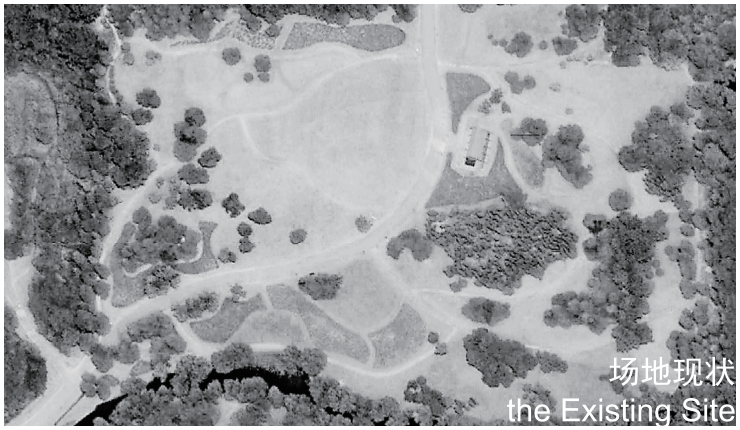
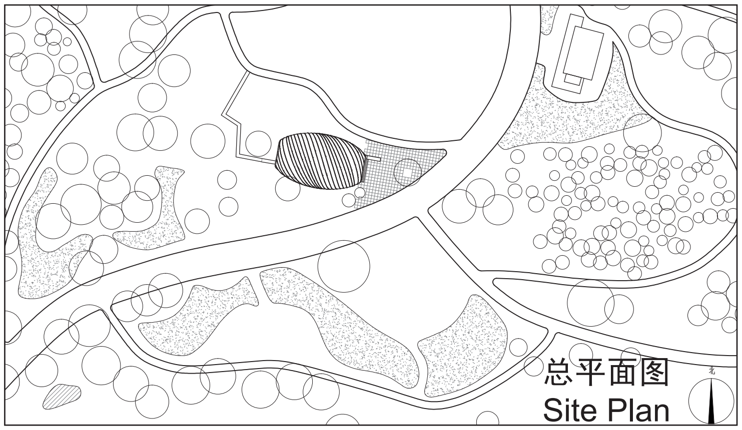
木海螺
THE WOODEN CONCH

参赛队员：王海深 沈绍冬 林雨铭 张昊天 孙弘历
指导教师：潘鹏 黄蔚欣

Team Member: Wang Haishen, Shen Shaodong, Lin Yuming, Zhang Haotian, Sun Hongli
Tutor: Pan Peng, Huang Weixin



