Council on Tall Buildings and Urban Habitat

CTBUH 2018 International Conference

POLYCENTRIC CITIES

The Future of Vertical Urbanism

Public Health Internal Drainage Standards

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Building Drainage

Fundamentally the purpose of a building drainage system is the removal of fluid and solid waste, whilst preventing sewer gases and pathogens contaminating the building environment.

Ensuring water trap seals are maintained is critical.

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Standards

- **Standards** facilitate our industry.
- A standard is an agreed way of doing something and can be referenced by regulators and legislators.
- Standards cover all aspects of construction from the making of a product, managing a process, delivering a service or supplying and installing materials .
- Standardisation ensures that products, services (design) and methods (installation) are appropriate for their intended use.
- Standards ensure that products and systems are compatible.
- Standard publications are technical specifications or preferred practices that can be used as **guidance** for the production of a product, carrying out a service or installation.
- Standards provide safety, reliability, regulation and compatibility.
- They set a minimum expectation for products, services and methods

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Standards

Plumbing Standards define:

- General and performance requirements

The system should remove all waste as quickly as possible

- Layout and calculation

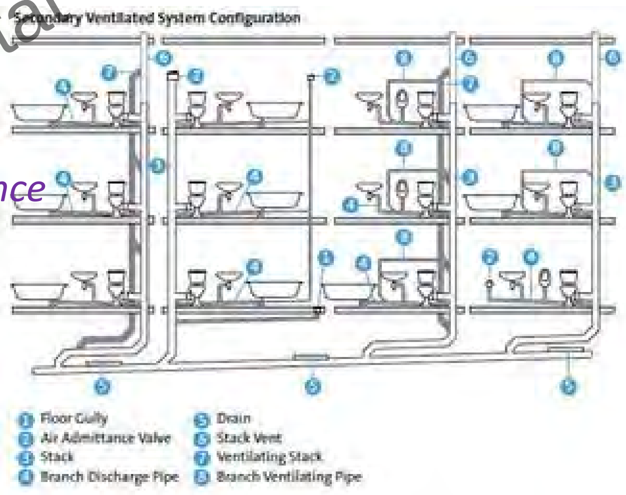
Pipe sizes should be adequate, horizontal runs should be self cleansing

- Installation and testing

Durable materials and proven solutions

- Operation, maintenance and use

Protection of water trap seal, ease of maintenance



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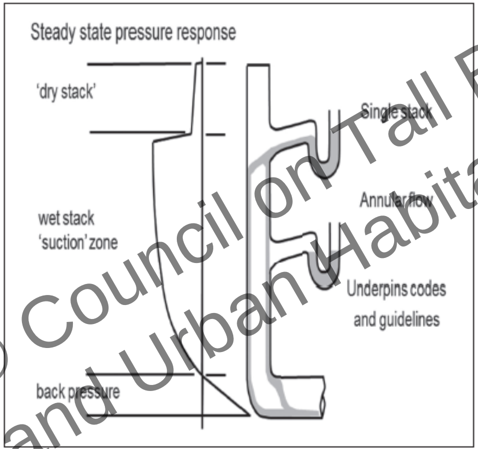
Codes and Standards

Codes and Standards

- All existing codes and standards are based on steady state and empirical data
- Fluids, air and water properties in the pipework do not change over time – it is in a constant state



