# TEMPORALITIES

Flexibility and adaption in large scale structures
- in connection with the 2024 Paris Olympics


CHALMERS

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# TEMPORALITY

/ˌtɛmpəˈralɪti/

**Noun**
**Plural noun** Temporalities

Temporality is traditionally the linear progression of past, present, and future.

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# 1.0
# Abstract

**”HOW LONG A BUILDING WILL AND CAN BE USED DEPENDS VERY MUCH ON THE BUILT-IN FREEDOM OF USE AND THE BUILDING’S FLEXIBILITY.”**



# 1.0
## Abstract

**IS THERE A WAY IN WHICH ARCHITECTURE CAN STAY FLEXIBLE OVER TIME?**

Temporality is traditionally the linear progression of past, present, and future. What design can keep up over time with unforeseeable developments and program changes, and adapt itself to an ever-changing urban environment, as well as to the constantly changing needs within the building?

This thesis is exploring how architecture can respond to constantly changing parameters, while influencing or defining them at the same time. In the urban and social transformation of a tomorrow - in connection with the Olympic games for Paris 2024, it is a search for a solution, where the aftermath of the games can change over time within the existing structure - and provide a change of use over time.

One way to make a building as self-sustaining as possible is to allow it a flexible structure. The discussion of flexibility in architecture and urban planning is tracing back to after the second world war, much influenced by Team 10, Archigram, the metabolism movement in Japan and the 1956 Manifesto by Yona Freidman. When it comes to the planning of future Olympic Games, and its long-term investment leaving a legacy behind - sustainability becomes an important aspect. Seeing it from a sustainable point of view, the often afterwards neglected arenas asks for architectural solutions to give them a future purpose.

How long a building will and can be used depends very much on the built-in freedom of use, and the buildings flexibility. If the structure of a building is seen as a skeleton in which you can adapt the content depending of the changing needs over time - one might find a solution of prolonging its lifespan. This thesis explores the relation between building flexibility and its influence on future planning, through the design and predictions of an Olympic stadium and its legacy use. It aims to make the project successful both during the Games, and work with the potential of transforming it over time, into a part of the urban context with mixed usage, after the temporary games have passed.

# 2.0
Objectives

”A REOCCURRING GLOBAL EVENT WHICH COULD BENEFIT LARGELY FROM HAVING A MORE SUSTAINABLE APROACH.”



# 2.0
Objectives

## WHY CHOOSE TO WORK WITH LARGE SCALE STRUCTURES?

I believe that by working with a large-scale project, it may also have a larger impact on the urban context and becomes more relevant to touch questions of prolonging the lifespan of the building. It interests me to work with large scale structures in relation to the problematic of “Bigness” scale (Koolhaas, 1994) and its impact in the city. Due to its enormous scale, such buildings are often no longer part of any urban tissue. Therefore, in the best scenario they just cope with the context, at worst they simply ignore it. By introducing flexibility which can enable changes of future needs within the structure, it might pose a solution of making these types of large-scale buildings more integrated and related to its context - instead of just coping with it. It is challenging to work in a large scale, and by doing so I’m not only pushing myself but also the boundary of the project.

## WHY CHOOSE TO WORK WITH THE OLYMPIC EVENTS?

When challenged with the questions of large-scale structures and their problematics being answered by adaption and flexibility as a possibility to prolong their lifespan - where better to find these types of problematics than in a context of the Olympic games. It’s a subject of high relevance seeing that it’s a temporary, reoccurring global event which could benefit largely from having a more sustainable approach. Given the amount of investment, and huge environmental footprint due to new infrastructure and new built structures in relation to the Games - in contrast of its short lifespan - one must critically analyze how the investment could contribute with other functions more needed afterwards. This may be done by planning for the structures to become part of the city, leaving a legacy behind after the temporary events by providing new functions which are able to change over time.

## THE IDEAL ARENA VS. THE IDEAL AFTERMATH

When it comes to the user experience of an arena there are two main groups of interest. The spectators and the athletes. It is key to make it a good spectator experience during the games, as well as give the athletes the perfect conditions to perform at their top level.
When it comes to experiencing the games from the spectator's point of view - it is primarily focus on having a good view of the sports as well as being shielded from the weather. For the audience to be engaged they need to be as close as possible to where the action is happening - which is hard to accomplish for an average Olympic arena in the size between 60-80 000 spectators. Therefore, additional aids might be needed in form of individual screens and speaker system. The audience can then choose to have an overview of what's happening in the arena, as well as looking at more zoomed in pictures where each person may choose which event they want to focus on. For each step of making it an ideal arena one must also consider how it could be used after the games. Can the individual screens for example be a governmentally sponsored learning aid for schools in the city afterwards? How does one set up the parameters of the fixed elements within the arena so that they could be used when the arena is converted into something else? Where does one find the balance of what needs to be flexible and what can be fixed structures and still used for different purposes?

For example, one of the key parameters for when the structure is used as an arena - is the angle of sightlines for seated spectators. This affects the angle of the stands where you have a certain span to play in when choosing the angles - too wide angle and there will be blocked views for the audience, or too steep angle will lead to impossible circulation around the stands. When converting the structure into post-event design, for example housing units - there's also the parameters of the maximum depth of where the daylight reaches into the apartment. One must therefore find a balance which fulfills both needs. This could be done by constructing low resolution steps in the permanent structure, equivalent in size to one floor, and allow for being filled up by temporary seats in between the steps, when used for the purpose of an Arena. One can plan for adaptation, but only try to predict the future needs of the structure in a long term perspective. Therefore, the more flexible the structure can be for future changes, the better in terms of prolonging its lifespan.

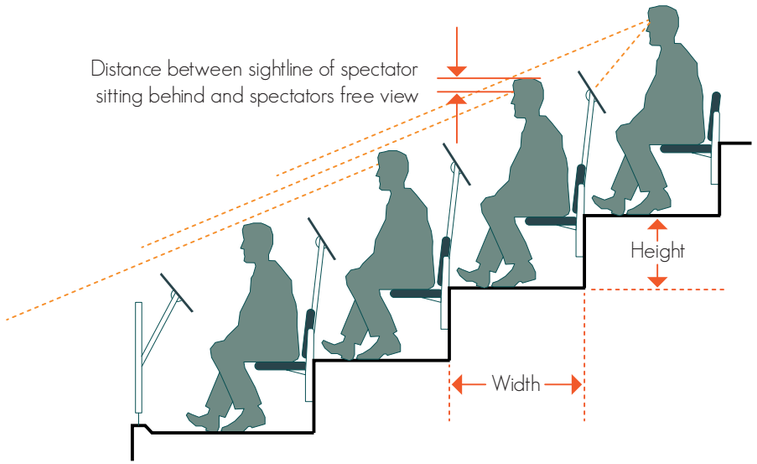



**DIAGRAM I**
Angles of sightlines for seated spectators

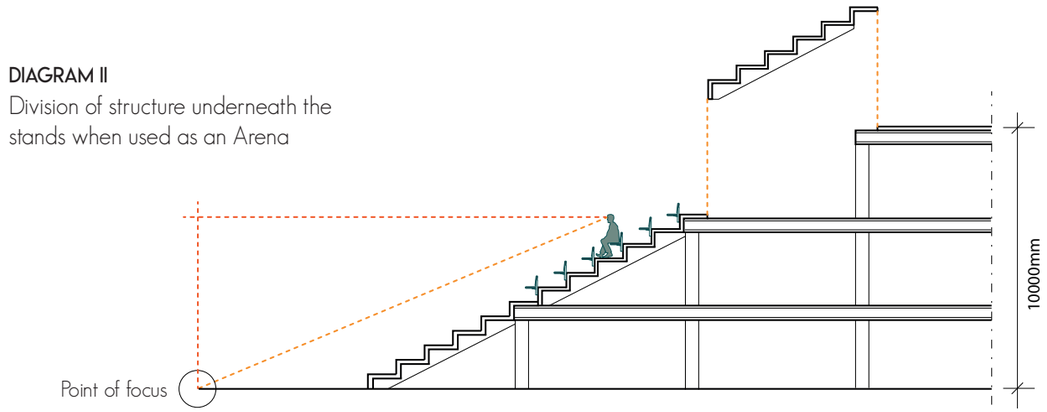



**DIAGRAM II**
Division of structure underneath the stands when used as an Arena

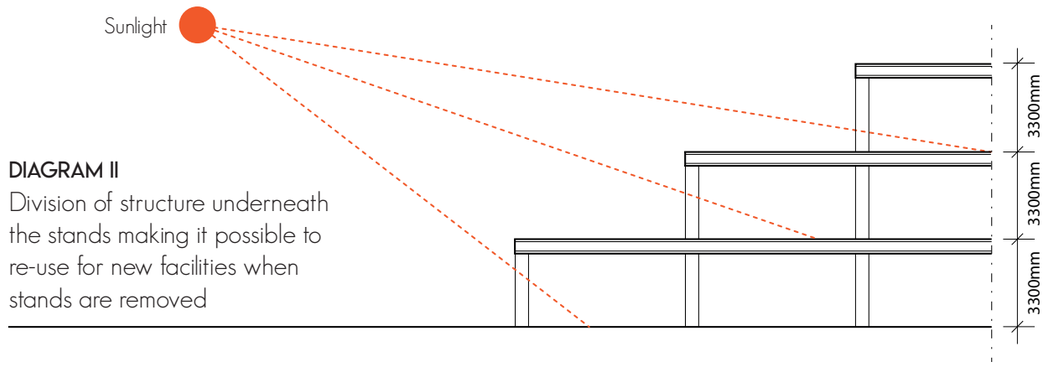



**DIAGRAM II**
Division of structure underneath the stands making it possible to re-use for new facilities when stands are removed

# 3.0
Background

> **”THE GAMES HAS BEEN HEAVILY CRITICIZED FOR SPENDING EXCESSIVE AMOUNTS OF MONEY ON THE VENUES WHILE FAILING TO UTILIZE THEM AFTER THE COMPLETION.”**
>
> (Govan, 2011)



# 3.0
Background

According to the bid for Paris hosting the Olympic games in 2024, they aim to leave a 55 percent smaller carbon emission footprint than the Olympic games London 2012, widely seen as a reference of sustainable games. One of the main factors of winning the bid was the promise of maximum use of existing facilities. Where no long-term venue legacy need exist, or can be justified, Paris intends to use temporary and demountable venues. They have set up a goal of using 95% existing or temporary venues during the games and largely renovate existing facilities to meet the demands instead of investing in new ones. How they will in fact reach that outcome is still very much in the future.

The strategical planning from Paris making it able to win the bid for 2024 is much thanks to how well they respond to the new 2020 Agenda. The International Olympic committee (IOC) have in 2017 introduced the 2020 Agenda, where specific frames were developed to guide the cities applying for hosting future games. By regulating these frames, the IOC puts pressure on the development of the Olympics to take a more sustainable approach. The Agenda 2020 includes definition of what the IOC considers as positive initiatives, where the usage of existing and deployable facilities is one of the key elements the committee look upon. Also, a great emphasis is put on the possibility to use existing, as well as long-term investment in infrastructure and facilities to be used after the Games.

Why the international Olympic committee have set up these new guidelines have much to do with the fallout of previous Games, where the outcome has not always been positive. Following texts in this chapter will briefly look into the history of the Olympic games with some chosen examples of their outcome and effect on the cities. Flexibility and their effects upon urban planning and architecture will also be further discussed as a possibility of how to deal with the problematics often found in relation to the Olympic games.

Start of modern summer Olympics


1896
**ATHENS**


1900
**PARIS**


1904
**ST LUIS**


1908
**LONDON**


1912
**STOCKHOLM**


1920
**ANTWERP**


1924
**PARIS**


1928
**AMSTERDAM**


1932
**LOS ANGELES**


1936
**BERLIN**


1948
**LONDON**


1952
**HELSINKI**

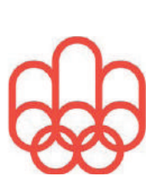

1956
**MELBOURNE**


1960
**ROME**


1964
**TOKYO**

1968
**MEXICO**

1972
**MUNICH**



1976
**MONTREAL**

1980
**MOSCOW**

1984
**LOS ANGELES**

1988
**SEOUL**

1992
**BARCELONA**


1996
**ATLANTA**


2000
**SYDNEY**


2004
**ATHENS**


2008
**BEIJING**


2012
**LONDON**


2016
**RIO**


2020
**TOKYO**


2024
**PARIS**



*All official Olympic logos retrieved from www.olympics.org, site of the official Olympic organisation

# 3.1
## Background

### A brief history of the Olympic Games

The first known Olympics were held in 776 B.C. at a site called Olympia in southern Greece. From the beginning, the Olympics were a religious event where athletes competed to honor the Greek god Zeus. The program initially held competitions where only men were allowed, but parallel to the events a smaller festival were hosted for women. A.D 394 the ancient games ended when the Christian emperor Theodosius I, banned all pagan festivals. In 1896 the games were revived in Athens, and the start of what we today refer to as modern Olympics. In 1924 the Winter Olympics were introduced, and today we alter between the winter and summer games every second year. (Little, B 2016)

As the Olympic games have developed through time, from the Olympiads in ancient Greece to the modern Olympics - they remain an important cultural heritage and now symbolize a global meeting point for people. From the beginning of the modern games inviting 14 nations and 241 athletes - it has grown to become the world's largest sports events with no less than over 200 nationalities and more than 11 000 athletes participating in the latest summer games in Rio. Although it is a festive event which brings the worlds eyes upon the hosting city and contributes with a rising tourism - there are also negative sides to take into aspect. Extremely large environmental and economic impact as well as often seen negative social aspects in terms of gentrification of the rapidly developed areas.

This is largely to do with the fact that most venues largely fall out of use after the big events. These large-scale buildings are not adapted to host other functions than the one of arenas, which is problematic since they are built into a size which may never be manageable for later events. Already in the beginning of the 19th century, arenas were built to host up to 90 000 spectators. Now the *International Olympic Committee* has set up a roof for future games in their 2020 Agenda, to try to reduce the overall size of the Games. (www.olympics.org)



**LOOKING INTO THE OUTCOME OF PREVIOUS OLYMPIC GAMES - WHAT WILL HAPPEN TO THE CITY'S OLYMPIC VENUES ONCE THE GAMES ARE OVER? A LOOK AT FORMER HOST CITIES SUGGESTS THE FACILITIES COULD FACE AN UNCERTAIN FUTURE OF DECAY AND NEGLECT.**

### ATHENS 2004
The Games has been heavily criticized for spending excessive amounts of money on the venues while failing to utilize them after the completion of the Games. There was an initiative by the government to transform the Olympic village into housings, but the project collapsed even though thousands of citizens signed up for the planned housings. Today most of the Olympic venues are deserted. (Govan, 2011).

### LONDON 2012
Most sustainable games in history; New innovative ways of building structures as well as thinking on a larger perspective on sustainability. The site was strategically chosen due to its location in connection to existing railway and the river, allowing building materials to be transported to the site in a more sustainable way. It was also the beginning of working with flexible structures in connection to the Olympics. Many of the arenas were planned only to exist during the games, and therefore designed in a way in which they could be easily reassembled and relocated to host the same function in a different location. Notable is also the work of the Olympic park, the efforts of bringing a biodiversity onto the site and leaving behind a public park for the citizens to enjoy not only during but also after the games. Great emphasis was put on how London's site would be integrated with the city, after the events. But it has also been criticized for gentrifying the area instead of renewing it for the people living there.

### RIO 2016
First down scaled Olympics, trying to focus on the games themselves more than the status of hosting the games. On the contrary of only building new arenas, many existing arenas were renovated and prepare for the purpose, especially ones built for the world championships in football just two years earlier. Like in London, some of the arenas like the aquatics center where deployable. However, the negligence after the games were palpable as the arenas once again were left to decay and the deployable structures left standing empty.
The games have also been accused of being corrupt and in many ways controversial seeing the huge investment for sports arenas while not solving the existing housing shortage. The athlete's village was turned into luxury condos to pay for their construction - but now more than two years after the games, 93% of the apartments are still vacant. (Davis, S 2017)
During the opening ceremony they initiated each athlete to plant a tree, and in that sense symbolically give something back to the city.

# 3.2
## Background

### Flexibility and adaption

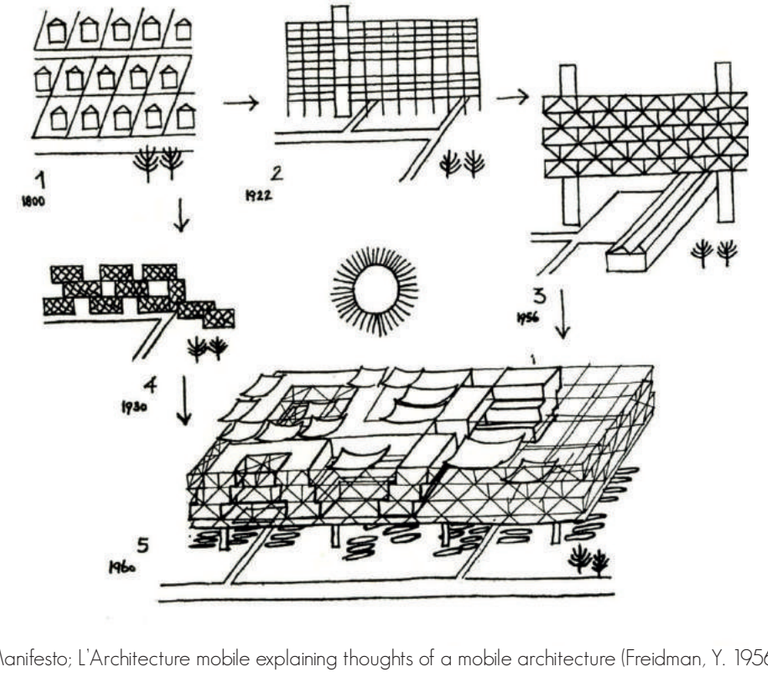
Flexibility - the ability to be easily modified - has within architecture been a subject present and heavily discussed ever since the post second world war reconstruction of our society.

It has been more than half a century since Metabolism was launched during the 1960 World design conference in Tokyo. Kenzo Tange's Tokyo Olympic stadium showcased modern Japanese architects' technological aesthetics. The world exhibition in Osaka six years later strengthened Metabolism's identity with a master plan by Tange and numerous pavilions by the Metabolist and like-minded Western architects characterized by megastructure and futurist design. (Zhongjie, 2016)

Reyner Banhams book *Megastructures,* associated Metabolism with the movements of megastructures in the West, between the mid-1950s and early 1970s. The authors subtitle given to the book; *Urban futures of the recent past*, refers to the utopian quality of the ambitious mega structural concepts and questions their relevance to contemporary architecture and cities. This much due to that the outcome of megastructures in the real world, hardly matched its theoretical promises.
In the book, Banham also ironically describes mega structural projects as "dinosaurs of the modern movement". (Banham, 1976)

Opinions regarding these avant-garde movements of the sixties, including Team 10, Archigram, Super Studio, Yona Freidman and the Metabolism movement, have undergone a considerable transition in architectural criticism in recent years where one can see a strong revival of the interest studying these theories. In Rem Koolhaas book from 2011; *Metabolism: Project Japan*, he interviews among others the Japaneese architect *Arata Izosaki* who explains the huge influence Team 10 had on the evolvement of Metabolism in Japan. (Koolhaas, 2011)






Manifesto; L'Architecture mobile explaining thoughts of a mobile architecture (Freidman, Y. 1956)

**"THE STRUCTURES THAT FORM THE CITY MUST BE SKELETONS, TO BE FILLED IN AS DESIRED. ADDITIONS TO THE SKELETONS ARE DEPENDENT ON THE INITIATIVE OF EVERY INHABITANT."**

(Freidman, Y. 1956)

Principle 8 taken from "Ten principles of new architecture" in the Manifesto: L'Architecture mobile. The underlaying principle in the theory of Freidman, is that design activity should be left to the occupants. A precondition for the application of this theory is that occupants need to be instructed on the consequences of all decisions they make during the design process.

Freidman's point is that architects are incapable of seeing to each individual preference of the occupants, the number of occupants and their mobility makes this impossible. Architects are therefore tempted to design buildings that reflect their own personal preferences, but architects do not live in the buildings they make. This design process results in that the buildings end up not being ideally suited to the needs of the occupants. By keeping the building adaptable for the needs of the occupant, it can be altered and modified at a later stage if desired. By introducing flexibility and enable changes of future needs within the structure, maybe it would be possible to make buildings more adaptable to its context, and changes of time, instead of just coping with it.

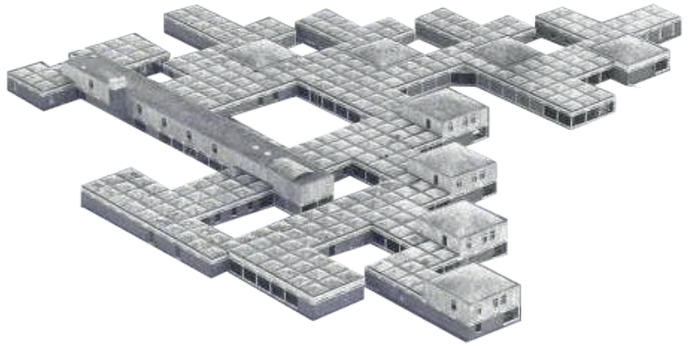
# 3.3
## Background

### Open vs. Closed structures

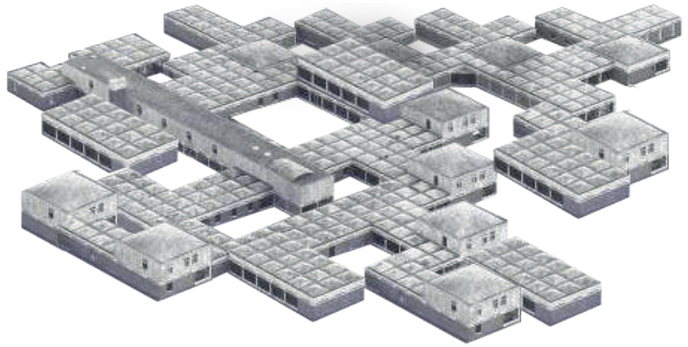
Another way of looking upon flexibility within architecture or urban planning is as open or closed structures. As Herman Hertzberger discuss in the article Architecture and structuralism, the ordering of space, many buildings which poses as open structures may be closed for changes. Open structures are - as opposed to closed structures - open to interaction with the outside world; they can influence their surroundings as be influenced by them. In architectural terms, this mainly relates to consequences in time and therefore to expansion or transformation. Many buildings wrongly identified as structuralist, or megastructures, are in fact closed structures - incapable of reacting to a changing environment. All too often they are also incapable of reacting to internal developments caused by changement of program and spatial challenges. (Hertzberger, 2015)

Hertzberger brings up the example of Aldo van Eyck's Orphanage (1956-60) which seemingly through its appearance could function as an open structure - but, due to the architect's unwillingness to make changes adapted to new program - becomes a closed structure. The spatial layout of the plan of the Orphanage, was organized like a small town with interior corridors resembling streets and square-like public space, but also by the way in which individual building units are repeated like small houses. The typology can be seen as modules, which act of the type of families - uniform but of different scale. The family of clustered modules invites for flexibility, where modules could work individually or be connected into larger spaces. This system invites for flexibility which could be used for internal changes over time, where the needs of different size of rooms may vary, as well as being expanded by adding more modules. This offering a structure suitable of multipurpose beyond the initial program of housing orphaned children. Despite the clear spatial layout of units, that suggests the possibility of flexibility and changement - the building remains a completed composition.



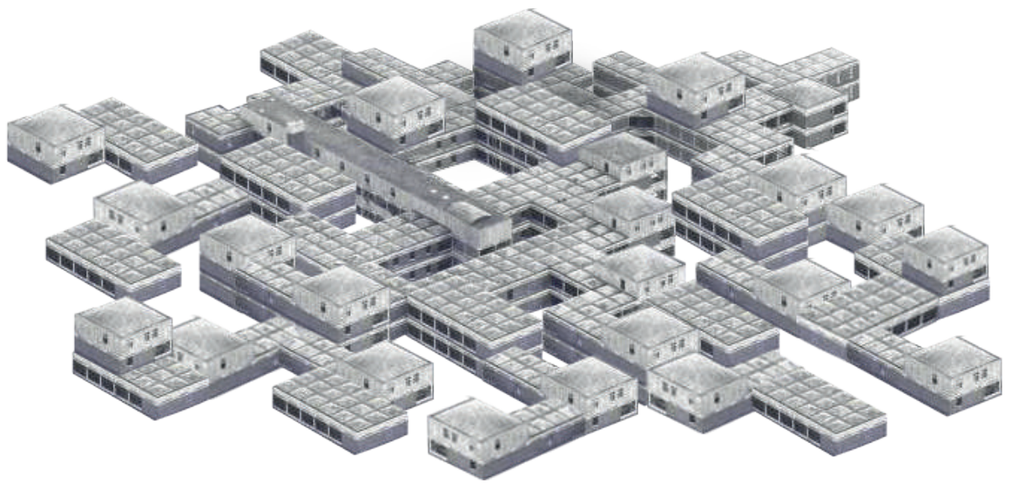


*Aldo van Eyck's Orphanage original layout as built in Amsterdam*



*Example of modest expansion with added modules to the existing scheme*

*Example of extensive expansion with added modules to the existing scheme both horizontally and vertically*



# 3.4
## Background

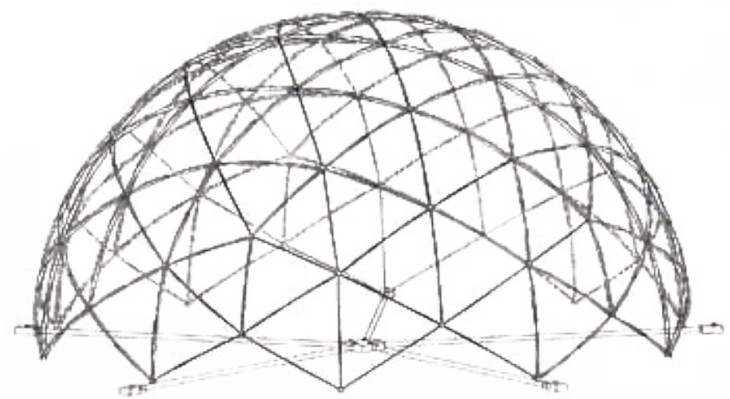
### Kinetic structures

Flexibility can be seen in different ways; a flexible program, possibilities within a structure for adaptation, but also the movement within the structure itself - which we know as Kinetics. Kinetic structures are dynamic and able to change shape whilst staying structurally sound. This allows the possibility to expand and deploy them.

