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Traditional and modern construction materials – innovations and environmental considerations

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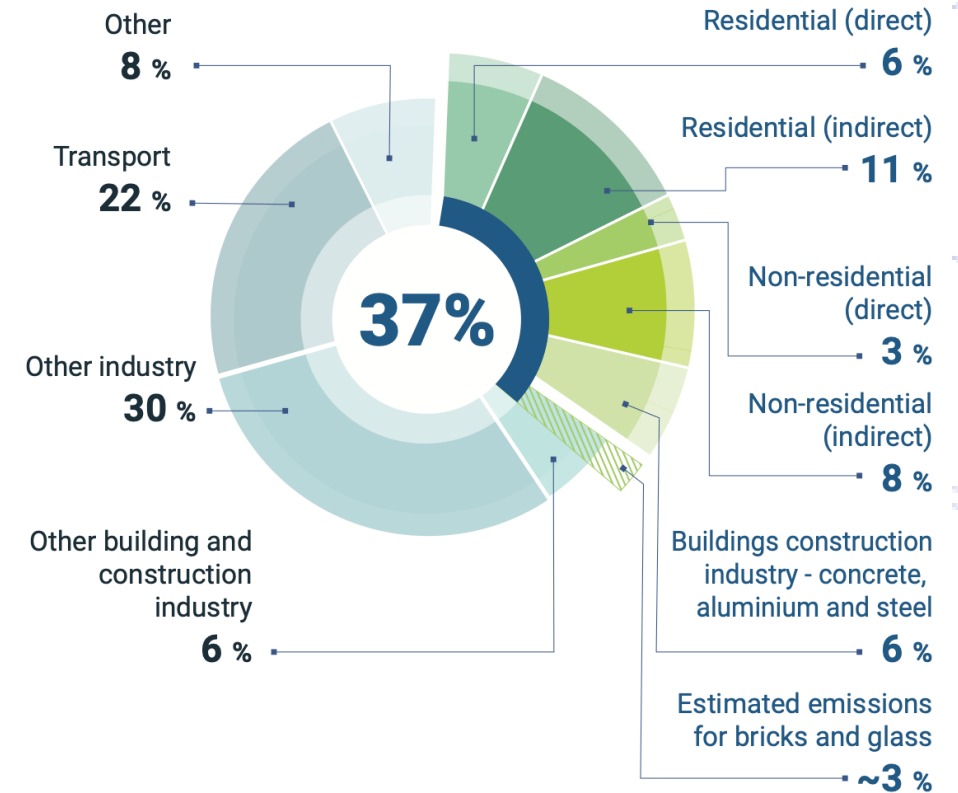


Environmental burden of the construction sector

- Dynamic expansion of construction sector.
- Embodied and operational emissions.
- Land use and depletion of natural resources.

37% of global emissions!

