SYSTEM AND METHOD FOR SLIP FORMING CONCRETE SLOTTED DRAINS

Inventor: Howard Cooper, Santa Ana, CA (US)

Correspondence Address:
KNOBBE MARTENS OLSON & BEAR LLP
2040 MAIN STREET, FOURTEENTH FLOOR
IRVINE, CA 92614 (US)

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ABSTRACT

A system for making slotted drains of slip-formed concrete can comprise concrete, a block, a drain path forming structure, a hopper and a mold. The hopper can be for receiving concrete and for providing concrete to the mold for molding concrete. The mold can comprise a drain member guide, a topper, a first side and a second side. The drain member guide can be configured to slide over the drain path forming structure and wherein the hopper can be configured to provide concrete around the drain member guide. The topper, first and second sides can be for molding the top, first and second sides of the slotted drain respectively. The second side can also be configured to create a slot in the slotted drain and to selectively hold the block, the slot configured to selectively receive the block.
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BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates generally to slip-form construction involving wet concrete and, more particularly, to slip-form construction of concrete drains.

[0003] 2. Description of the Related Art

[0004] Slip-form construction is a method of building involving wet concrete. The name refers to the moving form or mold the concrete is poured into, which moves along the project as the previously poured concrete hardens behind it. Slip-form relies on the quick-setting properties of concrete requiring a balance between early strength gain and workability. The technique has been applied to large buildings and to road construction.

[0005] In recent years, the drainage or lack of drainage on United States roadways has come under close scrutiny as related to the affect of the drainage on the roadway itself. It has been found that proper drainage can be a key factor in extending the life of the roadway. The Federal Highway Administration (FHWA) and others have done extensive research, over multiple States, into proper drainage techniques. These studies have established the need for installation of proper subsurface drainage systems along America’s highways. [U.S. Dept. Fed. Highway Admin., Summary of Federal Highway Administration’s Drainage Efforts, Feb. 5, 2002, http://www.fhwa.dot.gov/pavement/drain.cfm.]

[0006] The current installation of subsurface drains along roads in the United States is a complicated and labor intensive process. It involves many steps, many of which must be completed or finished by hand.

[0007] Initially, the drain area is trenched to sufficient depth and width so as to act as a form for wet concrete. Then, metal pipes or other types of conduit are placed in the trench. These conduits can have prefabricated down spouts and grating which are generally positioned directed above the center of the drain. Once in the trench, the conduit must be set in the proper location within the trench. This time consuming step is accomplished by leveling the conduit by hand using various sized shims.

[0008] Once properly positioned, small amounts of concrete are poured at certain intervals along the conduit to act as anchors, holding the conduit in place and ensuring that the conduit will not become dislodged in subsequent steps. These anchors are loosely poured and are not tightly packed, potentially trapping air in the finished product which can lead to points of structural instability. Finally, additional concrete is poured around and along the entire conduit. In addition to directing the concrete around the conduit by hand, the drain is also finished to grade by hand while the concrete is still wet. In some cases, reinforcing iron bars or rebar is shaped and placed under and around the proposed drain or conduit as well.

[0009] Because the subsurface drains typically include downspouts and grating centered over the pipe, the typical subsurface drain can not function as foundation for other structural components, for example curbs or barrier rills. If the project calls for an additional structural component, the drain is completed in a first phase of construction and the additional component is fabricated adjacent to the drain in a separate, second phase of construction.

[0010] There are currently three typical conventions for placement of subsurface slotted drains. They may be installed along a roadside. They may be installed next to a barrier rail or wall. Or they may be installed next to a curb. In each case, the drain installation is generally independent from the installation of other features such as the mentioned road, barrier rail, wall, curb, etc.

[0011] A typical installation of a drain with an adjacent curb is therefore a minimum of a five phase process. In the first phase, the area is prepped for the drain including trenching, laying rebar in the trench and laying the drain conduit over the rebar. In the second phase, the position of the drain conduit is fixed by hand, shimming the conduit along the length of the drain and periodically anchoring it with plugs of concrete. In the third phase, another pass along the drain is made where concrete is poured over the conduit and is distributed by hand and hand finished to grade. The poured concrete is then left to dry. In the fourth phase, the adjacent area is prepped for the curb. In the fifth phase, a slip-form machine forms the curb along the adjacent drain. The process requires multiple passes and time consuming, labor intensive steps.

