

# MSC Nastran Topometry Optimization of a Cantilever Plate

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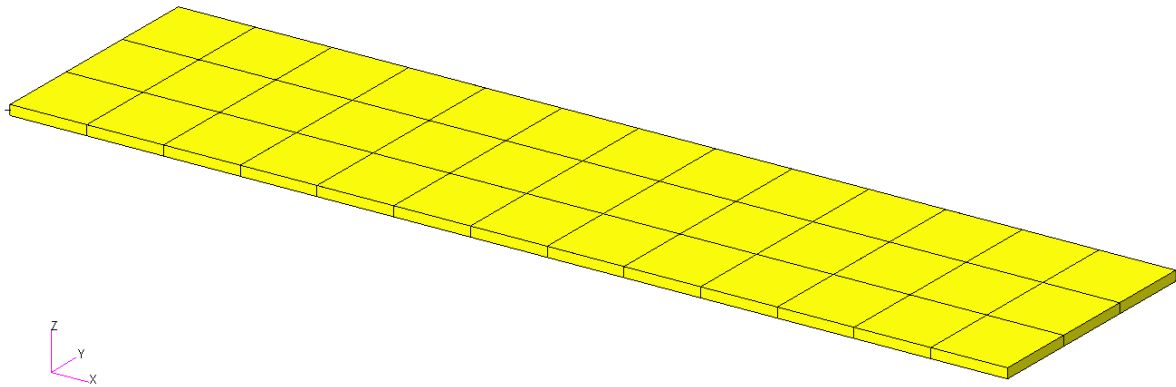
PRESENTED BY CHRISTIAN APARICIO

# Goal: Use Nastran SOL 200 Optimization

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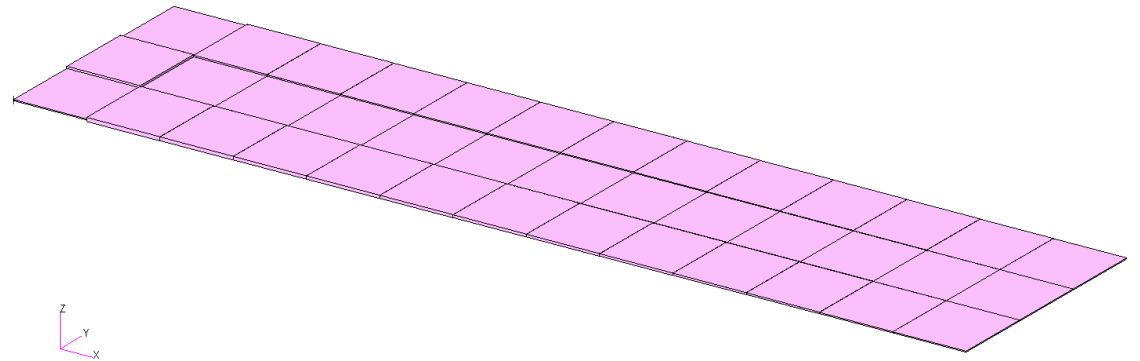
## Before Optimization

- Mass: 19.5 kg



## After Optimization

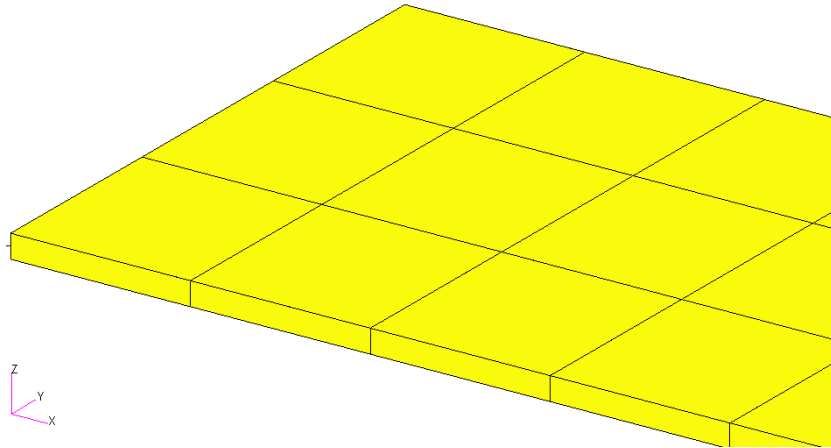
- Mass: 3.97 kg
- Vary the thickness of each element



