

Foster + Partners

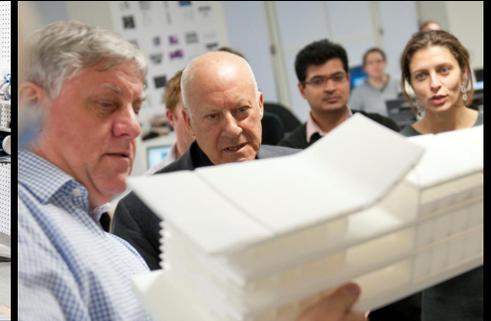
Innovation in the design of tall
buildings

Thouria Istephan

The Studio – projects at a glance



The Team



To undertake some of the largest and most complex projects in the world needs depth of resources



The Team



The scale, diversity and global reach of our projects was unimaginable 40 years ago, yet many of the issues that excited us in the early days continue to inform what we do today.

1184

Total number of staff

20

Worldwide offices

45

Languages spoken

34

Average age

46

Average age of Senior team

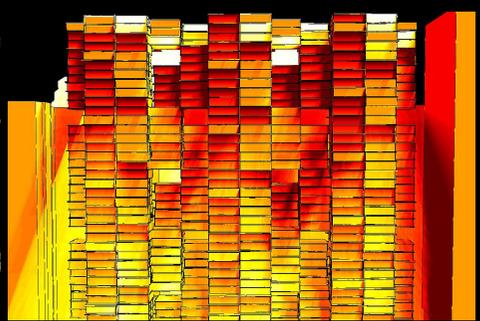
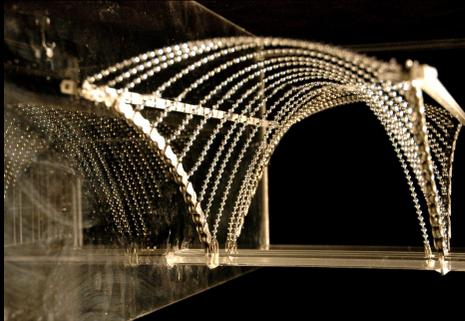
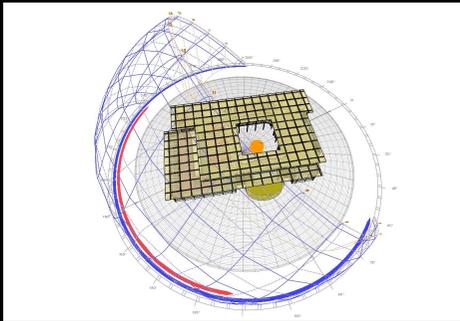
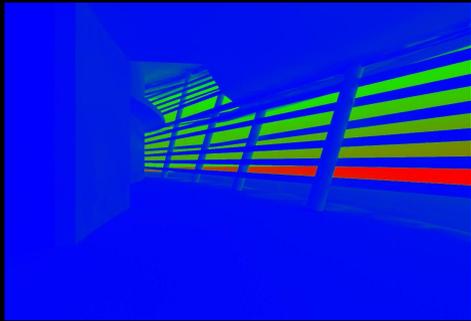
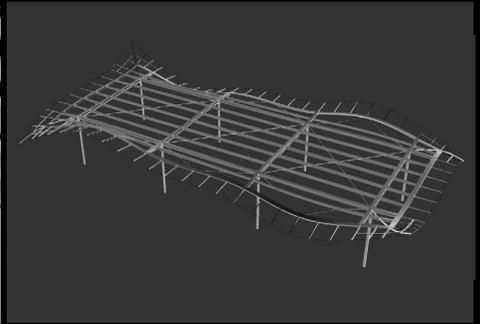
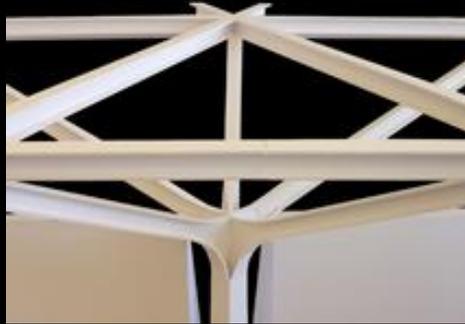
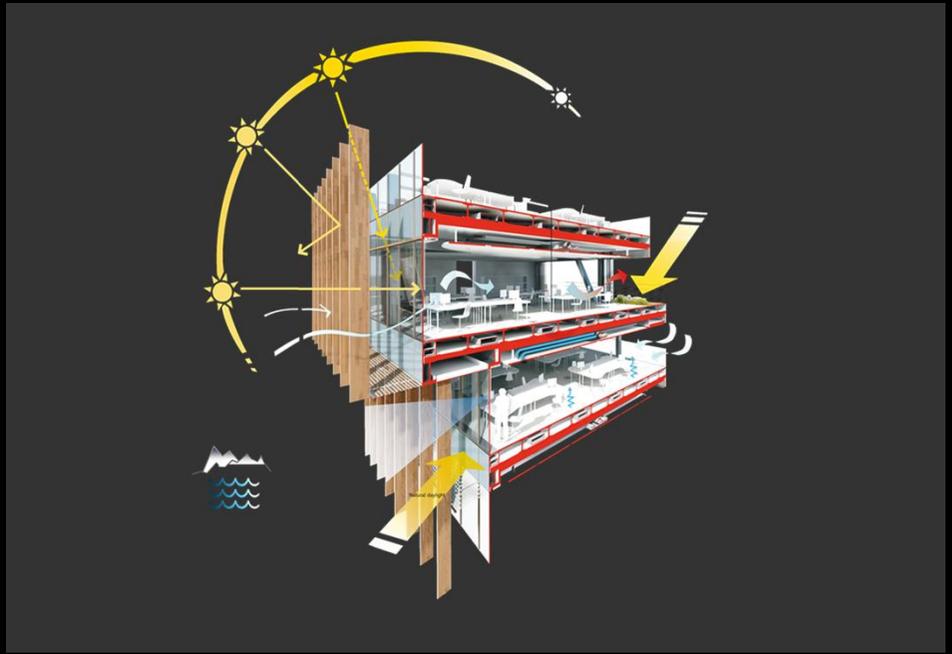
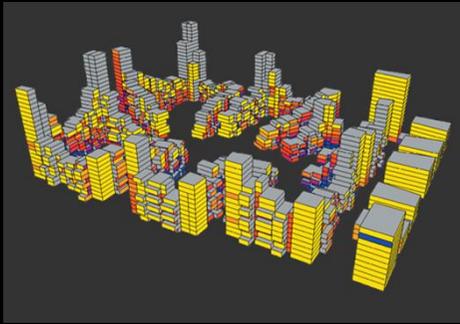
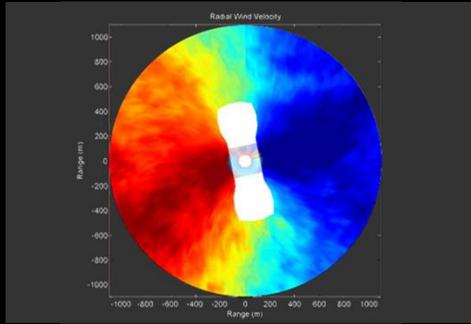
The Team – global network of offices



