Real Project Experience of Building Information Modelling Application in Architecture Discipline

David Fung
Senior Associate, Aedas
Head of BIM Division

Building Information

Graphical

Plan
Section
Elevation
Area Diagrams
Schematic Designs
General Building Plan
Structural Plans
E/M Drawings
Schematics
Analysis
Other Diagrams

Non-Graphical

Area Schedule
Finshing Schedules
Door/Window/Louvre Sch
Beam/Column Schedule
Equipment Schedule
Program
Specifications

Cost Estimate
Quantity Take Off
Bills of Quantities
Variation Assessments

Information

Graphical

CAD SYSTEMs

- Plan
- Section
- Elevation
- Area Diagrams
- Schematic Designs
- General Building Plan
- Structural Plans
- E/M Drawings
- Schematics
- Other Diagrams

e.g. AutoCAD, Microstation

Non-Graphical

- Area Schedule
- Ceiling Schedules
- Door/Window/Louvre Sch
- Beam/Column Schedule
- Room Schedule
- Program
- Bills of Quantities
- Variations

Word

Excel (spreadsheet)

Access (Data Base)

MS Project

BQ Softwares

Quantity Take Off

……

As a result……

Inefficiencies, mistakes and delays account for $200 billion of the $650 billion spent on construction in America every year.

New wiring, The Economist, January 13th, 2000

In the UK alone, the annual cost of rectifying construction defects caused by poorly detailed drawings and operatives being given incorrect instructions has been put a £1bn (≈$1.66bn).

IT Construction Best Practice service, http://www.itcbp.org.uk

The process of construction is itself repeated in its essentials from project to project. Indeed, research suggests that up to 80% of inputs into buildings are repeated.

M4i, http://www.m4i.org.uk

Information

Graphical

- Plan
Section
Elevation
Area Diagrams
Schematic Designs
General Building Plan
Structural Plans
E/M Drawings
Schematics
Other Diagrams

BIM

Non-Graphical

- Area Schedule
Finishing Schedules
Door/Window/Louvre Sch
Beam/Column Schedule
Equipment Schedule
Diagrams
Cost Estimate
Quantity Take Off
Bills of Quantities
Variations

Building Information Modeling

信息化建築模型

Building Information Modeling (BIM)
信息化建築模型

Definition:

BIM is an innovative approach to architectural design and documentation supporting all phases of design and all the architectural drawings and schedules required for the design, construction and management of a building project.

Building Information Modeling (BIM)

Misconceptions:

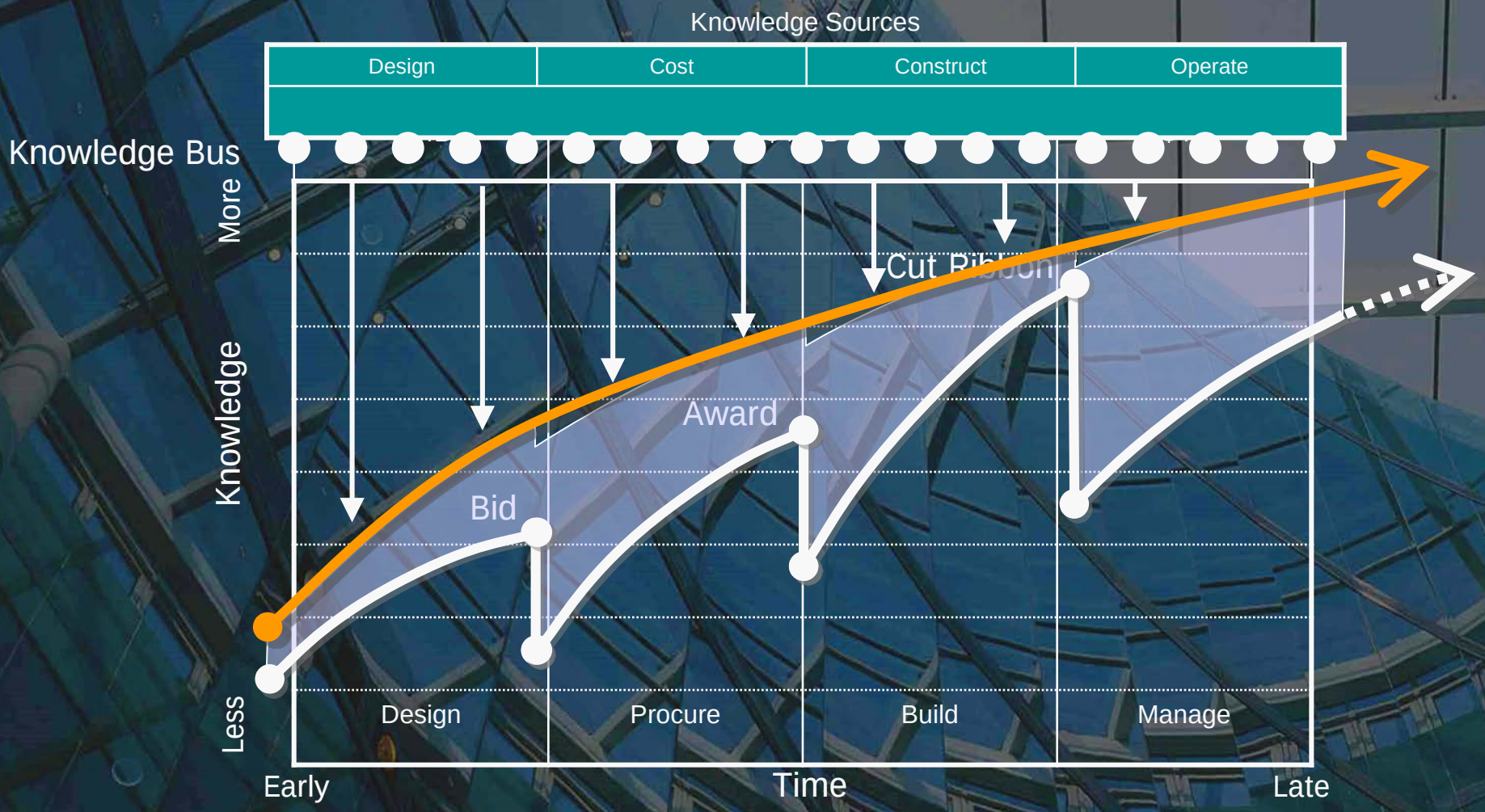
1 **BIM** < > **3D CAD**

Architectural Desktop (Autodesk)
Revit (Autodesk)
ArchiCAD (Graphsoft)
Triforma (Bentley)
Digital Project (Gehry Technology)

AutoCAD (Autodesk)
Microstation (Bentley)

2 **BIM** < > **Clash Analysis only**

Information “Backflow”



What is BIM (Building Information Model)

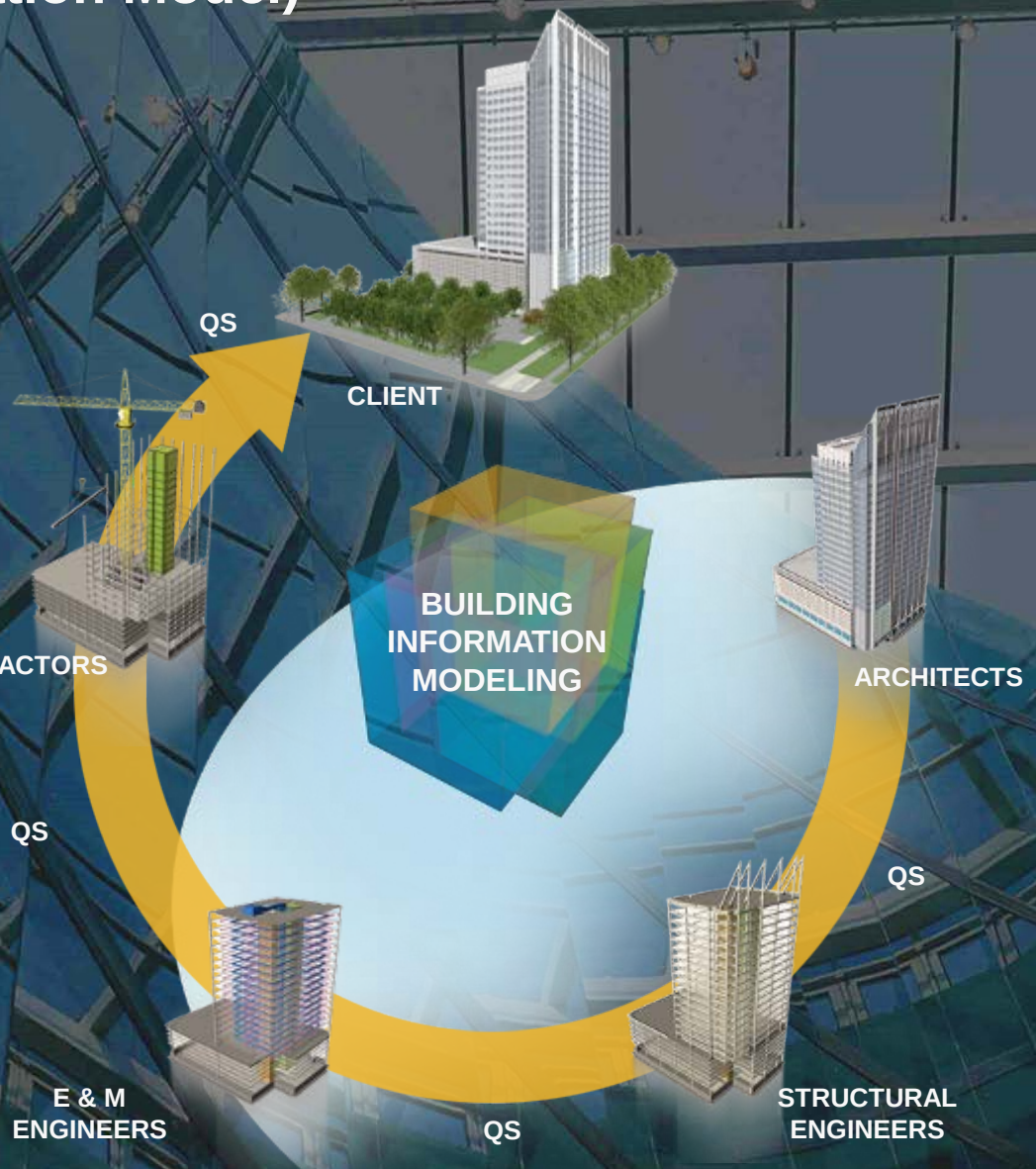
Graphical Data

+

Non-Graphical Data

+

New workflow



Use of Building Information Modeling (BIM)

1 Visualization
2 Production
3 Co-ordination/ Collaboration
4 Quantity Taking & BQ
5 Statutory submission
6 Analysis
7 Supply Chain Integration

…..

