

Process Integration and Design Optimization with Ansys optiSLang

October 5th 2023

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/ Agenda

- Introduction to PIDO
- Overview of Example
- Live Demo



Introduction to Process Integration and Design Optimization

Process Integration and Design Optimization

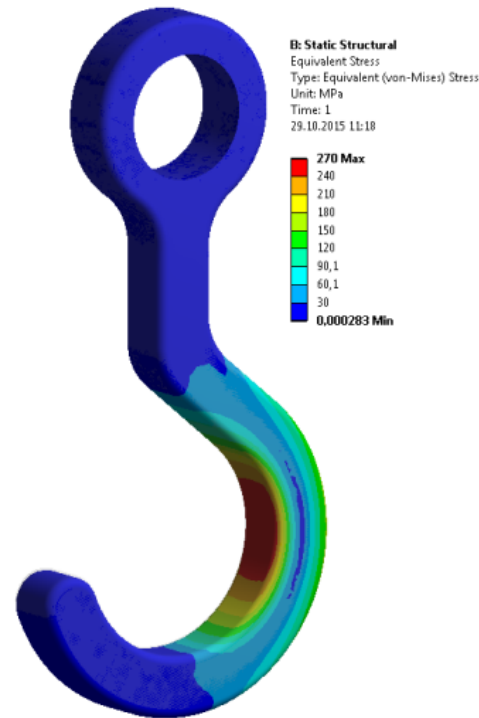
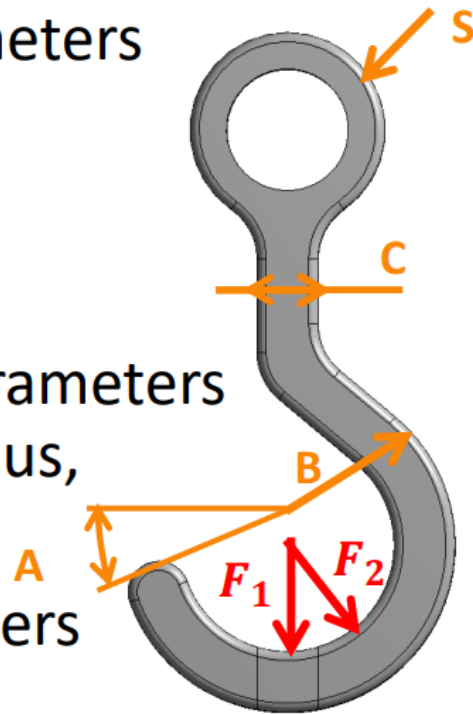
- Process Integration
 - Wrapping multiple steps or sub-processes in a convenient package
 - “Tool chaining”
- Design Optimization
 - Maximize desired output
 - Minimize required cost
 - Parametric optimization: define changeable inputs and measurable outputs

Introduction to Optimization

- Example: mass-produced cast hook we want to optimize
- Economical goal: maximize number of hooks per ton of metal
- Engineering goal: low volume while maximum stress less than allowable

Input Parameters:

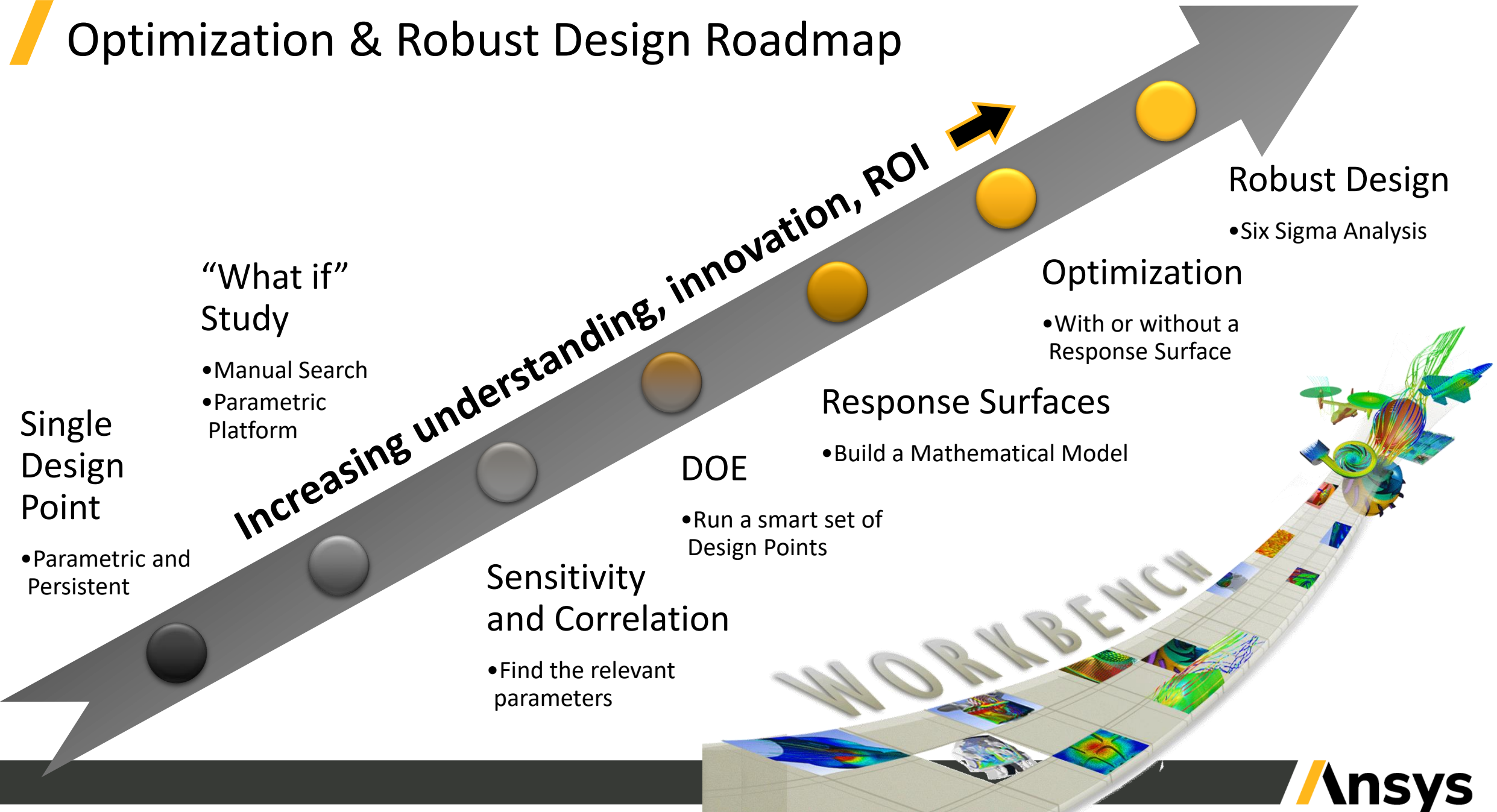
- Geometrical Parameters
e.g. A, B, C
- Load Parameters
e.g. F_1 , F_2
- Material model Parameters
e.g. Young's modulus,
Yield stress
- Scattering Parameters
e.g. A, B, F_1 , S



