UCT UNDERGROUND CONSTRUCTION TECHNOLOGY
THE UNDERGROUND UTILITIES EVENT | JANUARY 25-27, 2022 | FORT WORTH, TEXAS

Women-Run Team Designs, Constructs 60” Tunnel Under Houston Neighborhoods

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Vanessa Moreno – BRH Garver

Hazen

BRH GARVER

Agenda

- Project Description
- Design Proposal
- Tunnel Construction
- Summary

Need for Project

- Facilities Consolidation
- Reduce O&M Costs

Project Description

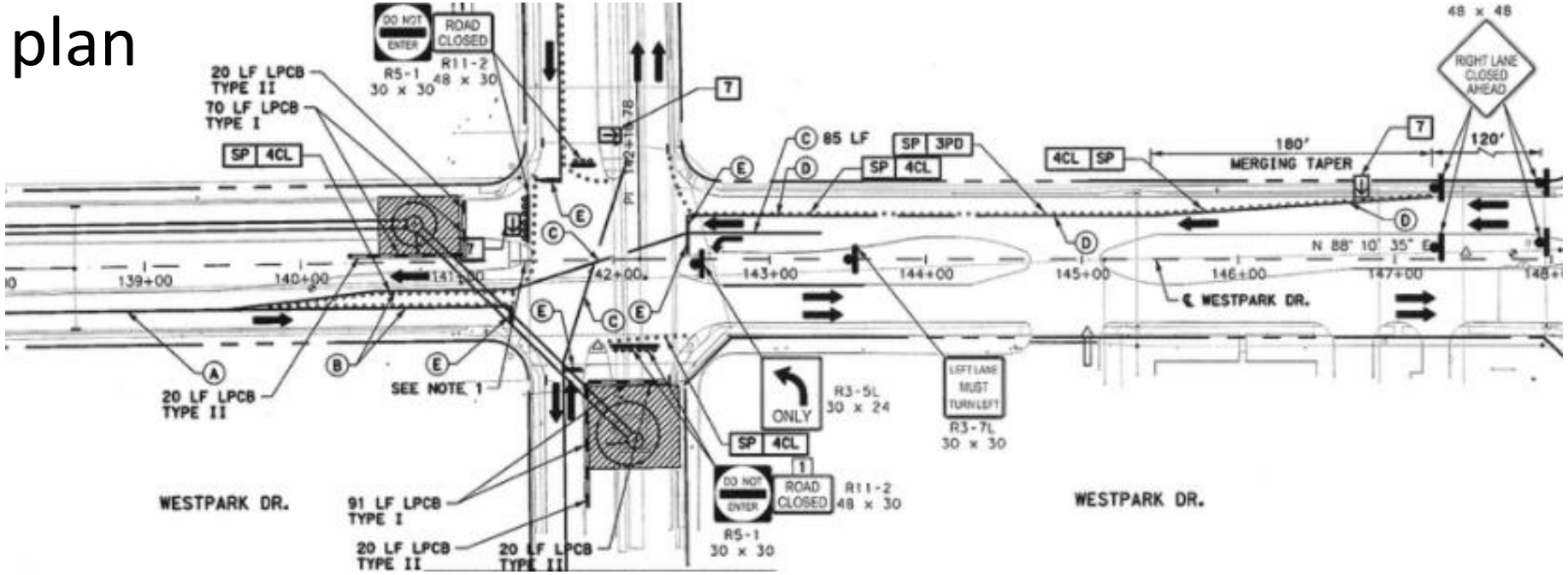
- ~4,600 LF of 60-inch FRP gravity sewer, ~55 feet deep
- Three 48-inch stub-out lines by tunnel methods (351 LF total)

Design Drivers

- Deep installation driven by the connection points
- Maximum design tunnel length: 700 LF
- Shaft locations chosen to minimize public and environmental impacts

Design

- 8 tunnels with 9 shafts
- Tunnel lengths between 177 LF and 682 LF
- Shaft locations resulted in a complex multi-phased traffic control plan



Design - Schedule

Activity	Date
Preliminary Design Kickoff	June 2015
Design Completion	October 2018
Bidding	February 2019
Notice to Proceed	October 2019

Tunnel Proposal

BRH Garver bid this job to include the purchase of a new microtunneling machine.

