

Ventilation Overview

Robert B. Krog

National Institute for Occupational Safety and
Health

Pittsburgh Research Laboratory

Introduction

- General ventilation practices
- Calculating face concentrations
- Previous use of belt air
- Current use of belt air
- Gateroad development
- Longwall extraction
- Summary

Number of U.S. Longwalls

- Approximately 49 coal longwalls
- 5 – Four entry (Blue Creek / Poc #3)
- 39 – Three entry
- 5 – Two entry (Utah)

Air Velocity Guidelines

Entry	Velocity (ft/min)
Intake	600 - 1000
Return	600 - 1000
Track (intake)	400 - 600
Belt (intake)	100 - 250
Belt (neutral)	50 - 200

- Economical step functions

Use of Belt Air

- Provides a secondary source of intake air to the working face



Calculating Face Concentration

$$C_F = \frac{(C_I \times Q_I) + (C_B \times Q_B)}{Q_I + Q_B}$$

Where:

C_I = Intake concentration

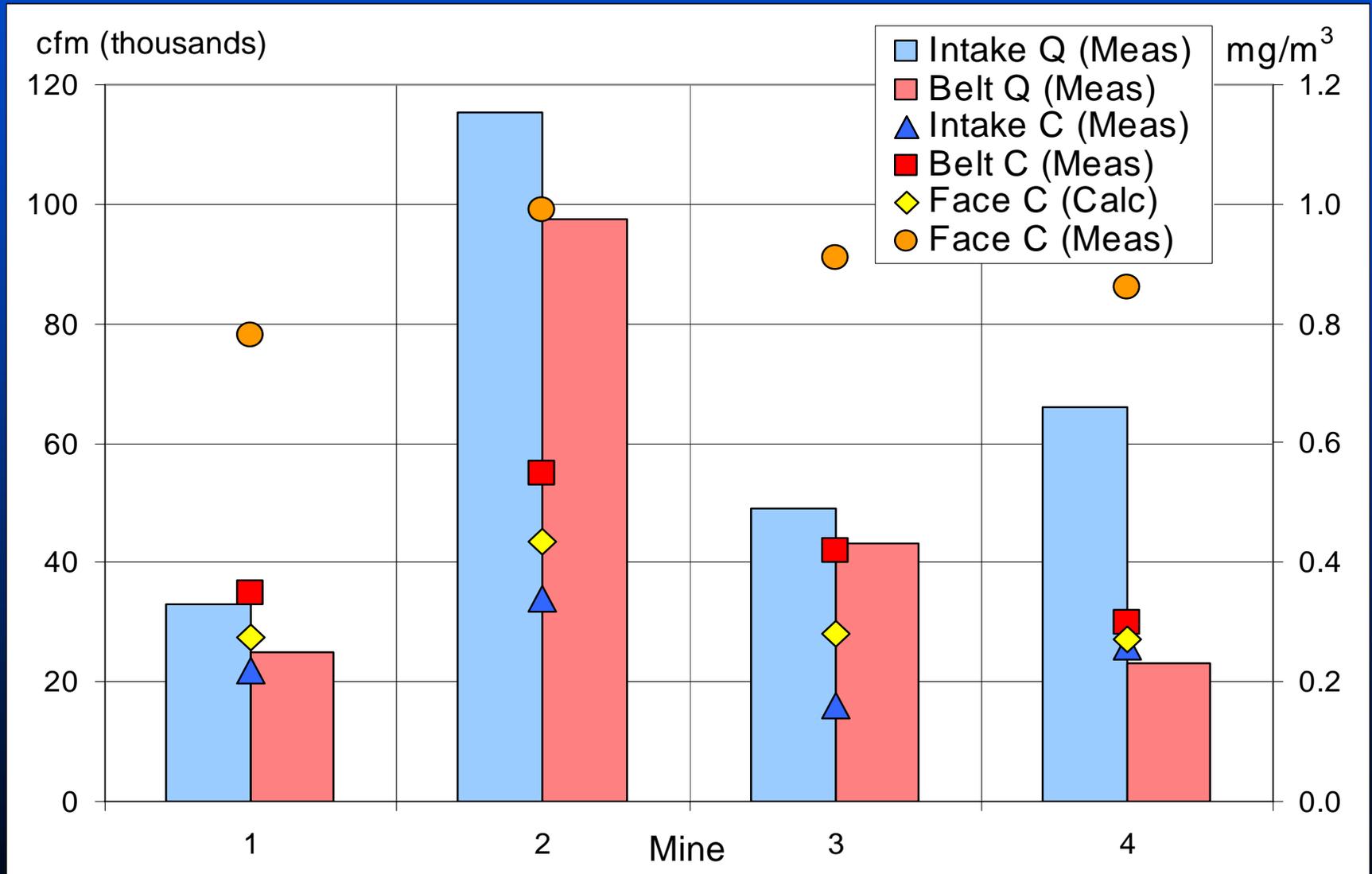
Q_I = Intake air quantity

C_B = Belt concentration

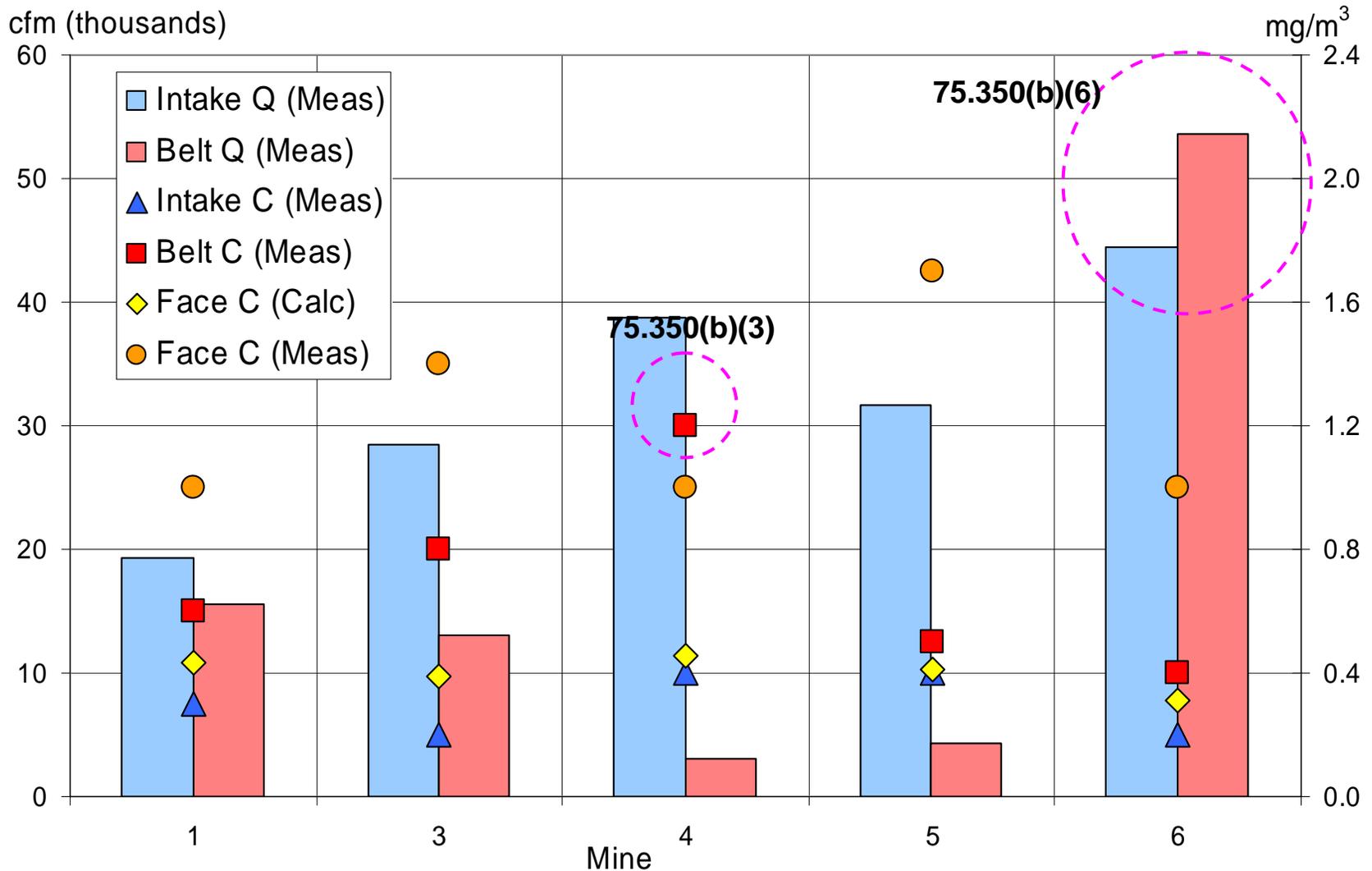
Q_B = Belt air quantity

C_F = Face concentration

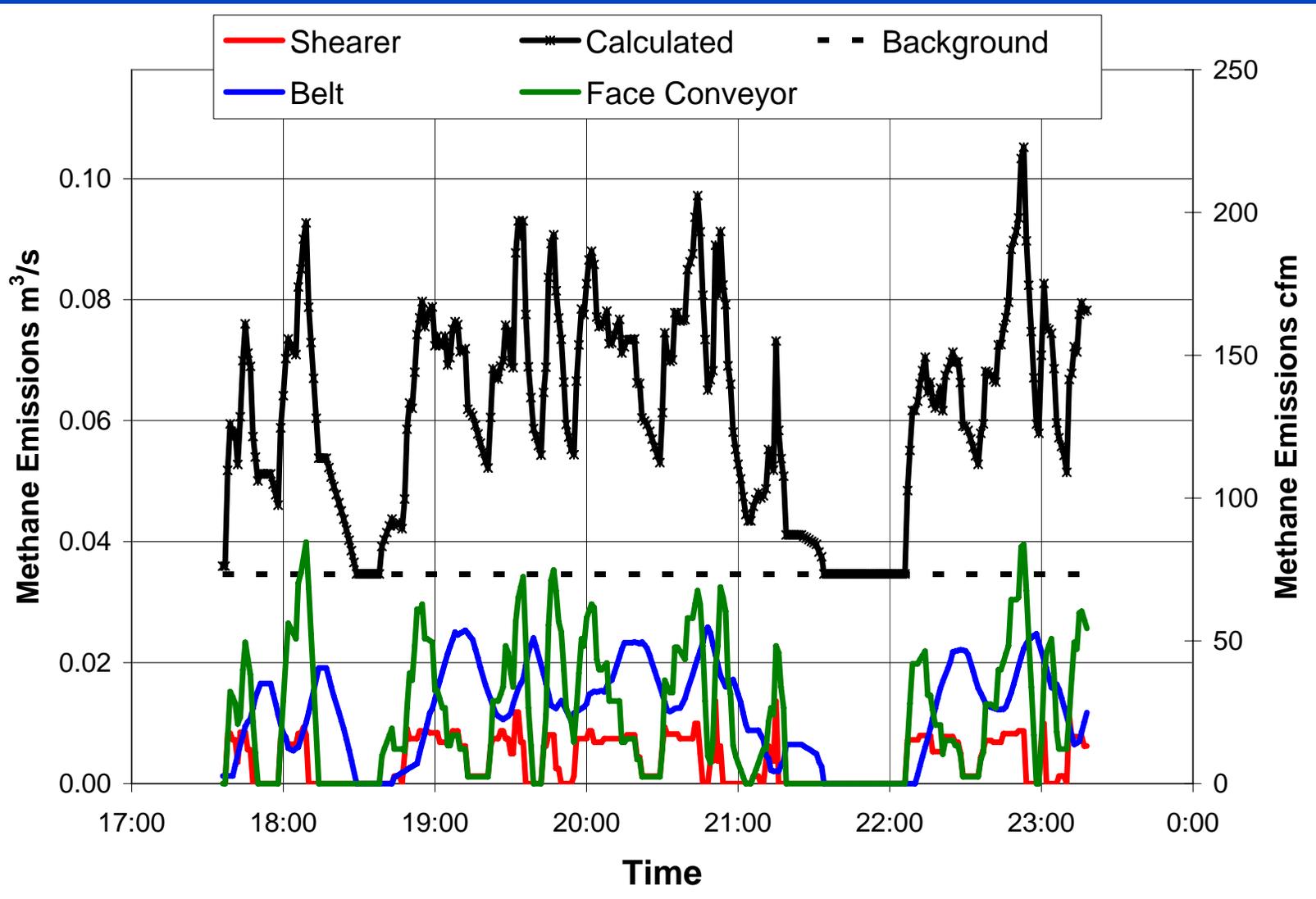
Calculated vs. Actual Face Dust Concentrations (NIOSH)



