Carbon Counting Calculators

Environmental Infrastructure
CEEQUAL, PAS 2080, ICE V3 & GBC Infrastructure Bespoke Module

This Presentation on GBE:

- Find this file on GBE website at:
  - https://GreenBuildingEncyclopaedia.uk/?P=39287
- GBC CPD
  - https://GreenBuildingEncyclopaedia.uk/?P=39145
- Infrapenny Infrapound Sustainable Infrastructure
  - https://GreenBuildingEncyclopaedia.uk/?P=398
- UN SDG For Railways
  - https://GreenBuildingEncyclopaedia.uk/?P=39377
- Go there for:
  - the latest update
  - versions presented to different audiences
  - the whole presentation all of the hidden slides
  - other file formats:
    - Handout, Show, PDF, Go to GBE Shop for PPTX
  - Links to other related GBE CPD and related GBE content

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Green or Violet Materials

- Construction/Infrastructure/Rail
  - Are energy, carbon and labour intensive
  - to create and maintain
- Imported materials:
  - High Carbon: Cement, Concrete, precast,
  - High Energy: Reinforcement, steel, copper, other metals
  - Carbon Sequestration: growing aggregates: CSS
  - Biogenic Carbon Sequestration: timber, bio-based materials
    - Revert to timber sleepers: durable Hardwood not treated softwood
  - Fossil Carbon: Asphalt, bitumen (Some fossil carbon)
  - Fossil Carbon: Plastics, hydro-carbons, petro-chemicals
  - High Energy & Emissions: Rail joining chemistry
- Heavy haulage and emissions: concrete, aggregates, soil, steel, green waste:
  - via rail v road?
- Labour Miles: rail v trucks v trucks on rails

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Material choices

- In particular OPC cement replacement in concrete (after water, concrete is the most used material)
  - GGBS or PFA: low carbon, Slower set
  - OPC & GGBS or PFA blended cements: normal setting forced on by OPC
- Risks of product or material surreptitious substitution raising the carbon count
- Robust specifications control substitution,
  - Policing the specification is essential
    - Be Proactive about it
  - Get it right first time

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Energy and Carbon in Rail

- Energy In use:
  - Energy Efficiency in production
    - Steam generators: lost opportunity? revert to steam trains!
    - Dispersed production: Local to Rail lines, along rail lines: PVs (EU examples)
  - Energy Efficiency in distribution: HV overhead or buried cable 11,000V radiation losses
  - Energy Efficiency in consumption
    - Catenaries? Bottom Rails? 11,000V radiation losses
- Embodied Energy
  - Copper & catenaries, electrical power and communications cables,
  - Steel: rails, signalling cables, steel tube piling
  - Galvanized steel Catenary supports,
- Embodied Carbon
  - Cement, Concrete
  - Fossil carbon: Plastics, Hydro carbons, natural Asphalt, natural Bitumen,
- Sequestered Carbon
  - Biogenic carbon calculations: few opportunities in rail? Acoustic fences in roads
  - Not Fossil carbon
    - Growing aggregates (rounded: not ideal for concrete or rail support)

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What New Rail Infrastructure?

- Signaling: Great Western Rail: (done)
- Goods Yards, Train parking Yards
- Logistics Yards: Container handling, Rail to Rail, Road to Rail to Road
- Passenger routes: Increasing capacity
  - Jubilee Line (done)
  - CTRL Channel Tunnel Rail Link to London St Pancras (done)
  - Cambs Pboro Bedford St Albans > St Pancras > South Coast (done)
  - HS2 London to North (over budget and open purse) via SSSIs and AFs
  - Cross rail: Queen Elizabeth Line (later still and bankrupt contracts?)
  - Cross rail 2?
- Stations: more platforms, more lines, ease train congestion?
  - Birmingham, London Bridge, Reading, Cambridge, Peterborough
- Rail to Rail Crossings > flyovers: Nuneaton, Cambridge-LKX

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What New Road Infrastructure?