# Goal: Use Nastran SOL 200 Optimization

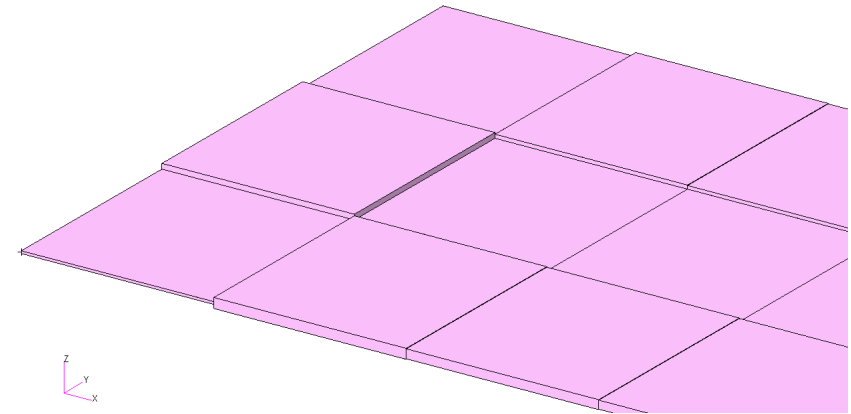
## Before Optimization

- Mass: 19.5 kg



## After Optimization

- Mass: 3.97 kg
- Vary the thickness of each element



# Agenda

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Details of the structural model

Optimization Problem Statement

Steps to use Nastran SOL 200 (Optimization)

- Convert a .bdf file to SOL 200
- Create:
  - Design Regions/Variables
  - Design Objective
  - Design Constraints
- Perform optimization with Nastran SOL 200

View optimization results

- Online Plotter
- Topometry Optimization and Structural Results

# Contact me

- Nastran SOL 200 training
- Nastran SOL 200 questions
- Structural optimization questions
- Access to the SOL 200 Web App

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# Details of the structural model

Units: m, N, MPa

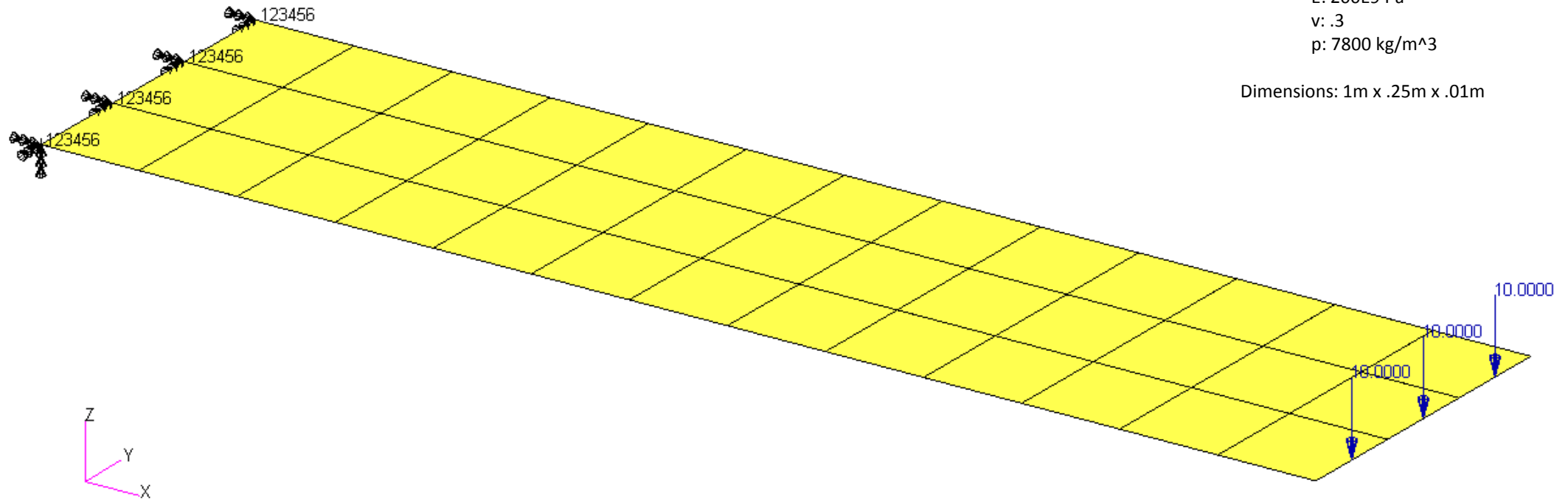
Material:

