A novel plastic strip applicator which can be employed in our invention for placement of the plastic strip within a concrete mass comprises, in general, a blade, means to immerse said blade into the plastic concrete mass, means to move said immersed blade through said concrete, plastic strip folding means integral with said blade, and means to feed a plastic strip to said folding means. Our invention can also comprise a vibratory means integral with said strip applicator to facilitate introduction of the plastic strip and to compact or smooth the surface after passage of said application means.

Our invention will now be described by reference to the drawings of which:

FIGURE 1 depicts the path of a plastic strip and the direction of fold employed in my invention;

FIGURE 2 illustrates a preferred embodiment of my invention, the blade having folding means incorporated therein;

FIGURE 3 illustrates the plastic strip embedding means of my invention;

FIGURE 4 is a plan view of a ribbon placement machine useful in finishing concrete roadways;

FIGURE 5 illustrates the assembly of a strip applicator means of our invention including a ribbon placement machine as depicted in FIGURE 4.

FIGURE 6 is a plan view of the FIGURE 6 apparatus, referring now to FIGURE 1, there is shown a cross section of concrete mass 1 in which plastic strip 2 is to be embedded along an edge plane parallel to top surface 8 of concrete mass 1. Plastic strip 2 is applied from roll 3 and directed into concrete surface 8 along an angle of incidence thereto, shown as A. To avoid uneven tension in plastic strip 2, it is apparent that the distance b-c along the top edge of plastic strip 2 must equal distance a-d. The fold a-c thus comprises a common hypotenuse for the respective right triangles a-b-c and a-d-c. Accordingly, for the legs of these triangles, a-d and b-c to be the same length, it is necessary that acute angles B and B' be equal. Since angle A equals the sum of angles B and B', it therefore is apparent that the angle of the fold relative to the edge of plastic strip 2 in the concrete, angle B', must be half the angle of incidence, angle A, of plastic strip 2 relative to concrete surface 8. Hence, the improved method of our invention comprises the introduction of a plastic strip edge into a concrete surface at an angle incidence to the surface thereof and, at the desired depth of placement of said plastic strip, folding said plastic strip into an edge plane parallel to said concrete surface along a fold having an angle which is half said angle of incidence.

Referring now to FIGURE 2, there is illustrated the preferred angles of incidence and fold of our invention together with blade means for introducing the plastic strip into a wet concrete mass and folding means integral with said blade to fold said plastic strip along an edge plane at the desired depth of penetration. In this illustration, plastic strip 2 is supplied at a right angle to surface 8 of concrete mass 1 and passed through slot or eye 5 of blade 6, eye 5 being supported at a 45 degree angle to top surface 8 of concrete mass 1. The desired angle of incidence of said plastic strip to said concrete surface. In this manner, since no uneven tension is applied across the plastic strip, the strip is laid into the concrete surface free from folds, crimps, or undesired zigzags. In its preferred embodiment, the plastic strip edge is introduced into the concrete at right angles to the surface thereof, being folded along a fold at 45 degrees to said surface so as to embed the plastic strip on its edge along a plane parallel to said concrete surface.
When using deep ribbon placements, a shield or deflector 4 is used as illustrated in FIGURES 6 and 7. Deflectors 5 are illustrated in FIGURE 1 with the concrete mix generally, from catching strip 2 as it moves along the surface of blade 6 prior to entering slot 5. Preferably, the edges of slot 5 are rounded or beveled to avoid tearing of plastic strip 2. It is also preferred to bevel the forward lower corner 7 of blade 6 to facilitate movement of blade 6 through wet concrete mass 1. Eye 5 is preferably located as close as practical to the forward edge of blade 7 so that when the blade comes to a header, as in a transverse strip placement, the flexible strip will be almost against the header. Blade 6 is kept to a minimum thickness for ease of passage through the concrete, the only limitation being sufficient structural stability for construction use.

