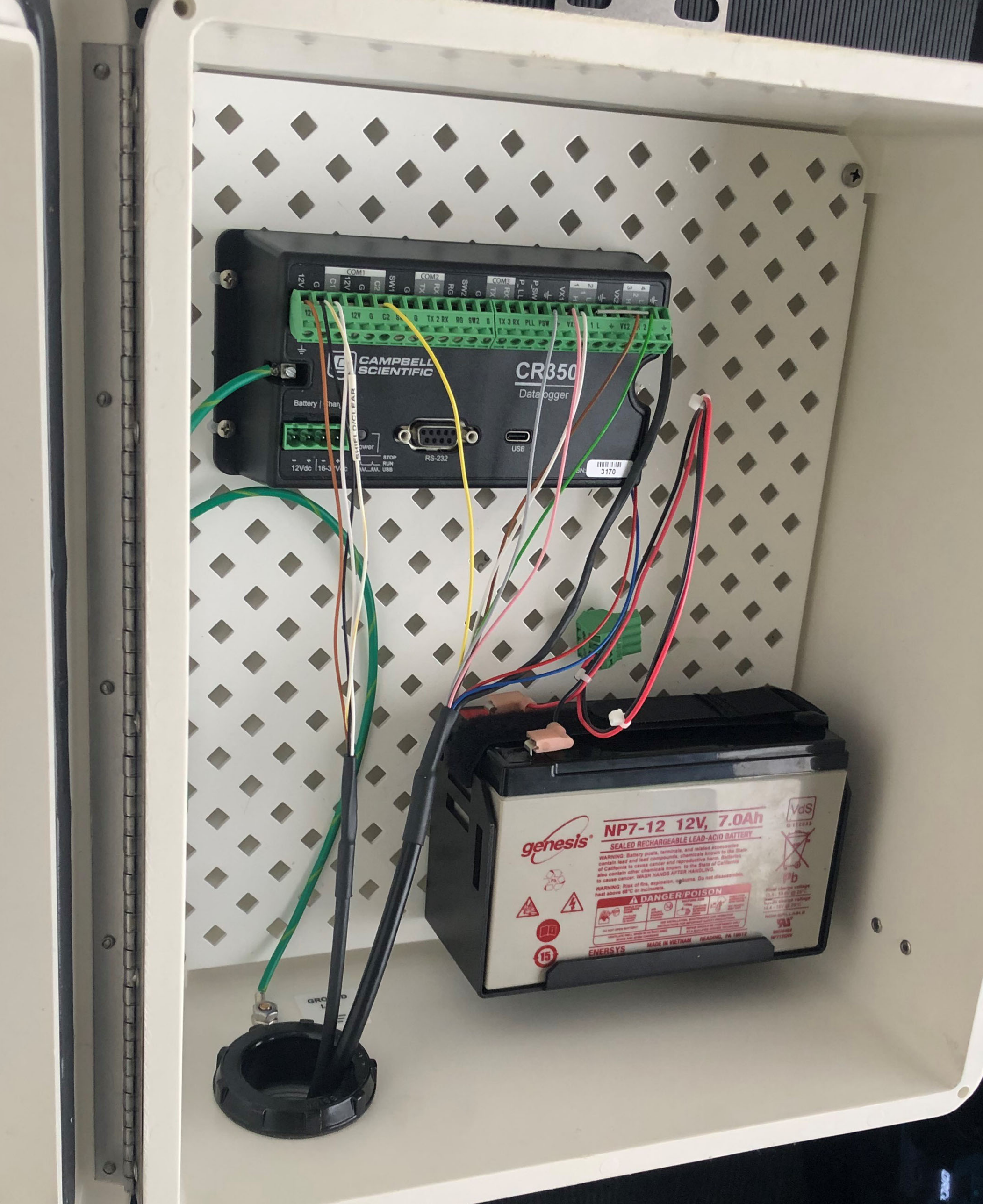
SUSTAINABLE OUTDOOR AND SEMI-OUTDOOR SPACES

Health-Promoting Urban Exteriors

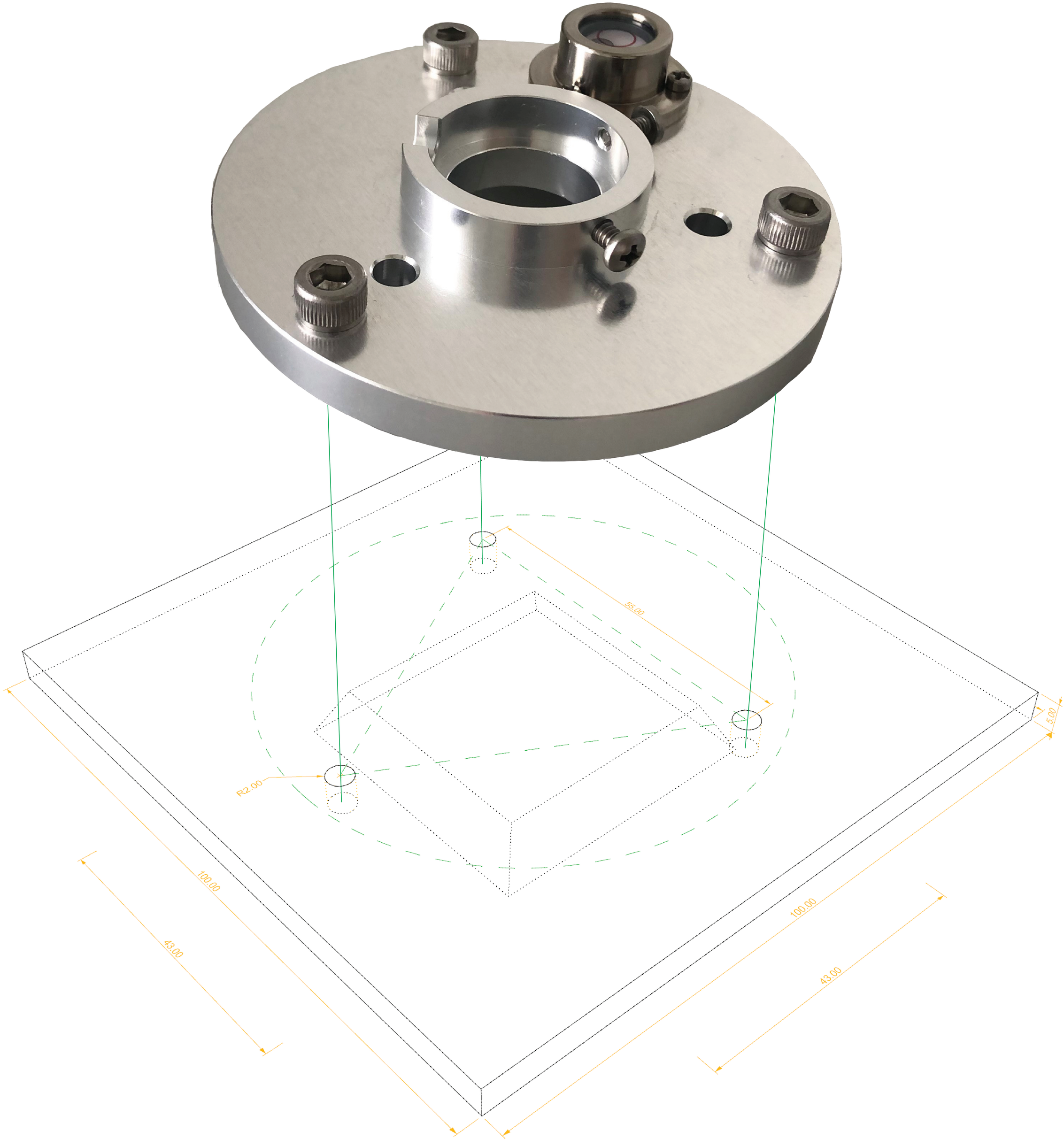
GERALD D. HINES COLLEGE OF
ARCHITECTURE AND DESIGN


FDC


COM1
COM2
COM3
CAMPBELL SCIENTIFIC
CR350
Datalogger
RS-232
USB
genesis
NP7-12 12V, 7.0Ah
SEALED RECHARGEABLE LEAD-ACID BATTERY
DANGER/POISON
ENERSYS
MADE IN VIETNAM
READING, PA 19612



