Edge

IFC International Finance Corporation WORLD BANK GROUP

*Creating Markets, Creating Opportunities*

www.edgebuildings.com

# EDGE USER GUIDE

## Part 5

# Material Measures

## Version 3

Date of Release: November 27th , 2024

**Official Document**

# Contents


Introduction ..... 2
Glossary ..... 3
Efficiency Measures Overview ..... 4
Base Case ..... 4
Baseline Types ..... 4
Efficiency Measures ..... 4
Material Considerations ..... 4
EDGE & BRI (Building Resilience Index) ..... 5
Submission Documentation ..... 6
Individual Measures in EDGE ..... 7
Requirement Summary ..... 7
Intention ..... 7
Approach/Methodologies ..... 7
Potential Technologies/Strategies ..... 7
Relationship to Other Measures ..... 7
Compliance Guidance ..... 7
MEM01 – Bottom Floor Construction ..... 8
MEM02 – Intermediate Floor Construction ..... 12
MEM03 – Floor Finish ..... 14
MEM04 – Roof Construction ..... 17
MEM05 – Exterior Walls ..... 20
MEM06 – Interior Walls ..... 24
MEM07 – Window Frames ..... 28
MEM08 – Window Glazing ..... 30
MEM09 – Roof Insulation ..... 32
MEM10 – Wall Insulation ..... 34
MEM11 – Floor Insulation ..... 36
Annex 1: Custom Materials Guidance ..... 38
Annex 2: Concrete Mix Embodied Carbon Calculation ..... 40

# Introduction

EDGE (Excellence in Design for Greater Efficiencies) is a standard, a green building certification and an online app of the International Finance Corporation (IFC). This document is part of a series of documents aimed at the global harmonization of EDGE buildings certification process for version 3.

In these documents, "Must" and "Shall" are used to prescribe obligatory actions. "Should" implies a recommendation, but it is not required. Lastly, "May" grants permission or suggests that an action is permissible, providing flexibility or discretion to the *project team*.

The target group for this document are *project teams*, EDGE experts, EDGE auditors, EDGE certifiers and anyone interested in learning more about the certification.

The **Part 5 - User Guide Material Measures** document offers detailed instructions on the requirements, intention, and a high-level methodology used to calculate the impact of each material measure. Furthermore, it advises on the process for achieving compliance with each Materials Efficiency Measure (MEM).

From January 1st, 2025, this document invalidates and substitutes the Materials Efficiency Measure section EDGE Version 3.0.a.

Table 1 shows the relative position of this document within the set of EDGE user guides.

*Table 1: Position of this document within the EDGE V3 modules.*

<table>
<tr><th>Module</th><th>Overarching</th><th>Design</th><th>Energy</th><th>Water</th><th>Materials</th><th>Operations</th></tr>
<tr><td>App User Guides</td><td rowspan="3">Part 1 – Building Certification Guidance</td><td>Part 2 - User Guide - Design Tab</td><td>Part 3 – User Guide - Energy Measures</td><td>Part 4 – User Guide - Water Measures</td><td>Part 5 – User Guide - Materials Measures</td><td>Part 6 – User Guide Operations</td></tr>
<tr><td>Building Certification Guidance</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Operations Certification Guidance</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Auditor Guidance</td><td></td><td colspan="5">Part 8 – Auditor Guidance</td></tr>
<tr><td>Methodology</td><td colspan="6">For future release</td></tr>
<tr><td>Homes Prescriptive Certification Guidance</td><td colspan="6">Check country-specific documentation</td></tr>
<tr><td colspan="7">Note 1: The shaded modules are not applicable.<br>Note 2: All guidance and user guide documents are complimentary information to the EDGE protocol documents.<br>Note 3: In the case of any discrepancy, the EDGE protocol document takes precedence</td></tr>
</table>

To share feedback with the EDGE team, please send suggestions along with relevant documentation to edge@ifc.org.

# Glossary

| | |
|---|---|
| ASB | Asymmetric Section Beam |
| ASHRAE | American Society of Heating Refrigerating and Air-conditioning Engineers |
| BRI | Building Resilience Index |
| EDGE | Excellence in Design for Greater Efficiencies |
| EPD | Environmental Product Declaration |
| GGBS | Granulated Blast Furnace Slag |
| GHG | Greenhouse Gas |
| GIA | Gross Internal Area |
| GWP | Global Warming Potential |
| IFC | International Finance Corporation |
| ISO | International Organization for Standardization |
| $kgCO_2e$ | Kilograms of $CO_2$ Equivalent |
| LCA | Life Cycle Assessment |
| OPC | Ordinary Portland Cement |
| PFA | Pulverized Fly Ash |
| PVC | Polyvinyl Chloride |
| UKC | Universal Column |

# Efficiency Measures Overview

This section provides an overview of the policies related to efficiency measures in EDGE.

## Base Case

The Base Case is the standard benchmark against which the proposed design is compared for EDGE certification. The base case values shown in the App are used to calculate the base case performance of a building.

EDGE defines the Base Case or "EDGE Baseline" as the 'standard construction practice currently prevalent in a region (e.g., city, district, state) over the previous 3 years for the specific building type being evaluated'.

- In a region which has mandatory building energy, water, or materials codes, and where these codes are implemented in most of the new buildings being built in last 3 years, the relevant code serves as the Baseline. If the code is sufficiently implemented in a few cities or states, and not the rest, their baselines can be different.
- In a region where no such codes exist, or where they do exist but are not sufficiently enforced, EDGE uses the standard practices followed by the local construction industry as the Baseline. For example, if most low-income homes in a region have walls constructed using concrete blocks, that serves as the EDGE low-income homes baseline. These assumptions may be different for different income category homes, and across different building types, such as offices, hotels, and shopping malls.

To maintain the simplicity of EDGE, the Baseline incorporates broad trends and practices and does not delve into the details of a specific building or technology unless that represents the normal/typical practice.

## Baseline Types

The base case varies by building type and by location. Each location in EDGE is assigned one of the following four (4) baselines:

1. Country-customized baseline: Countries with distinct building materials or a strong national building energy or water code are reflected in the EDGE baseline.
2. City-Customized baseline: Countries with inconsistent implementation of building energy code in cities, with some cities more stringent than others; or where cities have distinct building patterns because of weather variation have a baseline customized at the city level.
3. Global EDGE baseline: A global set of baseline parameters is used as the baseline for countries with emerging economies following typical global practices.
4. ASHRAE 90.1-2016: Not applicable to the current document.

## Efficiency Measures

The selection of efficiency measures can have a significant impact on the resource demand of a building. The results are shown in charts that compare the base case building with the improved case. This document focuses on the improvement in embodied carbon of materials.

Note: the default must be overwritten with actual values where applicable by editing the user input fields. Documentation demonstrating user input must be submitted during certification process.

## Material Considerations

EDGE has shifted its methodology for materials savings from assessing Embodied Energy to Embodied Carbon in building materials. This transition is significant as the construction sector moves toward reducing the overall carbon footprint, not just from operational energy but also from the materials used in the construction phase.

The EDGE App calculates the embodied carbon of building materials by measuring their Global Warming Potential (GWP), expressed in kilograms of $CO_2$ equivalent (kg $CO_2$eq). In line with Standard EN 15804+A2:2019, the app uses a life cycle assessment (LCA) approach to determine the environmental impacts of materials.

The EDGE App focuses on the "Cradle to Gate" aspect of the LCA, which encompasses the environmental impact associated with material production up to the point where the material leaves the factory gate. This includes:

- A1: Raw Materials – This stage covers the extraction and processing of raw materials.
- A2: Transport – This stage accounts for the emissions fromtransporting raw materials to the manufacturing site.
- A3: Manufacturing – This stage includes the emissions during the manufacturing process of the materials.

By incorporating regional variations in greenhouse gas (GHG) emissions, the EDGE App ensures that the calculated embodied carbon of materials accurately reflects the specific environmental impacts of different geographic locations. Such regions are:

- **East EU**: Eastern Europe
- **MENA**: Middle East & North Africa as defined by the World Bank Country and Lending Groups
- **RAF**: Region of Africa
- **RAS**: Region of Asia and Australasia (including all Pacific Islands)
- **RLA**: Region of Latin America and the Caribbean
- **US&CA**: United States and Canada
- **West EU**: Western Europe.

A list of relevant specifications for each building element (roof, exterior walls, interior walls, floor finishes, etc.) appears in the Materials tab in the EDGE App. Figure 1 shows a sample breakdown of the embodied carbon of the key building components for a hypothetical office building.

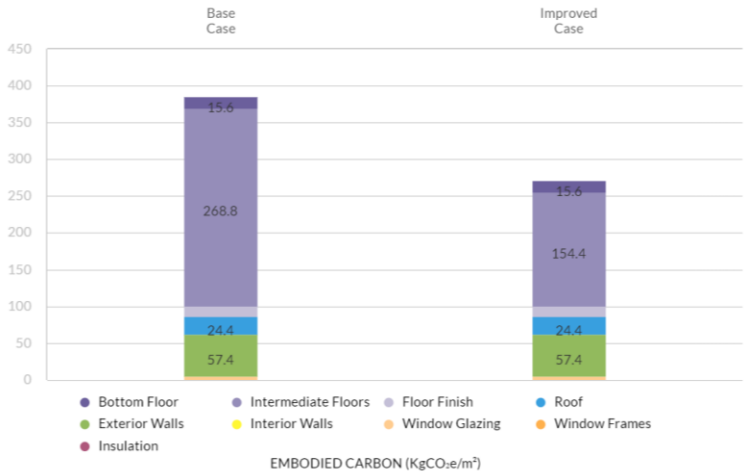


*Figure 1: Sample Materials Chart from the Offices typology.*

Where multiple specifications for each building element exist, the predominant specification should be selected. Materials covering less than 10% by area per building element, may be exempted from the calculation.

