FIG Congress 2014
Engaging the Challenges, Enhancing the Relevance
Kuala Lumpur, Malaysia, 16th – 21st June 2014

Use of GIS and BIM in the Development of Public Housing Estates in Hong Kong

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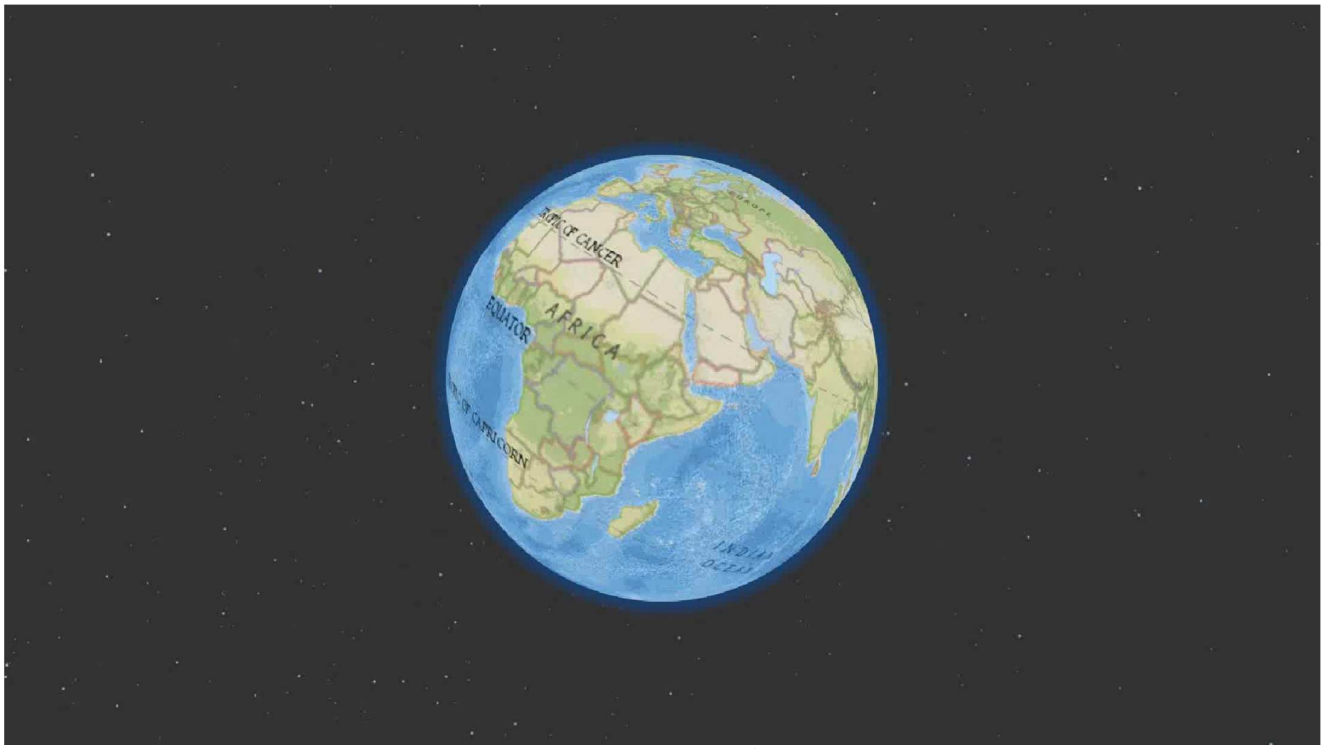
Hong Kong

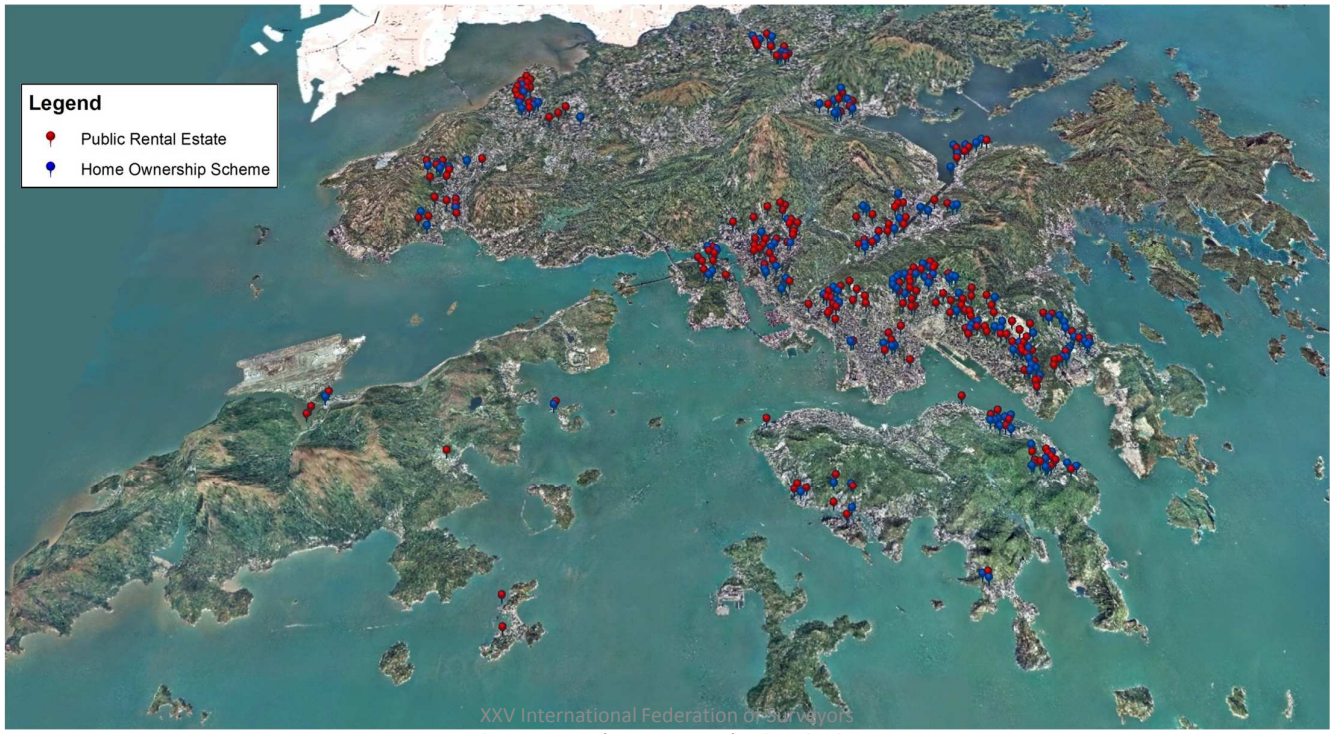


Hong Kong

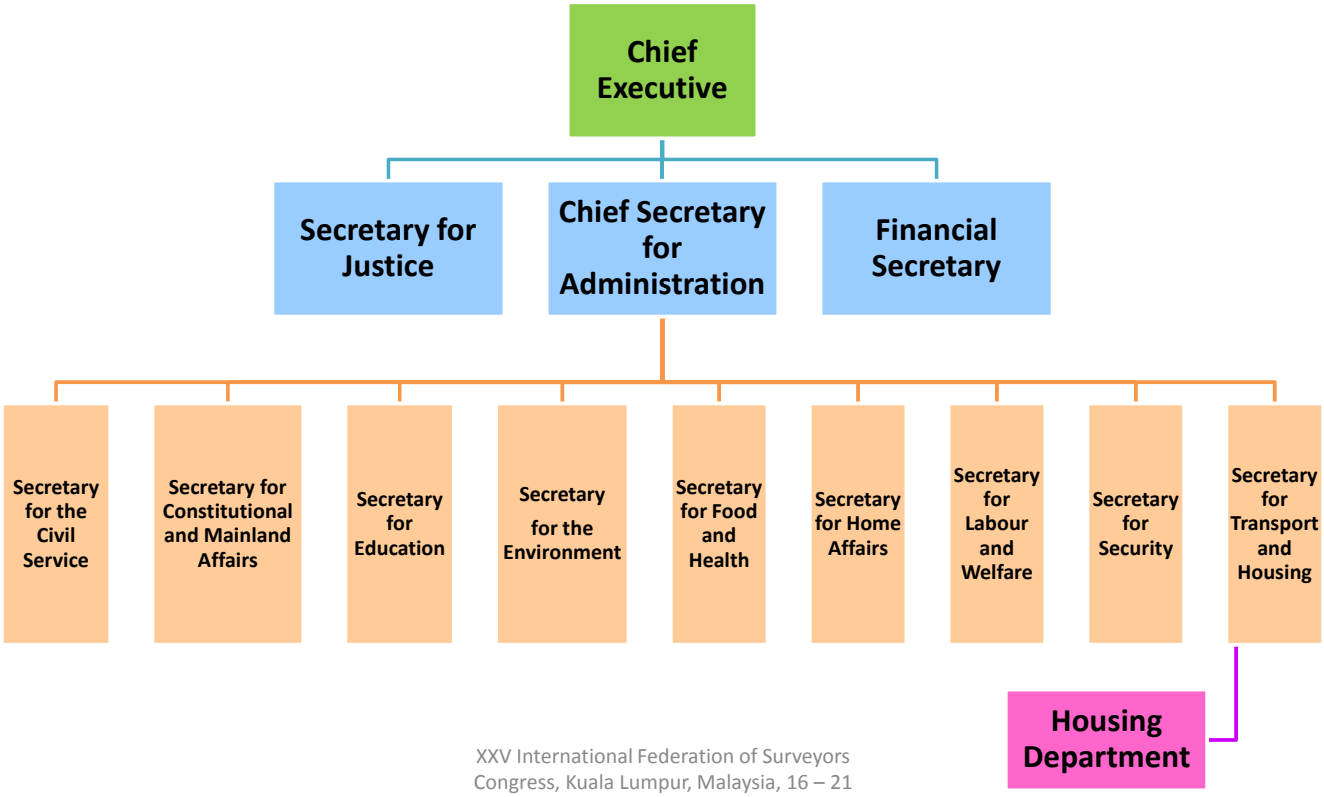
- Total Population: 7 Million
- Total Land Area: 1,108 sq.km
- Total Residential Area: 89 sq.km (about 8%)
  - Public Housing: 12 sq.km (about 1%)
- No. of Public Housing Estates: 213
- No. of Public Housing Residents: 2 Million (about 30%)
- Average Living Space: 13 sq.m/person

Hong Kong

Distribution of Public Housing Estates



Housing Department (HD)



Housing Department (HD)

People-centric approach

Vision 理想

To help low-income families with housing need to gain access to affordable housing

Mission 工作目標

To provide affordable quality housing, management, maintenance and other housing related services in a proactive and caring manner