VISUALIZATION & PRODUCTION

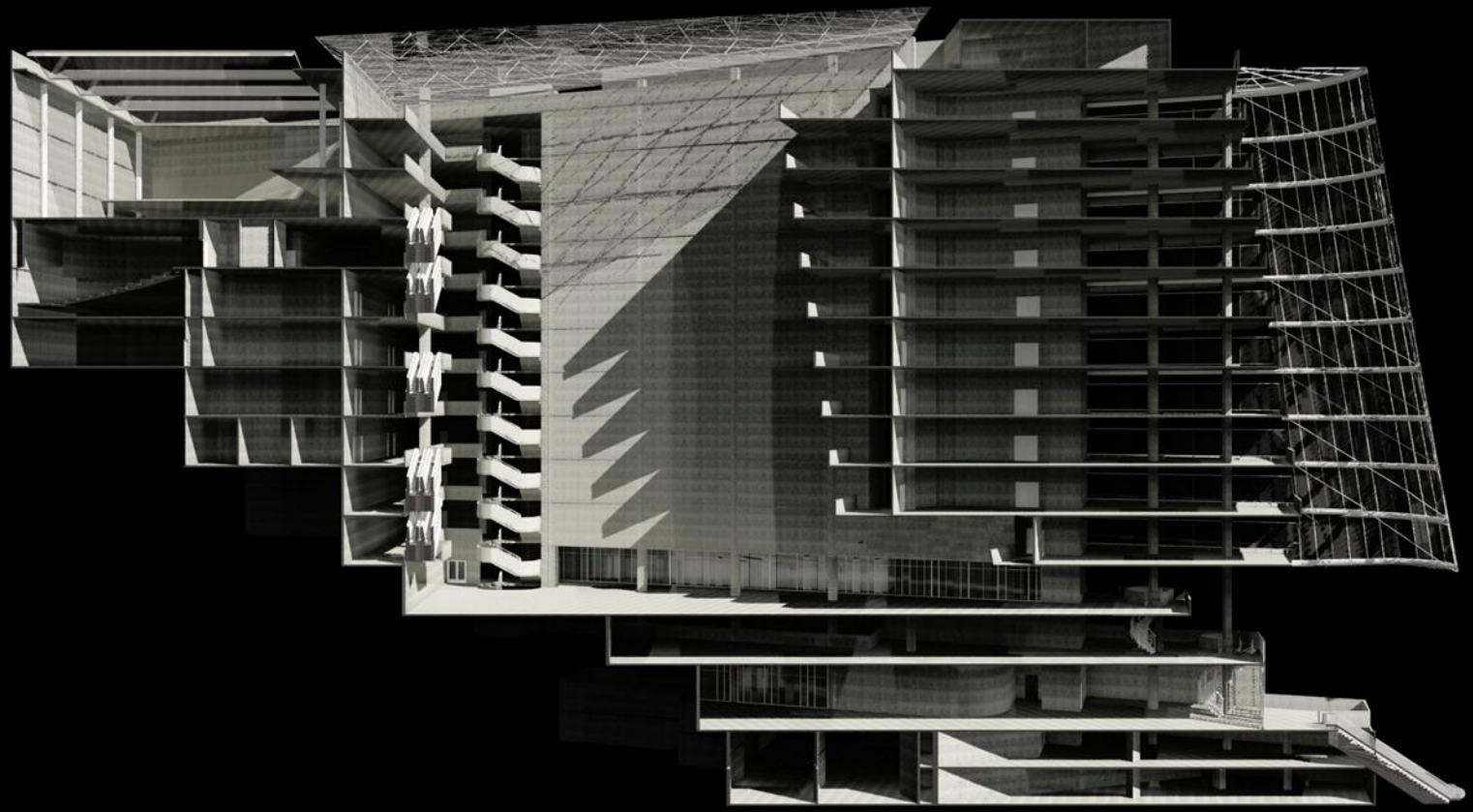
VISUALIZATION & PRODUCTION

PERSPECTIVE

CUT AWAY SECTIONS

VISUALIZATION & PRODUCTION

VISUALIZATION & PRODUCTION



CUT AWAY PESPECTIVE

VISUALIZATION & PRODUCTION

VISUALIZATION & PRODUCTION

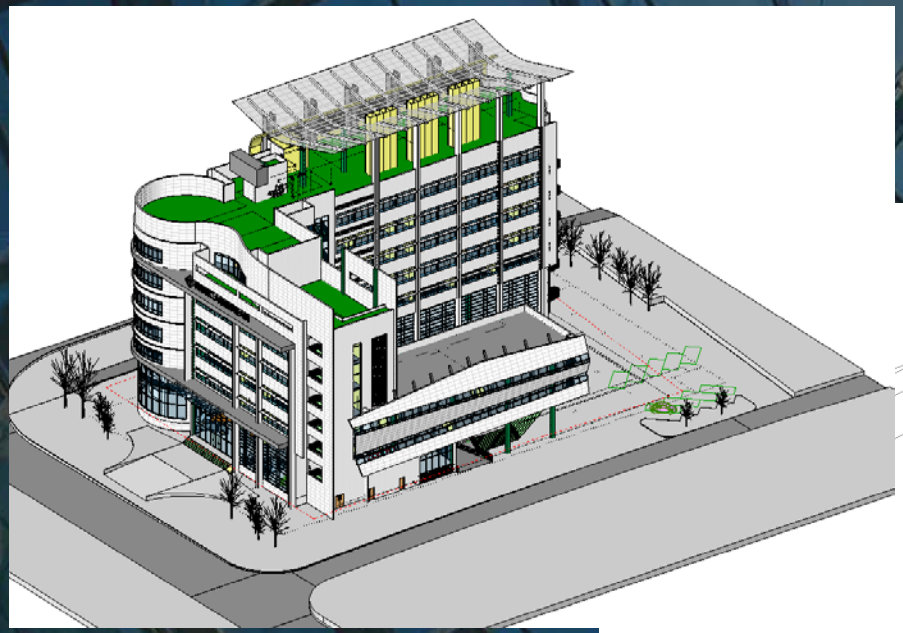
VISUALIZATION & PRODUCTION

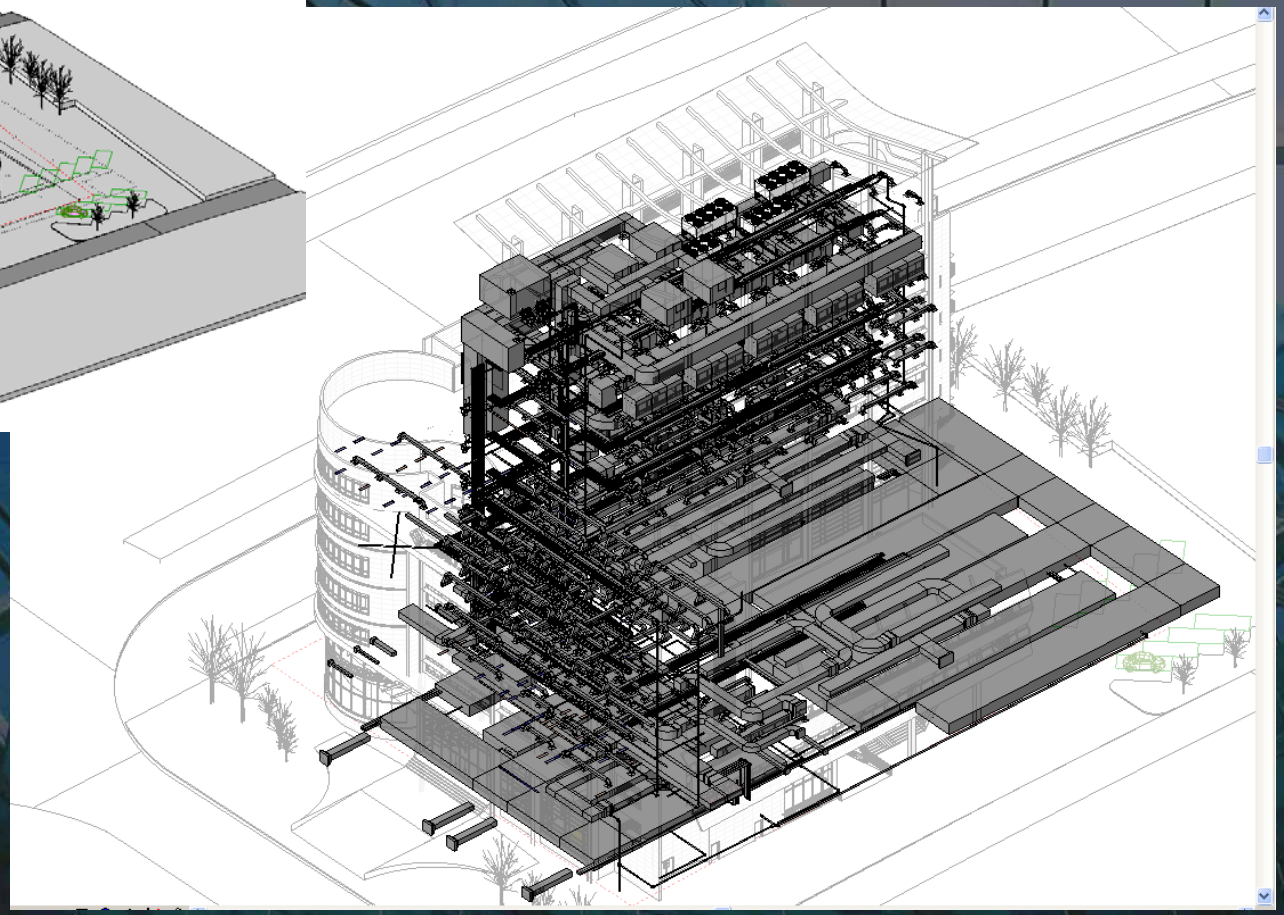
VISUALIZATION & PRODUCTION

VISUALIZATION & PRODUCTION

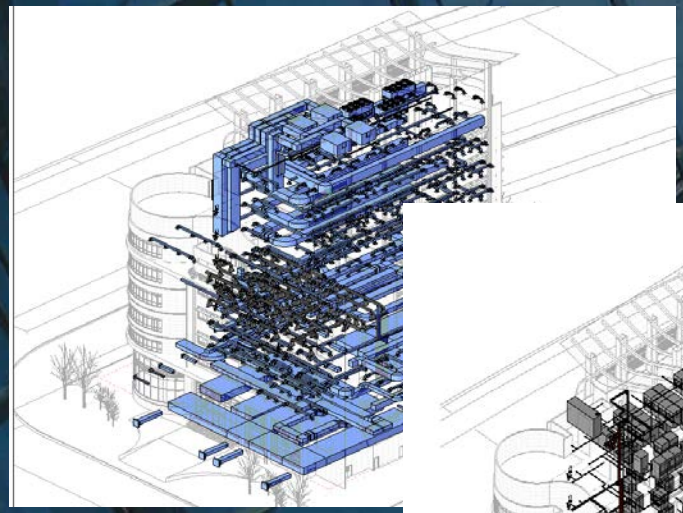
CO-ORDINATION / COLLABORATION

Work Flow – Establish BIM Models



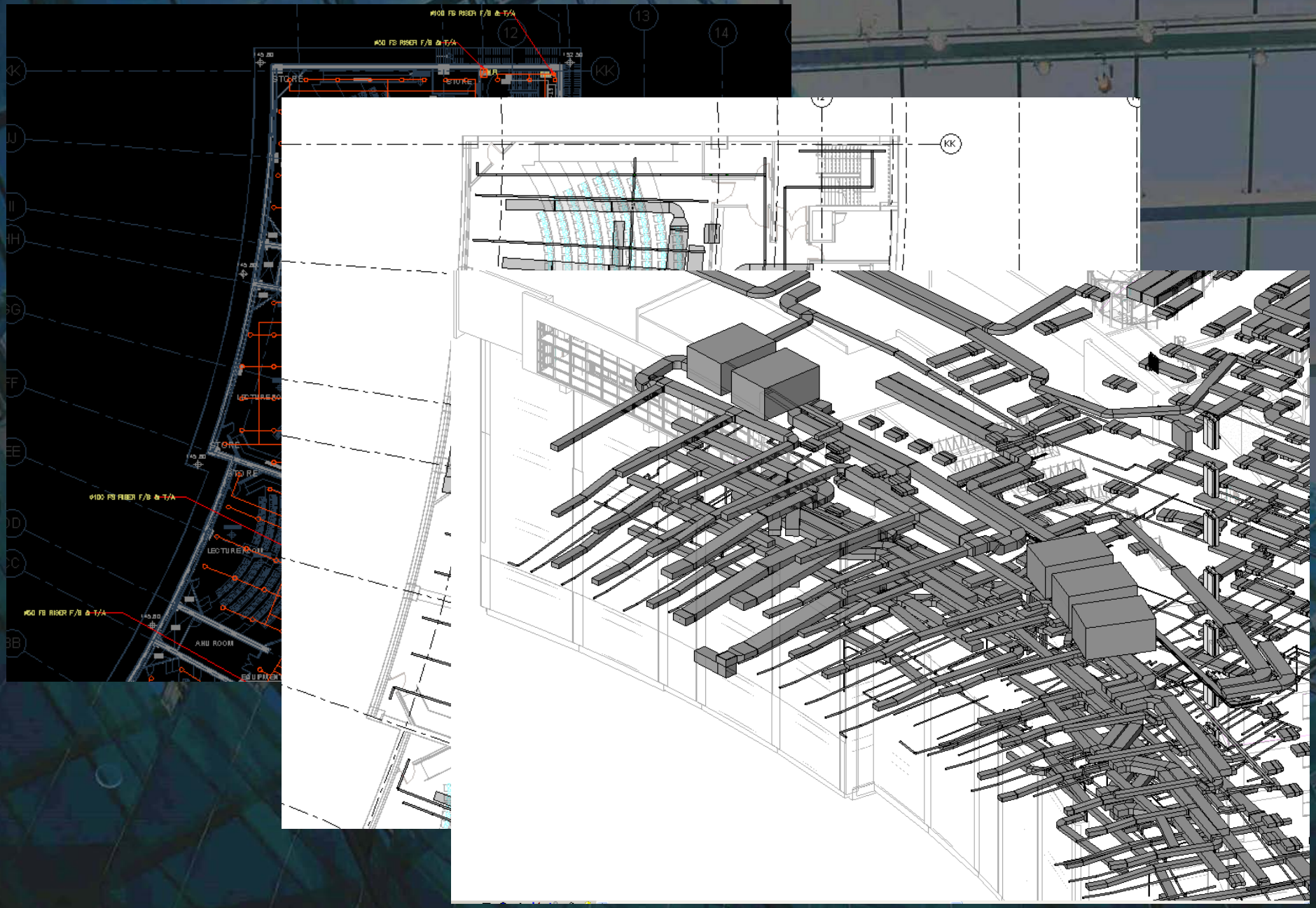


HVAC Installation

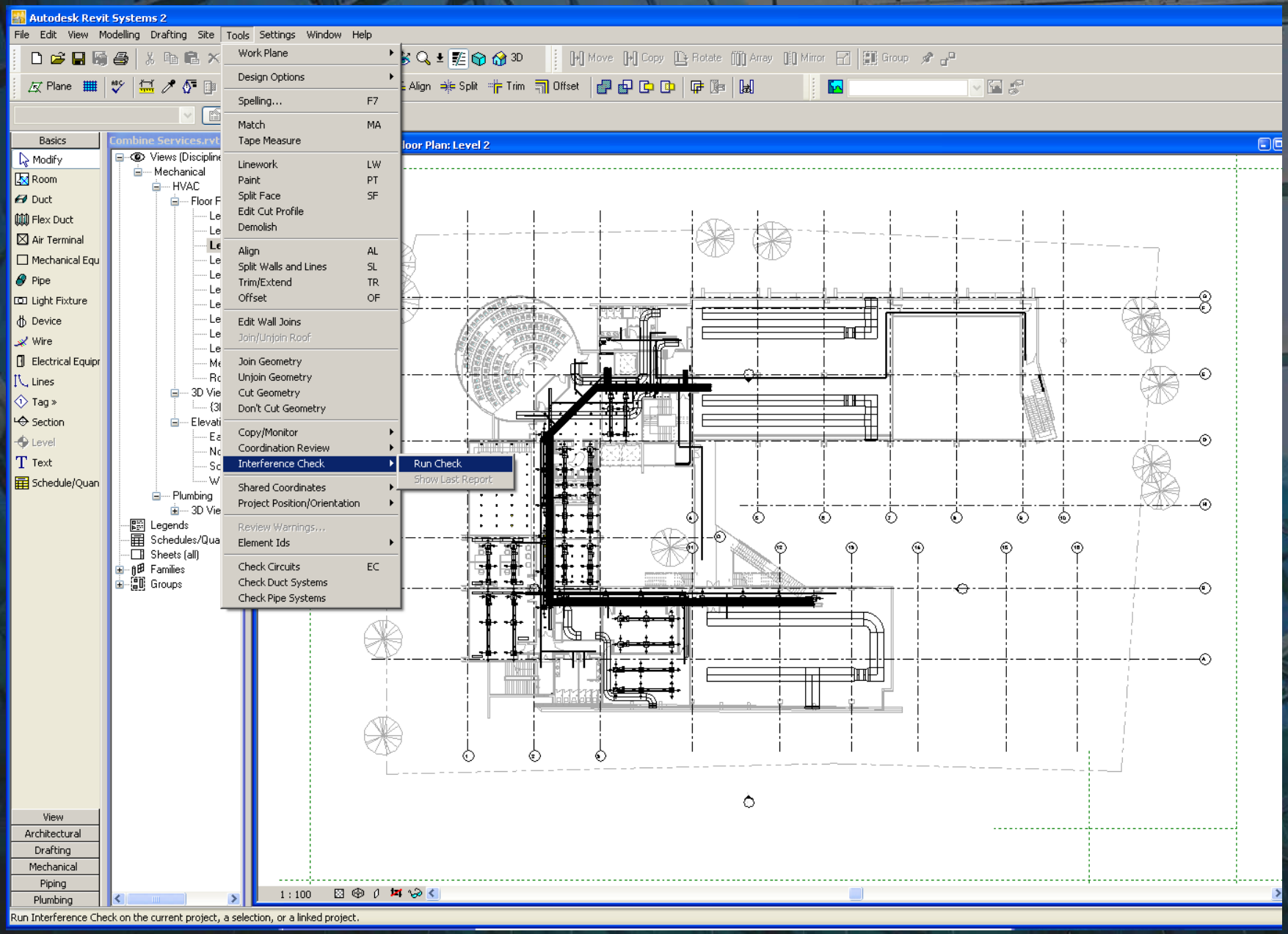


Fire Services Installation

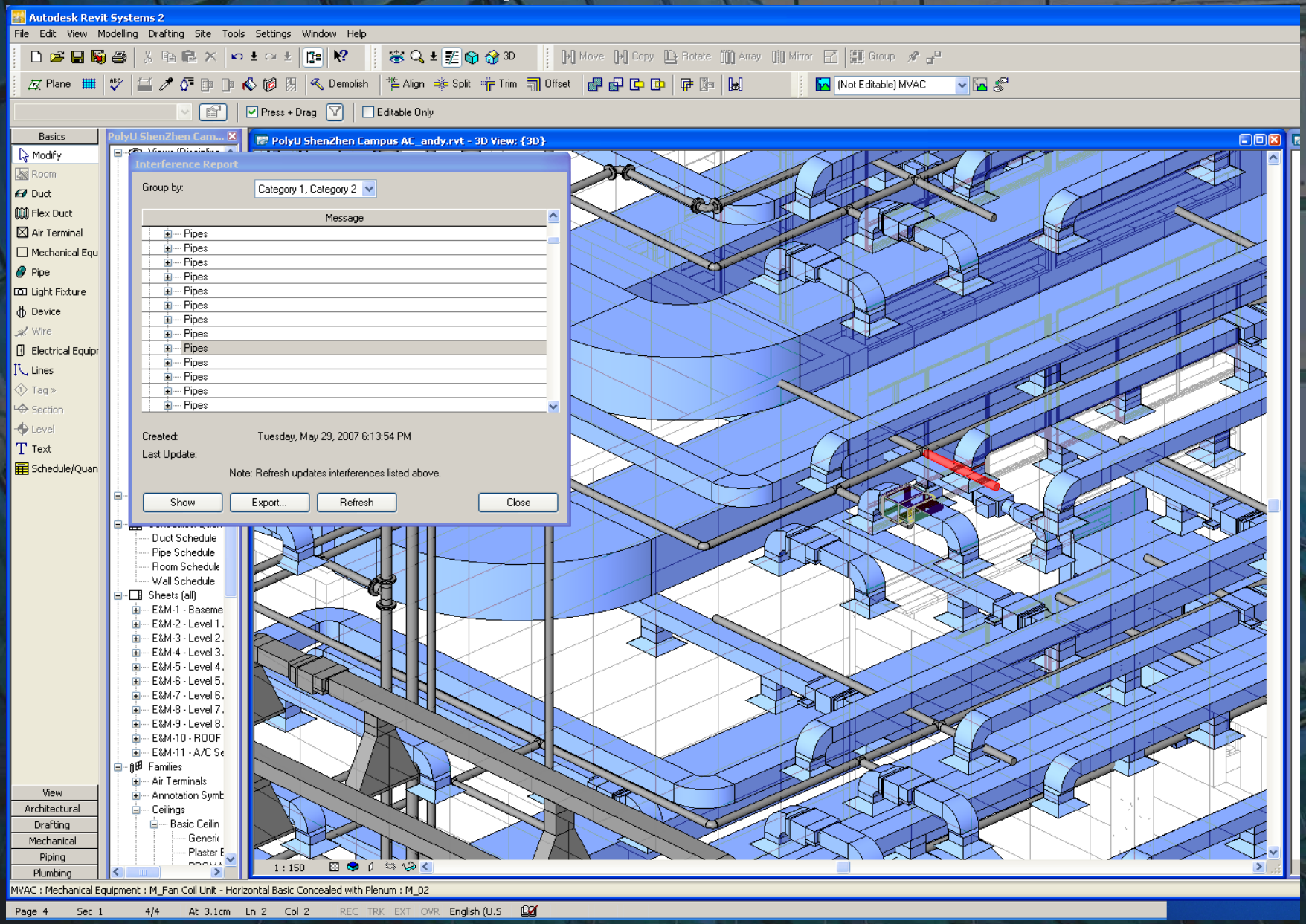
Electricity Installation


STORE
STORE
STORE
LECTURE ROOM
AHU ROOM
KK

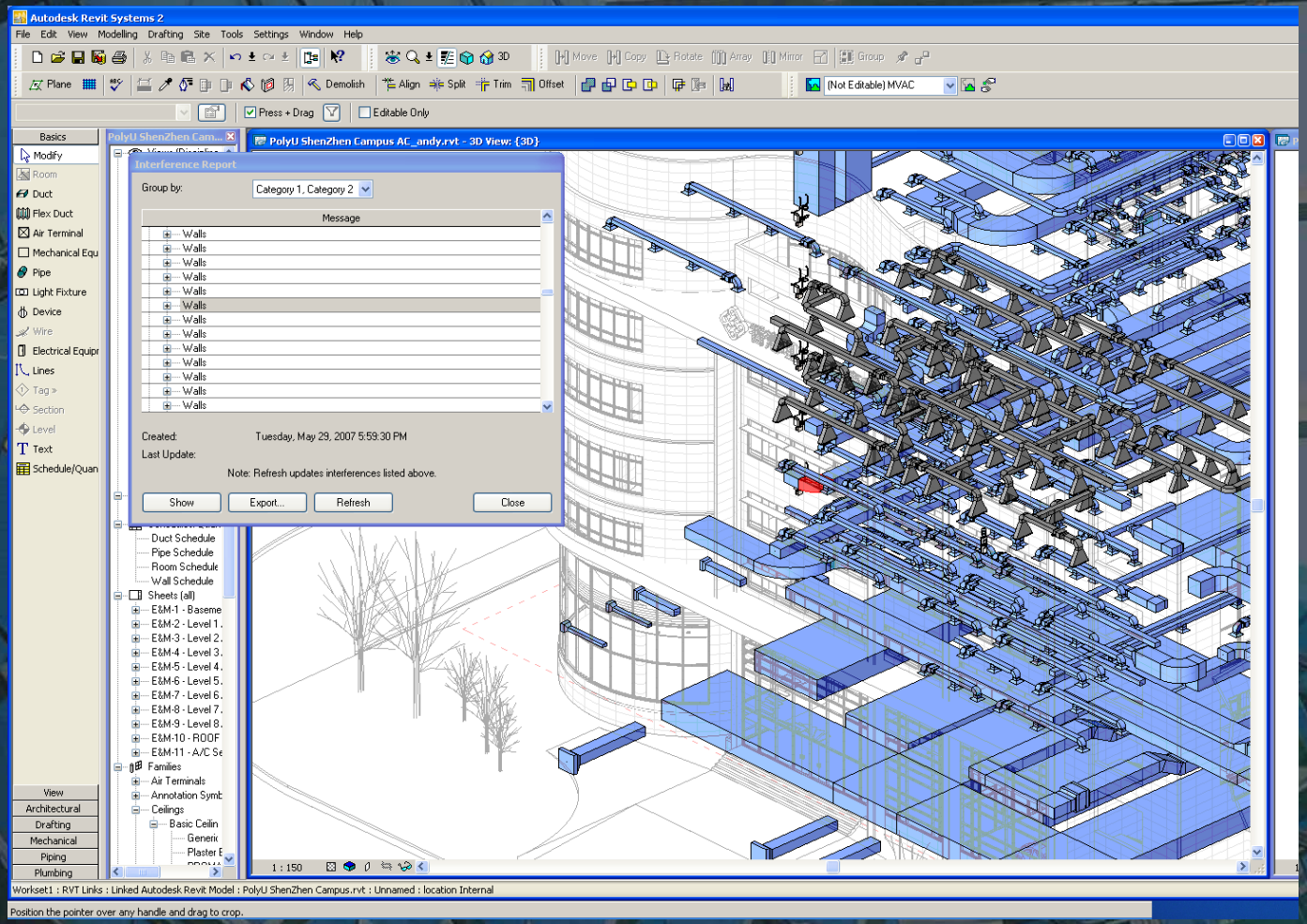
Work Flow – Clashes Report

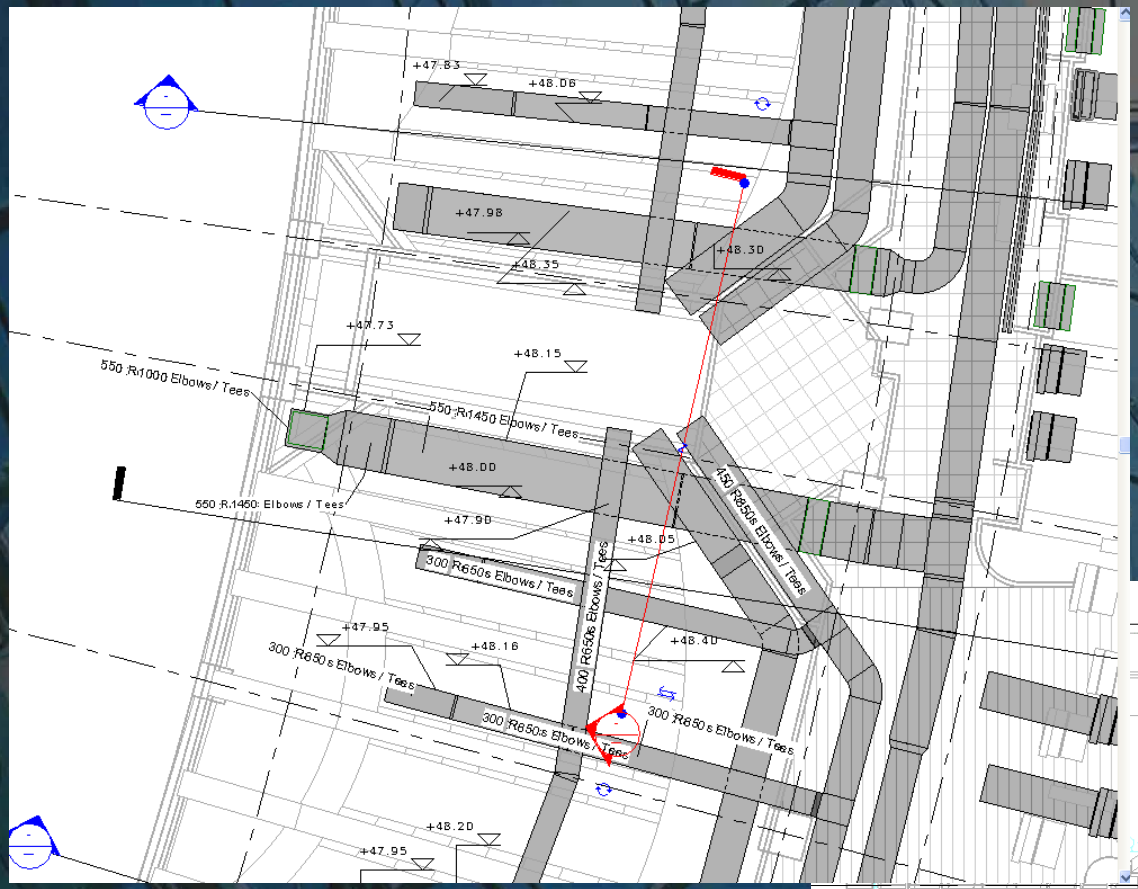


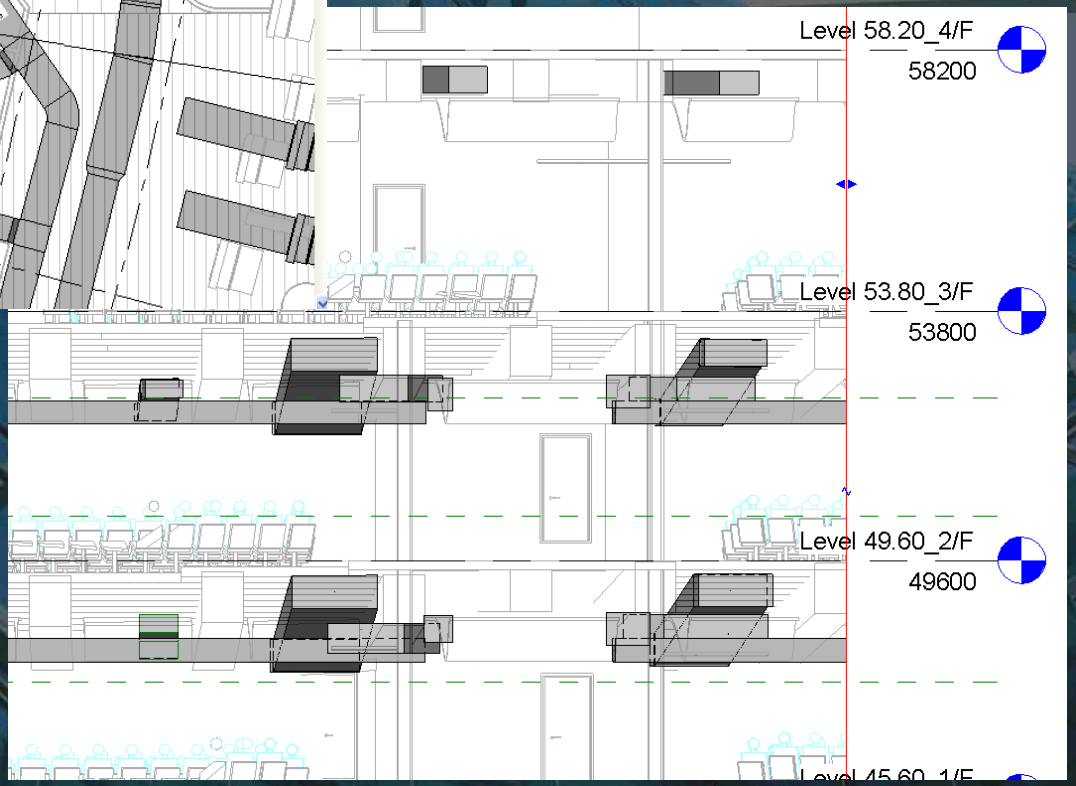
Work Flow – Clashes Report



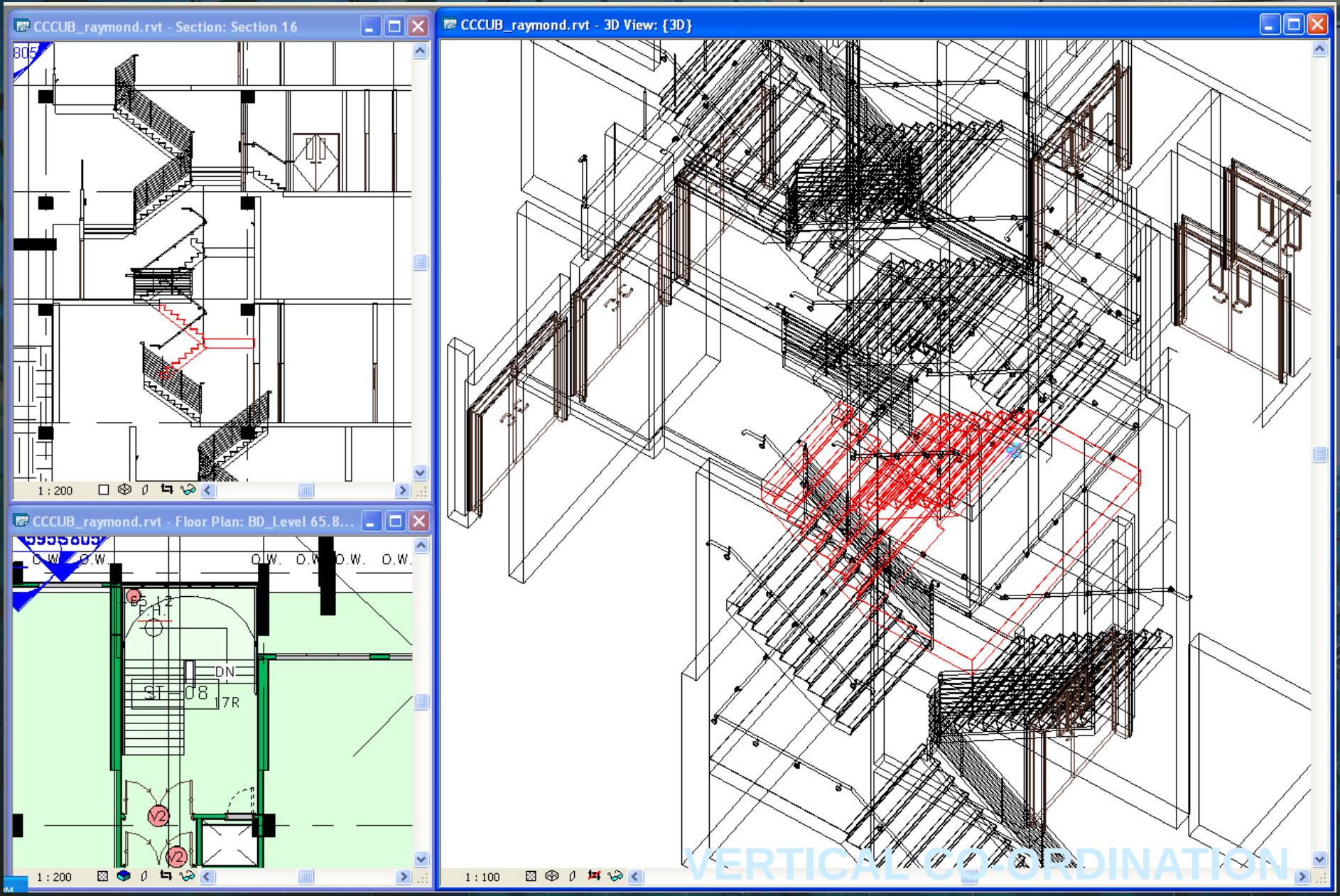
Work Flow – Clashes Report



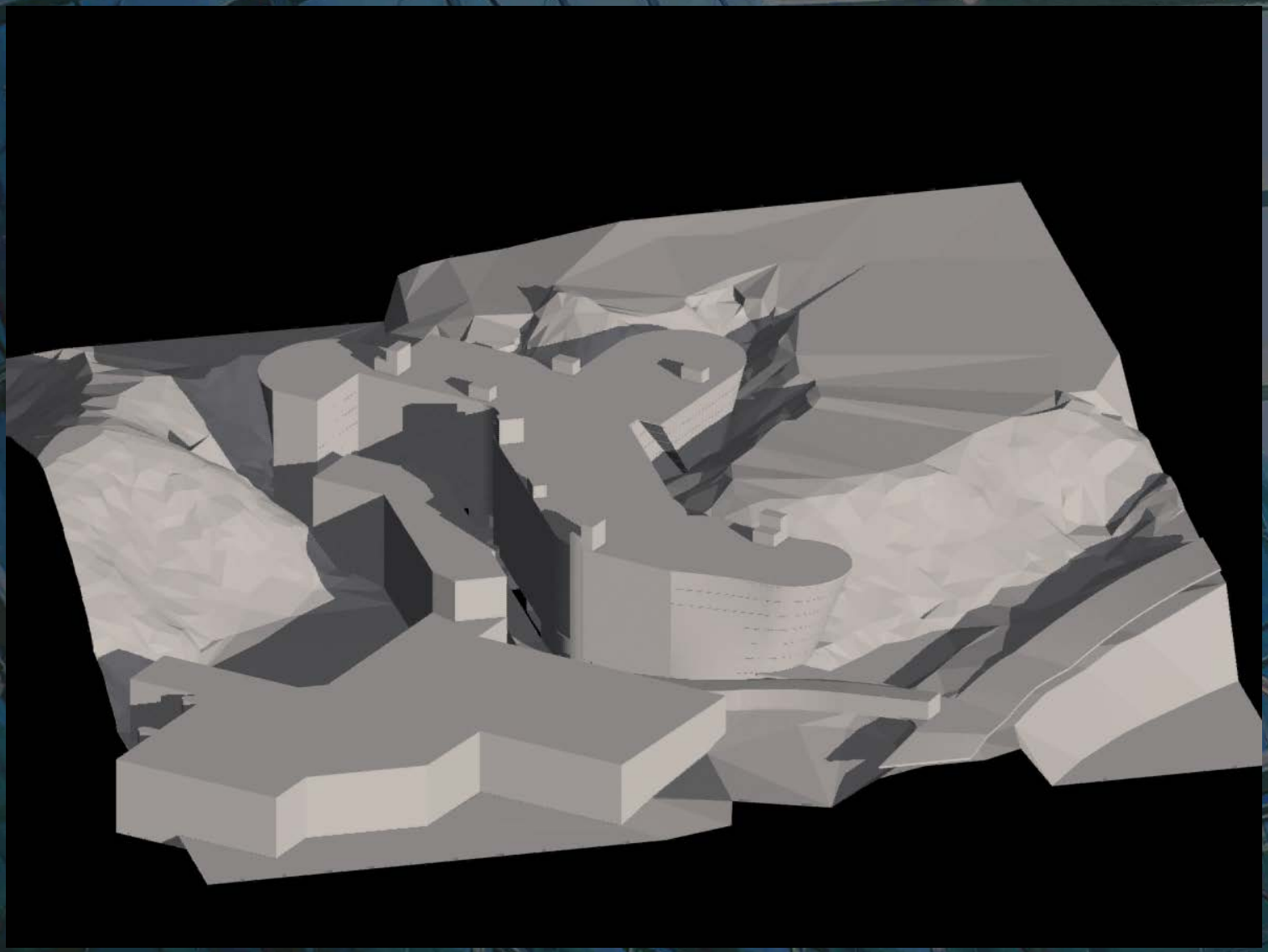

+47.83
+48.06
+47.98
+48.30
+48.35
+47.73
+48.15
550 R1000 Elbows / Tees
550 R1450 Elbows / Tees
+48.00
550 R1450 Elbows / Tees
+47.90
+48.05
300 R650s Elbows / Tees
400 R650s Elbows / Tees
450 R650s Elbows / Tees
+47.95
+48.16
+48.40
300 R650s Elbows / Tees
300 R650s Elbows / Tees
300 R650s Elbows / Tees
+48.20
+47.95


Level 58.20_4/F
58200
Level 53.80_3/F
53800
Level 49.60_2/F
49600

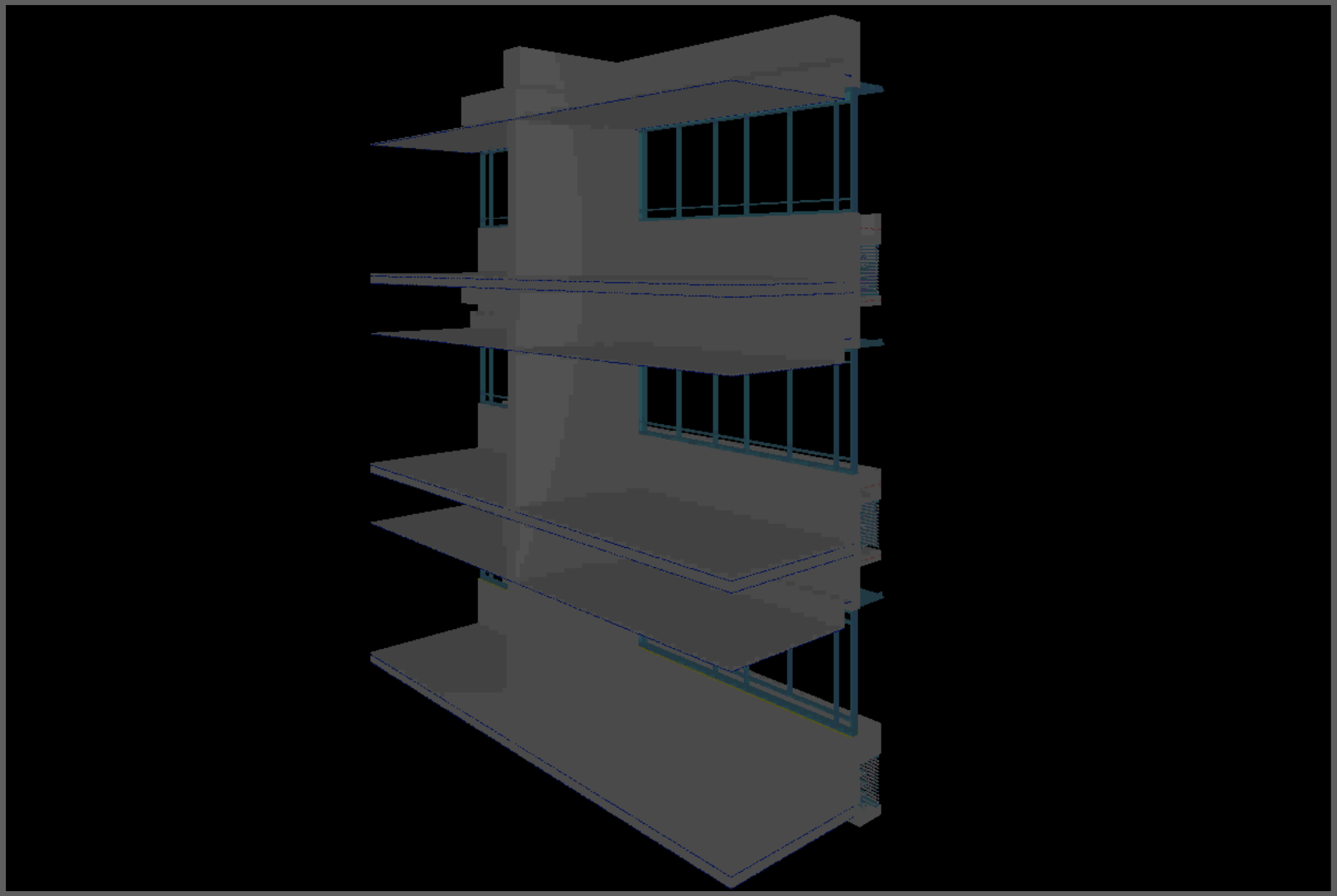
ANALYSIS


CCCUB_raymond.rvt - Section: Section 16
1 : 200
CCCUB_raymond.rvt - Floor Plan: BD_Level 65.8...
O.W.
DN
ST
08
7R
V2
1 : 200
CCCUB_raymond.rvt - 3D View: {3D}
1 : 100
VERTICAL CO-ORDINATION

