LINAC Electrical Cabinets - Structural Analysis

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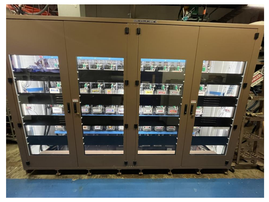
Introduction

The LINAC possesses dozen of cabinets containing wiring, electrical lines, capacitors, circuits, pipes, and various devices. Lab Technicians perform maintenance, and potentially need to stand on top of cabinet for access. This structural analysis will confirm integrity of cabinets.

Water Skid

PFN Module

PFN Power Supply



Marx

PFN = Pulse Forming Network

Physical Properties

Material - Structural Steel (comprises every component)

- Tensile Yield Strength = 36259 psi
- Compressive Yield Strength = 36259 psi
- Tensile Ultimate Strength = 66717 psi

Dimensions

PNF Module = 14’ x 5’10” x 6’3”

PNF Power Supply = 6’6” x 5’6” x 6’4”

Marx = 12’ x 4’ x 7’6”

Water Skid = 9’7” x 4’9” x 6’8”

Key Measurements

Panels and doors were measured to be 1/16” thick with an approximate depth of 7/8” to ¾”

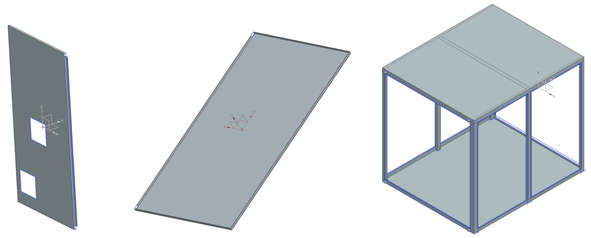
Frame measured at 1/8” thick: Top section remains largely unsupported except for the PNF cabinets, vertical edges/sides walls act as support for entire structure (U-Beams welded within interior)

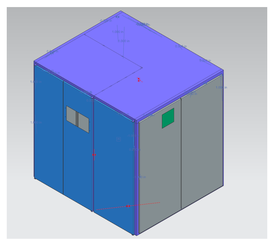
Design Phase

Components = Panels, Doors, Frame

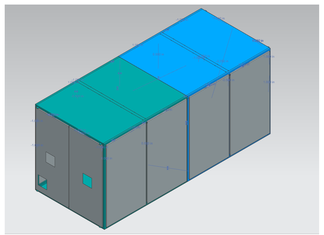
Each cabinet modeled/assembled in NX → hand measurements + older drawing of cabinets were used to create each component

- 2D sketches created main body (rectangle), additional sketches with each component created to model cutouts and edges with additional geometry
- 3D drawings required use of extrude and shell commands
- Inspections of the interior noted additional geometry (beams, supports, welds, ~dimensions)

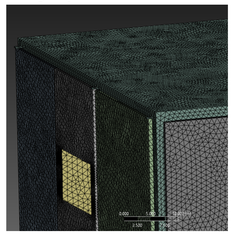




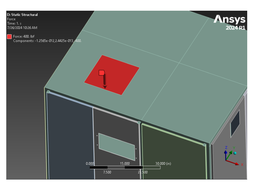
Finished PNF Power Supply Assembly



Finished PNF Module Assembly



Mesh generated on the PFN Power Supply



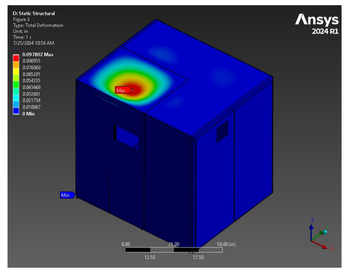
A square section on the top is used simulate a person's weight on a specific area

ANSYS Analysis

Test Setup

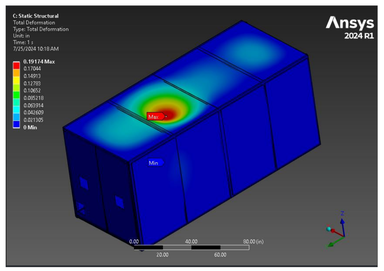
- 400lb force applied to each cabinet assembly from the top, bottom acts as fixed support (simulating weight of a person standing above)
- Standard Earth Gravity Conditions
- Mesh with 1” element size applied to cabinets
- Structural Steel used for cabinets (engineering data)

Total Deformation (in)



Max = 0.097802 in

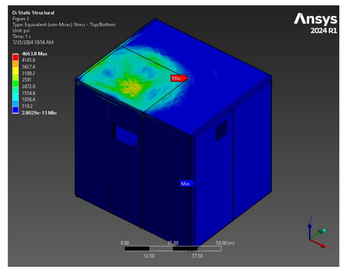
2 inner panels support top section



Max = 0.19174 in

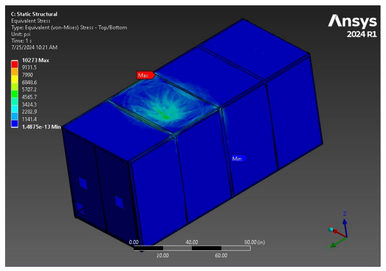
Beams underlining top section divides deformation into 4 sections

Equivalent Stress (psi)



Max = 4663.8 psi

90° point formed between inner panels experiences max stress



Max = 10273 psi

Max stress occurs on one of the beam corner beneath the top section

Conclusion

The yield strength of structural steel (36259 psi) is much higher than max equivalent stresses experienced by both cabinets: No permanent deformation will occur and compromise safety as a result.

Next Step

Create an engineering note for further analysis of the cabinets and begin the process of incorporating a fall protection plan.

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