# Smoke Control and Fire Engineering Design Course: Stair Pressurisation, Smoke Extract and CFD

30 August – 10 September 2027
Dubai - Five-star CBD venue



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**Ref:** 1697_26529 **Date:** 30 August – 10 September 2027 **Location:** Dubai - Five-star CBD venue **Fees:** 38610 SAR

## Introduction:

Smoke control and fire engineering design, with stair pressurisation, smoke extract and CFD, is a 2-week course for fire engineers, HVAC designers, commissioning engineers and plan reviewers that ends with a Smoke Control Design Basis and Fire Engineering Report for a case building. Organisations often receive stair fans that cannot hold pressure, atrium exhaust rates guessed from rules of thumb and CFD studies nobody can check, so approvals stall. Nominees already size ventilation or review fire strategies, and teaching is by modelling build on calculation sheets and simulation output. CoreConcept Training Center delivers this smoke control course.

## Course Objectives:

- Define smoke control objectives, tenability criteria and zoning for towers, malls, atria, car parks and tunnels from the fire strategy
- Calculate stair and lift shaft pressurisation airflow from leakage areas, pressure differentials, door opening forces and open-door velocity
- Size atrium and mall smoke exhaust from design fire heat release rate, plume type, smoke layer height and make-up air limits
- Configure FDS models and egress calculations to compare available and required safe escape time within a performance-based design
- Specify smoke fans, dampers, operating mode sequences and firefighter override controls in coordination with other building disciplines
- Plan acceptance and periodic testing of smoke control systems with NFPA 92 test procedures and readiness indicators

## Target Audience:

- Fire engineering teams responsible for fire strategies and performance-based solutions on building projects
- HVAC and MEP design teams responsible for sizing pressurisation, exhaust and make-up air systems
- Fire protection consultants who prepare smoke control calculations and design reports for approval
- Commissioning teams responsible for testing pressurisation and exhaust systems before handover
- Plan review and technical approval teams that check smoke control submittals and CFD studies
- Facilities engineering teams accountable for keeping smoke control systems ready in operating towers and malls

## Course Outline:

### Day 1: Smoke Movement Physics, Control Objectives and Building Context

- Buoyancy, Stack Effect and Wind Effects on Smoke Movement
- Tenability Criteria for Visibility, Temperature and Toxic Gases
- Smoke Containment Versus Smoke Management Design Objectives
- Building Type Profiles for Towers, Malls and Car Parks
- Fire Strategy Report Review and Smoke Zoning Baseline

### Day 2: NFPA 92, NFPA 101 and Design Fire Scenarios

- NFPA 92 Scope, Design Approaches and Documentation Requirements
- NFPA 101 Egress Provisions and Performance-Based Option Chapter
- ISO/TC 21/SC 11 Smoke and Heat Control Standards Landscape
- Design Fire Selection Using Heat Release Rate Growth Curves
- Steady and t-Squared Fire Curves With Sprinkler Control Effect

### Day 3: Stair and Lift Shaft Pressurisation Design

- Pressure Differential Criteria Across Stair and Lobby Doors
- Door Opening Force Calculation With Closer and Pressure Loads
- Open-Door Airflow Velocity Method for Pressurised Stairs
- Leakage Area Estimation for Walls, Doors and Shafts
- Lift Shaft and Refuge Floor Pressurisation Arrangements

### Day 4: Atrium and Mall Smoke Exhaust Sizing

- Axisymmetric, Balcony Spill and Window Plume Mass Flow Equations
- Smoke Layer Interface Height and Filling Time Calculation
- Exhaust Volumetric Rate and Plugholing Check per Inlet
- Make-Up Air Velocity Limits and Inlet Location Planning
- Mall Smoke Reservoirs, Channelling Screens and Curtain Selection

### Day 5: Guided Case Study on Tower, Atrium and Mall Smoke Design

- High-Rise Tower Case Stair Pressurisation Spreadsheet Calculation
- Atrium Case Plume and Exhaust Rate Calculation Workbook
- Mall Case Smoke Reservoir and Make-Up Air Layout
- Stack Effect Sensitivity Check on Case Tower Pressures
- Week-One Calculation Package Review and Peer Challenge

## Day 6: Car Park and Tunnel Ventilation With CFD Smoke Modelling

- Car Park Jet Fan Ventilation Layout and Thrust Sizing
- Tunnel Longitudinal Ventilation and Critical Velocity Against Backlayering
- FDS Mesh Resolution, Boundary Conditions and Fire Source Setup
- Smokeview Visualisation of Visibility and Temperature Slice Files
- CFD Grid Sensitivity Study and Result Plausibility Checks

