การใช้ BIM เป็นเครื่องมือบรรลุอาคารเขียว (G-GOODs)

12 September 2023

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การใช้ BIM เป็นเครื่องมือบรรลุอาคารเขียว (กรณีศึกษา)
Case Study for using Building Information Modeling, BIM as tools to achieve Green Building

การออกแบบอาคารภาครัฐให้เป็นอาคารเขียวภาครัฐ
Green Government Office Design Guidelines (G-GOODs)
ตามเกณฑ์กรมโยธาธิการและผังเมือง

วันอังคารที่ 12 กันยายน 2566 ณ ห้องวิศวภิวรระน์ อาคารสภาวิศวกร ชั้น 7

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หัวข้อสนทนา:

- What & Why is BIM?
- Green BIM = Green Building Certification
- How does it work and What can BIM do?
- Case Studies ? (BIM with Plugin Application)
- Conclusion and Discussion

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What & Why is BIM?

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BIM AND LEED CERTIFICATION

Building Information Modeling collects data that can be used to achieve LEED certification. Green building benchmarks can be incorporated into the design and building processes in the preconstruction phase. The following are some of the benefits of utilizing BIM to meet LEED certification requirements.

- Enables sustainable designs by enabling architects, engineers, and other professionals to integrate and analyze building performance.
- Helps simplify the process by simulating different conditions that would have environmental impacts. Examples include weather conditions and seasonal demands on heating and cooling systems.
- Allows for energy and sustainability analysis.
- Improves design and development processes for water supply and drainage.
- Tracks materials and manages material information.
- Plans for LEED credits and identifies required points based on particular LEED certification. BIM can identify which credits can be easily attained and which credits will be more challenging. Regional credits can be tracked, as these may help boost certification to the next level.

https://www.mckenneys.com/2022/04/how-bim-helps-companies-achieve-leed-certification/

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GREEM BIM

GREEN BUILDING CERTIFICATION

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DP 5 การใช้แบบจำลองสารสนเทศอาคาร (BIM) ในการออกแบบ

วัตถุประสงค์

เพื่อลดความขัดแย้งในแบบก่อสร้างแต่ละระบบ ซึ่งมักสร้างปัญหาในขั้นตอนการก่อสร้าง ทำให้บางครั้งมีค่าใช้จ่ายเพิ่มขึ้นในการแก้ไขปัญหานั้นๆ หรืออาจแก้ไขปัญหาได้ไม่สมบูรณ์ทำให้อาคารด้อยประสิทธิภาพ

ข้อกำหนด

ให้ใช้โปรแกรมการออกแบบที่เป็น แบบจำลองสารสนเทศอาคาร (building information modeling, BIM) ในการออกแบบโดยจะต้องเริ่มตั้งแต่ขั้นตอนการออกแบบร่างในทุกระบบ ทั้งสถาปัตยกรรม โครงสร้าง และงานระบบ เพื่อลดความขัดแย้งในแบบก่อสร้างของแต่ละระบบ

แนวทางการออกแบบ

ควรนำระบบ BIM มาใช้ในงานออกแบบตั้งแต่ขั้นตอนการออกแบบร่าง เพราะนอกจากจะลดปัญหาความขัดแย้งในแบบก่อสร้างแล้ว ยังสามารถใช้เป็นเครื่องมือในการวิเคราะห์งานออกแบบได้ในหลายด้านที่เกี่ยวข้องกับอาคารเขียว เช่น

- การวิเคราะห์เปรียบเทียบรูปร่างอาคารที่แตกต่างกัน 2 รูปแบบกับการใช้พลังงานที่เกิดขึ้น
- การวิเคราะห์ค่าความส่องสว่างในห้องต่างๆ
- การวิเคราะห์เงาที่เกิดขึ้น เพื่อหาตาแหน่งที่เหมาะสมในการวางแผงเซลล์แสงอาทิตย์ และยังมีประโยชน์ต่อเนื่องไปถึง
- การวางแผนจัดการทรัพยากรอาคารเมื่ออาคารสร้างเสร็จแล้วด้วย

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GREEN BIM

นิยามศัพท์ : แบบจำลองสารสนเทศอาคาร (building information modeling, BIM) หมายถึง

การสร้างแบบจำลองอาคาร (building model) พร้อมข้อมูลหรือสารสนเทศ (information) ในองค์ประกอบของแบบจำลองอาคารนั้นๆ เพื่อจำลองลักษณะอาคารที่ต้องการในการก่อสร้างจริง

BIM is an intelligent process that makes the planning, design, and construction of buildings highly collaborative and efficient.

A range of professionals involved in a project including developers, architects, engineers, and contractors can design a structure within a 3D model.

Information from the model allows those driving the project to make more informed decisions.

When changes are made, the BIM software updates the model to reflect that.

