Moving 3 Million Yards of Earth

Project Overview

- Re-Align & Widen 4 Miles of I-70 Mainline + New CD System
- Construct New Six Points Interchange
- Construct New Airport Interchange
- Construct 10 New Bridge Structures
- Install 2 Miles of 96" Pipe
- Relocate 10,000 Ft. of Creek Channels
- Project Design Started in April 2002
- Open to Traffic Date - December 2004

- Fast Track Process – Accelerated Design & Construction Schedule
- Project Broken into 7 Contracts – Let as Design Phases Completed
- 2.9 Million Cys Excavation & Embankment Required
- Grading & Embankment Contract Completion Key to Project Success
- Grading Contract Let October 2002; Work Started in November 2002

Grading Contract

- Major Embankments to be Complete by May 2003
- All Excavation Complete by July 2003
- Winter Embankment Construction Critical to Schedule
- Soil Modification Selected to Allow Uninterrupted Construction During Winter
- Analysis Indicated Use of KLD
- Winter '02-'03 Produced Extreme Weather Conditions
1.9 Million CY of Cut
800,000 CY of Fill
300,000 CY of Fill
12,000 ft One Way
11,000 ft One Way
Site Investigation

Economic Haul

Machine Selection

- Dual Engines
- Tractor Engine = 450 HP
- Scraper Engine = 249 HP
- Heaped Capacity = 31 CY

Caterpillar 637 Scraper
(Courtesy CASE Corporation)

Wheel Tractor with Pulled Scraper
(Courtesy CASE Corporation)
- Single Engine
- Tractor Engine = 425 HP
- 3 Bucket Set Up Heaped Capacity = 54 CY
- Top Speed = 25 MPH

Machine Selection

Quadtrac Tractor with Pulled Scraper
(Courtesy CASE Corporation)
- 4 Independent Tracks
- Single Engine
- Tractor = 450 HP
- 3 Bucket Set Up Heaped Capacity = 54 CY

Case Scenario

Courtesy INDOT & PB

Case Scenario

Courtesy INDOT & PB
Productivity & Cost

- Dual Engines
  - Productivity = 90 CY/HR
  - Much Higher EOE
  - $3.19/CY

- Single Engine
  - Productivity = 75 CY/HR
  - Average EOE
  - $2.80/CY

Dual Engines are more productive and have a much higher EOE compared to Single Engine. The cost per cubic yard is also lower for Dual Engines.

Mass Haul & Haul Road

- Walsh Construction's goal was to provide straight and smooth haul roads.
- The condition of the haul road greatly affected our production.
- Big difference between a tractor moving at 20 mph vs. 25 mph, hauling 54 CY each time over an 11 hour shift.
- We accomplished this by constantly using a CAT 12H Motor Grader.

Bridgeport Bridge Shoring

- Existing Bridgeport was the only access across I-70 closed to traffic.
- Predetermined by INDOT that existing structure could only carry 40 Ton load across.
- Extra weight of Tractors and 3 full Scraper Buckets necessitated the use of Temporary Shoring.
- H piles and cross beam members used on each span without effecting traffic on I-70 accomplished this.

Haul Road Maintenance

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Scraper Operations (in cut section)

- Pull Type 18 CY Scraper Buckets.
- Two models used: Miskin SP-D18 & John Deere 1810E
- Unnecessary for Excavator and Dozer to load scraper buckets.
- Wide open mouth scraper bucket. 30 Degree cutting edge angle.
- Each cut is 3 to 5 inches deep, i.e. clean cut area.
- Smooth cutting edges typically used, however serrated edges can be used in hard ground.
- Scraper Buckets can also be top loaded.

Scraper Operations (in fill section)

- Miskin Scraper Buckets use gravity to unload in the fill.
- John Deere Scraper Buckets use a hydraulic ejector to unload.
- Unloads in even 8” to 12” lifts.
- Precise Dumping. Dump one Bucket after another in a continuous train.
Placement of Fill

- After Scraper Bucket has dumped, a CAT D6 Dozer will knock down any small piles to create an even 8” lift.
- The lift is either compacted with a CAT 815 Sheepfoot Compactor to achieve the required density or Soil Modified.
- All Dozers were equipped with GPS.

