

Background report - concrete

Update 18.9.2025 (R01.06): generic values of ready-mix concrete updated. The principles for using values according to the BY low-carbon classification have been clarified.

Update 11.12.2024 (R01.05): accessibility update

Update 16.10.2024 (R01.04): added ready-mix concretes GWP.55 and GWP.45 and C40/50 class

Update 29.6.2023 (R01.03): update with GWP.85 ready-mix concretes

Update 3.10.2022 (R01.02): the most relevant values updated, and the appearance of the report has been updated

Update 23.11.2022 (R01.01): conversion factors corrected

Original 2021 (R01.00): compilation of previous background reports

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1 Background information

1.1 Manufacturing

Concrete products are one of the most common construction materials in building construction. Concrete products are manufactured in various shapes and forms. Most of the concrete products produced in Finland are also used in Finland. Domestic sales of concrete industry are presented in the figure 1.

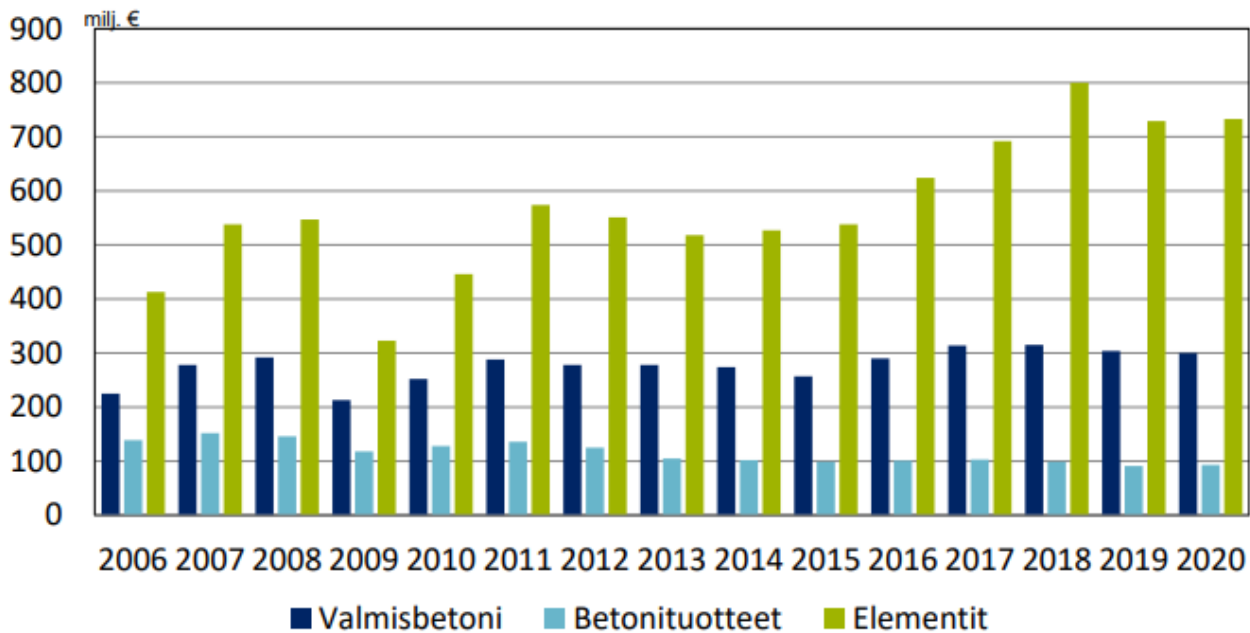


Figure 1. Domestic net sales of the concrete industry. ¹

Statistics Finland provides statistics about the production sales of precast concrete in euros and in volume. In 2017, precast concrete elements were sold for EUR 657 million and their product mass was 2.7 million tonnes (2,741,532 tonnes)².

According to the Finnish Customs statistics³, import of prefabricated structural elements (concrete and artificial stones) was 35 817 tonnes and export was 4 358 tonnes (2017). Thus, total net import was 31 460 tonnes. From net import 54% was imported from Estonia and 39% of products imported from Russia (2017).

From all sold reinforced concrete element (by mass) import was 1.1%. ($2\,741\,532 + 31\,460$ tonnes = 2 772 992 and 31 460 tonnes = 1.1%).

Domestic sales of the Finnish concrete element companies were EUR 793.6 million. Main 5 reinforced concrete element manufacturers are representing 64 % from the total domestic element production and sale. These manufacturers according to the gross sales were: ⁴

- Parma Oy

¹ Microsoft PowerPoint - Betonin kuviot 2020

² Statistics Finland, Manufacturing, Industrial production by product names as variables PRODCOM, Year and Data, 2017

³ Uljas - Statistical Database <https://uljas.tulli.fi/v3rti/> International trade in goods. Finnish Customs

⁴ Rakennusteollisuus RT Statistics, 2018

- Betset Oy
- Lujabetoni Oy
- Rudus Oy
- Betonimestarit Oy

However, in 2019 (According to the Finnish customs statistics) import of prefabricated structural elements has been growing approximately 3 times since 2017 and total import was 93 000 tonnes and export was 15000 tonnes. Net import by countries shows that in 2019 already 73% of products (by mass) were imported from Estonia and 22% from Russia. Import from other countries remain small. Trade with Lithuania and Sweden shows that products were exported rather than imported ('minus' % in figure).

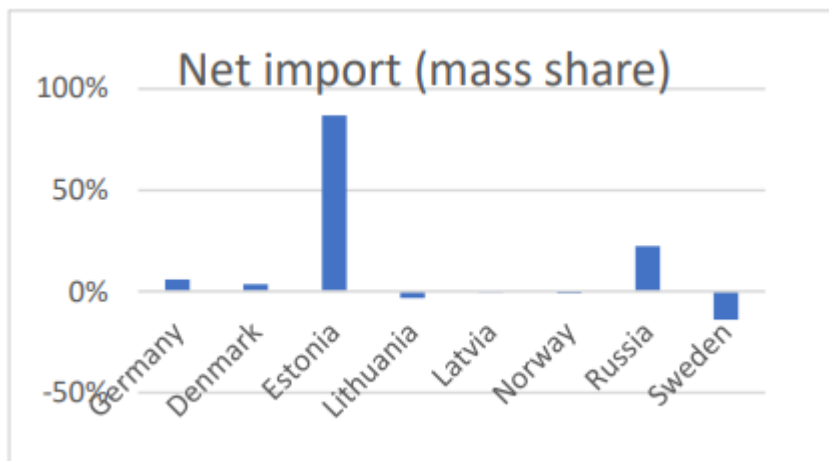


Figure 2. Net Import of prefabricated structural elements in 2019.

79 % of industrial production in Finland considers concrete slabs, exterior walls and other vertical elements (Figure 2). Other products such as beams, columns and other horizontal elements are

produced notably less by the mass share. However, the scale of concrete production is great and therefore, the production of all the above products can be considered significant.

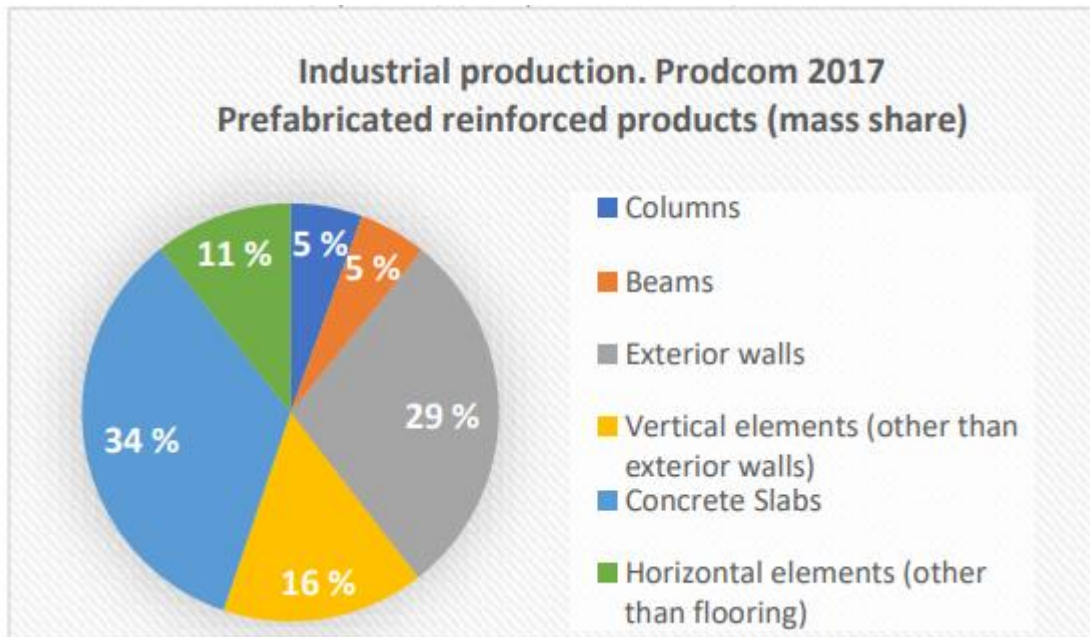


Figure 3. Industrial production (Prodcom 2017). Prefabricated reinforced products by mass share

1.2 Essential issues affecting the carbon footprint

In all product groups binder (mainly cement) accounts for the entire product life cycle greenhouse gas emissions are over half. In general, most of the emissions for concrete products are generated in the first phase (A1, raw material supply) of product stage (A1-A3). Ready-mixed concrete accounts for up to 70%. The transport of raw materials and products, as well as energy consumption, also play a significant role in the environmental impact. In addition, the carbon footprint of concrete products is affected by special requirements of each product. The most common of these are reinforcement, insulation and pallets for transportation.⁵

Waste processing (C3) emissions and carbon handprints are declared as stand-alone items within other database sections. See those sections⁶, including background reports, for more information.

⁵ [BET2101_86-91.pdf \(betoni.com\)](#)

⁶ [Rakentamisen päästötietokanta](#) (see sections: waste process & carbon handprint)

2 Ready-Mix Concrete

2.2 Use, market and products

Ready-mixed concrete is made by mixing the main raw materials cement, water and aggregate in a controlled proportion (according to recipe). Simplified concrete recipe contain cement around 12% and aggregates about 80%. The composition of the concrete recipe varies depending on the requirements of the concrete application. Chemical admixtures are used to improve fresh and hardened concrete properties. Ready-mix concrete can be delivered to site, and it is suitable to cast all type and shape of products.

Manufacturers of ready-mix concrete:

- Alavuden Betoni Oy (Alavus)
- Ansion sementtivalimo (Valkoja)
- Betoni-Sampo valmisbetonitehdas (Jämsä)
- Betroc Oy (Sodankylä)
- Betset-yhtiöt (Helsinki, Hämeenlinna, Kyyjärvi, Mikkeli, Nummela, Nurmijärvi, Parainen, Turku, Vierumäki)
- Hyvinkään Betoni Oy (Hyvinkää)
- JA-KO Betoni Oy (Kokkola, Mustasaari, Närpes, Seinäjoki, Pietarsaari)
- Lakan Betoni Oy konserni (Joensuu)
- Lujabetoni Oy (Siilinjärvi, Käräsämäki, Vieremä, Varkaus, Tampere, Oulu, Nokia, Orimattila, Kuopio, Muurame, Kontiolahti, Hämeenlinna, Helsinki, Haapajärvi, Espoo)
- Napapiirin Betoni Oy (Rovaniemi)
- Pielisen Betoni Oy (Liekka)
- Rakennusbetoni- ja Elementti Oy (Hollola, Lahti)
- Rudus Oy (Helsinki, Äänekoski, Espoo, Valkeakoski, Ylivieska, Vaasa, Seinäjoki, Vantaa, Tornio, Suonenjoki, Sipoo, Savonlinna, Salo, Rovaniemi, Rauma, Raasepori, Raahe, Pyhäjärvi, Porvoo, Pori, Oulu, Nummimäki, Tampere, Mäntsälä, Lahti, Masku, Lohja, Lapväärtti, Lappeenranta, Kuopio, Kouvola, Kotka, Kemi, Kalajoki, Järvenpää, Imatra, Turku, Harjavalta, Forssa, Aura, Helsinki)
- Rudus Ämmän Betoni Oy (Suomussalmi)
- Ruskon Betoni Oy (Oulu, Turku, Hollola, Paatela, Sotkamo, Vantaa, Tuusula, Raahe, Pyhäjoki, Pudasjärvi, Porvoo, Helsinki, Lappeenranta, Kuusamo, Espoo, Kouvola, Kotka, Kempele, Kemijärvi, Kajaani, Savela)
- Suutarinen Yhtiöt/SBS Betoni Oy (Mäntyharju, Mikkeli)
- Swerock Oy (Helsinki, Ylöjärvi, Tampere, Lapua, Vaasa, Salo, Naantali, Lieto, Lohja, Kirkkonummi).