Principal parties can easily track and coordinate data throughout the process.

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GREEN BIM สนับสนุนการประเมินจากเกณฑ์บังคับ ไปสู่ เกณฑ์เลือกทำ

สรุปเกณฑ์ประเมินอาคารเขียวภาครัฐสาหรับอาคารที่จะก่อสร้างใหม่

หมวด	เกณฑ์บังคับ	เกณฑ์เลือกทำ
1 การเลือกที่ตั้งโครงการ	0	6
2 กระบวนการออกแบบและบริหารโครงการ	3	3
3 การออกแบบผังบริเวณและงานภูมิทัศน์	4	1
4 การออกแบบงานสถาปัตยกรรมและวิศวกรรม	19	23
5 การก่อสร้างอาคาร	3	0
6 การใช้และการบารุงรักษาอาคาร	3	7
รวมจำนวนเกณฑ์	32	40

สรุปเกณฑ์ประเมินอาคารเขียวภาครัฐสาหรับอาคารที่มีอยู่เดิม

หมวด	เกณฑ์บังคับ	เกณฑ์เลือกทำ
~~1 การเลือกที่ตั้งโครงการ~~	0	0
1 กระบวนการออกแบบและบริหารโครงการ	3	3
2 การออกแบบผังบริเวณและงานภูมิทัศน์	2	3
3 การออกแบบงานสถาปัตยกรรมและวิศวกรรม	15	29
4 การก่อสร้างอาคาร	3	0
5 การใช้และการบารุงรักษาอาคาร	3	7
รวมจำนวนเกณฑ์	26	42

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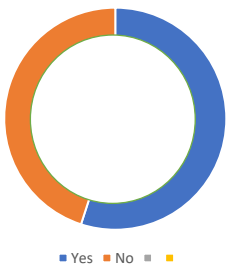
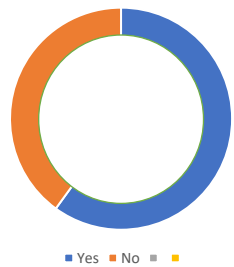
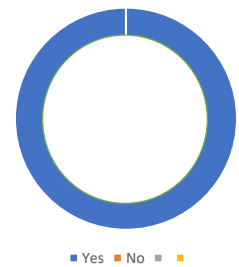
LEED (Energy Criteria)



BREEAM (Energy Criteria)



DGNB (Energy Criteria)



ตัวอย่างภาพแสดงสัดส่วนของการใช้ BIM ใน Energy Criteria ของแต่ละมาตราฐาน LEED / BREEAM/ DGNB

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How does it work and What can BIM do?

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Digital Capability

The digitisation of engineering provides a new way to envision design and to engage and collaborate with the client and stakeholders.

- **Incorporating digital and data tools for coordination (3D), schedule (4D), cost (5D), operations (6D)**
- **Reality capture, visualisation, virtual design and construction**
- **Skilled with various technology platforms including Revit, Navisworks, Grasshopper, Revizto, Dynamo, Fuzor and Python / API**

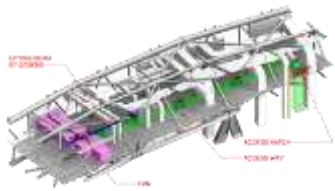
Coordination (3D)

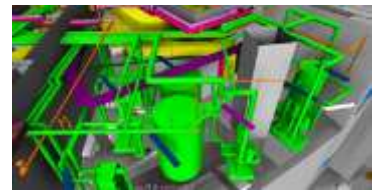
We create digital models to represent and analyse information across all that we do. Ranging from wind analyses of the structures to the detailed geometry and assembly of parts, models are the central source from which all other information is derived.

We understand the importance of a process in which 3D coordination is used to determine and identify 3D geometric conflicts to achieve a well-coordinated project to reduce and eliminate risk and increase productivity and more accurate information.

To achieve this, Aurecon adopts a clash avoidance philosophy where preliminary coordination of services is performed before starting to build digital models to achieve high-precision digital coordination services.

Ongoing interactive 3D coordination meetings throughout the project reinforcing collaborative working strategy, enables actionable outcomes instantly and track progress against actions with live up to date information.





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Design Integration (Architecture and Engineering)

- Potential problems can be identified early in the process. Real-time collaboration helps optimize processes to prevent costly changes later.

