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“We are not fit to lead an army into march unless we know the country; its mountains and forests, its pitfalls and prisppossess, its marshes and swamps.”

The Art of War, Sun Tsu
What is Constructability

• The effective and timely integration of construction knowledge into the conceptual planning, design, construction, and field operations of a project to achieve the overall project objectives in the best possible time and accuracy at the most cost-effective levels (Construction Industry Institute)

• Project Management technique

• A means to deliver a construction project with Improved Outcomes
Benefits of Constructability Review

- Project team is comprised of engineers and construction professionals
- Identify cost savings opportunities or alternative designs
- Develop more accurate estimated cost of construction for client
- Provide input to construction schedule / mitigate schedule delays
- Identify potential risk that impact construction
  - client H&S requirements
  - site operations
  - material of construction pricing and availability
When to Conduct Constructability Reviews

Typical Design Project Path

Conceptual Design → Preliminary Design → 30/60/90 Design → Final Design → Bid Documents → Construction
Contracting Relationships

Traditional Design-Bid-Build Triangle:
- Client
- CM
- Engineer
- Contractor

Turnkey Design/Build:
- Client
- Design/Build Entity
- Subcontractors
Design Build Contract Advantage

- Design-build firm retained by owner for design-build services
- Engineers and construction professionals are one team and collaborate during design phase
- Construction team implements the design and communicates with the engineer and owner as one team
Findings of Constructability Reviews

• Templated (cookie cutter) design elements do not work in every design
  – Wellhead vault designed with permeable bottom; local code required impermeable bottom. Sewer discharge: local permit required equalization tank prior to sewer connection

• Piping routes / design inefficient
  – Trench consolidation (reduce LF of trenching by combining pipes in one trench; reduces further risk of ground disturbance and surface disruptions)

• Compaction specifications do not meet the designed use of the finished surface
  – Can require additional compactions techniques/equipment
  – Can lead to future failure of finished surface in future, requiring repairs
Findings of Constructability Reviews

• Piping pressure test requirements are excessive or inadequate
  – Did not align with design performance criteria (max pump head pressure of 30psi, test required 100psi); (PVC piping pressure tested with air, creates hazard condition – alternative is hydraulic testing)

• Insufficient design drawing details for permitting purposes
  – Missing information: surveyed property boundary and offsets per building code, electrical design details (one line diagrams, service entrance details, load calculations)

Post construction Reviews

• Develop a “lessons learned” database to share with company design and construction professionals
Examples of Integrating Constructability in Design
Client Design Process Example: Chevron Remediation System Review Team (RSRT)

- Team of SME representatives: 3 Chevron staff and 3 key business partner staff
- Review remedial strategies for alignment with remedial drivers and cost efficiency
- Review mechanical system design for adherence to client design expectations, AND constructability of design
- Captured the lessons learned form over a decade of constructability reviews and operational input and published two key peer reviewed documents for internal use:
  - a standard design manual for mechanical remediation system
  - standard construction General Notes and Specifications
Chemical Processing Plant Remediation System Design

- Original design - Multiphase Extraction System with piping to be installed in an existing overhead pipe rack (20 feet elevation)
- Arcadis ECS conducted a Constructability Review which yielded a recommendation to change piping route from an existing aboveground piping rack to an underground piping installation
- Benefits:
  1. Pipe rack was near capacity and routing was difficult
  2. Eliminated need for expansion piping
  3. Allowed for remaining capacity in rack for future plant operations
  4. Eliminated the expenses and hazards associated with working from heights
  5. Eliminated challenges of hydraulic pressure testing of pipes at heights
  6. Estimated 30% cost savings
  7. Estimated 25% faster construction delivery schedule
About the Presenter

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