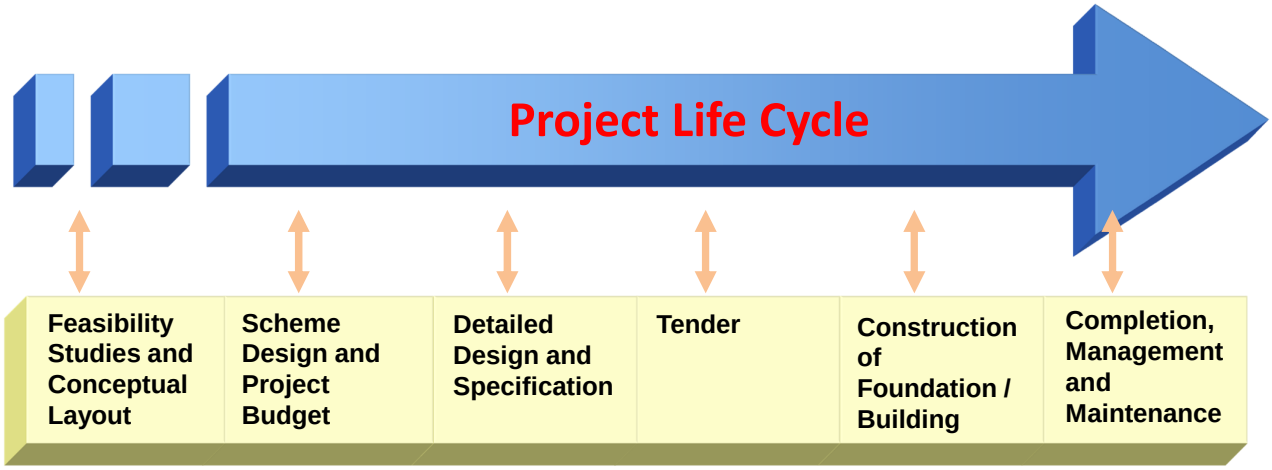
Cost-effective and rational use of public resources

Competent, dedicated and performance-oriented team

Core Values 基本信念

Public Housing Development

(a) Project Life Cycle

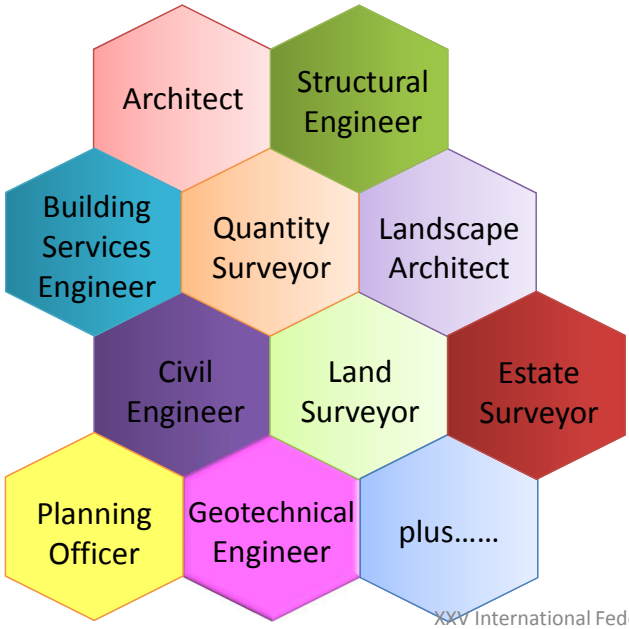


Project Functions

Design Options	Building Design and Performance	Documentation	Quality Control	Facility Management

Public Housing Development

(b) Internal Coordination



Public Housing Development

(c) External Coordination

土木工程拓展署 Civil Engineering and Development Department
運輸署 Transport Department
渠務署 Drainage Services Department
規劃署 Planning Department
香港消防處 Fire Services Department
路政署 Highways Department
環境保護署 Environmental Protection Department
地政總署 Lands Department
水務署 Water Supplies Department

Use of New Technologies in HD

(a) Geographic Information System (GIS)

- History of Evolution

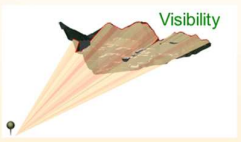
2005 Desktop Geographic Planning Information System (GPIS) for Planning Studies

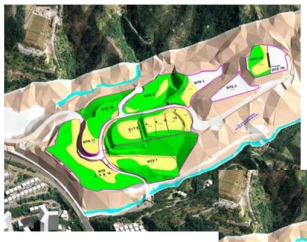
2009 Web-based 2D GPIS for Planning Studies

2012 3D GIS for Feasibility Studies & Design

2013 3D GIS for Facilities Management

Site Feasibility Study

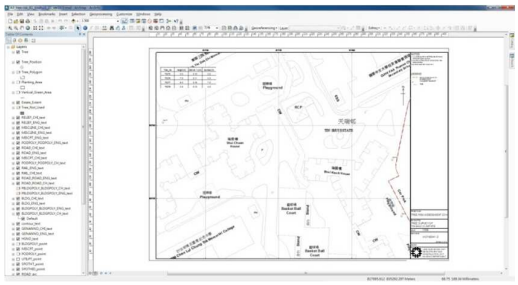




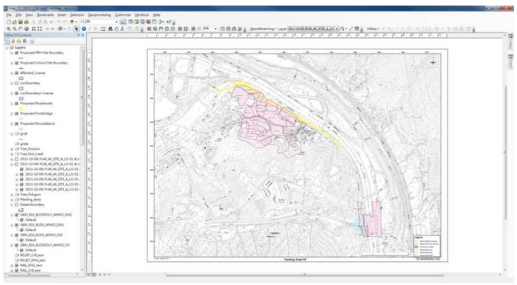
Terrain Modelling

Use of New Technologies in HD
(a) Geographic Information System (GIS)

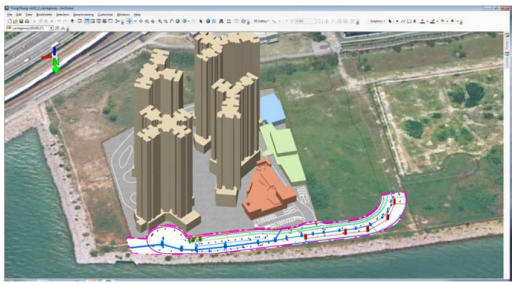
- Software



ArcInfo version 10.1



ArcEditor version 10.1



ArcScene version 10.1

ArcGIS Server version 10.1

Use of New Technologies in HD
(b) Building Information Modelling (BIM)

- History of Evolution

2012

BIM Construction & Facility Management

- BIM models carried down stream for construction simulation and site planning
- Also facility management

2007

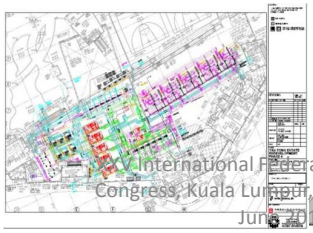
BIM Modelling & Drafting

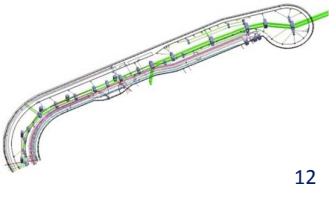
- 2D drawings are by product of 3D models
- Easy to revise
- Design and Coordinate in 3D
- Able to carry out analysis and design optimization

1985

Computer Aided Design

- Drafting using CADD & digital drawings
- Easy to amend
- Coordination by layers
- 2D drawings may convey ambiguous information





Before 1985

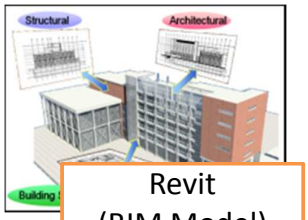
Manual Drafting

- Drafting using pen and drawing board
- Time consuming to edit drawings
- 2D drawings may convey ambiguous information

Use of New Technologies in HD

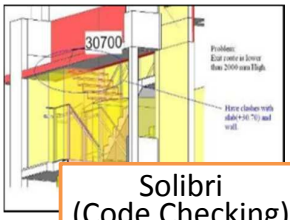
(b) Building Information Modelling (BIM)

- Software

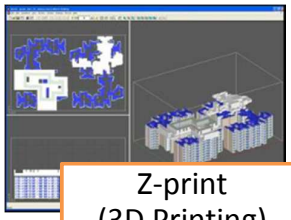


Revit (BIM Model)

ETABS/ ORION (Structural Analysis)



Solibri (Code Checking)

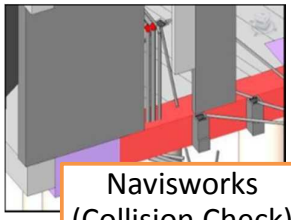


Z-print (3D Printing)

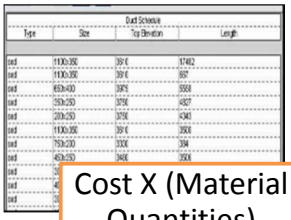
Navisworks (4D Simulation)

3D Max (Photo-realistic Rendering)

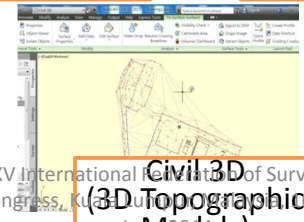
Ecotect (Performance Analysis)



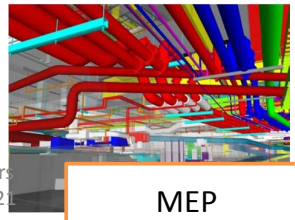
Navisworks (Collision Check)



Cost X (Material Quantities)



Civil 3D (3D Topographic Models)

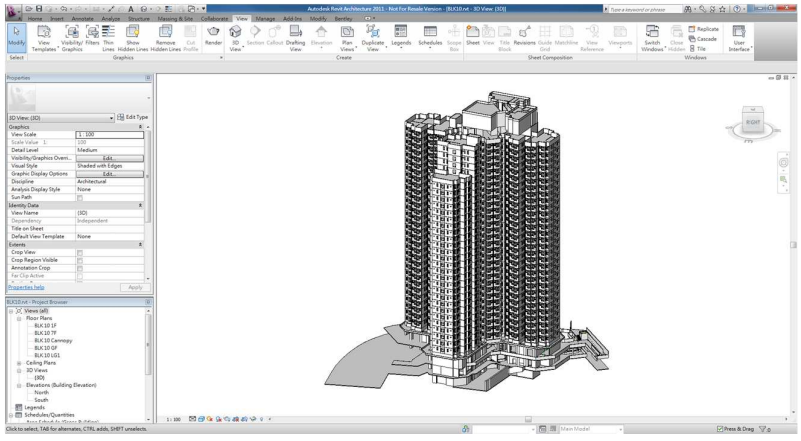


MEP

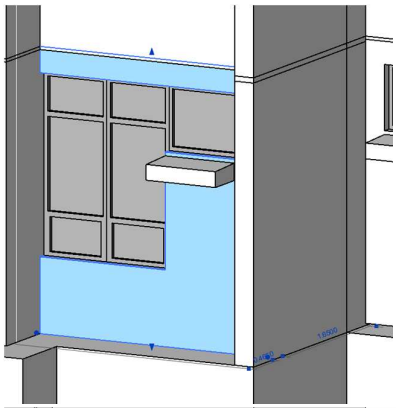
Use of New Technologies in HD

(b) Building Information Modelling (BIM)

