New Lightweight Fill Option in the West

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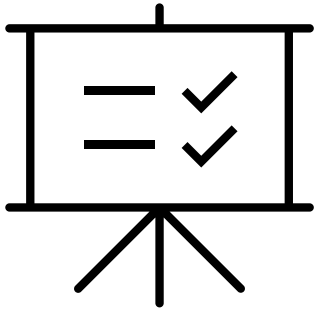
Presentation Objectives

By the end of this presentation you will be able to answer the following questions:

- What is lightweight fill, and why do we use it on transportation projects?
- What lightweight fills are in our “tool box”?
- What materials are becoming more prevalent in our area?
- What does the future hold for lightweight fill?



What is Lightweight Fill?

A fill material that has a lower unit weight than the unit weight of typical compacted soil fill.

Compacted soil fill unit weight typically ranges from about 115-140 pcf (FHWA GEC 013 2017).

Why Use Lightweight Fill?

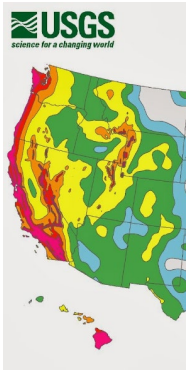
There are many uses for lightweight fill on transportation projects. A few common uses that we encounter are listed below:

- Road construction over poor soils
- Road widening
- Construction over or adjacent to existing utilities and structures
- Landslide mitigations
- Wall backfill
- Liquefaction mitigation, or to reduce seismic earth pressure on walls

Increasing use of Lightweight Fill

WSDOT's use of lightweight fill has grown over time due to a few factors, such as:

- State Route improvements in the built environment (Widenings, new infrastructure through areas of development etc)
- Increase in our understanding of seismic hazards in the PNW (i.e. stronger ground motion predictions)
- Landslide mitigations



Google Maps Image

Lightweight Fill Used at WSDOT

- Expanded Polystyrene (EPS, Geofoam)
- Low Density Cellular Concrete
- Volcanic Rock
- Wood Fiber
- Tire Derived Aggregate

It should be noted that there are other lightweight materials such as rhyolite, expanded shale, blast furnace slag, and fly ash, but they haven't been used by WSDOT in recent history.

Expanded Polystyrene

Pertinent Information:

- Weighs approx. 1/100th of conventional soil fill, for projects requiring a very light product this is the best
- Requires a very level base to build from
- Dissolves readily in gasoline and other organic vapors and fluids, thus needs to be protected.
- Very buoyant
- Susceptible to UV degradation
- Requires a load distribution platform
- Glacier glasses a must in construction

Low Density Cellular Concrete

Pertinent Information:

- Weighs 30 – 80 pcf
- Is a brittle material, differential settlements can pose challenges
- Batched on site and placed in lifts
- Requires curing between lifts, typically overnight
- Challenging to find accredited labs for material testing
- Can conform to unique geometries and areas
- Useful for walls
- Cured product looks and feels like pumice

Volcanic Rock

Pertinent Information:

- Weighs 50 – 70 pcf
- Easy placement with typical construction equipment
- Similar to the lava rock in your gas grill
- Subject to availability
- Free draining

Wood Fiber

Pertinent Information:

- Weighs 35 – 55 pcf
- Easy placement with typical construction equipment
- Fresh wood should be used to prolong life of the fill
- Subject to availability, more prevalent in forested regions
- Subject to creep settlement, pavement distress should be anticipated
- Water entering fill should be minimized, to reduce leachate

Tire Derived Aggregate

Pertinent Information:

- Weighs 45 – 55 pcf
- Easy placement with typical construction equipment
- Subject to availability
- Requires gravel load distribution pad on top of fill
- Fill thickness should be limited to approximately 10ft intervals with a lift of gravel in between. This eliminates the pesky issue of self-combustion of the material

Picture Courtesy of Dr. Dana Humphrey

Lightweight Fill Comparison

Type	Typical Unit Weight (pcf)
Expanded Polystyrene	0.5 – 3.0
Low Density Cellular Concrete	30 - 80
Wood Fiber	35 - 55
Tire Derived Aggregate	45 - 55
Volcanic Rock	50 - 70

*Typically material cost increases as the unit weight decreases.

New Material Entering the Market

Ultra Lightweight Foamed Glass Aggregate (UL-FGA)

- Until recently this material was only produced in the Eastern US, and Europe
- A production facility in California will open next month, with future plans of a facility possibly located in the Portland, OR area
- WSDOT is receiving inquiries from Design-Build teams concerning the use of UL-FGA on WSDOT projects

What is UL-FGA?

UL-GGA is made from 100% post-consumer recycled glass.

Cleaning process from left to right

What is UL-FGA? (continued)

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What is UL-FGA? (continued)

Lightweight Fill Comparison

Type	Typical Unit Weight (pcf)*
Expanded Polystyrene	0.5 – 3.0
Ultra Lightweight Foamed Glass Aggregate	20 - 25
Low Density Cellular Concrete	30 - 80
Wood Fiber	35 - 55
Tire Derived Aggregate	45 - 55
Volcanic Rock	50 - 70

*Materials lighter than 62.4pcf subject to buoyancy forces.

How is UL-FGA Shipped?

Placement of UL-FGA

Method Specification

Tracked Excavator or Dozer 625 - 1,025 psf

- 4 passes over the UL-FGA layer
- 24 inch maximum lift thickness

Plate Compactor 110-220 lbs

- 4 passes over the UL-FGA layer
- 12 inch maximum lift thickness

- Nonwoven Geotextile as separator
- Compaction typically 10-20% of a given lift thickness
- A gravel or structural load distribution is typically needed

UL-FGA and Sustainability

Future of Lightweight Fills

- Focus will be shifting from not just a material that meets a need, but also to materials that promote sustainable infrastructure. This shift is already starting thanks to efforts such as:
  - FHWA's Sustainable Highways Initiative which is intended to help transportation agencies expedite project delivery, advance economic growth, enhance accessibility, and build projects to last, while also addressing the impacts of transportation to the human and natural environments.
  - Agencies like WSDOT that incorporate sustainability into their Strategic Plans.

    "Lead in the development of transportation that combats climate change and enhances healthy communities for all."

WSDOT anticipates that products like UL-FGA will gain market share in our Region as availability increases due to both it's engineering properties and it's contribution to meeting the shift to sustainable highways.

Questions?

- Please contact:

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