**KEY TAKEAWAY:** Most projects do a sustainability kickoff, but TCORE prioritized sustainability early in the design process through a series of 11 Healthy Buildings Focus Group meetings with key Port stakeholders.

**PROCESS - An Enhanced Level of Engagement for TCORE**

**AGENDA**

- **INTRODUCTIONS**
- **GOALS**
- **DESIGN UPDATES**
  - SUSTAINABILITY THEMES AND ANALYSIS DISCUSSION
    - Track 1 - Healthy Buildings (IAQ and Daylight)
    - Track 2 - Energy
    - Track 3 - Landscape, Materials, Interiors
- **RECAP & NEXT STEPS**

**typical process -**
- 1 time Sustainability Charrette

**enhanced process -**
- 11 Healthy Building Focus Groups in 2018
- 1 full time sustainability person dedicated to TCORE
- detailed sustainability goals specific to TCore

**2018**

- 1/18 - HB Focus Group 1 - Kickoff
- 2/15 - HB Focus Group 2 - Energy, Daylighting, and Landscape Technical Challenges
- 3/15 - HB Focus Group 3 - TCORE Project Goals Primer
- 4/12 - HB Focus Group 4 - Decision Making, Certification, and Health & Wellness Goals Update
- 5/10 - HB Focus Group 5 - Energy, Carbon, and Water Goals Update
- 6/7 - HB Focus Group 6 - Natural Resources, Water, and Materials Goals Update
- 7/5 7/11 - HB Focus Group 7 - Materials, Resilience
- 8/2 - HB Focus Group 8 - MEP Integrated Focus Group - Comfort
- 8/29 - HB Focus Group 9 - Focus Group Integration, Wood Sourcing, Resilience, Certifications
- 10/25 - HB Focus Group 10 - PV Pricing / Materials Update / Certifications Deep Dive
- 12/13 - HB Focus Group 11 - SD Review
TCORE – Ground Source System

HEAT RECOVERY PLANT

Cooling
Heating

TO TERMINAL

Troutdale Sandstone Aquifer

2 | Extraction Wells

4 | Injection Wells
ENERGY and CARBON

KEY TAKEAWAY: The open-loop ground source heat pump central plant upgrade was key to meeting deep energy efficiency targets and port-wide carbon reduction goals.

ENERGY
- 53% reduction in energy usage compared to existing airport
- Doubled square footage while reducing energy consumption and load
- Open loop ground source heat pump accounts for over half of these savings

CARBON
- >95% of building heating load is fossil fuel free due to the open loop ground source heat pump
- Electrification of heating and future greening of the grid puts the Port on the path to meet the 2040 goal of an 80% emissions reduction from 1990 levels.
**KEY TAKEAWAY:** Re-using the existing airport’s structure is one of the most sustainable things we can do, but we’re also optimizing the embodied carbon footprint of new materials as well.

### EMBODIED CARBON (Structure + Envelope)

- Estimates show that up to a 60% savings in embodied carbon was achieved by re-using most of the structure in the terminal core.
- When only looking at new materials, a 20-30% savings will be achieved through the following design strategies.

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Factoring Reuse</th>
<th>New Materials Only</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>REPLACEMENT OF OLD</strong></td>
<td>~60% SAVINGS</td>
<td>~20-30% SAVINGS</td>
<td></td>
</tr>
<tr>
<td><strong>STRUCTURE WITH NEW</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CONCRETE STRUCTURE</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NEW STRUCTURE (BASELINE)</strong></td>
<td>65 mtCO₂</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>NEW STRUCTURE (PROPOSED)</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>NEW STRUCTURE (PROPOSED)</strong></td>
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</tbody>
</table>

- Mass timber roof
- Sustainable forestry
- Low carbon intensity concrete
- Local and recycled steel
KEY TAKEAWAY: Business as usual sourcing can only trace things back to the region, we’ve innovated the wood procurement process to tell the local story of our wood in ways that haven’t been told before.
2,600,000 board feet of glulam beams and ceiling lattice
100% from the Pacific Northwest
Over 1,000,000 board feet tracked back to source forest
>95% sustainably harvested
MASS TIMBER STORY – Sourcing from regional forests