Output/ Responses:

- Scalar
e.g. Maximum stress, Mass,
Cost
- Vectors, Signals, Curves
e.g. Force over Displacement
- Matrices
e.g. 2D and 3D Field data, like
stress at every node

Optimization & Robust Design Roadmap

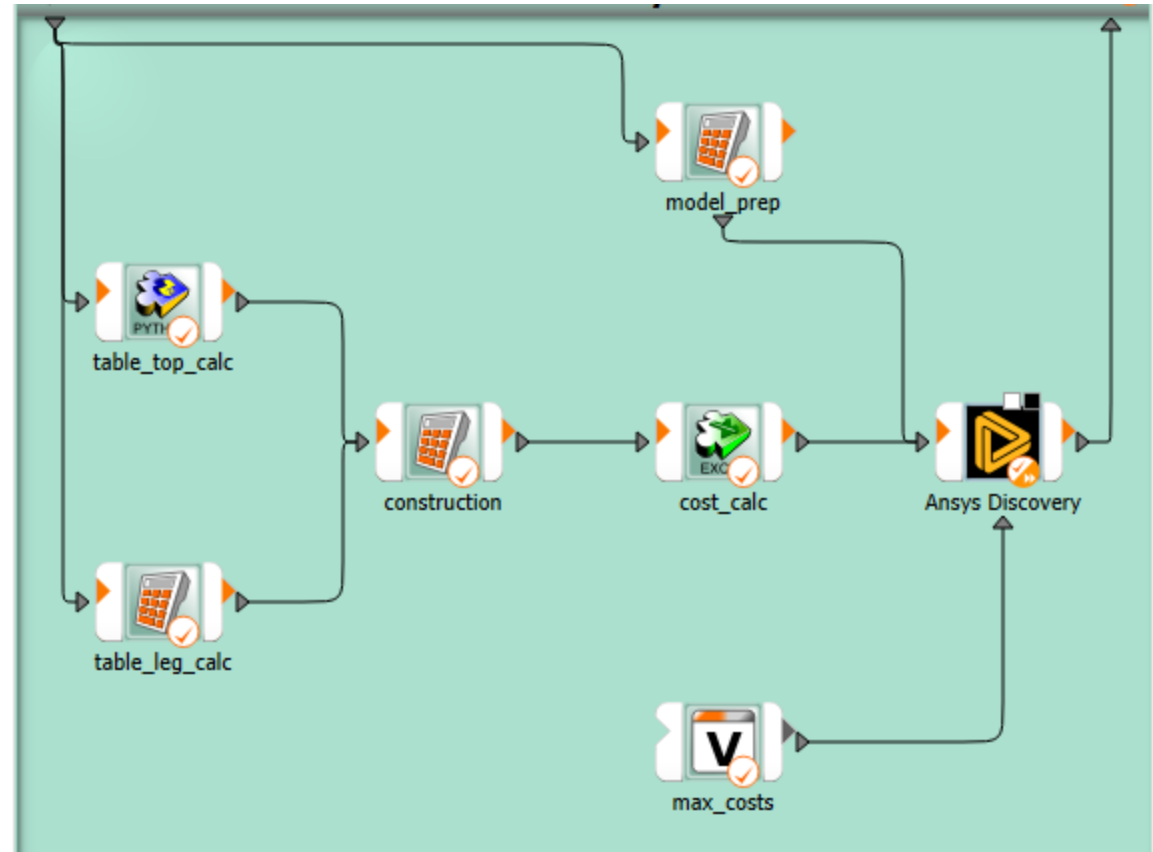
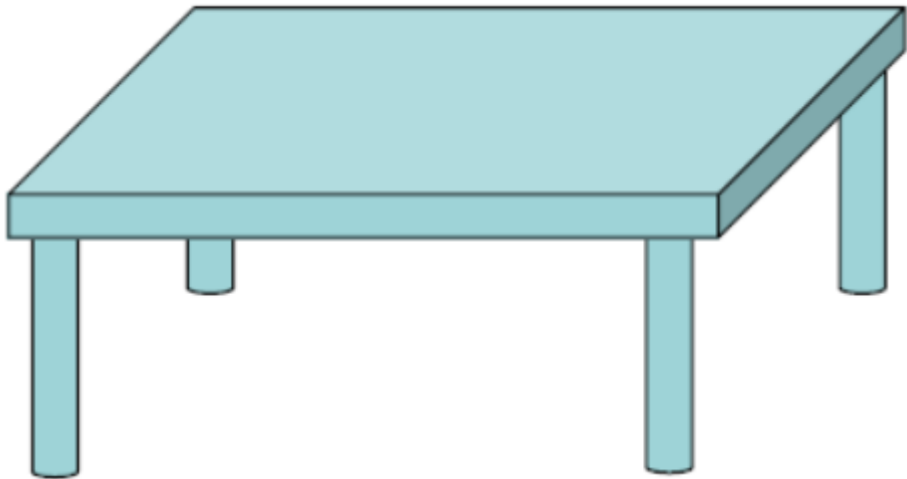