## EDGE & BRI (Building Resilience Index)

The Building Resilience Index (BRI) is a web-based framework developed by the International Finance Corporation (IFC) to assess and enhance the resilience of buildings. It serves as a tool to access hazard mapping and resilience assessment information specific to a location. The index provides measures and recommendations to mitigate risks associated with various hazards. Additional information may be accessed through https://www.resilienceindex.org/

The EDGE certification recognizes that achieving resilience in building construction may necessitate the use of additional materials. In particular, the structural elements of the following measures:

- MEM01: Bottom Floor Construction
- MEM02: Intermediate Floor Construction
- MEM03: Roof Construction
- MEM05: Exterior Walls
- MEM06: Interior Walls

may include additional materials, such as increased thickness or steel reinforcement, to enhance resilience. - As a result, these will not be considered in the EDGE certification if they are essential for addressing one or more hazards against **Wind**, **Water**, **Fire**, and **Geoseismic** for an equivalent building in BRI.

In *subprojects* where resilience considerations exceed the base case thickness and/or steel rebar, the *project team* may utilize base case values by documenting such additional requirements. In such cases, the *project team* must provide a self-assessment from the BRI along with a narrative that justifies the inclusion of such resilience-focused elements in their construction.

Additionally, *project teams* are encouraged to address the **Fire** hazards according to BRI for all the finishing and insulation measures, where applicable.


*Figure 2: Building Resilience Index Rating for each hazard category.*

In certain circumstances where there is a need for additional structural requirements due to **miscellaneous structural loads** that are essential for operations of the building, *project teams* are permitted to assume base case thickness and steel rebar reinforcement. In this scenario, the *project team* still may be able to claim savings using materials with lower embodied carbon than the base case. Examples of such requirements include the additional support needed for ceiling-mounted bridge cranes or heavy machinery. The *project team* must provide documentation to justify the necessity and type of these additional structural requirements.

## Submission Documentation

Documentation is required for all measures. The following documents shall be submitted, where applicable, for each measure claiming base case conditions due to resilience requirements or additional structural requirements.

- Provide a self-assessment from the BRI
- A narrative on how resilience is addressed on the *subproject*
- Non-standard structural requirements
- Supporting design and construction documentation that demonstrates the inclusion of resilience-focused elements and/or non-standard structural requirements.

# Individual Measures in EDGE

The Individual Measures Section in the user guide describes each measure included in EDGE, indicating the intent of the measure, how it is assessed, potential technologies and strategies to incorporate the measure, and what assumptions have been made to calculate the base case and improved case.

## Requirement Summary

A summary of the system or level of performance required to claim that a measure has been incorporated into the *subproject*.

## Intention

What the measure aims to achieve and why it is measured in a certain way in EDGE.

## Approach/Methodologies

The approach used to assess the design is provided with an explanation of the calculations and terminology used.

Note that EDGE makes default assumptions for a base case building. The key baseline values are displayed in the EDGE App.

## Potential Technologies/Strategies

The possible systems, materials and technologies that might be considered by the *project team* to meet the requirements of the measure.

## Relationship to Other Measures

EDGE calculates the impact of user-selected measures by taking a holistic view of the building project and assessing the impact on inter-related aspects of energy, water, and materials (also known as integrated analysis). For example, a higher window-to-wall ratio may increase energy use and increase embodied carbon of the building envelope if the windows have higher embodied carbon compared to the wall material. Another example is hot water; a reduction in hot water use would decrease the consumption of both water and the energy used to heat the water. Such inter-relationships between measures are listed in this section to clarify EDGE calculations and support the overall design process.

## Compliance Guidance

The compliance guidance provided for each measure indicates the documentation that will be required to demonstrate compliance for EDGE certification. Documentation requirements vary according to the measure being claimed.

Because available evidence depends on the current stage in the building design process, EDGE provides compliance guidance for each measure at both the design and post-construction stages. If the required evidence is not available during the design stage, a series of alternatives per measure is provided. During the post-construction stage, more rigorous documentation is required. However, a common-sense approach is recommended to verify that the measure has indeed been installed as per the specifications claimed. For example, some measures require purchase receipts to demonstrate compliance. If these are not available, similar locally used documents such as drawings or invoices may be used instead to verify the construction details.

In the case of EDGE projects that are going directly into post-construction phase, the compliance requirements of both design and post-construction stages are expected to be met, except where a post-construction requirement replaces the design stage requirement.

In most cases, a minimum of 90% of a particular specification must comply for certification, unless specifically stated. If the auditor has reason to believe that a measure should be recognized, then proper justification should be provided for the certifier's review. Approval of such justification is at the discretion of the certifier.

# MEM01 – Bottom Floor Construction

*Requirement Summary*

This measure selection must be made, and the material, thickness and steel rebar must reflect the type of lowermost floor used in the *subproject*.

*Intention*

The intent is to reduce the embodied carbon in the building by specifying floor types with lower embodied carbon than a typical floor slab.

*Approach/Methodologies*

EDGE evaluates the embodied carbon of the floor construction type by aggregating the impact of all the key materials such as concrete and any steel used in its construction per unit area of the bottom floor. In the EDGE App, the bottom floor area is calculated as:

$$Bottom\ Floor\ Area\ (m^2) = \ Gross\ Internal\ Area\ (m^2)/Total\ Number\ of\ Floors$$

The thickness of the floor construction also determines the embodied carbon per unit area of the bottom floor. The *project team* must select the specification that matches or most closely resembles the bottom floor slab specified in the *subproject* and enter its thickness.

If there are multiple specifications, the predominant specification must be selected as the primary floor type. A second type of construction can also be indicated and marked with its percentage (%) area. The second type of construction needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of construction, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

In a multistorey whole building certification, the specification for the bottom floor slab should be that of the lowermost floor for the building, as this floor slab specification is often different from the typical intermediate floor slab and dictated by the ground conditions. The thickness of the screed used to level the floor slab for the floor finish should not be included in this measure.

In partial building certification, the specification for the bottom floor slab should be that of the lowermost floor of the certified area. This may be the floor slab of the building, or it may be the intermediate floor of the building. For example, if the certified area is located above a podium, the bottom floor slab would be the one that separates the podium from the certified area.

Certain structural components needed for resilience and/or miscellaneous structural loads are exempt from the thickness calculation. Refer to the **Material Considerations** section for more details.

*Potential Technologies/Strategies*

Several construction techniques and materials are preloaded in the EDGE App, these include:

- **In-Situ Reinforced Concrete Slab** is widely used type of floor construction that consists of Portland cement, sand, aggregate, water, and reinforcing steel bars. The slab is formed and cast directly on the construction site, providing a strong and durable flooring solution.
- **In-Situ Concrete with >25% GGBS** consists of in-situ concrete with more than 25% GGBS content uses ground granulated blast furnace slag, a by-product of iron production, as a partial substitute for Portland cement. GGBS is a glassy, granular substance created by rapidly cooling molten iron slag, which is then ground into a fine powder. It can replace 30% to 85% of Portland cement in concrete mixes. Using GGBS reduces the embodied carbon of concrete, as producing Portland cement requires a lot of energy.

- **In-Situ Concrete with >30% PFA** consists of in-situ concrete with more than 30% PFA content uses pulverized fuel ash, also known as fly ash, as a partial substitute for cement. Fly ash is a by-product of coal combustion in power stations. Incorporating PFA in concrete not only lowers its carbon footprint but also minimizes the risk of air and water pollution. Utilizing PFA is strongly advocated for environmentally sustainable construction practices.
- **Concrete Filler Slab** A concrete filler slab is a construction technique that reduces material usage by incorporating filler materials like bricks, clay tiles, or cellular concrete blocks in the less stressed areas of the slab. These fillers take the place of concrete where tensile strength is not critical, allowing for a lighter slab that requires less concrete and steel. This approach is not only more cost-effective but also more environmentally friendly compared to traditional reinforced concrete slabs.
- **Precast RC Planks and Joist System** consists of precast concrete panels, ready-mixed Ordinary Portland Cement (OPC) concrete with a density of 2365 kg/$m^3$, and gypsum plaster. This system is pre-manufactured off-site and assembled on-site, offering a streamlined and efficient construction process.
- **Concrete Filler Slab with Polystyrene Blocks** designed to decrease the amount of concrete used, similar to traditional filler slab technology, making it more cost-effective than standard reinforced concrete slabs. It features precast concrete beams and permanent polystyrene forms positioned in the lower tensile areas of the slab, complemented by in-situ concrete. This approach not only saves on materials but also provides insulation benefits due to the polystyrene blocks.
- **In-Situ Trough Concrete Slab** uses temporary, reusable void formers to create trough-shaped indentations on the underside of a concrete slab poured on-site. These voids reduce the amount of concrete required while maintaining structural integrity.
- **In-Situ Waffle Concrete Slab** utilizes temporary, reusable void formers to create a grid of cube-shaped recesses on the underside of a concrete slab that is cast on-site. This technique reduces material usage and provides a distinctive waffle-like pattern that enhances the slab's strength and aesthetic appeal.
- **Hollow Core Precast Slab** is a type of precast concrete flooring that features continuous longitudinal voids, making it lightweight yet strong. Once the gaps between the planks are filled with grout, they act together like a single, solid slab. These planks can also form a structural diaphragm to counteract horizontal forces, with or without an additional structural layer on top.
- **Composite slim slabs with Steel I-beams** combine modified steel sections, either rolled asymmetric section beams (ASB) or flat steel plates welded to the bottom flange of a standard UKC section, with a floor slab. The steel section is partially embedded within the slab, creating a flush ceiling without protruding beams, thus minimizing floor-to-floor heights. The floor component can be precast hollow core concrete units or deep composite steel decking, both topped with in-situ concrete that is level with or above the beam's top flange, forming an integrated floor system.
- **Composite in-situ concrete and steel deck (permanent shuttering)** feature reinforced concrete poured over profiled steel decking. The steel decking serves as both a mold for the concrete during construction and as reinforcement once the concrete has set. For deeper decking, or in cases of heavy loads and required fire resistance, extra reinforcing bars may be added within the decking troughs.
- **Precast concrete double tee units** are structural elements that function as combined beam and column frames, simplifying installation by reducing the number of components and connections. Once assembled, they offer an immediate, stable work platform capable of supporting light construction loads
- **Thin precast concrete deck and composite in-situ slab** typically involve a composite slab placed on top of a down stand beam. The two components are connected by shear studs that are welded through the deck.
- **Timber floor construction:** A system made of air-dried sawn timber (580 kg/$m^3$), plywood board, gypsum plasterboard and plaster.
- **Light gauge steel floor cassette:** A system made of ready mix OPC concrete (2365 kg/$m^3$), steel sheet electrogalvanized corrugated zinc (9850 kg/$m^3$), gypsum plasterboard and plaster.

