CORE CONCEPT

Tall Building Structural Design Course: Lateral Systems, Wind, Outriggers and Column Shortening

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Introduction:

Tall building structural design, covering lateral systems, wind, outriggers and column shortening, is a 2-week course for structural design, checking and peer review units that ends with a Tall Building Structural Design Basis and Peer Review Plan for a case tower. Slender towers are governed by stiffness, wind response and axial shortening, and errors there surface as excessive sway, uncomfortable upper floors and late redesign. Nominees already analyse or check multi-storey frames, and learning is by modelling build on simplified tower models and shortening calculations. CoreConcept Training Center delivers this tall building structural design course.

Course Objectives:

- Select and proportion a lateral system for a tower from core-wall, core-outrigger, belt truss, framed tube, braced tube and bundled tube options
- Derive along-wind and across-wind design loads using ASCE 7 wind provisions and interpret high-frequency force balance and pressure model wind tunnel reports
- Check peak floor accelerations against ISO 10137 comfort criteria and size tuned mass or liquid dampers where a tower falls short
- Verify second-order P-delta stability, overall drift and torsional behaviour of a tall building analysis model
- Predict differential axial shortening of columns and core walls from elastic, creep and shrinkage strains and set construction compensation
- Prepare a Tall Building Structural Design Basis and Peer Review Plan covering transfer structures, analysis model checks and review hold points

Target Audience:

- Structural design units responsible for the lateral and gravity systems of high-rise residential, office and mixed-use towers
- Design checking units that verify tall building analysis models, wind loads and drift results before issue
- Independent peer review units appointed to examine tower structural designs on behalf of owners or approving bodies
- Developer and project management technical units that commission wind tunnel studies and structural design packages for towers
- Contractor engineering units that plan core climbing, column compensation and transfer structure construction sequences

Course Outline:

Day 1: Tall Building Behaviour and Structural System Families

- Height Classification and Slenderness Ratio for Tower Feasibility
- Premium for Height Curve and Material Quantity Benchmarks
- Shear Wall and Rigid Frame Interaction Under Lateral Load
- Framed Tube, Braced Tube and Bundled Tube Behaviour Compared
- Shear Lag Effects in Perimeter Tube Flange Columns

Day 2: Wind Climate, Design Codes and Load Derivation

- Atmospheric Boundary Layer Profiles and Terrain Roughness Categories
- ASCE 7 Directional Procedure for Main Wind Force Systems
- Gust Effect Factor and Dynamic Amplification for Flexible Towers
- Directionality Factors and Mean Recurrence Interval Selection
- Wind Load Combinations With Gravity for Tower Design

Day 3: Core-Outrigger and Belt Truss System Design

- Core-Outrigger Rotational Restraint Concept and Optimum Outrigger Levels
- Belt Truss Engagement of Perimeter Columns in Load Sharing
- Outrigger Stiffness, Delayed Connection and Shortening Release Details
- Virtual Outrigger Using Floor Diaphragms and Belt Walls
- Hand Method Drift Estimate for a Core-Outrigger Tower

Day 4: Tower Analysis Models, Stiffness Assumptions and Software Checks

- Three-Dimensional Tower Model Set-Up With Rigid and Semi-Rigid Diaphragms
- Cracked Section Stiffness Modifiers for Walls, Coupling Beams and Slabs
- Modal Analysis Periods and Mode Shapes for Wind Response
- P-Delta Second-Order Analysis and Stability Coefficient Checks
- Inter-Storey Drift and Overall Sway Limits for Serviceability

Day 5: Guided Modelling Build on a Core-Outrigger Office Tower

- Case Tower Geometry, Core Layout and Column Grid Review
- Case Tower Code Wind Load Calculation Spreadsheet
- Case Tower Outrigger Level Optimisation Using Drift Results
- Case Tower P-Delta and Drift Verification Worksheet
- Week-One Lateral System Selection Note for the Case Tower

Day 6: Wind Tunnel Testing, Across-Wind Response and Aerodynamic Shaping

- Vortex Shedding, Strouhal Number and Across-Wind Lock-In
- High-Frequency Force Balance Test Set-Up and Base Moment Spectra
- Synchronous Pressure Integration Models and Floor Load Distributions
- Aeroelastic Model Testing for Very Slender Towers
- Corner Softening, Tapering and Setbacks to Reduce Wind Excitation

