

I CONSIGLIO NAZIONALE
DEGLI INGEGNERI



Con il patrocinio del:



GIORNATA NAZIONALE DELL'IMPIANTISTICA SPORTIVA

4 aprile 2024

Roma, Salone d'Onore del CONI
Piazza Lauro de Bosis, 15

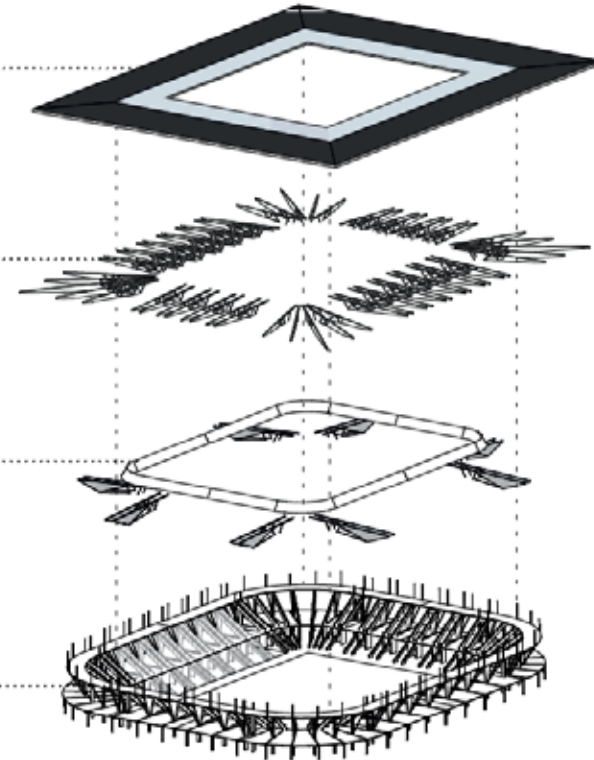


SISTEMI STRUTTURALI
PER I GRANDI STADI: IL CASO JUVENTUS

Prof. Ing. Massimo Majowiecki

Analisi del costo parametrica

STRUCTURE		STRUCTURE			
1		excavation/earthworks	2.14%		
2		foundation	6.39%		
3		structure	15.39%		
4		tiers	5.12%		
5		roof	13.80%	42.84%	
ARCHITECTURE + MEP					
12	glazing	0.56%			
13	paint	1.58%			
14	signage	0.38%			
15	lifts	0.32%			
16	pitch	0.98%			
17	seating	2.57%			
18	M&E	13.15%			
19	special M&E	2.33%			
20	access control	2.89%			
21	electronic scoreboards	1.13%			
22	equipment	2.57%			
23	furniture/fixings	0.84%			
24	various	3.54%	57.16%		
Total		100.00%	100.00%		

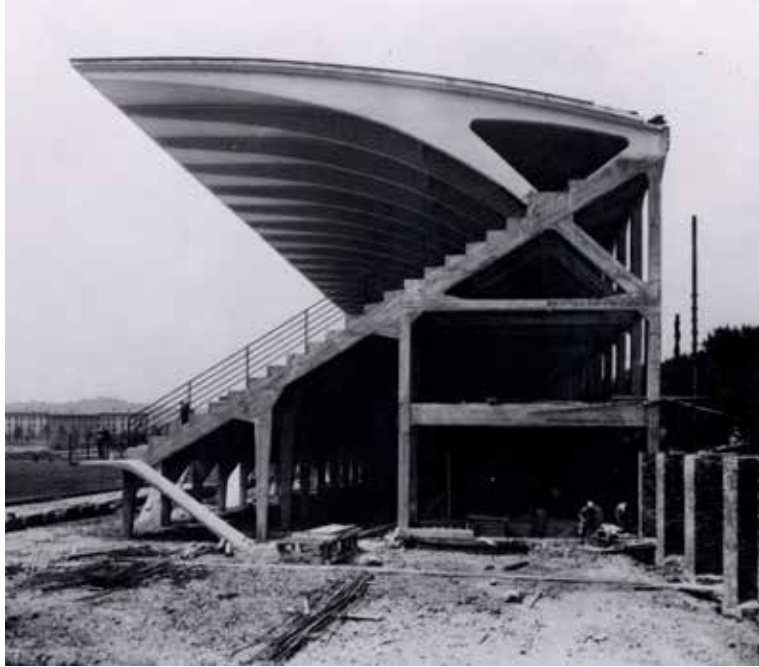


Otto coppie di travi principali a mensola collegate alla struttura delle tribune a cui è appesa la trave anulare interna.

Telai in cemento armato a cui si collegano le strutture di copertura e che sostengono i gradoni.



Pensilina di copertura tribuna VIP: progetto Nervi



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LO STADIO OLIMPICO DI ROMA

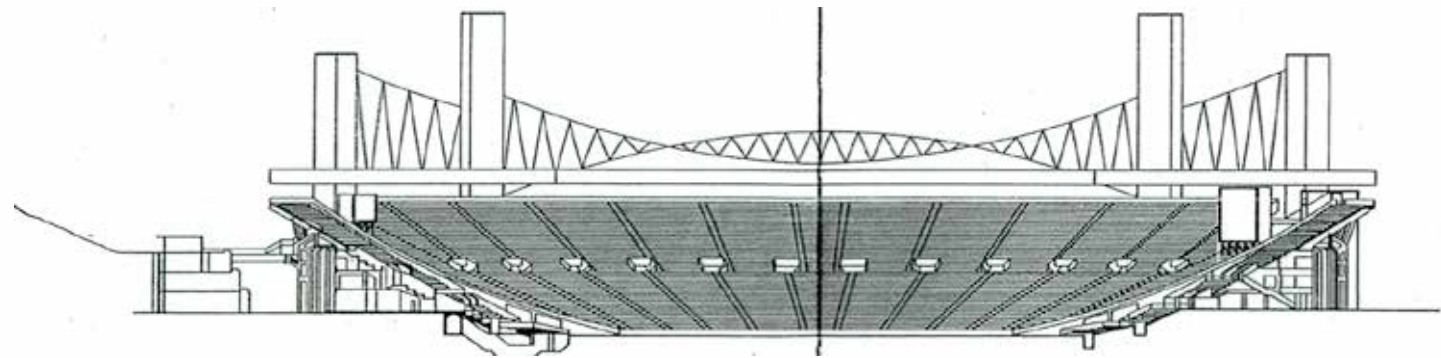
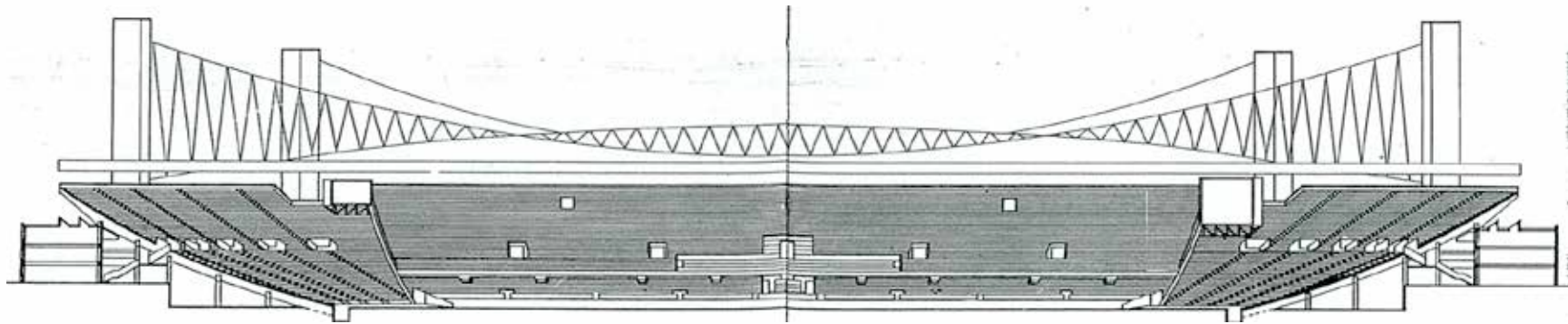
1953

ing. Roccatelli, ing. C. Valle, arch. A. Vitellozzi

1987

arch. M. Clerici, ing. P. Teresi, arch. A. Vitellozzi

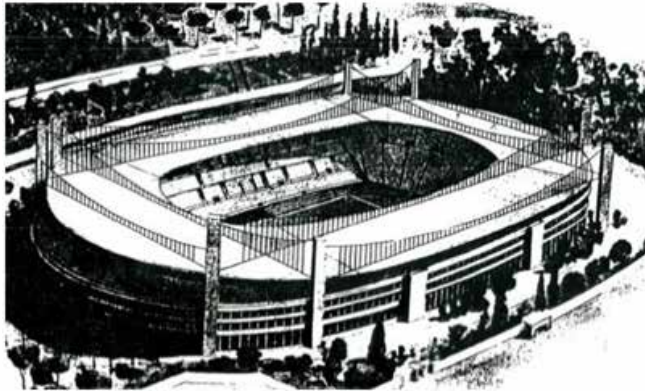




Roma – Stadio Olimpico

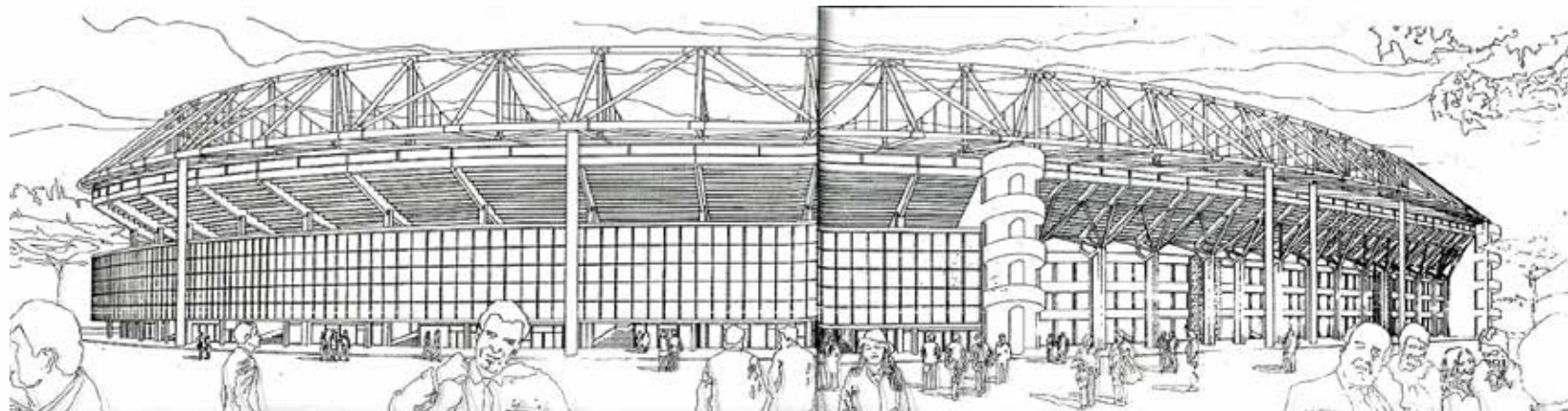
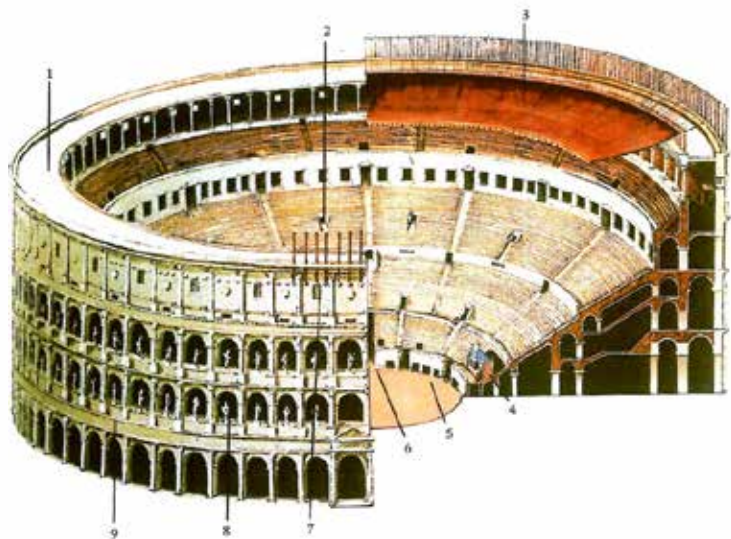
La copertura dello Stadio Olimpico a Roma è stata concepita, studiata e realizzata tra la fine del 1988 e l'Aprile del 1990, in 16 mesi di lavoro.

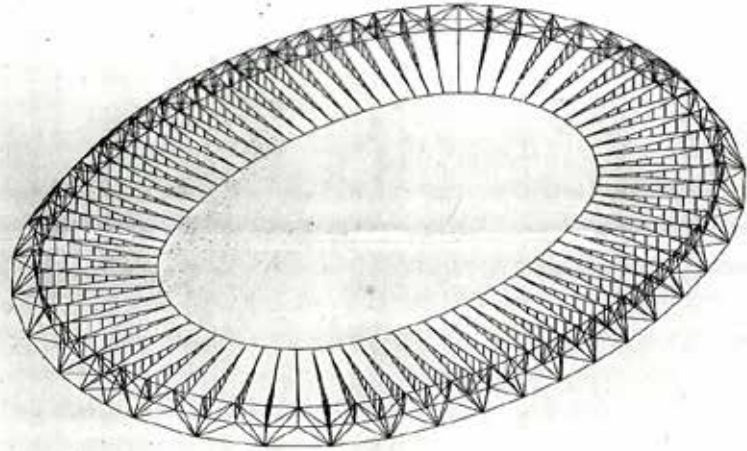
Questa copertura è il primo esempio di sistema strutturale Spoke Wheel, che oggi è largamente utilizzato in molti stadi in tutto il mondo.



