

**Federal Building and Fire Safety Investigation
of the World Trade Center Disaster**

Simulation of the Fires in WTC 1 and 2

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Overview

- Development and validation of the Fire Dynamics Simulator for use in the WTC investigation is complete
- Numerical simulations of fires in WTC 1 and 2 completed. WTC 7 postponed.
- Three fire simulations performed for each building – **Realistic Case, More Severe Case, Less Severe Case** – to assess sensitivity to changes in input parameters
- Results passed on to Fire/Structure Interface for analysis of temperature of steel and concrete (Prasad)

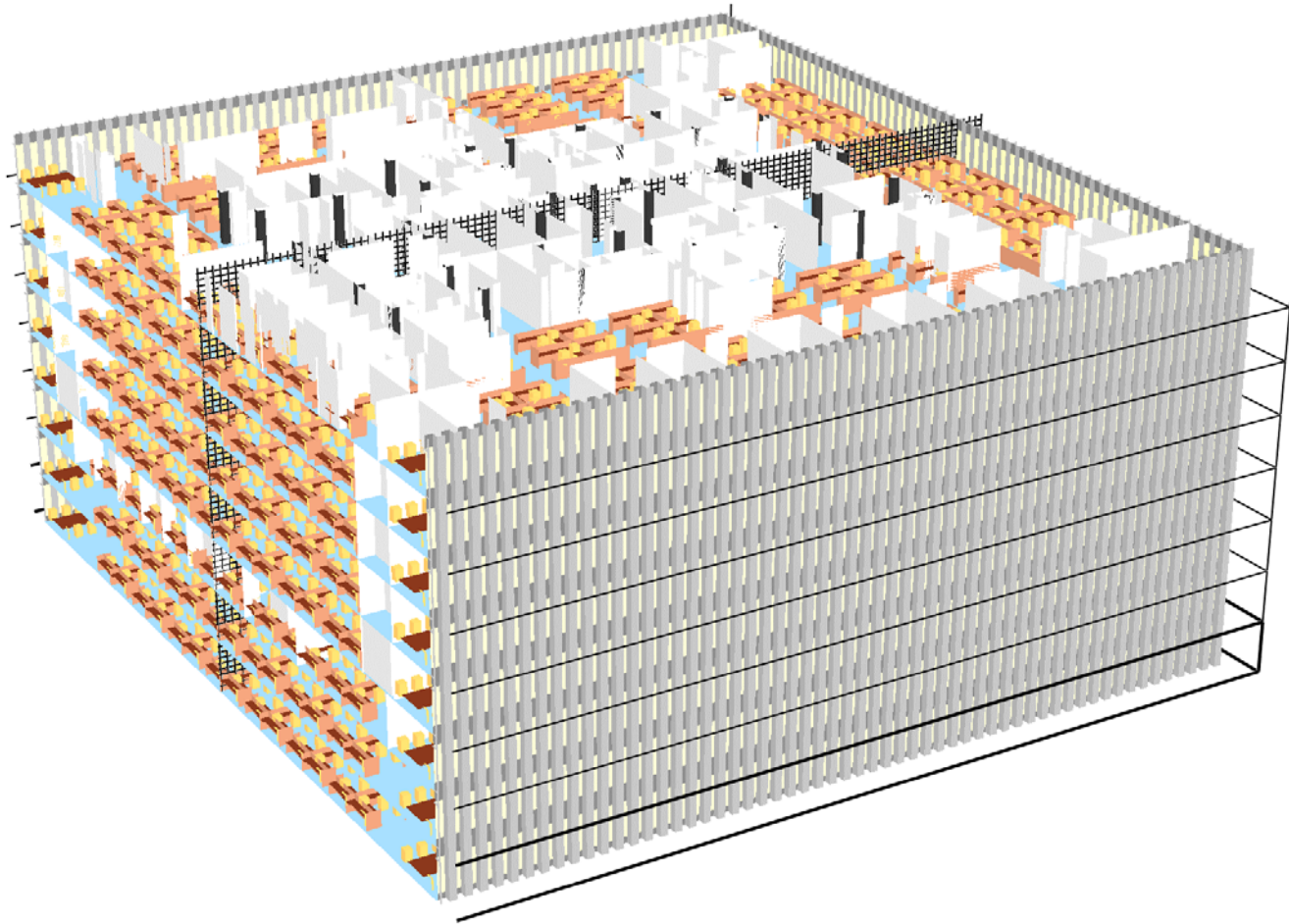
Parameter Variations for Fire Simulations

Less Severe Case	Realistic Case	More Severe Case
Combustibles 15 kg/m ² (3 lb/ft ²)	Combustibles 20 kg/m ² (4 lb/ft ²)	Combustibles 25 kg/m ² (5 lb/ft ²)
Soffits around openings of shafts	Vertical shafts completely open	Soffits around openings of shafts
Rubble throughout	Rubble in aircraft path only	No rubble, airplane debris concentrated

