



# Examining Tunnel Ventilation in a Point Extract-Supply Tunnel

Norris Harvey  
Practice Leader – Fire Life Safety  
New York City

Tunnel Safety and Ventilation 2020  
December 2-4, 2020

# Agenda

---

Description of Tunnel Ventilation Installation

Description of Problem

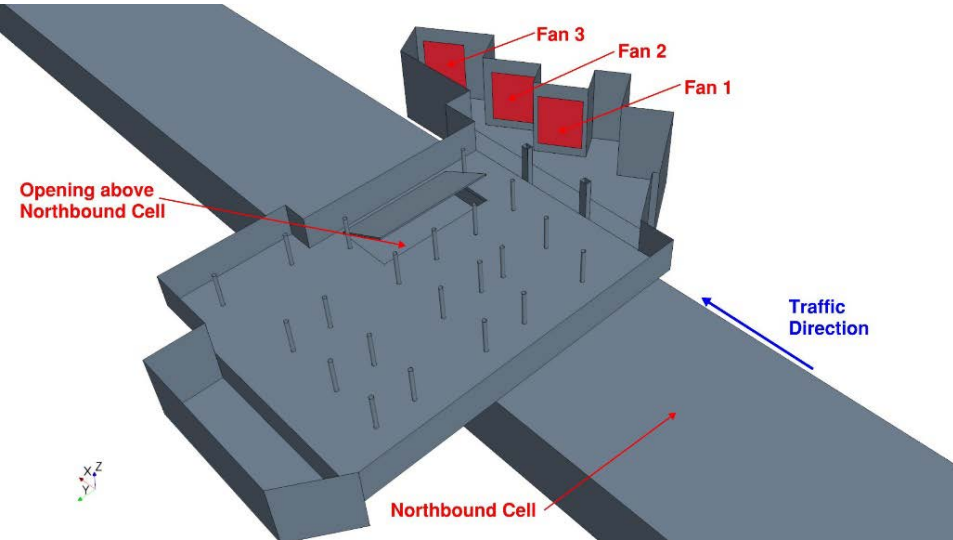
Approach to Solution

Establish a Solution

Field Verification



Description of the Tunnel Ventilation Installation  
375 m<sup>3</sup>/s Total Capacity



# Description of Problem

## Two Physical Phenomenon Resulted

### Saccardo Nozzle Effect Occurred

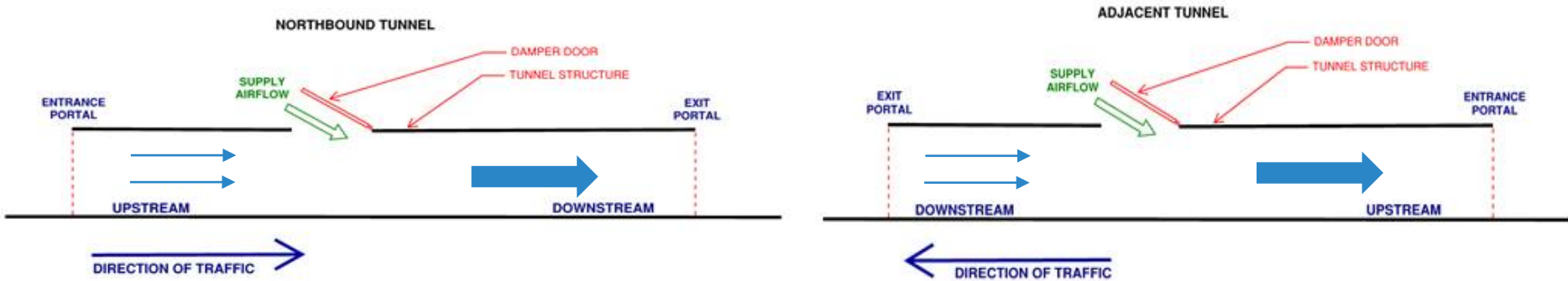
- Airflow was induced through the tunnel by the nozzle

