Narfoamkar

CFD Simulation of Water Mist and Sprinkler System in Resalat Tunnel of Tehran

MOTIVATION
INTRODUCING RESALAT TUNNEL
MODELING FIRE IN RESALAT TUNNEL
*INPUTS
*RESULTS
MAIN QUESTION
NFPA REVIEW
FIXED FIRE FIGHTING SYSTEMS
SPRINKLER & WATER MIST SYSTEM
*INPUTS
*RESULTS
CONCLUSION
FUTURE STUDIES

Motivation

- **Resalat tunnel is the first road tunnel in Tehran**
- **one of most crowded tunnels of Tehran**
- **my every day route, home to office and vice versa**

MOTIVATION

INTRODUCING RESALAT TUNNEL

FIRE MODELING IN RESALAT TUNNEL

*INPUTS

*RESULTS

MAIN QUESTION

NFPA REVIEW

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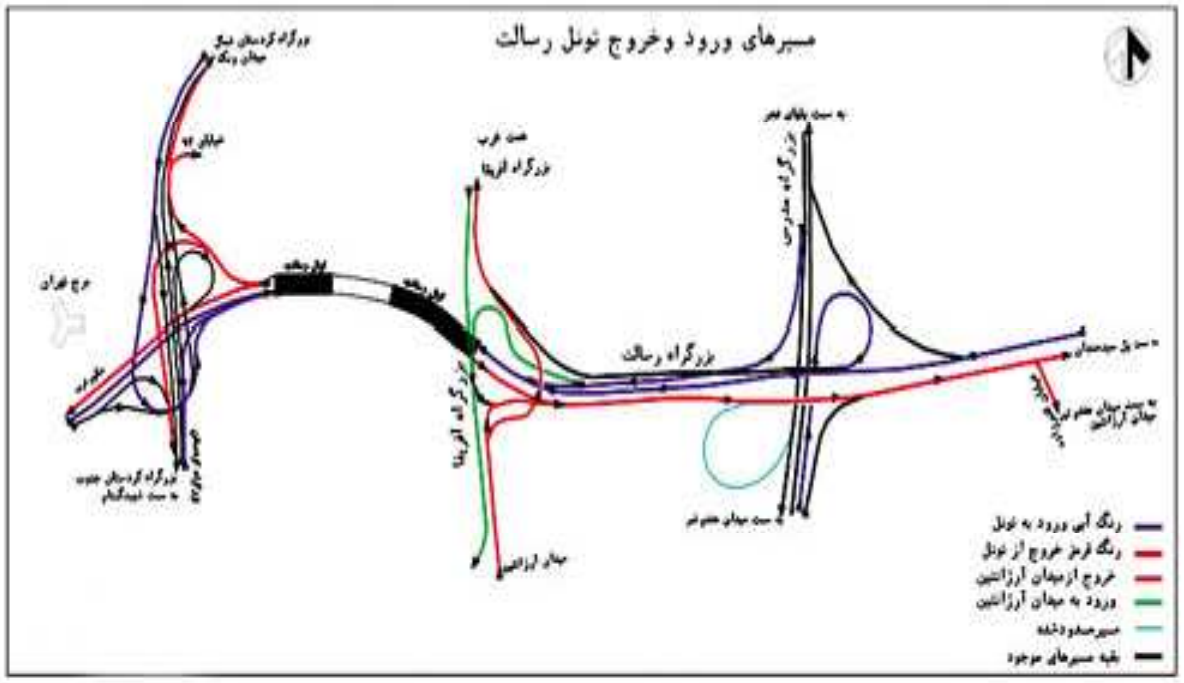
FUTURE STUDIES

Introducing Resalat Tunnel

Year of construction : 2006

Total Length : 950 m in 2 separate tube

Joins Resalat highway from east to Hakim highway in west



MOTIVATION

INTRODUCING RESALAT TUNNEL

FIRE MODELING IN RESALAT TUNNEL

*INPUTS

*RESULTS

MAIN QUESTION

NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

SPRINKLER & WATER MIST SYSTEM

*INPUTS

*RESULTS

CONCLUSION

FUTURE STUDIES

Introducing Resalat Tunnel

30 jet fans in each direction

Linear heat detector in each direction

CCTV system

Manual call point every 100 meters

Fire hose box every 25 meters in each direction including hose reel and manual extinguisher