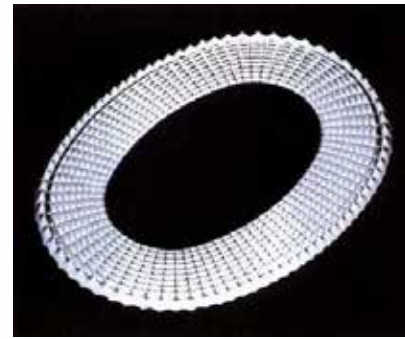
L'origine della copertura dello Stadio Olimpico di Roma è il risultato di una variante richiesta nel Gennaio 1988.





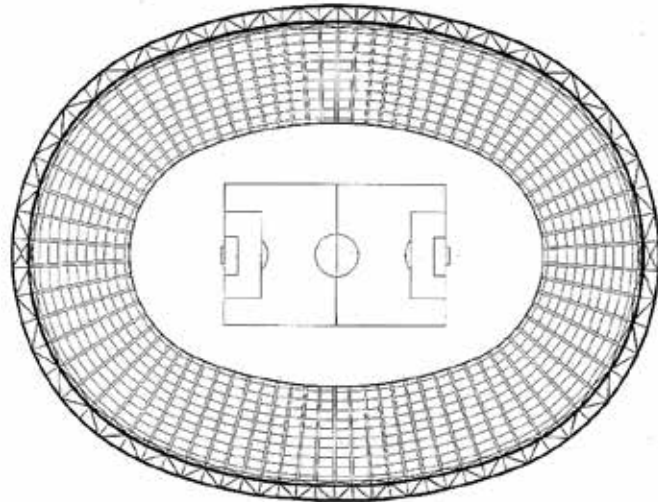
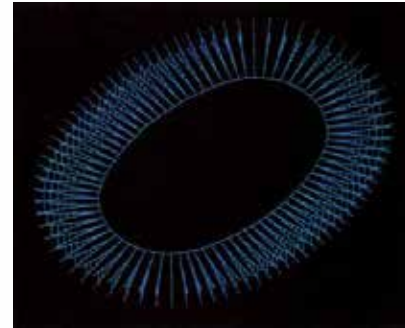


Membrane structures



*VISTA ASSONOMETRICA
DEL SISTEMA STRUTTURALE*

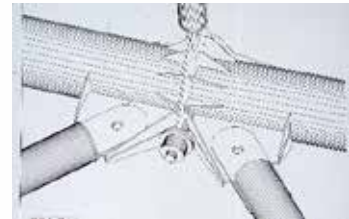
Radial cable structures



Compression ring



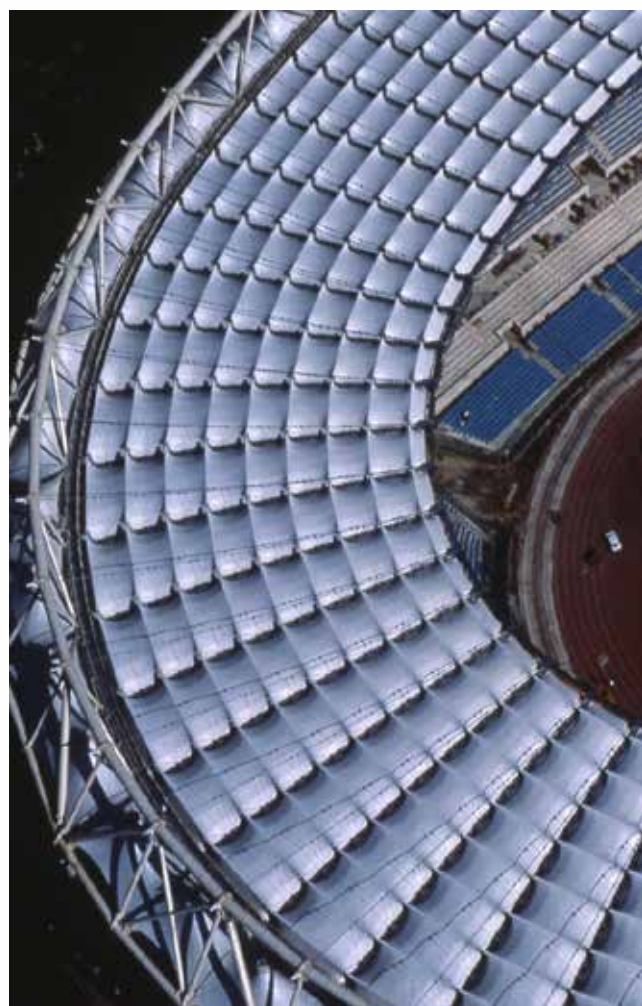
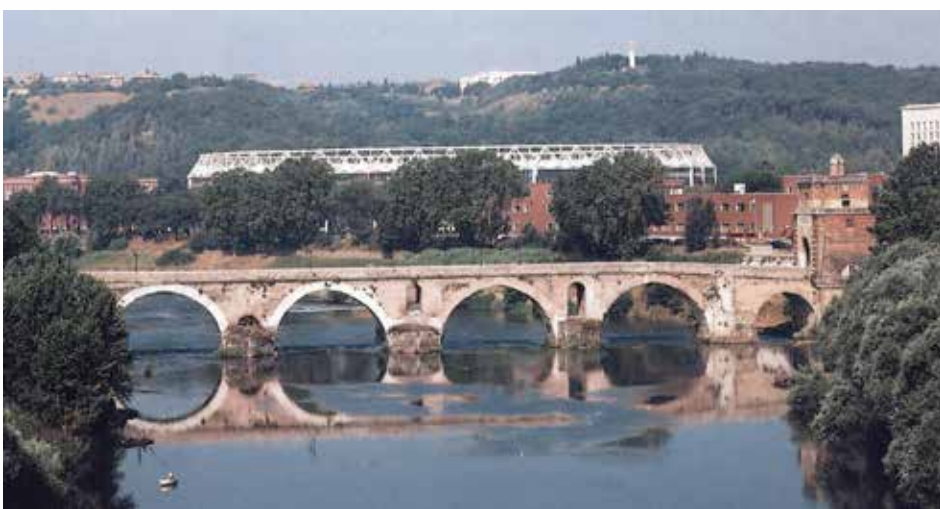






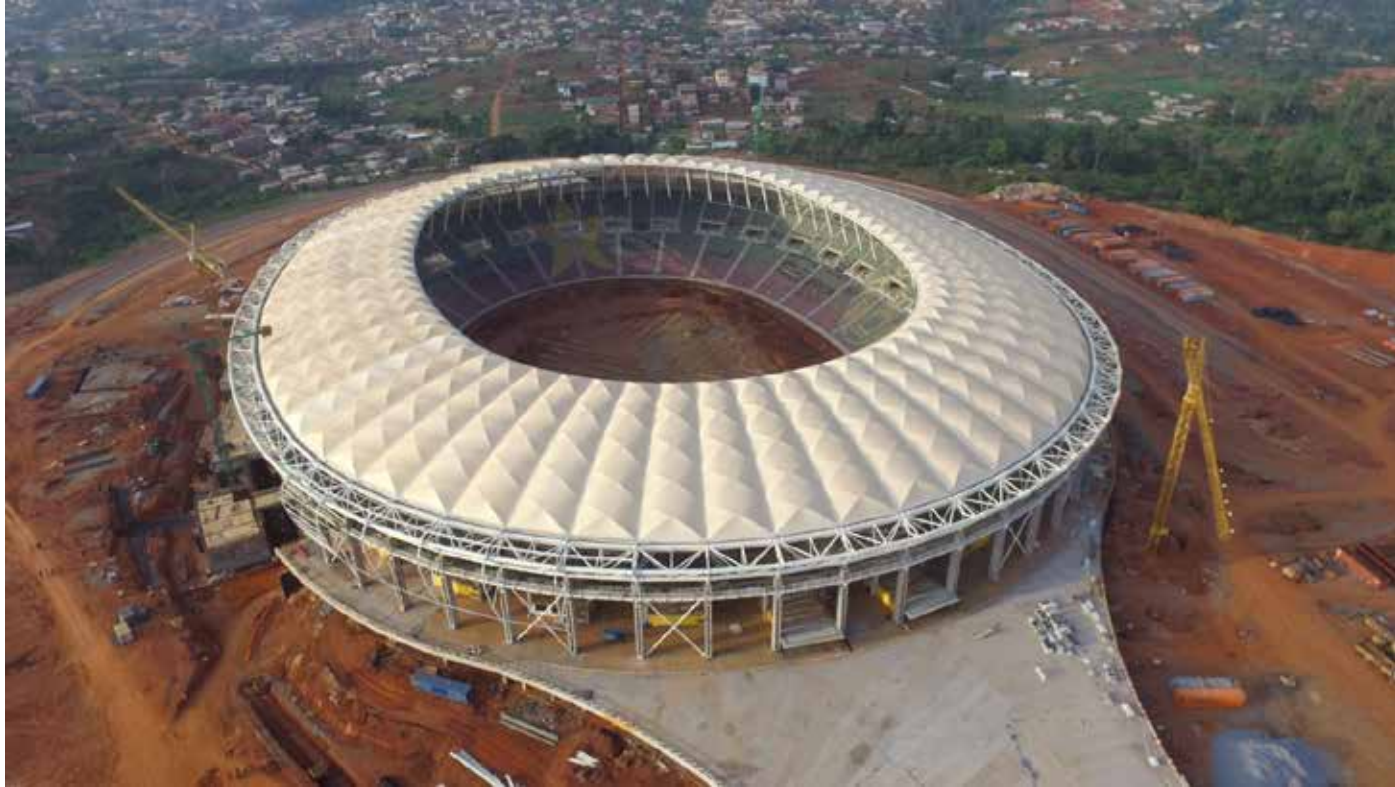






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Yaoundé – Paul Biya Stadium



BIG LIFT 04-Oct-2018





14dec2017

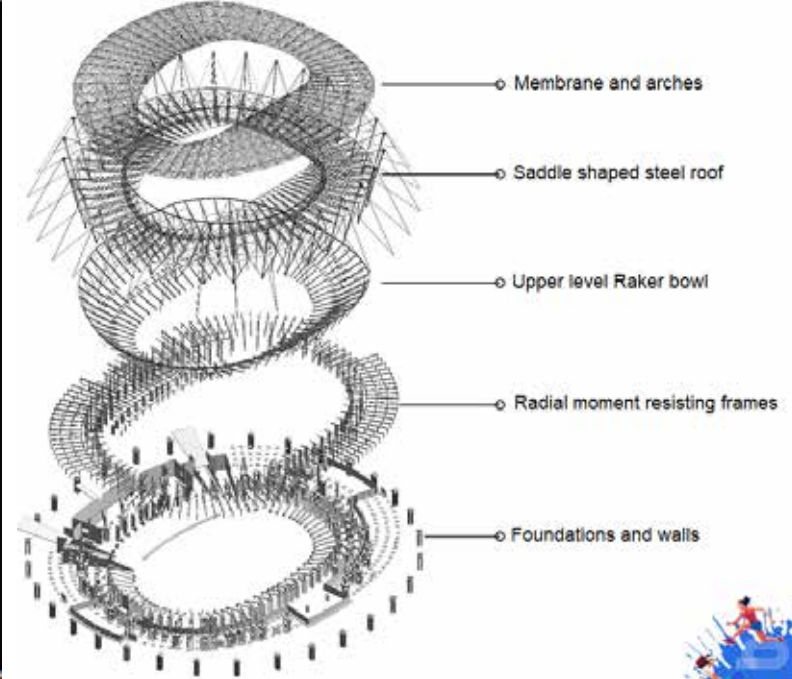
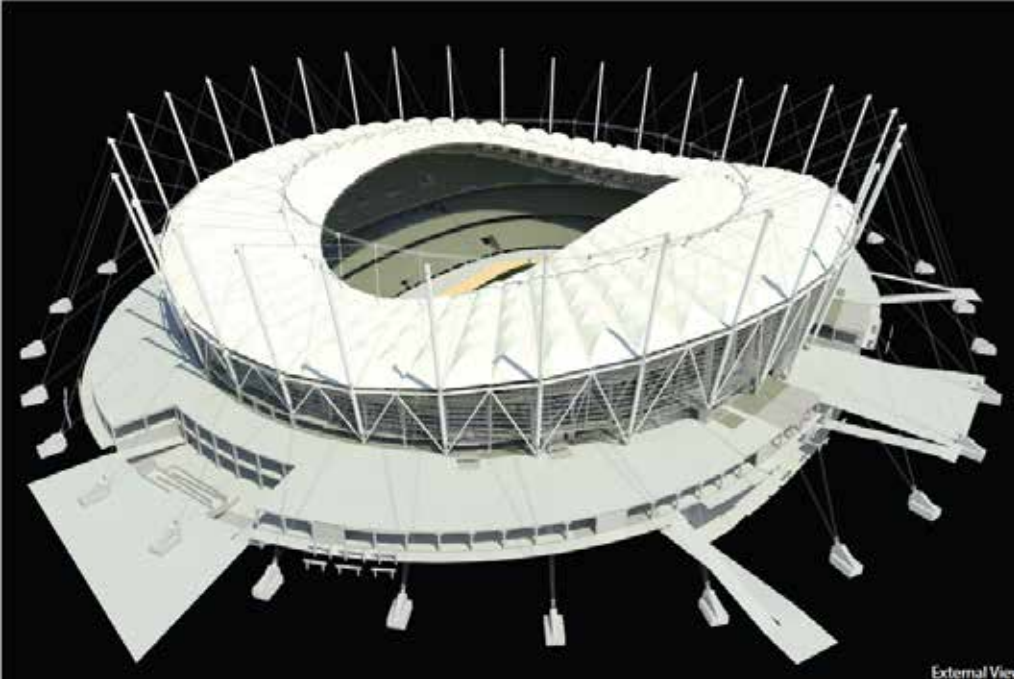