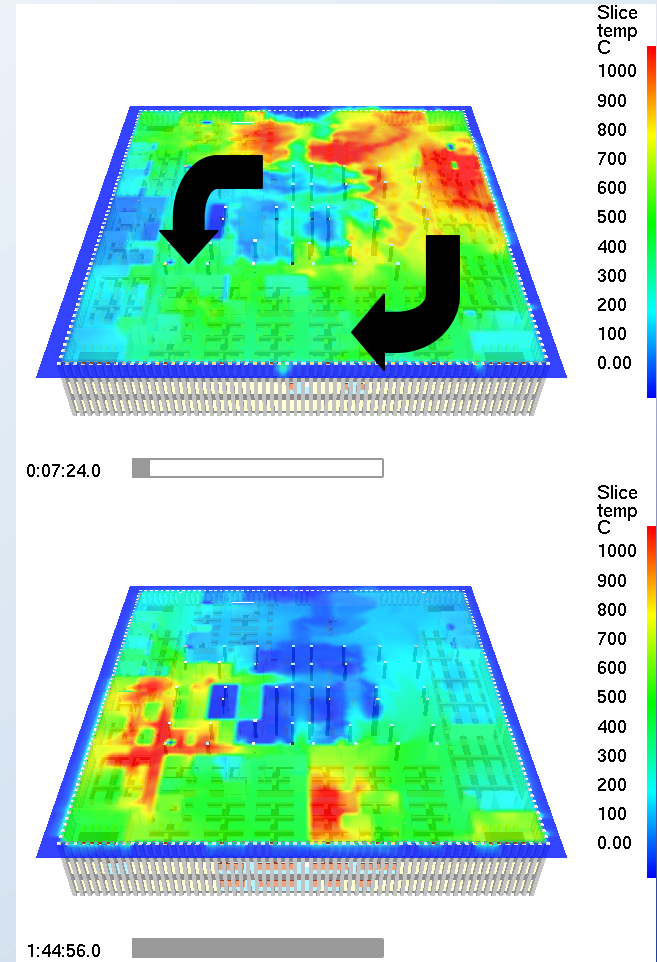
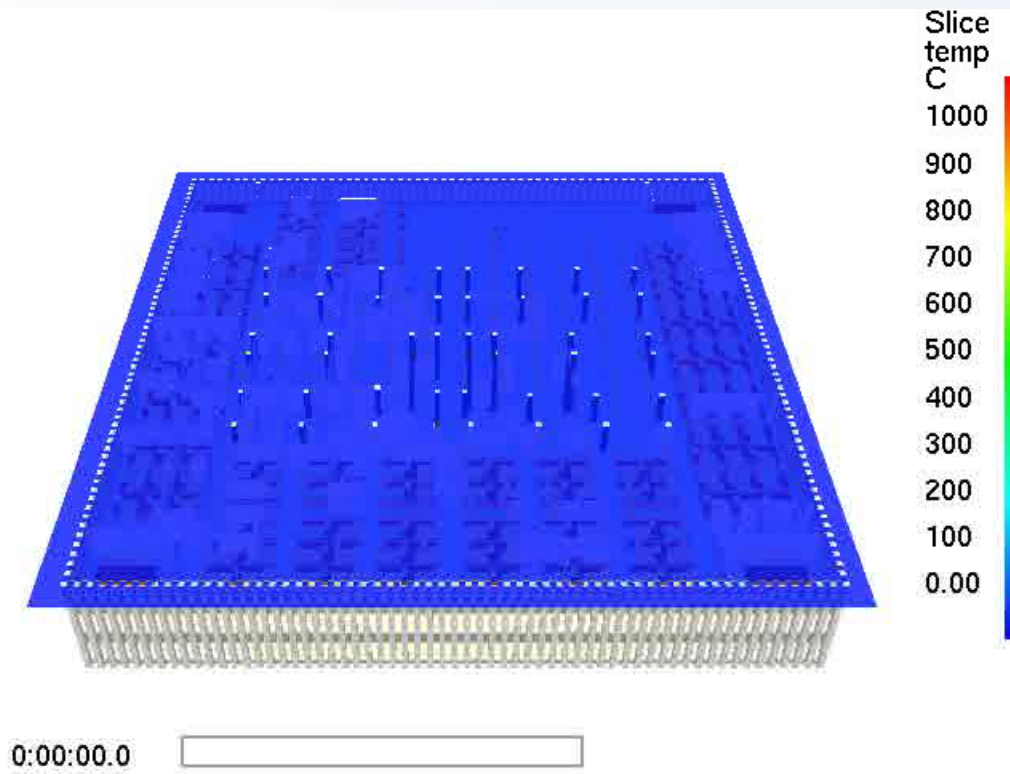
FDS Simulations to Date

3 for WTC 1, **Realistic Case, More/Less Severe** – 16 processors per calc
2 for WTC 2, **Realistic Case, More Severe** – 24 and 48 processors per calc

