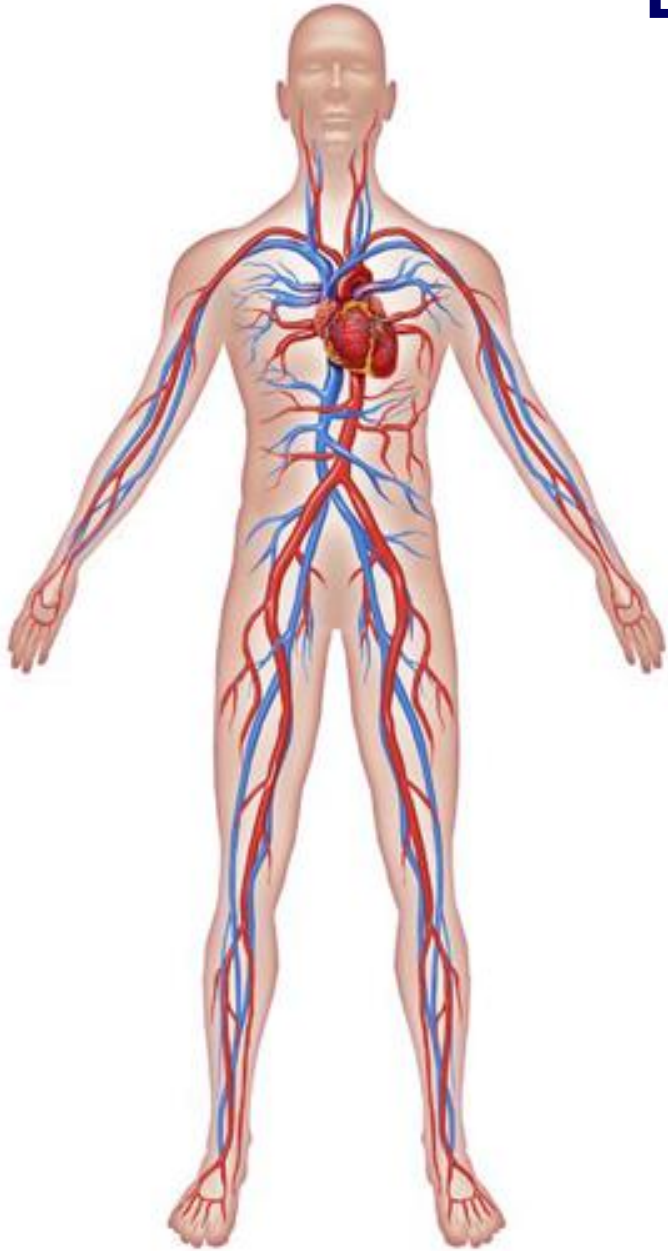


Transportation Infrastructure: Pathways to Vitality and Growth



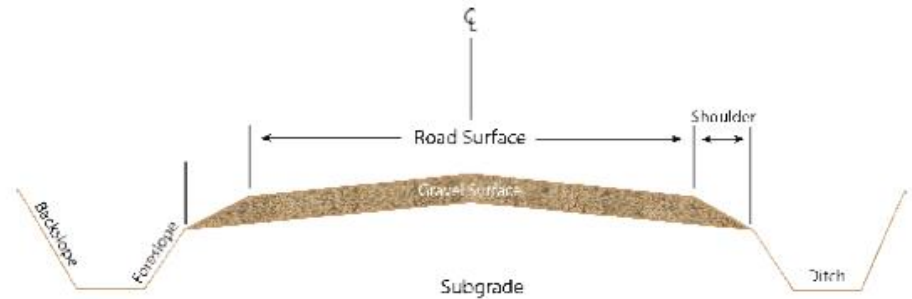
Eli Cuelho, P.E.

Life Flow



Keys to a Healthy Road System

Good design
+
Quality materials
+
Proper construction
+
Appropriate use
+
Maintenance
=
LONG LIFE!



