

# Concrete sustainability

CONFERENCE

“Innovations for competitiveness.  
The basic industries – a drive for growth.”

January 31, 2018, Sofia, Bulgaria

# Sustainability

- **Sustain**– to keep a process going, to support; the goal of **sustainability** is to sustain life on the planet for the foreseeable future;
- Three components of sustainability – *environment, economy* and *society*;
- Broad *social commitment* and strong *governmental policies* are the only way to progress towards sustainable development.
- At the moment environment is probably the most important component : sustainable is synonymous to *environmentally sound*.

# Environmental impact

- The critical elements of environmental impact are the utilization of *resources*, the embodied *energy* and the generation of *wastes*.
- Each construction material is manufactured from some combination of raw materials with the expenditure of some energy and with associated waste .



- During its life, the structures use considerable energy. Each material affects the energy usage.

# Sustainability of concrete

- \*Concrete – from lat. *concretus* – hardened, solidified (vb. *concerno* – mix together)
- ✓ **Aggregates** are mined *locally* or can be by-product of other processes (slag, recycled concrete) with modest amount of energy and waste involved;
- ✓ **Cement**, due to its manufacturing which involves heating of a mixture of limestone and marl in a kiln to a high temperature (1500 – 1600C) has rather high embodied energy;
- ✓ **Water** is an environmental issue only in locations with shortage;
- ✓ **Chemical admixtures** – increase compressive strength of concrete – less concrete is needed for the same job.
- ✓ **The process** of moving materials, mixing them and hauling the concrete requires modest amount of energy and produces small amount of waste; It is produced with specific design for specific use – *nothing more, nothing less* than what is necessary;

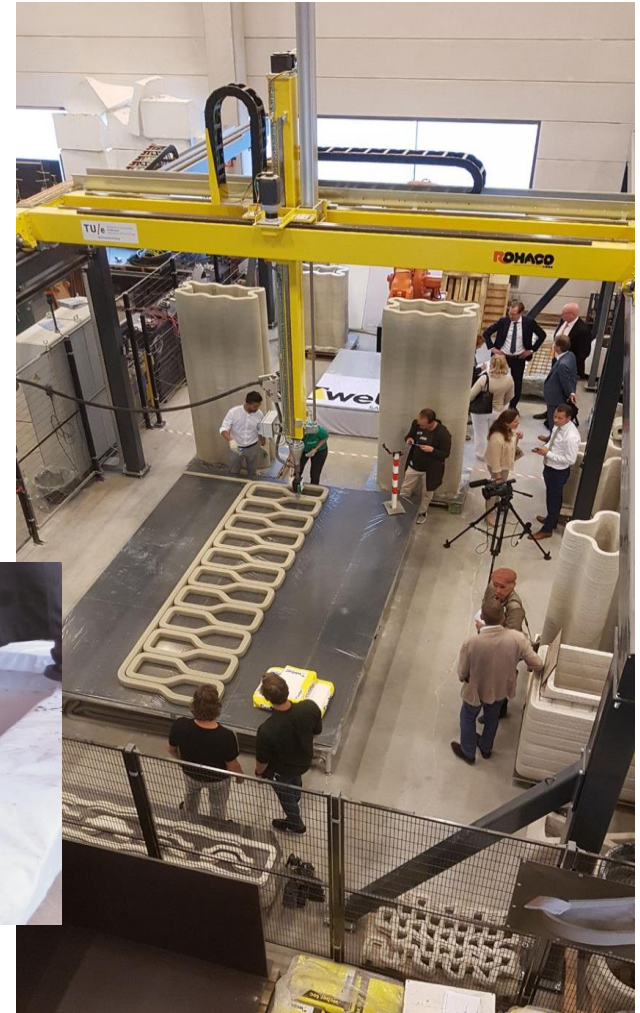
# Global issues – local approach

- ✓ Much environmental degradation occurs when struggling to obtain essential resources; Often, especially in developing economies, *economic struggle* takes precedence over *environmental sustainability*.
- ✓ Construction is the largest single economic activity and the greatest industrial employer in Europe with more than 20 million jobs.
- ✓ For each 1€, spent in construction output a total of 3€ are generated in total economic activity (GDP increase). For each job, created in construction, two additional jobs are created elsewhere.
- ✓ The value of concrete production in Europe for 2016 is € 74 billion. Concrete industry in Europe employs some 550 000 people.
- ✓ Concrete is a local business, employing local people. The materials for concrete production are sourced locally. Concrete is usually transported up to 20 – 30 km from the production site.

# Why concrete?

- ▶ **Concrete** is highly *flexible, durable, affordable* and *energy-efficient* material that can effectively address a wide variety of needs: above-ground and under-ground infrastructure, energy-efficient buildings, water infrastructure
- ▶ Concrete can be cast in virtually any *shape* and *form*, allows variety of applications and design freedom.
- ▶ Concrete is *made to last*. It can withstand shocks, absorb sound and regulate temperature.
- ▶ The *durability* and *resilience* of concrete makes it ideal for construction demanding high *safety levels*, like power plants, nuclear power plant, hydroelectric dams etc.

