

# Reusable Crates for STATCOM Converter Modules

Siemens Energy



## PROBLEM STATEMENT

- Siemens Energy ships Converter Modules in groups of six with a connected DC capacitor
- Current shipping crates are not designed for reuse, leading to increased costs and environmental impacts as well as more labor time.
- Project goal was to design and develop a reusable crate for transporting STATCOM Converter Modules
  - Be manufactured using recycled materials where possible
  - Ensure safe and secure transport
  - Be easily reusable
  - Contribute to reduced shipping costs and a more sustainable supply chain
  - Reduce labor time in assembling and disassembling.

#	Description
1	Reusable to limit waste and save on costs
2	Foldable/ removable walls for easier shipping
3	Forklift and crane accessible
4	Durable for shipping, stacking, and transferring

## CONCEPTS

- Our team began by creating sketches of each of our designs
- Made a concept matrix based on the requirements and narrowed it down to two designs
- Once the designs were finished, 3D models were made based on the size of the previous crates and the STATCOM converter modules
- Created a material matrix based on durability, cost, and availability
- Once a material was chosen, FEA was run on both designs to ensure they would be durable enough for shipping, stacking, and lifting
- Parts were redesigned until they had a factor of safety of at least 2
- Once the parts passed testing, clips were developed for the removable wall crate
- Testing was done using FEA then began printing and milling both designs

## FINAL DESIGN, APPROACH, PLAN

- Our team decided on two different final designs
- The first design consists of a box that has removable walls and clips for easy removal and assembly
- The first design was made from aluminum except for the clips which were 3D printed.
- The second design folds in and is attached by hinges
- The second design was 3D printed

