



1. YÜKSEK YAPILAR SEMPOZYUMU
04 – 05 MAYIS 2023 İSTANBUL

TMMOB
İNŞAAT MÜHENDİSLERİ ODASI



YÜKSEK BİNALARDA RÜZGAR VE DİĞER ÇEVRESEL ETKİLER

Dr. Ender Özkan

RWDI

Başkan Yardımcısı / Avrupa Bölge Direktörü



Ender Ozkan, PhD, FEng IMechE
Vice President, RWDI

Eğitim

- BS, ODTÜ İnşaat Müh., Türkiye, 1998
- MSc and PhD, Johns Hopkins University USA, 2003

Çalışma Tecrübesi

- 2013 – RWDI Inc.
- 2003-2013 – Ove Arup and Partners Ltd. (London)

Profesyonel Dereceler

- Chartered Engineer, IMechE
- Vice Chair and Committee Member of Wind Engineering Society

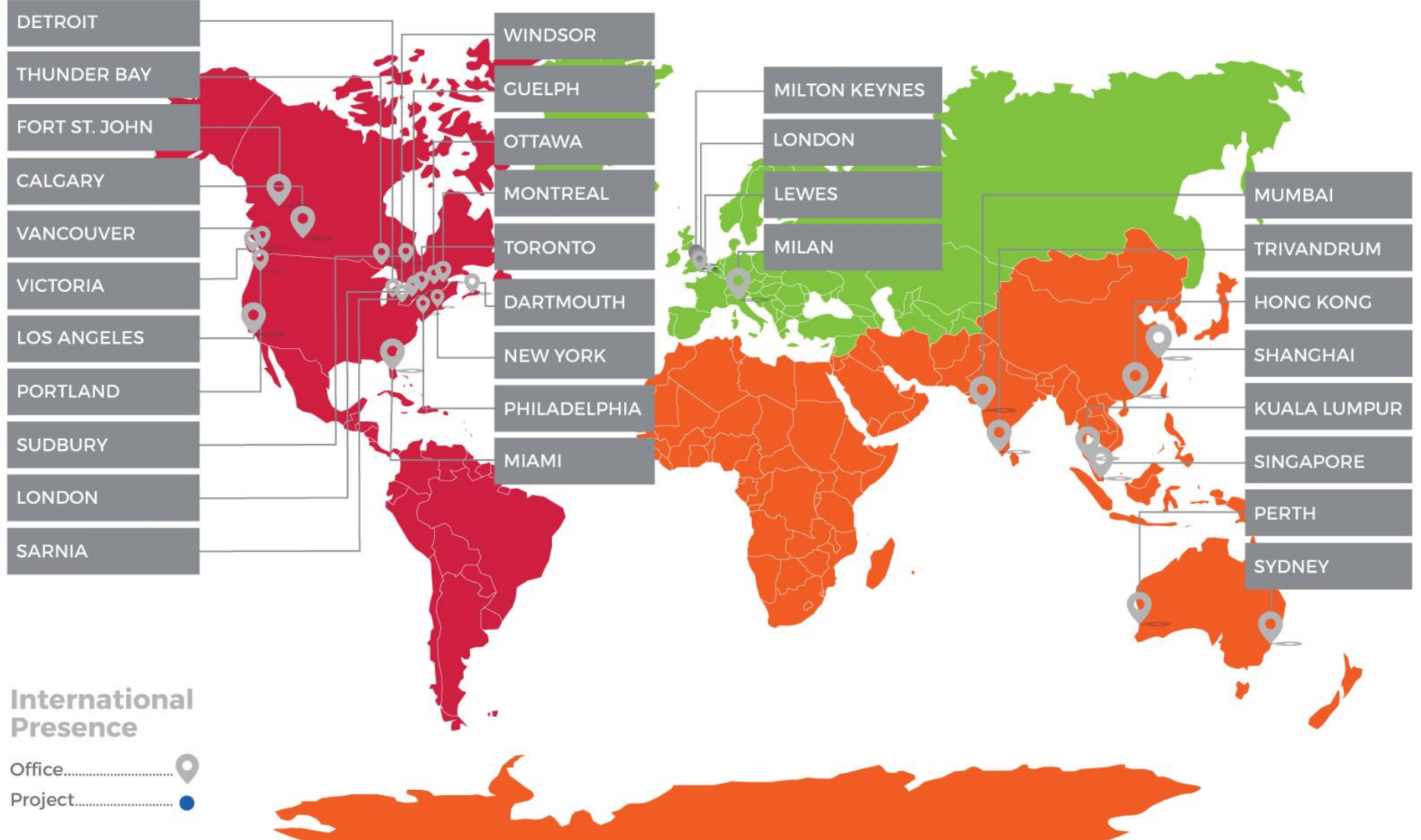


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RWDI
50
YEAR ANNIVERSARY





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Air Quality



Building
Enclosures



Building
Physics



Climate Change
& Resiliency



Commissioning



Dust & Sand



Energy



Environmental
Software



Field Services



Geoscience



Master Planning



Meteorology
& Climate



Noise &
Acoustics



Snow, Ice & Rain



Solar



Sport
Aerodynamics



Stewardship,
CSR & GHG



Sustainability
& Certification



Vibration &
Motion



Waste

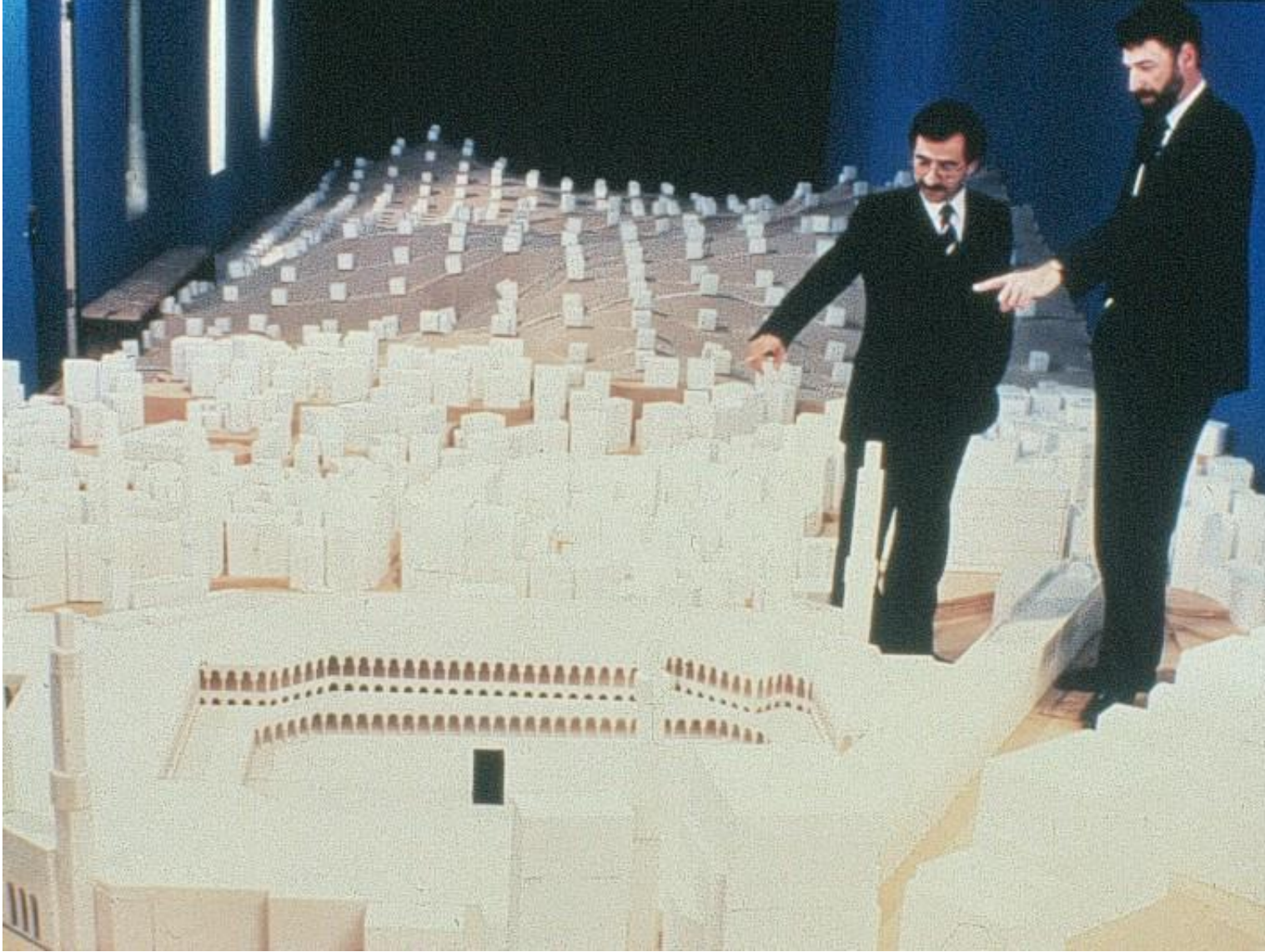


Wind



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**Yapısal
Rüzgar
Etkileri**

**Cephe Basınç
Etkileri**

**Yaya
Konforu**

**Diğer
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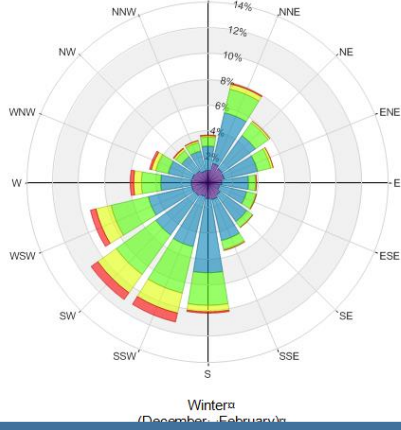


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Meteorolojik bilgi



Yüzey etkisi



Rüzgar Analizi



Aerodinamik+Mekanik

Kriter - Standart

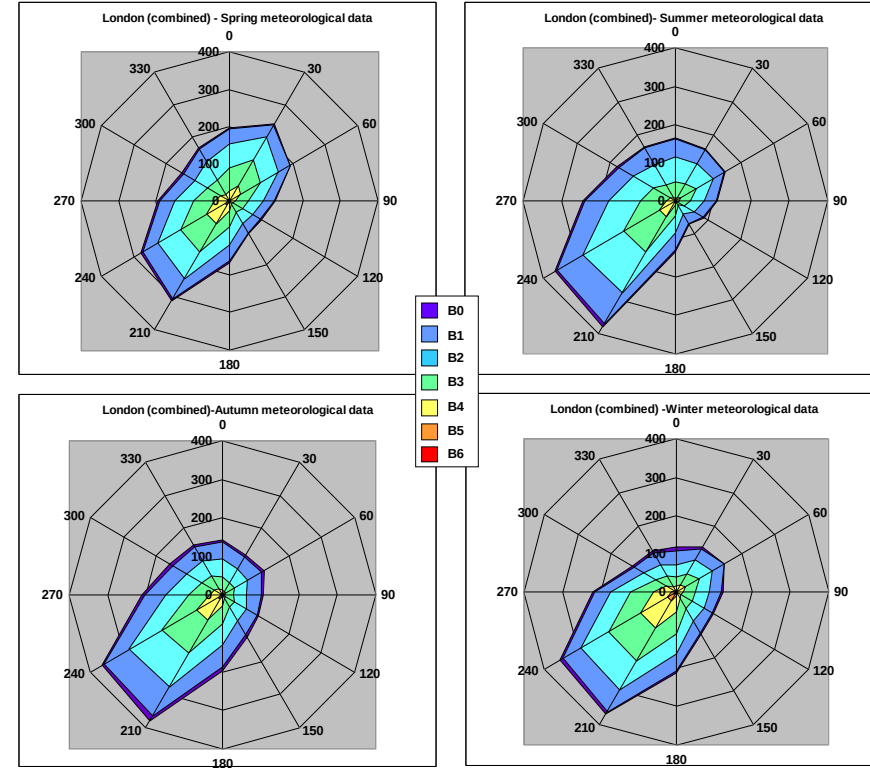




Meteoroloji Bilgileri



Anemometer



Wind Rose

En az 10 yıllık temiz saatlik ölçülmüş rüzgar datası gerekmektedir.

