
Plant Structures Engineering: Equipment Foundations, Pipe Racks and Containment Course

2 – 6 May 2027
Kuala Lumpur





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Programme Summary

Plant structures engineering for equipment foundations, pipe racks and containment is a one-week training course for civil and structural leaders at managerial level, culminating in a structural design basis and review plan for an industrial project they lead. Industrial plants depend on reinforced concrete that carries vibrating machines, heavy vessels, pipe loads and stored liquids, and errors surface as vibration, leaks and costly rework. The approach links loading, foundation behaviour, detailing and interdisciplinary review. Mars Training Centre UK delivers this programme in plant structures engineering.

The Business Case

Plant structures sit on the critical path, and late vendor data or piping changes force redesign at the worst moment. A compressor foundation that resonates or a bund that leaks can stop production or trigger an environmental incident. Leaders who set a sound design basis, ask the right review questions and manage interfaces keep construction moving.

- Rework and Schedule Delay: Fall as design bases, vendor data and piping loads are frozen and checked before construction.
- Operational Reliability: Improves as machine foundations are tuned away from resonance and support structures limit deflection.
- Environmental and Containment Risk: Reduces as liquid-retaining structures are detailed for crack control and tightness.

Principles and Evidence Base

- ACI 351.2R Report on Foundations for Static Equipment: Guides the loading and design of vessel and tank foundations in Session 2.
- ACI 351.3R-18 Report on Foundations for Dynamic Equipment: Frames frequency analysis, vibration limits and soil-structure interaction in Session 3.
- ACI 350 Requirements for Environmental Engineering Concrete Structures: Sets the crack-width and tightness approach for containment structures in Session 4.
- Heavy Industrial Structural Design Criteria: Inform the load combinations and design basis for plant structures in Session 1.



Intended Participants

- Leaders accountable for civil and structural deliverables on industrial and process plant projects.
- Managers who approve structural design bases, calculations and drawings for construction.
- Lead engineers who review contractor and consultant designs for plant structures.
- Project engineering heads who coordinate civil, mechanical and piping interfaces.

The programme serves oil, gas and petrochemical facilities, power and water plants, mining and minerals processing, and heavy manufacturing.

Learning Outcomes

1. Participants will be able to construct load combinations for plant structures.
2. Participants will be able to evaluate static equipment foundation designs for bearing, stability and anchorage.
3. Participants will be able to diagnose resonance and vibration risk in dynamic machine foundations.
4. Participants will be able to judge pipe rack and support structure designs for load paths, deflection and expansion.
5. Participants will be able to specify crack control and detailing for containment and liquid-retaining structures.
6. Participants will be able to prioritise design review checks and interface actions for a plant project.

Programme Structure

Day 1: Plant Structures Engineering Design Basis

What loads and criteria govern concrete structures in an industrial plant?

- Structural Design Basis Documents for Plant Projects
- Equipment, Operating, Test and Upset Loads
- Wind, Seismic and Thermal Actions on Plant Structures
- Load Combinations and Serviceability Criteria
- Geotechnical Data and Foundation Selection

Day 2: Static Equipment Foundations

How are vessels, tanks and heat exchangers supported safely?

- Vertical Vessel and Column Foundations
- Horizontal Vessel and Heat Exchanger Supports
- Tank Ring Walls and Slab Foundations
- Anchor Bolt Design and Grouting
- Pile Groups and Settlement Checks



Day 3: Dynamic Machine Foundations

How are foundations for rotating and reciprocating machines kept out of resonance?

- Machine Unbalance Forces and Vendor Data
- Natural Frequency and Resonance Margins
- Soil Stiffness and Damping Parameters
- Block and Table-Top Foundation Types
- Vibration Limits and Troubleshooting Existing Foundations

Day 4: Pipe Racks, Supports and Containment Structures

How are pipe racks and liquid-retaining structures detailed for performance?

- Pipe Rack Framing, Bracing and Expansion Joints
- Piping Friction, Anchor and Thermal Loads
- Bunds, Sumps and Secondary Containment
- Crack Width Control and Joint Detailing
- Durability of Concrete in Chemical Environments

Day 5: Applying the Structural Design Basis and Review Plan

How are loads, foundations, supports and containment brought together for one project?

- Design Basis Review for a Participant Project
- Foundation and Support Design Checks
- Civil, Mechanical and Piping Interface Register
- Peer Challenge of Design Review Plans
- Structural Design Basis and Review Plan Presentation

Methodology

The programme relies on case analysis and structured design-review exercises. Participants examine design bases, calculations and drawings from refinery, power and processing plant projects, identify missing load cases and weak details, and decide what a reviewer should accept or reject.

- Suggested activity: Building the load combinations for a pipe rack from piping and wind data.
- Suggested activity: Checking a compressor foundation for resonance against vendor operating speeds.
- Suggested activity: Reviewing a bund design for crack control and joint detailing.



Capstone Output

Each participant completes a structural design basis and review plan for a current or planned plant project. It records loading and serviceability criteria, foundation and support approaches, containment requirements, review checkpoints and the interface register with mechanical and piping teams, ready to issue to designers and contractors.

Frequently Asked Questions

Is plant structures engineering training suitable for managers who no longer design every day?

Yes. It is written for civil and structural leaders who approve and review designs. It assumes a structural engineering background but not recent hands-on calculation work.

Which guides underpin plant structures engineering in this course?

It draws on ACI 351.2R for static equipment foundations, ACI 351.3R-18 for dynamic equipment foundations, ACI 350 for containment structures and published heavy industrial design criteria.

How is the plant structures design basis and review plan used at work?

You take back a plan for a real project that sets design rules and review checkpoints for designers and contractors.

How does plant structures engineering differ from general building design courses?

It concentrates on equipment, piping and liquid loads, vibration and containment found in industrial plants, rather than on offices, housing and commercial buildings.