- Herrenknecht AVN-1200 MTBM

Proposal:

- Combine shorter tunnels
- Eliminate shafts
- Modify alignment to contain curves

Tunnel Proposal

Alignment	Number of Tunnels	Number of Shafts
Design	8	9
Proposed	4	5

- Eliminated 4 construction shafts
- 2 intermediate manholes to be installed after tunnel completion for interconnections

Tunnel Proposal

- Three design tunnels → 1,436 LF straight tunnel
- Two design tunnels → 1,609 LF curved tunnel
- Three design tunnels → 1,502 LF curved tunnel
- One tunnel remained unchanged

Tunnel Proposal Review

- Coordinated with Client, Engineer, and Regulatory Agencies
- Manhole spacing for cleaning
- Innovative Technology - First time Contractor will do a curved microtunnel

On-site manufacturer training and assistance during initial setup and MTBM launch for portions of all long tunnels.

Hazen
CITY OF HOUSTON TEXAS
TEXAS COMMISSION ON ENVIRONMENTAL QUALITY
BRH GARVER
HERRENKNECHT Tunnelling Systems
VMT
KILDUFF UNDERGROUND ENGINEERING, INC.

Tunnel Proposal Review - Benefits

- Cost credit for deleted shafts and manholes
- Shorter tunnel construction time
- Reduction in public and environmental impacts
- Apply to future design projects

Tunnel Proposal Review - Benefits

- Simpler traffic control plan
- Shorter tunnel construction schedule

Single Point of Entry to Neighborhood

Tunnel Proposal Review

Client and Engineer accepted the Contractor's proposal.

- Revised design met intent of project while minimizing impacts
- Built-in risk mitigation
  - Project started with shortest, straight tunnel drive
  - On-site manufacturer training and monitoring
  - If had problems during construction, they could revert to the original design

Construction – Work Sequencing

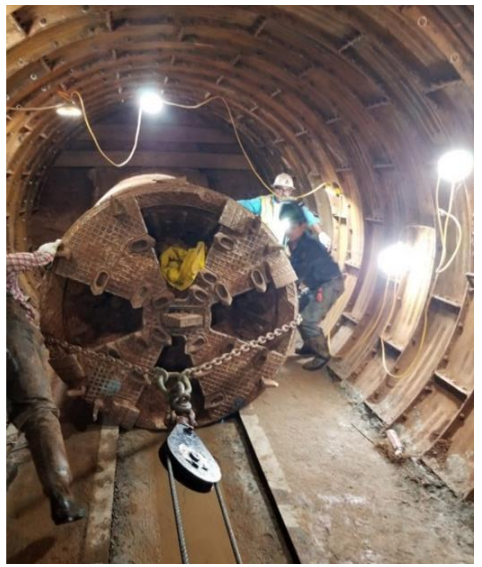
Construct tunnels in order of perceived risk:

1. 1,436 LF straight tunnel
   - Manufacturer training and assistance for operation of AVN system for first 50% of initial drive (700 foot minimum)
2. 1,609 LF tunnel with 5,139-foot radius curve
   - Manufacturer training and assistance for implementation and operation of gyroscopic guidance system for 100% of first curve installation
3. 1,502 LF tunnel with 4,016-foot radius curve
   - Manufacturer training and assistance for operation of gyroscopic guidance system for first 50% of second curve installation

Construction - First Tunnel

- 24-hour operation to cross-train multiple crews
- High jacking loads developed at 75% completion
- At 750 tons, movement in the shaft caused misalignment leading to pipe failure 35ft from completion
- MTBM recovered with 90-in hand tunnel