- **Re-use of existing floorslab:** If the building element is older than 5 years, it is classified as re-used. In Version 3.1, providing the thickness and steel rebar details is optional. In Version 3.0, these fields should be left empty.

Table 2 shows the floor slab options included in the EDGE App, their allowable thickness, and the range of composite embodied carbon for all the regions for a typical office building. The thickness refers to the total thickness of the assembly. If the thickness is outside the range of the allowable thickness, *project teams* shall "cap" the value to the maximum or minimum allowable and provide a narrative justifying such values as part of the measure documentation.

*Table 2: Allowable effective thickness ranges, and range of composite embodied carbon at default thickness and reinforcement for the bottom floor construction of an office building.*

| Description | Minimum Thickness (meters) | Maximum Thickness (meters) | Typical Composite Embodied Carbon ($kgCO2/m^2$) at default thickness for all regions | |
|---|---|---|---|---|
| | | | [Lower bound – Upper bound] | |
| Concrete Slab \| In-situ Reinforced Conventional Slab | 0.100 | 0.250 | 161 | 199 |
| Concrete Slab \| In-situ Reinforced Slab with >25% GGBS | 0.100 | 0.250 | 79 | 97 |
| Concrete Slab \| In-situ Reinforced Slab with >30% PFA | 0.100 | 0.250 | 81 | 100 |
| Concrete Slab \| Filler Slab | 0.100 | 0.300 | 74 | 90 |
| Composite Slab \| In-situ Concrete over RC Planks and Joist System | 0.100 | 0.200 | 64 | 79 |
| Concrete Slab \| Filler Slab with Polystyrene Blocks | 0.150 | 0.300 | 57 | 69 |
| Concrete Slab \| In-situ Trough Slab | 0.225 | 0.600 | 59 | 73 |
| Concrete Slab \| In-situ Waffle Slab | 0.350 | 0.650 | 78 | 96 |
| Concrete Precast \| Hollow Core Slab | 0.100 | 0.350 | 103 | 128 |
| Composite Slab \| In-situ Concrete on Precast Slim Deck with Embedded I-beam | 0.100 | 0.350 | 59 | 86 |
| Composite Slab \| In-situ Concrete on Corrugated Steel Deck over I-beam | 0.100 | 0.150 | 47 | 58 |
| Concrete Precast \| Double Tee Units | 0.350 | 0.800 | 79 | 98 |
| Composite Slab \| In-situ Concrete over Thin Precast Concrete Deck | 0.120 | 0.300 | 67 | 83 |
| Timber Floor \| Timber board or Chipboard on Timber Joists | 0.250 | 0.400 | -44 | -39 |
| Steel Floor \| Light-gauge Steel Floor Cassette | 0.200 | 0.300 | 54 | 76 |
| Re-use of existing floorslab | N/A | N/A | 0 | 0 |

If none of the default materials are deemed as similar, **Annex 1: Custom Materials Guidance** provides detailed guidance on how to document such cases. Where a new concrete mix needs to be documented, **Annex 2: Concrete Mix Embodied Carbon Calculation** provides such guidance.

**Note 1:** The database for materials has slight variations per building typology. Full disclosure of the assumptions per building types is not part of the scope of this document but the **Methodology** document, currently being worked on.

**Note 2:** The database for materials is undergoing updates to better reflect regional variations. *Project teams* shall consider the values presented in this document only for comparative guidance for improved decision making rather than as a source of absolute values.

### *Relationship to Other Measures*

The U-value of **EEM06 Insulation of Ground/Raised Floor Slab** may be calculated by combining the material selected for this measure with the insulation specified in **MEM11 – Floor Insulation**, if applicable.

### *Compliance Guidance*

*Preliminary Stage Certification*

- Floor sections showing the materials and thicknesses of the floor type(s); and
- Building plans marking the area of major floor types if more than one type of floor is present; and
- Manufacturer's data sheets for the specified building materials; or
- Bill of quantities with the floor slab specifications clearly highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the design stage documents to clearly reflect as-built conditions; and
- Geolocated and date-stamped photographs of the floor slabs taken during construction showing the claimed products on site; or
- Purchase receipts showing the installed products.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photos taken during renovation can be submitted.

# MEM02 – Intermediate Floor Construction

*Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of intermediate floors used in the *subproject*.

*Intention*

The intent is to reduce the embodied carbon in the building by specifying floor types with lower embodied carbon than a typical floor slab.

*Approach/Methodologies*

EDGE evaluates the embodied carbon of the floor construction type by aggregating the impact of all the key materials such as concrete and steel used in its construction per unit area of the intermediate floors. The area considered for the intermediate floor is based on the following formula:

$$Intermediate\ Floor\ Area\ (m^2) = \ Gross\ Internal\ Area\ (m^2) - \ Bottom\ Floor\ Area(m^2)$$

The thickness of the floor construction also determines the embodied carbon per unit area of the intermediate floors. The *project team* must select the specification that matches or most closely resembles the intermediate floor slab specified in the *subproject* and enter its thickness.

If there are multiple specifications, the predominant specification must be selected as the primary floor type. A second type of construction can also be indicated and marked with its percentage (%) area. The second type of construction needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of construction, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

In a multistory building, the specification for the floor slab must be that of the intermediary floor and not the ground floor, as the ground floor slab specification is often different from the typical and dictated by the ground conditions.

Certain structural components needed for resilience and/or miscellaneous structural loads are exempt from the thickness calculation, please see the Material section for more details.

*Potential Technologies/Strategies*

See Potential Technologies/Strategies in the **MEM01 – Bottom Floor Construction** section for more information.

*Relationship to Other Measures*

The contribution that the measure makes to the overall performance is not affected by any other measure.

*Compliance Guidance*

*Preliminary Stage Certification*

- Floor sections showing the materials and thicknesses of the floor(s); and
- Building plans marking the area of major floor types if more than one type of floor is present; and
- Manufacturer's data sheets for the specified building materials; or
- Bill of quantities with the floor slab specifications clearly highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Geolocated and date-stamped photographs of the floor slabs taken during construction showing the claimed products on site; or
- Purchase receipts showing the installed products.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photos taken during renovation can be submitted.

# MEM03 – Floor Finish

*Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of floor finish used in the *subproject*.

In Core & Shell and Partially Unfinished Projects, some measures may be passed onto tenants. Please refer to **Part 1 – Building Certification Guidance** for more information.

*Intention*

The intent is to reduce the embodied carbon in the building by specifying floor finishes with lower embodied carbon than a typical floor finish.

*Approach/Methodologies*

The floor finish includes the topmost layer of finishing material and screed; however, the *project team* must only report the thickness of the finishing material (excluding screed thickness). EDGE evaluates the embodied carbon of the floor finish by aggregating the impact of all the key materials per unit floor finish area, defined as:

$$Floor\ Finish\ Area\ (m^2) = Gross\ Internal\ Area\ (m^2)$$

The thickness of the floor finish also determines the embodied carbon per unit area of the floor. The *project team* must select the specification that matches or most closely resembles the floor finish specified in the *subproject* and enter its thickness.

If there are multiple specifications, the predominant specification must be selected as the primary floor finish type. A second type of construction can also be indicated and marked with its percentage (%) area. The second type of construction needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of construction, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

*Project teams* using customized materials shall include the embodied carbon of finishing material, binder, adhesive and screed, where applicable.

*Potential Technologies/Strategies*

Several floor finish materials are preloaded in the EDGE App, these include:

- **Ceramic Tile:** Composed by ceramic tiles (2000 kg/m$^3$), cement mortar as binder and cement floor screed (1590 kg/m$^3$).
- **Vinyl Flooring:** Composed by vinyl (PVC) flooring (3.2 kg/m$^2$), adhesive for parquet and cement floor screed (1590 kg/m$^3$).
- **Stone Tiles/Slabs:** Composed by stone floor tiles (2600 kg/m$^3$), cement mortar as binder and cement floor screed (1590 kg/m$^3$).
- **Finished Concrete Floor:** Composed by cement floor screed (1590 kg/m$^3$).
- **Linoleum Sheet:** Composed by linoleum (2.9 kg/m$^3$), adhesive for parquet and cement floor screed (1590 kg/m$^3$).
- **Terrazzo Tiles:** Composed by cement-based terrazzo (1580 kg/m$^3$), cement mortar as binder and cement floor screed (1590 kg/m$^3$).
- **Nylon Carpets:** Composed by nylon (5 kg/m$^2$), carpet underlay and cement floor screed (1590 kg/m$^3$).
- **Laminated Wooden Flooring:** Composed by laminated wooden flooring (515 kg/m$^3$ at 12% moisture), carpet underlay and cement floor screed (1590 kg/m$^3$).

- **Terracotta Tiles:** Composed by terracotta tiles (2000 kg/m$^3$), cement mortar and cement floor screed (1590 kg/m$^3$).
- **Parquet / Wood Block Finishes:** Kiln-dried sawn timber (580 kg/m$^3$), adhesive for parquet and cement floor screed (1590 kg/m$^3$).
- **Plant fiber (Seagrass, sisal, coir and jute) carpet:** Composed by jute, adhesive for parquet, carpet underlay and cement floor screed (1590 kg/m$^3$).
- **Cork Tiles:** Composed by cork, adhesive for parquet and cement floor screed (1590 kg/m$^3$).
- **Re-use existing flooring:** If the building element is older than 5 years, it is considered as re-used.