ANALYSIS



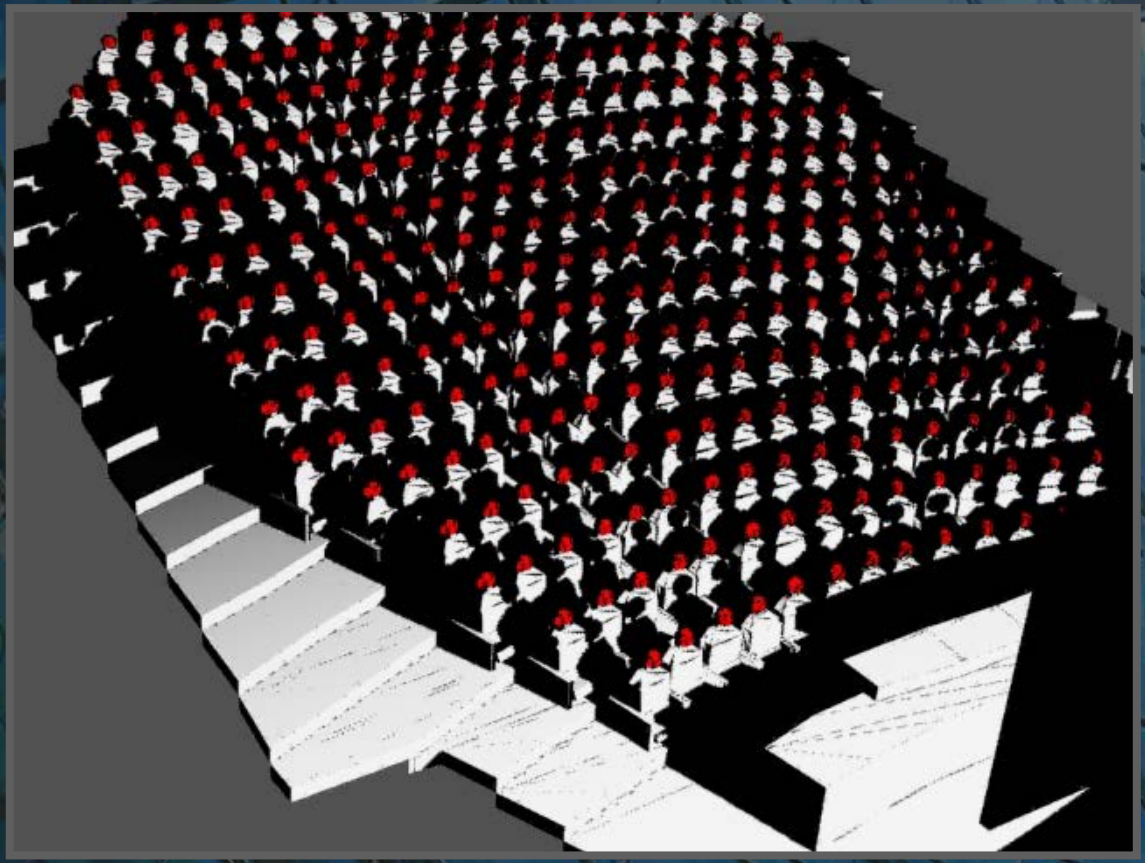
SUN STUDY



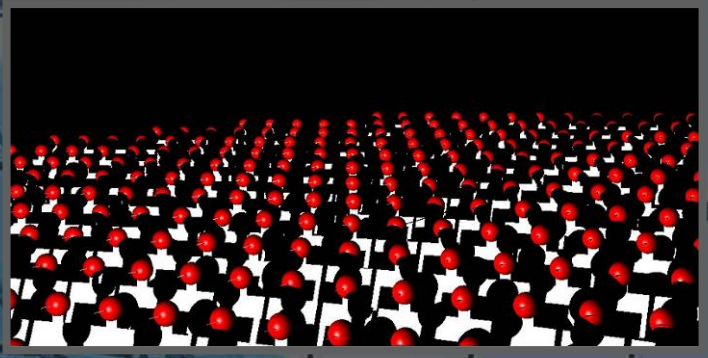
FAÇADE SOLAR STUDY

21/12/2006 7:00am – 6:00pm

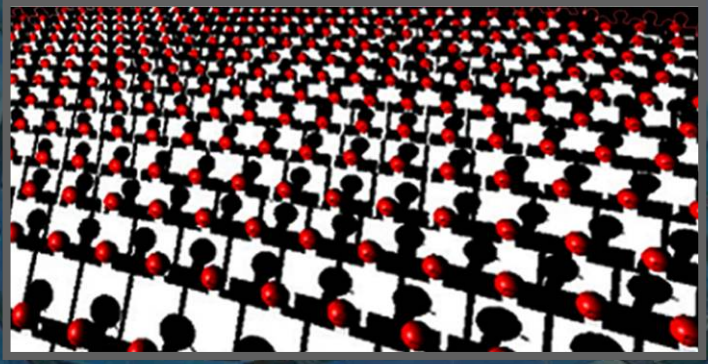
ANALYSIS



Radiating Light Method



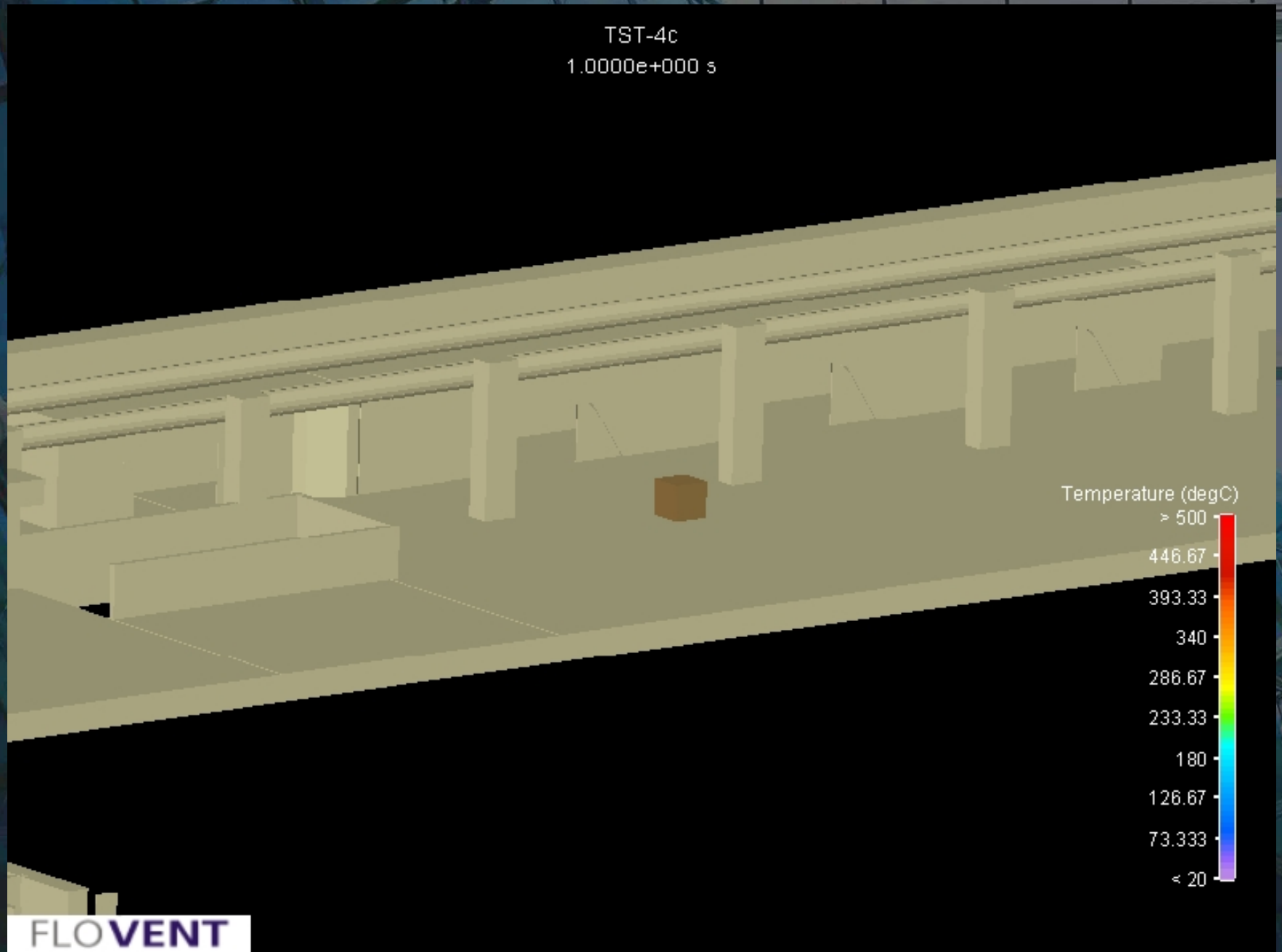
Unsatisfactory sightlines



Satisfactory sightlines

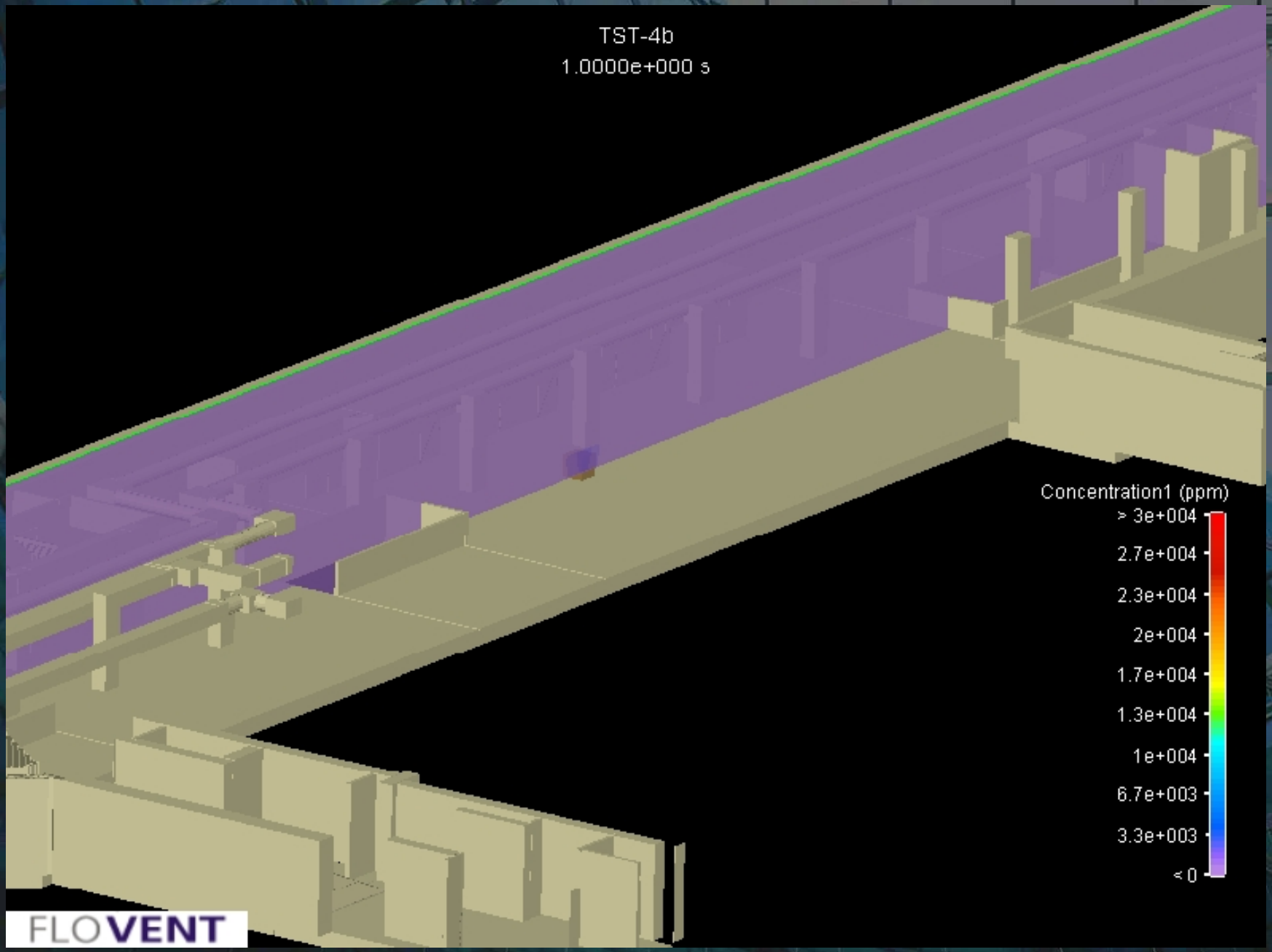
SIGHTLINE STUDIES

ANALYSIS

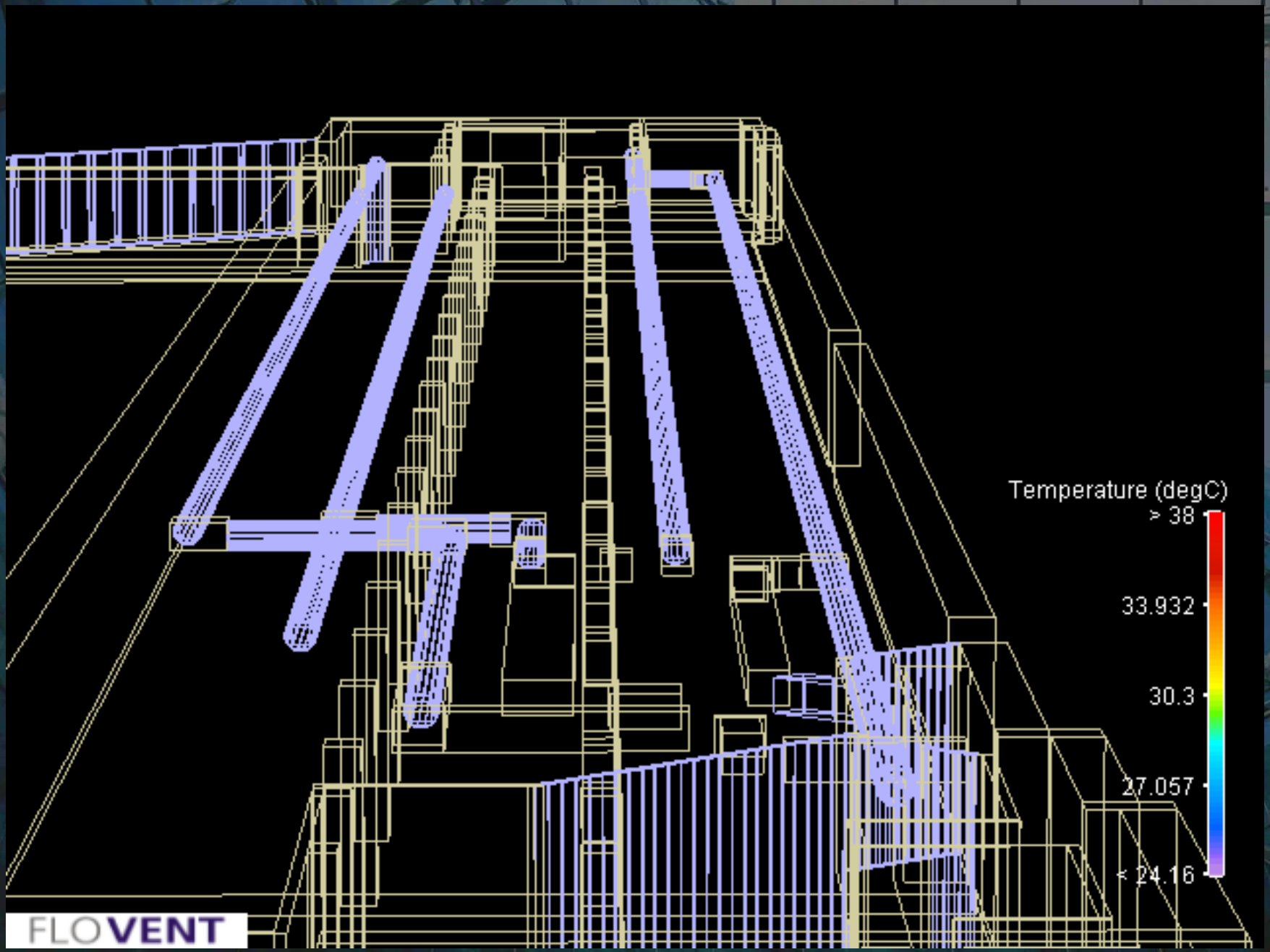


FLOVENT

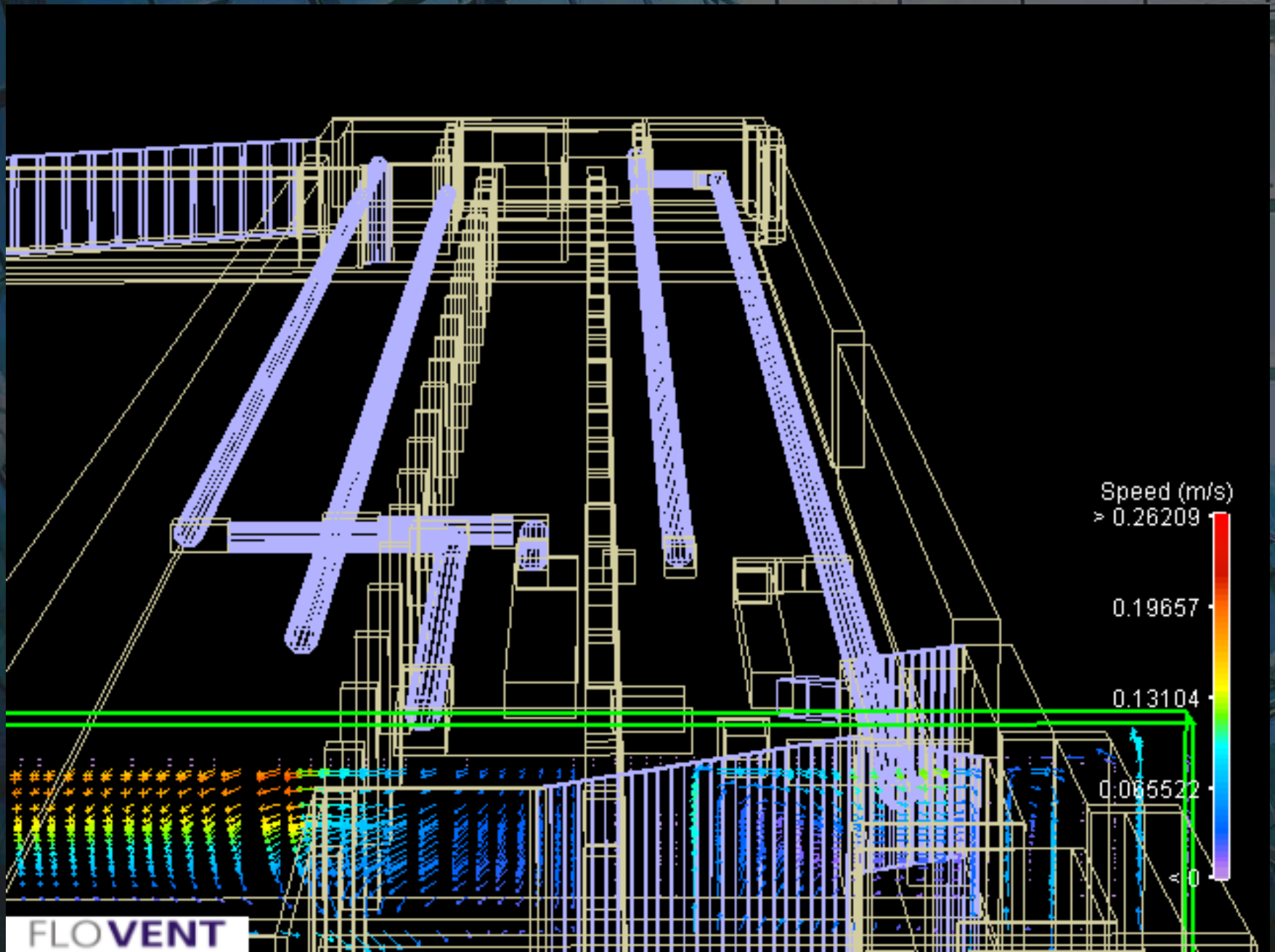
ANALYSIS


TST-4b
1.0000e+000 s
Concentration1 (ppm)
> 3e+004
2.7e+004
2.3e+004
2e+004
1.7e+004
1.3e+004
1e+004
6.7e+003
3.3e+003
< 0
FLOVENT

ANALYSIS

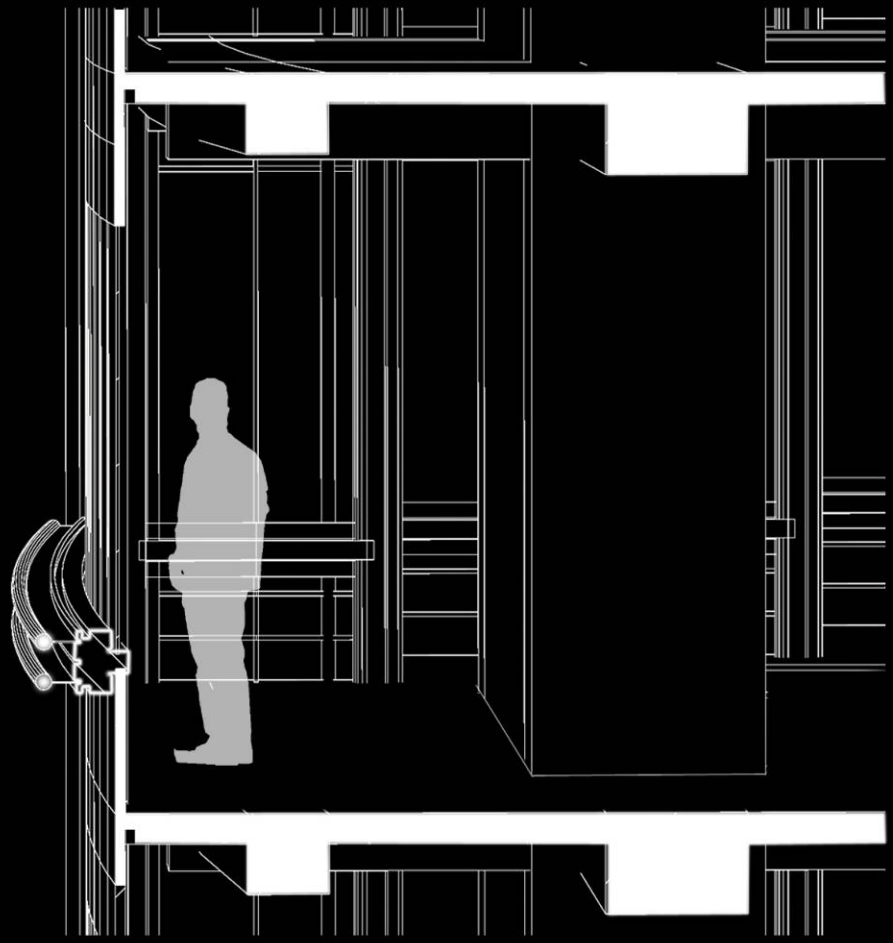


ANALYSIS



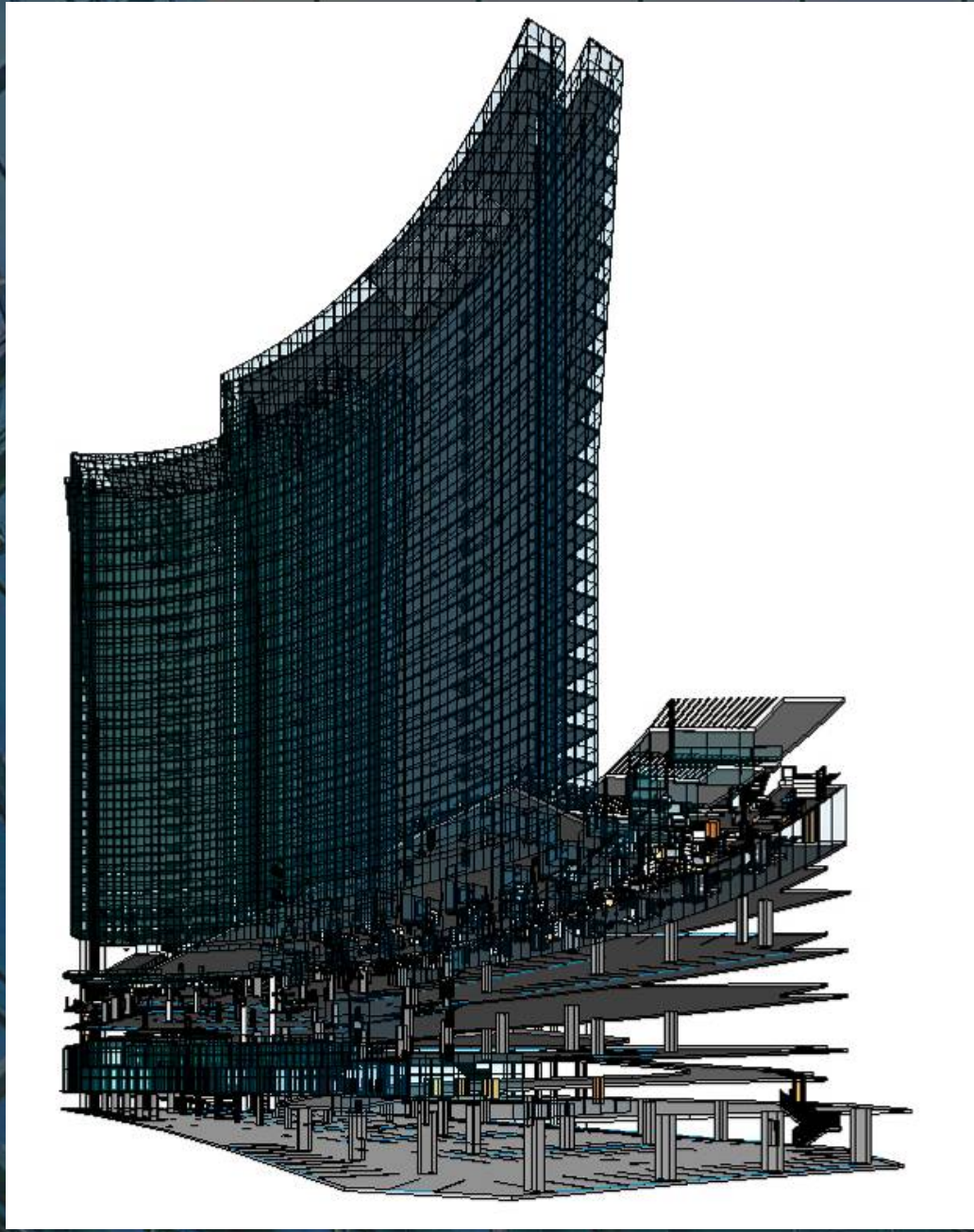
廣州辦公室項目

FAÇADE DESIGN and CO-ORDINATION



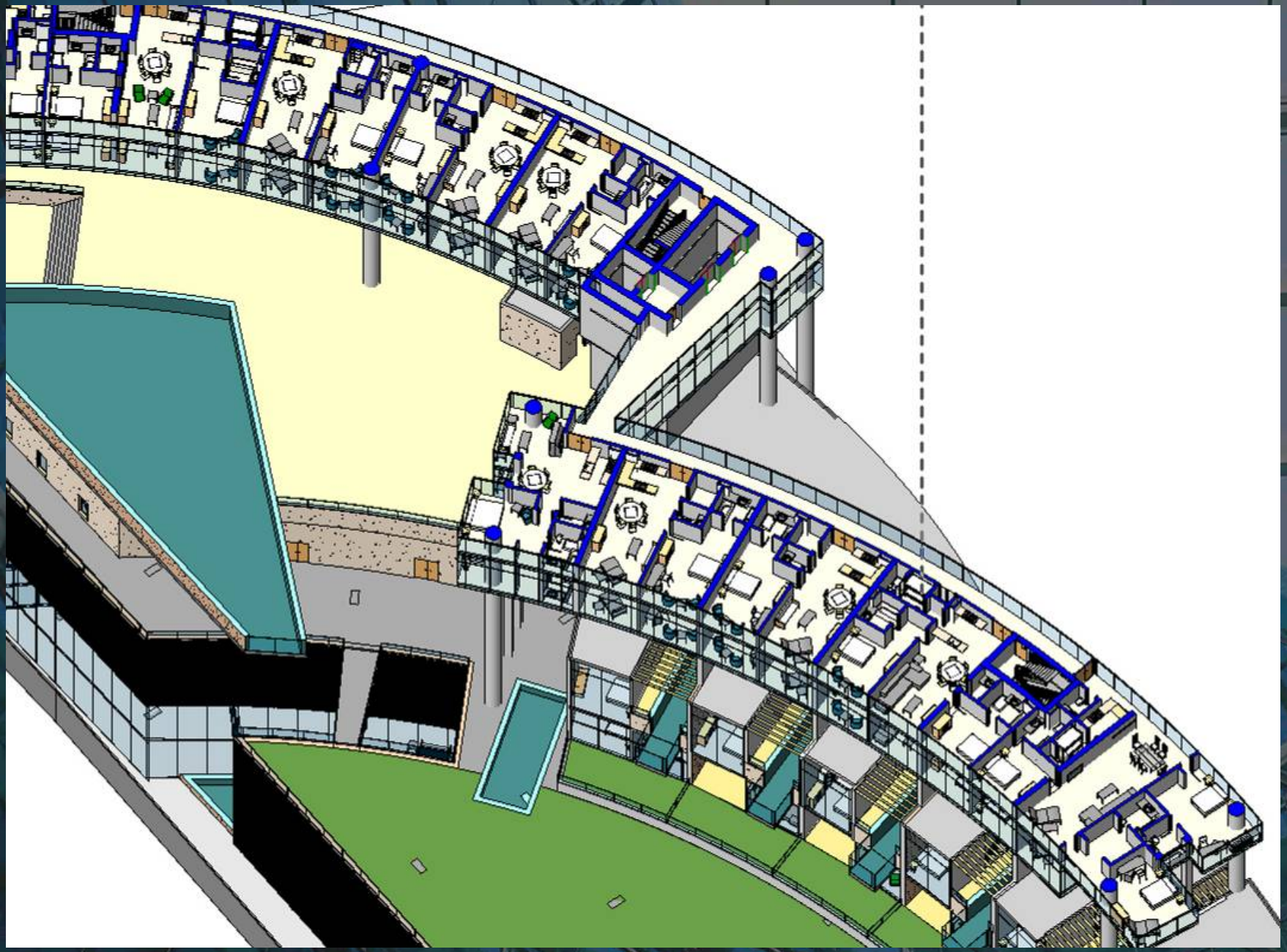
廣州辦公室項目

FAÇADE DESIGN and CO-ORDINATION



中東酒店項目

HORIZONTAL REPETITION / MODULARIZATION

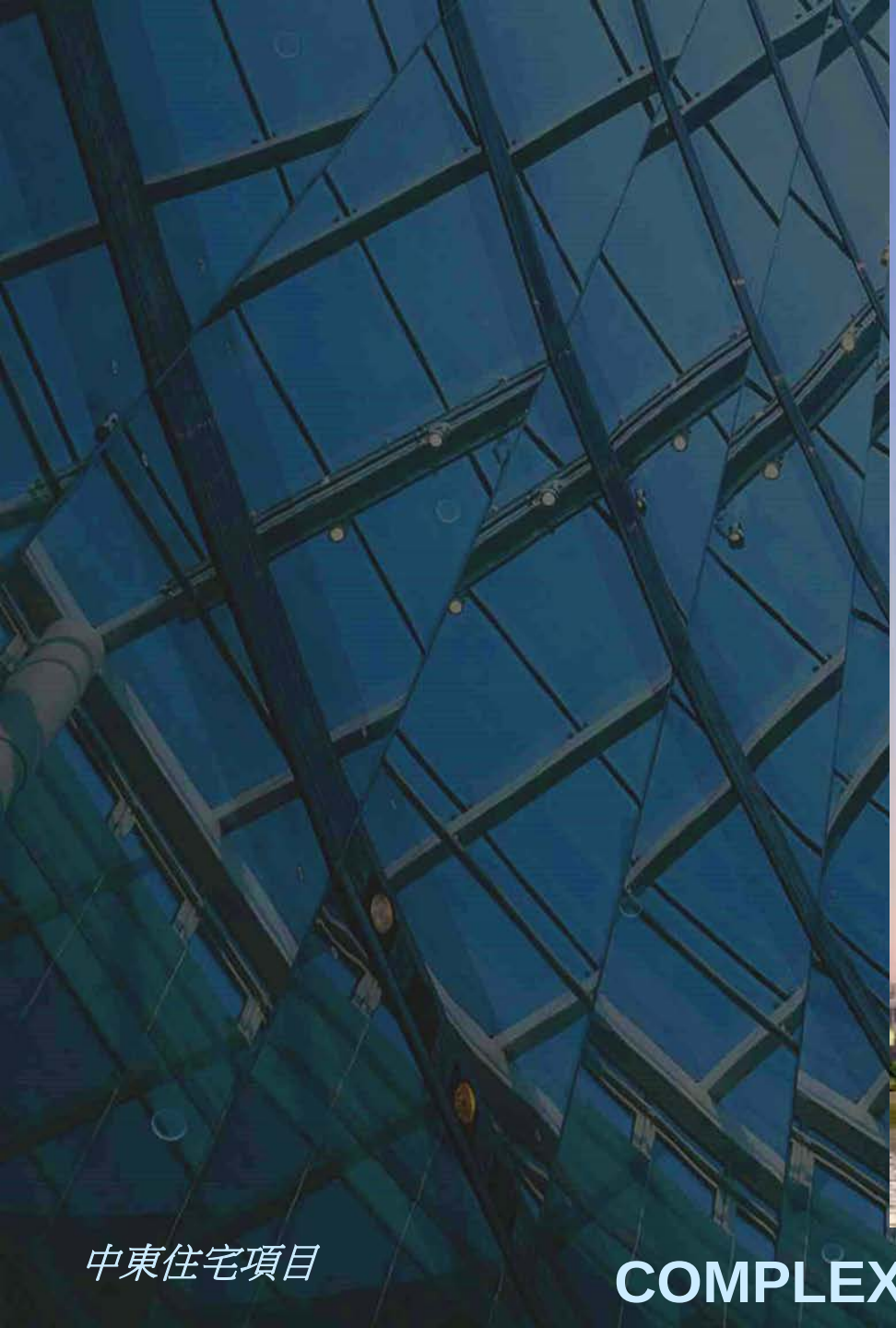


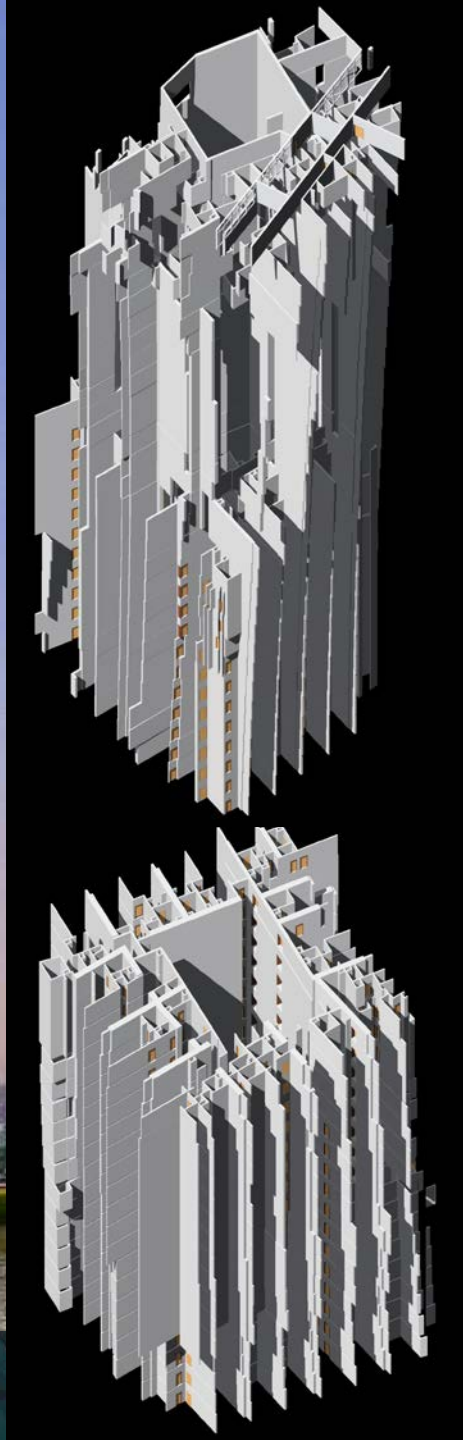
中東酒店項目

MODULAR DESIGN

Program **Residential** Site Area **3,746 sqm**
Floor Area 858,855 sqm Building Height **304 m**