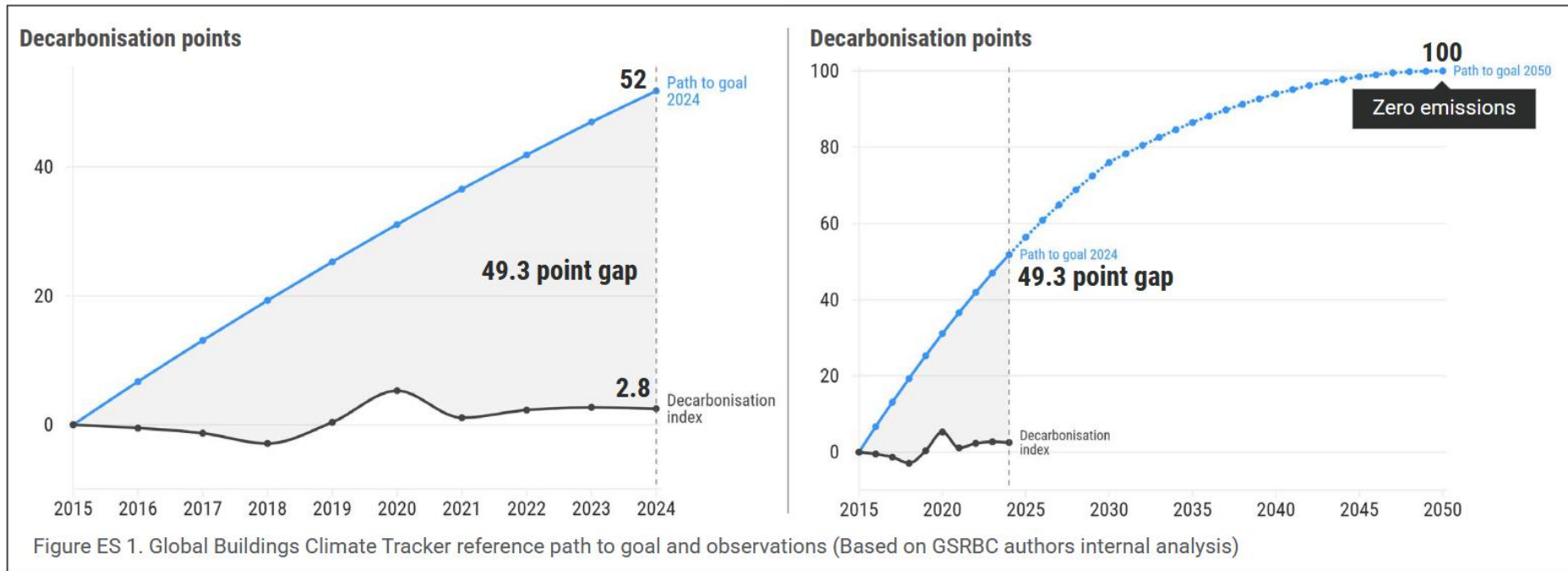
Nearly 50% of global material extraction!





Environmental burden of the construction sector

UN decarbonisation goals



56% reduction in emissions from 2024 required to get on track by 2030!





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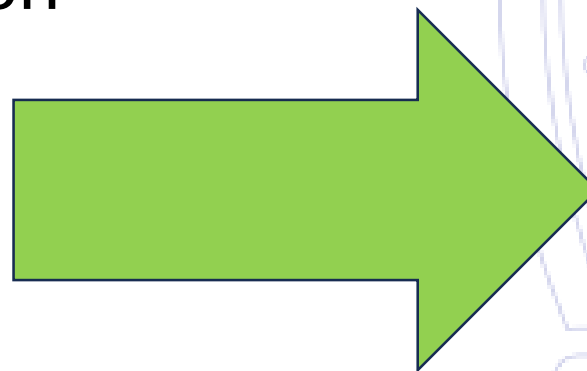
Environmental burden of the construction sector

UN strategies

Avoid – extraction and production

Shift – to regenerative material practices

Improve – materials and processes to support decarbonisation



**Sustainable and
circular economy**



AVOID

+



SHIFT

+



IMPROVE



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Environmental burden of the construction sector

