HKHS 75th Anniversary International Conference

"From Building Green to Ever-green Buildings: A Hidden Contribution to ESG in the Housing Sector"

Sr Prof. Bay WONG

MBA, FHKIS, FRICS, MCIArb, RPS(BS), RI(S)

Supervisory Board Member,
Hong Kong Housing Society

Adjunct Professor,
Department of Real Estate and Construction,
The University of Hong Kong

17 April 2023

The Origin of ESG

Corporate Social Responsibility (CSR) is a self-regulating business model that helps a company be responsible to itself, its stakeholders and the public.

…….companies should strive to ***uphold ethical standards*** ***and*** ***to improve the quality of living*** *of its staff and their families, as well as the local community and society as a whole. It is a* ***part of ESG*****.**

(source: https://www.linkreit.com/en/media/channel823/wellness/what-is-esg-how-is-it-related-to-sustainability-and-csr/)

……Many people think that the long-term goals of ESG are to make a property ***more "green" or improve its energy efficiency****. The ultimate goal of an ESG strategy is to* ***create value for all stakeholders*** *– including tenants, investors, employees, the community, and the environment.*

Source: https://refineddata.com/2022/06/esg-what-it-is-and-how-it-affects-the-real-estate-market

ESG Components in Housing Sectors

Environmental

Greenhouse gas emissions	Water consumption	Waste management	Resource management
Mineral extraction	Materials	Resource efficiency	Recycling

Social

Diversity and social inclusion	Health and well-being	Legacy planning
Community impact and integration	Education and skills	Emergency response planning

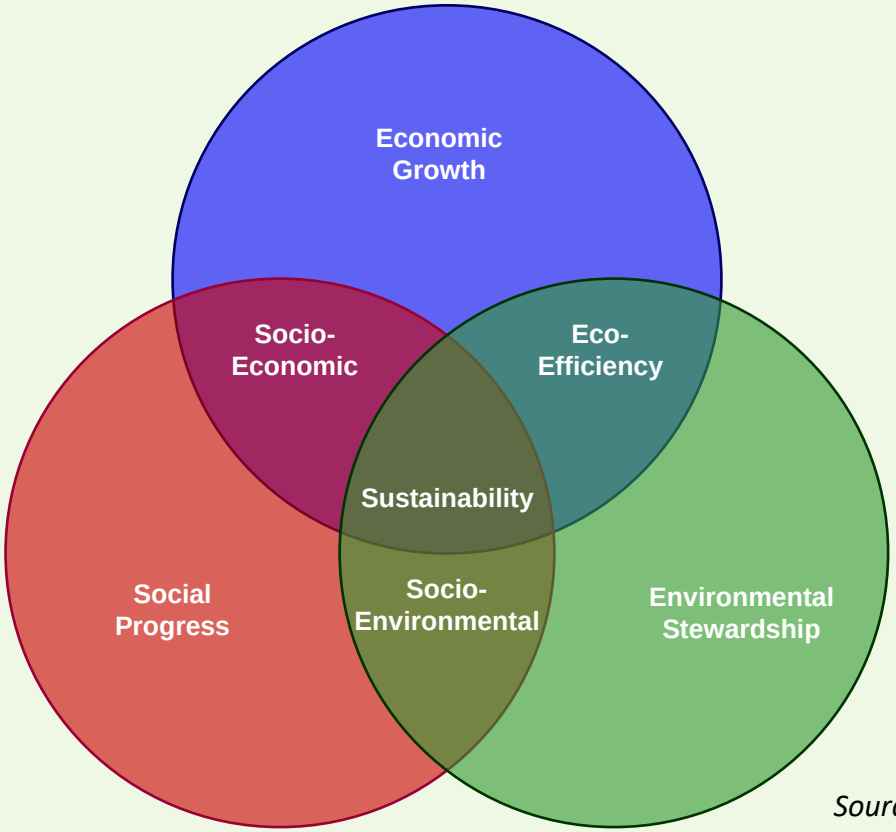
Governance

Strategies	Policies	Constitution of governing body	Procurement
Sales	Supply chain management	Stakeholder engagement	Diversity, equality, and ethics

Source: "Evidence of ESG in the Construction and Development Industry" by McMillian LLP

Sustainability

Norwegian Prime Minister Brundtland : "Meeting the needs of the present without compromising the ability of future generations to meet their own needs".



Sustainability is :

- **an attempt to merge ecology and economy into one system**
- **living a life of dignity in harmony with nature**
- **renewing resources at a rate equal to or greater than the rate at which they are consumed**
- **creating an economic system that provides for qualify of life while renewing the environment and its resources**

Source: http://www.gcbl.org/system/files/sustainability-venn-sm.jpg

A sustainable community is one that resembles a living system where all of the resources (human, natural and economic) are renewed and in balance for perpetuity.

Green Buildings

- Green buildings are designed, built, renovated, operated, and reused in **an ecological and resource-efficient manner** to meet certain objectives such as ***protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment***.

- Green-building concepts extend **beyond the walls of buildings** and **include site planning, community and land-use planning issues** as well.

(Source: https://www.greenbuilt.org/about/importance-of-green-building/)

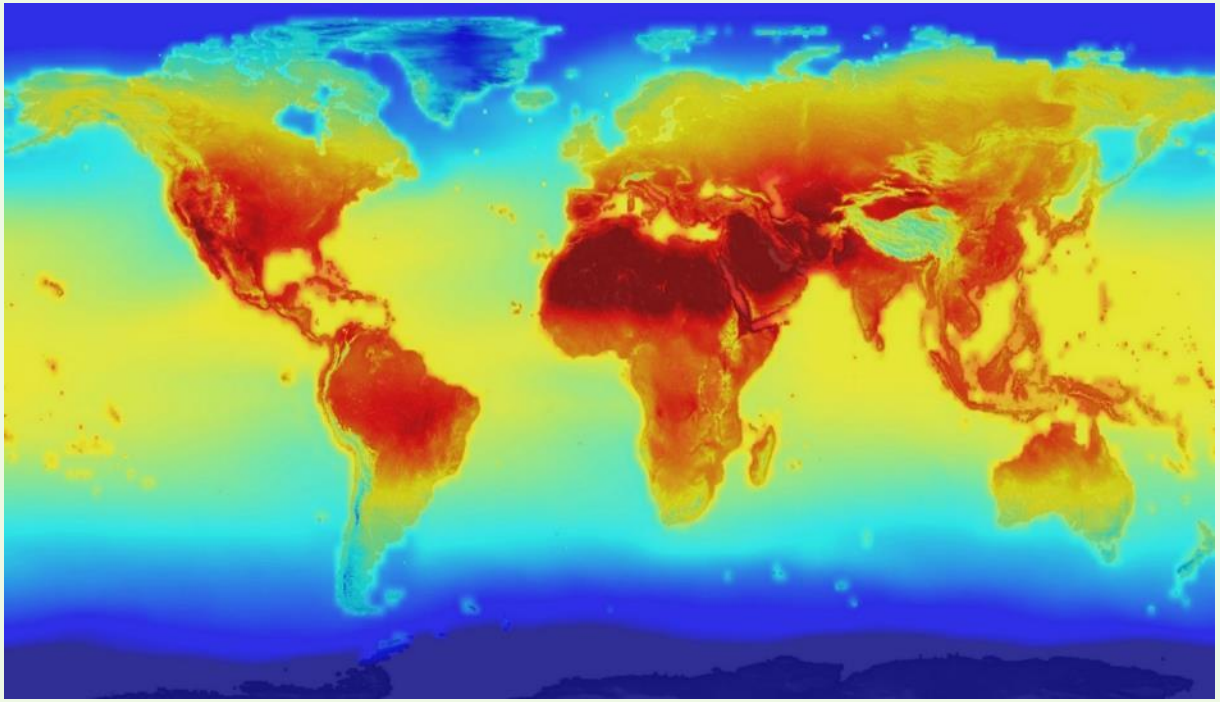
Trend of ESG in Housing Sector

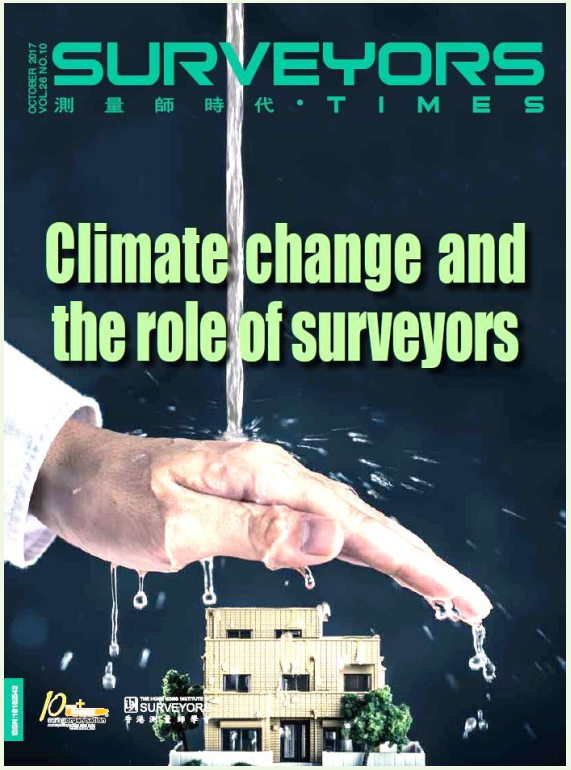
- *Awareness is growing that real estate can have a **significant social impact** either through the form of rehabilitation of public spaces (indirectly attributing value to existing real estate), affordable housing, social housing, and care centers, or through an environmental focus investment on new buildings such as green buildings.*

(Source: https://www2.deloitte.com/ce/en/pages/real-estate/articles/the-impact-of-social-good-on-real-estate.html)

Climate change!!

Global warming!!!