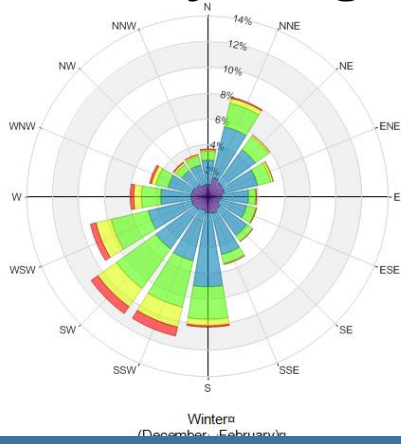


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Yüzey etkisi

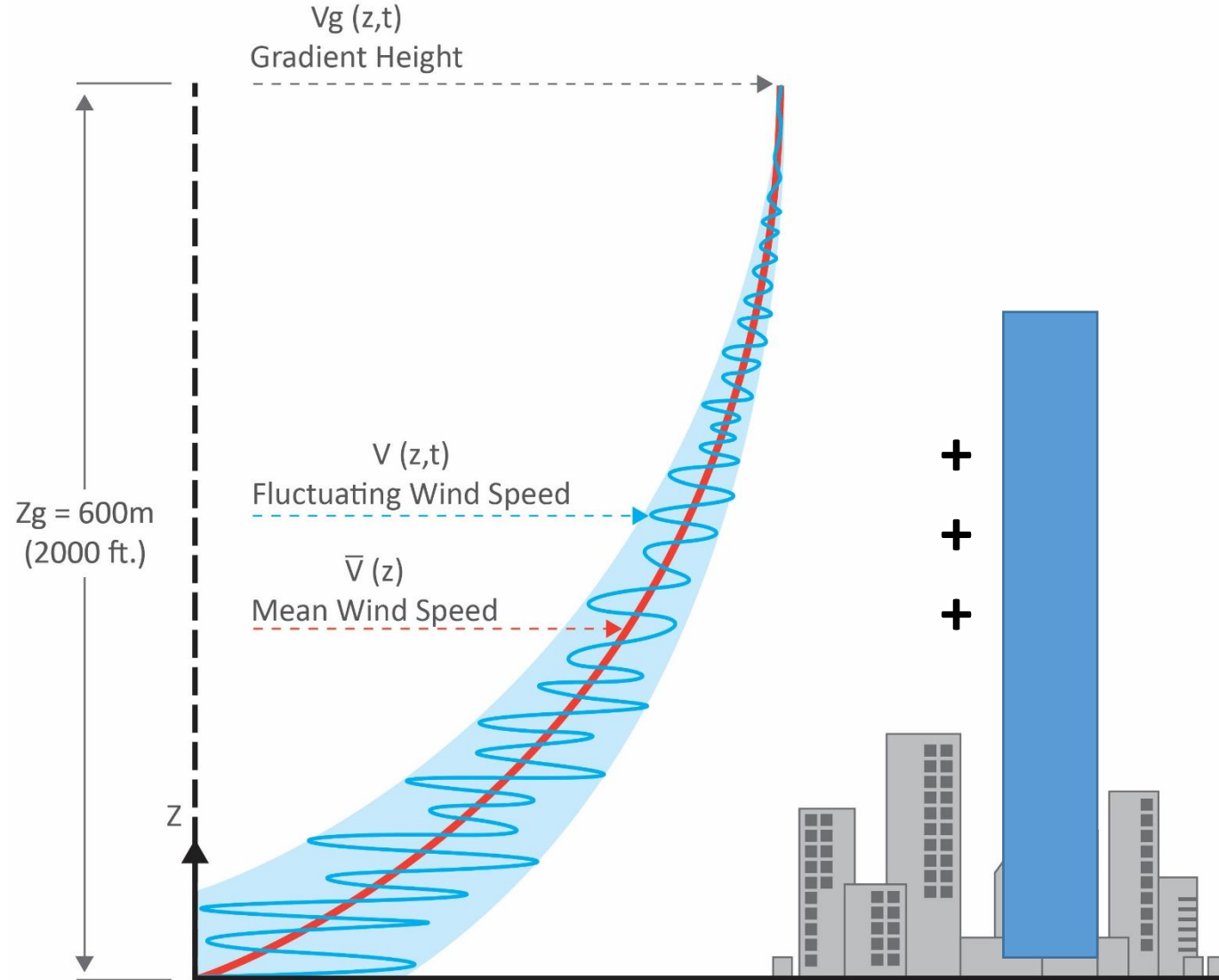


Microclimate
Assessment



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Terrain Roughness Analysis

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Built up Urban area – lots of obstructions



Open country – few obstructions



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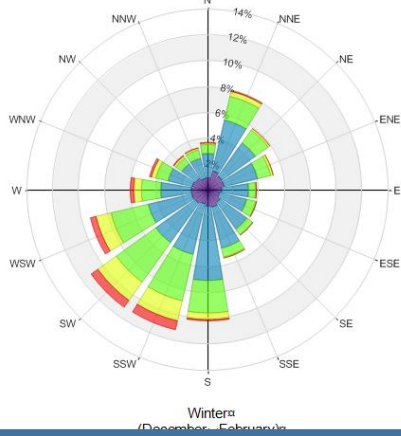


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Meteorolojik bilgi



Yüzey etkisi



Microclimate Assessment



Aerodinamik

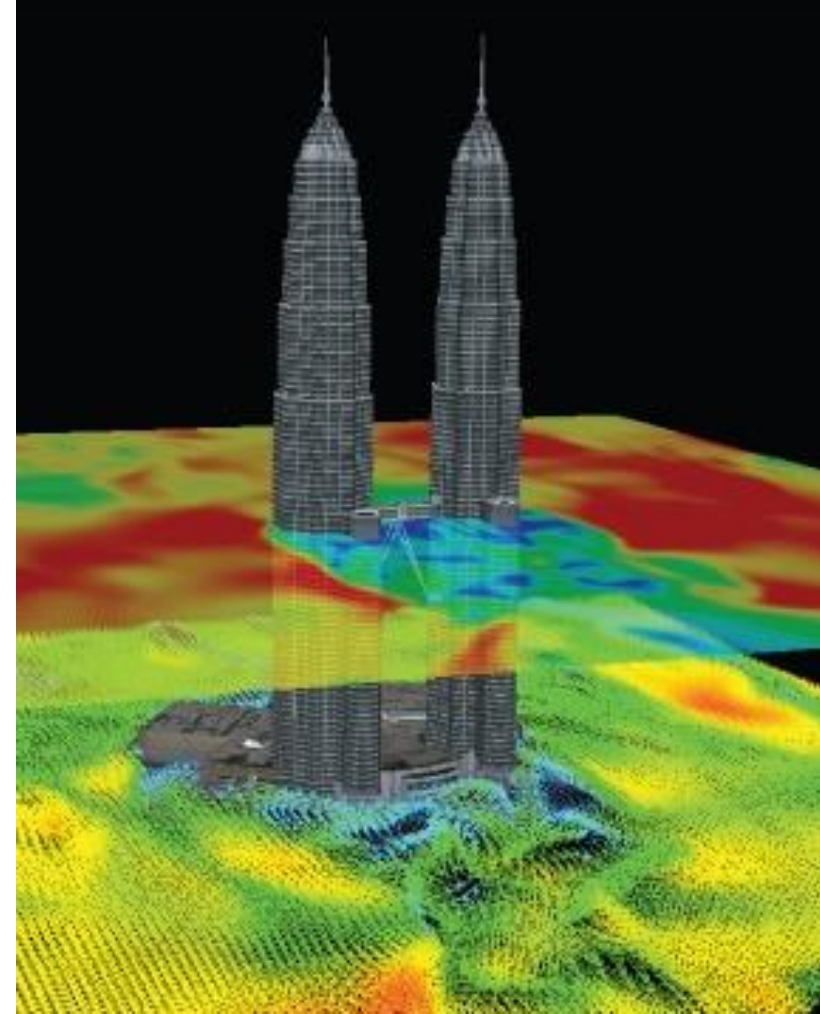


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Rüzgar Tüneli veya CFD





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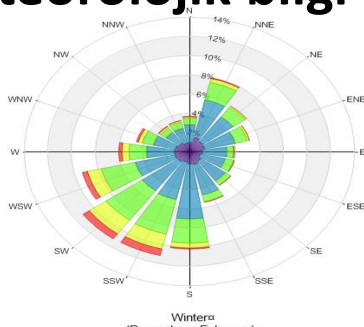
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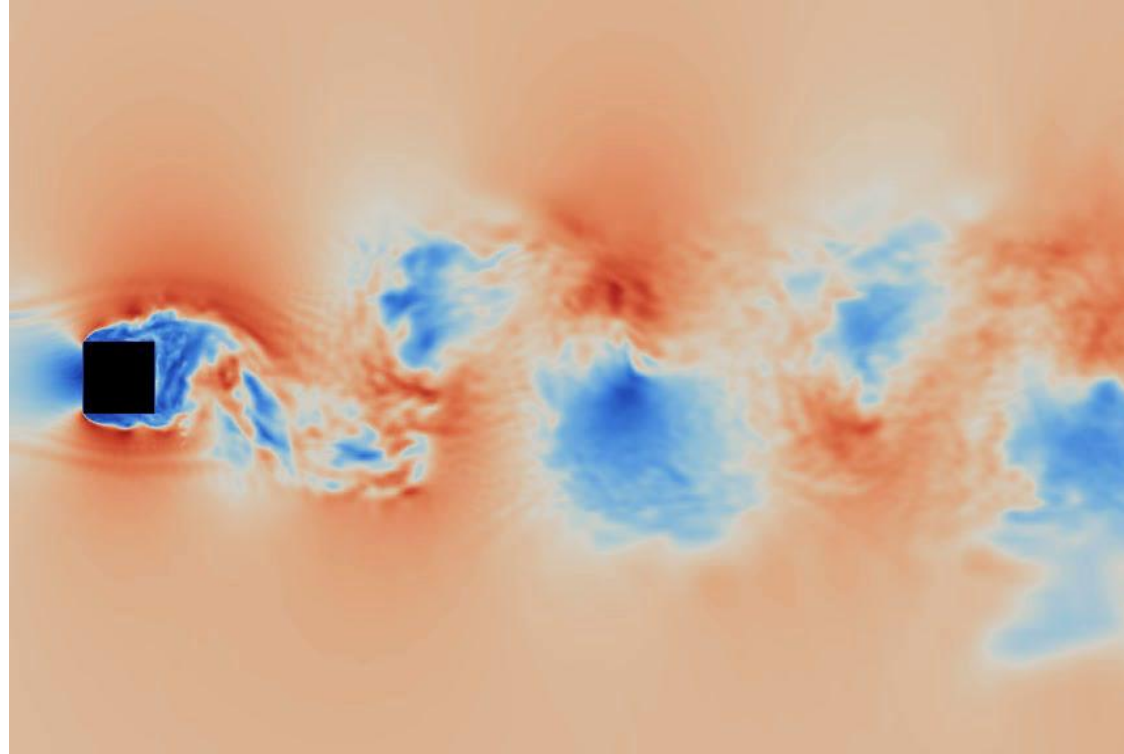
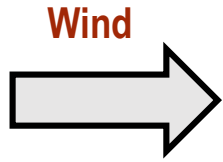
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Vortex Shedding



Shedding frequency N is given by:

$$N = S \frac{U}{b}$$

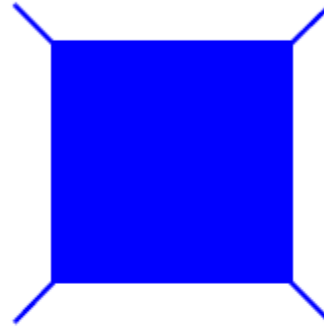
S = Strouhal number, U = wind speed, b = building width



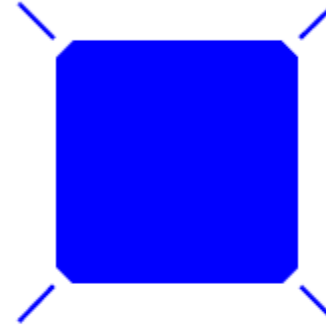
Wind-Induced Responses



Basic



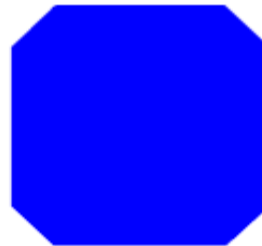
Fins



Vented Fins



**Slotted
Corners**



Chamfered Corners



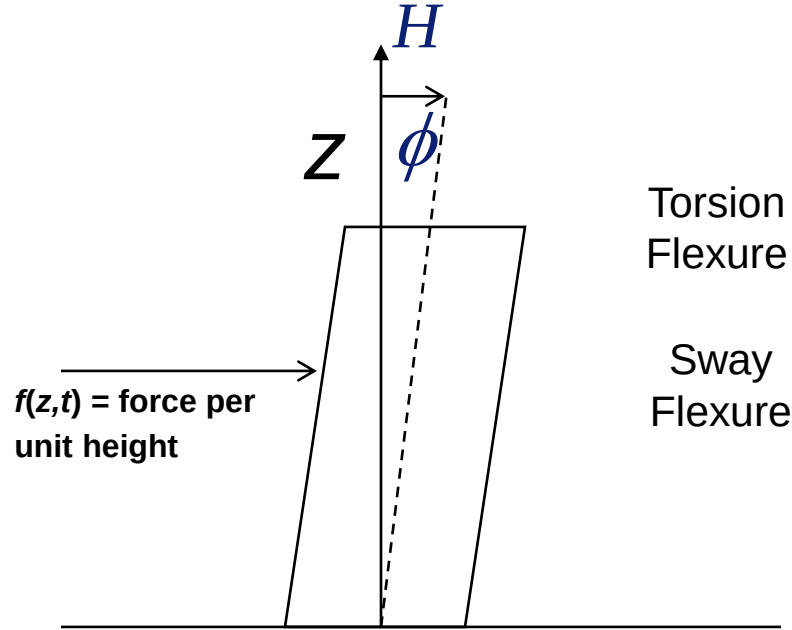


High Frequency
Force Balance
(HFFB)

