Evaluating the Use of Booster Fans in Two Underground Coal Mines

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Outline

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- Ventilation Models
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  - Mine B-Longwall
- Conclusions

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Introduction

- As underground coal mines develop ventilation demands are increased.
- Ventilation systems are often enhanced by:
  - Upgrading surface fans.
  - Installing new surface fans.
  - Developing new ventilation shafts.

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Introduction

- Booster fans are an alternative method of enhancing a ventilation system.
- Adequately located and sized booster fans can:
  - Reduce the required main fan pressure.
  - Reduce the overall system leakage.
  - Reduce the total power consumption.

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Introduction

- In the US, booster fans are prohibited in bituminous and lignite coal mines by CFR 30 Section 75.302.
- Uncontrolled recirculation is a notable risk associated with their use.

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Objectives

- Baseline ventilation models were developed.
- Expanded ventilation models were established.
- Future ventilation requirements were estimated.
- Expanded ventilation systems were modeled using booster fans.
- All models were inspected for recirculation.
- System power requirements were evaluated.

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Mine A-Background

- Room and Pillar is used as the primary means of coal production.
- Five development sections are maintained.
- The coal seam is nearly horizontal with an average thickness of 1.8 m (6 ft).
- Maximum depth of cover is 107 m (360 ft).
- 6.1 km (20,000 ft) from the surface to the farthest working face.

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Mine A-Ventilation System

- Powered by a 670 kW (900 hp) exhausting fan.
- Two intake airways and one return airway.
- Mains typically driven with four intake, four return, and three neutral airways.
- Sub-mains typically driven with two intake, two return, and three neutral airways.

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Mine A-Main Mine Fan

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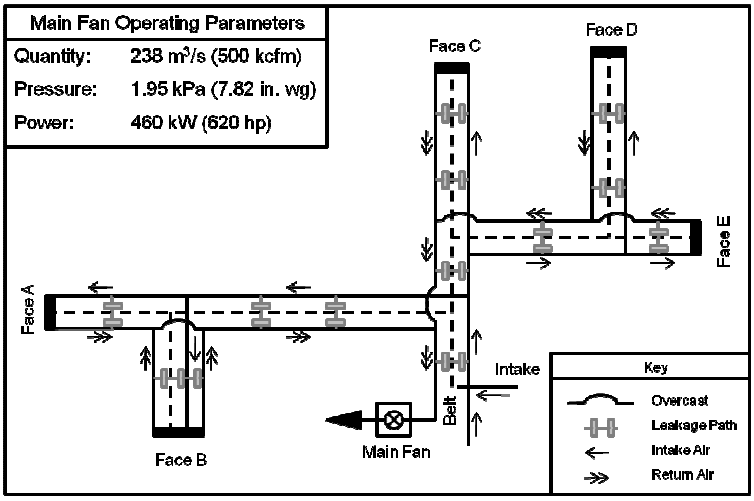
Mine A-Base Schematic

Main Fan Operating Parameters	
Quantity:	238 m^3/s (500 kcfm)
Pressure:	1.95 kPa (7.82 in. wg)
Power:	460 kW (620 hp)



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Mine A-Expanded Model

- Base model was expanded to include five years of additional development.
- After five years, most of the western region is mined out. A large portion of this area is sealed.
- Future development advances mostly north and east.
- A booster fan was added to the expanded model and the model was checked for recirculation.

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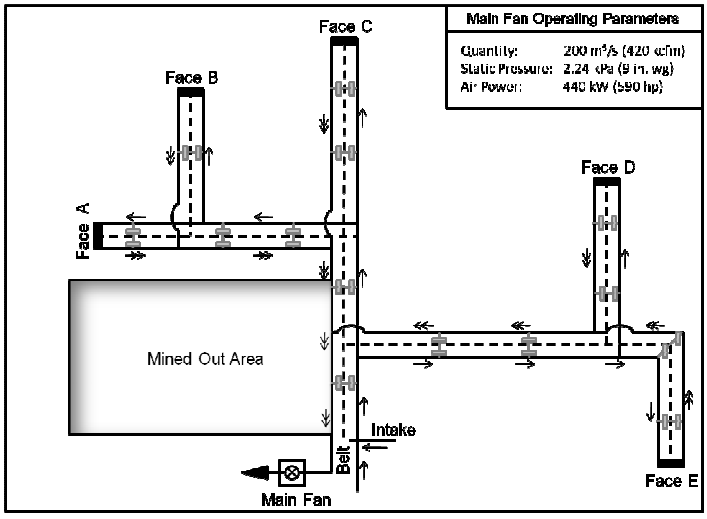
Mine A-Expanded Model