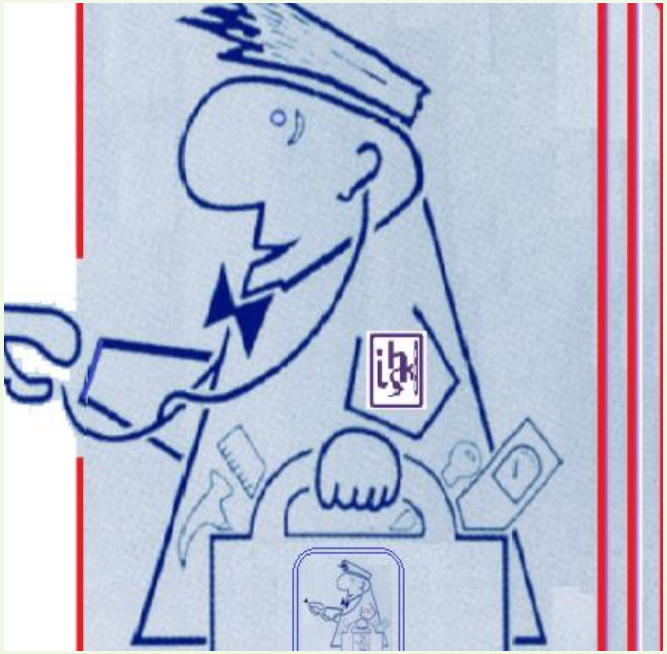


".....The quality of a city largely depends on how good it is planned, designed, constructed, managed and maintained.....but maintenance is not too well understood by practitioners and the public....."

- A Building Doctor's perspective

(Source: Sr Prof. Bay WONG, 2022)

THE HONG KONG INSTITUTE OF SURVEYORS
香港測量師學會



Every building has a life but it can have health problems

病

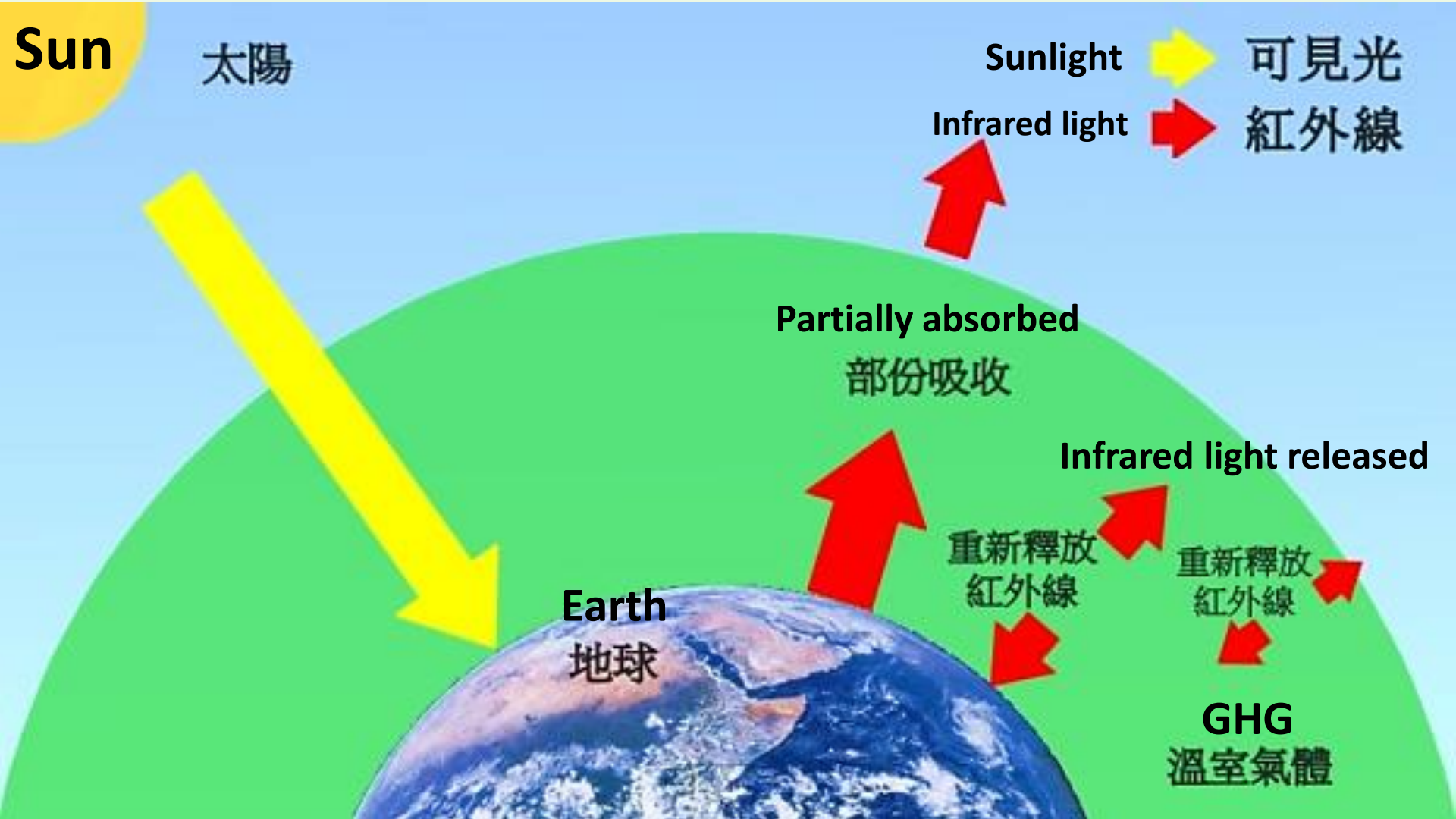
Sickness

Sick Buildings

Global Warming 全球暖化

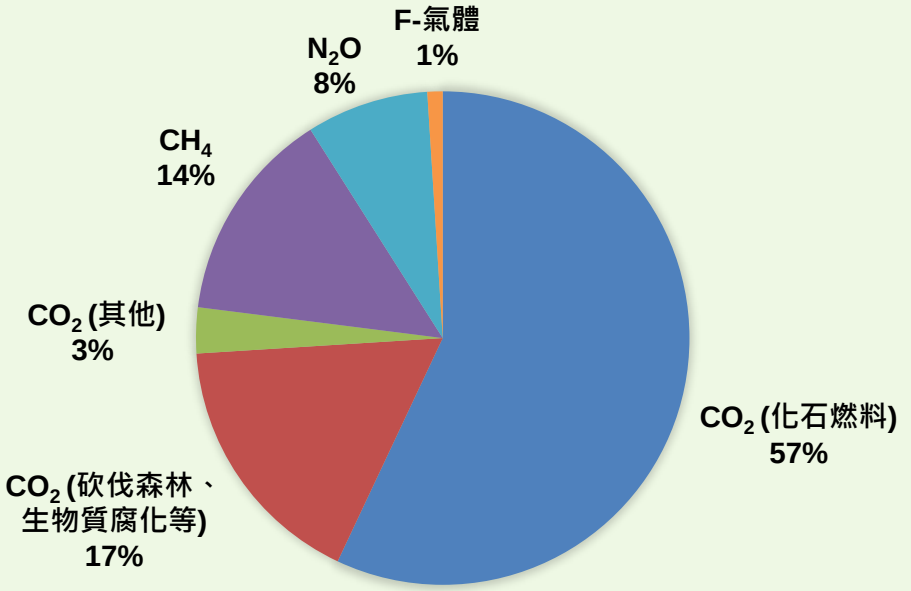
CO_2 concentration has increased

30% in the last 100 years



Common Green House Gases (GHG)

- **Carbon Dioxide [二氧化碳**：(fossil fuel) 以化石燃料的燃燒過程產生最多]
- **Methane [甲烷**：(fossil fuel/ refuse dumps) 化石燃料的生產、燃燒生物質能（如木頭）和堆填區的廢物處理]
- **N_2O [氧化亞氮**：(fossil fuel/solid waste burning) 化石燃料和固體廢棄物的燃燒]
- **Fluorinated Gases [氟化氣體**：(refrigerants/foaming agents) 在生產及/或使用製冷劑、發泡劑、噴霧劑的過程中都會產生氟化氣體]



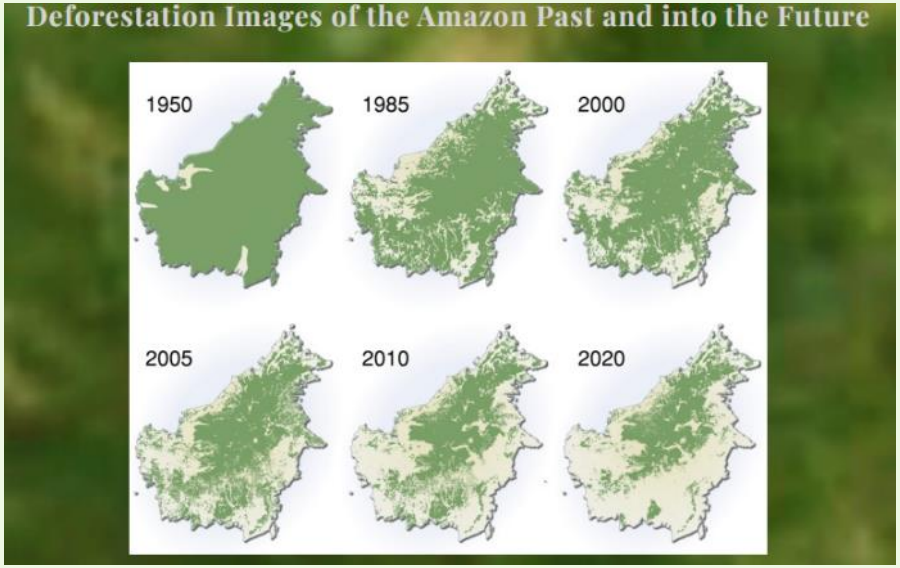
Effects of CO_2 Emission

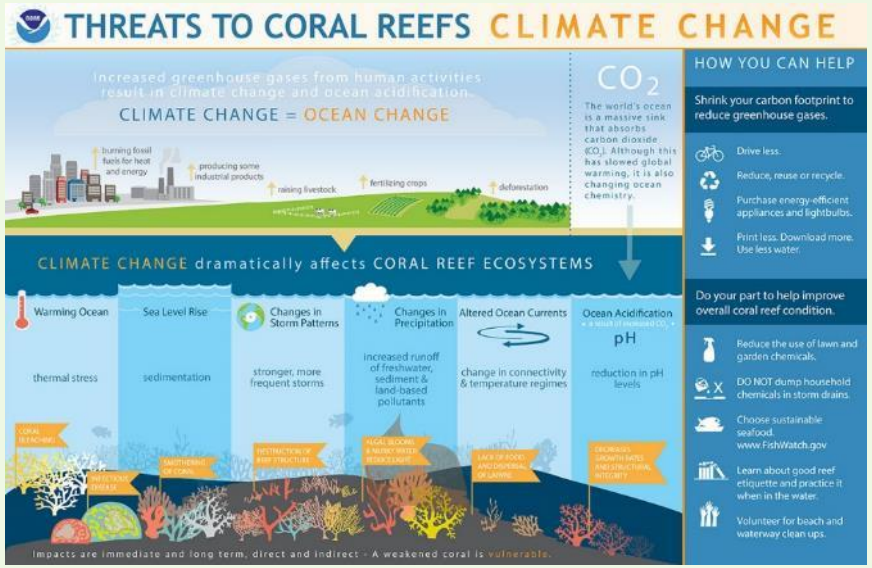
- **Extreme weather**
  [氣候反常，影響農作物的收成，減少全球糧食供應]
- **Rising of sea levels**
  [南北極冰層融化，海平面上升]
- **Animal/Plant extinction**
  [動物和植物可能因未能適應氣候改變，影響物種存活]

Sick Nature Syndrome

- Lungs on land
- Amazon Rainforest shrinking

- Lungs in sea
- Coral bleaching





Equilibrium of Nature

- ***The equilibrium of nature was disturbed due to the changes in pressure (both in the atmosphere and in the sea)!***

- ***The self-healing capability of nature was seriously damaged!***


Human activities in buildings in HK account for:
90% Total Electricity Consumption
60% Greenhouse Gas Emission

Peace
太和

Long Term Safety
長安

Comfort
永樂

Wisdoms and Philosophy of Lao-Zhuang in Ancient Chinese

老莊智慧，回歸自然
Returning to Nature is the Wisdom of Lao-Zhuang

- 天長地久。天地所以能長且久者，以其不自生，故能長生。(老子) 七章 (The operation of the environment is not for its own.)

