

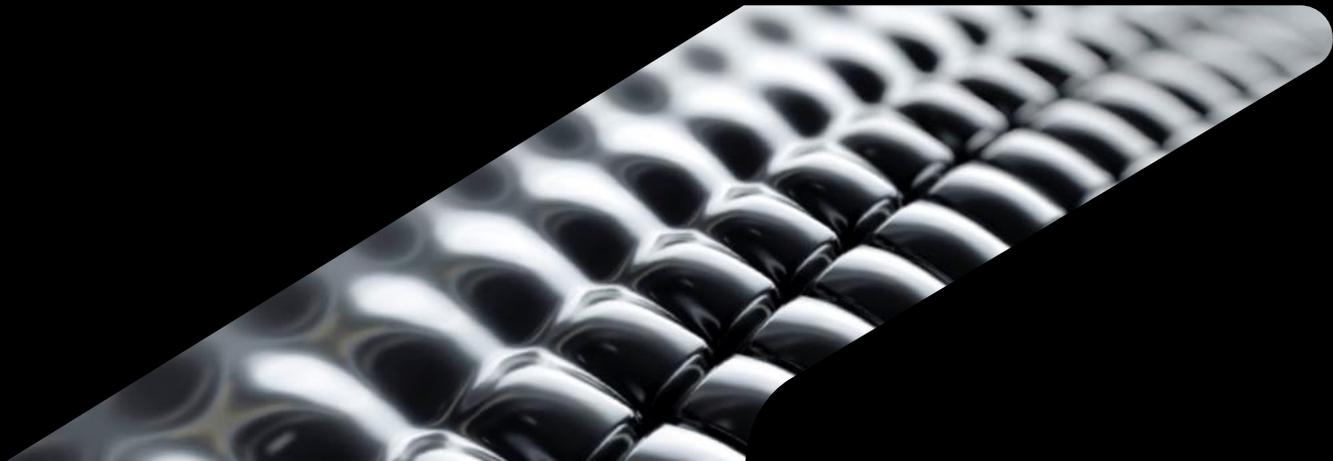


# There's no Planet B Sustainability's the Key!

BES500719

Justin Taylor  
Principal Sustainability Consultant

Marcel Lanjouw  
Sr. Implementation Consultant



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## Justin Taylor

Principal Sustainability Consultant | EMEA

#BIMAlchemist #BetterWorld #Sustainability

Justin has more than 30 years' experience working with Autodesk solutions across the globe. Having previously focused on helping AEC firms digitize their workflows, he is now super excited to join the Autodesk Sustainability Practice and support customers as they strive to meet their Net Zero goals.

*“Our customers design and build the world, so we are in the perfect position to influence and enable more sustainable design practices”*

He brings along expertise in areas such as reality capture for refurb and retrofit, low carbon design and material circularity, health & wellbeing design and analysis in buildings.

Outside of work Justin enjoys spending time with his family and his hyper-active Cocker Spaniel, Diego, in the great outdoors, exploring the countryside and the UK's historical sites of interest. He is also a bookworm, a amateur bonsai grower and trying to become a better guitar player.

Challenges don't get bigger than this and we all need to work together to build a #BETTERWORLD

### LOCATION

 United Kingdom

### CONTACT DETAILS

 Justin.taylor@autodesk.com

### INDUSTRY FOCUS

Sustainability

### EXPERTISE

BIM Alchemy, Sustainability, Construction Management & Reality Capture

Justin is a certified BREEAM International New Construction assessor, Green Star SA consultant, CAA PfCO certified drone pilot and has an HND in Electronics and Engineering, City & Guilds in Computer Aided Design, PgDip in Construction Management, PgDip in Marketing and is a Prosci® Certified Change Practitioner, as well as an Autodesk Certified Instructor and Autodesk Expert Elite.

*“We are living as though there is a planet B. News Flash... there isn't. We need to change the way we design and build NOW!”*



## Marcel Lanjouw

Senior Implementation Consultant

Marcel brings nearly 25 years of experience in construction and structural design. He has a history of promoting innovation in design technology within construction firms, and now brings the experience of in-house design software implementation to Autodesk customers.

Marcel has found it can be a challenge for construction firms to step back from day-to-day operations to make overhauls in design technology, but such overhauls can yield impressive process improvements when they are undertaken. Drawing on his combined experience with on-the-ground work with construction firms and technical expertise in Autodesk software, Marcel now demonstrates the value of digitizing design processes, and guides firms through their adoption. He has advised on numerous such projects, including bringing a pre-cast concrete operation from completely manual to 99% automated production.

### LOCATION



Netherlands

### CONTACT DETAILS



[Marcel.lanjouw@autodesk.com](mailto:Marcel.lanjouw@autodesk.com)

### INDUSTRY FOCUS

Construction, Manufacturing

### EXPERTISE

BIM 360 Design, Coordinate, and Build; Revit; Navisworks; AutoCAD

Marcel holds a graduate technical degree in construction and structural design.

*“Throughout my career, I’ve made it a goal to search for value in the most advanced design tools. Now, I help customers take a step back from their normal processes and find places where new tools can add value.”*

Our planet is a closed system  
Our resources are limited  
There is no Planet B



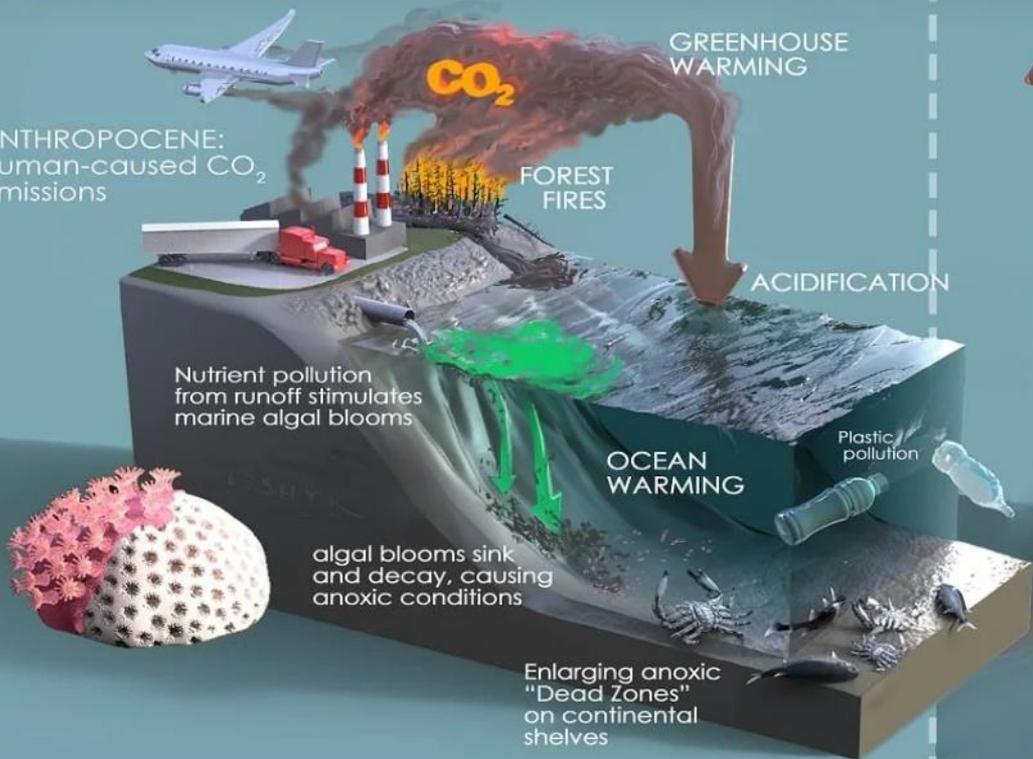


The villain

# MODERN DAY

Examples of oceanic warming, anoxia, coral damage, and acidification are increasing worldwide.

ANTHROPOCENE:  
Human-caused CO<sub>2</sub> emissions



# END-TRIASSIC: Seafloor spreading in Central Atlantic Magmatic Province

Heavy losses of coral genera and diversity

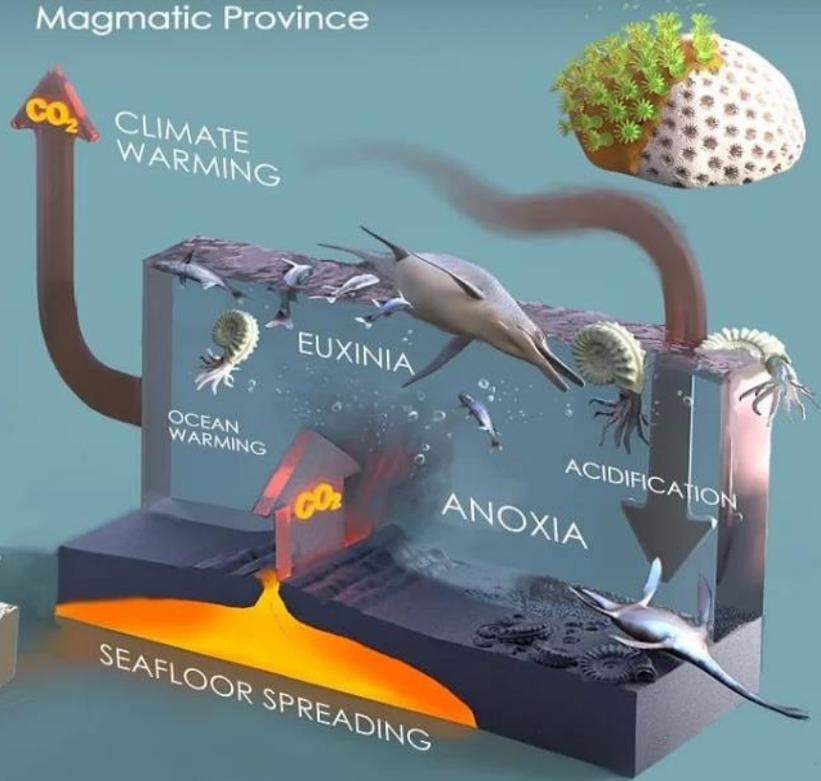
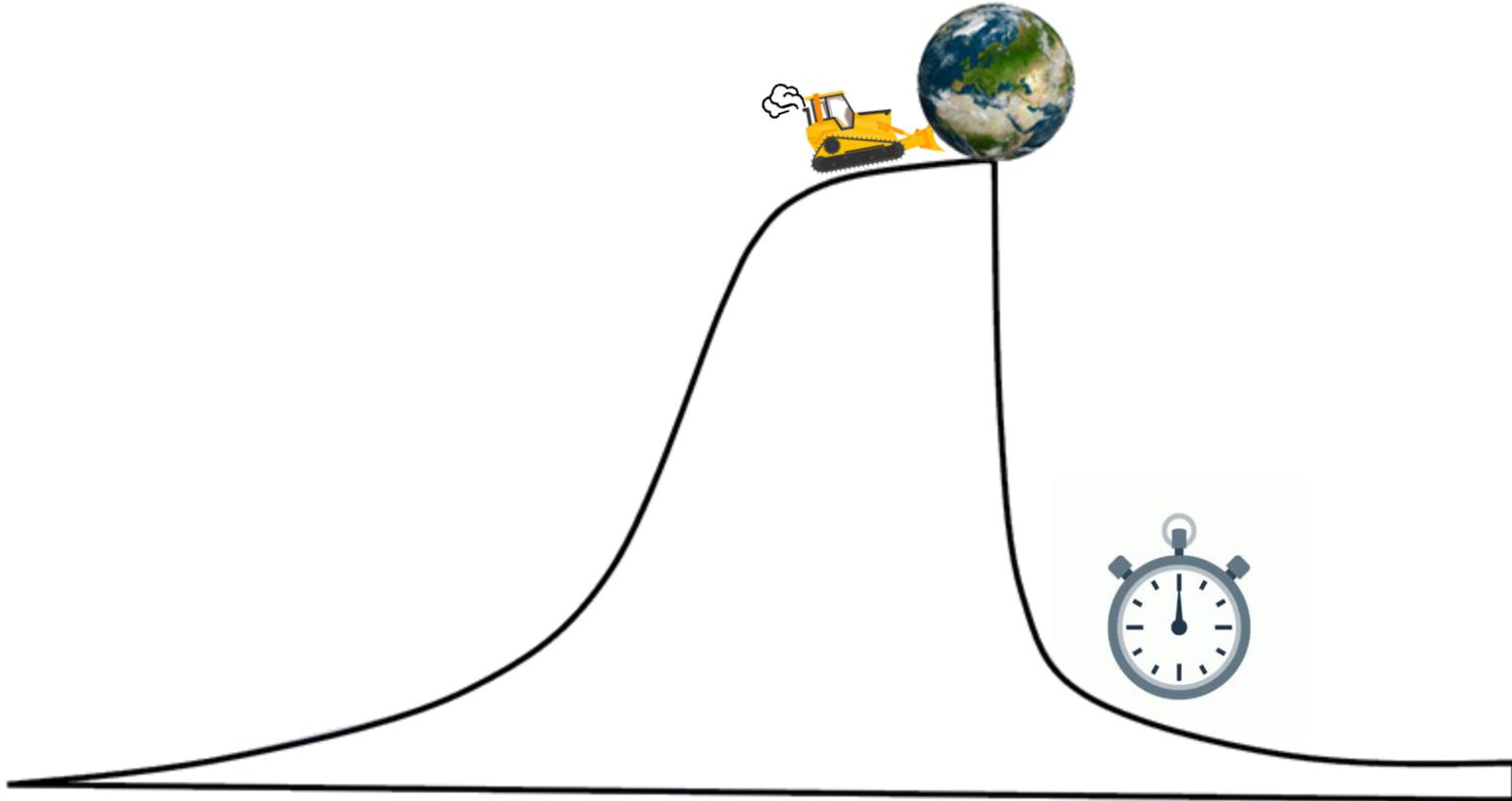


Image credit: Victor O. Leshyk

# The 2030 Tipping Point

8 Years and counting down



# Learning Objectives

1

Identify sustainable opportunities in every project, no matter the scale or complexity

2

Learn how BIM and DfMA data can improve both operational efficiency and reduce environmental impact

3

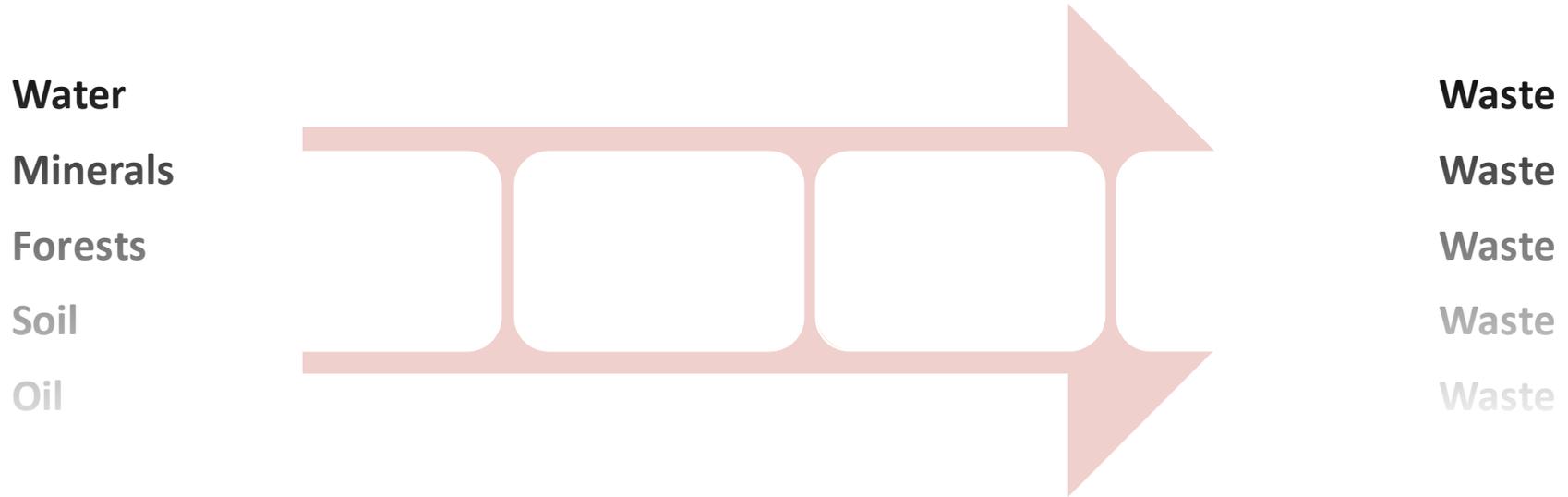
Realize how early data driven decisions can radically improve project outcomes