The domestic sales of ready-mixed concrete were 2.7 million concrete cubes, and the turnover was EUR 325 million (2019).⁷ In 2020 net sales were slightly lower, totaling EUR 300.3 million euros. According to sales, the four largest sellers of ready-mixed concrete are Rudus Oy, Ruskon Betoni Oy, Lujabetoni Oy, Swerock Oy. The turnover of other manufacturers was less than EUR 10 million euros.⁸

⁷ [Valmisbetoniteollisuus | Betoni](#)

⁸ [Betonteollisuuden suuruusjärjestys-2020.pdf](#)

2.3 Carbon footprint

Energy consumption for concrete mixing is small, raw-material transportation in Finland is also reasonable. Main environmental impacts come from the use of raw materials, process emissions of cement (decomposition of limestone) and the use of energy raw materials.

Finnish cement industry has reduced emissions from cement production over the years, the production of cement still causes around 90% of the total GWP impact of ready-mix concrete (when unit impact for cement is around 700 g CO₂e / kg, and impact from the production of aggregates is around 2.5 g/kg).

Ready-mix concrete is the product which normally not exported from neighbor countries. In addition, the composition of the concrete depends on the country-specific environmental conditions and official regulations.

Although ready-mixed concrete is very country-specific, the background data in this report selectively present the carbon footprint of ready-mixed concrete from other countries (Norway, Iceland, Sweden, the United Kingdom, Germany) for comparison (Appendix 1).

In Finland the BY-Low Carbon Classification⁹ presents classes for the carbon footprint values of ready-mixed concrete, which have been calculated based on input data from different manufacturers and are reported as the average GWP-total value per cubic meter of concrete.

The classification is based on the average emission level of concrete manufacturers in 2021. The values are based on concrete flexibility class S3 and a maximum aggregate grain size of 16 mm. However, the low carbon classes have been calculated in 15 % increments based on the reference levels, rounding the GWP values to the nearest 5 kg / m³. Thus, for example, in the GWP.70 class, the emission level is 70% of the emission of the reference level i.e. GWP.REF.

The GWP.REF values are selected as base for typical values of ready-mix concretes of different strength classes and air-entrained mixes as well. For these generic values, conservative value is calculated normally as presented in the database methodology.

Now, following generic ready-mix concrete items are added to the database:

- Ready-mix concrete, C20/25
- Ready-mix concrete, C25/30
- Ready-mix concrete, C30/37
- Ready-mix concrete, C35/45
- Ready-mix concrete, C40/50
- Ready-mix concrete, C45/55
- Ready-mix concrete, C50/60
- Ready-mix concrete, C30/37, air-entrained
- Ready-mix concrete, C35/45, air-entrained
- Ready-mix concrete, C40/50, air-entrained
- Ready-mix concrete, C45/55, air-entrained
- Ready-mix concrete, C50/60, air-entrained

Moreover, direct references to classes (GWP.REF, GWP.85, ...) of the BY-low carbon classification are also presented in the database. As these are not generic values of CO₂data, conservation factor is not applied to them. By using the values according to the BY low-carbon classification, you are committing to the principles set out by the Concrete Association of Finland for their use.

⁹ [Vähähiilinen betoni](#)

3 Concrete well elements

3.2 Use, market and products

High-strength concrete used in the manufacture of pipes is highly resistant to chemical stress and temperature fluctuations. Main GWP impacts come from the use of cement.

The production volume of concrete wells and rings in 2020 was about 65,000 tonnes, volume was about 15,000 more when compared to the previous year (Figure 4). There are different types of products regarding the strength, those features are described by the following abbreviation in connection with the product name: (Br - normal reinforcement, Dr - strong reinforcement and B - non-reinforced).

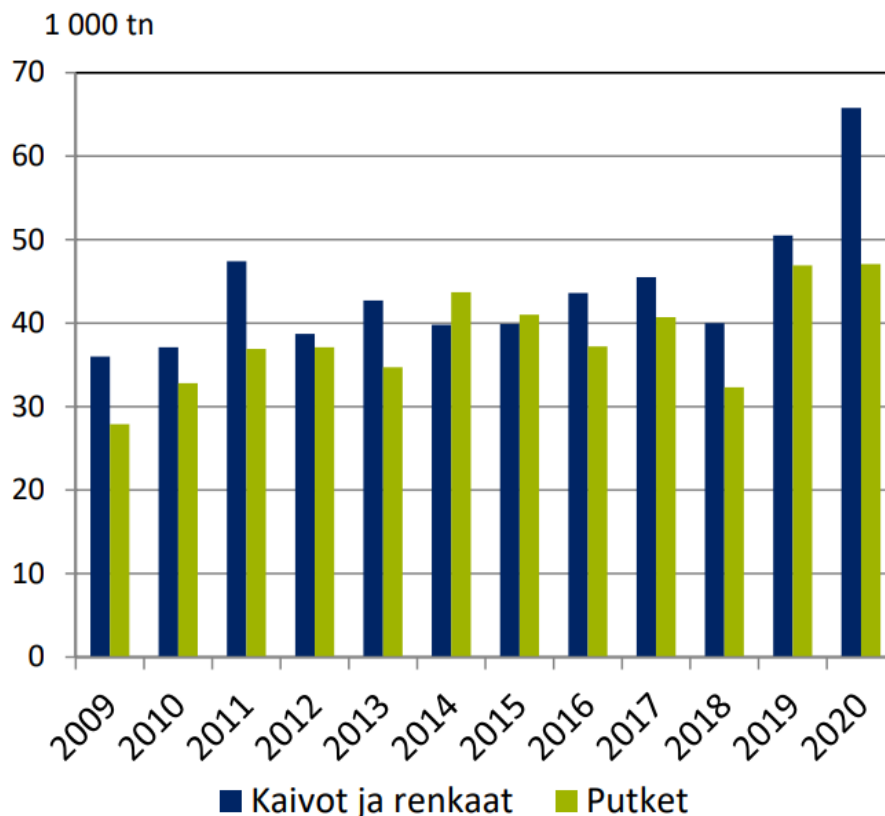


Figure 4 Production of concrete well elements and concrete pipes. ¹⁰

All conventional wells can be constructed from the EK concrete well system with a pre-installed fixed seal, such as:

- manholes,
- stormwater wells to direct rainwater into drains,
- suction wells to keep the groundwater level as stable as possible,
- grease, petrol and oil separation wells,
- underdrain wells,
- sedimentation wells,
- sedimentation and sewage wells in sparsely populated areas
- drinking water wells and ready-to-install pumping stations.

The products of concrete wells are:

- Elevation ring - a component of a concrete well (without a joint or installed step) to adjust the overall height of the structure and / or to accommodate a suitable frame and deck.

¹⁰ [Microsoft PowerPoint - Betonin kuviot 2020](#)

- Cover - Passageway A part of the horizontal roof of a well ring located immediately above the ring to which the platform ring or frame and cover are designed to fit.
- Well ring - hollow vertical component with symmetrical cross - section, except for the joint profile.
- Bottom ring - a vertical component with or without a solid base, with or without gutter casting and with suitable flexible joints for waterproof pipe connections, with or without fixed adapter pipes or adapters.
- Cone ring - a part of a well that forms an inclined roof into a round or oval well and thus reduces the diameter of the well to the desired size according to the size of the access opening.
- Shrink cover - a shrinkage part that forms the horizontal load-bearing structure of a well in which a compatible well ring can be mounted.

Manufacturers of concrete wells and stormwater systems are: ¹¹

- Rudus Oy (Helsinki)
- Ruskon Betoni Oy (Oulu)
- JA-KO Betoni Oy (Kokkola)
- Ohenmäen Sora Oy

3.3 Carbon footprint

The weight and carbon footprint of concrete well products depends on the size and weight of the well product used and the reinforcement class. Proposal for a database of 2 different well elements (Cr 800 and Cr 2000). The proposed well elements are based on the results published by Betoniteollisuus ry as an environmental product declaration (Betoniteollisuus Ry, 2021) regarding the products well ring 800 Cr and well ring 2000 Cr.

Additional products / additional sizes can be interpolated from the data in the environmental statement. Initially, unit emissions are calculated, CO₂e kg / tonne, and the result can be changed to one product unit. The product pieces can be used to assemble different well assemblies. For well products, the unit is also an inherent unit in the cost accounting system. Thus, the result can also be directly integrated into the cost accounting system. A linear dependence can be used for interpolation (see Figure 5).

Data on the manufacture of well products for the concrete industry have been collected on a plant-by-plant basis. The assessment is based on the volume-weighted average data of the mills. The variation in the result data is less than 20%, mainly due to differences in concrete recipes from different manufacturers.

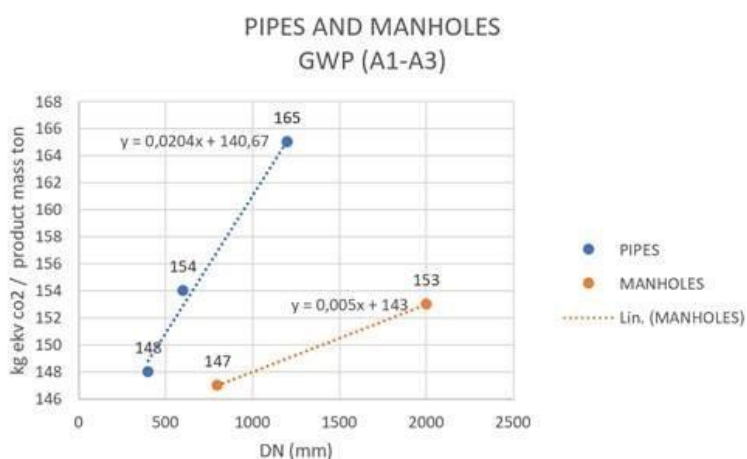


Figure 5 Interpolation of emissions of pipes and manholes

¹¹ [Betoniteollisuus ry:n jäsenyritysten tuotteet ja palvelut | Betoni](#)

Table 1. Carbon footprint of concrete well elements

Product	GWP fossil CO2ekg/kg	Waste during construction %	Share of recycled materials %
Concrete well element Cr 800	0.147	0	3,5-4
Concrete well element Cr 2000	0.153	0	3,5-4

4 Concrete pipes

4.2 Use, market and products

The production volume of concrete pipes in 2020 was about 47,000 tonnes, on average the volume has been increasing slightly since 2009. (Figure 6). There are different types of products regarding the strength, those features are described by the following abbreviation in connection with the product name: (Br - normal reinforcement, Dr - strong reinforcement and B - non-reinforced).

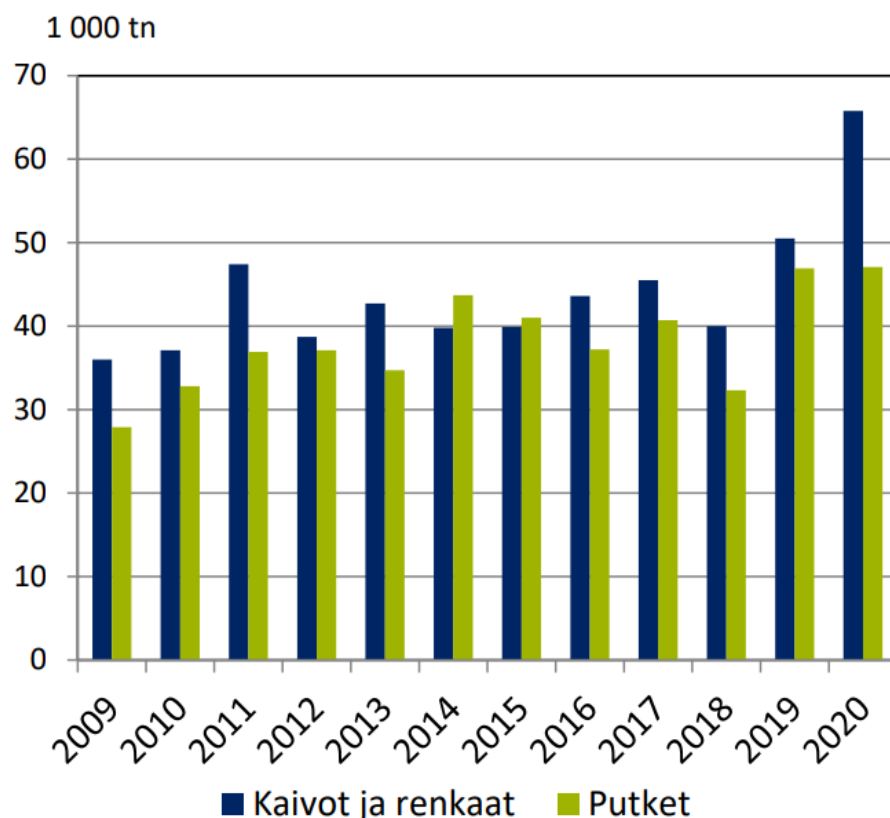


Figure 6 Production of concrete well elements and concrete pipes. ¹²

Concrete pipes are mainly used to construct sewer lines (wastewater, stormwater) and stormwater delay systems in which the fluid flows under the influence of gravity. Other applications include road drums, pressurized sewers and raw water pipes.