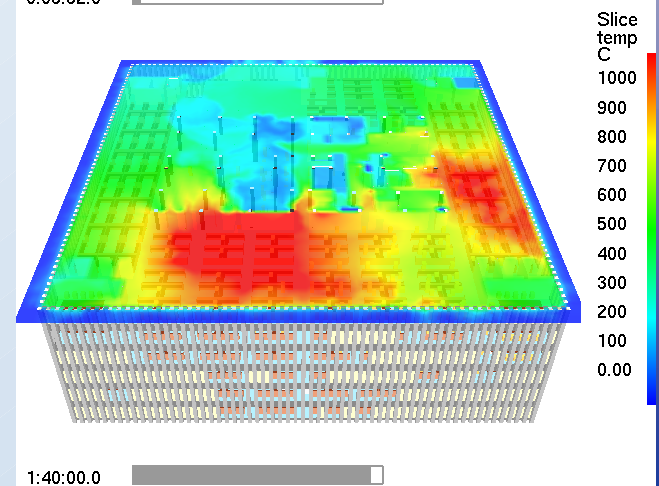
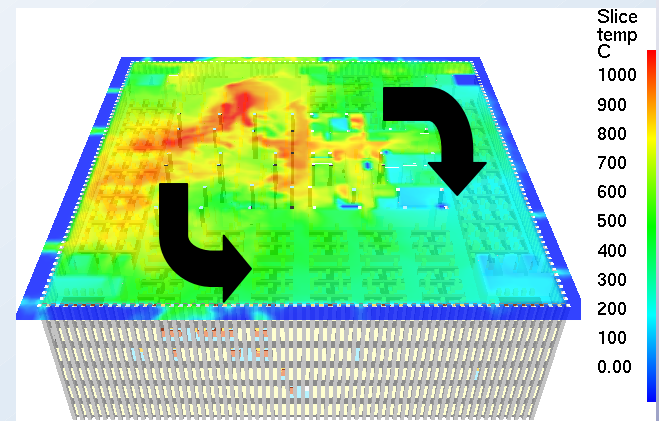
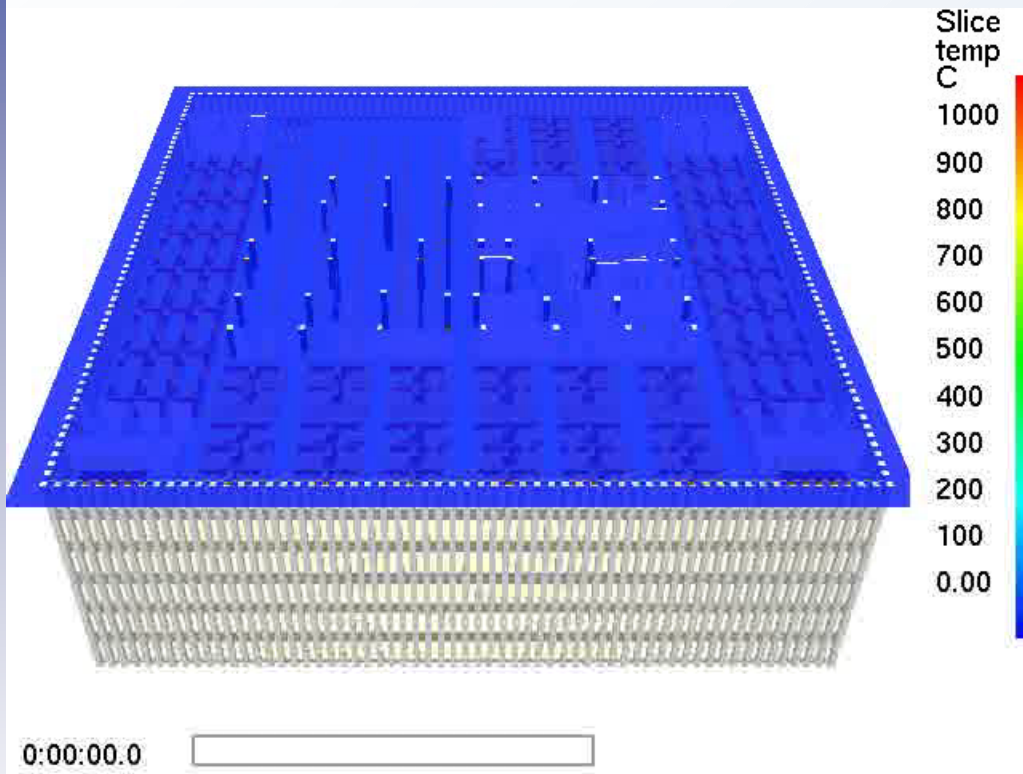
NIST



Upper Layer Temperatures, WTC 1, Floor 94



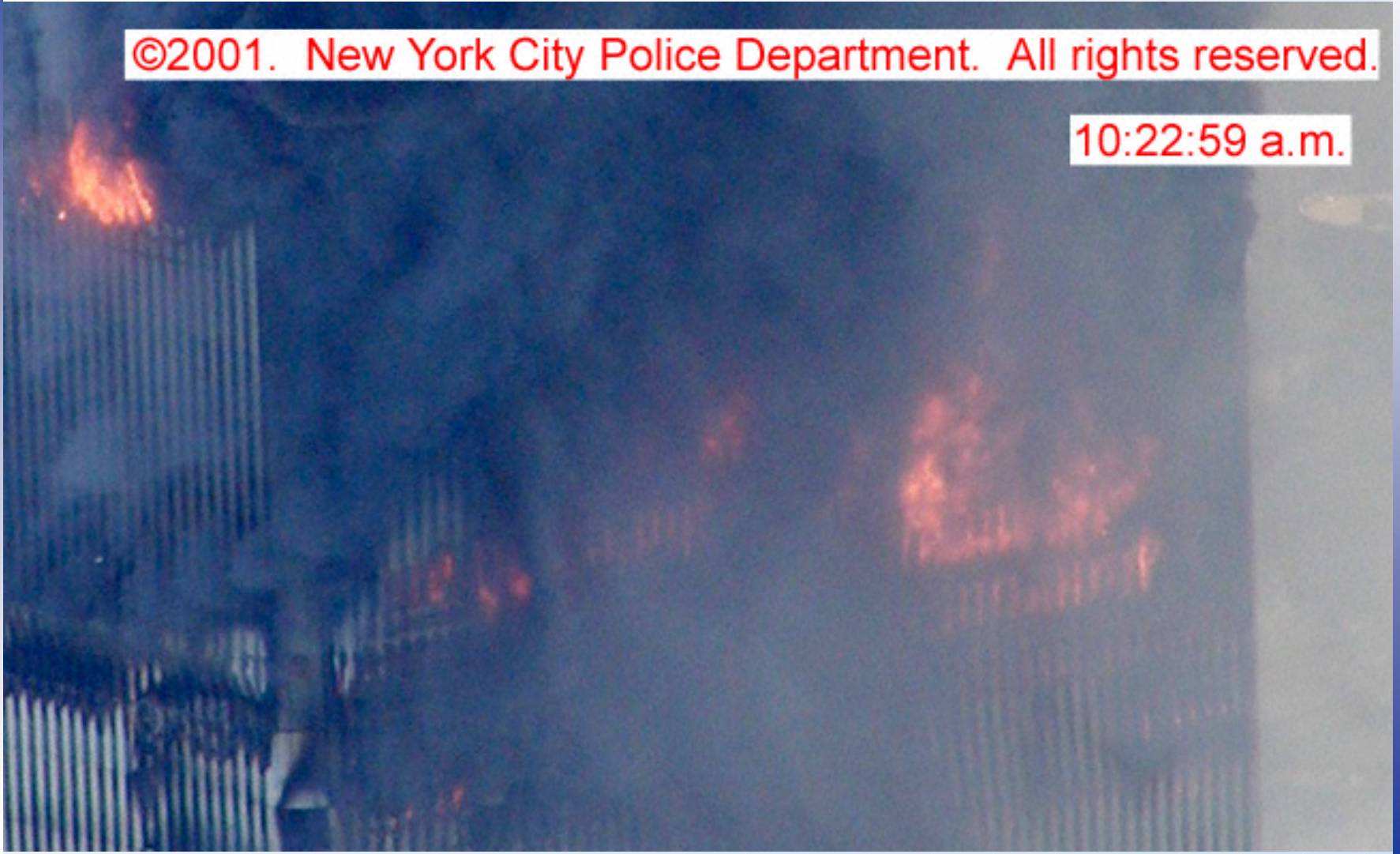
Upper Layer Temperatures, WTC 1, Floor 97