### A Vortex was Generated

- Air velocities > 80 km/hr

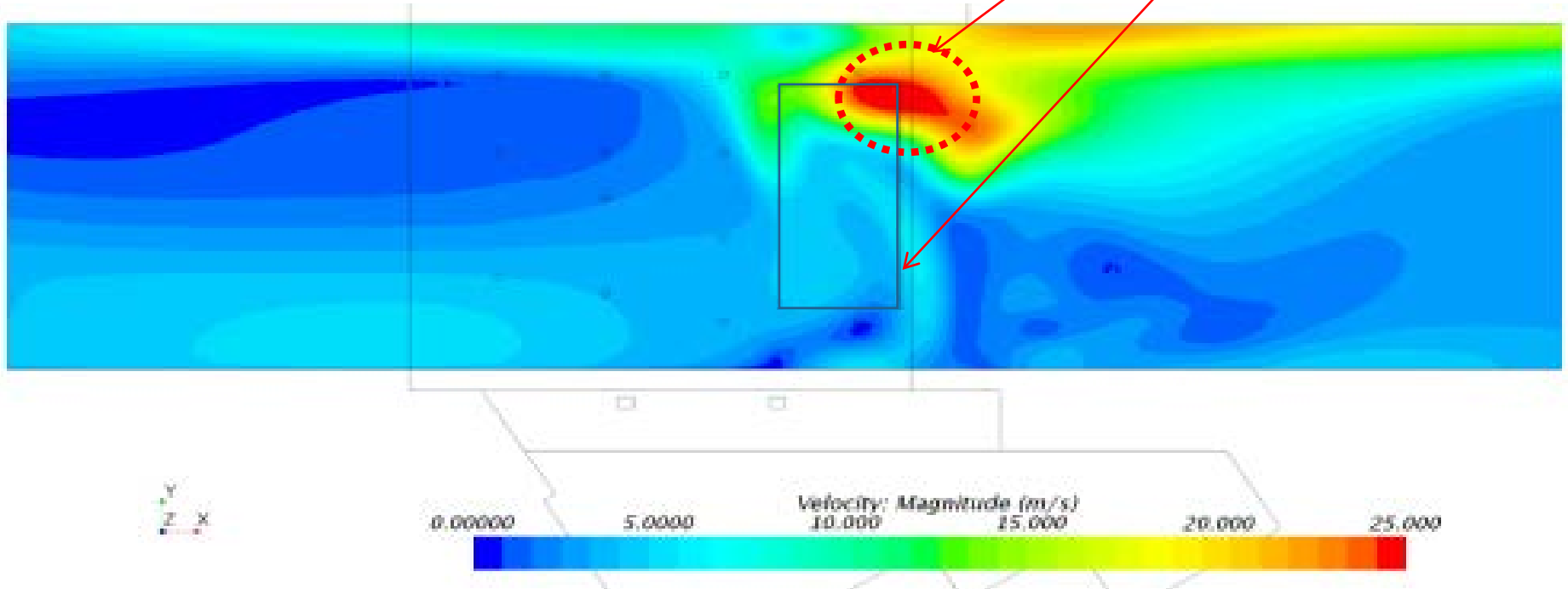
# Description of Problem

## Two Affected Roadways



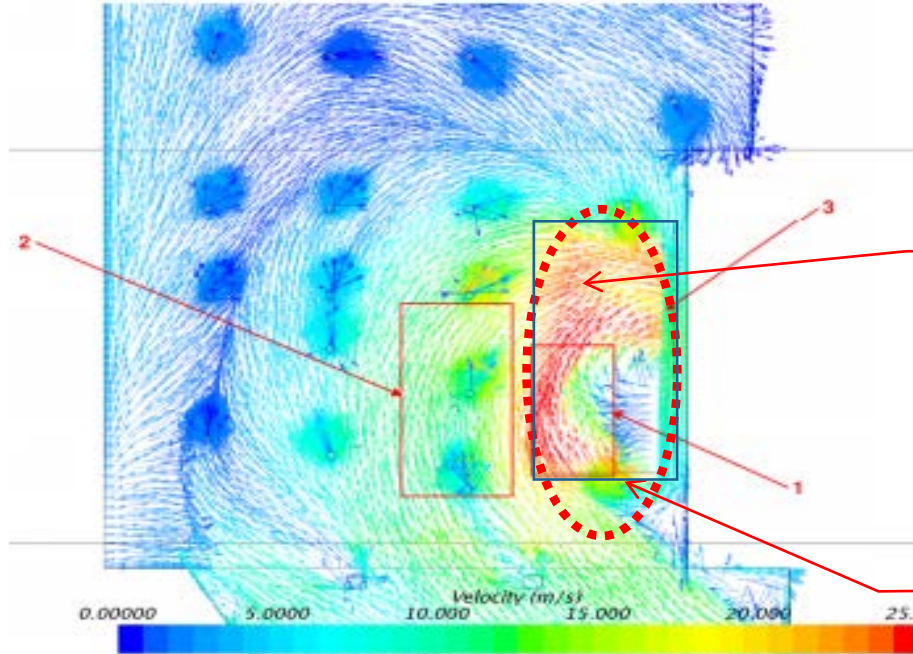
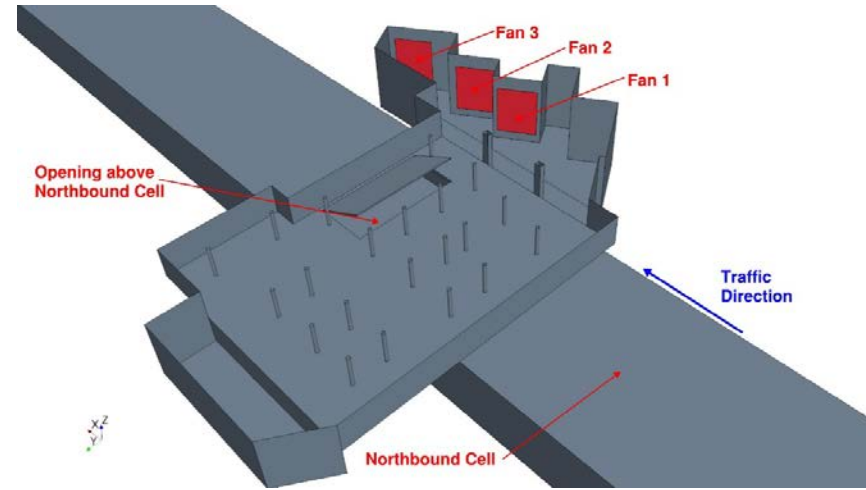
# Approach to Solution

