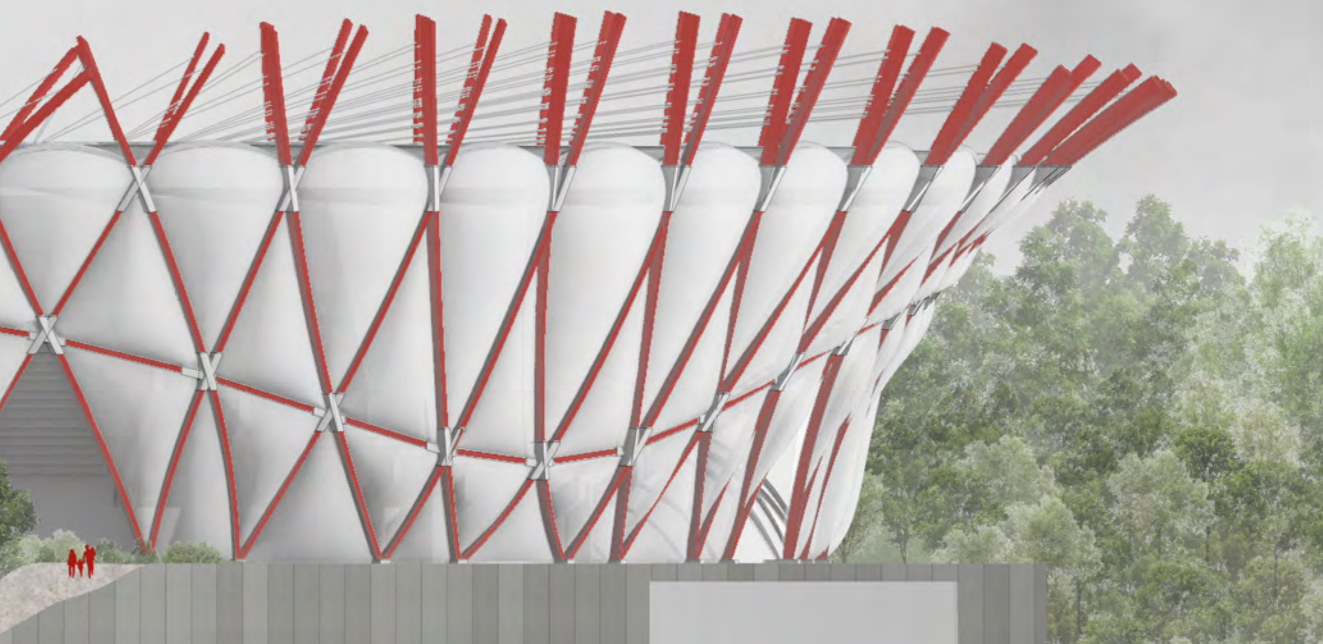
NEW AALBORG PORTLAND PARK



NEW AALBORG
PORTLAND PARK

Master Thesis Project, New Aalborg Portland Park

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Abstract

This thesis explores the design of a football stadium that integrates sustainable building practices, architectural innovation, and urban connectivity. The project investigates how a stadium can be both environmentally responsible and architecturally expressive, while also acting as a catalyst for local turism and social engagement. Central to the design is the implementation of passive strategies, life cycle assesment, and carefully considered material choices. These elements support long-term sustainability and aim to set a new benchmark for stadium architecture.

Located at the site of the former Racecourse Track in Aalborg, Denmark, the project transforms a singular functioning space space into a vibrant public park. This new urban landscape not only supports match-day activity but also provides recreational value to local residents year-round. The stadium itself is designed with sustainability as a core principle, incorporating Design for Disassembly to ensure that key structural components can be reused or recycled.

The design process was guided by an ongoing dialogue between technical performance and architectural ambition. Iterative testing and close integration of structural and environmental strategies allowed for a holistic design proposal. While some sustainable ambitions could not be fully realized within the scope of the project, the result is a comprehensive vision for a stadium that engages with its context, meets future demands, and demonstrates the urban potential for large-scale sports architecture.

Table of content

Reading guide

Disclaimer:
In this thesis, ChatGPT has been used as a grammar tool to proofread the text, catch spelling mistakes, and help ensure coherence and clarity.

This project is divided into three parts. Firstly, a program which outlines the intention of the project, the feasibility for the project as well as knowledge and analyses on relevant topics. Secondly, a process containing initial thoughts through drawings as well as technical calculations that have evolved as the design process progressed and knowledge developed. Lastly, a presentation containing illustrations of the final design proposal.

The report contents are divided into the following:

An introduction to the feasibility and the methodology used in this project.

Analysis of the existing stadium Aalborg Portland Park, diving into its history, the fan culture, architectural references, the stadiums technical qualities as well as its functions and user. The site of Racing Arena Aalborg, mapping the microclimate conditions, infrastructure and the municipalities plan for the site.

Theory section about stadium design, looking into requirement from different federations, literature on how to design with sustainability and circularity in mind, leading into the design drivers that will lead the design process.

Process that shows the initial thought through drawings that has evolved as the design process progressed, and new insights and knowledge were gathered. As well as goal orientated research to make decision on what materials to use, technical optimization and designing for safety through evacuation and inclusion.

Presentation, where the final design proposal is presented through plans, sections, elevation, diagrams and renders.

Throughout the report, architectural consequences or conclusions are marked in an red box, with the purpose of showcasing what is gained from the section.

INTRODUCTION

In November 2023 AaB's chairman released a press statement describing visions of a new Aalborg Stadium for 30.000 spectators. The new stadium is set to be a part of a new area intended to host elite level sport events, which besides a new stadium for AaB also includes a new MultiArena for Aalborg Handball, along with residencial blocks. The project is supported by the municipality, the Danish Football Association, Aalborg Pirates, SIFA and Racing Arena Aalborg, who will relocate and leave room for this new area (Estrup 2023). Along with this vision C.F. Møller have developed a conceptual masterplan over the new sport and culture area.

This thesis will take an offset in said vision with the intend of designing the stadium and its surroundings, functioning in the conceptual masterplan.

The project begins with an assessment of the overall need for a new stadium, and how the task is approached. All while uncovering the current issues of Aalborg Portland Park that are wished to be improved in the new stadium, along with gaining knowledge about Aalborg Stadium in a historical context.

Illustration 001 - Introduction

Feasibility

In an article from “The Danish Insitute for Sport Studies” published in 2017, a senior analyst from the institute did an analysis of the attendance on the stadiums in the Danish Superliga. The results showed that only two of the 253 matches in a season had more than 90% attendance. The average attendance across all the stadiums in the league for the season was 39%, meaning that over half of the seats were empty at every game (Gjersing Nielsen 2017).

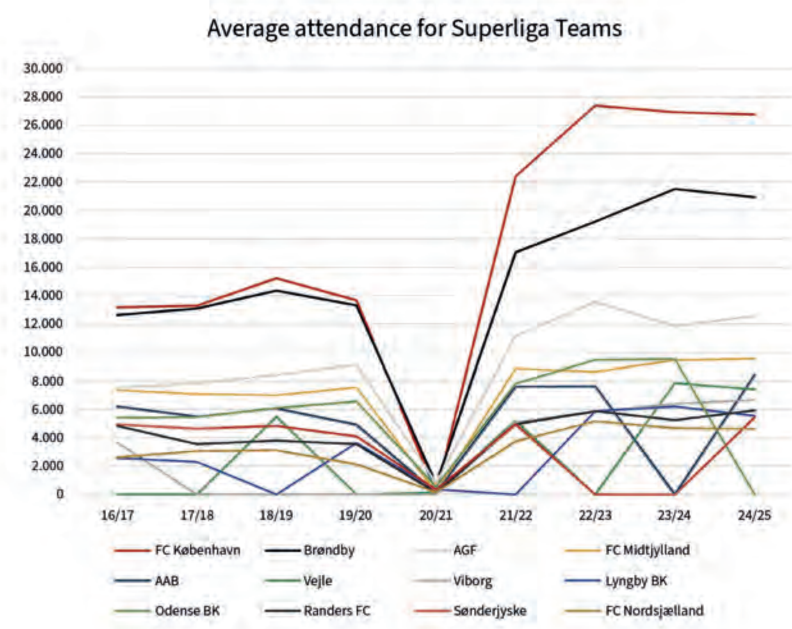
The article also describes a phenomenon called “crowding-in effect” meaning that if the consumer satisfaction is affected by the demand of tickets for a game. A long queue or the knowledge of that the tickets for a game I sold out, can by itself improve the demand for tickets for a club’s games. Full stadiums can therefore be a factor to improve spectator demand, but it also works the other way, if spectators are aware they can always get a ticket right up to kick off, a big part of the fans will wait until the last minute to decide whether to attend the match (Gjersing Nielsen 2017).

But in the years after this survey was done, the country was affected by the pandemic, leaving the stadium to function under restrictions for how many people could attend a match and how close they could sit. That took the average attendance from around 6.500 down to 4.700 the first year of the pandemic and 1.200 the second year. Those two year left the Danish football fans hungry to attend games again which meant the 2022-23 and 2023-24 seasons saw the highest average attendance ever recorded with over 10.000 average spectators (Worldfootball.net 2025).

Along the increase in average attendant at games, the bigger clubs in the league have also experienced and increase in season tickets. In 2018 Brøndby IF sold 12.000 season tickets and 15.500 in 2024. FC Copenhagen have sold more than 16.000 and are aiming for an average attendance of over 20.000 spectators (Ritzau 2024).

Together with the rise in season tickets for the clubs, and the average attendance per league match is rising. The Danish Football Association (DBU) has the intention to bid on big international tournaments, and, as it stands right now, Denmark doesn’t have the facilities to bid on the men’s European Championship, but they intend to bid on the women’s European Championship for a shared hosting with Sweden, that combined offers eight stadiums for the tournament.

The European federation UEFA demands that one of the eight stadiums must seat 50.000 spectators, three stadiums with a capacity of 30.000 and four stadiums with 20.000 seats. That is achievable as it is right now with Sweden having five of the stadiums and Denmark three. It is not a criterion that Denmark and Sweden provide an equal amount of stadiums, but it makes the process of delegating the matches between the countries easier. In Denmark one more stadium of 30.000 is therefore needed, as Parken, Brøndby Stadium and the new Aarhus Stadium makes up the remaining 3 stadiums, thereby improving the possibility of hosting the Women’s European Championship in 2029 (Idrætsmonitor & Ritzau 2024).



It is clear, that there is a growth in the average attendance, and that the pandemic created a hunger within the fans to attend the matches in person again instead of watching from home. That, together with DBUs ambition of hosting international tournaments as a shared host, creates the demand for bigger stadiums in Denmark, and therefore as Denmark's fourth biggest city it makes sense to build a new stadium in Aalborg.

Illustration 002 - Atendance Graph

Goal Oriented Stadium Design

Designing a stadium is a complex architectural and engineering task requiring a holistic approach. One key aspect is optimizing spectator viewing accommodation to balance profitability and comfort, ensuring good sightlines while maintaining structural integrity. The seating layout must also align with infrastructure for smooth evacuation and accessibility to amenities. This interdependence of engineering factors results in complex design-space solutions in need of structuring. To structure the plausible design spaces, Performance-Based Generative Design Systems (PGDS), have been used, as:

These systems directly apply the goal-oriented design method, in which the designer establishes performance goals for a given design and allows the system to automatically search that design's solution space for the solution that best meets the desired objectives. (Santos, Schleicher & Caldas 2017).

PGDS consists of 3 steps. Firstly, it requires a model able to generate a lot of design variations to be analyzed. Secondly, it requires a way of simulating said variations, and lastly a search mechanism assessing the results, guiding the newly generated design variations towards the design's solution space that suffice the set objectives.

In a stadium design context, it means that while searching for the design solution reaching the, for instance, desired level of sight quality, it takes into consideration the effect the solution will have on the stand's sectional geometry in relation to structural loads, etc. meaning that engineering interdependency is considered, throughout the PGDS.

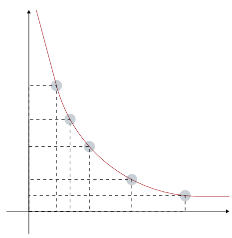
To administer the generative model, the parametric tool Grasshopper is introduced. By doing this, it allows for dynamic supplements of input data, achieved through multiple rounds of iterative studies. In Grasshopper Wallacei is applied, a plugin functioning as an Evolutionary Multi-Objective Optimization and Analytical Engine, thereby ensuring that the reiterated design variations are guided towards the set objectives.

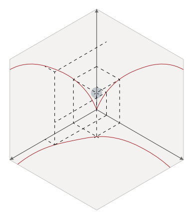
Wallacei is using Non-Dominated Sorting Genetic Algorithm, which in the scopes of this project, helps by highlighting the tradeoffs in each aspect, as illustrated on illustration 002, where the principal tradeoff is exemplified with the optimization of enhancing the quality of sight, while minimizing the use of concrete for the stands.

Though, as the design process becomes more complex, adding more axes to the otherwise illustrated two-dimensional complex, it requires a display of multiple dimensions, which Wallacei helps illustrate as seen on illustration 004-007, in which multiple dimensions call for parallel axes, when exceeding three dimensions.

If the optimization was made as multiple "single objective" the process would have resulted in multiple parallel coordinate plots, or PCP diagrams, not necessarily including the tradeoffs in one objective-optimization would have in a parallel optimization, and vice versa. Using a single, multi-objective, this issue is solved in the form of a diamond chart, showing all the multidimensional tradeoffs across the objectives.

From the diamond chart, the number of axes becomes larger as the design complexity improves, resulting in more genomes that are sought to be optimized. Then, to filter the plausible design solutions, individual design space ranges are applied, to limit the searching pile, to solutions conforming to all set objectives, as highlighted in illustration 008.





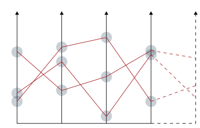
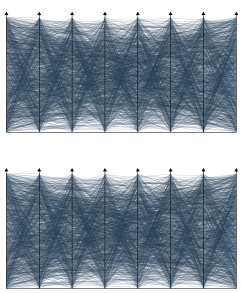
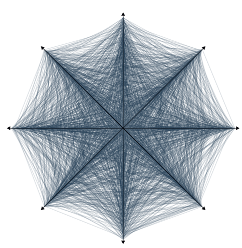


Illustration 003 - Two-dimensional optimization complex
Illustration 004 - Three-dimensional optimization complex
Illustration 005 - PCP for multidimensional optimization complexes





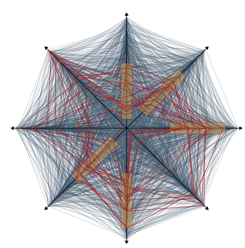


Illustration 006 - Multiple Parallel Coordinate Plots
Illustration 007 - Parallel Plotted Diamond Chart
Illustration 008 - Plausible Solutions

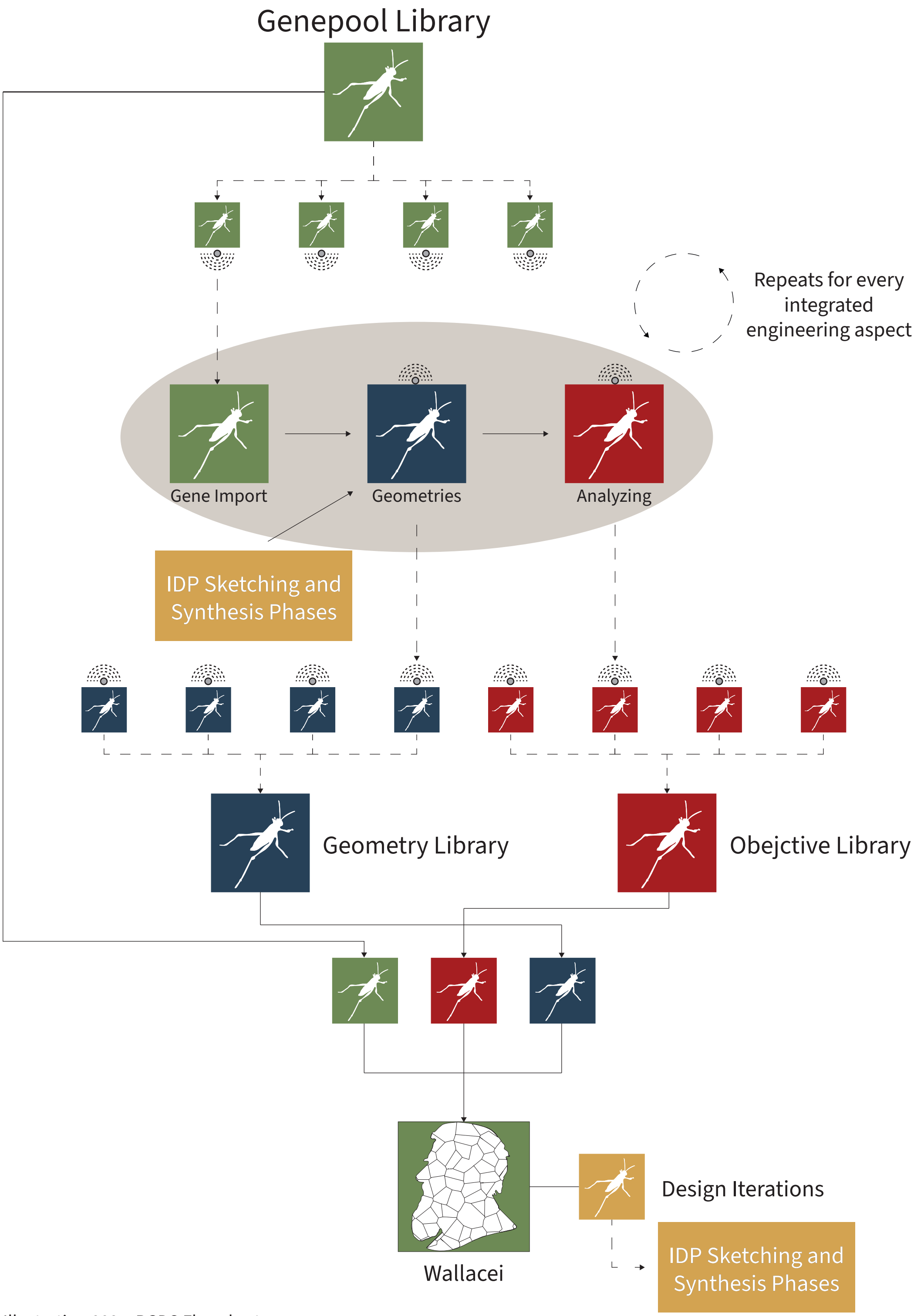


Illustration 009 - PGDS Flowchart

Performance-Based Generated Design Spaces

Throughout the design process, the various design spaces have been determined for each of the included fields of engineering. The flow chart on illustration 009, details the design process of goal-oriented design.

Firstly, the genepool library is defined, by setting up a model from where all the various parameters are orchestrated. An example could be the geometry of the stands, based on parameters such as step height, step length, count of rows, thickness of stand elements, and the planar shape of the stadium bowl. The genes are then used to generate a geometry, that is used as the Wallacei phenotypes.

The parametric model is then simulated upon, via another analytical parametric model that analyses the performance of the geometry based on the determined design spaces. The following example could be the stands performance in relation to the quality of sight, or steepness in relation to evacuation or material consumptions.

As previously mentioned, the sets of parametric models are then applied to the Wallacei, that searches the solution spaces for plausible solutions via multi-objective optimization. Following the example of the stands, Wallacei then generates new geometries, while searching for the optimal structure of the stands, that perform best across all aspects.

From the searching algorithms, the top-performing geometries across all included fields of engineering, are then used as benchmarks for the architectural design process, that follows its own trail of tracks.

Throughout the thesis the design process is therefore split into two parts. First the design space defining session, in which all the parametric boundaries are described, both technically and consequentially to the architecture design aspects of the stadium. Then secondly, the design process describing all the architectural sketching processes, and how the generated design solutions combine with the architecture.

The generated design spaces are only possible through a structured hierarchy. Although the overall process of generative design spaces, is considered holistically, as described previously, where all the simulations can affect each other, there is an unspoken hierarchy in terms of times consumption. Meaning that the theory of design spaces suits best for the early stages of the design, and as the design complexes, the time consumption for each generative iteration grows exponentially.

Aspects such as the structural calculations take considerably more time to reiterate compared to e.g. sightline evaluation. The same goes for the evacuation simulations. Therefore, the aspects having the biggest impact on these particular simulations, should be locked early in the design process, and then optimize the structural elements independently from the rest, as the process of reiterating and optimizing for all objectives would take up too much time from the project, compared to results that are to be assumed.

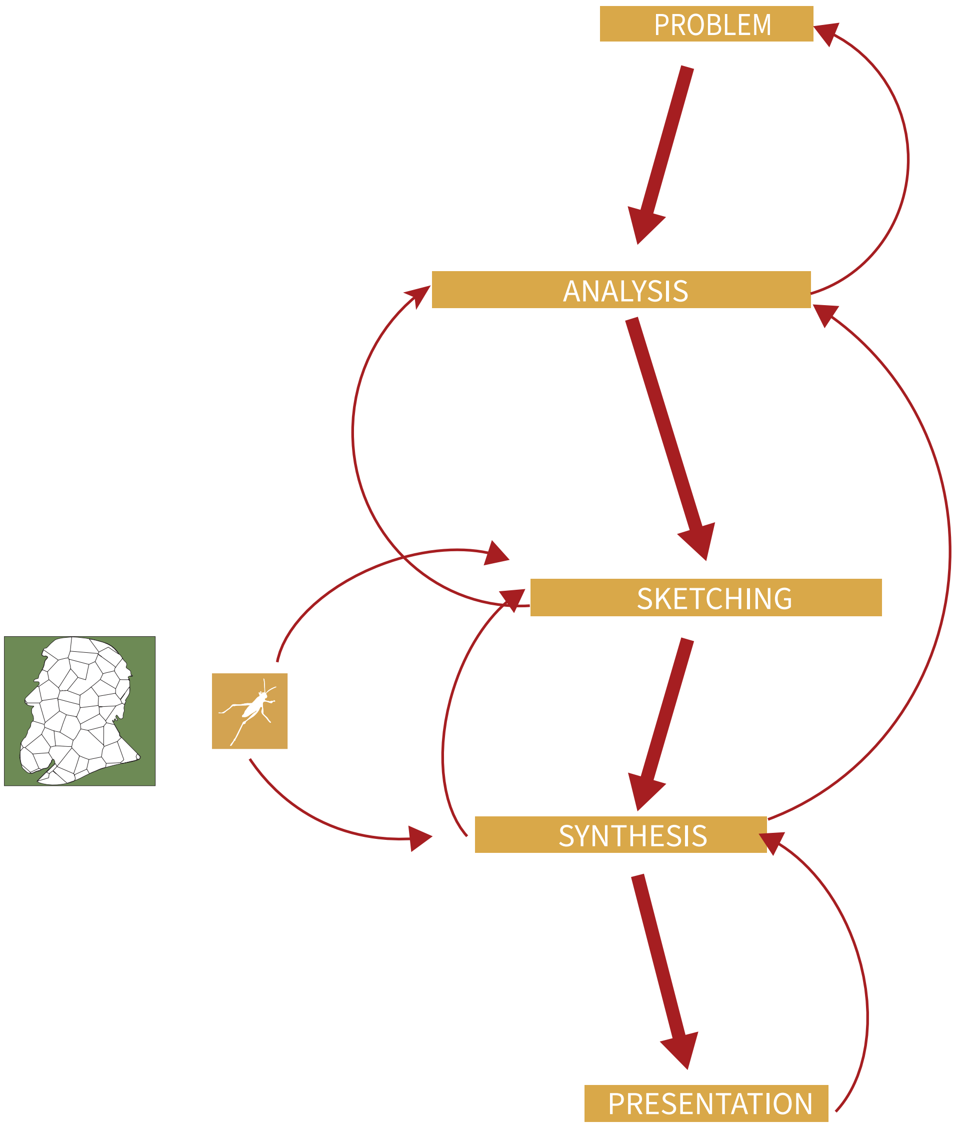


Illustration 010 - IDP

Methodology

This project draws inspiration from the Integrated Design Process (IDP). The purpose of this method is to ensure that the design processes of the architect and the engineers are integrated, resulting in a cohesive and holistic outcome. The methodology acknowledges the inherent complexity of the design process and divides it into five phases to facilitate a clearer understanding and promote a comprehensive and collaborative approach.(Knudstrup & Hansen 2005)

Problem:
The first step of a project is the description of the problem or the project idea, this is where the initial research question is formed.

Analysis:
The analysis in this project is divided into 3 aspects, the existing stadium, the site and how to design a stadium. This is where all the information is gathered regarding history, the site, microclimate, municipality planning, along with literature on how to implement sustainable building practices. This is boiled down into design drivers that will help shape the project in the sketching phase.

Sketching:
During this process the architectural and engineering aspects are investigated and iterated on to test different design proposals through both hand drawings and 3D modelling. This is done repeatedly to ensure that all paths are investigated to ensure a holistic approach and a design that solves the initial problem. Supporting the sketching phases are also the inputs gained from the PGDS.

Synthesis:
This is where the project starts to find its final form due to the inputs from the previous phases. Here, plans, function placement, technical calculations and aesthetical choices are held up against the design drivers and research question from the previous phase.

Presentation:
The presentation part contains the production of the final material, sections, plans, elevation, renders etc. This is where the final design proposal comes to life and where it becomes clear if the design drivers are visible in the final design. In the end a reflection of the design process and proposal is made to highlight what has been successful and what could have been improved

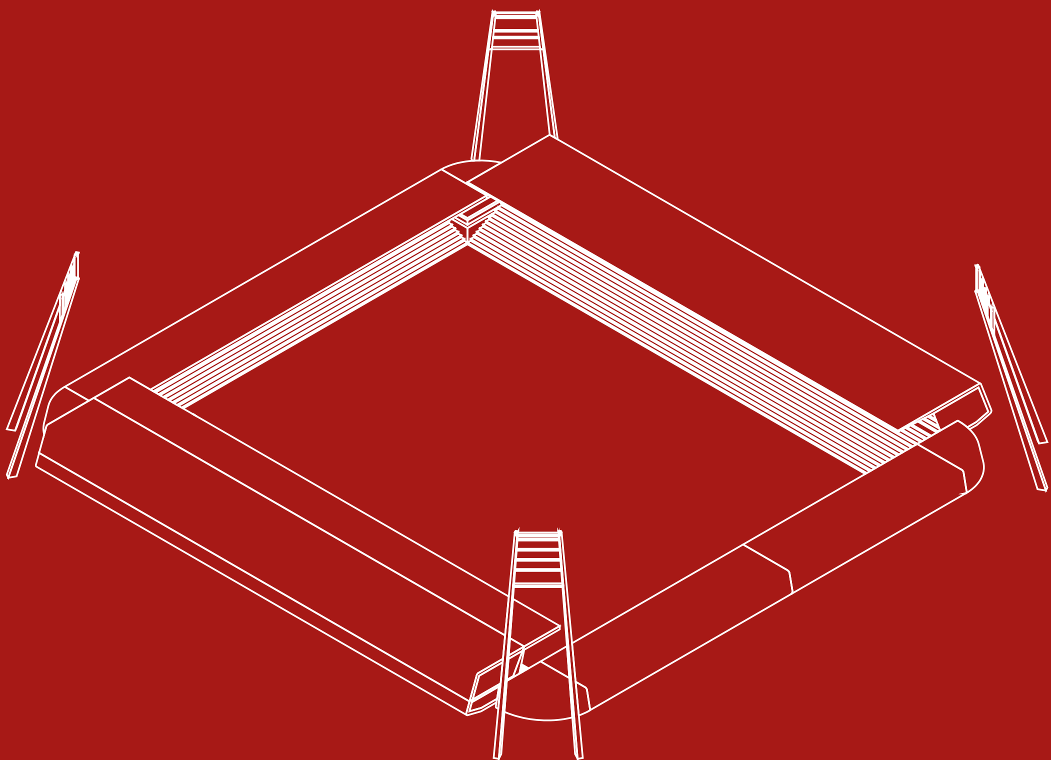


Illustration 011 - Aalborg Portland Park Chapter

AALBORG PORTLAND PARK

In this section the stadium's history is explored, along with its architectural references. The stadium stands are analyzed to evaluate their sightline translating into spectator enjoyment, along with a user and function diagram that provides insights into the spatial organization and usage of the stadium.

”...the remaining part of the property shall then be designated for public use by the city’s citizens, as we wish it to be laid out and planted as a public park with large open spaces or lawns for play, tennis, football, softball, and other summer and winter sports.”
- (Hansen 1996)

History of Aalborg Stadium

Aalborg Portland Park has been in its current location for more than a century, meaning that the stadium has seen dense city development around it throughout its history. Before that, AaB's residency was at the old military training field between Karolinelund and Østre Anlæg, where they played until 1920, when they relocated to the current location (AaB Supportclub & Wedege 2021a). The reason for relocation is due to Harald Jensen, former giant of the spirits-industry in Aalborg. Due to family issues, Harald decided to testament his estate in the western part of Aalborg to the municipality on the condition that the land should be reserved for sports and cultural activities.

This condition has been somewhat honored, as the land now known as Haraldslund, is housing both a swimming center and Aalborg Portland Park. The land around Haraldslund has, in contrast, seen large developments in residential blocks, which today, due to its popularity, needs space to evolve, while the municipality only allows expansion through strict transformation of existing buildings (Aalborg Municipality 2025).

Due to the development in the near context of Haraldslund, AaB has no viable option but to relocate the stadium should the decision be made to expand it.

Illustration 012 - Map of Aalborg Stadium location

Illustration 013 - Earliest representation in stripes

Illustration 014 - AaB Scarf Culture

Illustration 015 - AaB Ultras Fan march

AaB Fan Culture

In the beginning, AaB started as a cricket club, established by English engineers working in Aalborg in 1885, before changing the name in 1899, now only focusing on football. (Laden Jensen 2025) Back then the players played in all white shirts, as they were cheap and accessible. Later on, the stripes were added to distinguish from the other local teams, with the red color derived from Aalborg's old coat of arms dated as early as 1358. (Wulff 1867) & (Danmarks Nationalleksikon 2025) Illustration 013.

Playing in these red and white striped shirts, AaB rose through the divisions, and by 1926 winning their third consecutive Jutland championship. Due to the success on the field, the number of spectators increased, creating a tradition for the local working class to go watch their team play at the weekends. Wishing to express their loyalty towards the club, spectators started to wear ribbons or hats.

Especially, scarves took a liking as the cold, Nordic weather called for clothes that would keep fans warm, when attending matches. The trend like most football trends, developed in England, where the term "Granny Scarves" became popular in the early 1920s, describing homemade scarves knitted and braided with the club's name and colors. (Scoble 2021)

In Aalborg these scarves are still to this day a large part of the fan culture, as the scarf is almost a mandatory accessory when standing at the Western stand. Before every match, every AaB fan across the stadium rises and lifts their scarf in honor of the club's hymn that plays right before kick-off, a tradition that is uphold in most clubs around the world, most famous the "You'll Never Walk Alone" experience at Anfield in Liverpool, England. Furthermore, as seen on the image at illustration 014, the eastern stand, except the away fan zone, is dedicated to historical AaB scarves, as the back wall of the stand is decorated in its entirety with old and new scarves, representing the club's culture and merits.

Another pre-game ritual amongst the home fans is the fan march departing from Aalborg's party street Jomfru Ane Gade, in which the fans kickstart their matchday drinking. They then march as depicted on illustration 015, marching through Aalborg Vest on Kastetvej with chants and firework, firing up the rest of Aalborg letting the residents know that today is matchday. Along the route is Aalborg Vestby station from where all fans from Brønderslev and Hjørring that arrive by train, join the march towards the stadium.

The deep rooted fan traditions - such as the pre match march and the lifting of the scarves - highligt the importance of designing with them in mind. Therefore, there should be a plaza for the fans to arrive to after the march, a defined route for the fans to march and keeping the tradition with playing their song before kickoff.

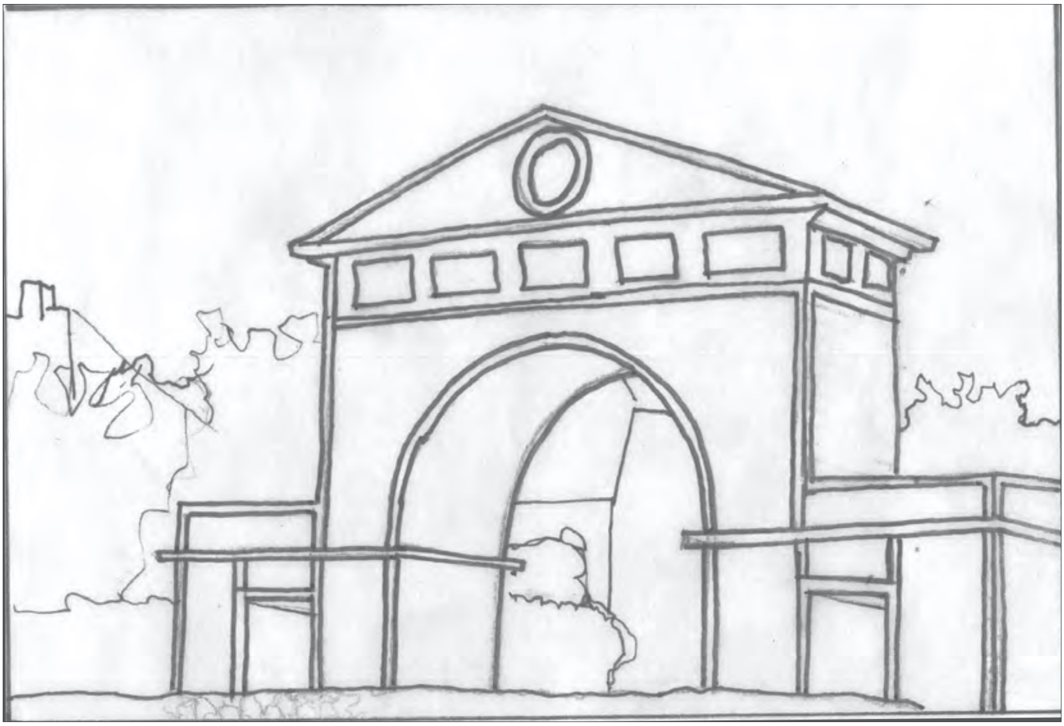


Illustration 016 - Eastern entrance point built 1938

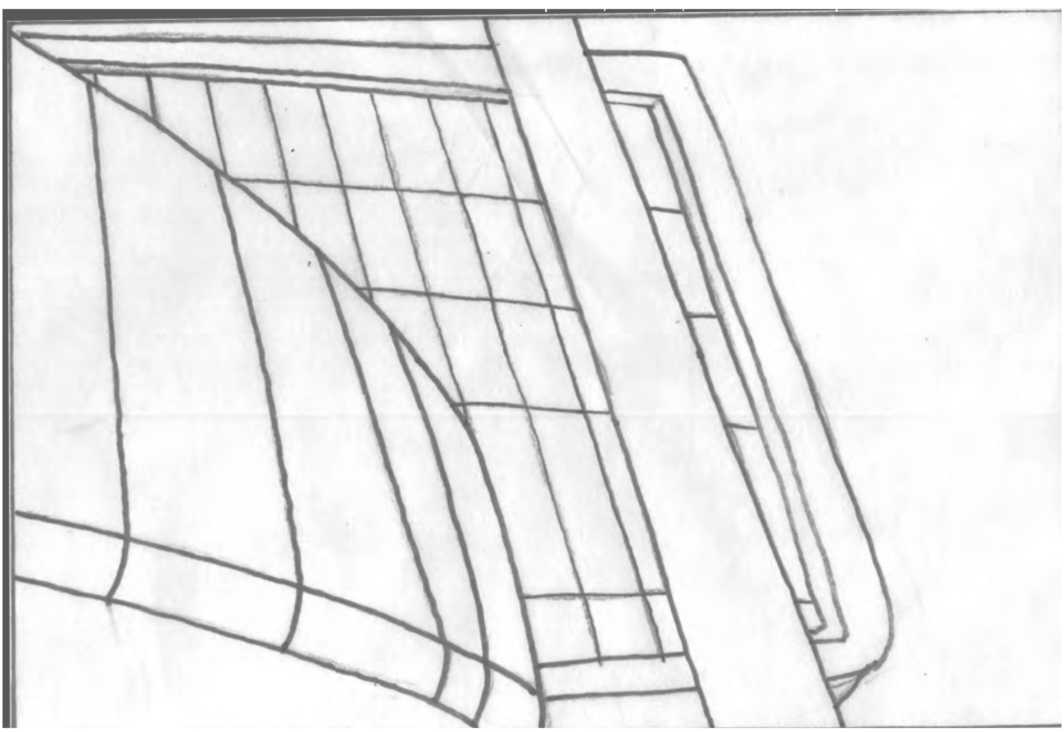


Illustration 017 - Aalborg Portland Park

Architectural References

The Western Stand is a key element of the AaB fan identity. Today at Aalborg Portland Park the Western Stand is designated for the home supporters from where the stadium atmosphere is generated, through song and coordinated jumping. Historically it is also the very first stand that was built, back then, built in relation to their successes. Back then, in 1927, the stand was designed by the architect Einar Packness, at the time, one of the leading architects of Northern Jylland (AaB Supportclub & Wedege 2021b).

Symmetry is a strong characteristic of the stand, along with some functionalistic tendencies such as a heavy foundation of brick, supporting the lighter stands made from wood, following the era in Danish architecture. Although structurally hinting towards functionalism, the aesthetics relate better to the late Edwardian architectural period. This is highly visible from the characteristic pediment, following the symmetrical center, which repeats in the grand entrance, that too, follows a consistent symmetry and use of materials, see illustration 016 & 018.

The current stadium, as seen on illustration 017, tells quite a different story. Here, the architecture is dominated by steel, concrete and glass, following the engineering evolution seen since the first stadium. Aalborg Portland Park was renovated in 2002 as a result of an architectural competition, announced shortly after AaB's second championship campaign in 1999 (Friis & Moltke Architects n.d.). Architecturally, this renovation is a statement about their professionalism and Aalborg's top position in Danish football, with a new modern stadium, and 2 out of the last 5 championships in 1995 & '99 (AaB Sport 2025).

The modernization was also highly due to recent accidents that occurred in Denmark in the 1990's, mainly the one in Vejle in 1995, and Aalborg in 1994 (Hartung 1995), which called for new robust structures, resulting in the large concrete structure seen today.

The new stadium should honor the symmetry of the old stadium

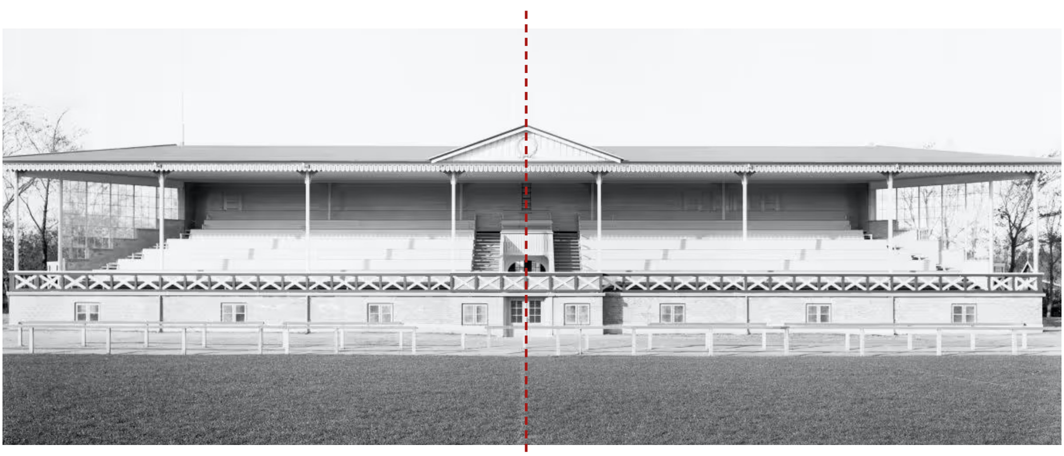


Illustration 018 - Original West Stand 1927 - 1961

Sightline evaluation

AaB's support club has addressed some of the issues that apply to Aalborg Portland Park(AaB Support club 2024). One of the aspects that they are keen to see improved is the steepness of the stands. This is related to the quality of sight, which can be described as C-value, a term that tells the theoretical quality, from a spectator's point of view. Therefore, the current C-values have been assessed based on the section of the A. Enggaard stand. Illustration 020.

The C-value is calculated via the following equation:

$$C = \frac{D \cdot (N+R)}{D+T} - R$$

The calculation is based on the horizontal [D] and vertical [R] distance between the spectator's point of view and the focal point, which is the edge of the field. It also considers the riser height [N] and depth [T] of the stands. FIFA recommends an optimal C-value of 120mm, but not less than 60mm (FIFA 2025), which sets benchmarks for the analyses of the current stands at Aalborg Portland Park, that can be found in Appendix 01.

The results indicate that there are some issues with the Western Stand, the 3F stand towards east and the Complea stand towards north. As the West- and Eastern Stand is designated to the hardcore fans for standing and jumping, the C-values are determined based on both sitting and standing scenarios.

When sitting, the last row results in a C-value that complies with the recommended 90mm, while standing the value becomes significantly worse, only reaching a value of 49mm, which speaks to the reasons why the supporters wanting the stands to become steeper in the new stadium (AaB Supportclub 2024).

Looking at the Complea stand, the two levels cause some complications, which is due to the second level reaching over the lower level, meaning that the line of sight becomes too steep. The second level is assessed in two scenarios, first assuming that the same riser elements applied on both levels, and second assuming that the riser height is maxed out to 600mm, determined by the manufacturer (Spæncom 2025a)(Spæncom 2025b). In the first case the C-value reaches an insufficient level, resulting in a C-value of -79mm while the second indicate a C-value of 102mm.

Both A. Enggaard- and Complea lower stands reach sufficient levels, with ranges of 157mm to 253mm and 84mm to 176mm respectively. For all stands a common issue recur. The sightline calculation does not consider other geometries as obstacles, as many of the sightlines show a collision with the boards, meaning that each of these spectators will not be able to see the near-line action on the field.

A design driver should be to reach a minimum C-value 120mm across all seats.

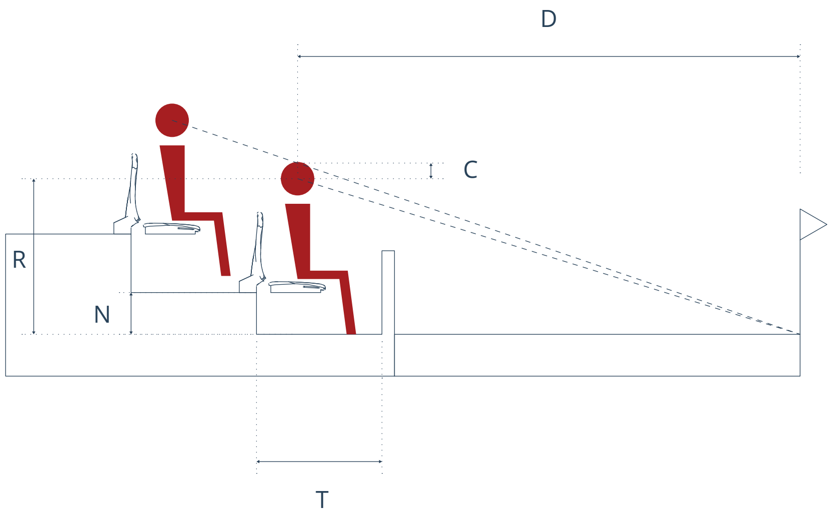


Illustration 019 - C-value principle

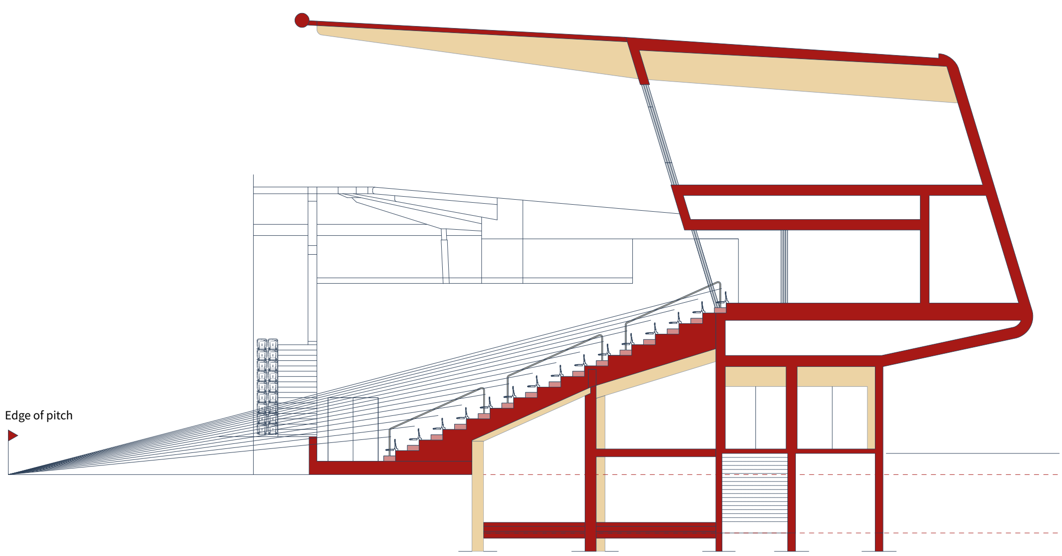


Illustration 020 - Enggarard Stand

Inclusivity at Aalborg Portland Park

Aalborg Portland Park offers their fans 28 wheelchair friendly seats for their home games, with a capacity of 13.310 fans, meaning that 0,2% of the seats in the stadium are wheelchair friendly, whereas the requirement from FIFA is a minimum of 0,5% + 1 companion friend (see appendix 2). Aalborg Portland Park has placed all their wheelchair seats in one row among the home team supporters, and request that it is not allowed to demonstrate affiliation to the away team on other stands than the away stand, through either attire or how they conduct themselves, if this is not complied with, the fan may be removed from the stadium without a refund(AAB 2025).

Aab themselves describes that the tickets are usually in demand and therefore quickly sold out. Therefore, it begs to ask the question of why they do not expand the number of available seats or add elevators around the other stands to create more seats. As it stands right now, wheelchair users have one elevator to enter their designated stand because all stands start with a steep staircase that takes the fans up onto the concession plateau and further onto their seats.

The design of the new stadium should facilitate wheelchair access all around the stadium, so ultras, regular and away fans in wheelchairs all have the option to sit next to their own group. The project should also aim to reach the 0,5% seats that are required by FIFA. Furthermore, the design should aim to eliminate the use of chairs or elevators for fans to get to their seats, so the journey for the wheelchair user gets more comfortable.

Illustration 021 - Entry stairs at A. Enggarard Stand

Illustration 022 - Aalborg Portland Park Materiality

Material Atlas

As part of the analysis of the existing stadium, and as a way of gathering information about what elements from it can be reused in the new stadium, a material atlas has been conducted to map the different types of elements and their quantities and quality. The following elements have been mapped and intended to be used in the new design: the seats, the steel trusses holding up the roof, the stairs taking the spectators from the ground up to the stands, the windows from the Engaard stand, the cladding from the exterior façade and the roof and the four different concrete stands. To read more about the elements and the quantities and quality of them see appendix (2).

The project should aim to reuse all the mapped materials in the new stadium to lower the global warming potential.

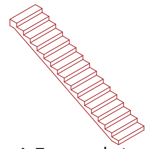


Illustration 026 - A.Engaard stand

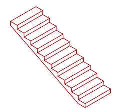


Illustration 027 - Vesttribunen

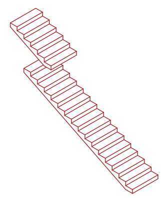


Illustration 028 - Complea stand

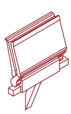


Illustration 023 - Seats

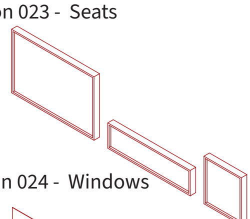


Illustration 024 - Windows

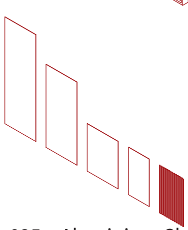


Illustration 025 - Aluminium Cladding

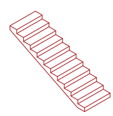


Illustration 029 - 3F stand

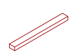


Illustration 030 - Concrete stairs

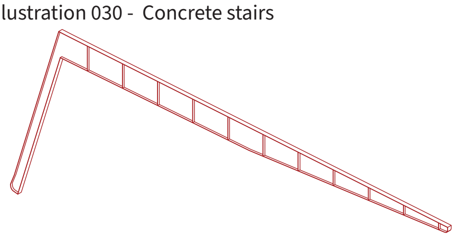
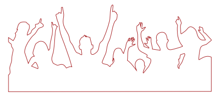


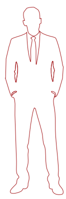
Illustration 031 - Steel Trusses

User diagram

A stadium is a complex place that attracts and creates work for many different types of people. Therefore, they have been mapped in this analysis to showcase the different types of spectators that attend a football game and who are the employees that keeps the machine running, to insure the new stadium facilitates them all.

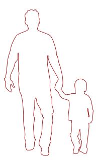


Regular fans
Enjoying the match at a relaxed pace, they cheer for goals and big chances while soaking in the experience without the intense commitment the hardcore fans have.

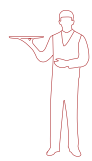


VIP fans.
Seated in the best spots, where they can enjoy a premium service, extraordinary lounges and exclusive perks while cheering for their home team.

Away fans
Very similar to the hardcore fans, they are loud and passionate, they stand their ground and defend their team throughout the game even though they are massively outnumbered.



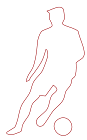
Family fans.
Parents can bring their children to soak up the excitement, sing along on the fan songs a take pictures with the mascot and players, while enjoying a safe football experience together.



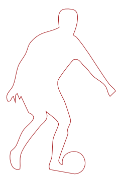
Kitchen staff
Working behind the scenes, they prepare and serve food and drinks for the regular fans in the concourse stands, and waits on the VIP, VVIP and hospitality fans.

Hardcore fans
Drumming, chanting, waving banners and flags, while bringing an intense amount of energy to motivate the players to do their best and create an electrifying atmosphere.

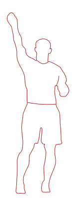
Groundkeepers
One of the hardest working in return of the amount of praise they get, the groundkeeper's job is to keep the pitch in perfect condition.



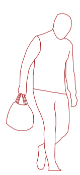
Home players.
Focused and determined, they give all they have got for the club, motivated by their fans singing and creating a loud atmosphere.



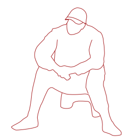
Away players.
Feeling undermined and outnumbered, the away players fight with all they have got to win in a hostile environment.



Officials
Enforcing the rules with precision, they try their hardest to keep the game fair, despite constantly being influenced by players and fans.



Medical staff
Always ready and watching, they rush to injured players, providing quick treatment and keeping the players health their top priority.



Security
Their job is to keep order in the stadium, they ensure fans stay safe and prevent any trouble escalating to keep the game safe.

Cleaning crew
Working extremely hard before, during and after the match, they keep the stadium clean and by that giving the fans a positive experience.

The diversity of users—ranging from hardcore fans to hospitality guests, staff, and players—highlights the stadium’s role as a multifunctional and inclusive space. Therefore, the architecture must accommodate a broad spectrum of needs by zoning spaces clearly, ensuring efficient circulation, prioritizing safety and accessibility, and creating varied spatial experiences that reflect the unique expectations of each user group.

Illustration 032 - Users of Aalborg Portland Park

Illustration 033 - Entrance Aalborg Portland Park

Function diagram

The function diagram illustrates how the different functions relate to each other in the flow of the stadium. There are three nearly identical flows for home fans, casual fans and away fans. The only exception is the effort to keep away fans and ultras separated in case a brawl might start.

The flow for these three groups begins with them scanning their tickets at the entrance. From there, they have the option to shop for merchandise at the club store or buy food and drinks from one of the food-stands and bring them to the stands.

The flow of VIPs, VVIPs, and hospitality fans is quite different. The entire route to their seats is indoors and begins with them receiving an armband that grants them access to a lounge, where they are served a buffet before the match, and coffee and dessert at halftime. They may also be offered blankets to bring to the stands if the temperature is low during the match.

Based on the diagram, it can be concluded that the new stadium should provide separate entrances and seating areas for away fans and ultras to ensure the safety of the remaining spectators. Additionally, the presence of multiple food stands at each section offers the opportunity to diversify food offerings.

