

International Symposium **CIB W062 | 2017** wednesday 23 - friday 25 august Haarlem, the Netherlands



# Performance evaluation for same-floor drain technology in residential buildings





### Content

### 1 . Itroduction

- 2 . Investigation and review
- 3 . Regulation and solutions
- 4 . Observation and discussions

### 5 . Conclusion





Nowadays, Drainage system is one of the most important facilities in building service engineering, the relevant technology used today was developed decades ago. However, little progress has been reported for building drainage systems. Meanwhile, the life cycle of drainage plumbing system in building is far shorter than building construction, thus maintenance and system reform are often necessary during the whole building life cycle. Inappropriate design of the drainage system within existing buildings can result in sanitary problems including infection and maintenance issues.

# <sup>01</sup> Introduction

In the 2016 statistics of housing dispute, leakage is the most enormous problem

#### **Common Problem**



The owner hides the fact that the house is leaking.



When people need to re-decorate, old design system is easily lead to pipe rupture.



The rupture of the old pipeline causes a leaking ceiling, leaking ceiling, and wall cancer.



### Investigation and review





The regulation of water supply and drainage in building code of Taiwan has more provisions on the system performance and materials design. The allocation of plumbing area and construction patterns are not the clear provided items for regulation. The apartment management and control guideline provided the property authority and privilege.



#### **Dispute statistics**

According to Taiwan's Ministry of the Interior statistics show that pipeline leakage disputes in the housing problems and conflict occurred before the first place.

#### 2011 ~ 2016 the first quarter of housing disputes







### Questionnaire



People who lived in an apartment 231 / 102



occurrence of four leaking above

231 / 102



Often leaking 231 / 102



Do not know the drainage pipe design and regulations 231 / 102







support this regulation providing to building code.

306 / 27

# <sup>03</sup> Regulation and solutions

#### in Japan

There was a clear definition and law for housing zoning property regulation in Japan from 1970's. In the same area of one housing Property. There are some definitions regarding the residential property zoning in the housing authority including public, communal and private piping line zoning



According to the clear definition and regulation, the building plumbing system allocated in private authority zoning would not cause the conflict situation for the plumbing system life-cycle maintenance and retrofitting work.



# <sup>03</sup> Regulation and solutions

### Japan Drainage Collector System



Concentrated sewage, it has a check hole which can easy to clean.

02

03

- The cross-sectional shape of the bottom under the Drainage Collector System is a dome. It can drain from multiple pipes system. This system can ensure the water is smooth flow through the pipes.
- The height of drainage water is 300mm, and it set between the floor and floor's empty areas.





Building water supply and drainage regulation of China had major reviews and amended from 2003. The provision of GB50015-2003 recommended and guideline the adoption of same-floor drainage principal in regulation. Due to the increasing problems and conflicts of plumbing maintenance between neighborhoods of upper or lower floors, the regulation positively promoted the adoption of same-floor drain technology in residential building. The guideline recommended the concept of solutions for same-floor drain construction including bring down slab, inside wall and lift up floor as



### 03 **Regulation and solutions**

### Falling plate type drainage system



Reduced drainage is also known as "caisson"



The toilet space down or local version of 300mm ~ 400mm.



04

Allocate the drain line in this space, and fill the space with the filling material.

The most common drainage method, and also mature construction.



### 03 **Regulation and solutions**

### Wall Drainage Drainage System

01

Wall drainage is the installation of drainage pipes in the back of the false wall.

02

False wall thickness of about 200mm, builtin hanging basin and toilet.



Health, aesthetics, clean.



Fewer choice of sanitary appliances, floor drain is difficult to set, the higher the price.







### 03 **Regulation and solutions**

# Elevation of the same layer of drainage system

- In the toilet space pad or local pad height, want to install the pipeline and sanitary equipment, must be raised more than 150mm.
- 02 This way increases the height of the toilet floor height above the floor and will increase the floor loading and cost.
- 03
- Waterproof would be the issue for this construction.