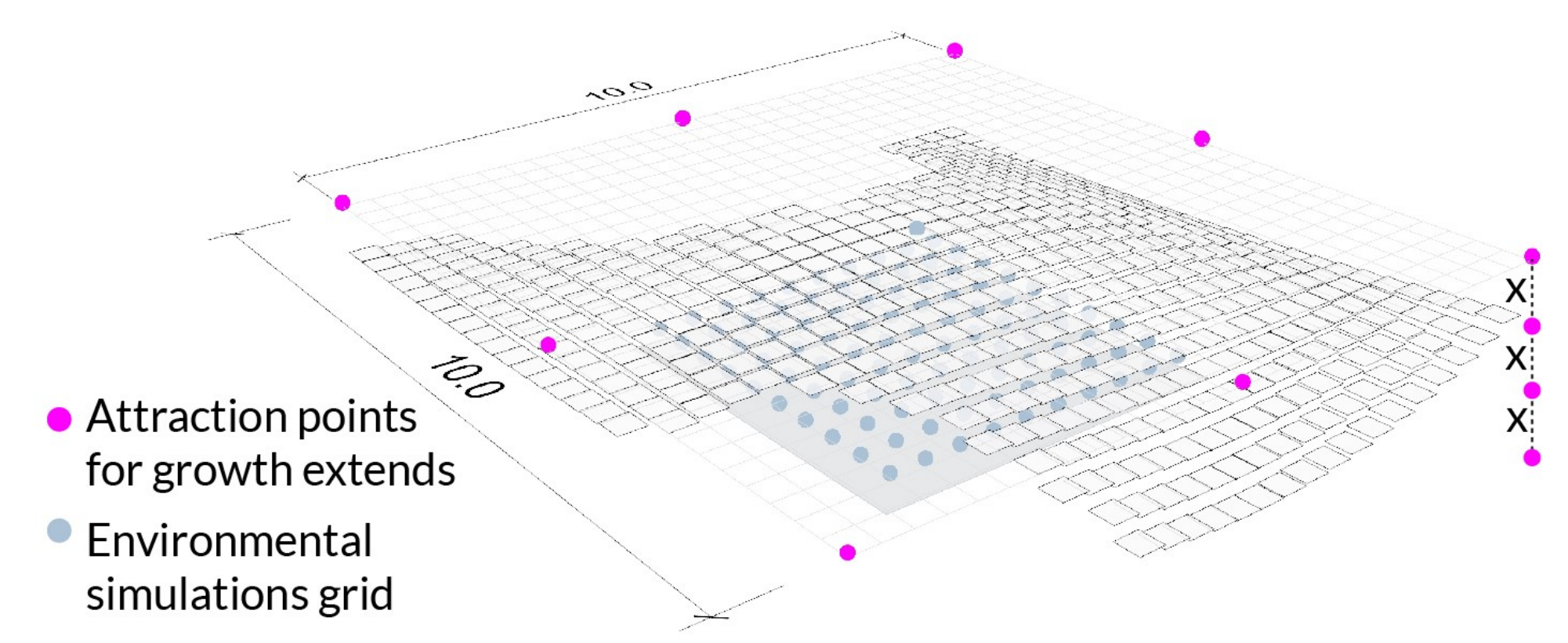

DOLICA
ST-510

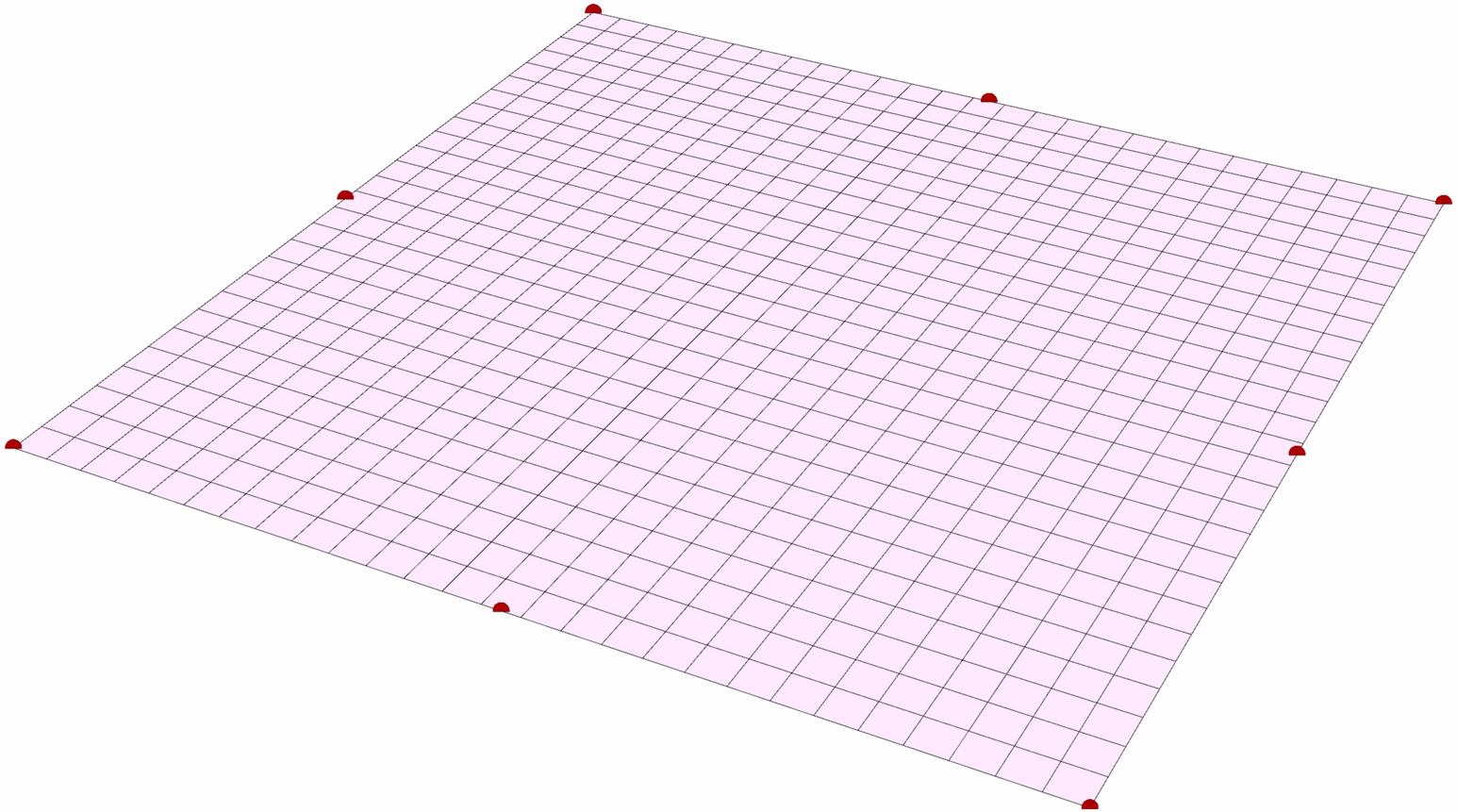

55.00
R2.00
100.00
43.00
5.00
100.00
43.00

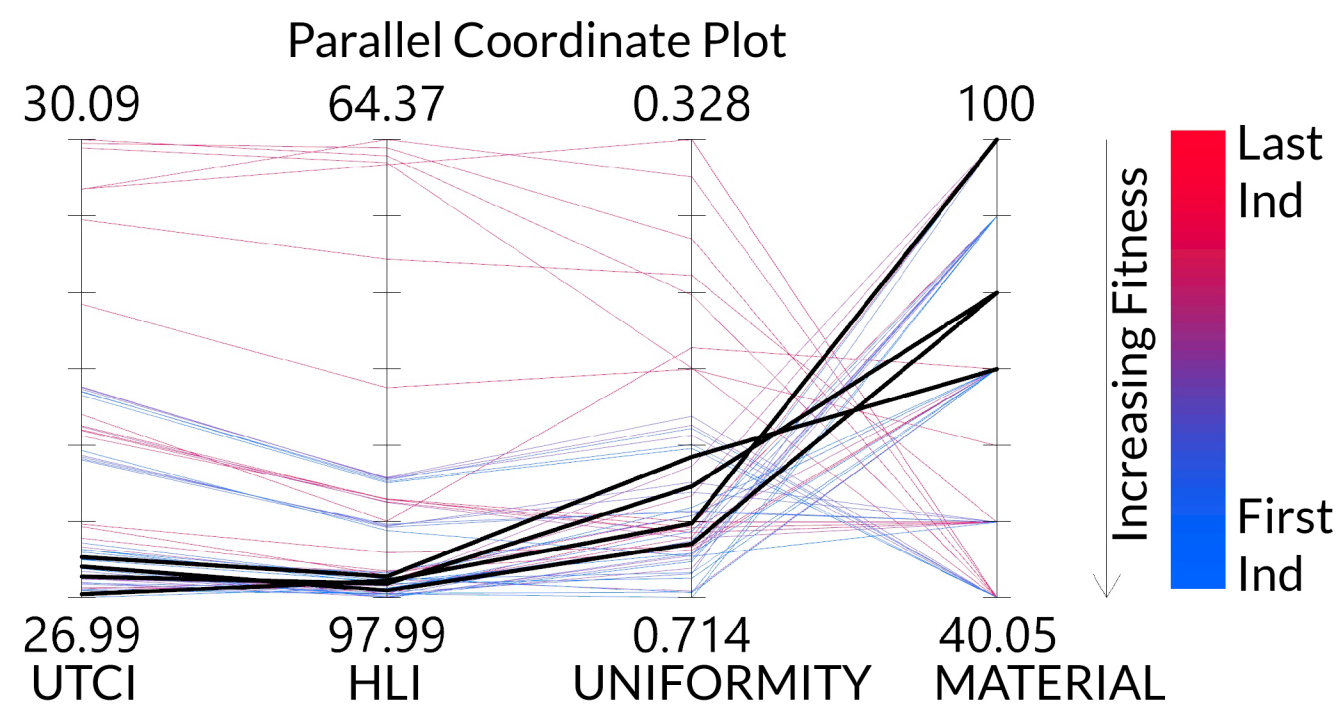


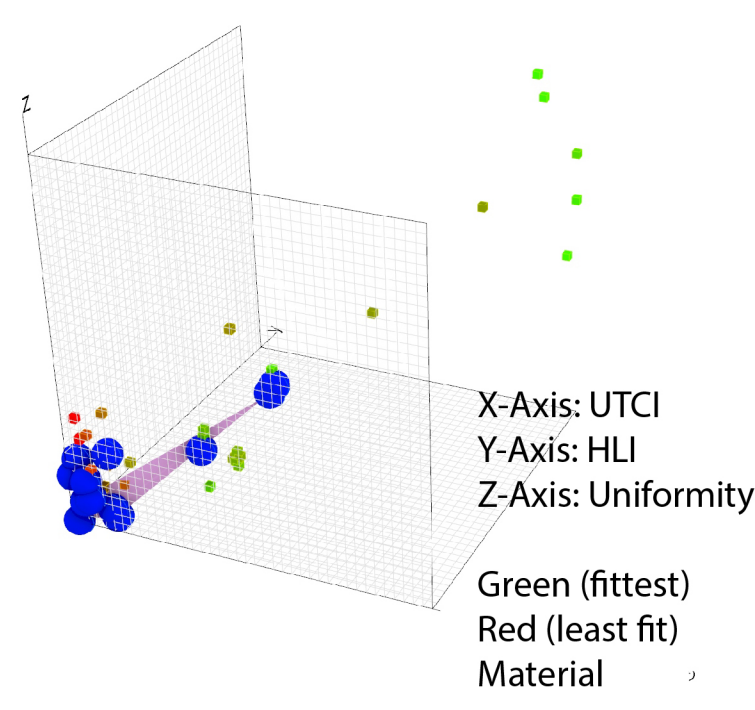
SUSTAINABLE OUTDOOR AND SEMI-OUTDOOR SPACES

Outdoor Generative Shading Design

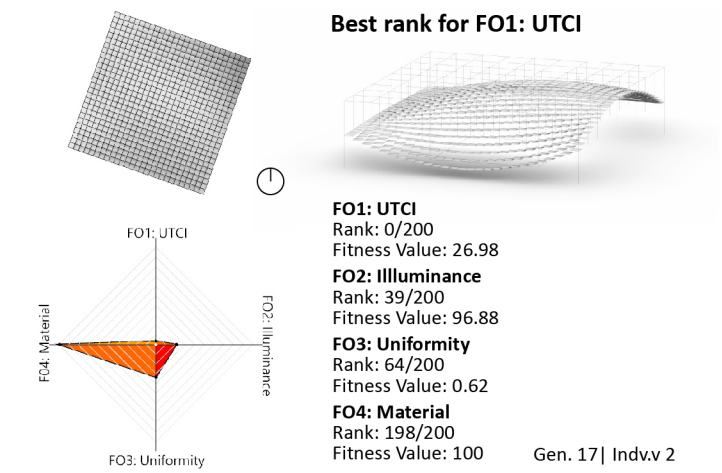

10.0
10.0
X
X
X
Attraction points for growth extends
Environmental simulations grid