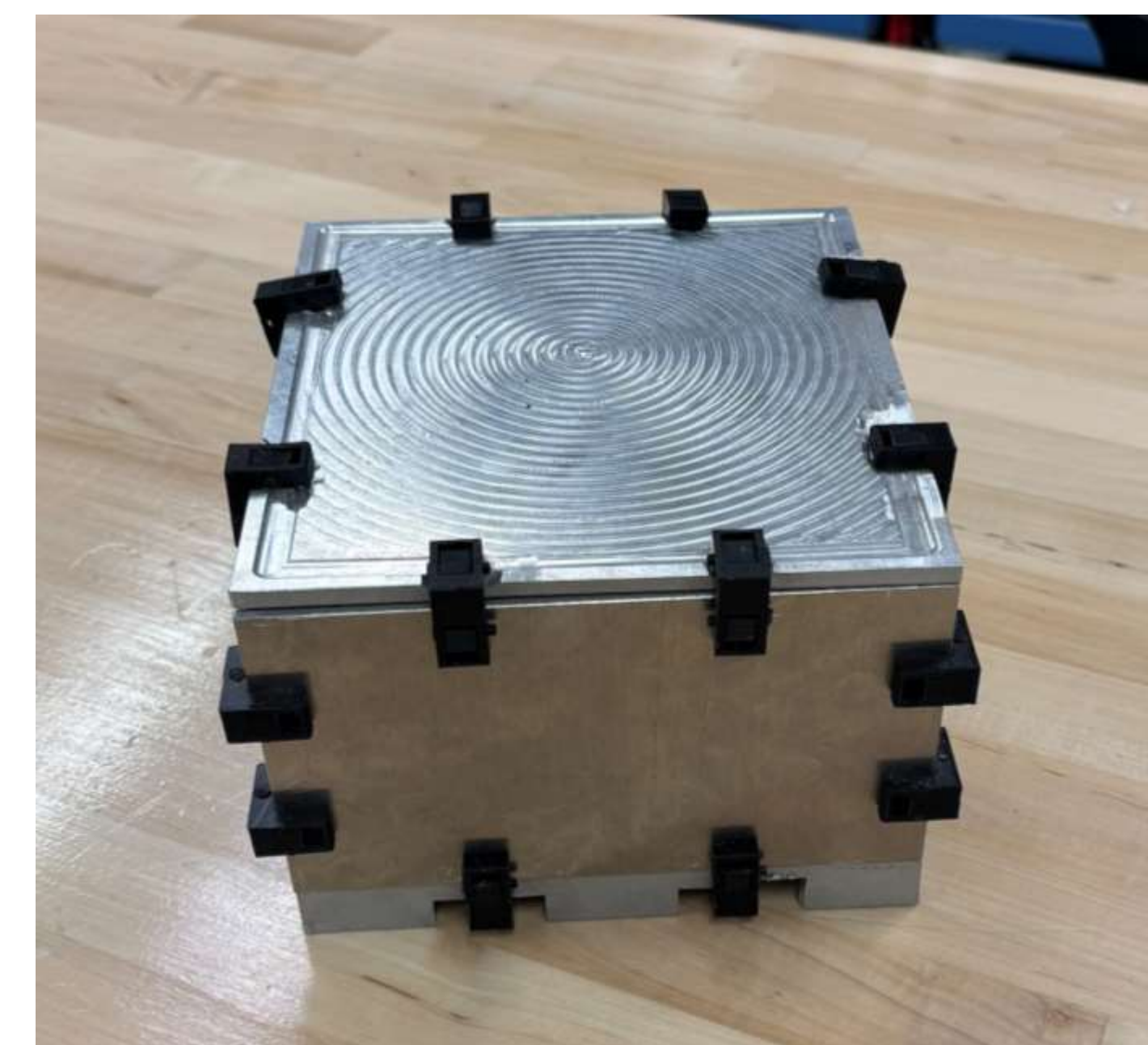


Photo Caption: Design 1, Removable walls, held together by clips. Made from Aluminum and clips 3D printed. Scaled 1:12



Photo Caption: Design 2, Foldable inward and outward. Made from HDPE. Scaled 1:12

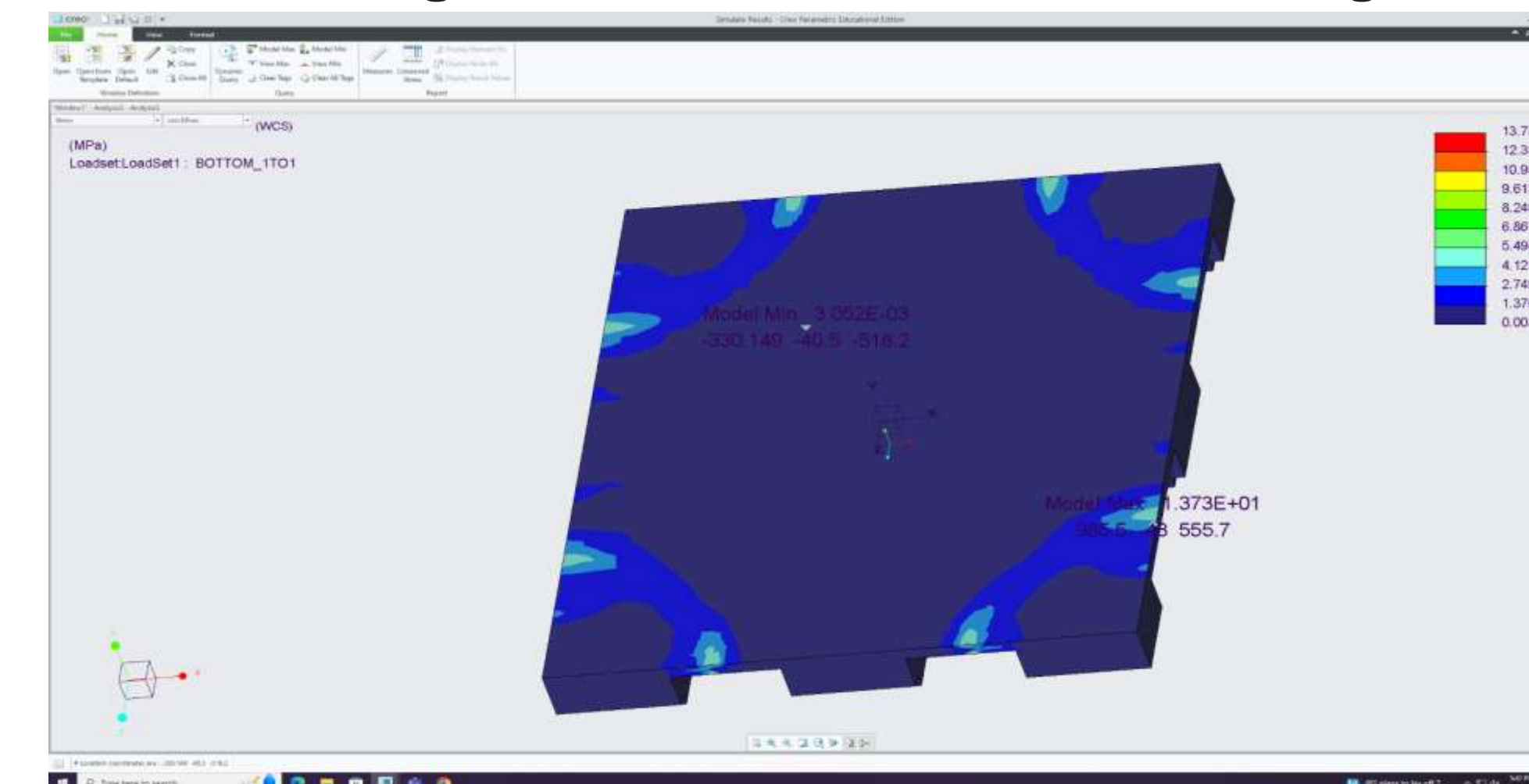


Photo Caption: Design 2, Foldable inward and outward. Made from HDPE. Scaled 1:12