PIDO Example

Household Table Configurer

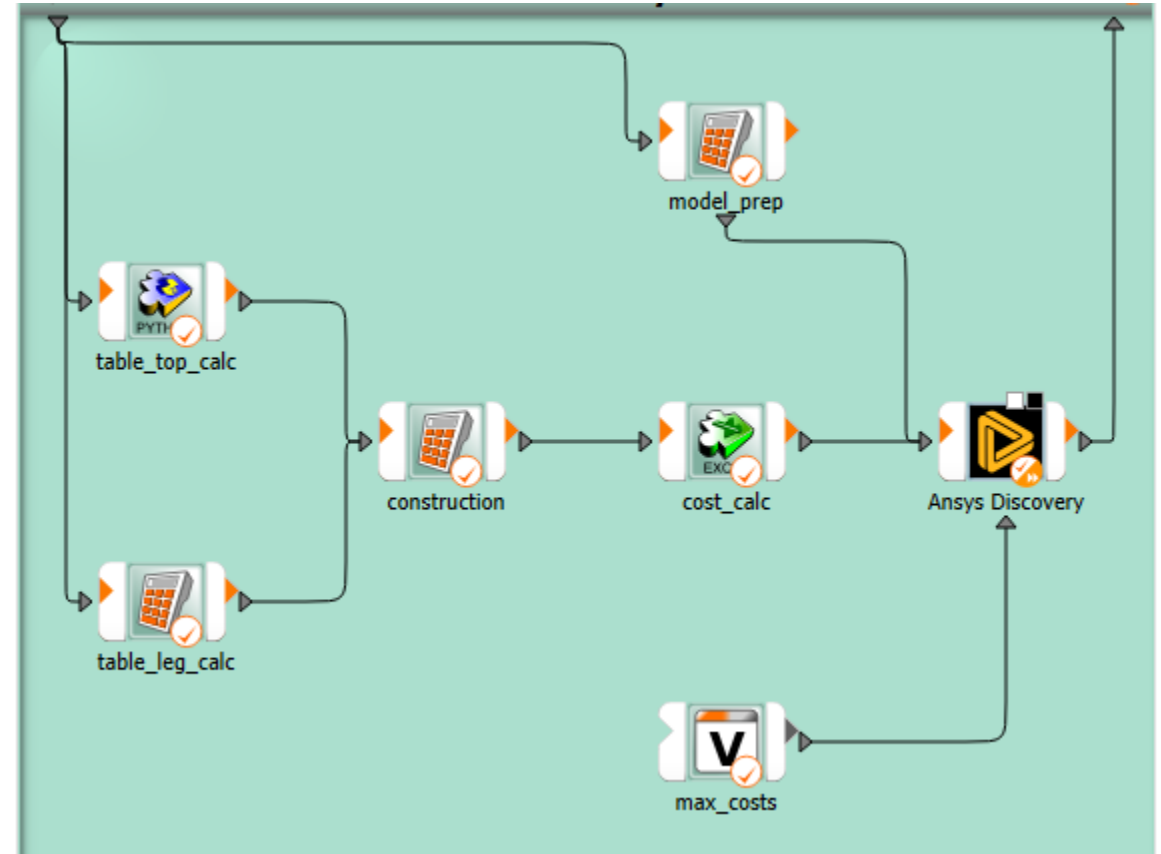
Overview

- Based on [Table Internet Application Configurer \(ansys.com\)](https://ansys.com/help-main/ansys/topics/table_internet_application_configurer.html) from the Ansys Help Documentation
- Design and analyze parametric table



Project Workflow

- Gather the customer inputs
 - Required size
 - Load
 - Maximum cost
- Calculate costs
- Prove the design using simulation
- Store the design
- Find optimal design