$$F_G(t) = \int_0^H f(z,t) \phi(z) dz$$

$$\approx \int_0^H f(z,t) \frac{z}{H} dz$$

$$= \frac{M(t)}{H}$$

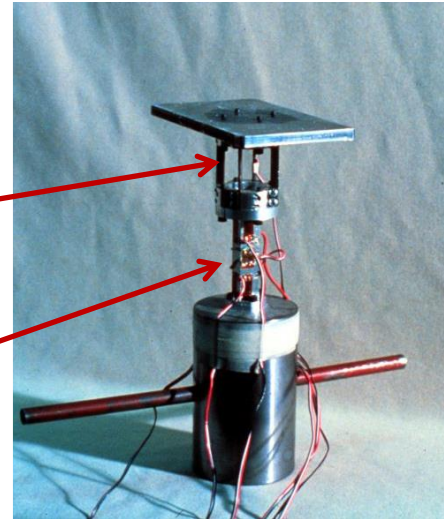


Rigid,
lightweight
model



Torsion
Flexure

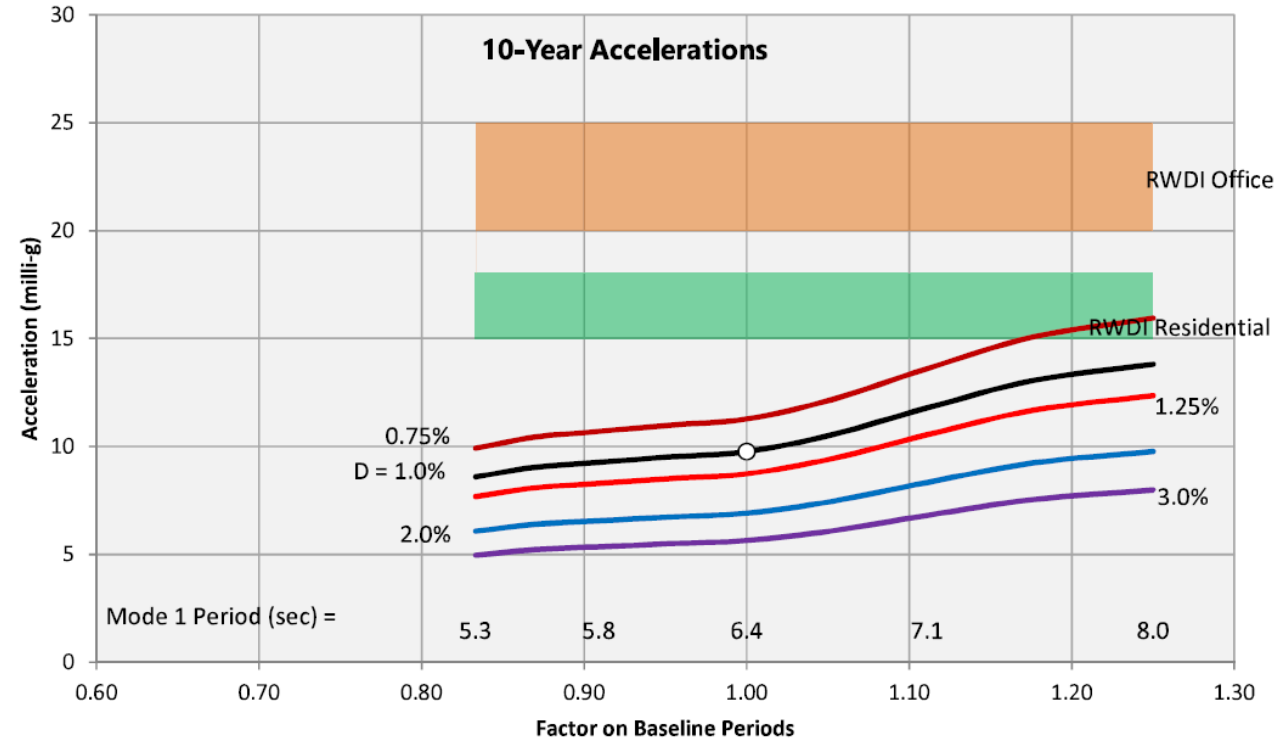
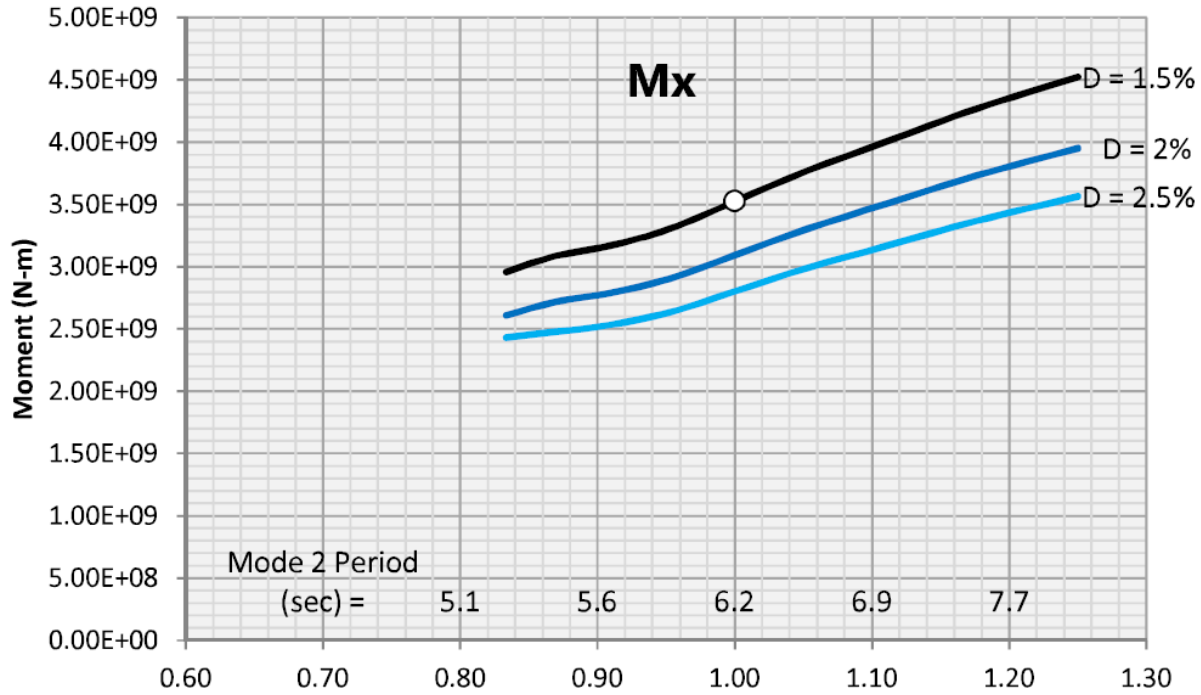
Sway
Flexure





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Aeroelastic Spine Model



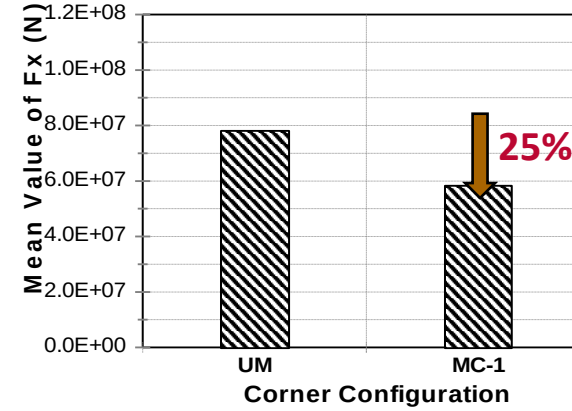
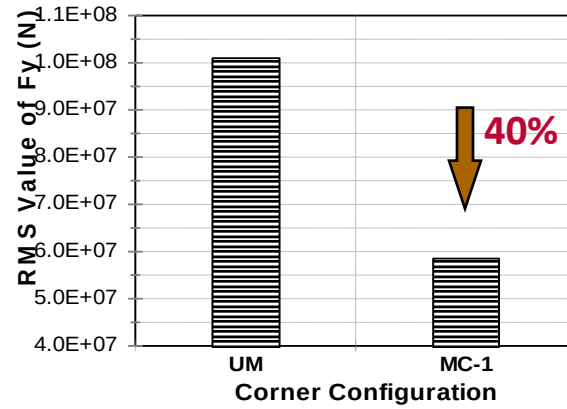
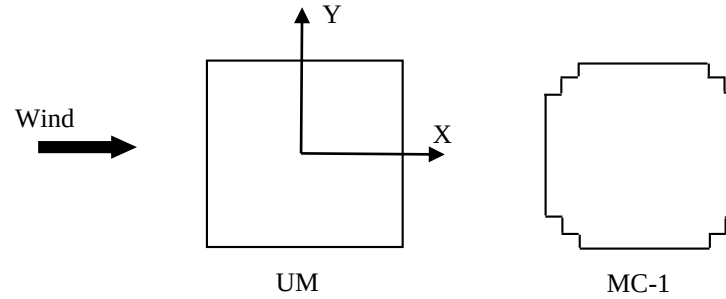


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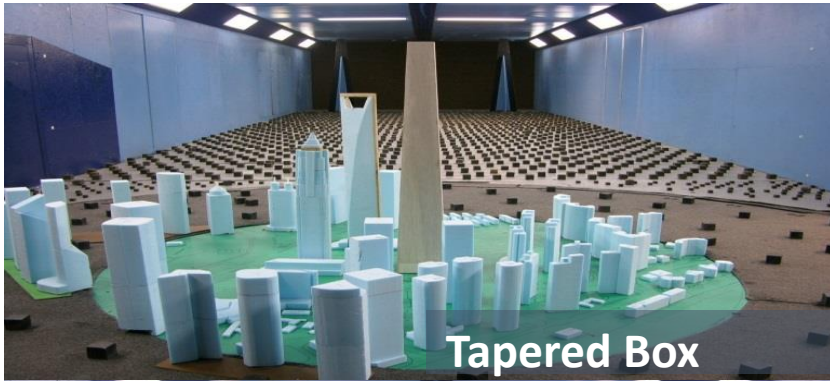
Building Geometry Effects



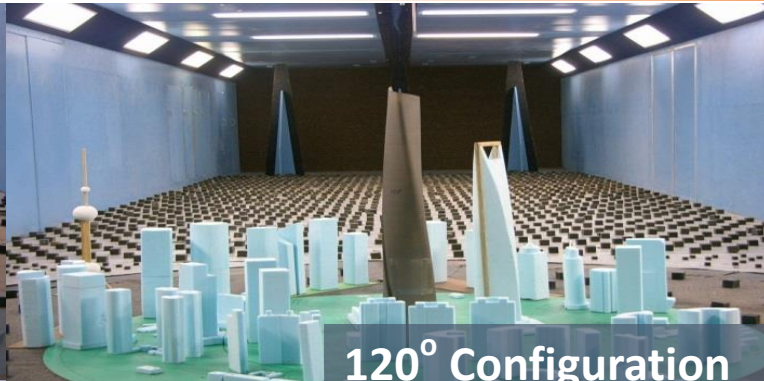


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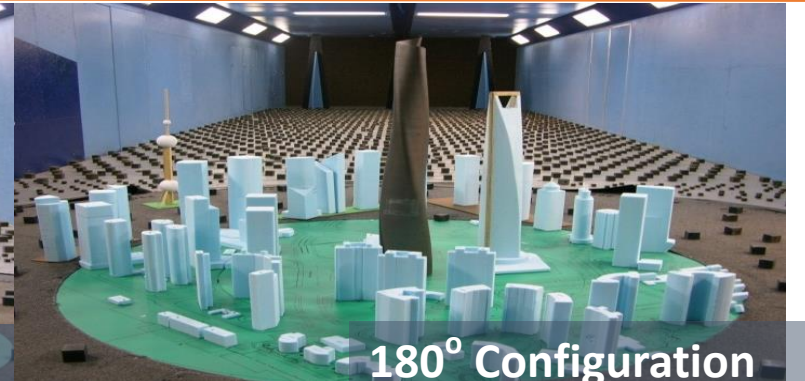
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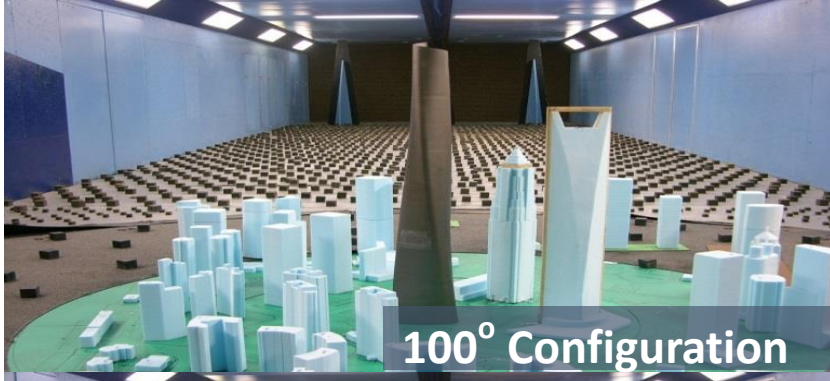
Tapered Box



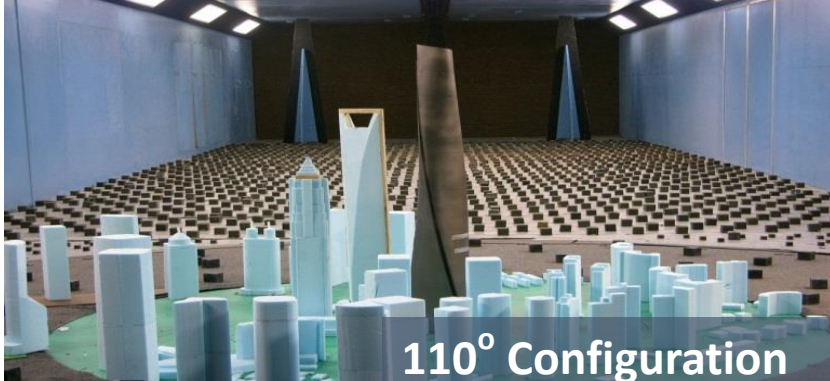
120° Configuration



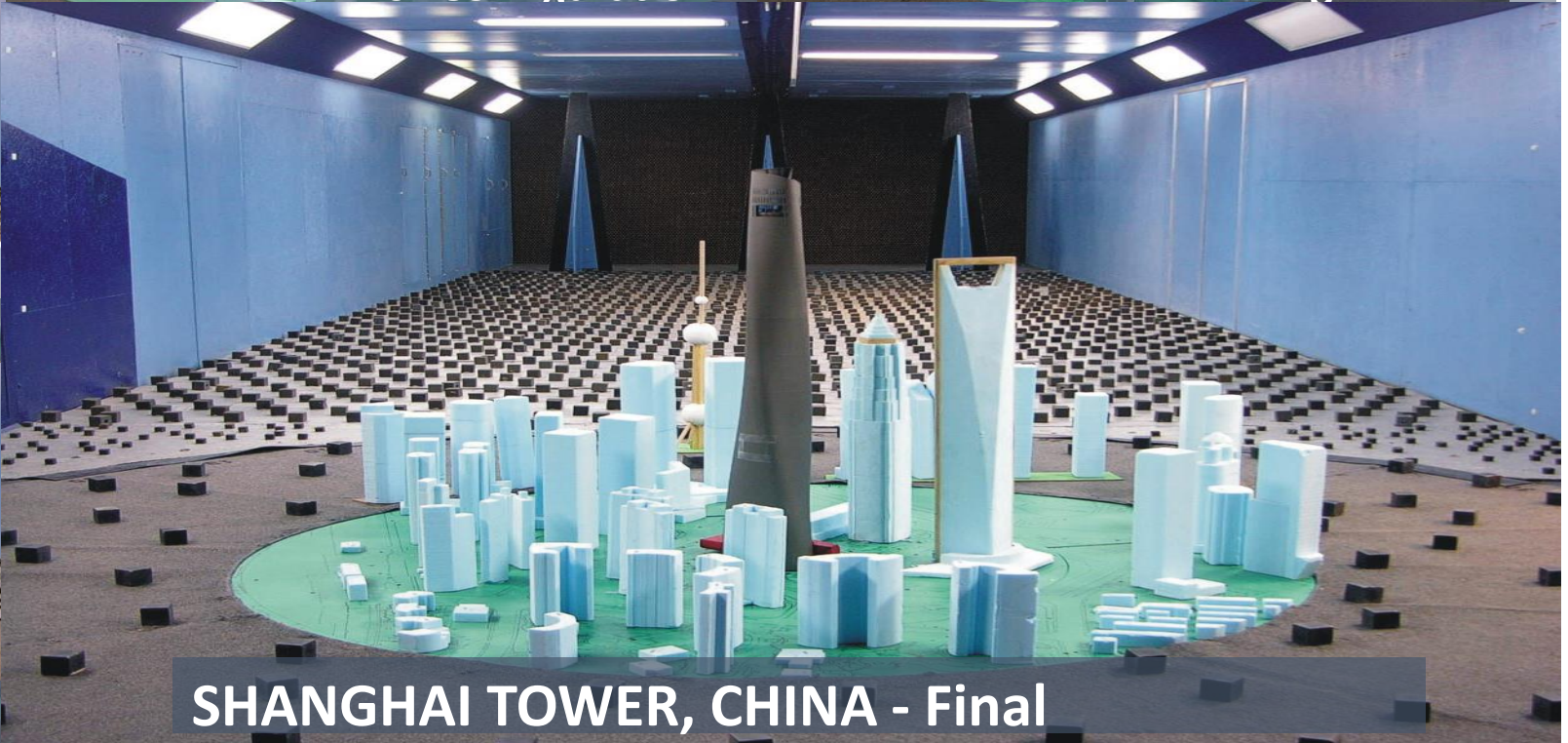
180° Configuration



100° Configuration



110° Configuration



SHANGHAI TOWER, CHINA - Final



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432 Park Avenue
New York City

