MECLA

A GUIDE TO LOW CARBON CONCRETE IN AUSTRALIA

The Materials and Embodied Carbon Leaders' Alliance (MECLA) is a collaborative effort from various stakeholders to actively address the reduction of embodied carbon within the building and construction domain in Australia.

Developed by
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INTRODUCTION

Australia's cement and concrete industry has long focused on reducing its environmental impact and, since 2000, Australian manufacturers and suppliers have steadily reduced carbon dioxide emissions by 25%. Yet, the challenge of decarbonising concrete will require further efforts and actions involving everyone – architects, designers, engineers, builders, suppliers, researchers, and end users along the entire construction value chain. With interest in low carbon building materials increasing, this guide will help you ask the right questions when specifying low carbon concrete.

It's also acknowledged that this document has some limitations; this is the initial release of the guide and is aiming to be good, not perfect. The document does not take into account the variety of regional areas and factors associated with that region to achieve low-carbon concrete. The document does also not account for the varying applications or type of concrete, and the impact on carbon emissions i.e. post-tensioned, pre-cast, piling etc.

Subsequent versions of this guide will aim to reduce the limitations mentioned above and any further limitations that may arise as more data and experience are gained.

LOW CARBON CONCRETE DEFINITION

Low carbon concrete is designed to reduce its carbon footprint and environmental impact compared to traditional concrete. Achieving emission reduction from concrete requires a holistic approach, considering every aspect of the concrete life cycle, including but not limited to material selection, transportation, production, design, procurement, and construction. Low carbon concrete aims to mitigate emissions and reduce its overall embodied carbon impact through a combination of these approaches.

Low carbon concrete should have the lowest embodied carbon available for the application while still meeting all specified technical and performance requirements. It must meet the requirements of AS 1379 to ensure compliance with the design of concrete structures regarding service life, as outlined in AS 3600, AS 5100.5, and any government standards used for concrete structures.

INSTRUCTIONS

The following should be considered and discussed with the supply chain as part of specification and procurement of low carbon concrete.

1. Specify the requirement for low carbon concrete.

This requirement should be specified as rigorously as any other performance criterion. Request the lowest possible carbon concrete while ensuring it meets all necessary technical and performance standards.

2. Require a verified Environmental Product Declaration (EPD).

EPDs provide users with an embodied carbon value and confidence in the standards and methodology used in the life cycle assessment. EPDs are third-party verified, publicly available, and compatible with life cycle tools.

3. Liaise with the supply chain and set embodied carbon reduction targets.

Set a performance target for embodied carbon for the project.
Avoid setting targets based solely on the percentage of supplementary cementitious materials (% SCM), as this approach may not effectively drive holistic and verified decarbonisation efforts.

FIVE CONSIDERATIONS

Five things to consider to help you through the process of specifying and using lower carbon concrete for your project:

1. Have you engaged with your supply chain yet?

Early engagement with the supply chain results in the greatest possible reductions. Collaborate with specialists to refine specifications, explore new products, and stay informed about industry advancements. A practical guide to upfront carbon reductions outlines steps to be taken during the design and construction process by each of the stakeholders, questions to ask, and opportunities to consider.

2. What are the cost considerations for low carbon concrete?

MECLA's members and spotlight events have highlighted that low carbon concrete solutions can be cost-comparable or at an insignificant additional cost in the wider context of the project. Opportunities for reducing or eliminating embodied carbon are varied and will differ between types of projects as well as by region. In general, the greatest savings can usually be realised at the earliest stages of a project. As a project progresses, it becomes more challenging and more costly to make design changes to reduce embodied carbon.

3. Do you need low carbon concrete or actually a low carbon structure?

The ultimate aim is a low embodied carbon structure or project. A holistic life cycle approach should be taken. As an example, pre-stressed or post-tension concrete has a higher embodied carbon impact per cubic meter than ordinary concrete. However, in some cases, it may result in less volume of concrete used and a lower total overall embodied carbon impact for the building structure. Early involvement with structural engineers and life cycle professionals is key to exploring potential opportunities.

4. Where is the project based?

Low carbon concrete is available in all Australian metro areas and many regional centers. However, the largest level of reductions may not be achievable in areas that are remote or have difficulty sourcing appropriate materials. Ensure you work with suppliers to request and source the lowest carbon concrete possible for your project. Demand for low carbon concrete supports further investments, innovation, and greater possible reductions. Engage with the supply chain regarding what is possible.