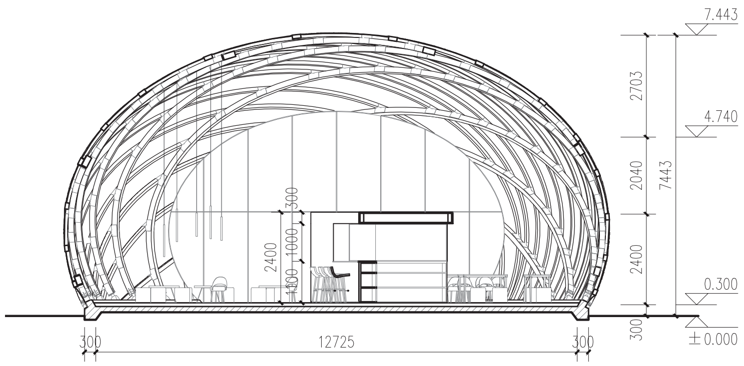
场地现状
the Existing Site



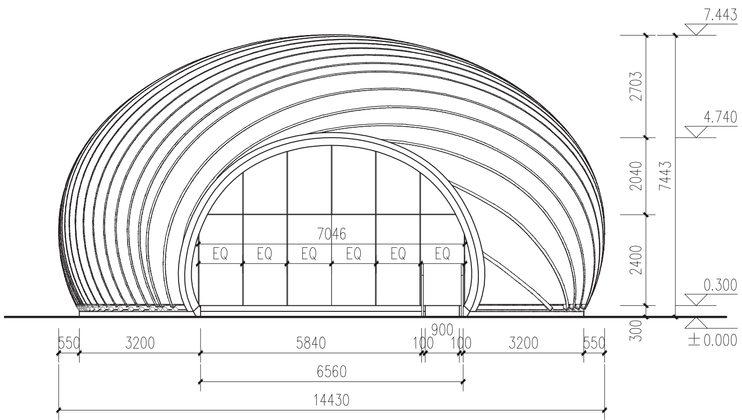
总平面图
Site Plan

建筑选址于上海滨江森林公园的一片空地中，旨在为园区的游客提供茶歇与交谈的空间。建筑尝试以轻巧的方式介入周边环境，在形体上选择了简洁的椭球形，室内布置则从弱处理，通过家具及中央点餐区的布置来进行空间组织。在材料上，方案力图展现木结构的韧性与轻巧，并用膜结构来最大限度地减少传统围护结构的厚重感，并强化轻盈与通透的效果。建筑的主体结构为一木结构编织网壳，摆脱了传统的梁柱体系，将通长的工程木杆件经纬编织，从而创造出性能高效而又形态丰富的结构，同时以精简的用材获得室内贯通的空间。本方案在设计过程中，也探索了建筑、结构、建筑环境等专业的协作模式，而最终方案也是多重考量相叠加后得出的综合结果。

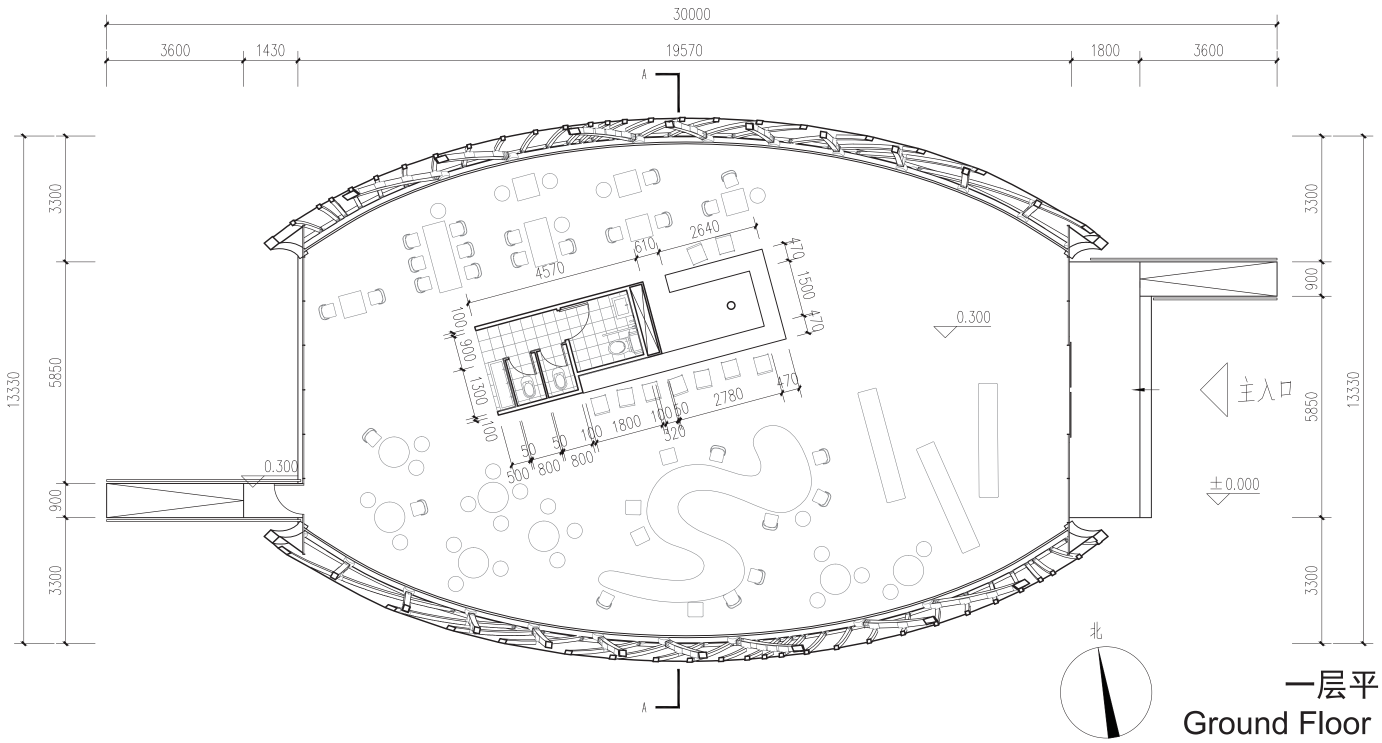
The building is located in an open space in Shanghai's Riverside Forest Park. It is designed as leisure cafe for visitors. The building is embedded in the surroundings in a dexterous way, leading to a simple ellipsoid shape. With the concise shape, the interior space is organized by the arrangement of furniture and the central dining area. The design tries to reveal the toughness and lightweight of wood structure, using the membrane structure to minimize the thickness of the envelope structure, and to enhance the feeling of light and transparent. The main structure of the building is a wooden weaving net shell instead of a beam-column system. Through the long engineering wood rods as warp and weft, we can create a highly efficient and abundant form of structure, obtaining a large span space using less timber. Throughout the design process, we explore the collaboration between architecture, structure, building environment and other professions, and the final program is a comprehensive and balanced result with multiple consideration.