The minimum diameter of the road drum is 300... 800 mm, depending on the type of road or junction. In track drums, the minimum diameter is 800 mm. The ends of drums with an inside diameter ≥ 800 mm are made chamfered. The drums use ordinary EK pipes, so the properties of the drum pipes are similar to those of sewer pipes (Petrow, S., Heikkinen, M., Forsman, J., Pirinen, M. 2017).

The abbreviation "EK" for the EK concrete drainage system means 'pre-assembled fixed seal'. The system includes concrete pipes and wells as well as connection and fitting parts. EK concrete pipes can be straight-walled or sleeve-shaped, round or legged. The cross section may also be oval. The fixed seal is pre-installed on the product, so no separate seals are required during installation.

EK concrete pipes with an internal diameter of ≤ 600 mm are usually produced both unreinforced and reinforced, depending on the future load. Larger concrete pipe sizes and all well ring sizes are made reinforced.

Manufacturers of concrete pipes, wells and stormwater systems are: ³

- Rudus Oy (Helsinki)
- Ruskon Betoni Oy (Oulu)
- JA-KO Betoni Oy (Kokkola)

¹² [Microsoft PowerPoint - Betonin kuviot 2020](#)

4.3 Carbon footprint

The weight and carbon footprint of the concrete pipe depends on the shape of the pipe (round, legged, beveled, oval), reinforcement class Br (normal reinforcement), Dr (strong reinforcement), B (non-reinforced), pipe size (effective height 1000. 1200. 1400. 1600. 225, 300. 400. 500. 600. 800) and the quality of concrete used.

Proposal for a database of 4 different concrete pipe grades.

The calculation is based on the EPD by Betoniteollisuus as well as interpolated results for products of different sizes. For them, the unit emission, CO₂e kg / tonne was initially calculated, and the result was changed to one pipe meter. The pipe meter is also an integral unit in the cost accounting system, so the result can also be directly integrated into the cost accounting system.

Interpolation:

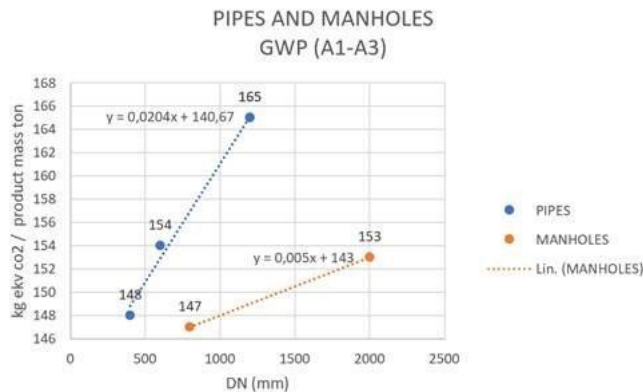


Figure 7 Interpolation of emissions of pipes and manholes

Table 2. Carbon footprint of concrete pipes

Product	GWP fossil CO ₂ ekg/kg	Waste during construction %	Share of recycled materials %
Concrete pipe 1200 Br	0.165	5	1.5-4
Concrete pipe 1200 Dr	0.165	5	1.5-4
Concrete pipe 600 Dr	0.154	5	1.5-4
Concrete pipe, unreinforced	0.148	5	1

5 Concrete piles

5.2 Use, market and products

Concrete foundation piles: Site conditions and structural requirements determine the type of pile. The concrete used in the piles is made in accordance with standard EN 206 and strength of the concrete is C40/50 (K-50) or C45/55 (K-55). Manufacturing of concrete piles include preparation of concrete, reinforcement work and pile casting. Includes various steel parts.

Concrete piles are particularly suitable for foundation when the ground is too weak and the load-bearing soil layer is deep (as is often the case, for example, in clay and soft areas).

The manufacture of concrete piles includes the manufacture of concrete, reinforcement work and pile casting. In addition, various steel parts are attached to the piles. They are pile tips, pile caps and extensions. The finished pile products are installed on site at the site with the help of a piling machine and are continued into uniform piles with the help of steel parts in accordance with the requirements of the Piling Instructions 2016.

The typical nominal size of piles is 300x300 mm², but piles are also produced in 250x250 mm² and 350x350 mm².

The standard pile is designed for environmental conditions XC2 (wet, rarely dry).

The following guidelines and standards are essential for the design of piles:

- Piling instructions PO-2016 (RIL 254–2016)
- SFS-EN 1992-1-1 Eurocode 2. Design of concrete structures
- SFS-EN 12794 Precast concrete parts. Foundation piles
- SFS-EN 12699 Foundation work. Piles displacing the ground
- SFS-EN 13369 General rules for precast concrete parts

Manufacturers of concrete piles are ¹³:

- HTM Yhtöt Oy (Hausjärvi)
- TB-Paalu Oy (Riste)
- Lujabetoni

5.3 Carbon footprint

Structural strength of RT-concrete due to the size of the pile cut and the reinforcement of the pile. In practice, the bearing capacity of the pile also depends on the temperature of the soil and the length of the pile.

Extension piles are equipped with steel extensions, using the piles to extend the construction site during the installation phase. The lowest piles are equipped with pile tips (rock or ground tip) based on the condition.

It is proposed to add three common concrete pile sizes with nominal cross-sectional dimensions of 250 x 250 mm, 300 x 300 mm and 350 x 350 mm to the database.

The average carbon footprint values presented in the Concrete Industry EPD 'Reinforced Concrete Impact Pile' (Betoniteollisuus Ry, 2021) for pile types RTB-250-16, RTB-300-16 and RTC 350-16 are proposed to be generic for the carbon footprint of concrete piles. These represent the average Finnish production of reinforced concrete piles.

Table 3. Carbon footprint of concrete piles

¹³ [Betoniteollisuus ry:n jäsenyritysten tuotteet ja palvelut | Betoni](#)

Product	GWP fossil CO2ekg/kg	Waste during the installation %	Conversion value kg/rm	Share of recycled materials %
Concrete pile RTB-250	0.168	3	157	4,9
Concrete pile RTB-300	0.161	3	227	4,5
Concrete pile RTB-350	0.169	3	309	5,4

6 Concrete blocks

6.2 Use, market and products

Concrete products are produced by mixing main raw materials cement, water and aggregate according to a controlled proportion (recipe). Chemical admixtures can be used to improve fresh and hardened concrete properties when needed. In the case of lightweight concrete, in addition to the normal aggregate also lightweight aggregate is used. The production of concrete blocks consists of material proportioning, mixing, molding, curing, and packing.

Import/Export by product mass According to the Finnish customs statistics, import of concrete blocks (by weight) was highest (among the assessed concrete products) and in total net import (import – export) was 29 629 tonnes. Import of lightweight concrete blocks is small and, in the case, lightweight concrete total net import (import – export) show ‘minus’ result, as export was higher than import.

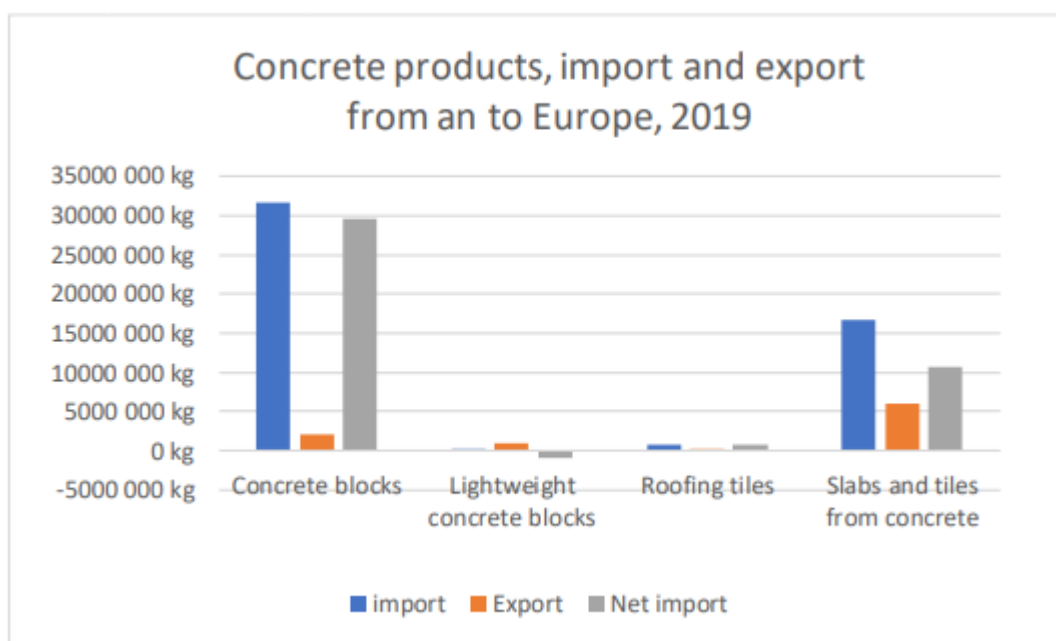


Figure 8. Concrete products, import and export from and to Europe, 2019

According to the Finland Prodcom statistics (2019) concrete blocks and tiles were sold by 50 million € and it represents product mass of 348 000 tonnes. At the same time net import was 29 000 tonnes. This represents 8 % from total sale of concrete block and tile product group (by mass). Statistics show that that from imported concrete blocks (excl. light weight concrete) 94% was imported from Estonia.

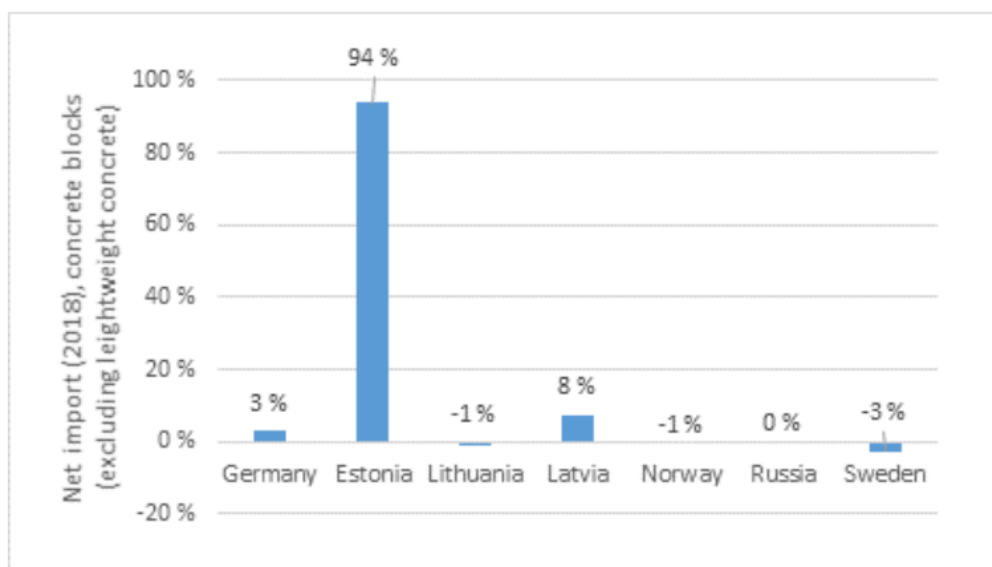


Figure 9. Net import (2018), concrete blocks (excluding lightweight concrete)

6.3 Carbon footprint

Lightweight concrete blocks produced from expanded clay with addition of cement, aggregates (dense and lightweight) and water. Blocks could be produced with different densities: 650 kg/m³, 700 kg/m³, 800...950 kg/m³ and 1100 kg/m³. Main GWP impact come from the manufacturing of lightweight aggregate.