- Software – Revit
  - Spatial Data

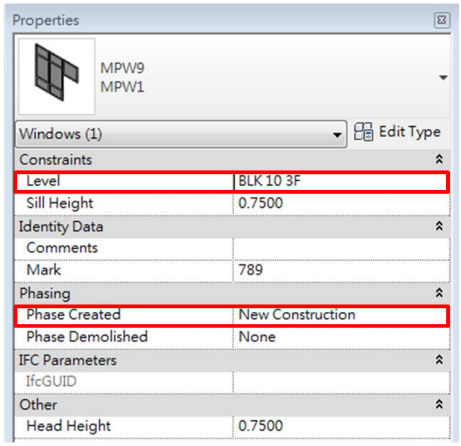


Spatial Data in Revit

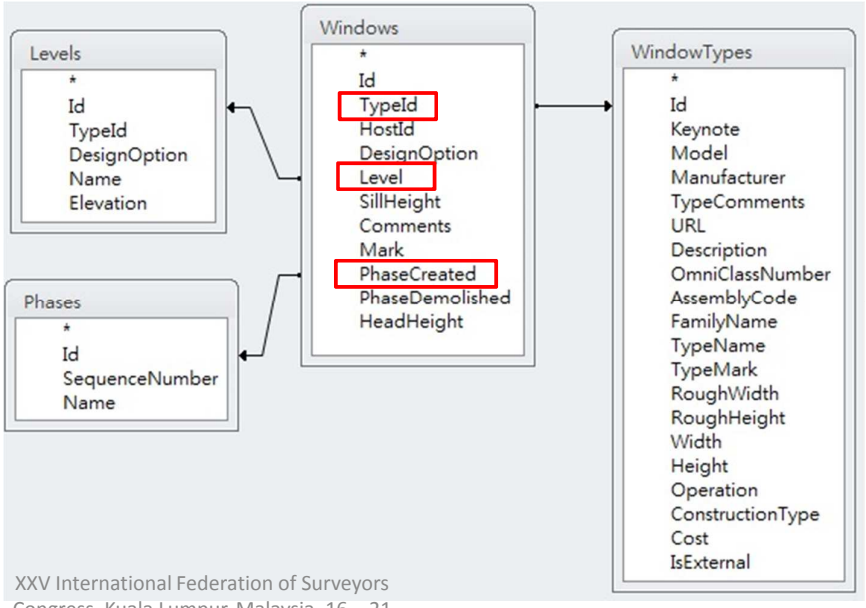


Use of New Technologies in HD
(b) Building Information Modelling (BIM)

- Software – Revit
  - Attribute Data Stored in Relational Database

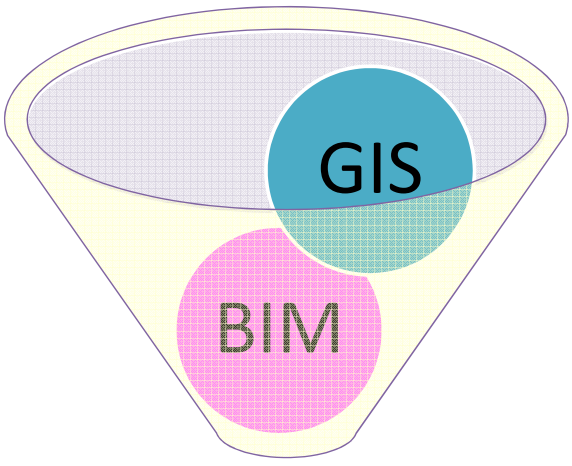


Attribute Data in Revit

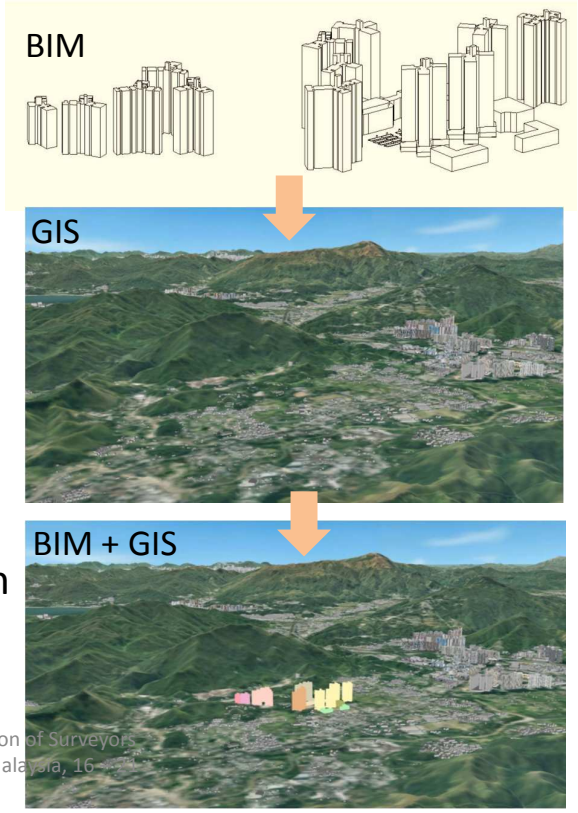


Relational Database in Revit

Use of New Technologies in HD
(c) Integration of GIS and BIM

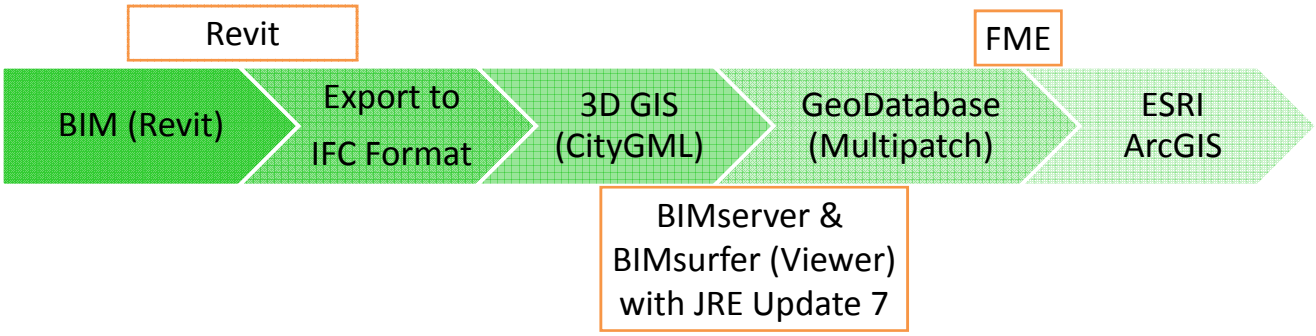


Perform 3D Visualization and Animation
Carry out Analysis
Streamline Workflow
Enhance Work Efficiency
Ensure Consistency of Data

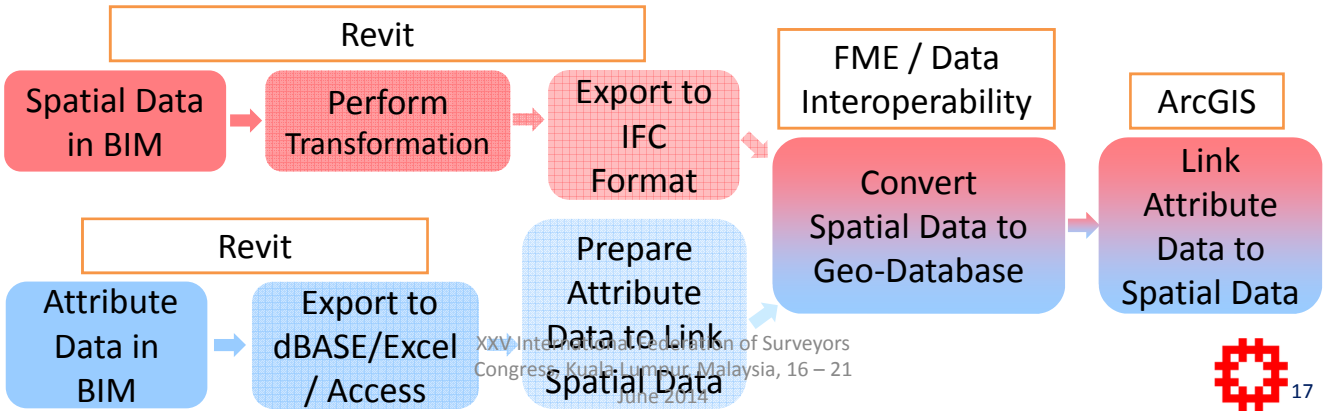


Workflow of Integration of GIS and BIM

- Method 1:



- Method 2:



Workflow of Integration of GIS and BIM

- Method 2:

  Final Step: Link Attribute Data to Spatial Data in ArcGIS by Unique Key

Converted Spatial Data

Tag of Converted Spatial Data

IfcWindow_surface

OBJECTID	SHAPE	GlobalId	OwnerHistory	Name	Description	Object Type	Tag	OverallHeight	OverallWidth
1	MultiPatch	15BsF5qLb2f8oc82U8CKY	#34	Staircase_Window 1350mm:Staircase_Window 1350mm:Staircase_Window 1350mm:353172	<Null>	Staircase_Window 1350mm	353172	1.5	1.35
2	MultiPatch	15BsF5qLb2f8oc82U8CKW	#34	Staircase_Window 1350mm:Staircase_Window 1350mm:Staircase_Window 1350mm:353174	<Null>	Staircase_Window 1350mm	353174	1.5	1.35
3	MultiPatch	15BsF5qLb2f8oc82U8CKg	#34	Staircase_Window 1350mm:Staircase_Window 1350mm:Staircase_Window 1350mm:353180	<Null>	Staircase_Window 1350mm	353180	1.5	1.35
4	MultiPatch	15BsF5qLb2f8oc82U8CKe	#34	Staircase_Window1:Staircase_Window:Staircase_Window:353182	<Null>	Staircase_Window	353182	1.5	1.175
5	MultiPatch	15BsF5qLb2f8oc82U8CKf	#34	Staircase_Window 2:Staircase_Window 2:Staircase_Window 2:353183	<Null>	Staircase_Window 2	353183	1.15	0.8
6	MultiPatch	15BsF5qLb2f8oc82U8CKM	#34	Staircase_Window 3:Staircase_Window 3:Staircase_Window 3:353184	<Null>	Staircase_Window 3	353184	1.15	0.8
7	MultiPatch	15BsF5qLb2f8oc82U8CKN	#34	Staircase_Window 4:Staircase_Window 4:Staircase_Window 4:353185	<Null>	Staircase_Window 4	353185	1.5	1.175
8	MultiPatch	15BsF5qLb2f8oc82U8CKK	#34	Staircase_Window1:Staircase_Window:Staircase_Window:353186	<Null>	Staircase_Window	353186	1.5	1.175
9	MultiPatch	15BsF5qLb2f8oc82U8CB3	#34	Staircase_Window 1350mm:Staircase_Window 1350mm:Staircase_Window 1350mm:353397	<Null>	Staircase_Window 1350mm	353397	1.5	1.35