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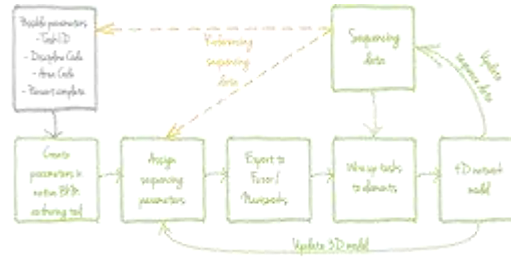
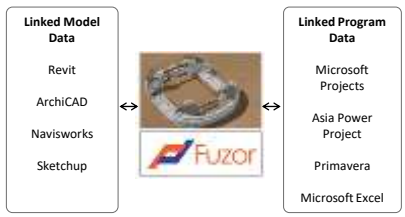
Construction Sequencing (4D)

Our digital team leverage digital models for construction planning using multiple digital tools to enhance the work schedule activity's by linking of master construction programme with digital models to facilitate site planning including site surrounding conditions, time constraints, sequencing, site logistics.

This workflow enhances site safety, site activities planning, monitoring of site progress against planned schedule and strengthening the confidence of project team in project execution.





Stadium Project
Erection Method / Sequencing of Main Stadium Roof

Site Planning
Site surrounding conditions, time constraints, sequencing, site logistics, linkage of master construction programme

Residential Building
Modular construction methodology

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Construction Sequencing (4D)

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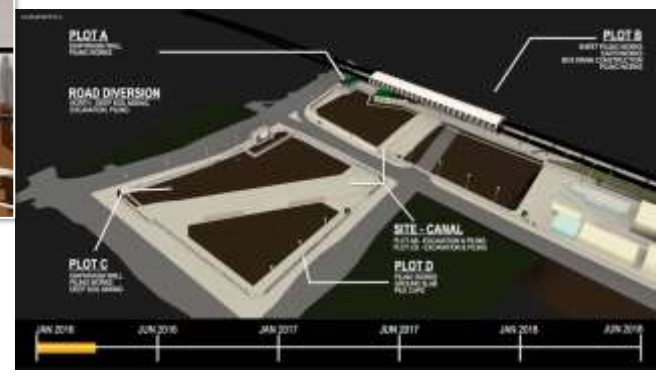

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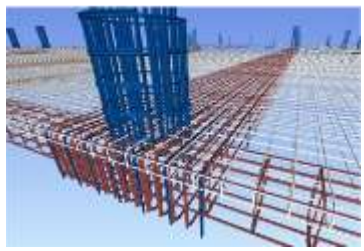
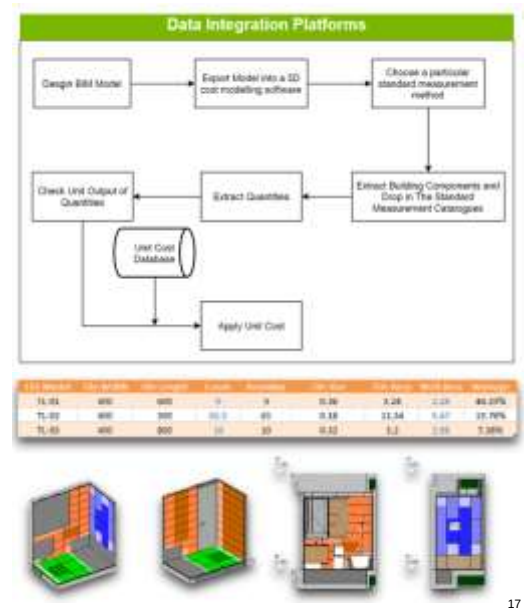
Cost Modelling (5D)

Aurecon vast expertise allows us to implement accurate cost planning in our client's projects.

Cost planning is fundamental to success for all projects, it allows us to forecast costs, extract detailed quantity take-offs from the virtual model, faster decision-making process with a click of a button and agile material procurement.





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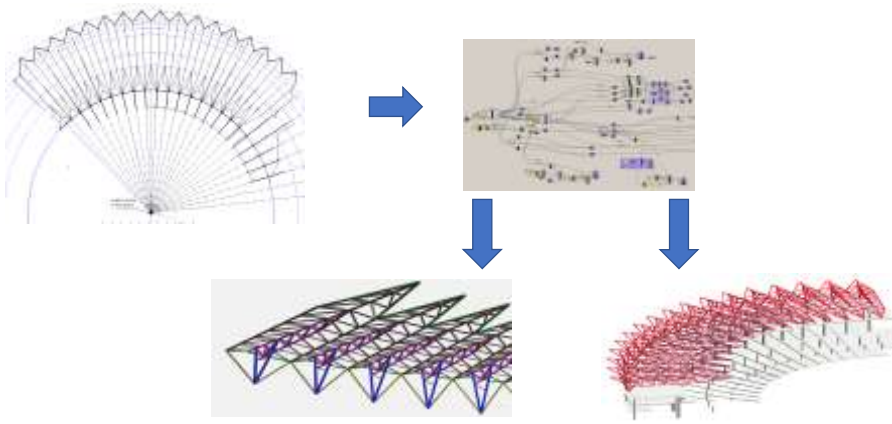
Long Span Steel Structures- Digital