VIPs, VVIPs, and hospitality guests should be given the option to arrive up to two hours before kick-off to enjoy a curated dining experience in designated lounges, allowing time for socializing and professional networking. During the match, these guests should also have access to additional amenities, such as blankets or complimentary beverages.

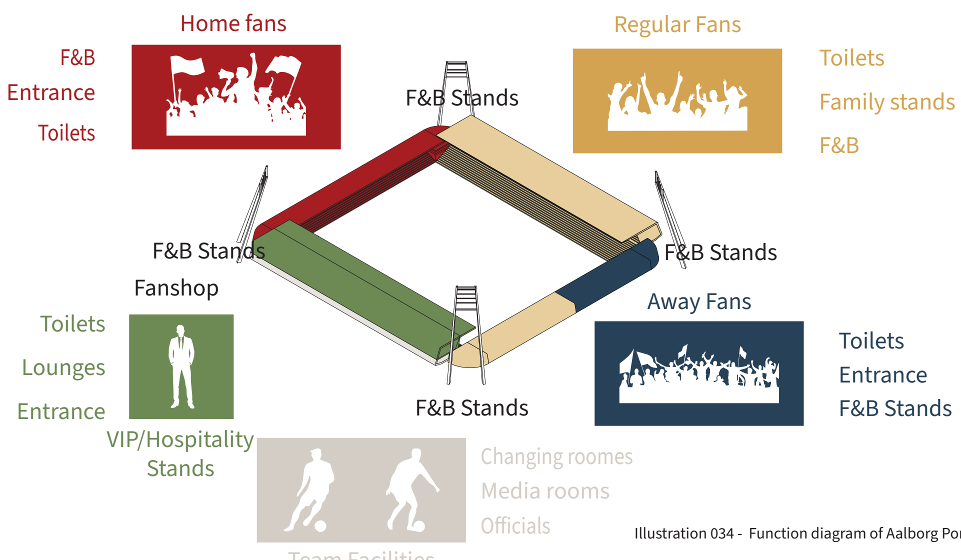


Illustration 034 - Function diagram of Aalborg Portland Park

Illustration 035 - Aalborg Race Arena Chapter

Racing Arena Aalborg

Ahead of the sketching phases a site visit was planned with the goal of uncovering existing issues with the proposed site. This includes aspects such as microclimatic, existing infrastructure and analyzing the conceptual masterplan.

The RaceArena

Illustration 036 - Entry gates of Racing Arena Aalborg

Illustration 037 - Conceptual masterplan

C.F. Møller Visions

C.F. Møller Architects have created a visionary illustration of how the Racing Arena could be developed. The plan commes from eight actors being, Erhverv Norddanmark, AaB, DBU, Aalborg Håndbold, Aalborg Pirates, SIFA, Spar Nord arena, Aalborg Væddeløbsbane og Aalborg Kongres- og Kultur Center.(Stenbro 2023)

The plan includes a new stadium for AaB, designed for both home matches and large outdoor concerts. Additionally, a new MultiArena is proposed to host Aalborg Håndbold games and serve as an exhibition center. Housing development with a view over Limfjorden, and space for a community-based sports facility (Stenbro 2023).

The vision is large, ambitious and expensive, which explains the incorporation of residential buildings, that, with the exclusive location, helps fund the overall project. (Stenbro 2023).
The plan is well divided into different areas of ownership and activity, it allows for good space around the two main attractions, the football stadium and multi-arena, and takes parking spaces into consideration, which is something the existing Aalborg Portland Park gets criticized for. The location of the football stadium is well placed with a natural entrance to the site from the north but also with the option to create an opening towards Vestre Kærvej (Stenbro 2023).

Acknowledging that the plan is early draft by C.F. Møller, there are things that should be challenged in this project. Firstly, the two high rise buildings close to the stadium seem a bit unnecessary and disconnected from the rest of the apartment units, therefore not included in this project. Secondly, the parking spaces are designed as one level, meaning that they take up a lot of open space. Therefore the alternative of parking houses should be investigated, in terms of keeping the open nature of the area.

To narrow the scope of the project and guide the focus more towards the stadium design, the project will comply with the plan from C.F. Møller on how to develop Racing Arena Aalborg. This approach allows for a dedicated focus on the design of the new football stadium and its close context.

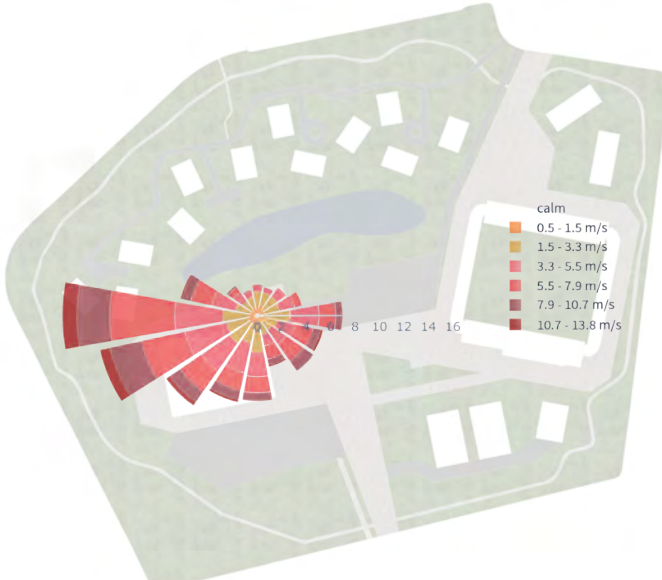


Illustration 038 - Windrose

Illustration 039 - Sun Path

Microclimate analysis

Wind
When analysing the wind around the site it became clear that Aalborg as a city in general experiences varying wind directions, but it predominantly coming from the west and southwest. To optimize the stadium design, the stadium should be positioned to minimize wind disruptions that would influence the players performance and the spectator's comfort if they are sitting in a draft.

Sun and shadow
Given the sites flat-open nature, shadowing is not a current obstacle. However, when designing the stadium, factors as sun and shadows are important to incorporate to ensure that the sun won't become an issue during matches. Furthermore, it is also important that the stadium itself does not cast shadows upon the fan zones or other match day arrangements.

Rainwater
The site currently consists primarily of permeable surfaces meaning that water would normally have no problem in sewing down naturally on the cost the ground becomes quite soft and muddy for a while. Due to its current function as a racetrack, two rainwater catchment pools are excavated in the center of the site. The near situated Limfjorden would need to rise 1.9 meter to flood the site, and according to studies from the Dansih Metreorological Institute by 2050 the water level would potentially rise with 20-40 centimeters. (Skovgaard Madsen & Schmith 2018)

When designing the new stadium there should be considerate thought about the space the stadium spreads shade over, as well as the facade of the stadium should shield the fans from the strong winds coming from the west.

Illustration 040 - Rainfall

Existing infrastructure

The existing infrastructure for transporting spectators to and from Aalborg Portland Park offers a wide variety of options. Away fans traveling to Aalborg to watch the match can either drive to the match and park in the north of the stadium, but there are not many parking spots and areas such as Fjordmarken, are usually filled with cars on matchday. Or there is the option of taking the train where it stops one kilometer away from the stadium.

Residents living in Aalborg who visit the stadium have the option of taking the train but also the option of the bus, with stops both north and south of the stadium and many connecting bus lines that all meet up at the bus terminal.

The existing stadium and the proposed site for the new stadium are both located in areas well-served by public transportation and wide roads accommodating both vehicles and pedestrians. Therefore, a key design driver should be the creation of clear, well-defined paths that separate soft and hard traffic flows.

Train route
Attractions
Bus routes
Bus stops

Illustration 041 - Existing Infrastructure

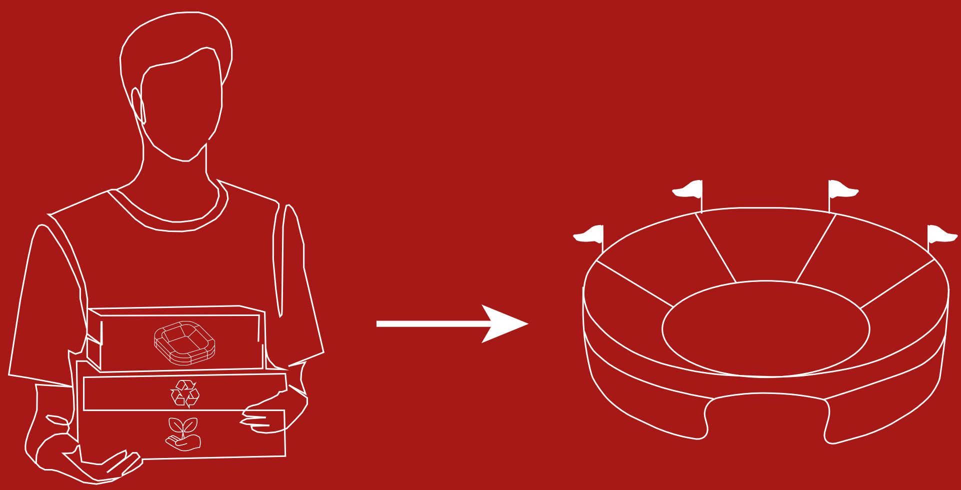


Illustration 042 - Stadium Design

STADIUM DESIGN

Stadium design is, as previously described, complex due to the many different groups of interest and requirements. In this section the stadium categories will be explained, along with theory on sustainability and circularity in architecture and theory on sustainable stadium design. Resulting in a vision for the project, a research question and design drivers to help shape the following design process.

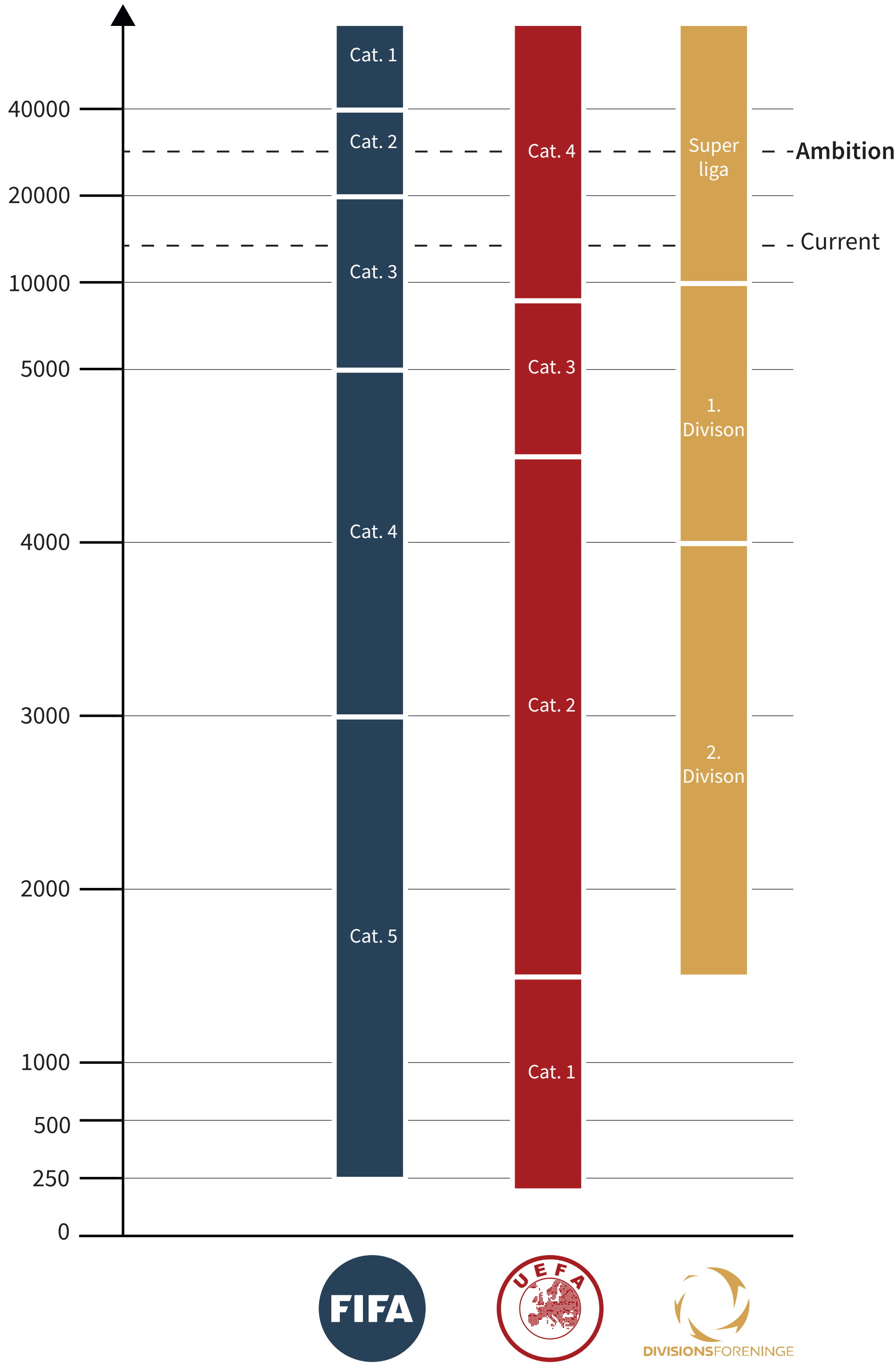


Illustration 043 - Stadium Category chart

Stadium Categories

When building a stadium various regulations apply, depending on the intended use. As the new stadium is intended to AaB - a football club in the Danish Superliga, the stadium must conform to "The regulations for Superliga stadiums" set by the Danish Division Association. The same approach applies to the UEFA Regulations. While AaB is not participating in any European tournaments now, the need for a European qualified stadium should apply in the future, implied by their press release about their stadium visions (Estrup 2023).

Furthermore, the Danish Football Association has publicly supported the idea of more international matches played in Aalborg, when a new stadium is built (DBU 2023). If the stadium is intended to host international matches, the FIFA Stadium Guidelines must be followed.

Determining the stadium category of each of the three mentioned levels, an important measurement is which level of matches is intended to be played there, as the resulting category can be used as an indicator of the scale of building regarding overall capacity.

In a Danish context the Superliga regulations apply, as AaB currently plays in that division. (Divisionsforeningen, 2024)

In a European context, UEFA's tournaments; Champions-, Europa - and Conference League require a Category 4 stadium to partake in the group stages, following AaB's vision. (UEFA, 2025)

In an international context, FIFA dictates that a stadium used for competitive international matches must be category 2, requiring 20.000 seating capacity. (FIFA, 2025)

As illustrated on illustration 043, the three resulting sets of regulations, FIFA Cat. 2, UEFA Cat. 4 and Superliga have some differences in requirement levels, meaning that designing for a FIFA Category 2 stadium will not necessarily qualify for either Superliga or UEFA Category 4.

Beyond the technical aspects of stadium design, there is a final factor to consider. A stadium is only used if it is approved by the supporters. To involve the supporters, AaB hosted an event inviting the AaB support club to brainstorm ideas to improve the fan experience on the new Aalborg Stadion(AaB Supportclub 2024). These ideas make up the fourth set of regulations that have been compared to specify the guidelines applicable to this project, which can be found in appendix 03 for detailed program.

Following the chart on illustration 043, a design driver should be to conform to the 4 sets of regulations.

Sustainability

Annually the construction sector emits millions of tons of CO_2e. In Denmark the sector is responsible for 10% of the national emission(Social- og Boligstyrelsen 2025), and with a global rise in sustainable responsibility the construction sector is under a paradigm shift in terms of environmental footprint. The same goes for mega structures such as stadiums, as megastructures require mega amounts of resources to be built. Beyond that, stadium upgrades may not always be a viable option, when a larger stadium is required. Therefore, some older stadiums will be abandoned, leaving behind large unusable structures thus adding large amounts to the environmental impact of new stadium development.

These issues have been addressed in various ways. In London, when building a new stadium in the early 2000's, Arsenal left behind Highbury Park, which today is refurbished into apartments built upon the old stands, while the field is used as a courtyard (Allies and Morrison 2010). Before the FIFA World Cup held in Qatar 2022, this issue was addressed alternatively as the afterwards use for the then newly build stadiums were limited, not wanting to leave behind massive structures with no purposes. Therefore, some of the stadiums were created with the intention of renovating into new functions or plain disassembly. (Fenwick Iribarren Architects 2025)

Stadium 974 by Fenwick Iribarren Architects is a benchmark project regarding designing for disassembly in stadium context. The concept of the design is that the whole stadium should be constructed by elements that individually fit into a standard cargo container. This does not only include all seating and structural elements, but even the containers are an integral feature of the facade, and the name, as the stadium constitutes of, and fits into, 974 containers. (Fenwick Iribarren Architects 2025)

As Aalborg Stadium cannot expand further at its current location, an entirely new stadium is needed elsewhere. Therefore, a design driver should be to future-proof the next chapter of Aalborg Stadium.

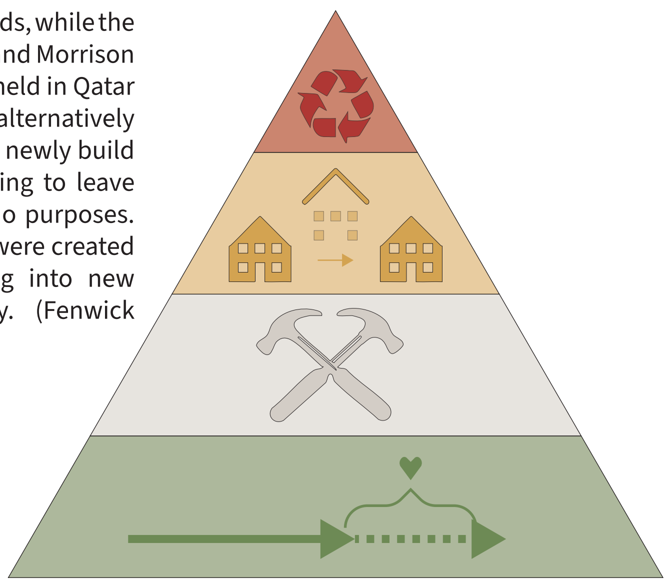


Illustration 044 - Circular strategies

Circularity

One way of implementing a future-proof aspect into the new stadium is circular use of materials, both for the construction and eventual deconstruction. Küpfer, Bastien-Masse and Fivet write the following about prioritizing of circular strategy implementation:

"…circular strategies should be implemented as follows: Extend the use of structures as long as possible without modification, repair or rehabilitate them if needed, if building removal is unavoidable, deconstruct it and reuse its pieces in another project with minimal reprocessing, if components are not reusable, recycle them into the manufacture of a similar or different product."
(Küpfer, Bastien-Masse & Fivet 2023)

As leaving the overall structure of Aalborg Portland Park is considered unavoidable, the goal of reusing its elements with minimal processing becomes an objective of the new stadium's design. Therefore, the quality and quantity of the existing elements at Aalborg Portland Park has been categorized, based on their reuse potential and material. The full material catalog can be found in appendix 04.

Geometrically, some of the existing structures are reuseable in a 1:1 setting. This goes for the seats as well as the doors and other equipment used for team facilities and the lounges. The quantities will not match exactly with the requirements of the new stadium but will help lower the need for new investments. Glazing panels from the lounges also fall under this category.

The structural elements on the other hand will possibly not be directly reuseable, as stands and sections will differ from the current due to improved conditions of view-accommodation and infrastructure. These elements therefore suit the strategy of recycling into similar products, e.g. new concrete elements, or can be otherwise interpreted in new contexts, thereby mitigating reprocessing. Same goes for the bend aluminum sheets used for the current facade.

To apply this in the new stadium, a design driver should be to reuse elements from Aalborg Portland Park, and most of other supplementing material should come from reused elements.

Environmental Sustainable Stadium

In a paper published on 19 April 2023 called "Environmental Sustainability in Stadium Design and Construction: A Systematic Literature Review" the rise of focus on environmental sustainabilty has been discussed with the objective of collecting and review how the design process and construction process develops. The paper presents a literature review of large stadiums environmental sustainability discourse over the last couple of years related to construction and design. The paper then provides the reader with a checklist that supports the leading practices in design and construction. (Francis, Webb, Desha, Thile & Caldera 2023)

The definition of an environmental sustainable stadiums (ESS) is being proposed to be defined as a stadium that can be utilised for the different functions in the community where its located, that it consumes a minimal amount of natural resources and fixes the environmental damage that has already been made. This definition of ESS contains three main parts. One, the stadium can be defined as being environmentally sustainable if there is the option to modify it and adapt it to different types of sports competitions, but also different needs, such as cultural events. Second, if it consumes as low amount of natural resources as possible, including materials, water and energy. Third, it can come up with ways to reverse the environmental damage that has already been made. (Francis et al. 2023)

This paper will be used for inspiration in relation to sustainable design choices for the new stadium as well as a way of gathering knowledge about tendencies in ESS and new technologies used.

An example of that is the Union of European Football Associations (UEFA) has made a guide to Quality Stadiums, where they explain the idea of sustainable stadiums and explains that energy, materials and water are three major points in sustainable buildings. (Francis et al. 2023)

Some examples of ways to create a more sustainable stadium design was in Poland for the 2012 European Championship, where they built a stadium with a dual water supply system. This meant that functions such as toilets, urinals and watering the pitch that uses non-potable water could be done by harvesting the rainwater and that resulted in them covering 70% of their water consumption in 2014.

Another example is Stadio Friuli in Italy that by implementing active and passive strategies into their design which meant that they approximately reduced their emissions by 100 kg CO_2-eq/m^2 with passive strategies and 1500 kg CO_2-eq/m^2 with active strategies.

A third example is the Education City Stadium in Qatar that was built for the 2022 World Cup. When excavating the site where the stadium was meant to be placed, they then used the excavated boulders in the concrete mix to cast the under-raft foundation resulting in a reduction of 32,2% greenhouse gas emissions and a 32% reduction in the total cost. (Francis et al. 2023)

This paper shines light on the problem that there are no green building certification systems for stadiums. As a result of that, stadium design and construction are behind the curve regarding green building methods. According to the literature, current stadium designs focus primarily on two categories when looking to design sustainable: Energy and Materials. Energy has the highest potential with the goal of minimizing energy consumption, materials have second priority with a focus on using locally sourced materials and use waste materials for construction. (Francis et al. 2023)

This means that for the design of the New Aalborg Portland Park there are not a plethora of stadiums to seek inspirations from, because it is a design process that is evolving right now. But as described there are different stadiums that has experimented with new technologies that will inspire someone else to pick up that technique and develop it further. And when that repeats itself, there will one day be a perfect ESS. (Francis et al. 2023)

The lack of established green certification systems for stadiums highlights the need for innovation in sustainable design. This project will draw on emerging practices and tested strategies to contribute to the evolving field of environmentally sustainable stadiums and inform future best practices.

Illustration 045 - Stadio Friuli

Designing for disassembly

Designing for Disassembly (DfD) is a growing tendency in architecture as it addresses the concern about how many resources the construction industry consumes each year and how low the recycling rate is.

The construction industry is the world's largest consumer of raw materials, and almost none of them return to the material loop. DfD is the design of buildings that can facilitate future changes or dismantlement for recovery of materials, components and systems. The strategy comes from architects starting to acknowledge the fact that the built environment has a limited lifespan and that a building holds a depository of resources, which should be a priority to fit back into the “reduce, reuse, recycle” loop instead of ending up as landfill. (Cutieru 2020)

DfD was defined in 1990, and is therefore a relatively new concept, meaning that only a few projects have been designed with disassembly in mind and even fewer have tested it out. The DfD process is also not without challenges. For the time being, the cost and speed of the process, as demolishing a building is cheaper and faster than deconstructing it and taking it apart piece by piece.

However, research shows that deconstruction could be cost-competitive to demolition if the materials in the construction have a good market value to offset the higher labor cost.

To ensure that a building is designed properly with DfD in mind, it requires a remarkable amount of planning in the early stages of the design process, and there are multiple principles and strategies to consider, to ensure that the objects hold onto its value once it has reached its end of life. (Cutieru 2020)

Some general guidelines to follow are:

Planning the deconstruction:
DfD requires that the architect creates a detailed deconstruction plan, that includes instructions on how to disassemble the elements, as well as a review of the materials and building components and how they should be reused, recycled and reclaimed.

Assessing Materials:
DfD requires extensive research into the construction materials to ensure that they are non-toxic, high quality and have excellent recycling potential.

Choosing connection details:
A fundamental principle in DfD is creating the right connections and choose appropriate ways of joinery, to make it easier to dismantle and not rely on heavy equipment, or too many tools. Therefore, the focus should be on mechanical joinery, that uses screwed, nailed or bolted connections, instead of non-removable, chemical joinery such as sealers, glues, binders or welding which makes materials difficult to separate and recycle. (Cutieru 2020)

To showcase the relevancy in regard to stadium architecture, an analysis of Stadium 947 has been conducted.

Stadium 947 is a project by Fenwick Iribarren Architects in collaboration with Schlaich Bergermann Partner and Hilson Moran. It was quickly realized that in previous World Cups, the stadiums were built for the occasion but then abandoned, and gradually deteriorated due to the lack of use after the tournament was over (Fenwick Iribarren Architects 2025).

To meet the requirements, they developed a concept in which the primary use of the stadium was incorporated into shipping containers. The containers that were used were standard units but in various lengths allowed them to design for modularity making it easy to ship from the factory to Doha. They combined three different units, to facilitate the different spaces that FIFA required. By using 20-, 30- and 40-feet containers and color code them so the same function has the same color.

Stadium 974 was created by inspiration from the concept of a traveling circus, in which the circus arrives at the city, sets up the tent, performs the show, disassembles the tent and moves on to the next city. Stadium 974 aims to follow that concept, where all pieces of the stadium can be disassembled and transported to the next World Cup destination.(Fenwick Iribarren Architects 2025)

Design for Disassembly offers a sustainable alternative to conventional demolition by enabling material reuse and reducing waste. Inspired by projects like Stadium 974, this stadium design will integrate modular elements and joinery, and early-stage planning to ensure flexibility, minimize resource loss, and support a circular material lifecycle.

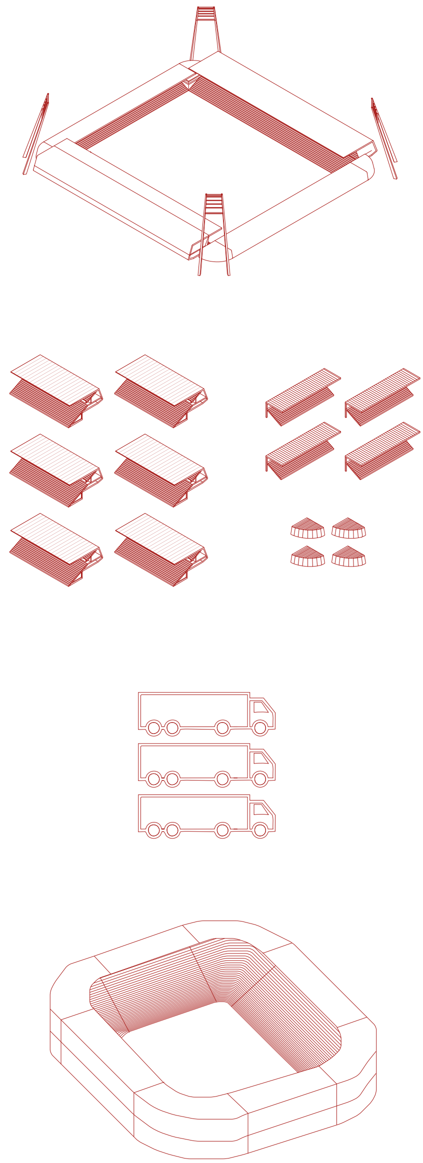


Illustration 046 - Concept of stadium disassembly

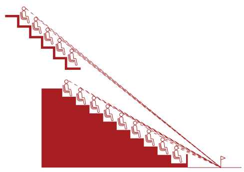
Vision

The vision of this project is to create a football stadium with the future in mind, that seamlessly integrates sustainable building practices, innovative design, and urban connectivity. The stadium should not only serve as a venue for sporting events, but also as a dynamic public space that strengthens the areas and identity and promotes environmental responsibility. By implementing passive design strategies, adaptable internal infrastructure and well thought material selection, the project aims to help set a new benchmark for sustainable stadium architecture.

Research question

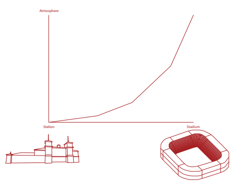
This project asks the question of how a new football stadium can be designed with a strong emphasis on sustainability, passive design strategies and long-term adaptability, while also delivering a powerful architectural identity. The goal is to investigate how such a stadium can meet modern environmental requirements without sacrificing aesthetic ambition. Furthermore, the project examines how the stadium can create a safe, inclusive, and engaging experience for all users on both match days and non-event days.

Design drivers



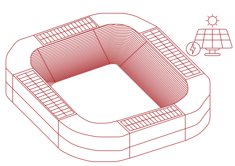
The seating bowl must conform to an optimized viewing accommodation.

The stadium must conform to the 4 sets of regulations.

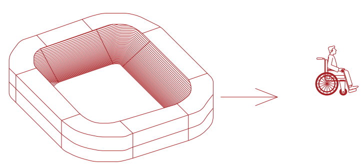


The football atmosphere should intensify as the spectators get closer to the stadium.

The design of the stadium should have a unique memorable design that gives it an identity and makes it an iconic landmark.

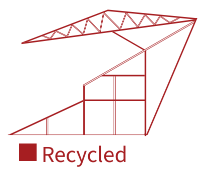


The stadium should be close to if not self-sufficient in green energy.

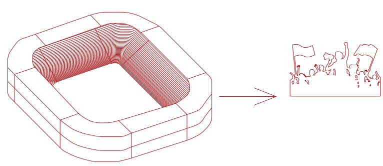


The stadium should ensure that it is accessible for all users, including people with disabilities.

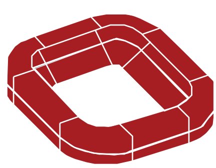
Illustration 047 - Design Drivers



As much as possible of the old stadium should be reused in the new



The stadium should accommodate up to 30.000 spectators all with optimal viewing, accessibility and comfort.



The stadium should be designed with the future in mind, design for disassembly.

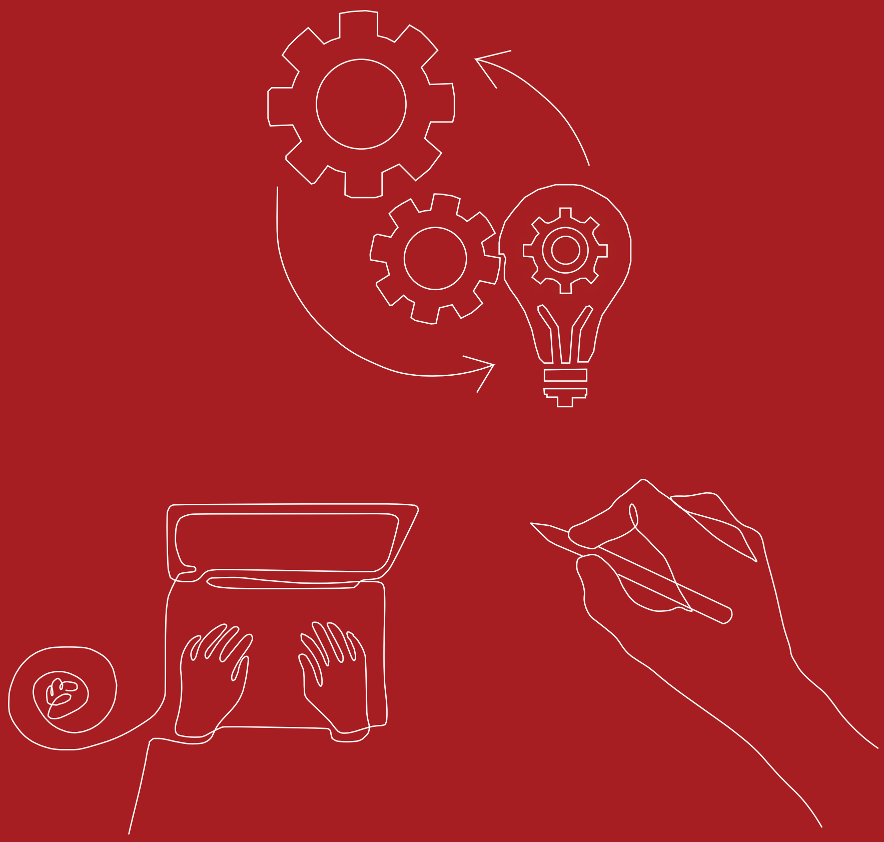
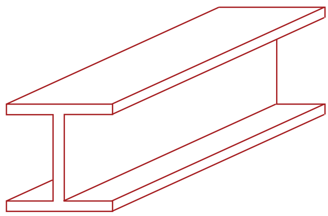


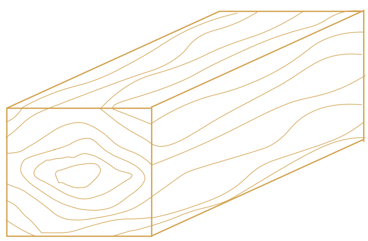
Illustration 048 - Design Process

DESIGN PROCESS PART I

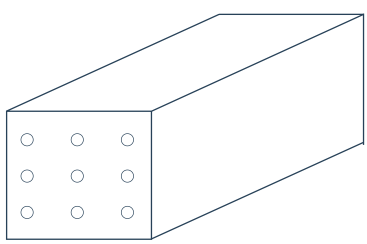
The design process for this project has been structured into two distinct parts within the report to enhance clarity and coherence. The first part concentrates on technical considerations, including material comparison, life cycle assessment (LCA), the configuration of the stadium bowl, evacuation and lighting design, as well as key structural components. The second part addresses the architectural dimensions of the project, such as the design of the façade, integration within the urban context, planning of the fan zone, parking layout, and the development of the VIP building.



Steel



Wood



Concrete

Illustration 049 - Materials

Material comparison

With a goal of creating an environmentally sustainable stadium design, which pushes the boundaries of the ordinary stadium practice, there is a need to gather information about the different materials available for the structural system: wood, concrete and steel. (Kukic 2021)

Wood is traditionally the lowest cost material but comes with lower structural durabilities than steel and concrete. Because of the risk of warping, shrinkage and mould, wood requires more maintenance. Compared to steel, wood is often fabricated by standard units, meaning that most of the components in the construction need to be cut and assembled on the building site. The largest setback for wood is the risk of fire. When a fire starts in a building made from steel or concrete, the structure does not burn, that means that after a building made from concrete and steel burns, it can be renovated and used again, whereas a timber-structured building will burn to the ground, if not designed properly. Wood has a very low carbon footprint, particularly if it is harvested sustainably and in an area that works with forest regrowth. However, when comparing wood with steel, it is less recyclable.(Kukic 2021)

Steel is cheaper than concrete but more expensive than wood. It is a low maintenance material, that has a longer lifespan than wood, that makes it a good choice for long lasting structures that can be erected in any type of climate. Steel is considered a lightweight profile with a high strength to weight ratio, therefore foundations for steel structures are up to 50% lighter than foundations for concrete structures. Steel has a recycling rate of 98%, making it the highest of any building framing material. While other materials' only option is to be downcycled into lower quality products, steel can be recycled repeatedly into new components, without it losing its quality. Steel can also be prefabricated, making it easier to install and requires less manipulation on the building site.(Kukic 2021)

Concrete is in some ways like steel, by having a long life span and low maintenance. However, if it is supposed to be cast on the building site it is very dependent on the weather for its ability to set. Furthermore, concrete can only be reused as aggregate and emits a lot during production.(Kukic 2021)

Recently a case study was made in which cost and time was compared when constructing a building with the load bearing system made from concrete or steel. The building was four-stories and 12.400 m^2. The study showed that the building made with a steel structure took 10 weeks less to build, thus saving over 200.000$. Furthermore, the total cost of the structure from the concrete building was 5.749.302$ compared to 4.968.260$ for the steel structure, meaning that not only was the steel option quicker to build but also cheaper in materials.(Kukic 2021)

As a conclusion, on which material to choose as the load bearing material for the stadium. Steel seems as the optimal option, due to its ability to recycle, its weight to strength ratio and that it can be pre-fabricated and easily installed at the construction site.

Shape of stadium bowl

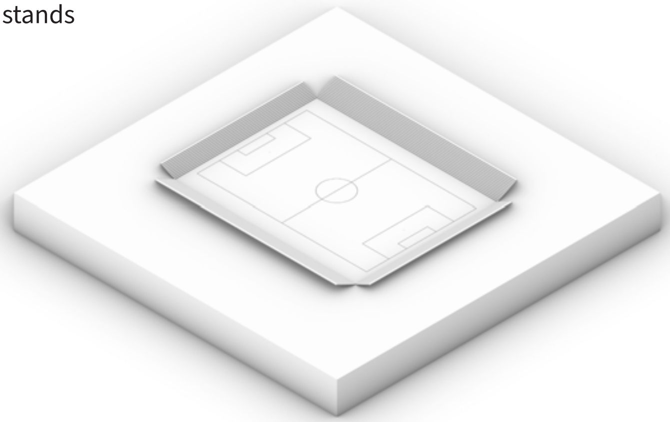
The stadium is designed from within, as the parametric model works of the shape of the stadium bowl. As a strategy to lower the need for new construction elements, the stadium bowl is shaped based on the reuse of the stands at Aalborg Portland Park, as described in the material atlas. The stands are then distanced from the pitch according to the desired C-value of 120mm. The current number of tribune elements being insufficient to construct the entirety of the new stadium new elements are required. Following the principle of designing for disassembly and due to the difference in life expectancy between the old and new elements, the new stands should be segmented into two parts, meaning that the reused part, can be replaced independently from the younger parts of the stands.

Designing for viewing accommodation, the older, less sloped, elements should be reused in the lower section of the stands, allowing the slope on the upper section to ensure a more consistent C-value for all the seating rows. Although the steepness is one of the aspects of the sightlines, the distance to the pitch also have a positive impact, as the value increases along the distance. This means that a solution could be to use only one type of tribune-element and increase the distance accordingly. In theory this solution is good in terms of reuse, but fails in creating an intense atmosphere, leaves a larger footprint, and compromises the viewing distances as set by FIFA (FIFA 2025).

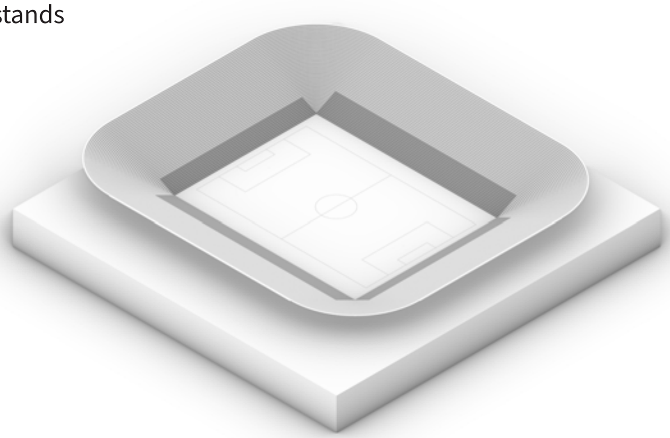
These viewing distances also influence the overall shape of the bowl, as all the seats should be situated within the optimal seating distance. To accommodate this, the corner sections must be shaped accordingly.

With the optimal seating distance in mind the design objective must be to minimize the distance from the pitch, thereby lowering the number of seats, situated beyond the optimal viewing distance, as illustrated on illustration 050.

Placing the reused stands



Generate the new stands



Shaving the corners

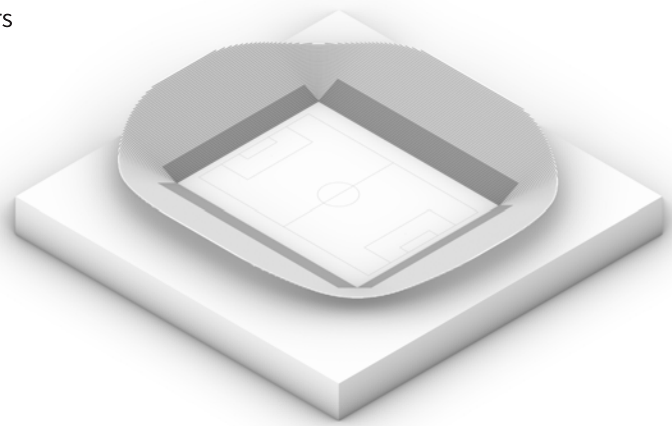


Illustration 050 - Bowl Principle

Designing for evacuation

The layout of the seating area at the stadium has an impact on multiple aspects, such as condition of view, and overall aesthetics of the stadium interior. The layout also depends on the safety and evacuation of the spectators in case of emergencies. Therefore, multiple layouts have been analyzed with the purpose of determining the upper limits of sequences of seats, finding the optimal placement of vomitories and the width of the transition area, along with how each type of layout performs in comparison.

The study takes a parametric offset, feeding off the inputs of the stand geometry, from which the vomitory supporting most spectators is simulated, with the according seating points. The results will then feed back to the central file, in which the seating layout will be updated accordingly to the best performing layout.

Three layouts have been simulated, varying the effect of having a transition aisle and placement of vomitories, leading to the 8 layout principles. All layouts are simulated with 30 rows of seats, and the results can be found in appendix 4.

As a tool for simulations, the software PedSim, a Grasshopper compatible Pedestrian Simulation plugin have been used. The tool provides real-time motions of pedestrians moving from point A to point B, the seats and center of the vomitory, respectively. Furthermore, the pedestrians are guided by target points, located at the staircase in between the seating sections, see illustration 050.. The simulator then updates based on a trigger-interval, then counting how many ticks are used to move from A to B, ultimately counting the cumulative number of ticks needed for all spectators to reach the vomitory.

Comparing the results, a clear point of impact is the placement of vomitories, as a central placement show 20% faster evacuation time compared to a top placed entrance. Furthermore, the transition aisle only showed a positive impact of around 5%, thereby questioning the overall need, as it also has a significant negative impact on the viewing conditions.

Moving Sequence

$A_x \rightarrow T_1 \rightarrow T_n \rightarrow B$

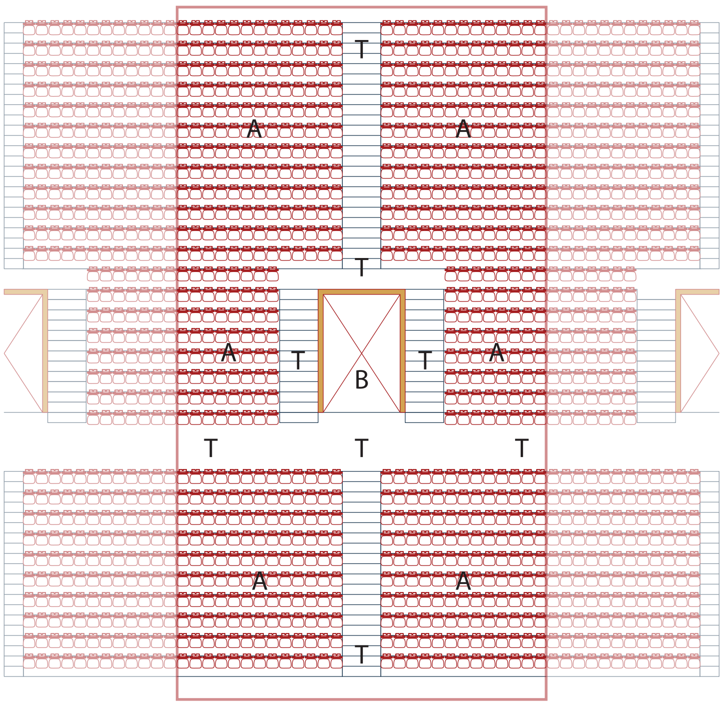


Illustration 051 - Layout Evaluation Model

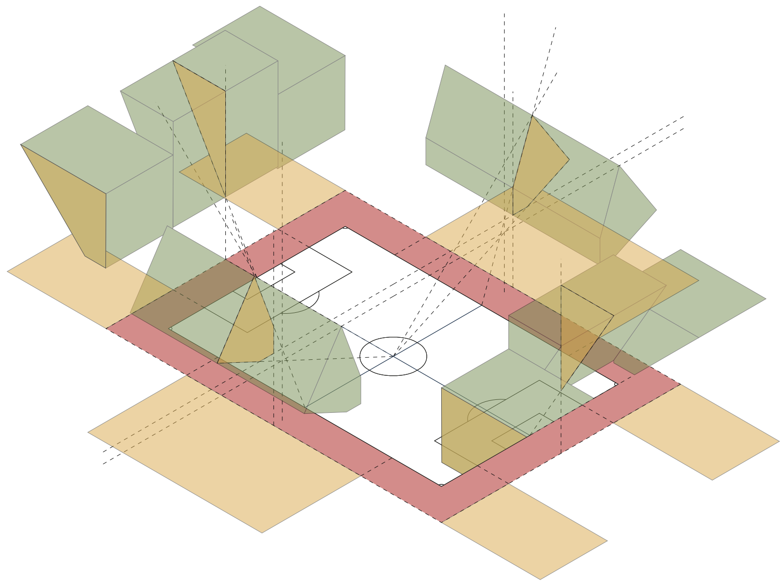


Illustration 052 - Roof-Attached Lights Positioning

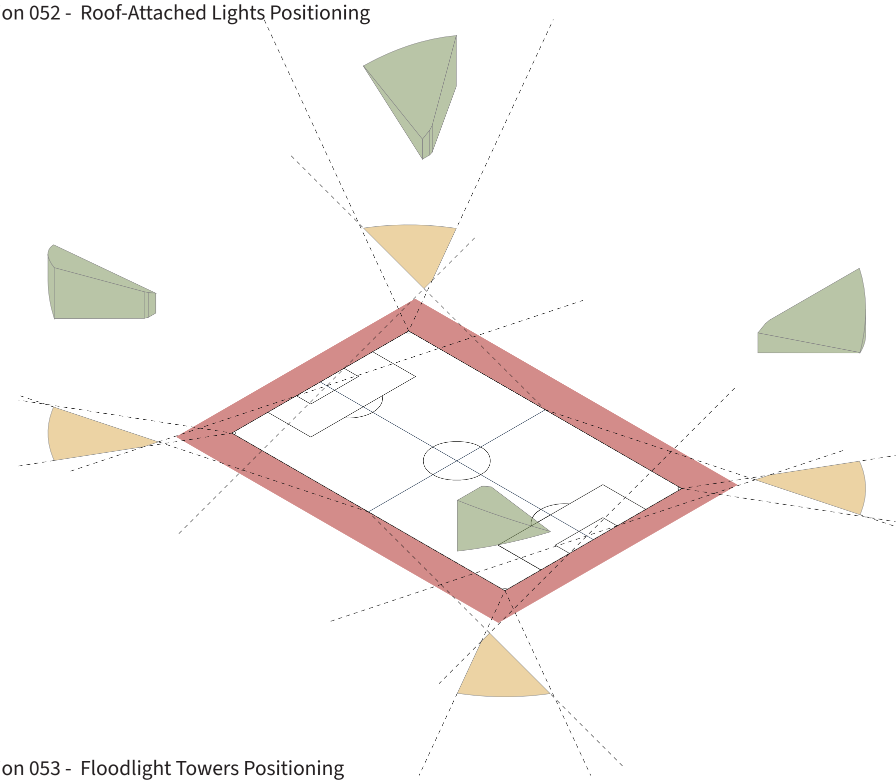


Illustration 053 - Floodlight Towers Positioning

Placement of lighting fixtures

With the visions of AaB participating in the international UEFA tournaments in the future, the stadium should be useable by the earliest group matches played 20th of January, and the latest 17th of December (Divisionsforeningen 2025). Furthermore, the matches are played as late as 9 pm, which will require some heavy lighting, to illuminate the pitch.

Following the regulations from UEFA, the lighting fixtures must be placed without the spectators and players experiencing glare or compromise the quality of television broadcasting. The regulations describe different lighting solutions, varying from roof perimeter to lighting towers. The regulations are summarized in appendix 5 and illustrated on illustration 052 and 053.

The illustrations highlights the plausible design spaces in which the equipment can be placed. Yellow indicates the two-dimensional planar design spaces and green indicates the three-dimensional design spaces, which in the overall optimization process will function determine the geometrical inclusion of the lighting equipment, serving to evaluate the generated phenotypes.

Both lighting types have pros and cons and are often decided based on the scale of the stadium, as the roof perimeter lighting is most suitable for large capacity stadiums, and the towers towards the smaller stadiums. Roof perimeter lighting requires a minimum mounting-height of 21m, which is a more plausible solution for larger stadiums, rather than smaller stadiums that typically will not reach such heights naturally.

Type of lighting is also a result of aesthetic assessments as roof perimeter lighting is easier integrated into a more holistic design, in contrast to the lighting towers, that typically reach a height north of 42 meters, tend to stand out from the rest of the stadium. This is applicable to the current lighting situation at Aalborg Portland Park, at which the lighting towers make up an iconic landmark in Aalborg Vestby, a quality with reasons why both types of lighting have been included in the optimization process, which also seeks to minimize the material use to reach the required positioning.

Roof structure

The main objective of the roof is to protect the spectators from the environment, but it can also be utilized further. When it comes to the roof of the stadium three structural types has been assessed. When considering the structural type it is important to consider the structural approach, the size of the stadium, requirements for future proofing the structure and the desired aesthetics.(FIFA Publications 2025) The three types are:

Cantilevered structures
A cantilevered roof is only supported at one end, usually the rear of a stand to create an unobstructed view of the pitch. A main advantage of this structure is that it can be installed section by section. By being able to install it that way it also allows the stadium to undergo future changes to the stadium. By having a cantilevered roof, a lot of the structure ends up at the rear of the stands, which have an impact of the operational flow behind the stand and the façade of the stadium.(FIFA Publications 2025)

Supported trusses
A supported truss roof is supported at the two ends of the stands, with a large truss. This method can be cost-efficient when designing individual stands and can also reduce the amount of material needed for the rear of the stadium. When placing the columns supporting the trusses, they need to be strategically placed to avoid sightline restrictions.(FIFA Publications 2025)

Tensile structures
This is a roof structure, that is stabilised by tension rather than compression and is usually constructed with a cable-net system

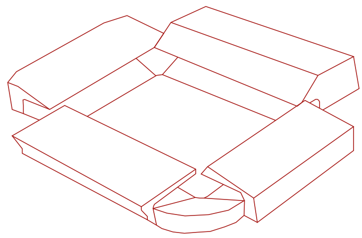


Illustration 054 - Cantilevered roof

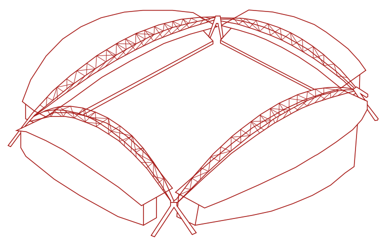


Illustration 055 - Supported truss roof

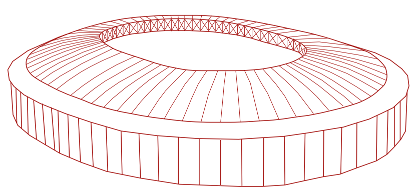


Illustration 056 - Tensile structured roof that functions by tension, to where the roofing membrane sits. This method is usually used in larger stadiums and can have difficulties when it comes to stadium expansion or development. The advantage of this method is that it appears light and elegant and often requires a minimal amount of structure for support.(FIFA Publications 2025)

On more functional terms the roof structure can be used to support the technical infrastructure such as lighting, sound systems, communications and various IT systems. Some other opportunities to fit into the roof structures, is rainwater harvesting to be used around the stadium as non-potable water. Another way to use the roof structure more effectively is to install solar collectors to generate energy and make the stadium more sustainable.(FIFA Publications 2025)

For the design of the new stadium, the roof should be designed as a cantilevered roof structure, due to its convenient assembly section by section and its potential for easy disassembly and unobstructed sightlines. With the added material at the rear of the stadium to hold the weight of the roof it gives the potential to add sustainable technical additions such as rainwater harvesting and solar collectors.

As previously stated, the roof's main objective is to protect the spectators from the environment (FIFA Publications 2025b). While doing so, it should not compromise the conditions of the pitch either. Meaning that while enhancing the cantilevered length and thereby ensuring better shelter in terms of rain for the spectators, the roof will, on sunny days, shadow the pitch, compromising the playing condition. This either calls for a retractable roof, that can be activated according to the weather conditions or reach a compromise between the two contradicting aspects.

A parameter that impacts the cantilevered length, is the drip-line angle, which describes the angular dimension between the edge of the roof and the first seating row. An aspect in which FIFA recommends an angle beyond 15 degrees, while in Denmark, it is only required to be at least 0 degrees. Appendix 6.