Architect:
Rafael Vinoly

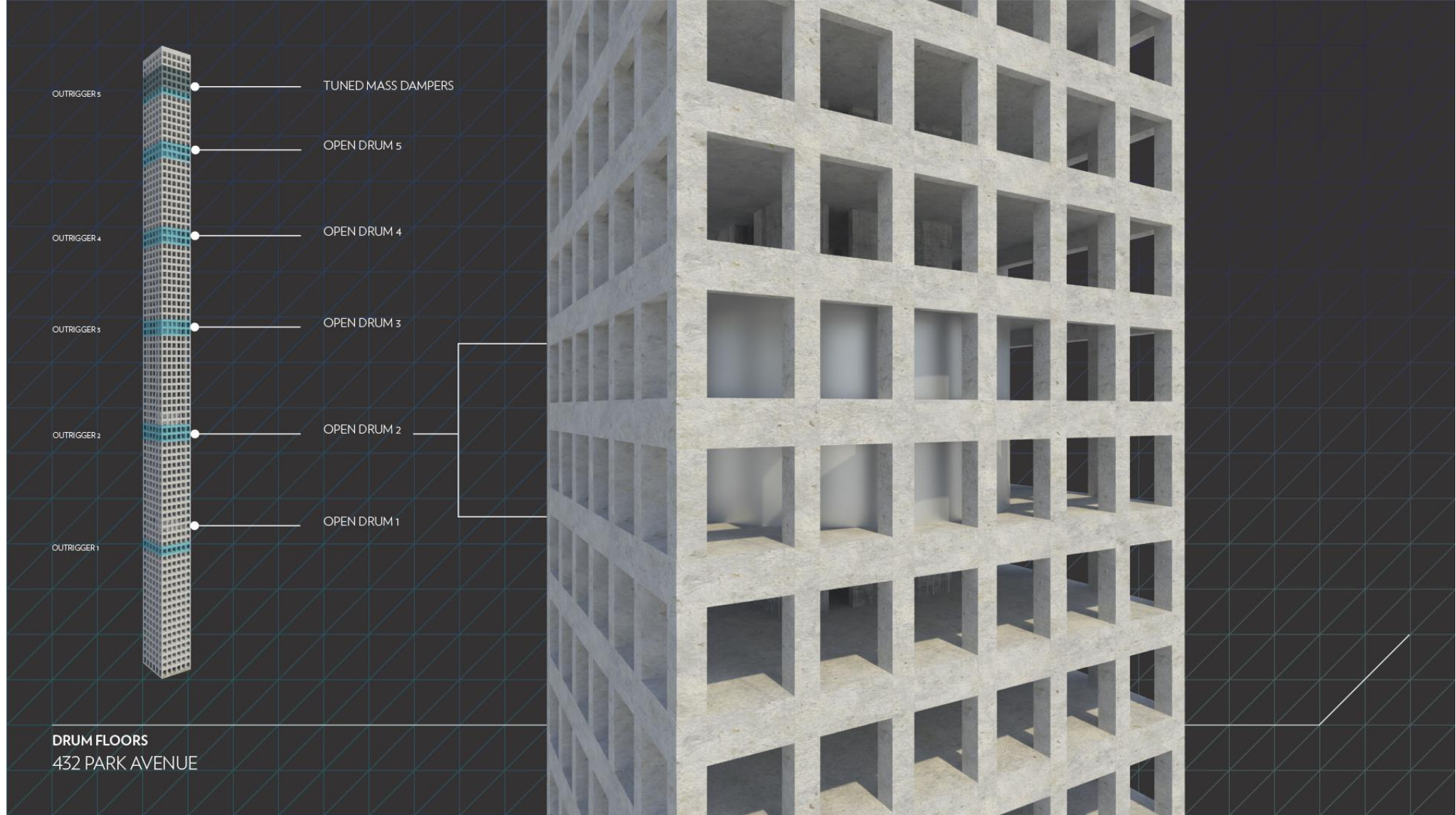
Structural: WSP





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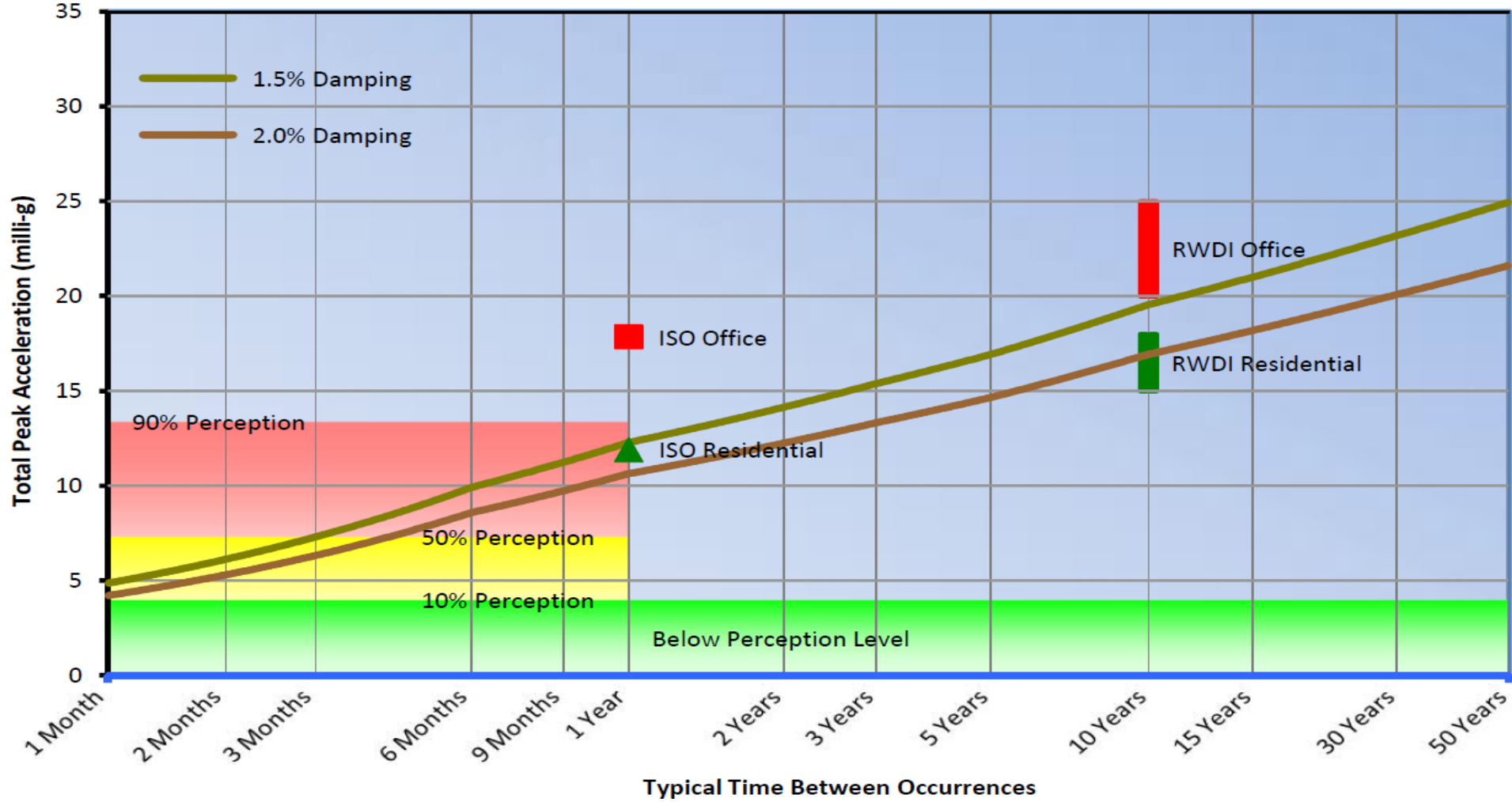


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• Örnek sonuç





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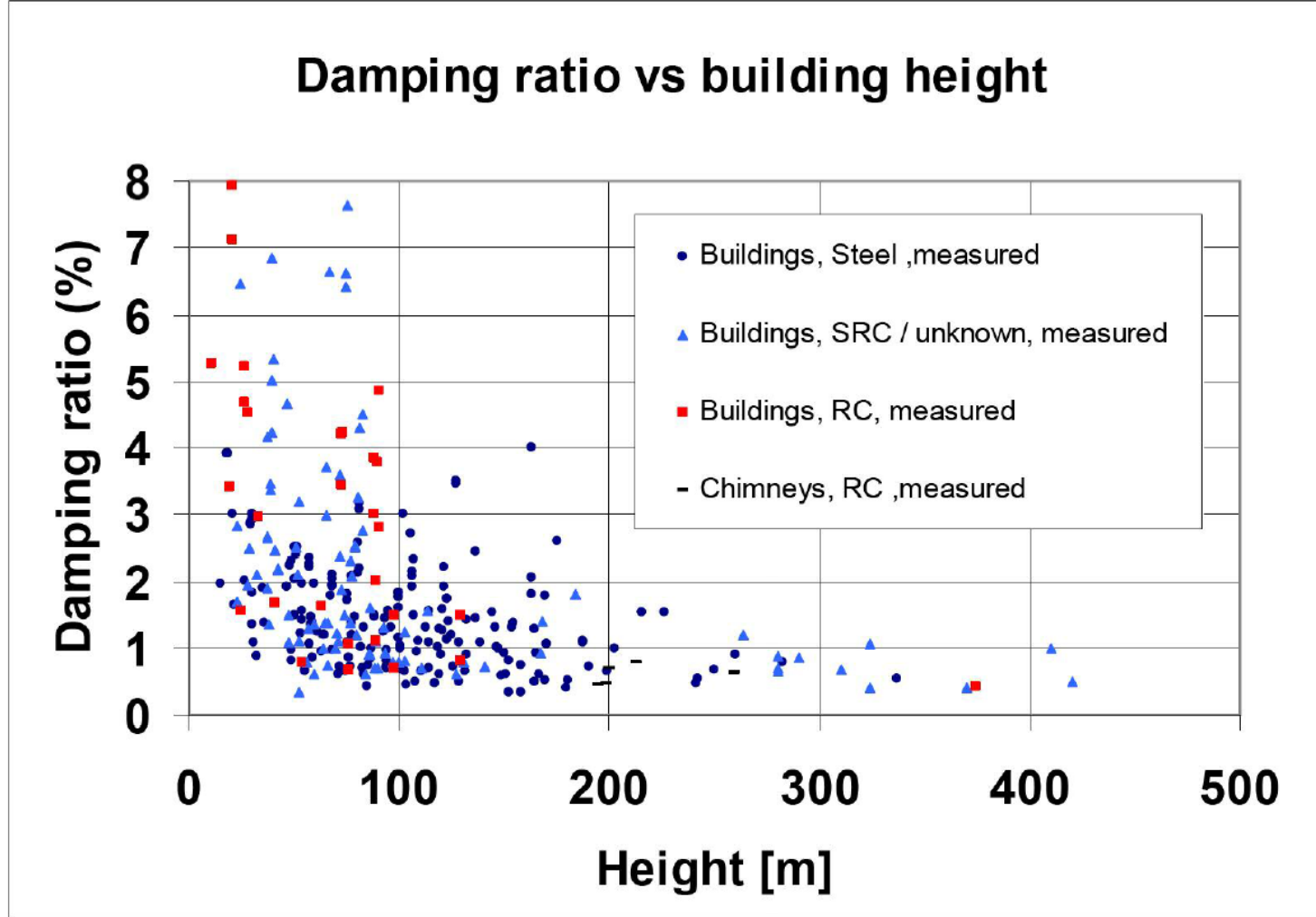
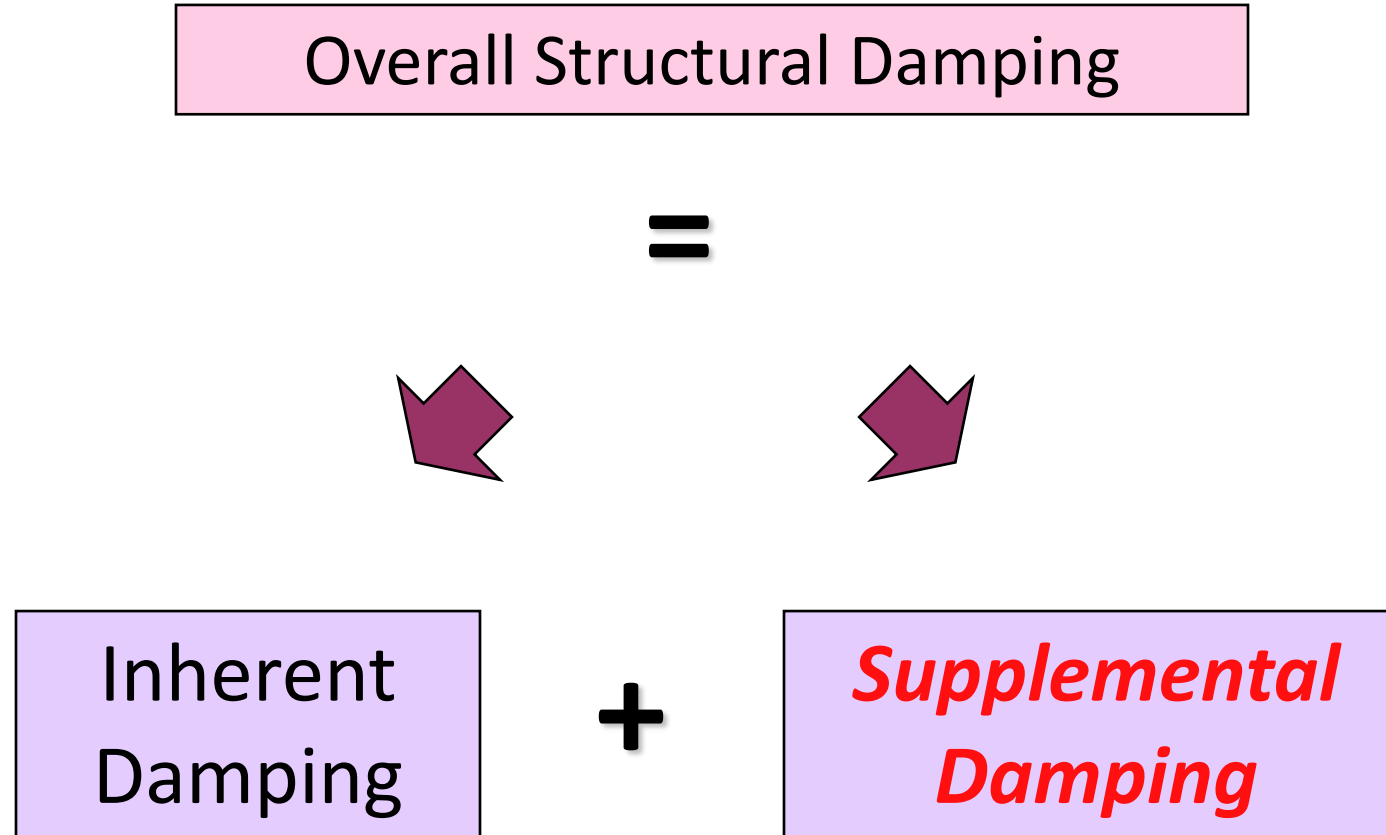


