OVERVIEW

Architects: Zaha Hadid Architects
Location: Rome, Flaminio, Italy
Architect: Zaha Hadid with Patrik Schumacher
Project Architect: Gianluca Racana
Client: Ministero Beni e Attività Culturali – Fondazione MAXXI
Lights And Illumination: Equation Lighting
Won Competition: 1999

Area: 27000.0 sqm
Project Year: 2009 (start 2003)
Building Type: low rise building
Architectural Style: deconstructivism
Building Usage: museum
Site Usage: exhibition and library
Height: 35.43 ft
Floors: 1 underground 3 above
Awards: Stirling Prize in 2010
PATRICK @ TAMU
The MAXXI National Museum is dedicated to 21st century Art and Architecture

The project was put forward by the Italian Ministry of Cultural Heritage in 1998

Out of the 273 total submissions from around the world, Zaha Hadid’s design was selected as the competition winner

The concept of an urban campus became the driving force behind the museum’s design, with particular emphasis on how the building begins to share in the public realm of the surrounding city

The design balanced the nature of a “static” city like Rome with the creation of a 21st century cultural landmark for the ‘Eternal City’
The project took over a decade to complete, with a total budget of approximately 150 million euros.

The nation of Italy saw 6 changes of national government during the duration of the museum’s construction.

Despite many setbacks, the MAXXI National Museum was inaugurated on May 28th, 2010.

The finished project was met with high praise both from architectural critics as well as local residents.

The museum would go on to earn Hadid the Stirling Prize for overall excellence in 2011.
The design process began by superimposing the two intersecting urban grids onto the site, creating a linear framework for the building organization.

- Parallel lines were drawn within the grids that curve and converge in and out of each other.
  - These lines are then used as the basis for wall placement, beams, stairs, ramps, and vertical ceiling ribs.
  - The 51° angle/curve created by the grids is used to vary the wall alignment.

- These lines are then separated into three levels and used to create interior and exterior space.
- The spatial premise focuses on “not a box, but a stream”
- Three levels of sinuous form allow patrons to flow throughout various galleries, allowing a single narrative to be expressed on a single wall and tangential narratives to flow into adjacent galleries
- Offset and highlighted staircases influence this flow.
- From the double height lobby, one may enter into the gift shop, Suite I, cafe, and auditorium.
- The branching stairways and corridors which bud from the central space elicits the feeling of discovery.
- Suite I's double-height space is used as a distribution point for all other suites
- Each second floor suite (II, III, IV) has unique spatial qualities that provide a wide variety of design and sensual opportunities for exhibits
- The third floor contains Suite V, which is accessed through ramps/stairs in the atrium and culminates in a large wall of glass and cantilevers over the entrance to the museum.
SOIL

- The topsoil and subsoil condition is a Cambisol, generally a discolored brown shade.
- The cambisol soil type is loam.
- Loam soil is made up of silt, sand, clay, and gravel.
- Loam is ideal for foundation construction because it has an evenly balanced composition and maintains water at a balanced rate.
- Soil on site is part of Imperfectly Drainage Class, meaning water moves through soil slower than it receives it.
- Soil has a pH level of 8.0 so it is carbonate rich.
- Site was excavated about 7 meters, and used bulkheads where the existing building was by driving piles down 16 meters with tie-rods to anchor them in place.
- Foundation piles, 800 mm and 1000 mm in diameter, drilled 40 meters.
- Piles sit on strip footings, which are typically double the width of the load bearing wall of columns they are supporting.
- Bearing Capacity of Loam (sand, silt, and clay) is approximately 3000 lbs/sq ft (32291.73 lbs/sq m)
- Strip footings are a good choice for these soil conditions because they reduce the loading per sq. m. by increasing the area the load is spread over.
- Estimated settlement from $\frac{1}{2}\text{"} - \frac{3}{4}\text{"}$
SEISMIC DESIGN

- Sees wind loads and seismic loads
- Five different sections separated by expansion joints to limit the effect of thermal variation
- In 2002 a 5.9 magnitude earthquake with a depth of 10 km struck the Italian region of Molise and Apulia.
- Resulted in the first serious anti-seismic design legislation in Italy in 2003 called OPCM 3274
- Rome was categorized as a category 3 seismic zone.
- The Design of the MAXXI had to be retro-fit
- 113 shock transmission units were used in addition to the expansion joints to reduce twisting, and pounding
- Devices can see 100-500 kN and a displacement of ±25mm.
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Each gallery changes in terms of the configuration of the roof and walls. However, the basic structural system is the same throughout.