# Concrete and innovation



# Durability of concrete

- ✓ The concrete used in the Channel Tunnel is contractually guaranteed to last for 120 years.



- ✓ The 42 meters dome of the Roman Pantheon is built 129 A.D.





# Concrete roads and pavements

- Concrete's *durability, low maintenance* and *lower whole-life costs* and impacts make it perfectly suitable for road pavement.
- Every km of concrete road can *reduce the CO2 emissions* of vehicles by 1000 – 4000 tones over a 30 year period.



- Court avenue, Bellefontaine, Ohio, US;  
Commissioned 1893



# Concrete and clean water

- ▶ Approximately 1 billion people in the world have no access to clean water.
- ▶ 2,5billion people lack sanitation facilities.
- ▶ Access to clean water is a fundamental human right.



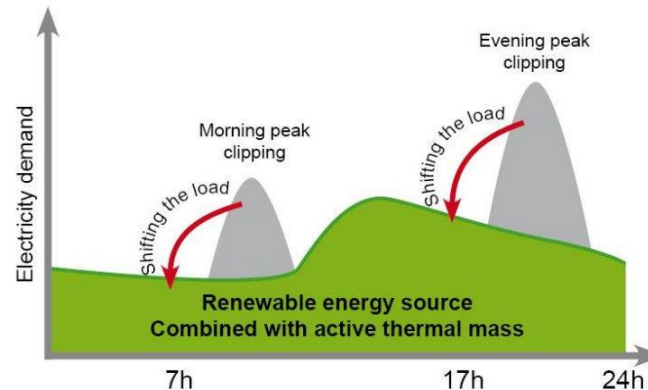
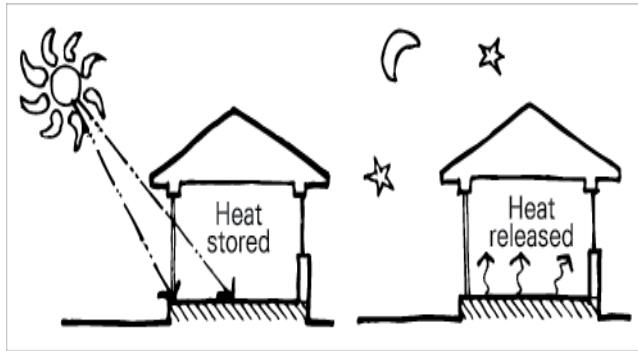
- ▶ The Proserpina dam, Merida, Spain;  
Commissioned late 1 century A.D.



# Concrete and housing

- ▶ According to European Commission 75% of the EU population lives in towns and cities.
- ▶ Concrete sector can help tackle the issue with the increasing **urbanization**, providing *comfortable, affordable and energy efficient* housing.
- ▶ **Durability** of concrete means maintenance and renovation are also reduced.
- ▶ Concrete has unsurpassed and proven **fire resistance** properties. It does not burn, does not melt and retains its structural stability at high temperature;
- ▶ The concrete in a standard family house **costs** less than 7 000 €.
- ▶ Concrete's ability to absorb temperature variations (called **thermal mass**) contributes to comfort and lower costs.
- ▶ The energy consumption of conventional buildings is typically 150–200 kWh/m<sup>2</sup>/year – Existing concrete technology enables buildings that use 50 kWh/m<sup>2</sup>/year of less.

# Thermal mass – renewable energy challenges



✓Building in Europe are currently responsible for 40% of the total energy consumption;