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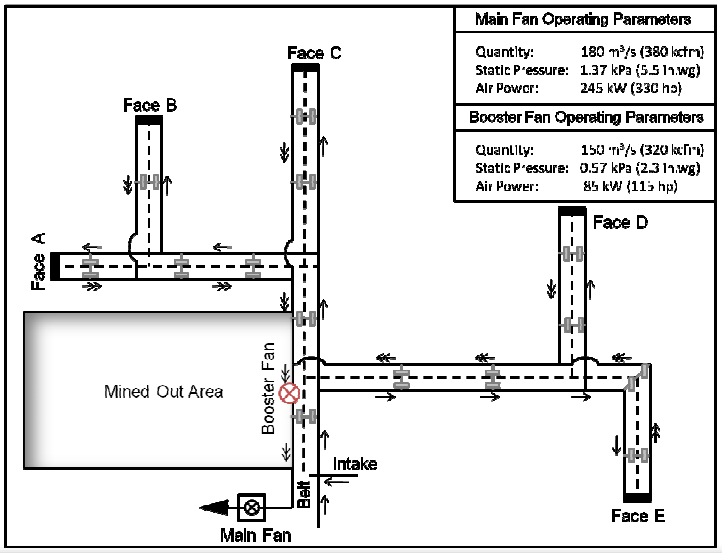
Mine A-Booster Fan Model



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Mine A-Summary

	Q, m³/s	Press, kPa	P, kW
Base Case:			
Main Fan	238	1.95	460
Expanded Case:			
Main Fan	200	2.24	440
Booster Fan Case:			
Main Fan	180	1.37	245
Booster Fan	150	0.57	85
Total Air Power			330

Power saved by two fan system: 110 kW

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Mine A-Conclusions

- A booster fan can make a difference in the ventilation system:
  - System air power is reduced by 110 kW (150 hp).
  - Main fan pressure is reduced by 0.87 kPa.
  - By reducing leakage the total required quantity is reduced by 20 m^3/s (42 kcfm).
- Because of the relative shallow depth of cover a new shaft may be more practical.

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Mine B-Background

- Longwall is used as the primary means of coal production.
- Three continuous miner sections and one longwall are maintained.
- The coal seam is nearly horizontal and ranges in thickness from 2 m (6.6 ft) to 6 m (19.7 ft).
- Maximum depth of cover is 610 m (2,000 ft).
- 18 km (59,000 ft) from the surface to the farthest working face.

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Mine B-Ventilation System

- Powered by a single exhausting fan.
- More than four intake airways and one return airway.
- Mains typically driven with two intakes, two returns, and one neutral airway.
- Longwall panels are typically driven with one intake, one return, and one neutral airway.

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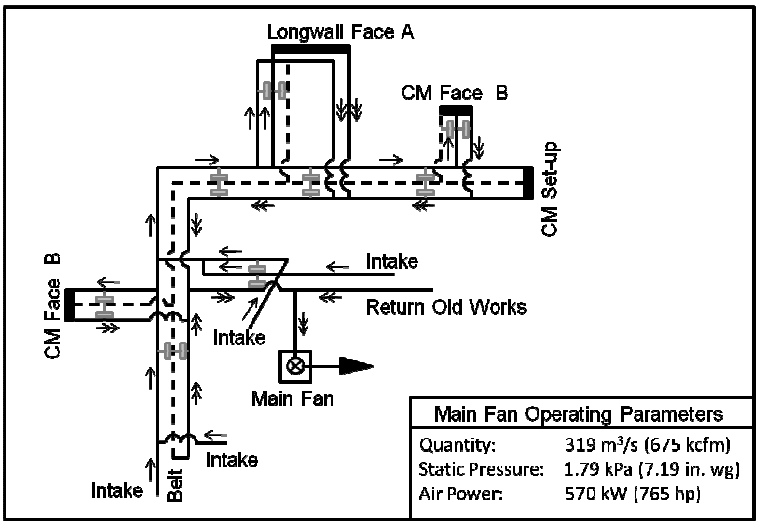
Mine B-Base Schematic



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Mine B-Expanded Model

- Base model was expanded to include additional years of development.
- Future development expands dramatically to the west.
- Depth of burden increases substantially as the mine develops.
- A booster fan was added to the expanded model and the model was checked for recirculation.

