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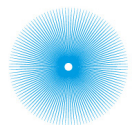
THESIS INCUBATOR STUDIO

VERSATILE SYSTEM
reconfigure through space and time



**POLITECNICO
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SCUOLA DEL DESIGN



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Autodromo Nazionale Monza

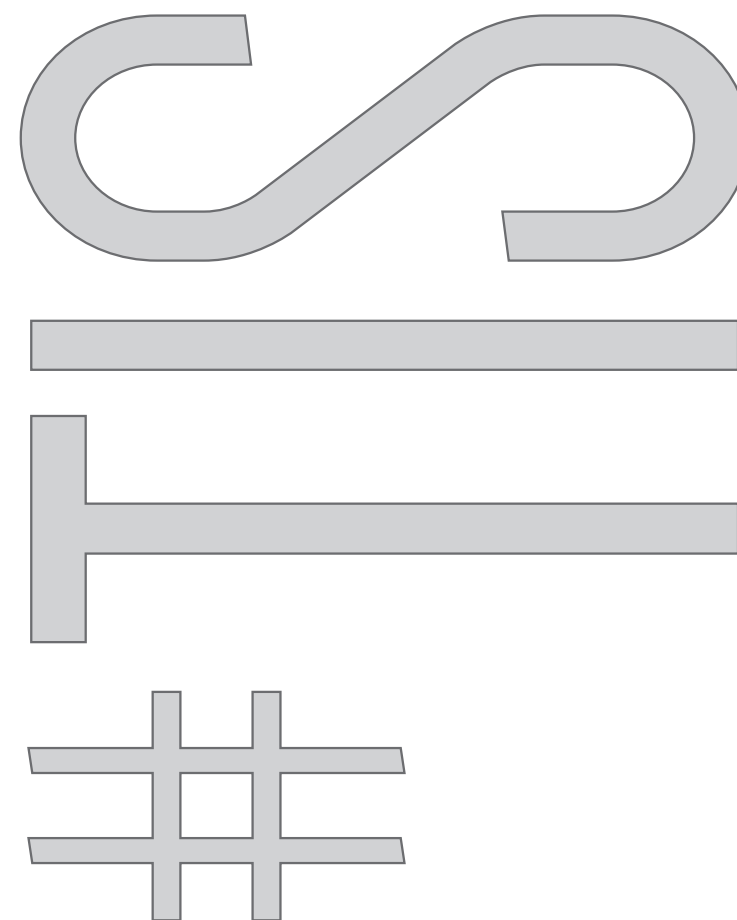
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THESIS INCUBATOR STUDIO

VERSATILE SYSTEM
reconfigure through space and time



versatile system:

reconfigure through space and time

A research about how a versatile system can be applied in Autodromo Nazionale di Monza to put in evidence its peculiarities and improve its functions.

A nonna,
perchè studiare è ciò che avresti voluto fare
e non hai mai potuto.

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Questa tesi tratta il tema della versatilità in relazione agli spazi.

Sono state analizzate le prerogative che uno spazio definito versatile richiede, e ne è stata di conseguenza sviluppata una metodologia da seguire, definita matrice, la quale può essere applicata a differenti condizioni spaziali e temporali.

Applicando tale matrice agli spazi e seguendone le principali linee guida, possono essere definite varie configurazioni spaziali. Essendo un sistema temporaneo, che varia nel tempo, anche tale dimensione deve essere presa in considerazione, in termini di durata ed in termini di strategia di appropriazione degli ambienti. Inoltre, devono essere considerate la dimensione, la forma, e la qualità degli elementi, e come essi possano cambiare, andando così a definire il sistema versatile.

Questa strategia sviluppata è stata applicata, nello specifico, all'Autodromo Nazionale di Monza con l'obiettivo di arricchirlo mediante innovativi spazi multifunzionali.

The subject investigated in this thesis is the theme of versatility related to spaces.

The prerogatives that a versatile space must have been analyzed and a methodology to follow is developed, defined as a matrix, which could be applied to different environmental temporary conditions.

Applying that matrix to spaces, different configurations could be defined, following the main features of it. Being it something that changes over time, this is one of the dimensions that have to be taken into account, both in terms of duration and strategy of appropriation on the space. Moreover, it must be considered the size, shape, and quality of the elements and how they could change, composing the versatile system, as well as the linkage between them.

The matrix will be applied to the Autodromo Nazionale di Monza in order to give to it innovative multifunctional spaces.

7

Assigned the project area, the Autodromo Nazionale di Monza, the research is aimed at the analysis of the company and of the project area which, being historical, has presented several peculiarities in terms not only of spaces and spatial components but also from a historical point of view. To understand the dimensions of that vast space, the scale comparison with commonly rather known places was made.

Another fundamental part of the exploration is the swot analysis which aims to find the strengths and weaknesses of space to exploit the former and eliminate the latter.

This analysis reported the presence of underused and unexploited spaces in which few activities during the entire year take place. That last point was developed in more depth in order to understand in detail the times of use of the space, as well as the frequency of events and the type.

project area

Autodromo Nazionale Monza

_ company

The Monza National Racetrack (Autodromo Nazionale di Monza) is an international motor racing circuit located within the Monza park.

It is the third oldest permanent racetrack in the world, after that of Brooklands, no longer used, and that of Indianapolis.

Since 1991, with the modifications at the Silverstone circuit, the Brianza circuit is the fastest among the World Championships, and the second in the world.

The Circuit is also used for numerous events, charity races, concerts, exhibitions, and guided tours of the track, and on some occasions, it was also a stage of Giro d'Italia.¹

_ history

The construction of Autodromo started in 1922 with the financial aid of the Milan Automobile Club, creating a society to manage the track.

It officially opened on 3rd September 1922 and hosted the second Italian Grand Prix on 10th September.

Between 1935 and 1938 the Circuit held many modifications, above all in the high-speed loop. Starting from 1939, the outbreak of World War II suspended the use of the track until 1948, when many parts of the Circuit were degraded because of the lack of maintenance and military use. During that year, it took two months to renovate the area, and a new Grand Prix was held on 17th October.

In 1950 the Circuit became officially part of the Formula 1 World Championship, which used the 10 kilometres high-speed track until 1961, when it was declared unsafe after a severe accident: from that moment on, only the shorter road circuit could be used for the Grand Prix.

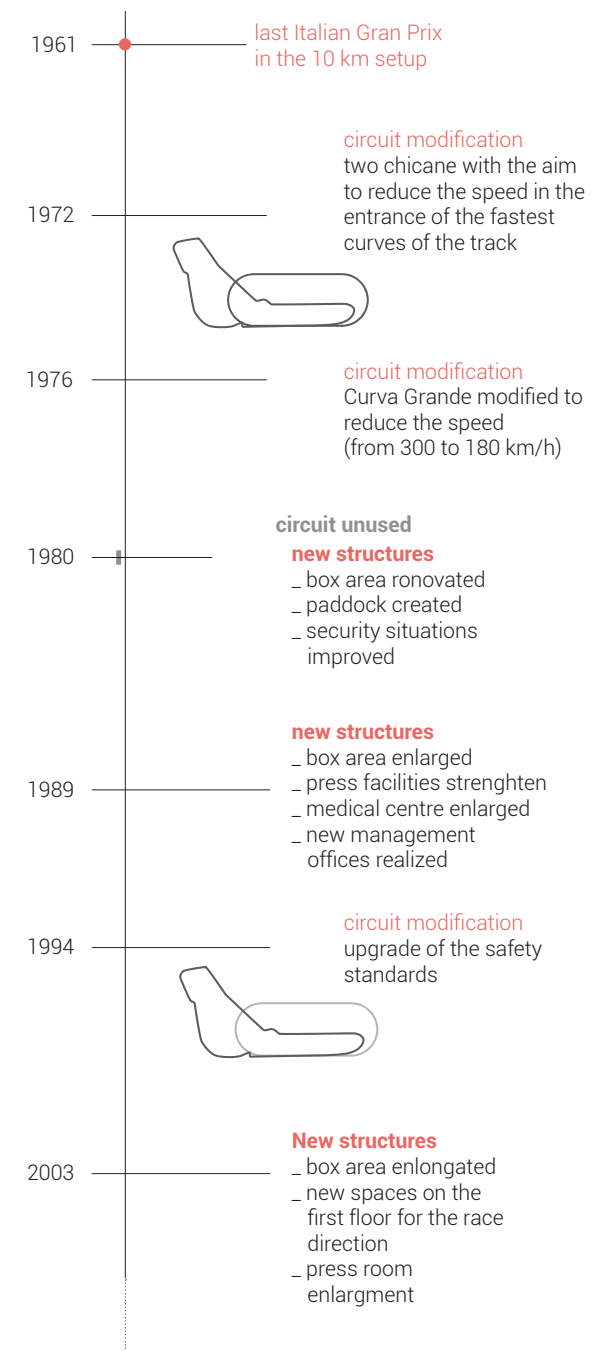
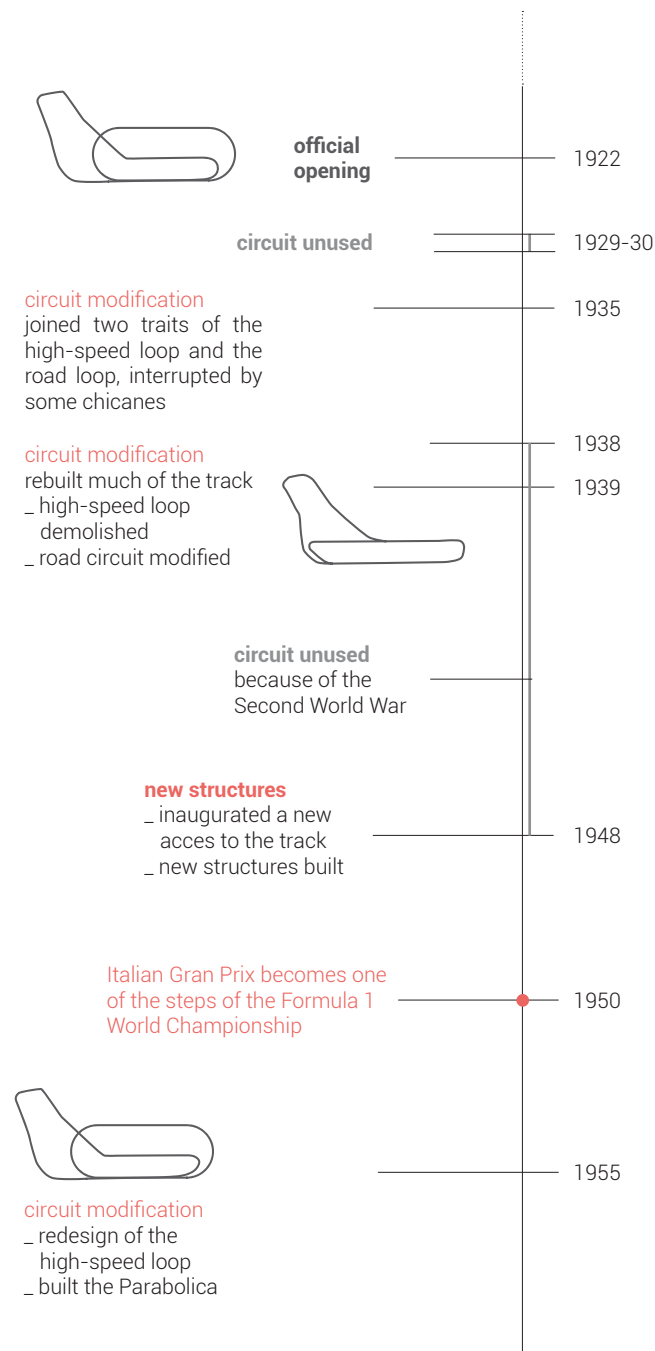
Between 1972 and 1976 modifications were held to reduce the speed of cars on the Circuit and improve the safety, for pilots and visitors.

In 1980 new structures were created and renovated, such as the box area and paddock. Some years later, the renovation was focused on the enlargement of those structures and the medical centre. Even though the expansion of some structures went on until the 2000s, the last important modification of the track is datable to the year 1994.^{2,3}

² Monzanet, "Storia", from <https://www.monzanet.it>, (n.d.)

³ F1Web, "Monza, 90 anni di storia tra successi leggendari e incidenti terribili", January 2012

¹ Monzanet, "Chi siamo", from <https://www.monzanet.it>, (n.d.)



project area

site analysis

_ soft scape

Autodromo di Monza is located inside the Monza Park, which is one of the largest enclosed parks in Europe. The park hosts a wide variety of natural environments, with different plants and bushes.

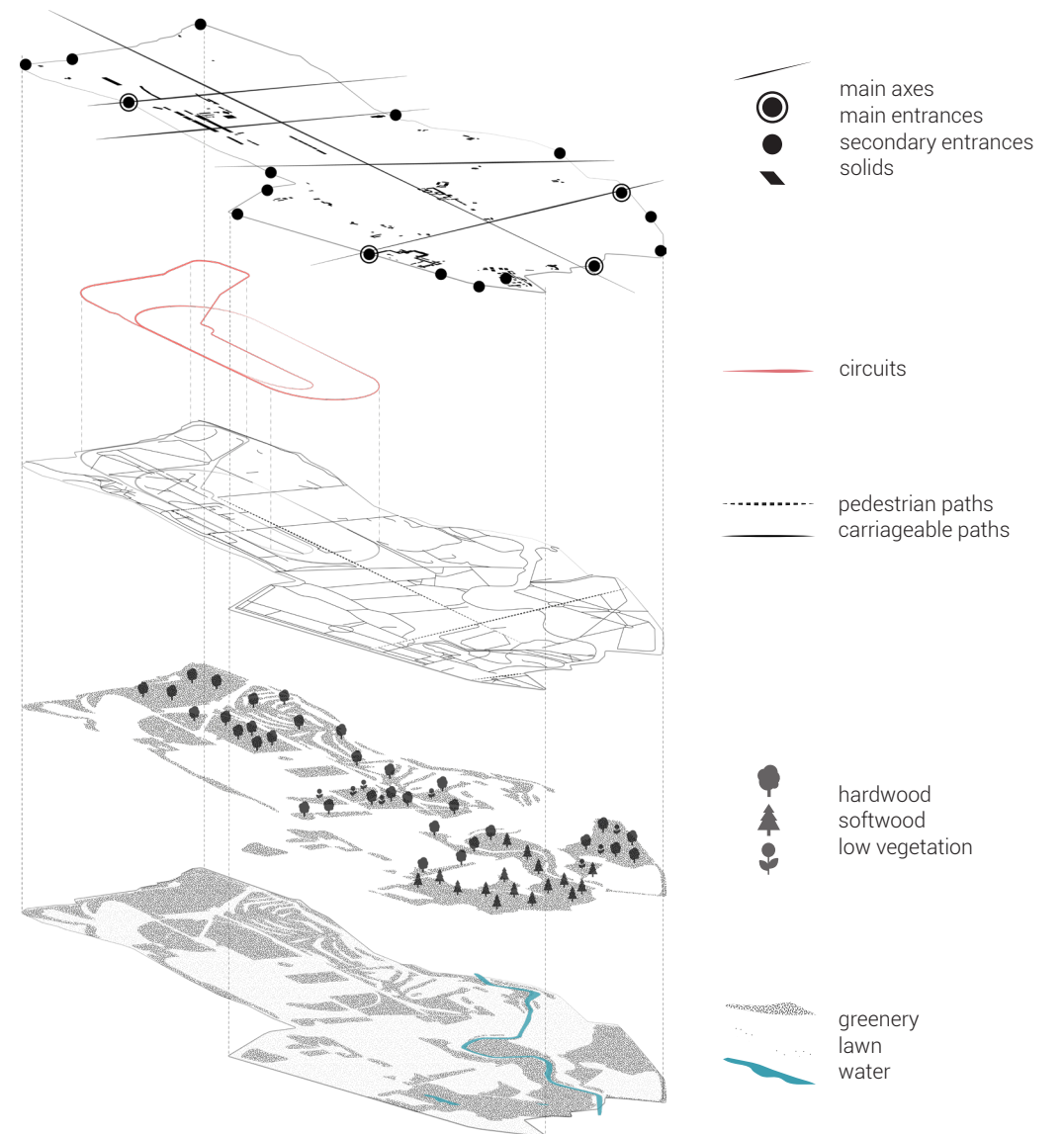
The only source of water is the river Lambro, that crosses the park from the South to East.

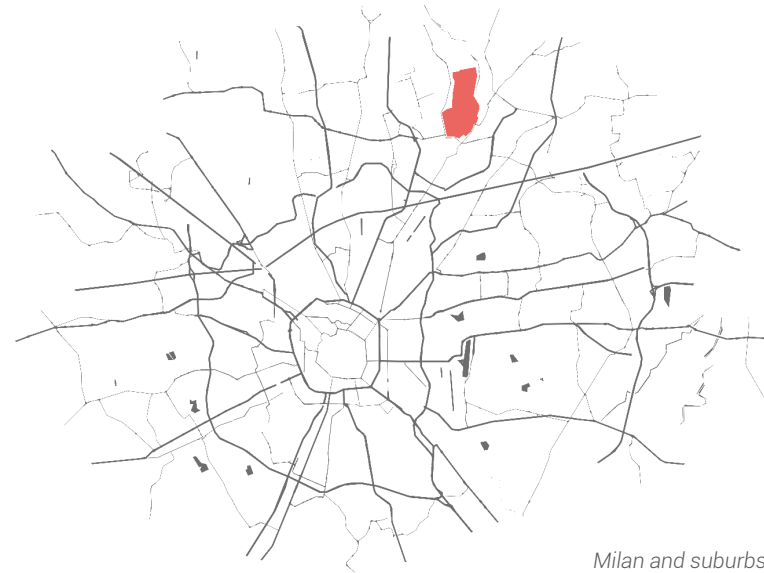
_ hard scape

Inside the park, there are few buildings, some historical, such as the Villa Reale and Serraglio, which is inside the Autodromo di Monza area, where there are the significant amount of buildings and two racetracks.

_ connection scape

The park is equipped with many pedestrian pathways but also exists some carriageable paths which cross the area along its two main axes and leading to the area of the Autodromo.

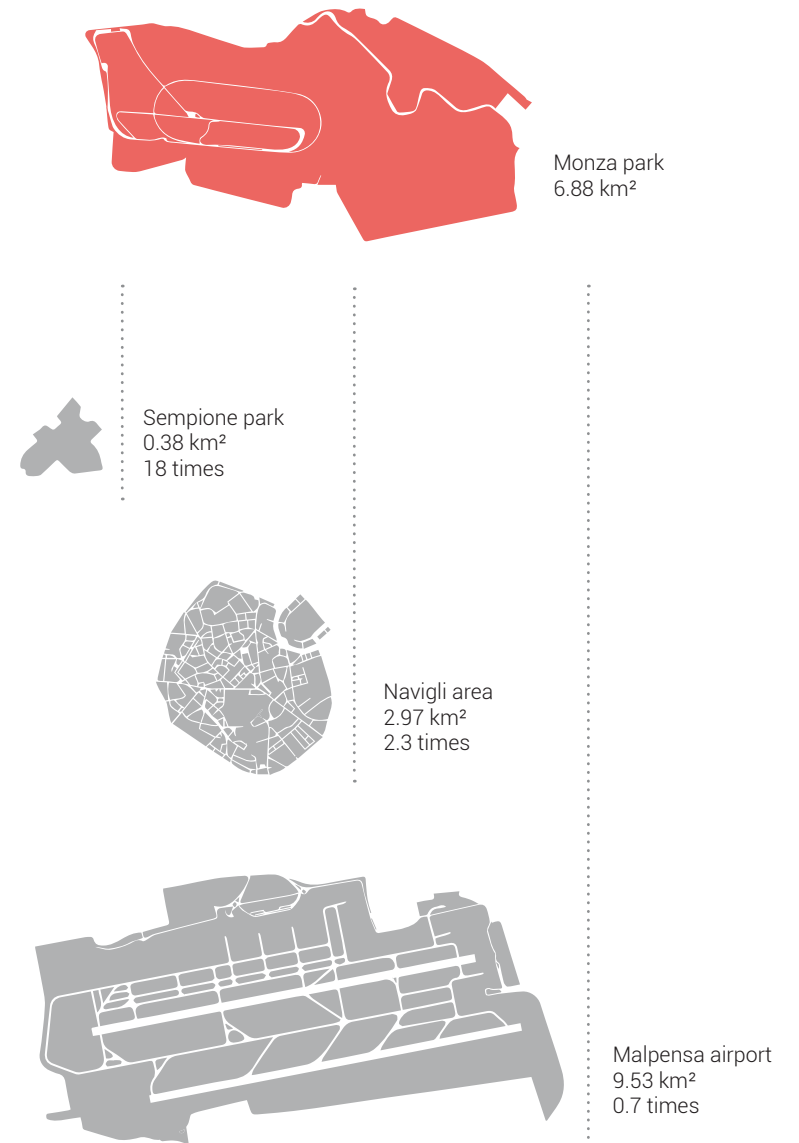




Milan and suburbs,
highlighted
Autodromo di Monza

_ scale comparison

The scale comparison aims to analyze the dimension of the space that, being a wide area, is difficult to understand and perceive. Comparing the Monza park, and consequently the Autodromo di Monza, to the city of Milan and some known spaces, it could be figured out better: Sempione park results tiny, the area of Navigli is one-third of the Autodromo, and the Malpensa airport turns out just a bit larger than the assigned area.



_ swot analysis

The swot analysis was done considering the entire area of the park, and it aims to put in evidence the main features of the space, positive and negatives, to reach out some opportunities and weakness that could be exploited to design the area in the better way.

Autodromo Nazionale di Monza is located in a strategic position for different reasons. The first one is that it is near the city centre of Monza and it is close to Milan and connected very well to them. Moreover, it is located in the middle of a big park, famous also for his historical buildings that are inside, of which the most important is Villa Reale. The Autodromo is famous all over the world because of the Circuit, which takes place one of the races of the Formula 1 Grand Prix. It is also known for his history and because it is one of the three oldest circuits in the world.

In the space, there are several different buildings, not homogeneous in the aspect, and it could be considered one of the weaknesses of the area.

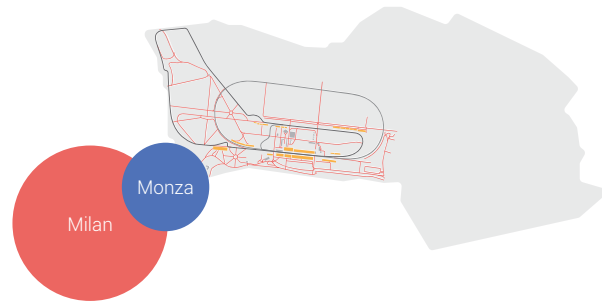
They were built in different periods, and this is one of the reasons of the inhomogeneity. Moreover, this is why there are several types of materials and styles in the entire space that create a not uniform and coordinated image.

As said before, Autodromo di Monza has numerous buildings and structures, and most of them are used just a few moments during the year and the rest of the time they are empty. Therefore one of the future improvements could be related to the implementation of palimpsest, to involve a broader target of people and exploit the unused spaces.

Another negative point is that in the area there are different historical points of interest unvalued and completely not highlighted and one of them is the Serraglio which was one of the ancient entrances that today is located in a green area very close to the Circuit used nowadays.

The entire space has not a clear identity, not only in terms of differences but also because there are not characterizing elements. Writing about inhomogeneity, that could also be found in the graphics, from the wayfinding in the space, to the website and papers.

strategic position



Historical place
_ fastest circuit in the world
_ third oldest world circuit

Strategic position
_ located in a big park
_ huge space
_ closeness to historical villas
_ closeness to big cities

Wordly known
_ national icon

wordly known



multifunctional spaces



Giving value to the historical points

Enlarging palimpsest
_ creating new services
_ creating multi-functional spaces
_ attracting a wider target

Developing space branding

W

Inhomogeneities
_ buildings, graphics, materials

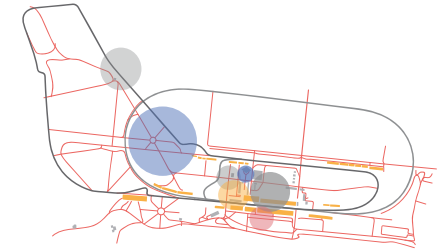
Confused identity

Unexploited spaces
_ not valued spaces

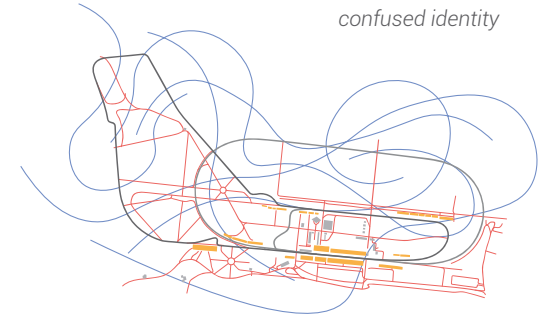
Monothematic palimpsest

Environmental impact

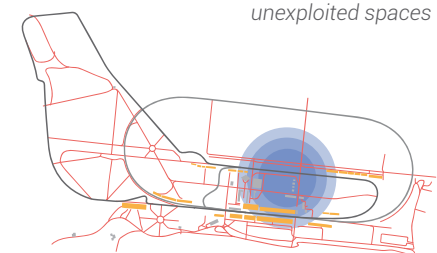
inhomogeneities



confused identity



unexploited spaces

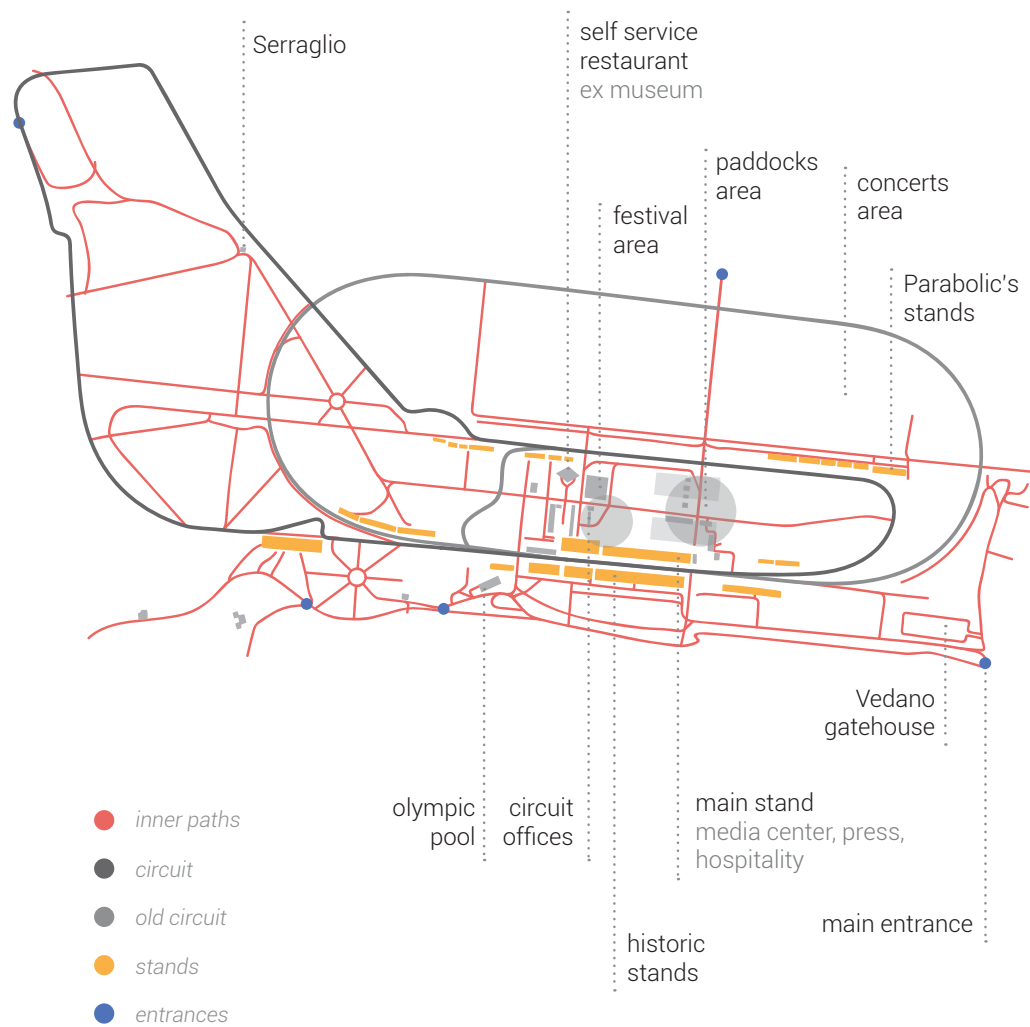


T

Bad connections with the cities
_ above all during the night

Limited users
_ monothematic palimpsest

Disagreement
_ Monza citizens
_ ecologists



zoom in

intervention area

_ site analysis

The active space of Autodromo Nazionale Monza is mainly the area near the paddocks, used above all during the races. Close to this area, different spaces exist to ensure all the commodities during the sports events.

One of them is the festival pavilion, of which the larger area is hardly used nowadays. Still, all around that structure different small slots contain commercial activities, such as the cafe, two other sport equipment shops and a bike renting, which are open in the same hours of the Autodromo.

Always in the same area, there is a self-service restaurant which has taken the place of the museum, and it is located inside a particular concrete structure that opens through two windowed arches towards a green area.

On the other side, closer to the Circuit, there is the newly built main stand dedicated to the media centre, the press and the hospitality, and it faces directly on the paddocks.

On the opposite side of the race track, instead, there are the renewed historic stands beneath which there is a completely untapped space.

zoom in system of events

_ activities analysis

The area of Autodromo Nazionale Monza includes different services and activities for visitors' entertainment.

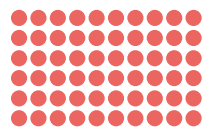
It is provided with an infopoint where visitors can ask for information and take part in activities. As entering the space, it is possible to find other facilities such as public toilets, a restaurant and a cafe. Nearby, there are specialized shops for motorsports equipment and souvenirs.

Moreover, a massive variety of activities are provided such as driving experiences on the Circuit both with given and own cars, guided tours of the track, driving courses, bike rental shops and bike tours, a driving experience simulator and commercial presentations of companies open to the public.

The most important events hosted in the Autodromo include the Formula 1 World Championship with the Italian Grand Prix, the endurance competition Blancpain GT Series, Monza Rally Show, competition European Le Mans Series and different motorbike races.⁴

linked with cars

61 events



not linked with cars

2 events



⁴ Monzanet, "Calendario 2018" adn "Calendario 2019", from <https://www.monzanet.it>, (n.d.)

● Competition

- _ 4 Ruote: Coppa Milano-Sanremo
- _ 4 Ruote: ACI racing weekend
- _ 4 Ruote: ELMS 4 ore
- _ 2 Ruote: the reunion
- _ Peroni Racing Weekend
- _ Formula 1 Grand Prix
- _ 4 Ruote: Monza historic
- _ 4 Ruote: international GT Open
- _ 4 Ruote: ACI racing weekend
- _ 4 Ruote: 4° Special Rally
- _ Monza rally show
- _ Run for Piro

● Driving camp

Certified school of special driving. It is for people who want to learn to control their own car, not only on asphalt but also with snowing conditions.

● Pure sport Top Driving Experience

Event on the Circuit in which people can ride a Gran Turismo or Formula-1 racing car. An expert will show the track and explain some important safety tools.

● Track days

- Event on the Circuit in which people can ride their own car. Open to everyone, no certificate needed.
- _ Track days
 - _ Pistenclub

● Kateyama test

Test day reserved to racing cars and pilots who holds a FIA licence. In the tests will always be active the timekeeping service with transponder.

● Kunoschaer test and track day

Test day and track day reserved to Roadsportscars and Touringcars/ GT-/DTM and Historic-Cars LMP 2-4 and Formel Cars.

● Pagani Open Day

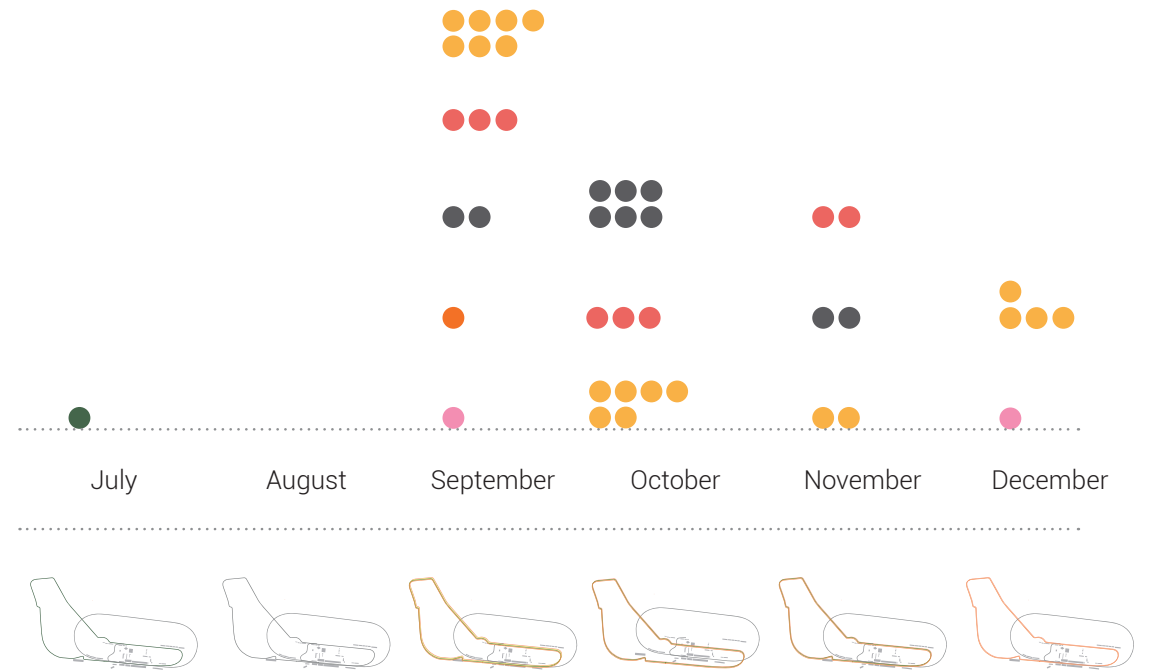
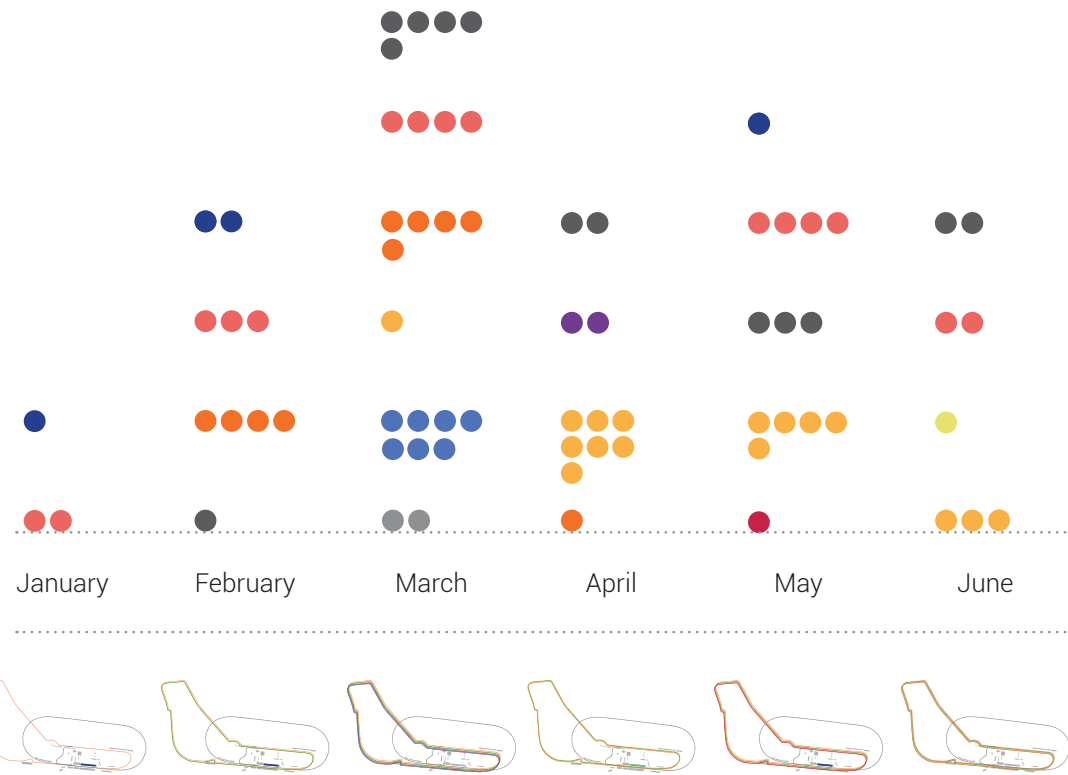
Open day Pagani and ride on a Pagani hypercar. People can also take part in the Pagani Contest to meet Horacio Pagani in person.

● Il Salone dello Studente

Study advisory, educational and career guidance fair organized by Campus Editore.

● Sport event

- _ Liit
- _ Usip Police Games

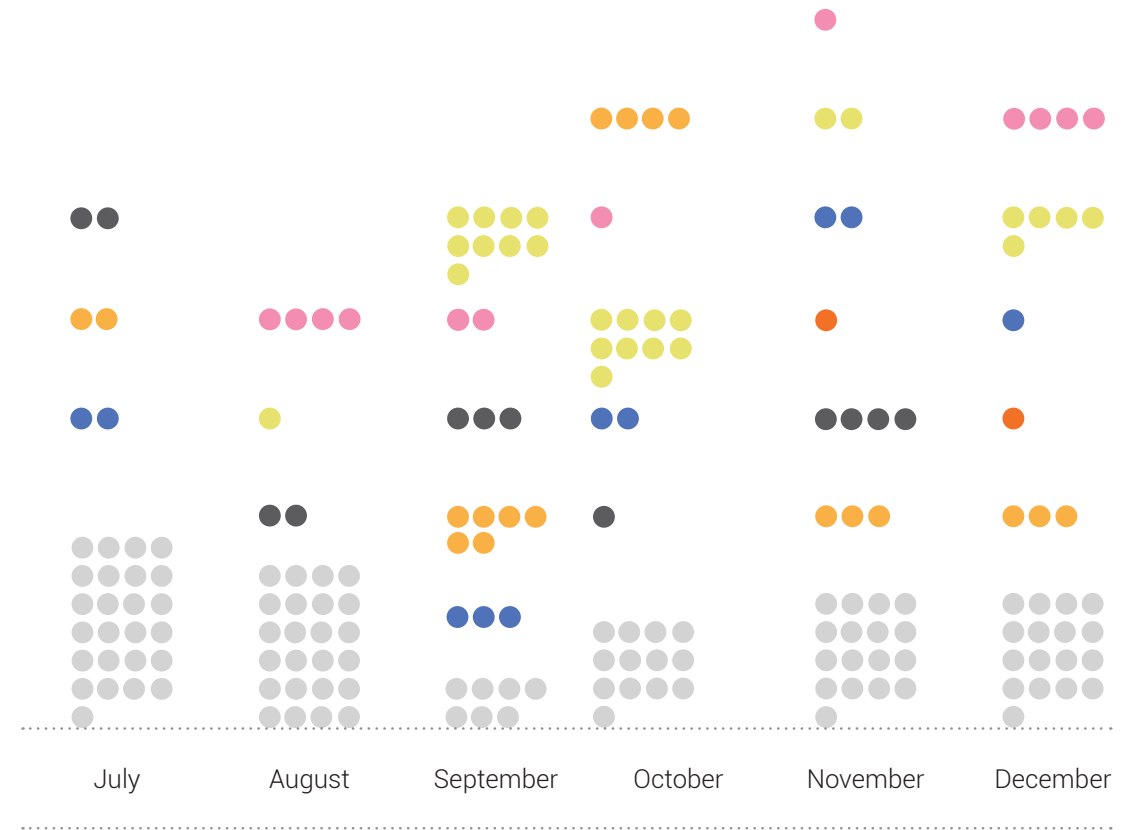
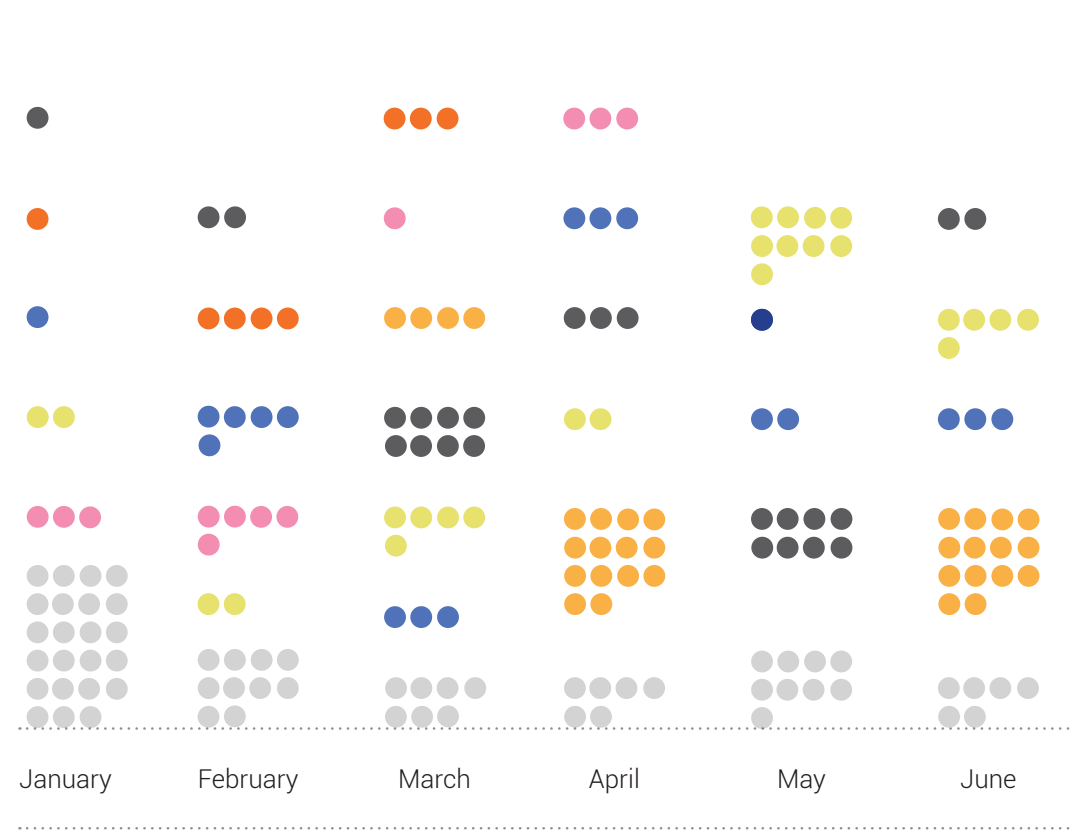


- Event presentation
- Competition
- Driving camp
- Pure sport / Top Driving Experience
- Track days
- Kateyama test
- Kunoschaer test and track day
- Pagani Open Day
- Il Salone dello Studente
- Sport event

_ analysis / per month

Analyzing the activities which take place in Autodromo Nazionale di Monza per month the result is that during spring and autumn the number the variety of activities increases and during the summer there are almost no events. Moreover, a significant amount of events are competitions and track days.

* Analysed year: 2018.
 Datas taken from the website <https://www.monzanet.it>,
 section calendar

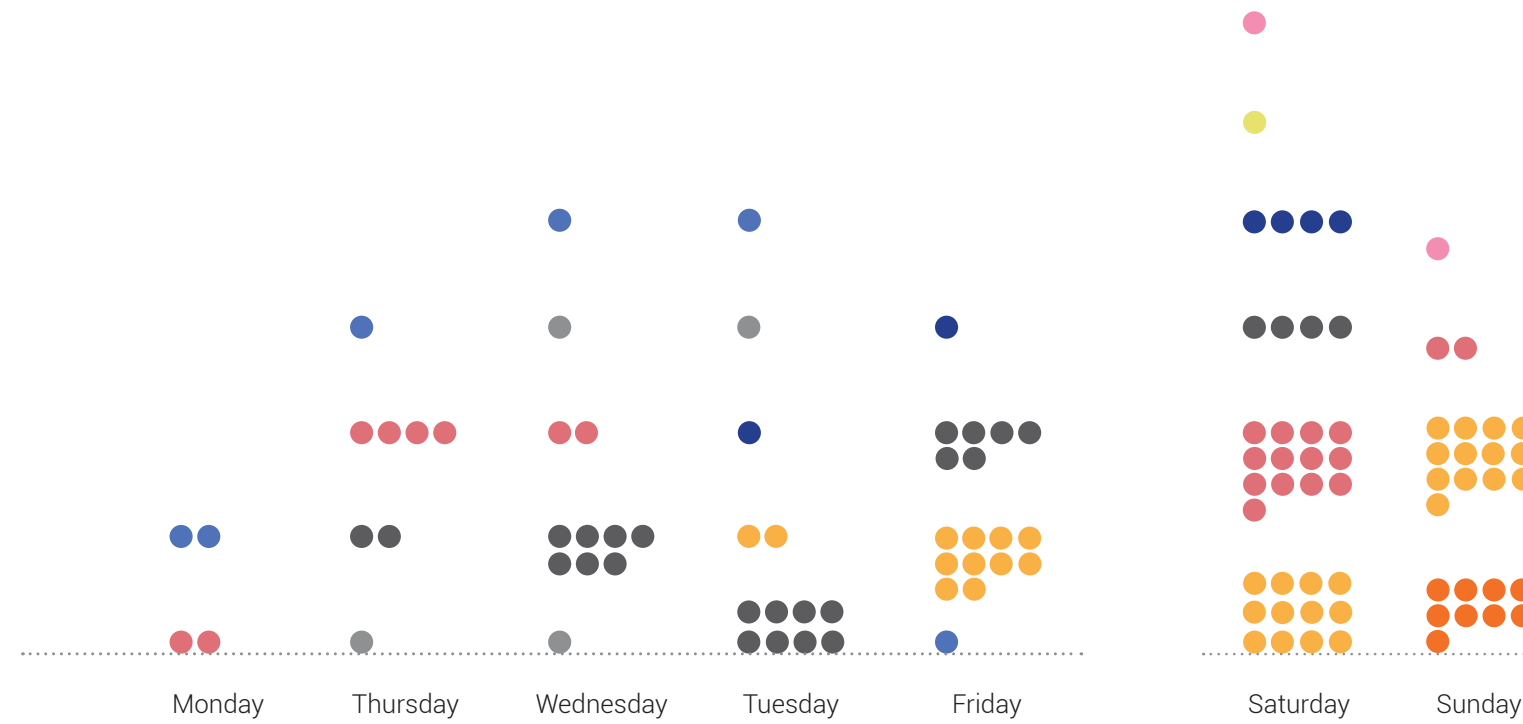


- Closed circuit
- Competition
- Test
- Track days
- Driving Experience
- Events
- Unsold

_ analysis / per month

Analyzing the activities which take place in Autodromo Nazionale di Monza per month, taking into account also the days when the Circuit is closed or unsold, the result is that during spring the number of days when the Circuit is not used is less than summer when the pitch is reached, and the variety is not that much. Moreover, days, when the spaces are unsold, are more in July and August, and December and January.