Three scenarios have been analyzed determining the conditions at 0, 15 and 30 degrees, evaluating the natural lighting conditions of the pitch, the resulting roof surface area, and cantilevered length. The outcome will then determine the parametric logic behind the generated roof.

The results indicate an approximately 25% increase in surface area while achieving a drip-line angle of 30 degrees, requiring an extra 14.5 meters and total length of 49 meters cantilevered roof structure.

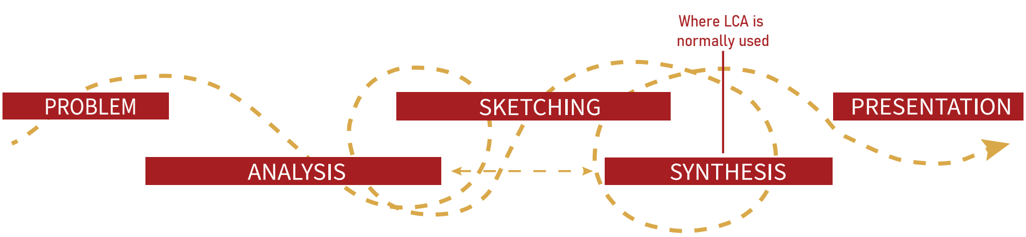
Integration of LCA

In this thesis, Life Cycle Assessment (LCA) is applied as an evaluation method for the final design proposal, but also as a key tool in the design process of the stadium, with a focus on evaluating the different materials that potentially can get used in both the load-bearing construction around the stands and the roof, but also in the interior construction of the hospitality, VIP and VVIP section. By integrating LCA early in the design process, the goal is to make more informed decisions regarding the correct choice of material, that balances both sustainability and the structural performance.

A crucial part of this thesis is the handling of the old Aalborg Portland Park and assessing what part has the potential to be reused in the new design.

This will be done by calculating the total the CO_2 -eq/m^2 emitted in the design of a new stadium giving that everything must be produced as new material and then subtracting the calculated CO_2 -eq/m^2 for the recycled material from the old stadium. This will provide two results that can then be compared to how much CO_2 -eq/m^2 that can be saved by replacing parts of the new material with the material from the old stadium and seeing how much CO_2 -eq/m^2 can be saved.

Ultimately, this thesis, will try and contribute with a sustainable approach to stadium design and mega structure design in general. By demonstrating how LCA can be used not only as an analysis tool but also as part of the design process. And in the end reduce the environmental impact of mega structures.



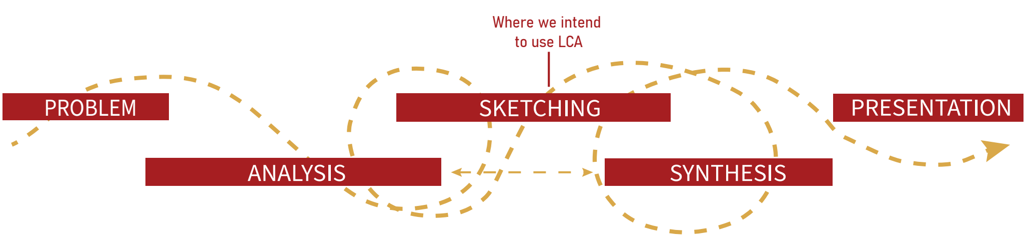


Illustration 057 - LCA Integration

Structural Concept

The stadium is designed for the supporters, with the goal of improving the overall stadium experience, so that the stadium capacity is utilized properly. Given the huge focus on the stadium supporters throughout the design, it is only reasonable to include them as structural inspiration, mimicking the supporters supporting the stadium structure.

The supporting elements shape is inspired by the gesture happening right before each game at which the supporters stand up, raise their hands in the air and display their with-brought fan-scarves. The construction is then dimensioned with the purpose of achieving a large catenary shaped beam, clad in red, symbolizing the fan scarves.

The roof then consists of large glue-laminated timber elements, upholding be the extended arms of the supporting structures. Between the roof beams are then installed a fabric-like surface, resulting in a catenated roof structure enhancing the perception of the scarf reference.

Illustration 058 - Structural Inspiration

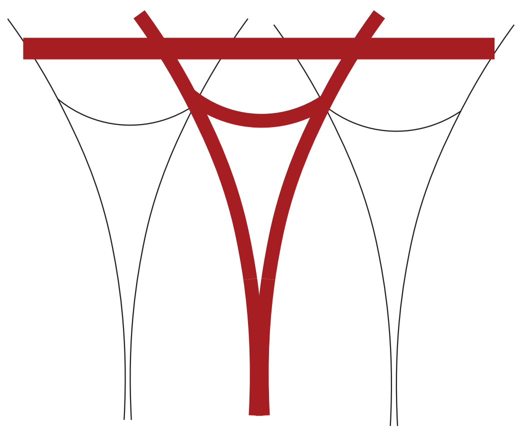


Illustration 059 - Structural Principle

Structural Optimization

When dimensioning the structure, the structural-engineering tool Karamba3D has been applied, a tool that fits into the parametric grasshopper environment. By doing so, the structure can be generated based on the parametric constraints, while being analyzed in real time, which means that the process fits into the idea of performance based generative design spaces. The structure can then be optimized based on multiple aspects, such as maximizing the utility of the elements, thereby mitigating the overall material use, while also considering the impact on the LCA calculations and the aesthetics of the structure.

Determining the dimensions of the elements, the structure has been disassembled into 15 groups of elements, across all varying structures. Although each structure is geometrically different, the structure is unified by keeping the dimensions consistent, meaning that e.g. Element group A, in each structure has the same cross section, and same goes for Element group B, C and onwards. Doing so, it means that the overall group cross-section is set based on the weakest group member regardless of the related structure. Each group is labeled as displayed on illustration 060.

Defining the structural model, the loads must be defined to ensure the capability of the structure. Therefore, the structure includes the loads from the spectators, considering maximum capacity, while accounting for extra load from jumping; the wind predominately from south-west; the lighting equipment hanging from the roof, and lastly the snow that will land on top of the roof. All loads will be detailed in appendix 7.

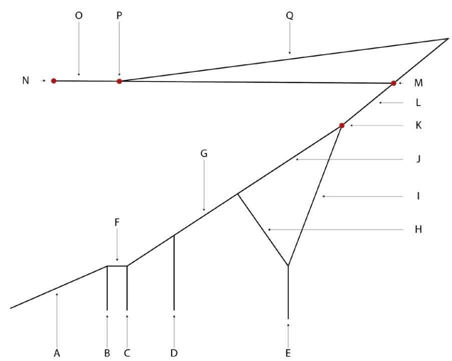


Illustration 060 - Element labels

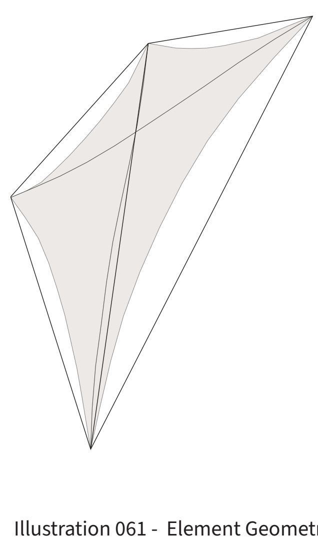


Illustration 061 - Element Geometry principle

To generate the cross-sections complying to a maximum utilization rate, the Karamba3D cross-section optimizing tool has been used. Although the tool implies optimization it rather relies on searching algorithms, determining the, in this case, smallest cross-section in a defined library, that meets the set utilization criteria. This process is rather time-consuming depending on either the length of the library, as fewer cross sections mean shorter running time, or the number of elements should be lowered, calling for a simplification of the model.

Another reason that calls for simplifying the model is the logic behind the tool. As illustrated on illustration 062, when optimizing for the lowest plausible cross section the results indicate individual cross-section for each sub-element, when analyzing on a detailed curve-like element, which slows the process drastically, and results in even more aesthetic variation between each structure. Considering the benefits of this approach is the results minimizing the overall material use, compared to the linear simplification.

The simple linear element structure is only considered as an analytical model, from which the optimized cross-sections are used to reinstate the detailed model, dimensioned to comply with the desired utilization rate.

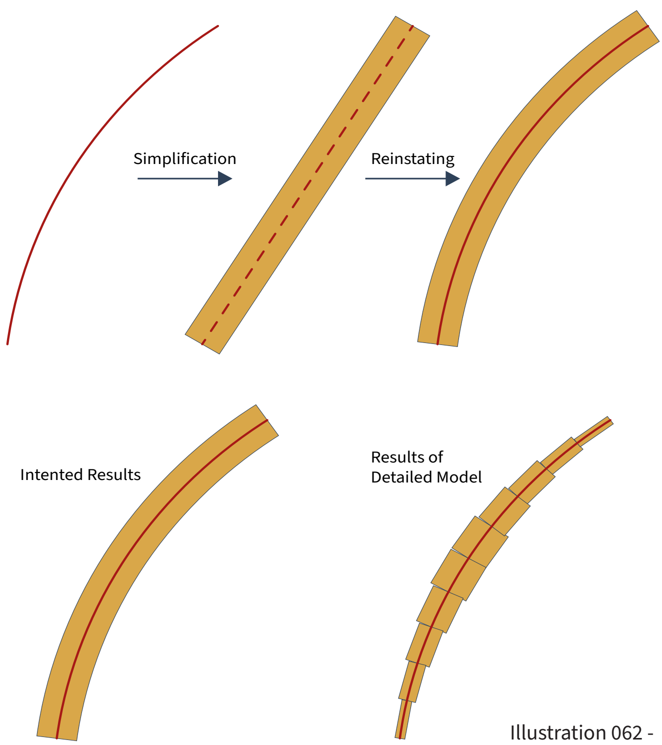


Illustration 062 - Element simplification

Joinery

Dimensioning the structure of the stadium all the joints in the structure, expect the wires in the roof, is considered fixed, allowing the stress to transfer from the elements to where the structure is best able to cope. A way of ensuring fixed joints is to weld the elements together. However, with the principles of designing for disassembly, the welding solution conflicts, and furthermore the type of joint would not be submissive to the principle of the generative design solutions, considering varying the material throughout the structure. This means that the joints that have been generated in the parametric model should be a solution fitting all the variations of materials, able to apply to both glulam timber, concrete and steel.

Therefore, most of the joints are designed based on timber socket systems, in which the structural elements are joined together in a steel socket with bolts, thereby easing both the construction- and the inevitable disassembly phases of the structure. The design of the joints is illustrated through illustrations 063-067.

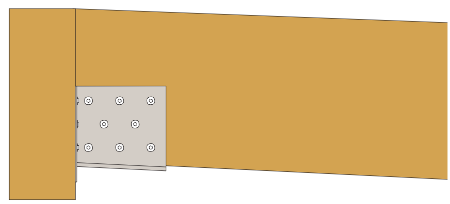


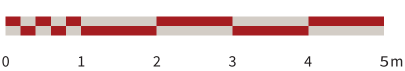
Illustration 063 - Roof x Rim Beam Joint

Steel

Wood

Concrete

Steel joints



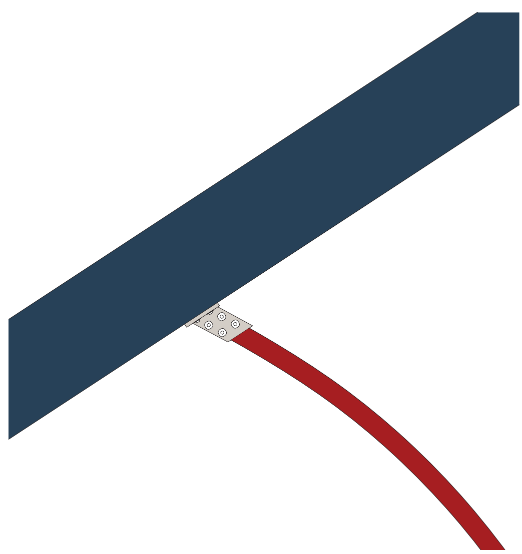


Illustration 064 - Raker x Support Element Joint

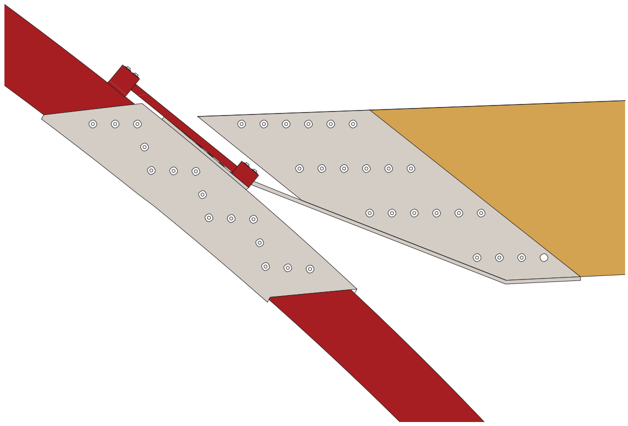


Illustration 065 - Facade Columns x Roof Beam Joint

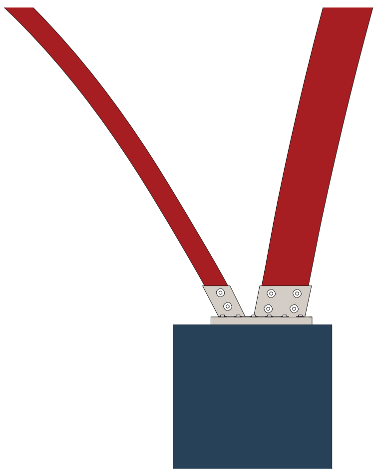


Illustration 066 - Facade Columns x Column

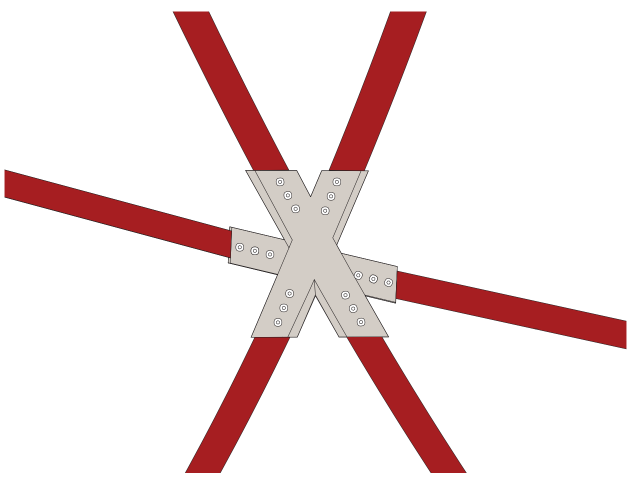


Illustration 067 - Facade Columns x Roof Beam Joint

Structural elements analysis

As part of the design process for the structural elements and roof of the stadium, a total of 36 variations were calculated and dimensioned to carry the previously described loads These variations included different combinations of materials, such as glue-laminated timber (Glulam), concrete, and steel. Based on their utilization rates, five variations were selected for further analysis using Life Cycle Assessment (LCA). This assessment was conducted to evaluate the environmental impact of each variation focusing on the amount of CO2 they emit and recycling potential.

The structural design was divided into two segments: one material for the roof and another for the structural system. As a result, these five combinations were selected:

1.Steel roof - Steel construction

2.Glulam roof - Concrete construction

3.Glulam roof - Glulam construction (Element previous described as L being Glulam)

4.Glulam roof - Glulam construction (Element previous described as L being steel)

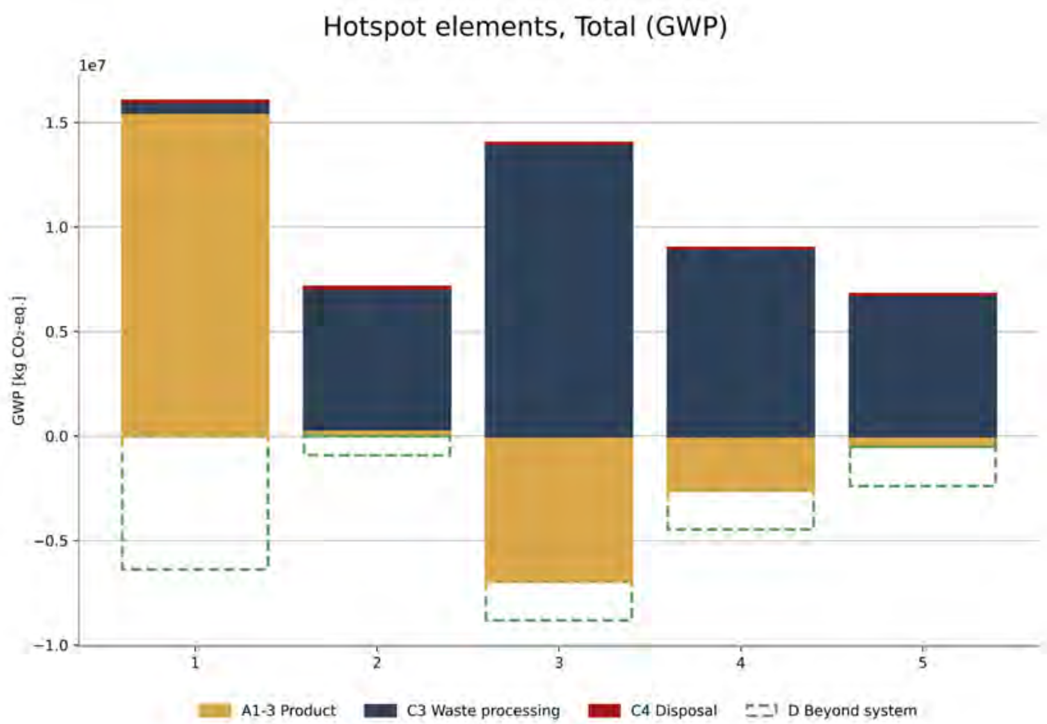
5.Glulam roof - Steel construction

The LCA results indicate that the steel-steel construction has the highest CO2 emissions, while the combination of Glulam-Steel has the least. The reason for the lower emissions of the Glulam-Steel construction is attributed to both the reduced total volume of material being used and the lower CO2 intensity of materials involved. Because of differences in material density and structural strength, the steel components in Variation 5 have a smaller cross-section than those in Variation 1. That is because the use of a wooden roof results in lower overall loads and bending moments on the structural system, resulting in a reduced total material volume.

These differences have been visually showcased in ten architectural renders that illustrate the appearance of each structural system and roof design. Including the architectural aspects, the atmosphere beneath the structure is assessed through said renders, as this aspect is just as important as how the elements perform in relation to LCA. Therefore, the variations were also evaluated in terms of the human scale and the expression of the facade.

The stadiums conceptual narrative puts emphasis on the fact that the supporters “carry the weight of the club on their shoulder.” This concept should be reflected in the way the structural systems carry the roof and the stands. Additionally, circulation around the stadium under the stands should feel intuitive and open, with high ceilings enhancing the spatial experience.

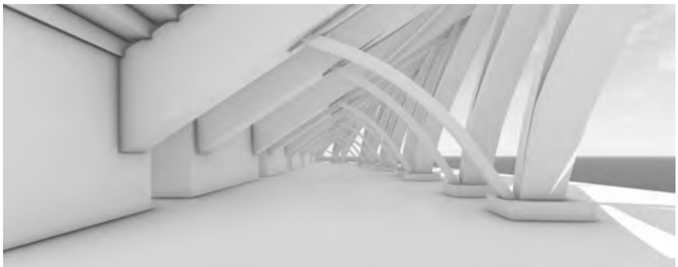
Ultimately, Variation 5 was chosen for this project. The decision is based on its performance in LCA analysis and its elegant, slim architectural expression. The combination of the two materials effectively conveys a lightweight and refined aesthetic, while structurally supporting the large roof and concrete stands, thereby fulfilling the projects design goals.



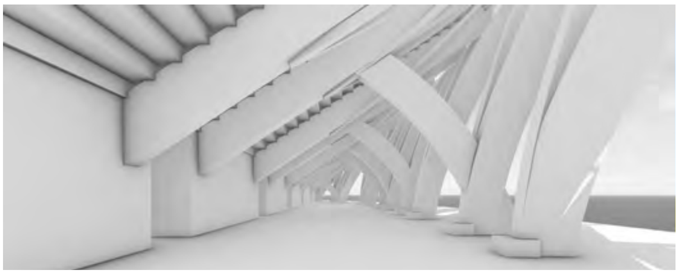
Name (Roof/Structural element)	A1-A3	C3	C4	D	Total
Variation 1 (Steel/Steel)	1.55E+07	5.00E+05	3.89E+04	-6.38E+06	9.65E+06
Variation 2 (Glulam/Concrete)	3.29E+05	6.74E+06	5.72E+05	6.20E+06	6.20E+06
Variation 3 Glulam/Glulam (Exex Glulam)	-6.96E+06	1.40E+07	1.79E+04	-1.86E+06	5.19E+06
Variation 4 Glulam/Glulam (Exex steel)	-2.60E+06	8.97E+06	1.79E+04	-1.87E+06	4.52E+06
Variation 5 (Glulam/Steel)	-5.05E+05	6.76E+06	1.98E+04	-1.89E+06	4.39E+06

Illustration 068 - LCA Calculations

Steel-Steel construction



Glulam-Concrete construction



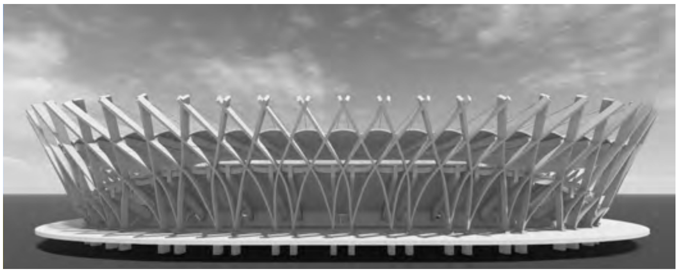
Glulam-Glulam (Glulam) construction

Glulam-Glulam (Steel) construction

Glulam-Steel construction

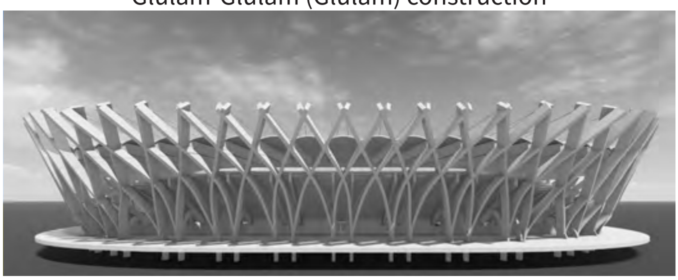
Illustration 069 - Concourse Dimension Perception

Steel-Steel construction



Glulam-Concrete construction

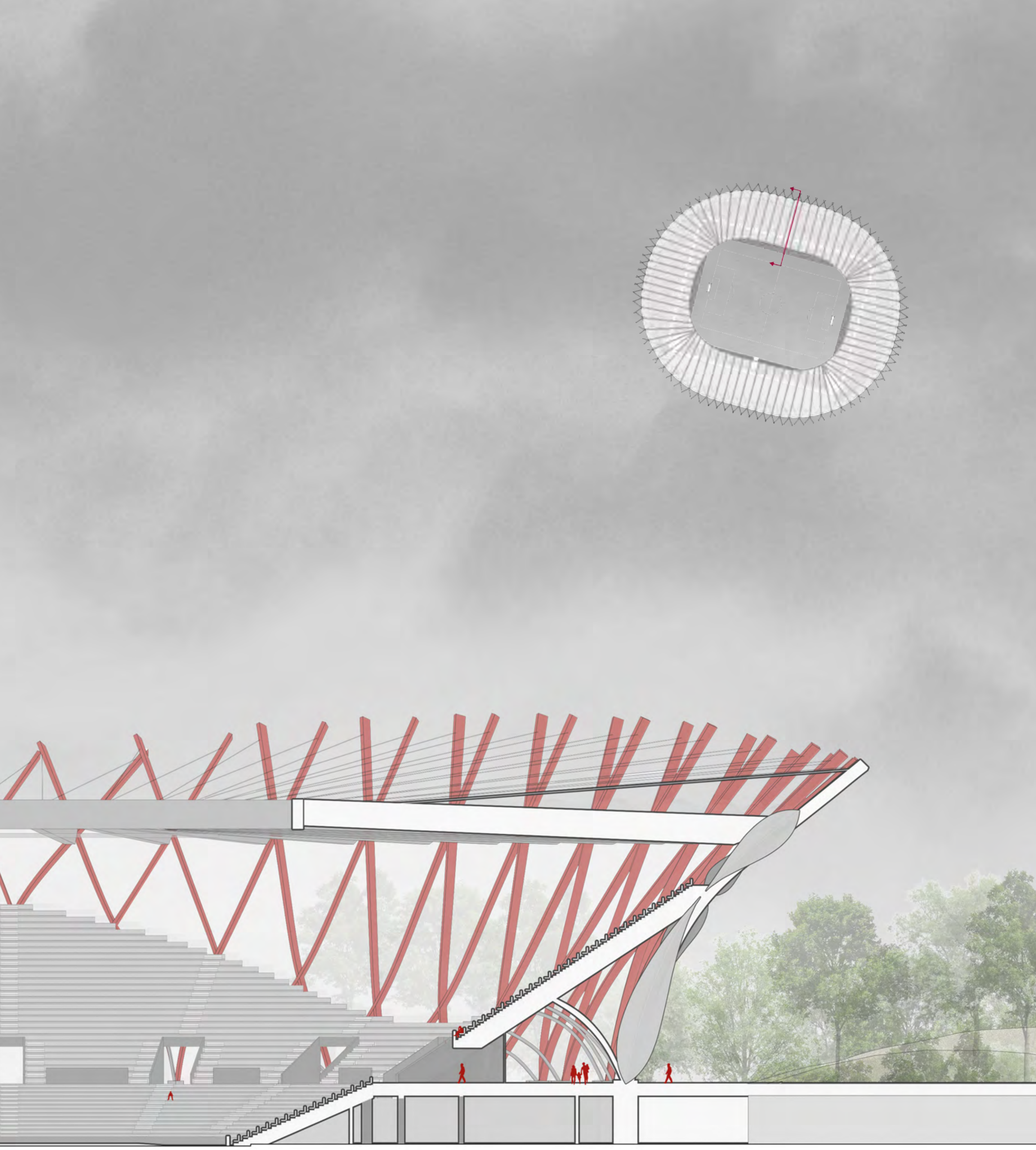
Glulam-Glulam (Glulam) construction



Glulam-Glulam (Steel) construction

Glulam-Steel construction

Illustration 070 - Elevation Dimension Perception



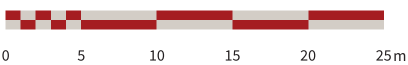


Illustration 071 - Section Level free access

Design for inclusivity

As previously stated, one of the issues at the current Aalborg Portland Park is the accessibility in relations to fans with disabilities. Currently the internal flow towards the stands requires the ability to use the stairs, due to the height difference between the entry levels of stands and the stadium. This issue is then solved by creating separate entrances in the corners, leading to the designated seats in the lower rows, with bad overview, on the verge of feeling disconnected from the rest of the stadium atmosphere.

Therefore, the design driver that describes the design for accessibility, has been a key driver towards the design of the sections. The resulting section allows for level free entry to the stands, while entering at a height from which the designated seats receive an improved overview of the stadium compared to the current conditions. At the same time, level-free entry mitigates the overall need for elevators around the stadium.

In total the stadium must, at a total capacity of 30.000 spectators, have at least 570 designated seats for fans with disabilities, including companion seats. This roughly matches the number of seats that are facing the transition aisle inside the stands, meaning that all accesabilty seating is spread out, across the stadium bowl, thereby having an inclusive stadium atmosphere for AaB fans in all shapes and sizes.

While the level-free entrance to the stands results in improved conditions for fans with disabilities, it compromises the aspects of the stadium concourse. The concourse serves a lot of functions. Primary it serves the purpose of circulation, requiring enough space for fans to transit between the spectator stands, and the concession stands. Commonly it is seen that the concessions are placed beneath the stands, serving a load carrying purpose and utilizing the odd shaped void. Having the concessions placed here it relies on reaching a certain room height, to have a comfortable working space.

The required space for the concession stands leaves a restricted area left for toilet facilities. Following the ideas of designing for inclusivity, these spaces will be arranged for extra-width toilets, supportive of wheelchair users. Therefore, the remaining volumes will serve the purpose of stairs leading towards the toilets for the fans that are capable of using the stairs.

While the concept of having to go to the cellar to visit the bathroom is not ideal, the overall circulation is not that different from the commonly seen at other stadiums as the stairs appear in both earlier described scenarios. Either the stairs is between the concession stands connecting the concourse and the stands, thereby having enough space to have the sanitary facilities at the same level as the food stands, or the stairs can be used as a separator between the sanitary facilities, and the food facilities, thereby not having the fans waiting in line for food along the bathrooms as the current conditions imply.

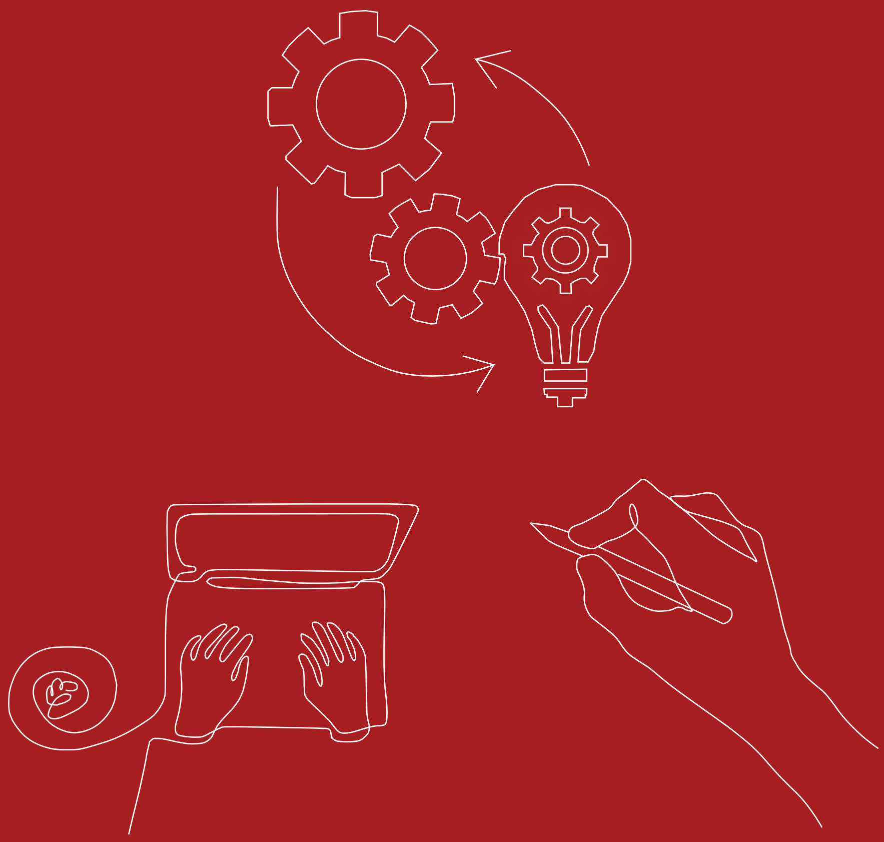


Illustration 072 - Design process part II

DESIGN PROCESS PART II

Stadium Envelope

A stadium is always judged by its first impression, as the first thing noticeable when arriving is the facade. Therefore, it is a vital part of the design process to create a façade that evokes emotion in the spectator and builds excitement for the experience.

Throughout the design process, various concepts for the façade have been investigated and analysed in terms of their visual qualities and their alignment with the structural design vision. Initially, it was explored whether the reused aluminium from the existing stadium façade could be repurposed and modified to create a visual reference to the red and white stripes that AaB plays in, along with integrated windows to bring in natural light, or just having a fully glazed facade, see illustrations 073 and 074.

However, this approach resulted in a façade that did not appear as a coherent whole, but rather as a disjointed composition, where the aluminium cladding and windows did not naturally align with the structural elements and with the facade fully glazed, it reads to simplistic and an easy solution.

This made it clear that if the goal was to highlight the structural elements as the dominant visual components of the façade, then the infill should be minimalistic and consist of a single material to avoid confusion in the visual reading of the façade. As a result, several alternative solutions were researched, and the material ETFE consistently emerged as a strong candidate due to its lightweight nature, self-cleaning properties, weather resistance, and high light transmission. Furthermore, ETFE is recyclable and flexible, allowing it to be manufactured to meet the specific needs of the project.

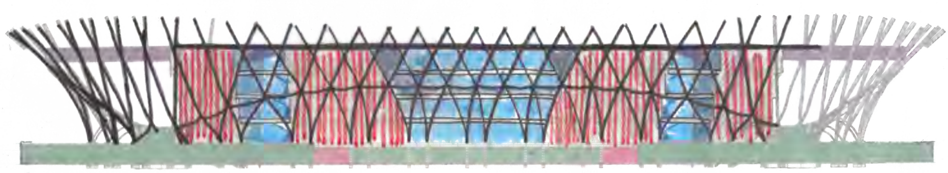


Illustration 073 - South Elevation Iteration

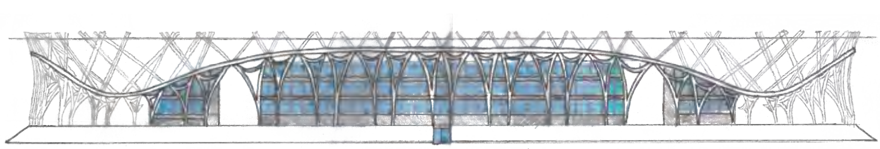


Illustration 074 - South Elevation Iteration

Another advantage of ETFE is its excellent ability to transmit colour, which enables the façade to be illuminated in various colours and patterns during matchdays and concerts.

Three iterations were designed, in which the ETFE surface was illuminated in different ways (see illustrations 077-079). One featuring a single colour, another used the beam supporting the stand as a divider to create a white and a red surface, and a third version that displays the entire façade in a single colour, with modern projection technology used to animate red lightning bolts that resembles the lyrics from the pre-match song.

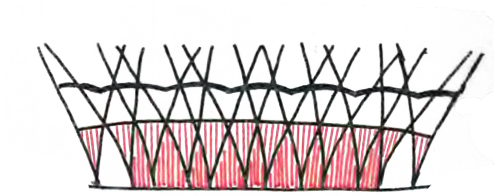


Illustration 075 - Striped Bottom Iteration

Illustration 076 - Diagonal Subdivided Surface Iteration

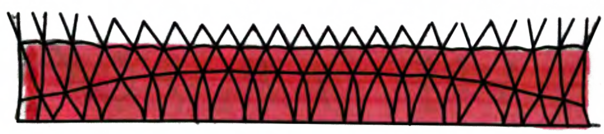


Illustration 077 - Fully Covered Facade Iteration

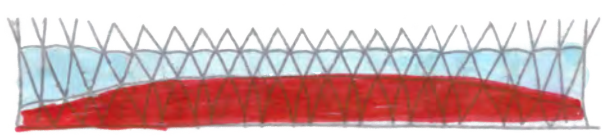


Illustration 078 - Bottom Covered Facade Iteration

Illustration 079 - Fully Transparent Iteration

Illustration 080 - Geometric Urban Iteration

Illustration 081 - Fanzone Urban Iteration

Illustration 082 - Pavement Urban Iteration

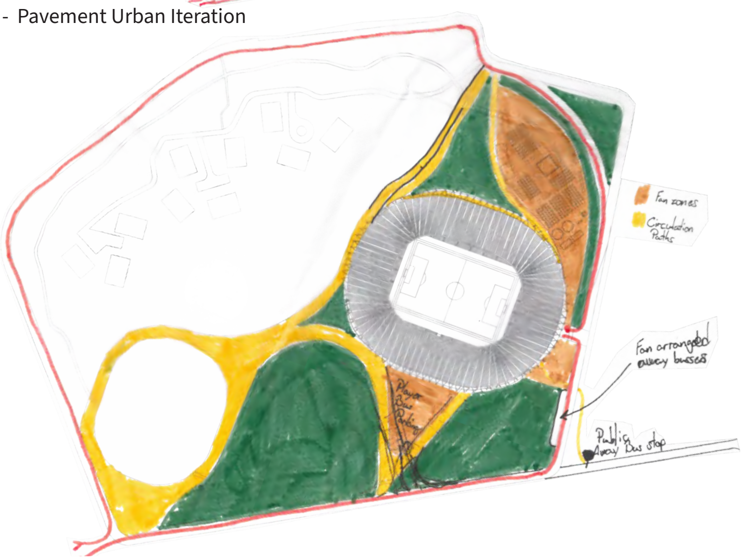


Illustration 083 - Zoning Urban Iteration

Urban context

Even though this project emphasizes the stadium architecture, the surrounding context plays an important role in creating a holistic stadium design that captures the city and becomes one with its surroundings. The placement of the stadium were chosen from the projected plan from C.F Møller, placing the stadium in the east of the site close to public transportation.

Along with the plan from C.F Møller, was also the placement of a new MultiArena for handball, concerts and exhibitions. The Multi Arena is in the southwestern corner and connected to the stadium via a paved path, dividing the site into and north and south area. That has been done to facilitate a recreational area with playgrounds and place for relaxation and longer stays in the north around the new apartment blocks, and a more nature friendly area towards the south to create a noise wall, shielding the residents living in the nearby suburban neighborhood.

Through the design process, the context have been iterated on a lot and things such as access points, car traffic, entry points, stadiums orientation and how pedestrians and cars cross each other. In the beginning of the design process, the existing route for cars to and from the stadium were anticipated to come from the east around the city centre, but with the plans for the new highway route called Egholmlinjen the route could be altered into a loop, meaning the car arrive from the west of the stadium, drive to the stadium at the south road into the parking cellar, and then exiting the cellar of the northern road back onto the highway, meaning that the flow of the cars becomes more linear and smooth.

The interaction between the cars and the pedestrians are also an important factor due to the number of fans expected to arrive by foot or public transport. Therefore, the roundabout on the north is expanded to deal with the larger car flow, but also to allow busses to have their own designed parking space between the road and the stadium, meaning that the busses will drop off the fans inside the stadium site so they will not need to cross a road to arrive at the fan zone.

Illustration 084 - Circulative Flow Iteration

Illustration 085 - Circulative Flow Iteration

Fan zone

The fan zone is a vital part of the experience when attending a football game. It offers the fans pre-match entertainment, food, music, and activities, that helps to create a lively and welcoming atmosphere for fans of all ages. Fan zones also help the club generate extra revenue through merchandise and concessions sales, furthermore, giving sponsors the opportunity to meet the fans and offer them an exclusive opportunity. The fan zone improves the flow of the crowd by encouraging them to arrive early to a designated area for them to build up expectations and enjoy cold beverages and delicious food.

At first the fan zone was designed as a large plaza wrapping around the east side of the stadium, but it eventually became its own separate area located north of the stadium. The placement of the fan zone quickly made sense, as most fans were expected to arrive from the north. To deny the possibility of the fan zone being shaded from the stadium during peak hours a shadow analysis was done, concluding that if the fan zone is active from noon, it would not be shaded from the stadium.

From there the fan zone started to be worked more into the larger context of the site, along with the intended circulation of both the soft and hard road users. Meaning that the fan zone was fitted into the pathway of the fans attending the stadium at foot or public transportation so they would be nudged into the area.

This resulted in a fan zone that was placed in the north of the site, raised from the cars to ensure a safe space, with facilities such as food trucks, beer stands, merchandise stores, sponsor events, a small musical scene, football activities for children such as panna, 3v3 and football dart, along with various seating arrangements for everyone.

Illustration 086 - Fanzone Iteration 1

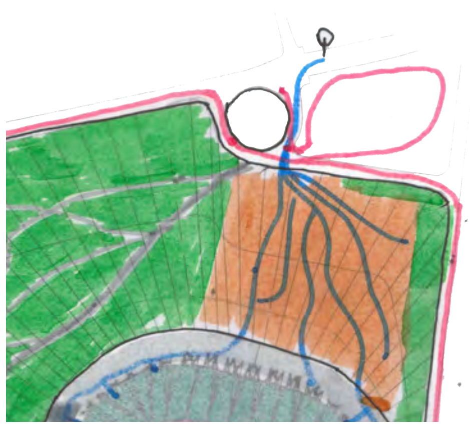


Illustration 087 - Fanzone Flow Iteration

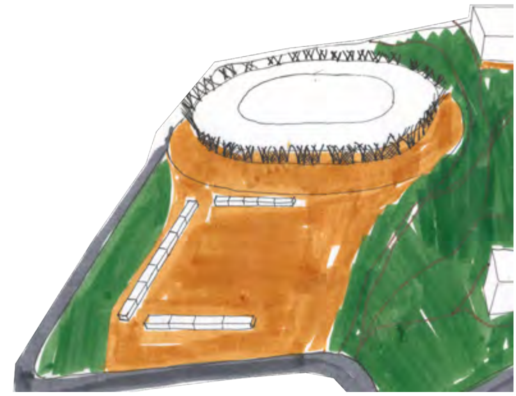


Illustration 088 - Fanzone Iteration 2

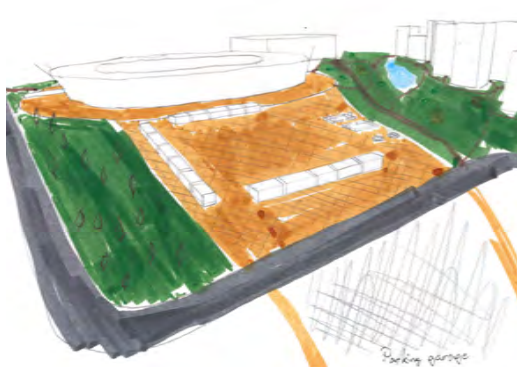


Illustration 089 - Fanzone Iteration 3

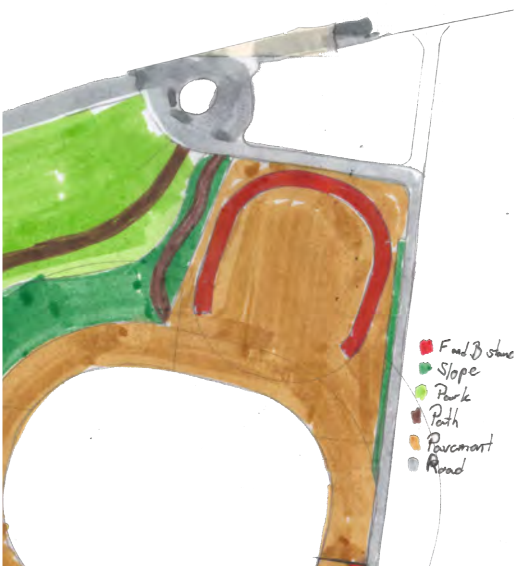


Illustration 090 - Fanzone Same Shape Iteration 4

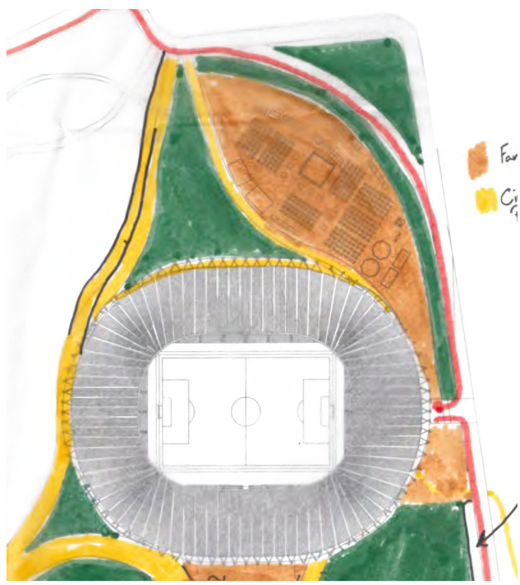


Illustration 091 - Fanzone Shape Iteration 5

Illustration 092 - Parking Iteration 1

Illustration 093 - Parking Iteration 2

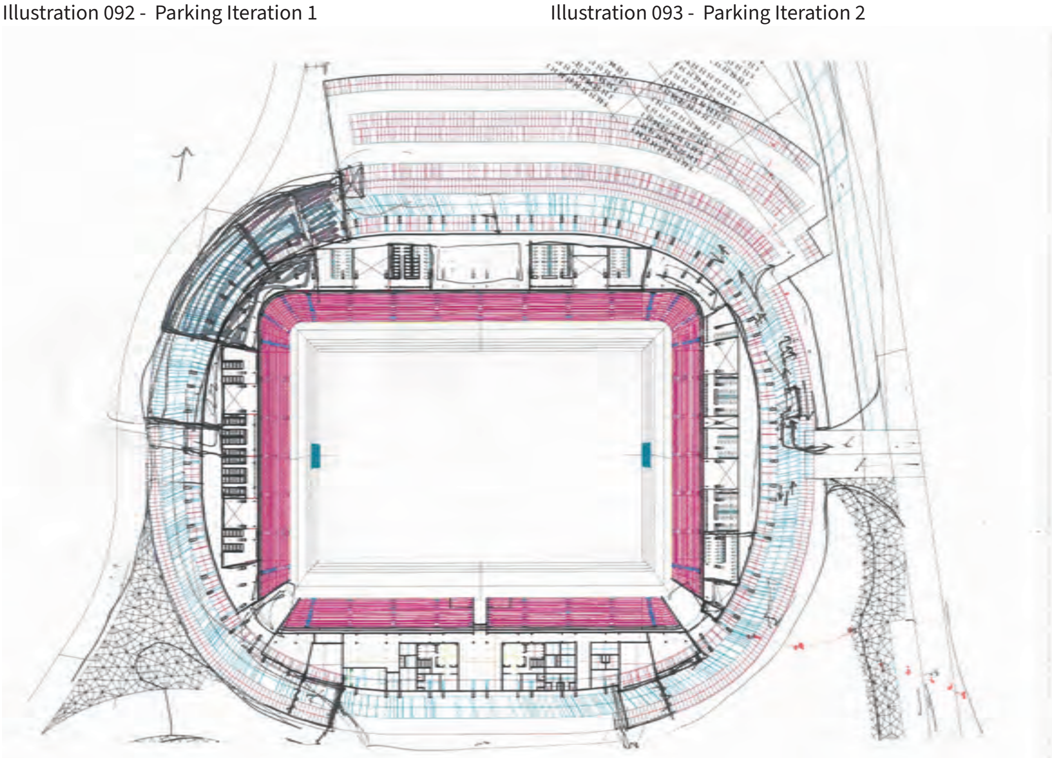


Illustration 094 - Parking Iteration 3

Parking

When designing a mega structure such as a football stadium, a thing that is often forgotten or low prioritised, is the parking. Therefore, it became an important design driver for this stadium to try and facilitate parking spaces for around 5% of the stadium's capacity around 1.500 parking spaces.

The placement of the parking spaces is vital to create a successful stadium circulation, where the traffic flows effortlessly and the distance from the parking space to the fan zone and stadium are not to long, and placing them in the right spot as they take up a lot of space.

At first the parking was intended to be placed around the stadium and primarily south of the stadium, as it is commonly seen in stadiums across Europe, but it would take up too much space on the site and did not comply with the vision for the stadium.

Therefore it was tested to see how many parking spots could be fitted under the stadium if it was raised a floor so the parking spots laid under the concourse and at the same level as the field, because the location of the site is close to the water, there is a raised risk of flooding, thus not recommended to dig into the ground.

As a conclusion the parking solution should be a mix of parking spots around the stadium and a one level parking cellar under the stadium to spread out the car traffic before and after a game ensuring smooth circulation.

Illustration 095 - Parking Zone Iteration 4

VIP Building

The VIP building in a football stadium serves as a premium space designed to offer an elevated and exclusive matchday experience for guest, sponsors, business partners and player's friends and family. Its primary purpose is to provide comfort, exclusivity, and high-end service, including fine dining, private lounges and the best seats in the stadium to watch the game. The VIP building is often used for networking and should therefore have spacious lounges, beyond matchdays the facilities can be used for meetings, conferences or private functions.

The VIP building is also something that separates the fans into groups. Through the design process the VIP building has been iterated thoroughly through both plan and section to fine tune not only the circulation, functions and flow, but also the appearance of the volume and how it becomes an integrated part of the stadium, where in some of the first iterations, it seemed dislocated and a volume of its own.

The plans have been reiterated corespondingly to the running updates on the facade and functions of the building. Enforcing that the vertical circulation strategy ensures clear and effortless transitions between levels, along with the function and placement on the different levels to ensure that the elites feel welcome and moves around intuitively.

This means that the VIP buildings volume should act as an integrated part of the stadiums façade and the floor plans should be individually designed and planned to their intended users purpose, leaving the user with a good experience and lust to return again.

