Research needs

in the aggregate and concrete industry

- Technological foresight
  - what lies in the future?
- Challenges for research
  - how do we meet the needs?

Technological foresight - the state of our industries

- Mature industries
  - mineral resources have been exploited during most of our known civilisation
  - concrete has been developed and produced since Roman time

→ The industries have come into a stage of slow, gradual improvement, and not one where major leaps in development can be expected.

Technological foresight - the impact of our industries

- Industries of major influence on
  - economy and employment
  - infrastructure
  - environment

→ We must continuously consider new options and challenges, and any major research results will have direct societal impact.

Technological foresight - the need and the challenge

- The urgent need:
  - to comply with increasing requirements from society to sustainability and environmental profile
    - waste depositing, energy use, emissions
    - management of natural resources
- The real challenge:
  - to do this while meeting the normal economic and industrial requirements
- → Creating industrial plants and products that are at the same time
  - → environmentally friendly, and
  - → economically profitable

Technological foresight - what lies in the future?

- Standards will have environmental priorities
  - energy consumption
  - sustainable use of resources
  - emissions and waste
  - health issues
- On-coming shortage of sand/gravel resources
  - calls for substitutes
- More countries will apply taxation of exploitation
- But: Increased understanding of the need for these materials

- Even more strict regulations
  - land-use and area preservation
  - waste deposits
  - protection of neighborhood
  - health effects of materials
  - use of substitutes to save resources and utilise waste
  - transport of materials
- Permissions for new quarries will be linked to end-use plans and integrated plants
- Sub-surface quarrying in densely populated areas

Challenges for research - how do we meet the needs?

Four urgent areas for research:

1. Concept development
2. Production technology
3. Basic materials knowledge
4. Application technology for materials

Challenges for research – concept development

- The ”integrated plant” concept
  - Resource management → quarrying an integral part of industry development and land-use planning → aggregate industry stronger into the value chain
  - Integrated production units combining quarrying, end-use materials production, land-fill and restoration
- Sub-surface quarry solutions
  - Economically feasible sub-surface solutions in urban areas combining quarrying and industrial/storage activities
- Energy efficient buildings
  - Energy saving based on the properties of ”heavy materials”, and natural climatisation
- Architectural and structural concepts
  - that utilizes SCC and alternative reinforcement (FRC, NM)

Challenges for research – production technology

- Reliable production systems for making high quality crushed aggregates with less energy consumption
- Alternative techniques for refining and utilising marginal resources for concrete aggregate
- Technology for obtaining and refining industry filler from sludge
- Production systems to reduce errors and complaints from concrete production and execution
- Zero-waste technology in both aggregate and concrete production
- Eliminate substances harmful to health and safety, e.g. reduce carbon hydroxide in concrete wastewater and crushed concrete

Challenges for research – basic materials knowledge

- Whether and how alkali reactive (or other?) fillers can replace/supplement conventional pozzolanas in concrete
- Utilising aggregate/mineral properties to control concrete properties (durability, strength, E-modulus, density etc.)
- Alternative and environmentally ”neutral” concrete constituents as part substitutes for cement
- New guidelines to implement alternative cementitious constituents in concrete
- Investigation on CO_2 uptake (carbonation of concrete surfaces)

Challenges for research – application technology

- Utilising thermal capacity of concrete to reduce the need for cooling/heating in buildings, thus reducing the life-time energy consumption
- Establish the relation between rock/mineral properties, production /processing and final performance of aggregates
- Mix design models to tailor-make concrete for specific use, based on various aggregate properties
- Technical basis for utilizing SCC and FRC to improve working environment
- Develop SCC with moderate binder contents

Challenges for research – Will this be a 2020 scenario?

- Environmental priorities in product standards – ”no-waste” required
- Sand/gravel is only marginally available for aggregate production
- Concrete can entirely be made based on manufactured aggregates, and tailor-made according to need, utilising aggregate properties
- Aggregate production takes place in sub-surface, integrated industrial plants, mostly locally, also incorporating use of recycled and secondary materials (accounting for some 20%)
- Aggregate production is performed in low-energy, 2-step plants
- Concrete is for >50% based on alternative binders
- Most concrete is SCC and FR, and necessary reinforcement is non-metallic
- Concrete is still the predominant building material, and its inherent properties are used for energy saving and economic construction
- Concrete is 100% recyclable

If so –

how do we get there?

how do we handle it?