South Face of WTC 1 at 10:23

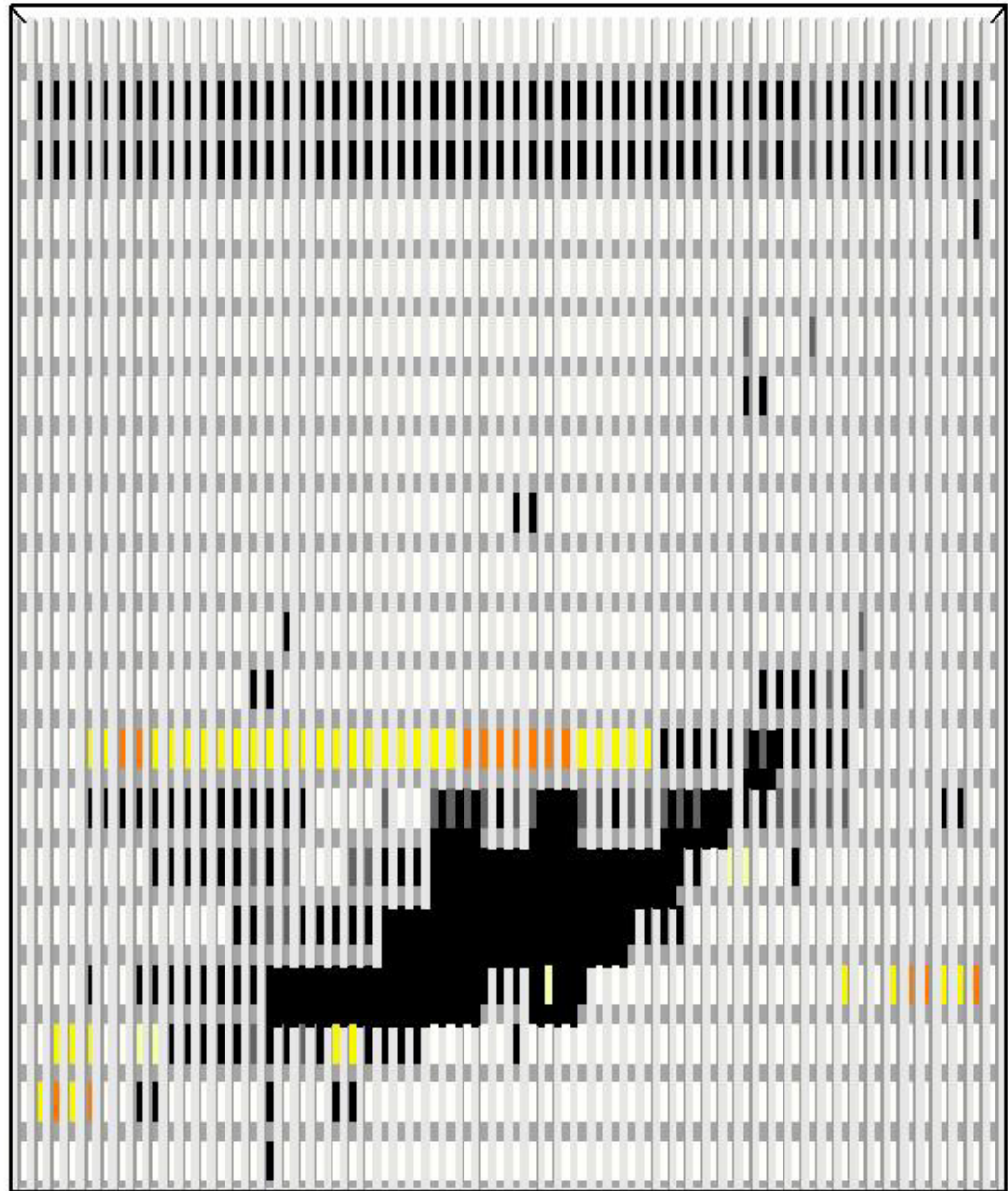
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10:22:59 a.m.