* Analysed year: 2017.
 Datas from Autodromo Nazionale Monza, SIAS Società
 Incremento Automobilismo e Sport SpA

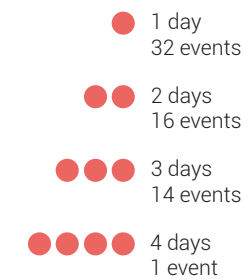


_ analysis / per day

Analyzing the activities which take place in the Autodromo during the week, the result is that in the first days there are just a few events and a significant amount of activities, particularly competitions, happen during the weekend and on Friday. Track days take place during Sunday and, most of the driving experiences are on Saturdays.

_ analysis / events duration

During a year, the event's duration is mainly one day, and just one event lasts four days.



- Event presentation
- Competition
- Driving camp
- Pure sport / Top Driving Experience
- Track days
- Kateyama test
- Kunoschaer test and track day
- Pagani Open Day
- Il Salone dello Studente
- Sport event

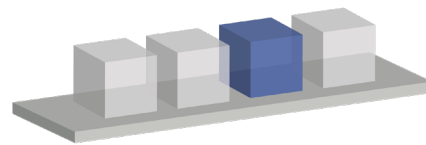
* Analysed year: 2018.
 Datas taken from the website <https://www.monzanet.it>,
 section calendar

_ current situation

Nowadays the Autodromo Nazionale di Monza is a space absolutely unexploited, first of all, because is not taken advantage of the fact that is a global icon, mainly because of the Formula 1, and besides because there are several structures used just in few moments, most of them linked to sports events, and definitely not exploited in the remaining ones.

SPACE

moments



empty moments

**How could the
Autodromo become
a versatile space?**

_ aim

The aim is to implement the space with new activities that fill the "empty moments" and attract different types of users. From a few activities all about the automotive sector, the aim is to create new various functions where the amount of people is wider and mixed. In this way, spaces will be exploited, and the structures will acquire value without changing.

MULTIFUNCTIONAL SPACE

moments



new activities

new users

2

Looking at the weaknesses of the space, the idea is to create flexible spaces that ensure adaptability to different situations, which are configurable and also attractive.

Also a visual identity will be designed in order to obtain a homogeneous space speaking in terms of image.

The idea is to create a versatile system, which has to be movable and could change shape and disposition. Different layouts will be created and different activities, events and functions will be hosted, always maintaining the same basic elements and, above all, in the same spaces.

The meaning of versatility and all the variations in relation to space, activities and people are studied. Moreover, how a versatile system works and its characteristics are analyzed, defining two main features on which it depends on: the elements and the time. On that two components further research is carried out.

versatility

what is

_ versatile

Versatility is the characteristic of moving some elements and even services where they need to be used, and it is related to frequent changes in the building, not only with a spatial meaning.¹

The term versatile contains itself some subterms related to the physical arrangements (space), to the social uses, therefore people, and to the functions and performances of it.

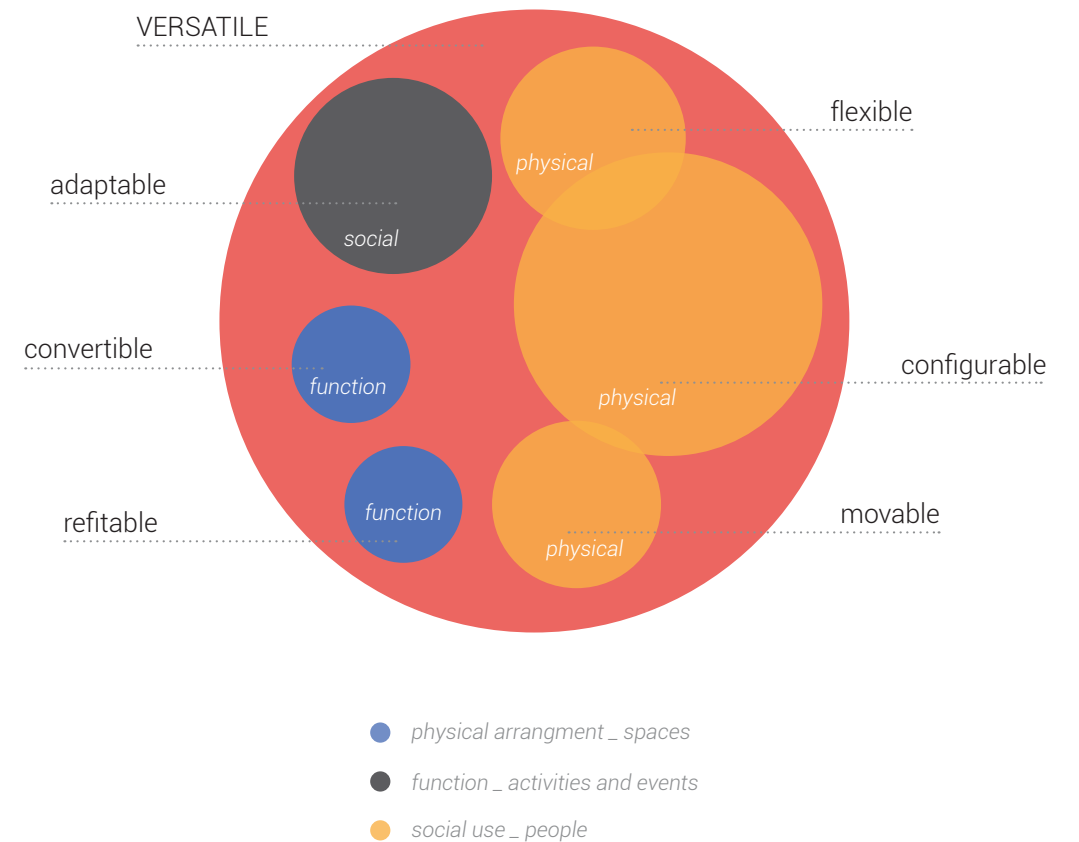
In terms of dimensions, versatile space is characterized by the conversion into different functions, without rebuilding structures, and it is the opposite of unitary space which is suitable for only a particular one.²

This type of space could be enjoyable also speaking about the future because, being versatile, the configuration will always change, and people are supposed to return to discover the new aspect of the place and people are supposed to return in order to discover the new aspect of the place.

¹ Heidrich, O., Kamara, J., Maltese, S., Re Cecconi, F., Dejaco, M. C., "A critical review of the developments in building adaptability", August 2017 in "International Journal of Building Pathology and Adaptation", Vol. 35 No. 4, pp. 284-303, Emerald Publishing Limited, 2017

² Li, H., "Versatile space: the trend to multi-functional space and design strategy" in Dense Living Urban Structures, Volume 1, 2003, pp. 58-75

Strategies in relationship to other dimensions.



versatility

strategies in relationship to other dimensions

_ flexible

change of space

Space which is capable of different physical arrangements. Flexibility, to achieve its full potential, has to mean more than continuous change without fixed determinants.³

4 hard _ determine the way hard technology

The designer determines how spaces can be used over time. Technologies developed to achieve flexibility.

soft _ indeterminacy soft technology

It allows the user to adapt the plan according to their needs. Stuff that enables to unfold in a not fully controlled way.

Layout physically fixed but socially flexible

Raw space splittable according to the needs

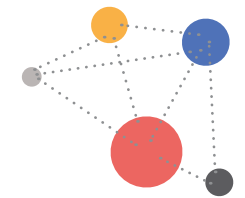
³ Schneider, T., Till, J., "Flexible housing: the means to the end", in *Arq, Architectural research quarterly*, Volume 9, Issue 3-4, June 2005, pp. 287-296, Cambridge University Press, 2005

⁴ Schmidt, R., Eguchi, T., Austin, S., Gibb, A., "What the meaning of adaptability in building industry?", Loughborough University, United Kingdom, 2010

_ configurable

change of space

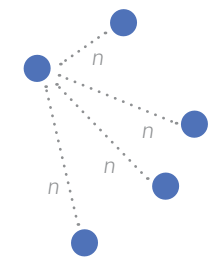
The configuration consists of free space which contains all possible configurations (states) of a system, and space occupied by obstacles. If space is presented as a subset of configurations, there is a number of intermediate configurations and transitions.



_ movable

change of location

An article of furniture that is capable of being moved, not fixed in one place, position, or posture, it is movable. Moveable is something that is not permanent about a place; capable of being moved. Movable could be things, as cattle or personal belongings, which can either move or be moved in space.⁵



*movable _ n-movable
n = times it is movable*

⁵ Klancar, G., Zdesar, A., Blazic, S., Skrjanc, I., "Wheeled mobile robotics.", Elsevier Inc, Cambridge, MA, United States, 2017

_ convertible

change of function

It is the possibility of changing the function of a structure or a zone/space without more effort and modification.

To correspond to changes the term adjustable could be added to it, responding to changes in task or user and consequently in the usage of the space.⁶

_ refitable

change of performance

It is a way to achieve the physical versatility capability of the building in being versatile, and it is the possibility to quickly improve the performance of one or more components, without the need for replacing the entire system.⁷

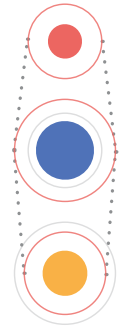
⁶ Heidrich, O., Kamara, J., Maltese, S., Re Cecconi, F., Dejaco, M. C., "A critical review of the developments in building adaptability", August 2017 in "International Journal of Building Pathology and Adaptation", Vol. 35 No. 4, pp. 284-303, Emerald Publishing Limited, 2017

⁷ ibid

_ adaptable

change of task

The adaptability of a space is the potential to change or adjust the elements constructing the space to respond to the changing environment. Unitary space could not accommodate new functions by maintaining its characters. A unitary space loses its value when the function changes.⁸



⁸ Heidrich, O., Kamara, J., Maltese, S., Re Cecconi, F., Dejaco, M. C., "A critical review of the developments in building adaptability", August 2017 in "International Journal of Building Pathology and Adaptation", Vol. 35 No. 4, pp. 284-303, Emerald Publishing Limited, 2017

versatility

why

_ versatile system as a need

A versatile system could be defined as a need of the Autodromo Nazionale di Monza to achieve its full potential, socially, economically and environmentally speaking. That is why it has to mean a fully versatile and endless change rather than a fixed determinant.

One way to determine the degree of versatility is the in-built opportunity for versatility, defined as 'capable of different social uses'.

_ partecipazione

Opportunities for people to make their markings and ensure that the place belongs to them, the humanization of the space is one of the aims, to make people being identified in many environments of that space.

modernism

Function zoning disrupts the linkage between functions. The following *form follows the function* concept: the function may impact the state, but not in a one-to-one relationship.

- _ one form could accommodate different functions
- _ one function could be expressed by various forms

_ usage

If people have different choices and functions in the same space, which has an undesigned communication, all the community is supposed to be involved, and in that way, a broader target will be reached.

digitalization

a society based on the information does not want to be constrained by forms, and space could be able to accommodate various dispersed functions.

- _ it eliminates *space* and *time* and make *functions* more adaptable

_ finance

Resource-saving will be an added value of the space if different functions will take place in the same area, simultaneously or successively: they will last longer, and it will result cheaper in the long time.

sustainability

To tear down or do not use an existing structure that does not expire is a waste of resources

- _ use and readapt the space

⁹ Schneider, T., Till, J., "Flexible housing: opportunities and limits", Volume 9, Issue 2, June 2005, p. 157-166 in "Arg, Architectural research quarterly", Cambridge University Press, 2005

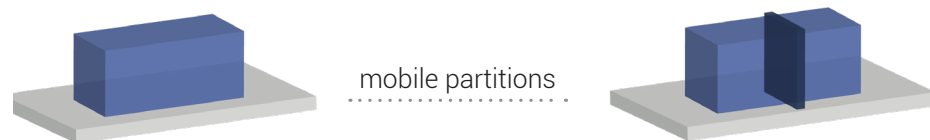
versatile system

elements

To analyze the factors of a space reacting with a function, appropriation of space's strategies are provided to facilitate the possibility of change. The function has a specific relation with three factors of a space: size, shape and quality (Peng Yigang 1983) and linkage that between them plays an important role.¹⁰

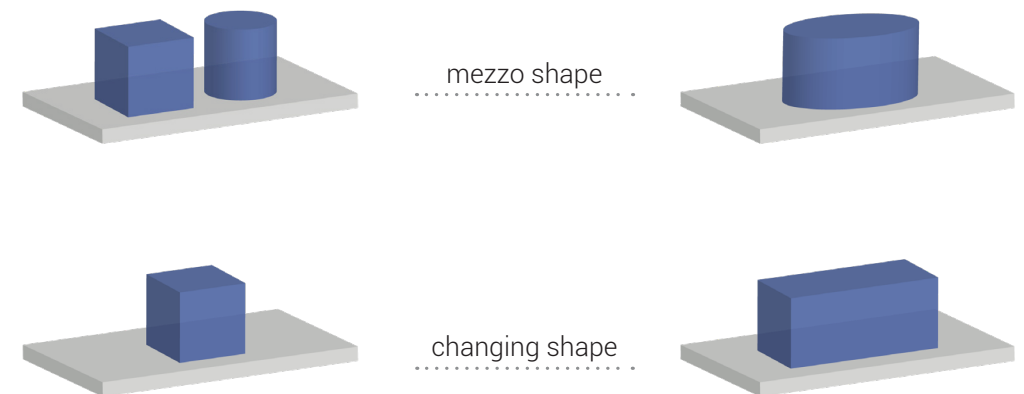
_ size

To contain certain function, space requires a specific size. And to manage various functions, the size of space should be proper for all the functions requiring a similar size.



_ shape

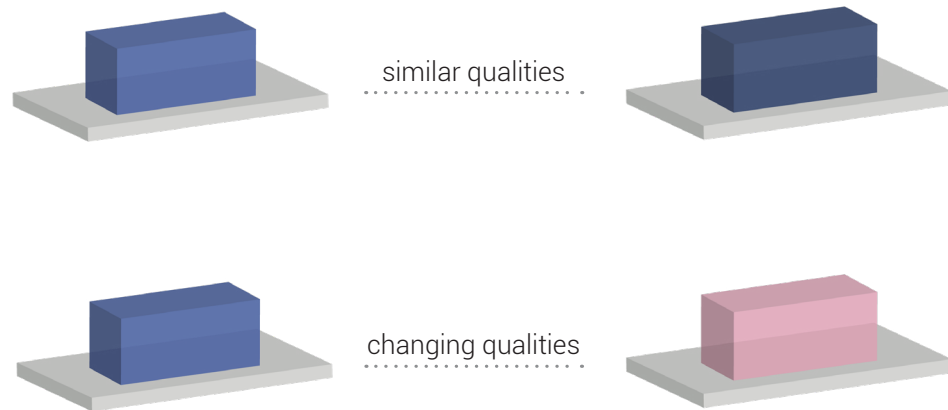
Space needs to have a particular shape to contain specific functions, and a versatile space could satisfy activities requiring similar shapes without changing itself. A mezzo shape or a changing shape should be chosen to make a space versatile.



¹⁰ Li, H., "Versatile space: the trend to multi-functional space and design strategy" in "Dense Living Urban Structures", Volume 1, pp. 58-75, 2003

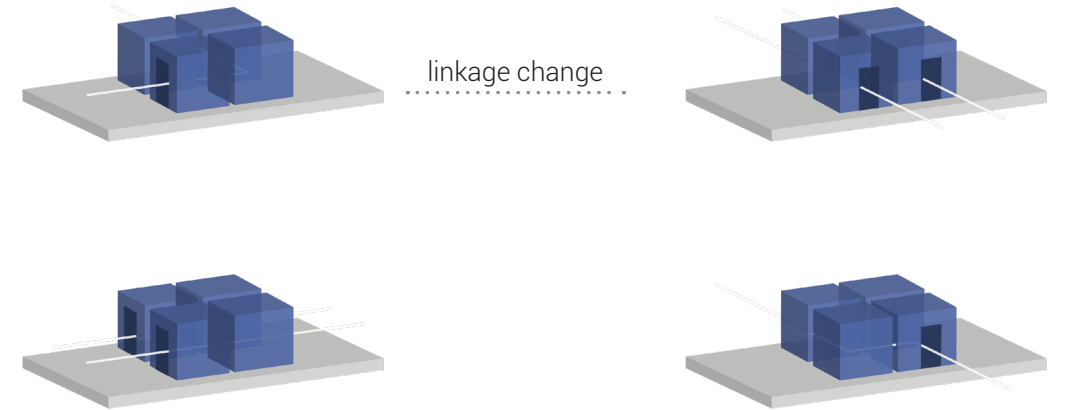
_ quality

Quality is another relevant factor in space and function relation.
 The quality of a space concerns lighting, ventilation, sunshine, temperature and so on.
 Versatile space contains functions requiring similar space qualities and could also change some of its qualities to content different functions.



_ linkage

Some function occurs in a single space, while some needs a series of spaces.
 Different functions may require different linkage of the spaces and a versatile space could accommodate other functions by changing the linkage of a series of spaces.
 As the linkage is different, the function is different.



versatile system

time

_ temporary

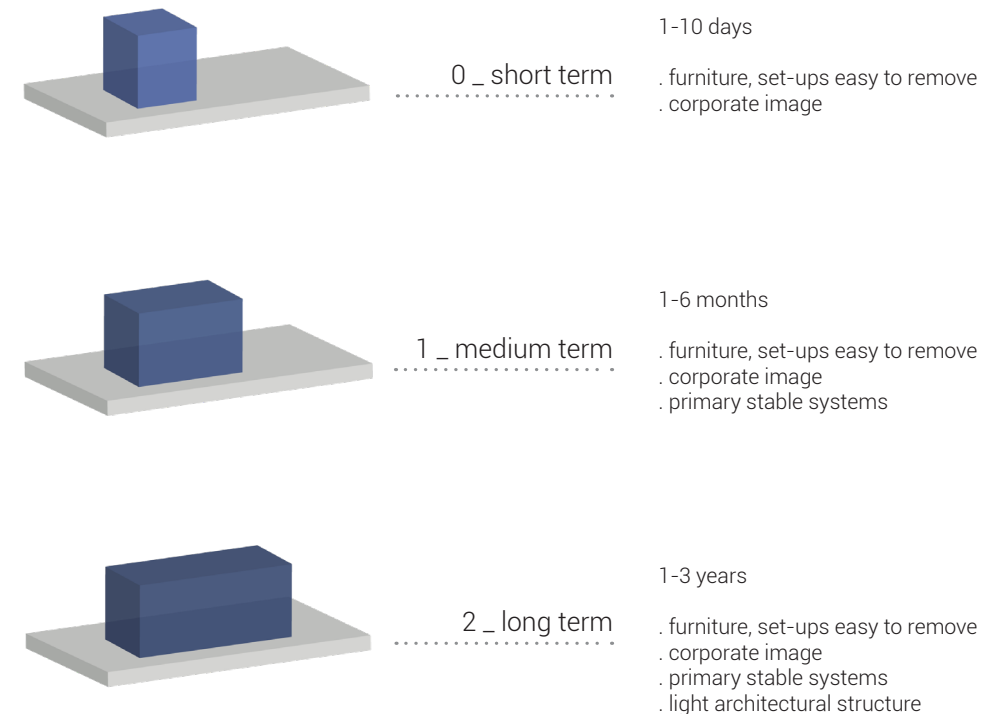
Temporary is the quality of being temporal, something lasting for only a limited period not permanent.

Relationships unfold over time will become observable only after a particular lap of time.

Every temporary architecture or infrastructure has a level of temporariness which means the laps of time it will last or it will be used for a specific function.

Three different categories are here established: the short term, which lasts between one and ten days, such as fairs, exhibitions, sports events and concerts, the medium term, which lasts from one to six months, like installations or temporary shops, and the long term which lasts at least one year and maximum three.

For each one of these categories the requirements are different; for instance, a long term temporary facility will need a light architectural structure, which is not required in case of a short term one.¹¹



¹¹ Inti, I., Cantaluppi, G., Persichino, M., "Temporioso. Manuale per il riuso temporaneo di spazi in abbandono in Italia.", Altra Economia, Milano, 2014

versatile system

time

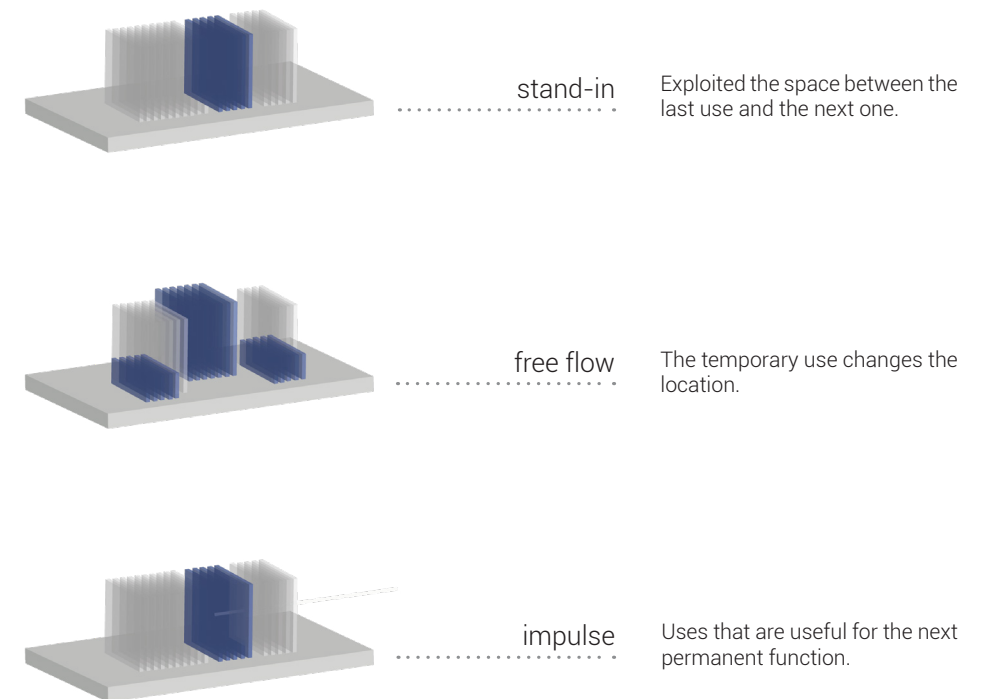
_ temporality

It is the state of existing within or having some relationship with time.

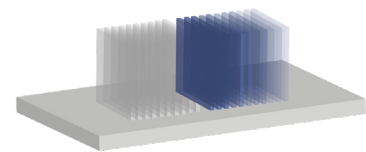
Temporary related to spaces could be considered a strategy to make the transformation processes as flexible as possible, without prefiguring the final state of the things, but considering forms and functions. These, continually changing and transforming, give solutions, not to a single problem, but to pluralize the answers.

Nine typologies of different temporality strategies of appropriation of the space by informal temporary users are classified in the volume *Urban Catalyst*¹², which represents different possibilities of applying temporary uses to a place and describes, in a synthetic way, all the possible conditions and arrangements where temporary use takes place.

The effect of temporary uses, indeed, can vary on the development of a specific place, and these strategies describe their configurations.

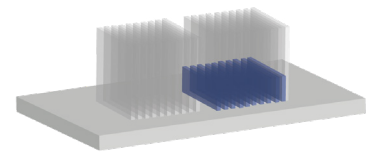


¹² Oswalt, P., Overmeyer, K., Misselwitz, P., "Urban Catalyst. The power of temporary use.", DOM Publishers, 2013



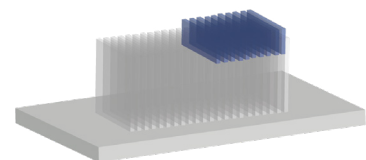
consolidation

Temporary activity implemented sometimes become permanent.



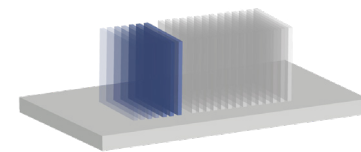
co-existence

Temporary and permanent uses are contemporary.



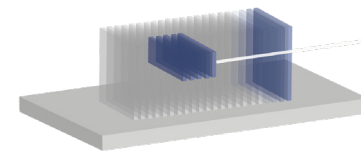
parasite

Use of a space for a short time to exploit its potential.



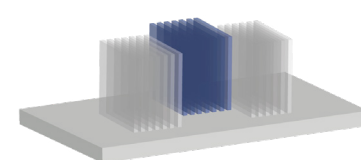
pioneer

Use of the space to "colonize" it giving a new meaning to it.



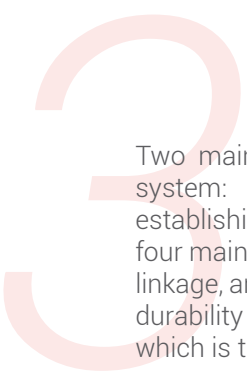
subversion

Use of a space to do a change (waiting spaces).



displacement

Temporary use that permits the dislocation of a permanent use.



Two main features characterize the versatile system: the elements, which are defined establishing their characteristics following four main components: size, shape, quality and linkage, and the time, in terms of temporary, the durability of things, and in terms of temporality, which is the quality of the time-intervention.

Following those concepts, which could be defined as the basis to compose a versatile system, a generator matrix is created, establishing the conditions that provide a system in which something grows or develops. This data structure provides the insertion of information in a special table.

The matrix aims to analyze different cases study from the architectural, interior and product design field. Still, also structures created spontaneously by nomadic people, to better understand the common strategies of existing projects clearly and graphically.

matrix

generator matrix creation

_ generation

To create a versatile space, which is composed of the objective space used and a versatile system, a generator matrix to understand the different peculiarities is designed.

The matrix is composed of two circles and one semi-circle: the central one represents the physical space without which a versatile space could not exist, the semi-circle, instead, contains all the components of a versatile system. The two sections represent the elements and the time, the main characteristics of the system. That sections, in turn, include other divisions that are the characteristics to be evaluated, described with dashes, that will be highlighted after investigating the case studies. Instead, the second big circle contains the image of physical space, which is defined by the versatile system with the characteristics mentioned above, and it represents the entire, versatile space.

_ objective space

- _ biggest part, located in the centre because it represents the starting point
- _ as a circle can not exist without a centre, the system can not exist without the objective space

_ versatile system

- _ it is just an element that is part of the general space
- _ the system's characteristics (lines) go inside the objective space in order to give it a meaning

=

_ versatile space

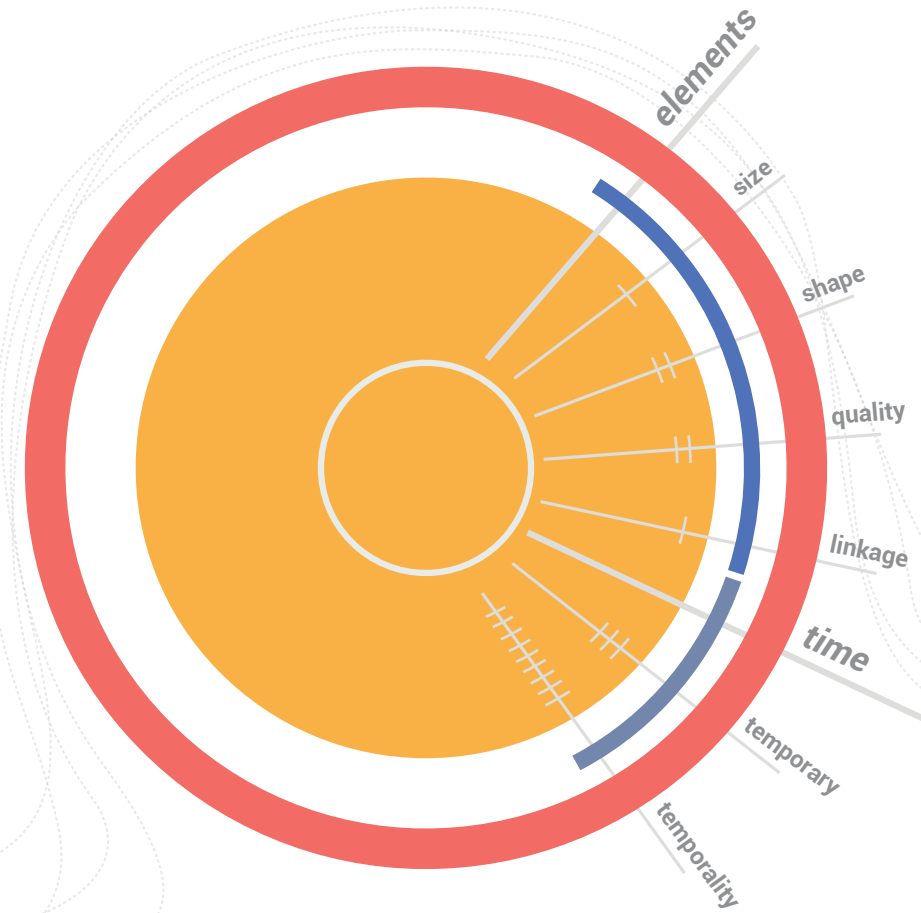
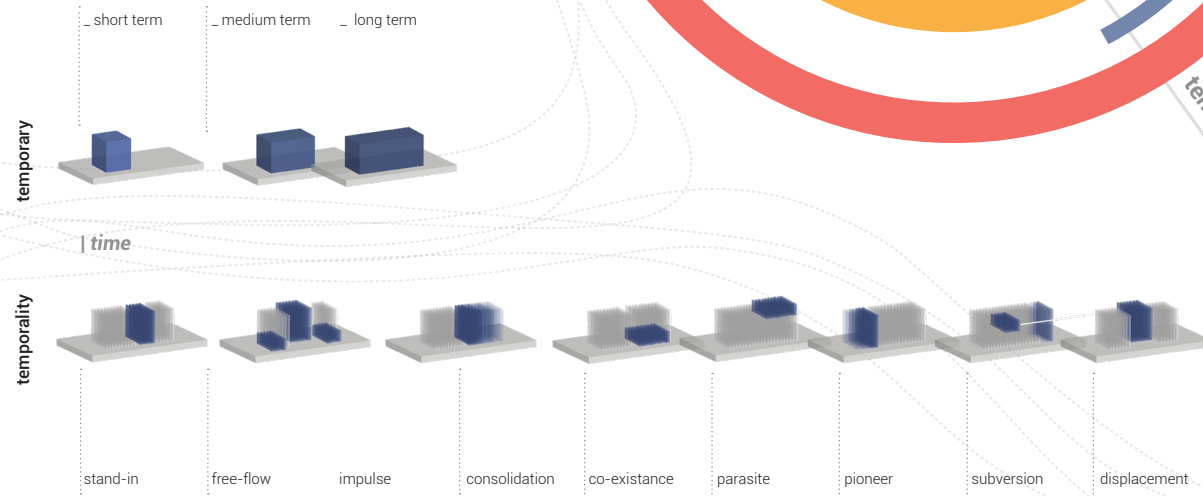
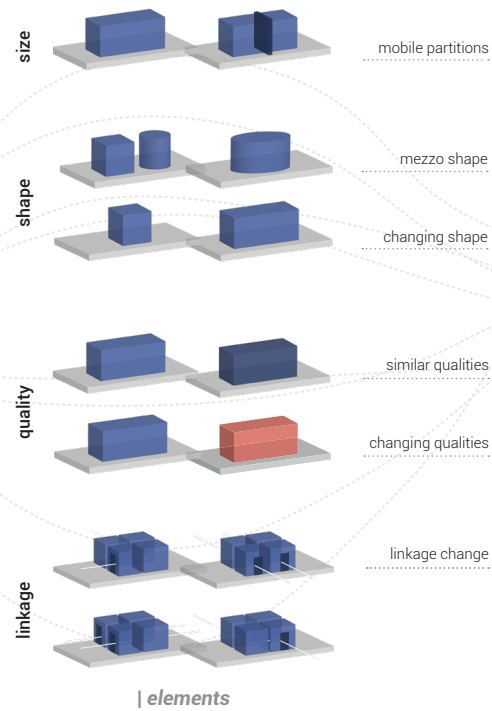
- _ the big circle contains the other in which it is the space itself with the applied characteristics of the versatile system

matrix

generator matrix creation

_ generation

Visual representation of the matrix generation. It is developed starting from the characteristics of the elements and of the time, which define a hypothetical versatile system. That one, if combined with a physical space, could establish a versatile space.



matrix

generator matrix application

_ study cases

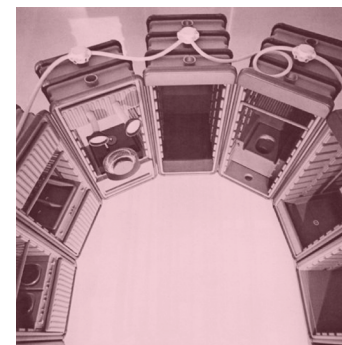
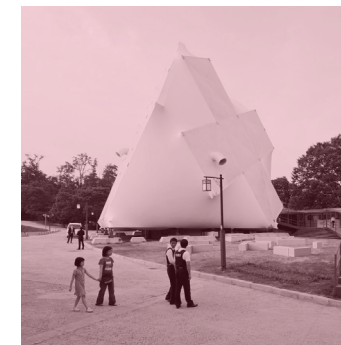
The generator matrix is a tool to analyze several study cases to better understand the theory, the main peculiarities, and the common strategies of existing projects in a practical manner, to exploit the strengths of the best ones.

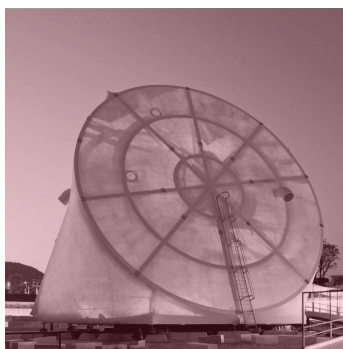
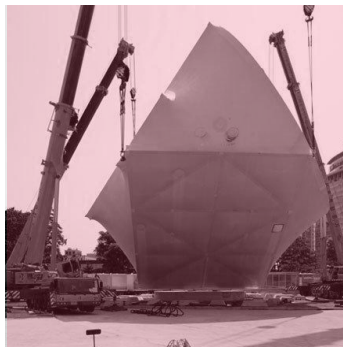
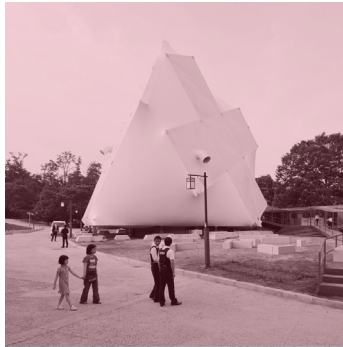
Different architectural projects, installations, urban structures, and objects are taken into account, from all over the world and not only focusing the research in recent years.

Thanks to the matrix, the assessment of study cases could be evaluated from a common point of view, and it could be applied to every structure which changes during the time.

For sure, the fourth dimension has to be considered, which is the feature that changes specific characteristics in the space or in space.

Each study case could also be analyzed in terms of just one between elements or time attributes.



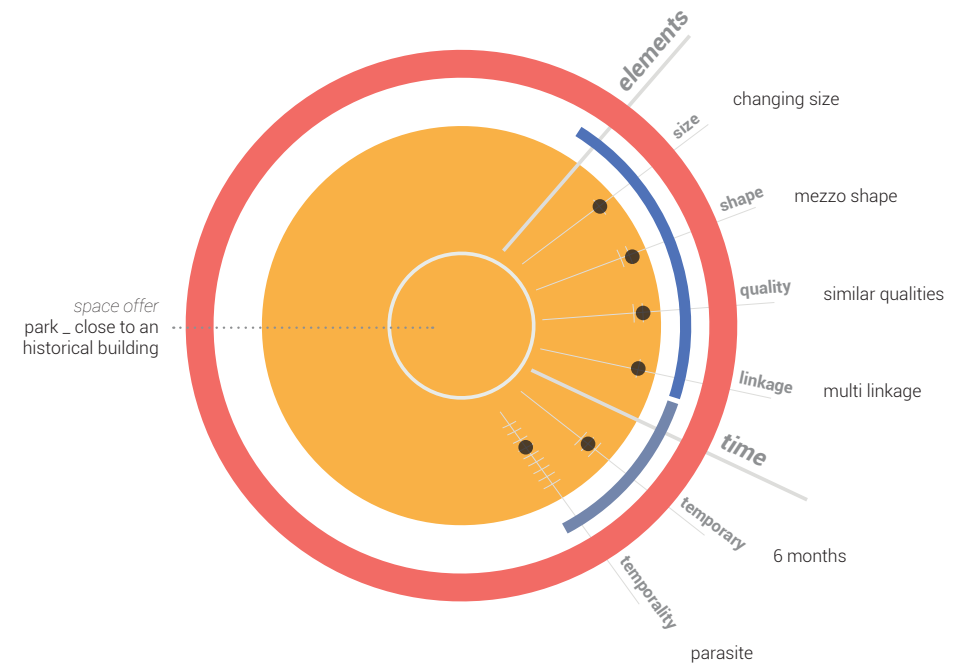


Prada transformer

Studio OMA _ Rem Koolhaas
Seoul, South Korea _ 2009

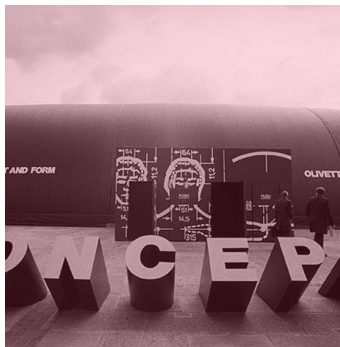
The pavilion is a temporary structure that consists of four basic geometric shapes - a circle, a cross, a hexagon, a rectangle - leaning together, and wrapped in a translucent membrane. Each form is a floor plan designed to be ideal for different cultural programming: a fashion exhibition, a film festival, an art exhibition, and a fashion show.

Walls become floors and floors become walls depending on the activity that happens inside. For six months, the cultural activities took place, always linked with Prada, and for the first time, all of them in the same place and space.^{1,2}



¹ OMA, "Prada Transformer" from <https://oma.eu/projects/prada-transformer>

² Prada Group, "Progetti speciali - Prada Transformer"

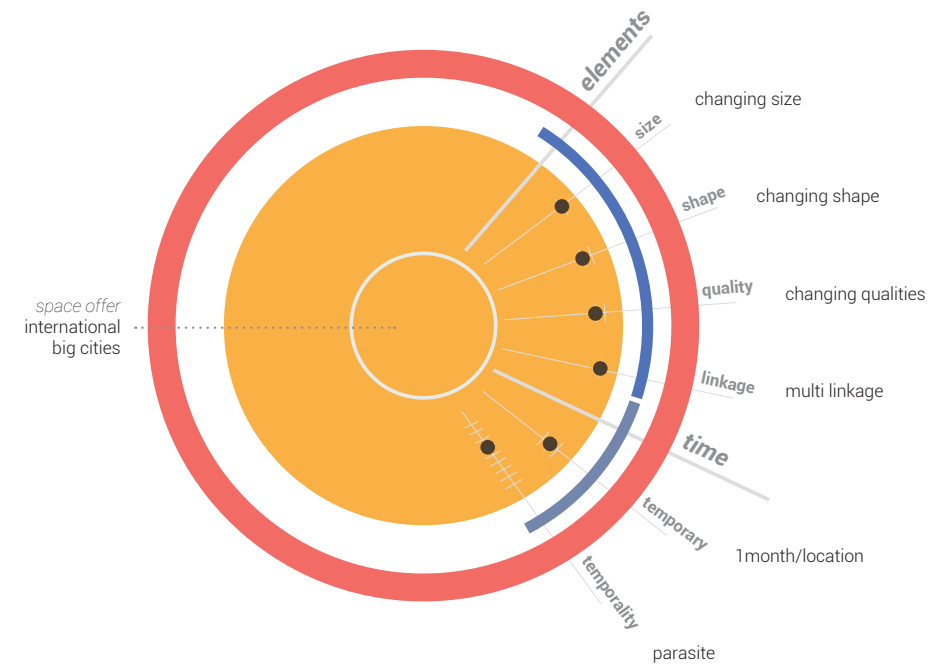


Olivetti itinerant exhibition Gae Aulenti Paris, Barcelona, Tokyo, _ 1969-1971

Olivetti Concept and Form has a different name depending on the place in which it is placed.

The itinerant exhibition aimed to draw a representative portrait of the Olivetti industry through an original narrative of the visual aspects that contributed to expressing its unique and specific character or image.

Through the creation of a dynamic relationship with the viewer, the exhibition is a constructed landscape where every single architecture implies harmony with. Each of them develops its particular references and weaves the relations.³



³ Turchetti, M., "Olivetti Formes et recherche. Industry and contemporary culture – an Olivetti historical exhibition (1969–1971)", *Blackout magazine*, 2017

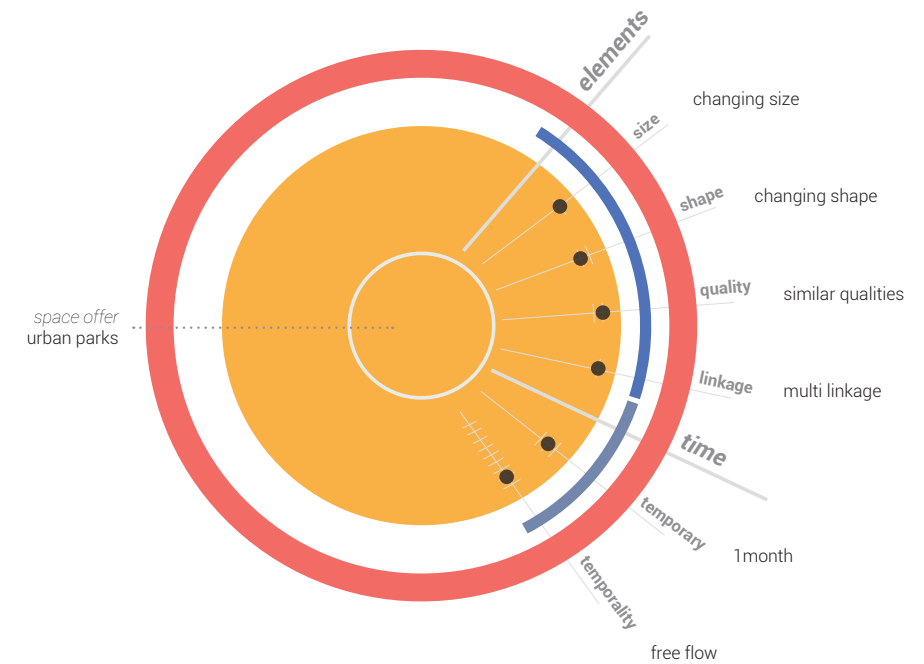


IBM Travelling Pavillon

Renzo Piano

20 European destinations _ 1982-86

IBM devised a travelling exhibition to promote advances in computer technology for telecommunications. Reinforcing their message that workstations could be virtually located anywhere, the temporary structure is designed to be assembled, exhibited for a month, and then dismantled at each of its destinations. The pavilion, installed in green urban spaces, is a transparent tunnel, sitting on a raised platform that houses its supportive services. The enclosure is made of modular, repetitive elements of wood and polycarbonate to facilitate easy assembly and disassembly.^{4,5}



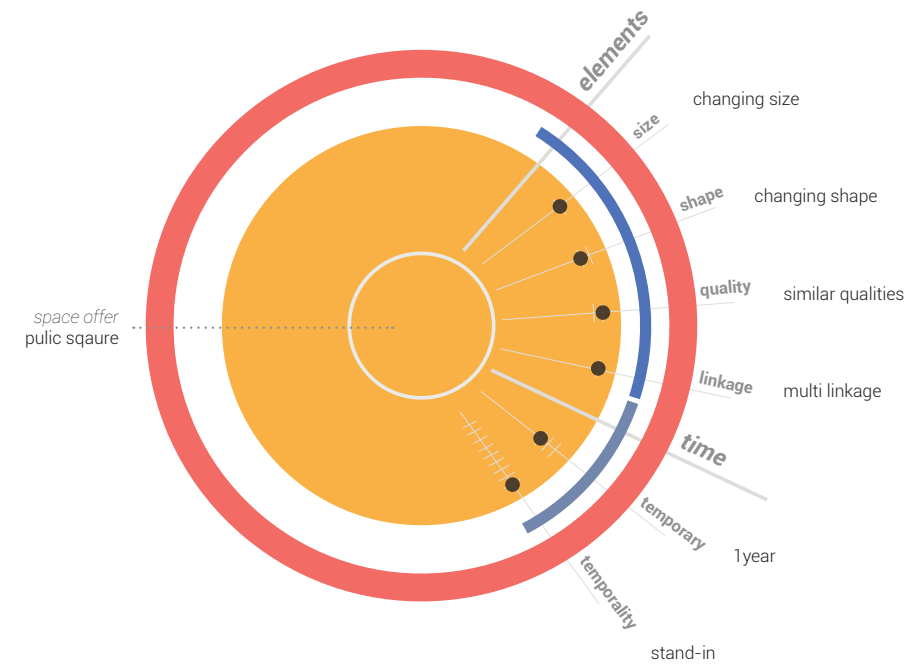
⁴ RPBW, "IBM Travelling Pavillon" in "The pavilion is a transparent tunnel, sitting on a raised platform that houses its supporting services."