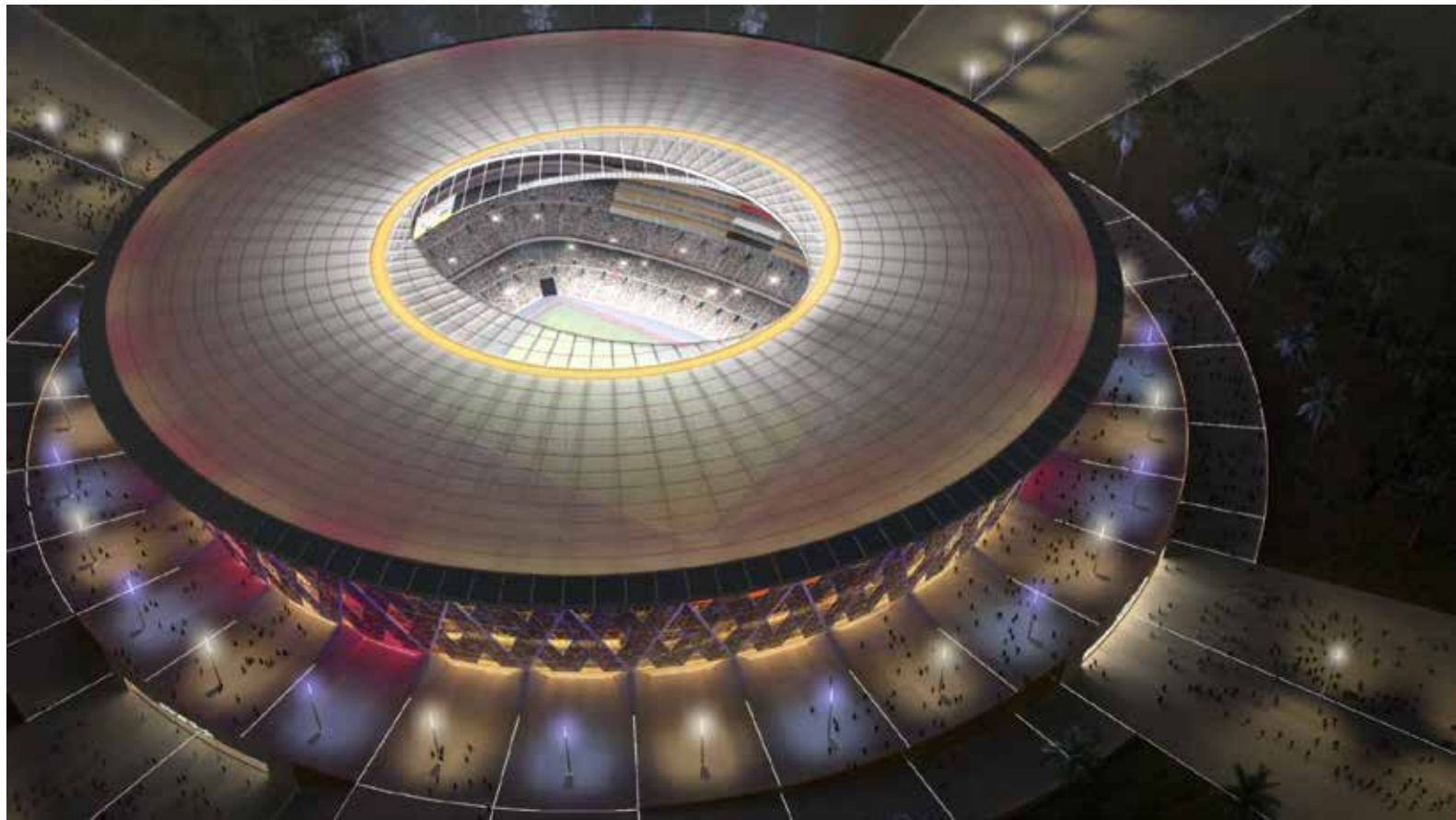
14dec2018



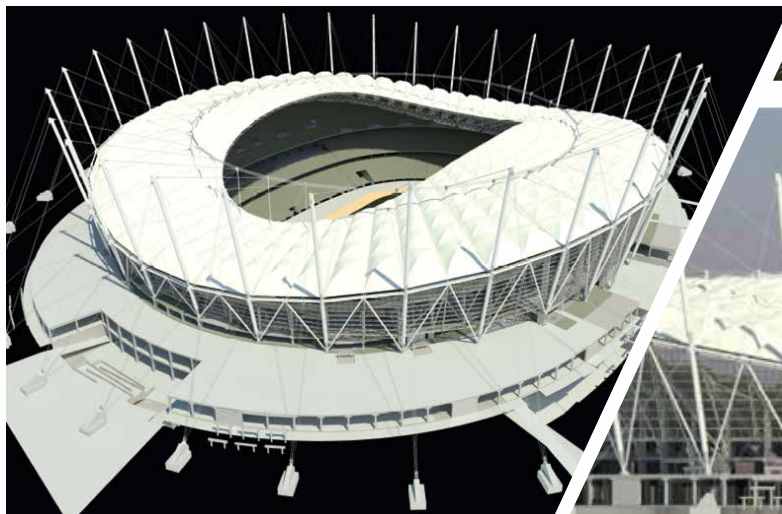
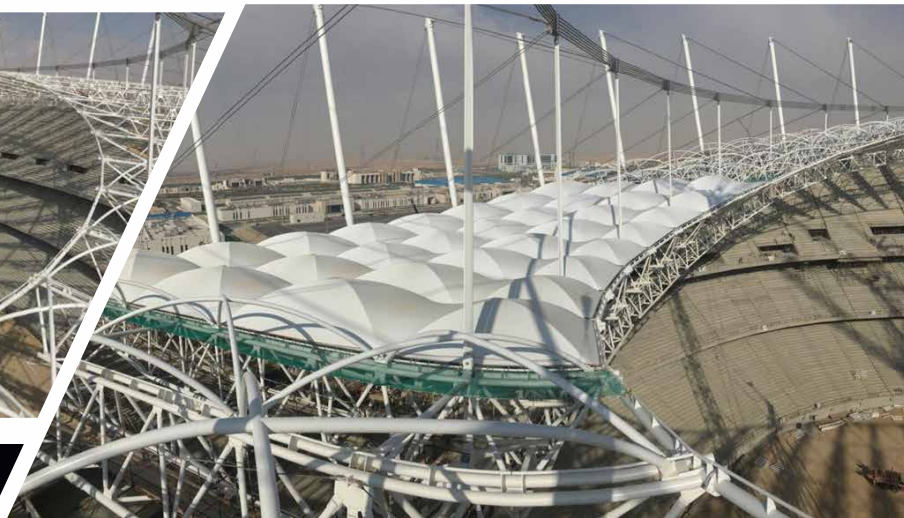