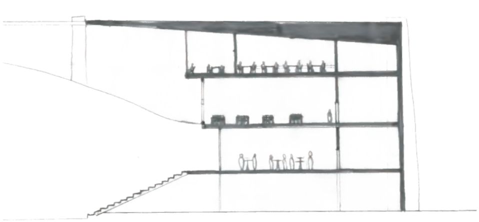


Illustration 096 - VIP Section Iteration 1

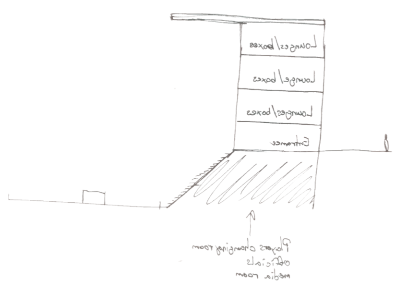


Illustration 097 - VIP Section Iteration 2

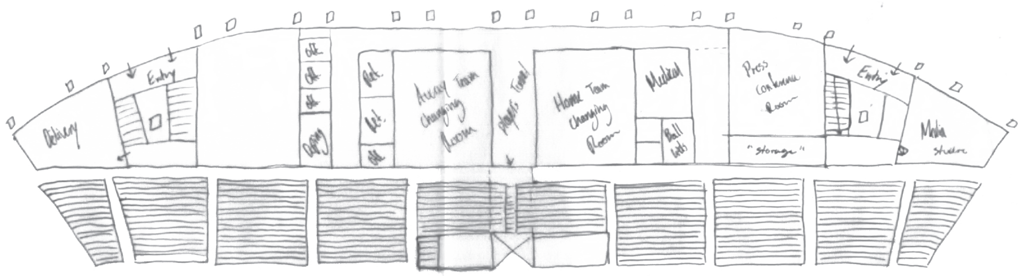


Illustration 098 - VIP Building Player Floor Plan Iteration

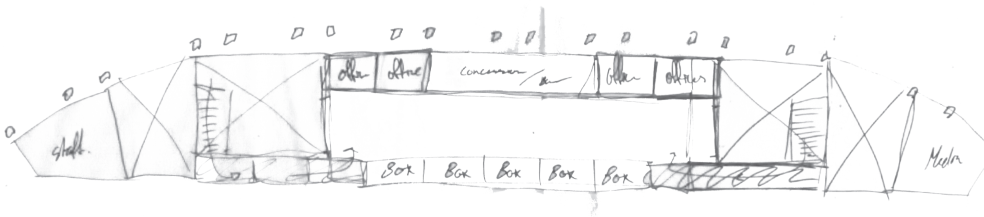


Illustration 099 - VIP Building VIP Floor Plan Iteration

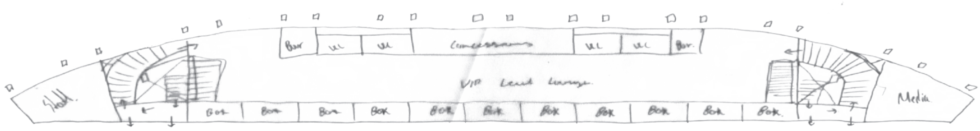


Illustration 100 - VIP Building VIP Floor Plan Iteration

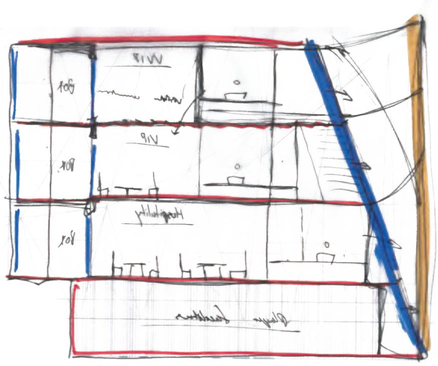


Illustration 101 - VIP Section Iteration 3

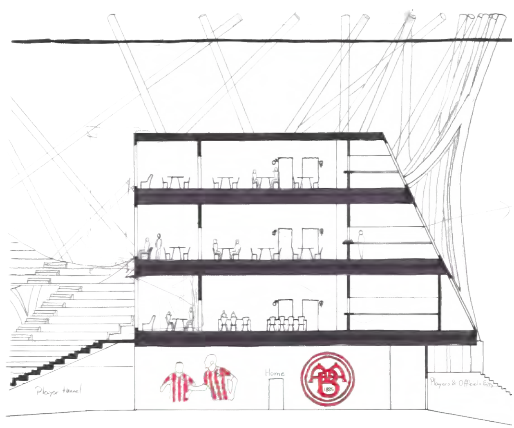


Illustration 102 - VIP Section Iteration 4

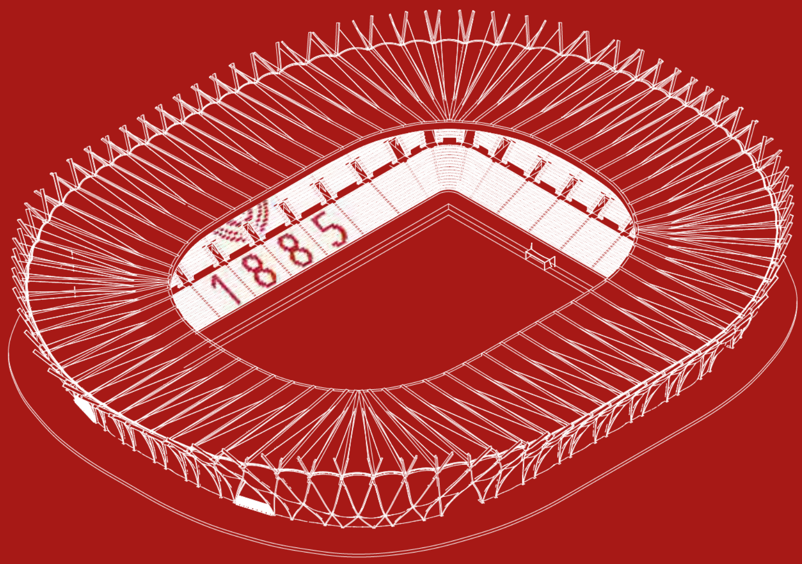


Illustration 103 - Presentation Axonometric

PRESENTATION

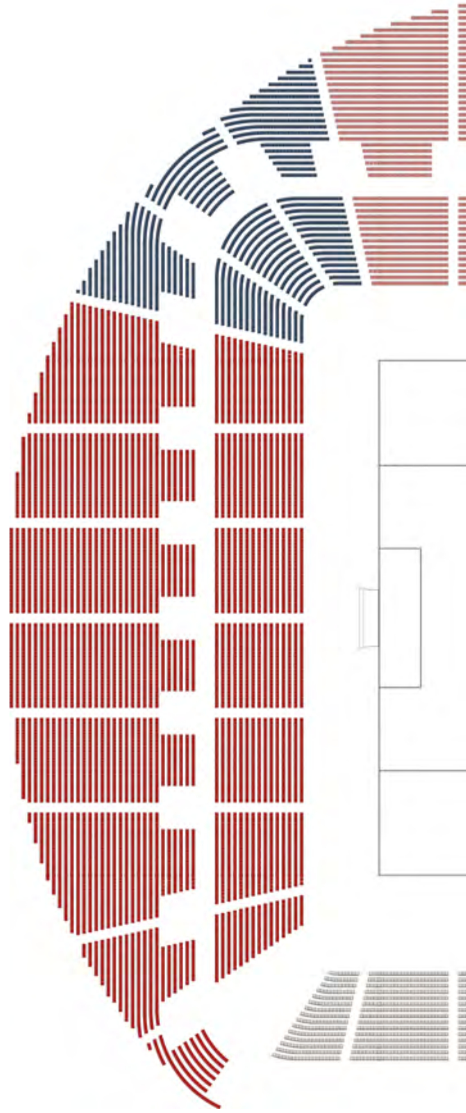
The final design proposal for the New Aalborg Portland Park and its surrounding park area is presented in this section. The presentation illustrates the envisioned atmosphere and user experience on a match day—from the perspective of regular fans navigating the concourse to VIP guests enjoying the lounges and private boxes. In addition, the final life cycle assessment (LCA) results, along with other technical analyses, demonstrate how the project has addressed its sustainability objectives. The design aims to create a stadium that evokes a sense of safety, satisfaction, and a lasting desire to return among its visitors.

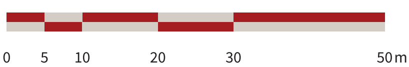
Stadium Overview

Illustration 104 - Stadium Overview Render

Seating Layout

The seating layout is organized to reflect the user groups attending the stadium, with the home ultras and away fans being at separate stands with the regular fans dividing them. Between the regulars and the away section is a buffer section, to add flexibility in size depending on demand for away tickets. The VIP stand is divided into the three users with the hospitality seats at both ends, the luxurious VVIP seats in the middle and the VIP fans in between. The result is a stadium facilitating 30.220 fans with four over all groupings; home ultras, away fans, regular fans including family, and VIP fans divided into Hospitality, VIP and VVIP.





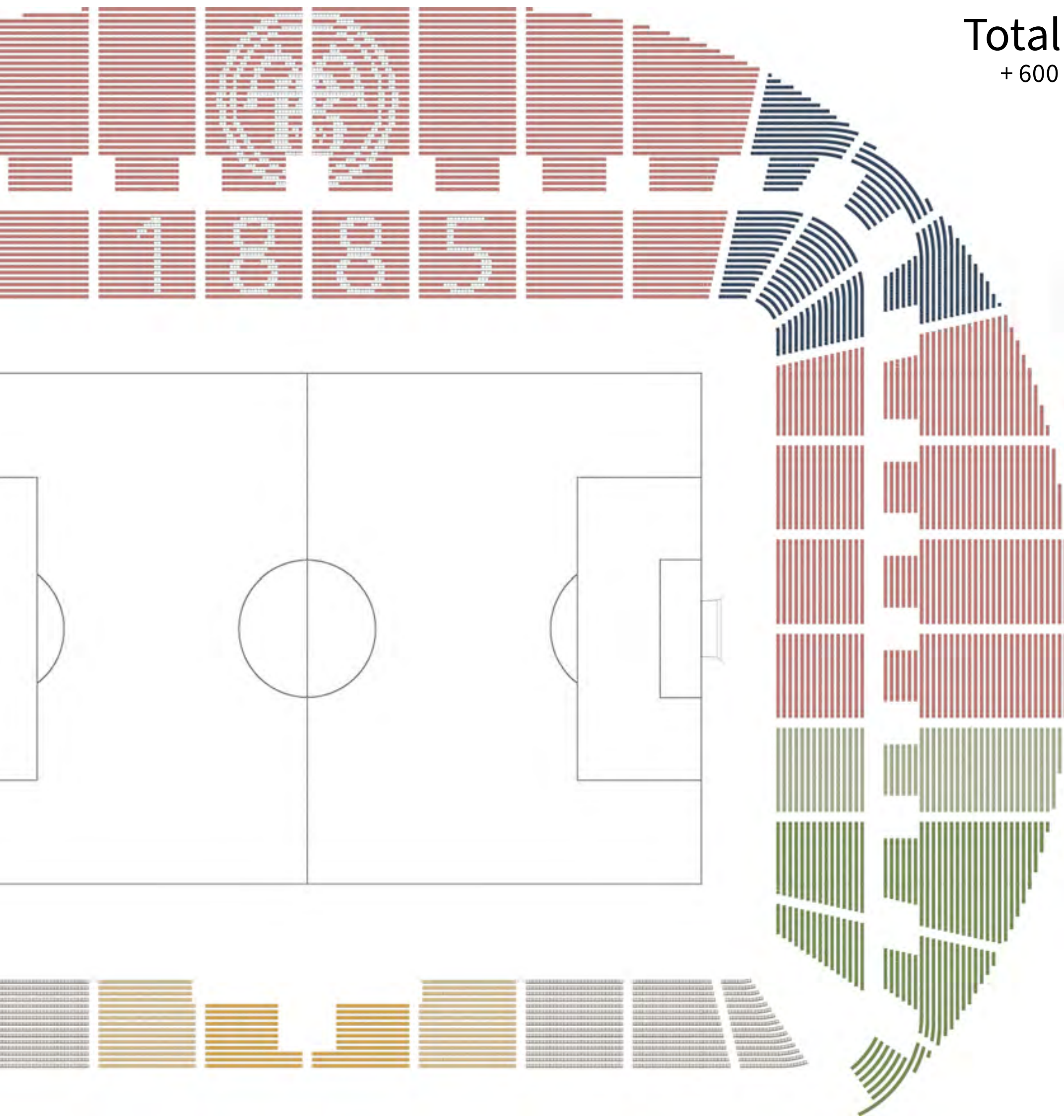
Ultras - 7.315

Home - 13.974

Family - 2.918

Illustration 105 - Bowl Seating Layout

Total 30.220
+ 600 accessibility

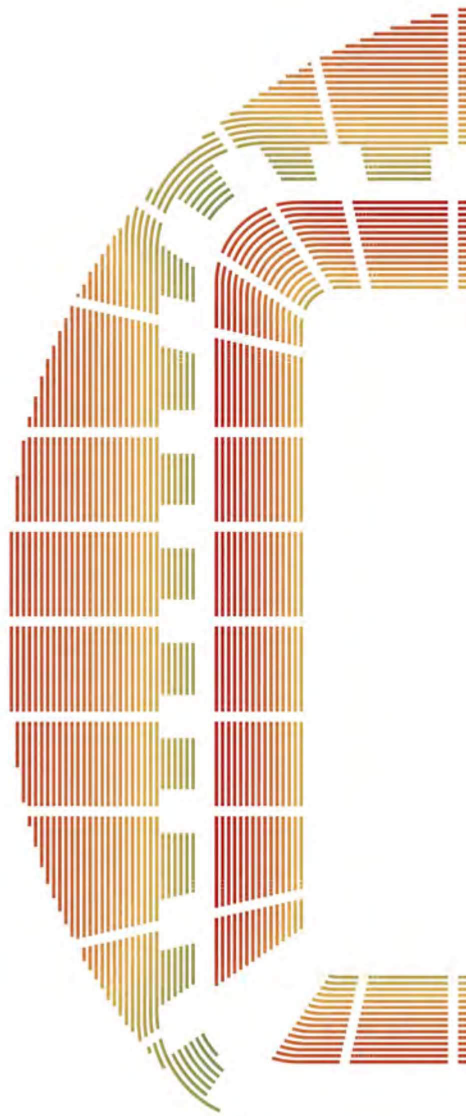


Buffer - 1.014
Away - 1.611
Hospitality - 2052
VIP - 832
VVIP - 504

C-values of the stadium bowl

With the implementation of goal-oriented design, the quality of sight has reached a high level throughout the entire stadium. As the gradient indicates, the local values range from 125 to 350mm - thereby conforming to FIFA's recommendations for optimal quality of sight. As illustrated, the highest value is actually achieved by the transition zone, thereby not compromising the view when other spectators are passing, when moving towards the concourse for refreshments.

At the same time, the initial C-values of the old stands are improved drastically, by moving them further away from the focal point, thereby declining the sightline angle between the spectator and the field. The quality of the sightlines is also shown as being most optimal in the corner stands, meaning that the overview of the field is not compromised whether the spectator supports the home or away team, that is located in the southeast corner of the stadium bowl.



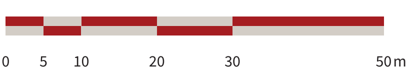
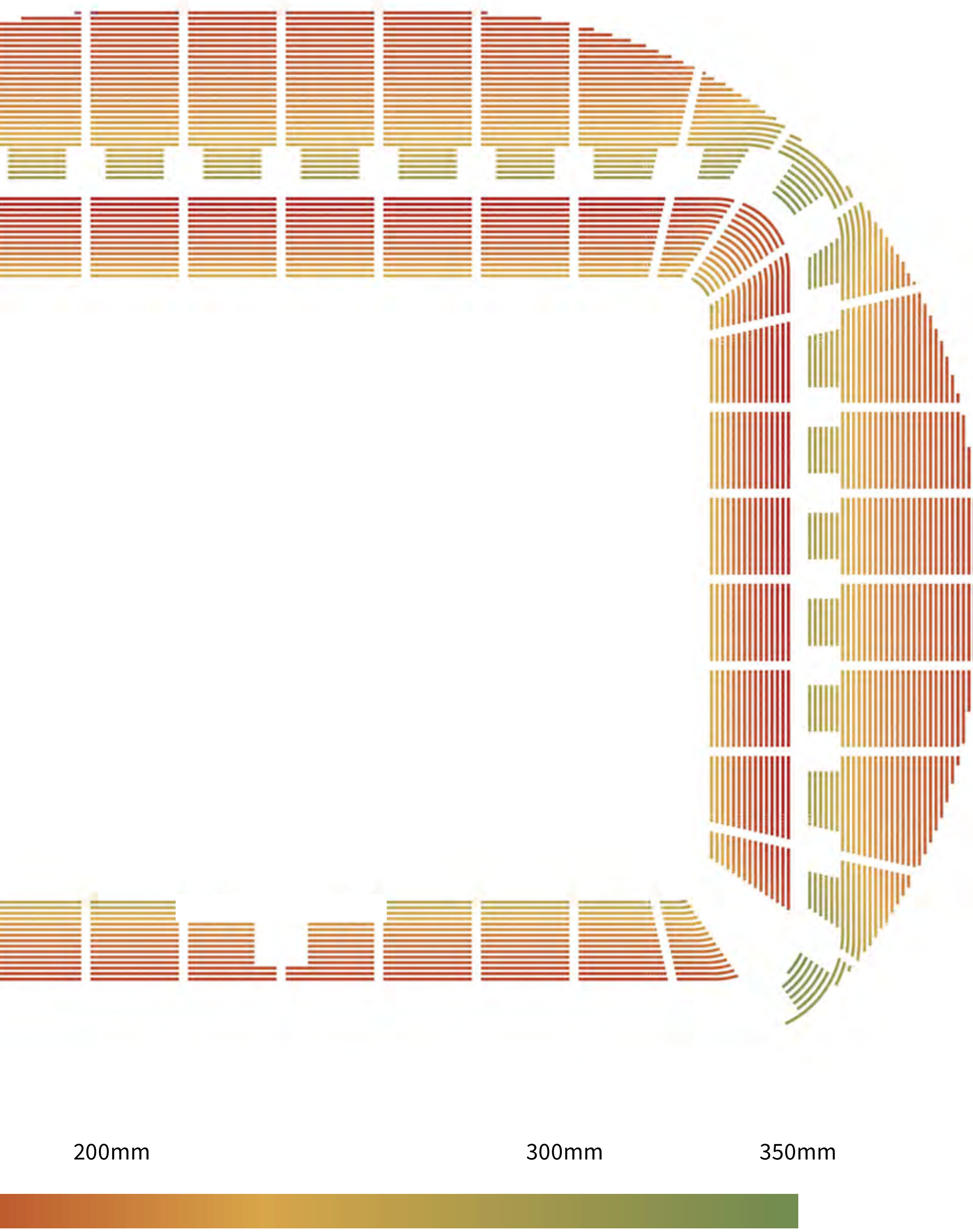
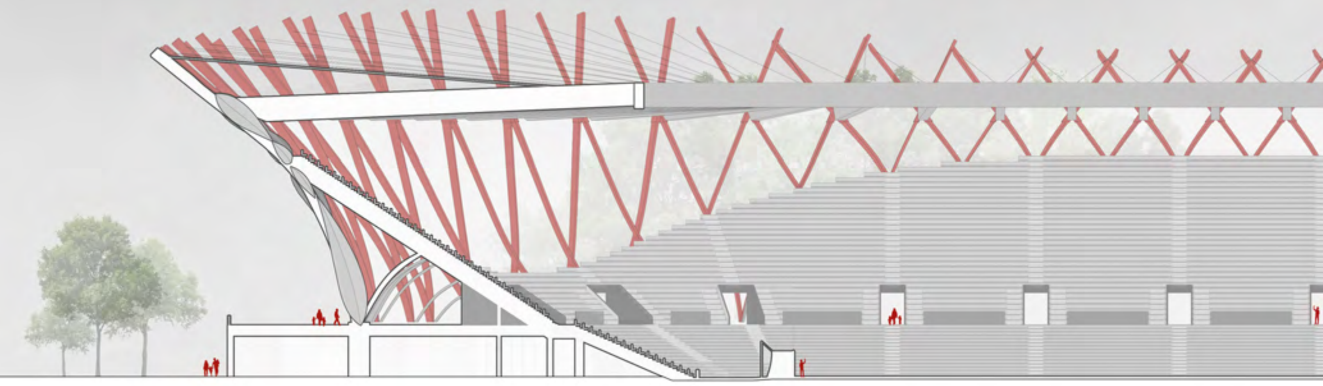


Illustration 106 - Bowl C-Values


200mm
300mm
350mm

Section - East to West



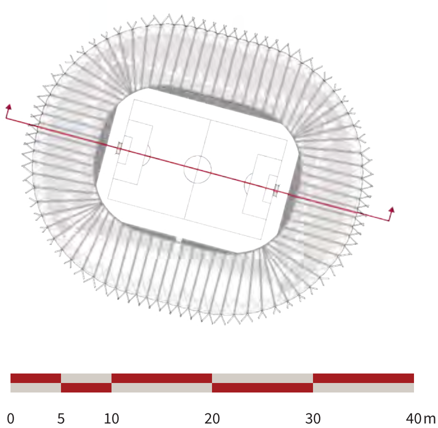
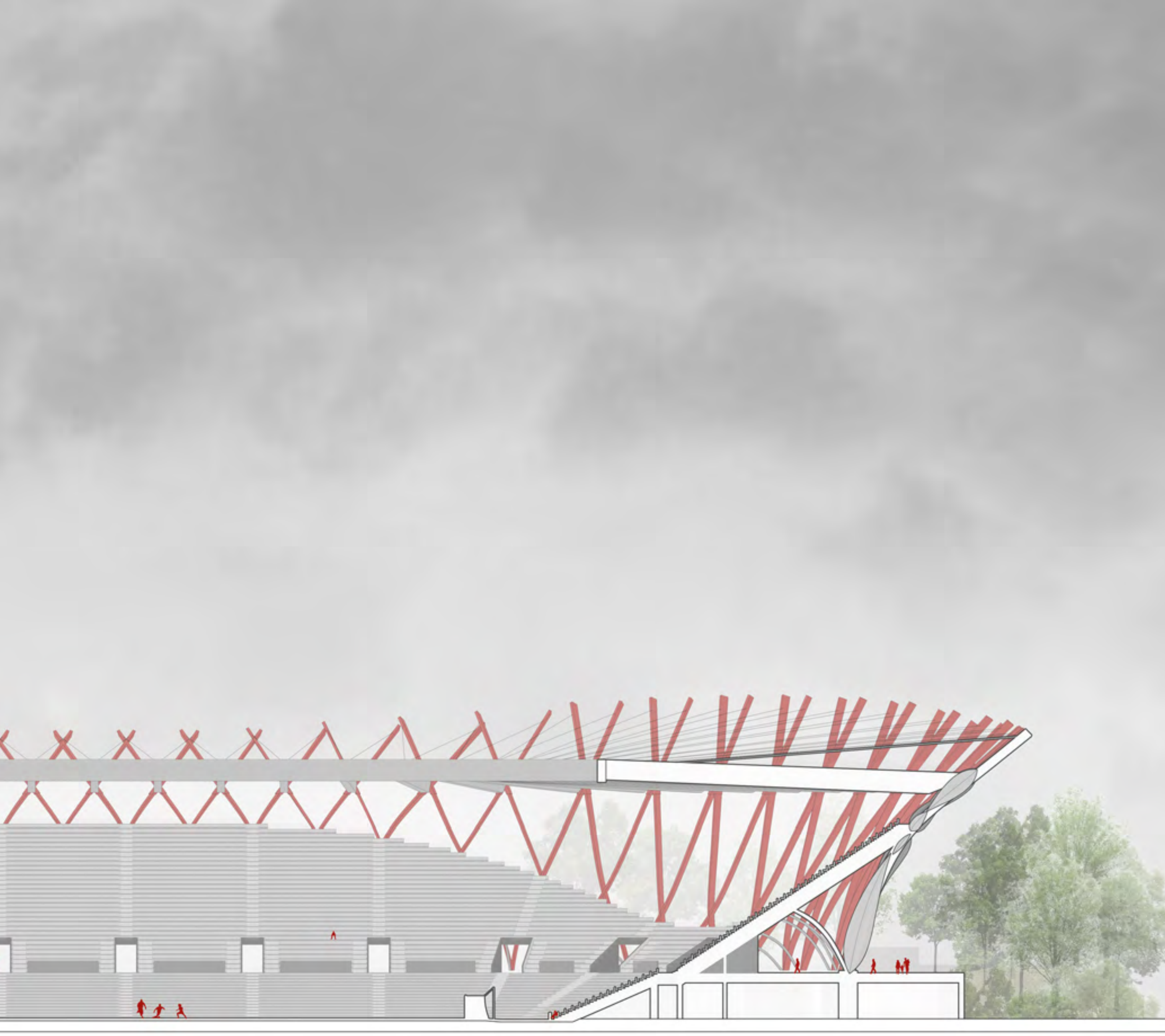


Illustration 107 - Section East-West



Player Tunnel Exit

Illustration 108 - Player Tunnel Exit Render

Ground Level - Floor Plan

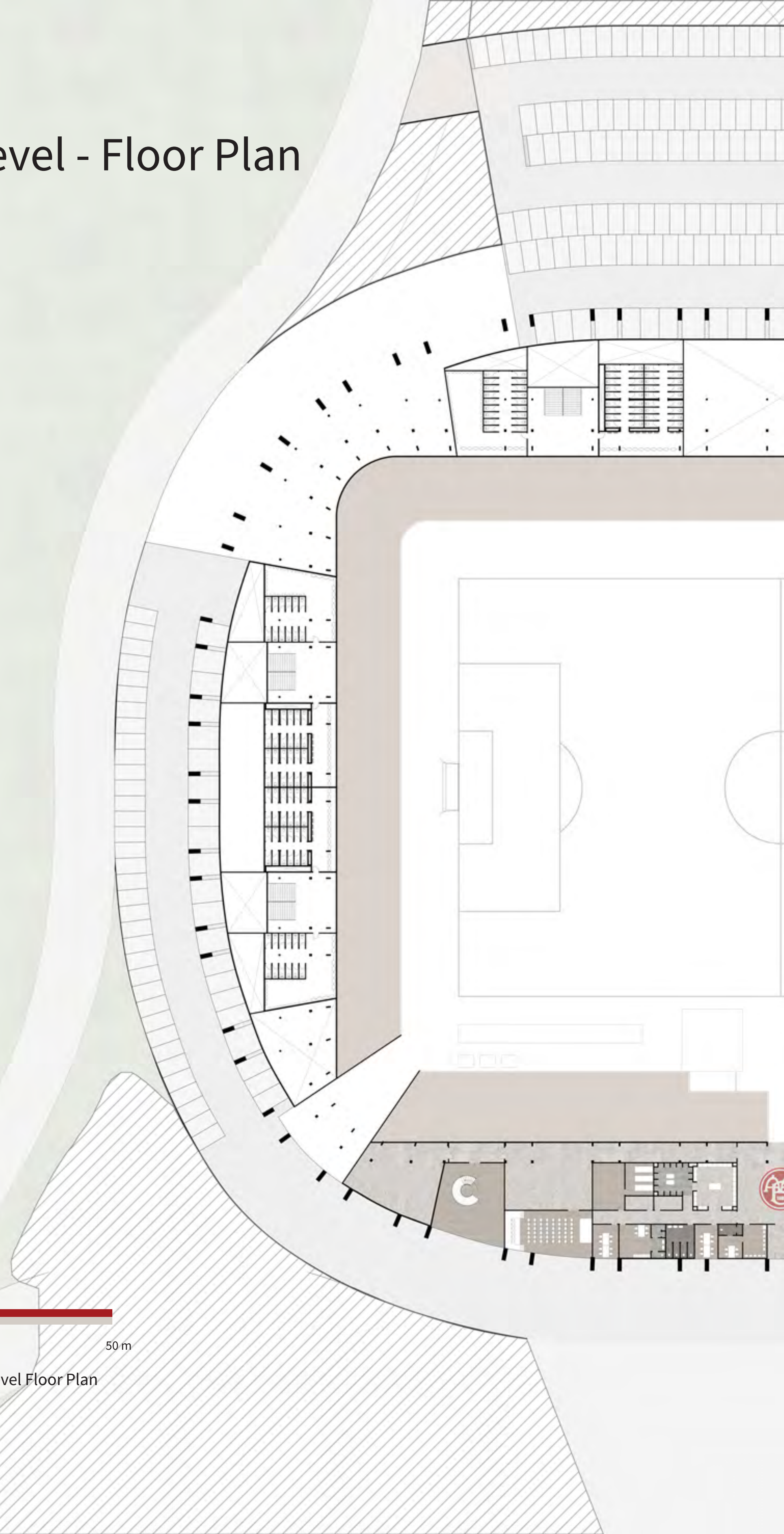
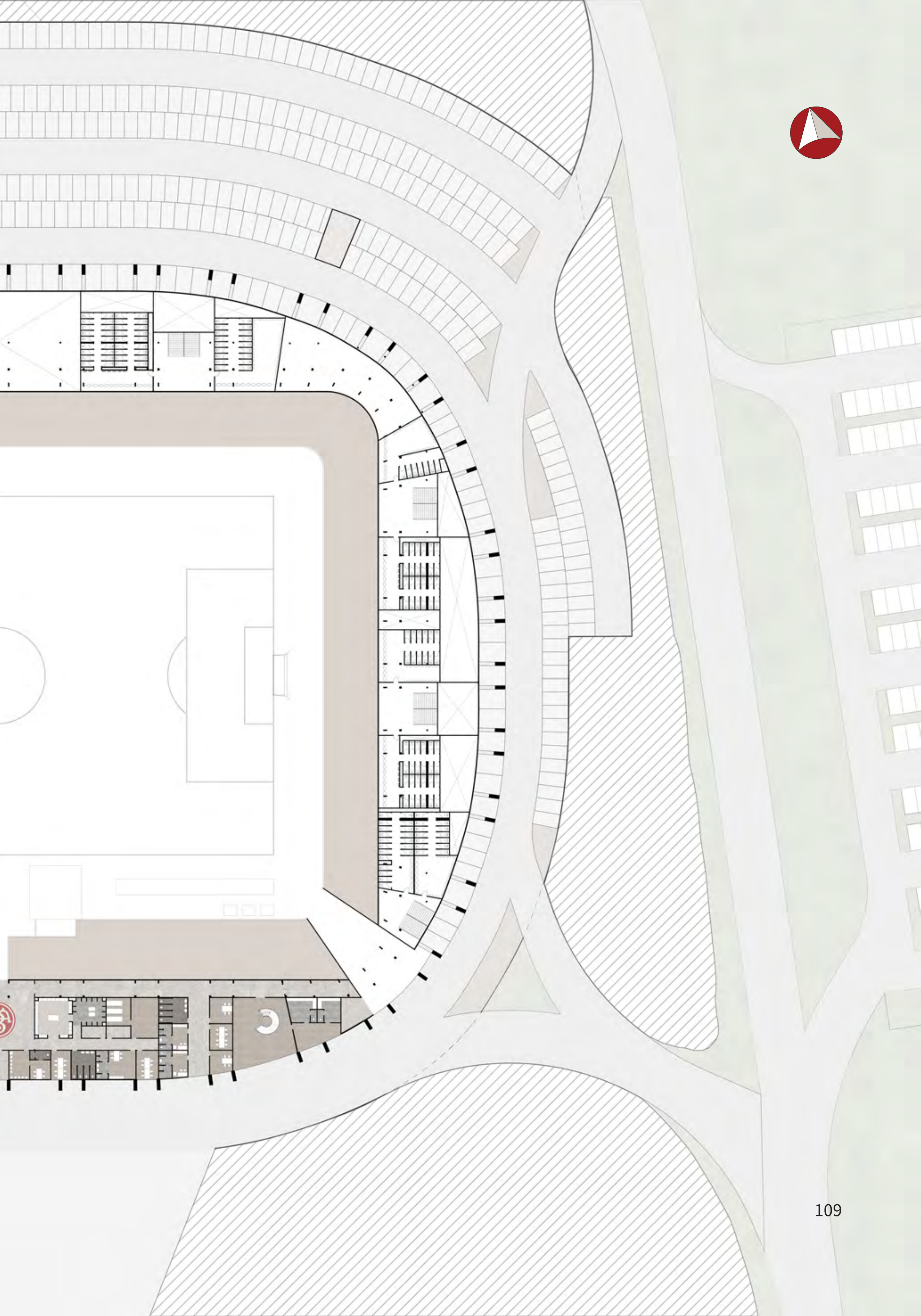


Illustration 109 - Ground Level Floor Plan



Function

To better understand the different functions that accommodate the different user groups a function axonometric diagram has been created to illustrate the placement of the functions beneath the stands, see illustration 110. The ground level, situated beneath the concourse, is designated to the practical functions, such as toilet facilities, storage, technical areas and parking. Described further in appendix 8.

Separating from the VIP volume, the two super vomitories are dimensioned so that trucks and ambulances can enter the field of play, or to set up concert events, or renovations. The vomitories also function as emergency escape routes to support quicker evacuation time.

In the VIP Volume, the player facilities are found, offering easy access from the changing rooms on to the field, while also facilitating entries for officials and media.

Surrounding the stadium boundary is the parking area with a capacity of 450 parking spaces. Towards north is also located a grocery store that tends to the residential area that is the north western part of the site. The parking spaces and grocery store will help activate the stadium beyond matchday, that only occurs a few hours every other week.

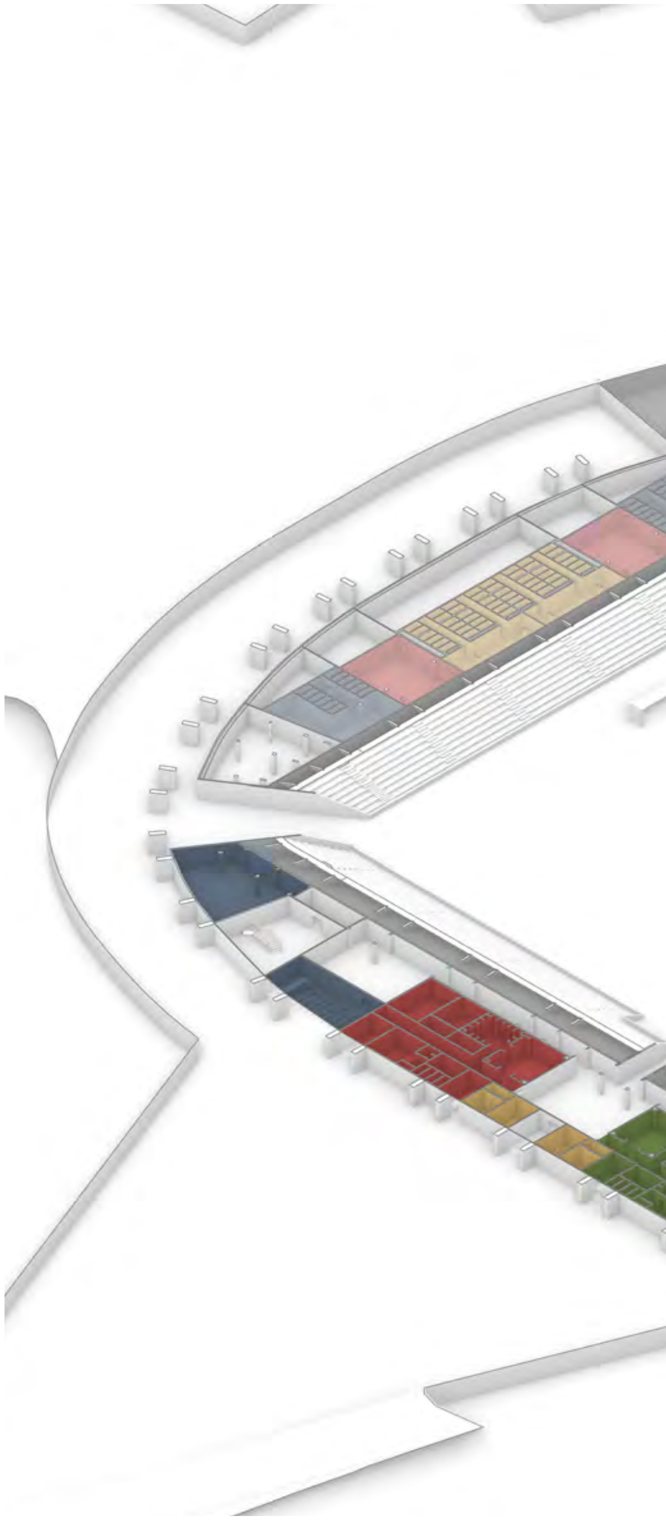
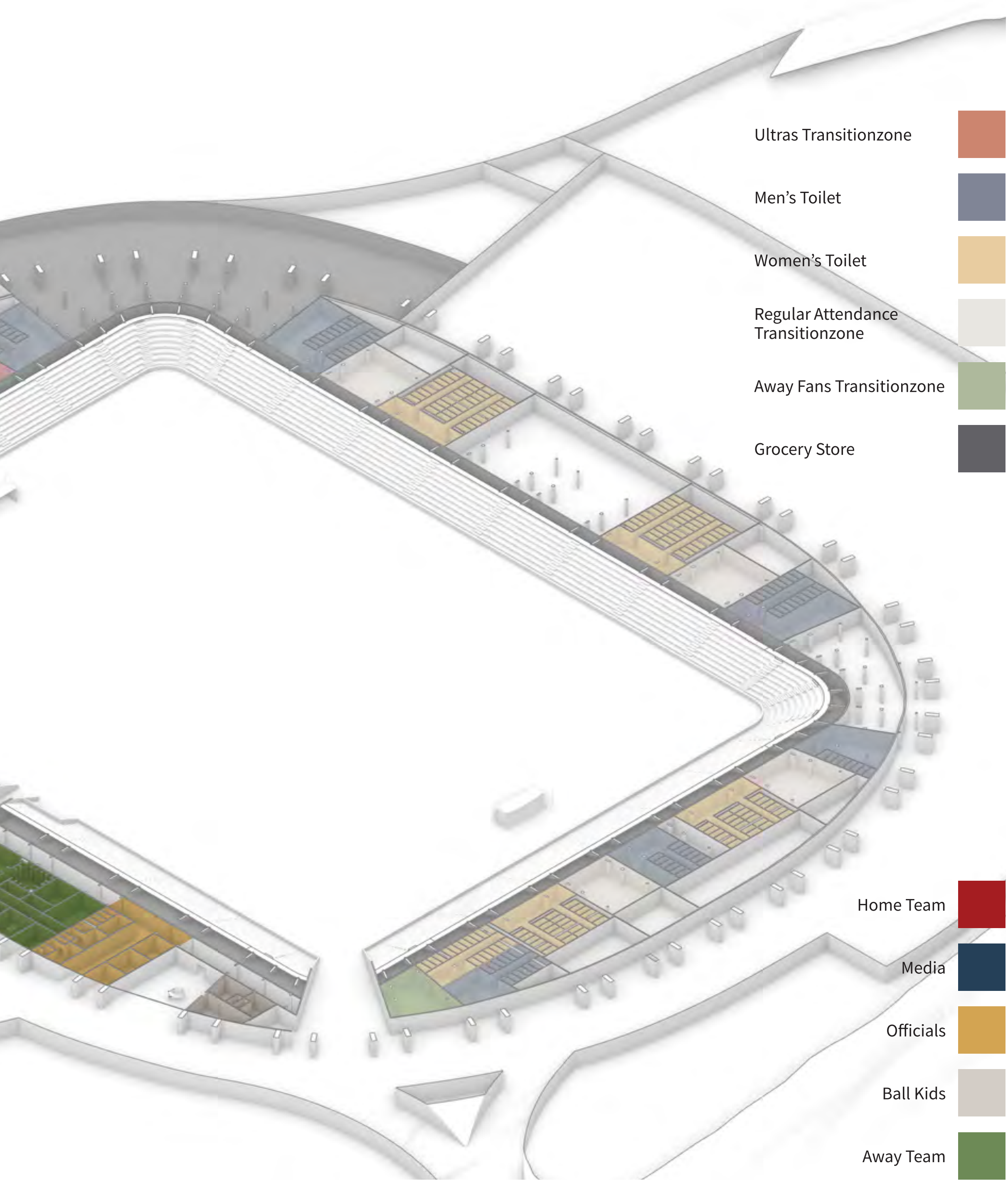
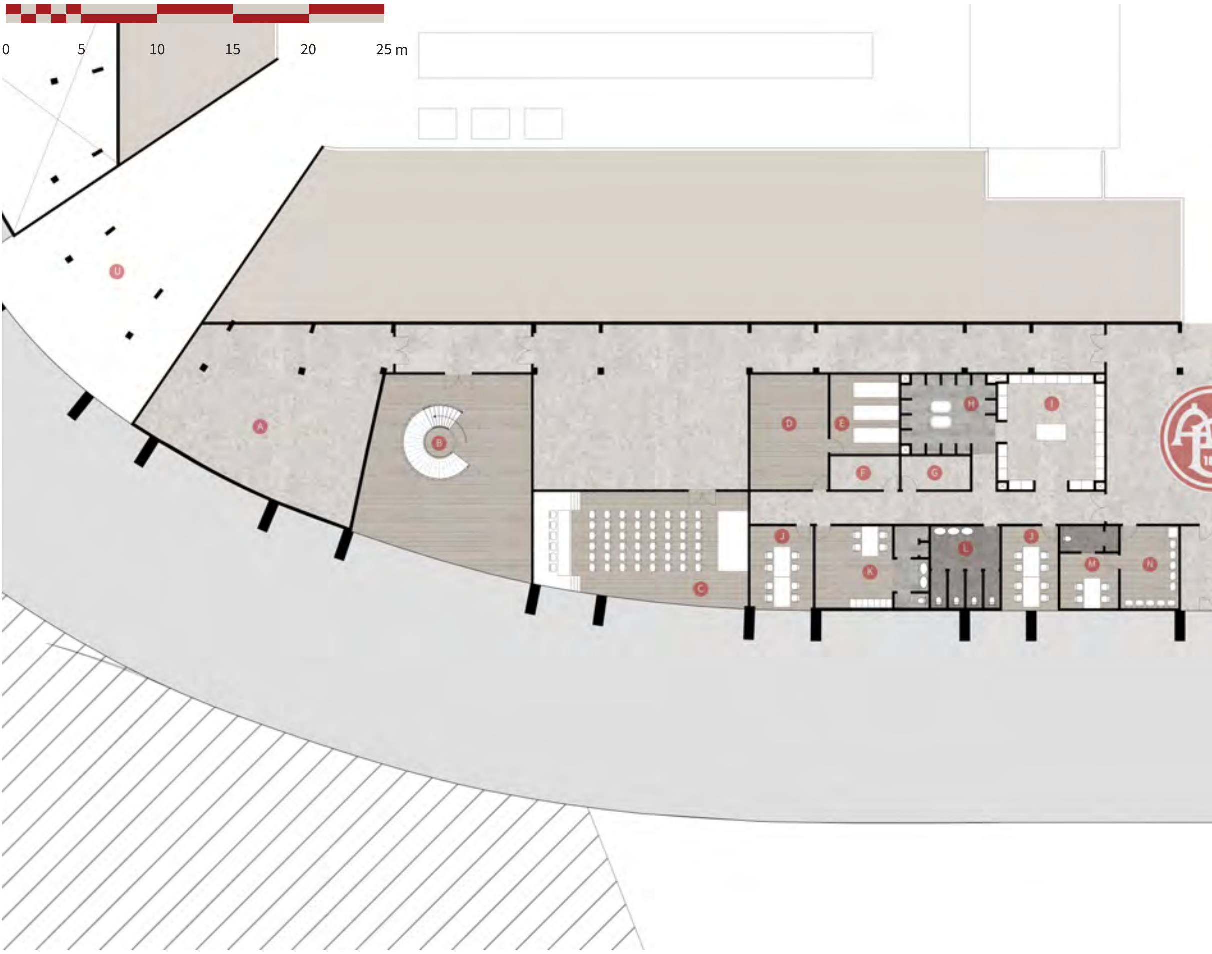


Illustration 110 - Ground Level Function Axonometric



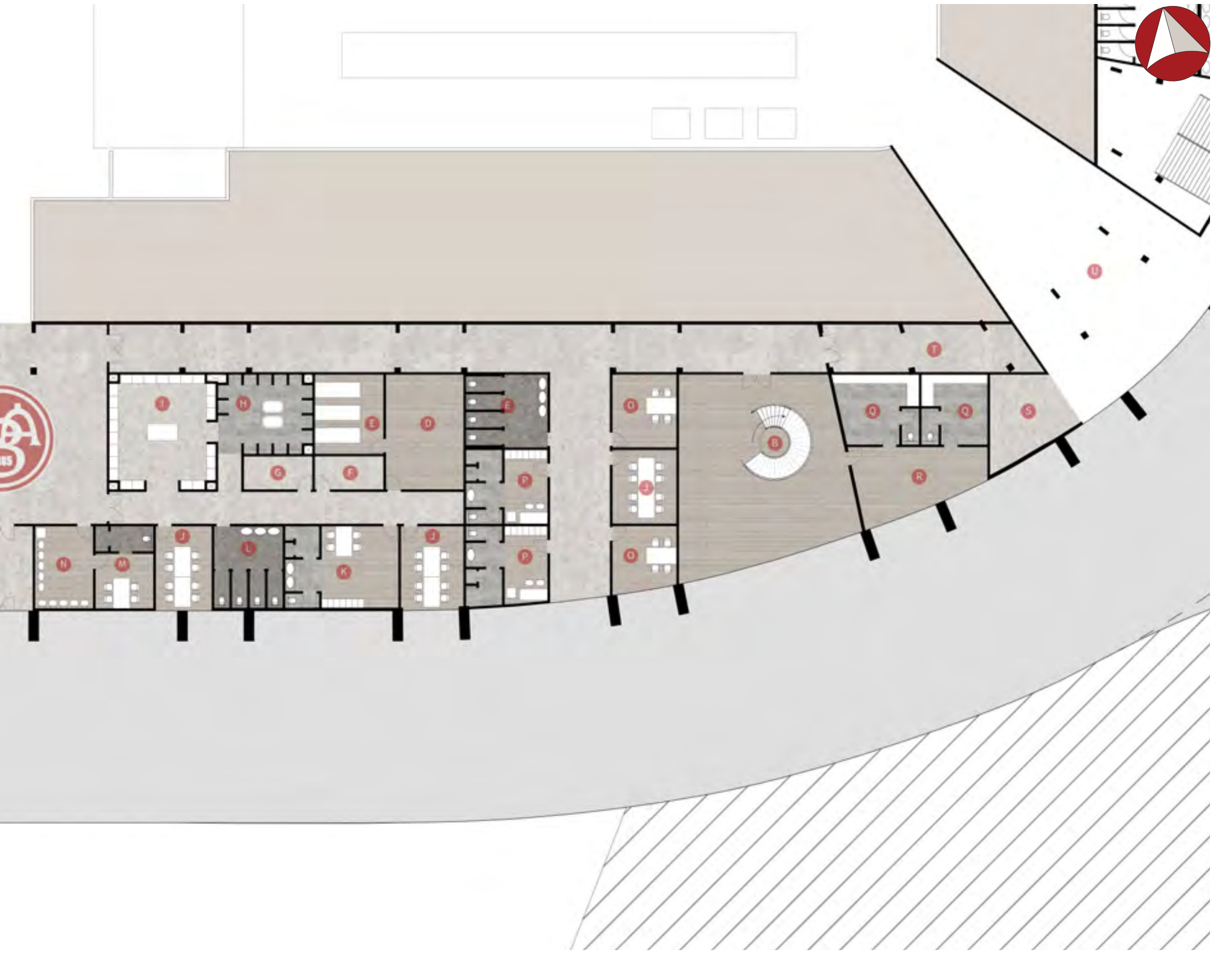
Ultras Transitionzone
Men’s Toilet
Women’s Toilet
Regular Attendance Transitionzone
Away Fans Transitionzone
Grocery Store
Home Team
Media
Officials
Ball Kids
Away Team



Level A - Player Facility Area Schedule

A	Media Storage Room	151 m²
B	Atrium	132 m²
C	Press Conference	94 m²
D	Medical	39 m²
E	Massage	24 m²
F	Washing Room	10 m²
G	Kit Room	10 m²
H	Player Showers	31 m²
I	Player Dressing Room	40 m²
J	Meeting Room	24 m²

Illustration 111 - Ground Level Area Schedule



K	Manager Dressing Room	41 m²
L	Sanitary	20 m²
M	Doping Control Room	14 m²
N	Waiting Room	21 m²
O	Delegate Office	20 m²
P	Officials Dressing Room	26 m²
Q	Ball Kids Dressing Room	22 m² + 24 m²
R	Ball Kids Waiting Area	33 m²
S	Bin Storage	28 m²
T	Storage	44 m²
U	Super Vomitory	

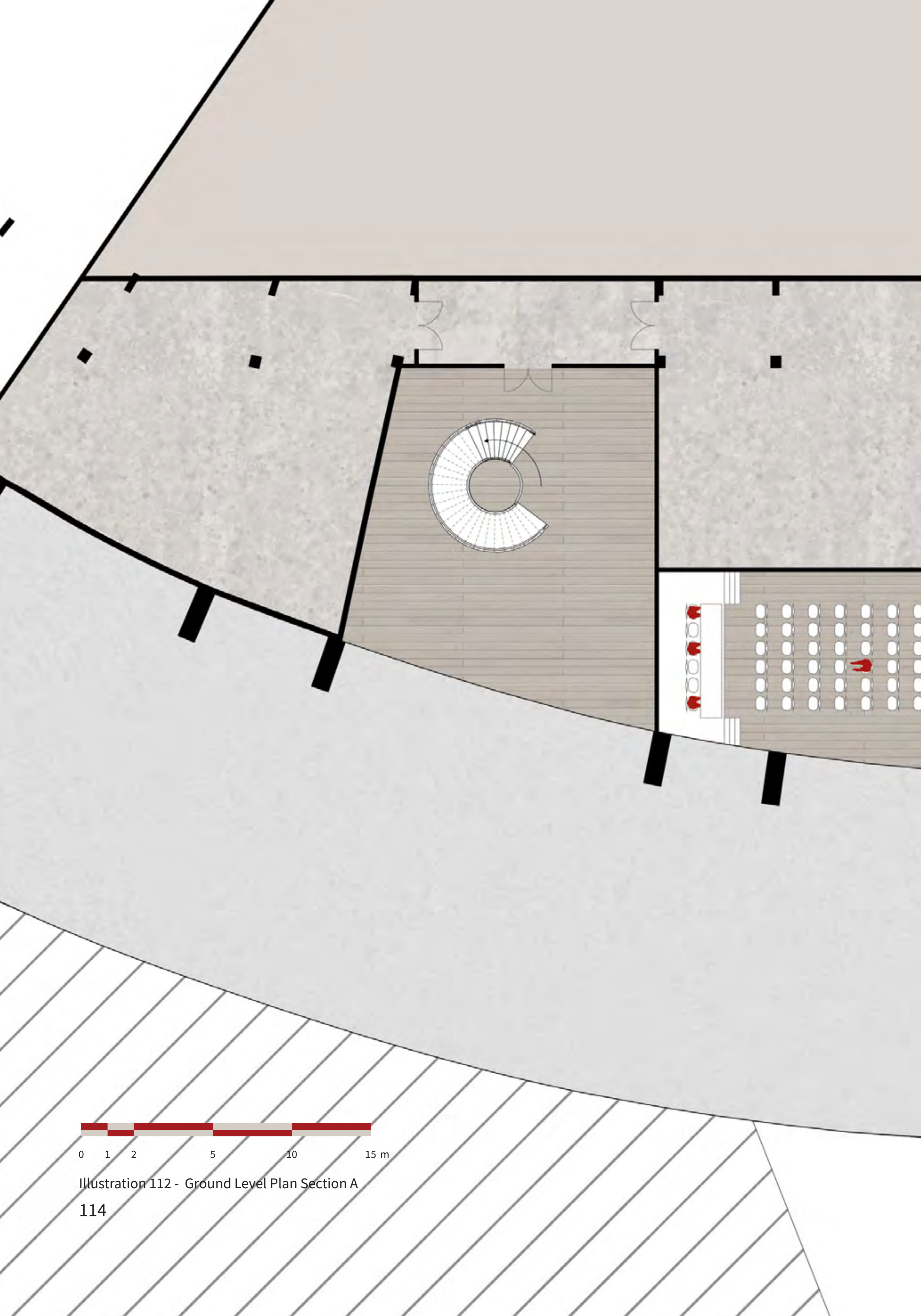
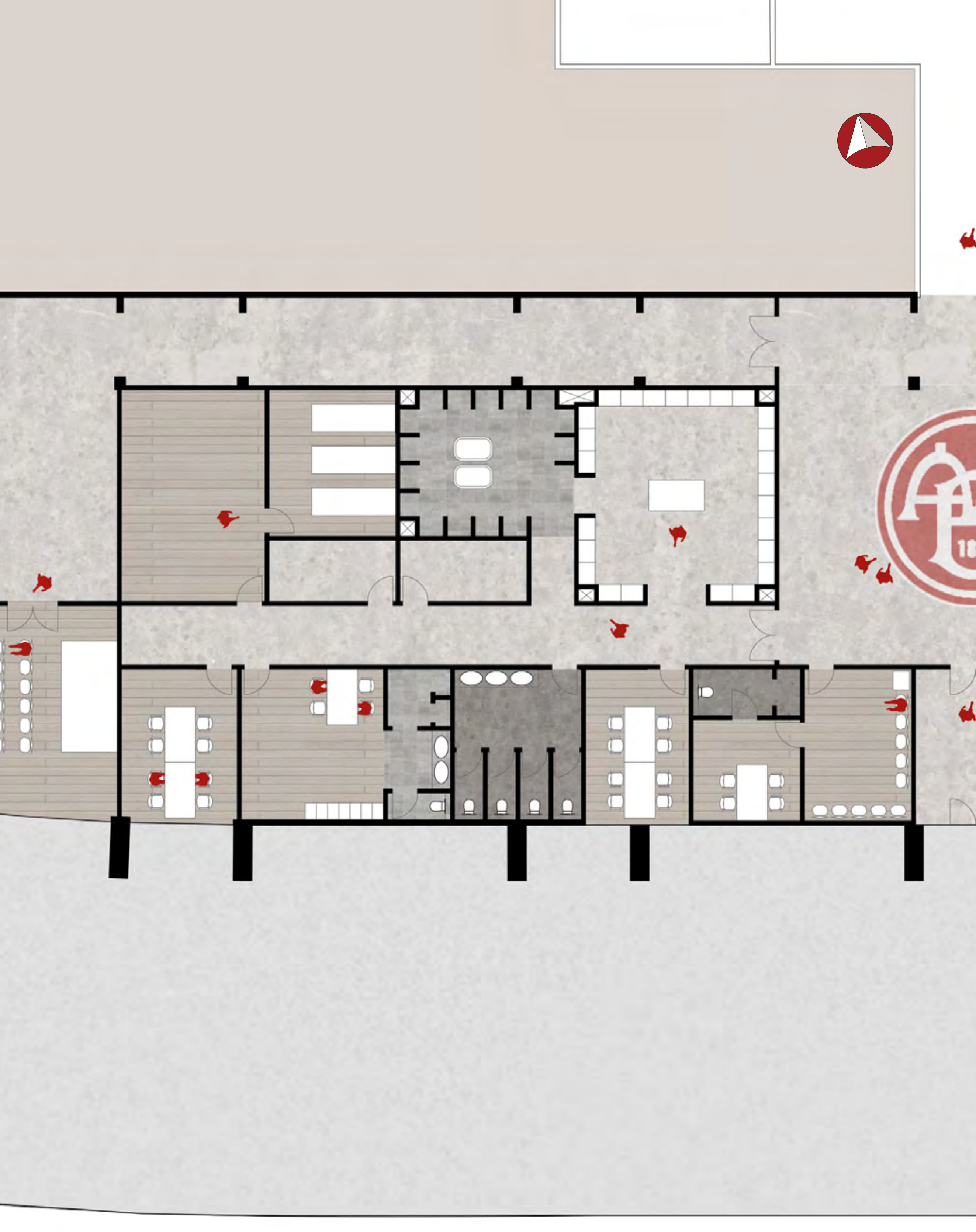