⁵ Riccini, R., "Da mostra a exhibit: il rapporto tra elettronica e design nel caso IBM italia", 2014

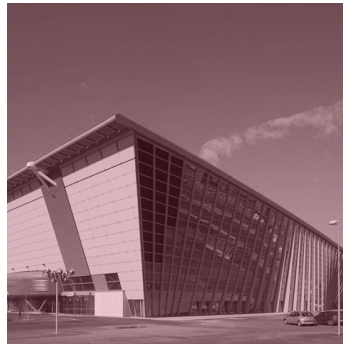


Lentspace Interboro partners New York, USA _ 2009

Lent Space is a privately-owned site that was temporarily open to the public to be an art space and a culture garden, as well as a nursery for trees that will migrate to neighbouring streets when the developer wants the site back. The spot includes a moveable sculptural fence facing the adjacent square that can enclose or open the area, creating an array of social spaces. It was conceived as an 'in the meantime' activity that gives life to a suspended site awaiting renovation. It looks like an item of public furniture since it has benches and panels for exhibitions.⁶



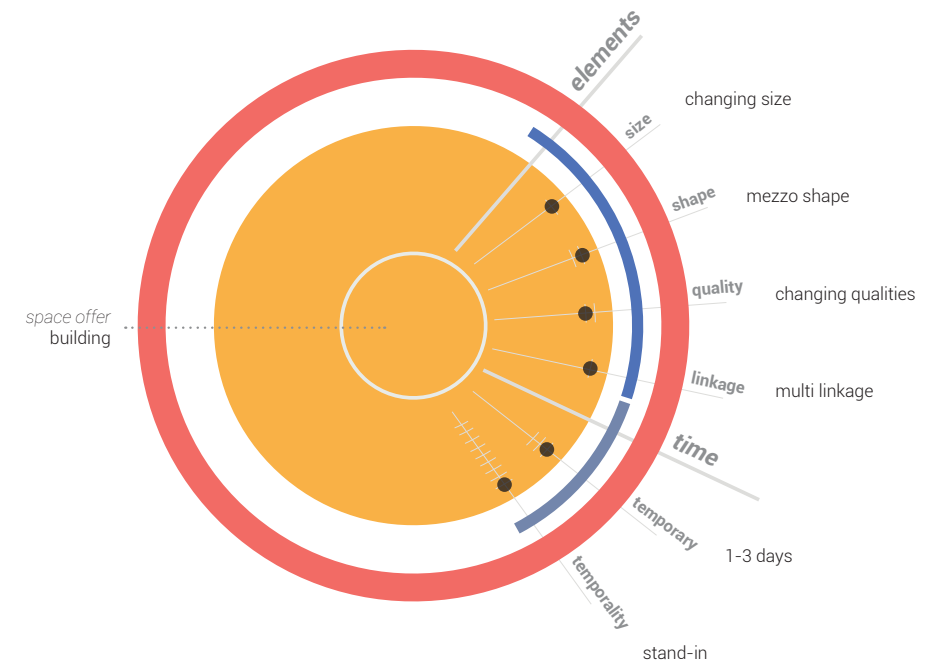
⁶ Interboro, "Lentspace. An art space and culture garden in Lower Manhattan", from <http://www.interboropartners.com/projects/lentspace>



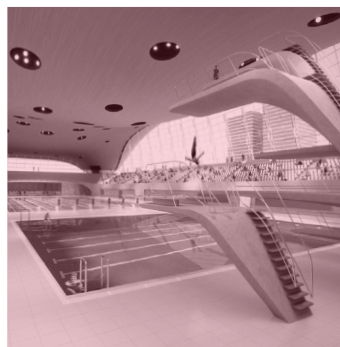
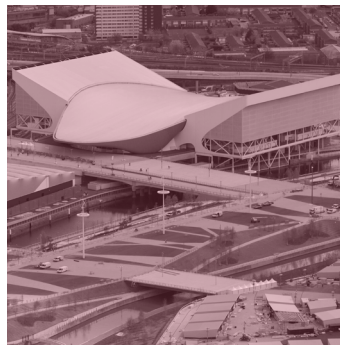
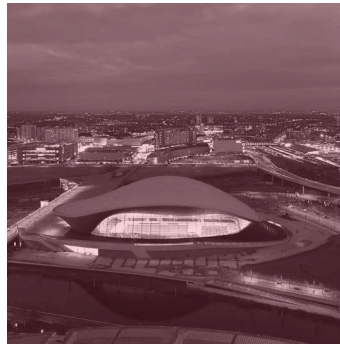
Oval

Arata Isozaki, Pier Paolo Maggiora
Torino, Italy _ 2006

The building was designed for the Winter Olympics in Turin with two main objectives: on the one hand, to quickly build ample space for the sporting event and, on the other hand, to have a highly specialized but at the same time flexible building for the next activities that will take place after the Olympics. Despite the name *Oval* the structure itself is a square, covered with inclined beams to eliminate the box-like effect of a formless container that could be divided into three spaces with movable partitions creating a multipurpose space for fairs and exhibitions.⁷

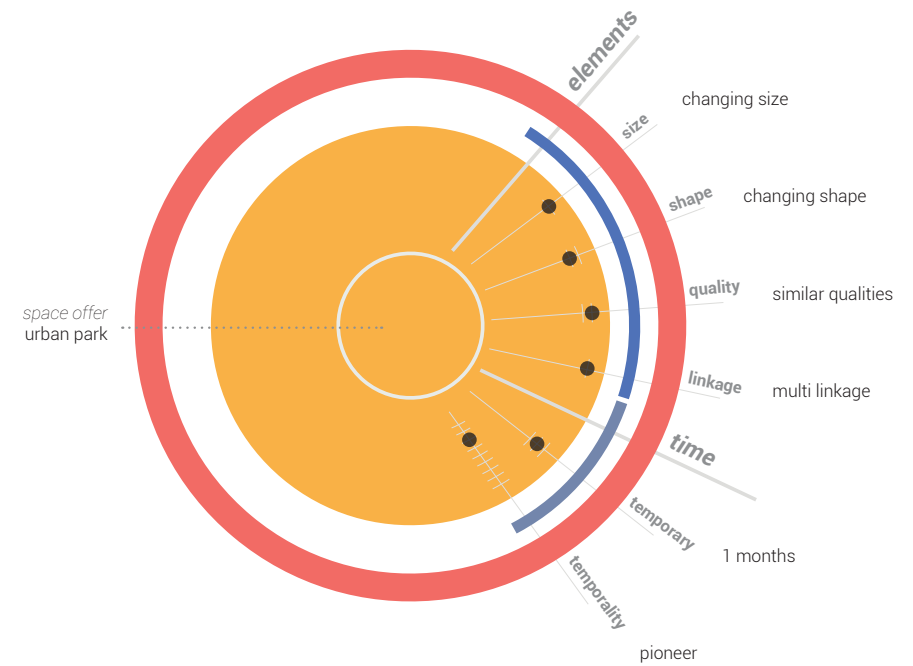


⁷ Rasheeda, M., MGS Architecture, (April May 2007), "Oval Torino - Light up with Steel & Glass"

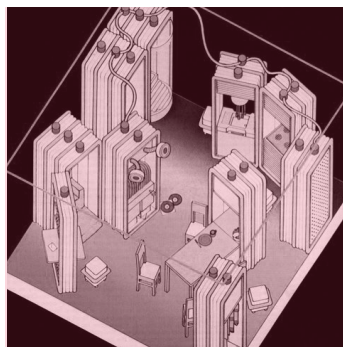


London Aquatics Centre Zaha Hadid London, UK _ 2012

The *London Aquatics Centre* was designed to have the size and capacity needed to host the London 2012 Olympics, and then to be reconfigured into a place at the disposal of the district and the city. During the Olympics, it had a 17.500 seat capacity, obtained by combining two large and steep temporary stands that were removed after the event, transforming the Aquatics Center. On the sides left free, two large windows appear to create a swimming centre immersed in natural light, and the absence of the stands reveals the elegant and slender external shape of the building that during the sporting event could barely be seen.⁸

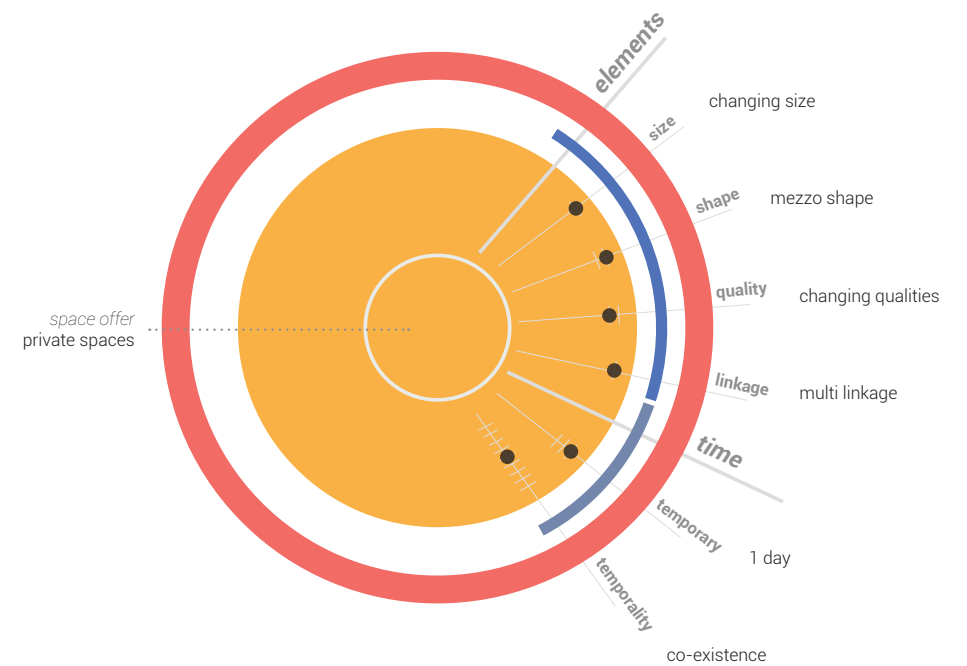


⁸ Domus, "London Aquatics Centre", 2014

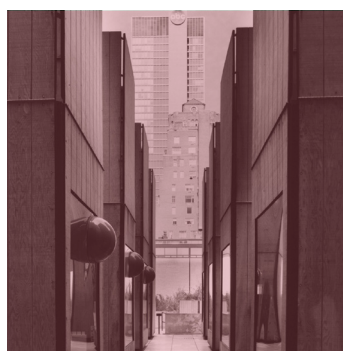


Mobile and Flexible Environment Module Ettore Sottsass Jr. New York, USA _ 1972

Ettore Sottsass Jr. designed a domestic environment composed of a modular system of plastic containers that have sliding wheels and plastic cables to be linked together. Each container has a function inside: a kitchen for cooking and a refrigerator, a wardrobe, a shower room, a library, a reading room, and the jukebox. The containers represent a catalog of possibilities within which everyone can choose according to his preferences, and also organize, through their grouping or removal, a solitary or collective experience of living space.⁹



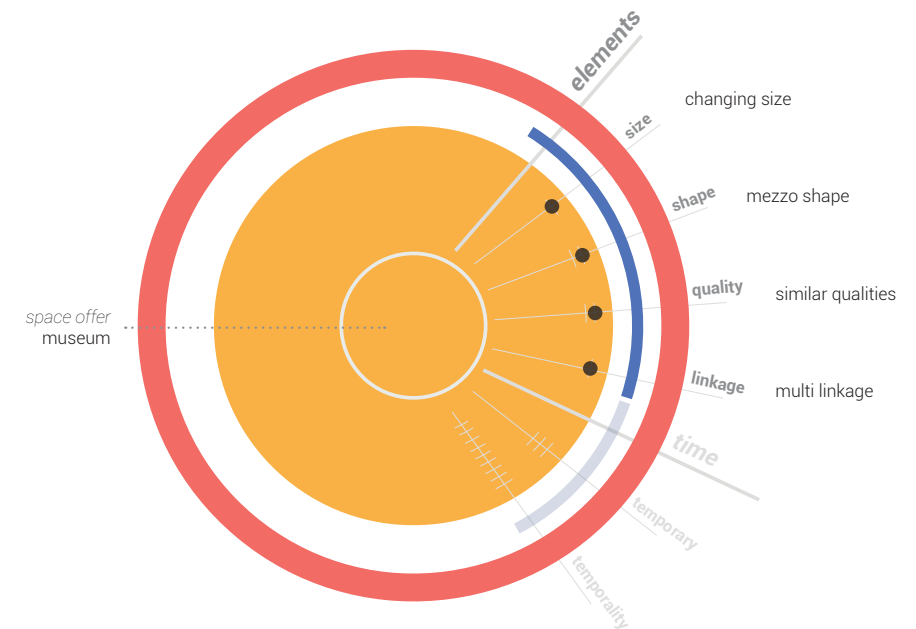
⁹ Lucarelli, F., "Ettore Sottsass jr., Mobile and Flexible Environment Module, 1972", 2013



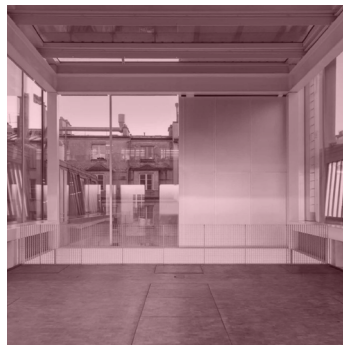
Italy: The New Domestic Landscape Emilio Ambasz _ exhibition set up New York, USA _ 1972

The objects of the exhibition are displayed on the roof garden in huge modular wooden display cases. They are about sixty towers with a 190x190cm base and about 6 meters high, completely covered in rough wood planks.

The container towers, inspired by *Le Dodici città ideali* of Superstudio, are arranged in rows of five elements to form a grid pattern that, in reality, creates a braided path. On the lower part of the terrace, some of them are coupled to form groups of two or four modules. Inside the objects are exposed, and a large-format image is put as background, took by studio Ballo, while Artemide studied the lighting.¹⁰



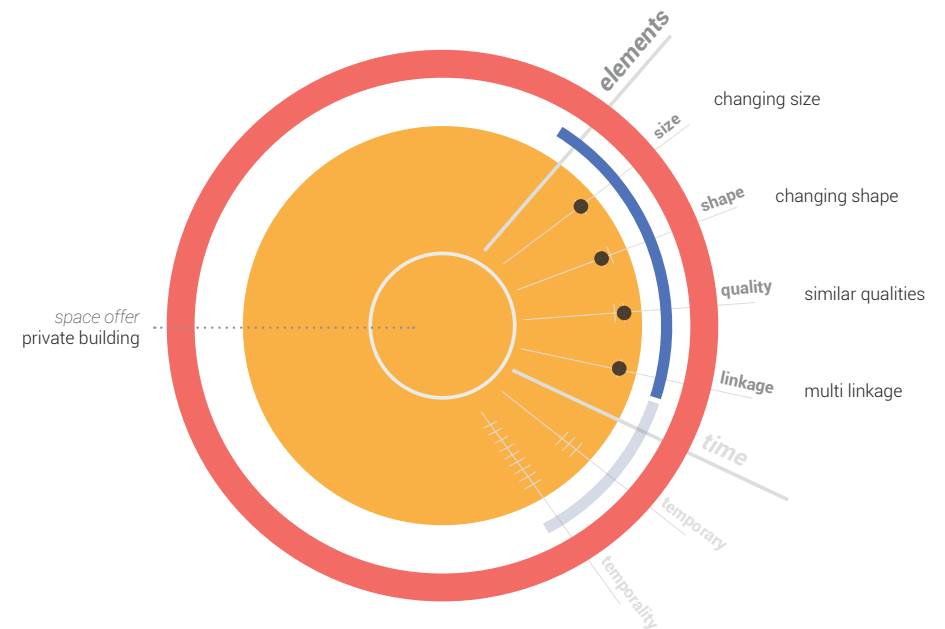
¹⁰ Décombas-Deschamps, S., Malesevic, D., Veragten, V., Borghs, L., "Ettore Sottsass Jr, Environment section from "The New Domestic Landscape", New York, 1972", 2016



Lafayette Anticipations

Studio OMA _ Rem Koolhaas
Paris, France _ 2018

Lafayette Anticipations is an art foundation that supports contemporary creations. Space is characterized by a high volume in glass and steel, which distinguishes the inner court of the foundation. The seven levels' space is flexible and can be set up in 49 different configurations that are achieved through the movement of mobile slabs to obtain galleries that can host small and big artworks. The offer of a vast repertoire of spatial configurations provides programmatic flexibility, which increases the potential of the existing building.¹¹



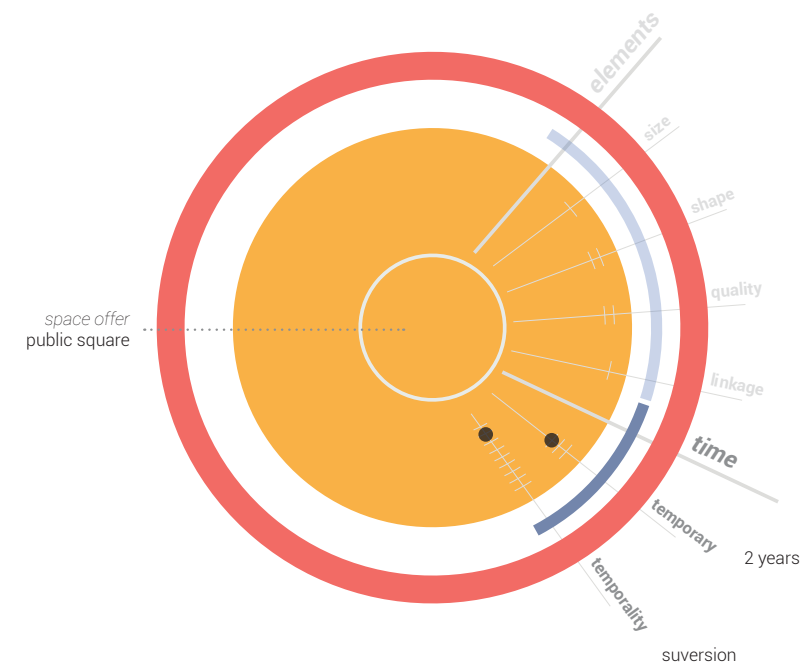
¹¹ OMA, "The fondation", from <https://oma.eu/projects/fondation-entreprise-galleries-lafayette>



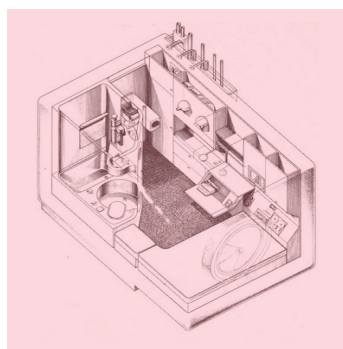
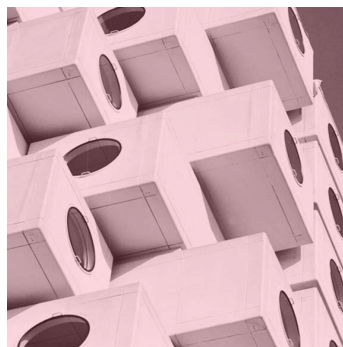
Cityscape Arne Quinze Brusselles, Belgium _ 2007

For two years, the Brussels Louisa neighborhood was brought to life again through the wooden sculpture *Cityscape*, which drew a lot of visitors to this remote and deserted corner of the city. For the inhabitants of this neighbourhood, the installation was a success, and it, therefore, stayed longer than was initially planned.

Many inhabitants of Brussels were pleased that something finally happened here. The positioning of concrete benches allowed people to come and rest in this place for a moment, something impossible before the installation of this work of art.¹²



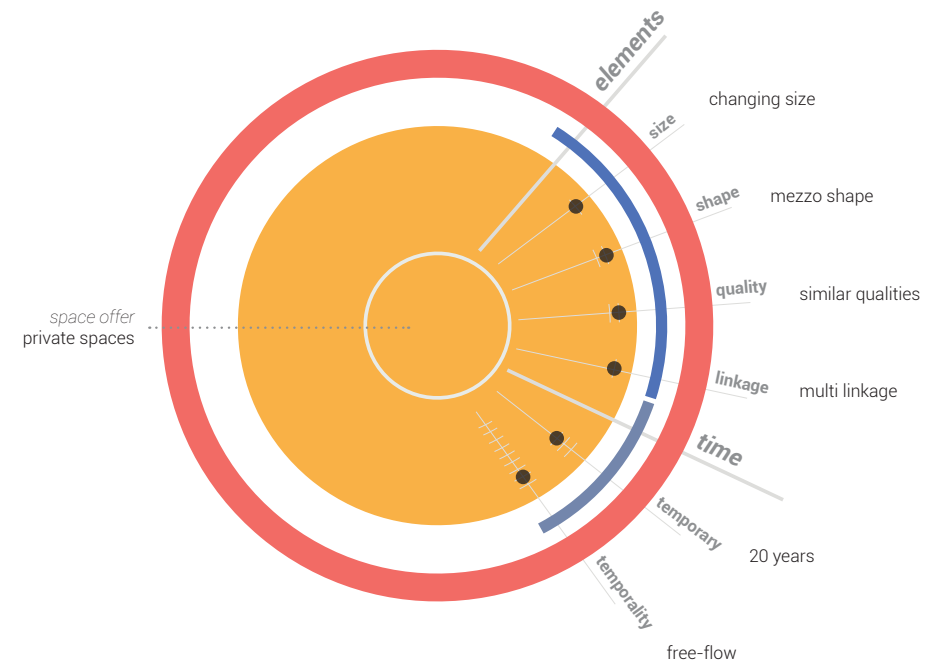
¹² Quinze, A., "Cityscape", 2007, from <https://www.arnequinze.com/art-and-exhibitions/cityscape>



Nakagin Capsule Tower

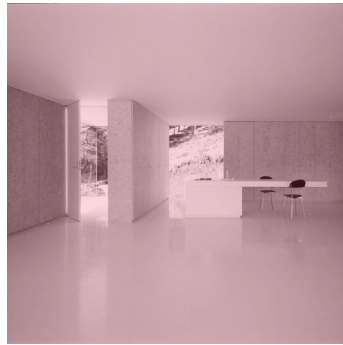
Kishō Kurokawa
Tokyo, Japan _ 1972

The tower is one of the best surviving examples of Metabolism, a postwar architectural movement in Japan. It was created with the intention of housing travelling business people that worked in central Tokyo during the week. A total of 140 modules are stacked and rotated at varying angles around a central core. The dimension of each capsule is 4 x 2.5 meters, which is the space of a room for one person to live comfortably. The interior space of each module can be manipulated by connecting the capsule to other capsules.^{13,14}



¹³ Doezema, M., "Time Is Running Out for Tokyo's Nakagin Capsule Tower", in Citylab, 2019

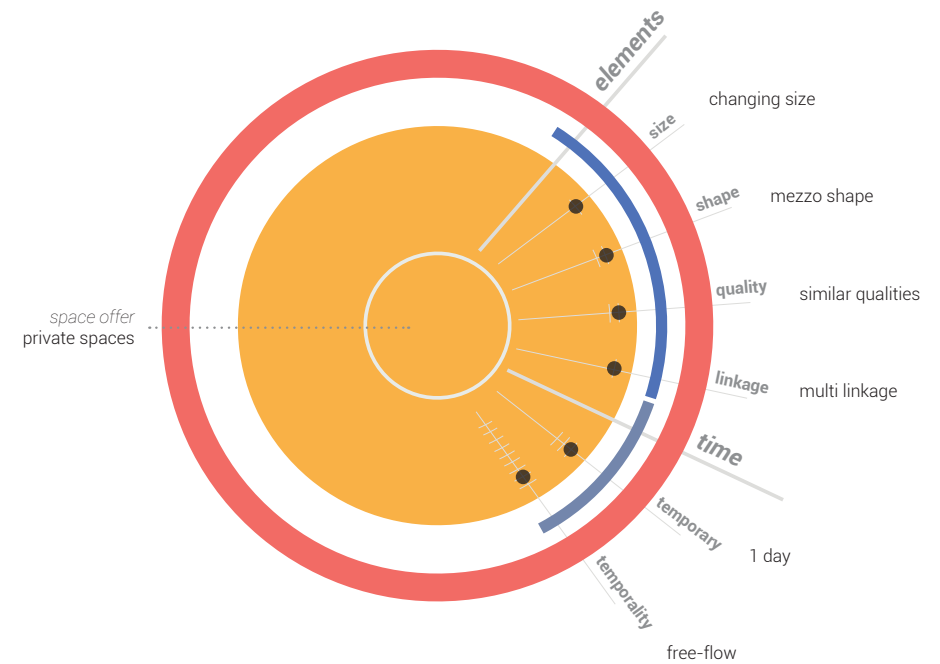
¹⁴ Sveiven, M., "Nakagin Capsule Tower / Kisho Kurokawa", in AD Classics, February 2011



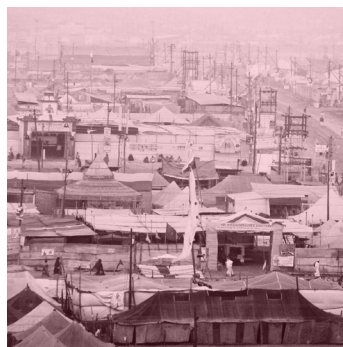
Furniture House 1

Shigeru Ban
Yamanashi, Japan _ 1995

The construction system for the Furniture House features factory produced full-height units that function as structural elements as well as space-defining elements. Since these units are pre-fabricated, construction time on-site is significantly reduced and cost-effective. The units enable equipment and labour reduction, in so far as serving both as furniture and as a building material. An individual unit weighs about 80 kg and can be easily handled by a single person, and its self-supporting function makes the arrangement simple.¹⁵



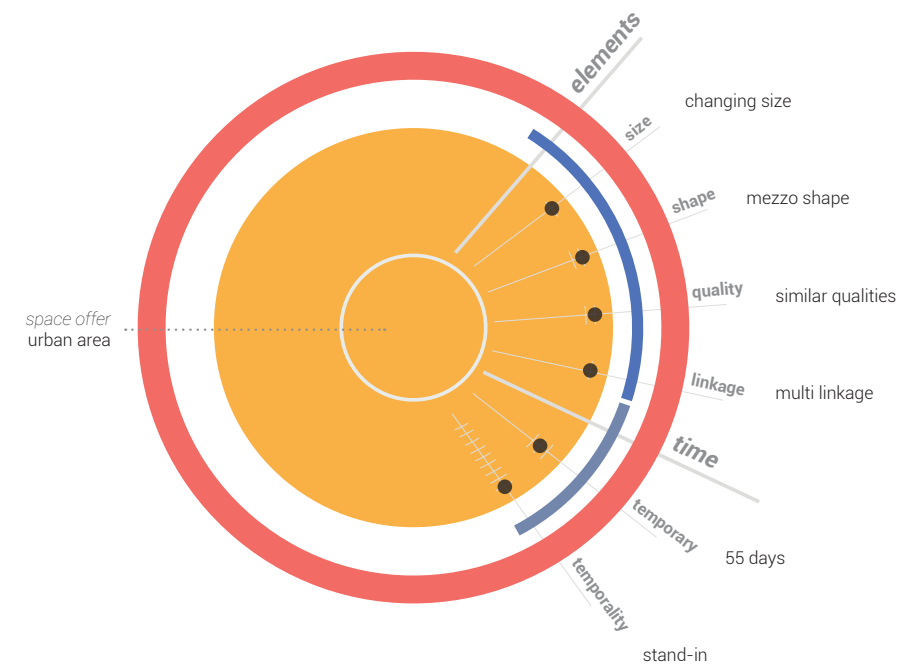
¹⁵ Shigeru Ban Architects, "Furniture House 1 - Yamanashi, Japan, 1995", (n.d.)



Kumbh Mela

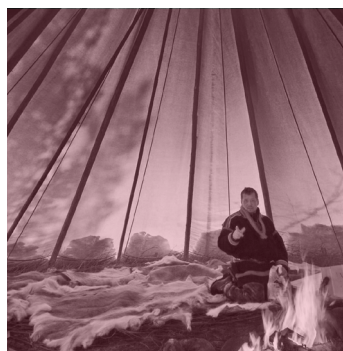
-
Allahabad, India _ every 12 years

On the occasion of a Hindu religious festival, an extraordinary flow arrives in the city. Crowds of million people arrive in 24-hour cycles on the six main bathing dates, often after waiting days for their opportunity to bathe. A temporary settlement is deployed to accommodate this massive human gathering, taking the shape of a proper urban environment. Over 300km of streets, nearly two dozen pontoon bridges, thousands of tents, venues for spiritual meetings and social infrastructures like hospitals, compose the temporary city.^{16, 17}



¹⁶ Mehrotra, R., "Constructing the World's Biggest (Disassemblable) City", in *Works That Work*, No. 4, 2014

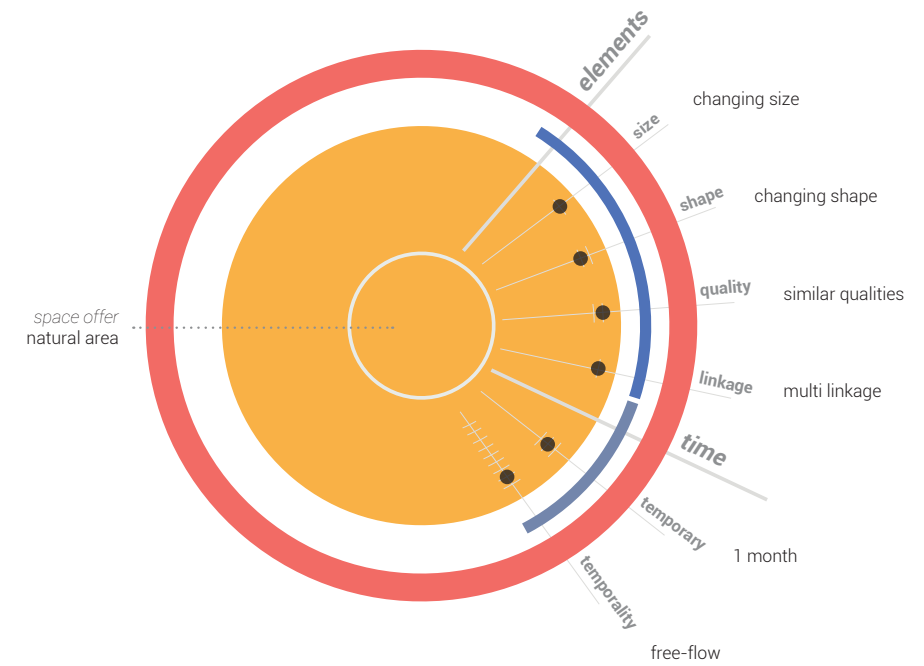
¹⁷ Mehrotra, R., Veraer, F., Amdreani, S., "Instant Megalopolis", in *Domus Web*, 2019



Lávvu

- Random destinations, Norway _ -

Lávvu is a traditional dwelling of Norway's reindeer herders. It is a temporary structure, designed to be easily disassembled, transported, and reassembled as the reindeer herds migrate across the tundra. Moreover, it is built lower to the ground to withstand the fierce winds and sub-zero temperatures. The structure adapts to the needs of the semi-nomadic community of the Arctic because of its remarkably resilient design. Construction of the lávvu begins with three long poles whose top ends are forked so that they interlock with each other.¹⁸



¹⁸ Bergmo, K., "An Ancient Design in a Modern Age", in Works That Work, n. 4, March 2014

macro functions

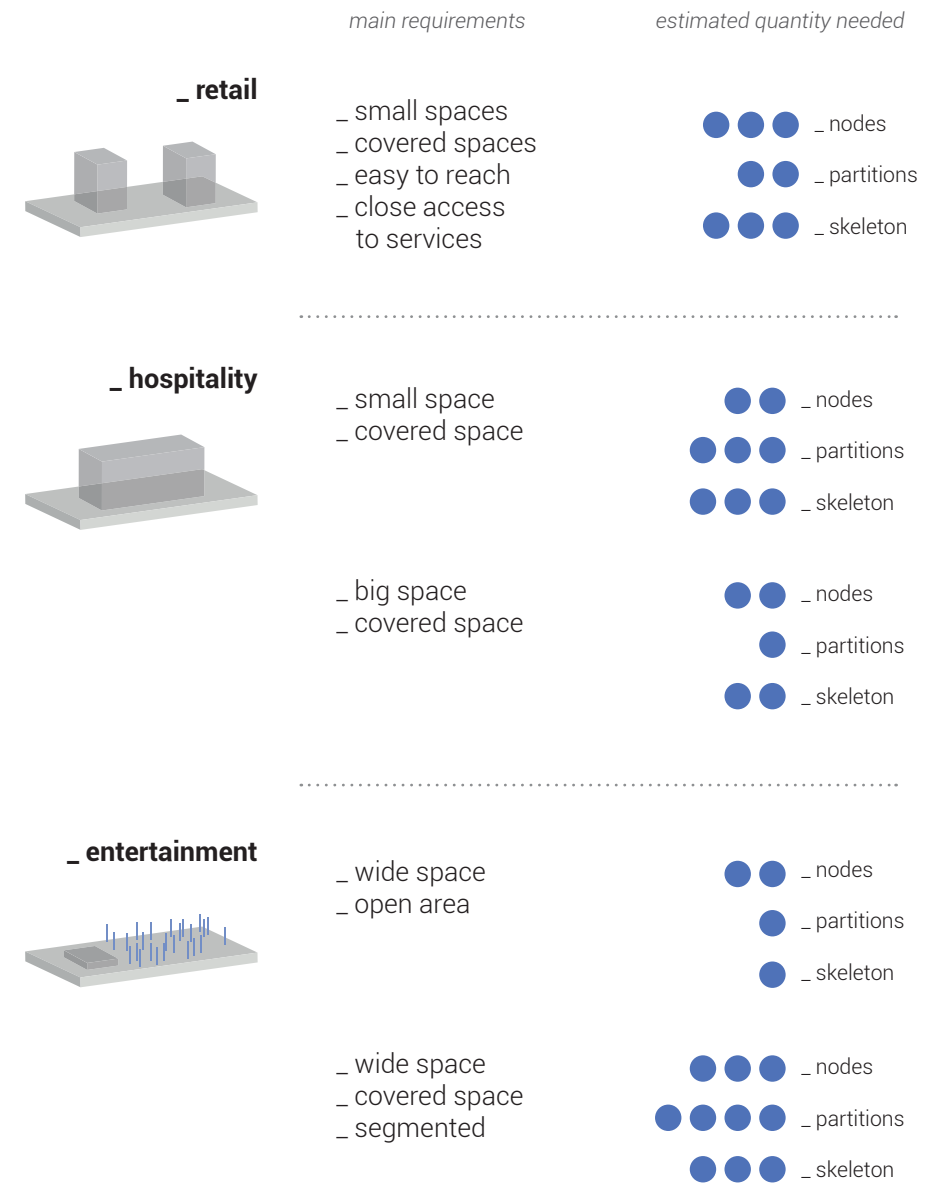
Three main macro functions to be placed in the space are defined, and each of them has some characteristics that need specific responses.

Speaking about retail, a temporary shop located outdoor could have an advertisement purpose, as is already the case of the racing events that already take place, or an investigative purpose. Also, mobile sales, that are the travelling vehicles are considered in that category.

Hospitable spaces' aim, indeed, is to exchange experiences and share spaces, particularly between hosts, tourists, guests and the inhabitants. To reach that goal, a community needs to be created, as well as networking, not only among people but also between spaces.

Space could also be considered as an *entertainment factory* that generates aggregative and integrative situations to involve users who have so the possibility to experience.¹⁹

According to each macro function, which are the needs in terms of space? The scheme in the next page explains the main requirements for each macro function and the estimated quantity of elements needed.



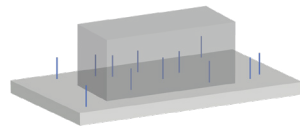
¹⁹ Fassi, D., "Temporary Urban Solutions", Maggioli Editore, Milano, 2012

users

_ temporary users

Space is designed according to the needs and dreams of the future users because they are the demand.

Users identify the possibilities, find solutions for themselves and the space in which they are established. The place belongs to populations, it is created by them and their actions, and also by the connections between them. Users transform the landscape according to their needs, and their degree of adaptiveness profoundly influences the general perception of other people regarding space.²⁰



98

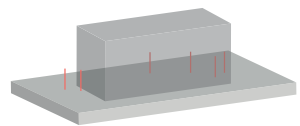
_ interim user

The user who lives the space with a short term perspective waiting for a provisional transformation that could generate new usage dynamics.

21

_ actors

The professional figures that work in the space, 'before of the project', designing it, and then the workers that 'build' it, but also who manage it. Could be described workers also the people who work permanently in the Autodromo, or in a temporary way, during the events.

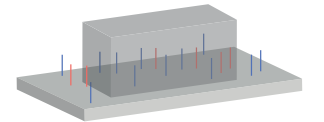


²⁰ Fassi, D., "Temporary Urban Solutions", Maggioli Editore, Milano, 2012

²¹ De Smet, A., "The role of temporary use in (re)development: examples from Bruxelles", in "Brussels Studies", Number 72, November 2013, The e-journal for academic research on Brussels, Collection générale, 2013

_ users + actors

The interaction between users and actors is fundamental in a consumption space, and it has to be designed in the most profitable way, not only in terms of management, to make people live a good experience.



_ temporary communitas

A psychological sense of community, which means closeness, exists among participants during consumption experiences.

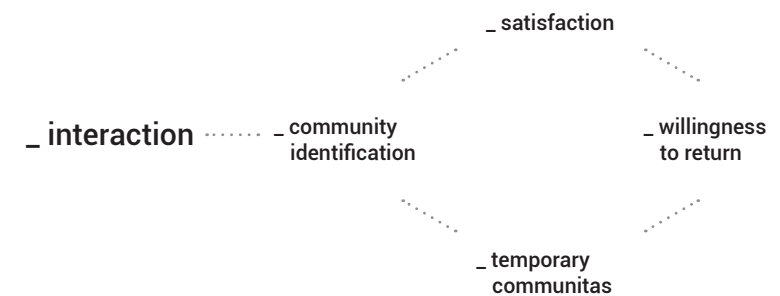
Temporary communitas at planned events can motivate people to repeat their experience by attending in the future.

Even short-lived events are able to make some commonalities among costumers more salient.

Satisfaction could be less important than shared social experience.

22

99



²² Jahn, S., Cornwell, T. B., Dregner, J., Gaus, H., "Temporary communitas and willingness to return to events", in Journal of Business Research, Issue 92, 2018, pp. 329-338

brief

_ project definition

The aim is to create a new environmental temporary condition that can be modified and opened to a broader palimpsest to attract a wider and more differentiated target.

A proper definition of the target that nowadays attends the Autodromo and their needs is required, as well as the definition of the future users that will be attracted and involved.

To define the functions is another point that has to be considered, which could be the starting point for the target's definition (*i decide who I want to attract*), or the consequence of the analysis of the most common users of the space (*W*).

Knowing the functions will be possible to define the general shapes of the spaces, the size needed and the qualities.

A versatile space is the objective of the project, and to achieve it, the temporary elements should be considered, taking account of all the possibilities and interactions between them. For sure, being something that changes, it is linked with time, which has to be considered in terms of quality of being temporal. Always connected to time is the strategy to put in act the transformation process, and a clear definition of it is required.

brief

_ goals

basic aims

- to create a **new environmental temporary condition** that
 - _ can be **modified**
 - _ opened to a **larger palimpsest**
 - _ to attract a **wider and more differentiated target**

elements and time

- elements of the versatile system
 - _ **materials**
 - _ **shape**and possibilities and interactions between them
- definition of the transformation process strategy
 - _ **'qualities of being temporal'**

functions

- knowing the functions will be possible to define
 - _ the **general shapes** of the spaces
 - _ the **size**
 - _ the **qualities**
- _ consequence of the analysis of the **most common users**
- _ define actions to define the **target**

target

- definition of the target that **nowadays attends** the Autodromo
 - _ their characteristics, needs, usual actions
- definition of the **future users** who will be attracted and involved
 - _ their characteristics, needs, usual actions

Shared features between versatile systems and emergency architectures

_ abstract

Design based on change could refer to the reuse of spaces. Spaces could be exploited in different ways to accommodate various functions, and this is considered sustainable as there are no new structures created or existing ones demolished. Instead, new meanings are given to them, thanks to agile temporary systems that allow composing several configurations inside different spaces. These features are the same requirements of emergency architectures, and, in the future, they might be considered as one of the prerequisites of a versatile system.

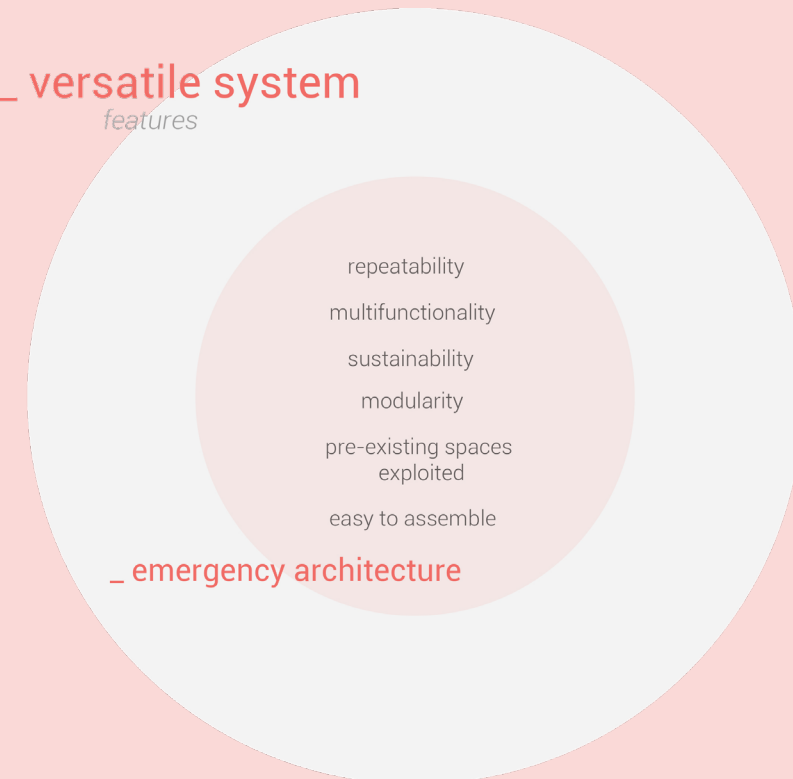
#adaptability #sustainability #temporary
#emergency architecture #future planning

_ paper

A versatile, and therefore temporary, system can adapt, take on different shapes, and host different functions. This system can be considered sustainable as new structures are not built, but pre-existing spaces are

_ versatile system

features

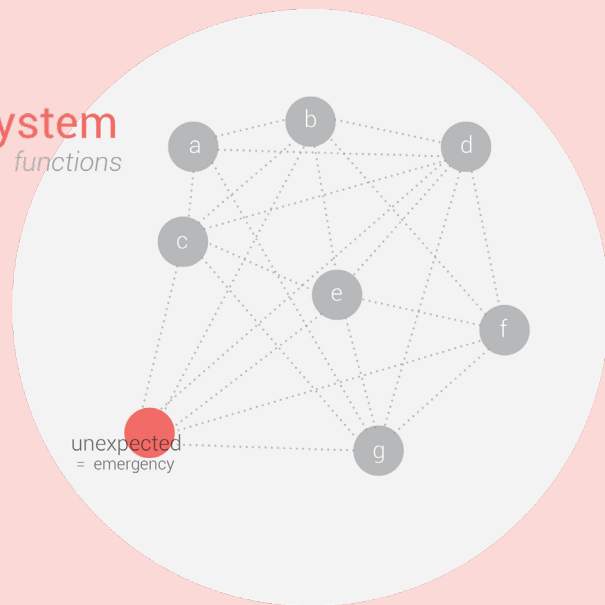


_ emergency architecture

exploited, implemented thanks to temporary constructions.²³ Multifunctionality, however, is dictated by the agility of these micro-architectures, thanks to components that are easy to handle, assemble and disassemble,

²³ De Tammernan, N., Alegria Mira, A., "Development of a sustainable construction system for temporary structures", 2011

_ versatile system
functions



and accessible to all. To achieve this, one of the main characteristics that a system of this type must assume is modularity, but also functionality, sustainability, and repeatability, which are characteristics that can be put in place to enrich a place, to transform it and to give it new life.

What might happen if all of a sudden everyone finds themselves in an emergency?

It is interesting how many features of a versatile system are also typical of emergency architectures built to succumb to natural

disasters, war situations, or pandemics. The emergency has some universal generalities, in particular the need for rapid and immediate intervention, which requires a pragmatic project and at the complete service of humanity. Today's world situation highlights these peculiarities even more and allows us to see them up close.²⁴

The installation of emergency tents in the areas in front of the hospitals, as well as the assembly of extremely temporary, agile structures capable of conforming to various environments, or the readaptation of some spaces generally dedicated to other functions, such as the Madrid ice rink that has become a morgue²⁵, represent a starting point for considerable reflection, in particular for future planning.

Are the structures and spaces connotations which allowed the readaptation in that emergency situation physical characteristics, such as the shape, or soft qualities, such as the temperature? What if, in the future, we took these qualities and possible needs into consideration when designing? One idea could be to design a versatile system thinking of the unexpected as a possible function intrinsic to the structure.

²⁴ Di Cosmo, F., "The Contingent Architecture to service of humanity", in LAB 2.0 MAGAZINE - Learning Architecture and Building, 2015

²⁵ Goodman, A, Perez Maestro, L., Formanek, M., Ramsay, M., Kottasová, I., "Spain Coronavirus - Ice Rink Turned into a Morgue amid Outbreak", 2020



Once established the project brief, it was made referring to the concept of the *mat building* to design the installations and their disposition in the space. It consists in inserting different elements that are part of three systems in space: the connection system, of which the flows were analyzed, the system of interlinking open spaces, of which the exploitable areas have been analyzed and the system of units.

Of the latter, the various components were specifically analyzed: nodes, partitions and skeleton. For each of them, in-depth research was carried out, examining the different possible shapes and qualities.

Subsequently, the shapes and qualities most closely related to the spaces and needs of the Autodrome were chosen and, taking into account three possible macro functions, three types of installations, containers, show and curtains were defined and took shape.

elements

_ elements definition

The aim is to create a new environmental temporary condition that can be modified and opened to a wider palimpsest.

In order to define the planning methodology, reference was made to the concept of *mat building*¹, theorised in the mid-Sixties by Alison and Peter Smithson.

concept of Mat Building

The *mat building* system acts as a sort of "horizontal assembly", governed by the interconnection of one part to another. It can lead and direct the fluxes of urban activities establishing extensive connectivity networks, both internally and externally, in which the connecting spaces not only play a neutral role but, like the primary nodes, form a continuous pattern characterized by varying functional arrangements.

A planning hypothesis is to structure the project area through the insertion of a grid which is the result of the superimposition of three figures, each one based on an ordering system:

- _ a connection system
- _ a system of interlinking open spaces
- _ a system of units

¹ Smithson, A., "How to Recognize and read Mat-Building. Mainstream architecture as it developed towards mat-building", in *Architectural Design*, No. 9, 1974

elements

system of connections

The connection system governs the relations at the different typologies of action:

- between open spaces and existing structures
- between the functions/activities and the events time

2 · _ flexibility

of the space composition

· _ adaptation

to receive different functions that change

The system of connections is considered for now as an organized track system which is spread through the existing spaces and structures of the Autodromo di Monza and which allows hosting different functions thanks to the versatility it may confer.

² Smithson, A., "How to Recognize and read Mat-Building. Mainstream architecture as it developed towards mat-building", in *Architectural Design*, No. 9, 1974

elements

system of connections

_ flow analysis

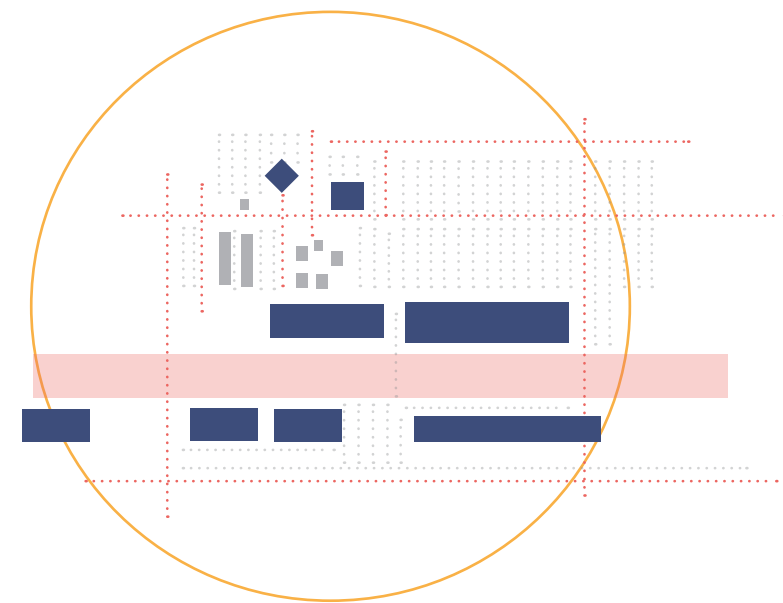
Analysis of the common flows and paths in the spaces of Autodromo Nazionale di Monza, especially in the central part where the majority of events take place. The study is mainly related to the different types of vehicles.