Referring now to FIGURE 3, there is illustrated one embodiment of the plastic ribbon embedding assembly of our invention. The assembly is employed to embed plastic strip 9 beneath a wet or pre-contracted concrete mass 10. The plastic strip 9 is preferably supplied to the assembly on a drum or reel 11. Plastic strip 9 can be of any suitable plastic material, e.g., polyethylene, polyvinylchloride, and the like. The width of plastic strip 9 usually is from about one to about three inches or more, preferably about two inches, and usually thickness is from one inch or less to about twenty-five mils or more. However, the strip width is not critical and can be as low as three-eighths inch or lower and as high as six inches or more. Further, the strip thickness is not critical as long as the strip is flexible and can be as thick as three-sixteenth of an inch or more. Preferably, when using a plastic strip, thicknesses from about two to about six mils are employed. Reel 11 is supported by uprights 12 which can be attached to the frame of the assembly. As previously mentioned, uprights 12 are vertical, i.e., perpendicular to the concrete top surface so that the angle of incidence of plastic strip 9 to the concrete surface is 90 degrees and a 45 degree fold is used beneath the concrete surface. Other angles of incidence can of course be used without departing from the spirit of the invention. To support the assembly on the equipment, two brackets 14 and 15 are employed. These brackets are joined at one end and spread at their opposite ends to form a triangular support. The base of the brackets are fastened to a 45 mounting plate 16 which can be attached to a frame or bed member 17 in the plane of concrete mixing or finishing machine, or any other suitable movable strip placement support means. A plastic strip deflecting plate 13 can be positioned between the vertical uprights 12 to guide the plastic strip.

Extending downwardly from the lower bracket 15 is concrete cutting blade 18 which has plastic strip folding means comprising an eye or groove 19. Preferably, the entire assembly is attached to bed-member 17 by a linkage that permits vertical adjustment of the depth of blade 18 in concrete mass 10 and permits retraction of blade 18 from concrete mass 10 after the strip has been placed. Concrete cutting blade 18 is adjustable vertically by moving mounting plate 16 up and down on bolts inserted from frame 17 through elongated slots 61 and 62 in mounting plate 16. Also attached to blade 18 is a suitable vibrator 20 which is adapted to vibrate blade 18 and facilitate its path through concrete mass 10. A vibrator is usually needed for strip placement when relatively large aggregate is used in the concrete mix. However, with certain consistency concrete mixes, a vibrator may not be required. The vibrator 20 can be used such that the weight which is driven around an eccentric race by air pressure, a motor driven cam arrangement, a solenoid type vibrator, or the like. A generally flat travelling means (not shown) can be placed above the blade at the concrete top surface to trowel the concrete as the assembly moves over the concrete surface.

To eliminate unnecessary twists in plastic strip 9 it is preferred to position plastic strip reel 11 as shown, i.e., with its axis along the path of motion. It is, of course, apparent that reel 11 can be positioned in any other angle and suitable means employed to feed plastic strip 9 in the manner illustrated. Also, if desired, a suitable tensioning means 21 can be employed to hinder the free rotation of reel 11 or dampen its motion to avoid backlassing of strip 9 on reel 11. To insure that plastic strip 9 is at the proper angular disposition to eye 19 in blade 18, strip guides such as 22 can be employed on member 13. As illustrated, blade 18 is an extension of element 13 and accordingly guides 22 can be rigidly affixed to member 13. In other embodiments, these guides can be adjsutable so that the angle of incidence of plastic strip 9 to the top surface of concrete mass 10 can be controlled to insure that strip 9 is fed to eye 19 at the proper angle of incidence so as to avoid any unbalance in tension on strip 9.

As described in regard to FIGURE 3, the strip embedding assembly can be attached to the frame member of a concrete grading machine. An example of such a machine is that employed for the mechanical finishing of concrete roadways. As illustrated, the strip placement assembly can be bolted to the trailing frame member of such a grading machine and thereby employed for positioning a continuous plastic strip along the length of the finished roadway. A typical method of starting the strip in a new section is to move the grading machine forward to position the strip and then move the machine, by means of the chart, to the beginning of the next section. The chart is then advanced to the beginning of the next section and the machine is moved forward to position the strip. The aforementioned trowels 18, 19, 20, and 21 are supported on downwardly directed legs which are spring-tensioned to transmit a compacting force from each trowel to the concrete mass. A typical trowel 24 can be placed on the front trowel beam 15 and the machine controls can be positioned on platform 23 for control of the machine.