- Consolidation centres & pallet services
  - Forced by Lorry driver Working Practices Directive
    - 12,000 lorry drivers too few overnight
  - Brexit: (Temporary?) Lorry parks
    - replacing M2 to Dover parking lanes
- Potholes repairs
- Central reservation barrier improvements (finished)
- Bridge/Flyover load capacity improvements (finished EU wide)
- Digital Technology cable laying (G5)
- Digital mapping below ground services (Ongoing)
- Road improvements? (local to GBE)
  - A604 > A14 (M1/M6 to A1) dual carriageway and lorry laybys
  - A1 > A1M Huntingdon A14 to Peterborough A1
  - A1 to M1 Bedford Bypass
  - A1 upgrades by-passing roundabouts
  - A14: A1 to M11 increase capacity (opened 1 year early)

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Green Infrastructure?

- Green Grids
  - Green Spaces and linking corridors
- Blue ribbons
  - Water bodies, SuDS, rivers, canals, dykes,
- Often associated with Grey (Road and Rail) Infrastructure modifications
- Critically important especially with COVID
  - Socially and mentally important places
  - Support Biodiversity recovery

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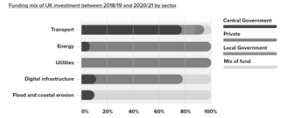
Who is commissioning/Funding Infrastructure/rail?

- Government <80% Rail
  - Network Rail?
- Local Government 10% Rail
- Private: >5% Goods Yards
- Private: 95% Energy: Wind and PV (+Gov. FIT? RHI?)



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Who designs and specifies?

- Stations and other buildings:
  - Starchitects to get planning
    - NF: How heavy are your buildings
      - (ignoring his foundations) (ignoring lightweight buildings overheat > A/C)
      - Asked to leave Architects Declare to carry on designing holiday airports
    - BA: In use impacts, for some decades
      - promoted BRE GGTS before it was scrutinized and found wanting
  - Passivhaus Designers: In use impacts not embodied
    - Embodied Plug in developed and available now
  - ACAN: Championing Embodied Carbon and Use of timber against fire
  - LETI: Championing Energy in use and Embodied Carbon
  - Greenies: WLC Embodied and In Use, as always
- Routes:
  - Civil Engineers
  - Rail Engineers
  - Bridge Engineers
  - Tunnel Engineers
  - Water & Utilities Engineers
  - Landscape Architects
    - Ecologists
    - Archeologists

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Sustainable Infrastructure?

- Contracts?
  - PFI or PPP (Do they still do them?) Focus on money, lax on spec
    - Superseded by better systems in Scotland
- Carbon targets: Implementation by:
  - Development Control?
    - Planning? Land owners?
    - Building Control? Pending BRADZ
  - Railways England?
    - National Rail Design Standards
    - National Rail Specification?
  - Highways England
    - DoT Standards
    - National Road Specification?
- Guidance
  - Missed opportunity: No promotion just updated and reissued
    - Example recycled content permitted, what about carbon?
  - WRAP's Aggregain website: no longer funded so gone
  - Earth Exchange website: also gone

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Sustainable Engineering Specification?

- Engineer's use Specification Templates
  - New cover for each job
  - List all materials and techniques Green and Violet
  - Little or no editing to be job specific
  - Rely on drawings to specify which where
  - Permit greener options but do not require it
- Concrete Mixing Plants
  - Have two cement silos
  - OPC & GGBS
  - They save money by blending OPC and GGBS
  - Just enough GGBS so you won't notice
  - OPC drives GGBS hydration to maintain 7 & 28 day strengths
  - Colour difference: Warm grey not cold grey

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Sustainable World & UK?

