

**CAMPUS Asia Plus::SUAEE Asia Program Summer School Workshop 2024**



# **Winter sport and Architecture**

## **- Case studies in China**

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# Outline

- 1. Winter Sports and Winter Olympics**
- 2. New facilities for Winter Olympics**
- 3. Renewal and renovation for Winter Olympics**
- 4. Supporting services for Winter Olympics**

# **1. Winter Sports and Winter Olympics**

# Winter Sports **Winter Olympics**

The Beijing Winter Olympics consists of 7 major events, 15 events, and 109 sub events.

The **Beijing Zone** undertakes all ice sports, the **Yanqing Zone** undertakes snowmobile, sled, and alpine skiing, and the **Zhangjiakou Zone** undertakes all snow sports except snowmobile, sled, and alpine skiing.





# Winter Sports Winter Olympics



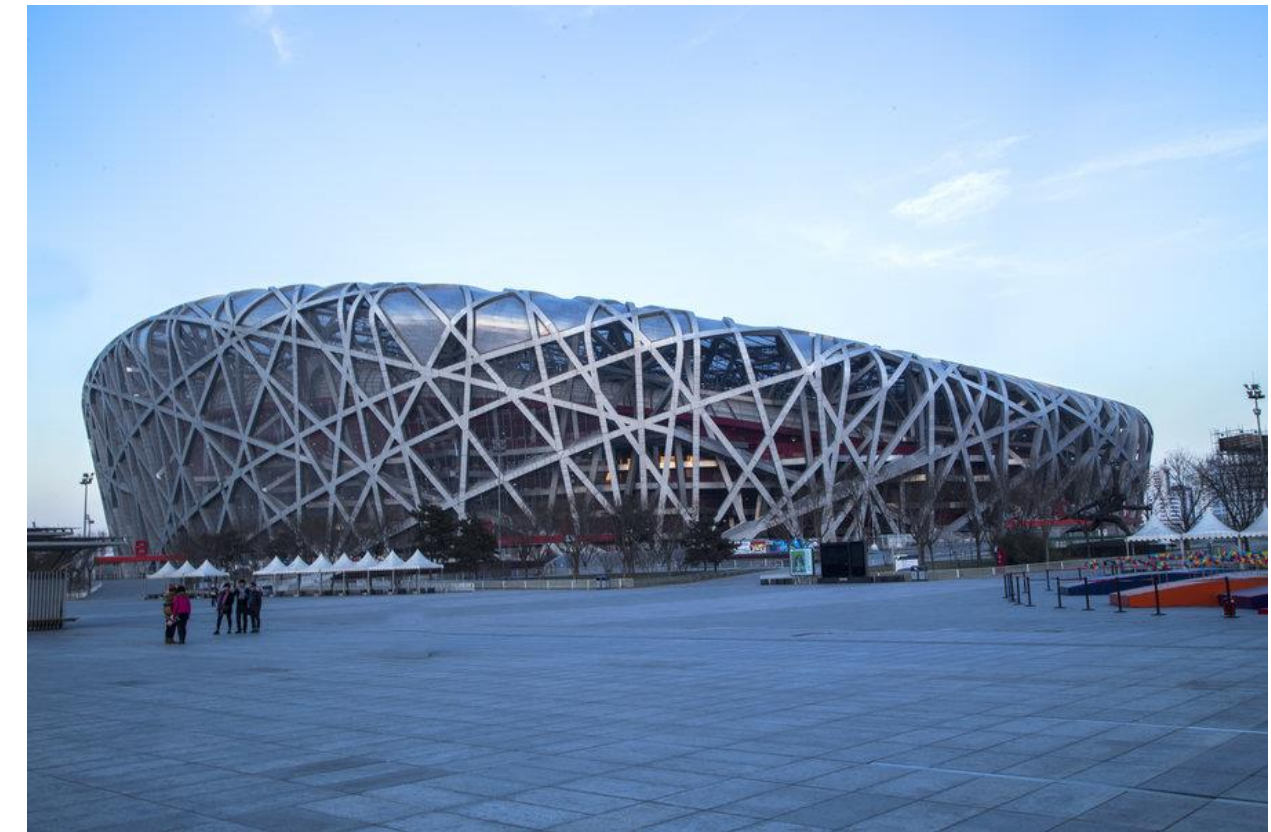


# Winter Sports **Winter Olympics**

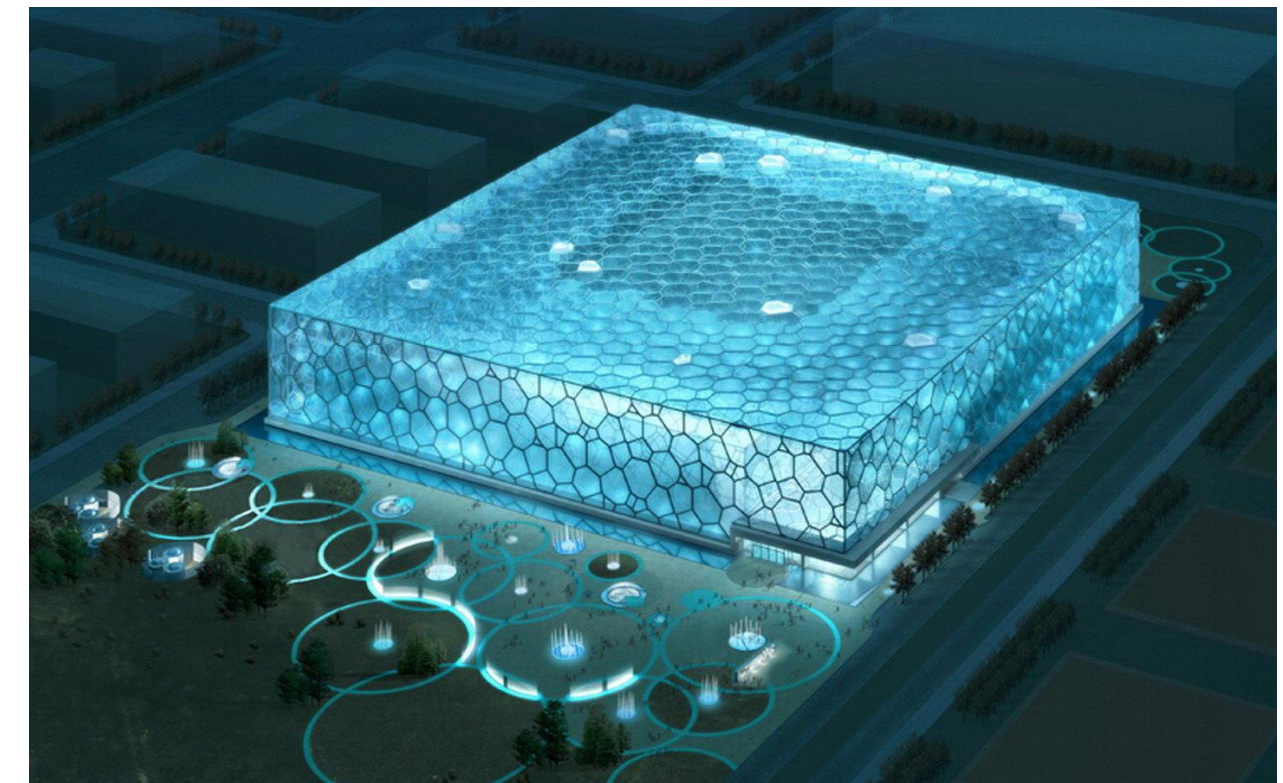
Among the 25 stadiums of the Winter Olympics, 10 are existing, 6 are planned for construction, 4 are for the construction of the Winter Olympics, and 5 are for temporary construction.

Stadiums such as the Bird's Nest and the Water Cube are heritage sites of the Beijing Summer Olympics, had been **continuing to use** in the Winter Olympics which can reduce construction costs.

New stadium such as "Ice Ribbon" (National Speed Skating Center) and Yanqing competition area, it will **become the place for public ice and snow activities after the Winter Olympics** that the reuse and comprehensive utilization of Olympic stadiums will be realized.



**Bird's Nest**



**Water Cube**



# Winter Sports **Winter Olympics**

All stadiums of the 2022 Winter Olympics in Beijing have got **green building certification**.

All stadiums are 100% supplied by green electricity.

The stadiums used **carbon dioxide** to produce ice on a large scale directly. Carbon dioxide ice making comes with environmental attributes and is pollution-free.

All stadiums in Beijing and Yanqing can be reached by **public transportation**.

Many stadiums also use the **waste heat** from freezing to provide hot water for athletes, melt ice in the melting pools, and water for ice surface maintenance.





# The Aerial Trail "**Ice Jade Ring**" ——Zhangjiakou zone

The aerial trail "**Ice Jade Ring**" is based on the concept of the "Olympic Ring Complex" proposed by a team from Switzerland.

It connects key buildings such as the National Ski Jumping Center, the National Biathlon Center, the National Cross country Ski Center, the Mountain Broadcasting Center, and the Technical Officer Hotel through an elevated trail.



By Tsinghua University Institute of Architectural Design and Research



# The Aerial Trail "Ice Jade Ring"



During the Olympics, strolling along the avenue can **connect various stadiums**, making it convenient for spectators to travel between them.

After the Olympics, the Wandering Avenue can be renovated for functions such as **entertainment, dining, performing arts, rest, and exhibition.**



## **2. New facilities for Winter Olympics**



# National Ski Jumping Center “Snow Ruyi” —Zhangjiakou zone



The National Ski Jumping Center is a **landmark mountain stadium** in the Zhangjiakou competition area of the Beijing 2022 Winter Olympics.

It locates in the northwest corner of Guyangshu District in Zhangjiakou Zone which covers an area of approximately 62 hectares.

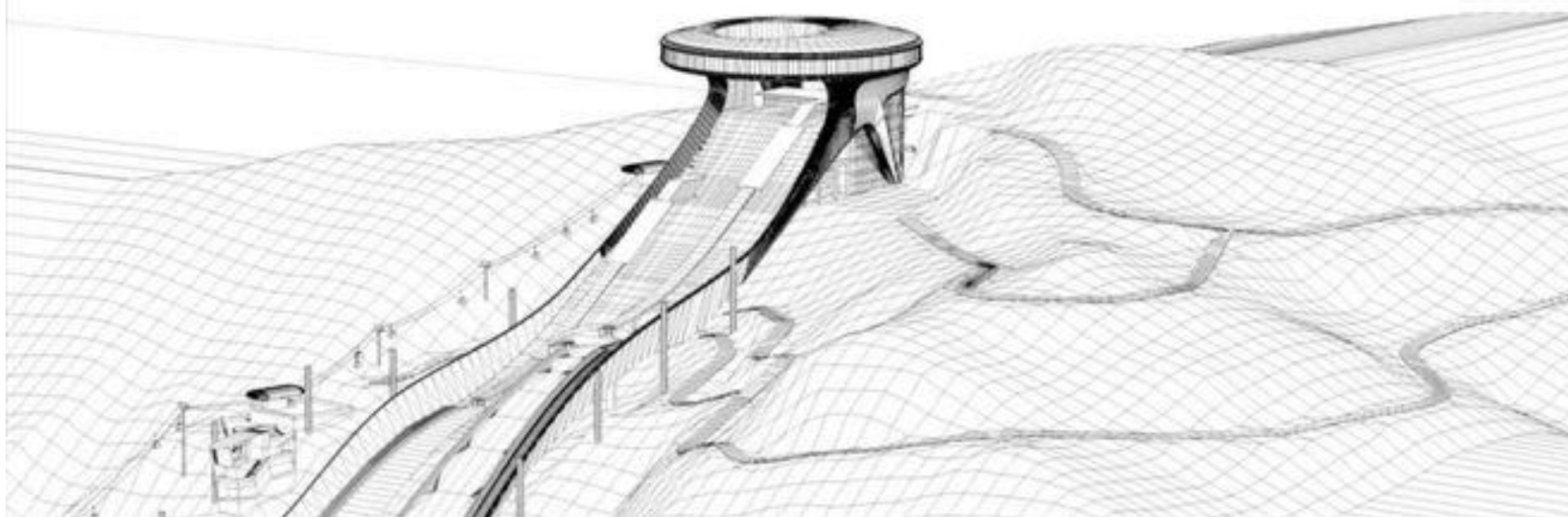


# National Ski Jumping Center “Snow Ruyi”

Its architectural design inspiration comes from **Ruyi** which is the traditional Chinese auspicious ornament. It symbolizes smooth sailing and prosperity. The handle is shaped like fingers.



By Tsinghua University Institute of Architectural Design and Research



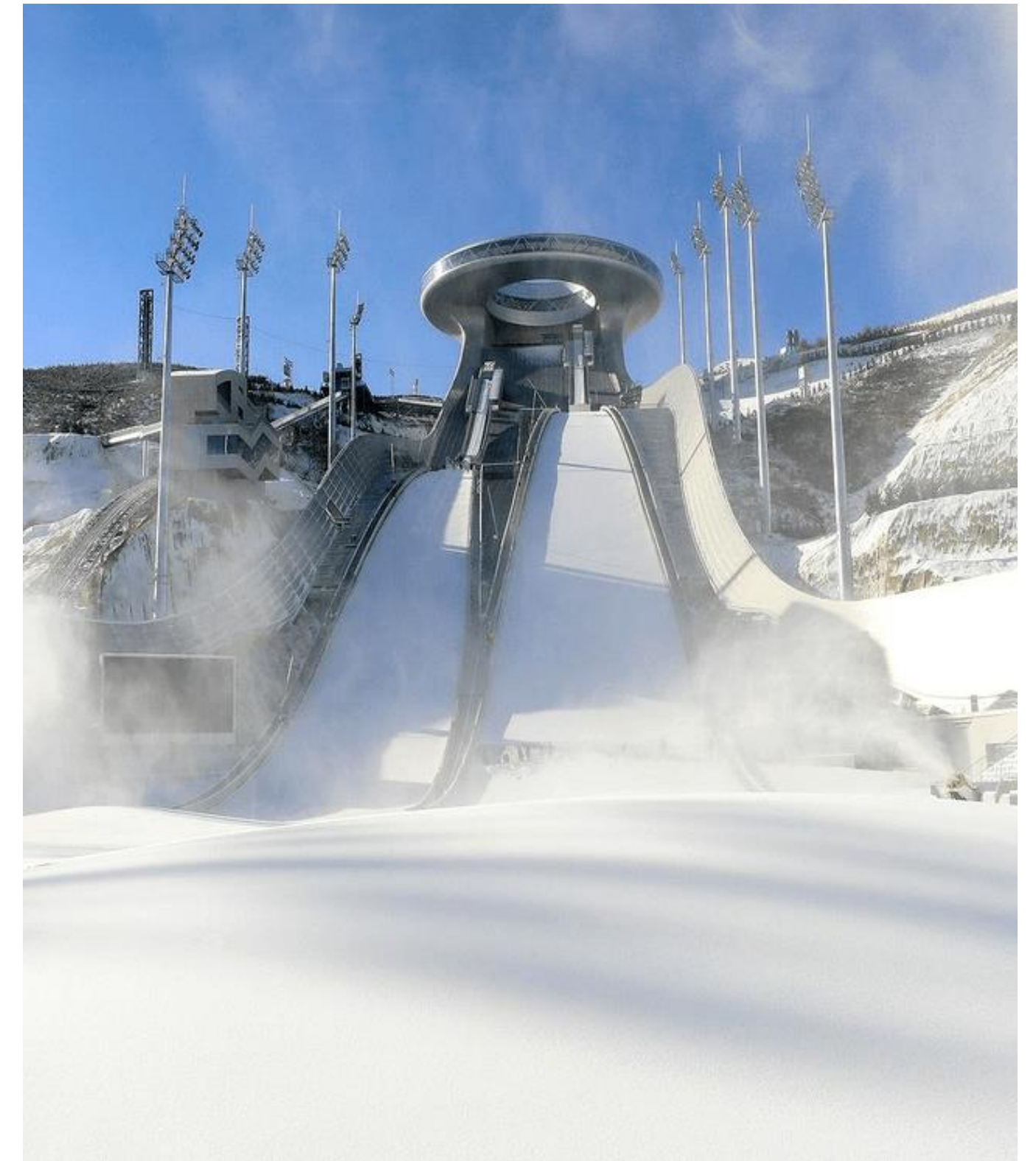


# National Ski Jumping Center “Snow Ruyi”



The side curve of the image of "Ruyi" has both **windproof function** in the northwest direction. The overall building includes a mountain top club, a 40 meter high circular observation deck at the top of the slope, and a panoramic restaurant inside.

