

# CIC BIM Competition 2021 – Team HKuST

Location Plan 1:2000



## About the New Development of the CIC Zero Carbon Park

### Design Concept:

The rationale behind the design is to improve the functionality of the ZCB by increasing the usable floor area and to provide comforts to occupants. For the design of the buildings, sustainable, green-building related and innovative ideas are to be incorporated in different floors.

### Building Form:

The site is located at 8 Sheung Yuet Road, Kowloon Bay, surrounded by high-density commercial buildings. Besides, the side facing southeast will be installed with solar panels to capture the solar energy. Considering the site where accessible to sunlight from Southeast, we proposed a terraced rectangular-shaped building to allow the solar panels to have the optimum exposure to sunlight for all levels.

### Spatial Arrangement:

G/F and 1/F of the building are open for public; therefore, canteen, multipurpose hall, and the internal exhibition area are located at these two floors. Some indoor exhibition area is located near outdoor open spaces for better accessibility. Besides, classrooms and laboratories are located at 1/F for educational purpose. The offices are located at 2/F, which is only accessible by the staff.

### Connectivity:

To facilitate the pedestrian connectivity, our building provides 1 passenger lift and 1 fireman's lift for the occupants. Besides, 4 staircases are placed to ensure effective evacuation and higher occupant connectivity within the building. Another special feature of our building is the ramp connecting G/F and 1/F to further enhance the connectivity between the open spaces at opposite sides of the building.

In terms of vehicular connectivity, the car parking area is included on G/F, with entrance connecting the Sheung Yuet Road. Charging stations are installed in the carpark for the more environmentally friendly electric cars.

### BIM Uses in Design, Collaboration, Engineering, Analysis and Optimization:

Our team used AutoCAD to formulate the floor plans at the design stage, while REVIT is used to generate our 3D model. We also incorporated other BIM software for engineering analysis and optimization such as Autodesk CFD for CFD computation, structural analysis, detailed designs, etc. We facilitated team collaboration through BIM360 and other Information Management software.

### BIM Collaboration approach:

The use of BIM allowed team members across different disciplines to collaborate the design smoothly. For instance, the architectural model made by REVIT provided a 3D model as an effective visual aid for MEP and structural design at the later stage. The use of BIM360 also facilitated team communication and the sharing of different BIM files. The use of various BIM tools also allowed team members to work individually on different tasks without clashes.

**Quality of Design:** The use of BIM allowed team members from different disciplines to collaborate the design smoothly. For instance, the members who responsible for different works (e.g. Architectural, Structural, etc.) can assess and link with the Revit model through BIM360. The use of Revit also Also, the use of BIM360 can ensure every model are reference to the latest version to prevent confusions. After the models of different streams are finished, the clash detection function in Navisworks also ensure the buildability and efficiency of the project, thus improved the quality of design.

**Sustainability:** We adopted passive building design through the utilization of natural ventilation, daylighting, and thermal and acoustic insulation. The installation of solar panels, usage of chemical energy and sustainable waste discharge policy are in place to improve building sustainability.

**MiC/DfMA:** The structural design of our building is divided into 2 parts, the in-situ framework to be constructed and MiC modules that are prefabricated in the Mainland's factories. The prefabricated modules include toilets, meeting rooms, classrooms, etc.

Moreover, the construction of interior R.C. staircases as well as some building services facilities (including water pump, HVAC system, etc.) will be incorporated with DfMA for standardization and quality assurance.

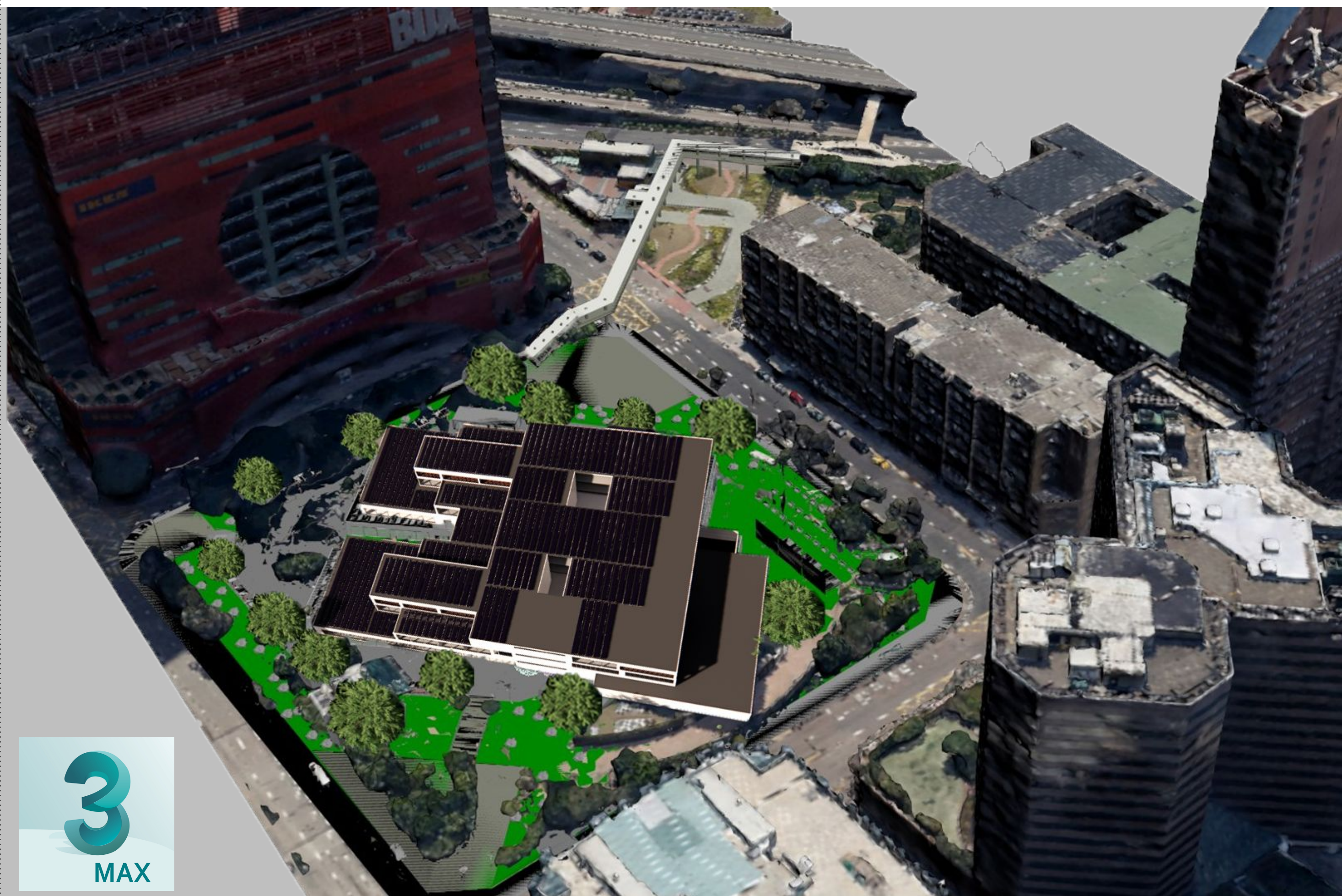
### Constructability:

The building is divided into main slab and smaller MiC components. MiC is mainly used to construct the toilet, classrooms, meeting rooms, etc. MiC modules can be prefabricated and installed once the slab is in place, which greatly shortens the construction period.

**Summary:** While producing the model, BIM facilitated the spatial arrangement by providing clash report. Linking of different models like structural and building services allow the model to be divided into smaller systems and handled by different teammates. BIM also allow engineering evaluation with the use of apps like Naviswork and can produce realistic overall view while presenting to client.



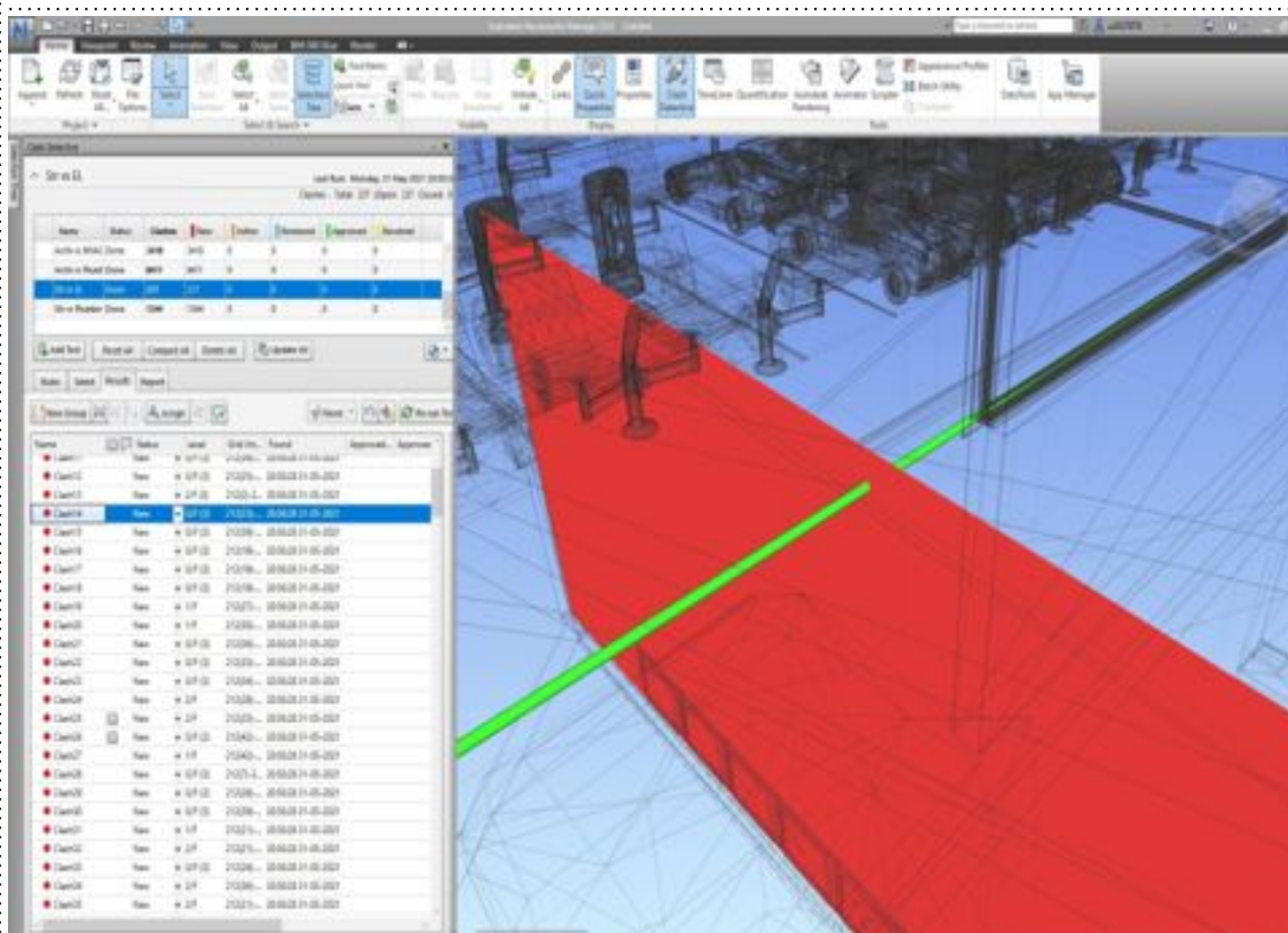
**Conceptual Diagram:** Our design used a terraced design to allow most solar panels to be installed with optimum angle facing the sunlight



**Overall Bird Eye view:** Our proposed building is in a terraced shape, which not only allow adequate sunlight on every floor, but the number of solar panels can also be maximized as well. The site of the building is full of green features, which aims to become a green oasis in urban area.