Project Workflow

- Gather the customer inputs

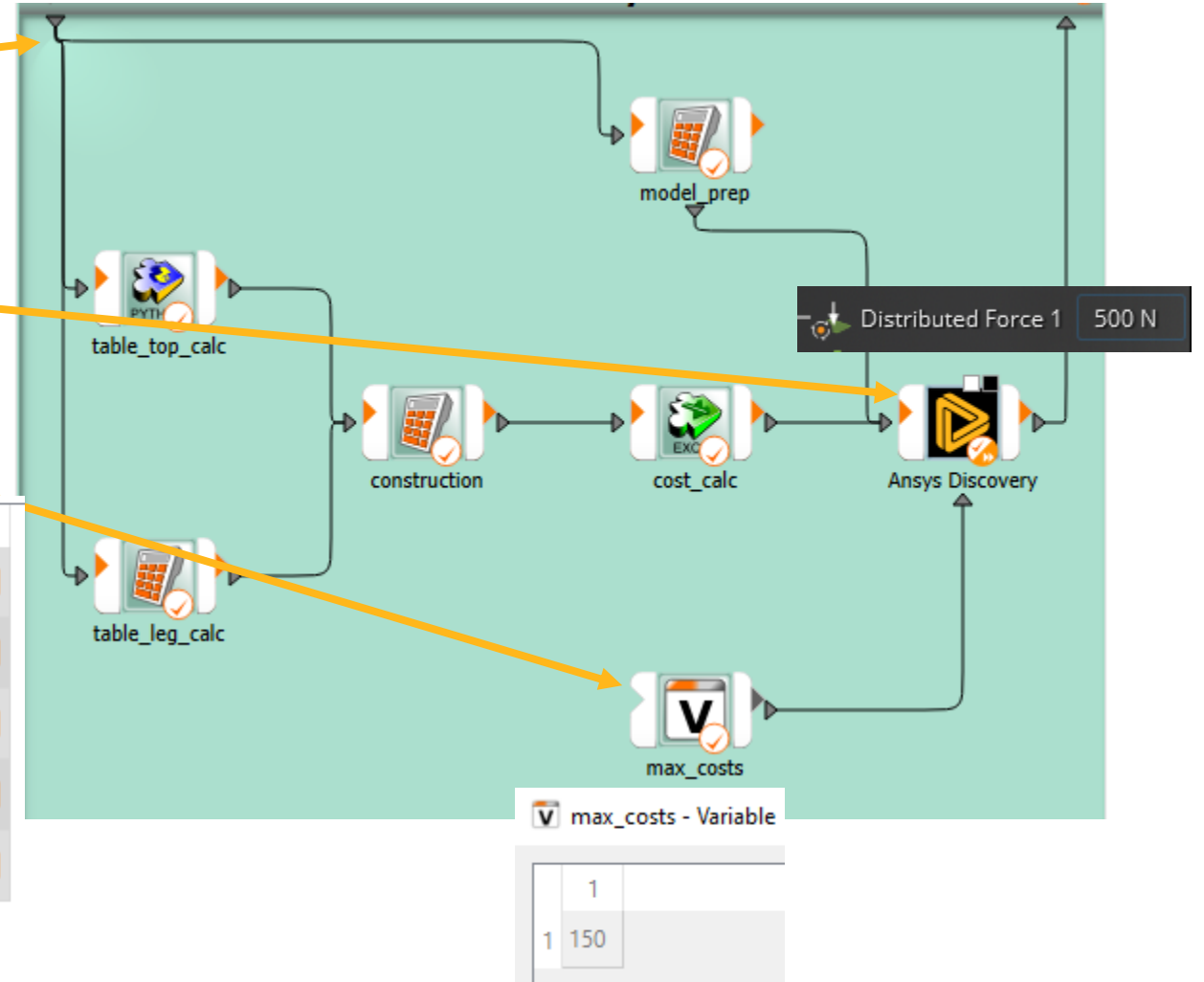
- Required size

- Load

- Maximum cost

- Calculate costs

	Name	Parameter type	Reference value	Constant	Value type	Resolution	Range	Range plot
1	table_top_height	Optimization	0.02	<input type="checkbox"/>	REAL	Continuous	0.01 0.055	
2	table_top_width	Optimization	0.2	<input type="checkbox"/>	REAL	Continuous	0.1 2	
3	table_top_length	Optimization	0.5	<input type="checkbox"/>	REAL	Continuous	0.2 4	
4	table_leg_height	Optimization	0.5	<input type="checkbox"/>	REAL	Continuous	0.1 1	
5	table_leg_radius	Optimization	0.01	<input type="checkbox"/>	REAL	Continuous	0.005 0.02	