- 亂天之經，逆物之情，玄天弗成。 (莊子) (在宥) (If the law of nature is disrupted, natural development cannot be sustained.)

- 萬物皆出於機，皆入於機。(莊子) (至樂) (We all come from nature and return back to nature.)

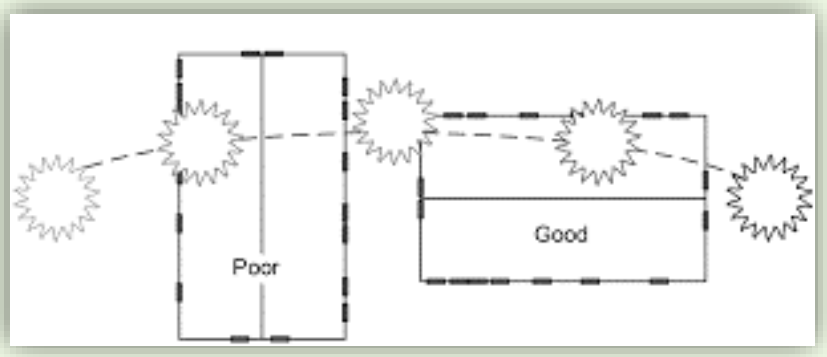
Nature Based Solutions *(Lessons from Tokyo, Japan)*

(Toranomon Hills - A vertical garden city with a skyscraper & YKK Building)

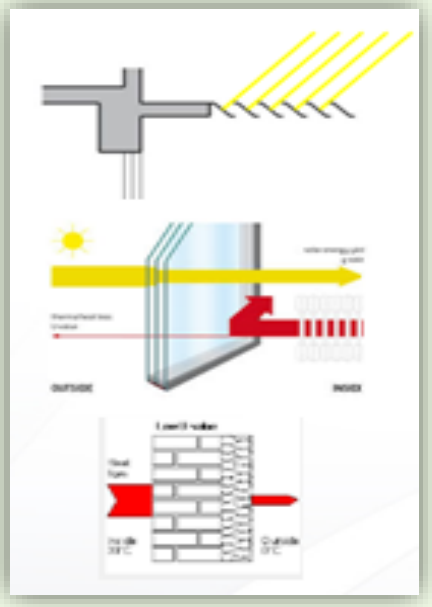
Nature Based Solutions - *Passive Design Concepts*

*回歸自然

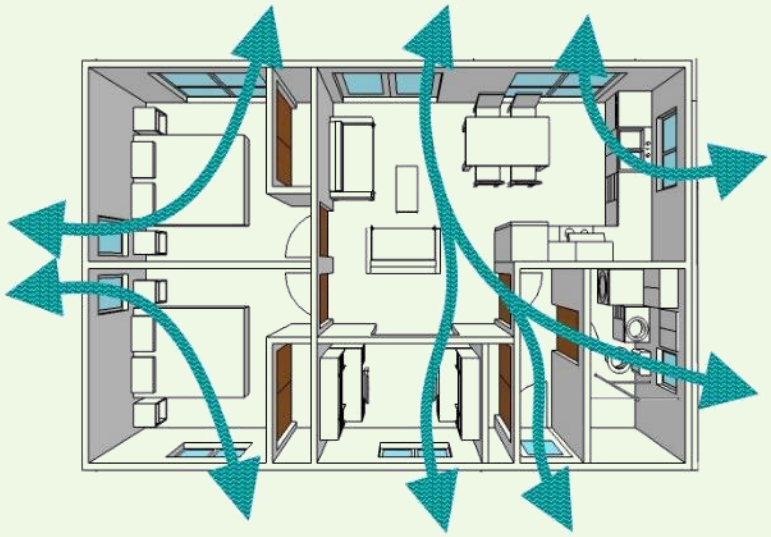
- Spatial Planning
- Building Fabric
- Daylight
- Natural Ventilation



Block layout, orientation and daylighting

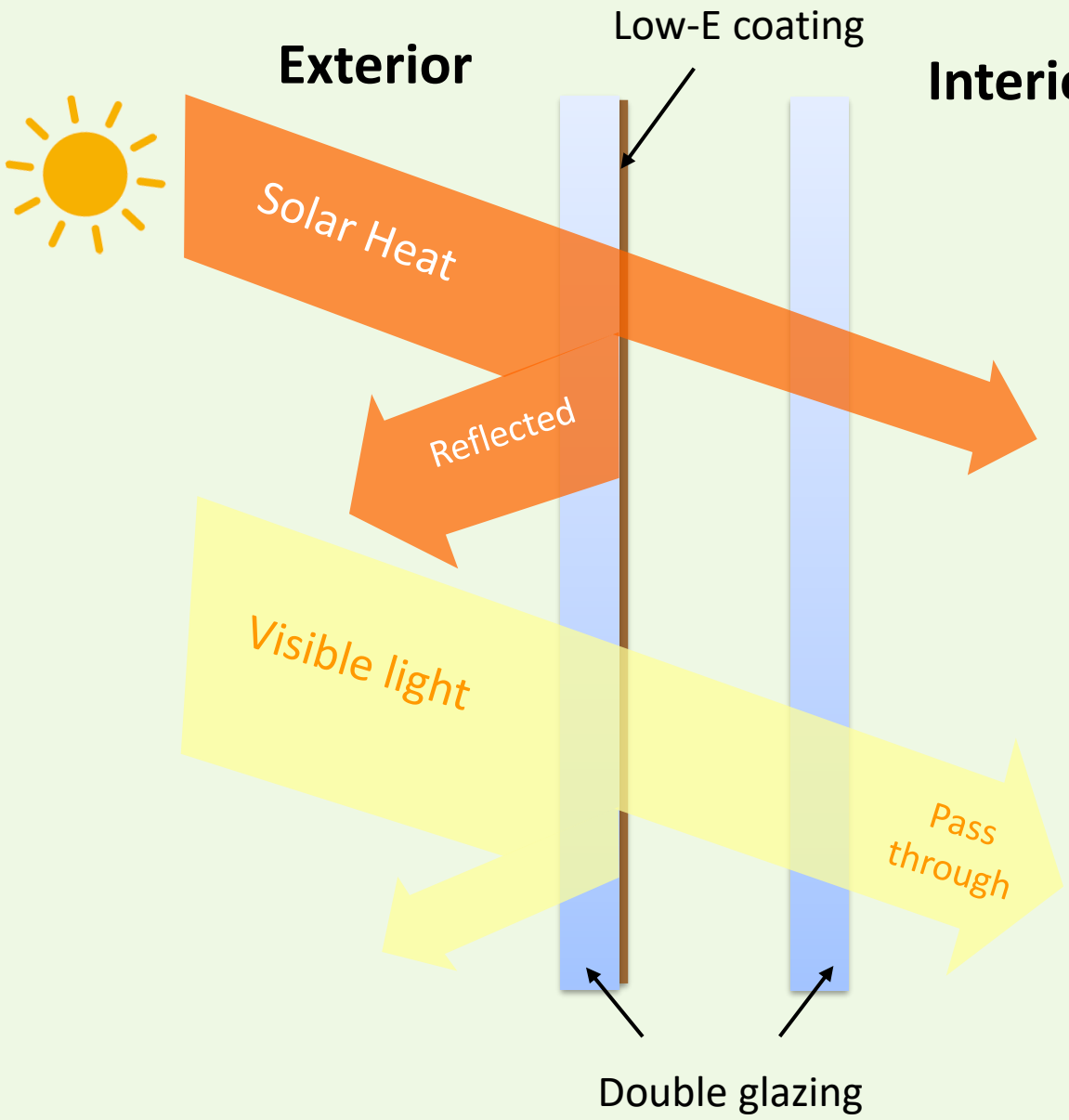


Fabric OTTV / RTTV



Cross ventilation

科技智慧 Glass Technologies: Low-E Glass



Low-E glass coatings can have an emittance as low as 0.04 thus

96% of the incident infrared radiation can be reflected

Hong Kong Green Building Council (HKGBC)

Inaugurated in November 2009

4 Founding Members:

- Construction Industry Council (CIC)
- Business Environment Council (BEC)
- BEAM Society Limited (BSL)
- Professional Green Building Council (PGBC)

CONSTRUCTION INDUSTRY COUNCIL 建造業議會

BUSINESS ENVIRONMENT COUNCIL 商界環保協會

BEAM 建築環保評估協會

PGBC 環保建築專業議會

Green Building Assessment

(Source: Conrad Wong, Past Chairman, HKGBC)

Assessment methods to evaluate green buildings in the world

- **Category of Assessment:**
  - **Site Aspect**
  - **Material Aspect**
  - **Water Use**
  - **Energy Use**
  - **Indoor Environmental Quality**
  - **Innovation and Additions**

- **Category of Assessment Area:**
  - **New Building**
  - **Existing Building**
  - **Fitting-out**
  - **Community (Neighborhood)**
  - **Enforcement Method**
    - **Market Force, Branding**
    - **Government Policy – BD Submission**
    - **Tax or Loan Incentive**

The Housing Sector has done a great job in building green in new developments!