The term “kinetic architecture” was introduced by William Zuk and Roger H. Clark in the early seventies when dynamic spatial design problems were explored in mechanical systems (Zuk, W. & Clark, R.H. 1970)

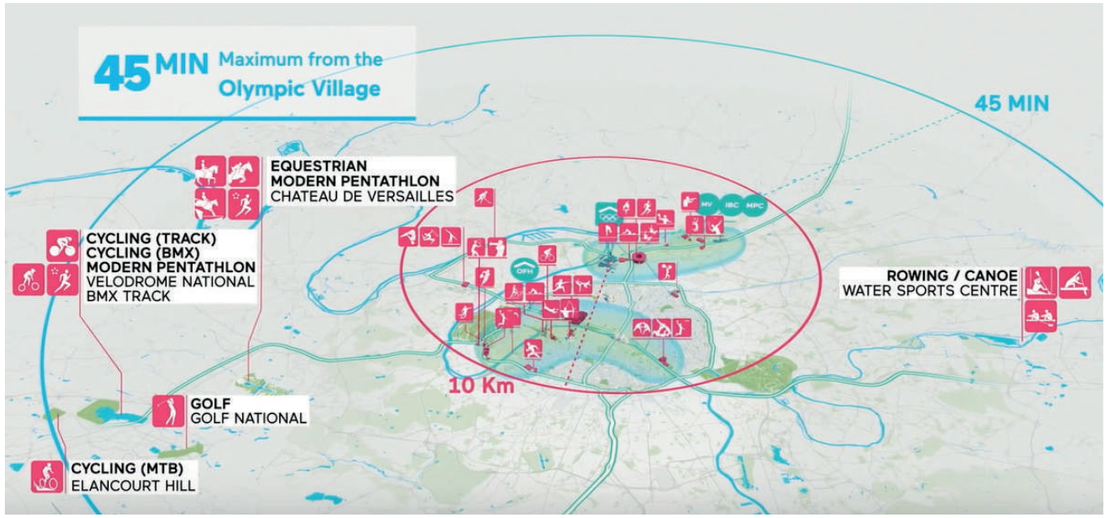
Chuck Hoberman invented and patended the Hoberman sphere in 1990. The sphere is made up by an isokinetic structure that resembles a geodesic dome, It is a structure which thanks to its rigid “scissor like” elements and pivot points enables the sphere to expand and retract smoothly while keeping the spherical shape throughout the transformation. The Hoberman sphere was produced in colourful plastic as a toy for children, but also exists in larger scale in metal, the largest model spanning 5.9m in diameter.

As Freidman put the similarity of a structure with a skeleton, and the way metabolism and theoretical work of Archigram discuss moving architecture - Kinetic structures can be seen as a skeleton, but one which can move and be dynamic.

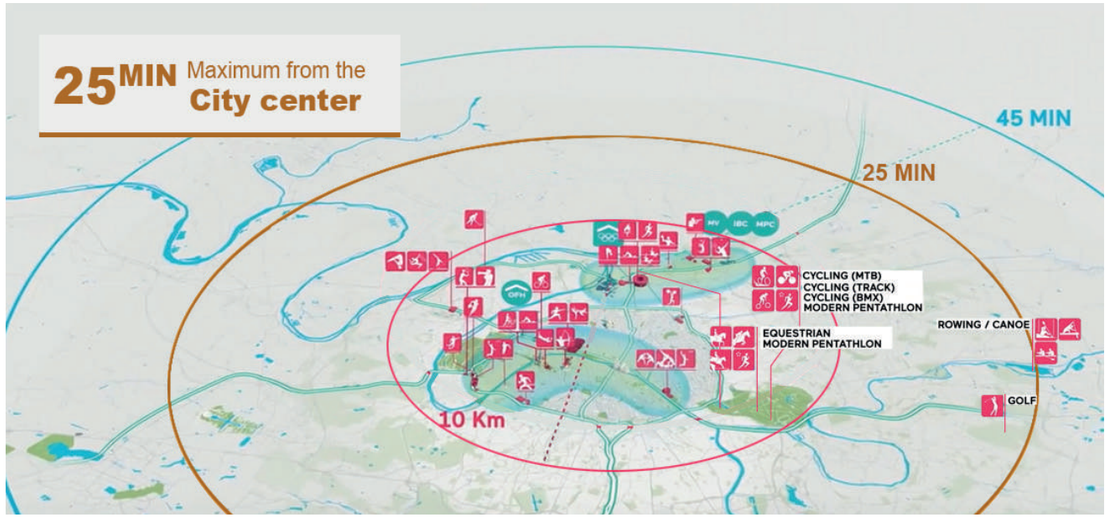


Expanding geodesic dome by Chuck Hoberman, Hoberman Associates, 1991

# 4.0
## Proposal




Map showing placements of venues whithin a 45min radius of the Olympic viillage. (www.olympic.org)




Map showing possible placements of venues whithin a 25min radius of the Paris city center.

## PARIS 2024 VISION

Paris 2024 aims to be the first Games fully aligned with the Paris Climate Agreement, leaving a positive legacy at local and international levels and a positive impact for sport.
It wants to set a new bar by having a groundbreaking emissions reduction strategy, and aims to deliver a 55 per cent smaller carbon footprint than the Olympic Games London 2012.

The Paris 2024 Games is aiming to ensure a great athletes experience but also ensuring a lasting legacy for the community. The Aquatics Centre, to be built in Saint-Denis, is planned to function as a new elite training centre and a recreational swimming facility after the Games. This deeply needed in an area of Paris where 50 per cent of children do not know how to swim.

The ambition and one of the key points in the bidding for hosting the Olympics when Paris applied, was to host the different events whithin a close distance from the city center. This much to enable to provide public transportation with zero carbon emission. Another strong argument was to use 95% existing or temporary venues throughout the games. Beyond competition venues, 100 million EUR will be invested in local sports facilities, many of which are planned to be used as training venues during the Games.

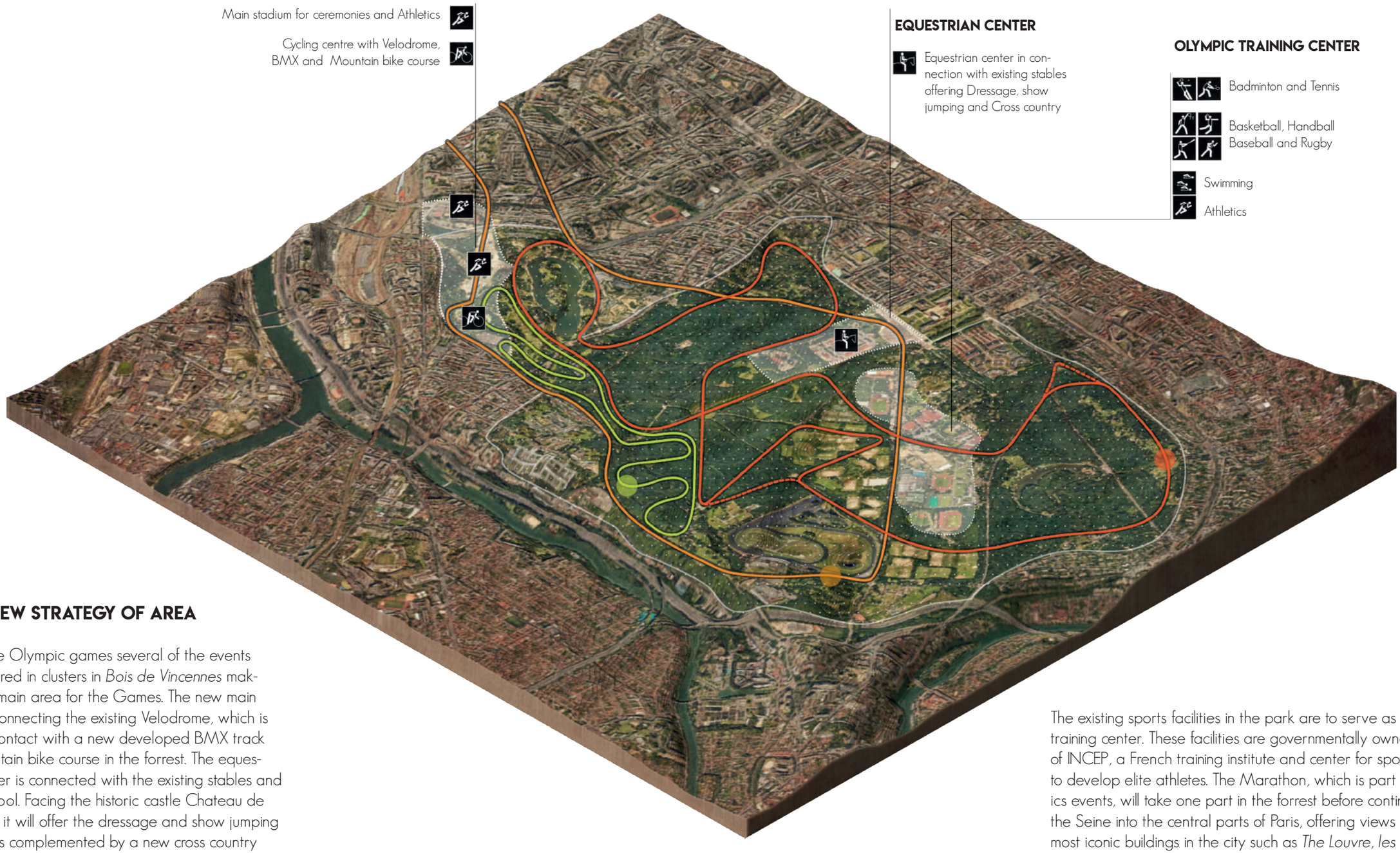
Whilst most of the planned activities are hosted close or whithin the city center - some more space requiering events like; golf, equestrian, cycling and rowing, are placed whithin a 45min perimeter.

## REDEFINED VISION

The aim of placing venues within a 45min commute radius may sound reasonable - but why not bring it even closer? Instead of investing in building a temporary velodrome, BMX and mountain bike track 45min from city center, why not use the chance of investing in the existing Velodrome in Bois de Vincennes and create cycling facilities in its surrounding to enhance the existing sports interest within the area. Same goes for the equestrian facilities. In bois de Vincennes there are already two large horse stables and riding schools and sufficiend facilities to host the competing horses during the Games. Why not develop a permanent cross country course embedded in the forrest, instead of putting up a temporary one in Chateau de Versailles. In this sense the investment of the games may give something back to the existing sports activities in the area for future use and a lasting legacy.

*Stade de France* is to be kept as one of the main arenas, but for football and rugby instead of the proposal of athletics and ceremonies.
The plan of developing the area of Saint-Denis by converting the athletes village into housings afterwards remains due to the areas need of development. The area may although be in need of a slower transition than a total regeneration within 5years which is the current plan. An all too quick changement of poor and underdeveloped areas always risk to fall into the problematic of gentrification. Also, one must carefully evaluate what typology would be beneficial in the area for the future, to not risk the mistake made by many previous Olympics where the conversion of athletes village to permanent housing ending up vacant. Therefore it might be good to take it step by step, and not develop to extensively within a short time period.

# STRATEGIES




## OVERVIEW STRATEGY OF AREA

During the Olympic games several of the events are gathered in clusters in *Bois de Vincennes* making it the main area for the Games. The new main arena is connecting the existing Velodrome, which is in direct contact with a new developed BMX track and mountain bike course in the forrest. The equestrian center is connected with the existing stables and riding school. Facing the historic castle Chateau de Vincennes it will offer the dressage and show jumping events. It is complemented by a new cross country course to be used by the existing stables in the park after the Games.

The existing sports facilities in the park are to serve as an Olympic training center. These facilities are governmentally owned and part of INCEP, a French training institute and center for sports dedicated to develop elite athletes. The Marathon, which is part of the athletics events, will take one part in the forrest before continuing along the Seine into the central parts of Paris, offering views of some of the most iconic buildings in the city such as *The Louvre, les Invalides* and the *Eiffel tower*. The race is then turning back towards the east parts and has its finish line within the new main stadium.

# THE SITE


## BOIS DE VINCENNES

The site fulfilling the most of my criterias as well as corresponding best to the capacity of hosting the Olympic games is located in bois de Vincennes, in the eastern part of Paris. The site embedded in the forest is an existing asphalted area of one hectar, with close connections to public transportations and existing urban fabric. The site is vast and yet hidden, surrounded by existing sports facilities. These facilities which are today somewhat neglected have the capacity of being re purposed for the games and thus strengthen the clubs in the area, leaving a strong legacy after the games. The area is also whithin close distance of railway and water, making transportation of building materials onto the site in a more sustainable way. Today the site is functioning as temporary accommodation for a traveling tivoli and amusement park which occupies it for less than one month per year. In summertime occasional music festivals use some of the area for a few days - but the remaining time it's deserted and gated - making it inaccessible by the public. By regenerating the area and filling it with life and activities on a permanent basis, it has the potential of becoming a unique new area during and after the Games




Photos of existing site

# OLYMPIC SCHEME

## MAIN STADIUM, WARM UP AREA AND OLYMPIC CYCLING PARK

The new main stadium is connecting the two existing arenas in the area to create a part of the Olympic park. The existing football field and athletics track is to be repurposed as warm up arena for the athletes. The elevated looped walkway then provides smooth transision from the warm up to mandatory obligations for the athletes (calling, doping controls etc.) in the new indoor training hall. The athletes are then escorted via the elevated looped walkway to the main arena - separating them from but still making them visible for spectators.

The Olympic cycling events are embedded between two curved double sided stands, with roof covering one of the sides. The stands provide the audience views of the Velodrome, BMX and finish line for the mountain bike events.

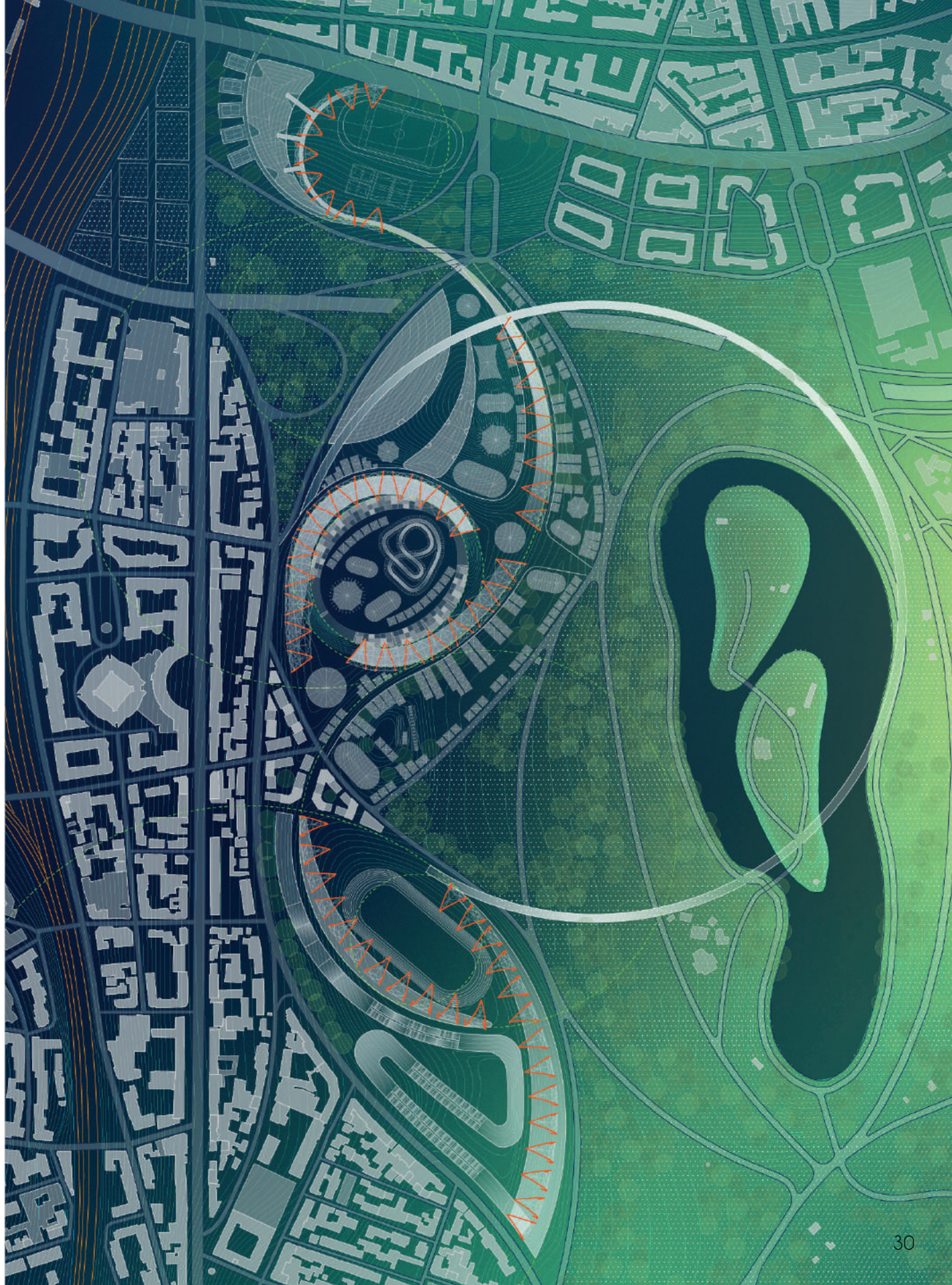
# +5 YEARS LATER

## TEMPORARY ACTIVITIES AND MODIFICATIONS OF MAIN ARENA

After the Games, the area will continue to transform to grow part of the urban fabric. The warm up arena is converted into sport facilities with added tennis courts to the indoor facilities. The elevated loop is turned into a “walk of fame” where visitors can walk in the footsteps of their idols. The elevated walkway which was built for the Olympics continues in the park connecting the existing pedestrian walkways and gives a new access point to the islands in the lake. The Olympic cycling facilities are turned used for training purose as well as competitions.

The main arena is modified into becoming a multipurpose building with new facilities such as museum, café, restaurants, offices, retail and pop-ups facing the street as well as the inner field.

The inner field as well as the surrounding area of the previous main arena, is used to continue hosting temporary events on the site in form of tivoli and amusement park.



# +10 YEARS LATER

## MODIFICATION OF CYCLING AREA AND PROGRESSION OF HOUSINGS

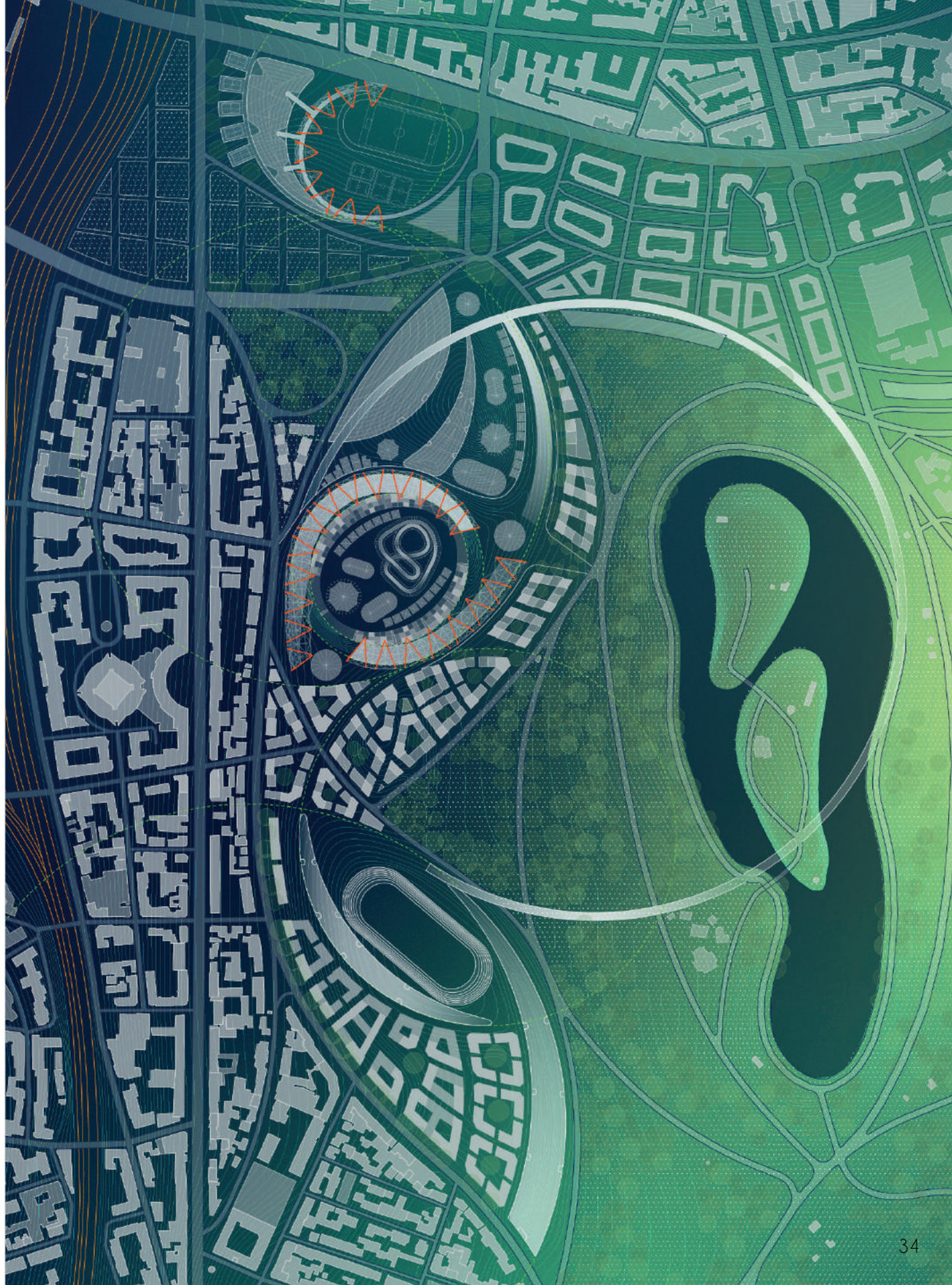
Ten years after the Games an anniversary is held in the memory of the Olympics, bringing back athletic competitions to the inner field. The event is hosted as a block party, inviting all of its old and new neighbors to view the competitions from the balconies, amphitheater and rooftops of the many restaurants and cafés facing the inner field.

The BMX park have made way for the more pressing needs of housing blocks. The previous roof structure for the stands have been reused to build the new housings. The temporary stands have been removed and sold onwards, leaving the artificial sloping ground underneath to become vegetalised and grows part of the urban landscape.

# +25 YEARS LATER

## OLD OLYMPIC STRUCTURES GROWING INTO A PART OF THE URBAN STRUCTURE

As 25 years have passed more and more structures have been built up reusing the frames and metalwork of the old arena structures. The Velodrome which was initially built for the Paris Olympic Games 1900 and since functioned as cycling stadium for 3 Olympic Games has become a cultural heritage, soon to celebrate its 200 year anniversary. It is still in use by the many cycling clubs in the area. The main athletics arena for the Paris 2024 Games is constantly reshaping within its structure to see to the changing needs of the time. The inner field is however kept an earmarked space for temporary events which no longer finds place to arrange large scale events within the densified Paris center. When not used for large events it works as a market space during weekends and a field for play during the weeks.

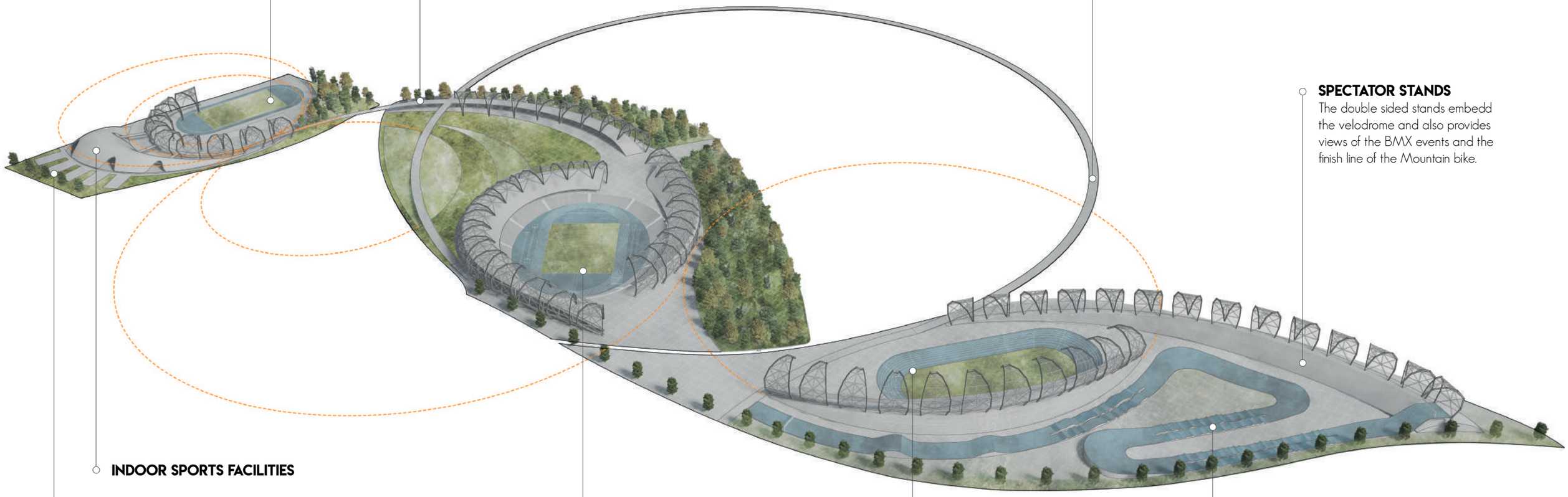


**WARM UP ARENA**
The old athletics track to be repurposed to host the warm up arena for the athletic events. After the games it will be transformed into a sports center for the clubs in the area.