Parallel Coordinate Plot
30.09
64.37
0.328
100
26.99
97.99
0.714
40.05
UTCI
HLI
UNIFORMITY
MATERIAL
Increasing Fitness
Last Ind
First Ind


X-Axis: UTCI
Y-Axis: HLI
Z-Axis: Uniformity
Green (fittest)
Red (least fit)
Material

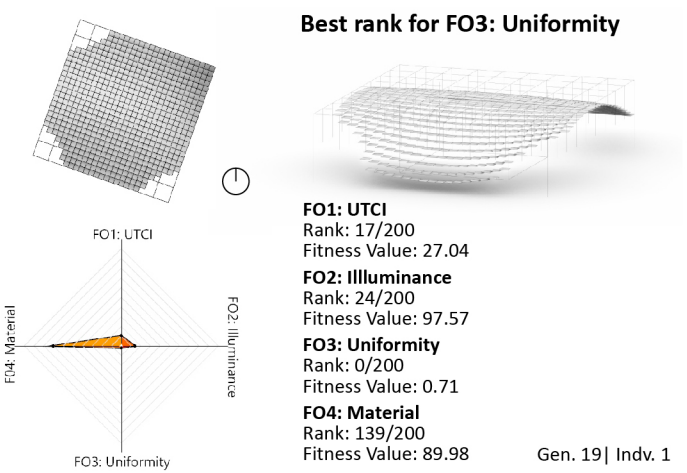
Best rank for FO1: UTCI



FO1: UTCI
Rank: 0/200
Fitness Value: 26.98
FO2: Illluminance
Rank: 39/200
Fitness Value: 96.88
FO3: Uniformity
Rank: 64/200
Fitness Value: 0.62
FO4: Material
Rank: 198/200
Fitness Value: 100

Gen. 17| Indv.v 2

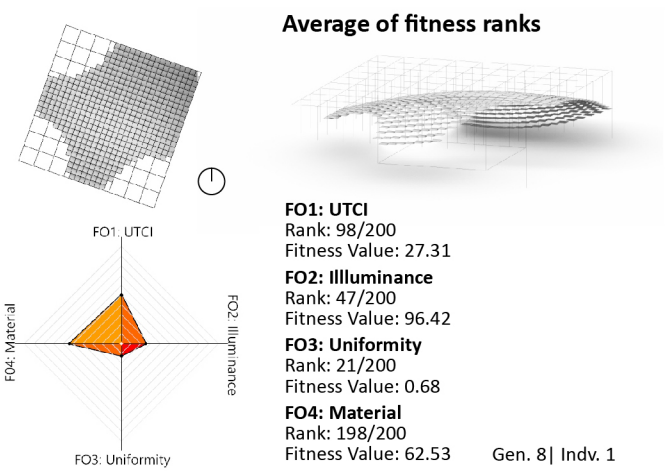
Best rank for FO3: Uniformity



FO1: UTCI
Rank: 17/200
Fitness Value: 27.04
FO2: Illluminance
Rank: 24/200
Fitness Value: 97.57
FO3: Uniformity
Rank: 0/200
Fitness Value: 0.71
FO4: Material
Rank: 139/200
Fitness Value: 89.98

Gen. 19| Indv. 1

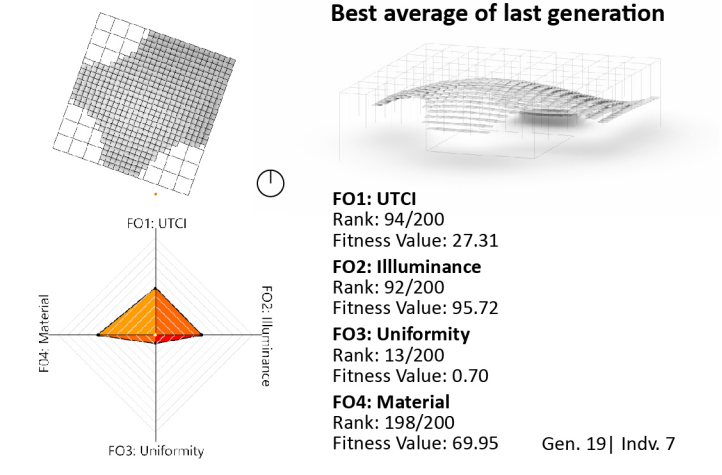
Average of fitness ranks



FO1: UTCI
Rank: 98/200
Fitness Value: 27.31
FO2: Illluminance
Rank: 47/200
Fitness Value: 96.42
FO3: Uniformity
Rank: 21/200
Fitness Value: 0.68
FO4: Material
Rank: 198/200
Fitness Value: 62.53