Tom Strong – Skokomish Indian Tribe, WA

"We're foresters in that we're stewards," says Tom Strong, Chief Executive Officer of the Skokomish Indian Tribe, which manages 200 acres of Washington forests for its 800 tribal members. "We’re not cutting and planting, seeking to develop our lands into a commodity. Instead, we’re doing it to restore the forest."
Over the past 100 years, the two dams on the North Fork River have had a major impact on the entire ecosystem of Skokomish land. "We want to restore the entire Hood Canal watershed," Tom says. The forests are just one part.

Ann & Richard Hanschu – Doneen, Forest Grove, Oregon

Ann Hanschu’s father first bought land outside Forest Grove, Oregon, in 1896. Ann grew up trailing her father around the forest, learning from him. The Hanschus now have three children, four grandchildren, and five great-grandchildren. Richard says, "We’re planting trees that our grandchildren will see the profits from — not even our children. It’s long-range thinking."

Ben Hayes – Hyla Woods, Cherry Grove, Oregon

Ben Hayes is a sixth-generation forester who manages Hyla Woods, outside Cherry Grove, Oregon, with his father, Peter. He is also a sustainable-forestry consultant. At Hyla Woods, the Hayes experiment with selective thinning and patch cutting, instead of clear-cutting, to foster diversity of tree species, ages, and sizes.
"When you look 100 years out, having greater complexity in terms of species and the structure of the forest, you can increase the forest’s resilience in the face of extreme weather and drought," he says.
"We’re working toward a model of forestry that you could practice for the perpetual future," Ben says. "It’s a model that lifts up both rural and urban communities and the ecosystems we rely on."

Herman Flamenco – Conservation Forester, WA

"We know historically that the stands we’re working on were overstocked," says Herman Flamenco, Central Cascades conservation forester for the Nature Conservancy, of the 50,000 acres outside Cle Elum, Washington, the organization manages. Thinning the trees welcomes in light and biodiversity.
"Western Washington is wetter. In our dry climate, there’s less moisture and increased fire risk," Herman says. "As we look at climate change, it’s just going to get dryer. We want to make sure we can keep our forests around."
TECHNICAL ACHIEVEMENTS – LONGSPAN

• VE Splice with SDD to no splice single span beam

Splice connection
PL 3/16” x 9” x 2’2” GR33
w/(40) Self Drilling Dowel through each side of splice
Construction Summary
Step 1: Enabling work for initial Y-columns

March 2020 – February 2022

Work area
Mega Column Pile Caps
Step 2: Site civil work

June 2020 – December 2021

- Work area
- Temporary

Existing Loading Dock and Recycling Areas
Alleyway Construction - June
Alleyway Construction - January
Step 3: Move south security checkpoint - Complete

July 2020 – November 2020

Temporary
Step 4: Reconfigure ticket lobby

November 2020 – November 2021

Temporary
Existing Terminal Roof Ductwork
Step 5: Build paths to get around construction

January 2021 – October 2021

- Demo
- Temporary
TCORE – Concourse Corridor Connector Relocation

• Utilize Self Propelled Modular Transport (SPMT) vehicles

• Disassemble connector into 2 parts

• Relocate north section (1.8 million pounds) week of March 15-19, 2021

• Relocate south section (1.4 million pounds) week of March 22-26, 2021
TCORE - Concourse Connector Move
North & South Bypass
Step 6: Close Oregon Market – Seismic Upgrade

April 2021 - March 2022

- Work area
- Temporary
Oregon Market Seismic Upgrade
Oregon Market Demolition
Step 7: Structurally Demolish Oregon Market

March 2022 – June 2022

- Hard Demo
- Temporary
Oregon Market Demo
Step 8: Start installing the new roof

June 2022 – January 2023

- Work area
- Temporary
THE BIG CHALLENGE: SEISMIC RESILIENCE

• Occupied during construction = maintain seismic safety during construction

Solution: Cantilever Columns with seismic isolation bearings at top supporting continuous ~400’x1000’ roof structure. Independent of 9 separate existing structures below.
PREFAB TO MODULAR – BUILDING OVER OCCUPIED SPACES

• How do you design for assembly over occupied spaces?