Replicate the Problem using CFD



# Approach to Solution

Replicate the Problem using CFD

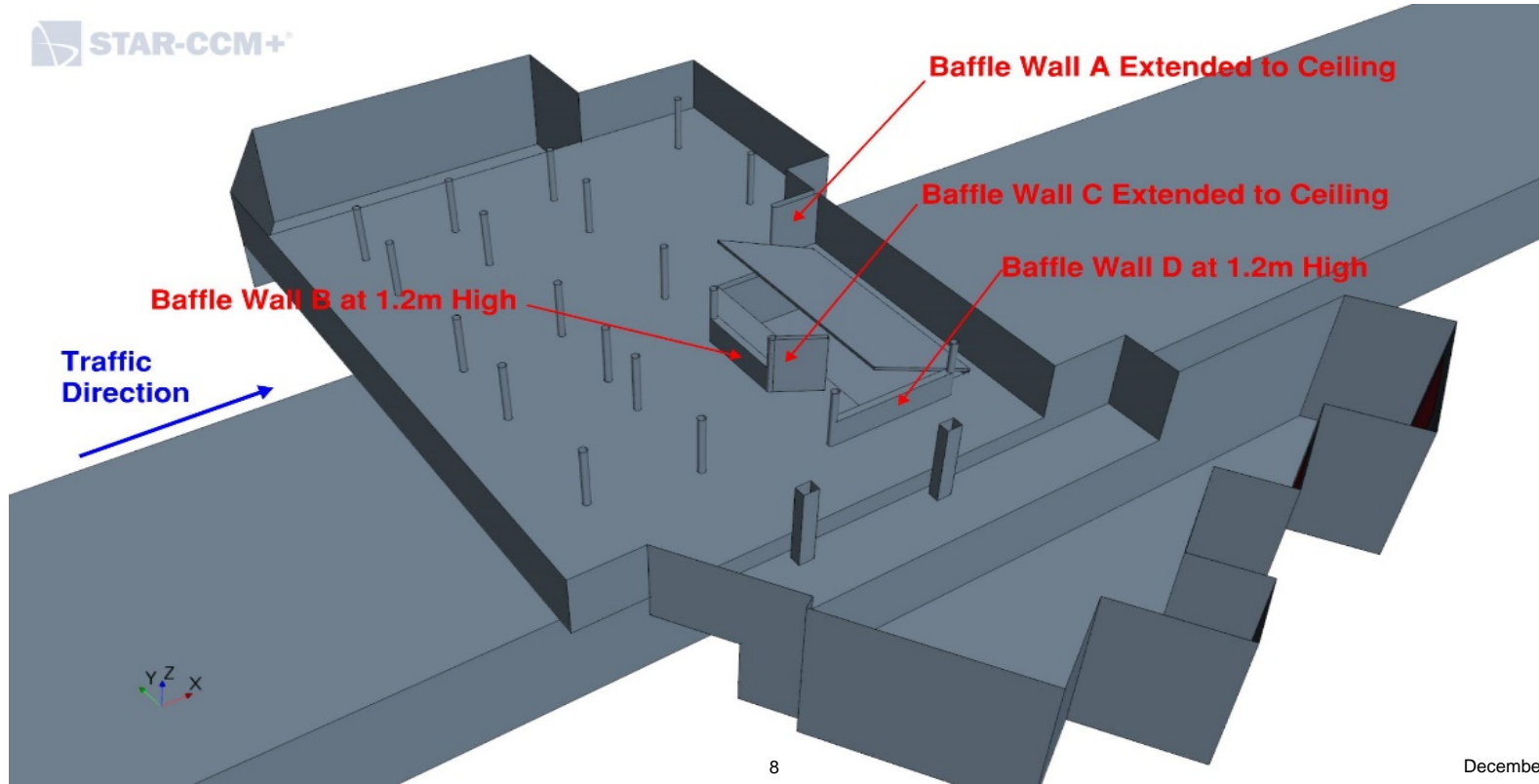


High velocities

Damper opening above roadway