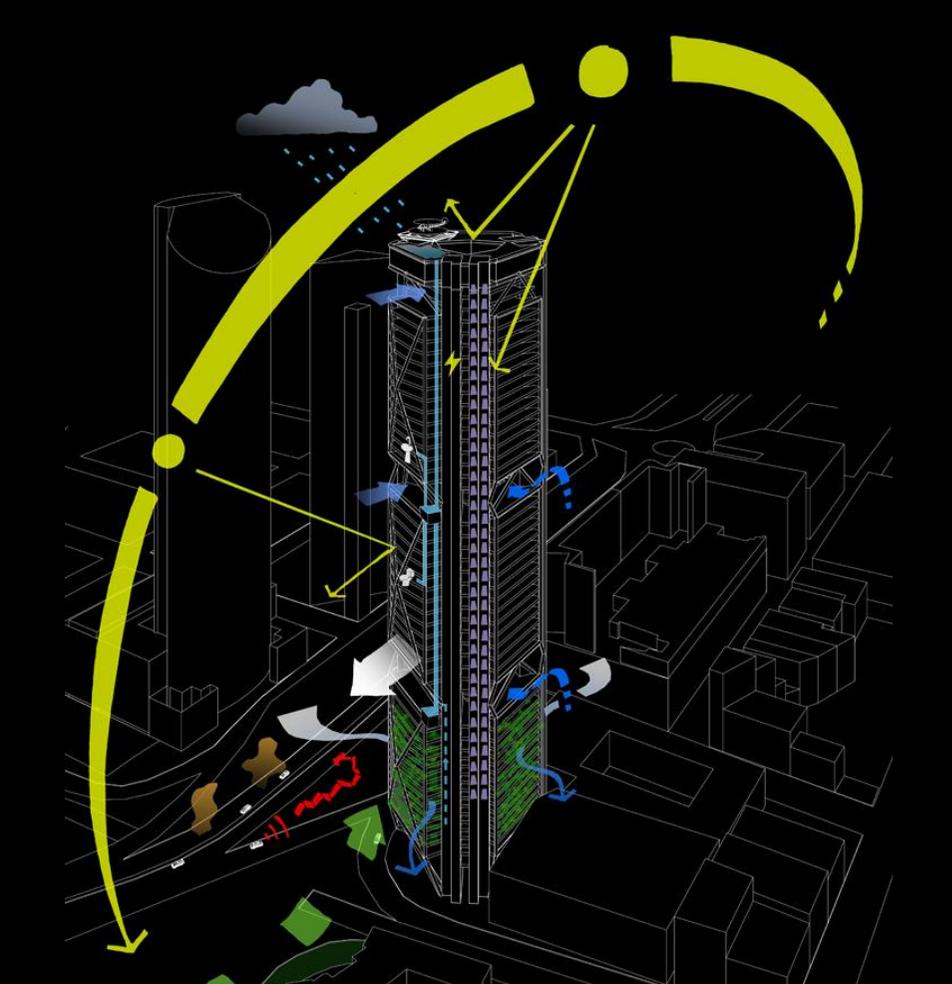
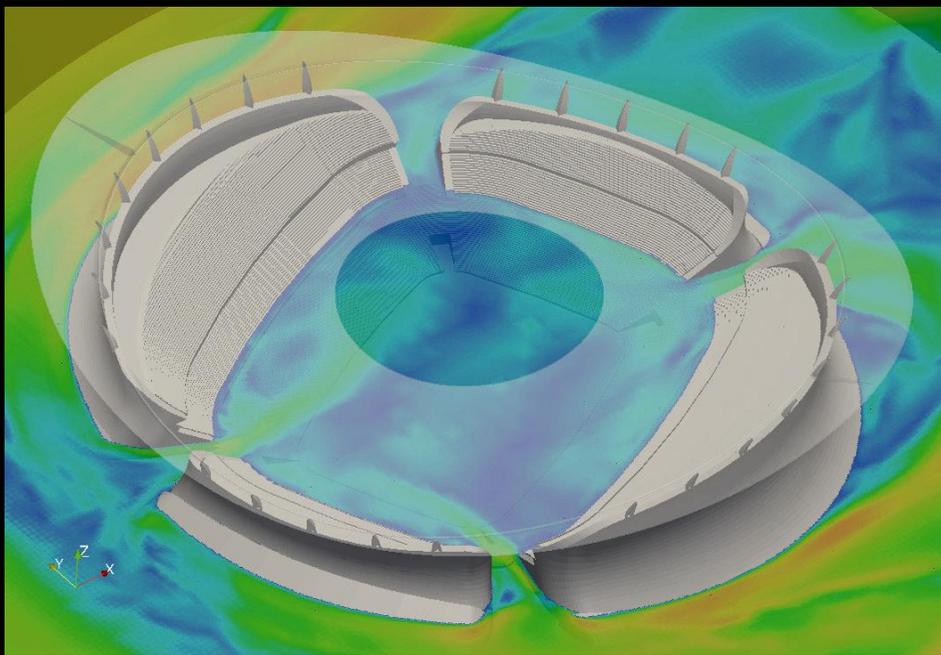
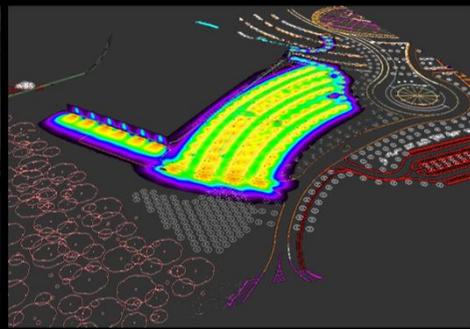