4

Understand how resilience can be designed into our products & buildings allowing them to adapt in our ever changing world



# Linear Economy



Construction creates an estimated third of the world's overall waste - at least **40% of the world's carbon dioxide emissions**

**So how much is 40%?**

8,611m  
(28,251')

We currently extract 100 billion tons of raw materials from the earth every year. That's the equivalent of two-thirds of Mount Everest

# 100 billion tons

828m  
(2,717') Burj Khalifa

That's 10,000 Burj Khalifa's

4000m above  
sea lvl





The hero

# Circular Economy (DfX)



**Circular design is about creating products and buildings that no longer have a lifecycle with a beginning, a middle and an end.**

The ultimate goal being zero use of virgin materials and zero waste going into landfill

# Circular Design



# LIFE CYCLE INFORMATION

PRODUCT

CONSTRUCTION  
PROCESS

USE

END OF LIFE

A1

A2

A3

A4

A5

B1

B2

B3

B4

B4

C1

C2

C3

C4

Raw Material Supply

Transport

Manufacturing

Transport

Construction Installation  
Process

Use

Maintenance

Repair

Replacement

Refurbishment

De-construction

Transport

Waste Processing

Disposal

B6 operation Energy Use  
B7 Operational Water Use



**DfX** (Designed for Circularity)

The complete Building Information Model

**“You can’t manage what you  
can’t measure”**

*Peter F. Drucker*

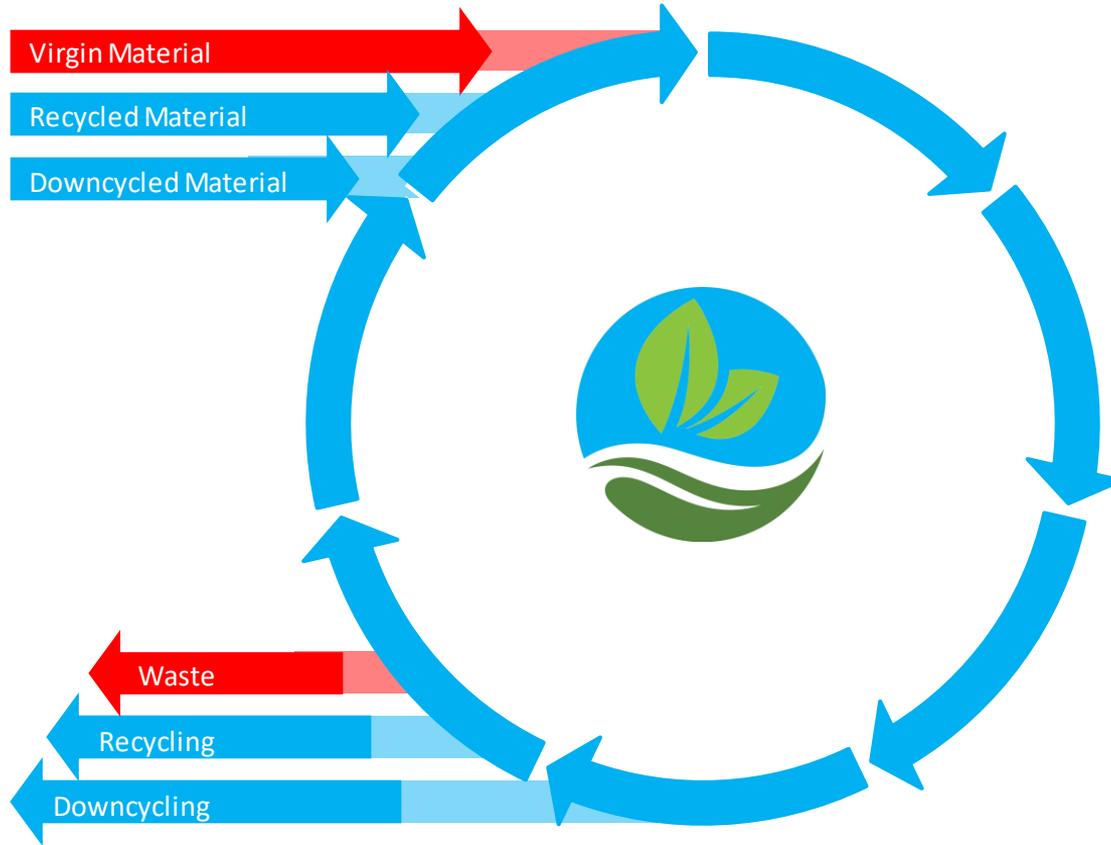


**“Just because you can measure everything doesn't mean that you should.”**

1. Appreciation of a system
2. Knowledge of variation
3. Theory of knowledge
4. Knowledge of psychology

*W. Edwards Deming*

# Design for Circularity (DfX)

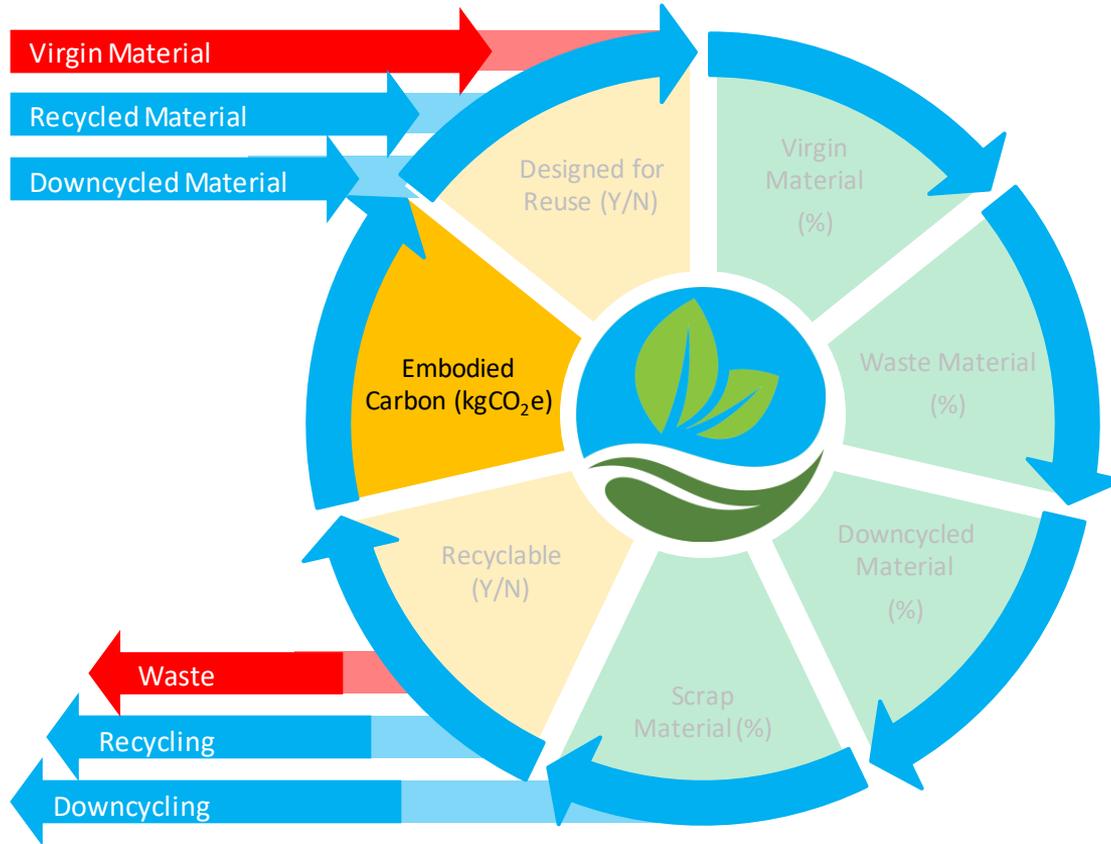


The first principle of developing a circular economy is eliminating waste and pollution.

The second principle is circulating products and materials.

The third is regenerating nature.

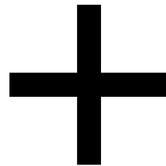
# Embodied Carbon



Whole life-cycle carbon, otherwise known as the 'carbon footprint', is the total greenhouse gas (GHG) emissions caused by an individual, event, organisation, service, place or product and is expressed as carbon dioxide equivalent (CO<sub>2</sub>e).

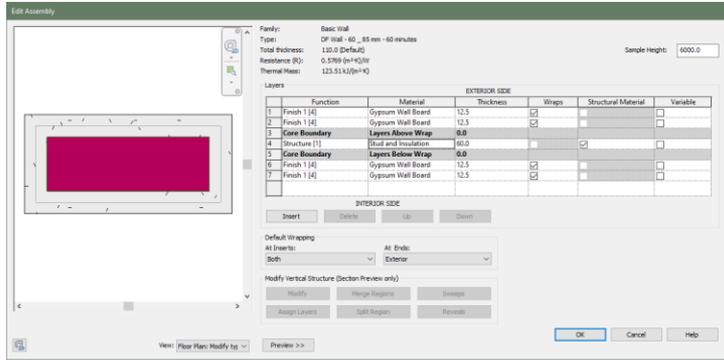
# Let's Talk Carbon

**Embodied Carbon (EC):** Refers to the GHGs (greenhouse gas emissions - CO<sub>2</sub>e) arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials. (Cradle-to-grave, or cradle-to-site)



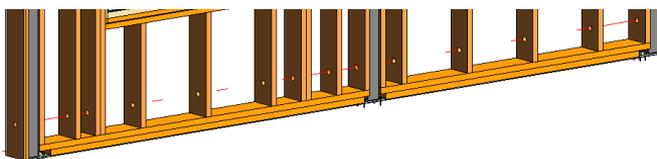
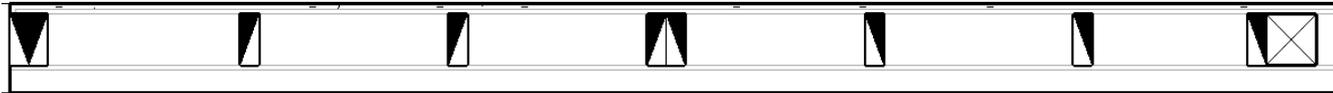
**Operational Carbon:** Refers to the amount of GHGs a building produces during its operational life and activities e.g., heating/cooling and lighting etc

# EC and Revit Compound Elements



Most systems for exterior Walls, Floor, Ceiling and Roof are comprised of layers with materials applied.

Then add a 2D detail or more than likely just specify the stud, beam or rafter spacing, and they are generally a standard configuration specified by the manufacturer. Generally, we don't model elements such as wall studs etc.



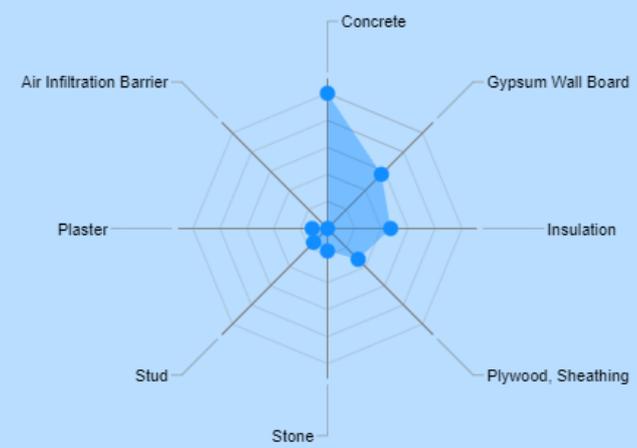


# EMBODIED CARBON OF HOUSE

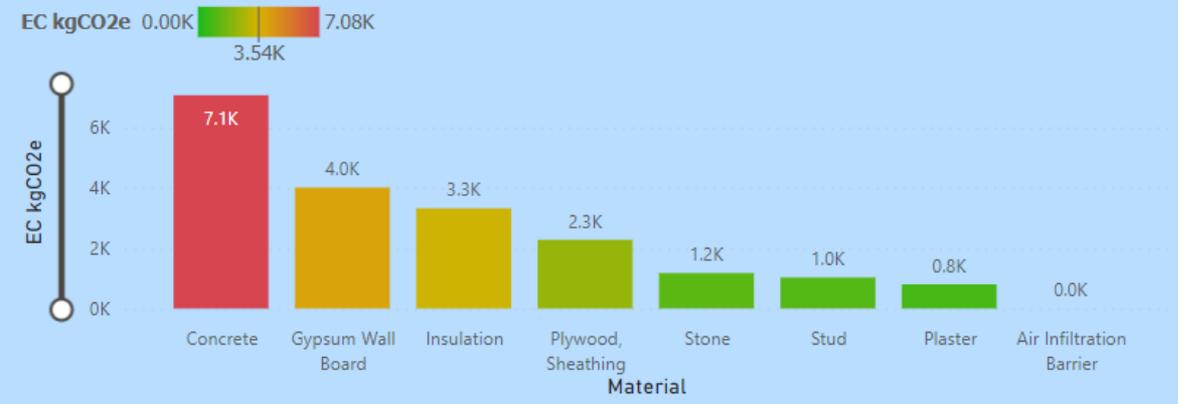
Single Family Residential House



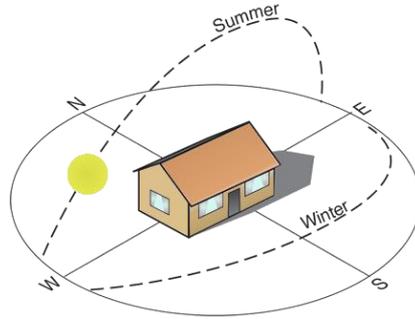
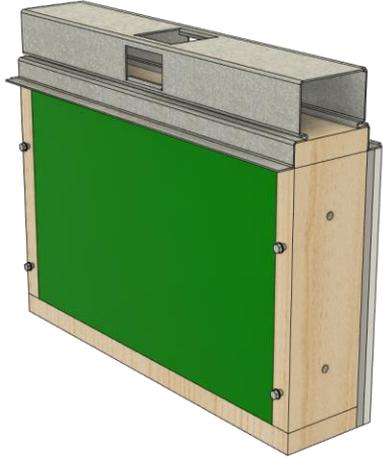
## Wall kgCO2e Weighting



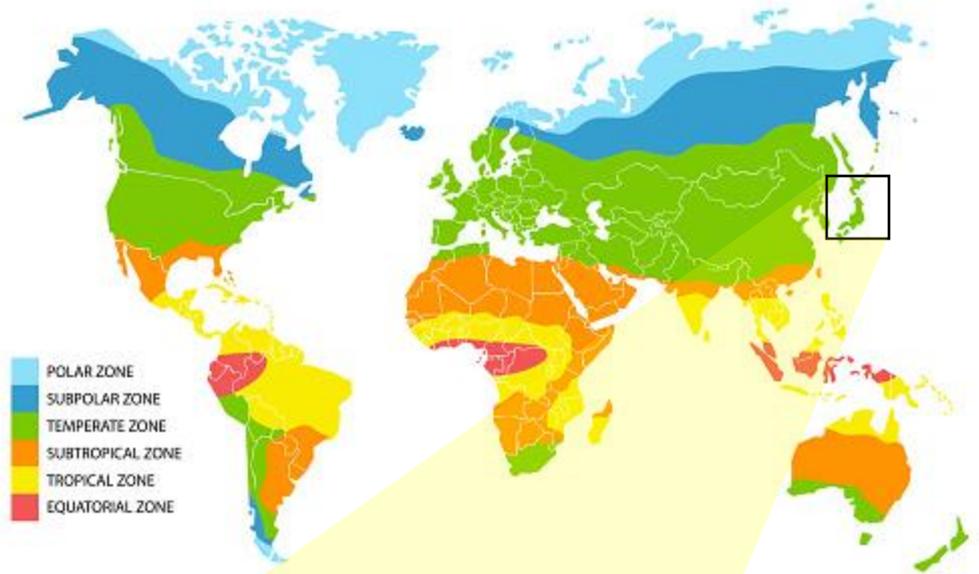
## Embodied Carbon by Material (kgCO2e)



