

National University of Singapore



Singapore's  
Global  
University

# Department of Civil & Environmental Engineering

## Policy and Strategy in Construction Industry, Singapore Perspective

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# Acknowledgement



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*Substantial information and data on Singapore construction industry obtained from the Singapore Building Control Authority (BCA) and other sources are gratefully acknowledged. These are also cited in the relevant slides where appropriate. However, it is the author's sole responsibility for any incomplete or inaccurate data included in the presentation.*

## Topics Covered in this Presentation:

- ❖ Safety in Construction Industry
- ❖ Productivity in Construction Industry
- ❖ Sustainability Development and Green Environment



Up-Down Basement  
Construction



ArtScience Museum,  
Marina Bay



Punggol Waterway



Sengkang Floating Wetland



Marina Barrage



# Singapore Construction Activities



Garden by the Bay



Photo: Gardens by the Bay

Singapore Skyline



Construction Activities in Singapore



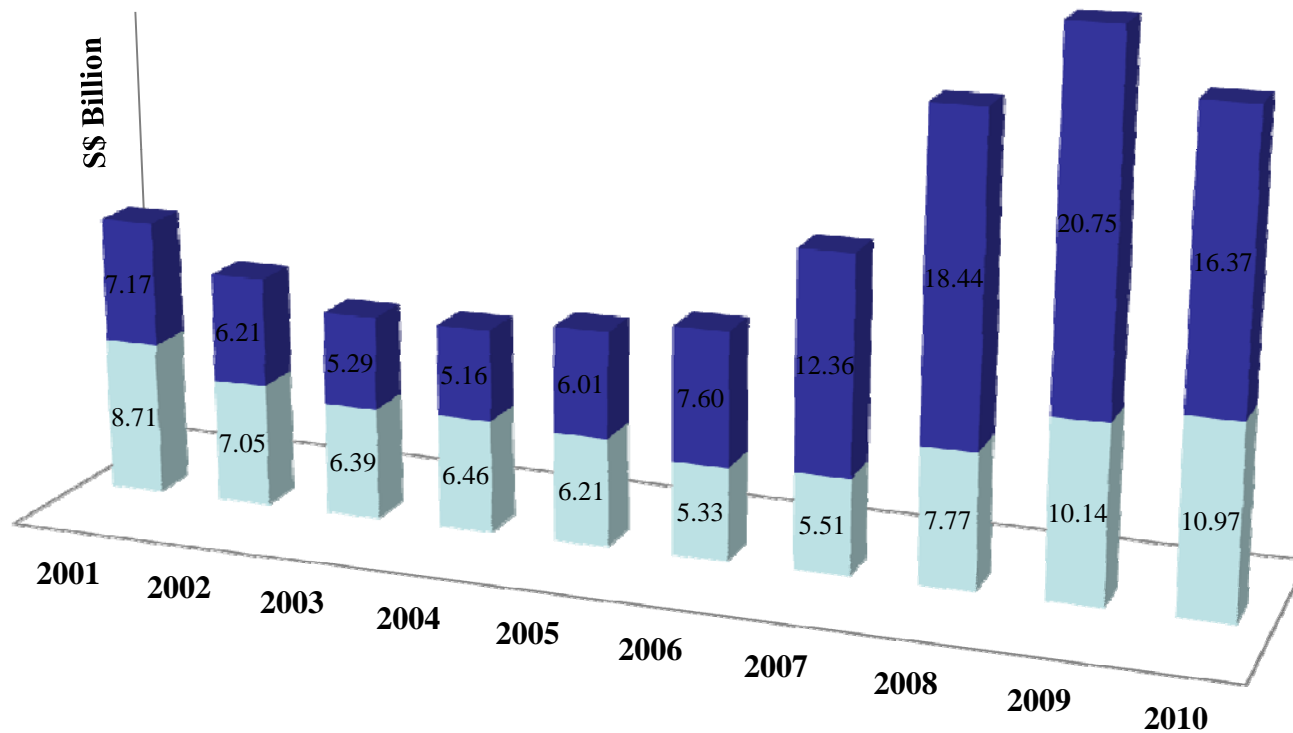
Esplanade Bridge

# Singapore Construction Output



## CONSTRUCTION OUTPUT

Public Sector Private Sector



*BCA (2010/11). The Next Level, Annual Report, BCA, Singapore.*

# Safety in Construction Industry

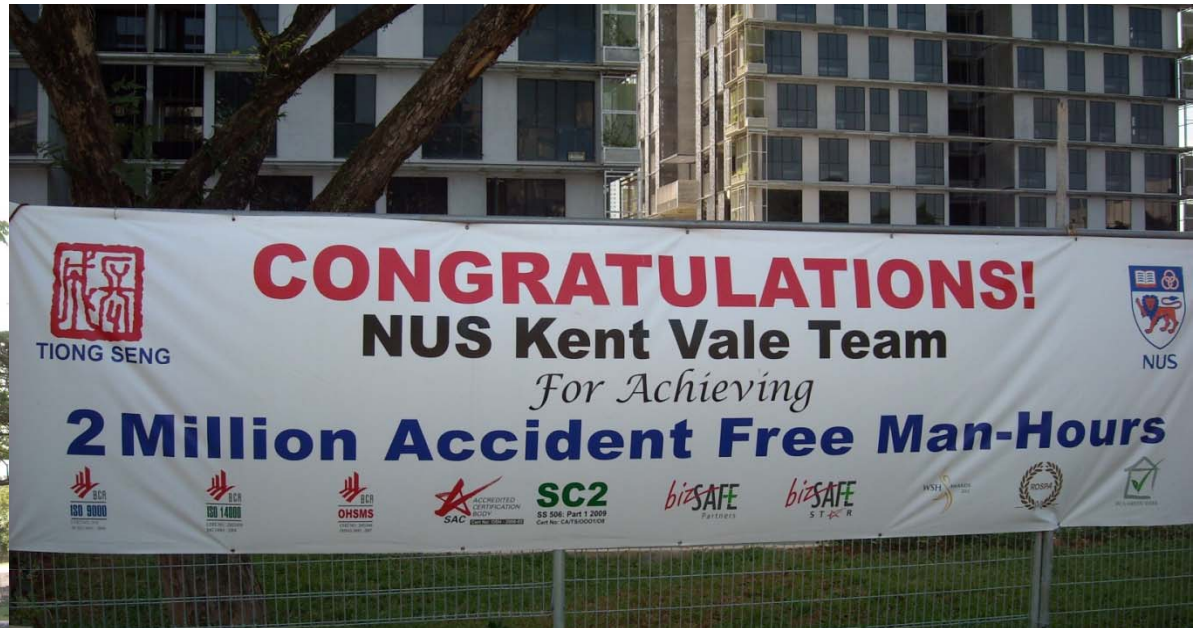


Besides the SOP stipulating safety measures at sites, the Building and Construction Authority (BCA) has pursued and implemented the following key features in the design and construction of infrastructure in Singapore:

