

A Holistic Approach for Public Housing Sustainability

Annual Concrete Seminar 2014

Ir. Danny K.C. Chung Chief Manager/Management (Support Services 5) Hong Kong Housing Authority Hong Kong Special Administrative Region, PRC

Public Rental Housing (PRH) Stock

- Public housing programme in HK over 60 years
- Over 2 million people or about 30% population in PRH
- More than 740,000 rental flats at 1,471 blocks in 208 estates (as at Dec 2013)



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Ageing PRH Stock



Age Distribution of PRH Flats

Key to building sustainability is extending service life of aged buildings via

- Total Maintenance Scheme (TMS)
- Comprehensive Structural Investigation Programme (CSIP)

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Total Maintenance Scheme (TMS)

- **Proactive Maintenance Programme** ۲
- Launched in 2006 •
- Target : Estates over 10 years old •
- 5-year cycle afterwards •
- Three-Pronged Approach to prevent ٠ minor defects from growing up into major problems



Total Maintenance Scheme (TMS)





- In-flat inspection ambassadors to conduct home visits and inspections
- Minor defects to be repaired on-the-spot and works orders to be issued for more complex problems for prompt action

Total Maintenance Scheme (TMS)





- Maintenance hotline to strengthen communication and promptly handle calls about repair appointments, complaints and enquiries
- Computerized system to streamline the workflow of maintenance service and facilitate contractors performance monitoring

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Total Maintenance Scheme (TMS)



- Ambassadors to provide handy information for tenants on maintenance issues
- Maintenance Education Centre and mobile booths to promote daily maintenance awareness

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Comprehensive Structural Investigation Programme (CSIP)

- Investigate PRH buildings approaching 40 years old
- 15-year cycles afterwards
- Assess in-depth structural conditions
- Develop and implement tailor-designed repair solutions to prolong service life of buildings





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Visual Survey Structural Assessment Repair **Solutions** Performance

Monitoring

Desktop ______Study

Structural assessment and develop repair solutions

- Assess whether buildings structurally safe
- Find out root causes of defects
- Develop tailor-made repair solutions







CSIP - Findings

The reasons of building deterioration:

- Hidden Corrosion
 - deterioration without observable defects
- Contamination
 - e.g. chloride attack, carbonation
- Multitude of Causes
 - undesirable design and workmanship
 - repair difficulties and improper use
 - inherent problems
 - aggressive environment of Hong Kong

CSIP Findings - Hidden Corrosion





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CSIP Findings - Contamination

- Very difficult to 'decontaminate' (e.g. remove carbonated concrete)
- Calls for solutions other than the small patch, repair-andrepair approach



CSIP Findings - Multitude of Causes (1) Undesirable Design

• Earlier design weak in durability

- Low concrete strength
- Small cover to re-bars
- Toilet cum bathroom design
- No waterproofing



Many piping through slab



Undesirable drain design

CSIP Findings - Multitude of Causes (2) Undesirable Workmanship



Porous infill to squat type toilet



Inadequate fall on slab

CSIP Findings - Multitude of Causes (3) Repair Difficulties and Improper Use

- Sea water for flushing toilet
- Low level of tenants' care



Overflow of salt water



Wetness caused by tenants' use



Difficult repair areas



Congested pipes

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CSIP Findings - Multitude of Causes (4) Inherent Problems

Aerosol Effect:



CSIP Findings - Multitude of Causes (5) Aggressive Environment of Hong Kong

- Warm and Humid Sub-tropical Climate
 - Mean Air Temperature
 - Mean Relative Humidity
- Acid rain / air pollution
- Coastal effect



23°C

77%

CSIP Findings - Multitude of Causes (5) Aggressive Environment of Hong Kong

Acid Rain:

Acid rain test - pH as low as 3.7 recorded

Ref. Hong Kong Environmental Protection Department : acid rain if pH < 5.0

cf. pH value of vinegar - 2.4 to 3.4





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CSIP Findings - Multitude of Causes (5) Aggressive Environment of Hong Kong

Coastal effect:

- Airborne chloride ion deposition rates
 - Station 1 up to 601 mg/m²/day
 - Stations 2-5 up to 41 mg/m²/day
- High deposition rate of airborne chloride ion increases the risk of corrosion for RC structures in coastal area





Sustainability of Aged Buildings



Residual Service Life of Aged Buildings



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- Effective and durable repair solutions were developed based on the following methods:
 - Moisture Control
 - Restoration of Structural Elements
 - Ingress Protection
 - Restoring Passivity
 - Cathodic Protection
 - Improving Maintainability
 - Improving Micro-environment
 - Omitting Vulnerable Elements
 - Replacing Vulnerable Elements