A-A 剖面图
Section A-A



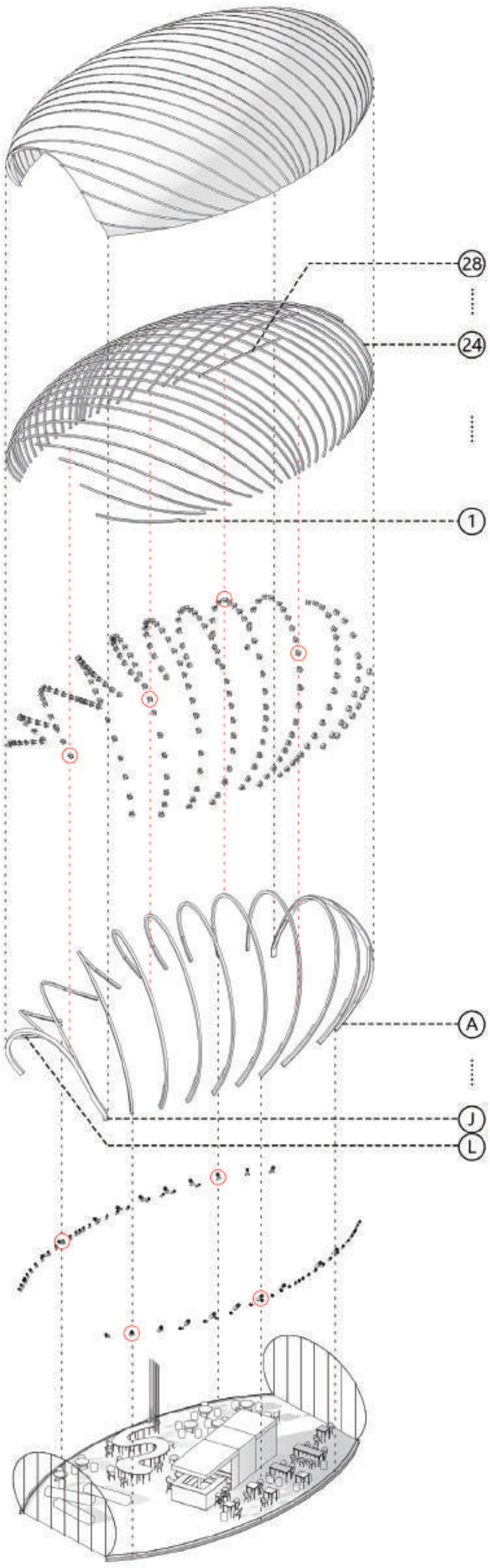
东立面图
East Elevation

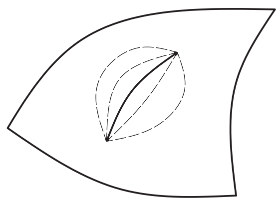


一层平面图
Ground Floor Plan

所有木结构杆件均沿着椭球面的测地线（Geodesic）生成，保证了方形截面的木杆件在弯曲加工过程中不会出现扭转，因此内、外层的杆件能够实现平接，保证了建造的可行性，以及节点的简洁。设计方法上采用了参数化方法，构件的数据信息可以直接从模型获取并与加工厂家无缝对接。

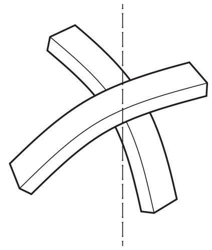
All wooden structural rods are generated along the ellipsoid geodesic curve, to ensure that the square section of the wood pieces does not appear torsion in the bending process, and to achieve a convenient construction and simple joints. The method of parameterization is adopted in the design method. The data of the component can be obtained directly from the model and seamlessly connected with the processing factory.





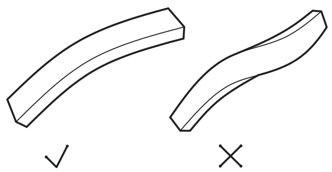
测地线是曲面上两点间的最短连线

The Geodesic is the shortest curve between two points on a surface.