A Collection of Green Buildings

A Key Element in ESG: Building Sustainability

- Buildings are key resources of the society
- **No building is maintenance free**
- Time and weather cause decay and wear
- Only **timely maintenance** will make them:

✓**safe**

✓ **habitable**

✓ **functional**

✓ **aesthetic and durable**

✓**appreciate in value**

✓ **with less breakdown**

Causes of Maintenance Problems
保養問題的成因

- Rain, water, salt water (水)
- sun light (陽光)
- Weather (風雨霜雪)
- Corrosion (金屬腐蝕)
- biological agencies (生物媒體)
- chemical action, salts (化學作用)
- Abrasion, wear & tear (磨損)
- Settlement (自然沉降)

Ageing and wearing (自然衰老及損耗)

- ***Climate change***
- ***Global warming***
- ***CO2 concentration***
- ***Heat waves***
- ***Extreme weather events***
- ***Heavy rainfall***
- ***Typhoon***

Maintenance is the Key to Building Sustainability

In theory: good design + proper choice of materials + good workmanship + supervision ➔ resulting minimum maintenance costs

- **In practice: A high % of buildings have maintenance problems, need closing down for maintenance or rehabilitation, wasting huge resources of the society**

- ***Pre-mature redevelopment* is quite common but a great loss to the society**

- **Experience from Hong Kong Housing Sector**:
  *Many owners and occupiers do not have a **culture** in maintenance care of their buildings resulting in* ***serious urban decay***

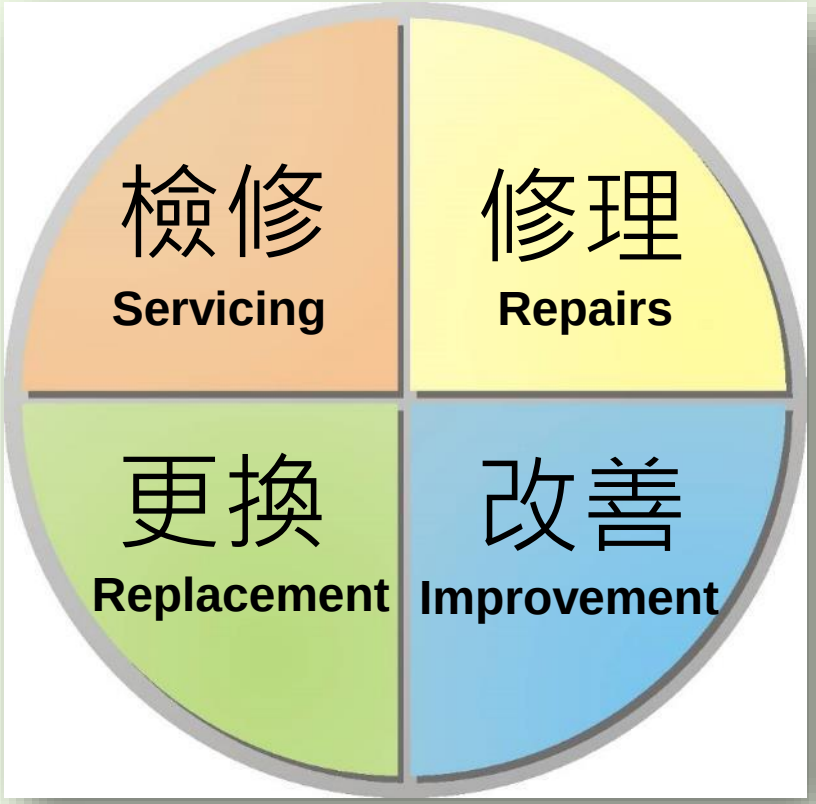
Effective Maintenance Works 妥善維護

A. Servicing
   - prevent wearing
   - minimize breakdown

B. Repairs
   - arrest breakdown, investigate causes
   - recovery

C. Replacement
   - renewal of parts at end of economic life

D. Improvement
   - enhancement of standard



Urban Decay Due to Disrepairs

- Accelerates wear & tear and causes breakdown
- **Depreciation in property value**
- Increases maintenance expenses
- ***Deferred maintenance* is a false economy: a waste of money**
- Repairs cause disruption to economic activities
- Disrepairs and breakdown cause economic losses, disturbance & safety hazards

❖ **Solution: *proper preventive planning, timely repairs and appropriate maintenance* (”適時保養, 妥善維護”)**

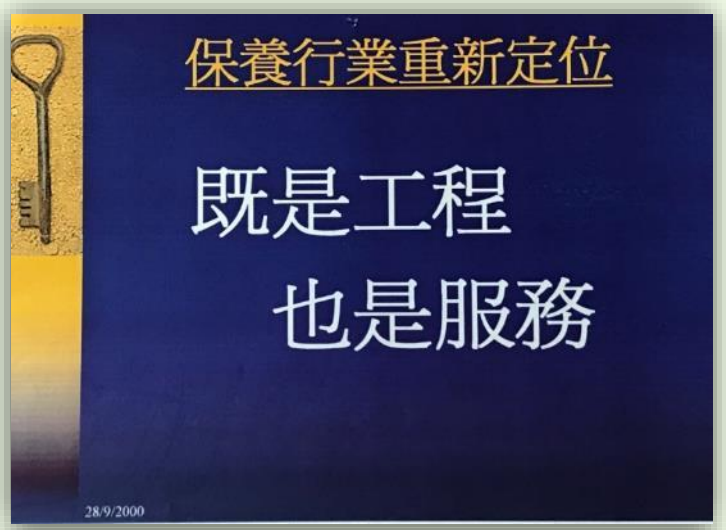
Maintenance Strategies in Practice
妥善維護

- ✓Unplanned Breakdown Maintenance
- ✓***Planned Maintenance***
- ✓Corrective Maintenance
- ✓***Preventive Maintenance*** 適時保養

Maintenance Management

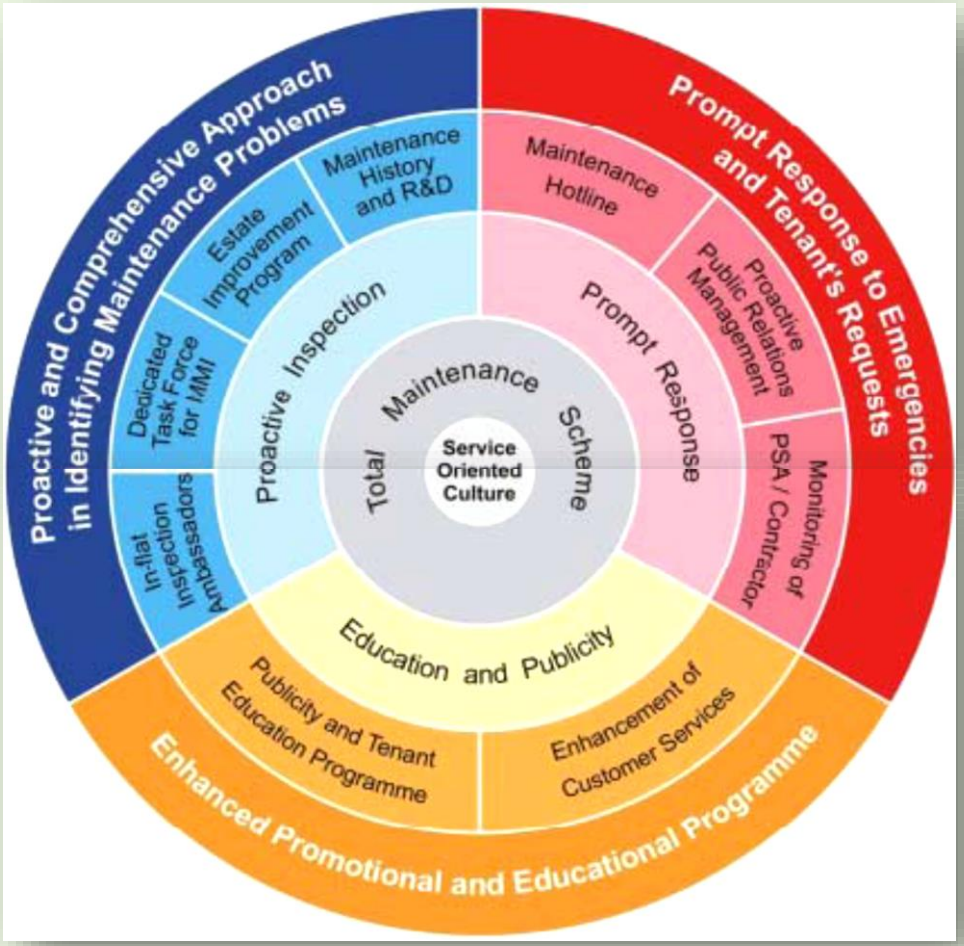
Objectives of the new generation of maintenance management

- **Reliability** of operation
- **Recovery** after breakdown
- **Customer focused** services
- **Total quality** of process



