

PANEL DISCUSSIONS

PANELIST

No	ROLE	NAME	AFFILIATION
1	Moderator	Dr. Masoud Moghaddasi (DMM)	Meinhardt (Thailand) Ltd.
2	Panel (Architecture)	Mr. Liew S. Shoon (LSS)	a+pgrp
3	Panel (Structure & Fire)	Mr. Calvin Chang (CC)	Calvin Consulting Engineers
4	Panel (MEP)	Mr. Andrew Moraes (AM)	Myanmar BECA Ltd.
5	Panel (Façade)	Mr. Ping Kuo (PK)	Piin Zan Engineering Ltd.
6	Panel (Construction)	Mr. Aung Htay Oo (AHO)	Min Dhama Co., Ltd.
7	Panel (Steel Fabrication)	Dr. Michael King (DMK)	Min Dhama Steel Structures Co., Ltd.

DMM : What are the significant characteristics of M Tower in relation to other building in Yangon and the region?

LSS : In other cities, high-rise building ranges from 50-70 or even 100 storeys high. But due to height restrictions in Yangon in relation to Shwe Dagon pagoda, the highest limit in this area is 111m. To create an iconic building at this height would need a very unique design. A simple modern design would be something that is needed in Yangon.

CC : Structural engineer needs to follow the design intent as conceptualized by the Architect. For M Tower, what is special is that all the external columns are inclined to form a diagrid system. Erection is a major challenge as there are 12m length columns with a 1:2 slope and is affected by stability issues. We incorporated a special rigging device to facilitate erection works. Fabrication also poses a challenge especially at the joints. Due to Earthquake requirements, there is a need for the joints to be as rigid as possible. There are various types of joints (X,Y,K) and needed the experience and support of various expert personnel.

AM : A building is something alive. Client has always been thinking about the needs of the people/ occupants. Client wanted a great building for the occupants as they spend a big portion of their daily lives there. What is great is the emphasis on quality of the internal space, such as fresh air, glass, safety, power redundancy, communications features, tenants' provisions, etc.

PK : The amount of members for curtain wall system is approximately 10 times more than that for the steel structures. This forms a bigger challenge compared to the steel structures. Curtain wall is like the dress of the building as it will be the main element that is visible from far, unlike the steel structure and MEP services that remain concealed. The curtain wall needs to protect the occupants inside and fit for purpose.

AHO : This is the highest steel structure building in Yangon with 4 basements.

DMK : Diagrid is the characteristics function and this is the only project in Myanmar with a diagrid system.

DMM : What was the most enjoyable experience working on this project?

LSS : Probably working with the Chairman of Mottama Group. We have worked together on various projects such as shopping centres, condominium, Myanmar Engineering Council building, etc. Chairman is passionate and hard-working. He is always challenging the Architect to come out with better ideas. We are fortunate to be given an opportunity to work on such a project.

CC : I find it very enjoyable working with such a great international team coming from Singapore, Malaysia, New Zealand and Taiwan. Secondly, there were many mistakes made in Taiwan previously and when invited to Myanmar, I try to avoid similar mistakes from being emulated here.

AM : The enjoyable things was that the Client really having 2 ideas. We want to be the best in Myanmar but we do not define the best as what is currently available in Myanmar. We take reference from other countries but it is not built the same. We use other projects as inspirations and benchmarks but localized it to suit local conditions. It is great to be able to bring different skills from around the world and adjust it to local context.

PK : I had previously worked on Taipei 101 for 3-4 years. I know how difficult it is to work with different people from different parts of the world, especially as there are different construction practices. To exchange ideas across was challenging and we went through arguments and so on, but we all had a common goal of creating the best in Myanmar that can stand the test of time. In the end, all of us became friends and I think that was most enjoyable experience from this project..

AHO : I am very lucky to be able to work as a project director for this project and interacting with different people from different parts of the world.

DMK : What was enjoyable was to be able to gain experience through working with such a big team, each member contributing a portion of their of their expertise. Another area was our Chairman's willingness to invest in new technologies. We get to utilize and learn, and indirectly increasing our knowledge and capabilities.

DMM : What was the hardest part and also the challenges faced in this project?

LSS : One of the most challenging part of this project is that this is one of the first steel high rise building in Myanmar. We had to learn new technologies and also dealing with authorities such as YCDC and CQHP. We need to work together with the authorities on understanding new areas such as structural requirements, earthquake, fire protection, etc, which are still quite new here. Before any technology or requirement becomes a norm, we need to share and learn from each other. This has been very testing.

CC : Design has to come along together with fabrication and erection. Design has to be practical. 4 years ago, we could not find tower cranes. The Chairman invested in 2 tower cranes. Design has to take into consideration these constraints and provide something that can be fabricated and erected without problem. I think this is a great challenge.

AM : The challenges were there were no track records or available data, as in other countries, to make the right decisions. Making decisions and overcoming it has been a challenge as you had to either be brave or follow a safer solution. Client has been helpful as they were being brave and bold to make decisions and embrace new ideas.

PK : Myanmar is hot with more than 5 months of rainy season. The challenge is how to make the building comfortable. We intend to use low-e glass which cut out the heat while allowing light to come through, making it comfortable for work. During heavy rains, a lot of water will flow into the façade. We need to get the water out quickly and ensure the joints are water tight. Particularly, the triangular area that is facing towards the sky would be receiving lots of water at the lower corners. All the design has to be careful. Design has to take into consideration the materials being used, installation sequence and silicone so that it will remain water-tight.

AHO : M Tower is an iconic building and the tallest steel structure in Yangon. There is no similar building here and in some other surrounding ASEAN countries. Logistics from factory to work site is a big challenge as the location is at a high traffic area. We need a proper erection plan to meet target schedules. We also have very limited construction space and limited material laydown area. As such, logistics is a major challenge. The other challenge is lifting operations. We had to use various types of cranes to install the steel structure from Basement 1 up to 26th floor. Another area is field welding process. We have to assign qualified welders, especially for inclined columns and the joints. All welders need to be qualified by 3rd party inspectors. Another challenge is quality issue. In order to meet quality requirements, we need a strong team to check on incoming materials, alignment, welding quality, bolt tightening, etc. Safety is top priority and this is achieved with a safety management plan. All personnel need to abide by the safety rules and regulations. We had no accidents and zero LTI for this project. This is our greatest achievement. We appreciate the contributions of all local teams to meet these targets.

DMM : Next, I would like to focus on the technical aspects of the project. I understand that you did a wind tunnel testing for this project. Could you please explain about the wind tunnel testing, the philosophy behind it and why you had to carry out this test.

PK : Wind tunnel test is quite unique even for Taiwan and also especially for Myanmar. Wind tunnel is carried out in a square hollow tube with a big fan on one end and a small funnel in the middle. There is a turn-table in the middle. There are about 400 to 500 sensors for wind pressure placed in the model. Basically, wind tunnel is recommended for buildings higher than 32-storeys; 10-storeys in hurricane areas or when the building has an unusual shape or construction methodology. For M Tower, it is above 22-storeys and it has a unique shape and not a rectangular box. Most of the wind load and design criteria provided in building codes area based on rectangular box that has been developed more than 40 years ago. So, what do we get from the wind tunnel test? We can get the wind load distribution diagram from the test. It will give the positive and negative wind loads of each portion of the façade. If you do not carry out the wind load test, then you will need to follow the building codes. The building codes suggest a uniform wind load on M Tower, with a higher wind load at the corners. The maximum wind load is 608 kgf/m² with a band width of 3.1m. The other regular areas would be 380 kgf/m². When compared to wind tunnel test results, the wind tunnel produces very

accurate wind loads while design codes give very simple distribution diagrams. Benefits would be there is no need for assumptions and the results are accurate. For the same high wind load areas, wind load test results shows 5.5kPa or about 550 kgf/m² and this is concentrated within a very small area only. Based on this results, we are able to use materials for a lower wind load. The wind tunnel test results will override building codes requirements. There will also be less damage in the future as you will know the areas that need to be reinforced.

DMM : We are made to understand that you have carried out a performance mock-up test as well? Can you explain about this?