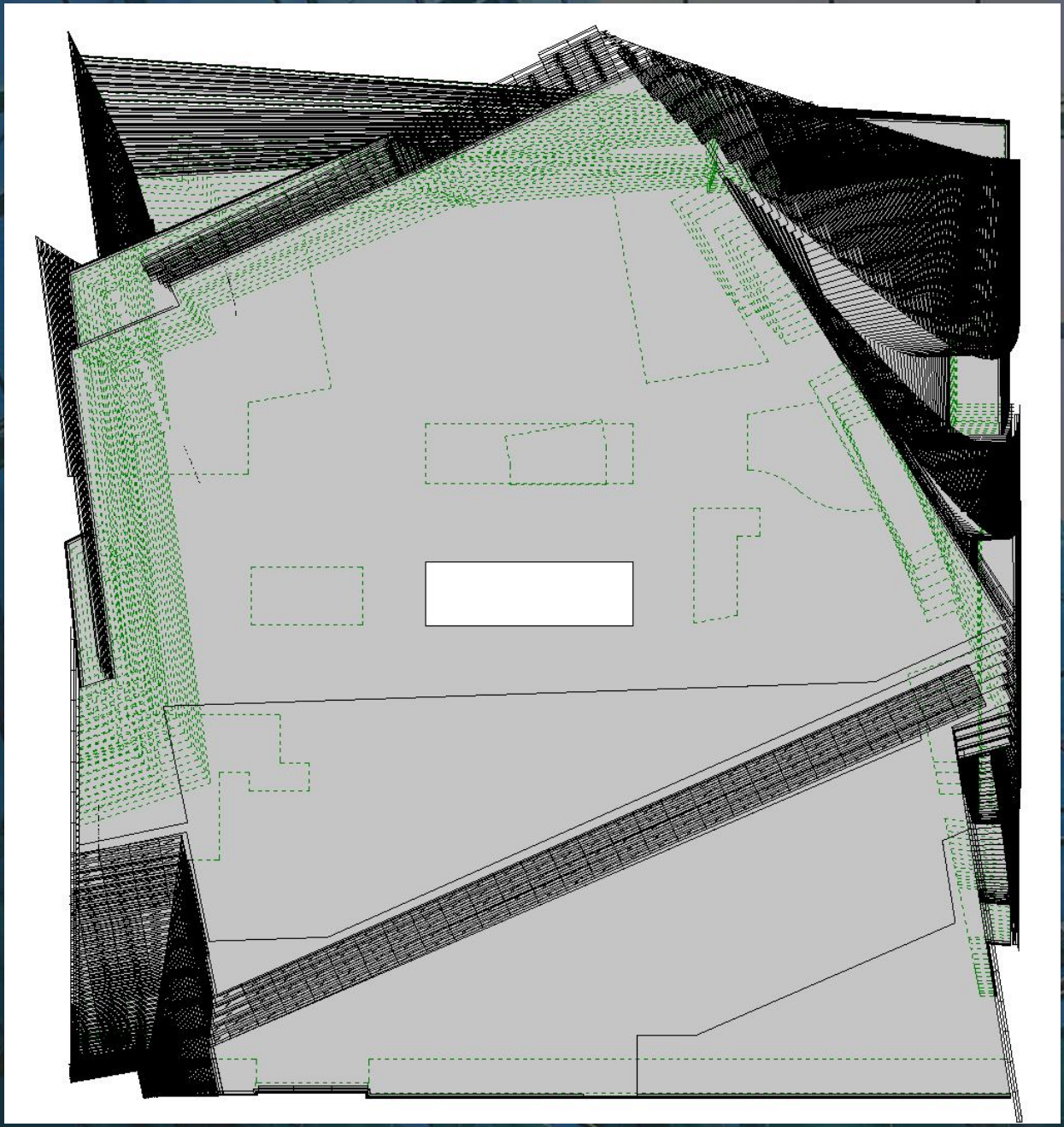
Dubai **Ocean Heights One**

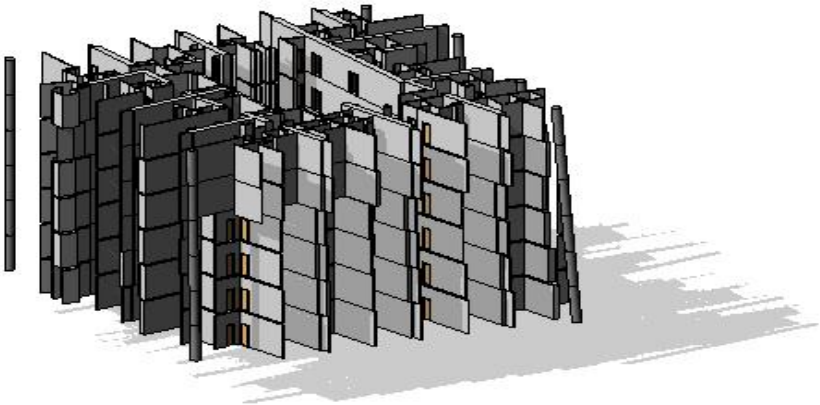


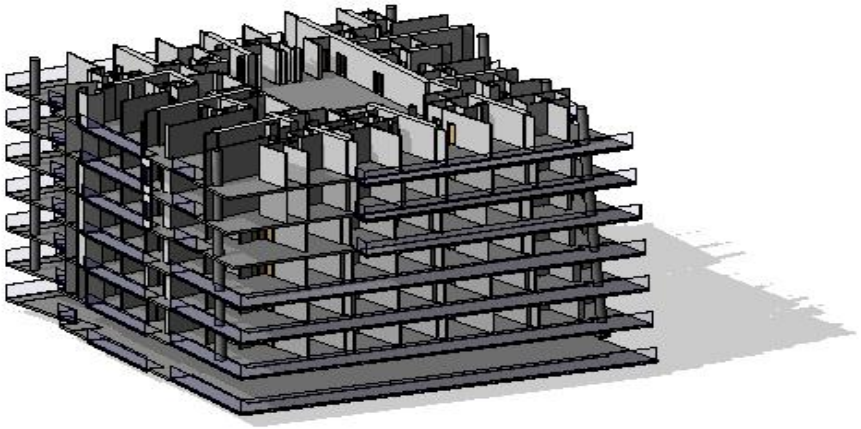


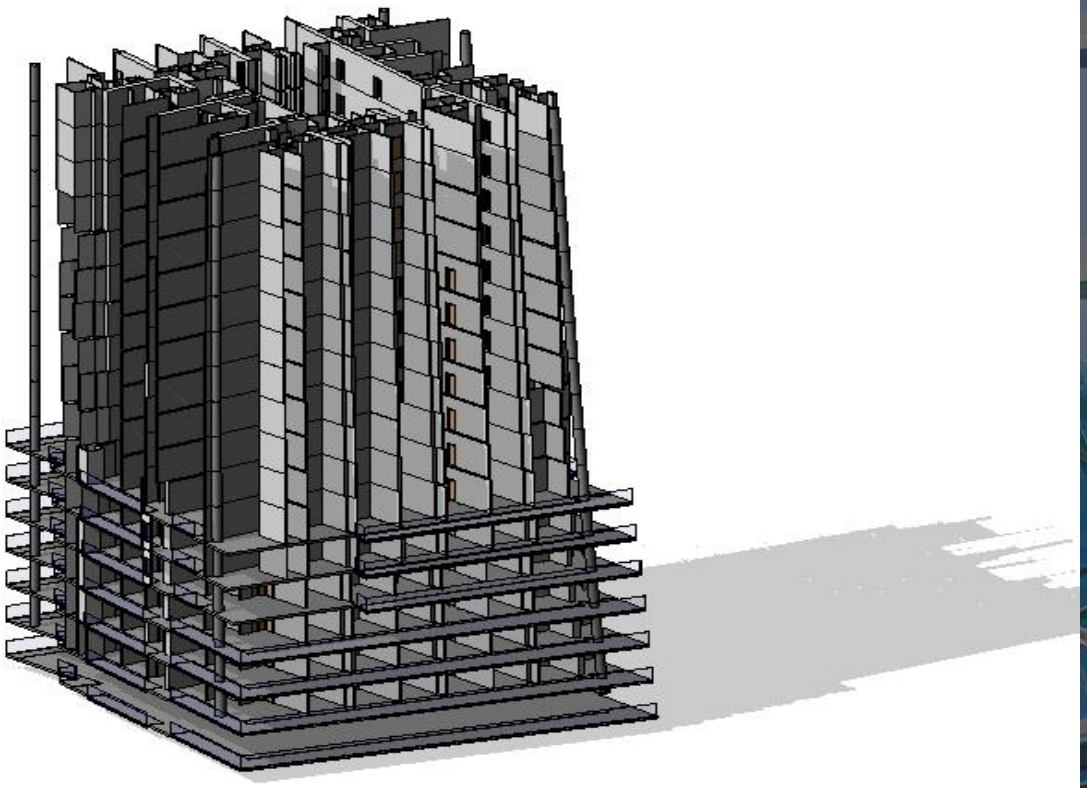
中東住宅項目

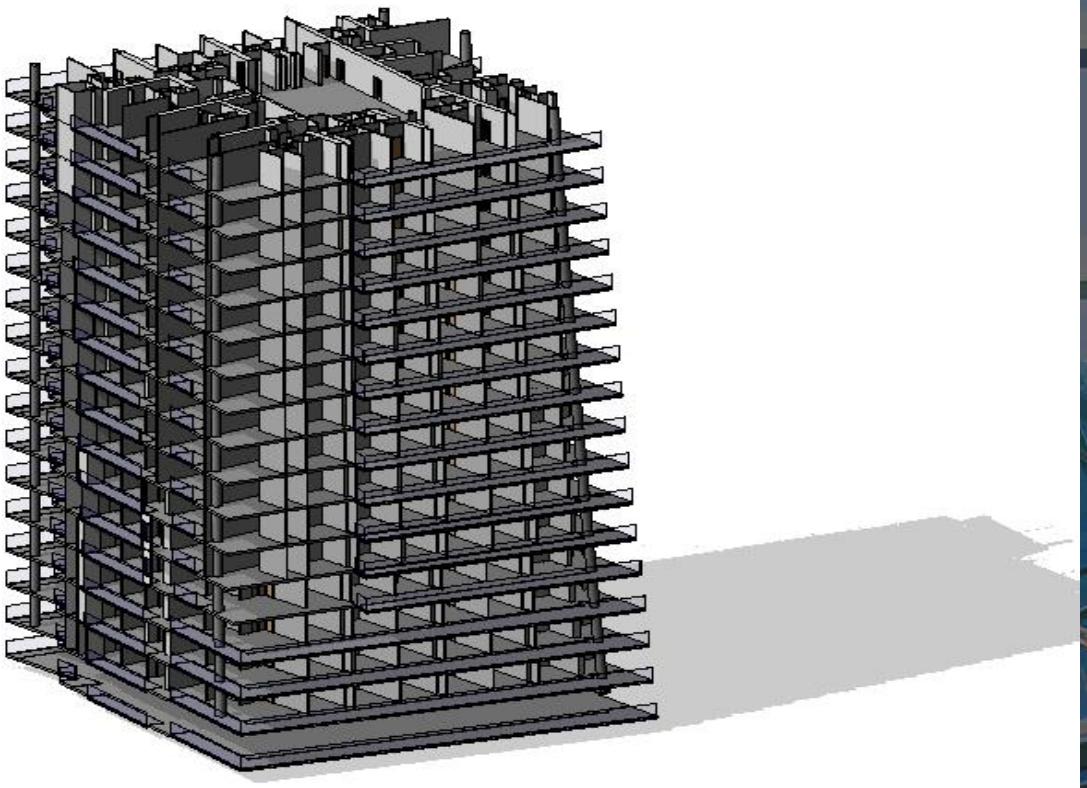
COMPLEX GEOMETRY

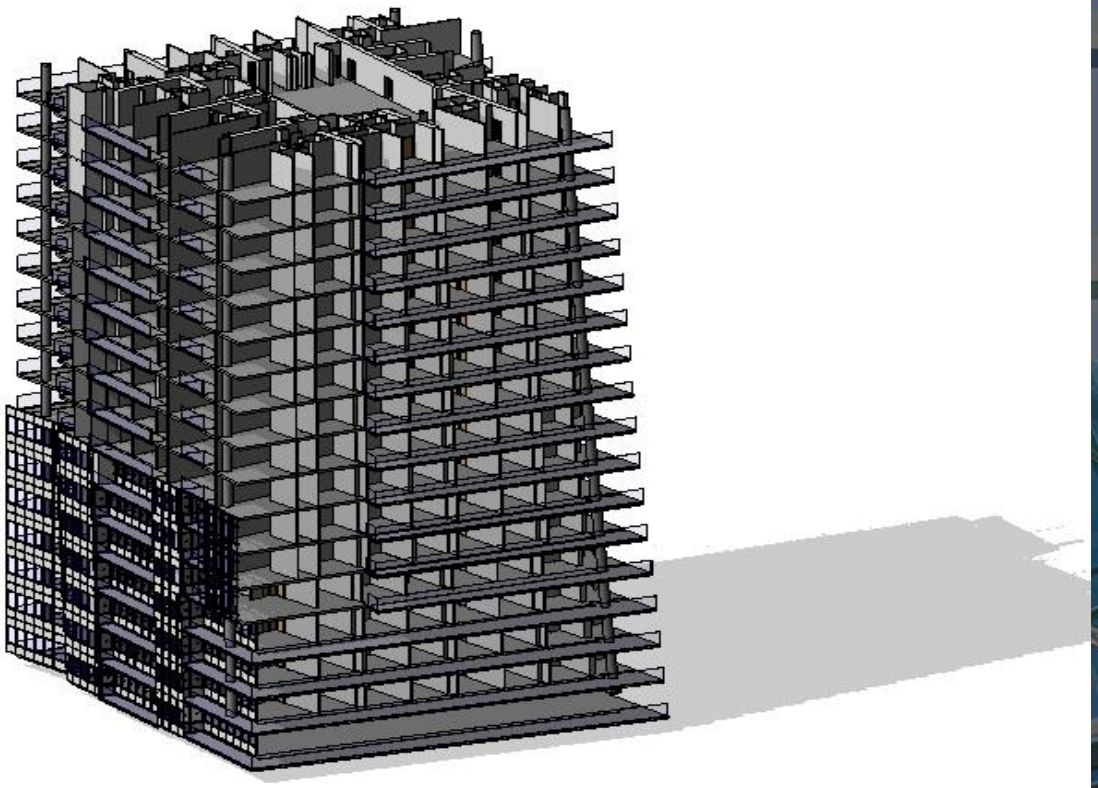


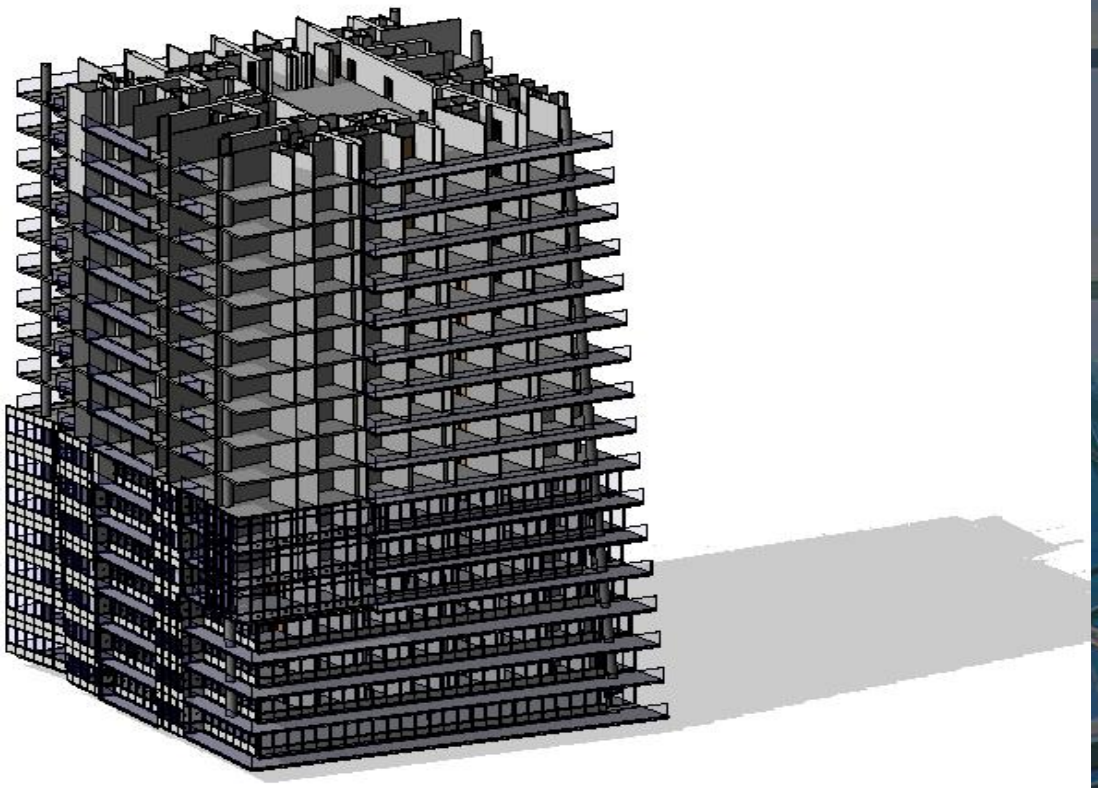


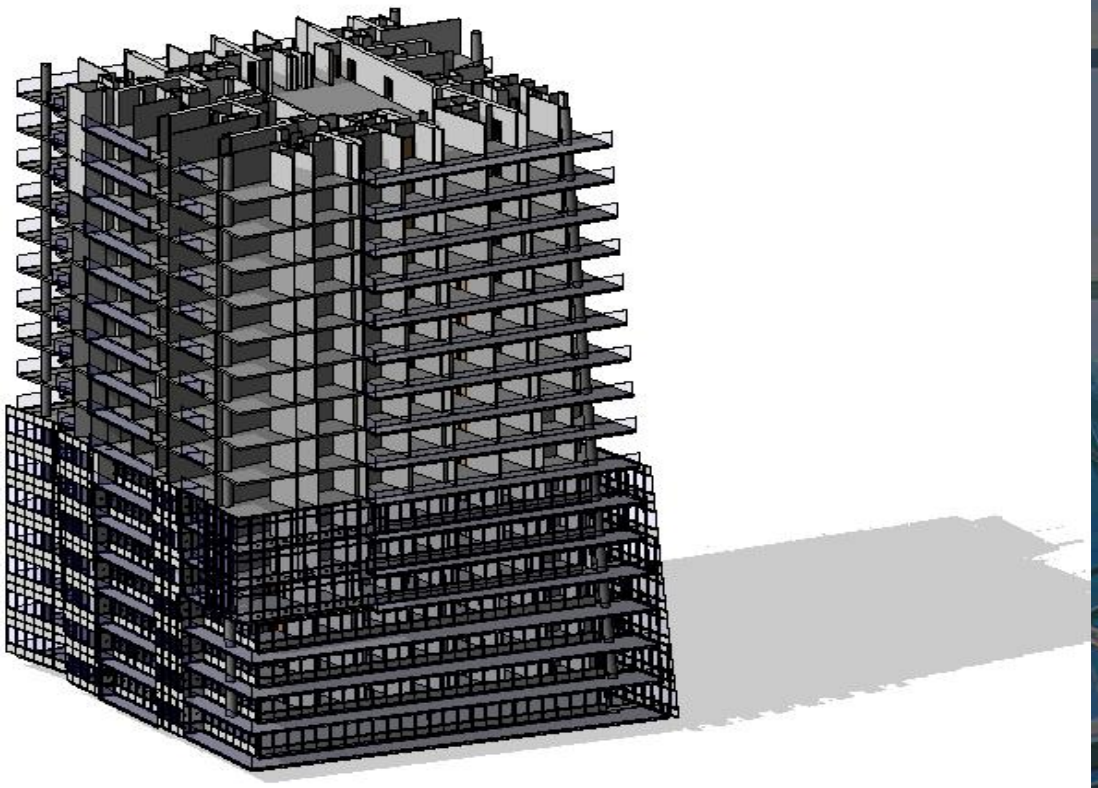


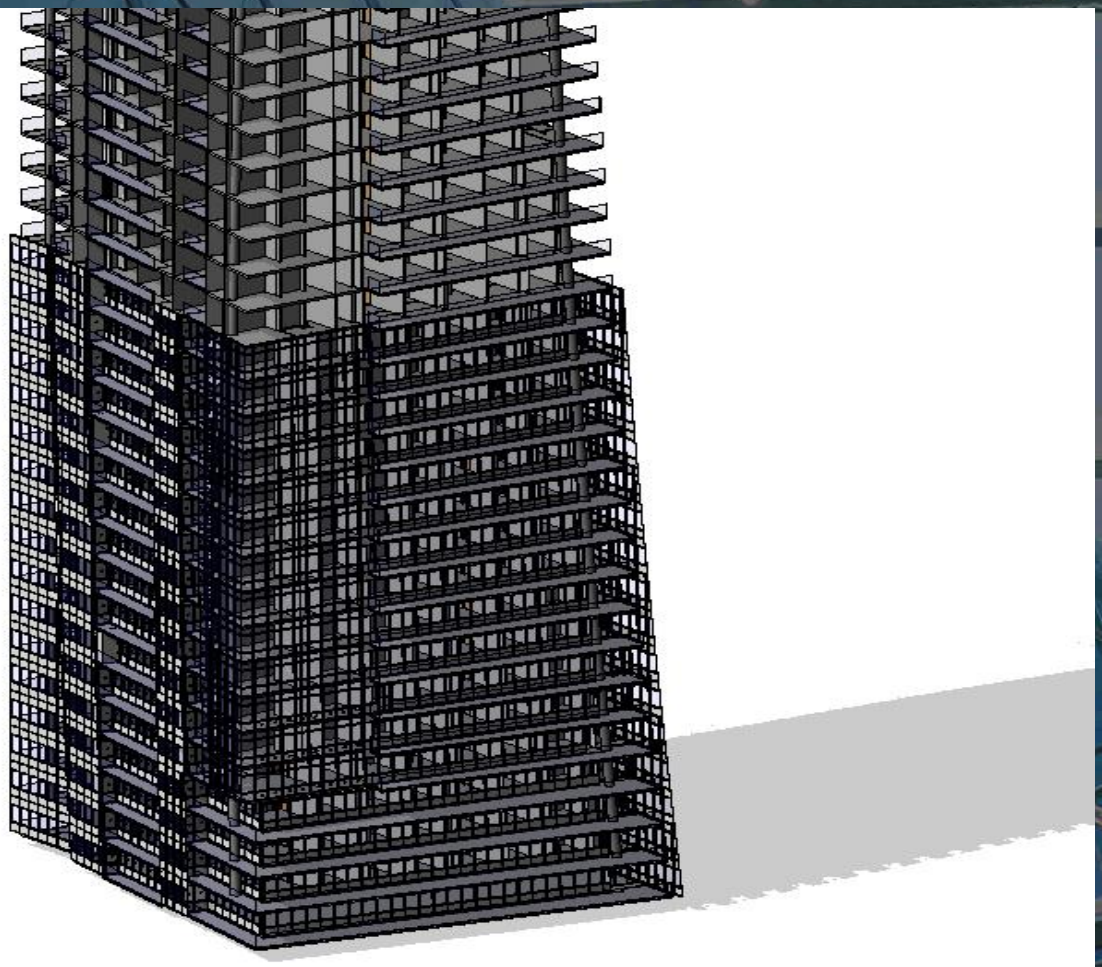


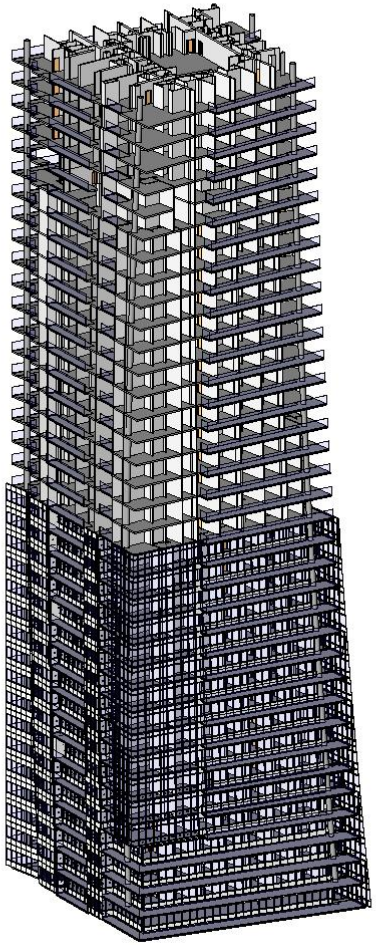


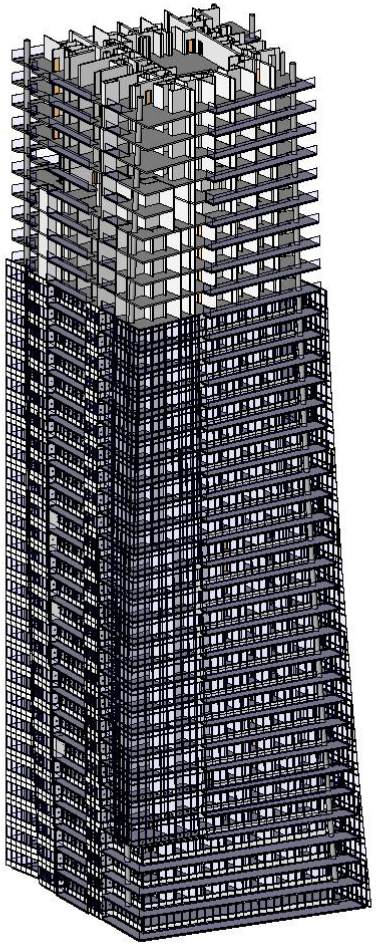


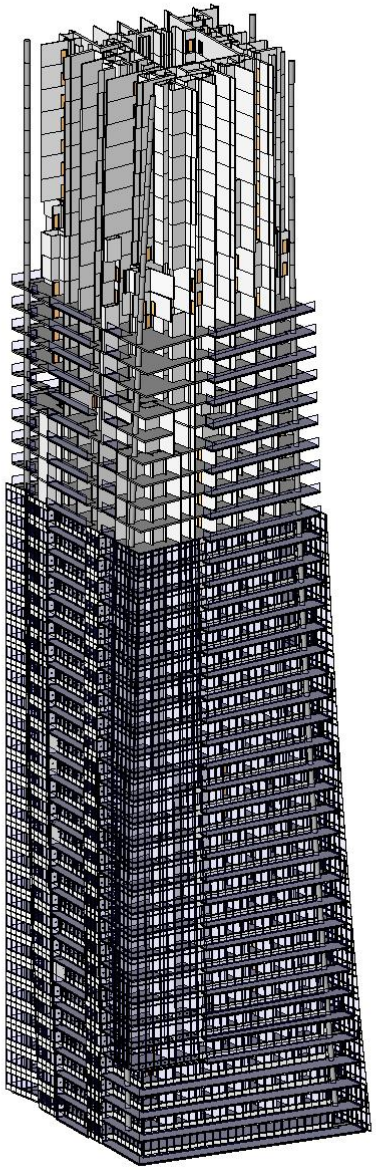


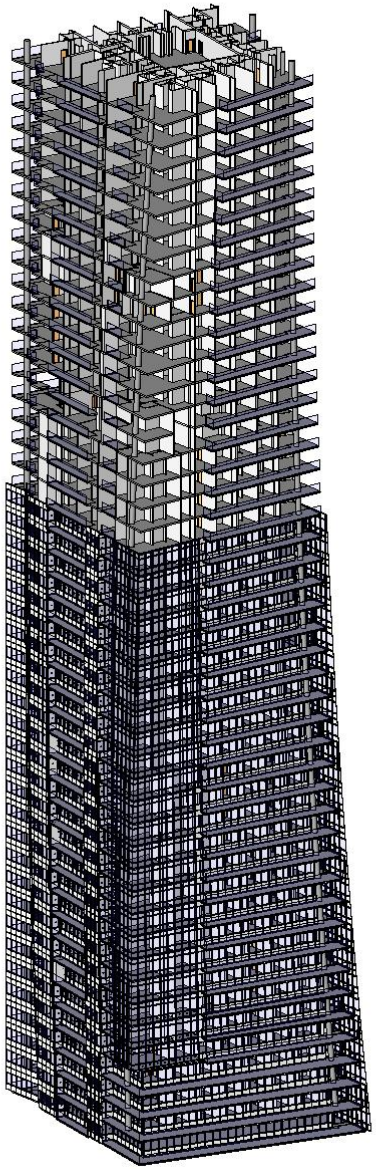


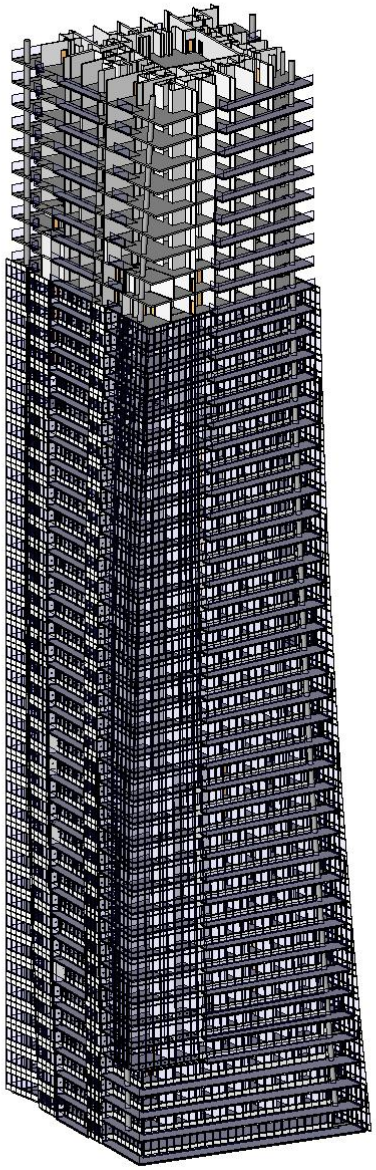


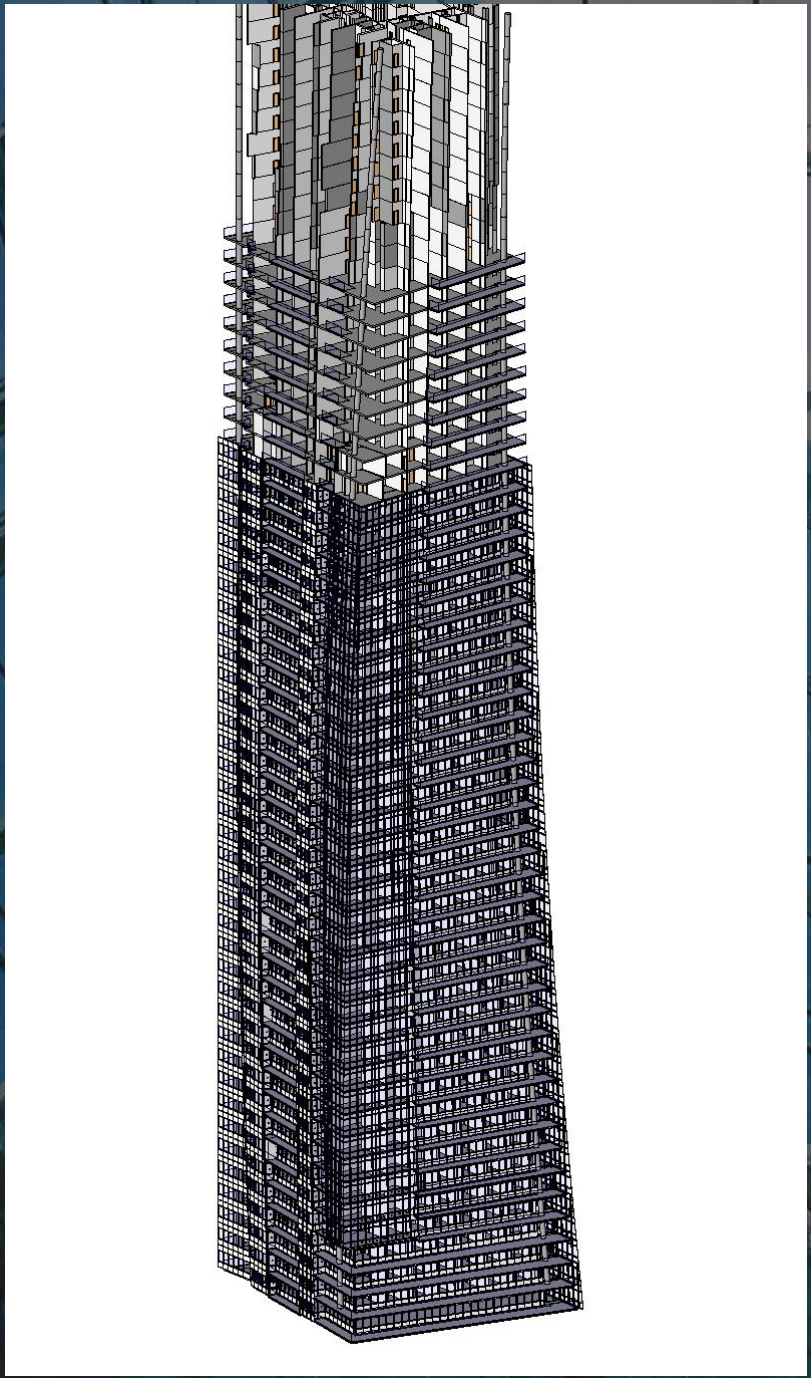


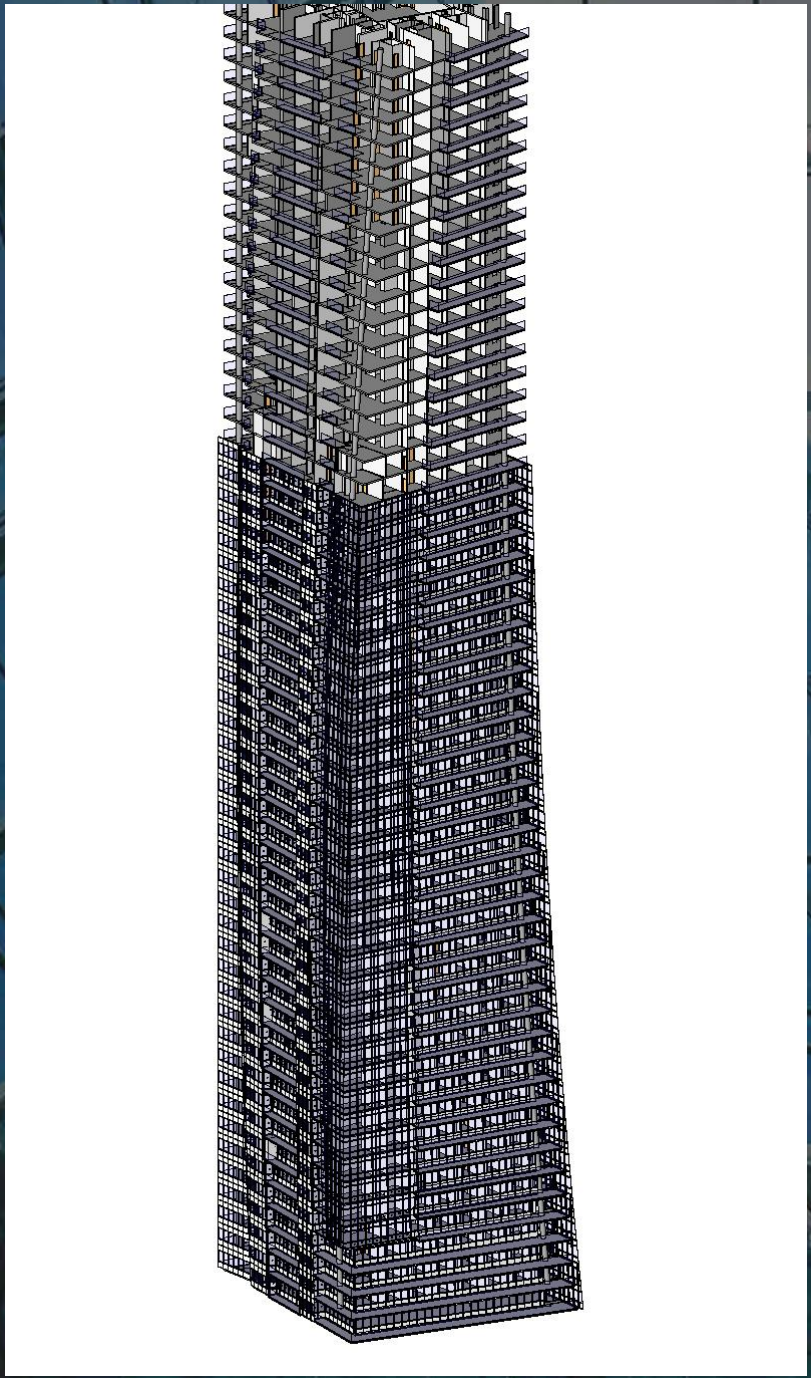


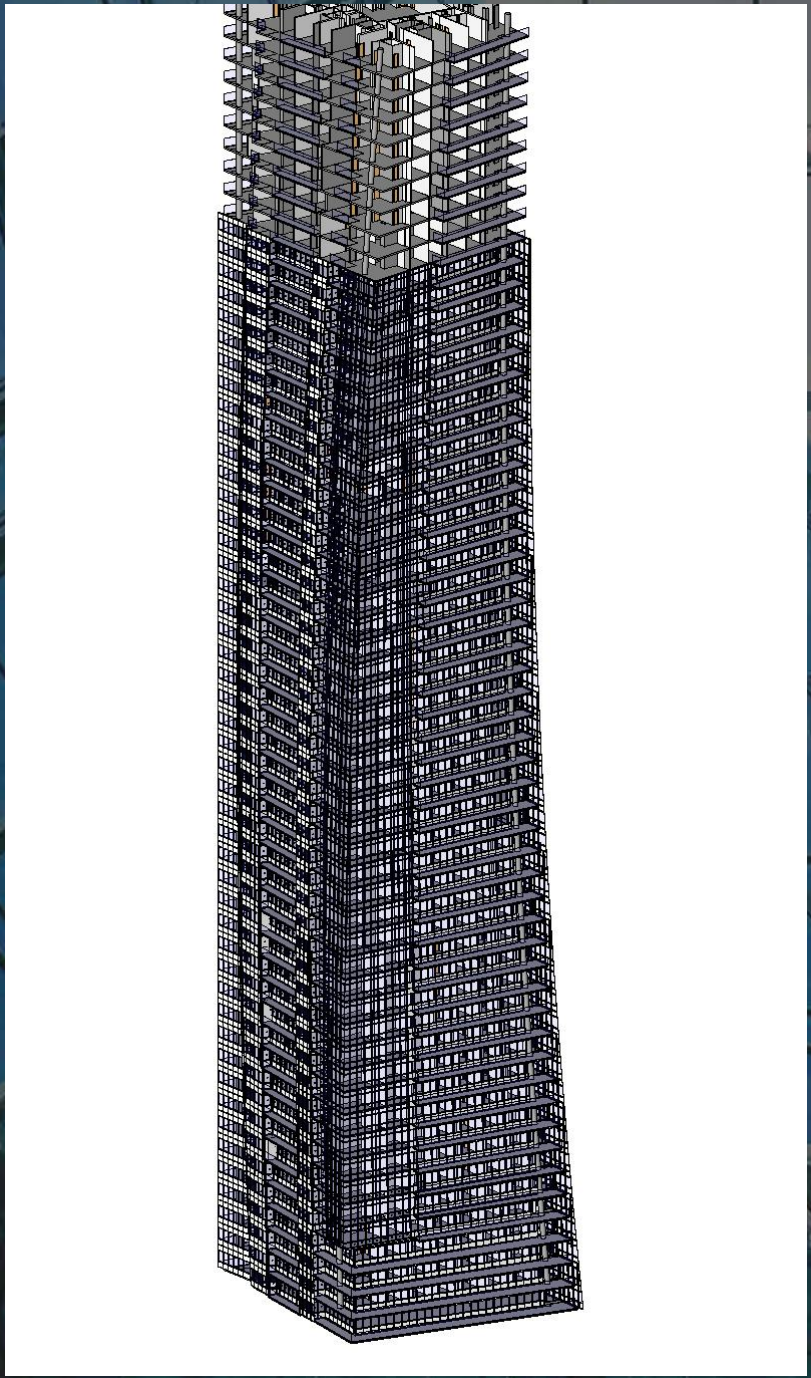


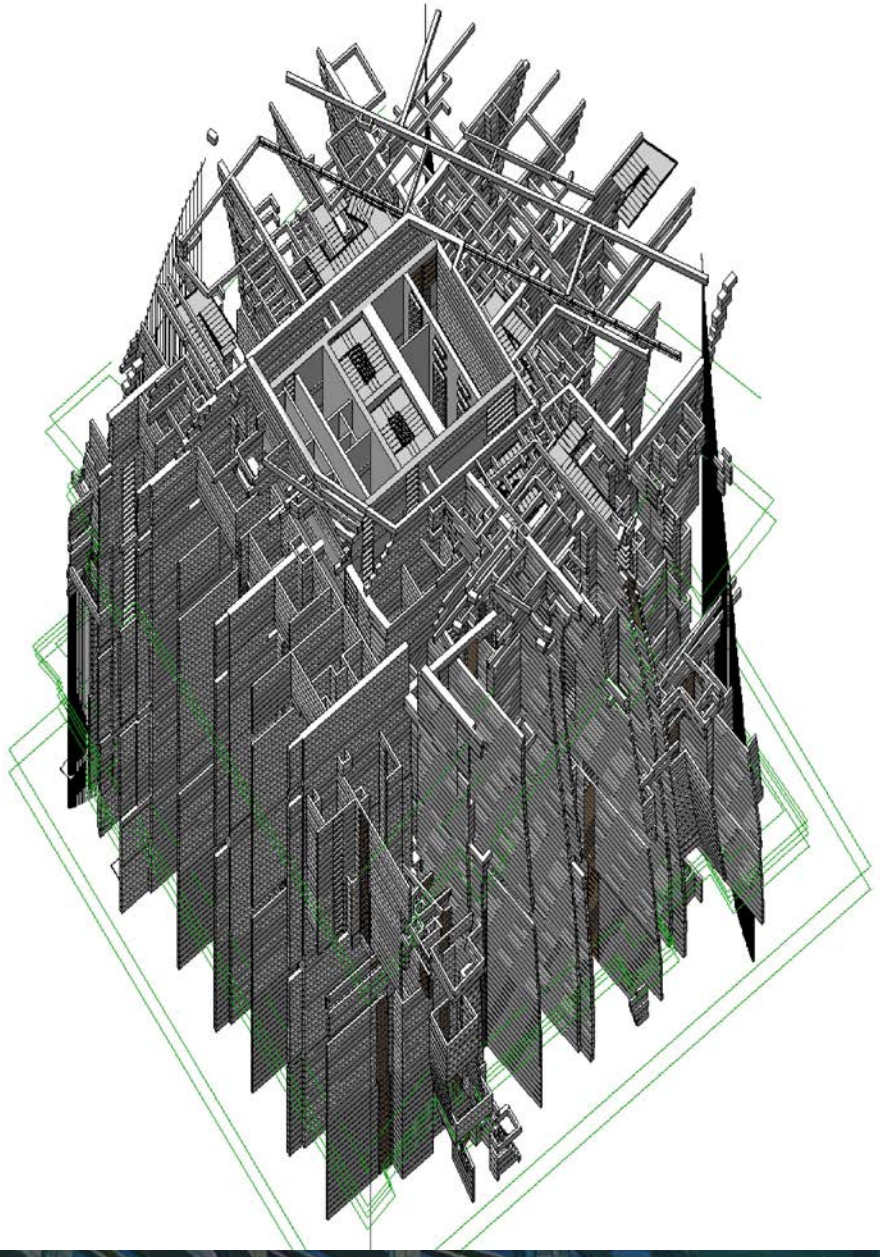






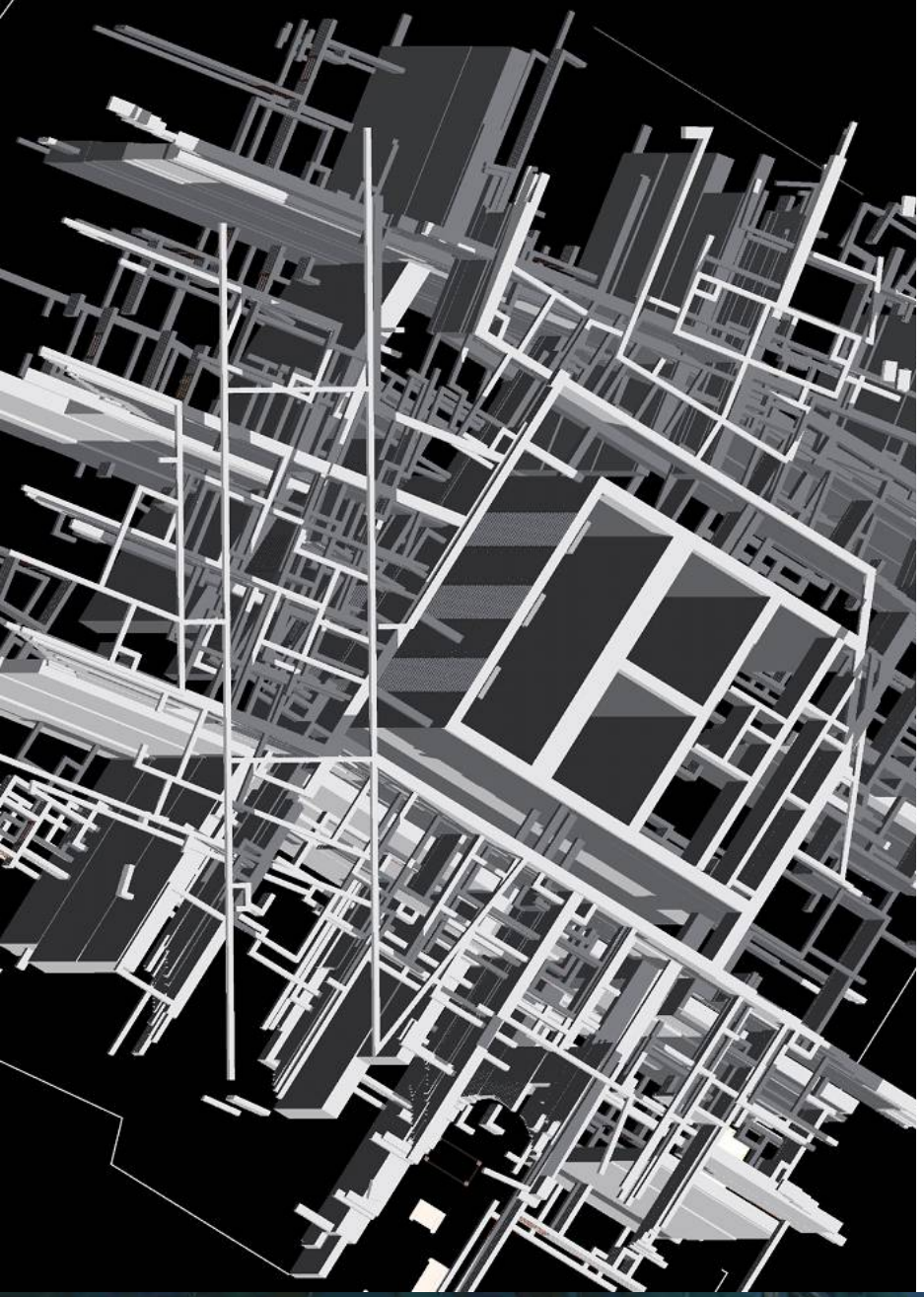


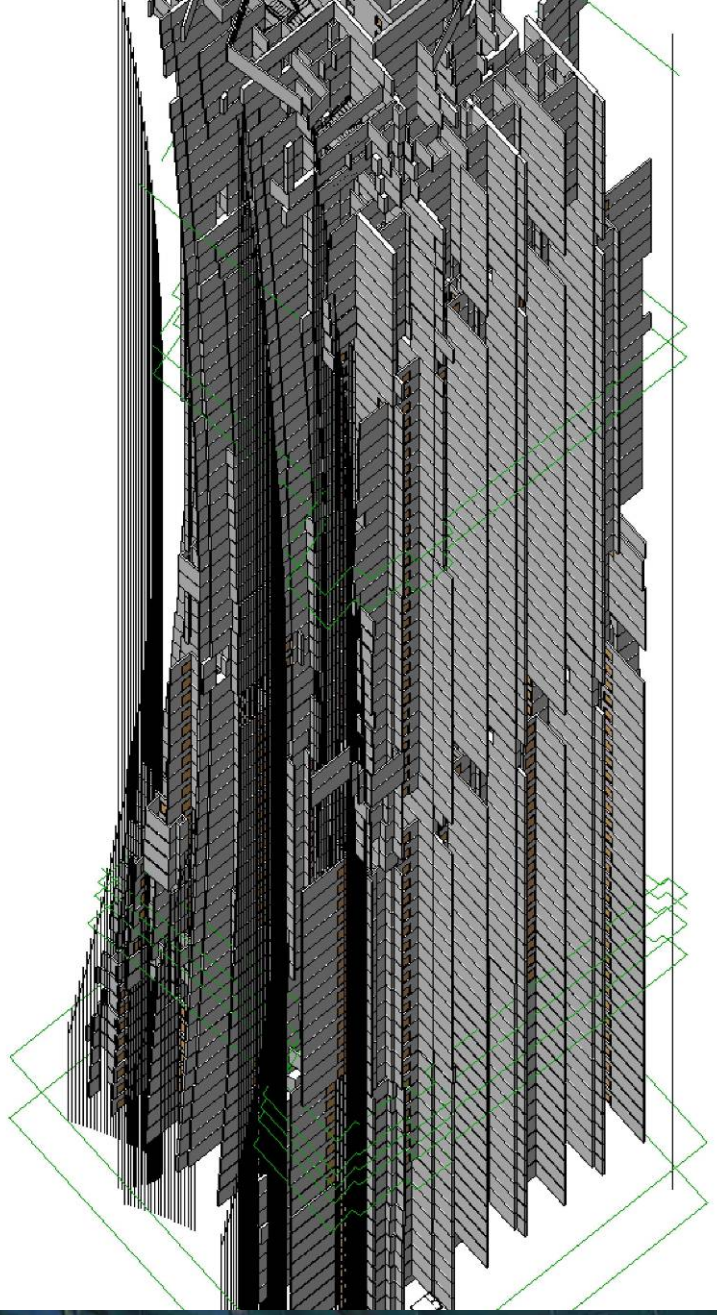




中東住宅項目

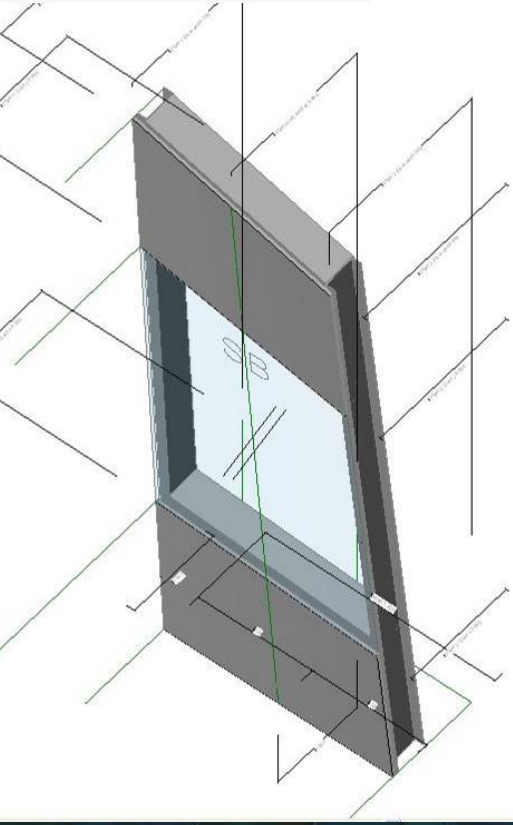
VERTICAL CO-ORDINATION

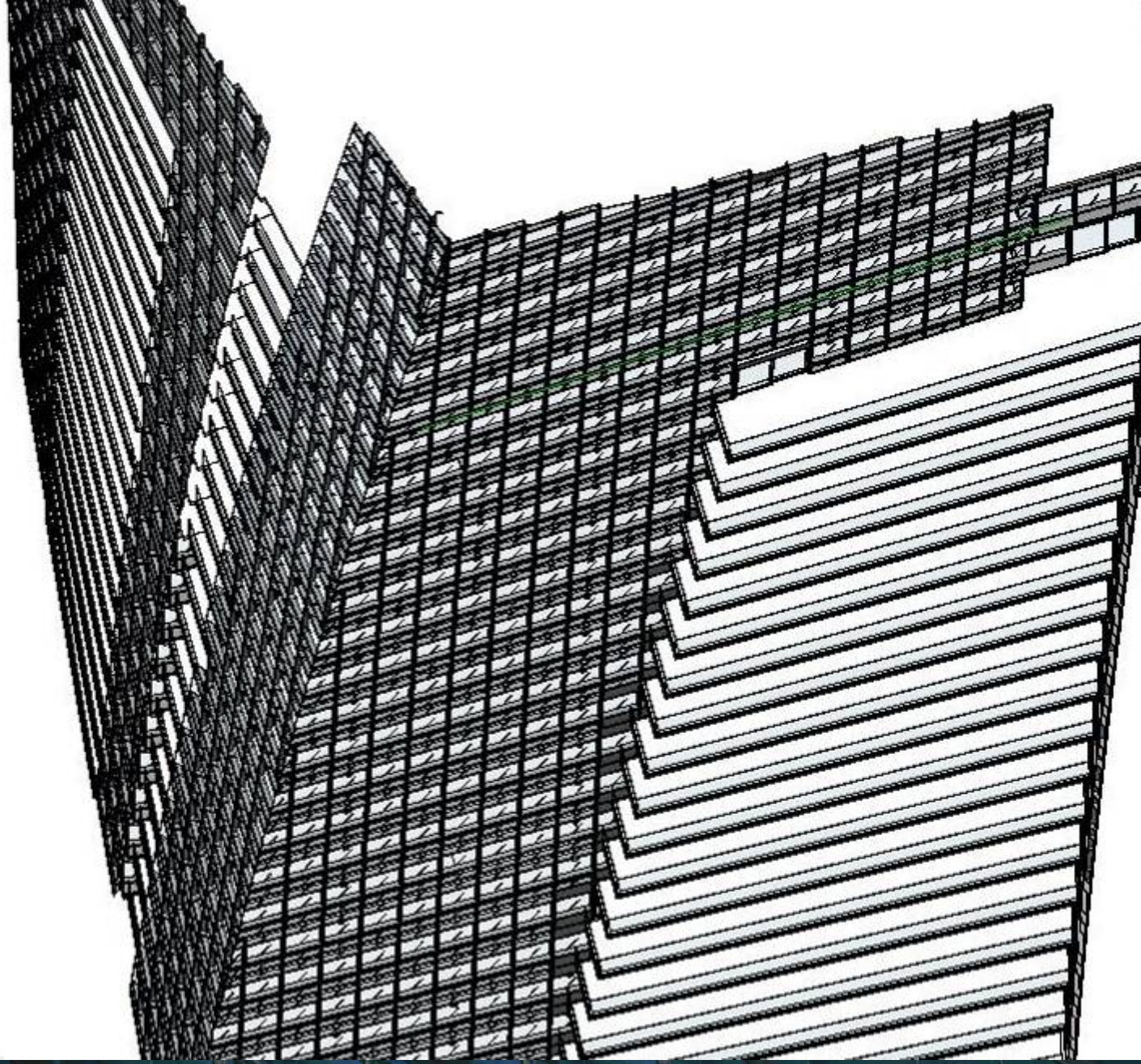




中東住宅項目

INTERNAL vs EXTERNAL





中東住宅項目

COMPLICATED CURTAIN WALL

Abu Dhabi **Empire Tower**

Empire Tower was challenged through a client request of not "pushing the limits" too far. The concern is that the residential project was located in the middle of a master plan filled with potential icons. The design standardizes the units to accommodate the client request but manipulates the section to develop a very dynamic solution, which holds its own amidst the visual clutter of its neighbors. This was deemed crucial to the financial viability of this project, which is dependent on pre-sales within a highly competitive market.

The design maximizes the tower's presence on the street, with vertical layers spreading out to the property lines. The building then bends back away from the street across from a large commercial tower, allowing for an enlarged view corridor between the central park of the community and the sea, one block away. The splayed vertical layers converge and rise up before bending forward together, as the 230-meter tower extends into the sky – maximizing its views between the park and the sea ▪

