

Carbon Calculator - Cradle to Gate - Limitations, Assumptions & References

Introduction:

Welcome to Angelus Block's Carbon Calculator

The energy efficiency and sustainability of concrete masonry construction is well known by designers and owners. The new Angelus Block Carbon Calculator now makes the cradle to gate carbon content easy to calculate.

Because of the significant environmental impact of building and structures, it is important to choose construction materials that can lessen carbon content. Block construction's energy efficiency, innovation and design flexibility has a proven track record of performance and continues to be a key element in state of the art structures.

This downloadable tool:

- estimates the cradle-to-gate carbon associated with a concrete masonry wall;
- is based on available published environmental data on products used in concrete masonry construction;
- comes with this simple reference, assumptions, and limitations document for environmental and technical transparency; and
- provides you the flexibility to input wall size/area, material volumes and types, and in return you get a cradle-to-gate estimate of the CO₂ footprint for that construction.

Please note, this tool is to be used as a guide only.

The calculator and this document have been reviewed by the Athena Sustainable Materials Institute.

Limitations:

The Angelus Block Carbon Calculator – Cradle to Gate, is a tool to assist designers and specifiers make an initial estimate of the “Cradle-to-gate” (A1 – A3)^{1,2}, CO₂ equivalent greenhouse gas emissions of their material selections. The tool does not include the operational CO₂ equivalent greenhouse gas emissions or address end of life factors because these can only be estimated with project specific building simulation tools. For all materials, including the Mortar and Grout, the energy required to mix, convey, and install the materials is also not included in the calculator.

The CO₂ equivalent greenhouse gas emissions estimated by this tool are based on published Environmental Product Declarations, plant/product-specific where available and industry averages otherwise, and are not specific to any individual project.

The basic unit for quantities is wall area. The geometry of inside and outside corners or intersections with other walls is not considered.

Seven plant-product specific block products produced by Angelus Block are represented, using their individual 3rd-party verified EPD GWPs.

Two block types are provided

1. Medium Weight Gray Block
2. White Calcite Block

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Two block shapes are included

1. Single Open End
2. Double Open End

Three block widths can be selected,

1. 7 5/8 inches
2. 9 5/8 inches
3. 11 5/8 inches

There are four options for Grout Type

1. 100% Portland Cement
2. 25% Fly Ash & 55% Slag
3. 25% Fly Ash
4. 40% Fly Ash

All cavities are assumed to be grouted in the calculator. The grout type has a significant effect on the carbon calculated due to the high carbon content of the Portland Cement displaced by the Fly Ash or Slag.

There are 7 options for vertical rebar and 4 options for horizontal rebar. The designer typically determines the spacing of reinforcing bars based on the earth quake resistance and wall strength requirements.

There are also two types of Masonry Mortar Provided. Type S mortar is the normal mortar for a block wall. Type M mortar is specified when greater strength is required.

Assumptions:

A concrete masonry wall is a composite system that uses materials from several industries and meets multiple performance criteria. For the purposes of this estimating tool, several assumptions have been made so that designers and specifiers should have ready access to the required inputs.

The accuracy of the output is determined by the accuracy of the inputs. All of the component material CO₂ equivalent greenhouse gas emissions were sourced from published Environmental Product Declarations (EPD) from either industry associations or typical producers in the Southern California market.

The Angelus Block Concrete Masonry Units EPD covers a wide range of products. For the purposes of this calculator the Global Warming Potential (GWP) for Medium Weight 2000 net psi (MW1) Concrete Masonry Units (CMU) are provided under six plant-specific EPD numbers and the GWP for the White Medium Weight 2000 net psi CMU is provided for the one plant-specific EPD from where this product is produced.

For mortar, the EPD for the Type IL Portland Cement was for the CalPortland product used by Angelus Block production facilities. Portland Limestone cements such as CalPortland's Type IL are considerably more energy efficient and have lower carbon contents than Normal Portland Type I or Type II cements.

Given that grout may be supplied from any number of ready-mix concrete facilities, the industry averages from the Portland Cement Association Industry-Average EPD for ASTM C595 Type IL (PLC) or ASTM C150 Portland Cement Type I or II are used.

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The amount of mortar used comes from typical industry averages and assumes a 3/8th inch (10 mm) mortar joint thickness. Weep holes and wall tie volumes are not included in the calculations.

Flashing materials at the top and bottom of walls were not considered.

Wall ties were not considered because their contribution to the overall CO₂ is small and considered negligible.

Assumptions			
A1	Block Face Dimensions	7.5 x 15.5 in	190 x 390 mm
A2	Mortar Joint Thickness	3/8 in	10 mm
A3	Wall Tie Steel Inconsequential		
A4	Flashing contribution inconsequential		
A5	Block wall is fully grouted		

References

R1 ISO 14040:2006/Amd 1:2020 Environmental management -- Life cycle assessment -- Principles and framework

R2 ISO 14044:2006/Amd 2:2020 Environmental management -- Life cycle assessment -- Requirements and guidelines

R3 https://www.boral.com.au/sites/default/files/media/field_document/Lime-Boral-Lime-and-Limestone-Products-EPD.pdf

R4 <https://www.calportland.com/wp-content/uploads/2023/07/CalPortland-Oro-Grande-EPD20038-2020-11-24.pdf>

R5 <https://www.astm.org/products-services/certification/environmental-product-declarations/epd-pcr/epd-angelus-block.html>

R6 <http://www.cement.org/docs/default-source/sustainability2/pca-portland-cement-epd-062716.pdf?sfvrsn=2>

R7 https://www.crsi.org/wp-content/uploads/CRSI_Industry-Wide_EPD_Sep2022.pdf

R8 https://www.vulcanmaterials.com/docs/default-source/default-document-library/pleasanton-epd_final

R9 https://pcr-epd.s3.us-east-2.amazonaws.com/537.EPD_for_VMC_Durbin_Sand_Gravel.pdf

R10 https://pcr-epd.s3.us-east-2.amazonaws.com/487.PCR_for_Manufactured_Concrete_and_Concrete_Masonry_Products.pdf

R11 https://pcr-epd.s3.us-east-2.amazonaws.com/707.EPD_for_Slag_Cement_Industry_Wide_EPD.pdf