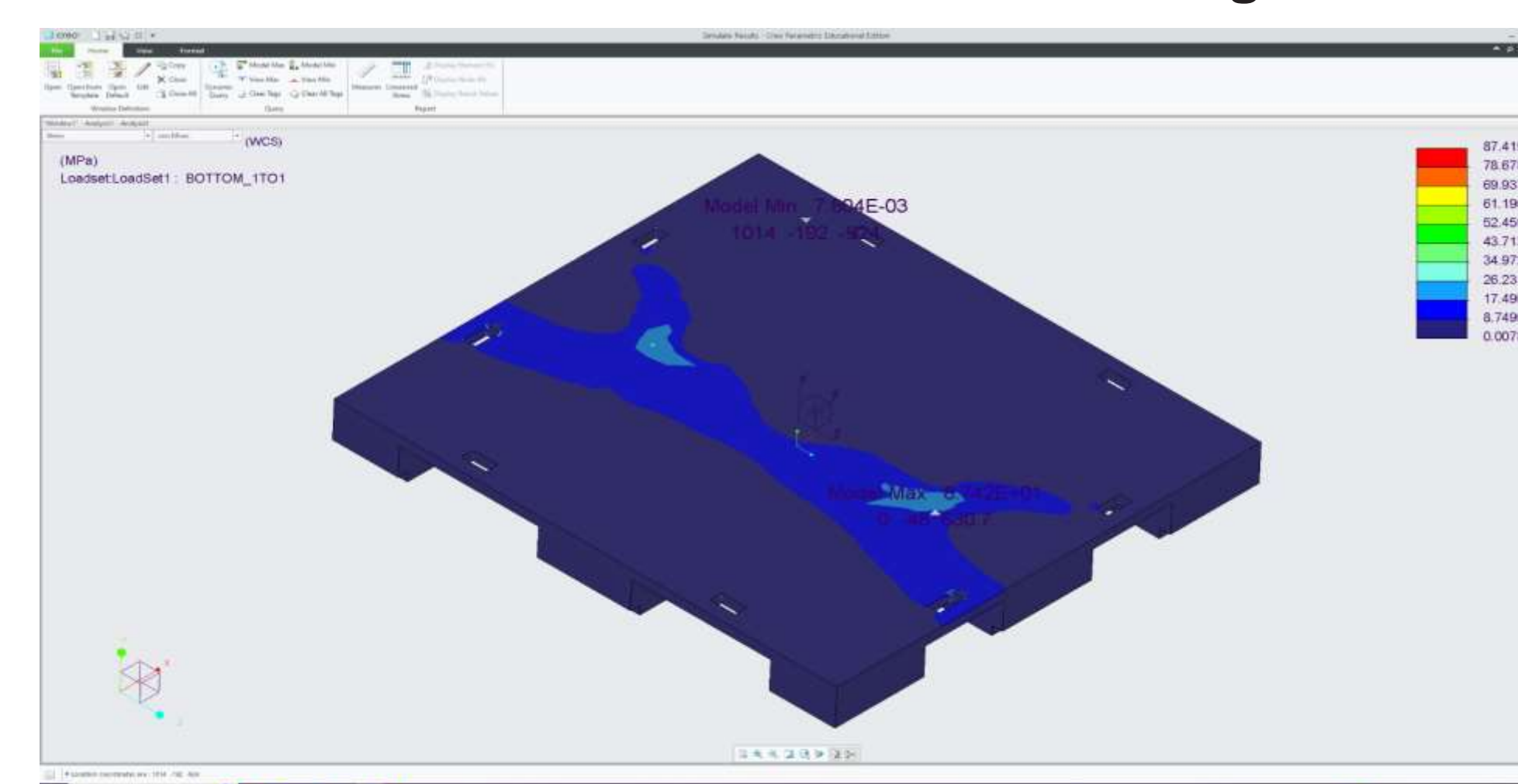
## RESULTS

- To test our prototypes, FEA was performed on all parts
- Our team calculated weight and forces for stacking, forklifting, crane lifting, and shifting of the crates
- All our parts passed with a factor of safety of 2 or better