PK : Performance mock-up has not been done yet since the system is still being developed. So, what is performance mock-up? Performance mock-up is to test full scale for an elevation of the façade. So, it is at least 2 and a half storey in height with actual materials to be used in the building. So, what do we test? We test the wind load resistance to see if any part of the building will come off under a strong wind. Next, we also test for air infiltration. We measure the air that infiltrates into the curtain wall. And the most critical is to test for the water resistance. We measure the water that comes in to the static as well as dynamic windows. Next, we test for the BMU Tie-Back Test. We also need to test for Inter-Storey Displacement to check for damage under Earthquake and Dynamic Seismic Performance. Earthquake does not come in 1 direction, so we need to test it vertically as well as laterally. We need to test that the curtain wall will not be damaged during earthquake. We need to simulate and check that no water leaks even under hurricanes or strong winds. Another reason for the performance mock-up for M-Tower is due to the complicated design. We need to do a 3D study to know that all the components will work together. We will pick the most difficult part of the building for the performance mock-up tests.

DMM : It is time to open up to the floor for the Question & Answer session.

Q1 : I am a local structural engineer in Yangon. It is my opinion that M Tower is very impressive. I would like to ask 1 question. As a structural engineer, which one is better for seismic load, RC or steel structure? In Mr.Calvin's presentation, he mentioned that almost 50% of buildings that collapsed in Taiwan 1999 earthquake are RC buildings and 14% are steel. This shows that steel is better for seismic resistance.

CC : With reference to the collapse during 1999 Taiwan earthquake, the number of RC buildings that collapsed is 52% while it is 2% for steel buildings. But we need to take into account that steel buildings are much lesser than RC buildings and this makes the percentage for steel buildings that collapsed seem low. But on average, the percentage is still lower for steel in comparison to RC. 50,000 buildings collapsed while another 50,000 had partial collapse. Most structural engineers at that time raised queries as to the collapse as they had followed the building codes. For structural analysis, we normally used a reduced seismic force to design the building. We reduce by about 80% and even though we have a safety factor, probably about 1.4, this is still below the actual seismic load. We trust ductility to reduce the load on the building. Every construction joint and detail should have very good ductility. But 30 to 40 years ago, the builder does not pay so much attention to seismic ductility requirements. As for M Tower, if the diagrid system were to be in RC, we will not have the problems with steel detailed design.

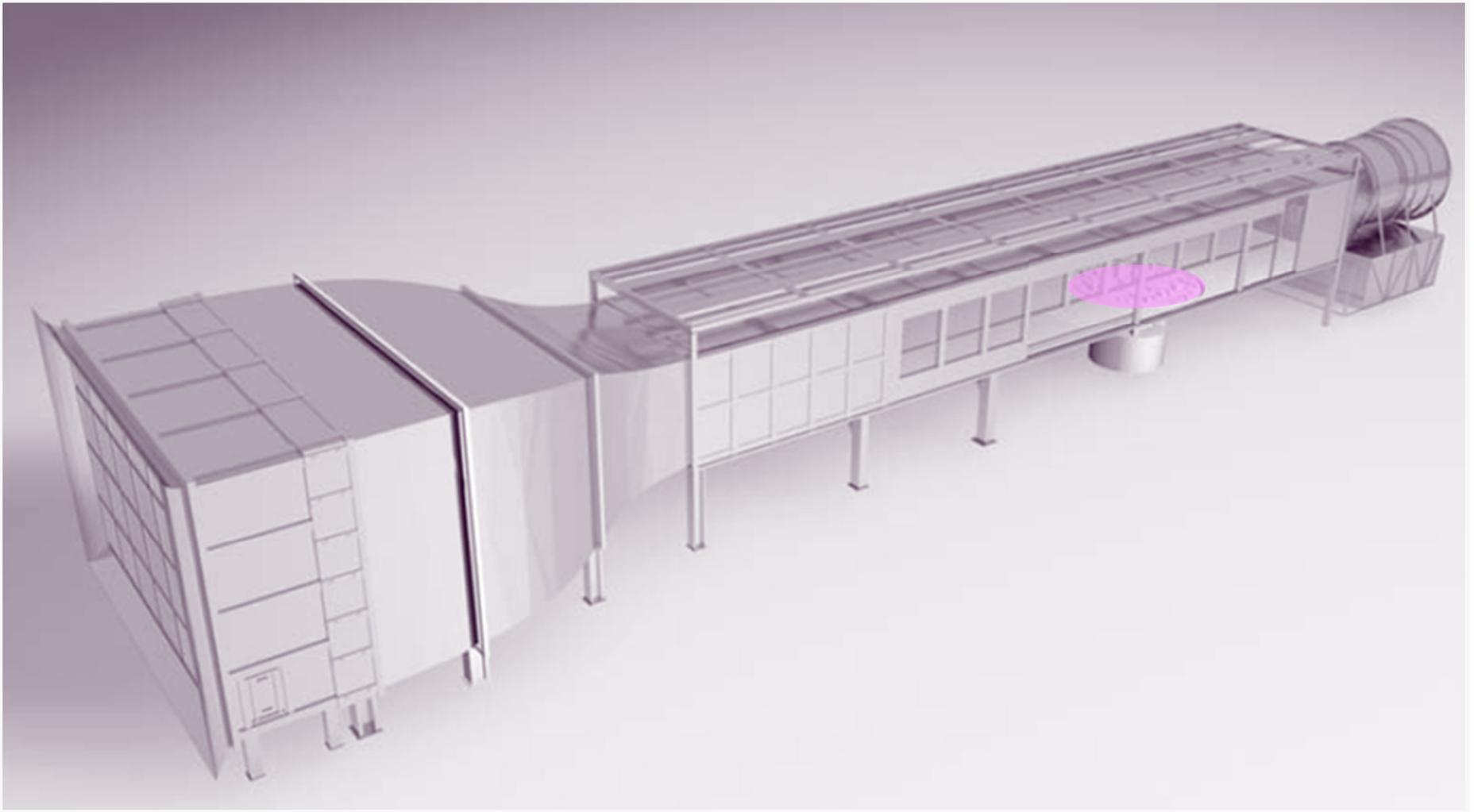
Rebar installation can be easily done on site, even for all the types of joints. But the inclined formwork will be a big challenge. That is why we choose to do it with steel.

Q2 : I would like to ask Mr.Calvin about the RC central core with perimeter steel diagrid. What is your concept for resist the earthquake force, by RC or by steel, or what is the percentage distribution.

CC : May be my earlier explanation was not too good. We are using pure steel frame. We have 2 cores. Inner pure steel core and the outer diagrid steel core. Most of the earthquake force will be resisted by the diagrid system. I would also like to clarify on my earlier presentation about the tower cranes. I mentioned that we couldn't find tower cranes in Yangon 4 years ago. What I meant was that you can find tower cranes then, but these were old meant for RC construction. The carrying capacity is much lower. We couldn't find tower cranes for heavy steel construction.

DMM : I hope all of you have enjoyed this panel discussion. Thank you very much.