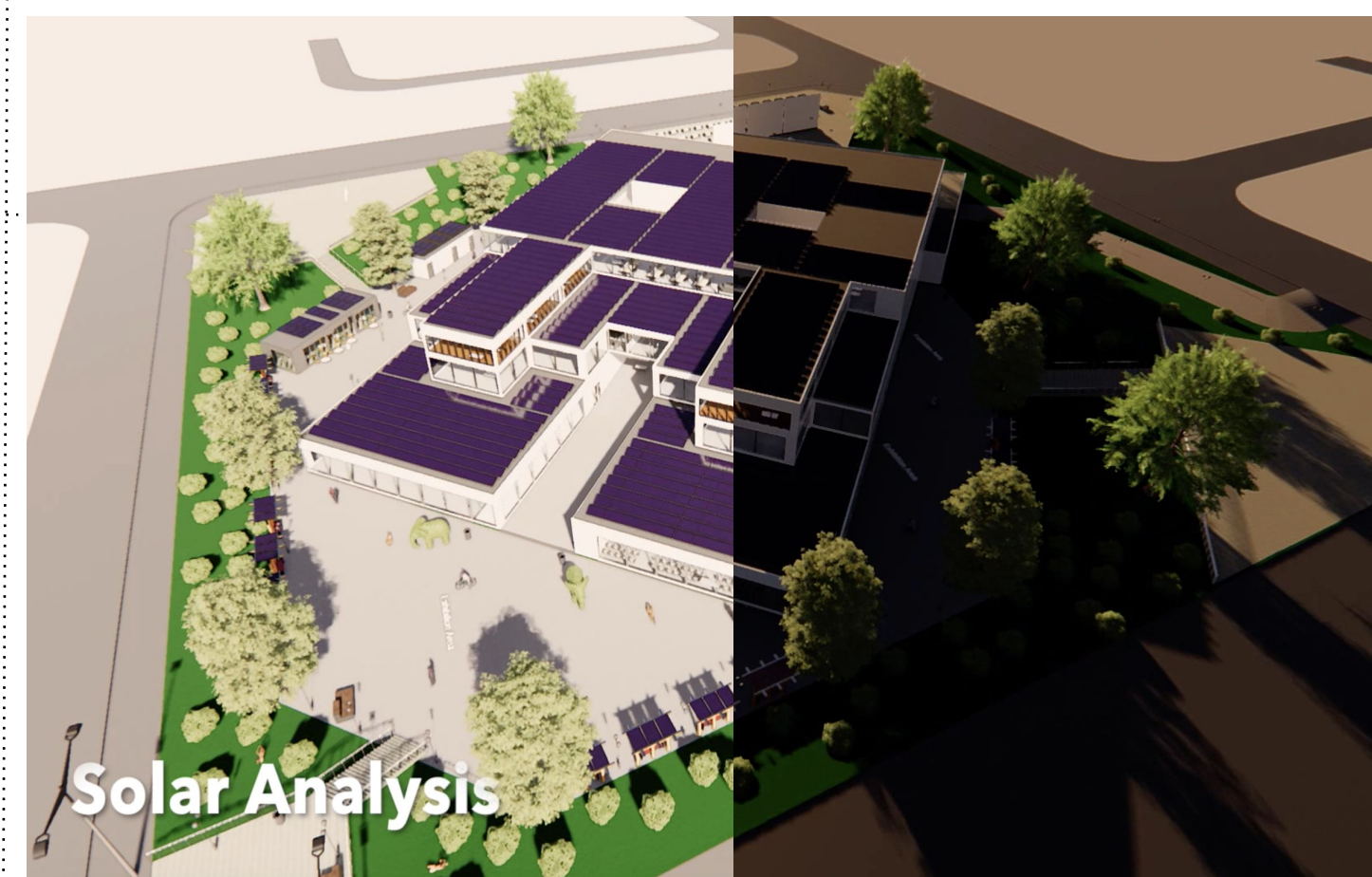
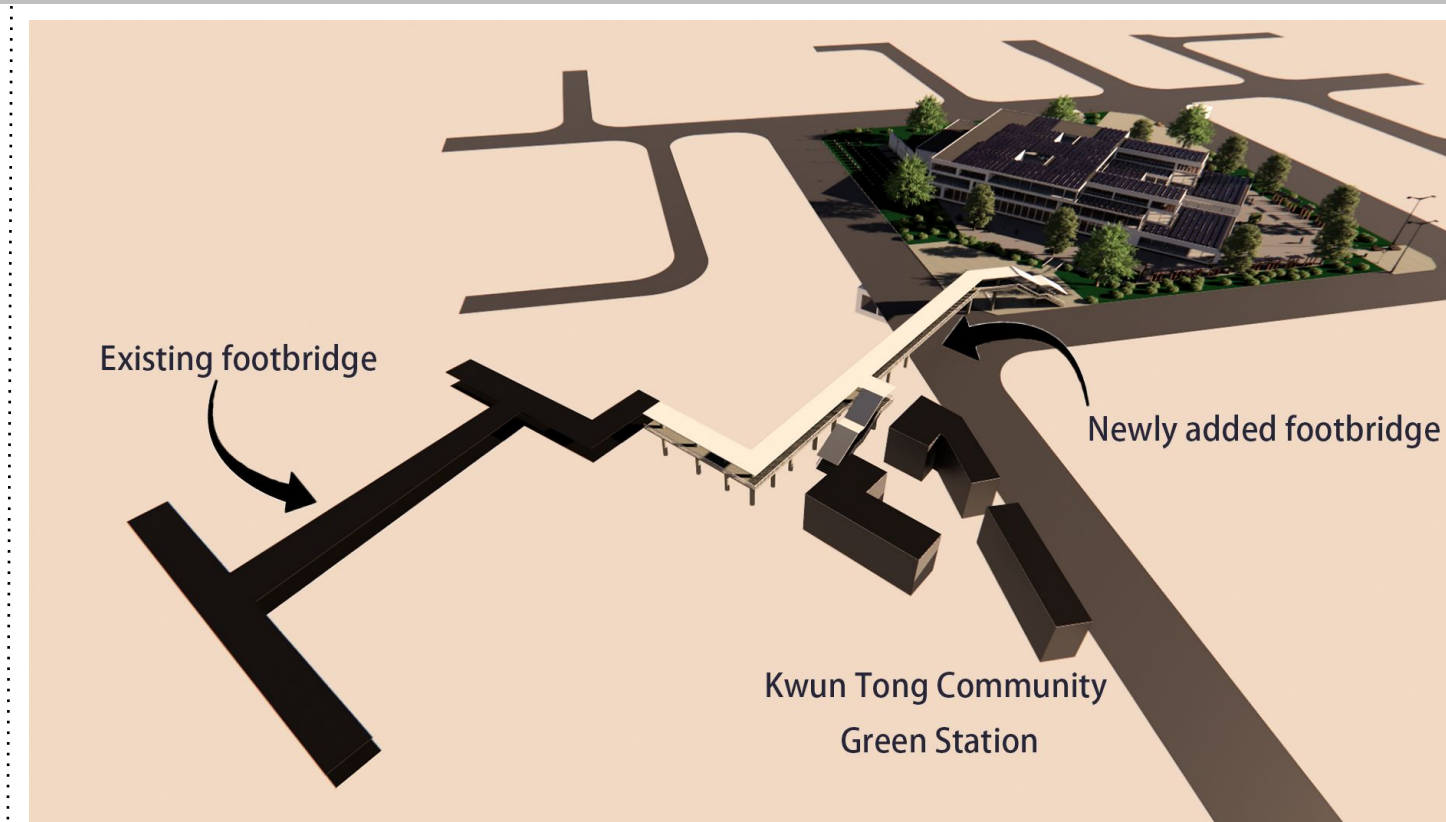
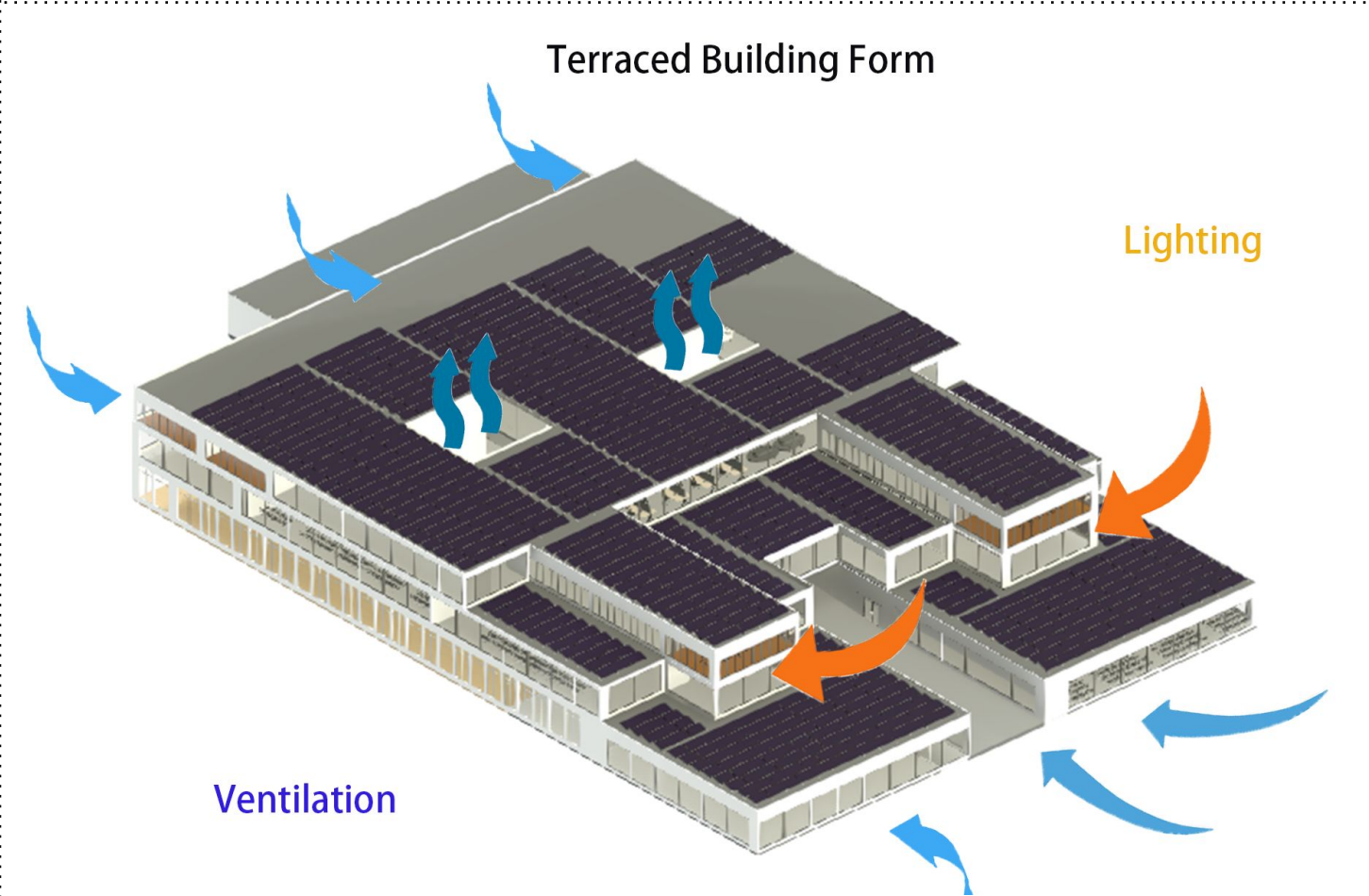


**Building Form and Space:** The building is formed by the slab in central and the MiC modules attached to the side. There is one atrium on each side to allow natural lighting. The main walkway from G/F to 1/F through the building connects the open spaces on the two sides of the site.



### Quality:

**The use of Naviswork can identify clashes and collisions between different building services models with the help of computer-generated clash reports. Early clash detection can prevent difficulties during construction.**



Energy - Saving Approach	Design Approach
Reducing Use of Energy (Passive design)	<u>Ventilation</u> Wind Catch & Earth cooling tube <u>Lighting</u> Skylight & Terraced building form <u>Solar Control</u> Heat Reflecting Shade (material) Insulated Roof (material) High Performance Glazing External Shading
Improving Energy Efficiency	<u>Ventilation</u> High Temperature Cooling System <u>Lighting</u> Intelligent Lighting Management <u>Solar Control</u> Active Skylight
Using Renewable Energy Sources	TESLA Powerpack Bio-diesel Trigeneration Photovoltaics

### Sustainability:

The design aimed at installing 3 times the number of solar panels compared to the original ZCP design to achieve Zero Carbon Building despite the increase use of energy with more floor area

Team Leader Bryan Lau

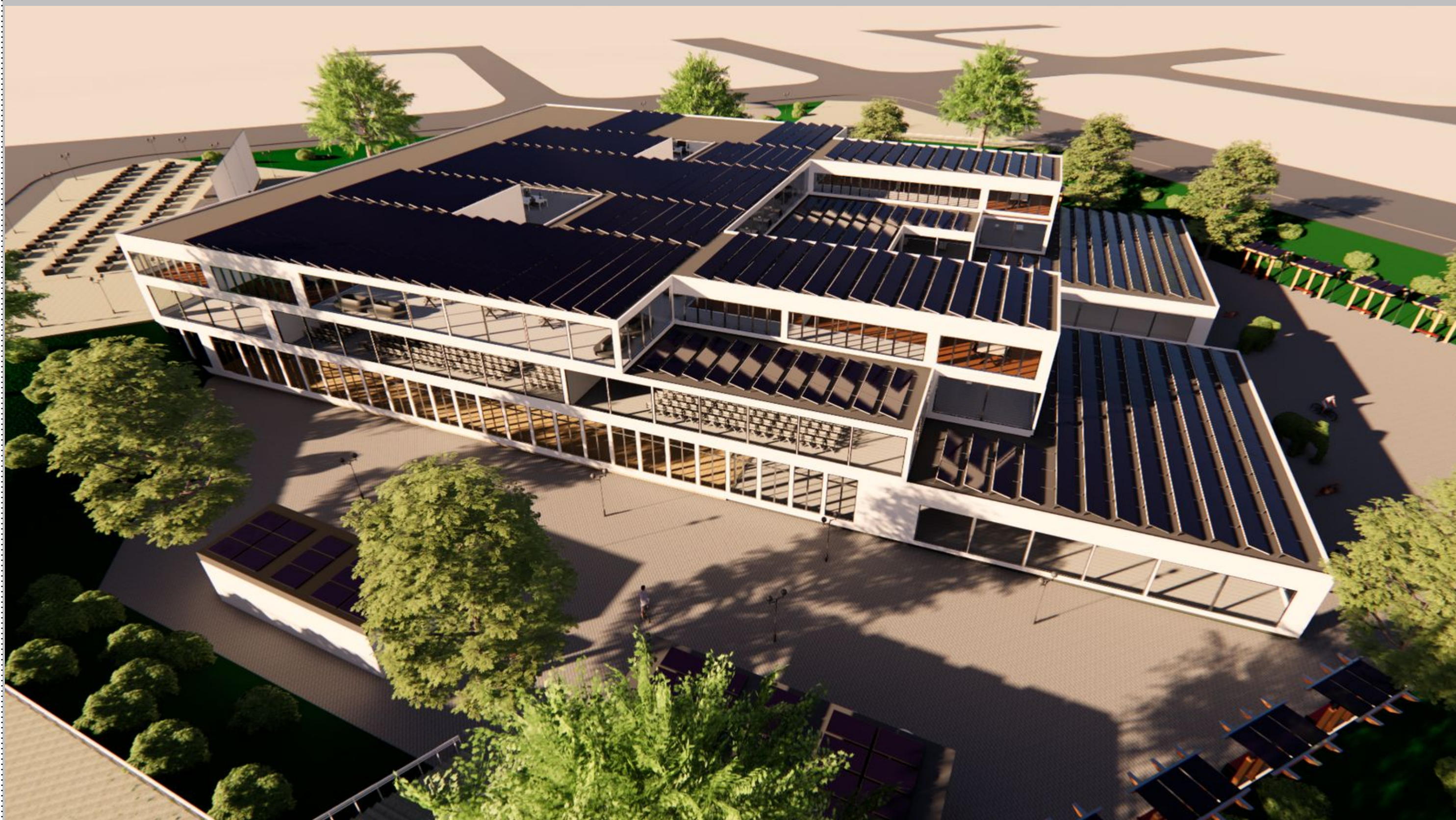
Team Members Aaron Lai  
Charles So  
Samson Lui  
Zachary Fu