Table 3 shows the floor finish construction options included in EDGE, their allowable thickness, and the range of composite embodied carbon for all the regions. If the thickness is outside the range of the allowable thickness, *project teams* shall "cap" the value to the maximum or minimum allowable and provide a narrative justifying such values as part of the measure documentation.

*Table 3: Allowable thickness ranges, and range of composite embodied carbon at default thickness for the floor finish construction of an office building.*

| Description | Minimum Effective (meters) | Maximum Effective (meters) | Composite Embodied Carbon (kgCO2/m2) at default thickness for all regions [Lower bound – Upper bound] | |
|---|---|---|---|---|
| Tiled \| Ceramic Tile | 0.005 | 0.015 | 11 | 14 |
| Vinyl Sheet | 0.002 | 0.004 | 6 | 7 |
| Tiled \| Stone Tiles | 0.010 | 0.025 | 6 | 7 |
| Concrete \| Finished Concrete Floor | 0.015 | 0.050 | 8 | 9 |
| Linoleum Sheet | 0.002 | 0.005 | 5 | 6 |
| Tiles \|Terrazzo Tiles | 0.015 | 0.025 | 14 | 17 |
| Carpet \| Nylon Carpets | 0.003 | 0.015 | 11 | 12 |
| Wood \| Laminated Wood | 0.010 | 0.025 | -4 | -3 |
| Tiled \| Terracotta Tiles | 0.012 | 0.025 | 16 | 19 |
| Wood \| Parquet / Wood Block Finishes | 0.015 | 0.025 | -9 | -5 |
| Carpet \| Plant fiber (Seagrass, sisal, coir and jute) carpet | 0.003 | 0.005 | 7 | 8 |
| Tiled \| Cork Tiles | 0.005 | 0.015 | 3 | 4 |
| X - Re-use existing flooring | N/A | N/A | 0 | 0 |

If none of the default materials are deemed as similar, **Annex 1: Custom Materials Guidance** provides detailed guidance on how to document such cases.

**Note 1:** The database for materials has slight variations per building typology. Full disclosure of the assumptions per building types is not part of the scope of this document but the **Methodology** document, currently being worked on.

**Note 2:** The database for materials is undergoing updates to better reflect regional variations. *Project teams* shall consider the values presented in this document only for comparative guidance for improved decision making rather than as a source of absolute values.

### *Relationship to Other Measures*

The contribution that the measure makes to the overall performance is not affected by any other measure.

### *Compliance Guidance*

*Preliminary Stage Certification*

- Drawings showing the flooring specifications selected; and
- Building plans highlighting the area of major flooring types if more than one type of flooring is present; and
- Manufacturer's data sheets for the specified building materials; or
- Bill of quantities with the specifications for the flooring materials clearly highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Geolocated and date-stamped photographs of the flooring during or after installation showing the claimed products on site; or
- Purchase receipts showing the installed products.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photographs can be submitted.

# MEM04 – Roof Construction

### *Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of roof used in the *subproject*.

### *Intention*

The intent is to reduce the embodied carbon in the building by specifying roof types with lower embodied carbon than a typical roof slab.

### *Approach/Methodologies*

The EDGE App evaluates the embodied carbon of the roof construction by aggregating the impact of all the key materials such as concrete and steel used in its construction per unit area. The roof area is assumed as the Aggregate Roof Area ($m^2$) provided in the design tab (yellow box).

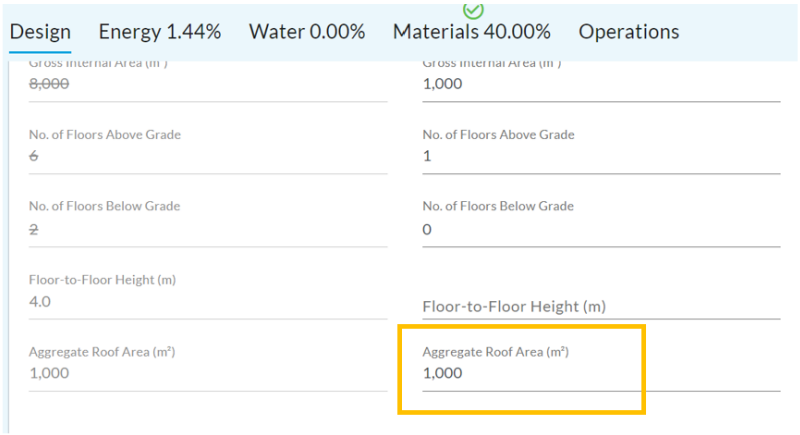


*Figure 3: The Aggregate Roof Area ($m^2$) is the value used to estimate the area of the room in this measure.*

The thickness of the roof construction also determines the embodied carbon per unit area of roof. The *project team* must select the specification that matches or most closely resembles the roof type specified in the project and enter its thickness.

If there are multiple specifications, the predominant specification must be selected as the primary roof type. A second type of construction can also be indicated and marked with its percentage (%) area. The second type of construction needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of construction, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

Certain structural components needed for resilience and/or miscellaneous structural loads are exempt from the thickness calculation, please see the Material section for more details.

### *Potential Technologies/Strategies*

Several roof construction materials are preloaded in the EDGE App, these are similar to the ones described in Potential Technologies/Strategies in the **MEM01 – Bottom Floor Construction** section.

Table 4 shows the roof construction options included in EDGE, their allowable thickness, and the range of composite embodied carbon for all the regions. The thickness refers to the total thickness of the assembly. If the thickness is outside the range of the allowable thickness, *project teams* shall “cap” the value to the maximum or minimum allowable and provide a narrative justifying such values as part of the measure documentation.

*Table 4: Allowable thickness ranges, and range of composite embodied carbon at default thickness and reinforcement for roof in an office building.*

| Description | Minimum Thickness (meters) | Maximum Thickness (meters) | Composite Embodied Carbon (kgCO2/m2) at default thickness for all regions | |
|---|---|---|---|---|
| | | | [Lower bound – Upper bound] | |
| Concrete Slab \| In-situ Reinforced Conventional Slab | 0.100 | 0.250 | 212 | 266 |
| Concrete Slab \| In-situ Reinforced Slab with >25% GGBS | 0.100 | 0.250 | 80 | 99 |
| Concrete Slab \| In-situ Reinforced Slab with >30% PFA | 0.100 | 0.250 | 81 | 100 |
| Concrete Slab \| Filler Slab | 0.100 | 0.300 | 74 | 90 |
| Composite Slab \| In-situ Concrete over RC Planks and Joist System | 0.100 | 0.200 | 64 | 79 |
| Concrete Slab \| Filler Slab with Polystyrene Blocks | 0.150 | 0.300 | 57 | 69 |
| Concrete Slab \| In-situ Trough Slab | 0.225 | 0.600 | 59 | 73 |
| Concrete Slab \| In-situ Waffle Slab | 0.350 | 0.650 | 78 | 96 |
| Concrete Precast \| Hollow Core Slab | 0.100 | 0.350 | 96 | 120 |
| Composite Slab \| In-situ Concrete on Precast Slim Deck with Embedded I-beam | 0.100 | 0.350 | 52 | 74 |
| Composite Slab \| In-situ Concrete on Corrugated Steel Deck over I-beam | 0.100 | 0.150 | 46 | 57 |
| Concrete Precast \| Double Tee Units | 0.350 | 0.800 | 80 | 100 |
| Composite Slab \| In-situ Concrete over Thin Precast Concrete Deck | 0.120 | 0.300 | 91 | 121 |
| Brick Panel Roofing System | 0.150 | 0.300 | 119 | 167 |
| Ferrocement Roof \| Ferrocement Roofing Channels | 0.100 | 0.250 | 96 | 122 |
| Tiled Roof \| Clay Roofing Tiles on Steel Rafters | 0.100 | 0.250 | 23 | 30 |
| Tiled Roof \| Clay Roofing Tiles on Timber Rafters | 0.100 | 0.250 | 11 | 14 |
| Tiled Roof \| Micro Concrete Tiles on Steel Rafters | 0.100 | 0.250 | 16 | 21 |
| Tiled Roof \| Micro Concrete Tiles on Timber Rafters | 0.100 | 0.250 | 4 | 6 |
| Metal Roof \| Steel Sheets on Steel Rafters | 0.100 | 0.250 | 31 | 50 |
| Metal Roof \| Steel Sheets on Timber Rafters | 0.100 | 0.250 | 22 | 39 |
| Metal Roof \| Aluminum Sheets on Steel Rafters | 0.100 | 0.250 | 42 | 120 |
| Metal Roof \| Aluminum Sheets on Timber Rafters | 0.100 | 0.250 | 31 | 110 |
| Metal Roof \| Copper Sheets on Steel Rafters | 0.100 | 0.250 | 89 | 94 |
| Metal Roof \| Copper Sheets on Timber Rafters | 0.100 | 0.250 | 80 | 83 |
| Tiled Roof \| Asphalt shingles on Steel Rafters | 0.100 | 0.250 | 11 | 17 |
| Tiled Roof \| Asphalt shingles on Timber Rafters | 0.100 | 0.250 | -1 | 1 |
| Metal Roof \| Aluminum-clad Sandwich Panel | 0.050 | 0.250 | 34 | 111 |
| Metal Roof \| Steel-clad Sandwich Panel | 0.050 | 0.250 | 19 | 32 |
| Re-use of existing roof | N/A | N/A | 0 | 0 |

If none of the default materials are deemed as similar, **Annex 1: Custom Materials Guidance** provides detailed guidance on how to document such cases. Where a new concrete mix needs to be documented, **Annex 2: Concrete Mix Embodied Carbon Calculation** provides such guidance.