Total Maintenance Scheme –

Experience from Housing Department



Picture Courtesy: HKHA

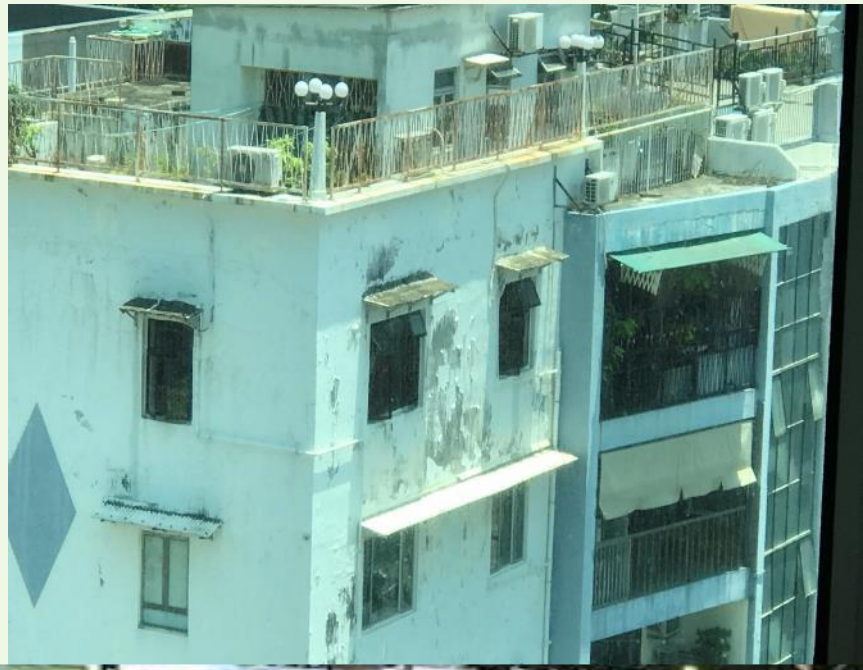
A Collection of Grey Buildings

Climate change ***resulting serious adverse weather***

Extreme Adverse Weather - 2018 超強颱風山竹

Effects of adverse micro-climate

Outdoor environmental issues



Defects affecting health and sanitation of occupiers

Indoor environmental issues

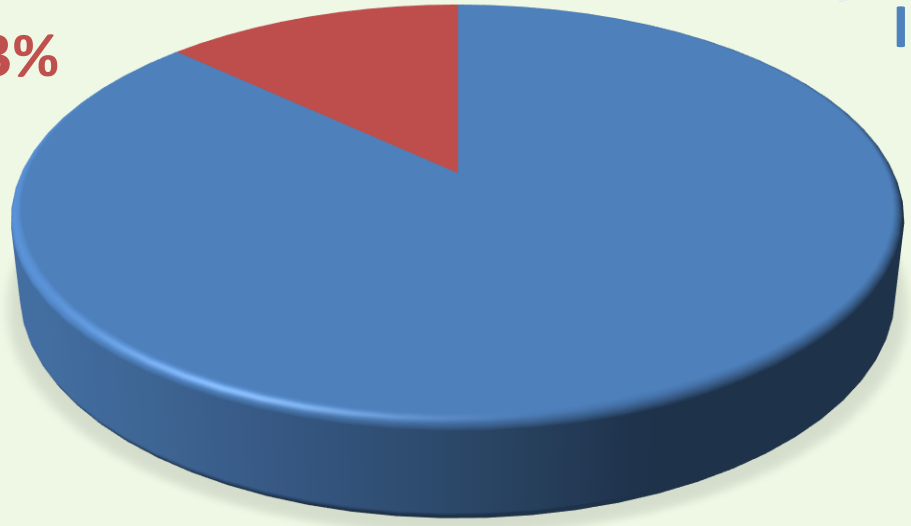
Every Building Has a Life

- ***As a practitioner in the Housing Sector, we have a duty to keep buildings healthy and their value sustainable!***

- ***We also have an ethical responsibility to keep the occupiers healthy! Check the indoor environmental qualities!***

People Focus Issues: Health and Wellbeing

Over 80% of human activities are carried out in buildings



Indoor Environment Qualities

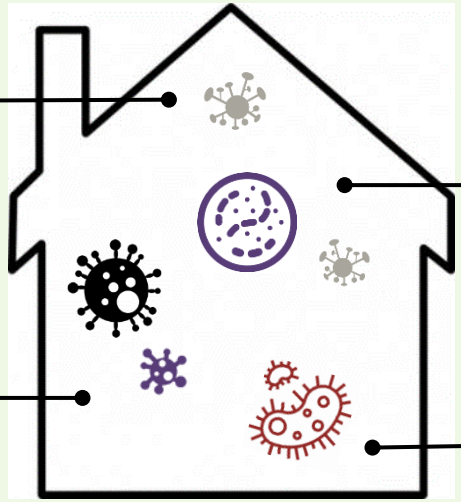
Healthy indoor climate increases productivity by

10-20%

Indoor air is

2~5 times

worse than outdoors (EPA)



72%

of toxic chemicals are from indoors (UL)

213 mil

work days lost in the US due to poor IAQ (ASHRAE)

Indoor Pollutants

CARBON MONOXIDE (CO) (一氧化碳)

Odorless, colorless and toxic gas,

CO reduces oxygen delivery to the body's organs and tissues;

At extremely high levels, CO can cause death.

PARTICULATE MATTER 2.5 (PM2.5) (懸浮顆粒)

Fine dust particles or droplets in the air 2.5 microns or less in width,

Short-term effects: eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath.

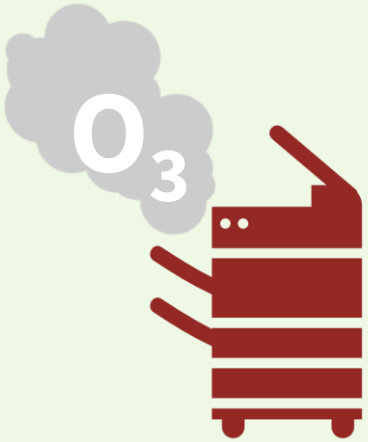
Long term exposure is associated with increased rates of chronic bronchitis, reduced lung function and increased mortality from lung cancer and heart disease.

Indoor Pollutants

VOLATILE ORGANIC COMPOUND (VOC) (揮發性有機化合物)

emitted as gases from certain solids or liquids,

can cause eye, nose, and throat irritation as well as headaches, loss coordination, and nausea; may cause damage to the liver, kidney, and central nervous system; Some suspected or known to cause cancer and asthma.



OZONE (O_3) (臭氧)

can trigger a variety of health problems; Inhaling fairly low amounts of ozone can still result in signs & symptoms such as coughing, congestion, wheezing, shortness of breath, & chest pain in healthy people.

People with already existing asthma, bronchitis, heart disease, and emphysema may find their conditions worsen while inhaling ozone.

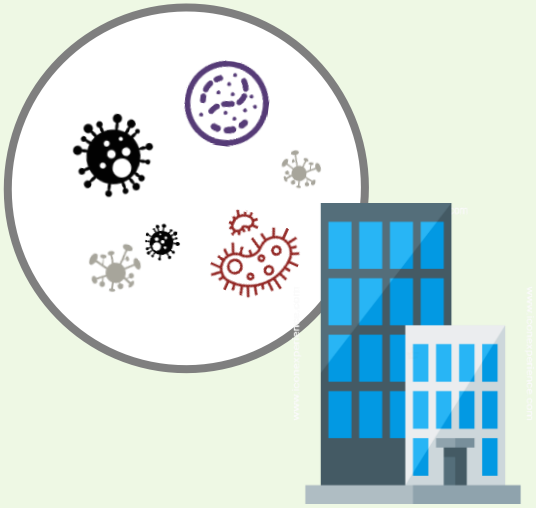
Indoor Pollutants

CARBON DIOXIDE (CO_2)
(二氧化碳)

accumulation indoor is normally related directly to the number of occupants.

Increasing CO_2 levels cause decreasing oxygen levels in the body, hampering the flow of oxygen to the brain.

It makes you sleepy, lazy and low in energy.



Other Pollutants:

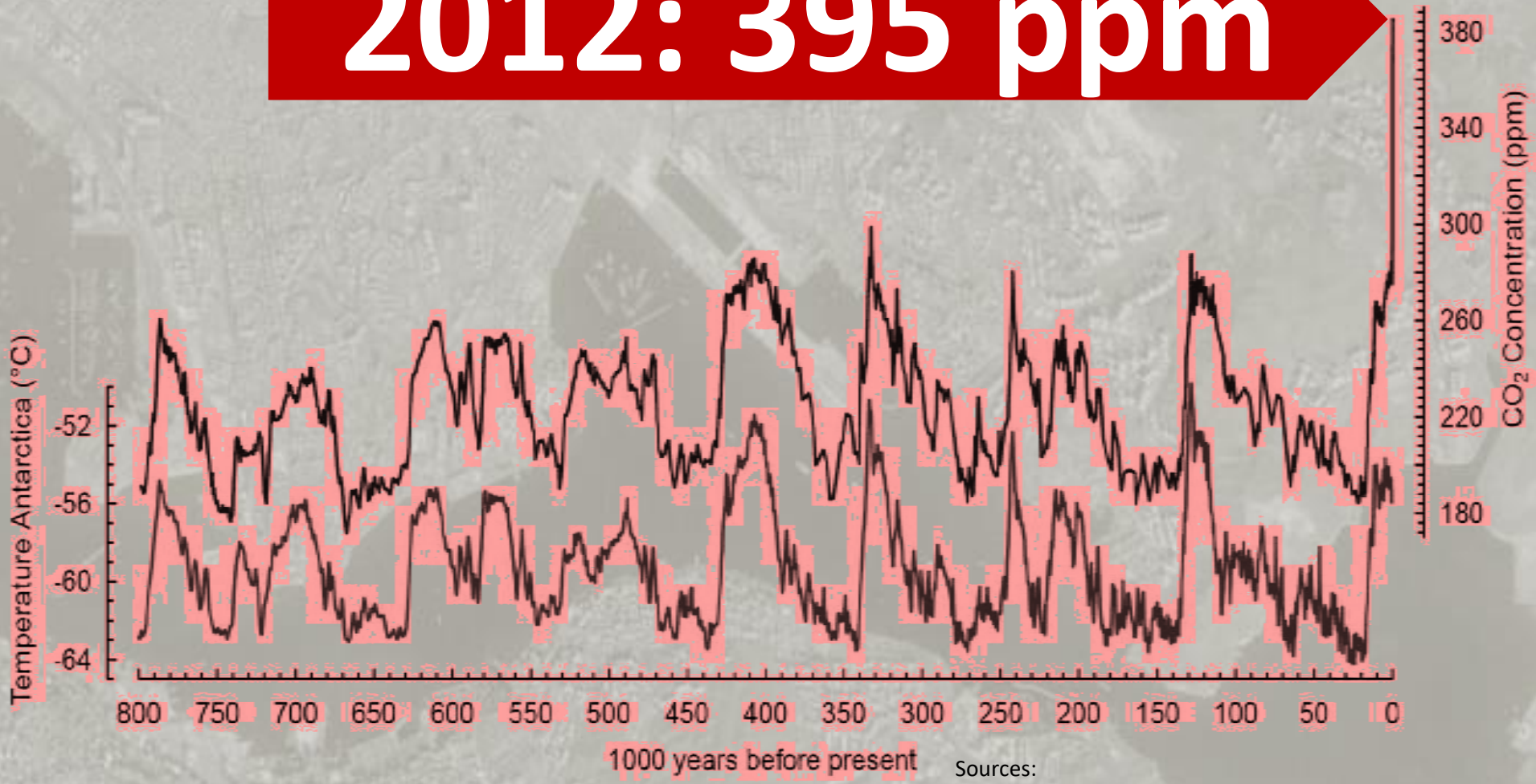
- ***Radon (氡)***
- ***Formaldehyde (HCHO) (甲醛)***
- ***Nitrogen Dioxide (NO2) (二氧化氮)***
- ***Airborne Bacteria (skin disease)***
- ***Mold (eczema)***
- ***Pollen etc.***

Global warming related problems:

Note the damaging effects of CO_2

CO_2 concentration increased 30% in the last 100 years!

