

**Advancing Simulation capabilities
in IES Virtual Environment using
Python Scripting**



Why Python?



Use Python to write simple programs to automate many specific modelling tasks in VE

Features of Python:

- User friendly and readable syntax
- Easy to learn
- Many open source libraries
- Many free online learning resources

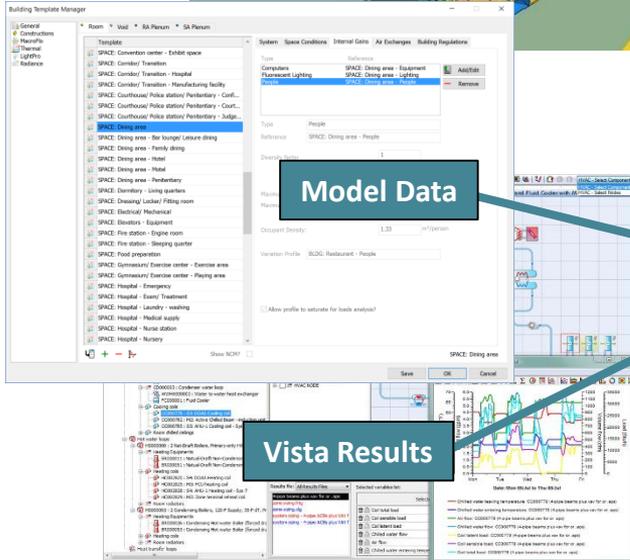
The screenshot shows the VEScript Python Editor interface. The left pane displays a file explorer with a tree view of 'VE Scripts' including folders like 'api_examples', 'airexchange', 'apachesim', 'casualgain', 'iesve', 'mv2', and 'resultsreader'. The 'energy_meters.py' file is selected. The main editor window shows the following Python code:

```
energy_meters.py
120 # Create Energy Use Matrix by Meter
121 if show_meter_matrix is True:
122     print("\n=== Energy Meter Matrix ===\n")
123     tbl_met = []
124     tbl_row = [ units ]
125     for use in all_uses:
126         tbl_row.append( use['name'] )
127     tbl_met.append( tbl_row )
128     for met in all_mets:
129         tbl_row = [ "Total" if met['source_id'] is iesve.EnergySource.unspecified else map_srcs[ met['source_id']
130                    if met['name'] is not "" :
131                        tbl_row[0] += " " + met['name']
132                    for use in all_uses:
133                        tbl_row.append( read_sum_convert(results_file_reader, use['id'], met['source_id'], met['id'], type, €
134                    tbl_met.append( tbl_row )
```

The output window shows the execution results:

```
1 >>> Run start, Mon Feb 27 16:01:18 2017
2
3 === Energy Source Matrix ===
4
5 kWh          Interior Lighting    Space Heating    Space Cooling    Pumps    Heat Rejection    Interior Central Fans
6 -----
7 Electricity    392788.480         0.000           39491.576       11111.190       22576.254         11209.760
8 Natural Gas    nan                281200.544      nan             nan            nan                nan
9 Total         392788.480         281200.544      39491.576       11111.190       22576.254         11209.760
10
11
12
```

VE Python Scripting – VE 2017



What can VE Python Scripting be used for?

- Automatically extract model or results data
- Perform simple or complex calculations
- Arrange the data into a customised format
- Write to Excel/Word/pdf or send across the internet



python™

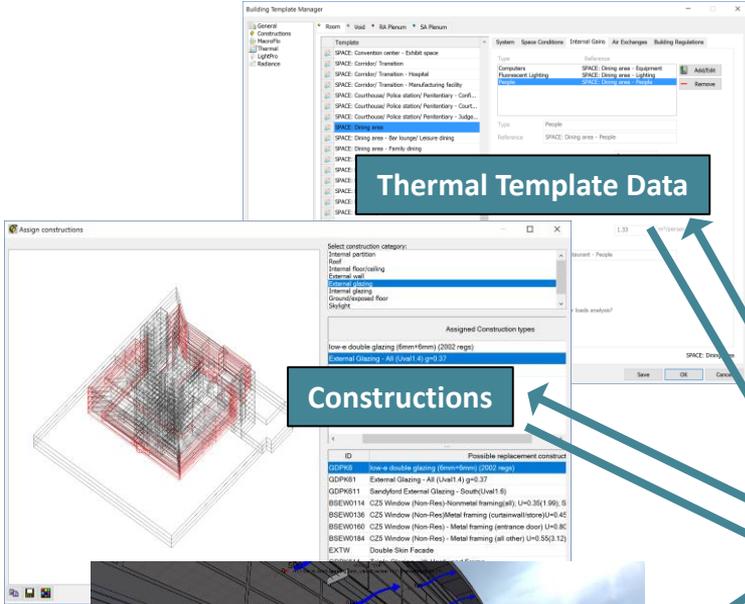


VE Python Scripting – VE 2018



What's new in VE 2018?

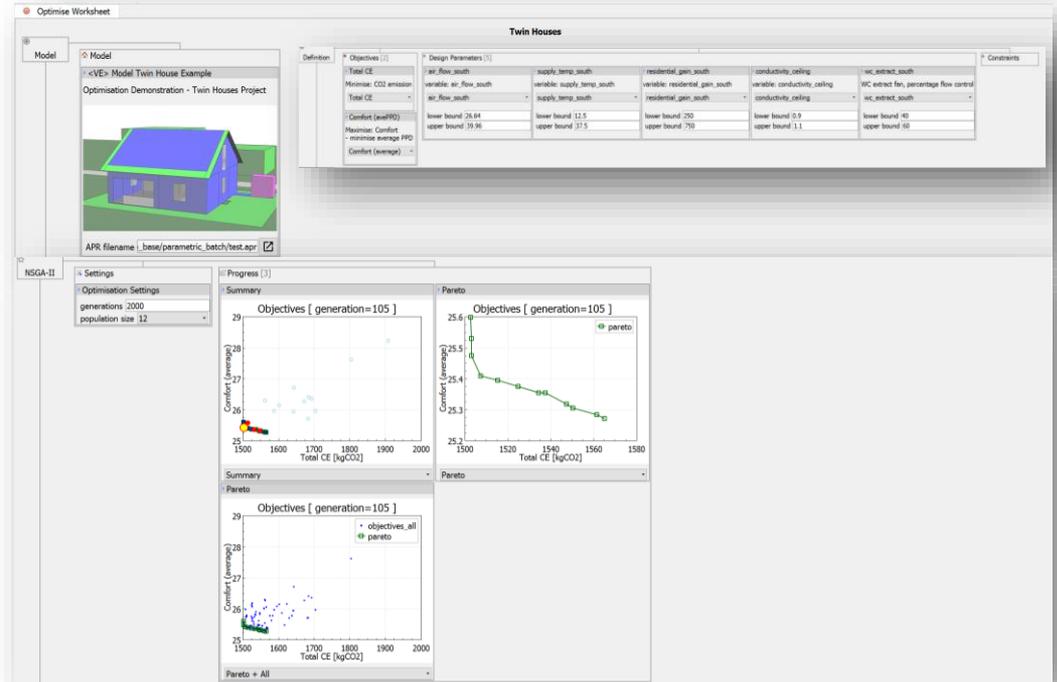
- Extract Constructions, Renewables, MacroFlo data
- Simple edits to model geometry
- Write Construction, Renewable, MacroFlo and room/template data back into the VE



Parametric Simulation



- Run customised parametric simulations directly in the VE
- Expand the capabilities of Hone by generating apr files and to expand its capabilities (constructions, geometry)
- Analyse the results using python and present in automated reports



Partnerships – One Click LCA



- Enabled by python scripting
- Export energy results and construction data from VE 2018
- Automatically upload data to One Click LCA to perform life cycle assessments



SOFTWARE ▾ SERVICES ▾ RESOURCES ▾ ABOUT ▾ PRICING

One Click LCA BUILD FOR THE FUTURE YOU WANT TO LIVE IN

▶ See video

with easy-to-use life-cycle performance software

SOFTWARE FOR GREEN BUILDING
CERTIFICATIONS

LIFE-CYCLE SOFTWARE FOR
CONSTRUCTION

CSR SOFTWARE FOR CORPORATIONS

PRICING

One Click LCA V1.0.9

One Click LCA INTEGRATED ENVIRONMENTAL SOLUTIONS

Automatically submit materials and energy consumption data from a VE Pro model to One Click LCA. It allows you to carry out a range of analyses including Life Cycle Assessment, Life Cycle Costing, and more.

Add energy data by choosing a Vista results file from the list below.

