

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN CONCRETE PIPES AND OTHER HOLLOW ARTICLES, AND METHODS OF MAKING THE SAME

(71) We, HUMES LIMITED, a company incorporated under the laws of the State of Victoria of 185 William Street, Melbourne in the State of Victoria, Commonwealth of Australia, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to improvements in concrete pipes and other hollow bodies made from concrete which will hereinafter be called generically pipes, and to methods of making the same. It specifically relates to concrete pipes including means on the internal surface to render the pipe fluid tight and impervious or highly resistant to chemical action or other deleterious influences encountered in use. The term "impervious" herein means a sheet or material which is substantially impervious or resistant to penetration or attack by the fluids which flow through the pipe during use.

Specifically the means to seal the internal surface or parts thereof is a sheet of flexible impervious material, which is known in the art.

Concrete pipes are conventionally made in one of two ways. In the first of these ways the pipe is formed centrifugally and has no internal mould or core. When pipes are centrifugally moulded it has been known to utilize a plastics sheet or foil material, such as plasticised polyvinyl chloride, to form an internal lining for the pipe, which sheet is provided on its inner surface with ribs or other projections which are embedded into the inner surface of the pipe during manufacture.

These ribs have conventionally been of "T", "L", diamond or other shape, and after being embedded in the pipe during manufacture are retained therein when the

pipe sets so that the sheet forms an inner skin within the pipe. The ribs can be located either transversely with respect to the axis of the pipe, that is, circumferentially around the pipe, or longitudinally. In many applications it is preferred that these ribs be located transversely as when the pipe is loaded, such as when it is used underground, the reduction in strength by transverse ribs is very much less than when longitudinal ribs are used, and, secondly, transverse ribs permit free drainage of any seepage through the pipe wall between the ribs, whereas when longitudinal ribs are used it is necessary to provide special channels to permit such seepage.

When pipes are made by the other conventional method, by vertical casting, an external mould and internal core are provided and the fluid concrete is placed therebetween and compacted.

The sheet from which the ribs extend is located around the core before the concrete is poured and the concrete passes between the ribs. The reason for transverse ribs being unsatisfactory is two fold. Even with good casting techniques voids can be left beneath the ribs, and more importantly there can be flow of the concrete after pouring and before it hardens to leave voids on the undersides of the ribs. These voids permit the ribs to be separated from the pipe and thus the internal lining can move away from the pipe with detrimental effect upon the fixing of the lining.

The object of the invention is to provide a concrete pipe which is formed by casting between a mould and core in which the internal lining is efficiently bonded thereto, and a method of forming such pipe.

The invention consists in a method of making a concrete pipe as hereinbefore defined by vertical casting between an external mould and an internal core including

the steps of placing an impervious sheet at least partially about the core, the sheet having integral ribs outwardly directed from the core, introducing concrete between the mould and the core, permitting the concrete to settle and vibrating the concrete after at least partial settlement to move the concrete to fill any voids formed during settlement, so that voids are not left beneath the ribs, the said sheet constituting at least part of the inner surface of the pipe.

Preferably the ribs are transverse to the longitudinal axis of the core.

The invention also includes a concrete pipe made by vertical casting between an external mould and an internal core, the pipe having an impervious sheet attached to at least part of its internal surface by ribs integral with the sheet and extending outwardly into the concrete of the pipe, the concrete of the pipe having been vibrated after at least partial settlement thereof to minimize voids in the pipe beneath the ribs.

The ribs are formed so that they cannot be withdrawn from the concrete of the pipe without breaking the concrete in shear, and they are also formed so that the critical point, that is the point at which the shearing commences, are close to the stem of the ribs. The ribs are also formed so that their heads cannot be deformed to pass through a width equal to the width of the stem.

In order that the invention may be more readily understood reference will be made to the accompanying drawings in which:

Figure 1 is a cross-sectional view of a first form of rib and a partial view of the sheet to which it is attached;

Figure 2 is a section similar to Figure 1 of a second form of rib; and

Figure 3 is a schematic view showing the formation of a concrete pipe made in accordance with the invention, and using the second form of rib.

Referring firstly to Figure 1, the rib and its attached sheet may be of any plastics material which can be moulded or extruded and which has physical properties which will be described hereinafter. As illustrated the sheet 1 is provided with a stem 5 or the like extending outwardly therefrom to which stem there is connected a head 2. The arrangement is such that when the head 2 and stem 5 are embedded in the concrete outward movement can only occur when the concrete is sheared along the line (shown broken) of shear 3. The critical points from which shear occurs are shown as 4 and are at the outward extremities of the head 2.

Depending on the material used the thickness and length of the stem 5 and the

size of the head 2 are selected so that the head cannot deform and be pulled from the concrete through the slot occupied by the stem 5. Also, depending on the size of the pipe the critical points 4 must be relatively close to the stem 5 and we believe that the best distance for this is a distance of about 0.050 inches. Also the critical points must be spaced from the sheet by a distance sufficient to provide sufficient shear force before the concrete adjacent thereto shears and we have found that for a pull-out strength of 75lb. per inch of rib that this distance must normally be at least 0.220 inches. It is to be understood that the figures set out herein are only exemplary and can vary with different materials and also be varied for different sized pipes.