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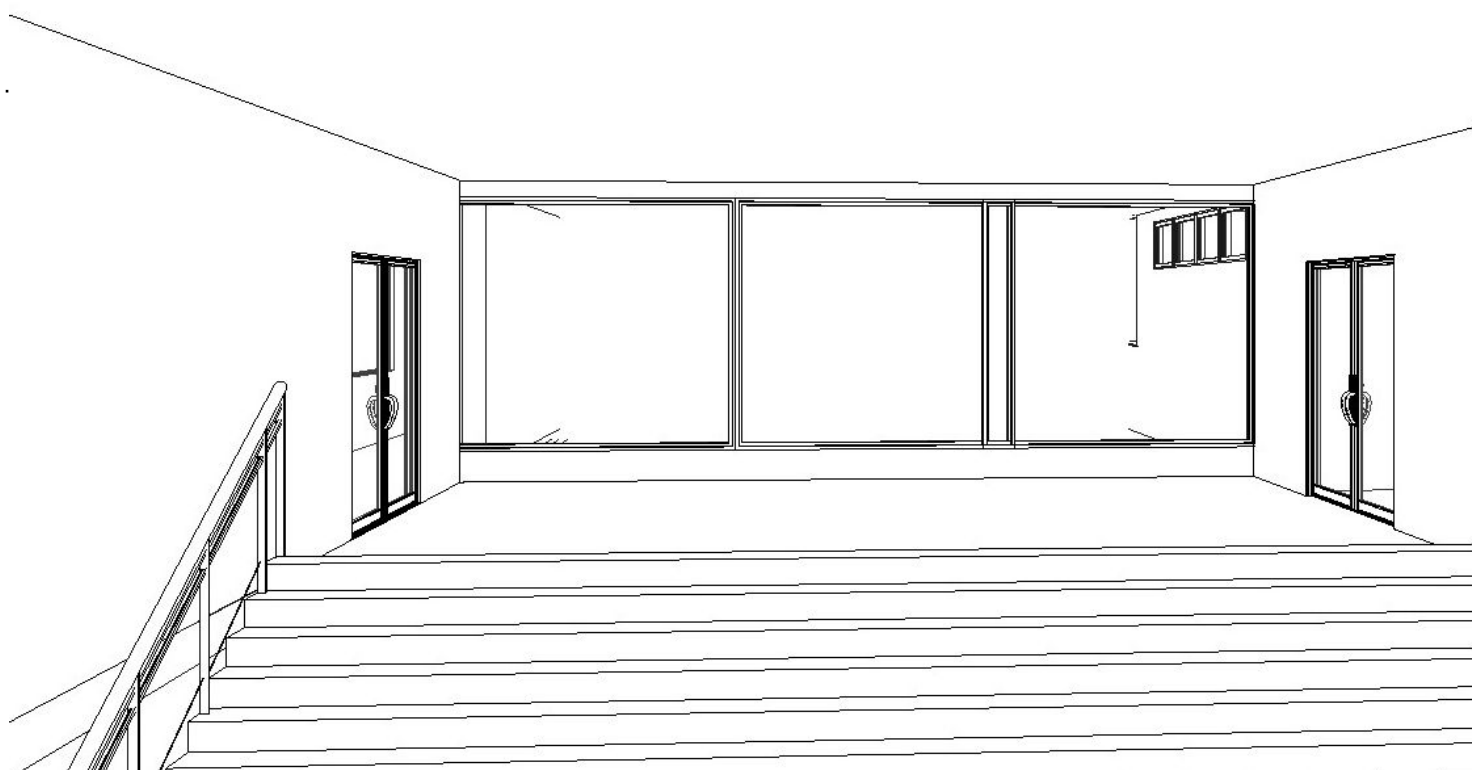


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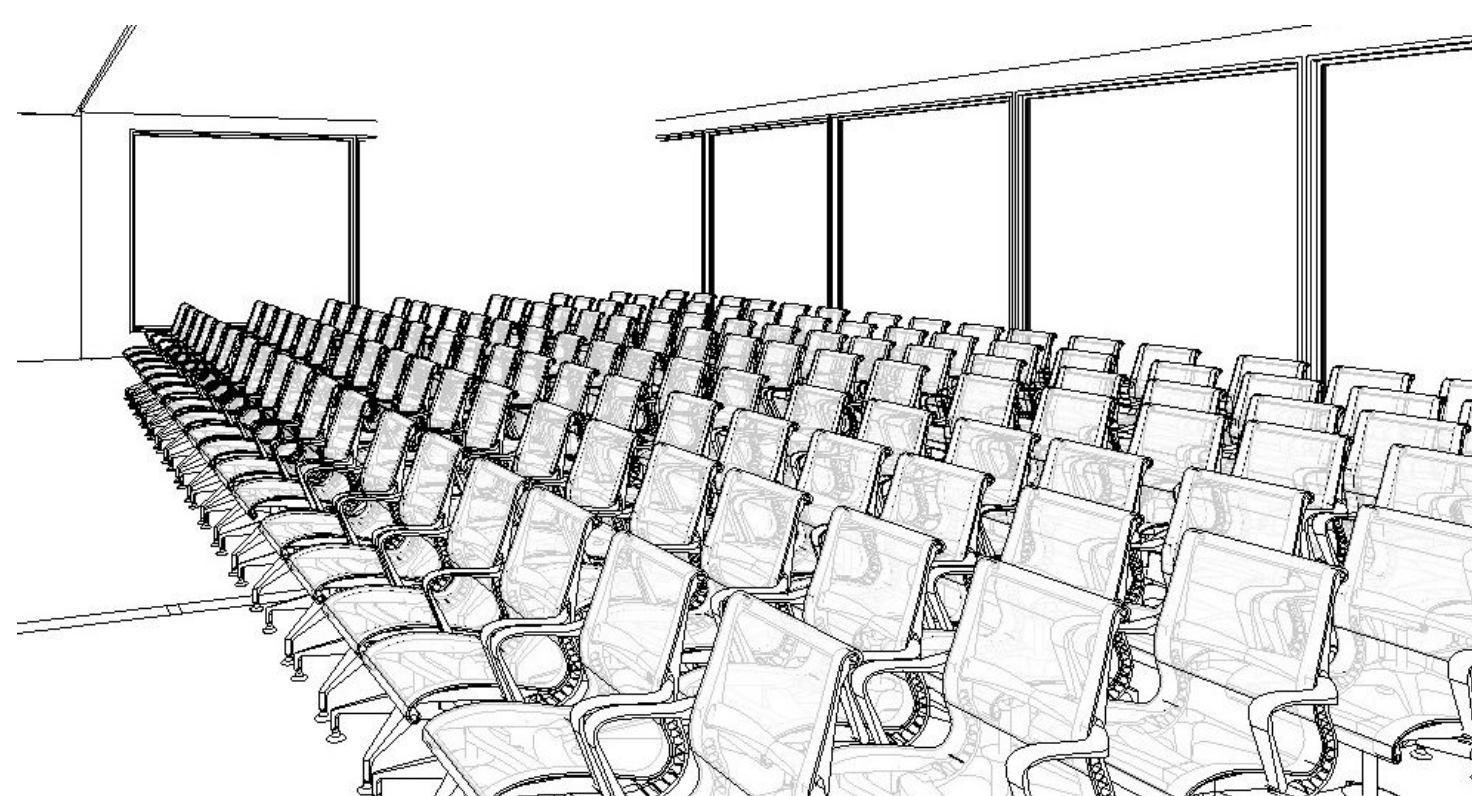
Site Layout Plan 1:1000



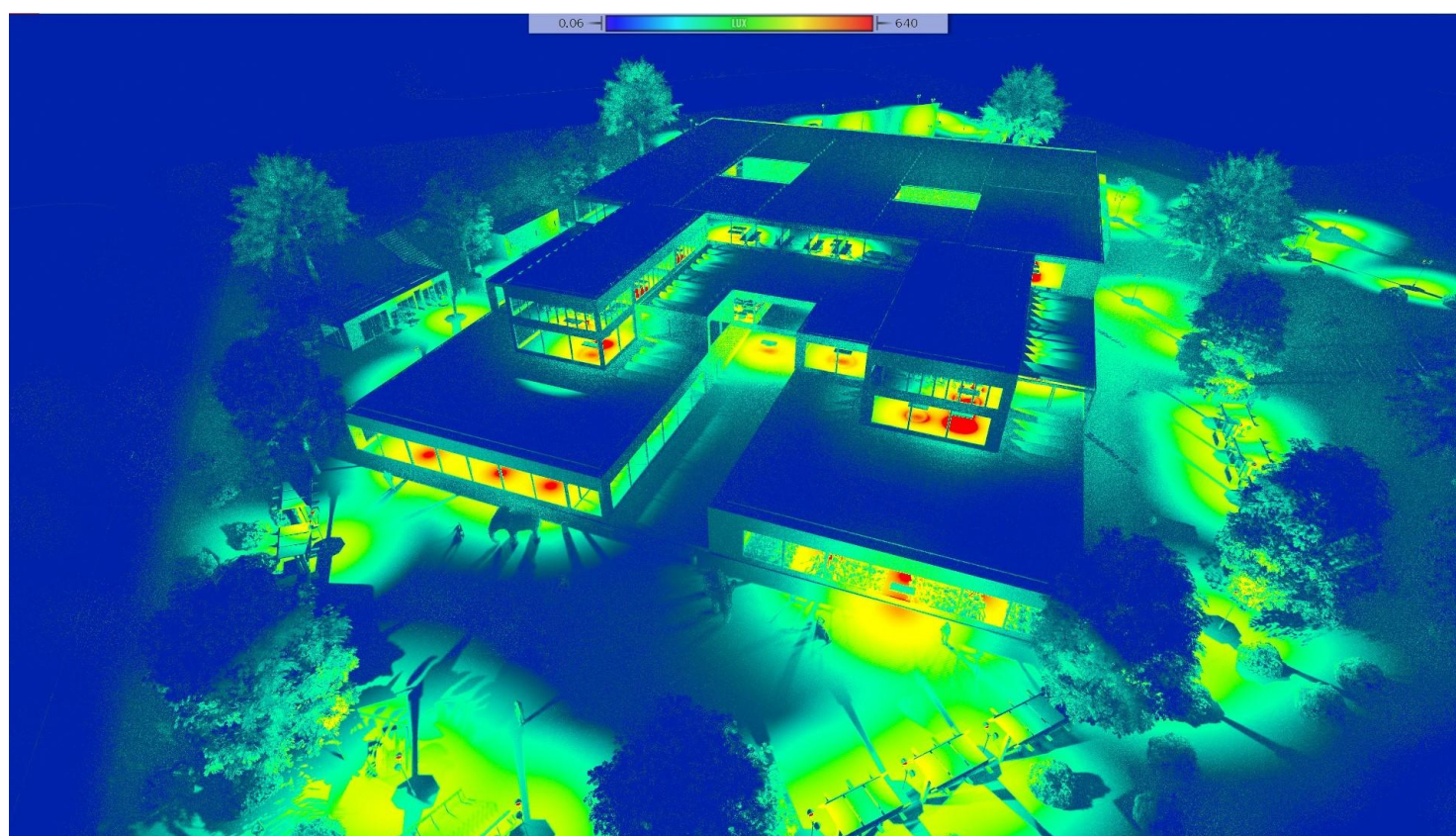
Perspective View: The bird-eye view of the construction rendered by Enscape



Internal View of G/F to 1/F Staircase generated by REVIT 1:500



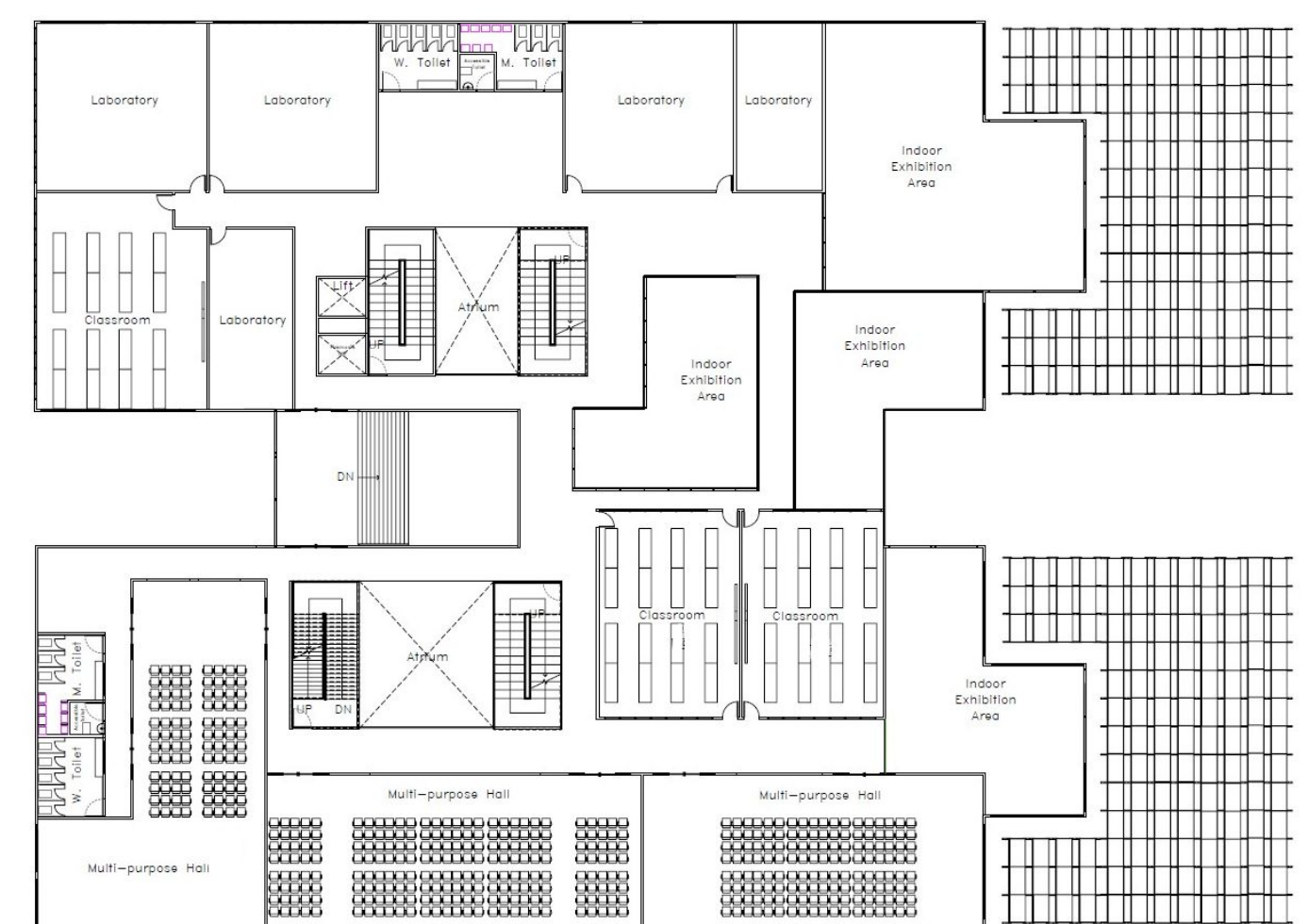
Internal View of Multipurpose Hall generated by REVIT 1:500