**Note 1**: The database for materials has slight variations per building typology. Full disclosure of the assumptions per building types is not part of the scope of this document but the **Methodology** document (Part 9), currently being worked on.

**Note 2:** The database for materials is undergoing updates to better reflect regional variations. *Project teams* shall consider the values presented in this document only for comparative guidance for improved decision making rather than as a source of absolute values.

### *Relationship to Other Measures*

The U-value of **EEM05 Insulation of Roof** may be calculated by combining the material selected for this measure with the insulation specified in **MEM09 – Roof Insulation**, if applicable.

### *Compliance Guidance*

*Preliminary Stage Certification*

- Roof sections showing the materials and thicknesses of the roof(s); and
- Building plans marking the area of major roof types if more than one type of roof is present; and
- Manufacturer's data sheets for the specified building materials; or
- Bill of quantities with the roof material specifications clearly highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Geolocated and date-stamped photographs of the roof(s) taken during construction showing the claimed products on site; or
- Purchase receipts showing the installed products.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photos taken during renovation can be submitted.

# MEM05 – Exterior Walls

*Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of exterior wall used in the *subproject*.

*Intention*

The intent is to reduce the embodied carbon in the building by specifying exterior wall types with lower embodied carbon than a typical exterior wall.

*Approach/Methodologies*

The $External\ Wall\ Area_{base\ case}$ area calculation is explained in the **Methodology** document.

The $Exterior\ Wall\ Area_{improved\ case}$ is defined as the sum of the exposed façade area provided in the **EEM01 Window-to-Wall Ratio** calculator. Note that the exposed façade areas in the **EEM01 Window-to-Wall Ratio** calculator have already excluded areas with permanent openings.

The EDGE App evaluates the embodied carbon of the wall construction type by aggregating the impact of all the key materials such as brick and plaster or gypsum board used in its construction per unit area of the exterior wall. The EDGE App also considers plaster finishes wherever applicable and thickness entered should be inclusive of the plaster finishes. The thickness of the wall also determines the embodied carbon per unit exterior wall area. The *project team* must select the specification that matches or most closely resembles the exterior wall specified in the *subproject* and enter its thickness.

If there are multiple specifications, the predominant specification must be selected as the primary exterior wall type. A second type of construction can also be indicated and marked with its percentage (%) area. The second type of construction needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of construction, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

Certain structural components needed for resilience and/or miscellaneous structural loads are exempt from the thickness calculation, please see the Material section for more details.

*Potential Technologies/Strategies*

Several exterior walls materials are preloaded in the EDGE App, some of those are:

- **Common Brick Wall (0-25%) with/without internal & external plaster:** Composed by common brick and facing brick (1800 kg/m3) and gypsum plaster.
- **Cored (25-40%) bricks with/without internal & external plaster:** Composed by cored brick (500 kg/m3) and gypsum plaster.
- **Honeycomb Clay Blocks (40-60%) with/without internal & external plaster:** Composed by Honeycomb brick (815 kg/m$^3$) and gypsum plaster, where applicable.
- **Medium Weight Hollow Concrete Blocks:** Composed by Medium density block (1606 kg/m$^3$) and gypsum plaster, where applicable.
- **Solid Dense Concrete Blocks:** Composed by dense concrete block (2000 kg/m$^3$) and gypsum plaster, where applicable.
- **Autoclaved Aerated Concrete Blocks:** Composed by Aircrete (Autoclaved Aerated Concrete) (471 kg/m$^3$) and gypsum plaster, where applicable.
- **Fly-Ash Stabilized Soil Blocks:** Composed by Fly Ash Stabilized Soil (2000 kg/m$^3$), and gypsum plaster, where applicable.
- **Compressed Stabilized Earth Blocks:** Composed by Stabilized Soil (2000 kg/m$^3$) and gypsum plaster, where applicable.

- **GGBS Stabilized Soil Blocks:** Composed by GGBS Stabilized soil (2000 kg/m$^3$) and gypsum plaster, where applicable.
- **Rammed Earth Blocks/Walls:** Composed of Rammed Earth (2000 kg/m$^3$) and gypsum plaster, where applicable.
- **Precast Concrete Panels:** composed of precast concrete panels, steel reinforcement (7850 kg/m3) and gypsum plaster, where applicable.
- **Straw Bale Blocks:** Composed of straw bale and mud plaster.
- **Steel Profile Cladding:** Composed of Steel sheet Electrogalvanized (hot rolled) "corrugated zinc" (7850 kg/m$^3$), Steel section (7850 kg/m$^3$), and Gypsum Plasterboard (800 kg/m$^3$)
- **Curtain walling (opaque element):** Made of Aluminum profiled cladding (AL density 2712 kg/m$^3$), Mineral Wool, Gypsum Plasterboard (800 kg/m$^3$). Additionally, an air gap (<100mm) is considered.
- **3-D Wire panel with 'shot-crete' both sides:** Made of Ready mix OPC concrete C30/C37 mix (2365 kg/m$^3$), EPS (Expanded Polystyrene) insulation - high density, Steel reinforcement (7850 kg/m$^3$), Gypsum Plasterboard (800 kg/m$^3$)
- **Re-use of existing wall.** If the building element is older than 5 years, it is considered as re-used.

Table 5 shows all the exterior wall construction options included in the EDGE App, their allowable *effective thickness*, and the range of composite embodied carbon for all the regions. The thickness refers to the total thickness of the assembly. If the thickness is outside the range of the allowable thickness, *project teams* shall "cap" the value to the maximum or minimum allowable and provide a narrative justifying such values as part of the measure documentation.

*Table 5: Allowable thickness ranges, and range of composite embodied carbon at default thickness and reinforcement for exterior walls in an office building. Materials marked with * may not be present in the EDGE App but can be provided using custom materials.*

| Description | Minimum Effective Thickness (meters) | Maximum Effective Thickness (meters) | Composite Embodied Carbon (kgCO2/m2) at default thickness for all regions [Lower bound – Upper bound] | |
|---|---|---|---|---|
| Brick Wall \| Solid Brick (0-25% voids) with External & Internal Plaster | 0.134 | 0.354 | 130 | 202 |
| Brick Wall \| Cored (25-40% voids) with External & Internal Plaster | 0.134 | 0.354 | 93 | 131 |
| Brick Wall \| Honeycomb Blocks (40-60%) with External & Internal Plaster | 0.134 | 0.354 | 62 | 87 |
| Concrete Blocks \| Hollow Blocks of Medium Weight | 0.124 | 0.324 | 71 | 82 |
| Concrete Blocks \| Solid Blocks of Dense Concrete | 0.124 | 0.324 | 50 | 59 |
| Concrete Blocks \| Autoclaved Aerated Concrete (AAC) Blocks | 0.124 | 0.324 | 45 | 49 |
| Soil Blocks \| Fly-Ash Stabilized Soil Blocks | 0.124 | 0.324 | 5 | 10 |
| Soil Blocks \| Compressed Stabilized Earth Blocks | 0.124 | 0.324 | 30 | 37 |
| Soil Blocks \| GGBS Stabilized Soil Blocks | 0.124 | 0.324 | 4 | 4 |
| Soil Blocks \| Rammed Earth Blocks/Walls | 0.200 | 0.500 | 3 | 3 |
| Concrete Panels \| Precast Panels (single layer) | 0.080 | 0.150 | 120 | 153 |
| Straw Bale Blocks* | 0.200 | 0.900 | -25 | -25 |
| Timber Stud Wall \|with Brick Facing | 0.200 | 0.450 | 63 | 107 |
| Timber Stud Wall \|Phosphogypsum Panel | 0.200 | 0.400 | -10 | -7 |
| Ferrocement Wall Panel | 0.100 | 0.200 | 87 | 108 |

| | | | | |
|---|---|---|---|---|
| Concrete In-Situ\| Reinforced Concrete Wall | 0.200 | 0.400 | 87 | 108 |
| Concrete Blocks \| Cellular Light-Weight Concrete Blocks | 0.200 | 0.400 | 47 | 54 |
| Stone Blocks \| Stone Blocks Machine-cut Polished or Unpolished | 0.200 | 0.400 | 7 | 12 |
| FaLG Blocks \|Fly Ash-Lime-gypsum Blocks | 0.200 | 0.400 | 68 | 84 |
| Metal Wall \| Steel Profile Cladding on Steel Frame | 0.200 | 0.400 | 29 | 49 |
| Metal Wall \| Aluminum Profile Cladding on Steel Frame | 0.200 | 0.400 | 41 | 119 |
| Brick Wall \| Solid Brick (0-25% voids) Exposed with Internal Plaster only | 0.200 | 0.400 | 136 | 214 |
| Brick Wall \| Cored Brick (25-40%) Exposed with Internal Plaster only | 0.200 | 0.400 | 98 | 138 |
| Concrete Blocks \| Hollow Blocks with Brick Facing | 0.200 | 0.400 | 85 | 128 |
| Concrete Blocks \| Solid Blocks with Brick Facing | 0.200 | 0.400 | 108 | 152 |
| Concrete Blocks \| Hollow Blocks with Polymeric Render | 0.200 | 0.400 | 53 | 61 |
| Brick Wall \| Solid Brick (0-25%) with Polymeric render | 0.200 | 0.400 | 95 | 147 |
| Concrete Panels \| Precast Sandwich Panels (2 layers of concrete) | 0.200 | 0.400 | 88 | 112 |
| Concrete Panels \| Precast Sandwich Panels with Brick Facing | 0.200 | 0.400 | 110 | 152 |
| Concrete Panels \| Precast Sandwich Panels with Stone Facing | 0.200 | 0.400 | 64 | 77 |
| GFRC Panels \| Glass fiber Reinforced Concrete Cladding Panels | 0.100 | 0.200 | 66 | 82 |
| Stone Profile Cladding* | 0.100 | 0.200 | 64 | 75 |
| Metal Stud Wall \| with Cement Fiber Boards | 0.100 | 0.200 | 11 | 17 |
| Timber Stud Wall \| with Cement Fiber Boards | 0.100 | 0.200 | -5 | -4 |
| Timber Stud Wall \| with Timber Weatherboard | 0.100 | 0.200 | -22 | -19 |
| Timber Stud Wall \| with UPVC Weatherboard | 0.100 | 0.200 | -1 | 1 |
| Metal Stud Wall \| with Clay tiles Cladding (or 'Terracotta Rainscreen Cladding') | 0.100 | 0.200 | 21 | 31 |
| Timber Stud Wall \| with Plasterboard | 0.100 | 0.200 | -11 | -9 |
| Metal Stud Wall \| with Plasterboard | 0.100 | 0.200 | 12 | 19 |
| Curtain Wall \| Aluminum Frame and Opaque panels | 0.100 | 0.200 | 46 | 138 |
| Shotcrete Wall \|3-D Wire Panel with Shotcrete on Both Sides | 0.150 | 0.270 | 38 | 47 |
| Metal Wall \| Aluminum-clad Sandwich Panel | 0.050 | 0.200 | 34 | 111 |
| Metal Wall \| Steel-clad Sandwich Panel | 0.050 | 0.200 | 19 | 32 |
| X - Re-use of existing wall | N/A | N/A | 0 | 0 |
| Stone Blocks \| Hand-cut | 0.200 | 0.400 | 7 | 12 |