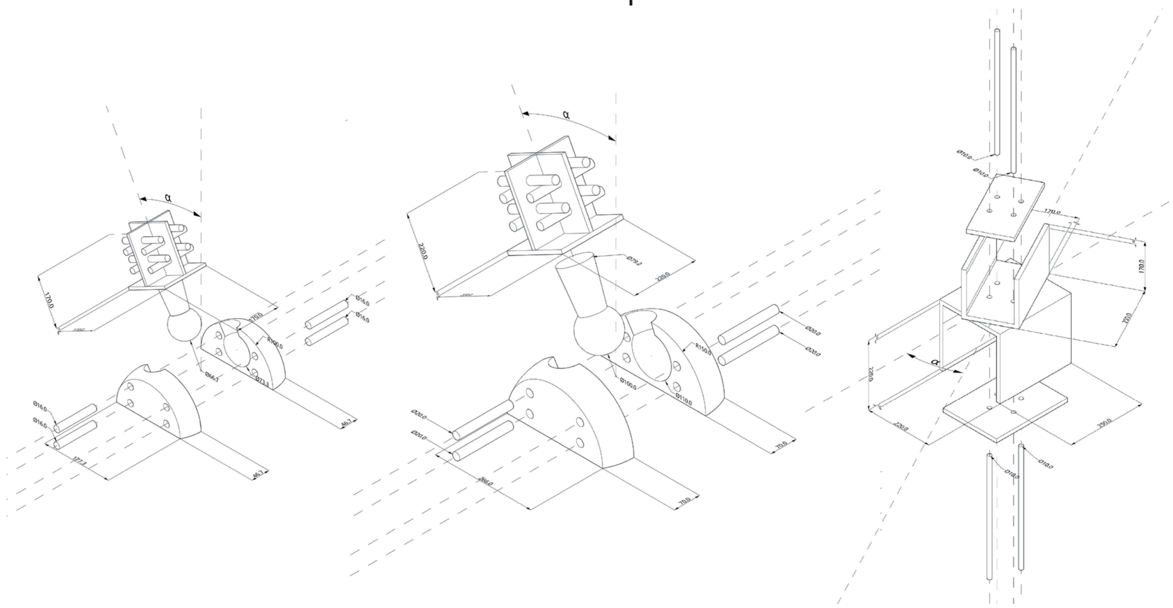
构件交点处曲线法向量相同，使得构件的标准化连接成为可能

The curvature directions on the intersection of two curves are the same, which makes it possible for standardized components.



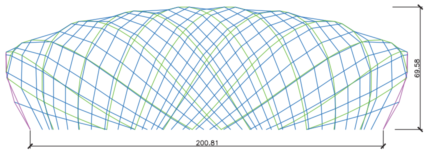
构件无扭转，易加工，曲线可展开

The poles are not twisting and are easier to process.

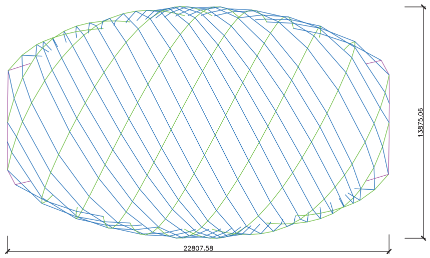


考虑到杆件的空间受力较为复杂，杆件与地面交接采用球铰节点以释放多余约束，根据杆件尺寸分为 图 1 和 图 2 两种规格。通过参数化调整，将节点预先浇筑入混凝土基座中，得以将空间角度简化为平面角度。节点同样通过单一参数描述，为工厂加工提供便利。

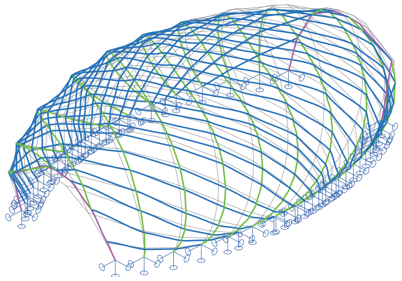
Considering the spacial force of the pole is relatively complex, the connections between the pole and ground are designed as spherical joints to release redundant constraints, and are shown seperately in fig.1 and fig.2 according to size difference. Through parameterized adjustment, the joints are pre-cast into the concrete base, allowing the spatial angle to be simplified to plane angle. The joints are also described by a single parameter, facilitating plan processing.



