METHOD FOR FORMING CONCRETE BOX CULVERTS AND THE LIKE

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Abstract

Construction of a box culvert on an already-poured concrete base which includes a concrete riser at each edge thereof and studs encased in the base under the risers which extend horizontally outwardly therefrom by securing vertical wall forms to such studs so that the wall forms extend upwardly from the outer edges of the risers, connecting the upper edges of the wall forms together at their top by a longitudinal member of adjustable length, rolling interior mold apparatus between the risers and the vertical wall forms, such apparatus having vertical beams carrying vertical interior forms, the vertical beams being connected by expandible rods which force the interior vertical wall forms against the inner edges of the risers into an opposed relationship with the outer vertical wall forms, providing expandible rods connected to the vertical beams so as to maintain them and also the interior vertical wall forms in rigid parallel relationship, securing the outer vertical wall forms and the interior vertical wall forms together at their edges, securing a ceiling form across the upper edges of the interior vertical forms, pouring concrete into the space defined by the outer vertical wall forms and the interior mold apparatus to form the walls and top of the culvert, and when the concrete is sufficiently hardened, removing the forms by increasing the length of the longitudinal member securing the outer wall forms together, contracting the rods connecting the interior wall forms and moving the forms to the next station along the base to repeat the process.

References Cited

UNITED STATES PATENTS

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METHOD FOR FORMING CONCRETE BOX CULVERTS AND THE LIKE

This application is a continuation of Ser. No. 683,924, filed Nov. 17, 1967, and now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a method for the positioning of mold parts to receive concrete in the production of culverts and the like and the apparatus utilized for this purpose. More particularly, the invention concerns exterior and interior mold parts which cooperate with an already poured base having concrete risers at either end so that the mold parts can be rapidly positioned prior to pouring the concrete and removed after the concrete has been hardened.

The box culvert is, at least in this country, perhaps the most common type of poured concrete culvert. The box culvert design permits the accurate positioning of the reinforcement rods without having to conform same to special shapes. It is generally strong, provides ample space for the flow of water, is adaptable to roadways, and is reasonably economical of material cost for the results obtained. However, at least until the introduction of my invention, there has been no generally accepted significant changes in methods of constructing such culverts. As a rule, the forms were affixed in place by standard carpentry procedure; that is, in the contemporary process, large inside and outside wall forms, together with top forms, are nailed together at the site for the culvert. The outer wall forms are generally braced or otherwise urged against the edges of the risers of the base and the inner mold apparatus, generally plywood mold parts, are nailed to the outer mold part or otherwise braced by carpentry to remain in position when concrete is poured. The plywood mold pieces used in such construction last, on the average, 20 to 25 pours. The instant inventor was co-inventor for a method and apparatus (U. S. Pat. No. 3,277,556) which relates primarily to the positioning of molds and reinforcement rods in the construction of the base portion of the culvert. The method and apparatus disclosed therein is utilized to construct the concrete base for the invention, although it will be understood that conventional methods may also be used for this purpose if desired.

A problem with contemporary methods is the necessity that about one-half of the crew consist of skilled labor. A further problem is that molding apparatus suggested by the prior art has generally been limited to a particular construction and is not practical for the variety of specifications which exist in the normal construction businesses because of inventory costs.

The inventor has ascertained that his invention permits a labor cost reduction of about forty per cent, drastically reduces the skilled labor requirement, provides that the forms will outlast by many times forms used in conventional methods, and gives a cleaner and smoother concrete finish than is provided by prior art conventional construction methods. Moreover, the invention may be applied to a broad choice of sizes without requiring the practitioner of the invention to inventory an unduly large number of mold parts.