04

This method is generally used for the retrofitting of the old house







# <sup>03</sup> Regulation and solutions



There are many type of bathroom layout for residential building in Taiwan. The size of water area depends on the scale of the housing unit and its design. Three pieces with basin, toilet and bathtub in one room is the most typical design for residential building and Fig.4 shows the common set of bathroom design and sizes in Taiwan. The planning of how many sets of involved bathroom depend on the design and needs of the housing units. The confirmation of the drainage performance in housing unit is a crucial issue for the feasibility of adoption same floor drain principle in regulation.





In order to enhance the performance of building drainage system, A confluent device of Integrated Unit Trap (IUT) is verified as a feasible concept and substitute for individual trap of floor and washbowl and bathtub in bathroom for recent years in Taiwan.

This compact device IUT is conducted by manufacturers and applied to residential buildings for recent years in Taiwan.





#### **Performance Evaluation**

According to previous documents, the building drainage performance index could include equipment materials, construction, heat resistance, allowable flow rate, self-cleaning, seal stability and etc.. There are some testing methods for the conformation of these index, such as the allowable flow rate should be under 1.25 I/s which adopts the bathtub 0.6 I/s, washing basin 0.25 I/s, shower 0.15 I/s and allowance factor. Through the expert's interview and questionnaire by the methodology of FDM, AHP and FMEA, the evaluation system for the drainage performance could be concluded. The results would improve the feasibility of same floor drain technology to apply in the building water supply and drainage system.

Target	Items		Conservative cognition		Optimism cognition		Average		Test value	Expert Consensus Gi	Expert onsensus Gi Selected
			Min	Max	Min	Max					
		Factors									
SFD Performance Evaluation	Drainage	Flow rate	2	7	7	10	5.44	8.69	3.25	7.00	
		Self-clean	3	9	6	10	5.19	8.50	0.31	7.19	
		Drain	4	8	6	10	6.00	9.00	1.00	7.20	
		Sanitation	3	9	6	10	5.56	8.31	-0.25	7.21	
	Construct ion	Difficulty	3	10	6	10	5.38	8.00	-1.38	7.21	
		Check	3	7	5	10	4.81	7.75	0.94	6.11	Х
		Integration	3	10	5	10	5.13	7.75	-2.38	6.80	Х
		Indoor	3	10	6	10	5.94	8.50	-1.44	7.52	
		Waterproof	3	10	7	10	7.00	9.25	-0.75	8.29	
	Life- cycle	Leakage	3	10	7	10	6.38	8.94	-0.44	8.04	
		Block	3	10	8	10	6.75	9.06	0.31	8.49	
		Maintain	3	8	7	10	5.69	8.13	1.44	7.33	
		Renewal	3	7	6	9	5.13	7.56	1.44	6.45	Х
	Cost	Construction	3	10	5	10	5.81	8.38	-2.44	7.23	
		Design	3	8	5	10	4.25	6.94	-0.31	6.02	Х
		Maintain	3	9	5	10	5.56	8.00	-1.56	6.86	Х
		Usage	3	9	5	10	4.94	7.63	-1.31	6.57	Х
	Original factor	17	Selected percentage		100%	Test	value	7	Th	eshold alue	7.149
	Selected factor	-				1000			V		



Fuzzy Delphi Method (FDM) was used to collect the experts' consensus and build the evaluation system for SFD. The methodology would test the fuzzy judgments and make the convergence for the common factors for the SFD evaluation. Furthermore, the Analytic Hierarchy Process (AHP) can adopted for the weighting decision for these evaluation index.



# <sup>05</sup> Conclusion



Domestic construction usually put the drainage plumbing system under the floor and caused great problems for the maintenance and retrofitting work during the building life cycle. This research focuses on the same-floor drain technology and the fundamental performance issues, and surveys on the solutions for building drainage system design. There are still many field procedure and construction method should be integrated and regulated for the same floor drain technology. Due to the difference of domestic situation for construction and water supply and drainage system, the optimal adaptation and application for same floor drain technology including the drainage performance and bounding conditions need to be conducted in the future.