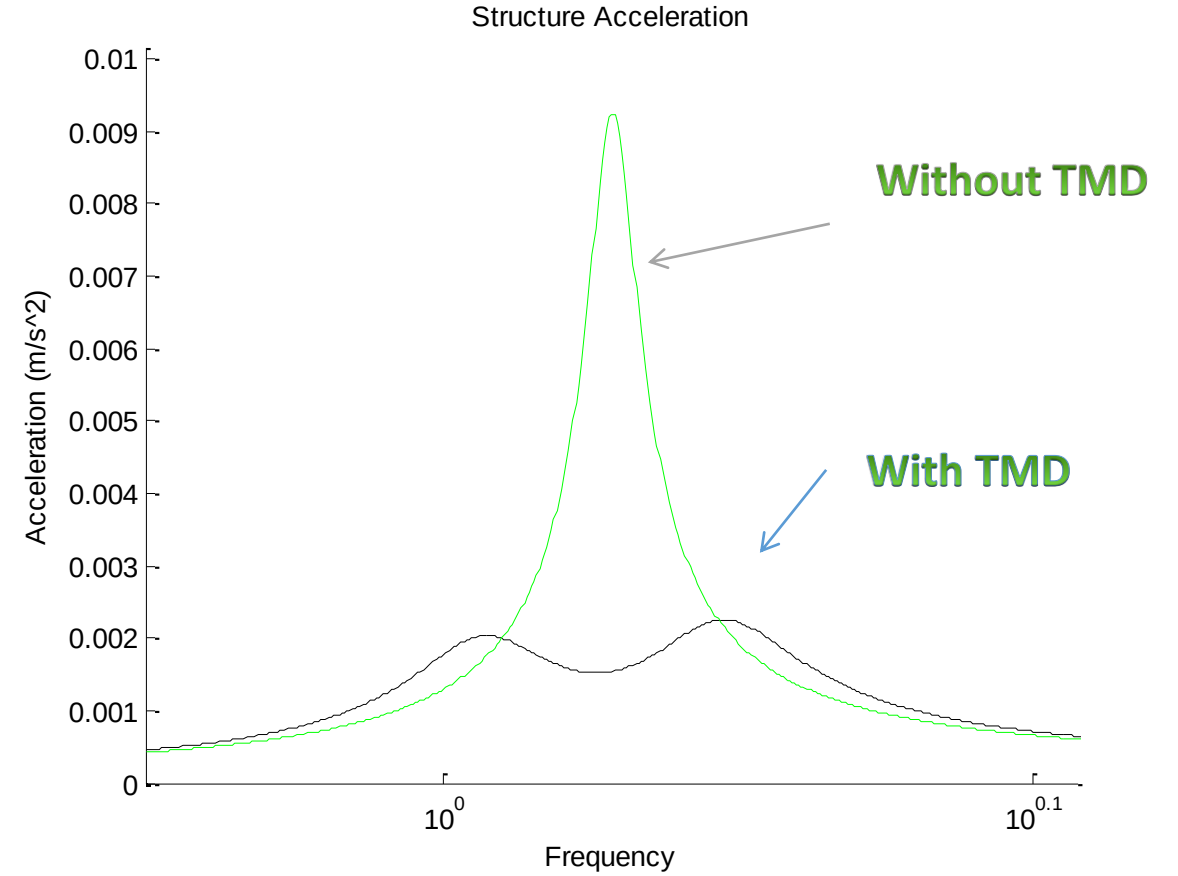
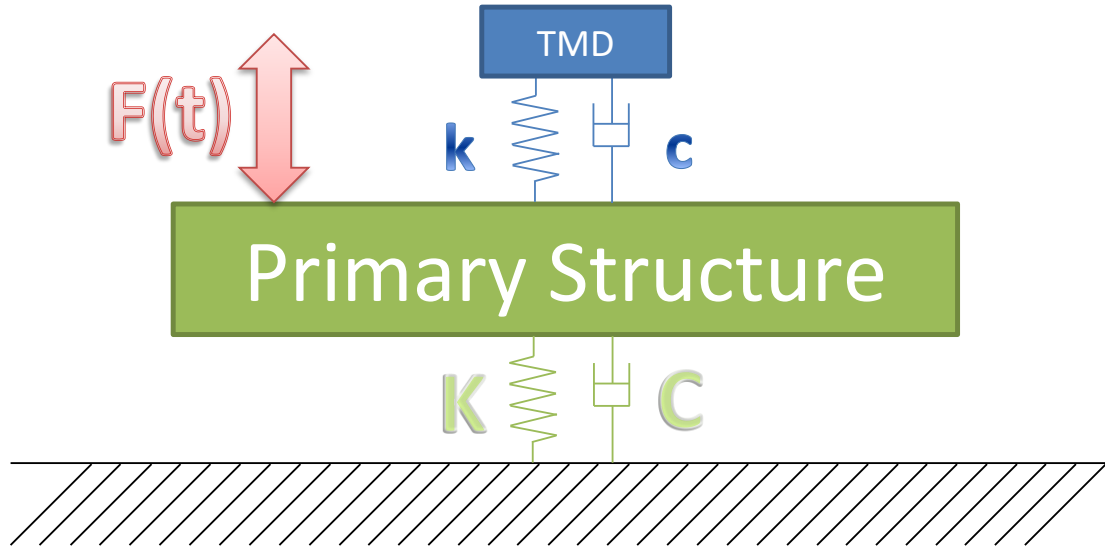
Image Credit: Smith & Willford, Arup, "Damping in tall buildings – uncertainties and solutions", 17th Congress of IABSE, 2008





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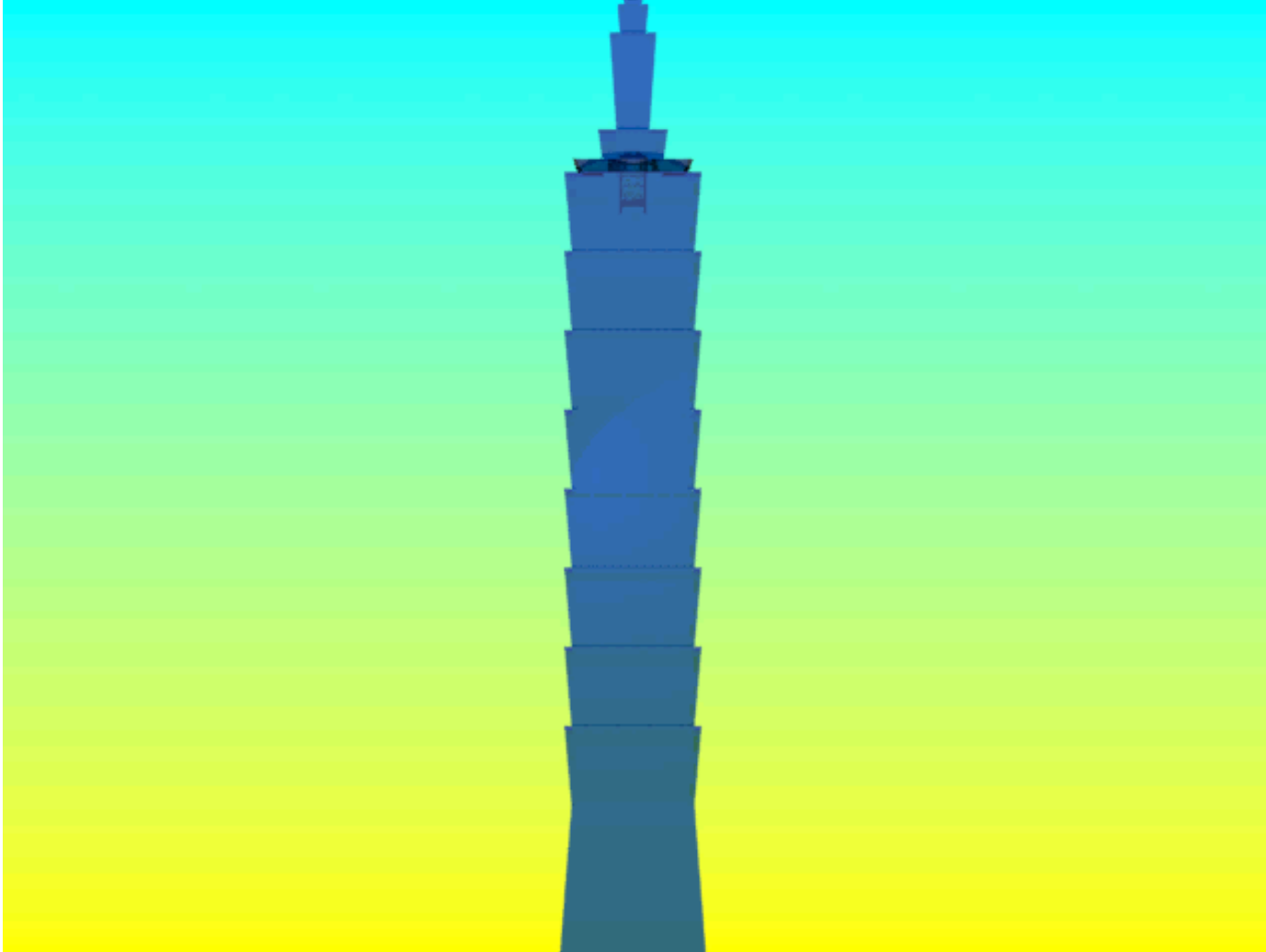
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Taipei 101



