

Technical paper

Requirements for a well-designed high-rise drainage system

Crucial in the safety and comfort for inhabitants

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Abstract

Put simply, the main requirement of a well-designed high-rise drainage system is that it should operate without the user being aware of its existence, and to protect the occupants of the building from the sewer gases and pathogens within the drainage 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

To most people the building drainage system lurking beneath their pristine ceramic and stainless steel appliances presents a mystery beyond their usual 'need to know'. How their sink full of soapy water gets from their newly refurbished kitchen island to the municipal treatment plant is of little or no interest, and, likewise, few people ponder the similar journey from the WC, bath or bidet in the bathroom; until that is, they are suddenly faced with a foul smell from 'somewhere down there' or are met by a filling WC bowl which keeps on filling and pours onto the new floor covering. The mystery surrounding the drainage system suddenly deepens on the presentation of an unfeasibly costly repair bill. In fact the heart of any building system are the services, which are only a small part of the construction investment. By contrast, the comfort of a high-rise building highly depends on the correct functioning of the services, especially the drainage system that protects the inhabitants against bad smells and pathogens present in the sewer.

In truth there are few mysteries about the operation of a building drainage system. The underlying principles governing the flows of all fluids (water and air) have been well described and indeed applied to the building drainage system for both design (making the system work) and forensic analysis (finding out why it didn't work) for many years.

This is a crucial point because, building drains carry unsteady flows which mean that they are rapidly changing and cannot be analyzed using simple calculations based on steady, unchanging flows, flow principles. Understanding these principles and requirements for high-rise drainage designs leads to the goal of invisible system for the occupants.

Requirements of the system

The following requirements are essential in achieving a safe, usable and reliable drainage system for high-rise buildings;

- The system should remove all waste as quickly as possible
- Long horizontal pipe runs must be self-cleansing
- There must be minimal loss of water trap seal to ensure there is a barrier for the ingress of sewer gases
- Minimal noise from the system
- Ease of maintenance
- Durable and proven solutions

Codes and Regulations

Code regulations were essentially designed in order to ensure that installations meet these requirements, and to protect inhabitants against any possible health risks from contact with contaminated fecal material, sewer gases and pathogens.

In developed industrialized countries the majority of installations meet these standards and the health risks from drainage systems are still very low. The basis for this has been achieved on data generated for low rise buildings based on the research carried out in the 1950s and 1960s by CEN.

With modern day high-rise buildings and urbanization the usage patterns and the density of occupants, it is recommended that the codes and regulations be revisited to ensure the guidance meets the requirements in modern high-rise buildings.

Solution

As with most fields of engineering, sanitary equipment and techniques have benefited from scientific and engineering research, manufacture innovation and product development, which together has improved understanding of system operation and helped develop new innovate and cost-effective ways of achieving the goal of safe, reliable drainage systems with no increase in health risk.

In particular the active drainage ventilation solution for protecting water traps seals, stack-aerator solutions that control the flows, both these options are to provide single stack drainage systems solutions and have been designed for use in high-rise buildings from their initial concept.

Testing of these systems as well as conventional pipe systems as recommend by the codes is ongoing and the ability to validate their performance at the Hydro-Dynamics Experience Centre (HDEC) and the National Lift Tower (NLT) (two dedicated drainage test towers) and working with leading research institutions - for example, the Drainage Research Group at Heriot Watt University - will allow designers and code regulators to give guidance and solution for meeting the requirements for high-rise drainage systems.



Figure 1.
National Lift Tower

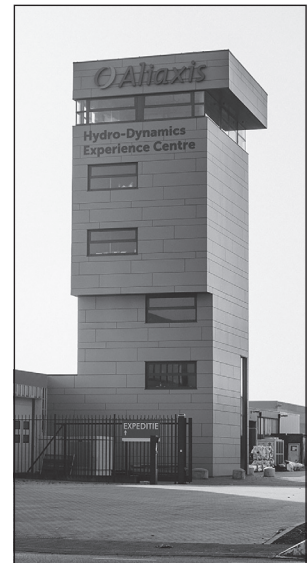


Figure 2.
Hydro-Dynamics Experience Centre

Conclusion

It is not unreasonable for occupiers living and working in high-rise buildings to expect that their drainage system works and has no issues for the life of the system. The system requirements to achieve this are well known. Given that new buildings are being built ever taller and are out of scope of current guidance, manufactures and research work together to provide solutions and data to allow regulators the information so that all high-rise buildings meet the requirement for high-rise drainage systems.

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- Relevance - Water Trap Seal
- Research - Current venting diameters for high-rise drainage ventilation
- Research - What happens at the base of the stack
- Solution - Air Admittance Valves (AAV)
- Solution - Active Ventilation Single Stack Drainage