Il Cairo – Olympic Army Stadium 2024



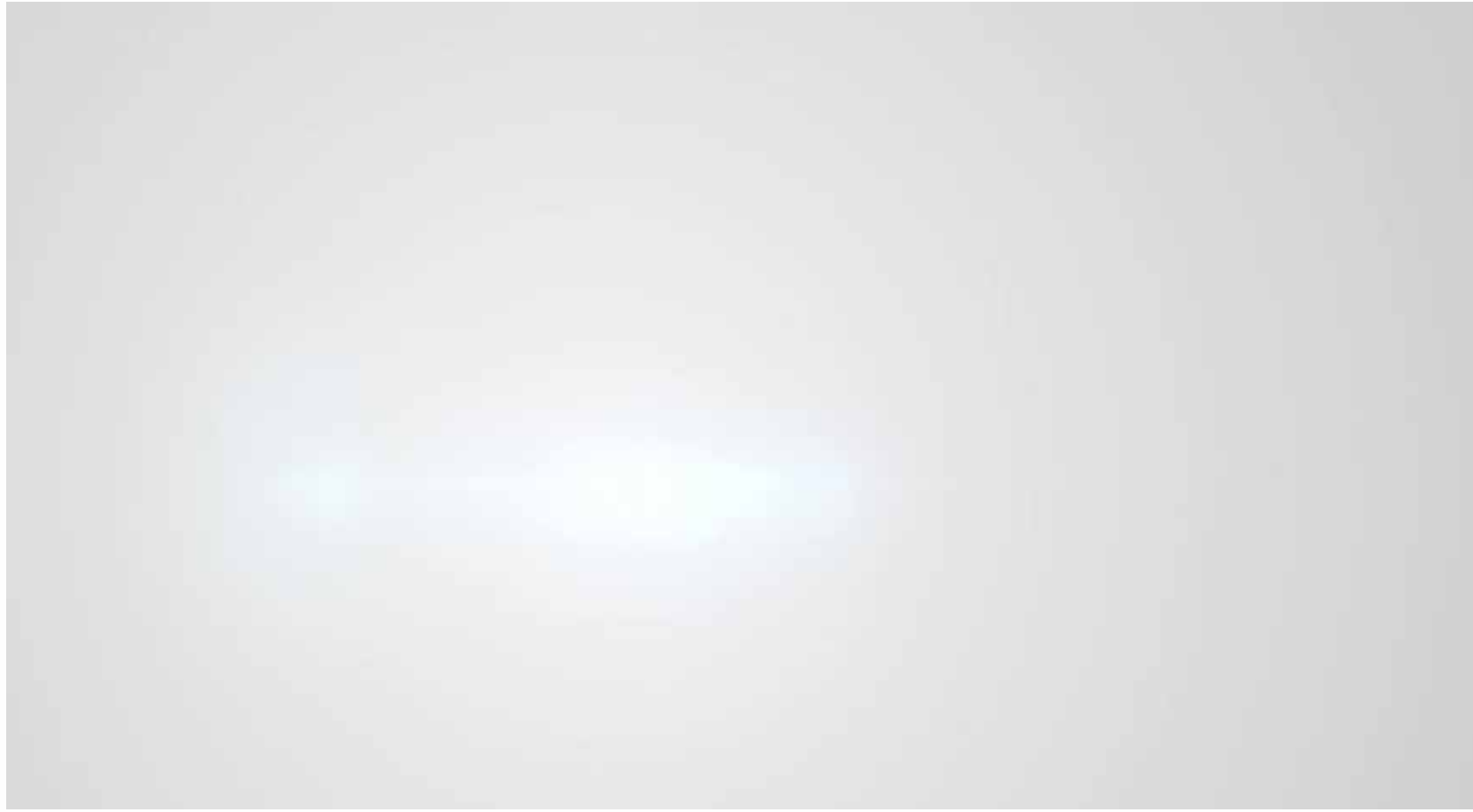




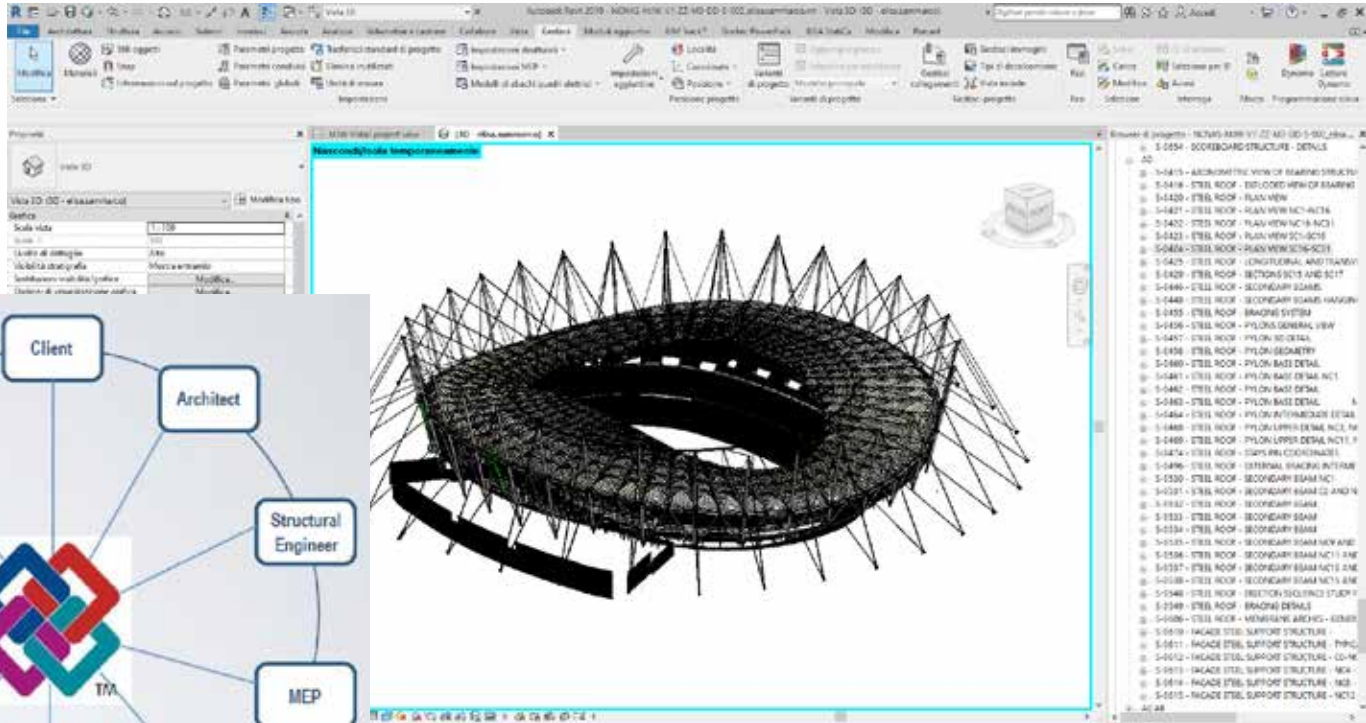








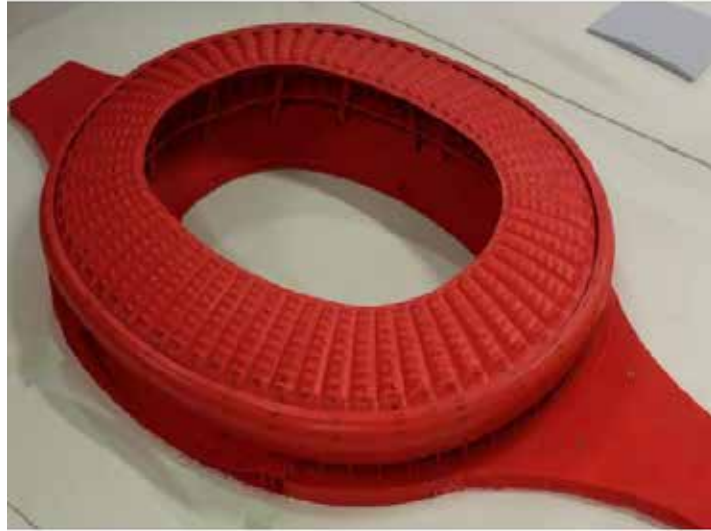
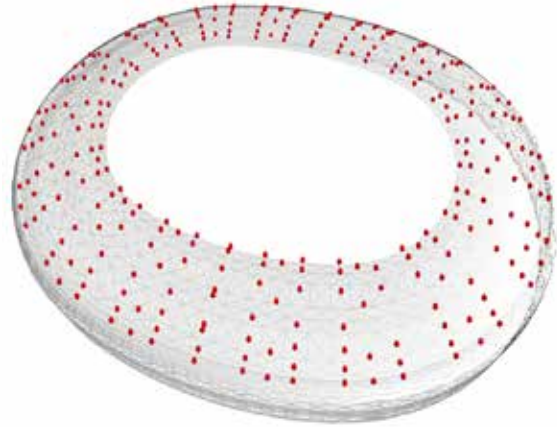
BIM Model



AUTODESK
BIM 360



Test in galleria del vento



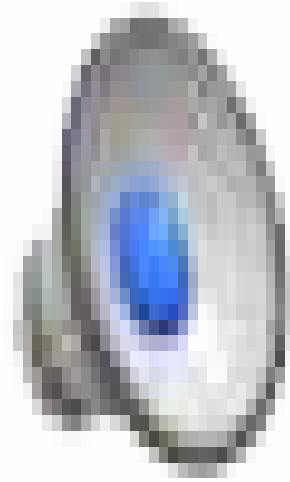
Il general contractor ha commissionato le prove sperimentali in galleria del vento a RWDI. In via preliminare sono stati svolti degli studi su un modello rigido in scala 1:300 presso la galleria del vento di RWSI a Milton Keynes.

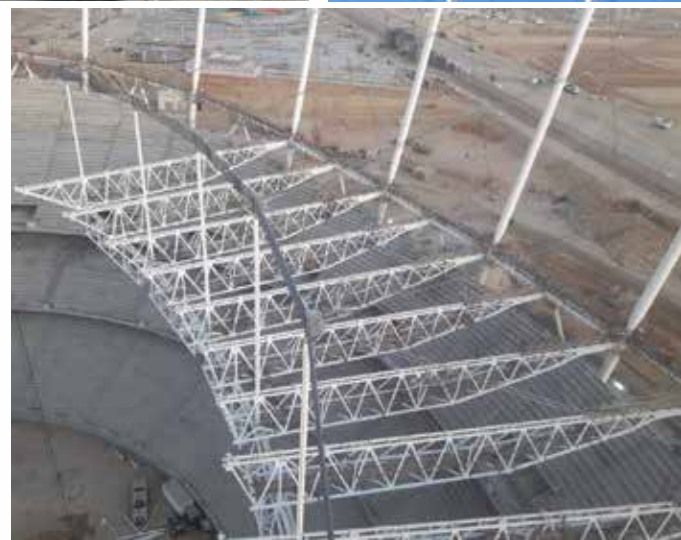
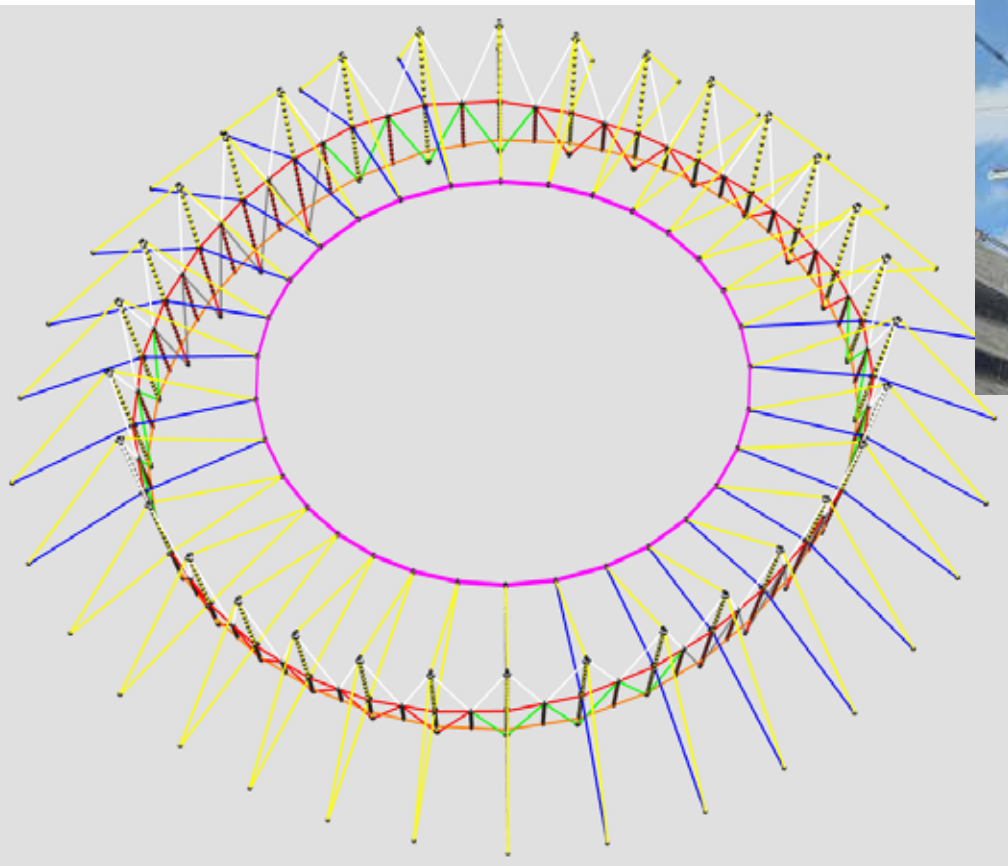
Sono stati considerati un totale di 36 angoli di attacco e una pressione misurata a frequenze di 512Hz per 36 secondi.

La velocità di riferimento misurata a 0.4m dal pavimento della galleria del vento era approssimativamente di 12 m/s per tutti gli angoli di attacco considerati.



Test in galleria del vento







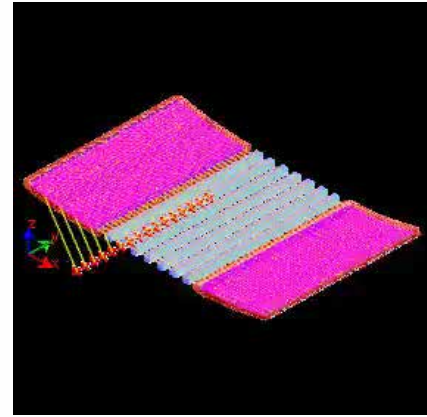
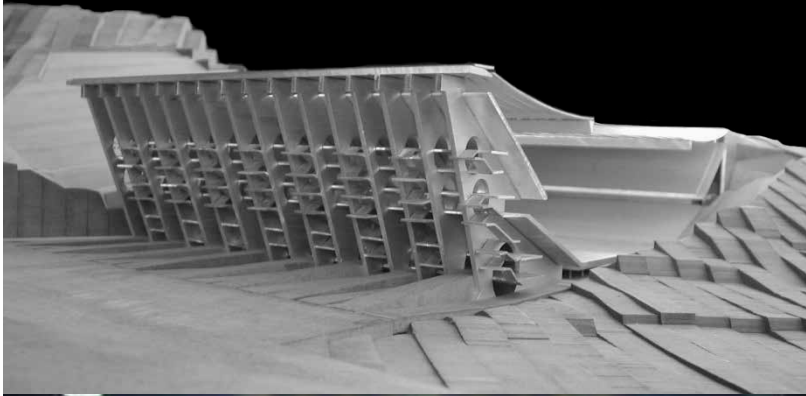


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Braga – Stadio







Giappone – Stadio di Ohita



Giappone – Stadio di Ohita

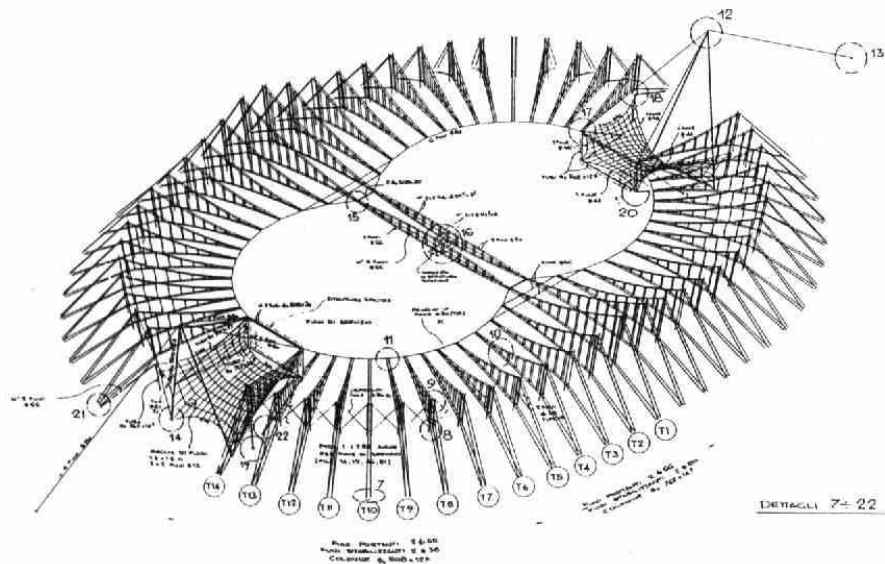
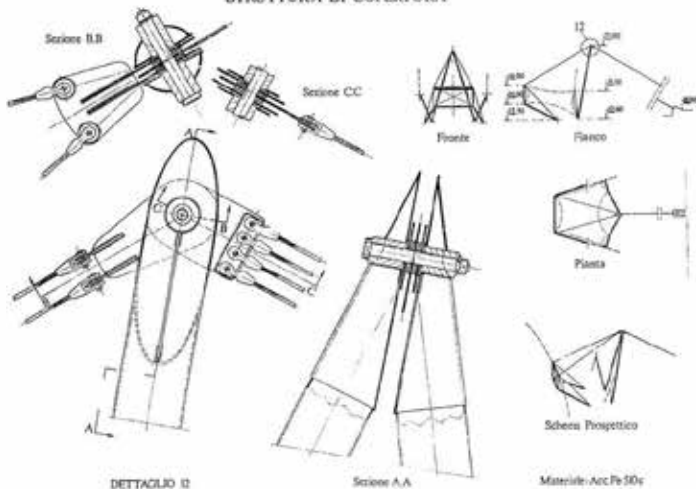


