Dar Al Riyadh Insight #104
Construction Basis of Design (CBOD)

Dar Al Riyadh Insights reflect the knowledge and experience of our Board, executives and staff in leading and providing PMC, design and construction management services. Dar Al Riyadh believes in the importance of broadly sharing knowledge with our clients and staff to improve project outcomes for the benefit of the Kingdom of Saudi Arabia.

Construction Basis of Design (CBOD)

The CBOD seeks to further actualize Construction Industry Institute (CII) Constructability Concepts I-1 and I-5.

- ***CII Constructability Concept I-1 states "Constructability program is an integral part of the project execution plan."***
- ***CII Constructability Concept I-5 states "Basic design approaches consider major construction methods."***

Specific elements that an effective construction basis of design consider include:

- ***Comprehensive identification of required or preferred construction strategies, tactics, techniques, and tools to be incorporated in the construction process that influence project management and design.***
- ***Construction labor, skills, equipment, materials of construction, and logistical constraints to be reflected in basis of design.***
- ***CBOD addresses unique requirements to be incorporated in design development that reflect owner or contractor preferences for achieving the OPR.***

These owner project requirements may reflect:

- ***Prior experience of the owner.***
- ***Unique risks, opportunities, or constraints associated with the project.***
- ***Contractor capabilities and experience.***
- ***Special tools uniquely available to the project.***
- ***Broader programmatic objectives required of the owner or independently committed to by the owner that influence construction execution.***
- ***Applicable safety program to be used on project.***

CBOD considerations may be broadly grouped as basis of design requirements related to:

- ***Labor***
- ***Equipment***
- ***Materials***

- *Means and methods*
- *Management processes and practices*

Labor

- *Sourcing*
  - *Labor relations*
    - *Work rules and requirements*
    - *Labor jurisdictional requirements to be addressed*
  - *Visa requirements, limitations, process durations*
  - *Multi-national labor force impact on site segregation and development*
- *Safety*
  - *Hazard elimination*
    - *Hazard avoidance or reduction features to be facilitated by design*
      1. *Eliminate hazards*
      2. *Pinch points*
      3. *Heavy lifts minimized or eliminated*
         a. *Use of jack up construction*
         b. *Vertical modules*
      4. *Work at height*
         a. *Minimized or eliminated by construction at grade (less than 6')*
         b. *Permanent structures incorporate platforms or provisions for temporary platforms*
  - *Hazard mitigation*
    - *Reduce the hazard*
      1. *Equip any required scaffolding with railings and toe boards*
    - *Improved access to workface*
      1. *Access requirements for construction identified considering sequence of construction (and maintenance)*
    - *Enhanced positional awareness through use of RFID (radio frequency identification)*
  - *Knowledge*
    - *Activity linked safety and skills training reflected in construction resourcing plan and master project schedule*
    - *Activity linked equipment, materials and tools to facilitate staging and reduction in idle time*
    - *Reskilling for later stage activities including maintenance phase activities*
  - *Welfare*
    - *Onsite medical facilities and requirements*
    - *Camp requirements (facilities and services)*
  - *Productivity*
    - *Enhance labor productivity through design*

1. *Minimize the number of sku's for components and materials to be manually installed (nuts & bolts; welds; fasteners)*
2. *Use controlled environments at environmentally challenged sites*
   a. *Early usage of permanent facilities (warehouse, admin building)*
   b. *Temporary facilities provided for in plot plan development (dynamic air shelters).*

Equipment

- *Procurement*
  - *Labeling/tracking requirements (barcode/RFID)*
  - *Measurement units in installation (and maintenance) documents (English/metric)*
  - *Orientation of installation schematics to conform to installation position*
  - *Hazard mitigation*
  - *No sharp corners*
- *Logistics*
  - *Incorporation of adequately sized and placed lifting points*
  - *Shipping and packaging to eliminate removal of temporary bracing*
  - *Single stream protection and packaging materials to facilitate recycling*
- *Installation*
  - *Self-alignment*
  - *Self-leveling*
  - *Required laydown and movement envelopes including associated logistical equipment*
  - *Access corridors for installation*
- *Pre-commissioning*
  - *Incorporation of pre-commissioning isolation valves and electrical lockouts required*
  - *Accessible temporary attachment points for test equipment*

Materials

- *Preferred material sources and alternates and impact on design*
- *Material tracking requirements to be reflected in design specifications*
- *Preferred logistical approach and impact on design*
- *On-site use of batch plant – available quality of concrete*
- *Concrete placement strategy – pumped vs. bucket*
- *On-site bending of rebar – quality considerations to be reflected in design*
- *On-site welding of pipe and structural steel assemblies – impact on design and construction sequence*

Means and Methods

- *Focus is on means and methods selection rationale for design impacting elements of construction.*
- *Strategies*
  - *Reduce indirects*

- *Reduce general conditions cost by*
  - *Shortening schedule elements with high GC costs (specialized labor or equipment)*
  - *Reducing overall project schedule*
- *Reduce need for enabling works*
  - *Reduce overall project schedule*
- *Modularization/fabrication with appropriate metrics such as work-hours displaced embedded in each shipment received*
- *Requirements for off-site construction*

- *Tactics*
  - *Reduce temporary works*
    - *Minimize need for scaffolding by incorporating platforms or support for temporary, reusable platforms in structural design*
    - *Incorporate temporary steel for shipping of assemblies in final assembly design to eliminate removal of shipping steel*
  - *Reuse formwork and temporary works*
    - *Size foundations to re-use formwork*
  - *Minimize excavations*
- *Techniques*
  - *Lift many once – high lifts with long duty cycle benefit from lifting many items at once to height and final placing with alternate equipment*
    - *Daisy chaining requires lift points that facilitate safe lift*
    - *Racking and packaging for lifts may eliminate lifting skids and pallets*
- *Tools*
  - *Unique equipment to be employed*
    - *Heavy lift*
    - *Welding*
    - *RFID*

Management Processes and Practices

- *Owner's policies, guidelines or other directives affecting construction*
- *Regulatory limitations on construction practices, means & methods*
- *Desired sequence of construction*
  - *Early work packages required*
  - *Permanent facilities to support construction*
  - *Trade sequencing or other labor driven sequencing*
  - *Restricted construction*
  - *Preliminary execution strategy and plan*
  - *Eliminate later stage trenching operations impacting site logistics*
  - *Incorporate commissioning sequence and temporary facilities and equipment*

- *Establish "site needs" dates (including mod yard need dates)*
- ***RFI reduction by reflecting means & methods considerations in design model (BIM)***
- ***Sustainability***
  - *Construction energy, water, waste requirements*
    - *Energy*
    - *Waste*
    - *Water*
    - *Social*
      1. *Knowledge transfer*
      2. *Community development*
      3. *Industry development*
         a. *Areas targeted for local sourcing*
- ***Validation and verification***
- ***Quality control and assurance***
- ***Commissioning***
  - *Provisions to be reflected in design.*
    - *Systems/subsystems/components should be designed to be functionally, mechanically, electrically, and electronically as independent as practical to facilitate pre-commissioning testing.*
    - *Recognize that commissioning starts with the first drawings in the feasibility stage.*
- ***Workface planning***