SUMMARY OF THE INVENTION

[0012] For the reasons including those discussed above, there exists a need for improved systems, molds and construction methods for installing subsurface drains and slotted drains that can, for example, reduce cost, reduce the amount of human labor required for installation, reduce the number of steps required, simplify the process and reduce redundancies.

[0013] In some embodiments, a system for making slotted drains of slip-formed concrete can comprise concrete, a block, a drain path forming structure, a hopper and a mold. The hopper can be configured for receiving concrete and for providing concrete to the mold for molding concrete. The mold can comprise a drain member guide, a toppler, a first side and a second side. The drain member guide can be configured to slide over the drain path forming structure and the hopper can be configured to provide concrete around the drain member guide. The toppler, first and second sides can be for molding the top, first and second sides of the slotted drain respectively as they are passed along the area intended for the drain. The second side can also be configured to create a slot in the slotted drain and to selectively hold the block, the slot configured to selectively receive the block.

[0014] According to some embodiments, a mold for use with a slip-form machine can comprise a drain member guide, a first portion, and a second portion. The first portion can be configured to receive concrete and direct the concrete around a portion of the drain member guide. The second portion can be configured to shape the concrete to a desired shape. The second portion can comprise a top portion, a first segment and a second segment. The top portion can be configured to shape a top of the concrete in a flat linear manner. The first segment can be connected to the top portion and can be configured to shape a first side of the concrete. The second segment can be configured to shape a second side of the concrete with a slot along the second side of the concrete. The second segment can also be connected to both the top portion and the drain member guide. According to some embodiments, the mold can further comprise one or more rebar guides.

[0015] Additional embodiments of a mold for slip-forming a concrete slotted drain can comprise a cylindrical metal pipe and a forming apparatus. The forming apparatus can com-
prise a top member and a side member. The top member can be configured to be above a part of a top of the cylindrical metal pipe. The top member can have a flat bottom surface parallel with the axis of the pipe and the top member can be configured to substantially block concrete from flowing over the bottom surface and can direct concrete between the bottom surface and the top surface of the pipe. The side member can be connected to and, in some embodiments, at an angle from the bottom surface of the top member. The side member can have a portion formed by or attached to a side of the cylindrical metal pipe and can have a closed end. According to some embodiments, the side member can be further configured to hold an elongated block.

Some embodiments of a mold for use with a slip-form machine can comprise an outer housing, a drain member guide and a void forming projection extending outwardly from the drain member guide. Some embodiments may further comprise one or more dropout side shields.

A method of laying slip-formed concrete, according to some embodiments, can comprise laying a main drain portion which can define an outer surface, and positioning a guide member around the main drain portion. The guide member can comprise a void generating outward projection. The method can further comprise initiating the flow of concrete onto the guide member, encouraging the concrete to shift around substantially all of the outer surface of the main drain portion and moving the guide member along the main drain portion. The method can include the step of generating a void in the concrete along a predetermined portion of the main drain portion. The void can expose the outer surface of the main drain portion to the atmosphere.

The method according to some embodiments can include the step of selectively inserting a secondary material into the void as the guide member moves along the main drain portion. The method can also include a guide member further comprising a rebar guide and the step of selectively inserting rebar along the rebar guide into an outer surface of the concrete. In addition, where at least a portion of the rebar extends above the outer surface of the concrete, the method can further comprise forming a concrete barrier over and connected to the rebar.

In some embodiments, a combination curb and slotted drain is prepared in two phases. In the first phase, the area is prepped for the drain including trenching, laying rebar in the trench (if required) and laying the drain conduit over the rebar. In the second phase, a single pass of the slip-form machine properly positions the conduit, forms the concrete drain around the conduit, allows the placement of downspouts as needed and forms the finished curb above the drain. In the same phase, holes can be hand finished as needed as the machine passes along the drain area.

These and other objects of the present inventions will become readily apparent upon further review of the attached drawings and specification.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the inventions, and the manner of attaining them, will become apparent by reference to the following description of preferred embodiments of the inventions taken in conjunction with the accompanying drawings.

