

# Environmental Product Declaration

## High strength precast concrete balconies

As per EN 15804:2012+A1:2013 and EN 16757:2017 (Sustainability of construction works – Environmental product declarations – Product Category Rules for concrete and concrete elements)



### Declaration owner

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### Published by

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### Declared product

High strength precast concrete balconies

### Declared unit

1 m<sup>3</sup>

### Production site

Hjallerup in Denmark

### Product application

The products are used in a variety of large and small buildings. Design and functionality are important features of the products.

### Life cycle assessment

The EPD is based on a life cycle assessment in compliance with the requirements of the standards EN 15804:2012+A1:2013 and EN 16757:2017.

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Environmental product declarations of construction products may not be comparable if they do not comply with the requirements in EN 15804:2012+A1:2013.

### Type of EPD

Cradle to gate with options.

The EPD is in accordance with ISO 14025 and EN 15804.

### Use

The intended use of the EPD is to communicate scientifically based environmental information about the products to professional stakeholders with the end goal to enable assessments of buildings.

## Product description

All products are produced at Hi-Con's manufacturing site in Denmark.

The main constituents in the concrete are given in the table below. Due to confidentiality reasons they are specified in ranges and make out approximately 95% of the declared product.

*Table 1. Constituents in declared product*

<b>Constituent</b>	<b>Weight % of declared product</b>
Cement	25-35%
Silica fume	5-10%
Sand and gravel	50-60%
Steel reinforcement and fibers	10-20%

In addition to the specified constituents, water and a certain quantity of superplasticizer is also used in the recipe.

The products are precast and are produced in wooden moulds for which the materials wood, glue, lacquer and a small quantity of bolts and screws are used.

The product density is 2,7 ton/m<sup>3</sup>.

## Representative projects

Almost every Hi-Con balcony project is unique and therefore there is some variety between products. Examples of varieties is the installation method and the balcony dimensions. This Environmental Product Declaration is representative for all concrete balconies from Hi-Con and is based on two specific and large recent Hi-Con projects. Where varieties exist between included balcony types, conservative estimates have been made for increased robustness of results.

The declaration pertains to 1 m<sup>3</sup> of product, which can be scaled to a specific balcony at building level by dividing the results with the required volume per square meter (m<sup>3</sup>/m<sup>2</sup>). This will generate the results for one square meter instead of one cubic meter, which allows for a comparison with other concrete balconies. A pre-requisite for such a comparison is that any compared balconies fulfil applicable technical and functional requirements and that the RSL is known.

## Reference service life (RSL)

The RSL is equal to the ReqSL<sup>1</sup> of the building in which the high strength balcony is installed. No maintenance is required, but one-off cleaning may apply for elements with specific purposes (e.g. aesthetic). No repairs, replacements or refurbishments are normally needed.

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<sup>1</sup> Reference service life required by the customer or by legislation

## LCA approach and additional information

### Data collection

All Hi-Con data are collected in a data collection excel sheet. The quantity of product constituents is based on Hi-Con recipes. Consumption of energy, water and ancillary materials are quantified for the year 2017. Data related to the transportation to the building site and the assembly is based on two specific representative projects. Secondary data originate from thinkstep/GaBi databases. Two datasets of minor importance are not from thinkstep.

### Cut-off rule

The EPD accounts for 100% of the declared product and therefore no cut-off rule is defined.

### Allocation

Allocation is performed in accordance with the PCR. Recycled outputs in the product stage (A1-A3) are allocated as co-products in accordance with the EN 15804 standard. Reuse of wooden moulds are taken into account by considering the number of uses in accordance with the standard EN16757. Consumption of energy, water and ancillary materials are quantified for the year 2017 and are divided by the total production of concrete (m<sup>3</sup>) in the same year.

### Content of hazardous substances

The product does not contain REACH substances from the Candidate List of Substances of Very High Concern for authorization, in concentrations exceeding 0,1% (w/w).

### Disposal

By disposal of discarded balconies Hi-Con recommends recycling of the concrete.

