A Total Engineered Approach to Coke Drum Skirt and Foundation Repairs

By

Becht Engineering Co., Inc
CTLGroup
Land Source

A team of specialty engineers and surveyors.

Why Use This Approach

1. Allows Owner Company to work with a single source for technical issues
2. Typically results in shorter turnaround time which can save significant maintenance and operating costs
3. End result is highly durable repair with extended service life
4. Physical repairs completed by mechanical/civil contractors

No Single Company has all the Answers

1. Utilize integrated technical team approach for best mix of experts in their respective fields
2. This team has worked together for past 15 years
3. Have been involved in numerous repairs to delayed coker drums and their associated foundations

Becht Engineering Utilizes Mechanical Experts in Coke Drum Repairs

1. Dr. Charles Becht, Mechanical Expert and President of Becht Engineering
2. Dr. Delroy Forbes, Civil/Structural expert with over 30 years experience with ExxonMobil
3. J.E. Sims, Welding Expert with over 30 years experience with CB&I
4. G.G. Karcher, Mechanical Expert with over 30 years experience with ExxonMobil

Note: Sims and Karcher were co-authors of the “Coke Drum Evaluation Manual” Published by The Materials Property Council

Typical Repairs Encountered

1. Shim plates corroded and ejected
2. Vessel tilted and/or rotated
3. Cracks in steel skirt
4. Cracks in skirt to vessel weld
5. Skirt deformation and buckling
6. Broken, bent and corroded anchor bolts
7. Damaged concrete octagonal foundation
8. Deterioration of coke pit

Overview of CTLGroup

- Evolved from the R&D of Portland Cement Association
- Independent Engineering/Consulting/ Laboratory Company since 1987
- Staff of 130 professionals and specialized technicians
- 85% of Professional Staff with Masters/PhDs and leaders on Technical Committee
- Range of High Profile Projects: Lincoln and Jefferson Memorial, Pyramids of Egypt, NASA - Goldstone Antenna, Launch Control Center, Shuttle Program, Lunar Concrete

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Approach To Coker Evaluation

- Condition Surveys – Visual Examination
- Nondestructive Testing – Impulse Radar, Impulse Response, Impact Echo, Corrosion Measurement, Service Life Prediction
- Repair Design and Material Selection – Environmental Concerns, Chemical Attack
- Sensors – Structural Health Monitoring Systems
- Laboratory Testing – Petrographic Examination, Chloride Testing, Compressive Strength, Sulfate Contamination

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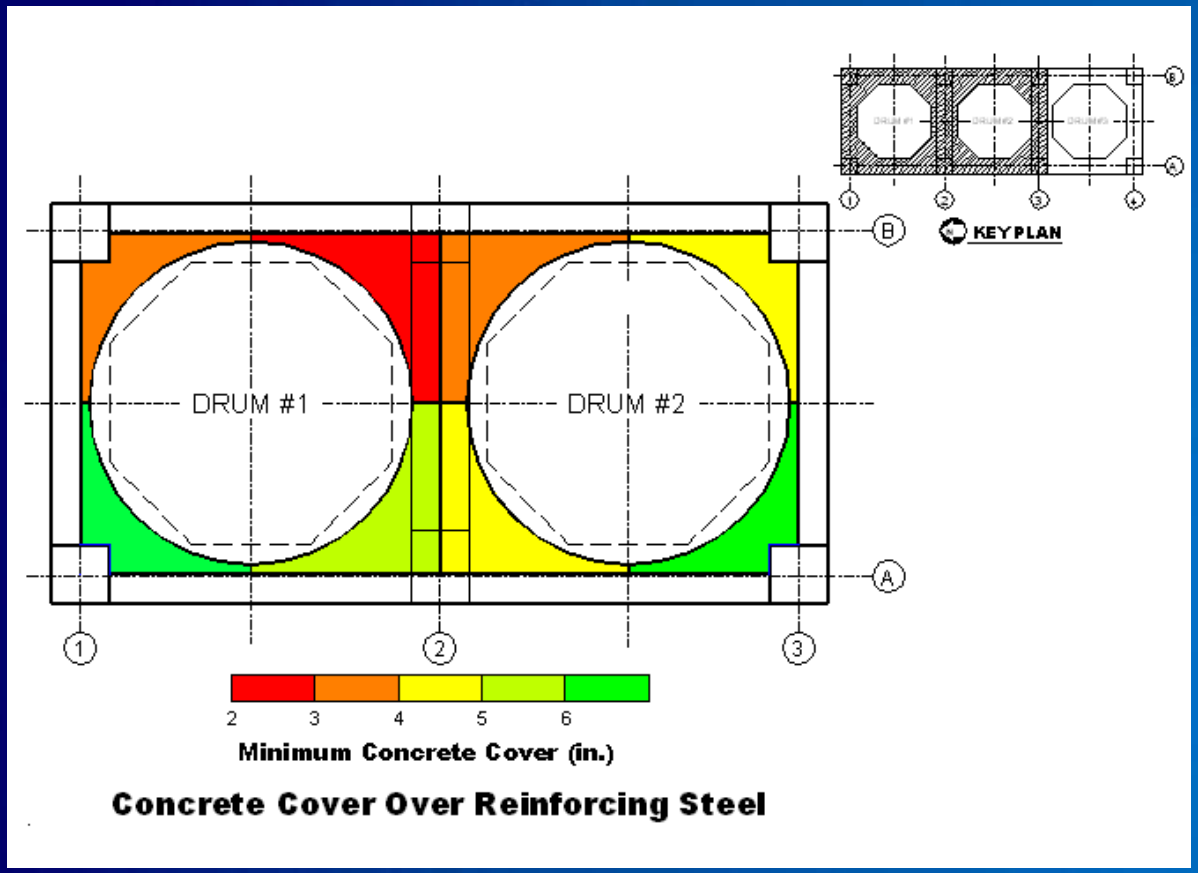
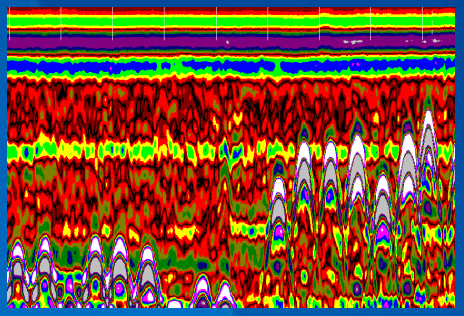
Impulse Radar