FIG. 1 is a perspective front view of an embodiment of a system to create a drain by slip forming concrete. FIG. 2 is a perspective rear view of an embodiment of a system to create a drain by slip forming concrete. FIG. 2A is a rear end cross-sectional view of the slip form mold of FIG. 2. FIG. 3A is a cross-section of a drain showing the placement of rebar which will serve as a foundation for another structure. FIG. 3B is a cross-section of a drain-foundation with a barrier wall being slip formed on top and with a void filler still in place. FIG. 3C is a cross-section of a curb with a drain and drain opening. FIG. 3D is a cross-section of a drain with a vertical down-spout. FIG. 4 is a schematic view of concrete being poured into a hopper of a slip form mold, showing a general overview of the position and location of a slip form mold in a trench with relation to rebar and a conduit, according to some embodiments.

FIG. 5 is a rear view of an embodiment of a slip form mold with a conduit shaped guide around a balloon in a trench. FIG. 5A is a rear view of an embodiment of a slip form mold with a conduit shaped guide around a steel pipe in a trench. FIG. 6 is a rear view of an embodiment of a slip form mold beginning to form a concrete drain in a trench. FIG. 7 is a rear view of an embodiment of a slip form mold showing a finish form that is shaping the top of the concrete.

FIG. 8 is a rear view of an embodiment of a slip form mold and the top of a newly formed drain, and showing a foam block being inserted into a void in the concrete created by an outwardly extending projection. FIG. 9 is a view of a slip formed drain, newly formed, with rebar inserted along the drain and void filler in the drain openings, but with no rebar along the drain openings.

FIG. 10 is a view of the internal structure of a slip formed drain, newly formed, with the foam block still in the drain opening and the conduit removed.

FIG. 11 is a view of a slip formed barrier wall formed on a slip formed drain-foundation.

FIG. 12 is a view of a slip formed drain, newly formed, showing a single grade on the left side.

FIG. 13 is a view of the slip formed drain of FIG. 12 in a completed state.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the figures and the description below, certain preferred embodiments of a system and method of installing subsurface drains or conduits in wet concrete will be described. Such drains or conduits may be installed in, for example, roads, road shoulders, road curbs, barrier rails, road side retaining walls, or road side sound or sight barrier walls. The molds and methods disclosed herein can be adapted for use with slip-form construction machinery as known to those of skill in the art.

FIG. 1 illustrates one embodiment of a system 10 that can comprise a hopper 42 for receiving concrete and a concrete slip form mold 20 that can extrude a drain 30. As will be explained below, the system 10 can extrude while simultaneously forming and finishing a drain 30 (see FIGS.
the drain 30 can be a stand alone drain or can act as a foundation and drain combination. The mold 20 of some embodiments can be configured to extrude a shape and dimension to accommodate (a) various drain or conduit void forms including circular, elliptical, or polygon, (b) intermittent or continuous inlets including cylindrical openings, scuppers, and elongated trapezoidal down spouts, (c) drain or conduit void forming materials including inflated PVC balloon and prefabricated pipe or conduit consisting of metal, corrugated steel, plastic, and/or resin, and/or (d) instillation of down spout entry and entry gratings. For example, FIG. 3A shows a schematic cross-section of a slip-formed foundation and drain combination according to some embodiments. FIG. 3B shows a barrier slip-formed over the foundation and drain combination shown in FIG. 3A. FIG. 3C shows a schematic cross-section of a slip-formed curb and drain combination according to some embodiments. FIG. 3D shows a schematic cross-section of a slip formed down drain positioned over the center of a drain according to some embodiments.

As seen in FIGS. 1 and 2, the slip form mold 20 can be used to form the drain 30. The mold 20 of some embodiments can comprise a finish form 28 and a conduit shaped guide 14 suspended from the finish form 28. The conduit shaped guide 14 according to a preferred embodiment can be made of steel. The conduit shaped guide 14 can optionally have a front flange 35. The front flange 35 can project forward from the front of the guide 14 and can ease mounting the guide 14 on a conduit 6 (see FIG. 4). The flange 35 can help to center the guide 14 on the conduit 6. The flange 35 can also help ensure that the conduit does not enter into the guide 14. The flange 35 can be formed in various shapes. One example is of a flared flange 35 in FIGS. 1 and 2. Another example is an outwardly projecting flange (not shown). Some embodiments can have a flange 35 of other shapes that can achieve some or all of the benefits heretofore described.