5. What level of embodied carbon reduction is possible / what are the limitations?

The greatest level of embodied carbon reductions is typically possible with normal class concrete designed for everyday applications such as residential and commercial foundations, driveways, and footpaths. The level of embodied carbon reduction achievable for special class concrete (e.g. precast concrete, high early age strength, low shrinkage, post-tension slabs, etc.) is typically less due to the performance requirements of the specification. This needs to be taken into consideration when setting your project's embodied carbon reduction target. Overly prescriptive specification requirements or competing production requirements (e.g. precast concrete cycle times) can also reduce the opportunity to reduce the embodied carbon of concrete. Look for opportunities and unnecessary requirements for further reductions.

EMBODIED CARBON CLASSIFICATION SCHEME FOR CONCRETE

The purpose of this classification scheme for concrete is to function as a tool to communicate the embodied carbon of concrete within the industry. It is based on the Embodied Carbon Classification Scheme for Concrete approach developed in the UK. The following figure shows EPD data (sourced from EC3) for all concrete applications and regions across Australia. The classifications below are segmented according to the strength class of the concrete. At this level, they do not take into account other characteristics of the concrete, such as the application (e.g. foundations, slabs), production route (e.g. ready-mix, precast), region, or performance characteristics other than compressive strength (e.g. durability or workability).

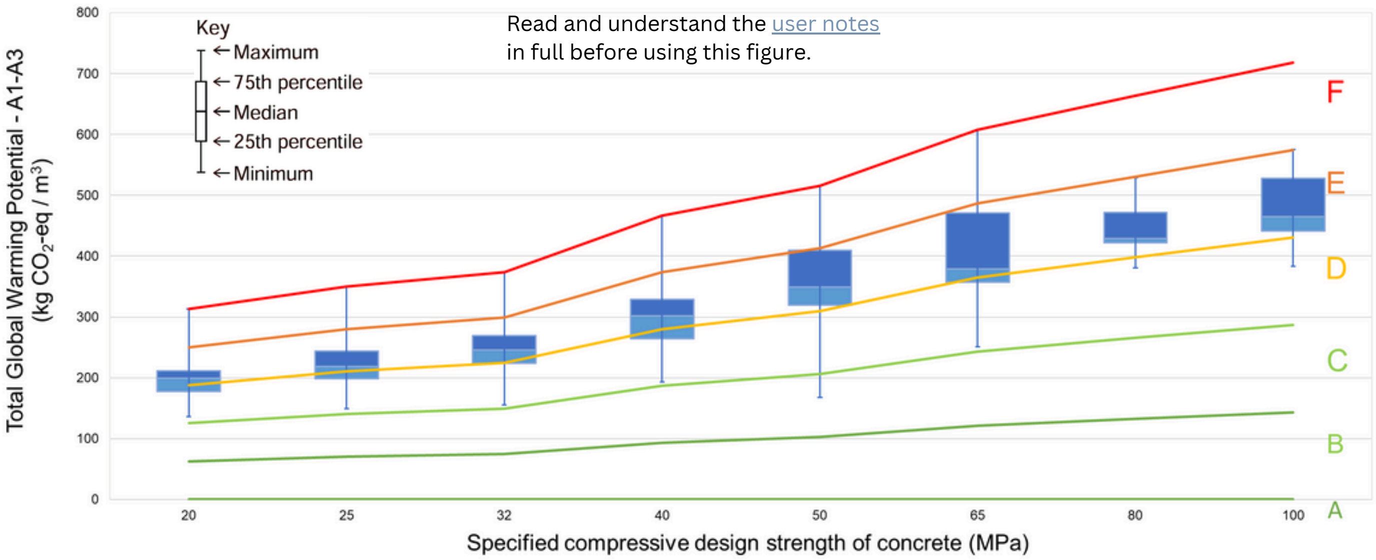

Figure 1. Embodied Carbon Classification for Concrete and 2019-23 Australian EPD Data (kg CO_2-eq/m^3)

Table 1. Embodied Carbon Classification Scheme for Australian Concrete

Classification	Concrete Strength (MPa) & Embodied Carbon (kg CO_2-eq / m^3)							
	20	25	32	40	50	65	80	100
F	313	350	374	467	516	608	664	718
E	250	280	299	374	413	486	531	574
D	188	210	224	280	310	365	398	431
C	125	140	150	187	206	243	265	287
B	63	70	75	93	103	122	133	144
A	0	0	0	0	0	0	0	0

Table 2. 2019-23 Statistics for Australian EPDs: All regions and types of concrete

Statistics for EPD data scope	Concrete Strength (MPa) & Embodied Carbon (kg CO_2-eq / m^3)							
	20	25	32	40	50	65	80	100
Maximum	313	350	374	467	516	608	529	575
75% percentile	211	244	270	329	410	471	472	528
Medium - 50% percentile	199	218	246	302	349	379	429	465
25 % percentile	177	198	224	264	320	357	422	441
Minimum	136	149	155	193	168	251	381	383