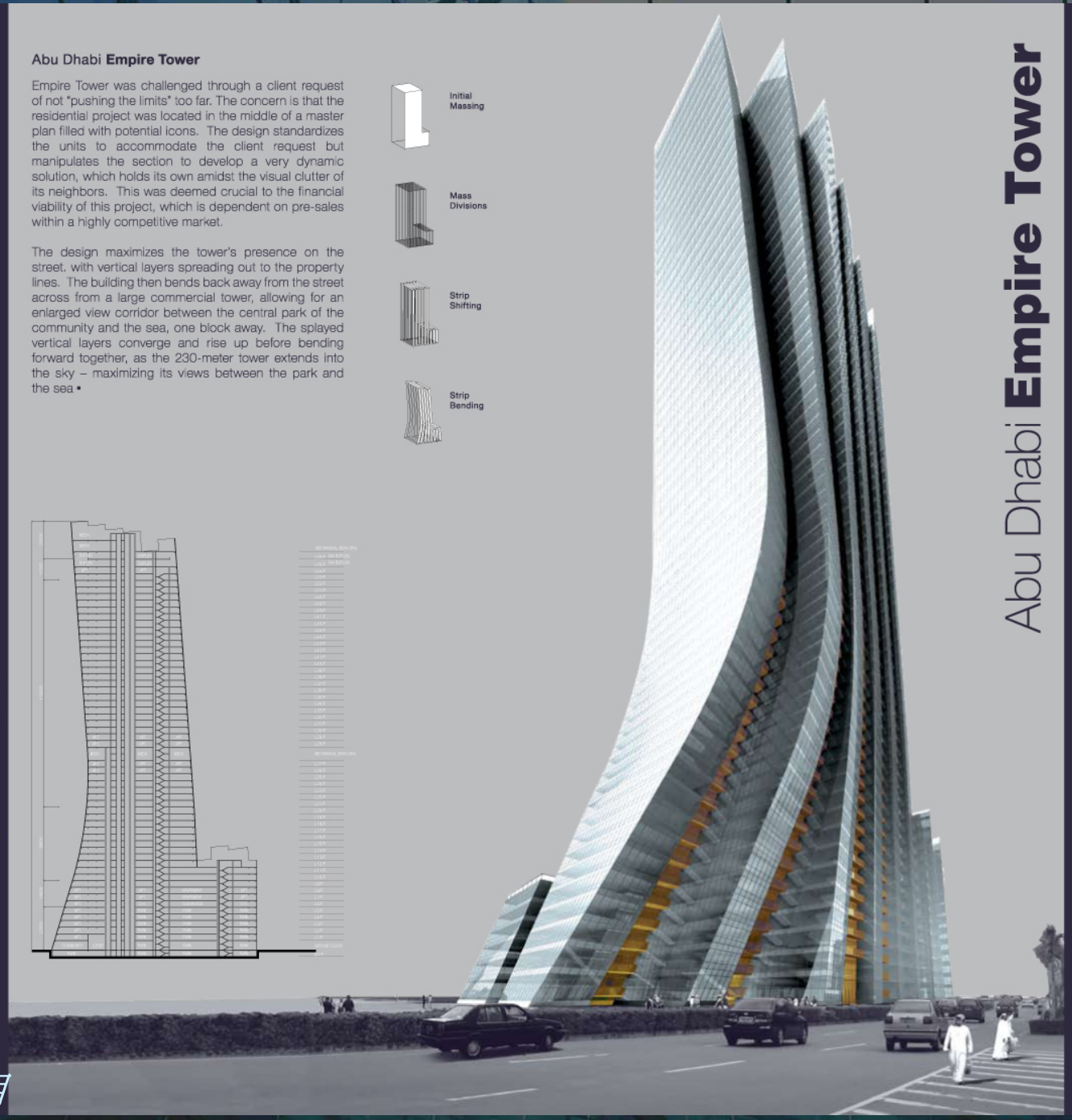
Initial Massing

Mass Divisions

Strip Shifting

Strip Bending

Program **Residential** Site Area **7,007 sqm**
Floor Area **90,206 sqm** Building Height **225 m**



Abu Dhabi **Empire Tower**

中東住宅項目

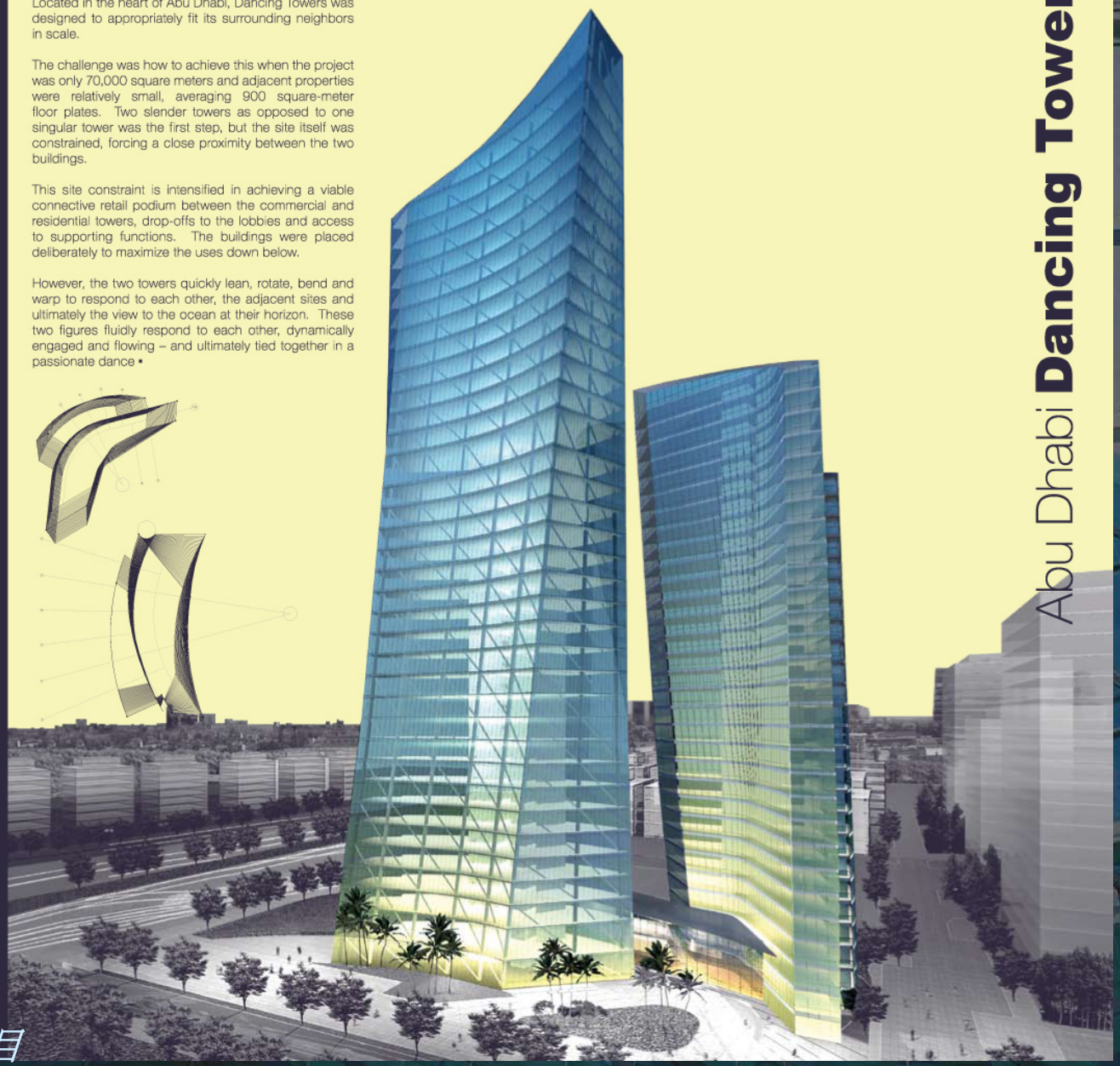
Abu Dhabi **Dancing Towers**

Located in the heart of Abu Dhabi, Dancing Towers was designed to appropriately fit its surrounding neighbors in scale.

The challenge was how to achieve this when the project was only 70,000 square meters and adjacent properties were relatively small, averaging 900 square-meter floor plates. Two slender towers as opposed to one singular tower was the first step, but the site itself was constrained, forcing a close proximity between the two buildings.

This site constraint is intensified in achieving a viable connective retail podium between the commercial and residential towers, drop-offs to the lobbies and access to supporting functions. The buildings were placed deliberately to maximize the uses down below.

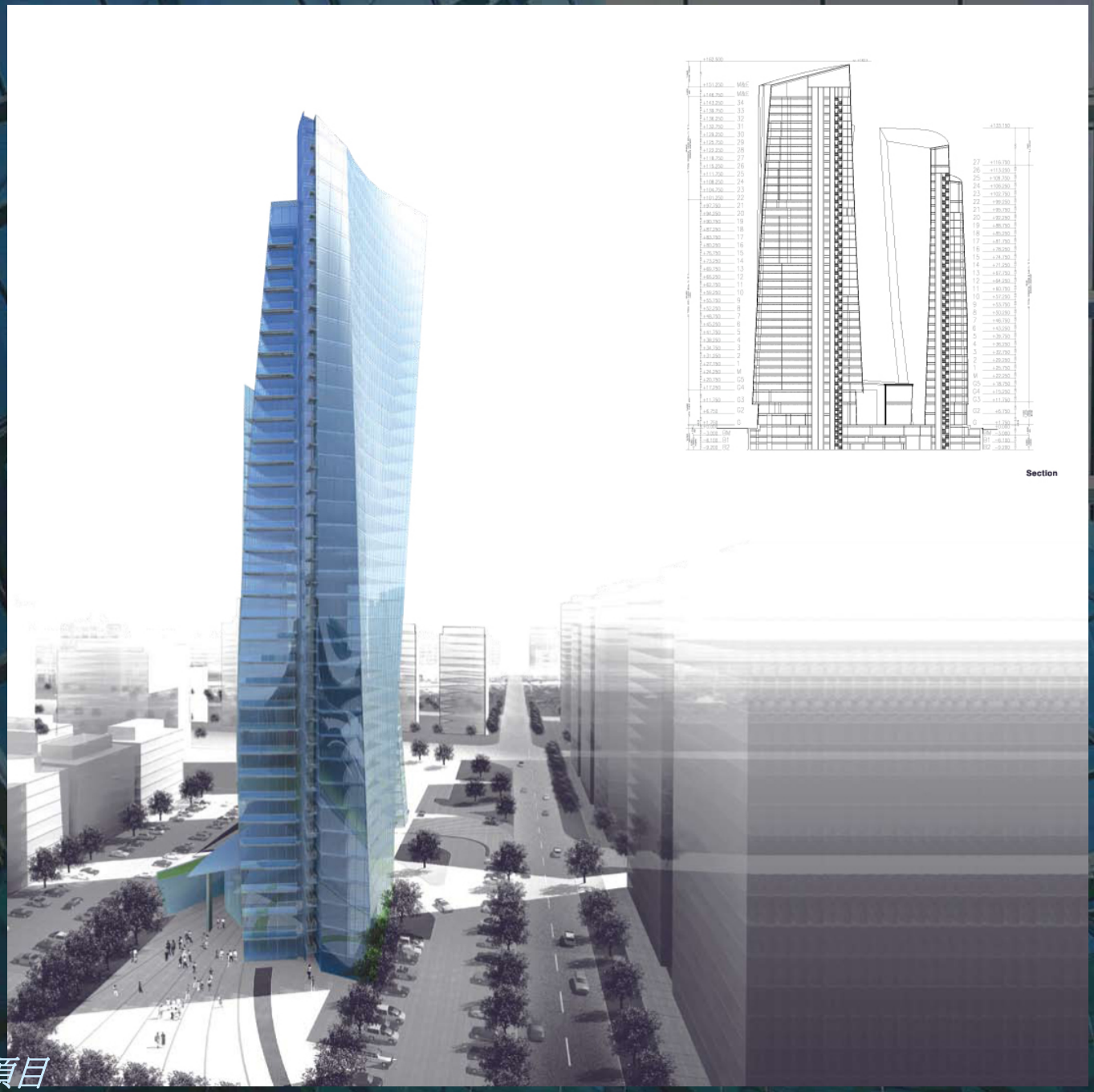
However, the two towers quickly lean, rotate, bend and warp to respond to each other, the adjacent sites and ultimately the view to the ocean at their horizon. These two figures fluidly respond to each other, dynamically engaged and flowing – and ultimately tied together in a passionate dance •



Program **Mixed Use** Site Area **4,180 sqm**
Floor Area **44,235 sqm** Building Height **160 m**

Abu Dhabi **Dancing Towers**

中東住宅項目



中東住宅項目

Dubai **Ocean Heights Two**

Ocean Heights Two is also located in Dubai Marina, UAE, along with its sister project, Ocean Heights One. At 460 meters in height and 105 floors, it will be the tallest tower in its vicinity. However, unlike its predecessor, the requirements for more modulated units up to the 60th floor, forced a different approach while intending to maintain the spirit of its sister.

