The Institution of Structural Engineers

Sustainability Resource Map

Please Note: These resources are highlighted to the reader for their potential value/interest. Further resources are available via the "see more" links on the Climate Emergency webpage, as well as new resources published since the last update to the resource map. Some have been produced by third parties. The Institution of Structural Engineers does not necessarily endorse (nor is it responsible for) any statement or opinion expressed within these.

1. Get Informed

1.1 Sustainability in the built environment

Essential Resources
What are you going to do about it? (climate action video)
Decarbonate - why we must change
Steps to achieve a net-zero construction industry
Climate Jargon Buster
LETI - Climate Emergency Design Guide

Videos
Designing with nature

Short Reads
Carbon: Embodied and Operational

Longer Reads
Understanding embodied and operational carbon
SMART Healthcare facilities

External Content
Design Council - Beyond Net Zero
Fundamentals of sustainability in civil engineering
UKFIRES, - Absolute Zero
WGBC: Bringing Embodied Carbon Upfront

1.2 Sustainability in structural engineering

Essential Resources
Design for Zero
Structural Engineers Declare: setting the scene
Structural engineers declare: what it means for ISructE
Structural engineers declare: what it means for structural engineers
The institution's response to the climate emergency
The structural engineer's responsibility
Blog: The Hierarchy of Net Zero
Reducing embodied carbon on a smaller scale
Geotechnics and sustainability: a short guide
Embodied carbon basics for structural engineers on-demand course

Short Reads
Kenneth Severn Award 2022: Learning to tackle the climate emergency through materials and reuse
Getting started in sustainable design
Held to carbon account: the end of 'bog standard' new build?

Longer Reads
Key climate emergency actions for engineers and the institution

1.3 Beyond the climate emergency

Essential Resources
What is sustainability?
Carbon trading
A short guide to carbon offsetting
Video: Healthy building design - what can structural engineers do?

Short Reads
Structural sustainability beyond carbon
Addressing the biodiversity emergency: what role can structural engineers play?
Climate Emergency e-conference 2022: people and planet - Biodiversity
Climate Emergency e-conference 2022: people and planet - Social Sustainability
Engineering climate justice: how can we contribute to equitable global decarbonisation?
Sustainability for bridge engineers part 1
Sustainability for bridge engineers part 2

Longer Reads
A targeted approach to the UN Sustainable Development Goals

External Content
K. Raworth - Doughnut Economics
J. Allwood & J. Cullen - Sustainable materials without the hot air
Materials and sustainable development. Oxford: Elsevier
RIBA - Environmental design sourcebook: innovative ideas for a sustainable built environment
CRC Press - Fundamentals of sustainability in civil engineering, 2nd ed
CIBSE (2020) Sustainability. 2nd ed. London: CIBSE. (CIBSE Guide, L).
Halliday, S. (2019) Sustainable construction. 2nd ed. Abingdon: Routledge. [E-book]
Whole life costing for sustainable building. Abingdon: Routledge. [E-book]

2. Low Carbon

2.1 Embodied carbon calculations

Essential Resources
How to calculate embodied carbon (second edition)
A brief guide to calculating embodied carbon
An introduction to the structural carbon tool
Software: The Structural Carbon Tool
Software: Cost and Carbon Concept V5
Blog: Engineering insight into embodied carbon
Circular Ecology: Embodied Carbon - The ICE Database
What's new in the latest edition of the Institution's carbon calculation tools?

Short Reads
Measuring carbon – a small practice perspective
Measuring carbon in structures - advice for small practices
Seeing the bigger picture – industry emissions, your project and the performance gap
Capital vs lifecycle vs whole-life costs
Deriving embodied carbon factors from scratch
Understanding carbon factors - new guides available
Assessing carbon in timber buildings: how to factor in connections, fire protection and soundproofing
Viewpoint: Transporting carbon: calculating A4 emissions for mass timber

Videos
Video: Carbon in concrete, steel and timber

Longer Reads
Video: How to calculate embodied carbon: an overview of the guidance
Climate emergency conference 2021: Carbon
Climate emergency conference 2021: Carbon in materials
Minimising Energy in Construction (MEICON) overview lecture

External Content
WLC assessment - RICS
ASCE - Structural materials and global climate: a primer on carbon emissions for structural engineers
WRAP: Cutting Embodied Carbon in Construction Projects
BCSA: Bridge Carbon Calculator