# Location and Orientation



## World Climate Zones

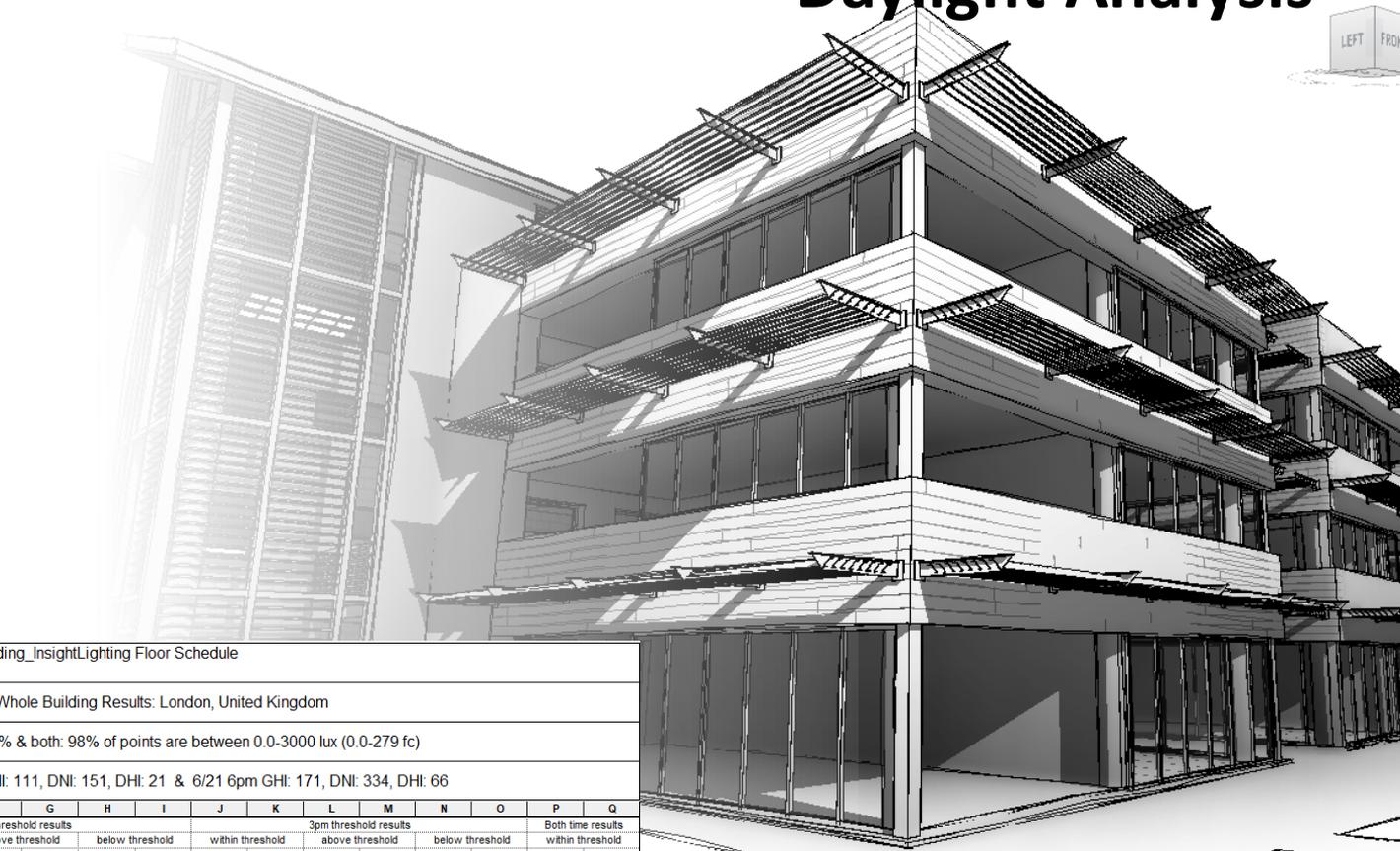
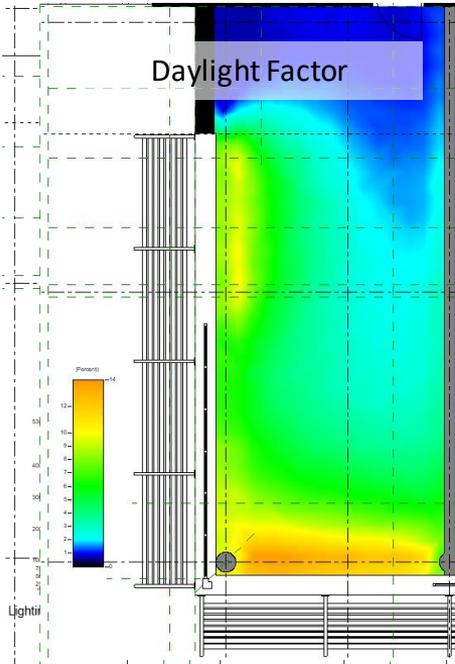


Regional Climate Zones

Climatic Zone		Floor Slab	Floors	External Walls	Internal Walls General	Ceilings	Roofs
WI < 23	Alpine	High	High	High	High	High	High
WI 23 - 45	Subalpine	High	Medium	High	Medium	Medium	High
WI 45 - 92	Cool-temperate	Medium	Low	Medium	Medium	Low	Medium
WI 92 - 117	Semi-temperate	Low	Low	Medium	Low	Low	Medium
WI > 117	Warm-temperate	None	None	None	None	None	High

Warm oceanic climate  
Humid subtropical climate (Cfa)  
Temperate continental climate/ Humid continental climate (Dwb)

# Daylight Analysis



Shading\_InsightLighting Floor Schedule

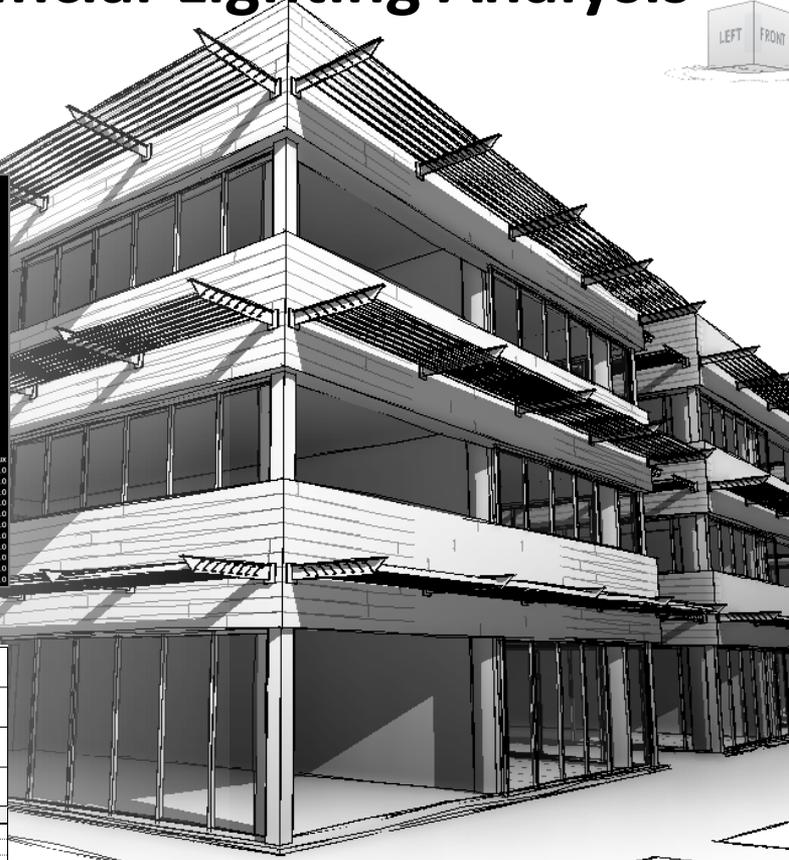
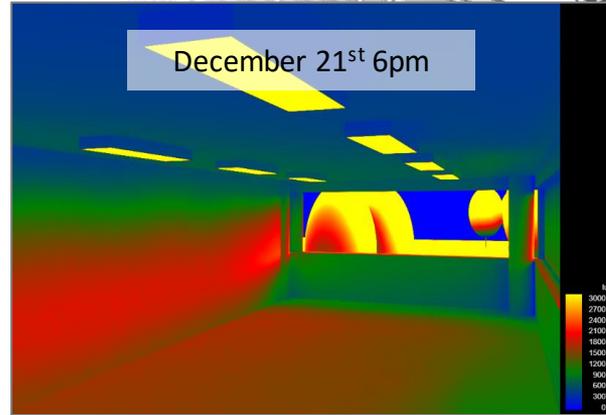
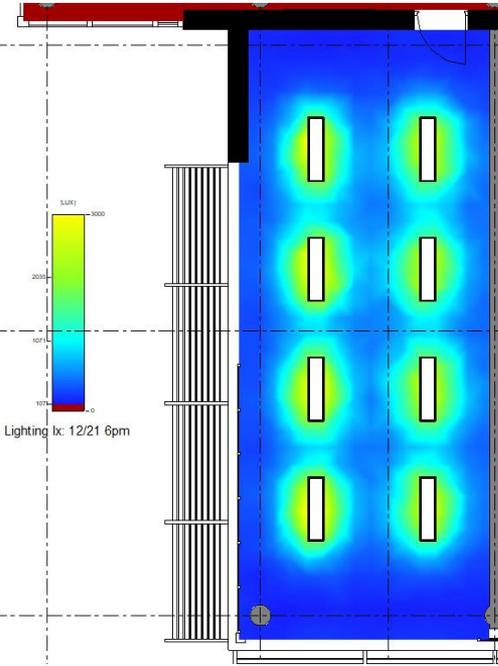
Custom Analysis Whole Building Results: London, United Kingdom

6/21 8am: 99% & 6/21 6pm: 98% & both: 98% of points are between 0.0-3000 lux (0.0-279 fc)

Solar Values (W/m2): 6/21 8am GHI: 111, DNI: 151, DHI: 21 & 6/21 6pm GHI: 171, DNI: 334, DHI: 66

A	B	C	9am threshold results						3pm threshold results				P	Q		
			within threshold		below threshold		within threshold		below threshold		Both time results within threshold					
Name	Floor Area Included in Daylighting	Total Floor Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area		
Level 2	1162 m <sup>2</sup>	1162 m <sup>2</sup>	99	1155 m <sup>2</sup>	1	7 m <sup>2</sup>	0	0 m <sup>2</sup>	98	1140 m <sup>2</sup>	2	22 m <sup>2</sup>	0	0 m <sup>2</sup>	98	1133 m <sup>2</sup>

# Artificial Lighting Analysis



Shading\_InsightLighting Floor Schedule

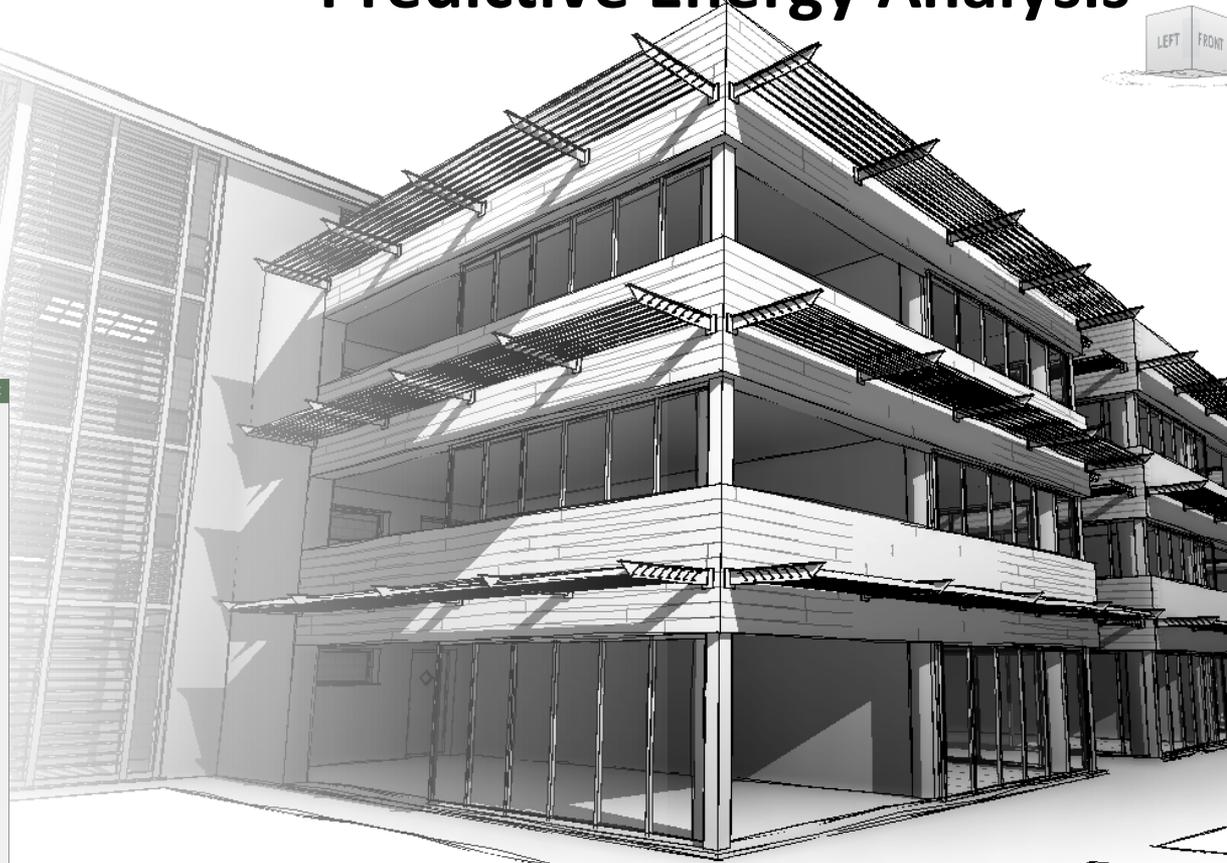
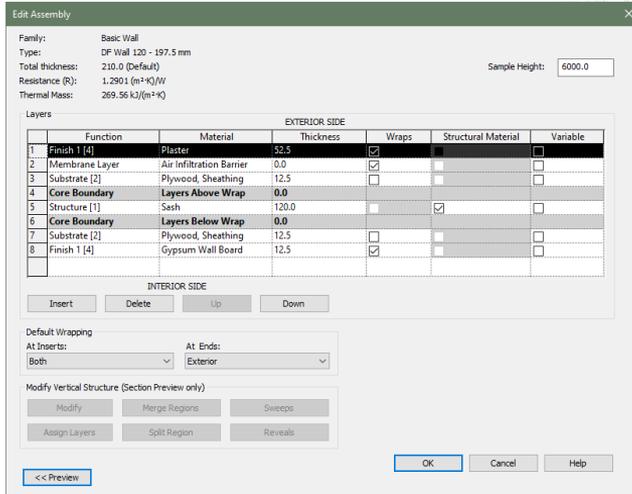
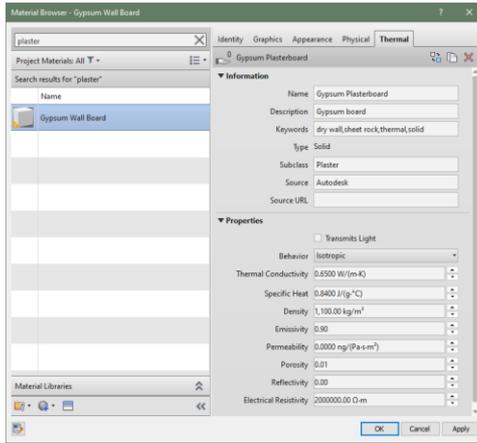
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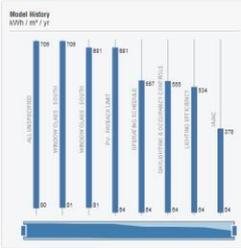
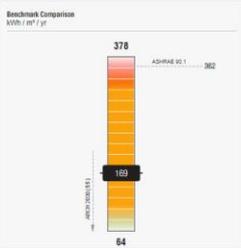
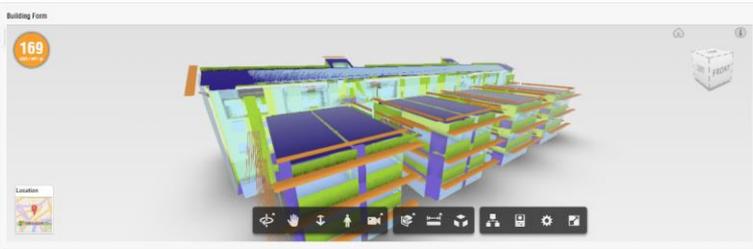
Solar Values (W/m2): 6/21 8am GHI: 111, DNI: 151, DHI: 21 & 6/21 6pm GHI: 171, DNI: 334, DHI: 66