## System boundaries and scenarios

The environmental product declaration is of the type cradle-to-gate with options as specified in figure 1 below.

*Figur 1. Life cycle stages covered in accordance with EN 15804:2012+A1:2013. Modules marked with "X" are included, where as the remaining modules are not declared "MND".*

PRODUCT STAGE			CONSTRUCTION PROCESS STAGE		USE STAGE							END OF LIFE STAGE				BENEFITS AND LOADS BEYOND THE SYSTEM BOUNDARIES
Raw material supply	Transport	Manufacturing	Transport from the gate to the site	Assembly	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	De-construction demolition	Transport	Waste processing	Disposal	Reuse-Recovery-Recycling-potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	X	X	X	X	X	X	X	X	MND	MND	MND	MND	MND

The following information specifies and supports the declaration of the included modules.

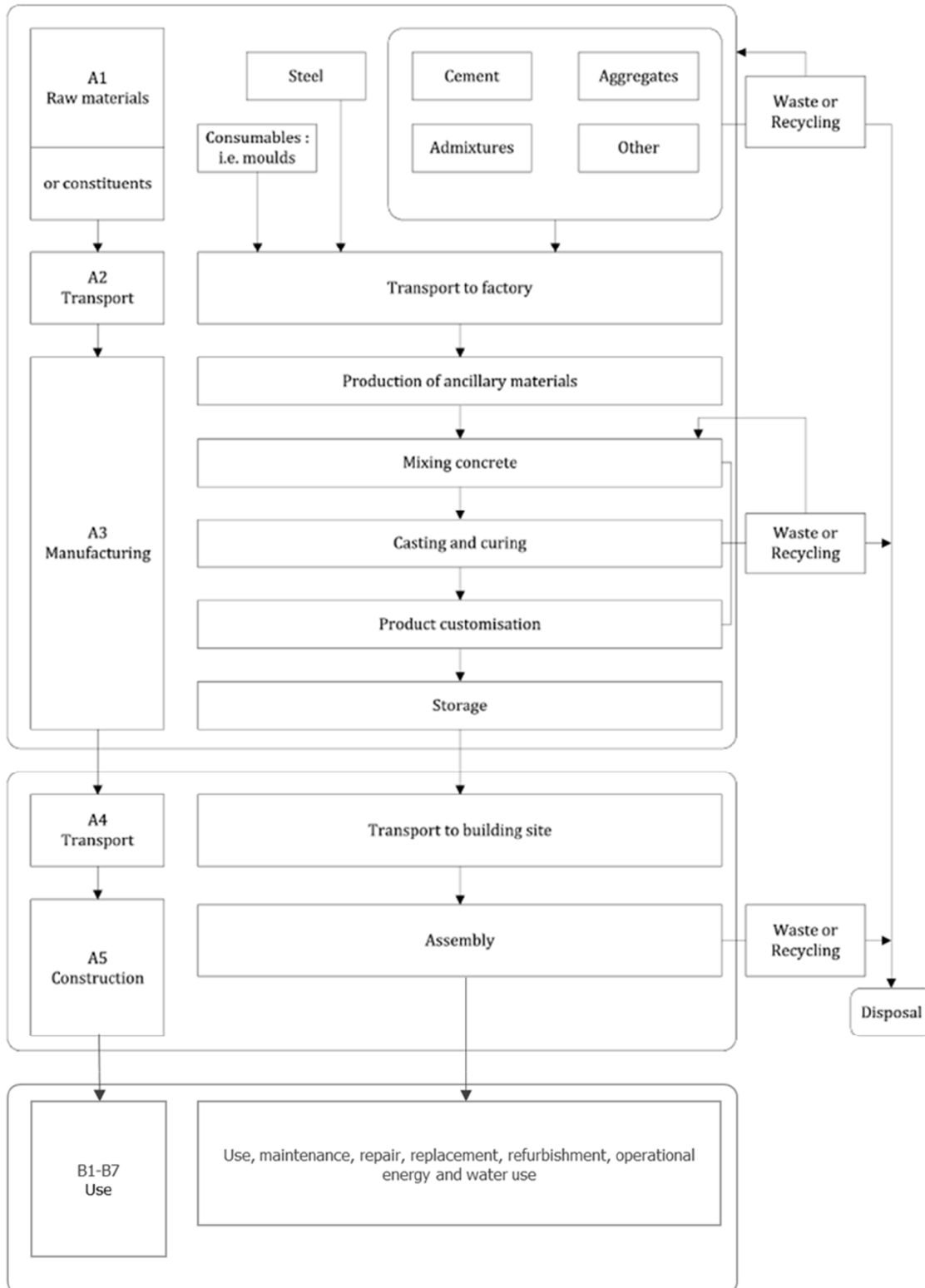
**A1-A3:** The product stage includes all raw materials and energy production (A1) and transport of these to the production site (A2), where the products are manufactured (A3) by mixing the concrete constituents, adding reinforcement steel and casting and curing using wooden moulds. Handling of waste from production (A3) is included until the end-of-waste. The production of needed ancillary materials such as lubrication and wax for moulds are part of the manufacturing (A3).