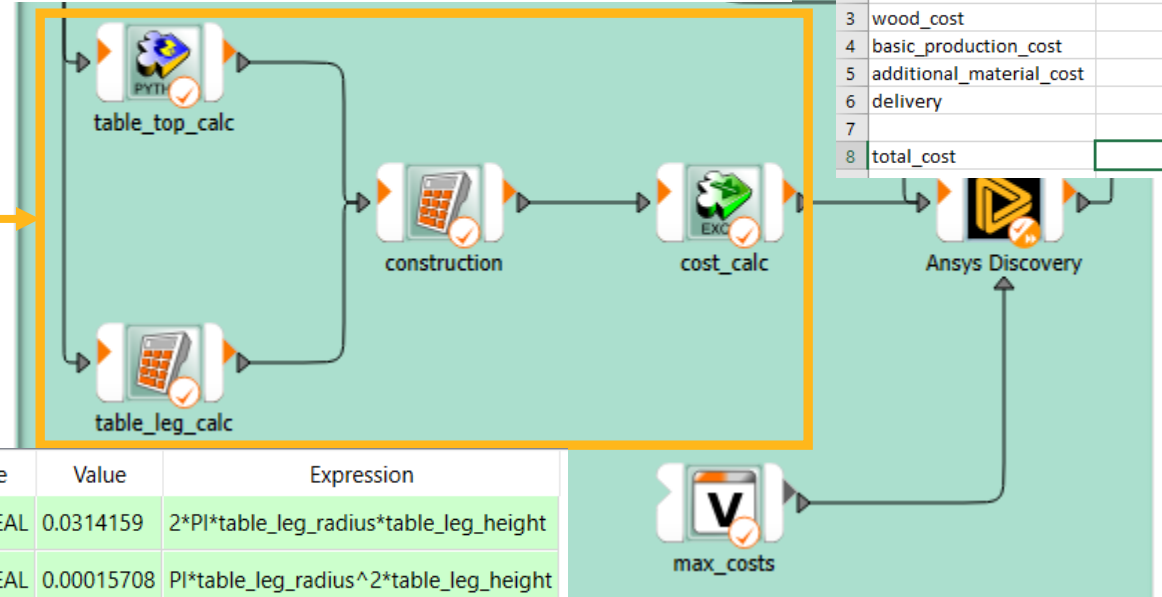
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```

1  #.(c) 2021 ANSYS, Inc. Unauthorised use, distribution, or duplication is prohibited.
2
3  import calc_cuboid
4
5  try:
6      test = table_top_length
7  except NameError:
8      table_top_length = 1.8
9
10 try:
11     test = table_top_height
12 except NameError:
13     table_top_height = 0.05
14
15 try:
16     test = table_top_width
17 except NameError:
18     table_top_width = 1.0
19
20 table_top_area = calc_cuboid.area(table_top_length, table_top_height, table_top_width)
21 table_top_volume = calc_cuboid.volume(table_top_length, table_top_height, table_top_width)
22
23 print('Table top area:', table_top_area)
24 print('Table top volume:', table_top_volume)
25
    
