CASE STUDY
WIDE-SCALE USAGE OF FLY ASH IN IMPROVEMENT OF DETERIORATED ROADS

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PRESENTATION OUTLINE

• Backgrounds and facts
• Design principles
• Description of the used construction methods
• Project outcome and conclusions
• Current state and future
BACKGROUNDS AND FACTS

• UUMA research programme 2006-2010
  -> UUMA = “reused or recycled materials”
  -> target: utilisation of all types of reused and recycled materials
  -> regional demonstration projects
• Fly ash construction seen as too complex and risky
  -> need to prove efficiency
• There are a lot of road sections, which are very difficult and expensive to fix using conventional methods.
  -> need to be innovative to overcome these problems
BACKGROUNDS AND FACTS

- Two deteriorated road sections totalling 9 km of road
- Located in city of Jämsä, Central Finland
- More than 10 000 tonnes of fly ash used (60 000 t/y produced in local plants)
- All fly ash handled at one site
DESIGN PRINCIPLES

Knowledge on basic conditions → Methods to assess the problems → Damage assessment & laboratory testing → Allocation of the used methods → Road structure design
DESIGN PRINCIPLES – KNOWLEDGE ON BASIC PROBLEMS

• Road No 16563
  • 8 million axes in 20 years
  • heavy-weight traffic
  • 70 km/h speed limit
  • Problems with load bearing capacity

• Road No 16573
  • 0.4 million axes in 20 years
  • built in steep slope
  • Severe frost heave problems
DESIGN PRINCIPLES

Knowledge on basic conditions → Methods to assess the problems → Damage assessment & laboratory testing → Allocation of the used methods → Road structure design
METHODS TO ASSESS THE PROBLEMS

• Road No 16563
  • Stabilisation of the road base with fly ash and cement binder to improve load bearing capacity

• Road No 16573
  • Thermal insulation layer with fly ash below road base to reduce frost heave
  • Stabilisation of the road base with fly ash and cement binder to improve load bearing capacity
**PRINCIPLES BEHIND THE METHODS**

- Thermal insulation properties of fly ash is based on lower thermal conductivity and higher water content than typical earth materials
  - -> thinner structures
  - -> less materials

- Stabilisation increases the e-modulus and fly ash works as a constituent for cement
  - -> thinner AC surface
  - -> higher load bearing capacity
DESIGN PRINCIPLES

Knowledge on basic conditions → Methods to assess the problems → Damage assessment & laboratory testing → Allocation of the used methods → Road structure design
MATERIAL TESTS

- Basic index properties
- Compaction parameters
- Unconfined compressive strength
- Freeze-thaw durability
- Frost susceptibility
- Leaching parameters
DESIGN PRINCIPLES

Knowledge on basic conditions

Methods to assess the problems

Damage assessment & laboratory testing

Road structure design

Allocation of the used methods
CONSTRUCTION - PREPARATION OF THE MATERIALS

- New and old fly ashes for the thermal insulation layer mixed in windrows using a windrow turner
  - homogenity
  - a lot of added water
- Binding agent mixture prepared using a portable mixing unit
  - very accurate
CONSTRUCTION – ROAD NO. 16573, THERMAL INSULATION LAYER

1. Milling of the old pavement into the road base

2. Cutting of the aggregate road base
   -> side supports for fly ash layer compaction

3. Fly ash spreading shaping and compaction

4. Reconstruction of the aggregate road base
CONSTRUCTION - ROAD NO. 16573, STABILISATION OF ROAD BASE

5. Spreading the binding agent mixture
6. Stabilisation mixing with a rotary mixer
7. Shaping and compaction
8. Paving
• First follow-ups provided really encouraging results
  -> no uneven frost heave
  -> high load bearing capacity
• These methods can be used to diminish typical problems found in Finnish roads and most likely improve the longevity of road structures
• Methods are suitable for straightforward construction
  -> materials need to be well prepared
2012 AND BEYOND

• New waste legislation and taxation
  -> Driving force for better utilisation

• Ashes should be included in local planning
  -> bring supply and demand together

• Guidelines for ash construction
  -> Finnish handbook of ash construction was released in Jan 2012

• Ash producers should get more storage knowledge and facilities
  -> Retain the technical properties
  -> Make handling the materials cost-efficient
THANK YOU!
MANGE TAK!