**A4-A5:** The construction process stage includes transportation of the precast elements by truck to the building site (A4) and the assumed distance is 380 km. Installation into the building (A5) implies using small cranes for lifting and various products, such as brackets and bolts, for assembling and fixing the elements in place on site. A total of 55 kg/m<sup>3</sup> materials are used for the assembly.

**B1-B7:** The use stage is included although the only environmental impacts occurring in the use stage is carbonation, which is accounted for in use (B1). No maintenance repair or replacements is needed for the normal use of Hi-Con high strength concrete balconies. There is also no operational energy or water requirement associated with the product, although it is acknowledged that some cleaning may occur, for example if a person spills on the balcony.

For a flow diagram showing the system boundaries, see figure 2 on the next page.

Figur 2. Flow diagram showing system boundaries



## LCA results

Table 2. Environmental impacts for 1 m<sup>3</sup> concrete element from Hi-Con

Impact category	Unit	A1-A3	A1	A2	A3	A4	A5	B1	B2-B7
GWP	kg CO <sub>2</sub> -e	1063,7	987	30,1	46,6	46,3	208	-3,4	0,00E+00
ODP	kg R11-e	3,42E-07	6,61E-08	7,70E-13	2,76E-07	1,92E-12	2,17E-06	0,00E+00	0,00E+00
AP	kg SO <sub>2</sub> -e	2,1543	1,85	0,234	0,0703	0,0285	1,19	0,00E+00	0,00E+00
EP	kg PO <sub>43</sub> -e	2,87E-01	2,46E-01	2,64E-02	1,41E-02	5,78E-03	7,89E-02	0,00E+00	0,00E+00
POCP	kg C <sub>2</sub> H <sub>4</sub> -e	0,28009	0,257	0,0159	0,00719	0,00654	0,0707	0,00E+00	0,00E+00
ADPE	kg Sb-e	0,001542	0,00152	1,27E-06	2,05E-05	2,66E-06	0,0103	0,00E+00	0,00E+00
ADPF	MJ	7,71E+03	6,74E+03	3,94E+02	5,78E+02	6,29E+02	2,53E+03	0,00E+00	0,00E+00
Abbreviations	GWP = Global Warming Potential (Climate Change); ODP = Ozone Depletion Potential; AP = Acidification Potential for Soil and Water; EP = Eutrophication Potential; POCP = Photochemical Ozone Creation; ADPE = Abiotic Depletion Potential – Elements; ADPF = Abiotic Depletion Potential – Fossil Fuels								