Traditional Steady State Pressure Profile

The existing standards make no reference to the height of buildings

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Standard Comparisons

Code	BS EN 12056-2:2000	International Plumbing Code	Uniform Plumbing Code	Uniform Plumbing Code	
Comparisons					**Comments**
Drainage System	Gravity	Gravity	Gravity	Gravity	
	Secondary vented Primary vented	Secondary vented	Secondary vented (Primary vented)	Secondary vented	BS EN table 11 & 12 UPC appendix L (primary vented) Public and Assembly
Calculation/sizing method	Hydraulic calculations Tables Charts	Tables Charts	Tables Charts	Tables Charts	BS EN 12056, delivers flow rate calc's for drainage systems in association with look up tables and charts .
Maximum loading per trap size	Table 4	table 709.2	Para 702.0	Para 702.1	BS EN 12056, table 4, is nearest equivalent to IPC, UPC & AD UPC
Stack sizing	Tables	Tables	Tables	Tables	BS EN 12056, Hydraulic capacity (Qmax) and nominal dia, Tables 11 & !2 Max unit loading and max length of vertical & horizontal pipework IPC table 710.1(2) UPC Table 7-5, AD UPC table 7-4
Vent stack sizing	Hydraulic calculations Tables & notes	Tables & notes	Tables & notes	Tables & notes	BS EN 12056 Table 12 and ND.3.6.2 IPC table 709.1 & chapter 9 UPC table 7-5 & chapter 9 AD UPC table 7-4 & chapter 9
Cross venting (relief)	Every floor (secondary ventilation) ND.3.6.2.1	Every 10 floors Para 914.1	Every 5 floors Para 907.1	Every 5 floors Para 907.1	

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Standard Comparisons

Comparisons of the recommended design solutions for a 20 storey residential block

Based on BS EN 12056-2-2000, US UPC, US IPC and the Abu Dhabi UPC.

Country	**UK**		**USA**		**USA**		**Abu Dhabi**	
Code	**BS EN 12056-2-2000**		**International Plumbing Code**		**Uniform Plumbing Code**		**Uniform Plumbing Code**	
	System III							
1 floor	9.2 DU	2.12l/s	16 DFU	N/A	18 DFU	N/A	13 DFU	N/A
20 floors (2 lower direct to drain)	**165.6 DU**	9.0l/s	**288 DFU**	N/A	**324 DFU**	N/A	**234 DFU**	N/A
	Primary vented	*Secondary vented*						
Stack size	**150mm**	**150mm**	**100mm**		**150mm**		**100mm**	
Vent stack required	N/A	Yes	Yes		Yes		Yes	
Vent stack size	N/A	**80mm**	**80mm**		**125mm**		**80mm**	
Cross vent size	N/A	same as ventilating stack	same as ventilating stack		same as ventilating stack		same as ventilating stack	
Offset vent	N/A	above & below offset	**		no specific mention		no specific mention	

Note ** Above offset - stack should be vented as separate stack with vent stack connected and offset considered as stack base.

Below offset - vented by cross vent between offset an the next lowest horizontal branch.