Road Design

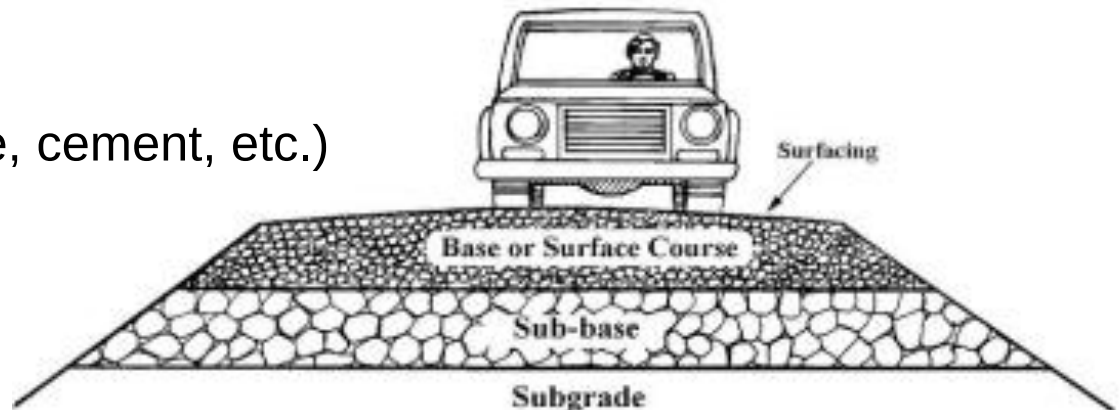
- Can be done by private or public entity
- Based on intended use, for efficiency
 - Traffic levels
 - Truck weights
- Design based on decades of research and development work + experience
- Standardized solution optimized using safety standards, engineering, and cost information
- Standard designs exist that are part of a robust system

Design and Specifications

- USDOT – United States Department of Transportation
- National Highway Institute, Designing with Geosynthetics
- Low-Volume Roads Engineering, Best Management Practices Field Guide
- Gravel Roads Manual

Materials

- Subgrade – existing materials, beneath the foundation
- Structural base – major load carrying layer
 - Usually made of crushed stone
 - » Strong
 - » Permeable
 - Thickness depends mainly on support needs
- Driving surface – smooth top surface
 - Can be made of unbound or bound materials
 - Requires maintenance to ensure long-term performance
- Other
 - Geosynthetics
 - Admixtures (lime, cement, etc.)
 - Dust palliatives



Materials Standards

- Quality
 - Particle-size distribution (ASTM D6913)
 - Fines content (ASTM D1140)
 - Fractured face count (ASTM D5821)
 - Classification (ASTM D2487, AASHTO M145)
 - Durability (ASTM C5353, AASHTO T96)
- Strength
 - CBR (ASTM D1883)
 - Stiffness (AASHTO T307 – Resilient Modulus)
 - Shear strength (AASHTO T236)
- Permeability (ASTM D2434, AASHTO T215)
- Compaction
 - Proctor (ASTM D1557)
 - Density measurement during construction (ASTM D6938)
- Thickness

**Properties
and
Characteristics
Associated
with
Good
Performance**

Construction

Need a system in place to ensure quality materials because the design is based on a certain properties of the individual components of construction

Step 1 – Evaluate field conditions of construction site

Step 2 – Find material sources for construction

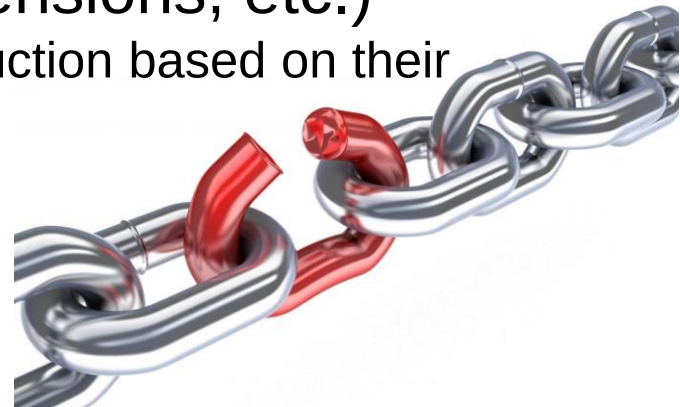
Step 3 – Evaluate properties of material sources

Step 4 – Create design based on available conditions and materials

Step 5 – Construction

Step 6 – Inspect construction to ensure meeting minimum requirements (quality, dimensions, etc.)

