Construction IT in Hong Kong: Past, Present and Future

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Good News: the trend of IT adoption in Construction has been increasing and there is evidence of efficiency gain in doing certain tasks.

A survey of IT applications has been conducted among over 250 QS (quantity surveying) firms in HK in 2006.

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IT Applications

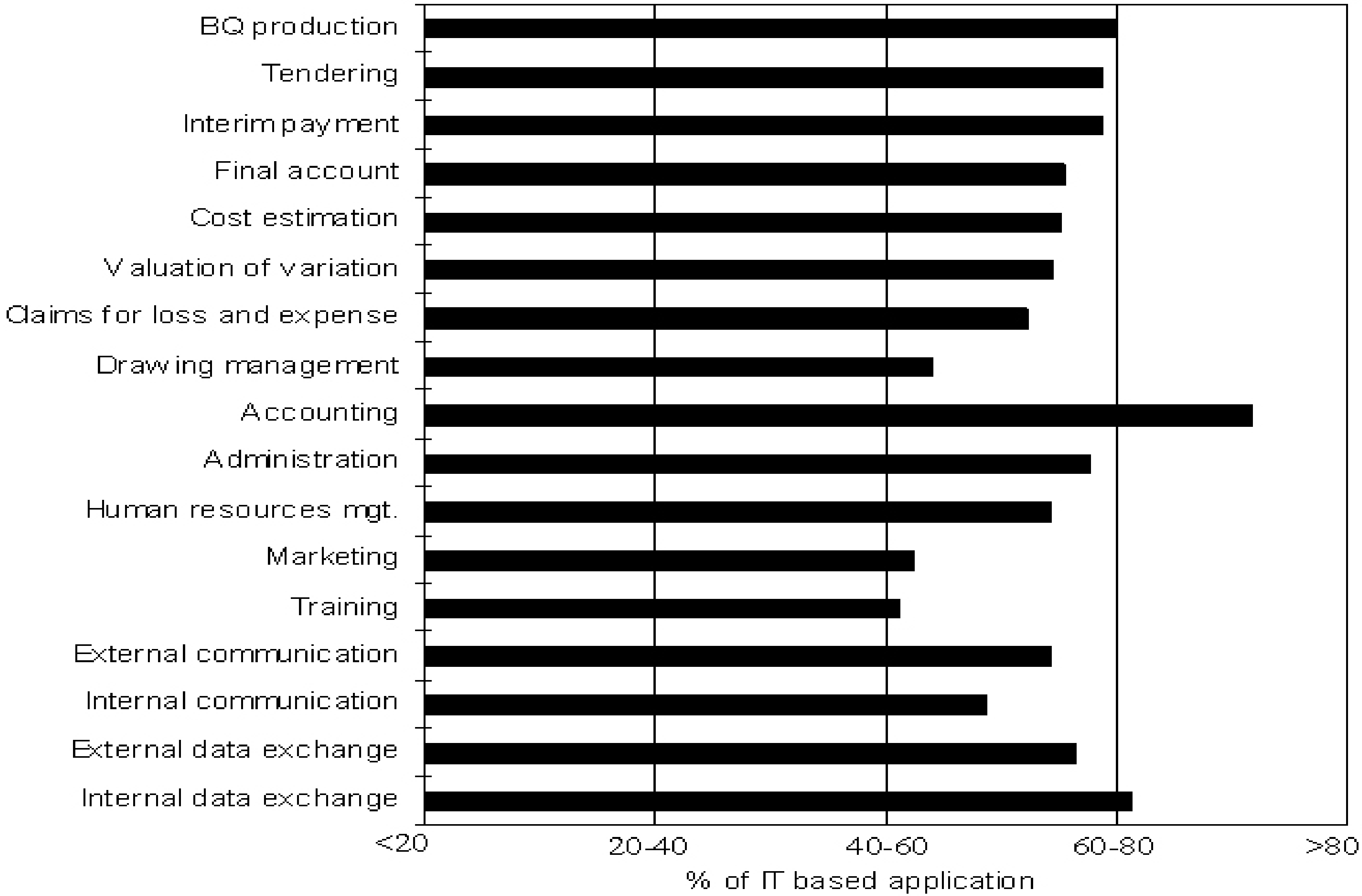


Figure 1: IT applications in QS tasks

IT Packages

Table 2: Software packages used in QS (percent [ranking])

	MS Excel	MSWord	Ripac	MS Project	Atles	Buildsoft	Everest	Others
Cost estimation	57.1[1]	21.4[2]	3.6[4]	10.7[3]	-	-	3.6[4]	3.6[4]
BQ production	39.4[1]	33.3[2]	9.1[3]	-	3.0[6]	6.1[5]	-	9.1[3]
Tendering	38.7[1]	38.7[2]	6.5[3]	6.5[3]	3.2[5]	3.2[5]	-	3.2[5]
Drawing management	64.3[1]	28.6[2]	7.1[3]	-	-	-	-	-
Valuation of variation	55.6[1]	29.6[2]	3.7[3]	3.7[3]	3.7[3]	-	-	3.7[3]
Interim payment	51.9[1]	37.0[2]	3.7[3]	-	3.7[3]	-	-	3.7[3]
Claims for loss and expense	45.2[1]	35.5[2]	-	12.9[3]	-	-	-	6.5[4]
Final account	50.0[1]	36.7[2]	6.7[3]	3.3[4]	-	-	-	3.3[4]

User Satisfaction

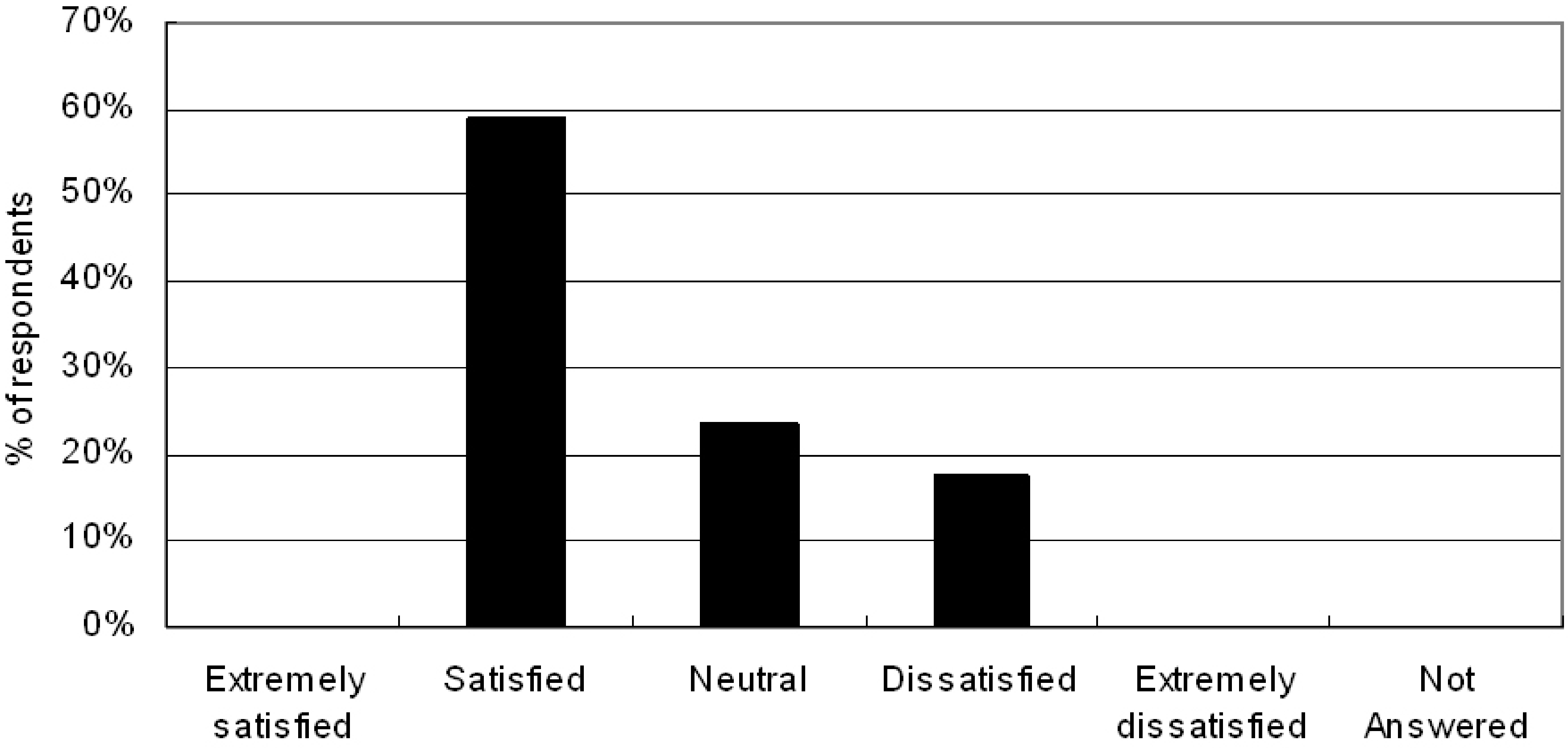


Figure 2: Satisfaction with the use of IT applications

IT BENEFITS

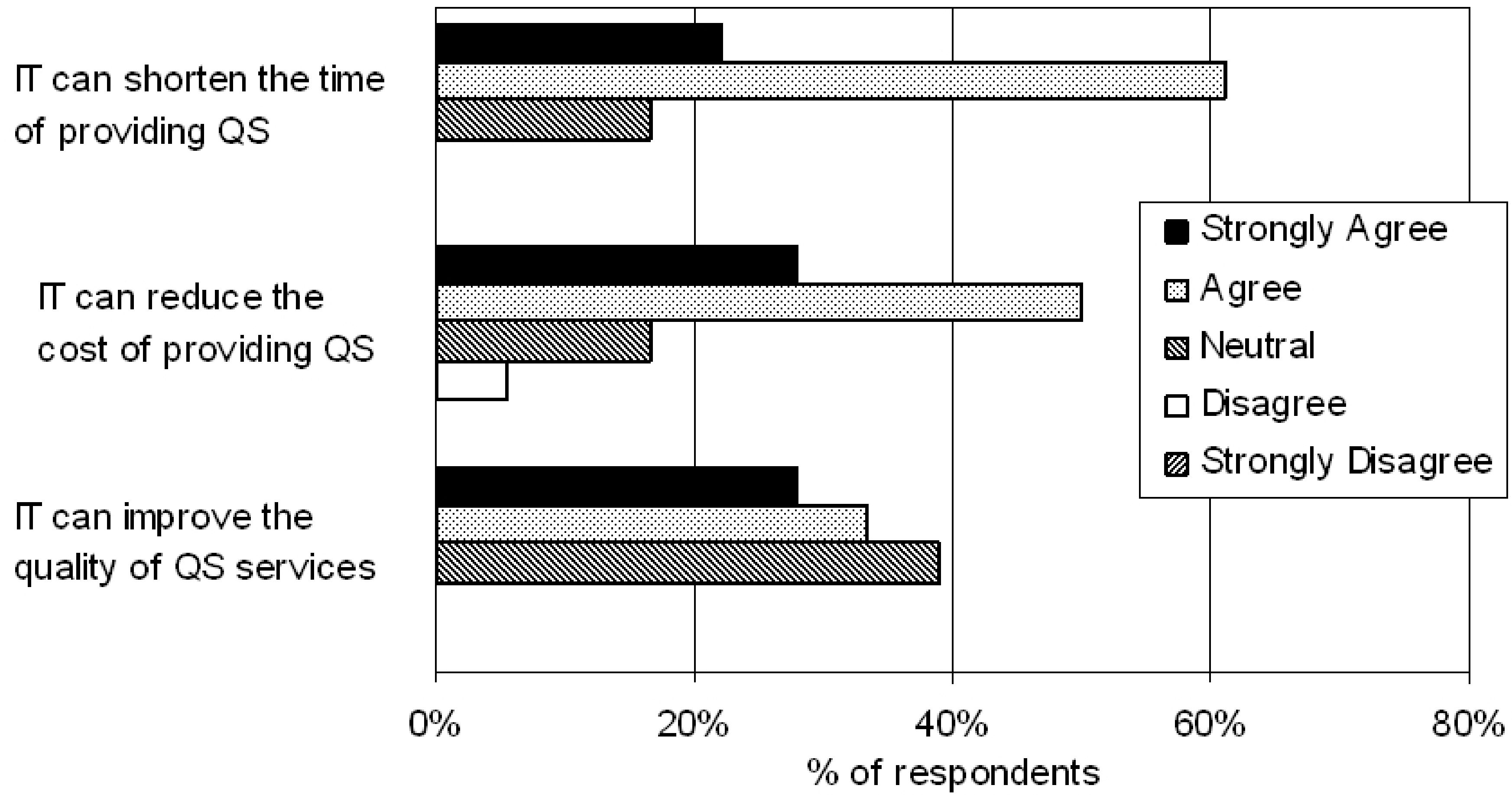


Figure 3: Benefits of IT application

Selection of IT Packages

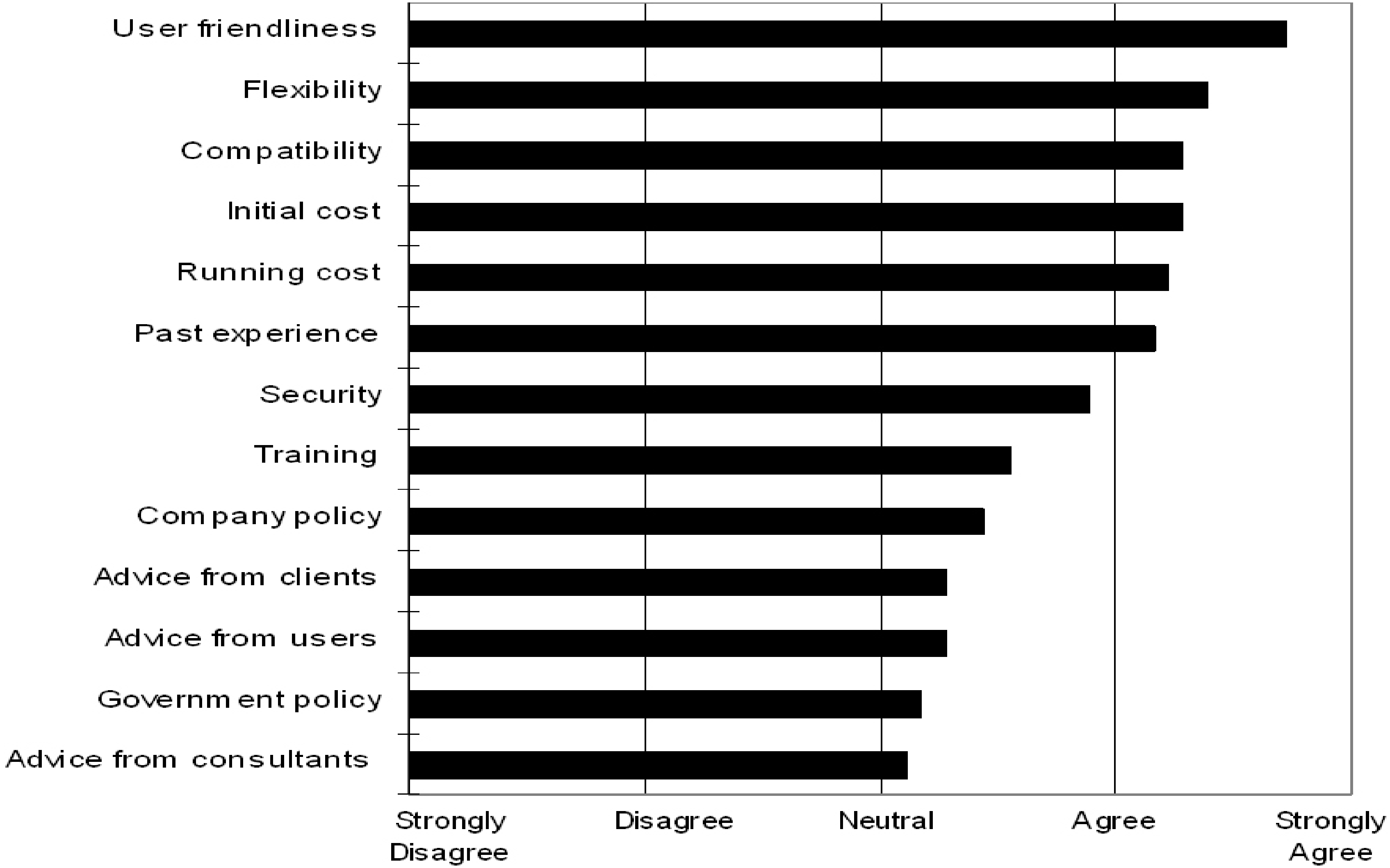


Figure 4: The major factors used in selecting software packages

IT BARRIERS

Figure 5: Obstacles to IT implementation

Bad News: IT has not yet brought in any productivity improvement to the construction industry