Cat D6R GPS Dozer

- All grades are downloaded from a website, created by an outside engineering firm that generated the grades from the contract drawings.
- Information is downloaded onto a Memory Card. This memory card is installed into a Sitemvision Monitor in each dozer cab.
- Stakeless Environment.
- Typically six crews of two men each would have been used to stake a project of this magnitude. Walsh Construction used two engineers.

Soil Modification

- Walsh Construction used a day and night shift to complete the project on schedule.
- Two 11 hour shifts were incorporated each day.
- The 12th hour was used for re-fueling and maintenance.
- During winter months, Walsh Construction worked 7 days a week to maintain soil temperature above 35 degrees.
- The third worst winter in Indiana was just another challenge for Walsh Construction to overcome.

Shift Schedule

- Walsh Construction used a day and night shift to complete the project on schedule.
- Two 11 hour shifts were incorporated each day.
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96” Pipe

- Over 11,000 LF of 96” Pipe
- Deepest section was 42’ below existing grade
- Material used for pipe was “96” SmoothCor Metal Pipe”
- Polymer Coated Double Walled Pipe.

Pipe Material Selection

- Reduced Weight, 66% lighter than concrete pipe
- Reduced weight also affected handling and placement.
- 20’ long sections. Less joints, over 11,000 LF.
- Material Selection affected equipment selection
Soil Condition

• Soil Borings were carried out prior to the bid to establish exact material that was to be encountered on 96" pipe.
• Typically the material encountered was clay, hard (blue) clay, sandstone, siltstone and shale.
• Pockets of groundwater were encountered above hard rock. The hard rock was approximately 10' below the invert of the pipe.

Equipment Selection

• Hitachi EX1200 excavator was used to dig and place the 96" pipe. The operating weight of this piece of equipment is 250,000 #. Walsh Construction used a 7 ½ CY bucket.
• The spoil material was handled with a CAT 345 Excavator.
• B-Borrow material was placed using a CAT 325 with plate tamp.
• Dirt Backfill was placed with two CAT D8 Dozers and CAT 815 Sheepsfoot Compactor.
• A Trench Box was specially made for this application. 28' long, 14’ wide and 18’ tall.

Construction Statistics

• 3,000,000 CY of Earthwork (volume of 3 Conseco Fieldhouses)
• 11,000 LF of 96" Pipe
• One of the worst winters in decades
• Completed the job as scheduled!!!

Final Product

• Excess material > planned due to reduced shrinkage of treated soil
• Post modified soil is an “engineered” material - may be < 100 pcf
• JTRP Studying lime modification & developing new guidelines for use by INDOT

Construction Issues

• Continuous shifts during sub-freezing temps. to maintain 35 degree soil
• Proctor required for each lift due to time sensitivity of modified soil properties
• Reduced durability of nuke gauges in freezing temps.
**Construction Issues**

- Final quantity measurements?
  - Use of GPS for original & final surfaces
  - Use of DTM to provide quantities
  - Additional CE for sectioning
- When is modification warranted?
  - MC taken daily compared to optimum
  - Drying time vs. Schedule
  - Sub on-site vs. Additional mobilizations

**Construction Facts**

- 2.97 Million Cys Moved from Nov. 2002 thru August 2003 at a Cost of $11.2 Million
- 118,000 Tons of KLD Incorporated into Embankments at a Cost of $7.1 Million
- Total Unit Cost = $6.87 per Cy in Embankment
- Avg. Pct. KLD = 5.4%
- Critical Embankments Completed on Schedule

**Temperature**

**Precipitation**

**Production**

**Production**
Production

Production vs. Weather

Benefits

- Eliminates Typical Construction Winter Downtime
- Provides Engineered Soil & Improved Material for Embankment
- Allows Excellent Process Control
- Cost Effective? - $7.1 Million to Gain 5 Month’s Production – 1 Construction Season
- Maintained Critical Schedule for Project Completion

Work in Progress

Questions