Responsibility of ALL participants of the construction process



BUILDING MATERIALS AND THE CLIMATE: CONSTRUCTING A NEW FUTURE



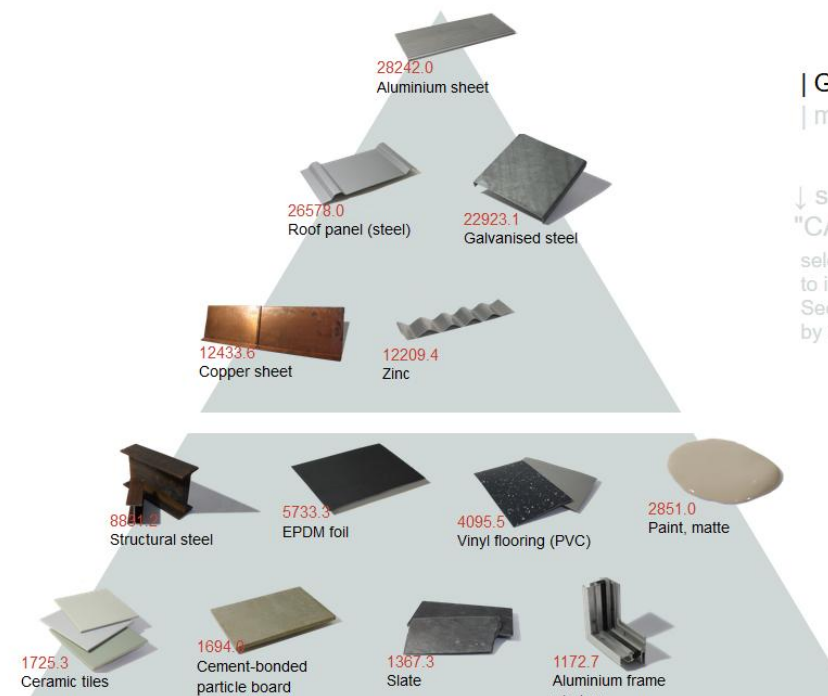


Environmental burden of the construction sector

THE CONSTRUCTION MATERIAL PYRAMID

THINK ABOUT AMOUNTS

Emission pyramid



| GWP [kg CO₂ eq / m³]
| module A1-A3

↓ scroll down to
"CALCULATOR"
select materials in the pyramid (click)
to include them in the calculator.
See the data used for the materials
by double-clicking on the material.





Concrete

- The most popular building material in the world.
- Composite material composed of cement, aggregates, water and additives.
- Ease of formation, high mechanical strength.
- Multitude of additions that can modify its properties to specific applications.
- High impact due to emissions, use of water and natural aggregates.





Concrete



Reuse and
prefabrication

Supplementa
ry
cementitious
materials

Low
emission
cements
(LC3)

Limestone
Calcined
Clay
Cement

LC³

Environmenta
lly friendly
innovations

Waste
valorisation

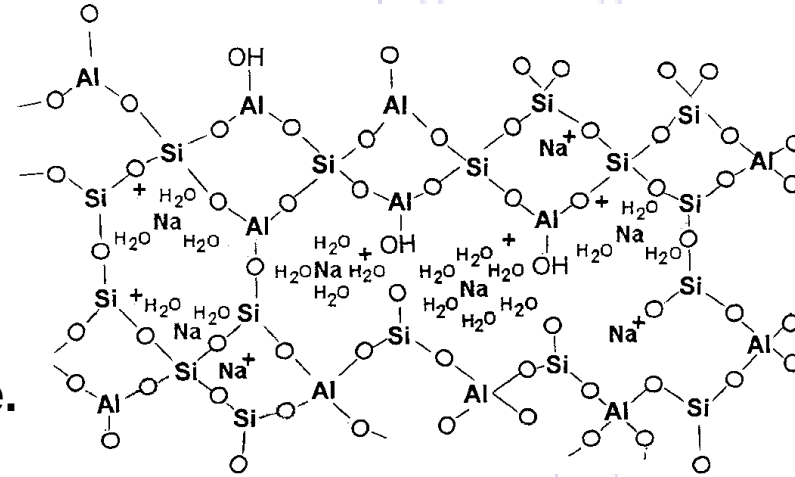
Recycled
aggregates





Geopolymers

- Alkali activated materials based on materials rich in alumina and silica.
- Similar mechanical properties to concrete.
- High durability and fire resistance.
- Possibility to utilize waste materials as base.
- Up to 50% lower GHG emissions compared to concrete of the same class.





