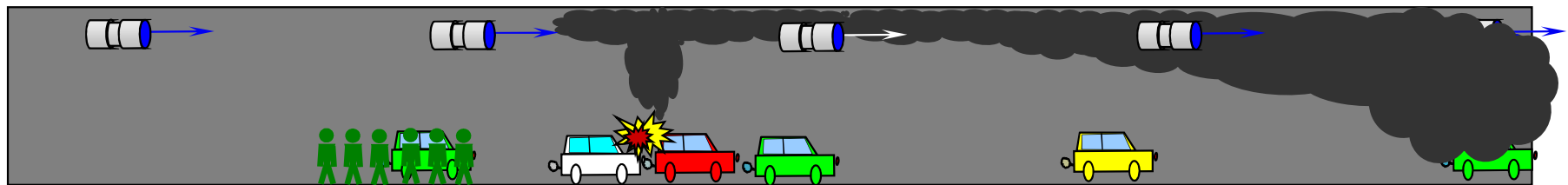


*Principles of Road
Tunnel
Design (longitudinal)*

1. Jet Fans only (simple)
2. Axial Fans with Saccardo Nozzle (complex)
3. Jet Fans with Shaft Axial Fans (complex)
4. Jet Fans with Spot Extraction by Axial Fans (complex)

1. Jet Fans only (longitudinal)



Flow & traffic direction



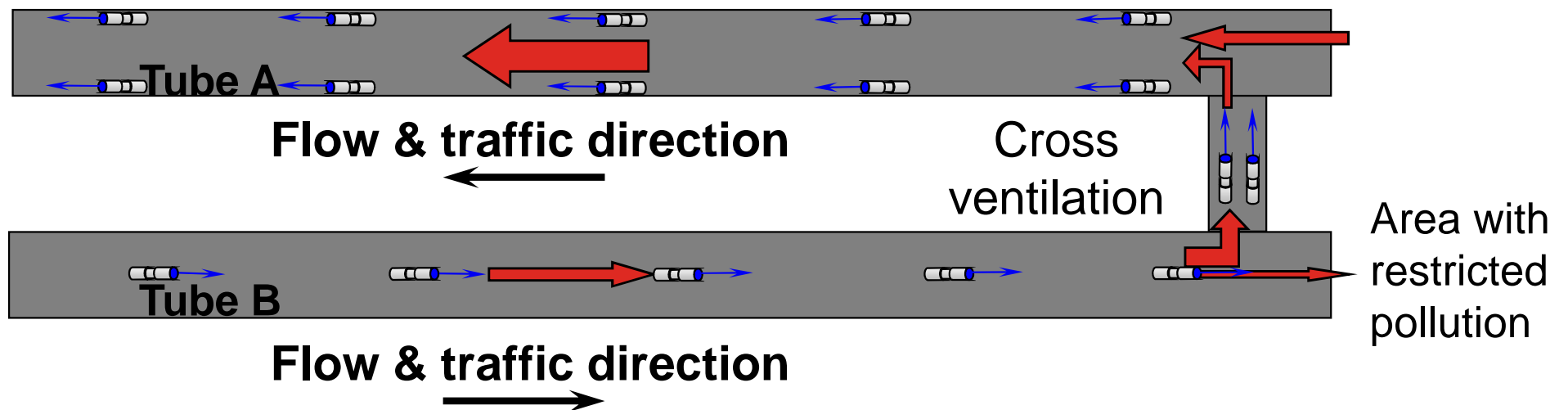
- ⊕ Good smoke control (upstream of fire: no smoke)
- ⊕ Medium safety level
- ⊕ Low investment costs
- ⊕ Simple design

