

Scan Tour on Long-Life Concrete Pavements



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Sponsors: FHWA, AASHTO, NCHRP

Growing concerns in the US

Aging highway system

Heavier truck loads

Maintenance costs



Growing concerns in the US



Congestion

Economic impact



Noise



Work zone safety



The Goal of Long-Life Concrete Pavements:

A cost-effective initial investment that results in a pavement needing no substantial future investment over a long performance period.

The Return on Investment in Long-Life Concrete Pavements:

Durable, smooth, safe pavements built to last at least 30 years before first rehabilitation, and minimal maintenance requirements.

Scan Objectives

Identify techniques used in other countries, and implementable in the US, for achieving longer concrete pavement service lives



Areas of interest

Design



Materials

Construction



Maintenance

LLCP Team



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Countries Visited

- Canada
- Germany
- Austria
- Belgium
- Netherlands
- United Kingdom



Findings: Pavement Selection Strategies

- *“Concrete pavement” means “long life”*
- *Public’s concerns (congestion, safety, environment) influence pavement type selection*



Findings: Pavement Selection Strategies



- *Public-private partnerships (PPP) and alternative bids becoming more common*
- *Initial cost and other factors more important in pavement type selection policy than life-cycle cost*

Findings: Pavement Design

- *Design catalogs used in Austria, Belgium, and Germany*
- *Design lives of 30 years typically used; up to 50 years service expected*
- *Truck loadings are heavier than in US, supersingles are used more*



Findings: Pavement Design

- *Full-width, full-depth concrete emergency lanes constructed for future capacity needs*
- *Widened slabs used to reduce concrete stress and deflection*



Findings: Pavement Design



- *Fewer tie bars used in longitudinal joints*
- *Smaller dowel bars (1-in-diameter) are used*
- *JCP and CRCP built to same thickness in most countries visited*
- *CRCP used with good success for long life in Belgium; design and construction technology adopted from the US*

Findings: Pavement Design



- Sealed and unsealed joints appear to perform equally well
- Open-graded permeable layers in Canada but not Europe; dense HMA and CTB layers are used; also unstabilized bases in Germany
- Thick geotextile now used to separate CTB and PCC in Germany
- Foundations are drainable, stable, protect against frost, and allow recycling of materials



Findings: Construction and Materials



- Moderate-alkali cements and blended cements used to mitigate alkali-silica reaction
- Supplementary cementitious materials not considered in mix proportions
- High level of attention given to aggregate selection, quality, and gradation ...
- ... Especially for top layer in two-course construction



Findings: Construction and Materials

- *Recycled concrete and recycled asphalt pavement used (or mandated) in lower layer in two-course construction*
- *Some countries using tie bars coated only in middle third*



Findings: Maintenance

- *Little to no concrete pavement maintenance done*
- *Little if any joint resealing is done*
- *Thin overlays used to correct studded tire rutting*
- *Canada is field-testing precast slab techniques for rapid repair*

Findings: Construction and Materials

- *Coated dowel bars used*
- *Intelligent compaction control used in Austria*
- *Small-plate proof testing of granular layers used in some countries*
- *Roughness measured with four-meter straightedge; excellent smoothness achieved*

Findings: Research

- *Most European concrete pavement research is done by trade and academic institutions, not government agencies*



Findings: Training and Education

- *Construction training happens on the job*
- *Contractor personnel well educated and qualified*
- *No certification standards for inspectors and contractor personnel*

Findings: Training and Education

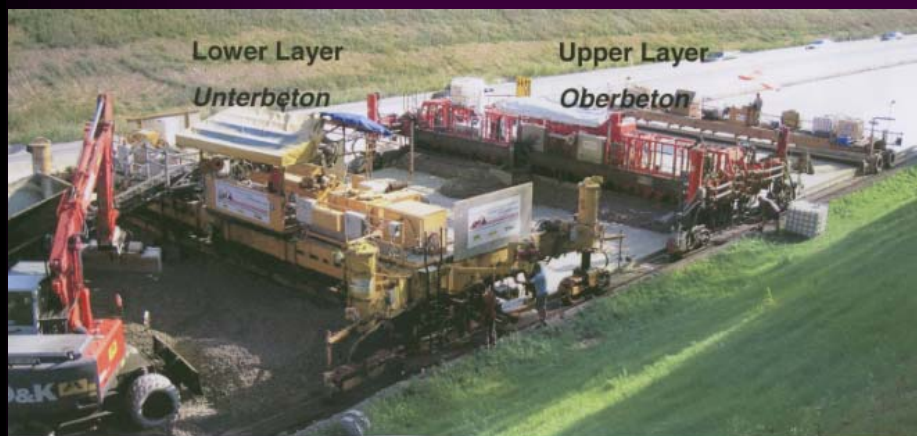
- *Inflow of labor from eastern Europe may increase demands for construction training*
- *Design and construction practices established through collaboration of agency, industry, academia*