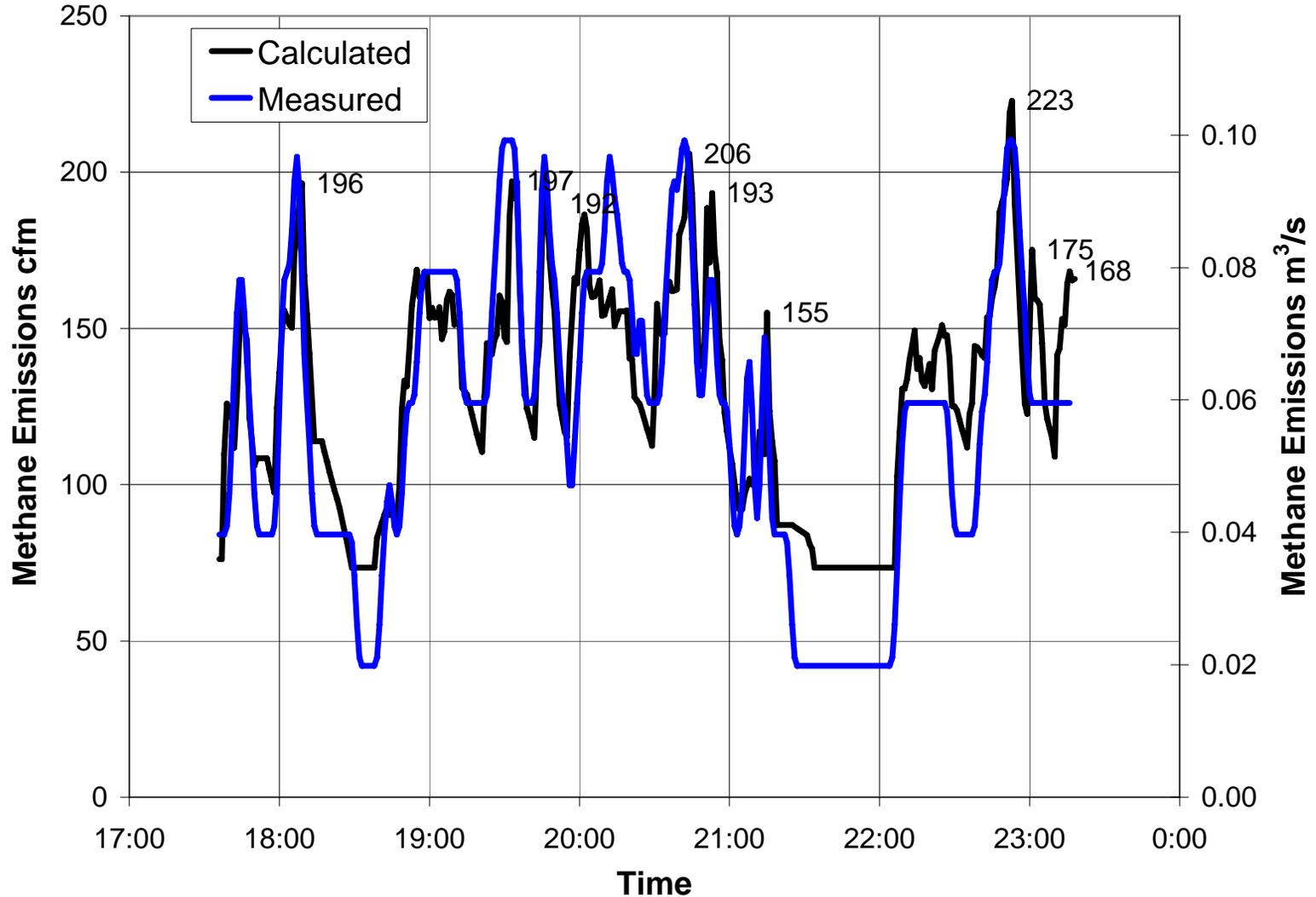
Calculated vs. Actual Face Dust Concentration (MSHA)