- ⊖ Increasing concentration of pollutants until portal
- ⊖ Smoke laden section

1. Jet Fans only

Principle of cross ventilation

→ one portal area with restricted pollution level

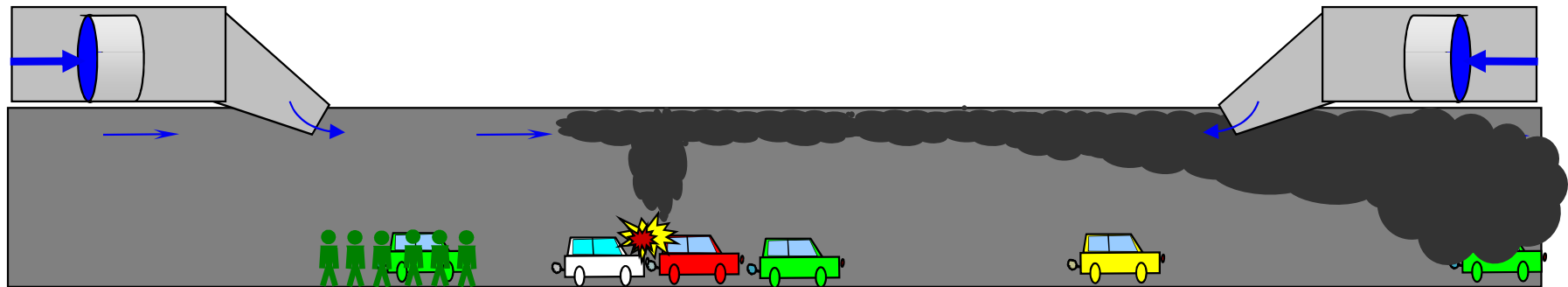


Partial amount of polluted air extracted
from Tube B into Tube A

→ amount of fan has to be increased for Tube A

→ increased pollution concentration in Tube A

2. Axial Fans with Saccardo Nozzle

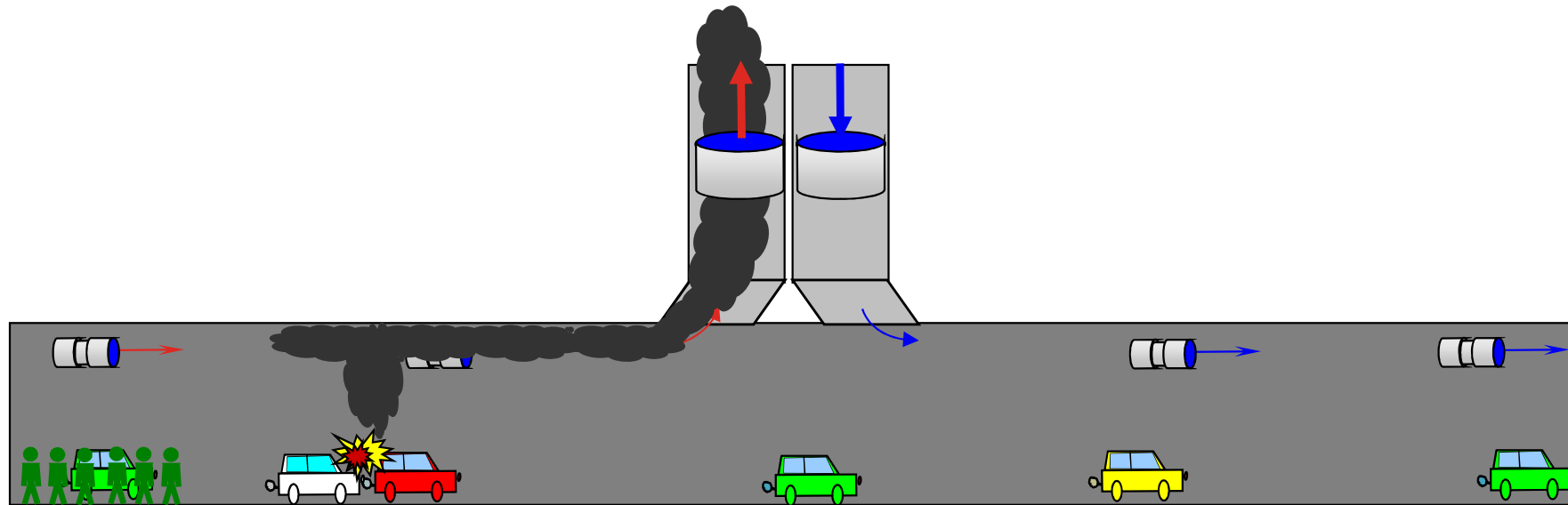


Flow & traffic direction



<ul style="list-style-type: none"> ⊕ Good smoke control (upstream of fire: no smoke) ⊕ Medium safety level 	<ul style="list-style-type: none"> ⊖ High investment costs ⊖ Complex design ⊖ Increasing concentration of pollutants until portal ⊖ Smoke laden section ⊖ 2nd fan room for reversing!!!
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3. Shaft Extraction