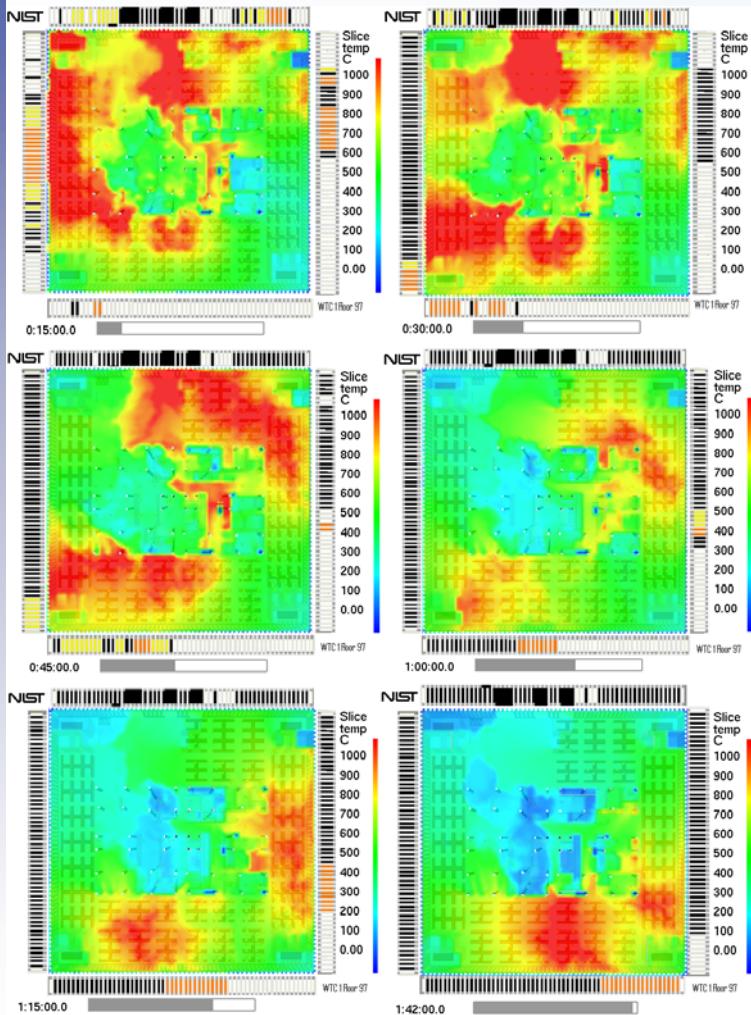
Summary of Fire Activity WTC 1 North Face