Concrete blocks are made of natural stone, cement, and water. Concrete blocks with cavities can be used to build concrete structures without the erection and demolition of separate formwork structures. The production of concrete blocks consists of material proportioning, mixing, molding, curing, and packing. Concrete blocks can be installed without mortar by pouring flexible concrete mass into the cavities. In concrete blocks main GWP impact come from the use of cement.

Representativeness of proposed values is very good as it is based on the assessment of Finnish producers, and from the newest available operation year (2019). The proposed value for concrete blocks is based on the values Betoniteollisuus published in 2021. The following table shows a summary of proposed GWP values (kg/kg).

Table 4. Carbon footprint of concrete blocks

Product	GWP fossil CO ₂ e/kg	Waste during the installation %	Conversion value kg/m ³	Share of recycled materials %
Concrete block, lightweight aggregates, insulated, U 0.17 W/m ² K	0.391	5	537	2
Concrete block, lightweight aggregates, not insulated	0.273	5	644	1
Concrete block, insulated, U 0.17 W/m ² K	0.286	5	552	1
Concrete cavity block	0.159	5	863	1

End of life treatment of concrete blocks depends on the materials used in the product. Insulated concrete products cannot be recycled as a secondary raw material as efficiently as uninsulated products. Therefore, the end-of-life scenario is different for some products. For uninsulated concrete blocks it can be assumed that about 80 % is recycled as secondary raw materials meaning that 20 % of the product is directed to final disposal.

7 Concrete roofing tiles and paving blocks

7.2 Use, market and products

After concrete blocks, second mostly imported product class was concrete slabs and tiles but in this product class export was higher than in previous case and thus, total net import remains 10 627 tonnes. Import of lightweight concrete blocks and roofing tiles was small and, in the case, lightweight concrete total net import (import – export) show 'minus' result, as export was higher than import. In case of roofing tiles net import was only 764 tonnes.

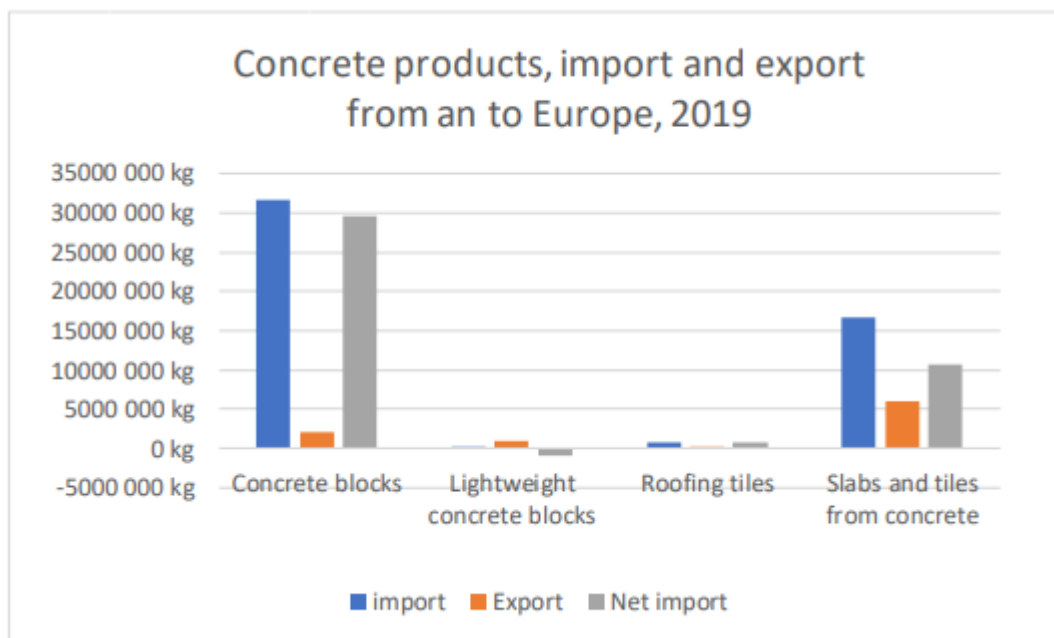


Figure 10. Concrete products, import and export from and to Europe, 2019

7.3 Carbon footprint

Concrete roofing tiles are made coloured concrete, in which a colour pigment, according to the basic colour of the brick, is mixed into the concrete mass. The roof tile is made by dry pressing, after pressing, brick is strengthened in the curing chamber. Main GWP impact come from the use of cement.

Proposed value for roofing tile is based on the VTT calculation: assessment based on the proposed concrete mix design for Finland. Main impact from roofing tile production come from the life cycle phase A1. The mass of the roofing tile is 4.2 kg. Assessment doesn't contain any material losses and wastes, thus it is recommended to add coefficient for conservative approach. Carbon handprint: Concrete waste is recycled and replaces gravel and sand.

Concrete paving blocks production includes proportioning, Mixing, Compacting, Curing & Drying. A concrete mix with sand/gravels are used for making paving block, for colouring also pigments might be included. Main GWP impact come from the use of cement.

The concrete industry has published a verified life cycle assessment for Finnish environmental concrete products¹⁴. The information has been collected per factory. For concrete stones and tiles, the life cycle assessment is based on average data weighted by the factories' production volumes.

¹⁴ Betoniteollisuus ry, 2021. Ympäristötuotteet, Betonikivet ja -laatat sekä muuri- ja reunakivet. Verifioitu elinkaariarvio (LCA). Laatijat: Salminen, E., Anttonen, R., ja Marttila, L., Vahanen Environment Oy. Julkaistu 30.4.2021. Todennuksen suorittajat: Petrucci, L. ja Kainila, V., Bionova Oy)

The variation from the average of the result data is less than 20%, mainly due to the differences in the concrete recipes of different manufacturers. In the cost calculation, the surface treatment and the color option increase the price of the product, but in the calculation of the carbon footprint, the significant effect is the weight of the product. In calculating the carbon footprint, three typical weight categories of concrete stone have been used, which represent thicknesses of 80 mm, 100 mm and 120 mm. The effect of surface treatment or the use of colors on the carbon footprint of concrete stones is very small, so color options have not been examined as a variable.

Table 5. Carbon footprint of concrete roofing tiles and paving blocks

Product	GWP fossil CO ₂ eq/kg	Waste during the installation %	Conversion factor kg/unit	Share of recycled materials %
Concrete roofing tile	0.137	5	4.2	0
Concrete paving block	0.135	5	-	2.1

8 Concrete beams

8.2 Use, market and products

Total production of prefabricated reinforced products were 2.7 million tonnes in 2017. The share of sold beams (by mass) is 5 %, which corresponding to 137,076 tonnes (Figure 3). The largest producers of reinforced concrete produce several concrete products, which is why more detailed data of use and market are presented in the general description of prefabricated concrete products (see chapter 1.1 manufacturing).

8.3 Carbon footprint

Prefabricated concrete, such as beams, are prepared by mixing main concrete raw materials cement, water, and aggregates, and additives at the plant for producing concrete products. In case of reinforced products, concrete mix is poured to the mold already including the reinforcement steel. Concrete process contains also fresh concrete compaction and curing until the lifting strength is achieved. The quantity and type of cementitious materials and reinforcement have a big influence on the GWP of precast elements.

The proposed value for prefabricated concrete products is based on the VTT calculations (2020) and values Betoniteollisuus published in 2021 (Salminen et al. 2021). In both cases the representativeness is good, because both are representing Finnish concrete production. However, the approach between these assessments was different. In VTT assessments, it based on the concrete recipes, cements and insulations produced in Finland, Finnish energy mix etc., but in Salminen et al. 2021 case assessment based on the industry one-year operation data (2019), collected from Finnish prefabricated concrete producers. In addition to the local production, small number of concrete products have been imported. In 2017, from all sold reinforced concrete elements (by mass), import was 1.1%. Even so, that the trade has been growing almost three times in 2019, it still holds just a small share from the total element sale in Finland. Due to the small share, imported products are not relevant in the database.

Table 6. Carbon footprint of concrete beams

Product	GWP fossil CO ₂ e/kg	Waste during the installation %	Conversion values	Share of recycled materials %
Precast concrete, beam 480 x 380 mm	0,178	3	433 kg/rm	5.8
Precast concrete, beam 580 x 380 mm	0.178	3	561 kg/rm	5.8
Precast concrete, beam 680 x 380 mm	0.177	3	648 kg/rm	5.8
Precast concrete, beam 780 x 480 mm	0.178	3	970 kg/rm	5.8
Precast concrete, prestressed beam	0.202	3	2546 kg/m ³	7

9 Concrete columns

9.2 Use, market and products

Total production of prefabricated reinforced products were 2.7 million tonnes in 2017.¹⁵ The share of sold columns (by mass) was 5 %, which corresponding to 137,076 tonnes (Figure 3). The largest producers of reinforced concrete produce several concrete products, which is why more detailed data of use and market are presented in the general description of prefabricated concrete products (see chapter 1.1 manufacturing).

9.3 Carbon footprint

Prefabricated concrete products, such as columns, are prepared by mixing main concrete raw materials cement, water aggregate and chemicals at a plant for producing concrete products. In case of reinforced products, concrete mix is poured to the mold which contain already reinforcement steel. Concrete process contains also fresh concrete compaction and curing till to the hardening. The most well-known prefabricated concrete products are hollow core slabs, frame, and facade elements, as well as piles and stair elements. In Concrete products carbon dioxide emissions come from the use of cement, particularly from calcium carbonate in limestone, which decomposes in high temperature environment and releases process-based carbon dioxide into the air. In case of Finnish cement industry this represents more than half of total cement CO₂ impacts of cement.

The proposed value for prefabricated concrete products is based on the Betoniteollisuus ry as an environmental product declaration (Betoniteollisuus Ry, 2021) In publication of Betoniteollisuus ry 2021 assessment is based on the industry one-year operation data (2019), collected from Finnish prefabricated concrete producers. In addition to the local production, small number of concrete products have been imported. In 2017, from all sold reinforced concrete elements (by mass), import was 1.1%. Even so, that the trade has been growing almost three times in 2019, it still holds just a small share from the total element sale in Finland. Due to the small share, imported products are not relevant in the database.

Table 7. Carbon footprint of concrete columns

Product	GWP fossil CO ₂ ekg/kg	Waste during the installation %	Conversion value kg/rm	Share of recycled materials %
Precast concrete, column 280 x 280 mm	0.186	3	194	10
Precast concrete, column 380 x 380 mm	0.186	3	359	10
Precast concrete, column 480 x 480 mm	0.186	3	572	10
Precast concrete, column 580 x 580 mm	0.186	3	816	10

¹⁵ Statistics Finland, Manufacturing, Industrial production by product names as variables PRODCOM, Year and Data, 2017

10 Concrete slabs

10.2 Use, market and products

Total production of prefabricated reinforced products were 2.7 million tonnes in 2017. The share of sold slabs (by mass) was 34 %, which corresponding to 932,121 tonnes (Figure 3). The largest producers of reinforced concrete produce several concrete products, which is why more detailed data of use and market are presented in the general description of prefabricated concrete products (see chapter 1.1 manufacturing).

10.3 Carbon footprint

Prefabricated concrete products, such as concrete slabs, are prepared by mixing main concrete raw materials cement, water aggregate and chemicals at a plant for producing concrete products. In case of reinforced products, concrete mix is poured to the mold which contain already reinforcement steel. Concrete process contains also fresh concrete compaction and curing till to the hardening. The most well-known prefabricated concrete products are hollow core slabs, frame, and facade elements, as well as piles and stair elements. In Concrete products carbon dioxide emissions come from the use of cement, particularly from calcium carbonate in limestone, which decomposes in high temperature environment and releases process-based carbon dioxide into the air. In case of Finnish cement industry this represents more than half of total cement CO₂ impacts of cement.

The proposed value for prefabricated concrete products is based on the VTT calculations (2020) and values Betoniteollisuus published in 2021 (Salminen et al. 2021). In both cases the representativeness is good because both are representing Finnish concrete production. However, the approach between these assessments was different. In VTT assessments, it based on the concrete recipes, cements and insulations produced in Finland, Finnish energy mix etc., but in Salminen et al. 2021 case assessment based on the industry one-year operation data (2019), collected from Finnish prefabricated concrete producers. In addition to the local production, small number of concrete products have been imported. In 2017, from all sold reinforced concrete elements (by mass), import was 1.1%. Even so, that the trade has been growing almost three times in 2019, it still holds just a small share from the total element sale in Finland. Due to the small share, imported products are not relevant in the database.