Architect Model – Grasshopper Script



Automate Structural Analysis Model and Structural Revit Model

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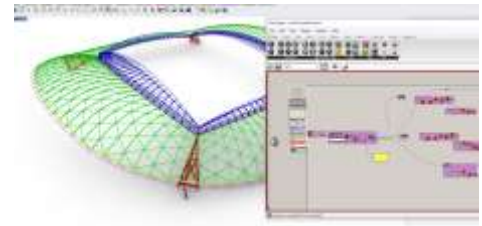
Sydney Stadium



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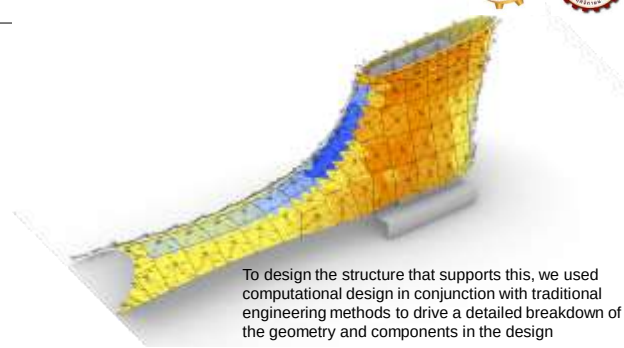
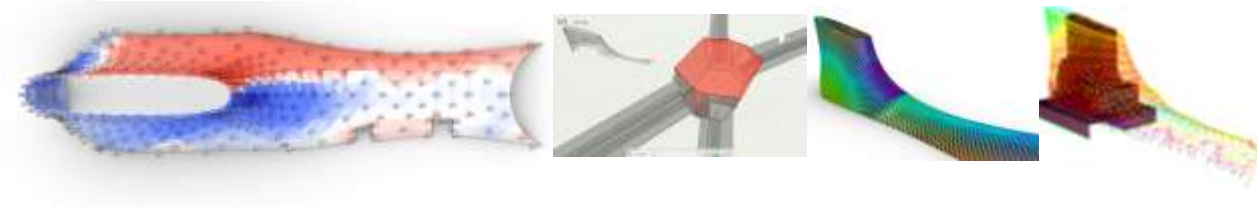
Sustainability – Efficient Structural Design



To design the structure that supports this, we used computational design in conjunction with traditional engineering methods to drive a detailed breakdown of the geometry and components in the design



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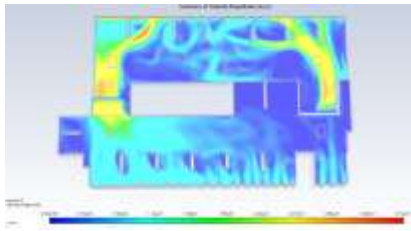
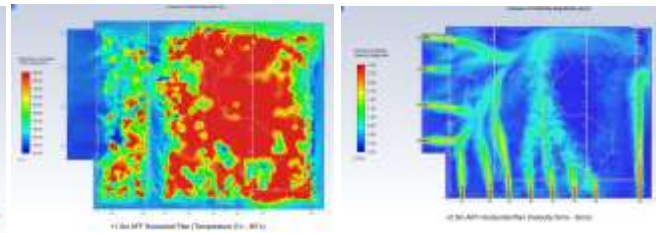
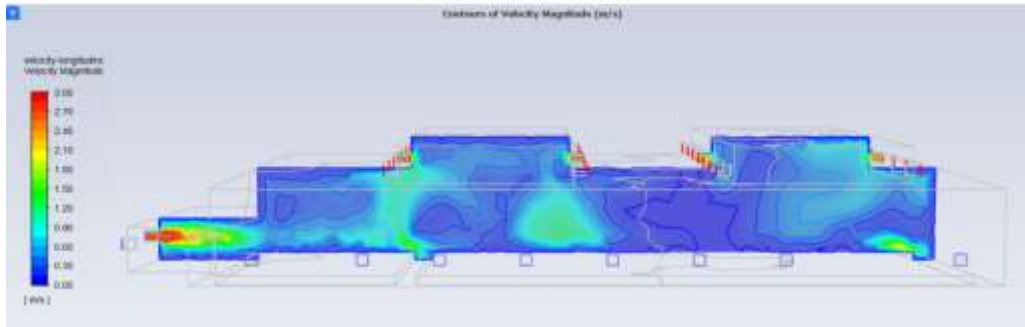
Environmental Study (CFD)