There is a referee tower halfway down the mountain, with a sports stadium at the bottom.

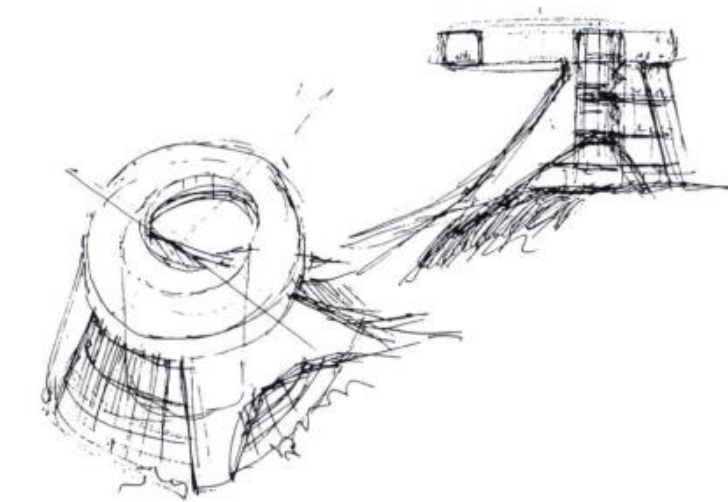
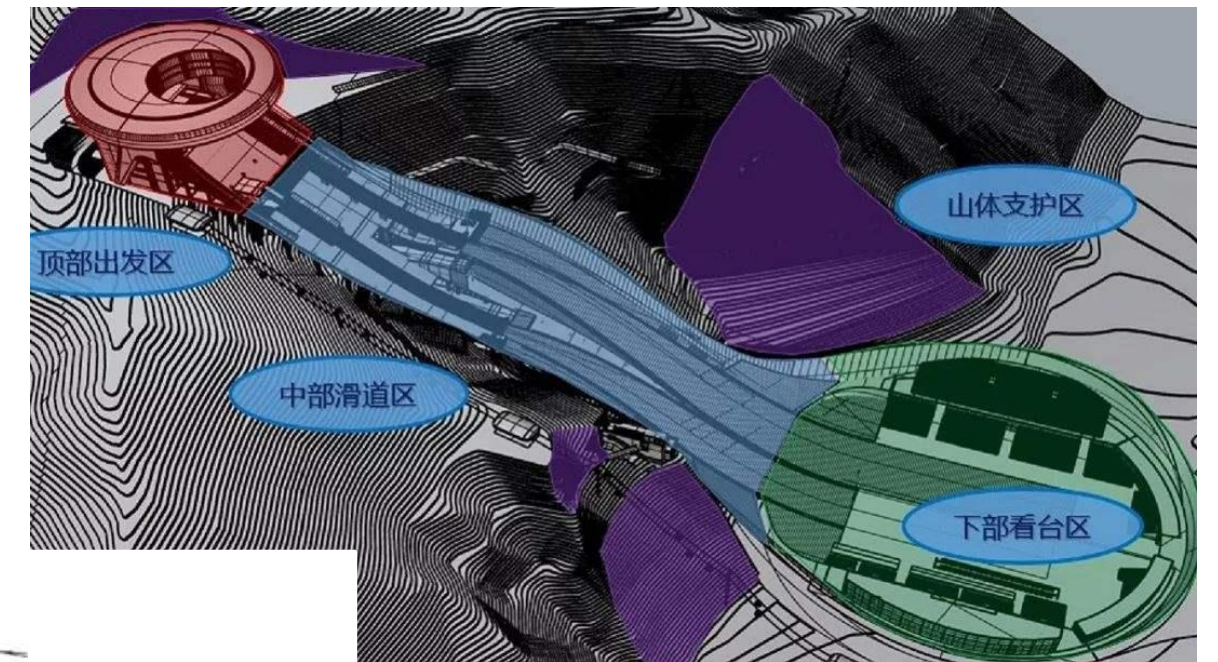




# National Ski Jumping Center “Snow Ruyi”



The National Ski Jumping Center consists of the Peak Club, departure area, slide area, and stand area. The slide of the National Ski Jumping Center is divided into **HS106 standard ski jump** and **HS140 large ski jump**.



草图



- 1 会议厅层
- 2 大跳台出发层
- 3 贵宾入口层
- 4 标准跳台出发层
- 5 暖房 / 机房
- 6 出发区
- 7 职工用房
- 8 起跳区
- 9 裁判塔
- 10 大家庭看台
- 11 观众站席区



# National Ski Jumping Center “Snow Ruyi”



From different angles such as top and bottom.



# National Ski Jumping Center



**It is the competition stadium with the largest amount of construction and the highest technical difficulty in the Zhangjiakou Zone.**



# National Biathlon Centre—Zhangjiakou zone

The National Biathlon Center is located in Chongli District, Zhangjiakou Zone. It is the stadium with the highest total number of gold medals generated in this Winter Olympics. It consists of the stadium, competition area, and technical building.



**Shooting range and two parallel tracks**



**Technical Building and Sprint Track**

By Tsinghua University Institute of Architectural Design and Research



# National Biathlon Centre

Winter biathlon is one of the snow sports and an official event of the Winter Olympics. The combination of cross-country skiing and shooting, which have different characteristics, is a sport that requires athletes to have both the ability to turn from dynamic to static and the ability to turn from static.





# National Biathlon Centre



The design is clean and neat, simple and elegant, and the internal partition walls adopt a **movable and detachable lightweight partition system**, which is convenient for post Olympics function conversion.

The technical building adopts reinforced concrete structure and steel structure roof. The main functions of the four floors above ground are event management and technical rooms, which will be a place for athletes and technical officials to rest or depart in the future.



Core area of the competition stadium



# National Biathlon Centre



Track Plan

The center has three tracks, including the **competition track** in the middle, the **training track** in the east, and the **Winter Paralympic competition track** in the northern valley. The total length of the competition track is 8.7 kilometers.



# National Biathlon Centre



**View of the competition venue and small lakes on the track**



**Paralympic track**



# National Cross Country Ski Centre —Zhangjiakou zone



**The National Cross Country Ski Center covers an area of 106 hectares and has a construction area of approximately 5700 square meters.**

**It is located in the southeast valley of the Taizi city in Chongli District, Zhangjiakou Zone.**

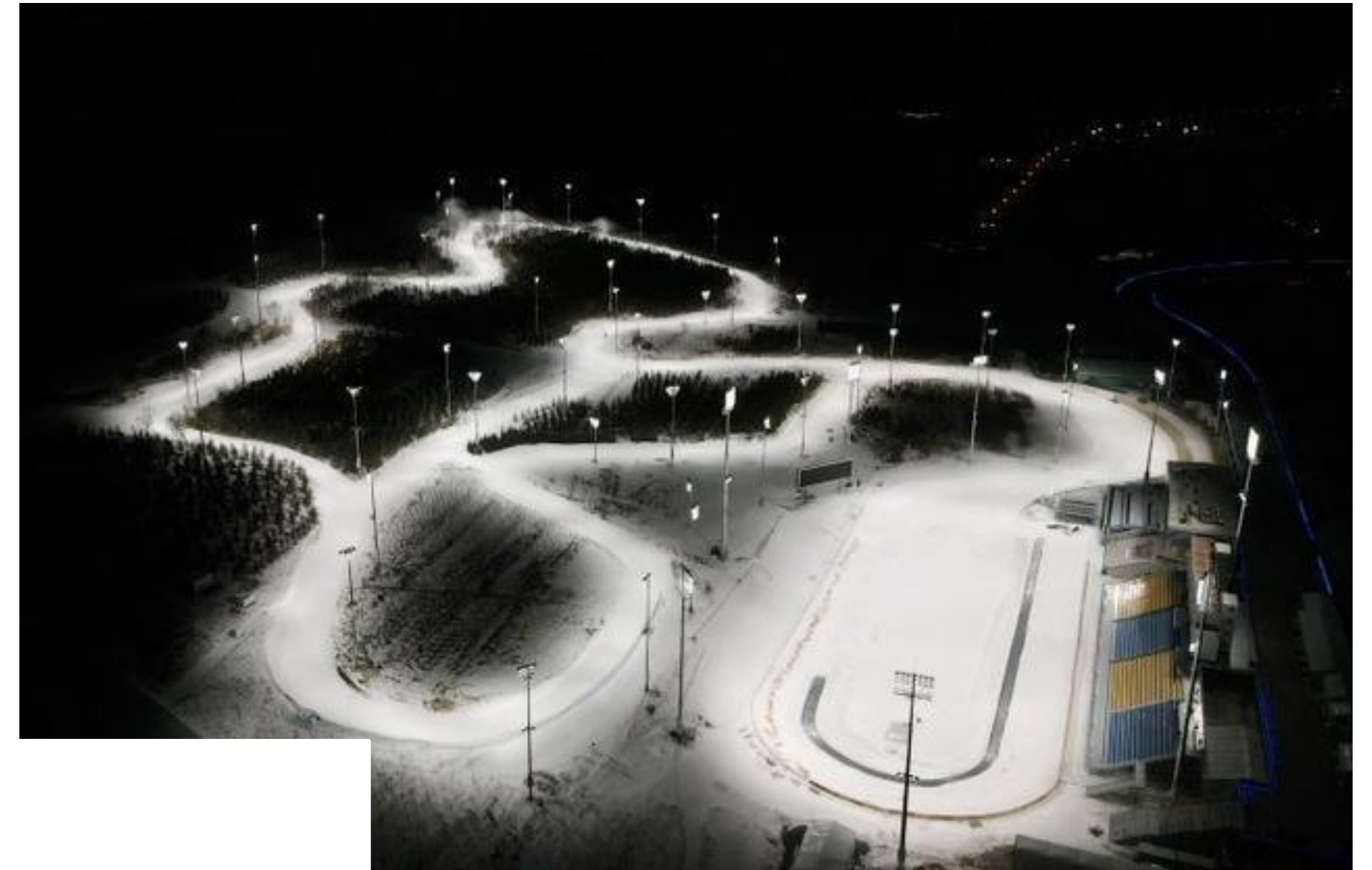


**Panoramic view of the National Cross country Ski Center**



# National Cross Country Ski Centre

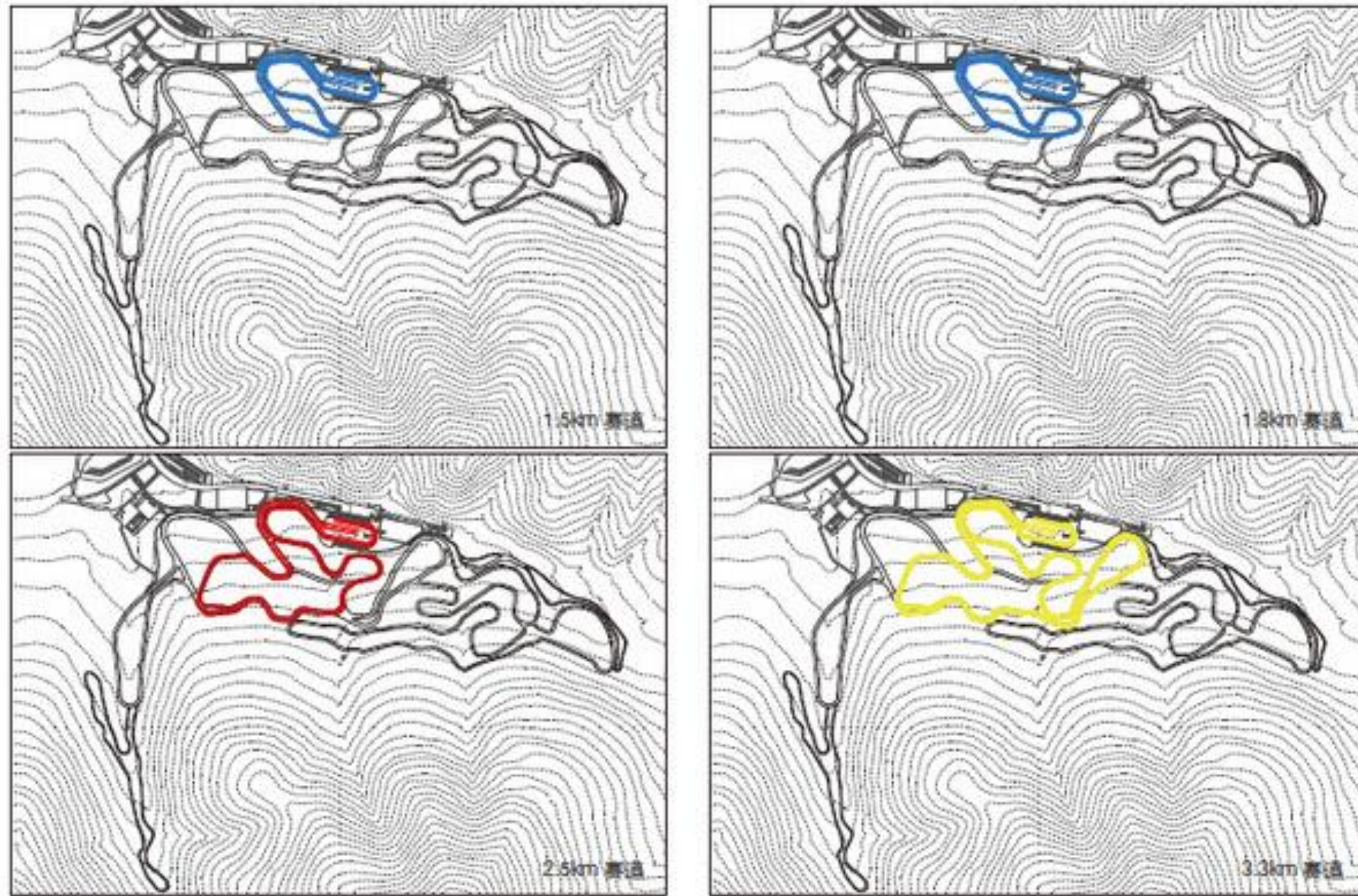
The total length of the track is 9.7 kilometers, and cross-country skiing events such as men's 15 kilometers and women's 10 kilometers are held here.



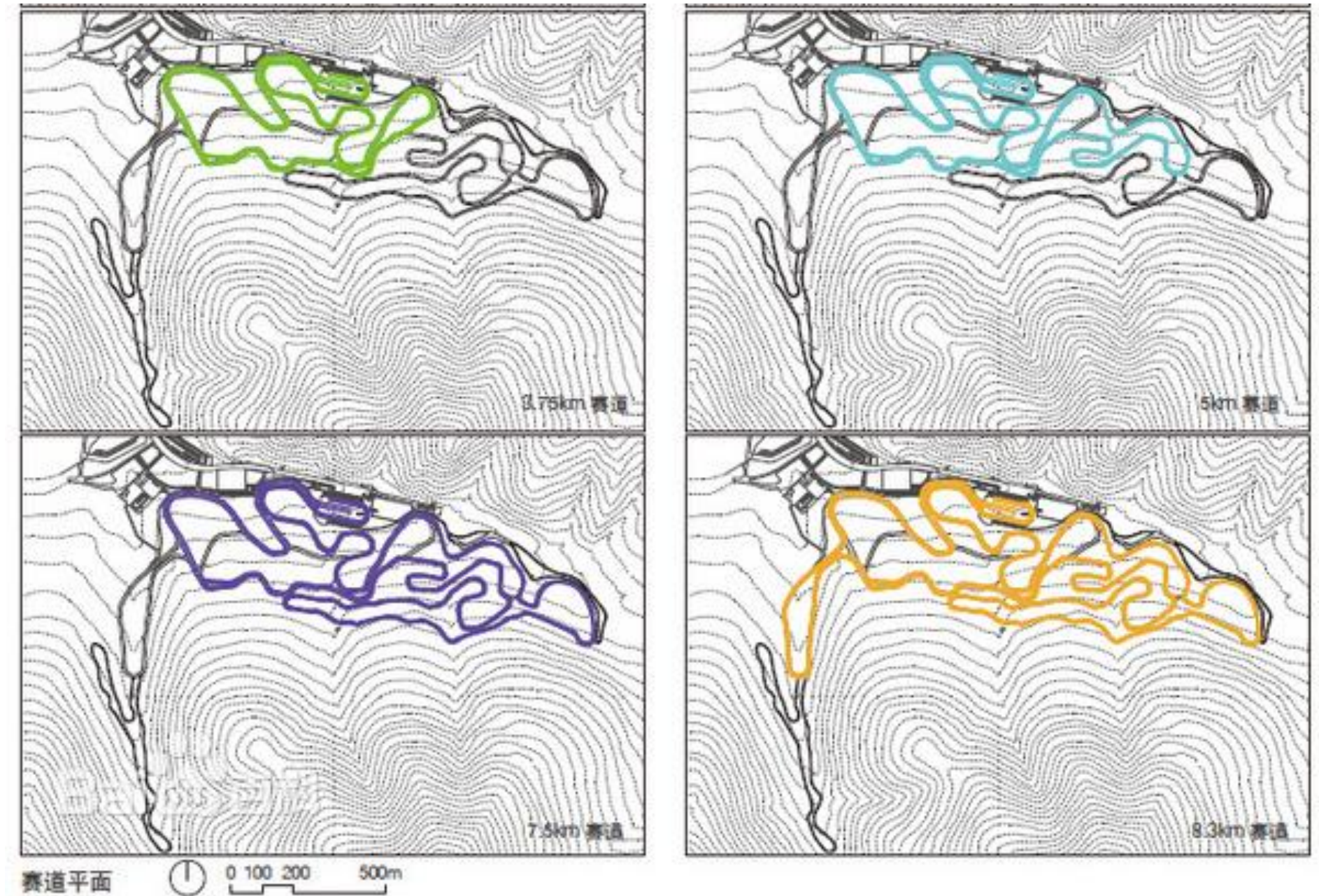
After the competition, it will be developed into a "mountain park" and an "outdoor ice entertainment center".