Wind Tunnel



Wind Tunnel

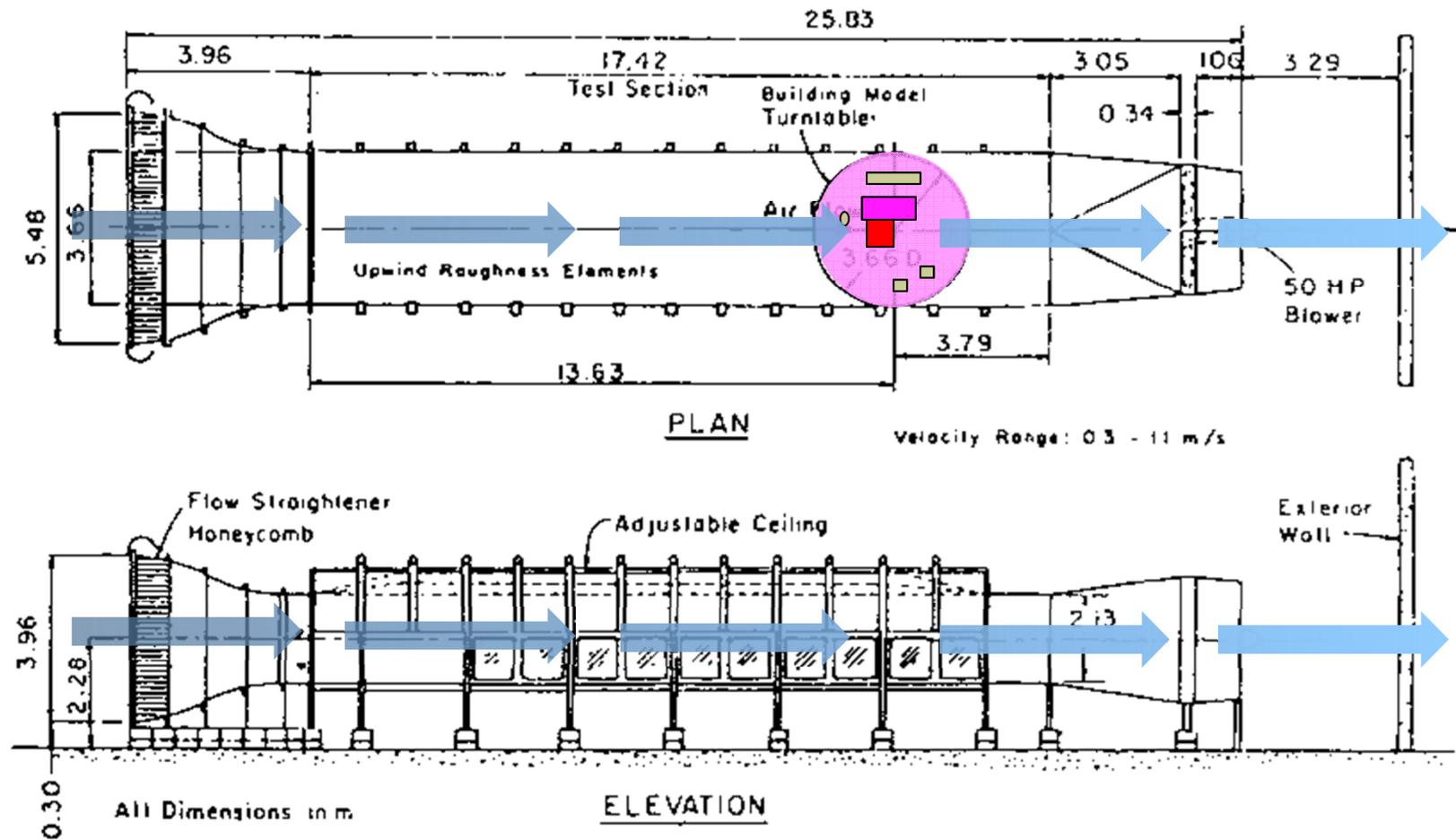


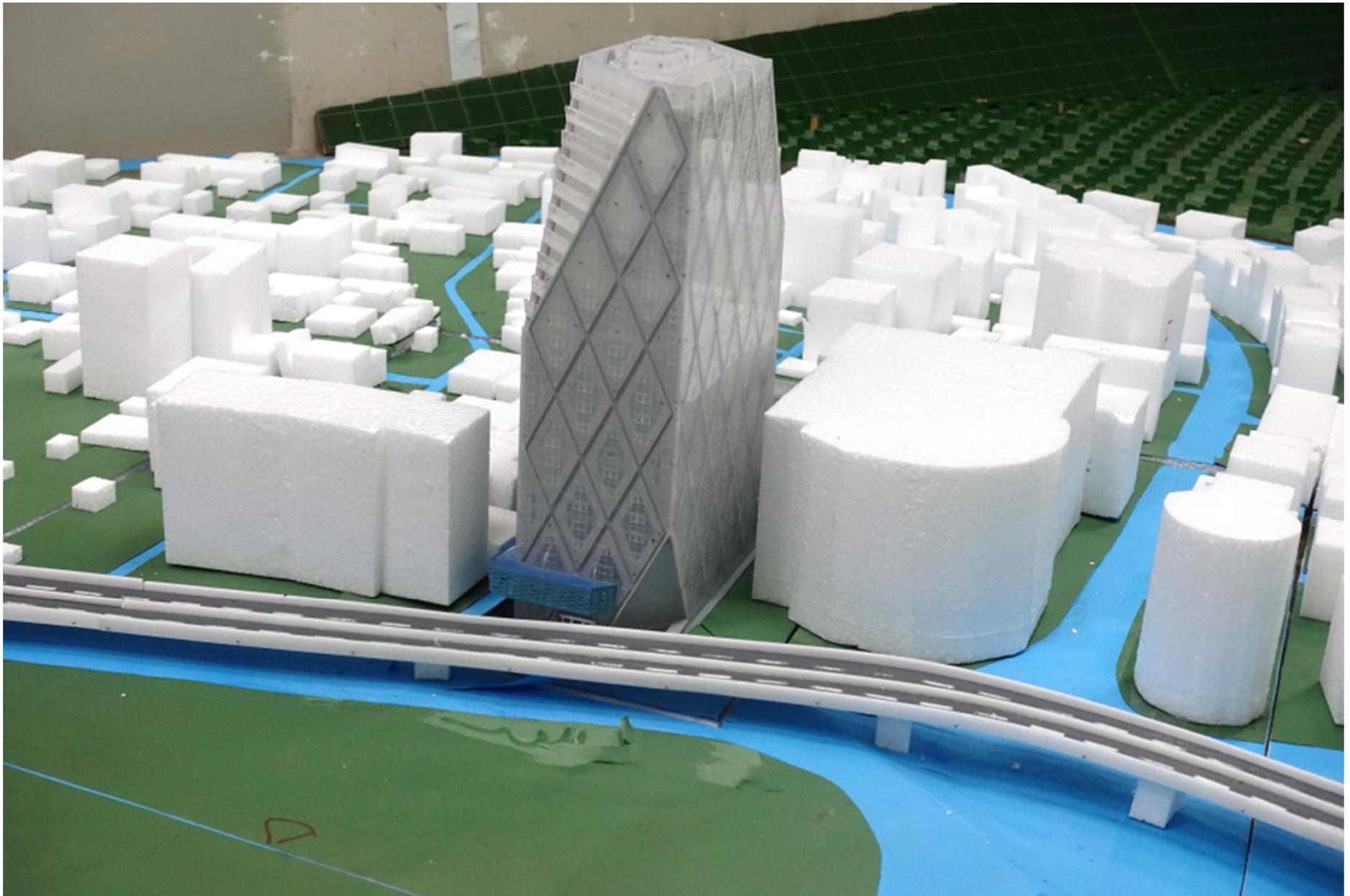
Fig. 3.10 Environmental wind tunnel configuration.