2.2 Targets/ Benchmarking

Essential Resources
Setting carbon targets: an introduction to the proposed SCORS rating scheme
LETI One Pager Series: Whole Life Carbon, Embodied Carbon, Target Alignment, Net Zero
How to achieve a SCORS A rating using current materials and technology
LETI Embodied Carbon Primer
Racing to zero: isn't it time you committed to emission reduction targets
The Built Environment Carbon Database

Short Reads
We signed the climate declaration – now what? Lessons from counting carbon
Carbon targets for bridges: a proposed SCORS-style rating scheme
Carbon footprint benchmarking data for buildings
Embodied carbon: structural sensitivity study

Videos
Video: Whole life carbon, targets, and project examples

Longer Reads
A comparative embodied carbon assessment of commercial buildings.
Embodied carbon assessment using a dynamic climate model: Case-study comparison of a concrete, steel and timber building structure (Structures journal)
Embodied CO2 of structural frames
Life cycle carbon analysis of a six-storey residential building

External Content
SEI - Achieving net zero embodied carbon in structural materials by 2050

2.3 Concrete

Essential Resources
MPA: UK Concrete and Cement industry roadmap to beyond net zero
Engineers can help solve the concrete challenge
Blog: How to specify lower carbon concrete
How can we reduce the embodied carbon of structural concrete?
Marginal gains – carbon in concrete buildings
Website: Global Cement and Concrete Association
ICE: Low Carbon Concrete Route Map
Practical specification of lower-carbon concrete
The efficient use of GGBS in reducing global emissions
Concrete technology tracker

Short Reads
A review of GGBS use in the UK and its role in reducing embodied carbon
Recycled and secondary aggregates in concrete
Beyond Portland cement: Low-carbon alternatives
Use of recovered toner powder to enhance durability, engineering and sustainability performance
Specifying concrete: what's new in the forthcoming revision to BS 8500?
National Structural Concrete Specification - looking ahead to the fifth edition
Lower-carbon concrete technologies

Videos
What's happening with sustainability (commission 7)

Longer Reads
Fiberglass rebar: a proven and sustainable technology for concrete infrastructure
Developments in structural concrete conference 2021
Novel materials series: Low carbon concrete technology

External Content
Concrete Centre: How to specify lower carbon concrete
Concrete Centre: Specifying Sustainable Concrete
MPA: Low Carbon Cements and Concretes
Concrete Centre Webpage: Low Carbon Concrete
Concrete Centre Webpage: Concrete Futures
MPA: Carbonation of Concrete
Website: Sustainable concrete org

2.4 Steel

Essential Resources
Developing a low-carbon economy for steel
Blog: Making your steel specification more sustainable
Specifying sustainable steel: revised CARES Sustainable Constructional Steel certification scheme
Enabling steel's circular economy potential
Delivering steel's circular economy potential

External Content
Chatham House: Achieving Net Zero in the Steel Sector
SCI: Sustainability Guidance Webpage
SCI: The whole story from cradle to grave
UK Structural Steelwork: 2050 Decarbonisation Roadmap
BCSA Webpage: Sustainability
SCI: Target Zero Design Guides

2.5 Timber

Essential Resources
Timber & Sustainability
Timber and carbon sequestration
Mass timber embodied carbon factors
Timber Engineering Notebook

Short Reads
Design solutions for efficient timber buildings
Designing timber buildings for longevity
Making the most of timber - specialist skills for a complex material
Designing modern fire-safe timber structures - where does the responsibility lie?
Mass Timber Insurance Playbook - providing common ground in addressing insurance risks
Water ingress to cross-laminated timber structural frame
Modern timber-frame design: an introduction
Should we care where our timber comes from?
Talking mass timber: why early engagement is key to allaying insurers' concerns
Successful timber bridge design - a pedestrian/cycle bridge perspective
Durability of mass timber: managing moisture effectively

Longer Reads
Wooden Domes
Fire Safe Use of Wood in Buildings Global Design Guide

External Content
Video: TDUK - Timber and carbon
ASBP: Mass Timber - Challenges & Potential Solutions

2.6 Other materials

Short Reads
Diversity of materials
Developments in structural glass
Innovative composite floors for sustainable schools
Viewpoint: Navigating the risks of innovative construction materials: lessons from history and the present
Working with low-carbon brick alternative for repairs to imperial-sized bricks in historic buildings
Structural use of bamboo