# National Cross Country Ski Centre



Organization of different competition tracks





# Genting Snow Park —Zhangjiakou zone



**The Genting Snow Park covers an area of 119.2 hectares and has a temporary construction area of approximately 26500 square meters.**





# Genting Snow Park —Zhangjiakou zone



**Genting Snow Park is an existing ski resort, which will have two independent stadiums. During the Winter Olympics, Park A is used for freestyle skiing, Park B is used for snowboarding, and each stadium can accommodate 7500 spectators.**





# National Sliding Centre "Snowy Dragon" — Yanqing Zone

The National Sliding Center is located in the southern part of the core area of the Yanqing Zone which is 75 kilometers north of Beijing. It is 1975 meters long and also known as the "Snowy Dragon". It will serve as a sliding competition venue.

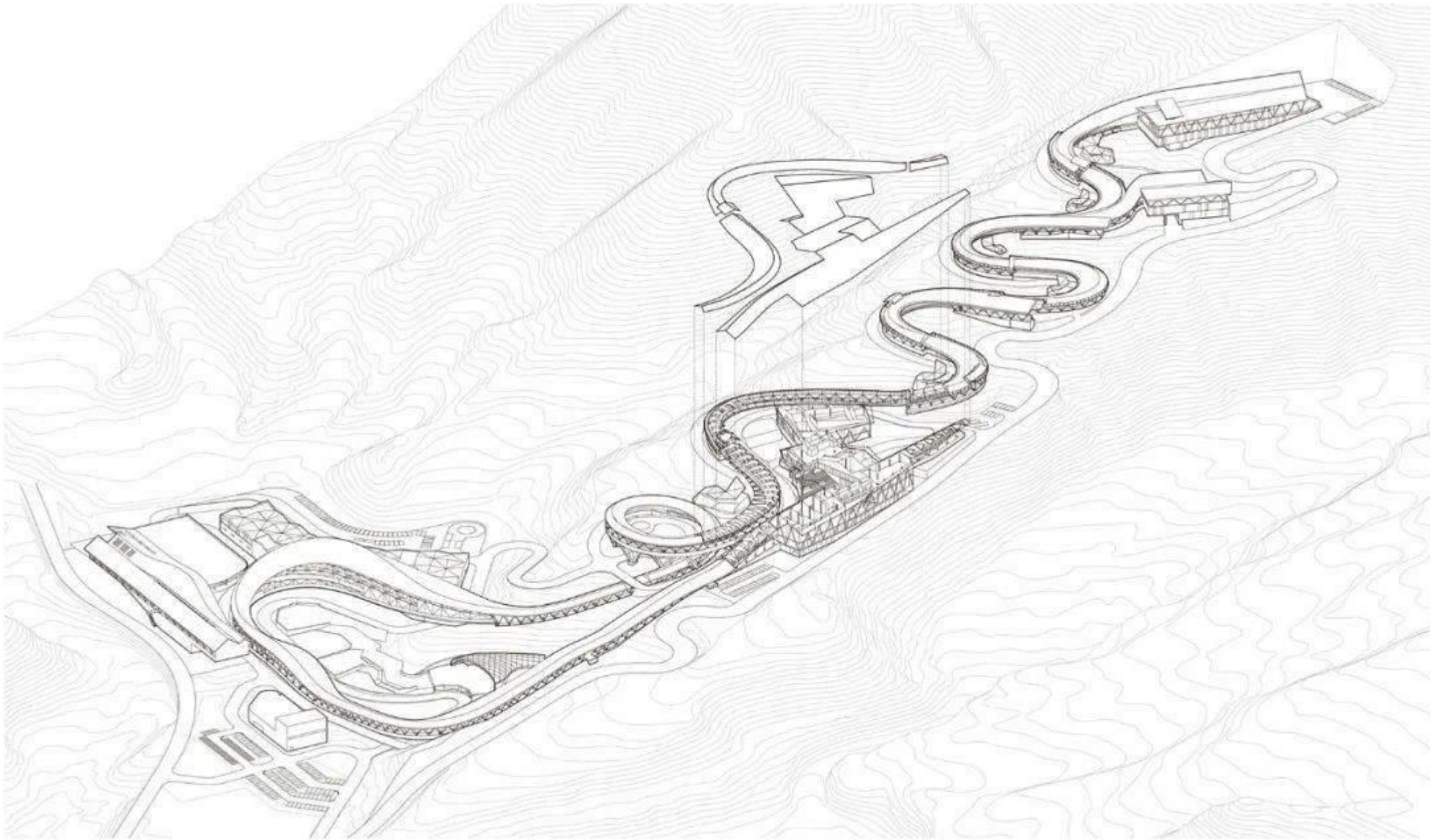


Functional distribution of national sliding centers



# National Sliding Centre "Snowy Dragon"

Perspective View



Plan



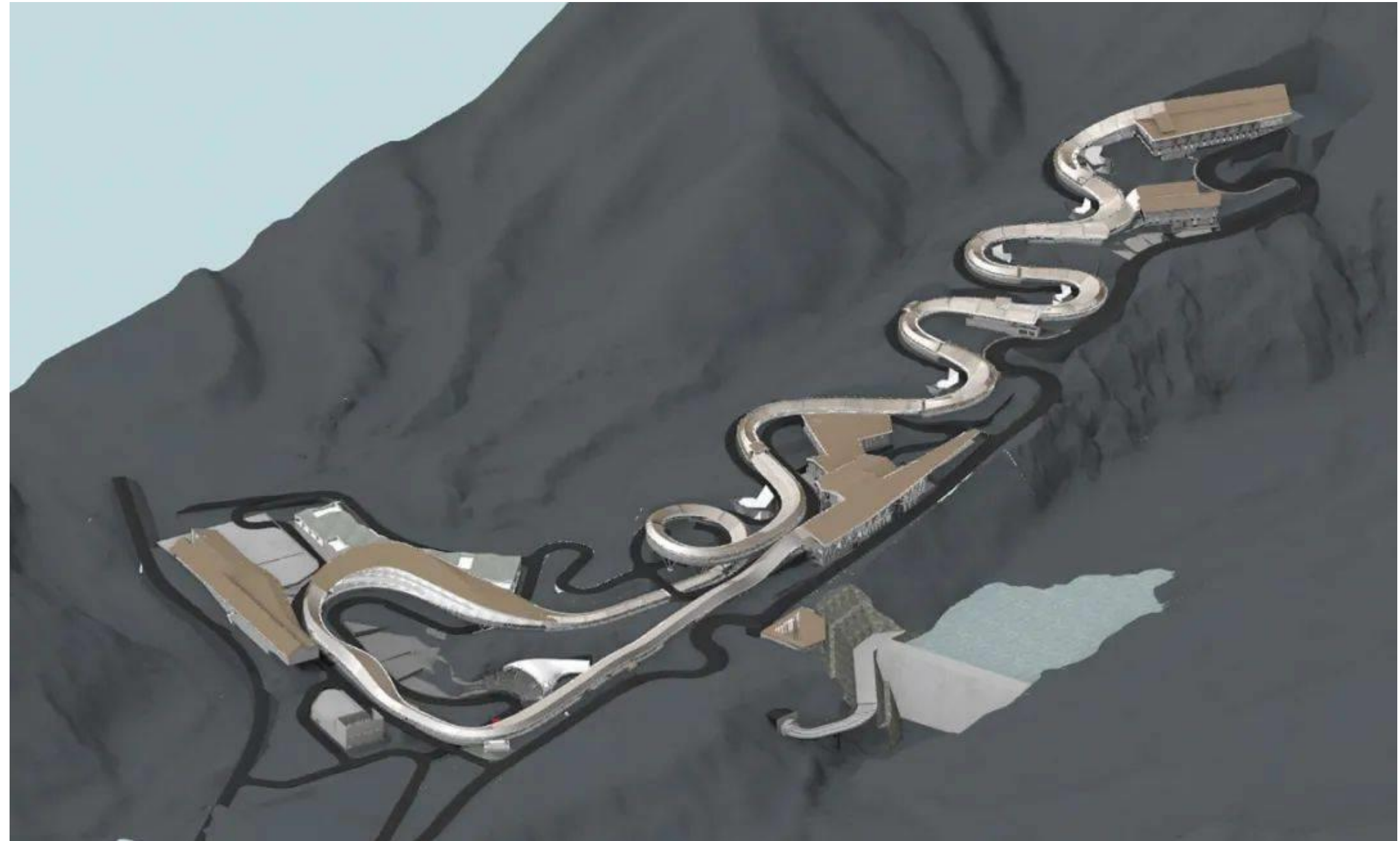
- |         |              |         |
|---------|--------------|---------|
| 1 出发区 1 | 4 螺旋弯        | 7 观众主广场 |
| 2 出发区 2 | 5 运营及后勤综合区   | 8 制冷机房  |
| 3 出发区 3 | 6 训练道冰屋及团队车库 | 9 结束区   |



# National Sliding Centre "Snowy Dragon"



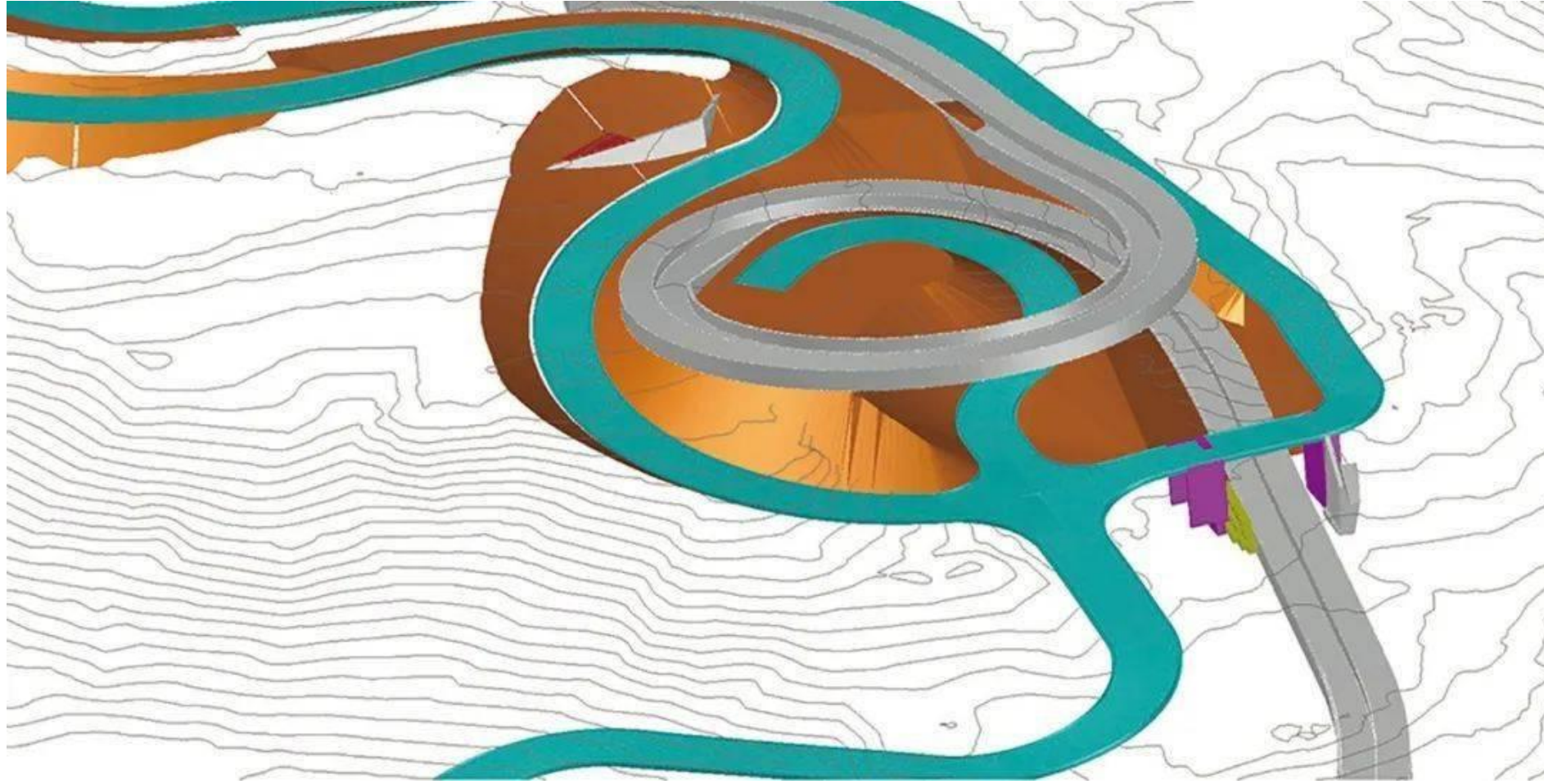
**Current site BIM Model**



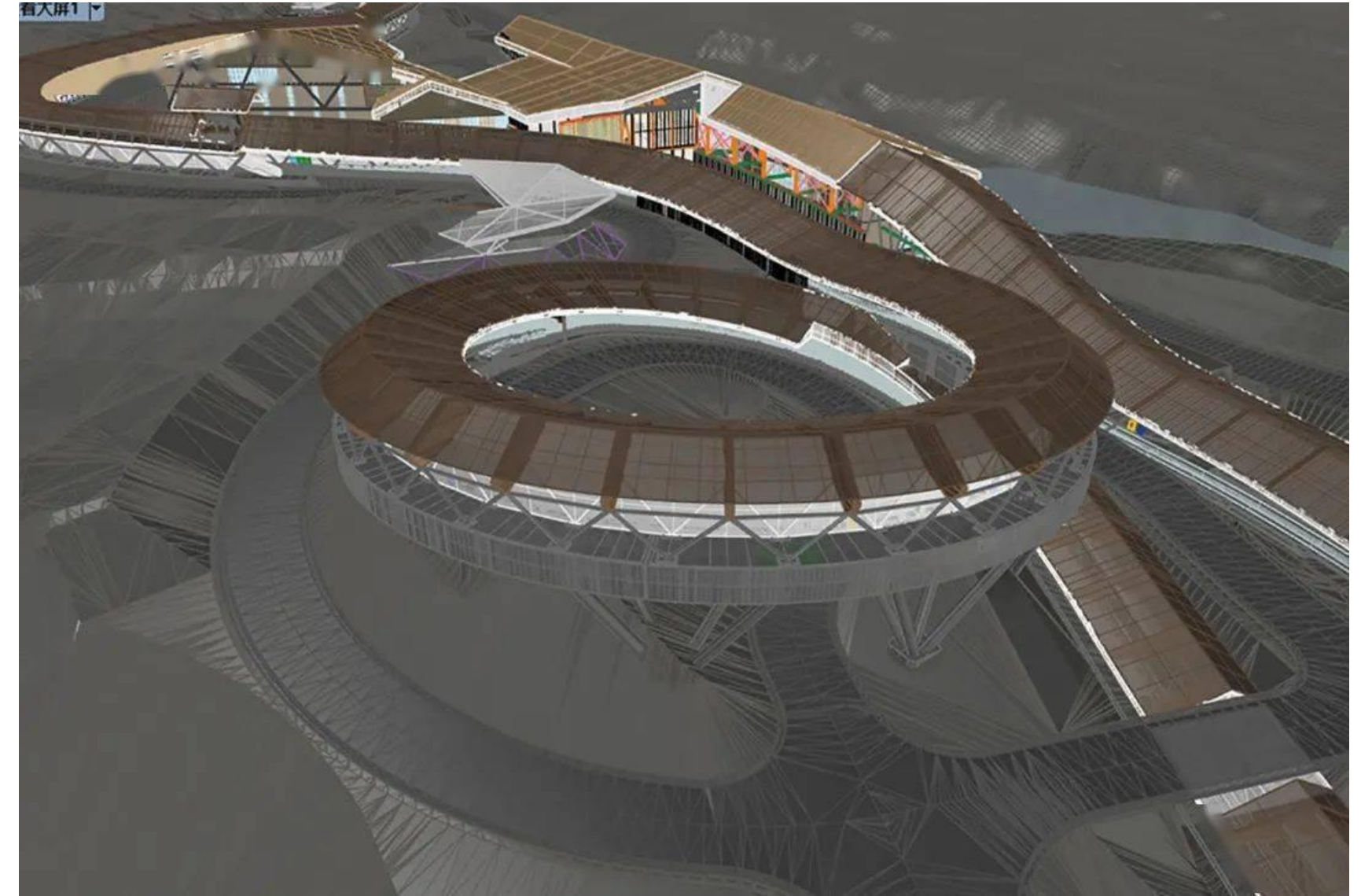
**Building+Site Integrated BIM Model**



# National Sliding Centre "Snowy Dragon"



**Spiral Bend Site BIM Base Model**



**Spiral Curved Building+Site BIM Overall Model**



# National Sliding Centre "Snowy Dragon"



It is like a dragon winding from north to south on the ridge west of the entrance to the competition area, and will compete in snowmobile, steel frame snowmobile, and sled races during the Winter Olympics.





