Pedestrian Walkback Tunnel, Finishes Package
Washington Dulles International Airport

**Introduction**

**Project Background**

**Soil Retention System**

**Curtain Wall System**

**Airport Project Delivery**

**Conclusions**

**About the Project...**

**Intended Use:**

"Allow passengers the choice of a short walk between the Main Terminal and Concourse B, or transport via Mobile Lounge"

**Key Issues:**

1) Two levels below grade, Tunnel and Basement Level, 60,000 CY of bedrock to be removed from the site

2) Entire North Face of façade is glazed curtain wall

3) Pedestrian Walkback Tunnel Project is split up into 4 separate "packages"

**Project Design**

Tunnel Shell, Connector A under separate contracts

Existing Conditions for the Finishes Package: Rendering of Tunnel

Finishes in the Tunnel to recall the swooping roof of the main terminal

**Project Team**

Owner: Metropolitan Washington Airports Authority (MWAA)

Owner’s Representative: Parsons Management Consultant (PMC)

Design Consultant: PMC Design

Engineer: Earth Tech

Architect: Giuliani Associates

General Contractor: Hensel Phelps Construction Co. (HPCC)

**Major Subcontractors:**

Soil Retention System: Berkel & Co. Contractors


Earth Removal: Strittmatter Contracting, LLC
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Project Organization

Owner

Metropolitan Washington Airport Authority

Owner's Representative

Parsons Management Consultant

Design Consultant

PMC Design

General Contractor

Heenan-Phelan Construction Company

Engineer

Leith, Mack

Subcontractor

Architect

Giuliani Associates

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Project Execution

Projects are broken into phases, or "Packages," in this case...

Connector C

Connector B

Curtain Wall Finishes

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Project Site

Existing Main Concourse

"Portal" (Tunnel Entrance)

Connector A (NIC)

Tunnel Shell (NIC)

Tunnel Finishes

Connector B

"Object Free Zone"

Active Taxiway

Tunnel Shell (NIC)

Tunnel Finishes

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Project Cost

For the Pedestrian Walkback Tunnel project...

Cost: $50,000,000

Schedule: Spring 1998, Design began

December 2004, expected completion

For the Finishes Package alone...

Cost: approx. $25,000,000

Size: Connector B: Four Stories – 20,000 SF

Tunnel: 750 ft long x 30 ft wide – approx. 22,500 SF

Schedule: October 2002 – December 2004

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Project Timeline

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Construction Process

• Rock Grinder grinds rock in 7' lifts

• Spoils excavated with Excavator in 7' lifts

7 repetitions to reach an overall depth of 44'

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Original Design

8" Shotcrete wall with tiebacks on a 7’ x 7’ grid
4" Shotcrete w/ WWF
Install Tiebacks
4" Shotcrete w/ WWF
Waterproofing with foundations

Constraints/Issues

No setback allowed
Highly fractured, weathered rock
Poor RQD
Heavy surcharge loads
Existing Concourse B adjacent to site

Alternate System Selection

Suggested systems, from geotech report:
- Braced Walls using Wales and Struts
- Soldier Beams & Lagging
- Braced Shooting
- Rockfill/Walls
- Diaphragm/Slurry Wall

Alternate System Design

Using the same design conditions for the shotcrete & tiebacks
- Terzaghi and Peck Trapezoidal Apparent Earth Pressure Diagram, as recommended by the Geotech
- 44’ Height of Excavation

Alternate System Selection

Diaphragm/Slurry Wall

Major Issue: Rocky subgrade conditions
Solution: The Big Dig in Boston, MA:
- Similar soil conditions
- Hydromills/Rock Mills
- Clamshell bucket removes spoils

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**Alternate System Design**

- Input the 1' width beam into STAAD
- Design reinforcing for the wall based on:
  - STAAD results
  - ACI

**Impacts on Sequencing**

**Old:** CYCLE: Grind, Excavate, Shotcrete, Tiebacks, Shotcrete

**New:** Construct entire slurry wall before excavation begins

CYCLE: Grind, Excavate, Tiebacks

**Schedule Impacts**

Old: 8 month duration, due to Differing Site Conditions

New: 3 weeks at front end for slurry wall

3-4 days per lift = 5-6 weeks total!

3 weeks

+ 5-6 weeks = 8-9 weeks

-6 MONTH DIFFERENCE

**Cost Impacts**

Including,

- Rock Grinding: ~$400,000
- Excavation: ~$500,000

**OLD SYSTEM:**

~$2,000,000

**NEW SYSTEM:**

~$1,350,000

**COST SAVINGS:**

~$650,000

**Conclusions**

Efficient use of slurry wall in most locations on the project

However,

Alternate system on South side at Concourse B, and at the Tunnel connection

Shotcrete problems vs. Slurry wall problems

The original shotcrete design is justified in its application on this project.