SUMMARY OF THE INVENTION

The invention in this case provides substantial savings and improves the construction of box culverts. Whereas one skilled in the art might give more weight to one aspect of the invention than to others, the inventor considers that there are two components of special importance. The first of these lies in the threaded studs which are initially embedded in the concrete base and provide an effective and efficient means of supporting and positioning the outer wall forms in the correct, rigid relationship with the concrete base. The second component is the connection members for the interior mold apparatus which cooperate with other elements to provide a strong and convenient means for anchoring the interior mold apparatus in a correct rigid relationship with the concrete base. These components, in their relationship with the other elements such as the adjustable fastening means which secures the tops of the outer molds together, assist greatly to make the method and apparatus as a whole a practical and commercially acceptable improvement for normal culvert construction operations.

Other objects, adaptabilities and capabilities will appear as the description progresses, reference being made to the accompanying drawings in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view illustrating the components of the invention about an already-poured section of box culvert;

FIG. 2 is an elevational view showing the invention;

FIG. 3 is a fragmentary perspective view of the connection between the interior expansible members and the upright beams which carry the interior mold;

FIG. 4 is a fragmentary sectional top view of the connection shown in FIG. 3; and

FIG. 5 is a fragmentary side elevation showing a barrier mold in place on the open end of the mold.

DESCRIPTION OF THE PREFERRED EMBODIMENT

After the necessary excavation, grading and preparation of underlying earth is completed, a concrete base 10 is laid with each edge including a riser 11, which is on the right, and 12, on the left, as seen in FIG. 2. Preferably the concrete base 10 is formed in accordance with the method set forth in U. S. Pat. No. 3,277,556. Inasmuch as various means for constructing a base 10 are well known, it is, however, not considered necessary to describe same in detail to impart an understanding of the instant invention to a person skilled in the art. In forming the base 10, however, a plurality of threaded studs are secured to extend outwardly from both sides of the base 10 under the risers 11 and 12. The threaded studs may, if desired, be carried by jack nuts which are completely encased in the concrete.

The studs 14 are aligned with care at, say, 8 inches under the top of the riser and spaced a predetermined distance apart, say 56 inches, to receive the vertical exterior beams 16 which carry the vertical mold forms 17. A standard length mold form is 16 feet and thus, with the studs 14 spaced 56 inches apart, 1 foot is provided between the edge of the mold form 17 and the stud 14 on each end.
The widths and heights of box culverts are generally specified by even feet. With knowledge of the specified height and width for a culvert's underpass, an interior mold apparatus designated generally 20 is fashioned about interior steel bracing designated generally 21. The bracing 21 comprises a plurality of vertical steel beams 22 with a fastening structure 24 welded thereto. As shown in detail in FIGS. 3 and 4, the fastening structure 24 comprises a U-shaped bracket 25 which is welded to the beam 22 and provides a space 26 at the side of beam 22 facing towards the center of base 10. A slot 27 is also provided in the spaced portion of the bracket 25. The space 26 together with the slot 27 is adapted snugly to receive the flanged part 30 and the tube portion 31, which is rigidly affixed to part 30. In order to provide the entire structure with rigidity, it is important that in the manufacture of the fastening structure 24, the tolerances be such that flange part 30 fits snugly although removably within the space 26.

Flange part 30 and tube part 31 are components of an expandable means designated generally 32 which also includes a joint 34 which rigidly connects tube part 31 to a further tube part 35 through flanges with bolts or other appropriate securing means. Extending from tube part 35 on the end away from joint 34 is a threaded rod 36 which receives a turnbuckle 37 which is, in turn, threadably received on its other end by a further rod 38 terminating in a flange part 30 snugly received by bracket 25.

As will be understood by reference to FIG. 2, a plurality of interior steel bracing parts 21 have secured thereto the interior wall forms 40. Each wall form 40 includes a plurality of ribs 41 rigidly secured thereto by bolts, nails or other appropriate means. Forms 40 are, through plates 42 and 44, affixed to the vertical beams 22.