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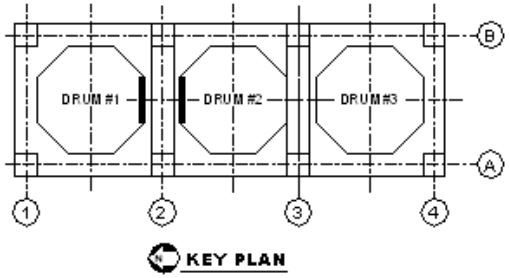
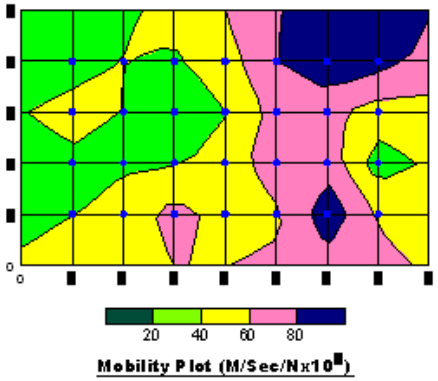
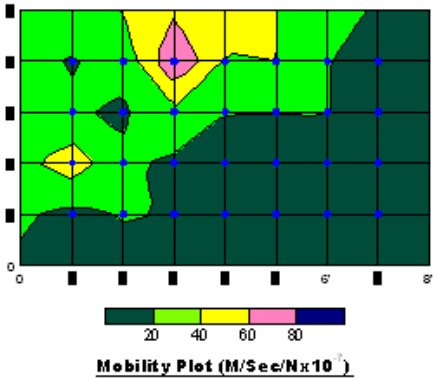
Impulse Response