You need a user account and a valid license for One Click LCA.

Hit Run LCA/LCC button and the data will be instantly transferred to the One Click LCA cloud service.

More Information at: www.oneclicklca.com

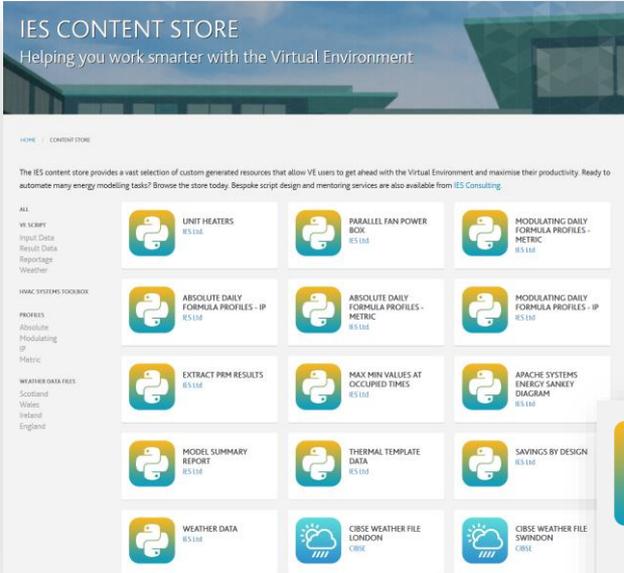
Select energy data to upload from a Vista results file (optional):

No Energy Results

One Click LCA user account is required. Create yours [here](#)

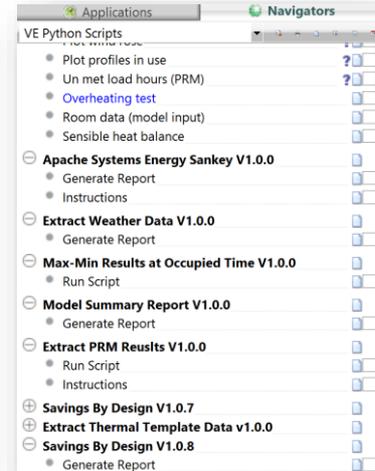
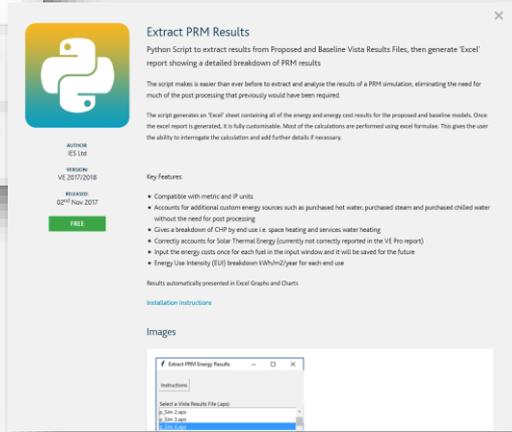
Help Run LCA/LCC

IES Content Store



Features:

- Download additional paid for and free content
- Python Scripts , Weather Files, HVAC Systems, Profiles
- Install encrypted python scripts
- Run from VE Python Scripts navigator
- Coming Soon – User Created Content



VE Python Scripts



INTEGRATED ENVIRONMENTAL SOLUTIONS

Thermal Templates Data

7. SPACE: Manufacturing - Low bay (<25 ft floor to ceiling Ht)

SPACE: Manufacturing - Low bay (<25ft floor to ceiling Ht) - People

Occupancy Density (m ² /person)	10.0	
Sensible Gain (W/person)	75.0	
Latent Gain (W/person)	55.0	
Radiant Fraction	0.4	

Process Steam Woodchip

Power Consumption (W/m ²)	72.7	
Sensible Gain (W/m ²)	61.8	
Latent Gain (W/m ²)	0.0	
Radiant Fraction	0.4	

SPACE: Manufacturing - Low bay (<25ft floor to ceiling Ht) - Lighting

Lighting Power Consumption (W/m ²)	13.0	
Lighting Heat Gain (W/m ²)	13.0	
Radiant Fraction	0.4	

Heating

Heating profile is set to 'on continuously'. Heating set point is defined as an absolute profile which is displayed on the right:

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INTEGRATED ENVIRONMENTAL SOLUTIONS