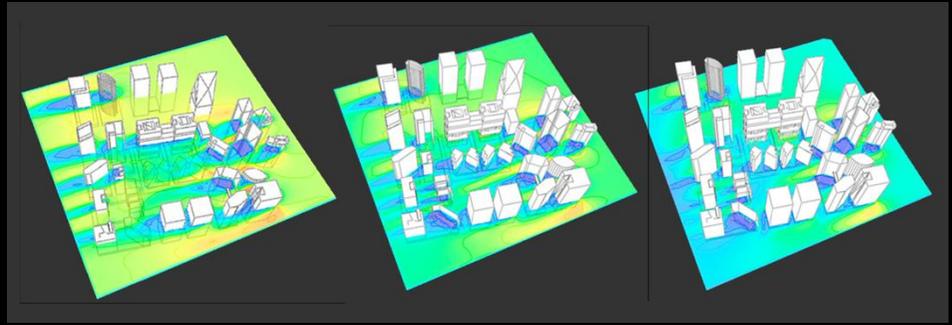
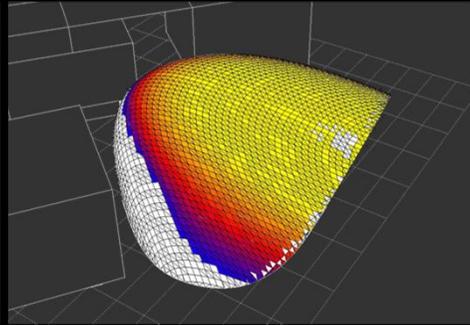
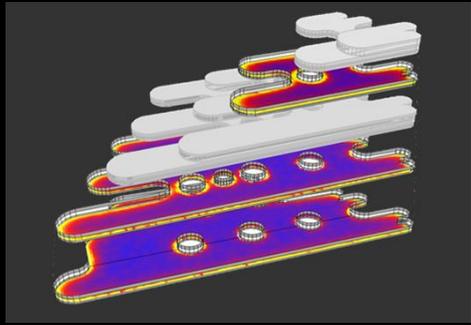
The Team – Projects on site