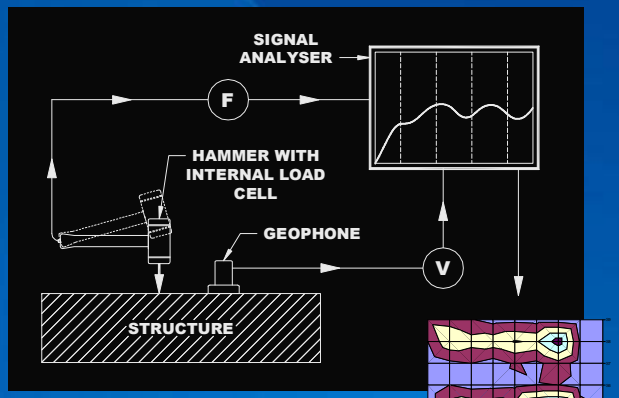




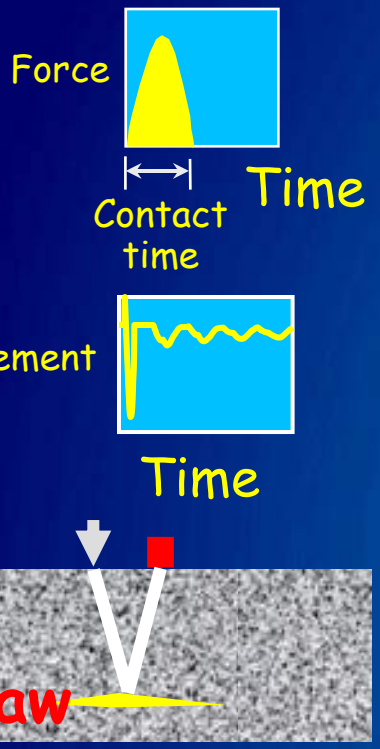
Drum #1 - South Beam

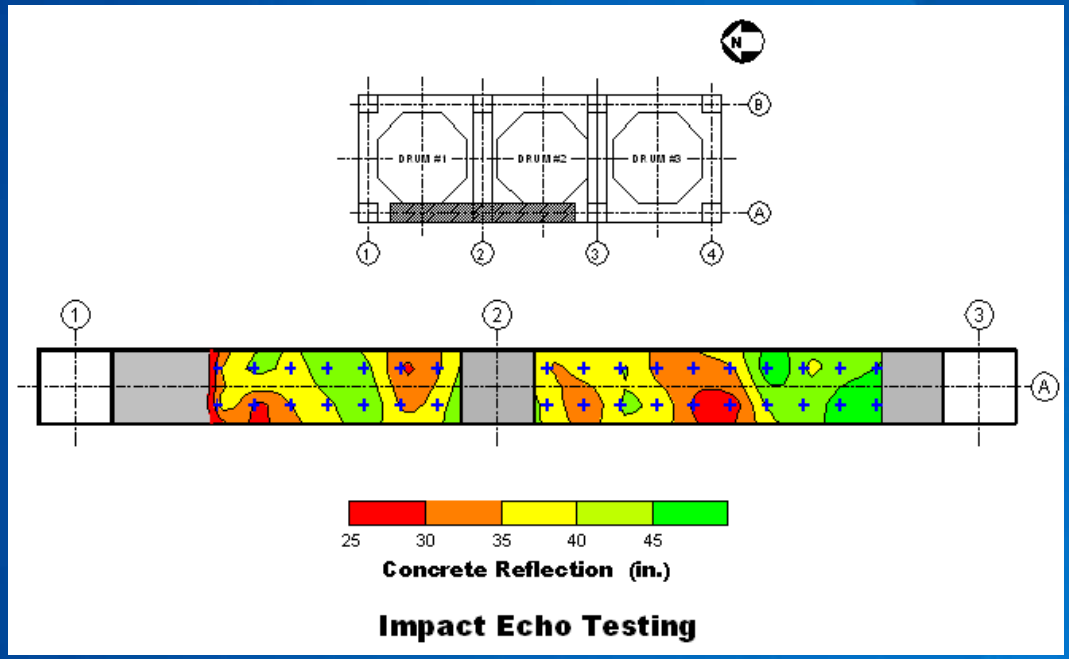


Drum #2 - North Beam



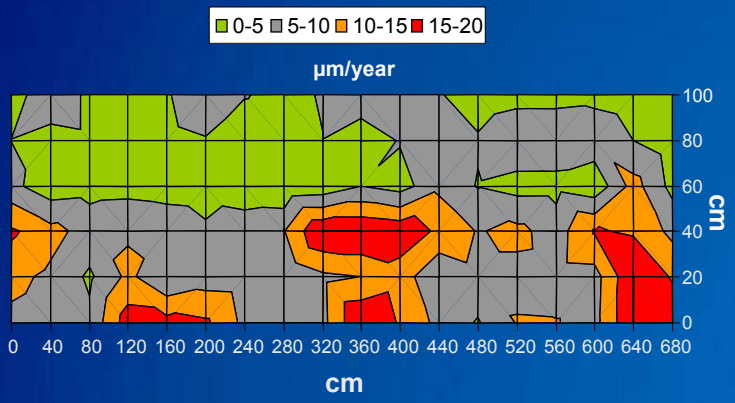
Impact Echo

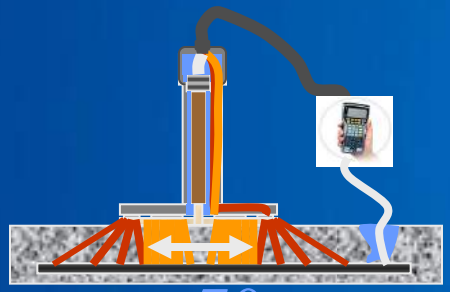

Force
Time
Contact time
Displacement
Time
Flaw


DRUM #1
DRUM #2
DRUM #3
25
30
35
40
45
Concrete Reflection (in.)
Impact Echo Testing