**ELEVATED WALKWAY**
The looped elevated walkway connects the warm up and main arena and serves purpose of escorting the athletes through the mandatory procedures during the Games. Afterwards it is kept as a "walk or fame" where visitors can walk in the footsteps of their idols.

**LOOP**
The elevated walkway continues in the park, connecting the existing infrastructure and providing a new access to the islands in the lake with a new bridge.

**SPECTATOR STANDS**
The double sided stands embedd the velodrome and also provides views of the BMX events and the finish line of the Mountain bike.



**INDOOR SPORTS FACILITIES**

**NEW TENNIS COURTS**

**MAIN ARENA**
The main arena for the Olympic ceremonies and athletics events. Later adapted into hosting a mix of facilities and functions.

**VELODROME**
The Velodrome being the main arena for the 1900 Olympic Games in Paris is being repurposed to hold the cycling events for the new Games of 2024.

**BMX ARENA**
The BMX arena built for the Games is to be kept a training facility for the cycling clubs in the area for as long as its frequently used.

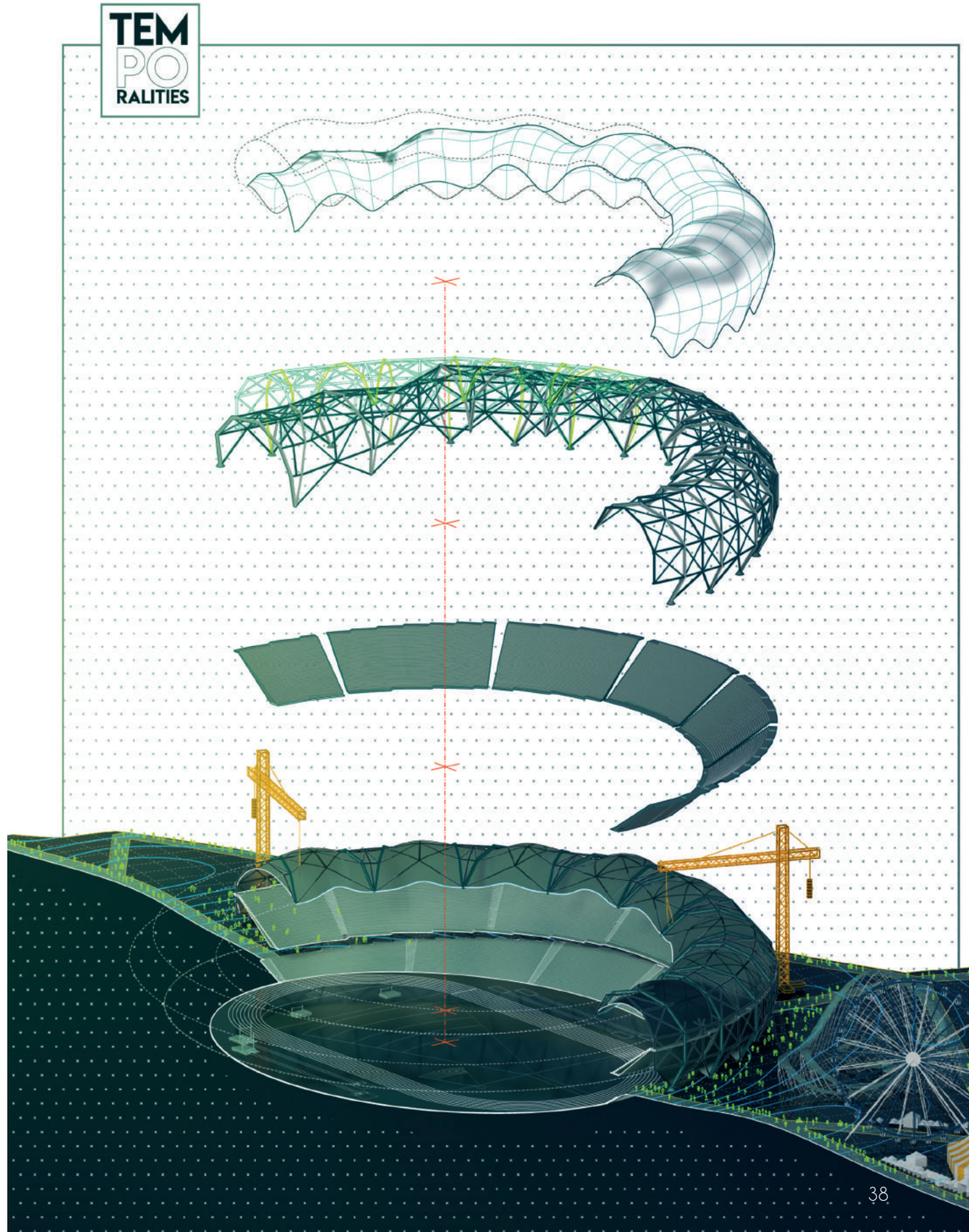
**ROOF** The roof structure is designed to resemble the playfulness of activities historically being active on the site. The roof is constructed by semitransparent PVC membranes, making it light and flexible whilst being able to recycle.

**STRUCTURE** The main structure is to be made form recycled steel, sourced from recycling centers surrounding Paris. The structure is made up from kinetic frames which are anchored to the ground and joined together in the top - to compose a triangular vault structure. The vaults are connected together by a secondary load bearing in form of a metal grid structure. All joints are able to rotate and lock in different positions - making the structure able to change shape over time to adapt itself to the future needs of the building. The adaptation of the structure will not be using actuators but using cranes on site at specific points in time where the structure needs changement. Where the structure meets the ground it is anchored at 32 fixed points. This enabling an open circulation around the structure on ground level as well as giving an emphasis to the main entrances.

**SPECTATOR STANDS** The spectator stands are divided in two levels - the lower one, in the sunken down part of the arena - and the high level, elevated over the ground. The lower stands are sitting on a structure which divides each seating section in 3x3. This allows the stands to be easily demounted after the purpose of them are no longer needed - and other facilities such as restaurants, pop-up shops, retail, offices and housing can be replacing them within the same grid structure. The higher stands, enabling 55 000 spectators, are temporary and will be removed and sold onwards to another arena after the Games.

**INNER FIELD** The inner field is lowered down to prevent wind while keeping an open circulation around the building. It also allows the overall structure to be lower and more fitting in its context with a total height of 35m over ground level. The inner field is lowered down 10m, adapted to allow for the transformation of up to three stories building to replace the lower stands.

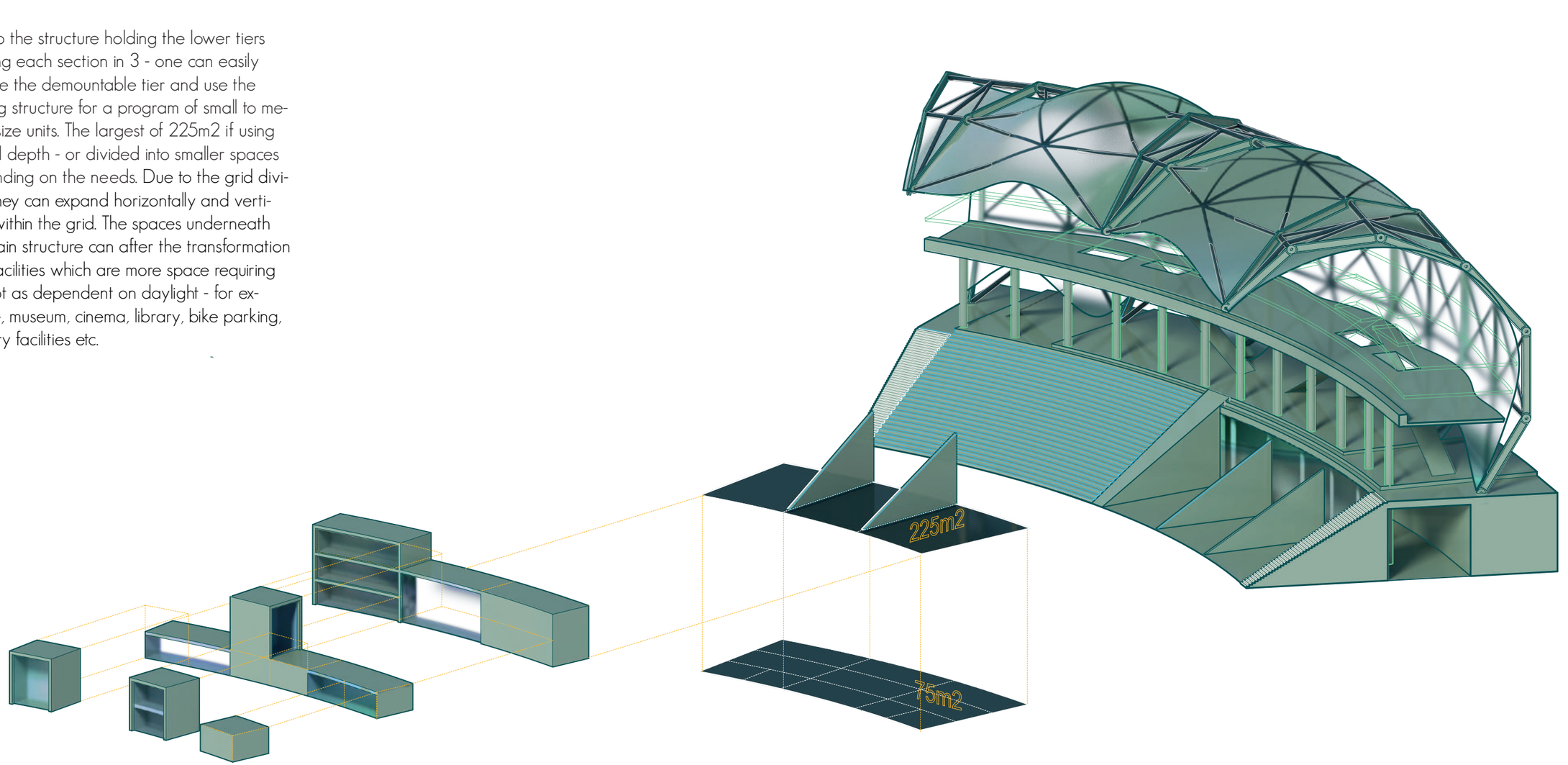




# TRANSFORMATION

## LOWER TIER TO GIVE PLACE FOR NEW FACILITIES

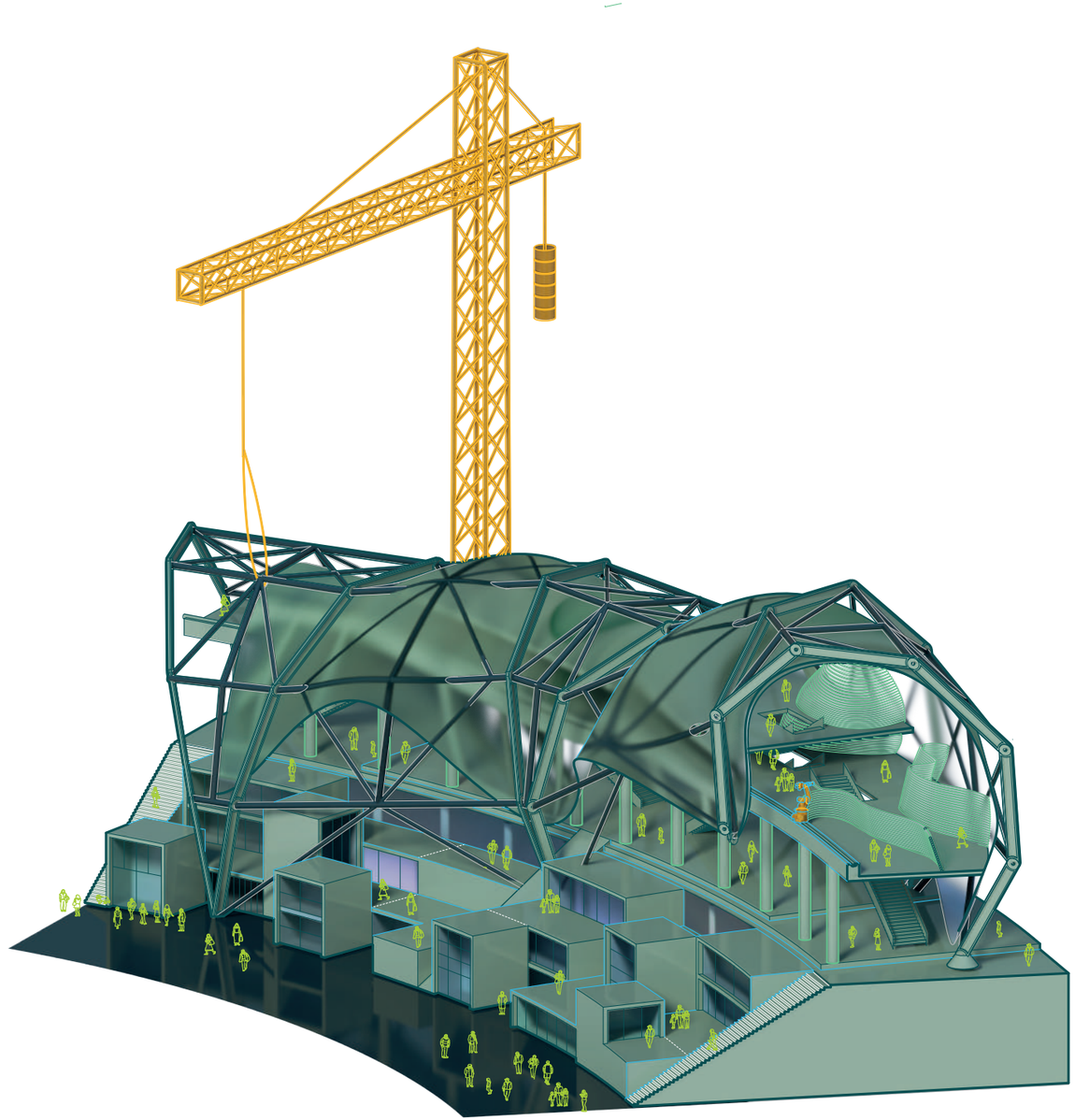
Due to the structure holding the lower tiers dividing each section in 3 - one can easily remove the demountable tier and use the existing structure for a program of small to medium size units. The largest of 225m2 if using the full depth - or divided into smaller spaces depending on the needs. Due to the grid division they can expand horizontally and vertically within the grid. The spaces underneath the main structure can after the transformation host facilities which are more space requiring but not as dependent on daylight - for example, museum, cinema, library, bike parking, laundry facilities etc.



# TRANSFORMATION

## INTRODUCING FLEXIBILITY TO THE STRUCTURE - NOT ONLY TO THE PROGRAM

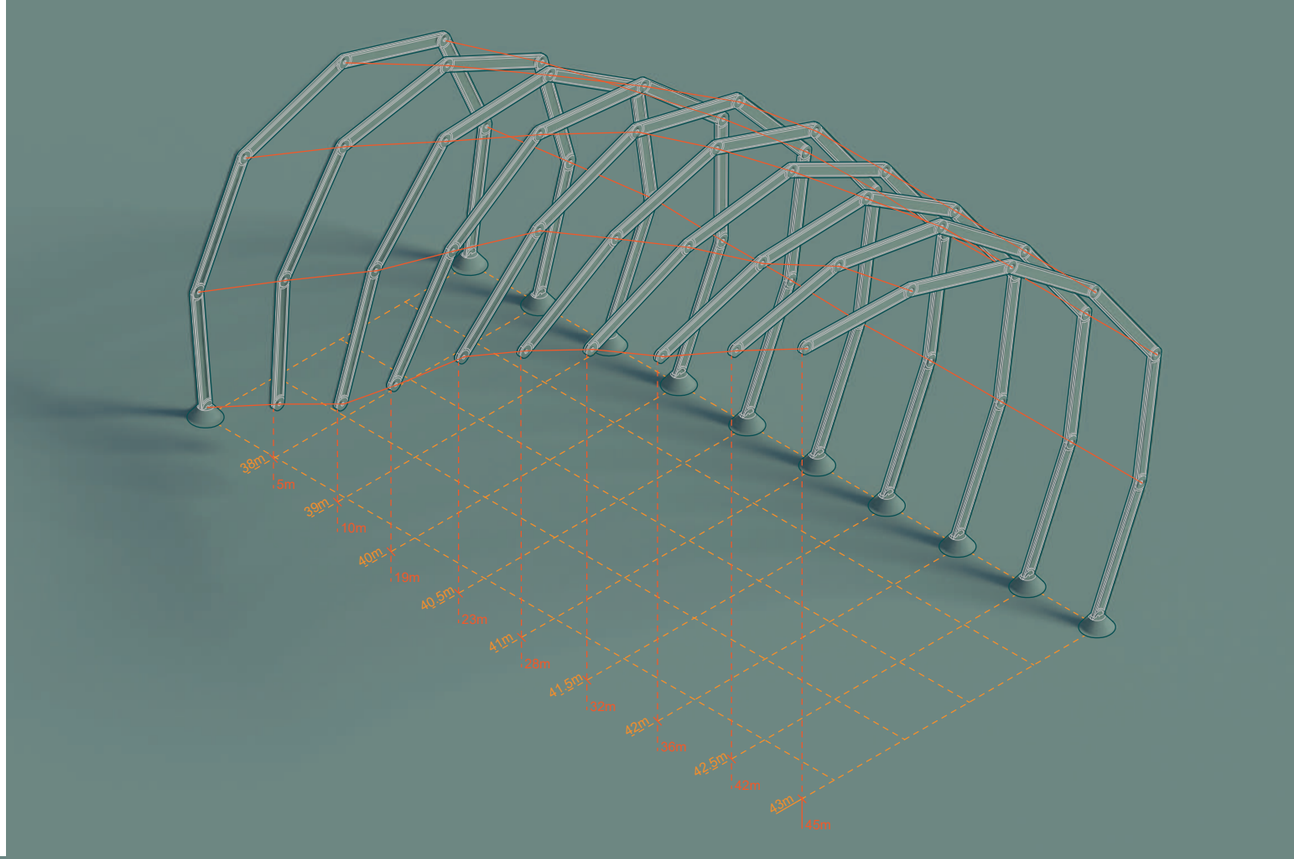
By working with straight load bearing elements with movable joints it introduces a freedom of flexibility to change the structure over time. When fully expanded the structure can be used for supporting the spectator stands. After the arena is no longer used frequently the structure can change over time to host different programme, for example a mix of housing, offices, public spaces and leisure facilities. The structure could possibly be de-attached to create two seperate structures from the same base elements or joined togehter again if expansion is needed. Giving the possibility for changement within or using elements from the same structure may enable a longer life span.

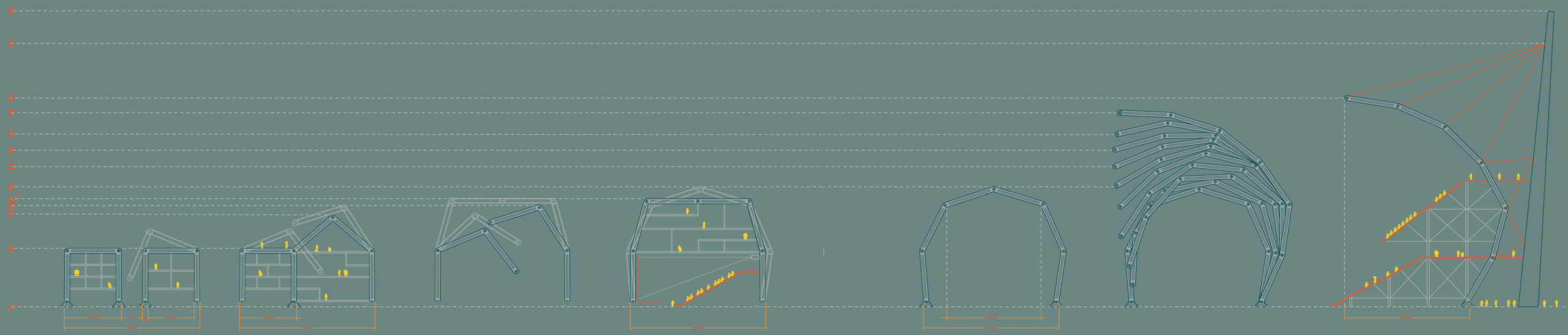


# FLEXIBLE SKELETON

## STRUCTURE

The flexible metal structure is the result of the experiments to be found in the chapter with same name on page xx-xx. It is a system made up by straight load bearing elements connected into a frame with rotatable interlocking joints. The frame is then connected together with a second frame creating a vault, and the vault is complemented by a flexible grid structure. Diagram below describes the flexibility within one single frame - and how it can be detached to form new frames of different scales. When the frames are connected into the hybrid structure - tension cables and pillars supporting the frames are no longer needed, making it more lightweight and flexible.



STRUCTURE SUITIBLE FOR HOUSING UNITS

TWO FRAME STRUCTURES ATTATCHED TO EACHOTER

STRUCTURE DIVIDED INTO 2 SEPARATED FRAMES

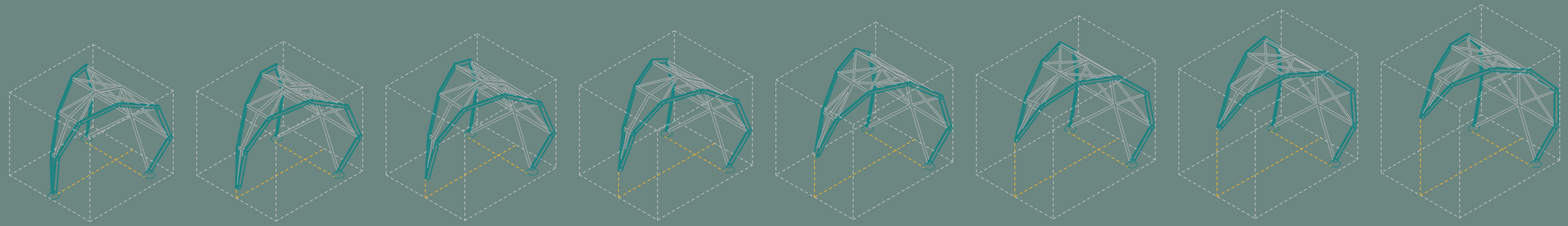
STRUCTURE FOR SPACE REQUIERING PROGRAM

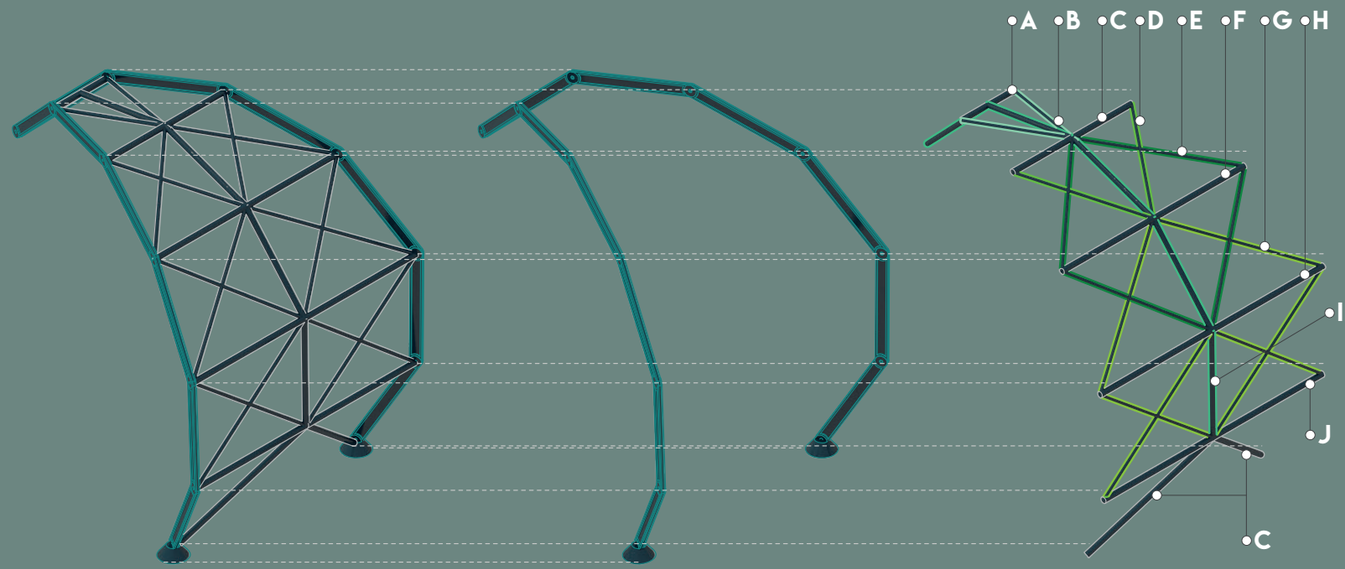
STRUCTURE FOR SPACE REQUIERING PROGRAM

FOLDING STRUCTURE

STRUCTURE SUPPORTED BY TENSION IN ARENA SCENARIO

# DISASSEMBLY DIAGRAM





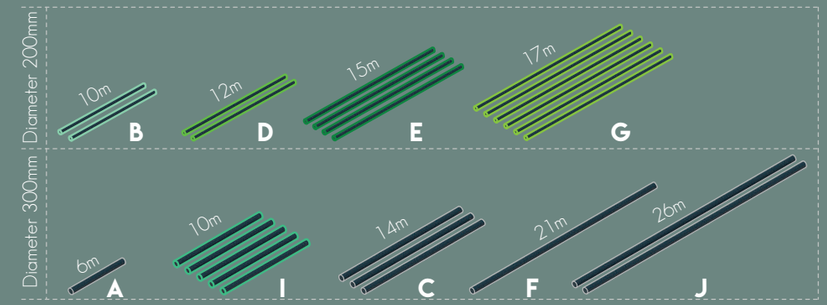

**HYBRID STRUCTURE**
The flexible hybrid structure is made up by two connected frames creating a vault, and complemented by a grid for added stability

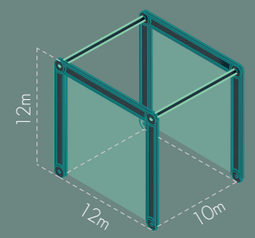
**VAULT STRUCTURE**
The frames made up by 6 straight elements connected by rotatable joints. The two frames are joint to create a more stable vault structure

**GRID STRUCTURE**
The vault is complemented by a flexible grid structure made up from straight elements of varying lenghts