If none of the default materials are deemed as similar, **Annex 1: Custom Materials Guidance** provides detailed guidance on how to document such cases. Where a new concrete mix needs to be documented, **Annex 2: Concrete Mix Embodied Carbon Calculation** provides such guidance.

**Note 1:** The database for materials has slight variations per building typology. Full disclosure of the assumptions per building types is not part of the scope of this document but the **Methodology** document (Part 9), currently being worked on.

**Note 2:** The database for materials is undergoing updates to better reflect regional variations. *Project teams* shall consider the values presented in this document only for comparative guidance for improved decision making rather than as a source of absolute values.

### *Relationship to Other Measures*

The gross façade area in the **EEM01 – Windows-to-Wall Ratio** calculator is used as the area for this measure.

The U-value of **EEM08 Insulation of Exterior Walls** may be calculated by combining the material selected for this measure with the insulation specified in **MEM10 – Wall Insulation,** if applicable.

### *Compliance Guidance*

*Preliminary Stage Certification*

- Drawings of the external wall sections; and
- Building plans or elevations highlighting the area of major external wall types if more than one type of external wall is present; and
- Manufacturer's data sheets for the specified building materials; or
- Bill of quantities with the specifications for the materials used for the walls clearly highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Geolocated and date-stamped photographs of the walls taken during construction showing the claimed products on site; or
- Purchase receipts showing the installed products.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photos taken during renovation can be submitted.

# MEM06 – Interior Walls

### *Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of interior wall used in the *subproject*.

### *Intention*

The intent is to reduce the embodied carbon in the building by specifying interior wall types with lower embodied carbon than a typical interior wall.

### *Approach/Methodologies*

The interior walls of the building are those that are within the building and not exposed to the outdoor environment.

EDGE evaluates the embodied carbon of the wall construction type by aggregating the impact of all the key materials such as brick and plaster or gypsum board used in its construction per unit area of the interior wall.

The $Interior\ Wall\ Area_{base\ case}$ area is explained in the **Methodology** document.

The formula to calculate the $Interior\ Wall\ Area_{improved\ case}$ is:

$$Interior\ Wall\ Area_{improved\ case}\ (m^2) = External\ Wall\ Area_{improved\ case}\ (m2) * \ Internal\ Wall\ Area\ Factor$$

Where the internal wall area factor varies by building typology according to Table 6.

*Table 6: Internal wall area factors.*

| Building Type | Internal Wall Area Factor |
|---|---|
| Nursing Home | 0.50 |
| Private Hospital | 0.50 |
| Public Hospital | 0.50 |
| Multi-Specialty Hospital | 0.50 |
| Clinics | 0.50 |
| Diagnostic Center | 0.50 |
| Teaching Hospital | 0.50 |
| Eye Hospital | 0.50 |
| Dental Hospital | 0.50 |
| Office | 2.00 |
| Apartments Low Income | 0.40 |
| Apartments Middle Income | 0.80 |
| Apartments High Income | 1.60 |
| Homes Low Income | 0.55 |
| Homes Middle Income | 0.90 |
| Homes High Income | 1.15 |
| Department Store | 0.01 |
| Shopping mall | 0.10 |
| Supermarket | 0.10 |
| Small Food Retail | 0.10 |
| Non-Food Big Box Retail | 0.01 |
| Light Industry | 0.10 |
| Warehouse | 2.00 |

| Building Type | Internal Wall Area Factor |
|---|---|
| 5 Star Hotel | 1.00 |
| 4 Star Hotel | 2.00 |
| 3 Star Hotel | 2.00 |
| 2 Star Hotel | 2.00 |
| 1 Star Hotel | 2.00 |
| 5 Star Resort | 0.40 |
| 4 Star Resort | 2.00 |
| 3 Star Resort | 2.00 |
| 2 Star Resort | 2.00 |
| 1 Star Resort | 2.00 |
| Preschool | 1.00 |
| School | 2.00 |
| University | 2.00 |
| Other Educational Facilities | 2.00 |
| Sports Facilities | 2.00 |
| Self-Defined Building | 1.00 |
| Serviced Apartment | 0.30 |

EDGE also considers plaster finishes wherever applicable and thickness entered should be inclusive of the plaster finishes. The thickness of the wall also determines the embodied carbon per unit interior wall area. The *project team* must select the specification that matches or most closely resembles the interior wall specified in the *subproject* and enter its thickness.

If there are multiple specifications, the predominant specification must be selected as the primary interior wall type. A second type of construction can also be indicated and marked with its percentage (%) area. The second type of construction needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of construction, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

Certain structural components needed for resilience and/or miscellaneous structural loads are exempt from the thickness calculation, please see the Material section for more details.

### *Potential Technologies/Strategies*

Several indoor wall materials are preloaded in the EDGE App, these are similar to the ones described in Potential Technologies/Strategies in the MEM05 – Exterior Walls section.

Table 7 shows the interior wall construction options included in EDGE, their allowable thickness, and the range of composite embodied carbon for all the regions. The thickness refers to the total thickness of the assembly. If the thickness is outside the range of the allowable thickness, *project teams* shall “cap” the value to the maximum or minimum allowable and provide a narrative justifying such values as part of the measure documentation.

*Table 7: Allowable thickness ranges, and range of composite embodied carbon at default thickness and reinforcement for interior walls in an office building. Materials marked with * may not be present in the EDGE App but can be provided using custom materials.*

| Description | Minimum Effective Thickness (meters) | Maximum Effective Thickness (meters) | Composite Embodied Carbon (kgCO2/m2) at default thickness for all regions [Lower bound – Upper bound] | |
|---|---|---|---|---|
| Brick Wall \| Solid Brick (0-25% voids) with External & Internal Plaster | 0.100 | 0.354 | 58 | 89 |
| Brick Wall \| Cored (25-40% voids) with External & Internal Plaster | 0.100 | 0.354 | 42 | 58 |
| Brick Wall \| Honeycomb Blocks (40-60%) with External & Internal Plaster | 0.100 | 0.354 | 29 | 39 |
| Concrete Blocks \| Hollow Blocks of Medium Weight | 0.100 | 0.324 | 32 | 37 |
| Concrete Blocks \| Solid Blocks of Dense Concrete | 0.100 | 0.324 | 23 | 28 |
| Concrete Blocks \| Autoclaved Aerated Concrete (AAC) Blocks | 0.100 | 0.324 | 22 | 24 |
| Soil Blocks \| Fly-Ash Stabilized Soil Blocks | 0.100 | 0.324 | 5 | 7 |
| Soil Blocks \| Compressed Stabilized Earth Blocks | 0.100 | 0.324 | 16 | 19 |
| Soil Blocks \| GGBS Stabilized Soil Blocks | 0.100 | 0.324 | 5 | 5 |
| Soil Blocks \| Rammed Earth Blocks/Walls | 0.100 | 0.500 | 4 | 4 |
| Concrete Panels \| Precast Panels (single layer) | 0.080 | 0.150 | 66 | 84 |
| Straw Bale Blocks* | 0.100 | 0.900 | -10 | -10 |
| Ferrocement Wall Panel | 0.100 | 0.200 | 49 | 60 |
| Concrete In-Situ\| Reinforced Concrete Wall | 0.100 | 0.400 | 49 | 60 |
| Concrete Blocks \| Cellular Light-Weight Concrete Blocks | 0.100 | 0.400 | 22 | 25 |
| Stone Blocks \| Stone Blocks Machine-cut Polished or Unpolished | 0.100 | 0.400 | 6 | 9 |
| FaLG Blocks \|Fly Ash-Lime-gypsum Blocks | 0.100 | 0.400 | 31 | 38 |
| Brick Wall \| Solid Brick (0-25% voids) no Finish* | 0.100 | 0.400 | 72 | 113 |
| Brick Wall \| Cored (25-40% voids) no Finish* | 0.100 | 0.400 | 51 | 72 |
| Concrete Panels \| Precast Sandwich Panels (2 layers of concrete) | 0.100 | 0.400 | 35 | 44 |
| Metal Stud Wall \| with Cement Fiber Boards | 0.100 | 0.200 | 12 | 19 |
| Timber Stud Wall \| with Cement Fiber Boards | 0.100 | 0.200 | -3 | -2 |
| Timber Stud Wall \| with Plasterboard | 0.100 | 0.200 | -1 | 3 |
| Timber Stud Wall \| with Plasterboard with Insulation* | 0.100 | 0.200 | 3 | 7 |
| Metal Stud Wall \| with Plasterboard | 0.100 | 0.200 | 15 | 24 |
| Metal Stud Wall \| with Plasterboard with Insulation* | 0.100 | 0.200 | 18 | 26 |
| Shotcrete Wall \|3-D Wire Panel with Shotcrete on Both Sides | 0.100 | 0.270 | 40 | 49 |
| Shotcrete Wall \|3-D Wire Panel with Shotcrete on Both Sides with Insulation* | 0.100 | 0.270 | 43 | 51 |

| | | | | |
|---|---|---|---|---|
| X - Re-use of existing wall | N/A | N/A | 0 | 0 |
| Stone Blocks \| Hand-cut | 0.100 | 0.400 | 6 | 9 |

If none of the default materials are deemed as similar, **Annex 1: Custom Materials Guidance** provides detailed guidance on how to document such cases. Where a new concrete mix needs to be documented, **Annex 2: Concrete Mix Embodied Carbon Calculation** provides such guidance.