Table 8. Carbon footprint of concrete slabs

Product	GWP fossil CO ₂ ekg/kg	Waste during the installation %	Conversion value kg/m ²	Share of recycled materials %
Precast concrete, solid slab element 220 mm	0.159	3	533	6.5
Precast concrete, solid slab element 280 mm	0.159	3	674	6.5
Precast concrete, solid slab 260 mm	0.159	3	628	6.5
Precast concrete, hollow core slab 200 mm	0.152	3	247	2.70
Precast concrete, hollow core slab 265 mm	0.152	3	350	2.70

Product	GWP fossil CO ₂ ekg/kg	Waste during the installation %	Conversion value kg/m ²	Share of recycled materials %
Precast concrete, hollow core slab 320 mm	0.151	3	382	2.70
Precast concrete, hollow core slab 370 mm	0.151	3	481	2.70
Precast concrete, hollow core slab 400 mm	0.152	3	446	2.7
Precast concrete, hollow core slab 500 mm	0.152	3	579	2.7
Precast concrete, ribbed floor, TT-slab C50/60	0.189	3	360	5.8
Precast concrete, solid balcony slab 240 mm, C30/37	0.148	3	583	3

11 Concrete wall elements

11.2 Use, market and products

Total production of prefabricated reinforced products were 2.7 million tonnes in 2017. The share of sold wall elements (by mass) altogether was 45 %, which corresponding to 1,233,689 tonnes (Figure 3). The largest producers of reinforced concrete produce several concrete products, which is why more detailed data of use and market are presented in the general description of prefabricated concrete products (see chapter 1.1 manufacturing).

11.3 Carbon footprint

Prefabricated concrete products, such as concrete wall elements, are prepared by mixing main concrete raw materials cement, water aggregate and chemicals at a plant for producing concrete products. In case of reinforced products, concrete mix is poured to the mold which contain already reinforcement steel. Concrete process contains also fresh concrete compaction and curing till to the hardening. The most well-known prefabricated concrete products are hollow core slabs, frame, and facade elements, as well as piles and stair elements. In Concrete products carbon dioxide emissions come from the use of cement, particularly from calcium carbonate in limestone, which decomposes in high temperature environment and releases process-based carbon dioxide into the air. In case of Finnish cement industry this represents more than half of total cement CO₂ impacts of cement.

The proposed value for prefabricated concrete products is based on the values Betoniteollisuus published in 2021 (Salminen et al. 2021). Salminen et al. 2021 assessment is based on the industry one-year operation data (2019), collected from Finnish prefabricated concrete producers. In addition to the local production, small number of concrete products have been imported. In 2017, from all sold reinforced concrete elements (by mass), import was 1.1%. Even so, that the trade has been growing almost three times in 2019, it still holds just a small share from the total element sale in Finland. Due to the small share, imported products are not relevant in the database.

Table 9. Carbon footprint of concrete walls

Product	GWP fossil CO ₂ ekg/kg	Waste during the installation %	Conversion value kg/m ²	Share of recycled materials %
Precast concrete, inner wall 150. insulation 140 mm	0.179	3	368	5
Precast concrete, inner wall 180. insulation 140 mm	0.169	3	446	4.8
Precast concrete, inner wall 200. insulation 140 mm	0.164	3	500	4.8
Precast concrete, partition wall 200 mm	0.151	3	493	4.5
Precast concrete, partition wall element 150 mm	0.150	3	347	4.5
Precast concrete, partition wall element 250 mm	0.151	3	611	4.5
Precast concrete, sandwich 80+220+80 mm	0.228	3	396	3.8

Product	GWP fossil CO2ekg/kg	Waste during the installation %	Conversion value kg/m2	Share of recycled materials %
Precast concrete, sandwich, inner wall 150+220+80 mm	0.208	3	554	4

End of life treatment of concrete wall elements depends on the materials used in the product. Insulated concrete products cannot be recycled as a secondary raw material as efficiently as uninsulated products. Therefore, the end-of-life scenario is different for some products. For uninsulated concrete wall elements, it can be assumed that about 80 % is recycled as secondary raw materials meaning that 20 % of the product is directed to final disposal.

APPENDIX 1 Reference values for ready mix concrete

Subject matter	Information
Source	Verified LCA of ready-mix concrete, published by Betoniteollisuus ry (30.4.2021). Available: https://betoni.com/wp-content/uploads/2021/05/Elinkaariarvio_valmisbetonit-1.pdf
Description	Product: Normally hardened structural concrete Composition: Cement 13.7 %, aggregate (sand, gravel and crushed stone) 78.2% and water 7.8% Other information: Represents Finnish ready-mixed concrete products used in the manufacture of various types of concrete structures (weighted average result of 19 manufacturers according to production in 2019). The results have been converted to kg / kg using product group specific densities.
GWP fossil (A1 – A3), kg/kg	0.113
Carbon handprint, kg/kg	-0.0021
Content of recycled materials, %	2.1 %
Content of renewable materials %	-

Subject matter	Information
Source	Verified LCA of ready-mix concrete, published by Betoniteollisuus ry (30.4.2021). Available: https://betoni.com/wp-content/uploads/2021/05/Elinkaariarvio_valmisbetonit-1.pdf
Description	Product: Weatherproof structural concrete Composition: Cement 15.5 %, aggregate (sand, gravel and crushed stone) 76.9 % and water 7.5 % Other information: Represents Finnish ready-mixed concrete products used in the manufacture of various types of concrete structures (weighted average result of 19 manufacturers according to production in 2019). The results have been converted to kg / kg using product group specific densities.
GWP fossil (A1 – A3), kg/kg	0.126
Carbon handprint, kg/kg	-0.0021
Content of recycled materials, %	2.3 %
Content of renewable materials %	-

Subject matter	Information
Source	Verified LCA of ready-mix concrete, published by Betoniteollisuus ry (30.4.2021). Available: https://betoni.com/wp-content/uploads/2021/05/Elinkaariarvio_valmisbetonit-1.pdf
Description	Product: Normally hardened structural concrete Composition: Cement 12.5 %, aggregate (sand, gravel and crushed stone) 79.4 % and water 7.8 %

Subject matter	Information
	Other information: Represents Finnish ready-mixed concrete products used in the manufacture of various types of concrete structures (weighted average result of 19 manufacturers according to production in 2019). The results have been converted to kg / kg using product group specific densities.
GWP fossil (A1 – A3), kg/kg	0.103
Carbon handprint, kg/kg	-0.0021
Content of recycled materials, %	2.0 %
Content of renewable materials %	-

Subject matter	Information
Source	Verified LCA of ready-mix concrete, published by Betoniteollisuus ry (30.4.2021). Available: https://betoni.com/wp-content/uploads/2021/05/Elinkaariarvio_valmisbetonit-1.pdf
Description	Product: Low carbon structural concrete Composition: Cement 7.4 %, aggregate (sand, gravel and crushed stone) 79.5 % and water 5.4 % Other information: Represents Finnish ready-mixed concrete products used in the manufacture of various types of concrete structures (weighted average result of 19 manufacturers according to production in 2019). The results have been converted to kg / kg using product group specific densities.
GWP fossil (A1 – A3), kg/kg	0.176 (0.074 kg/m3)
Carbon handprint, kg/kg	-0.0021
Content of recycled materials, %	1.4 %
Content of renewable materials %	-

Subject matter	Information
Source	EPD International S-P-01018, ACCIONA Construction Available: Data (environdec.com)
Description	Product: Ready mix concrete FCK 55 MPa for Follo Lien. Project 'Railway Tunnel' (Norway). Composition: Cement 13-16%, silica 0.4-0.7%, sand 17-20%, Crushed stone 11-14%, Coarse aggregate (various fractions) 11-14% and 32-35%, Water 3-6%, air entrainer 0.1 to 0.4%, liquefier 0.1 to 0.4%, PP fibers 0.02 to 0.05% and steel fibers 0.6 to 0.9%. Manufacturing: Åsland, Norway. Other information: The results have been converted to kg / kg using product group specific densities.
GWP fossil (A1 – A3), kg/kg	0.149
Carbon handprint, kg/kg	-
Content of recycled materials, %	3.3 %

Subject matter	Information
Content of renewable materials %	-

Subject matter	Information
Source	EPD Norge, NEPD-2365-1103-EN, BM Vallá Available: NEPD-2365-1103 Ready-mix-concrete-C30-C37-outdoor-.pdf (epd-norge.no)
Description	Product: Ready mix concrete C30 / C37 (use outdoors) (Iceland). Composition: Cement I 15.23%, aggregate 77.43%, water 7.18% and chemicals 0.16%. Manufacturing: Reykjavik, Iceland (BM Vallá). Other information: The results have been converted to kg / kg using product group specific densities.
GWP fossil (A1 – A3), kg/kg	0.132
Carbon handprint, kg/kg	-
Content of recycled materials, %	2.1 %
Content of renewable materials %	-

Subject matter	Information
Source	Previous calculations, which are made by VTT for Finnish Transport Infrastructure Agency and cities (Excel/VTT, Rapal)
Description	Products: Ready-mix concrete 50/60 (K60) Ready-mix concrete 20/25 (K25) Ready-mix concrete 25/30 (K30) Ready-mix concrete 28/35 (K35) Ready-mix concrete 30/38 (K38) Ready-mix concrete 32/40 (K40) Ready-mix concrete 35/45 (K45) Ready-mix concrete 57/70 (K70) Ready-mix concrete K-10 (Ground moisture) Ready-mix concrete K-60 Other information: There are a total of 10 ready-mixed concrete inputs in the fairway agency's and the city's carbon footprint database. Results are presented in kg CO2e / m3 only, as average densities were not known.
GWP fossil (A1 – A3), kg CO2e/m3	345 (Ready-mix concrete 50/60) 199 (Ready-mix concrete 20/25) 259 (Ready-mix concrete 25/30) 287 (Ready-mix concrete 28/35) 295 (Ready-mix concrete 30/38) 315 (Ready-mix concrete 32/40) 335 (Ready-mix concrete 35/45) 345 (Ready-mix concrete 57/70) 194 (Ready-mix concrete K-10) 345 (Ready-mix concrete K-60)
Carbon handprint, kg/kg	-

Subject matter	Information
Content of recycled materials, %	-
Content of renewable materials %	-

APPENDIX 2 Reference values for concrete well

Subject matter	Information
Source	Verified LCA of ready-mix concrete, published by Betoniteollisuus ry (30.4.2021). Available: Elinkaariarvio_betoniputki-ja-kaivotuotteet.pdf
Description	Product: Concrete well element 800 Cr Composition: Cement 12.5%, aggregate (gravel, crushed stone, sand) 79%, fly ash 2%, water 5.1%, steel 1.2%, rubber seal 0.2% Other information: Value represents concrete well element production in Finland
GWP fossil (A1 – A3), kg/kg	0.147
Carbon handprint, kg/kg	0.0021
Content of recycled materials, %	3.7 %
Content of renewable materials, %	-

Subject matter	Information
Source	Verified LCA of ready-mix concrete, published by Betoniteollisuus ry (30.4.2021). Available: Elinkaariarvio_betoniputki-ja-kaivotuotteet.pdf
Description	Product: Concrete well element 2000 Cr Composition: Cement 13.5 %, aggregate (gravel, crushed stone, sand) 77.8 %, fly ash 2 %, water 5.2 %, steel 1.5 %, rubber seal 0.1 % Other information: Value represents concrete well element production in Finland
GWP fossil (A1 – A3), kg/kg	0.153
Carbon handprint, kg/kg	0.0021
Content of recycled materials, %	3.7 %
Content of renewable materials, %	-

Subject matter	Information
Source	Previous calculations, which are made for Finnish Transport Infrastructure Agency and cities (Excel)
Description	Products: Well element (Bet) 1000 Well element (Bet) 1200 Well element (Bet) 600 Well element (Bet) 800 Other information: Values are presented per unit. Functional unit is pcs.
GWP fossil (A1 – A3), kg/kg	736.1 (Well element (Bet) 1000) 946.5 (Well element (Bet) 1200) 310 (Well element (Bet) 600) 735 (Well element (Bet) 800)
Carbon handprint, kg/kg	-
Content of recycled materials, %	-
Content of renewable materials, %	-