MOTIVATION

INTRODUCING RESALAT TUNNEL

FIRE MODELING IN RESALAT TUNNEL

*INPUTS

*RESULTS

MAIN QUESTION

NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

SPRINKLER & WATER MIST SYSTEM

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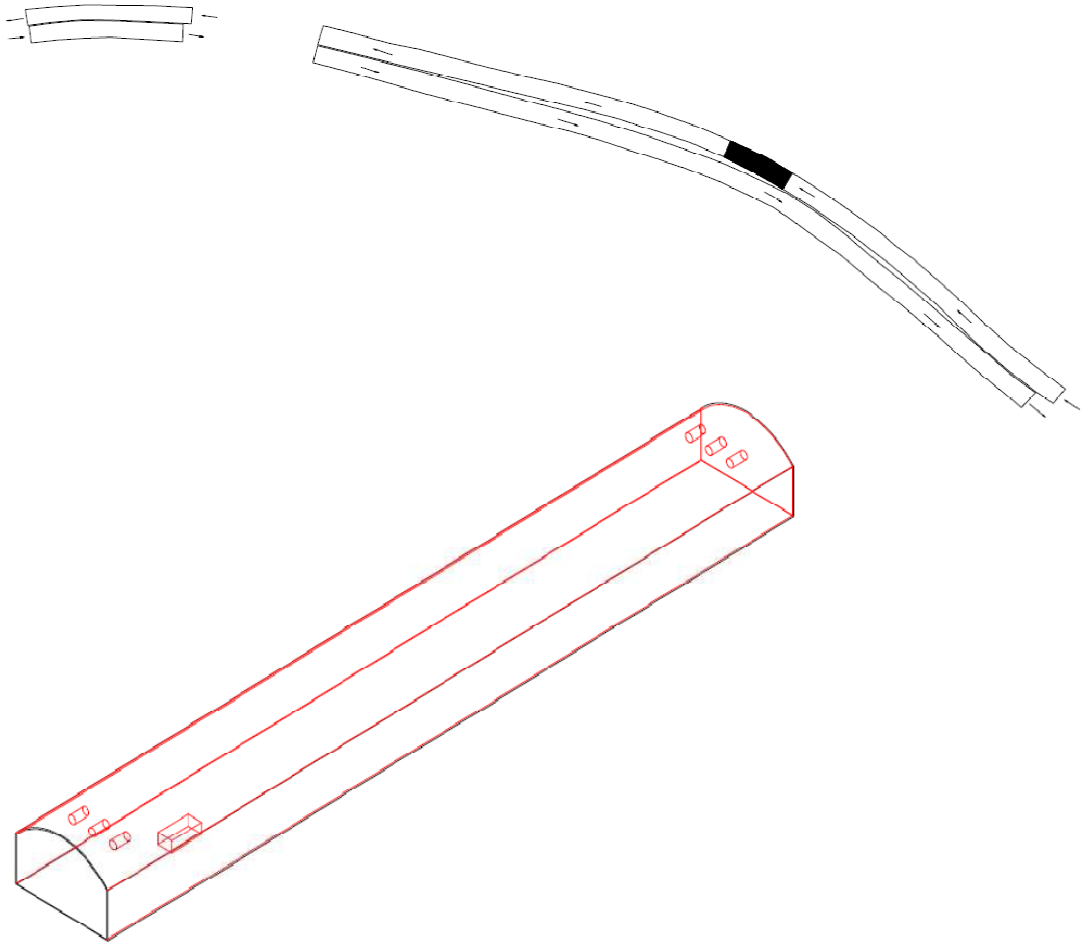
*RESULTS