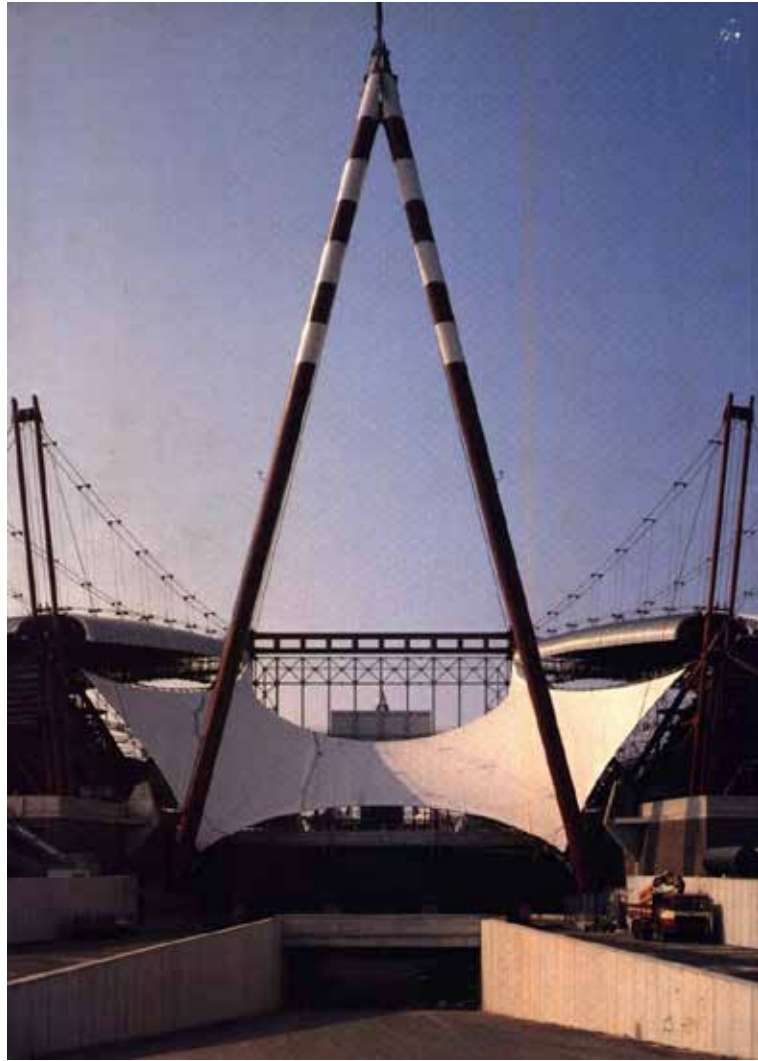
Torino – Stadio delle Alpi





STRUTTURA DI COPERTURA





GIORNATA NAZIONALE DELL'IMPIANTISTICA SPORTIVA
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Development cost per seat of recently built football stadiums

Name	City	Stadium capacity (# seats)	Development cost (EUR/m)	Opening year	Development cost per seat (EUR)
Wembley Stadium	London	90,000	912	2007	10,137
Emirates Stadium	London	60,335	440	2006	7,292
Grand Stade Lille Métropole	Lille	50,157	324	2012	6,460
Melbourne Rectangular Stadium	Melbourne	30,050	186	2010	6,179
Arena Lviv	Lviv	34,915	211	2011	6,043
Friends Arena	Stockholm	50,000	300	2012	6,000
Donbass Arena	Donetsk	51,504	294	2009	5,706
Allianz Arena	Munich	69,901	340	2005	4,864
Astana Arena	Astana	30,000	136	2009	4,524
Nelson Mandela Bay Stadium	Port Elizabeth	48,459	214	2010	4,416
PGE Arena Gdańsk	Gdańsk	43,016	185	2011	4,260
National Stadium	Bucharest	55,600	234	2011	4,209
MMArena	Le Mans	25,000	102	2011	4,080
Stade Océane	Le Havre	25,178	101	2012	4,011
Arena do Grêmio	Porto Alegre	60,540	239	2012	3,955

Name	City	(# seats)	cost (EUR/m)	Opening year	(EUR)
Juventus Stadium	Turin	41,000	125	2011	3,049

Turk Telekom Arena	Istanbul	52,650	160	2011	3,039
Stožice Stadium	Ljubljana	16,038	43	2010	2,681
AFAS Stadion	Alkmaar	17,023	38	2006	2,232
Hypo Arena	Klagenfurt	31,957	67	2007	2,097
Grand Stade de Tanger	Tanger	45,000	80	2011	1,778
Estadi Cornellà El Prat	Barcelona	40,500	62	2009	1,531
New Tivoli	Aachen	32,900	50	2009	1,520
Impuls Arena	Augsburg	49,000	65	2009	1,327
Coface Arena	Mainz	33,500	44	2011	1,313

Development cost per seat is ...