Subject matter	Information

Subject matter	Information
Source	Previous calculations, which are made for Finnish Transport Infrastructure Agency and cities (Excel)
Description	Products: Well ring EK 600 600x250 Well ring EK 600 600x1000 Well ring EK 800 Well elevation ring 600x100 Well bottom ring EK 600 600x750 Other information: Values are presented per unit. Functional unit is pcs.
GWP fossil (A1 – A3), kg/unit	10 (Well ring EK 600 600x250) 41 (Well ring EK 600 600x1000) 54.9 (Well ring EK 800) 4.1 (Well elevation ring 600x100) 37 (Well bottom ring EK 600 600x750)
Carbon handprint, kg/kg	-
Content of recycled materials, %	-
Content of renewable materials, %	-

APPENDIX 3 Reference values for concrete pipes

Subject matter	Information
Source	Ökobaumat Available: Process Data set: Concrete pipe, reinforced; reinforced (en) (oekobaumat.de)
Description	Product: Concrete pipe, reinforced (German) Other information: LCA for concrete pipes covers the production of concrete (C20 / 25) with reinforcement. Electricity has been used in the production. Reinforcement accounts for 0.6%. The estimate represents a country-specific situation in Germany.
GWP fossil (A1 – A3), kg/kg	0.142
Carbon handprint, kg/kg	-0.002021
Content of recycled materials, %	2,035
Content of renewable materials, %	0

Subject matter	Information
Source	Ökobaumat Available: Process Data set: Concrete pipe, non-reinforced; not reinforced (en) (oekobaumat.de)
Description	Product: Concrete pipe, non-reinforced (German) Other information: LCA for concrete pipes covers the production of concrete (C20 / 25) without reinforcement. Electricity has been used in the production. Reinforcement accounts for 0.6%. The estimate represents a country-specific situation in Germany.
GWP fossil (A1 – A3), kg/kg	0.132
Carbon handprint, kg/kg	-0.002054
Content of recycled materials, %	0
Content of renewable materials, %	0

Subject matter	Information
Source	ICE
Description	Product: Concrete pipe DN600. not reinforced Composition: Cement 17% (24% replaced by by-products). The estimate is based on ICE Cement, Mortar, Concrete calculations (UK, Bath University) and the result is presented in the ICE V3.0 database (10th of November 2019).
GWP fossil (A1 – A3), kg/kg	0.146
Carbon handprint, kg/kg	-
Content of recycled materials, %	-
Content of renewable materials, %	-

Subject matter	Information
Source	EPD Norge NEPD-2513-1253 Available: NEPD-2513-1253 ig-falsror-DN-600-x-2250--uarmert---iht-Basal-Standard.pdf (epd-norge.no)
Description	Product: Concrete pipe DN 600 x 2250 (unreinforced), with recessed rubber seal Application: for wastewater transport (surface water and sewage) Pipe size: inner diameter 600 mm and length 2.25 m, which mass is 520.3 kg. Composition: cement 13.5%, aggregate 79.4%, filler 2.5%, water 4.2%, chemicals <0.5% The result is calculated per 1 m of pipe and converted to kilograms with the mass of 2.25 meters pipe. The estimate represents pipe production in Norway (Loe Rørprodukter AS).
GWP fossil (A1 – A3), kg/kg	0.205
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.076
Content of renewable materials %	0

Subject matter	Information
Source	EPD Norge NEPD-3079-1742 Available: NEPD-3079-1742 Basal-falsror-IG-600x2000-uarmert--iht-Basal-standard.pdf (epd-norge.no)
Description	Product: Concrete pipe DN 600 x 2000 (unreinforced) Application: Piping systems are used in sewer and stormwater systems Composition: cement 13.99%, aggregate 80.23%, water 5.47%, chemicals <0.5% Pipe size: length of the pipe is 2 meters and the mass is 516 kg. The result is calculated per 1 m of pipe and converted to kilograms with the mass of 2 meters pipe. The estimate represents pipe production in Norway (Førde Sementvare AS).
GWP fossil (A1 – A3), kg/kg	0.196
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.059
Content of renewable materials %	0

Subject matter	Information
Source	Verified LCA of ready-mix concrete, published by Betoniteollisuus ry (30.4.2021). Available: Linkaariarvio betoniputki-ja-kaivotuotteet.pdf
Description	Products: Composition (% by weight) (average): Reinforced concrete pipe 600 (Dr) Reinforced concrete pipe 1200 (Dr) Reinforced concrete pipe 1200 (Br) Unreinforced concrete pipe 400 (B)

Subject matter	Information
	Composition: Cement 13.1%, aggregate (sand, gravel and crushed stone) 76.8%, water 5.1%, fly ash 2.1%, reinforcement 2.8% and rubber seal 0.08% (600 Dr) Cement 15.3%, aggregate (sand, gravel and crushed stone) 77.3%, water 4.8%, reinforcement 2.6% and rubber seal 0.09% (1200 Dr) Cement 14.3%, aggregate (sand, gravel and crushed stone) 76.8%, water 5.2%, fly ash 1.6%, reinforcement 1.9% and rubber seal 0.09% (1200 Br) Cement 14.5%, aggregate (sand, gravel and crushed stone) 80.6%, water 4.9%, and rubber seal 0.1% (400 B) Other information: The estimate represents the average production of concrete pipes in Finland.
GWP fossil (A1 – A3), kg/kg	0.153 (600 Dr) 0.165 (1200 Dr) 0.164 (1200 Br) 0.148 (400 B)
Carbon handprint, kg/kg	0.00204 (600 Dr) 0.00205 (1200 Dr) 0.00206 (1200 Br) 0.00212 (400 Br)
Content of recycled materials, %	3,7 % (600 Dr) 3,8 % (1200 Dr) 2,29 % (1200 Br) 0.897 % (400 B))
Content of renewable materials-%	

APPENDIX 4 Reference values for concrete piles

Subject matter	Information
Source	EPD International S-P-01729 Available: S-P-01729EPD(English version).pdf(environdedec.com)
Description	Product: Concrete piles from Peab Grundläggning AB (Sweden). Production: The factories in Tollarp, Sjövik and Västerås produce foundation piles in different dimensions. Product specification: steel reinforcement, concrete and concrete components, rock shoes/pile joints, spirals and spacers. Pile dimensions: SP1type = 235 x 235 mm ² PP-25, SP2 and SP3 types = 275 x 275 mm ² . Declared unit: 1 rm (converted here to 1kg, according to the pile weight) (table below). Market: Nordic countries
GWP fossil (A1 – A3), kg/kg	0.306 (PP25 type) 0.236 (SP1 type) 0.227 (SP2 type) 0.250 (SP3 type)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.110 (PP25 type) 0.056 (SP1 type) 0.049 (SP2 type) 0.085 (SP3 type)
Content of renewable materials-%	-

Subject matter	Information
Source	EPD International S-P01763 Available: https://api.environdedec.com/api/v1/EPDLibrary/Files/152f5fd3-aefe-48dd-baac-fd5c7b03c0da/Data
Description	Product: Concrete piles from Hercules Grundläggning AB (Sweden). Result is given for different dimensions and factories- Ucklum (U) and Västerås (V) factories. Product specification: Portland Cement clinker 13.6 – 14.4%, Limestone 2 – 3.4%, granite 71%, Steel parts (reinforcement and fitting elements) 6%, additives <0.1%, other 0-0.8% Market: Nordic countries

Subject matter	Information
GWP fossil (A1 – A3), kg/kg	0.193 (Ucklum, 235x235, 12m, 128 kg) 0.180 (Västeås, 235x235, 12m, 133 kg) 0.188 (Ucklum, 235x235, 14 m, 128 kg) 0.186 (Västeås, 235x235, 14 m, 133 kg) 0.190 (Ucklum, 270x270. 12m, 178 kg) 0.180 (Västeås, 270x270. 12m, 182 kg) 0.200 (Ucklum, 270x270. 14m, 185 kg) 0.189 (Västeås, 270x270. 14 m, 189 kg) 0.191 (Ucklum, 350x350. 14 m, 303 kg)
Carbon handprint, kg/kg	-
Content of recycled materials, kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation
Description	Product: Concrete pile Size: 300 x300 mm (RTB 300) were assessed (without steel parts) Product specification: cement 14%, natural aggregate 37%, Gravel 37%, Water 7%, Plasticizer 0.4%, reinforcement 4.3%
GWP fossil (A1 – A3), kg/kg	0.150
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg	-
Content of renewable materials, %	-

APPENDIX 5 Reference values for concrete blocks

Subject matter	Information
Source	EPD Norge NEPD-1462-486- EN Available: Isolerblock Exakt EPD sv.pdf (finja.se)
Description	Product: Lightweight Concrete Block with EPS-insulation from Finja Betong AB (Sweden) Product specification: Cement 16%, Glue 1%, Leca aggregate 43%, Gravel 26%, Water 14%, Packing Product specification: Cement 16%, Glue 1%, Leca aggregate 43%, Gravel 26%, Water 14%, Packing <1% and EPS insulation. Block for walls and pillars are in accordance with SS-EN 771-3 standard. Size: Available in widths 250 mm (only for Sweden), 290. 350 and 400 mm. Place of production: Sweden Market: Nordic countries
GWP fossil (A1 – A3), kg/kg	0.245 (concrete block part) + 3.21 kg/kg (EPS part) according to the insulation thickness needed (size affects on environmental impacts)
Carbon handprint, kg/kg	-
Content of recycled materials, kg	0.0198
Content of renewable materials %	

Subject matter	Information
Source	VTT calculation
Description	Product: Lightweight Concrete Block with EPS-insulation (Finland) Product specification: Cement 14%, Fly ash 2%, Natural aggregate 33%, lightweight aggregate 39%, Water 8%, Packing 2% and Insulation 2%. Product specification: Cement 15%, Fly ash 2%, natural aggregate 34%, Lightweight aggregate 40%, Water 8%, Packing 2% Density: for Lightweight Concrete Block with EPS-insulation density is 686 kg/m ³ and without insulation is 700 kg/m ³ .
GWP fossil (A1 – A3), kg/kg	0.366 (with insulation) 0.294 (Without insulation)
Carbon handprint, kg/kg	
Content of recycled materials, kg/kg	0.02 (fly ash)
Content of renewable materials %	0.02 (packing)

Subject matter	Information
Source	EPD Norge NEPD-1461- 486-EN (Product1) Available: Murblock Bas EPD sv.pdf (finja.se) NEPD-1463- 486-EN (Product2) Available: https://www.finja.no/storage/ma/79a94e4220ee43a295bea33fc1d13170/8e6198e730864ee58794b3c869547c95/pdf/7334F1CF210B1A6C8791EA2CE132CDB87CC1DFB/Murblokk%20Fordel EPD no.pdf
Description	Product1: Lightweight Concrete Block, Blokk from Finja Betong AB Sweden Product 2: Lightweight Concrete Block, Murblokk fördel from Finja Betong AB (Sweden) Product 1 specification: Cement 9%, Fly ash 6%, Leca aggregate 50%, Gravel 23%, Water 12%, Packing <1%.