Comparison of the manufacturing and construction

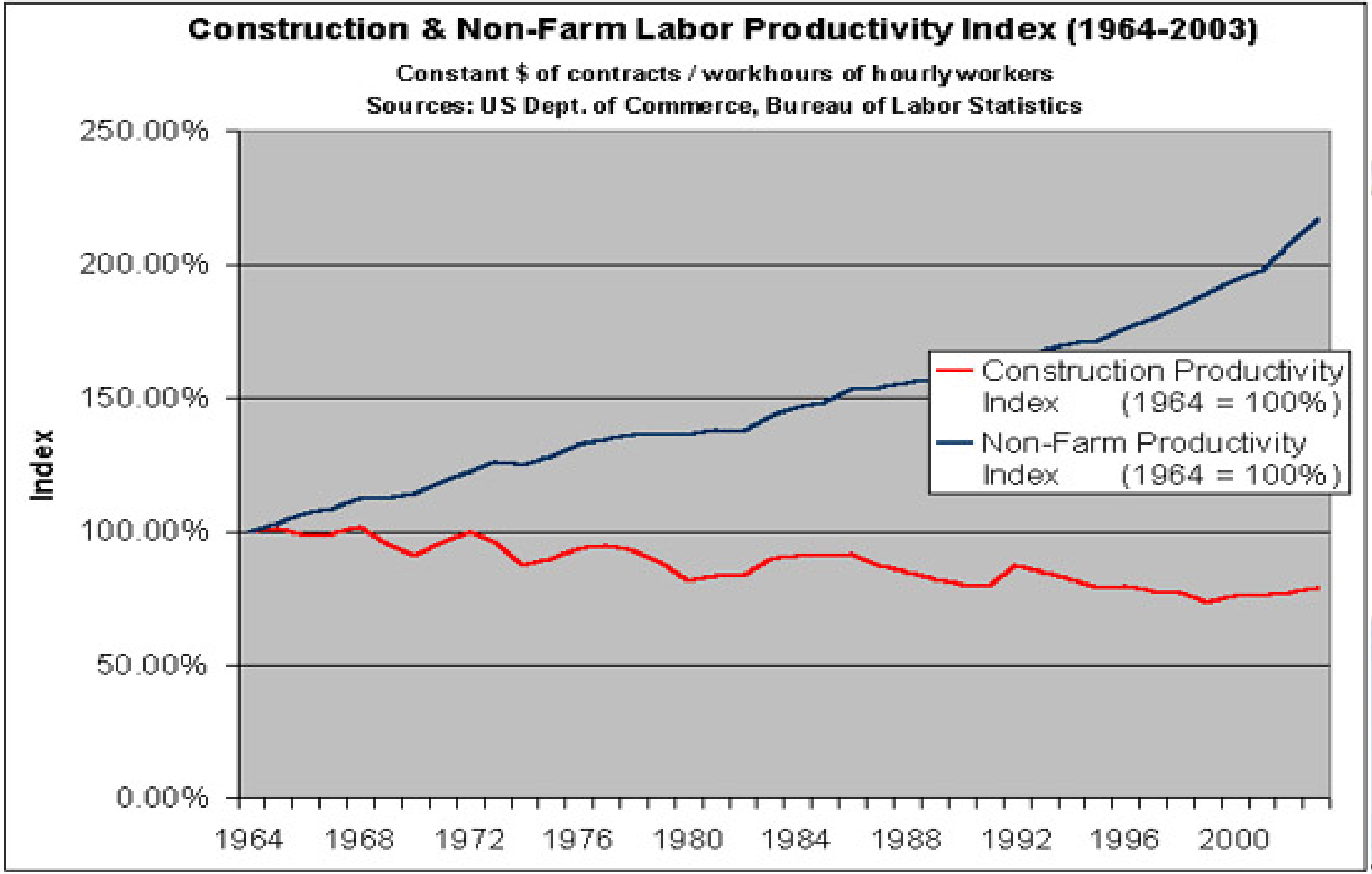
Low productivity in construction in Japan

Comparison of Labor Productivities (Unit: Yen/Man/Hour)

Year	Manufacturing	Construction
1990	3,531	3,714
2004	5,131	2,731

From "2006 Construction Industry Handbook" published by Japan Federation of Construction Contractors et al.

Similar observations have been made in USA, China, Thailand and many other countries.



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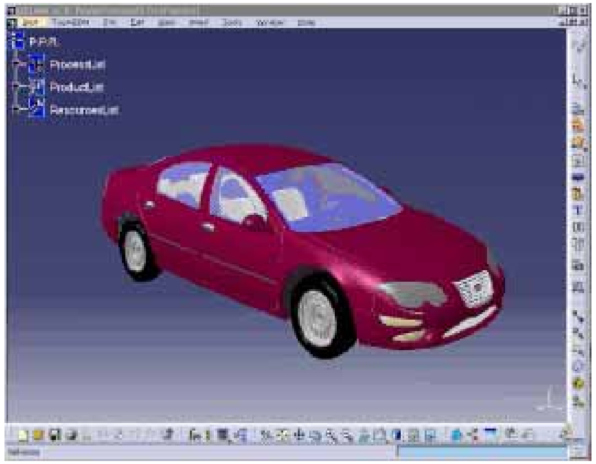
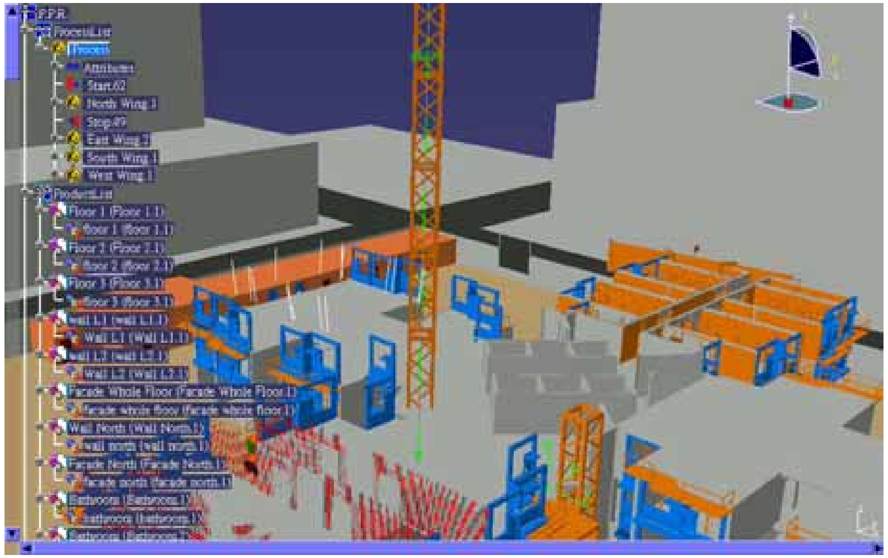
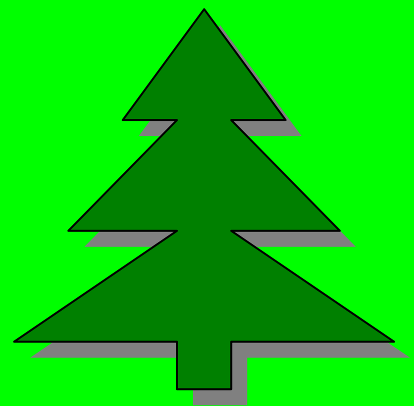
Why?

- The construction industry does not have a fixed production line where the productivity is dominated by the speed of machines;
- We don’t have an effective platform to capture and re-use knowledge
- We could not ‘try before build on site’ .





Possible solution: Virtual Prototyping Technology



Application of VP: IsE Project in HK

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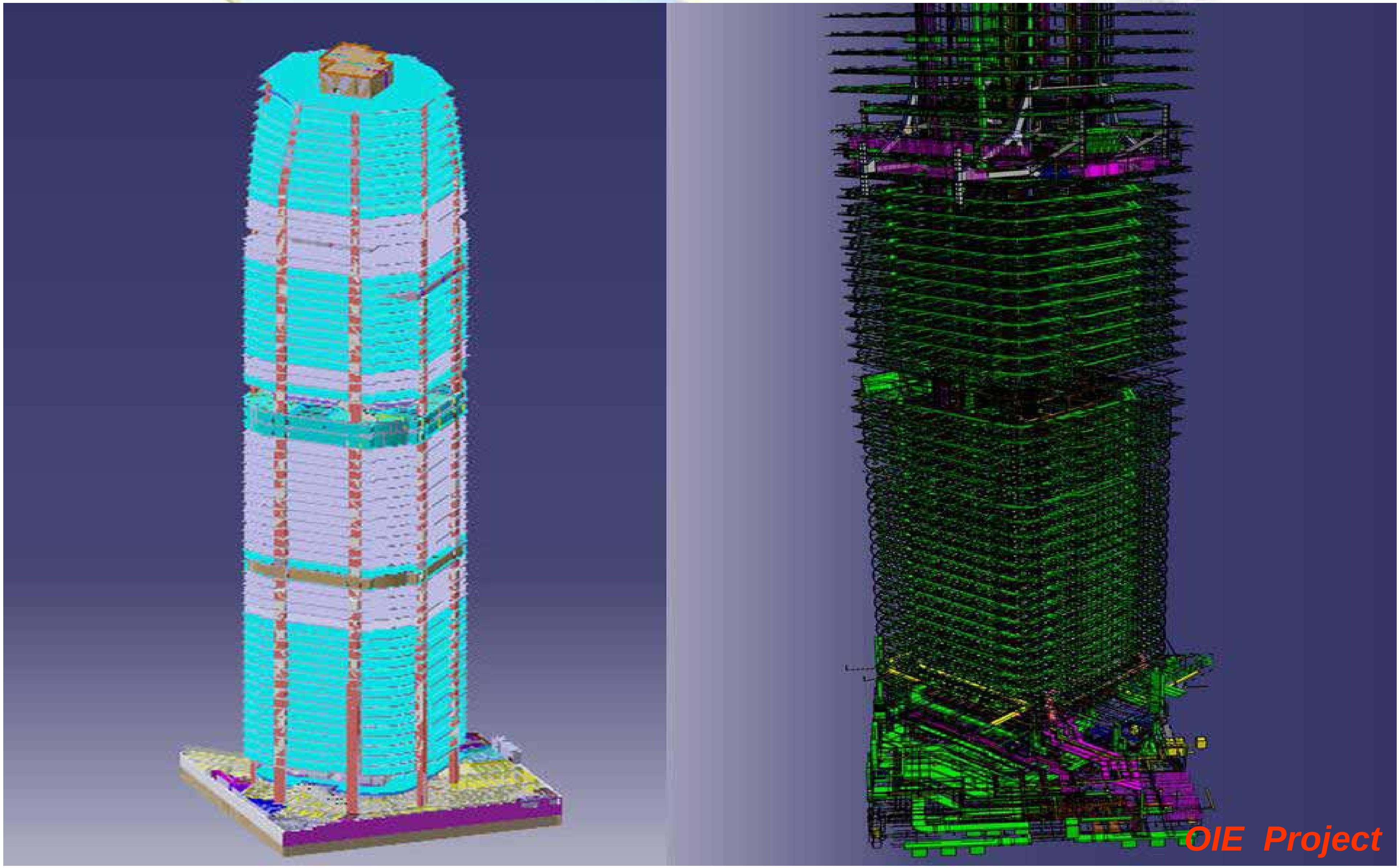
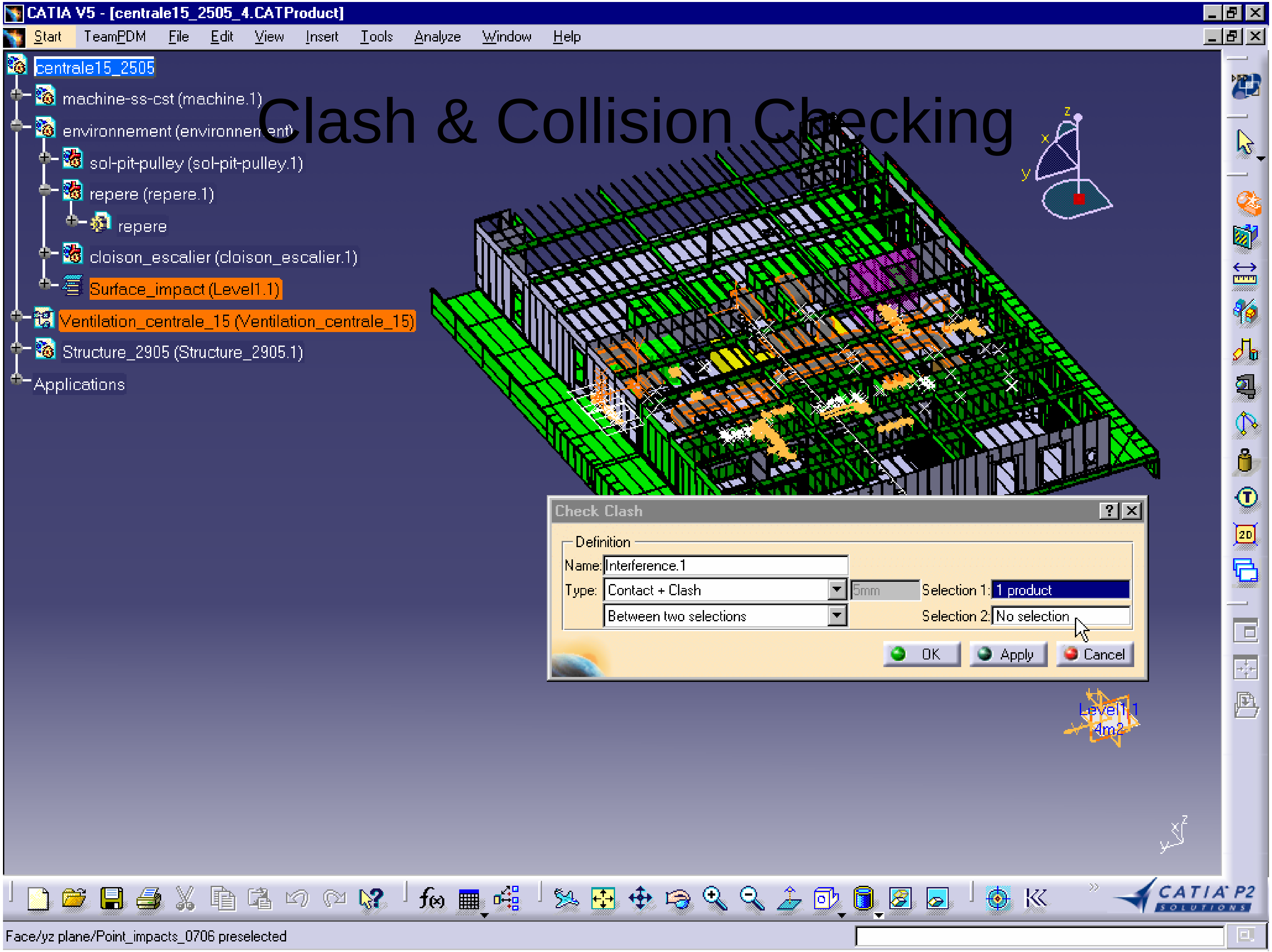
BIM Model