Integrated Design – engineering



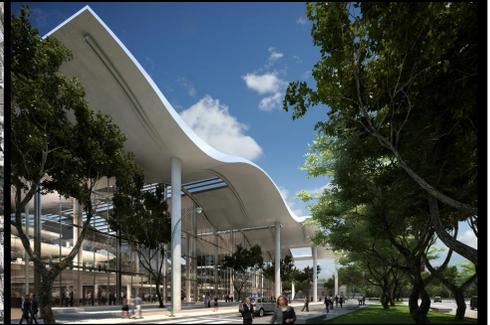
Integrated Design – environmental engineering



Recently completed projects



Current projects



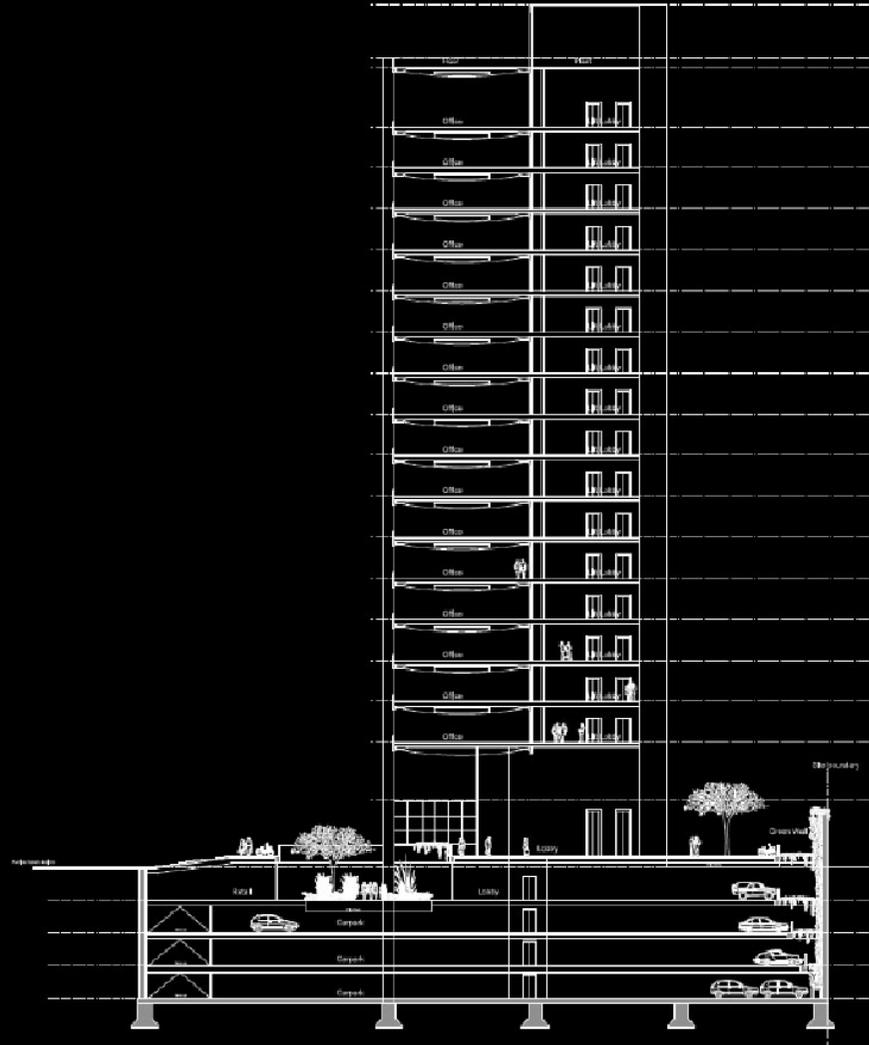
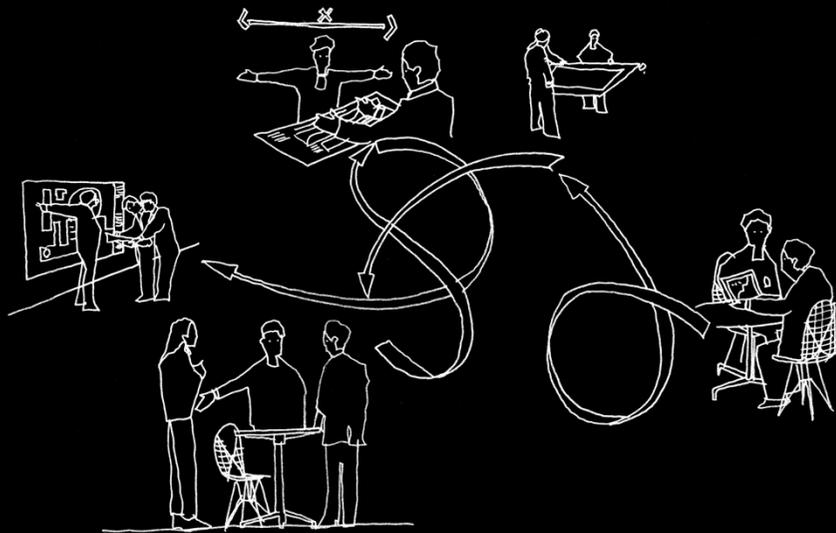
Projects around the world