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Other Considerations

Sustainable Impact

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Green Buildings

CODE FOR A SUSTAINABLE BUILT ENVIRONMENT
BREEAM

REuse
REduce
REcycle

Low
Carbon
Footprint

U.S. GREEN BUILDING COUNCIL
LEED
USGBC
LEED
LEARDERSHIP IN ENERGY & ENVIRONMENTAL DESIGN

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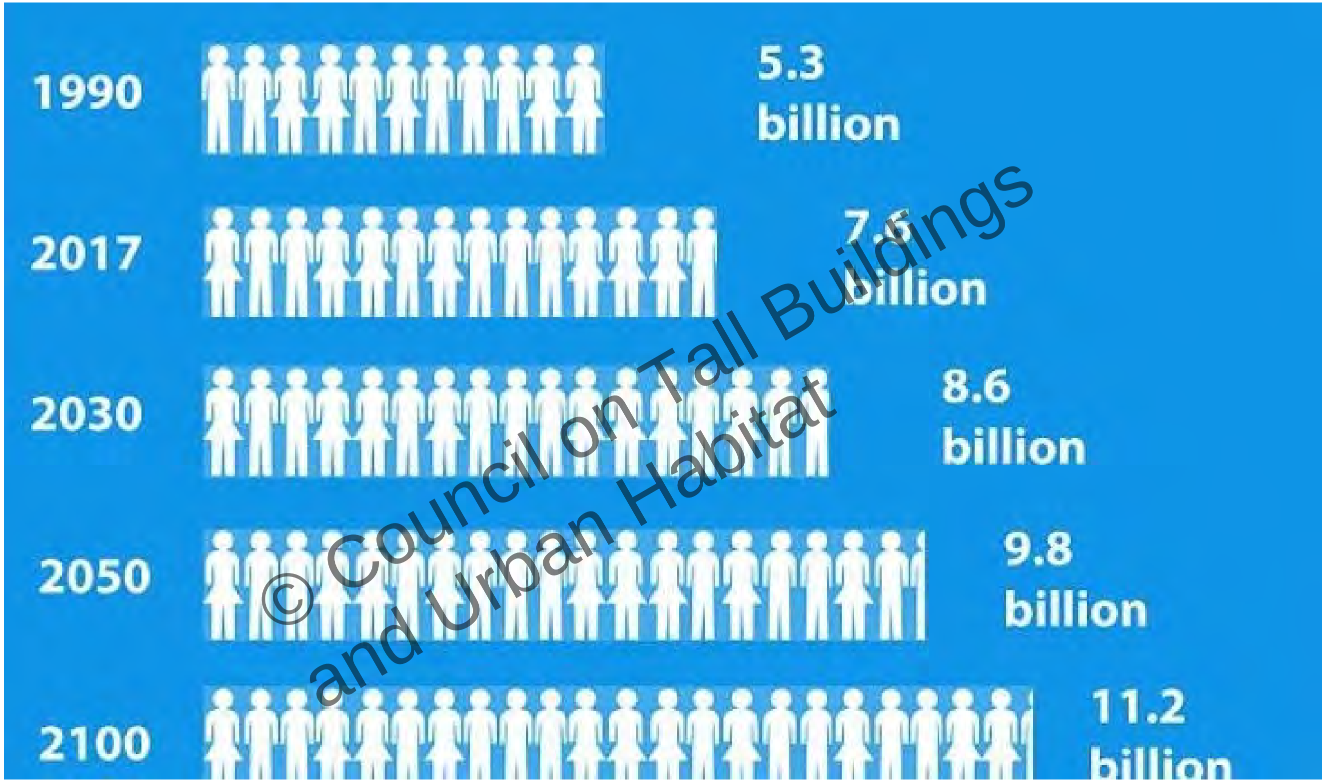
World Population Projections



UN Department of Economic and Social Affairs, 2017

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Urbanisation changing the way we live

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Tall Building Drainage Systems

Buildings are getting taller and more complex.

Recent research has confirmed the air pressures and transient air flows generated in the pipework create a number of operating conditions:

1) Increases in stack downflow generate (entrain) a greater airflow creating suction (negative pressure).

2) Reductions in entrained airflow at a local surcharge generate positive transients

3) Pressure fluctuations within the sewer can affect the internal drainage pipework system.

4) Wind shear over stack terminations generate transient oscillations within the network.