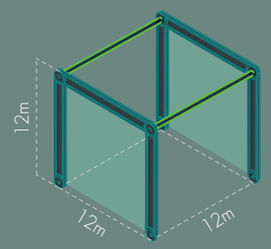
**GRID ELEMENTS**
The straight elements making up the grid structure can later be dissembled, and together with the elements making up the frames be reassebled into new structures . See example of new constillations below

**MAIN STRUCTURE**
The main structure of the arena is made up by flexible elements enabling it to change shape depending on the needs for changement in the future

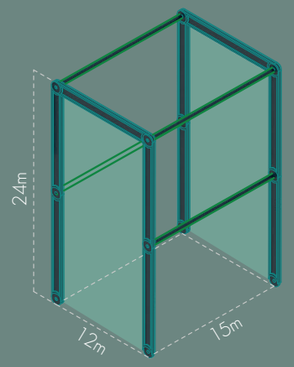


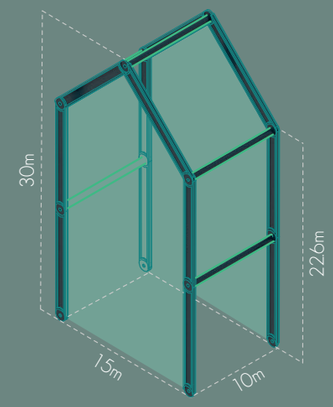

**HOUSING B**



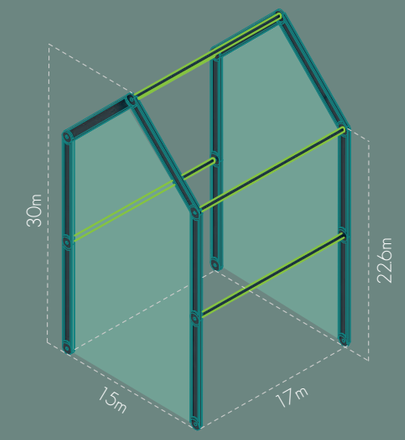

**HOUSING D**




**HOUSING E**

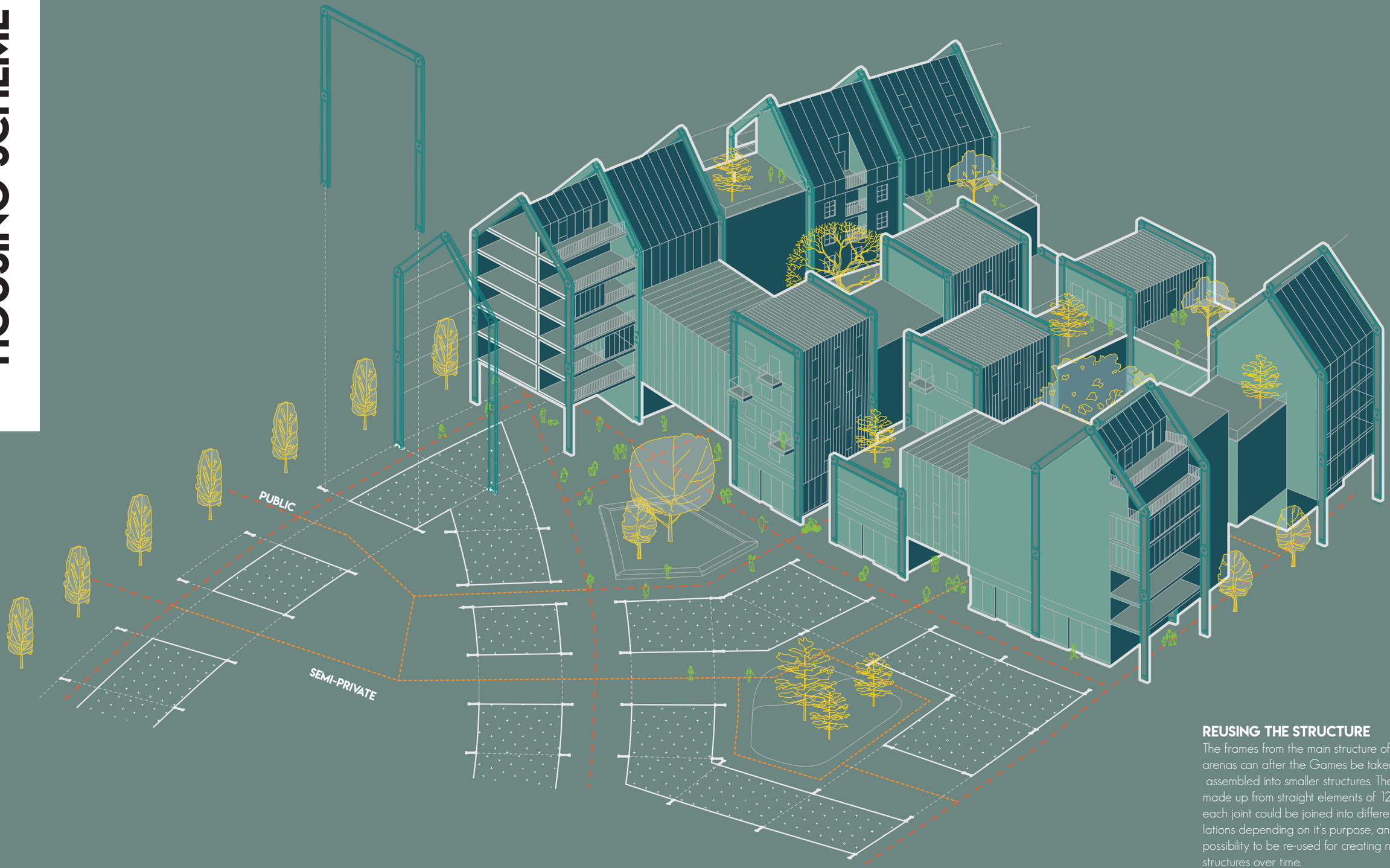



**HOUSING I**




**HOUSING G**

# HOUSING SCHEME



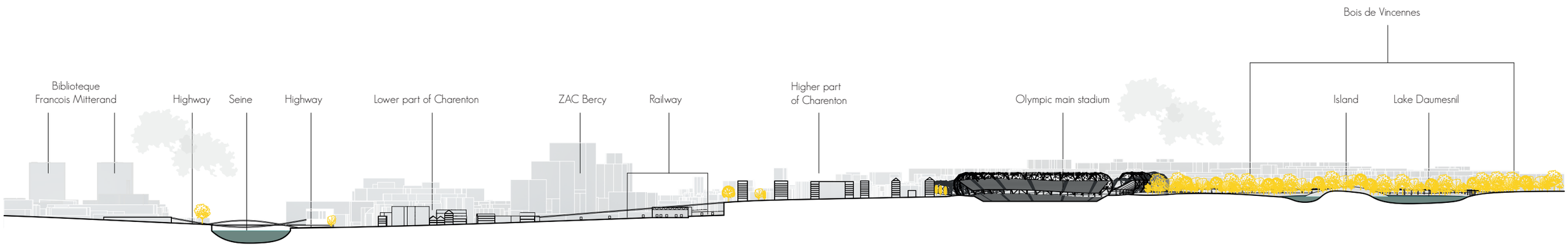

**REUSING THE STRUCTURE**

The frames from the main structure of the Olympic arenas can after the Games be taken part and assembled into smaller structures. The structures made up from straight elements of 12m between each joint could be joined into different constellations depending on it's purpose, and has the possibility to be re-used for creating new urban structures over time.

# LONG SECTION

## URBAN CONTEXT

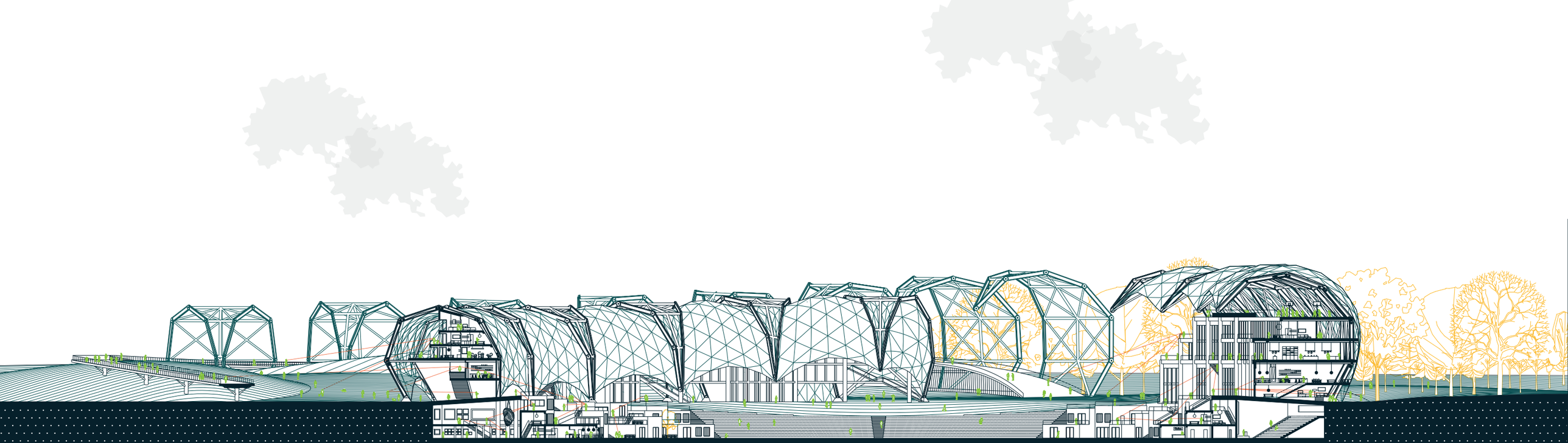
BNF (Biblioteque national Francois Mitterand) south of the Seine makes for one of Paris more recent landmark and is frequently visited, both by tourists and locals. Charenton is a municipality just outside the border of Paris. The lower part of Cherenton mainly persists of old industrial buildings embedded between the highway and railway. The higher part, north of the railway, being more mixed in terms of facilities. It is a neighborhood mainly made up by commerce and housing, and having straight access to Metro stations. ZAC Bercy is an area highly under development. In the drawing one can see the suggested development plan by Rogers Stirk Harbour + partners.



# SECTION

## +10 YEARS LATER

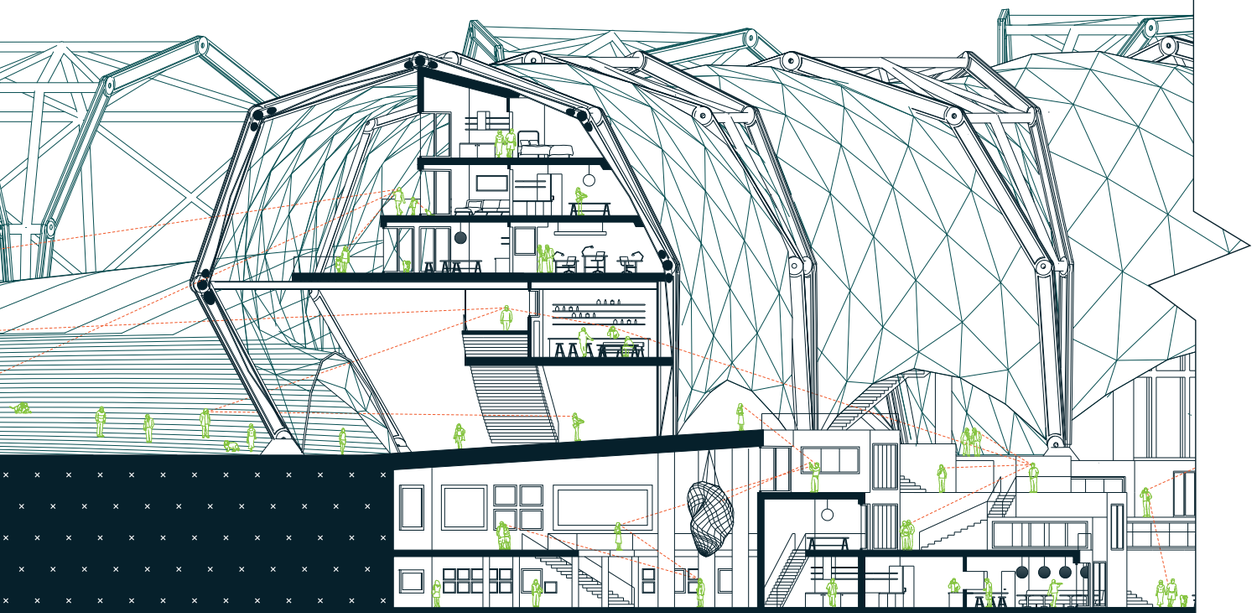
The sunken down inner field of the arena Makes it possible to create an overall lower structure more adapted to the site. The total height of the structure being only 35m over ground level allows it to blend in among the tree tops. It also allows for generous sightlines from the ground level through the arena and towards the park - making it an open and inviting structure bridging the urban fabric to the park.



# MIXED USAGE

## ZOOM IN SECTION

The zoomed in section from +10 years later shows variations of how the structure can be used and modified over time. From fully closed to open where the roof protects the underlaying structures and allows for less permanent structures underneath. It creates a variety of urban rooms - as well as architectural qualities depending on the need of shelter. The openness between the levels allows for visual connection between the different areas where you have visual contact both towards the inner field as well as the park or street.



**ETAGE**
On a ground level the generous ceiling heigt allows for facilities with double height .

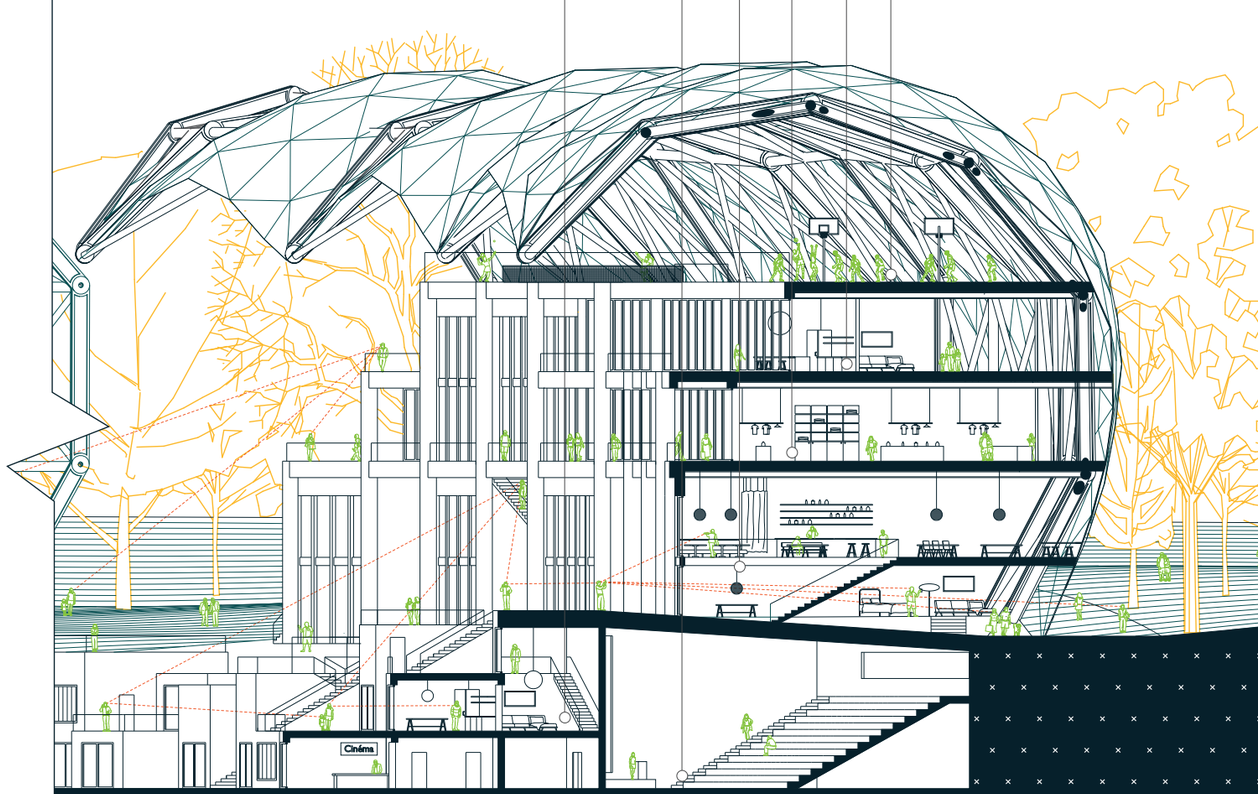
**RETAIL**
Second level is dedicated to a mix of retail, pop-up's, café's and restaurants.

**CINEMA**
Facilities underneath the main structure can be used for facilities less dependent on natural daylight.

**APARTMENTS**
Apartments with daylight from two directions with exterior balcony providing circulation and semi-private space for the neigbours to meet.

**HOUSING**
Replacing the stands - housing and a mix of retail, restaurants etc. will take its place - allowing for tailormade solutions depending on the need of daylight .

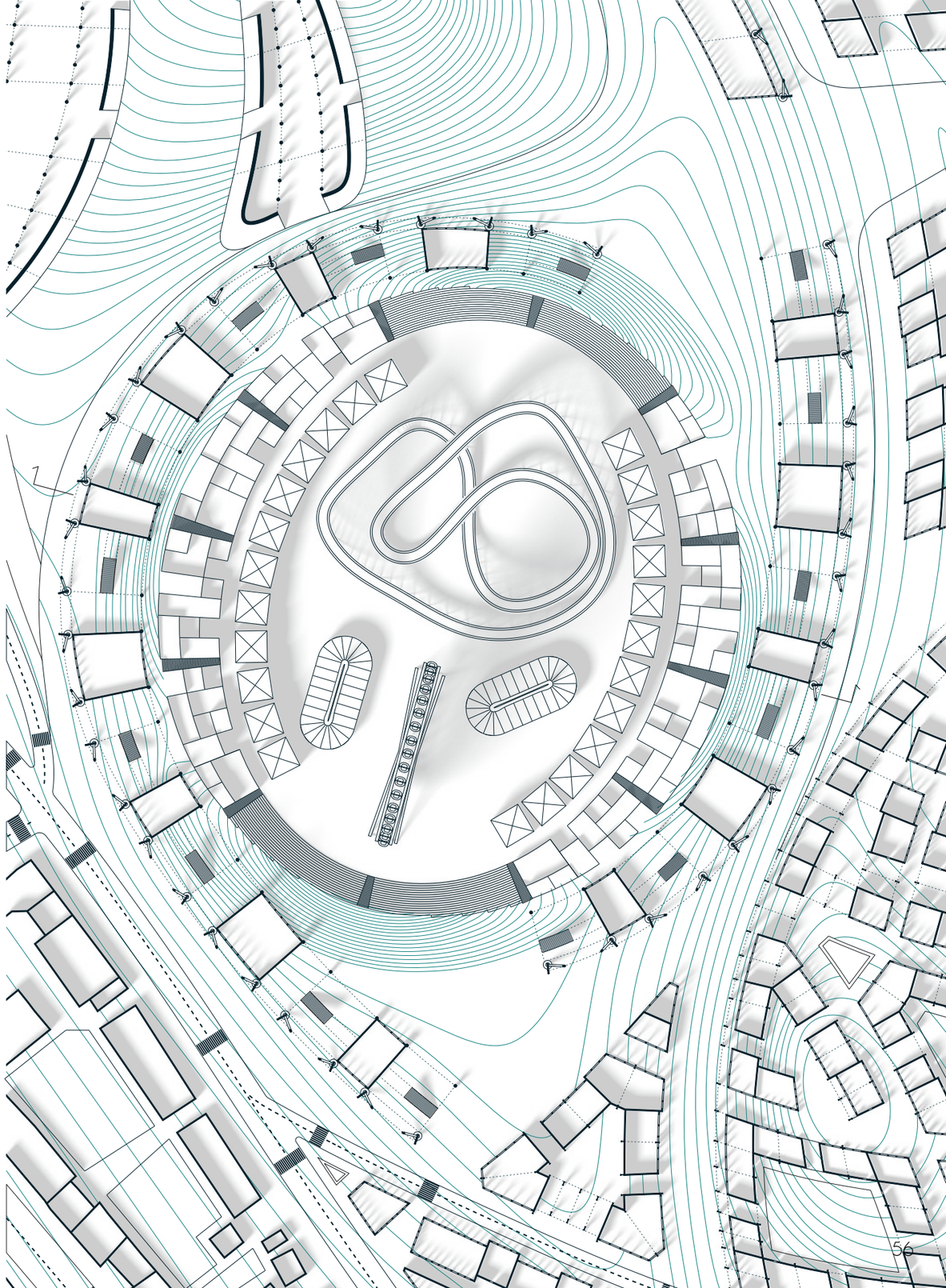
**ROOFTOP**
Basketball and tennis courts on the rooftop, shielded from rain and wind from the lightweight roof structure offering an open and public area.



# PLAN +25 YEARS

## OPEN STRUCTURE

As the arena has undergone changement throughout the years the area grows more densified. Part of the stands are left as amphi-theater with views of the spectacles hap-pening on the inner field, whereas most parts underneath the lower tiers have been con-verted into multipurpose facilities. On a ground level the building remains relatively open, with clear sight-lines through the building and facilities facing both the street as well as the inner field. The new structures surrounding the arena is being built up from the frames of the structure no longer in use. These form the new neighborhood where the distinction between private and public is being blurred by the openness on the ground level. The space for temporary events and activities is still being kept on the inner field.



# 5.0

## Context

> LOOKING BACK AT PREVIOUSLY HOSTED OLYMPIC GAMES ONE CAN SEE TWO MAIN TRENDS OF STRATEGICAL PLACEMENT. FIRST ONE, THE SATELITE OUTSIDE OF THE CITY WHICH LEAVES THE SITE FREE OF URBAN CONTEXT BY CREATING IT'S OWN NARRATIVE. SECOND ONE, EMBEDDDING IT WHITHIN THE EXISTING URBAN STRUCTURE AND TRYING TO INTEGRATE IT WITH THE CONTEXT."

# 5.1
## Context

### Urban Analysis and Strategic Decisions

"Utopia is to be considered experimentally by studying its implications and consequences on the ground. These can surprise. What are and what would be the most successful places? How can they be discovered? According to which criteria? What are the times and rhythms of daily life which are inscribed and prescribed in these "successful" spaces favorable to happiness?"

Lefebvre Henri. (1967)

In order to develop the hypothesis of the architectural project it needed to be set in a context. In this case, an urban context within the perimeter of *le grand Paris*. * The process of choosing a site for the project needs to ask questions of the character Lefebvre brings up in regards of Utopia, in the text of "the right to the city". What are and what would be the most successful places, and according to which criteria?

Defining the criteria has in this case taken into consideration social, economic and environmental aspects - in order of narrowing down areas of interest choosing a site. Looking back at previously hosted Olympic games one can see two main trends of strategical placement. First one, the satellite outside of the city which leaves the site free of urban context by creating its own narrative. Second one, embedding it within the existing urban structure and trying to integrate it with the context. Seing the previous outcomes in the aspect of usability afterwards - the second solution brings more successful results. Both in the sense of bringing the games to be a central meeting point bringing people together during the games - as well as avoiding it becoming a deserted area afterwards. However, in an already dense city, central sites with the capacity of new large-scale structures are hard to come by.

