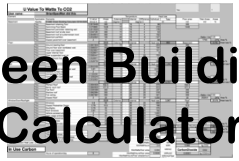
Green Building Calculator



Today

- STBA & SPAB Online Conference 2020
- Day 1 of 3 Embodied Carbon
- BrianSpecMan Murphy ONC HNC Construction BSc pgDip Architecture
- Title: 'TargetUValues + Overheating +GreenCostPlan +VE-CC +BIMBoM +BIMBoQ +EE +EC +SC +LCA = GBC'
- GBC = Green Building Calculator
- Not UK GBC

Calculator on GBC:

- Find GBC V1.0.0. file on GBC website at:
- https://GreenBuildingCalculator.uk
  - V0.0.0. Video
  - V1.0.0. Video Soon
  - Shop: XLSX file
    - Different prices for different users
  - GBC and GBE Newsletter: 1st last week
  - Video show: PPTS file
  - Zoom Recording on YouTube

This Presentation on GBE:

- Find this file on GBE website at:
- https://GreenBuildingEncyclopaedia.uk/?p=38491
  - PDF Show: from V0, V1 & V1+ PowerPoint
  - Full version of this presentation (84/227 slides)
  - To be updated after this event
  - Handout/print/read: PDF file to print
  - Shop: PPTX file
  - GBE & GBC Newsletter: 1st last week
  - Video show: PPTS file
  - Zoom Recording on YouTube

Why did I start making GBC?

- I want I want I want….. us all to do better, first time
  - Clients: to get what they asked for not what we gave them
  - Quality Surveyors: to do VE not Cost cutting, WLC not cheap
  - Manufacturers: to provide all important data, multi-functional products
  - Environmental Assessors: to guide designers with facts
  - Building Designers: to do more analysis themselves
  - Tenderers: to price a proper job and aim to claim no extras
  - BIM: Do what it claims to be possible in the advertising
  - Advisory Bodies: To be able to give more robust guidance
- To have better information at hand when they make all specification decisions
  - Evidence Based Design
  - Competent as was intended

Datasets>Equations>Calculators>Apps

- Data is okay, not much use on its own
  - Up to date and reliable data is essential
  - Consistently ordered data is good
  - Datasets can be orderly, in one place, are better
  - Open datasets are best
  - Datasets do not tell the whole story
- Equations are essential
  - Equations can interrogate the datasets
- Calculators save time
  - Consistently competently join up equations and datasets together
  - Can be readymade and waiting to be used speed the process
  - Accommodate many choices and changes and bring instantaneous results
  - Interrogate many issues at the same time
  - Allow comparison of scenarios
  - Allow value engineering (in its original meaning) not just cost cutting
  - Could be educational, guiding, problem avoiding,
  - Could enable and empower individuals
- CAD BIM App Calculators
  - Save time populating the input cells of the calculator
  - Allow two way flow of information

I am reminded to

Be the change you want to see in the world

Mahatma Gandhi

20 years collection of idle information

- 1000s Product Information
  - Product properties from many databases
  - Spreadsheets
  - Specifications
- 892 Elemental Assemblies from GreenSpecStudio
  - Elemental Assemblies to Passivhaus
  - Competent Construction assemblies
  - Specification Generator
- Calculators, Equations

GBE Whole Building Calculators

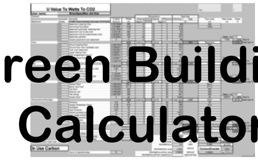
- Previous GBE Green Building Encyclopaedia
  - Elemental calculator: for a student's office task
  - ICE datasets into Excel for practical comparison
  - Whole Building Calculators:
    - Embodied energy, Embodied Carbon, Sequestered Carbon
    - Energy and CO2 in use
    - Created for Post graduate Architectural students 2015-18
  - Waste Cost® lite: created from SWMP workshops
  - Psi values: created for a manufacturer
- GBE Green Building Calculator
  - https://GreenBuildingCalculator.uk
  - Bring them all together in one place, one file
  - 10th June 2020 Version 1.0.0. Launched
    - 440 hours to assemble V1.0.0.
  - 4-5 months to V2.0.0. (end of October 2020?)
    - 395 hours so far V2.0.0. (835 total so far V1 and V2)
    - Excluding marketing, website and CPD
  - 21 versions planned: >24 months of development?

https://GreenBuildingEncyclopaedia.uk https://GreenBuildingCalculator.uk

Desire to drive environmental

- Bio-based Construction
  - Low to negative carbon products and materials
  - CAPEM Partner's know-how
  - LCA know-how and LCA datasets
- Plastics Avoidance
  - Changing Streams plastics avoidance campaign
  - Charm & Accord HA Interreg Project
- Circular economy
  - Recycled content
  - Reclaim and Reuse
  - Reclaimed materials with product passports: BAMB

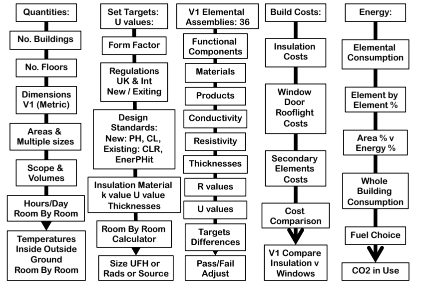
https://GreenBuildingEncyclopaedia.uk https://GreenBuildingCalculator.uk