Luminous intensity generated by Enscape 1:500



Ground Floor Plan 1:500



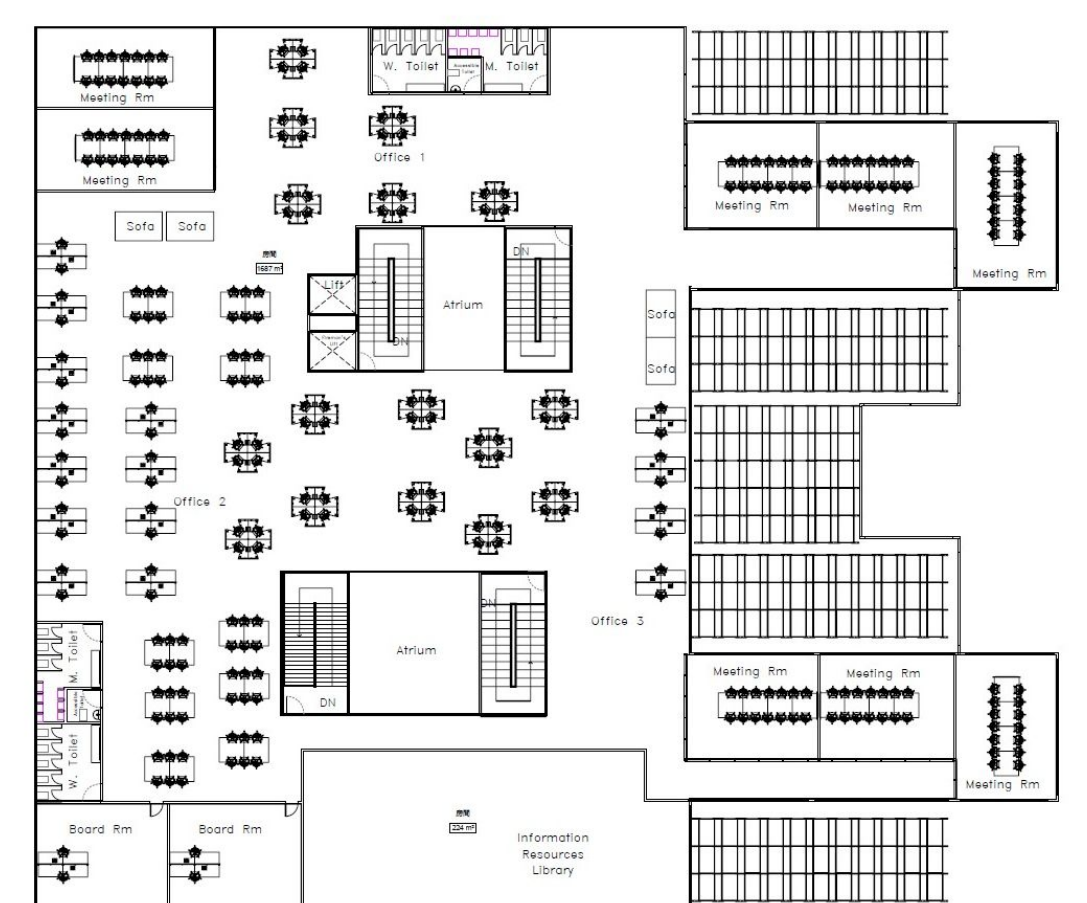
First Floor Plan 1:500



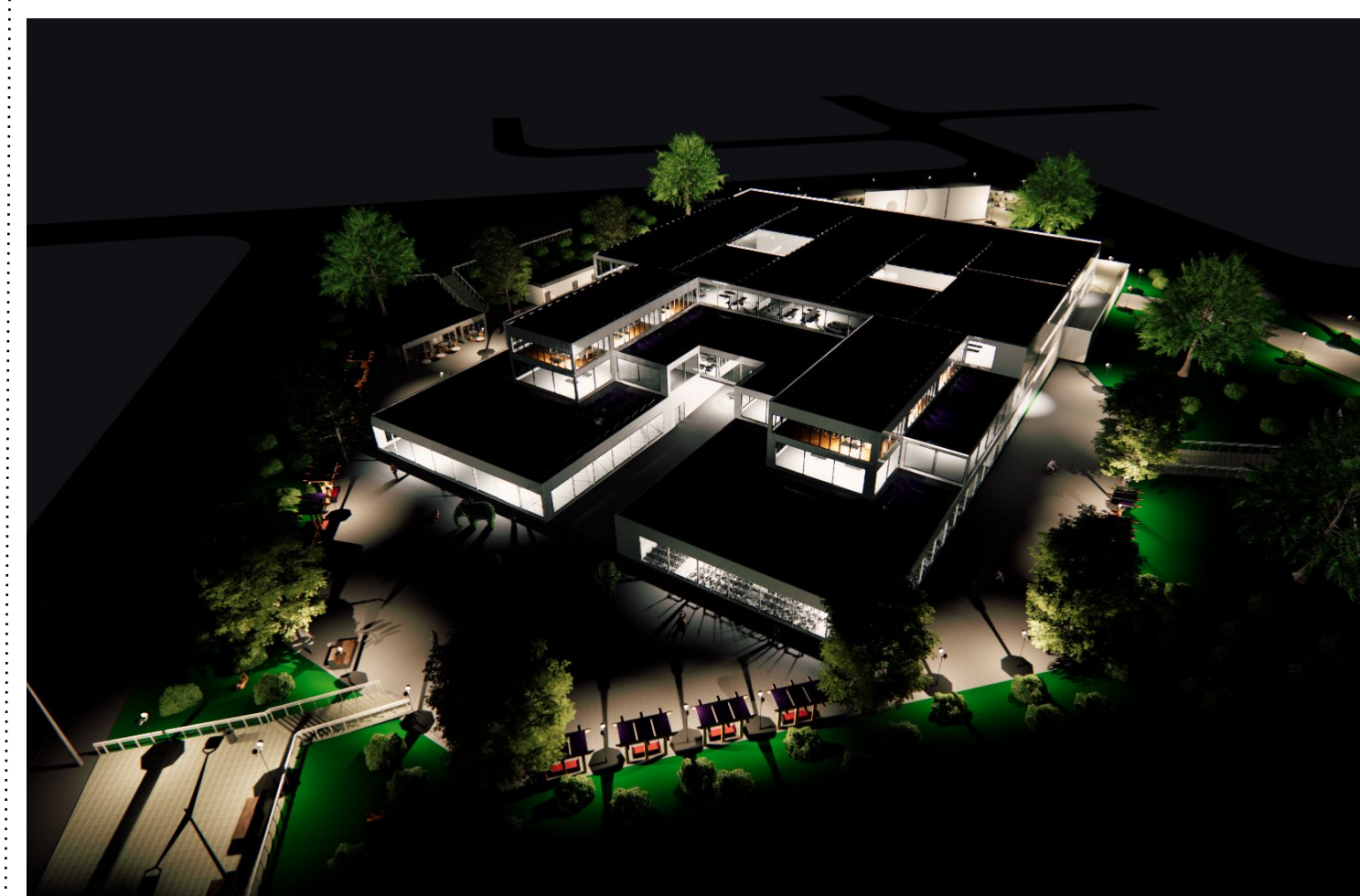
Internal Perspective – Canteen 1:500



Internal Perspective – Computer Lab 1:500



Second Floor Plan 1:500



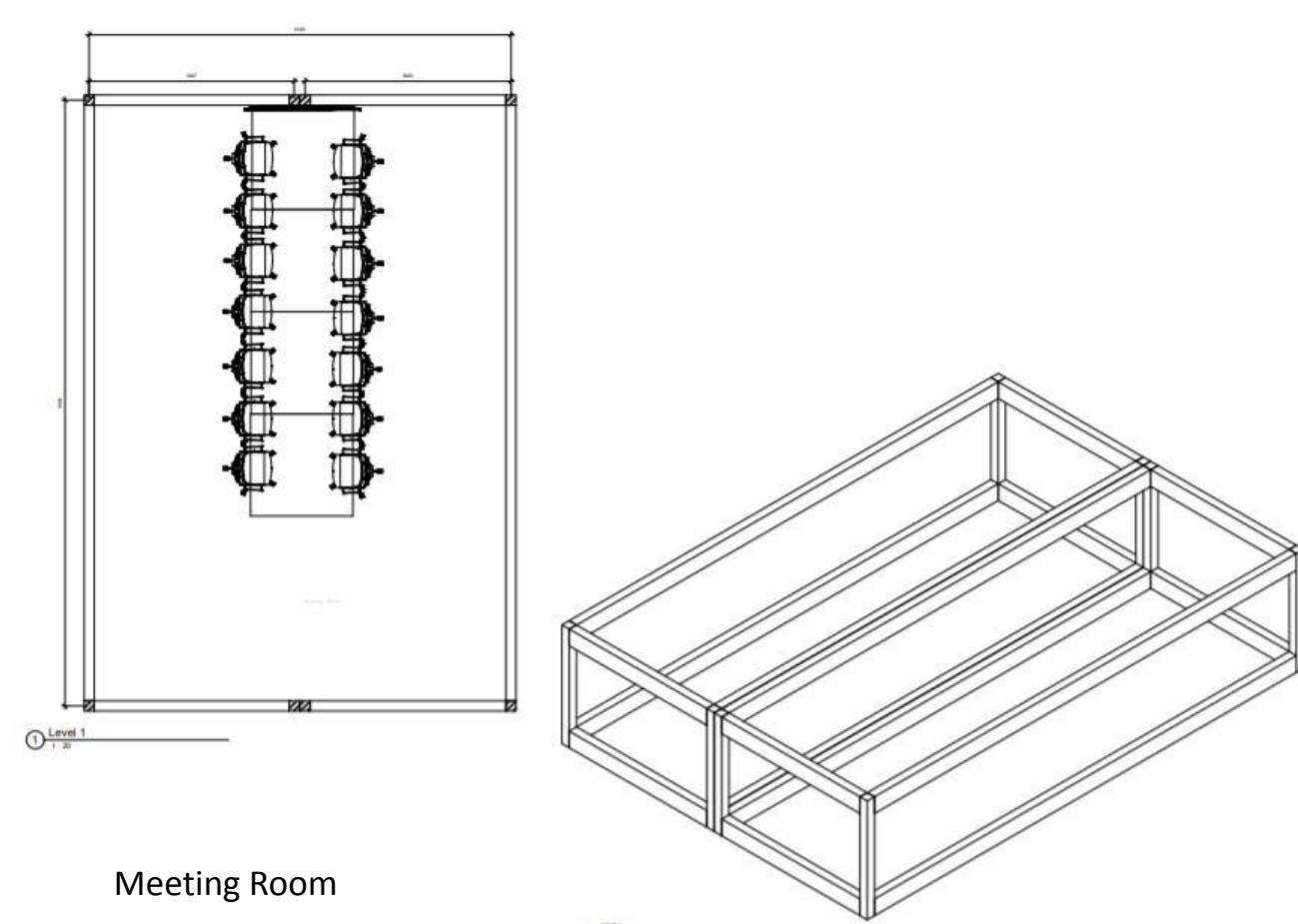
Overall Bird Eye view (Night View)

**Computational Design:** Revit and Enscape is used to generate the internal views and visualize the luminous intensity around the building