# National Sliding Centre "Snowy Dragon"

The sliding track applies a wooden stacked roof, which looks like a swimming dragon from a distance.



By China Architecture Design & Research Group



# National Sliding Centre "Snowy Dragon"

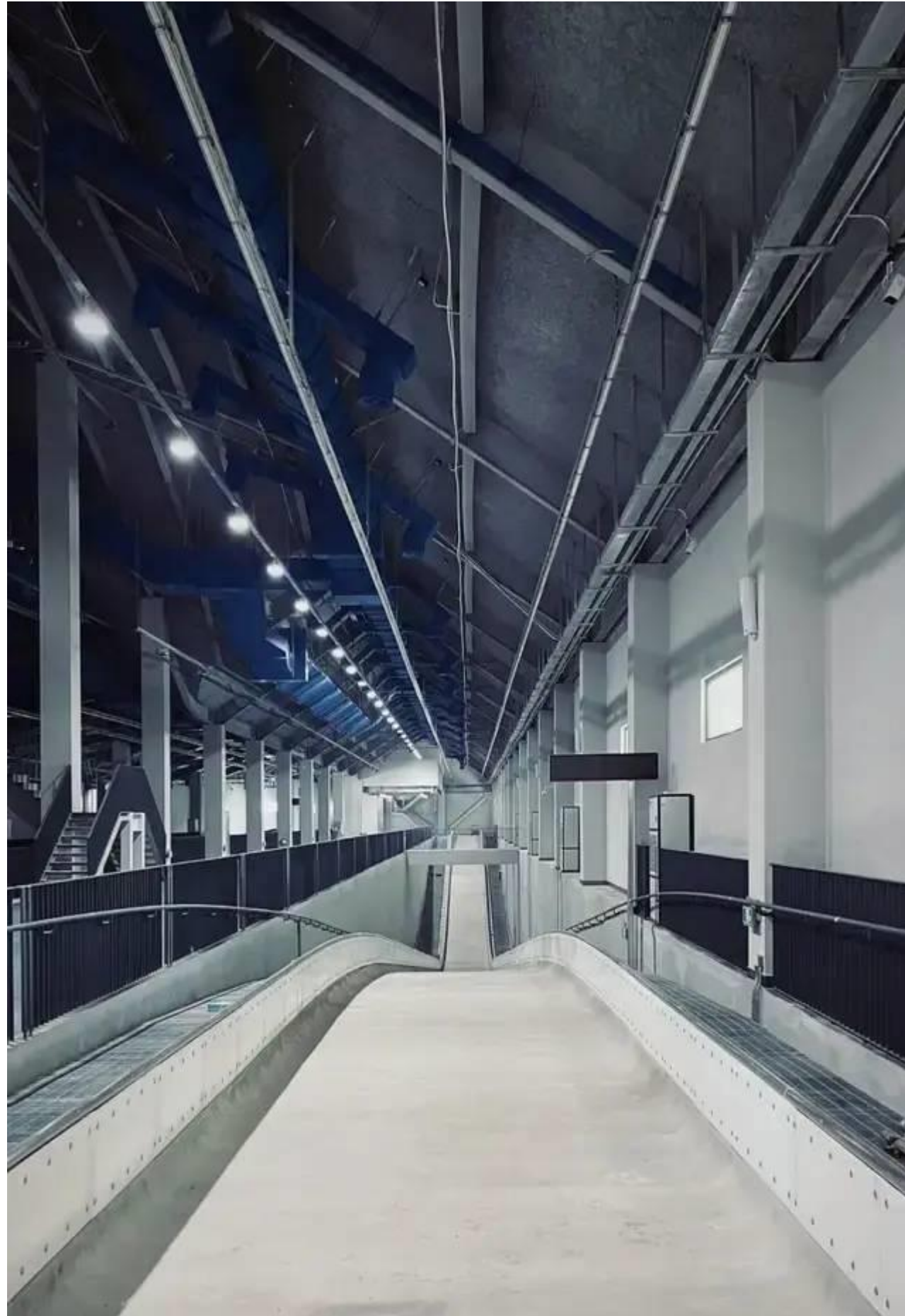


It is the first and third sliding track in China and Asia, that using extremely complex curved concrete spraying technology in construction and overcoming many technical difficulties in engineering.





# National Sliding Centre "Snowy Dragon"



**As one of the most challenging newly built stadium in the design for the Winter Olympics, the national sliding track is divided into 54 refrigeration units, with a vertical drop of over 121 meters alone, and also needs to be composed of 16 curves with different angles and inclinations.**





# National Sliding Centre "Snowy Dragon"



**A comprehensive operational area  
suspended above the track**

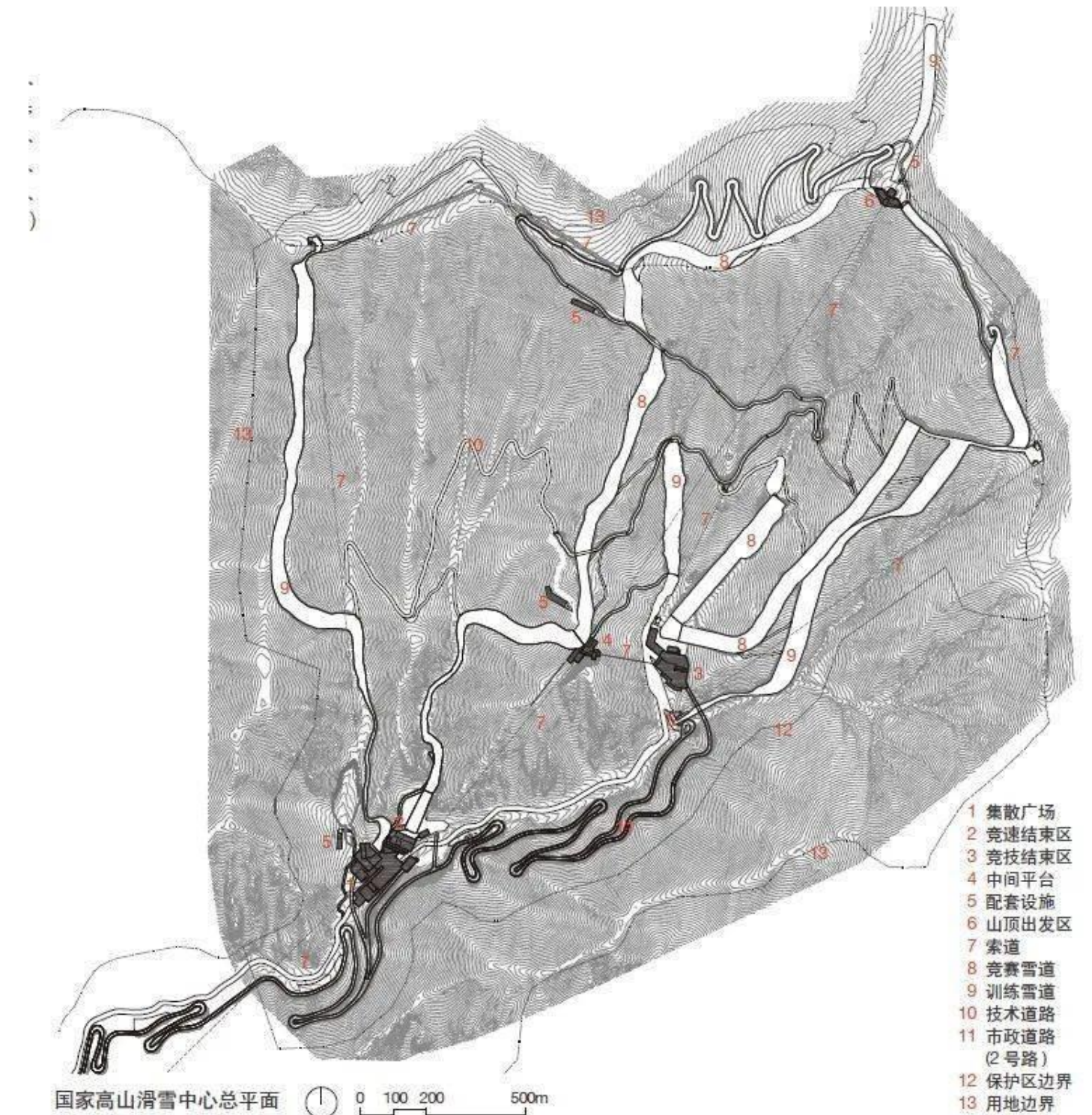




# National Alpine Skiing Centre — Yanqing Zone



**View from the south side of the National Alpine Skiing Center**



**Plan**

The National Alpine Skiing Center is located in the Xiaohaituo Mountain area in the northwest of Yanqing Zone, which consisting of seven ski slopes with a maximum vertical drop of 900 meters.



# National Alpine Skiing Centre



**External view of the distribution plaza and racing end area**

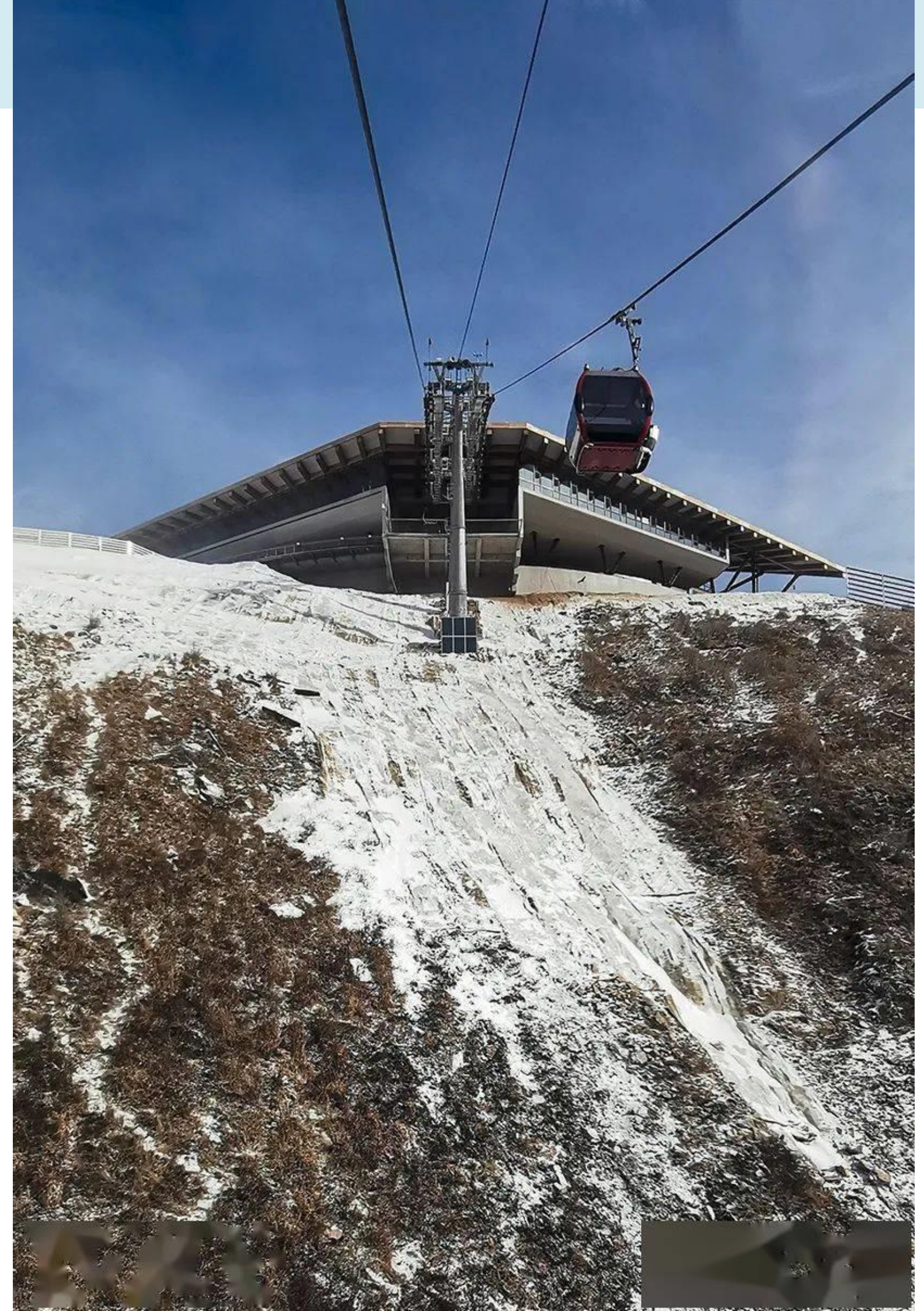
**The stadium will continue to be used after the Winter Olympics and can accommodate 5000 seats and 3500 standing seats.**