# Approach to Solution

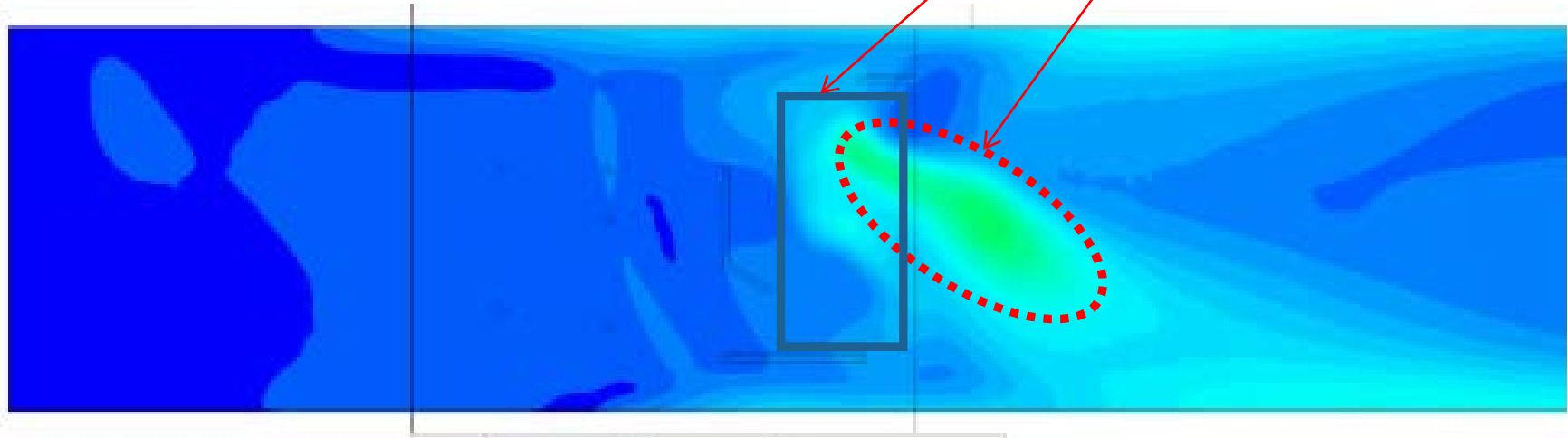
Propose a solution using CFD





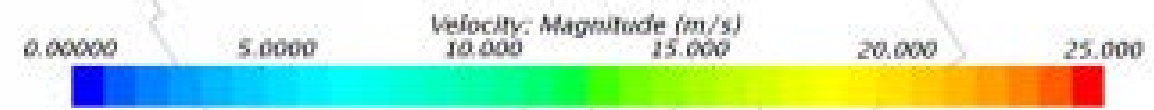