*le grand Paris** - *"Grand Paris is an urban, social, and economic development project which brings together the Greater Paris Region's strategic areas with Paris at the heart of the Greater Paris area". (www.grand-paris.jll.fr)*



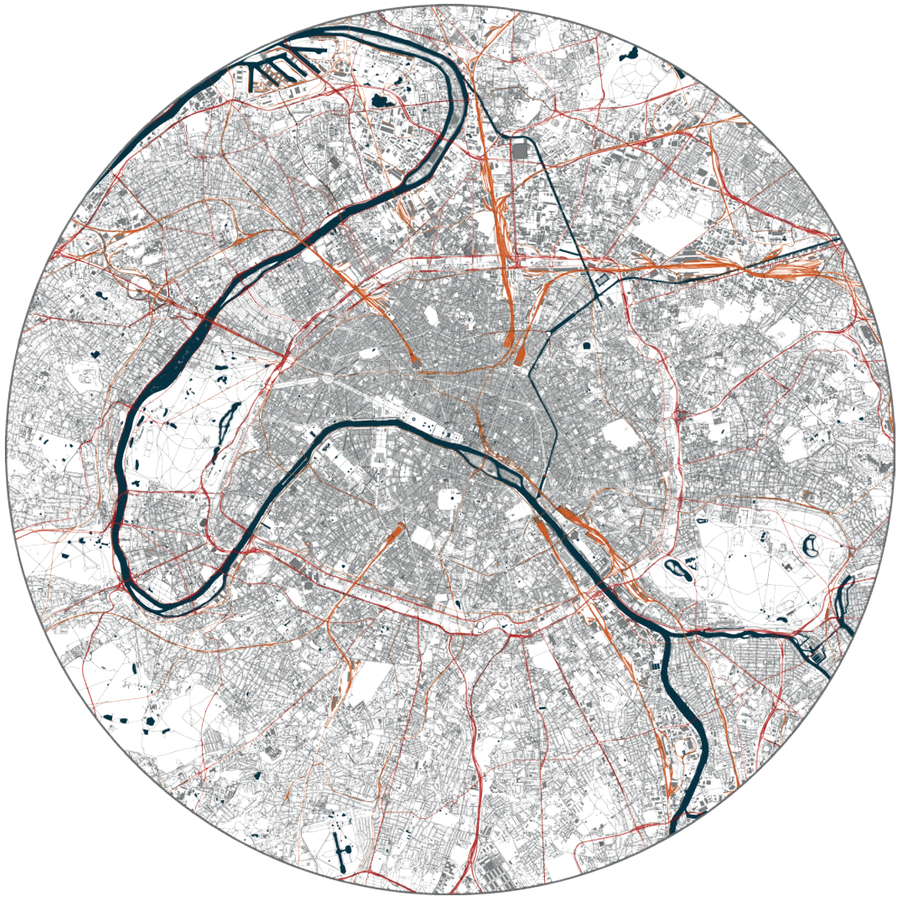
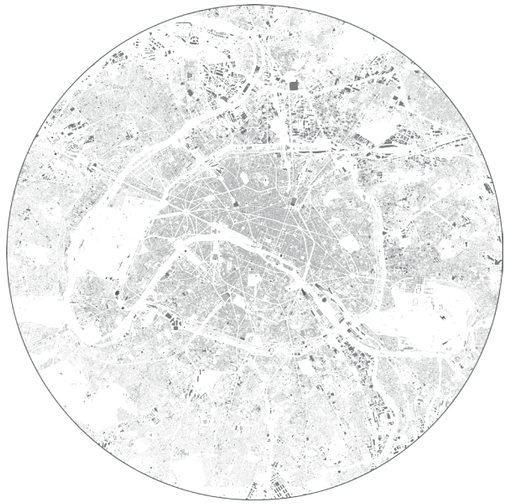


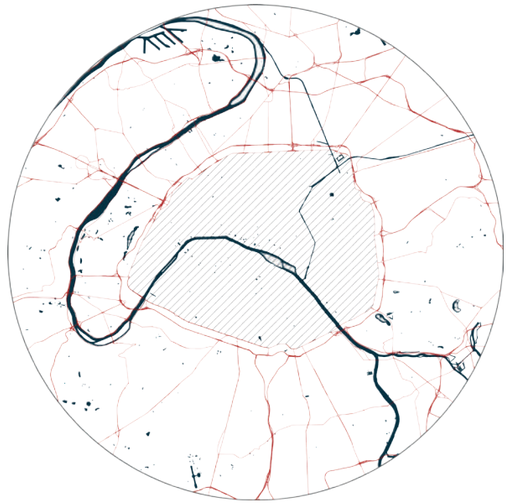
Diagram of the outer boundry area of Paris showing the existing urban structure

**CRITERIAS FOR CHOOSING THE SITE**

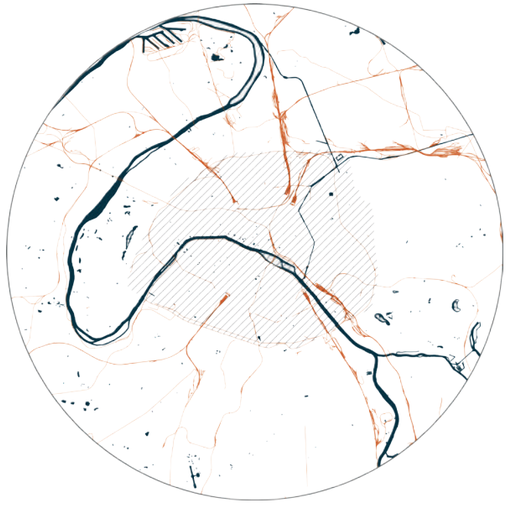
The main criteria's needed to taken into consideration has, apart from a central placement, been to find a site with near location to water and railway - making it possible to transport materials onto the construction site in a more sustainable way. From a demographic point of view its easy to spot on the diagram on top that there are limited areas where water and railway collide whilst not already being densely built. Ideally would be to restrain the demolition of existing urban tissue in order to make enough space to accommodate the new structures for hosting the Olympic games. The new structures then have the possibility to grow part of the urban tissue in comparison with if constructing it as an isolated satellite. Another important aspect for narrowing down sites of interest is to if possible - find a site where there's already established sports activity, to strengthen those clubs and activities by providing them renovated or new facilities to continue these activities.



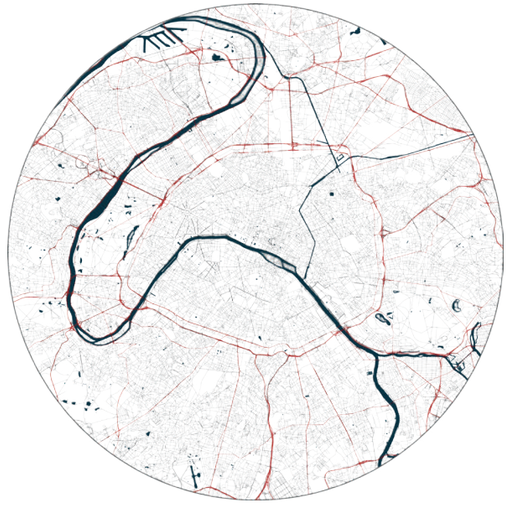
Nolli plan of existing buildings



Water and main roads



Water, main roads and trains



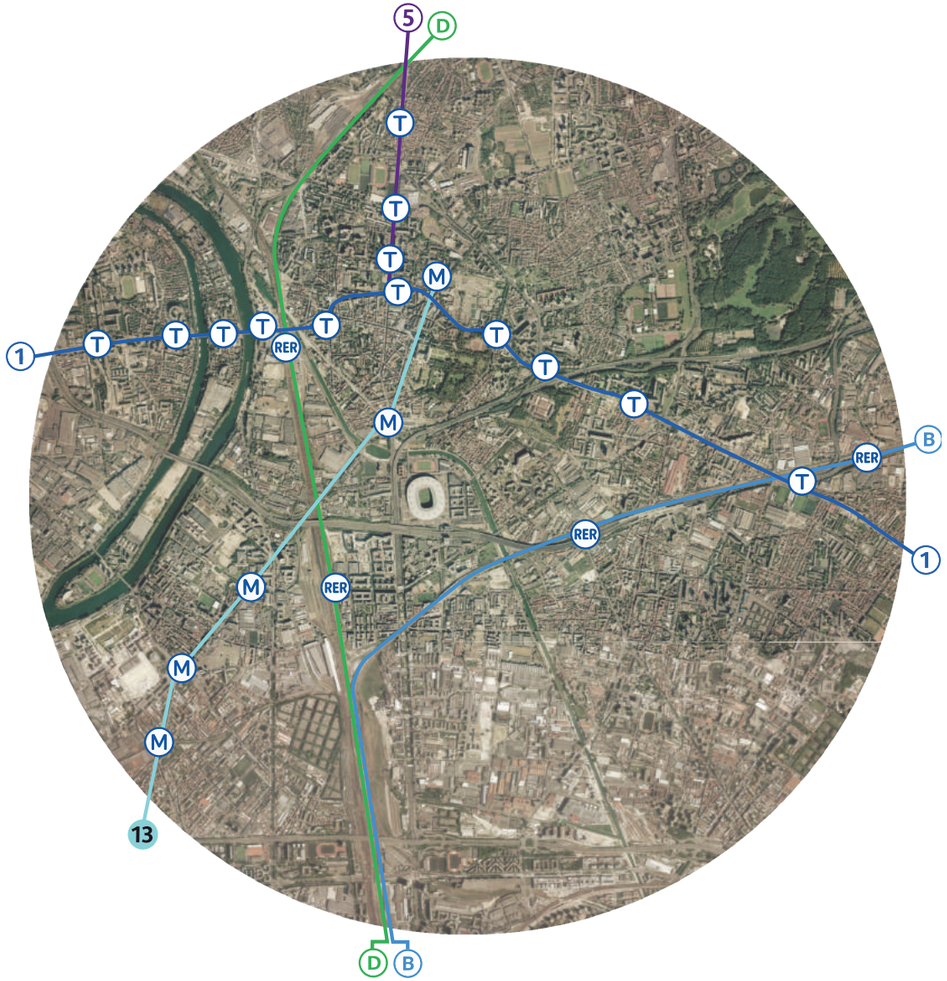
Water, main and secondary roads




## PLACES OF STRATEGICAL INTEREST

When adding the parameters of defining the ideal area - closeness to infrastructure, railway, water, existing sports activity - it narrows it down to four strategical areas of interest. *Colombes*, *Saint-Denis*, *Bobigny* and *Charenton*. Looking closer into the areas *Colombes*, located north west of Paris seems to densely built and not having sufficient enough railway to be ideal for transporting materials onto the site. *Bobigny*, north east of Paris has sufficient railway to provide supplies, although the canal is seemingly to narrow to transport materials onto site sufficiently. Also, *Bobigny* currently have social aspects such as safety and security problems which speaks in its disadvantage.

*Charenton* in the east part just outside of the city brim is a considerably safer area, surrounded by existing structures and the large forest *Bois de Vincennes* highly populated by sports activities. Another thing that speaks in its favor is that it's the closest of the four to the city center. The area of *Saint-Denis* is also well provided with both water, railway and sports activity making it an attractive spot for the Olympics. To narrow down the places of strategical interest the decision then landed in going forward with *Saint-Denis* and *Charenton* as potential areas to host the games of 2024. Two areas with similar infrastructural advantages but highly different character.




## SAINT-DENIS

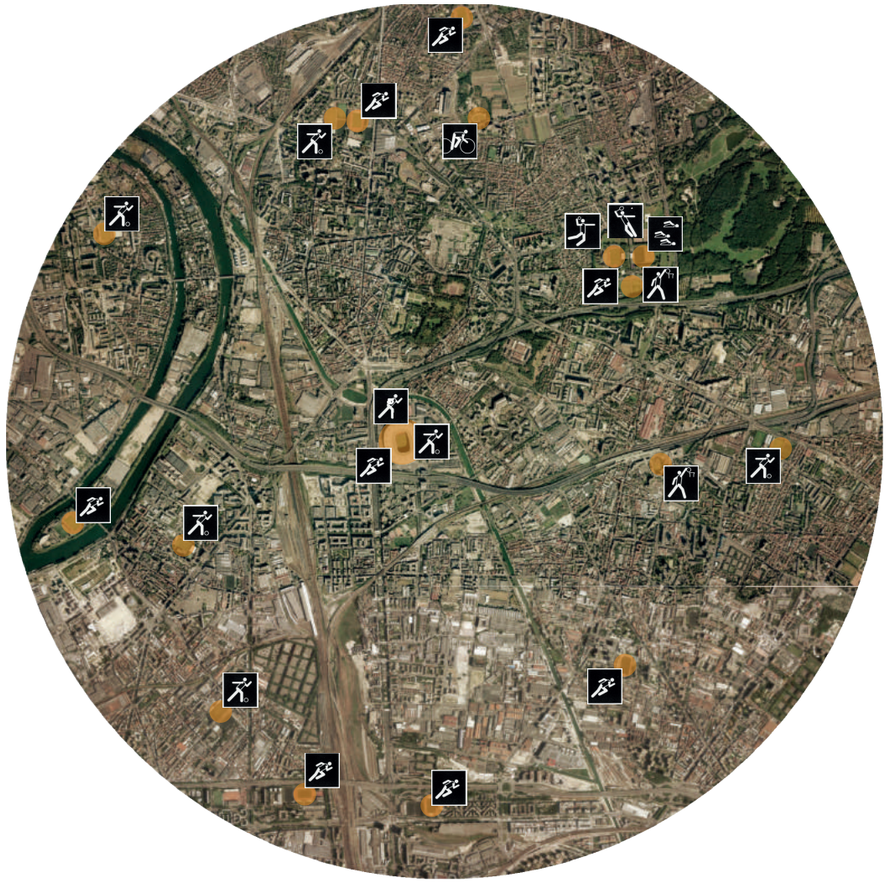
The area surrounding *Saint-Denis* in the north of Paris is connected with public transportation mainly provided by RER, trains for commuters to reach Paris. In the north part of *Saint-Denis* there are two tram lines interlinking - number 1 going in a northern half circle outside of Paris and number 5 continuing north of the area.

The only metro line is the number 13 having its end stop in one end at *Saint-Denis Université* and continuing all the way through Paris to its southern outskirts. In general, the area is not very well commuted, but within the grand Paris project there are plans to extend the existing lines and complement them over time.




## CHARENTON

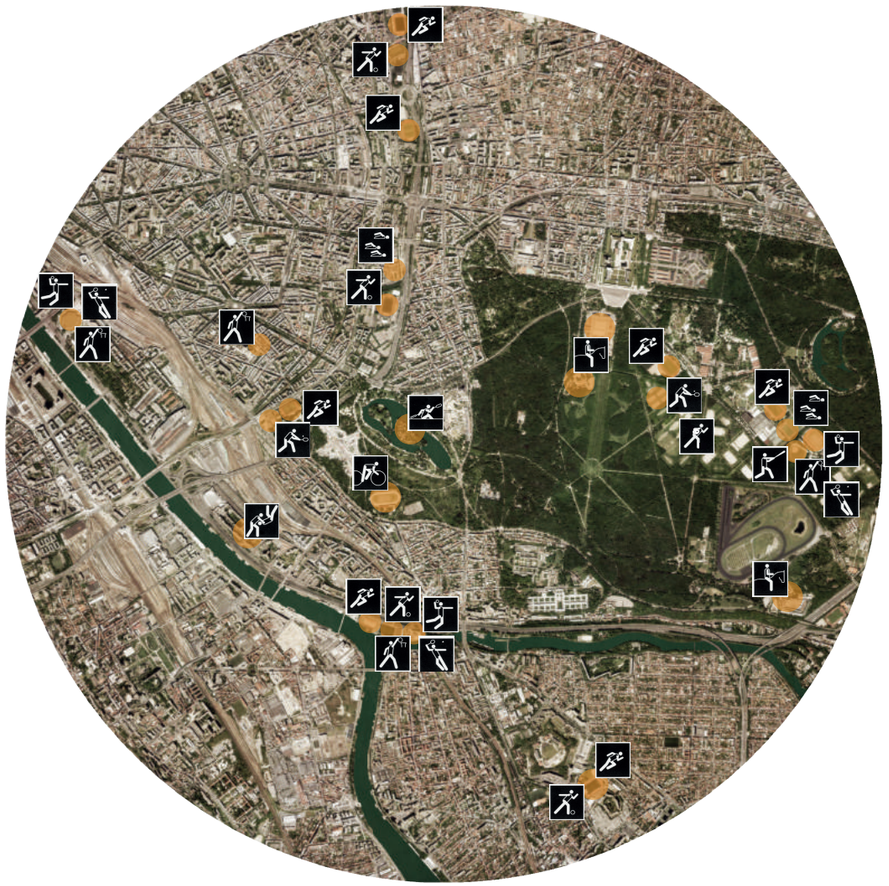
The area surrounding *Charenton* on the other hand is much more well distributed with public transportation in comparison with Saint-Denis. Three RER lines, two tram lines and no less than five metro lines. This is much due to the area being closer in relation to the inner circle of Paris, situated just outside of the highway perimeter which defines its barrier. The area is part of the 12th arrondissement of Paris, even though it geographically is placed outside of the city circle - but this mental connection to the city is not to be underestimated as a factor which speaks in its favor of not becoming an isolated enclave.



## SAINT-DENIS

Looking at existing sports activities found in the area *Saint-Denis*, the main stadium *Stade de France* a natural symbol of sport in the city. The arena hosts sports events in form of Football, rugby and can also host athletics when removing the temporary stands otherwise covering the tracks. Apart from this there's also a sports center *Parc des sports de la Courneuve* with indoor ball sports, a swimming swimming pool, tennis courts and an athletics track. In the north you find some more athletics tracks as well as football fields and a small sized velodrome. Other sports activities in the near around area are a bit sparser and less well connected but it's fair to say the area remains a symbol of sports activity although the different arenas aren't very well distributed by public transport.





## CHARENTON

When looking at the existing sports activities surrounding the potential site. in *Bois de Vincennes* you find a broad variety of sports. From rugby to tennis, to horse riding facilities, swimming and a diversity of ball sports. *Bercy Accord hotels* arena, which is hosting international sports events such as the world indoor championships in equestrian events, as well as the female European championships in handball.

As seen on the map above, the sports activities in this area are more clustered than the ones around *Saint-Denis*. There is also a large sports facility governmentally sponsored of the institution of INCEP (*institute centre de sport professionellles*) which is an area for athletes aiming to compete at an Olympic level, located in the eastern part of *Bois de Vincennes*. There's also potential to host equestrian events and cycling due to the existing velodrome.

# 5.2
## Context

### Motivation of Site

Historically, the strategical placement of Olympic arenas can be divided into 3 categories

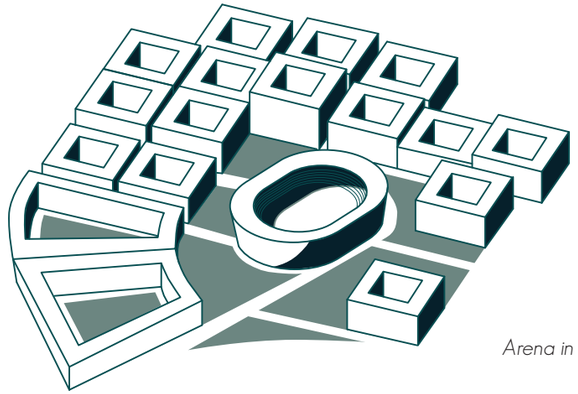
**ARENA IN URBAN CONTEXT**
It is one of the most rare strategy of placements, often due to the lack of space within the cities. It also risks the problems of gentrification due to demolition of existing housing and facilities in order to make place for the large scale structures.

**ARENA IN LANDSCAPE**
More common strategy where the venues often are placed in the outskirts of the city, surrounded by nature. This type of placement often fall into the category of being neglected afterwards due to lack of communication and surrounding urban fabric - leading it to become deserted when no longer used.

**ARENA IN SPORTS PARK**
Most of the recent Olympic Games fall into this category where the aim is to build up a center of connected arenas. Although, just like the arena in landscape they are rarely connected with the city in a way that it is afterwards used in a sufficient way.

Following the urban analysis - the site fulfilling the most criteria as well as corresponding best to the capacity of hosting the Olympic games landed in the area of *Charenton,* in *bois de Vincennes*. It is an area with good infrastructure and public transportation, as well as a dense urban fabric which stands in contrast with the existing forest with its strong sports legacy. Instead of the common strategical placements of Olympic arenas - this area has the benefits of all three, without falling into any of the categories. Therefore it holds the potential of bridging the urban texture with the park and existing sports facilities where the Olympic venues could be a catalyzer for letting it growing together over time.





*Arena in urban context*

*Arena in landscape*

*Arena in sports park*

# 5.3
Context

## History of the Site


Fair grounds poster of the Paris Colonial Exposition 1931 (clioweb.canalblog.com)

**FROM ROYAL HUNTING GROUNDS TO MILITARY TRAINING ZONE, LATER TO HOST THE COLONIAL EXHIBITION AND TURNED INTO OPEN PUCLIC SPACE. OVER THE DECADES THE LARGE GRASSY LAWN HAS GIVEN WAY TO GRAVEL. SURROUNDED BY TREES, THIS EMPTY SPACE WHICH MAKES UP THE SITE TODAY HOSTS MANY EVENTS EVERY YEAR, ALONG THE MAIN HISTORIC AXIS LEFT BY THE COLONIAL EXHIBITION OF 1931.**

The site in *Bois de Vincennes*, next to *Charenton* is today a multi-purpose space that hosts all kinds of activities. From kite sailing to political manifestations, circus and tivoli - the Festival of Humanity was held there for several years before moving to *Parc de la Courneuve*. The most important usage of the site today are probably the *Foire du Trône* a traveling amusement park, and the circuses that settle there for international festivals and at the end of year celebrations. The circuses *Pinder*, *Phénix* or *Gruss* are among the most famous, giving performances under their big tent structured domes of two to five thousand people.



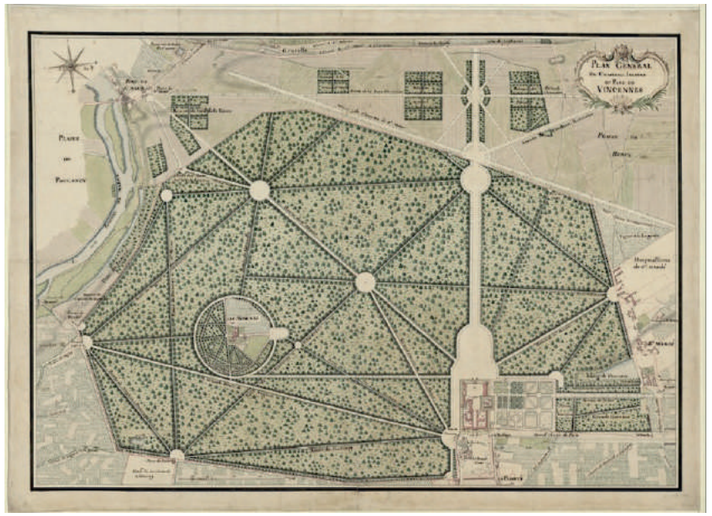
**THE COLONIAL EXHIBITION** The zoo embedded in the park finds its roots back in the colonial exhibition from 1931. The exhibition was put in place to present spectacular findings from the French colonization. The new zoo, offering the audience animals retrieved from the colonies - gave the animals opportunity to move in a maximum freedom, without visible bars, in an African setting. The zoo proved to be the most popular attraction of the colonial exhibition, attracting more than 5 million visitors. Faced with this success, the communities bordering the Bois de Vincennes demanded the opening of the zoological park to be extended beyond the colonial exhibition. The extension of the zoo was considered, and lead to the creation of the zoological park of Paris in 1934, which still stands today as one of the parks main attractions.

**FOIRE DU TRÔNE** Tracing back to 957 this festival was initially called *gingerbread fair*, i but was in 1131 renamed *Foire Saint-Antoine*. In addition to the traditional gingerbread stalls, it was then possible to find shops of all kinds, game makers and acrobats. Disappeared until 1805, this market re-emerged to become a small carnival where trade was no longer the dominant activity. After a period of decline between 1885 and 1918, this festival gradually regained success after the First World War. In 1957, it was given the current name *Foire du Trône* and in the early 1960s, the municipality decided to install the fair at the edge of Bois de Vincennes where the site is today. Nowdays, *Foire du Trône* welcomes five million visitors, six weeks every year. It is no longer a simple carnival but a vast and prestigious amusement park.

**BEACH PROJECT ON LAC DAUMESNIL** The proposed project of making Lac Daumesnil into a public beach consisted of developing the existing lake into a public swim area. The beach would have regulated opening hours and with a maximum capacity of 1,000 people simultaneously. The project validated by the Paris council on September 28, 2016, with a cost on departure 3.5 million euros, was presented as a response to the commitments of the Paris mayor Anne Hidalgo with her «swim in Paris» plan. Bois de Vincennes being classified in 1960, as a historic site, to preserve its historical and picturesque interest. The natural site includes a great diversity of fauna and flora with up to 80 different species. For these reasons, the redevelopment project had a lot of opposition, as much among ecologists, heritage curators, as among the inhabitants who frequent these places on a weekly basis. Finally, due to protests, the project has been postponed for now.

## 1793

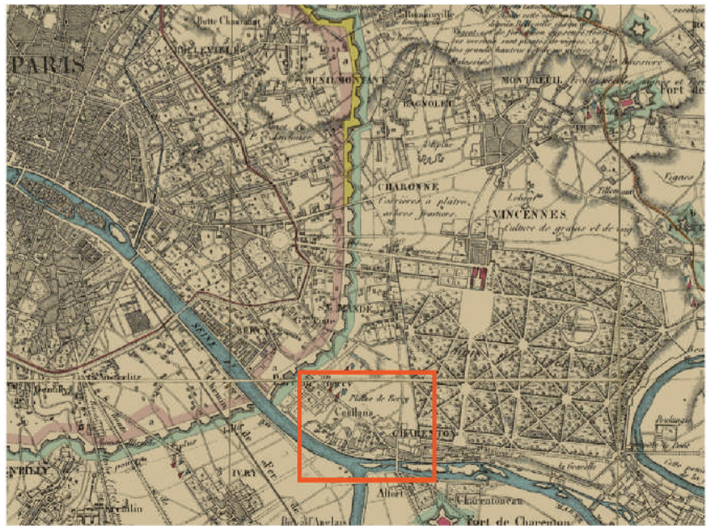
*Bois de Vincennes* is a remnant of the forest that covered the surroundings of the acient Paris. In the eleventh century, it was a forest close to the confluence of the Marne (river branching out from the Seine) and the Seine, unfit for culture. When *Hugues Capet*, King of France from 987 to 996, set up his residence on the *Île de la Cité* - the forest became his hunting ground.
It subsequently remained the exclusive use of the kings of France.




Map of the Bois de Vincennes and the castle in 1739 (www.larevueeclair.org)

## 1841

During the French Revolution, the forests became a military training zone. The army casts 166 hectares and built various buildings within its perimiter: firing range, barracks, etc. Between 1855 and 1866, on the order of Napoleon III, the Bois de Vincennes was arranged to become the counterpoint of the Bois de Boulogne, the other large forest located west of Paris. The two parks were, according to the wishes of the Emperor, to provide «a vast park to the working class population, one of the Parisian East, and one of the Parisian west».




Map of Paris and its surroundings in 1841 (www.rocbor.net)



## 1950-1965


Map of the Bois de Vincennes and the site, flight photo taken sometime in betweel 1950-65 (www.larevueeclair.org)

The lawn of *Reuilly*, is one of the remains of the International Colonial Exhibition that took place from May 6 to November 15, 1931. After the dismantling of the pavilions of the exhibition, the old main alley of the exhibition was preserved for future events in the form of the large open field. The cykling statium Initially built as a velodrome in 1894, it became the main stadium for the 1900 Summer Olympics; Events that took place in the Velodrome at the 1900 Summer Olympics included cycling, cricket, rugby union, football and gymnastics.

## 2016


Map of the Bois de Vincennes and the site during the spectacles of Foire du Rhône 2016 (google maps)

In modern time the site has been asphalted into a huge open area surrounded by trees, to accomodate temporary events. During winter it is turned into a temporary circus, between November and January. In summertime the traveling tivoli, *Foire du Trône*, with around 350 temporary attractions occupies the site. Surrounding the site you find numerous running tracks in the forrest with outdoor gym stations along the routes. Lac Daumesnil is a popular attraction where one can rent rowing boats and paddle on the lake. There is also pony riding and a well equipped playground for kids just next to the site.