“LIFT” VS. “LAUNCH”
PREFAB TO MODULAR – MINIMIZE IMPACTS

• Minimize impacts by launching long span structural modules
THE BIG CHALLENGE: PHASE 2

• Phase 2: Building a brand-new roof (2022)

  I. **STEP 1:** Pre-Fab Kit of Parts Assembly on the Airside of the Airport

  II. **STEP 2:** Break roof into 20 large modules approx. 120’ x 200’

  III. **STEP 3:** Move the modules in place over the existing terminal and reunite to make complete roof again

Sustainably sourced timber from regional forests

*The story of the roof begins in local forests, where we’re taking care to sustainably source the timber. It’s in honor of the stewards of the land and our region’s crafty heritage.*
THE BIG CHALLENGE: SAFETY & LOGISTICS
THE BIG CHALLENGE: SAFETY & LOGISTICS
PREFAB TO MODULAR – CASSETTE MOVEMENT

STEP 1: Pre-Fab Kit of Parts Assembly on the Airside of the Airport
STEP 2: Break roof into 20 large modules approx. 120’ x 200’
STEP 3: Move the modules in place over the existing terminal and reunite to make complete roof again
PREFAB TO MODULAR – MODULARIZATION

MEGA CASSETTE

DRAWER

<table>
<thead>
<tr>
<th>Total Weight</th>
<th>Total Length</th>
<th>Total Width</th>
<th>Transport Height</th>
<th>Overall Height</th>
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</thead>
<tbody>
<tr>
<td>817,560</td>
<td>213'</td>
<td>122'</td>
<td>55'1&quot;</td>
<td>70'6&quot;</td>
</tr>
</tbody>
</table>
Roof Module Implementation

“Unstitch” and prep individual module at fabrication yard for transport to site.
Roof Module Implementation

Mass structure is built beneath module in prep for transport.
Roof Module Implementation

Bracing is put in place to keep module stable during transport.
Roof Module Implementation

Module is raised 55 feet in air for transport.
Roof Module Implementation

More shoring and bracing is added to stabilize module for transport.
Roof Module Implementation

Self-propelled modular transport (SPMT) moves roof module to erection site overnight.
Roof Module Implementation

Night 1 of module erection process: once transported to erection site, module is structurally secured, inspected and signed off for the night.
Roof Module Implementation

Night 2: module is disconnected from structural connection, and launched halfway across to shoring tower; module is again structurally secured, inspected and signed off for the night.
Roof Module Implementation

Night 3: module is disconnected from structural connection, and launched rest of way to mega columns; module is structurally secured, inspected and signed off for permanent location.
TCORE – New Roof
THE BIG CHALLENGE: Planning

• Playing chess with occupant flow
Roof Module Implementation

Finished roof – both phases
Roof Pre-fabrication - August
Roof Pre-fabrication - November
Roof Pre-fabrication - December
Roof Pre-fabrication - November
Roof Pre-fabrication - November
Roof Pre-fabrication
TECHNICAL ACHIEVEMENTS – LONGSPAN

• VE Splice with SDD to no splice single span beam

Splice connection
PL 3/16" x 9" x 2'2" GR33
w/(40) Self Drilling Dowel through each side of splice
Step 9: Build out new ticket lobby and Western Expansion

February 2023 – May 2024

- Work area
- Temporary
Step 10: Complete South Node and Front House

May 2024 – October 2025

- Work area
- Temporary
Step 11: Complete North Node

July 2024 – December 2025

- Work area
- Temporary
Step 12: Closeout Activities

December 2025 – June 2026

Demo