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Transformer Support-Base:Design & Analysis

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Project number MNE 524 | **Team members:** Tamrat Abebe, Hiba Aldar, Charles Wold | **Faculty adviser:** Daren Chen, Ph.D. | **Sponsor:** ABB
Sponsor adviser: Christopher Belcastro

Project Background

ABB is a large global manufacturer of power systems and electronic products. Many of their enterprise products are subjected to varying weights, depending on unit type and size. There is a need at ABB for a set of methods and standards regarding the design of support-structures that can accommodate a variable range of transformer sizes.

Project Proposal to accommodate:

- 1 MVA transformer
  - Weight: 6300-8500 lbs.
  - Dimensions: 50in W x 30in D
- 500 kVA transformer
  - Weight: 3800 lbs.
  - Dimensions: 50in W x 22in D
- 300 kVA transformer
  - Weight: 2500 lbs.
  - Dimensions: 32in W x 22in D

Problem

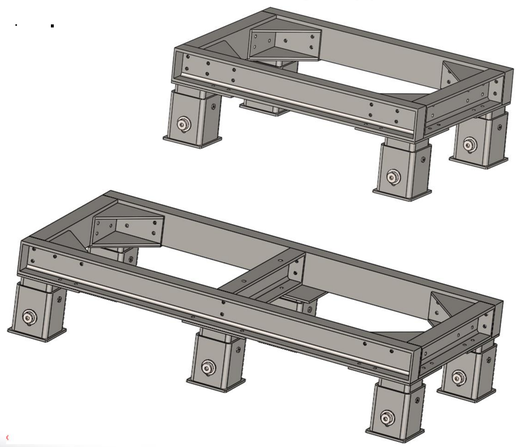
To accommodate moderate changes in a transformer's dimensions, weight or configuration, requires a new custom support-base design.

Goals

- Develop:
  - Scalable design standards
  - Universal parts & compatibility
  - Cost-effective design
  - Structural reliability
- Increase:
  - Finished product transportability
  - Ease of assembly
  - Product marketability

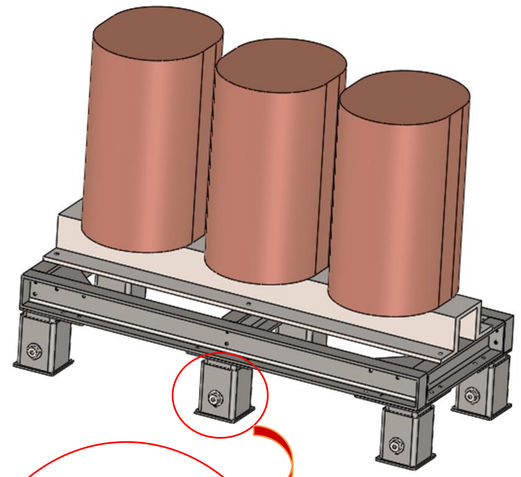
Proposed Design

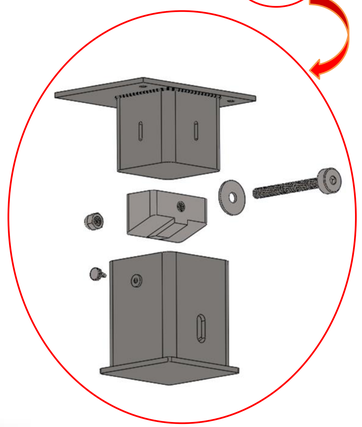
- Parallel-Flange C-channel
- ASTM A36 Steel Members
- Extendable sectional-design
  - Scalable width & depth
- Universal Corner & Leg Supports



Design Benefits

- In-house assembly; build as needed
- Stock universal parts not assemblies
- Nut & bolt assembly vs. welding
- Optional caster-wheel mobility
- Forklift and pallet-jack compatible
- Easily modified to fit changes in size
- Exceeds *factor of safety* 2X
- Built-in leveling device (see below)





***Unique Feature:** Built-in easily adjustable leveling device. Designed to handle extreme loads. Threaded tapered alloy-steel slider that can accommodate up to 3/4-inch adjustability.*

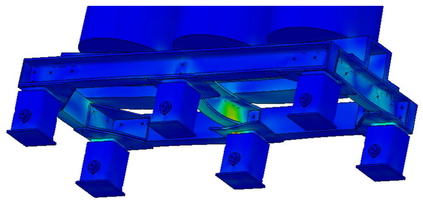
Results & Analysis

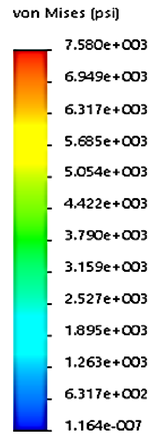
Primary Material: ASTM A36 Steel

Tensile Yield Strength:	36.3	ksi
Compressive Yield Strength:	22.0	ksi
Modulus of Elasticity:	29,000	ksi
Poisson's Ratio:	0.260	

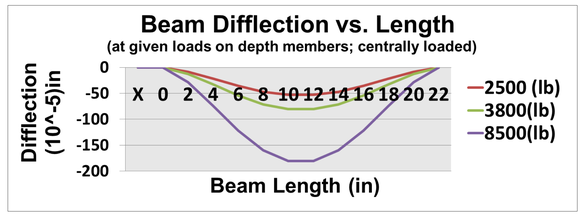
Test Analysis on 500kVA Base

Base Size:	50in W x 22in D
Max Stress:	7.58 ksi
Max Deflection:	0.0027 in





Resultant Stress @ 7600 lb load
Deformation Scale = 500X



Conclusions

At double the actual load, the 500 kVA test model has a 2.9 *factor of safety*. The design satisfies all of the specified goals, but further testing should be done across a broader range of dimensions and loads. To reduce costs, future considerations should be given to reduce the size of the support materials as needed, versus a "one size fits all" approach.