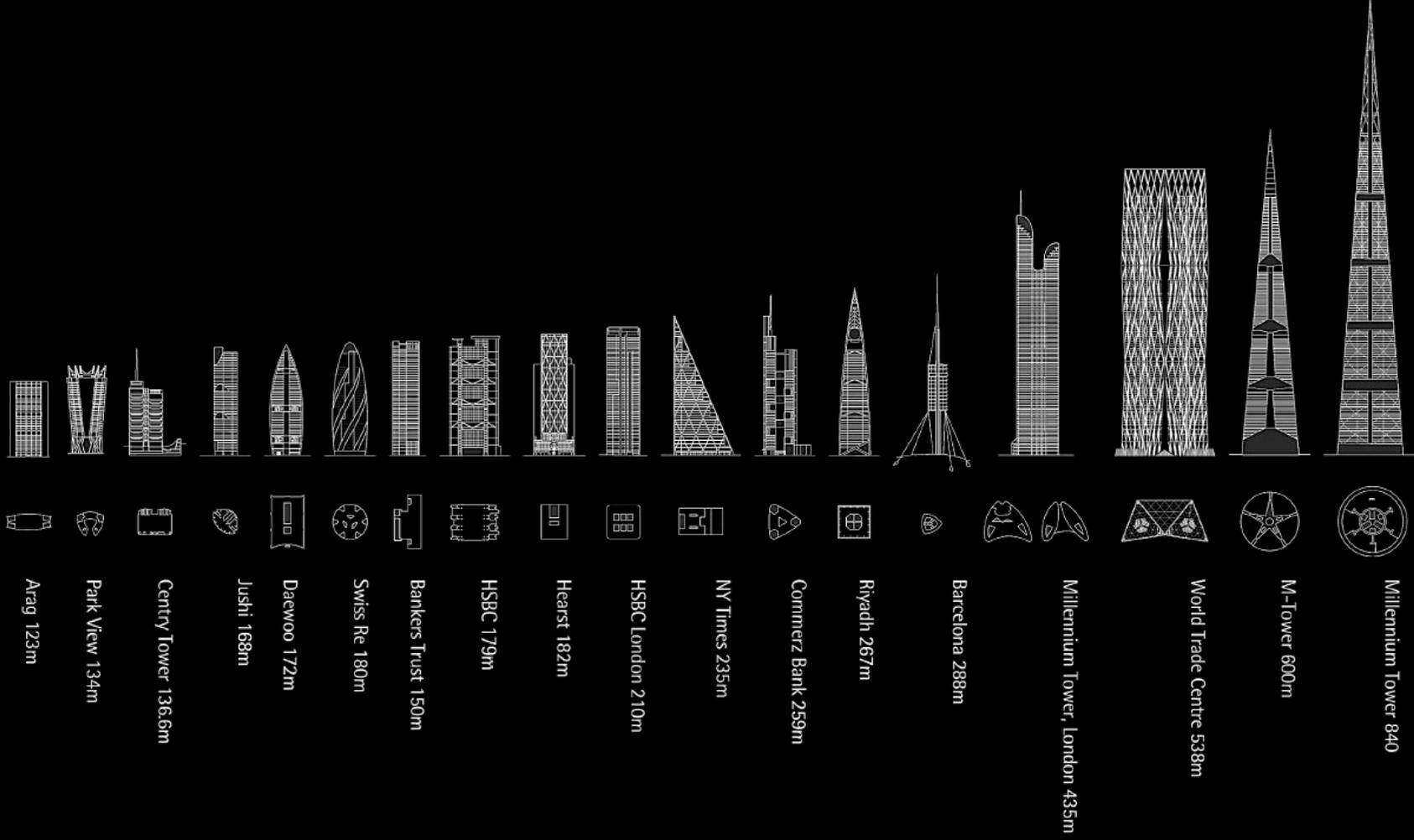
We have worked in **333** cities worldwide