_ different types of flows

- _ vehicle paths
- _ pedestrian paths
- _ circuit

Around the departure and arrival of the Circuit is developed the more active area where shops, main buildings and main stands are located. In this space, the types of flows are analyzed, and the result is that the majority of the space is pedestrian, but for other necessities, vehicle paths go through this area, too.

During the events, these areas could change the paths disposition assuming different functions and the roads dedicated to vehicles may become pedestrian streets.

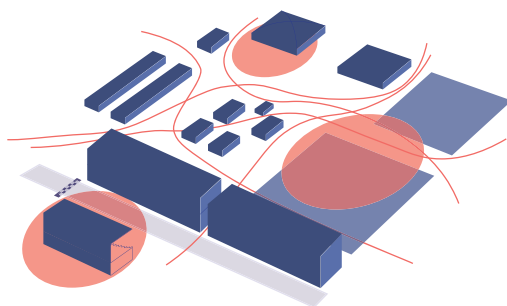


vehicle paths
 pedestrian paths
 circuit

elements

system of interlinking spaces

The existing spaces and the structures located in the Autodromo Nazionale Monza shall be read as spaces which are part of the interlinking spaces' system. Connections between the grid systems and relationships between unities, modified and specialized according to the feature and to the duration of the event, happen inside these exploitable spaces.³



As system of interlinking spaces are intended the areas of the Autodromo that could be used and exploited and the interstitial spaces, in which do not take place every-day specific works or actions.

³ Perriccioli, M., "Piccola scala per grande dimensione. Sistemi di micro-architetture per la città temporanea.", in *Techne*, Issue 12, pp. 174-181, Firenze University Press, 2016

elements

system of interlinking spaces

_ exploitable spaces analysis

An analysis of the spaces of the Autodromo that could be used and exploited to install the versatile system, to be connected with, is done to understand which are the most suitable and enjoyable ones.

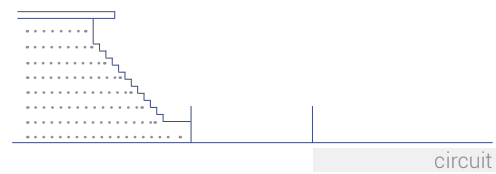
The analysis is done in terms of the quality of the spaces - materials and soft qualities - dimensions, the function they host if something happens inside, the duration of it, and the adjacent areas.

- _ stands
- _ festival pavillon
- _ paddock area
- _ concerts area
- _ interstitial spaces
 - . entrances
 - . streets
 - . internal paths
 - . tunnels
 - . bridges

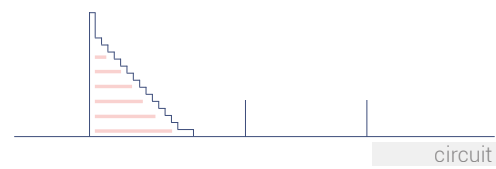
_ stands

Twenty-six stands are distributed through the entire Circuit, concentrated above all close the departure and arrival area, which is also where the podium is located.

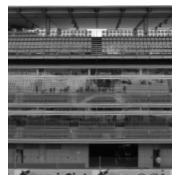
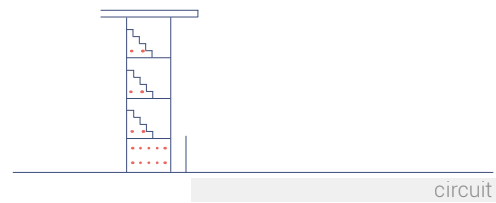
historical stand



stands

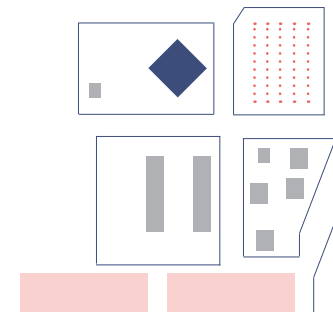
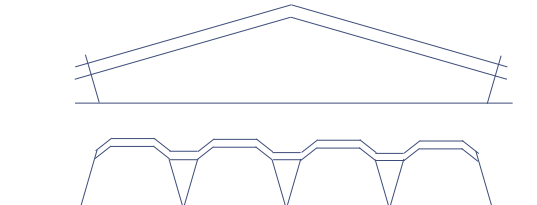


'new' stand



_ festival pavilion

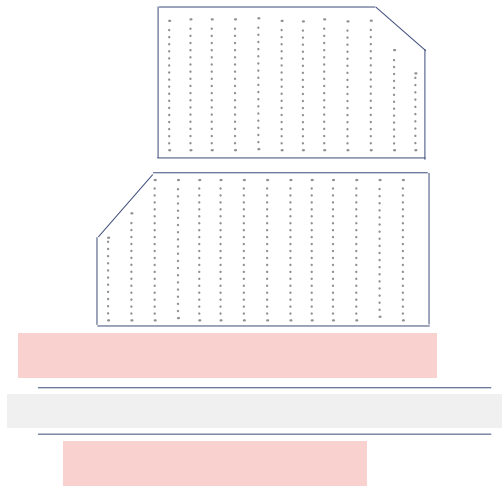
The festival pavilion is used as a warehouse and storage, despite the imponent a good-looking structure and wide area it covers, which could be exploited in different ways.



festival pavillon

_ paddock

The paddocks are two which, during the races, are usually one dedicated to cars and drivers, with services such as water, electricity, toilets and showers inside, and the other, smaller, to commercial structures, only with water and electricity services.

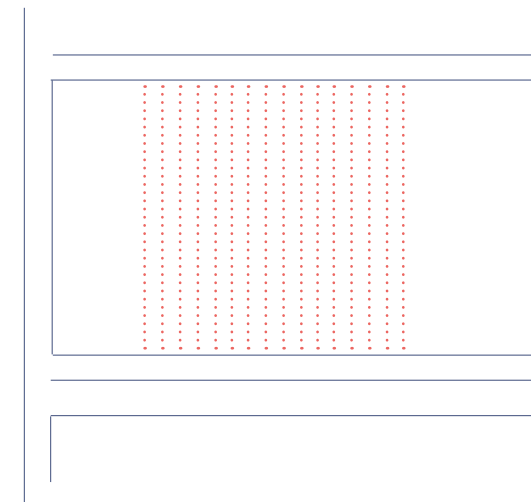


••••• paddock area



_ concerts area

The Pratone Gerascia is the space that is usually used for large concerts and measures approximately 75,000 sqm. It has no pre-existing services inside as it only consists of a large flat lawn with big trees that enclose it, but additional locks are required during events.



••••• concerts area

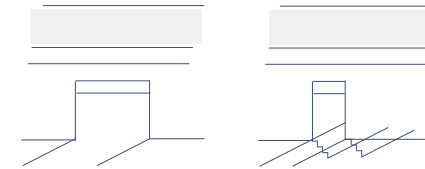
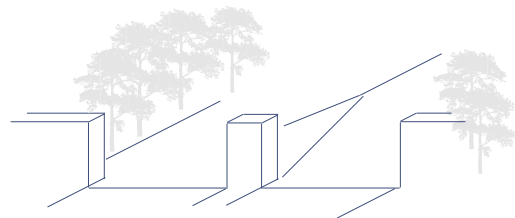
_ interstitial spaces

Interstitial spaces mean all the passage spaces present within the area of the Autodromo, such as entrances, pedestrian and automotive tunnels, pedestrian overpasses and all the typologies of internal paths.

Since the Monza racetrack is vast and crossed by the Circuit, both old and new, there are many spaces of this type, which, however, are not characterized and do not represent the spirit of the Circuit in any way.

Especially the entrances, that should be one of the main points of that space are not characterized at all.

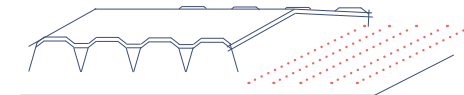
entrances



tunnels



pedestrian bridge



paths

elements

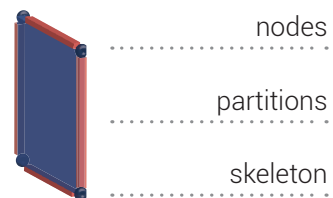
system of detachable units

It is a system of units that have to be small, light, mobile and detachable.

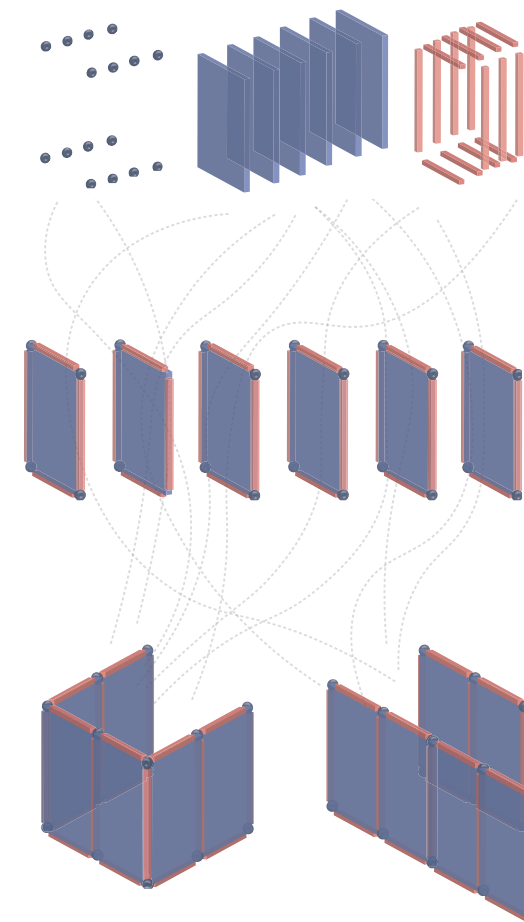
⁴ _ microarchitectures

Designed as open and flexible space functional devices, based on a systemic logic.

The components which will be assembled, have to be simple, light and modular in order to allow the modification of usage of space during the scheduled events and will host supportive functions for the events.



As system of detachable units are considered the versatile structures that aim to create a multifunctional space thanks to its versatility principle.



⁴ Smithson, A., "How to Recognize and read Mat-Building. Mainstream architecture as it developed towards mat-building", in *Architectural Design*, No. 9, 1974

elements

system of detachable units

_ shapes

Study of some possible shapes of the systemic components which will compose the physical part of the versatile system. Shape is meant in terms of the physical aspect.

_ node

- _ connection
- _ interlocking
- _ magnet
- _ added element

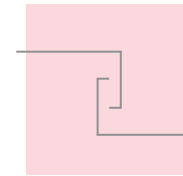
_ skeleton

- _ linear
 - . external . internal
- _ curve

_ partition

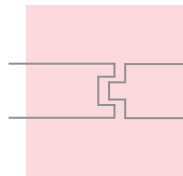
- _ squared
- _ triangular
- _ rounded
- _ undefined

_ node



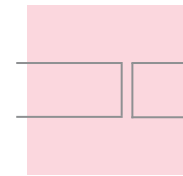
connection

- _ equal sides
- _ easy to use
- _ weak stability
- _ not expensive



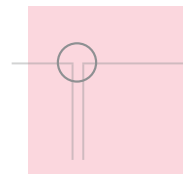
interlocking

- _ accuracy required
- _ two different sides
- male/female division
- _ not expensive



magnet

- _ easy to install
- _ easy to use
- _ space saver
- _ expensive

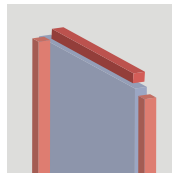


added element

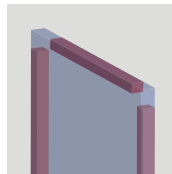
- _ equal sides
- _ not easy to use
- _ weak stability
- _ not expensive

⁵ Smithson, A., "How to Recognize and read Mat-Building. Mainstream architecture as it developed towards mat-building", in *Architectural Design*, No. 9, 1974

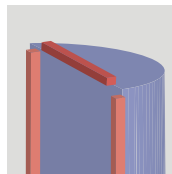
_ skeleton



linear external
_ solid
_ expresses heaviness
_ keep the structure

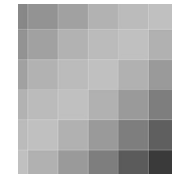


linear internal
_ 'invisible'
_ embedded



curve
_ solid
_ expresses heaviness
_ adaptable

_ partition



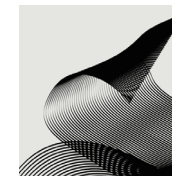
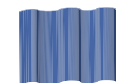
squared
_ easy linkage
_ super modular
_ stiff
_ few combination angles



triangular
_ modular
_ different shapes
_ quite stiff
_ few combination angles



rounded
_ difficult linkage
_ impossible to fill
_ smooth
_ several combination angles



undefined
_ difficult linkage
_ smooth
_ adaptable
_ infinite combinations

elements

system of detachable units

_ qualities

Study of the most common qualities that could be a possible application for the components of a versatile system. Quality is meant the aspect and some peculiarities that could be transmitted through the materiality.

6

_ node

- : _ neutral : fits anywhere
- : _ multilinkage : stands with everyone
- : _ handy : easy to use

_ skeleton

- : _ structural : which conveys stability
- : _ neutral : fits anywhere
- : _ functional : containing implant systems

_ partition

- : _ ephemeral : to drive, to address
- : _ covering : to clear divide
- : _ functional : containing implant systems
- : _ interactive : to inform, to entertain

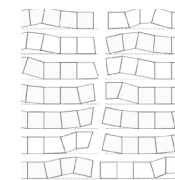
⁶ Smithson, A., "How to Recognize and read Mat-Building. Mainstream architecture as it developed towards mat-building", in *Architectural Design*, No. 9, 1974

_ node



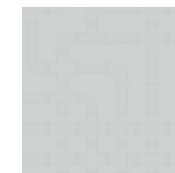
neutral

- _ 'invisible'
- _ embedded
- _ solid
- _ adaptable



handy

- _ lightweight
- _ easy to use
- _ solid



multilinkage

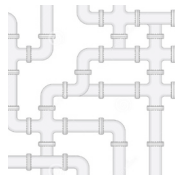
- _ lightweight
- _ easy to use
- _ embedded
- _ suitable

_ skeleton



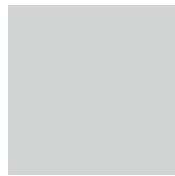
structural

- _ solid
- _ expresses heaviness
- _ keep the structure



functional

- _ 'invisible'
- _ embedded



neutral

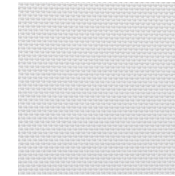
- _ solid
- _ systems inside
- _ fragile

_ partition



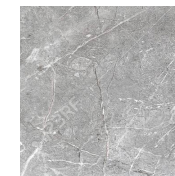
ephemeral

- _ transparent
- _ translucent
- _ lightweight
- _ fragile



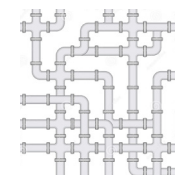
interactive

- _ textural
- _ digital
- _ printed
- _ playful



covering

- _ opaque
- _ solid
- _ expresses heaviness
- _ no light effects



functional

- _ solid
- _ waterproof
- _ contains installations
- _ fragile

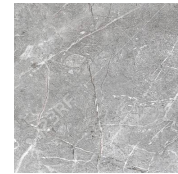
_ partition



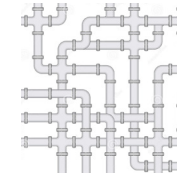
ephemeral
_ transparent
_ translucent
_ lightweight
_ fragile



interactive
_ textural
_ digital
_ printed
_ playful

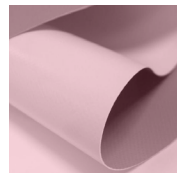


covering
_ opaque
_ solid
_ expresses heaviness
_ no light effects



functional
_ solid
_ waterproof
_ contains installations
_ fragile

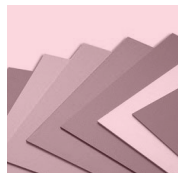
white fabrics
PVC-coated fabrics



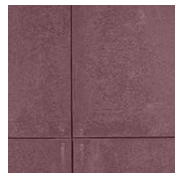
see-through sheets
scrim fabric



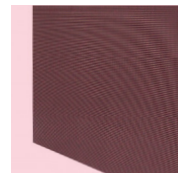
opaque plastics
PVC sheets



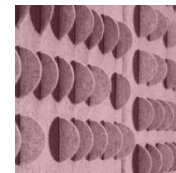
metal sheets
corten steel



digital
led panel



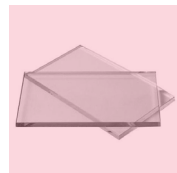
textural panel
fabric panel



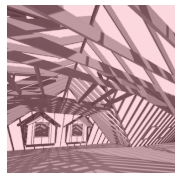
lighting panels
led-light



insulation boards
sound-absorbing



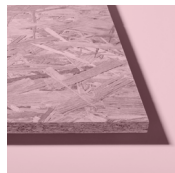
transparent sheets
glass



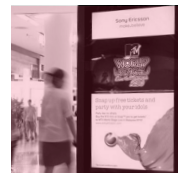
frames
wooden beams



opaque fabrics
polyester panel



wooden oards
os board



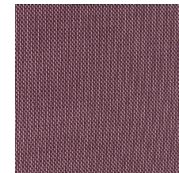
touch
lcd touch screen



playing board
interactive climbing system



systems
electric system



loudspeaker
music maker

implementation

system

idea

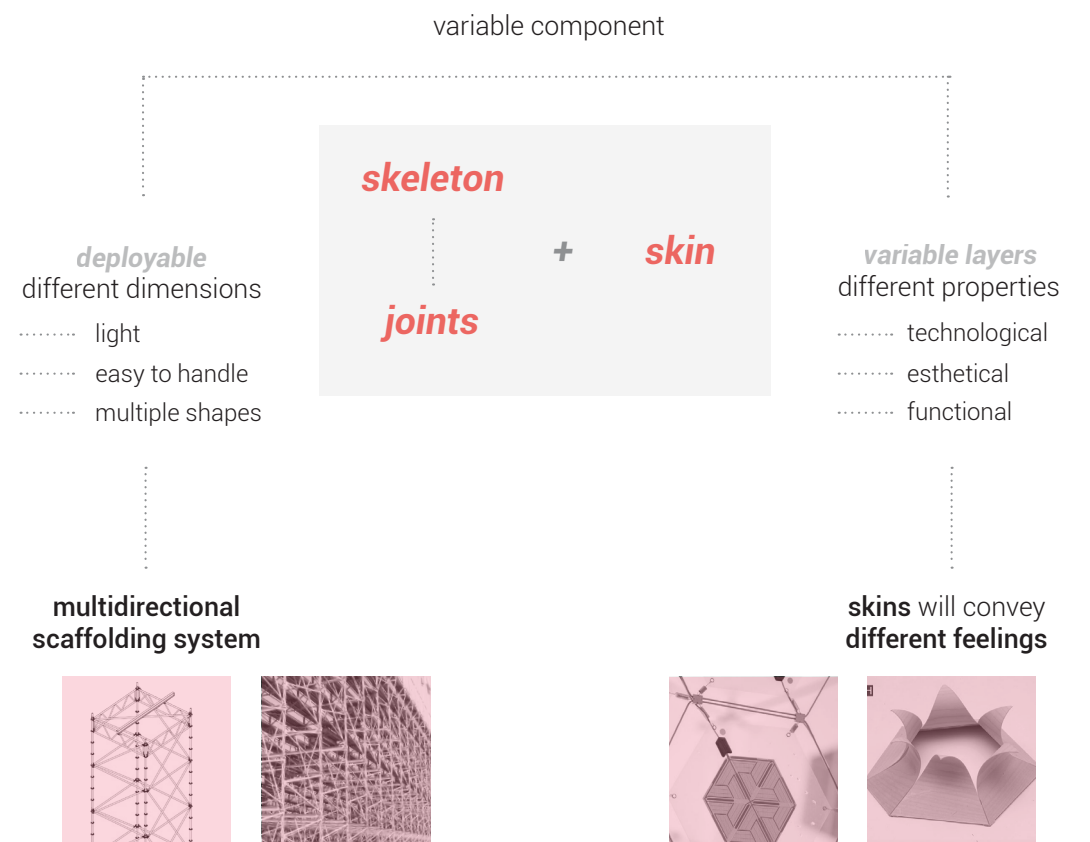
_ proposal

The main idea is to create a linear and light skeleton which could change its configuration easily and quickly, this is why the variable component is so important and involves the entire system.

The skeleton will be connected with joints, to compose structures with different dimensions depending on the need and requirements of the functions that have to be hosted.

A multidirectional scaffolding system could be a solution that fits with all the requests.

Different skins will act as partitions to differentiate the temporary installations, with various materials in order to convey mixed feelings. These coatings could be of three types: technological, esthetical and functional and the layer could be used alone but also combined with others, to obtain a structure which solves different concerns. The resulting structure with different skins will convey various feelings, strictly linked with what happens inside.



system inspiration

case study

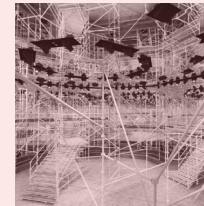


1984 Olympics
Deborah Sussman, Jon Jerde
Los Angeles, USA_ 1984

The brief for the LA Olympics was to achieve maximum impact with minimum means. It was the first Olympics designed for television, so Sussman, working with architect Jon Jerde, deployed a hybrid of architecture and graphic design, using tricks from Hollywood and retail to create a pop-up city. The designers worked together to create a "kit-of-parts" visual alphabet that could be adapted with flair to the disparate venues. There were pasteboard triumphal arches and nylon canopies, banners strung across scaffolding and columns fashioned from painted cardboard shipping tubes. It was all temporary, doing away with the costly structures that most Olympics leave as redundant relics in their wake. The design also included a wayfinding and identification system.⁷

⁷ Winton, E., "Deborah Sussman: 1984 and all that", from <http://new-mb.com.au/deborah-sussman-1984/>, September 2014

case study



Christian Dior Couture 2015
Bureau Betak
Paris, France _ 2015

Kaleidoscopic scaffolded set, provided with a mirror in the ceiling in order to reflect, with the aim to be entirely suitable for losing oneself in time, space and thought. White metal, towering above of dusty-pink carpeting and guests seated below. The tubes are fixed on the ground and seem to disappear under the carpet.⁸



case study



Information Point Barcelona
Peris + Toral arquitectes
Barcelona, Spain _ 2016

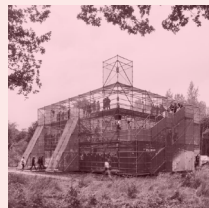
The pavilion is a temporary venue to host an information point, an exhibition space for the regeneration project of the square, which is located in the Northern area of Barcelona, and a rental hub for electric bicycles. The facilities are arranged in a line within a scaffolding structure, which is designed to be easily disassembled. Polycarbonate panels are fitted to the scaffolding to create a tubular space within, while the exterior of the pavilion is wrapped in a layer of metal mesh and another of netting.⁹



⁸ Bureau Betak, "Christian Dior Couture SS2015", from <https://blog.bureaubetak.com>, (n.d.)

⁹ Archilovers, "Information Point in Glorias Square", from <https://www.archilovers.com/projects/191817/information-point-in-glorias-square.html#info>, 2015

case study

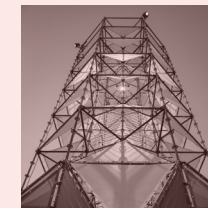


Horst Festival stage
 Assemble
 Newcastle, UK _ 2017

Utilising a system scaffold to recreate the shape of the original castle, the structure looks to achieve something of the same scale as the original castle. Wrapped in a blue net, the Newcastle appears under construction. It has an abstracted form and the facade is hidden, in that way its appearance changes from day to night.¹⁰

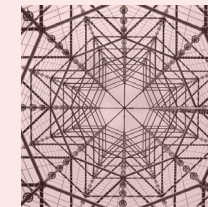


case study



Lowlands Music Festival
 Dennis Parren
 Biddinghuizen, Netherlands _ 2015

The continuously changing, mystical, 18m high light sculpture made with scaffolding has to function as the central meeting point, a point of orientation, that can be seen from everywhere, in the Lowlands music festival. The tower of light inside had a moving LED platform that projected light and creates shadows on the outside.¹²

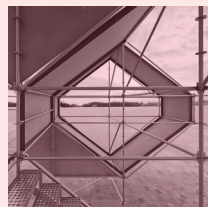


case study



Hex Pavillon
 Felipe Campolina
 Pabellon Mextropoli contest _ 2018

Serving as a point of reference for the pedestrian, this geometry is able to evoke the curiosity of the passerby. The goal is also to experiment new construction techniques, using scaffolding as load-bearing structures, inviting the visitor to reflect about the new possibilities of this material's applications, which is becoming increasingly attractive due to the great flexibility that can provide, either for temporary emergency situations or even for permanent self-construction buildings.¹¹



case study



Point Cloud
 John Ensor Parker
 Washington DC, USA _ 2016

Public art sculpture installation which was located in a park. This temporary light sculpture is a clear example of public art which is also 'usable'; in fact people could go on it, interacting directly with the scaffolding system, but also with lights and fabric. Moreover, this interaction created also a show for the audience.¹³



¹⁰ Assemble, "Horst Festival 2016 2017", from <https://assemblestudio.co.uk/projects/horst-festival/>, (n.d.)

¹¹ Blog Esprit Design, "Hex Pavillon: vivons mieux vivons perchés!" from <https://blog-espritdesign.com/artiste-designer/architecture/hex-pavillon, 2018>

¹² Studio Dennis Parren, "Lowlands 2015", from <https://dennisparren.com/portfolio/lowlands-2015/>, (n.d.)

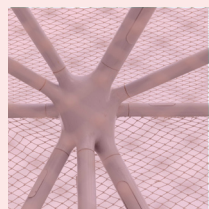
¹³ Parker, J. P., "Point Cloud", from <http://www.natureofenergy.com/#/point-cloud/>, (n.d.)

case study



Airmesh
AirLab
Singapore _ 2019

AirMesh is the world first architectural structure made of 3D printed components in stainless steel. The ultra-lightweight temporary pavilion, is both a gathering space and a light sculpture and the shape is conceived as a polyhedron defined by four rectangular view frames oriented towards highlights in the surrounding landscape.¹⁴



140

case study



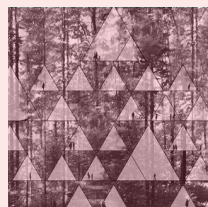
EXPO 1967 Pavilion
Otto Frei
Montreal, Canada _ 1967

The goal of the structure was to provide the maximum coverage possible but with minimal materials. The architect understood that by deforming an elastic surface in anticlastic the fibres tension made possible reducing the weight of the material to a minimum, overturning the historical relationship with the weight carried.¹⁶



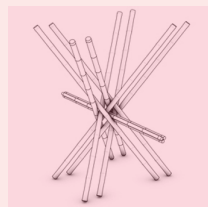
141

case study



One with the Birds
Penda
Washington DC, USA _ 2014

Flexible, portable hotel made from rods of bamboo, designed to bring guests closer to nature. It is a low-impact hotel which structure can be easily expanded. The horizontal rods support the flooring, and the joints could be multiplied horizontally and vertically to increase the width and height of the structure.¹⁵

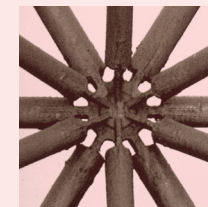


case study



Biosphere Geodesic Dome
Richard Buckminster Fuller
Montreal, Canada _ 1967

The geodesic dome (76 metres in diameter and 62 metres high) served as the U.S. pavilion for the World's Fair on Saint Helen's Island. The Biosphere, as it's now culturally referred to, was originally made entirely of steel tubes and acrylic cells welded together to make hundreds of tetrahedrons.¹⁷



¹⁴ Astubury, J., "AIRLAB 3D prints stainless steel pavilion for Singapore's Gardens by the Bay", January 2020

¹⁵ Tebbutt, L., "Penda's modular bamboo hotel could be expanded horizontally and vertically", July 2014

¹⁶ Aymar, F., "Le tensostrutture di Frei Otto: il padiglione tedesco per Expo 1967", (n.d.)

¹⁷ Carodine, V., "Buckminster Fuller's Biosphere Celebrates 50", March 2017

system requirements

There are some requirements (generally, the local laws of the Municipality) to be followed in order to design temporary structures that could host public inside.

The **main features** of the structures are:

- 18 : _ dismantlable structures
- _ use of light materials
 (such as wood or aluminium)
- _ lowest possible environmental impact
- _ dimensions justified according
 to the activity
- _ anchored to the ground but
 easily removable

Moreover, the European regulations about temporary structures have been sought, and the results are that about this, there are two main UNI norms.

19 : _ UNI EN 13782 (2015)

about the safety requirements related to the design, calculation, construction, installation, maintenance of structures installed on a temporary basis, with a covered area greater than 50 m². The regulation is also applied to multiple small tents which are installed close together and cover an area greater than 50 m².

¹⁸ INAIL, "Palchi per spettacoli ed eventi similari. Leggi norme e guide.", 2017

¹⁹ UNI Ente Italiano di Normazione, "UNI EN 13782:2015" from <http://store.uni.com/catalogo/uni-en-13782-2015>, (n.d.)

20 :

_ UNI 11580 (2015)

about the requirements for the design, calculation, manufacture, and inspections of beams, towers and any associated element, made of aluminum and/or steel for use in public entertainment. Structures composed of these elements can also have a complex shape through the use of corner elements, arches or combinations of other special elements that are not linear beams. Beams and towers can be suspended, supported from the ground or on the wall, permanently installed or used as a mobile structure.

Moreover, there are other features required by the characteristics of the space of the Audutodromo itself, but also by the activities that could happen there.

For example, the materials that when dismantled need to save space, and need to be light to be easily moved. To be quickly mounted and dismantled, a proper connection to build up the structure needs to be designed. But, despite being light, the structure needs to be strong and safe to host people, often needs to show up sponsors advertisements, and needs to be enlightened in the right way during the night. The structure has to be able to protect people when the weather changes.

Of course, the system has the aim to be more versatile as possible, so the last feature is the adaptability to different areas and situations.

²⁰ UNI Ente Italiano di Normazione, "UNI 11580:2015" from <http://store.uni.com/catalogo/uni-11580-2015>, (n.d.)

system starting point

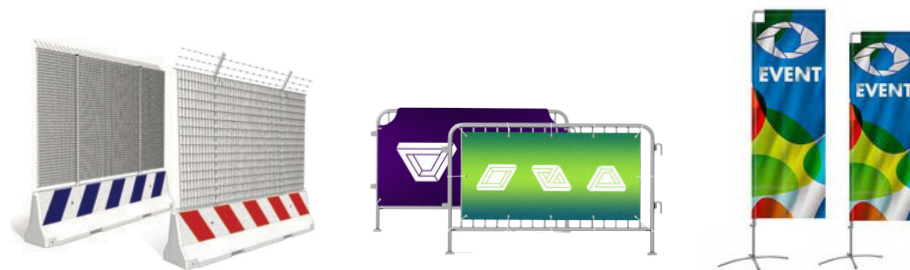
_ basic elements

The basic elements always needed in that space will be the basis to design all the other elements, thanks to the different shapes they could assume.

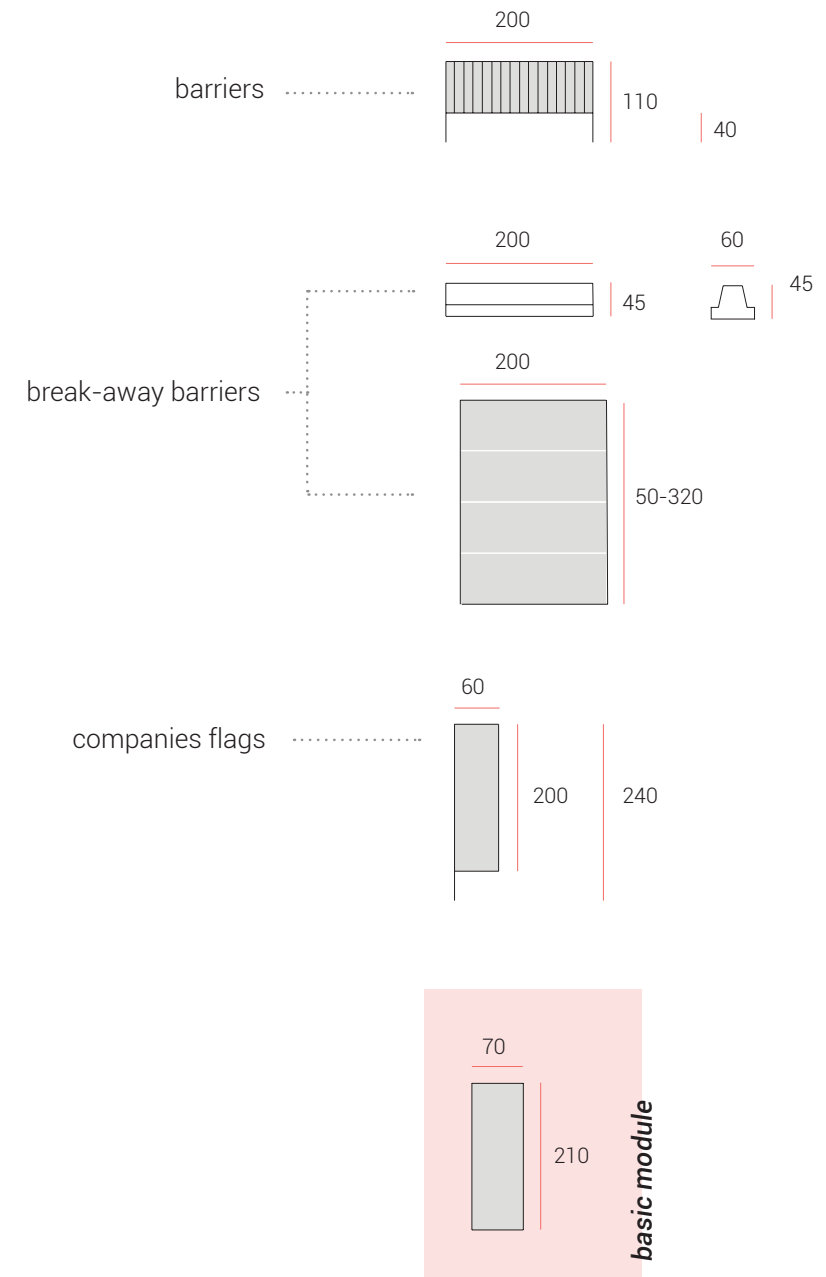
They are small elements daily used in the Autodromo to define the areas, to guide people, to hang advertisements, etc.

elements to consider

- _ barriers
- _ break-away barriers
- _ advertisement panels
- _ companies flags



general dimensions (cm)

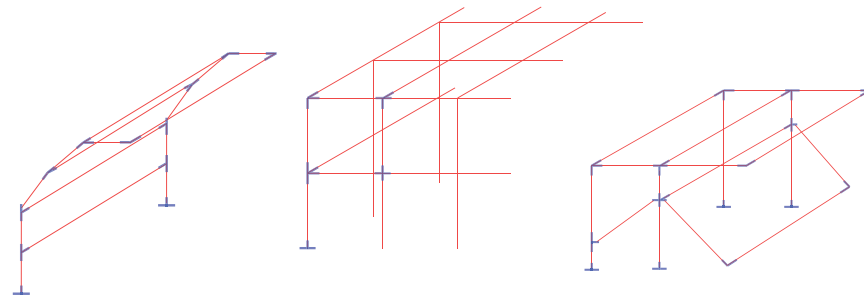


system joints

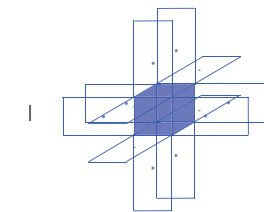
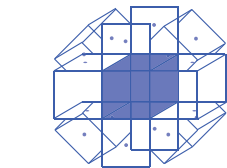
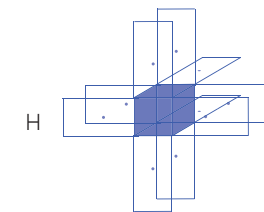
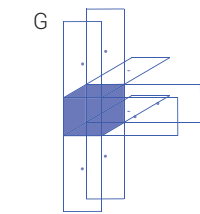
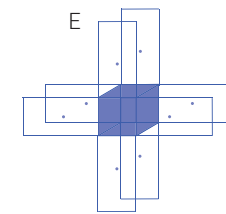
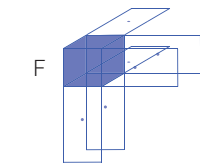
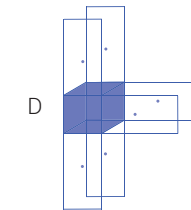
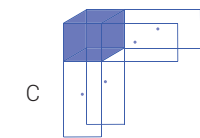
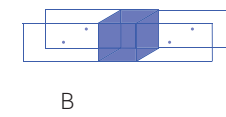
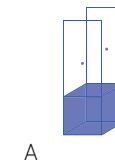
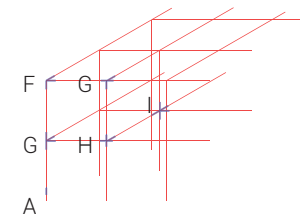
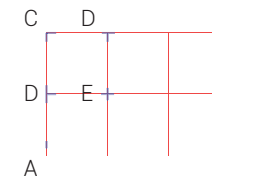
_ design

The joints could have different shapes with the aim to satisfy all the possible combinations: they could have from one to six connections to the skeleton's tubes.

In order to facilitate the linkage, a rose and bolt connection is installed in the squared profile to connect the joints with the structure.



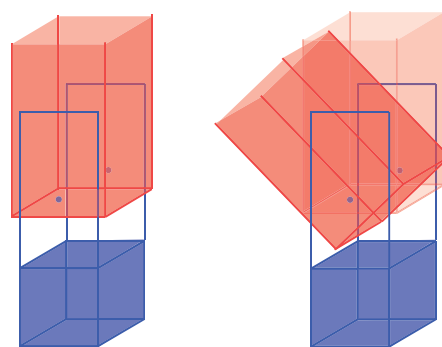
Ten types of different joints were designed in order to make possible all the different combinations and as much as possible different shapes.



_ rolling joints

Thanks to the distance between the hole and the main body of the joint, which means the central squared part, and the fact that the other two sides are 'empty', the profile of the skeleton inserted in it could be moved at the desired angle. In this way, much more possible structures could take shape.

Having the ability to rotate in space, the rolling joints work as hinges. The rotation and the adjustability of the rods makes it possible to realize any type of geometry, including irregular, only using the standard node.



_ material

The material in which they are composed is stainless steel. Thanks to the material, it is possible to weld them in the desired shape to obtain the different possible linkages.

In order to connect the skins with, the stainless steel needs to be magnetic, and a couple of requirements need to be met:

- 21 : _ the stainless steel must have iron in it
- : _ the stainless steel must have its crystal structure be arranged in a ferritic or martensitic structure

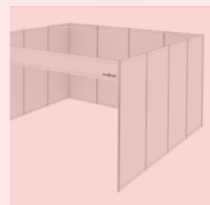
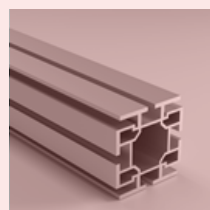
Ferritic stainless steels have large quantities of ferrite, which is a compound of iron and other elements, in their chemical composition. The combination of a ferritic crystal structure with iron makes ferritic stainless steels magnetic. The same happens with martensitic steels that can be ferromagnetic if iron is present.

The idea is to make the joints in a blue colour to highlight their function. Together with the skeleton, they will have the two primary colours of the Autodromo, and in this way, they will also create a unified image of the space.

²¹ Metal Supermarkets, 19 November 2018, "Is stainless steel magnetic?" retrieved 10 August 2020 from <https://www.metalsupermarkets.com/is-stainless-steel-magnetic/>

system joints

case study



ALU4Expo Aluminium for Expo solutions Brescia, It

ALU4Expo produces modular aluminum structures. The anodized extruded bars are designed for quick and easy assembly. Through the wide range of accessories, it is possible to create light and resistant metal structures. Thanks to the versatility of the different profiles, it is possible to make the most of the different digital printing techniques on textile and rigid support, creating customized and functional solutions. The modular system is easily reconfigurable: it allows you to create customized environments for every need. Composed of a few structural elements and easy to assemble offers several solutions and considerable compositional freedom. Moreover, there is the possibility of reuse in different spaces and places adapting them in a modular way to the pre-existing ones.²²

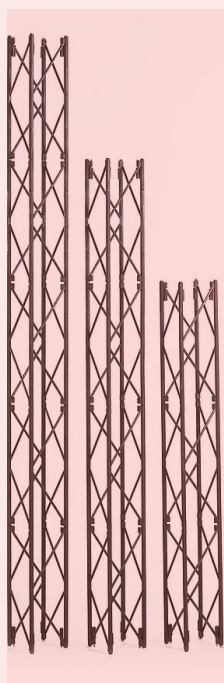
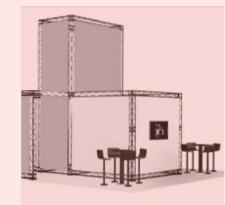
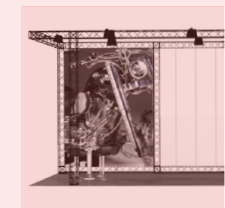
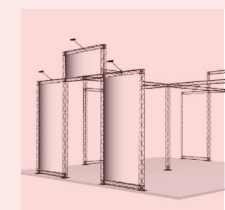
²² Alu4Expo, "Modular aluminum structures for stands and shop windows", retrieved 10 March 2020 from <https://www.alu4expo.com>

case study

X-module X-Module Harlev, Den

The system is foldable, which makes it highly flexible and easy to set up. It allows you to build many different setups using the same set of components with no tools. The system has three standard colours: black, white and grey, and they are composed of some materials, composite, aluminium and steel. Accessories like banners, shelves, lamps or TV brackets could be added. If just a single wall or an exhibition stand is needed, the X-10 CROSSwire is a super accessible and flexible solution. In contrast, for exhibitions, events, and pop-up shop, X-15 EXPOwire is recommended. Considering the system X-20, it is simple in design and handy for building large stands and tall stands; in fact, it is recommended for more extensive trade fair solutions, events and can also be used as a permanent outdoor solution.²³

²³ X-Module, retrieved 10 March 2021 from <https://www.x-module.com/displaysystems>

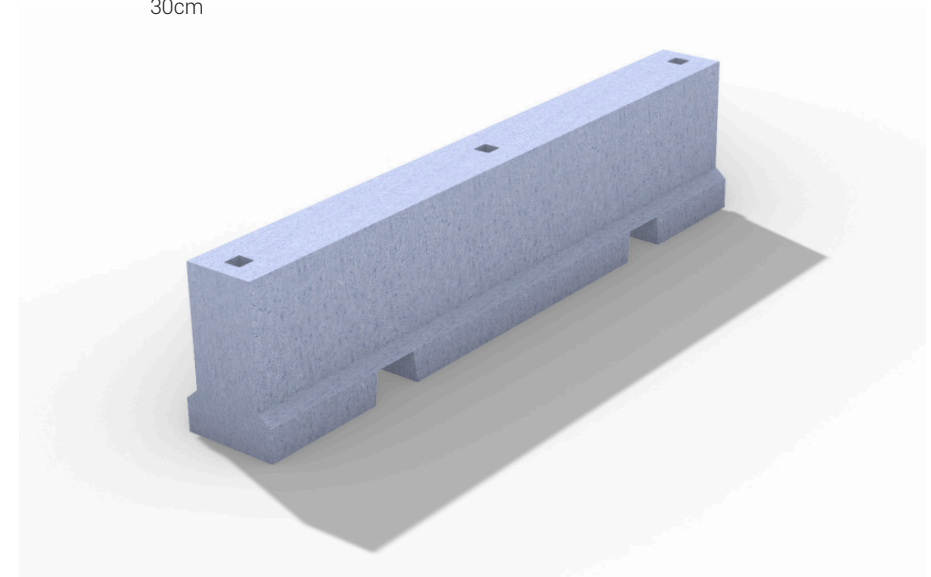
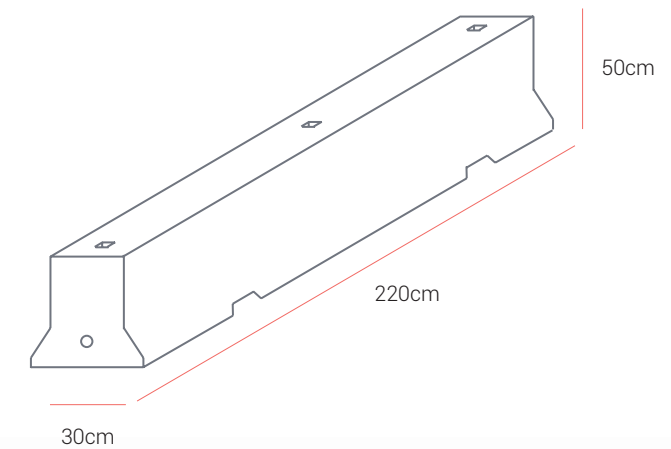
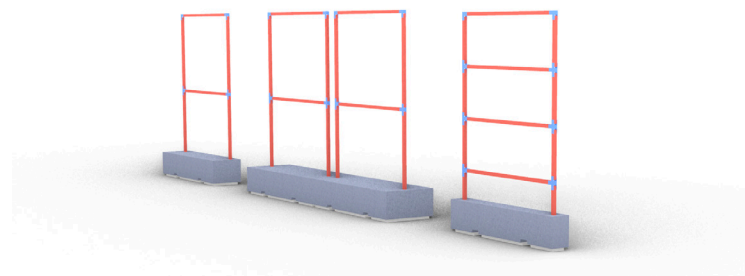


_ anti-overturning Jersey

The anti-overturning Jersey barriers are used in the system as a ballast for the different elements. They could have various heights and widths to be a small basis, a more significant basis.²⁴

From standard high-strength concrete (50N/mm²) the barriers are quick and easy to install, thanks to their shape studied to be transported with the fork-lift and then with trucks.

These Jersey barriers are ideal for temporary works, and because of their material, they are suitable outdoor. They are 220cm long and weigh about 500 kg.

