P3 Reflection

Daniella Naous 4290038

In beginning the topic has been chosen out of passion, interest and goals to learn more in this field. By P2 it was evident that the plan was over ambitious and unrealistic to achieve within the limited time the thesis needs to be completed within. Therefore, the goals had to be adjusted to a procedure excluding any comparisons between different designs or TO software. Throughout the process, I was confronted with a lot of challenges. One would think that the most difficult thing in this thesis is engineering glass and structurally validating a shell structure. Engineering glass is indeed challenging, but to my surprise the number one challenge was meshing and sculpting the model in a controllable way. The mesh models were, more often than desired, not able to be read, mesh, or process by Ansys for analyses or topology optimization. So, I have not been able to structurally verify a lot of different models. I ended up learning more about the strengths of software what about structural mechanics after P2. I learned a bit of linear algebra that explained how computational geometry is represented and modeled. This explained why a certain geometry might look ok for the naked eye but is algorithmically ill defined as a computational geometry. After understating a bit of the logic behind computational geometries, I was able to overcome most glitches that were occurring throughout the procedure. I'm happy to say that by now I am more than ever confident with my skills in grasshopper Maya Auto desk and Rhino. Other tools like mesh mixer and Lumion where interesting to experiment with and useful for rendering and sculpting. For example, I learned that rhino is powerful in handling NURBS but is not very handy when working with complex meshes. Maya is better equipped at editing meshes. This was important to have an accurately meshed shell, with a uniform thickness, subdivided into layers for TO, and with a clean trim at the bottom for the foundations. These were design informatics challenges, that caused a long delay in my progress, but I had happily overcome them with a wide set of computational skills that I would never have had the chance to practice without encountering these challenges.

As usual, software are tools, they are not our intellect, cognitive power, or creative mind. I learned that if after a reasonable amount of computational trials my mesh was not processed enough to be usable, I should start thinking of primitive alternative ways for TO. Cutting wholes in hanging waxed cloth was one idea. Another Idea was using actual clay. I did not need to resolve to these methods eventually, but I was happy to realize that I can always use common sense to achieve my goal regardless of the available means. Perhaps using primitive tools would not lead to legal structural verification of the model, but it would surely proof that I understand the engineering principles behind the design. This applies to interpreting the finite element analyses results. The software provides numbers and a color scheme that looks nice, but what does it really mean? I wanted to delve into the requirements and be able to discern whether a certain amount of deflection is acceptable of not. I wanted to be able to execute judgment regarding the level of stress in this design. Can these stresses be handled by this material given the dimensions? Is the model safe or over dimensioned? I have enjoyed further developing my skill of analyses assessment. The results generated by the software mean nothing without the keen knowledge and experience of an engineer. Hopefully my future career would give me the opportunity to further develop my experience and skill. I have way much more to learn, but I'm happy with where I am now at for the time being.

One challenge that I have faced is creating one model that is ideal for all purposes. I have realized that a model for rendering might need to be slightly different that the one for FEA. The reason is that the model for rendering and later on additive manufacturing of mould can be more complex in

shape and organic than that for FEA. FEA is sensitive to any nonlinearity, non-manifold, overlap, or misconnection that the model should be simplified enough to ensure a smooth FEA run. This means again that an engineer's eye is needed to judge whether an alteration in the design would be within the margins of the structurally validated simplified model or not. Therefore, the procedure was as follows. The shell was topologically optimized. This result was too complicated to run through FEA. Therefore, a simplified shell with ecliptic wholes was created under inspiration from the TO result of the first shell. This simplified shell with TO ecliptic wholes was topologically optimized again. The result inspired me to know where the thickest ribs should be located. The final result was manually drawn indicating the shape, and with color codes the variation in thicknesses. This means that I needed to be modest and realize that for a MSc thesis I do not have the time to structurally verify the final model using FEA. However, this meant that I needed to be creative and rely on my understanding of deflections, and stresses shown in previous simplified versions of the model.

I have also experienced the vitality of organization, file naming, time management, multi-scenario-based procedure flowcharts, backup, and general planning. At times creating a flowchart with all the probable solutions was handy to make sure that all possibilities have been tested. Going back the literature review and design criteria helped me stay in check with the requirements. Dealing with frustration of lost VPN connection midway through a 16-hour long iteration simulation is just part of the job. Take a deep breath then restart the optimization, meshing or analyses procedure anew.

At times I got stuck for days in something, but as soon as I reached out to an expert in the field, I received a solution within minutes. Sometimes, emailing, posting a question on an online forum, or just paying someone an office visit was all the shortcut to the solution I needed. I have experienced the truth of the following words: "Knock and you will be answered, ask and you will be given." It made me realize that complex projects are possible at engineering firms because they work in teams. There is always someone who can help, inspire, or provide a new perspective. Now it is the time for me to proof that I am adequate to work independently, and I am confident that I can. However, I look forward to work in a team where everyone helps each other, brainstorm together at times, share knowledge and experience. Teamwork is also healthy for moral support and encouragement that we have surely missed during the corona virus social distancing experience. One should not be too proud to ask for help or think that he/she can do everything on his/her own. After graduating I will be an adequate, and confident engineer, but I do not want to be a presumptuous, haughty, or overconfident one that thinks to know everything. Nobody knows everything, and we can always learn something new. Modesty is a beautiful quality to have in balance with confidence.

I hereby would like to seize the opportunity to thank my wonderful supervisors, for their insightful and knowledgeable feedback, constructive criticism and support. Faidra Oikonomopoulou's knowledge and experience with glass was very informative inspiring and useful. She did not hesitate to connect us with her network of expertise around the world for extra consultation. Marcel Bilow's focus on adaptability regarding the procedure was liberating. His focus on practical production and assembly will definitely be of practical use in the upcoming stages. Thanks to Paul de Ruiter who, even though is not my supervisor, was willing to help me with Autodesk Maya. F. Oikonomopoulou and M. Bilow, are very encouraging and supportive morally as well, which was encouraging for me to keep up the pace even when facing challenges. Both Faidra and Marcel really want us to succeed and learn the most from our experience and this is evident in their word and action.

Sincerely,

Daniella Naous