In FIGS. 1 and 2 it will be noted that the vertical beams are each mounted on casters 43 which are turnable so that the interior steel bracing may be moved as desired along the upper surface of the base 10. The wall forms 40 are situated on beams 22 to overlap risers 11 and 12. Thus, if the risers are, say, 6 inches in height, the wall forms 40 may be, say, 4 inches from the base 10. When the interior steel bracing 21 with wall forms 40 is to be placed into its desired position, turnbuckle 37 is adjusted so that the distance between wall forms 40 is somewhat less than the distance between the risers 11 and 12. Upon bringing the interior steel bracing 21 into its desired location along base 10, shimming boards 48 are placed under the wall forms 40 which are raised slightly in the process, and the turnbuckles 37 are adjusted to force the lower portions of wall forms 40 against adjacent risers 11 and 12 and to insure that the wall forms 40 are vertically disposed. When so positioned, horizontal ceiling forms 46 are laid over the upper ends of the vertical beams 22 so that their biased edges 50 are received between the upper ends of the wall forms 40. The ceiling forms 46 also include a plurality of horizontal ribs 47. Boards 51 may be provided to extend longitudinally with reference to the culvert for the purpose of engaging the ends of the beams 22 and to bear forms 46 through ribs 47. A tight fit of the ceiling form 46 is insured by the inward adjustment of the upper expandable means 32 through its turnbuckle 37. The edges 50 have sufficient give that they can be moved towards each other a slight but significant distance. Turnbuckle 37 should not be tightened at this point to such an extent as to preclude further inward movement after the concrete has hardened.

From foregoing description it will be understood that the interior mold apparatus is braced rigidly in place with the lower expandable means 32 being generally in compressive stress urging the vertical beams 22 apart, whereas the upper expandable means 32 is in tension to provide a tight relationship between the horizontal ceiling forms 46 and interior wall forms 40.

With the interior mold apparatus 20 now in place, the exterior mold forms 17 having beams 16 secured thereto are maneuvered to receive threaded studs 14 in apertures 52 located in the lower portions of the beams 16. Wing nuts 54 are threadably received by the threaded studs 14 whereby they urge vertical beams 16 towards base 10. As was noted with reference to the interior wall forms 40, the exterior vertical mold forms 17 overlap the risers 11 and 12 and are thus urged against such risers through the agency of the wing nuts 54. The external vertical mold forms 17 include a plurality of horizontal ribs 55 which are affixed thereto. Beams 16 have welded or otherwise secured thereto plates 56 which carry forms 17, such forms being attached to plates 56 by nails or other securing means.

Disposed above the interior mold apparatus 20 and connecting to the upper ends of beams 16 are adjustable fastening members 60. These fastening members 60 are connected to beams 16 by a steel pin or bolt 61 which is received in one of the spaced horizontal apertures 62. Each member 60 comprises tube portions 64 and 65, which include the apertures 62. Oppositely threaded rods 66 and 67 which extend from the tube portions 64 and 65, respectively, are received by turnbuckle member 70. By properly selecting apertures 62 for the bolts 61 and adjusting the distance between the vertical beam 16 by means of turnbuckle 70, beams 16 and therefore forms 17 may be brought into vertical alignment.

In order to space the reinforcement rods 71 correctly with reference to forms 17 and 40, a plurality of spacers 72 known as highchairs are positioned to engage the reinforcement rods 71 and bear against the forms 17 and 40, as shown in FIG. 2. It has been found that these highchairs 72 frequently need not be nailed to the forms, whereby a smoother wall results. In the event, however, that the spacers fail to be brought against the forms, the threepenny nail is ample to secure the highchair to the adjacent form. The horizontal reinforcement rods 74 are similarly spaced from the horizontal mold 46 by means of a plurality of highchairs 75. As desired, further reinforcement rods may be similarly positioned relative to the forms.