Clash & Collision Checking



Tendering Stage

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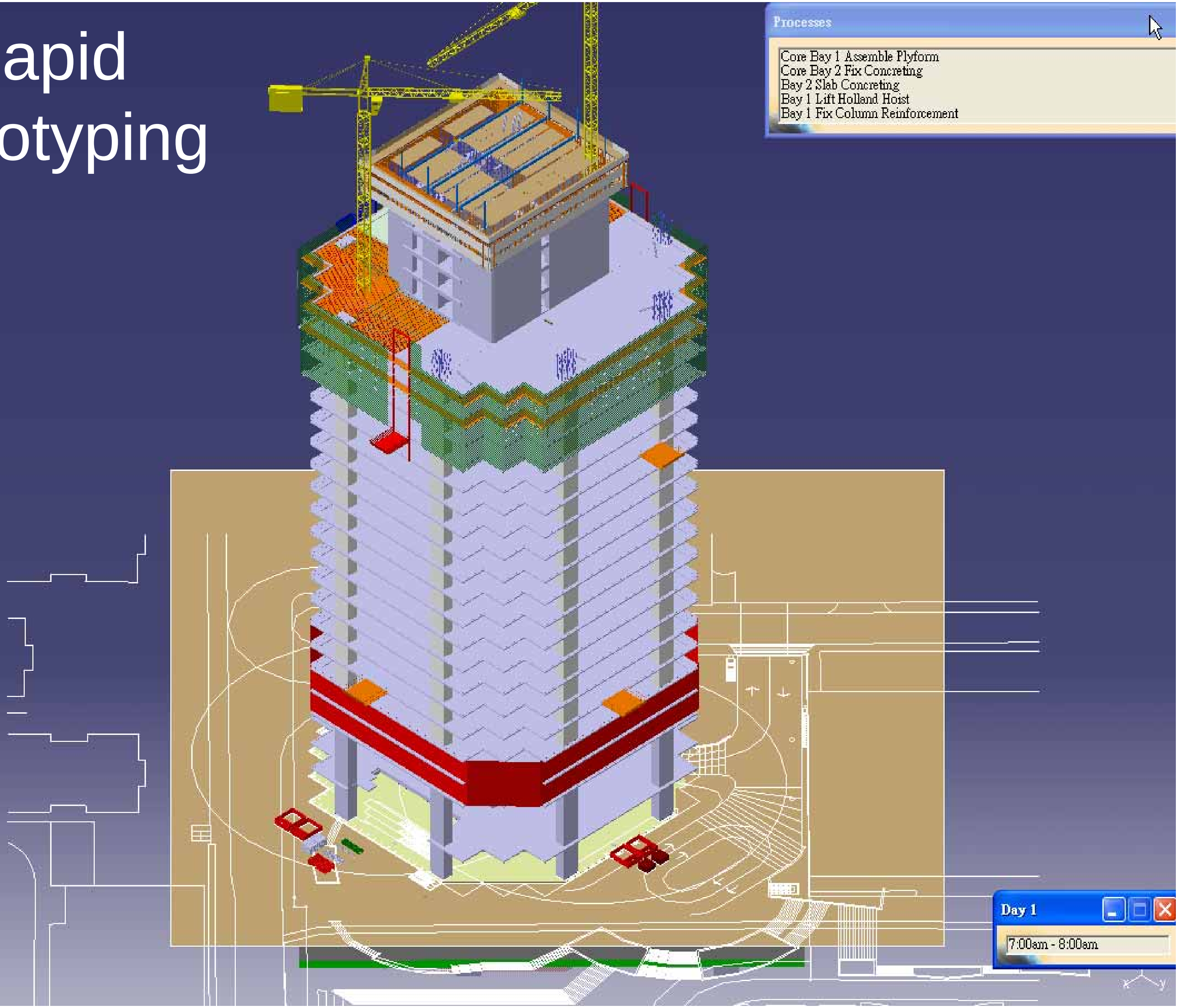
Rapid Prototyping



Construction Stage

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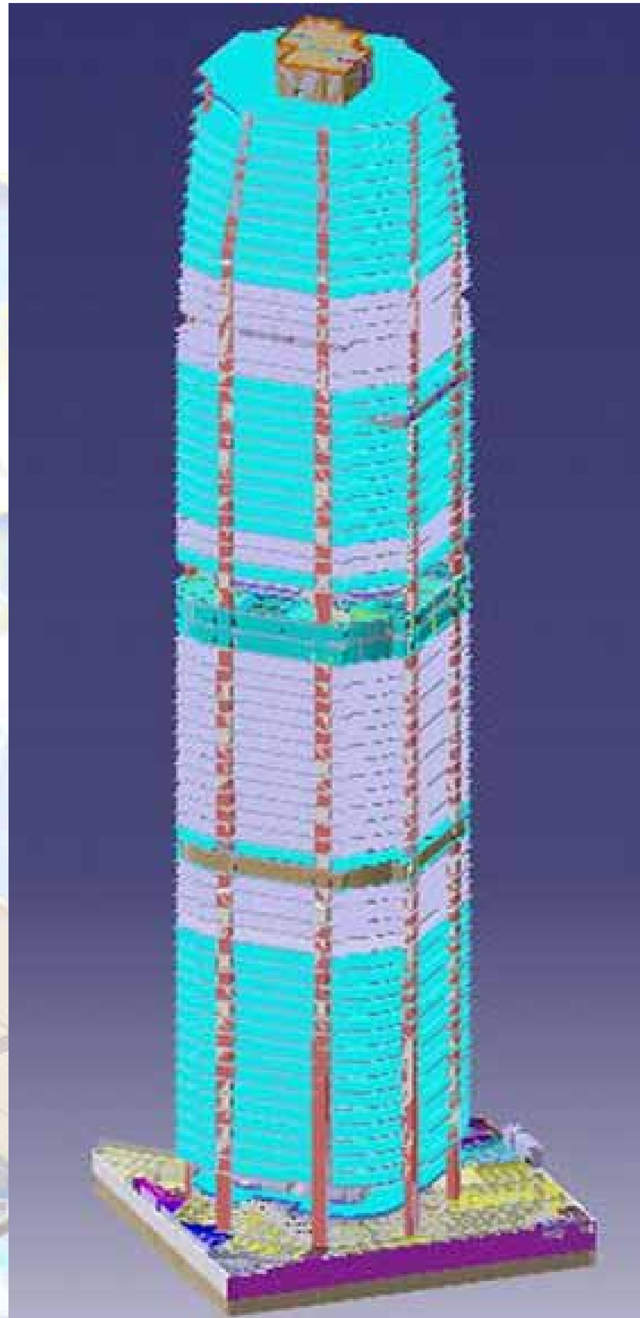
77th floor

Nontypical floor construction

32th floor

Typical floor construction

1st floor



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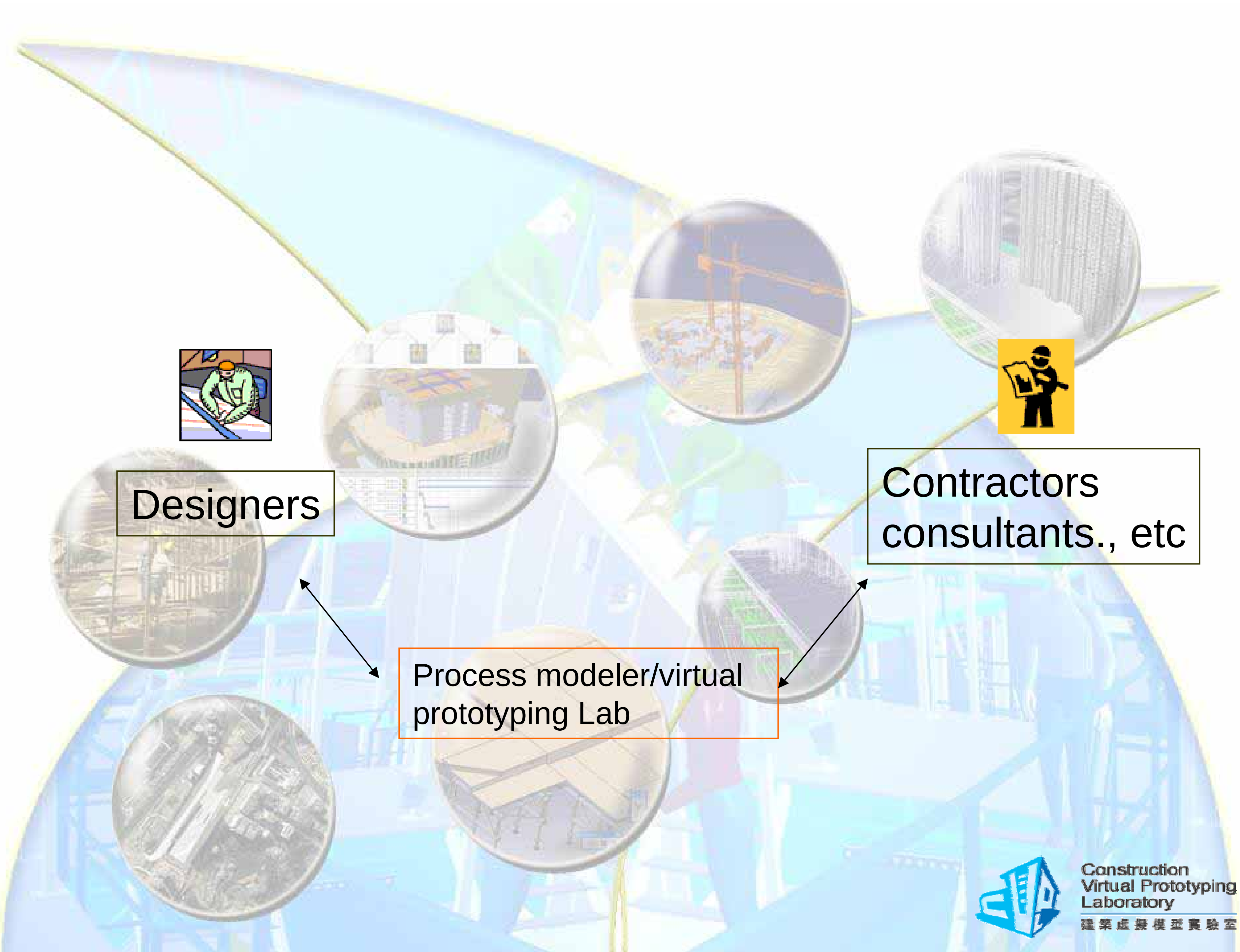
Designers
Contractors consultants., etc
Process modeler/virtual prototyping Lab
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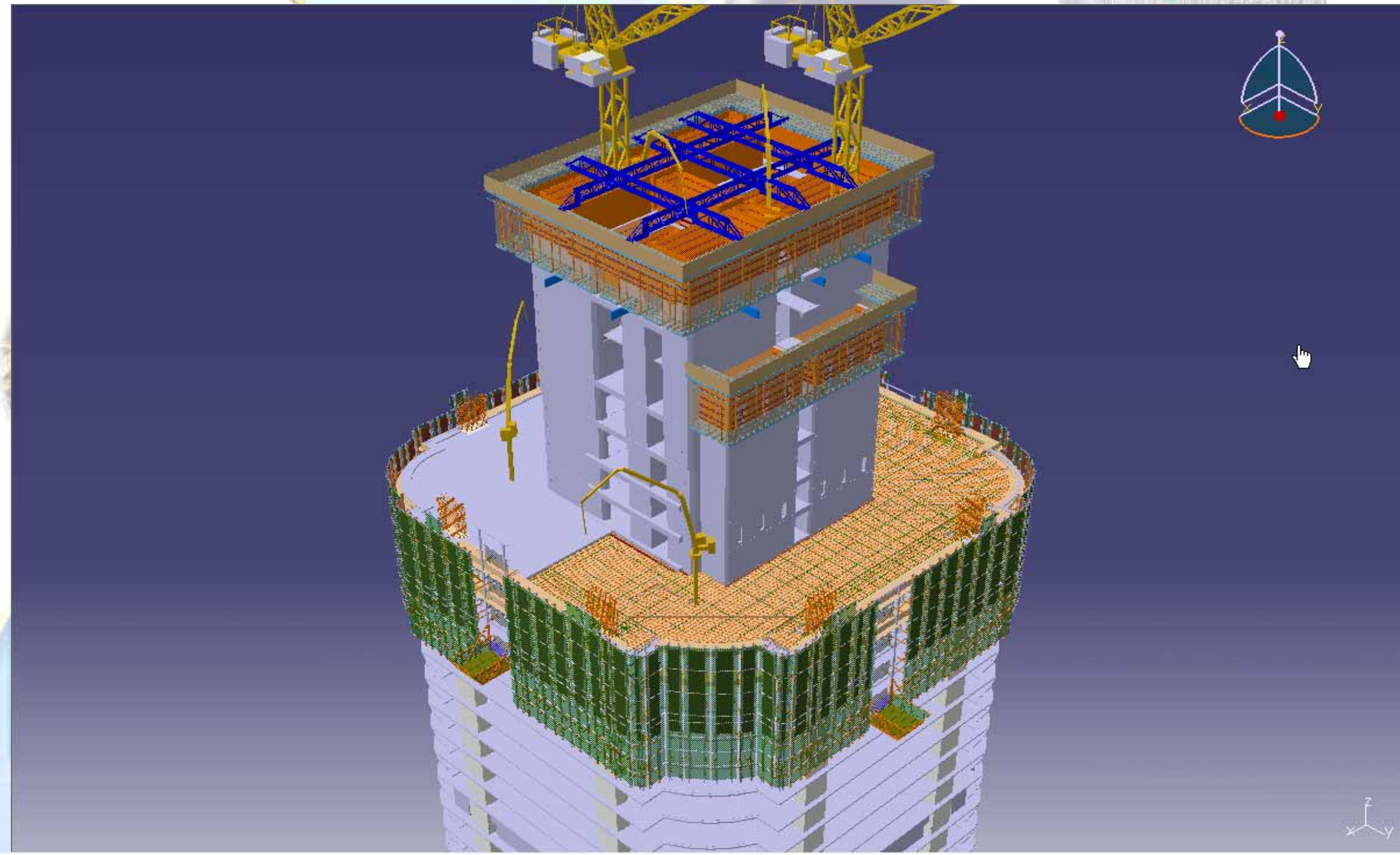
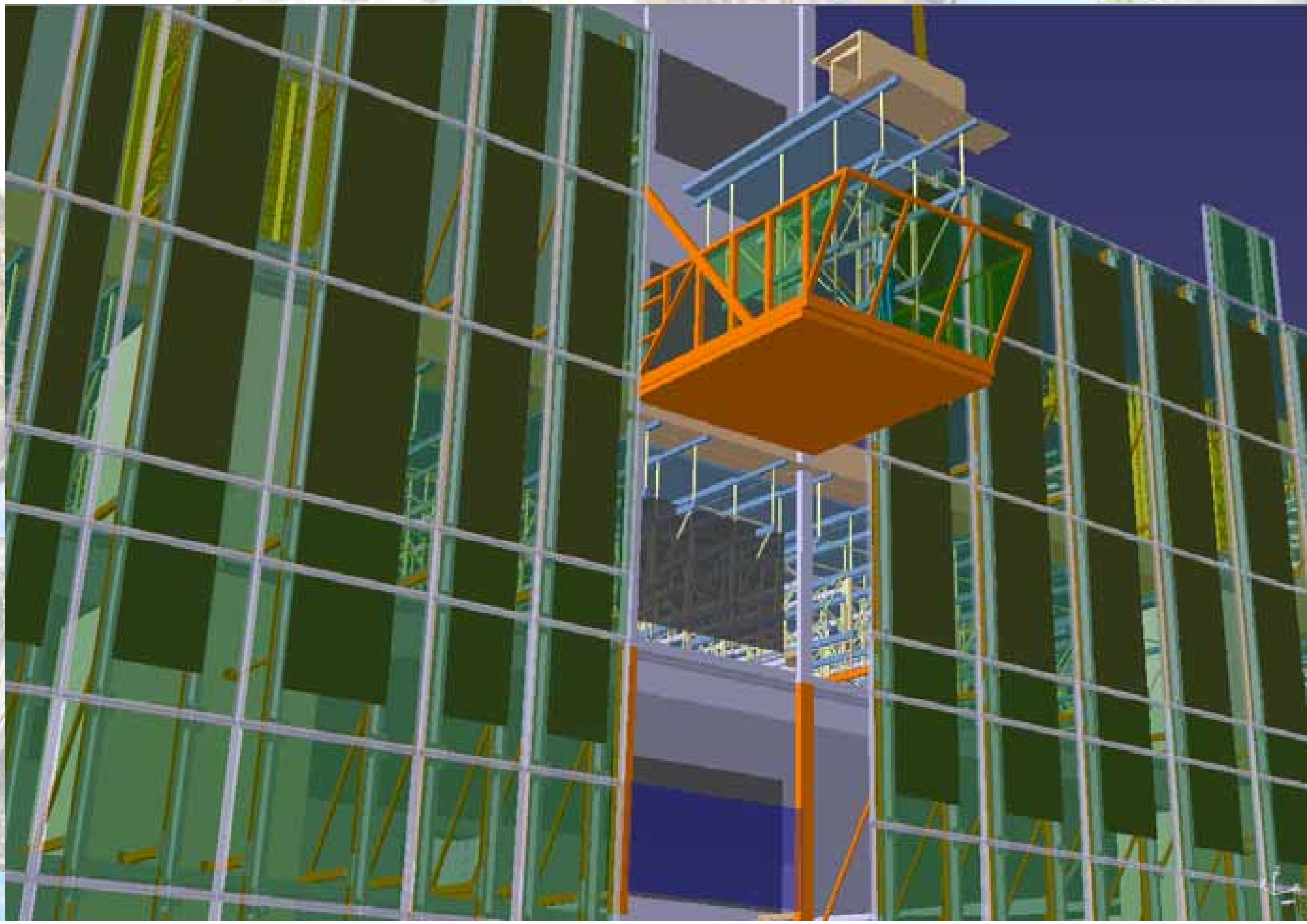
Optimization of 4-Day cycle of Typical Floor construction



Check Conflicts between Activities

- Construction activities can be simulated to check if there are physical conflicts. Remedy efforts such as redesign or reschedule can then be done to prevent conflicts.



