Technical paper

Offsets in Building Drainage systems

How to keep the system ventilated

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Abstract

Offsets in vertical stacks in High-rise and complex buildings sometimes cannot be avoided, for example projects with podium common lower floors where multiple vertical stacks are brought together prior to the connection to a sewer, or a change of direction in the vertical stack where the flow runs at the base of the stack for example a change of direction for 1 meter vertically. Offsets should be avoided as they merely provide opportunities for surcharging in the system.

Context of this paper

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Research | Relevance | **Design** | Solutions | Materials | Installation | Terminology | Standards

High-rise building solutions

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Introduction

In early drainage engineering designs for high-rise buildings offsets where introduced in the belief that it would slow down the annular flows within the stacks, but the understanding of terminal velocity of annular flow was not well understood. That being in 100 mm to 150 mm stacks the water will flow at terminal velocity of 3-6 m/s and solids up to 15m/s and it reaches this between 3-6 meters from entering the stack, so the requirement to slow the flow is not needed.

In modern high-rise designs it is generally understood that offsets, where possible, should be avoided, but this is not always possible due to the design requirements of the building. This could be structural requirements or even the placement at different appliances in the apartments, which means that the vertical stacks have to change direction.

Offsets will cause surcharging and generate transient pressures both upstream (positive) and downstream (negative). The offset due to the change of direction will also produce noise and vibration as the water, solids and air move through it. To overcome the effects generated by the offset, national codes recommend a bypass venting. An alternative option is to use active drainage ventilation.

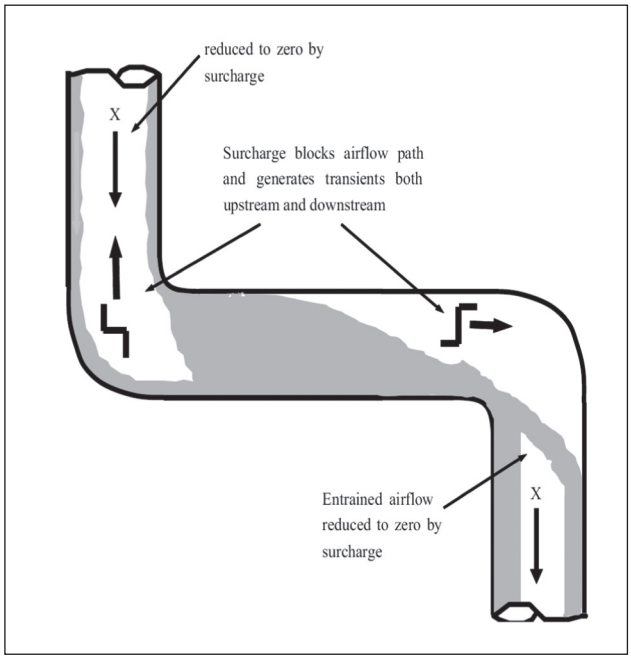

Figure 1.
Surcharge in an offset leading to transients

Bypass Venting

Bypass or relief venting is what is recommended in many national codes to overcome the surcharge pressures generated by the offsets. The purpose of the vent is to overcome the closure and allow an alternative path upstream and downstream of the offset by linking a loop vent back into the relief vent or running a separate relief vent to atmosphere.

The size of the bypass vent is critical for its performance as it has to be a path of least resistance around the offset so that air and the pressure transients are not restricted by closure of the air path and surcharge pressures within the offset. In doing so the branches and trap seals above and below the offset are protected.

Many national codes recommend that the bypass vent is smaller in diameter than the stack and offset diameters, as they do for the recommendation for the size of relief and branch vents. By increasing the relief vent size, more air will be bypassed. If the relief vent is the same size then the air will split equally between the bypass vent and the stack.

Increasing the bypass vent so that it is larger than the offset diameter will ensure that the air will travel in the bypass vent as it is the path of least resistance and ensure the branches upstream and below stream are protected.