Illustration 112 - Ground Level Plan Section A



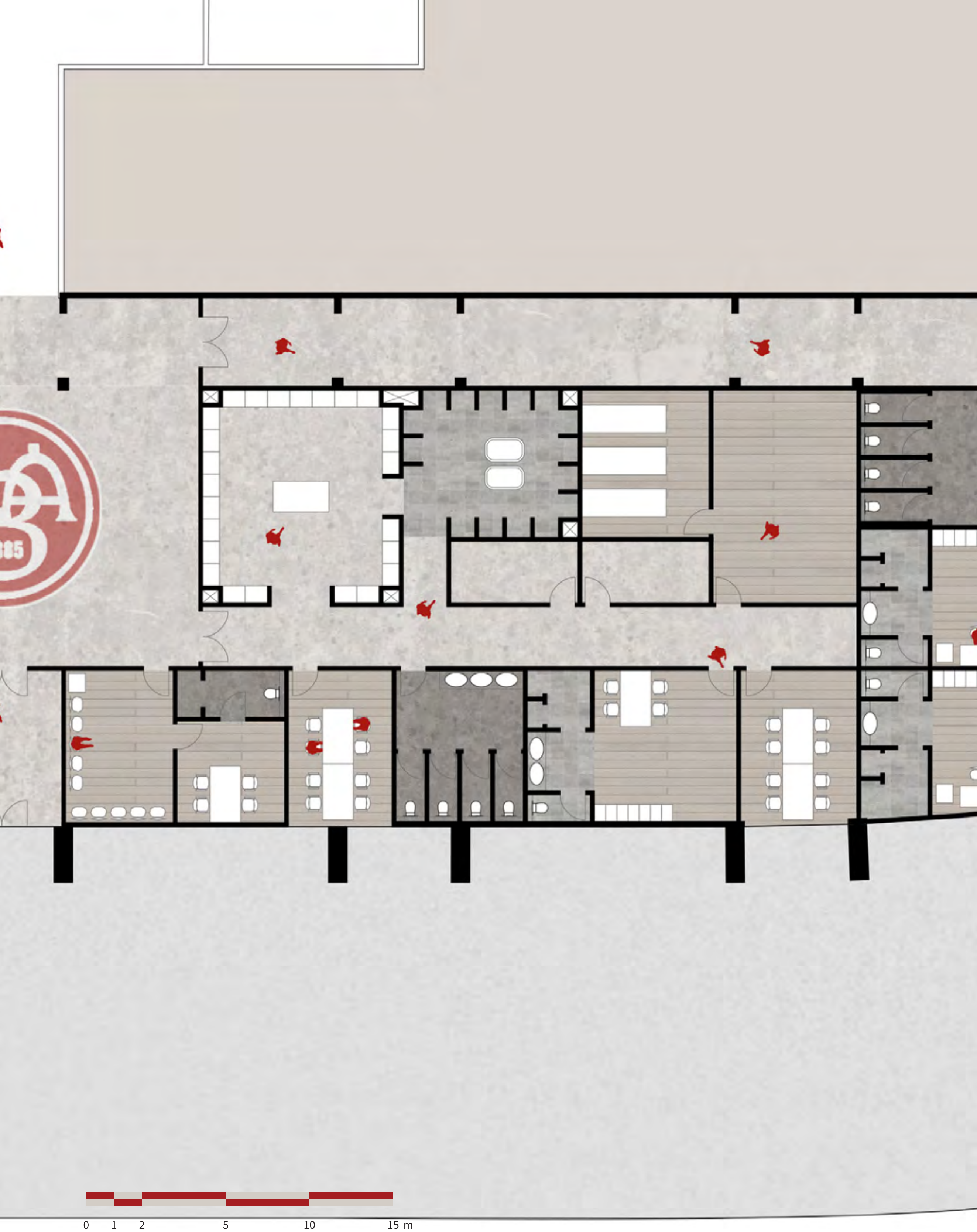
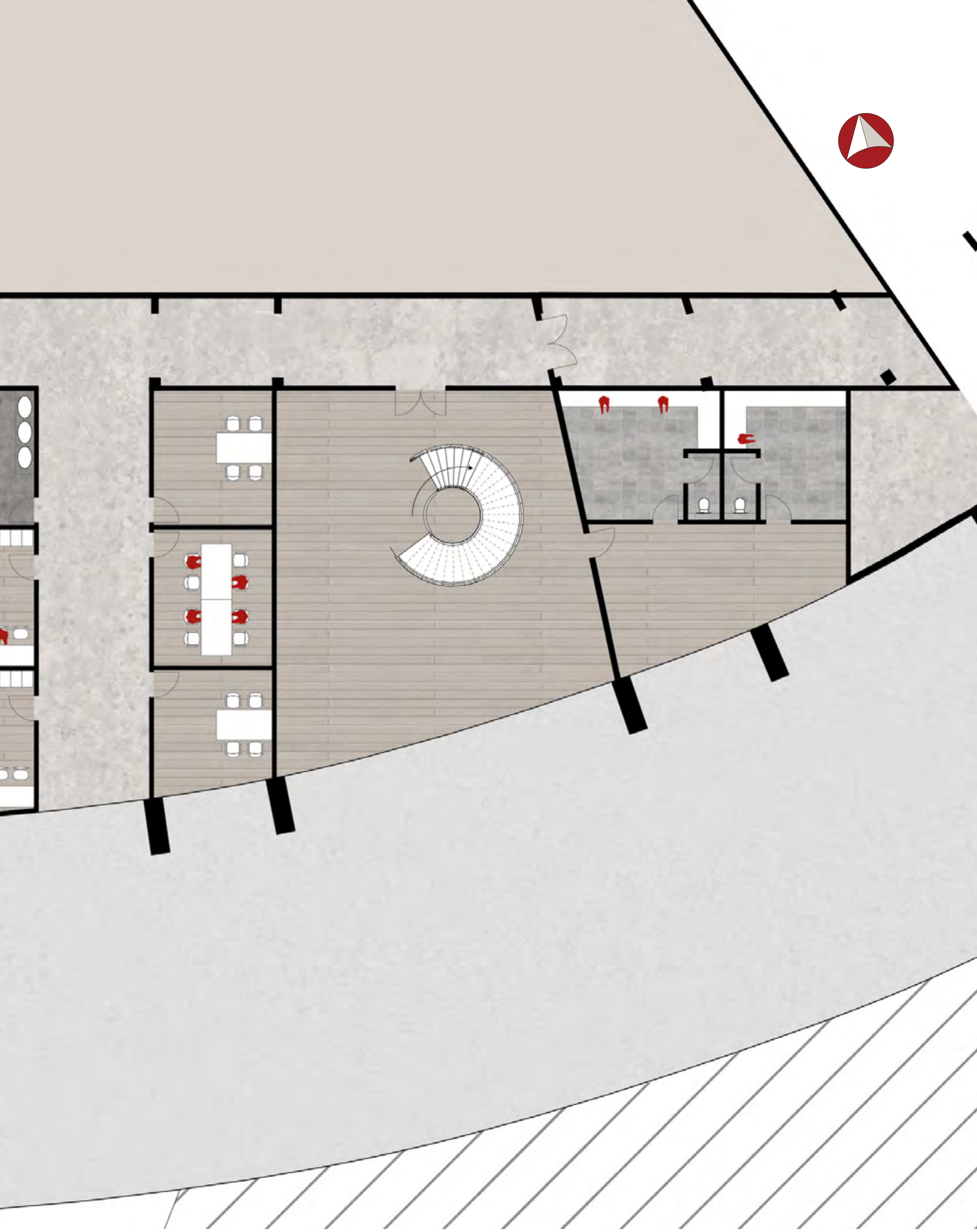


Illustration 113 - Ground Level Plan Section B



Section - North to South

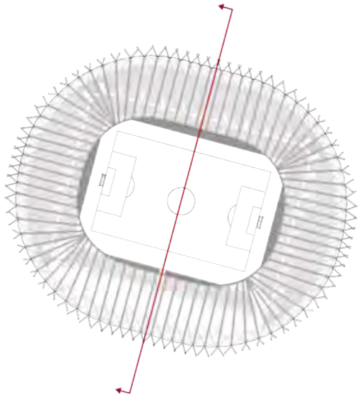
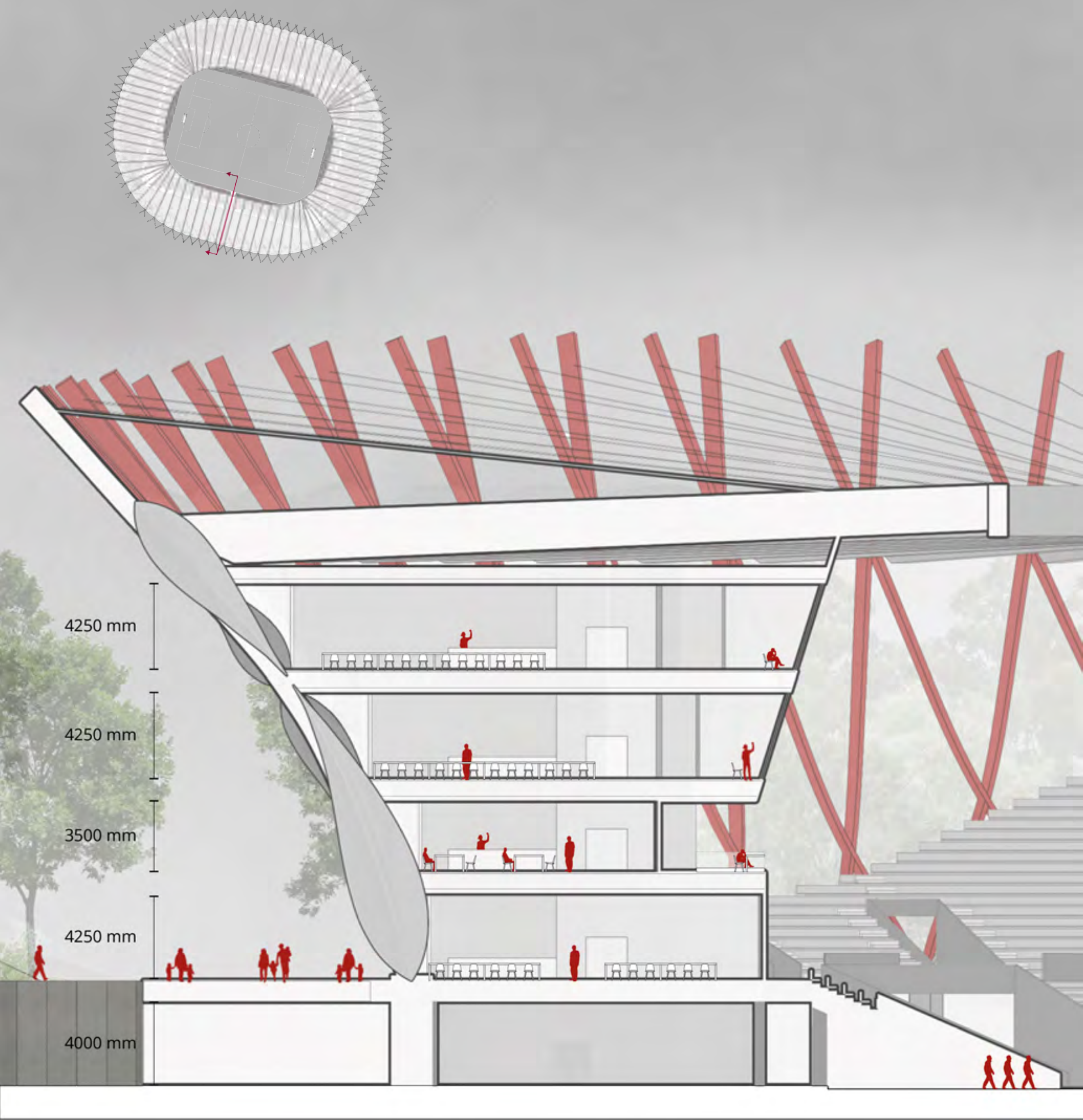


Illustration 114 - Section North-South



0 1 5 10 15 m

Illustration 115 - VIP Section

VIP Section

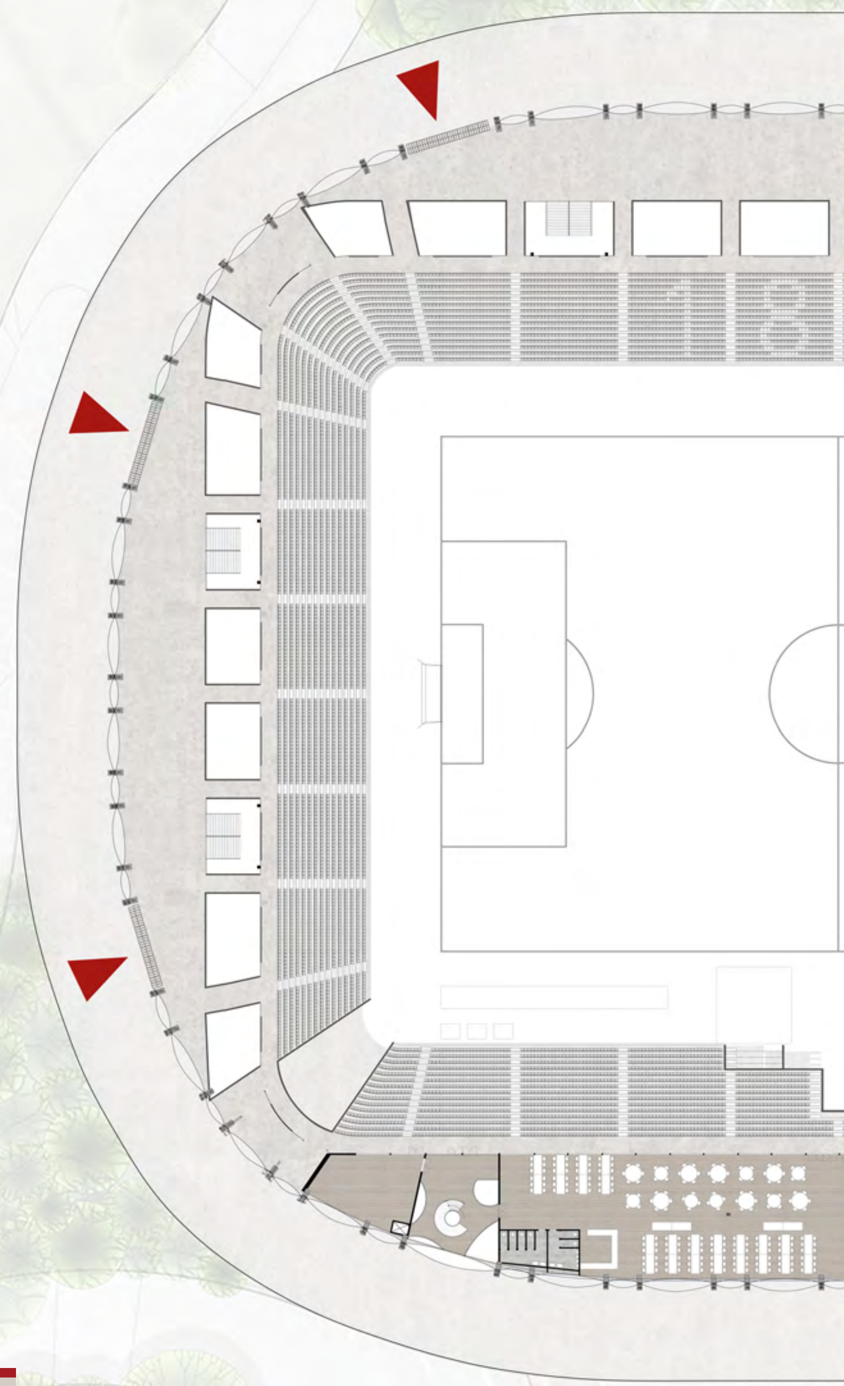
The VIP Section has its own building mass within the stadium. The facade oriented towards the field of play is fully transparent so that hospitality guests of all three levels can enjoy the match from their preferred seating point, whether it is indoors or outdoors. The building consists of 5 levels in total ranking from the ground level, where the players and officials reside, up through the levels of hospitality, to the media floor, and lastly the VIP and VVIP floors.

The hospitality enters at the level of the concourse, thereby said, the same accessibility as the rest of the stadium, following the principles of inclusivity. The hospitality level has access to the transition-ring that follows around the whole stadium.

Above the hospitality level, is the media level, which has a balcony situated atop the hospitality dining area, so that the media workers, announcers, journalists and commentators have designated outdoor seating during the match, while having the opportunity to go inside at halftime. The broad balcony also allocates space for camera platforms, and other equipment for televised broadcasting.

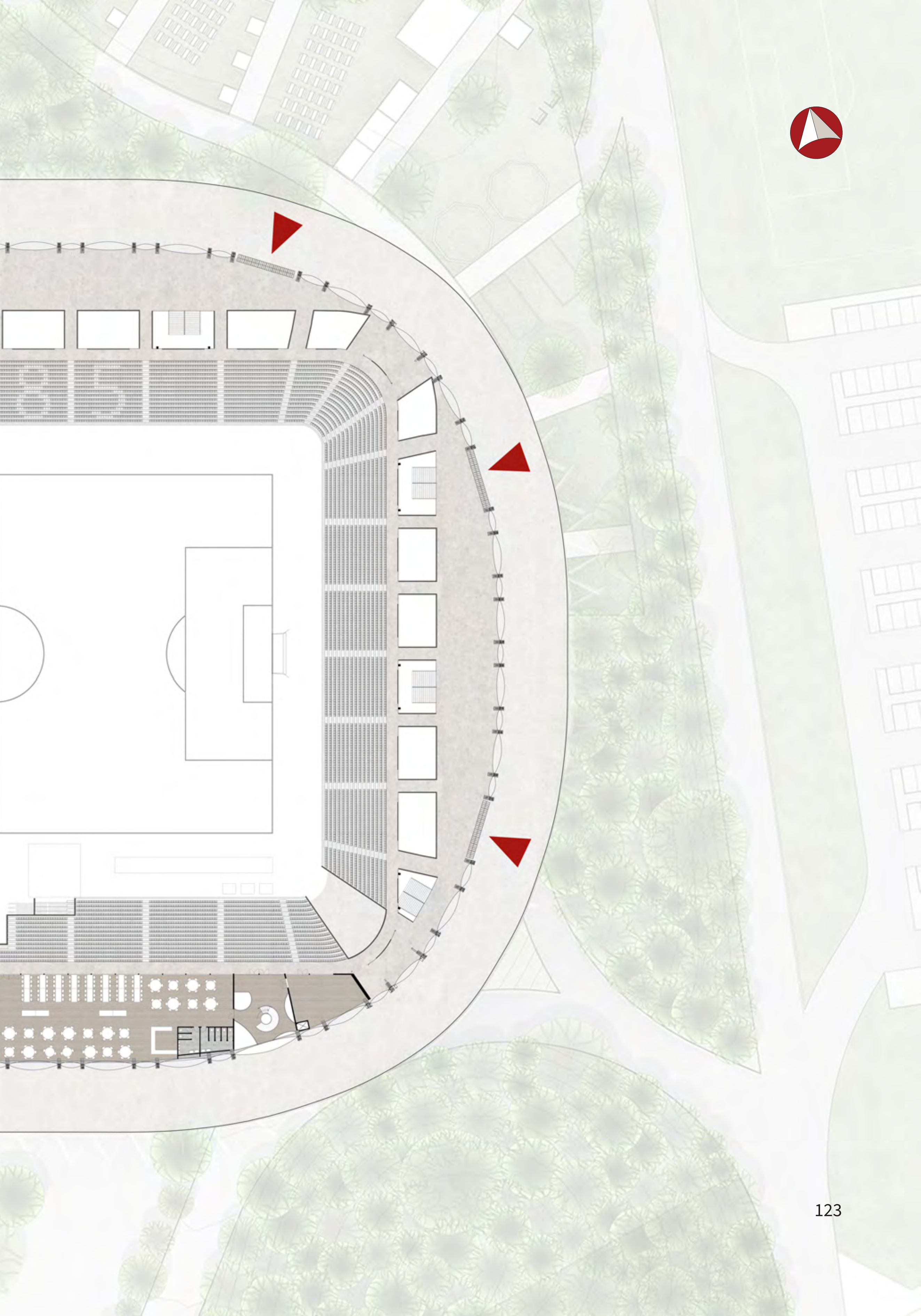
Extended above the media, is the VIP and VVIP levels that cantilevers above the media balcony, creating a shadow line that architecturally mimics the section of the current stadium at Haraldslund. The VIP and VVIP has their own exclusive lounges, with adjoined balconies, so that they have the option of a private spectating experience or to enjoy the designated seats centered in the stands.

Concourse - Plan



0 5 10 20 30 50 m

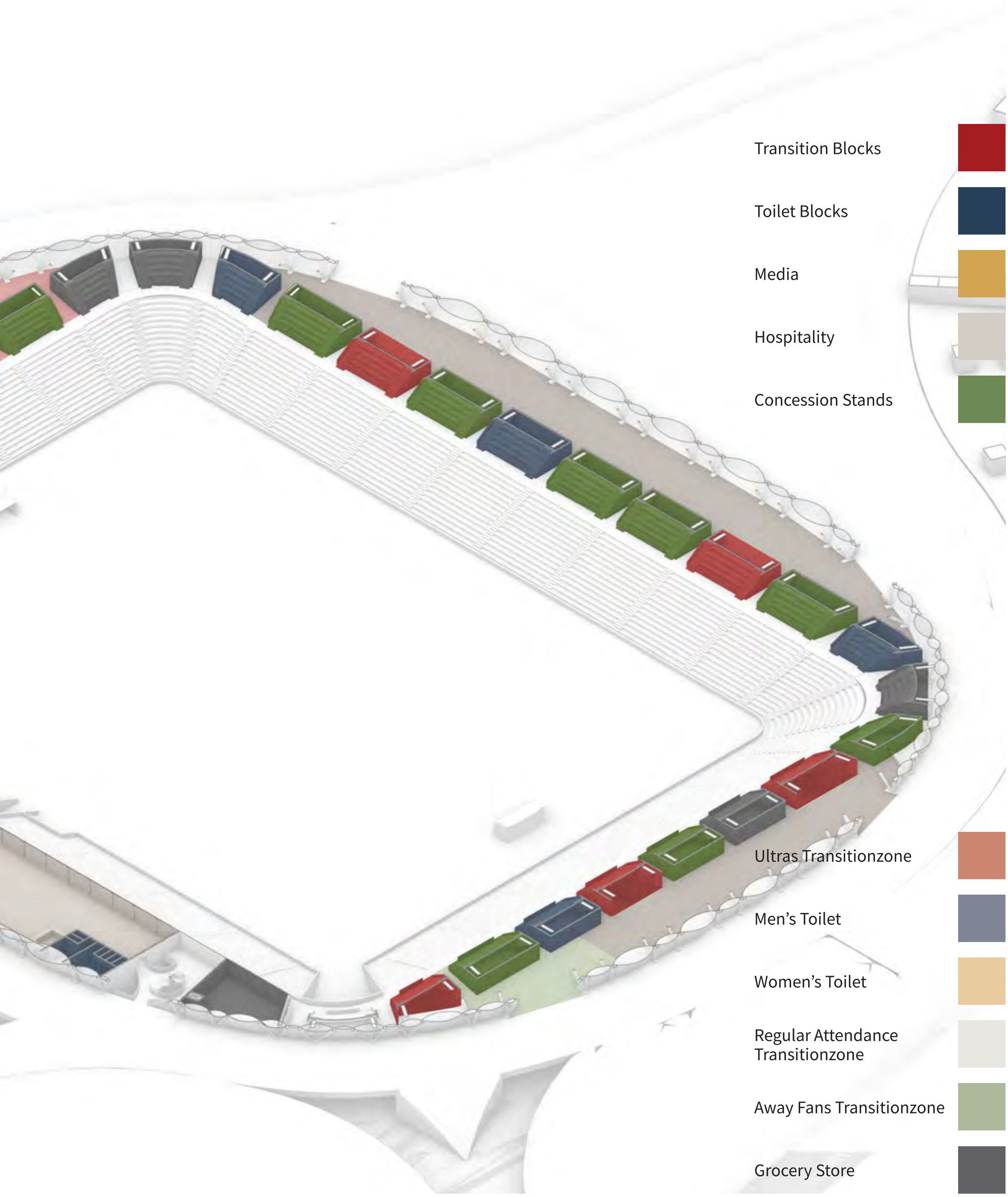
Illustration 116 - Concourse Floor Plan



Concourse - Program

The concourse functions as a key transition zone from the fan zone on to the stands. It is designed with the fans experience in mind, it is equipped with essential amenities that support the social interaction between the fans. The layout includes careful placed concession stands with enough service points to limit the wait during peak service. Toilets for wheelchair users and people with disabilities at the same level as the concourse, and regular men’s and women’s toilets in the basement. The concourse is divided into separate transition zones to allow the different fan groups to have their own safe circulation space with a fitting atmosphere.

Illustration 117 - Concourse Program Axonometric


Transition Blocks
Toilet Blocks
Media
Hospitality
Concession Stands
Ultras Transitionzone
Men's Toilet
Women's Toilet
Regular Attendance Transitionzone
Away Fans Transitionzone
Grocery Store

Concourse - Circulation

The circulation axonometric illustrates the movement patterns of the different users of the stadium on match day. Ultras, regular, and family fans access the site from the north, either by taking public transportation or by walking in the fan march. From there, they move through the fan zone or head directly to their designated entry points, where they scan their tickets at the turnstiles. Afterward, they enter the concourse, where they have the option to buy food or drinks before proceeding to the stands to find their seats.

VIP fans typically arrive in their own cars and park beneath the stadium. From the parking area, they enter the atrium and begin their journey through the VIP building. As outlined earlier in the project, VIPs are divided into three categories: Hospitality, VIP, and VVIP. Hospitality fans have access to a lounge on the first floor and designated seats on either side of the stands. VIP fans have their lounge on the third floor; some will watch the game from private boxes, while others have premium seats closer to the center of the stands than Hospitality fans. VVIP fans occupy the top floor of the building and, like the VIPs, have access to private boxes or specially designated seats in the stands as close to the players as possible.

Players arrive by team buses, which park directly in front of their dedicated entrance to minimize interaction with journalists and reporters. This same entrance is used by officials, medical personnel, and other staff, who also have the option to park beneath the stadium.

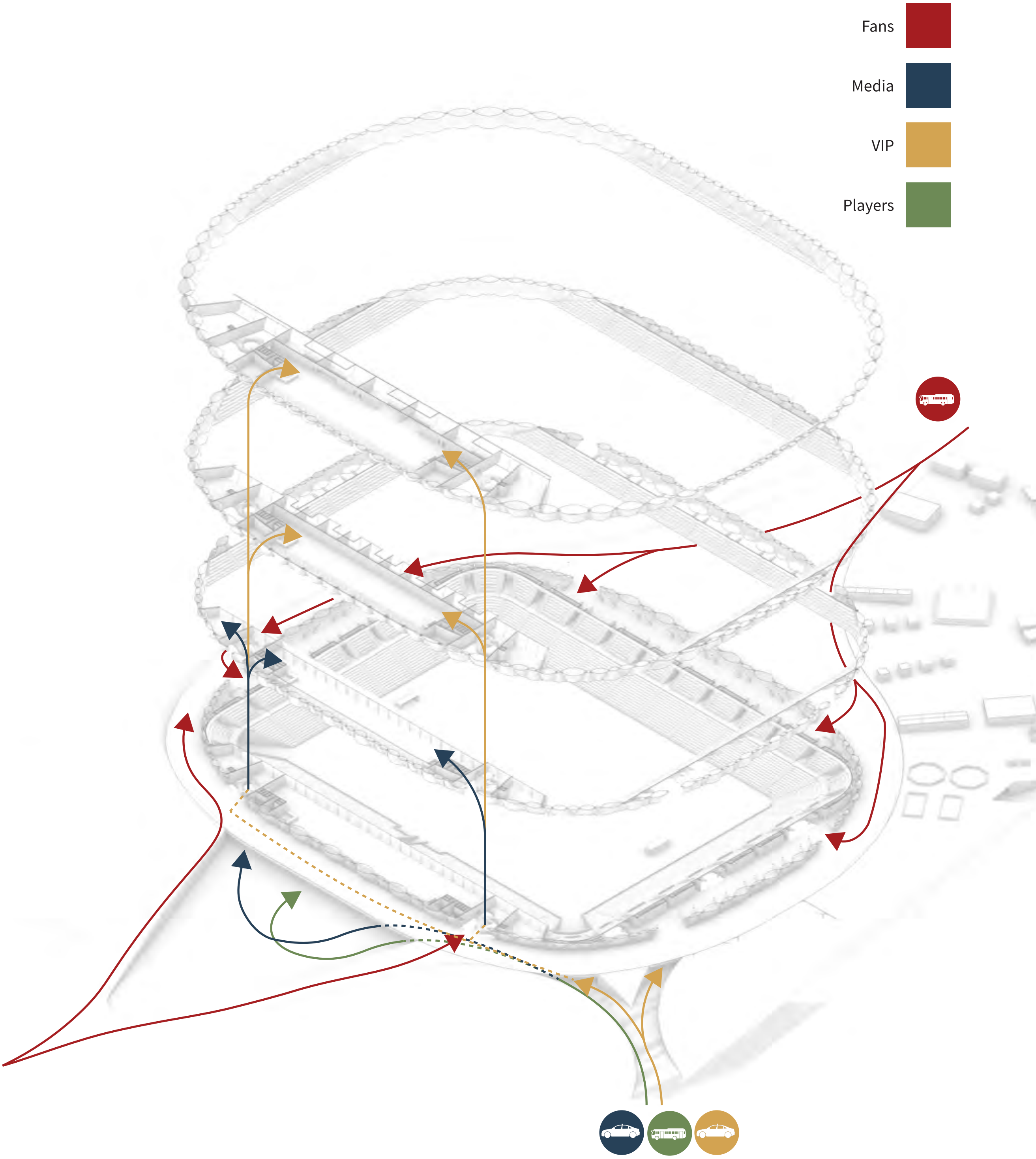


Illustration 118 - Circulation Axonometric

Concourse

Illustration 119 - Concourse Render

Level B - Hospitality

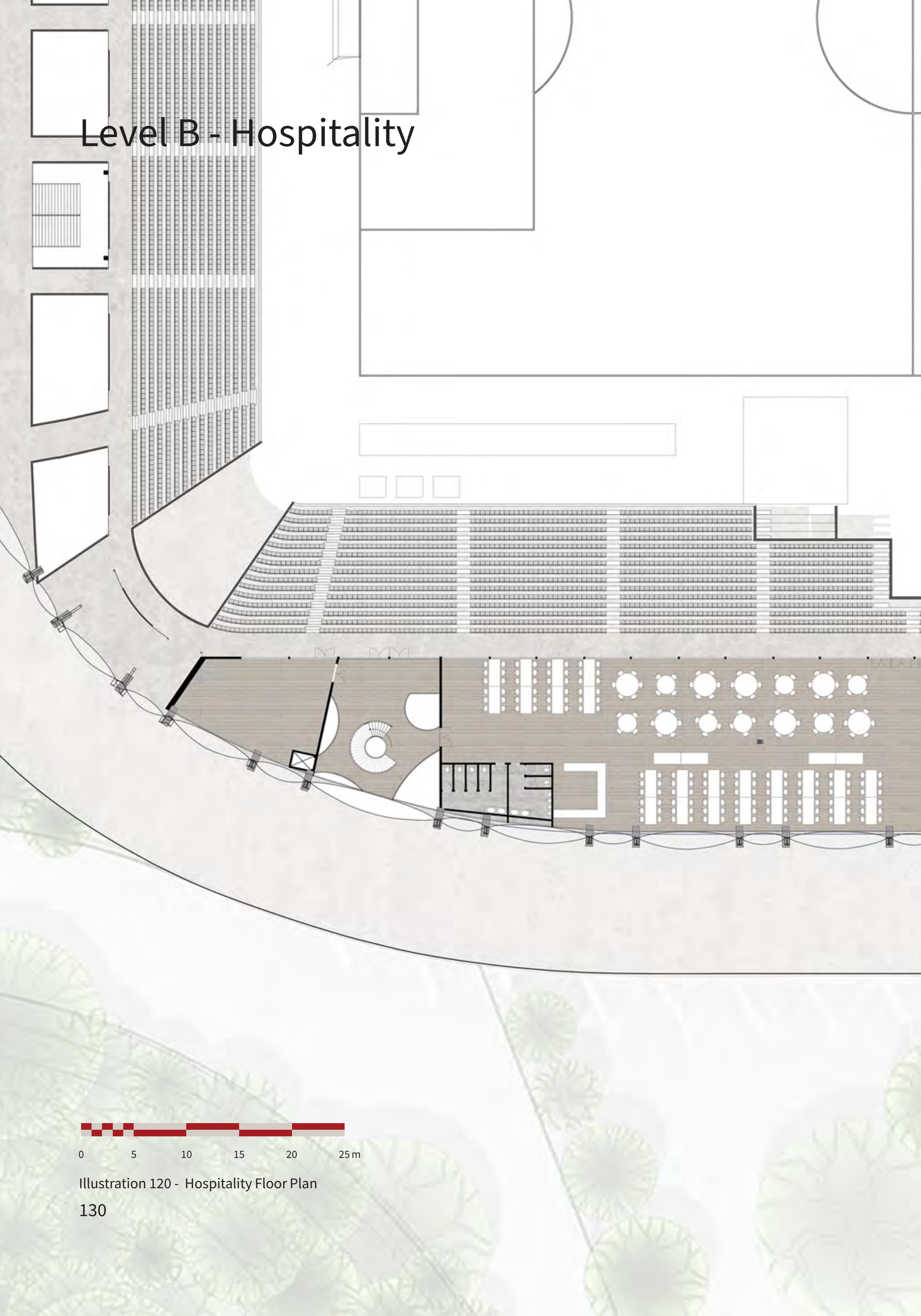
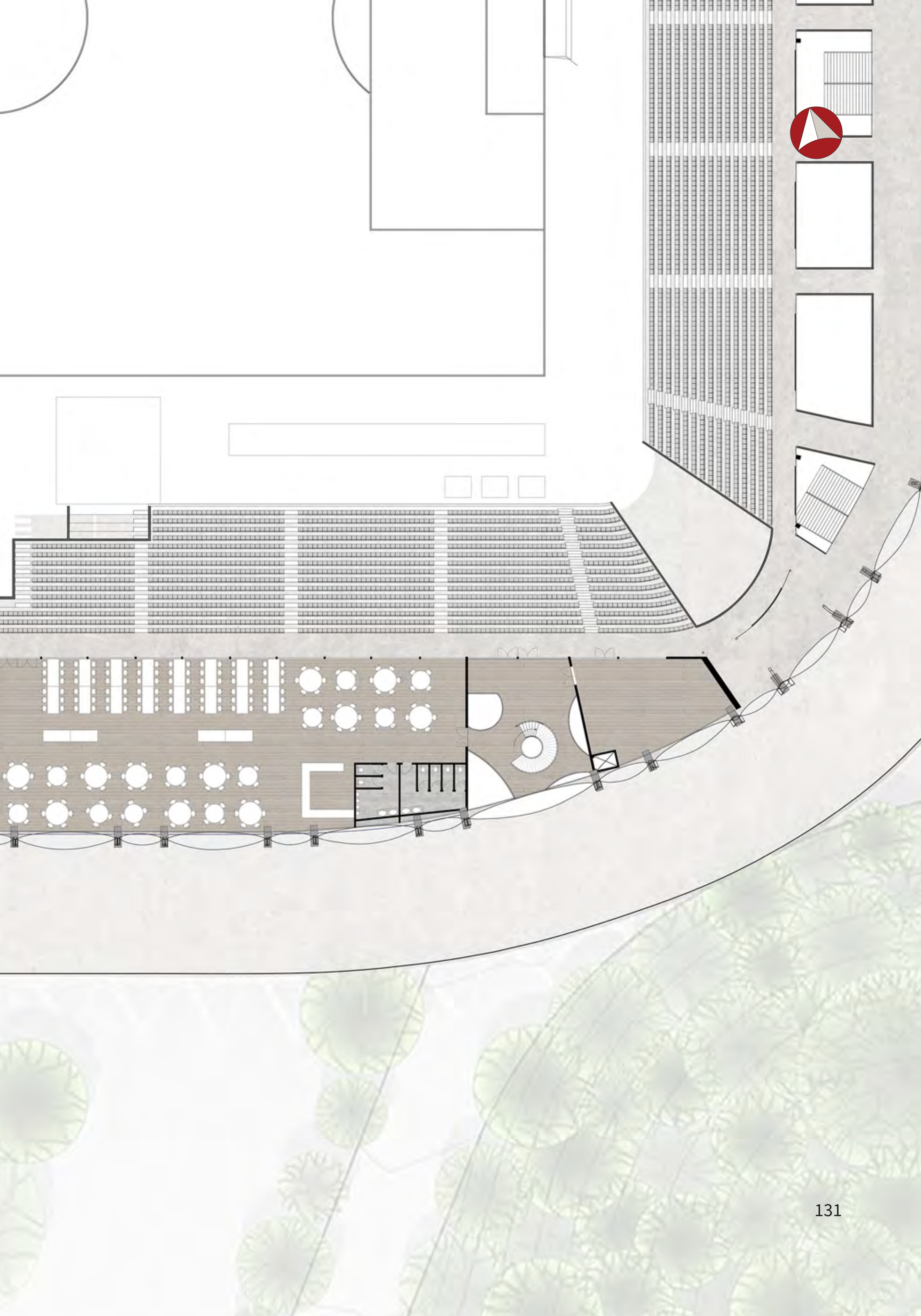


Illustration 120 - Hospitality Floor Plan



Level C - Media

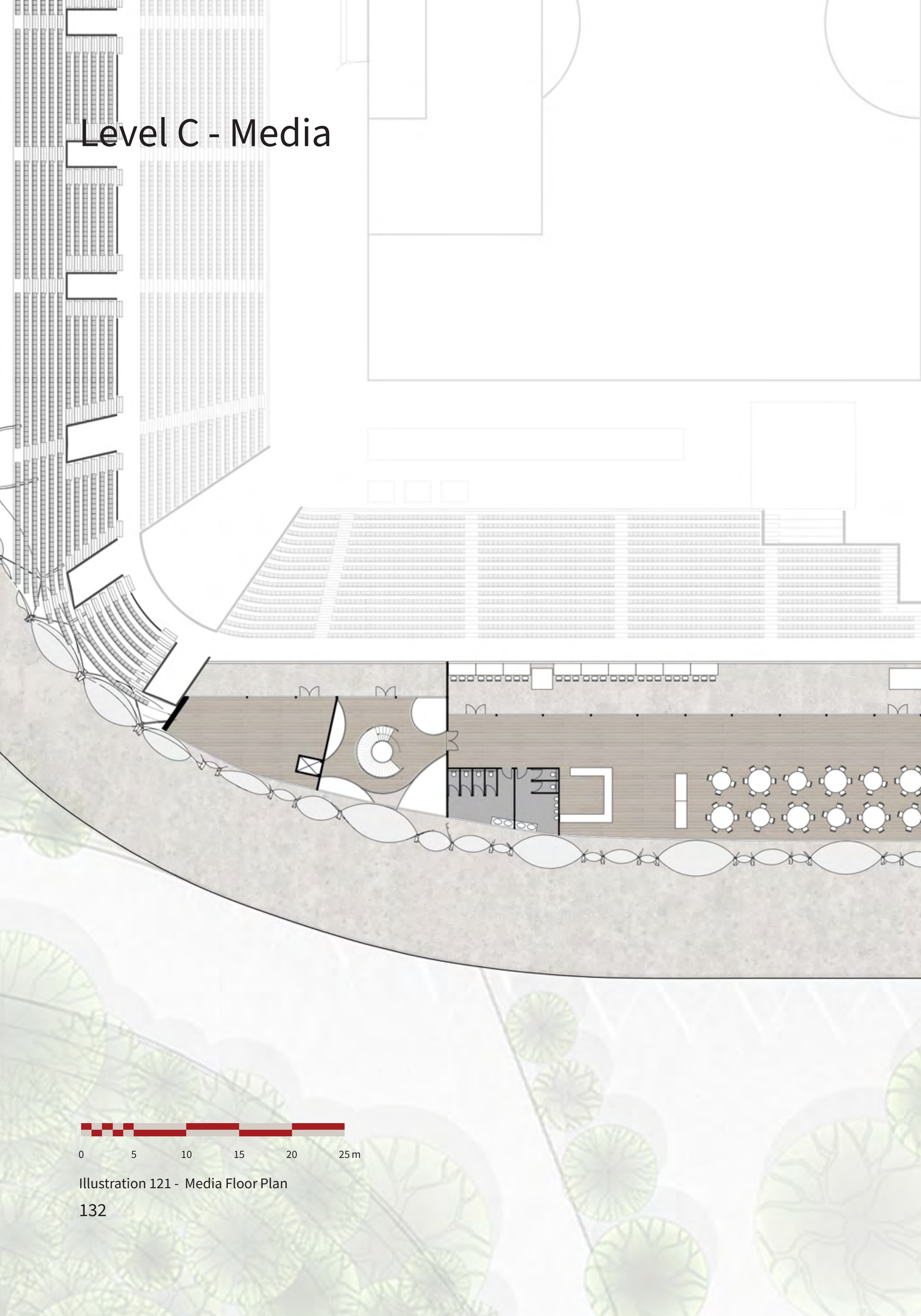
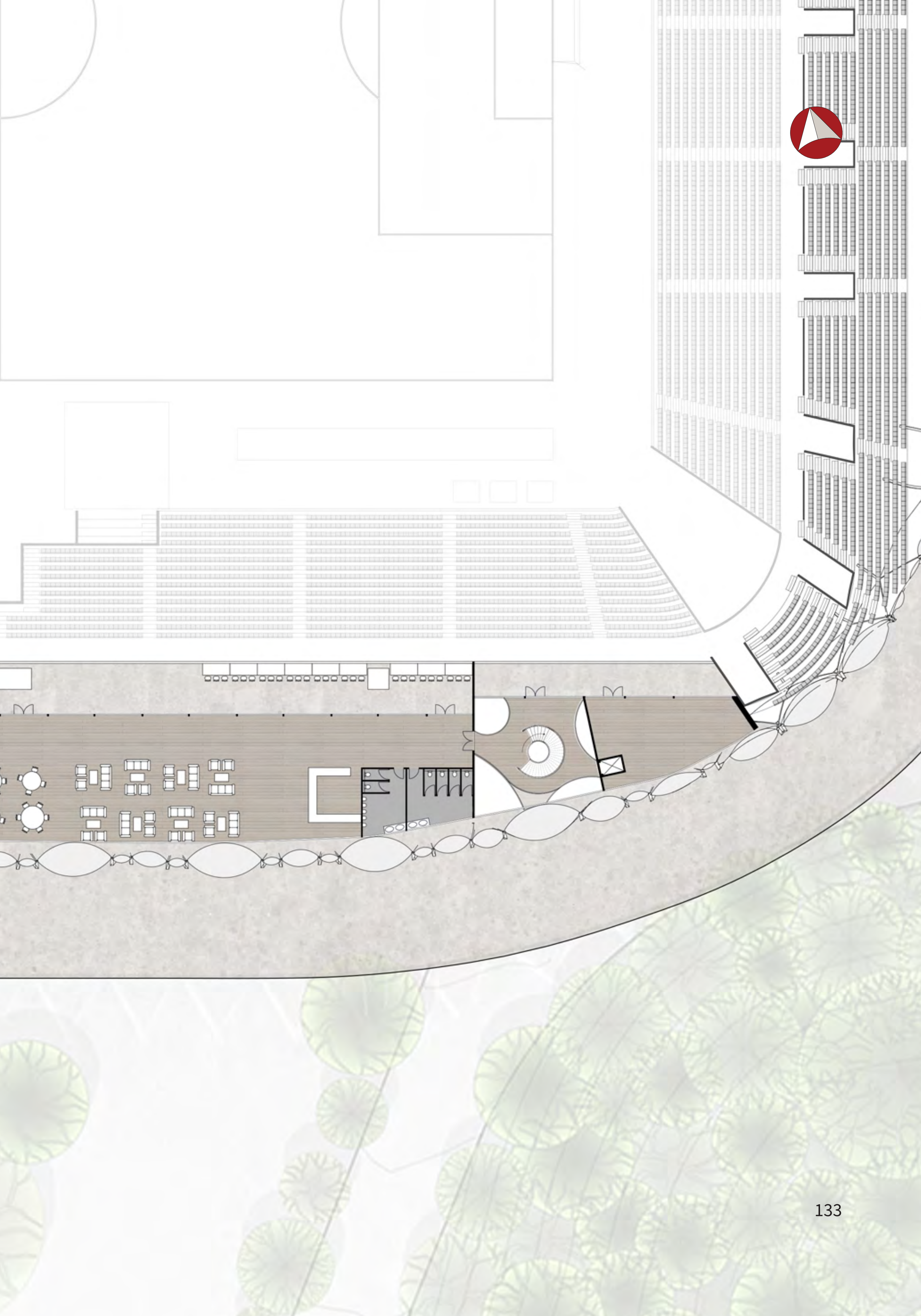


Illustration 121 - Media Floor Plan



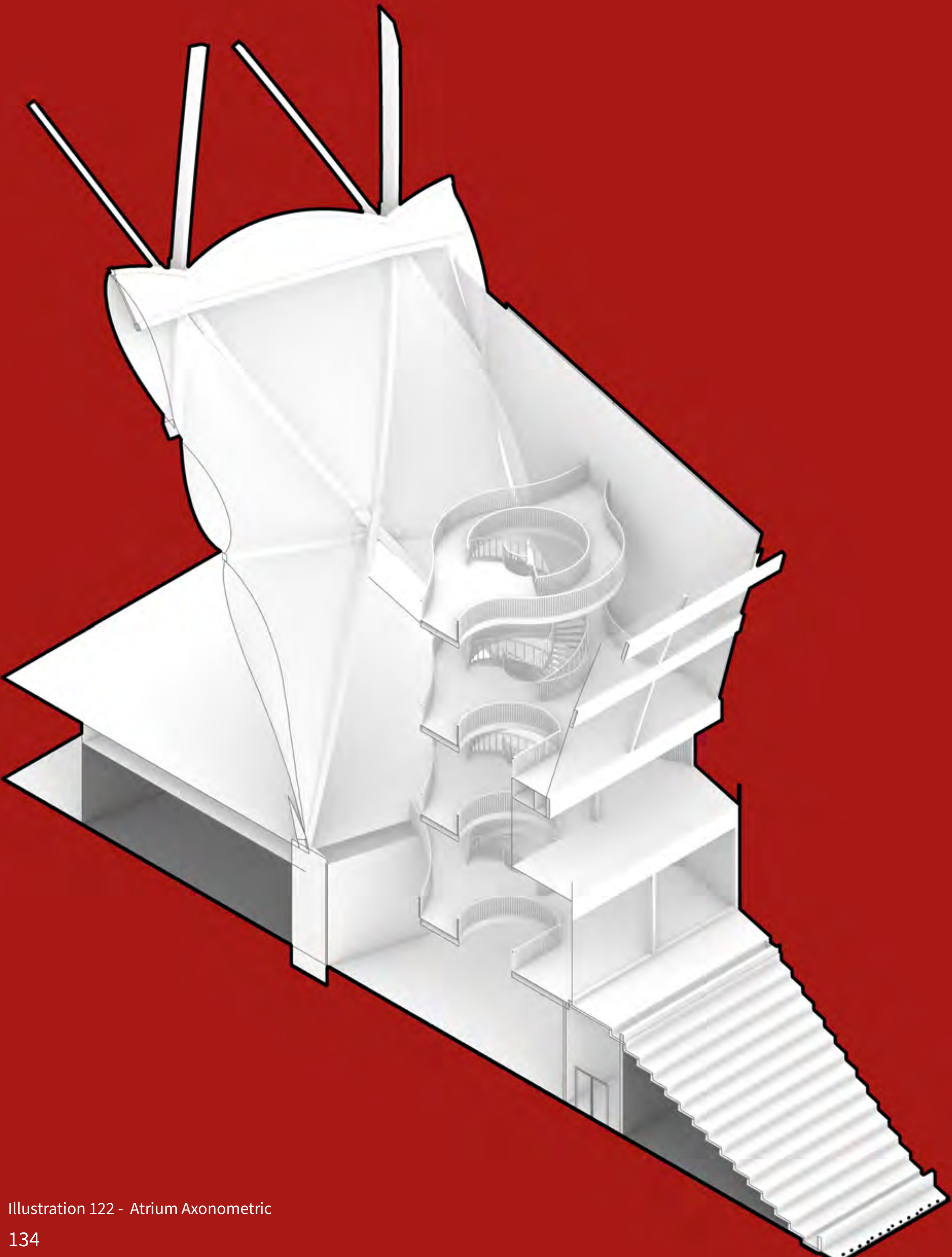


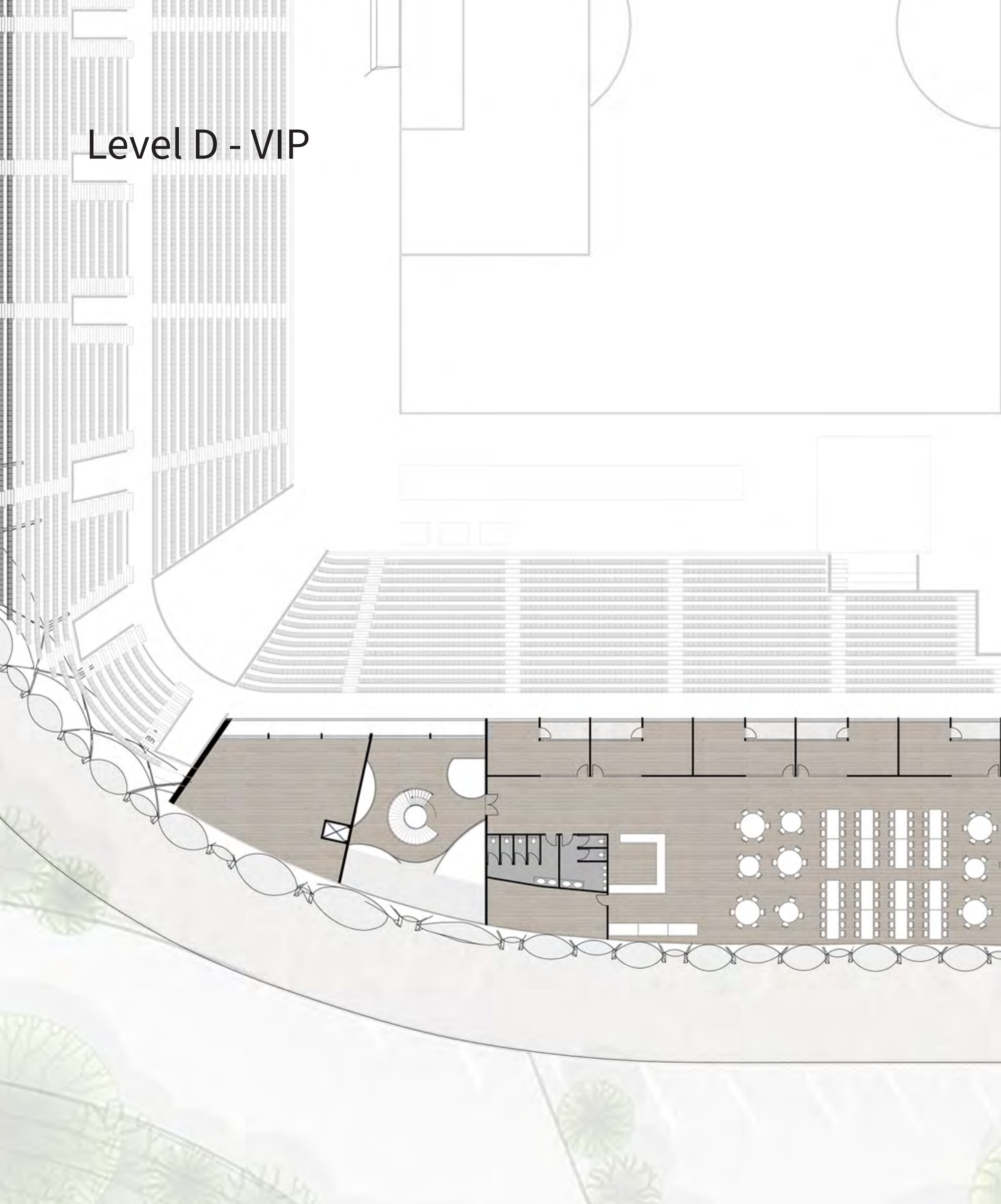
Illustration 122 - Atrium Axonometric

Atrium

The atrium is designed with the purpose of transparency, which becomes evident throughout the void, allowing for visual connections across the atrium from the outside to the field of play. Beyond that, it also allows for visual connections across the different levels of the VIP building, as it also serves a circulative purpose, supporting the matchday flows for hospitality guests, the media, as well as the players and officials of the game.

