



**GROWTH AND INNOVATION:  
APPLICATION OF SUSTAINABLE  
CONSTRUCTION**

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## **EXECUTIVE SUMMARY**

The following document provides information on the carbon footprint left by the construction industry. Sustainability is become more prevalent more than ever with the increasing threat of climate change. Alternative materials that are sustainably sourced and recycled can reduce project costs and emission. Recycled steel, sustainable insulation and recycled plastic cement are some of the alternatives to raw material procurement.

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## PROJECT SCOPE

Building and construction are responsible for 39% of all carbon emissions in the world. As the construction industry aims to reduce the carbon footprint created by the manufacturers of materials and the company's that purchase the materials, project developers need to seek alternative materials that are commonly used in the construction. The largest producer of CO<sub>2</sub> in the construction process is the laying of the concrete slab. Concreting, insulation and recycled steel are essential materials in construction. By using recycled steel, mineral wool and recycled plastic cement. Construction companies can reduce their carbon footprint and save money.

## RESEARCH

- Building and construction are responsible for 39% of all carbon emissions in the world.
- With operational emissions (from energy used to heat, cool and light buildings) accounting for 28%
- The remaining 11% comes from embodied carbon emissions, or 'upfront' carbon that is associated with materials and construction processes throughout the whole building lifecycle.
- New construction is expected to double the world's building stock by 2060 causing an increase in the carbon emissions
- Approaches such as maximising the use of existing assets, promoting renovation instead of demolition and seeking new circular business models that reduce reliance on carbon intensive raw materials are also needed.
- Building and construction activities together account for 36% of global final energy use and 39% of energy-related carbon dioxide
- London City is one of the drivers for the C40 cities aimed at reducing carbon emissions within the construction industry.
- London is one of the leaders for climate action plans (Zero Carbon Transport)
- The energy intensity per square meter (m<sup>2</sup>) of the global buildings sector needs to improve on average by 30% by 2030 (compared to 2015) to be on track to meet global climate ambitions set out in the Paris Agreement.
- 75 per cent less energy is used every time that steel, for example, is repurposed.
- It was found that the reinforced concrete has the significant negative impact, as it represents 78% of the total embodied carbon emissions.
- On the other hand, the insulation materials represent (2%) of the total emissions.
- the life cycle costs of green certified buildings and conventional buildings, and it turns out that the life cost of green buildings reduced by 24% to 28% compared to conventional buildings
- A study by Seo et al. in Korea pointed out that the CO<sub>2</sub> emissions from the material production phase accounted for 93.4% of the total CO<sub>2</sub> emissions
- Akbarnezhad et al. showed that using low embodied carbon material instead of using conventional material achieved a 30% reduction in the building's total CO<sub>2</sub> emissions

## SUSTAINABLE PRODUCTS

### *Recycled Steel*

Steel-to-steel recycling means that a steel can is just as likely to become part of a bridge, a car, or a ship, in its next life. Steel is 100% recyclable. It can be recycled any number of times without loss of quality. It is one of the only materials that does not lose its properties when recycled.

#### Benefits of recycled steel

- It diverts them from landfill, reduces the need to extract and manufacture raw materials
- contributes to significant savings in greenhouse gas emissions.
- Recycling steel uses 75% less energy than making steel from raw materials.
- All types of steel are 100% recyclable and can be recycled an infinite number of times.
- It is always cheaper to recycle steel than to mine virgin ore and move it through the process of making new steel

### *Recycled Plastic Cement*

MIT scientists found that concrete with fly ash or silica fume was stronger than concrete made with just Portland cement. And the presence of irradiated plastic along with fly ash strengthened the concrete even further, increasing its strength by up to 15 percent compared with samples made just with Portland cement, particularly in samples with high-dose irradiated plastic.

Recycled plastic cement also performs very well:

- Resists chemicals and solvents
- 10 to 40 per cent lighter than conventional concrete
- Easy to reshape thermoplastics
- Strong thermal and sound insulation
- Prevents energy leakage
- Fire-resistant (depending on the plastic material used)
- Durable and long-lasting
- Withstands extreme temperatures and heavy loads
- 23% & 50% reduction in the total embodied carbon emissions respectively. It is recommended to use autoclaved aerated concrete component as environmental alternative to reinforced concrete.

### *Eco Friendly Insulation (mineral wool)*

Mineral wool insulation (also called rock or slag wool insulation): Made from rock, blast furnace slag, and other raw materials which are melted and spun into fibers to resemble the texture of wool. Mineral wool comes in batts, rolls or loose-fill forms.

Benefits of mineral wool.

- In many ways, mineral wool is a superior insulation product compared to fibreglass by 22-27%
- It contains 70% recycled material, making it a greener product than fiberglass at 20-30% recycled material.
- With a density over three times that of fiberglass, mineral wool has superior sound-deadening properties
- more expensive than fiberglass, often between 25-50% higher in cost.
- Cellulose Insulation Is the cheapest alternative but does not outperform mineral wool.

## **RISK ANALYSIS**

### *Higher costs for green construction practices and materials*

Green products can cost 1 to 25% higher than standard structural components. The additional cost comes from design complexity and modelling costs. The issues associated with increased costs is the impact it has on the budget allocation. To reduce the cost of green products it is important to factor in green materials into project budgets. Opportunities to reduce green material costs can be negotiated through long term contracts with businesses/repeat business and finding competitive prices different green material suppliers.

### *Unfamiliarity with green technologies*

Green technologies tend to be complicated in nature because of the techniques required during the construction process. If the complexities are not considered prior to construction, the results could be costly to the project, monetarily and in time. The techniques require may require adjustments to the building design. This can result in a back log of the project. To reduce the impacts of the unfamiliarity, extensive research into the products is required before procurement. It is also important to discuss the techniques with managers, architects, and engineers to determine feasibility of the technology.

### *Lengthy approval process for new green technologies and recycled materials*

The approval time required to use green products on a project can be lengthy. Approval by architects, engineers and clients can create issues with over scheduling. This is an important aspect of the project to ensure the structural integrity of the building/structure will be safe and durable. The process can be hastened by using materials that have been approved on previous projects within the company or from other companies. This indicates the materials have been approved because they have been used previously.

### *More time required to implement green construction practices on site*

On-site checks are required by project managers to ensure sustainable practices are being implemented by site workers. It is common that workers may neglect sustainable practices to meet time requirements for project delivery. As a result, project managers time is lost enforcing sustainable practices throughout the project. To prevent complacency by employees it is important at the start of every day to brief employees on the importance of sustainable practice, the requirements of the building, and develop a schedule that removes the needs for workers to meet the deadline.

### *Technical difficulty during the construction process*

Often, green technologies require complicated techniques and construction processes. If complexities are not addressed well, then it may affect the project manager's performance. Managers need to hire workers who are familiar with the technology before implementing it in their projects.

## **SUMMARY**

The construction industry can reduce their project costs as well as their carbon footprint by using recycled materials. Recycled materials have equal performance, if not greater performance than traditional methods of material production. Other areas for investigation include recycled/engineered wood and recycled bricks.