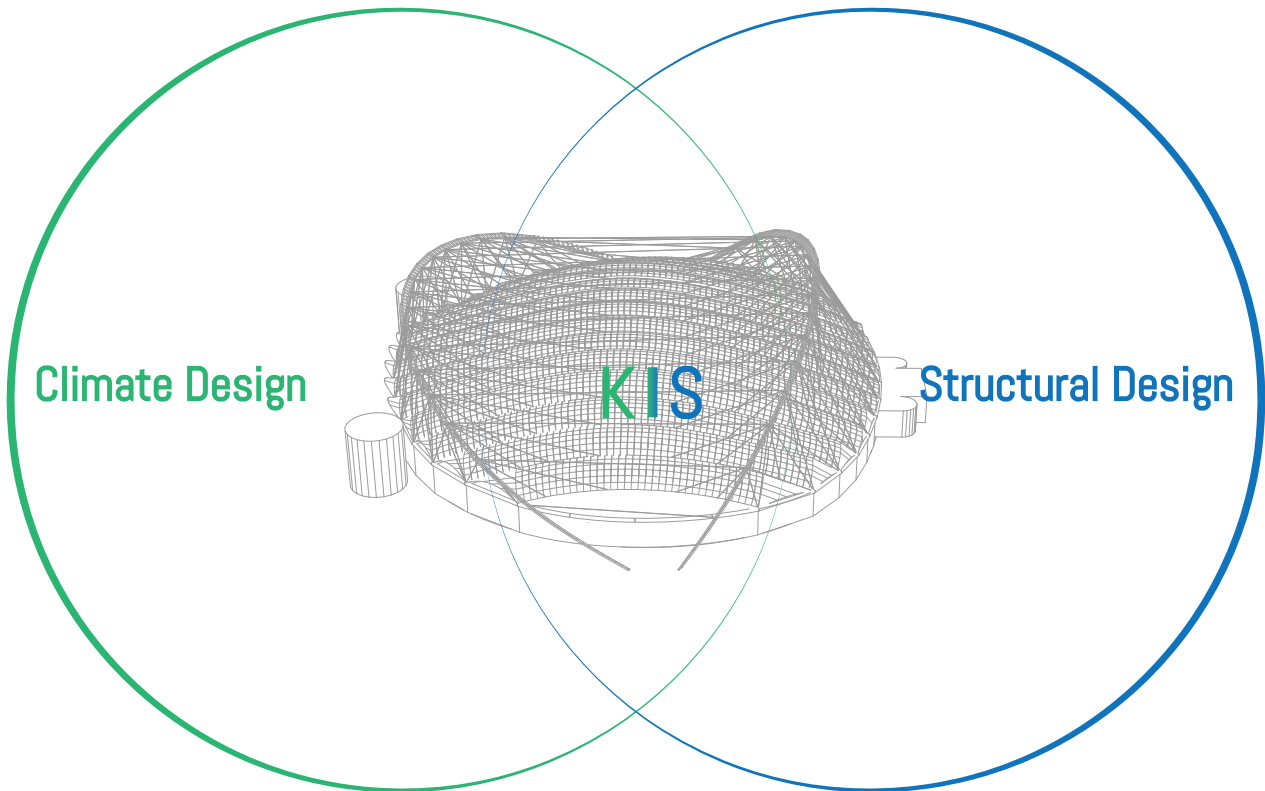


10. REFLECTION

The roof design of the Khalifa International Stadium (KIS) is a final product of comprehensive climate research and analyses which are decisive to how the roof structure is researched, analysed and designed. The climate design gained its input from adaptability, meaning that the climate context was determinative to what the design would have to conquer. On the other hand, the structural design gained its input from geometries and properties of the climate design. This makes the climate design a product of design by research/context and the structural design a product of research by design. With this approach called parametric design and engineering, the design could be optimally integrated (see figure below).



Academically:

Looking at the graduation lab theme of MSc Building Technology: Sustainable Design Graduation, the approach of designing a maximum transparent climate roof in Qatar is a challenge where sustainability and innovation are of great importance. Only with use of new sustainable and energy efficient analysis techniques and building technologies it is possible to design a maximum transparent roof that is cooling at the same time.

The first chosen design and analysis methodology was to first design all the needed climate aspects and afterwards design the whole structure. However, if the climate and the structural design/analysis have constant interaction, the final design would be more integrated. This resulted in a methodology where the influence of the wind decided the final form of the primary steel structure and the influence of lighting and heating decided the final form of the secondary glass structure. Which created a final structural supported climated design and a climate supported structural design. This final methodology fitted, in my opinion, well in the approach of the Sustainable Design Graduation Studio. Which is doing research by design, design by research or combining them to come to a suitable and sustainable solution in the architectural, design, engineering and technology practice.

Socially:

The social context of the design is the most critical point of the graduation project. The 2022 World Championship of Qatar is controversial, because of its extreme climate and poor labour conditions. The reason why Qatar is a good location to implement such a roof design, is to create awareness on what is possible in the fields of sustainability in such extreme climate conditions. Nevertheless, the disabuse of labour is something that cannot be justified, but unfortunately this is not the main focus in the field of building technology.

Practically:

The overall design, analysis and engineering approach resulted in a complex but interesting design on the fields of structure and climate. In the future to make the design more reliable, it would be more sufficient to do next to parametric computer calculations also physical tests in every discipline. The early stage Rhinoceros+Grasshopper analyses gave insight in the multiple design solutions of climate adaptive structural design. However, to test the real feasibility of certain design solutions, the climate situation has to be modelled and tested with actual climate measurement tools and the innovative structural materials tested to a material science level. The reason why physical tests always have to be conducted next to computer driven analyses, is to foresee unpredictable uncertainties. However, due to lack of time and people in relation to knowledge during this graduation project, the only physical test that was conducted: was the wind tunnel test. There were two reasons why the wind was tested physically: the first reason is that the wind is the most important factor of the design and the second reason was to determine the fluctuation of air movement, which you cannot predict with a CFD analysis. Next to the fact that physical tests are needed to determine the verity of the Rhino+Grasshopper analysis, it is very interesting to see what one individual can achieve with the help of parametricism (algorithmic aided parametric design and engineering). Parametricism will make the future of building will be more efficient, smarter, faster and less divided. In the end, designing such a large and complex object is too complicated to be conducted by one person and should be always elaborated by a team. However, this process was very instructive on what is most valueable in terms of stadium design and engineering. Resulting in knowledge and understanding of certain tools, where, as a building technologist, I will be able speak the designer's and the engineer's language.