The guide rail 33 can be particularly useful in regards to the use of a conduit 6 made from corrugated steel. This type of conduit 6 typically has multiple ridges which could become caught on the end of the conduit shaped guide 14. The flange 35 can reduce the likelihood of the conduit shaped guide 14 catching on the front end of the conduit shaped guide 14.

The slip form mold 20 can also comprise a guide rail 33. The guide rail 33 can be an outward extension of most any shape that can be along the side or sides of the conduit shaped guide 14. In some embodiments, the guide rail 33 is a steel bar that is welded onto the conduit shaped guide 14. In some embodiments, the guide rail 33 is formed integrally with the conduit shaped guide 14. In some embodiments, the guide rail 33 can span only a portion of the conduit shaped guide 14, for example, a forward portion 15 of the conduit shaped guide 14.

The forward portion 15 of the conduit shaped guide 14 can also be beneficial to slip-forming the concrete drain 30. In particular, an elongated forward portion 15 can offset the front end and/or front flange 35 of the conduit shaped guide 14 from the hopper 42. This can ensure that concrete does not enter the front of the conduit shaped guide 14 as the mold 20 moves along the trench 2. This can also help to ensure that the mold 20 forms a smooth interior drain region. This can also be helpful to obviate the potential problem of concrete getting caught between the conduit shaped guide 14 and the conduit 6 which could bind up the system or cause other problems, such as popping the conduit 6 if a PVC balloon is used.

The guide rail 33 can help ensure the proper spacing of rebar 8 and the conduit shaped guide 14 as the mold 20 moves through the trench 2. The guide rail 33 can be used to help center the conduit shaped guide 14 within the trench 2 and/or the rebar 8. For example, the guide rail 33 can contact rebar 8 placed within a trench 2 and maintain proper spacing with respect to the rebar 8 within the trench 2. In addition, if the rebar 8 is improperly placed, the guide rail 33 and mold 20 can force the rebar 8 into the correct position. This in turn also helps provide the proper spacing for the placement of the conduit 6. The guide rail 33 can also work with the flange 35 to help ensure proper alignment of the conduit 6.

The conduit shaped guide 14 can lift and position or adjust the conduit 6 to the proper depth to grade and distance from the side walls of the trench 2. The conduit 6 can comprise, for example, a PVC balloon, corrugated pipe, or resin conduit. After the trench 2 is properly prepared, which will be described in more detail below, the conduit 6 can be placed in the trench 2. The conduit shaped guide 14 can be positioned around the conduit 6 within the trench 2 to properly position the conduit 6 during the slip forming of a concrete drain 30, as will also be described in more detail below.

The mold 20 according to some embodiments can have other features such as dropdown side shields, or mounting legs. Drop down side shields can allow the mold 20 to adjust the sides of the form. This can, for example, accommodate differing grades on the two sides of the trench 2. Mounting legs can be retractable or attachable/detachable and can be used for storage purposes when the mold 20 is not in use and to protect the mold 20, in particular to protect the guide 14 from becoming damaged or bent.

Whether or not the mold 20 has dropdown side shields, the mold 20 can form the sides of the form and it can do so in many different ways. For example, the mold 20 can provide a top surface that is generally flush with the grade to facilitate the formation of a top that is generally smooth and that concrete spillage over the sides of the trench is minimized. As another example, the mold can provide side surfaces that descend into the trench or that are generally flush with the grade along the trench, again to facilitate a generally smooth surface and that to minimize concrete spills over the sides. Or in some embodiments, the mold can provide one or both of the entire sides. In general, whether the mold provides some, all or none of the sides, the mold can be generally flush with a grade or surface to facilitate the formation of concrete with a generally smooth finish and that minimizes the amount of excess concrete that spills over or out.

The finish form 28 can also be made of steel, according to a preferred embodiment. The finish form 28 can shape and finish the top of the drain 30. In other words, where the trench 2 can provide the bottom and sides to the form, the finish form 28 can provide the top 34 (FIG. 2A). In certain embodiments, the finish form 28 can also provide the sides 36, 38, one side or some of the side or sides. The finish form 28 can make many different forms or shapes depending on the desired outcome. Some examples include, but are not limited to: a flat form, a step form that can create two different grades, one on each side of the form, and a flat top with angled or rounded sides.