Design Challenges

- Achieve suitable floor plate efficiencies
- Achieve an efficient superstructure solution
- Maintaining core integrity
- Façade specification and performance
- Complexities arising in mechanical and electrical systems design
- New materials
- Local requirements

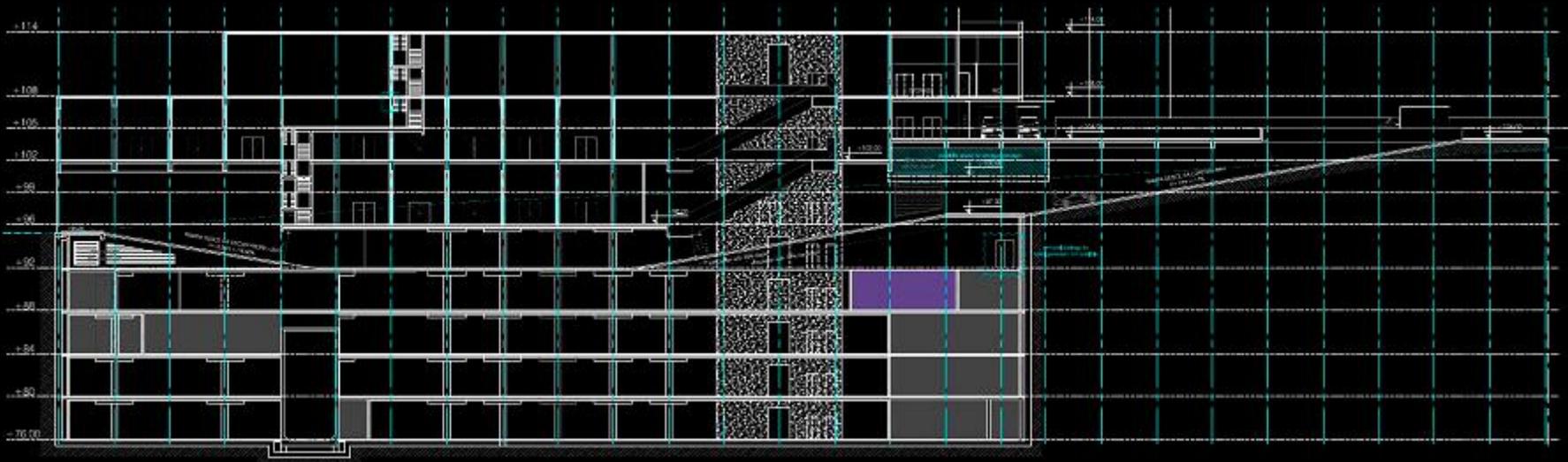
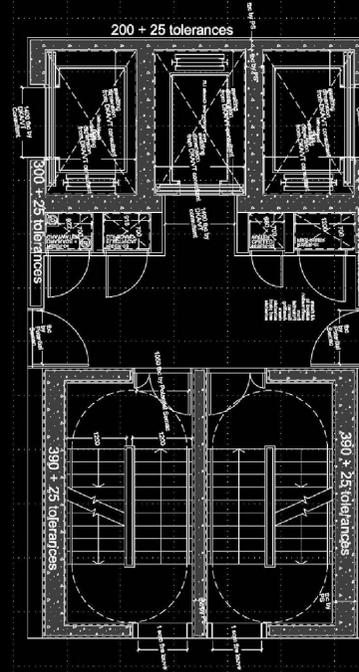