Gen. 8| Indv. 1

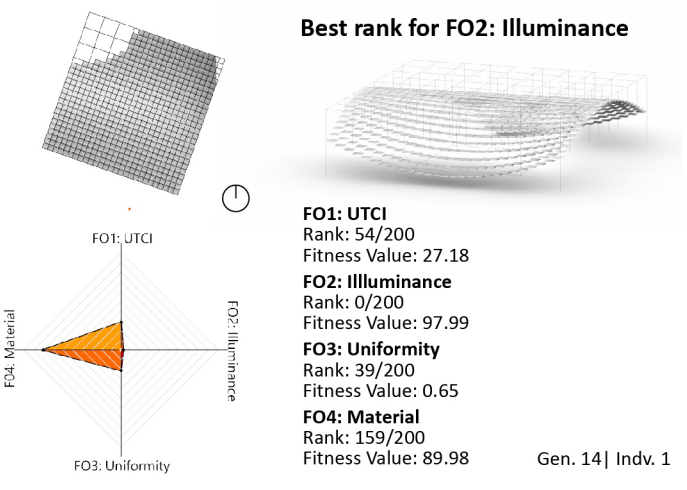
Best average of last generation



FO1: UTCI
Rank: 94/200
Fitness Value: 27.31
FO2: Illluminance
Rank: 92/200
Fitness Value: 95.72
FO3: Uniformity
Rank: 13/200
Fitness Value: 0.70
FO4: Material
Rank: 198/200
Fitness Value: 69.95

Gen. 19| Indv. 7

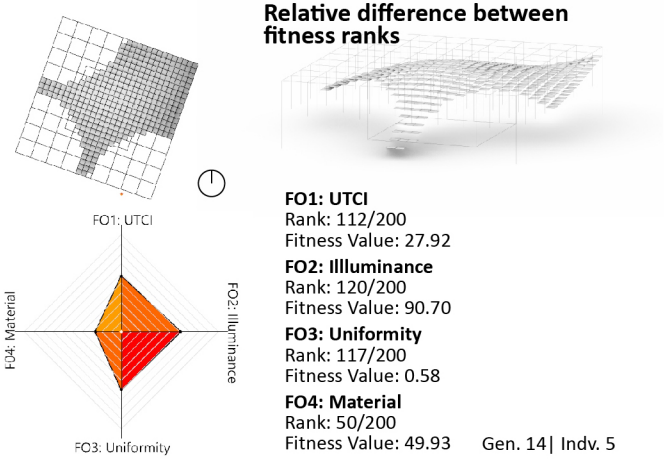
Best rank for FO2: Illuminance



FO1: UTCI
Rank: 54/200
Fitness Value: 27.18
FO2: Illluminance
Rank: 0/200
Fitness Value: 97.99
FO3: Uniformity
Rank: 39/200
Fitness Value: 0.65
FO4: Material
Rank: 159/200
Fitness Value: 89.98