Recommendations for Implementation

Recommendations which will be given serious consideration in Pennsylvania

Recommendations for Implementation

Two-lift construction



Recommendations for Implementation

Two-lift construction:

- *Facilitates recycling (concrete or asphalt)*
- *Use when it makes economic sense (scarcity of quality aggregates)*
- *Put high-quality aggregates in top lift*
- *Enhances surface durability, safety, and noise characteristics*
- *Pilot in several states*

Recommendations for Implementation

Geotextile separation interlayer



Recommendations for Implementation

Geotextile separation interlayer

- *In place of asphalt interlayer – reduces overall thickness*
- *Looking at placing on small projects to evaluate*

Recommendations for Implementation

Construction of high-quality foundations



Recommendations for Implementation

Construction of high-quality foundations:

- *Revisit philosophy of good quality base/foundation*
- *Eliminates frost and swelling problems*

Recommendations for Implementation

*Other Recommendations for Implementation
which were also noted by the Scan Team*

Recommendations for Implementation

Design features catalog

| | | Thickness [cm] | | | | E _{v2} - Bearing value [MN/m ²] | | | | | | | | | | | |
|---|--|-----------------|------------------|------|------------------|--|-----------|------------------|-----|------------------|----|------------------|----|-----------------|------------------|----|----|
| Zelle | Bauklasse | SV | | I | II | III | | | | | | | | | | | |
| | Äquivalente 10-1-Achsübergänge in Mio. | B | | > 32 | > 10 - 32 | > 3 - 10 | > 0,8 - 3 | | | | | | | | | | |
| Dicke des Frostsch. Oberbaues ¹⁾ | | 55 | 65 | 75 | 85 | 55 | 65 | 75 | 85 | 55 | 65 | 75 | 85 | 45 | 55 | 65 | 75 |
| Tragschicht mit hydraulischem Bindemittel auf Frostschuttschicht bzw. | | | | | | | | | | | | | | | | | |
| Schicht aus frostunempfindlichem Material | | | | | | | | | | | | | | | | | |
| 1.1 | Betondecke | 27 | | 25 | 24 | 23 | | | | | | | | | | | |
| | Vliesstoff | 15 | | 15 | 15 | 15 | | | | | | | | | | | |
| | Hydraulisch gebundene Tragschicht (HGT) | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | 120 | | | | | | | |
| | Frostschuttschicht | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | | | | | | | |
| | Dicke der Frostschuttschicht | - | 33 ²⁾ | 43 | 25 ³⁾ | 35 | 45 | 26 ³⁾ | 36 | 46 | - | 27 ³⁾ | 37 | | | | |
| 1.2 | Betondecke | 27 | | 25 | 24 | 23 | | | | | | | | | | | |
| | Vliesstoff | 20 | | 15 | 15 | 15 | | | | | | | | | | | |
| | Verfestigung | 47 | | 40 | 38 | 38 | | | | | | | | | | | |
| | Schicht aus frostunempfindlichem Material - weis- oder intermitierend gestuft gemäß DIN 18 196 - | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | | | | | | | |
| | Dicke der Schicht aus frostunempfindlichem Material | 8 ⁴⁾ | 16 ⁴⁾ | 26 | 38 | 15 ⁴⁾ | 25 | 35 | 45 | 16 ⁴⁾ | 26 | 36 | 46 | 7 ⁴⁾ | 17 ⁴⁾ | 27 | 37 |
| 1.3 | Betondecke | 27 | | 25 | 24 | 23 | | | | | | | | | | | |
| | Vliesstoff | 25 | | 20 | 20 | 20 | | | | | | | | | | | |
| | Verfestigung | 52 | | 45 | 44 | 43 | | | | | | | | | | | |
| | Schicht aus frostunempfindlichem Material - enggestuft gemäß DIN 18 196 - | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | 45 | | | | | | | |
| | Dicke der Schicht aus frostunempfindlichem Material | 3 ⁴⁾ | 13 ⁴⁾ | 23 | 33 | 10 ⁴⁾ | 20 | 30 | 40 | 11 ⁴⁾ | 21 | 31 | 41 | 2 ⁴⁾ | 12 ⁴⁾ | 22 | 32 |

Recommendations for Implementation

Design features catalog:

- A template for State DOTs to develop catalogs of design features
- Standard design features for different types of roads
- Highlights features necessary for long-life pavements

Recommendations for Implementation

Greater attention to mix design components



Recommendations for Implementation

Greater attention to mix design components:

- *Cements are interchangeable in EU*
- *Blends and ternary mixes*
- *High strengths in top layer of two-layer construction*

*Recommendations for
Implementation*

Exposed aggregate surfacing



*Recommendations for
Implementation*

Exposed aggregate surfacing

- *Evaluate costs versus noise reduction benefits*

Thank You