Courtesy Bill Pitts

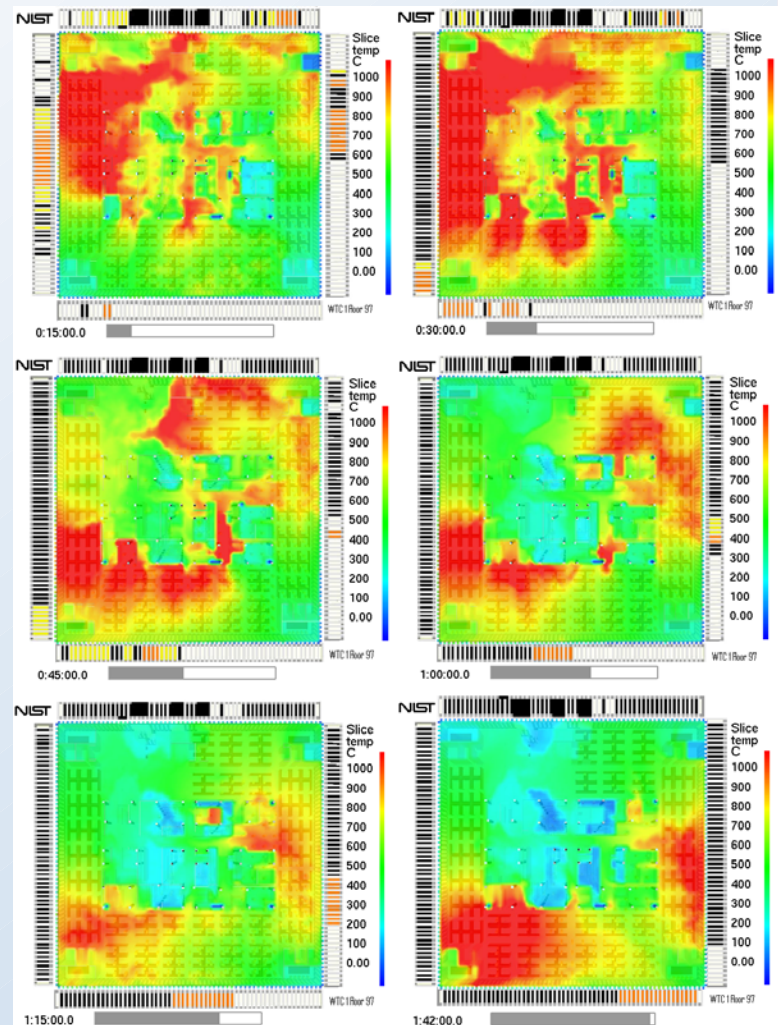


WTC 1, 97th Floor, Sensitivity Analysis

Realistic Case

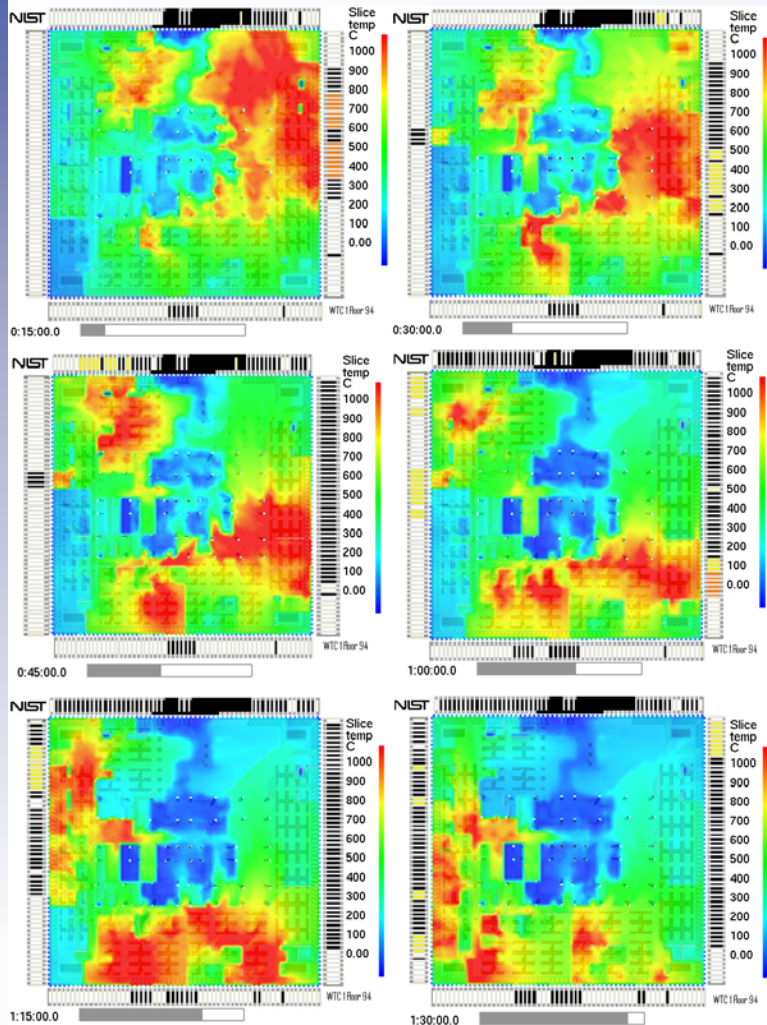


More Severe

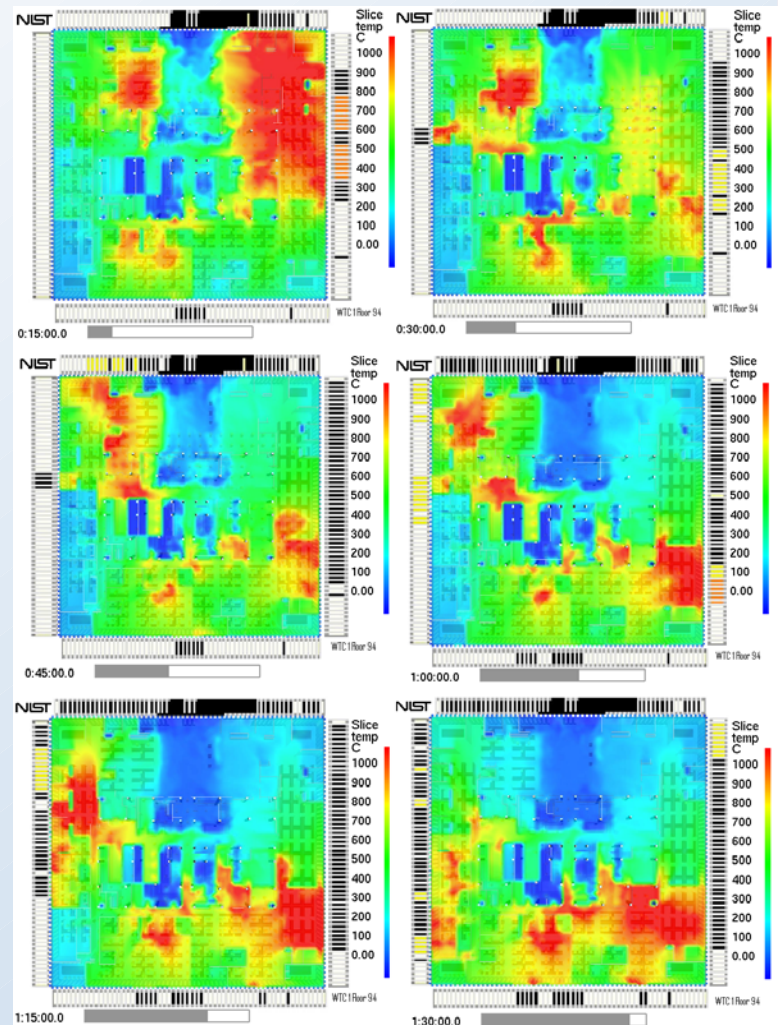