A plastic strip placement assembly, similar to that previously described, is shown as element 24 riding on transverse carriage or track 25 which is supported at opposite ends of the machine. Preferably track 25 is supported from the machine frame by hydraulic cylinders 26 which can be used to control the vertical height of track 25 above the concrete road bed and, hence, control the depth of the plastic strip placement in the concrete and also effect removal of plastic strip placement assembly 24 from the concrete mass after the laying of plastic ribbon. A separate drive motor 27 is employed to move the plastic strip assembly 24 on track 25. The angle of track 25 to the main axis of the machine and the road bed longitudinal axis is illustrated at an angle of about 7° from the horizontal. This angle can be used such that a vehicle wheel contact with the failure planes at different times, thus reducing the thumping characteristic of concrete roadway travel. The particular shape and construction of the plastic strip assembly 24, track 25, and power supply 27 can be similar to that hereafter described regarding FIGURE 5.

FIGURE 5 illustrates a portable plastic strip placement machine that can be manually positioned on con-
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Concrete road bed 52 or on any extended concrete surface. This construction employs an I-beam track 30 supported at either end by A-frames 31 and 32 which have feet 33 adapted for positioning on the edge of the concrete or on the concrete-retaining forms 34. A horizontal surface 34 is also placed at each end of the assembly. Preferably, the apex of the A-frame comprises support 35 through which the track 30 extends. To permit the position of A-frames 31 and 32 to be varied according to the width of the concrete or road bed, pins 36 are employed to lock into any of a series of holes bored into the upper flange of I-beam track 30. The plastic strip placement assembly is supported on I-beam track 30 by a box 37 which is slideable along I-beam track 30. Preferably, two or more rollers 38 are provided on each side of the I-beam web of I-beam track 30 to roll upon the upper surface of the lower flange. In this manner, a rolling contact of the assembly on I-beam track 30 is obtained.

Box 37 supports the assembly on a downwardly dependent leg 40. Eyes 41 are placed on this leg 40 and threaded with a cable 42 which passes over drive pulleys 43 and is wound up in drum 44. The drive motor 46 is reversibly or drives pulley 43 through a reversible gear train so that the assembly can be readily returned to the opposite end of track 30 for the next strip placement. The reel of plastic strip 45 is supported on vertical uprights 39 in the manner previously described in regard to FIGURE 30.

3. At the base of leg 40 is mounted a suitable finishing shoe 49 having an upwardly turned lip 50 at its leading edge. Beneath shoe 49 is mounted a blade, such as blade 18 having a plastic holding eye 19 as previously described in regard to FIGURE 3. A suitable vibrator 51 can be employed on shoe 50 to facilitate passage of the blade through the wet concrete mass 52.

As previously mentioned, the failure planes are to be positioned longitudinally and transversely to the concrete roadway. Accordingly, in the placement of the second set of plastic strips it is necessary to traverse or intersect a previously positioned plastic strip. It is preferred to employ a blade such as 18, described in FIGURE 3, having a sharp leading edge so that this plastic strip will be cut cleanly without pulling out of place. It is also within the scope of our invention to employ other means for severing the previously placed plastic strip. In one embodiment, an electrical resistance wire can be placed along the lower beveled edge of plate 18. The opposite ends of this resistance wire can be connected to any suitable electrical supply, e.g., storage battery or electrical generator, by a switch which can be manually or automatically controlled to close the circuit and heat this wire when the knife edge approaches or contacts the plastic strip. The hot wire will melt the plastic strip and thereby produce a clean break to permit blade 18 to traverse this previously placed strip. It is, of course, apparent that other obvious means such as remotely controlled knife blades or other cutting devices can be employed to sever previously placed ribbons and thus permit blade 18 to traverse this ribbon.

While the previous discussion has dealt with the use of our invention in laying concrete masses, it is to be understood that it is applicable to use with any material through which a flexible, foldable ribbon can be laid. Further, the flexible strip used with materials other than concrete can comprise any of the aforementioned materials such as metal strips, paper strips, plastic strips, wood strips, or their equivalents. Also, although the previous discussion has related to the placement of flexible ribbon widths substantially perpendicular to concrete surfaces, i.e., on edge, it is to be understood that it is within the scope of our invention for the width to be placed at any desired angle to the concrete top surface which is easily accomplished by merely tilting the blade transversely to the direction of blade travel.