Wind Tunnel – Inside

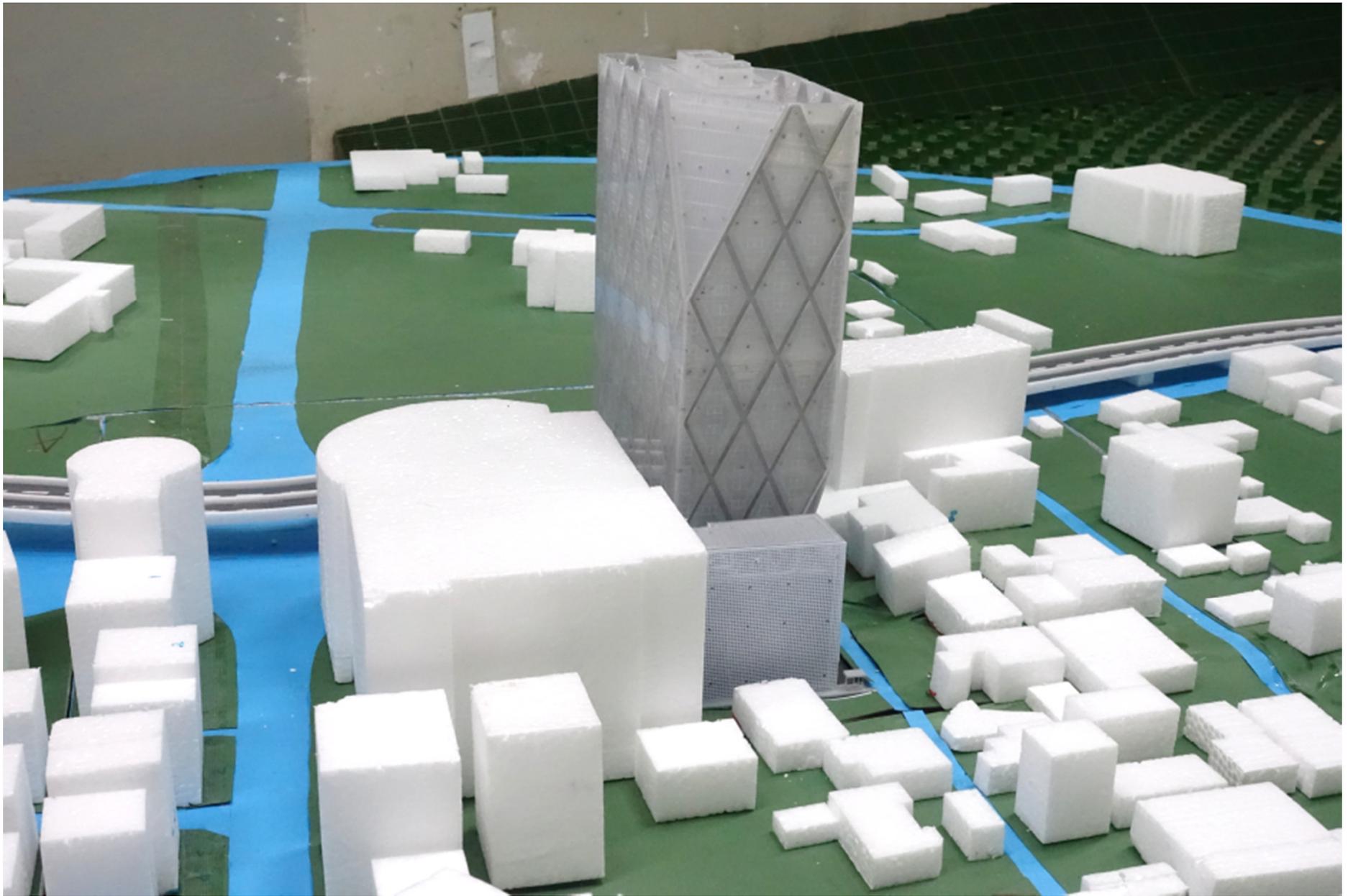


Wind tunnel testing is recommended for buildings higher than 22 stories (10 stories in hurricane areas) or where the building or structure is an unusual shape or construction methodology.