**PICTURE 1** Old postcard of people walking along Lac Daumesnil in Bois de Vincennes. (http://paris1900.lartnouveau.com)

**PICTURE 2** People sunbathing and having pick-nick in the fields in June 2013 (Photo: Elena Dijour, www.Shutterstock.com)

**PICTURE 3** Poster from 2015 of the reaccuring music festival *We love Green* taking place in Bois de Vincennes each summer - attracting thousands of people during its two days, with international acts. (www.welovegreen.fr)

**PICTURE 4** *Lac Daumesnil* and the charecteristic pavillion with Ionic columns situated on île Daumesnil, one of the islands. The lake is a popular attraction to both walk around, having a tour on the two islands or renting rowing boats to paddle along the lake.
(Photo: unknown, www.parisianist.com)

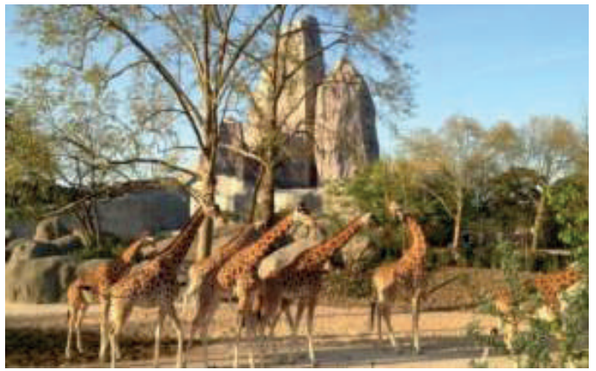
**PICTURE 5** The popular Zoo situated in Bois de Vincennes viewing giraffes in front of the 55m heigh atrificial rock.
(www.parczoologiquedeparis.fr)

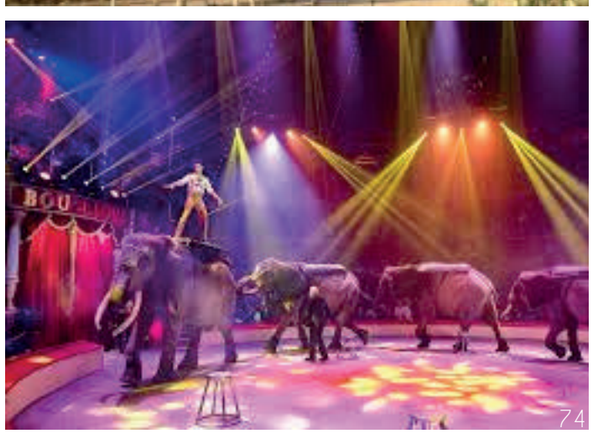
**PICTURE 6** View of the site at nighttime when occupied by *Foire du Trône*. The Foire du Trône welcomes for six weeks every year, five million visitors. What started as a simple carnival has become a vast and prestigious amusement park in the city of Paris.
(www.foiredutrone.com)

**PICTURE 7** *Le Cirque Pinder*, a reaccuring traveling circus which occupies the site one month each winter with its temporary build up of red and yellow circus tents.
(www.cirquepinder.com)









# 6.0
Reference projeccts



# 6.0
Reference projects

## WHAT KNOWLEDGE IS RELEVANT FROM THE PAST?

Following references are focused on bringing forward projects in relevance for the thesis. Although arenas and their possible transformation is of particular interest, there are also projects of different character lifting the subject regarding housing, modular units and flexible structures.

**LONDON ARENA** - The main stadium from the Olympic games in London 2012, which have afterwards been converted into a permanent football stadium, but still holds the possibility to still host athletic events thanks to its retractable stands.

**CENTRE POMPIDOU** - by Renzo Piano and Richard Rogers. Completely mind changing of the 20th century architecture where the concept of Bigness intervenes with a highly flexible structure to enable changes of program as well as interior changes within the shell.

**NAKAGIN TOWER** - Example of Japanese Metabolism in relation to housing inventions. A tower with dock in units made to be replaceable and adaptable. However in reality neither of those methods have been applied to the building.

**CASA FUTBOL** - Suggestion of multipurpose use of arenas where housing units could be inserted to the existing structure. An attempt to start a debate on what to do with the remaining arenas after the World Championship in Football taken place in Brazil 2016.

**LAS ARENA** - Richard Rogers. Old bull fighting arena transformed into mixed leisure center and offices as well as regenerating its surrounding neighborhood. Interesting conversion of an existing arena into a new function for the city.

# 6.1
## Case studies

### London Olympic Games 2012

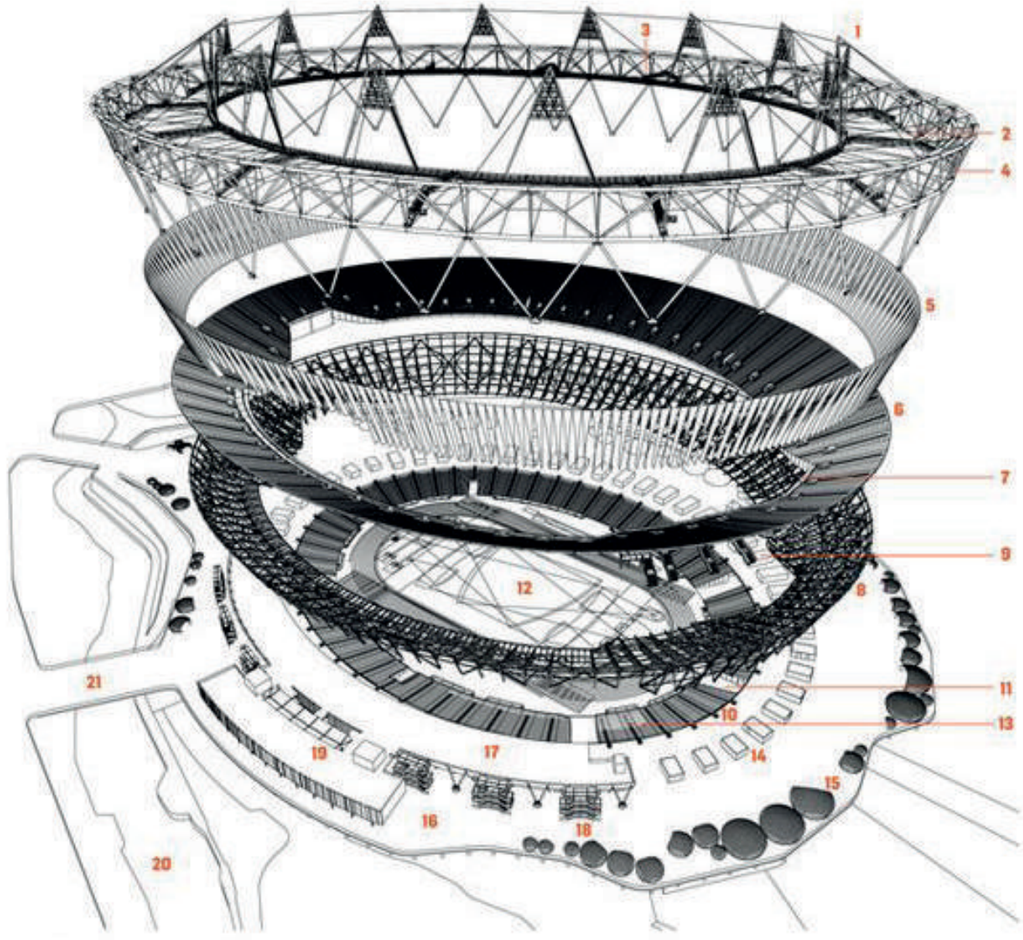
Located in the Queen Elisabeth park, in Stratford London it was the main arena for the 2012 Olympic games. The Games as previously mentioned, having an ambitious and new thinking strategy of sustainability. Whilst several of the arenas used for hosting the Games were rapidly deployable structures - the main arena hosting the Athletics, were intended to be kept, but re purposed afterwards.

Much of the original structure was built with recycled materials. From PVC membranes shielding the arena from wind - to recycled old gas pipes making up most of the metal construction. The dug down inner field makes for a lower total height of the structure, as well as shields it better from the wind.

After the Games, the arena was converted into a permanent football stadium for the local club West-ham united, where the arena was reduced from 80 000 seats into the more manageable 56 000 seats. This was possible due to the upper deck being constructed as temporary seating. The arena has been adapted with introduced a new flexible seating system, integrated with a lower tier on the same level as the inner field. This makes it possible to be pulled out, to get the audience closer to the inner field sports events when the track is not being used. This also makes it flexible to host different type of activities on the inner field from football, rugby and athletics to concerts or festivals with a higher number of spectators. The new roof is being expanded to twice the original size, now covering all seats. With the iconic triangular lighting towers from the original structure re-integrated underneath.

Flexibility in this sense may be highly useful when adapting a sports venue to become more manageable in size - never the less, it remains an arena with similar functions as before. The learnings taught from the reference project has primarily been the materiality and the clever way to lower down the inner field to make an overall lower building height.






Exploded axonometric diagram of the London Arena and how it looked during the Olympic games (www.bbc-co.uk)

1 Spotlight towers.
2 Access bridges over roof fabric for access maintenance and ceremony activities.
3 Roof tension ring.
4 PVC-created polyester fabric membrane roof.
5 336 wrap fabric panels, each 25m high and 2,5w twisted by 90 degrees.
6 Upper tier, gross capacity 55 000 spectators.
7 Large format video screens and scoreboards.
8 Upper tier supporting steel structure.
9 Stairs to the upper tier from entrence level.
10 Lower tier, gross capacity 25 000 spectators.
11 Field of play access tunnels for athletes + officials
12 Athletics field of play.
13 Photographers platform.
14 Internal toilet packages.
15 External "pod village" for spectators.
16 Public circulation podiums.
17 Level 02 courtesy and hospitality terrace.
18 West stand external escape stairs.
19 Tensible fabric canopy over the escalator void areas for hospitality and VIP.
20 River lea.
21 Venue entrence bridge.

# 6.2
## Case studies

### Campo Marzio

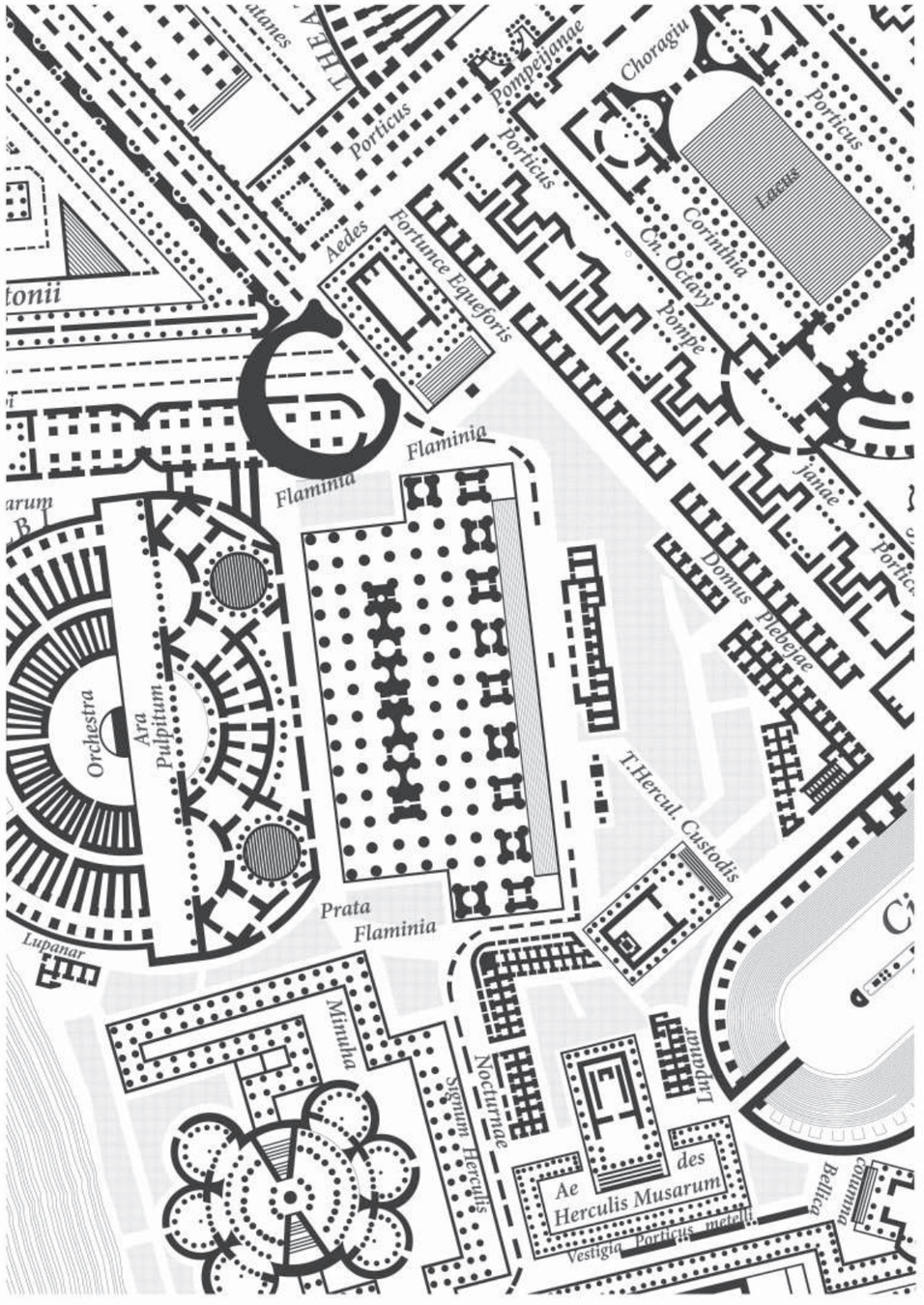
In 1762 the Italian engraver and architect Giovanni Battista Piranesi made the drawings of an experimental design for Rome, named Campo Marzio. With the passion of the glory of the ancient Rome, Piranesi created a labyrinth like plan based on old drawings of ruins from the site. The plan mix typologies and scales of the structures in a balanced way and plays with the boundary of indoor-outdoor thanks to the many sheltered passages held up by columns blurring the distinction between public and private space.

In Campo Marzio, the marginalized area outside of the Roman city walls become the focus of all that is excluded from the city center; military exercise yard, stadium, gymnasia, amphitheaters and circuses, gardens and pleasure fountains, crypts and tombs. The conventional institutions of the imperial city are absent in this plan. Streets are nonexistent, as is the whole domestic fabric of the city. (Allen, S. 1989)

In the city, time is represented by the accumulation of materials, its decay and transformation. Piranesi therefore claims that he is not the inventor of the plan, only a contributor since the city plan is not static and is revised on ruins.

For the 13th International Architecture Exhibition at the Venice Biennale in 2012 - David Chipperfield invited Peter Eisenman who in turn asked Jeffrey Kipnis and Pier Vittorio Aureli to join him in an exploration of Piranesi's drawings of Campo Marzio. It resulted with an exhibition of 3 varied contemporary interpretations named *Piranesi variations*.

Seemingly the old utopian drawings from Piranesi is still creating debate amongst architects in the 21st century. The study is a way of seing urban structure as something building onto the erased ruins from the past and using it to inform the site. Another interesting aspect is how the urban rooms are enriched by the lack of distinction between public and private space where the passages and exterior rooms blend together.




A fragment of Piranesi's Campo Marzio plan of Rome (1762), re-drawn by Jess Coxon (September 2014).
www.cameronmcewan.wordpress.com

# 6.3
## Case studies

### Centre Pompidou

Innitiated as a competition for a  new cultural center by formerely French president Georges Pompidou. Won by the collaborating efforts between Richard Rogers and Renzo Piano after radically suggesting to only use half of the given site, leaving the rest as an open public square. This being far from their most radical idea. By opening up a public space and bringing a cultural center, combined with art exhibitions, cinema and library to the unattractive area it was an attempt to start a catalysing effect of revitalizing the neighborhood. It is distinctively first in the way it frees up the space inside, with each floor extending through the building entirely uninterrupted by load-bearing structures. The whole of each 7 500 m2 floor is thus available for the display of works or other activities, and can be divided up and reorganised at will, ensuring maximum flexibility. The strong colour coding of each important element has made it a visually striking landmark. Blue is symboling air circulation, yellow electricity, green for water and red for the flow of people circulation.

Regarding Rem Koolhaas discussion of architectural "*Bigness*" in relation to the impact of the city - Centre Pompidou becomes an interesting example. Due to its enormous scale, it becomes independent of the quality of the design; therefore, such buildings are "no longer part of any urban tissue" - in the best scenery they just cope with context, at worst they simply ignore it. (Koolhaas, 1995) What is the threshold size when architecture becomes urbanism if any? One may then start to question whether the bigness scale is in fact becoming the urban context intself by creating its own narrative.

The building is today seen as an icon of 20th century architecture as well as being the largest modern museum in Europe. With the neighborhood of le Marais surrounding it, having become one of the most popular areas in Paris. This suggesting that even though a building is independent from its context - it may still be part of influencing it.
By creating new attraction points in the urban context, it may result in revitalizing the surrounding neighborhoods.



View from one of the exterior escalators overlooking the public square place de Beaubourg (www.rogerstrik+partners.

# 6.4
## Case studies

### Nakagin Tower

The Nakagin Capsule Tower is the world's first capsule architecture built for actual use. The idea of capsule architecture is by using independent units which can be inserted into a mega-structure to gain flexibility. Instead of having a fixed program for the tower it could expand and adapt to the need of the person living in the units. Kurokawa developed the technology to install the capsule units into a concrete core with only 4 high-tension bolts, as well as making the units detachable and replaceable. The capsule is designed to accommodate the individual as either an apartment or studio space, and by connecting units can also accommodate a family. In the Nakagin tower the units came on site completed with appliances and furniture, from audio system to telephone. The capsules were pre-fabricated and the interior pre-assembled in a factory off-site. The units or capsules are then lifted by cranes, and fastened with high-tension bolts to the concrete core shaft.

The module was created with the intention of housing traveling businessmen that worked in central Tokyo during the week. It was a prototype for recycling and sustainable architecture, as each module can be plugged in to the central core and replaced or exchanged when necessary. The tower contains a total of 140 capsules, 14-stories high - that are stacked and rotated at varying angles around a central core. Each capsule measure 4 x 2.5 meters, permitting enough room for one person to live comfortably within only 10m2.

This unique take on apartments and high-risers in Tokyo is a prime example of the Metabolism architecture movement by Kisho. Nakagin tower expresses the contemporary ideas of architecture, which is in many ways similar with other works from the late 1960's, in particular with the Archigram Group and the theoretical work of Yona Friedman.

So far, neither of the modules have been changed of replaced - begging the question if there's other methods of building which could make the flexibility of housing more realistic. Perhaps a more horizontal scheme could make it more adaptable for change.



Nagakin Tower by the architect Kisho Kurokawa, demonstrating the thoughts of Metabolism with its tower constructed as a stem in the sense of a tree - with branches of leaves in form of flexible units which could expand or change over time.

Photo by Fumarola, Carlo. (2008)

# 6.5
## Case studies

### Casa Futbol

Axel de Stampa and Sylvain Macaux are two architects who in 2013 started up the collective *1week1project,* to set a challenge of producing "spontaneous architecture". Casa Futebol is one of their initiatives of starting a debate of what to do with the world cup football arenas sin Brazil after the championships.

Brazil having a shortage of housing and yet putting down millions on creating new arenas for the world cup in football is controversial and much criticized. As a response for what to do with the arenas *de Stampa* and *Macaux* have proposed an integration of housing units within the existing structure. The designs are tailored to each stadium, allowing them to continue to operate smoothly, where a part of the money raised by ticket revenue is used to finance the construction and maintenance of dwellings. By either replacing part of the stands with the prefabricated units or by occupying the external facade, Casa Futebol adds a human scale and added functionality to these monumental buildings. (www.archdaily.com)

By inserting housing units of 105m2, the architects aim to provide around 1500-2000 units per arena - which in their proposal of populating the facades of 6 arenas - will be able to create around 20 000 new homes. (www.1week1project.org)

The project remains on a conceptual level and is not intended to be built - but it creates a debate of the possibility to adapt arena structures into dwellings and re-purpose them. In this case with new functions in a scheme of docked in housing units not far from the ideas behind Nagakin tower. However, a repetition of thousands of identically sized apartments of the vast size of 105m2, and only allowing dayligth from one direction - may not the an optimal scheme for revitalizing the buildings. It instead falls into the risk of becoming extremely homogen and isolated due to lack of functions.



National stadium by
Castro Mello, Photo by EFE
(www.1week1project.org)


Arena das dunas by Populous
Photo by Jobson Galdino
(www.1week1project.org)

Casa futebol inserted units
de Stampa and Macaux
(www.1week1project.org)

# 6.6
## Case studies

### Las arenas

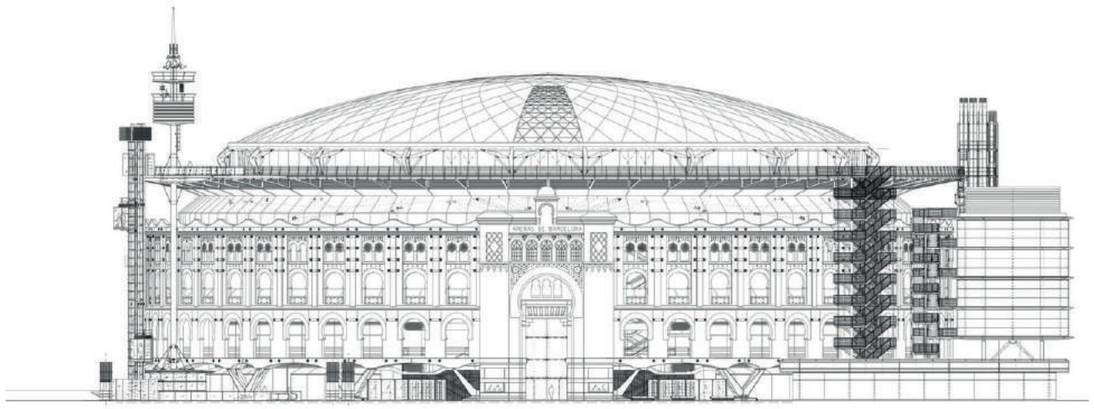
Las arena is a realized project by Rogers Stirk Harbour + Partners, where an old bullfighting arena in Barcelona has been converted into new mixed-use leisure, entertainment and office complex. Whilst the facade has been kept intact - the inner structure is completely changed to make place for its new function. The original stadium being built the end of the 19th century has for long been an historic landmark. But due to the decline of interest for bullfighting in Catalonia, the arena largely fell out of use in the 1970s.

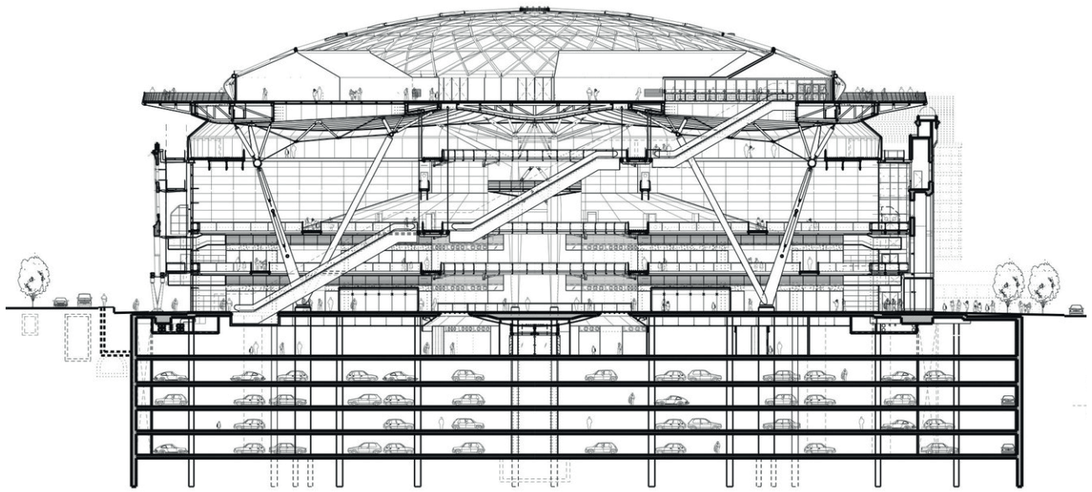
To remain the existing facade but allow for its new functions - the bull-ring was raised above the levels of the surrounding streets with ramps and stairs within the surrounding plinth providing access. This opened up the public area around the base of the building providing level access to a wide range of retail facilities and connections with the existing met-ro station and neighboring Parc Joan Miró. The street level is providing cafés and restaurants, while four main access routes are cutting through the building at 90 degrees to each other. These access routes divide the circular core into 4 zones which all have public access throughout all floors including the rooftop plaza. (www.rsh-p.com, 2011)

The rooftop plaza consists of a 100-metre-diameter habitable area with a 76-metre- diameter domed roof, floating over the façade of the bullring and is structurally independent from it to cover the various activities taking place below. This 'plaza in the sky incorporates large terraces around the perimeter with space for cafés and restaurants with stunning views over the city. The renamed building, now Las Arena was formally opened to the public in March 2011. (www.dezeen.com)

The project brings up the questions on how one can integrate old arena structures to revive the existing fabric. It is doing so by provid-ing mixed functions and public spaces both within and surrounding the building. It is of  interest in relation to Olympic stadiums due to their cultural value and risk of falling out of use after the Games and poses an example of how the conversion can be made.







Las Arenas - Elevation and section
by Rogers Stirk Harbour + Partners
(www.rsh-p.com)

# 7.0
Experiments



# 7.0
Experiments

## THE RELEVANCE OF EXPERIMENTS

The following experiments described in this chapter have been constructed in a way to investigate and develop the metal frame structure of the arena. The experiments have been a search of a lightweight and flexible structure which enables changement - without loosing its structural abilities.

