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Boardroads, Boardwalks, and Hardened Trails & Roads for Alaska

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We’ll look today at Transportation Facilities that work well on the Tundra & Wetlands:

1. Boardroads / Boardwalks

2. Geocell Hardened Trails

3. Composite Mats
Where are the Tundra and Wetlands?

• **Tundra** is in the western & northern areas of Alaska (orange area on map)

• **Wetlands** are scattered all over the state: cover 43% of Alaska (green & red areas on map; many too small to see here).
Importance of the Top Layer

- **Preserve the top layer** of the tundra and wetlands when building boardroads, boardwalks, trails, or roads on them.

**Layers of the tundra:**

1. **Top layer** is the “Insulating tundra”, 4 to 6 inches thick.
2. “Freezing zone”, 1 to 6 feet thick, freezes in the winter.
3. “Permafrost” will melt if all or part of the two layers above are removed.
1. Boardroads / Boardwalks

- *Board roads* are usually designed for ATVs and small pickup trucks.
- *Board walks* are designed for pedestrians **only**.
1. Boardroads / Boardwalks

Old “at-grade” (on the ground) Boardwalks:

- Boards tend to warp and break
- Boardwalk overtopped by flood waters
1. Boardroads / Boardwalks

**Old at-grade Boardwalk Disadvantages:**

- **Follows the uneven ground:**
  - Broken or warped boards are unsafe for pedestrians and ATV’s; and
  - May hold mud puddles that can be unhealthy.
- **Tundra or wetland** grasses cannot live underneath;
- **Maintenance cost is high, due to wood rot and broken boards.**
1. Boardroads / Boardwalks

New Elevated Boardroad    Old at-grade Boardwalk
1. Boardroads / Boardwalks

- New Boardroads & Boardwalks are often elevated (raised up) a few feet on piers;
- Advantages are:
  - Tundra and wetlands can survive underneath;
  - More even riding / walking surface;
  - Less wood rot, lower maintenance;
  - May put Boardroad / Boardwalk above flood waters;
  - Can hold utilities (water line & sewer line) underneath the floor beams, but above the ground.
An early attempt (1990’s) at elevated Boardroads used styrofoam filled plywood footings:

- Some of the insulating tundra layer was removed to install the footings;
- So, some permafrost melted; and
- Unwanted large ponds formed on the ground.
Today, **Steel helical piers** are used for elevated boardwalks and boardroads:

- “Helical” means it looks like a giant screw;
- These are twisted into the ground with hydraulic machinery;
- Installed deep enough to carry the load specified by the design engineer.
1. Boardroads / Boardwalks

Steel helical piers (cont’d):

- Piers are skinny; less impact on the tundra or wetland;
- Less melting of the permafrost;
- Equipment & materials can stay on the boardroad as it is built; keeping them off the tundra or wetland.
- Less maintenance, made of galvanized steel to resist rust;
- Blades can have modified edges for good installation into permafrost.
1. Boardroads / Boardwalks

Steel stringers rest on the piers

Steel helical piers

Boardroad : Profile view
1. Boardroads / Boardwalks

*Boardroad with helical piers*
1. Boardroads / Boardwalks

**Boardwalk** with **helical piers**:

*During construction*

*Completed structure*
1. Boardroads / Boardwalks

Boardroad with wood railing:
1. Boardroads / Boardwalks

Boardroad with driveway access ramp:
1. Boardroads / Boardwalks

*Boardroad* with speed bumps
1. Boardroads / Boardwalks

New *at-grade* boardwalks:

- *Should not* be built on tundra or wetlands.
- *This one at St. Michael was correctly located on an existing roadbed (as designed by Bristol Engineering)*:
2. Geocell “Hardened” Trails

- **Geocells** “harden” existing ATV Trails, or build new ones.
  - Geocells are good for the tundra and wetlands;
  - They allow old ATV ruts to heal, and prevent new ones.
2. Geocell “Hardened” Trails

- **Without** Geocells, the ATV wheel load is **narrow**;
- **So, the wheels cut through the insulating tundra layer**, exposing the **freezing zone**. Then, ruts form and get worse.
2. Geocell “Hardened” Trails

- **With Geocells, the ATV wheel load is spread wide;**
- **The insulating tundra layer is not broken through.**

- Similar benefits for wetlands (that are not on the tundra).
- Geocells also reduce wheel spin.
2. Geocell “Hardened” Trails

• *The Geocells allow grasses on the tundra & wetlands to grow through:*
2. Geocell “Hardened” Trails

- **Geocell Trails:**
  - Reduce fuel cost & damage to ATV;
  - More reliable path, without these dangers and obstacles.

- **Several Geocell trails in Alaska:**
  - Ones in Tununak and Kwigillingok were designed by FHWA.