A	B	C	9am threshold results				3pm threshold results				Both time results					
			within threshold	above threshold	below threshold	within threshold	above threshold	below threshold	within threshold	Area						
Name	Floor Area Included in Daylighting	Total Floor Area	%	Area	%	Area	%	Area	%	Area	%	Area				
Level 2	1162 m <sup>2</sup>	1162 m <sup>2</sup>	99	1155 m <sup>2</sup>	1	7 m <sup>2</sup>	0	0 m <sup>2</sup>	98	1140 m <sup>2</sup>	2	22 m <sup>2</sup>	0	0 m <sup>2</sup>	98	1133 m <sup>2</sup>

# Predictive Energy Analysis



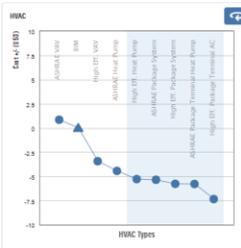
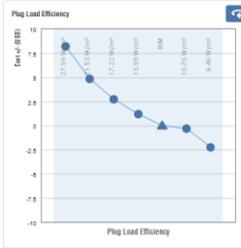
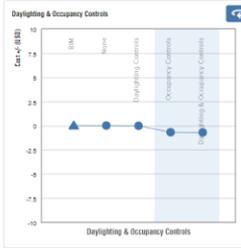
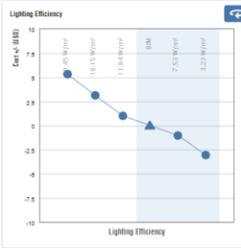
# Predictive Energy Analysis



**Building Orientation**

Rotates a building clockwise from 0 degrees, e.g. 90 degrees rotates the North side of the building to face East.

Current Setting:  
180 - 45



**Operating Schedule**

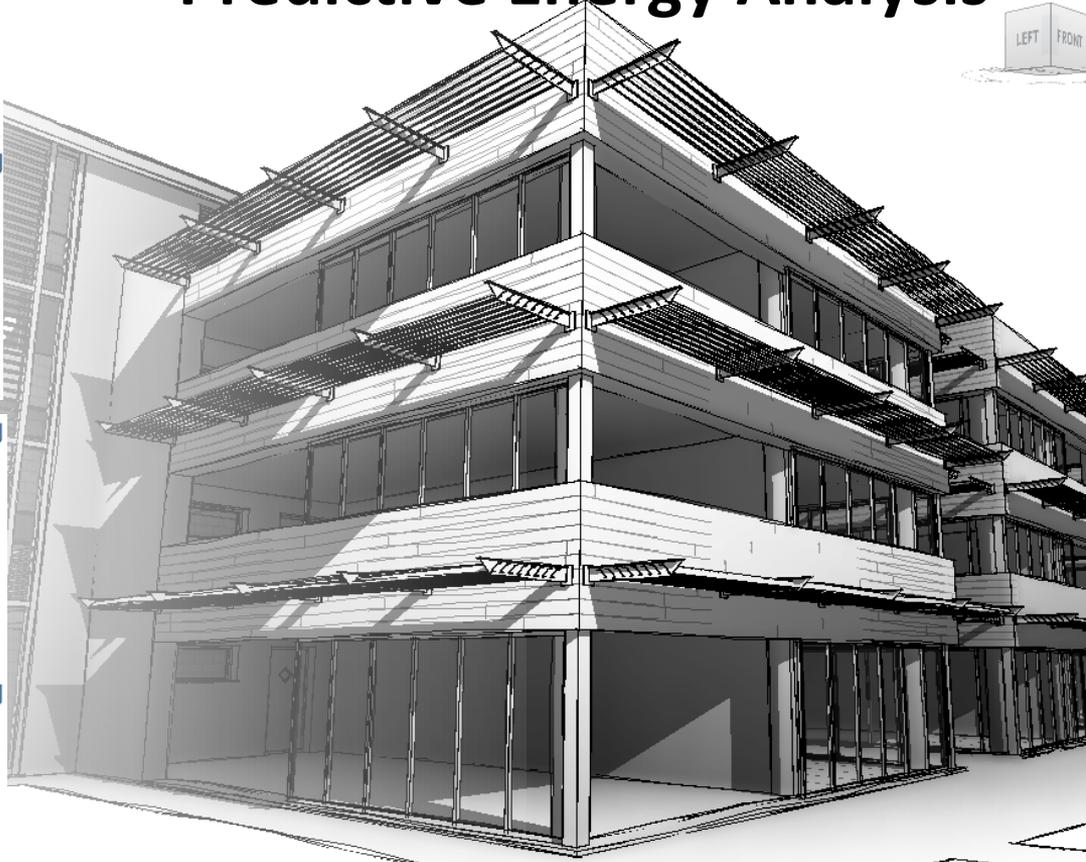
The typical hours of use by building occupants.

Current Setting:  
BIM

**PV - Panel Efficiency**

The percentage of the sun's energy that will be converted to AC energy. Higher efficiency panels cost more, but produce more energy for the same surface area.

Current Setting:  
16% - 20.4%

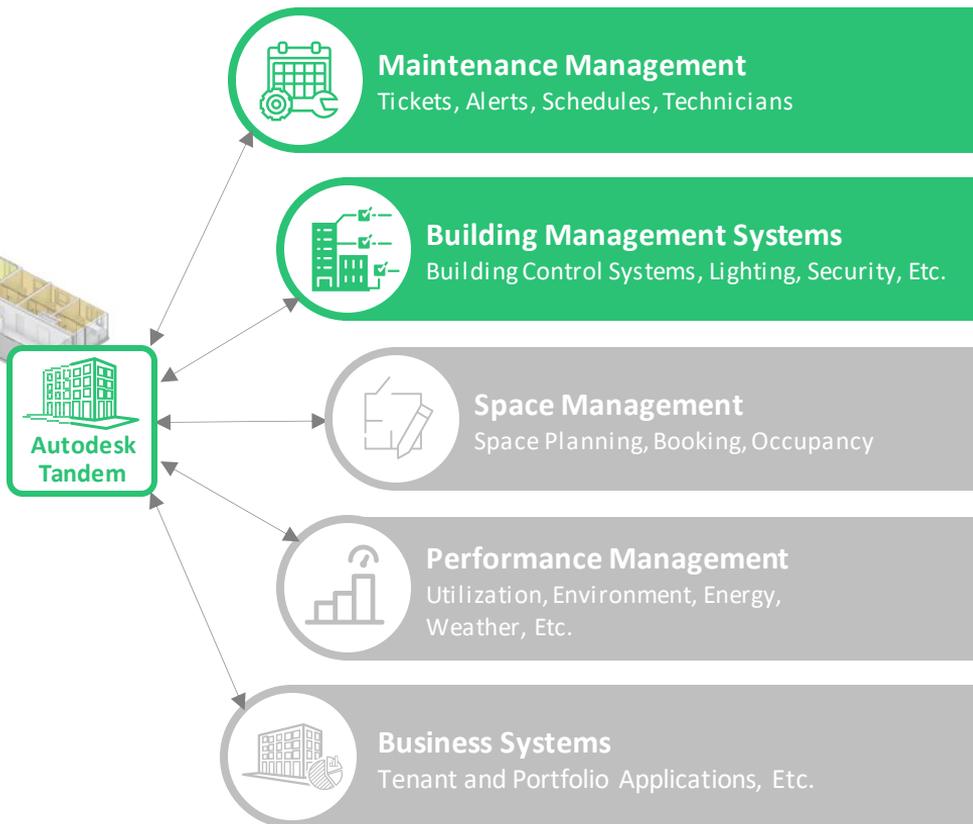


# Operational Energy Analysis

## Informative Digital Twins

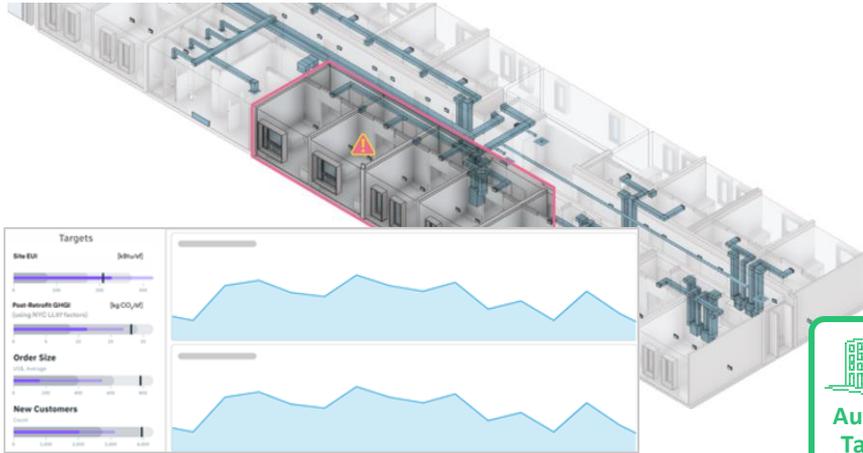


Monitor operations through a single pane of glass turning alerts and data into actionable insight



# Operational Energy Analysis

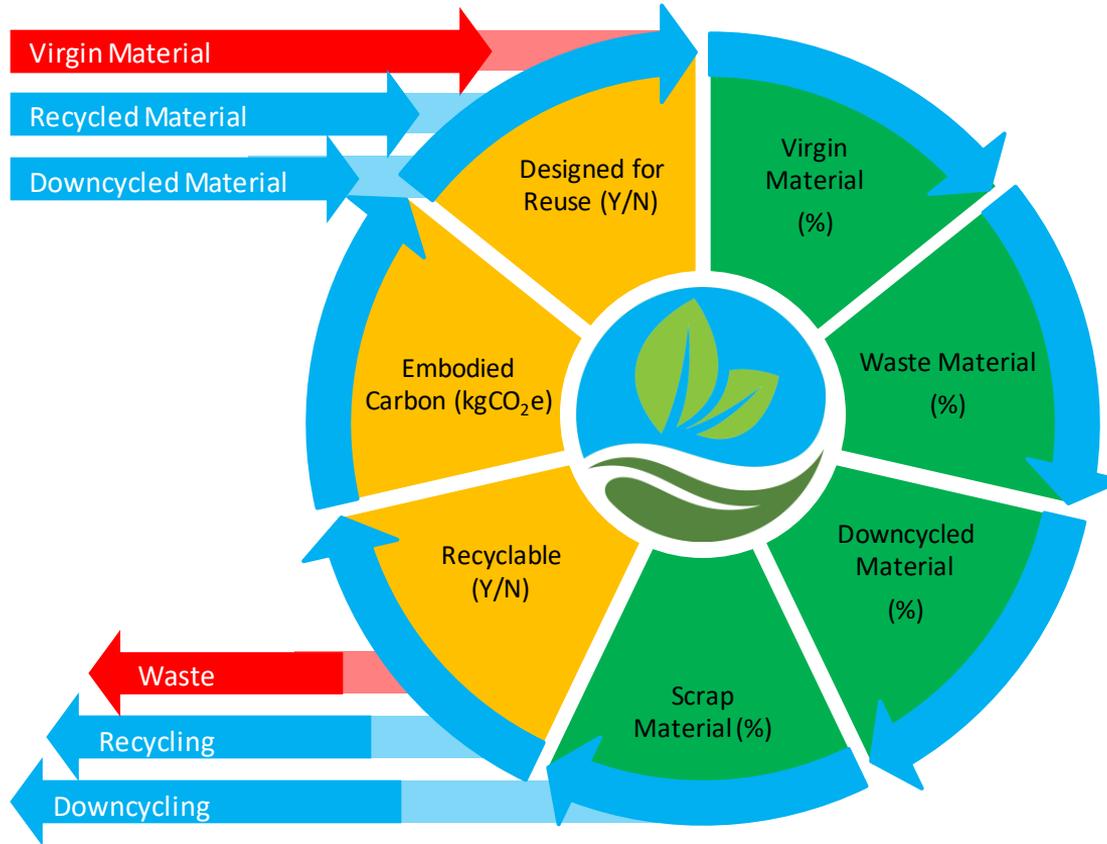
## Predictive Digital Twins

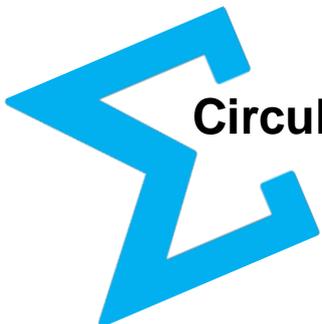


Analyze data to prevent potential failures and suggest actions for improving efficiency



# Circularity Factors



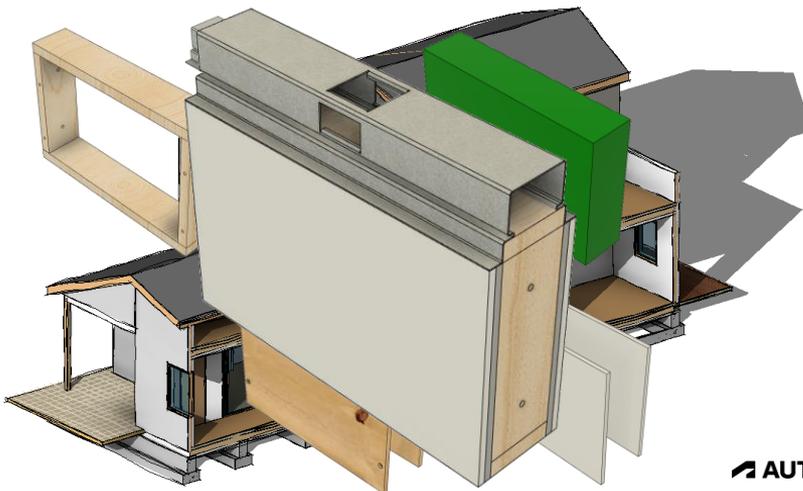


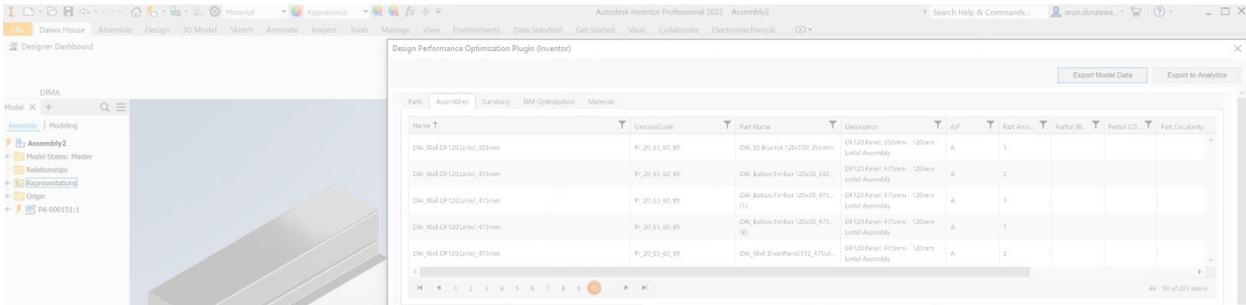
$$\text{Circularity} = 100\% - ((M\%_{\text{virgin}} + M\%_{\text{wasted}} + M\%_{\text{downcycled}} + M\%_{\text{scrap}}) / 2)$$

