Vacuum Drainage - Innovation Report

Bloomberg London

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Revision 01

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1. Executive Summary

This report provides a summary of the ***Vacuum Drainage*** for WC solution, also is an abstract from BREEAM Innovation credit application for the North Building of the Bloomberg London development.

The development provides a mix of office and retail space in the City of London. Located between the Bank of England and St Paul's Cathedral, the site provides approximately 1 million square feet of sustainable office space, two new public spaces featuring specially commissioned works of art, a retail arcade that will reinstate an ancient Roman travel route, and an anticipated cultural hub that will restore the Temple of Mithras to its original site.

The use of potable water in WC services is long established, and yet is a practice which represents an obvious area for improvement in terms of increasing the sustainability and environmental performance of building design. To this end, there have been significant developments in recent years aimed at tackling this problem, including the use of grey- and rain-water for flushing toilets, and the development of low-flush volume WC cisterns.

The design team at Bloomberg London identified a number of solutions aimed at reducing the unnecessary consumption of potable water. Being the first of its kind for a commercial office building in the UK, one of these solutions, the provision for ***Vacuum Drainage*** for WC operation, is considered to be an innovation in the sustainable and environmental performance of commercial buildings in the UK.

The *Vacuum Drainage* solution for the Bloomberg Building was awarded an Applied Innovation credit under BREEAM 2014 New Construction (non-domestic) scheme.

2. Introduction

Bloomberg London is a new development in the City of London comprising two high-grade specification buildings (namely the North and South Buildings), with retail units at ground floor level. When completed, it will provide approximately 1,000,000 ft^2 of office and retail space and includes a new entrance to the London Underground at Bank station.

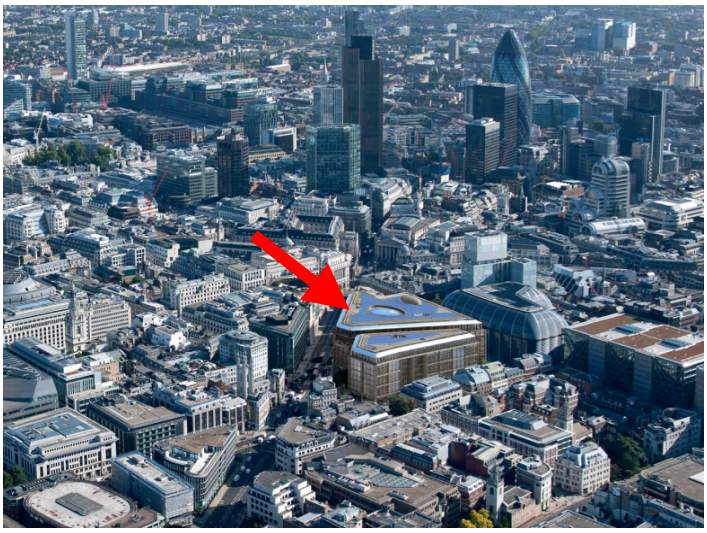

Fig. 1 Location of the Bloomberg London Development

2.1 Overview

The design of the commercial office building at Bloomberg London has been led throughout by principles of environmental design, with an aspiration to develop innovative techniques and practices in order to secure the sustainable performance of the building during the design, construction and occupation of the building.

One of the areas that was identified as being appropriate for innovation was the consumption of potable water, for purposes other than those related to direct human consumption.

To this end, a number of innovative solutions were developed, including the provision of ***Vacuum Drainage*** for WC operation.

2.2 The Problem

The unsustainable use of potable water is one of the key challenges our society faces in terms of its consumption of natural resources. Even in a temperate and relatively wet climate such as the UK's, it is important to preserve clean water and secure its use for essential needs such as human consumption.

Water consuming processes in building design include those related to servicing of HVAC equipment, as well as the more commonly recognised application of WC flushing. The

unnecessary consumption of potable water represents a number of risk factors, including:

- Degradation of finite quality clean water supplies
- Added pressures placed on ageing drainage systems
- Contribution to the problems associated with flood risks

Any reduction in the consumption of potable water for this purpose will have direct, as well as indirect, benefits.

2.3 The Benefits

Despite the difficulties in challenging established procedures and norms, particularly when faced with understandably conservative attitudes to water, recent advances have demonstrated the benefits in reducing the unnecessary consumption of potable water.

However, the Client and the team delivering Bloomberg project recognised the numerous benefits that water-saving measures can deliver. These include:

- Sustainable use of potable water for WC flushing
- Cost savings related to water and drainage
- Preservation of clean water supplies
- Alleviation of pressures on existing drainage systems
- Reduced risk of local and regional flooding

These benefits were identified as being considerable and appropriate for the exploration of bespoke solutions that would enable them to be realised. In light of this, the innovative ***Vacuum Drainage*** for WC operation solution was developed.

2.4 The Solution

The team delivering Bloomberg project incorporated a number of water-saving designs that address the concerns associated with water consuming plant, while also driving forward and delivering real and tangible benefits.

The ***Vacuum Drainage*** for WC operation solution was identified as being an innovative solution that addressed all the above.