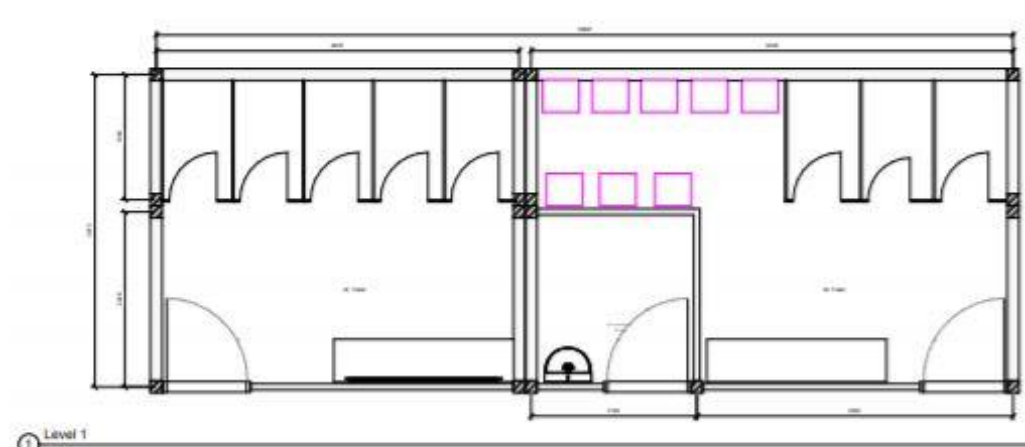




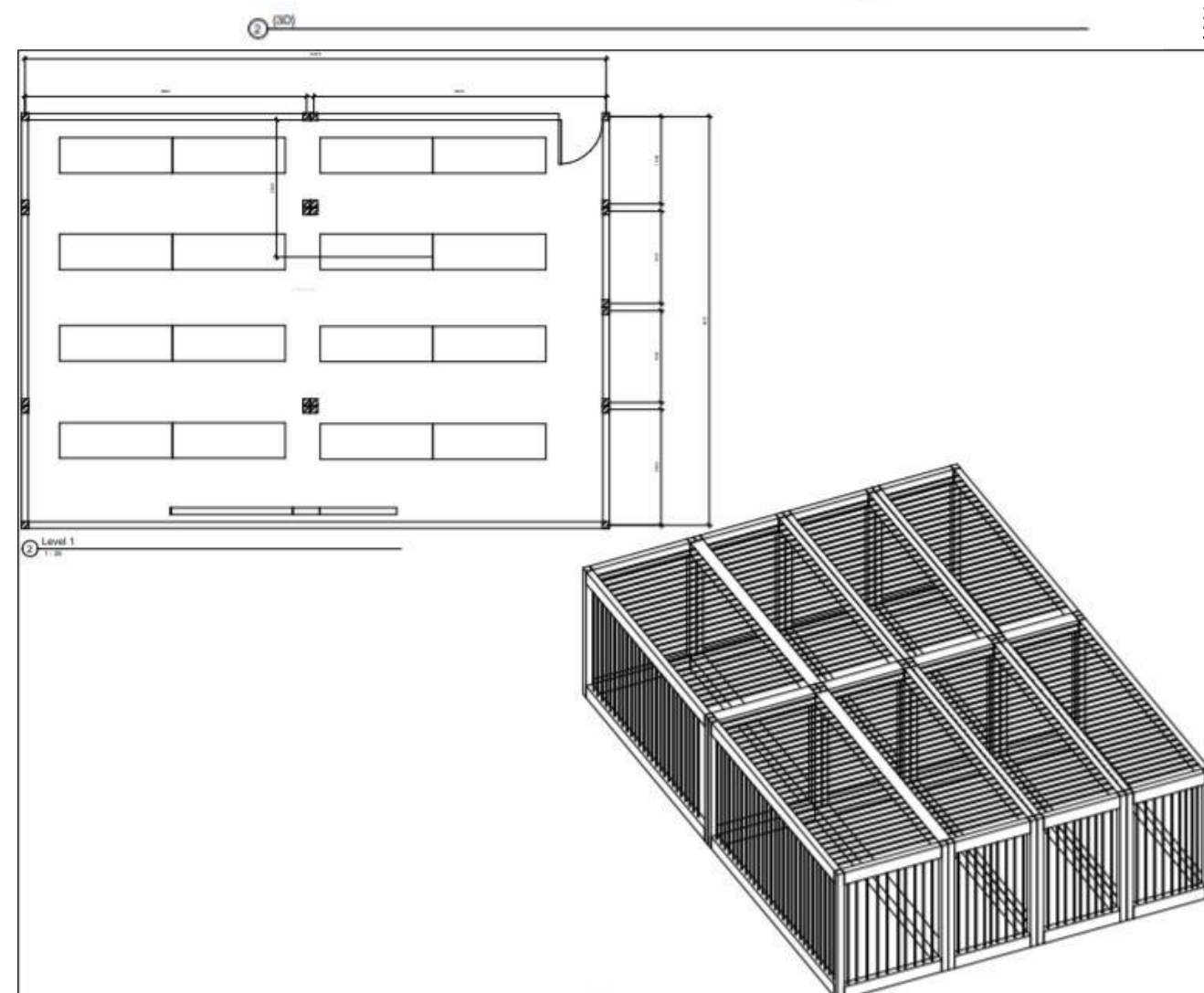
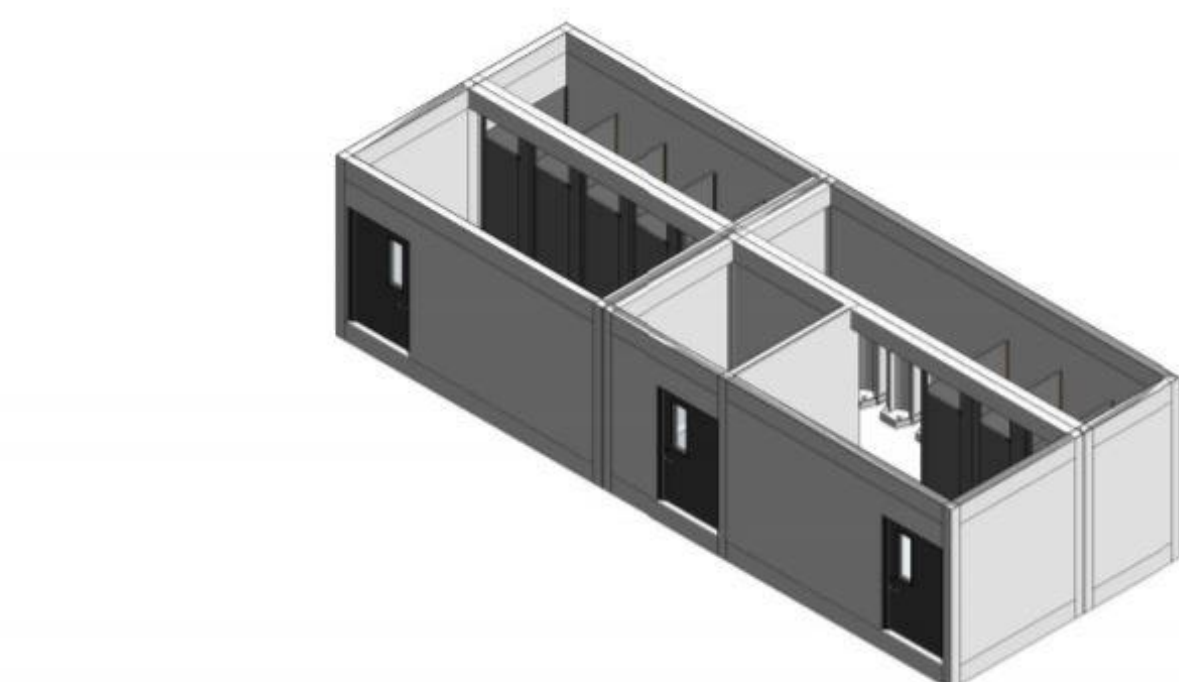
Transportation route of MiC module



Meeting Room



Toilet

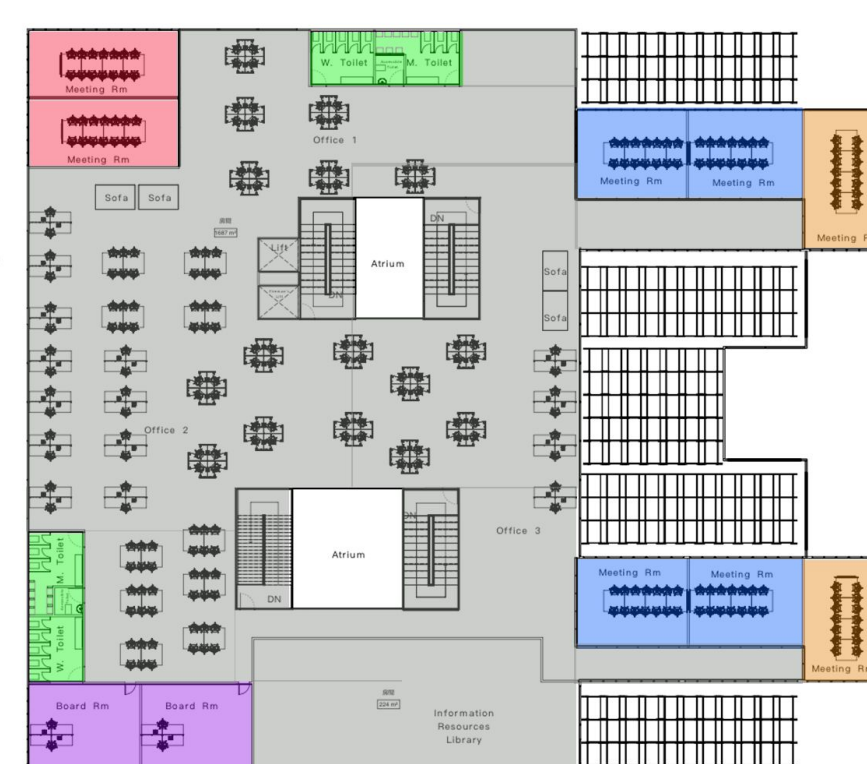


Classroom



**MiC:**  
Steel MiC module of toilet and classroom were utilized in the design and the general layouts were shown in the above figure.

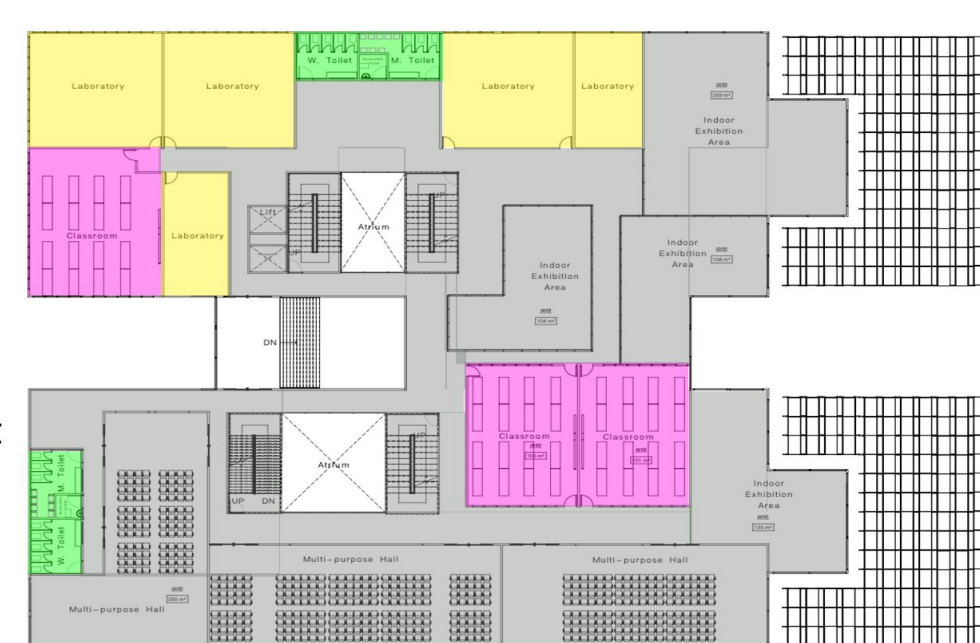
- Module A - Toilet
- Module B1 - Meeting Room
- Module B2 - Meeting Room
- Module B3 - Meeting Room
- Module C - Board Room



Second Floor



Ground Floor

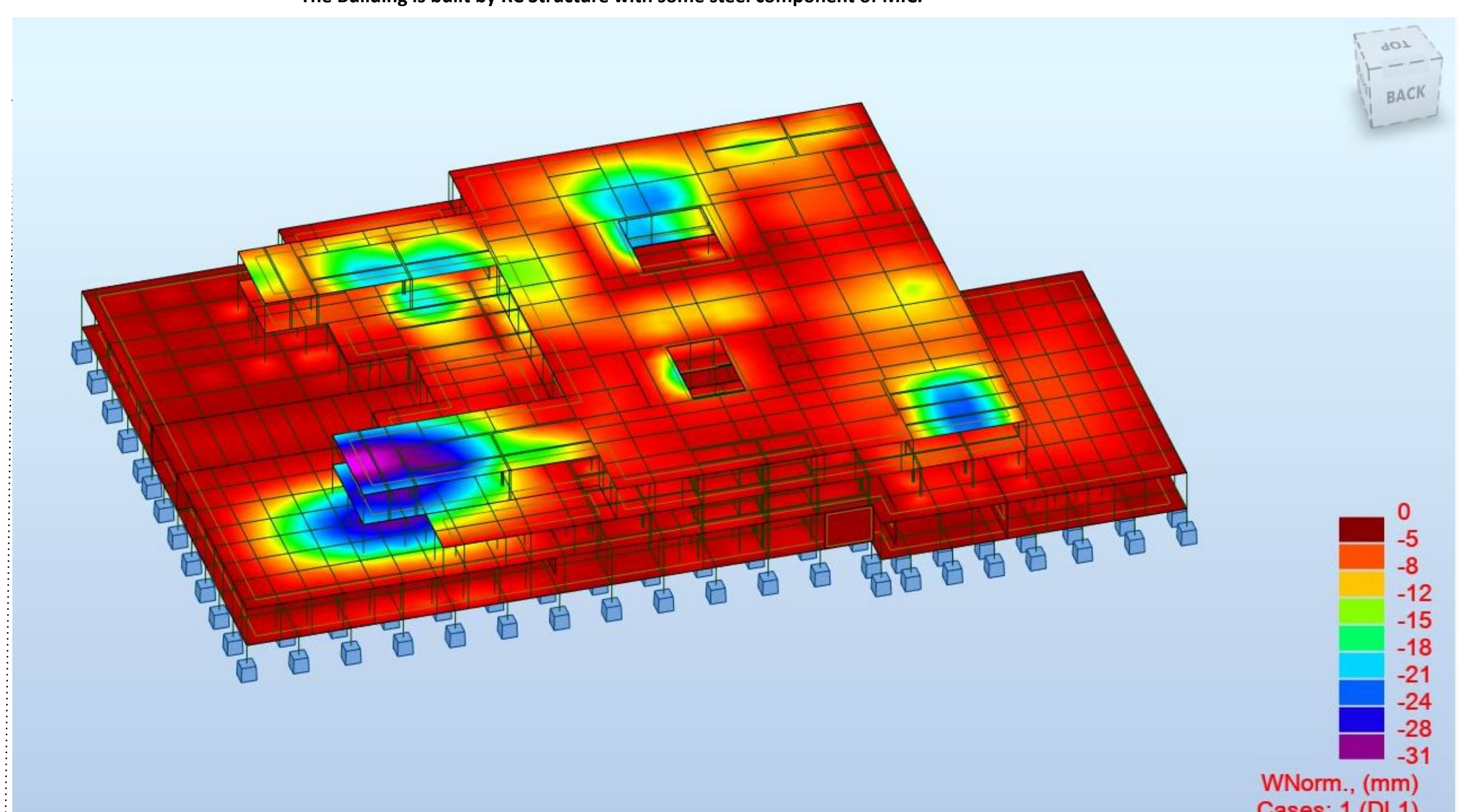
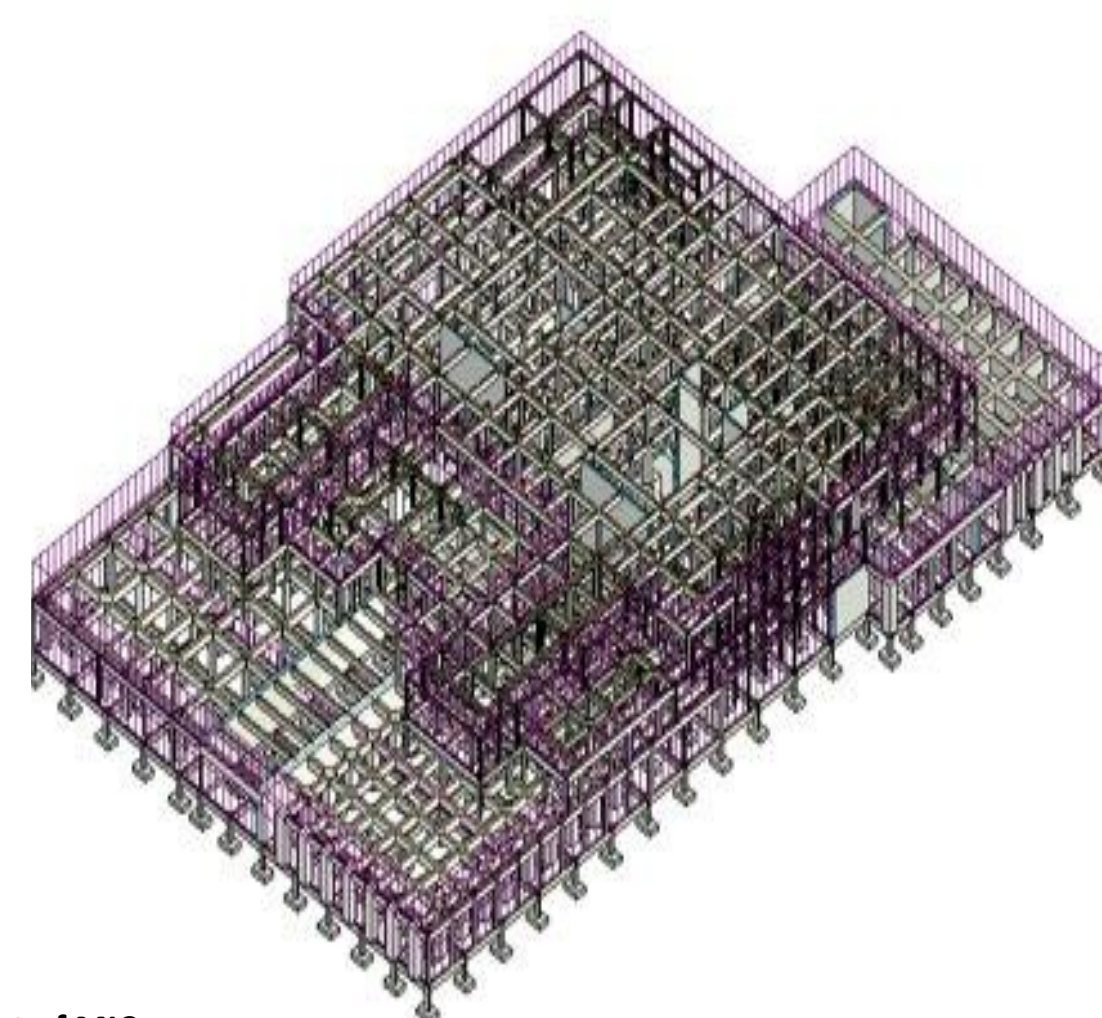