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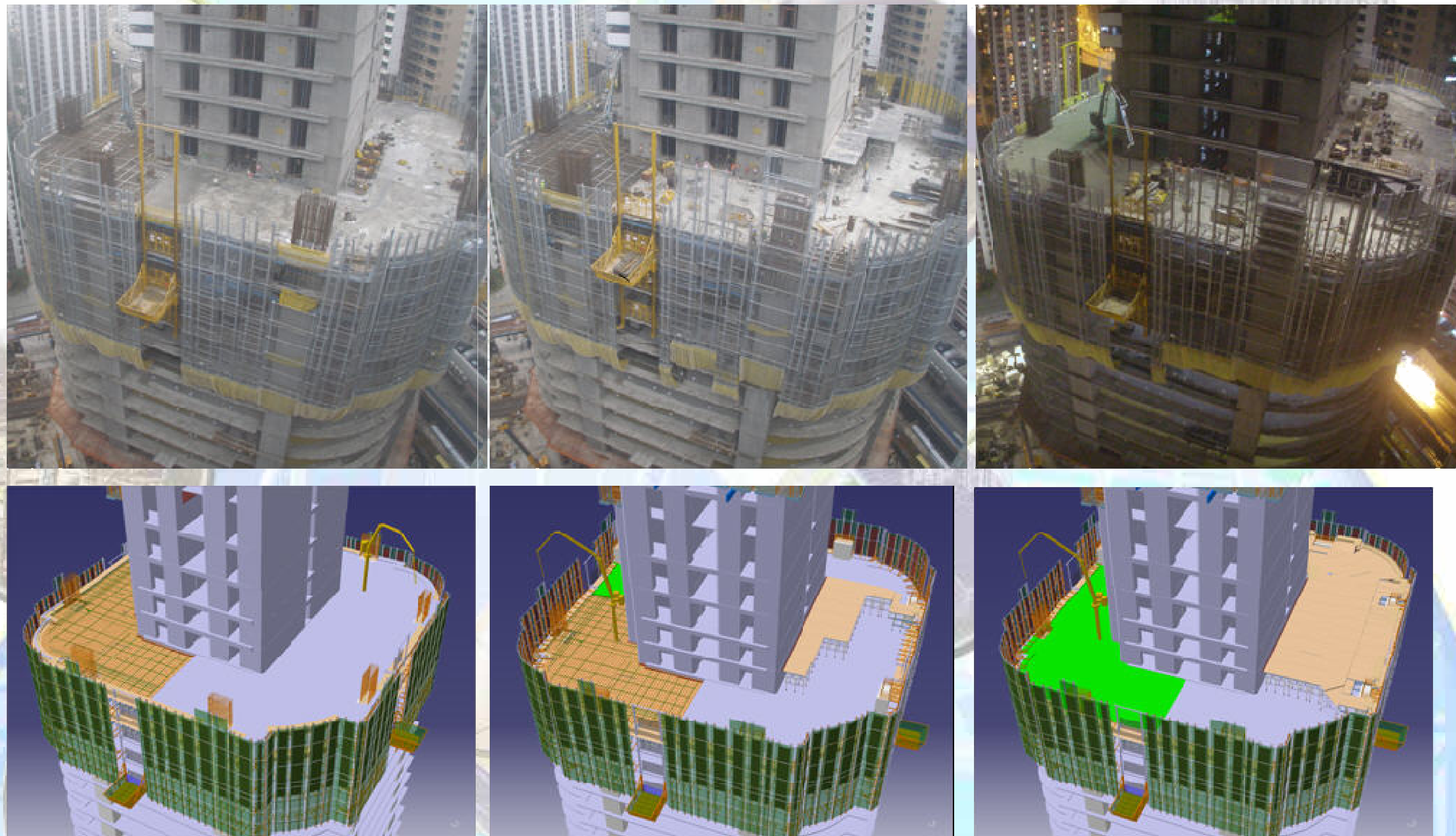
4-Days Cycle
(Reality vs VP) Day 1



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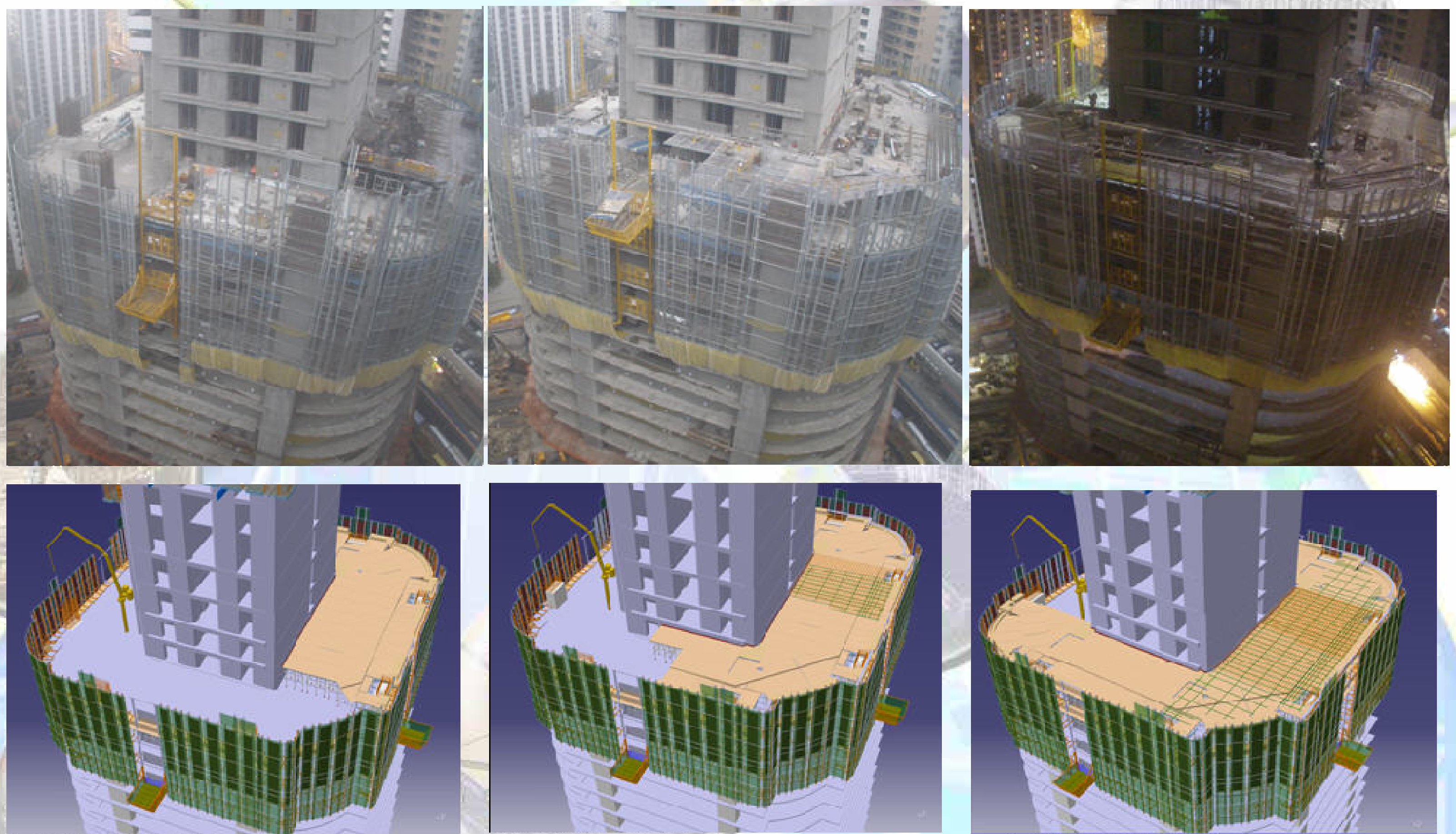
4-Days Cycle
(Reality vs VP) Day 2



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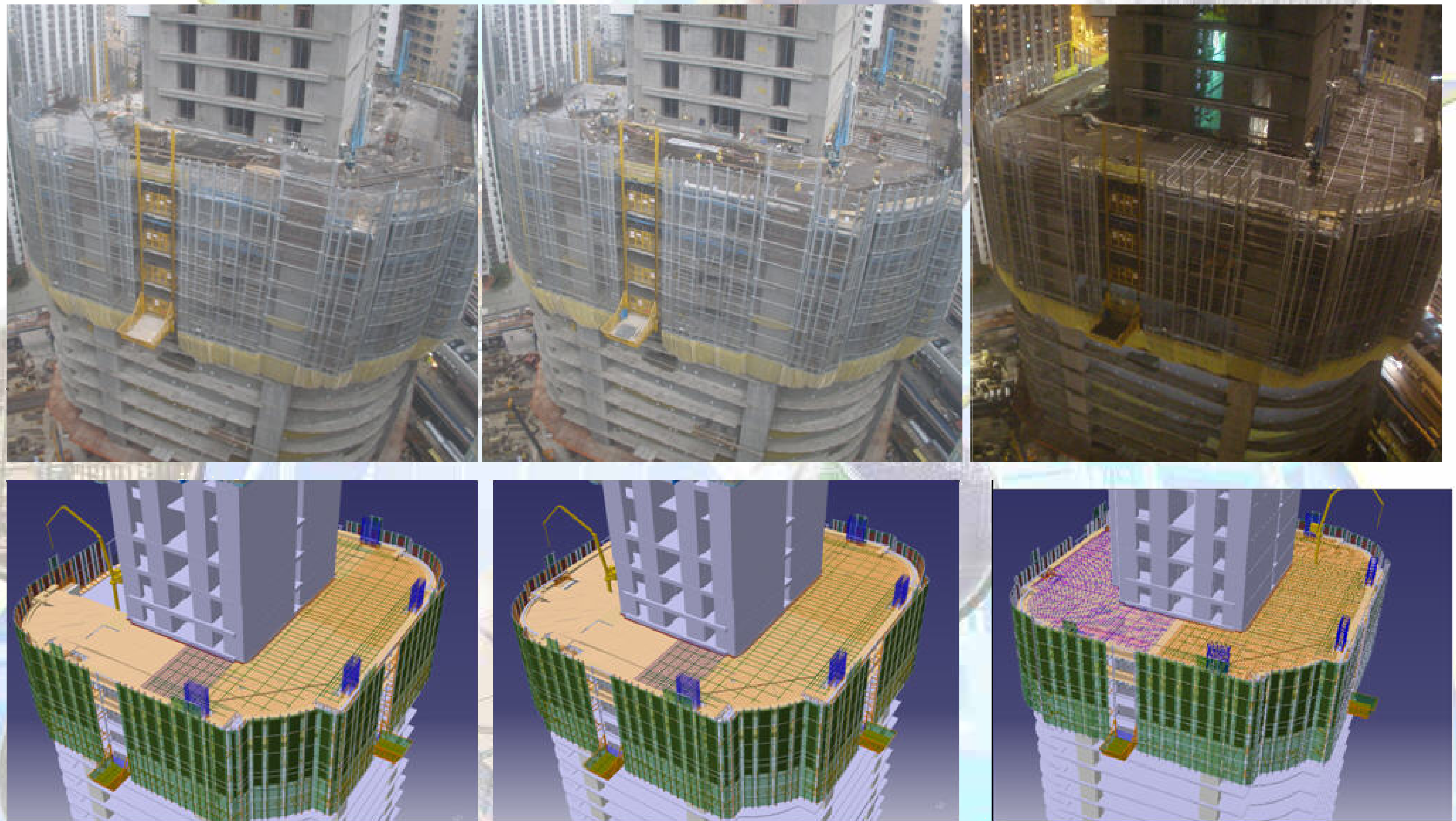
4-Days Cycle

(Reality vs VP) Day 3



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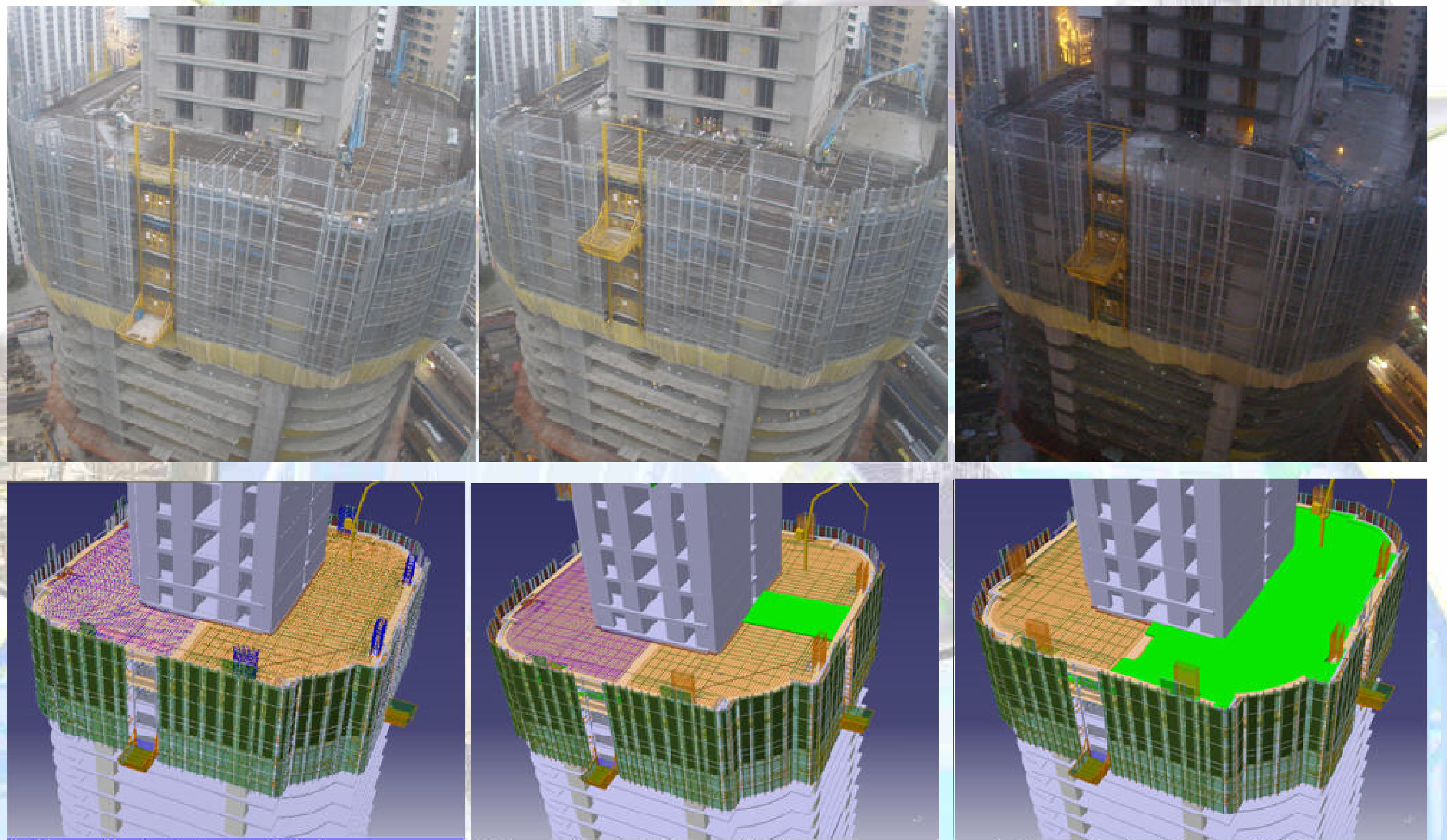
4-Days Cycle
(Reality vs VP) Day 4