**Note 1:** The database for materials has slight variations per building typology. Full disclosure of the assumptions per building types is not part of the scope of this document but the **Methodology** document, currently being worked on.

**Note 2:** The database for materials is undergoing updates to better reflect regional variations. *Project teams* shall consider the values presented in this document only for comparative guidance for improved decision making rather than as a source of absolute values.

### *Relationship to Other Measures*

The contribution that the measure makes to the overall performance is not affected by any other measure.

### *Compliance Guidance*

*Preliminary Stage Certification*

- Drawings of the internal wall sections; and
- Building plans or elevations highlighting the area of major internal wall types if more than one type of internal wall is present; and
- Manufacturer's data sheets for the specified building materials; or
- Bill of quantities with the specifications for the materials used for the walls clearly highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Geolocated and date-stamped photographs of the walls taken during construction showing the claimed products on site; or
- Purchase receipts showing the installed products.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photos taken during renovation can be submitted.

# MEM07 – Window Frames

### *Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of window frames used in the *subproject*.

### *Intention*

The intent is to reduce the embodied carbon in the building by specifying window frames with lower embodied carbon than the typical window frames.

### *Approach/Methodologies*

Window frames in EDGE include the frames for all the exterior glazing in a building, including any exterior glass doors. The EDGE App assumes a frame factor of 0.15 of the glazing area to determine the window frames areas.

EDGE provides several options for the materials of window frames. The *project team* must select the specification that matches or most closely resembles the window frames specified.

If there are multiple specifications, the predominant specification must be selected as the primary window frame type. A second type of frame can also be indicated and marked with its percentage (%) area. The second type of frame needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of frames, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

### *Potential Technologies/Strategies*

Table 8 shows window frame options in EDGE, and the range of composite embodied carbon for all the regions.

*Table 8: Composite embodied carbon ranges for window frames across all regions.*

| Description | Composite Embodied Carbon (kgCO2/m2) for all regions | |
|---|---|---|
| | [Lower bound – Upper bound] | |
| Aluminum | 57 | 169 |
| Steel | 26 | 46 |
| Timber | 4 | 42 |
| UPVC | 51 | 71 |
| Aluminum-clad Timber | 15 | 67 |
| X-Re-use Existing Window Frames | 0 | 0 |

If none of the default materials are deemed as similar, **Annex 1: Custom Materials Guidance** provides detailed guidance on how to document such cases.

**Note 1:** The database for materials has slight variations per building typology. Full disclosure of the assumptions per building types is not part of the scope of this document but the **Methodology** document, currently being worked on.

**Note 2:** The database for materials is undergoing updates to better reflect regional variations. *Project teams* shall consider the values presented in this document only for comparative guidance for improved decision making rather than as a source of absolute values.

### *Relationship to Other Measures*

The embodied carbon of the building window frames is based on the glazing area from **EEM01 – Windows-to-Wall Ratio**.

The choice of window frame material has a direct impact on thermal performance of window assembly alongside measure **EEM09 – Efficiency of Glass**.

### *Compliance Guidance*

*Preliminary Stage Certification*

- Building elevations marking the window frame(s) specifications; or
- A window schedule for the building showing the major window frame types if more than one type of window frame is present; and
- Manufacturer's data sheets for the specified window frames; or
- Bill of quantities with the specifications for the windows/window frames highlighted.
- This measure includes exterior glass doors.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Manufacturer's data sheets showing the make and model, material and U-value of the installed window frames; and
- Geolocated and date-stamped photographs of the window frames during or after installation showing the make and model; or
- Purchase receipts showing the make and model of the installed window frames.
- This measure includes exterior glass doors.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photographs can be submitted.

# MEM08 – Window Glazing

### *Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of window glazing used in the *subproject*.

### *Intention*

The intent is to reduce the embodied carbon in the building by specifying window glazing with relatively lower embodied carbon.

### *Approach/Methodologies*

Window glazing in EDGE includes all the exterior glass in a building, including any glass for exterior doors.

Embodied carbon is calculated based on the area of the windows specified in the window-to-wall ratio in the Energy tab multiplied by the embodied carbon of the window glass per unit area.

EDGE provides three options for window glazing — single, double, or triple pane. The *project team* must select the specification that matches the window glazing specified in the building and report the total thickness of the glazing without the air gap(s).

If there are multiple specifications, the predominant specification must be selected as the primary glass type. A second type can also be indicated and marked with its percentage (%) area. The second type needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of glass, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

### *Potential Technologies/Strategies*

Table 9 shows the window glazing options included in the EDGE App, their allowable thickness, and the range of composite embodied carbon for all the regions. If the thickness is outside the range of the allowable thickness, *project teams* shall "cap" the value to the maximum or minimum allowable and provide a narrative justifying such values as part of the measure documentation.

*Table 9: Allowable minimum and maximum effective thickness and typical composite embodied carbon ranges for window glazing across all regions.*

| Description | Minimum Thickness (meters) | Maximum Effective (meters) | Composite Embodied Carbon (kgCO2/m2) at default thickness for all regions | |
|---|---|---|---|---|
| | | | [Lower bound – Upper bound] | |
| Single Glazing | 0.002 | 0.200 | 27 | 27 |
| Double Glazing | 0.012 | 0.040 | 54 | 54 |
| Triple Glazing | 0.018 | 0.060 | 81 | 81 |
| Re-use Existing Glazing | N/A | N/A | 0 | 0 |

If none of the default materials are deemed as similar, **Annex 1: Custom Materials Guidance** provides detailed guidance on how to document such cases.

**Note 1:** The database for materials has slight variations per building typology. Full disclosure of the assumptions per building types is not part of the scope of this document but the **Methodology** document, currently being worked on.

**Note 2:** The database for materials is undergoing updates to better reflect regional variations. *Project teams* shall consider the values presented in this document only for comparative guidance for improved decision making rather than as a source of absolute values.

### *Relationship to Other Measures*

The embodied carbon of the building window glazing is based on the glazing area from **EEM01 – Windows-to-Wall Ratio**.

The U-value of **EEM09 – Efficiency of Glass** should reference the type of glazing selected in this measure (i.e., single, double or triple glazing).

### *Compliance Guidance*

*Preliminary Stage Certification*

- Building elevations marking the window glass specifications; or
- A window schedule for the building showing the major window glass types if more than one type of glass is present; and
- Manufacturer's data sheets for the specified glazing; or
- Bill of quantities with the specifications for the window glass highlighted.
- This measure includes exterior glass doors.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Manufacturer's data sheets showing the make and model, U-value and SHGC of the installed glass; and
- Date-stamped photographs of the glazing during or after installation showing the make and model; or
- Purchase receipts showing the make and model of the installed windows/glass.
- This measure includes exterior glass doors.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photographs can be submitted.

# MEM09 – Roof Insulation

### *Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of roof insulation used in the *subproject*. In the case that insulation is not included in the design, the *project team* may indicate that no insulation has been specified.

### *Intention*

The intent is to reduce the embodied carbon in the building by specifying roof insulation with relatively lower embodied carbon.

### *Approach/Methodologies*

The *project team* must select the specification that most closely resembles the insulation specified.

If there are multiple specifications, the predominant specification must be selected as the primary insulation type. A second type can also be indicated and marked with its percentage (%) area. The second type needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of insulation, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

If the base case assumes that no insulation is specified, the embodied carbon calculation will not take account of the insulation selected unless the Insulation of Roof Surface and/or Insulation of External Walls measures are selected in the energy efficiencies section.

### *Potential Technologies/Strategies*

Table 10 shows the allowable thickness, and typical ranges of composite embodied carbon at default thickness for generic insulation in an office building. If the thickness is outside the range of the allowable thickness, *project teams* shall "cap" the value to the maximum or minimum allowable and provide a narrative justifying such values as part of the measure documentation.

*Table 10: Allowable effective thickness ranges, and range of composite embodied carbon at default thickness for roof insulation in an office building.*

| Description | Minimum Thickness (meters) | Maximum Thickness (meters) | Composite Embodied Carbon (kgCO2/m2) at default thickness for all regions | |
|---|---|---|---|---|
| | | | [Lower bound – Upper bound] | |
| Polystyrene Foam Spray or Board Insulation | 0.010 | 0.300 | 3 | 3 |
| Mineral Wool \| Stone Wool Insulation Batt or Boards | 0.010 | 0.300 | 2 | 2 |
| Glass Wool \| Fiberglass Batt | 0.010 | 0.300 | 4 | 4 |
| Polyurethane Foam Spray or Board Insulation | 0.010 | 0.300 | 9 | 9 |
| Cellulose Insulation | 0.010 | 0.300 | -3 | -3 |
| Cork Board Insulation | 0.010 | 0.300 | -7 | -7 |
| Wood Wool Board Insulation | 0.010 | 0.300 | 26 | 26 |
| Air gap <100mm wide (Insulating) | 0.025 | 0.100 | 0 | 0 |
| Air gap >100mm wide (Non-Insulating) | 0.100 | 0.250 | 0 | 0 |
| X - No insulation | N/A | N/A | 0 | 0 |

If none of the default materials are deemed as similar, **Annex 1: Custom Materials Guidance** provides detailed guidance on how to document such cases.