The first 60th floors of the tower are intended to be service apartments, which in order to be marketable, needed to have the majority of units standardized. The curved shape of the tower improves views past its densely located neighbors. The playfulness of this tower was concentrated into the two most visible faces, allowing units to bend up the tower in two blades. These blades were still modulized up to the 60th floor before the tight restrictions of unit area fluctuations become more relaxed. At this point, the modules drop off and the blades continue, tapering and bending into the sky ▪

View Diagram

Program **Residential**, Site Area **3,435sqm**
Floor Area **197,375 sqm**, Building Height **460 m**

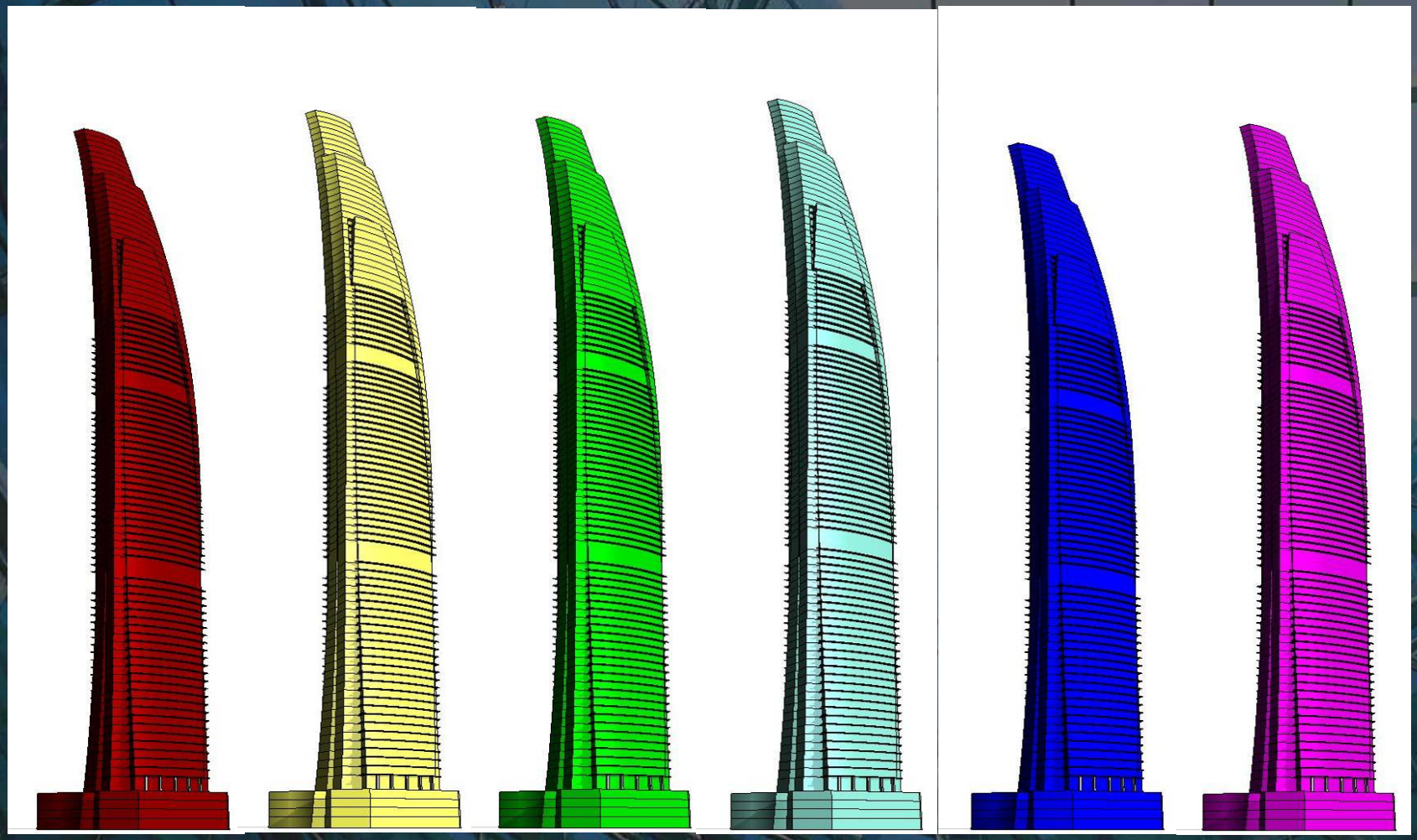
Dubai **Ocean Heights Two**

中東住宅項目

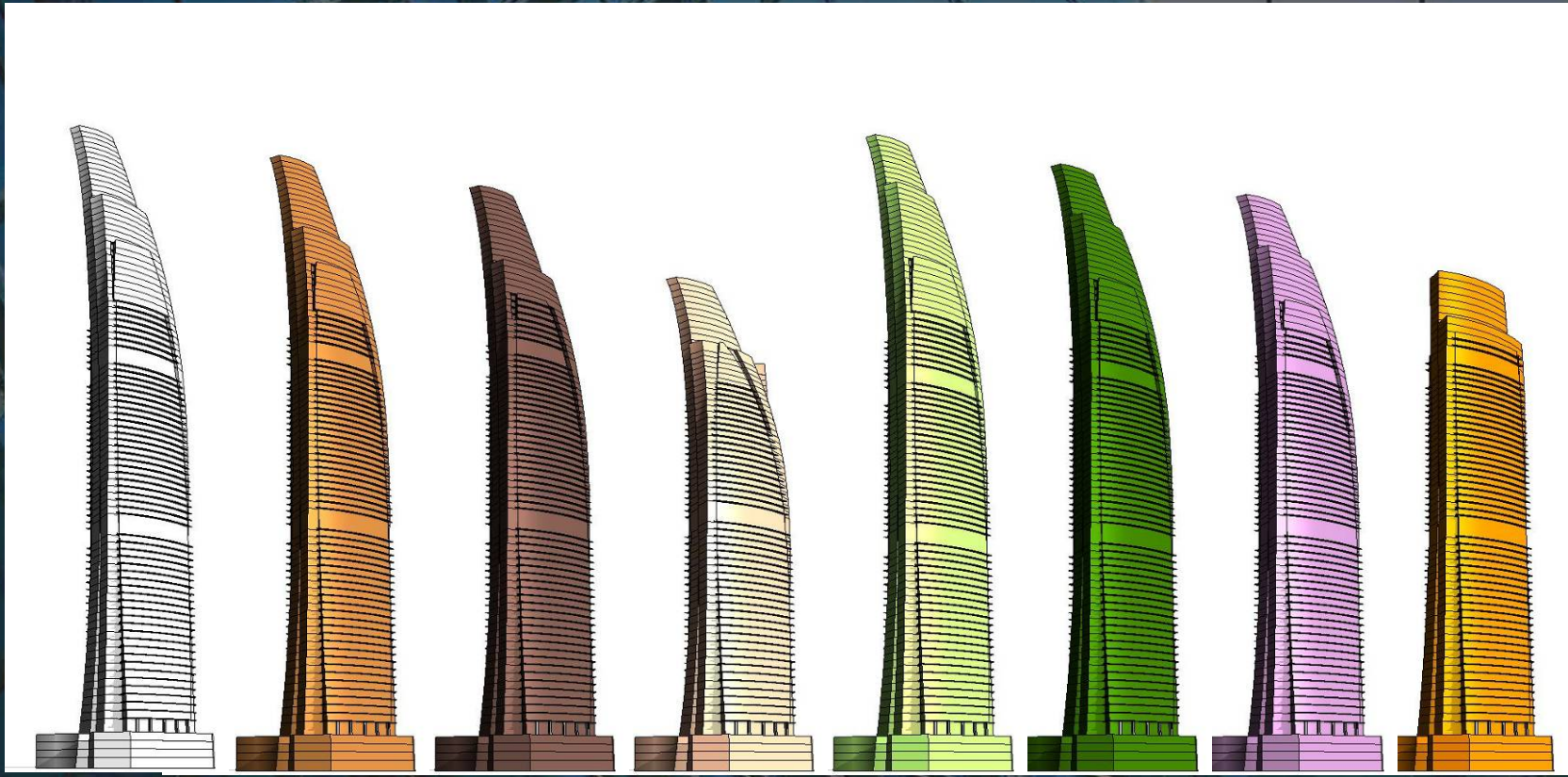

1st Floor
2nd-3rd Floors
4th Floor
7th Floor
37th Floor
69th Floor
79th Floor
90th Floor
100th Floor
101th Floor

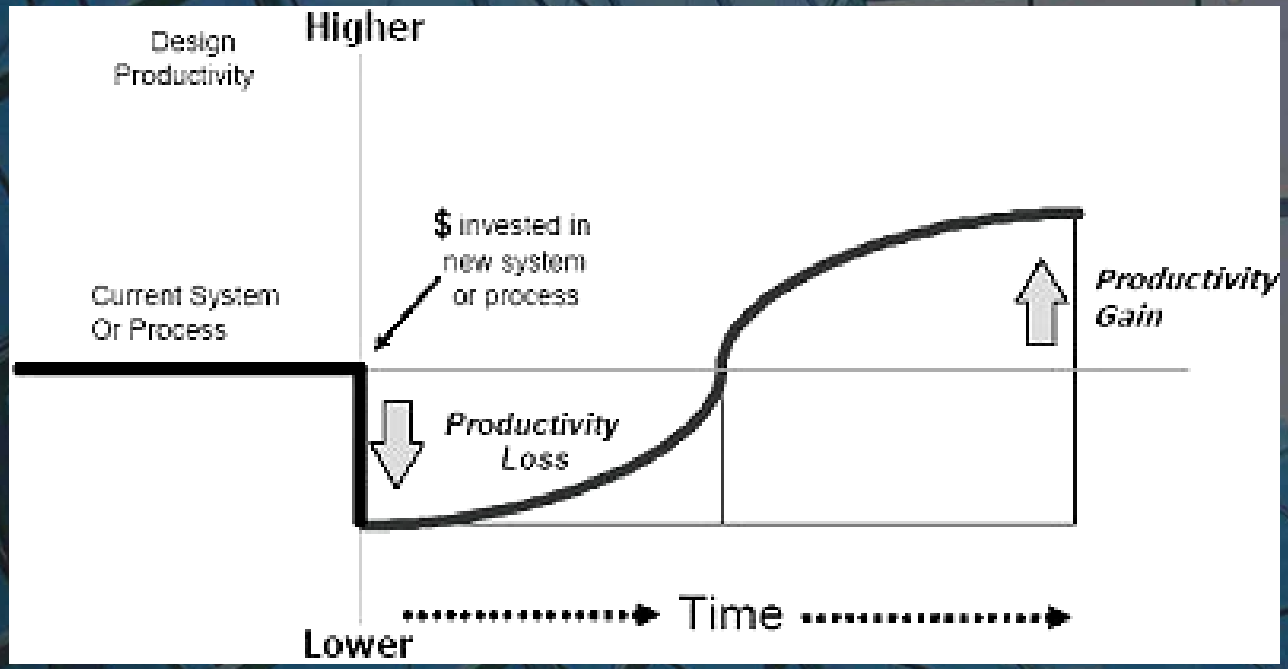
中東住宅項目

Ocean Heights II – Options



Ocean Heights II – Options





$$\frac{\left(B - \left(\frac{B}{1+E}\right)\right) \times (12 - C)}{A + (B \times C \times D)} = \text{First Year ROI}$$

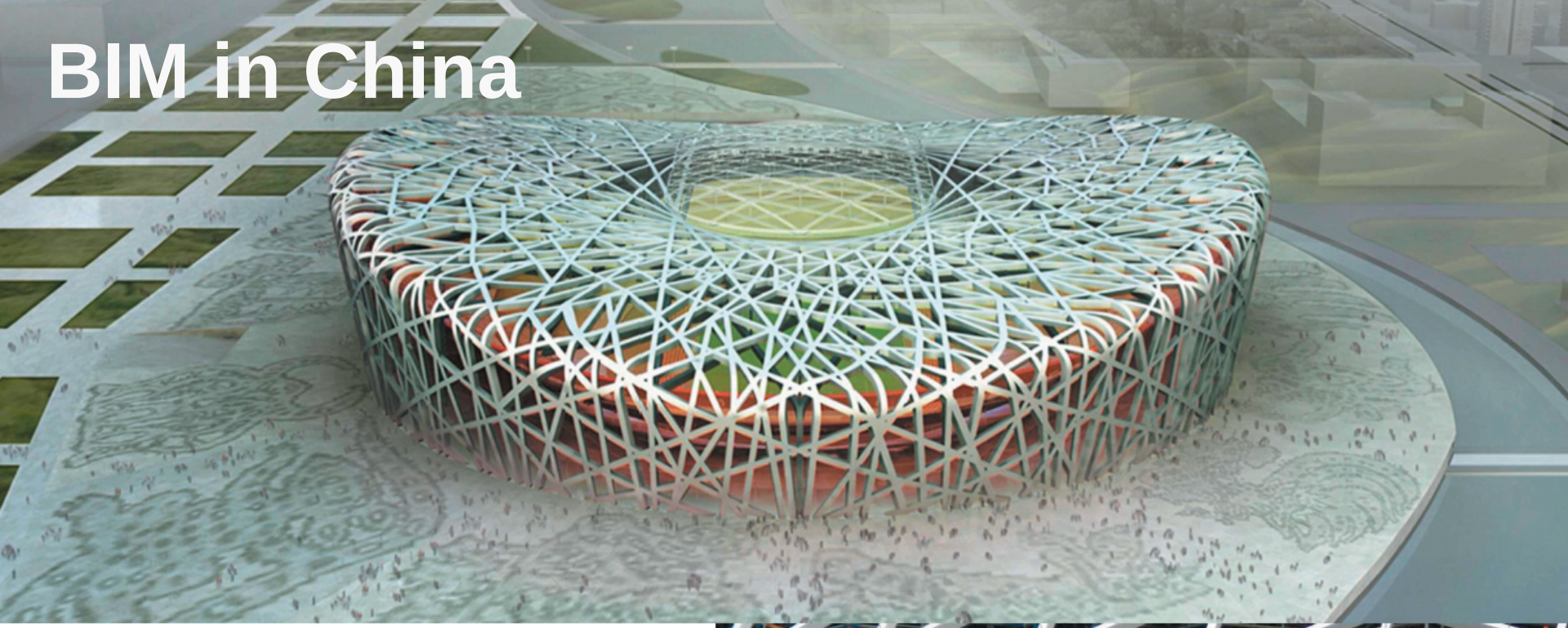
A = cost of hardware and software	$6,000
B = monthly labor cost	$4,200
C = training time	3 months
D = productivity loss during training	50%
E = productivity gain after training	25%

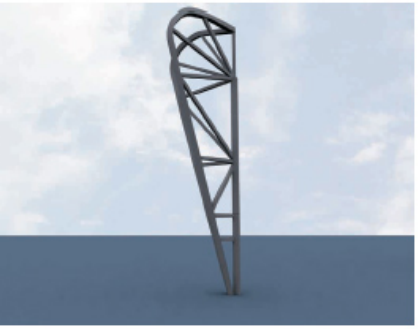
Source 26/1/07: http://aec.cadalyst.com/aec/article/articleDetail.jsp?id=124222