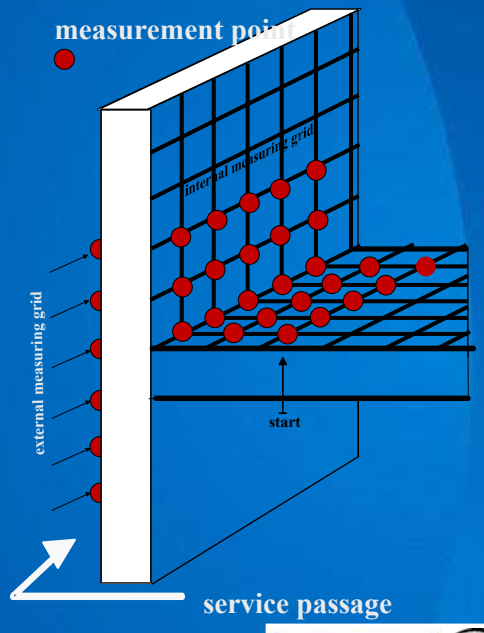
Service Life Prediction

Casting joint





70 mm



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Selection of Appropriate Repair Material

Coker Environment Issues:

- Chemical Attack
- Durability Concerns
- High Temperature and Shock Loading
- Repair Constructability Issues

Sensors

Structural Health Monitoring Systems

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Sensors

Structural Health Monitoring Systems

- Develop Instrumentation Specifications
- System Design
- System Installation
- System Maintenance
- Data Management
- Data Analyses
- Training and Operation

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Why Use Specialty Survey Organization?

LandSource has extensive experience working in petrochemical environment, coke drums in particular

Comprehensive Survey Capabilities

LandSource has wide array of tools to address all measurement needs

- Conventional Survey Methods
- Robotic Reflectorless Total Stations
- 3D Laser Scanning Capability

Damaged Concrete and Rebar on Octagonal Foundation

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Damaged Concrete in Octagonal Foundation

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Old Shims Under Baseplate

Severely Corroded Shims

Vessels Prepared for Lift

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Jack Pumps Prior to Lift

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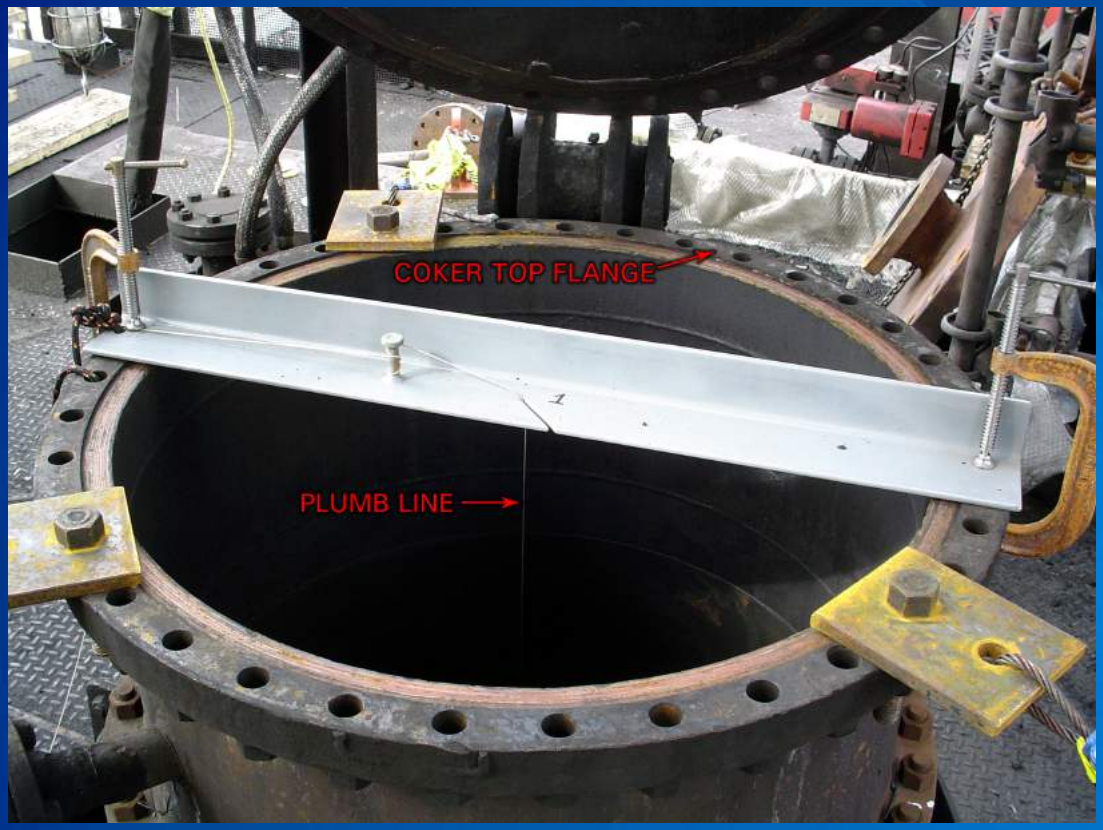
Plumb Bob Support at Top Flange of Coke Drum