- UN SDG United Nations 25th Sept 2015
  - 193 world leaders committed to 17 SDGs
  - 17 Sustainable Development Goals by 2030
- Climate and Biodiversity Emergency
  - UK Government Signed up 1st May 2019
    - Local authorities followed suit: without any idea how and little follow up action
- Extinction Rebellion: frustration at lack of action by all governments
- Greta Thunberg's behaviour change campaign
  - Global call to Adults to join
  - Architects Declare: Oct 2019
  - Construction Declare: May 2019
  - Education Declare
  - Structural & Civil Engineers Declare
  - Interior Design Declare: March 2021
- Dictatorship Boris:
  - Brexit/Border controls/Irish unrest/Riots
  - Dilute Human Rights
  - COVID Incompetence
  - Ban all Protests no matter how bad he and his projects/actions get

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UN SDG

- United Nations
  - 25th Sept 2015
  - 193 world leaders
  - committed to 17 SDGs
  - Sustainable Development Goals by 2030
- Green Building Encyclopaedia
  - Sustainable Rail UN SDG (Brain Dump) G#39377
  - https://GreenBuildingEncyclopaedia.uk/?p=39377
- Interreg SusStations Project
  - Environmental Assessment Method
  - Like BREEAM only more Rail
  - https://GreenBuildingEncyclopaedia.uk/?p=916

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Sustainable Government Procurement

- Water Sector: Gov. driver: TOTEX = CAPEX + OPEX (saving £ms)
  - Other Sector roll out? Nothing happening
- Government Procurement: Post-Brexit:
  - EU Procurement Rules V2: No longer
    - CE mark Essential Requirements
      - Environmental added
      - TC 350 and TC351 rolled out >
      - LCA > EN 15804 > Product Category Rules > Impacts > EPD reports
    - CE mark replaced by UKCA for goods in UK Jan. '21
      - Essential requirements still relevant: but aim at BSs not ENs
  - GPP Green Public Procurement: Still possible
    - OGC Office of Government Commerce:
      - Gateway Process Reviews:
      - More due diligence than spec?

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UK Government Publishes others join in

- But is anybody in the industry reading?
  - Yes: Librarian or Knowledge Manager
  - No: Everybody else is busy
- UK Government Commitment to Net Zero Carbon 2050
  - Construction 2025: July 2013
  - Committee on Climate Change: May 2019:
  - The Construction Playbook: V1 Dec. 2020
- Infrastructure
  - National Infrastructure Strategy Nov. 2020 CP 329
- Government Soft landings

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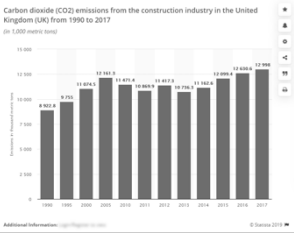
UK Government Commitment to Net Zero Carbon 2050



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Construction 2025

- Industrial Strategy: Government and Industry in Partnership
  - Did anybody sign up to this?
- July 2013
- Discounts on top of Constructing Excellence's
  - 10% year on year improvement challenge
- The Construction industry is already effectively bankrupt
  - Supported by supply chain funding MC with 90+ delay on payments
  - And severe mental stress

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The Construction Playbook V1 Dec. 2020

- Sourcing and contracting public works projects and programmes
- 'Build Back Greener'

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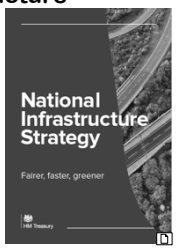
Infrastructure

- National Infrastructure Strategy Nov. 2020 CP 329
  - Fairer Faster Greener
  - COVID recovery
  - Decarbonising & Climate Change Adaptation
  - Investment plans
  - Transport
    - Tailpipe emissions
    - EVs infrastructure
      - but RE too?
  - Energy
    - More renuables % in mix
  - Buildings (27m homes)
    - Green homes Grant
    - Withdrawn April 2021
  - Nature for Climate fund
    - 30,000 hectares of trees/year
    - To replace HS2 devastation
  - 10 Point plan for Green Industrial Revolution



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London Plan Whole Life-Cycle Carbon Assessment

- ADD2363 August 2019
- Operational emissions
- E.g. Heating, Hot water
- Embodied are not currently measured
- LETI London Energy Transformation Initiative (Campaign for better)
  - Energy & Carbon in use and embodied
  - Public consultation on Future Buildings Standard this week (April 2021)

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Environment Sectors Prepares

- LCA Life Cycle Assessment & EPD Environmental Product Declarations
  - Method: Normalising to EN 15804:2012, over last decade +AMD A1 2013 +AMD A2
  - Sequestered Carbon Method, outside of EN 15804 boundaries
    - Biogenic carbon, EN 16449:2014
  - Manufacturers: 9000 EPDs in market plenty are in construction materials
- LCA is a broader set of impacts, but we must focus on:
  - Embodied carbon, – CAPEX
  - Sequestered Carbon, Biogenic carbon, Timber and Bio-based materials
    - EN 16449:2014 (we might not be in EU but standards are private enterprise in UK)
  - In use carbon, – OPEX
- PEF Product Environmental Footprinting (Future development)
- PAS 2080:2016 Whole Life carbon Assessment
- RICS Carbon Calculation methodology Ed. 1 Nov. 2017
- ICE Inventory of Carbon & Energy V3 Nov. 2019
- CEEQUAL 6 Civil Engineering Environmental Assessment Method

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EN 15804 LCA > EPD Dataset

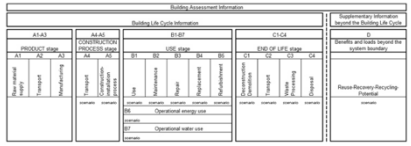

Figure 1: Life cycle stages and modules used in CEN/TC 350 standards such as EN 15804

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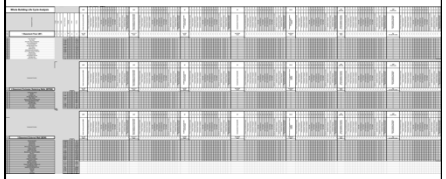
GBC V2 LCA Calculator



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PAS 2080

- BSI
  - Publically Available Specification
  - PAS 2080:2016 Whole Life carbon Assessment
- The Green Construction Board
  - Guidance Document for PAS 2080
  - Managing Whole Life Carbon in Infrastructure
  - Roles and Responsibilities
  - Process
  - Introduction to LCA
  - Case Studies
  - Carbon Measurement Tools
  - Rules for Calculations
  - Sample datasets from many sources

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RICS Whole Life Carbon

- RICS
- Whole Life Carbon Assessment for the built Environment
- Calculation methodology
- Edition 1
- Nov. 2017
- Elemental Assemblies
  - Relates to elemental cost plan
    - Relates to Spon
    - Not confident this helps
  - Bad Cost planning?
    - Bankrupt industry?
  - Crippled Supply chain?
    - Late payments?
    - Mental Stress prevails?
- GBC does components > elements > whole building calculations

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ICE database

- ICE Inventory of Carbon & Energy
- V3 remains free access
- Nov. 2019
- Many more derived from consistent method LCA
- More Infrastructure & Civils Datasets
- Haulage and transport datasets
- Less Energy datasets
- Update funded by infrastructure:
  - Heathrow, RSSB, EA
- https://circularecology.com/embodied-carbon-footprint-database.html

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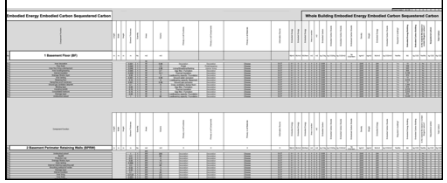
GBC V2 EE EC SC Calculator



Highways England Carbon Tool

- Guidance
- July 2020
- Version v 2.3
- Excel On-line tool
- E.g. Schedules for data collection

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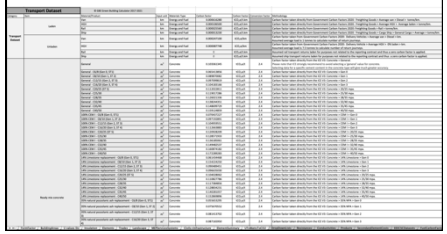
GBC V2 Transport datasets



Life Cycle Analysis of Transport

- Impact of road and rail transport in LCA
  - Flights are very carbon and energy inefficient
  - Ships are very efficient
  - Rail is very efficient
  - Road is worse
  - Big trucks are better than small vans
- Role of consolidation centres
  - Long haul in big trucks or trains
  - Pallet services removes many small vehicles off road
    - Needs less drivers
  - Switch goods to smaller trucks in consolidation centres
  - Short haul in small trucks for easy access
  - Round robin journeys: site <> consolidation centres

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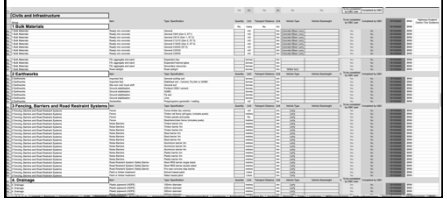
GBC V2 Civils & Infra Datasets



ISE Carbon tool: Structures

- Institute of Structural Engineers
- The Structural Carbon Tool
- Launched: March 2021: Free to use
- https://greenbuildingencyclopaedia.uk/encyclopaedia/the-structural-carbon-tool-calculator/
- Building Structure only
  - (more with user effort endless hours)
- SCORS:
- https://www.istructe.org/IStructE/media/Public/TSE-Archive/2020/Setting-carbon-targets-an-introduction-to-the-proposed-SCORS-rating-scheme.pdf
- Embodied carbon:
- https://www.istructe.org/IStructE/media/Public/Resources/istructe-how-to-calculate-embodied-carbon.pdf
- Sequestered Carbon:
- https://www.istructe.org/IStructE/media/Public/TSE-Archive/2021/Timber-and-carbon-sequestration.pdf

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Environmental Assessment Methods: Drive change?

- BREEAM driven via GGtS & Green Book Live
  - Green Guide to Specification
    - Industry average Generic Materials (no incentive to improve)
    - 1200 Readymade Assemblies (probably not what you are doing)
    - Bespoke assessments (BRE take their time)
      - 400 more assemblies added?
  - GreenBook Live Products
    - Mostly plastic or bitumen backed carpets
    - BRE EP = EPD once recalculated to EN 15804
- BREEAM Infrastructure (Pilot)
  - Like all BREEAM Tools
    - it records what you did,
    - not change the way you did it
    - "If not BREEAM could have been greener"
  - HS2 destroys easy targets (whilst COVID lockdown hides evidence)
    - Many SSSI Sites of Special Scientific Interest
    - Many Ancient forests
    - 400 year old tree felled for a maintenance slip road
- It completely fails on behaviour change

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Infrastructure Environmental Assessment Method: Drive change?

- CEEQUAL V5
- 15 years, 1300 trained assessors,
- now BRE's
- + BREEAM Infrastructure Pilot
- = CEEQUAL 6
  - June 2019,
  - + Whole Life Carbon

https://www.ceequalonline.com/login/
Must be trained to use it
Cannot even see it
Video Thank you BRE, link will not work
Fee: £3000 (£3m)-£38,000 (£1000m)

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World & UK GBC

- WorldGBC Net Zero Carbon Buildings Commitment by 2030 Sept. 2018
- UKGBC Net Zero Carbon Buildings:
  - A Framework Definition: April 2019
- WGBC Bringing Embodied Carbon Upfront
  - Sept. 2019 'Upfront Carbon'
  - disconnecting from OPEX therefore TOTEX
  - Whole live VE becomes more complicated
- Budget March 2021:
  - Government: Build Back Better
  - UKGBC: Build Back Business as Usual
- Net Zero Whole Life Carbon Roadmap for the Built Environment:
  - March 2021

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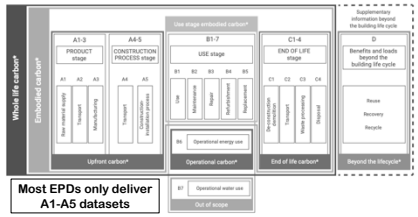
‘Upfront’ carbon A1-A5

used within this report. In the following definitions we make reference to the lifecycle stages or modules defined in the widely-adopted European standard EN 15978 shown in figure 1.



Most EPDs only deliver A1-A5 datasets

MEP Services Carbon Accounting

- BSRIA carbon accounting for services:
- Rules of engagement
- Topic Guide TG3/2012
- Metals and Plastics
- Sections:
  - duct simplicity
  - cable complexity
- Components & Accessories
- Circuit boards:
  - generic values/mm2

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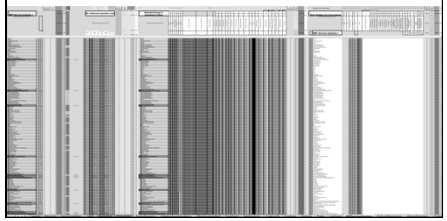
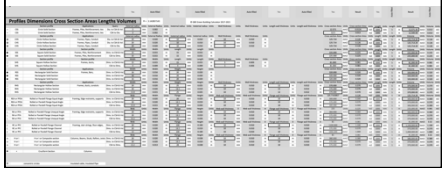
GBC V2 MEP Services Items BOMQC EEECSC LCA

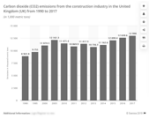


GBC V2 Sections Calculations MEP Services & Structures Profiles XSA Lengths Volumes



What purpose carbon counting?

- Growing designer’s awareness of growing impacts
- Carbon reduction potential opportunities and consequences
- Materials decision making
  - More performance
  - Conflicting performances
  - = less long term impacts
  - = more initial impacts
- As designed v as built
  - Performance Gap
- Substitution Value Engineering
  - Cost cutting in disguise
- Belgium’s 2012 ambition
  - ‘fine not tax development’
  - Based on designed impacts
  - Not forgetting substitutions



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Project Carbon Accounting

- CAD & BIM Apps:
  - ready to interrogate the models and datasets?
- Or getting ahead of the game
  - and doing it for yourself in Excel

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Green Building Calculator V2

- Excel for now V1 July 2020; V2 April-May 2021
- Building Elemental Assemblies V1 & V2
- Bill of Materials, Quantities, Costs V2
- Materials EE EC SC datasets & Calculator V2
- Materials and Products LCA Datasets & Calculator V2
- Infrastructure materials Datasets V2
- Transport emissions Datasets V2 Calculator Later
- Services & Structures Sections Calculator V2
- Building Landscape Road Readymade Assemblies V3 & V4
- Services Design Calculator: Later
- Rail Elemental Assemblies Later needs specialist advice
- Infrastructure Module Calculators V10
  - (sooner if any demand shown, or funded to develop early)
- BIM App later V20 (but early discussions have started)

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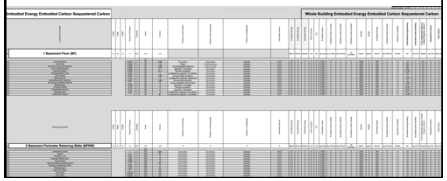
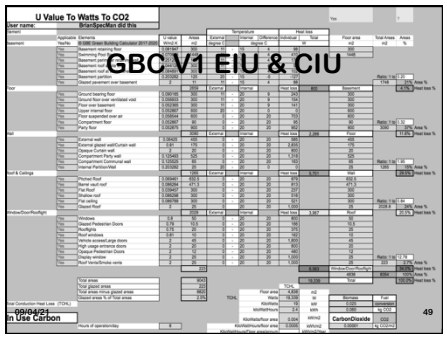
GBC V2 EE EC SC Calculator



