Applications of Expanded Polystyrene Geofoam for Transportation Infrastructure

Overview of functions, applications, design considerations and guidelines

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• Geofoam Functions
• Applications for Transportation Projects
• Design Considerations and Guidelines
Functions

- Lightweight Fill
  - Roadway
  - Embankment
  - Structures
- Compressible Inclusion
  - Earth pressure reduction
  - Damping
- Fluid Transmission & Drainage (not discussed)
- Thermal Insulation (not discussed)
• Geofoam Functions
• *Applications for Transportation Projects*
• *Design Considerations and Guidelines*
Expanded Polystyrene (EPS) Geofoam Applications & Technical Data

Stark, Bartlett, Arellano
Primary Uses For Transportation Projects

- Roadway widening
- Road construction over poor soils
- Bridge abutments
- Bridge underfill
- Bridge support
- Culverts, pipelines and buried structures
- Light-weight backfill
- Railway embankment
- Slope stabilization
Roadway Widening

Schematic drawing of road widening using EPS geofoam

- Geomembrane/separation layer
- EPS geofoam blocks
- Sand-leveling course
- Pavement construction
Primary Settlement

2.5 year duration

(I-15 Reconstruction Project – Settlement Record)
I-15 Reconstruction Project
Salt Lake City, Utah
Roadway Widening

Reinforced Concrete Load Distribution Slab

Completed Load Distribution Slab

(I-15 Reconstruction Project)
Roadway Widening

(I-15 Reconstruction Project)
Road Construction Over Poor Soils

Cross section of road construction using EPS geofoam and overlying pavement system
EPS geofoam blocks  Pavement construction
Sand-leveling course
Geomembrane/separation layer
Road Construction Over Poor Soils

Flom Bridge – 1972 – Lillestrom, Norway

Figure 3. Excavation of the first EPS embankment at Flom bridge (EPS and polyurethane as protective layer).
St. Rosa Road
Private Road
Constructed Over Rice Fields
St. Rosa, Philippines
Bridge Abutments, Underfill and Support

Schematic drawing of geofoam used to construct bridge abutment

EPS geofoam blocks

Pavement construction

Granular fill

Geomembrane/separation layer
I-15 Reconstruction, Salt Lake City, Utah

Overpass, 5300 S. over UTA TRAX
Salt Lake City, Utah
North Temple Viaduct – Salt Lake City, Utah

Bridge Approaches
Bridge / Tunnel Underfill

I-215 at 3300 South,
Salt Lake City, Utah
Temporary Bridge Supported on EPS

Lokkeberg Bridge, Norway
Permanent Bridge Supported on EPS

Hjelmungen bru, Norway

EPS block
Common EPS Protection Strategies

a) Pavement
- EPS Blocks
- Backfill
- Pipe or Culvert

b) Pavement
- EPS Block
- Backfill
- Pipe or Culvert

c) Pavement
- EPS Blocks
- Concrete Slab
- Backfill
- Slot Trench
- Ductile Steel Pipe

D) Pavement
- EPS Blocks
- Concrete Slab
- Void
- Backfill
- Pipe with Hanger
Culverts

UTA Commuter Rail Widening Over Existing Culvert, Corner Canyon, Draper, Utah
Eidanger, Norway 1988 (photo courtesy of Norwegian Public Roads Administration).
Slot Trench Cover System

Salt Lake City, Utah
Post and Beam Cover System

Brian Head Ski Resort, Cedar City, Utah
Light-Weight Backfill

Graphic Description:
- Geomembrane/separation layer (if required)
- Landscaping/soil
- EPS geofoam blocks
- Retaining wall, abutment or protective facing
- Granular backfill
- Drainpipe

Schematic drawing of retaining wall with EPS geofoam backfill.
Tunnel Infill, Tucker Blvd., St. Louis, Missouri
Light Rail Embankments

UTA – Light Rail – Salt Lake City, Utah
Light Rail Embankments

UTA –Light Rail – Salt Lake City, Utah
Light Rail Embankments

UTA – Light Rail – Salt Lake City, Utah
Commuter Rail Embankments

Front Runner – UTA – Corner Canyon – Draper Utah
Slope Stabilization

EPS geofoam blocks

Landscaping/soil

Geomembrane/separation layer (if required)

Sand-leveling course

Drainpipe

Schematic drawing of EPS geofoam placement in a slide area
Step 2 - Rebuild slope and roadway with geofoam and tiebacks. Rebuilt roadway.

- Geofoam
- Reinforced shotcrete facing
- Cables anchored at back of plates or ribs
- Level bench
- Rebuilt roadway
- Concrete lined drainage ditch
- Light gauge cable tiebacks placed in geofoam of each level.
- Steepened back slope (slope > 4V:1.5H)
- Bedding sand (level)
Slope Stabilization
Topics

• Geofoam Functions
• Applications for Transportation Projects
• Design Considerations and Guidelines
Design and Construction Considerations

**Design**
- Roadway & Pavement Design
  - Situation and Layout
  - Geometrics
  - Protective Systems
    - UV degradation
    - Chemical adsorption
    - Concentrated Loads
  - Pavement Design
    - Dead & Traffic Loadings
  - Internal and External Stability
    - Settlement – Foundation Soils
    - Bearing Capacity
    - Global Stability
    - Extreme Loadings
      - Seismic
    - Drainage & Buoyancy

**Construction**
- Bedding Material
- Compaction
- Handling
- Block Dimensions
- Block Layout & Placement
- Cover and UV protection
- Quality Assurance/Control
  - Specifications / Provisions
  - Testing and Sampling
  - Inspection
  - Corrective Action
Current Design Methods / Guidance

- Norwegian Public Roads Administration (1987, 1992)
- European EPS White Book (2011)
- NCHRP Project 24-11(02) Phase I Study (slopes) (2011)
- Various Research Reports
- Technical Papers
Questions