First Floor

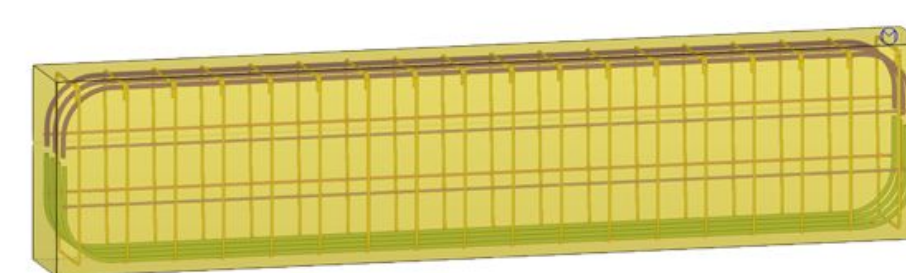
- Module A - Toilet
- Module D - Classroom
- Module E - Laboratory
- RC Core Slab

## Structural Design:

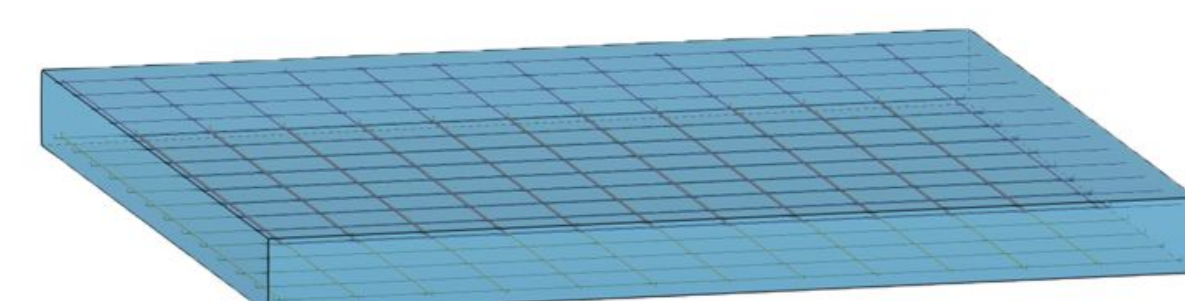
The Building is built by RC Structure with some steel component of MiC.



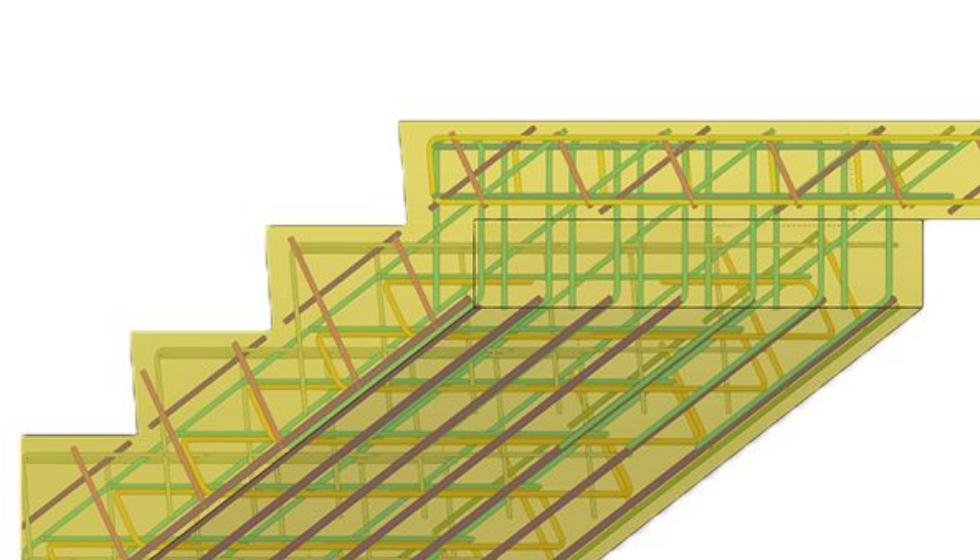
**Structural Analysis:** By undergoing structural analysis in Robot, conceptual design of the building structure were able to be verified and the overall structural integrity could be evaluated for design optimization.



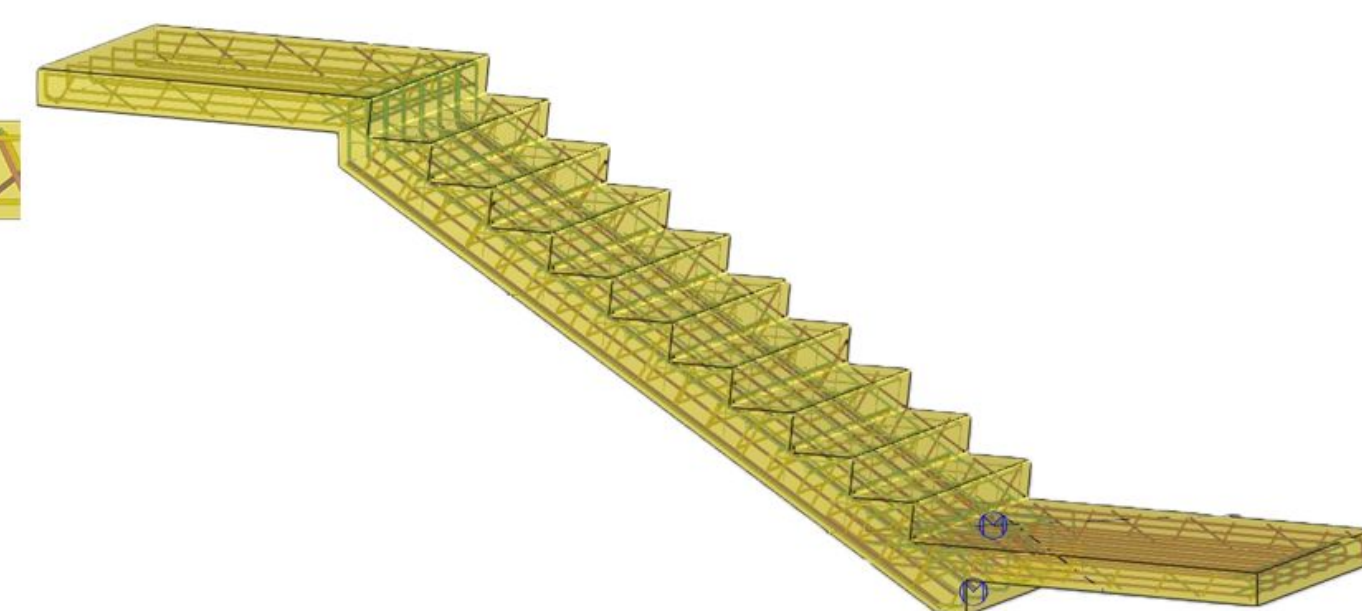
Beam Dfma



Slab Dfma



Stair Dfma Detail



Stair Dfma

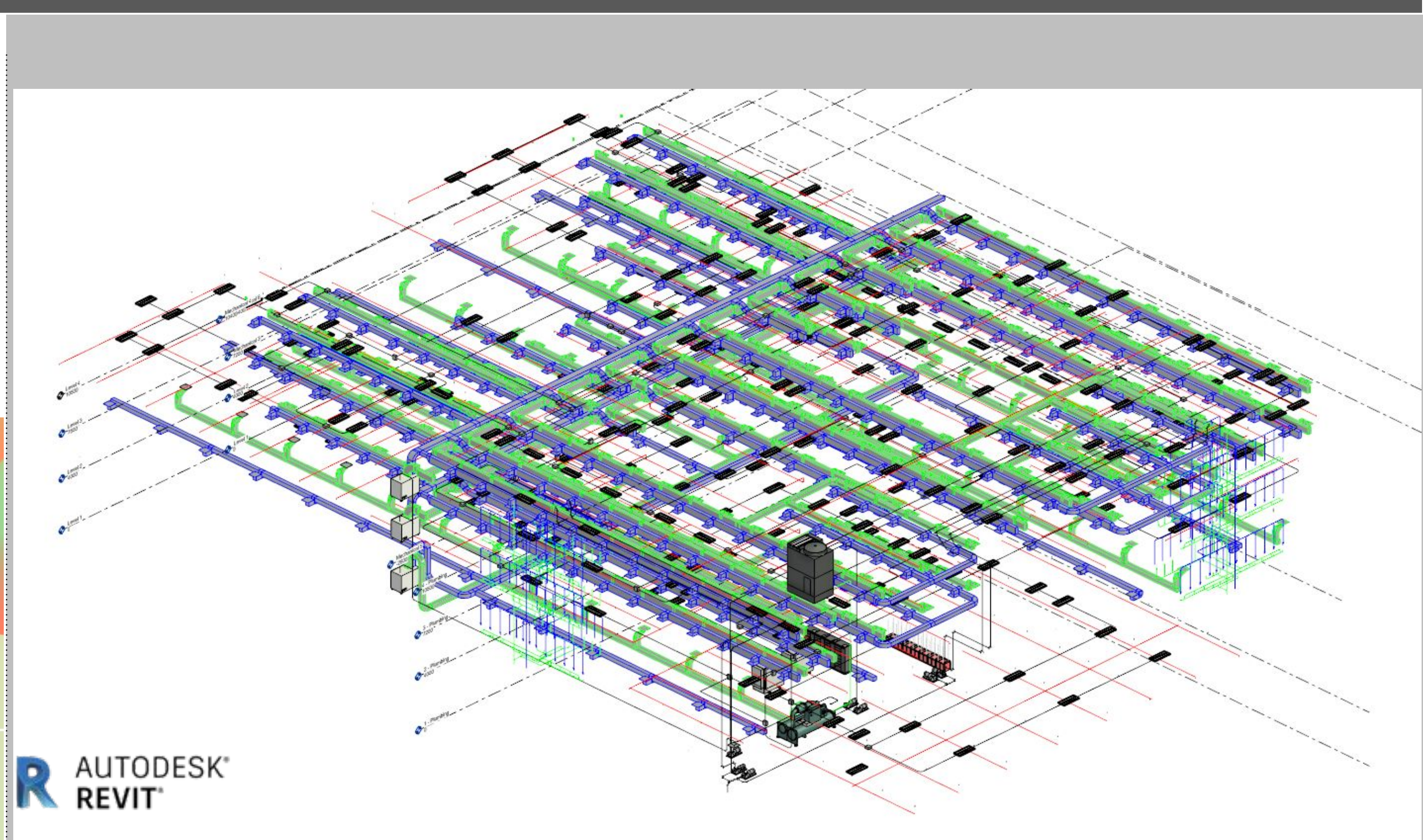
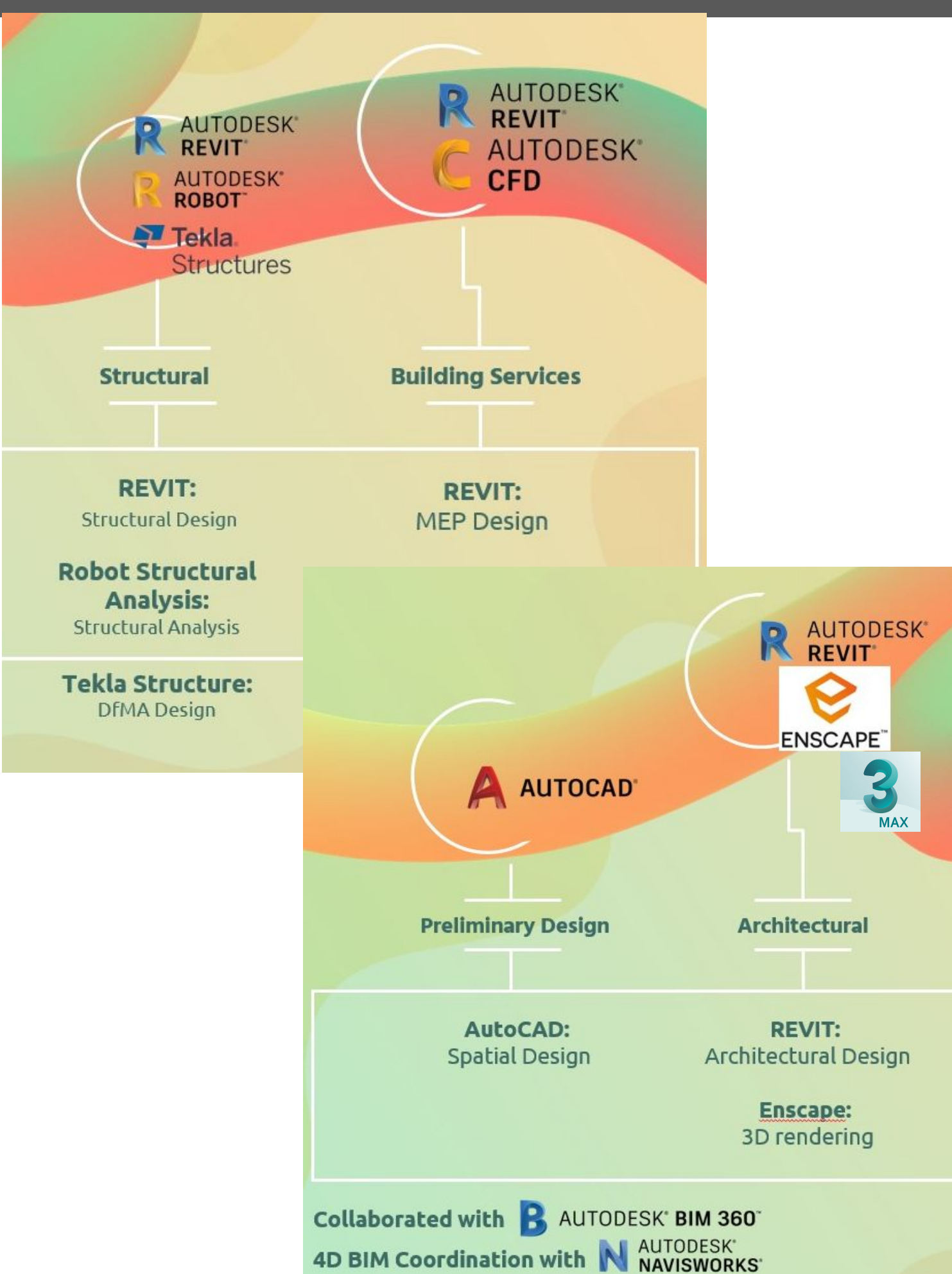
## DfMA:

Different prefabricated structural elements detail were designed in Tekla to optimize the size and thickness of concrete and reinforced bars.





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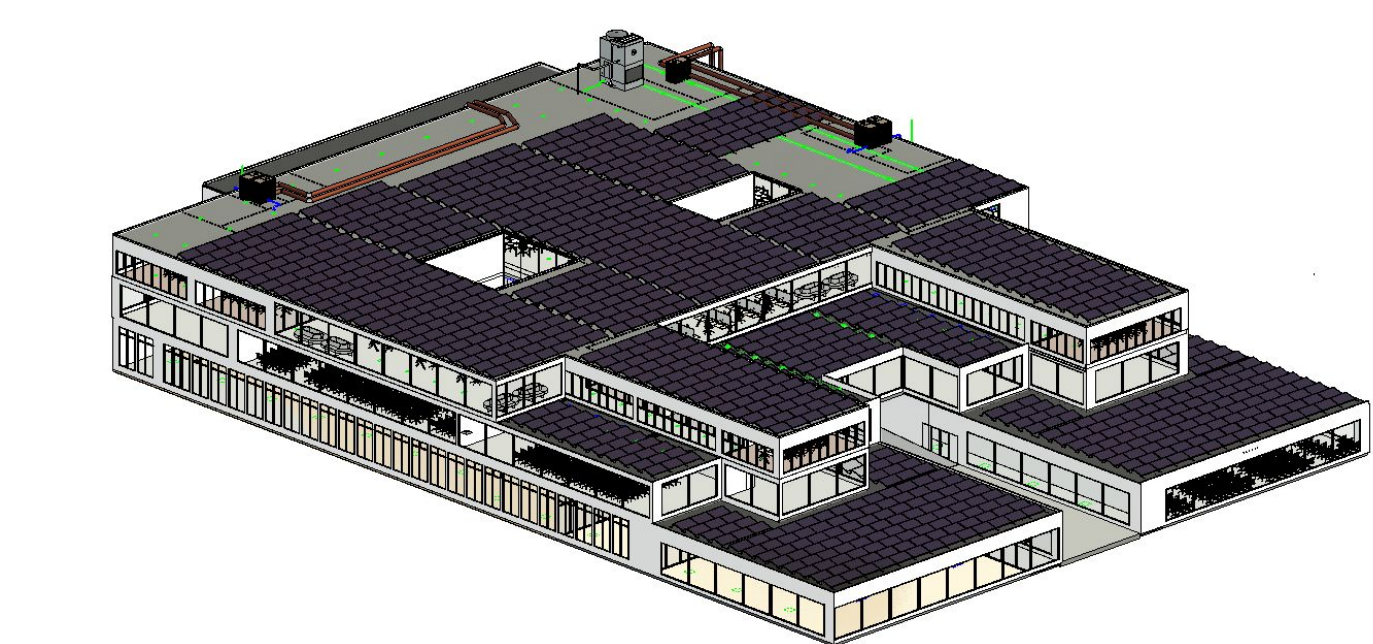
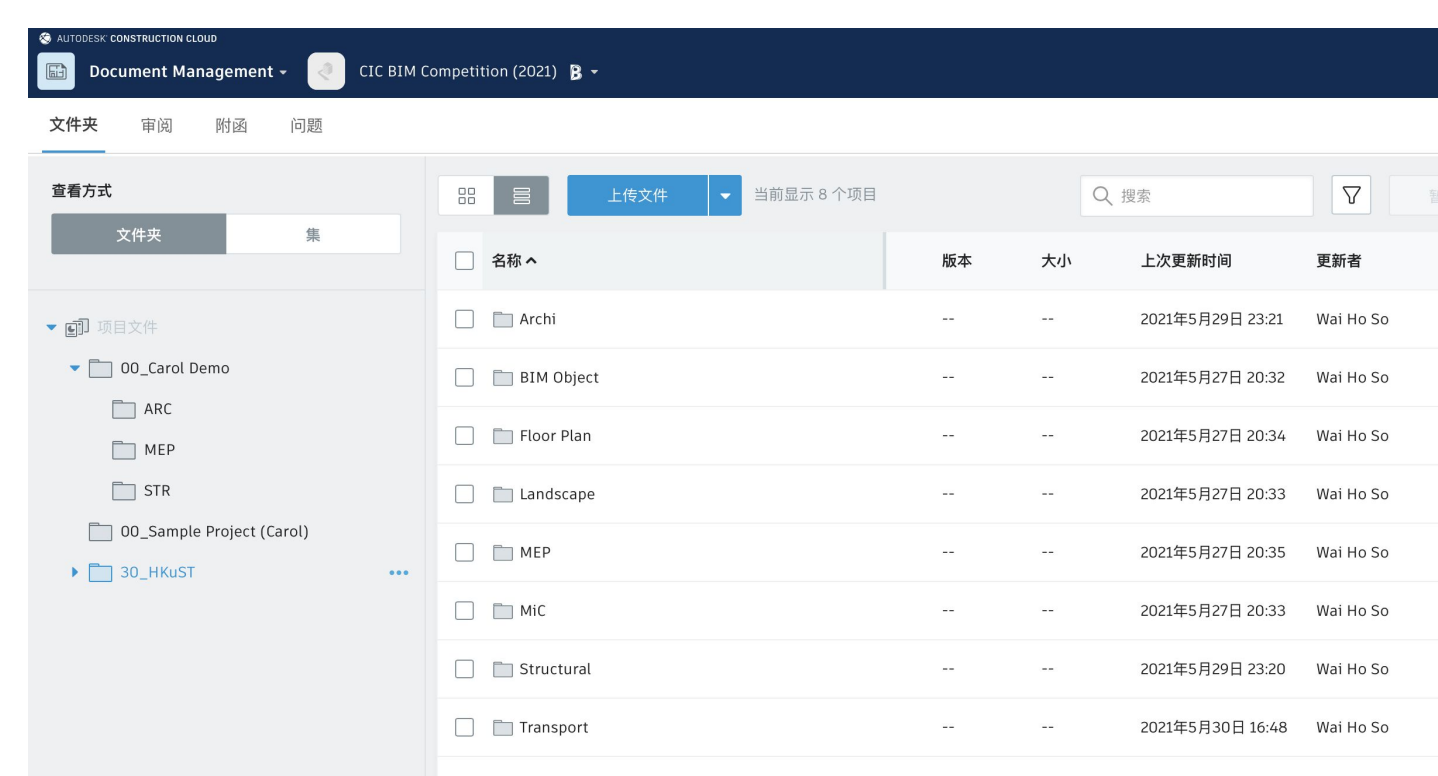


## Perspective View:

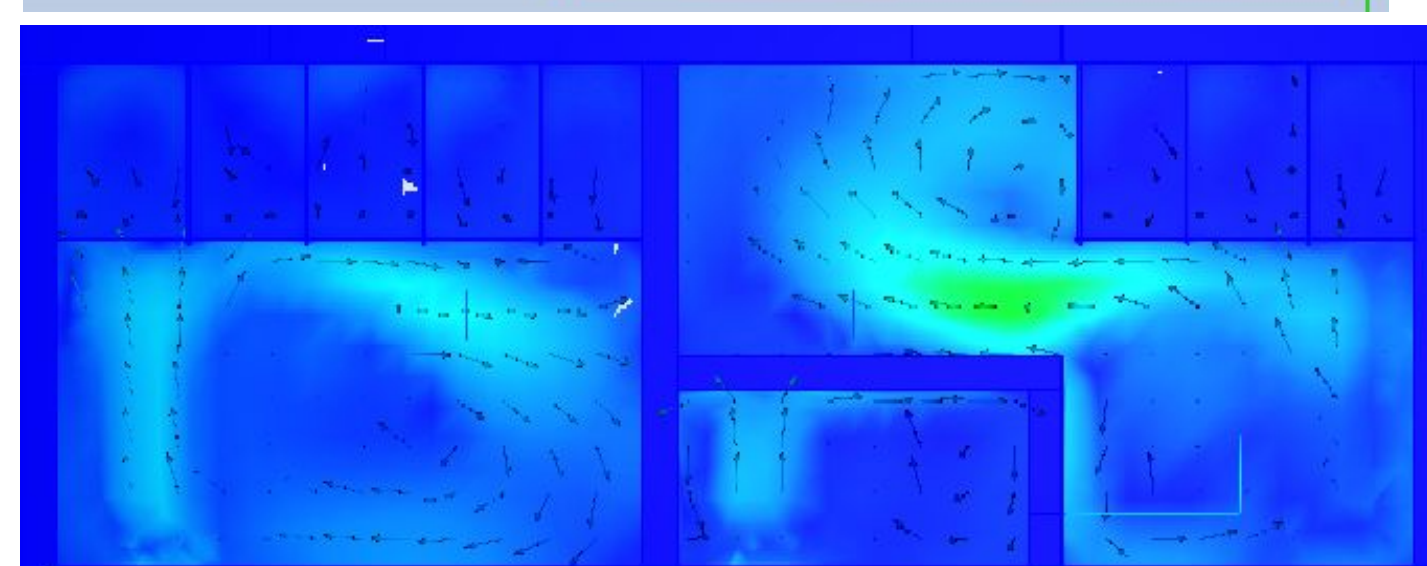
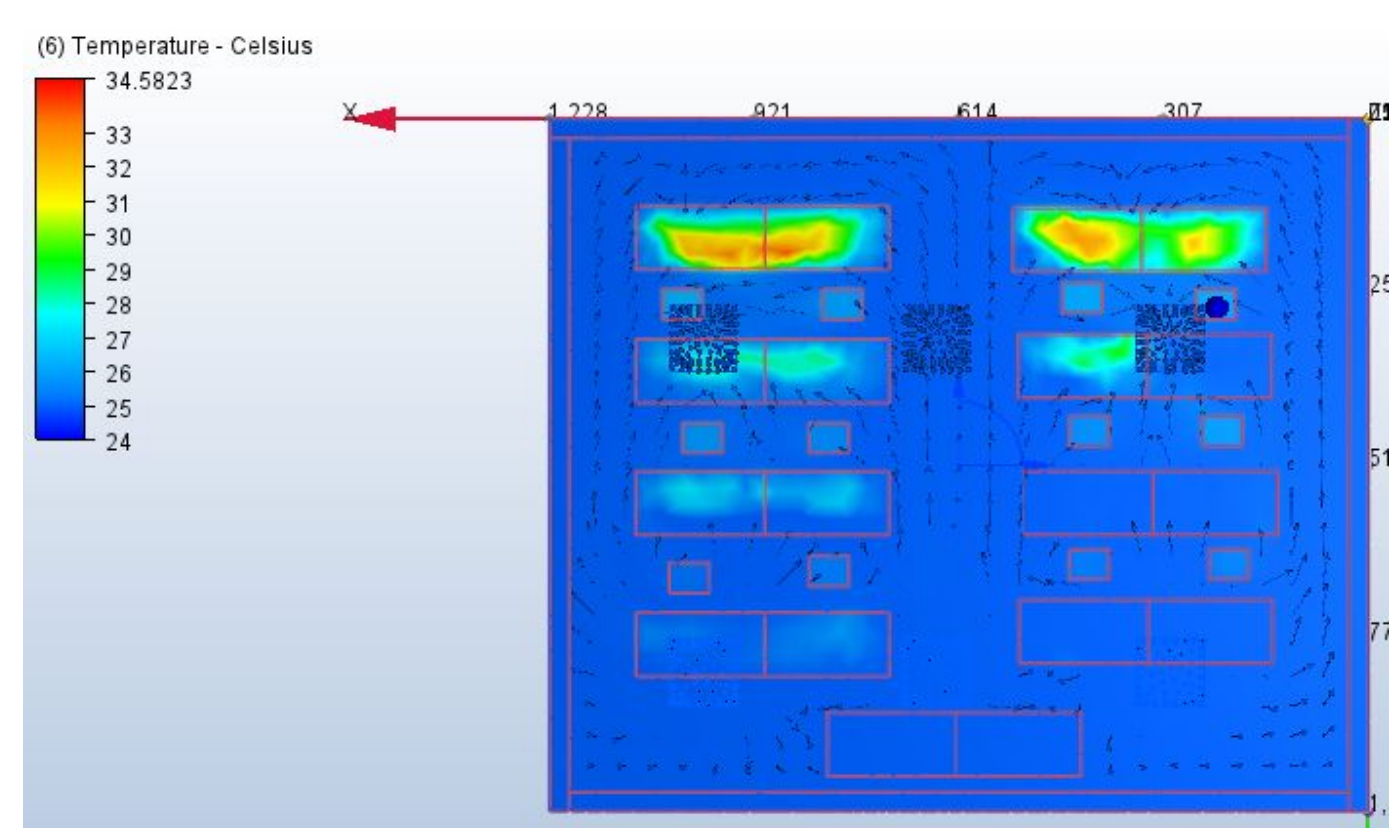
Models of plumbing, drainage, HVAC system, fire services installation and electrical appliances are combined into the above view using Revit

## Design Coordination:

BIM 360 allow the storage of different plan, through collaborating with other building services plans to mitigate the risk of duplication in terms of location.