Multi-Pulse Sequencing System to Remedy Basement Water Seepage









After installation

Semi-recasting to Restore Deteriorated Structural Elements



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Repair Solutions Developed through CSIP Surface Coating to Protect against Ingress of Chemicals and

Water

Moisture Control

Restoration of Structural Elements

Ingress Protection

Restoring Passivity

Cathodic Protection

Improving Maintainability

Improving Micro-environment

Omitting Vulnerable Elements

Replacing Vulnerable Elements





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Repair Solutions Developed through CSIP Replacement of Contaminated or Carbonated Concrete Moisture Control Remove carbonated Restoration of concrete with Structural Elements repair mortar in toilet **Ingress** Protection **Restoring Passivity** Cathodic Protection Improving Maintainability Improving Micro-environment **Omitting Vulnerable** Elements

Replacing Vulnerable Elements

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Installation of Sacrificial Anodes to Protect Steel







Installation of Accessible Lourve for Easy Maintenance



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Replacement of Open Grille Blocks by Top-hung Windows



Diversion of Rainwater Dripping Path





Removal of Projecting Cantilevered Fins





Replacement of Vulnerable Elements





Concrete Repair Strategy– People-oriented Approach

High Performance Concrete



Work can complete in a day ! (open to tenants at night)



Welcomed by

Improved Working Environment

Shortest

Time

Minimum Nuisance

Minimum Inconvenience

Tenants

Concrete Repair Strategy– People-oriented Approach Hydro-scarification



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Shortest Time

Minimum Nuisance

Minimum Inconvenience

Improved Working Environment

Welcomed by

Tenants

Concrete Repair Strategy– People-oriented Approach

Noise Screens during Construction

Minimum Nuisance to Tenants !



Noise Absorbent Curtains at working areas to reduce noise and dust

Dust Screen Protection in tenant's flat

Concrete Repair Strategy– People-oriented Approach

Polyurea Waterproofing System (PWS)



A More Advanced Waterproofing System !

- ✓ More effective waterproofing -forming a seamless layer
- No need to remove tiles or screed
- ✓ Minimal noise, dust and vibration

Concrete Repair Strategy– People-oriented Approach Fire Test

Maybe an Alternative with Less Cost, Time & Nuisance !

S	ho	rte	es'
	Tir	ne	è

Minimum	
Nuisance	

Minimum Inconvenience

Improved Working Environment

Welcomed by Tenants

Fire Resistance of Reinforced	FRP = 1 hour			FRP = 2 hours		
Concrete Slabs	Min. cover (mm)			Min. cover (mm)		
CP114:Part 2: 1969		15			15	
CoP for Fire Safety in Building 2011		20			25	

- Upgrade existing structural elements in A&A works by spraying concrete to increase concrete cover
- Alternatively, conduct **Fire Test** to verify fire resistance; thus reducing works scope, cost and time of construction



FIRE

IEST

Concrete Repair Strategy– People-oriented Approach Ventilated Working Site

A Healthier Environment for Workers !



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Shortest Time

Minimum Nuisance

Minimum Inconvenience

Improved Working Environment

Welcomed by

Tenants

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Public Engagement Activities Meet Tenants and Community Needs ! Shortest Time **Consultation with Tenants** & Council Members Minimum Nuisance Minimum Inconvenience Improved Working Environment Welcomed by **Tenants**

Concrete Repair Strategy– People-oriented Approach

Partnering Workshops with **Tenants**

Attending International Conferences & Technical Meetings



ICCRRR Conference in 2012



SB11 Helsinki World Sustainable Building Conference in 2011



Mainland Staff Exchange Program 2012



ISO Technical Committee Meeting in 2011



Assist HKIE to produce guidance for building maintenance



CSIP reported by the HKIE

Widely and Positively Reported by Media



Award from Industry and Civil Service Bureau







Meritorious Award of "Civil Service Outstanding Service Award Scheme 2011" Most Innovative Measure/Proposal - Gold Award from Housing Authority 2012 Merit Award in Innovation Award of the Year from RICS 2013



Conclusions

- The HKHA is committed to provide affordable quality housing to meet the needs and expectations of our tenants.
- With the aging of our housing stock, the HKHA is better sustaining our existing estates through the TMS and CSIP.
- With our tenants at heart, all repairs and upgrades are customer-focused, addressing key concerns and needs of tenants while keeping nuisance to a minimum.



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