■ ... higher than EUR 6,000

■ ... between EUR 3,000 and EUR 6,000

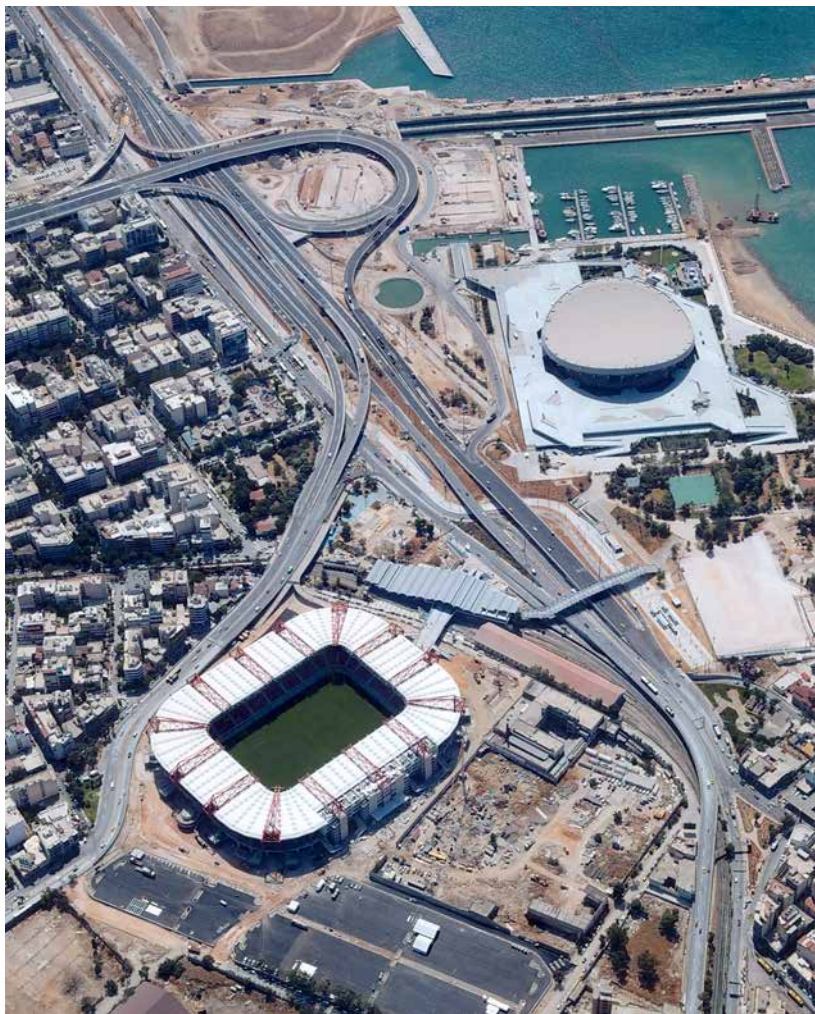
Source: KPMG research

■ ... lower than EUR 3,000

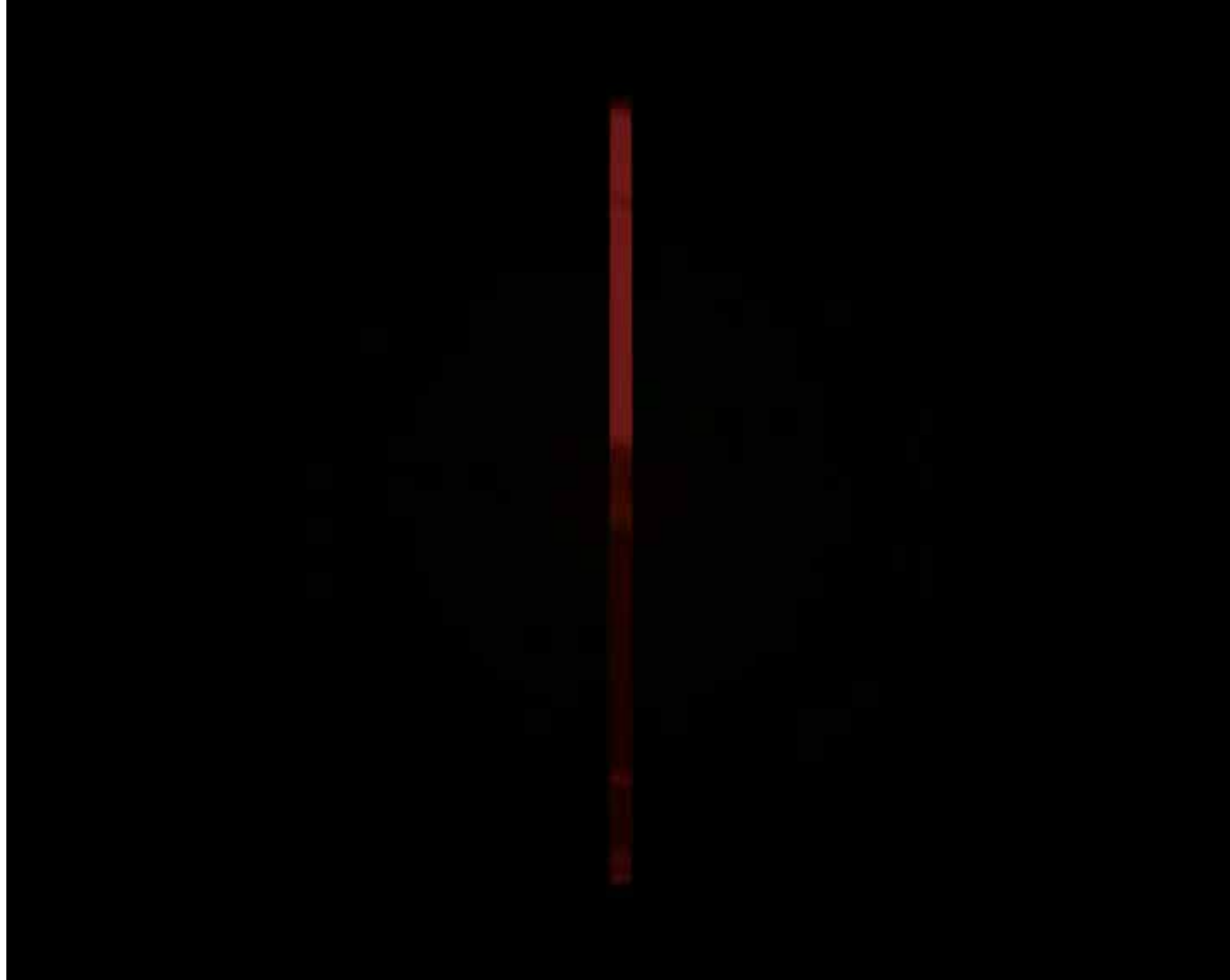


Atene – Olympiako Stadium





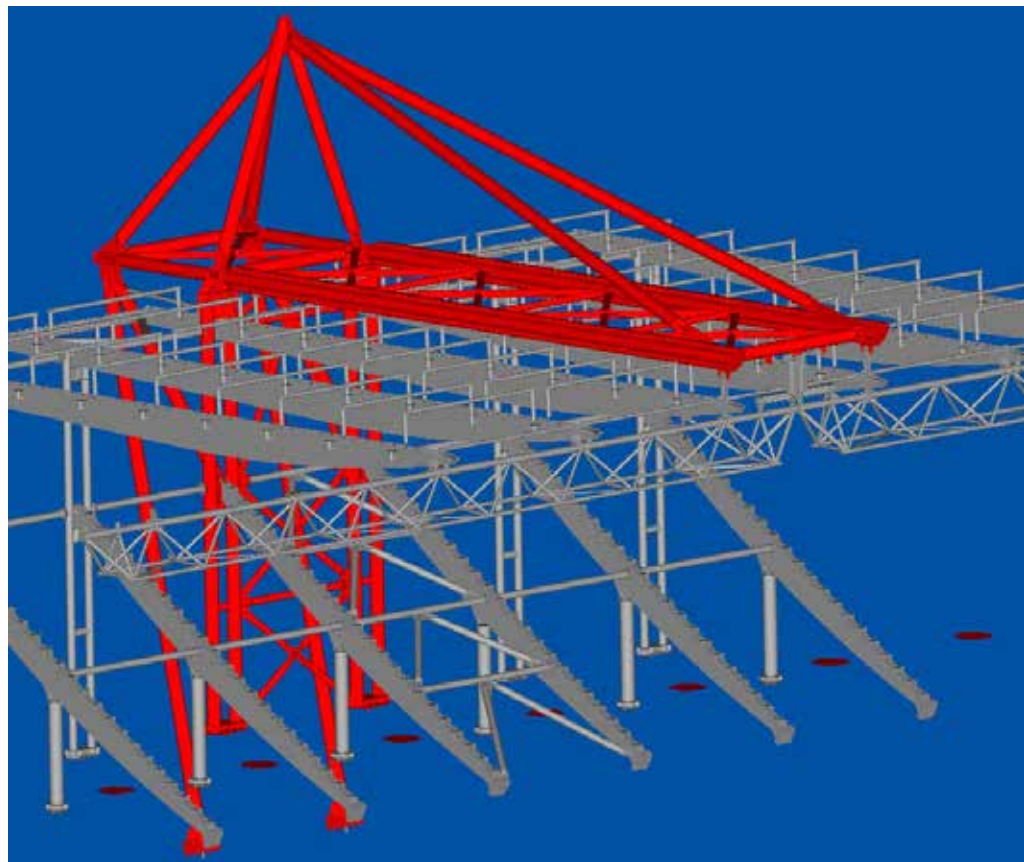
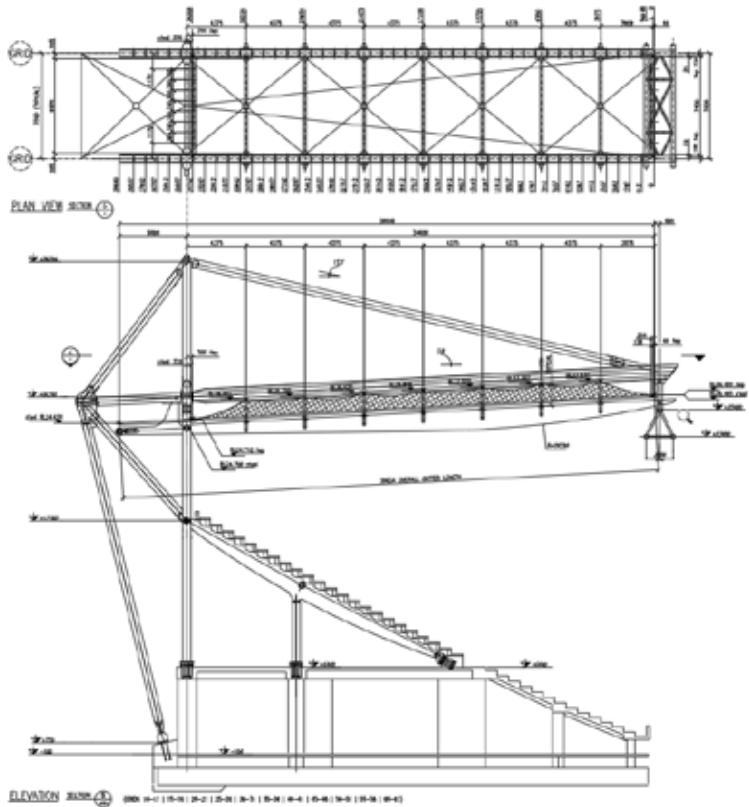


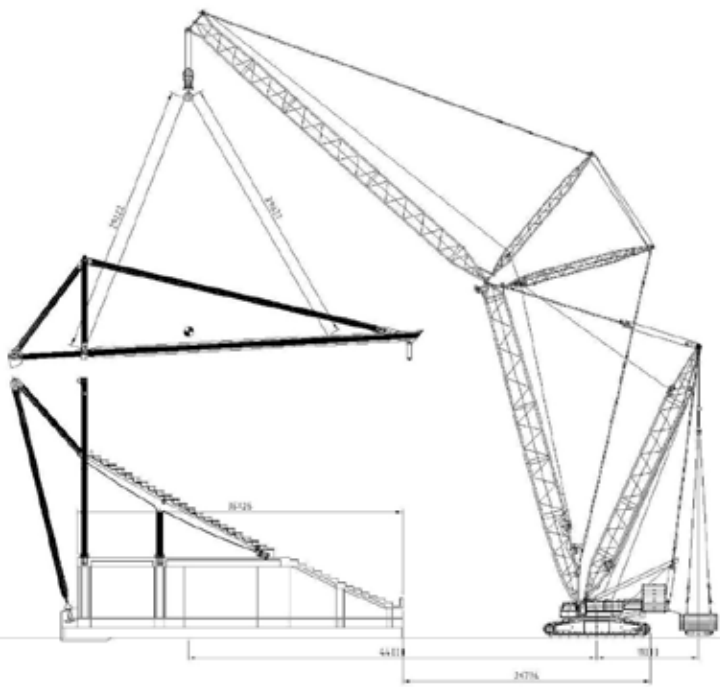


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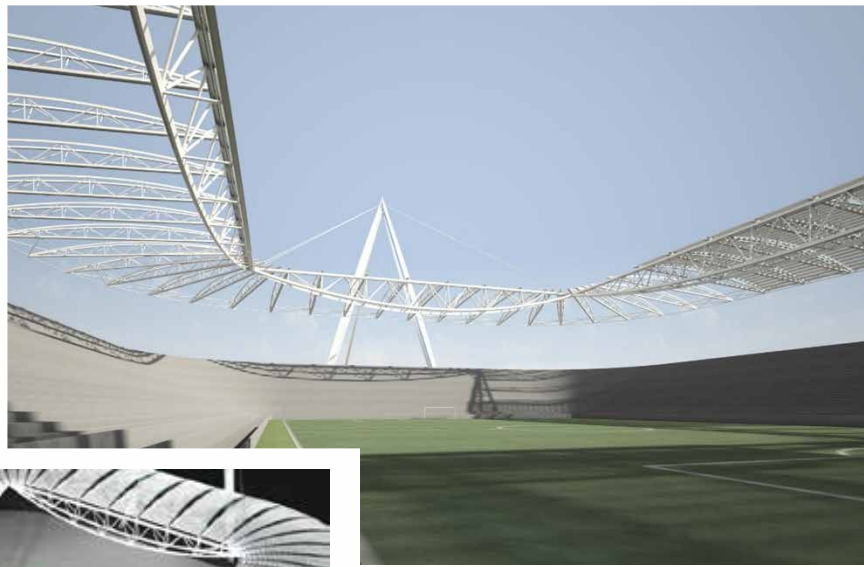
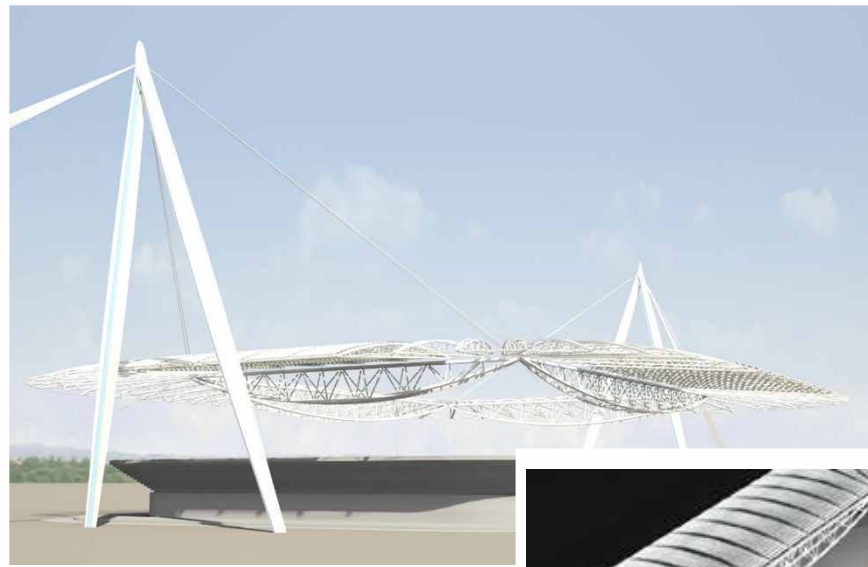


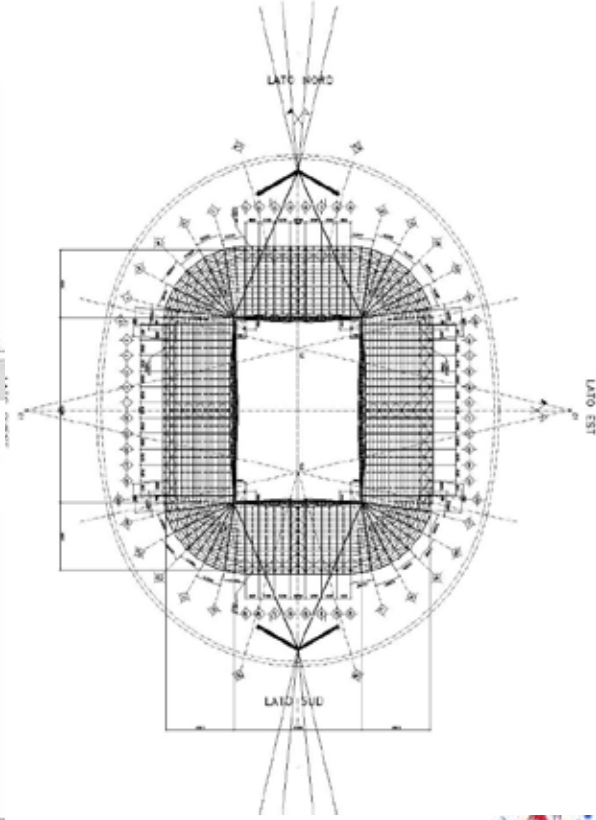
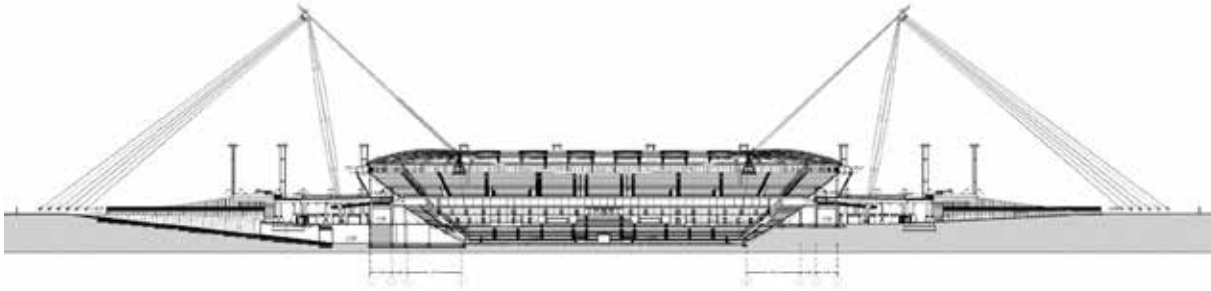
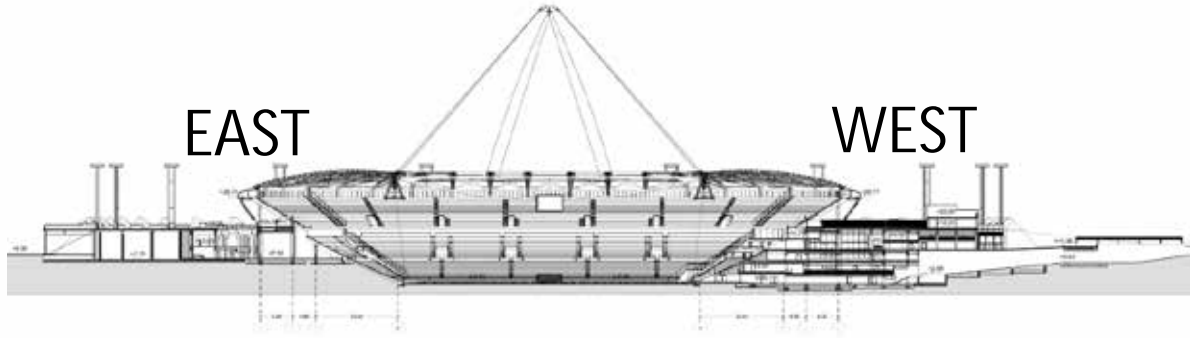
Torino – Juventus Stadium