E: 200E9 Pa

v: .3

p: 7800 kg/m<sup>3</sup>

Dimensions: 1m x .25m x .01m

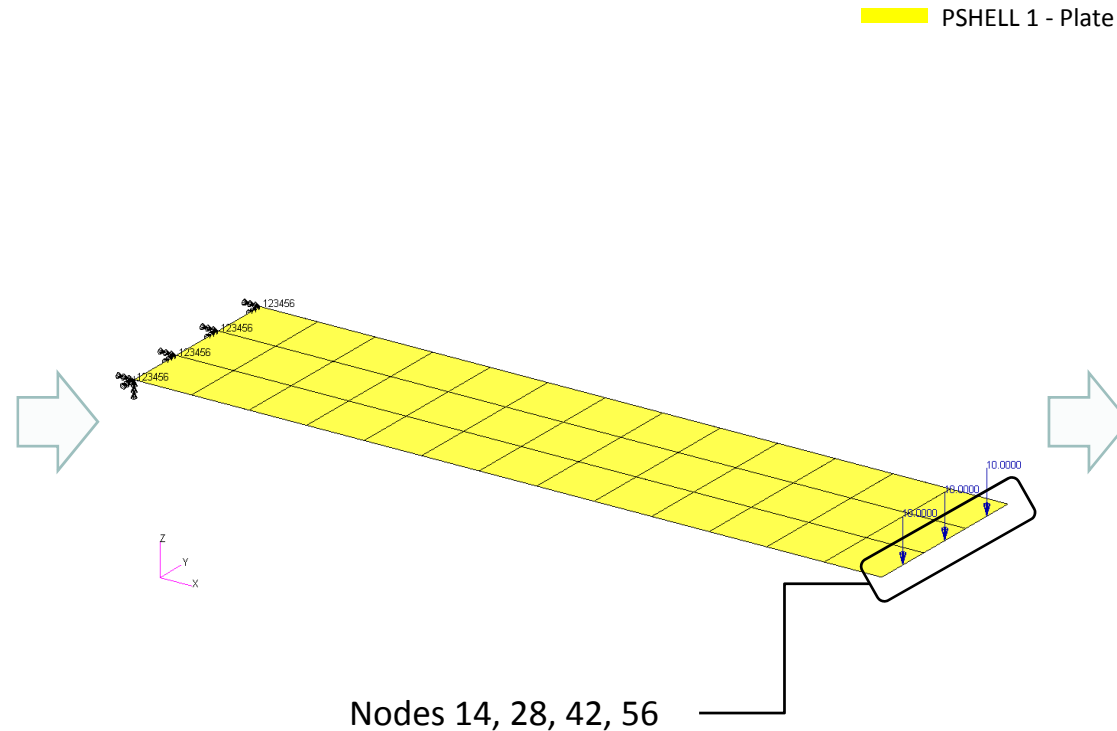


# Optimization Problem Statement

## Design Region/Variables

z1: Thickness (T) of PSHELL 1

$$.001 < z1$$



## Design Objective

r0: Minimize weight

## Design Constraints

r1: von Mises stress of PSHELL 1

$$r1 < 250E6$$

r2: Z Displacement of nodes 14, 28, 42, 56 (GRID IDs: 14, 28, 42, 56)