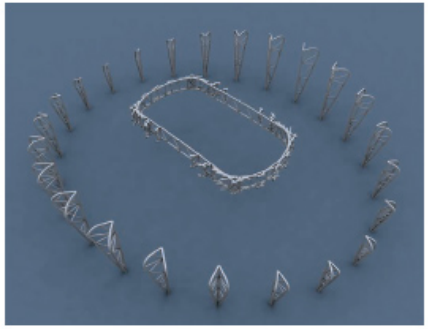
PRODUCTIVITY

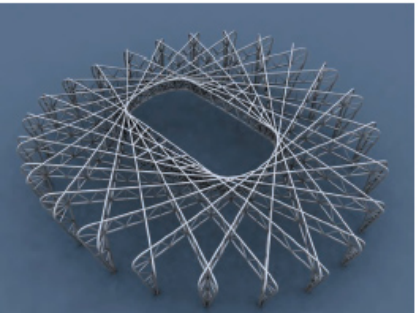
>60%

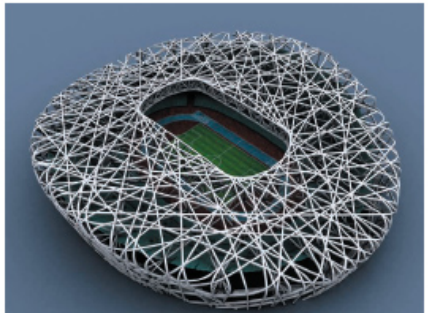
BIM in China

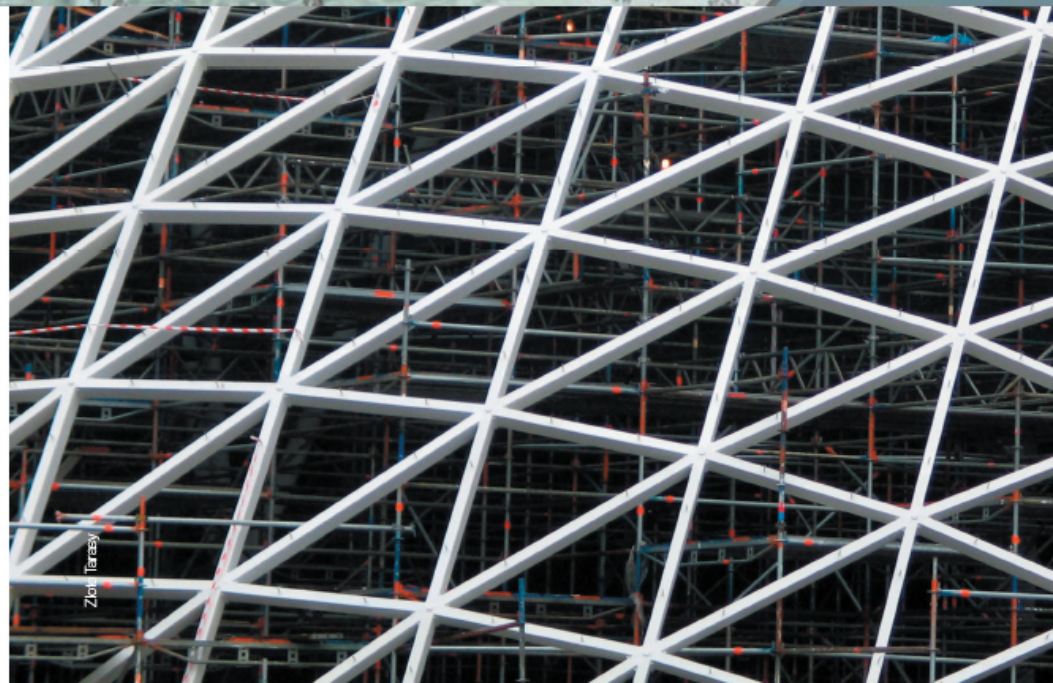




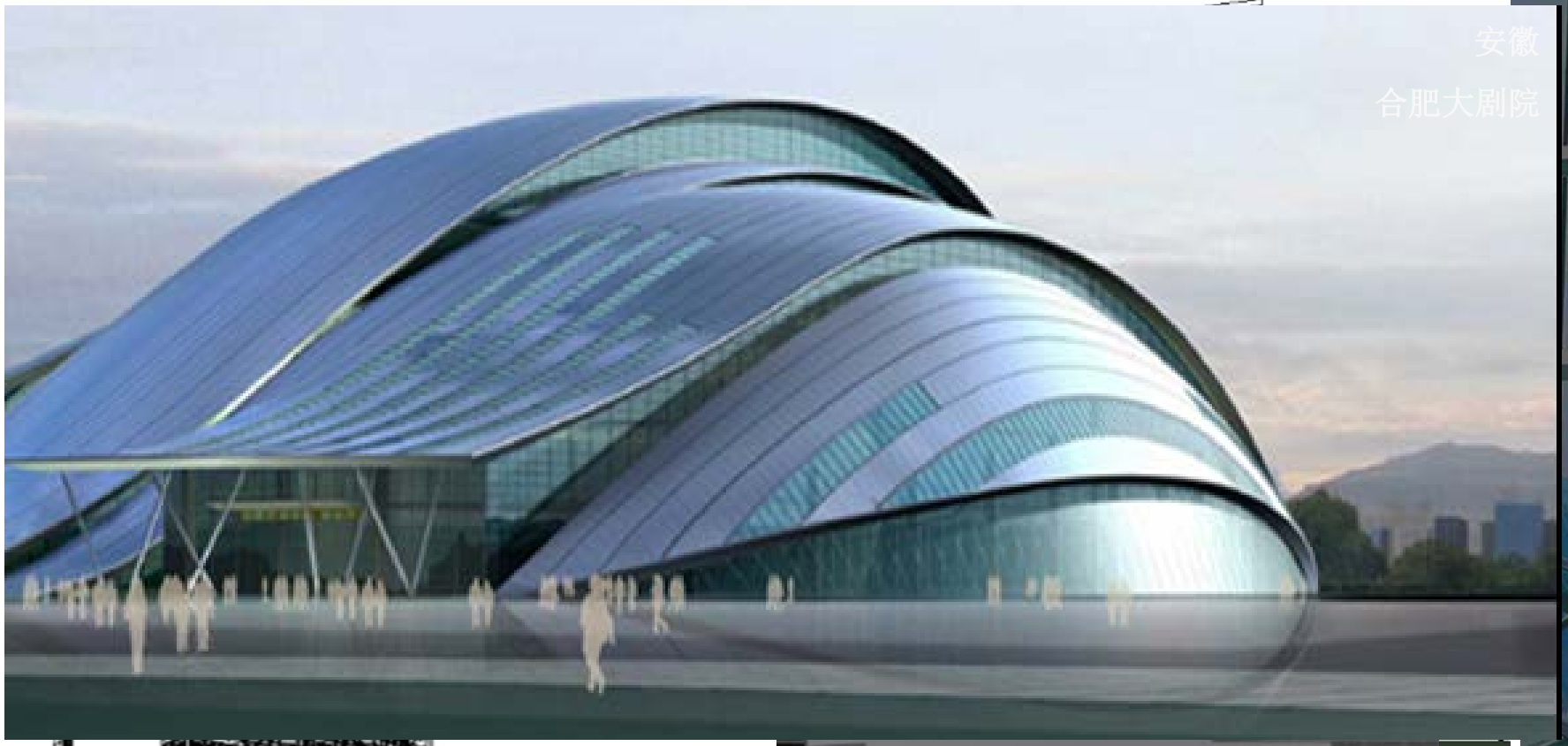


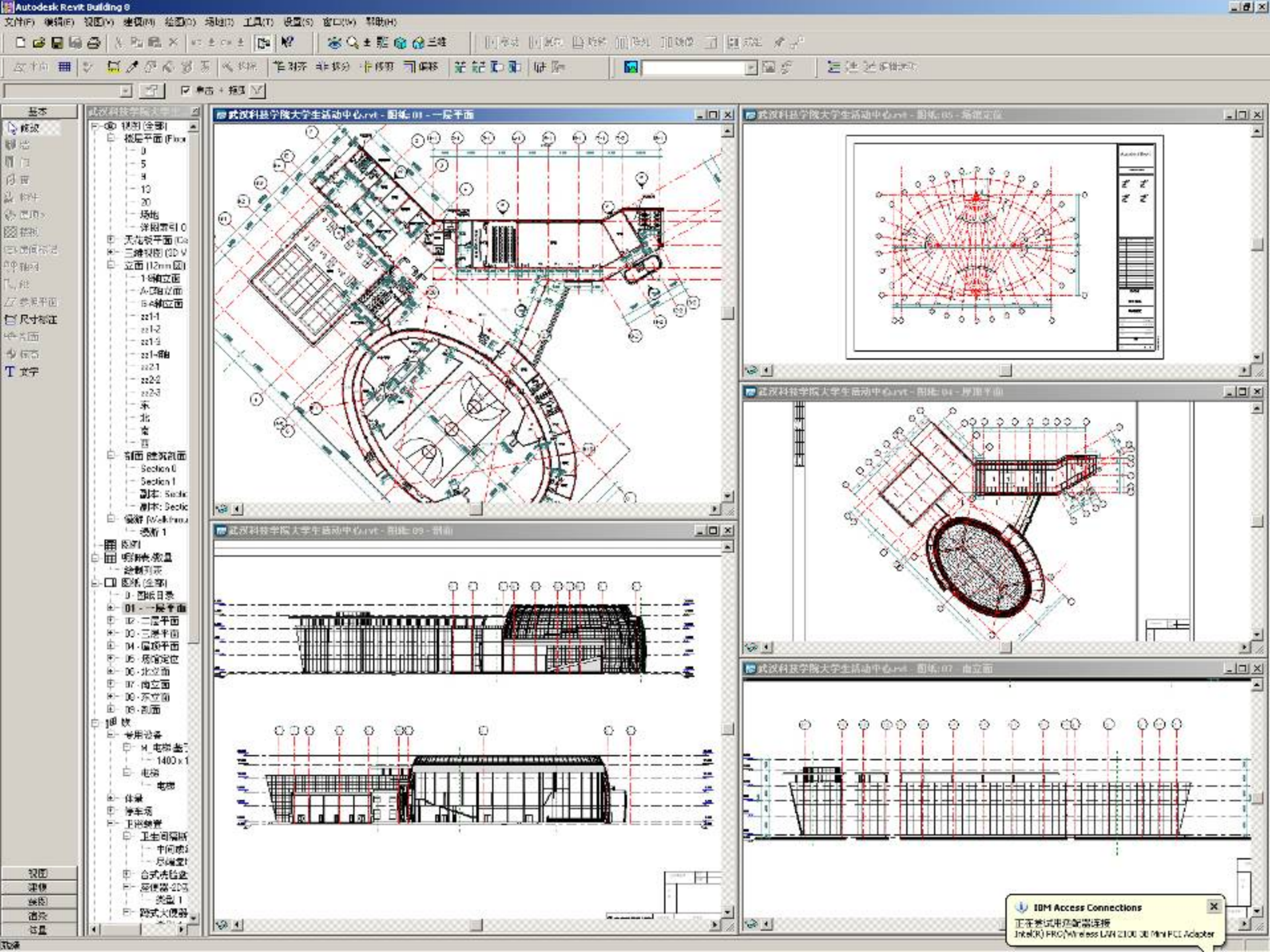


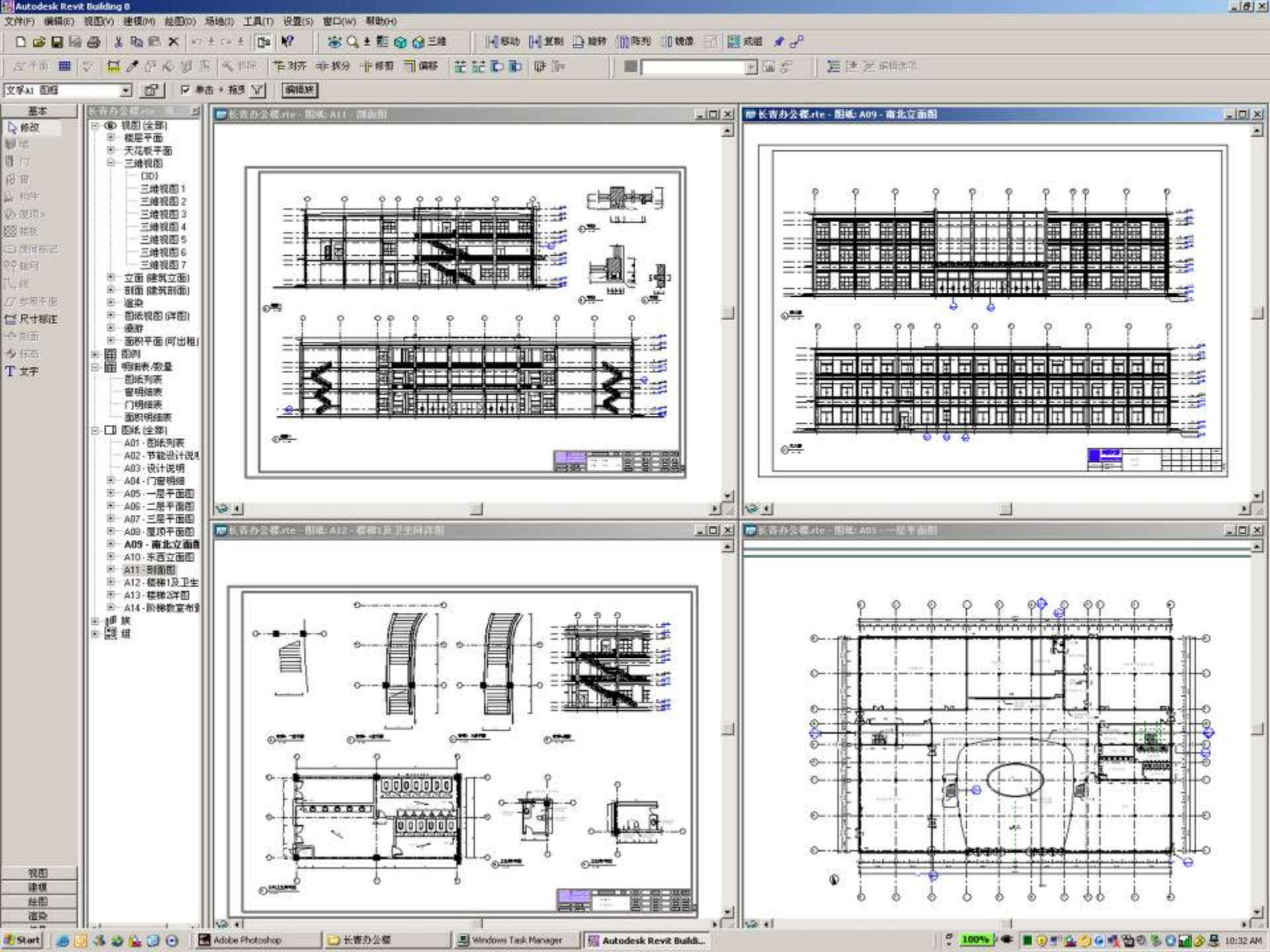


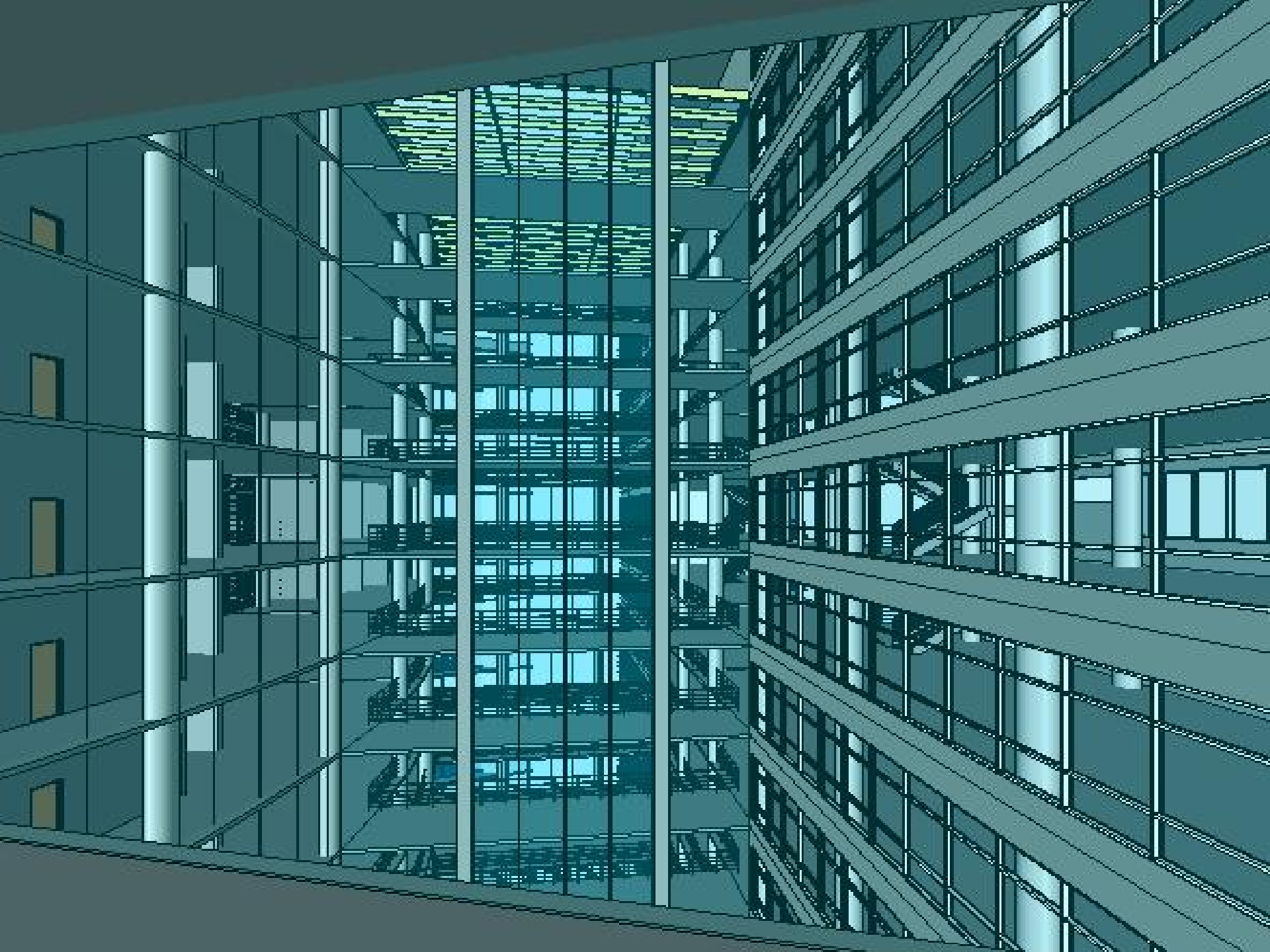


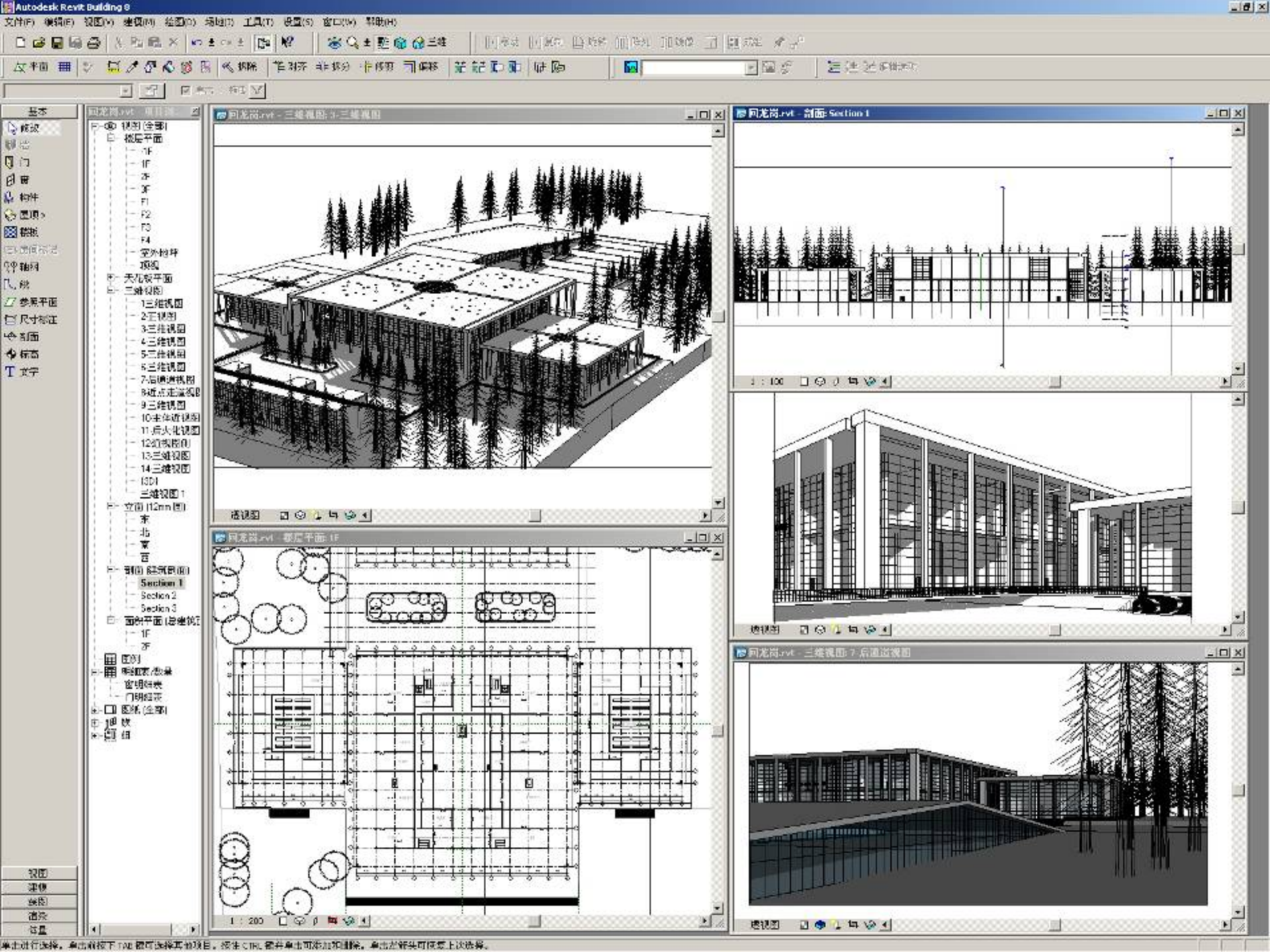
BIM in China

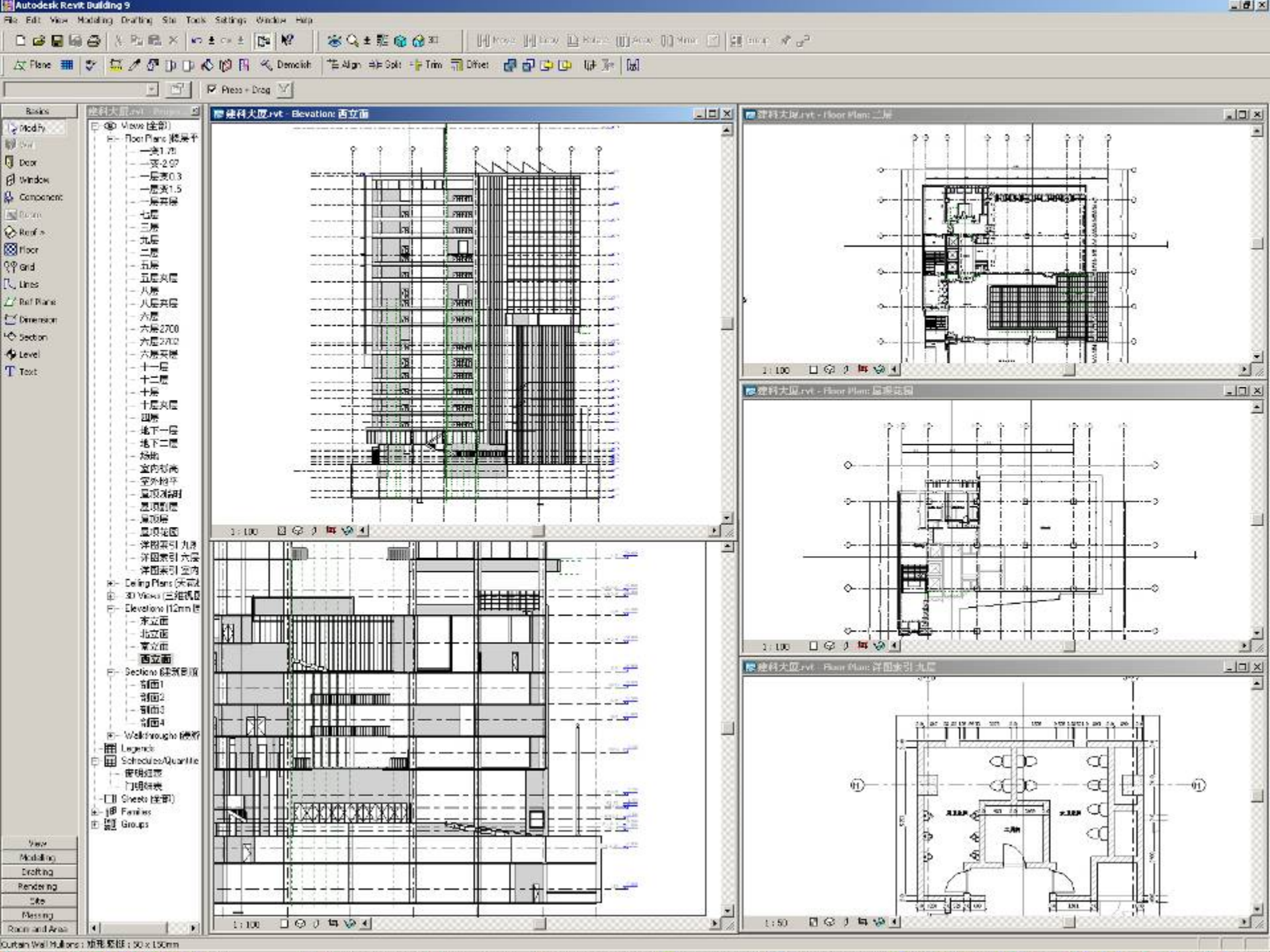


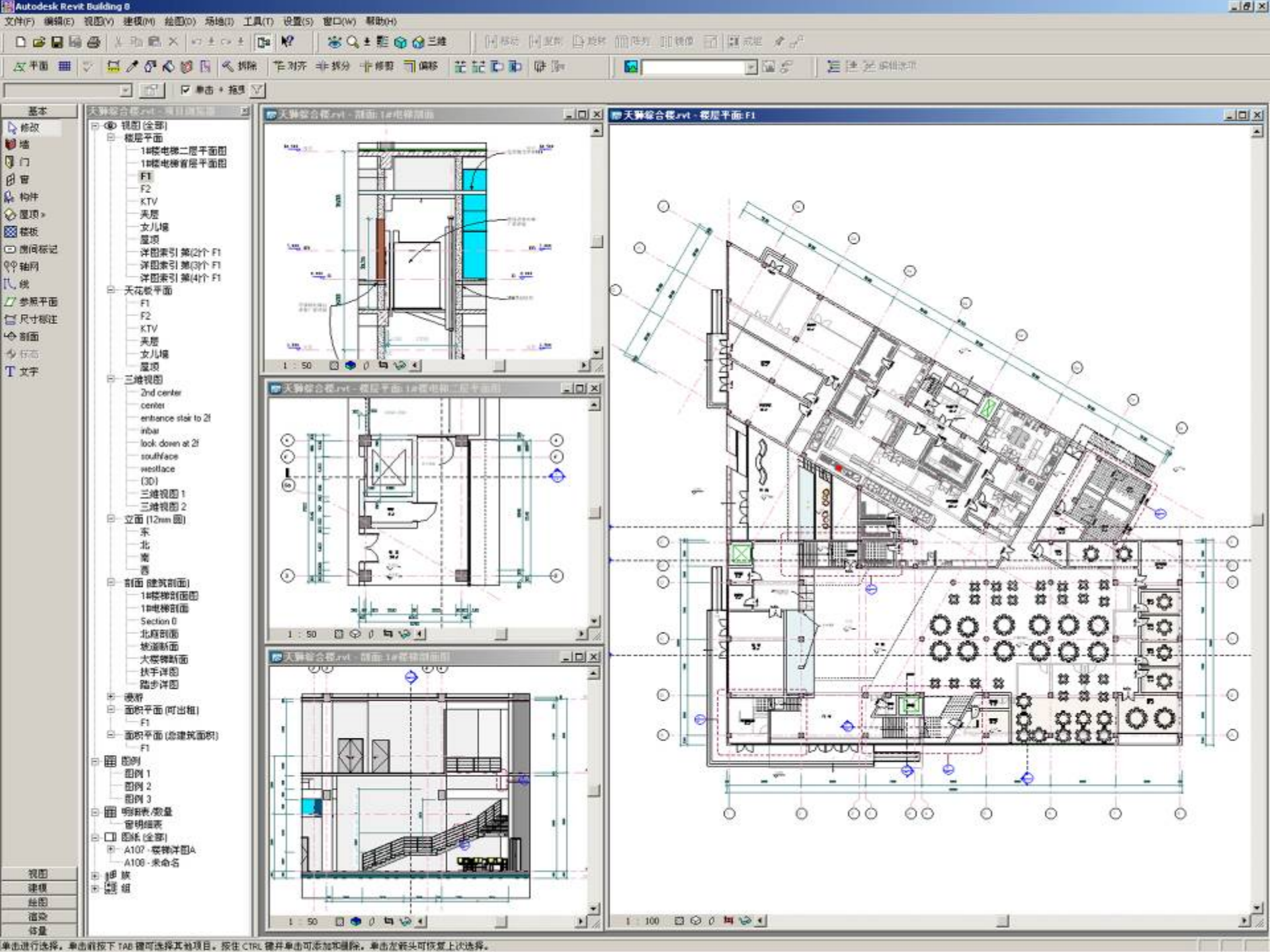

Autodesk Revit Building 9
武汉科技学院大学生活动中心.rvt - 图纸: 01 - 一层平面
IBM Access Connections

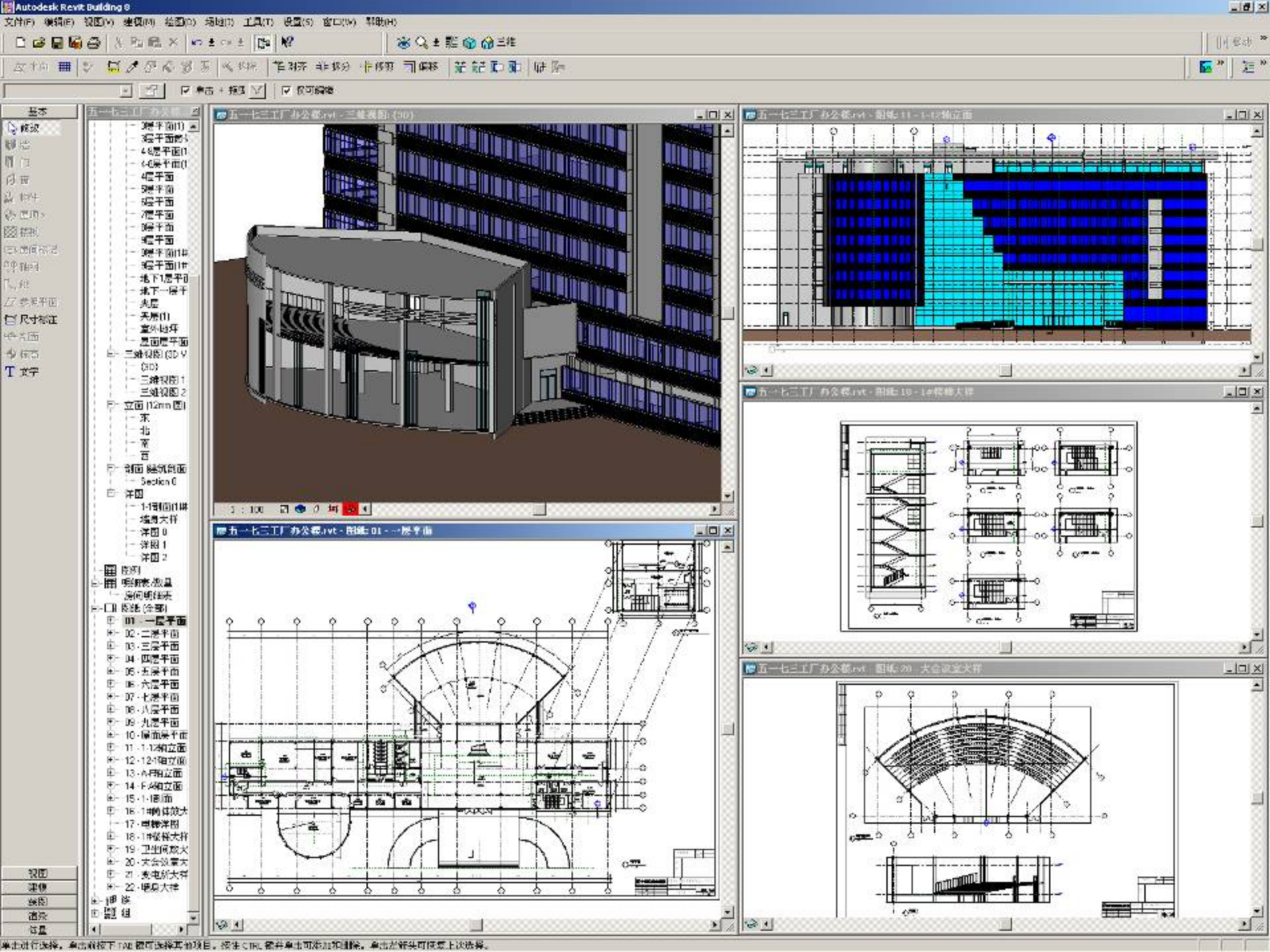

Autodesk Revit Building 8
文件(F) 编辑(E) 视图(V) 建模(M) 绘图(D) 场地(I) 工具(T) 设置(S) 窗口(W) 帮助(H)
长青办公楼.rte - 图纸: A11 - 剖面图
长青办公楼.rte - 图纸: A09 - 南北立面图
长青办公楼.rte - 图纸: A12 - 楼梯1及卫生间详图
长青办公楼.rte - 图纸: A05 - 一层平面图
视图(全部)
楼层平面
天花板平面
三维视图
立面 (建筑立面)
剖面 (建筑剖面)
渲染
图纸视图 (详图)
漫游
面积平面 (可出租)
图例
明细表/数量
图纸列表
窗明细表
门明细表
面积明细表
图纸 (全部)
A01 - 图纸列表
A02 - 节能设计说明
A03 - 设计说明
A04 - 门窗明细
A05 - 一层平面图
A06 - 二层平面图
A07 - 三层平面图
A08 - 屋顶平面图
A09 - 南北立面图
A10 - 东西立面图
A11 - 剖面图
A12 - 楼梯1及卫生
A13 - 楼梯2详图
A14 - 阶梯教室布置
族
组
Start
Adobe Photoshop
长青办公楼
Windows Task Manager
Autodesk Revit Buildi...
100%
10:32 AM

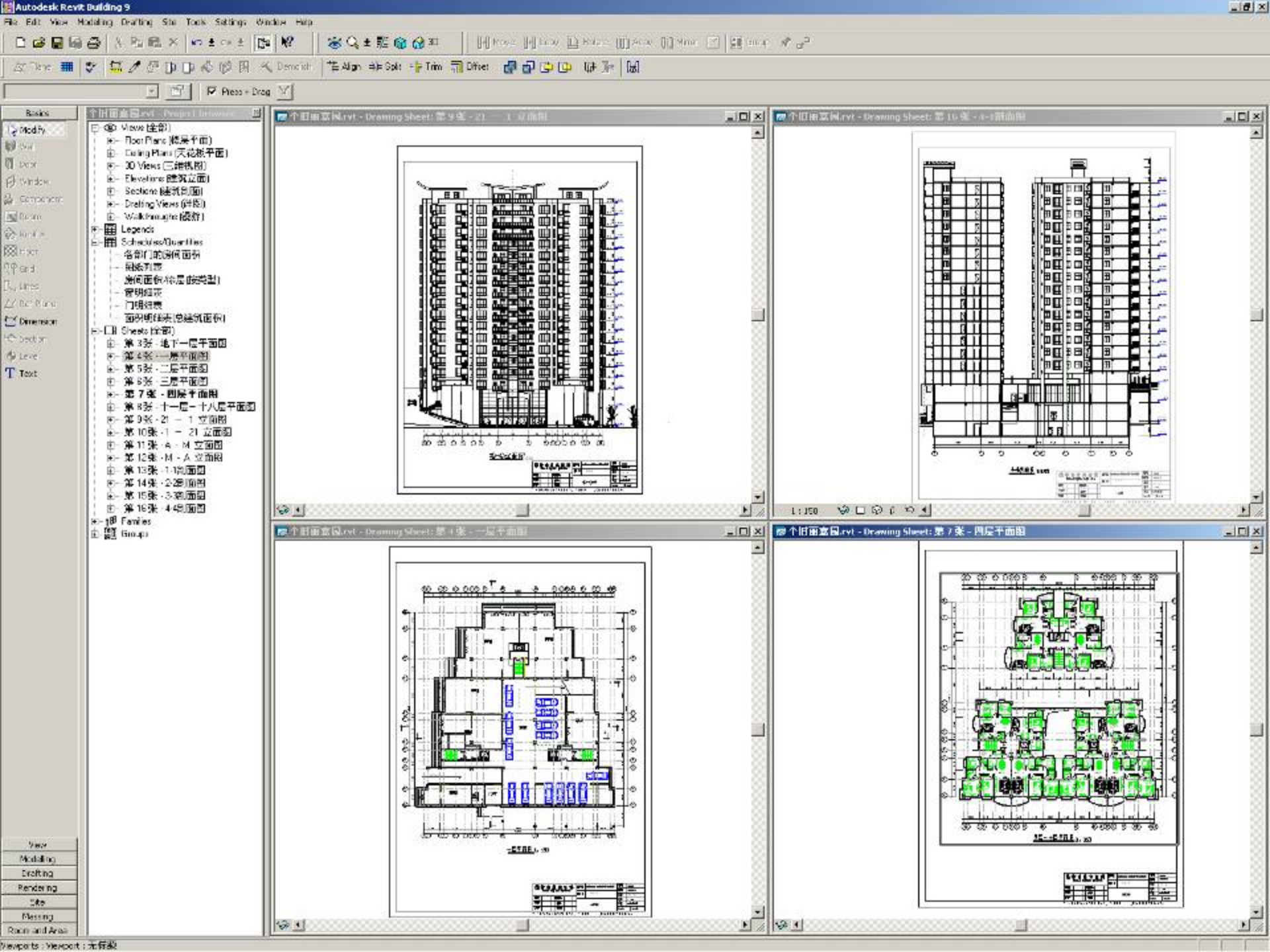


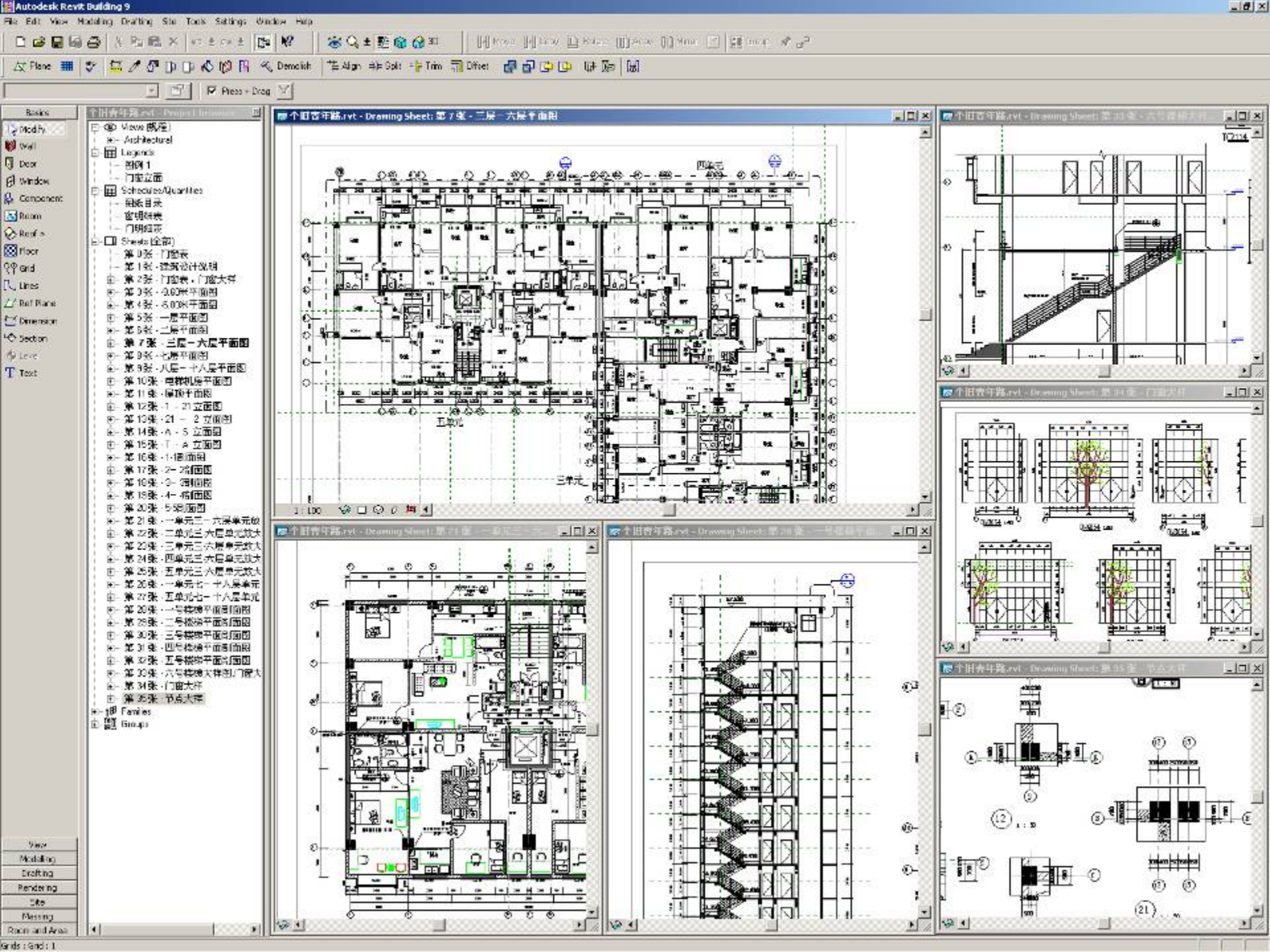

Autodesk Revit Building
同龙岗.rvt - 三维视图: 3-三维视图
同龙岗.rvt - 剖面: Section 1
同龙岗.rvt - 楼层平面: 1F
同龙岗.rvt - 三维视图: 7-后通道视图
Section 1
Section 2
Section 3

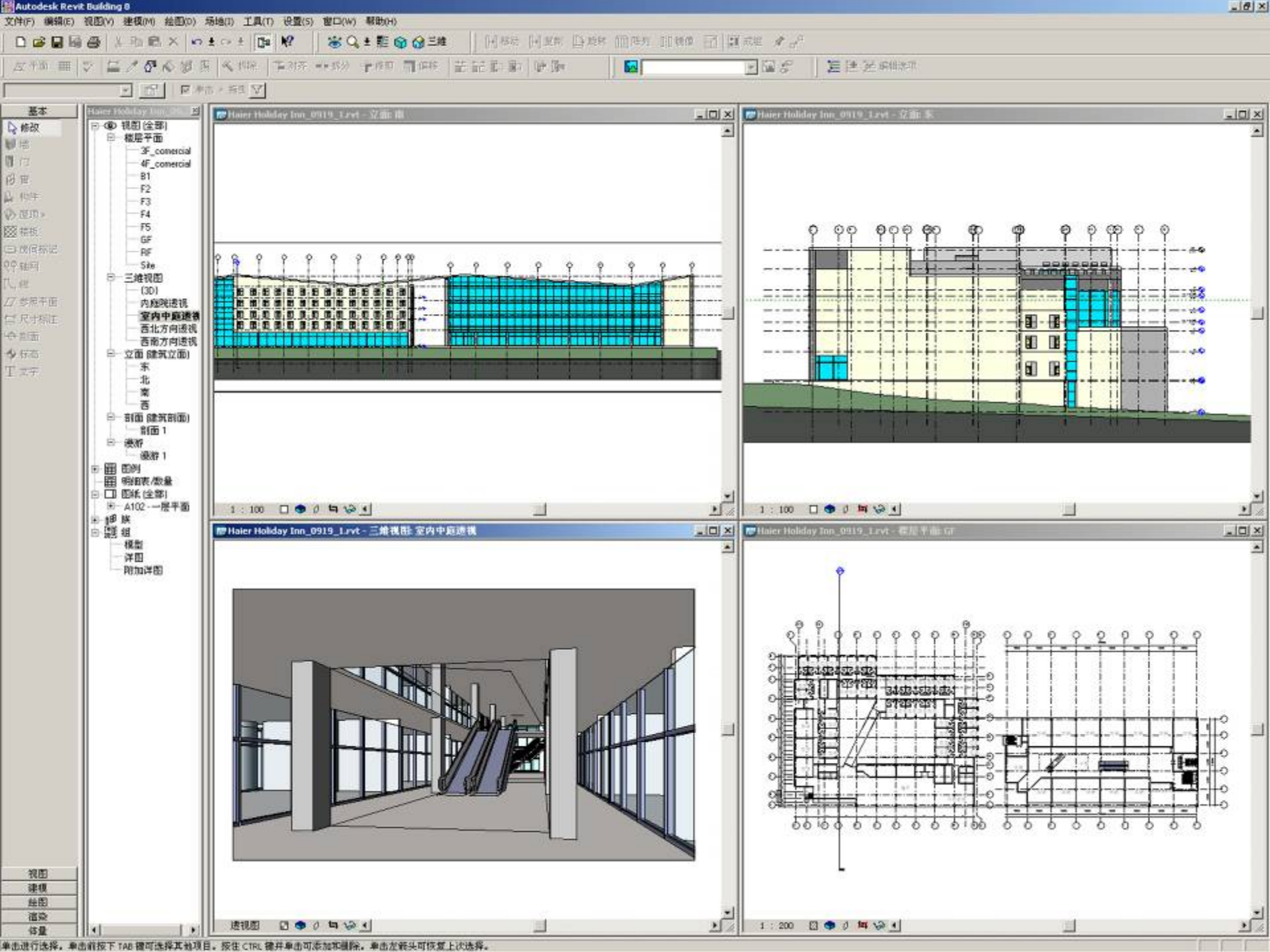

Autodesk Revit Building 9
File Edit View Modeling Drafting Site Tools Settings Window Help
Plane
Demolish
Align
Split
Trim
Offset
Press + Drag
Basics
Modify
Wall
Door
Window
Component
Room
Roof
Floor
Grid
Lines
Ref Plane
Dimension
Section
Level
Text
建科大厦.rvt - Elevation: 西立面
建科大厦.rvt - Floor Plan: 二层
建科大厦.rvt - Floor Plan: 屋顶花园
建科大厦.rvt - Floor Plan: 详图索引 九层
View
Modeling
Drafting
Rendering
Site
Massing
Room and Area
Curtain Wall Mullions : 幕墙竖梃 : 50 x 150mm