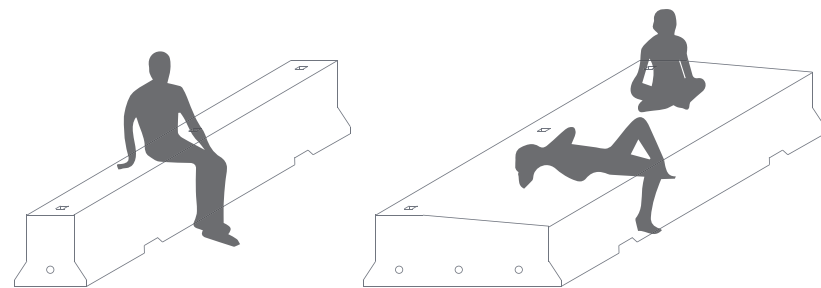


²⁴ Tecno Tre s.r.l., (n.d.) "New Jersey - Barriere di Sicurezza"

_ structural and esthetical

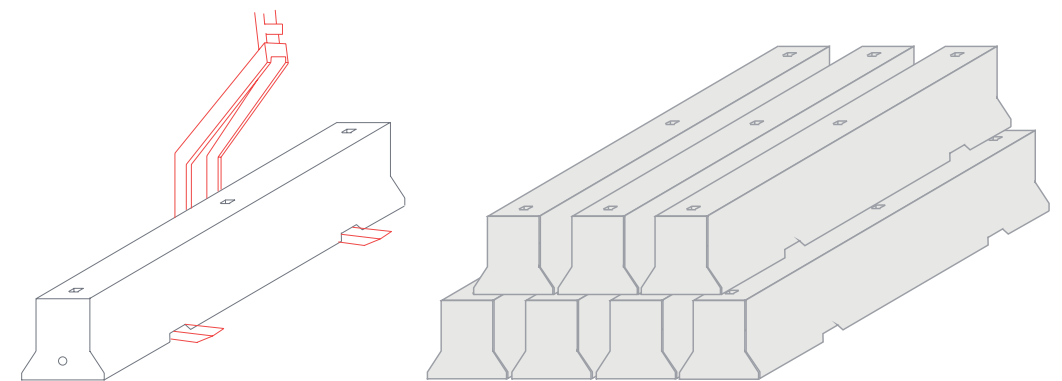
In addition to its primary structural function, anti-overturning Jersey, as a break-in barrier, can also acquire other functions. People can acquire different behaviours around this object, separate from its basic function. For example, they also act as seats to support the functions that will take place within the structures in which Jersey serve as a base or, those with a more elongated shape can ensure that people assume a horizontal position for rest. Moreover, other spontaneous behaviours not planned in the design, such as the placement of objects, is possible will take place.

They are also essential from an aesthetic point of view, and their arrangement strongly characterizes the environment where they are inserted, thanks to their shape and colour.



_ transportation

The barriers are quick and easy to install, thanks to their shape studied to be transported with the fork-lift and then with trucks.



system

skeleton

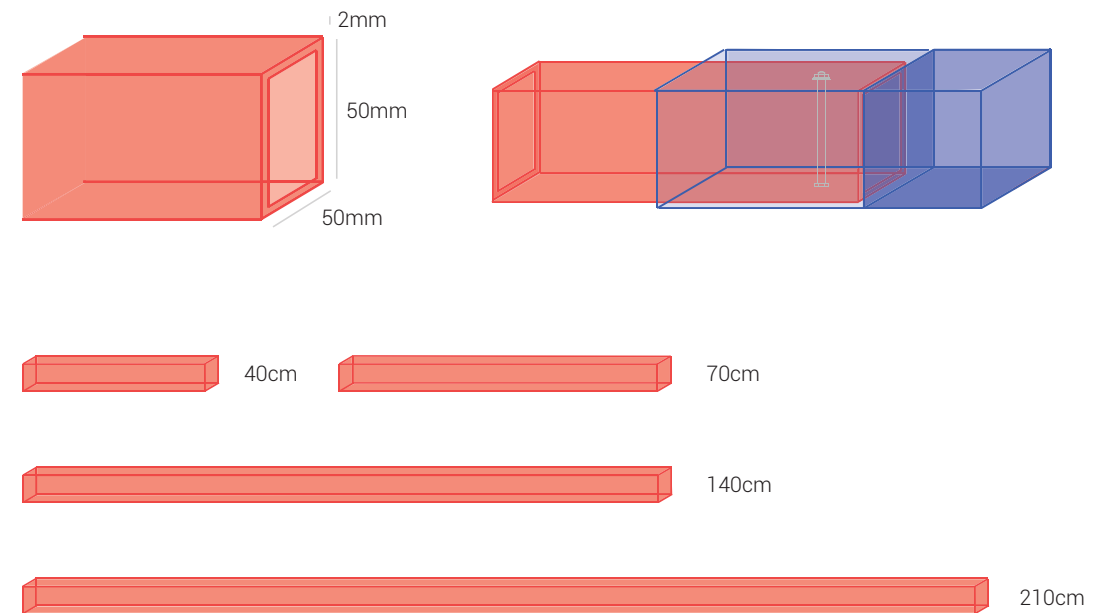
_ design

The skeleton is composed by squared aluminium profiles which could have four different lengths to be adaptable to the situations, always with the same diameter. The dimensions are based on the most common structures still used in the Autodromo Nazionale di Monza.

The squared aluminium profiles always have the same diameter and thickness, which are respectively 50 millimeters and 2 millimetres.

Since the system is a modular structure that could change, the components of the skeleton have three different lengths: 40cm, 70cm, 140cm and 210cm, that could be combined thanks to the different shaped joints.

The modular pieces could be linked together thanks to the joint, and this is the reason why at either ends there is a fixed connection (fastening screw and nut).



_ material

The skeleton's material is steel chosen because of the lightness and resistance to the outdoor weather and its structural function. Temporary structures are widely used for multiple activities at public and private events, and they are often used to have short times related to assembly, use and disassembly.²⁵

advantages of steel frame structures

- _ **durability:** steel is long lasting and strong enough to carry huge tons of weight for years without the need of any restoration.
- _ **flexibility:** it can be arched as the required specification. This helps design steel structures in such a way that it can withstand an earthquake or heavy winds.
- _ **ductility:** this property allows steel buildings to bend out of shape, or deform, thus giving warning to the users.
- _ **temporary structures:** steel frame structures can be easily built and detached with the help of various methods, reducing the time taken to make a temporary structure.

²⁵ Eckerwall, F., Glans, D., "Temporary Steel Frame Warehouses. A Conceptual Design for a Modulus System." Master of Structural Engineering and Building Performance Design, Chalmers University of Technology, 2012.

_ electrocolouring

The term "electrocolouring", or electrolytic colouring, indicates a colouring process of anodized aluminium, consisting in subjecting the material to a suitable alternating electric current in a tank containing a solution of metal salts and chemical additives. Under the effect of the current, the metal particles are deposited on the bottom of the pore of the aluminium oxide, thus creating a highly resistant colour to the various testing tests.²⁶

In this case, the process is used, first of all, to give the desired colour, red, but also to solve the profiles' wear problem and, at the same time, also the corrosion issue.

To the electrocolouring could be added the anti-scratch treatment, which is an optional process that gives the finished product a particular resistance to abrasion and friction. Besides, it also offers improvements in aesthetic terms, improving the brightness of the treated aluminium surfaces. Moreover, this treatment can be achieved with several colour shades.²⁷

²⁶ Emmeti s.r.l., "Ossidazione anodica ed elettrocolore" retrieved 30 August 2020 from <https://www.emmeti-srl.it/it/ossidazione-elettrocolore.php>

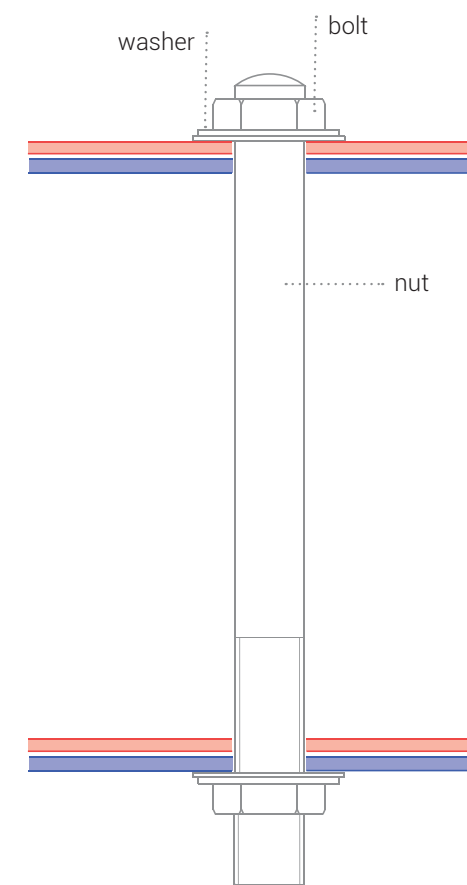
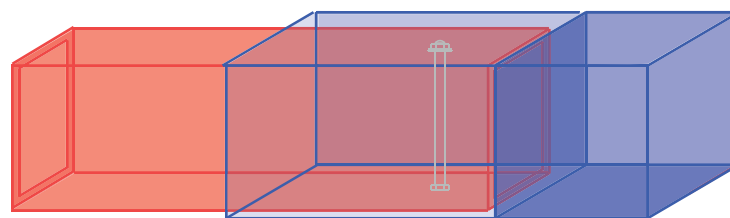
²⁷ Nece s.p.a., "Trattamento antigraffio" retrieved 30 August 2020 from http://www.nece.net/dynamicdata/Trattamento_Antigraffio.aspx

_ bolted connection

At either end of the profiles, in any module, there is a bolt and nut connection.

It has been chosen this type of linkage because of ease-of-use, which makes all the assembly and disassembly work quicker, and because of its strenght and resistance.

This connection could be used for both round and squared profiles, and it is up to 5 centimetres wide. A washer on both sides is added to make safer and fixer the linkage.



system skeleton

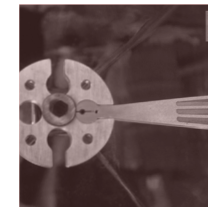
case study

Renzo Piano Joints and connections

Renzo Piano always articulates the connections and joints in his projects, and most of the times he completely avoid the welding, studying specific solutions for each project requests.

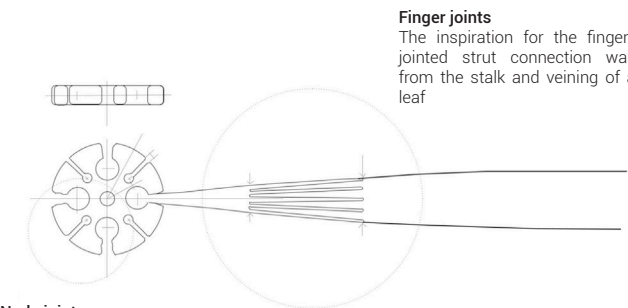
For example, at the Pompidou Centre in Paris, the connections were custom built and at a larger and industrial scale, as all the building is. For that structure, Renzo Piano designs more that one type of joint, according to the problem it has to solve.

Indeed, for the itinerant IBM pavilion, these connections are completely humanized. They can be touched from within the structure, and the inspiration for the joints and structural components was drawn directly from nature. For example, the stalk and veining of a leaf can be seen in the finger joints.



IBM Padiglione itinerante Renzo Piano Italy _ 1983-84

A glued finger joint cements wooden strut to cast aluminium elements that slips into one of the slots in the node-joint.²⁸



Finger joints
The inspiration for the finger-jointed strut connection was from the stalk and veining of a leaf

Node joint
Each wooden strut slips into the cast aluminium component

Centre Pompidou Renzo Piano Paris, Fr _ 1971-77



In order to resolve multiple members into one point on the sling support for the walkways, a round donut shaped plate is used. The circular geometry is able to easily resolve the varied angles of the incoming members. Bolted pin connections allow for rotation during erection.



In the second case, the geometry of multiple incoming members along the front face of the building is again resolved using a circular connector. In this case the circle is a short section of hollow member, and holes are drilled into the side of the tube, to allow the incoming truss and X bracing members to bolt through. A plate is fastened to the front of the circle to clean up the appearance and to seal the connections from excessive moisture.²⁹

²⁸ Piano, Renzo. "IBM Padiglione Itinerante", 1982.

²⁹ Meyer Boake, T., Hui, V., "Innovation in steel connections", retrieved 25 March 2021 from <http://www.tboake.com/SSEF1/pompidou.shtml>

system skins

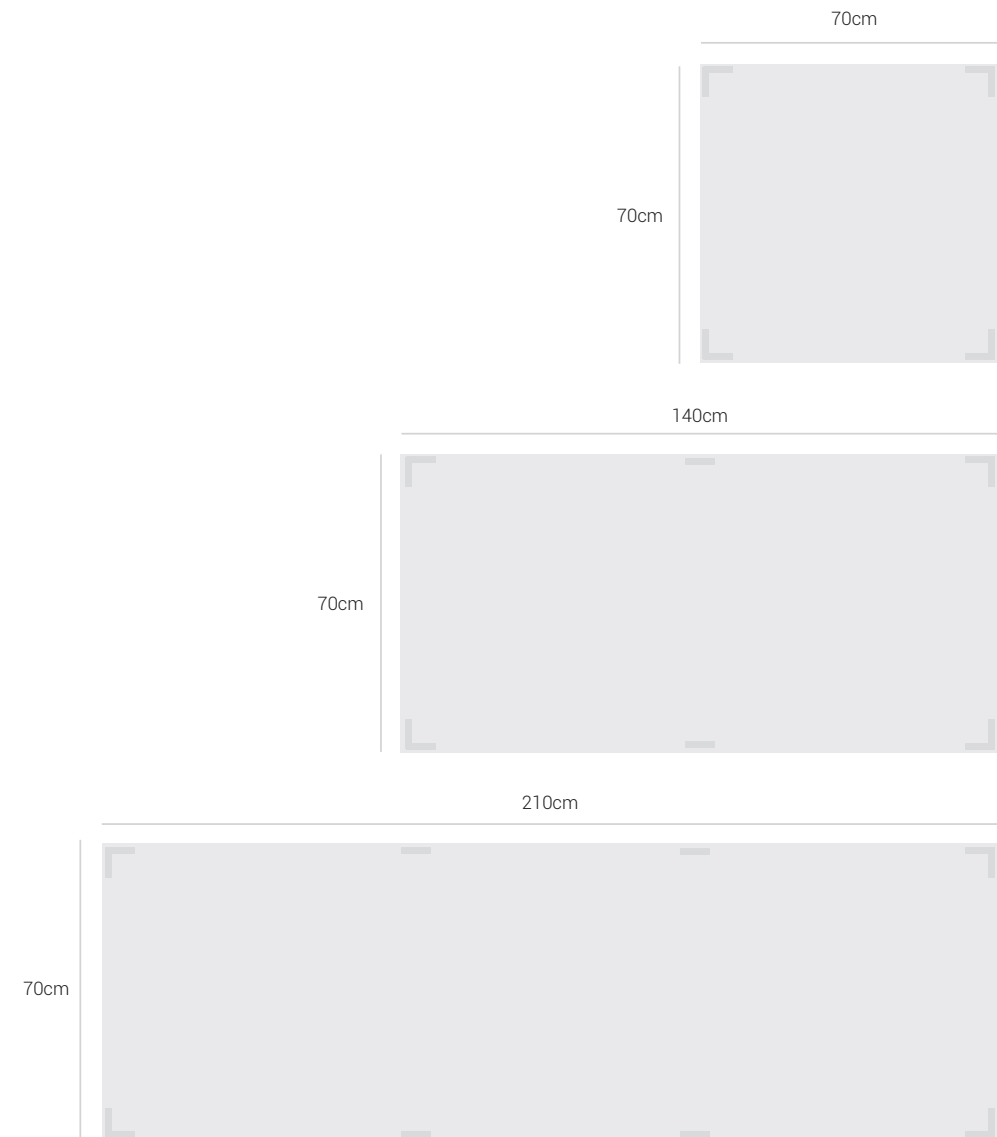
_ design

The skins could be done with different materials, ranging from the PVC for the advertisement panels, to the metal mesh, and covering panels with other materials, to the smart skins with unique materials.

They could have standard dimensions, which are three, according to the different modules of the skeleton, but could also be personalized according to the shape they have to assume during a specific event.

Besides, they could be softly applied to the structure or according to the need.

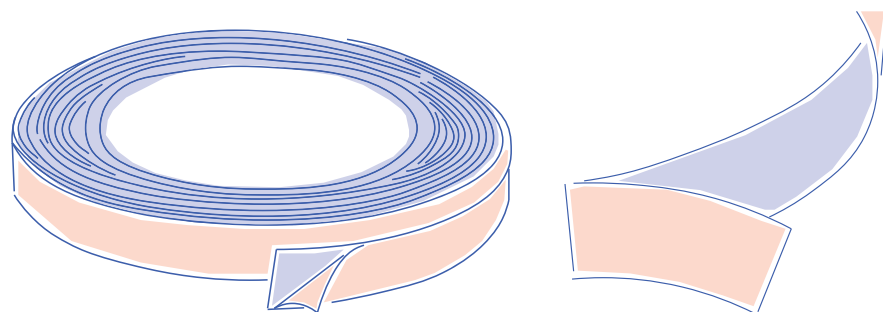
Thanks to a flexible magnetic tape located on the perimeter, they could be easily applied to the structure. The different powers of the magnet make them easy-to-remove or not, depending on their function and their location in the structure.



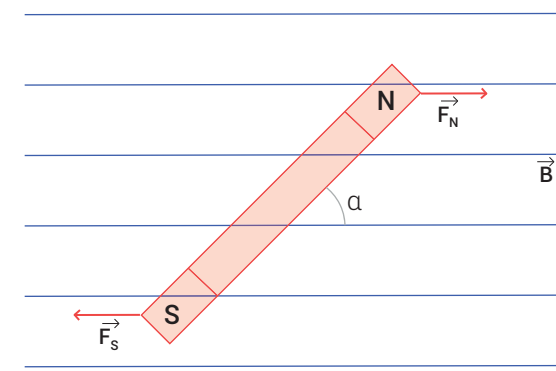
_ magnetic tape

In all the skins a magnet has to be applied on the perimeter to fix them with the joint and skeleton.

The 3M® Flexible Magnet Tape³⁷ resulted in a proper solution. This acrylic adhesive backing will bond to many materials, including powder-coated paint, low-surface-energy plastics such as polypropylene, wood, fabric, and fiberboard. Moreover, the 3M® tape could be used more than one time on a surface and could have different magnetic power.³⁰



³⁰ 3M Industrial Adhesives and Tapes Division, "3M Flexible Magnet tape" retrieved 22 August 2020 from <https://multimedia.3m.com/mws/media/8188400/3mtm-flexible-magnet-tape.pdf>



_ magnetic moment

The magnetic moment is the magnetic strength and orientation of a magnet or other object that produces a magnetic field. The term magnetic moment refers typically to a system's magnetic dipole moment, the component of the magnetic moment that can be represented by an equivalent magnetic dipole: magnetic north and south pole separated by a minimal distance. The magnetic dipole moment of an object is readily defined in terms of the torque that object experiences in a given magnetic field. The same applied magnetic field creates larger torques on items with more massive magnetic moments. The strength of this torque depends not only on the magnitude of the magnetic moment but also on its orientation, relative to the direction of the field.³¹ The magnetic moment may be considered, therefore, to be a vector and the relationship is given by:

$$\tau = m \times B \quad [1 \text{ m}^2 \cdot \text{A} = 1 \text{ J/T}]$$

- ⋮ _ τ is the torque acting on the dipole
- ⋮ _ B is the external magnetic field
- ⋮ _ m is the magnetic moment

³¹ Wikipedia, "Momento Magnetico" retrieved 22 August 2020 from https://it.wikipedia.org/wiki/Momento_magnetico

_ skins and feelings

Different skins applied to the structures will convey different functions and feelings, thanks to the differences in the use of materials. Different material properties could make the function of the skin:

- _ technological
- _ esthetical
- _ functional

Organic photovoltaic (OPV)³² materials convert light into electrical power and is an example of a technological skin. The OPV laminates have a flexible structure and can be adapted to almost any surface. As a case for the esthetical skin, indeed, the Biomimetic meteorosensitive pavilion²⁷ was chosen. Utilizing hygroscopicity, the intrinsic physical characteristic of wood, the project creates a mechanism that is entirely animated by the naturally changing climate. At least, as an example for the functional skin, the Coldblack³³ fabric was chosen. This dark-coloured textile absorbs both visible and invisible sunlight, meaning both heat and light, reducing the absorption of thermal radiation.

³² Sharma, V., Arch20, "OPV Solar Technology.", (n.d.) from <https://www.arch2o.com/opv-solar-technology-belectric/>

³³ Schoeller, "Coldblack. Protection from heat and UV rays.", (n.d.), from <https://www.schoeller-textiles.com/en/technologies/coldblack>

technological

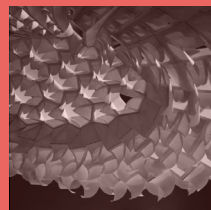
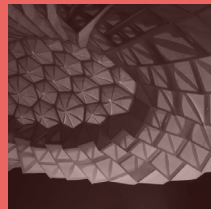
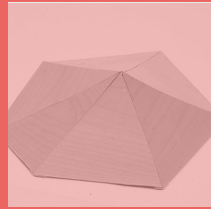
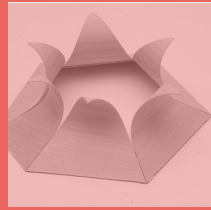


34

³⁴ Sharma, V., Arch20, "OPV Solar Technology.", (n.d.) from <https://www.arch2o.com/opv-solar-technology-belectric/>

esthetical

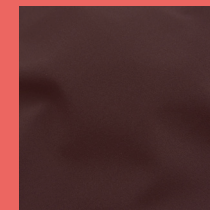
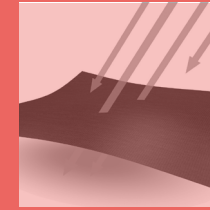
Hygroscope _ Achim Menges and Steffen Reichert, Paris, 2012



³⁵ Archim, M., "HygroScope: Meteorosensitive Morphology", from <http://www.achimmenges.net/?p=5083>, 2012

functional

Coldblack _ Schoeller, Switzerland



³⁶ Schoeller, "Coldblack. Protection from heat and UV rays.", from <https://www.schoeller-textiles.com/en/technologies/coldblack>, (n.d.)

system skins

case study



Luna Rossa Team Base
Renzo Piano
Valencia, Es _ 2007

The headquarters designed for the Luna Rossa team are a temporary building designed for the 32nd America's Cup in Valencia. It is simple in the structural conception of its steel framework and linear in form. For the façade Renzo Piano proposed to reuse the 50 used sails from Luna Rossa's past entrants in the America's Cup. The envelope of the building thus appears as a light, transparent curtain wall of 3100 sqm: a patchwork of mainsails and jibsails cut and reassembled into 485 panels mounted on a load-bearing aluminium frame and steel substructure. Reusing the sails seemed the logical choice. They have the ideal qualities for a building envelope: high mechanical strength, lightness, non-deformability under wind pressure, resistance to wear, and they are airtight and watertight.³⁷

³⁷ Renzo Piano Building Workshop, "Progetti d'acqua-Projects with Water"

case study



Freitag
Freitag brothers
Zurich, Germany _ 1993



In 1993, in Zurich, the Freitag brothers created the "messenger bag", a bag made from truck tarpaulins, discarded bicycle inner tubes and car seat belts. Each bag is recycled, and each one unique. Nowadays, Freitag recycles almost 400 tonnes of tarp annually, the equivalent of 110 km of trucks in a row.³⁸

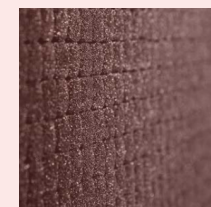
³⁸ Freitag, "The birth of Freitag", retrieved 25 November 2020 from <https://www.freitag.ch/en/history>

³⁹ Ecopneus, "L'impiego della gomma riciclata in edilizia", (n.d.)

case study



PFU Ecopneus
Ecopneus
Milan, Italia



Through the processing of End of Life Tires (ELT) it is possible to obtain building products of various uses due to the significant elasticity characteristics of the rubber, outcomes for acoustic insulation from noise and vibrations. The rubber obtained from ELTs is a material with particular physical properties that make it a significant resource in the construction sector.³⁹

system

zoom in

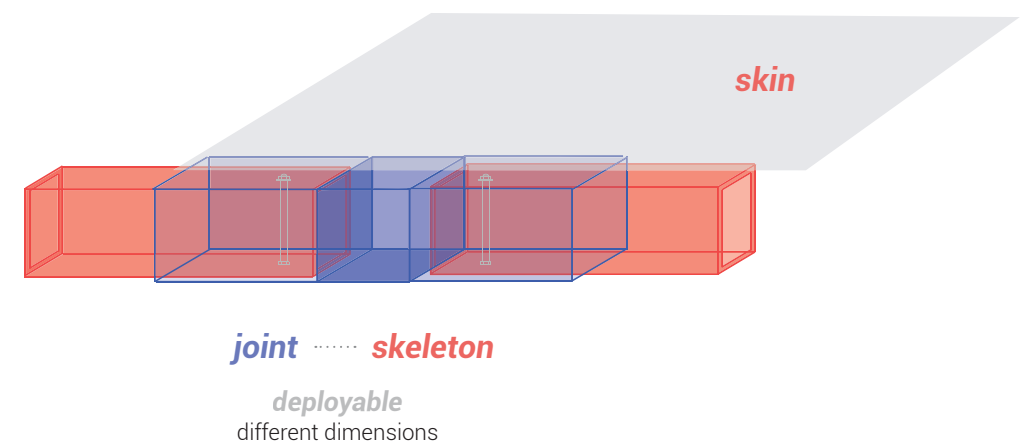
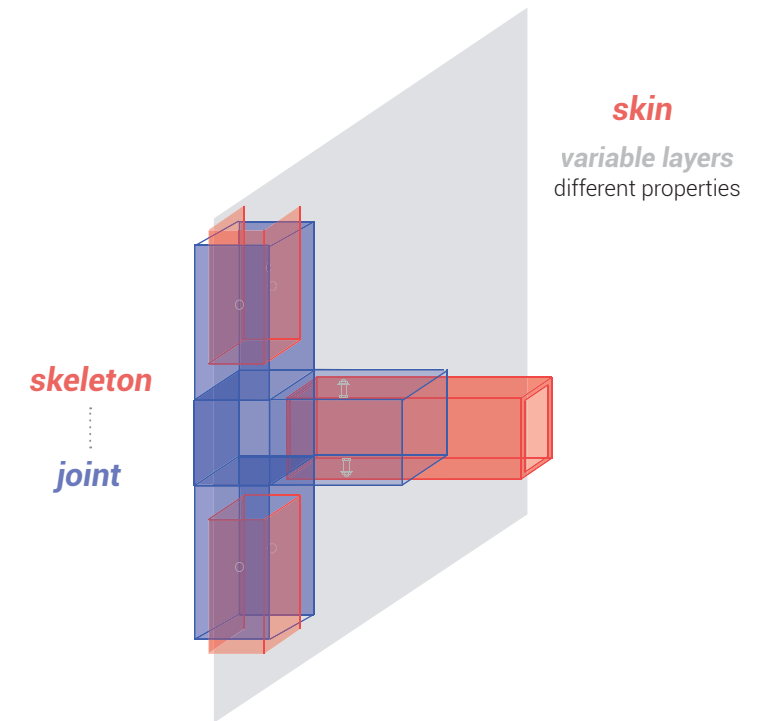
_ connections detail

Some drawings of the connection between joint, skeleton and then the skin are illustrated on the next page.

The fact that are designed different joints, from one to six possible linkages with the skeleton, and four profile dimensions of it, gives to the structure versatility thanks to its deployment and transformation properties.

The same happens with the skins, which are composed of variable layers that could be applied according to the different needs during specific events or moments. Thanks to the fact that it is possible to link the layers on more than one side of the structure, and also different skins one close to the other, makes the system even more versatile.

The user-friendliness of all these linkages between the components of the structure, skeleton-joint and skin-joint, is an added-value of the versatile system, site-specific for the Autodromo's needs.



system development

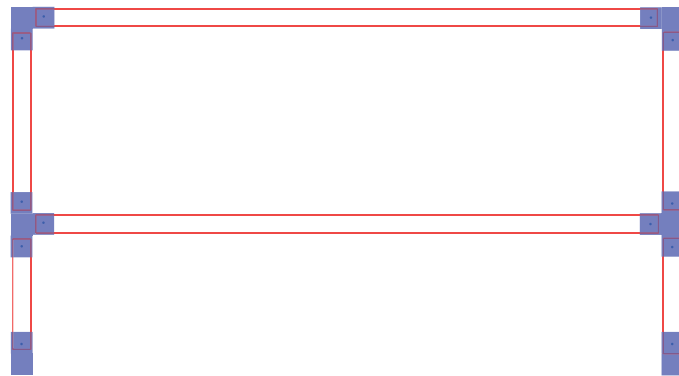
_ basic elements

Basic and essential elements developed starting from the three components of the system: joints, skeleton and skin. For each element an analysis of the elements quantity in done.

176

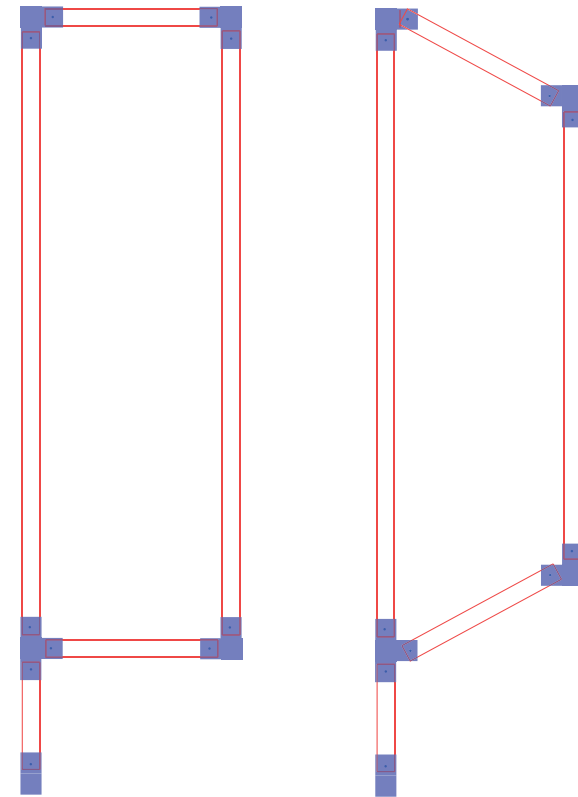
Barriers

- joint
- _ 2 x A
- _ 2 x B
- _ 2 x C
- skeleton
- _ 2 x 40cm
- _ 2 x 70cm
- _ 2 x 210



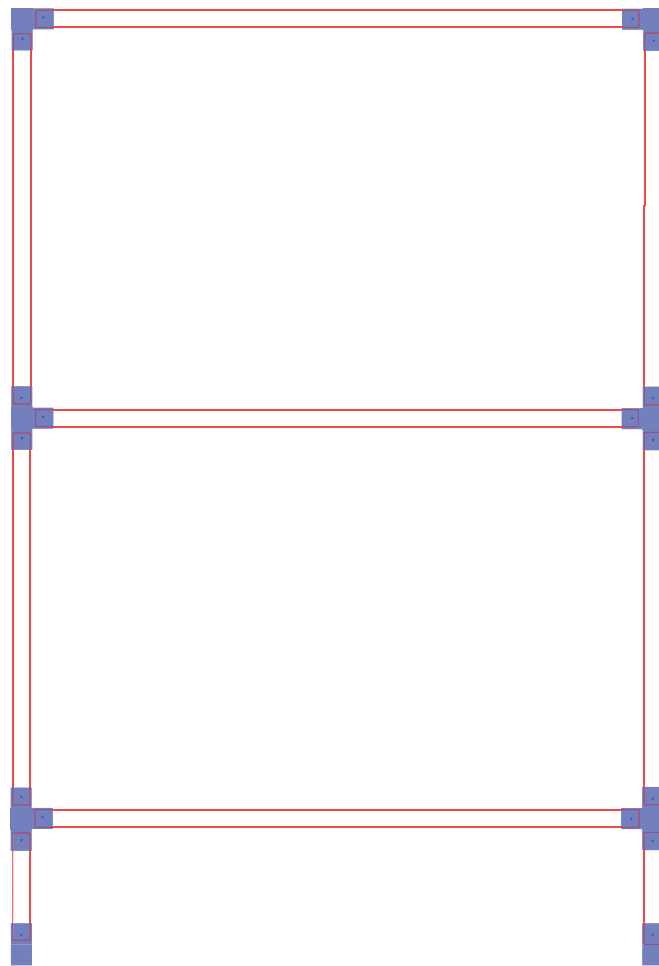
Companies flags

- joint
- _ 1 x A
- _ 1 x B
- _ 3 x C
- skeleton (.1)
- _ 1 x 40cm
- _ 2 x 70cm
- _ 2 x 210
- skeleton (.2)
- _ 1 x 40cm
- _ 2 x 70cm
- _ 1 x 140
- _ 1 x 210



177

178

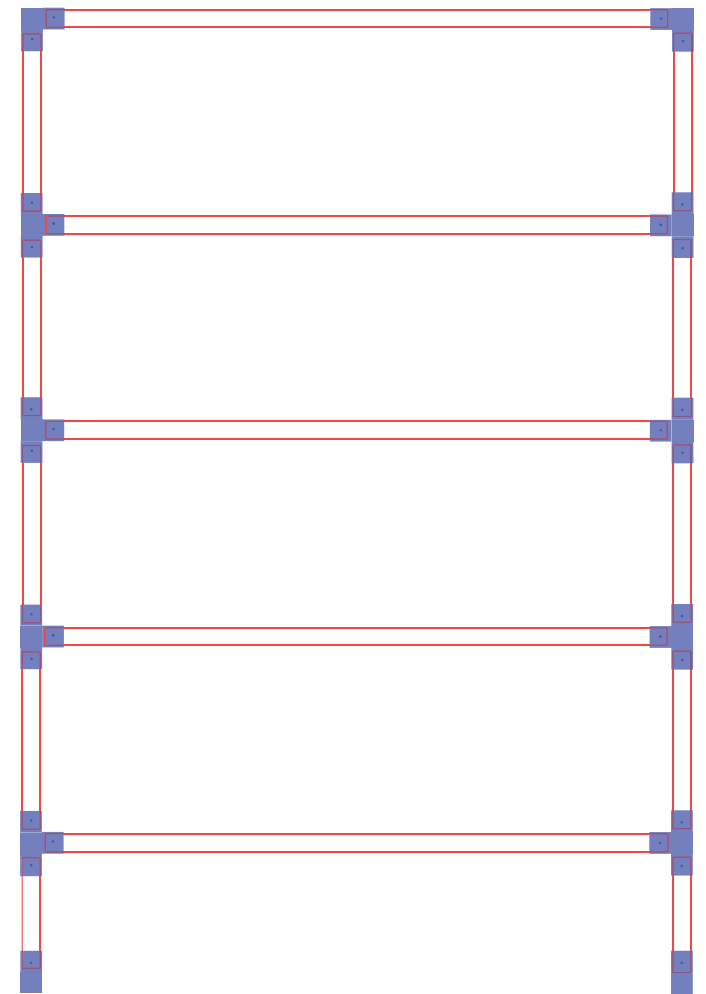


Break-away barriers

- joint
- _ 2 x A
- _ 8 x B
- _ 2 x C

- skeleton
- _ 2 x 40cm
- _ 4 x 70cm
- _ 3 x 210

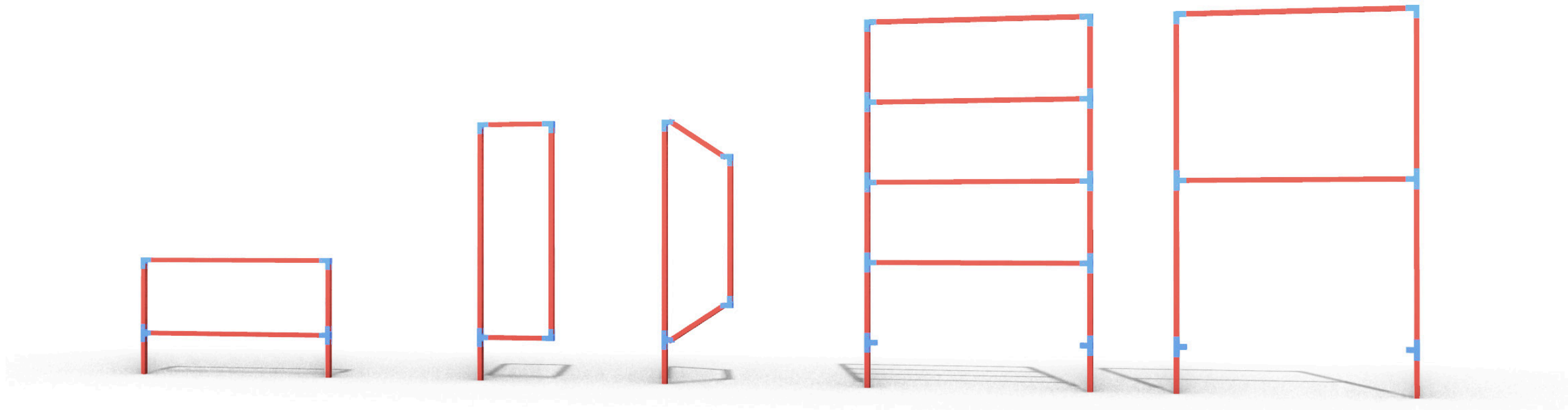
179



Break-away barriers

- joint
- _ 2 x A
- _ 8 x B
- _ 2 x C

- skeleton
- _ 2 x 40cm
- _ 8 x 70cm
- _ 5 x 210



Barriers

- joint
- _ 2 x A
- _ 2 x B
- _ 2 x C

- skeleton
- _ 2 x 40cm
- _ 2 x 70cm
- _ 2 x 210

Companies flags

- joint
- _ 1 x A
- _ 1 x B
- _ 3 x C

- | | |
|---------------|---------------|
| skeleton (.1) | skeleton (.2) |
| _ 1 x 40cm | _ 1 x 40cm |
| _ 2 x 70cm | _ 2 x 70cm |
| _ 2 x 210 | _ 1 x 140 |
| | _ 1 x 210 |

Break-away barriers

- joint
- _ 2 x A
- _ 8 x B
- _ 2 x C

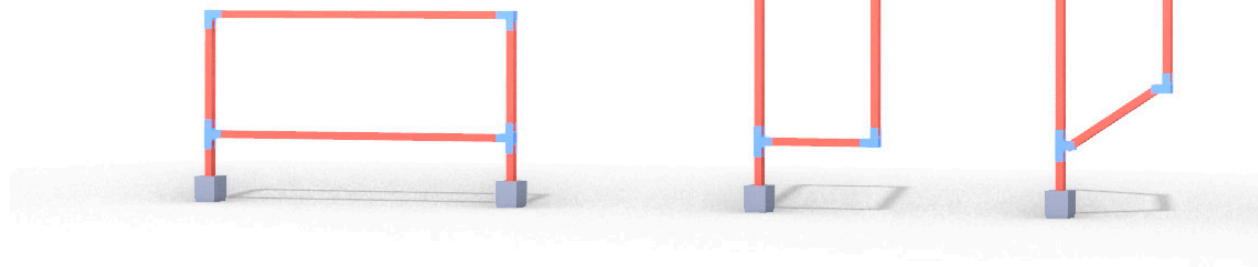
- skeleton
- _ 2 x 40cm
- _ 4 x 70cm
- _ 3 x 210

Break-away barriers

- joint
- _ 2 x A
- _ 8 x B
- _ 2 x C

- skeleton
- _ 2 x 40cm
- _ 8 x 70cm
- _ 5 x 210

implementation



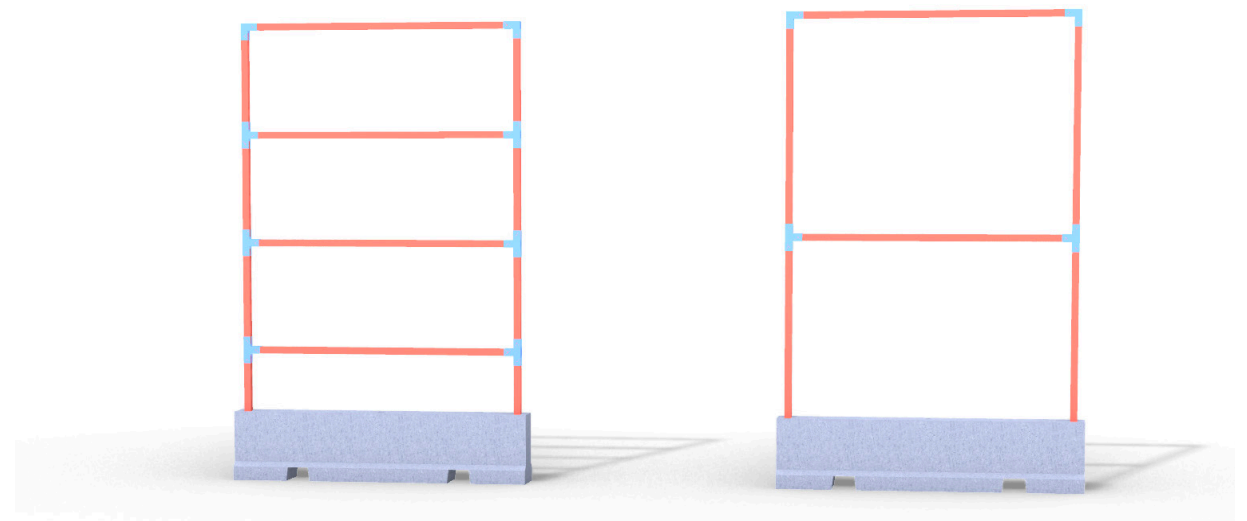
Barriers

anti-overturning Jersey
_ 2 x A

Companies flags

anti-overturning Jersey (.1)
_ 1 x A

anti-overturning Jersey (.2)
_ 1 x A



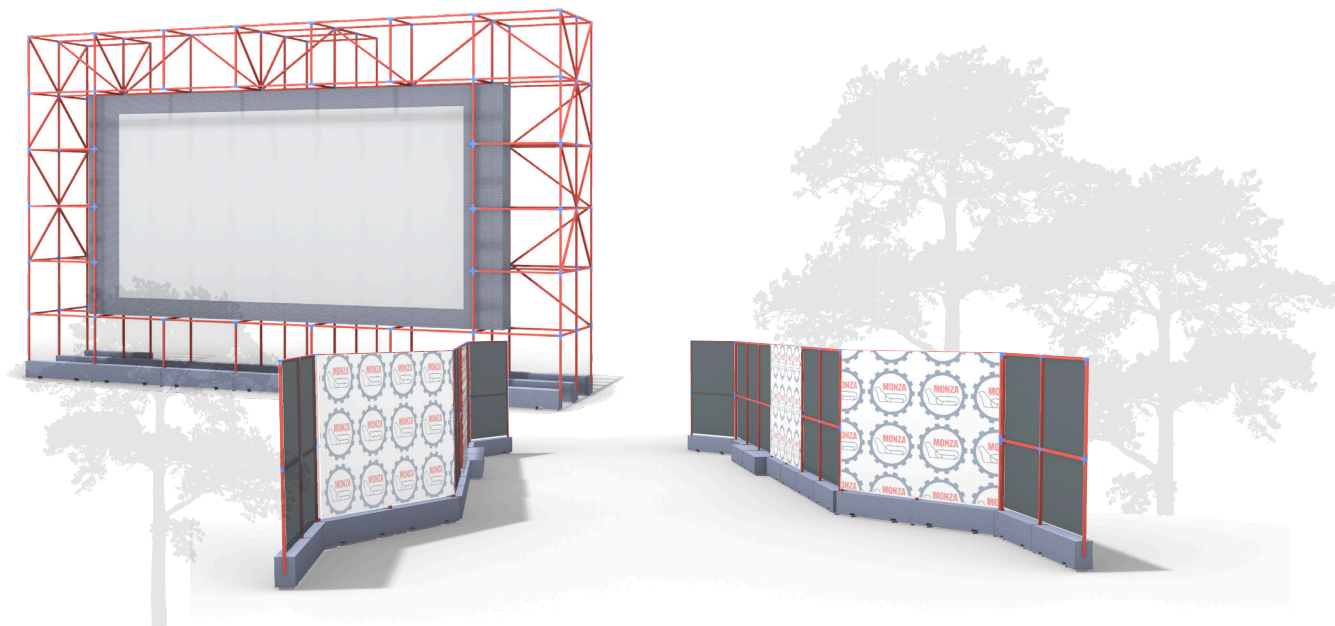
Break-away barriers

anti-overturning Jersey
_ 1 x B

Break-away barriers

anti-overturning Jersey
_ 1 x C

184



system development

_ space frame system

The spatial reticular structures are characterized by freedom of composition and by the possibility of uniformly distributing the loads on the individual rods and the external constraints.

... _ *geometries*: thanks to these characteristics, **complex geometries with a lower structural weight** than any other type of solution can be obtained with spatial reticular structures. The result is a highly hyperstatic system that internally increases resistance to damage due to fire, explosions, impacts and earthquakes.

... _ *modularity*: **the spatial grids are modular** and made up of highly industrialized elements, therefore made with considerable dimensional accuracy and accurate surface finishing.

... _ *transport and storage*: **transport is effortless** as the single components have small dimensions, **easily packable**, while assembly can be carried out efficiently and quickly by not overly qualified teams.