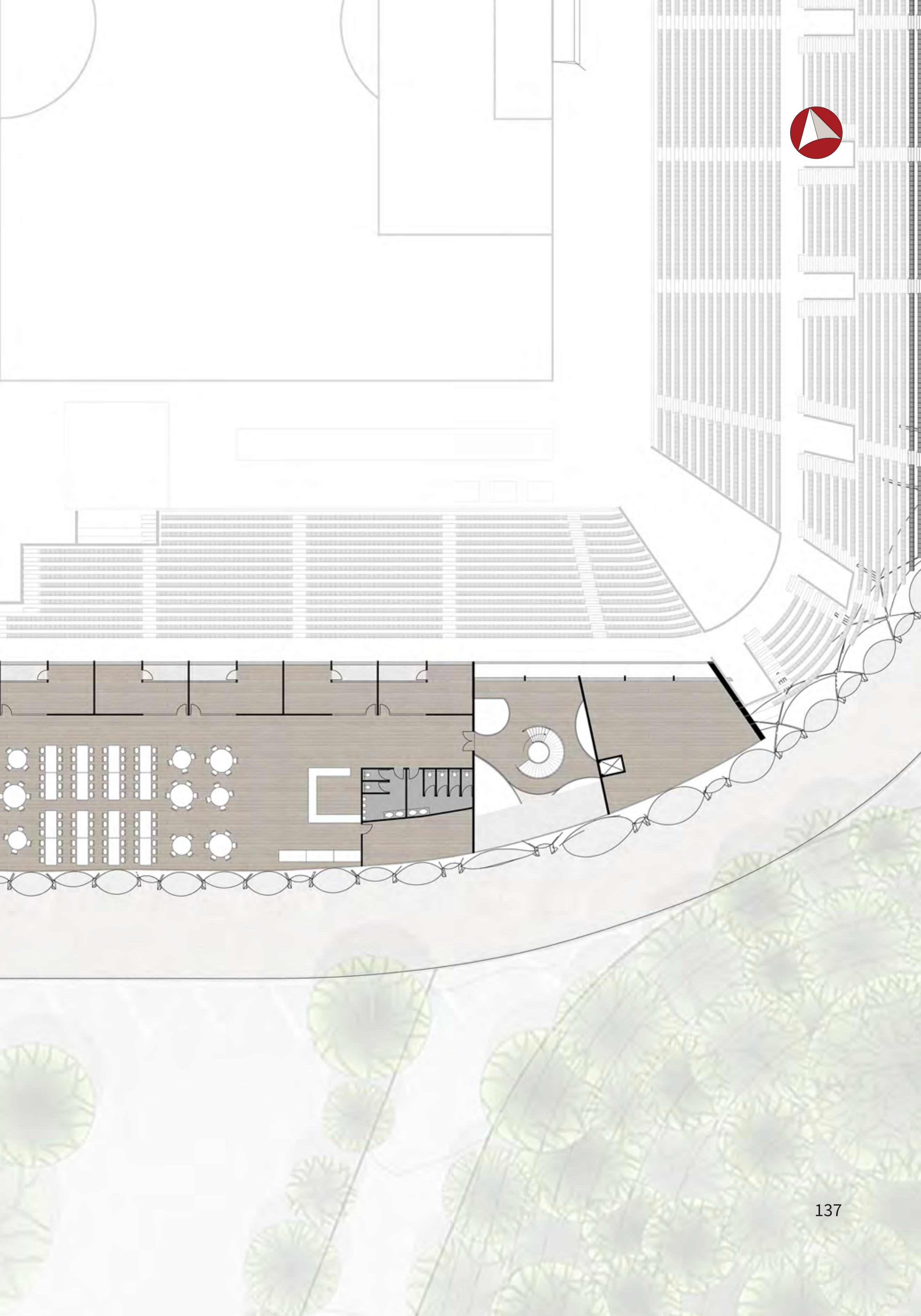
The staircase is located in the middle of the atrium, connecting all floors to a singular spiral staircase. From the spiral is then created a landing that connects to the entry points of the adjacent rooms. The landing is then carved to mitigate unnecessary flooring, thereby creating a void throughout the atrium. The landing and staircase are then clad with pattern-colored balustrades mimicking the vertical red and white stripes that are associated with AaB.

Level D - VIP



0 5 10 15 20 25 m

Illustration 123 - VIP Floor Plan



VVIP Lounge

Illustration 124 - VVIP Lounge Render

Level E - VVIP

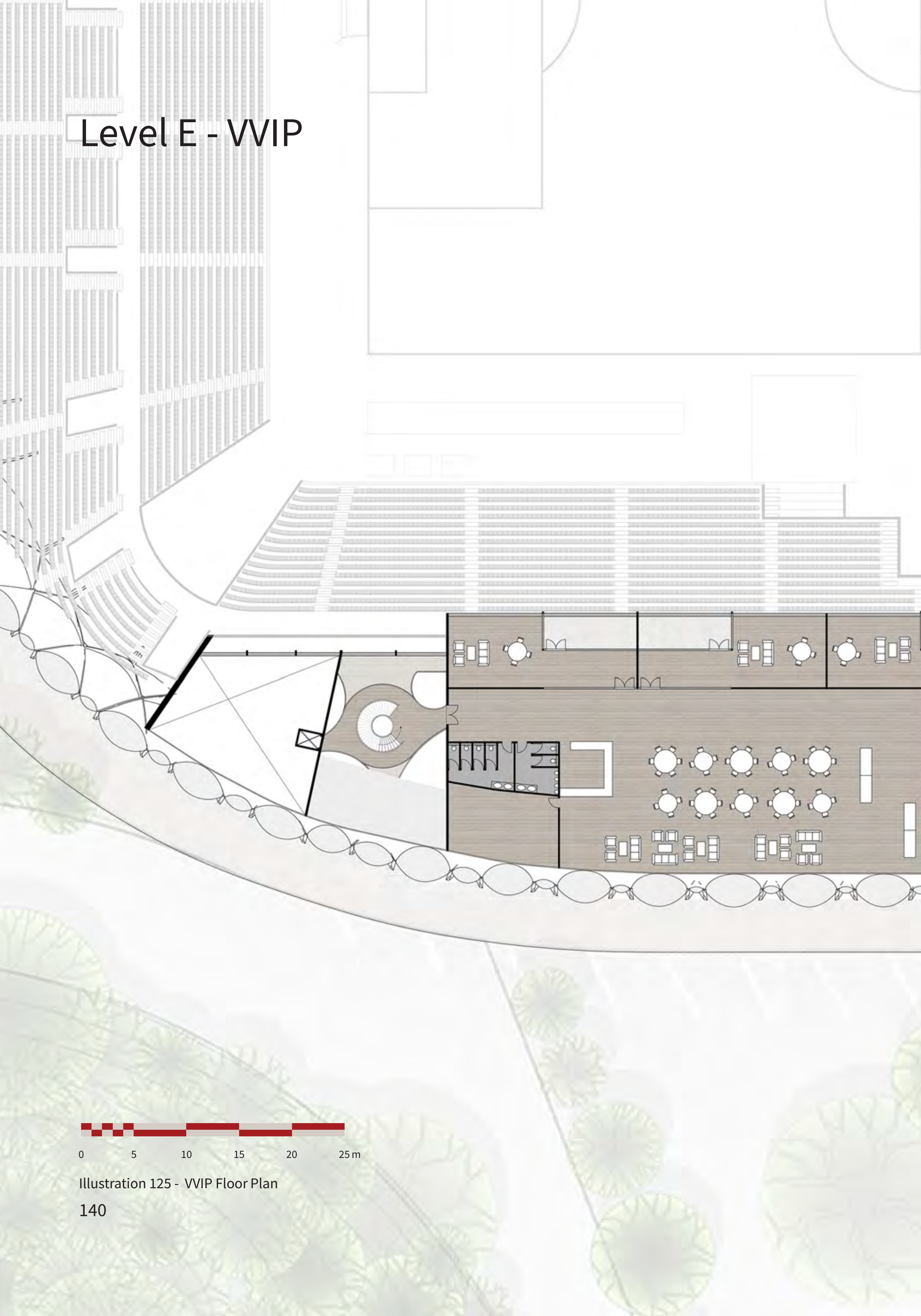
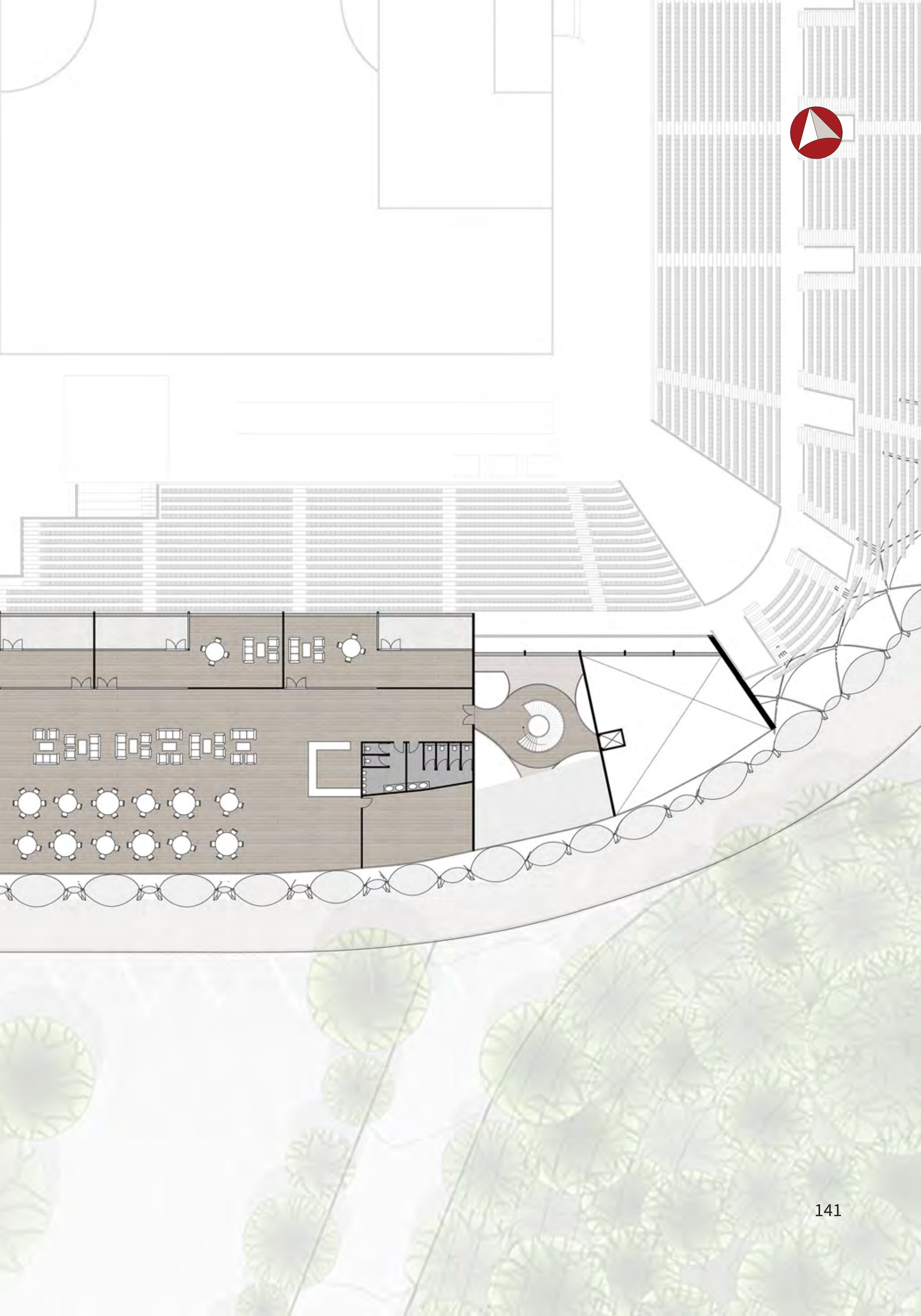


Illustration 125 - VVIP Floor Plan



VVIP Boxes

Illustration 126 - VVIP Box Render

Exit Concourse

Illustration 127 - Exit Concourse Render

Final LCA

In this project, Life Cycle Assessment (LCA) has been employed both as a design tool during the design process, but also as a final evaluation tool to asses the environmental sustainability of the proposed stadium design. Currently there are no specific sustainability requirements for stadiums on the Danish Building Code. Therefore, the stadium is subject to the general regulation for all new buildings over a 1000 m2, which stipulates a maximum Global Warming Potential (GWP) of 12 kg CO_2-eq./m^2/year. (Bygningsreglementets (§ 297 Stk 2.1., 2025)

In addition, a sustainability recommendation from FIFA, suggest that large stadiums should aim for a total GWP of less than 1000 kg CO_2-eq./m^2 and for medium sized stadiums such as the one in this project, under 750 kg CO_2-eq./m^2.(FIFA 2.7, 2025)

These two benchmarks serve as primary targets for the design. To meet – or come as close as possible – to these goals, the strategy involves reusing as much material as possible from the existing stadium, as previously mapped. The mass of the reused material is therefore subtracted from an LCA calculation if it can be used directly as it is, or it will be calculated without the A1 phase if it has to be recycled before it can be used again in the new stadium.

The initial analysis indicates that constructing the stadium entirely with new materials would result in a GWP of 13.4 kg CO_2-eq./m^2/year, which corresponds to a total of 670 kg CO_2-eq./m^2. This complies with FIFA's recommendations but exceeds the Danish building regulation threshold.

To improve the environmental profile, a revised analysis incorporates the mapped materials from the existing stadium. The revised LCA results in a GWP of 11.96 kg CO_2-eq./m^2/year, or 597.9 kg CO_2-eq./m^2 in total. This means the final design complies with both the Danish building regulations and achieves a GWP that is 20% below FIFA's suggested limit.

Value definitions is described in appendix 9.

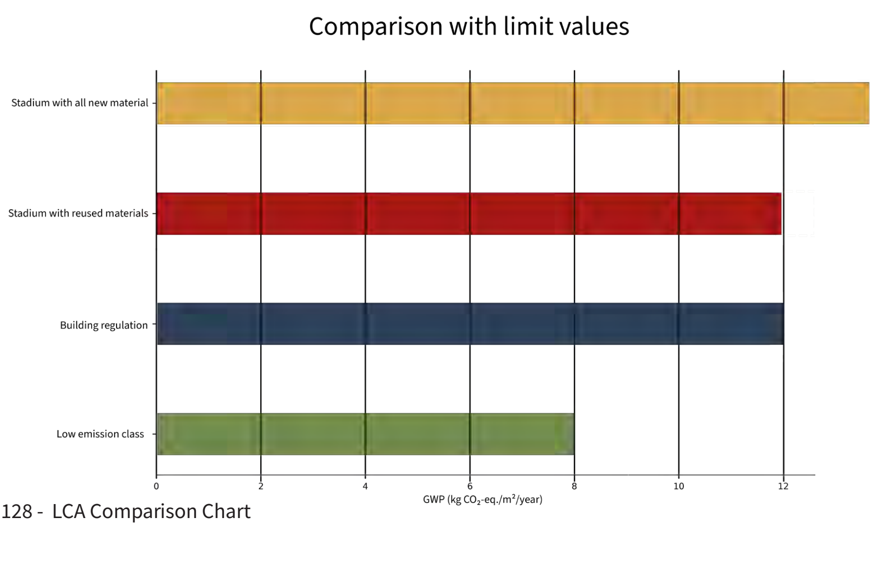


Illustration 128 - LCA Comparison Chart

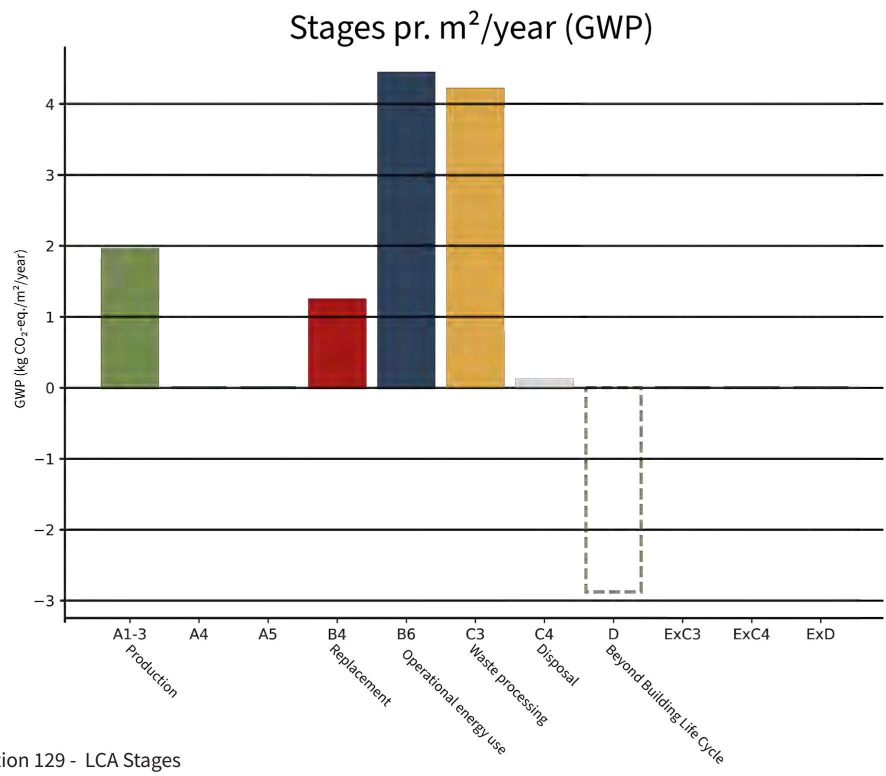


Illustration 129 - LCA Stages

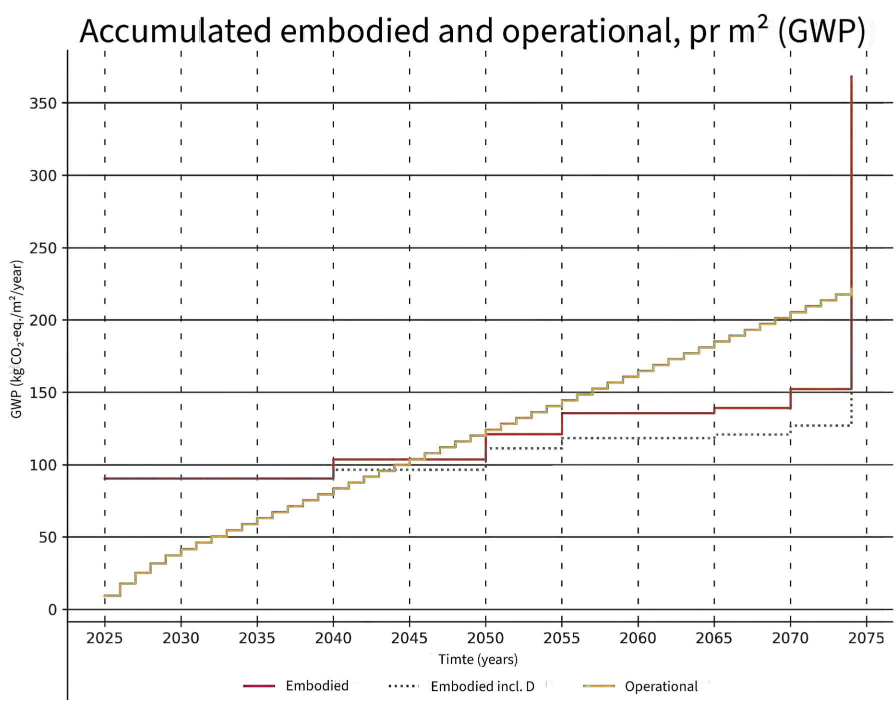
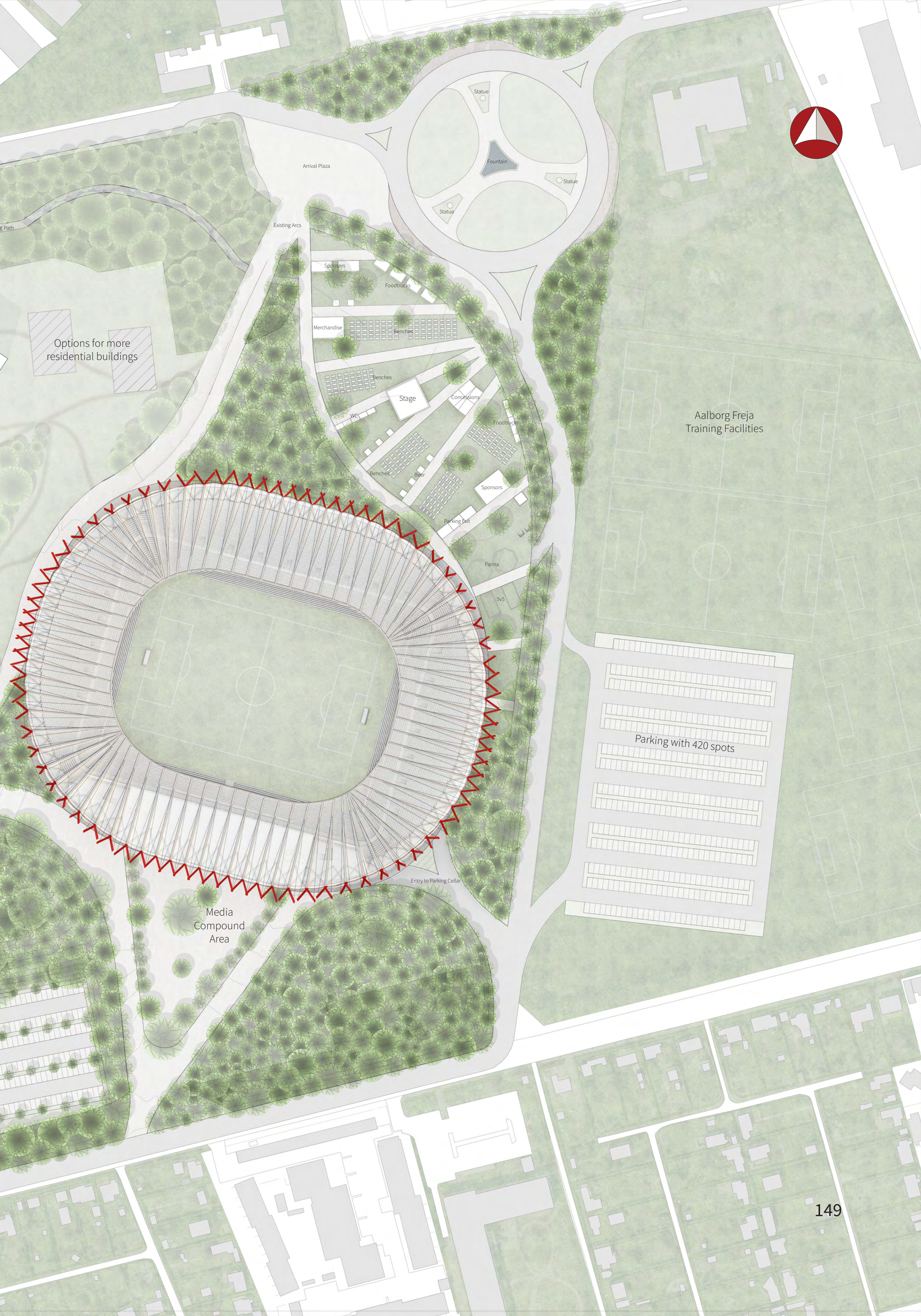


Illustration 130 - LCA GWP

Masterplan

Illustration 131 - Masterplan

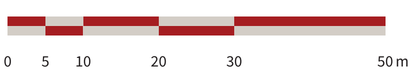

Statue
Fountain
Statue
Statue
Arrival Plaza
Existing Arcs
Options for more residential buildings
Sponsors
Foodtrucks
Merchandise
Benches
Benches
Stage
Concessions
WC
Foodtrucks
Benches
Beer
Sponsors
Parking Exit
Panna
5v5
Aalborg Freja Training Facilities
Parking with 420 spots
Entry to Parking Cellar
Media Compound Area

Fanzone

The fan zone is designed as an engaging public space that activates the area around the stadium on match days. It functions as a key gateway between the city and the stadium, offering fans a rich a varied pre-game experience. The layout includes a mix of temporary and permanent facilities such as food trucks, beer stands, sponsor tents and merchandise stores, strategically placed to encourage movement and interaction. A dedicated area will be designed for football-related activities to invite fans of all ages to engage in 3v3 and 5v5 mini games, as well as themed games such as football dart, table soccer and much more. A central stage provides space for live entertainment, announcements, or pre-match events. Together, these elements contribute to a festive atmosphere that builds anticipation before the game and strengthens the sense of community around the club and the fans.

The greenery around the fan zone mimics the rest of the sites transformation into a recreational green space, by zoning the site with paths, trees and green spaces, it becomes an urban hub attracting users from the entire city. This follows the wish Harald Jensen had for the current site of AaB stadium, that did not succeed.

"...the remaining part of the property shall then be designated for public use by the city's citizens, as we wish it to be laid out and planted as a public park with large open spaces or lawns for play, tennis, football, softball, and other summer and winter sports." - (Hansen 1996)



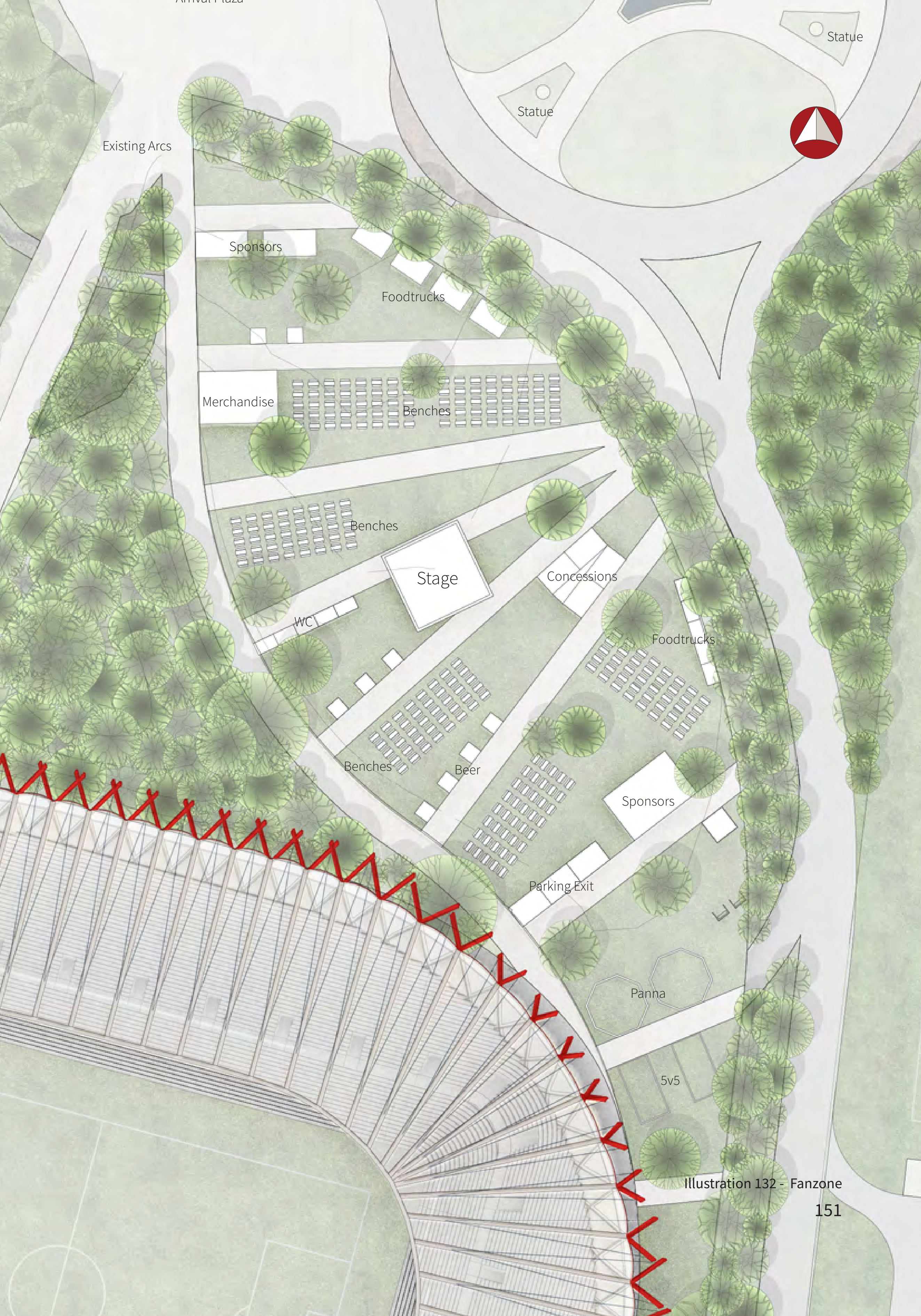


Illustration 132 - Fanzone

South Elevation

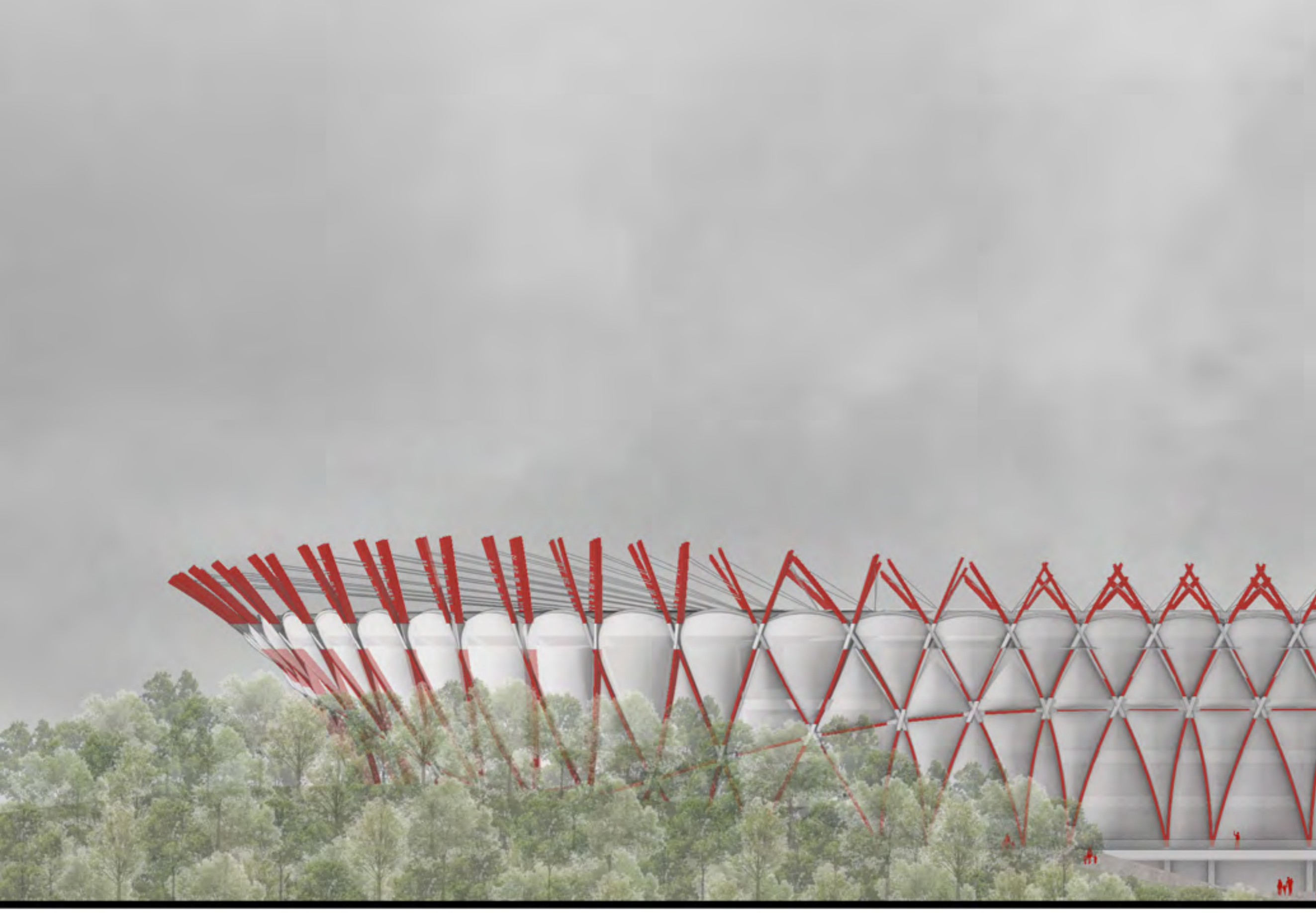
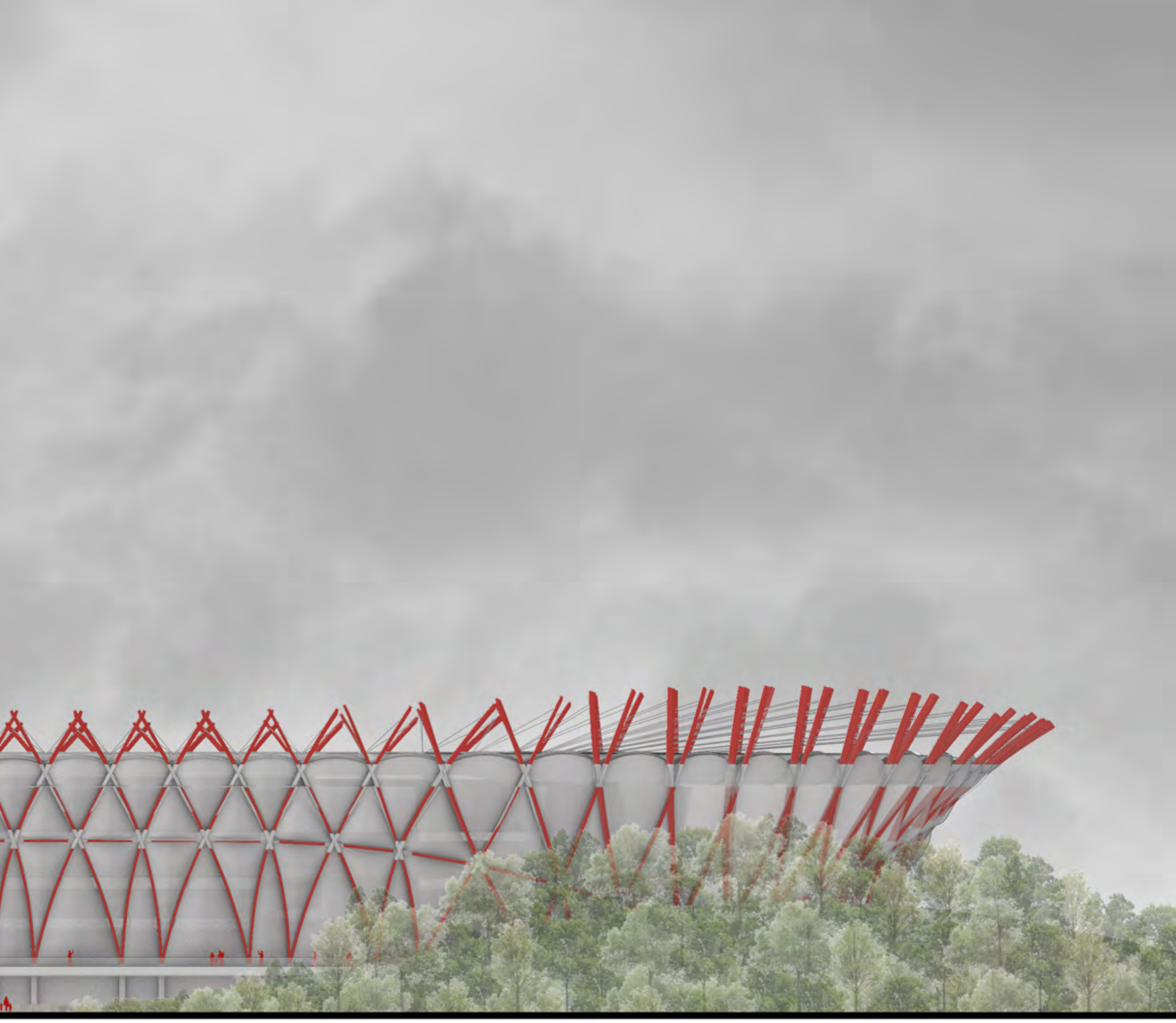
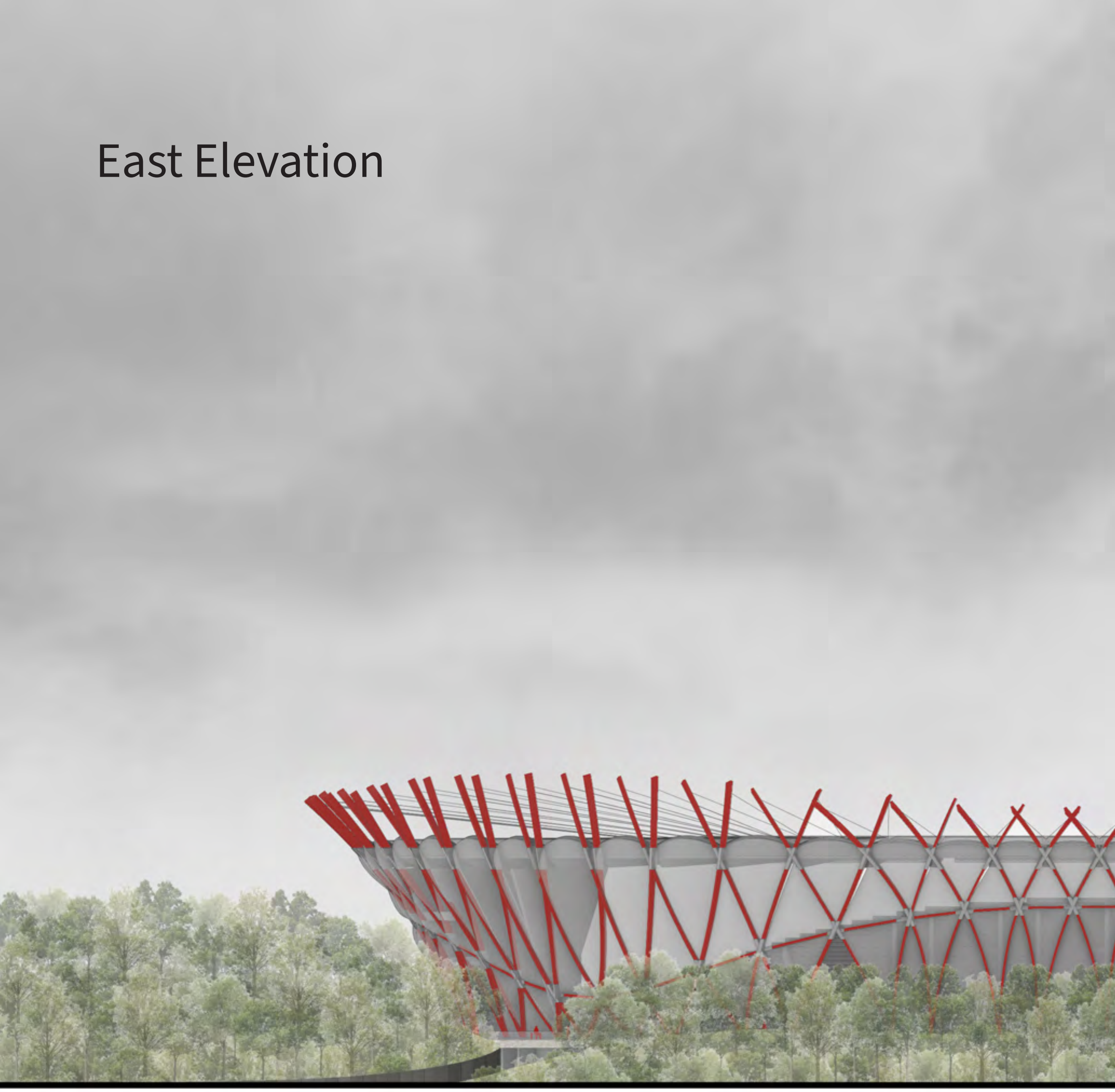


Illustration 133 - South Elevation



East Elevation



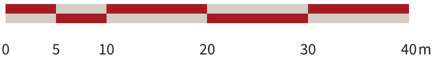


Illustration 134 - East Elevation

West Elevation

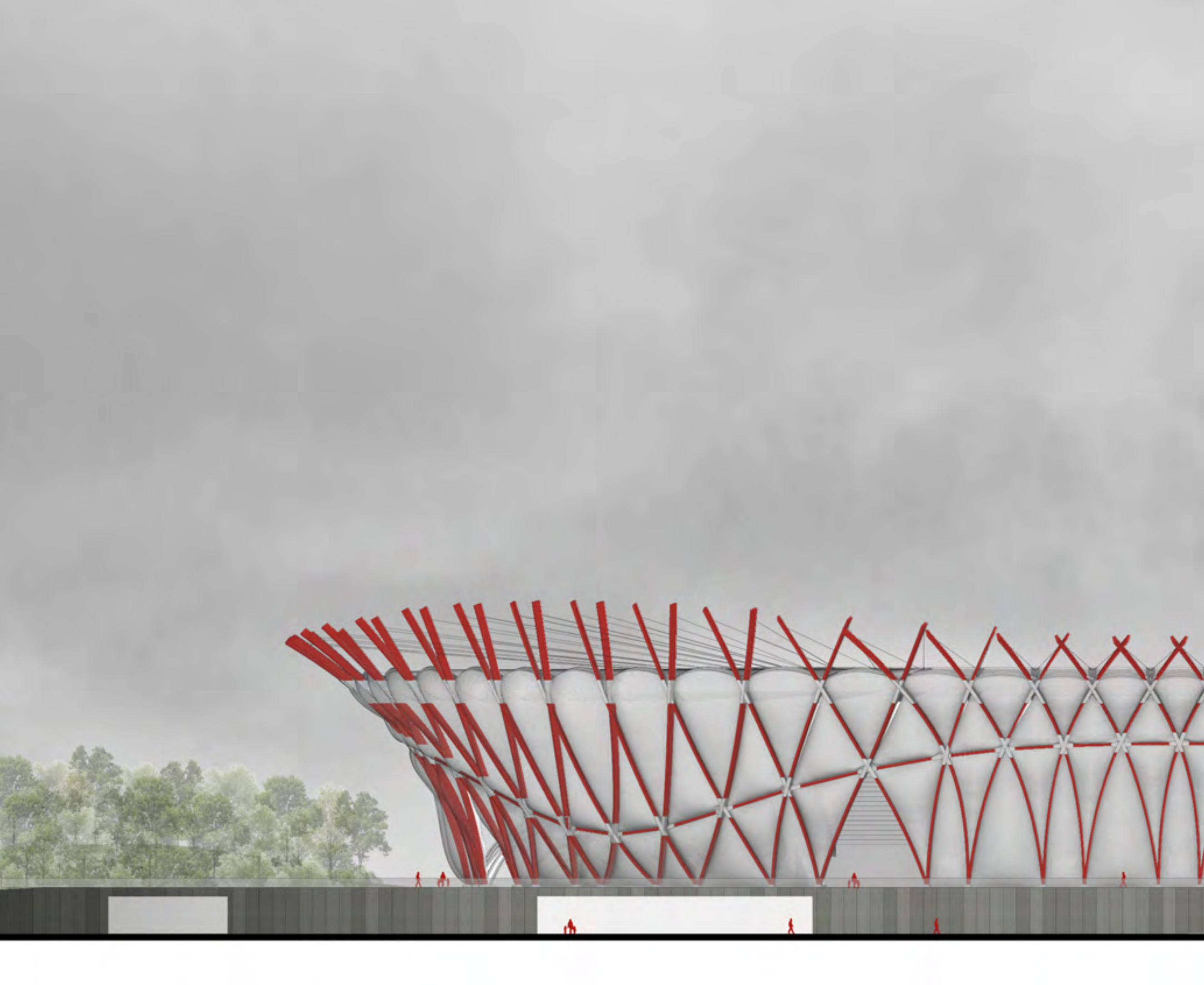
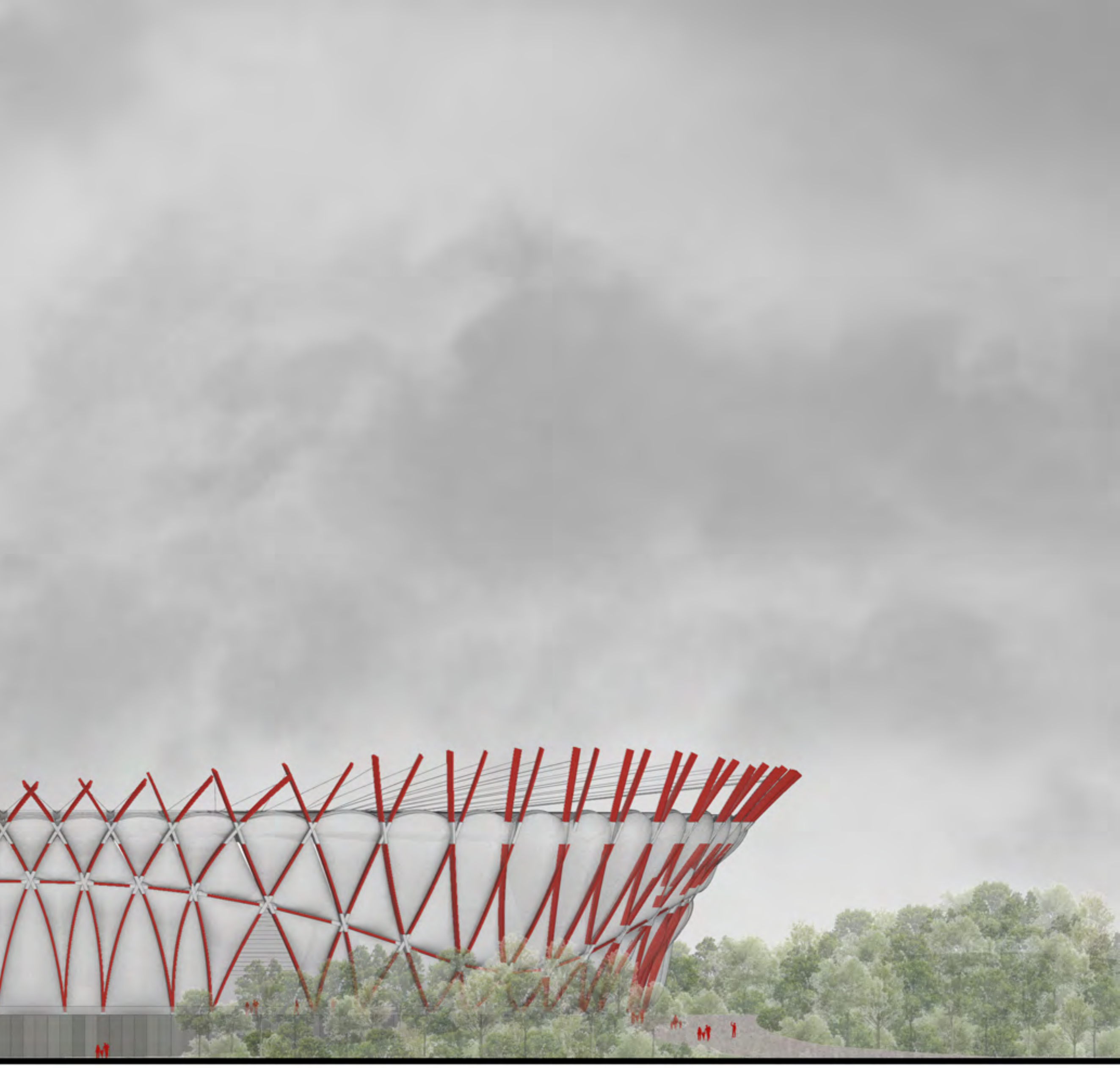
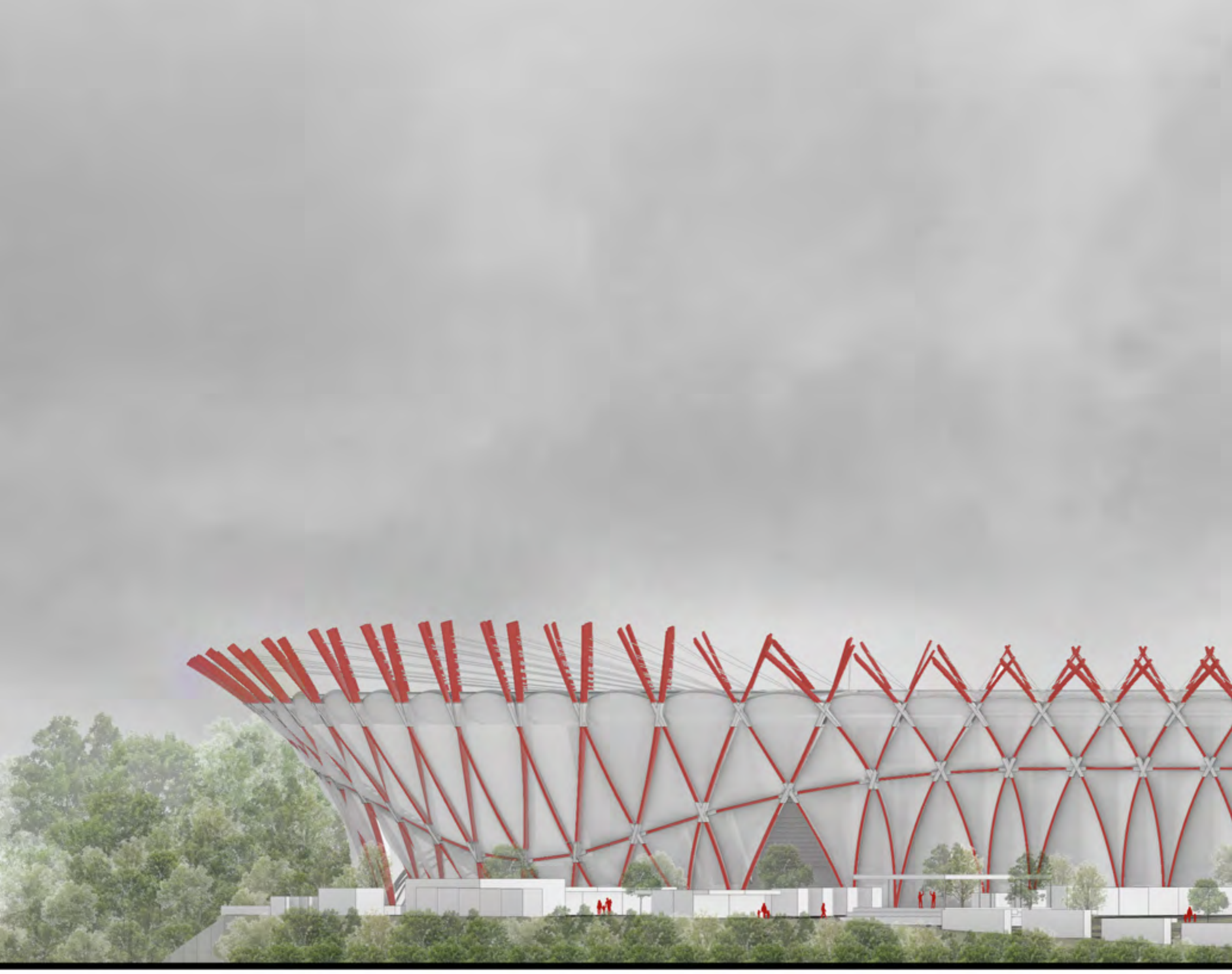


Illustration 135 - West Elevation

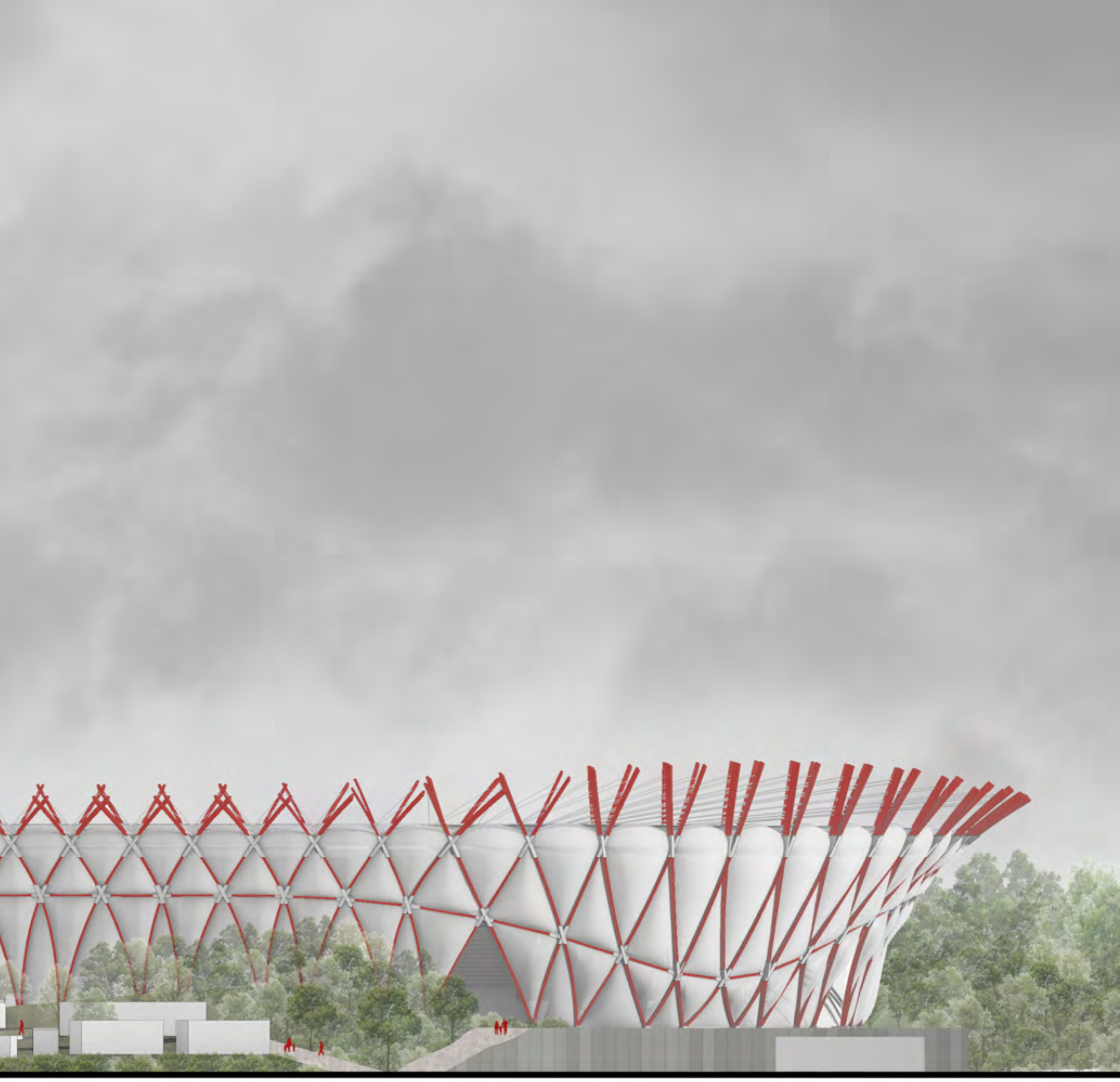


North Elevation



0 5 10 20 30 40 m

Illustration 136 - North Elevation



Atmosphere

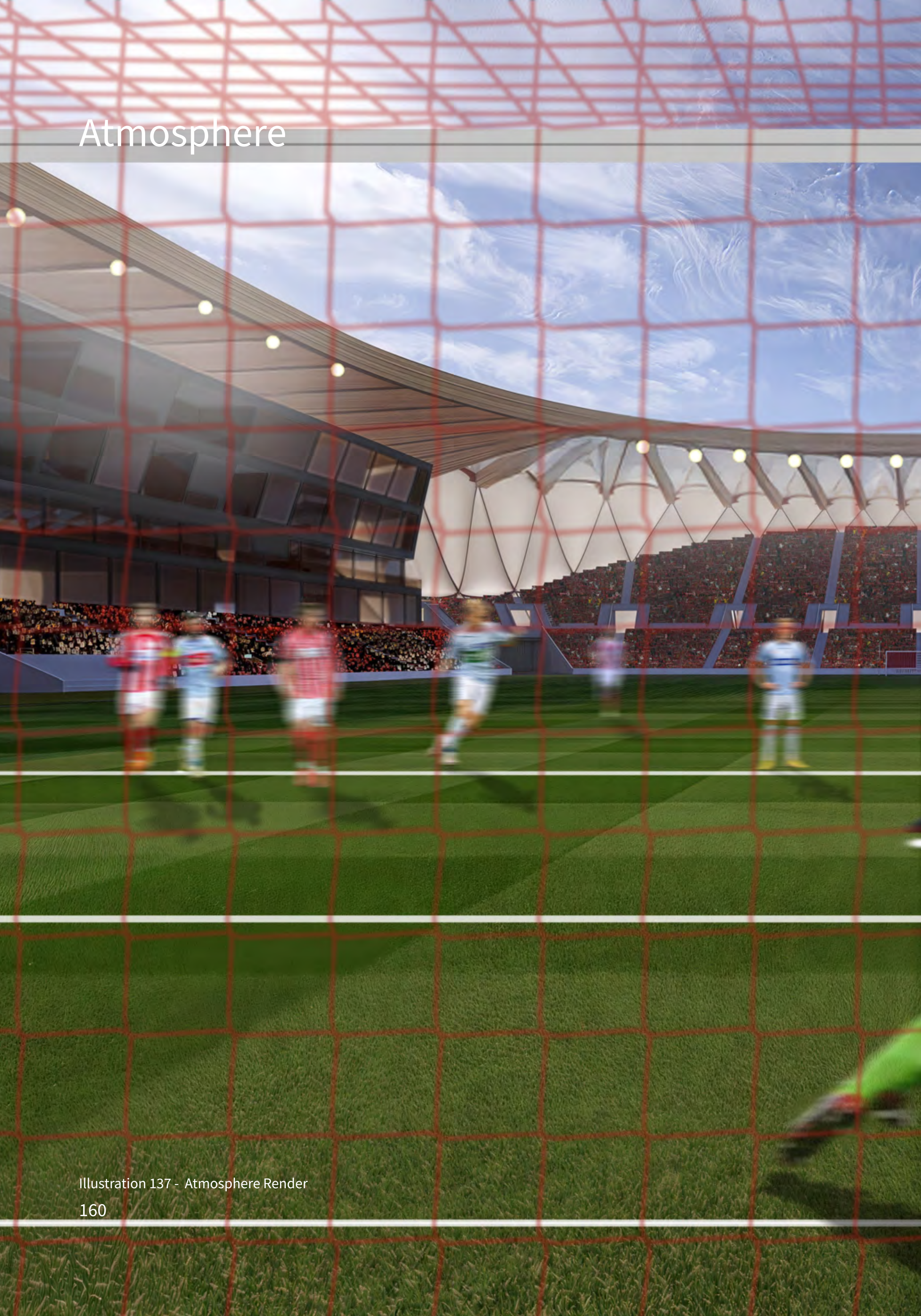


Illustration 137 - Atmosphere Render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Conclusion

The transformation of the site from a former racecourse into a generous and vibrant park marks a significant shift in its identity and urban function. What once was a singular functioning space, directing its focus inwards, has been reinvented as an open, public and inclusive park that invites to everyday use and fosters community engagement. The newly founded park does not only support the stadiums match day activities but also serves as a valuable urban space on its own by offering recreational opportunities for the new residents in the area and the public in Aalborg.