# National Alpine Skiing Centre

Starting from the cableway to the mountaintop departure area

Panoramic view





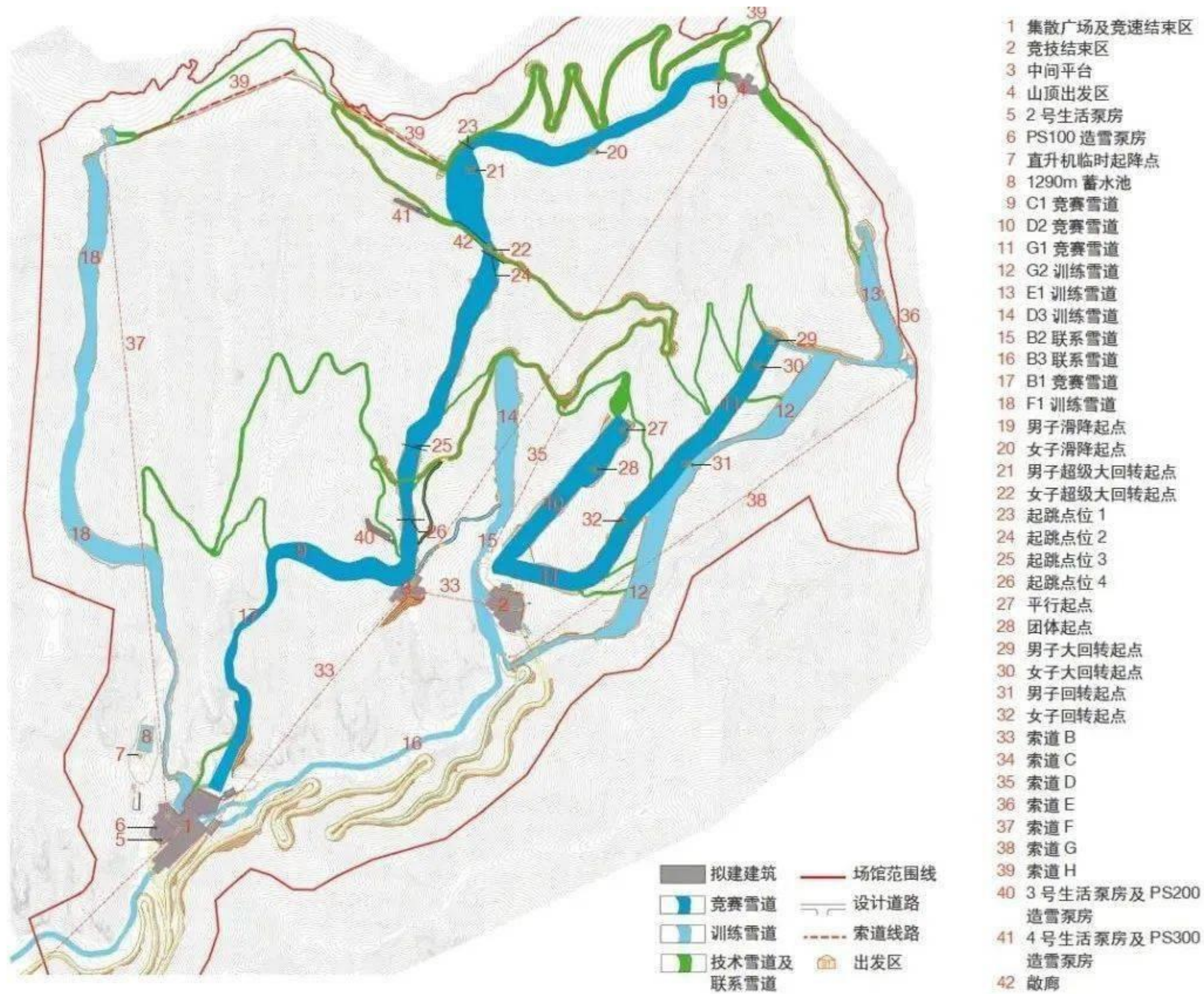
# National Alpine Skiing Centre



When constructing the track, it should make full use of the terrain and build according to it.



# National Alpine Skiing Centre



Racing trail

The outdoor skiing track mainly uses artificial snow making and requires a large amount of water.

Snow Track Layout of National Alpine Ski Center



# National Alpine Skiing Centre



**Competitive Skiing Track**

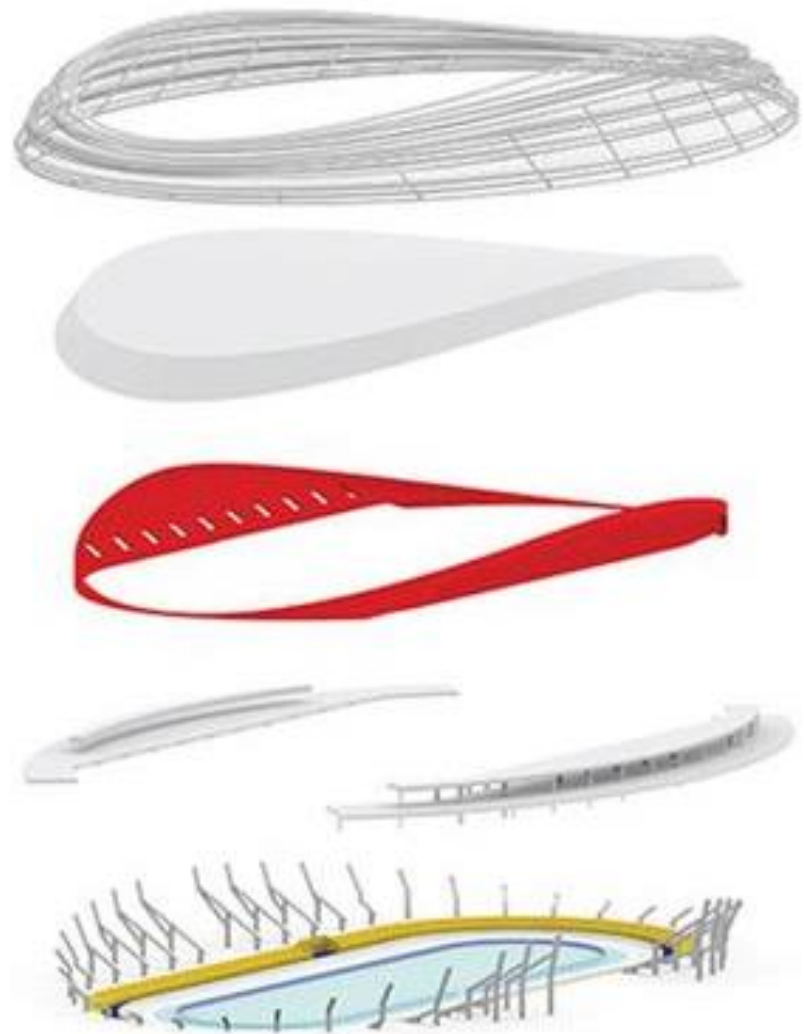
**There is sufficient water source near the center, and there are three gullies with base flow year-round. The water quality is excellent, and the annual flow rate is about 440000 cubic meters. Convenient water collection ensures the use of artificial snow making.**



**Technical Skiing Track**



# National Speed Skating Oval **"Ice Ribbon"** —Beijing Zone



NSSO Design Concept\_Populous

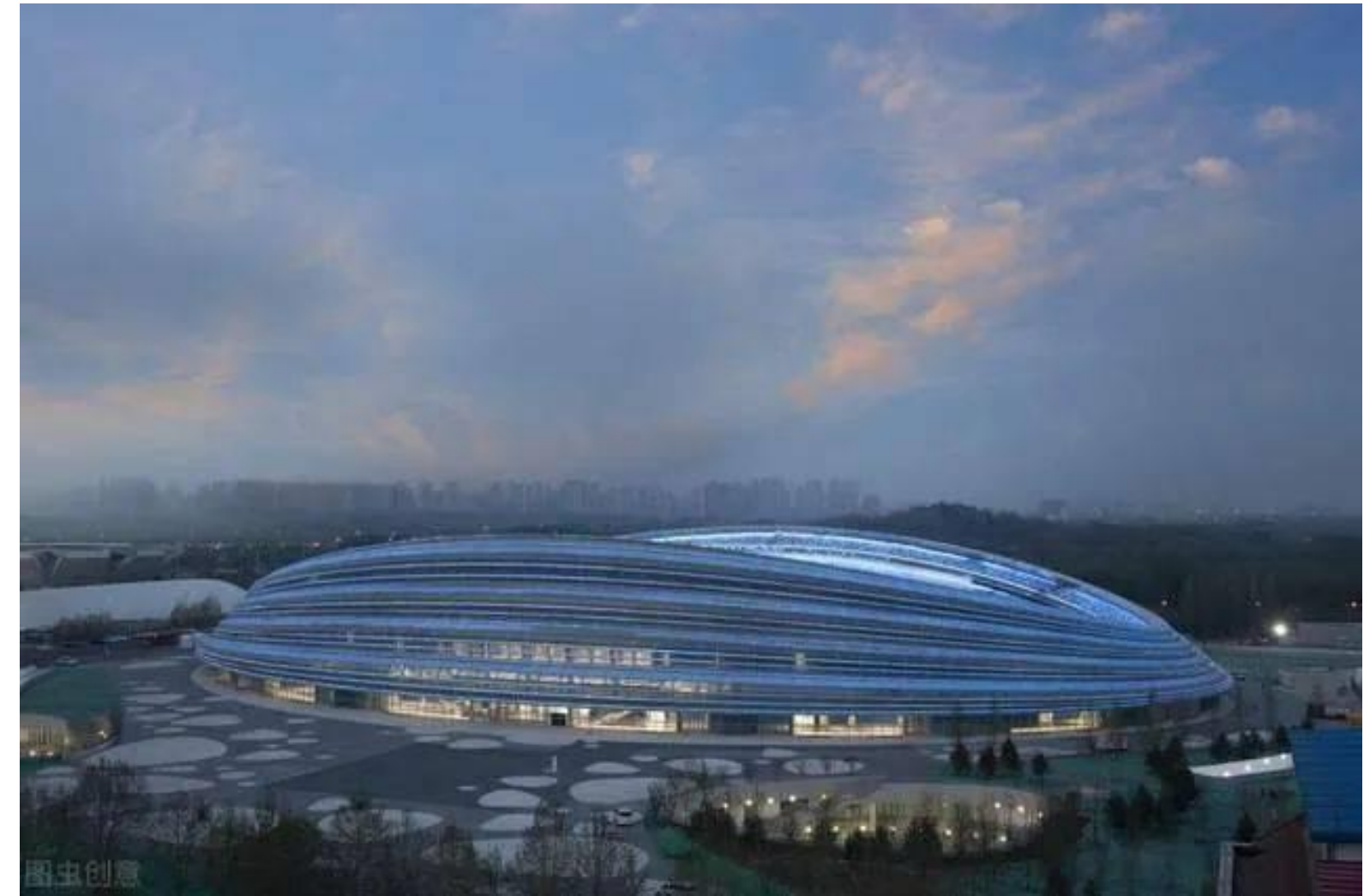
POPULOUS

The oval is located on the west side of the Olympic Forest Park at the northern end of the Beijing urban axis.





# National Speed Skating Oval



The overall shape of the building is elliptical, with "ice" and "speed" as design symbols, and the exterior has 22 flowing and luminous ribbon lines.



# National Speed Skating Oval

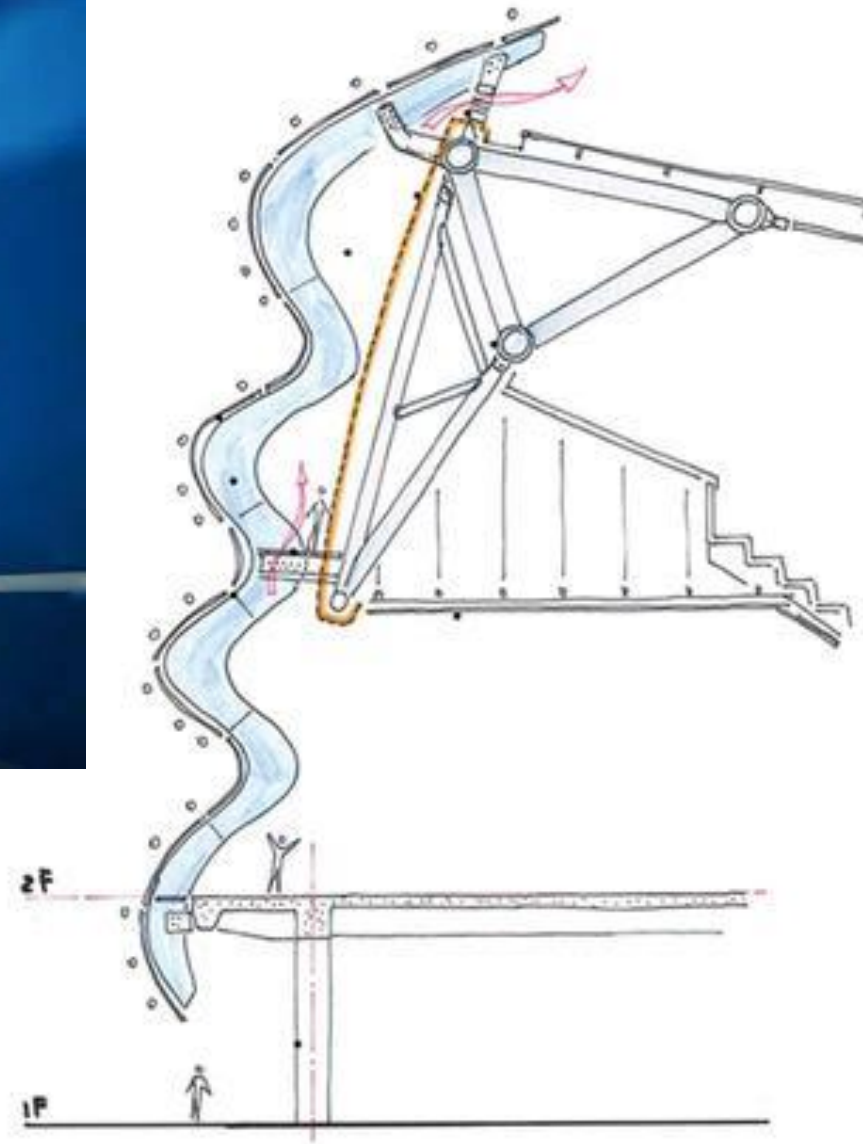
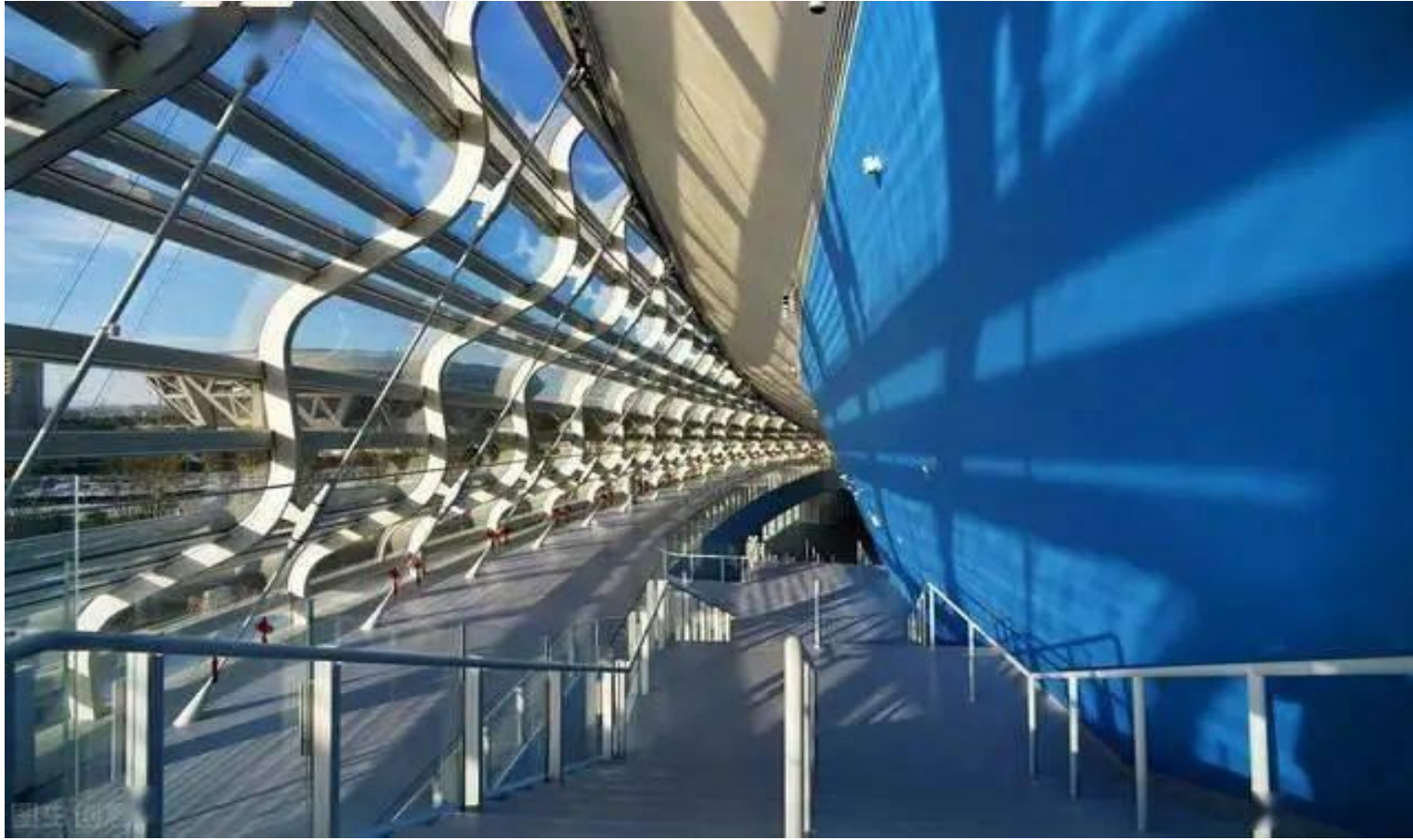