WTC 1, 94th Floor, Sensitivity Analysis

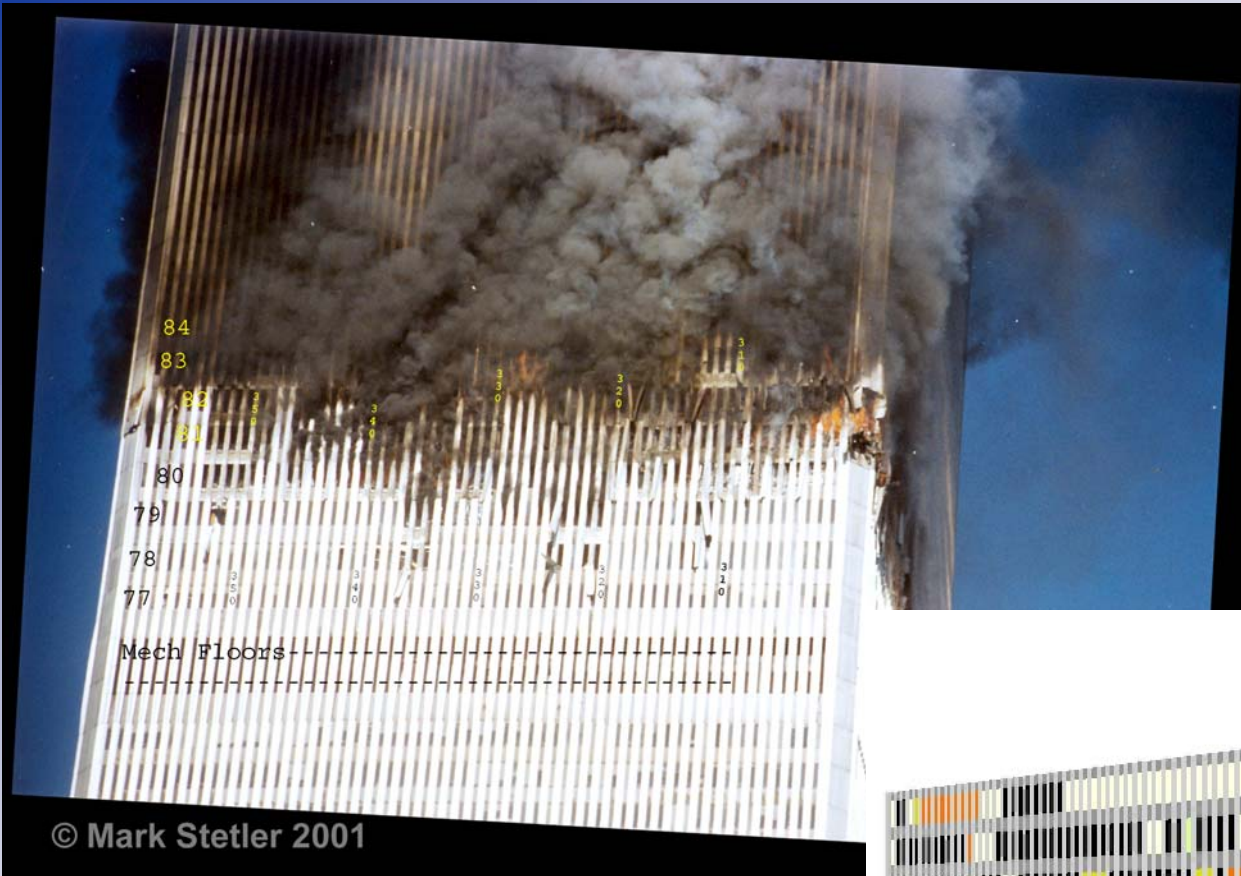
Realistic Case



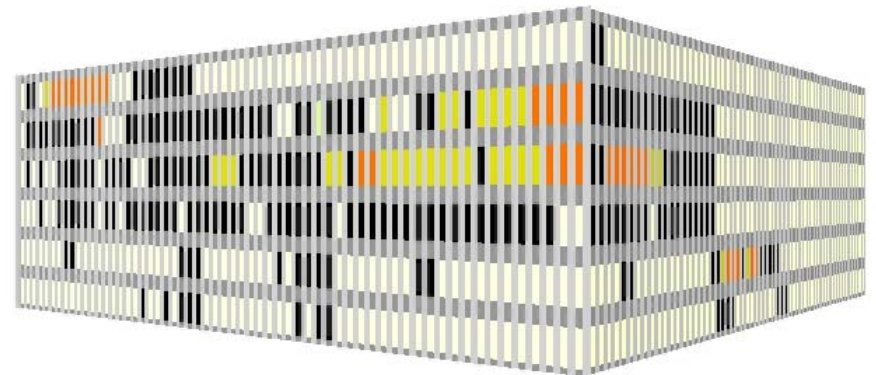
More Severe



**WTC 2
East Face
9:26 am**



**Fire Activity
East/North Face**



9:03:00.0