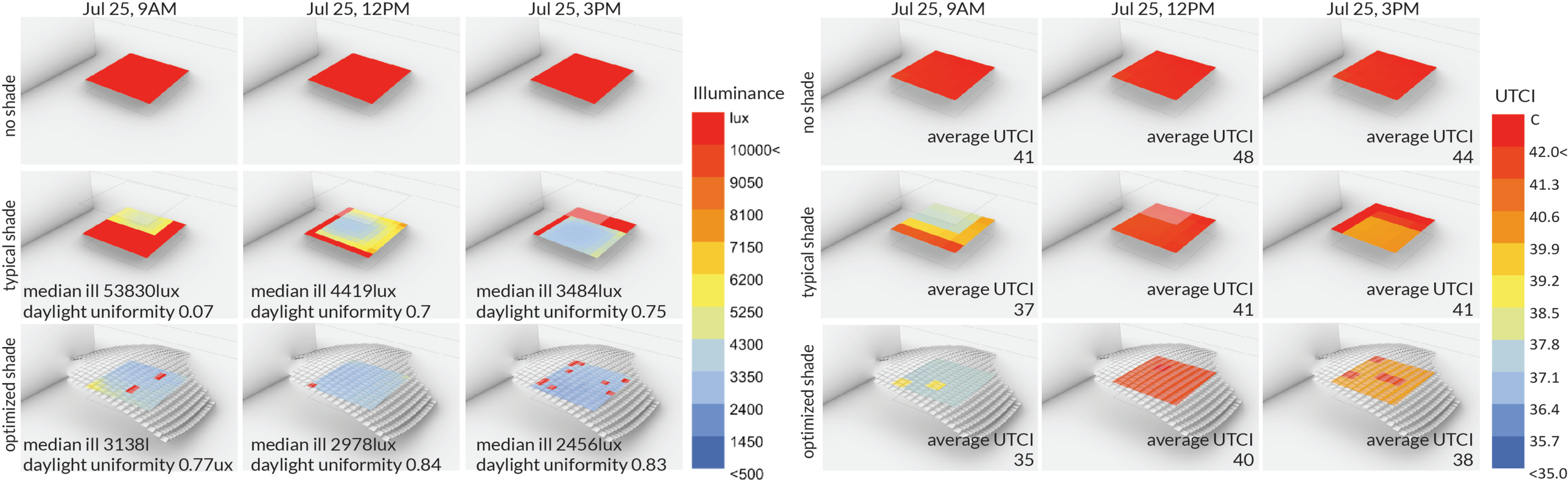
Gen. 14| Indv. 1

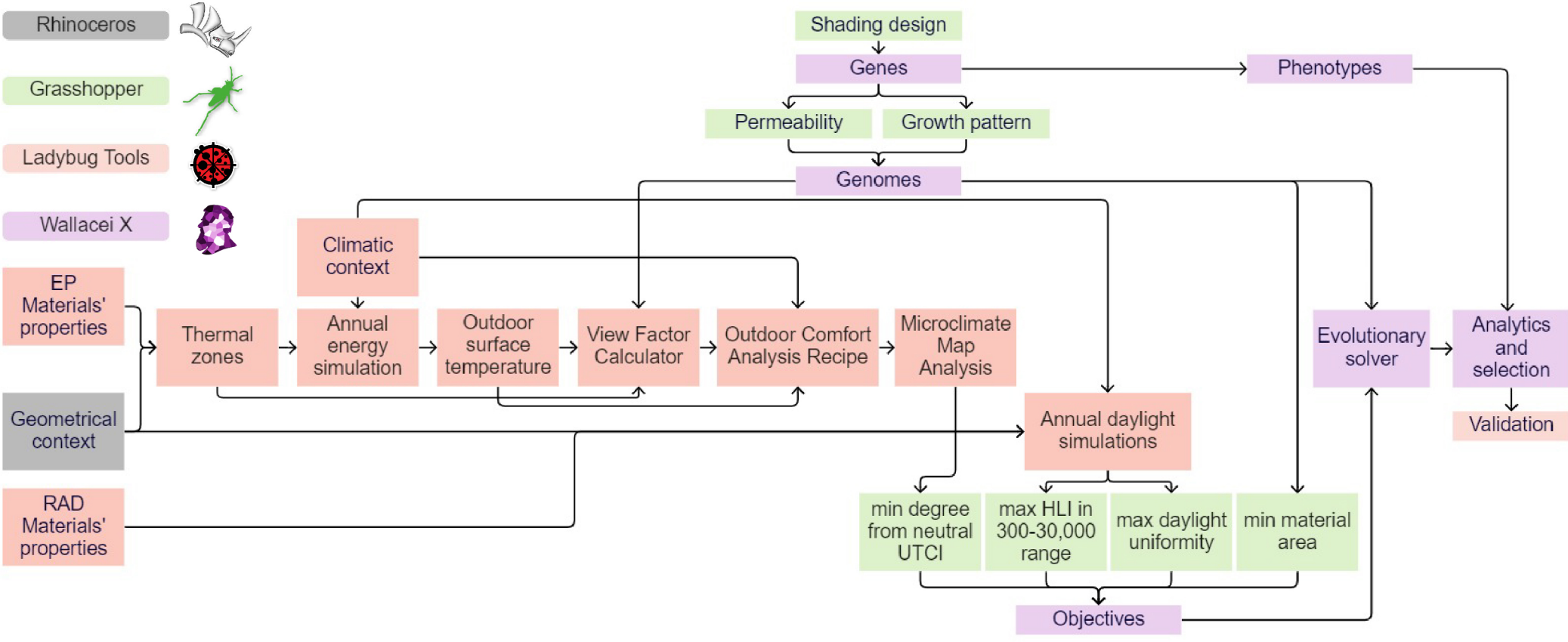
Relative difference between fitness ranks



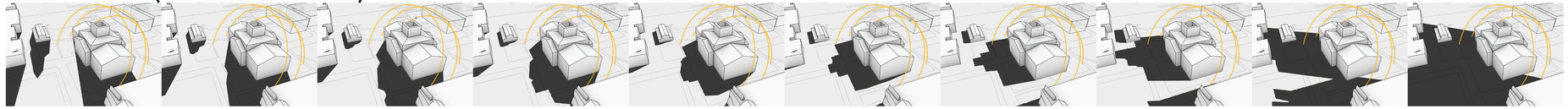
FO1: UTCI
Rank: 112/200
Fitness Value: 27.92
FO2: Illluminance
Rank: 120/200
Fitness Value: 90.70
FO3: Uniformity
Rank: 117/200
Fitness Value: 0.58
FO4: Material
Rank: 50/200
Fitness Value: 49.93

Gen. 14| Indv. 5

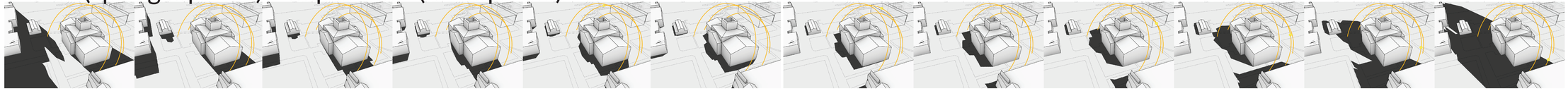

Jul 25, 9AM
Jul 25, 12PM
Jul 25, 3PM
no shade
typical shade
optimized shade
median ill 53830lux
daylight uniformity 0.07
median ill 4419lux
daylight uniformity 0.7
median ill 3484lux
daylight uniformity 0.75
median ill 3138l
daylight uniformity 0.77ux
median ill 2978lux
daylight uniformity 0.84
median ill 2456lux
daylight uniformity 0.83
Illuminance
lux
10000<
9050
8100
7150
6200
5250
4300
3350
2400
1450
<500
Jul 25, 9AM
Jul 25, 12PM
Jul 25, 3PM
no shade
typical shade
optimized shade
average UTCI
41
average UTCI
48
average UTCI
44
average UTCI
37
average UTCI
41
average UTCI
41
average UTCI
35
average UTCI
40
average UTCI
38
UTCI
C
42.0<
41.3
40.6
39.9
39.2
38.5
37.8
37.1
36.4
35.7
<35.0


Rhinoceros
Grasshopper
Ladybug Tools
Wallacei X
EP Materials' properties
Geometrical context
RAD Materials' properties
Shading design
Genes
Phenotypes
Permeability
Growth pattern
Genomes
Climatic context
Thermal zones
Annual energy simulation
Outdoor surface temperature
View Factor Calculator
Outdoor Comfort Analysis Recipe
Microclimate Map Analysis
Annual daylight simulations
Evolutionary solver
Analytics and selection
Validation
min degree from neutral UTCI
max HLI in 300-30,000 range
max daylight uniformity
min material area
Objectives