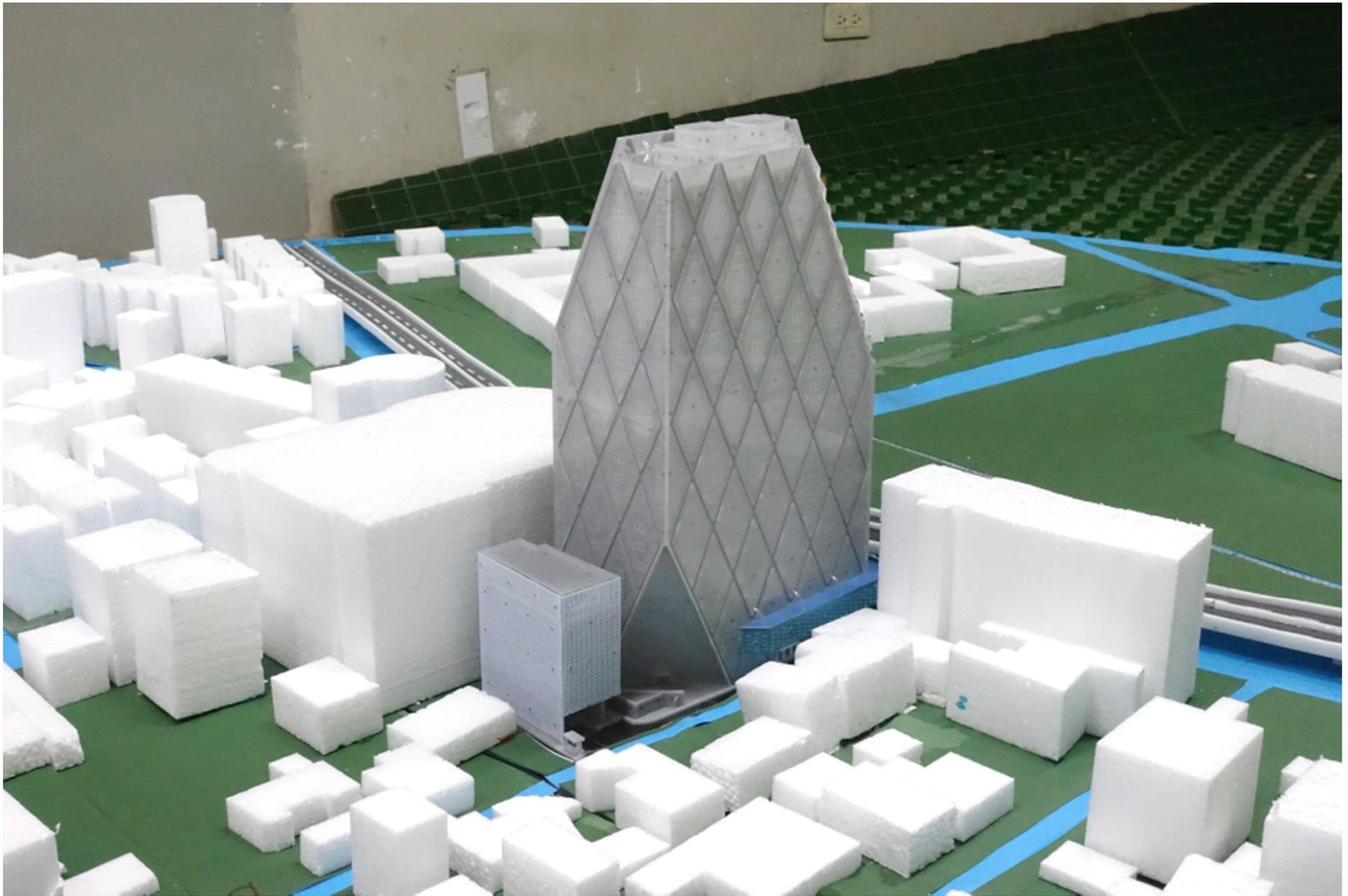
M Tower— The Shape & The Surroundings



M Tower— The Shape & The Surroundings



M Tower— The Shape & The Surroundings



M Tower-- Inside The Wind Tunnel



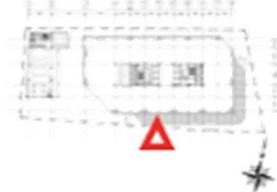
M Tower-- Inside The Wind Tunnel



M Tower– Cables Underneath The Model

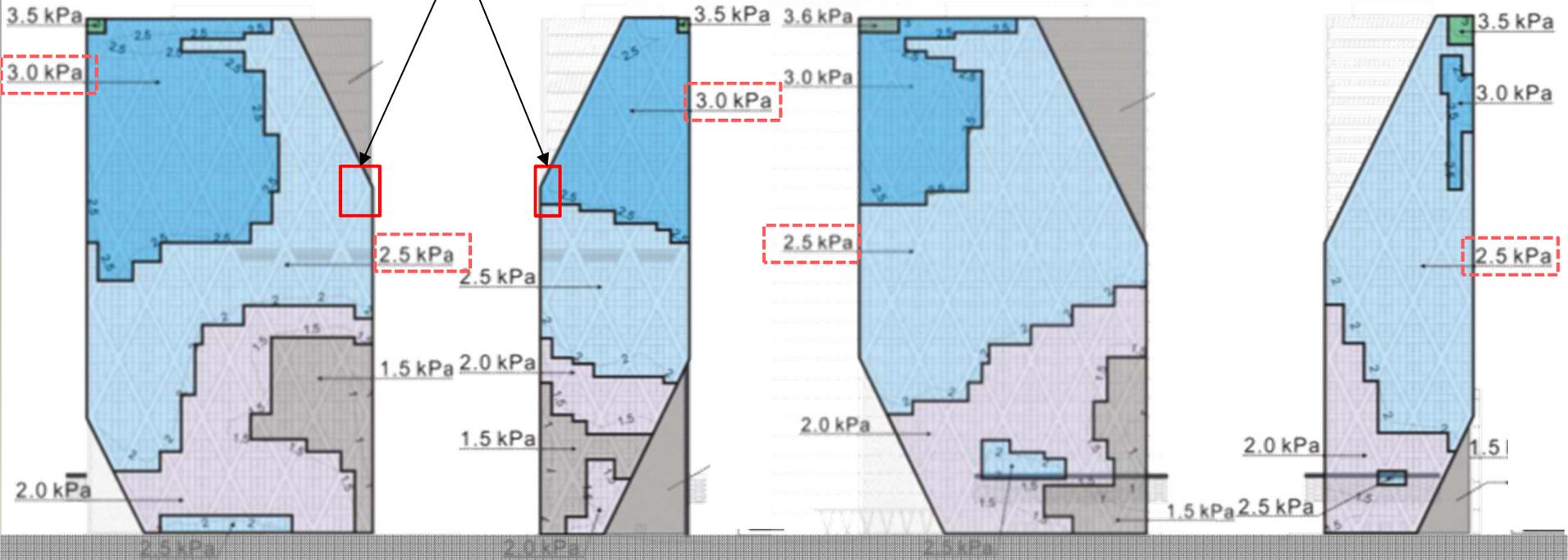


Wind Load Distribution (by Test) Positive

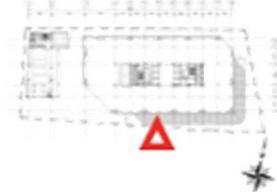


PMU

**+ 3.0 kPa
- 4.0 kPa**

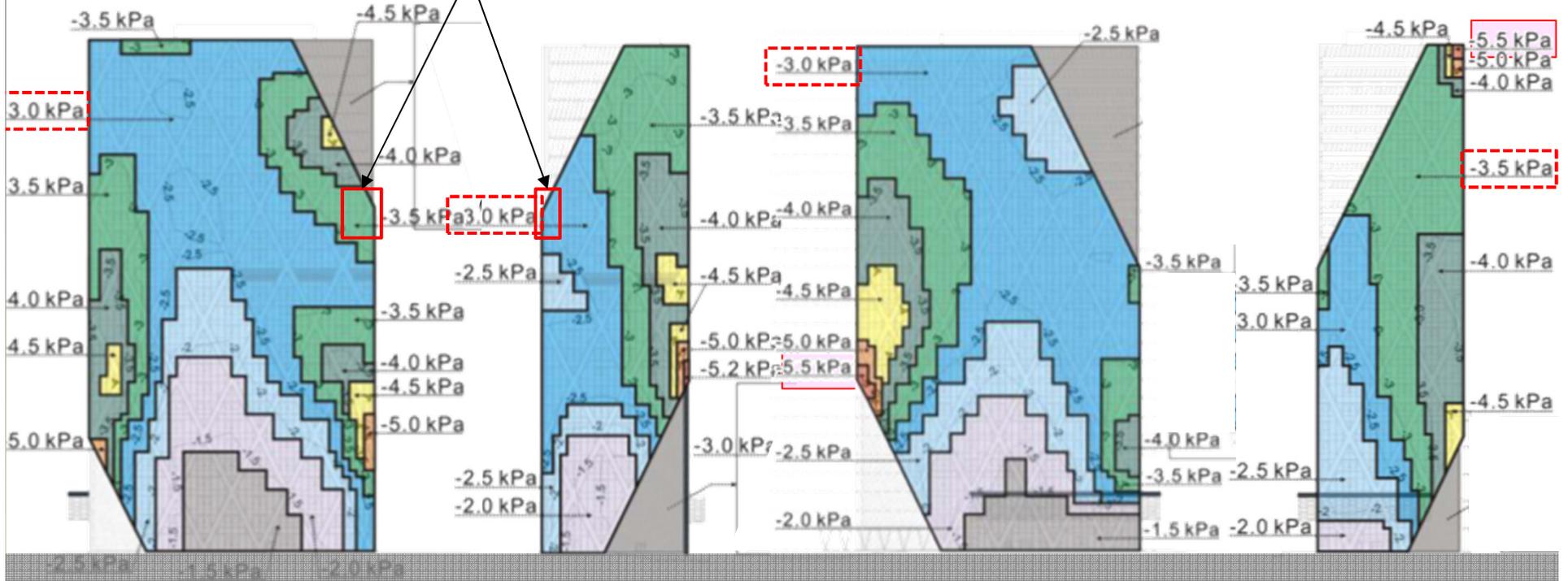


Wind Load Distribution (by Test) Negative