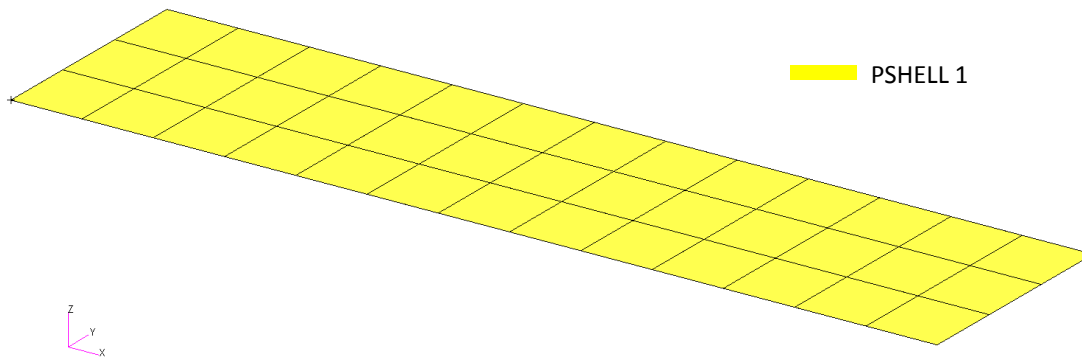
$$-.01 < r2$$

# Difference Between Size and Topometry Optimization

## Size Optimization

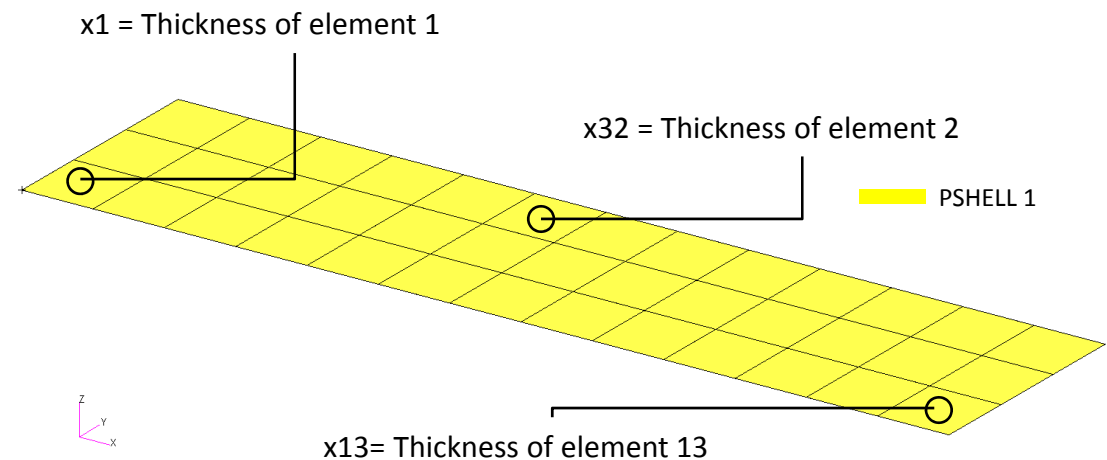
1. Select the parameter to optimize
2. One design variable ( $x_1$ ) is created and applies to all the elements

$x_1$  = Thickness of every element related to PSHELL 1



## Topometry Optimization

1. Select the parameter and design region
2. In the background, one design variable is automatically created for each element => Element-by-element optimization





# Steps to use Nastran SOL 200 (Optimization)

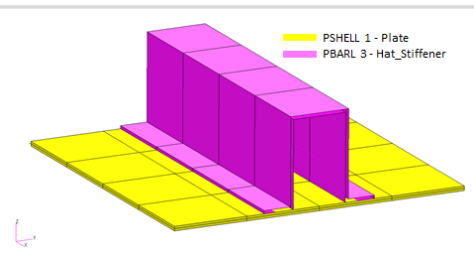
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1. Start with a .bdf or .dat file
2. Use the SOL 200 Web App to:
  - Convert the .bdf file to SOL 200
    - Design Regions/Variables
    - Design Objective
    - Design Constraints
  - Perform optimization with Nastran SOL 200
3. Review optimization results
  - Online Plotter
  - Topometry Optimization and Structural Results

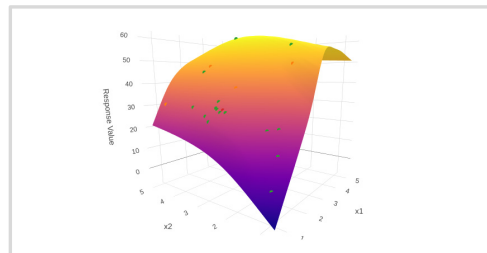
# SOL 200 Web App Capabilities

## Capabilities

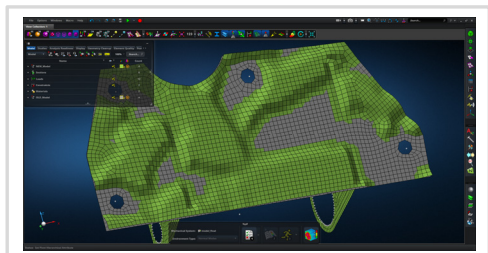
## Benefits



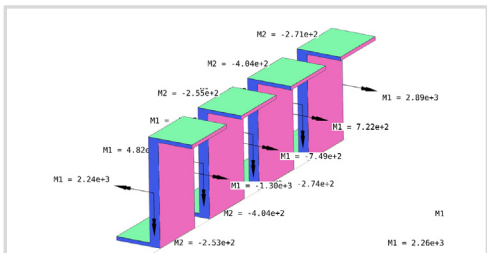
**Web Apps for SOL 200**  
Pre/post for MSC Nastran SOL 200. Support for size, topology, topometry and topography.