2012: 395 ppm



Sources:

ZERØCARBØNCØMPENDIUM – who's doing what in housing worldwide

Scripps CO2 Program, Mauna Loa Observatory in Hawaii

Common Building Problems in Grey Buildings

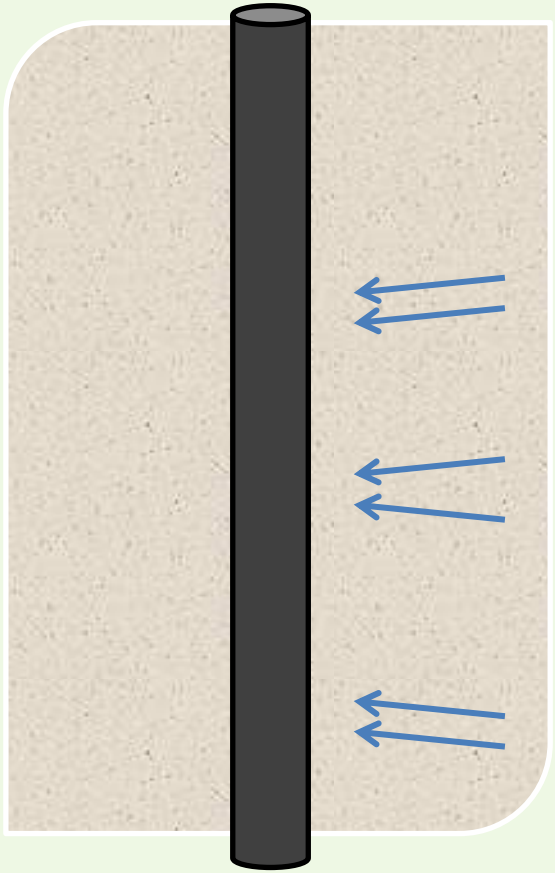
Concrete Spalling

cracking of ceiling, wall and column

- **Symptoms**
  - rust staining
  - exposure of rusty reinforcement
  - spalling of covering and cracks develop

- **Reason:**
  - Air, **(CO_2)** (carbonation of concrete cover)
  - **(Chloride)** (salt water toilet flushing , a major source of chloride)

Process of Concrete Spalling



Steel de-passivation
(鹼性保護層受破壞)

Carbonation
(碳化作用)

Electrolysis
(產生電解作用)

Chloride + Water
(氯化物 + 水)

Oxidation of steel
(鋼筋氧化)

Oxygen
(空氣中氧)

Carbonation of Cover

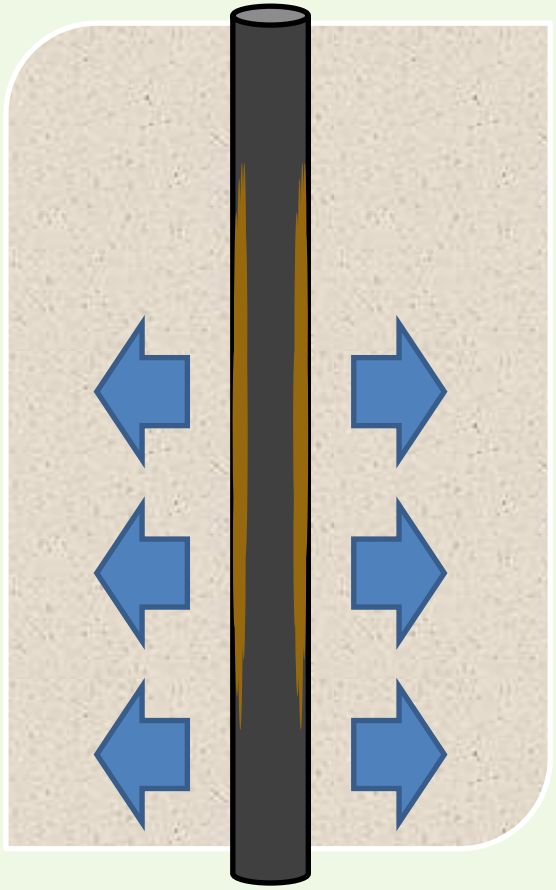
$$Ca(OH)_2 + CO_2 \rightarrow CaCO_2 + H_2O$$

Calcium Hydroxide	Carbon Dioxide		Calcium Carbonate (low alkalinity)	water

	pH values		
Alkaline	14.0 9.5		Reinforcement protected from corrosion
Neutral	7.0		Corrosion of reinforcement
Acidic	1.0		

Fully carbonated concrete has a pH of around 8.3. Carbonation of concrete is checked by **phenolphthalein indicator solution**.
(i.e. colorless = acidic; purple/red if alkalinity > pH 9.0)

Rusting of Reinforcement



- Corrosion occurs

Rust on the bar expands

→Tension on the protective layer

- Concrete spalling

Some Sharing on Durability of Concrete

(Source: Sr Raymond A. Bates, 1985)

- Factors to influence durability of reinforced concrete
  - **Depth of reinforcement (cover)**
  - **Permeability of the concrete**
- Chlorides can be from a **leaking salt water pipe**
- 4-5% chlorides may be associated with additives during construction & **leaking salt water flushed toilets**
- **Tackling a problem at source**: **repairing leaking toilets, waterproofing bathroom floors, lining salt water tanks & providing adequate floor drainage**
- The **weathering effect on buildings** must be considered when **designing preventive maintenance**; same applies to the **use of a building**

Building Maintenance Crises

(Source: Sr Dr. Danny PM Cheng, 2019)

Building maintenance crises

Aging buildings

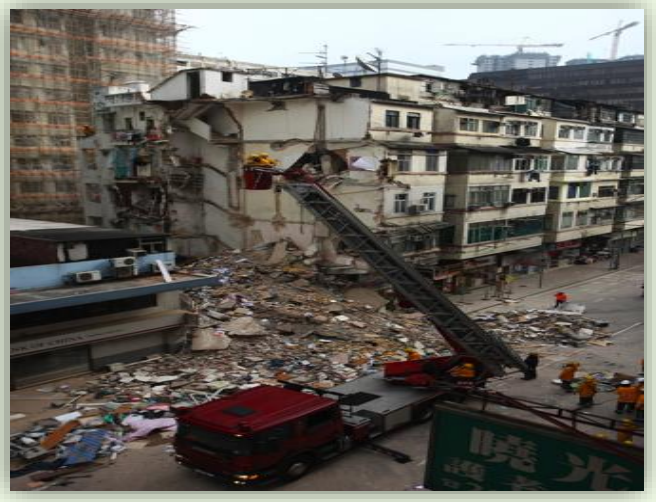
Building Maintenance Crises

(source: Sr Dr. Danny PM Cheng, 2019)

Falling concrete

Water seepage

馬頭圍塌樓奪4命



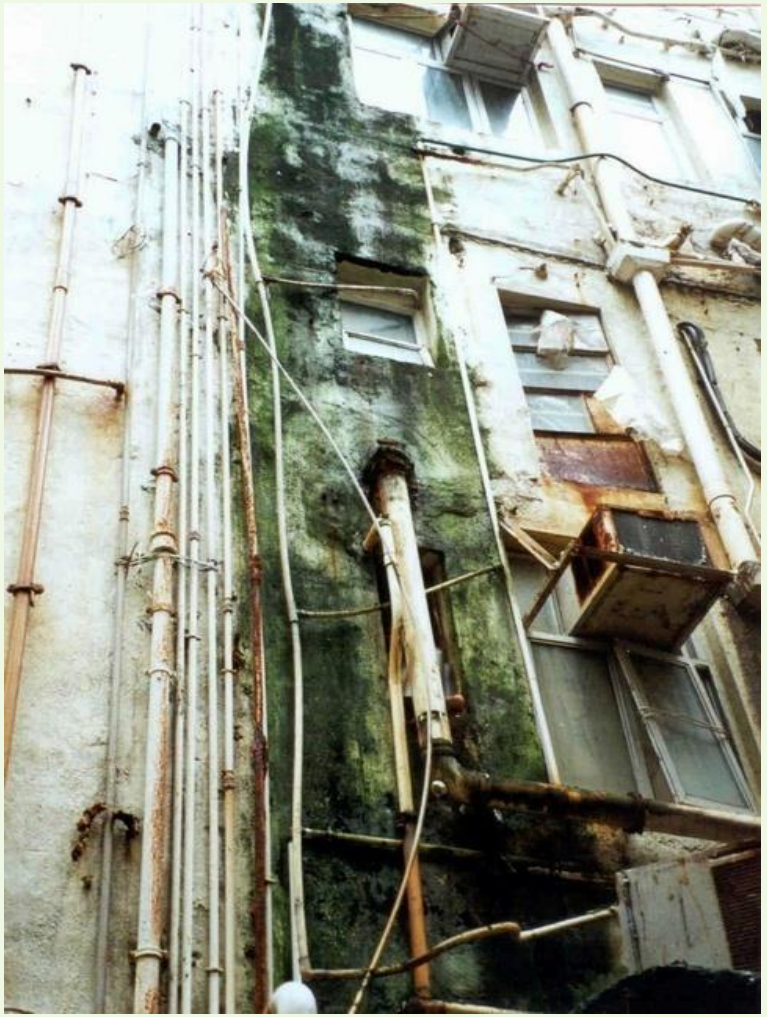
Falling windows

Water pipe bursting

Balcony collapse

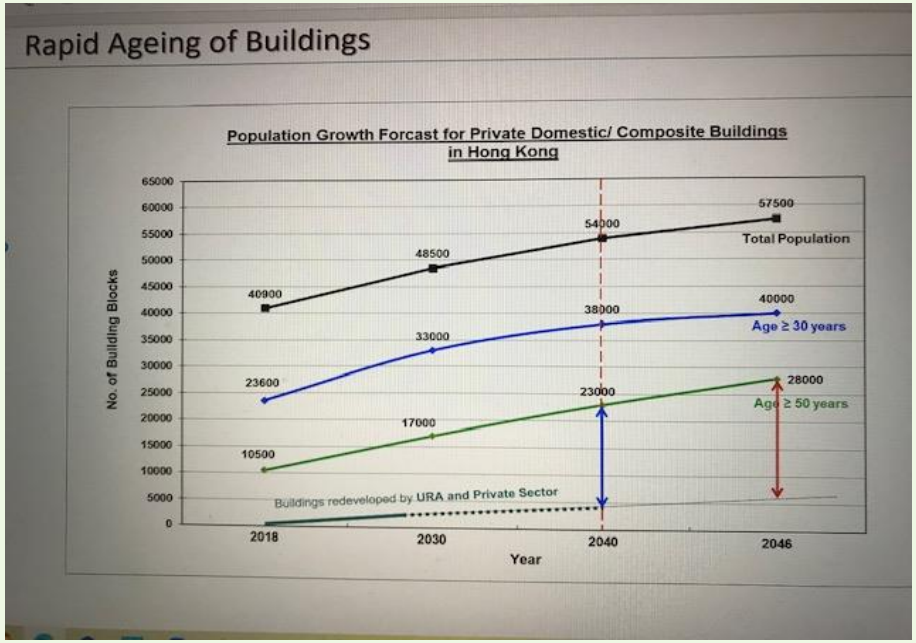
Our Building Stock is Ageing Rapidly!