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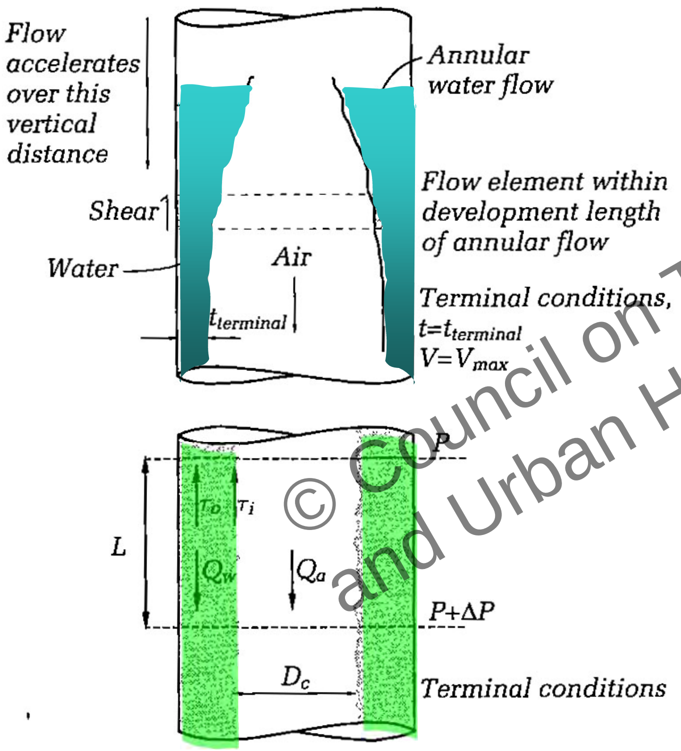
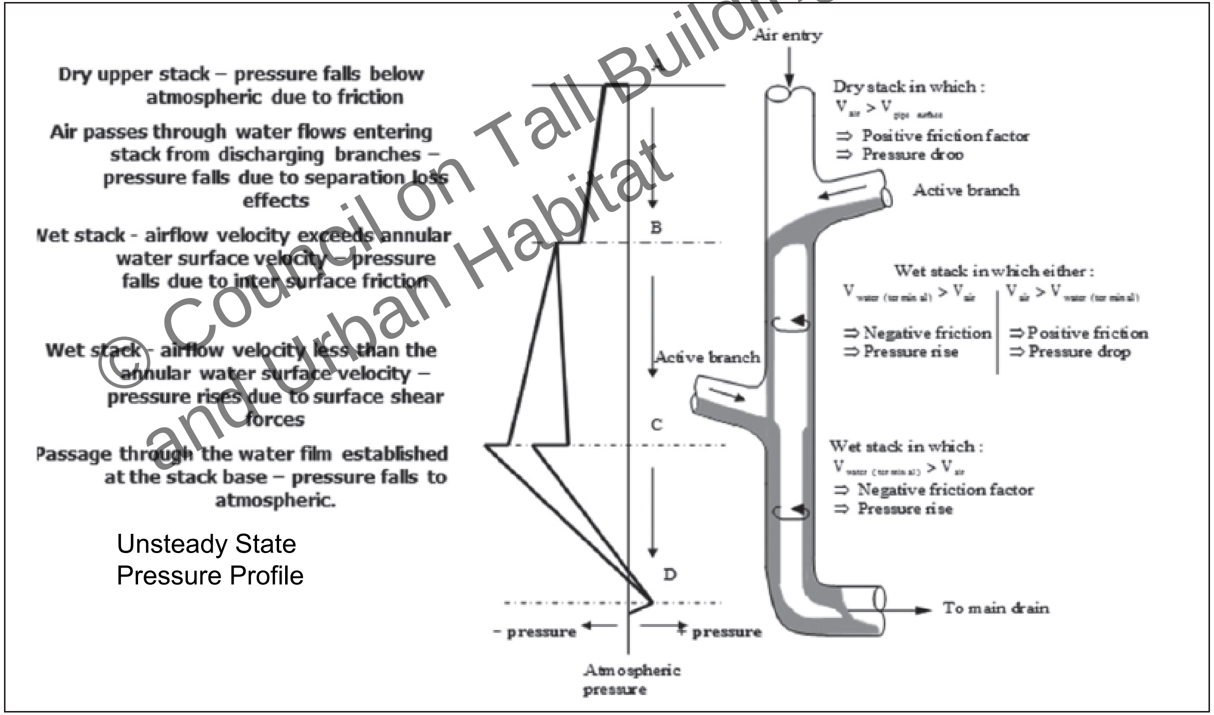
Tall Building Drainage Systems



- Annular flow depth within the pipework varies
- Fully developed within 3-5m of point of entry
- Terminal velocity of 3-5 m/s
- Water velocity at base will be the same between 3 and 100+ storey buildings

