Seismic Design Training Course: Hazard, Ductility, Isolation and Retrofit of Structures

4 – 8 January 2027
Amsterdam

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Programme Summary

Seismic design is the subject of this one-week training course for senior structural engineers, engineering directors and asset owners at managerial level, ending in a seismic design review file for one structure. Earthquake demand, structural response and detailing decisions often reach approval with thin evidence. The programme moves from hazard and ground motion to dynamic response, code-based design, ductility, isolation and retrofit, then a full review. Mars Training Centre UK delivers this programme on seismic design to mixed-organisation cohorts.

The Business Case

Seismic performance depends on choices made long before an earthquake: the design basis, the structural system, the detailing and the decision to strengthen or replace. When these choices are poorly documented, approvals slow and owners carry risk they cannot see. Leaders who can question the seismic design basis approve with better support.

- Life Safety Exposure: Falls as design basis, ductility and retrofit choices are tested before approval.
- Redesign Cost: Reduces as weak load paths and irregularities are found at review rather than on site.
- Approval Cycle Time: Shortens as review questions follow a fixed file and agreed evidence.

Principles and Evidence Base

- ASCE 7 Seismic Provisions: Supplies the design response spectrum, response modification and drift concepts, used in Sessions 1 to 3.
- Eurocode 8 EN 1998 Capacity Design: Applies the hierarchy of strengths that keeps yielding in ductile members, used in Session 3.
- ASCE 41 Seismic Evaluation and Retrofit: Sets performance objectives for assessing existing buildings, used in Sessions 4 and 5.
- Structural Dynamics Principles: Relates period, mode shape and damping to the force and displacement a structure attracts, used in Sessions 2 and 4.

Intended Participants

- Structural engineering leaders who approve seismic design basis documents.
- Engineering directors who sign off designs for buildings and bridges in seismic regions.
- Asset owners who decide whether to strengthen, isolate or replace existing structures.
- Design review managers who challenge consultants on seismic assumptions.
- Technical advisers who brief boards on earthquake exposure.

Typical settings include commercial property, transport infrastructure, healthcare estates and industrial plant.

Learning Outcomes

1. Participants will be able to construct a seismic design basis statement from hazard, site and ground motion data.
2. Participants will be able to evaluate dynamic response results against period, damping and drift expectations.
3. Participants will be able to appraise code-based seismic force and capacity design provisions for a given structure.
4. Participants will be able to diagnose irregularity, weak load paths and gaps in ductile detailing.
5. Participants will be able to prioritise isolation, damping and retrofit options against stated performance objectives.
6. Participants will be able to justify an approval recommendation using a seismic design review file.

Programme Structure

Day 1: Seismic Design Basis: Hazard and Ground Motion

What seismic demand does a site place on a structure?

- Seismic Hazard Assessment Summary
- Design Response Spectrum Construction
- Site Class and Soil Amplification Check
- Ground Motion Record Selection Sheet
- Seismic Design Basis Statement

Day 2: Structural Dynamics and Seismic Response

How does a structure respond when the ground moves?

- Natural Period and Mode Shape Review
- Damping Ratio Assumptions Table
- Equivalent Lateral Force Method Check
- Response Spectrum Analysis Review
- Base Shear and Drift Comparison

Day 3: Code-Based Seismic Design and Ductility

How do design codes turn seismic demand into member detail?

- ASCE 7 Seismic Force Provisions
- Eurocode 8 Capacity Design Principles
- Response Modification and Behaviour Factors
- Ductile Detailing Review Checklist
- Irregularity and Load Path Screening

Day 4: Base Isolation, Damping and Existing Structures

When do isolation, damping devices or retrofit change the outcome?

- Isolation Bearing and Damper Selection Matrix
- Isolated Period Shift Calculation
- ASCE 41 Performance Objectives
- Existing Building Deficiency Screening
- Bridge Seismic Vulnerability Ranking

Day 5: Seismic Design Review File for One Structure

Do the earlier tools form one seismic design review file that supports an approval decision?

- Applying the Session 1 Seismic Design Basis Statement
- Testing the Session 2 Base Shear and Drift Comparison
- Reviewing the Session 3 Ductile Detailing Review Checklist
- Checking the Session 4 Retrofit Option Matrix
- Completing the Seismic Design Review File

Methodology

The programme uses a design review exercise built on a prepared package for one mid-rise building and one bridge, each with a site report, an analysis summary, drawings and a draft design basis. Participants review the package in small groups and record findings as the sessions progress.

- Suggested activity: Building a design response spectrum and testing the base shear it produces.
- Suggested activity: Marking a drawing set to find ductile detailing gaps.
- Suggested activity: Ranking retrofit options for an existing building against a performance objective.

Capstone Output

Each participant completes a seismic design review file for one structure. It holds a design basis statement, a response and drift comparison, a detailing checklist, a retrofit option matrix and an approval recommendation. The file is used at work to question a design, brief an asset owner and record the approval decision.

Frequently Asked Questions

Is seismic design suitable for leaders who are not specialist earthquake engineers?

Yes. Seismic design is taught through a review package and checklists. It assumes a structural or engineering background and experience of approving designs, but no earlier specialist work in earthquake analysis.

Which standards does seismic design in this programme rest on?

Seismic design here rests on the ASCE 7 seismic provisions, the Eurocode 8 capacity design approach and the ASCE 41 evaluation and retrofit objectives, together with structural dynamics principles.

How is the file from seismic design review used at work?

You use the seismic design review file to question a consultant's assumptions, brief an asset owner and record the reasons for approving, amending or rejecting a design.

How does seismic design differ from a general structural design programme?

Seismic design concentrates on ground motion, dynamic response, ductility, isolation and retrofit, while a general structural design programme covers gravity loads, wind and everyday member checks.