CONCLUSION

FUTURE STUDIES

Fire Modeling

Computational Domain



MOTIVATION

INTRODUCING RESALAT TUNNEL

FIRE MODELING IN RESALAT TUNNEL

*INPUTS

*RESULTS

MAIN QUESTION

NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

SPRINKLER & WATER MIST SYSTEM

*INPUTS

*RESULTS

CONCLUSION

FUTURE STUDIES

Fire Modeling

The study makes an extensive use of the code FDS:

- ✓ **It is free and open source**
- ✓ **It is widely used by scientists in the field of fire science**
- ✓ **A water spray model is already included**

FDS technical reference guide:

FDS has been aimed at solving practical fire problems in fire protection engineering , while at the same time providing a tool to study fundamental fire dynamics and combustion.

Tunnel Dimension	100m X 13.5m X 9.0m
Vehicle dimension	4.4m X 2m X 1.4m
Flow Rate of Jet Fans	33.3 m^3/s
Fire Heat Release Rate	10 MW [2]

MOTIVATION

INTRODUCING RESALAT TUNNEL

FIRE MODELING IN RESALAT TUNNEL

*INPUTS

*RESULTS

MAIN QUESTION

NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

SPRINKLER & WATER MIST SYSTEM

*INPUTS

*RESULTS

CONCLUSION

FUTURE STUDIES

Fire Modeling

35 s

75 s

150 s

300 s

MOTIVATION

INTRODUCING RESALAT TUNNEL

FIRE MODELING IN RESALAT TUNNEL

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MAIN QUESTION

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SPRINKLER & WATER MIST SYSTEM

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*RESULTS

CONCLUSION

FUTURE STUDIES

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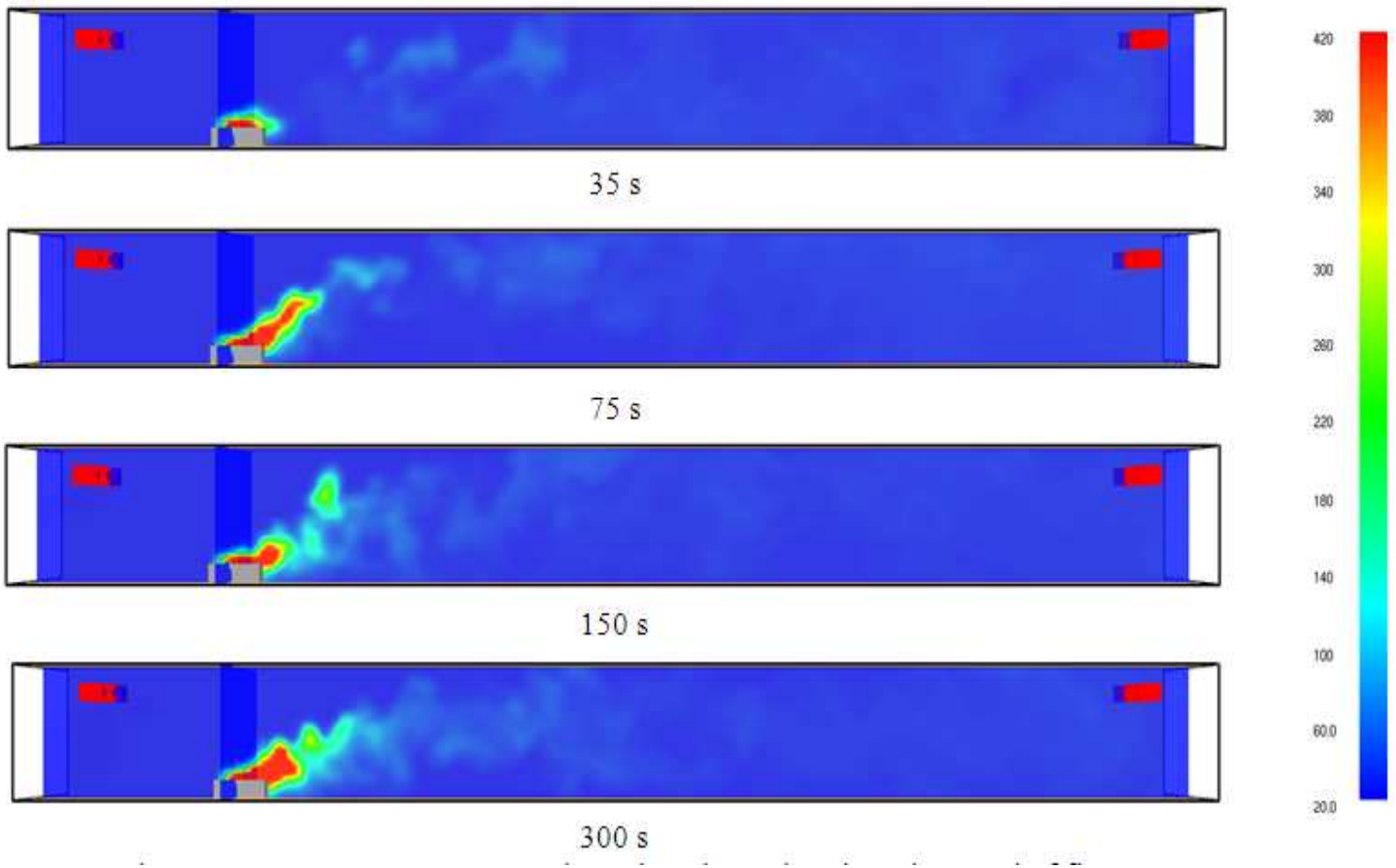

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*INPUTS

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NFPA REVIEW

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FUTURE STUDIES

Main Question

*** in 5 minutes the temperature will reach 130°C near the burning car**

*** according to NFPA 502 Motorists should not be exposed to maximum air temperatures that exceed 60°C (140°F) during emergencies**

Is it enough to have just stand pipe system to protect motorists from fire?

What about fixed fire fighting system?

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NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

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CONCLUSION

FUTURE STUDIES

NFPA Review

NFPA® 502

Standard for Road Tunnels, Bridges, and Other Limited Access Highways

2001 and 2004 Editions:

✓Currently, the use and effectiveness of sprinklers in road tunnels are not universally accepted.

2008 Edition:

✓Fixed fire suppression system is a Not mandatory requirement for road tunnels.

✓Catastrophic road tunnel fires have encouraged a re-evaluation of water based fire fighting systems for use in future road tunnels in Europe.

2011 Edition:

✓Water-based fire-fighting systems has been defined

✓Where the tunnel length equals or exceeds 1000 m, Fixed fire suppression system is conditionally mandatory requirement

2014 Edition:

✓Where the tunnel length equals or exceeds 300 m and 1000m, Fixed fire suppression system is conditionally mandatory requirement

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FIRE MODELING IN RESALAT TUNNEL

*INPUTS

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MAIN QUESTION

NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

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*INPUTS

*RESULTS

CONCLUSION

FUTURE STUDIES

Fixed Fire Fighting Systems

NFPA® 502

Standard for Road Tunnels, Bridges, and Other Limited Access Highways

There is general agreement that, in many cases, the inclusion of water-based fire-fighting systems can act as a valuable component of the overall fire and life safety system in a tunnel. Some of the benefits and capabilities of water-based fire-fighting systems include the following:

✓***Minimizing fire spread***

✓***Fire suppression and cooling***

✓***Improved conditions for first responders***

✓***Improved performance of ventilation systems***

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MAIN QUESTION

NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

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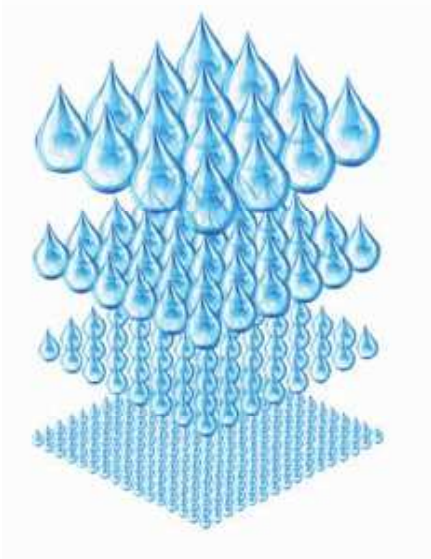
CONCLUSION