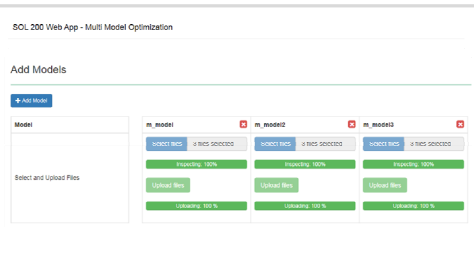
**Machine Learning Web App**  
Bayesian Optimization for nonlinear response optimization (SOL 400)



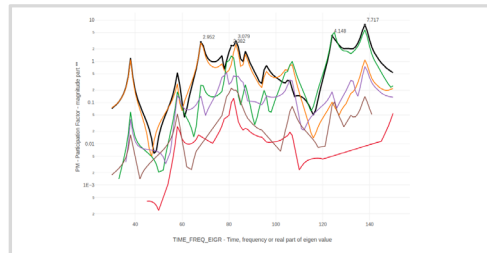
**MSC Apex Post Processing Support**  
View the newly optimized model after an optimization



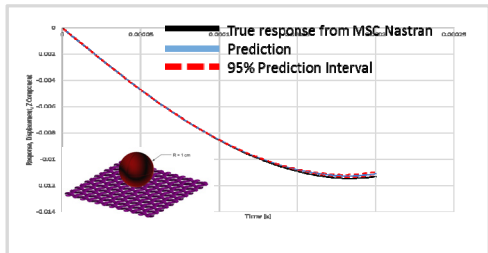
**Beams Viewer Web App**  
Post process 1D element forces, including shear forces, moments, torque and axial forces



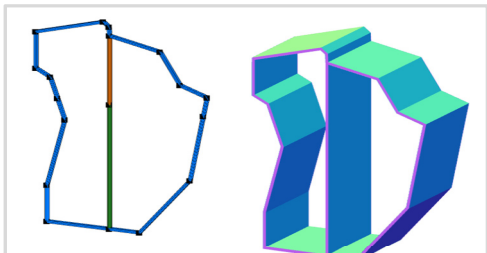
**Multi-model Optimization Web App**  
Pre/post for multi model optimization



**HDF5 Explorer Web App**  
Create XY plots using data from the H5 file



**Prediction Analysis Web App**  
Gaussian process regression to predict output of MSC Nastran without time consuming analyses



**PBMSECT Web App**  
Generate PBMSECT and PBRSECT entries graphically

- 200+ error validations (real time)
- Web browser accessible
- Automated creation of entries (real time)
- Automatic post-processing
- 50+ tutorials