Attribute Data of Revit Database

Windows

Id	TypeId	HostId	DesignOption	Level	SillHeight	Comments	Mark	PhaseCreated	PhaseDemolishe	HeadHeight
353172	343022	353171		108565	0.68000000000000 7		6	86961		0.68000000000000 7
353174	343022	353173		108565	0.68000000000000 7		7	86961		0.68000000000000 7
353180	343022	353175		108565	0.68000000000000 7		8	86961		0.68000000000000 7
353182	343024	353181		108565	0.68000000000000 7		9	86961		0.68000000000000 7
353183	343026	353156		108565	1.39999999999999		10	86961		1.39999999999999
353184	343028	353156		108565	1.39999999999999		11	86961		1.39999999999999
353185	343030	353138		108565	0.68000000000000 7		12	86961		0.68000000000000 7

ID of Attribute Data

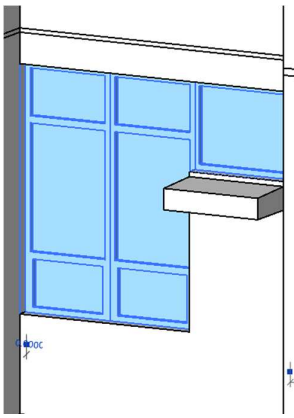
Link Attribute Data to Spatial Data by the Field 'Tag' of Converted Spatial Data and the Field 'ID' of Attribute Data in GIS Platform

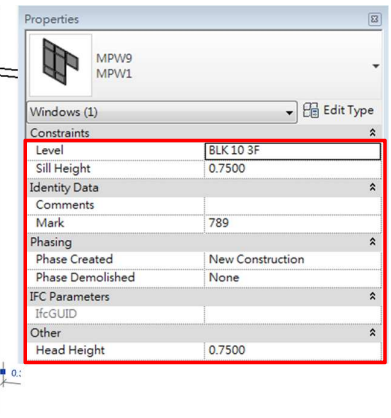
Workflow of Integration of GIS and BIM

- Method 2:

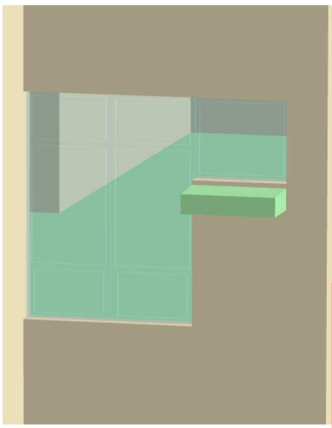
  Converted Spatial and Attribute Data in ArcGIS

BIM





GIS



Field	Value
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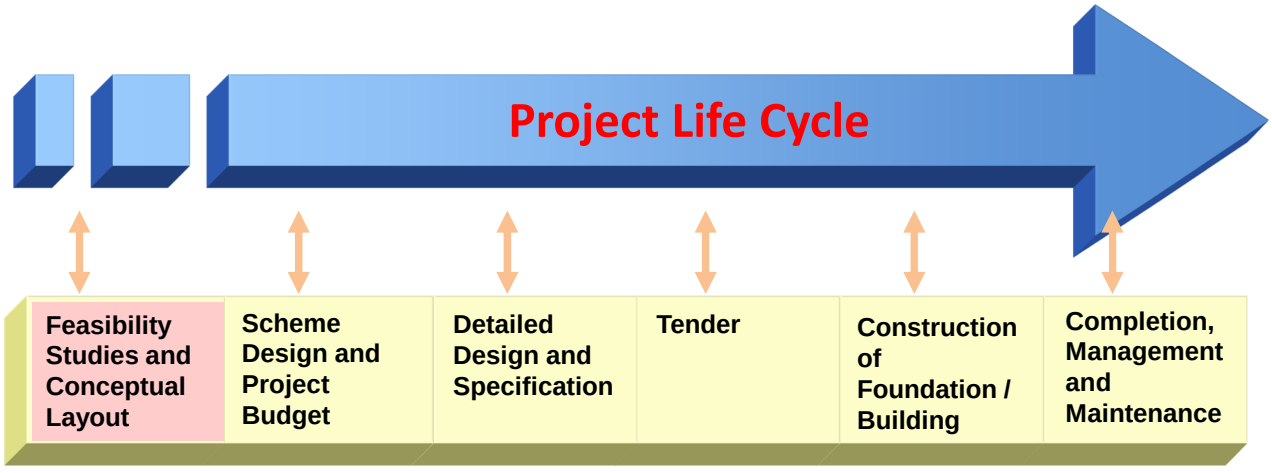
SHAPE	MultiPatch
GlobalId	1apLFGTWfD2fhyyxT77d_4
OwnerHistory	#34
Name	MPW9:MPW1:MPW1:475245
Description	<null>
ObjectType	MPW1
Tag	475245
OverallHeight	1.75
OverallWidth	2.05
OID	784
TYPEID	406336
LEVEL	BLK 10 3F
SILLHEIGHT	0.75
COMMENTS	
MARK	789
PHASES_CREATED	New Construction
PHASE_DEMOLISHED	
HEADHEIGHT	0.75

Applications of GIS and BIM in Housing Development

Project Life Cycle



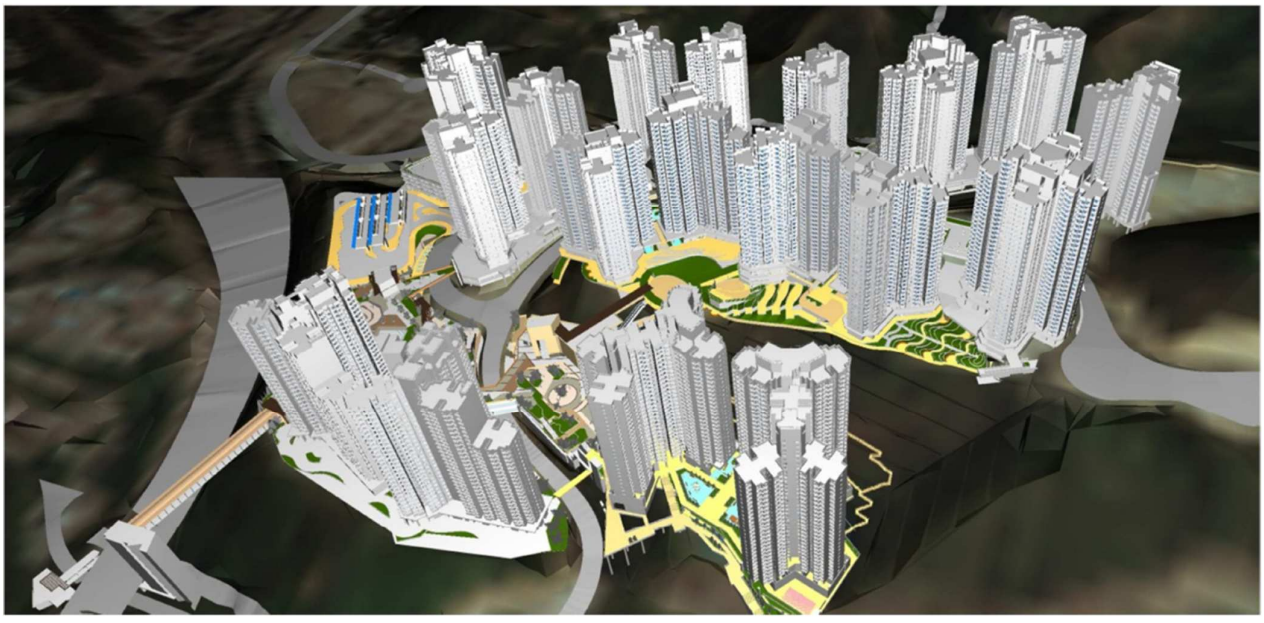
Project Functions

Design Options	Building Design and Performance	Documentation	Quality Control	Facility Management