FUTURE STUDIES

Sprinkler and Watermist Systems



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INTRODUCING RESALAT TUNNEL

FIRE MODELING IN RESALAT TUNNEL

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MAIN QUESTION

NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

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*INPUTS

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CONCLUSION

FUTURE STUDIES

Sprinkler and Watermist Systems

	Sprinkler System	**Watermist System**
K-Factor (l/min/)	80	4.3
Droplet Size (µm)	750	100
Nozzle Spacing (m)	3	3
Nozzle Quantity (Pcs)	12	12
Working Pressure (bar)	0.56 bar	80 bar
Flux (l/min/m2)	5	1.5
Duration (min)	5	5

[1, 11, 17]

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MAIN QUESTION

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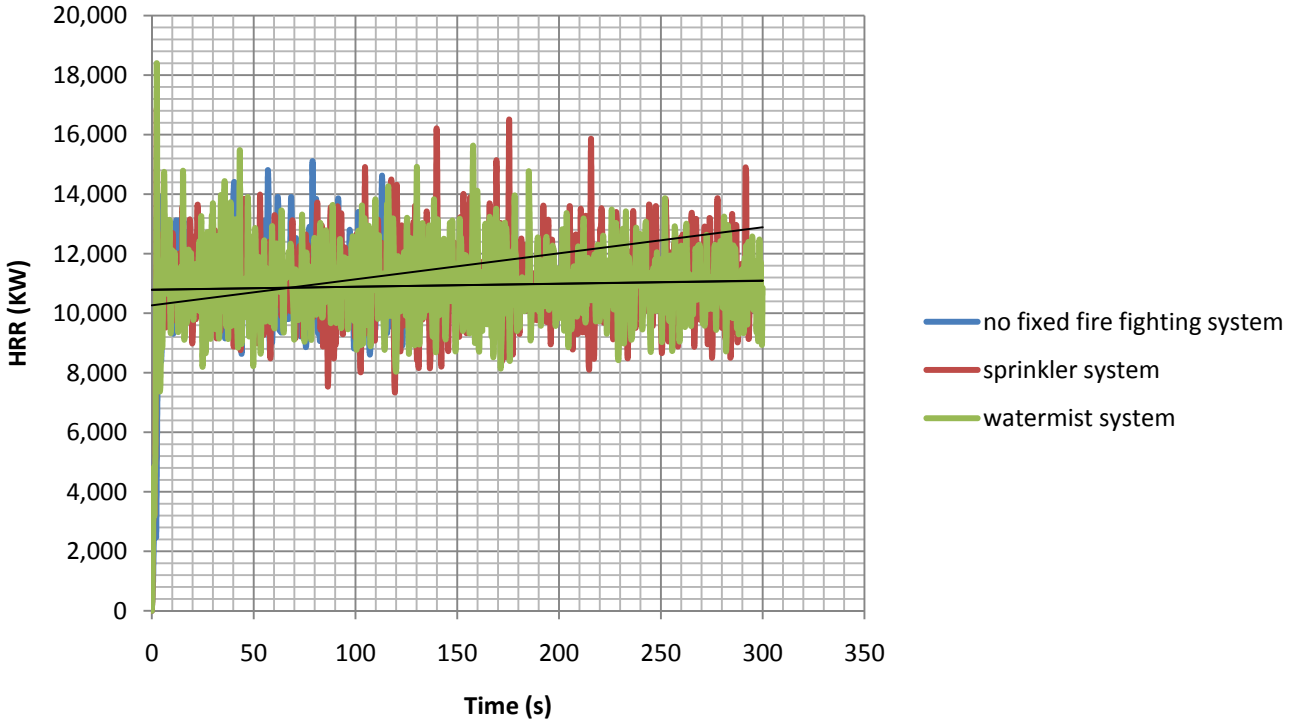

Reduction in HRR Growth in First 5 Minutes:

Sprinkler System	Water Mist System
-87.96%	-88.68%

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MAIN QUESTION

NFPA REVIEW

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FUTURE STUDIES

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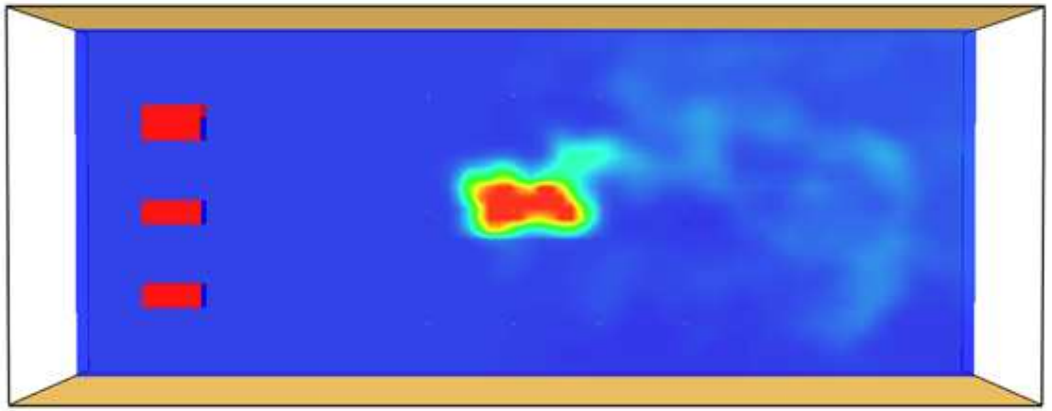

Figure 8: Snapshot of fire with sprinkler system

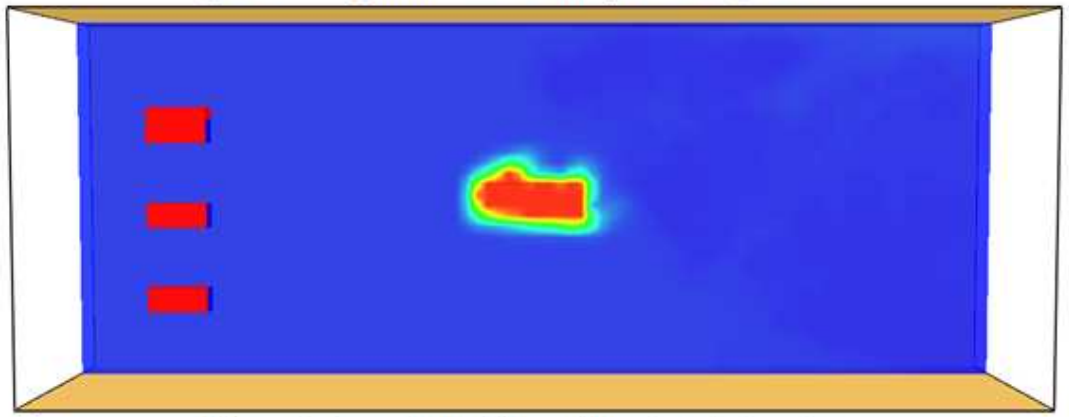

Figure 9: Snapshot of fire with watermist system

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*RESULTS

CONCLUSION

FUTURE STUDIES

Conclusion

✓A requirement to improve fire fighting systems of Resalat tunnel in compliance with 2014 edition of NFPA 502

✓An optimistic view about fixed fire fighting systems from 2008 on

✓Water mist system disturbs the smoke layers more than sprinkler

✓ Water mist system can keep fire from spreading to other vehicles

✓Water mist system prevent migration of hot airflow through the tunnel

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CONCLUSION

FUTURE STUDIES

Future Studies

✓**Increasing time of calculation up to 15 minutes**

✓**Repeat current study for Tohid and Sadr Tunnel in underground portions.**

✓**Field-work for fire fighting systems of road tunnels in main roads of Iran**

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NFPA REVIEW

FIXED FIRE FIGHTING SYSTEMS

SPRINKLER & WATER MIST SYSTEM

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CONCLUSION

FUTURE STUDIES

Thanks for Your Attention

Any Question?