185

S

dimension

_ size S
simple structures,
vertically developed,
small size

spazial [m²]

until 3m²

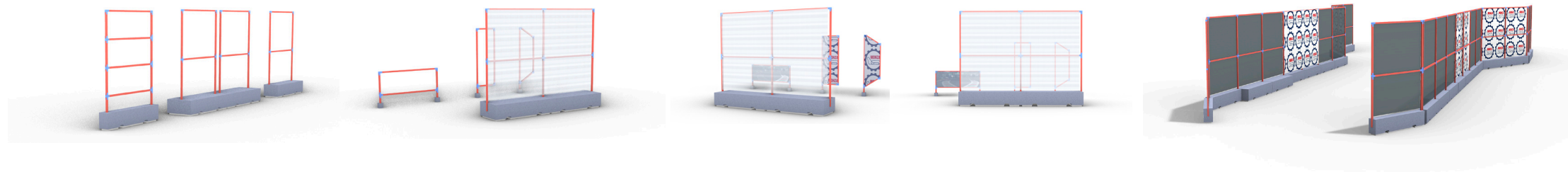
quantity
[joint]
[skeleton]

4 - 15
4 - 20

functions

- _ advertisement
- _ signage and wayfinding
- _ spaces and areas division
- _ flows directionality

positioning in the space



m

dimension

_ size M
medium complexity structures,
horizontal cover-up,
medium size

spazial [m²]

from 3m² to 25m²

quantity
[joint]
[skeleton]

15 - 30
20 - 50

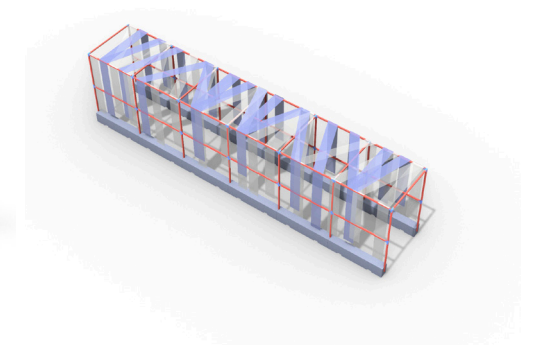
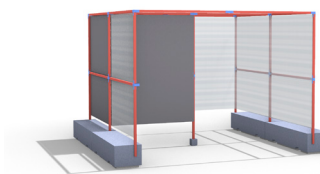
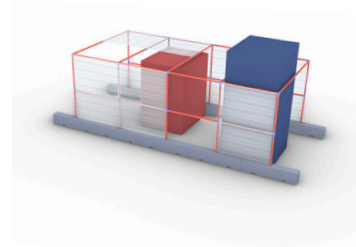
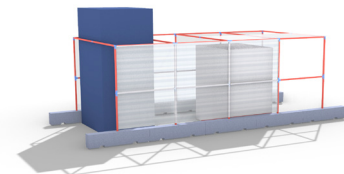
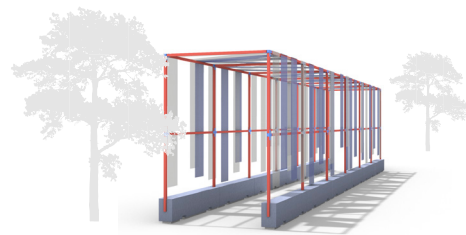
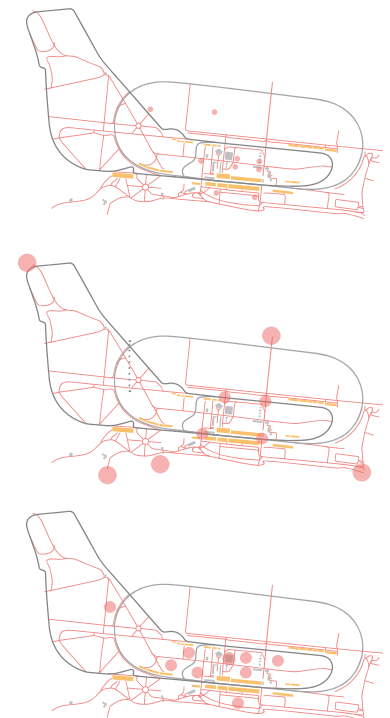
peculiarities



functions

- _ toilets and hygienic services
- _ small covers and tunnels
- _ shelters and entrances
- _ single and temporary stands
- _ food trucks

positioning in the space





dimension

_ size L
complex structures,
horizontal cover-up,
high heights

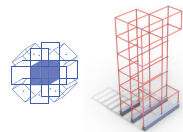
spazial [m²]

more than 25m²

**quantity
[joint]
[skeleton]**

30 - x
50 - x

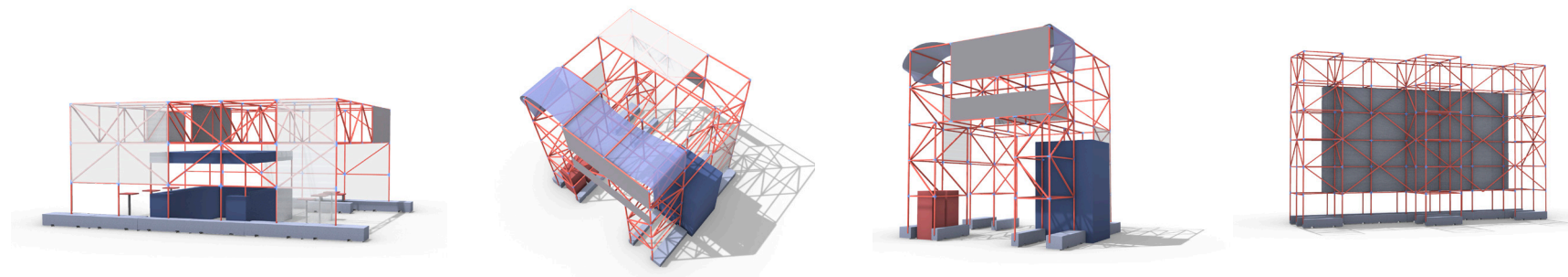
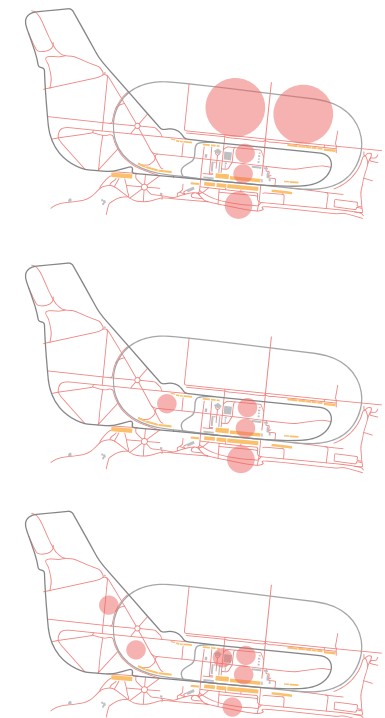
peculiarities



functions

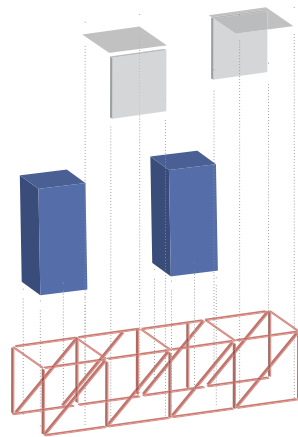
- _ entertainment structures
 - . drive-in cinema
 - . cinema (screen + accessories)
 - . concerts (stage + accessories)
- _ restoration structures (on-site consumption)
- _ pavilions

positioning in the space

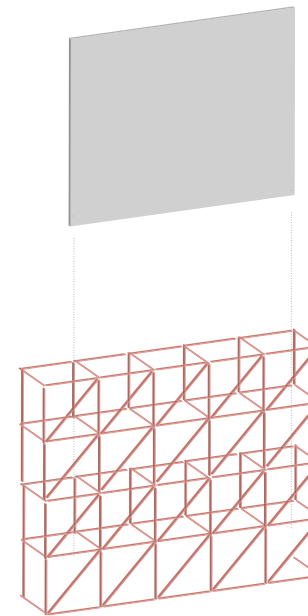


system

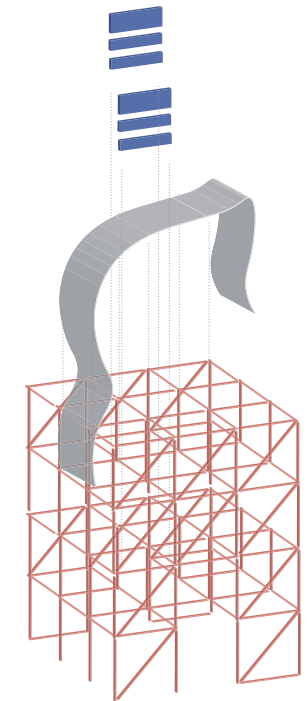
additional process



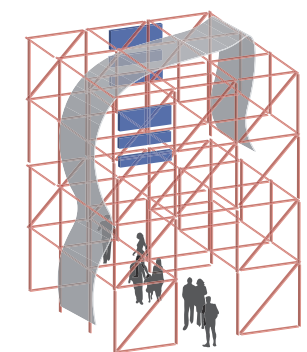
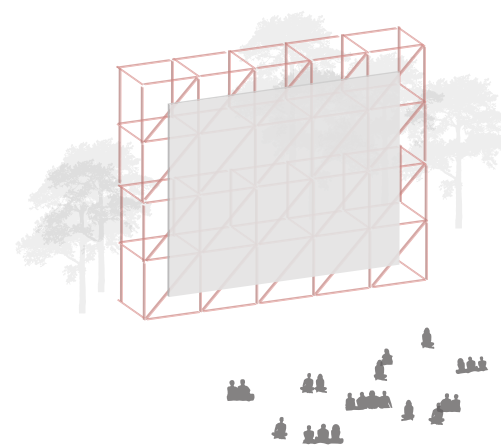
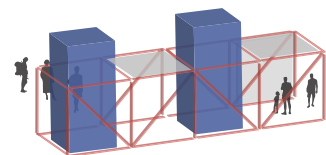
_ installation as a container



_ installation as a show



_ installation as a curtain



system

functions

Functions are one of the main points of the versatile system in that, the reconfigurability in space and time determines the structures' versatility, especially in terms of functions, which are the cause and consequence of the shape that the installations assume.

This functional flexibility is also of central importance because it is required by a society which increasingly reduces its transformation times and tends to diversify, over time, its needs of the spaces and in the spaces in which it lives.⁴⁰



⁴⁰ Giachetta, A., "Architettura e tempo. La variabile della durata nel progetto di architettura.", Libreria CLUP srl, Milano, 2004

Temporary structures that are part of a context such as the Autodromo Nazionale di Monza, can perform functions for which temporary occupation of spaces is necessary, and can be divided into three types and contain different features:

_ installation as a container

- _ food and beverage
- _ shop
- _ toilette

_ installation as a curtain

- _ advertisements
- _ wayfinding
- _ interstitial spaces

_ installation as a show

- _ concerts
- _ drive-in
- _ exhibitions

⁴¹ Giachetta, A., "Architettura e tempo. La variabile della durata nel progetto di architettura.", Libreria CLUP srl, Milano, 2004

system functions

_ installation as a container

The installations assume value concerning the functions that carry out and the relation with the space and the context in which they are.⁴²

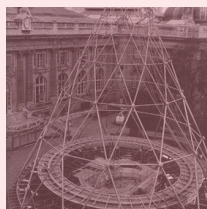
- ∴ _ Temporary use of a **shared space**
- ∴ _ Contain certain **functions**

196

case study



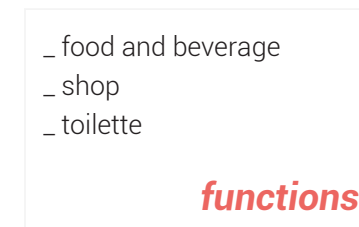
Tepee Beaubourg
Philippe Chaix, Jean-Paul Morel
Paris, France _ 1993



The structure was designed as a reception pavilion for a major exhibition held in the Grand Palais in Paris. The entrance situation was to be inviting and at the same time, have a striking appearance. The outcome was a much-acclaimed temporary structure used subsequently in other locations.⁴³

⁴² Giachetta, A., "Architettura e tempo. La variabile della durata nel progetto di architettura.", Libreria CLUP srl, Milano, 2004

⁴³ Chaix & Morel et associés, "Tepee Beaubourg, Paris", from <http://www.chaixetmorel.com/en/cat/2/110/>, (n.d.)



incremented during car events

temporary structures needed pollution problem

skeleton
∴
joint

temporary structures that absorb pollution

skin

+

service units

197

implementation

_ installation as a container

After mounting the scaffolding with the best shape for the function it will host, different skins can be applied, such as *The Breath* from Anemotech which absorbs pollution. Besides, different service units that contain more complicated systems such as toilets and cafe necessities can be inserted within the structures to complete the installation.

position



198

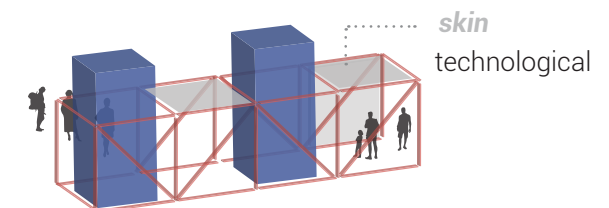
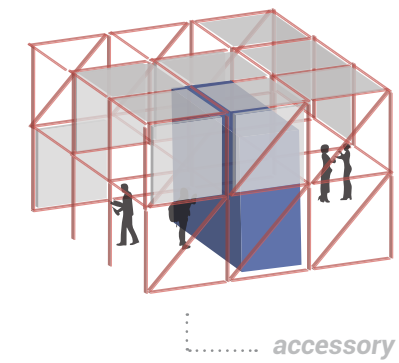
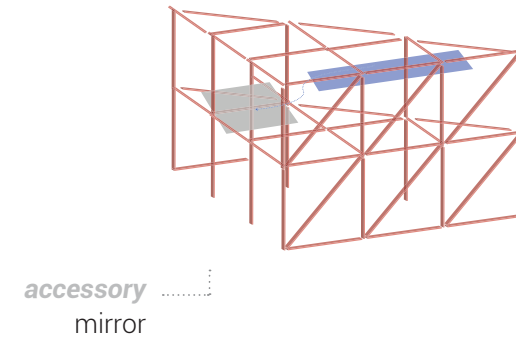
skin



The Breath
Anemotech
Milan, Italy

Fabric capable of absorbing harmful fine dust present in the air and breaking it down, reintroducing clean air into the circulation.⁴⁴

⁴⁴ Anemotech, "theBreath", from <https://www.thebreath.it>, (n.d.)

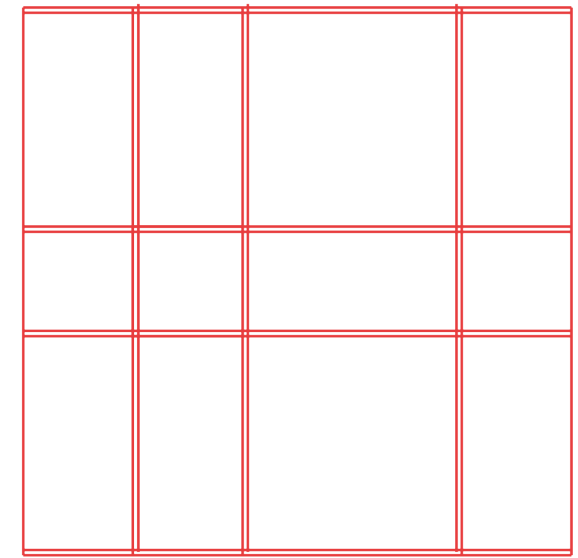
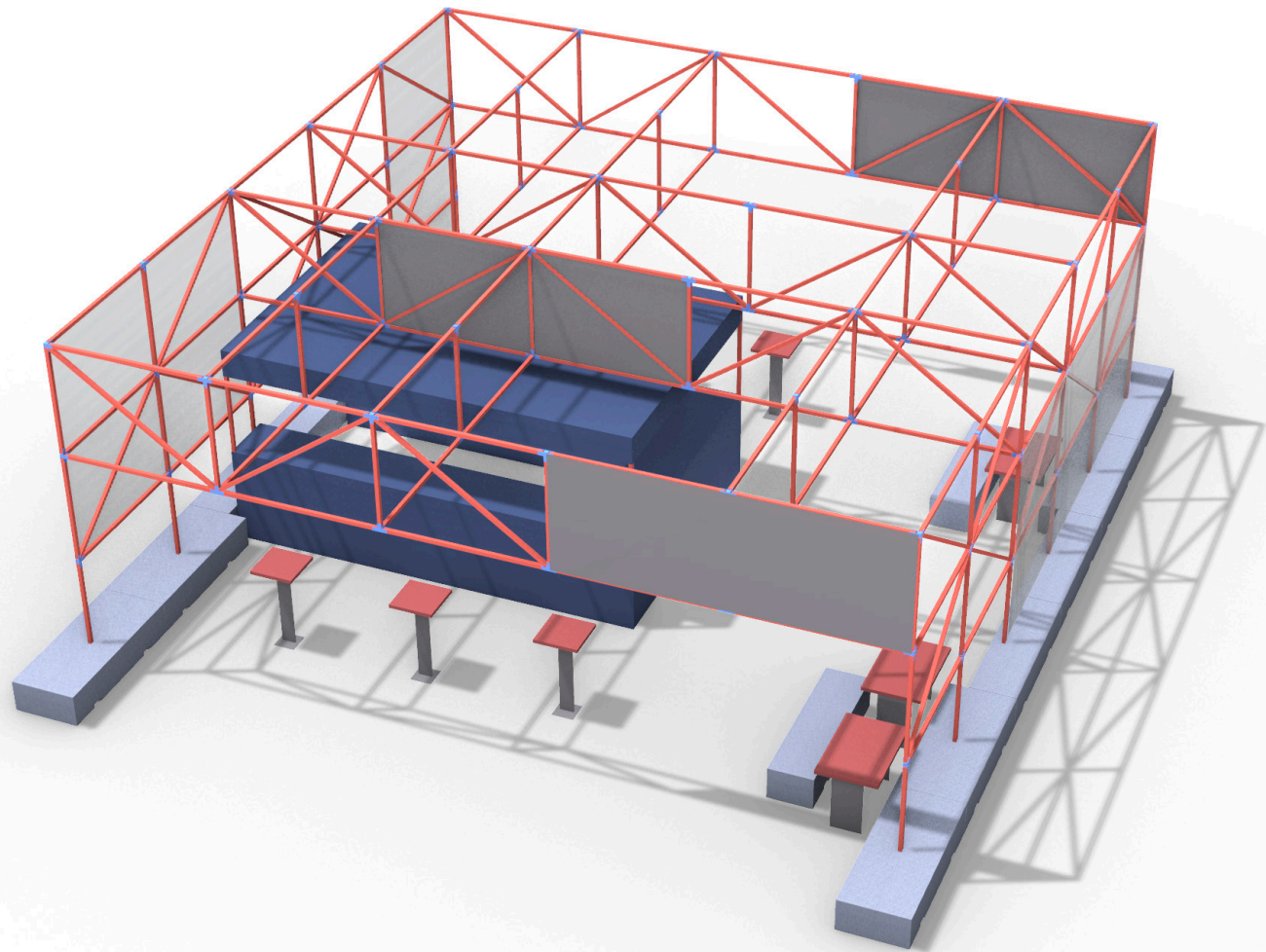


199

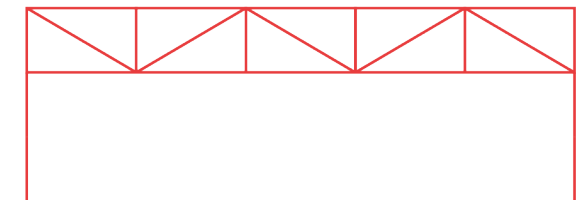
implementation

_ food & rest area

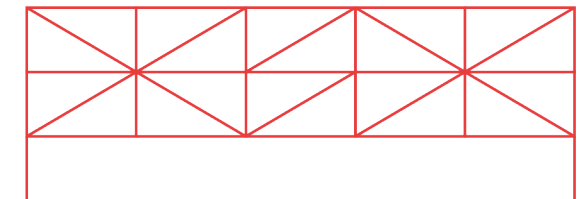
200



plan

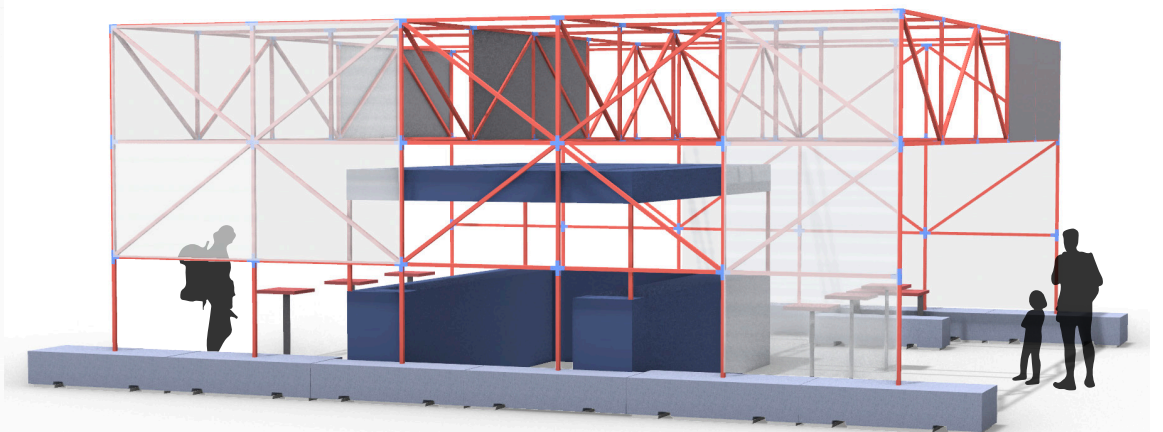


elevation A

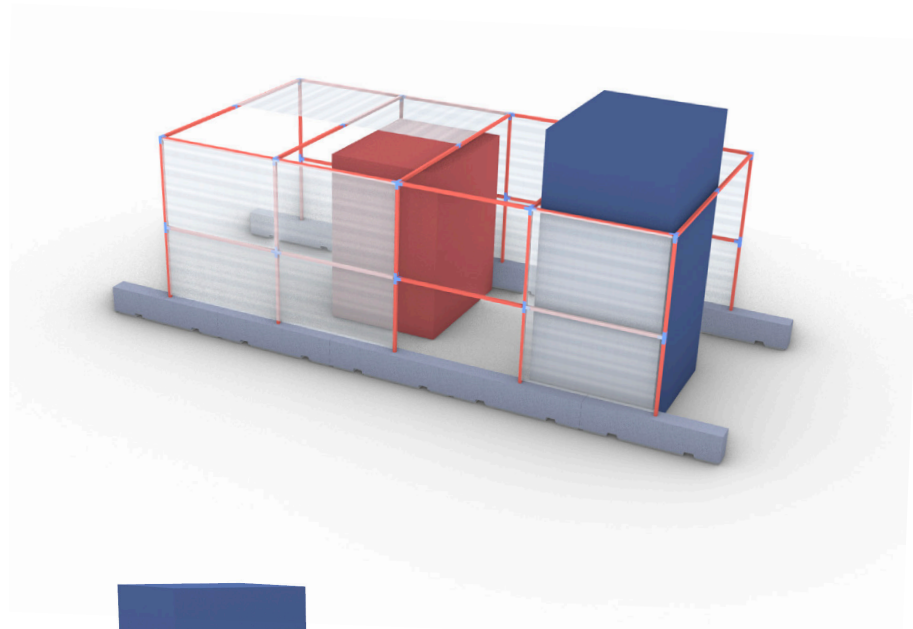


elevation B

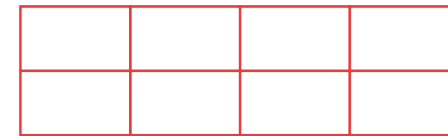
201



_ toilet & rest rooms

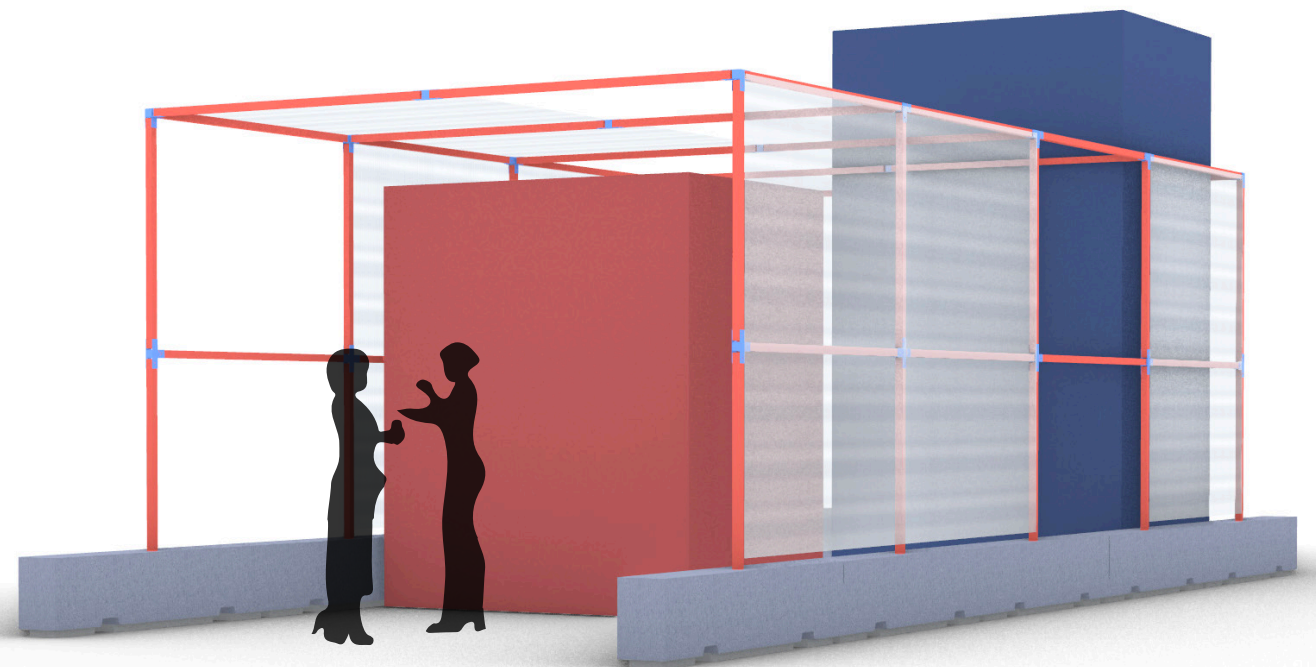
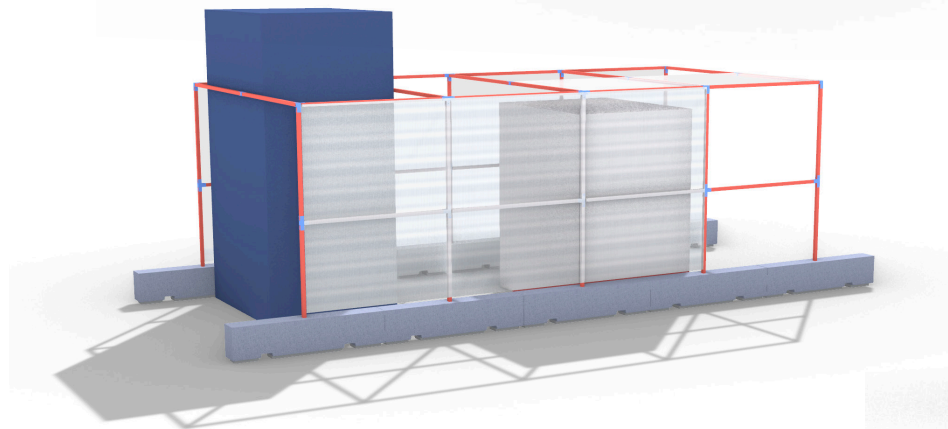


plan



elevation A

202



203

implementation

system functions

_ installation as a curtain

The installation usually is the setting up of advertising or directional panels.⁴⁵

- _ Temporary construction in which there are **no functions inside**
- _ Usually in correspondence of an **existing building or area**

204

case study



Rinascente scenographic yard Fraco Origoni Rome, Italy_ 1986

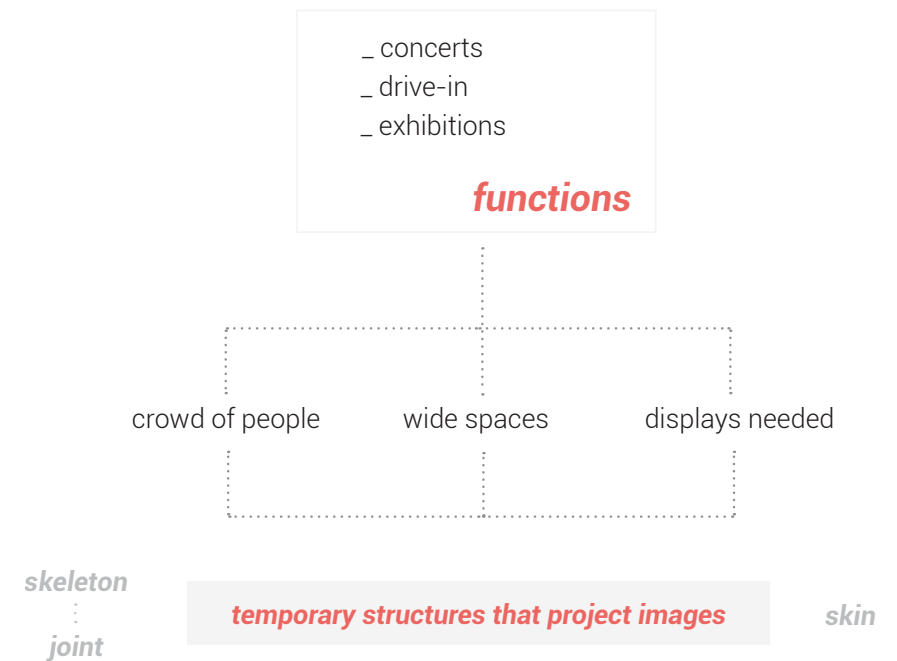
The installation was carried out with a tubular scaffolding structure, covered with vertical canvas bands that served both to communicate the event of the internal renovation to the outside accentuating the concept of the work in progress, and to create an exhibition itinerary with images on the history of the department store.⁴⁶



⁴⁵ Giachetta, A., "Architettura e tempo. La variabile della durata nel progetto di architettura.", Libreria CLUP srl, Milano, 2004

⁴⁶ ibidem

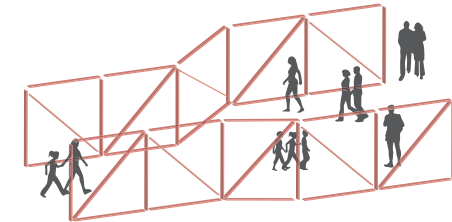
205



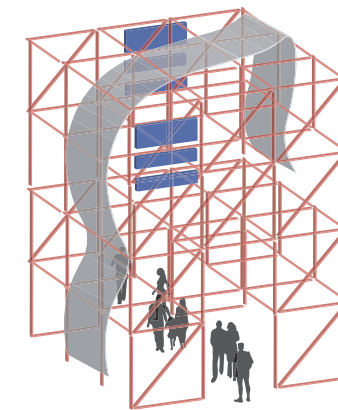
implementation

_ installation as a curtain

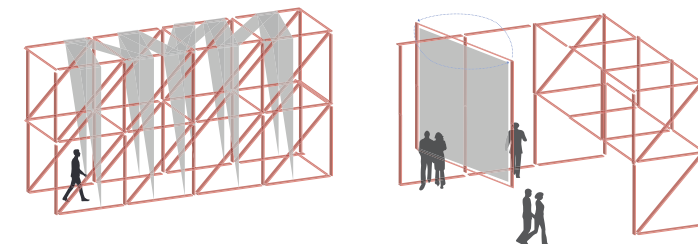
Sometimes, this type of installation is an esthetical solution to cover in-progress works or to advertise something. Still, it could assume more value if it used to create the corporate image of a space that is always changing or the wayfinding of a vast area that contains every day or week a different event with a different spatial disposition.



wayfinding
addressing people



advertisement
entrance

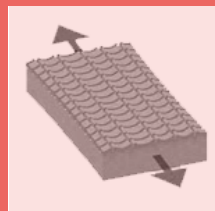


wayfinding
addressing people

position



skin

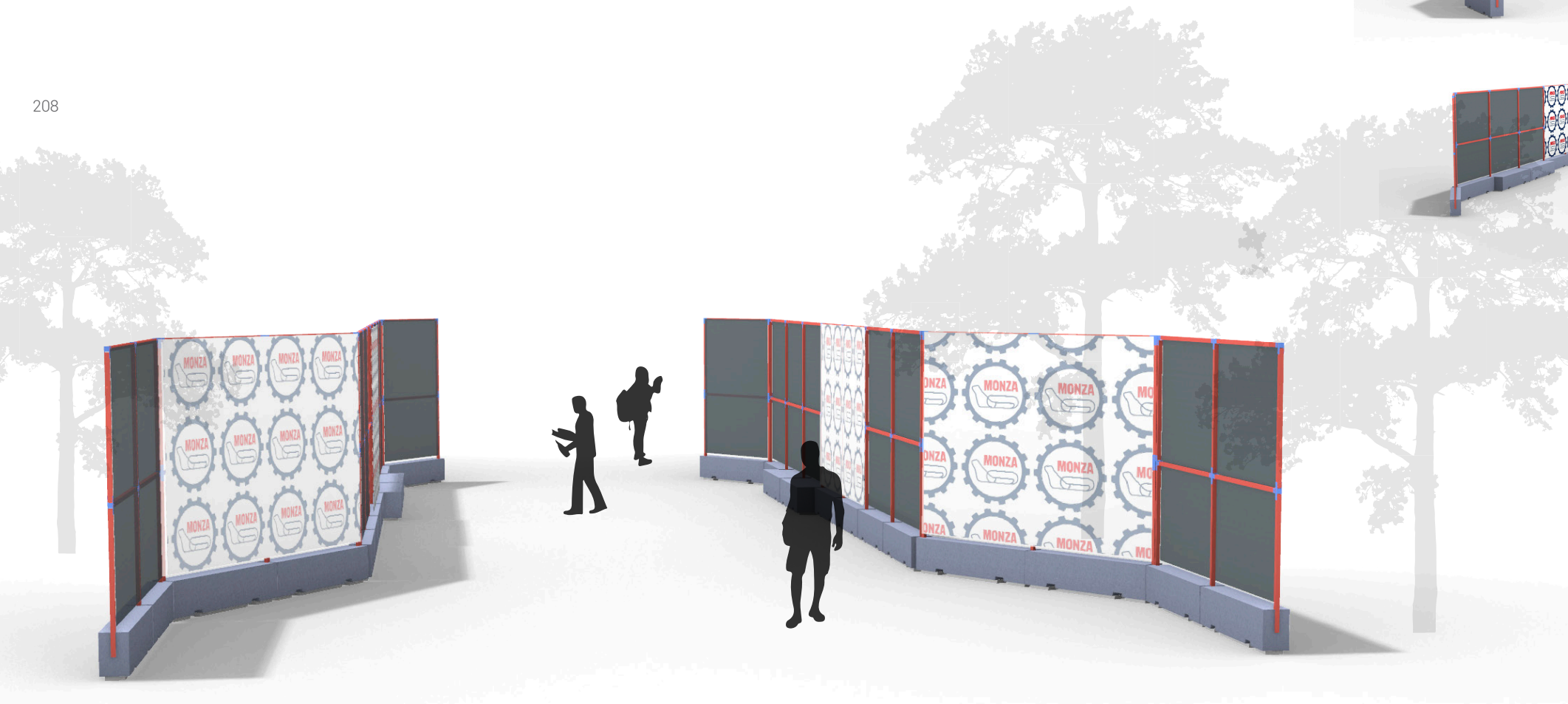
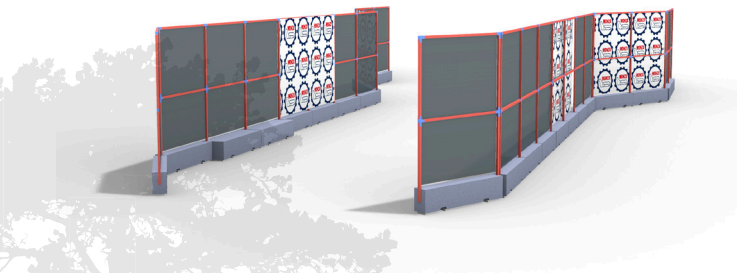
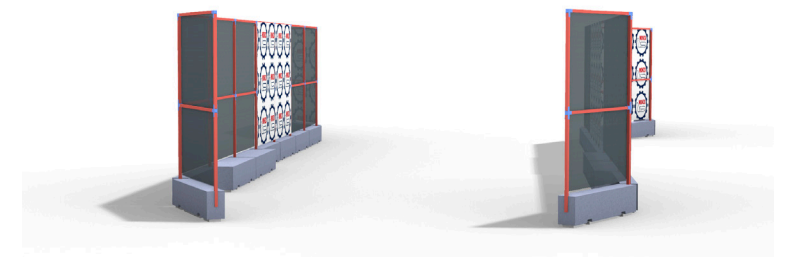
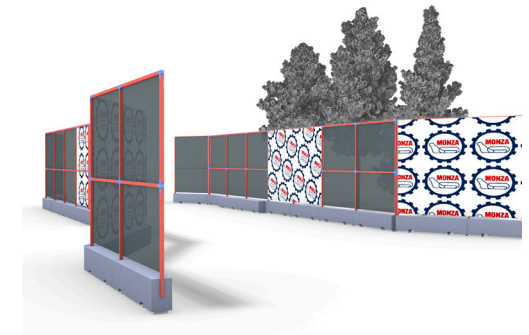


LM
Stuttgart University Research
Stuttgart, Germany

Luminescent mechanochromism is a rigid film adhered to a soft substrate that when the device undergoes stretching, display luminescence.⁴⁷

⁴⁷ Zeng, S., Zhang, D., Huang, W. "Bio-inspired sensitive and reversible mechanochromisms via strain-dependent cracks and folds", 2016

_ wayfinding



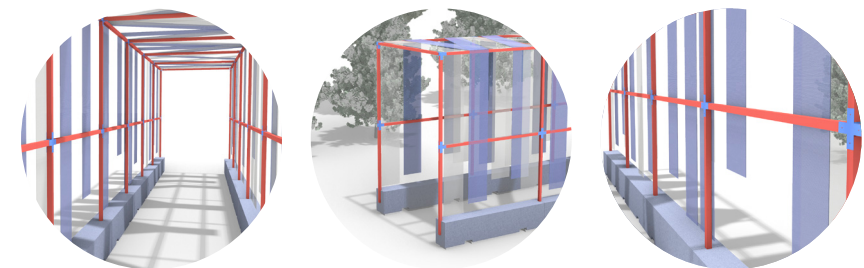
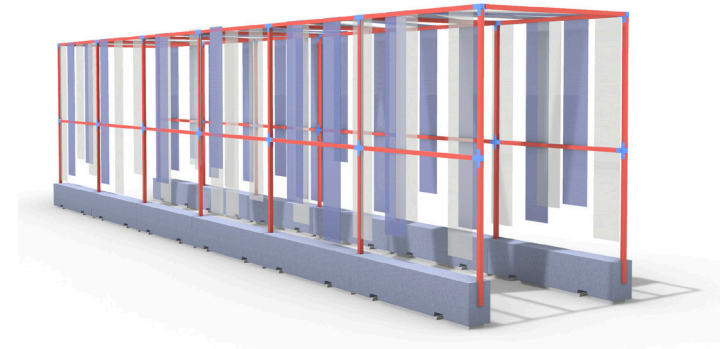
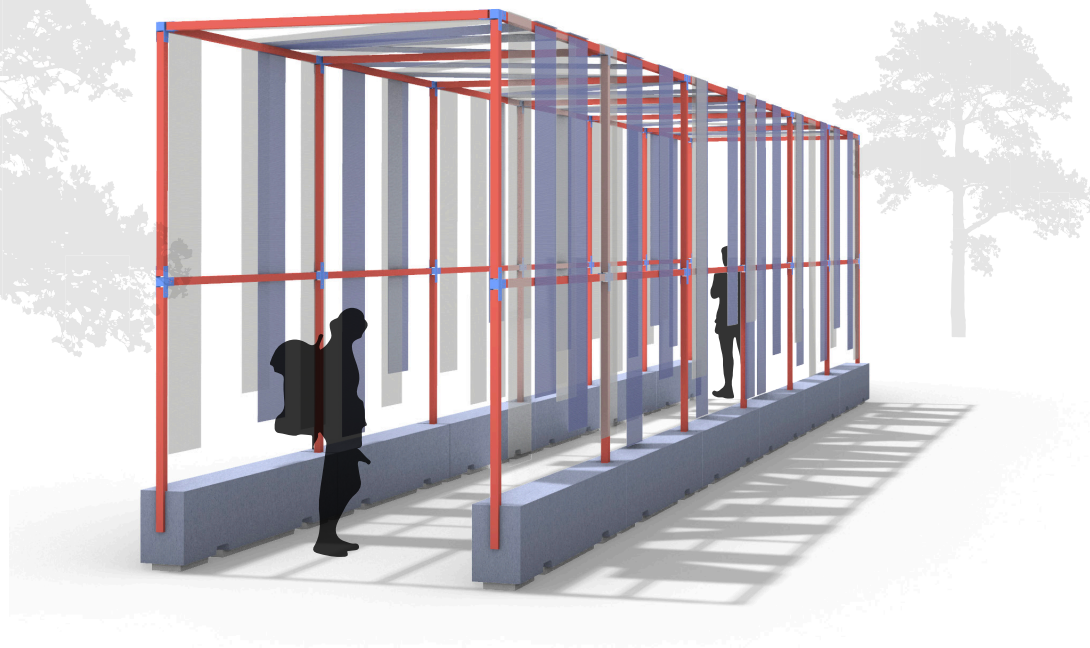
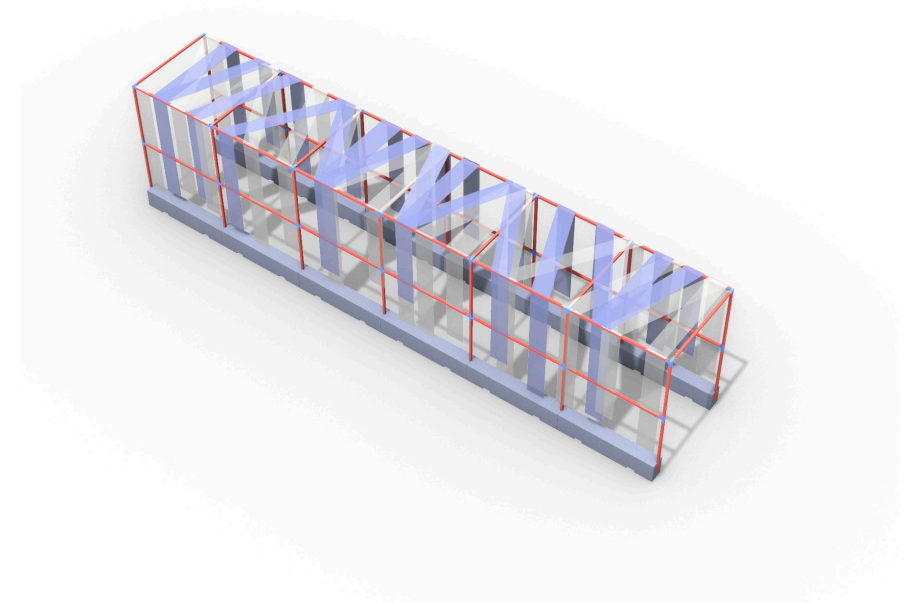
_ wayfinding

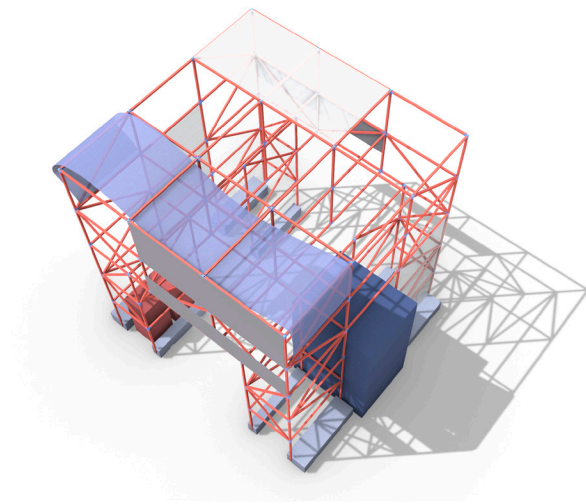


plan

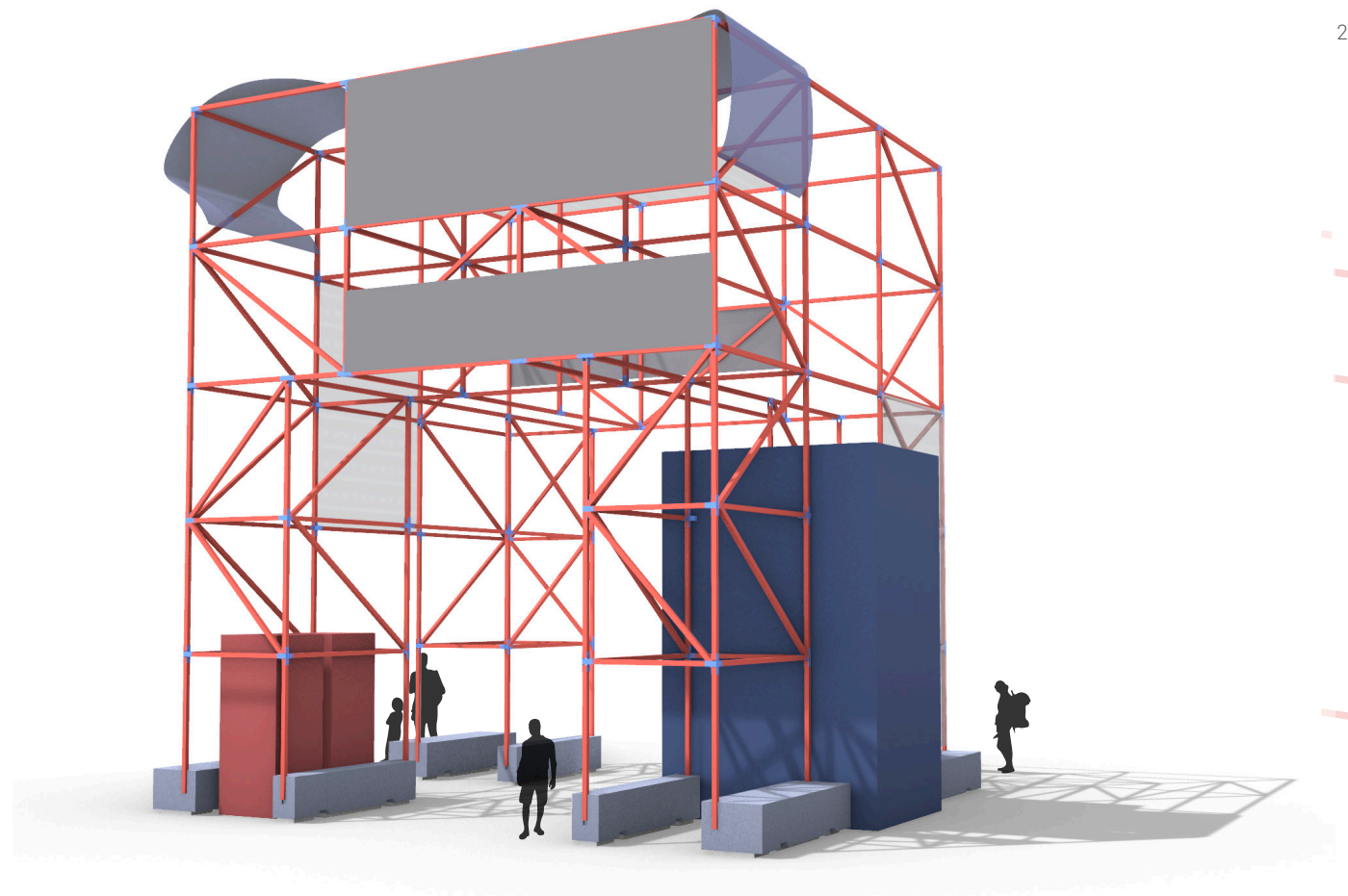
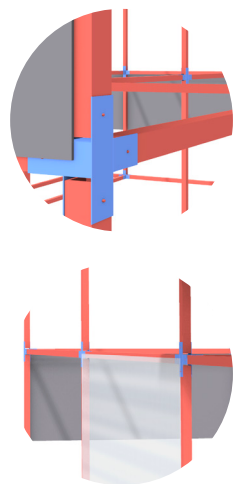
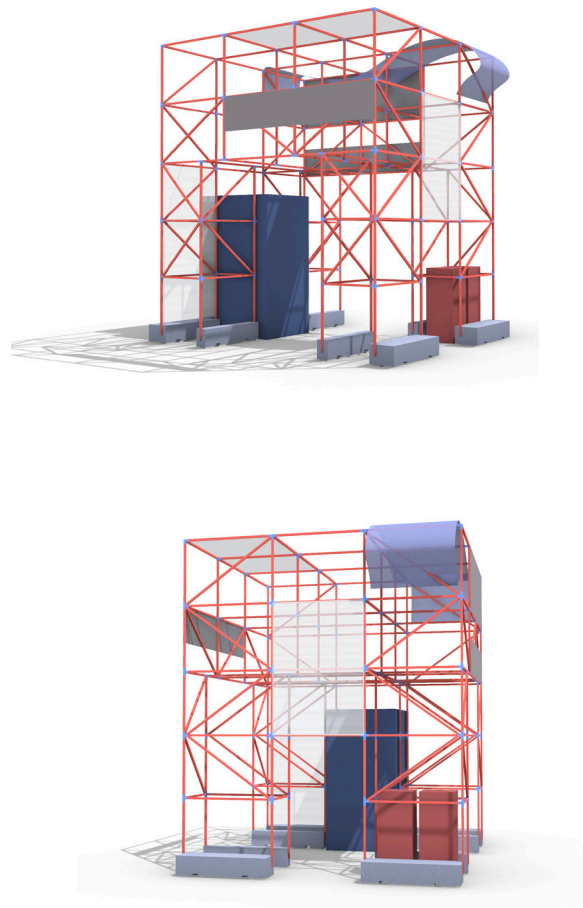
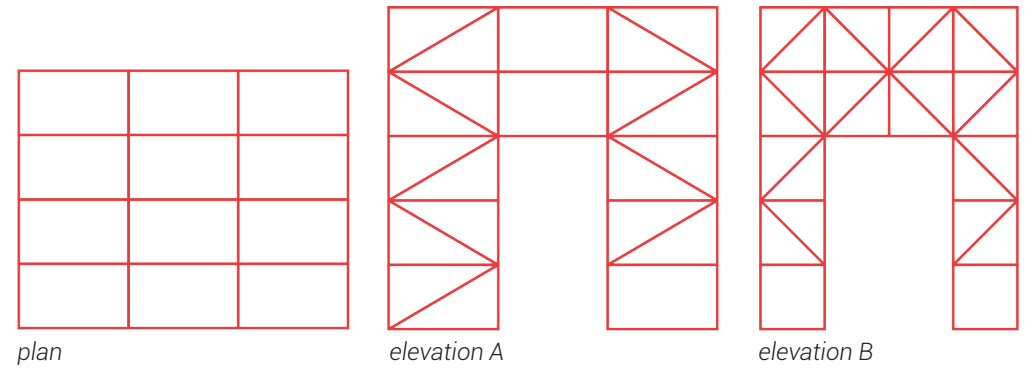


elevation





_ wayfinding



system

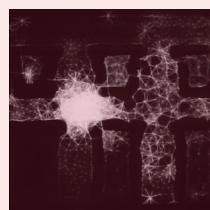
functions

_ installation as a show

The installation assumes value when lived by people, that activate it. Activating does not mean necessarily to interact physically with the structure, but it could also be a video projection or a sound installation. It is the primary function of entertainment installations.⁴⁸

