TECHNICAL PAPER

AKASISON

EFFECTS OF THERMAL EXPANSION ON SYPHONIC ROOF DRAIN INSTALLATIONS

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EFFECTS OF THERMAL EXPANSION ON SYPHONIC ROOF DRAIN INSTALLATIONS

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ABSTRACT
Thermal expansion must be taken into consideration in design and installation of Syphonic roofing systems. It is well known that plastics materials will expand or contract more than metals due to temperature influences. Akatherm International BV has carried out extensive design and test work to ensure optimum functional and aesthetic performance of Polyethylene piping in combination with its specially developed metal clamp and rail systems. The “Akatherm PE drainage handbook” contains installation guidelines derived from this development work ensuring that thermal effects are controlled and accounted for in Akasison Syphonic roof drain installations.

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1. INTRODUCTION

Siphonic roof drain installations consist of a plastic pipe hung directly under the roof surface inside in a building. One common method of installation is shown in Illustration 1. Metal rail is supported from the roof using threaded bars. The pipe is then supported by clamps at predetermined standard distances depending on the diameter.

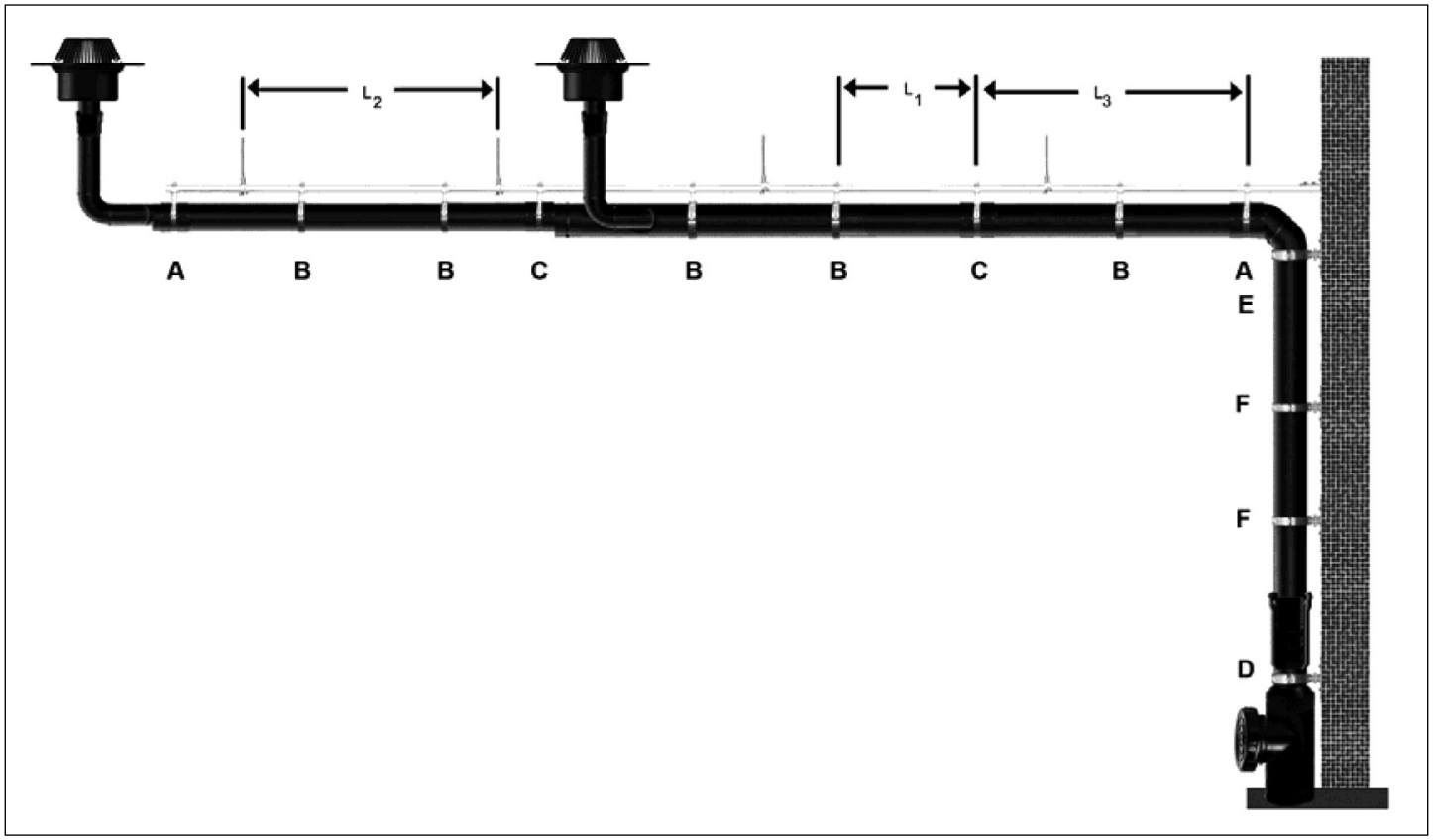

Illustration 1: Typical layout of siphonic roof drainage system.