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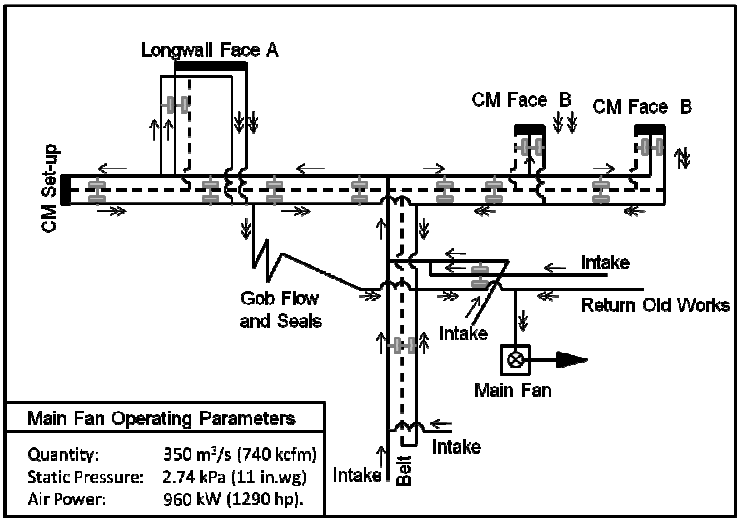
Mine B-Expanded Model



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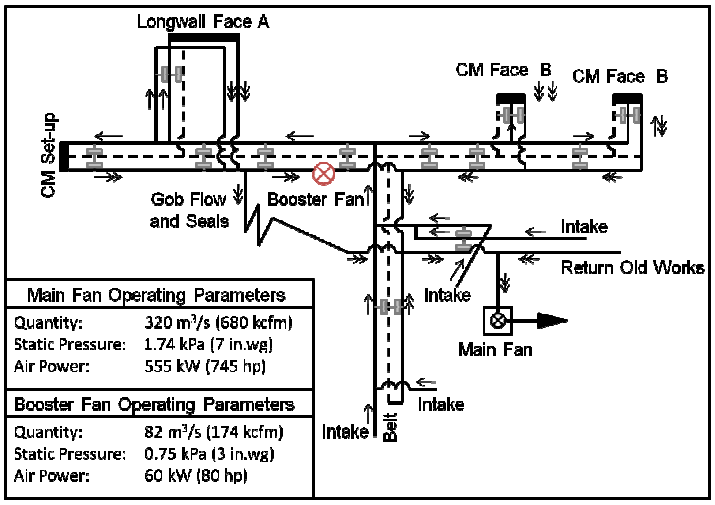
Mine B-Booster Fan Model



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Mine B-Summary

	Q, m³/s	Press, kPa	P, kW
Base Case:			
Main Fan	319	1.79	570
Expanded Case:			
Main Fan	350	2.74	960
Booster Fan Case:			
Main Fan	320	1.74	555
Booster Fan	82	0.75	60
Total Air Power			615

Power saved by two fan system: 345 kW

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Mine B-Conclusion

- A booster fan can make a difference in the ventilation system:
  - System air power is reduced by 345 kW (465 hp).
  - Main fan pressure is reduced by 1 kPa (4 in. wg).
  - By reducing leakage the total required quantity is reduced by 30 m^3/s (64 kcfm).
- For this mine the impact of a booster fan is significant.

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Conclusions

- The demand on ventilations systems generally increases with mining advance.
- Properly sized and located booster fans can:
  - Reduce the required system air power.
  - Reduce the required main fan pressure.
  - Reduce system leakage.
- Booster fans could be a good alternative to developing new shafts or installing new surface fans.

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