Calculated Methane at Tailgate



Calculated vs. Measured Methane at Tailgate (NIOSH)



Effects of Contaminants on Face Concentrations

Dust

- Expect actual face respirable concentrations to be greater than calculated due to dust sources positioned between intake/belt sampling locations and face location

Gases (CH_4 , CO , CO_2)

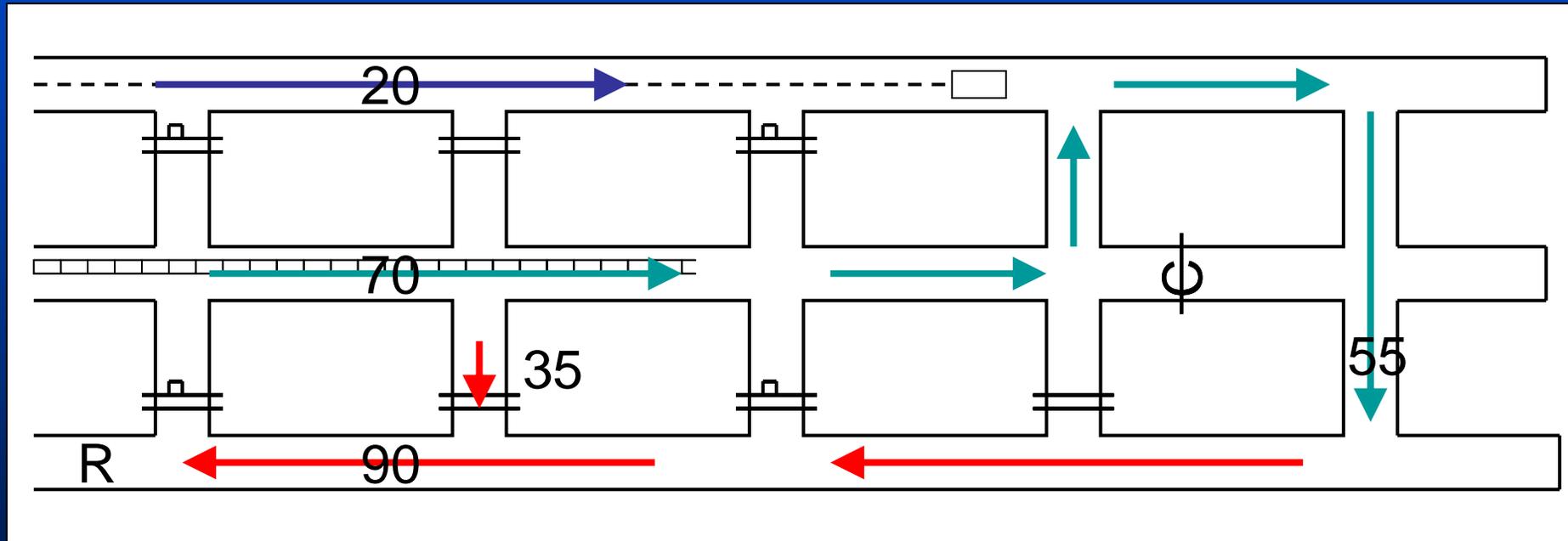
- (CH_4) Unless gas intrusion from gob at headgate, actual face concentration should be close to calculated value
- (CO , CO_2) Actual face value could exceed calculated if diesel-powered vehicles are in intake entry inby sampling locations