Steel

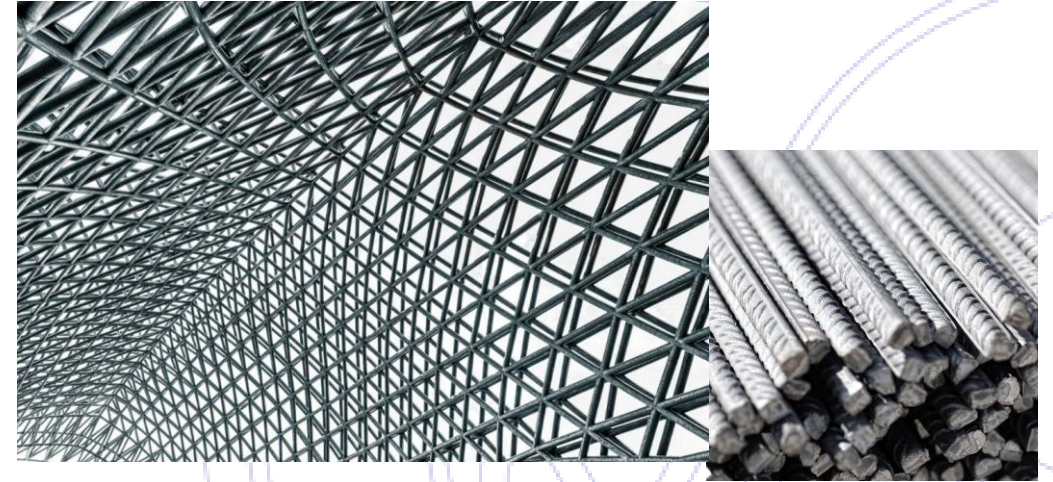
- Used as structural steel or concrete reinforcement.
- High tensile strength.
- Allows slender, complicated forms.
- High emissions from production processes but also a high potential for recycling and reuse of elements.
- 55% of steel produced is used in construction.

Up to 2,18t CO₂eq/t of steel produced

<https://worldsteel.org/climate-action/climate-change-and-the-production-of-iron-and-steel/>



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Steel



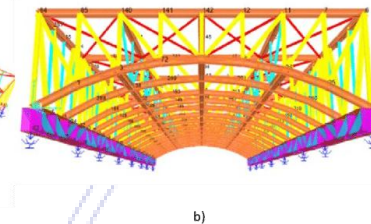
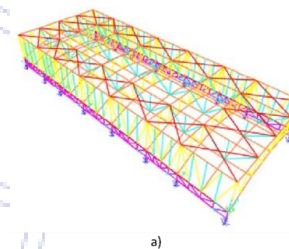
**Reuse of
elements**



**Use of
recycled
raw
materials**

**Environment
ally friendly
innovations**

**Design
optimisation**



**Modern
production
processes**

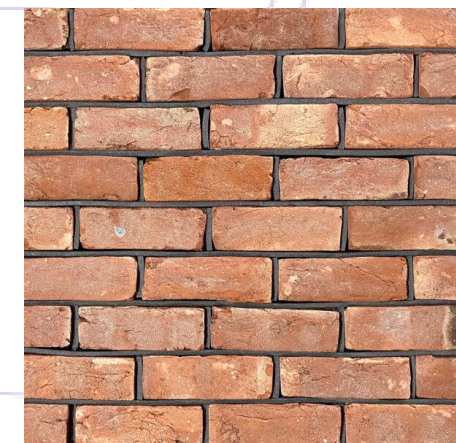


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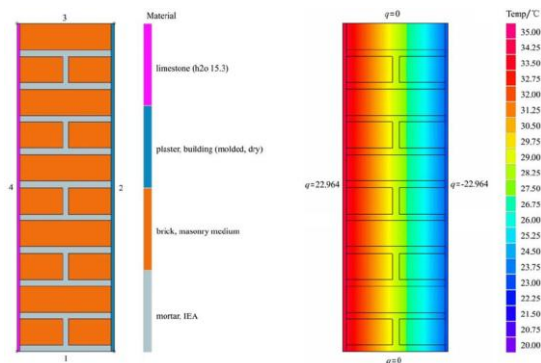
Masonry

- One of the traditional materials used for centuries
- Traditionally used clay bricks or modern masonry elements.
- Ease of construction without specialistic equipment.
- Modern systems aim at reduction of environmental impact during production and energy efficiency.
- Impact highly dependent on the type of element.