- Inspectors have authority to reject construction based on their independent evaluation
- Penalties can be applied if minimums are not met



Construction

- If the quality of the construction does not meet the minimum quality of the individual components of the design then the performance of the system will be jeopardized
 - Time and resources will be wasted
 - Service will be compromised
 - Longevity of the roadway will be negatively affected
- Contractor should take pride in their work!



Appropriate Use

- Truck weight limits and tire pressures
- Adjustments to these limits based on seasonal strength changes
- Enforcement based on permitting process
- Penalties for noncompliance to fund road repair and construction
- Educate trucking industry



Maintenance

- Periodic performance monitoring to assess condition
- Proactive maintenance is proven to be more cost effective
- Materials used to maintain roads also need to be tested and proven
 - Meet minimum standards
 - Be installed/constructed correctly



Standards Development Process

- Participation by variety of parties
 - Practitioners / users
 - Manufacturers
 - Researchers
 - Quality assurance testing
- Open forum for discussion
- Consensus
- Process creates opportunity to **collaborate** and build **trust**



Road Building Standards

- **ASTM International** – American Society for Testing and Materials
- **AASHTO** – American Association of State Highway Transportation Officials
- **ISO** – International Standards Organization
- **ASCE** – American Society of Civil Engineers
- **URi** – Unpaved Roads Institute
- **GSI** – Geosynthetics Institute

Demonstrate Success

- Conduct small pilot projects
- Inform managers of successful processes
- Train staff



Materials Testing

- Ensure materials meet standards
- Evaluate properties of materials made or constructed on site
 - concrete
 - soil



Inspection and Enforcement

- Ensuring that work is done according to design and construction is critical
- Need backing from officials, law, public
- Rewards for good work
- Penalties for poor work



Benefits of Standards for Roads

1. Standards help ensure good performance
 - Predictable performance helps planning and design efforts
 - Helps managers select the best option
 - Provides the best resource for the traveling public
2. Standards development process creates opportunity to collaborate, and helps build trust
3. Good performance results in a strong economy
 - Save money
 - Save time
 - Save limited resources

HEALTHY ROADS = HEALTHY ECONOMY

TRI ENVIRONMENTAL



- Geosynthetics and Geotechnical Testing Services
- Erosion Control Materials Testing and Analysis
- Liner Integrity Survey/ Leak Detection
- Protective Clothing Testing and Certification
- Independent Sampling Auditing Services
- Methane and Water Vapor Barrier Testing and Certification
- Pipe Testing

tri-env.com



Texas Research International, Inc.

tri-intl.com

General Types of Testing

Materials QA



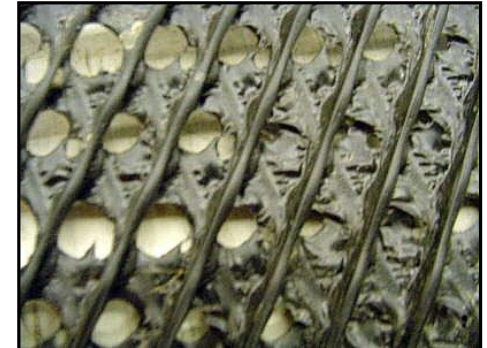
Performance Testing



Product comparisons



Forensics





HDPE, PVC, PP
Pipe



RECPs



Geosynthetic
Reinforcement

TRI Trafficking Test Center



Geosynthetic-reinforced subgrade and base course, over range of subgrade strengths, both paved and unpaved surfaces

Accelerated Pavement Testing Lab



**TRI Accelerated
Pavement Tester**

**Controlled Indoor
Testing Facilities**



TRI Training Courses





Services Provided

- In-plant sampling/field inspection
- Conformance/verification
- Performance investigation/confirmation
- Geotechnical services
- Reduction factor characterization
- Leak location / live survey services
- Forensic and durability evaluations
- Testing equipment
- Technical / consulting support services
 - Specification review
 - Design support and review
 - Literature surveys
 - Training /education



Thank you!



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