Where M% is the mass percentage of materials

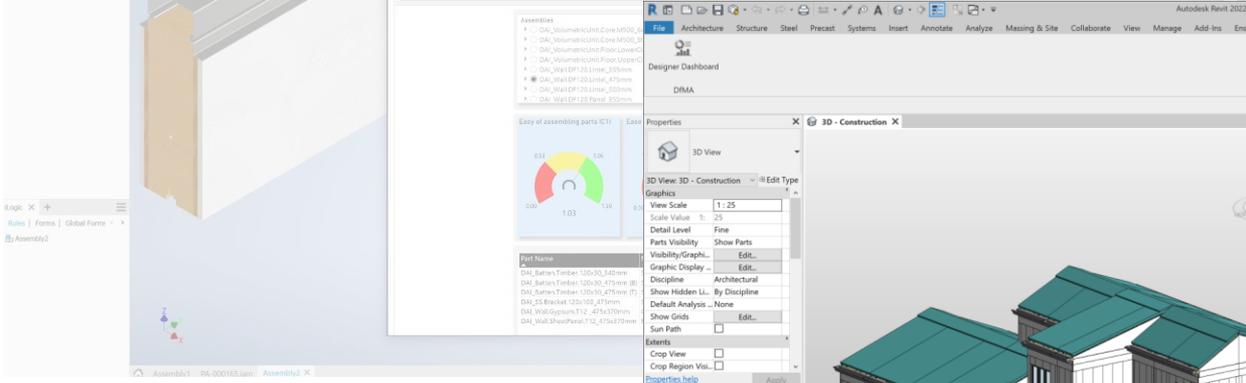
Part	Count	Part Circularity Score	Weight	Total Parts Weight	Parts % of Assembly	Virgin	Waste	Downcycled	Scrap	Assembly	Weight	Assembly Circularity Score
DAI_Wall.DF60.Generic.CableTray.Top_515mm	1	49.38%	3.42	3.42	13.28%	80.00%	0.00%	0.00%	21.25%			
DAI_Wall.DF60.Lintel.Plasterboard_515mm	2	40.50%	5.24	10.48	40.74%	100.00%	19.00%	0.00%	0.00%			
DAI_Wall.DF60.Lintel.Plyboard_515mm	2	50.00%	2.62	5.24	20.37%	100.00%	0.00%	0.00%	0.00%	DAI_Wall.DF60.Lintel_515mm	25.73	44.44%
DAI_Wall.DF60.Lintel.TopBatten_515mm	2	42.90%	2.33	4.66	18.10%	100.00%	0.00%	0.00%	14.20%			
DAI_Wall.DF60.Lintel.BottomBatten_515mm	1	42.90%	1.16	1.16	4.52%	100.00%	0.00%	0.00%	14.20%			
DAI_Wall.DF60.Lintel.SideBatten_515mm	1	50.00%	0.77	0.77	2.99%	100.00%	0.00%	0.00%	0.00%			
DAI_Wall.DF60.Lintel_515mm	1	44.44%		25.73	1.00	97.34%	7.74%	0.00%	6.03%			

Material Library	Complete list of all materials and their attributes used
Inventor Parts Library	Complete library of all individual building components in the Kit-of-Parts
Inventor Assembly Definition	Complete library of all building assemblies in the Kit-of-Parts inc. the individual parts which make up that assembly and no. of
Inventor Assembly Summary	Complete list of building assemblies and their overall circularity scores
Volumetric Units	Complete list of volumetric units inc. the individual assemblies, parts and no. of
Revit Building Definition	This is the live schedule for a house design, showing the required building assemblies and traditional building elements.
BaMB Potential	This shows the type and quantity of pre-used assemblies and parts currently in stock in the warehouse
BIM OfA Settings	BIM based OfA factors and value ranges
BIM OfA Assemblies	This shows the BIM base OfA score for each building assembly type in the Kit-of-Parts
BIM OfA Standard Values	Standard BIM based OfA values for formula

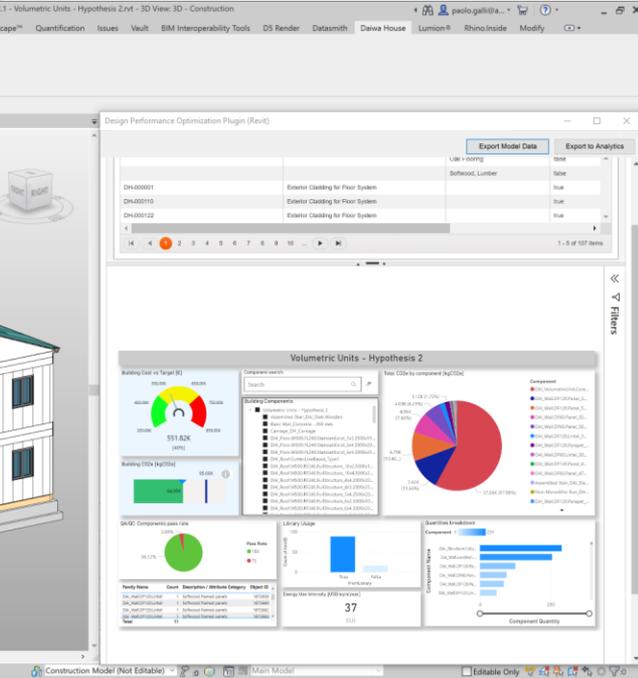




# Revit integration

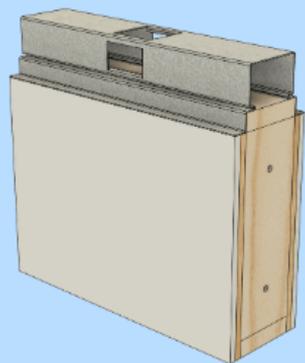


# Inventor integration



# ASSEMBLY DESIGN PERFORMANCE

Design Assembly: DAI\_Wall.DF60.Lintel\_515mm

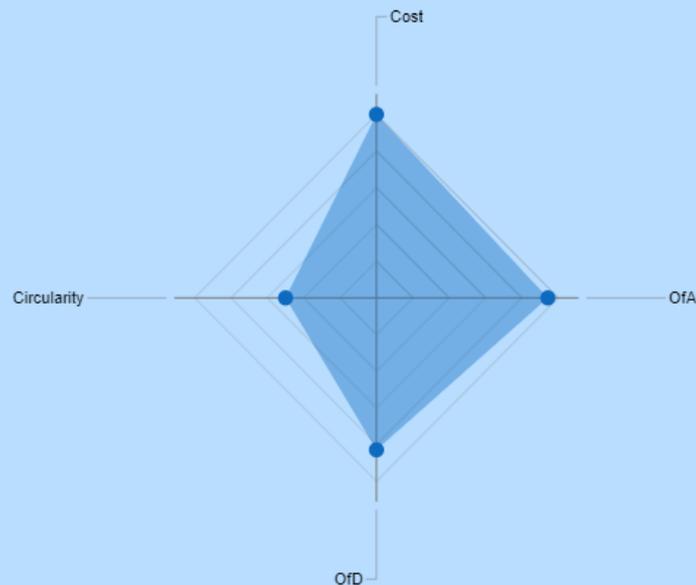


kgCO2e

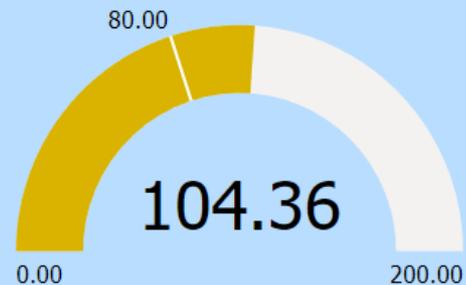
104.36

Embodied Carbon

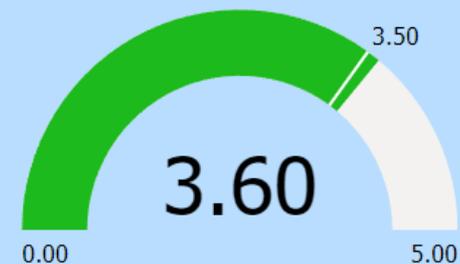
## Design Performance Weighting



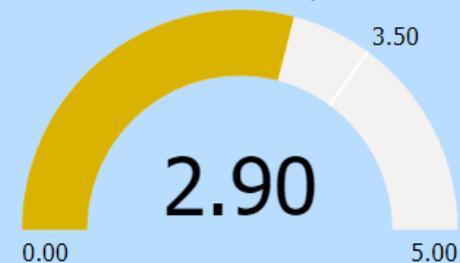
Embodied Carbon (kgCO2e)



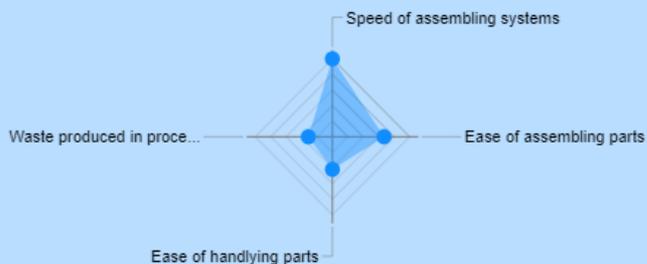
Composite Optimized Assembly



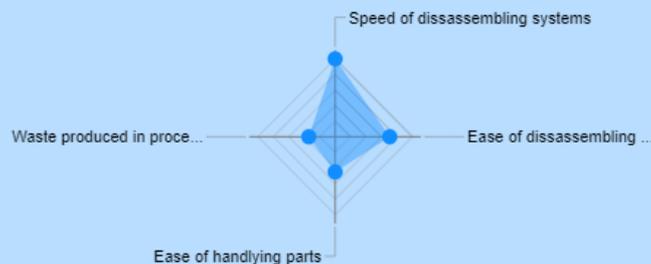
Composite Optimized  
Dissassembly



## COA Rating

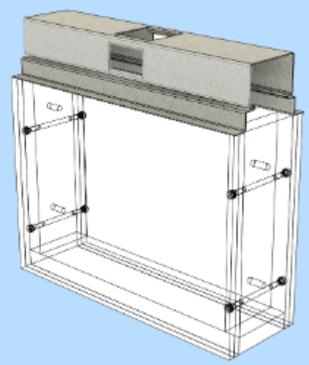


## COD Rating



# DESIGN PERFORMANCE

Design Assembly: DAI\_Wall.DF60.Lintel\_515mm

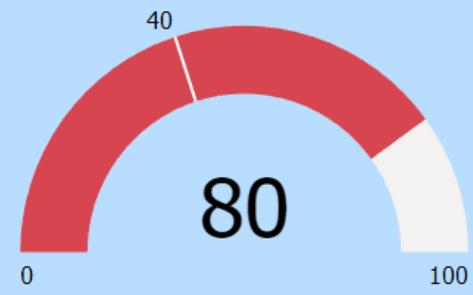


kgCO2e

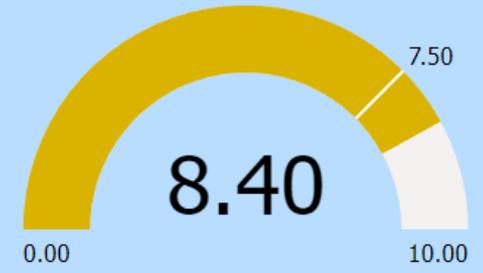
# 8.4

First Part Embodied Carbon

Virgin Material %



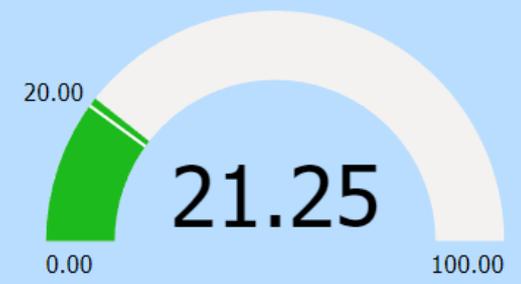
Embodied Carbon (kgCO2e)



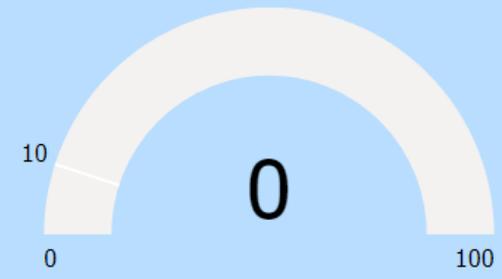
Recyclable %



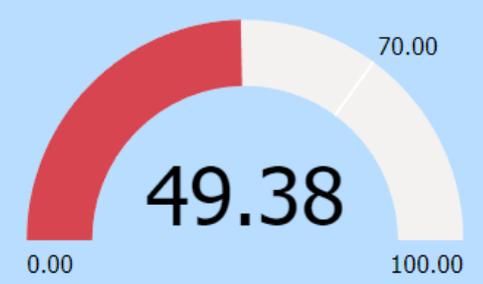
Scrap %



Waste %



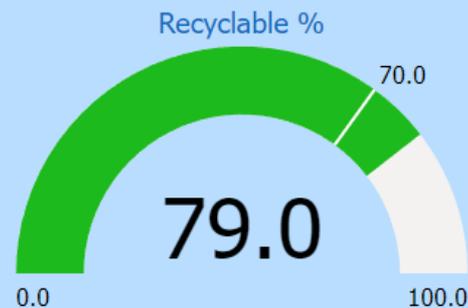
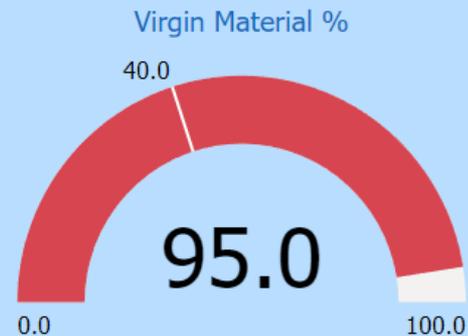
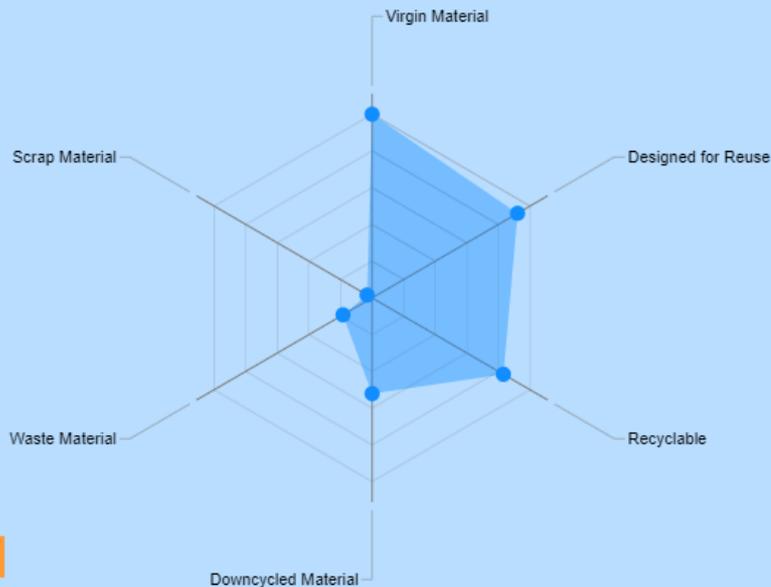
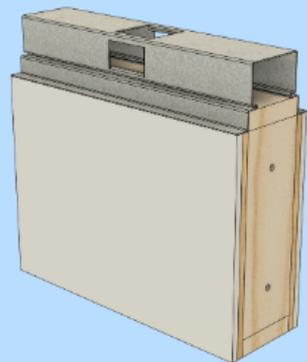
Part Circularity



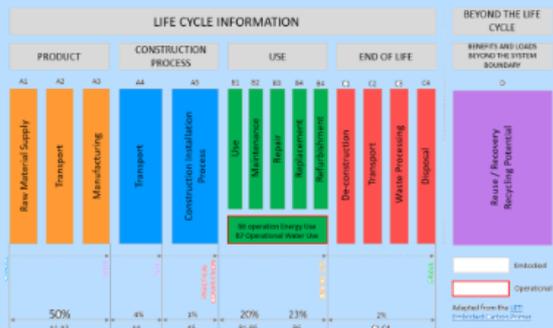
# ASSEMBLY CIRCULARITY DASHBOARD

Design Assembly: DAI\_Wall.DF60.Lintel\_515mm

Design Performance Weighting



Design & Manufacture A1 A2 A3



# Fusion and Makersite

## Autodesk Integrations



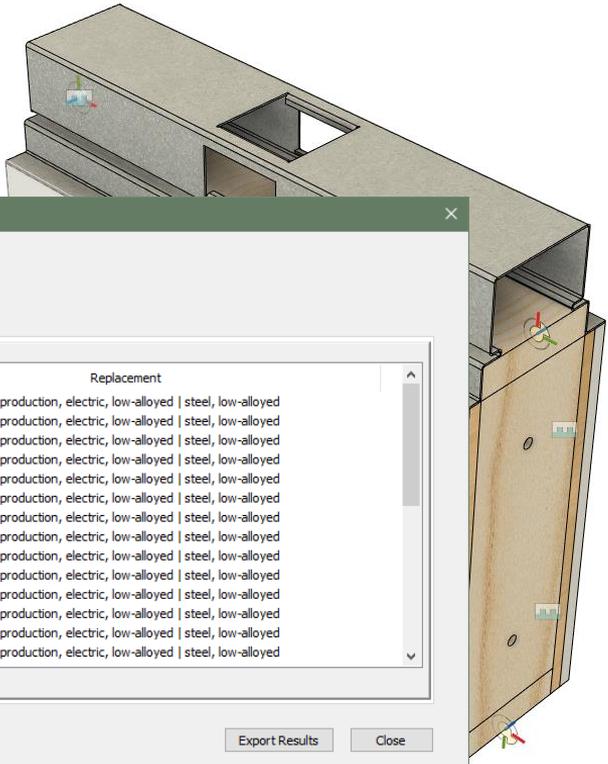
My Recent Data

- Lintel - 515 mm  
5:40:50 PM
- Lintel - 490  
9/30/21
- EXPSG-120-100W  
7/14/22
- Lintel - 600 mm

DESIGN CONNECT

BROWSER

- Lintel - 515 mm v4
  - Document Settings
  - Named Views
  - Origin
  - Analysis
  - Joints
  - Frame:1
  - Plywood:1
  - Plasterboards:1



Autodesk-Makersite BOM assessment (v1.0.0.8)

Send BOM

Environment Calculation Costing Product Recommendation

Name	Savings (% CO2 emission)	Replacement
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	69.3	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	69.3	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	64.67	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	64.67	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	55.16	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	55.16	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	42.38	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	42.38	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	21.61	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	21.61	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	0.35	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	0.35	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	0.33	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	0.33	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	0.35	steel production, electric, low-alloyed   steel, low-alloyed
Lintel - 515 mm v3_Upper Tray - 515 mm v8_Body1 (S...	0.35	steel production, electric, low-alloyed   steel, low-alloyed

Export Results Close

Model courtesy of: Paolo Galli

9/28/21

Upper Tray - 515 mm

COMMENTS

Autodesk Fusion 360 toolbar

# Why the BIM OfA

# BIM Optimizer for Assembly

## What is missing?

- Good methods and tools available for DfMA and for LEAN Construction
- What about the combination of both?
- How can we optimize the production and design process with the use BIM models, BIM data, offsite and onsite feedback and Sustainability?

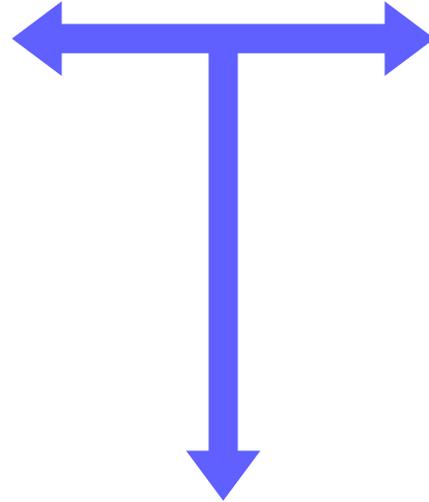
Lean Construction is NOT just about efficiencies on the construction site



# BIM Optimizer for Assembly

What is missing?

DfMA



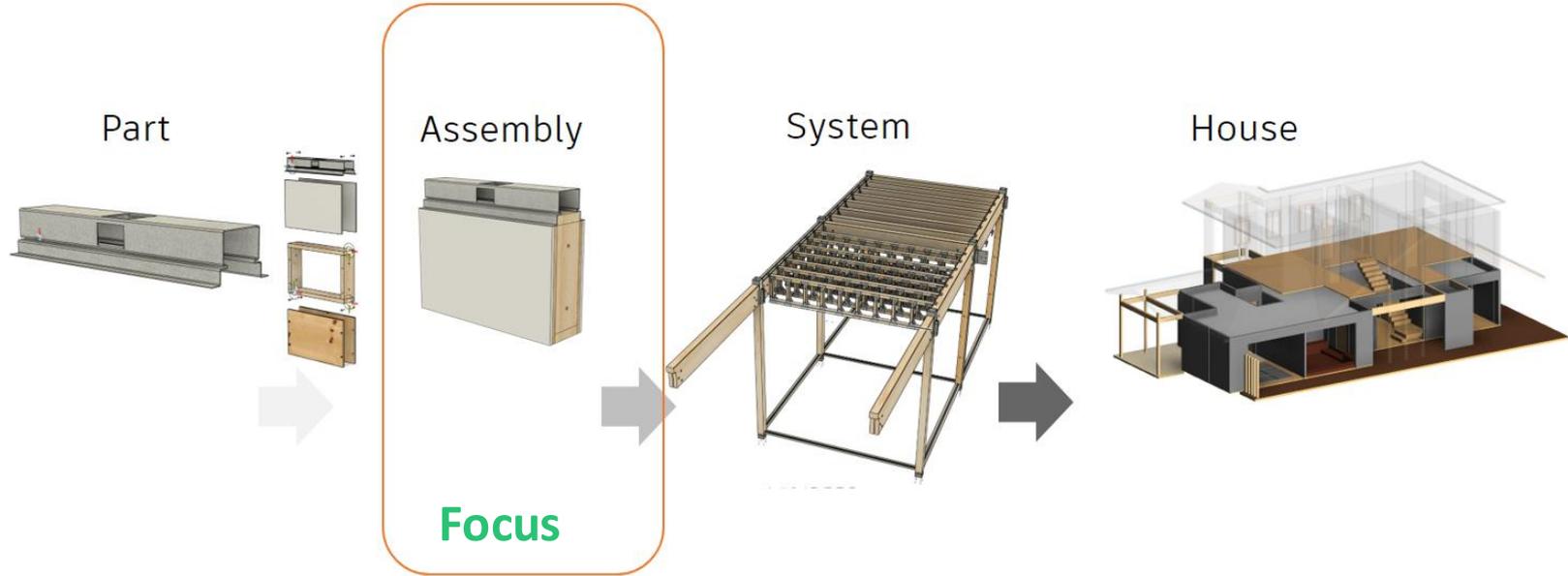
LEAN Construction



BIM OfA

# BIM Optimizer for Assembly

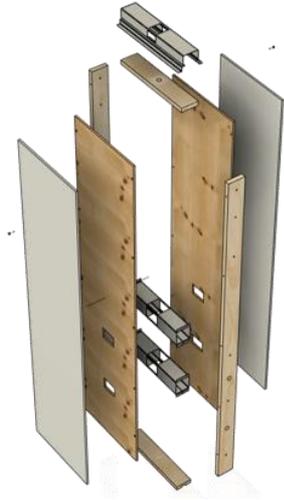
What?



# BIM Optimizer for Assembly

## How?

- 4 Categories / 14 factors
  - Ease of assembling parts
    - How easy is to assemble the different parts of the component
  - Ease of handling parts
    - How easy are the parts to handle during assembling the component
  - Speed of assembling systems
    - How fast can the component be assembled in a system
  - Waste produces in the process of assembly
    - What is the overall amount of waste for producing and assembling the component



# BIM Optimizer for Assembly

How?

Table 6: Weighted Importance of assessment factors		Categories Weighting ( $W_c$ )	Factors ( $F_i$ )		Factors Weighting ( $W_{Fi}$ )	Global Weighting ( $W_i$ )
Categories ( $C_i$ )						
C1	Ease of assembling parts	0.3184	F1	Connection between parts	0.2898	0.0923
			F2	Connection to main building elements	0.2057	0.0655
			F3	Post-assembly secondary finishes	0.1165	0.0371
			F4	Standardization of parts	0.1510	0.0481
			F5	Multiple material usages in production	0.1088	0.0347
			F6	Geometric complexity of parts	0.1282	0.0408
C2	Ease of handling parts	0.2096	F7	Number of parts	0.2101	0.0440
			F8	Weight of parts	0.2882	0.0604
			F9	Tools and equipment requirement	0.1426	0.0299
			F10	Fragility of parts	0.1475	0.0309
			F11	Quality control requirement	0.1069	0.0224
			F12	Number of workers required	0.1048	0.0220
C3	Speed of assembling systems	0.3216	F13	Efficiency of operations	1.000	0.3216
C4	Waste produced in process	0.1504	F14	Waste Index	1.000	0.1504

$$OA_{EAi} = W_{EAi} \times \sum_{i=1}^6 (W_{Fi} \times F_i)$$

$$OA_{EHi} = W_{EHi} \times \sum_{i=7}^{12} (W_{Fi} \times F_i)$$

$$OA_{SAi} = W_{SAi} \times (W_{F13} \times F_{13})$$

$$OA_{AWi} = W_{AWi} \times (W_{F14} \times F_{14})$$

$$COA_i = \sum_{i=0}^n (f(OA_{EAi}, OA_{AHi}, OA_{SAi}, OA_{AWi}))$$

# BIM Optimizer for Assembly

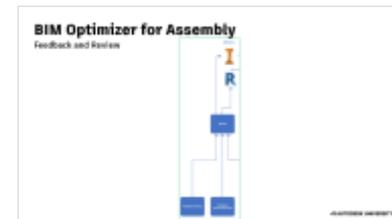
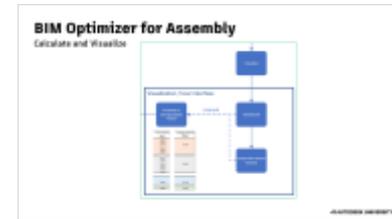
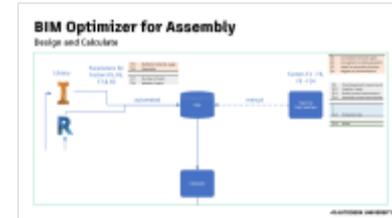
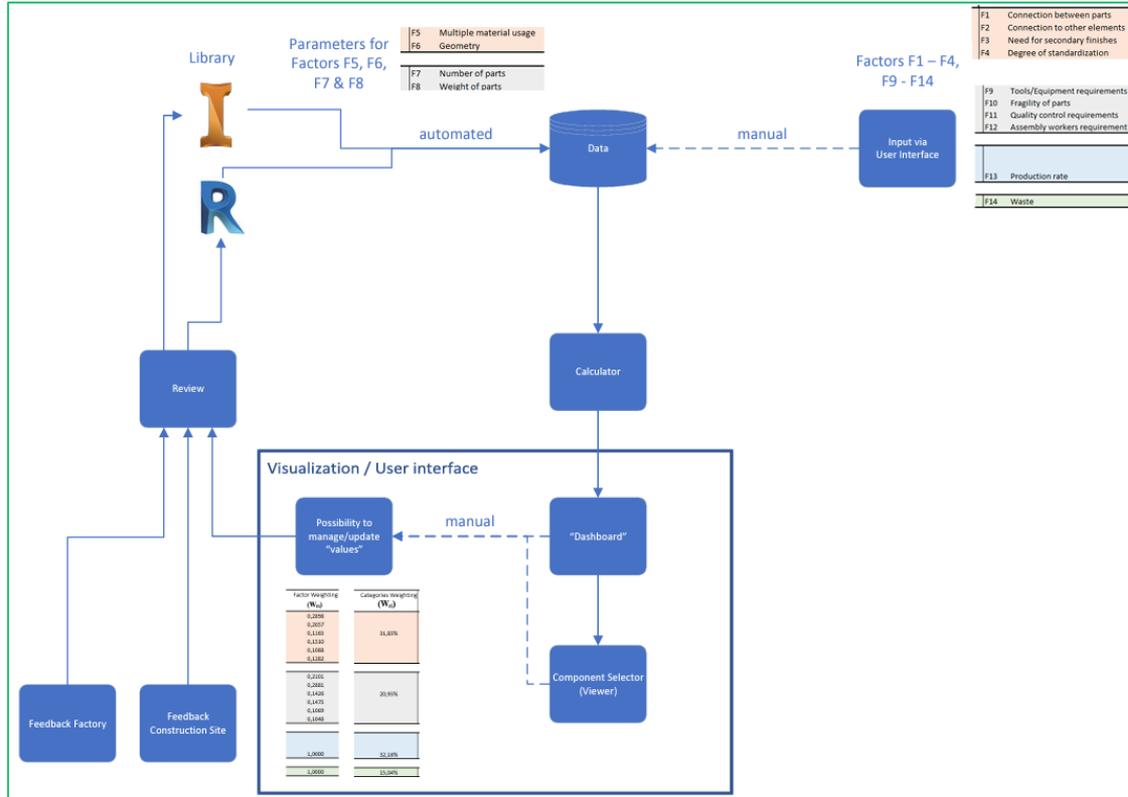
## How?

C1 - Easy of assembling parts						C2 - Ease of handling parts						C3 - Speed of assembling systems		C4 - Waste produced in process	
F1	F2	F3	F4	F5	F6	F7	F8	F9	F10	F11	F12	F13	F14		
0	0	1	≤0.1	≥ 7 material types	≥ 0,81m	≥ 13,1	≥ 100kg	4 plants+tools	Require specialized or expert handling	≥ 86%	6 workers or more	≤ 0,5 m2/man-hour	96-100%		
0,2	0,2	0,8	0.11-0.25	6 material types	0,6m-0,8m	10,1 - 13,0	75-100kg	3 plants+tools	Require individual part packaging	66% - 85%	5 workers	0,51-1,0 m2/man-hour	80-95%		
0,4	0,4	0,6	0.26-0.44	5 material types	0,45-0,59m	7,1 - 10,0	51-75kg	2 plants+tools	Require packaging and special movement tools	31% - 65%	4 workers	1,1-2,0 m2/man-hour	60-79%		
0,6	0,6	0,4	0.45-0.65	4 material types	0,31m-0,45m	4,1 - 7,0	26-50kg	1 plant+tools	Require protective bulk packaging	16% - 30%	3 workers	2,1-4,0 m2/man-hour	40%-59%		
0,8	0,8	0,2	0.66-0.84	3 material types	0,16m-0,30m	1,1 - 4,0	11-25kg	3 - 5 tools	Require non-protective bulk packaging	4% - 15%	2 workers	4,1-6,0 m2/man-hour	20-39%		
1	1	0	≥ 0.85	≤ 2 material types	0,02m-0,15m	≤ 1,0	≤ 10kg	≤ 2 tools	Require no packaging or damage protection	1% - 3%	1 worker	≥ 6,1 m2/man-hour	0-19%		

Attribute	Description	Entry	Extracted from Inventor
F1	Connection between parts	Manual	
F2	Connection to other elements	Manual	
F3	Need for secondary finishes	Manual	
F4	Degree of standardization	Manual	
F5	Multiple material usage	Extracted from Inventor	Number of materials
F6	Geometry	Extracted from Inventor	Area
F7	Number of parts	Extracted from Inventor	Number of parts
F8	Weight of parts	Extracted from Inventor	weight
F9	Tools/equipment requirements	Manual	
F10	Fragility of parts	Manual	
F11	Quality control requirements	Manual	
F12	Assembly workers requirement	Manual	
F13	Production rate	Manual	
F14	Waste	Manual	
C1	Easy of assembling parts	Calculated in Excel	
C2	Ease of handling parts	Calculated in Excel	
C3	Speed of assembling systems	Calculated in Excel	
C4	Waste produced in process	Calculated in Excel	
COA	Overall Optimized Assembly Score	Calculated in Excel	

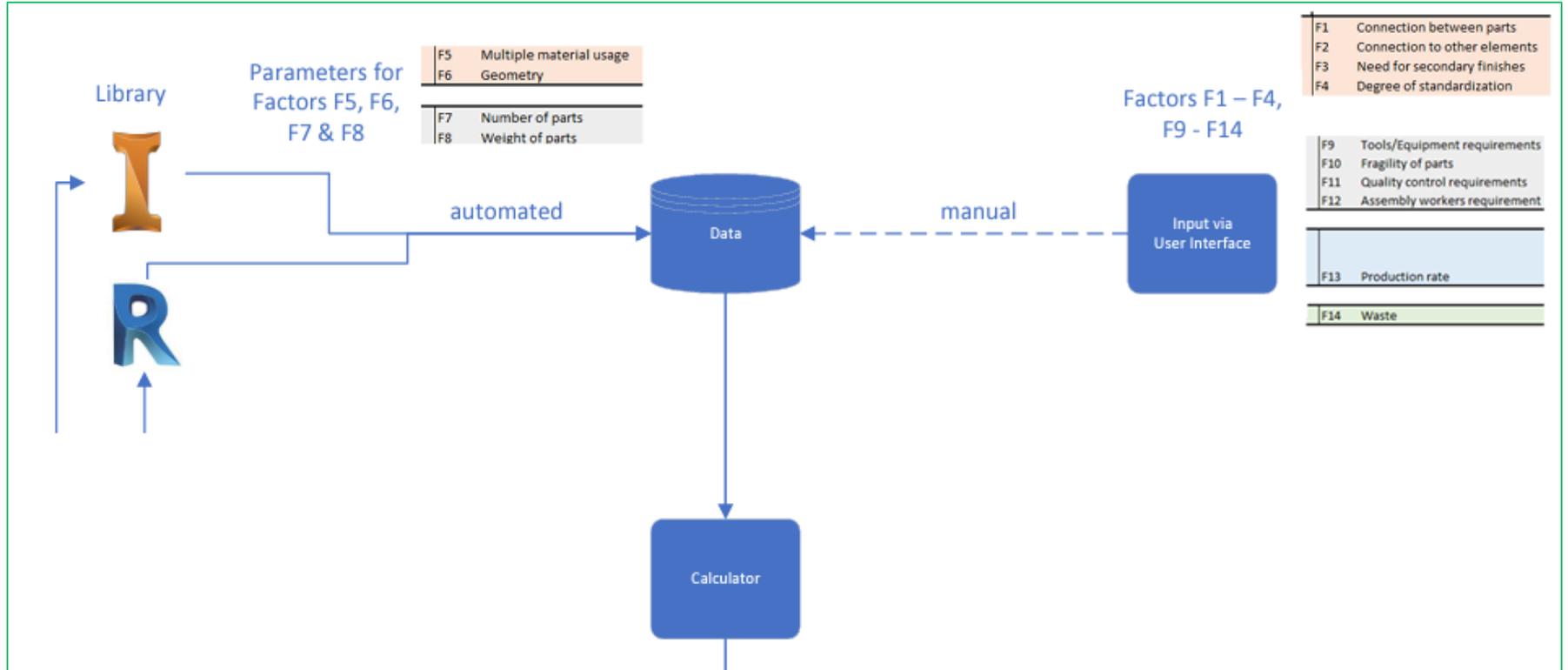
# BIM Optimizer for Assembly

How?



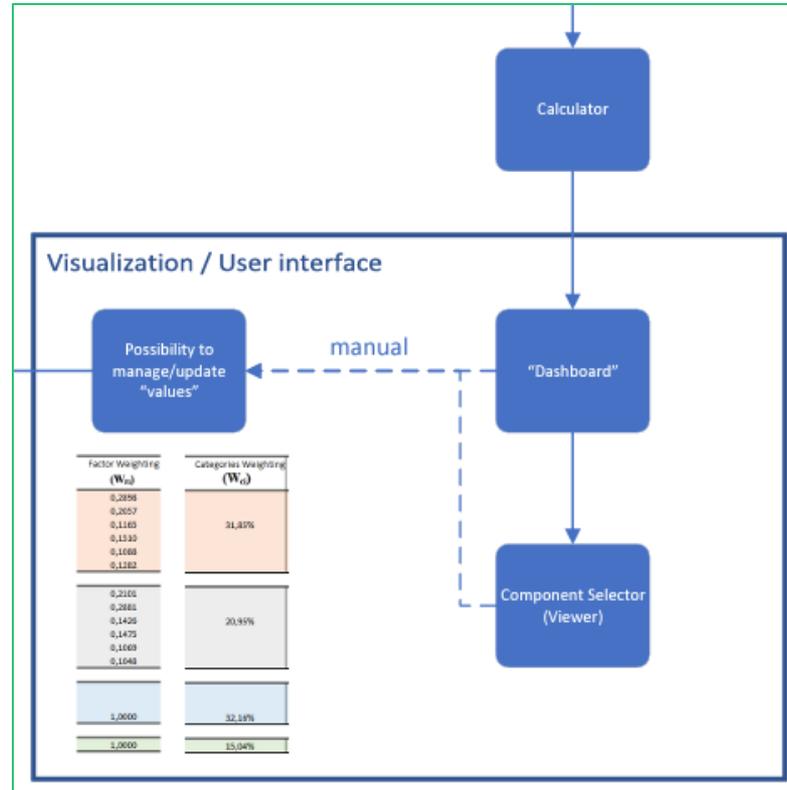
# BIM Optimizer for Assembly

## Design and Calculate



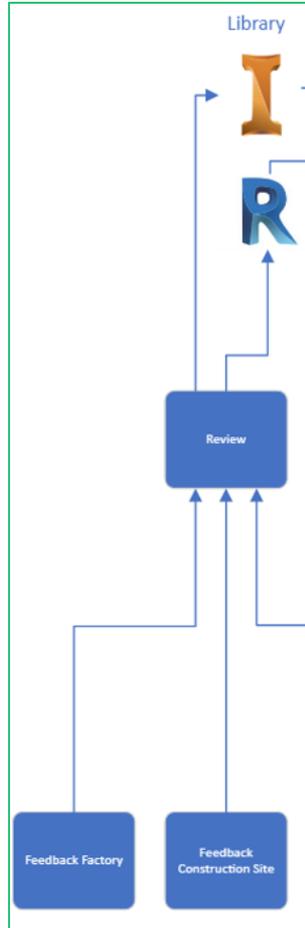
# BIM Optimizer for Assembly

Calculate and Visualize



# BIM Optimizer for Assembly

## Feedback and Review



# BIM Optimizer for Assembly

## How?

AutoSave BIM OIA - Original version tab - Saved - Search (Alt+Q) Marcel Lajoux

File Home Insert Draw Page Layout Formulas Data Review View Developer Help ASSEMBLE BLUEBEAM Autodesk Vault Acrobat

F17 : 4,1-6,0 m2/man-hour

				Grading scale equivalente (F <sub>i</sub> )	Factor Weighting (W <sub>n</sub> )		Global Weighting (W <sub>g</sub> )	Score	Categories Weighting (W <sub>c</sub> )	Optimized Assembly Score (OA)	
2		Factor	Interval Assessment scales								
3	C1 - Ease of assembling parts (EA)	C <sub>EA</sub>	F1	Connection between parts	0,6	3	0,2898	0,8694	0,0923	0,0802	0,9479
4			F2	Connection to other elements	0,8	4	0,2057	0,8228	0,0655	0,0539	
5			F3	Need for secondary finishes	0,8	1	0,1165	0,1165	0,0371	0,0043	
6			F4	Degree of standardization	66%-84%	4	0,1510	0,6040	0,0481	0,0291	
7			F5	Multiple material usage	3 material types	4	0,1088	0,4352	0,0347	0,0151	
8			F6	Geometry	0,6m-0,8m	1	0,1282	0,1282	0,0408	0,0052	
9											
10	C2 - Ease of handling parts (EH)	C <sub>EH</sub>	F7	Number of parts	7,1 - 10,0	2	0,2101	0,4202	0,0440	0,0185	0,5836
11			F8	Weight of parts	11-25kg	4	0,2881	1,1524	0,0603	0,0695	
12			F9	Tools/Equipment requirements	2 plants+tools	2	0,1426	0,2852	0,0299	0,0085	
13			F10	Fragility of parts	ire packaging and special movement	2	0,1475	0,2950	0,0309	0,0091	
14			F11	Quality control requirements	31% - 65%	2	0,1069	0,2138	0,0224	0,0048	
15	F12	Assembly workers requirement	2 workers	4	0,1048	0,4192	0,0220	0,0092			
16											
17	C3 - Speed of assembling systems (SA)	C <sub>SA</sub>	F13	Production rate	4,1-6,0 m2/man-hour	4	1,0000	0,3216	1,2864	0,3216	1,2864
18											
19	C4 - Waste (AW)	C <sub>AW</sub>	F14	Waste	40%-59%	3	1,0000	0,1504	0,4512	0,1504	0,4512
20											
21											
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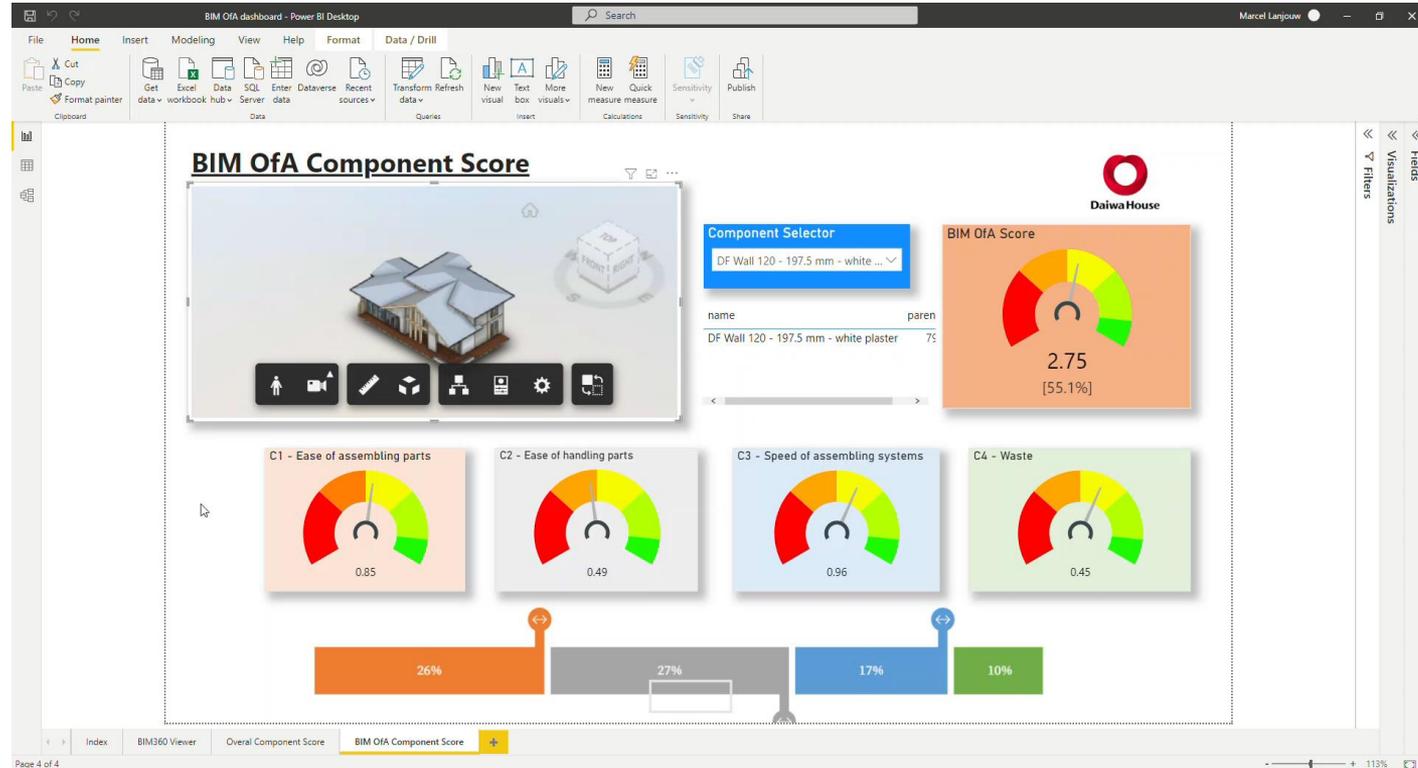
**COA Score 3,2691**

BIM OIA Formulae BIM OIA Lookup COA scores

Ready Accessibility: Investigate 115%

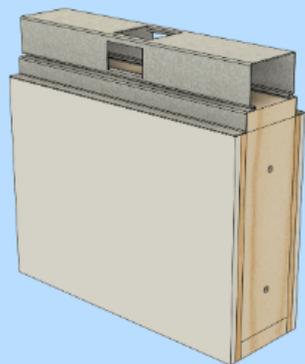
# BIM Optimizer for Assembly

## How?



# COMPOSITE OPTIMIZED ASSEMBLY

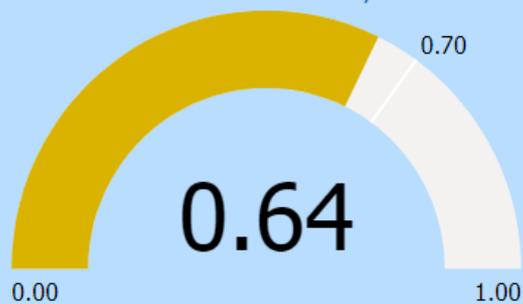
Design Assembly: DAI\_Wall.DF60.Lintel\_515mm



COA Score

**3.60**

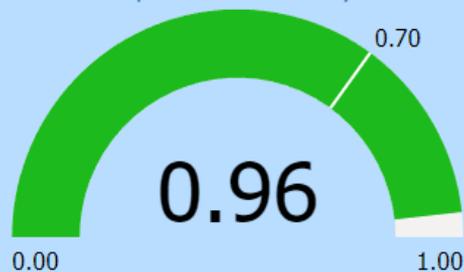
Ease of Assembly



Ease of Handling



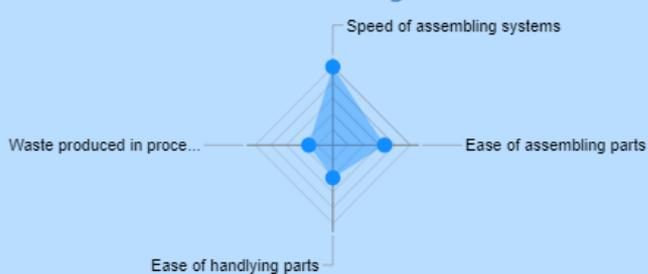
Speed of Assembly



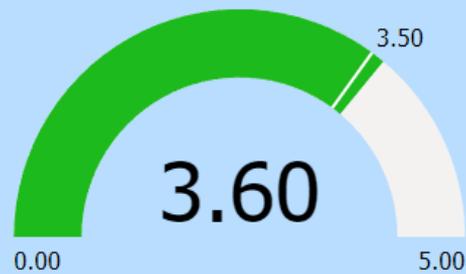
Waste Produced



COA Rating

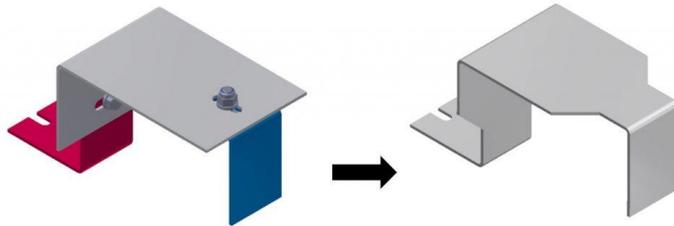


COA Score



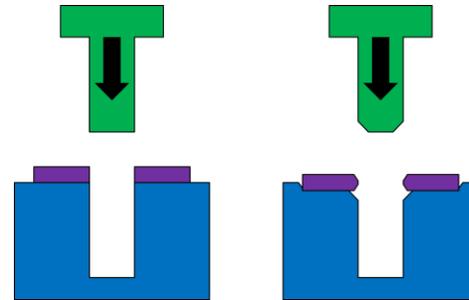
**What is still missing in  
this BIM OfA story?**