Example of Natural Ventilation study



Example of Temperature analysis and Velocity air flow



Example of Velocity air flow

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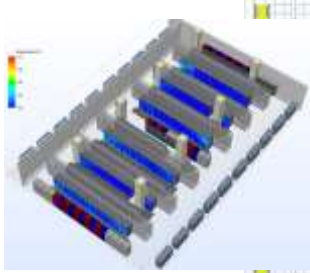
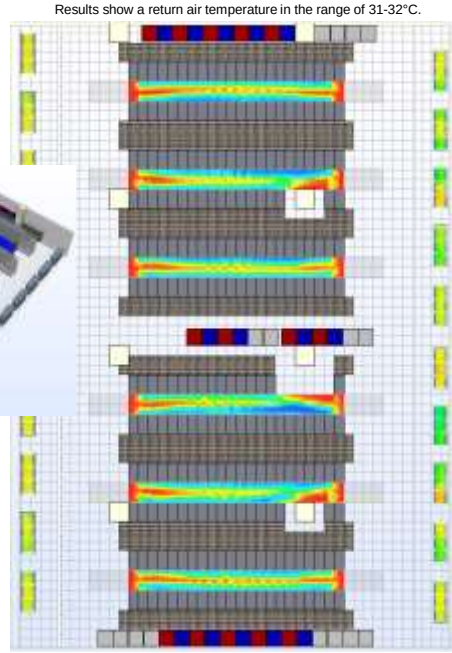
CFD Simulation

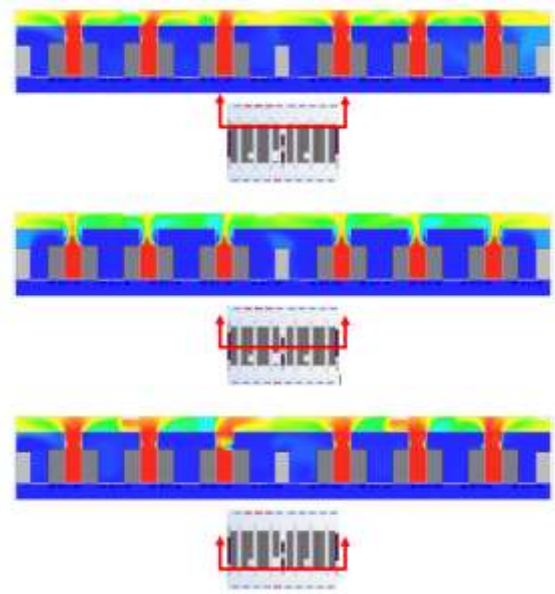


Temperature Plot at 3600mm AFFL (Ceiling Return)

Results show a return air temperature in the range of 31-32°C.



Data Hall Sections



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Case Studies ?

(BIM with Plugin Application)

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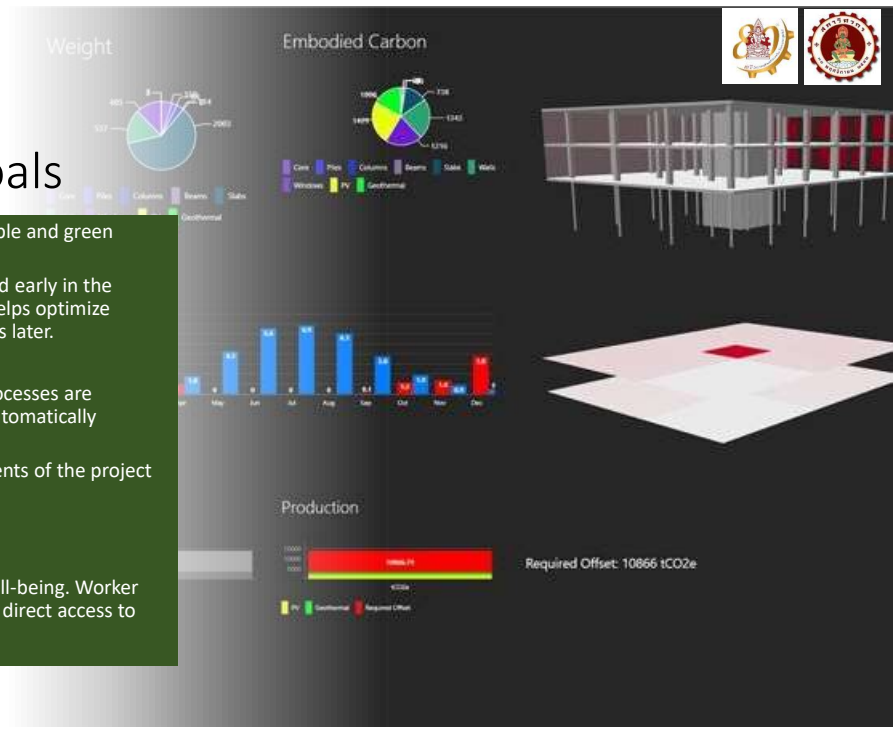
GREEN BIM – Benefits & Goals



The fundamental principles of sustainable and green building design include the following:

- Potential problems can be identified early in the process. Real-time collaboration helps optimize processes to prevent costly changes later.
- Reducing energy consumption.
- Minimizing waste. Construction processes are enhanced as workflow plans are automatically generated and updated as needed.
- Scheduling is improved as all elements of the project can be properly sequenced.
- Using renewable materials.
- Conserving water.
- Promoting occupant health and well-being. Worker safety is increased as workers have direct access to information.