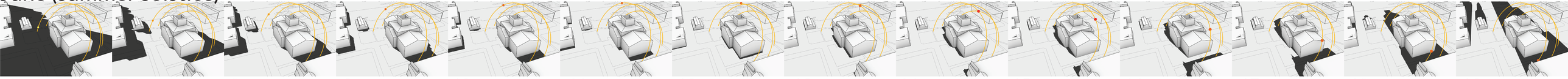
December (winter solstice)



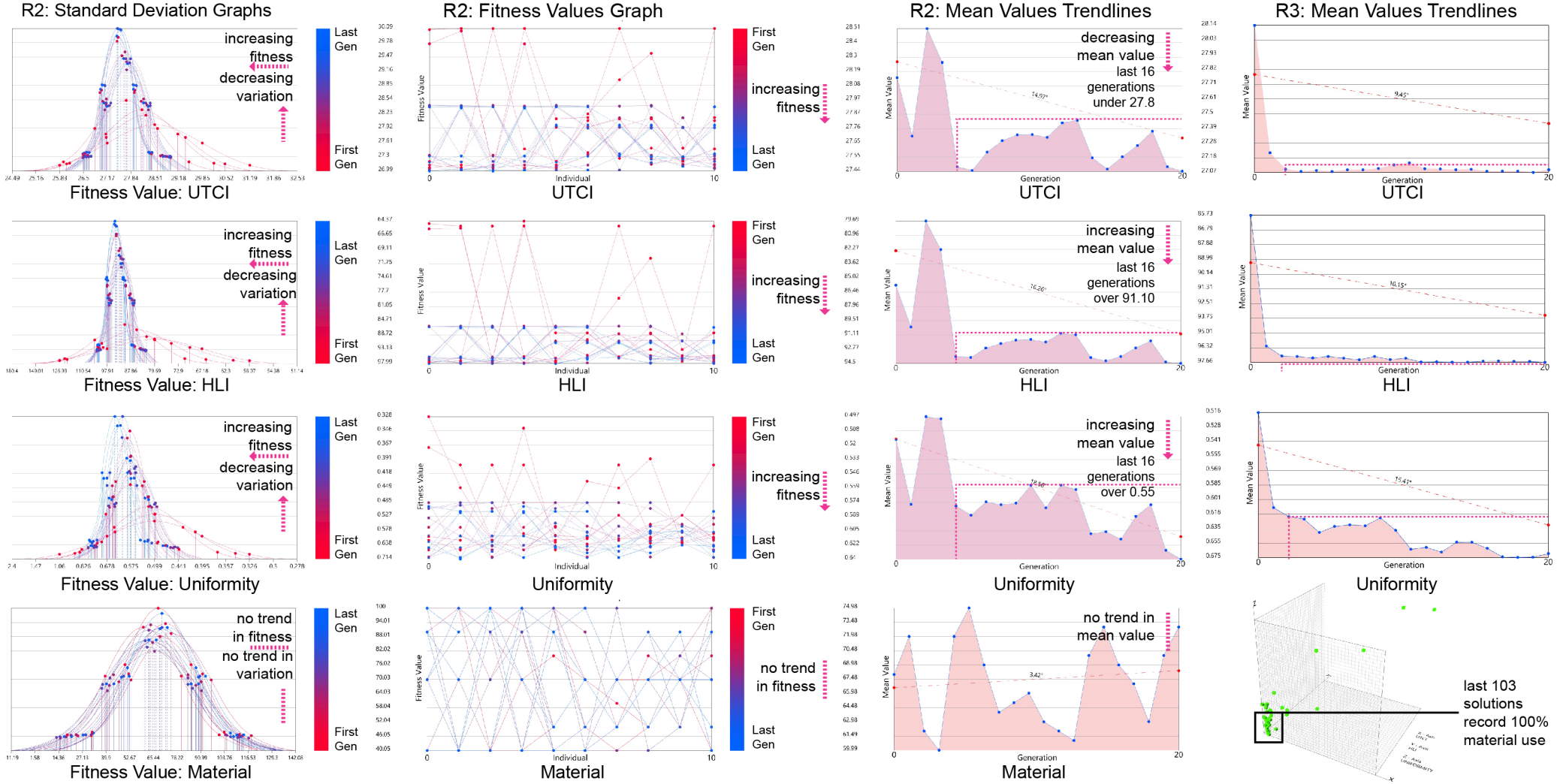
March (spring equinox) ~ September (fall equinox)



June (summer solstice)



6 7 8 9 10 11 12 13 14 15 16 17 18 19


R2: Standard Deviation Graphs
R2: Fitness Values Graph
R2: Mean Values Trendlines
R3: Mean Values Trendlines
increasing fitness
decreasing variation
Last Gen
First Gen
Fitness Value: UTCI
Fitness Value
Individual
UTCI
decreasing mean value last 16 generations under 27.8
Mean Value
Generation
Fitness Value: HLI
HLI
increasing mean value last 16 generations over 91.10
Fitness Value: Uniformity
Uniformity
increasing mean value last 16 generations over 0.55
no trend in fitness
no trend in variation
Fitness Value: Material
Material
no trend in mean value
last 103 solutions record 100% material use