By Populous Architecture Firm and Beijing Institute of Architectural Design and Research



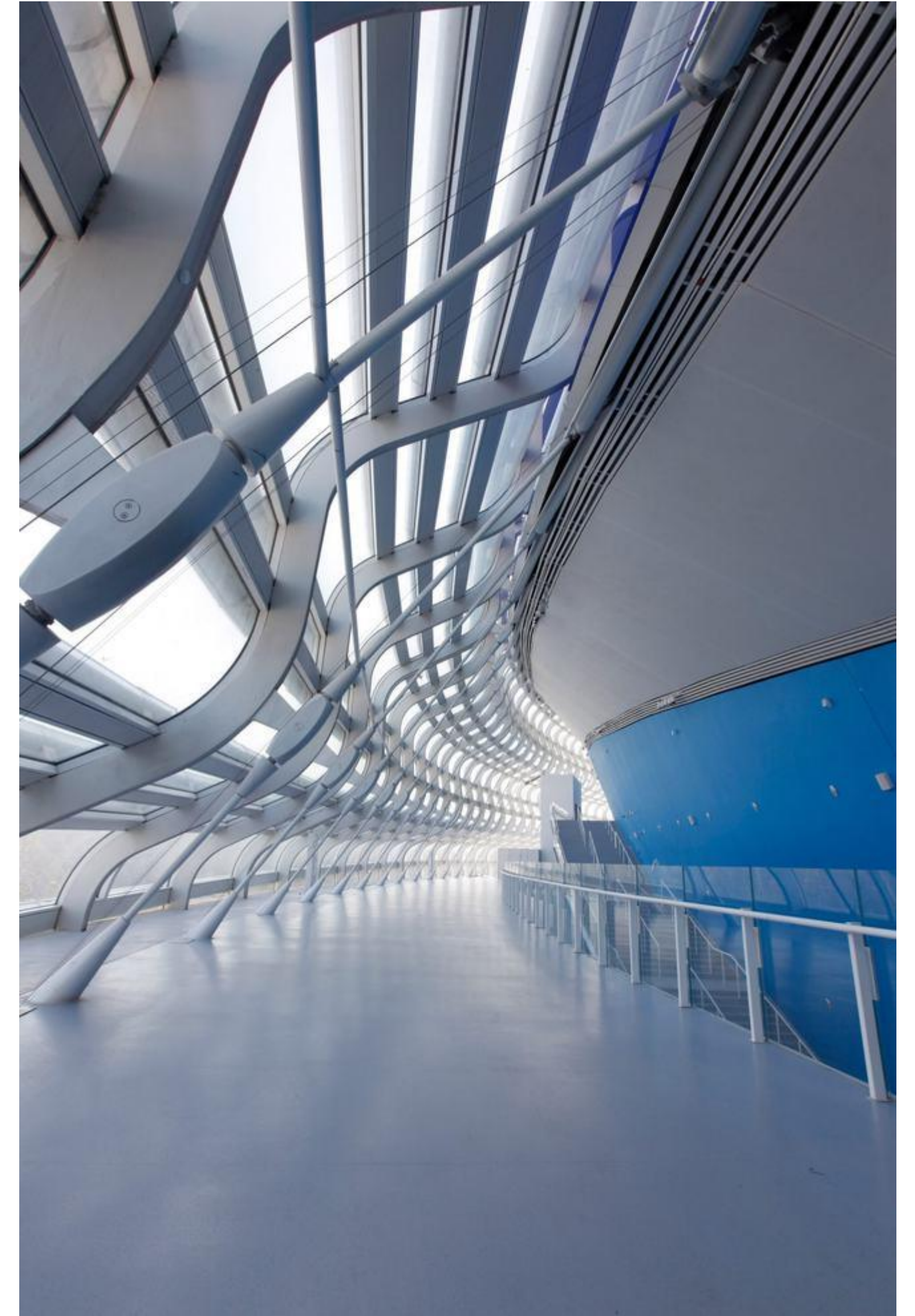


# National Speed Skating Oval



NSSO Design Concept\_Populous

**Populous stated that on the 400 meter long slide, there are 12000 seats, and every viewer can hear the sound of "every time the skates slide over the ice."**





# National Speed Skating Oval



东立面图 (奥林西路)  
EAST ELEVATION



西立面图 (林翠路)  
WEST ELEVATION

NSSO Design Concept\_Populous

POPULOUS

Elevations



# National Speed Skating Oval



The interior space of the oval also rotates and rises around an elliptical curve, symbolizing speed and passion.



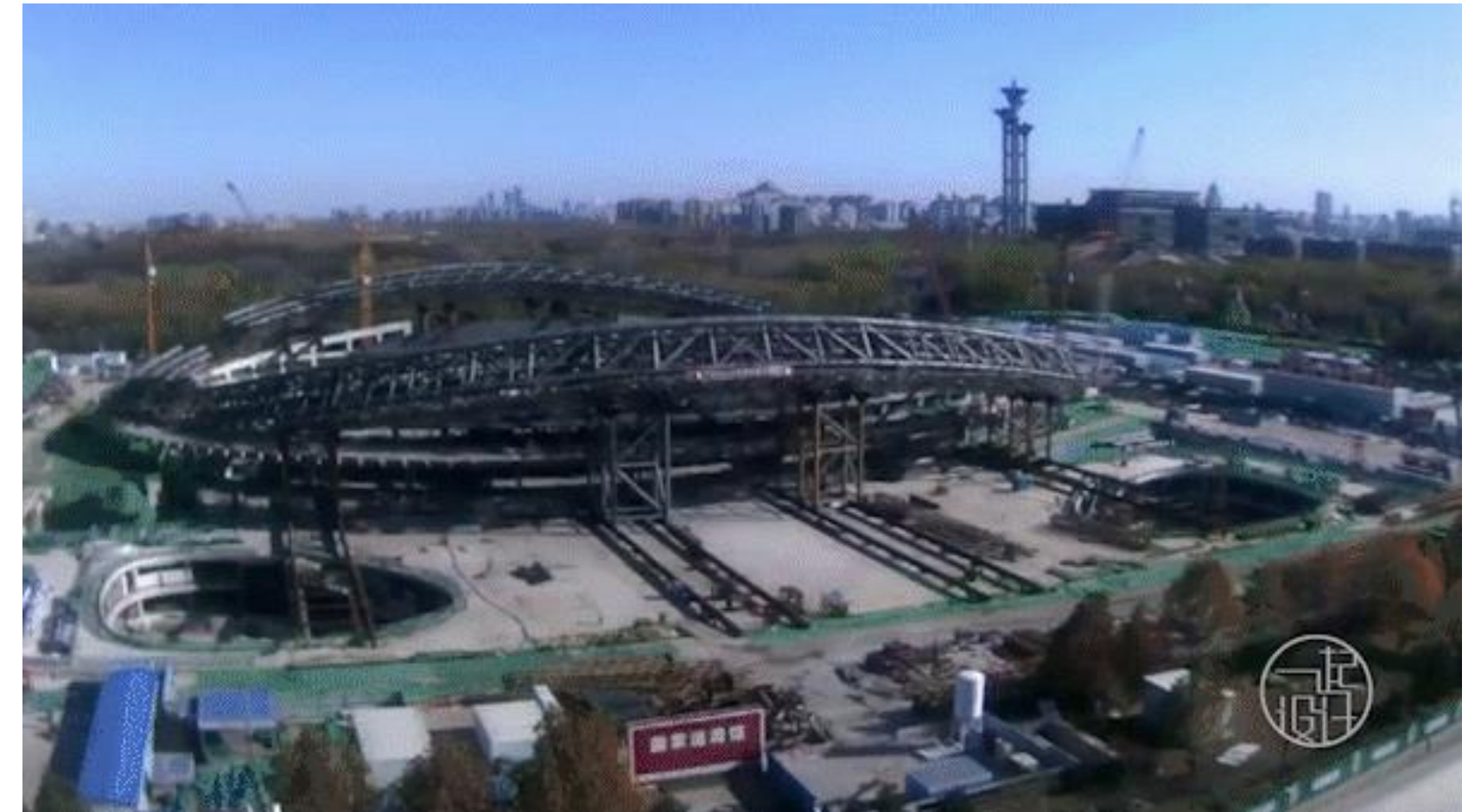


# National Speed Skating Oval



The ice surface area reaches 12000 square meters, and ice sports such as ice hockey and figure skating can be carried out simultaneously.

## Construction process





# Big Air Shougang "Snowy Flying" —Beijing Zone



The inspiration for the design of the big air comes from the combination of the jumping platform competition profile curve and the Dunhuang "Flying Apsaras" ribbon image. The steel structure design of the big air also reserves the possibility of future changes in the competition profile.

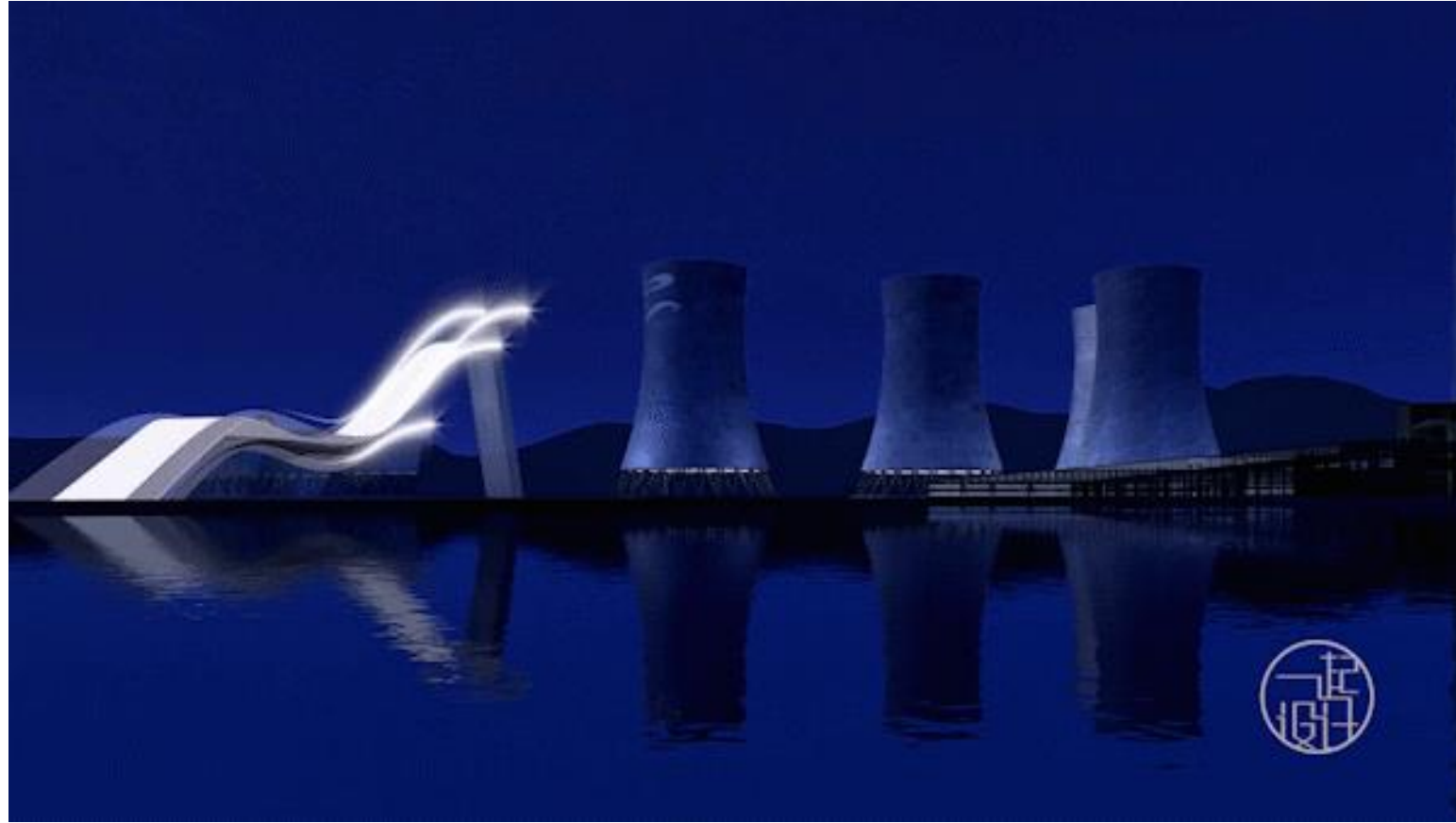
The Big Air Shougang which is Skiing Jumping Platform is located in Shougang Park that is former capital iron and steel plant, Shijingshan district, Beijing Zone.