- ⋮ _ The installation has a **meaning itself**, and not in relationship to the function that hosts
- ⋮ _ They allow to temporary live a space, **giving value** to it and **changing the meaning**

case study

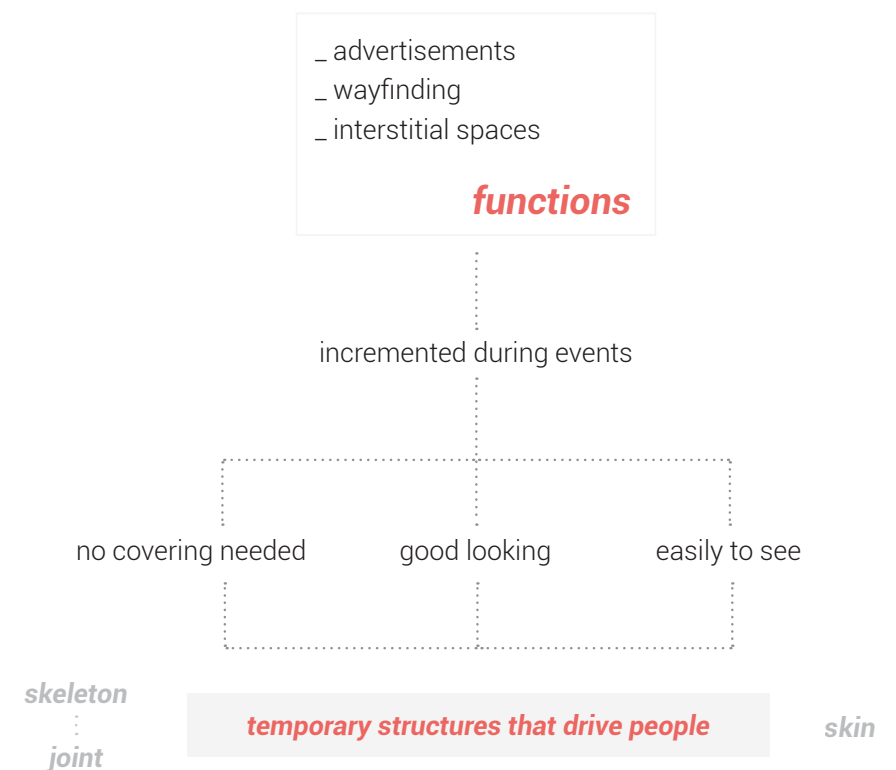


Chiostro
CamerAnebbia
Firenze, Italy_ 2015

Interactive video mapping created on the main facade of Palazzo Corsini, Firenze.⁴⁹

⁴⁸ Giachetta, A., "Architettura e tempo. La variabile della durata nel progetto di architettura.", Libreria CLUP srl, Milano, 2004

⁴⁹ CamerAnebbia, "Chiostro", from <https://www.google.com/search?client=safari&rls=en&q=chiostro+cameranebbia&ie=UTF-8&oe=UTF-8>, (n.d.)



implementation

_ installation as a show

Since the primary function of this type of installation is entertainment, and one of the most common means to reach this aim is showing videos, as the skin was chosen a PVC coated fabric. That could have wide dimensions, suitable for outdoor use and that works well with projections. It could have also smaller sizes but must always be in tension.

position



216

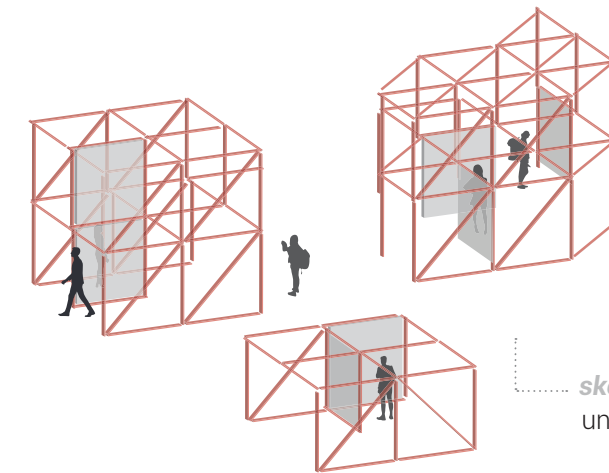
skin



Mesh 30
Rose Brand
Milan, Italy

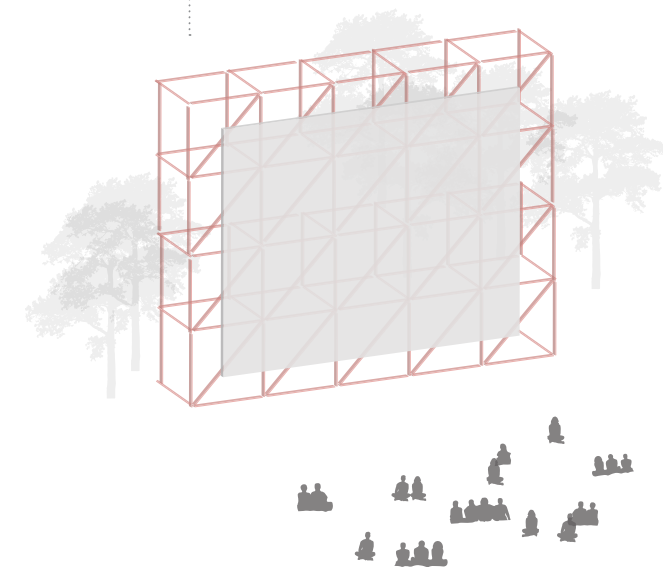
White PVC coated fabric suitable for long-term exterior use. It can be printed on or painted and works well as a front projection surface.⁵⁰

⁵⁰ Rosebrand, "Mesh 30, IFR", from <https://www.rosebrand.com/product3953/Mesh-30-IFR.aspx>, (n.d.)



skeleton + joint units for exhibitions

skin
video projector



217

implementation

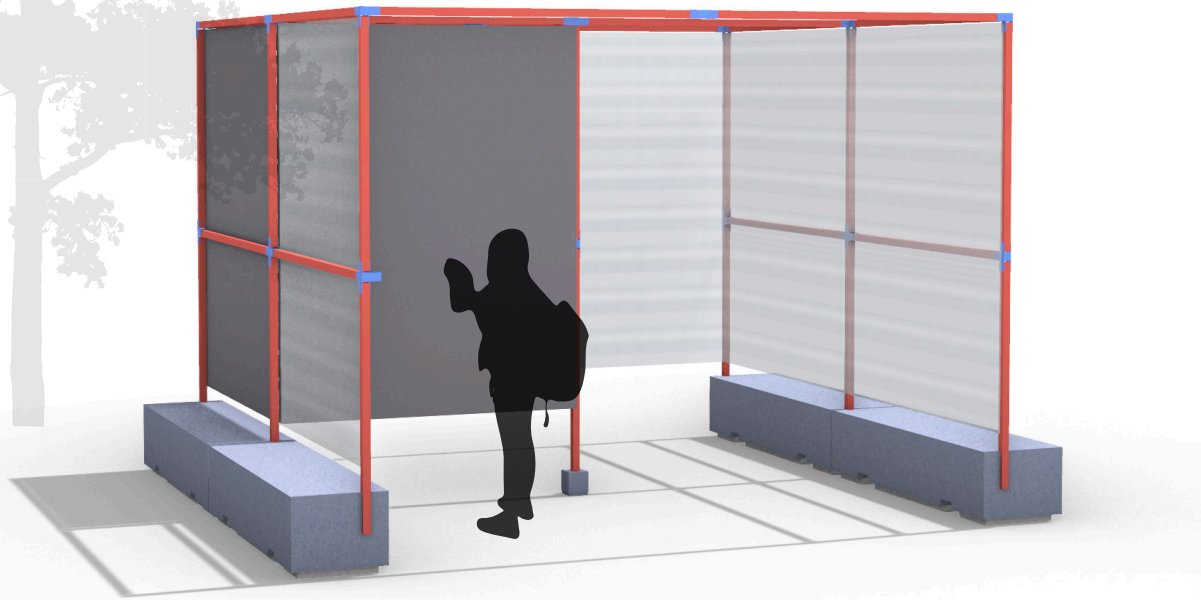
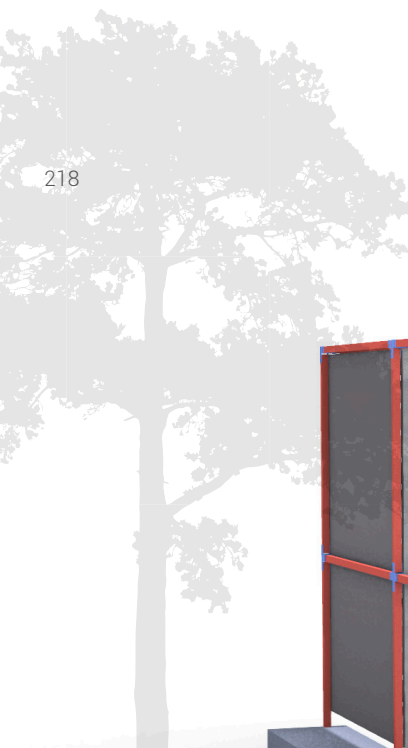
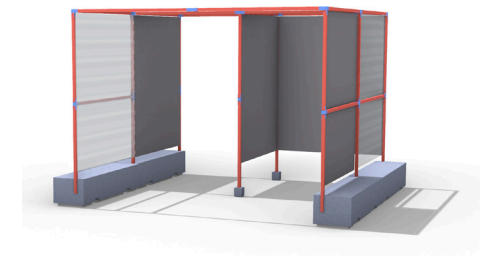
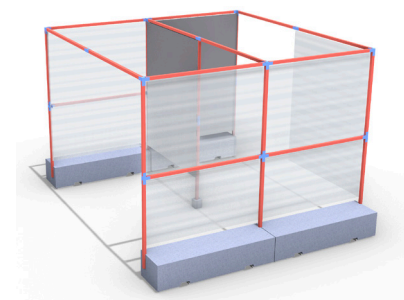
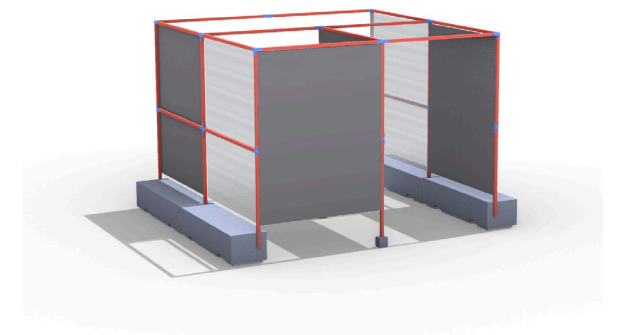
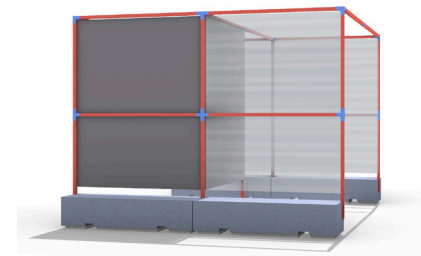
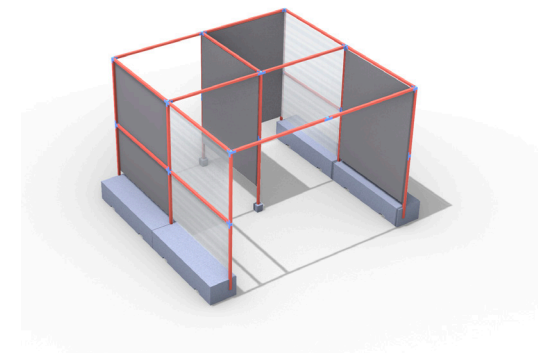
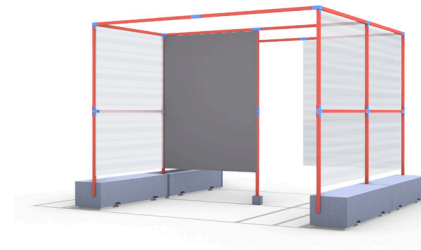
_ wayfinding



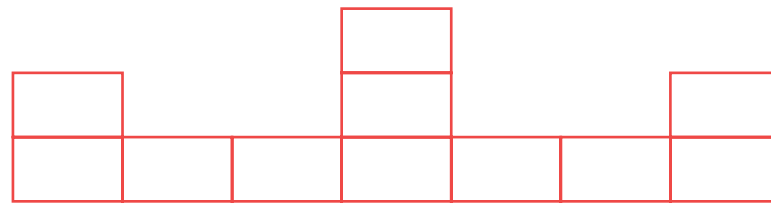
plan



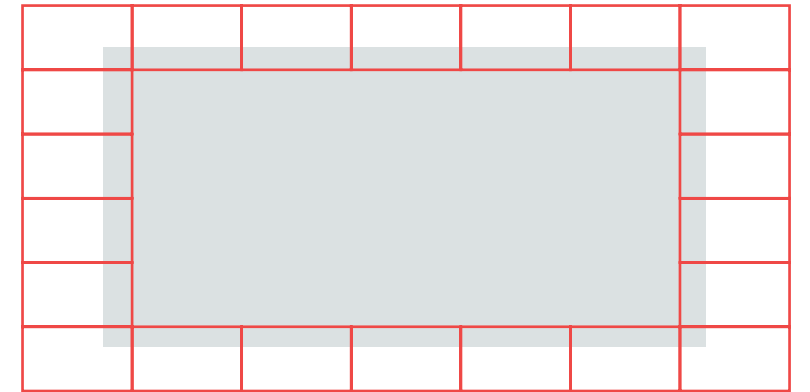
elevation



_ cinema

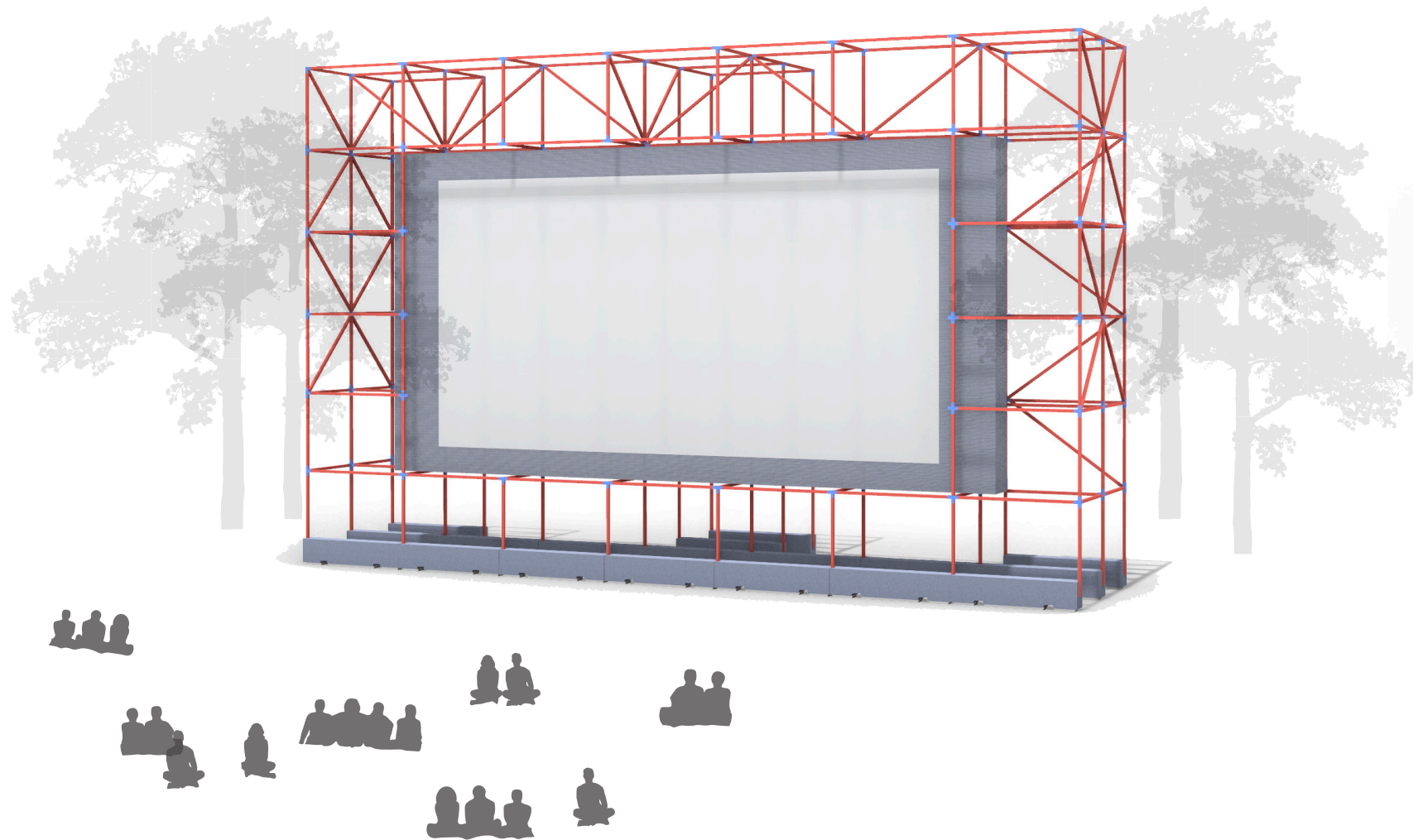


plan

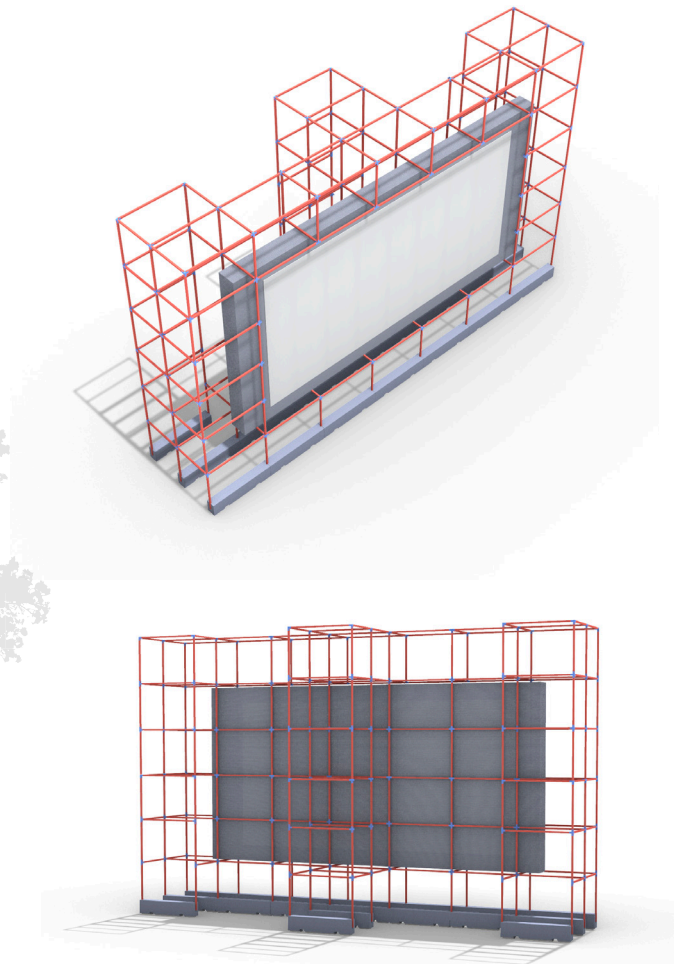


elevation

220



221



implementation

system

future

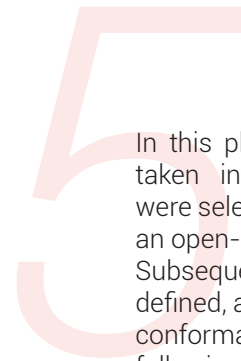
_ proposal

Being a project that will be carried out, the following step is to increase the variety of skins, improving those chosen, and to look for new ones that can perform new functions. Furthermore, the plan is to put various layers in relation to each other and obtain even more features, thanks to the different combinations of multiple skins and structures that can perform.

The lighting of the structures will also be studied, always connected to the skins, and it is thought that various types of lighting can allow, with simple tricks, very different outputs, which again adapt to multiple functions and events, a characteristic element of the Autodromo.

The idea is also to go into more and more detail. Starting from the scaffolding, to which it is thought to attribute an intense color, characteristic of the Autodromo Nazionale di Monza (red or blue), which is itself an element that makes uniform the space. Something that, at this moment, does not happen.

And then, arrive at the technical details of the link between joint + skeleton (represented by the scaffolding) and the various skin linkages. Moreover, concerning skins, it will be necessary to understand the multiple shapes and forms that each of them could take: soft, in tension, or both.



In this phase, events of a specific type were taken into consideration; specifically, three were selected: a drive-in cinema, a concert, and an open-air cinema.

Subsequently, an area where to place them was defined, and the paddock to then determine the conformation that each of them can assume, following the various peculiarities.

The application was put into practice to demonstrate the system's versatility within the space, based on the temporary events that may take place here.

Besides, to eliminate the anti-overturning Jersey barrier, a system of stalls foundations has been studied, arranged in the paddock's large area. It was designed according to a scheme that considers the elements present in that area, the principal axes, and the events that could take place and follow the logic of ground design.

entertainment

events and area

_ entertainment events

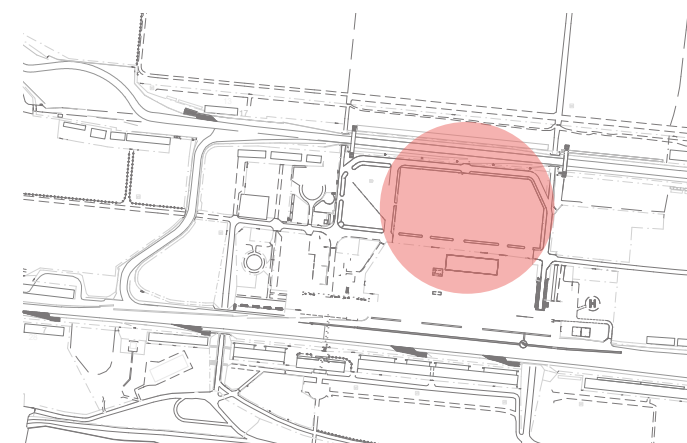
An articulated and complex application of the versatile system, which adapts to create a more complex equipped area, is designed, and it involves three different types of entertainment events:

- _ drive-in cinema
- _ concert
- _ open air cinema (multi movie)

_ paddock area

The paddock area, located in the Autodromo di Monza area where majority of events take part, has been chosen for placing the considered entertainment events.

A strategy to divide the paddock area and to create a *grid* for different configurations for the entertainment events (which happen when there are not evented related to the primary use of this area) is studied.



analysis of the area very close to the paddock in order to define the grid

entertainment

multi purpose grid




_ ground design

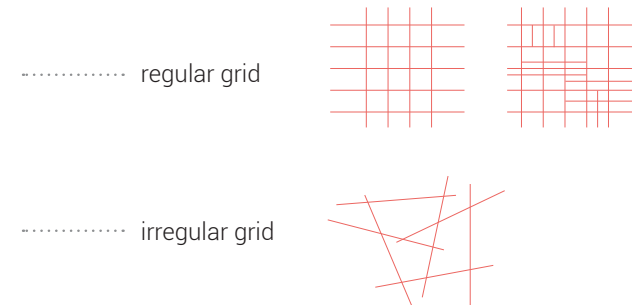
After deciding to consider the paddock area and after establishing that the entertainment events will occur here, it is necessary to implement a strategy in the space that aims to divide this wide area according to a specific logic and in a flexible and adaptable way.

Therefore, the area under consideration is deconstructed to design new rhythms through the different configuration of the (versatile) system to create a new compositive logic of the Autodromo di Monza.

Linear strategies and punctiform strategies are defined to subdivide the area. Speaking about the first ones, they include the connections and exploitable spaces, while the second consists of the functions and services. Both of them could have different properties and could assume different configurations, resumed in the following page scheme.¹

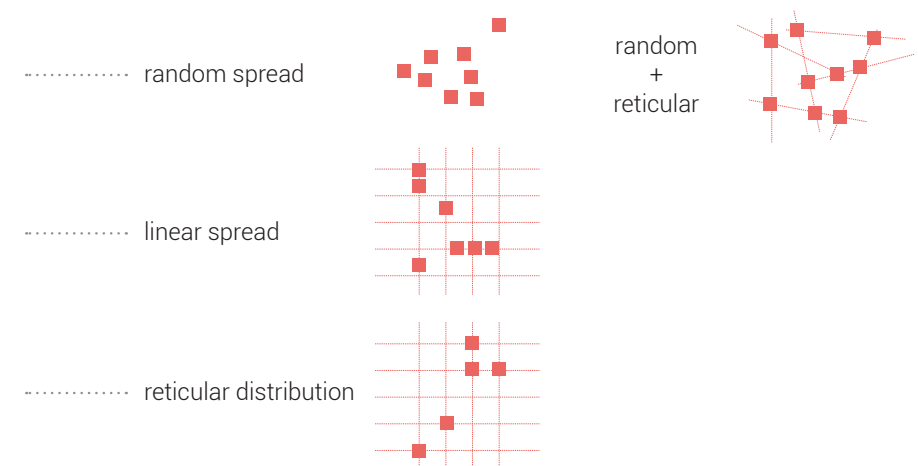
_ Linear strategies – connections and exploitable areas and spaces

-  they operate linearly
-  they have one or more direction
-  they assume different thickness



_ Punctiform strategies – functions and services

they operate as structures
simple or complex relations with the context



¹ Brizzi, C., "Una metodologia compositiva per gli spazi urbani in-between. Codici e strategie codificative applicate a Scalo Farini.", [Master thesis]. (Politecnico di Milano, 2014)

entertainment

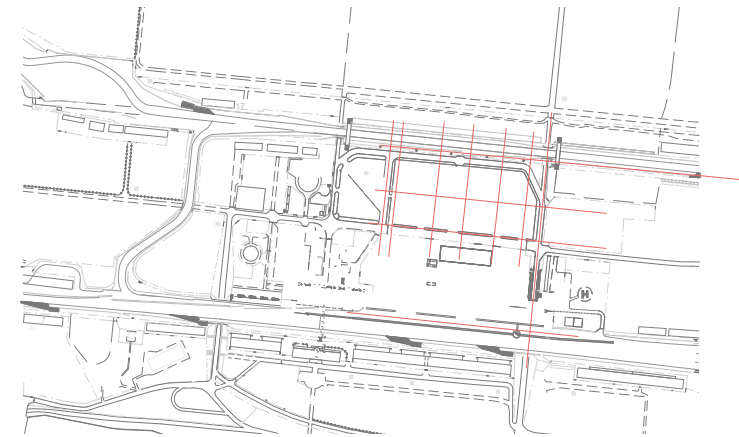
multi purpose grid

_ grid application

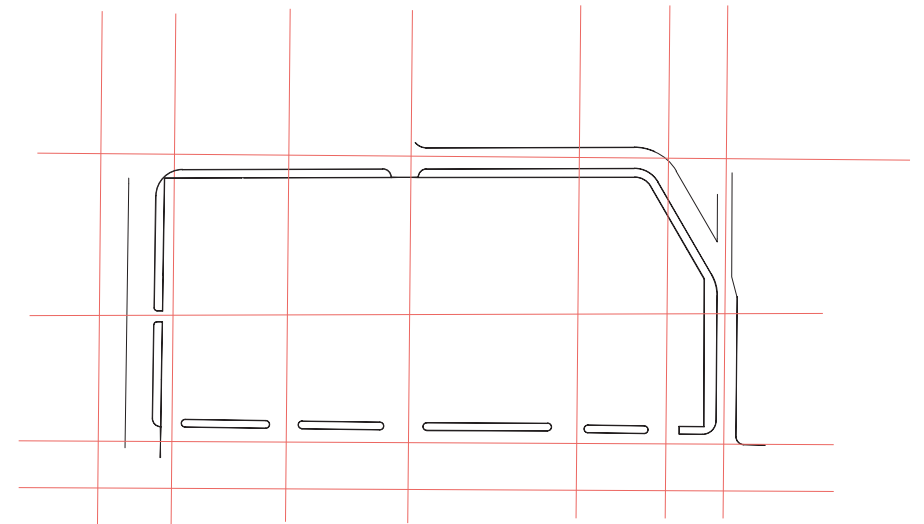
Following those as mentioned above linear and punctiform strategies, a grid for the paddock area is designed, starting from the main existing elements which already define the space, such as entrances, paths or main axes that connect relevant elements.

The result is a pretty regular grid, composed of orthogonal axes which could have both directions. The axes' intersections will nextly place the additional elements useful for the entertainment of different events and follow mainly a linear spread.

According to each type of event, the grid will work as a basis for the elements located systematically in these pre-established areas, following the shape and dimension needed and the sub-spaces required.



study of the grid + grid definition



grid definition

entertainment

multi purpose grid

_ drive-in cinema

_ physical elements

structures

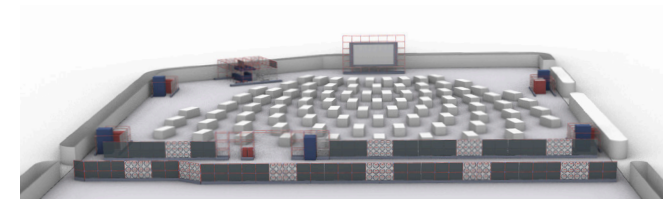
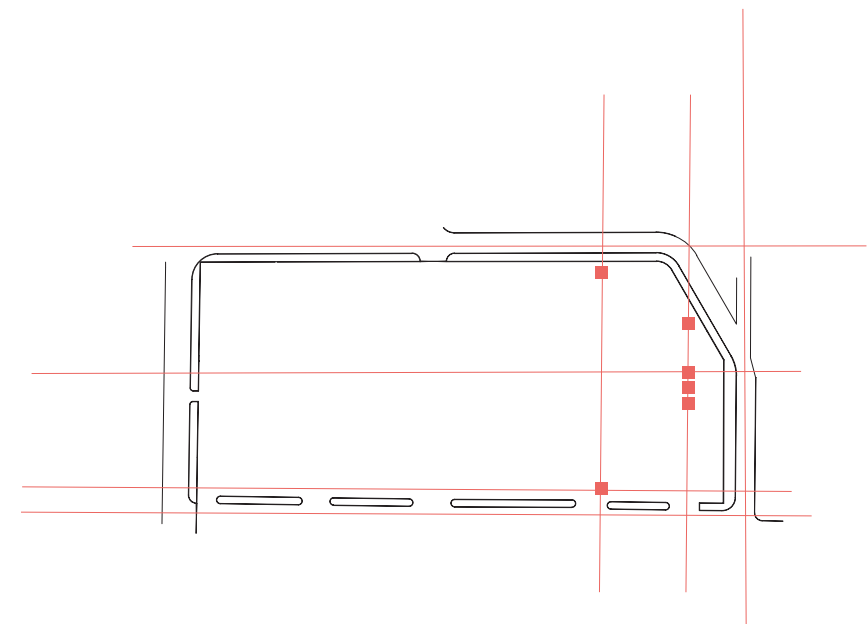
- _ screen
- _ directing (movie, lights, etc)
- _ speakers and light supports

sub-structures

- _ entrance
- _ ticket office
- _ cafe (track + eating area)
- _ toilets
- _ division from the other paddock area
- . barriers
- . break away barriers

_ requirements

- _ hosting about 100 cars
- _ every person in the car has to clearly see the screen
- _ cars need to enter and go out easily
- _ consider people basic services



entertainment

multi purpose grid

_ concert area

_ physical elements

structures

- _ stage
- _ speakers and light supports
- _ elements which delimit the area
 - . barriers
 - . break away barriers

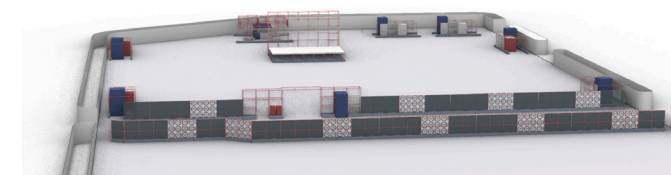
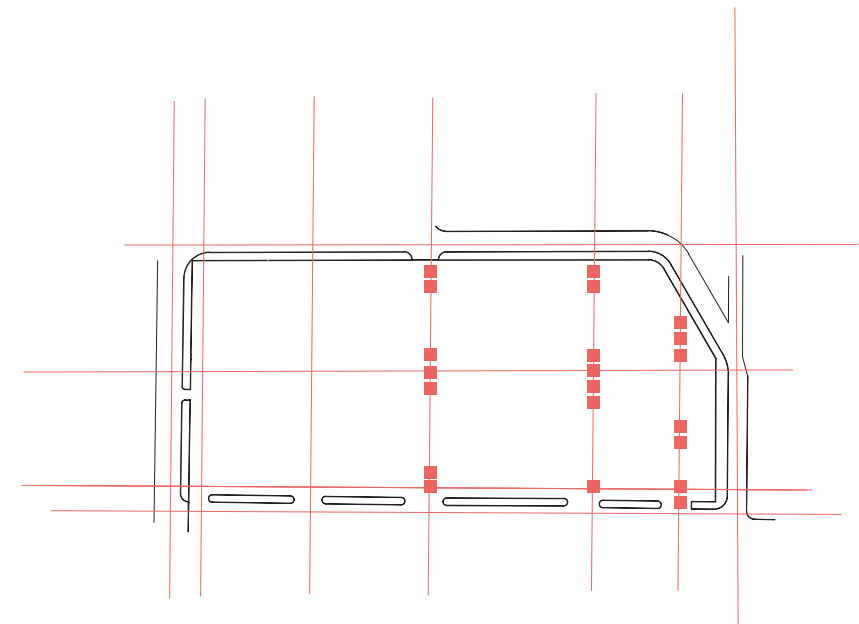
sub-structures

- _ entrance
- _ cafe (track + eating area)
- _ toilets

_ requirements

- _ hosting about 5000 people
- _ every person needs their own space around
- _ people need to enter and go out easily and in a safe way
- _ consider people basic services

area: 5000mq
1 pers / mq
= 5000 pers



entertainment

multi purpose grid

_ open air cinema (multi movie)

_ physical elements

structures

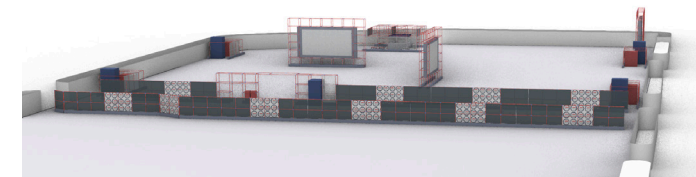
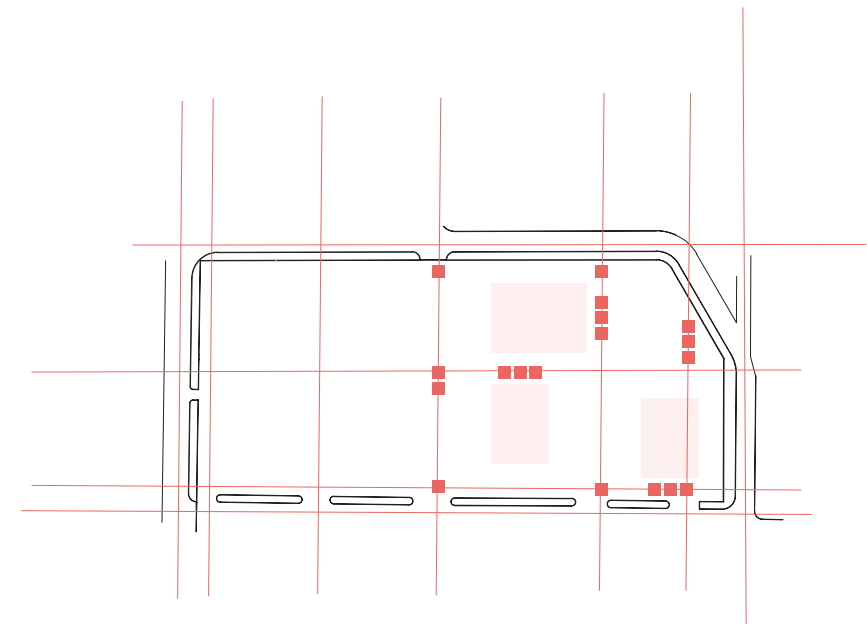
- _ 3 screens
- _ directing (movie, lights, etc)
- _ speakers and light supports
- _ elements which delimit the different areas and divide from the other paddock
 - . barriers
 - . break away barriers

sub-structures

- _ entrance
- _ ticket office
- _ cafe (track + eating area)
- _ toilets

_ requirements

- _ hosting about 500 people (100 / screen)
- _ every person needs their own space around and their own chair
- _ people need to enter and go out easily and in a safe way
- _ consider people basic services



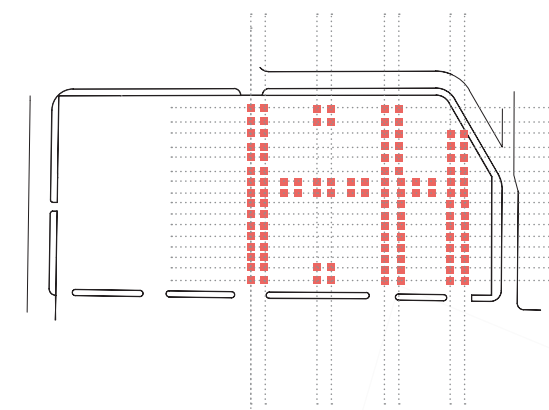
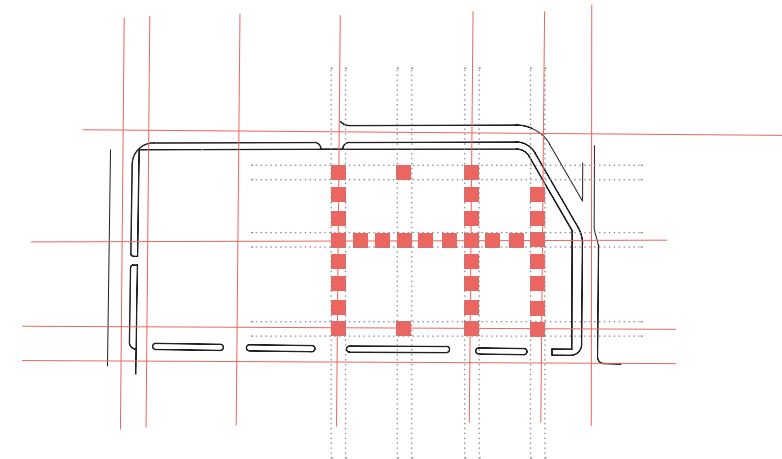
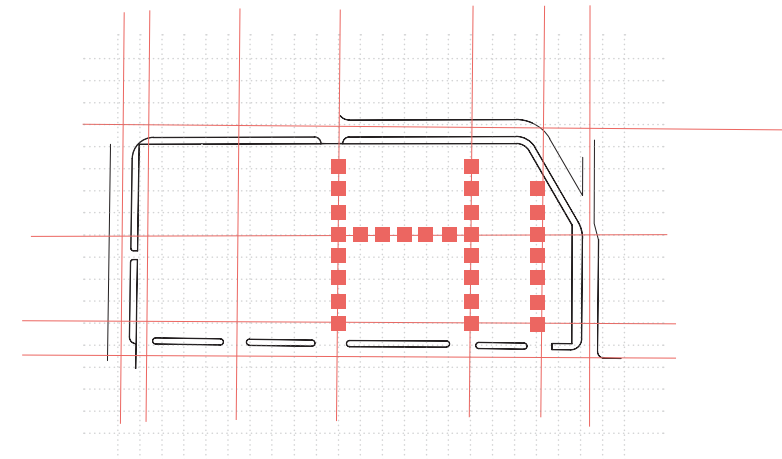
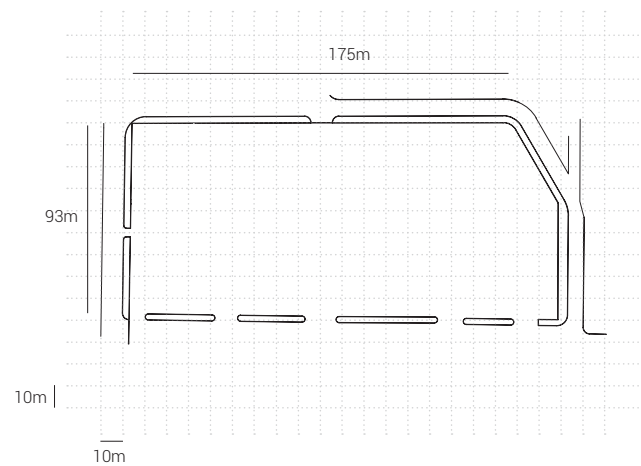
entertainment

common grid

_ common grid definition

Taking as an example the three different configurations for the entertainment and considering the main structures they need, a standard grid on which several dispositions could happen is studied.

The grid was developed in three main phases:
 1. tracing the main paddock axes and establishing a regular grid (10mx10m)
 2. analyzing the three entertainment typologies which structures and configuration need
 3. creating a standard grid where the skeleton of the system could be fixed.



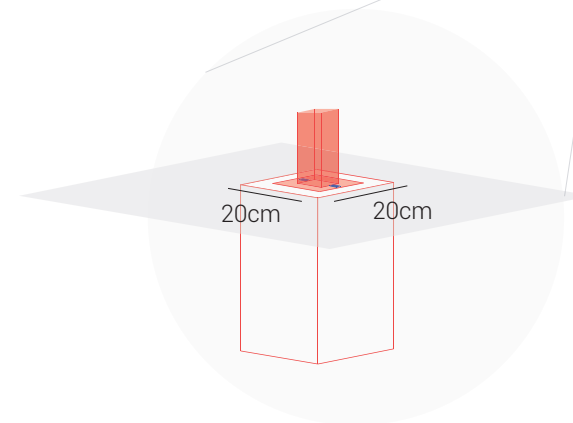
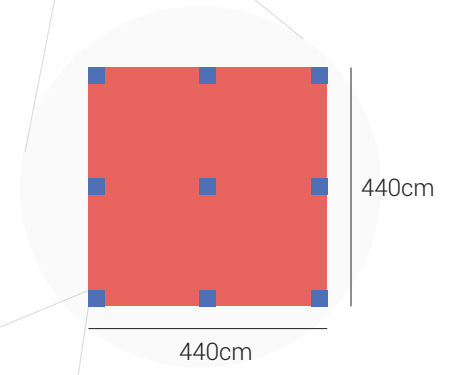
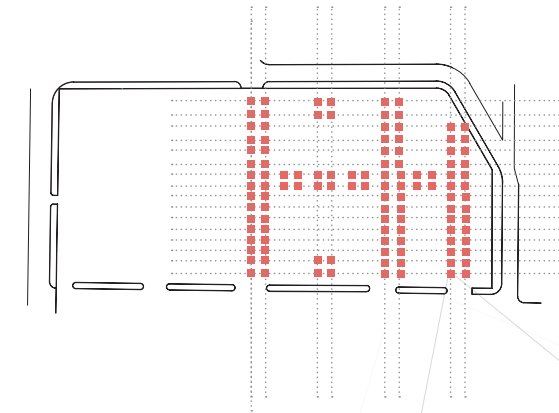
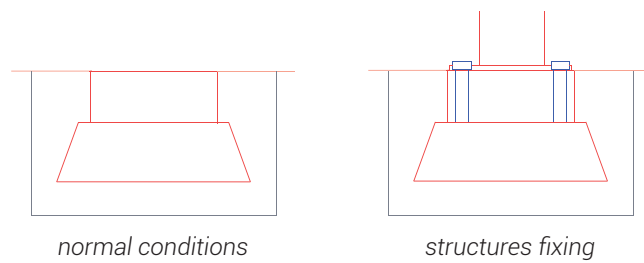
entertainment

common grid

_ fixing points

The skeleton of the system could be fixed directly in the ground, without any anti-overturning Jersey, in which there are established points where the foundations could be hidden in the ground, opened and used when there is the necessity.

In normal conditions, the stalls foundations are hidden by a pit, while when the assembly of a temporary structure is required, they must assume their function of foundation being opened. A nut and bolt connection will fix the structure on them.



The internship was done at the Autodromo Internazionale di Monza, in the period between April and August 2020.

The work was carried out for the most part independently and, due to Covid-19, most of the meetings took place via video call, while some took place on site. During the visits to the Circuit, it was possible to know the places accessible to the public, but also some of the spaces usually rented to for private events.

Thanks to the support of the company tutor, it was possible to understand in detail the operation and organization of the company and how these spaces are managed.

During the internship, I was able to verify that the project was consistent with the reality of the space and making some changes that would make the project more akin to the everyday reality of the racetrack.

drive-in cinema

general view

_ why

Drive-in cinema is the only architecture that relates to the car beyond the functionality of transportation. It is interesting because it happens inside the Autodromo di Monza circuit and the 'temple of the automobile'.