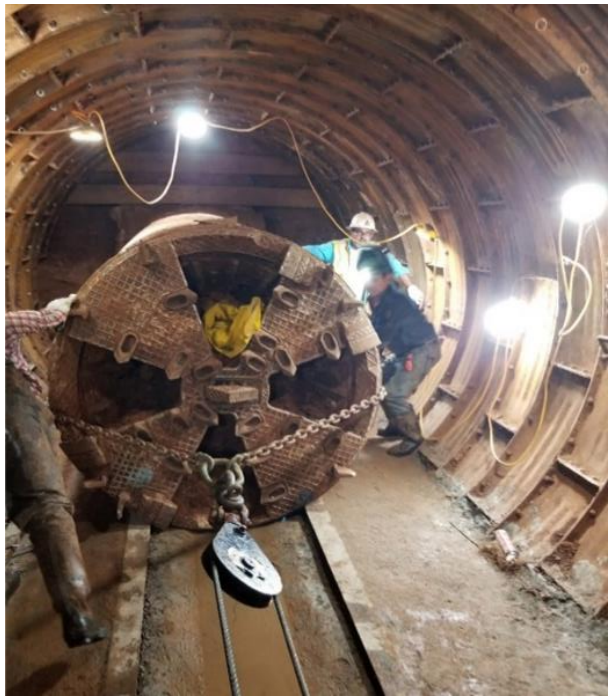



First Tunnel - Lessons Learned

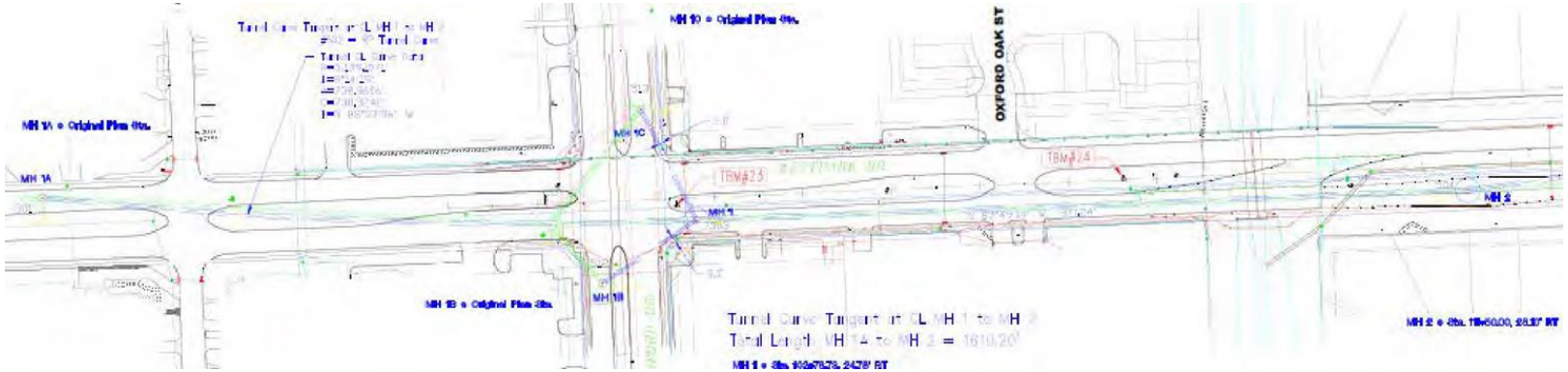
Don't break a pipe!

