DRAINAGE ASSEMBLY AND METHOD

Field of the Invention

The invention relates to drainage systems and, in particular, those used for multiple floor / repetitive floor drainage (example balcony, corridor) storm water drainage into a vertical downpipes.

Background

Gravity rainwater systems draining multiple / repetitive floor (for example balcony, corridors etc) have the risk of backflow of water if the system is not sized correctly. The backflow is very difficult to predict with current gravity rainwater design principles. The principle cause of the backflow is air escaping from the gravity stack through the openings. The backflow situation can be made worst if the gravity rainwater system discharge is impeded, for example for a submerged discharge situation due to flooding of external drain, under sizing of the discharge pipe, etc

To prevent the above uncertainty, the flow rates for vertical stacks have to be limited to very low flow capacity. This allows a central core of space to allow the air to escape vertically upwards instead of through the repetitive floor drainage opening.

Most rainwater drainage codes, for example the British Standard and European Standard BS EN 12056-3, suggest that the vertical pipe has a fill degree of between 0.2 to 0.33.

Meaning that the central core of 67% or more of the cross-section of the pipe is set aside for the air. The purpose of this is to prevent any pressure fluctuation inside the gravity system and always maintain the system pressure at atmospheric pressure.

However these rainwater drainage codes are meant for gravity roof drainage. It does not mention anything about repetitive floor drainage. From experiments for repetitive drainage, the backflow phenomenon is more likely to occur due to the many entries and exit point for the air in the pipe. The surest way to reduce the chances of backflow is to have a large vertical pipe; or limit the capacity of the gravity system. However this makes the gravity system inefficient.

Summary of invention

In a first aspect, the invention provides an flow concentration assembly for coupling to a downpipe, the assembly comprising; a flow concentration pipe having an upstream diameter equal to the downpipe and an exit section having a diameter less than the upstream diameter; the flow concentration pipe positioned in the downpipe such that an exit aperture of the exit section is concentric with the downpipe and directed downwards, and; an flow concentration section in the downpipe, providing a fluid path between a point adjacent to the exit aperture and a point external to the downpipe; wherein, in use, water is arranged to flow through the exit aperture so as to create an annular space about the water flow, such that air in the annular space is releasable along the fluid path.

In a second aspect, the invention provides a method for releasing air trapped within a downpipe, the method comprising the steps of: flowing water, annularly about a bore of the downpipe, into an flow concentration pipe positioned collinearly in the downpipe; reducing the diameter of water flow as it flows through said flow concentration pipe to be less than the diameter of the downpipe; flowing water out of a concentrically positioned exit aperture of the flow concentration pipe so as to form an annular space around the exiting water flow; providing a fluid path between a point adjacent to the exit aperture and a point external to the downpipe, and so; releasing the air trapped in the annular space along the fluid path.

The invention provides a flow concentration assembly that can be incorporated into the pipe system at critical points, such as inlet trays, where incoming water may prevent the release of air from the system.

In general, the invention provides a flow concentration pipe that acts as a transition to reduce from an upstream diameter to a lesser diameter, and so preventing annular flow by concentrating the downward flow into a centrally directed column. In turn, this creates an annulus space about the column flow within the lower pipe. This has the dual effect of allowing incoming water to enter the system as a downward annular flow, as well as release air within the system that would otherwise be trapped by one or both of the upper pipe flow, or the entering flow.

Brief Description of Drawings

It will be convenient to further describe the present invention with respect to the accompanying drawings that illustrate possible arrangements of the invention. Other arrangements of the invention are possible and consequently, the particularity of the accompanying drawings is not to be understood as superseding the generality of the preceding description of the invention.

Figure 1 is a sectional elevation view of a gravity stormwater assembly according to the prior art;

Figure 2 is a sectional elevation view of a gravity stormwater assembly according to one embodiment of the present invention;

Figures 3A to 3C are isometric views of a gravity stormwater assembly according to a second embodiment of the present invention; and

Figure 4 are various cross sectional views of a gravity stormwater assembly according to several embodiments of the present invention.

