CO_2 2.Low carbon

How to read an EPD: basics for the structural engineer

Emily Lorenz provides a brief guide to environmental product declarations, enabling structural engineers to better understand the information these contain when making design decisions.

Glossary
EPD = environmental product declaration
LCA = lifecycle assessment
PCR = product category rules

Introduction

Environmental product declarations (EPDs) are Type III environmental labels (according to ISO 14025[1]) that report a peer-reviewed summary of the results of a lifecycle assessment (LCA). As EPDs play an increasing role in design decisions, it is important for structural engineers to understand the basic information that is contained within these labels. This article will outline how an EPD is created, and the role of product category rules (PCR) in ensuring consistency. It will also describe the basic components of an EPD.

Where do EPD data come from?

Structural engineers are familiar with various European and international standards that govern the structural design of buildings and civil engineering works. Likewise, European and international standards also exist that govern the environmental assessment of buildings and civil engineering works. The two primary standards that detail the requirements for conducting an LCA are ISO 14040, *Environmental management – Life cycle assessment – Principles and framework*[2], and ISO 14044, *Environmental management – Life cycle assessment – Requirements and guidelines*[3].

ISO 14040 and ISO 14044 outline the methodological framework for LCA, which includes four steps. Broadly, these are:

→| defining the goal and scope
→| conducting a lifecycle inventory
→| performing a lifecycle impact assessment
→| interpreting the results.

In each of these steps, the LCA practitioner makes decisions that influence the results of the study, which frequently means that different studies are not conducted consistently and should not be compared.

A PCR sets many of these choices for a product so that the EPDs can be consistent. The overarching standard for PCRs is ISO 14025, which sets out the reporting structure for an EPD, ensuring that key information can be readily understood[1].

For building products, there are two core PCRs: ISO 21930[4] or EN 15804[5]. In this case, the core PCRs set the basic choices when performing an LCA, and what is reported in an EPD, for the product category of 'building products'.

In addition, all PCRs require that EPDs state whether they have been prepared or verified internally or externally.

Program operators, CEN product technical committees, or ISO product technical committees may develop subcategory PCRs to further define rules for a given product category, such as steel reinforcement, prefabricated concrete, structural steel, cladding, windows, and so forth.

At a minimum, use of the same core PCR is necessary to ensure consistency in EPDs and potentially enable comparisons. There are also many other requirements to ensure comparability, which will not be covered in this article.

Basic components in an EPD

Because the core PCR standardises the minimum reporting requirements, structural engineers will be able to find the same basic components in an EPD for any building product. From a structural engineer's perspective, some of the more important information included in an EPD are the:

→| core PCR
→| lifecycle stages
→| declared or functional unit
→| product description
→| environmental impacts
→| background technical information.

Core PCR

As previously discussed, there are two core PCRs for building products, ISO 21930 or EN 15804, and an EPD is required to state which standard was used as the basis of its development. There are two versions of ISO 21930 (2006 and 2017) that may be referenced in current, existing EPDs, and several versions of the EN 15804 standard, including additional parts. It is useful to note which version of the core PCR was used in the development of an EPD because EPDs created with different core PCRs cannot be compared.

Lifecycle stages

The lifecycle stages that are included in the background LCA, and thus the lifecycle stages reflected in the EPD results, are always reported in an EPD. EN 15804 has developed a useful figure to reflect the lifecycle stages for a product, which is also listed in ISO 21930 (Table 1). The primary difference between the figure in EN 15804 and ISO 21930 is that module D is excluded in ISO 21930.

The product lifecycle stages can be grouped into four categories:

→| production stage: A1–A3
→| construction stage: A4–A5
→| use stage: B1–B7
→| end-of-life stage: C1–C4.

EPDs can be created for various combinations of lifecycle stages; however, at a minimum, the production stage (A1–A3) must be included. This is also called a cradle-to-gate scope and it represents the lifecycle stages over which manufacturers have the greatest control.

When all lifecycle stages are included in the analysis (A1–A5, B1–B7, and C1–C4), it is said to have a cradle-to-grave scope. Modules A4–C4 use standard approximations based on the PCR and the manufacturer's particular product and situation.

Each EPD will have a detailed description of what is included in each lifecycle module for a given product. It will also include a list of what is excluded from the scope or system boundary.