Subject matter	Information
	Product 2 specification: Cement 16%, Fly ash 1%, Leca aggregate 39%, Gravel 32%, Water 12%, Packing <1 % Block for walls and pillars are in accordance with SS-EN 771-3 standard (Product 1 and 2). Product 2: is a cavity wall block which has weigh up to 20% less than blocks without cavities (Product1). Place of production: Sweden Market: Nordic countries
GWP fossil (A1 – A3), kg/kg	0.158 (Product 1) 0.185 (Product 2)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.0112 (Product 1) 0.0198 (Product 2)
Content of renewable materials-%	-

Subject matter	Information
Source	EPD Norge NEPD-2023- 890-NO Available: https://www.epd-norge.no/betongvarer/forskalingsblokk-multi-19-15-12-article2400-316.html
Description	Product: Concrete, cavity wall block (Murblokk Multi 19 - Multi 15 - Multi 12) from Multiblokk (Norway) Blocks are suitable for wall construction (garages, ring walls, fireplaces or free-standing wall in the garden). The concrete blocks are fireproof and have soundproofing properties. The blocks can be coated. Assessment is made for Multi 19 block per m2 stacked wall. A1 = 23.6 kg/m2 (97%) A2 = 0.276 kg/m2 (1.1%) A3 = 0.359 kg/m2 (1.5%) Total 24.235 kg/m2 This result is converted also to the according to the sizes: • Multi 12 block • Multi 15 block Sizes: • Multi 19 block 387 x 187 x 187 mm3 . Weight 18 kg/block and usage 12.5 block/m2 • Multi 15: LXBXH = 387 x 150 x 140 mm3 . Weight 12.9 kg/block and usage 17.5 block/m2 • Multi 12: 387 x 120 x 187 mm3. Weight 13.6 kg/block and usage 12.5 block/m2 . Product specification: Cement 14.07%, aggregate 80.31%, water 5.63% Masonry blocks are manufactured in accordance with NS -EN 771 - 3 - 2006. Place of production and Market: Norway
GWP fossil (A1 – A3), kg/kg	0.108 (Multi block 19) 0.075 (Multi block 15) 0.121 (Multi block 12)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.034
Content of renewable materials-%	-

Subject matter	Information
Source	VTT calculation
Description	Product: Concrete Block, dense aggregate (Finland) Estimation based on the concrete block mix assessment. Product specification: Cement 10%, Natural aggregate 81%, Water 7%, Packing 2% Density: 2203 kg/m ³ Carbon handprint: concrete waste replacing concrete aggregates
GWP fossil (A1 – A3), kg/kg	0.083
Carbon handprint, kg/kg	- 0.0016
Content of recycled materials, kg/kg	-
Content of renewable materials %	0.02 (packing)

Subject matter	Information
Source	Ökobau dat Available: Process Data set: Concrete masonry brick; 2000 kg/m³ (en) (oekobaudat.de)
Description	Product: Concrete masonry brick; 2000 kg/m ³) Product specification: The data set represents the country specific situation in Germany, focusing on the main technologies, the regionspecific characteristics and / or import statistics. The production of concrete bricks covers the production of concrete C20/25 as well as the required electricity demand to produce bricks.
GWP fossil (A1 – A3), kg/kg	0.121
Carbon handprint, kg/kg	-0.0021
Content of recycled materials, kg/kg	-
Content of renewable materials %	-

Subject matter	Information
Source	ICE (UK)
Description	Product: Concrete block (UK) Product specification: Estimated from the concrete block mix proportions according to the Compressive strength class, plus an allowance for concrete block curing, plant operations and transport of materials to factory gate
GWP fossil (A1 – A3), kg/kg	0.063 (8 MPa) 0.078 (10 MPa) 0.088 (12 MPa) 0.107 (13 MPa)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials %	-

APPENDIX 6 Reference values for concrete roofing tiles and paving blocks

Subject matter	Information
Source	EPD IBU EPD-ETE-20150305- IAC1-DE
Description	Product: Roofing tiles from Eternit Österreich GmbH (Austria) Product specification: Cement 18.5%, quartz sand 72%, pigment 0.4%, paint 0.9% and water 8.1% Size:330 x 424 mm2 Place of production: Austria Market: Europa
GWP fossil (A1 – A3), kg/kg	0.254
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	Ökobau dat (Dachsteine)
Description	Product: concrete roofing tiles from Nelskamp GmbH (Germany) Product specification: For the production of the concrete roof stones, the raw materials sand, cement, staining, coating paint and water are required. The raw materials are added to an intensive mixer one after the other and then fed to the forming machine. The profiled fresh concrete leaves the forming machine as an endless strand and is cut to roof stone length with a knife controlled by compressed air. For surface finishing, the dachstein is coated with a waterbased plastic dispersion. The roof tiles undergo two drying processes during production. The finished products are packaged and are then ready for transport. At the end of life 0.0676 kg/kg (A1-3) are directed to recycling.
GWP fossil (A1 – A3), kg/kg	0.209
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation
Description	Product: Concrete roofing tile (Finland) Based on the concrete mix design. Product specification: Cement 13%, Slag 6%, Natural aggregate 75%, Water 3%, Pigment and paint 1%, Packing 2%. Carbon handprint: Concrete waste is recycled and replaces gravel and sand
GWP fossil (A1 – A3), kg/kg	0.137
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.06 (slag)
Content of renewable materials, %	0.02 (packing)

Subject matter	Information
Source	Ökobau dat Available: Process Data set: Concrete masonry brick; 2000 kg/m3 (en) (oekobaudat.de)
Description	Product: Concrete masonry brick; 2000 kg/m3) (Germany) Result was presented per 1 m3 of block, in this it is concerted to kg bases according to the given density 2000 kg/m3. Product specification: The data set represents the country specific situation in Germany, focusing on the main technologies, the region-specific characteristics and / or import statistics The production of concrete bricks covers the production of concrete C20/25 as well as the required electricity demand to produce bricks.
GWP fossil (A1 – A3), kg/kg	0.121 (242.4 kg/m3)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	EPD Norge NEPD-1900- 812-NO Available: NEPD-1900-812 Markbetong.pdf (epd-norge.no)
Description	Product: Concrete paving tiles (Belegningsstein og mur) from Asak Miljøstein AS (Norway) Product specification: Cement 13.34%, aggregate 83.04%, Filler 0.25%, Water 3.1%, Chemicals 0.27%. This concrete could be used for paving stones, curbs, slabs, block products and masonry, produced from dry concrete. Size: Typical paving stone has 5 and 6 cm thickness and for industrial covers from 7 to 10 cm. Production of Paving Stone and slabs satisfies the requirements of the current Norwegian Standard NS -EN 1338 and 1339. Market: The market area is essentially Norway. Some exports to Sweden
GWP fossil (A1 – A3), kg/kg	0.096
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.0214
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation
Description	Product: General Concrete paving block (Finland) Product specification: Cement 14%, Natural aggregate 29%, Gravel 52%, Water 3%, Packing 2%. Sizes for example: 225 x 112.5 x 60 mm; 280 x 140 x 80 mm, 300 x 300 x 50 mm, 490 x 490 x 50 mm
GWP fossil (A1 – A3), kg/kg	0.110
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials, %	0.02 (packing)

Subject matter	Information
Source	Verified life cycle assessment of the concrete industry 'Environmental concrete products' (Published on 30 April 2021) Available: Linkaariarvio_ymparistobetonituotteet.pdf
Description	Product: Concrete stones and tiles. Composition: Cement 12.6%, aggregate (sand, gravel and gravel) 82.2%, water 3.9%. Use: Paving stones. Place of production: Finland. Market: Finland.
GWP fossil (A1 – A3), kg/kg	0.135
Carbon handprint, kg/kg	-0.00212
Content of recycled materials, kg/kg	0,5

Subject matter	Information
Content of renewable materials-%	

Subject matter	Information
Source	EPD International AB S-P-02095 Available: Data (environdec.com)
Description	Product: Concrete product for walls and walkways from S:t Eriks AB (Sweden) Product specification: Cement <15%, gravel, crushed <30%, gravel, natural <60%, plasticizer <0.1%, cast oil <0.001% and Water <5% (calculated by amounts left after hardening, to sum up to the total weight). This concrete could be used for paving stones, curbs, slabs, block products and masonry, produced from dry concrete. Size:. Typical paving stone has 5 and 6 cm thickness and for industrial covers from 7 to 10 cm. Production of Paving Stone and slabs satisfies the requirements of the current Norwegian Standard NS -EN 1338 and 1339. Place of production: Sweden (four production sites) Market: Nordic countries
GWP fossil (A1 – A3), kg/kg	0.0968
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.002
Content of renewable materials-%	

APPENDIX 7 Reference values for concrete beams

Subject matter	Information
Source	Beams and Columns Data from 'Low carbon construction' preliminary database
Description	Products: Average beams and columns.
GWP fossil (A1 – A3), kg/kg	0.196 (Concrete beam) 0.265 (Pre-stressed concrete beam)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes
Description	Product: Prestressed beam Product specification (weight %): Cement 16%, Natural aggregate 24%, Gravel 47%, Water 7%, Reinforcement steel 5.8%, plasticizer 0.2%. Density 2546 kg/m ³ Secondary material: recycled steel content (1.2 kg/kg steel used -> 0.058*1.2= 0.07 kg/kg prestressed beam)
GWP fossil (A1 – A3), kg/kg	0.202
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.07
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes
Description	Product: Concrete Beam Product specification (weight %): Cement 14%, Natural aggregate 39%, Gravel 33%, Water 7%, Reinforcement steel 5.9%, plasticizer 0.13%. Density 2523 kg/m ³ Carbon handprint: Concrete waste is recycled and replaces gravel and sand Secondary material: recycled steel content
GWP fossil (A1 – A3), kg/kg	0.155
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.04
Content of renewable materials, %	-

APPENDIX 8 Reference values for concrete columns

Subject matter	Information
Source	EPD Norge NEPD-2321-1065-EN Concrete column Available: https://www.epd-norge.no/getfile.php/1314463-1597923642/EPDer/Byggevarer/Betongva rer/NEPD-2321-1065_Columns.pdf
Description	Product: Precast concrete column from Skonto Prefab SIA (Latvia) Result is given for the column with screw type fastening (column shoes or with the socket type foundations. because of that total steel consumption (reinforcement + steel fastening parts) is high (36%). Sizes: Columns are structural building elements delivered in various sizes, shapes and lengths. Minimum crosssection size is 200 x 200 mm ² . Place of production: Latvia Market: Norway, Sweden GWP for electricity consumption in Latvia is high (0.604 kg/kWh).
GWP fossil (A1 – A3), kg/kg	0.613
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	<0.1%?
Content of renewable materials, %	0.0000236

Subject matter	Information
Source	Beams and Columns Data from 'Low carbon construction' preliminary database
Description	Products: Average beams.
GWP fossil (A1 – A3), kg/kg	0.196 (Concrete column)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	ICE (version 2011) Concrete Nominal proportion method (volume)
Description	Product: Slab, column, load bearing structure. Results in database are given only for concrete (reinforcement and prefabrication should be added separately according to proposed values). Product specification for traditional concrete: Cement / sand/ aggregate is 1:1.5:3 (without reinforcement) Product specification for high strength concrete: Cement / sand/ aggregate is 1:1:2 (without reinforcement) Prefab. and reinforcement: impact for prefabrication is 0.029 kg/kg and for reinforcement rebar 100 kg/m ³ is 0.077 (but for 150 kg steel factor is 1.5).
GWP fossil (A1 – A3), kg/kg	0.261(traditional concrete) 0.351 (high strength concrete)
Carbon handprint, kg/kg	-

Content of recycled materials, kg/kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	EPD Norge NEPD-1892-815-NO Available: https://www.epd-norge.no/getfile.php/1311365-1571141205/EPDer/Byggevarer/Betongvarer/NEPD-1892-8155919-Soyleelement.pdf
Description	Product: Concrete column from Overhalla Betongbygg AS (Norway) Columns are used for load bearing functions but also as an architectural elements. Fastened with steel bolts or by gluing. Columns can be used over several floors without a joint but are usually produced for one floor. Can be produced with consoles. Standard fire class for the pillars are REI 90. but simple adjustments to the reinforcement guide may improve fire class. Concrete strength: B45 M40 Market: Norway
GWP fossil (A1 – A3), kg/kg	0.185
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.159
Content of renewable materials, %	-

Subject matter	Information
Source	EPD Norge NEPD-2244-1025-NO Available: https://www.epd-norge.no/getfile.php/1313688-1591085489/EPDer/Byggevarer/Betongvarer/NEPD-2244-1025Vagg--Pelare--Balk--Balkong--E-.pdf
Description	Product: Concrete column, beam, wall, balcony slab from Kynningsrud Prefab AB (Norway) (without reinforcement) Concrete strength: C45/55 Use conditions: XC 4 -XS3 -XD3 -XF4 Concrete with the CO ₂ e 336 kg/m ³ is used for the production of assessed products Market: Sweden and Norway
GWP fossil (A1 – A3), kg/kg	0.143
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.030
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes
Description	Product: Concrete Column Product specification (weight %): Cement 14%, Natural aggregate 39%, Gravel 33%, Water 7%, Reinforcement steel 5.9%, plasticizer 0.12%. Density 2523 kg/m ³ Carbon handprint: Concrete waste is recycled and replaces gravel and sand Secondary material: recycled steel content

Subject matter	Information
GWP fossil (A1 – A3), kg/kg	0.155
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.04
Content of renewable materials-%	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes
Description	Product: Concrete high strength column Product specification (weight %): Cement 18%, Silica 1.1%, Natural aggregate 34%, Gravel 34%, Water 7%, Reinforcement steel 5.8%, plasticizer 0.7%. Density 2543 kg/m3 Secondary material: contains silica and recycled steel content. Carbon handprint: Concrete waste is recycled and replaces gravel and sand
GWP fossil (A1 – A3), kg/kg	0.155
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.04
Content of renewable materials-%	-