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GREEM BIM ควรนำมาใช้ตามหมวดที่สำคัญคือ Land, Water, Energy, and Material.

- Land – BIM regulates and simulates the progress of construction as well as site processes.
- Water – BIM aids inefficient use of water and optimizes the design in water supply, drainage, and planning.
- Energy – BIM controls the energy consumption within the building and analyses deficits.
- Material – Keeps a check on the consumption and use of materials at all stages of the project

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Case study

Physical Risk

Physical risks from climate change include

- risk to facilities and infrastructure, impact on operations,
- water and raw material availability,
- supply chain disruptions,
- threats to health and wellbeing.

Transition Risk

Risk associated with the transition to a low-carbon economy relate to changing stakeholder and consumer preferences, government policies, legal and regulatory drivers, and resulting impacts on social license, enterprise value, and communities.

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Background

- Buildings and Construction contributes to ~39% GWP
- To avoid devastating effects and safeguard planet for future generations we need change

- **<u>What are we doing about it?</u>**

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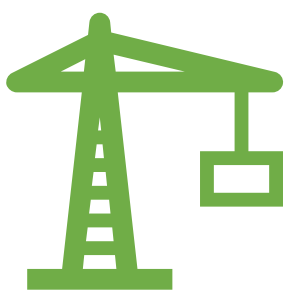
Background



- Structural Engineers currently seldomly consider GWP in designs as it is not a Code requirement and not well understood
- Life Cycle Assessment only carried out on some projects, challenges:
  - Misleading/ Inaccurate
  - Time-consuming
  - Manual material take-offs
  - Arduous process to input
  - After design complete – too late

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Client Benefit

- More sustainable building
- Savings on offsets
- Higher certification rating (for example LEED)
- Tax incentives some locations
- Increased sellable GFA some locations
- Marketing – drive price/ rent
- Expected to be included in future Codes (benchmark)

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Embodied, operational and enabled emissions

Embodied: Emissions associated with the materials and processes up to a defined point in a product lifecycle (e.g. at bridge commissioning)

Operational: Emissions associated with operation of the product during its operating life (e.g. emissions resulting from bridge lighting)

Enabled: Emissions associated with the activities enabled by the product during its operating life (e.g. emissions from additional road traffic)

- *Useful conceptualisations, but not universally recognised (e.g. not used in GHG protocol).*
- *Most commonly used in built environment.*

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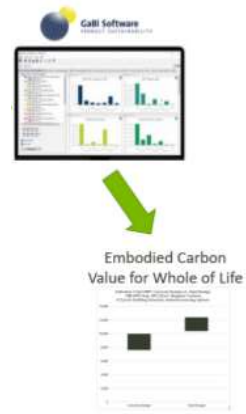
REAL TOOL - Overview



GABI:

Trusted, widely used
Comprehensive backing data sheet
Aurecon already has licenses
Inbuilt modules
Used for Buildings and Infrastructure
Flexibility to input data (real suppliers) and create modules

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REAL TOOL - Overview

GABI:

Trusted, widely used
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Environmental Product Declaration Sheet – EPD
LTA Gabi – Software (https://sphera.com/product-sustainability-software/)