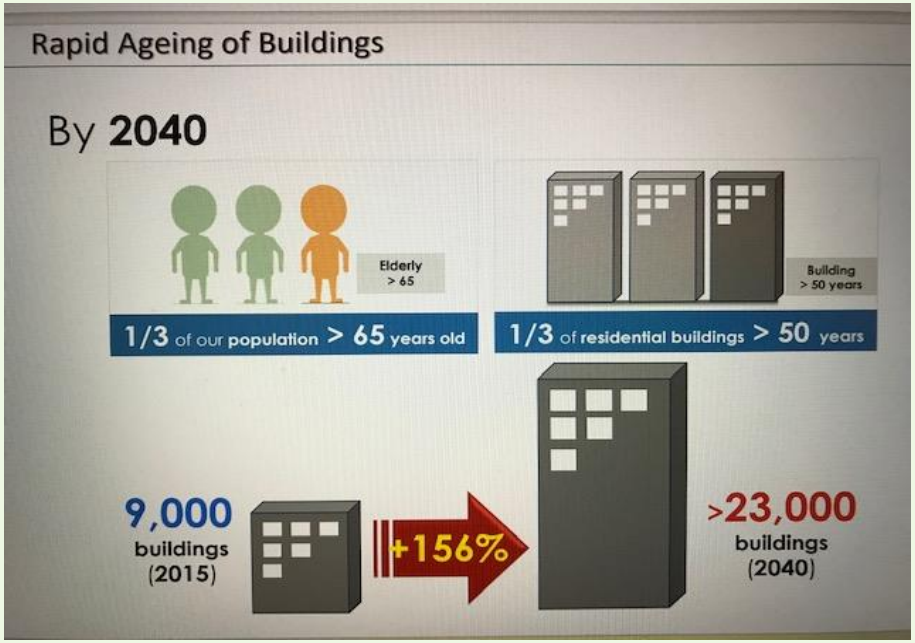
Whilst green building professionals focus their energy and attention in retro-commissioning and retro-fitting energy-inefficient buildings, the building maintenance of these old buildings are often neglected !



Our Building Stock is Ageing Rapidly!

(source: Sr Peter WF Dy, 2022)





The Grey Buildings – A Serious Social Issue!

- By **2046** there will be **326,000** private housing units **aged 70 or above**
  (Note that buildings normally have a design life of 50 in Hong Kong)

- Nearly **300 times** of the building stock of the same age in **2015**

(Source: Hong Kong 2030+)

DC district	Number of buildings (approximate figures)
Sham Shui Po	1 200
Yau Tsim Mong	1 860
Kowloon City	1 580
Kwun Tong	370
Wong Tai Sin	280
Sai Kung	30
Southern	440
Central and Western	1 460
Eastern	580
Wan Chai	1 140
Sha Tin	60
Tai Po	80
North	190
Tsuen Wan	300
Tuen Mun	30
Yuen Long	150
Kwai Tsing	120
Islands	20
Total (Approx. figure)	9 900

Source: LCQ21: Redevelopment of old buildings, GovHK (2014)

Building Maintenance -

Why a *seriously neglected problem in the Housing Sector?*

Some suspected reasons

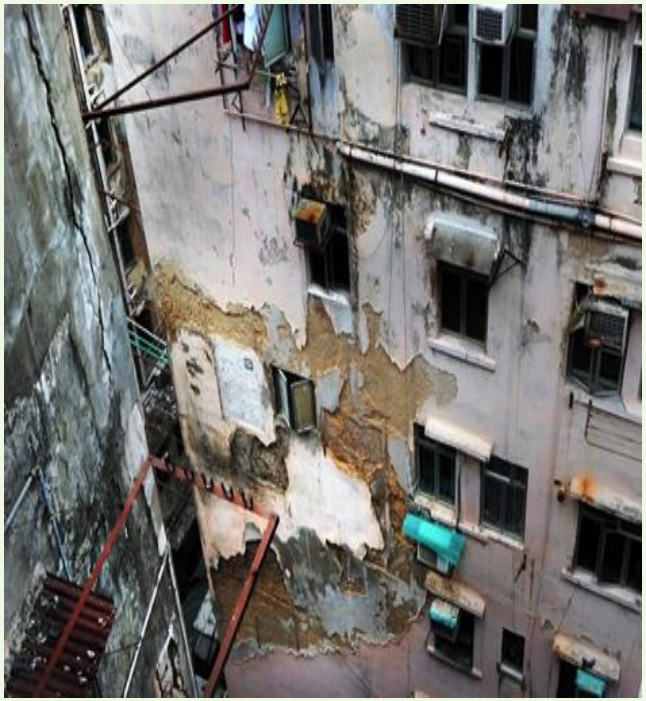
(Source: Sr Prof. Bay WONG, 2022)

- ***Repairs* 維修 – *wait until it is serious***
- ***Renovations* 更新 – *wait and find the resources***
- ***Disrepair* 失修 – *wait for redevelopment***
- ***Preventive Maintenance* (適時)保養 – *seldomly understood***

Building Maintenance Crises – A Serious Social Issue!

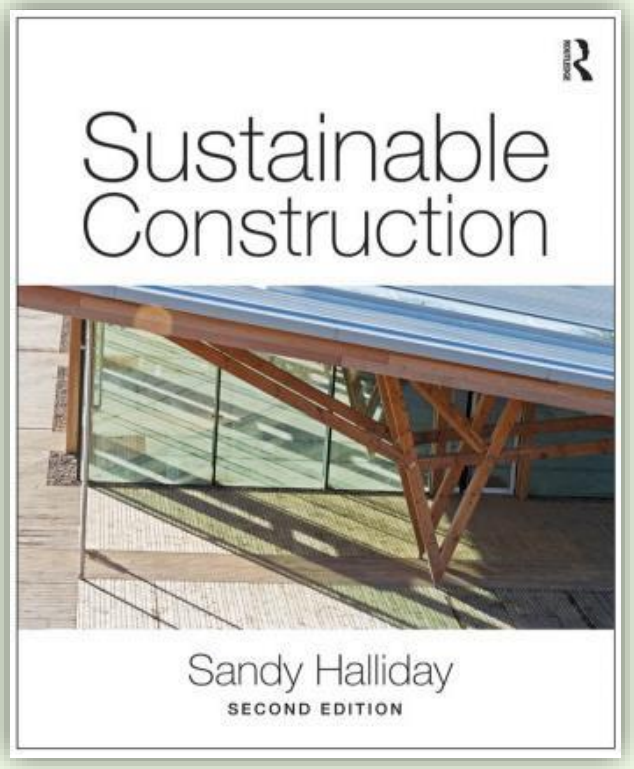
- The Housing Sector has achieved good progress in building green but lacks the confidence in tackling the grey building problems

- **Ageing and wearing**
- ***The residents and property owners are ageing***
- ***Climate change + Global warming + CO2 concentration + Heat waves + Extreme weather events + Heavy rainfall + Typhoon***
- ***Can the Housing Sector do something?***



Planned maintenance is an essential prerequisite of sustainability.

(Sustainable Construction, Sandy Halliday, 2019)

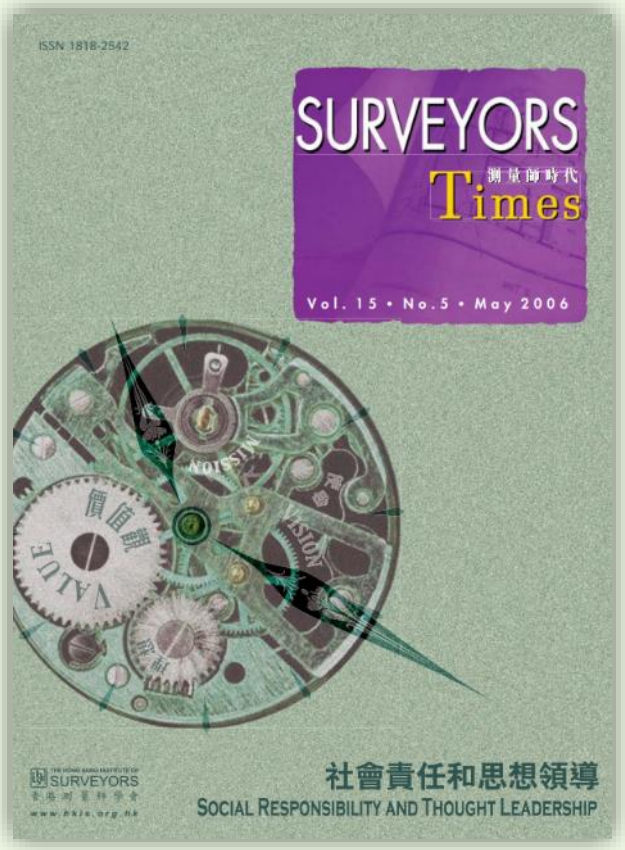


Preventive Maintenance 適時保養

- BS EN 13306: 2017 – Preventive maintenance is intended to assess and reduce the probability of failure/degradation of a building element/facility

- Includes:

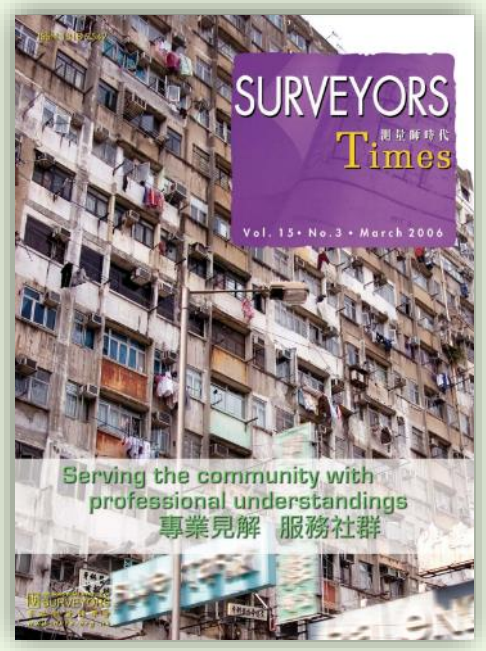
inspection, checking, testing, cleaning, oiling, protective coating, retro-commissioning, control re-setting, minor repairs & condition monitoring