Adjustments made to tunnel process

- Overcut
- IJS use
- Support Equipment



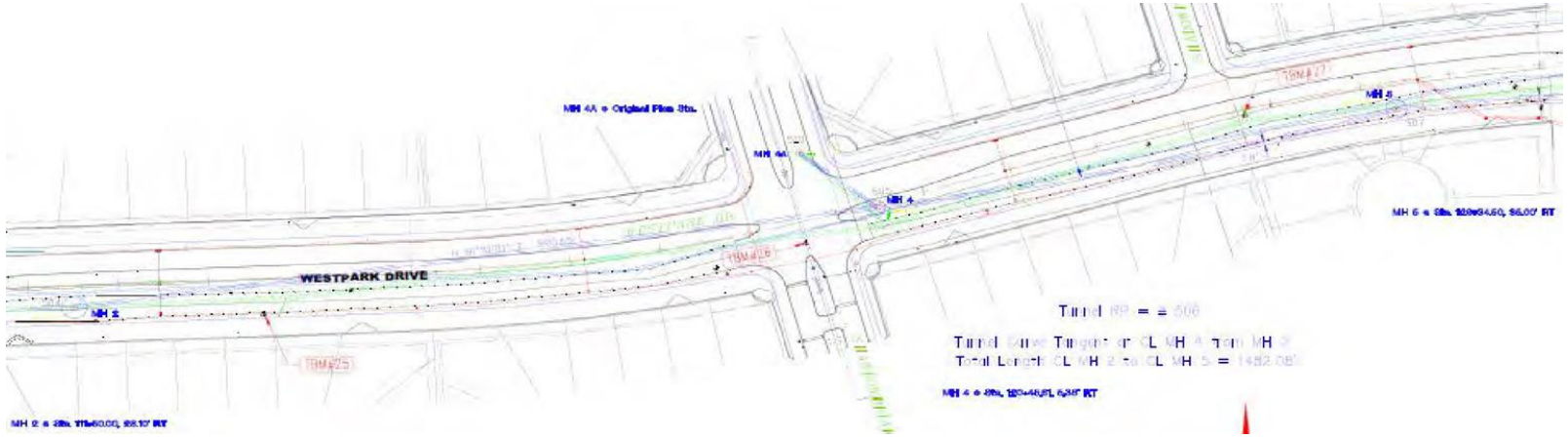
Construction - Second Tunnel



- First curved microtunnel installation
- MH 2 to MH 1A: 1,609ft
  - Curve Radius – 5,139ft
  - Curve Length – 738.9ft
- Completed tunnel at 250 tons

Construction - Third Tunnel

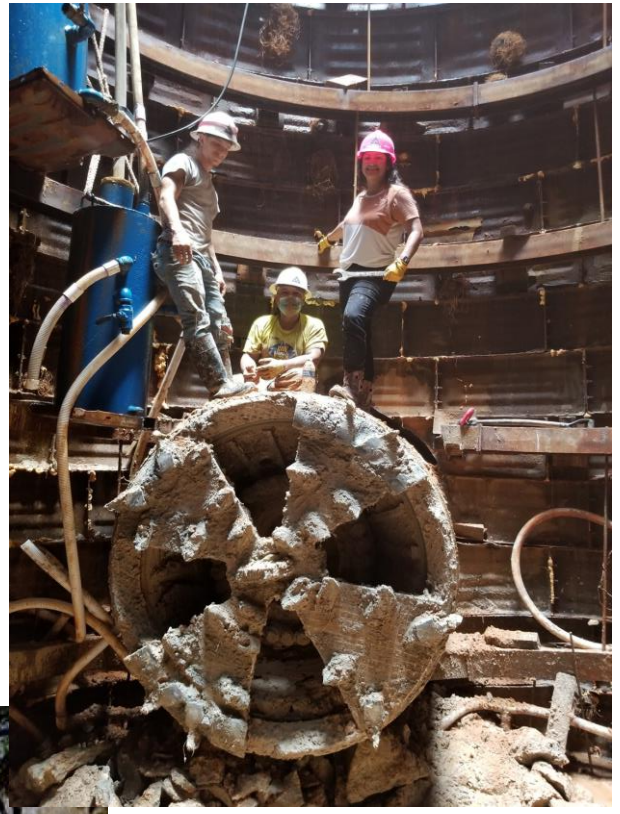
- MH 2 to MH 5: 1,502ft
  - Curve Radius – 4,016ft
  - Curve Length – 586.4ft
- Drive Completed at 200 tons



Construction

Key Components of Success

- Appropriate equipment
  - Guidance systems
  - Lubrication systems
  - Intermediate jacking stations
- Stakeholder participation
- Contractor's team



Summary

- Record drive
  - MH 2 to MH 1A: 1,609ft
- On line and grade
- No settlement
- Completed ahead of original tunneling schedule
  - Original Tunnel Completion Date: May 2021
  - Actual Tunnel Completion Date: October 2020
  - Tunnel Duration Reduction: 7 months

Questions?

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