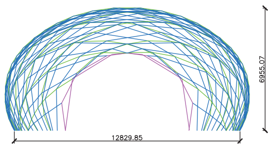
结构正视图
Structural Front View



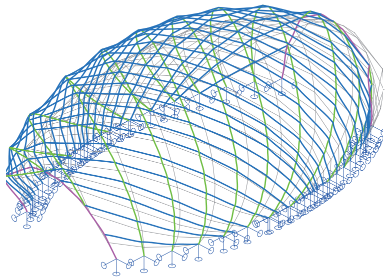
结构平面布置图
Structural Plan



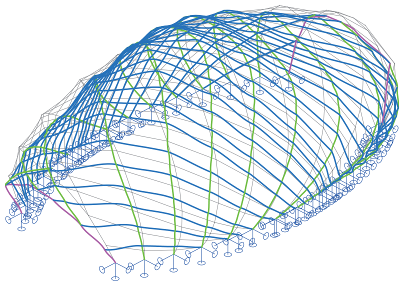
结构振型 2　T=0. 29s
Structural Vibration 2
T=0.29s



结构侧视图
Structural Side View



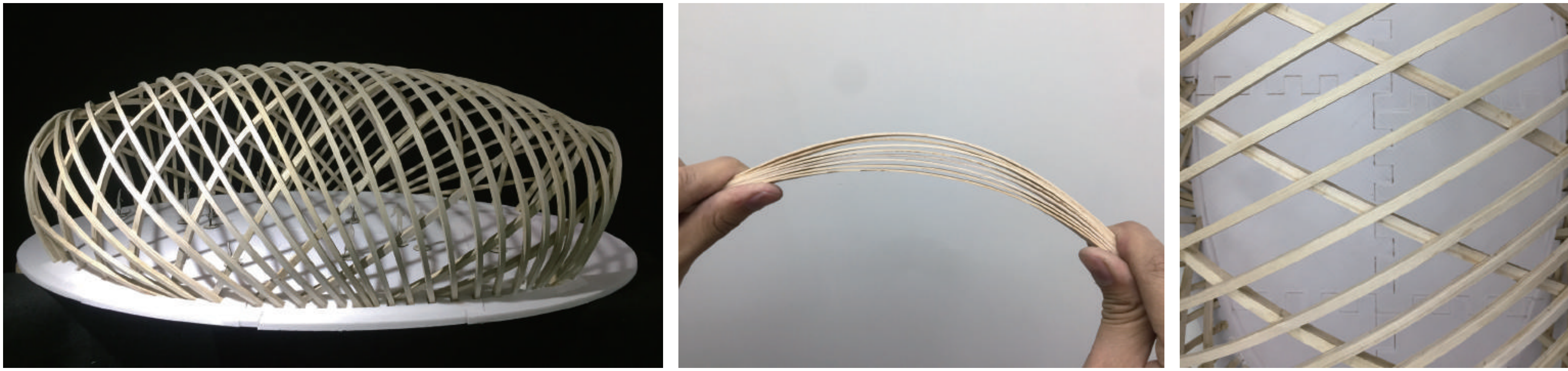
结构振型 1　T=0. 43s
Structural Vibration 1
T=0.43s



结构振型 3　T=0. 19s
Structural Vibration 3
T=0.19s

结构按照单层网壳结构进行设计，网壳节点之间杆件简化为直杆件，杆件与杆件之间在节点相交；将距离较近的杆件和支座进行合并处理，木构件之间节点设计为刚节点，支座为固定铰支座。本项目采用的工程木产品，容易加工成曲面形状，可设计性强，性能稳定。
结构计算考虑双向水平地震作用　，不考虑竖向地震作用，采用振型分解反应谱　法进行计算，考虑多种荷载组合进行受力分析，得到结构主要受风荷载控制，进行稳定性分析，得到结构整体稳定性强，不易发生局部失稳。节点设计满足刚性节点要求，采用参数化设计，施工简单，性能稳定。