The finish form 28 can extend from the rear of the hopper 42. The hopper 42 can be attached to the conduit shaped guide 14 with openings 43 on either side. This can
allow concrete to surround the conduit shaped guide 14. The finish form 28 can create certain openings at the rear of the hopper 42.

[0052] In some embodiments, the hopper 42 and finish form 28 to work together in the following way. Concrete 4 enters the hopper 42. The hopper 42 can transfer concrete 4 into the trench 2 and around the conduit shaped guide 14. The finish form 28 can control the contours of the top and sometimes the sides of the concrete 4. In this way, the finish form 28 can control the top shape of the extruded concrete 4. Also, in this way, the finish form 28 can grade and finish the exposed portions of the concrete 4.

[0053] A slip form mold 20 can also comprise a void forming projection 40 that can extend outwardly from the conduit shaped guide 14. The projection 40 can form a void 18 in the concrete 4 along the conduit 6. The void 18 can be used, for example, to form a drain opening or a scupper. The projection 40 can function similar to the finish form 28 in that it can control part of the form of the extruded concrete 4. Thus, the projection 40, as in FIG. 2, can force concrete to flow above and below the projection 40 but not through it, forming a void 18 (see FIGS. 3A-3C) in the concrete 4. Once the concrete 4 has completely left the mold 20, such a void 18 can be maintained, filled in or parts maintained while other parts filled in.

[0054] Outward extending projections 40 of different embodiments can be of various sizes, shapes and angles of projection. For example, the cross-section of the projection 40 can be generally rectangular, trapezoidal, or triangular. The cross-section of the projection 40 can also be a combination of arcs, or lines, or a combination thereof. The center of the projection 40 according to certain embodiments can be approximately 45 degrees from the horizontal axis of the center of the guide 14. In addition, the projection 40 can be configured to create a void 18 at one end and be open on the other end to hold a secondary material 16 (see FIG. 3B and FIGS. 6-8).

[0055] The secondary material 16 can be inserted into the void 18 in the cement 4 created by the projection 40. For example, the secondary material 16 can comprise a foam block 16 that can be inserted into the concrete 4 to preserve the void 18 in the concrete 4. The inserted foam block 16 can be precut to dimensions and angles desired for a scupper or drain opening. Once the concrete 4 is cured, the foam block 16 can be removed to form a drain opening. As an alternative example, the secondary material 16 can comprise a grate that could be inserted into the void 18 to form the drain opening. Depending on the embodiment, more may be required than solely inserting and in some cases, removing the secondary material 16, to create a scupper or drain opening. For example, it may be desirable to add additional concrete 4 to the area around the opening to create a scupper that is slightly above ground level for an “overflow” scupper which can limit a level of water from pooling in the area.

[0056] The slip form mold 20 can further comprise a rebar insertion guide 24. FIGS. 2 and 2A illustrate one embodiment of the rebar insertion guide 24. The rebar insertion guide 24 can extend past the conduit shaped guide 14 to facilitate the manual insertion of rebar 8 through the rebar insertion guide 24 along the newly formed drain 30. According to a preferred embodiment, the mold 20 can comprise a rebar insertion guide 24 on both sides of the mold 20. As the mold 20 moves along the trench 2, rebar 8 can be inserted into the concrete 4 with the aid of the rebar insertion guide 24. The rebar insertion guide 24 can provide a user with the proper orientation and location to insert the rebar 8 into the wet concrete 4. This can be particularly useful when the drain 30 is to serve as a foundation for another structure 22, as further explained below.

[0057] FIGS. 3A-D illustrate cross-sectional views of embodiments of drains 30 that can be created by various embodiments of a slip-form mold 20. As described above, FIG. 3A shows a drain 30 prepared as a foundation for a secondary structure 22, such as a barrier rail, as in FIG. 3B. The figures illustrate the possible position of the internal parts of the drain 30 such as the location of rebar 8, secondary material 16 and drain opening 18. FIG. 3B also shows a schematic of a secondary slip-form mold 26 forming the secondary structure 22. An additional embodiment is shown in FIG. 3C, where a cross-section of a curb is shown. FIG. 3D shows a cross-section of a drain 30 and vertical downspout 16 combination. The drain 30 is illustrated above the grade of the surrounding surfaces. According to some embodiments, the drain combination can be formed prior to the surrounding finished surfaces. For example, the road or side walk can then be filled or ground flush with or slightly above the drain 30. In this way the drainage system can be created before the surrounding road work. In some embodiments, a drain 30 could alternatively be formed in a trench or partly in a trench and partly above ground. Now turning to FIGS. 4-12, some embodiments can comprise a method of slip forming a drain 30. The method can comprise preparing the area for forming the drain 30. This can involve excavating the drain trench 2 with sufficient depth and width to act as a form for wet concrete 4 and placing the conduit 6 in the trench. Thus, the sides and bottom of the trench 2 can serve as part of a form. The method can also comprise placing rebar 8 in the trench or around the conduit 6 to provide added structural integrity to the finished drain 30.