Applications of GIS and BIM in Housing Development

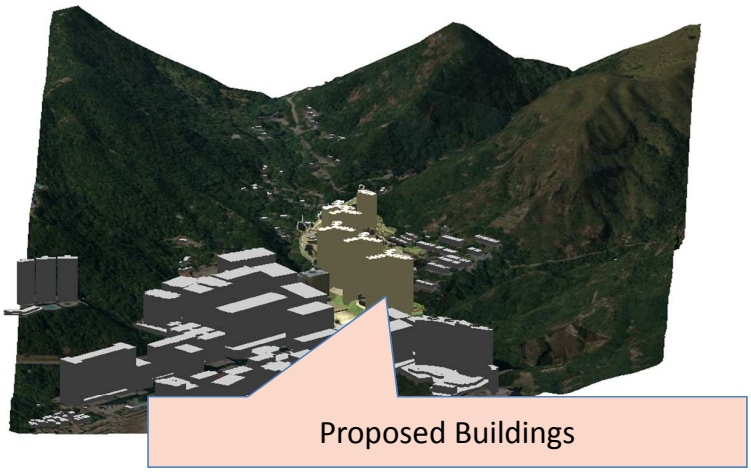
Contextual Study

Applications of GIS and BIM in Housing Development



Spatial Planning

Applications of GIS and BIM in Housing Development



Ridge Line Analysis

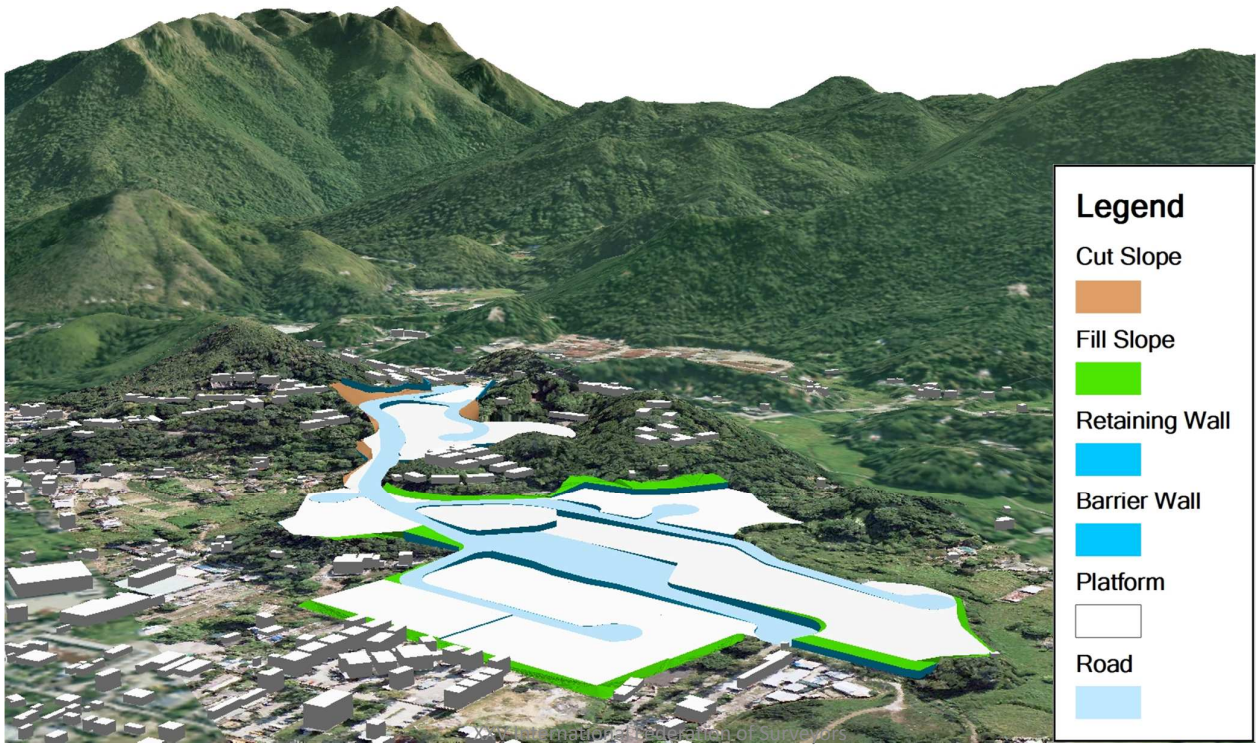
Applications of GIS and BIM in Housing Development

Schemes Design Comparison

Applications of GIS and BIM in Housing Development

Colour Scheme Study

Applications of GIS and BIM in Housing Development



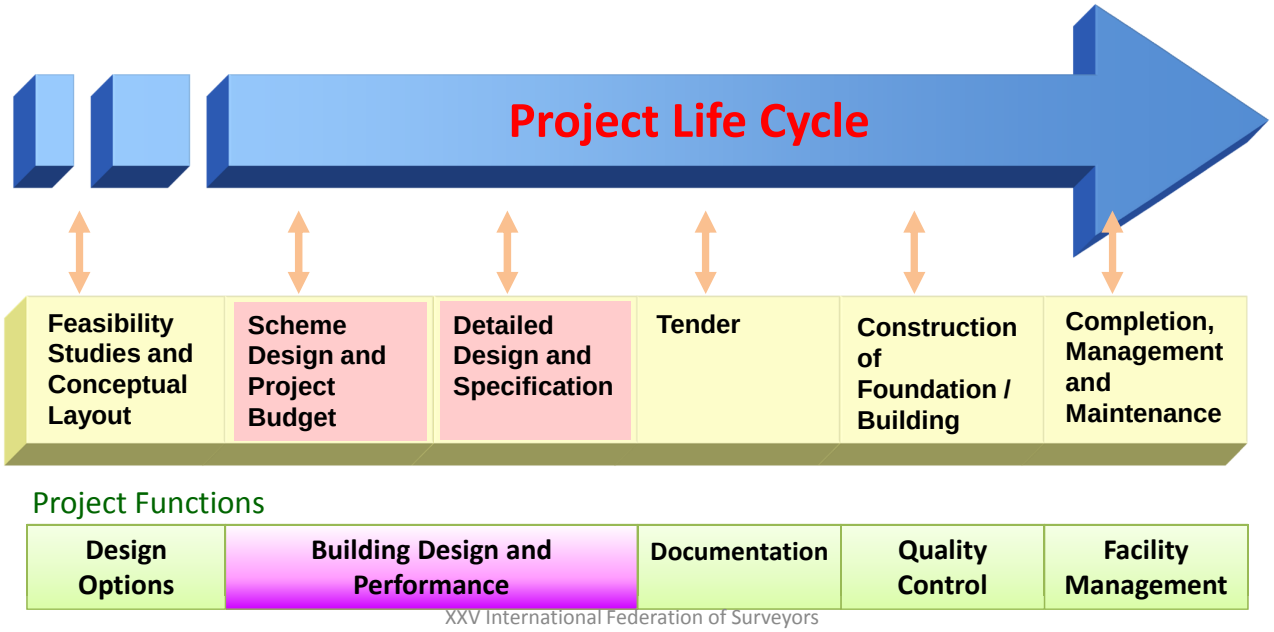
Geotechnical Study

Applications of GIS and BIM in Housing Development

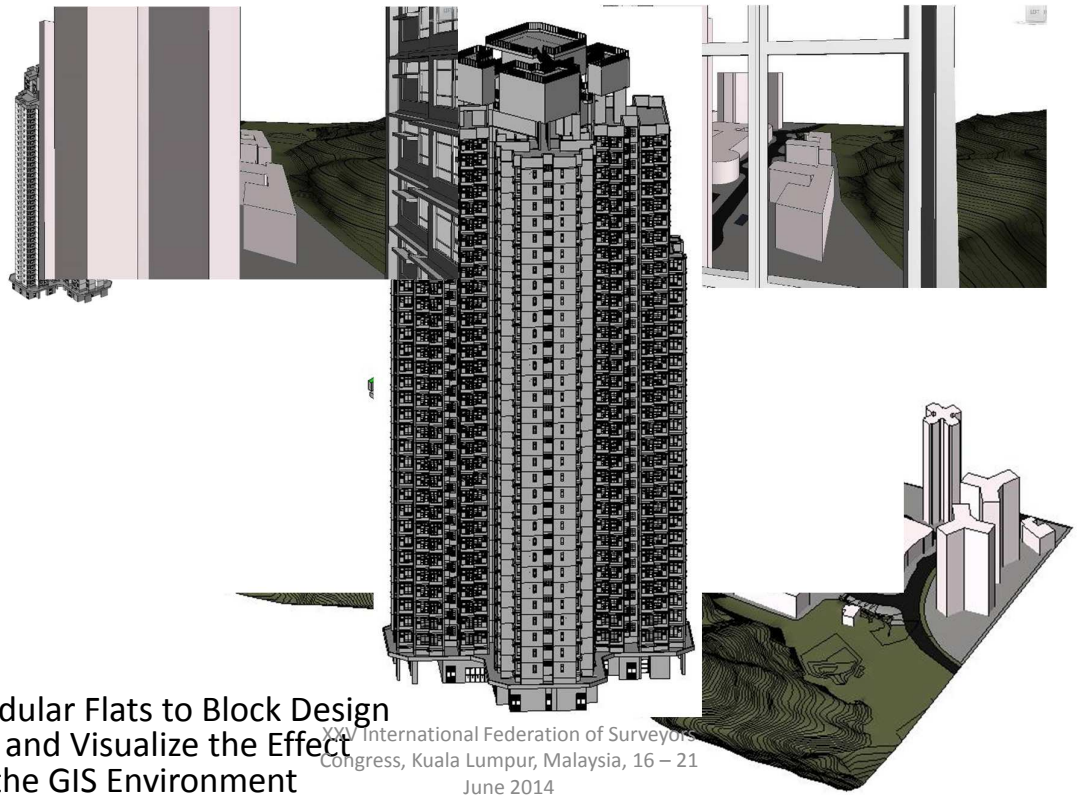
- Proposed Public Housing Development
  - Integration of GIS and BIM
  - Perform 3D Visualization and Animation in GIS Environment
  - Demonstration of
    - Contextual Study
    - Spatial Planning
    - Geotechnical Study

Applications of GIS and BIM in Housing Development

Project Life Cycle



Applications of GIS and BIM in Housing Development



From Modular Flats to Block Design in BIM and Visualize the Effect in the GIS Environment

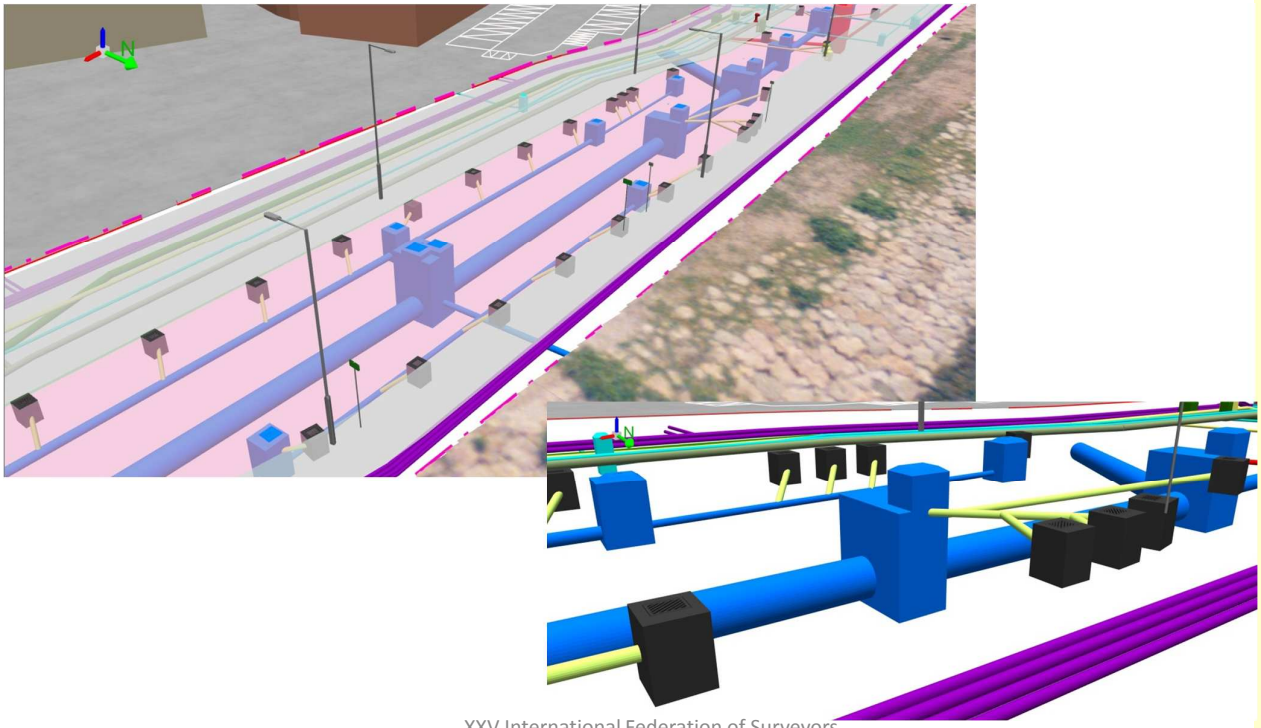
Applications of GIS and BIM in Housing Development