APPENDIX 9 Reference values for concrete slabs

Subject matter	Information
Source	VTT, Concrete slabs Data from 'Low carbon construction' preliminary database
Description	-
GWP fossil (A1 – A3), kg/kg	0.178 (hollow core slab) 0.222 (TT-slab)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	RTS EPD (28-19) Hollow core slab Available: rts-epd_116-21_consolisparma_lowcarbonslab.pdf
Description	Product: Hollow core slab from Consolis Parma Oy (Finland). Product specification: Aggregate 83% (50% sand+33% gravel), Cement 14%, Fly ash 2% Pre-stressed steel 1%. Result is calculated for 1m ² hollow core slab (P37) with thickness 370 mm, width 1200 mm and length 5,928 m. Result is converted to kg/kg using weight factor 485 kg/m ² . Other conversion factors: see table below. slab density: 1310 kg/m ³
GWP fossil (A1 – A3), kg/kg	0.133
Carbon handprint, kg/kg	-0.00114
Content of recycled materials, kg/kg	0.0152
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes.
Description	Product: Hollow core slab 370mm (485 kg/m ²) Product specification (weight %): Cement 11%, Fly ash 2%, Natural aggregate 43%, Gravel 36%, Water 5%, Reinforcement steel 1.5%, plasticizer 0.2% Concrete density: 2499 kg/m ³ Weight of hollow core slabs: 320 mm – 380 kg/m ² • 200 mm – 245 kg/m² • 265 mm – 360 kg/m² • 370 mm – 485 kg/m² • 400 mm – 435 kg/m² • 500 mm – 560 kg/m² Carbon handprint: Concrete waste is recycled and replaces gravel and sand: Secondary material: fly ash and reinforcement steel (1.2 kg/used steel kg).
GWP fossil (A1 – A3), kg/kg	0.116
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.038

Subject matter	Information
Content of renewable materials-%	

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes.
Description	Product: Solid slab, balcony slab, 240 mm, C30/37 Product specification (weight %): Cement 15%, Natural aggregate 25%, Gravel 50%, Water 6%, Reinforcement steel 4.1%, plasticizer 0.2% Density: 2430 kg/m ³ Carbon handprint: Concrete waste is recycled and replaces gravel and sand: Secondary material: reinforcement steel 0.73 kg /steel kg.
GWP fossil (A1 – A3), kg/kg	0.148
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.030
Content of renewable materials-%	

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes.
Description	Product: Ribbed floor element, TT-slab, C50/60 For example, when TT-slab height is 700mm and rib length 180mm, then slab weight is 360 kg/m ² . Product specification (weight %): Cement 16%, Natural aggregate 47%, Gravel 25%, Water 7%, Reinforcement steel 4.8%, plasticizer 0.2% Density: 2504 kg/m ³ Carbon handprint: Concrete waste is recycled and replaces gravel and sand: Secondary material: reinforcement steel 1.2 kg/used steel kg
GWP fossil (A1 – A3), kg/kg	0.189
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.058
Content of renewable materials-%	

Subject matter	Information
Source	EPD Norge NEPD-2401-1195-SE Hollow core slab Available: Hollow core slab https://www.epd-norge.no/getfile.php/1315220-1602662404/EPDer/Byggevarer/Betongvarer/NEPD2401-1195_Prefabricerade-haldackselement--HD-F-pdf
Description	Product: Hollow core slab (HD/F 27) from Starka Betongelement AB (Sweden) Concrete strength: C40/50 - C50/60 Use for the X0 and XC1 conditions. Market: Sweden Results for the other Hollow core slab dimensions, see table below.
GWP fossil (A1 – A3), kg/kg	0.162
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.0398

Subject matter	Information
Content of renewable materials-%	

Subject matter	Information
Source	EPD Norge NEPD-2319-1065-EN Hollow Core Slabs Available: NEPD-2319-1065_Hollow-Core-Slabs.pdf (epd-norge.no)
Description	Product: Hollow core slab from Skonto Prefab SIA (Latvia) Pre-stressed hollow core slabs (HCS) are used for floors in multi-story buildings. Manufactured with extrusion method and heated in order to speed up hardening process. Product specification: Reinforcement: steel with diameter 9.3 and 12.5 mm. Four different thicknesses, ranging from 200 mm up to 400 mm. Standard extruded width is 1200 mm. HCS span length is up to 16 meters Compressive strength is C35/45 - C50/60. Length is 1000 - 12000 mm, Width is 400 - 1200 mm and Height is 200-400 mm. Market: Norway, Sweden
GWP fossil (A1 – A3), kg/kg	0.295
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.00222
Content of renewable materials-%	

Subject matter	Information
Source	Ökobaudat Available: Process Data set: Precast concrete slab, ceiling, 20cm; 504 kg/m2 (en) (oekobaudat.de)
Description	Product: Precast concrete slab, ceiling, 20cm; 504 kg/m2 (Germany) Assessment represents the country specific situation in Germany, focusing on the main technologies, the regionspecific characteristics and / or import statistics. Product specification: concrete strength class is C30/37, reinforcement steel content is 120 kg/m3 , average density of concrete is 2400 kg/m3 .
GWP fossil (A1 – A3), kg/kg	0.1676
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.0603
Content of renewable materials-%	0.1676

Subject matter	Information
Source	EPD Norge Hollow Core Slabs NEPD-1571-597-NO Håldäck Klass A Available: NEPD-1571-597_H--ld--ck-Klass-A.pdf (epd-norge.no) NEPD-2240-1010-NO Håldäck Klass B Available: NEPD-2240-1010_Heldekk-Klass-B---HD--(1).pdf (epd-norge.no) NEPD-2241-1010-NO Håldäck Klass Bransjereferanse (HDS) Available: NEPD-2241-1010_Heldekk-Klass-Bransjereferanse---HDS--(1).pdf (epd-norge.no)
Description	Product: Hollow core slab from Kynningsrud Prefab AB (Sweden) Class A: Concrete strength class C35/45 (content of cement is reduced with the use of fly ash. Recipe meets the requirement for low-carbon concrete

Subject matter	Information
	class A, in relation to table 1 in NB publication No. 37 "low carbon concrete" (June 2015). (CO₂e for concrete mix is 209.5 kg CO₂e/ m³). Class B (HD): Concrete strength class is C45/55 (CO₂e for concrete mix is 259.2 kg/m³). Class HDS: Concrete strength class is C45/55 (CO₂e for concrete mix is 300 kg/m³). Class A kg CO₂e/m² HD200 = 22,00 HD265 = 31.60 HD320 = 34,66 HD400 = 42,34 HD500 = 51.94
GWP fossil (A1 – A3), kg/kg	0.109 (Class A, without reinforcement) 0.114 (Class B, without reinforcement) 0.128 (Class HDS, without reinforcement)
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.0524 (Class A) 0.00089 (Class B) 0.0010 (Class HDS)
Content of renewable materials-%	-

Subject matter	Information
Source	EPD Norge NEPD-2271-1039- SE Available: NEPD-2271-1039_Balkongplatta.pdf (epd-norge.no)
Description	Product: Balcony slab from Thomas Betong AB (Sweden) Concrete: strength class is C32/40L, thickness is 190 mm. Market: Sweden, Norway
GWP fossil (A1 – A3), kg/kg	0.177
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.0412
Content of renewable materials-%	-

APPENDIX 10 Reference values for concrete walls

Subject matter	Information
Source	VTT, Concrete walls Data from 'Low carbon construction' preliminary database
Description	-
GWP fossil (A1 – A3), kg/kg	0.190 (Solid concrete wall (80mm + steel)) 0.191 (Solid concrete wall (100mm+steel)) 0.193 (Solid concrete wall (150mm+steel)) 0.211 (Solid concrete wall (150 mm + stainless steel)) 0.202 (Solid concrete wall (150 mm + stainless steel))
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	-
Content of renewable materials, %	-

Subject matter	Information
Source	RTS EPD (77-20) Precast concrete wall Available: rts-epd_77-20_tmb-element_precastconcretewall_signed.pdf
Description	Product: Precast solid wall element from OU TMB Element. (Estonia) Strength class of at least C30/37. Used mainly at the construction of dwelling houses but also non-residential buildings. Product specification: Limestone 39.2%, Sand 29,2%, Granite 5%, Cement 13.8%, Water 8.1% and Steel 4.7% Calculated according to the EN 15804 + A2 (PEF) Conversion factor to m2 is 435.4 kg/m2 (for average thickness 192 mm).
GWP fossil (A1 – A3), kg/kg	0.205
Carbon handprint, kg/kg	-0.034
Content of recycled materials, kg/kg	0.0397
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes.
Description	Product: Sandwich, inner wall 80 mm, insulation 220 mm, outer wall 80 mm (381 kg/m2) Product specification (weight %): Cement 14%, Natural aggregate 27%, Gravel 48%, Water 8%, Reinforcement steel 1.5%, Insulation 0.8%, plasticizer 0.2% Secondary material content: reinforced steel recycled content 0.73 kg/kg
GWP fossil (A1 – A3), kg/kg	0.167
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.011
Content of renewable materials, %	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes.
Description	Product: Sandwich, inner wall 80 mm, insulation 220 mm, outer wall 150 mm (545 kg/m ²) Product specification (weight %): Cement 14%, Natural aggregate 27%, Gravel 48%, Water 8%, Reinforcement steel 1.1 %, Insulation 0.6%, plasticizer 0.2% Carbon handprint: Concrete waste is recycled and replaces gravel and sand Secondary material content: reinforced steel recycled content 0.73 kg/kg:
GWP fossil (A1 – A3), kg/kg	0.153
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.008
Content of renewable materials-%	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes.
Description	Product: Inner wall element, 150 mm with insulation 140mm (357 kg/m ²) Product specification (weight %): Cement 13%, Natural aggregate 27%, Gravel 49%, Water 8%, Reinforcement steel 1%, Insulation 0.6%, plasticizer 0.2% Carbon handprint: Concrete waste is recycled and replaces gravel and sand Secondary material content: reinforced steel recycled content 0.73 kg/kg
GWP fossil (A1 – A3), kg/kg	0.140
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.0073
Content of renewable materials-%	-

Subject matter	Information
Source	VTT calculation 2020. based on proposed concrete recipes.
Description	Product: Partition wall element 200mm (476 kg/m ²) Product specification (weight %): Cement 13%, Natural aggregate 27%, Gravel 49%, Water 8%, Reinforcement steel 1.6%, plasticizer 0.2% Carbon handprint: Concrete waste is recycled and replaces gravel and sand:
GWP fossil (A1 – A3), kg/kg	0.135
Carbon handprint, kg/kg	-0.002
Content of recycled materials, kg/kg	0.016
Content of renewable materials-%	-

Subject matter	Information
Source	EPD Norge NEPD-2273-1039-SE Concrete wall Available: NEPD-2273-1039 Skolvagg.pdf (epd-norge.no)
Description	Product: Solid Concrete wall element from Thomas Betong AB (Sweden) Concrete strength C30/37 Market: Sweden and Norway
GWP fossil (A1 – A3), kg/kg	0.176

Subject matter	Information
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.0461
Content of renewable materials-%	-

Subject matter	Information
Source	Ökobau dat Available: Process Data set: Precast concrete slab, wall, 12cm; 291,3 kg/m2 (en) (oekobaudat.de)
Description	Product: Precast concrete slab, wall, 12cm; 291.3 kg/m2 (Germany) The data set represents the country specific situation in Germany, focusing on the main technologies, the region-specific characteristics and / or import statistics. Product specification: Concrete strength class is C20/25, average density of concrete is 2400 kg/m3, density of steel is 7860 kg/m3 and minimum reinforcement content is 0.5 Vol.-%.
GWP fossil (A1 – A3), kg/kg	0.134
Carbon handprint, kg/kg	-0.00202
Content of recycled materials, kg/kg	0.0204
Content of renewable materials-%	-

Subject matter	Information
Source	Ökobau dat Available: Process Data set: Precast concrete slab, wall, 40cm; 971 kg/m2 (en) (oekobaudat.de)
Description	Product: Precast concrete slab, wall, 40cm; 971 kg/m2 (Germany) The data set represents the country specific situation in Germany, focusing on the main technologies, the regionspecific characteristics and / or import statistics. Product specification: Concrete strength class is C20/25, an average density of concrete is 2400 kg/m3 and density of steel is 7860 kg/m3 and minimum reinforcement content is 0.5 Vol.-%.
GWP fossil (A1 – A3), kg/kg	0.133
Carbon handprint, kg/kg	-
Content of recycled materials, kg/kg	0.0204
Content of renewable materials-%	-