[0058] The conduit 6 of certain embodiments can comprise metal pipe, PVC pipe, ABS pipe, PVC balloon, thin walled corrugated pipe, prefabricated slot drain pipe of metal or resin balloon, or pipe made of similar type materials. According to a preferred embodiment, the conduit 6 can comprise a PVC balloon. The PVC balloon can be placed into the trench 2 in a deflated condition and then inflated.

[0059] Depending on the embodiment, the conduit 6 may or may not comprise prefabricated slots 12, down spouts and/or grating. For example, some embodiments can comprise a steel pipe with slots 12 that have been precut in the pipe at preselected locations to allow access to the interior of the pipe as shown in FIG. 5A. The slots 12 can be opened prior to slip-forming the concrete body or can be left in place during the pour and can be later punched or otherwise opened after the pour. Such pipes are generally configured to remain inside the completed drain 30. As described in greater detail below, in some embodiments the conduit is removed after the concrete 4 has dried, such as when a PVC balloon is used. In such embodiments, slots 12 may be unnecessary as the entire outer conduit wall can be removed and the set concrete 4 can form the interior of the drain 30.

[0060] The method of some embodiments can further comprise placing the conduit 6 into a slip form mold conduit guide 14 and then pumping wet concrete into the slip form mold 20 through the hopper 42 (FIGS. 4 and 6). Passing the conduit 6 through the conduit guide 14 allows for simultaneous adjustment of the conduit 6 to the proper trench depth, angle and lateral position while surrounding the conduit 6 in wet con-
crete 4 to ensure a proper placement both as the concrete 4 dries and after it has hardened.

As concrete 4 is poured into the slip form mold 20, the mold 20 can vibrate to encourage compaction of concrete 4 into the void around the conduit 6. As the concrete 4 passes onto the mold 20, one or more elements (not shown) may be positioned on or near the mold to encourage the concrete to completely surround the conduit 6 and to substantially reduce the air pockets trapped in the concrete 4 during the setting process. In some embodiments, these elements include vibrating members that can use high frequency oscillations to condense the poured concrete 4. Reducing the amount and/or size of the air pockets in the concrete can increase the structural integrity of the finished drain or other molded form.

The mold 20 can be further shaped such that, as the mold 20 moves and forms the drain 30, the concrete 4 is smoothed to grade. The top of the drain 30 and finishing of the wet concrete 4 can be completed by the slip form mold 20. As the slip-form machine (not shown) moves along the trench 2, it can be guided by remote sensors (not shown) which can control the precise placement of the conduit 6 in the trench in one or more directions, greatly increasing the efficiency of the operation by eliminating the manual shimming required in prior art methods. The mold 20 can be manipulated in dimensions and angle to facilitate the manufacture of drains 30 incorporating equal or uneven grade on both sides of the trench 2. In some embodiments, the drain 30 can be efficiently installed, compacted, smoothed and finished in a single step with minimal work done by hand.

As explained above, in certain embodiments, the mold 20 can comprise the outwardly extending projection 40. As the mold 20 moves and forms the drain 30, it can also form the void 18 in the concrete 4 along the conduit 6. The shape of the void 18 which is formed can depend on multiple factors. These factors include, but are not limited to: the shape of the outwardly extending projection 40, the angle of projection 40 from horizontal, and the type or mix of concrete used. These factors and others can be factors in determining the ultimate shape of the void 18 that is formed as the mold 20 moves along the trench 2.

In addition, some embodiments of the method can involve filling in all or part of the void 18 with concrete 4. FIGS. 11 and 13 both illustrate examples where part of the void 18 has been filled in with concrete 4 and smoothed to complete the finished form.