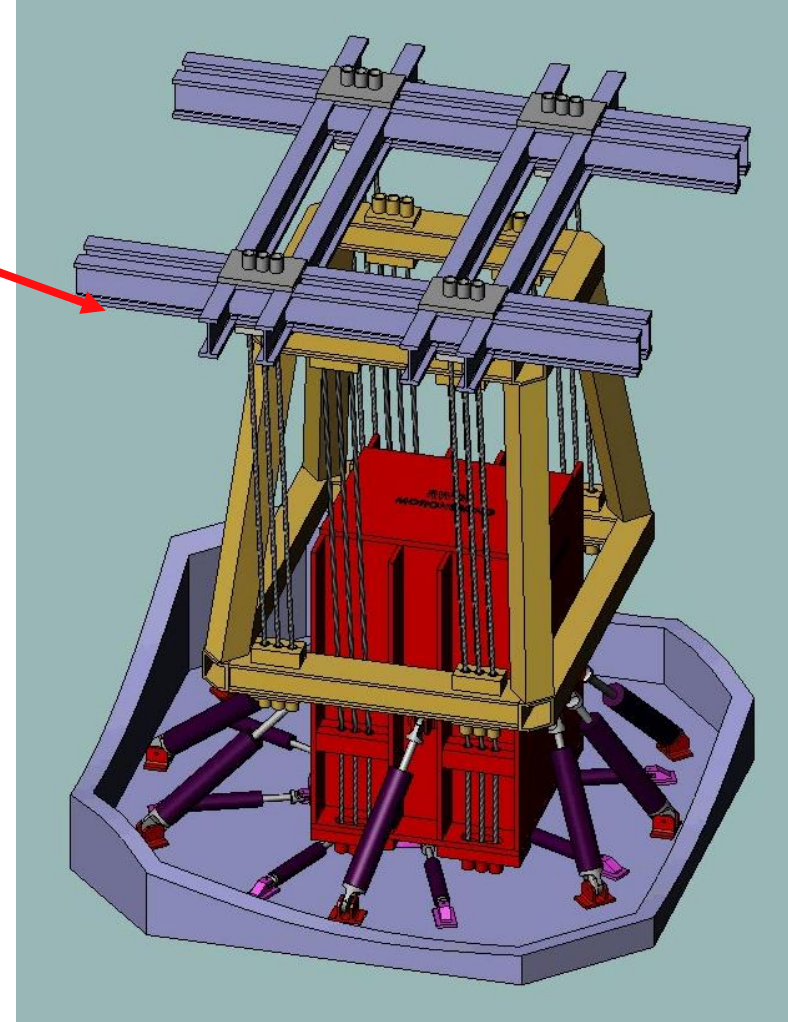


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Trump Tower –
New York City





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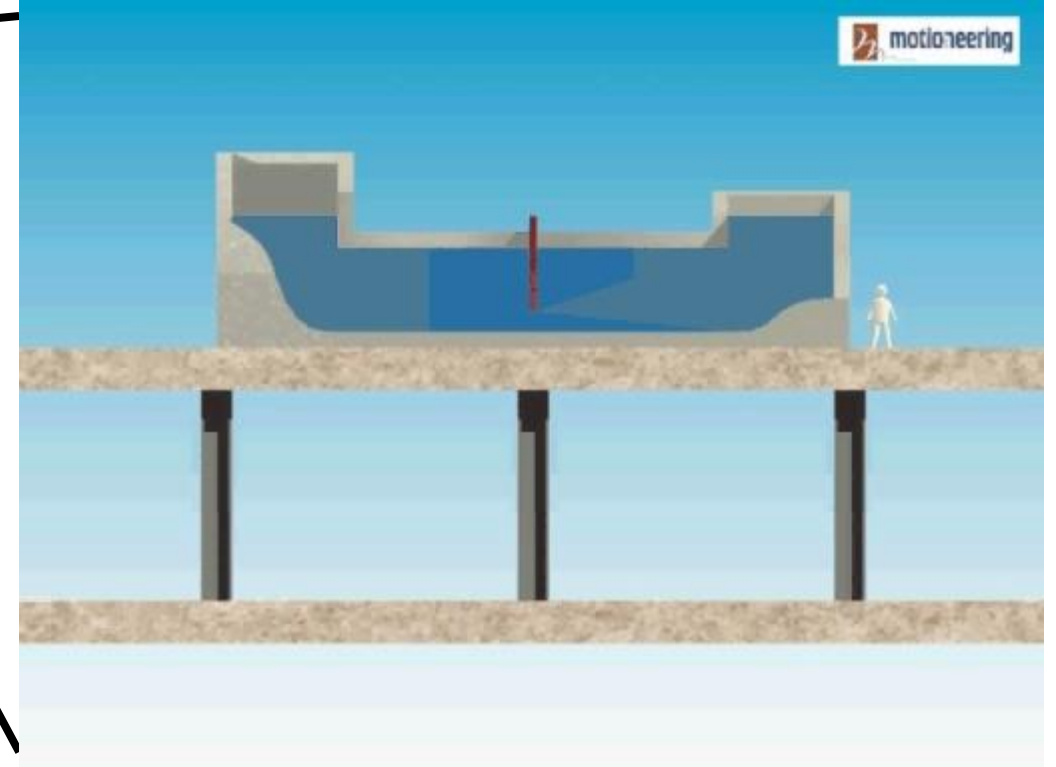
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TLCD Example:
Random House,
New York



48 floor mixed-use Tower



Animation demonstrating motion of TLCD



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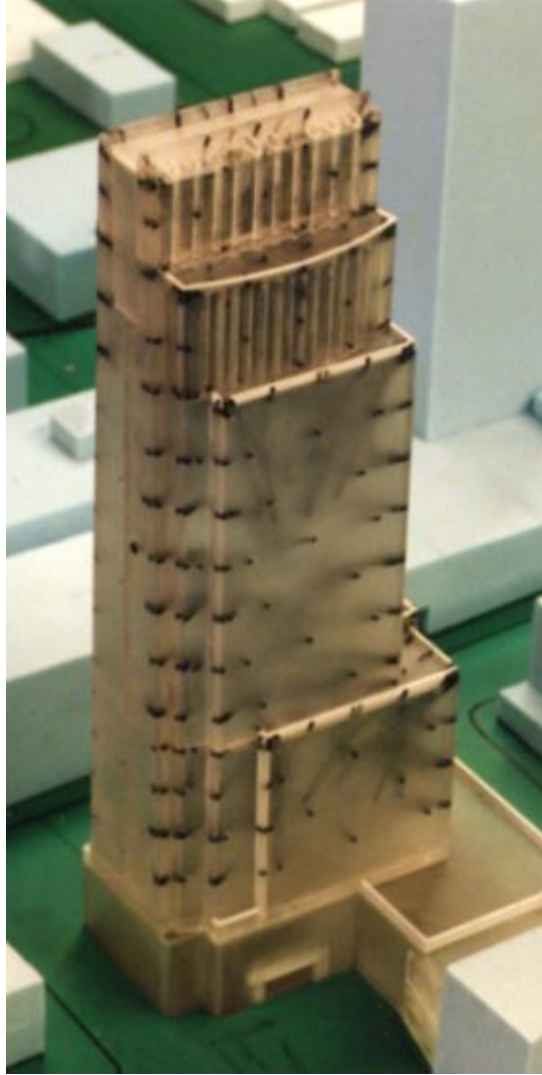
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First National Bank Tower



Pressure Tap Tubing Inside Model

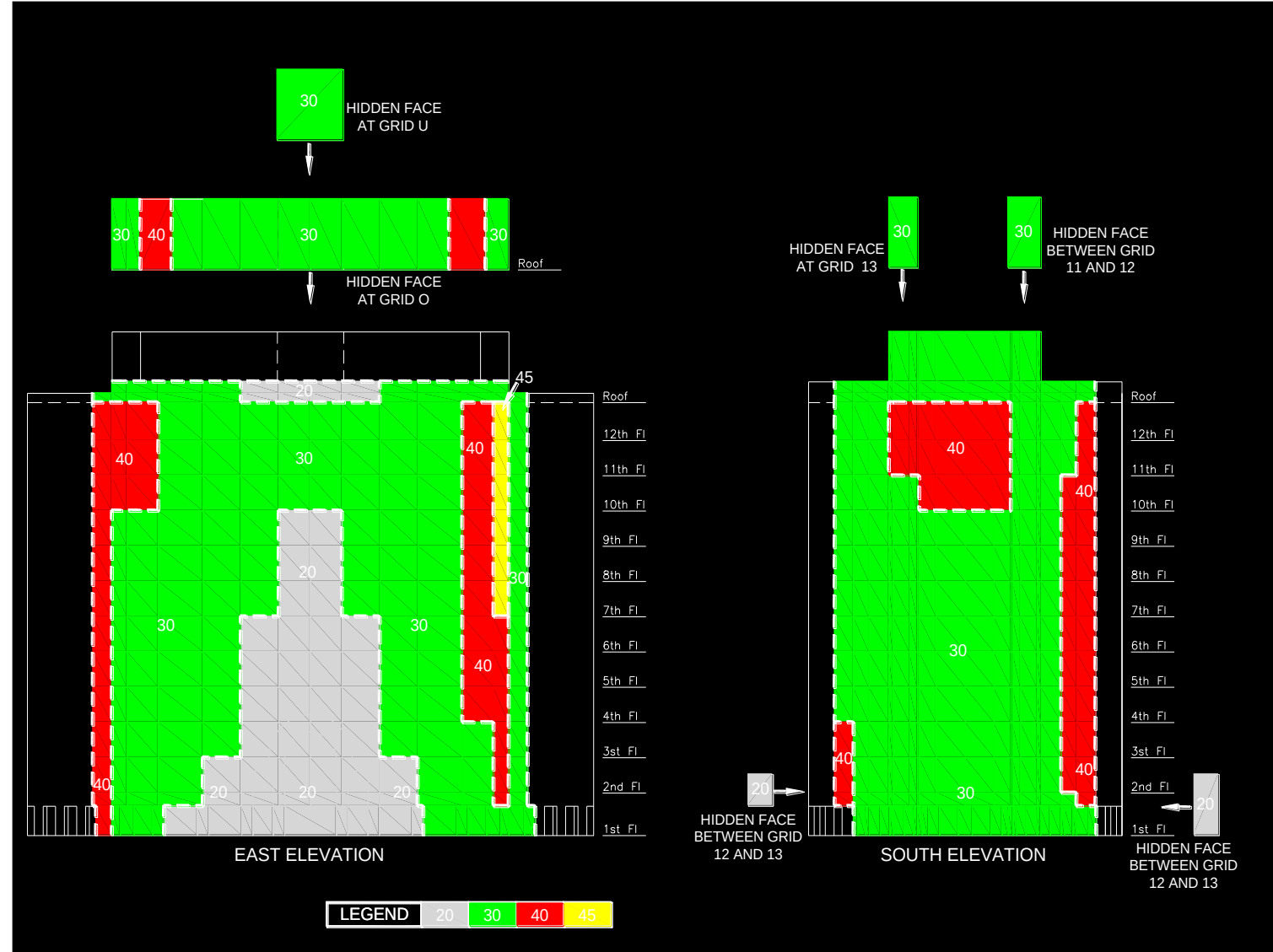


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Wind Pressures on Elevation of Building

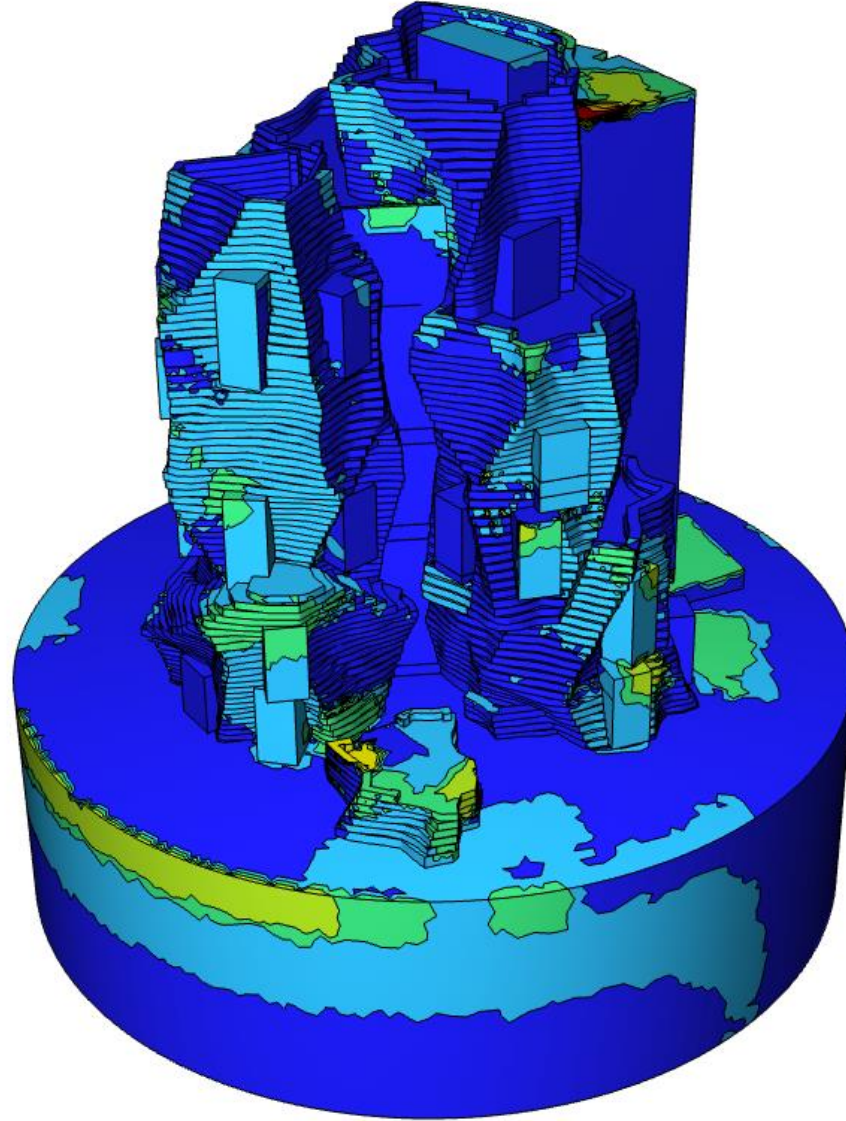


Note: Pressures in psf



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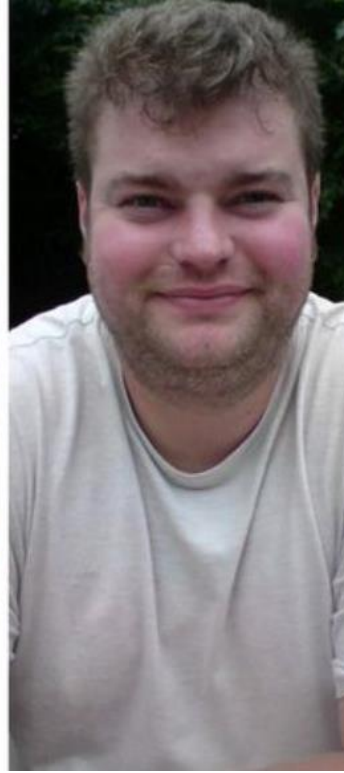
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Bridgewater Place, Leeds, UK