GBC V1 EIU & CIU



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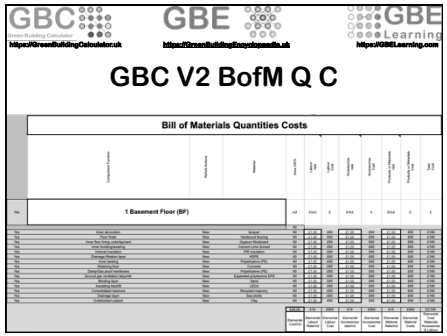
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https://GreenBuildingCalculator.uk
GBE
https://GreenBuildingEncyclopaedia.uk
GBE Learning
https://GBELearning.com
GBC V2 BofM Q C
Bill of Materials Quantities Costs
1 Basement Floor (BF)


GBC
https://GreenBuildingCalculator.uk
GBE
https://GreenBuildingEncyclopaedia.uk
GBE Learning
https://GBELearning.com
GBC CPD
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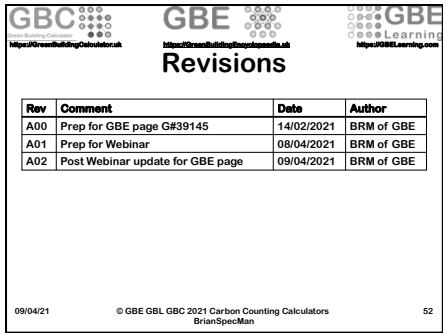
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https://GreenBuildingCalculator.uk
GBE
https://GreenBuildingEncyclopaedia.uk
GBE Learning
https://GBELearning.com
Revisions
Rev | Comment | Date | Author
A00 | Prep for GBE page G#39145 | 14/02/2021 | BRM of GBE
A01 | Prep for Webinar | 08/04/2021 | BRM of GBE
A02 | Post Webinar update for GBE page | 09/04/2021 | BRM of GBE
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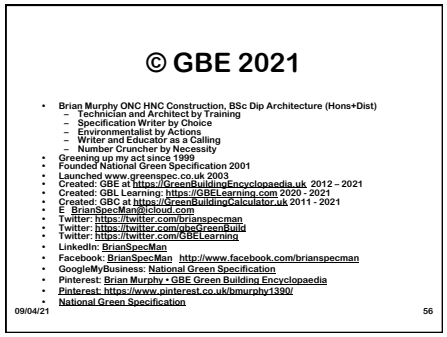
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• Brian Murphy ONC HNC Construction, BSc Dip Architecture (Hons+Dist)
– Technician and Architect by Training
– Specification Writer by Choice
– Environmentalist by Actions
– Writer and Educator as a Calling
– Number Cruncher by Necessity
• Greening up my act since 1999
• Founded National Green Specification 2001
• Launched www.greenspec.co.uk 2003
• Created: GBE at https://GreenBuildingEncyclopaedia.uk 2012 – 2021
• Created: GBL Learning: https://GBELearning.com 2020 - 2021
• Created: GBC at https://GreenBuildingCalculator.uk 2011 - 2021
• E BrianSpecMan@icloud.com
• Twitter: https://twitter.com/brianspecman
• Twitter: https://twitter.com/gbeGreenBuild
• Twitter: https://twitter.com/GBELearning
• LinkedIn: BrianSpecMan
• Facebook: BrianSpecMan http://www.facebook.com/brianspecman
• GoogleMyBusiness: National Green Specification
• Pinterest: Brian Murphy • GBE Green Building Encyclopaedia
• Pinterest: https://www.pinterest.co.uk/bmurphy1390/
• National Green Specification
09/04/21
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