Sun Shading Study from 8:00am – 4:00pm

XXV International Federation of Surveyors Congress, Kuala Lumpur, Malaysia, 16 – 21 June 2014

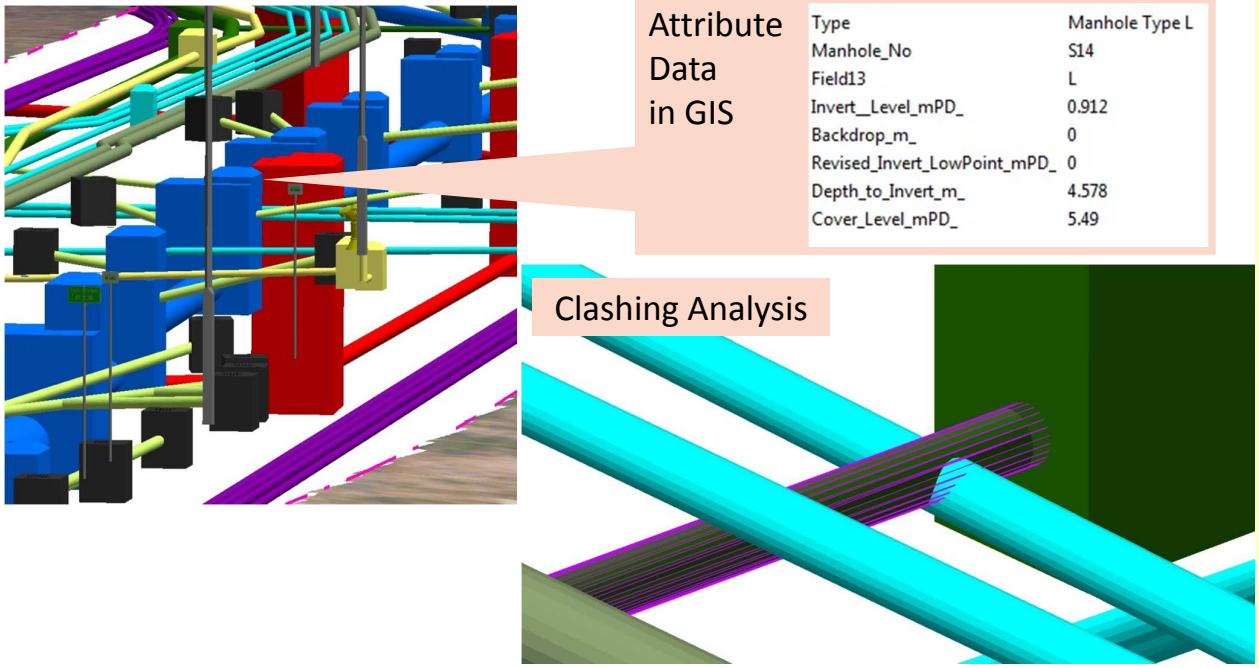
Project Life Cycle – Scheme and Detailed Design

Applications of GIS and BIM in Housing Development



Detailed Design of Underground Utilities

Applications of GIS and BIM in Housing Development



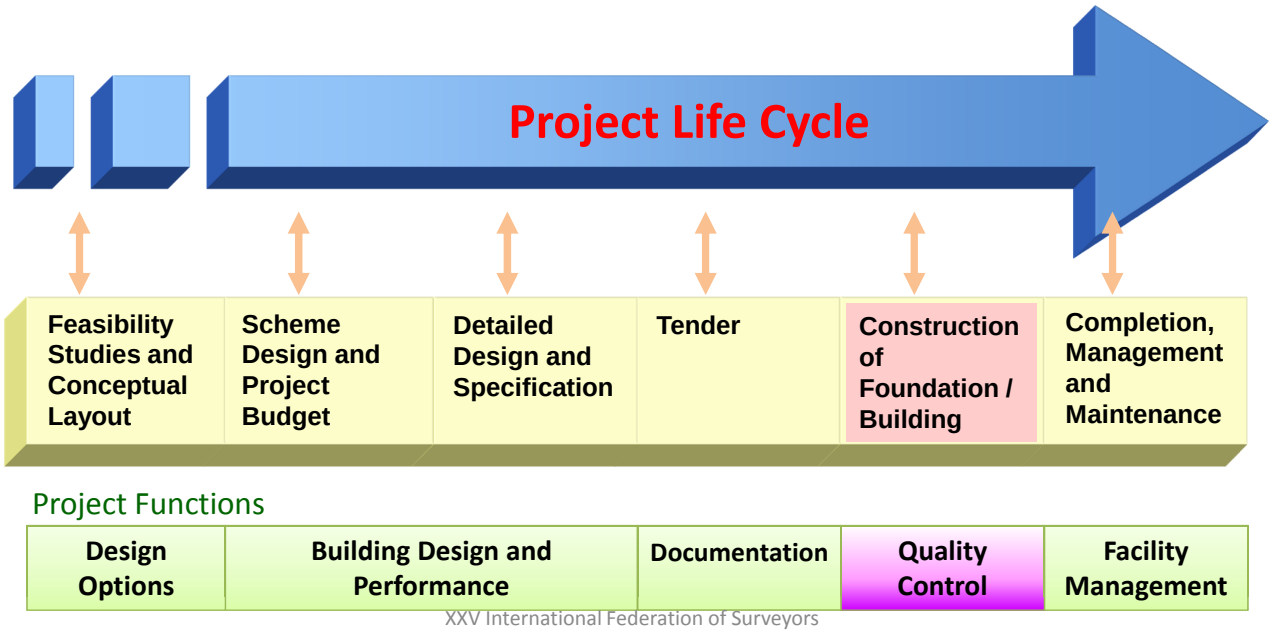
Checking of Underground Utilities

Applications of GIS and BIM in Housing Development

- Proposed Housing Development and Underground Utilities at Tung Chung
  - Integration of GIS and BIM
  - Perform 3D Visualization and Animation in GIS Environment
  - Demonstration of
    - Contextual Study
    - Geotechnical Study
    - Detailed Design

Applications of GIS and BIM in Housing Development

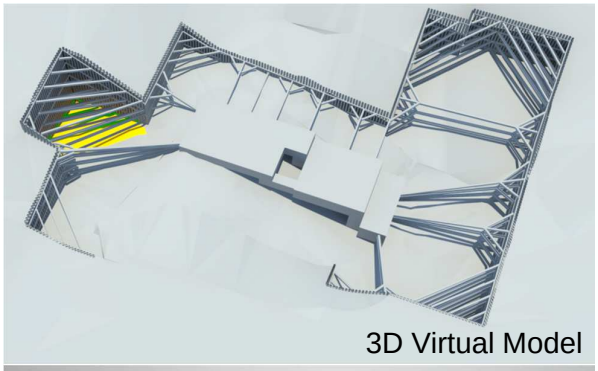
Project Life Cycle



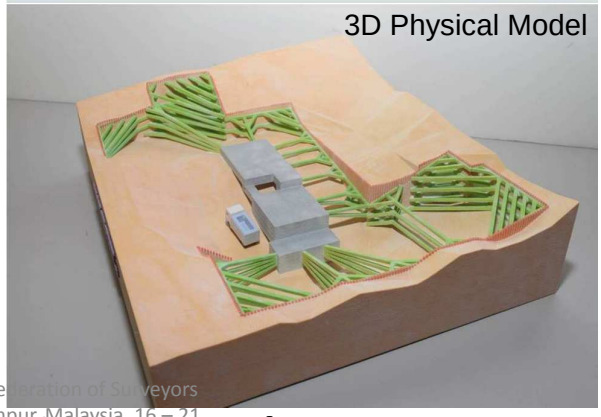
Applications of GIS and BIM in Housing Development

Kwai Chung Area 9H

1. Complicated excavation and lateral support system on site
2. 3D model is easier to understand than 2D drawings and written method statements
3. Discussed with site staff and contractor before construction to ensure smooth/safe operations