```

	A	B	C
1	table_volume		0.2 m ³
2			
3	wood_cost		800 €/m ³
4	basic_production_cost		100 €
5	additional_material_cost		7 €
6	delivery		30 €
7			
8	total_cost		297 €



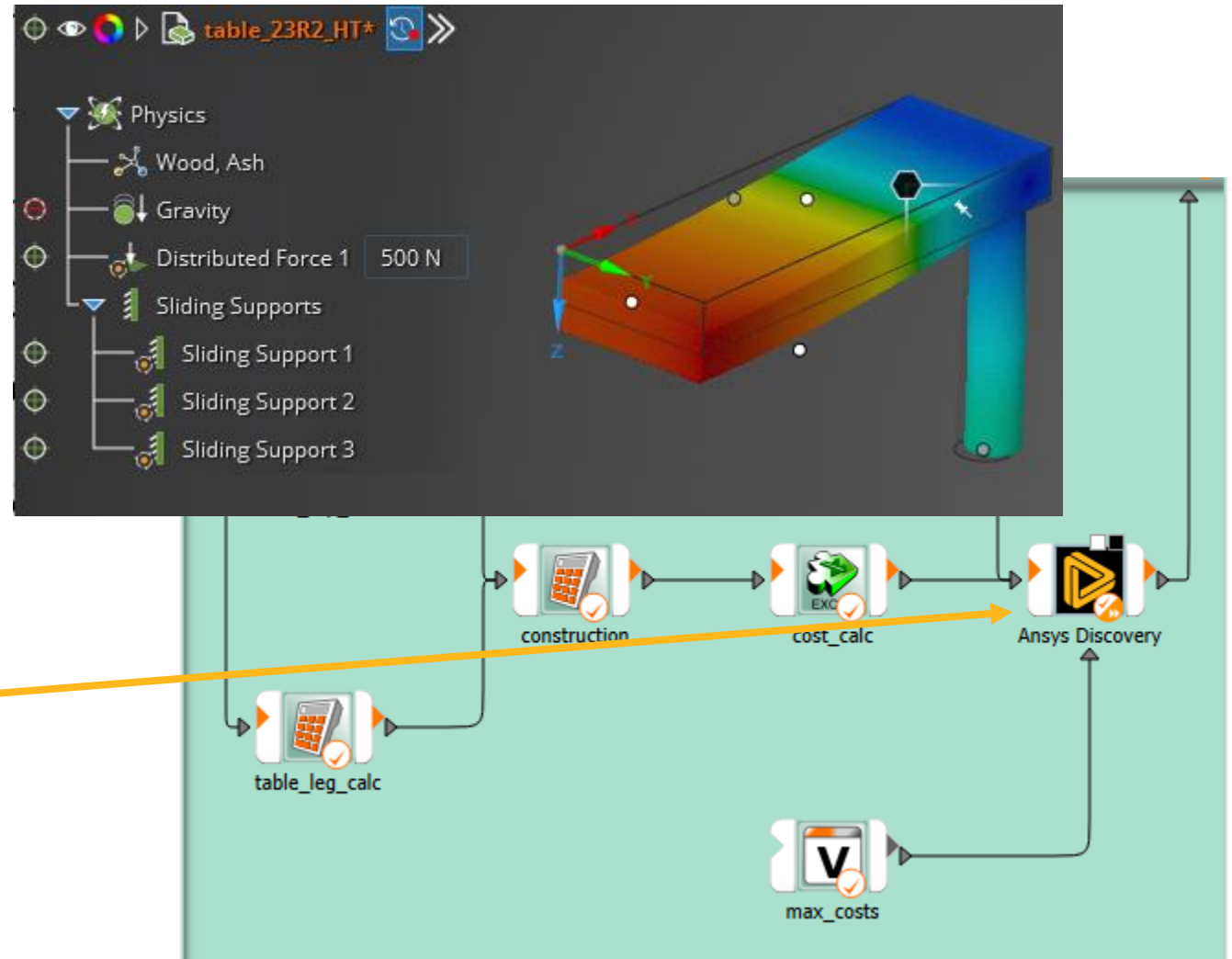
ID	Description	Type	Value	Expression
1	table_leg_area	REAL	0.0314159	2*PI*table_leg_radius*table_leg_height
2	table_leg_volume	REAL	0.00015708	PI*table_leg_radius^2*table_leg_height

ID	Description	Type	Value	Expression
1	number_of_legs	REAL	4	4
2	table_area	REAL	4.00566	number_of_legs*table_leg_area+table_top_area
3	table_volume	REAL	0.0906283	number_of_legs*table_leg_volume+table_top_volume



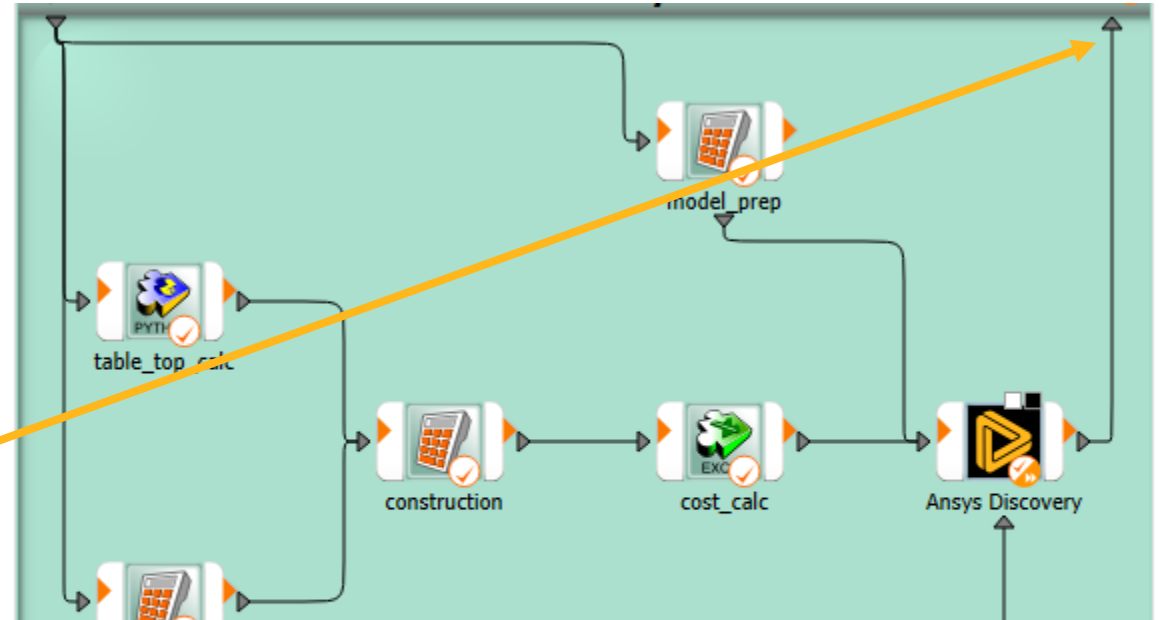
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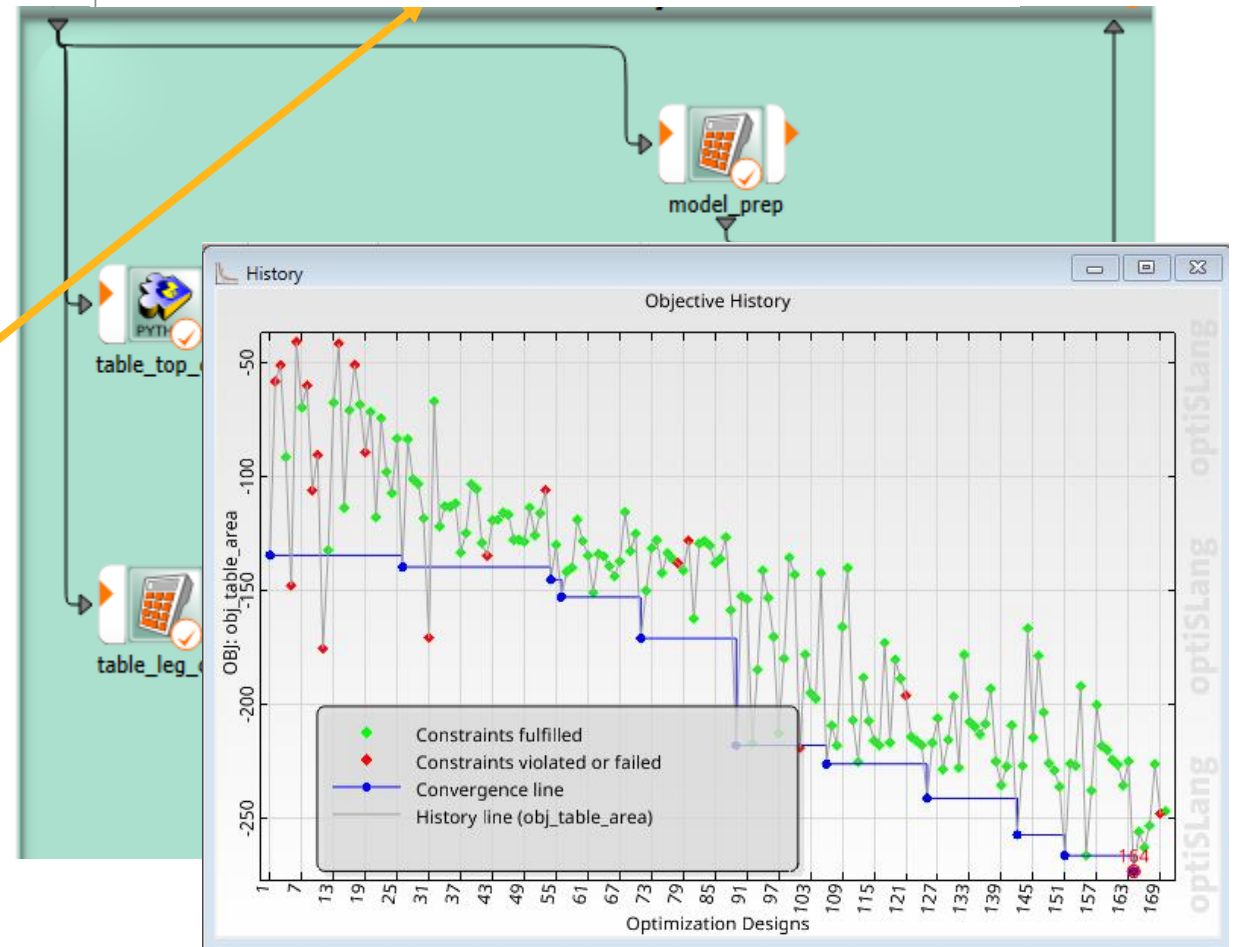