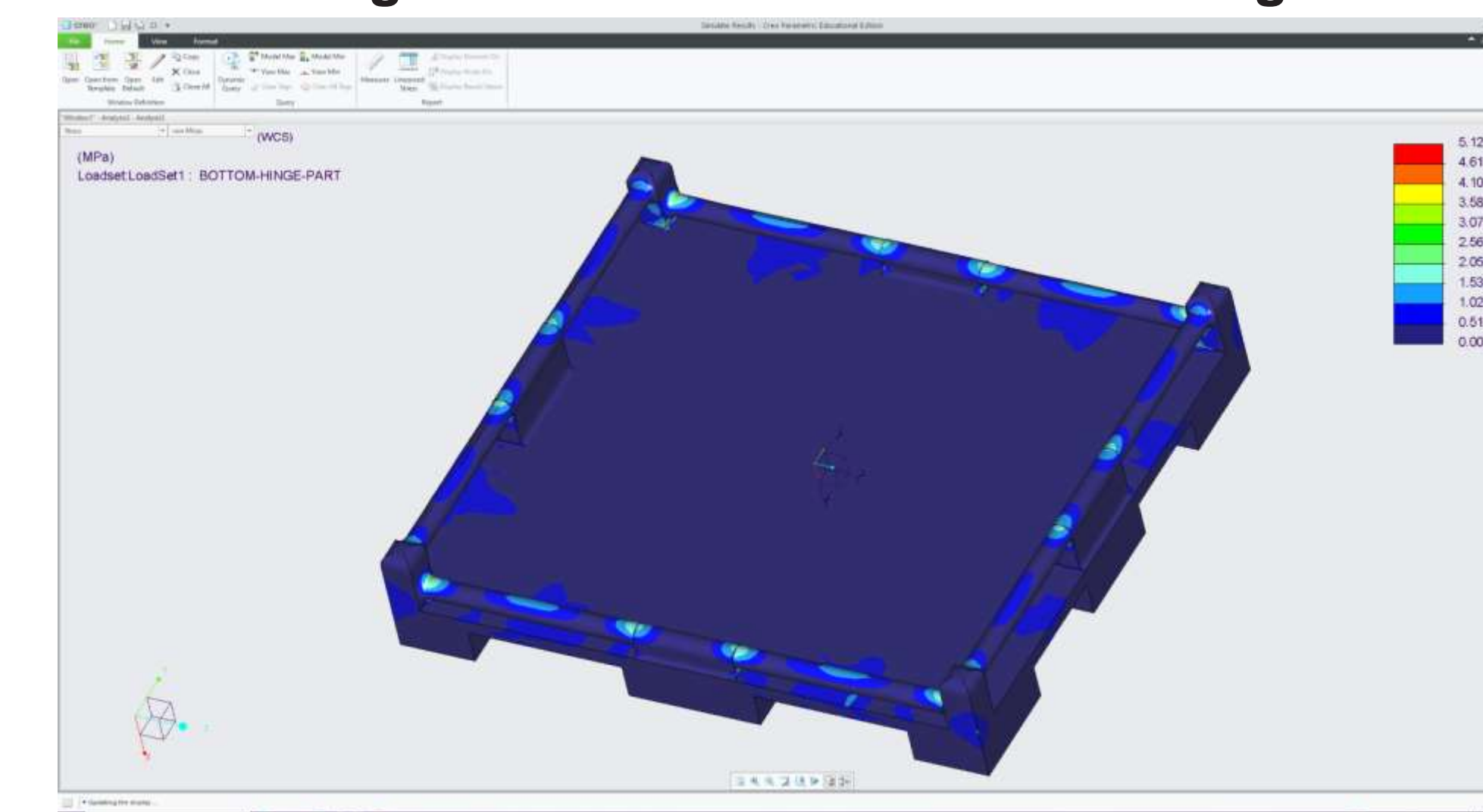
### Crane Lifting FEA Results on Bottom of Design 1