Autodesk Revit Building 8
文件(F) 编辑(E) 视图(V) 建模(M) 绘图(D) 场地(I) 工具(T) 设置(S) 窗口(W) 帮助(H)
天狮综合楼.rvt - 楼层平面: F1
视图 (全部)
楼层平面
1#楼电梯二层平面图
1#楼电梯首层平面图
F1
F2
KTV
夹层
女儿墙
屋顶
详图索引 第(2)个 F1
详图索引 第(3)个 F1
详图索引 第(4)个 F1
天花板平面
三维视图
2nd center
center
entrance stair to 2f
inbar
lock down at 2f
southface
westface
{3D}
三维视图 1
三维视图 2
立面 (12mm 圆)
东
北
南
西
剖面 (建筑剖面)
1#楼梯剖面图
1#电梯剖面
Section 0
北庭剖面
坡道剖面
大楼梯剖面
扶手详图
踏步详图
漫游
面积平面 (可出租)
面积平面 (总建筑面积)
图例
图例 1
图例 2
图例 3
明细表/数量
图纸 (全部)
A107 - 楼梯详图A
A108 - 未命名
族
组
1 : 50
1 : 100

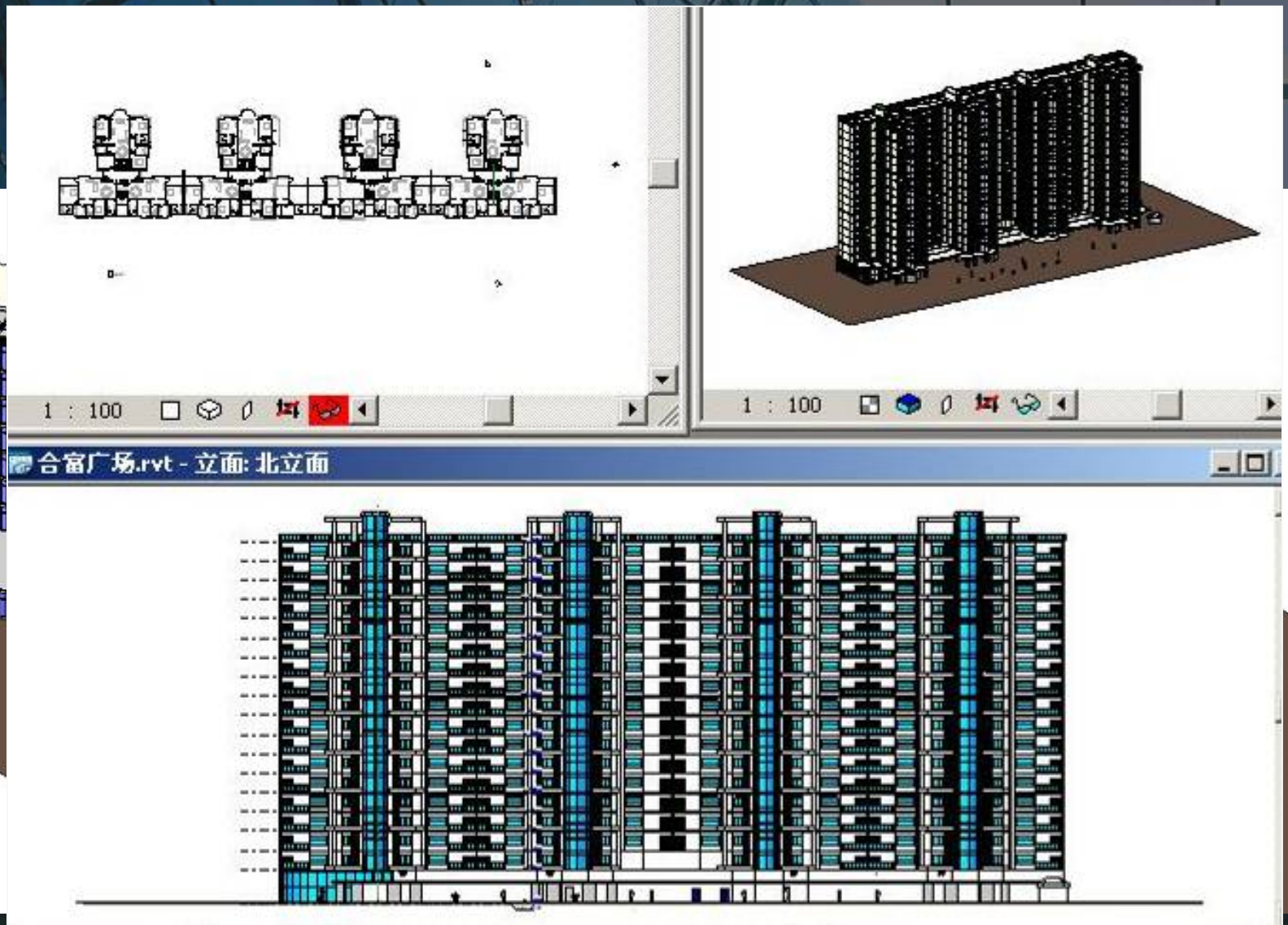

Autodesk Revit Building
五一七三工厂办公楼.rvt - 三维视图: {3D}
五一七三工厂办公楼.rvt - 图纸: 11 - 1-13轴立面
五一七三工厂办公楼.rvt - 图纸: 10 - 1#楼梯大样
五一七三工厂办公楼.rvt - 图纸: 01 - 一层平面
五一七三工厂办公楼.rvt - 图纸: 20 - 大会议室大样


Autodesk Revit Building 9
File Edit View Modeling Drafting Site Tools Settings Window Help
Basics
Modify
Wall
Door
Window
Component
Room
Roof
Floor
Grid
Lines
Ref Plane
Dimension
Section
Level
Text
Project Browser
Views (全部)
Floor Plans (楼层平面)
Ceiling Plans (天花板平面)
3D Views (三维视图)
Elevations (建筑立面)
Sections (建筑剖面)
Drafting Views (详图)
Walkthroughs (漫游)
Legends
Schedules/Quantities
Sheets (全部)
第 3张 - 地下一层平面图
第 4张 - 一层平面图
第 5张 - 二层平面图
第 6张 - 三层平面图
第 7张 - 四层平面图
第 8张 - 十一层－十八层平面图
第 9张 - 21 － 1 立面图
第 10张 - 1 － 21 立面图
第 11张 - A － M 立面图
第 12张 - M － A 立面图
第 13张 - 1-1剖面图
第 14张 - 2-2剖面图
第 15张 - 3-3剖面图
第 16张 - 4-4剖面图
Families
Groups
View
Modeling
Drafting
Rendering
Site
Massing
Room and Area
Viewports : Viewport : 未保存


Autodesk Revit Building 9
File Edit View Modeling Drafting Site Tools Settings Window Help
Plane
Demolish
Align
Split
Trim
Offset
Press + Drag
Basics
Modify
Wall
Door
Window
Component
Room
Roof
Floor
Grid
Lines
Ref Plane
Dimension
Section
Level
Text
Views (概览)
Architectural
Legends
Schedules/Quantities
Sheets (全部)
Families
Groups
View
Modeling
Drafting
Rendering
Site
Massing
Room and Area
Grids : Grid : 1

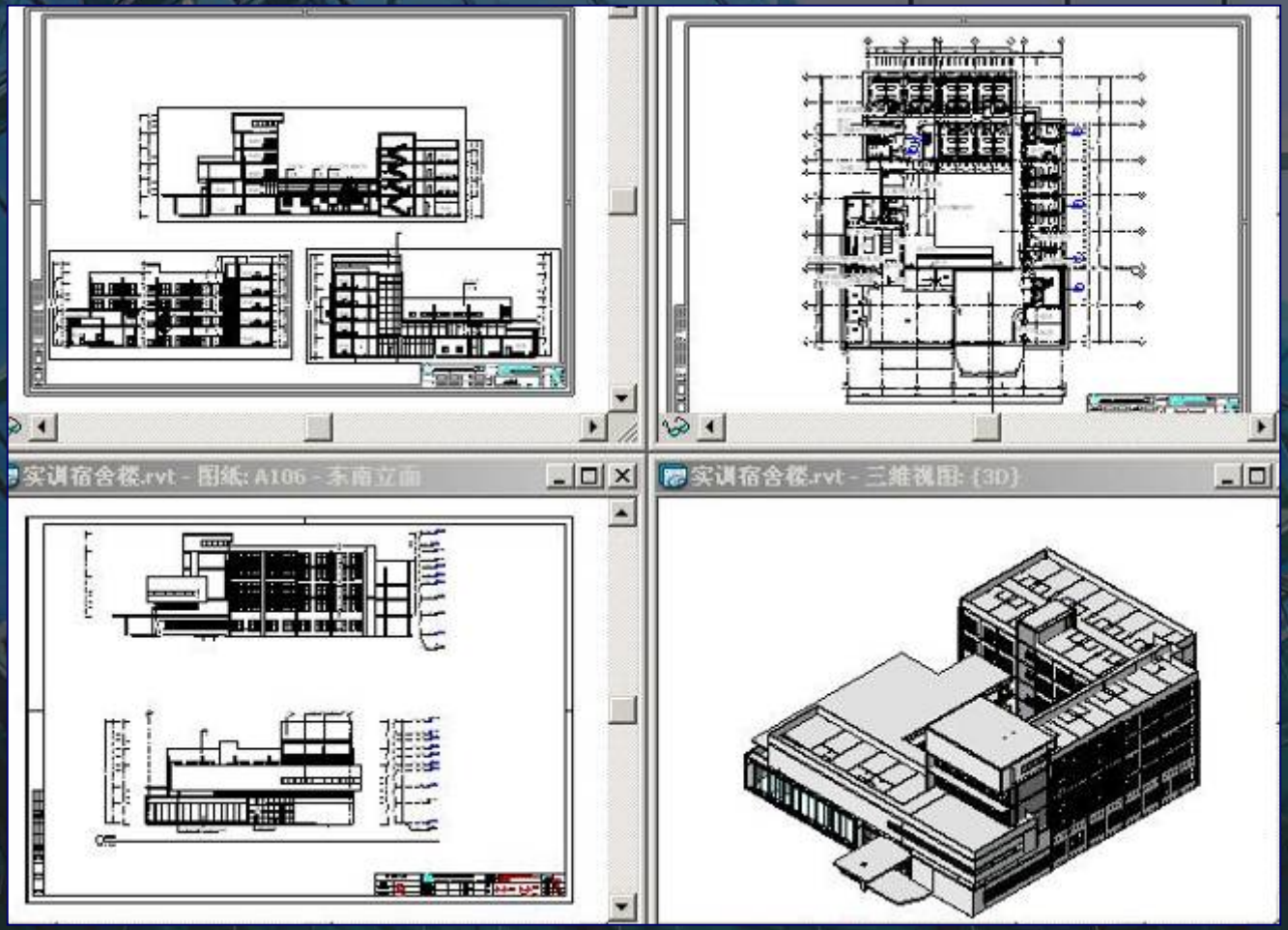

Autodesk Revit Building 8
文件(F) 编辑(E) 视图(V) 建模(M) 绘图(D) 场地(I) 工具(T) 设置(S) 窗口(W) 帮助(H)
基本
修改
视图 (全部)
楼层平面
3F_comercial
4F_comercial
B1
F2
F3
F4
F5
GF
RF
Site
三维视图
{3D}
内庭院透视
室内中庭透视
西北方向透视
西南方向透视
立面 (建筑立面)
东
北
南
西
剖面 (建筑剖面)
剖面 1
楼梯
楼梯 1
图例
明细表/数量
图纸 (全部)
A102 - 一层平面
族
组
模型
详图
附加详图
视图
建模
绘图
渲染
体量
Haier Holiday Inn_0919_1.rvt - 立面: 南
Haier Holiday Inn_0919_1.rvt - 立面: 东
Haier Holiday Inn_0919_1.rvt - 三维视图: 室内中庭透视
Haier Holiday Inn_0919_1.rvt - 楼层平面: GF
1 : 100
1 : 100
透视图
1 : 200
单击进行选择。单击前按下 TAB 键可选择其他项目。按住 CTRL 键并单击可添加和删除。单击左箭头可恢复上次选择。

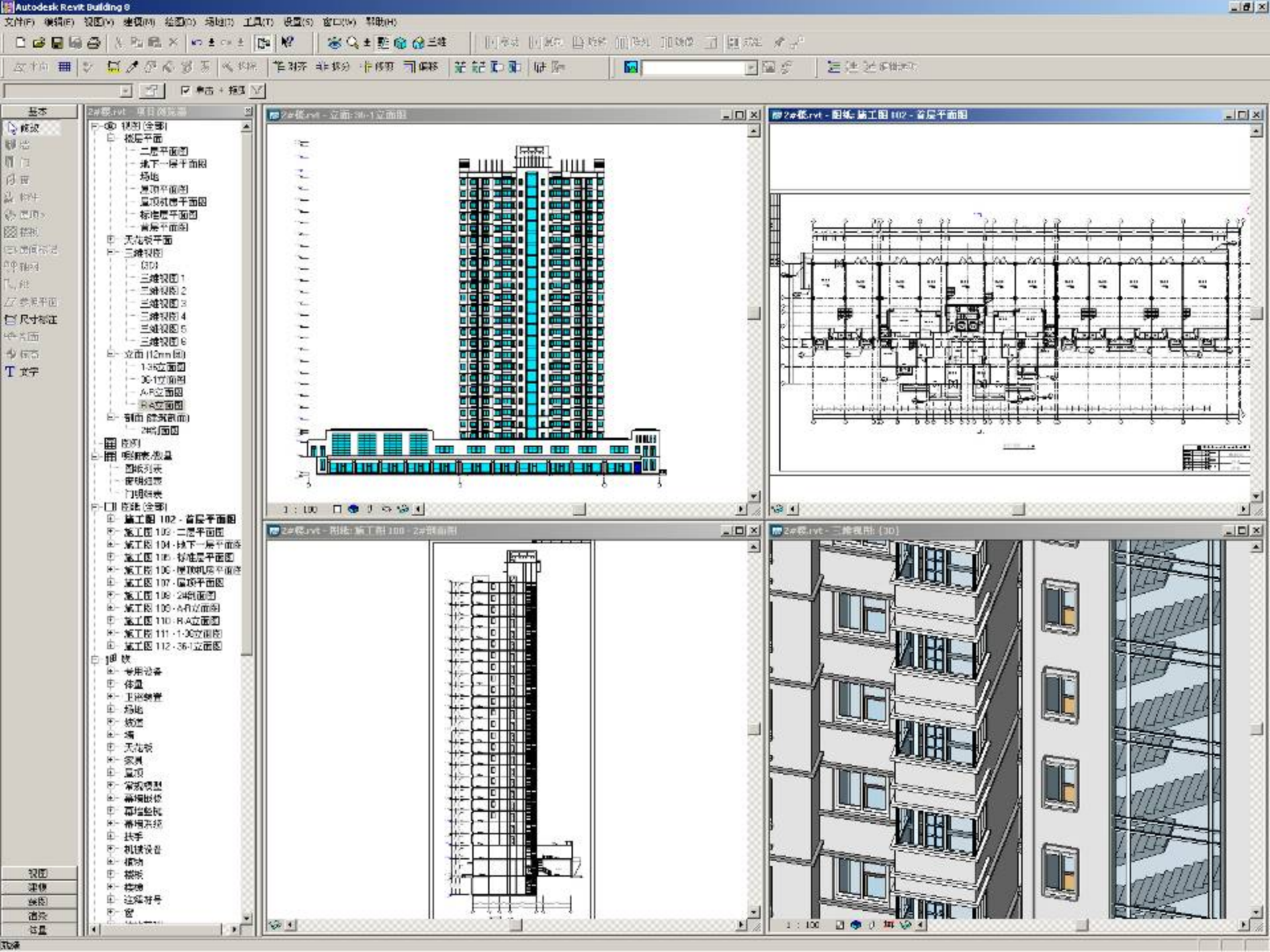
广东省建筑设计研究院 建筑师：郑凯帆

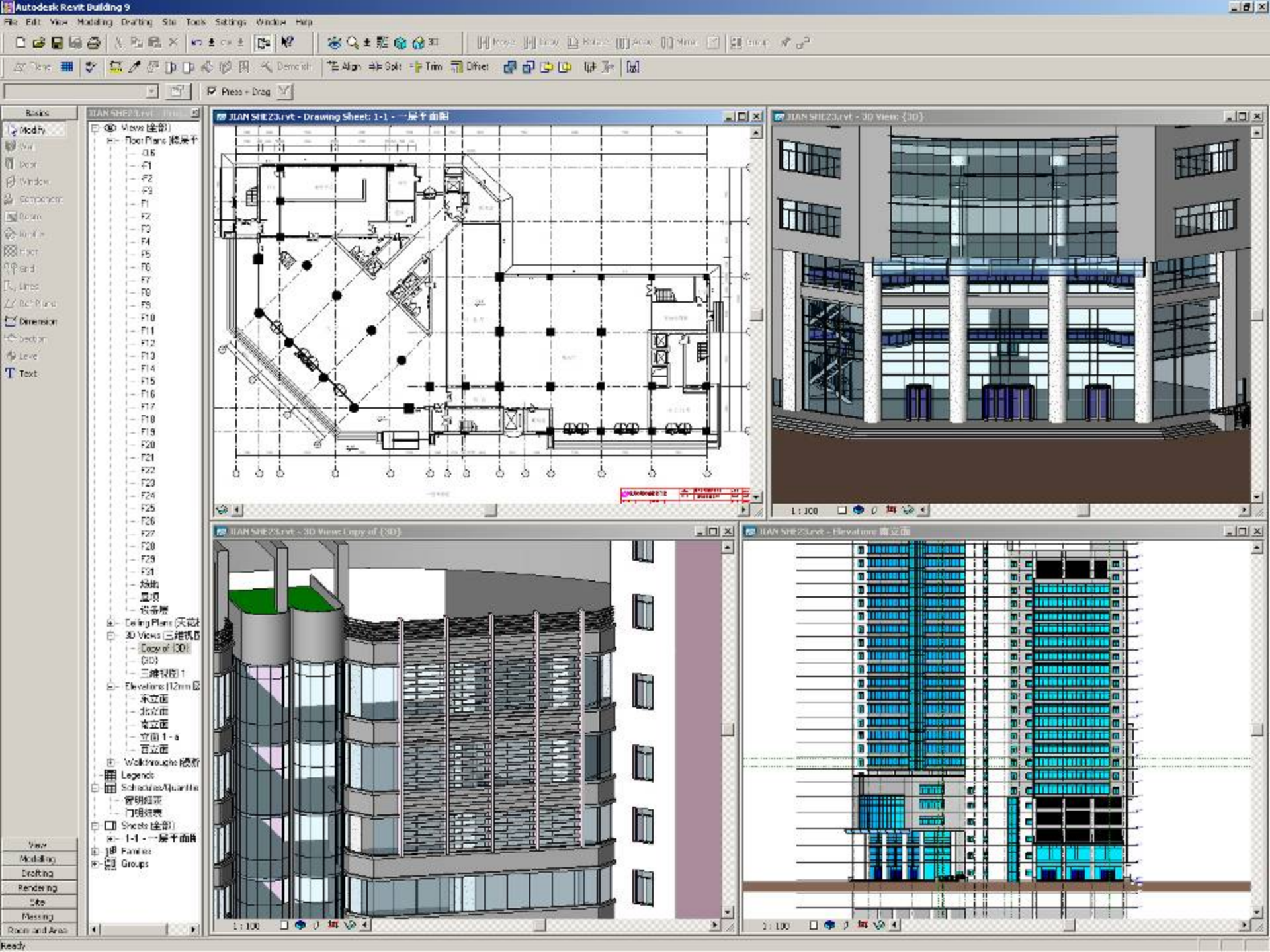


盛邦（上海）咨询有限公司成都分公司 建筑师：许 燕

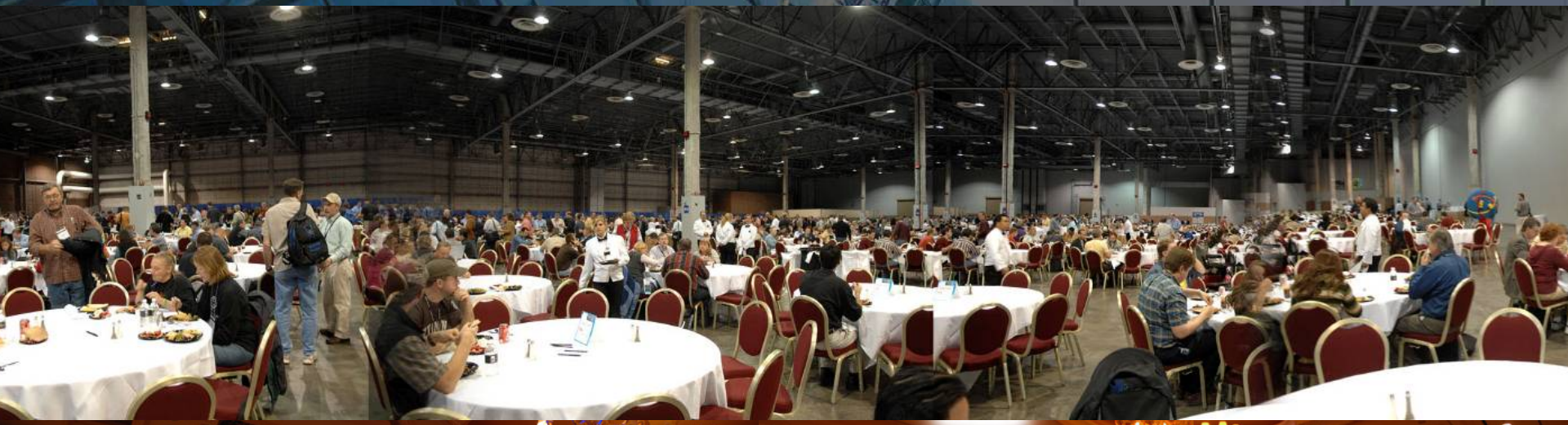
- 中国民航飞行学院模拟机训练中心




Autodesk Revit Building 8
文件(F) 编辑(E) 视图(V) 建模(M) 绘图(D) 场地(T) 工具(T) 设置(S) 窗口(W) 帮助(H)
基本
视图
详图
图纸
族
连接
设置
2#楼.rvt - 项目浏览器
视图 (全部)
楼层平面
二层平面图
地下一层平面图
场地
屋顶平面图
屋顶机房平面图
标准层平面图
首层平面图
无光板平面
三维视图
{3D}
三维视图 1
三维视图 2
三维视图 3
三维视图 4
三维视图 5
三维视图 6
立面 (12mm图)
1-36立面图
36-1立面图
A-F立面图
F-A立面图
剖面 (建筑剖面)
2#剖面图
图例
明细表/数量
图纸列表
窗明细表
门明细表
图纸 (全部)
施工图 102 - 首层平面图
施工图 103 - 二层平面图
施工图 104 - 地下一层平面图
施工图 105 - 标准层平面图
施工图 106 - 屋顶机房平面图
施工图 107 - 屋顶平面图
施工图 108 - 2#剖面图
施工图 109 - A-F立面图
施工图 110 - F-A立面图
施工图 111 - 1-36立面图
施工图 112 - 36-1立面图
族
专用设备
体量
卫浴装置
场地
楼梯
墙
无光板
家具
屋顶
常规模型
幕墙嵌板
幕墙竖梃
幕墙系统
扶手
机械设备
植物
楼板
结构基础
注释符号
窗
2#楼.rvt - 立面: 36-1立面图
2#楼.rvt - 图纸: 施工图 102 - 首层平面图
2#楼.rvt - 图纸: 施工图 108 - 2#剖面图
2#楼.rvt - 三维视图: {3D}
1 : 100


Autodesk Revit Building 9
File Edit View Modeling Drafting Site Tools Settings Window Help
Basics
Modify
Wall
Door
Window
Component
Room
Roof
Floor
Grid
Lines
Ref Plane
Dimension
Section
Level
Text
JIAN SHE23.rvt - Drawing Sheet: 1-1 - 一层平面图
JIAN SHE23.rvt - 3D View: {3D}
JIAN SHE23.rvt - 3D View: Copy of {3D}
JIAN SHE23.rvt - Elevations: 南立面
Views (全部)
Floor Plans 楼层平
Ceiling Plans 天花
3D Views 三维视图
Copy of {3D}
{3D}
三维视图 1
Elevations (12mm
东立面
北立面
西立面
立面 1 - a
南立面
Walkthroughs 漫游
Legends
Schedules/Quantities
管线明细表
门明细表
Sheets (全部)
1-1 - 一层平面图
Families
Groups
View
Modeling
Drafting
Rendering
Site
Massing
Room and Area
Ready

Is the Building Industry changing?



GSA U.S. General Services Administration

SEARCH

HOME | BUILDINGS | PRODUCTS | SERVICES | TECHNOLOGY | POLICY | ABOUT GSA

Design and Construction

- Overview
- Architecture & Engineering
- CAD Standards
- 3D-4D Building Information Modeling
  - 3D-4D-BIM Overview
  - Spatial Program Validation
  - 4D Phasing
  - 3D Laser Scanning
  - Energy and Sustainability
  - BIM Library
- Commissioning
- Construction Excellence
- Design Excellence and the Arts
- Facility Access for the Disabled
- Sustainable Design
- Urban Development
- Design and Construction Delivery Process

Home > Buildings > Public Buildings > Design and Construction > 3D-4D Building Information Modeling

3D-4D Building Information Modeling

Since 2003, the General Services Administration (GSA) through its Public Buildings Service (PBS) Office of Chief Architect (OCA) has established the National 3D-4D-BIM Program. OCA has completed 10 pilot projects. It has 11 pilot projects underway in its current capital program, while assessing and supporting 3D, 4D, Building Information Modeliing (BIM) applications in over 25 ongoing projects across the nation. The power of visualization, coordination, simulation, and optimization from three-dimensional (3D), four-dimensional (4D), and BIM computer technologies allow GSA to more effectively meet customer, design, construction, and program requirements. GSA is committed to a strategic and incremental adoption of 3D, 4D, BIM technologies.

There is a progression from 2D to 3D, 4D and BIM. While 3D models make valuable contributions to communications, not all 3D models qualify as BIM models since a 3D geometric representation is only part of the BIM concept.

Critical to successful integration of computer models into project coordination, simulation, and optimization is the inclusion of information—the "I" in BIM—to generate feedback. As a shared knowledge resource, BIM can serve as a reliable basis for decision making and reduce the need for re-gathering or re-formatting information. GSA is currently exploring the use of BIM technology throughout a project's lifecycle in the following areas: spatial program validation, 4D phasing, laser scanning, energy and sustainability, and courts design validation.

For all major projects (prospectus-level) receiving design funding in Fiscal Year 2007 and beyond, GSA will require spatial program BIMs be the minimum requirements for submission to OCA for Final Concept approvals by the PBS Commissioner and the Chief Architect. At the same time, all GSA projects are encouraged to deploy mature 3D, 4D, and BIM technologies—spatial program validation and beyond—at strategic project phases in support of specific project challenges.

BIM Program Flyer

The following are highlights of the GSA National 3D-4D-BIM Program:

- Established policy to phase in 3D, 4D, and BIM adoption for all major projects
- Leading 3D-4D-BIM pilot application on current capital projects
- Providing expert support and assessment for ongoing capital projects to incorporate 3D, 4D, and BIM technologies
- Assessing industry readiness and technology maturity
- Developed GSA-specific incentives for 3D-4D-BIM
- Developed solicitation and contractual language for 3D-4D-BIM services
- Partnered with BIM vendors, professional associations, open standard organizations, and academic/research institutions

CONTACTS

Charles Matta
(202) 219-2365
charles.matta@gsa.gov
- View Contact Details

Calvin Kam
(202) 208-0447
calvin.kam @gsa.gov
- View Contact Details

Contact Us

GSA Staff Directory

GSA Organizations

Choose... GO

Abbreviation Look-up

GSA Regions by State

Choose State: AK GO

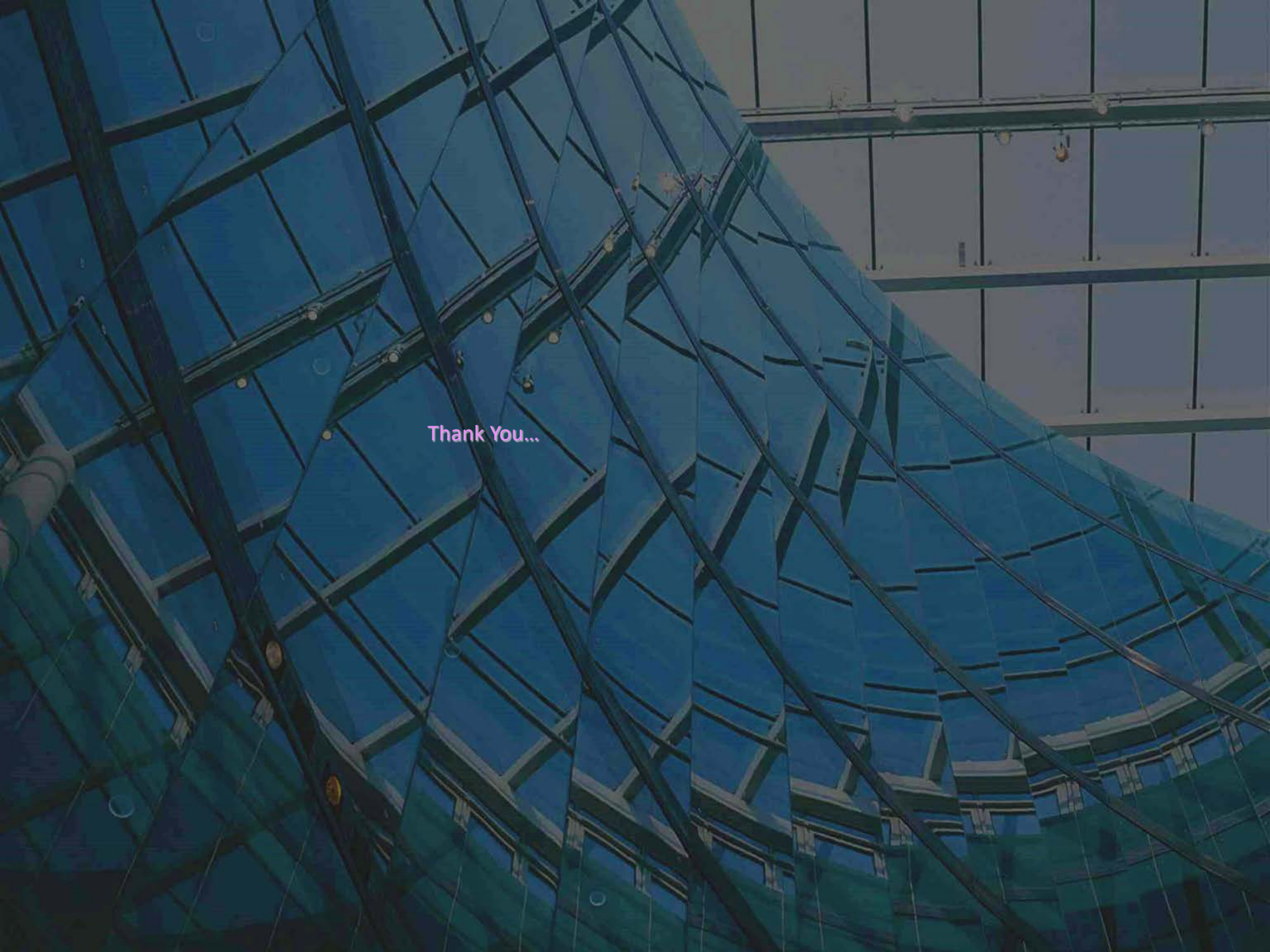
QuickLinks

A-Z Links to GSA Topics

For all major projects (prospectus-level) receiving design funding in Fiscal Year 2007 and beyond, GSA will require spatial program BIMs be the minimum requirements for submission to OCA for Final Concept approvals by the PBS Commissioner and the Chief Architect.

Challenges from the Technology to the Industry

- Participation of all participants
- Redefinition of roles of all Building Industry Participants
- Project Delivery Time
- Fee Structure
- Standard Contract Provision – position of BIM model
- Contractual Relationship
- Other supports – Government, Professional Bodies, Education
- BIM Authorities – Standards and Certification
- …..


Thank You...