Apache Systems Data

1.2. Actual Building HVAC Systems

System Name	Radiators with Extract	VAV AHU 3	FCUs	Radiators	VAV AHU 2
Number of Rooms Assigned	4	48	175	175	48
Total Floor Area (m ²)	400.0	4800.0	17500.0	17500.0	4800.0
Heating	-	-	-	-	-
Heating Gen Efficiency:	0.81	0.81	0.81	0.81	0.81
Delivery Efficiency:	0.89	0.73	0.92	0.89	0.73
Fuel:	-	-	-	-	-
Heating SCoP:	0.72	0.59	0.75	0.72	0.59
Uses CHP:	No	No	No	No	No
HR Effectiveness:	0.0	0.0	0.0	0.0	0.0
HR Return Temp:	21.0	21.0	21.0	21.0	21.0
Cooling	-	-	-	-	-
Cooling Vent Mechanism:	-	a/c	a/c	-	a/c
SEER	-	2.0	2.0	-	2.0
Delivery Efficiency	-	0.72	0.88	-	0.72
Fuel	-	-	-	-	-
SSEER	n/a	1.11	1.35	n/a	1.11
Absorption Chiller	-	No	No	-	No
HR Pump & Fan Power	-	10.0%	10.0%	-	10.0%
Auxiliary Energy Method	SFP & AEV	SFP & AEV	AEV	AEV	SFP & AEV
AEV (W/m ²)	1.0	14.82	13.57	1.0	14.82
Off Schedule AEV (W/m ²)	0.0	0.0	0.0	0.0	0.0
System SFP (W/l/s)	0.0	3.0	-	-	3.0
Equivalent Energy kWh/m ² /y	3.26	48.24	44.18	3.26	48.24

2

Apache Systems

INTEGRATED ENVIRONMENTAL SOLUTIONS

Model Summary

Model Name : Many Fuels

Model Location : C:\Projects\Projects\Python\Astellas Test Model\Many Fuels\

VE Version : 2017.0.1.0

Script Version : V1.0.0

Units: Metric

1

Model Summary

Thermal Templates

VE Python Scripts - continued...



05/12/2017 Software Version: IESVE 2017.0.1.0

IESVE Savings By Design Report

Project: HQ, San Francisco
 Project Owner: Savings By Design Modeler
 Address: 1234 Market Street
 Climate Zone: CDD2

Design Team: IES
 Savings By Design Modeler: Energy Modeler
 Climate Zone: CDD2

ANNUAL SITE ENERGY USE (kBtu/ft²/year)

Energy End Use	Standard	Proposed	Margin
Space Heating Gas	0.0	0.7	0.06
Space Heating Electricity	0.0	3.2	3.2
Space Cooling	7.0	1.8	0.7
Fans Interior	0.4	0.6	0.2
Heat Rejection	0.5	3.5	3.0
Plumbing	0.1	0.2	0.1
DHW Gas	0.1	0.1	0.0
DHW Electricity	0.0	0.0	0.0
Interior Lighting	7.9	3.2	4.4
Receptacle	7.8	8.4	-0.5
Data Center	0.0	0.0	0.0
Cooking Gas	0.0	0.0	0.0
Cooking Electricity	0.1	0.1	0.0
Refrigeration	0.1	0.1	0.0
Other Process	0.6	0.6	0.0
TOTAL	40.1	21.3	18.9

PERCENT BELOW TITLE 24-2013

Energy End Use	Standard	Proposed	Margin
Space Heating Gas	0.0	0.7	0.5
Space Heating Electricity	0.0	25.5	25.5
Space Cooling	7.2	24.5	47.6
Fans Interior	4.9	22.0	37.3
Heat Rejection	43.9	30.0	31.9
Pumps	1.0	1.5	-0.5
DHW Gas	0.0	0.0	0.0
DHW Electricity	0.0	0.0	0.0
Interior Lighting	16.8	20.9	23.7
Receptacle	10.7	10.0	-7.5
Data Center	1.1	1.1	0.0
Cooking Gas	0.0	0.0	0.0
Cooking Electricity	0.4	0.4	0.0
Refrigeration	0.1	0.1	0.0
Other Process	1.5	1.5	0.0
Design Team Incentive (~10%)	0.5	0.5	0.0
TOTAL	77.4	218.3	98.3

PEAK DEER DEMAND MARGIN (Zpm Sgm) (kW and Therm)