Tall Building Drainage Systems

- Drainage systems are fundamentally unsteady state systems
- Fluids, air and water all move at different speeds within the pipework due to time dependency and random discharge profiles



Unsteady State Pressure Profile

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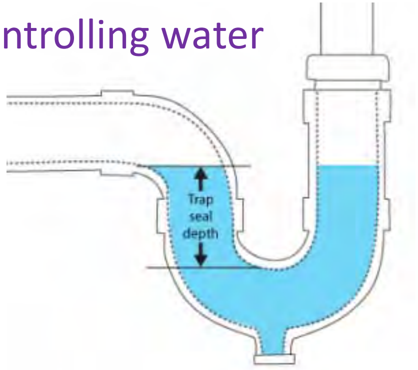
Tall Building Drainage Systems

- Tall buildings are out of the scope of existing standards
- Drainage pipework is always full…
- The taller the building, the further the air has to travel and the resistances generated result in increasing negative pressure
- When water is discharged, air is entrained at 8-15 times that volume
- Foul air is kept within the pipework system via water seal traps, which are very sensitive to air pressure transients
- The key issue is controlling air pressure and <u>not</u> controlling water velocity
- No requirement for velocity breaks



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Challenges require a new way of thinking

Challenges require a new way of thinking

Existing codes are based on steady state flow, but the reality of a drainage system is that the flows are inherently unsteady.

The flow rate, annular downflow thickness, entrained airflow and suction pressure all vary with time.

Current research and drainage modelling tools provide real evidence that there is a requirement to re-evaluate how we design and install internal drainage systems for all buildings. The pre-cursor to this is the reassessment and updating of current drainage design and installation standards.

Develop a Global Standard with National/Regional Annexe

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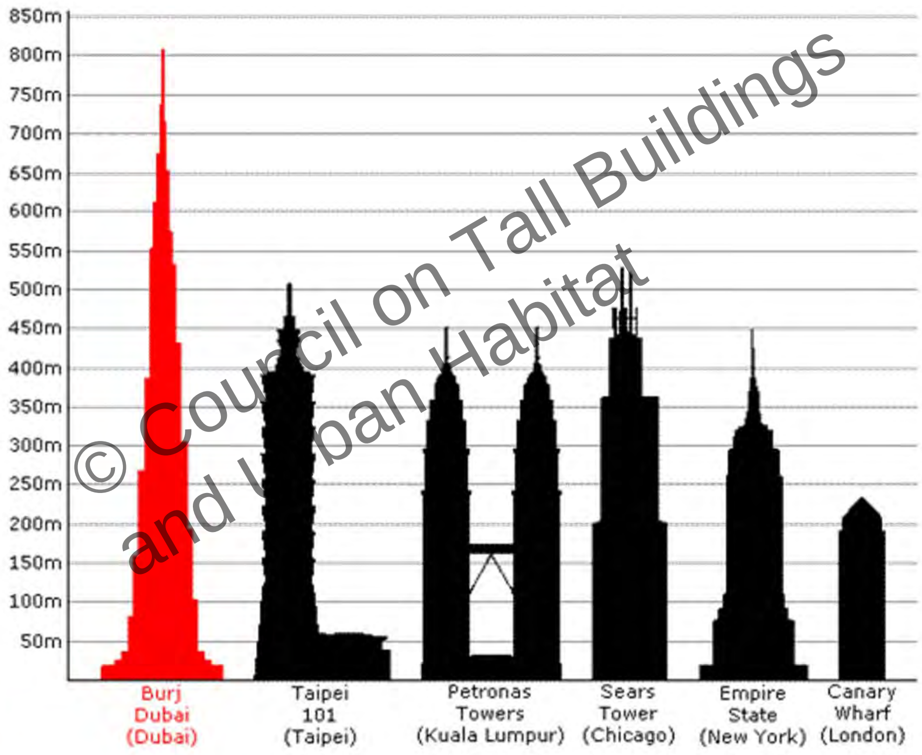
Thank You



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