By Tsinghua University Institute of Architectural Design and Research



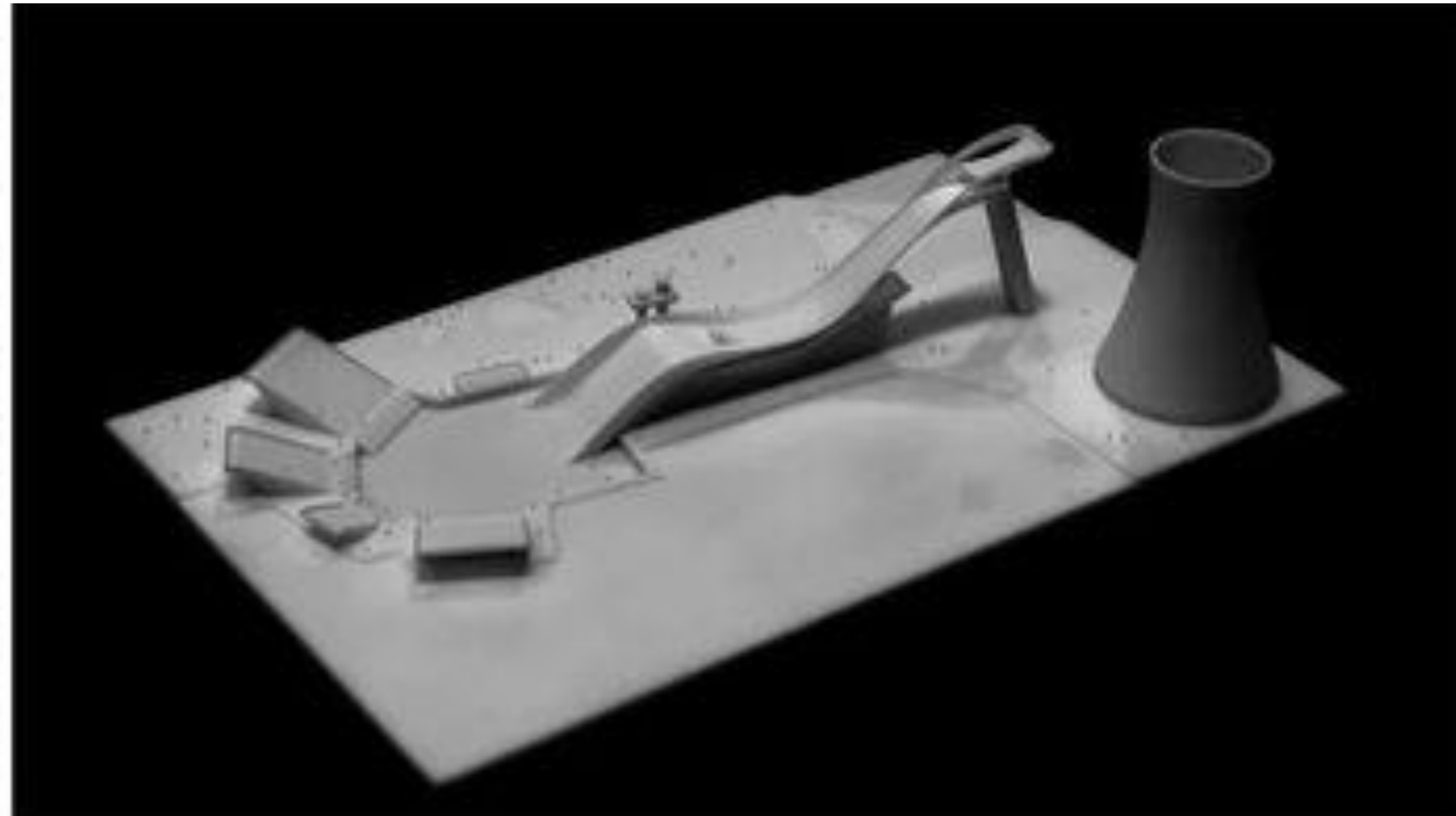
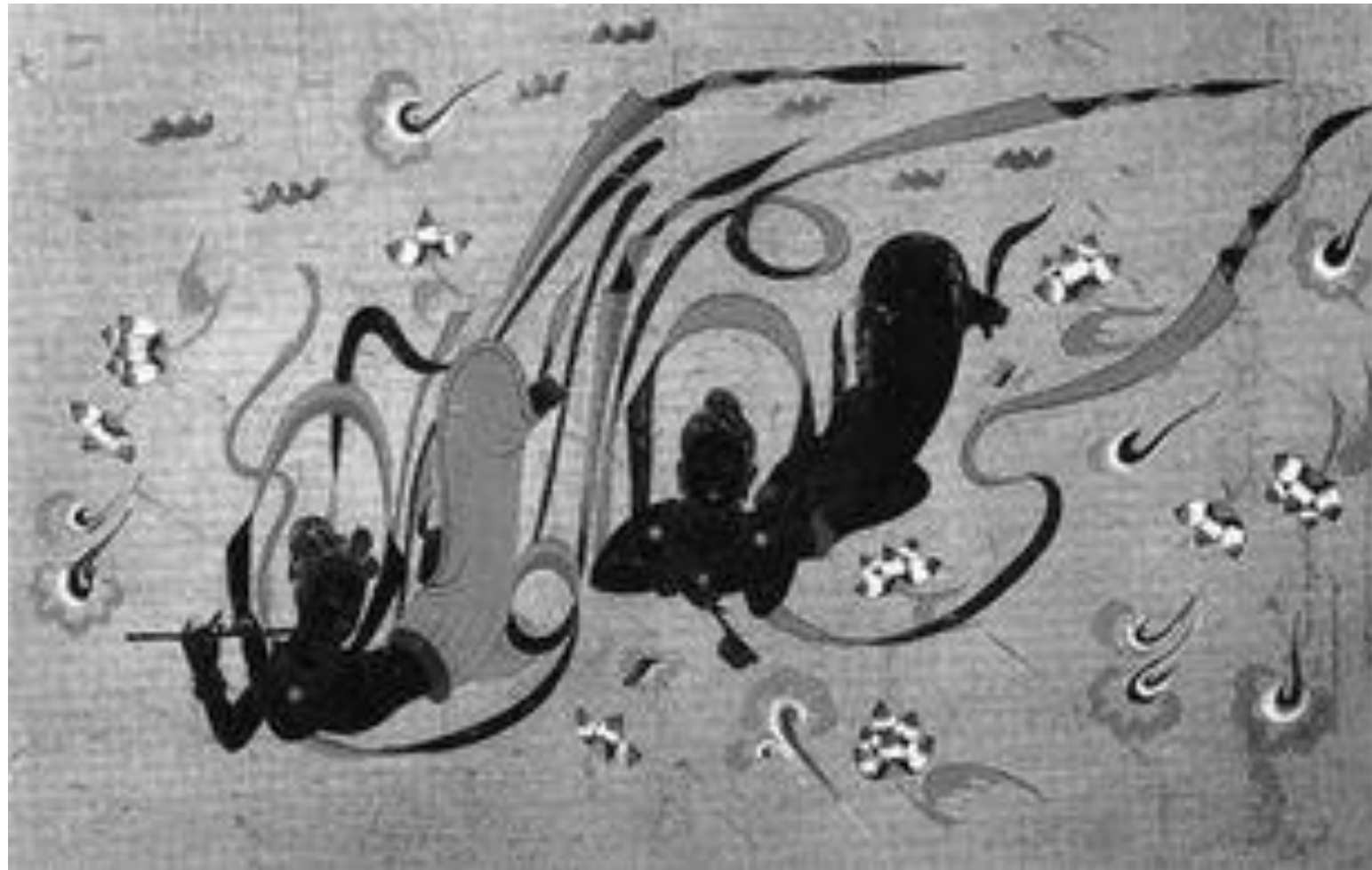


# Big Air Shougang



The characteristic style of **Dunhuang Flying Apsaras** is that it does not grow wings or feathers, relying on clouds instead of clouds. Instead, it relies on fluttering clothes and fluttering ribbons to soar in the air, with various forms and variations.

" **Flying Apsaras** " mural (left) and project model (right)





# Big Air Shougang



It is the world's first permanent platform for the sport of Big Air, and also the first competition stadium in the history of the Winter Olympics that directly combines the **reuse of industrial heritage**.





# Big Air Shougang

The outer surface of the Big Air is made of perforated aluminum panels that are easy to install and have a high degree of completion. It is another **innovative project that utilizes industrial heritage for urban renewal.**



It has a gradient color appearance based on the color of the Winter Olympics emblem and is built around the site of the in Shougang Park .





# Big Air Shougang

The main body of the Big Air is a steel structure, with a total height of 60.5 meters and a length of about 164 meters. The amount of steel used for the main structure has reached 4100 tons, with the usage of a large amount of high-strength and weather resistant steel. According to the designer's introduction, **the project has saved a total of 9.75% of steel and reduced carbon emissions by about 950 tons.**



**we will host events such as freestyle skiing and snowboard diving here**



# Wukesong Ice Sports Center "**Ice Diamond Flower**" —Beijing Zone

The Wukesong Ice Sports Center is the ice hockey training stadium for the Beijing Winter Olympics, located adjacent to Chang'an Street in Beijing. It is currently the **largest ultra-low energy** sports stadium in the country.



By integrating various energy-saving technologies in building envelope structures, energy and equipment systems, lighting, intelligent control, and renewable energy utilization, the energy consumption level is far lower than that of conventional buildings.



# Wukesong Ice Sports Center

The building functions are distributed on two underground floors and two above ground floors. The underground two floors are ice rinks and 1900 fixed seating audience areas, serving as training and warm-up venues for the Olympics.

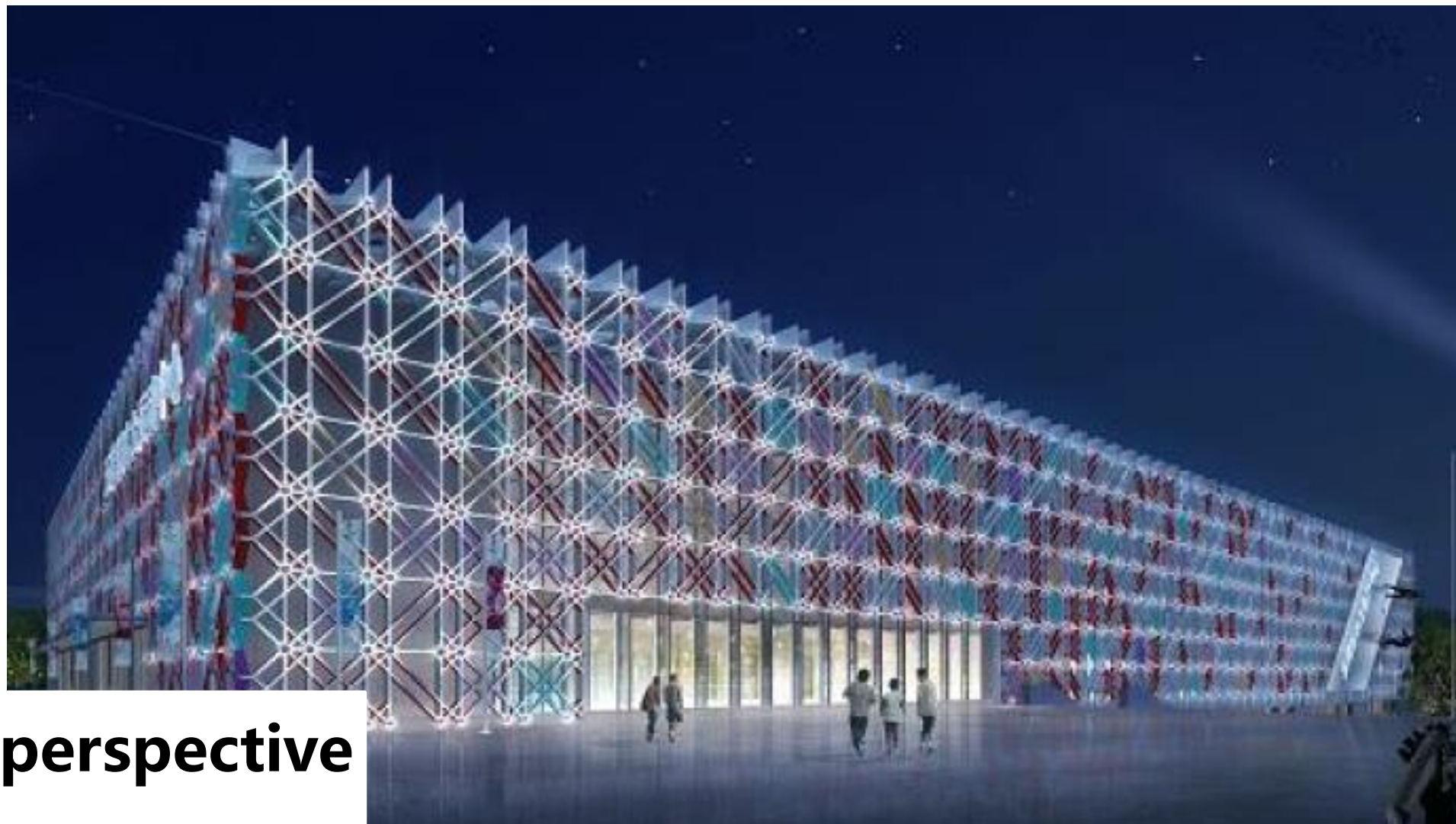


By ZXD ARCHITECTS

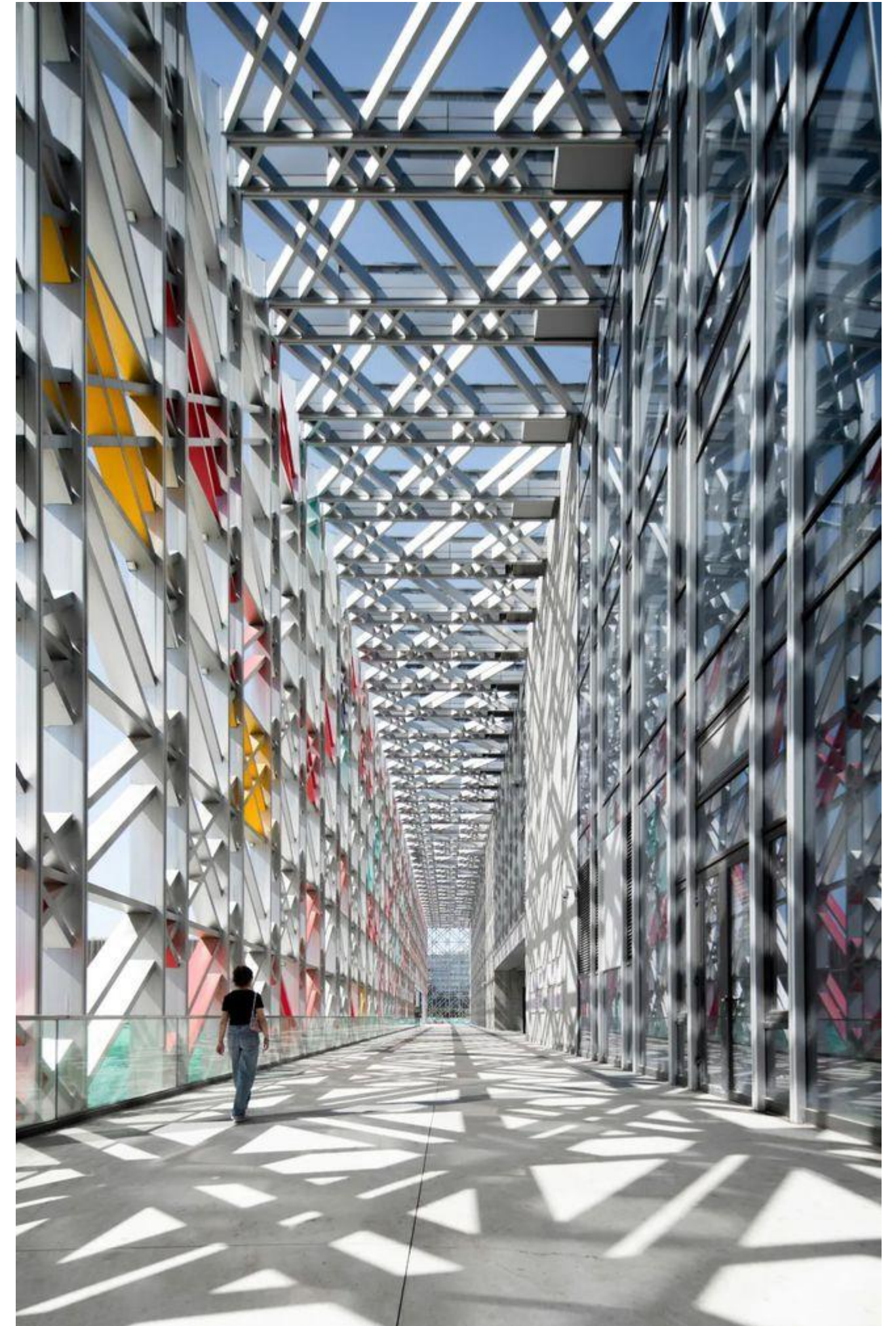


# Wukesong Ice Sports Center

The leisure viewing area is arranged around the ice rink, and the related supporting functional spaces can provide viewers with more diverse ways to watch the games. The two floors above ground are sports and cultural supporting spaces, as well as 910 theater spaces.



perspective



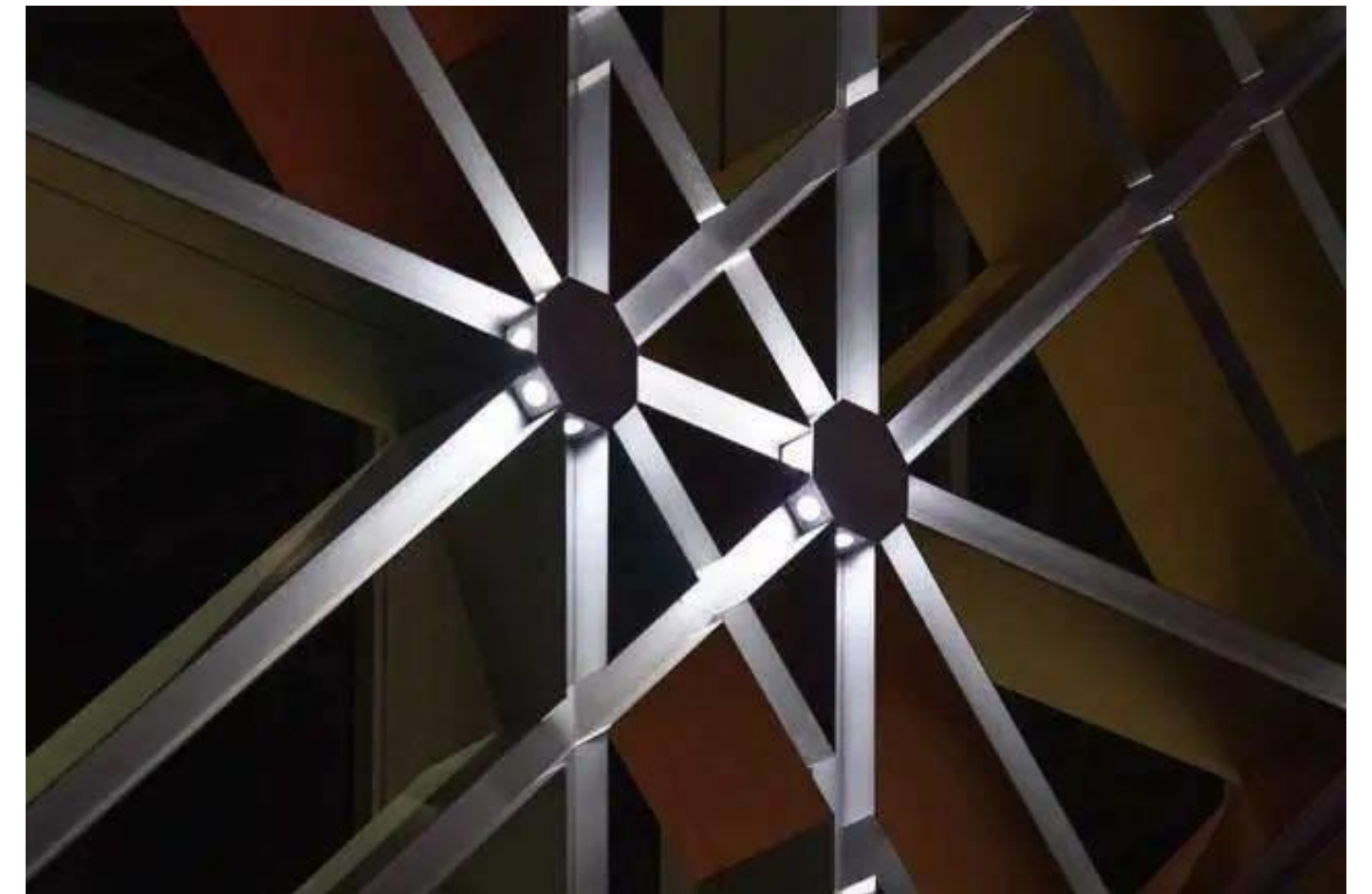


# Wukesong Ice Sports Center



In the **mystery of opaque transparency**, it evokes symbolic meaning and ignites people's enthusiasm and expectations for the Winter Olympics.