Day 7: Occupant Comfort, Damping and Vertical Movement Risk

- ISO 10137 Peak Acceleration Criteria for Residential and Office Floors
- Inherent Structural Damping Estimates and Their Uncertainty
- Tuned Mass Dampers and Tuned Liquid Sloshing Dampers Sizing
- Viscous Damper and Damped Outrigger Arrangements for Towers
- Pendulum Damper Frequency Tuning Robustness and Maintenance Access

Day 8: Differential Column Shortening, Transfer Structures and Construction Sequence

- ACI 318 Creep and Shrinkage Inputs for Vertical Element Strains
- Staged Construction Analysis of Core and Column Shortening
- Floor Level Compensation and Camber Schedule for Contractors
- Transfer Girder, Transfer Plate and Belt Wall Load Paths
- Core Climbing Formwork Lead and Slab Connection Sequencing

Day 9: Peer Review, Design Verification and Performance Measures

- Independent Structural Peer Review Scope and Terms of Reference
- Analysis Model Audit Checklist for Mass, Stiffness and Boundaries
- Key Design Metrics Benchmark for Drift, Period and Acceleration
- Review Comment Log and Resolution Tracking Between Designer and Reviewer
- Wind Tunnel Report Review Questions for Design Engineers

Day 10: Modelling Build Capstone on the Tall Building Structural Design Basis

- Case Organisation Tower Brief and Lateral System Decision Matrix
- Case Tower Wind Tunnel Loads Against Code Loads Reconciliation
- Case Tower Acceleration Check and Damper Option Appraisal
- Case Tower Shortening Prediction and Compensation Schedule
- Tall Building Structural Design Basis and Peer Review Plan Completion

Skills You Will Gain:

- Lateral System Selection for Towers
- Wind Load Derivation
- Wind Tunnel Report Interpretation
- Occupant Comfort Assessment
- Supplementary Damping Sizing
- Second-Order Stability Verification
- Axial Shortening Prediction
- Structural Peer Review Planning

Why Attend This Course:

- Hand the lead structural engineer and the owner's technical director a Tall Building Structural Design Basis and Peer Review Plan for a case tower
- Decide whether a tower needs outriggers, aerodynamic shaping or a damper, and when a wind tunnel study should be commissioned
- Avoid excessive sway, upper-floor motion complaints and slab level mismatches caused by unchecked shortening
- Coach design and checking colleagues using the wind load spreadsheet, drift worksheet and shortening schedule built during the course

Conclusion:

Back at work, the participant gives the lead structural engineer and the owner's technical director a Tall Building Structural Design Basis and Peer Review Plan setting out the lateral system, wind design route, comfort criteria, damping strategy, shortening compensation and review hold points. Designers use it to fix assumptions before detailed modelling, project units use it to scope the wind tunnel study, and reviewers use its checklist to examine models. After the first wind tunnel results arrive, the unit should compare tested loads, periods and accelerations with the basis and revise it.

Frequently Asked Questions FAQ:

What should participants know before a tall building structural design course?

Participants should already analyse or check reinforced concrete or composite building frames in analysis software and understand load combinations and drift. Bringing drawings, an analysis model summary or a wind report from a current tower helps them apply each modelling exercise to their own projects.

How does a tall building structural design course differ from an earthquake engineering course?

This course centres on stiffness, wind response, occupant comfort, axial shortening and peer review of towers. An earthquake engineering course centres on seismic hazard, response spectra, ductile detailing and retrofit, which are referred to here only where they interact with tower lateral system choices.

When does a tall building structural design need a wind tunnel study?

A wind tunnel study is usually needed when a tower is slender, flexible or irregular in shape, or when nearby buildings change the wind flow, because code methods may not capture across-wind response, vortex shedding or interference effects reliably.

What does a participant take back from a tall building structural design course?

Participants take back a Tall Building Structural Design Basis and Peer Review Plan for a case tower, plus a code wind load spreadsheet, a drift and P-delta worksheet, a damper option appraisal and a column shortening compensation schedule for use on live projects.