It is not intended that our invention be unduly limited or restricted by the specific illustrations and mode of practice herein set forth. Rather, our invention is intended to be described by the steps or their obvious equivalents of the following method claims, and the elements or their obvious equivalents of the following apparatus claims.

We claim:

1. A flexible ribbon placement means comprising:
   a generally flat blade having two sides;
   means to immerse said blade in a plastic mass having a top surface;
   means to move said immersed blade through said plastic mass;
   an inclined guide carried by said blade, said inclined guide having a straight edge adapted to contact and fold a flexible ribbon as it passes from one side of said blade to the other, said means to immerse being adapted to position said blade with its plane in the direction of its motion so that said straight edge extends beneath said top surface at an inclined angle to said top surface; and
   means to feed a flexible ribbon along one side of said blade to said guide, said means to feed being adapted to feed said flexible ribbon so that the edge of said ribbon is at an angle incident to said top surface, said incident angle being twice said inclined angle.

2. A flexible ribbon placement means comprising:
   a generally flat blade having two sides;
   means to immerse said blade in a plastic mass having a top surface;
   means to move said immersed blade through said plastic mass;
   a laser opening through said blade, the top edge of said opening being a straight edge adapted to contact and fold a flexible ribbon as it passes through said opening from one side of said blade to the other, said means to immerse being adapted to position said blade with its plane in the direction of its motion so that said straight edge extends beneath said top surface at an inclined angle to said top surface; and
   means to feed a flexible ribbon along one side of said blade to said opening, said means to feed being adapted to feed said flexible ribbon so that the edge of said ribbon is at an angle incident to said top surface, said incident angle being twice said inclined angle.

3. A flexible ribbon placement means comprising:
   a frame;
   a reel adapted to contain a flexible ribbon, said reel being supported above said frame;
   a generally flat knife blade having two sides, said blade being positioned beneath said frame and adapted for immersion into and movement through a plastic mass having a top surface with the plane of said blade in the direction of said movement; and
   a generally elongated eye passing laterally through the lower portion of said blade, said elongated eye being at an angle of inclination to said top surface, said reel being positioned to feed a flexible ribbon having two edges down one side of said blade with the edges of said ribbon at an angle of incidence to said top surface, said ribbon being folded through said eye along a straight line in the length of said blade and the other side of said blade with the edge of said ribbon parallel to said top surface, said angle of inclination being about half said angle of incidence.

4. The assembly of claim 3 wherein a vibrating means is attached to said blade to facilitate its passage through said plastic mass.

5. The apparatus of claim 3 having reel tensioning means to maintain a constant tension on said flexible ribbon.

6. A machine for the edgewise placement of a flexible
ribbon beneath the surface of a plastic mass that comprises:

- a track having supports at each end thereof adapted to vertically position said track above the top surface of said plastic mass;
- a carriage slidably mounted on said track;
- a reel adapted to contain a flexible ribbon, said reel being supported by said carriage;
- a generally flat blade having two sides, a forward and a rearward edge, said blade extending generally vertically beneath said carriage and attached thereto;
- means for adjusting the vertical position of said blade to permit said blade to penetrate said top surface;
- a generally elongated eye laterally disposed in said blade, said eye being adapted to extend beneath said top surface at an angle of inclination to said top surface when said blade is embedded in said plastic mass;
- said eye being adapted to contact and fold said ribbon along a straight line as said ribbon passes through said eye from one side of said blade to the other;
- means for feeding a flexible ribbon down one side of said blade to said eye with the edge of said ribbon being at an angle of incidence to said top surface, the angle of incidence of said flexible ribbon edge to said top surface being about twice said angle of inclination of said eye to said top surface; and
- means to move said carriage along said track, said blade being positioned so that the plane of said blade is parallel to the motion of said carriage.

7. The machine of claim 6 having cutting means attached to said carriage and located at the forward edge of said blade to sever previously laid flexible ribbons positioned in said plastic mass in the path of said blade.

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