Masonry



Optimization
of insulating
properties

Autoclaved
Aerated
Concrete

Environmentally
friendly
innovations

Reduction
of joint
thickness

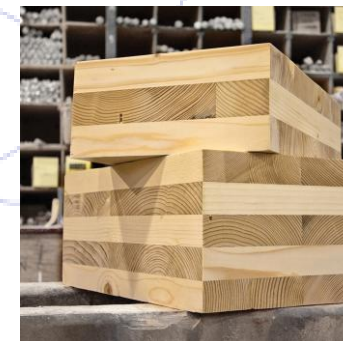
Modern
production
processes





Wood

- One of the traditional, natural building materials.
 - Traditionally used mass timber elements and modern laminated high strength construction elements.
 - Used for all types of structural members.
 - Negative environmental impact due to CO₂ absorption of trees during growth.
- Up to 75% lower carbon footprint compared to concrete and up to 90% compared to steel





Structural glass

- Traditional building material with modern functionalities in modern applications.
 - Used as facade elements but also for railings and stairs.
 - Most emissions derive from production stage.
 - Important influence on operational emissions due to insulation.
- Around 0,3% of global emissions from glass production





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Structural glass



Use of
recycled
materials
as raw
materials

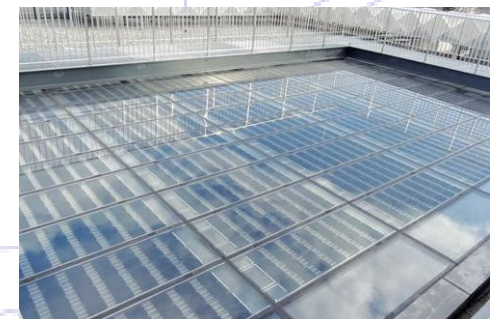
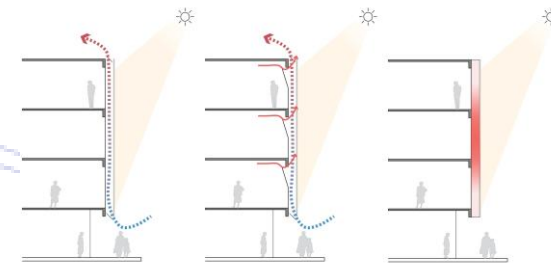
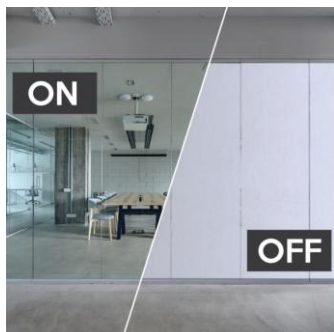
Adaptive
facade
systems