Table 3. Resource use for 1 m<sup>3</sup> concrete element from Hi-Con

Resource use	Unit	A1-A3	A1	A2	A3	A4	A5	B1	B2-B7
PERE	MJ	1,99E+03	1,65E+03	1,72E+01	3,27E+02	3,30E+01	4,50E+02	0,00E+00	0,00E+00
PERM	MJ	1,02E+03	1,02E+03	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
PERT	MJ	3,01E+03	2,67E+03	1,72E+01	3,27E+02	3,30E+01	4,50E+02	0,00E+00	0,00E+00
PENRE	MJ	9,27E+03	8,25E+03	3,95E+02	6,24E+02	6,32E+02	2,70E+03	0,00E+00	0,00E+00
PENRM	MJ	8,80E+01	8,80E+01	0,00E+00	0,00E+00	0,00E+00	5,81E+01	0,00E+00	0,00E+00
PENRT	MJ	9,36E+03	8,34E+03	3,95E+02	6,24E+02	6,32E+02	2,76E+03	0,00E+00	0,00E+00
SM	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
RSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
NRSF	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
FW	m <sup>3</sup>	23,2645	22,7	0,0295	0,535	0,0613	5,32	0,00E+00	0,00E+00
Abbreviations	PERE = Use of renewable primary energy excluding renewable primary energy resources used as raw materials; PERM = Use of renewable primary energy resources used as raw materials; PERT = Total use of renewable primary energy resources; PENRE = Use of non-renewable primary energy excluding non-renewable primary energy resources used as raw materials; PENRM = Use of non-renewable primary energy resources used as raw materials; PENRT = Total use of non-renewable primary energy resources; SM = Use of secondary material; RSF = Use of renewable secondary fuels; NRSF = Use of non-renewable secondary fuels; FW = Net use of fresh water								

Table 4. Waste categories & Output flows for 1 m<sup>3</sup> concrete element from Hi-Con

Waste categories & Output flows	Unit	A1-A3	A1	A2	A3	A4	A5	B1	B2-B7
HWD	kg	6,45E-02	6,45E-02	1,78E-05	5,91E-07	3,33E-05	7,67E-06	0,00E+00	0,00E+00
NHWD	kg	2,04E+03	1,98E+03	1,31E+00	5,50E+01	3,18E+00	1,62E+03	0,00E+00	0,00E+00
TRWD	kg	6,53E-01	6,34E-01	5,26E-04	1,86E-02	1,32E-03	8,84E-02	0,00E+00	0,00E+00
CRU	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MR	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
MER	kg	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
EE	MJ	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00	0,00E+00
Abbreviations	HWD = Hazardous waste disposed; NHWD = Non-hazardous waste disposed; TRWD = Total Radioactive waste disposed; CRU = Components for reuse; MR = Materials for recycling; MER = Materials for energy recovery; EE = Exported energy								

## Interpretation

Interpretation of the results has been carried out considering the methodology, data related assumptions and any limitations declared in the EPD.

The LCA results show that 81% of the GWP (Global Warming Potential) occurs in the product stages A1-A3 and that more than half of this is due to the use of cement in the products.

For the construction process stage, more than half of the potential environmental impact categories, are dominated by the use of steel brackets for mounting balconies in buildings.

Carbonation is included in the EPD results as the only impact in the module B1, but the carbonation process does not influence the GWP significantly.

## References

### **EN 15804**

EN 15804 + A1:2013 "Sustainability of construction works – Environmental product declarations – Core rules for the product category of construction products"

### **EN 16757**

EN 16757:2017 "Sustainability of construction works – Environmental product declarations – Product Category Rules for concrete and concrete elements"

### **EN 15942**

EN 15942:2011 "Sustainability of construction works – Environmental product declarations – Communication formats: business to business"

### **ISO 14025**

EN ISO 14025:2010 "Environmental labels and declarations - Type III environmental declarations – Principles and procedures"

### **ISO 14040**

EN ISO 14040:2008 "Environmental management – Life cycle assessment – Principles and framework"

### **ISO 14044**

EN ISO 14044:2008 "Environmental management – Life cycle assessment – Requirements and guidelines"

### **LCA Software and databases**

Thinkstep™, GaBi database version 2018

### **REACH**

Registration, Evaluation, Authorization and restriction of Chemical substances