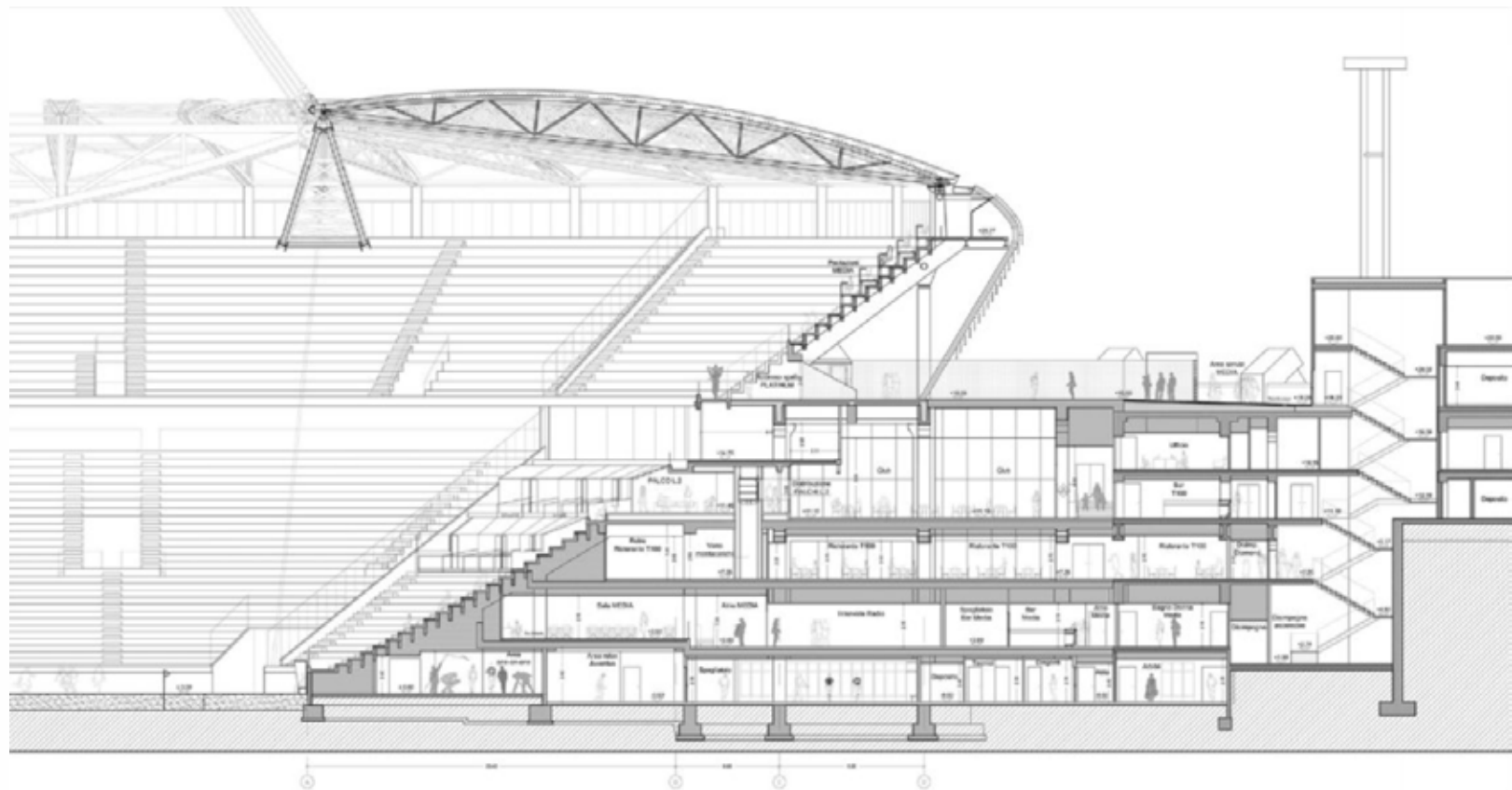


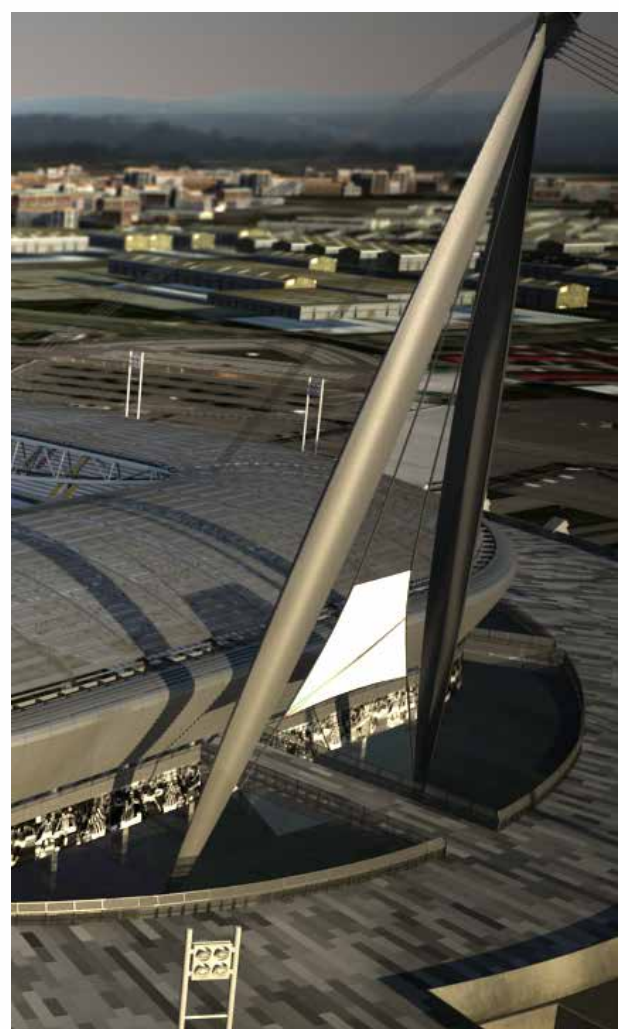
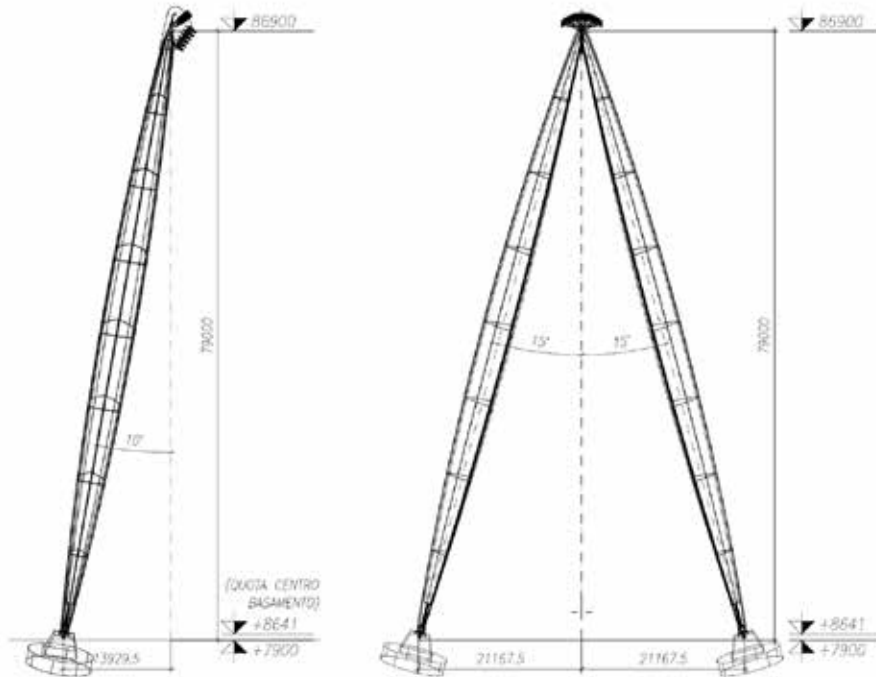
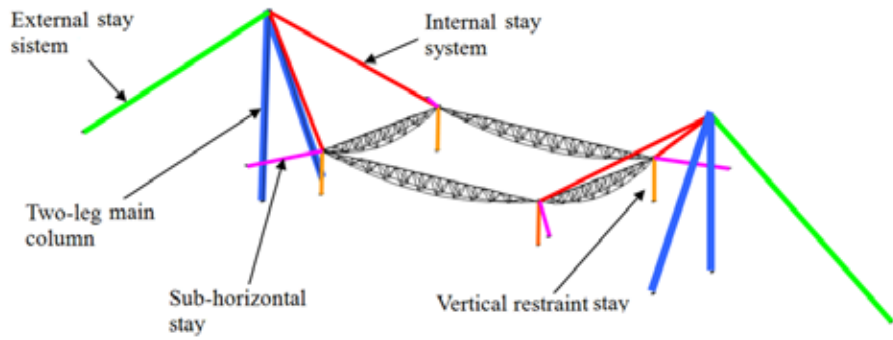


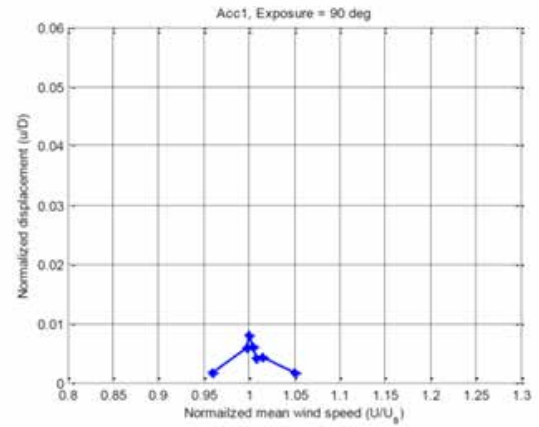
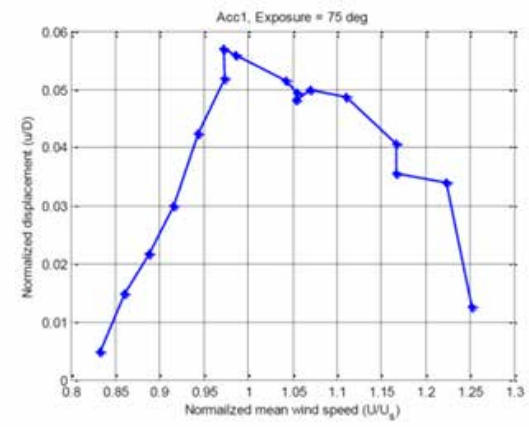
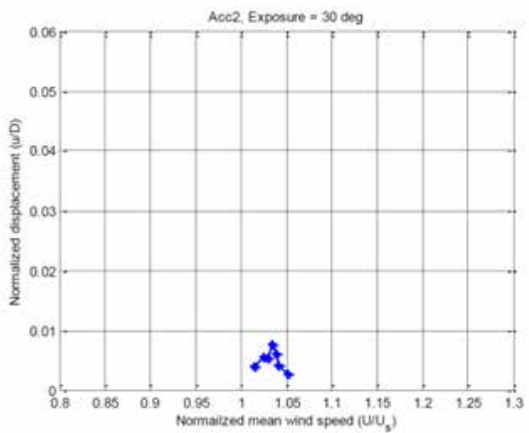
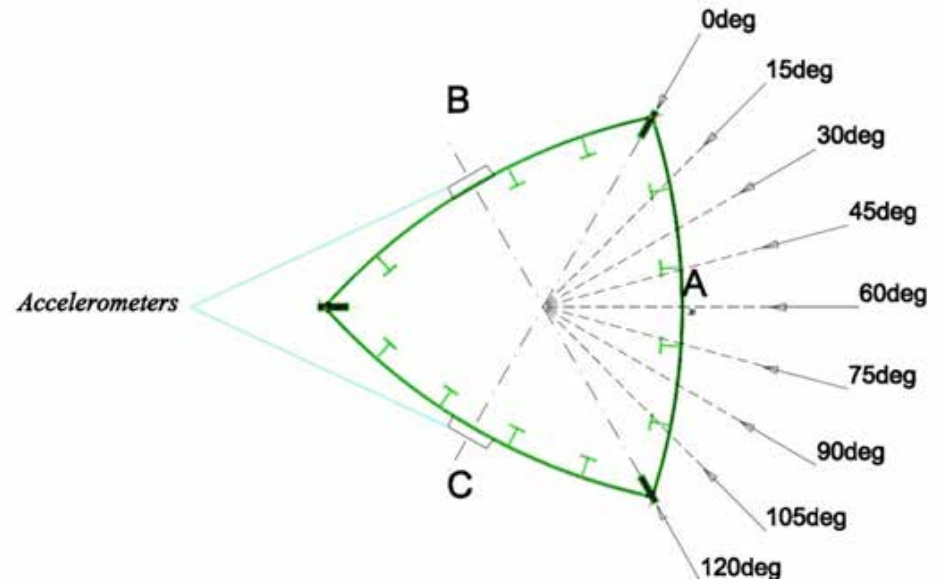


