices are required to determine a position of the concrete during screeding.

6. The support apparatus of claim 1, wherein the one or more mats comprise a bottom mat, a top mat, and an intermediate mat; and wherein one of the one or more trusses are operatively coupled between the bottom mat and the intermediate mat, and another of the one or more trusses are operatively coupled between the intermediate mat and the top mat.

7. The support apparatus of claim 1, wherein the one or more trusses are operatively coupled to the one or more mats, such that no additional positioning of the mats with spacers is required.

8. The support apparatus of claim 1, further comprising:
   - cross-bracing between two or more trusses to provide additional support in the reinforced concrete structure.

9. An apparatus, comprising:
   - a screed guide bar removably coupled to a support structure;
   - wherein the support structure comprises at least one rebar mat and at least one truss; and
   - wherein the screed guide bar is used during screeding, after concrete covers at least a portion of the support structure, to position a level of the concrete using at least a portion of the screed guide bar as a guide.

10. The apparatus of claim 9, wherein a void left by the removal of the screed guide bar after screeding is at least partially filled with concrete.

11. The apparatus of claim 9, wherein the screed guide bar is used as the positioning device to screed the concrete, such that no additional positioning devices are required to position the level of the concrete during screeding.

12. The apparatus of claim 9, wherein the support structure comprises a bottom mat, a top mat, and an intermediate mat; and wherein trusses are operatively coupled between the bottom mat and the intermediate mat, and trusses are operatively coupled between the intermediate mat and the top mat.

13. The apparatus of claim 9, wherein the truss is operatively coupled to the mats, such that no additional positioning of the mats with spacers is required.

14. A method for forming a reinforced concrete structure, comprising:
   - installing trusses;
   - installing mats, wherein the mats are operatively coupled to the trusses to form a support structure;
   - installing a screed guide bar, wherein the screed guide bar is operatively coupled to the support structure;
   - supplying concrete to the support structure; and
   - screeding the concrete into a proper position using a screed bar and at least a portion of the screed guide bar as a guide.

15. The method of claim 14, wherein the screed guide bar is removably coupled to the support structure such that after screeding at least a portion of the concrete, the method further comprises:
   - removing the screed guide bar from the support structure;
   - filling at least a portion of the void left by the screed guide bar with concrete.

16. The method of claim 14, wherein the screed guide bar is used as a positioning device to screed the concrete, such that no additional positioning devices are required to determine the proper position of the concrete during screeding.

17. The method of claim 14, wherein the mats are operatively coupled to the trusses such that no additional positioning of the mats with spacers is required.

18. The method of claim 14, wherein installing the trusses comprises installing at least partially pre-assembled trusses at the installation site.

19. The method of claim 14, wherein installing the trusses comprises installing cross bracing between two or more trusses to provide additional support in the reinforced concrete structure.

20. The method of claim 14, wherein installing the mats comprises assembling rebar in cross-patterns.