TABLE 1: Product lifecycle stages

A1–A3			A4–A5		B1–B7				
PRODUCTION Stage (Mandatory)			CONSTRUCTION Stage		USE Stage				
A1	A2	A3	A4	A5	B1	B2	B3	B4	
Extraction and upstream production	Transport to factory	Manufacturing	Transport to site	Installation	Use	Maintenance (incl. production, transport and disposal of necessary materials)	Repair (incl. production, transport and disposal of necessary materials)	Replacement (incl. production, transport and disposal of necessary materials)	
			Scenario	*Scenario*	*Scenario*	*Scenario*	*Scenario*	*Scenario*	
					B6 Operational energy use				
					Scenario				
					B7 Operational water use				
					Scenario				

Source: ISO 21930:2017[4]

Declared or functional unit
Environmental impacts reported in an EPD are based on either a declared or a functional unit. A declared unit is frequently used when the scope of the analysis is cradle-to-gate and when the function of the product is unknown or cannot be stated for the whole lifecycle. Both EN 15804 and ISO 21930 define a declared unit as a 'quantity of a construction product for use as a reference unit in an EPD based on LCA, for the expression of environmental information needed in information modules'. Examples of a declared unit are mass (kg) or volume (cubic metre).

A functional unit is defined in ISO 21930 and EN 15804 as 'quantified performance of a product system for a construction product or construction service for use as a reference unit in an EPD based on LCA that includes all stages of the life cycle'. An EPD based on a functional unit requires the use of scenarios that define the performance of the product system that must be met. Establishing a functional unit for a product that has fewer possible uses, like carpet, is easier than establishing one for a product with infinite uses, like steel.

Product description
The EPD will include a description of the product, which should be described in sufficient detail to enable the structural engineer to understand its composition. This may include construction product names, product codes, visual representation, and a description of the intended application and use. When an EPD is based on a functional unit, the use of the product will be described as part of the functional unit.

Environmental impacts
The core PCR establishes the environmental impacts and lifecycle inventory items that must be reported in an EPD. All impacts and inventory items are reported based on the declared or functional unit of the product. Common environmental impacts that are reported include global warming potential (GWP), acidification potential, eutrophication potential, photochemical oxidant creation potential, and ozone depletion potential.

Lifecycle inventory items could include freshwater consumption, primary energy use, resource use, and waste flows for a more holistic understanding of the environmental impacts of a product. For structural engineers seeking embodied carbon data, they will find this reported in an EPD under the heading GWP or climate change, with the units $kgCO_2e$.

The methodology used to calculate various environmental impacts in ISO 21930 and EN 15804 typically differs, except in the case of climate change, where the methods are nearly identical.

Background technical information
The EPD will report background data sets, including sources, used in the LCA to develop the environmental impacts and lifecycle inventory items. If an EPD is based on a functional unit, scenario descriptions will also be reported in the EPD. Because any scenarios used in the development of EPD data are based on assumptions, the scenarios and technical data must be reported so that the structural engineer can assess whether the EPD is applicable for a given project.

ISO 21930 further states that 'the technical scenario information provided in an EPD shall be detailed so as to enable the user of the EPD to assess whether the scenario assumptions are applicable to the context for which the EPD information is to be used'.

Summary

EPDs are a tool for structural engineers to use in the development of more sustainable designs. The goal of this article is to improve the structural engineer's understanding of how EPDs are created, the role of PCRs, and the basic components of an EPD. In this way, the structural engineer is better prepared to assist in tackling the climate emergency.

Emily Lorenz
PE

Emily Lorenz is an independent consultant in the areas of LCA, EPDs, PCRs, green building, and sustainability. She serves as an engineer in the areas of green structures and practices, energy efficiency, thermal properties, and moisture mitigation. She is a US expert to ISO TC59\SC17\WG3 Environmental Declarations of Products.

		C1–C4			
		END-OF-LIFE Stage			
	B5	C1	C2	C3	C4
	Refurbishment (incl. production, transport and disposal of necessary materials)	Deconstruction/ demolition	Transport to waste processing or disposal	Waste processing	Disposal of waste
	Scenario	*Scenario*	*Scenario*	*Scenario*	*Scenario*

STRUCTURAL ENGINEERS WILL BE ABLE TO FIND THE SAME BASIC COMPONENTS IN AN EPD FOR ANY BUILDING PRODUCT

REFERENCES

1) International Organization for Standardization (2006) *ISO 14025:2006 Environmental labels and declarations – Type III environmental declarations – Principles and procedures*, Geneva: ISO

2) International Organization for Standardization (2006) *ISO 14040:2006 Environmental management – Life cycle assessment – Principles and framework*, Geneva: ISO

3) International Organization for Standardization (2006) *ISO 14044:2006 Environmental management – Life cycle assessment – Requirements and guidelines*, Geneva: ISO

4) International Organization for Standardization (2017) *ISO 21930:2017 Sustainability in buildings and civil engineering works – Core rules for environmental product declarations of construction products and services*, Geneva: ISO

5) British Standards Institution (2020) *BS EN 15804:2012+A2:2019 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products*, London: BSI (withdrawn)