# Approach to Solution

Model the Solution to Verify



Damper opening  
above roadway

Area of interest

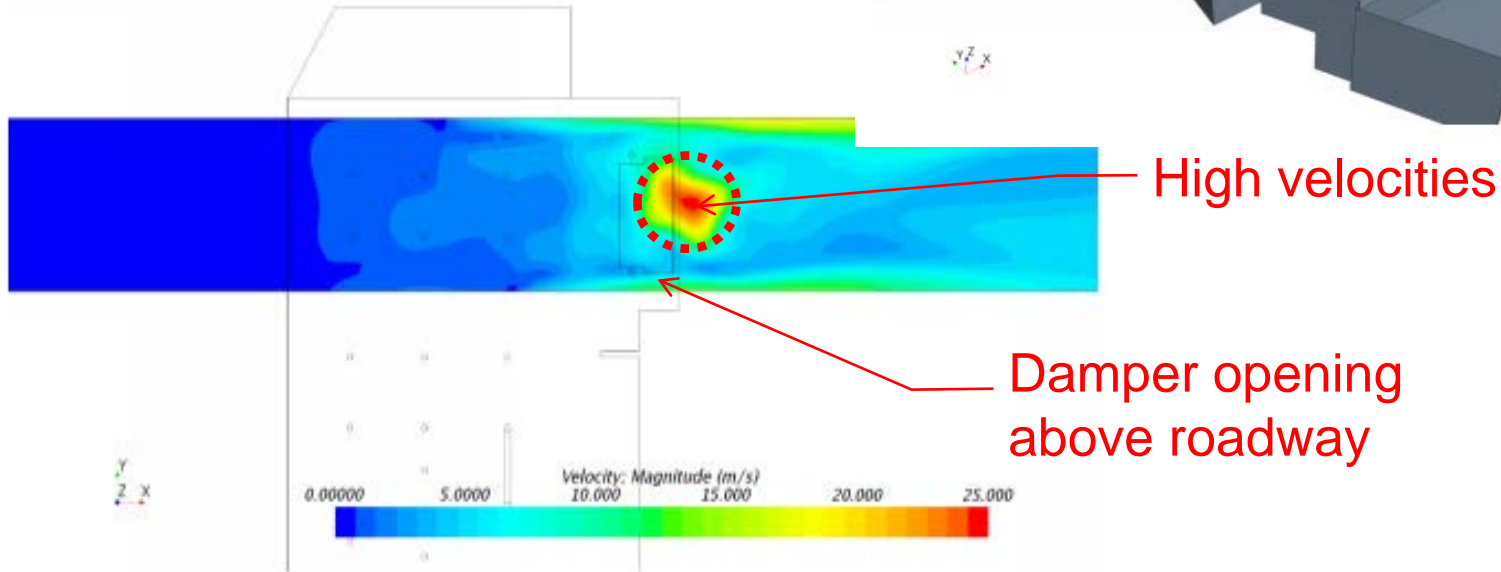
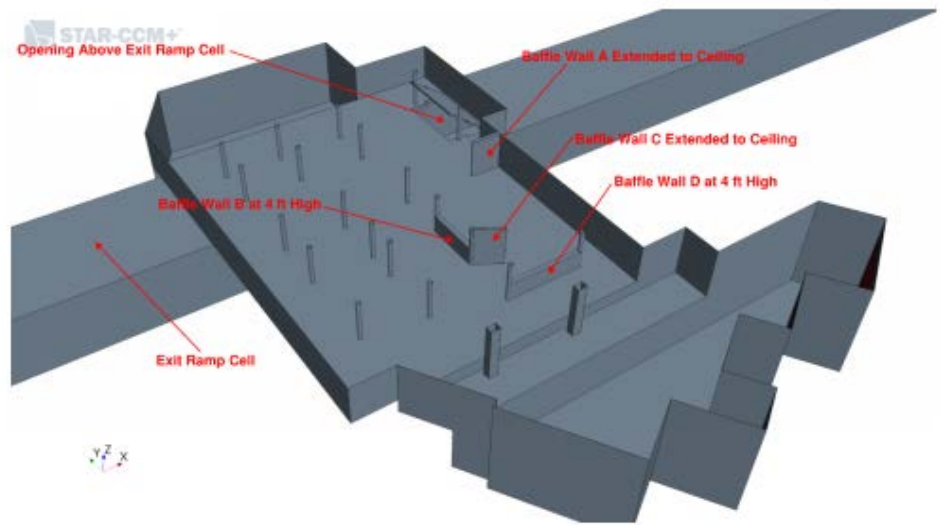