**DfMA principles reduce the overall number of parts, cost of materials, manufacturing processes and the assembly time, thus supporting sustainability.**  
We're sure everyone has heard of DfMA (Design for Manufacturing and Assembly)



Three parts and fasteners

One single part



Difficult to positioned three parts and fix

Parts are self locating



**Now we need to  
start designing for  
easy disassembly**

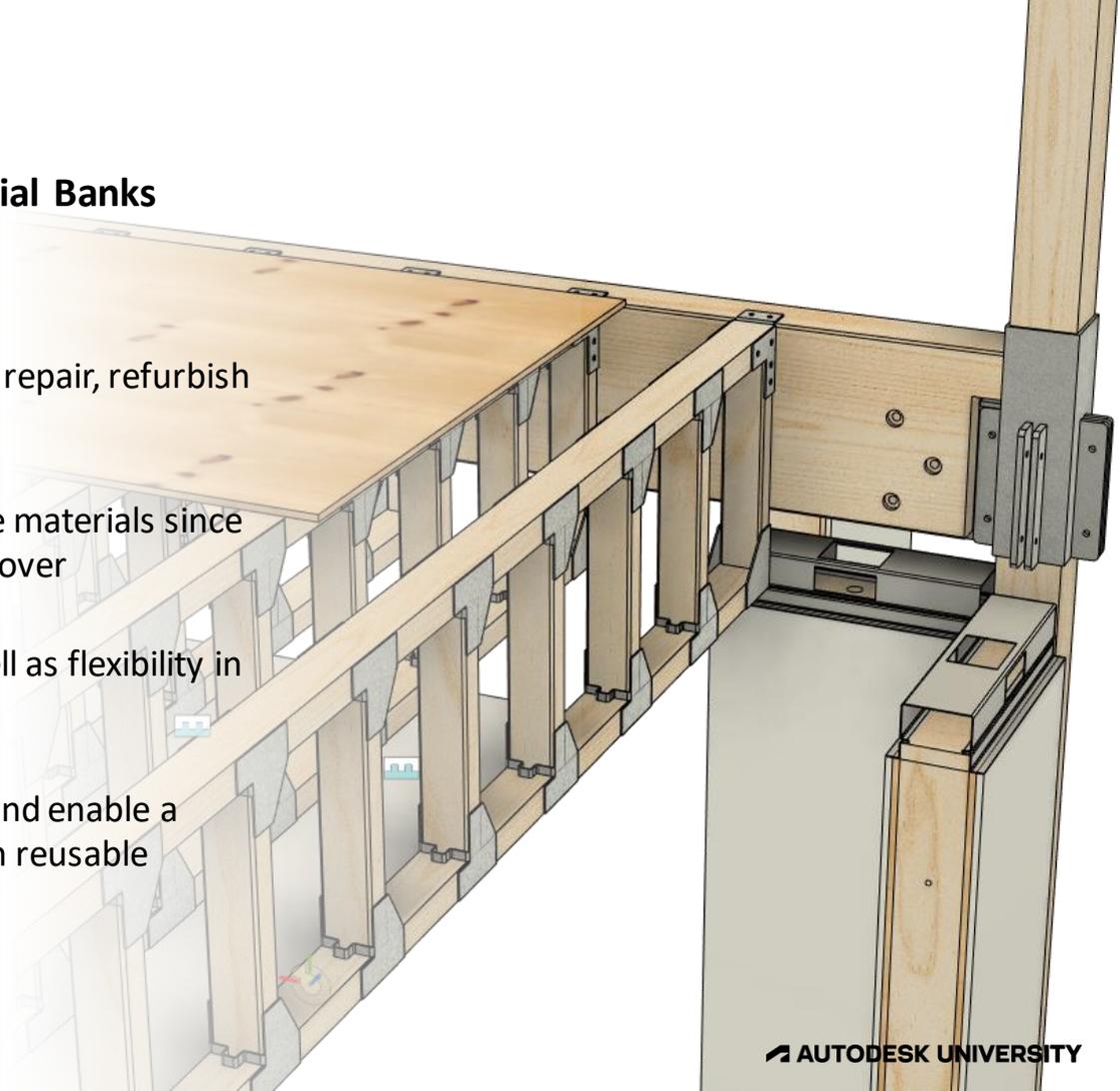
# BaMB

## Reversible Buildings & Buildings as Material Banks

Reversible Building Design enables:

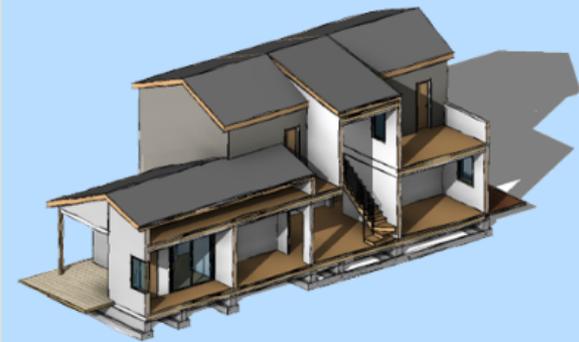
- Flexible and transformable buildings, easy to repair, refurbish or change whilst generating less waste
- Buildings which function as banks of valuable materials since valuable materials are easy to access and recover
- Resource efficient maintenance, repair as well as flexibility in the use of space and systems

Reversible Buildings by design eliminate waste and enable a circular building sector when used together with reusable materials, products and components.



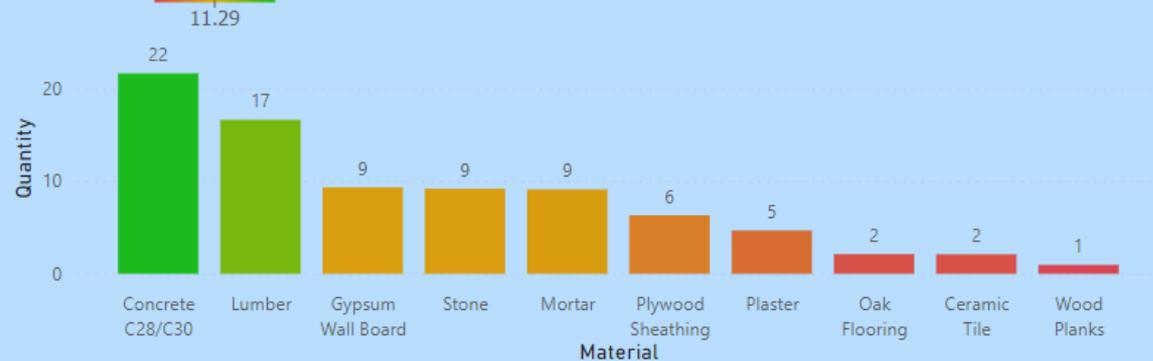
# BUILDING AS MATERIAL BANK

Single Family Residential House

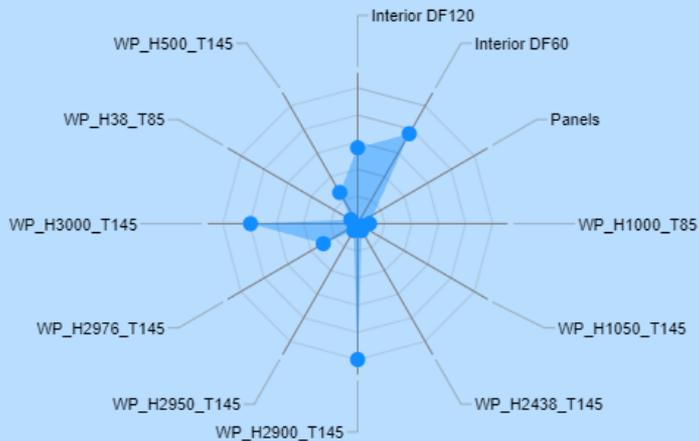


## Quantity by Material (Cubic Meters)

Quantity 0.96 11.29 21.61



## Prefabricated Panels



## Window Units

Quantity 81.99 81.99 81.99



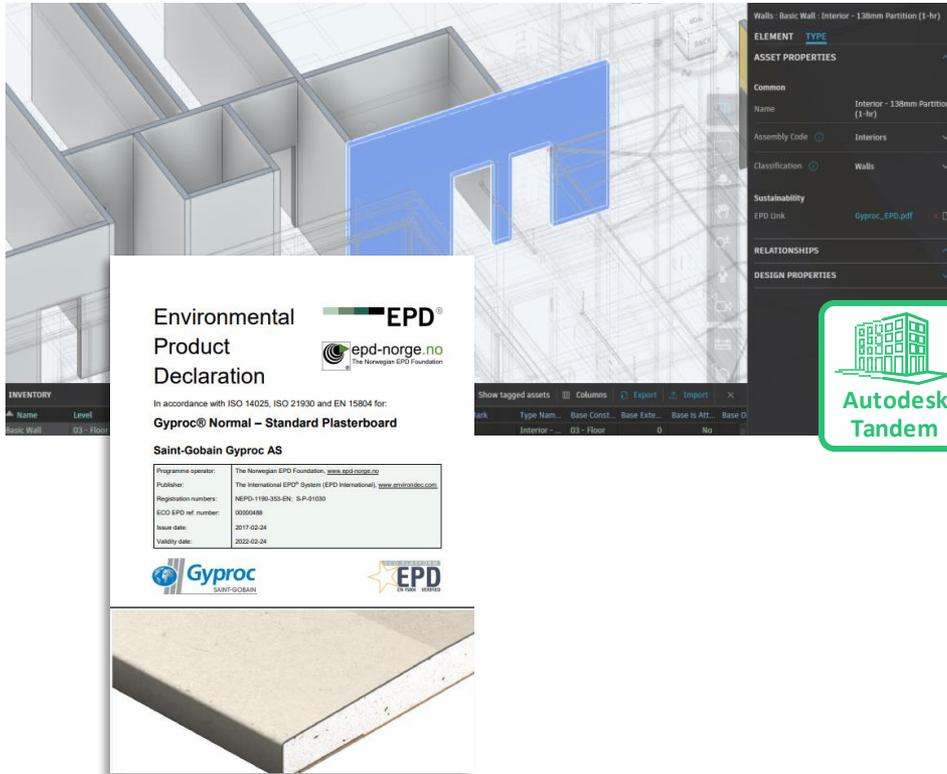
## Doors

Quantity 81.99 81.99 81.99



# Enable a Circular Way of Building

## Digital Twins for BaMB's



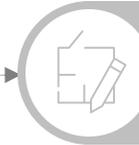
### Maintenance Management

Tickets, Alerts, Schedules, Technicians



### Building Management Systems

Building Control Systems, Lighting, Security, Etc.



### Space Management

Space Planning, Booking, Occupancy



### Performance Management

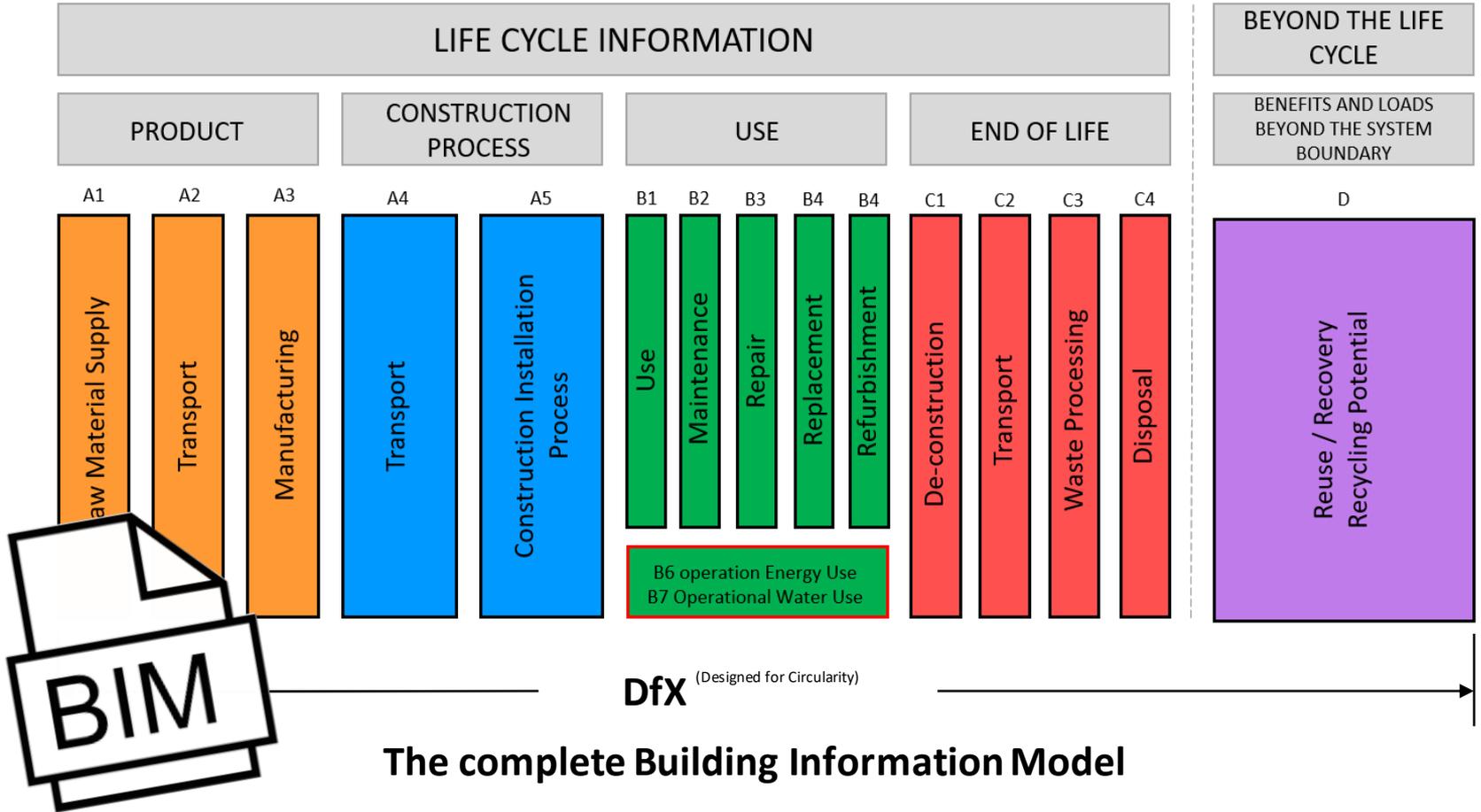
Utilization, Environment, Energy, Weather, Etc.



### Business Systems

Tenant and Portfolio Applications, Etc.





The crazy thing is that unlike the dinosaurs and trilobites etc. we can do something about this.

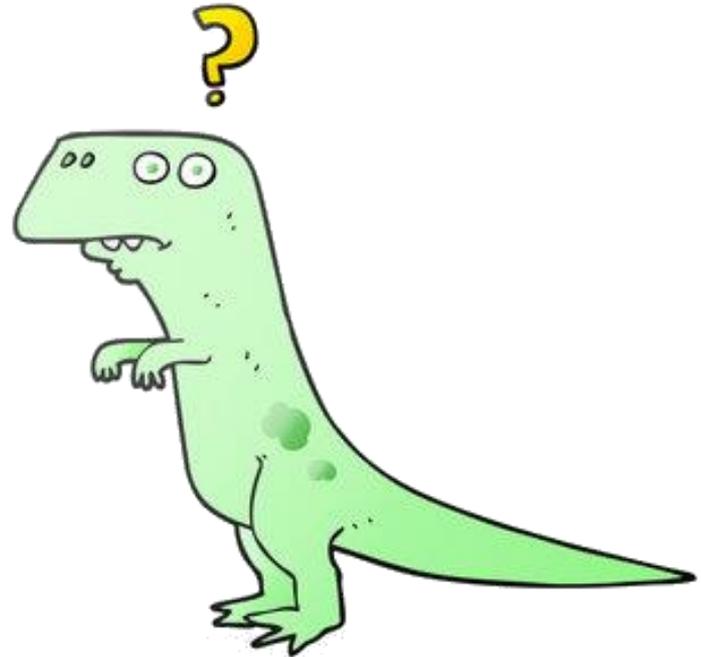
Let's not be the cause of the sixth mass extinction.

Remember:

Our planet is a closed system

Our resources are limited

**There is no Planet B**



**Thank you for listening and we hope this is  
not the end.**



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