Longer Reads
Scaling low-carbon construction materials
Essential knowledge text no.8 - New structural materials
Blog 11 recommended reads on using timber and bamboo
Blog 9 recommended reads on earth and straw
Webinar series: Novel materials and methods to achieve net zero
Novel materials series: How to get novel materials adopted on projects: R&D to construction
Novel materials series - Timber concrete composites
Novel materials series: Designing with rammed earth
Novel materials series: Designing with straw bale
Structural engineering with bamboo
Sustainable bamboo housing

External Content
Website: Alliance for Sustainable Building Materials

2.7 Carbon wider reading

Essential Resources
Making low-carbon material choices
How to read an EPD: basics for the structural engineer

Short Reads
How to carry out a carbon impact assessment of a structural consultancy office
Climate emergency e-conference 2022: people and planet - Understanding materials
Considerations when choosing sustainable materials
Blog: Steel, concrete & climate change
What if carbon drives our design from the outset?
Internal environment and thermal mass
Towards a holistic performance-based design approach
Structural thermal breaks: design considerations and certification
A guide to assessing existing roofs for the addition of solar panels
Thermal bridging and structural thermal breaks

Longer Reads
Carbon on site and in bridges
Balancing embodied and operational carbon in building envelope design
Masonry solutions for low energy buildings

External Content
Concrete Centre Webpage: Energy Efficient Buildings
Concrete Centre Webpage: Local Material
SCI: Thermal Mass
LETI & CIBSE: Net Zero FAQs

3. Lean Design

3.1 Safety and Resilience

Essential Resources
Resilience
Structural safety when designing lean in the climate emergency
Structural fire safety when responding to the climate emergency
Lean yet resilient – designing for the future
Reuse of existing buildings: a safety perspective
The risk of collapse of multi storey CLT buildings during a fire
Engineering for the future, a resilience-based approach
Adaptable structures - what really is serviceability?

Short Reads
Designing buildings for a warmer future
How can structural engineers contribute towards disaster mitigation?
Innovating our way to a safe and resilient future
Design of efficient steel trusses to resist progressive collapse
Viewpoint: Safety must be our highest priority
MMC and Robustness
Durability issues with engineered timber

3.2 Optioneering and Optimisation

Essential Resources
Lean design: 10 things to do now
Engineering in the climate emergency: doing less, better
Rationalisation versus optimisation – getting the balance right in changing times
Blog: Minimising waste in design and construction
Resource efficiency
Detailing for durability - an introduction
Case study: Building less and building clever
Layout optimisation of structures: doing more with less

Short Reads
What do we mean by efficiency? A holistic approach to reducing embodied carbon
Reduced reinforcement through reduced material partial factors
Climate Emergency E-Conference 2022: People and Planet - Digital software
Viewpoint: Computational design: embedding sustainability
TSE v100, v101 11 to 10
Comment and reply: Time to be lean
Embracing probability; could big data spell the end of safety factors as we know them?

Longer Reads
Lean design principles and implementation
Shell structures: lessons in structural efficiency for sustainable construction

External Content
Guide to Improving Value by Reducing Error – GIRI
Concrete Centre Webpage: Material Efficiency
Economic Concrete Frame Elements to Eurocode 2

4. Zero Waste

4.1 Circular economy

Essential Resources
Circular economy and reuse: guidance for designers
Climate Emergency E-Conference 2022: People and Planet - Circular economy
Practical application of circular economy principles
Three ways structural engineers can help create a zero-waste future
Applying circular principles to the design process
Design for deconstruction
Steel recovery and reuse - a case study of City Place, London
Circular partnerships database

Short Reads
The reuse of structural components and materials
Industry CPD: Structural steel and the circular economy
How circular is your building?
LETI: Circular Economy 1-paper
Material passports: an enabling solution for material use?
Viewpoint: Returning glass to the supply chain
Viewpoint: Reusing wood from demolition in mass timber products
Interview: Roy Fishwick

Longer Reads
Nothing is lost, nothing is created, everything is reused: structural design for a circular economy
SCI: Steel and the Circular Economy
Concrete Centre Webpage: Circular Economy

External Content
SCI P428 - Guidance on Demountable Composite Construction Systems for UK Practice
The Handbook to building a circular economy
The reuse atlas: a designer's guide towards the circular economy
Circular Economy Guidance for Construction Clients
Arup: Realising the value of the circular economy in real estate

4.2 Reuse of existing structures

Essential Resources
How to approach the assessment of an existing building
Risk and existing building assessments: understanding the approach
Video: The principles of reusing existing buildings
A short guide to reusing foundations
Analysing existing structures: a brief introduction
What can you do if you are convinced a structure will work but can't prove it to code?
Strengthening of existing buildings: an introduction
Design approach for structural strengthening of reinforced concrete structures using FRP

Short Reads
Specifying reused structural steel: some professional indemnity insurance considerations
Renovation not demolition: a case study of saving carbon on a private residence
Understanding existing buildings – five studies to complete before design work starts
An introduction to refurbishment. Part 1
An introduction to refurbishment. Part 2
Vertical Extensions: Technical Challenges and carbon impact
Refurbishments of existing structures: risk and insurance considerations
Provisions for assessment of existing structures in the second-generation concrete eurocode
Reusing and repurposing concrete-framed structures: practical engineering consideration
Historical defects in buildings series (No. 1 to 6)
Viewpoint: Rethinking CLT: the case for its use in retrofit

Longer Reads
Appraisal of existing structures, 3rd Ed
Assessment and retrofit of deficient reinforced concrete structures using advanced composites
Reuse and life extension of existing structures conference
Re:Crete - Reuse of concrete blocks from cast-in-place building to arch footbridge
Seismic Evaluation and Retrofit of Existing Buildings
Concrete-encased steel frames, 1900-70: considerations in their assessment and refurbishment

External Content
LETI Climate Emergency Retrofit Guide
SCI P427 structural steel reuse: Assessment, testing, and design principles

4.3 Conservation

Essential Resources
Conservation Compendium
Knowledge, skills, history - a foundation for a climate-positive future

Short Reads
Managing Health & Safety Risks (No. 32): Identifying and managing contaminated ground

Longer Reads
Averting disaster: How to save a collapsing building
Traditional brickwork: Construction, repair and maintenance

4.4 Offsite manufacture

Essential Resources
An introduction to modern methods of construction
Modern methods of construction: a study of upfront embodied carbon
Modernising design for minimal waste

Short Reads
Viewpoint: Releasing carbon-reduction benefits from DfMA/MMC - reflections from a major infrastructure project
Minimising upfront carbon emissions of steel-framed modular housing: a case study

Longer Reads
Refocusing modern methods of construction on the climate emergency: a five capitals model for action
Manufacturing buildings for people and planet
Digital fabrication
Optimising the structural design of modular housing by combining timber and lightweight steel framing

External Content
ACORN
Concrete Centre Webpage: Offsite Concrete Construction

5. Influence the Brief

5.1 Building Less & Standardisation

Essential Resources
Blog: Why understanding outcomes is the key to challenging briefs
Barriers to low-carbon design: what are they and how can we overcome them?
Carbon-reduction measures - cutting through the pushback
Company-wide carbon targets: overcoming barriers to progress
Video: Questioning and influencing the brief
Influencing the project brief and business model

Short Reads
Discussing sustainability with clients and collaborators

Videos
Video: The brief, policy and risk/resilience
Video: The art of persuasion and collaboration

External Content
LETI Client Guide for Net Zero Carbon Buildings

5.2 Effecting Change

Essential Resources
Persuasion and influence in a climate emergency
Barriers to low-carbon design: what are they and how can we overcome them?
Carbon-reduction measures - cutting through the pushback
Company-wide carbon targets: overcoming barriers to progress
Video: Questioning and influencing the brief
Influencing the project brief and business model

Short Reads
Discussing sustainability with clients and collaborators

Videos
Video: The brief, policy and risk/resilience
Video: The art of persuasion and collaboration

External Content
LETI Client Guide for Net Zero Carbon Buildings

6. Get Involved

6.1 Your role

Essential Resources
Putting the net-zero hierarchy into practice: Build Nothing
Putting the net-zero hierarchy into practice: Build Less
Putting the net-zero hierarchy into practice: Build Clever
SPOW Sustainability Checklist
Six climate emergency actions for structural engineers
Five actions structural engineers can take to design more sustainably
Viewpoint: Are you ready to challenge the status quo?
Viewpoint: Business as usual?
Tackling the climate emergency through daily project work
Structural engineering innovation for a zero-carbon world: an R&D agenda to match the carbon budget

Short Reads
Chartered Environmentalist registration: a new opportunity for members
Putting sustainable design practices at the heart of the IStructE exams
Blog: Addressing the climate emergency within a small engineering practice
Working towards the climate emergency goals
Own your agency: what part will you play in the climate revolution?
Don't let climate grief stop you taking action
Young engineers and the climate emergency
Sustainability Open Spaces
Ethics and the climate emergency: personal values and corporate decision making
Industry CPD: Incorporating carbon assessments into your modelling workflow