2. THEORETICAL BACKGROUND

In buildings the air temperature directly under the roof can vary quite considerably depending on the weather circumstances, and internal influences. For example heat generated from production machinery, influences of air conditioning etc. It not unthinkable that the temperature could fluctuate from say 10°C in winter to 70°C in extreme summer conditions. The temperature at the moment of installation can also vary widely.

Metal components will expand relatively less than plastic components due to temperature changes. For PE (Polyethylene) the coefficient of thermal expansion lies in the range 0,13 to 0,19 mm /m°C according to tests carried out in accordance with DIN53752.

For example a PE pipe, which is 5 meters long at 10°C, will expand 57 mm in length if heated to 70°C.

The calculation is as follows,

(0,19 mm x ΔT) x 5 meter = (0.19 mm x (70°C - 10°C) x 5 meter = 57 mm expansion.

where ΔT is the temperature difference

The metal rail has a coefficient of expansion of 0,0117 mm/°C. Using the same method of calculation over the same temperature range the rail will expand only 3,5 mm.

This difference in expansion causes generation of opposing forces between the metal rail with its pipe clamps and the PE pipe.

Akatherm has carried out extensive work in developing installation guidelines to ensure that this expansion phenomenon can be controlled and accounted for without any negative affects on the total system. Strict adherence to the installation guidelines as published in the “Akatherm PE drainage handbook” will ensure that thermal expansion effects are controlled and minimised.

The basic principle is that the forces generated in the pipe are transferred to the metal rail at “fixed points” along the pipe length. The “fixed points” consist of metal pipe clamps fixed in such a manner that will not allow any relative pipe movement between pipe and rail. This can be achieved by placing an electrofusion coupler each side of the metal clamp, thus restricting pipe movement at this point completely. See Illustration 2.

The Akatherm PE drainage handbook contains guidelines for spacing of the metal clamps and for recommended distances between fixed points per pipe diameter.

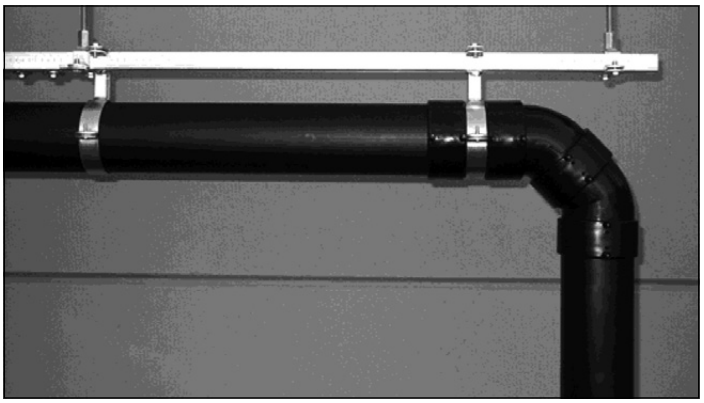

Illustration 2: Fixed point arrangement using 2 electrofusion couplers.

In practice it has been found that the Akatherm rail is capable of resisting the expansion forces. Akatherm has invested considerable time and effort in choosing the optimal rail cross sectional profile with regard to strength.

Tests have been carried out at Akatherm to simulate the worst possible situation. Ø200, 250 mm and 315 mm PE pipe was installed at low ambient temperatures. Heated water at 60°C was then pumped through the installation causing the PE to expand. It was observed that the fixed pipe clamps successfully restricted pipe axial movement. The forces generated were transferred to the rail which did not exhibit any appreciable deformation.

As a comparison the same installation was built up without using fixed points. Here it was very evident that the pipe expansion caused deformation that was optically unacceptable. However the functionality and safety of the system remained good. PE is an extremely tough elastic material and even in a worst case scenario where installation is done without using the proper fixed points the system will function safely.

3. SUMMARY

1. Polyethylene (PE) pipe will expand more than the metal supporting rail due to the influence of temperature changes.
2. Akatherm have developed and tested a metal rail and pipe clamp system that can withstand the expansion forces involved without significant deformation.
3. Proper installation using fixed points at the correct specified distances and locations will ensure a system that functions properly and also is aesthetically pleasing.
4. In a worst case scenario where installation is incorrect the system will function correctly and be safe due to the toughness of the PE material. However it will be optically unsatisfactory.

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