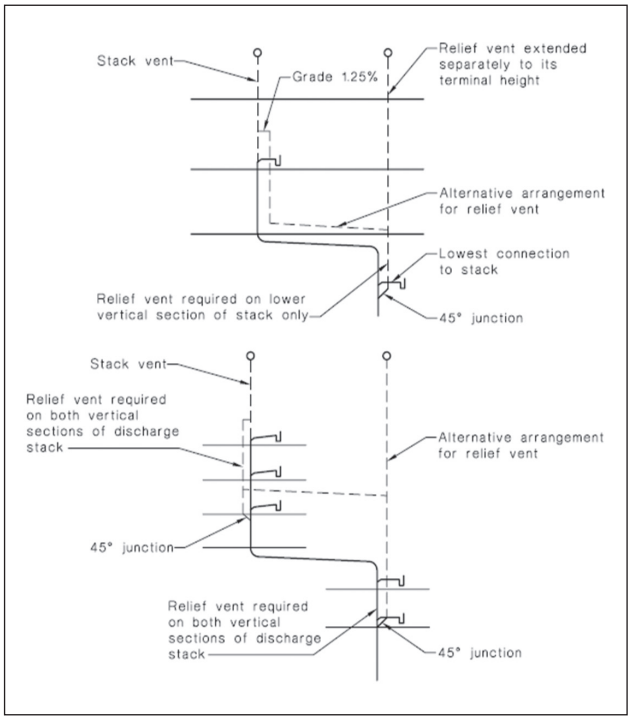

Figure 2.
Typical design for bypass venting

Active drainage venting solution for offsets

Active drainage ventilation using P.A.P.A and AAVs gives an alternative solution to the bypass venting for the offsets. It performs the same function; providing upstream protection with the P.A.P.A above the offset protecting the branches and trap seals from the positive transients generated by the partial or full closure of the air path in the offset.

Below, the offset P.A.P.A. and AAVs protect the branches and water trap seals. The AAVs ensure that the air required and the negative transients are alleviated, and the P.A.P.A would attenuate any positive transient reflection due to the closure of the air path in the offset.

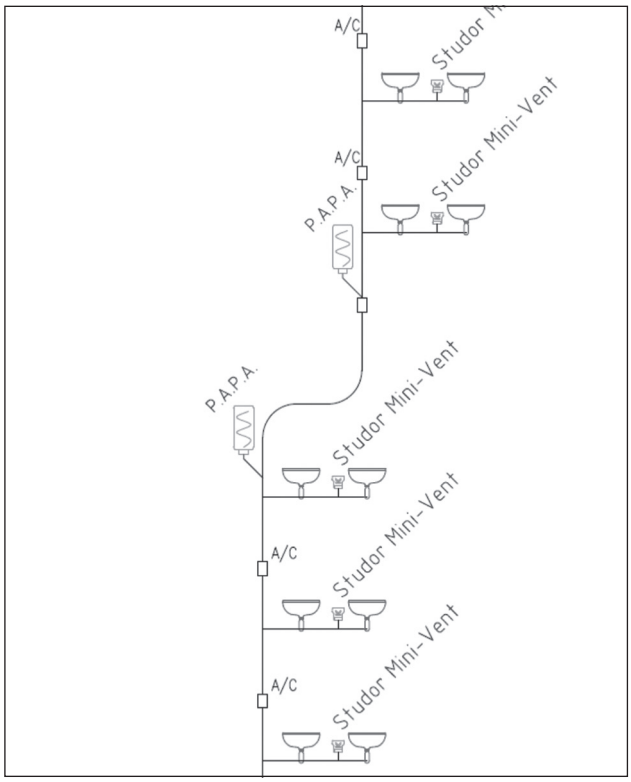

Figure 3.
Active ventilation of an offset

Conclusion

Offsets in modern high-rise buildings cannot always be avoided, either by the design and layout of the apartments and usage or by structural requirements. If they are not vented correctly the surcharging into the offset and leaving the offset partially or fully blocks the air path which leads to positive and negative transient issues that can pull or push out water trap seals above and below the offset. Using bypass vents recommended by national codes are deemed to protect the system, with the high-rise buildings and the greater pipe periods involved, the vents must, by use of the correct sizing, quickly respond to the surcharge events within the offset. The down side is also having to find space for the bypass vents, or, as some codes recommend, running a separate relief vent from below the offset, adding more cost and space lost for these vents. Using active ventilation provides a good alternative without the need for the extra vent pipework with the added cost and loss of space and provides the same function protecting the branches upstream and below stream of the offsets.

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1. EN 12056:2000 *'Gravity Drainage Systems inside buildings Part 2: Sanitary Pipework, layout and calculations'*, British Standards Institute, London

2. London, 2000 Swaffield, J. (2010) *Transient airflow in building drainage systems*, Oxon: Spon Press

3. Standard Australia (2003). Australian Standard AS/NZS 3500.2-2003

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- Relevance - Requirements for a well-designed high-rise drainage system
- Research - Current venting diameters for high-rise drainage ventilation
- Solution - Air Admittance Valves (AAV)
- Solution - Active Ventilation Single Stack Drainage

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