- **The Accredited Checkers System** to enforce an independent assessment of structural design by another team of experienced professional engineers.
- **The Updating of Standards and Codes of Practice** to adopt the state of the art in design and construction of infrastructure.
- **The Licensing of Builders** to ensure that they are professionally competent.
- **The Periodic Structural Inspection (PSI) Program** to spot any defects and early rectifications.
- **Education and Retraining** of Professionals and Workforce. It is mandatory for construction supervisors to attend certain course before becoming registered CoreTrade personnel.



# Safety First



# Up-to-Date Structural Design Codes



Singapore construction industry adopts the Singapore Standards (National Annex) prepared by SPRING Singapore based on various Eurocodes on structural design. These include the following:

- SS EN 1990 : 2008. to Eurocode 0 – Basis of structural design;
- SS EN 1991-1-4 : 2009. to Eurocode 1 – Actions on structures;
- SS EN 1992-1-1 : 2008. to Eurocode 2 – Design of concrete structures;
- SS EN 1993-1-5 : 2009. to Eurocode 3 – Design of steel structures;
- SS EN 1994 : 2009. to Eurocode 4 – Design of composite steel and concrete structures;
- SS EN 1995 : XXXX. to Eurocode 5 – Design of timber structures;
- SS EN 1996 : XXXX. to Eurocode 6 – Design of masonry structures;
- SS EN 1997-1 : 2010. to Eurocode 7 – Geotechnical design;
- SS EN 1998 : XXXX. to Eurocode 8 – Design of structures for earthquake resistance;
- SS EN 1999 : XXXX. to Eurocode 9 – Design of aluminium structures.