External Content
Construction Industry Council - Climate Change
Construction Leadership Council - CO2nstructZero

6.2 Policy

Essential Resources
Policy measures affecting the sustainability of structural engineering designs
Could sustainability be advanced through simplification of codes of practice
Why the Net Zero Carbon Buildings Standard is going to change the industry
Introducing the Net Zero Carbon Buildings Standard - a cross-industry approach to decarbonisation
UK Net Zero Carbon Buildings Standard
Embodied carbon regulation: alignment of industry policy recommendations
UKGBC: Net Zero Whole Life Carbon Roadmap for the Built Environment
Part Z: A proposed amendment to UK Building Regulations 2010

Short Reads
Financing a greener built environment

External Content
Royal Academy of Engineering: Decarbonising Construction - building a new net zero industry
RIBA Built for the Environment report

7. Report and share

7.1 General

Essential Resources
Sustainability Report Template

Short Reads
Climate action two years on: are we on the right track

Longer Reads
Climate emergency conference 2021: Next big steps
Climate Emergency E-Conference 2022: People and Planet - Panel Discussion
Climate Emergency e-conference 2023
Climate Emergency conference 2024
Circular economy panel debate
A livelihoods approach to construction in Zambia
Mass Design Group's Impact Driven Approach to Design & Construction in Africa
Climate Emergency Task Group: End of year report 2020
Climate Emergency Task Group: End of year Report 2021
Climate Emergency Task Group: End of Year Report 2022
Climate Action End of Year Report 2023

External Content
MPA: Decarbonising UK Concrete and Cement. Accelerating the Net Zero Journey
Concrete Centre Webpage: Concrete Industry Sustainability Performance
World Green Building Council Reports

7.2 Project write-ups

Short Reads
Blog: 8 vertical extensions you should know about
Mansion block becomes offices
Learning from the feedback loop: case studies in timber
Eden Project Dundee - bringing regenerative aspirations to life
The Lark: reducing carbon emissions through collaboration and good relationships - a model for everyday concrete frames
One Sherwood Street: realising the benefits of a modular approach
Holbein Gardens: delivering a low-carbon structure with reclaimed steel
Battersea Power Station - regeneration of an icon
Quay Quarter Tower, Sydney - conservation, life extension and upgrade using live digital twinning
Carbon assessment - operation, maintenance and use of the clifton suspension bridge

Longer Reads
1 Triton Square, London – low-carbon development through reuse of an existing building
RICA – climate-positive design using locally sourced materials
Nature's invention: The Enterprise Centre, University of East Anglia
Reuse, build less, build lean: low-carbon design for 22 Bishopsgate, London
Structural Awards 2022
Design and construction of Hams Way Footbridge, Worcester
Terminus, Vancouver Island: Solving a mass timber challenge in a seismic region
Structural Awards 2021
Upgrading the IMAX theatre at london's science museum
The living planet centre - a sustainable home for WWF-UK

Videos
Video: the Passivhaus residential development at Goldsmith Street

7.3 Profiles

Short Reads
Profile: John Orr
Profile: Penny Gowler
Profile: Caitlin Mueller
Profile: Jo da Silva
Interview: Dr John French (the client's perspective)
Profile: Mike Cook
Profile: Kate Simonen
Profile: Cameron Archer-Jones
Profile: Shalini Jagnarine-Azan

7.4 Education

Essential Resources
Structural Engineers Declare: what it means for Education & Research

Short Reads
Viewpoint: Teaching 'reuse' principles at university

Longer Reads
Teaching new skills within the core subjects
Effective teaching methods to help deliver new outcomes
Developing syllabuses and learning outcomes based on industry needs
Annual Academics Conference 2021 - Teaching and the climate Emergency

8. Regenerative

8.1 Regenerative

Essential Resources
The regenerative structural engineer

Short Reads
Learning from living systems - regenerative principles in practice
Regenerative design for building engineers: the role of the structural engineer
Viewpoint: Moving towards co-creating with communities
Regenerative education in practice
Workshop: Regenerative design: what is it and how can we do it?
Holistic regenerative design: the Common House by Common Practice

Sustainability Guidance

Zoom in to click the links and use Ctrl+F to search

To provide feedback or suggest revisions to this document, please email climateemergency@istructe.org