Physical Installation

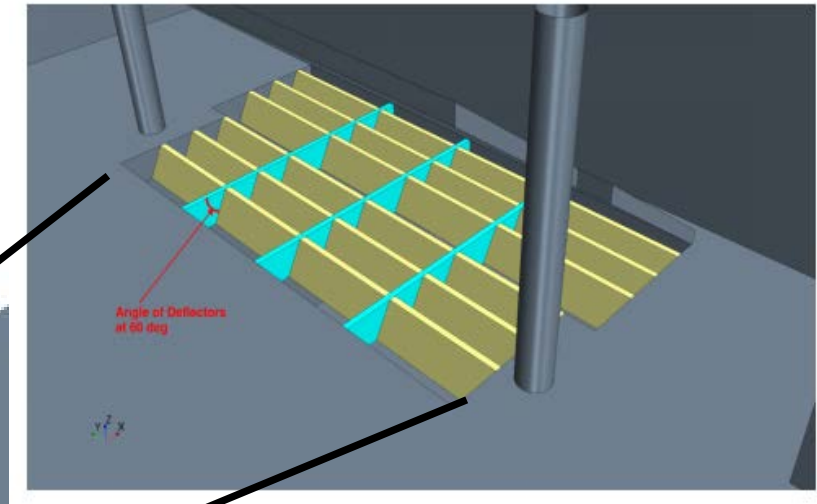
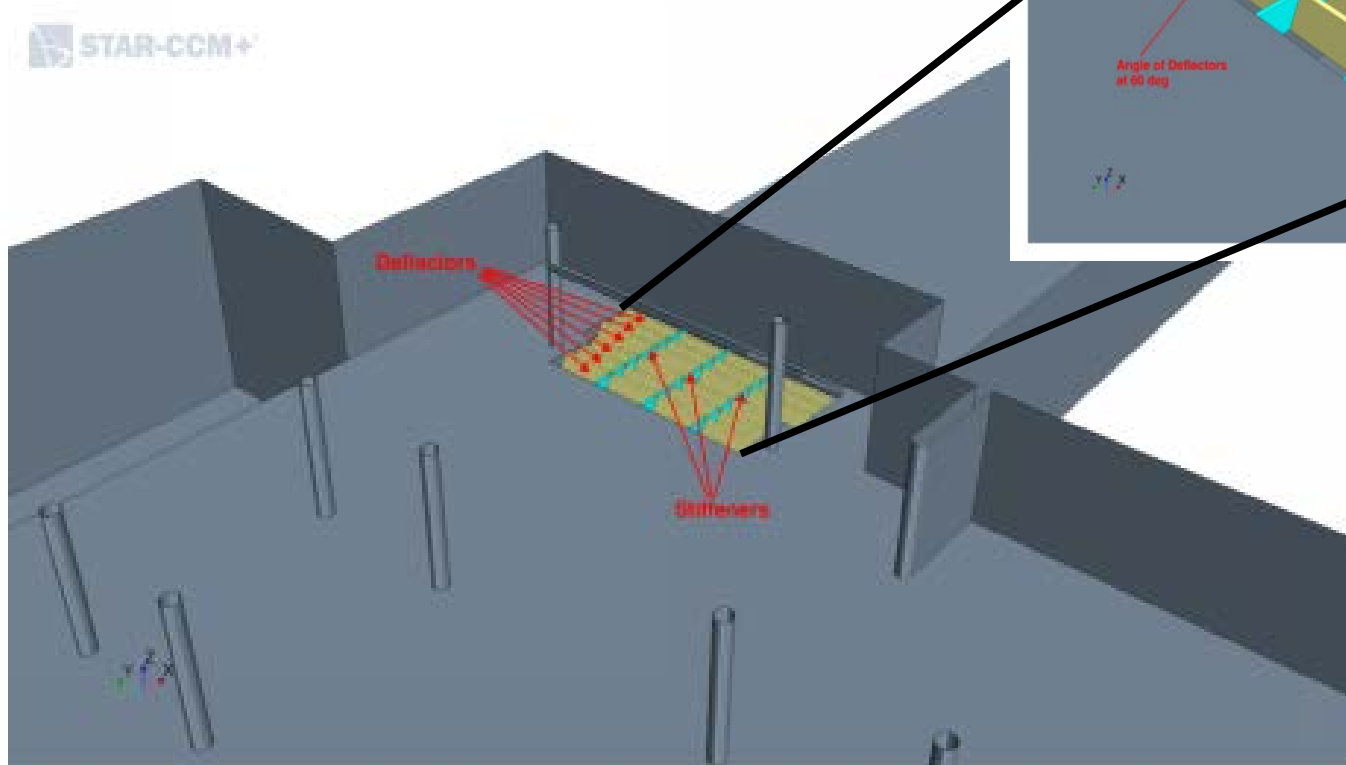
# Approach to Solution

