Pavement Subgrade Stabilization
One Engineer’s Perspective

Joshua Barker, P.E.
Kumar & Associates, Inc

Pavement Thickness Design

- Thickness Design Methods
  - American Association of State Highway and Transportation Officials (AASHTO)
  - Empirical Design (AASHTO 1993)
  - Mechanistic-Empirical Design (ME)
- Metropolitan Government Pavement Engineers Council (MGPEC)
- More...

General Pavement Design

- Traffic Loads
  - Convert estimated traffic to an 18-kip Equivalent Single Axle Load (ESAL)
- Design Equation Inputs
  - Reliability, Initial and Final Strength Assumptions, etc...
- Pavement Strength Coefficient
- Subgrade Strength Properties
Firm Subgrade

- Firm and Stable Subgrade Needed in Order to Help Extend (and Achieve) the Useful Life of the Pavement Section
- Firm Subgrade Allows Proper Compaction of Asphalt Materials

Soft Subgrade

- Most Times Soft Subgrade is the result of too High of a Moisture Content
  - Mostly in Clayey Soils, but not always
- Softening can Occur Anywhere
  - Soils with naturally high moisture contents
  - Soils below existing pavements
  - Materials used as fill in low areas
  - Etc...
Concerns

- Subgrades can be firm, but not stable
  - Pass a proofroll, but numerous passes from construction equipment can result in pumping
  - Instability can be much deeper than a few feet

Firm, Not Stable
Stabilization Methods

- Various Methods for Stabilization
  - Remove and Replace Soft Materials
    - May be able to dry the existing materials for reuse
    - May need to import quality material depending on cost and schedule impacts
  - Crowding
    - Pack VTC or some other “rock” product into soft material until firm base
    - Usually need a layer of compacted material above the crowded layer

Stabilization Methods, cont.

- Chemical
  - Change the Composition of the Soil Structure Chemically
    - Can Lower Moisture Content of On-Site Materials
    - Adds Strength to On-site Soils
- Mechanical
  - Add a layer(s) of Geosynthetic Material and Gravel
  - Thickness of Gravel Layer Can Vary

Crowding / Remove & Replace

- Crowding / Remove & Replace is typically the lowest cost alternative
- Usually able to achieve Design Subgrade Strength Values
Chemical Stabilization

- Uses on-site soil to blend with chemical agent (usually cement, flyash or lime)
- Provides a very firm surface for additional pavement section materials (base course, asphalt, etc...)
- If Materials are Tested for Strength (usually Unconfined Compressive Strength) During Placement, May be Able to Reduce The Required Pavement Section
Mechanical Stabilization

- Can Require Sub-Excavation to Achieve Final Subgrade Elevations
- Geosynthetic in Combination with Angular Rock Adds a Zone of Stronger Subgrade Below the Pavement Section
- Can Be Incorporated into Pavement Section to Help Reduce the Required Pavement Section
Mechanical Stabilization with TriAx Geogrid

**Subgrade Stabilization**

Used to provide a competent temporary road surface or a stable foundation layer for a permanent road when weak subgrade conditions are encountered.
Subgrade Improvement Defined

- **FIRM AND UNYIELDING SUBGRADE LAYER**
  - Unstable Subgrade
  - Selected Fill

- **Compromised Subgrade Layer**
  - Unstable Subgrade
  - Stabilized Fill
  - Full Depth Asphalt Concrete

Acceptable Gradation
Various Sizes for Apertures

Top size can be flexible (generally 3” minus).  
Dso is the import measure.
Well-graded

- Always open to other methods of stabilization
  ▫ Think out of the box
  ▫ On-site source of materials for stabilization?

Municipal Requirements

- Some Municipalities are Requiring More Stringent Testing of the Subgrade within Public Roadways
  ▫ Usually in-situ testing using Falling Weight Deflectometer (FWD)
• Special Thanks to:
  ▫ Derek Garben with ARS
  ▫ Phil Law with Tensar
  ▫ Kate Vitale with Tencate