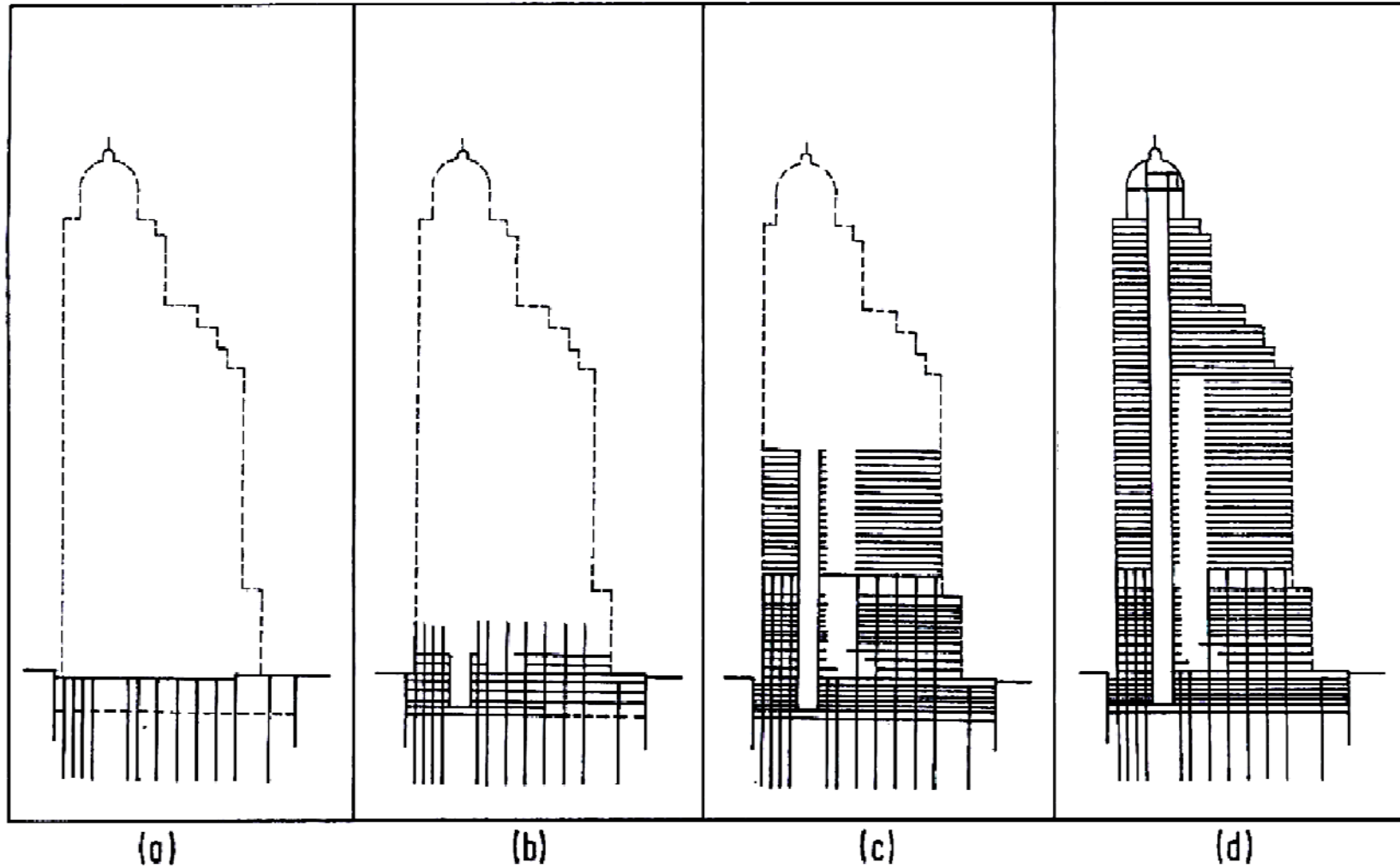
# Productivity in Construction Industry



Key features adopted for construction productivity in Singapore are:

- (1) **Framework for buildability with less risk, time, material and manpower**, through, e.g., prefabrication system & up-down basement construction for tall buildings.
- (2) **Raising the skills and capabilities of the workforce** via training & retraining of the workforce, providing incentives to retain experienced workers and construction registration of tradesmen (CoreTrade).
- (3) **Providing Construction Productivity & Capability Fund (CPCF) of \$250 million** to promote the following activities:
  - (i) Enhanced BCA-Industry Scholarship and Workforce Upgrading;
  - (ii) Mechanization Credit, Productivity Improvement Projects (PIP) and Building Information Modeling (BIM) Funds; and
  - (iii) Construction Engineering Capability Development to enable the workforce capability to handle complex projects that are common nowadays.