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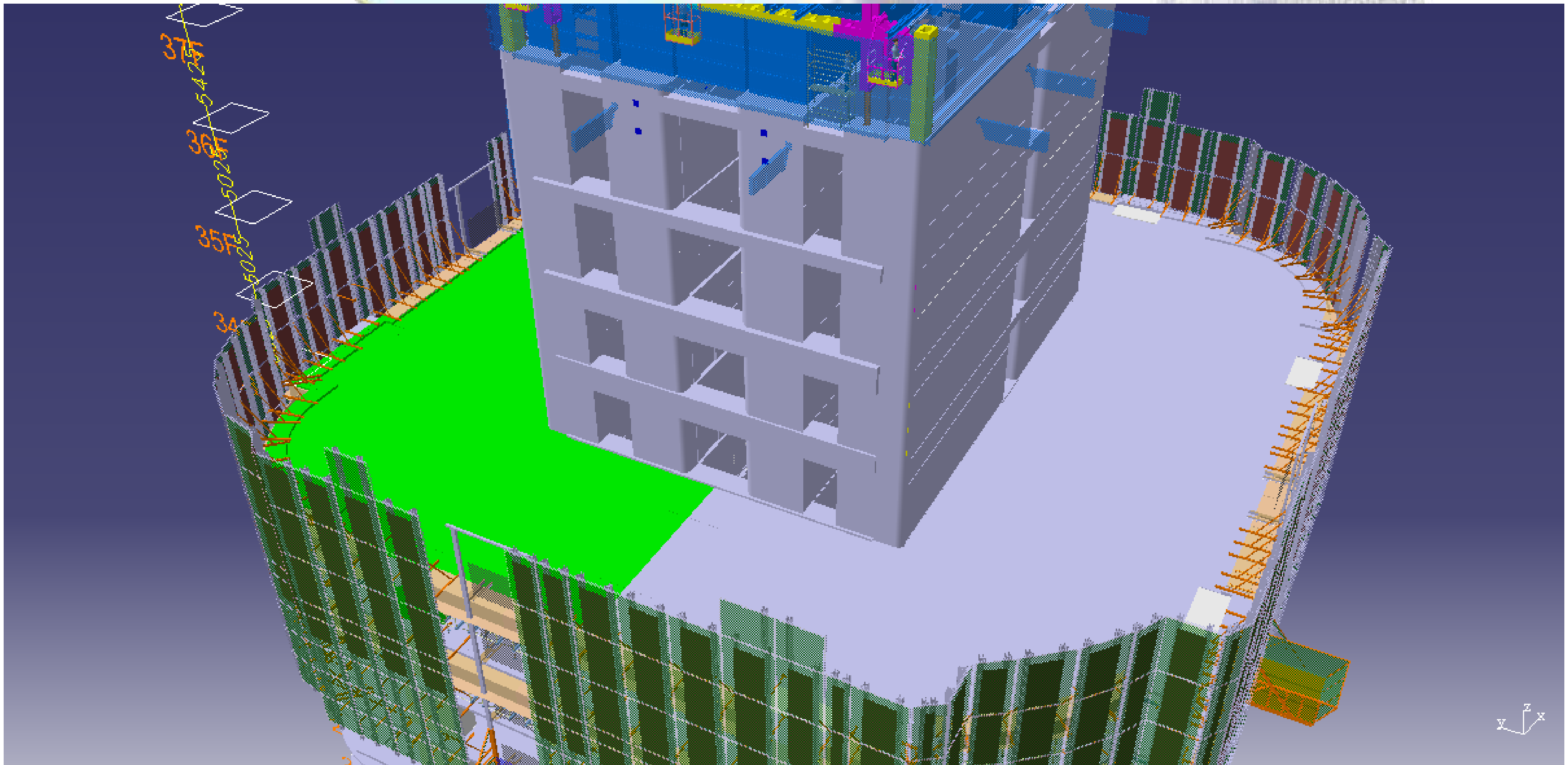
Virtual Prototyping of Non-typical work: Outrigger construction



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Outrigger Design Review

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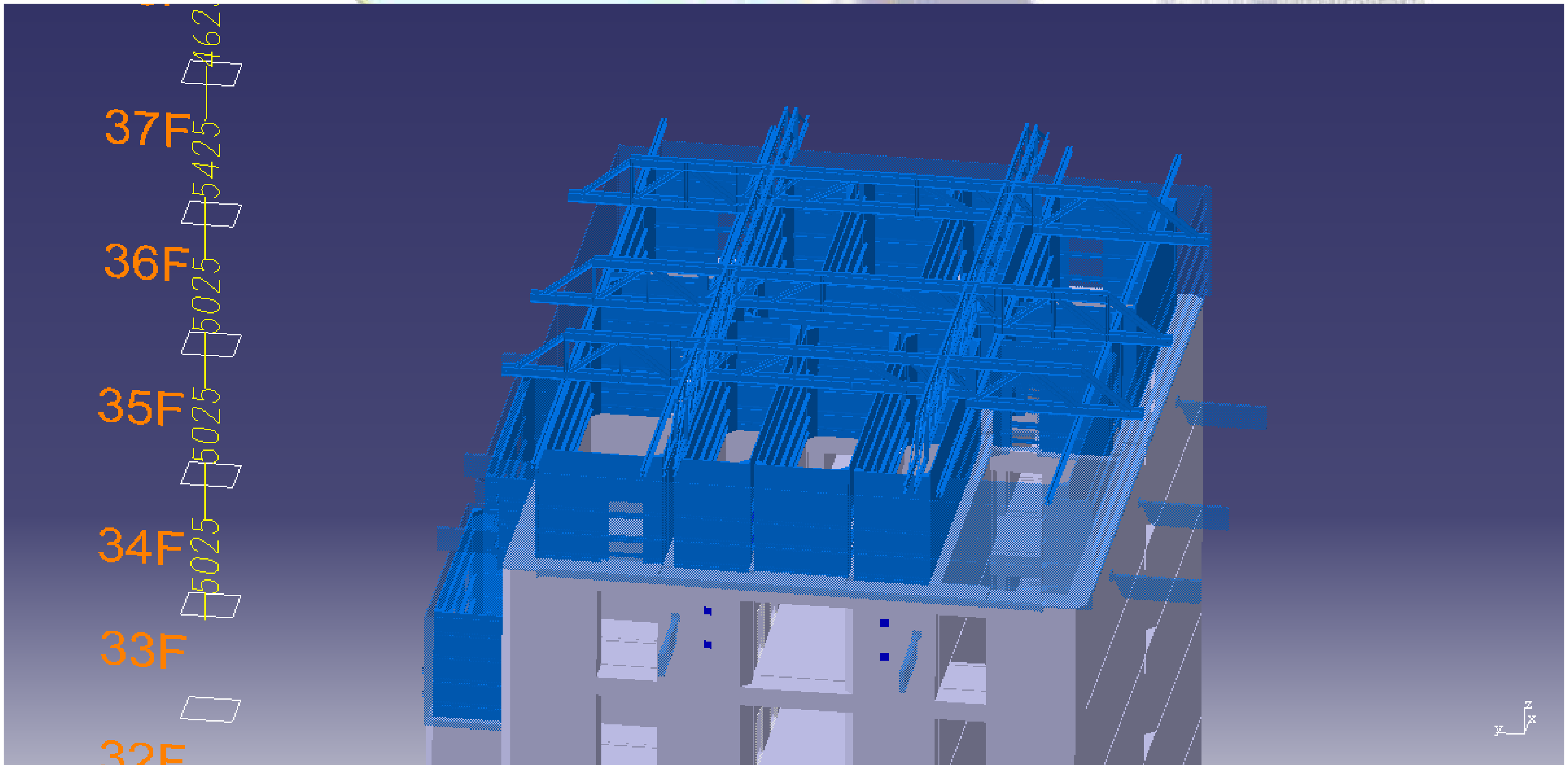
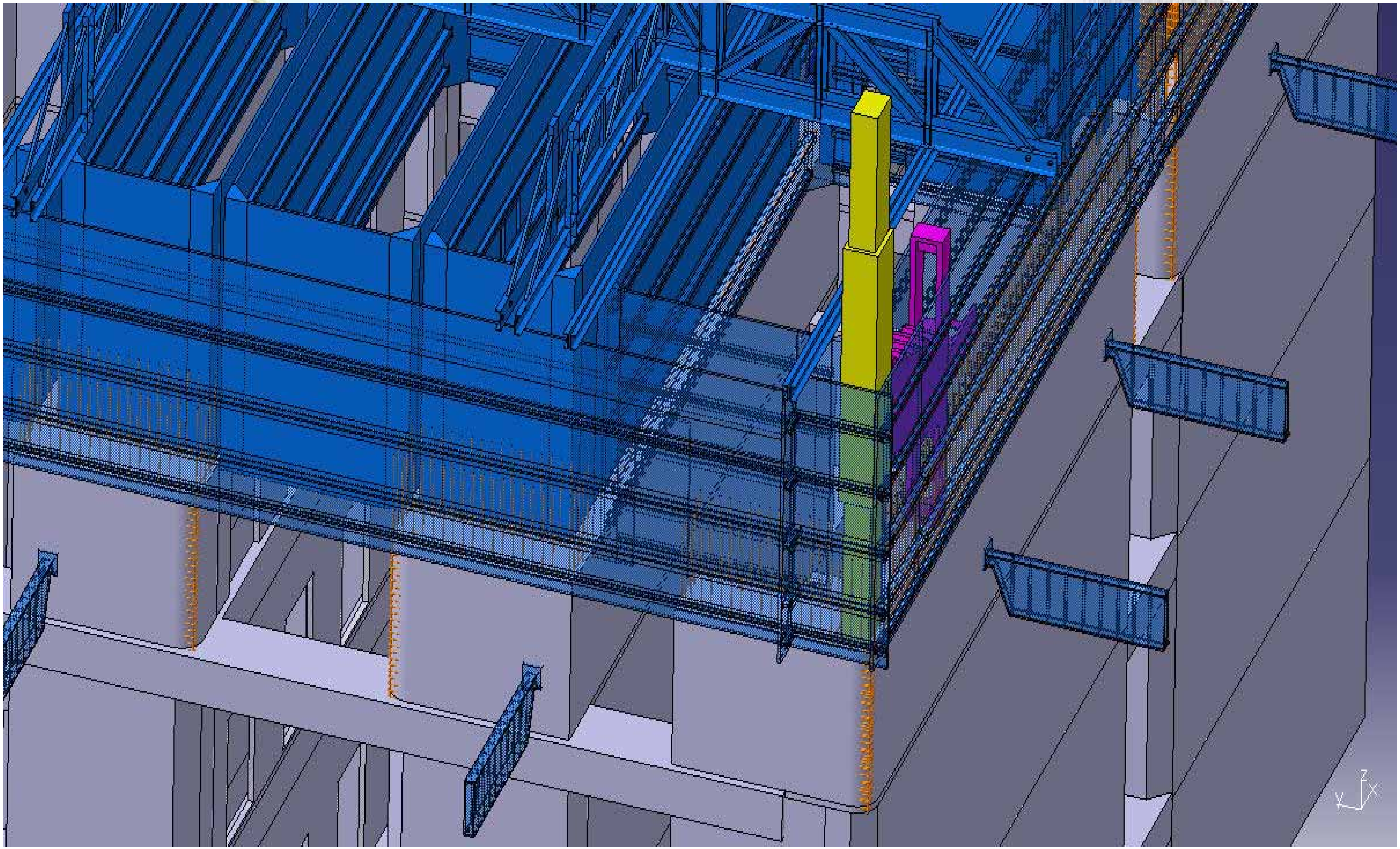
Outrigger Installation Planning

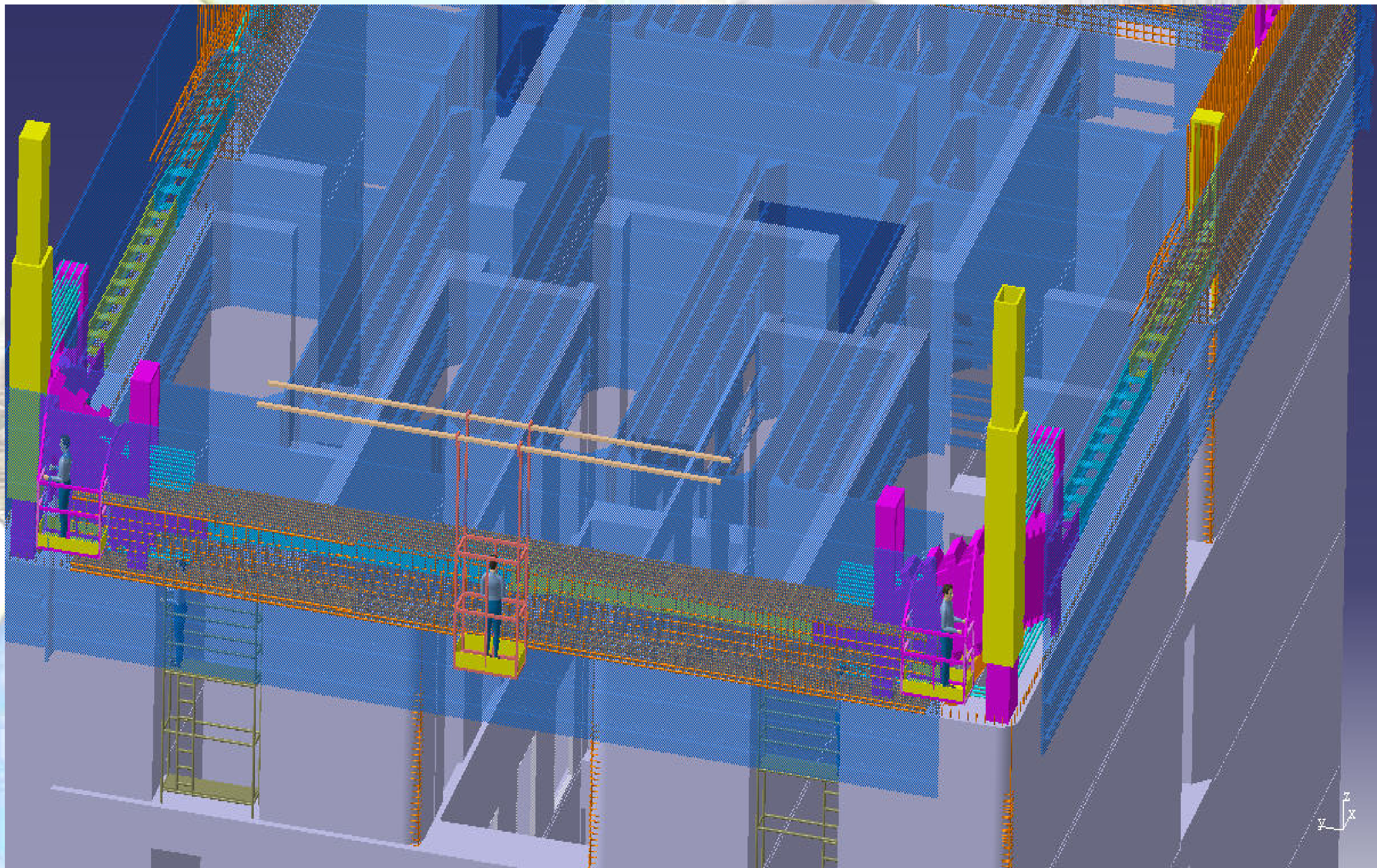
- The simulation of Outrigger Installation (Inside)