The architecture is like a collection of falling **"ice diamond flowers"** that aggregate into ice and snow texture images. The design aims to interweave and overlap these concrete image symbols with abstract architectural structures in perception.





## **3. Renewal and renovation for Winter Olympics**



# National Aquatics Center "**Ice Cube**"——Beijing Zone

The "**Ice Cube**" was the renovated venue of the "Water Cube" for the 2008 Olympic Games, which used intelligent technology to establish a swimming pool conversion ice rink.



By PTW Architecture Firm





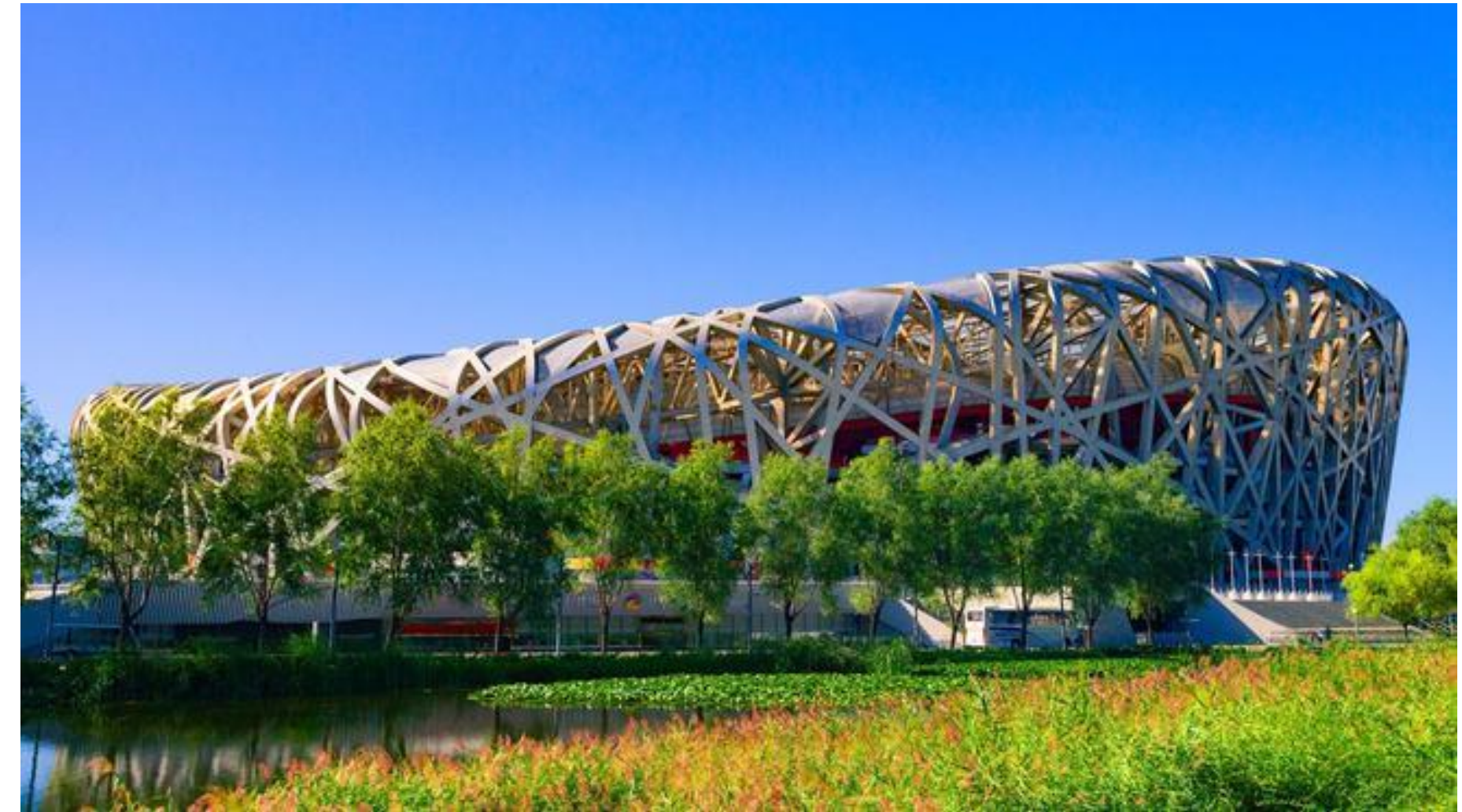
# National Aquatics Center



The "**Water Cube**" has been transformed into an "**Ice Cube**", allowing stadium to freely switch between "water functions" and "ice functions", while also possessing the ability to carry out water ice sports and various large-scale activities.



# National Stadium "Bird's Nest" —Beijing Zone



**The Bird's Nest, as the venue for the opening and closing ceremonies of the Winter Olympics, does not host any sports competitions, but it is also one of the venues that attracts worldwide attention.**

**By Pierre de Meuron, Jacque Herzog, China Architecture Design & Research Group**



# National Indoor Stadium “Ice Sail” —Beijing Zone



**During the 2008 Summer Olympics, artistic gymnastics, trampoline, and handball competitions were held in it. This stadium will host the ice hockey competition for the 2022 Winter Olympics. It can accommodate 20000 spectators.**

**By Glöckner Architekten GmbH Architecture Firm**



## **4. Supporting services for Winter Olympics**



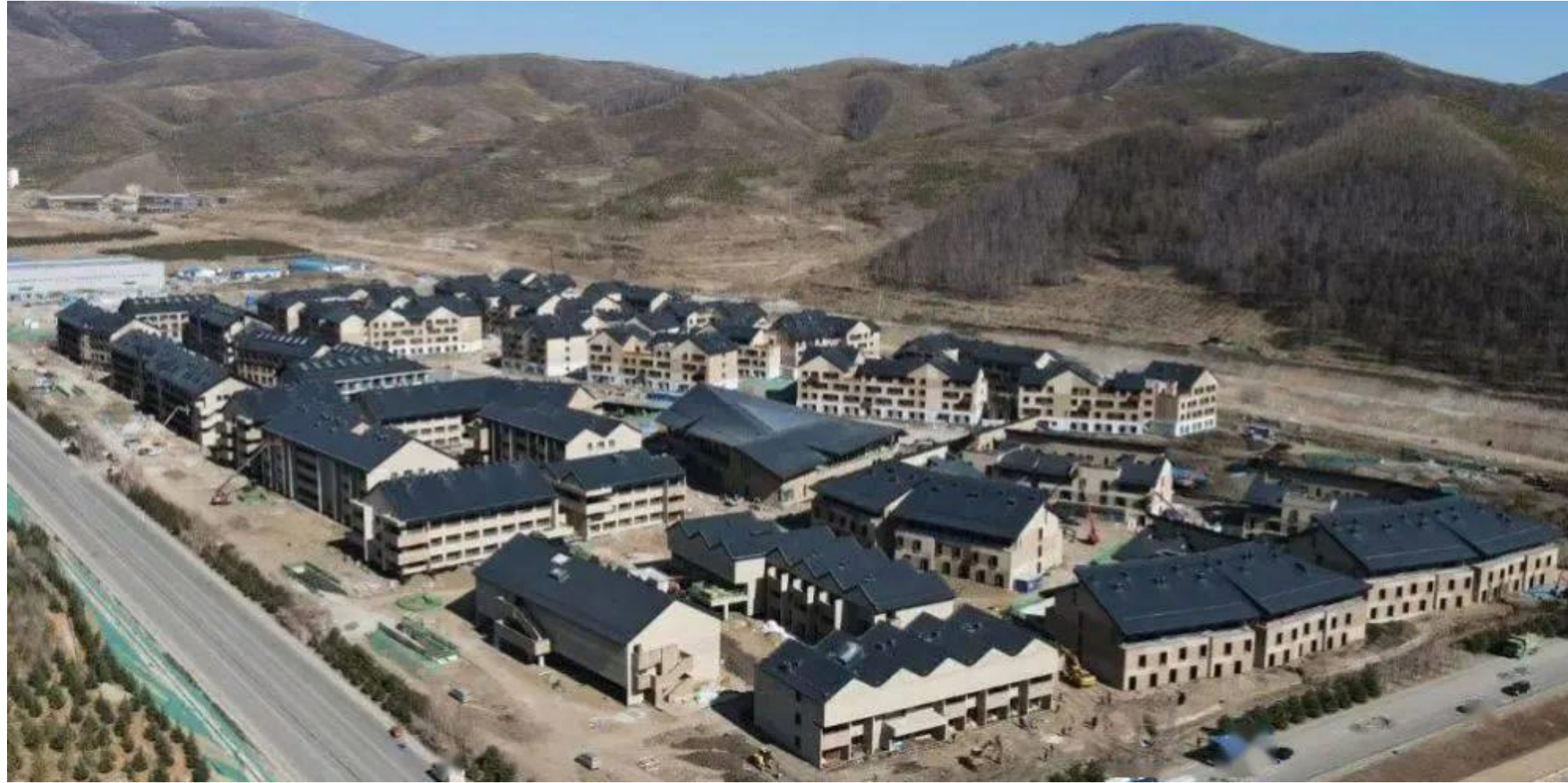
# Winter Olympics Village —Beijing Zone



**The total construction area is about 333000 square meters, located south of the Olympic Center and east of the central axis, with a total of 20 residential buildings. With the end of the Winter Olympics and Paralympics, this Olympic Village will become a public rental housing for the public.**



# Winter Olympics Village —Zhangjiakou Zone



**During the Winter Olympics and Paralympics, 2640 athletes and team officials will be accommodated, and after the competition, the location will be transformed into a commercial area.**

**Zhangjiakou Winter Olympics Village is located between the Ancient Poplar Tree stadiums cluster and Genting Snow Park, covering an area of approximately 24 hectares.**

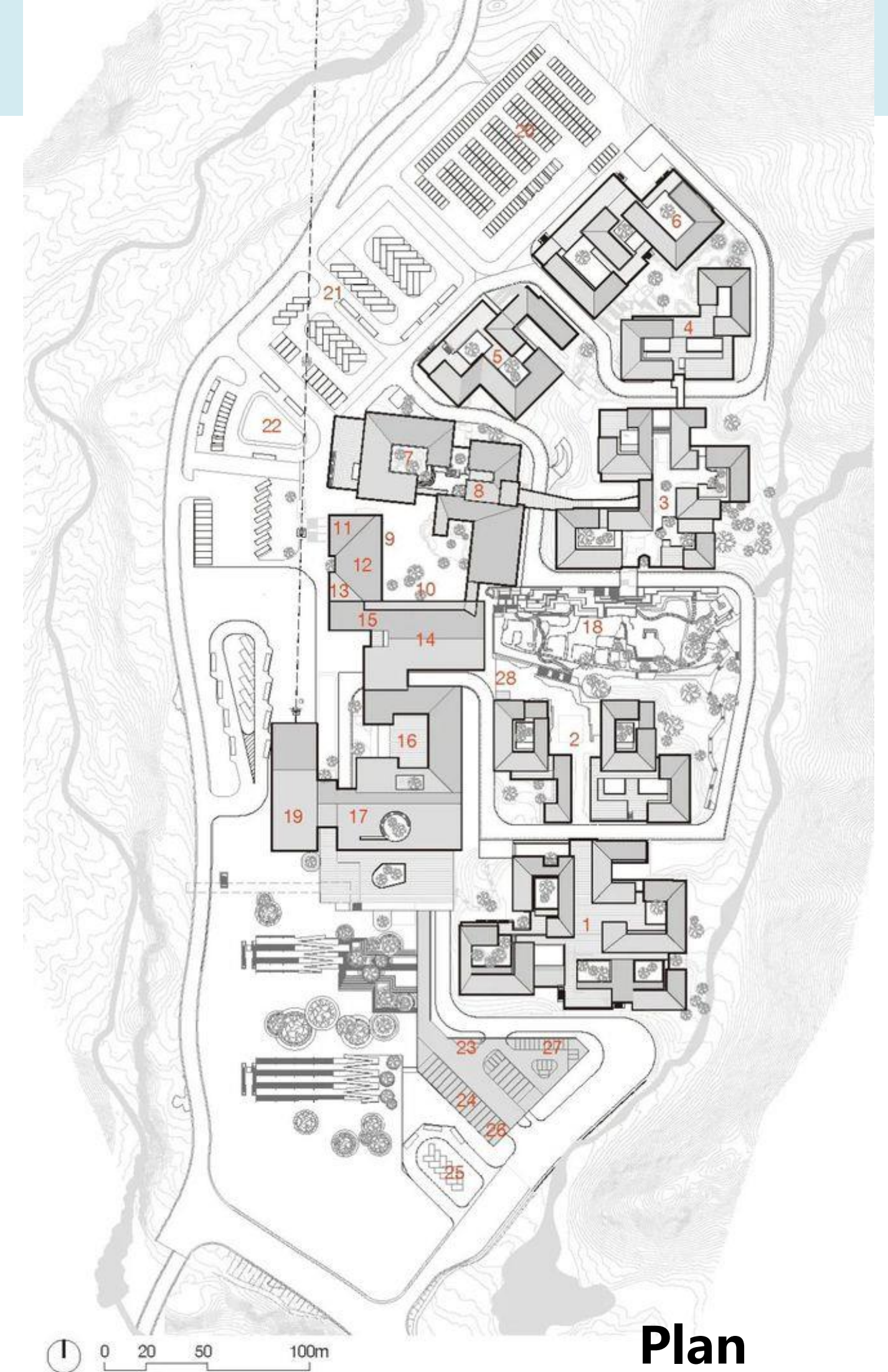




# Winter Olympics Village —Yanqing Zone



**Yanqing Winter Olympics Village (Winter Paralympic Village) is located in the eastern part of the southern core area of the Yanqing competition area.**





# Winter Olympics Village

**It is situated at the foot of Haituo Mountain, a naturally formed and relatively flat alluvial plateau. The site is 62 meters high in the north and low in the south, with a difference of 30 meters between the east and west.**



**View of the Winter Olympics Village from Tangba    Snowy Scenery from the National Sliding Center**

**Adopting a low rise, high-density "mountain village" style architectural layout, the semi open architectural courtyard is built along the mountain.**

**By China Design and Research Institute**



# Winter Olympics Village



**Athlete group courtyard**



**Post Olympics hotel public space**

**The total construction area of Yanqing Winter Olympics Village is 118000 square meters (91000 square meters above ground), providing 1430 beds and reserved areas for athletes and team officials during Olympics.**



# Winter Olympics Village



**Post Olympics hotel public space**



**Realistic view of athlete rooms during Olympics**

**It will be opened to the public as a leisure resort hotel after Olympics.**



**We are looking forward:  
Sustainable Architecture in Winter Sports:  
Building for the Nordic World Championship in 2031 in Ramsau am Dachstein**





# Reference

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