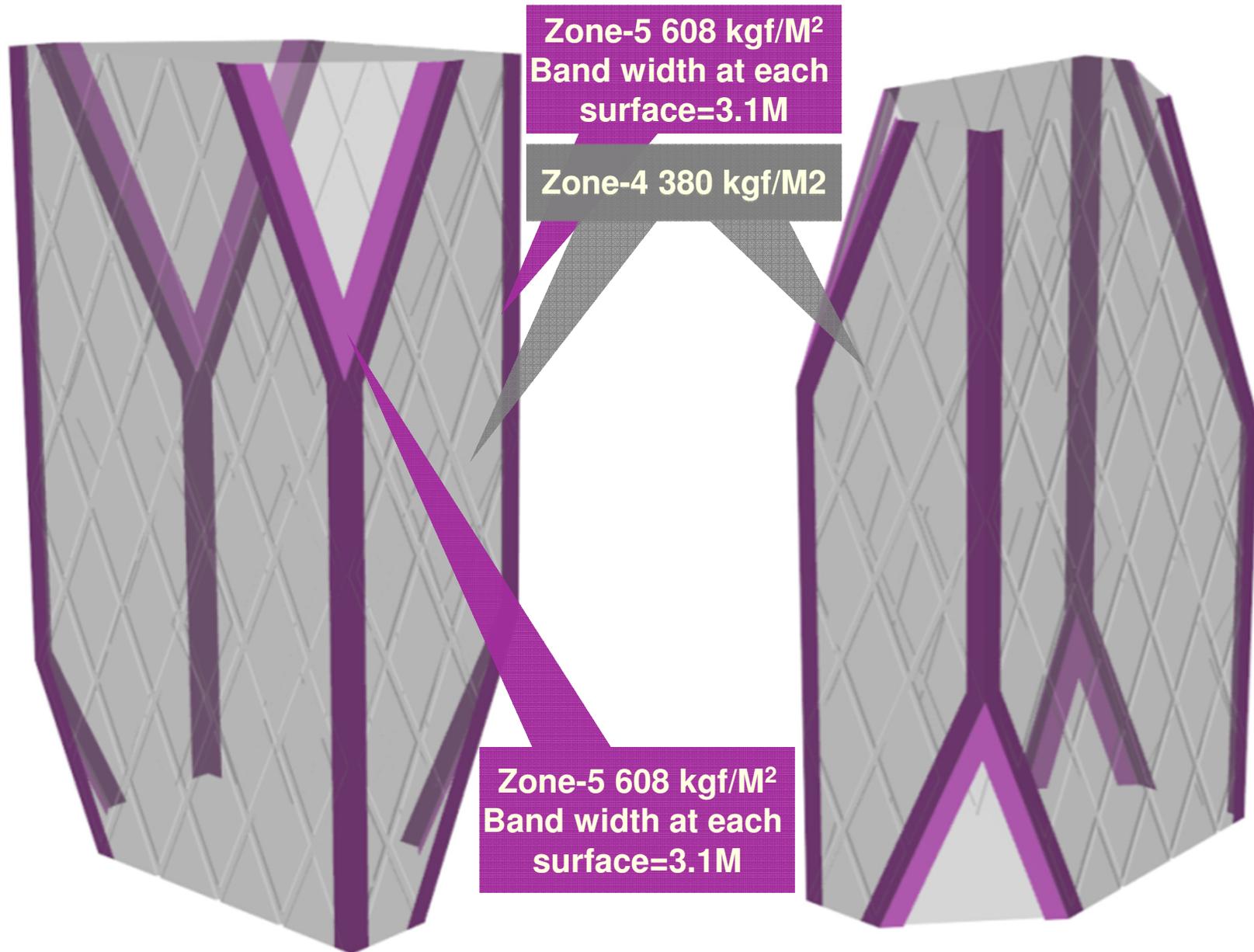


+ 3.0 kPa
- 4.0 kPa

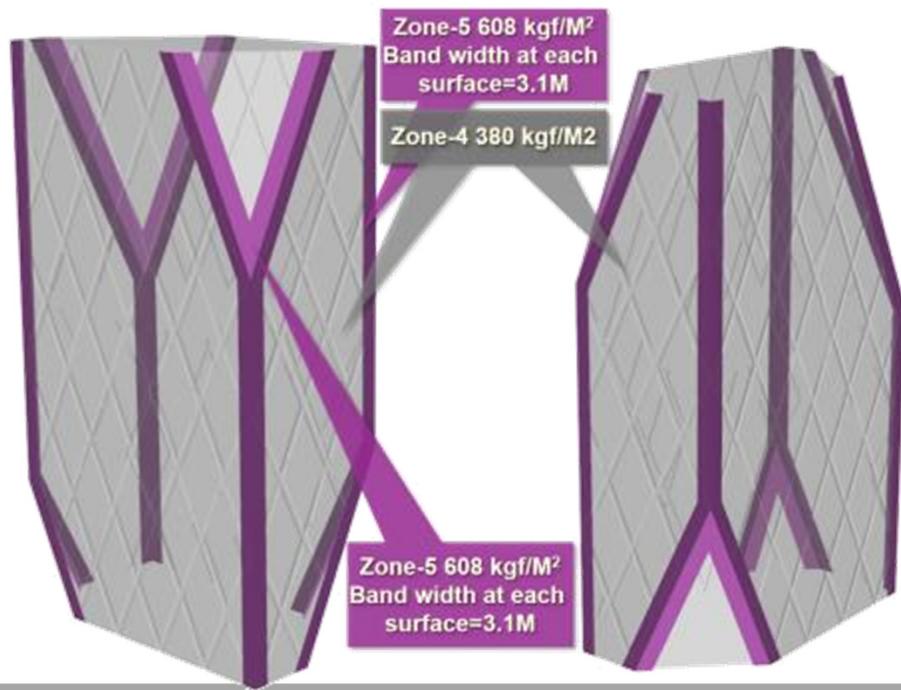
PMU



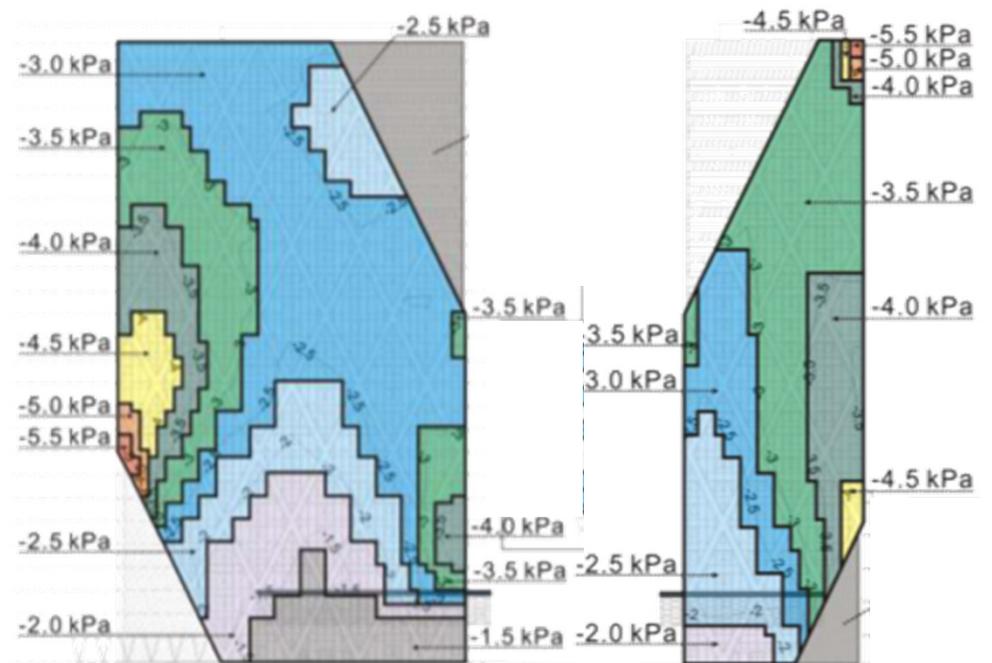
Wind Load Distribution (by Code)



Wind Load Comparison



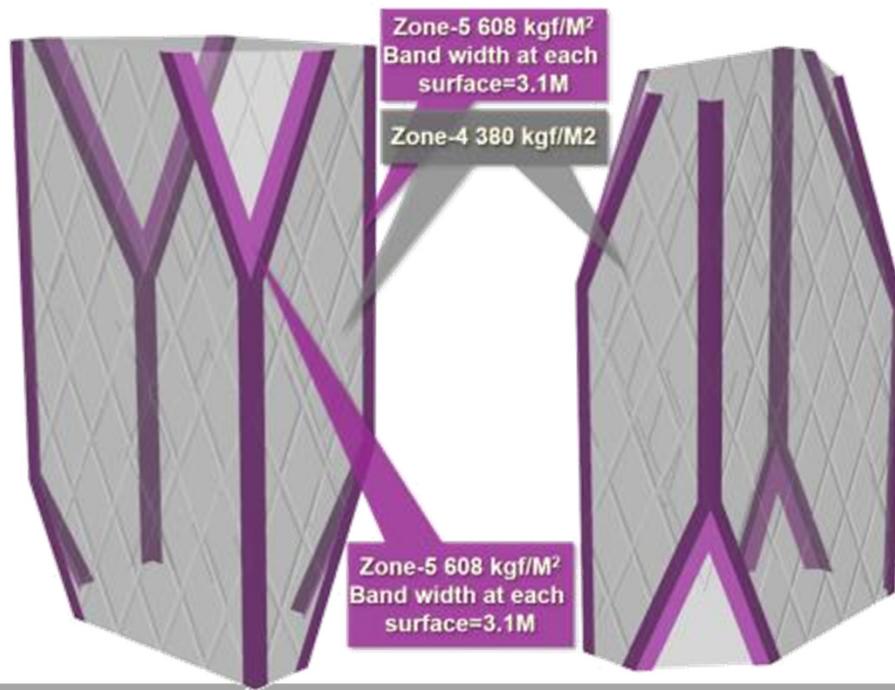
By Code



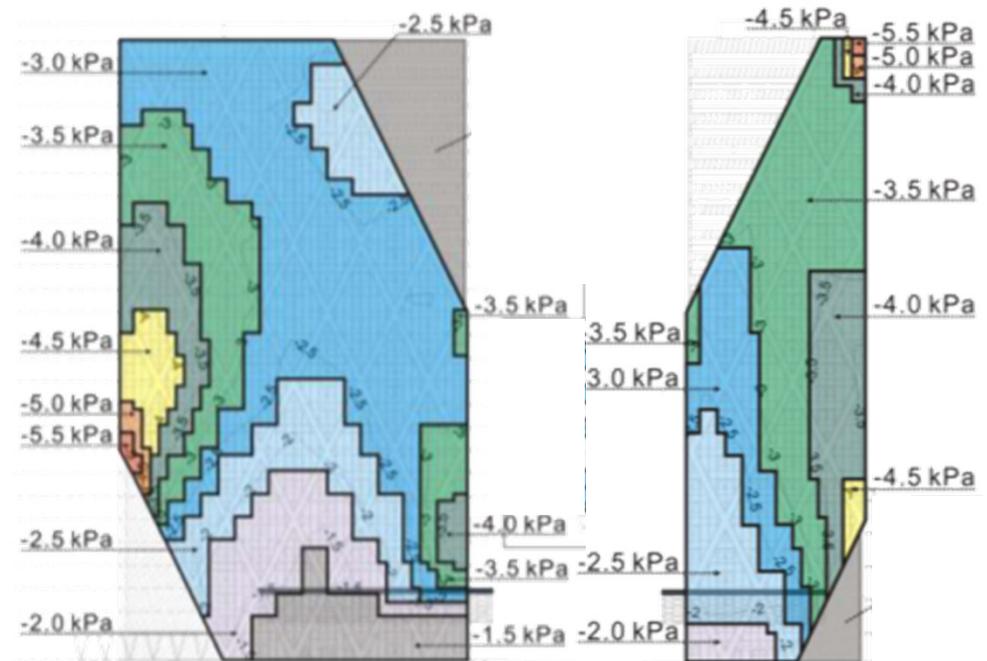
By Test

Benefit of Wind Tunnel Test

- Accurate results to minimize assumptions
- Construction savings of building structure and curtain wall for the owner
- Assurance – often recommended by code
- Increased litigation protection