Detailed Description

Figure 1 shows a pipe system according to the prior art, where an inlet, such as a balcony drain 25 receives surface flow 8. The rain 25 in this case is part of a stormwater stack, with an upper pipe 2 directing a downward flow 3. Water flow characteristics are such that, at less than full capacity, the flow 3 will be annular, leaving a central void 4. During a rain storm event, where surface flow 8 and pipe flow 3 are coincident, a water curtain 6 is formed that has the effect of blocking the surface flow from entering the

downstream pipe 10, causing flooding of the surface (eg balcony etc.). Further, this water curtain 6, being circumferentially arranged about the bore of the pipe, also blocks air 9 within the downstream pipe 10 from being released, reducing the available capacity of the system, resulting in both generalised flooding and localised flooding at each inlet/drain.

Figure 2 shows a flow concentration pipe 5 positioned collinearly within a downpipe 10, having a drain/water flow inlet section 25. The water flow inlet 25 may, for instance, be positioned in a balcony as part of a stormwater pipe stack for a multi-storey building. The flow concentration pipe 5 may be an extension of an existing pipe or a separable element that is attachable to an existing pipe within the stormwater pipe stack. The flow concentration pipe 5 includes an upper section, corresponding to the downpipe system, a transition 15 and an exit section. The transition 15 is an intermediate diameter reduction section to concentrate the water flow from the upper section diameter to a smaller diameter for the exit section 20. The exit section 20 having an aperture 30 through which water flows 35 from upstream 55 and eventually exiting 40. The flow concentration assembly further includes the downpipe 10 being modified to include a flow concentration section 25 which comprises an enlarged annular flange.

As the upstream water 55 enters the transition, the constricted diameter leads to a small backup 37 of water, resulting in the whole bore being used, and removing the annular flow pattern of Figure 1. As water flows 35 through the transition 15 and into the exit section 20, the diameter of flow 40 exiting the flow concentration pipe 5 is such that the water is concentrated concentrically with the downpipe 10 at a smaller diameter than the

downpipe 10. Water then flows through the exit aperture forming an annular space 45 around the water flow 40. The water flow 40 undergoes an increase in speed and pressure as it exits, forming a concentric centralised jet of water. Consequently, the upstream water is prevented from forming an annular flow in the downpipe 10, and so a water curtain as shown in Figure 1 is avoided. The annular space 45 allows for air to pass along a fluid path from a point adjacent to the exit aperture 30 to a point 50 external to the downpipe. Thus, air within the annular section is releasable from the flow concentration section 25. Further, surface water 47 is collected by the drain 25, and is allowed to pass into the downpipe 10. As the water 47 is flowing into contact with the surface, it will tend to flow down as an annular flow. With the drain 25 receiving surface water within its capacity, the arrangement of the concentration pipe 5 will allow for the surface water 47 to flow as annular flow. Thus all three fluid paths (surface water 47, released air 50 and downpipe flow 40) can co-exist without interfering with the flow capacity of the system.

Figures 3A to 3C show a flow concentration assembly according to a further embodiment of the present invention. In this embodiment the flow concentration pipe 60 is a separable element which may be attached to an existing downpipe, such as being soldered, bolted, strapped, clamped, screwed or welded in place. The embodiment of Figures 3A to 3C shows a flow concentration pipe 60 which includes a combined the transition and exit section, as compared to the separate sections of the embodiment of Figure 2.

In this embodiment, the flow concentration pipe 60 includes a profiled exit section 70 having concave portions 75 located circumferentially about the flow concentration pipe 60. The concave portion 75 act to both transition the diameter of the flow of water, as well as providing a profile to the water so as to confine it to the central axis of the flow concentration section 65. Thus, the water exits the aperture 90 to enter into the downpipe 65 creating an annulus space 95. It will be noted that the drain 85 is similar to the drain 25 of Figure 2. It will be appreciated that by applying a concentration pipe according to the present invention, with drains of different configurations may operate in the same way to allow for the aforementioned three fluid paths.