Yaya konforunda çevresel etkiler

Rüzgar Hızı

Aktivite

Sıcaklık - Kıyafet

Nem Oranı

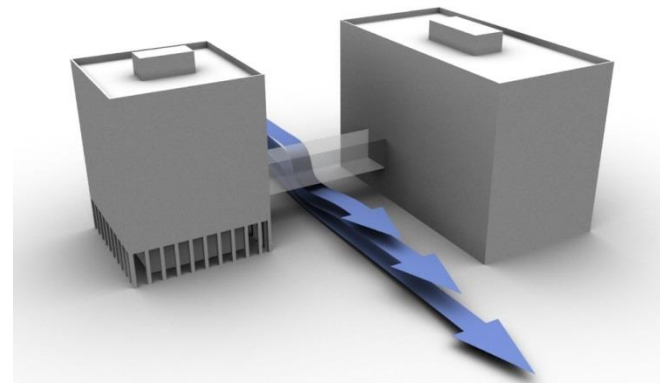
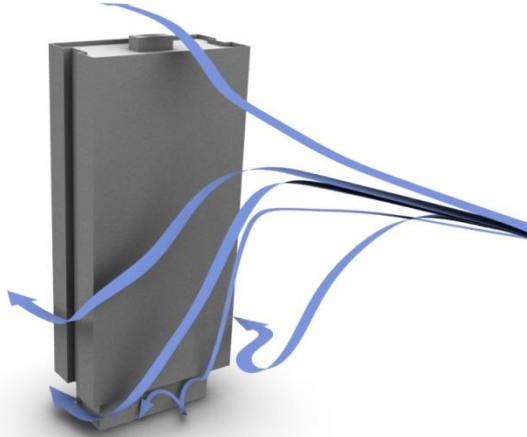
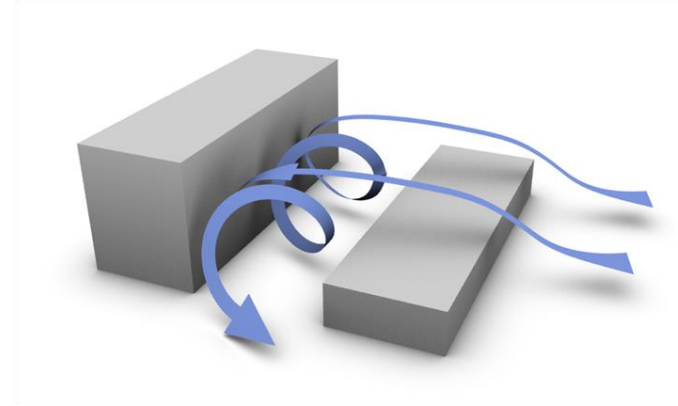
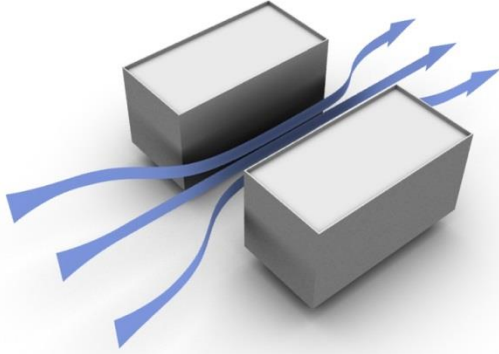
Güneş

Gürültü

...



Yaya Konforu





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- T.V. Lawson Criteria



SITTING
Oturma

STANDING
Bekleme

STROLLING
Yürüyüş

FAST WALKING
Hızlı Yürüyüş





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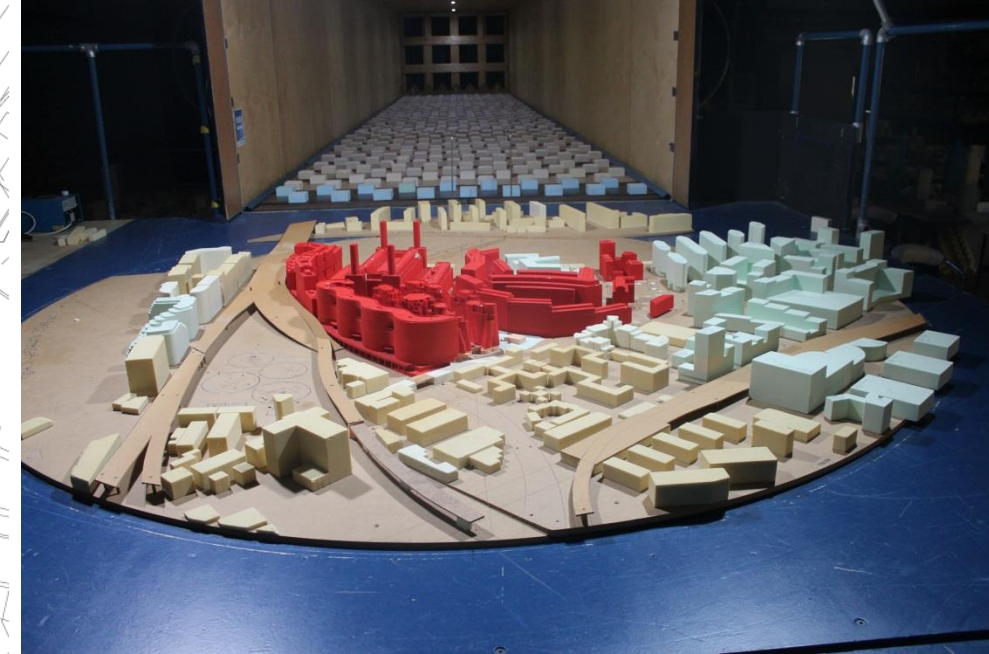
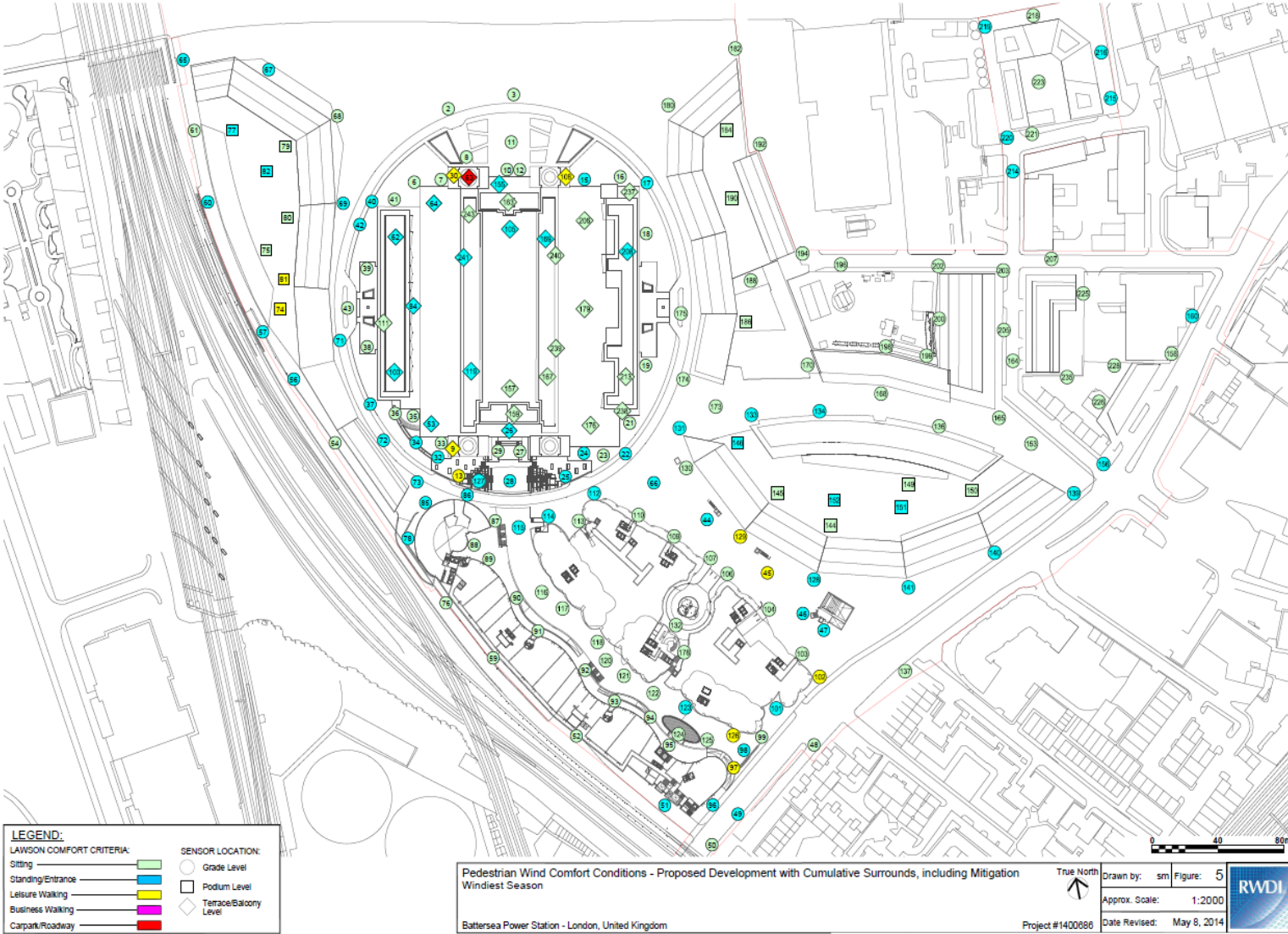
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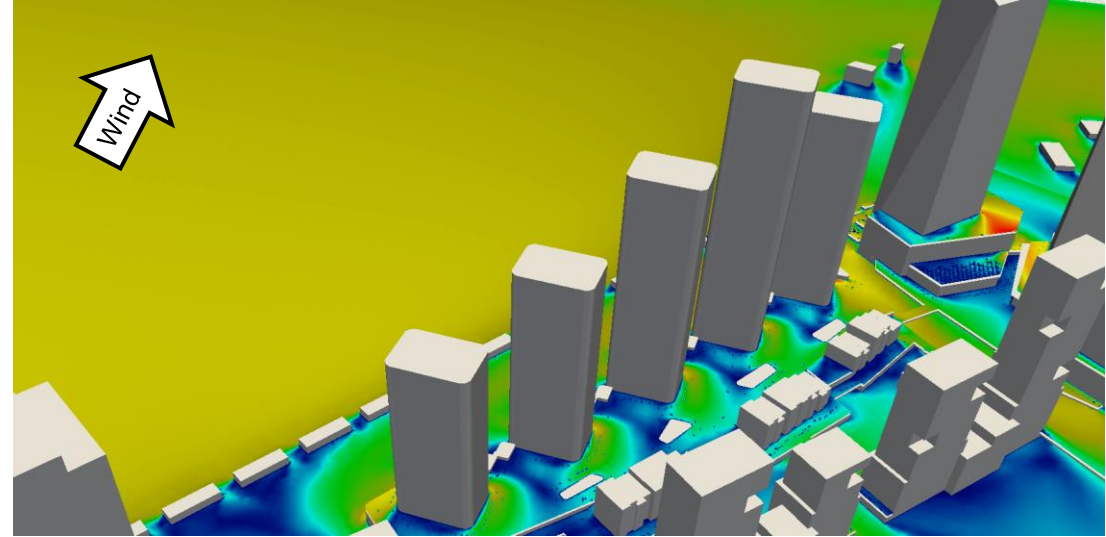
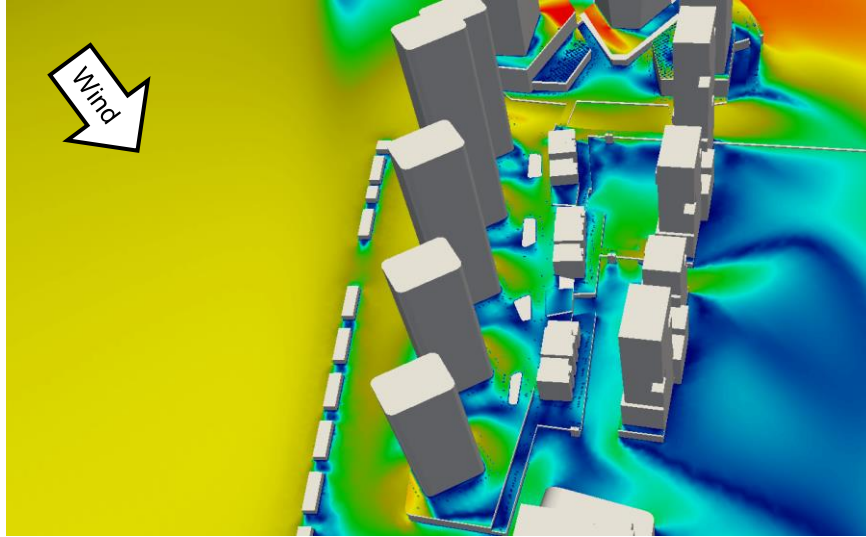
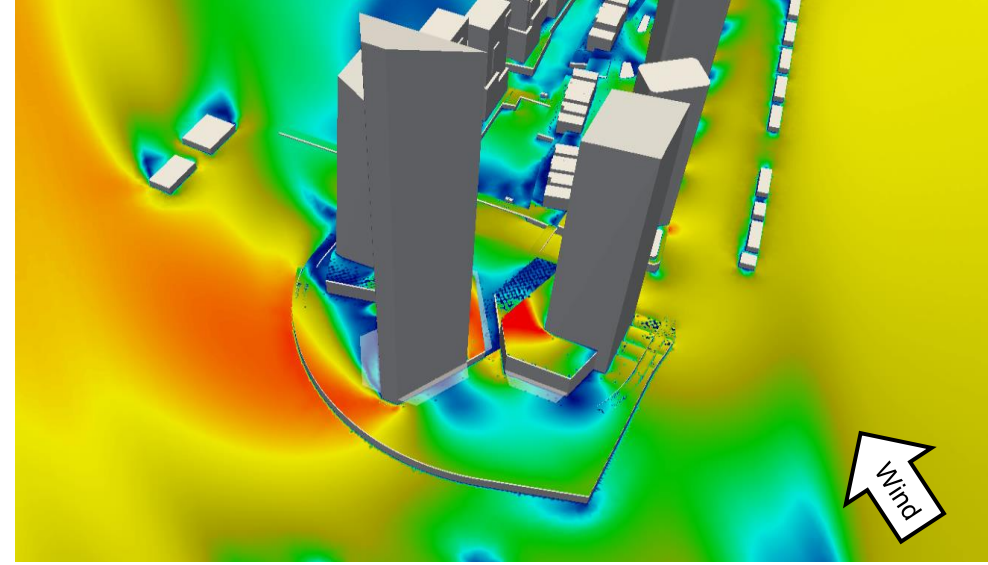
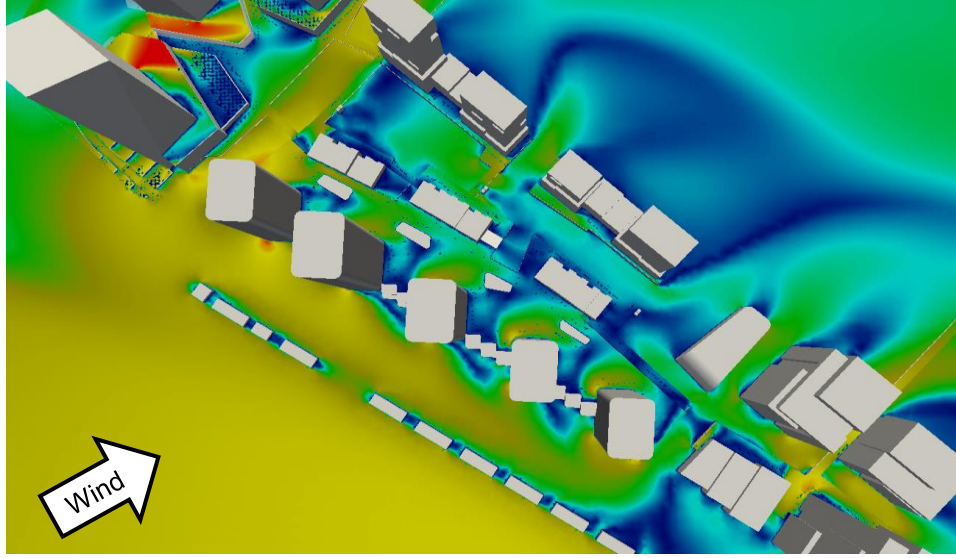
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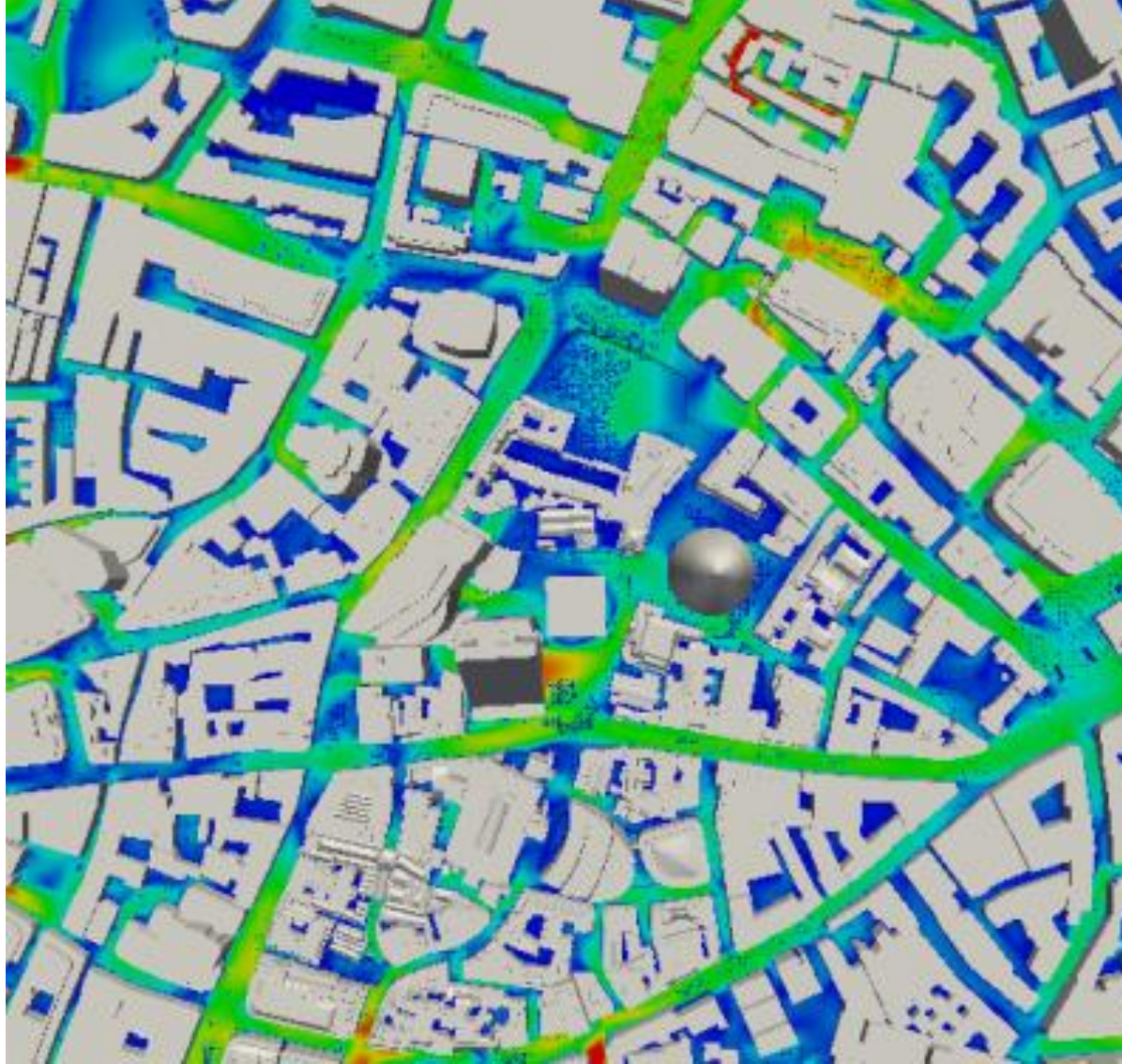
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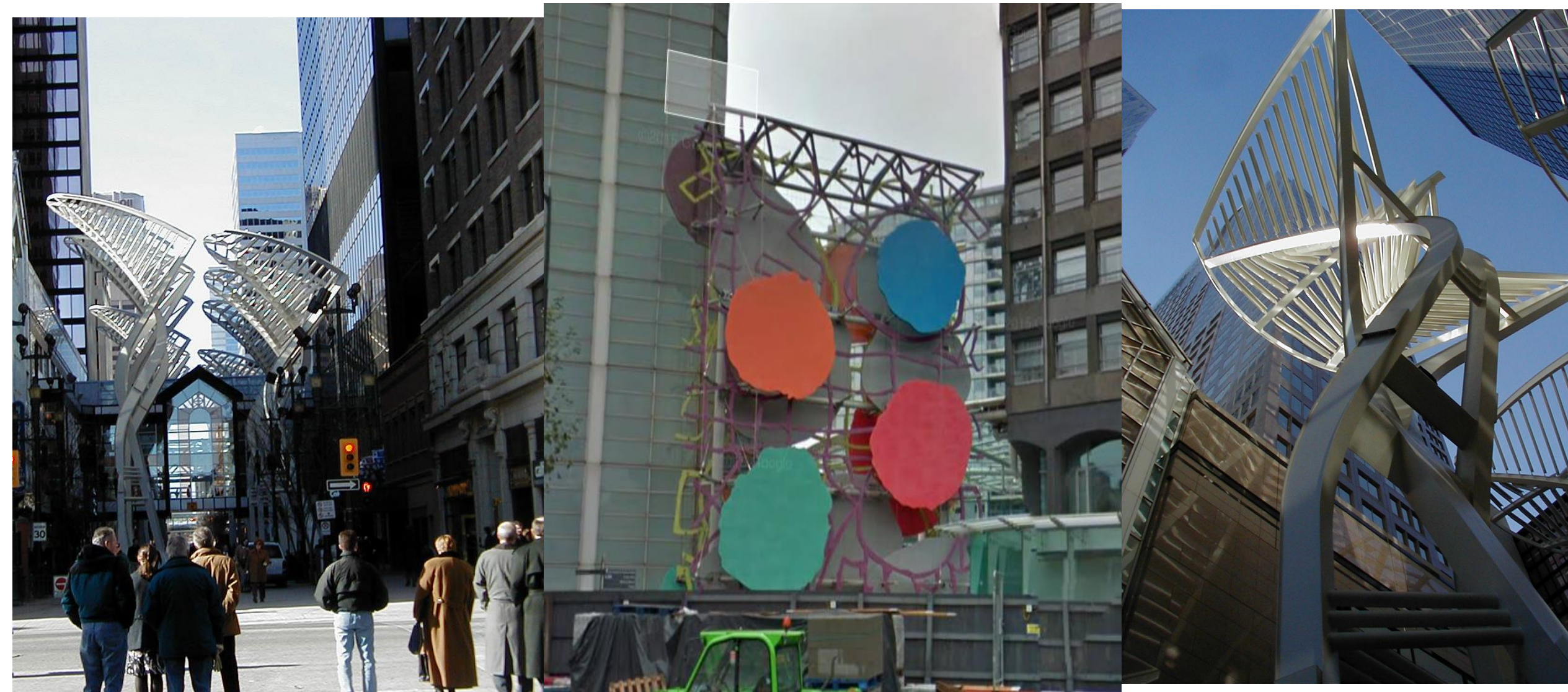