The construction of Figure 2 is basically very similar to that of Figure 1 and the same reference numerals as those used for Figure 1 have been used for the same parts of the embodiment of Figure 2.

The major difference occurs in that the sharp shoulder 13 of Figure 1 is replaced by a sloping portion 14 and the critical shear points 4 are thus part way along the thickness of the head 2 rather than at the edge thereof. This construction is particularly preferred to that of Figure 1 in that it is easier to ensure that when concrete is being cast it substantially fills the underside of the head.

The schematic diagram of Figure 3 shows the method of forming a concrete pipe. The sheet 1 is initially wrapped around the core 7 with the ribs extending outwardly therefrom. As can be seen from the figure there are a plurality of these ribs which are transverse relative to the core axis and which are spaced along the length of the core. The actual form of ribs illustrated is similar to those shown in Figure 2.

The inner core 7 and outer mould 6 are then located on a base plate 8 and as illustrated a vibrator 10 is in contact with the outer mould 6. Concrete 11 is then placed between the outer mould 6 and core 7 and by operation of the vibrator 10 this concrete becomes fluidized and flows around and into contact with the whole of each of the ribs. When the moulding has been carried out the vibrator is switched off and the concrete is allowed to settle for a period which will depend on various physical characteristics of the concrete mix and the size of the pipe to be made, but often of the order of 30 minutes. During the settling period the concrete tends to flow from the underside of the ribs so that voids are formed and the ribs would not be satisfactorily embedded in the pipe if the concrete was permitted to completely set. At this

time the vibrator is again operated for a period which depends on the various characteristics but desirably for a period of the order of one minute and the concrete again tends to become fluidized and moves into contact with the underside of each rib. After this period the vibrator is again stopped and the concrete is permitted to set at which time the required characteristics will have been achieved. The inner core and outer mould and the base plate are then removed.

In an alternative form the inner core and outer mould can be removed before the concrete has fully set and such techniques are well known in the art.

It is to be understood that the particular shapes, spacing and material of the sheet material and the ribs formed thereon can vary widely whilst satisfying the criteria of the invention and it must also be realised that the sheet material may occupy the whole of the internal surface of the pipe, or may occupy only some of the surface longitudinally and/or circumferentially depending on the application to which the pipe is to be put.

WHAT WE CLAIM IS:—

1. A method of making a concrete pipe as hereinbefore defined by vertical casting between an external mould and an internal core including the steps of placing an impervious sheet at least partially about the core, the sheet having integral ribs outwardly directed from the core, introducing concrete between the mould and the core, permitting the concrete to settle and vibrating the concrete after at least partial settlement to move the concrete to fill any voids formed during settlement, so that voids are not left beneath the ribs, the said sheet constituting at least part of the inner surface of the pipe.

2. A method as claimed in claim 1 wherein the ribs are transverse to the longitudinal axis of the core.

3. A method as claimed in claim 1 or claim 2 wherein the introduced concrete is vibrated during introduction to ensure that voids are not formed beneath the ribs.

4. A method as claimed in claim 2 wherein the ribs have a cross-section such that they cannot be withdrawn from the pipe without causing the concrete adjacent thereto to break in shear.

5. A method as claimed in claim 2 or claim 4 wherein each rib has a stem by which it is attached to the sheet and a head attached to the stem, the head being of a width greater than the stem and of such rigidity that it cannot deform and pass through the width occupied by the stem.

6. A method as claimed in claim 5 wherein the head is triangular, in section,

the stem being attached to the centre of one side of the triangle.

7. A method as claimed in claim 5 wherein the head is substantially diamond shaped, in section, the stem being attached to one point of the diamond.

8. A method as claimed in any one of claims 5 to 7 wherein the critical point, as herein defined, of the head is close to the stem.

9. A concrete pipe as hereinbefore defined made by vertical casting between an external mould and an internal core, the pipe having an impervious sheet attached to at least part of its internal surface by ribs integral with the sheet and extending outwardly into the concrete of the pipe, the concrete of the pipe having been vibrated after at least partial settling thereof to minimize voids in the pipe beneath the ribs.

10. A concrete pipe as claimed in claim 9 wherein the ribs are transverse to the longitudinal axis of the core.

11. A pipe as claimed in claim 9 or claim 10 wherein the ribs have a cross-section such that they cannot be withdrawn from the concrete of the pipe without causing the concrete adjacent thereto to break in shear.

12. A pipe as claimed in any one of claims 9 to 11 wherein each rib has a stem by which it is attached to the sheet and a head attached to the stem, the head having a width greater than the stem and being of such rigidity that it cannot deform and pass through the width occupied by the stem.