By Code



By Test

Performance Mock-Up



Performance Mock-Up

**Wind Load
Resistance**

**Dynamic
Seismic
Performance**

Air Infiltration

**Inter-story
Displacement**

**Water
Resistance**

**BMU Tie-Back
Test**



PMU– Water Resistance Test



PMU– Water Resistance Test



Performance Mock-Up



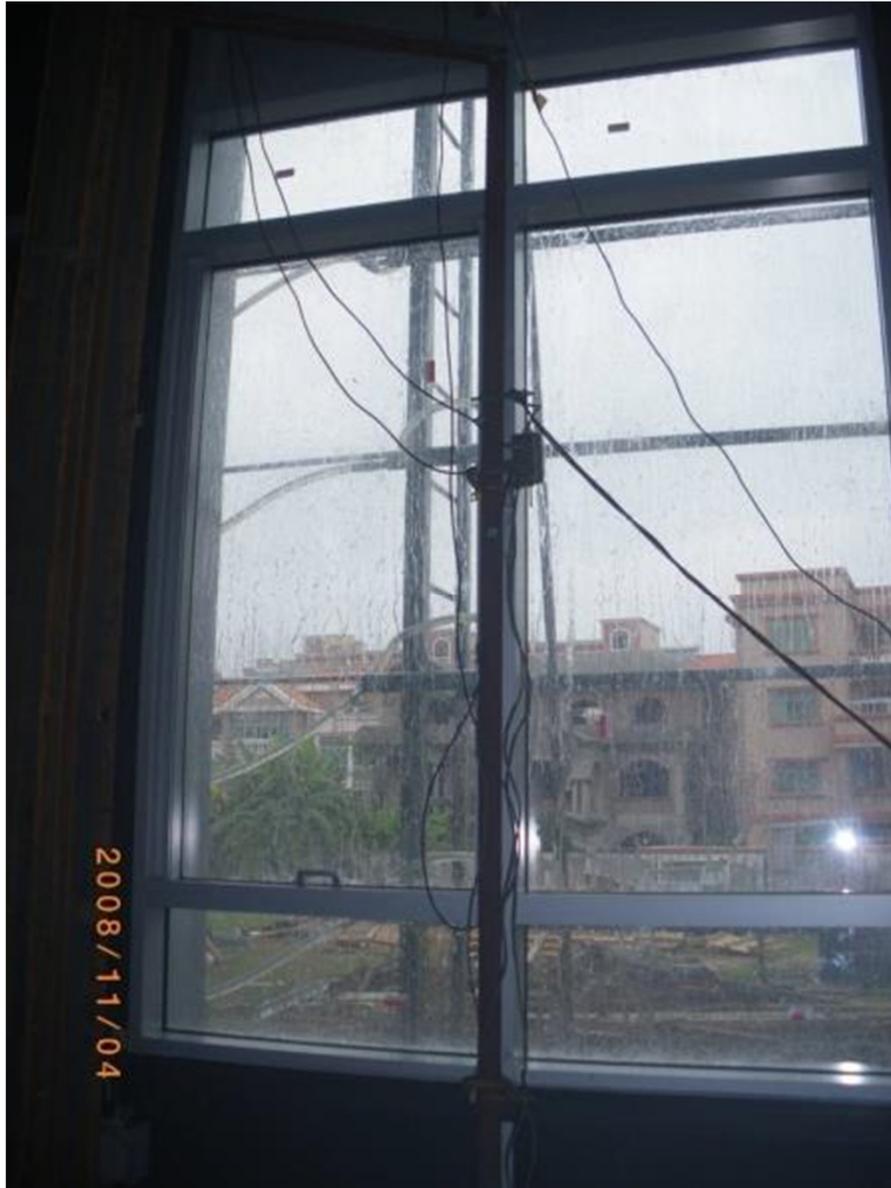
PMU– Wind Load Resistance (Deflection)