The method according to certain embodiments can further comprise inserting a secondary material 16 into the concrete. This can be done after the conduit 6 has been adjusted and wet concrete 4 pumped into the mold 20. The secondary material 16 can be inserted into the void 18 created by the projection 40. This can serve to help maintain the shape of the void 18. Inserting a secondary material 16 according to some embodiments can serve to help bond the secondary material 16 to the drain 30, as in the case where a grate is used as the secondary material 16.

The secondary material 16 can comprise many different materials. For example, for those conduits 6 without a prefabricated down spout and grating, a down spout throat and grating can be inserted as the slip form mold 20 moves along. As another example, a block of wood or foam 16, or other material can be inserted into the poured concrete 4 along the conduit 6. This block 16 can later be removed to expose the void 18 in the concrete and provide access to the conduit 6 or to the internal structure of the formed drain 30.

According to some embodiments, the secondary material 16 can be inserted into the void 18 in the following manner. The mold 20 can have a holding area for holding the secondary material 16. The holding area can be the rear of the outwardly extending projection 40 wherein the forward end is closed off and the rear is open allowing the secondary material 16 to be held, see for example, FIG. 6. As appropriate, a worker can hold the secondary material 16 and push or insert it into the void 18 formed by the projection 40. The worker can hold the secondary material 16 in place and let the movement of the mold 20 create a location for the secondary material 16 to be placed into until the secondary material 16 is fully inserted into newly extruded concrete 4 (FIG. 8). As explained previously, some portions of the void may require backfilling. As an example, it can be desirable to fill in the areas of the void 18 without secondary material 16. This can help the extruded concrete 4 to maintain its finished shape.

The mold 20 can continue along the trench 2 extruding concrete 4 to create the drain 30. Secondary material 16 may be inserted periodically or at desired intervals.

After the concrete 4 sets the conduit 6 can be removed. For example, when a PVC balloon is used as the conduit 6, the balloon can be deflated and removed. In certain other embodiments, such as for example, with the use of corrugated pipe, the conduit 6 can be left in place after the concrete 4 sets. The conduit 6 can establish the insides of the drain 30 within the trench 2, or in the case where the conduit 6 is removed, the conduit 6 can establish the mold for the concrete 4 which then can define the insides of the drain 30 within the trench 2. If desired, the secondary material 16 can also be removed. This can be desirable when the secondary material 16 comprises, for example, foam or wooden blocks. When the secondary material 16 comprises, for example, a grate or other permanent structure it can be undesirable to remove the secondary material 16. In addition, as discussed previously, the conduit 6 can comprise pipe with precut slots 12 that may require additional work to finish, such as punching out the slots 12.

With the concrete 4 set and the conduit 6 and secondary material 16 either removed or in place, as desired, the drain 30 has obtained its finished form.

The slip form concrete drain 30 according to certain embodiments can be integrated with a foundation for a road side structure 22 including, but not limited to: barrier rail, curb, retaining wall, and sound wall (see FIGS. 3A, 3B, 9 and 11). Such integration can eliminate the redundancy of having to create trenching 2 for both the road side structure 22 and the separate drain 30. For example, a drain 30 can be formed according to one of the embodiments described herein which can then be used to form a foundation for the above ground structure 22. To facilitate this function, any of the methods described herein can further comprise inserting rebar 8 into the poured wet concrete 4 at predetermined locations. As the mold 20 moves along the trench 2, rebar 8 can be inserted into the concrete 4. The rebar 8 can be inserted by hand. The insertion can be without any aids or with the aid of the rebar insertion guide 24 to provide the proper orientation and location to insert the rebar 8 into the wet concrete 4.

The method can further comprise pumping wet concrete 4 into a secondary slip form mold 26 and moving the secondary slip form mold 26 along the top of the drain 30 to form the desired structure 22.

When a secondary material 16 is inserted in the concrete 4 and the mold 20 is being used to create a founda-
tion, once the mold 20 passes over the drain 30 foundation the secondary material 16 inserted into the concrete 4 can remain in place during the pass of the secondary slip form mold 26. This can be beneficial to ensure that concrete 4 does not enter or block the void 18 previously created.

Once the desired structure 22 is poured, the secondary material 16 can remain or be removed and the integrated drain-foundation 30 and other structure 22, such as a barrier rail is formed. Similar integration of drain 30 and foundation can be completed for curbs, retaining wall, sound walls, etc.