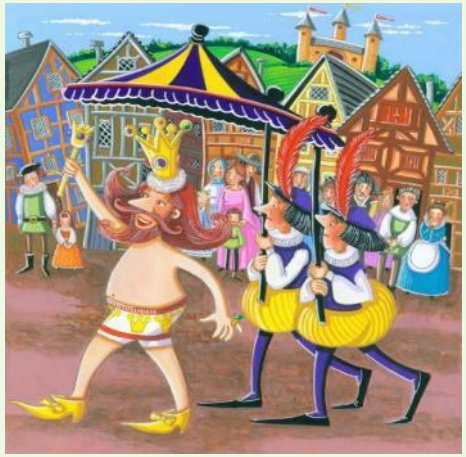


Green Building (BEAM Plus) by Figures

(as at 18.2.2023)

- NB registered projects (1658)
- ✓ ***NB projects assessed (1029)***
- EB projects registered (117)
- ○ ***EB projects assessed (65)***
- EB projects registered under EB 2.0 (380)
- ➢ ***EB projects assessed under EB 2.0 Selective Scheme (253)***
- ➢ ***Hong Kong has 42000+ existing buildings and 8000+ government buildings/facilities***





Ingredients of Green Building

Local Engagement
是就地取材

Saving Energy, Saving Water, Reducing CO_2, and Environmentally Sustainable
是節能減排，環保永續

Simple, Stylish, Pragmatic but not luxurious
是簡約時尚，實而不華

Communication, Collaboration and Back to Nature
是溝通合作，回歸自然

Be Smart, Intelligent, Inclusive and harmonious
是科技智慧，包容和諧

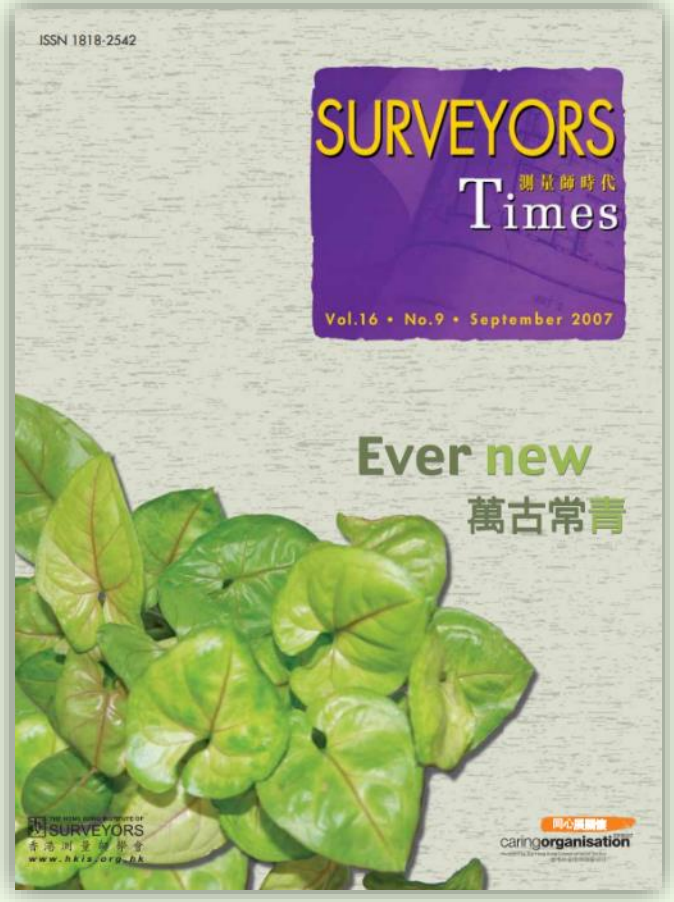
(Source: Sr Bay Wong, 2017)

To ensure existing buildings ever-green:

- ✓ ***Retro-Commissioning and Retrofitting***
  重新校驗、恢復機能

- ✓ ***Total Building Maintenance***
  全面保養、代代無憂

- ✓ ***All about Creativity and Balance***
  一切盡在創意與平衡

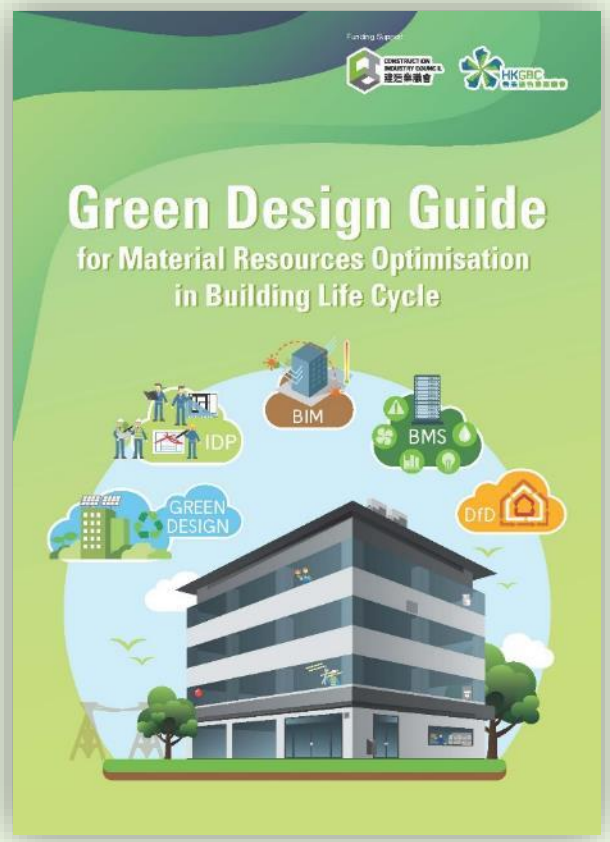


(Source: Sr Prof. Bay WONG, 2019)

Integrated Design Process

(Larsson, 2002) (Source: Green Design Guide for Material Resources Optimization in Building Life Cycle, HKGBC, 2018)

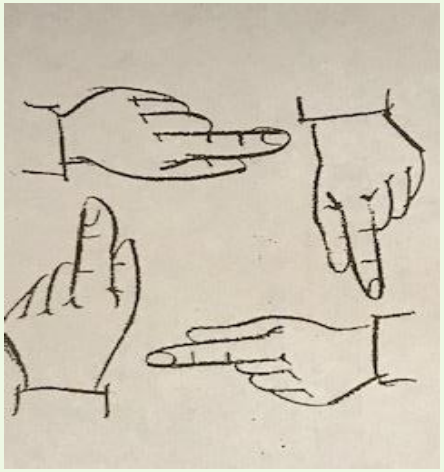
- A collaborative process that focuses on **design, construction, operation & occupancy of a building over its complete life cycle**

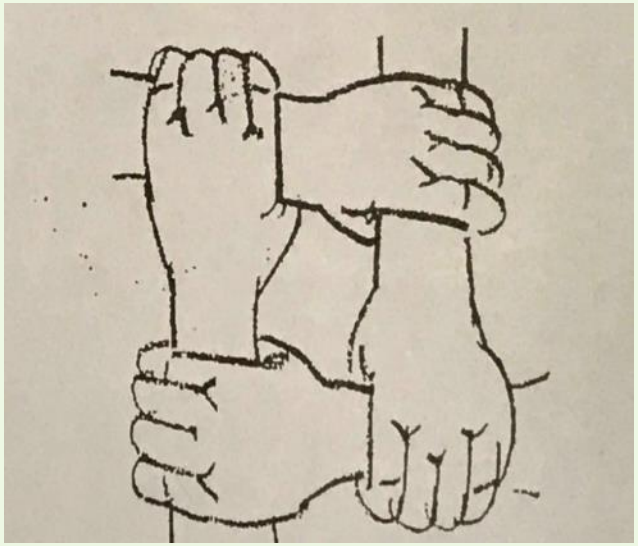


Integrated Design Process

(Source: Green Design Guide for Material Resources Optimization in Building Life Cycle, HKGBC, 2018)

- IDP requires construction team specialists, owner, developers and facility management to **fully participate in early stages with free flow of information** so that it would reduce cost of design changes
- The core team to include contractor, property management & representatives of FM team



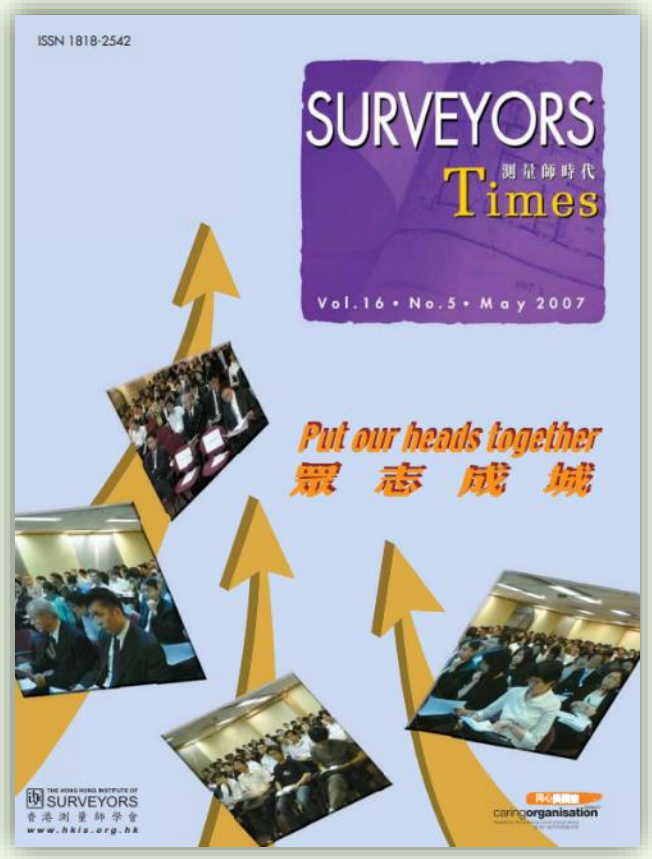


Green building designs and management create a useful platform for early interdisciplinary design communication and co-ordination:

Great opportunity for changing the silo attitude of the professions!

To tackle this Building Maintenance Crises - serious social issue……..

We need a conscious effort to control urban decay and invest appropriate resources in keeping our green building ever green!



The Green Culture is Flourishing

Hope you can join us in ensuring our green buildings ever-green!

綠色建築
環保永續

Thank You