Components of the structural System:
- Pair of reinforced concrete walls
- Transverse Beams
- Longitudinal composite truss fins
REINFORCED CONCRETE

- Load-bearing walls act like a 30 meter long free-span longitudinal beam. This allows for the interior to be column-free.
- Due to the long span and cantilevers of the galleries, the form-work had to be much stronger than typical.
  - Usually 15-20 kilograms per square meter is ample, but the Maxxi called for 45 kg per sm
- The floor is either precast concrete tees with a layer of concrete poured over them or are a reinforced slab with a depth ranging from 60-100 cm.
- The heaviest loads are placed on the floors which travel horizontally to the walls, then vertically to the foundation.
Steel beams (I Section) run transversely across the top of the reinforced concrete wall:
- Nominal Spacing of 12.6 meters
- Composite truss-fins spaced 1.2-1.6 meters apart run longitudinally spanning between the beams.
- Cantilevered gallery has beams running both parallel and perpendicular to the walls for extra stiffness as well as diagonal bracing.
- Columns support the wall on the exterior in areas where it does not reach the ground.
- Vertical circulation is made of steel and attached to either the floor slab or the walls by way of fixed joints, hinges or supports. An H section is most typically used.
CONNECTIONS
The MAXXI’s expansive use of curved concrete and slanted walls required a mixture that would be able to settle around considerable reinforcement bars. Zaha Hadid Architects specified Self-Compacting Concrete (SCC) which would allow an easy flow and compaction around congested reinforcement. However, this mixture was susceptible to cracking due to its continued curation over time. How could the cracking be solved without the adding of contraction joints?

3SC Concrete:
- **Self-Compacting Concrete:**
  - Acrylic plasticizer and limestone filler for fluidity
- **Self-Compressing Concrete:**
  - Calcium oxide (CaO) used as expansive agent
- **Self-Curing Concrete:**
  - Shrinkage-reducing mixture to prevent cracking due to curation
<table>
<thead>
<tr>
<th>Mix Composition (kg/m³)</th>
<th>3-SC</th>
<th>SCC</th>
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<tbody>
<tr>
<td>Cement → CEM 42.5 N</td>
<td>350*</td>
<td>350**</td>
</tr>
<tr>
<td>Ground Limestone (0.1-0.2 mm)</td>
<td>150</td>
<td>185</td>
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<tr>
<td>Sand (0-4 mm)</td>
<td>905</td>
<td>905</td>
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<tr>
<td>Gravel (4-16 mm)</td>
<td>875</td>
<td>875</td>
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<tr>
<td>Water</td>
<td>161</td>
<td>165</td>
</tr>
<tr>
<td>Acrylic Superplasticizer</td>
<td>6.5</td>
<td>6.5</td>
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<tr>
<td>CaO-Based Expansive Agent</td>
<td>35</td>
<td>---</td>
</tr>
<tr>
<td>SRA</td>
<td>4</td>
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</tbody>
</table>

*Pozzolanic Cement with 15% of pozzolan
**Portland Cement
- follows the movement of the spaces below
- composed of three major components: fins, glazing, and grilles

**FINS:** the vertical fins are parallel to outer walls, following their curves and emphasizing the directionality of the galleries and walkways

**GLAZING:** two layers of glazing block UV rays to protect the artwork

**GRILLES:** shading grills and adjustable louvers adapt to maximize daylighting along with the whitewashed walls
ROOF COMPONENTS

FIBERGLASS REINFORCED CONCRETE CAPPING
GALVANIZED STEEL GRATE WITH BLACK EPOXY FINISH
DUAL LAYER GLAZING WITH ANTI-UV FILM LAYER
BEAM STRUCTURE WITHIN CONCRETE CLADDING
INTERIOR TOUGHENED MIRRORED GLAZING
HIDDEN COMPONENTS (MECHANICAL, LIGHTING)
BEAM RUNNING PERPENDICULAR TO FINS
TRUSS STRUCTURE WITHIN CONCRETE CLADDING
ADJUSTABLE LOUVERS (IN ELEVATION)
ADJUSTABLE LOUVERS (IN SECTION)
TRACK FOR HANGING ARTWORK
STRUCTURAL ANALYSIS
STRUCTURAL ANALYSIS
CANTILEVER @ 3RD STORY

Moment  Shear  Deflected Shape  Axial Forces
STRUCTURAL ANALYSIS
CANTILEVER @ NORTH WEST END

- Moment
- Shear
- Deflected Shape
- Axial Forces
STRUCTURAL ANALYSIS
FIN TRUSS + HANGING ART LOAD

Moment
Shear
Deflected Shape
Axial Forces
SUMMARY

- The MAXXI’s innovative concrete mix composition permitted a fluid and relatively open building design, while eliminating the need for contraction joints that would interrupt the form.
- The concrete load-bearing walls eliminate the need for interior columns while supporting the roof structure and forms above it.
- The roof trusses are utilized to support the glass roof structure while acting as “fins” that accentuate the linear nature of the building and direct natural light.
SOURCES