Work Instruction

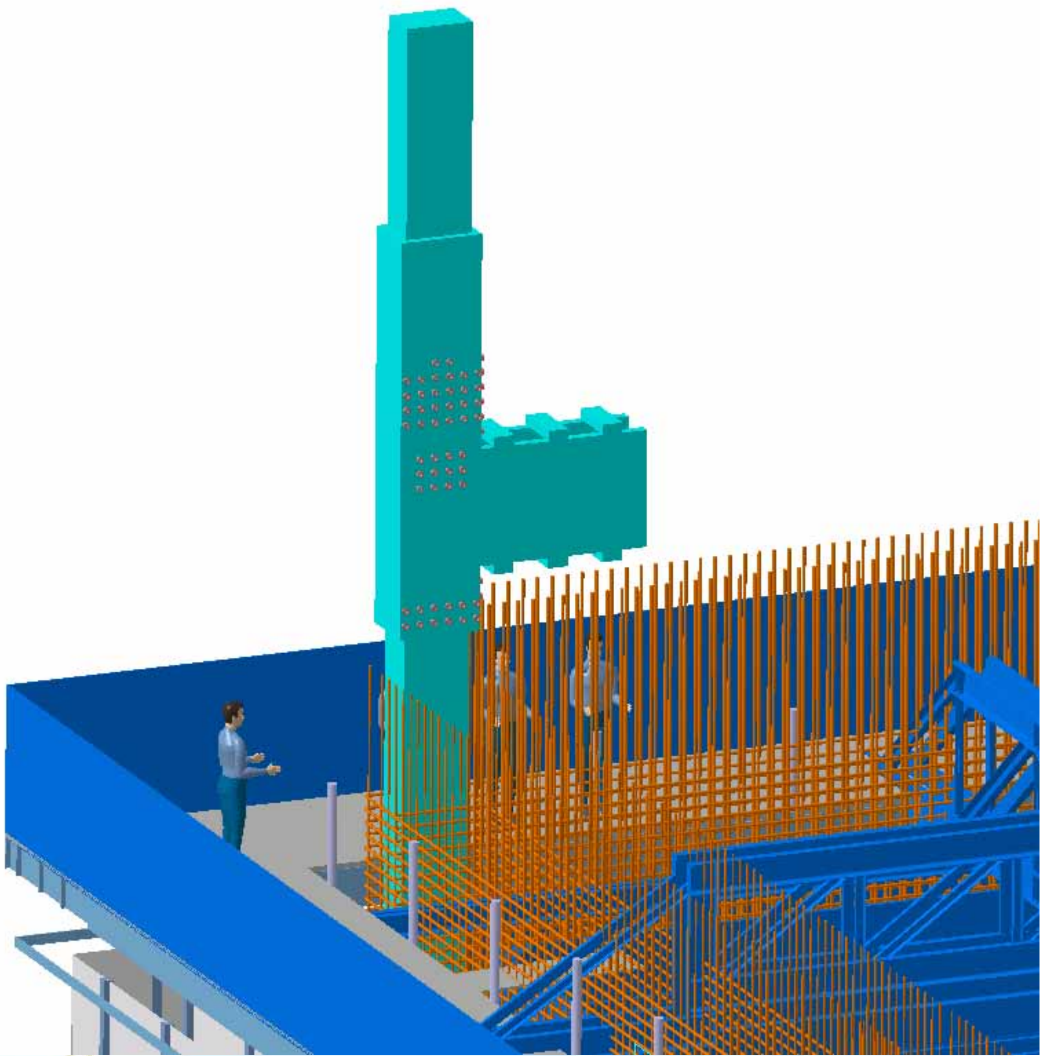


Identification of Risk and Safety Issues

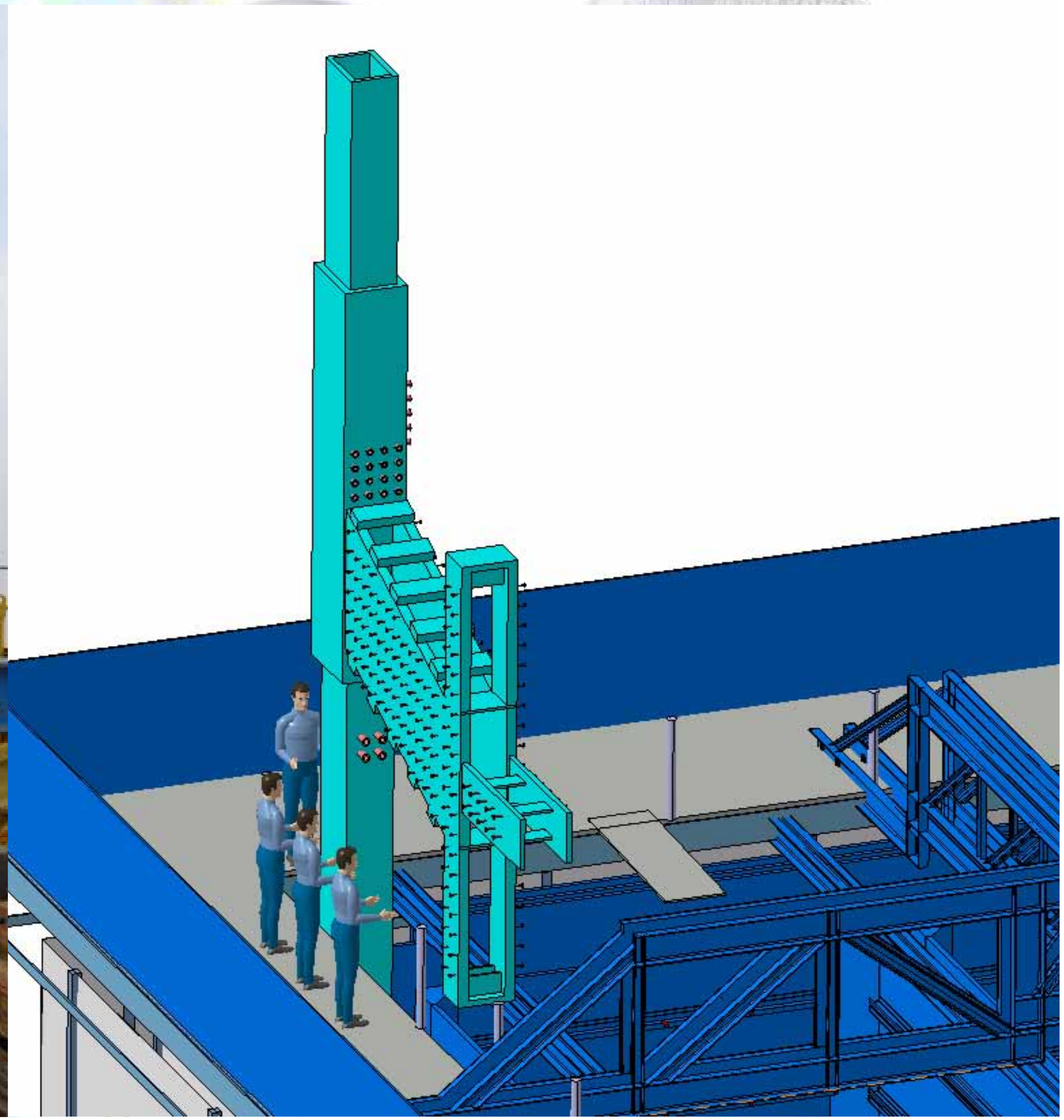


Outrigger Installation (inside)

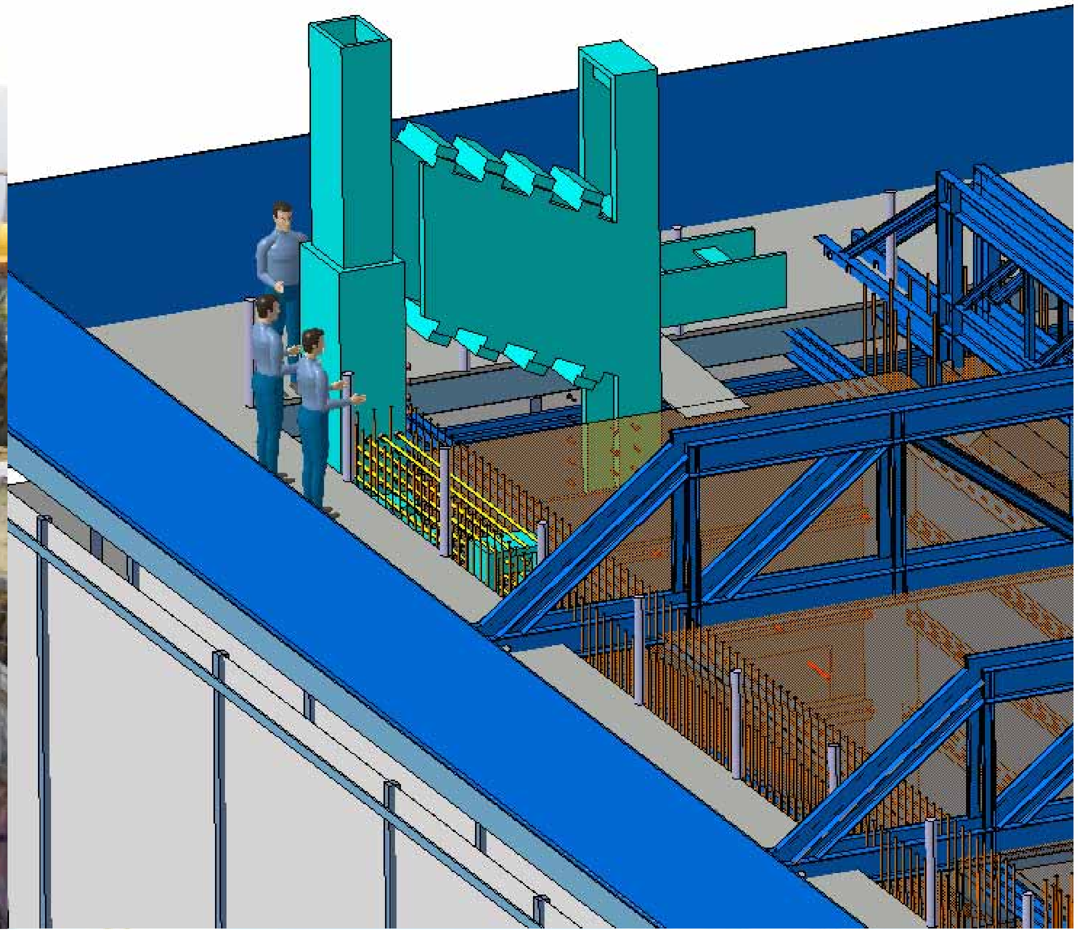
(Reality vs VP) Day 1



Outrigger Installation (inside)
(Reality vs VP) Day 2

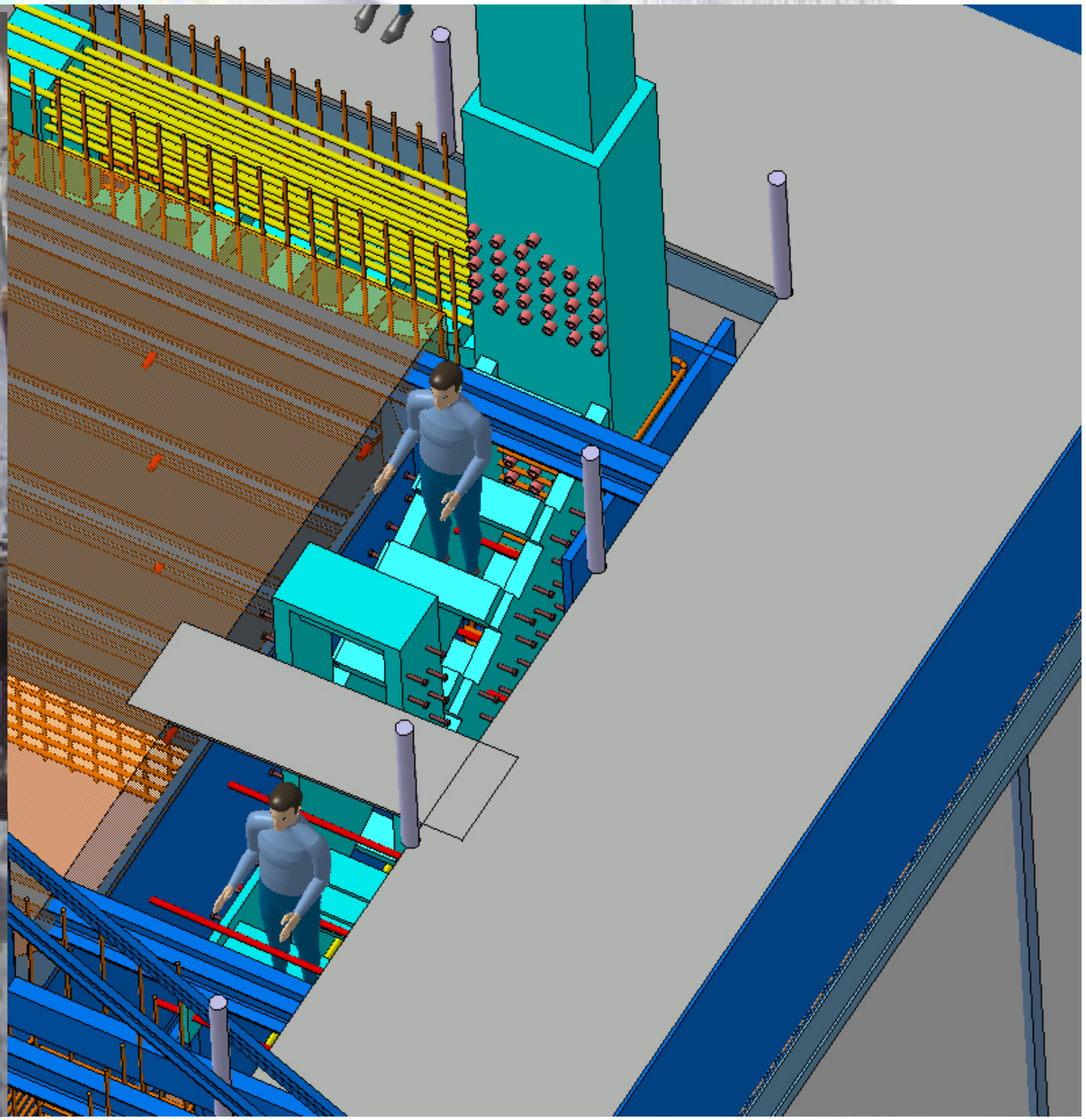


Outrigger Installation (inside)
(Reality vs VP) Day 5



Outrigger Installation (inside)

(Reality vs VP) Day 6



Summary of benefits

- VP provides a platform ‘to try before actual construction’;
- The simulation captures knowledge and expertise which is otherwise lost; and,
- Over 10% cost saving for the typical floor construction; and over 10% cost saving during the non-typical floor construction, installation of outrigger).

Other industrial projects

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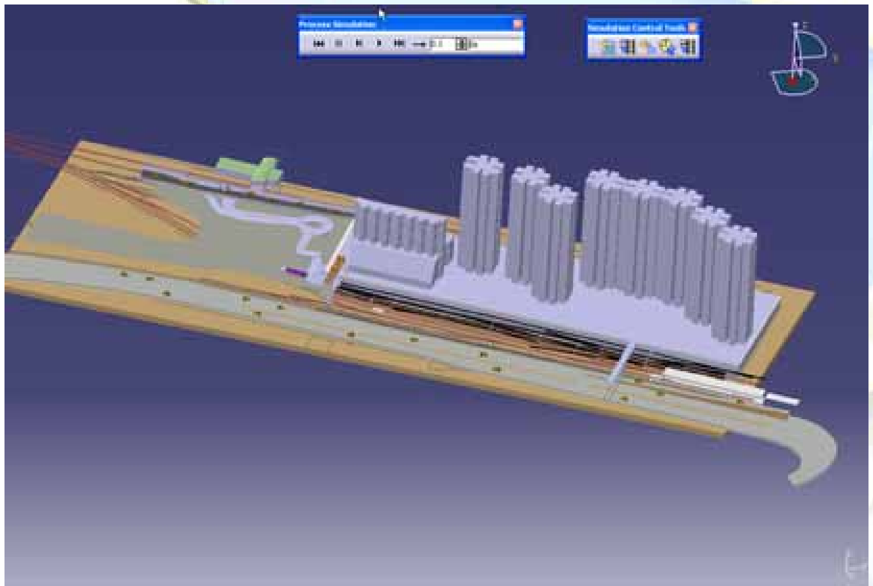
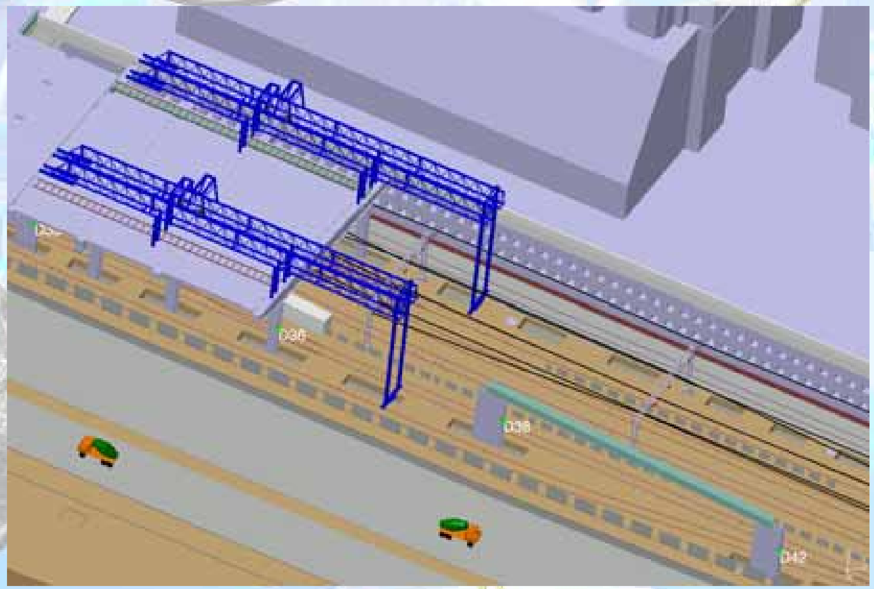
Construction Methods Assessment