13. A pipe as claimed in claim 12 wherein the head is triangular, in section, the stem being attached to the centre of one side of the triangle.

14. A pipe as claimed in claim 12 wherein the head is substantially diamond shaped, in section, the stem being attached to one point of the diamond.

15. A pipe as claimed in any one of claims 12 to 14 wherein the critical points, as herein defined, of the head are close to the stem.

16. A concrete pipe as hereinbefore defined formed by casting between an external mould and an internal core by the method of claim 1 at least part of the internal surface of the pipe having an impervious sheet attached thereto by ribs integral with the sheet and extending outwardly into the concrete of the pipe, characterized in that the ribs are of such cross-section that they cannot be withdrawn from the pipe without causing the concrete adjacent thereto to break in shear.

17. A method of making a concrete pipe by vertical casting substantially as hereinbefore described with reference to

time the vibrator is again operated for a period which depends on the various characteristics but desirably for a period of the order of one minute and the concrete again tends to become fluidized and moves into contact with the underside of each rib. After this period the vibrator is again stopped and the concrete is permitted to set at which time the required characteristics will have been achieved. The inner core and outer mould and the base plate are then removed.

In an alternative form the inner core and outer mould can be removed before the concrete has fully set and such techniques are well known in the art.

It is to be understood that the particular shapes, spacing and material of the sheet material and the ribs formed thereon can vary widely whilst satisfying the criteria of the invention and it must also be realised that the sheet material may occupy the whole of the internal surface of the pipe, or may occupy only some of the surface longitudinally and/or circumferentially depending on the application to which the pipe is to be put.

WHAT WE CLAIM IS:—

1. A method of making a concrete pipe as hereinbefore defined by vertical casting between an external mould and an internal core including the steps of placing an impervious sheet at least partially about the core, the sheet having integral ribs outwardly directed from the core, introducing concrete between the mould and the core, permitting the concrete to settle and vibrating the concrete after at least partial settlement to move the concrete to fill any voids formed during settlement, so that voids are not left beneath the ribs, the said sheet constituting at least part of the inner surface of the pipe.

2. A method as claimed in claim 1 wherein the ribs are transverse to the longitudinal axis of the core.

3. A method as claimed in claim 1 or claim 2 wherein the introduced concrete is vibrated during introduction to ensure that voids are not formed beneath the ribs.

4. A method as claimed in claim 2 wherein the ribs have a cross-section such that they cannot be withdrawn from the pipe without causing the concrete adjacent thereto to break in shear.

5. A method as claimed in claim 2 or claim 4 wherein each rib has a stem by which it is attached to the sheet and a head attached to the stem, the head being of a width greater than the stem and of such rigidity that it cannot deform and pass through the width occupied by the stem.

6. A method as claimed in claim 5 wherein the head is triangular, in section,

the stem being attached to the centre of one side of the triangle.

7. A method as claimed in claim 5 wherein the head is substantially diamond shaped, in section, the stem being attached to one point of the diamond.

8. A method as claimed in any one of claims 5 to 7 wherein the critical point, as herein defined, of the head is close to the stem.

9. A concrete pipe as hereinbefore defined made by vertical casting between an external mould and an internal core, the pipe having an impervious sheet attached to at least part of its internal surface by ribs integral with the sheet and extending outwardly into the concrete of the pipe, the concrete of the pipe having been vibrated after at least partial settling thereof to minimize voids in the pipe beneath the ribs.

10. A concrete pipe as claimed in claim 9 wherein the ribs are transverse to the longitudinal axis of the core.

11. A pipe as claimed in claim 9 or claim 10 wherein the ribs have a cross-section such that they cannot be withdrawn from the concrete of the pipe without causing the concrete adjacent thereto to break in shear.

12. A pipe as claimed in any one of claims 9 to 11 wherein each rib has a stem by which it is attached to the sheet and a head attached to the stem, the head having a width greater than the stem and being of such rigidity that it cannot deform and pass through the width occupied by the stem.

13. A pipe as claimed in claim 12 wherein the head is triangular, in section, the stem being attached to the centre of one side of the triangle.

14. A pipe as claimed in claim 12 wherein the head is substantially diamond shaped, in section, the stem being attached to one point of the diamond.

15. A pipe as claimed in any one of claims 12 to 14 wherein the critical points, as herein defined, of the head are close to the stem.

16. A concrete pipe as hereinbefore defined formed by casting between an external mould and an internal core by the method of claim 1 at least part of the internal surface of the pipe having an impervious sheet attached thereto by ribs integral with the sheet and extending outwardly into the concrete of the pipe, characterized in that the ribs are of such cross-section that they cannot be withdrawn from the pipe without causing the concrete adjacent thereto to break in shear.

17. A method of making a concrete pipe by vertical casting substantially as hereinbefore described with reference to



the accompanying drawings.
18. A concrete pipe substantially as
hereinbefore described with reference to
the accompanying drawings.

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