Assignment 2				
Team name	Leena and Michael	Reviewer team name		
Name #1	Leena Khan	Reviewers #1	Matt Bousche	
Name #2	Michael Luchini	Reviewer #2	Sara Denner	
LAB DATE	THUR			

## Short Description of Design

Our design was made to do something that is resourceful to one of us. Michael is an avid biker, and thought it would be fine to make a water bottle holder for all his adventures. The design is dimensioned to fit Michael's water bottle, which is a 750 mL CamelBack Eddy. The design also has a slot in the back of the water bottle holder that is able to help attach the holder to a bike. This slot was made to be a long oval shape so there will be minimal warping and overhangs that can be caused when 3D printing a circle.

#### Lattice approach

We used nTop as our latticing software. When creating our lattices, our primary focus was selecting a pattern that was able to be structurally sound while only filling in our 3mm thick part walls. This turned out to be more difficult than expected, as the combination of thinness and curviness of the lattice eliminated almost all options. We decided to use a TPMS pattern with a scale size of seven. This choice formed a functional and aesthetically appealing lattice.





## Figure 3: Angled view of water bottle holder

The first iteration of our part served as a means of examining the structure and functionality of the part. The original design turned out mostly as expected. The part functions as designed, although a printing error caused it to be slightly larger than intended.

This iteration allowed us to determine weak and strong points in the physical structure, so we could decide exactly where a lattice would be necessary and possible.

The only problem we noticed, besides the scaling issue, is the low resolution of the part. This can be easily fixed by downloading a higher resolution STL final for the final version.

# Iteration 1 Cost and time. How much material and how long did the print take? How many prints did you do before lab? If the part was originally solid (i.e., no in-fill) what would the weight be before and after lattice

FDM Print: Time: 6hrs and 8mins Material: 19.66 m Weight: 58.64 g Cost: \$1.47

## What feedback did you get from your peers?

- Chord height make it small for cleaner print
- Keep an outline of the frame and lattice inside the frame
- Size reduction
- Fix lopsided stand
- Make stand bigger
  - Reduce material by making it hollow





Figure 6: Water bottle holder attached to bike

More material can likely be removed from the area where the bottle holder is attached to the bicycle as well as the back side of the part, but an excess is left because we are unsure of the strength that it will require during use. In the next iteration, the design would be more focused on having less and more effective supports added before printing. The benefits of this include saving material, easier post-processing and a generally smoother finish. This could potentially be achieved by having a different lattice than used in the current iteration. A second design change that can be made is making the bottle holder itself smaller, so that there can be a tighter fit for different types of water bottles for different users.

#### What build direction did you pick and why?

The build direction for the part was so that the part itself can have a lot of material removed and replaced with a lattice structure. Supports were necessary for the build direction that was taken, but the supports that were automatically generated by the software were excessive. Many of the supports were removed to leave only the supports that were desired.

#### How did you optimize the part for supports?

The part designed did need supports for connecting the raft to the lower edge of the bottle

holder because of the steep angle in the design. The steep angle is considered to be an overhang, but it was designed in order to have an angle less than 45°. Supports are used in all iterations to have the print be more of a complete cylinder, rather than a cylinder that has a lot of overhangs and geometry.

For doing the second iteration of the bottle holder, PreForm's automated supports were excessive. Some supports were removed, but many were needed to account for minima.

#### How did you reduce the weight as much as possible?

Material reduction was thought of in the design, but as the first draft was printed, the thought of material reduction was not executed. When designing the first iteration, it did not seem necessary to reduce the material until after the print was completed because of material reduction that comes along from the lattice structures. For the second iteration, where the lattices get incorporated, less material is being used just because of the lattice structure. More material is still being used than expected in the lattice structure, only because how close together the lattice is designed.

Team: Process settings and materials			
FDM Print Settings:SLA FLayer Height: .18 mmLayerPerimeter Shell: 2Fill DFill Density: 15%MaterFill Pattern: HexagonFill Pattern: HexagonPrint Speed: 60mm/sTravel Speed: 80mm/sRight Extruder: 200 °CPlatform: 50 °C	Print Settings: Height: .3mm ensity: Solid ial: Draft 1		

## Team: what did you learn

This project was more time consuming than the last, because of the lack of resources that are available for creating lattices in different softwares. The first software used to create the lattice was Creo, but the resources for creating a lattice structure were not helpful due to the lack of material on creating a lattice on a cylindrical surface. The program that was able to properly create a lattice structure ended up being NTopology, which was the program recommended to use. The nTop software is relatively new, that has minimal resources as to how to properly

make the lattice structure. With the help of Professor Thorton's demos, the lattice structure was able to be completed on nTop, but the next issue was the method on saving the part. In order to save the part, we opted to export three separate STL files and combined them using mesh mixer.