Gantry



Mobile Crane

Launching Girder

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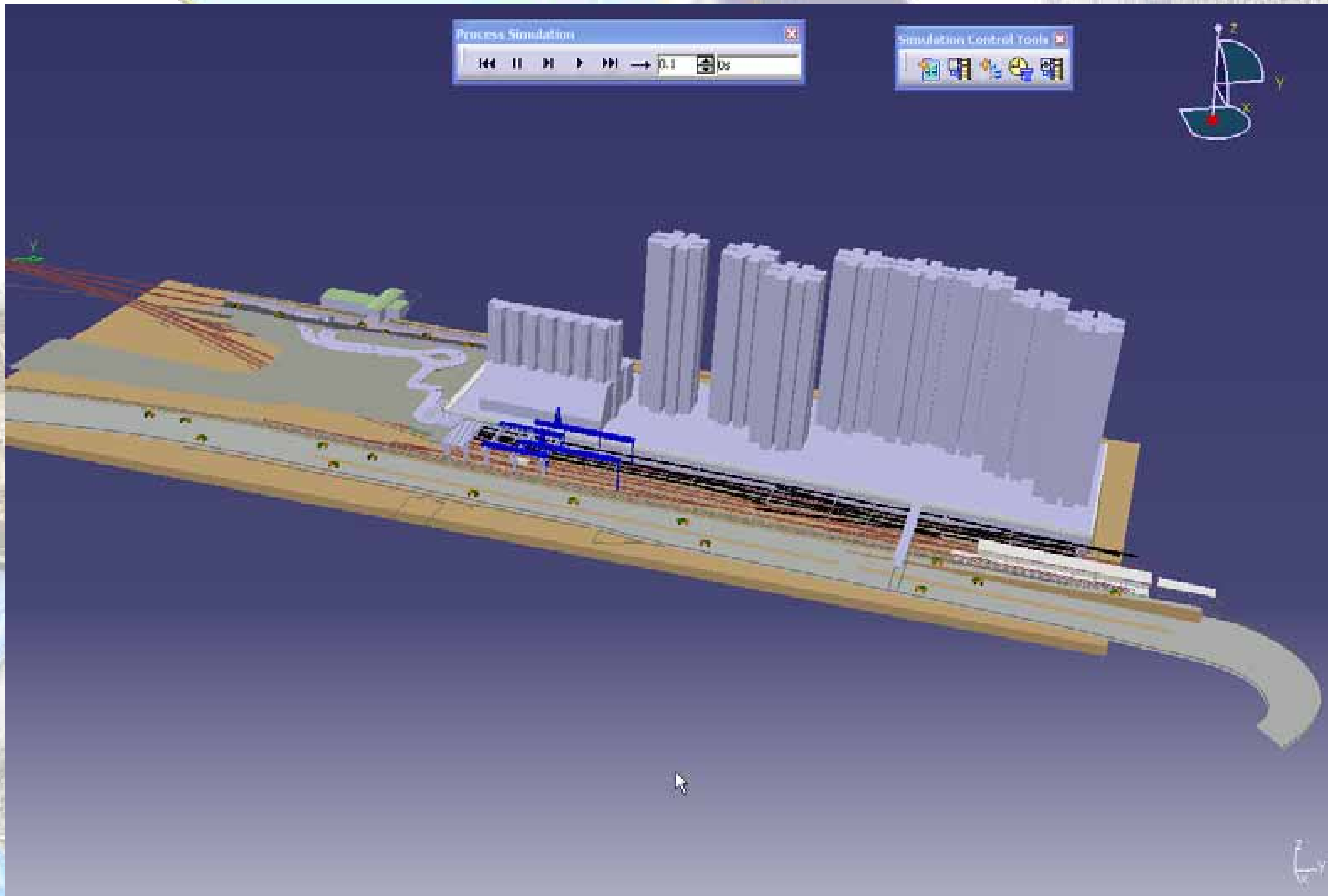
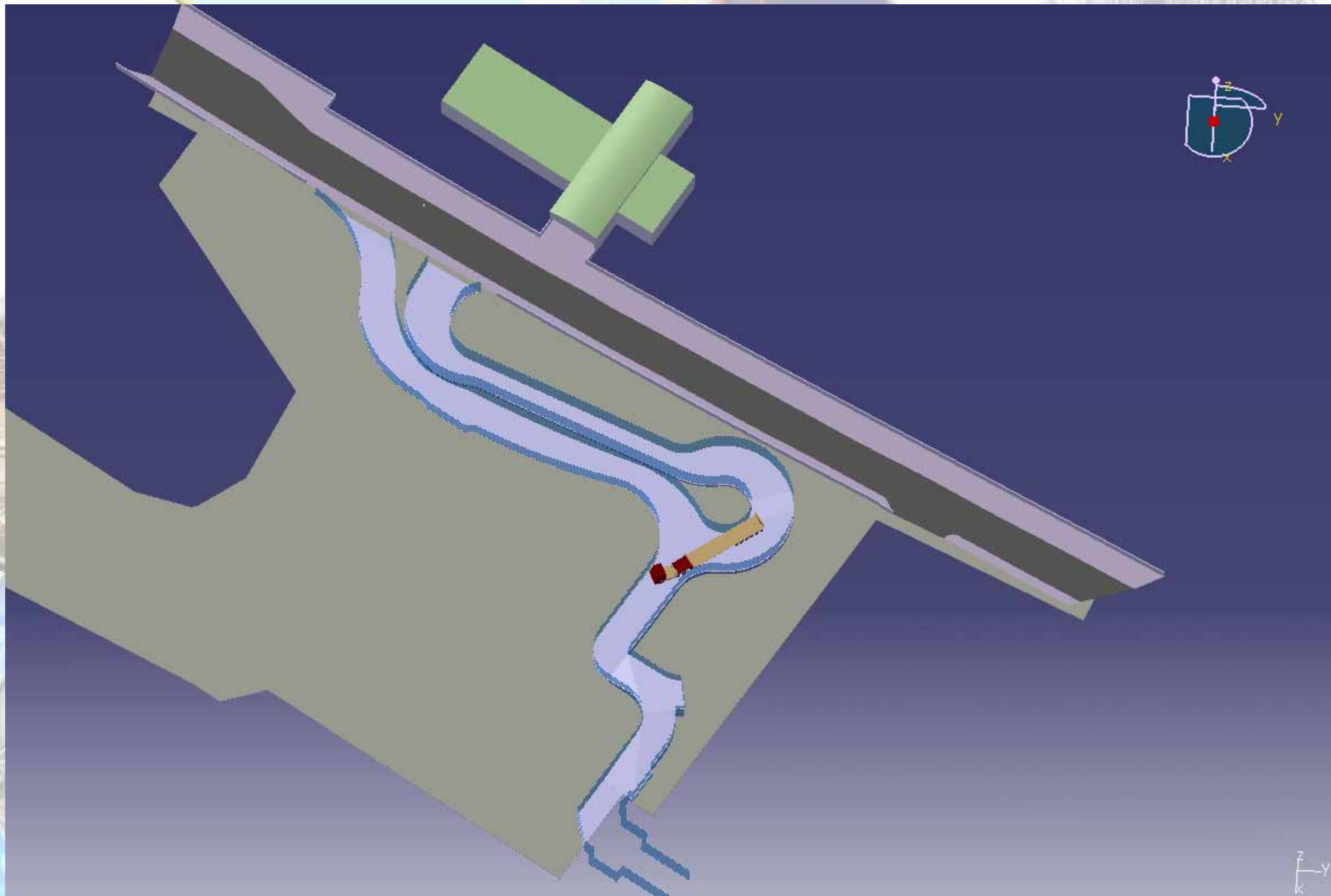
Launching Girder Method

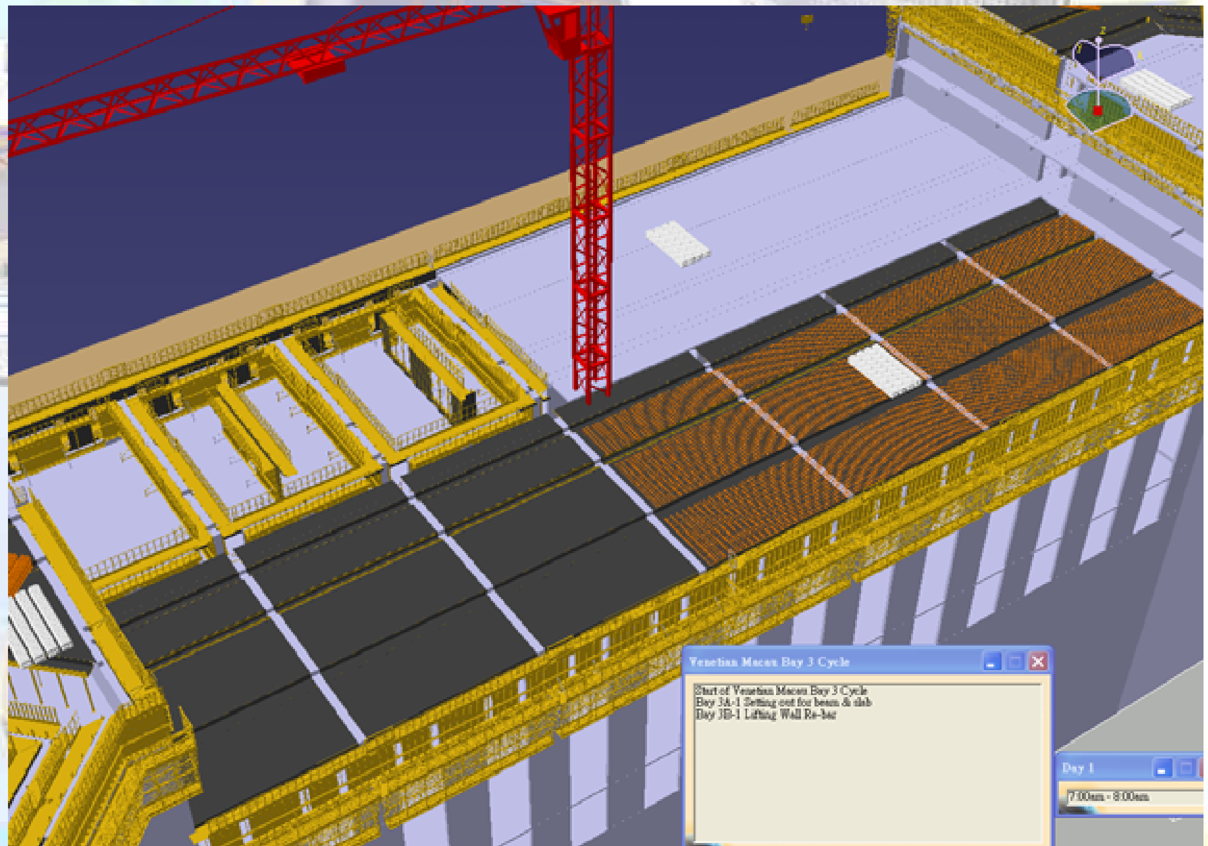


Collision Detection of Vehicle Transport



Case Study on Venetian Macau Hotel Project

- The aim of this virtual prototyping project is to visualize, analyze and improve the 4-day cycle.



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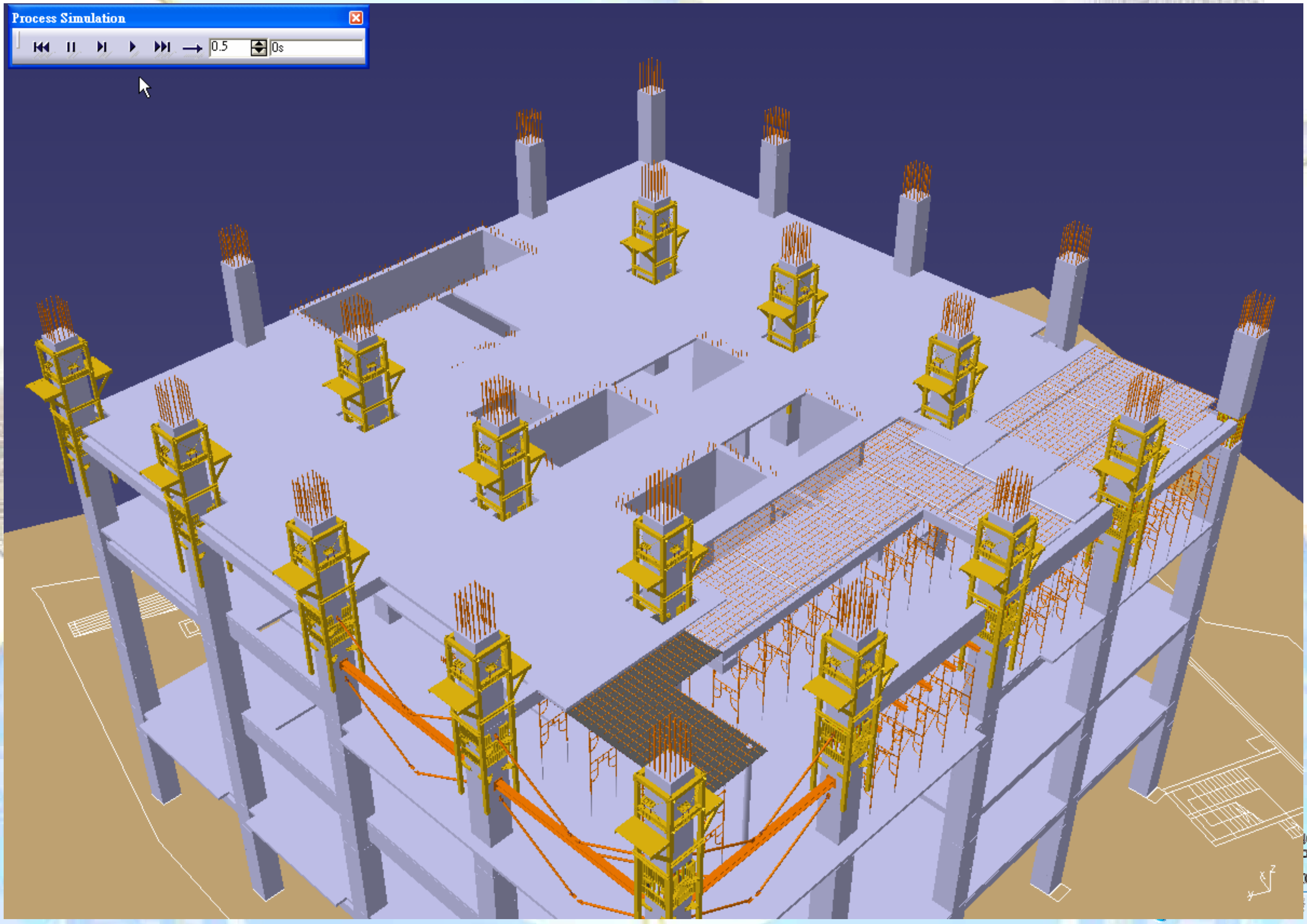
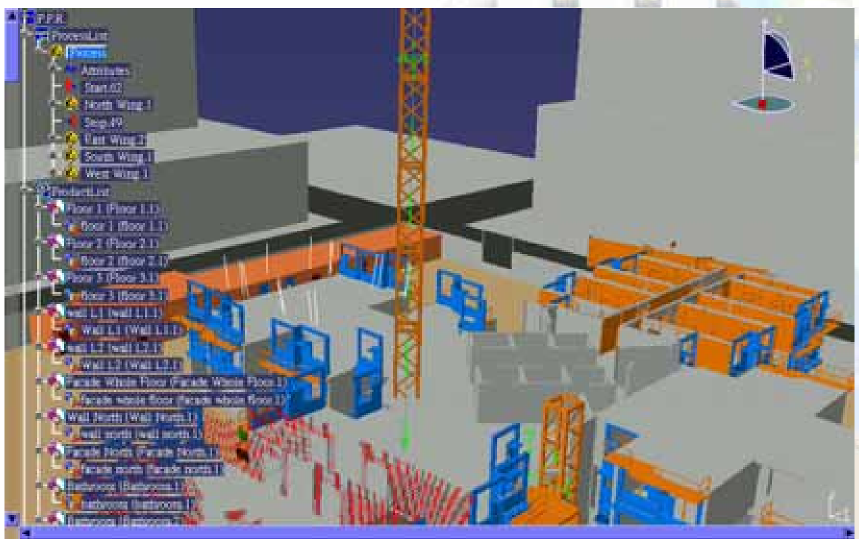
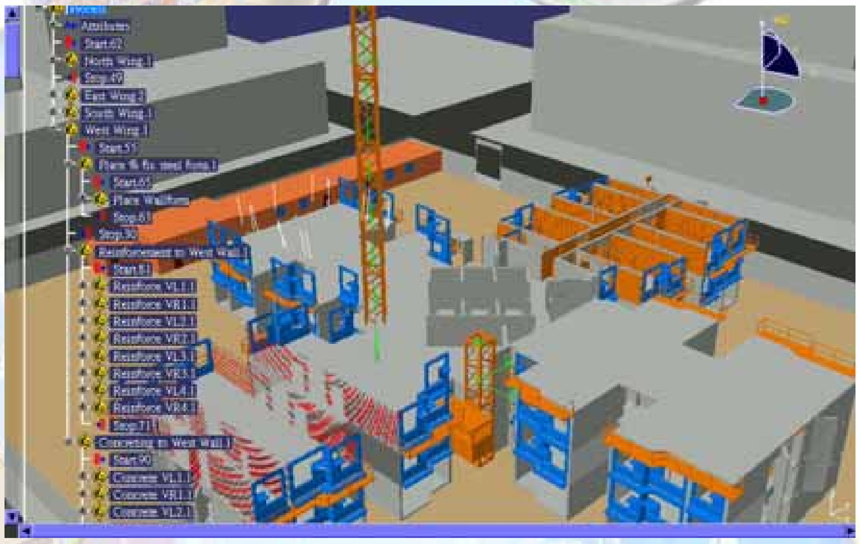
HKCC