3D Virtual Model



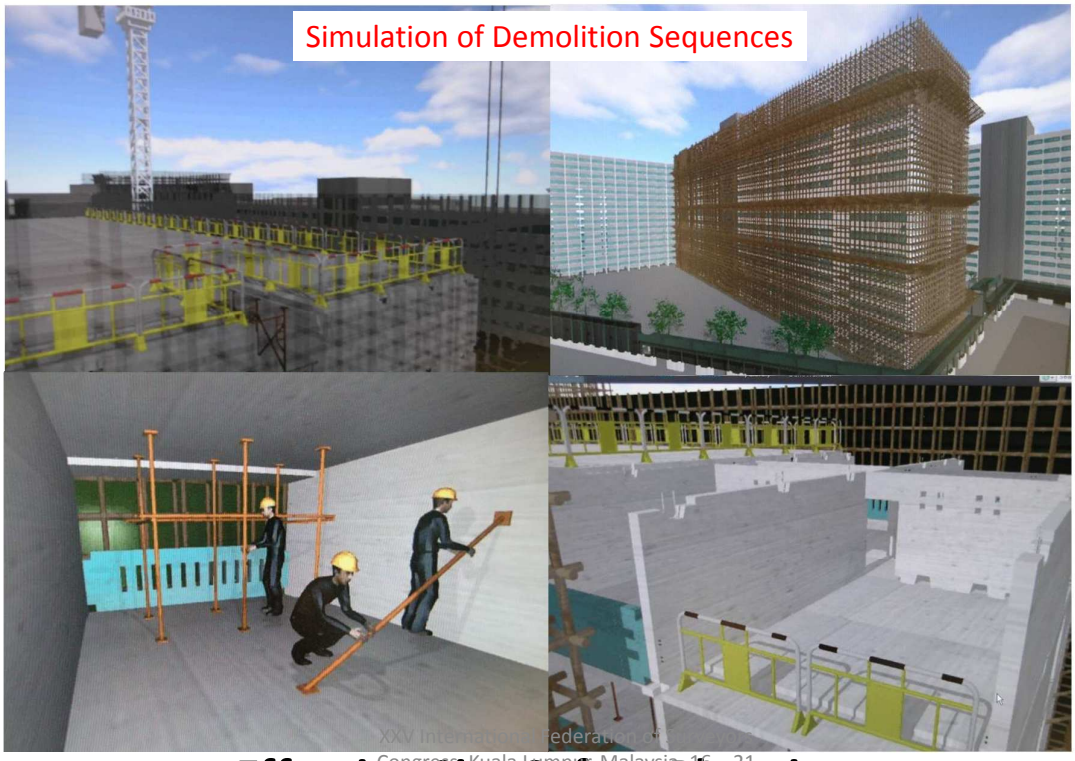
3D Physical Model

Site Formation - Excavation, Lateral Support

Applications of GIS and BIM in Housing Development

Safety and Logistics Arrangement through Virtual Construction Sequence Model

Applications of GIS and BIM in Housing Development

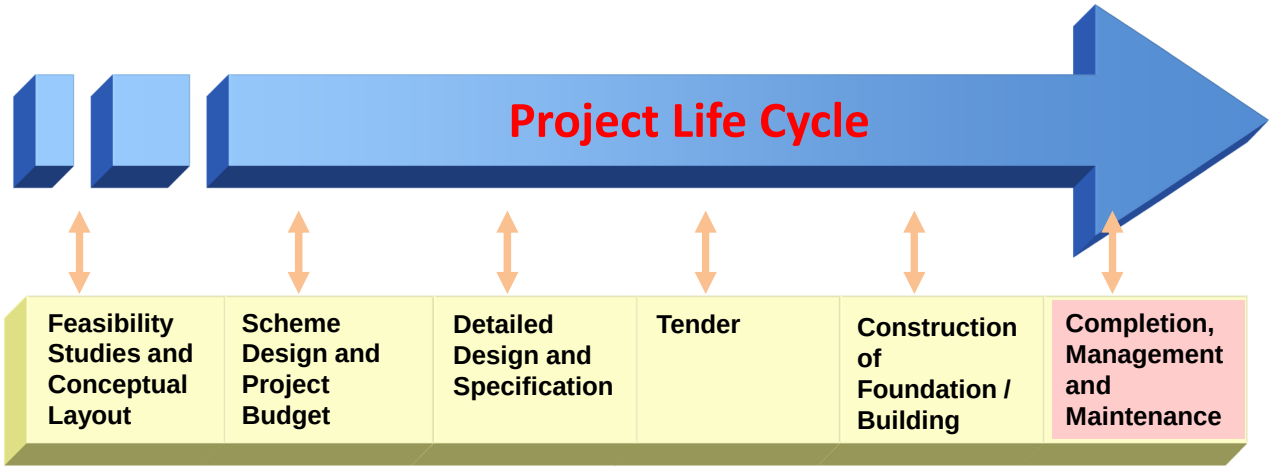


Effective Site Safety Planning

Project Life Cycle – Construction

Applications of GIS and BIM in Housing Development

Project Life Cycle

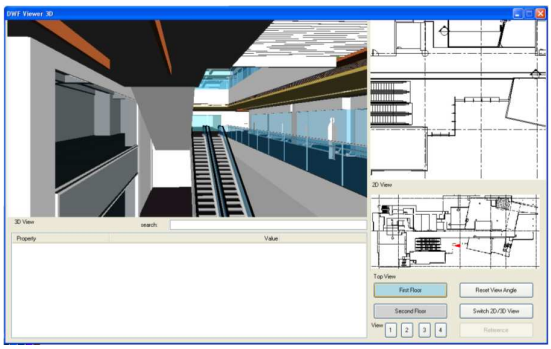


Project Functions

Design Options	Building Design and Performance	Documentation	Quality Control	Facility Management

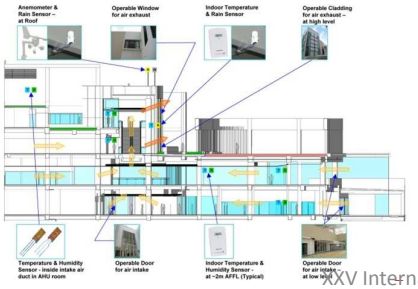
Applications of GIS and BIM in Housing Development