	Id	Feasible	Duplicates	Status	table_leg_height	table_leg_radius	table_top_height	table_top_length	table_top_width	Factor_of_Safety	/max_Displacemen	table_area	table_volume	total_cost
1	0.1	true		Incomplete	0.145	0.01175	0.02125	0.77	1.145			1.88751	0.0189866	150.379
2	0.2	true		Incomplete	0.685	0.00875	0.05275	1.15	1.525			3.94035	0.0931694	210.467
3	0.3	true		Incomplete	0.415	0.00725	0.03475	3.43	0.955			6.93168	0.114103	227.423
4	0.4	true		Succeeded	0.955	0.01325	0.04375	0.39	0.575	35.8043	0.000305524	0.850961	0.0119178	144.653
5	0.5	true		Incomplete	0.595	0.01625	0.02575	2.67	0.385			2.45623	0.0284441	158.04
6	0.6	true		Incomplete	0.235	0.01775	0.03925	1.91	1.905			7.68141	0.143743	251.432
7	0.7	true		Incomplete	0.325	0.01475	0.04825	3.05	0.195			1.62312	0.0295852	158.964
8	0.8	true		Incomplete	0.775	0.01925	0.01675	2.29	1.335			6.61069	0.0548161	179.401
9	0.9	true		Incomplete	0.865	0.01025	0.03025	3.81	1.715			13.6254	0.1988	296.028
10	0.10	true		Succeeded	0.505	0.00575	0.01225	1.53	0.765	2.27027	0.0542636	2.47011	0.0145478	146.784

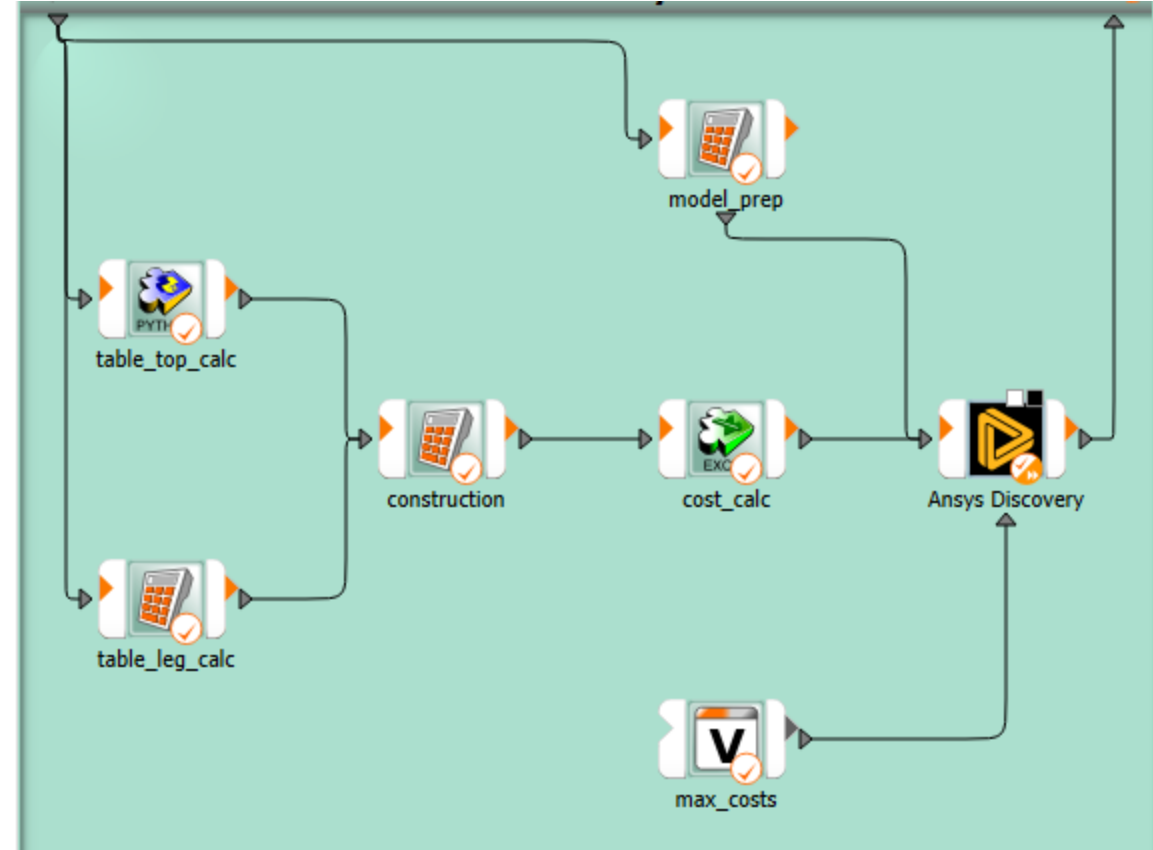
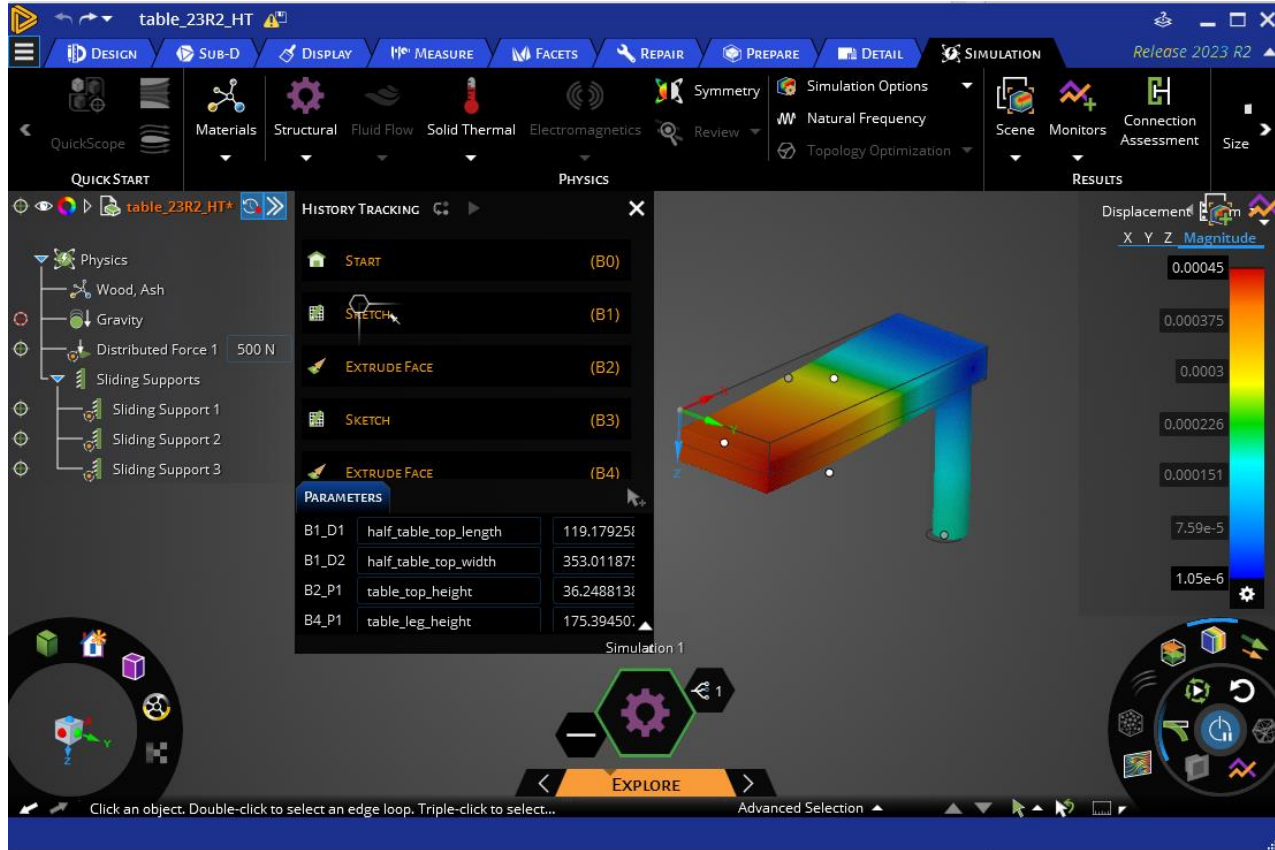
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Name	Type	Expression	Criterion	Limit
 constr_Factor_of_Safety	Constraint	Factor_of_Safety	\geq	2
 constr_Max._Displacement	Constraint	Max._Displacement	\leq	0.0254
 obj_table_area	Objective	table_area/table_volume	MAX	



Demo



The Ansys logo consists of a yellow slanted bar followed by the word "Ansys" in a bold, black, sans-serif font.