While the described inventions are described in terms of specific embodiments, it is implicit that the inventions are not limited to these disclosed examples. The inventions may be embodied in many different varieties and should not be construed as limited to the embodiments set forth herein; rather these embodiments are provided by illustration purposes only. Undeniably, many modifications and other embodiments of the inventions will come to mind of those skilled in the art to which the inventions pertain, and which are intended to be and are covered by this disclosure, the drawings and the claims.

What is claimed is:

1. A system for making slotted drains of slip-formed concrete comprising:
   a block;
   a drain path structure;
   a hopper for receiving concrete and for providing concrete to a mold for molding concrete, the mold comprising:
   a drain member guide configured to slide over the drain path structure wherein the hopper is configured to provide concrete around the drain member guide;
   a topper for molding the top of the slotted drain;
   a first side for molding a first side of the slotted drain; and
   a second side for molding a second side of the slotted drain, wherein the second side is configured to create a slot in the slotted drain and to selectively hold the block, the slot configured to selectively receive the block.

2. The system of claim 1, wherein the drain path structure comprises metal piping.

3. The system of claim 1, wherein the drain path structure comprises an elongated balloon.

4. The system of claim 1, wherein the drain member guide is a metal pipe.

5. A mold for use with a slip-form machine comprising:
   a drain member guide;
   a first portion configured to receive concrete and direct the concrete around a portion of the drain member guide; and
   a second portion configured to shape said concrete to a desired shape comprising:
   a top portion configured to shape a top of the concrete in a flat linear manner;
   a first segment connected to the top portion and configured to shape a first side of the concrete; and
   a second segment configured to shape a second side of the concrete with a slot along the second side of the concrete, the second segment connected to both the top portion and the drain member guide.

6. The mold of claim 5, further comprising a rebar guide.

7. The mold of claim 5, further comprising a front flange, wherein the front flange projects outward from a front of the drain member guide.

8. The mold of claim 5 wherein the drain member guide is a cylindrical metal pipe.

9. A mold for slip-forming a concrete slotted drain comprising:
   a cylindrical metal pipe;
   a form comprising:
   a top member configured to be above a part of a top of the cylindrical metal pipe, having a flat bottom surface parallel with the axis of the pipe and the top member configured to substantially block concrete from flowing over the bottom surface; and
   a side member connected to and at an angle from the bottom surface of the top member and having a portion formed by or attached to a side of the cylindrical metal pipe and having a closed end.

10. The mold of claim 9, further comprising a rebar guide.

11. The mold of claim 9, wherein the side member is further configured to hold an elongated block.

12. A mold for use with a slip-form machine comprising:
   an outer housing;
   a drain member guide;
   a void forming projection extending outwardly from the drain member guide; and
   a pair of dropdown side shields.

13. A method of laying slip-formed concrete comprising the steps of:
   laying a main drain portion defining an outer surface;
   positioning a guide member around the main drain portion, the guide member comprising a void generating outward projection;
   initiating the flow of concrete onto the guide member;
   encouraging the concrete to shift around substantially all of the outer surface of the main drain portion;
   moving the guide member along the main drain portion;
   generating a void in the concrete along a pre-determined portion of the main drain portion, the void exposing the outer surface of the main drain portion to the atmosphere; and
   selectively inserting a secondary material into the void as the guide member moves along the main drain portion.

14. The method of claim 13, wherein the guide member further comprises a rebar guide, the method further comprising selectively inserting rebar along the rebar guide into an outer surface of the concrete.

15. The method of claim 13, wherein the main drain portion comprises steel pipe with preformed slots, the method further comprising punching out the preformed slots.

16. The method of claim 13, wherein the main drain portion comprises a balloon, the method further comprising:
   deflating the balloon; and
   removing the balloon.

17. The method of claim 13, wherein the secondary material comprises foam block, the method further comprising removing the foam block to expose the main drain portion.

18. The method of claim 13, wherein the secondary material comprises a preformed drain with grating that is not removed from the void.

19. The method of claim 13, further comprising vibrating the concrete around the main drain portion.
20. The method of claim 13, further comprising positioning rebar before laying the main drain portion.

21. The method of claim 14, wherein at least a portion of the rebar extends above the outer surface of the concrete, the method further comprising forming a concrete barrier over and connected to the rebar.