The relationship between the downpipe and exit diameters may be a function of several parameters, including flow rate, downpipe length, height of the downpipe above the flow concentration pipe and secondary factors affecting these parameters such as the size and number of branches above and below the flow concentration assembly 60, 65. Thus, for very high flow rates the exit aperture diameter, relative to the downpipe diameter, to create a sufficient annulus space to efficiently release air, may be in the range of 50% to 90% of the downpipe diameter.

Figure 4 shows various embodiments of shapes of the flow concentration pipe exit aperture. There are four shapes provided 125 to 140 with various cross sections shown 105 to 120. It will be appreciated that the applicable shapes falling within the invention may extend beyond those shown in Figure 4. Figure 4 shows a non-exhaustive list of

possible shapes for the flow concentration pipe. Other shapes that provide a reduction of the pipe to create pressure to discharge the upstream of water, at the same time allow air to escape and addition water to enter the system, such as a cylindrical shape, will also fall within the present invention.

The 1st section 105 provides a cross section through the flow concentration pipe, with the second section 110 being a plan view of the flow concentration assembly. The third section 115 is the downpipe and the last section is a cross section of the exit aperture of the flow concentration pipe.

Each of the shapes shown are concave polygons having three or more degrees of rotational symmetry. It will be appreciated that a shape having one or two degrees of rotational symmetry may be possible if the concentric water flow is achieved. The concave portion of the flow concentration pipe acts to assist in the transition of the flow from the upper downpipe diameter to the aperture diameter. The octagonal 135 and hexagonal 140 convex polygons emulate a more circular shape of the exit flow with the 3-point 125 and 4-point star shaped concave polygons acting as a more stringent transition. In the case of the star shaped apertures, a longer transition may be required to reduce shock losses during the transition as compared to the more open shapes 135, 140.

In each case, whilst each shape may create varying flow patterns on exiting the flow concentration pipe, each has benefit subject to flow rates and length of the transition

which may also be functions of the relationship between the aperture diameter and flow concentration pipe diameter.

Claims

1. An flow concentration assembly for coupling to a downpipe, the assembly comprising;

a flow concentration pipe having an upstream diameter equal to the downpipe and an exit section having a diameter less than the upstream diameter;

the flow concentration pipe positioned in the downpipe such that an exit aperture of the exit section is concentric with the downpipe and directed downwards, and;

an flow concentration section in the downpipe, providing a fluid path between a point adjacent to the exit aperture and a point external to the downpipe;

wherein, in use, water is arranged to flow through the exit aperture so as to create an annular space about the water flow, such that air in the annular space is releasable along the fluid path.

2. The assembly according to claim 1, wherein a cross sectional shape of the exit aperture is a concave polygon.

3. The assembly according to claim 2, wherein the concave polygon includes at least three degrees of rotational symmetry.

4. The assembly according to claim 2, wherein the concave polygon having arcuate sides.

5. The assembly according to any one of claims 1 to 4, wherein the flow concentration pipe includes a transition intermediate the downpipe section and the exit section, said transition providing an intermediate diameter reduction.

6. A method for releasing air trapped within a downpipe, the method comprising the steps of:

flowing water, annularly about a bore of the downpipe, into an flow concentration pipe positioned collinearly in the downpipe;

reducing the diameter of water flow as it flows through said flow concentration pipe to be less than the diameter of the downpipe;

flowing water out of a concentrically positioned exit aperture of the flow concentration pipe so as to form an annular space around the exiting water flow;

providing a fluid path between a point adjacent to the exit aperture and a point external to the downpipe, and so;

releasing the air trapped in the annular space along the fluid path.