View at Each Floor

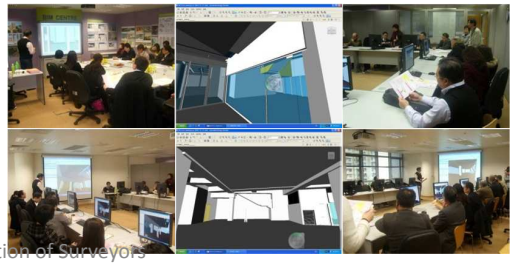


View at Front End

Zoom in Special Design Features

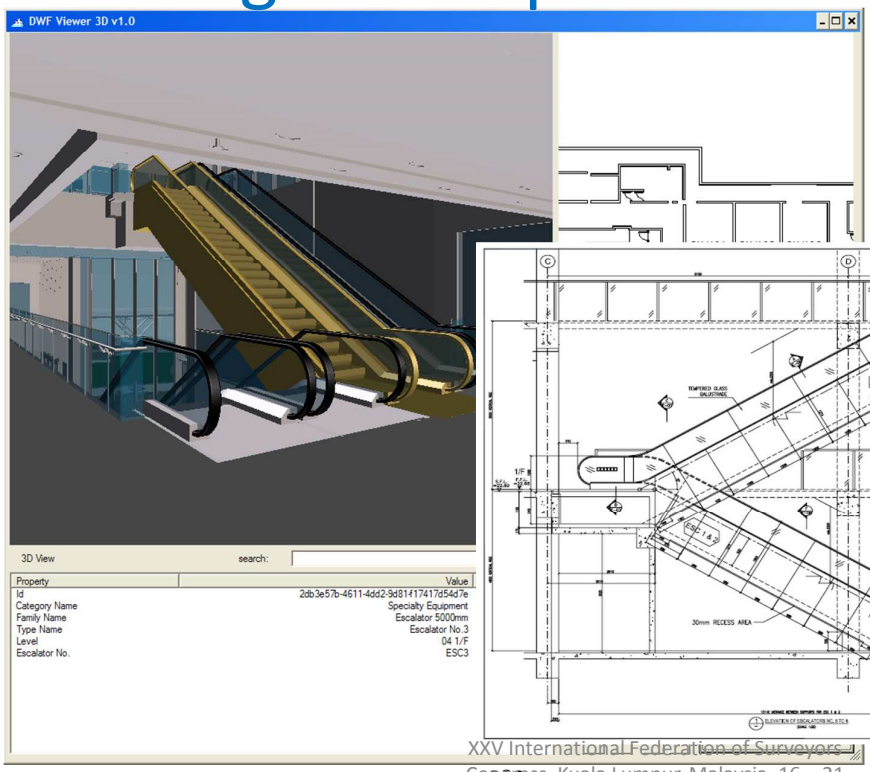


Prospective Tenants can Visualize the Space before Placing Bids



Facility Management

Applications of GIS and BIM in Housing Development



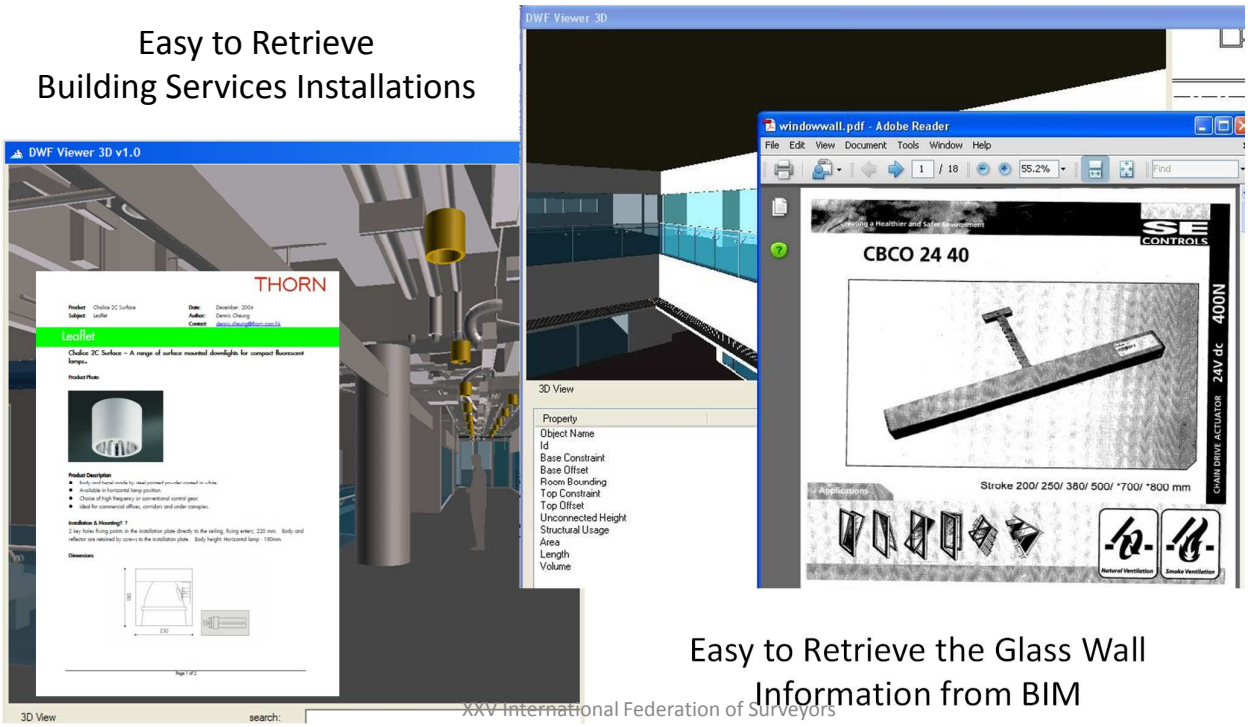
Building Services Installations

Facility Management

Project Life Cycle – Facility Management

Applications of GIS and BIM in Housing Development

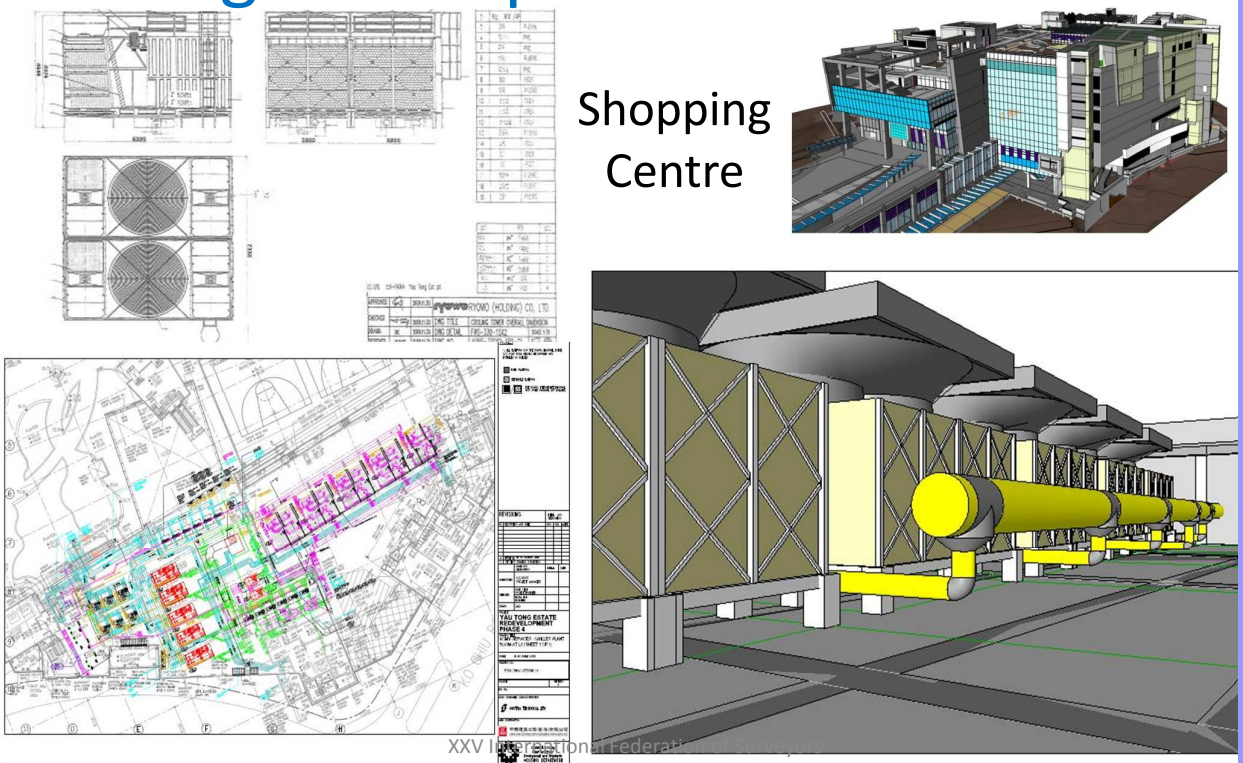
Easy to Retrieve
Building Services Installations



Easy to Retrieve the Glass Wall Information from BIM

Facility Management

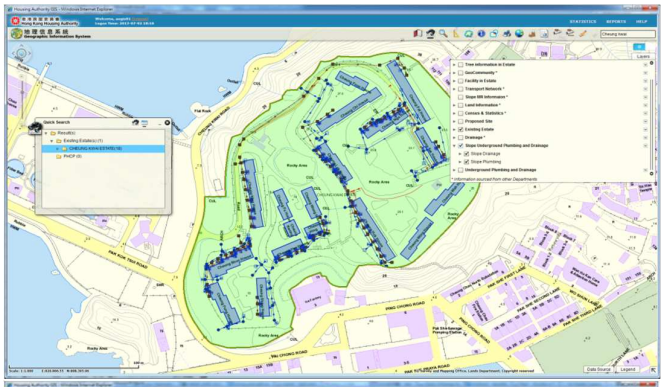
Applications of GIS and BIM in Housing Development



Shopping Centre

MEP BIM Model of Shopping Centre

Applications of GIS and BIM in Housing Development

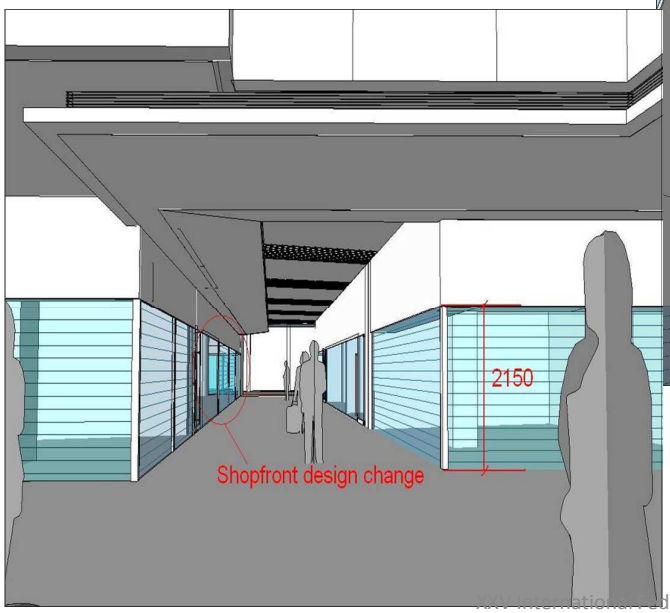


- Estate Management GIS database maintains all the Underground Plumbing and Drainage Records of Public Housing Estates for effective daily facilities management.
- Updating of the records through web-based interface for maintaining the data quality.

Utilities Management

Applications of GIS and BIM in Housing Development

Better Visualization



Space Management

Benefits of Using GIS and BIM in Housing Development Projects

1

Effective & Efficient Internal Coordination

- Better presentation and visualization quality by 3D graphics and animation
- Provide accurate location of designed structures with real surrounding environment
- Improve interoperability of various disciplines

Benefits of Using GIS and BIM in Housing Development Projects

2

Effective & Efficient External Coordination

- Sharing of information among various government departments for improvement of work efficiency
- Example: Sharing with colleagues of Rating and Valuation Department to carry out visual impact simulation, rates assessment and 3D spatial analysis

Rating and Valuation Department

Highways Department

Benefits of Using GIS and BIM in Housing Development Projects

3 Higher Quality of Work

- Preserve 3D data
- No data loss
- Enhance consistency, quality and availability of spatial data for interlinked design, construction and maintenance works

4 Sustainability Development

- Avoid duplicated works
- Minimize material wastage
- Simulation of environmental studies facilitates planning and design for sustainable developments

5 Environmental -friendliness

- Accurate design information allows the wider use of standard modular components with quick assembly on site
- Less in-situ works and less waste materials are disposed

Benefits of Using GIS and BIM in Housing Development Projects

6 Better Site Safety Management

- Prior understanding of site conditions
- Locate the accurate position of machinery and utilities
- Visualize virtual construction and walkthrough of the sites at different stages and times

7 Shortened Construction Time

- Construction sequencing can be visualized and studied beforehand
- Work is less likely to be affected by unforeseeable site conditions and inaccurate information

8 Cost Saving

- Reduce construction waste and redundancy of work
- Shorten construction time resulting in cost saving

Change Management Transformation Process

Technologies	3D modeling, analysis, 3D printer, RFID, GIS, BIM…
Processes	Upfront design process, re-engineering, office procedures, disciplines practices, industry practices
Organization	Tighter team formation, multi-disciplinary team, supporting team structure
Partnership	Collaboration among project team, consultants, contractors and subcontractors.
People	BIM skill, think ahead, teamwork, change management, industry practitioners, academia, workforce

Change Management Evolution to 3D Matrix Team Structure

Before 1997
- Functional Structure
  - emphasizes more on effectiveness (quality) but less on interdisciplinary co-operation

1997 – 2001
- Matrix Structure
  - emphasizes more on efficiency (managerialism) but the PM teams lack expertise in managing quality

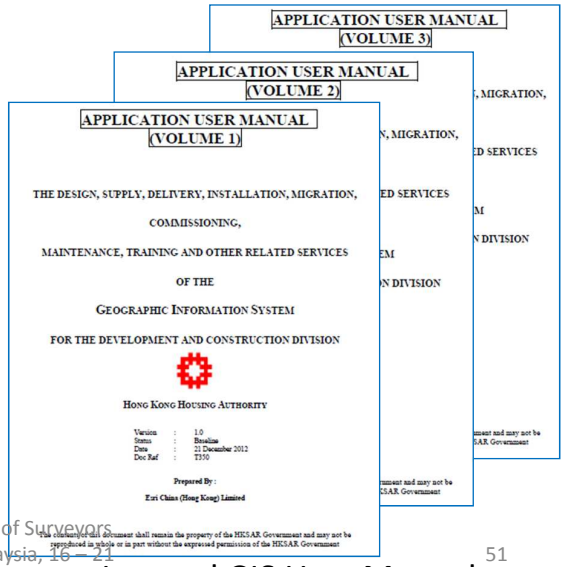
2002 Onward
- 3D-Matrix Team Structure
  - more flexible & adaptive to changing environment
  - everybody is working on one's own expertise
  - everyone is learning continuously
  - everyone is constantly challenged to do more
  - everyone feels adding value & contributing to the society

3D-Matrix Team Structure

Present Situation

HD facilitates the staff to use GIS by

- publishing internal GIS User Manuals including
  - Web Application
  - 3D Analysis
  - Data Maintenance
  - Tree Management Module
  - System Administration



Internal GIS User Manuals

Present Situation

HD promotes the Use BIM to the Public by

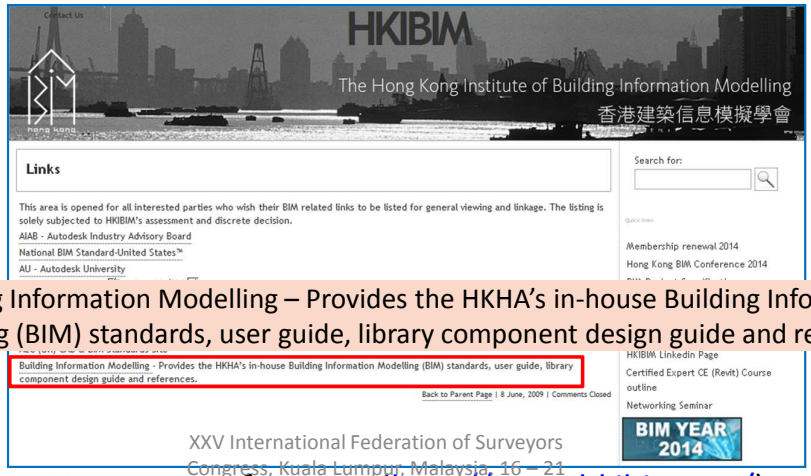
- drafting standardization guidelines for implementation of BIM in a systematic way
- publishing BIM documents in homepage including
  - Library Component Design Guide
  - Standards
  - User Guide
  - References

Homepage of Hong Kong Housing Authority (http://www.housingauthority.gov.hk/)

Present Situation

HD promotes BIM to Construction Industry by

- Co-operating and sharing BIM related documents with Hong Kong Institute of Building Information Modelling (HKIBIM)



Building Information Modelling – Provides the HKHA's in-house Building Information Modelling (BIM) standards, user guide, library component design guide and references.

Homepage of HKIBIM (http://www.hkibim.org/)

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The Way Forward

- Widen the applications of BIM and GIS in HD
- Extend data flow from BIM to GIS and vice versa
- Encourage our business partners to use GIS and BIM
- Collaborate with other Government Departments

GIS BIM

Conclusions

- HD is constantly exploring new and innovative ways for sustainable development and continuous improvement of public housing to meet the public needs.

- Application of GIS and BIM in housing development
  - provides a much tighter collaboration platform among design teams at an early stage to resolve any design problems, clashes and difficulties.
  - enhances site planning, safety and project delivery.

- Gained valuable experience in the evolution and transformation of technology, organization, processes, people and partnership for review and improvement