

ENGINEERED SMOKE CONTROL IN METRO TUNNEL RENOVATION USING CONSTRUCTION MANAGEMENT PROJECT DELIVERY

This month's B2B focuses on the renovation of an existing metro station with the addition of a new smoke evacuation system located within the building and the subway's inbound and outbound tunnels. This month's test will address the design intent of an engineered reversible smoke control of supply air and exhaust air system serving the above-grade entrance structure, the below-grade platform, and the inbound and outbound tunnels. The associated ADA-compliant elevator will have its own stand-alone, engineered, smoke control, 100 percent outside air fan to the positive-pressurized elevator shaft system.

The project delivery method shall be construction management (CM) in accordance with the Construction Management Association of America (CMAA). The design team, along with the CM project manager, shall include the transportation system division management; owner representative; transportation system facility manager; and third-party commissioning and testing, adjusting, and balancing (TAB) air and water balancing (CxTAB) consultant. The team will also include the architect; consulting engineers for HVAC, structural, plumbing, and electrical; and the information technology (IT) engineer at the transportation system remote control center. The facility manager and her O&M staff including the BAS operator will also participate in the CM process beginning at the conceptual design phase.

The designer engineer and the owner-CM team is directed to 2015 *ASHRAE Handbook — HVAC Applications*, chapter 11 (Mass Transit), chapters 36-43 (Building Operation and Management), chapter 53 (Fire and Smoke Control), and chapter 59 (HVAC Security). They should also read National Fire Protection Association (NFPA) 92-Standard for Smoke Control Systems for a complete understanding of ventilation, air pressure, and direction of airflow for this application.

The design team will complete a study of the proposed building pertaining to locations of air intakes, air exhaust shafts, rail car traffic, and location of commuters within the facility as well as occupants in the tunnel in an emergency situation.

Smoke control scenario 1 — Evacuating the platform due to the smoke detector initiated coming from the metro tunnel toward the platform. An exhaust fan in each shaft located mid-way at both the inbound and outbound tunnels shall start, and the associated automatic dampers will open, drawing the air from the tunnel and away from the platform. A makeup air fan at the top of the platform entrance shall start, and an automatic damper will open for the fan to direct outdoor air down toward the platform to positively pressurize the platform and the escaping commuters.

Smoke control scenario 2 — Evacuating occupants from the rail car in the tunnel due to smoke within the car: The exhaust fan in each shaft located mid-way in both the inbound and outbound tunnels shall start, and the associated automatic dampers open to draw the air from the tunnel and away from the platform. The makeup air fan at the top of the platform entrance shall start, and the automatic damper will open for the fan to direct outdoor air down toward the platform to

positively pressurize the platform and direct air into the tunnel toward the escaping commuters walking toward the platform. Exhaust air will be drawn away from the commuters and the platform and up the exhaust shaft to the outdoors.

Each supply air and exhaust air fan shall be sized for 60 air changes and 3 inches of static pressure. Other exhaust scenarios are pressurizing a tunnel with the shaft exhaust fan by reversing the air direction, delivering outdoor makeup air to the tunnel below, and normal tunnel-platform ventilation sequences.

The design team and CM firm shall begin to come together at the conceptual phase of the design, working closely with the facility staff. The third-party CxTAB consultant shall use the design team's basis of design to begin the initial training of the O&M personnel as well as invite the local fire department personnel in for an introduction-training of fire/smoke control of this metro exhaust engineered system design.

At the end of this first phase of design, the CM will provide the initial project estimate. At the end of the design development phase, the CM will provide a guaranteed maximum price for the job. During the construction phase, the O&M staff shall follow along with the subcontractors when the smoke control system is started up and air balanced for normal operation and smoke control operation. The team shall also observe the CM's mechanical-electrical coordinator and automatic control subcontractor demonstrating the third-party CxTAB consultant's functional performance tests. Demonstration shall also include an interface with the transportation system's remote control center operation.

The design and CM team shall complete static air pressure and a direction of airflow test for each smoke control simulation working closely with the third-party CxTAB consultant.

The CM team's HVAC subcontractor shall include the following during the shop drawing submittal phase:

- Equipment submittals - Fan curves - Sheet metal field fabrication drawings - Startup sheet - Troubleshooting sheets - O&M manuals, parts, and lubricants - ATC and energy management submittal including one complete ATC submittal integrating the transportation system remote control center overall ATC requirements.

The owner's third-party CxTAB consultant services in the construction phase include the following:

- TAB system flow diagram of the entire supply air and exhaust air systems with cfm and static pressure indicated at each piece of equipment and air velocity within the tunnels.
- Observe the commissioning functional performance test by the CM's team for the supply air and exhaust air systems under normal operation and engineered smoke control operation conditions.

Refer to The Facility File for additional information pertaining to completing the B2B test. **ES**



The design engineer shall check off the boxes from the list of company’s standardized field observation checklists that he will need to upload on to his tablet computer prior to heading out to the construction site to complete his final HVAC inspection and punchlist. These checklists will be touchscreen type. When the engineer returns to the office, or he sends the completed checklists

via the internet to the office, the completed checklists shall be automatically downloaded to the company’s computer server and placed in the job folder’s “Project Closeout” section. The completed checklists, along with associated digital photographs taken at the time of the field visit, will automatically be electronically sent to the following individuals and departments.

TEAM CORRESPONDENCE DIRECTORY CHECKLIST

(Check the appropriate boxes)

- Division Manager Owner Representative IPD Lead Engineer
- Construction Manager General Contractor Design-Build Contractor
- Transportation Systems Facility Manager HVAC Subcontractor
- IT Engineer Electrical Subcontractor
- Plumbing Subcontractor Fire Protection Subcontractor ATC Subcontractor
- Architect Consulting Engineers ASHRAE
- Piping Subcontractor Sheet Metal Subcontractor Third-Party CxTAB Consultant
- Equipment Manufacturers Building Inspector Others: *(insert list)* _____

HVAC CONTRACT SPECIFICATION CHECKLIST

- Division 1 Project Closeout Telecommunication Equipment
- Owner Furnished Equipment Structural Electrical
- Plumbing Fire Protection HVAC Information Technology-ATC
- ATC Pumps Fans Air Handlers Terminal Units
- Piping System Sheet Metal System TAB Commissioning
- Others: _____

HVAC CONTRACT DRAWING INSTALLATION CHECKLIST

- Telecommunication Equipment Owner Furnished Equipment
- Structural Electrical Plumbing Fire Protection HVAC
- Information Technology-ATC ATC Pumps Fans Air Handlers
- Terminal Units Piping System Sheet Metal System
- TAB Commissioning Others: _____

HVAC STARTUP CHECKLIST

- Telecommunication Equipment Owner Furnished Equipment
- Structural Electrical Plumbing Fire Protection HVAC
- Information Technology-ATC ATC Pumps Fans Air Handlers
- Terminal Units Piping System Sheet Metal System
- TAB Commissioning Others: _____

COMMISSIONING FPT (Functional Performance Test)

- Telecommunication Equipment Owner Furnished Equipment
- Structural Electrical Plumbing Fire Protection HVAC System
- Information Technology-ATC ATC Pumps Fans
- Air Handlers Terminal Units Piping System Sheet Metal System
- TAB Commissioning Others: _____