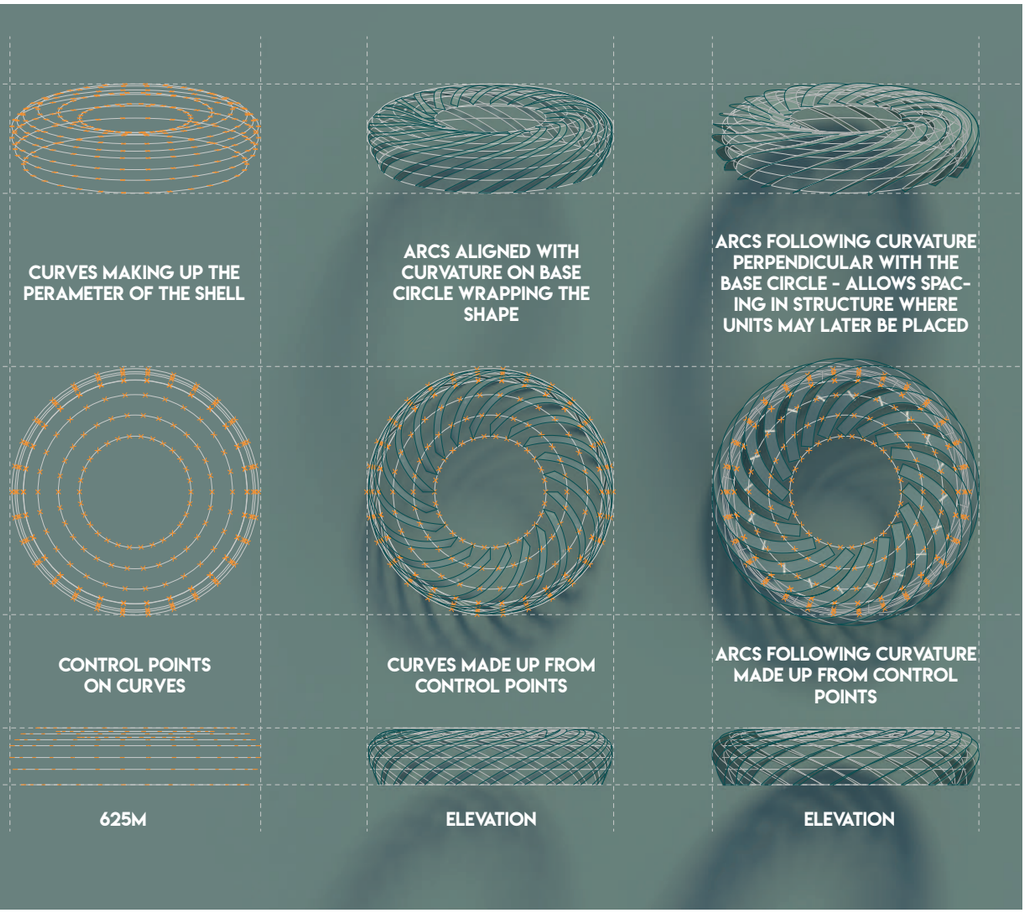
Through a derivative process in search for new solutions, it has taken departure in looking at existing load bearing structural principles and developing them into something new, less static. Different variations of flexibility have been investigated from the starting point of simple structural principles such as frame, vault and grid structure. By using their built in structural advantages they have through experiments been tweaked and developed into alternations allowing for flexibility.

For example, in comparison with a rigid frame structure it has been key to find solutions of how the structure can remain load bearing but also allow for change and adaption.

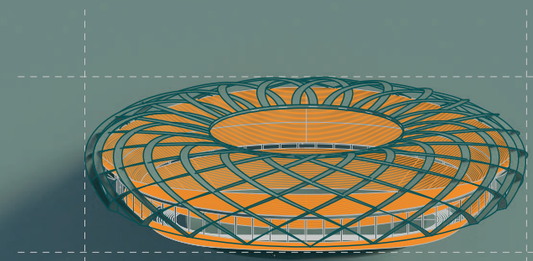
The experiments have largely affected the development of the thesis and influenced the design proposal.

# 7.1
Experiments

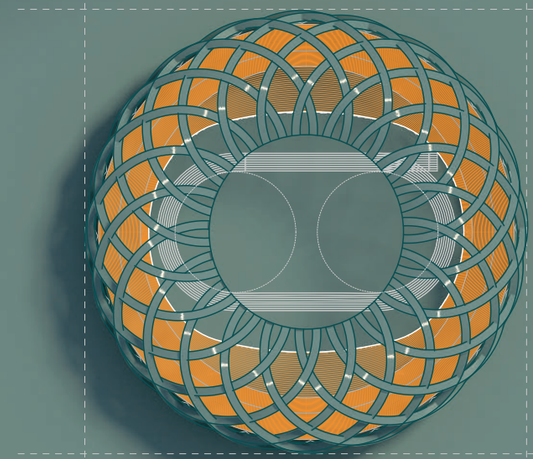
## SYMETRICAL ARCS



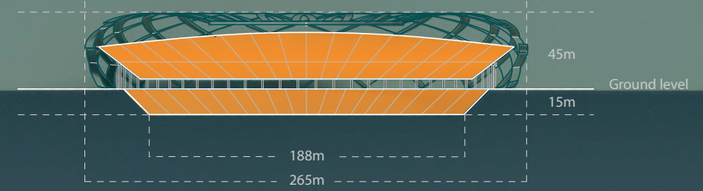


ARENA ITERATION WHERE EACH ARC HAVE BEEN MIRRORED AT ITS BASE POINT TO CREATE A GRID STRUCTURE SUPPORTING THE STANDS FOR SPECTATORS



TOP VIEW SHOWING SYMETRY OF THE ARC STRUCTURE AND HOW MUCH OF THE ARENA IS COVERED BY CEILING

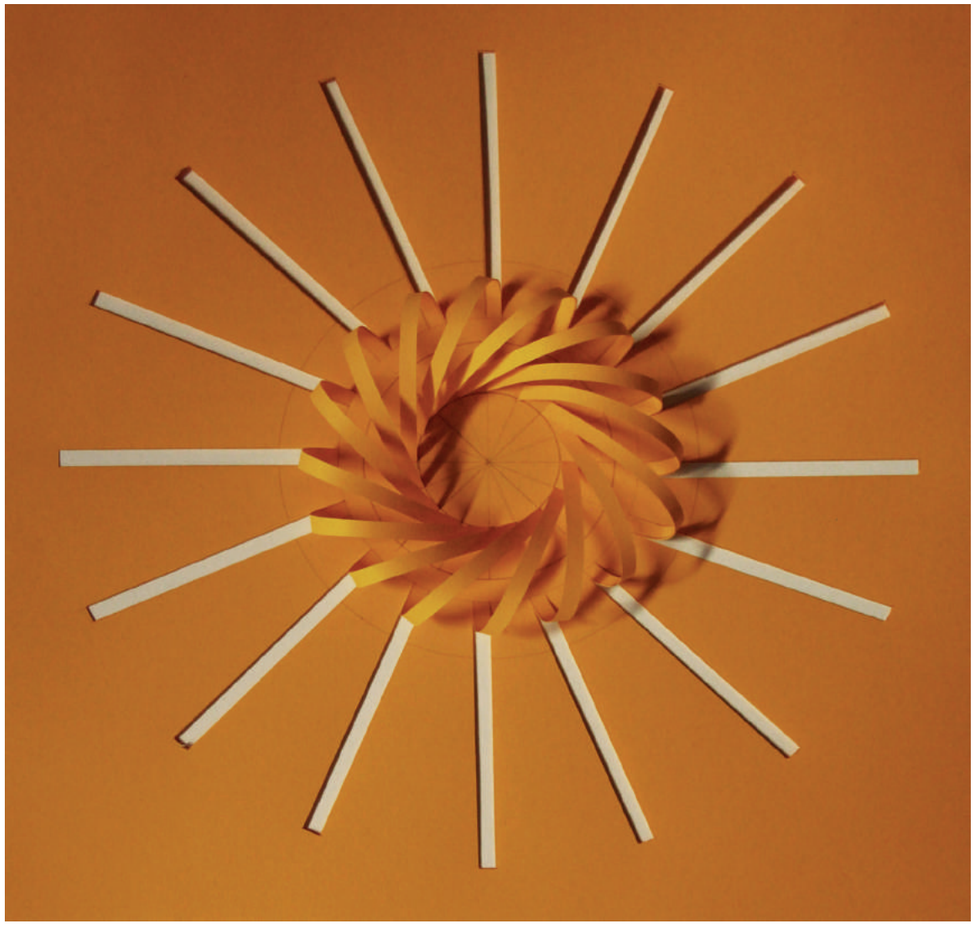



BY DIGGING DOWN THE ARENA IT ALLOWS FREE SIGHTLINES THROUGH THE STRUCTURE FROM GROUND LEVEL AS WELL AS PROVIDING WIND TO PASS THROUGH TO AVOID THE PHENOMENON OF WIND CIRCLES IN THE STADIUM

## SYMETRICAL ARCS

In experiment 1 the aim was to investigate the possibilities of creating flexible structures using flat surfaces. It started with several paper models where a circle with an offset from the main curve defines the span of the structure. Straight ribbons of paper were then cut perpendicular to the angle of the base curve. Where one attaches the end of the cut elements define the height of the structure as well as the void in between the arcs.

In the first model the end points are fixed to the same level as starting point. In the second model (see photos on next page) the end points are fixed on a separate circle with a neutral state of 45 degrees in between. This model can however both change the angle, if twisting the structure attaching the ring where the arcs are fixed - as well as changing the overall height by pulling the strings.





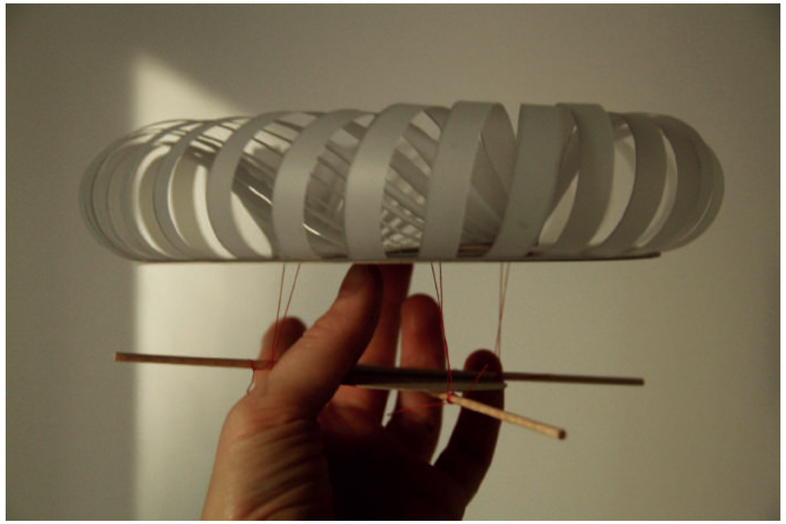
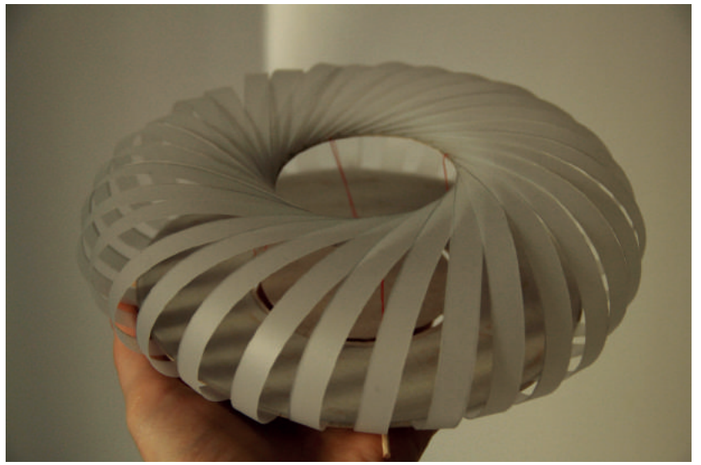


Photo to the left showing sketch model where the endpoints of the straight elements are pulled down to the same level as the base.

Top view of cymetrical rounded model.

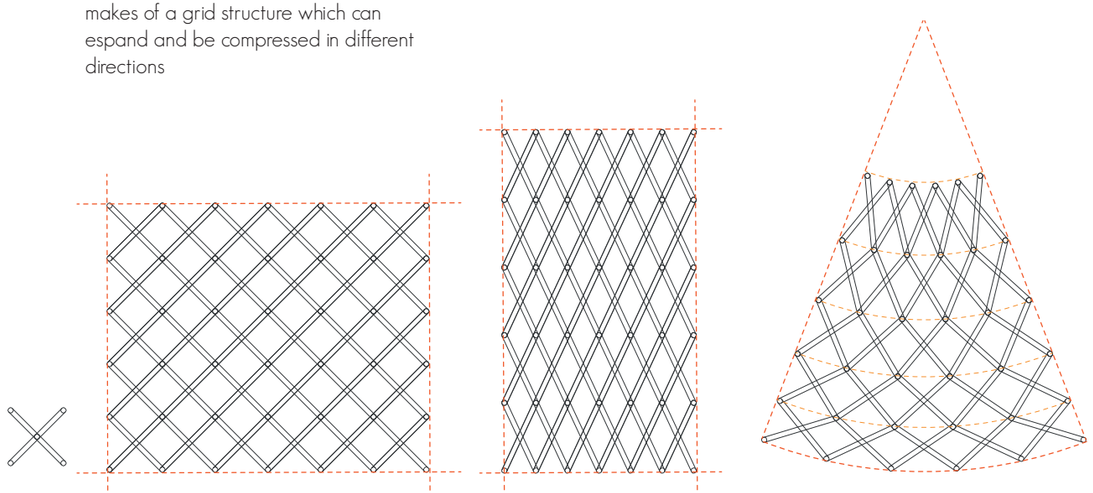


View showing model in neutral mode with base point and endpoint 45 degrees apart

View from different angle of model with same level for start and end points

## FLEXIBILE SKELETON

Photos showing sketch model of flexible grid structure, made from equally long straight elements joined in 3 points which makes of a grid structure which can espand and be compressed in different directions



Grid 45degrees



Grid compressed



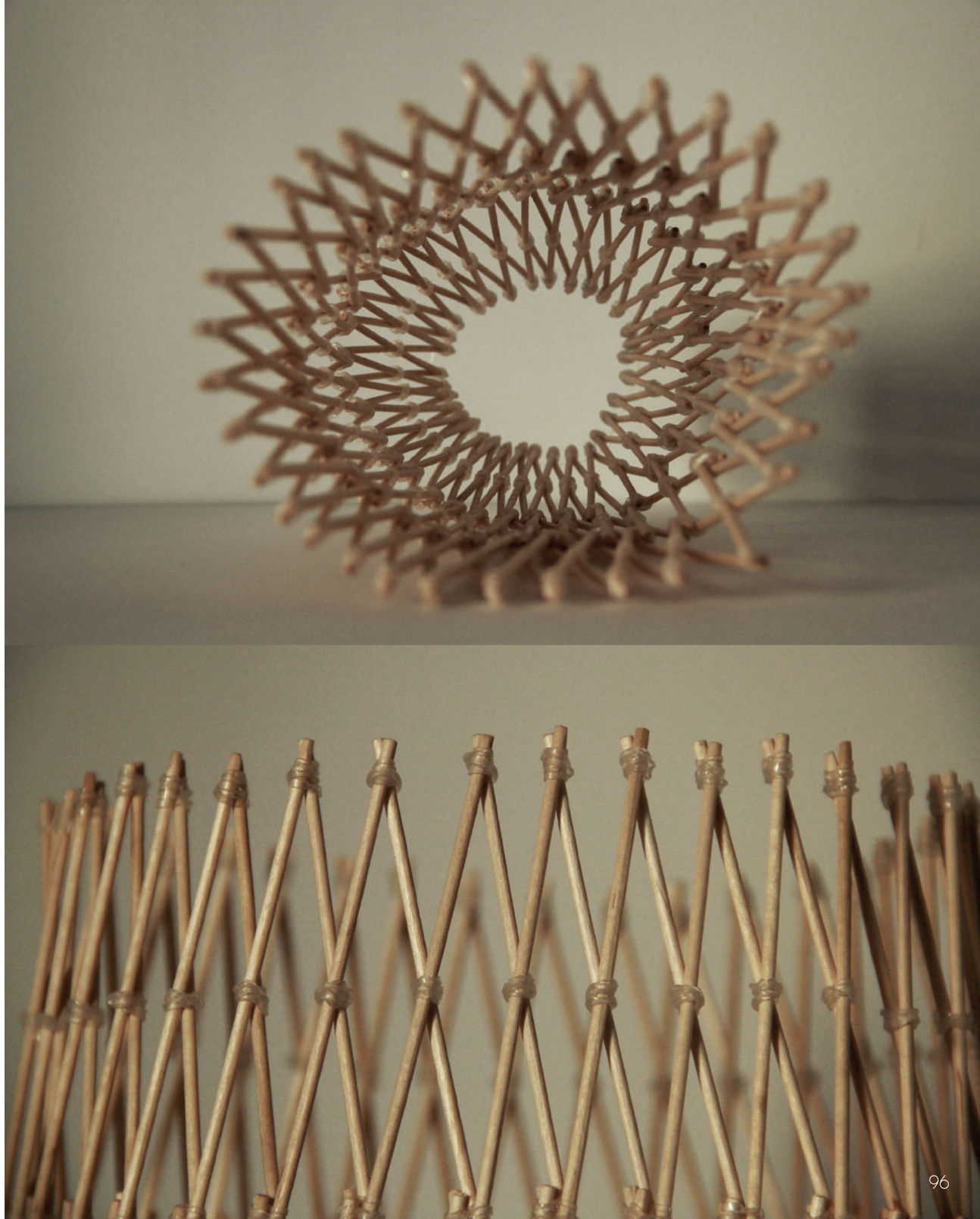
Grid with curvature

Compressed

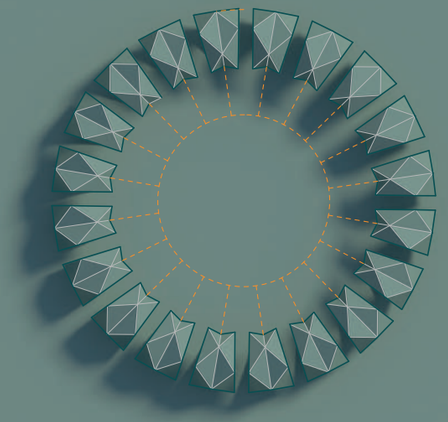
Neutral

Expanded

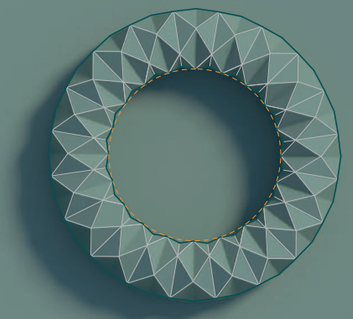




# VAULT STRUCTURE 7.2

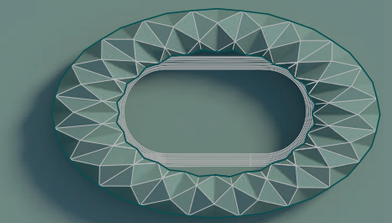


DISASSEMBLED BASE STRUCTURES



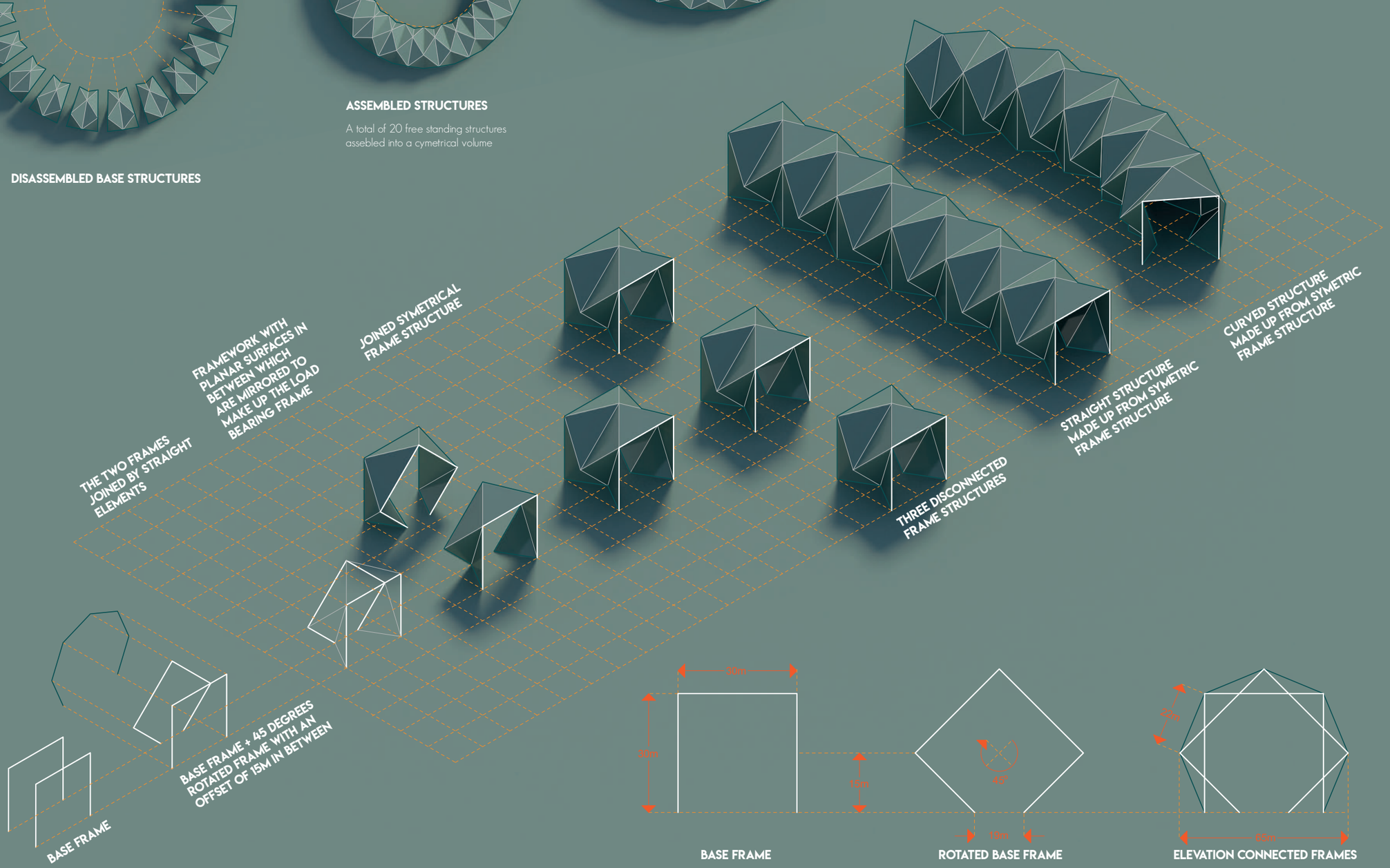
**ASSEMBLED STRUCTURES**

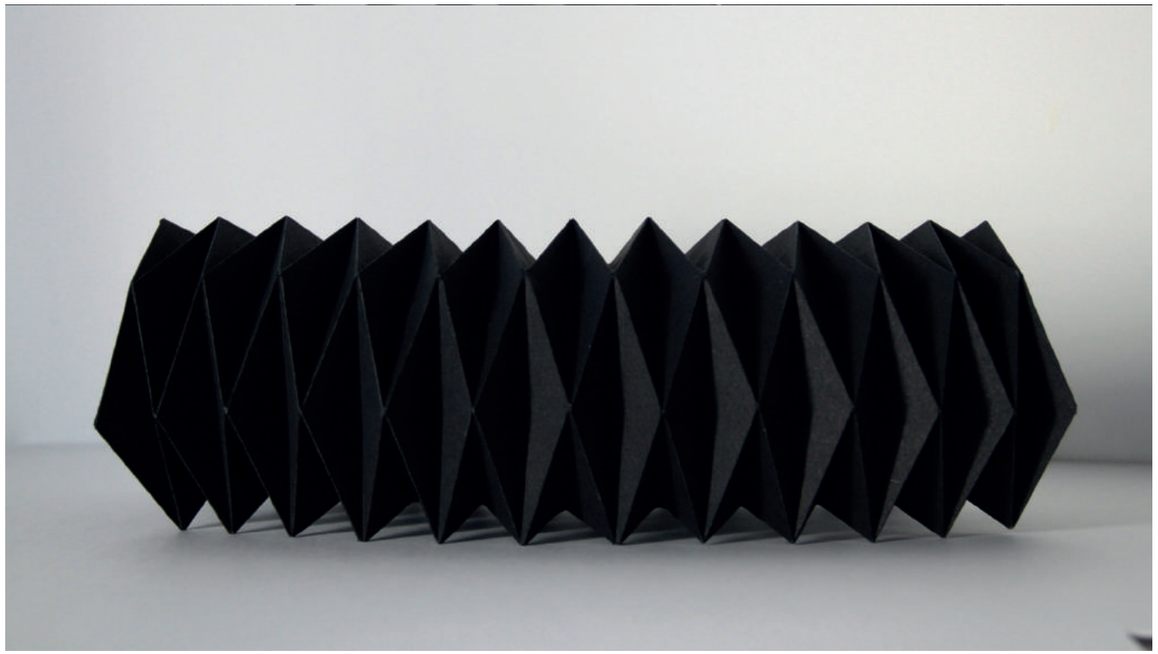
A total of 20 free standing structures assebled into a cymetrical volume



**DEFORMED STRUCTURE**

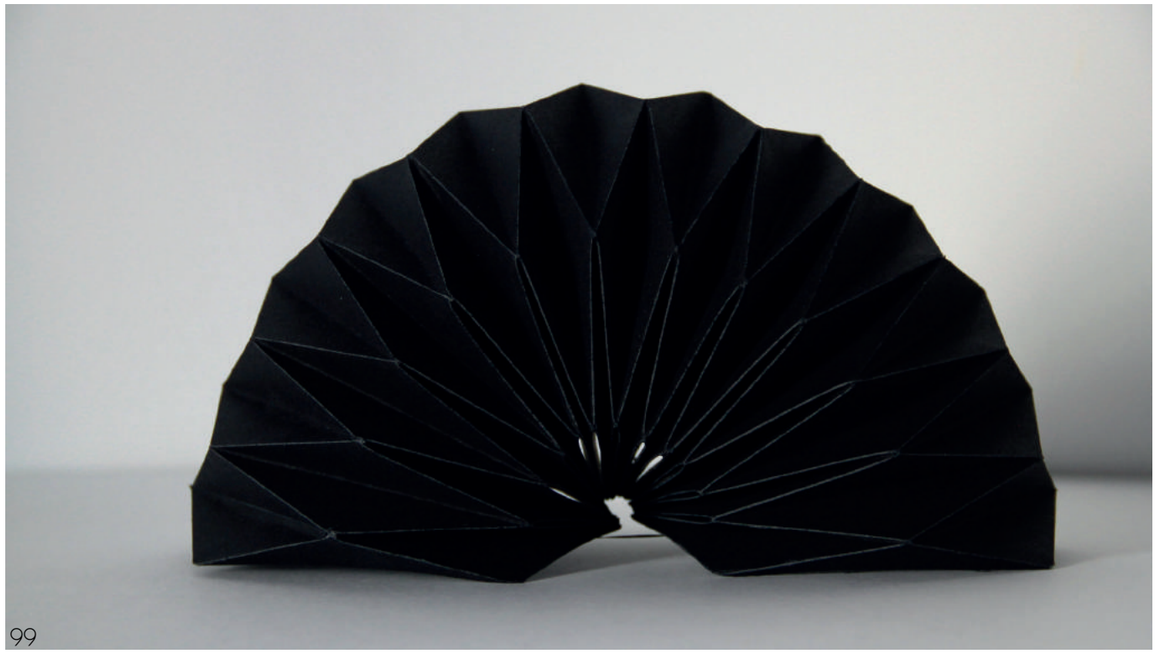
Possibility of changement whithin base structure to create a curvature using symetrical vaults that can expand and create supporting structure of the arena



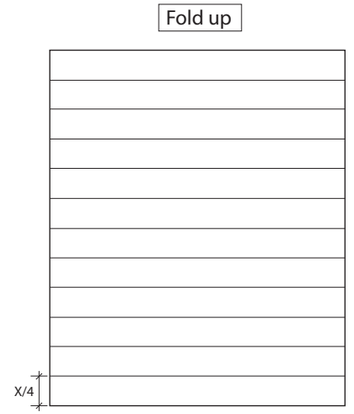


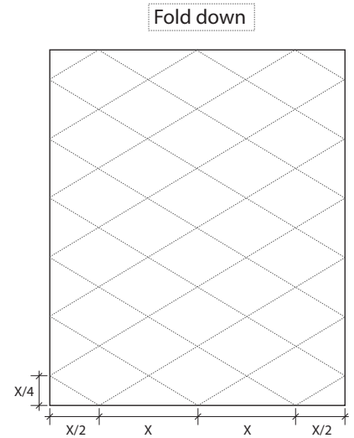
## VAULT STRUCTURE

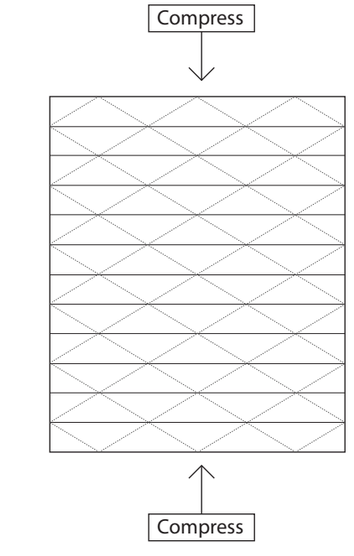
The tubular shape is made up from a folded paper sheet and simulates a structure which can expand and increase in size between the load bearing vaults. Due to its symetrical folding it remains structurally stable as well as sllowing it to change shape.