Standard	Proposed	% Better		
ELECTRICITY	132.57	227.99	304.58	83.4
GAS	18,118.23	8,243.13	9,875.10	54.3

POTENTIAL INCENTIVES AVAILABLE

% TDV	Incentive Rate	kWh Saving	Subtotal
15.0%	\$0.15	88,907.4	\$13,336.14
5.0%	\$0.05	1,076	\$53,827.56
1.0%	\$0.01	204,58	\$2,045.80
0.5%	\$0.005	2,045.8	\$10,229.00
0.25%	\$0.0025	2,045.8	\$5,114.50
0.1%	\$0.001	2,045.8	\$2,045.80
0.05%	\$0.0005	2,045.8	\$1,022.90
0.025%	\$0.00025	2,045.8	\$511.45
0.01%	\$0.0001	2,045.8	\$204.58
0.005%	\$0.00005	2,045.8	\$102.29
0.0025%	\$0.000025	2,045.8	\$51.14
0.001%	\$0.00001	2,045.8	\$20.46
0.0005%	\$0.000005	2,045.8	\$10.23
0.00025%	\$0.0000025	2,045.8	\$5.11
0.0001%	\$0.000001	2,045.8	\$2.05
0.00005%	\$0.0000005	2,045.8	\$1.02
0.000025%	\$0.00000025	2,045.8	\$0.51
0.00001%	\$0.0000001	2,045.8	\$0.20
0.000005%	\$0.00000005	2,045.8	\$0.10
0.0000025%	\$0.000000025	2,045.8	\$0.05
0.000001%	\$0.00000001	2,045.8	\$0.02
0.0000005%	\$0.000000005	2,045.8	\$0.01
0.00000025%	\$0.0000000025	2,045.8	\$0.00
0.0000001%	\$0.000000001	2,045.8	\$0.00
0.00000005%	\$0.0000000005	2,045.8	\$0.00
0.000000025%	\$0.00000000025	2,045.8	\$0.00
0.00000001%	\$0.0000000001	2,045.8	\$0.00
0.000000005%	\$0.00000000005	2,045.8	\$0.00
0.0000000025%	\$0.000000000025	2,045.8	\$0.00
0.000000001%	\$0.00000000001	2,045.8	\$0.00
0.0000000005%	\$0.000000000005	2,045.8	\$0.00
0.00000000025%	\$0.0000000000025	2,045.8	\$0.00
0.0000000001%	\$0.000000000001	2,045.8	\$0.00
0.00000000005%	\$0.0000000000005	2,045.8	\$0.00
0.000000000025%	\$0.00000000000025	2,045.8	\$0.00
0.00000000001%	\$0.0000000000001	2,045.8	\$0.00
0.000000000005%	\$0.00000000000005	2,045.8	\$0.00
0.0000000000025%	\$0.000000000000025	2,045.8	\$0.00
0.000000000001%	\$0.00000000000001	2,045.8	\$0.00
0.0000000000005%	\$0.000000000000005	2,045.8	\$0.00
0.00000000000025%	\$0.0000000000000025	2,045.8	\$0.00
0.0000000000001%	\$0.000000000000001	2,045.8	\$0.00
0.00000000000005%	\$0.0000000000000005	2,045.8	\$0.00
0.000000000000025%	\$0.00000000000000025	2,045.8	\$0.00
0.00000000000001%	\$0.0000000000000001	2,045.8	\$0.00
0.000000000000005%	\$0.00000000000000005	2,045.8	\$0.00
0.0000000000000025%	\$0.000000000000000025	2,045.8	\$0.00
0.000000000000001%	\$0.00000000000000001	2,045.8	\$0.00
0.0000000000000005%	\$0.000000000000000005	2,045.8	\$0.00
0.00000000000000025%	\$0.0000000000000000025	2,045.8	\$0.00
0.0000000000000001%	\$0.000000000000000001	2,045.8	\$0.00
0.00000000000000005%	\$0.0000000000000000005	2,045.8	\$0.00
0.000000000000000025%	\$0.00000000000000000025	2,045.8	\$0.00
0.00000000000000001%	\$0.0000000000000000001	2,045.8	\$0.00
0.000000000000000005%	\$0.00000000000000000005	2,045.8	\$0.00
0.0000000000000000025%	\$0.000000000000000000025	2,045.8	\$0.00
0.000000000000000001%	\$0.00000000000000000001	2,045.8	\$0.00
0.0000000000000000005%	\$0.000000000000000000005	2,045.8	\$0.00
0.00000000000000000025%	\$0.0000000000000000000025	2,045.8	\$0.00
0.0000000000000000001%	\$0.000000000000000000001	2,045.8	\$0.00
0.00000000000000000005%	\$0.0000000000000000000005	2,045.8	\$0.00
0.000000000000000000025%	\$0.00000000000000000000025	2,045.8	\$0.00
0.00000000000000000001%	\$0.0000000000000000000001	2,045.8	\$0.00
0.000000000000000000005%	\$0.00000000000000000000005	2,045.8	\$0.00