Replicate the Problem using CFD



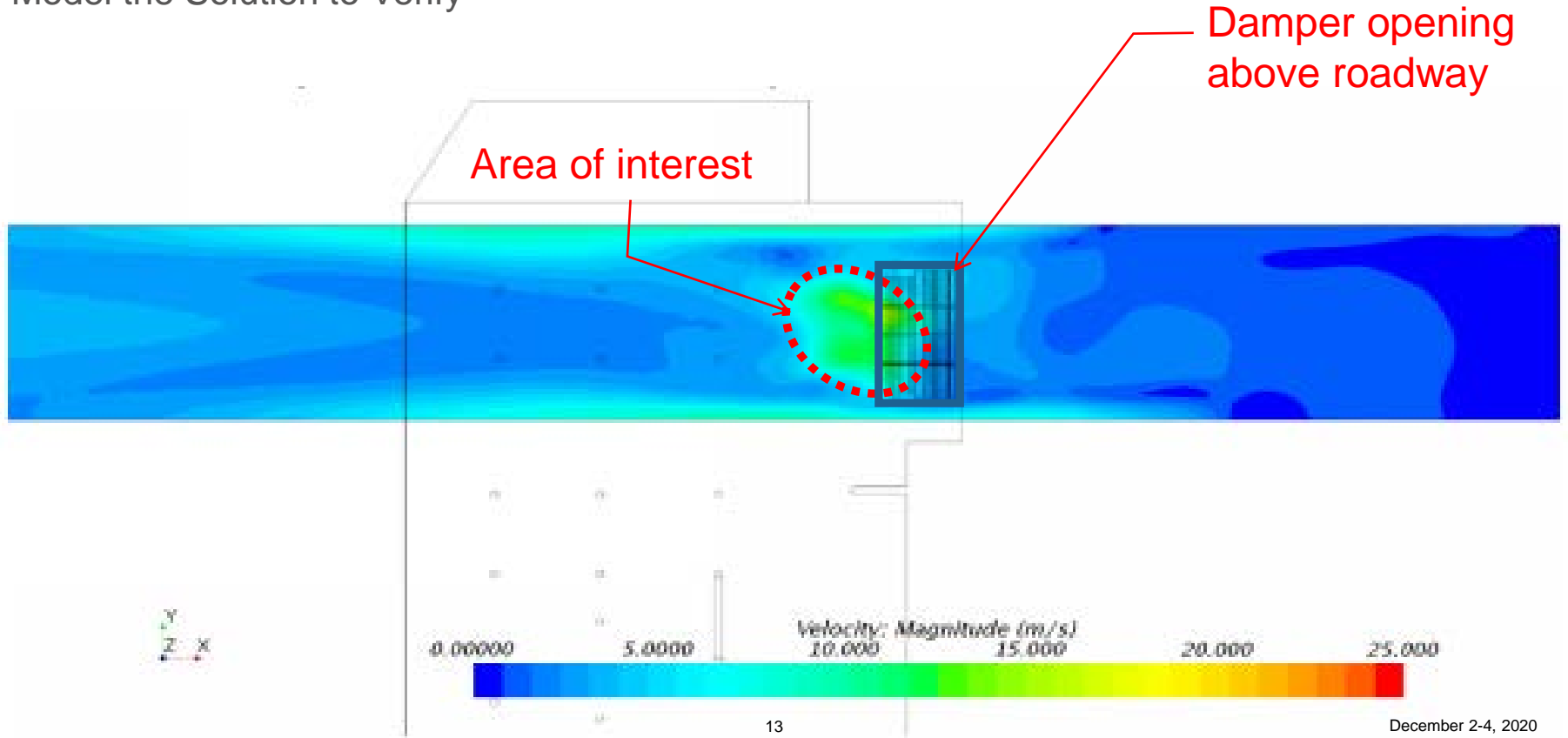
# Approach to Solution

Propose a solution using CFD



# Approach to Solution

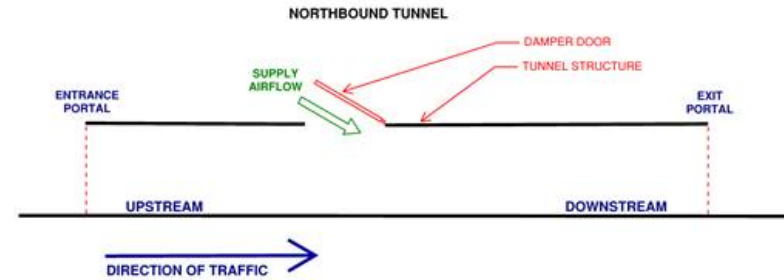
Model the Solution to Verify



# Physical Installation



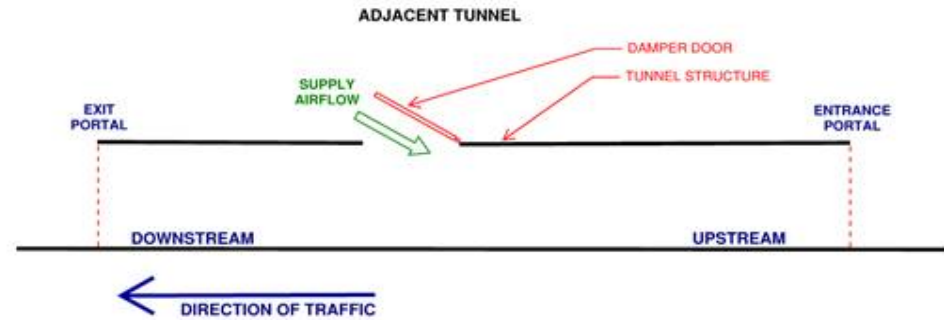
# Field Verification



**Table 1: Northbound Roadway Results**

Case No.	Configuration	Ventilation Response	Reading location	Field Measurements
3.	Initial Installation	Supply (3 Fans at Full Speed)	Downstream	3.3 m s <sup>-1</sup> with local velocities reaching 28.4 m s <sup>-1</sup>
4.	Post Modification	Supply (3 Fans at Half Speed)	Downstream	3.56~4.07 m s <sup>-1</sup>

# Field Verification



**Table 2:** Adjacent Tunnel Results

Case No.	Configuration	Ventilation Response	Reading location	Field Measurements	Notes
3.	Initial Installation	Supply (2 Fans at Full Speed)	Toward the entrance portal  Toward the exit portal	6-7 m s <sup>-1</sup> toward the entrance portal  0.7 m s <sup>-1</sup> toward the exit portal	Local high velocities, along with low velocities recorded downstream of the damper. Ventilation response was revised.
4.	Post Modification	Supply (1 Fan at Full Speed)	Toward the exit portal	4.06~4.19 m s <sup>-1</sup>	



# Conclusions

- CFD was able to replicate Saccardo Nozzle effect
- CFD was able to accurately predict the solutions
- Solutions were inexpensive
- Solutions avoided roadway closures on the Northbound roadway
- Solutions did not add to maintenance overhead
- Solutions remained within existing geometries







Thank you