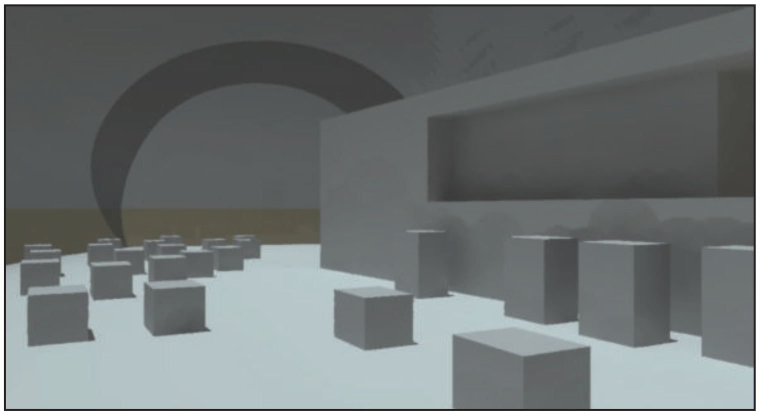
The structure is designed as single-layer lattice shells, the bars are simplified as straight lines, crossing each other through nodes; bars and pedestals which are close are merged. Nodes are designed as rigid joints considering the structure type, the pedestals are fixed pins. Most of the material used in this project is engineering wood, which is easy to be designed as curved surface as well as stable performance.
The structure calculation considers bi-directional horizontal earthquake action, ignoring vertical seismic influence, the seismic calculation uses Modal Response Spectrum Analysis Method. All of the most important load cases are considered in this project, and the structure is controlled by the wind loading cases. The result of stability analysis shows that this structure shows good overall stability, the local instability is also unlikely to happen. The design of nodes and pedestals meet the demand of rigid joints.
This project successfully uses parametric design method, which is convenient and powerful for communication between structure and architecture.



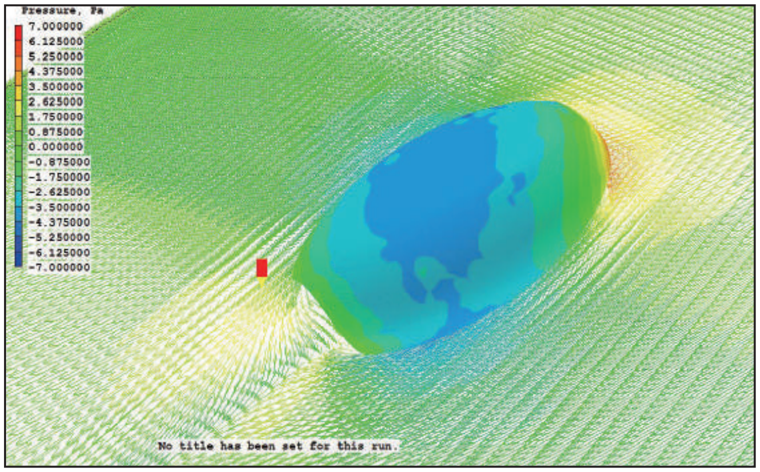
结构模型
Structural Model

建筑考虑了自然通风和采光，能够实现生态和节能。我们通过上海的风的特点来选择最利于通风的建筑朝向。送风模式方面，夏天上送风，冬天下送风，实现气流组织的优化。

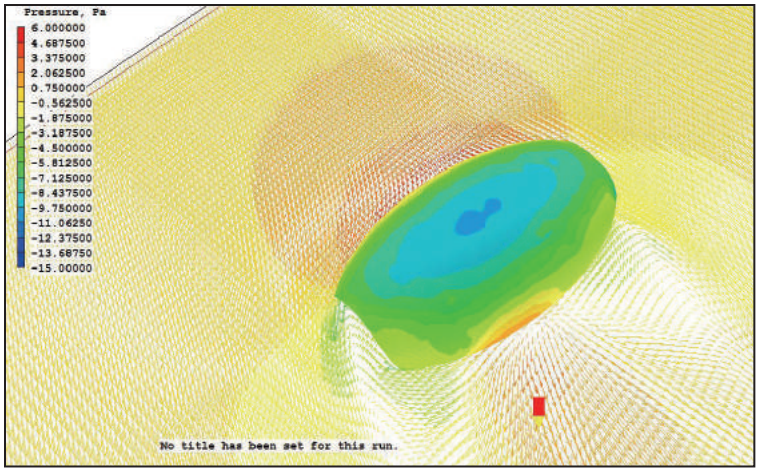
When designing, we consider natural ventilation and lighting to make this building ecological and energy saving. We analyse the wind in Shanghai to choose the most conducive direction for building ventilation. The airflow mode is optimized through the mode switch of summer and winter air-supply: the fresh air enter from above in the summer and below in the winter.



室内采光模拟
Indoor Lighting Simulation



夏季室外模拟轴测图
Simulation of Outdoor Wind Field in Summer



冬季室外模拟轴测图
Simulation of Outdoor Wind Field in Winter