**Note 1:** The database for materials has slight variations per building typology. Full disclosure of the assumptions per building types is not part of the scope of this document but the **Methodology** document, currently being worked on.

**Note 2:** The database for materials is undergoing updates to better reflect regional variations. *Project teams* shall consider the values presented in this document only for comparative guidance for improved decision making rather than as a source of absolute values.

### *Relationship to Other Measures*

The U-value of **EEM05 – Insulation of Roof** shall include the insulation material selected in this measure.

### *Compliance Guidance*

*Preliminary Stage Certification*

- Drawings marking the type(s) of insulation specified; and
- Building plans marking the area of major insulation types if more than one type of insulation is present; and
- Manufacturer's data sheets for the specified insulation; or
- Bill of quantities with the specifications for the insulation materials highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Manufacturer's data sheets showing the brand and product name and insulating properties of the installed insulation; and
- Date-stamped photographs of the insulation during construction showing the product; or
- Purchase receipts showing the brand and product installed.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photographs can be submitted.

# MEM10 – Wall Insulation

*Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of wall insulation used in the *subproject*. In the case that insulation is not included in the design, the *project team* may indicate that no insulation has been specified.

*Intention*

The intent is to reduce the embodied carbon in the building by specifying wall insulation with relatively lower embodied carbon.

*Approach/Methodologies*

The *project team* must select the specification that most closely resembles the external wall insulation. The insulated area is defined as the sum of the exposed façade area provided in the **EEM01 Window-to-Wall Ratio** calculator. Note that the exposed façade areas in the **EEM01 Window-to-Wall Ratio** calculator have already excluded areas with permanent openings.

If there are multiple specifications, the predominant specification must be selected as the primary insulation type. A second type can also be indicated and marked with its percentage (%) area. The second type needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of insulation, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

If the base case assumes that no insulation is specified, the embodied carbon calculation will not take account of the insulation selected unless the Insulation of Roof Surface and/or Insulation of External Walls measures are selected in the energy efficiencies section.

*Potential Technologies/Strategies*

See Potential Technologies/Strategies in the MEM09 – Roof Insulation section for more information.

*Relationship to Other Measures*

The U-value of **EEM08 – Insulation of Exterior Walls** shall include the insulation material selected in this measure.

*Compliance Guidance*

*Preliminary Stage Certification*

- Drawings marking the type(s) of insulation specified; and
- Building plans marking the area of major insulation types if more than one type of insulation is present; and
- Manufacturer's data sheets for the specified insulation; or
- Bill of quantities with the specifications for the insulation materials highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Manufacturer's data sheets showing the brand and product name and insulating properties of the installed insulation; and
- Date-stamped photographs of the insulation during construction showing the product; or
- Purchase receipts showing the brand and product installed.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photographs can be submitted.

# MEM11 – Floor Insulation

*Requirement Summary*

This measure selection must be made, and the selected value must reflect the type of floor insulation used in bottom floor of the *subproject*. In the case that insulation is not included in the design, the *project team* may indicate that no insulation has been specified.

*Intention*

The intent is to reduce the embodied carbon in the building by specifying floor insulation with relatively lower embodied carbon.

*Approach/Methodologies*

The *project team* must select the specification that most closely resembles the insulation specified in the bottom floor. The area is assumed as:

$$Floor\ Insulation\ Area\ (m^2) = \ Gross\ Internal\ Area\ (m^2)/Total\ Number\ of\ Floors$$

If there are multiple specifications, the predominant specification must be selected as the primary insulation type. A second type can also be indicated and marked with its percentage (%) area. The second type needs to be indicated only if it represents more than 10% of the area; areas smaller than 10% are optional. If there are more than two types of insulation, the smaller areas can be modeled as one of the two predominant types being modeled with which they match more closely.

If the base case assumes that no insulation is specified, the embodied carbon calculation will not take account of the insulation selected unless the Insulation of Roof Surface and/or Insulation of External Walls measures are selected in the energy efficiencies section.

*Potential Technologies/Strategies*

See Potential Technologies/Strategies in the MEM09 – Roof Insulation section for more information.

*Relationship to Other Measures*

The U-value of **EEM06 – Insulation of Ground/Raised Floor Slab** shall include the insulation material selected in this measure.

*Compliance Guidance*

*Preliminary Stage Certification*

- Drawings marking the type(s) of insulation specified; and
- Building plans marking the area of major insulation types if more than one type of insulation is present; and
- Manufacturer's data sheets for the specified insulation; or
- Bill of quantities with the specifications for the insulation materials highlighted.

*Post Construction Stage Certification*

- Documents from the design stage if not already submitted. Include any updates made to the documents to clearly reflect As-Built conditions; and
- Manufacturer's data sheets showing the brand and product name and insulating properties of the installed insulation; and
- Date-stamped photographs of the insulation during construction showing the product; or
- Purchase receipts showing the brand and product installed.

*Existing Building Documentation*

- The same documentation applicable for *Post Construction Stage Certification* may be presented. If the documents required above are not available, other evidence of construction details, such as existing building drawings or photographs can be submitted.

# Annex 1: Custom Materials Guidance

In situations where the defaults list of materials in the EDGE App is not representative of the actual materials in the building design (or existing building), *project teams* are encouraged to create a custom material for each building element that needs it. The following steps describe in a high level the process to create it.

1. Calculate the total mass (kg) or volume ($m^3$) of the material type used.
    - Certain structural components needed for resilience and/or miscellaneous structural loads are exempt from this calculation, please see the Material section for more details.
2. Divide the total mass (kg) or volume ($m^3$) of the material type by the wall/roof/floor area ($m^2$) to get the material density (kg/$m^2$ or $m^3/m^2$).
    - For external walls areas, use the total external wall area provided in the **EEM01 Window-to-Wall Ratio** calculator.
    - For interior wall areas, see the Approach/Methodologies section in the **MEM06 – Interior Walls** measure.
    - For bottom floor construction, see the Approach/Methodologies section in the **MEM01 – Bottom Floor Construction** measure.
    - For intermediate floor area, see the Approach/Methodologies section in the **MEM02 – Intermediate Floor Construction** measure.
    - For roof area, see the Approach/Methodologies section in the **MEM04 – Roof Construction** measure.
3. Obtain the primary embodied carbon from the best available source. In order of priority, sources of embodied carbon information are:
    - Check if an EPD exists for the specific product used,
    - If not, check for an EPD or dataset from the country of manufacture,
    - If no country-specific data exists, look for a regional EPD,
    - If there is no regional EPD, use a generic dataset from another country,
    - If no datasets exist, find EPDs from other manufacturers using similar technology,
    - Use an average of multiple manufacturers' EPDs if from the same region.
4. Multiply the primary embodied carbon (kg $CO_2$eq/kg or kg $CO_2$eq/$m^3$) of the material, calculated in step 3, by the material density (kg/$m^2$ or $m^3/m^2$) calculated in step 2 to obtain the embodied carbon (kg $CO_2/m^2$) and write it in the EDGE App (red box).

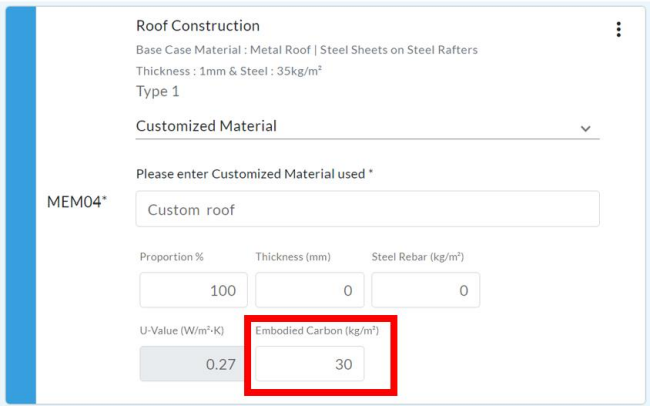


*Figure 4: Embodied carbon field for custom materials.*

5. Set the Thickness (mm) as 0. If additional fields show up, e.g., Steel Rebar (kg/$m^2$), set them as 0 as well. This is to avoid double counting.

6. If another type of material is needed, provide the Proportion % for that type, and repeat steps 1 to 4. Percentages should add up to 100%. Be aware that you can add up to a maximum of two types of materials in the current EDGE version.

The EDGE App then calculates the relevant area ($m^2$) and multiplies it by the weighted average of the embodied carbon (when more than one type if selected), to get the total embodied carbon of the customized material.

Note: The following are sources of EDPs globally. This is not an exhaustive list.

- Built Environment Carbon Database: https://carbon.becd.co.uk/
- ICE Data base: https://circularecology.com/embodied-carbon-footprint-database.html

Note: The following are embodied carbon calculator tools for global use. This is not an exhaustive list.

- The Structural Carbon Tool: https://www.istructe.org/resources/guidance/the-structural-carbon-tool/
- OneClick LCA Planetary: https://oneclicklca.com/resources/planetary

# Annex 2: Concrete Mix Embodied Carbon Calculation

Embodied Carbon of concrete significantly contributes to the embodied carbon of buildings. However, it also presents an opportunity for substantial carbon reductions. The embodied carbon of concrete is largely influenced by the content of Portland cement.

Using greener concrete mixes that show a reduction in Portland cement, such as those incorporating ground granulated blast furnace slag (GGBS) or fly ash (also known as pulverized fuel ash or PFA), can lower the carbon footprint since these materials have lower embodied carbon than ordinary concrete.

To calculate the embodied carbon of custom concrete mixes, *project teams* may use the concrete carbon calculator in the link below. To be valid, the final calculation shall be signed by the concrete provider together with a product brochure or technical sheet supporting the information reflected in the calculation.

https://circularecology.com/concrete-embodied-carbon-footprint-calculator.html

Edge

IFC International Finance Corporation WORLD BANK GROUP

*Creating Markets, Creating Opportunities*

www.edgebuildings.com

Date of Release: November 27th , 2024

**Official Document**