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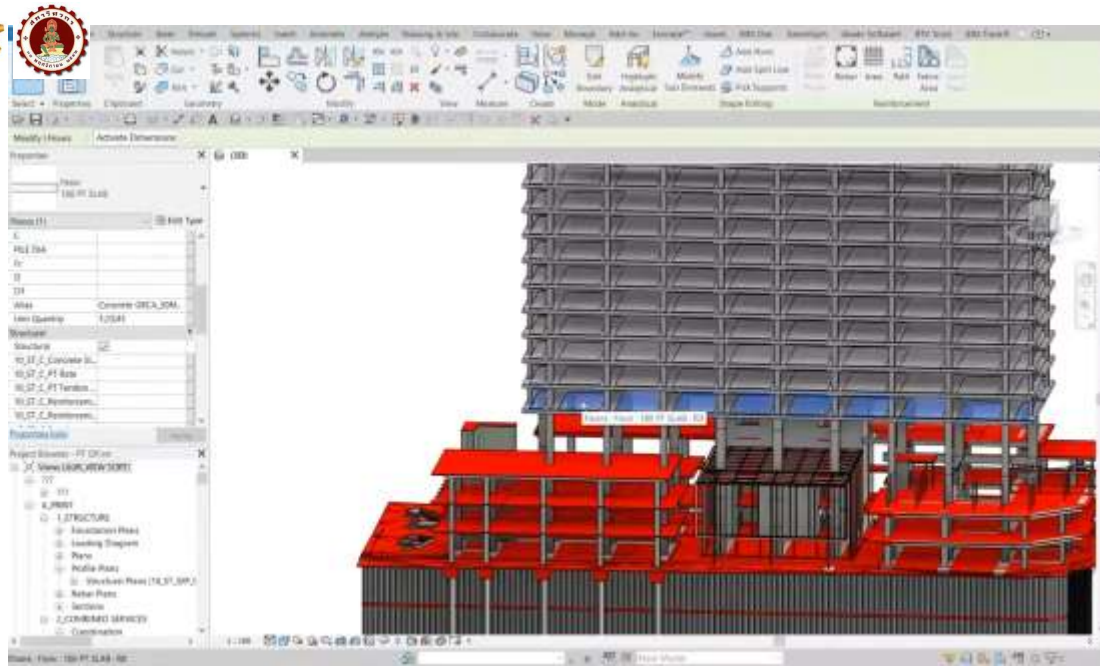

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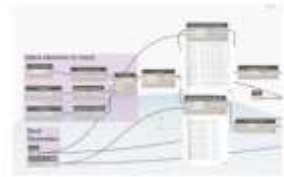
REAL TOOL - SCRIPT

- *Elements categorized in Dynamo*
- *Elements Filtered and converted to correct units*
- *Python used for reinforcing and PT conversion from concrete*
- *Look up alias in spreadsheet and populate*



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Case Study- Test Tool

- *Real Building, compare options*

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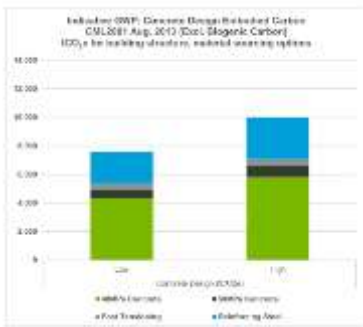
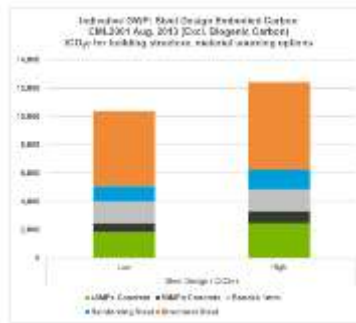
Design and Construction Stage

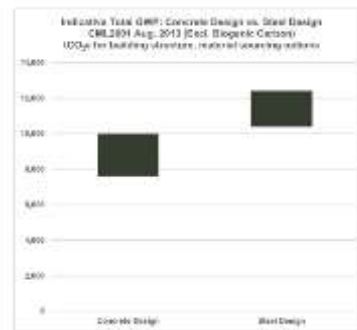
Embodied Carbon
Concrete Design



Embodied Carbon
Steel Design



Embodied Carbon
Concrete Vs Steel Design



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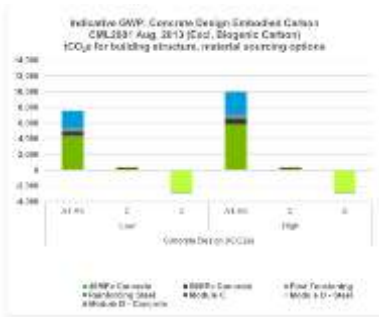
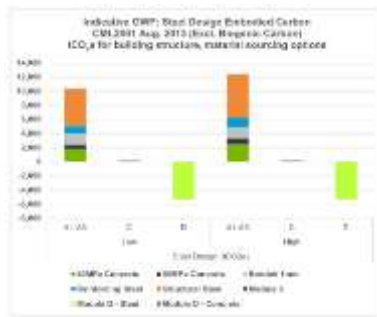
Whole of Life

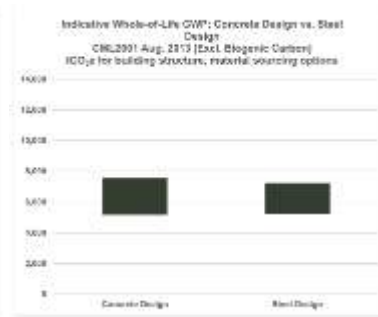
Embodied Carbon - Concrete Design
[Gain on Module D]



Embodied Carbon - Steel Design
[Gain on Module D]



Embodied Carbon
Concrete Vs Steel Design



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Sustainability – Efficient Structural Design

ID Lab : User Interface and design dashboard for reporting and evaluating embodied carbon in the design model

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GREEN BIM สำหรับอาคารเขียวสาหรับอาคารที่มีอยู่เดิม