From the outset, the stadium has been designed with sustainability as a central design driver. The architectural and structural strategies reflect a conscious effort to minimize environmental impact. Along this approach, Design for Disassembly got implemented, ensuring that the stadiums load bearing structures can be easily dismantled, reused or recycled at the end of their life cycle. These efforts underline the project's ambition to push the benchmark for sustainable stadium design.

The design process has been an endless dialog between architectural vision and technical feasibility. Early conceptual ideas were gradually refined through iterative testing and well-thought decision making. Structural elements have been dimensioned to carry out the most extreme scenarios without failing, not only to ensure it meets safety standards, but to support the architectural language with emphasis on rhythm and symmetry. The integration of architectural practices and technical calculations from the early stages has been instrumental in achieving a holistic design approach.

New Aalborg Portland Park has not only resulted in a comprehensive stadium design proposal, but also in a deeper understanding of the responsibilities that the architect holds when it comes to creating inclusive, sustainable and recreational environments. The project aspires to become a meaningful place for the city and its residents. The transformation of the racecourse reflects the commitment of environmental consciousness, and even though not every idea and sustainable aspect could be fully realized within the projects scope, the process opens the conversation about how to design sustainable mega structures and keeps pushing the boundaries for what's possible.

Reflection

This reflection serves as a critical evaluation of the design process, decisions, and outcomes of the stadium. It considers both the successes and limitations encountered throughout the development, from concept to final proposal.

Passive Strategies

Early in the design process, passive strategies such as integrating solar panels in the roof and rainwater harvesting for non-potable water were considered as key elements to create a sustainable stadium and being close to being self-sufficient. These ideas helped to design early iterations on the roof structure, that would facilitate both strategies and help achieve environmental ambitions. However, as the project took shape and progressed into the synthetic phase, these strategies were not fully translated into the final design proposal. Even though the passive strategies have not been drawn in the presentation material or the technical drawings, they have still been accounted for in the LCA analysis and calculated how many square meters of solar panels are needed to be self-sufficient. This suggests that it is possible to integrate it in the design, but it would need to be of higher priority and investigated further, in how to technically integrate them.

Acoustic Atmosphere

Acoustics play a crucial role in shaping the atmosphere of a football stadium, especially when the aim is to create a loud, energetic atmosphere that enhances the experience for the fans and provides the home team with an advantage. However, despite the clear importance of having the right acoustic scenery, it is something that has only been touched upon a conceptual level, due to complexity and time consumation. Given the compromise on the acoustic early in the design process the roof cladding were able to be ETFE elements, that performs well by being lightweight and transparent, but too thin to keep the noise in the stadium. Therefore, if the vision were more on creating the loudest atmosphere, a different roof material would probably have been selected.

VIP Building

The VIP building is a complex structure with high demands for diverse functions and vertical circulation. It offers a unique and exclusive experience, something most people encounter only once or twice. As such, the atmosphere upon entering the building should reflect and enhance that sense of occasion. Architecturally, the volume and façade facing the pitch present a sense of grandeur, leaning inward with expansive glazing and generous balconies from which VIP guests can overlook the crowd. However, the interior qualities, such as materiality, lighting, and spatial planning have been somewhat overlooked. A deeper exploration of these aspects could have helped craft a truly luxurious experience tailored to the building’s three distinct user groups.

Personal insights

Throughout the project, the design team learned the importance of planning ahead and setting deadlines along the way, as it greatly facilitates maintaining an overview of the project. This realization came somewhat late in the process, resulting in a first half that was relatively unstructured and less efficient. In contrast, the second half benefited from weekly planning and clearly defined deadlines, which improved workflow and coordination.

The project also highlighted both the challenges and opportunities of reusing materials from the existing stadium, incorporating sustainable building methodologies, applying goal-oriented stadium design, and exploring parametric modelling. Over the course of the project, the team developed a deeper appreciation for multi-dimensional optimization, recognizing its value in improving design efficiency and supporting more realistic architectural proposals. Looking ahead, this approach will inform future work, encouraging a more integrated, holistic design process and more achievable, well-resolved outcomes.

Illustrations

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THESIS TITLE PAGE

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This thesis was written by (full name):		
Andreas Chresten Lyngsøe Poulsen		
Mathias Ravnholt Ovesen		
Title of the thesis: New Aalborg Portland Park		
Supervisor´s name: Luis Santos		
Submission date/year: 02/06-2025		
Is the project confidential?	**Yes** ☐	**No** ☒
External collaboration*	**Yes** ☐	**No** ☒
External collaboration partner (name of company/organization):		
Contact at external collaboration partner (title, name og email):		

What is an external collaboration? Read more here.

Appendices

Appendix 1 - Initial Sightline Calculations

Western Stand

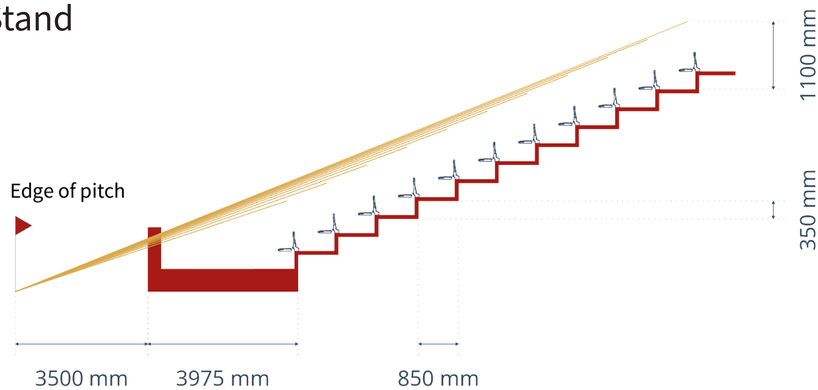


Illustration 138 - Western Stand Standing

West- & East Stands (Standing)		1st row	Last row
Horizontal Distance	[D]:	7175 mm	14825 mm
Vertical Distance	[R]:	2400 mm	5550 mm
Riser Length	[T]:	850 mm	850 mm
Riser Height	[N]:	350 mm	350 mm
Resulting C-Value		58 mm	30 mm

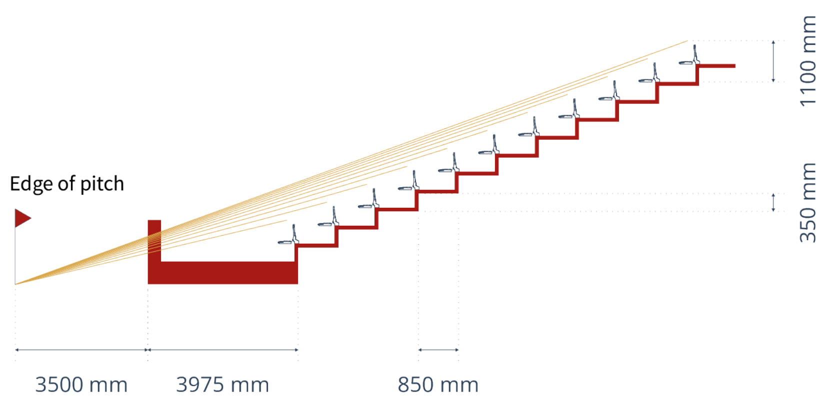


Illustration 139 - Western Stand Seating

West- & East Stands (Seating)		1st row	Last row
Horizontal Distance	[D]:	7175 mm	14825 mm
Vertical Distance	[R]:	1700 mm	4850 mm
Riser Length	[T]:	850 mm	850 mm
Riser Height	[N]:	350 mm	350 mm
Resulting C-Value		133 mm	68 mm

A. Enggaard Stand

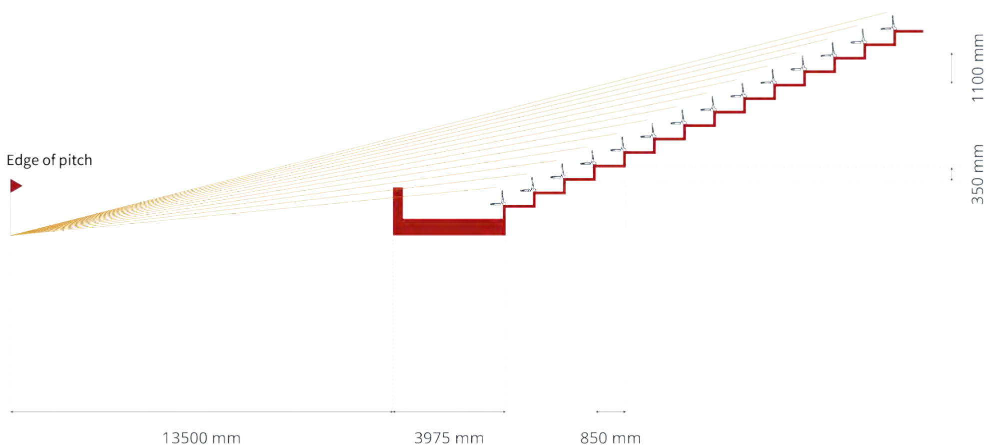


Illustration 140 - A. Enggaard Seating

A. Enggaard VIP Stand		1st row	Last row
Horizontal Distance	[D]:	17175 mm	28225 mm
Vertical Distance	[R]:	1700 mm	6250 mm
Riser Length	[T]:	850 mm	850 mm
Riser Height	[N]:	350 mm	350 mm
Resulting C-Value		253 mm	157 mm

Complea Stand Version 1

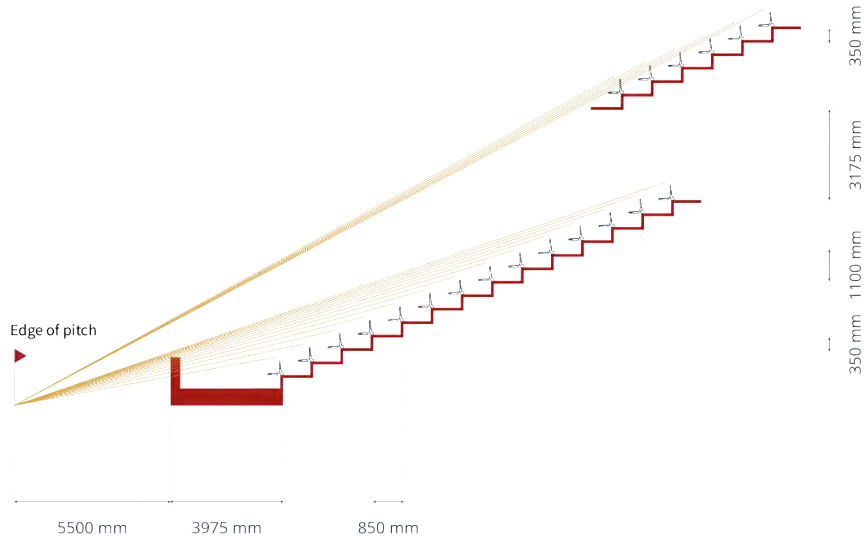


Illustration 141 - Complea Stand Version 1

Complea Lower Stand ver. 1		1st row	Last row
Horizontal Distance	[D]:	9175 mm	20225 mm
Vertical Distance	[R]:	1700 mm	6250 mm
Riser Length	[T]:	850 mm	850 mm
Riser Height	[N]:	350 mm	350 mm
Resulting C-Value		176 mm	84 mm

Complea Upper Stand ver. 1		1st row	Last row
Horizontal Distance	[D]:	18725 mm	23825 mm
Vertical Distance	[R]:	10000 mm	12100 mm
Riser Length	[T]:	850 mm	850 mm
Riser Height	[N]:	350 mm	350 mm
Resulting C-Value		-99 mm	-79 mm

Complea Stand Version 2

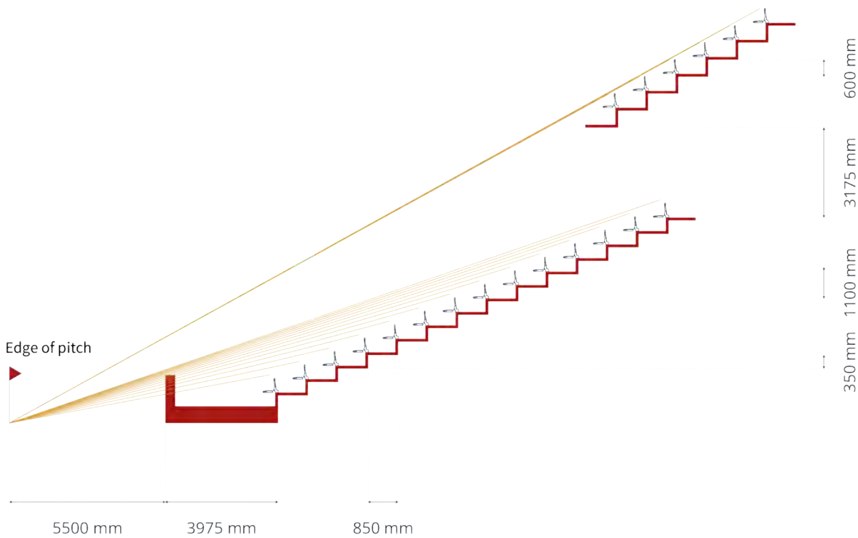


Illustration 142 - Complea Stand Version 2

Complea Lower Stand ver. 2		1st row	Last row
Horizontal Distance	[D]:	9175 mm	20225 mm
Vertical Distance	[R]:	1700 mm	6250 mm
Riser Length	[T]:	850 mm	850 mm
Riser Height	[N]:	350 mm	350 mm
Resulting C-Value		176 mm	84 mm

Complea Upper Stand ver. 2		1st row	Last row
Horizontal Distance	[D]:	18725 mm	23825 mm
Vertical Distance	[R]:	10250 mm	13850 mm
Riser Length	[T]:	850 mm	850 mm
Riser Height	[N]:	600 mm	600 mm
Resulting C-Value		129 mm	102 mm

Appendix 2 - Material Atlas

Location	Element Name	Category	Quantity
Complea Stand	Red seats	Seats	4349
Complea Stand	White seats	Seats	623
3F Stand	Red seats	Seats	1008
A. Enggaard Stand	Red seats	Seats	2562
Complea Gable	CS_Glazing panels	Windows	102
A. Enggaard Gable	AES_Glazing panels	Windows	102
A. Enggaard Facade	AES_VIP Glazing	Windows	40
A. Enggaard Facade	AES_VIP Glazing	Windows	80
Complea Stand	Facade Cladding	Cladding	150
Complea Stand	Facade Cladding	Cladding	75
A. Enggaard Stand	Facade Cladding	Cladding	225
Vesttribunen	Facade Cladding	Cladding	90
3F Stand	Facade Cladding	Cladding	90
All Stadium	Roof Cladding	Cladding	7150
Complea Stand	Complea Stand	Stand	1
Vesttribunen	Vestribunen	Stand	1
3F Stand	3F Stand	Stand	1
A.Enggaard Stand	A.Enggaard Stand	Stand	1
All Stadium	Steel Trusses	Trusses	60
All Stadium	Steps on the stands	Steps	380
All Stadium	Stairs to the stands	Stairs	9
All Stadium	Big Screens	Big Screens	2
Floodlight Towers	Arenavision MVF404	Lighting Equipment	168

Height	Length	Width	Material
520 mm	550 mm	460 mm	Plastic
520 mm	550 mm	460 mm	Plastic
520 mm	550 mm	460 mm	Plastic
520 mm	550 mm	460 mm	Plastic
	1500 mm	1360 mm	Glass
	1500 mm	1360 mm	Glass
	2000 mm	3000 mm	Glass
	800 mm	3000 mm	Glass
	4500 mm	1500 mm	Aluminium
	2000 mm	1500 mm	Aluminium
	4500 mm	1500 mm	Aluminium
	4500 mm	1500 mm	Aluminium
	3500 mm	1500 mm	Aluminium
	1000 mm	1000 mm	Aluminium
340 mm	114.000 mm	800 mm	Concrete
340 mm	90.000 mm	800 mm	Concrete
340 mm	90.000 mm	800 mm	Concrete
340 mm	114.000 mm	800 mm	Concrete
10.000 mm	22.200 mm	200 mm	Steel
200 mm	1500 mm	400 mm	Concrete
180 mm	300 mm	3000 mm	Concrete
10.000 mm	300 mm	5.500 mm	LED
535 mm	368 mm	592 mm	Mixed

Appendix 3 - Program and Design Criteria

Field of play		Regulator
Field Dimensions	105m x 68m	DIVISIONSFORENINGEN, UEFA, FIFA
Field Surface	FIFA Quality Pro Football Turf	FIFA
Free Height Above Field	21m	UEFA
Safety Distance	Additional 4m on long sides Additional 5m on short sides	UEFA
Fencing	LED Boards on 3 sides	FIFA
Players Bench	2 x 23 seats	FIFA
	4m from lines	UEFA
Officials Bench	1	FIFA
Warm-Up zone	25m x 3m	FIFA
Players' Tunnel	3m wide, covered and retractable	FIFA
Maintenance Plan	Yes	DIVISIONSFORENINGEN

Hospitality		
VIP Lounge	300 pax lounge + 300 seats	DIVISIONSFORENINGEN
	Main stand between the two 16m lines Assigned parking	UEFA
VVIP Lounge	50 seats + Lounge for 50 pax	FIFA
Hospitality	500 seats + Lounge for 500 pax 10 boxes of 10 pax	FIFA

		Regulator
Home fans		
Covered roof		DIVISIONSFORENINGEN
Stands	Accessable from all stands Steeper than present Continuous Standing Split stands on the long side	
Fan-activities	Tifo Capo Tower	DIVISIONSFORENINGEN
	Automatic hoisting system for the whole stadion Fan meeting rooms AaB Museum	
Away fans		
Capacity	1000 or >5% of total seating count Min. half the standing capacity of the home zone	DIVISIONSFORENINGEN, UEFA
	Adjustable	
Placement	Opposing the home fans (East) Visible connection Close to the pitch as possible	DIVISIONSFORENINGEN
Food and Beverage Stands		
Ratios	min. 1 service point per 200 pax min. 1m per service point	FIFA
TVs streaming the match		

Accessability		Regulator
Wheelchair spaces	0.5% of total capacity + 1 companion seat	FIFA
Easy access standard	0.2% of total capacity + 1 companion seat	FIFA
Easy access amenity	0.2% of total capacity + 1 companion seat	FIFA
Easy access extra width	0.1% of total capacity	FIFA
Sensory viewing room	1 room	FIFA
Accessible parking	30% of accessible seating provision	
Fan-coordinator		DIVISIONSFORENINGEN
Handicap-coordinator		DIVISIONSFORENINGEN

Aesthetics		
Seats	Red and White Colours Spell out either ”AaB”, ”1885” or ”Aalborg”	
Street Art / Graffiti in the surrounding area		
Aalborg Citys history as inspiration		
Flag Avenue		
All advertisiments in Red & White		
Symmetrical stadium geometry		
Statues of club icons		
LEDs in facade and roof		

Matchday facilities		Regulator
Changing room for players	min. 5 showers 2 seated toilets min. 25 Seats Massage table Tactical board Lockers Icebath 2 x 60 m²	UEFA DIVISIONSFORENINGEN FIFA
Changing room for referees	2 Showers 1 seated toilet 6 seats 1 desk Lockers At least 45m²	UEFA FIFA
Medical room	Close to players and staff 30 m²	DIVISIONSFORENINGEN FIFA
Doping room	Seperate Toilet Waiting room 25 m²	FIFA
Delegate room	Easy access to dressing rooms 1 office	UEFA FIFA
Parking	2 Buses pr. team 10 cars pr. team Secure area in the immediate vicinity of the entrances	UEFA

Media		Regulator
Journalists	30 working spaces	UEFA
	Centered from the pitch (Same side as VIP)	DIVISIONSFORENINGEN
Press room	Min. 50 seats Top Table Podium Camera platform (min. 8 cameras)	UEFA
Photographer	20 workstations - Preferably seperate room	UEFA
Media seating	60 seats - hereof 30 with desk	UEFA
Mixed zone	At least 50 media representatives	UEFA
	Can use the reserved bus area if necessary	FIFA
Reserved Parking		DIVISIONSFORENINGEN
Own entrance		DIVISIONSFORENINGEN
Camera platforms	Main or opposite stand 8m x 2m for 3 cameras away from the sun 2x 16m line platforms (2m x 2m) At least one on opposing stand	UEFA
TV Commentary positions	10 x 180 cm wide desks	UEFA
TV Studios	2 rooms of 5m x 5m x 2,5m (LWH) At least one unobstructed pitch-view Could support alternative use as a hospitality box	UEFA
Flash interview	4 positions, each 4m x 3m	UEFA
TV Compound area	1000 m^2	UEFA

Technical Qualities		Regulator
Enclosed Envelope		DIVISIONSFORENINGEN
Capacity	Beyond 20.000 spectators	
	20.000 seats All standing areas convertible to seating	FIFA
Green Building Certification	Equivalent of LEED Silver	FIFA
Orientation	Based on FIFA Guidelines Section 2.2	FIFA
Lighting	1400 Eh(Lux) U1h >0.5 U2h > 0.7 1000 Ev(lux) U1 > 0.4 U2 > 0.5	UEFA
	350 Eh (lux) Hor. 900 Ev (lux) Ver.	UEFA
Result Board	2 with clock, standings and announcements	DIVISIONSFORENINGEN
Exterior Perimeter Lighting		DIVISIONSFORENINGEN
Ticket-Scanning Turnstiles	1 pr. 660seats or Enough to support an evaquation time of 8 min.	UEFA

Signage		
Colouring of public stairs and pathways		DIVISIONSFORENINGEN
Separation of home and away zones		DIVISIONSFORENINGEN
Evacuation plan		DIVISIONSFORENINGEN

Security

CCTV Room with overview over the entire stadium	
Separate entrance for players, staff and officials	
Separate entrance for opponents	
Ambulance entrance	
Safe parking for visiting team	Fencing Security Camera Guards
Spectator medical	1 room for each sector by tier (1 x 25m²)

Sanitaries

Toilet facilities	Assuming 65:35 1 seated pr. 200 male 1 sink pr. 200 males 1 urinal pr. 85 male 1 seated pr. 50 female 1 sink pr. 100 female
Handicap facilities	1 ”limited mobility” pr block or 1/10 unit 1 pr. 15 wheelchair seat 2.2m x 1.5m

Appendix 4 - Seating Layout

As mentioned in the report, the layout relies on trigger time rather than actual time, as there are some inaccuracies found with the simulation tool. Therefore, the overall goal with the simulation is to see the percentage wise impact of the different layout iterations. The layout consists of 8 iterations.

Centered Offset without aisle

Centrally located vomitory, all actors evacuating towards the nearest exit. The staircase is offset so that is non-continual.

Centered Offset with aisle

Centrally located vomitory, all actors evacuating towards the nearest exit. The staircase is offset so that is non-continual. This iteration has a transition aisle, supporting a wider person load.

Centered without aisle

Centrally located vomitory, all actors evacuating towards the nearest exit. The staircase is centered so that is continual.

Centered with aisle

Centrally located vomitory, all actors evacuating towards the nearest exit. The staircase is centered so that is continual. This iteration has a transition aisle, supporting a wider person load.

Top Entry without aisle

All actors evacuate towards the nearest upper situated vomitory.

Top Entry with aisle

All actors evacuate towards the nearest upper situated vomitory. This iteration has a transition aisle, supporting a wider person load.

Bottom Entry

Entrance from the bottom of the stands, needing all the actors to evacuate towards the lowest point. Should be showing the same indications as top entry.

Entry from outside

Actors can escape by reaching the nearest ending point of the staircases.

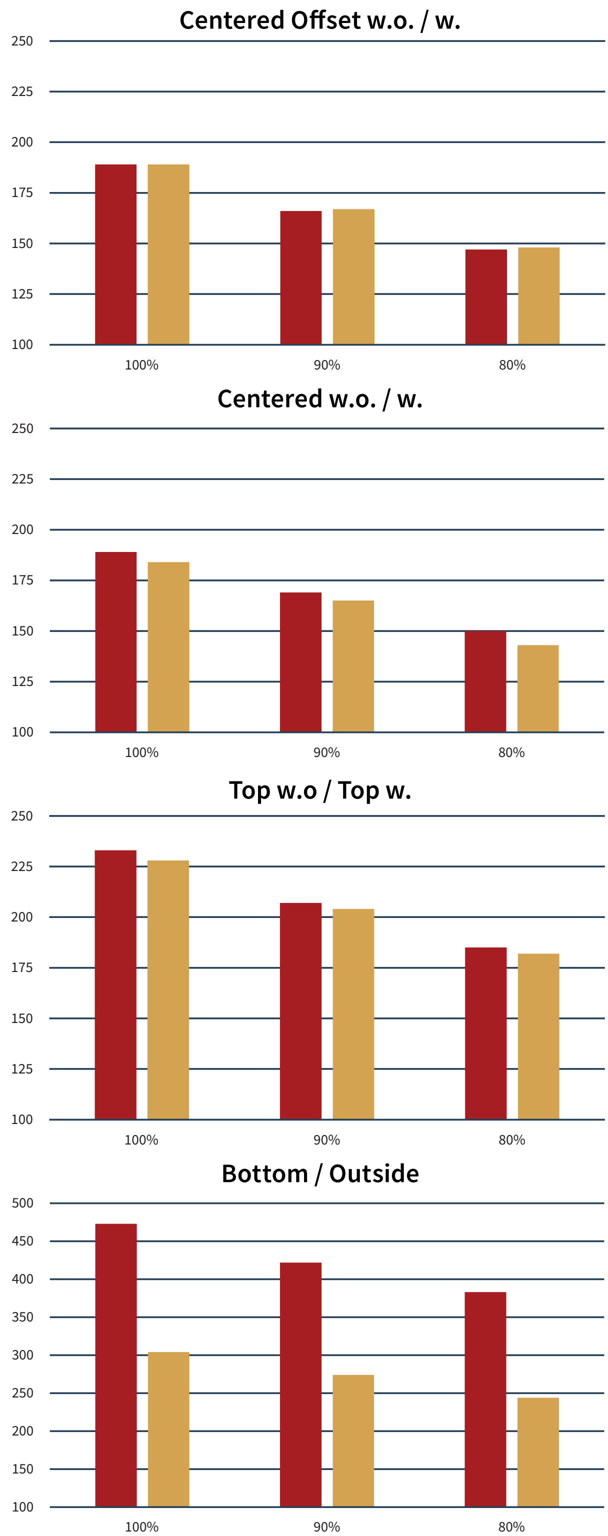
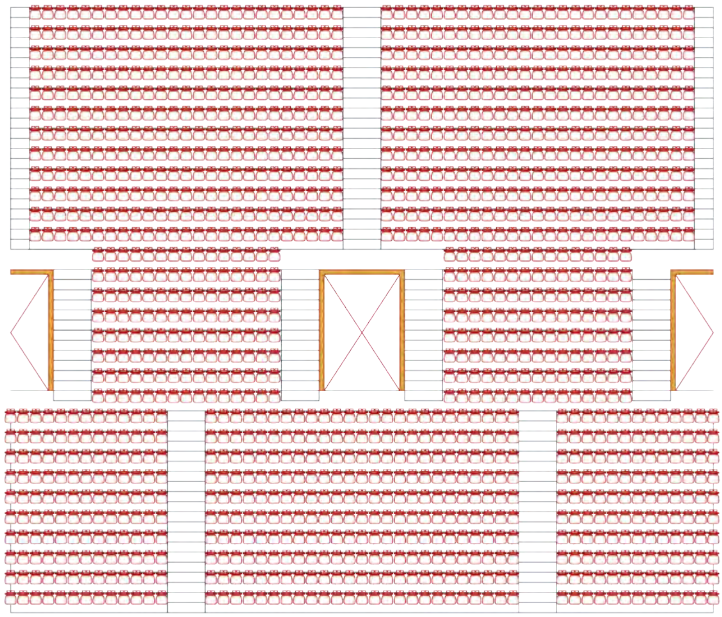
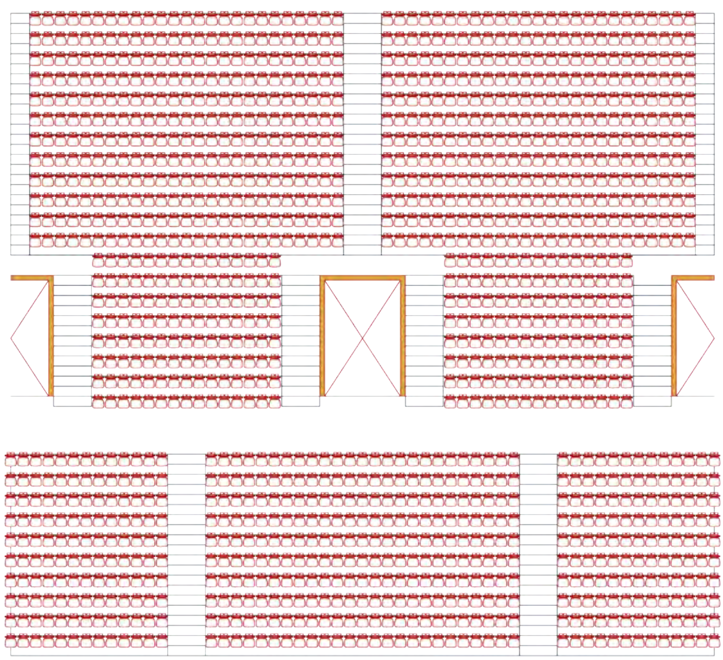