An end barrier 80, illustrated in FIG. 5, may be secured by C-clamps 81 or other appropriate means across an open end or ends of the mold. In such case, in order to promote rigidity of the mold, the barrier 80 may also be nailed to ribs 41 of the interior mold apparatus 20. Alternatively, where other barrier means are provided, wood struts 84 may be nailed across the forms 17 and 40 for the purpose of maintaining the wall thickness when the pouring of concrete takes place.

With end barriers 80 or other appropriate barriers in place, the pouring is normally accomplished by first
poured concrete to about one-third of the height on one side and then pouring two-thirds of the height on the other side, followed by completely filling the first poured side, next the other side, and then the top area. Finally, the concrete is permitted to harden in a normal manner.

After the concrete has hardened to the point that the molds may be removed, the vertical wall forms 17 are easily loosened by turning turnbuckles 70 so as to extend the adjustable fastening members 60. Wing nuts 54 and bolts 61 are removed and the forms 17 can then be readily taken to the next section or from the area. The interior mold apparatus 20 is removed by removing shim boards 48, taking up on the upper and lower turnbuckles 37, and simply rolling the interior steel bracing 21 together with the interior wall molds 40 from under the concrete box culvert. As the vertical beams 22 are removed, the horizontal ceiling forms 46, if not already loosened, tend to loosen of their own weight and may be readily removed. The threaded studs 14 are screwed out of the jack nuts 15 or otherwise removed from the base 10. The holes which are left are filled with concrete after the operation is completed.

The expandible means 32 can be lengthened or shortened, if desired, by merely inserting different lengths of a further tube part 35. Also, in order to construct culverts of a number of different sizes, it is necessary to have steel vertical beams 22 of various lengths and horizontal ceiling forms 46 to correspond to various widths of the culvert opening. Otherwise, the same components can be used for constructing many different sizes of box culverts.

The above description and drawings disclose the preferred embodiments of my invention, but it is to be understood that it is capable of other adaptations and modifications within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A method of forming a concrete box culvert which comprises the steps of: pouring a concrete base so that it includes at opposite sides a pair of parallel risers having vertical side walls with the outboard walls of said risers extending vertically from a height below the surface of the base between said risers; causing to be embedded a plurality of parallel studs within the said base so as to extend horizontally and normally from the outboard walls under the level of said base surface between said risers; securing a pair of vertical wall forms to said studs whereby said wall forms are supported by said studs, urging said wall forms against the upper sides of the vertical sidewalls of said risers; adjustably fastening the upper end of said wall forms together by an adjustable fastening means; introducing an interior mold means between said risers, said interior mold means including a pair of vertical forms, a horizontal ceiling form, and horizontal extensible means connecting said pair of vertical forms; expanding said vertical forms of said interior mold means by horizontally lengthening said extensible means; allowing the inboard of said vertical sidewalls of said risers so that a pair of vertically extending channels are formed by said vertical forms of said interior mold means and said wall forms which channels are uninterrupted by any mold apparatus for maintaining said interior mold means and said wall forms in rigid relationship; pouring sufficient concrete into said channels to fill them and to cover said interior mold means while maintaining said wall forms and said interior mold means in a rigid relationship by said adjustable fastening means and said extensible means; permitting the concrete to harden in the normal manner; and removing said wall forms by horizontally extending said adjustable fastening means, and lowering said interior mold means and drawing said vertical forms of interior mold means together horizontally shortening said extensible means for the removal of same.

2. A method in accordance with claim 1 wherein reinforcement rods rise out of said risers, which includes the step of placing highchairs between said reinforcement rods and said wall forms whereby said reinforcement rods are spaced by the dimensions of said highchairs away from said reinforcement rods.

3. A method in accordance with claim 1 which includes the additional step of removing said studs from said concrete base after the vertical wall forms have been removed therefrom and filling the holes left by said studs with concrete.

4. A method in accordance with claim 1 wherein said interior mold means and exterior wall forms are secured together prior to pouring concrete in said channels.

5. A method in accordance with claim 1 wherein said vertical wall forms are urged inwardly against said ceiling form.

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