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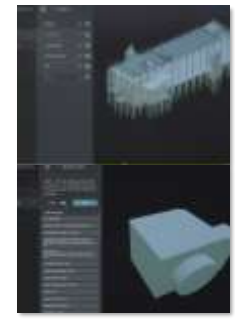
Digital twin implementation from existing building

Ref. Aurecon group (copied right, 2022)

As-Built

Critical to Design



Digital Twin

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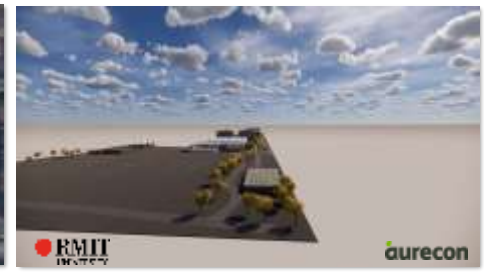

Exterior Site Scanning (Backpack and P50)

Interior Building Scanning (RTC360)

360 Camera for Faster Capture

Capture of Asset Data (Linked to Point Cloud)

Ref. Aurecon group (copied right, 2022)

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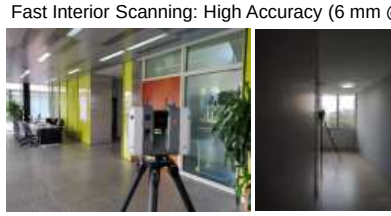
Scanning of Exterior: 2 – 3 cm accuracy

Exterior Site Scanning: High Accuracy (0.8 mm @ 10 m)

Fast Interior Scanning: High Accuracy (6 mm @ 10 m)



Ref. Aurecon group (copied right, 2022)

Ref. Aurecon group (copied right, 2022)

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- **operations (6D)**

AM/ BIM Interface

- Internal client: Built Environment
- Visual representation
- Integrate with Design (Revit)
- View assets / space in a quick and simple manner
- View performance and IoT integrated
- View critical BIM information and show optioneering

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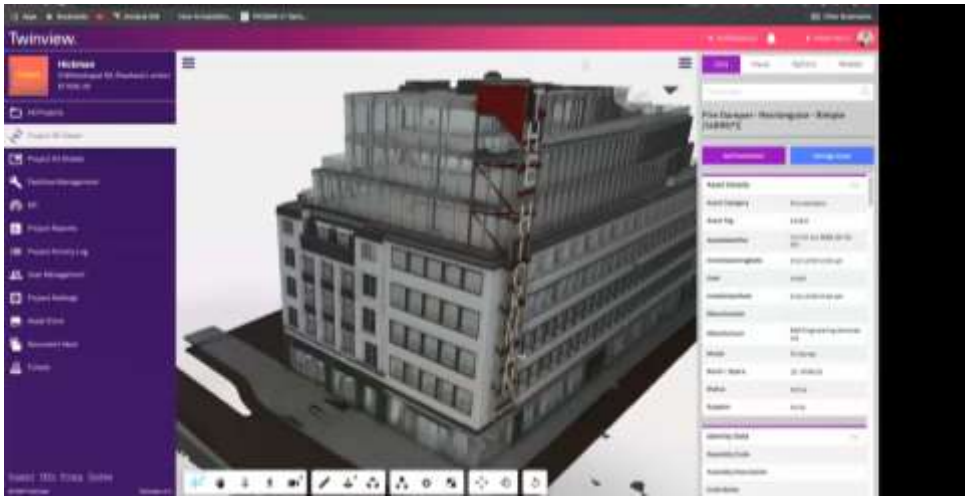

AM/ BIM Interface

- Browser-based Digital Twin platform.
- 3D model viewed dashboard.
- Facility Management
- Asset management
- Ticket order
- IoT connecting
- BAS-BMS

Twinview is a browser-based Digital Twin platform for the property sector connecting building systems' data to a 3D model viewed on a single dashboard. Twinview becomes your first step to achieving Net Zero with continuous live data, optimising building performance and reducing cost whilst improving user experience and business outcomes.
Twinview now is Aurecon's partnering business in Asia

Twinview.

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Conclusion and Discussion

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Benefits of utilizing GREEN BIM to meet GREEN Certification requirements

Enables sustainable designs by enabling architects, engineers, and other professionals to integrate and analyze building performance.

Helps simplify the process by simulating different conditions that would have environmental impacts. Examples include weather conditions and seasonal demands on heating and cooling systems.

Allows for energy and sustainability analysis.

Improves design and development processes for water supply and drainage.

Tracks materials and manages material information.

Plans for LEED credits and identifies required points based on particular LEED certification. BIM can identify which credits can be easily attained and which credits will be more challenging. Regional credits can be tracked, as these may help boost certification to the next level.

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