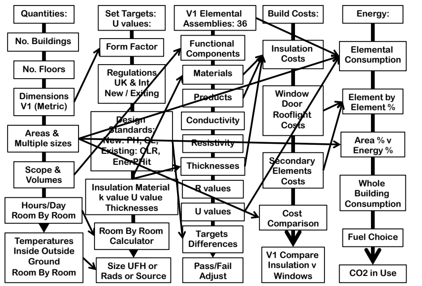
Green Building Calculator

Executive Summary

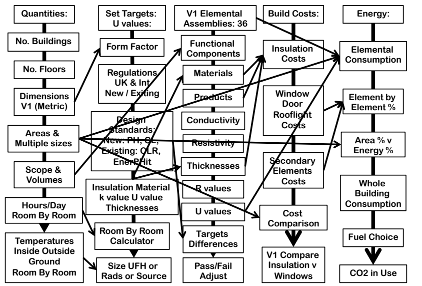
V1.0.0. launched June 2020



V1.0.0. launched June 2020



V1.0.0. launched June 2020

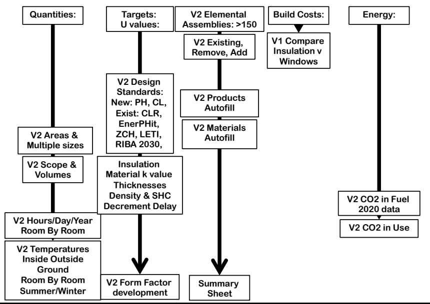


https://GreenBuildingEncyclopaedia.uk https://GreenBuildingCalculator.uk

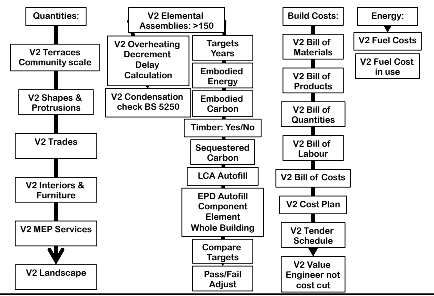
GBC Green Building Calculator

- Scope: V1.0.0. Completion:
- New Build, Domestic, Multi-storey, Multi-occupancy, Non-domestic (partial)
- Building Size:
  - Number of buildings and floors, heights, lengths, areas, volumes
- Temperatures: inside, outside, below ground and swimming pool
- Hours in use: per day (period temperatures maintained)
- Room by Room heat loss calculator: size radiators UFH or Boiler
- Form Factor: to set higher targets where necessary
- Regulations v Design standards:
  - U value target Selection:
  - Part L, Passivhaus, EnerPHit, AECB: CL or CLR or others
- Winter Thermal Insulation Material Choices
  - K values v U values = Thicknesses of different materials (50 mm is not enough)
- Assemble elements and all their components,
  - replace components with generic materials or products
  - Get U values, R values, meet targets or not, review thicknesses or materials
  - Energy Consumption, element by element %, add fuel choice > CO2 in use
  - Bill of Materials, Quantities, Labour, Products, Costs
  - Cost planning by the designer for the client investment not cost cutting

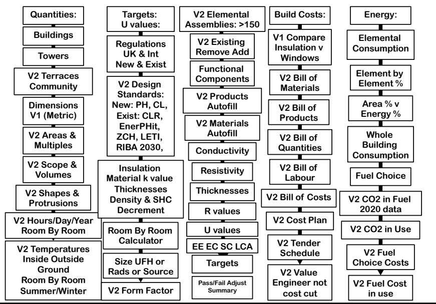
V2.0.0. updates



V2.0.0. additions



V2.0.0. update additions combined



V2 Current Development

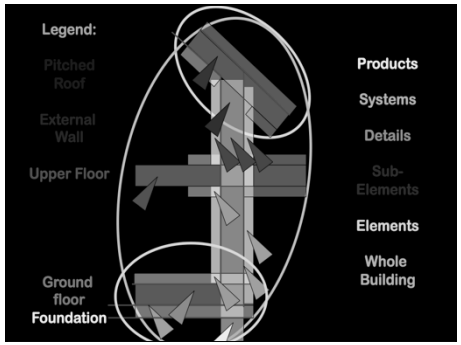
- Progress:
- Non-Domestic, Retrofit and Newbuild more elements;
- Terraces, Community level,
- Decrement Delay, Form Factor refinements: dormers, bays, porches; Condensation Check,
- Embodied Energy, Carbon and Sequestered carbon; LCA Calculator & Materials Miles
- External Envelope elements: 24 > 41
- Envelop Secondary Elements: 12
- Non-external envelope elements:
  - MEP Services: 20 Domestic,
  - Landscape: 20 elements
  - Interiors, Furniture: 25 elements
- Secondary Element Calculator:
  - U Glass, U Frame, Psi glazing bar, U Window, Psi Perimeter

V2-V15 Planned Development

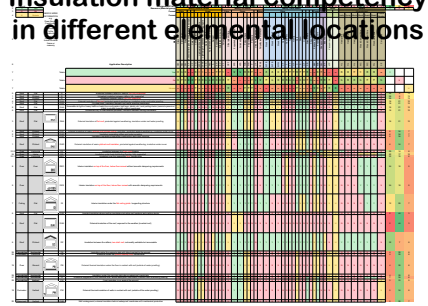
- Priorities to bring forward:
- V2 Retrofit, Terraces, Community level, MEP Services,
- V3 Decrement Delay, Form Factor refinements: dormers, bays, porches
- V4 Building Section Coding, Competent Application, 892 ready made elements, Bespoke Assemblies, Accessories, Specification Generator
- V5 Non-Domestic, Retrofit and Newbuild more refinement
- V6 Embodied Energy, Carbon and Sequestered carbon; Non-external envelope elements
- V7 Condensation Check, Thermal Bridge, Secondary Element Calculator, Thermal mass calculator
- V8 LCA Calculator
- V9 Civils and Infrastructure: scope Increased
- V10 Waste Calculator Using WasteCost®Lite
- V11 Plastic free v Recycled Plastic
- V12 Interiors: Scope increased, Ska fit-out. refit
- V14 Circular economy: Reclaim Reuse
- V15 Self-build Interface

V3.0.0. additions no date yet

- Elemental Assemblies:
- 2D/3D View
- Building Section Coded up
- Elements: inner, core, outer; sub-elements
- Element Junctions
- Product Datasets
- Competent Application objective
- Look up tables Subdivided to limit application



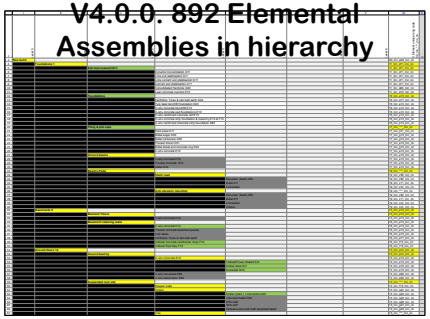
Insulation material competency in different elemental locations



V4.0.0. additions no date yet

- Elemental Assemblies:
- V4 892+ readymade elemental assemblies
- V4 User's Bespoke Assemblies
- V4 Manufacturer's Competent System Assemblies
- V4 Manufacturers & Suppliers Product datasets
- V4 Look up table refinements only competent applications
- V4 Specification Generator

V4.0.0. 892 Elemental Assemblies in hierarchy

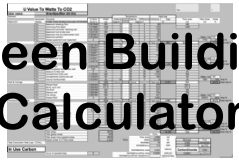


V4.0.0. 892 Elemental Assemblies & Specifications

Future Development Versions

- V5 Thermal Bridge, Thermal mass calculator
- V6 Civils and Infrastructure
- V7 Waste Calculator Using WasteCost®Lite
- V8 Plastic free v Recycled Plastic
- V9 Interiors: Scope increase, Ska fit-out. refit
- V10 Circular Economy Reclaim Reuse
- V11 Self-build Interface links back to GBE Encyclopaedia
- V12 BIM App (conversations started)
- V13 Whole Project Budget calculations: Prelims and fees
- V14 EU, International & Regional versions (USA: Feet inches)
- V15 Services Design Module: Occupancy level, Energy Sources and uses,
- V16 Lighting Design Module: Health & Wellbeing
- V17 Biodiversity Inclusion
- V18 Local Climate Appropriate construction and materials
- V19 Vernacular, local: materials, trades, economy
- V20 GBPB Green Building Price Book
- V21 Value Engineering Opportunities
- V22 Design Life and Durability

Green Building Calculator



Bespoke Development Opportunities

Historic Fabric Upgrades

- Compare upgrade measures: what do we really want to know?
  - e.g. single > double or triple glazed windows
  - Glass, spacers, gasses, LowE/SC coatings, frame profile, frame materials, weight, trickle vents
  - Embodied
    - Embodied Energy
    - Embodied Carbon
    - Sequestered Carbon
  - In-use
    - Energy savings: before and after
    - Carbon savings: before and after
  - Costs
    - Of upgrade measure
    - In-use energy cost saving: before and after
    - Financial comparison period? = life expectancy of measures
      - Temporary, Short, Normal and Long term
  - Value for money
    - Cost pay-back periods, profiteering at expense of performance or comfort
  - Value Engineering not just cost cutting
    - Carbon-back periods
  - But don't forget the other properties features, benefits, considerations
    - Thermal comfort (PH & EnerPHit), less condensation, vapour open/closed
    - Plastic content, plastic avoidance, recycled content, fire life risk
    - High recycled content may lead to bad choice of materials and properties

Window frame, Glass, Coating, Perimeter, Spacer, Gas, Finishes, Specifications Guesswork gut instinct Turn +, - & ? to numbers Evidence based design & specification	U value	Energy in use	Carbon in use	B1 Carbon saved in use	V2 Cost in use	Materials	Finishes	V1>V2 Profiles	Initial Cost	B1 Pay back period	Embodied Energy	Embodied Carbon	V11 B1 Carbon in waste	Sequestered carbon	B1 Carbon back period
Existing Single glazing	-	++++	++++	0	++++	0	+	0	?	+/-	+/-	0	0	?	
Existing to Double glazing	-	++++	++++	+	++++	+	+	++	?	+/-	+/-	+	0	?	
+Secondary Glazing	-	+++	+++	++	+++	++	++	+++	?	+/-	+/-	+	++	?	
+Secondary Double Glazing	-	++	++	++	++	++	++	+++	?	+/-	+/-	+	++	?	
Replace with double glazing	-	+	++	+++	+	+++	++	+++	?	+/-	+/-	+	++	?	
Replace with triple glazing	-		+	+++		+++	++	+++	?	+/-	+/-	+	++	?	

Evidence-based Guidance

Exiting Single glazed Windows

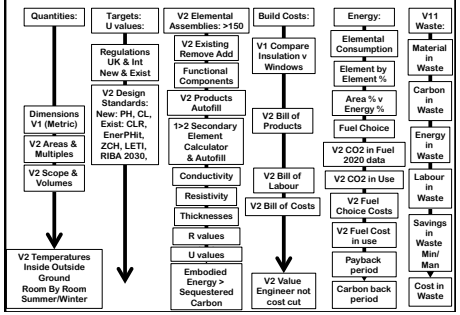
U values > Energy Saving > Cost saving > Carbon saving > Embodied Energy to Sequestered Carbon

Repair & Upgrade Exiting to Double Glazed Window

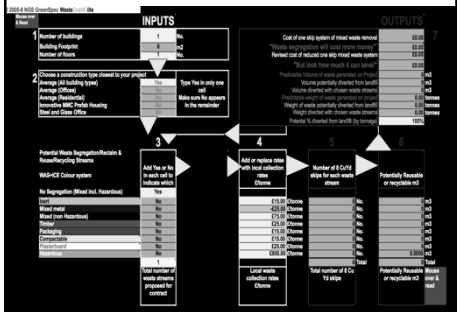
Secondary glazing with double glazed units

New Double or Triple Glazed windows

V1 V2 & V11 Compare Element Upgrade measures



V11 NGS WasteCost® *Lite* 2005 + new datasets



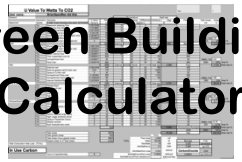
2020-2022 Future Development:

- 21+ Versions >24 months development
- Early sales: = development time +grow team
- Users to guide GBC on priorities & scope
  - Order of development: survey/steering group
- Commissioned work may allow parts to be developed or finished sooner
- Consultancy:
  - House Types analysis
  - Competition Entries
- Bespoke:
  - Compare Element Upgrade Measures

Green Building Calculator Website

https://GreenBuildingCalculator.uk

Green Building Calculator

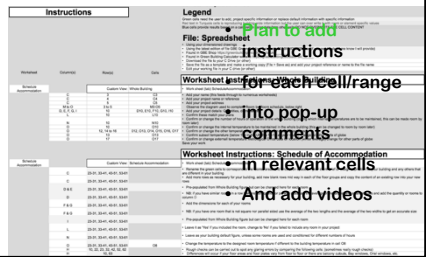


V1.0.0. In Detail

Green Building Calculator ScreenShots

Preview V2 relevant to retrofit

V2 Instructions

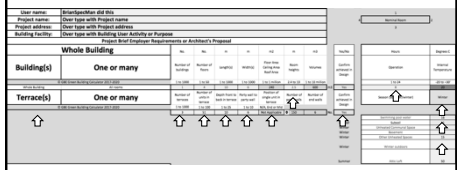


- Plan to add instructions for each cell/range into pop-up comments
- in relevant cells
- And add videos

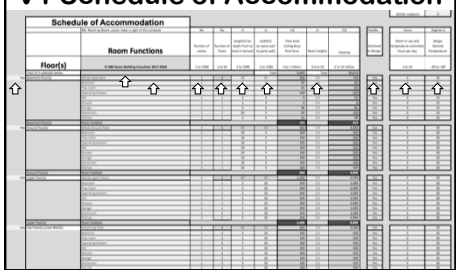
V2 V12 Cell colour Legend

Legend	In Excel	In BIM
Cell colour code/content	Explanation	
	User input cell, feeds into calculations througout GBC	From Bill of Materials
	GBC calculated results, that the user can overwrite. e.g. for variables	From Model?
	GBC calculated results, applying user inputs in other cells or sheets	From Bill of Materials
	User to select option from drop down list GBC will apply choice to calculations	From Bill of Materials?
	Row or Column titles	n/a
Yes/No	User input cell requiring user choice from drop down list	n/a
No	Not complete by GBC OR Users to ignore this row's cells. 'No' will turn red automatically	n/a
?	GBC awaiting information OR User to interrogate this row's cells and review decisions so far	n/a
Yes	Started by GBC OR To be completed by Users. 'Yes' will turn Green Automatically	n/a

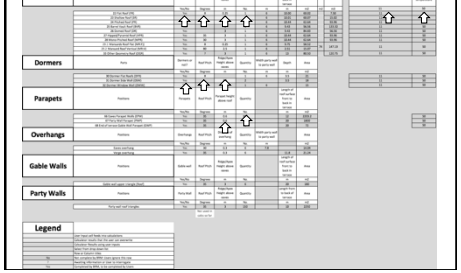
V2.0.0. Whole Building/Terraces



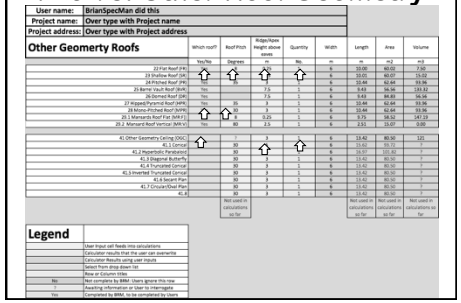
V1 Schedule of Accommodation



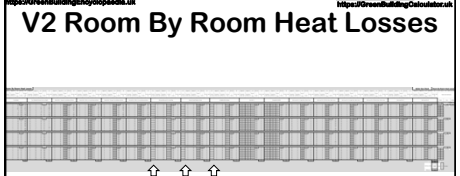
V2.0.0. Roofs Parts



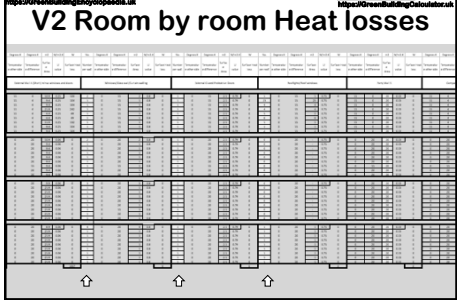
Future: Other Roof Geometry

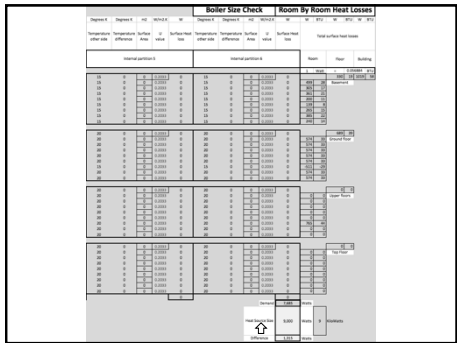


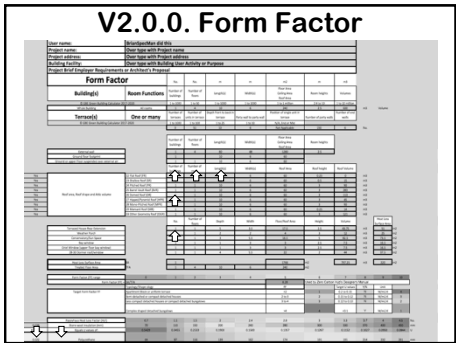
V2 Room By Room Heat Losses

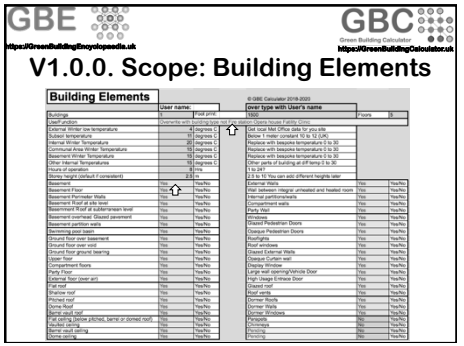


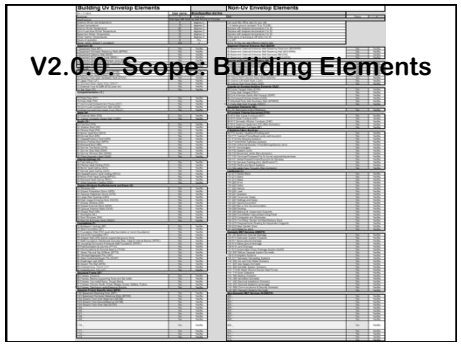
V2 Room by room Heat losses

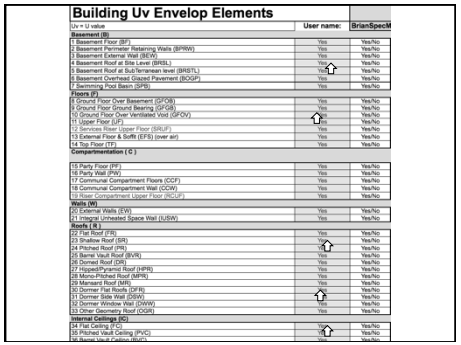


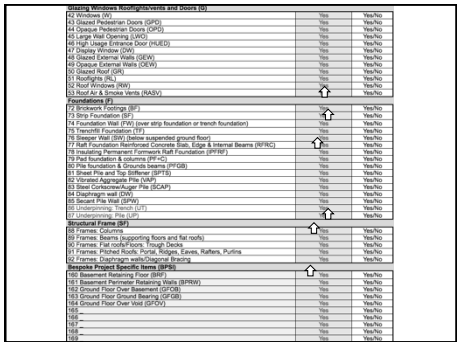

Boiler Size Check
Room By Room Heat Losses

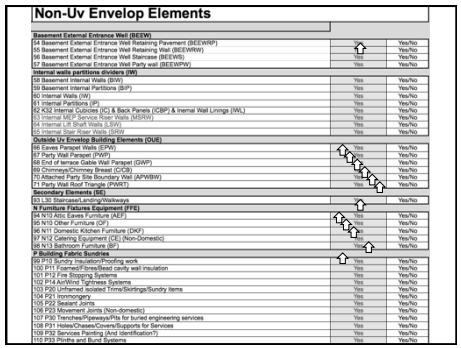

V2.0.0. Form Factor
Form Factor

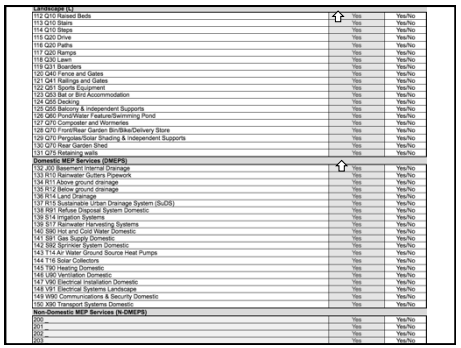

GBE
https://GreenBuildingEncyclopedia.uk
GBC
https://GreenBuildingCalculator.uk
V1.0.0. Scope: Building Elements
Building Elements

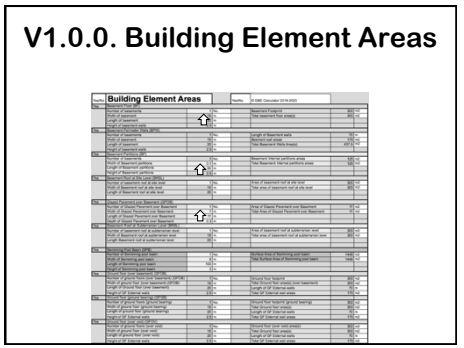

V2.0.0. Scope: Building Elements


Building Uv Envelop Elements


Glazing Windows Rooflights/vents and Doors (G)
Foundations (F)
Structural Frame (SF)
Bespoke Project Specific Items (BPSI)

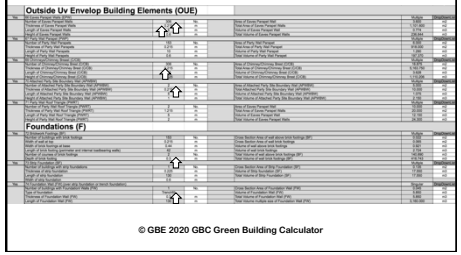

Non-Uv Envelop Elements


Landscape (L)
Domestic MEP Services (DMEPS)
Non-Domestic MEP Services (N-DMEPS)

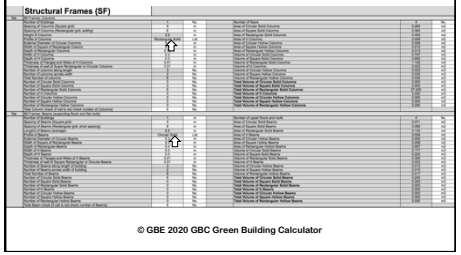

V1.0.0. Building Element Areas

Building Element Areas

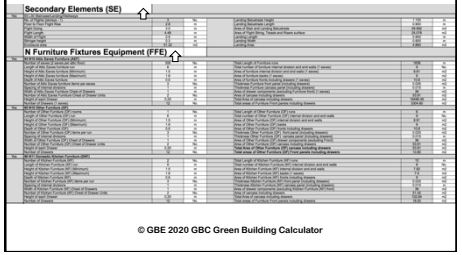
V2.0.0. Building Element Areas



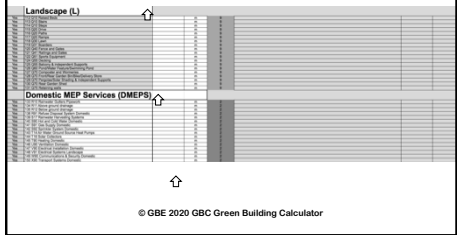
V2.0.0. Building Element Areas



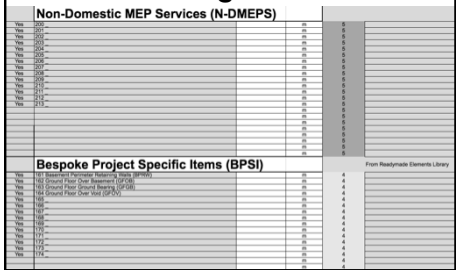
V2.0.0. Building Element Areas



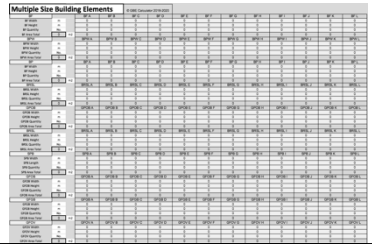
V2.0.0. Building Element Areas (V9.0.0. Landscape Pending) MEP in development



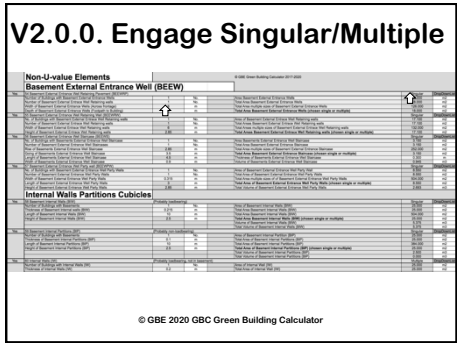
V5.0.0. Services Systems V4.0.0. Building Element Areas



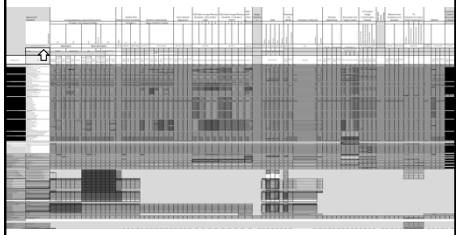
V1.0.0. Building Elements Multiple sizes



V2.0.0. Engage Singular/Multiple



V2 U values Etc. Energy Targets Regulations & Design Standards



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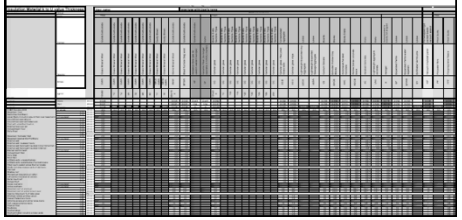
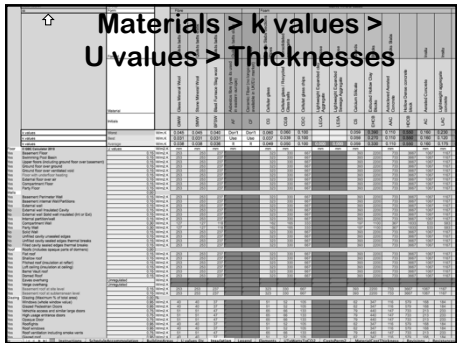
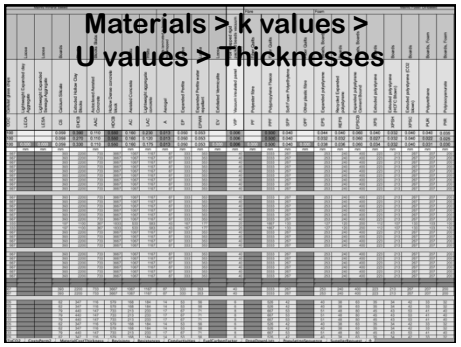
V1.0.0. Insulation Thicknesses k values

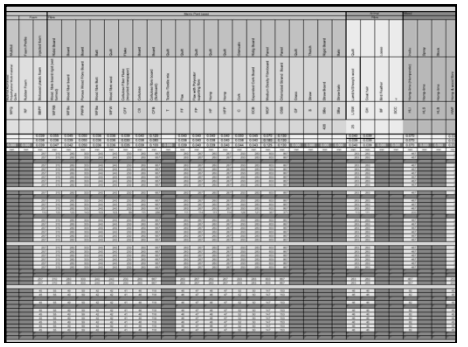


Materials > k values > U values > Thicknesses

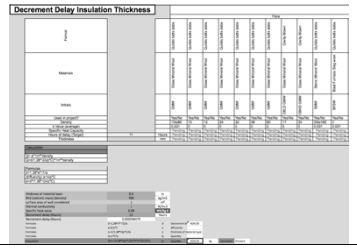


Materials > k values > U values > Thicknesses

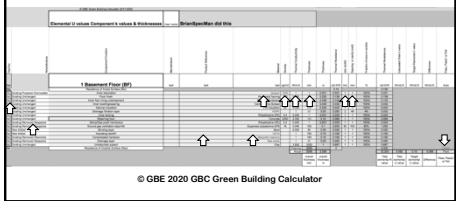




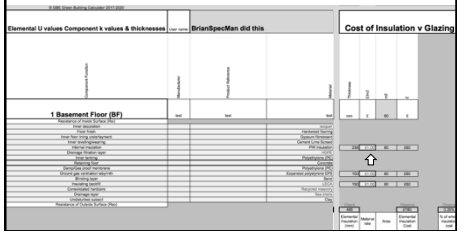
V2.0.0. Decrement Delay Insulation Thickness (Dev)



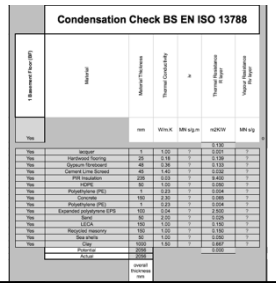
V1>V2 24 of 39 Elements
U or R value
12 secondary element U/R values
Refurb Actions



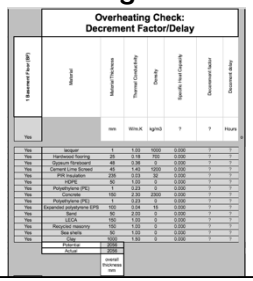
V1>V2 24 of 39 Elements
12 secondary element U/R values
Insulation v Window Costs



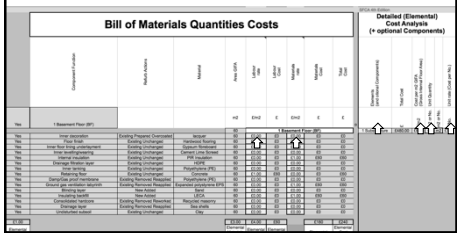
V2 Condensation Check (Dev)



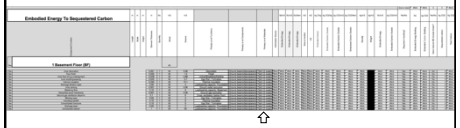
V2 Decrement Delay Overheating Avoidance



V2 Bill of Materials Quantities Labour Products Costs Refurb actions



V2 EE EC SC



V2 LCA EPD (Dev)

V1 Resistances

	Direction of heat flow		
	Upwards	Horizontal	Downwards
inside resistance	0.10	0.13	0.17
outside resistance	0.04	0.04	0.04
underfloor space*	-	0.13	0.17
Below Ground Exterior Surface		0	

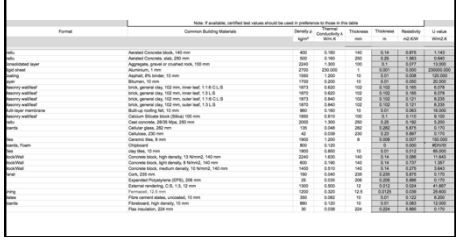
*These values should be used for the upper and lower surfaces of the underfloor space according to BS EN ISO 13370:1998

BS EN ISO 6946
Roofs, walls and exposed floors
Air space resistanes (m2.K/W)
Direction of heat flow

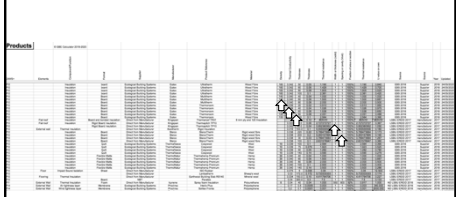
thickness of air spae	Upwards	Horizontal	Downwards
0	0	0	0
5	0.11	0.11	0.11
7	0.13	0.13	0.13
10	0.15	0.15	0.15
15	0.16	0.17	0.17
25	0.16	0.18	0.19
50	0.16	0.18	0.21
100	0.16	0.18	0.22
300	0.16	0.18	0.23

BS EN ISO 6946
Scaling factors for ceiling fixings and wall ties

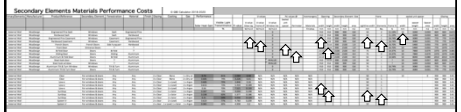
V1 Conductivities of Materials



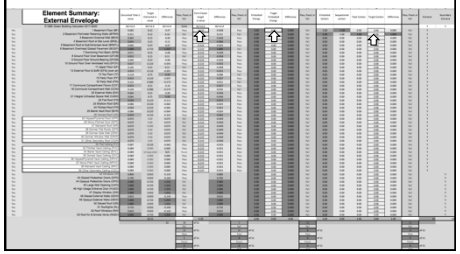
V1 Properties of Products



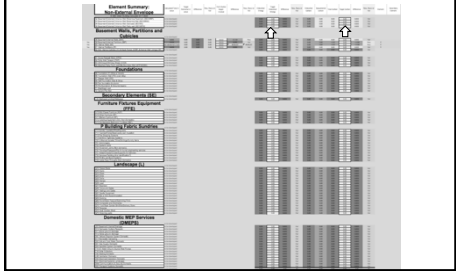
V1 Secondary Elements Data Collection and Calculator



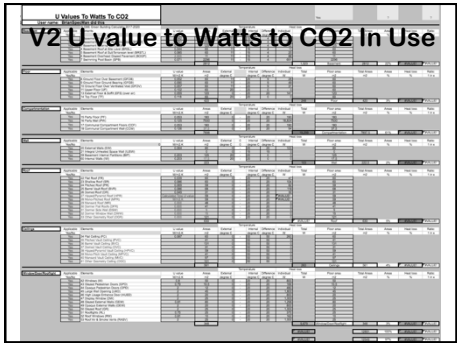
V2 Element Summary Ext Env For U Value Calculations



V2 Element Summary: Non-Ext Env for EE EC SC LCA



V2 U value to Watts to CO2 In Use



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V1 > V2 Fuel Carbon Factor

FuelOptions	kgCO2/kWh	
Biomass	0.025	0.025
Coal	0.33	0.33
Grid Electricity	0.537	0.186
LPG	0.214	0.214
Natural Gas	0.185	0.185
Oil (Gas oil)	0.252	0.252
Renewable		
	2009	2020

V2 Drop Down Lists: MSR

Drop Down List Manufacturer Supplier Request (MSR)

Element	Component	PrimaryFunction	Format	MSR Materials
U value Envelope Elements		Alphabetic order		
Basement (B)		Access		
1 Basement Floor (BF)		Air tightness		
2 Basement Perimeter Retaining Walls (BPRW)		Anchor		
3 Basement External Wall (BEW)		Cladding		
4 Basement Roof at Site Level (BRSL)		Conditioning		
5 Basement Roof at SubTerranean level (BRSTL)		Containment		
6 Basement Overhead Glazed Pavement (BOGP)		Cross ventilation		
7 Swimming Pool Basin (SPB)		Daylight entry		
Floors (F)		Decoration		
8 Ground Floor Over Basement (GFOB)		Disposal		
9 Ground Floor Ground Bearing (GFGB)		Fastening		
10 Ground Floor Over Ventilated Void (GFOV)		Finish		
11 Upper Floor (UF)		Fire resistance		
12 Services Riser Upper Floor (SRUF)		Fixing		
13 External Floor & Soffit (EFS) (over air)		Fixing/Support/Restraint/Anchor/Fastening		
14 Top Floor (TF)		Frost heave accommodation		
Compartmentation (C)		Furniture		
15 Party Floor (PF)		Gap Filler		
16 Party Wall (PW)		Gap filler / Formation		
17 Communal Compartment Floors (CCF)		Gap Formation		
18 Communal Compartment Wall (CCW)		Ground exclusion		
19 Riser Compartment Upper Floor (RCUF)		Ground gas exclusion		
Walls (W)		Ground water exclusion		
20 External Walls (EW)		Heat emissions loss resistance		
21 Integral Unheated Space Wall (IUSW)		Impact sound isolation		
Roofs (R)		Lateral stability		
22 Flat Roof (FR)		Lateral stability/Sheer Resistance		
23 Shallow Roof (SR)		Lining		
24 Pitched Roof (PR)		Lining/Sheathing/Sarking		

V2 Manufacturer Supplier Request Product Data Sheet

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V1 Awards/Shortlists

- 3 months after V1.0.0. launch
  - Green Apple 2020 Award Winner
    - Category and metal to be announced
  - Central England Prestige 2020-21 Winner
    - November announcement
  - Construction Computing 2020 Awards Shortlisted: (Announcement Nov/Dec 2020)
    - Innovation of the year 2020
    - One to watch Company 2020
- Submitted Applications:
  - CIBSE Building Performance Award 2021
  - PEA Awards 2020

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- Brian Murphy BSc Dip Arch (Hons+Dist)
  - Architect by Training
  - Specification Writer by Choice
  - Environmentalist by Actions
  - Writer and Editor by necessity (Websites)
  - Educator by calling
  - Number Cruncher by necessity (Calculators)
- Greening up my act since 1999
- Founded National Green Specification 2001
- Funded and Launched www.greenspec.co.uk 2003
- Created: GBE at https://greenbuildingencyclopaedia.uk 2015
- Launched: GBE Learning https://GBELearning.com 2020
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