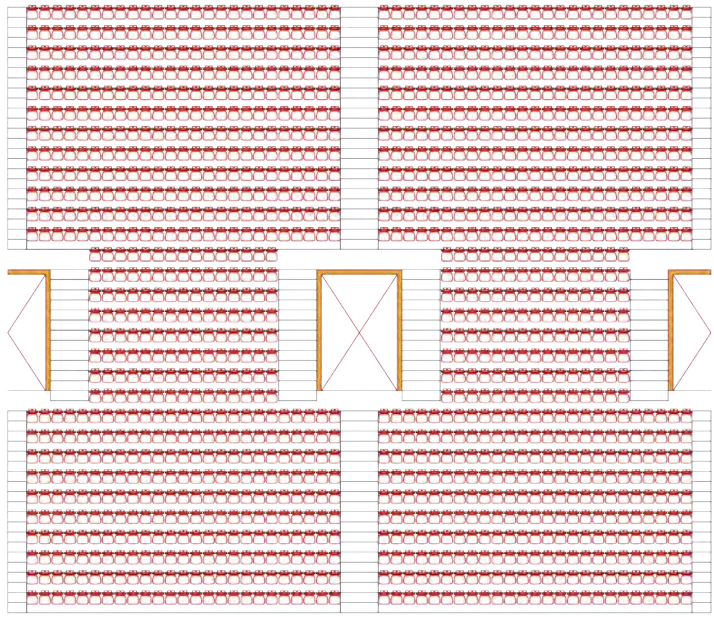
Illustration 143 - Evacution Results



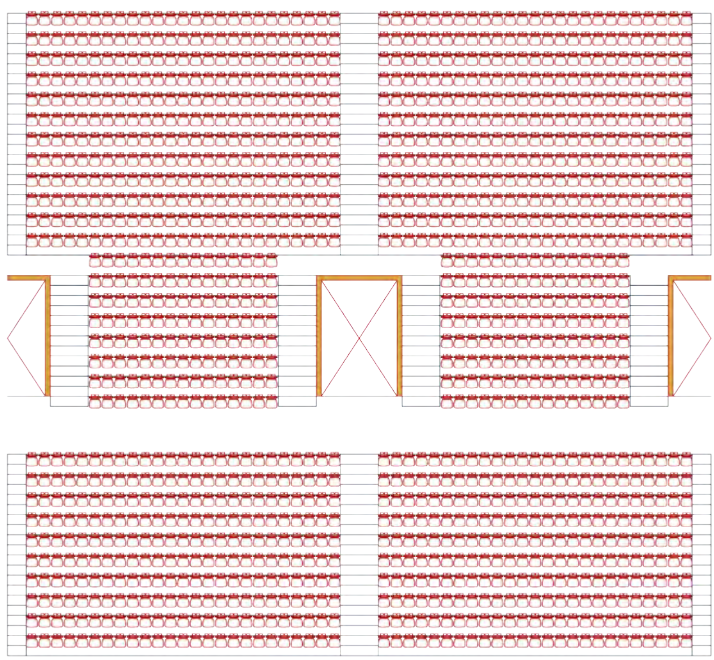
Centered Offset without aisle



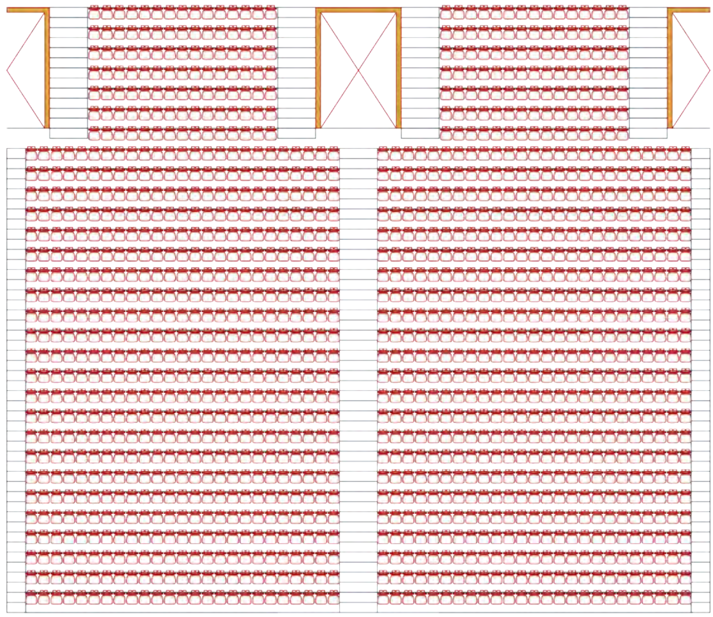
Centered Offset with aisle



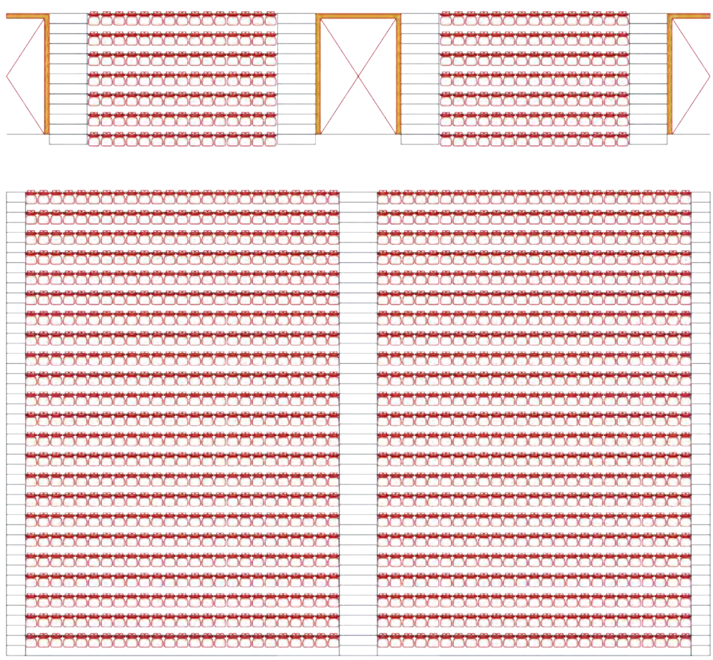
Centered without aisle



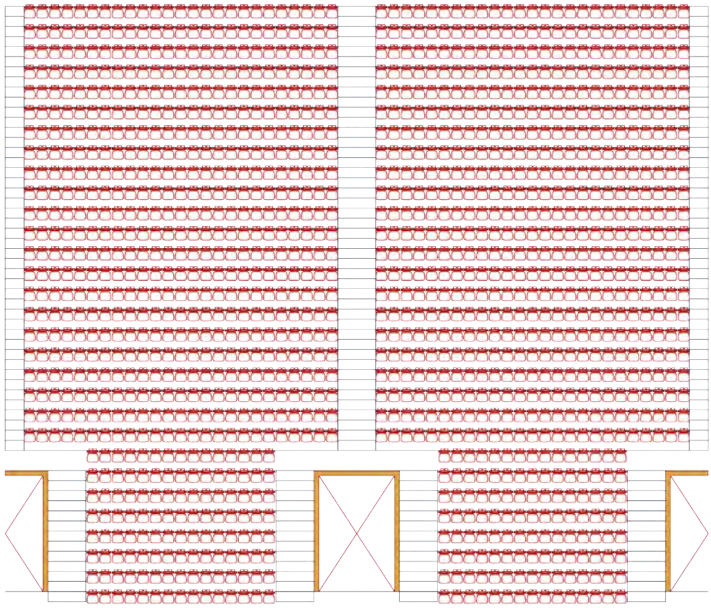
Centered with aisle



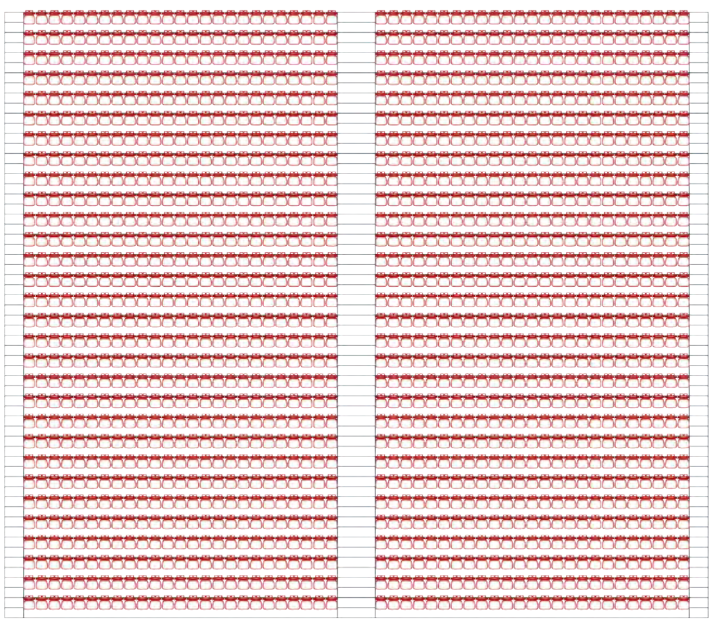
Top Entry without aisle



Top Entry with aisle



Bottom Entry



Entry from Outside

Appendix 5 - Roof Constraints

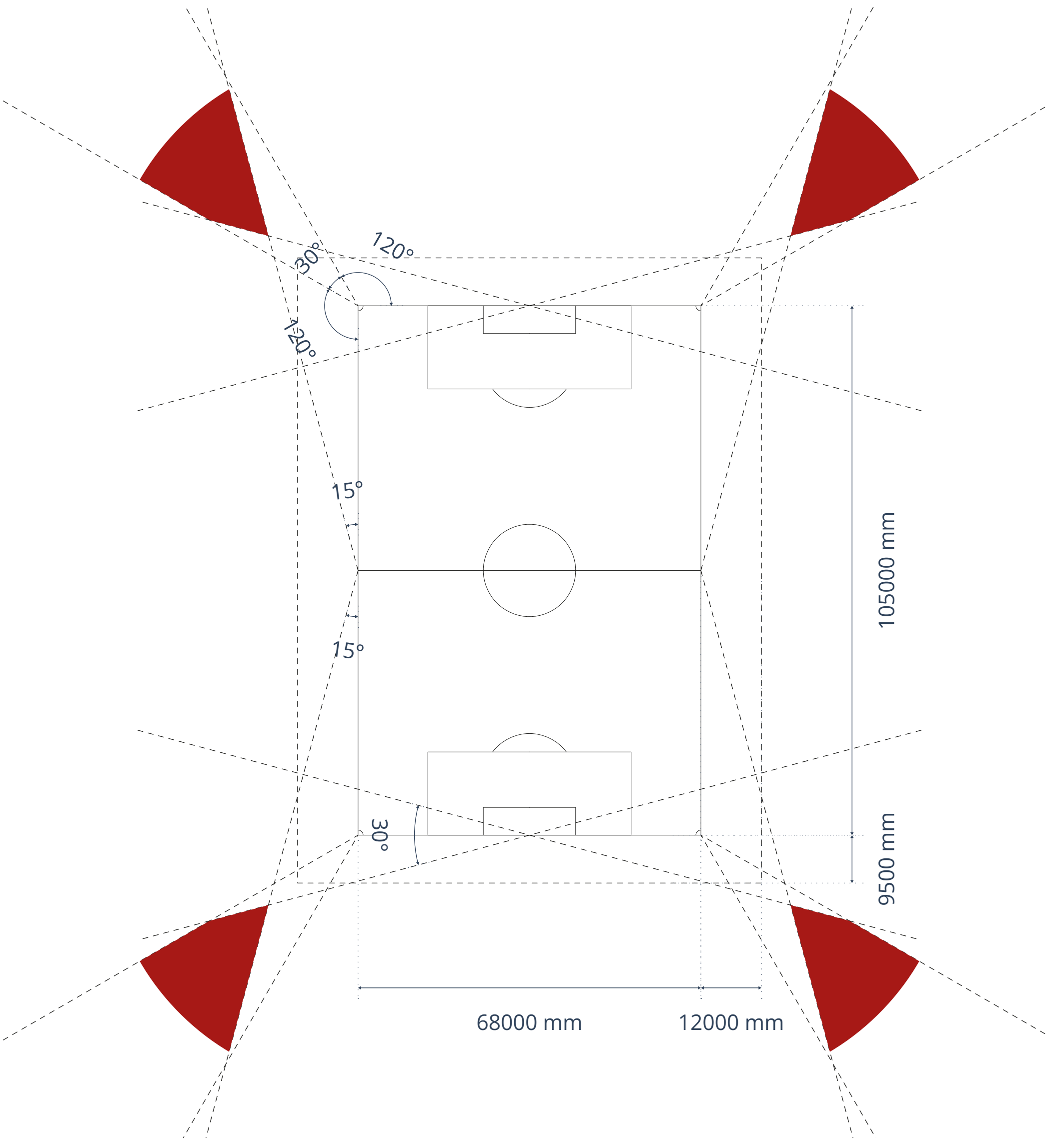


Illustration 144 - Floodlight Tower Positioning

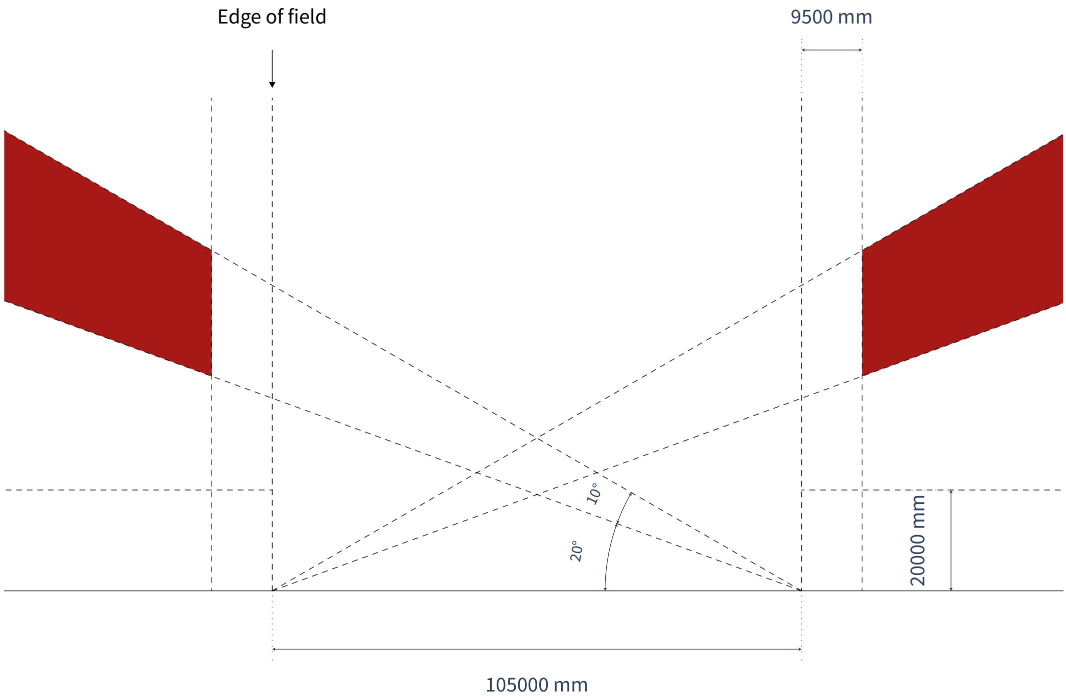


Illustration 145 - Floodlight Tower, Length of the field

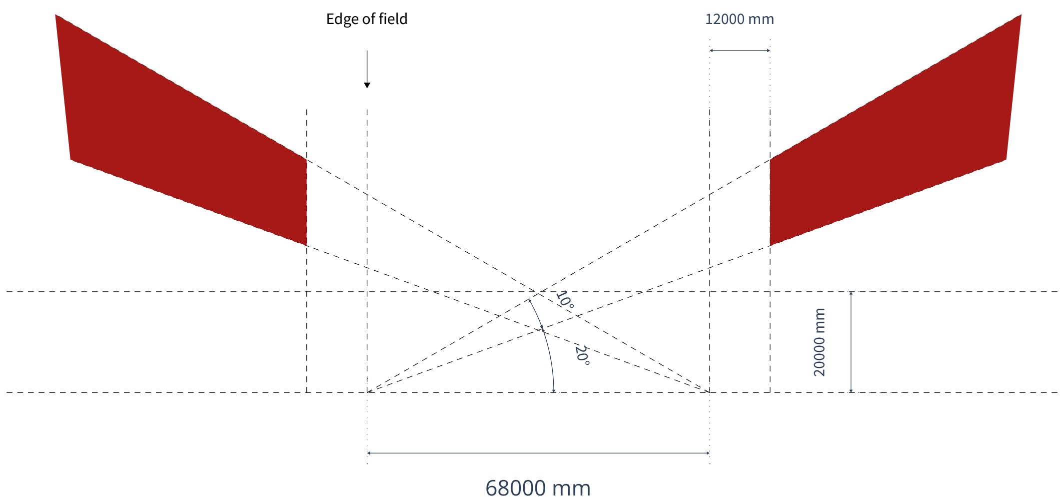


Illustration 146 - Floodlight Tower, Width of the field

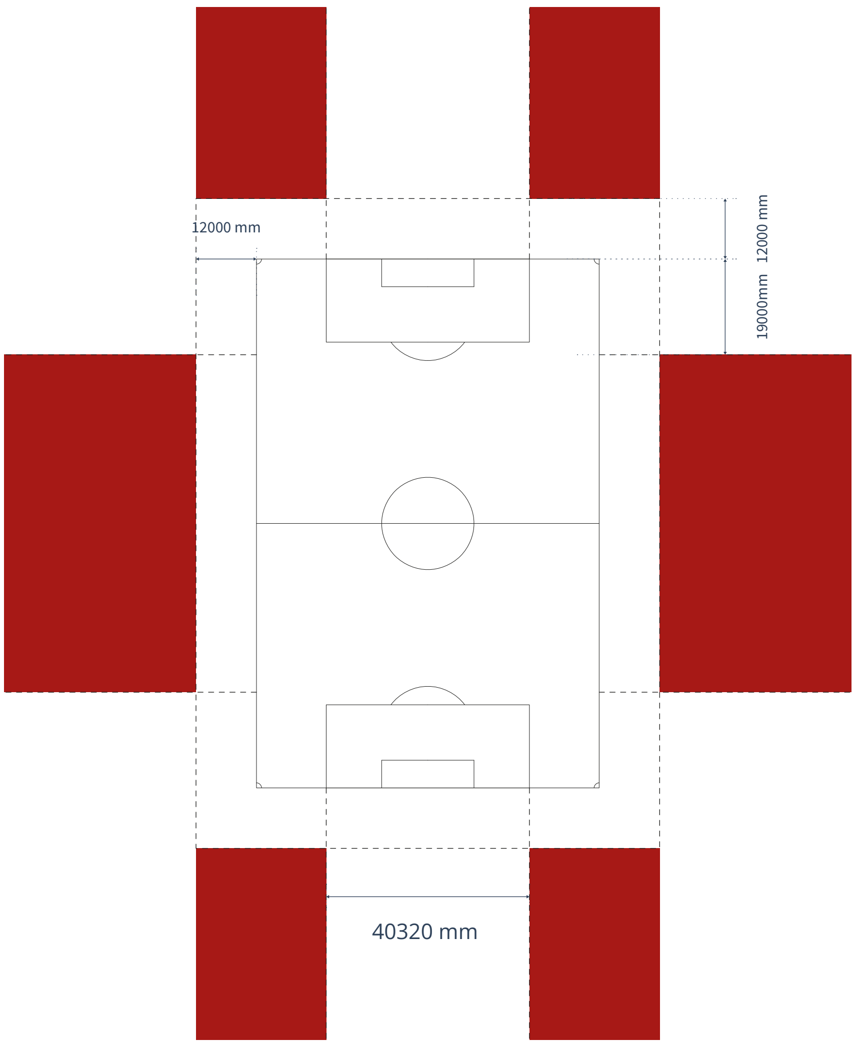


Illustration 147 - Pitch Perimeter Lighting Planar Positioning

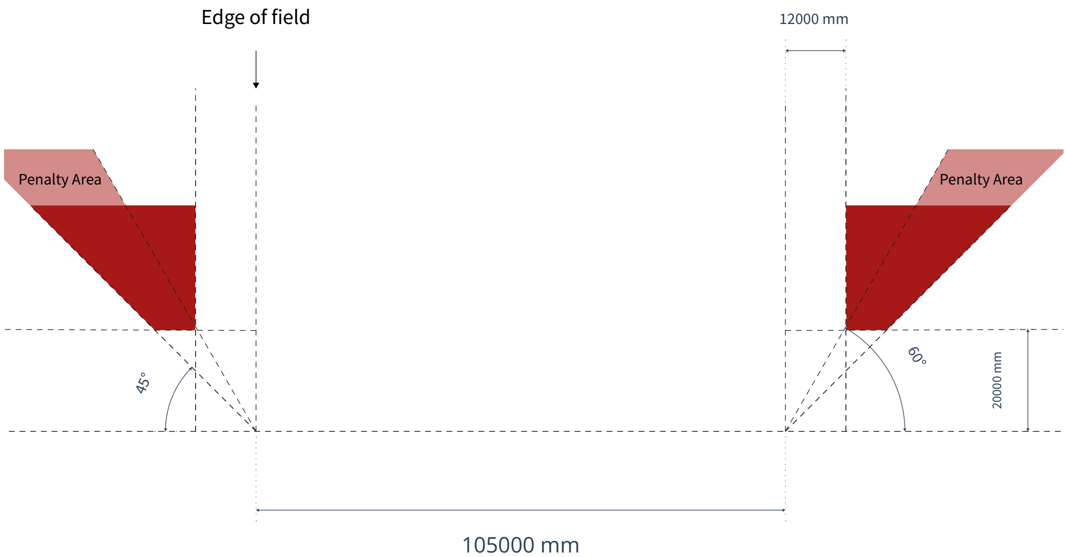


Illustration 148 - Pitch Perimeter lighting, Length of the field

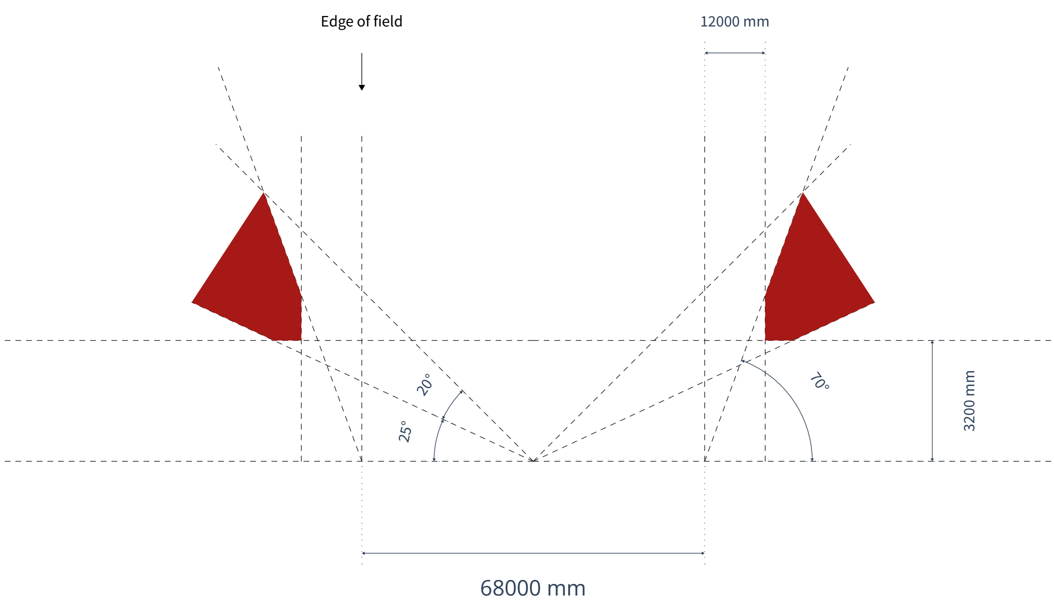


Illustration 149 - Pitch Perimeter lighting, Width of the field

Appendix 6 - Roof Cantilever

This aspect of the roof related design boundaries was introduced early in the design process, then result-wise setting the boundaries for the remaining structure. The analysis of the stadium is based on a solid roof surface, contrary to the semi-transparent roof that is in the final design proposal. Therefore, there are points of reflection on this analysis, as the resulting sunlight values, may be with less difference than illustrated here, compared to the proposed design.

The analysis considers three scenarios with a cantilevered roof structure as depicted on the illustration below. The three roof scenarios are then analyzed on the amount of annual sunlight hours on the pitch, as the daylight hours can help indicate the savings in terms of floodlight usage.

From the analysis, it can be seen that performance decreases as the cantilever is extended, as predicted. However, based on the recommendations set by FIFA, it becomes evident that the optimal drip line angle of 30 degrees performs 33% worse than 0-degree drip line based on annual direct sun hours, while only increasing the roof surface area by 25%, by extending the cantilever with 38%. Therefore, it is determined that the 30-degree drip line is not a viable option, as a cantilevered roof structure also would benefit from a shorter span.

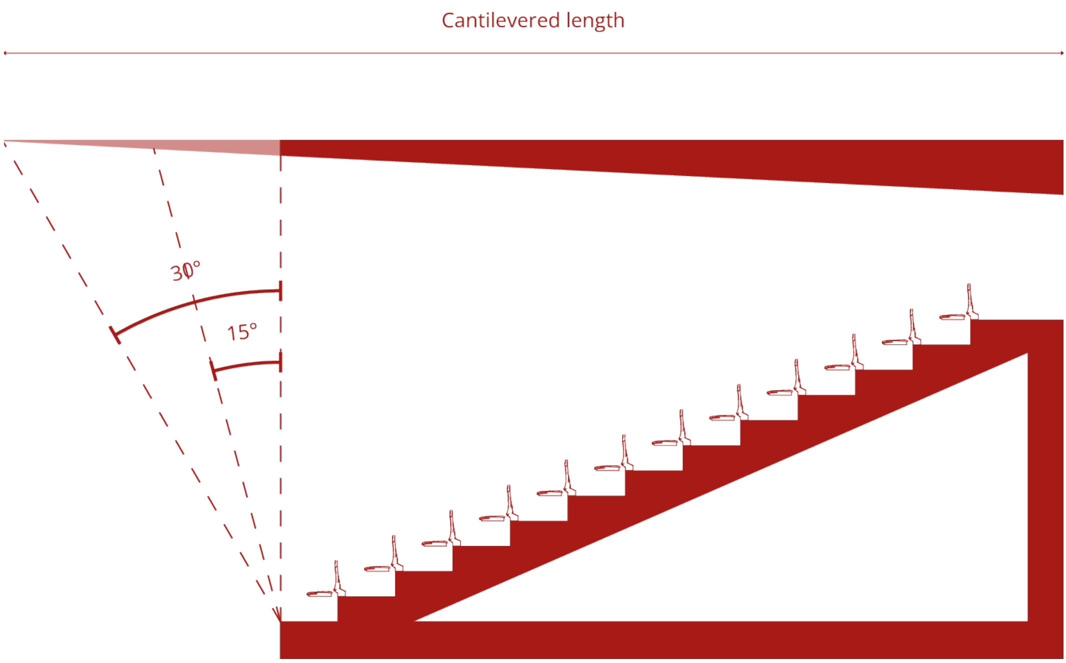
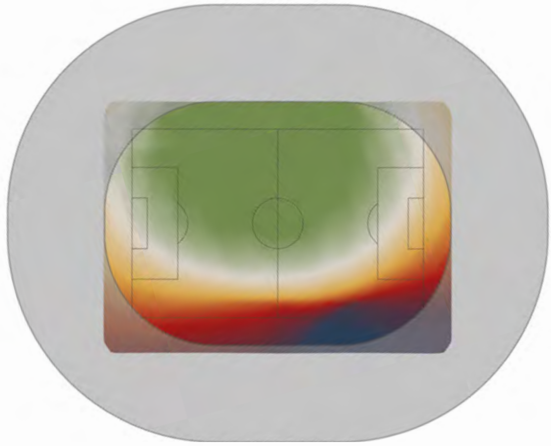
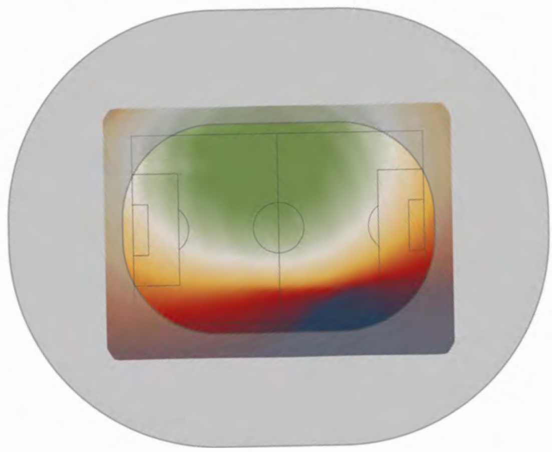


Illustration 150 - Cantilever Drip-Line Angle Principle

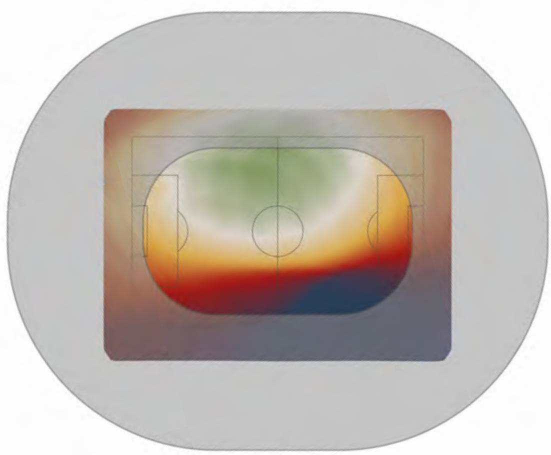
0° drip line
Approx. 16.500 m² roof
Approx. 35,4m span
Average: 1885 Hours
>2000 hours: 53%

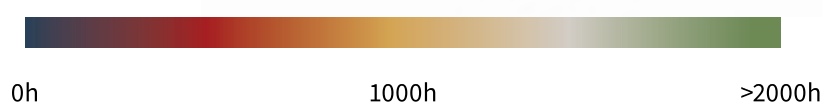


15° drip line
Approx. 18.300 m² roof
Approx. 41,1m spa
Average: 1640 Hours
>2000 hours: 39%



30° drip line
Approx. 20.600 m² roof
Approx. 48,8m span
Average: 1360 Hours
>2000 hours: 23%





Appendix 7 - Structural Calculations

As briefly mentioned earlier regarding the dimensioning of the structure, the optimization tool has some minor problems. Beyond the aspects previously mentioned, the tool also has some issues with the order of the submitted elements. Ideally the process would be able to consider all elements all at once, dimensioning the elements per group, each group with their own library of viable cross-sections. Contrary, the process is then optimizing regardless of element groups meaning that while seeking to optimize all at once, all elements result in the same dimensions not considering some of the elements to be e.g. steel wire, and redefining them as Concrete beams instead. Thirdly it also tends to consider the groups individually, but parallel, producing a new model per element group, with Model A, optimized for Element A, while remaining elements fail and so forth.

Therefore, the most effective way to use the tool is to use it in series, optimizing for one cross-section at a time, moving to the next, and so forth. Also, this process has some implications regarding the submitted order, as the structure should be dimensioned from the top, following the path of the forces. The only problem with that logic is that some of the elements encounter the loads simultaneously, meaning that the overall results will defer according to which order, or prioritizing, the structure is optimized. Therefore, a study has been conducted, considering two different optimization orders, while also analyzing the impact of replacing the roof with either GLT or Steel Elements, while replacing the structural elements with GLT, Steel or Concrete, resulting in 36 combinations, that will be used to access the proper dimensions needed for the final structural design as described in the report.

Load Combinations

	Modification Factors			
Dead Load	1.20	1.00	1.00	1.00
Live Load	0.10	1.50	0.45	0.45
Wind Load	0.10	0.45	1.50	0.45
Snow	0.10	0.10	0.10	1.50

Load combinations applied from Teknisk Ståbi table 4.4 - Resulting Load Combinations for permanent or non-permanent dimensioning cases.

Permanent Dead Loads

The lighting equipment is included as permanent loads, hanging from the roof. With the intention of reusing the current floodlights from the light polygons at Aalborg Portland Park, the load consists of 196 locations, from where a light of approximately 10 kg, hangs. (ArenaVision 2008) (Philips 2025).

Furthermore, the extra mass from the shape of the raker is added to the permanent dead loads, located in the same point loads that will be described with the live loads.

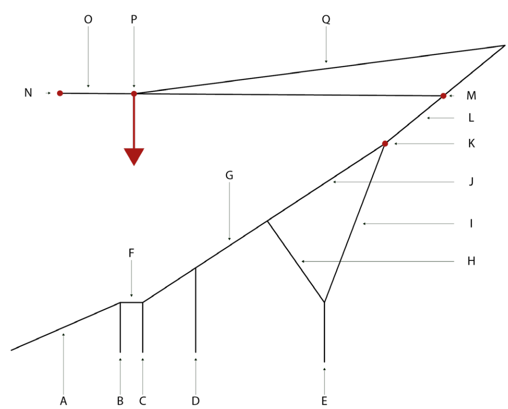
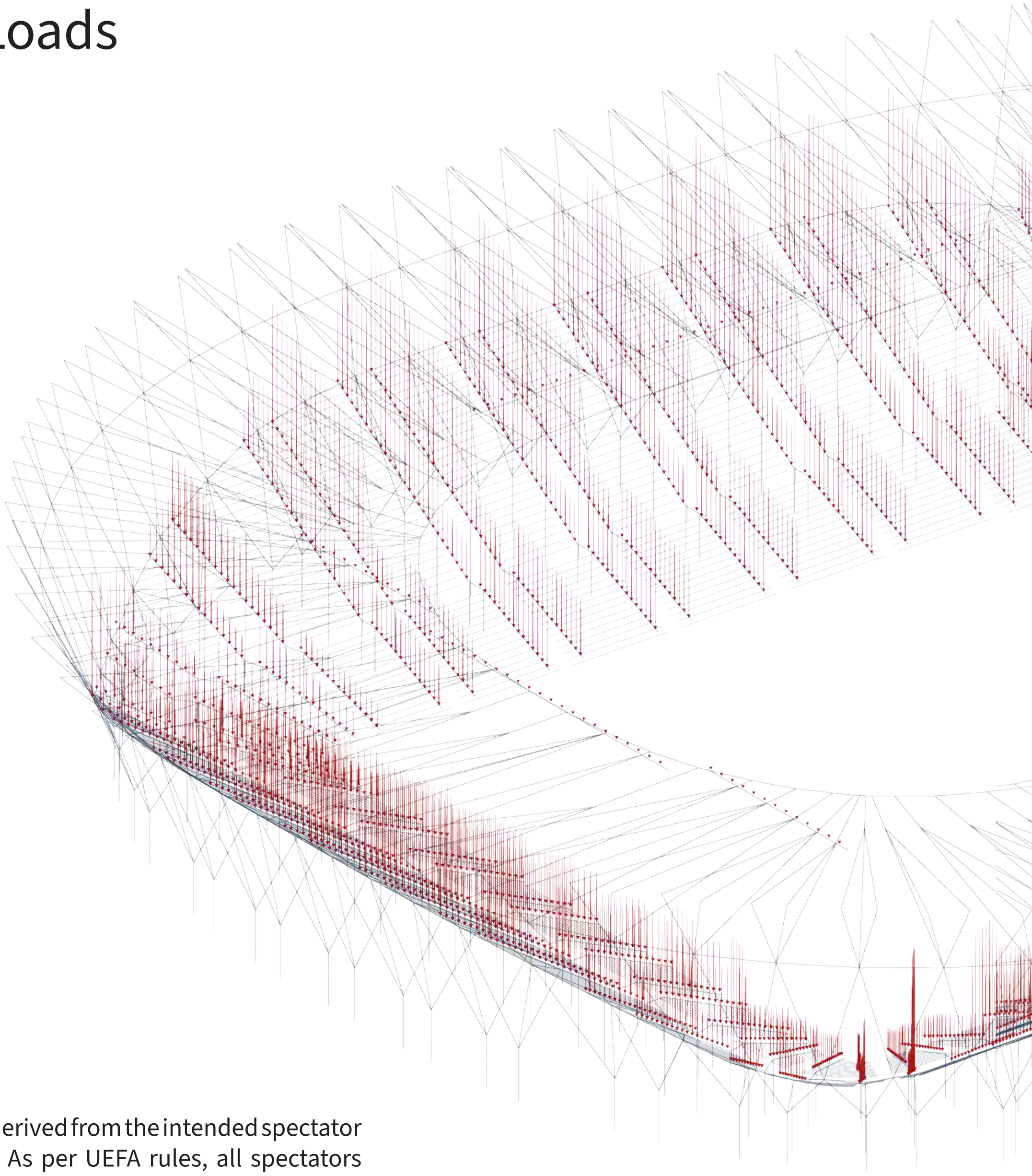
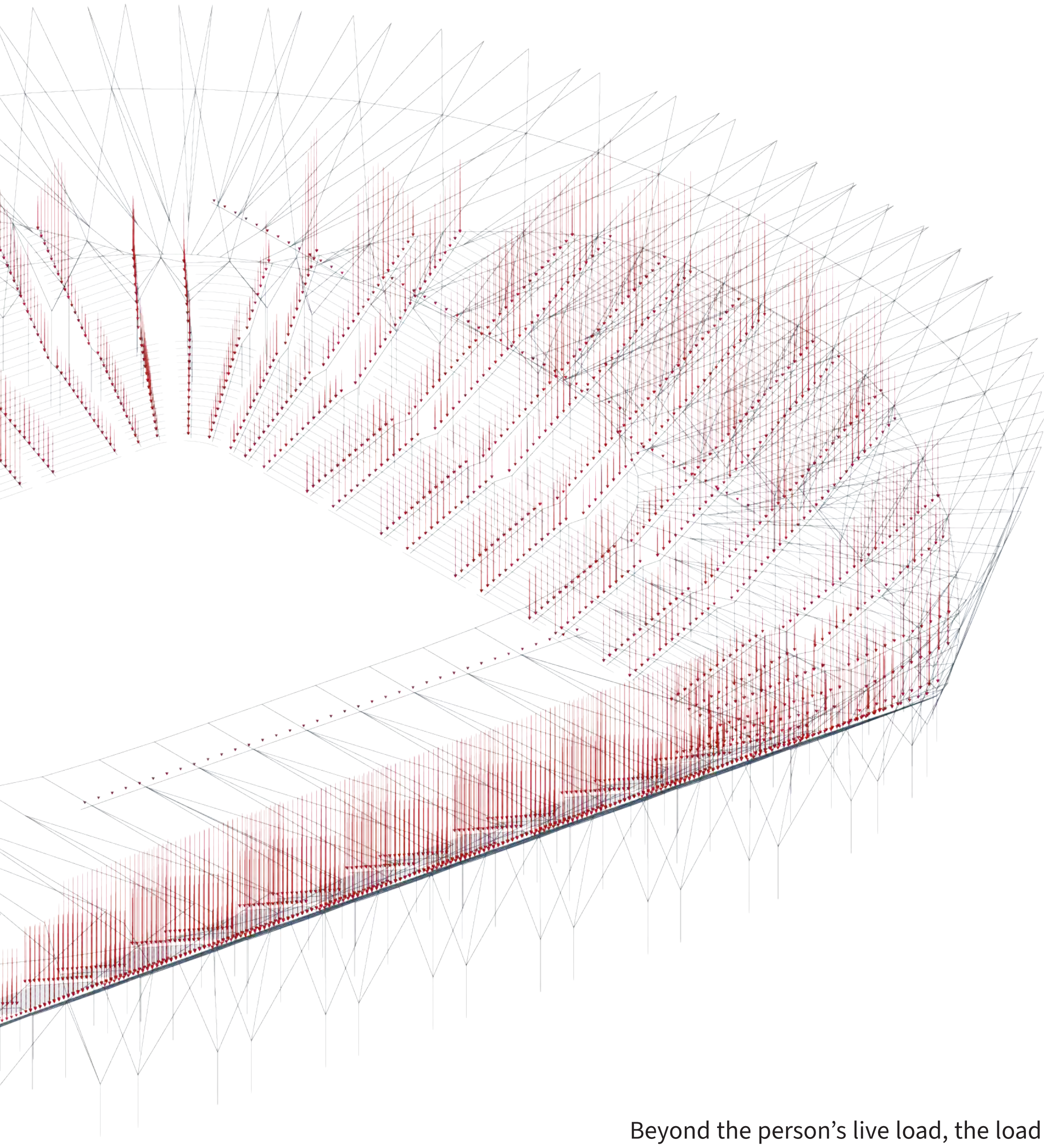


Illustration 151 - Element Labels

Live Loads



Live load is derived from the intended spectator attendance. As per UEFA rules, all spectators must have a designated seating spot, thereby not allowing for standing tickets, whereas in the Danish Superliga, it is permitted. This means that areas such as the western stand could in the most extreme scenario support twice as many spectators as there are seats. Structurally this means that the load increases from 2 to 4 people of 100kg pr. meter of stand elements. There by assuming a linear live load of 4 kN/m. However, the stands also sustain considerable loads from the coordinated jumping during the match, from which the stands can experience a load six times larger than when spectators are sitting (Hansen & Jönsson 1995). Therefore, the applied live load is increased to 24kN/m.

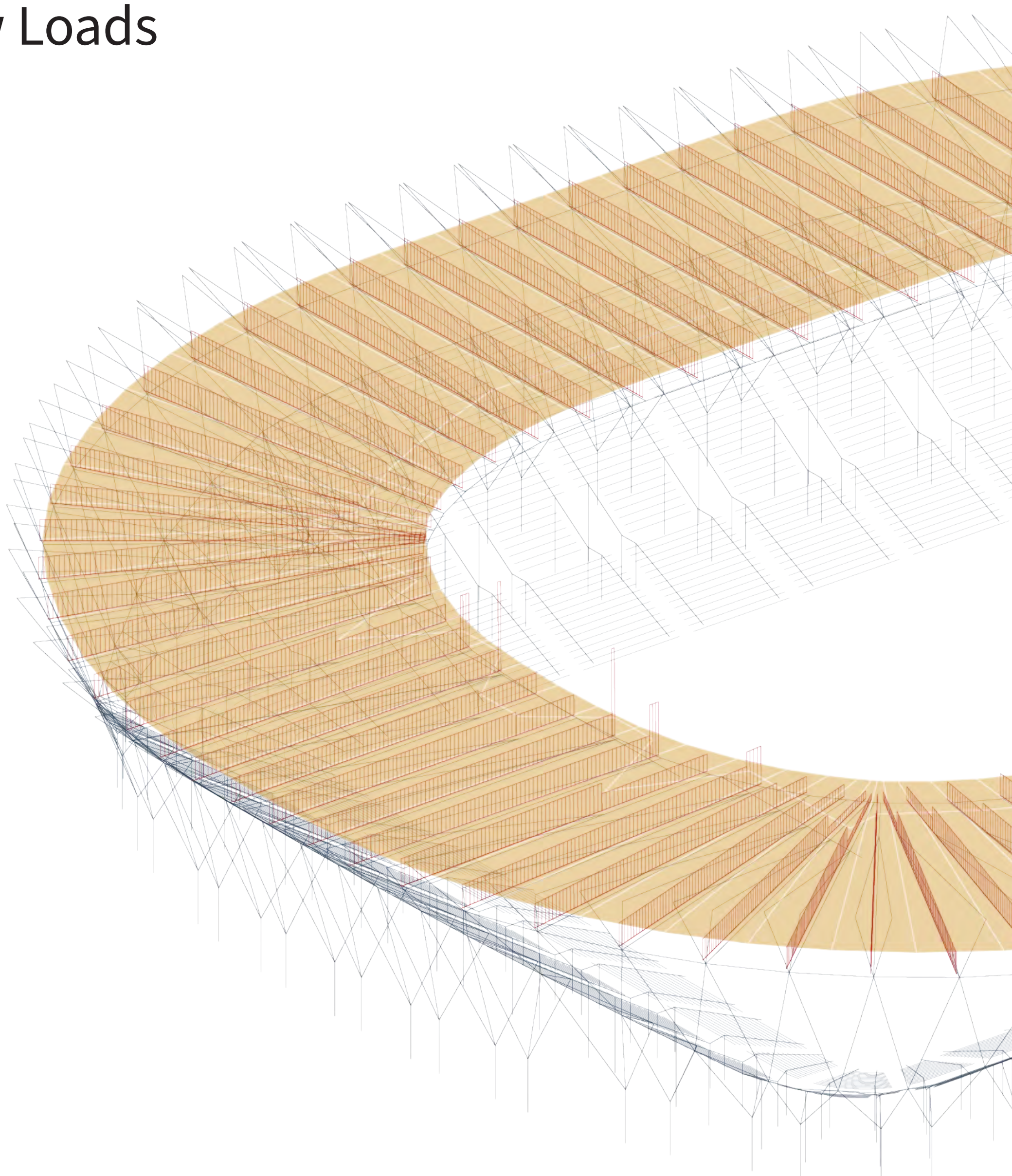


Beyond the person's live load, the load added to the Raker-beam also includes the weight of the stand elements, as well as the not included self-weight of the beams. When simulating upon the raker, it only considers a linear element, with a rectangular profile, whereas the raker terraces, therefore not including the added mass from the steps.

As the stand elements are intended to reuse, it is assumed that the stands currently can sustain such loads, wherefore the linear load is converted to point loads located at the Raker-beam Elements, that supports the stands, thereby carrying the load of the spectators.

Illustration 152 - Karamba Live Loads

Snow Loads



Snow load is applied as an area load, with a pressure of 1kN/m2. Due to the distribution of beams supporting the roof, the roof surface is subdivided into equal, trapezoidal shaped areas, each relative to the supportive beam, thereby insinuating a trapezoidal linear load applied to the elements. This means that the load is largest at the joint, connecting to the façade elements, and lowest at the inner rim connecting all the roof beams. The roof has a small incline, in order to ensure rainwater flow towards the façade rather than the field of play. However, the incline is less than 5 degrees, therefore not having an impact upon the snow load distribution.

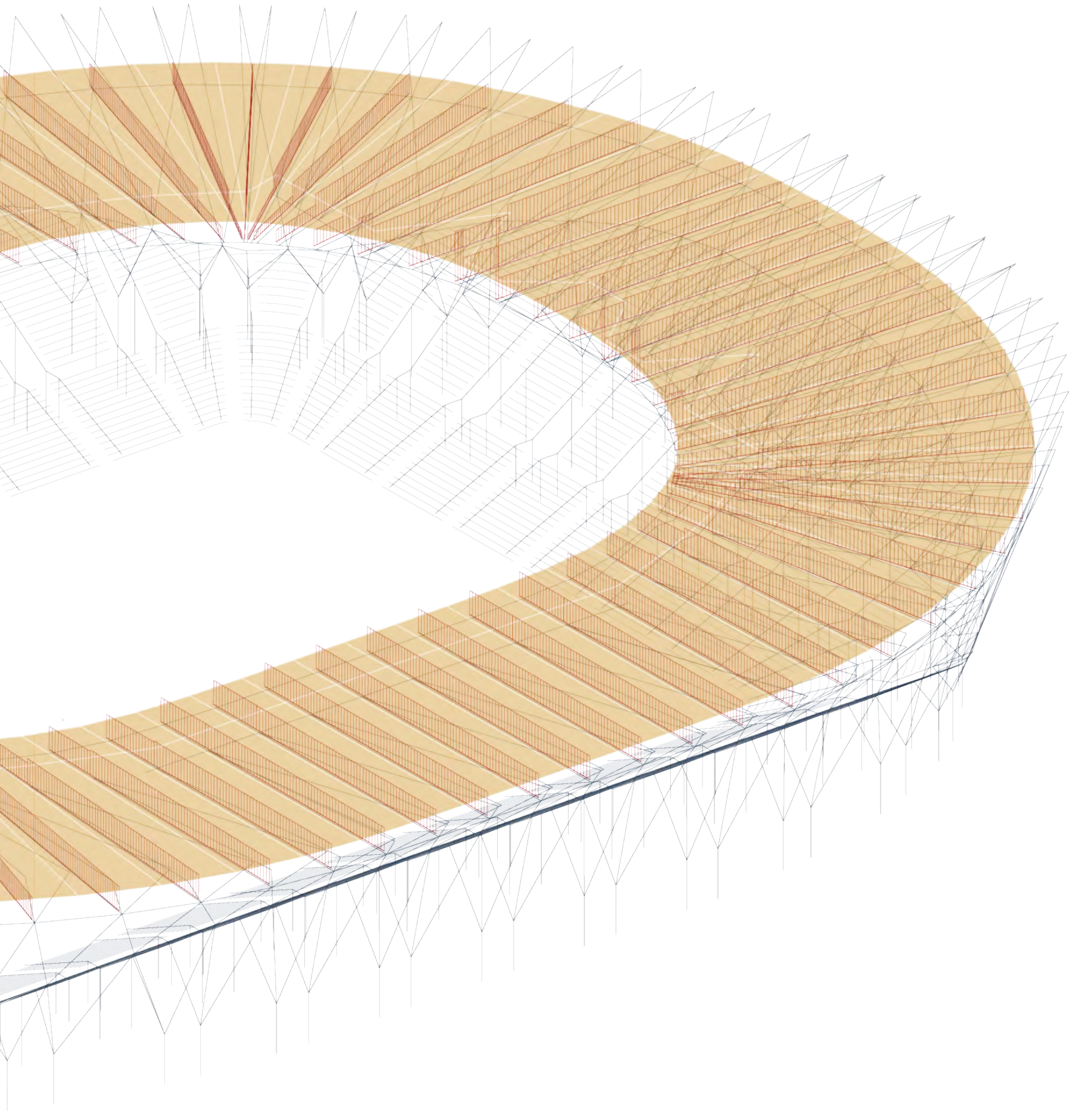
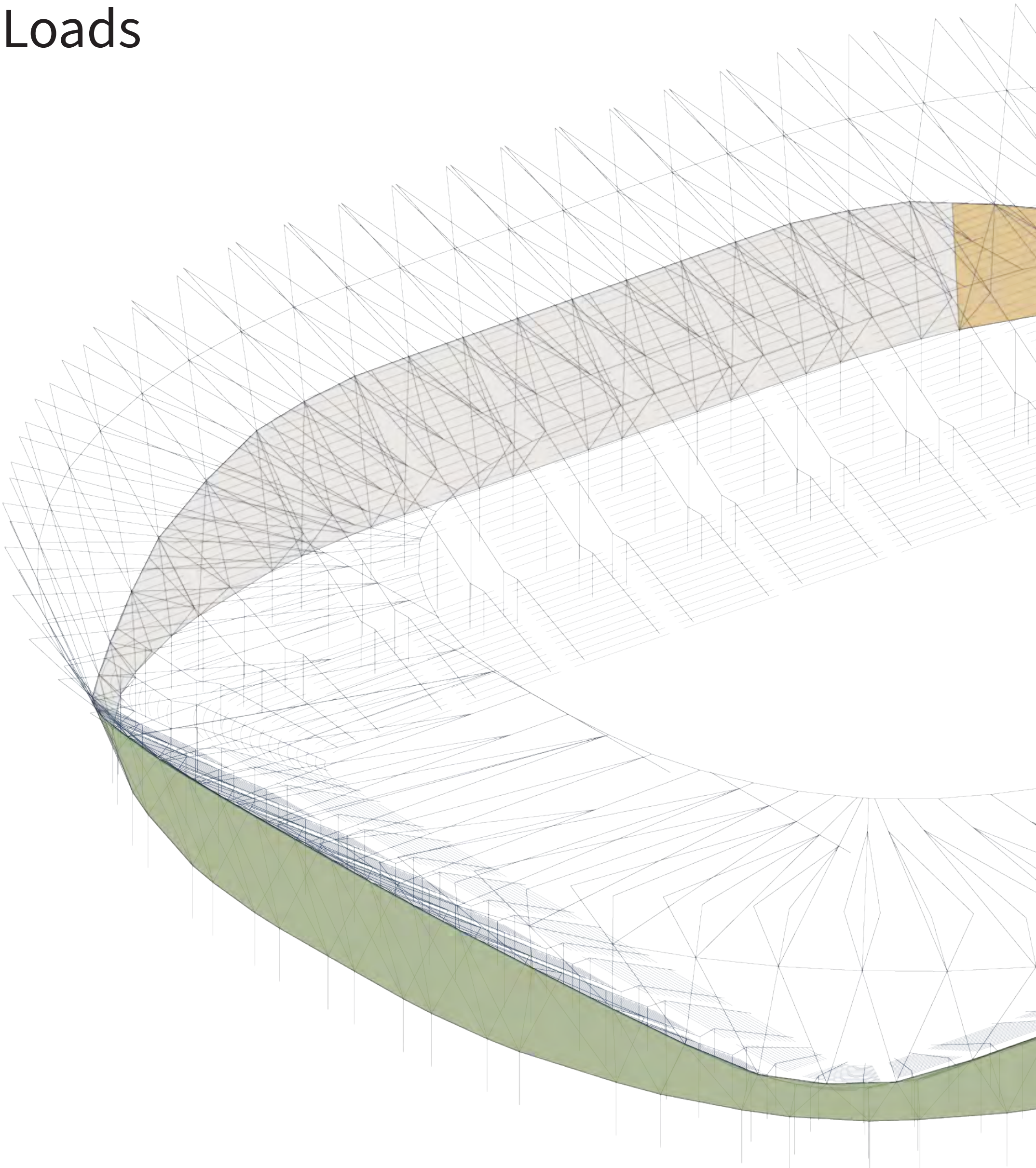


Illustration 153 - Karamba Snow Loads

Wind Loads



The wind data is derived from the most frequent wind-direction, set to 240 degrees (SW). The structure is then split into two segments, based on the areas displayed on illustration xxx, applying wind load at the wind- and leeward sides of the stadium. Having 25% of the façade facing the windward and 25% leeward.

The loads are applied based on the values from (Statikeren 2025) - assuming a boxlike stadium shape, in the LxWxH dimensions of 200mx100mx30m.

Illustration 154 - Karamba Wind Loads

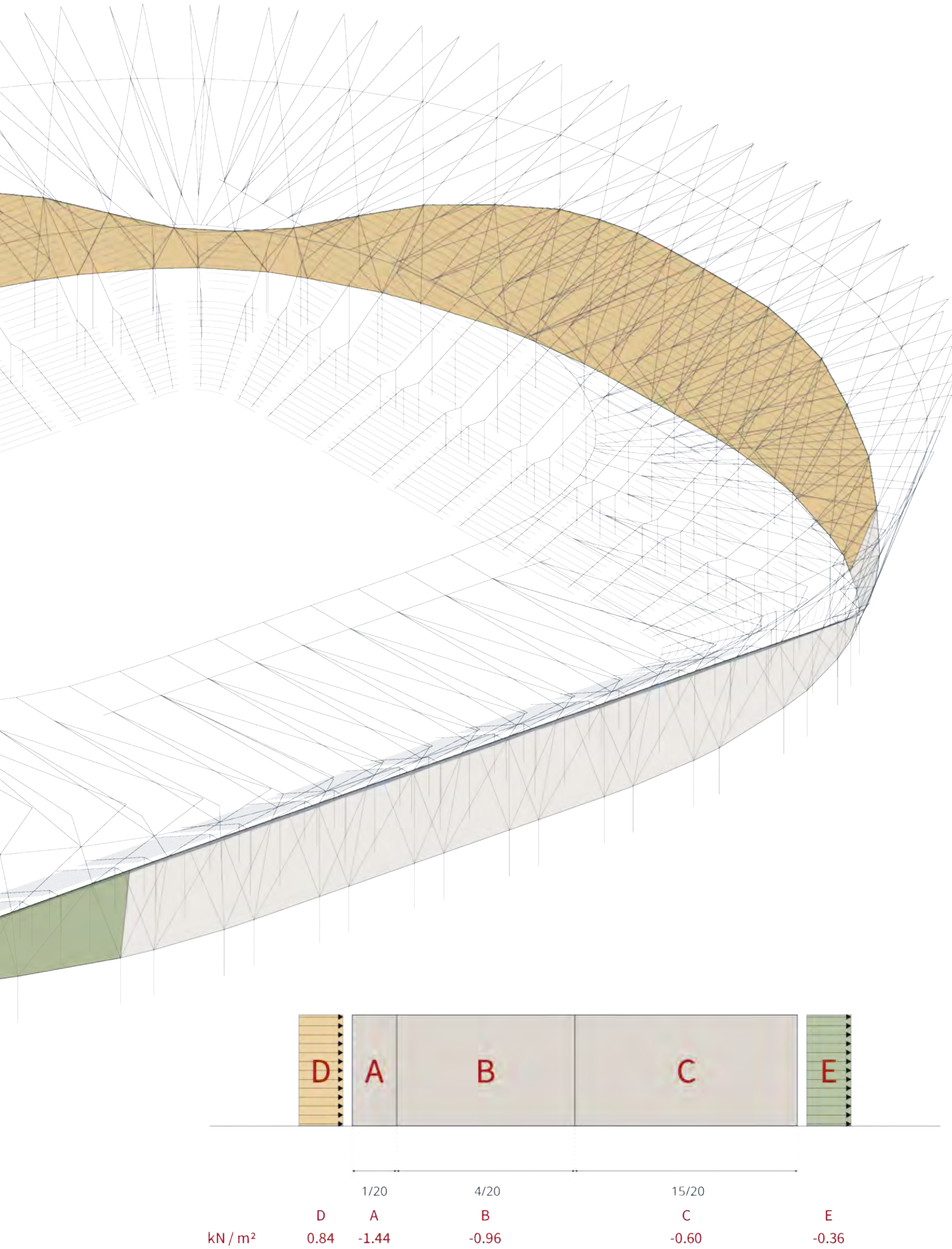


Illustration 155 - Snow load factors

Results

Element Group	Width	Height	Material	Utilization Rate
A	550mm	1550mm	Concrete C50	93%
B	275mm	750mm	Concrete C50	80%
C	400mm	450mm	Concrete C50	78%
D	500mm	650mm	Concrete C50	58%
E	725mm	2150mm	Concrete C50	83%
F	1000mm	150mm	Concrete C50	96%
G	700mm	2050mm	Concrete C50	75%
H	300mm	325mm	Steel 400	84%
I	350mm	450mm	Steel 400	80%
J	50mm	75mm	Steel 400	59%
K	300mm	675mm	Steel 400	65%
L	350mm	900mm	Steel 400	83%
M	275mm	300mm	Steel 400	63%
N	875mm	2550mm	Gl36H	77%
O	900mm	2350mm	Gl36H	87%
P	325mm	400mm	Steel 400	81%
Q	40mm	40mm	Steel 400	51%

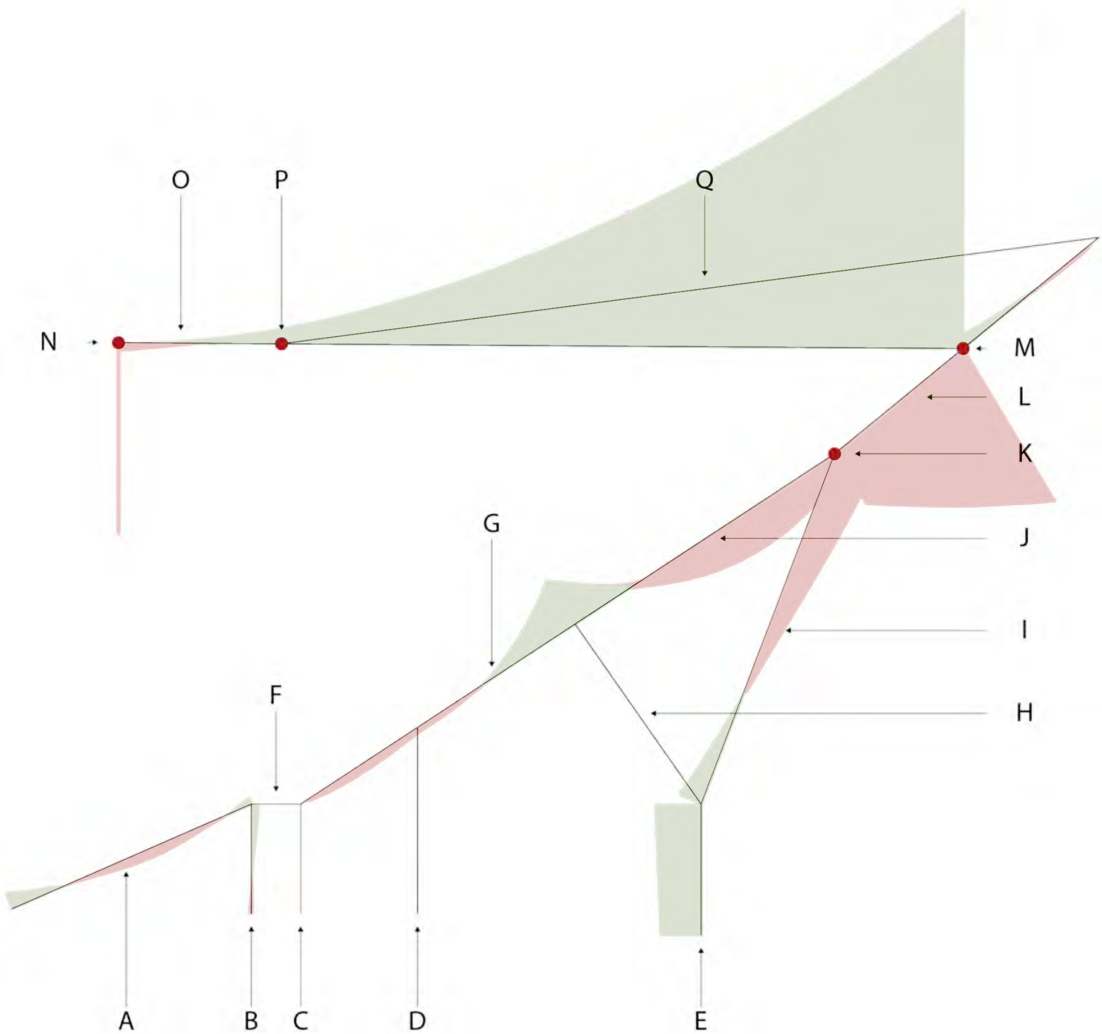


Illustration 156 - Moment Forces

Utilization results

Element Group	Glulam Roof Glulam Structure Steel Extension	Glulam Roof Glulam Structure Glulam Extension
A	101%	107%
B	76%	69%
C	84%	87%
D	33%	40%
E	87%	86%
F	64%	71%
G	83%	83%
H	75%	71%
I	89%	89%
J	86%	84%
K	44%	42%
L	84%	81%
M	33%	39%
N	68%	60%
O	84%	81%
P	58%	56%
Q	56%	73%

Glulam Roof Steel Structure	Steel Roof Steel Structure	Glulam Roof Concrete Structure
102%	52%	90%
65%	97%	67%
62%	104%	69%
41%	37%	50%
89%	85%	85%
61%	162%	59%
83%	39%	83%
83%	73%	72%
99%	86%	85%
80%	154%	84%
53%	34%	43%
82%	74%	79%
63%	162%	10%
89%	143%	33%
89%	65%	81%
76%	185%	20%
59%	84%	82%

Appendix 8 - Toilet and Concession Stands

Based on the program of criteria from FIFA, UEFA and the Danish Division Association, following requirements for toilet facilities and concession stands have been determined. This appendix highlights said requirements and compared to the achieved amounts from the design proposal.

As the buffer section is not a stand-alone section, such as the away zone, the requirements found with this section, to be interpreted as extra needs for adjacent sections, thereby meaning that there are added extra toilets and service points to the away zone, so that the requirements are met regardless of which adjacent section the buffer is supplementing.

The same goes for the family sections connecting to both the ultras section and the general attendance sections.

Ultras - 7315 seats

	Required	Achieved
Concession Serving Points	37	48
Toilets		
Urinals	56	56
Male Sinks	24	24
Male Seating Toilets	24	24
Female Sinks	26	26
Female Seating Toilets	52	48

Families - 1459 seats

	Required
Concession Serving Points	7
Toilets	
Urinals	11
Male Sinks	5
Male Seating Toilets	5
Female Sinks	10
Female Seating Toilets	5

Away - 1611 Seats

	Required	Achieved
Concession Serving Points	14	14
Toilets		
Urinals	12	23
Male Sinks	5	7
Male Seating Toilets	5	14
Female Sinks	12	19
Female Seating Toilets	6	7

General Attendance East - 4232 seats

	Required	Achieved
Concession Serving Points	21	24
Toilets		
Urinals	32	52
Male Sinks	14	16
Male Seating Toilets	14	19
Female Sinks	30	48
Female Seating Toilets	15	26

General Attendance North - 9742 seats

	Required	Achieved
Concession Serving Points	49	60
Toilets		
Urinals	74	88
Male Sinks	32	40
Male Seating Toilets	32	36
Female Sinks	68	72
Female Seating Toilets	34	26

Buffer - 1014 Seats

	Required
Concession Serving Points	5
Toilets	
Urinals	8
Male Sinks	3
Male Seating Toilets	3
Female Sinks	7
Female Seating Toilets	4

Appendix 9 - LCA

This appendix outlines the process, assumptions and results of the Life Cycle Assessment (LCA) conducted for the final design proposal New Portland Park. The LCA was carried out to evaluate the environmental impact of the project across its life cycle along with and evaluation tool in the design process to decide materials and aesthetic choices.

The vision for the implementation of LCA in this project was to make more informed decisions in the design process and use the Danish building regulation demands as a benchmark to see if it's possible to push the barriers for what a sustainable stadium is.

Through the design process the LCA has taken its shape as the design of the stadium became more established. Because the LCA analysis has been in process alongside the design of the stadium itself, it meant that even though the project is complex and advanced, it became more manageable to map all the different constructions along the way.

At the beginning, some of the assumptions about designing a stadium were that the main construction would be made entirely of reinforced concrete and steel and that stadiums structures are so enormous and consume so much material that they cannot be sustainable. Therefore, it was important in the process to investigate if it was possible to create the structural system from as much wood as possible

As seen on illustration 069 and 070 on pages 80-81, the structure made entirely of wood, surprisingly didn't score the lowest total GWP, something that might be confusing when only looking at the LCA analysis, but comparing it with the structural calculations and total material use, it becomes clear that the amount of material used in a wood construction is around 60% larger compared to a construction made from both steel and wood. And therefore, influencing the LCA analysis and making a mixed construction the best choice.

The LCA indicates that the most significant environmental impacts stem from the long-term operation energy use and the waste processing phase. The reason for the high C3 GWP is because of the amount of glue laminated timber (GLULAM) being used in the roof construction. These findings highlight the importance of design strategies that focus on passive design, renewable energy systems such as solar panels and material efficiency.

	GWP [kg CO_2-eq/m²/year]
Building	1,196e+01
└*Additional climate impact cf. § 298*	7,938e-01
Operational	4,434e+00
└*Additional climate impact cf. § 298*	7,938e-01
Elements	7,525e+00
Other	1,054e+00
Other	1,054e+00
New chairs	1,054e+00
Floor decks	9,008e-01
Floor deck	6,006e-01
Concrete circulation plateau	7,202e-01
Floor slab VIP Building	-1,197e-01
Floor	8,824e-02
Floor Player & Officials	8,824e-02
Basement floor deck	2,120e-01
Concrete slab parking cellar	2,120e-01
Electrical installations	7,009e-01
Energy production	7,009e-01
Solar panels	7,009e-01
Internal walls	5,347e-02
Non-load-bearing walls	5,347e-02
VIP Building Interior walls	5,347e-02
Columns and beams	3,323e+00
Other (columns and beams)	2,819e+00
Structural beams and Trusses	2,819e+00
Beams	5,045e-01
Concrete stands	4,163e-01
Stairs on the stands	8,824e-02
Roofs	6,103e-01
Ceiling	6,661e-02
Ceilling VIP building	6,661e-02
Roofs	5,437e-01
Roof Cladding	5,231e-01
Roof construction VIP Building	2,059e-02
Stairs and ramps	2,311e-02
Stairs and ramps	2,311e-02
Stairs in VIP	2,542e-03
Stairs down to toilets	2,057e-02
Windows, doors, glazing systems	1,825e-01
Windows	1,825e-01
Windows South facade	7,422e-02
Windows facing the pitch - Reused windows	1,083e-01
External walls	6,763e-01
External walls	6,763e-01
ETFE facade cladding	4,084e-01
Concession stands	8,905e-02
Toilet basement	1,788e-01

Illustration 157 - LCA Definitions