# Up-Down Basement Construction: Schematic Procedure





## Up-Down Basement Construction

- *Save cost (materials)*
- *Save space*
- *Save time*
- *Safer*



# Up-Down Basement Construction





## Silom Precious (Chareon Krung) Tower, Bangkok, Thailand

*Completed project as standing  
now.*



## *Unfinished Building*

*Similar unfinished building in Bangkok, Thailand during economic crisis in 1997 (Photo taken in 2007)*



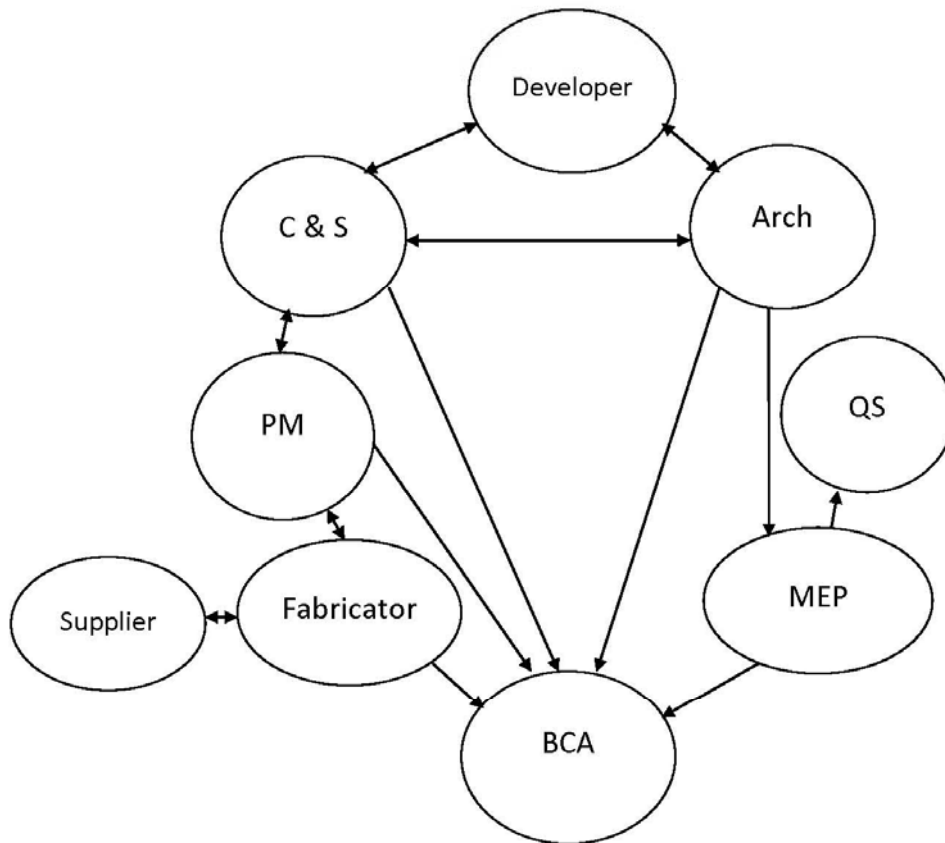


# Productivity in Construction Industry, the BIM Advantages

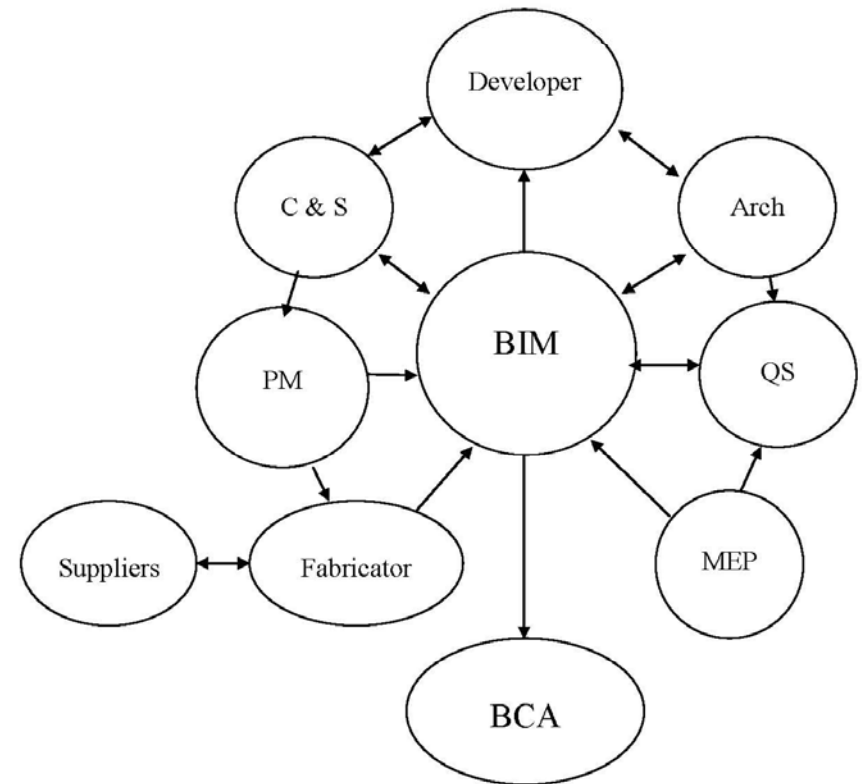
The key advantages are as follows:

- The overall integration and collaboration of various professionals across the construction industry leading to higher productivity with less conflicts and reworkings.
- Greater cost savings as wastage of resources is reduced, potential problems identified and addressed early at modeling stage via 3-D model.
- Time savings through avoiding repetitive work by various parties, using standardized templates and early rectifying of any design issues.
- Facilitating other value-added onto the project, such as creativity consideration, more green and sustainability design.

# Interaction of Work with and without BIM



Without BIM



With BIM

# Strategy and Action Plan for BIM



**Leading Agency:** Building and Construction Authority (BCA)

Main Strategy	Action Plan
Leading by public sector.	Working with Government Procurement Entities (GPE) to use BIM in GPE projects from 2012.
Promoting & building up BIM capability	<p>Introducing BIM Funds as part of CPCF of \$250 million.</p> <p>Centre for Construction IT (CCIT) to guide the industry on BIM.</p> <p>Conducting short courses, workshops and seminars for construction workforce on BIM usage and its benefits.</p> <p>Engaging relevant Institutes of Higher Learning (IHL) on BIM training to students.</p> <p>Providing consultation services to the industry.</p>
Removing obstacles	<p>Developing templates and guidelines to all relevant parties on submission using BIM.</p> <p>Collaborating with professional bodies to set up project collaboration guidelines and object library standards.</p>



# BIM e-Submission System

**Leading Agency:** Building and Construction Authority (BCA)

**Construction Real Estate NETwork (CORENET)** was adopted as the platform for **BIM e-Submission**. In 2010, nine Singapore regulatory agencies (BCA, CBPU, FSSD, HDB, JTC, LTA, NParks, PUB, and URA) accepted architectural 3-D BIM submission via CORENET. The structural, M&E and plumbing 3-D BIM e-submissions was permitted in 2011. Standardized templates and guidelines with instructions are provided for BIM e-submissions.

BIM e-Submission is to be adopted by 80% of the construction industry by 2015. This forms part of the plan to increase the productivity of the construction industry by 25% over the next decade.

# BIM e-Submission System

## Target Dates:

**Architectural BIM e-Submission is mandatory by 2013 for projects with floor areas greater than 20,000 m<sup>2</sup>.**

**Structural and MEP BIM e-Submission is permitted in April 2011 and is mandatory by 2014 for projects with floor areas greater than 20,000 m<sup>2</sup>.**

**All BIM e-Submission is mandatory by 2015 for projects with floor areas greater than 5,000 m<sup>2</sup>.**

**According to BCA annual report, 386 BIM e-submissions have been made by 88 projects in 2010.**

*BCA (2011). BuildSmart, Construction Productivity Magazine, BCA, Singapore.*

# Notable Projects in Singapore Adopting BIM



**ArtScience Museum,  
Marina Bay, Singapore**



**Singapore Sports Hub**



## Regular BIM Seminars by BCA & IT Engineers to CEE Students at NUS

You are cordially invited to the Seminar titled “Building Information Modeling (BIM) in Civil & Structural Engineering” which will be held as follows:

**Date:** Friday, 19 August 2011

**Time:** 3.00 pm to 5.00 pm

**Venue:** Lecture Theatre 2 (LT2), Faculty of Engineering, NUS

The Seminar will be delivered by the following Distinguished Speakers:

**Mr Sonny Andalis**

*Technical Consultant & Structural BIM Specialist*

*Centre for Construction IT, BCA*

**Mr Kelvin Ng,**

*Technical Specialist, Tekla (SEA) Pte Ltd*

**Mr Madhan Elumalai,**

*Senior Application Engineer, Structural Software products, Bentley Systems Singapore*

# Regular BIM Seminars by BCA & IT Engineers to CEE Students at NUS



You are cordially invited to the Seminar titled “Building Information Modeling (BIM) in Civil & Structural Engineering” which will be held as follows:

**Date:** Friday, 09 Mar 2012

**Time:** 3.00 pm to 5.00 pm

**Venue:** Lecture Theatre 2 (LT2), Faculty of Engineering, NUS

The Seminar will be delivered by the following Distinguished Speakers:

**Mr Sonny Andalis**

*Technical Consultant & Structural BIM Specialist  
Centre for Construction IT, BCA*

**Mr Alfred H'ng**

*Structural Design Engineer,  
Engineering Manager in steel fabricator &  
Technical Consultant in BIM software developer*

**Mr Phil Lazarus**

*Senior BIM Specialist, ARUP Singapore Pte Ltd &  
Faculty member, Singapore BCA's Specialist Diploma Program*

# Topics Covered in BIM Workshop to Students and Professionals



- ❖ **BIM fundamentals and technology**
- ❖ **BIM tools user interface**
- ❖ **Modelling structure model**
- ❖ **Documenting a project**
- ❖ **Structural Detailing**
- ❖ **BIM E-submission**
- ❖ **BIM for structural analysis**
- ❖ **BIM for integration and interoperability**
- ❖ **BIM future technology**
  - **Cloud computing**
  - **BIM Especs**
  - **ePlanCheck**
  - **Computer aided virtual environment**
  - **CFD for wind and energy**
  - **Automated QS**

# Regular Workshop on BIM by BCA Personnel to Students and Professionals





# Sustainability and Green Environment



*Sengkang Floating Wetland*



*Yishun Pond*

## *Green Environment*



# Strategy and Action Plan

## Incentive Schemes:

- ❖ *\$50 million MND research fund for R&D in green building technologies;*
- ❖ *Bonus gross floor area for higher tier Green Mark ratings;*
- ❖ *\$120 million Green Mark incentive scheme;*
- ❖ *\$15 million sustainable construction fund.*

## Legislation and Government to Lead:

- ❖ *Met minimum Green Mark certified standards since April 2008;*
- ❖ *Existing government buildings to achieve Green Mark GoldPlus standard by 2020;*
- ❖ *Higher Green Mark standards for land sales in strategic growth areas.*

## Green Professionals:

- ❖ *To train 18,000 to 20,000 'green specialists' by 2020;*
- ❖ *Created and conducted various courses on sustainability.*

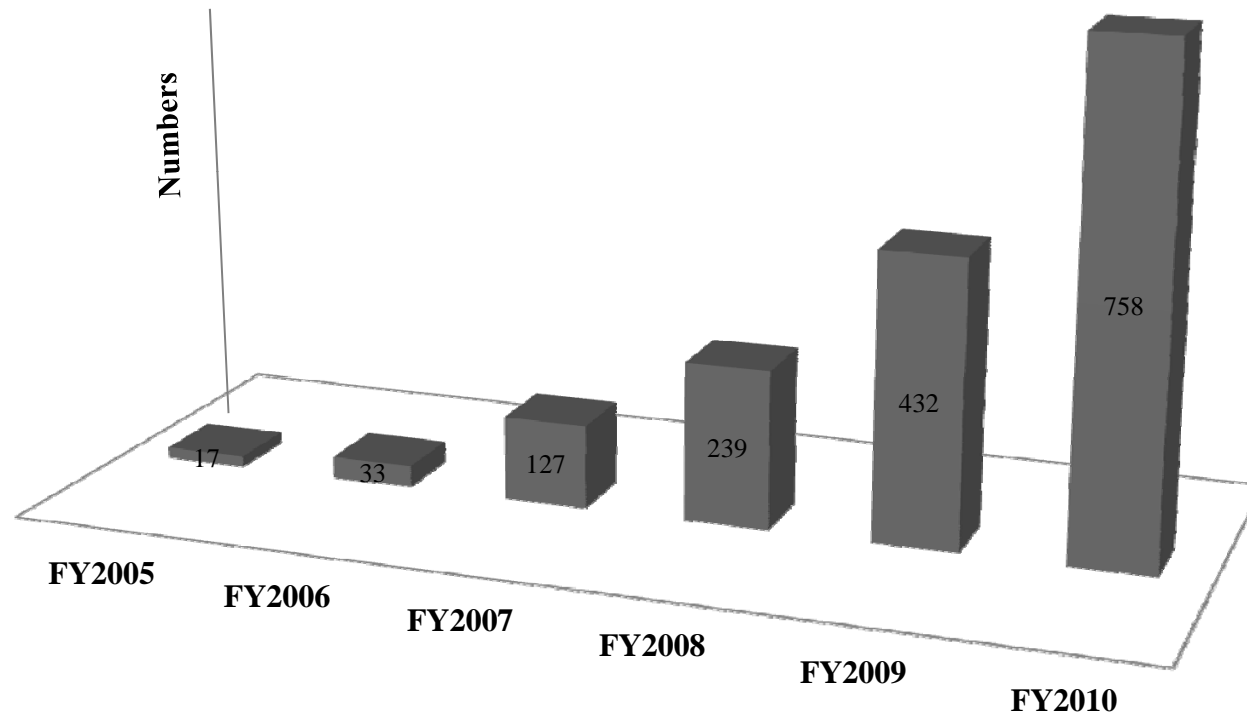
## Various Outreach Programs:

- ❖ *Green Sparks Competition;*
- ❖ *Green Building Exhibitions;*
- ❖ *BCA Green Mark Awards;*
- ❖ *Green beyond Borders.*

# BCA Green Mark Buildings in Singapore



## BCA GREEN MARK BUILDINGS IN SINGAPORE



*BCA (2010/11). The Next Level, Annual Report, BCA, Singapore.*



# Construction, De-construction and Re-construction *(Reduced, Reuse, Recycle)*



Photo by Mark D. Webster



Fig. 12 C.K. Choi Building, University of British Columbia



Fig. 13 panelization of roof structure

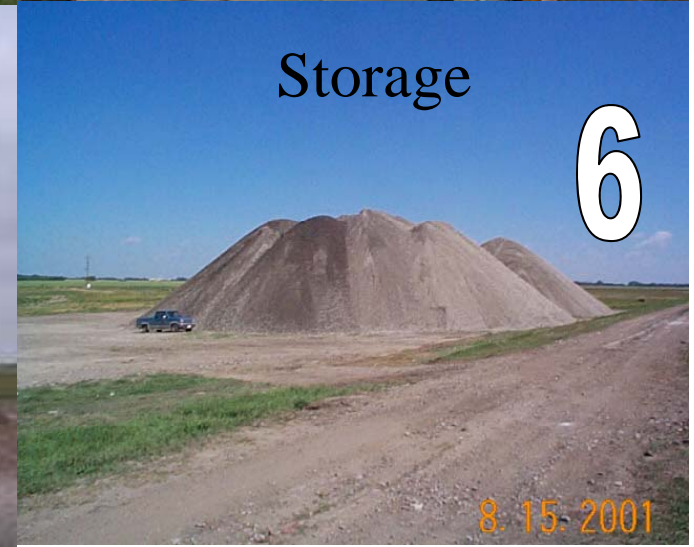


Fig. 14 theoretical disassemblable infill housing project



# Recycled Aggregates from Demolition Waste *(Reduced, Reuse, Recycle)*

Demolishing



# Recycled Aggregates



Contaminated  
Concrete  
Specimen

Surface  
Decontamination

Decontaminated  
Concrete  
Specimen

Crushing and  
Sieving

Recycled  
Concrete  
Aggregate

Tests on  
RAC

Tests on  
RCA

Aggregate beneficiation using  
microwave

Tests on  
RAC

High Quality Recycled Concrete Aggregate

Tests on  
RCA

# Designed for Disassembly (DfD) Solution for Resource Efficient Building



DfD intends to maximize material conservation from building end-of-life management and create adaptable buildings and avoid building removal altogether.

## Conceptual Framework (5 levels of analysis & 4 principles)\*

### Levels of Analysis:

Systems

Elements

Component or assembly:  
Nonstructural layers

Subcomponent

Material

### Concepts & Key Components:

**Adaptability principles:**

*Versatility, Convertibility, Expandability*

**Disassembly principles:**

*Accessibility, Disassembly information, Durability, Reversible connections, Recyclability & Simplicity*