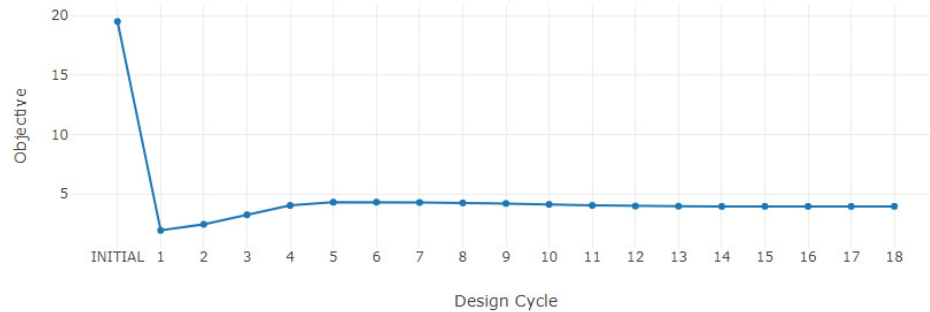
# View Optimization Results

## Online Plotter

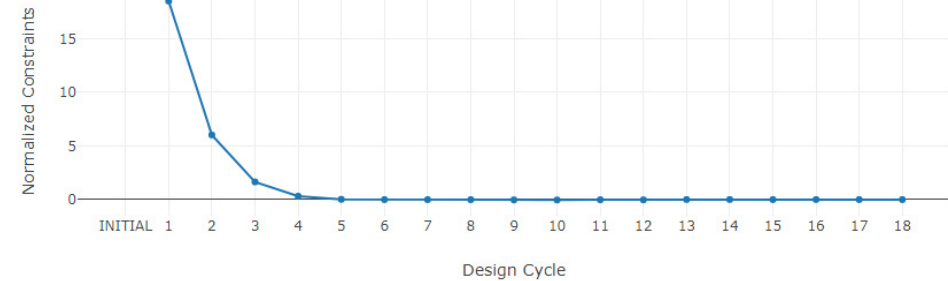
Final Message in .f06

✓ RUN TERMINATED DUE TO HARD CONVERGENCE TO AN OPTIMUM AT CYCLE NUMBER = 18.

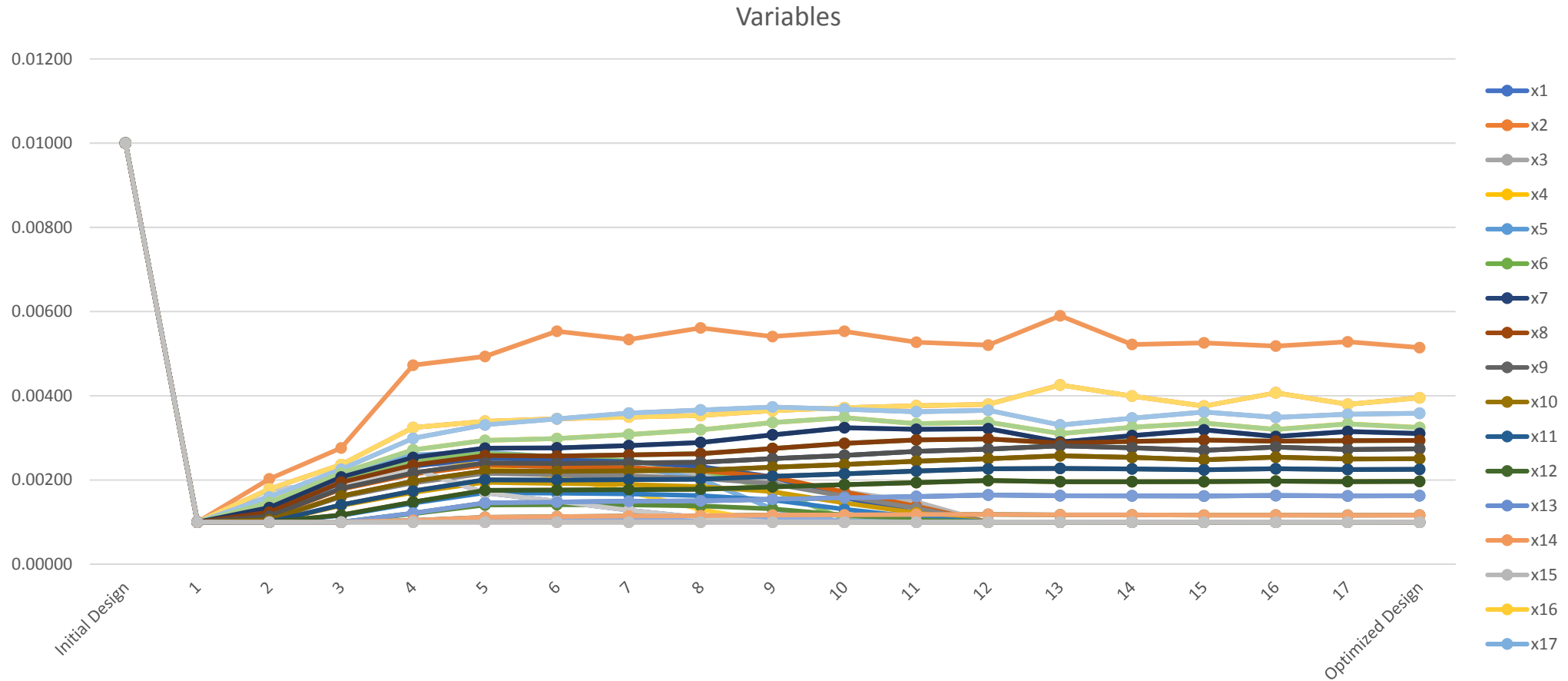
Objective



Normalized Constraints



# View Optimization Results



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