**Project Team Collaboration:** BIM 360 was used to share Architectural, Building Services and Structural for team collaboration such as the function of Link Revit.



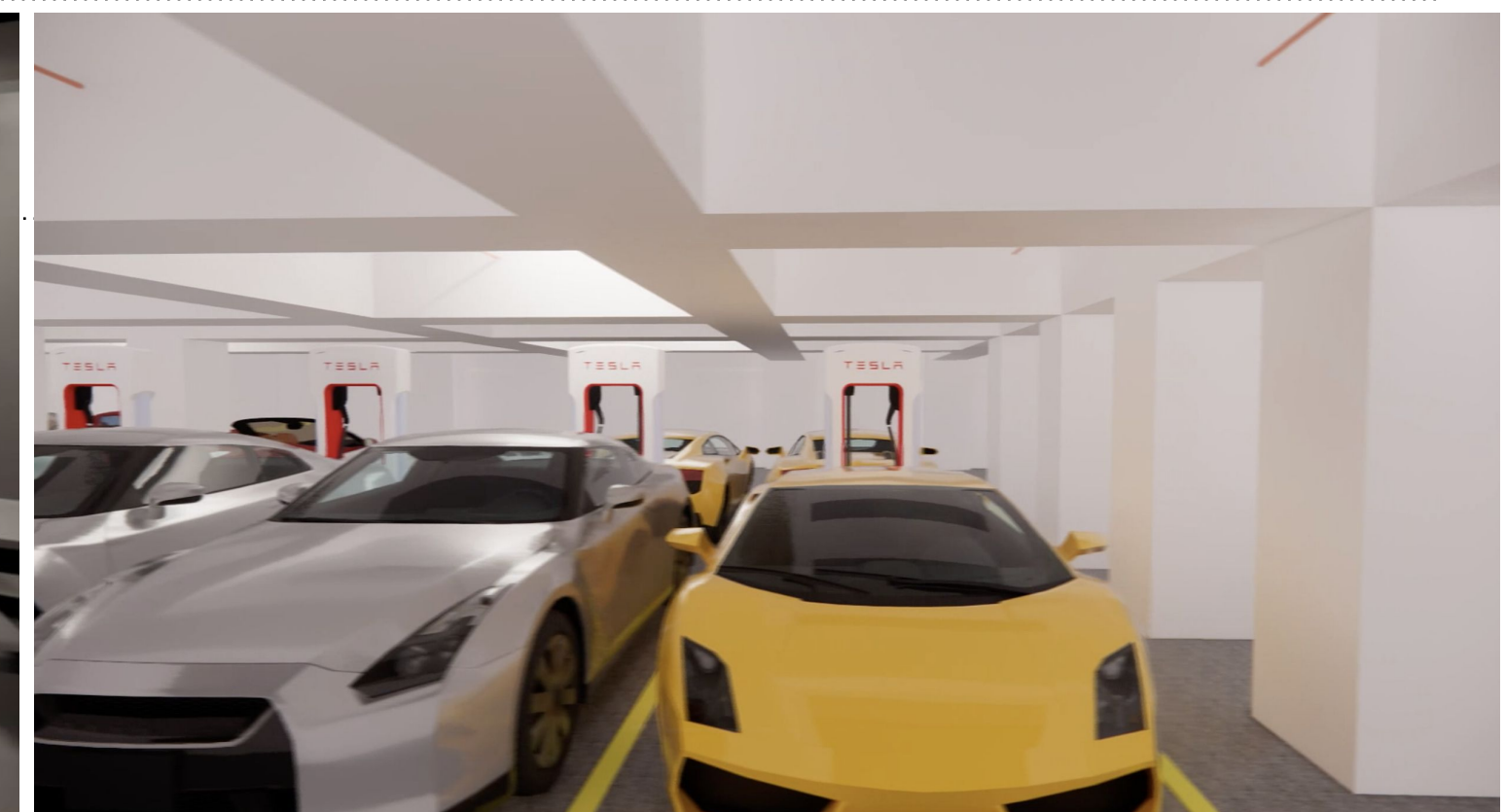
## Computational

## Design

By exploring the geometry of the student room and toilet BIM model, CFD simulation help us to optimal HVAC design and visualize the air flow for thermal comfort and virus spread.



Classroom with lighting, sprinkler and ventilation systems



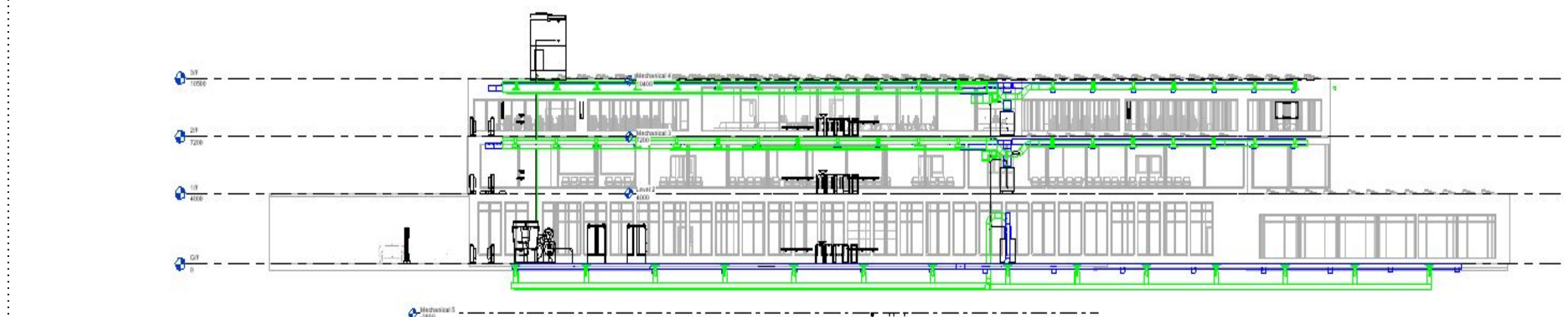
Car parking space with electric car charging station



Coordination between building services facilities in the plant room

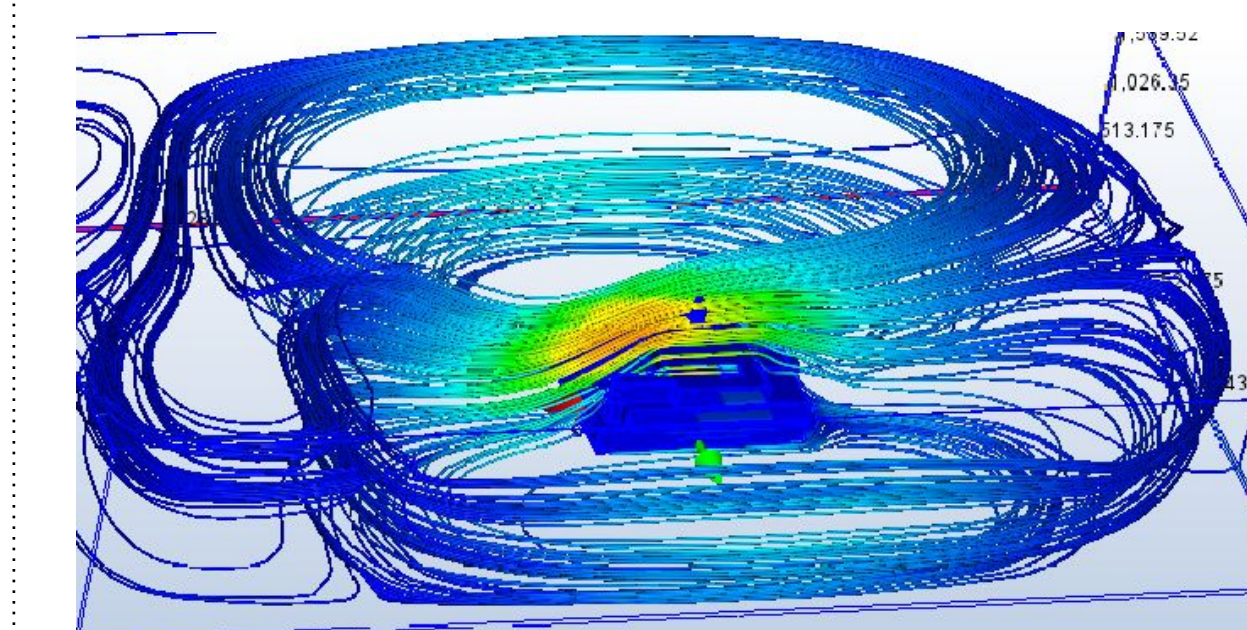
Object-based design enables the changes in dimension, functionality and lower the possibility of mis-conjunction of building services

Internal Perspective 1:500

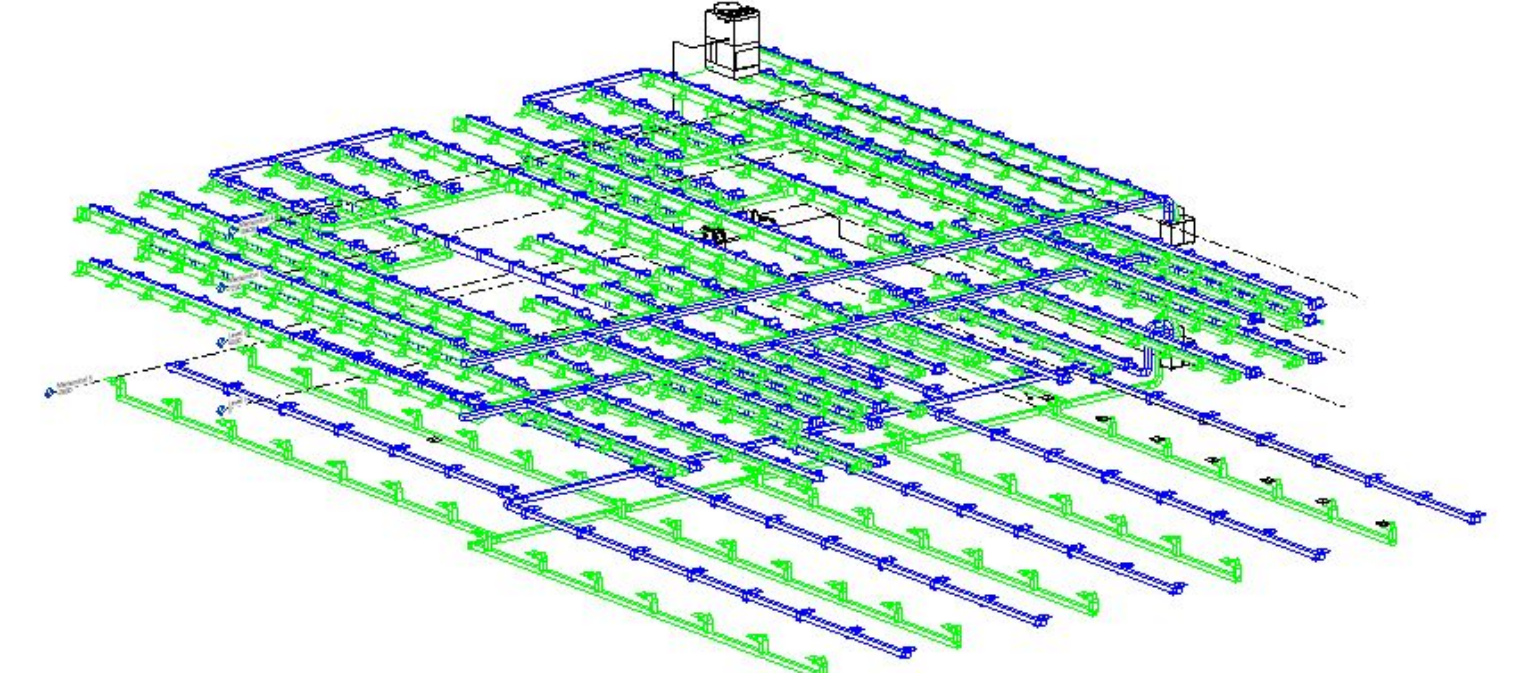


## Section view (Up) and Overview (Down)

BIM allows all MEP components to contain geometric and parameters so that a better installation and operation can achieve via BIM



Natural ventilation of external and internal flow were analysed by CFD



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