Tall Buildings – All shapes and sizes



Challenges

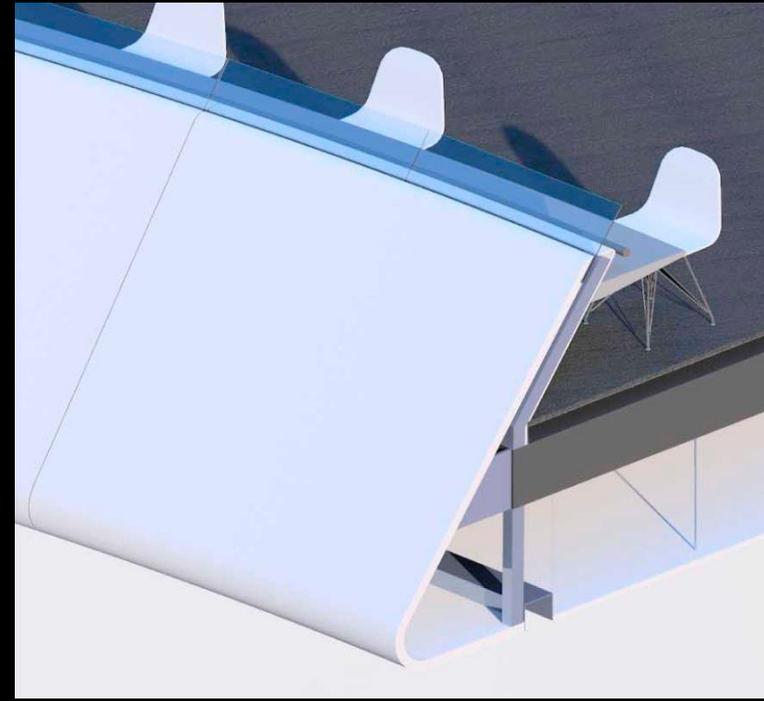
- Helipads
- Back to back staircases
- Refuge floors
- Active/Passive smoke extract
- Car Park – High fuel load
- Intumescent Paint



Case Study

The Balustrades and Roof

- The balustrades were originally specified as plywood formwork with Glass-Reinforced Gypsum (GRG)
- The GRG balustrades were replaced with a cheaper alternative – Polyurethane (PU)
- Additionally the roof material was specified to be PU



The Material: Coated Polyurethane (PU)

- The formed polyurethane balustrade sections achieved desired performance criteria in terms of:
 - Cost
 - Aesthetics
 - Weight
 - Acoustics



Material Fire Performance

- The material obtained certification for use in building construction
- The Turkish contractor had already used it in several other projects outside the UK
- The Construction Review Group noted PU as a potential fire hazard

 TEBAR Test Belgelendirme Araştırma ve Geliştirme Ticaret A.Ş.	TÜRKAK TÜRK AKKREDİTASYON KURUMU TURKISH ACCREDITATION AGENCY tarafından Akredite edilmiştir.		
		AB-0302-T	
		R1000056	
TEBAR TEST BELGELENDİRME ARAŞTIRMA ve GELİŞTİRME TİC. A.Ş. Adres: Şerifali Çiftliği Hendem Caddesi Kible Sk. No:33 Y.Dudullu 34775 Ümraniye/İSTANBUL		02-06	
DENEY RAPORU TEST REPORT			
Müşterinin Adı/Adresi: DECPOL POLİÜRETAN SİSTEMLERİ A.Ş. Antalya Serbest Bölgesi 0 ada Batı 2. Cad. 4. Sokak Köşesi Antalya Customer Name/Adres			
İstek Numarası: İ1000008 Order No. Numune Numarası: N1000035 Specimen No.			
Numunenin Adı ve Tarihi: (1200x600)mm ebadında, 160kg/m³ yoğunluklu 6 adet sarı renkli Poliüretan Köpüğü (PUR) Name and identity of test item			
Numunenin Laboratuvara Geliş Tarihi: 25.05.2010 The date of receipt of test item Numunenin Kabul Tarihi: 27.05.2010 The date of receipt of test item			
Açıklamalar: (1200x600)mm ebadında 6 adet sarı renkli Poliüretan Köpüğü (PUR) numuneleri müşteri tarafından laboratuvara gönderilmiştir. Tam boyut halindeki deney numunesinden (250x180)mm ebatlarında 6 adet deney parçası kesilerek deneye tabi tutulmuştur. Remarks			
Deneğin Yapıldığı Tarih: 28.05.2010-01.06.2010 Date of Test			
Raporun Sayfa Sayısı: 1/4 Number of pages of the Report			
Türk Akreditasyon Kurumu (TÜRKAK) deney raporlarının tanınması konusunda Avrupa Akreditasyon Birliği (EA) ve Uluslar arası Laboratuvar Akreditasyon Birliği (ILAC) ile karşılıklı tanınma antlaşması imzalamıştır. The Turkish Accreditation Agency (TURKAK) is signatory to the multilateral agreements of the European co-operation for the Accreditation (EA) and of the International Laboratory Accreditation (ILAC) for the Mutual recognition of test reports.			
Deneğin ve/veya ölçüm sonuçları genişletilmiş ölçüm belirsizlikleri (olması halinde) ve deney metodları bu sertifikanın tamamlayıcı kısmı olan takip eden sayfalarda verilmiştir. The test and/or measurement results, the uncertainties (if applicable) with confidence probability and test methods are given on the following pages which are part of this report.			
	Tarih Date 02.06.2010	Deneğin Yapan Person in charge of test Kimya Teknikeri/Chemistry Tec. P.GÖKSU	Teknik Laboratuvar Yöneticisi Head of Testing Laboratory Kimyager/Chemist G.OZGÜN

* İşareti ile gösterilen deney metodları Akreditasyon kapsamı dışındadır.