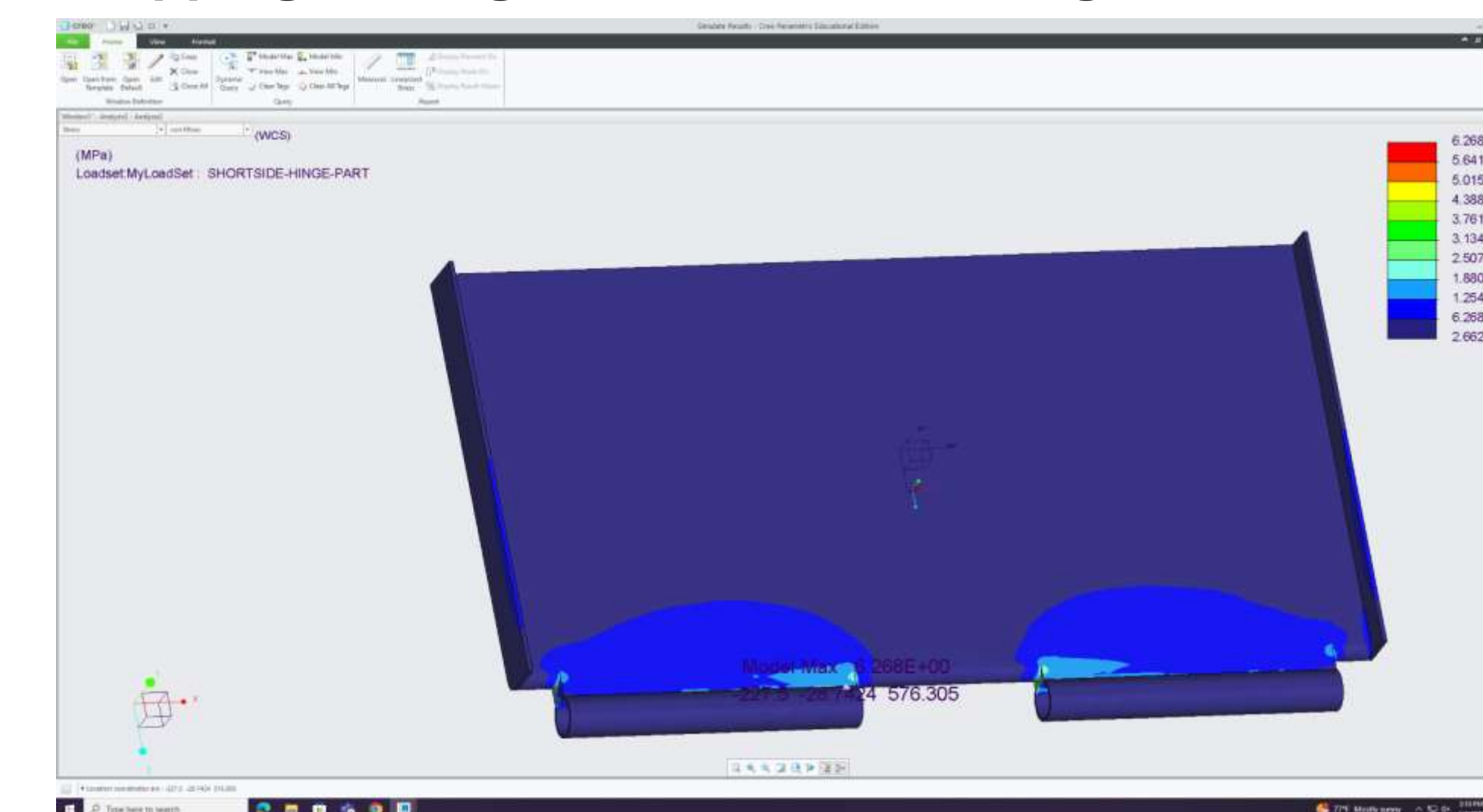
### Partial Forklift Insertion on Bottom of Design 1



### Crane Lifting FEA Results on Bottom of Design 2



### Shipping Testing on the Walls of Design 2



## SUMMARY AND CONCLUSIONS

Our project successfully met the goal of designing reusable crates for STATCOM Converter Modules that are both functional and environmentally conscious. We developed two different crate designs; one made from aluminum with 3D-printed clips for the prototype, and another that folds in using hinges. We were able to explore versatile options for streamline of transport and assembly. Both designs passed Finite Element Analysis (FEA) with a factor of safety of at least 2, confirming they are structurally sound under crane lifting and forklift handling. These crates contribute to reduced shipping costs, less material waste, less time to construct and deconstruct and a more sustainable supply chain for Siemens Energy.

## FUTURE WORK

Our team is going to give our sponsors the drawings for both models so that they can hopefully begin implementing one or both designs. Since we were only able to test using FEA, further testing would need to be conducted on a full-sized model. The STATCOM converters would be protected best by adding a cushioning material on the inside of the crate. Other changes that could be added would be a strap for Design 1 so that all parts could be kept together when disassembled. The 3D printed clips on the first design were also too bulky due to the limitations of WCU's printers. They should be made with a lower profile clip.

## TEAM & ACKNOWLEDGEMENTS

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