**Overview**

Permanent building systems

- Greater impact on the building's overall performance
- Long-term owner, long-term building
  - Improving quality will have lasting effects
  - Security vs. Energy Efficiency
  - Life-cycle costs

Minor components, major impacts

Example: Curtain Wall System

- Glazing
Modeling the original design
Curtain Wall modeled into ENERGY10 software
• Double glazed system
  • 1/4" glass with low-e coating
  • 1/2" airspace
  • 1/4" glass
  • 2 layers of 1/8" sandwich a polyvinyl membrane
  • improves soundproofing
  • improves security
  • U-value: 0.509 BTU/(hr-SF-°F)

Change impacts of various components
Value Engineering:
Coatings:
• Low-e
Shading:
• Add shading system
Layers of Glazing:
• Triple glazing

Conclusions
Evaluate the importance of Energy Efficiency with respect to…
• the actual application
• the initial cost
• the operating cost

The original glazing design holds the most value to the owner in this application.
**Project Delivery Selection**

Elements affecting the Project Delivery Process:

- Owner experience, capabilities
  - e.g. Multiple projects for MWAA; construction staffing
- Source of funding
  - e.g. Public bonds for MWAA
- Project complexity
  - e.g. Tunnel Construction is unique
- Project timeline
  - e.g. Not urgent; compare to data center, pharmaceuticals

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**Commonalities to other Airport Projects**

**Data Collection**

- Survey
  - Sent to airports across the country
  - Gathering information from multiple airport projects

**Results**

- Four International Airports:
  - Washington Dulles International Airport
  - Chicago O'Hare International Airport
  - Miami International Airport
  - Seattle-Tacoma International Airport

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**Commonalities to other Airport Projects**

Key questions:

- How was the project awarded?
- How was the project funded?
- What type of contract was used?
- What were the effects of phasing or packaging on the project?

Additional questions alluded to the relationship developed between project team members:

- Corresponds to the number of change orders, schedule extensions and general communication
**Analysis**

A change is needed...

The first steps:
- Owner decisions related to Project Delivery have the ability to create, or relieve, tensions in the project team
- How does an owner know if a decision will negatively impact their project?
- More owners must be educated to understand impacts of their decisions

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**Owner Education**

Help more owners to realize the impacts of...
- **Type of Contracts**

<table>
<thead>
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**Commonalities to other Airport Projects**

**Respondents:**
- Primarily contractors, an architect

**Common Responses:**
- Use a contractor selection method based on Best Value
  - Low Bid is insufficient
  - Funding source not a barrier – eg. BWI
- Use a lump sum contract
  - If quantities are unknown, use Unit Price – eg. Excavation

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**Responses cont.**

- Packaging common throughout the Airport market sector
  - Due to increased communication between packages
  - As a result...significant cost growth
- Phasing less common
  - Less cost growth seen, as on BWI (no cost growth)
  - Better relationship between Owner’s Rep and GC

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**Owners vs. Contractors**

Owner and contractor interests are more closely aligned
Change orders are less frequent
Contractors are encouraged to find the best way to deliver the project

---

**Change orders**

- Higher bids due to increased coordination, mobilization impacts
  - Project is bid out at different times in packages
  - Fast-Tracking the project

---

**Possible Results**

- **Impact on the Project**
- **Possible Results**
  - **Low Bidder**
    - Highly competitive bids
    - Change orders are a major issue
  - **Best Value**
    - Contractors are encouraged to find the best way to deliver the project
    - Change orders are less frequent
    - Owner and contractors interests are more closely aligned

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**Conclusions**

Help more owners to realize the impacts of...
- **Type of Contracts**

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**Phasing**

- Phasing requirements define sequencing
  - Contractors understand/define it to owner’s interests in phasing

**Packaging**

- Project is bid out at different times in packages
  - Higher bids due to increased coordination, mobilization impacts
Conclusions

A fundamental change is needed.

Until then,

Owner education is key

Allowing for,

Decreased tensions

Better relationships within team

Less wasteful projects

Better product delivered to the owner

Presentation Summary

Analyzing the Pedestrian Walkback Tunnel,
- Soil Retention System ➔ Slurry Wall
  - Significant issues eliminated
  - Cost and schedule decreased
- Curtain Wall System
  - Low-e, double glazed windows are optimal
- Project Delivery Systems Analysis
  - Further education
  - Increase awareness of the impacts of owner decisions

More importantly,

Analysis focuses around the owner’s needs and requirements
and their definition of value

QUESTIONS?

Impacts

Cost

Costs can be justified through the savings of time from the
duration of the excavation, and also the redesign of formwork for the
cement foundation walls.

Old: SRS original cost: approx. $700,000
  Change Orders: nearly $700,000
  -DOUBLES the original cost of the system
  -Due to Flooding and Earth Movement
New: 20,000 SF @ $10/SF = $200,000 for trench and slurry
  2000 CY concrete, 1500 tons of rebar = $250,000
  Rock Grinding: $400,000 (unchanged)
  Excavation: $500,000 (unchanged)

Schedule

Old: 8 month duration ÷ 7 lifts = 1 month per lift

New: 3 weeks added at the front end of the project for slurry wall
  -Mobilization: 1 week
  -100 ft/day @ 400 ft = 4 days ≈ 1 week
  -Demobilization: 1 week
  Better flow of work due to decreased activities on site
  -2 track grinders: 2 days
  -Full use of loader and excavator
  -Tiebacks installed in 2 days
  3-4 days per lift = 5-6 weeks total!