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0.0000000000000000000001%	\$0.000000000000000000000001	2,045.8	\$0.00
0.00000000000000000000005%	\$0.0000000000000000000000005	2,045.8	\$0.00
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0.0000000000000000000000025%	\$0.000000000000000000000000025	2,045.8	\$0.00
0.000000000000000000000001%	\$0.00000000000000000000000001	2,045.8	\$0.00
0.0000000000000000000000005%	\$0.000000000000000000000000005	2,045.8	\$0.00
0.00000000000000000000000025%	\$0.0000000000000000000000000025	2,045.8	\$0.00
0.0000000000000000000000001%	\$0.000000000000000000000000001	2,045.8	\$0.00
0.00000000000000000000000005%	\$0.0000000000000000000000000005	2,045.8	\$0.00
0.000000000000000000000000025%	\$0.00000000000000000000000000025	2,045.8	\$0.00
0.00000000000000000000000001%	\$0.0000000000000000000000000001	2,045.8	\$0.00
0.000000000000000000000000005%	\$0.00000000000000000000000000005	2,045.8	\$0.00
0.0000000000000000000000000025%	\$0.000000000000000000000000000025	2,045.8	\$0.00
0.000000000000000000000000001%	\$0.00000000000000000000000000001	2,045.8	\$0.00
0.0000000000000000000000000005%	\$0.000000000000000000000000000005	2,045.8	\$0.00
0.00000000000000000000000000025%	\$0.0000000000000000000000000000025	2,045.8	\$0.00
0.0000000000000000000000000001%	\$0.000000000000000000000000000001	2,045.8	\$0.00
0.00000000000000000000000000005%	\$0.0000000000000000000000000000005	2,045.8	\$0.00
0.000000000000000000000000000025%	\$0.00000000000000000000000000000025	2,045.8	\$0.00
0.00000000000000000000000000001%	\$0.0000000000000000000000000000001	2,045.8	\$0.00
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0.000000000000000000000000000001%	\$0.00000000000000000000000000000001	2,045.8	\$0.00
0.0000000000000000000000000000005%	\$0.000000000000000000000000000000005	2,045.8	\$0.00
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0.0000000000000000000000000000000005%	\$0.000000000000000000000000000000000005	2,045.8	\$0.00
0.00000000000000000000000000000000025%	\$0.0000000000000000000000000000000000025	2,045.8	\$0.00
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0.000000000000000000000000000000000025%	\$0.00000000000000000000000000000000000025	2,045.8	\$0.00
0.00000000000000000000000000000000001%	\$0.0000000000000000000000000000000000001	2,045.8	\$0.00
0.0000000000000000000000000000000000005%	\$0.00000000000000000000000000000000000005	2,045.8	\$0.00
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0.00000000000000000000000000000000000001%	\$0.00000000000000000000000000000000000001	2,045.8	\$0.00
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0.0000000000000000000000000000000000000001%	\$0.0000000000000000000000000000000000000001	2,045.8	\$0.00
0.005%	\$0.005	2,045.8	\$0.00
0.0025%	\$0.0025	2,045.8	\$0.00
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0.0005%	\$0.005	2,045.8	\$0.00
0.00025%	\$0.0025	2,045.8	\$0.00
0.0001%	\$0.001	2,045.8	\$0.00
0.005%	\$0.0005	2,045.8	\$0.00
0.0025%	\$0.0002		



Free IES Faculty Event

DIGITAL DESIGN & ENGINEERING: *applications of simulation in BIM*

22ND March 9.30 am, Royal Society (London)

<https://www.iesve.com/discoveries/article/6991/ies-faculty-march-18>