Bu raporda verilen deney sonuçları aksi belirtilmedikçe sadece deneye tabi tutulan numuneler için geçerlidir ve ürünün uygunluğunu göstermez. Bu rapor, laboratuvarın yazılı izni olmadan kısmen kopyalanıp çoğaltılamaz. İmzasız ve mühürsüz raporlar geçersizdir.
The result shown in this test report refer only to the sample(s) tested unless otherwise stated. This report shall not be reproduced other than in full except with the permission of the laboratory. Testing reports without signature and seal are not valid.

FR.081/00/06.03.2009

Additional Tests

- The BRE Centre for Fire Safety Engineering agreed to conduct additional tests
- The aim of the test was to establish whether the fire-retardant coating could resist a radiant heat flux similar to one imposed by a real fire
- It was assumed that the PU foam behind the fire-retardant coating was highly flammable and would release large amounts of HCN, CO and CO₂ if ignited



Sample 1 – Thick Coating

- The **thick** fire retardant coating was insufficient to prevent ignition of the PU foam behind



- Exposed to Heat Flux



- Ignition



- Flaming



- After Being Extinguished

Time

Sample 1 – Thick Coating

- The heat caused the fire retardant coating to crack
- The PU vapour poured through cracks, creating jets of flame
- The test sample produced so much toxic smoke it had to be extinguished by the lab technician, normally under test conditions this would not be necessary



Sample 2 – Thin (Paint) Coating

- The **thin** (paint) coating performed much worse, exposing the PU foam after only a few seconds
- The lab technician had difficulty extinguishing the sample



- Exposed to Heat Flux



- Ignition



- Flaming



- After Being Extinguished

Time

Sample 2 – Thin (Paint) Coating

- The coating failed in less than 20 seconds, exposing the highly flammable polyurethane foam beneath.



Discussion

- How was it possible for this material to gain approval for building construction?
- The fire tests conducted by the Turkish Contractor are standard tests used to measure flame spread across wall coatings
- A flame is held against the material for 15 seconds after which time the flame spread rate over the surface is measured
- This test was designed for wall coatings such as paper or wood and was not designed to test composite materials
- The test effectively measured the flammability of the fire retardant coating on the surface, rather than the flammability of the PU behind
- The test assumes that the PU will remain protected and intact throughout the lifetime of the building
- **The tests did not create an environment representative of real fire conditions**

AB-0302-T
R1000056
02-06



TEBAR
Test Belgelendirme Araştırma ve Geliştirme Ticaret A.Ş.

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DENEY RAPORU
TEST REPORT

Sayfa : 4/4
Page : 4 of 4

TABLO 1: DENEY SONUÇLARI

Numune No	Tutuşma (E/H)	DeneY Süresince Alevin 150 mm Yayılıp Yayılmadığı (E/H)	t ₁₅₀ (sn)	Süzgeç Kâğıdında Yanma (E/H)	Ek A'da verilen işlemin uygulanması (E/H)	Karar (G/K)
1	Evèt	Hayır	-	Hayır	Evèt	G
2	Evèt	Hayır	-	Hayır	Evèt	G
3	Evèt	Hayır	-	Hayır	Evèt	G
4	Evèt	Hayır	-	Hayır	Evèt	G
5	Evèt	Hayır	-	Hayır	Evèt	G
6	Evèt	Hayır	-	Hayır	Evèt	G

Kısaltmalar:
E: Evèt H: Hayır G: Geçti K: Kaldı t₁₅₀: Alevin 150mm'ye yayılma süresi

"Bu deneY sonucu, deneYin uygulandığı özel şartlar altında bir mamulün deneY numunesinin davranışıyla ilgilidir; gerçek kullanım şartlarındaki bir mamulün potansiyel yangın tehlikesinin değerlendirilmesi için yegâne bir kriterle ilgili değildir."



Resim 1: DeneY işleminde ve sonrasında çekilen fotoğraflar



* İşareti ile gösterilen deneY metodları Akreditasyon kapsamı dışındadır.
Bu raporda verilen deneY sonuçları aksi belirtilmedikçe sadece deneY tabii tutulan numuneler için geçerlidir ve ürünün uygunluğunu göstermez.
Bu rapor, laboratuvarın yazılı izni olmadan kısmen kopyalanıp çoğaltılamaz. İmzasız ve mühürlü raporlar geçersizdir.
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Conclusions

- Polyurethane should not be used for building construction
- Polyurethane (PU) is highly flammable and produces highly toxic fumes when burned
- **New materials, particularly composite materials, must be tested for performance in fire by a competent fire safety professional**