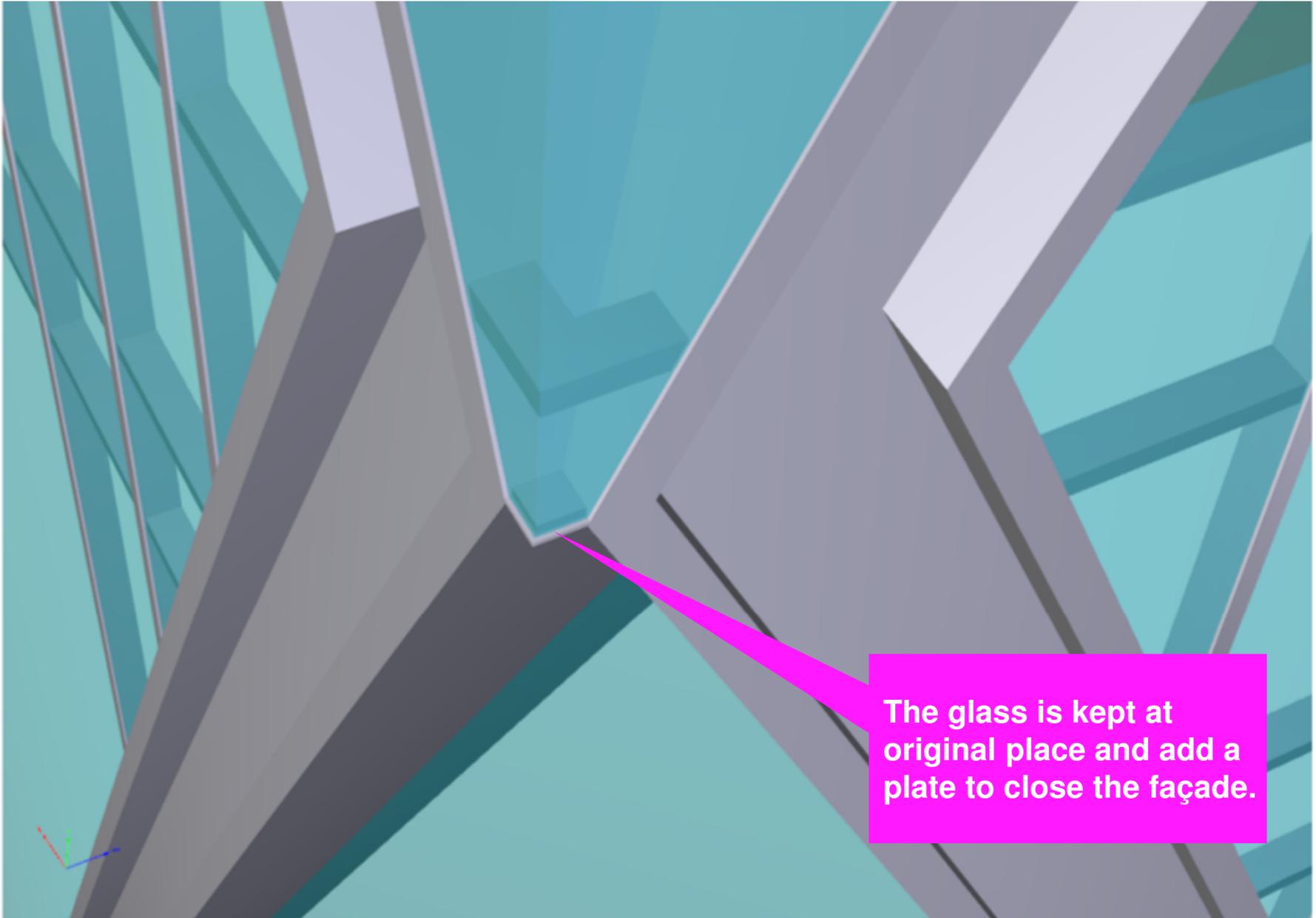
PMU– BMU Tie-Back Test



風雨試驗

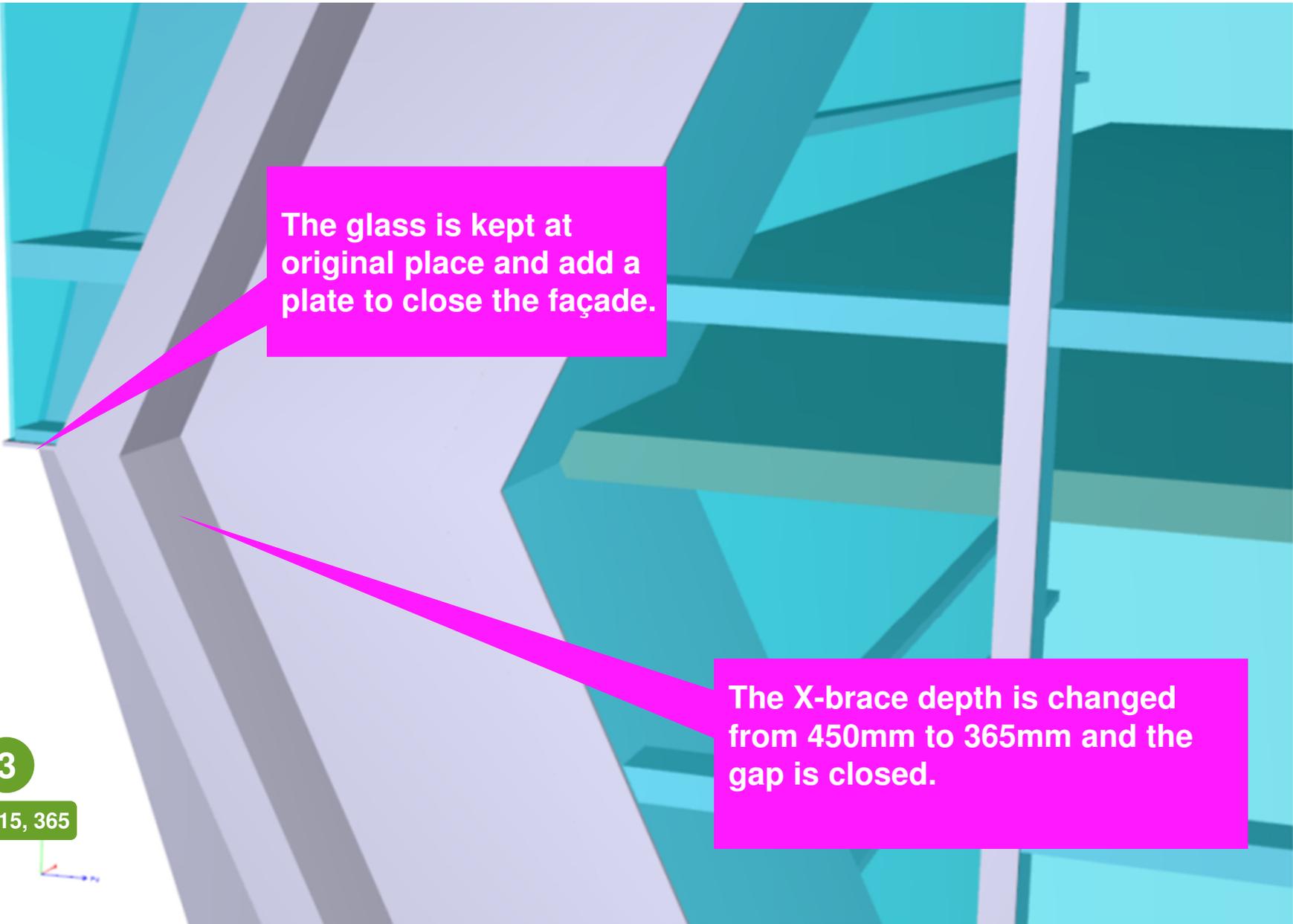


3D Study



The glass is kept at original place and add a plate to close the façade.

3D Study



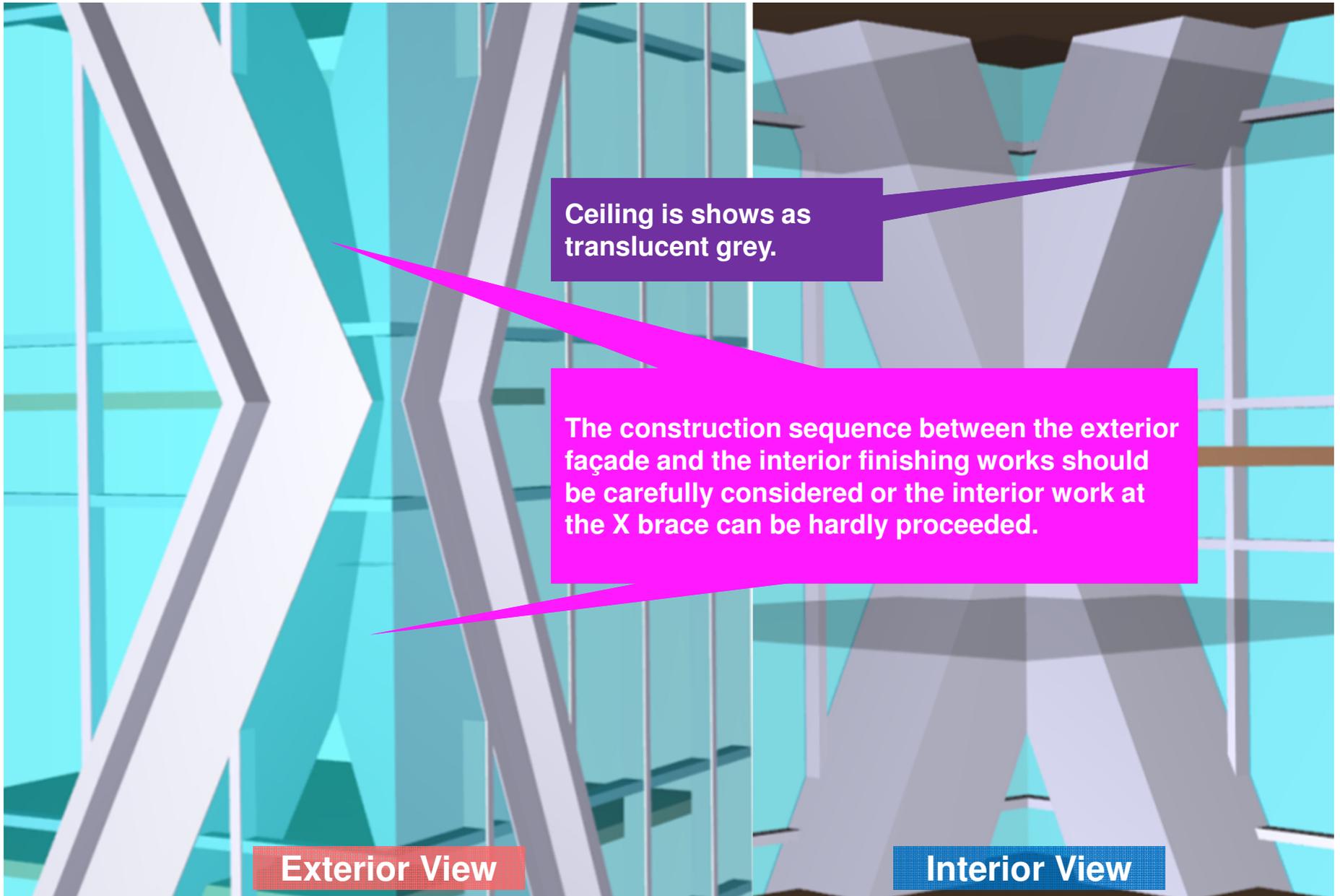
The glass is kept at original place and add a plate to close the façade.

The X-brace depth is changed from 450mm to 365mm and the gap is closed.

3

15, 215, 365

3D Study



PMU Area