It is a public-private space located in a wide area, where more people could see the same movie while maintaining their privacy.

Moreover, this happens in a year where the Covid-19 virus spreads around the world and the most efficient and quick solution to fight against that pandemic is social distancing. From a facilities perspective, an outdoor cinema tackles many social-distancing issues that other entertainment industries struggle with.

Autodromo di Monza

the automobile's temple

this place is related only to the **automobile**, and its **function**, which are the **starting point** and the **aim** of that

VS

the architecture is related to the **automobile beyond the functionality** of transportation

movie structure + parking area

automobile as a **social bubble**

drive-in cinema

social distancing issues

Covid-19 pandemic

_ advantages/disadvantages

The drive-in cinema is characterized by a special atmosphere caused by the vehicle privacy, but oppositly, happening in an automobile, it has a low sound quality and depends a lot on the weather.

advantages

- _ social atmosphere
- _ privacy of vehicle
- _ being outside
- _ lower admission cost
- _ multiple features
- _ family friendly
- _ can bring personal belongings

disadvantages

- _ limited movie selection compared to a traditional cinema
- _ lower sound quality
- _ reliance on weather

_ social distance elements

From a facilities perspective, an outdoor cinema tackles many social-distancing issues, a relevant charecteristic in 2020, when this type of safety is a priority.

- _ **Retail** – Customers purchase tickets online, inputting vehicle registration information
- _ **Set-up** – Two touring trucks will set up the day before a screening
- _ **Entry** – This is via license plate recognition to minimise staff interaction
- _ **Parking** – Cars are parked with more than a 2 metre space around them
- _ **Audio** – The sound will be transmitted via FM radio straight to the car's radio
- _ **Waste management** – Customers are asked to not dispose of any rubbish at the event
- _ **Catering** – Customers will have the chance to order in advance or on the night via an app
- _ **Hygiene** – Hand sanitiser stations are provided at each toilet location
- _ **Washrooms** – A larger number of toilets will be put in place to limit groups.
- _ **Clean up** – The screen and kit will be dismantled and packed up after the last screening

_ nowadays

In the summer of 2020, at the Monza racetrack, the Drive-In Monza took place as an evening event held in the paddock area.

The event, of course, guaranteed all the necessary security measures related to Covid-19, also helped by the fact that it took place in an ample space. People enjoy the event from inside their car or, if they liked to view the film outside the cockpit, deckchairs were made available, clearly to be used in a limited area near the vehicle.

There were nine evenings dedicated to this event, during which films such as "Grease", "Flashdance" or "Beauty and the Beast" were screened.

Inside the event area, there was a food & beverage service: a street food truck.



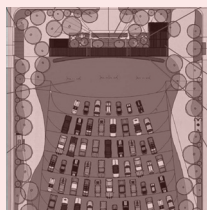
* pictures of the paddock area set up in July 2020, when the Drive-in Cinema took place at night

drive-in cinema

inspiration

case study

250



August Moon drive-in

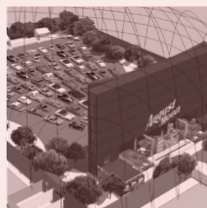
Michael Counts
Nashville, U.S.A. _ 2011

Project for a maxi indoor drive-in with the 1960s feel in Nashville, the U.S.A that will be opened in 2021.

The designer wants to give visitors the whole experience of an American Drive-in movie, down to every last detail, including comfort food and fireflies. In the 40,000 square-foot space with an air-supported dome simulating a starry sky, the environment has inside 40 vintage cars, full-sized trees, hammocks, and a starry night with an August "sailor's moon".

There are two party rooms in the back, a food truck, the bar and, on the side, the bathrooms.

The movie screen is on one side of the space, and it is enormous to reach all the people watching at it from their automobile-seatings, surrounded by fake trees and grass, children games, and services, such as the fast-food restaurant and the bar. Also, from the outside, it reminds the 60s period.¹



¹ August Moon Drive-in, (n.d.) retrieved on 30 August 2020 from <https://augustmoondrivein.com/location>

case study

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Walk in Cinema 2017

Mezzo Atelier, Filippo Losi
Piacenza, It _ 2017

For the Piacenza Film Festival, the Walk-in cinema project consists of a series of coordinated elements and signs distributed throughout the park where the event happens.

Inspired by old cinemas and drive-in typography, the designers created "narrative scenographic furniture" to guide visitors from the park entrance to the open-air cinema and the various festival activities.

The structures combine manual and digital manufacturing, with laser-engraved letters and metal joints made ad hoc to quickly assemble and transport all components such as tables, benches, totems and armchairs.

The metal joints are made on purpose to collect and transport all parts easily.

In the evening, the pieces lit up little by little, creating a compelling atmosphere and illuminating some writings to guide the festival audience.²



² Domus, "Walk in cinema", retrieved on 30 August 2020 from https://www.domusweb.it/it/notizie/2017/01/13/mezzo_atelier_walk_in_cinema.html

drive-in cinema

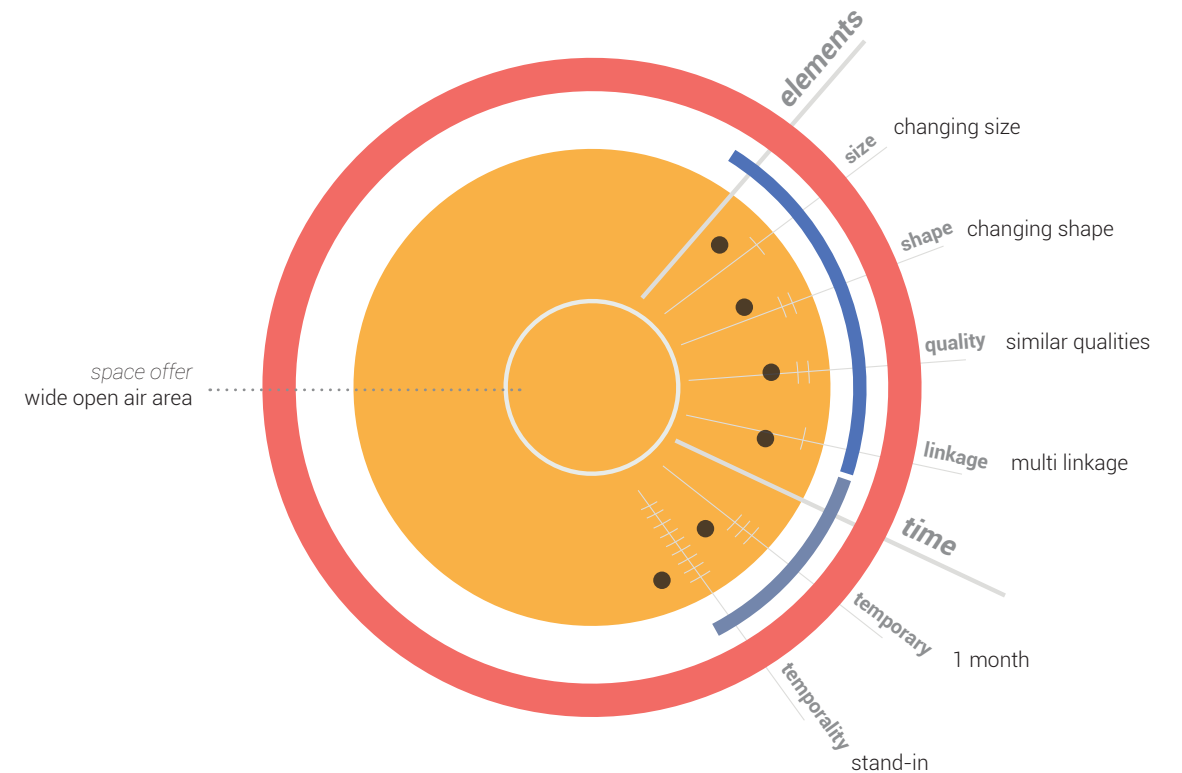
drive-in cinema

comparisons

Following the data structure designed to analyze systems that grow or develop through space and time, the drive-in cinema information and characteristics are inserted in this particular table.

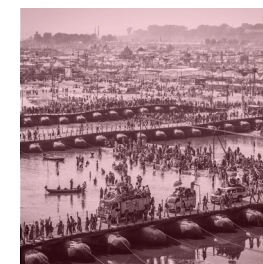
The matrix aims to analyze from the architectural, interior and product design field the structures to better understand the strategies of existing projects. This case helps compare the generated drive-in matrix with the other study cases data structures to realize if the matrix effectively works well.

The drive-in generated matrix results very similar to the Maha Kumbh Mela matrix, the mass Hindu pilgrimage in which the faithful gather to immerse themselves in the sacred river. It happens every 12 years, and the project Lentspace, a temporary park designed by Interboro partners in New York where people continuously change its configuration, moving the designed elements. The conclusions are that both the case studies use the same concept of drive-in cinema and have similar characteristics.



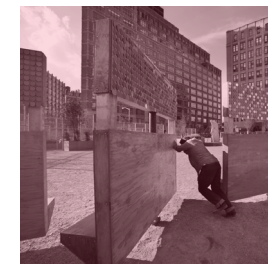
Kumbh Mela

-
Allahabad, In _ ev 12 years



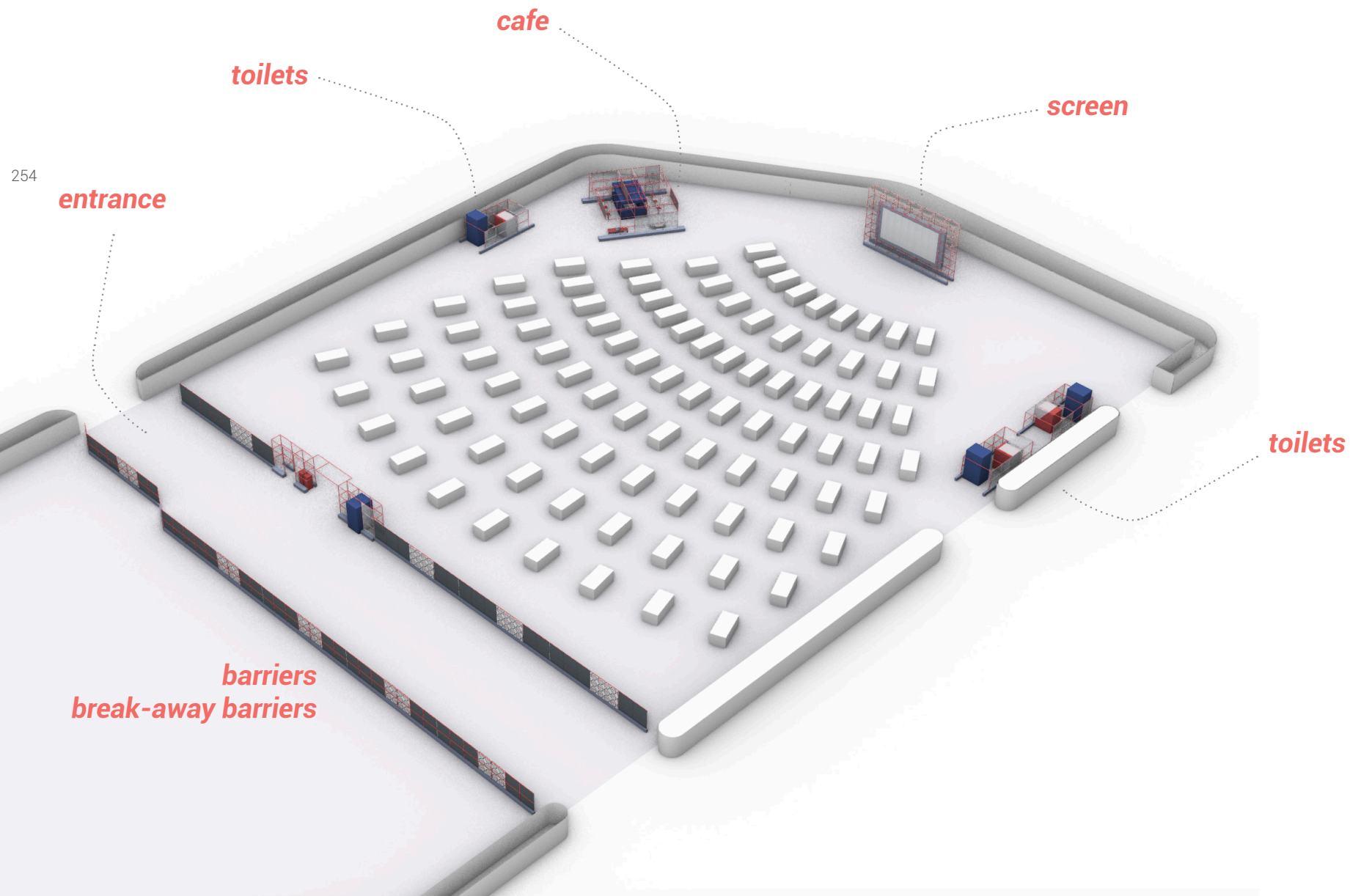
Lentspace

Interboro partners
New York, USA _ 2009



drive-in cinema

project application

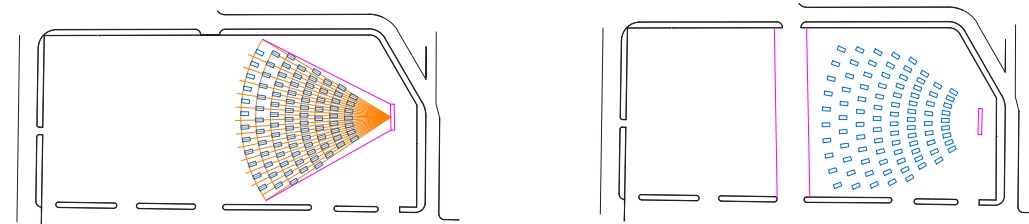
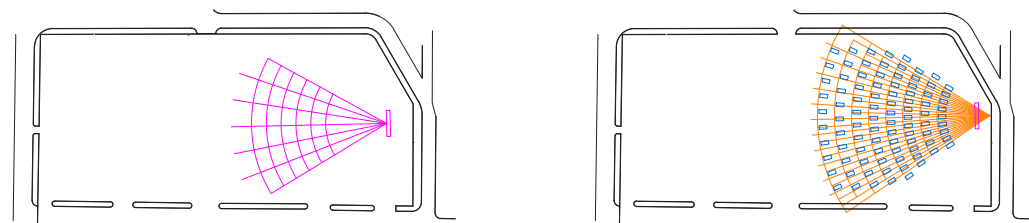
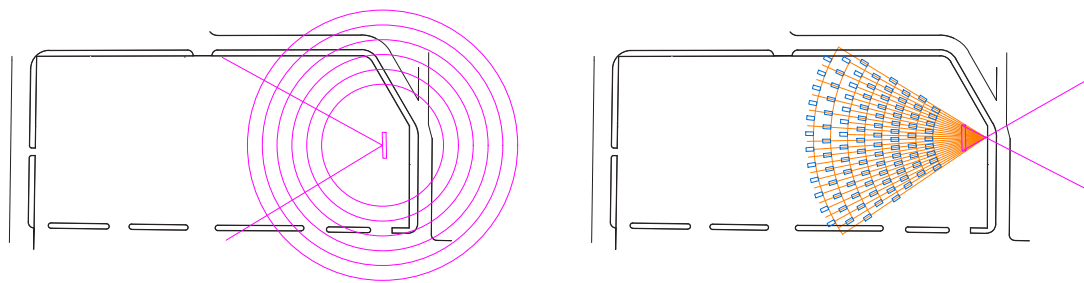


_ elements

There are some essential elements necessary for the drive-in design and consequently set up, without which it could not work in the right way.

physical elements

- _ entrance
- _ ticket office
- _ cafe (track + eating area)
- _ toilets
- _ screen
- _ directing (movie, lights, etc)
- _ speakers and light supports
- _ division from the paddock area
 - . barriers
 - . break away barriers



_ layout

The drive-in cinema layout is studied to host about 100 automobiles, which are disposed of regularly, starting from the screen in front of them, located in the extreme of the area. Of course, automobiles disposed in order not to cover the view to the screen.

_ layout painting

Airlite

Water-based paint in powder form to dilute with water called Airlite Sunlight Exterior, which is anti-pollution, transpiring, antibacterial and self-cleaning, containing photocatalytic substances, ultra-fine inert elements and special additives, is used to draw in the ground the automobile's area.

Furthermore, the product must prevent the development of mould and must be non-flammable.²⁶



drive-in cinema

screen

_ screen structure

The screen is, of course, one of the essential elements for a cinema and, in the context of the drive-in cinema, which takes place outdoors, there are greater characteristics that must be taken into account and the characteristics that it must have.

The screen must be of a material that is resistant to atmospheric agents, safe for people. Because of this reason, we opted for the *Airscreen* inflatable screen, fixed employing tie rods inside the designed temporary structure, and the size chosen is for the visibility of 100 cars, the same number of seats available in the paddock.

Furthermore, the screen must be visible to everyone and therefore be positioned correctly in the space. In addition to being visible, no lights of any kind, whether artificial or natural, must be reflected on it, which can be a problem outdoors.

*Airscreen*³

inflatable -> disposed inside the structure through straps
permanent high pressure inflation

visibility : 100 cars
screen dimensions : 10 x 5m (16:9)
frame : 14 x 9.2m
straps (20m x 5cm)

shipping dimensions : 2 pallets (120 x 100 + 120 x 80cm)



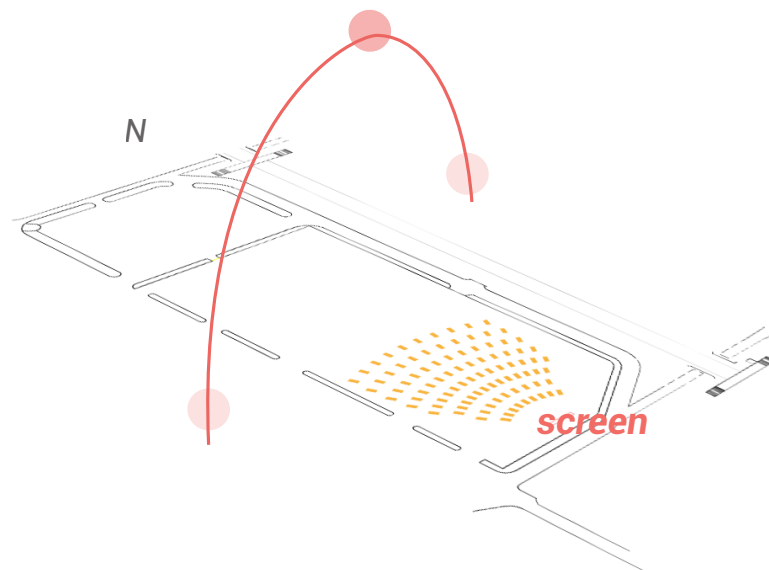
³ The AIRSCREEN Company, Munchen, Germany, "Airscreen data sheet", retrieved from www.airscreen.com

drive-in cinema

screen position

_ Sun's sideral rotation

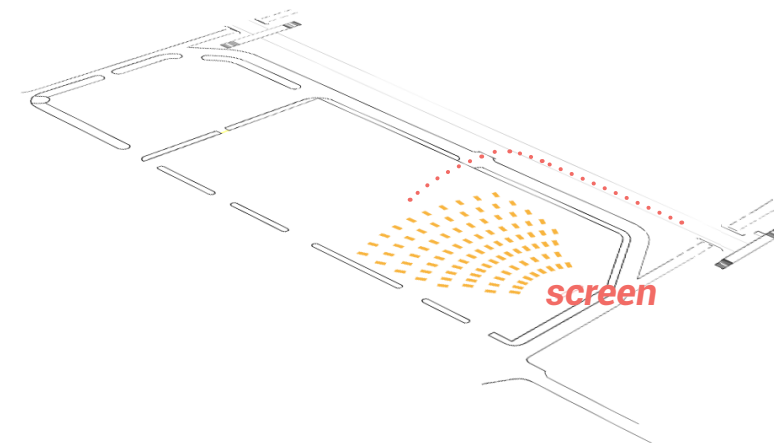
In order not to have the reflection on the screen in the sunset, when mainly the events will take place, and considering the cardinal points, the screen is located on the south side of the paddock area.



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_ back second-use

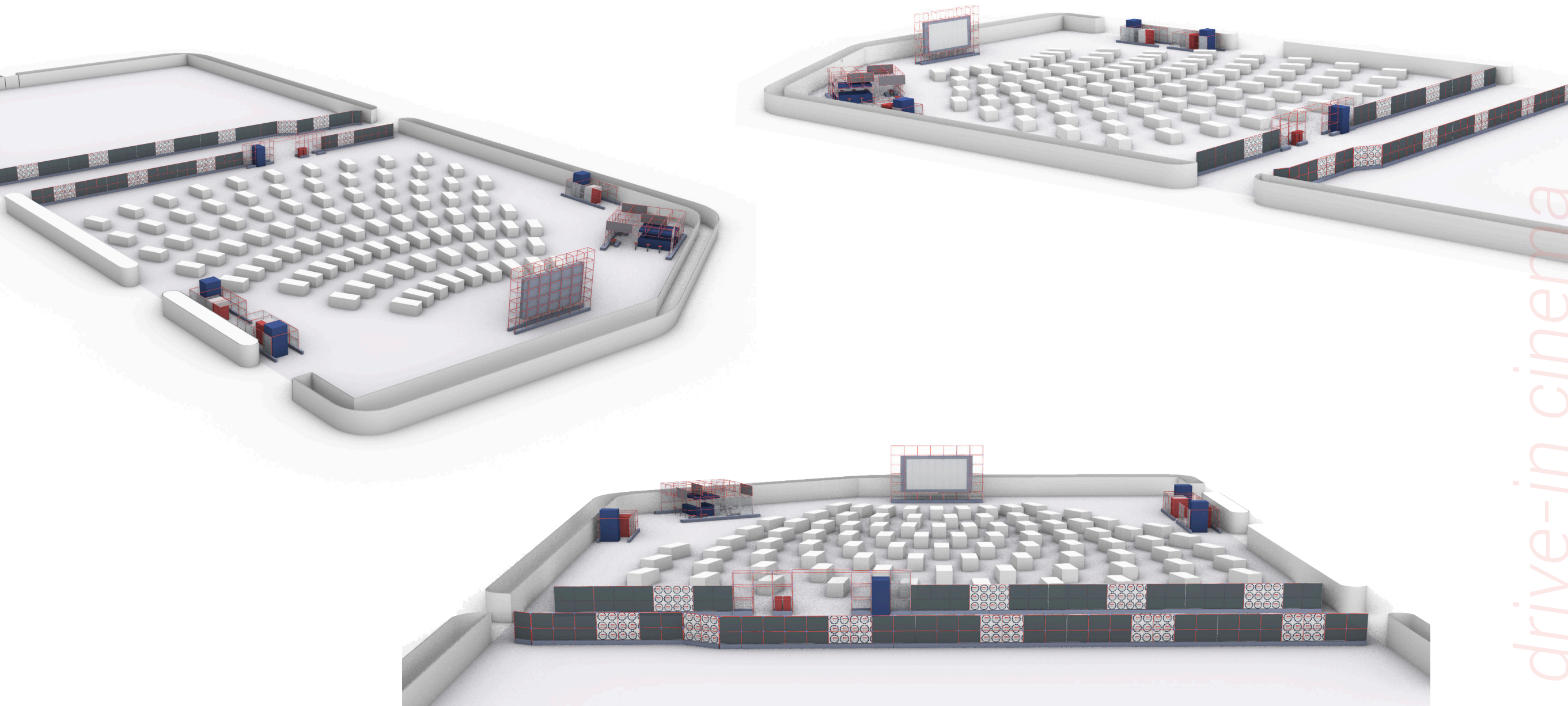
Another advantage of this location is that in this way the back of the screen could be used for the advertisement, clearly visible from the entrance, exactly like drive-in cinemas did in the past. Infact, they were located close to the highways in order to be visible when passing by and attract people, who actually where driving an automobile, the mean necessary to go in that place.



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drive-in cinema

visualizations

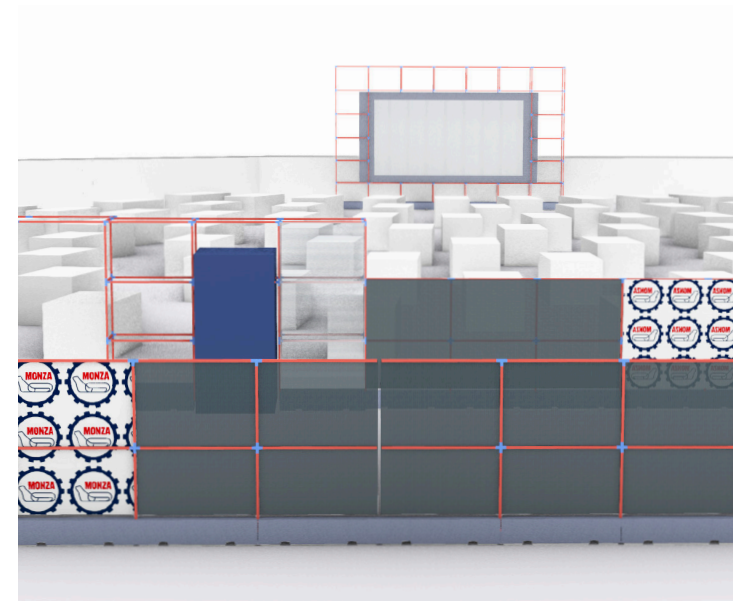
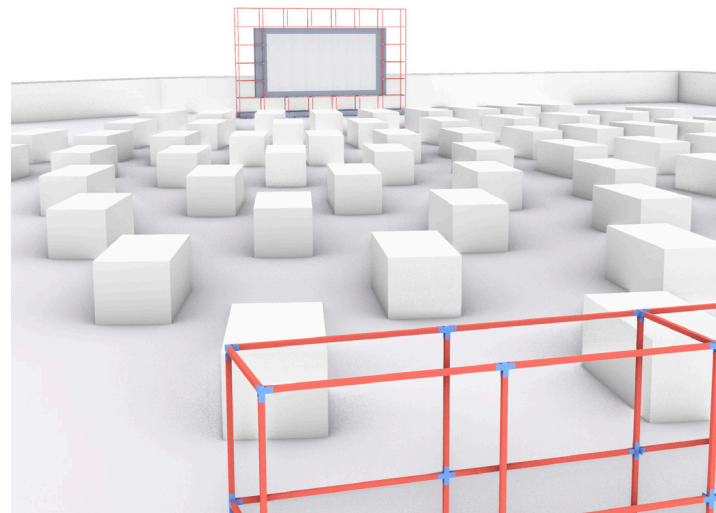
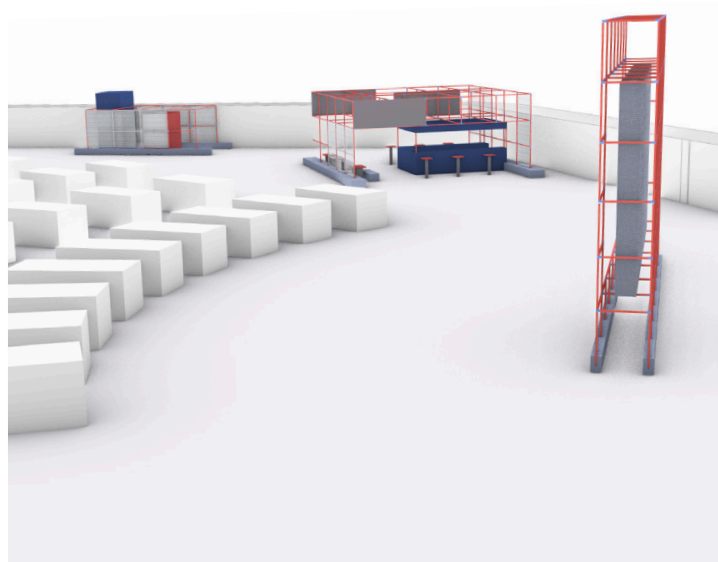


drive-in cinema

drive-in cinema

visualizations

264



* closer visualization of the drive-in cinema

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During the Double Degree Program with Tongji University of Shanghai I developed an other thesis, which title is **"A research on how residues produced by coffee companies can be exploited to design future coffee stores"**.

The work aims to investigate how environmental design tools could be used to research an innovative way to reuse coffee residues, coffee grounds and waste packaging, which are growing exponentially, particularly in China, as well as coffee stores.

The reuse of coffee grounds could define a new strategy for constructing future shops, creating a perfect example of a circular economy system, which will also avoid the vast amount of waste. Moreover, it also aims to understand and define different roles that design is playing in this new innovative process, investigating a variety of different contexts and environments, both in the Asian and European reality.

research

general view

The global consumption of coffee significantly increased worldwide in the last ten years. Notably, Chinese coffee consumption increased by more than 1000% between 2008 and 2018. That lead to a rise in the number of roasters and coffee shops. For example, Starbucks and Luckin, a Chinese chain, nowadays have about 3300 stores in China, but they are planning on opening 10000 stores by 2022.

Most of the coffee drinkers in China are Millennials, and they correspond to 75% of users that order coffee using apps, which means that coffee bought for delivery is very common. Consequently, the amount of waste packaging material to be disposed of went up, resulting in a significant environmental concern, adding to the massive amount of coffee grounds produced every day in-store and to delivery.

¹ Statista, "Coffee Consume Worldwide". (May, 2020), retrieved from <https://bit.ly/3sP6jc0>

² Grant Tasmin, "Entering China's Emerging Coffee Market". (February 13, 2020), retrieved from <https://bit.ly/3rOS70E>

³ Grant Tasmin, "Entering China's Emerging Coffee Market". (February 13, 2020), retrieved from <https://bit.ly/3cK19d8>

⁴ Song Guanghan, Hui Zhang, Huabo Duan, Ming Xu, «Packaging waste from food delivery in China's mega cities», Resources, Conservation and Recycling. (March 2018): 226-227, Vol.130.

⁵ South China Morning Post, «Green groups raise alarm over China's growing e-commerce waste mountain», Resources, Conservation and Recycling. (November 2019)

Global coffee consumption

Volume of coffee seeds consumed globally every year. It is expected to amount more by 2025.¹



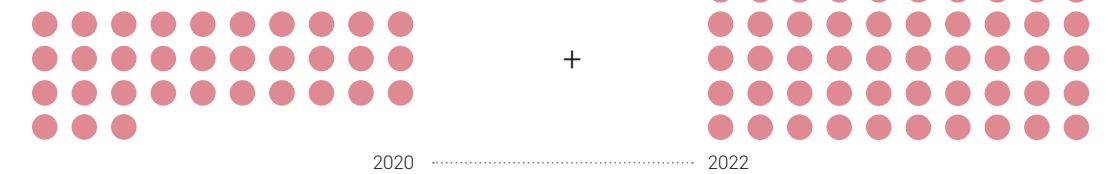
Chinese coffee consumption

Coffee consumption increased by more than 1000% between 2008 and 2018.²



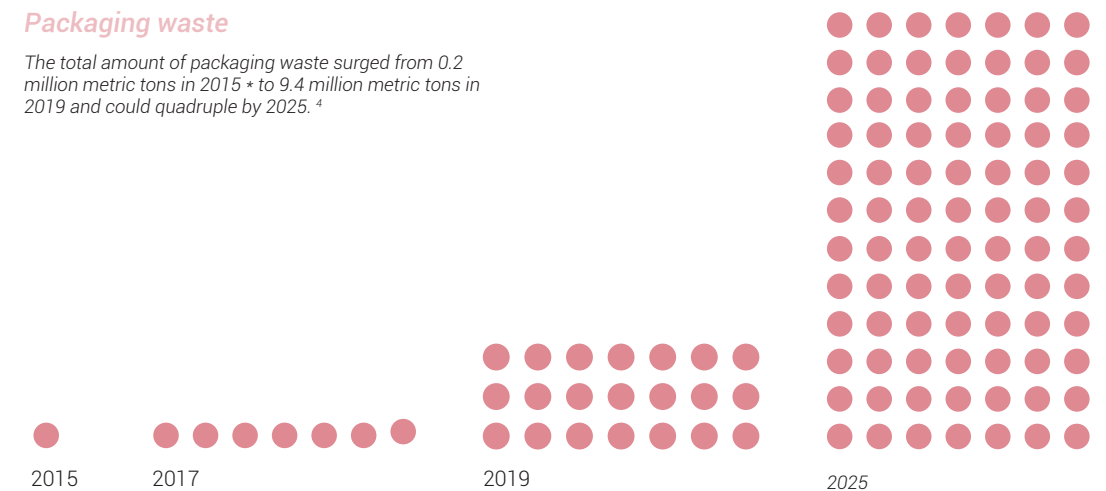
Rise of coffee shops

Starbucks and Luckin nowadays have about 3300 stores in China, but they are planning on opening 10000 stores by 2022.³



Packaging waste

The total amount of packaging waste surged from 0.2 million metric tons in 2015 * to 9.4 million metric tons in 2019 and could quadruple by 2025.⁴



research

innovative reuses

The project intends to serve proposals for the innovative reuse of coffee residues in the rising coffee stores themselves, distinguishing between basic types of reuse, such as for the products or surfaces, and specific reuse, like sound-absorbing panels.

For specific reuses, the coffee powder functionality as sound-absorbing material was considered. Porous material can effectively

be used to absorb sound, and some studies demonstrate that it is possible to do that through coffee waste by developing a composite material manufactured using other natural resins mixed with it. nother material derives from coffee grounds liquefied. The latter's lignin content influences the rigid polyurethane foam's structure and mechanical properties; for example, it is sound absorbent.

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Coffee powder is a **porous material** that can effectively be used to **absorb sound** thanks to its combination with resin. This study presents a new construction material manufactured through coffee waste that is in turn applied to cafes where the coffee waste itself is produced.

* "Circular reutilization of coffee waste for sound absorbing panels: A perspective on material recycling", *Environmental Research*, 2020.

The main objective of the analyzed study was to evaluate the **sound absorption** properties of rigid **polyurethane foams** (PUFs) produced from crude glycerol (CG) and/or liquefied **coffee grounds** derived polyol (POL). The lignin content of POL proved to have a major influence on the structure and mechanical properties of the foams.

* "Sound absorption properties of polyurethane foams derived from crude glycerol and liquefied coffee grounds polyol", *Polymer Testing*, 2017.

Specific composite created from the spent coffee grounds ultrasonification extraction. Through this process coffee oil and a new form of spent coffee grounds is produces which, mixed with polipropylene, will be extruded and then injected to create **composite** products of various types.

* "Effect of oil extraction on properties of spent coffee ground-plastic composites", 2016.

Using coffee grounds as organic residue has been proven to be **effective for pore formation** in clay body, increasing its **insulating properties** yet maintaining acceptable mechanical properties.

* "Incorporation of coffee grounds into clay brick production", 2011

Biodegradable plastic

Scientists have been working on making plastics and chemicals from cellulose, and coffee grounds were used as a source for cellulose.

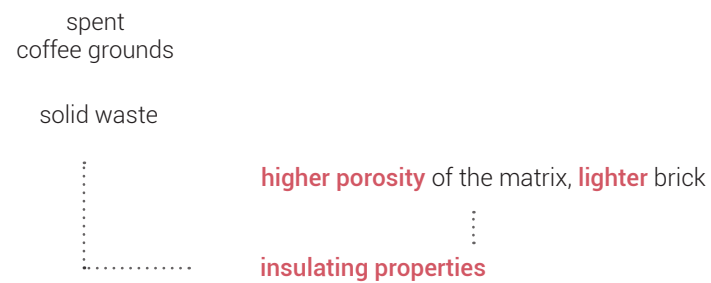
They extracted cellulose and mixed it into polyvinyl alcohol, a polymer used to produce biodegradable plastics, to make a composite plastic.

* "Structural characterization of cellulose nanofibers isolated from spent coffee grounds and their composite films with polyvinyl alcohol: a new non-wood source.", *Cellulose*, 2020

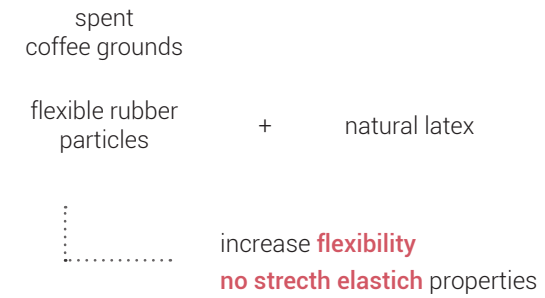
research

exploitable properties

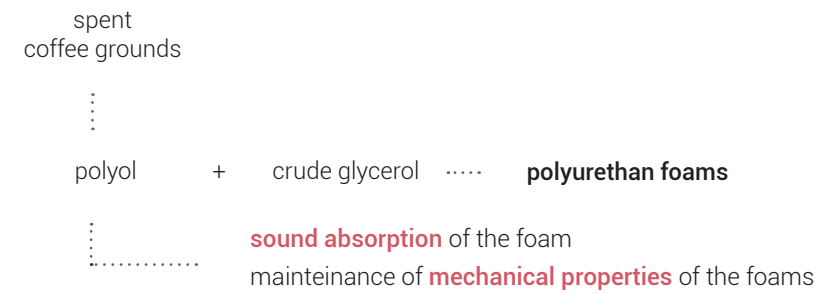
Coffee grounds have several properties that could be exploited and an analysis of the ones that resulted more relevant to design sound absorbing panels was done. Because of its higher porosity it could confer insulating properties, or absorb the sound, but it also has thermal properties and resists to water.



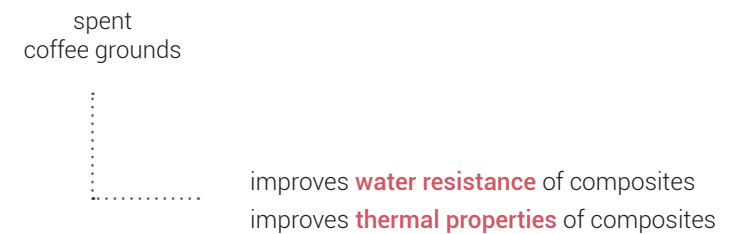
* D. Eliche-Quesada, L. Pérez-Villarejo, F. J. Iglesias-Godino, C. Martínez-García and F. A. Corpas-Iglesias, "Incorporation of coffee grounds into clay brick production", 2011.



* R. Leemasathaporn, T. Tachatiemchan, "A Preliminary Study on The Application of Coffee Grounds in Latex", 2016.



* N. Gamaa, R. Silva, A. P.O.Carvalhoc, A. Ferreira, A. Barros-Timmons, "Sound absorption properties of polyurethane foams derived from crude glycerol and liquefied coffee grounds polyol", Polymer Testing, 2017.

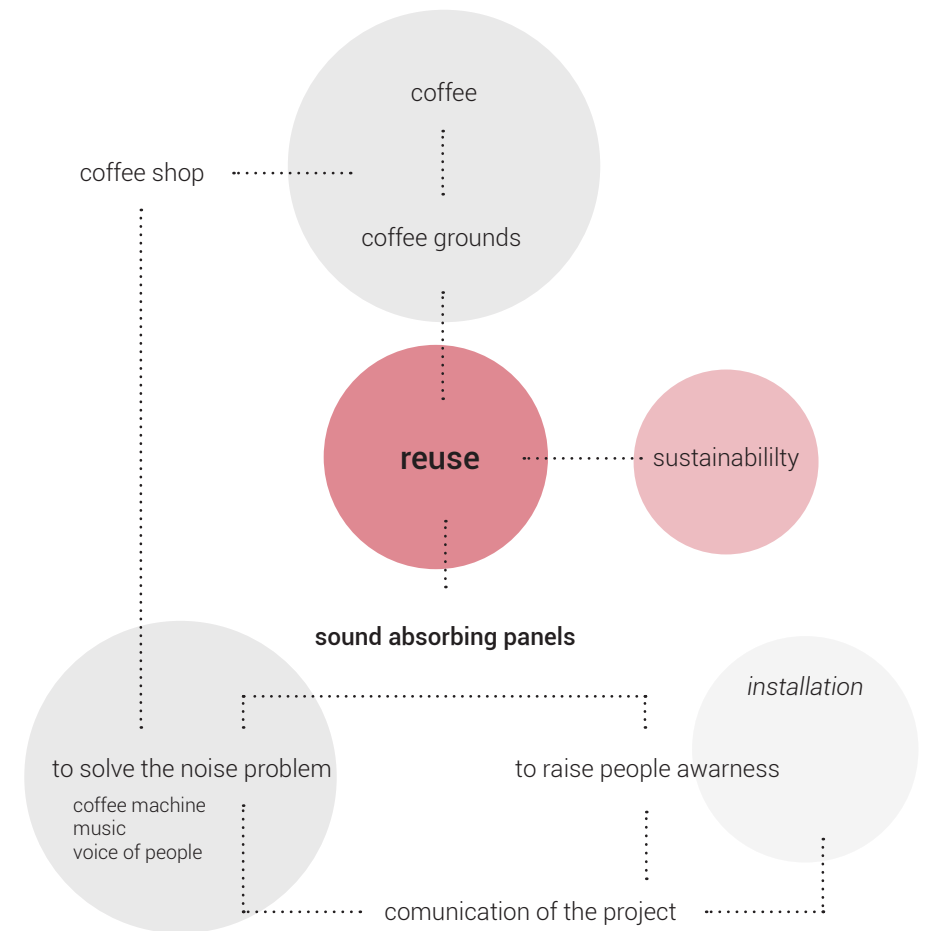


* H. Wu, W. Hu, Y. Zhang, L. Huang, J. Zhang, S. Tan, X. Cai, X. Liao, "Effect of oil extraction on properties of spent coffee ground-plastic composites", 2016.

the process

general view

Thanks to the research resulted that the reuse of coffee grounds is restricted in few fields, and innovative ways to recycle those residues could be proposed, thanks to its enormous potentiality. Another relevant result is that the two big coffee shops companies established in China, Starbucks, and Luckin, are planning to open several stores in the next years. These two statements could be the starting point for a reflection about innovative reuses of coffee grounds, that may be useful for the new coming stores, not to use other materials that will need to be disposed of again in the future. Particularly, is considered the coffee powder functionality as sound-absorbing material. Porous material can effectively be used to absorb sound, and some studies demonstrate that it is possible to do that through coffee waste. These sound absorbing panels could, then, used in the new coffee stores, and it represents an example of circular economy system.



raw proposal

The treated coffee grounds are of the porous sound absorbing type, thanks to its compression degree, so the sound waves that hit the panel are softened at the first layer and absorbed by the second layer; in the first option one layer is defined by more compressed coffee, while in the option B it is represented by the pressed wood fiber. Infact, this feature is owing to the different densities of the materials.

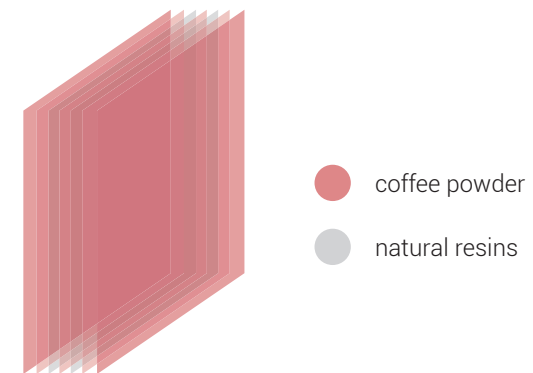
The sound-absorbing feature is also significant inside the Monza racetrack, for space itself characterized by this peculiarity due to the noise produced by cars, but also within events that take place in this space. Some examples may be the events considered in the thesis regarding entertainment, such as open-air cinema (multi-movie) or concert performances.

In both cases, the sound is a characteristic that could be a problem: in the case of concerts, it could disturb the spaces and events adjacent to the area, while in the second case, there could be a problem in terms of sound between the different rooms of the multi cinemas.

Therefore, an idea could be to use the sound-absorbing panels produced with the coffee grounds also as skins for the versatile temporary system inside the Monza racetrack.

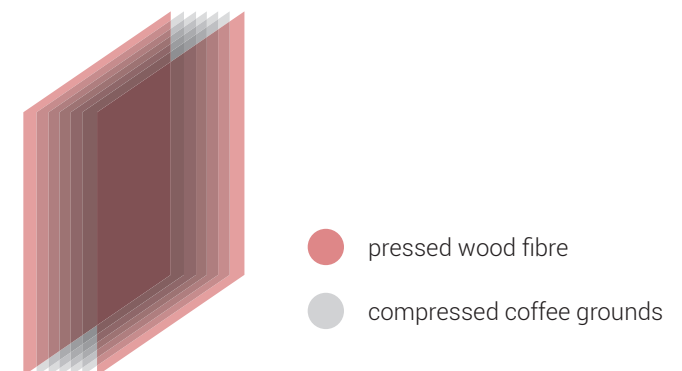
A - panel with natural resin

Coffee powder is a porous material that can effectively be used to **absorb sound** thanks to its combination with **natural resins** deriving from plants.



B - sandwich panel

The panel is made up of two layers of environment friendly **pressed wood fibre**, with a wadding layer of **compressed coffee grounds** in between.



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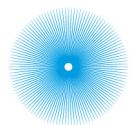
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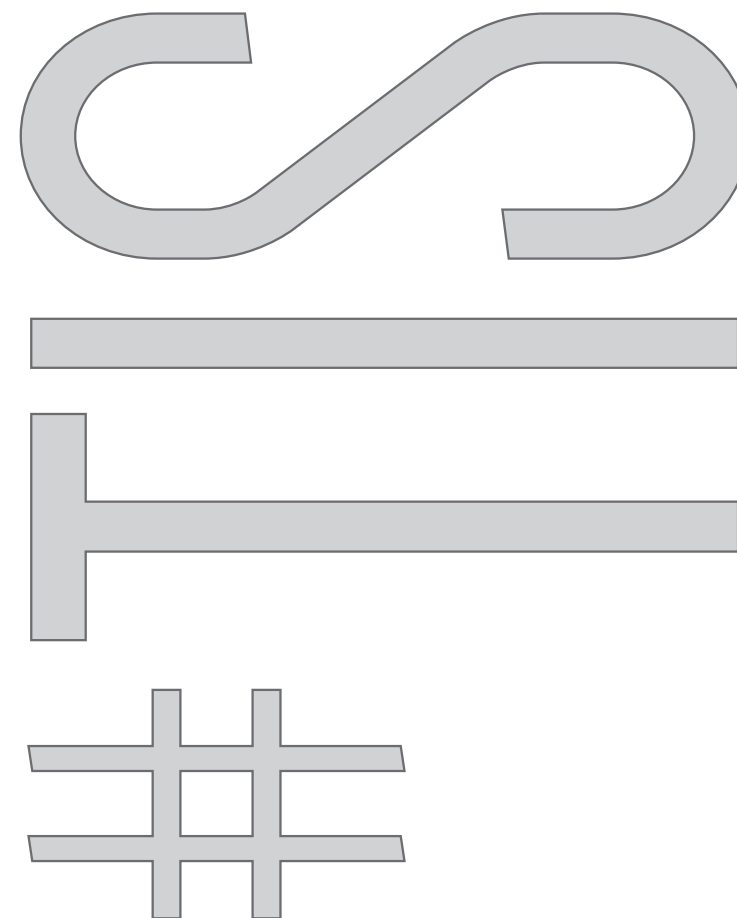
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