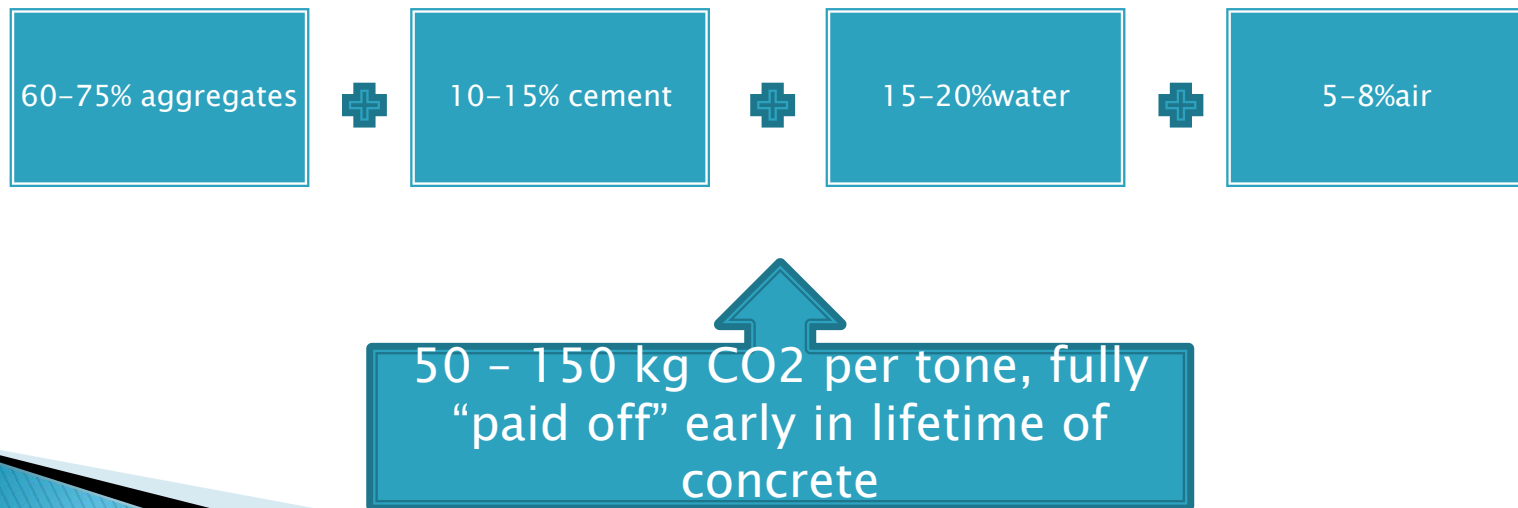
✓Matching generation of energy by renewables and demand – lack of flexibility in electricity grid;

✓Heavyweight buildings can provide this flexibility by allowing consumer demand to be shifted in time by using structural thermal energy storage without additional investment in storage devices;

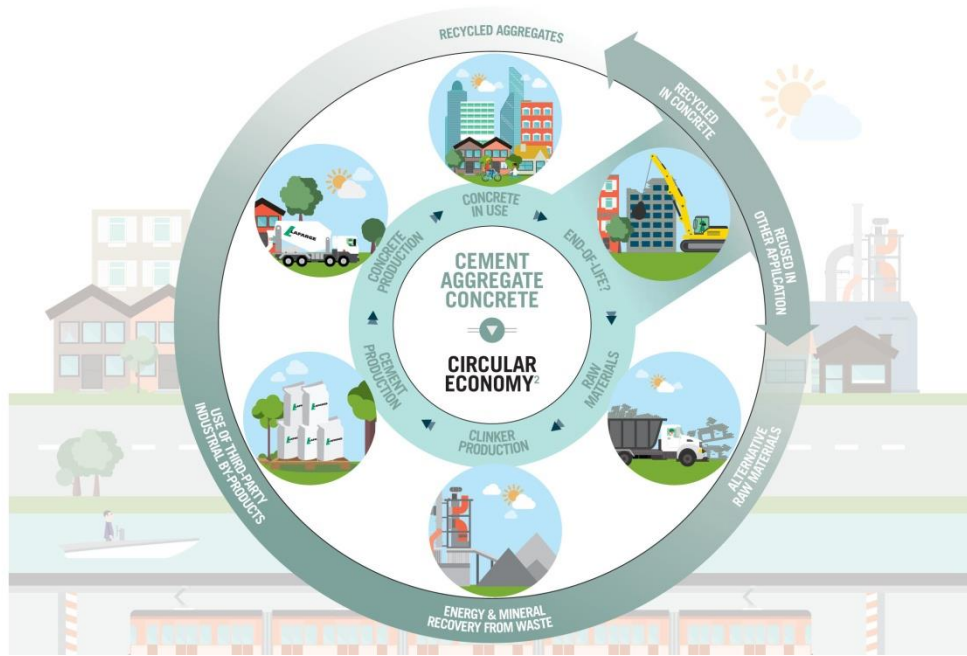
✓The balancing of the green infrastructure –peak reduction up to 50% , operational savings up to 40%, CO2 emissions reduction up to 25%

# Concrete is 100 % recyclable

- ✓ Concrete can be *100% recycled* after demolition.
- ✓ Recycled aggregates are used as road base and can be also used as aggregates for concrete.
- ✓ During and after the lifetime of concrete structures, concrete absorbs CO<sub>2</sub> from air – *Carbonation*. Concrete as CO<sub>2</sub> sink.



# Concrete and circular economy



- ✓Raw materials are abundant;
- ✓Cement production focuses on *alternative fuels* and materials from *wastes* to reduce environmental footprint.
- ✓Concrete production uses *by-products* from other industries, such as slag and fly ash.
- ✓At the end of its life, concrete can be fully *recycled*, either into new concrete or in other applications such as road base. Ergo – concrete production is an example for "*circular economy*".

# Concrete is beautiful



# Concrete is green

Concrete offers the highest level of "*whole-life performance*" compared to the other construction materials. Concrete industry continually striving to provide a net positive environmental impact throughout the lifetime of its products.