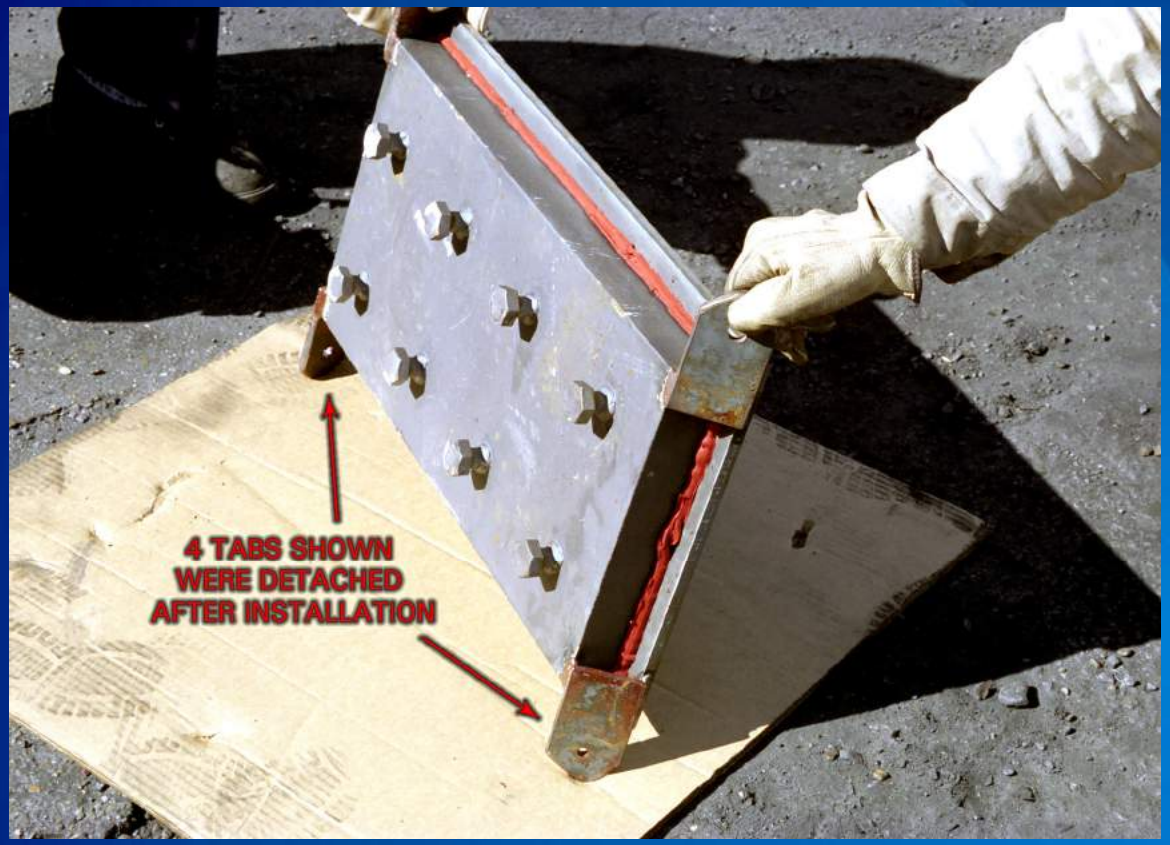


Plumb Bob Over Target at Bottom of Flange of Coke Drum

150 Ton Jack in Raised Position

Lift Frame (36 in. WF)

New Shims with Rulon Slide Plates



New Shims Installed

Concrete Test Cylinders

Forms, Rebar and Shims Before Concrete Placement

Final Product