Double
skin
facades

Environmen
tally friendly
innovations

Smart
glass

Building
Integrated
Photovoltai
cs

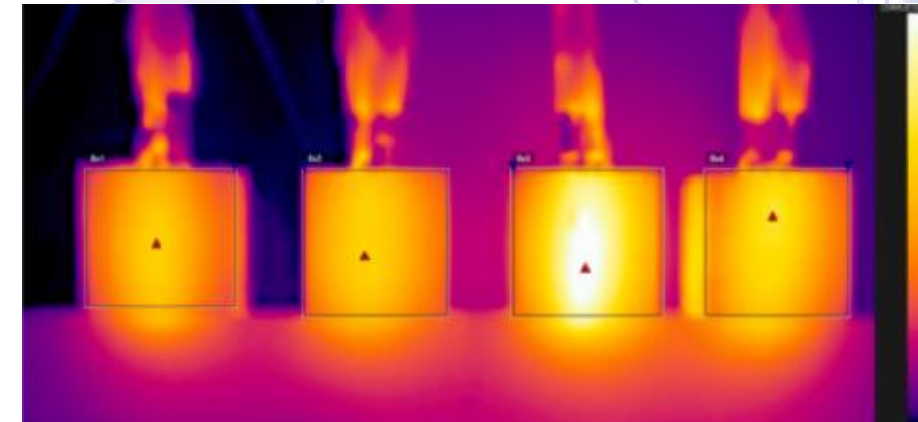
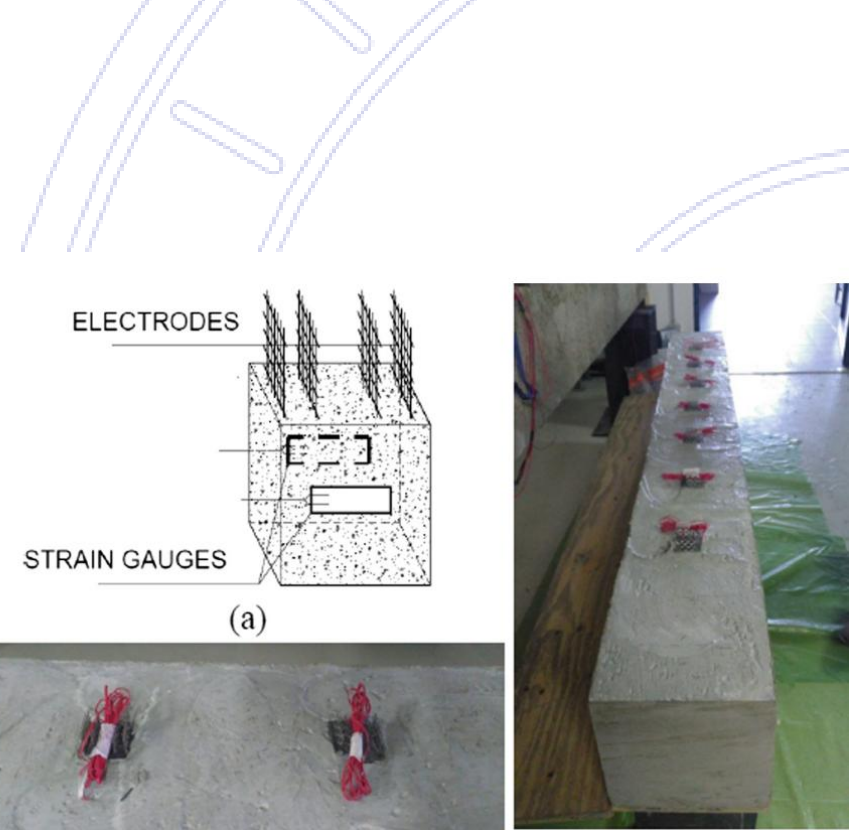


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Functional composites

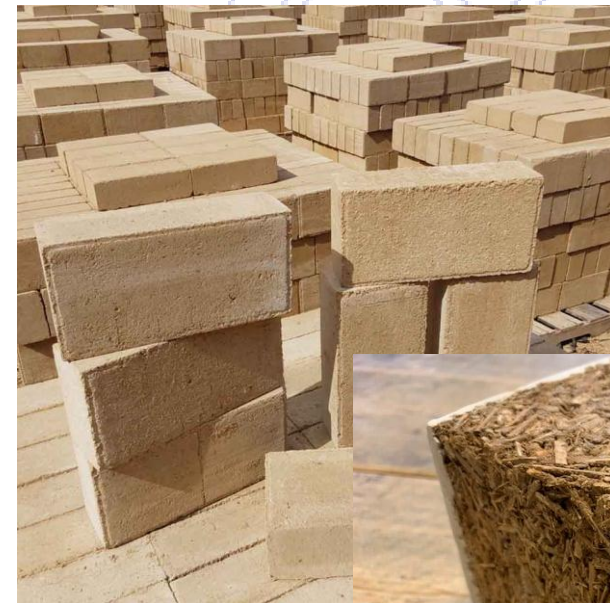
- Modern innovative materials with functional fillers.
- Additional functionality in structural materials.
- Functionality of self-sensing, self-heating, energy harvesting, self-healing.
- Functionality can potentially improve the environmental performance by reducing operation and maintenance costs.





Bio-based materials

- A return to traditional materials with new technologies.
- Earth blocks as sustainable alternative to masonry.
- Bamboo as a quick growing material for temporary and permanent structures.
- Biomass for insulation applications.
- Green walls and rooftops.





Summary

- Construction sector is dedicated to reduce the environmental impact and emissions from its operations by improving traditional materials and shifting towards modern solutions.
- The main strategies for reducing the environmental impact of construction materials include:
 - Possible reuse of elements and materials,
 - Improving production methods,
 - Improving energy efficiency of wall and facade elements,
 - Shifting towards renewable and natural materials.
- Design of sustainable construction materials needs to consider both embodied and operational emissions of building structures.





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