Kwai Chung Public Housing Project



Originally planned for 6 days cycle



Through Virtual Prototyping, it was optimised to 4 Day cycle

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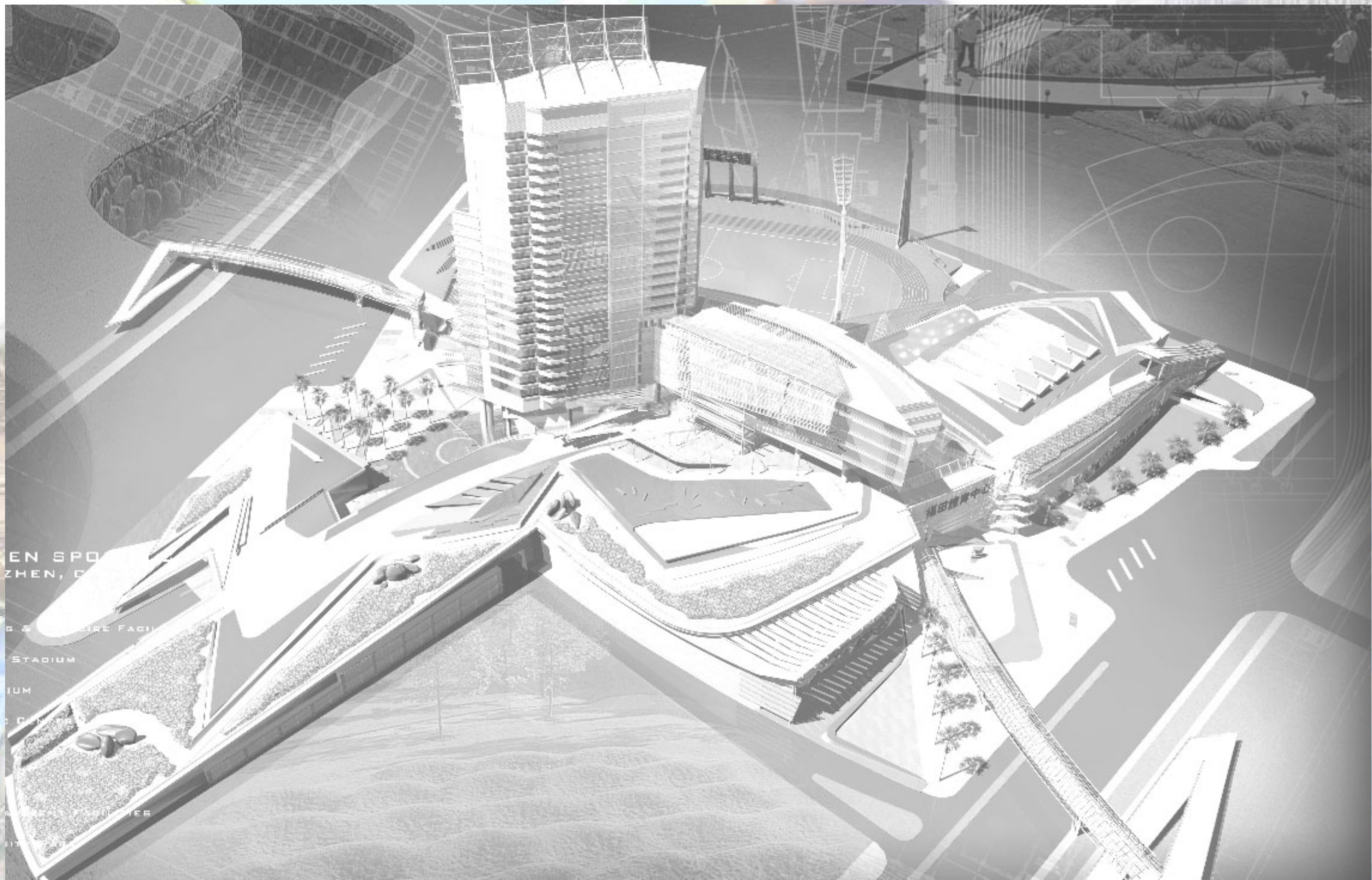
Futan Sports Complex



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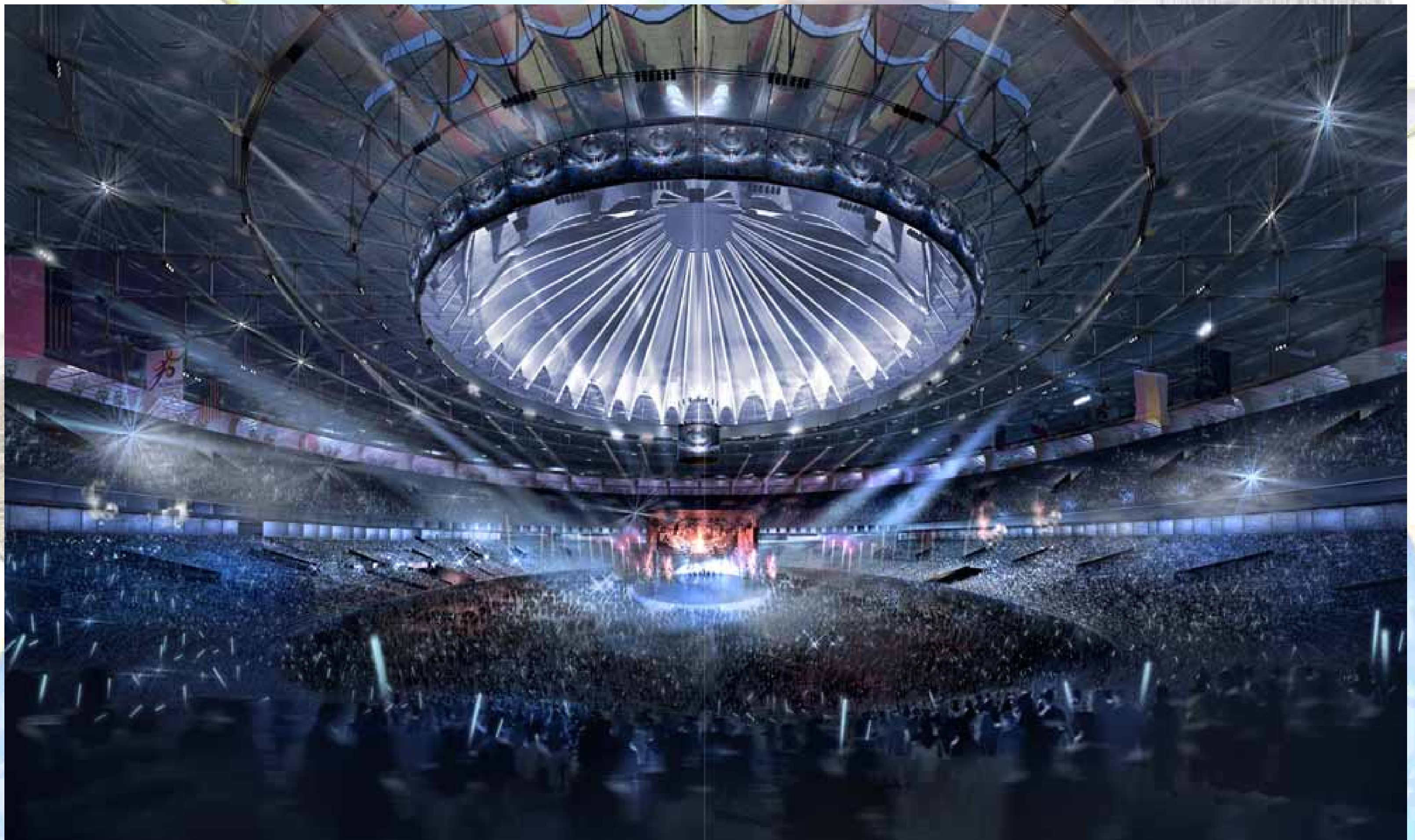
JKO Sports Stadium



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Research issues

The focus of our research is on how to better model a construction process.

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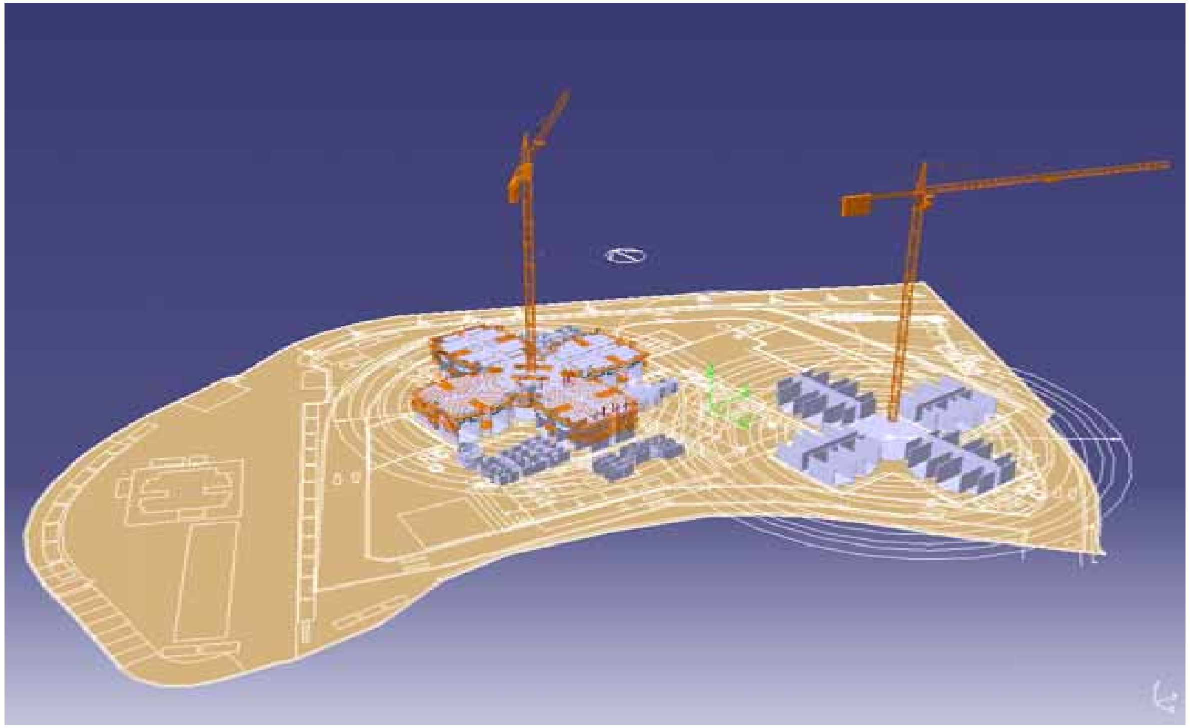
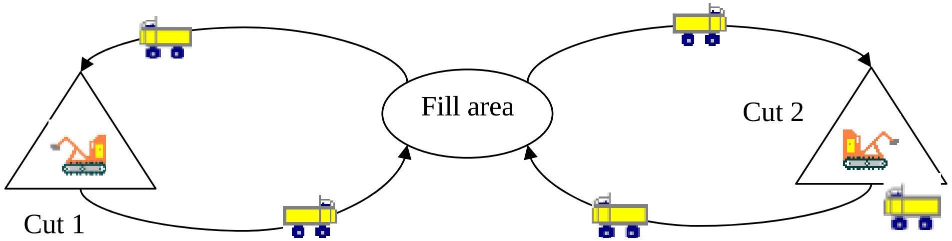
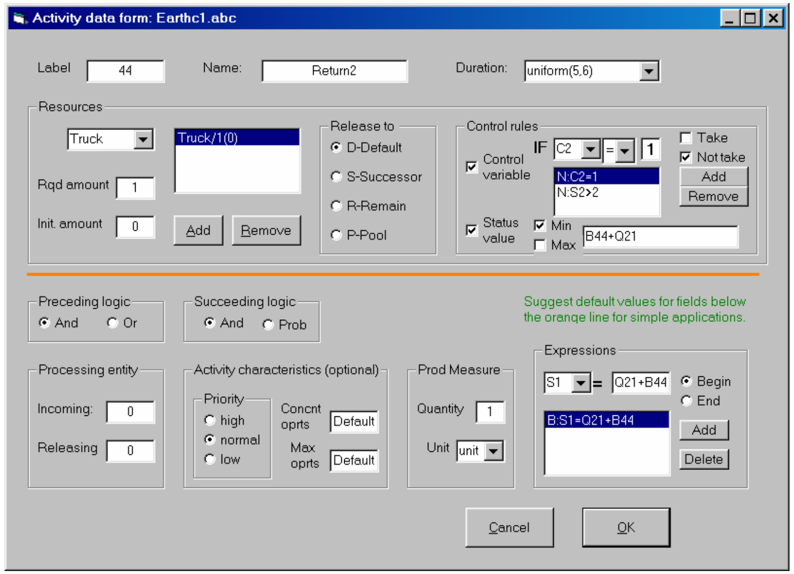
Q1: BIM/VP requires designers to modularize design, to encourage standardization and prefabrication, which indirectly introduces a production line. However, who owns BIM? who should manage the process simulation? do we need a new profession (BIM manager/process modeler)?



Q2: What is the best simulation engine to handle uncertainties?





Limited resources?

Zhang, H and Li H (2004) Simulation-based Optimization for Dynamic Resource Allocation. *Automation in Construction*. **13**(3), pp409-420.

Q3: How to best conduct Time-Cost Optimization?

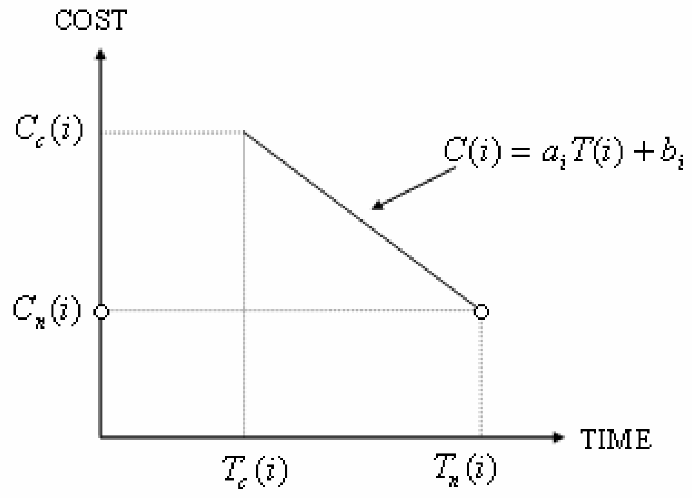


Fig. 1: Cost-Time relationship for activity i

Note:

$C_n(i)$ = normal cost for activity i

$C_c(i)$ = crash cost for activity i

$T_n(i)$ = normal time for activity i

$T_c(i)$ = crash time for activity i

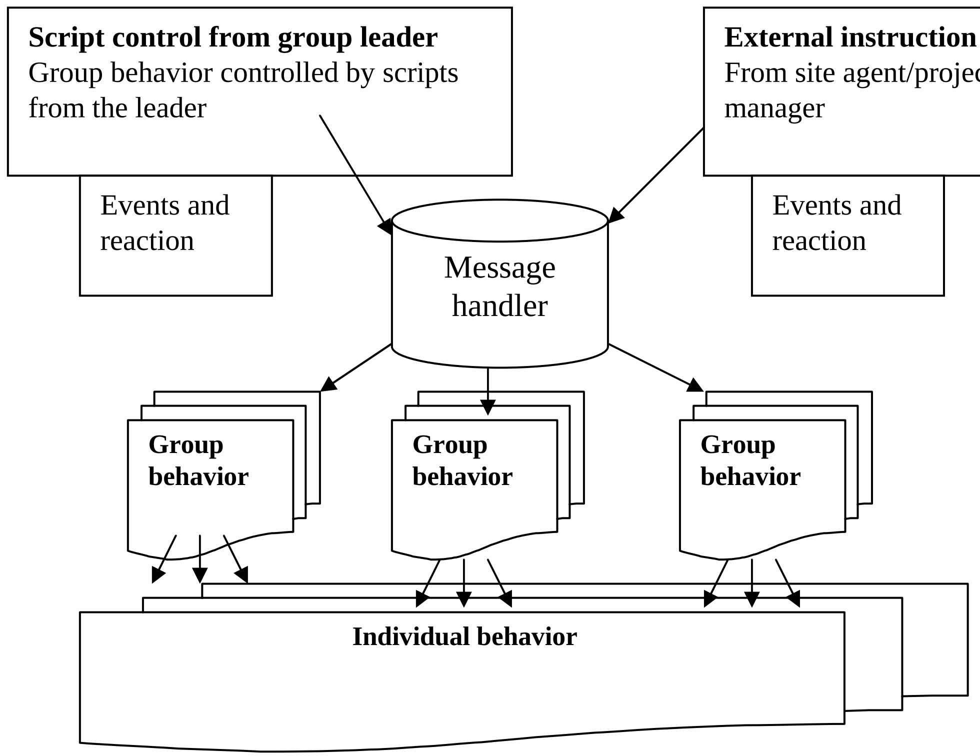
$T(i)$ = intermediate time for activity i

$C(i)$ = intermediate time for activity i

$a_i = \left(C_n(i) - C_c(i)\right) / \left(T_n(i) - T_c(i)\right)$

$b_i = \left(C_c(i)T_n(i) - C_n(i)T_c(i)\right) / \left(T_n(i) - T_c(i)\right)$

Q4: How to simulate the spontaneous behaviors of Construction Workers?



Summary

- Current IT investment has been mainly focused on assisting design, information gathering, sharing and exchange, not directly helping the production process.
- Traditional planning is ‘blind chessing’. VP puts back the chess board.
- VP is needed in certain projects, or certain aspects of a construction process.
- VP brings cost saving at the expense of huge data input (BIM).
- The procurement process needs change so that all participants can share the benefits brought by VP.
- VP trims down managerialism, but creates a new profession (process modeler).
- The VP technology, as a tool, is not ready for practitioners to take over and use.

Thank you!

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