3. The Design

3.1 General Design

The development of vacuum drainage solutions for WCs offers significant water savings over conventional systems.

The solution relies on induced flushing pressures in the drainage pipework. The following illustrates the general arrangement of the system.

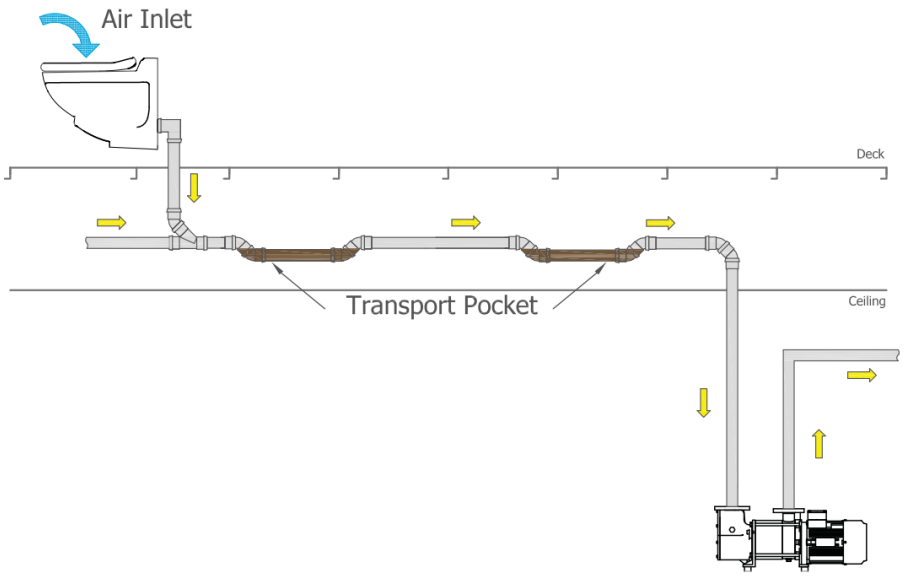

Fig. 1 General arrangement of vacuum drainage

A close up of the key design component of the system shows how this simple principle operates.

Fig. 2 Induced flushing pressures and transport pocket to re-form 'slug'

Vacuum drainage system uses difference in air pressure to transport of sewage from toilets to a vacuum unit.

In idle mode, a semi-vacuum (~0.5bar pressure) is maintained in the system. When flushed, approximately 60-80 litres of air and 1 litre of water is sucked through the toilet, in turn sucking the contents of the toilet into the system. The water and effluent forms a 'slug' in the system, and is being transported along the pipework system during the discharge period, to stop after approximately 5-15m. When the toilet valve closes the sewage will flow under gravity to re-form the 'slug' in a specially arranged pipework

section called 'transport pocket'. Subsequent flushes will move the formed slug along the network, from one 'transport pocket' to the next.

During running, the pump generates vacuum within the drainage pipework transporting the sewage to a macerating chamber to discharge the sewage to the external sewerage system

The system as a whole uses between 0.8 and 1 litres of water per WC flush. This is in comparison to traditional gravity systems that use and up to 6 litres per flush or 4.5 litres on average for dual flush option.

3.2 Coordination with Other Water Savings Solutions

As noted, a number of water-saving measures have been incorporated into the design for Bloomberg North Building. These include the recycling of cooling tower water, rainwater harvesting and the recycling of grey water from showers and hand wash basins.

These solutions, together with ***Vacuum Drainage*** for WC operation, enables all WC flushing to be undertaken through the use of recycled water and rainwater only. There will be ***no consumption*** of potable water for operating WCs at Bloomberg North Building.

4. The Benefits

The benefits of this innovative solution are clear and various.

- Over 19,000m3 per year saving of potable water consumption compared to a traditional gravity drainage system in identical building of that size
- Over 15,000m3 per year reduction in sewerage discharge due to reduced flush volumes of WCs
- The application of this technology combined with water recycling will eliminate the use of potable water for WC flushing purposes.
- Cost savings related to water and drainage
- Preservation of clean water supplies
- Alleviation of pressures on existing drainage systems
- Reduced risk of local and regional flooding

The first installation of its kind in a commercial office development in the UK, this innovative solution will also act as a clear and forward looking case study for other developments seeking to encourage and support the sustainable use of clean potable water.

5. Why Innovative?

The design should be considered ***Innovative*** *for the following reasons:*

- A nationwide ***first*** for the specification in a large scale commercial office development of vacuum drainage for WC flushing.
- This solution will reduce by up to ***80%*** the consumption of water for operating WCs,
- And the application of this technology combined with water recycling systems will ***eliminate*** the use of potable water for WC flushing purposes.
- Supporting this design will reduce the risk of regional ***flooding*** and help to alleviate the ***strains*** on local drainage infrastructure, some of which dates back to the 19th century.

	Innovative	Vacuum Drainage	Bloomberg North Building
Nationwide ***first*** for commercial office development	✓	✓	✓
Eliminating the use of potable water for WCs	✓	✓	✓
Reduced risk of flooding and drainage problems	✓	✓	✓
80% reduction in WC water consumption	✓	✓	✓

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