Three Entry Ventilation

- Most common layout (39 longwalls)
- Belt
 - Intake
 - Neutral outby
- Intake
 - Track
 - Travelway
 - Primary escapeway
- Return

Intake Belt Air

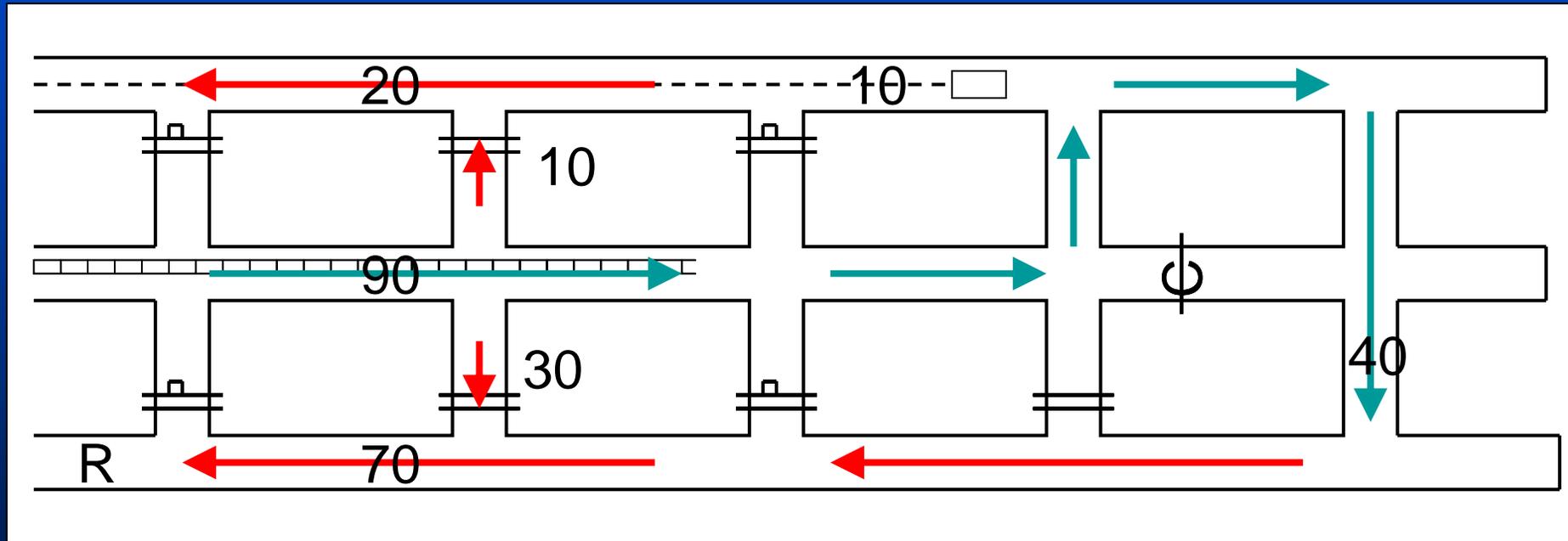
Three-entry Development Panel



12,000 ft gateroad with 65 crosscuts

Neutral Belt Air

Three-entry Development Panel

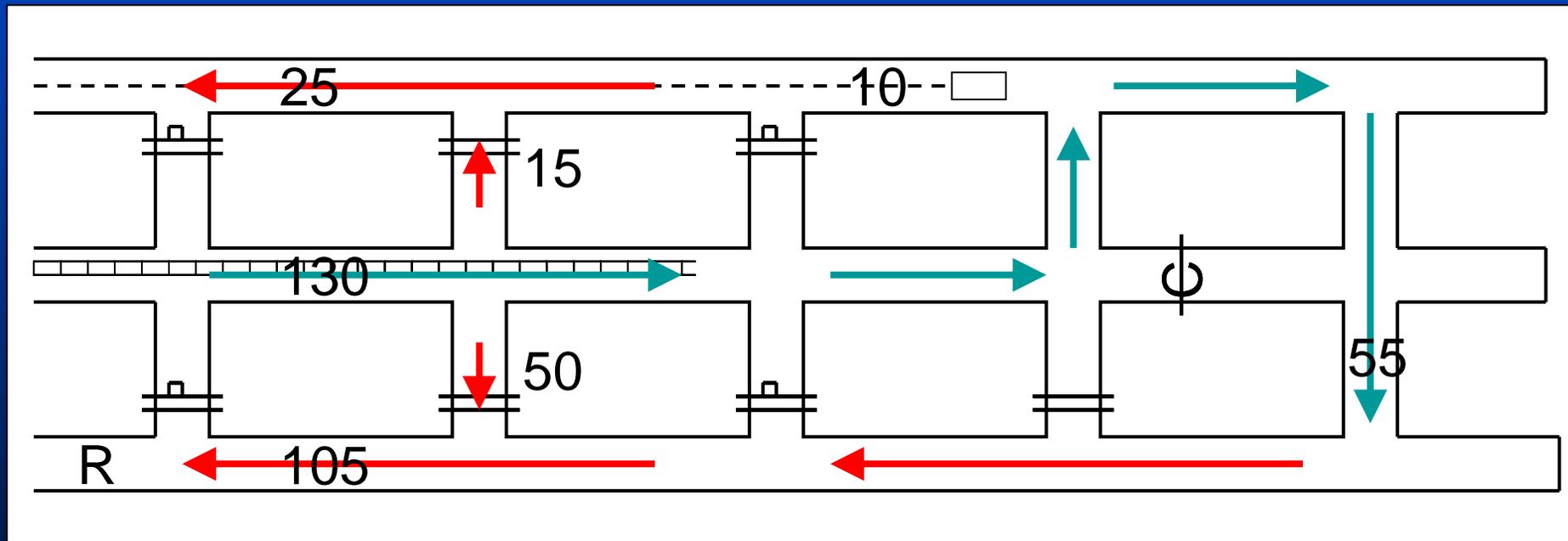


12,000 ft gateroad with 65 crosscuts

Increased Pressure Loss

- Intake airflow increased from 70 to 110 K cfm
- $P = RQ^2 \sim (110/70)^2 = 2.47$ times initial pressure loss down intake entry
- Increased pressure across the return stoppings
 $= (2.47 + 1)/2 = 1.73$ times higher
- $Q = (P/R)^{1/2}$
- $Q = 1.32 \times 35,000 = 46,000$ cfm leakage

Final Airflow and Leakage



Panel Ventilation Results

	Belt – Intake (cfm)	Belt – Neutral (cfm)
Belt entry	20 K	10 K
Intake	70 K	130 K
Return	90 K	105 K
Last open crosscut	55 K	55 K
Leakage into return	35 K	50 K
Leakage into belt	0	15 K