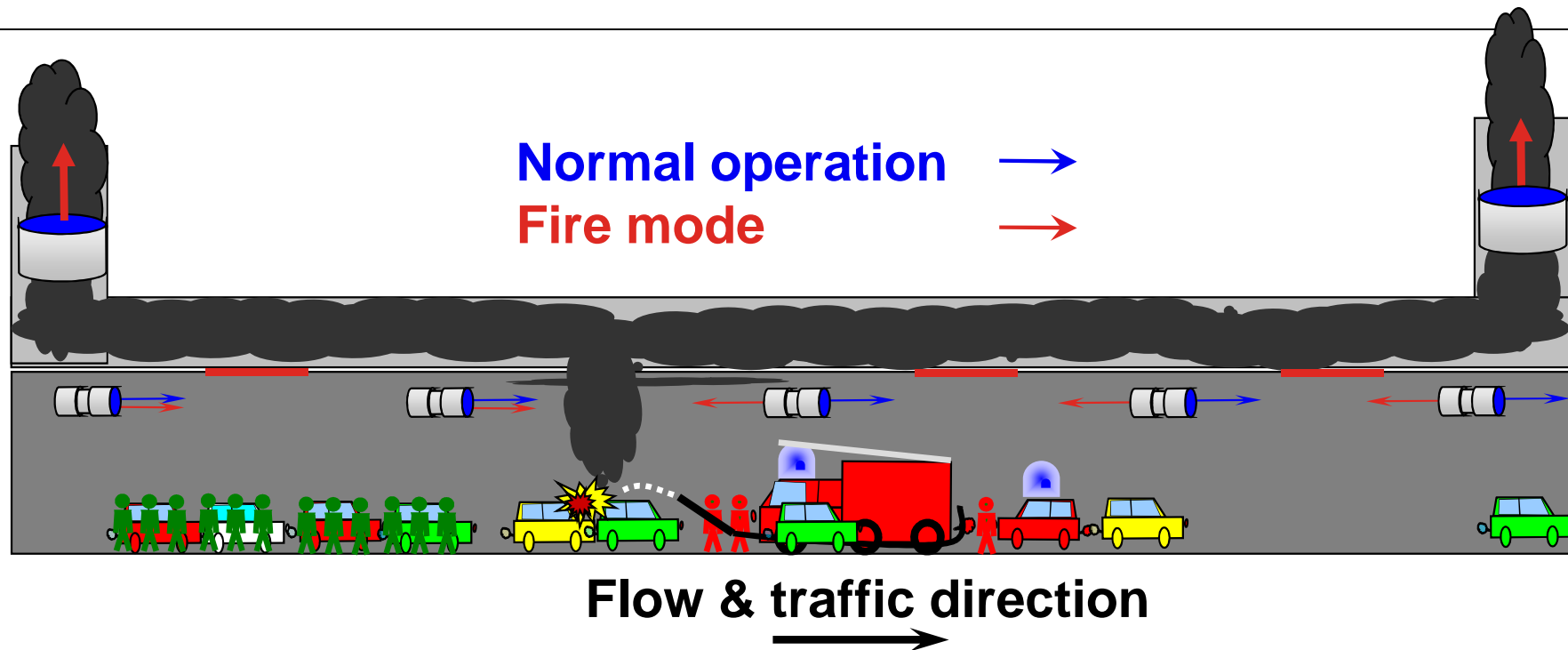


Flow & traffic direction



<ul style="list-style-type: none"> ⊕ Increasing concentration of pollutants reduced (50%) ⊕ Split smoke section (smoke laden max. 50%) ⊕ Good smoke control (50% of tunnel smoke free) ⊕ High safety level 	<ul style="list-style-type: none"> ⊖ High investment costs ⊖ Complex design
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4. Spot Extraction



⊕ Concentration of exhaust capacity at spot of fire	⊖ Very high investment costs
⊕ Simultaneous evacuation and fire fighting	⊖ Complex design
⊕ Excellent smoke control	
⊕ Highest safety level	

Advantages and Disadvantages of General Road Tunnel Designs:

- Jet Fans only (simple design, low investment costs, good smoke control upstream of fire, increasing concentration of pollutants until portal)
- Axial Fans with Saccardo Nozzle (very complex design, high investment costs, good smoke control upstream of fire, increasing concentration of pollutants until portal)
- Jet Fans with Shaft Axial Fans (complex design and cost intensive)
- Jet Fans with Spot Extraction by Axial Fans (complex design, cost intensive, excellent smoke control)