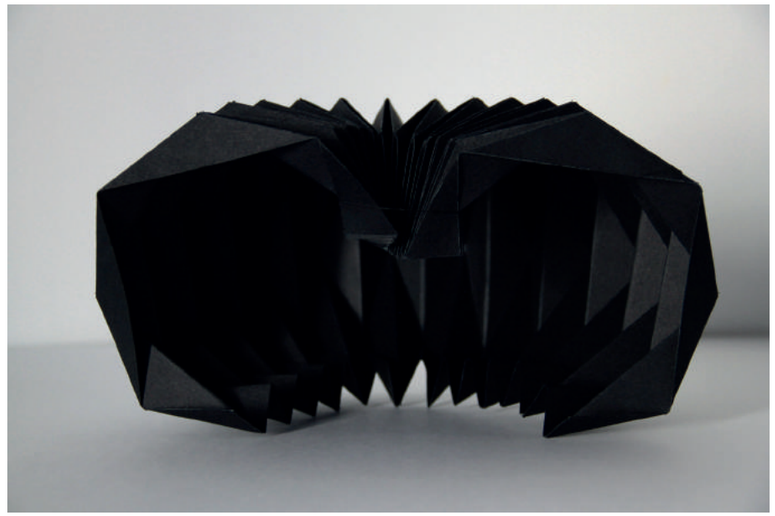


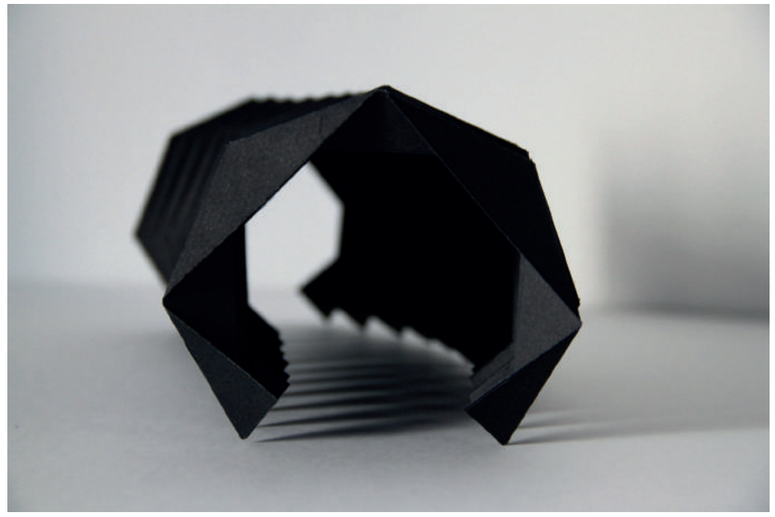


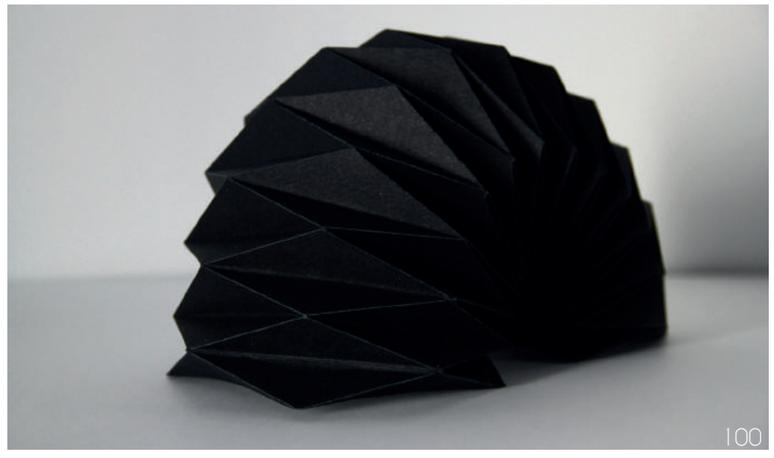




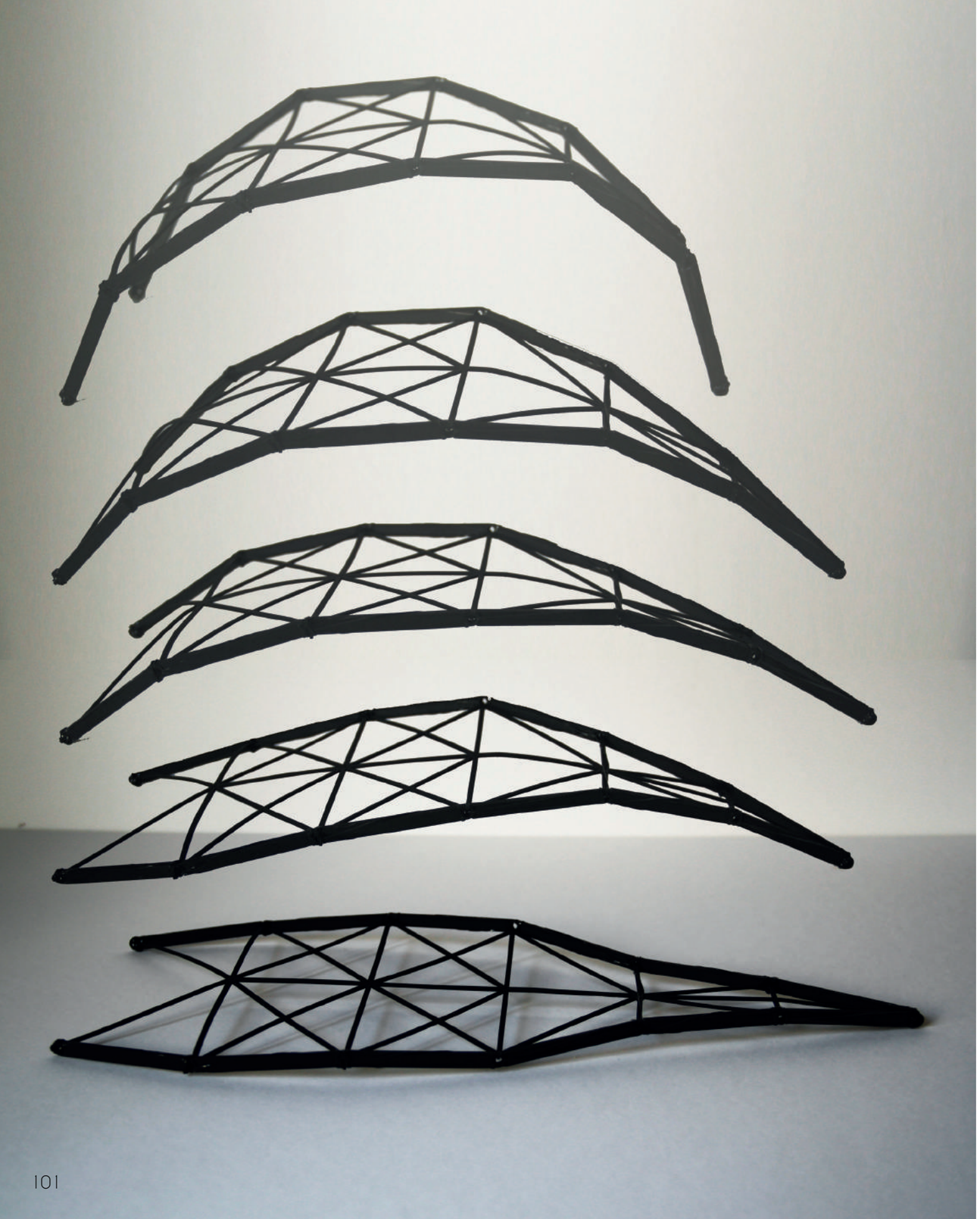


# HYBRID STRUCTURE

## 7.3

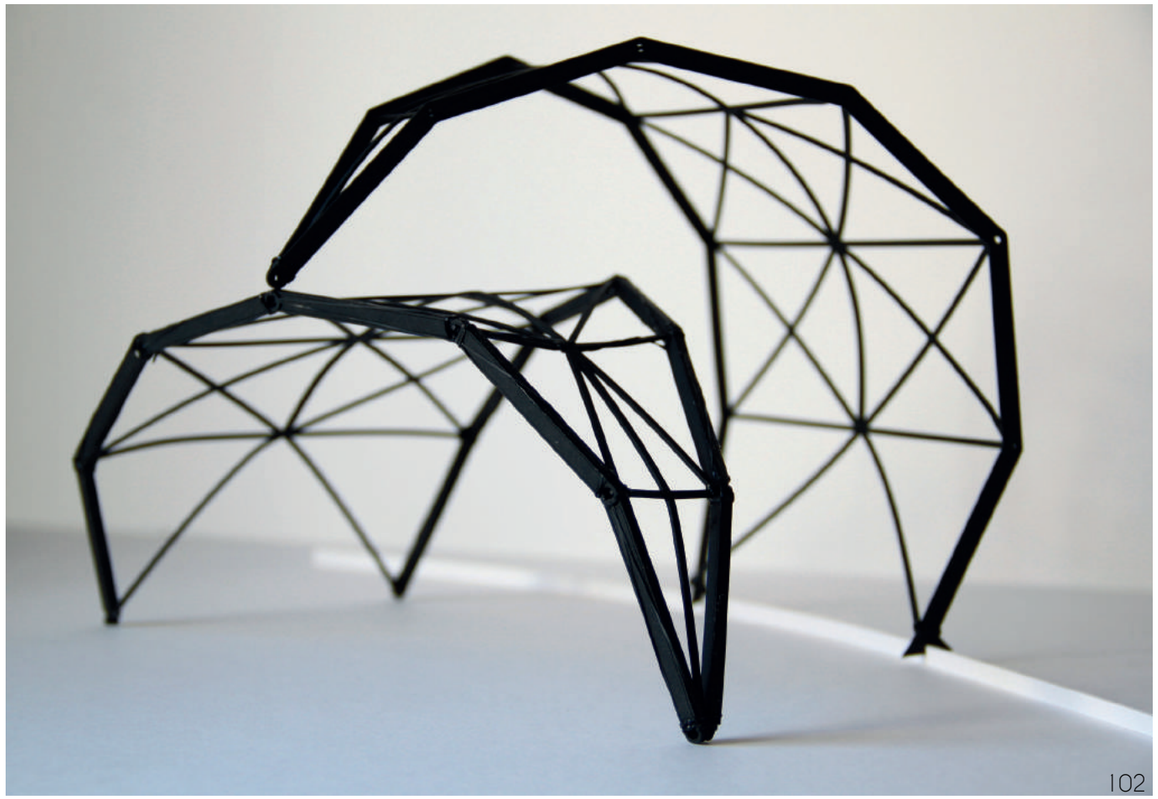
### DEPLOYABLE

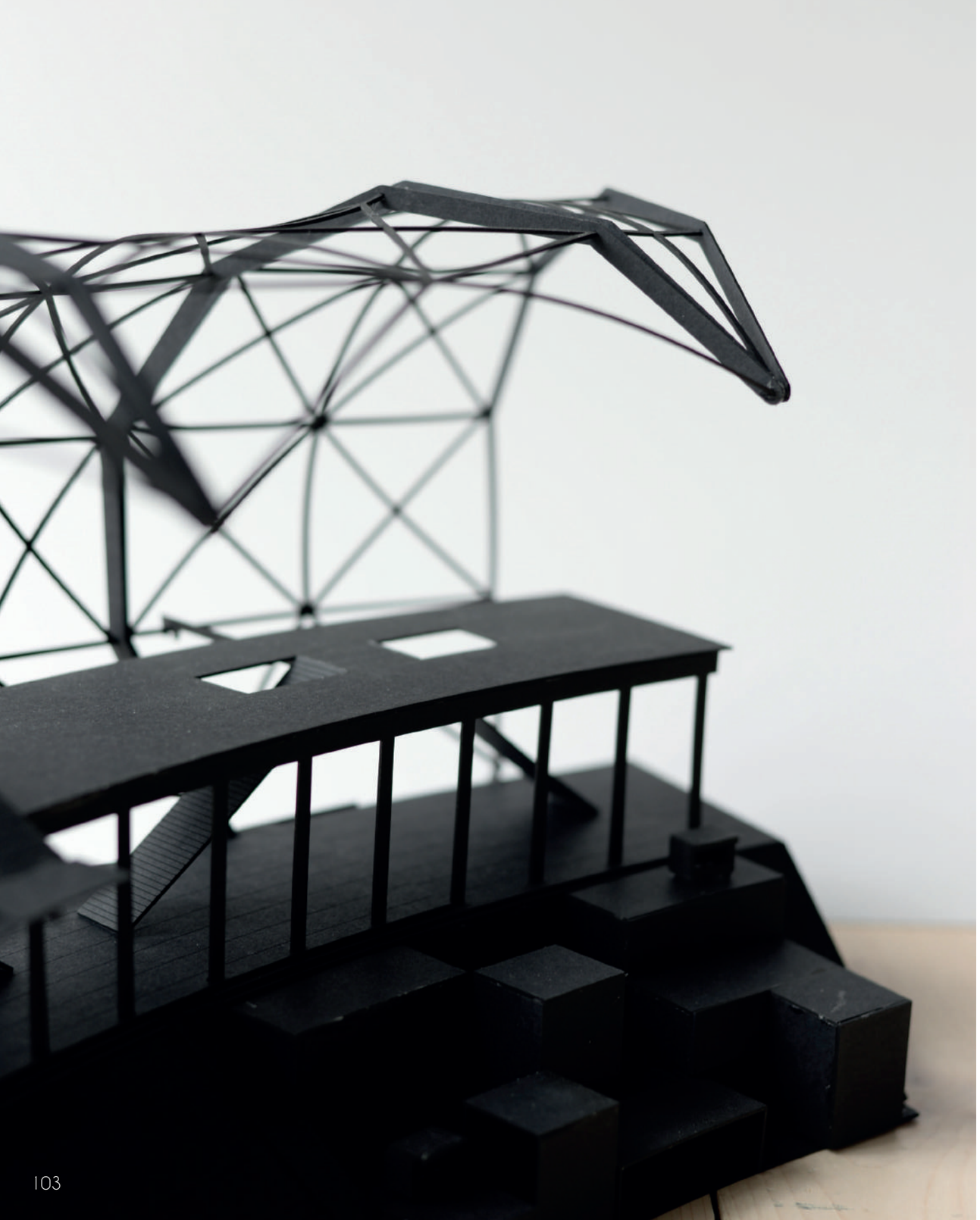
Photos showing sketch model made from straight laser-cut black cardboard of 1mm. The models are a test of how the two joined frames can be interlinked by a grid structure and still be shape changing. The frames are made up by 6 straight elements with flexible joints. The two frames are joined together by elastic rubber bands to gain flexibility.
The grid in between the two frames making up a triangular vault is made from flat cut cardboard. When the vault is changing curvature the grid adapts and remains in position without any fixing. Picture to the left describes how the angle between straight elements are changing the overall curvature.





Two vault structures standing next to eachother. One made from straight cur cardboard, the other one joined together with rubber bands.





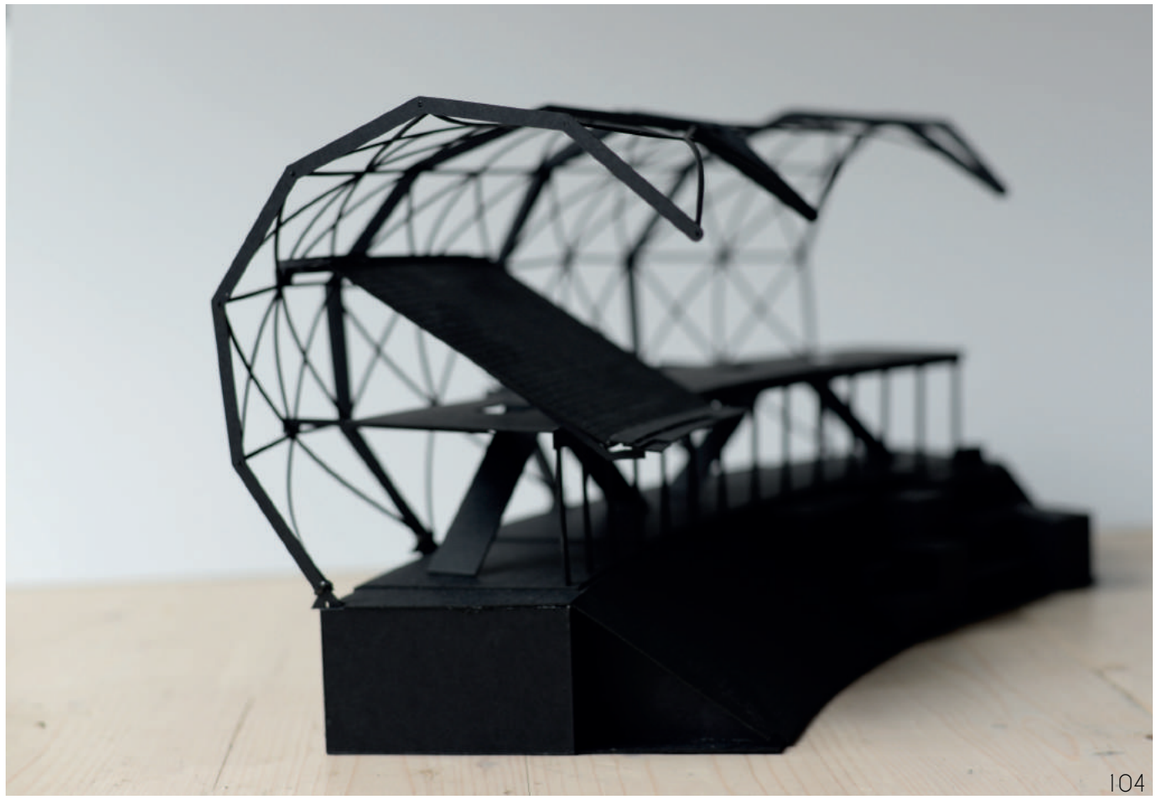
# SECTION MODEL

## 7.4

### COMBINED

Photos showing section model with described functions on page 39-42. It shows the arena structure with its hybrid structure holding the access level for higher tier of stands as well as changement of lower tier partly converted into scheme of new functions. The slab providing circulation to higher level of tier is connected to the hybrid structure as well as a column row. The columns and metal structure is also supporting the tiers when in place - and can later be removed and replaced by other functions.

Three hybrid structures connected together with flexible grid  making up the roof structure and providing the load bearing of the higher tiers.



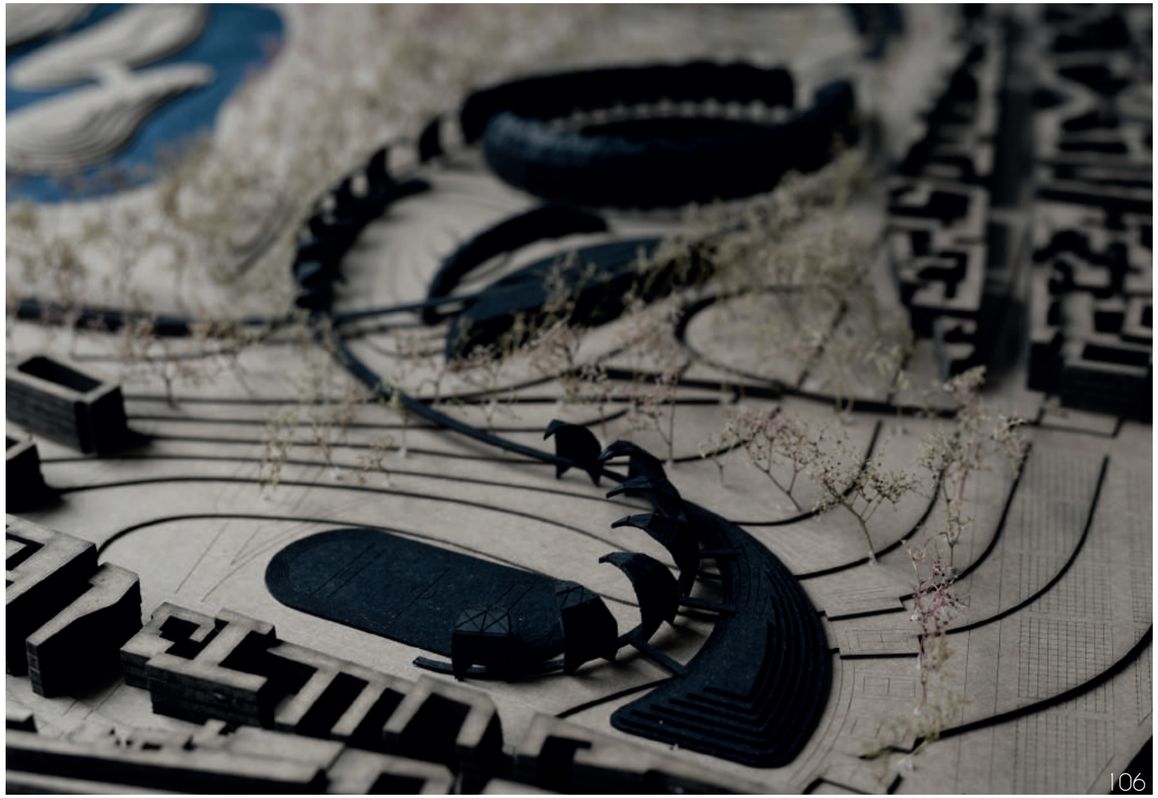
# 7.5

## URBAN STRUCTURES

## SITE MODEL

Photos showing site model laser cut in various thickness between 1-3mm. It shows the design proposal in its urban context where the new structures creates urban rooms to be developed and densified over time. In some parts it creates new urban rooms framing the street on a ground level and then opening up to more generous spaces towards the park. By breaking up the orthogonal grid structure it creates a continuos flow of movement and opens up the previously closed area - connecting the urban and natural fabric.

Picture below describing the warm up arena in the north and its connection via the elevated walk with the new main Olympic arena for Paris 2024.



# 8.0
Conclusion



# 8.0
Conclusion

When planning for future Olympic Games, I believe it essential to balance the amount of temporary structures with investing in new facilities for the future, to also ensure a legacy of the Games afterwards. The answer to the problematics of large scale arenas falling out of use can not only be answered by flexibility within the structure - it must also allow for an urban flexibility when planning for new areas to grow. The current Olympic planning trend of creating temporary structures, may be a good solution in some aspects. But it is also of highest importance to analyze strategical placement and reinforcing existing sport activity if wanting the effect of a legacy use afterwards.

Just like the outcome of megastructures in the real world, hardly matched its theoretical promises - it is hard to say weather the hypothetical design proposal of this thesis would be successfully if implemented in the city of Paris. In order to test the conceptual work, it would need time to settle into the urban context and an evaluation of it can not be done in a short period of time. By providing a framework in which the new area can develop, it's future development becomes very much dependent of the initiatives of the people using the facilities. They are then part of shaping their future and as architects we can only provide the tools or framework.

To finish of I would like to point out that there are many aspects to take into consideration when planning for the future Olympics, as well as for flexibility in architecture. - Where I have only looked into a few parameters, such as overall strategies and flexibility within metal frame structures. However, I believe it relevant as architects to reflect upon our projects as only being a temporary part of what makes up the urban fabric, and to plan for future change to be part of that planning. Although this has only been an initial investigation of 4 months of the many complex parameters - the hope is for this thesis work touching questions on developing strategies, to somehow contribute to the discussion on the topic of Olympic architecture and urban planning.

# 9.0

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# 9.0
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All illustrations, diagrams, photos, drawings, images and pictures in this report are made by the author, if not stated otherwise.

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