- **Can be installed by:**
  - a contractor; or
  - a Tribe’s employees ("force account").
2. Geocell “Hardened” Trails

- Geocell is 1.57 ft. x 3.15 ft. x 2 inches thick;
- Are connected to make a trail;
- Made from high density polyethylene;
- Information on one brand of Geocell (Geoterra® mats and stainless steel PadLoc Connection Devices by Presto) is located at [http://www.prestogeo.com/geoterra_construction_mats](http://www.prestogeo.com/geoterra_construction_mats)
2. Geocell “Hardened” Trails

Installation steps:

- Haul Geocells to the project site, from the barge or airplane:
2. Geocell “Hardened” Trails

**Installation steps (cont’d.):**

- Connect Geocell blocks with **stainless steel** connectors, in a pattern recommended by the manufacturer.

*Geocell typical pattern – Plan view*
2. Geocell “Hardened” Trails

**Installation steps** (cont’d.):

- **Prepare the Ground**: Some cutting down of high spots along the trail may be needed;
- **Do not cut completely through** the insulating tundra layer or wetland vegetation layer.
- **Remove all sharp objects, rocks, sticks, etc. from the ground surface.**
2. Geocell “Hardened” Trails

**Installation steps (cont’d.):**

- **Connect Geocells into a larger mat before placing on ground;**
- **Place Geocells on prepared ground.**
2. Geocell “Hardened” Trails

- **Geocell trail typical section:**

  - Add “biaxial” geogrid fabric on very soft soil.
  - **Note:** This will not allow grasses to grow, so could be a wetland “take”.

![Diagram showing Geocell trail with typical section and notes on geogrid fabric and wetland impact.]
2. Geocell “Hardened” Trails

**Installation steps (cont’d.):**

- Anchor Geocells to ground with “earth anchors”, according to manufacturer’s recommendations.
- Earth anchors are installed by hand.

Handle to install earth anchors
2. Geocell “Hardened” Trails

**Installation steps (cont’d.):**

- Expansion joints are every 90 feet along trail for thermal expansion.

![Expansion Joints Diagram](image)
Stream crossings can be (in order of complexity):
1. Simple plank structures, anchored down;
2. Geocells with boards under the Geocells;
3. Prefabricated fiberglass bridge;
4. Steel beam & timber deck bridge.
2. Geocell “Hardened” Trails

Steel beam & timber deck bridge

• Can be partially prefabricated off-site;
• Has steel grates as transition to Geocell trail.
3. Composite mats

- These serve a different purpose than the Geocells;
- These mats are made for large trucks and equipment;
  - Made from high-density polyethylene (HDPE);
- A Disadvantage of composite mats:
  - They have no openings; they kill grass underneath in 14 days;
- Composite mats are mainly for temporary use;
- In some cases can be a permanent installation if environmental impacts are acceptable.
3. Composite mats

- *Install mats to have an even contact surface with the ground.*
- *Cutting down some high spots of the ground may be needed;*
  - *However, do not cut all the way through the insulating tundra layer or the wetland vegetation layer.*
3. Composite mats

- Each mat is 8 feet wide x 14 feet x 4\(\frac{1}{4}\) inches thick.
- On very soft soil, use two layers of mats plus a geotextile separator fabric.
- Each mat weighs 1,050 pounds.
- Requires a forklift or crane, and 2 - 3 laborers to install.
- One brand is Dura-Base composite mat system made by SOLOCO.
3. Composite mats

- Connect Mats together with fasteners; and
- Anchor Mats to ground with flood restraints (similar to helical piers for boardroads).
# Comparison of Facility Types

<table>
<thead>
<tr>
<th>Facility Type</th>
<th>Cost per lineal foot</th>
<th>Good for Tundra &amp; Wetlands?</th>
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<tbody>
<tr>
<td><strong>Elevated boardroad, 10 ft. wide</strong></td>
<td>$ 440</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>At-grade boardwalk, 8 ft. wide</strong></td>
<td>$ 200</td>
<td>No</td>
</tr>
<tr>
<td><strong>Geocell trail, 6.33 ft. wide</strong></td>
<td>$ 75</td>
<td>Yes</td>
</tr>
<tr>
<td><strong>Composite mats, 8 ft. wide</strong></td>
<td>$ 300</td>
<td>Yes, but only if temporary</td>
</tr>
</tbody>
</table>
Comparison of Facility Types (cont’d.)

Construction Costs shown in the table on the previous slide:

• Are from a few remote projects in western Alaska.

• Include all costs to build the project, such as:
  o shipment of equipment & supplies to site, surveying, erosion control, labor, construction management, equipment, materials, etc.

• These costs will vary a lot by remoteness, length of work, and whether a contractor or force account crew builds it.
Questions?
Contact & Program Info

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FHWA Program Delivery Guide: