CONCRETE

APPLICATIONS

- load-bearing structures, wall, floor, pavement. Mostly with steel reinforcement
- concrete hollow blocks primarily for basement and plinth walls, but also for construction of facade walls, partitions, internal load-bearing walls
- concrete floor block for slabs with small elements and heavy structure

PRODUCTION PROCESS

Raw material production begins at the concrete mixing plant using computer-controlled machines, where the product-specific raw material with the appropriate consistency is made from cement, aggregates, additives and water. Additives are added to control specific properties of fresh or hardened concrete, e.g. setting and hardening, workability, porosity.

Ready-mix (monolit) concrete is mixed in a plant and transported to the construction site. It can be placed by pump or bucket, consolidated by vibration and finished. Curing of concrete protects the hardening concrete from drying and controls the temperature. Prefabricated concrete elements, e.g. concrete blocks are produced in a plant. Concrete is poured into mould, air-dried and packed. Lightweight concrete blocks are produced with lightweight aggregates, e.g. expanded clay or polystyrene.

MAIN ENVIRONMENTAL IMPACTS

Main inputs are cement, gravel and water. Even if the cumulative energy demand of concrete is relatively low, the large amounts used in the construction industry lead to significant environmental impacts. The production of cement clinker is the largest contributor to this demand and emissions. Cement production has a significant impact on the environment. A major contributor to global GHG emissions is ordinary Portland cement, which accounts for about 8% of global CO2 emissions (Chatham House 2018). If cement production were a country, it would be the world's third-largest emitter after China and the USA (Olivier et al. 2016). There are two sources: the energy demand of the factory, which includes furnace heating, grinding, transportation, and the calcination of limestone (loss of carbon dioxide), which in simple terms means that during the burning of limestone ($CaCO_3$), its carbonate (CO_3) content becomes CO_2. The first source can be reduced through various technical solutions, such as reducing the share of fossil fuels. However, the latter cannot be significantly reduced.

During concrete production dust emissions are relevant, but they are controlled. Waste water and some solid waste also arise. Maintenance demand of concrete structures is low. At the end of life, concrete can be recycled or landfilled.

MATERIALS

monolit concrete

prefabricated concrete floor block

Source: https://www.leier.hu/

prefabricated concrete hollow block

TECHNICAL DATA

Thermal conductivity (W/mK)	2,00
Density (kg/m^3)	2000-2600

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REBAR (Reinforcing Steel in bars)

APPLICATIONS

used as a tension device in reinforced concrete and reinforced masonry structures to strengthen and aid the concrete under tension.

PRODUCTION PROCESS

The base material of rebar products is iron. Alloying elements are added in the form of ferroalloys or metal.
Iron and steel manufacture are high energy demanding processes.
The manufacture of rebars is accomplished by melting the steel in an electric arc furnace to produce billets, which are then subjected to the hot rolling process. The rib profile is rolled onto the bar in the last stand of the rolling process. At the end of the rolling operation, the rebar is cut to the required length, generally bundled and labeled.
The chemical reaction of smelting iron combines the carbon with the oxygen in ferric iron to produce CO2.

MAIN ENVIRONMENTAL IMPACTS

Combustion emissions from ore refinement, and blast furnace operations include greenhouse-and acid rain forming gases. Volume of dust are produced by ore refinement and blast furnace operations to produce raw iron. There is also a danger of water pollution from improper disposal of processing waters from mining and milling operations. The main environmental advantage of steel is that it can be recycled into high quality products. The estimated recovery rate is 60-70%.

MATERIALS

Source: http://www.betonacel.eu/

TECHNICAL DATA	
Thermal conductivity (W/mK)	50
Density (kg/ m^3)	7800

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CEMENT

APPLICATIONS

hydraulic binder, for concrete and mortar

PRODUCTION PROCESS

Isolation and preparation of raw materials. Clinker is produced by calcination of limestone, marl and clay in a rotary kiln at a temperature of maximum 1450 °C (pyroprocessing). The energy demand is reduced by burning of waste. Other components are prepared and finally the components are ground with calcium sulphate to regulate setting.

Portland cement is the most common type.

MAIN ENVIRONMENTAL IMPACTS

Main inputs are the cement clinker, gypsum and milling substances (these are usually wastes, such as dust from cement rotary kiln, fly ash, silica dust or limestone). The cumulative energy demand is dominated by clinker production. Most important emissions are dust, nitrogen oxides, sulphur dioxide, carbon monoxide and carbon dioxide. The main dust emissions are due to the mining of limestone and to a lesser extent from clinker burning.

The slag additive, which is also a waste material, can also be radioactive. Cement production has a significant impact on the environment. During the combustion of clinker, a number of chemical processes take place that release various substances. The composition and dust content of the flue gas are strictly controlled by a continuous emission measuring device, and compliance with the limit values is provided by filters and various flue gas treatment procedures. Cement production is responsible for 5% of the world's CO2 emissions. There are two sources of CO2 emissions from the cement industry. The first is the energy demand of the factory, which includes furnace heating, grinding, transportation, and so on. The second is the calcination of limestone (loss of carbon dioxide), which in simple terms means that during the burning of limestone (CaCO3), its carbonate (CO3) content becomes CO2. The first source accounts for about 1/3 of CO2 emissions from cement production and can be reduced through various technical solutions, such as reducing the share of fossil fuels. However, the latter, in the opinion of the cement industry, cannot be significantly reduced either. Depending on the technology, the production of 1 ton of cement emits 400-650 kg of CO2.

MATERIALS

Source: www.oeconomus.hu

TECHNICAL DATA	
Thermal conductivity (W/mK)	1,00
Density (kg/ m^3)	1800

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GRAVEL AND SAND

APPLICATIONS

aggregate for concrete, mortar, raw material for sand lime bricks, landfill, foundation for highways, railways.

PRODUCTION PROCESS

Sand and gravel are products of rock erosion and occur in nature as unconsolidated or poorly consolidated materials. Silica sand is a special sand with a high percentage of quartz. Gravel and sand are mined/digged in open pits, cleaned and classified. Gravel can also be crushed to reduce oversize material.

MAIN ENVIRONMENTAL IMPACTS

Main inputs of the production process are the water use for cleaning and the electricity demand. The production is a wet process, hence the dust emissions are negligible. The waste water is not polluted (contains only sand and gravel). The relevant impacts are the emissions to air from the thermal energy generation, the waste heat and solid wastes. The cumulative energy demand of crushed gravel is about 2.5 times higher than for the round gravel. Mines should be recultivated after use.

MATERIALS

Source: www. portfolio.hu

TECHNICAL DATA	
Thermal conductivity (W/mK)	2,00
Density (kg/ m^3)	1700-2000

Co-funded by the Erasmus+ Programme of the European Union

LIME

APPLICATIONS

raw material for mortar production, sand lime bricks and porous concrete production

PRODUCTION PROCESS

Quicklime is produced by the thermal decomposition of limestone. The complete calcination requires temperatures above 900 °C. Hydrated lime is a dry calcium hydroxide powder, which is produced by reacting quicklime with water under atmospheric pressure at about 100 °C.

MAIN ENVIRONMENTAL IMPACTS

Global warming potential of lime is related to CO_2 emissions,partly caused by the calcination of limestone and partly by the fuel combustion. Dust emissions and emissions from thermal energy generation are relevant.

MATERIALS

Source: www.kreativlakas.com

TECHNICAL DATA

Thermal conductivity (W/mK)	0,80
Density (kg/ m^3)	1600

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GYPSUM

APPLICATIONS

in extremely diverse way, including as a binder

PRODUCTION PROCESS

Gypsum is a dihydrate of calcium sulfate ($CaSO_4 \cdot 2H_2O$), a mineral belonging to the group of aqueous sulphate minerals Natural gypsum is produced in mines. Large masses of gypsum are formed naturally, mainly in the salt layers (evaporites) of the evaporating seawater. In contrast to mineral gypsum, REAgips is obtained by the desulphurisation process of smoke emitted by power plants. REAgips is formed in large quantities during the reduction of the sulfur dioxide content of flue gases using wet limestone technology, which is done by using a so called desulphurisation equipment on the industrial scale.

MAIN ENVIRONMENTAL IMPACTS

Gypsum is a sustainably extracted natural resource from mines but can also be recycled and is a by-product from power stations.
Gypsum is an inherently sustainable material as it can be completely recycled an infinite number of times. Removing water from gypsum rocks through dehydration at around 160 °C produces a plaster powder used to make both plasters and plasterboards and is scientifically known as calcium sulphate. This process is totally reversible: adding water reproduces gypsum.

MATERIALS

Source: www.kreativhobbi-dekor.hu

TECHNICAL DATA	
Thermal conductivity (W/mK)	0,18-0,56
Density (kg/ m^3)	600-1500

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