Intake Air Velocities

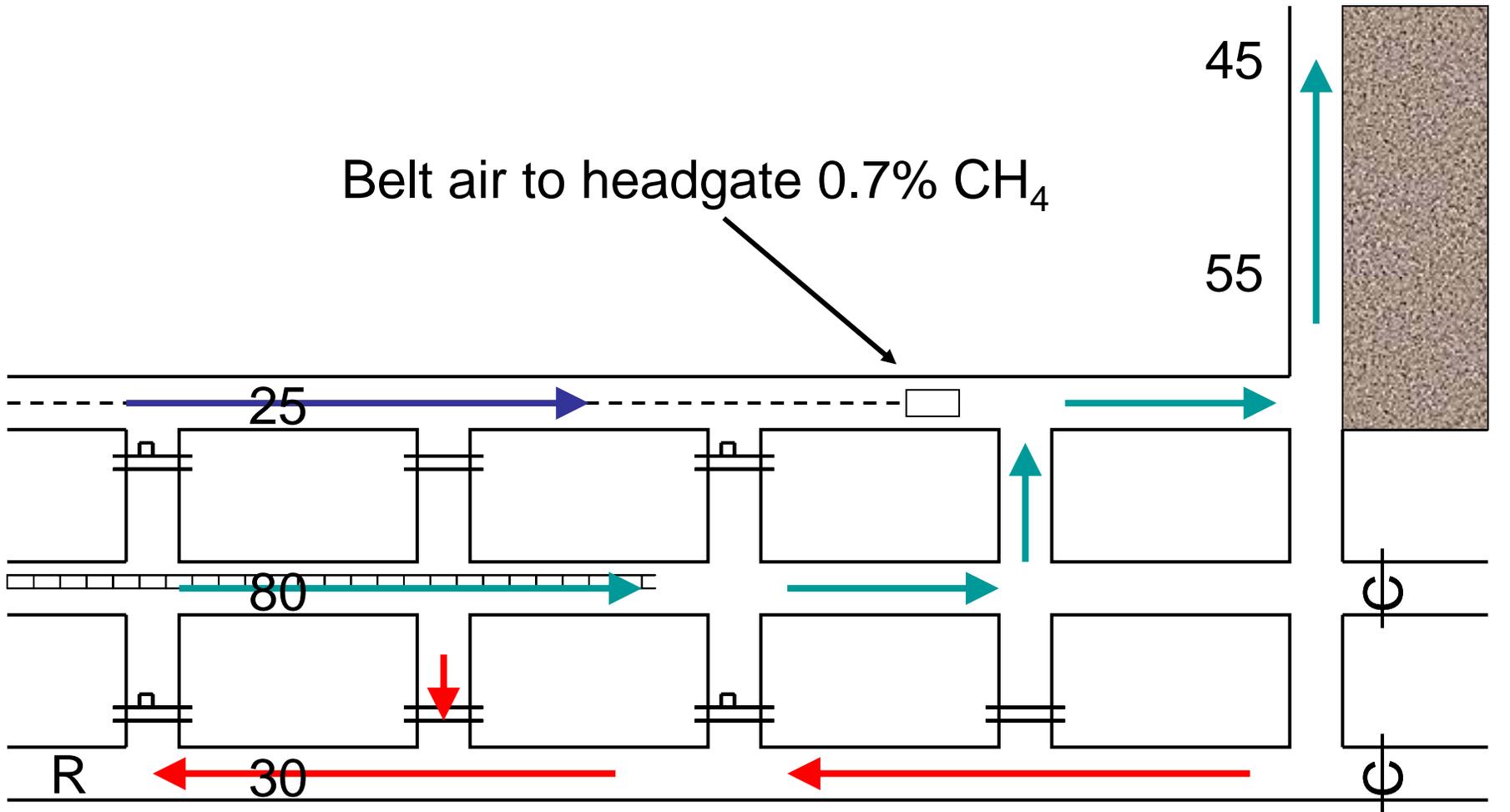
- Assume entry has 15.5 foot width and 7 foot height; area = 108.5 ft²
- Belt on intake
 - Velocity in track intake ~ 650 ft/min
- Belt on return
 - Velocity in track intake ~ 1200 ft/min

Three Entry Longwall Extraction (Eastern Mine)

- Belt air methane liberation is a significant contributor to longwall face methane levels
- The use of intake belt air becomes a hindrance as the longwall panels increase in length
- 14,000 ft panel with 25 K cfm intake recorded 0.7% methane in belt entry at the beginning of the panel

14,000 ft Long Panel

Belt air to headgate 0.7% CH₄



Panel Ventilation Results

	Belt – Intake (cfm)	Belt – Return (cfm)
Belt entry	25 K	25 K
Intake	80 K	80 K
Return/Intake	30 K	50 K
Shield #10	55 K	80 K
Shield #139	45 K	60 K
Headgate T	75 K	105 K

Advantages

- Belt on neutral outby
- The second isolated intake can supply more air to the headgate T junction
- Headgate at a higher relative pressure
- Increased airflow across longwall face
- Increased airflow to bleeders (sweetener)

Summary (Eastern Mines)

- Three entry gateroads have a difficult time during development with belt as neutral outby without pre-methane drainage
- Three entry gateroads during panel extraction have over the past few years gone to dual intakes, with belt neutral outby

Western and Illinois

- Western mines – two entry Utah, require belt air on longwall extraction
- Spontaneous combustion
- Illinois – lower methane coal (Springfield, Herrin); belt air on intake does not bring excessive methane to working areas

Questions