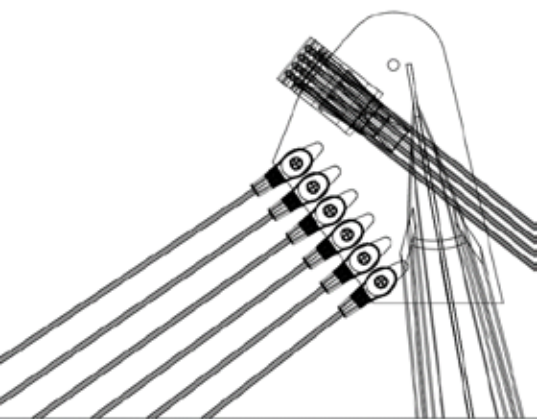




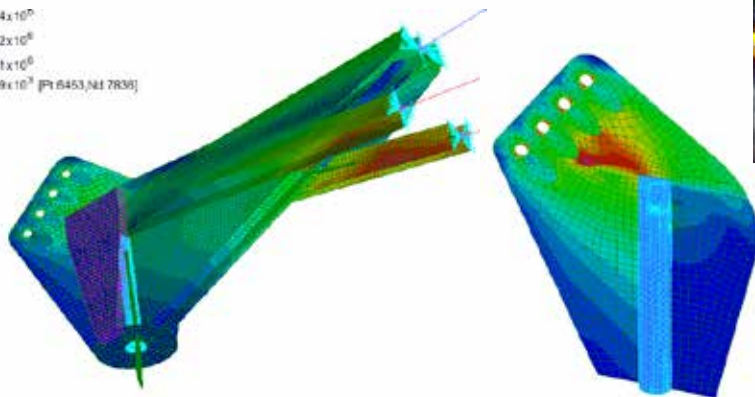
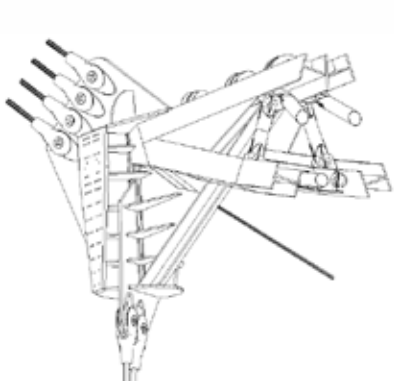
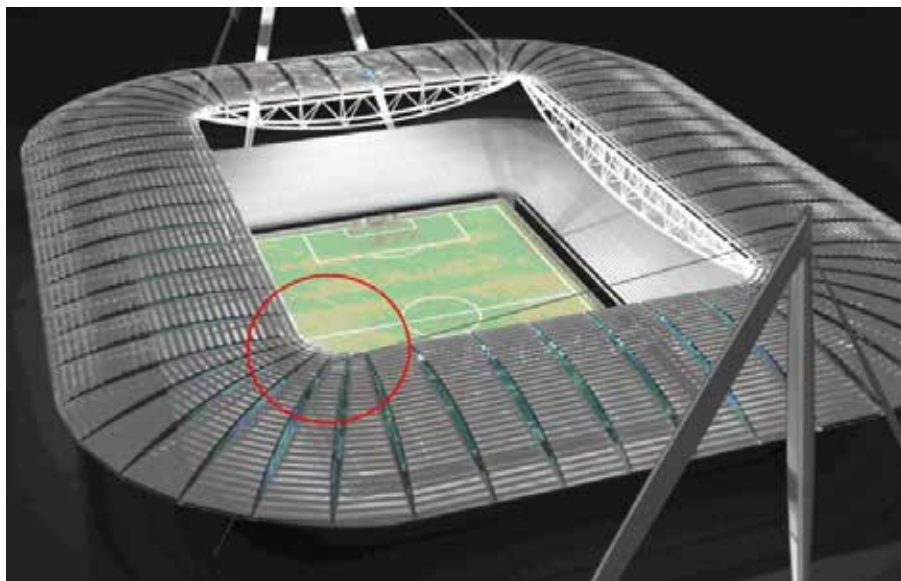






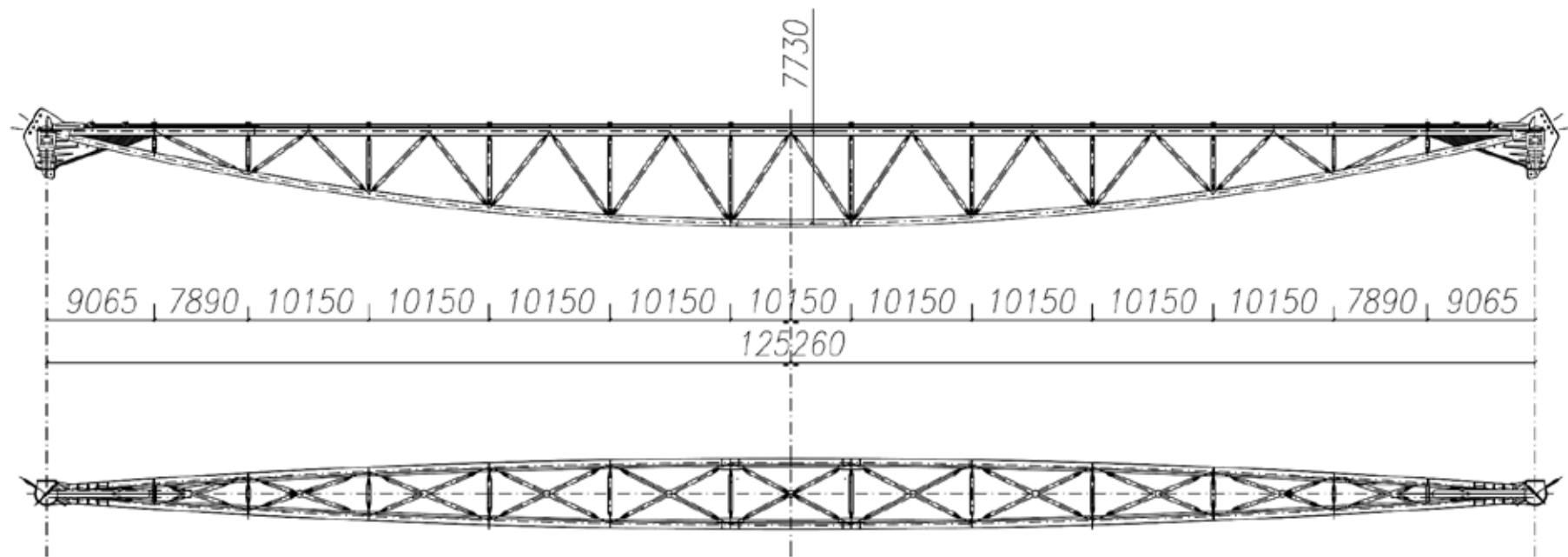




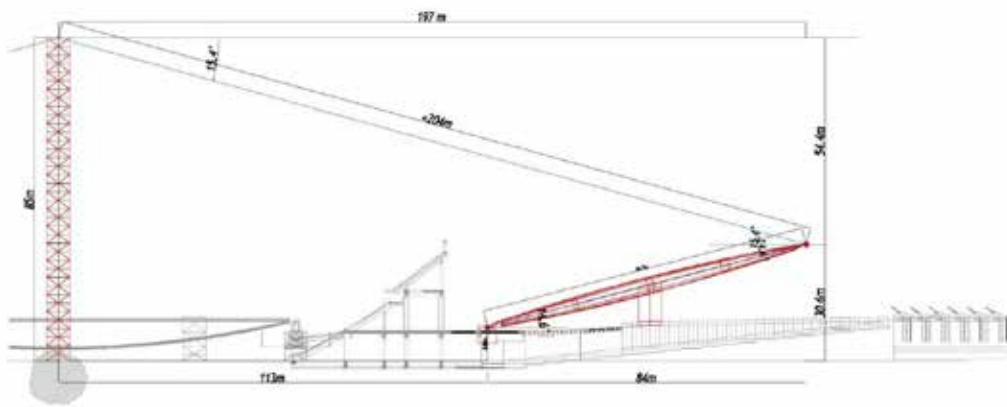


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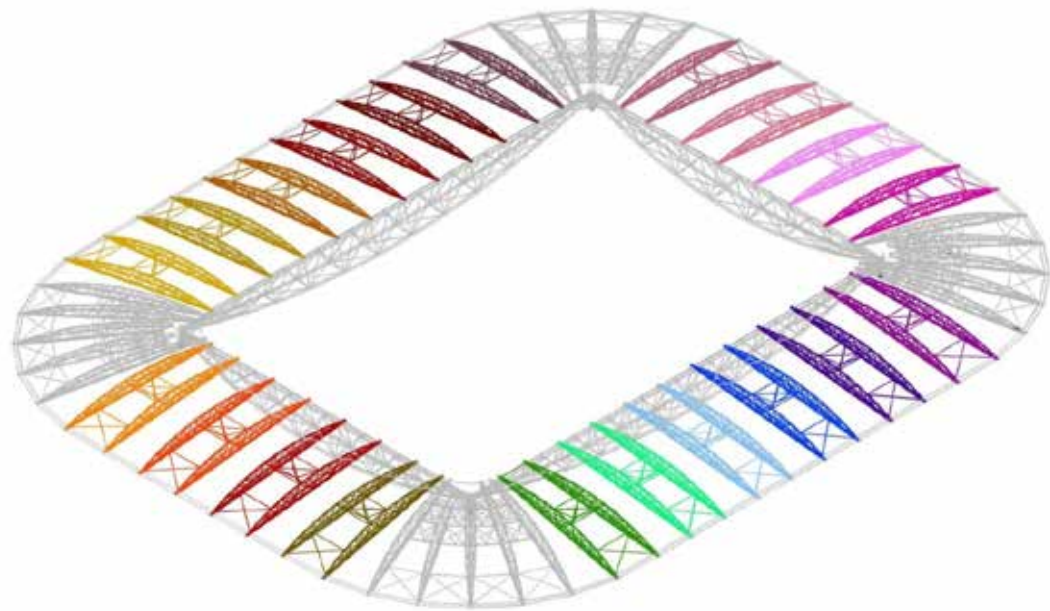
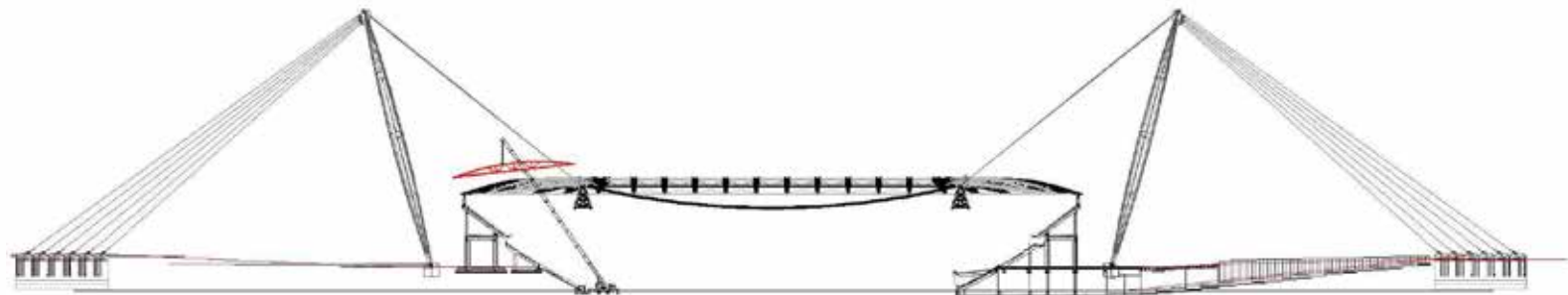
Strain jack

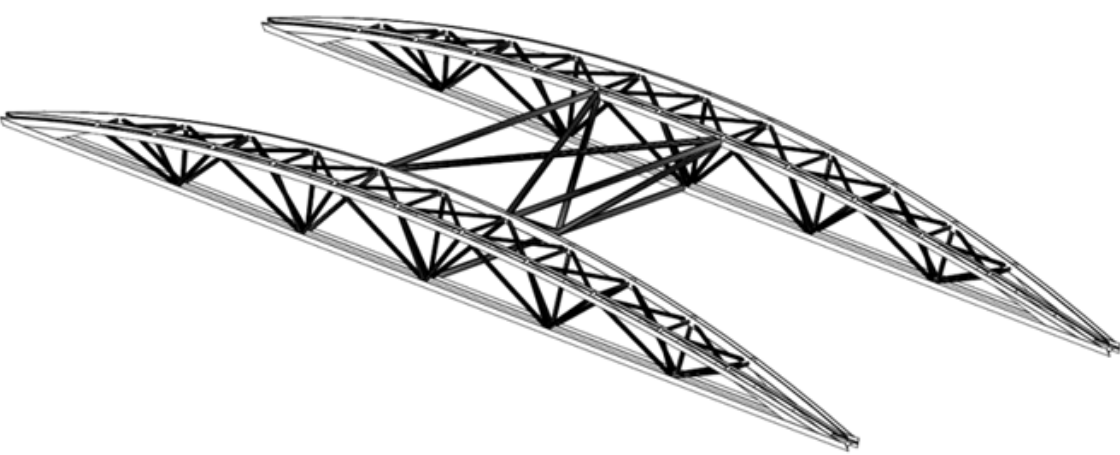
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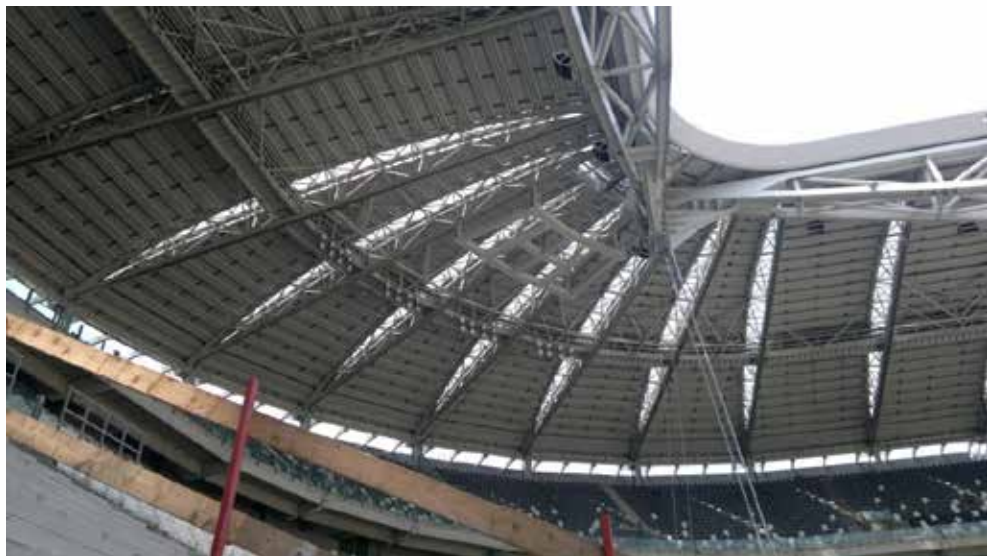
















GRAZIE A TUTTI