## Day 7: Performance-Based Design, Egress Modelling and Design Assurance

- Performance-Based Design Brief and Acceptance Criteria Agreement
- ASET Versus RSET Timeline Comparison With Safety Margin
- Egress Modelling of Pre-Movement and Travel Times
- Uncertainty Treatment and Sensitivity Scenarios in Fire Engineering
- Independent Peer Review Checklist for Fire Engineering Reports

## Day 8: Fans, Dampers, Operating Modes and Discipline Coordination

- Smoke Exhaust Fan Temperature Rating and Duty Point Selection
- Smoke Damper and Combination Damper Specification and Location
- Smoke Mode Sequence Matrix for Each Fire Zone
- Firefighter Smoke Control Panel Override and Status Display
- Design Coordination Register With Architectural, HVAC and Power Teams

## Day 9: Commissioning, Acceptance Testing and Performance Verification

- NFPA 92 Acceptance Testing Procedures and Witness Records
- Pressure Differential and Door Force Field Measurement Methods
- Hot Smoke Test Planning and Visual Smoke Observation
- Periodic Testing Frequencies and Smoke System Maintenance Logs
- Readiness Indicators for Smoke System Defects and Impairments

## Day 10: Modelling Build of the Smoke Control Design Basis and Report

- Case Organisation Building Fire Strategy and Scenario Selection
- Case Pressurisation and Exhaust Sizing Calculations Consolidation
- Case CFD and Egress Results Against Tenability Criteria
- Case Commissioning Test Plan and Acceptance Criteria Schedule
- Smoke Control Design Basis and Fire Engineering Report Completion

## Skills You Will Gain:

- Smoke Movement Analysis
- Design Fire Characterisation
- Pressurisation Airflow Sizing
- Plume and Exhaust Calculation
- Jet Fan and Tunnel Ventilation Design
- FDS Smoke Modelling
- Egress Timeline Analysis
- Smoke System Acceptance Testing

## Why Attend This Course:

- Deliver a Smoke Control Design Basis and Fire Engineering Report for a case building to the lead fire engineer, the MEP design manager and the approving reviewer
- Judge whether a proposed stair fan, exhaust rate, jet fan layout or CFD result will keep escape routes tenable before drawings are issued
- Avoid failed pressurisation tests, oversized or undersized fans, rejected CFD studies and late redesign of smoke shafts during construction
- Coach junior designers and commissioning technicians on plume equations, leakage calculations, FDS input files and field test records

## Conclusion:

Back at work, the participant hands the Smoke Control Design Basis and Fire Engineering Report to the lead fire engineer, the MEP design manager and the approving reviewer, who use it to fix fan duties, shaft sizes, damper locations and the performance-based acceptance criteria for the project. The commissioning team uses its test plan to witness pressure, door force and exhaust checks. After the first acceptance test, the team should compare measured pressures and airflows with the design calculations, record the gaps and update the leakage assumptions and modelling inputs.

## Frequently Asked Questions FAQ:

### What should participants know before a smoke control and fire engineering design course?

Participants should understand basic airflow and pressure, read building drawings and have sized ventilation or reviewed fire strategies. A laptop with a spreadsheet tool helps during the pressurisation, plume and exhaust calculations, and prior exposure to any CFD software is useful but not required.

## How does a smoke control and fire engineering design course differ from a fire alarm or sprinkler design course?

It designs the systems that keep smoke out of escape routes: pressurisation, smoke exhaust, jet fans and tunnel ventilation, supported by CFD and egress modelling. Fire alarm courses design detection and notification, and sprinkler courses design water-based suppression and its hydraulics.

## Why does smoke control and fire engineering design use CFD instead of hand calculations alone?

Hand calculations suit simple spaces, but irregular atria, malls and car parks produce smoke flows that plume equations cannot predict reliably. CFD tools such as FDS show visibility and temperature over time, which supports a performance-based case when combined with egress timing.

## What do participants take back from the smoke control and fire engineering design course?

Participants take back a Smoke Control Design Basis and Fire Engineering Report for a case building, with pressurisation and exhaust calculation sheets, an FDS input template, an ASET and RSET timeline, a smoke mode sequence matrix and a commissioning test plan.