Wind canopies and podiums



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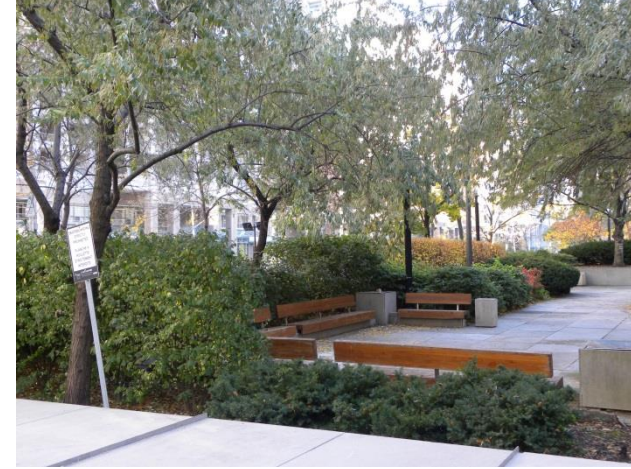
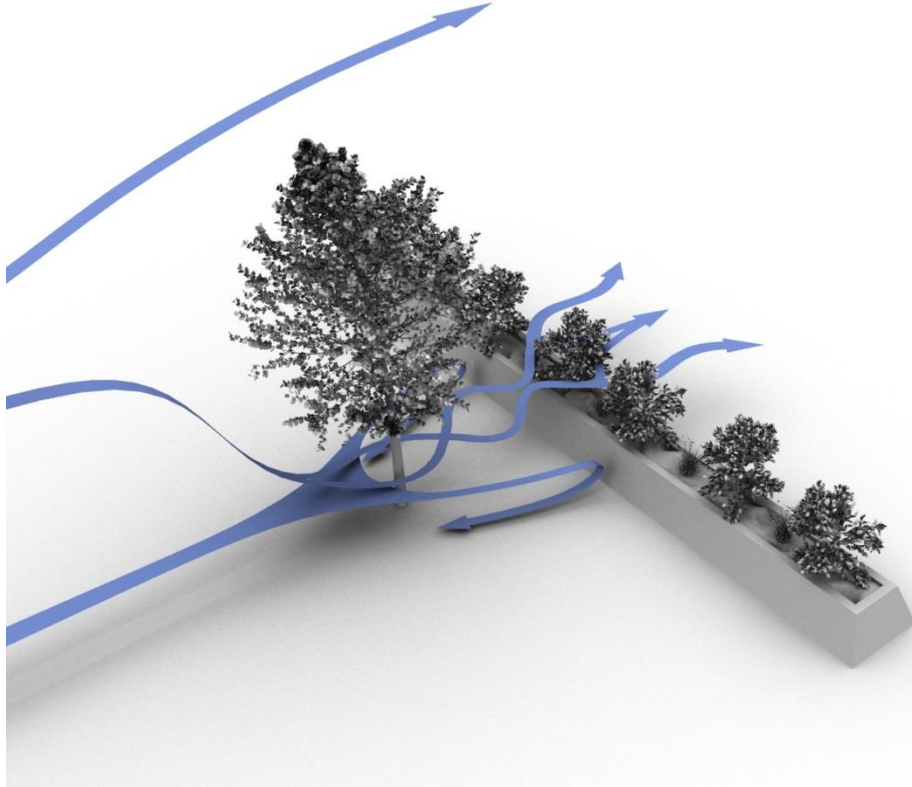
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Peyzaj

(sorunların büyük olmadığı durumlarda)





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**Temel
Prensipier**

**Yapısal
Rüzgar
Etkileri**

**Cephe Basınç
Etkileri**

**Yaya
Konforu**

**Diğer
Çevresel
Etkiler**



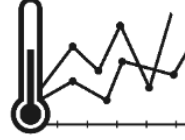
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Climate Risks Assessment



Climate Threats



Storm



Flood



Wildfire



Drought



Precip.



Temp.
(degree days)



Temp.
(extremes)



Earth-
Quakes



Climate
Change

Vulnerability Checklist



Building Systems



Mech.



Water



Security



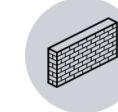
Site



Structure



Access



Enclosure



Elect.



Enviro.

Climate Change Resiliency Database



Resiliency Best Practice Guides



Adaptation Plan





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1. Wind Loads
2. Building Physics
3. Building Enclosures
4. Stewardship & Greenhouse Gases
5. Climate Change & Resiliency
6. Sustainability & Certification
7. Commissioning
8. Vibration & Motion
9. Noise & Acoustics
10. Air Quality & Ventilation
11. Field Services - Regulatory Permitting (ECA)
12. Waste Management
13. Dust & Sand
14. Snow, Ice & Rain
15. Meteorology & Climate
16. Environmental Software
17. Sports Aerodynamics
18. Geoscience
19. Master Planning
20. Energy
21. Solar/Glare/Daylighting