**Application:** *Reduced, Reuse, Recycle*

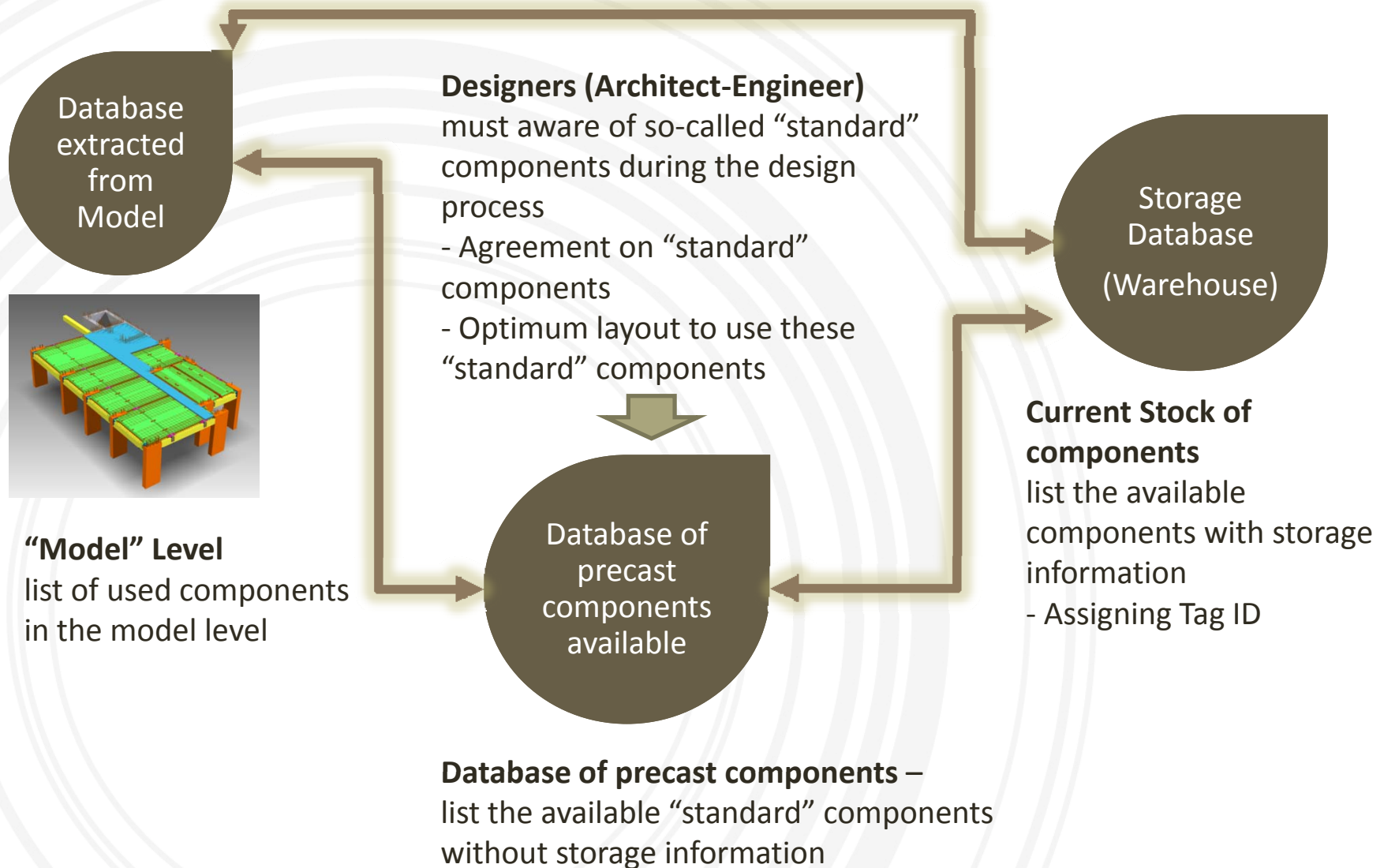
**Assessments**

Key features: Connections, Disassembly information and Information management system to support DfD

\*CSA Standards: Z783-11 (2011) & Z782-06 (2006), Canadian Standards Association, Ontario.

# DfD Information System : DfD Database

Proposed approach of the DfD Design & Database:





## Concluding Remarks



- ❖ The keywords, namely, (i) **safety**, (ii) **productivity**, and (iii) **sustainability development** are featured prominently in Singapore construction industry. Singapore BCA has worked out the strategies and action plans and implemented them with remarkable success. The authority always emphasizes on safety in construction industry and is aiming at near zero accidents.
- ❖ Singapore has embraced **BIM initiatives to improve the productivity** of the built environment industry **engaging professionals at all levels** from various relevant designing aspects all the way downstream to the implementation, construction and documentations for future works.

## Concluding Remarks



- ❖ Singapore **BCA is the leading agency spearheading and expediting BIM usage** in the construction industry. Strategies, action plans and target dates have been set and funds provided to promote BIM usage, train manpower at various levels and less pain financially for the industry to switch to BIM.
- ❖ BCA emphasizes good design and technologies to **enhance sustainability development**. The authority has also devised various schemes and outreach programs to encourage all parties including the public **to embrace and adopt the best green practices** in their daily lives.

# A Warm Welcome to Visit Singapore