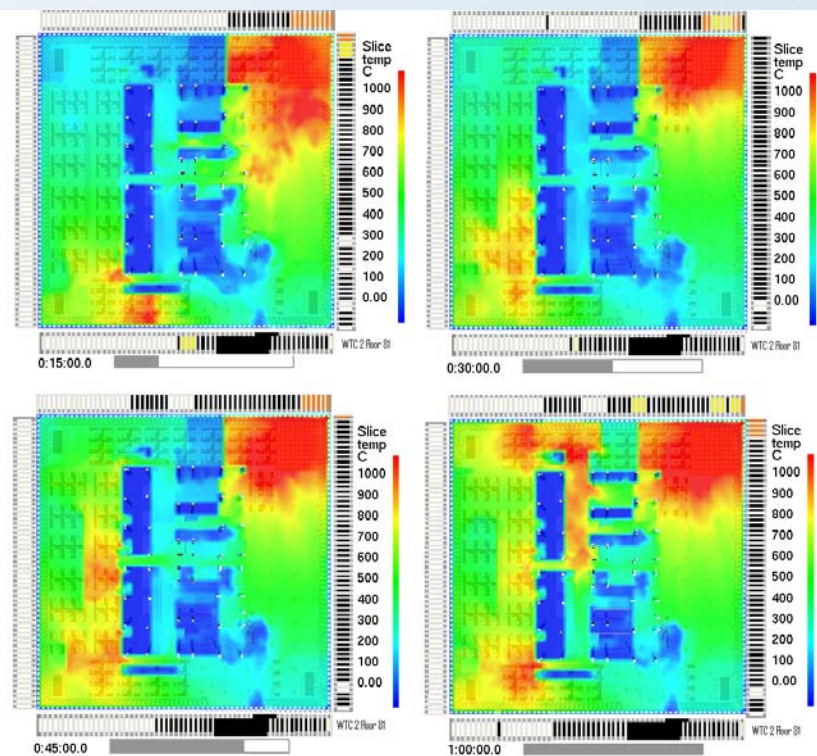
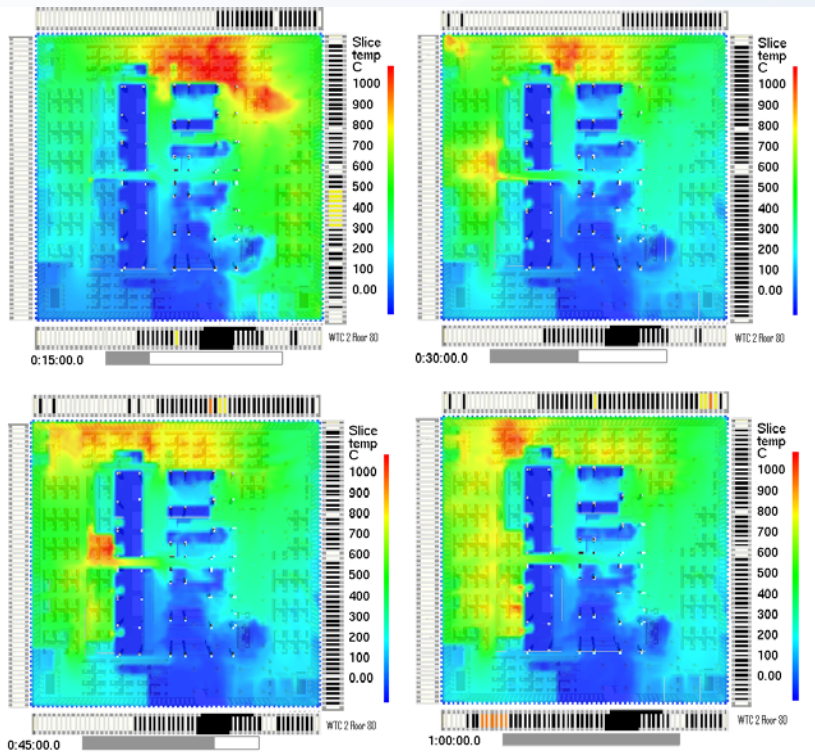


Realistic Case Simulation, WTC 2

Contrasting Fire Behavior on Impact Floors

80th Floor

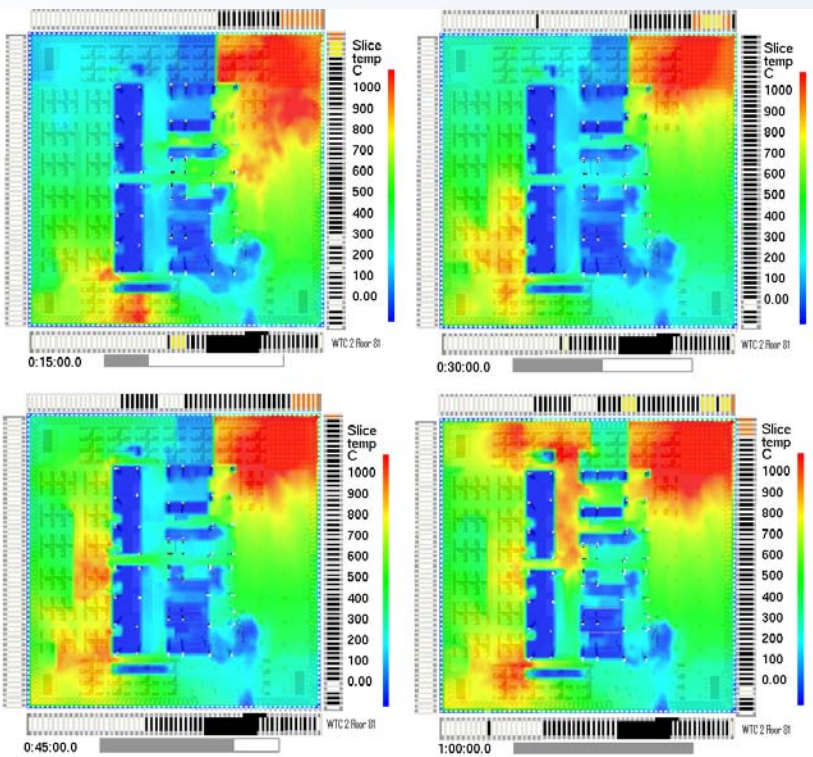
81st Floor



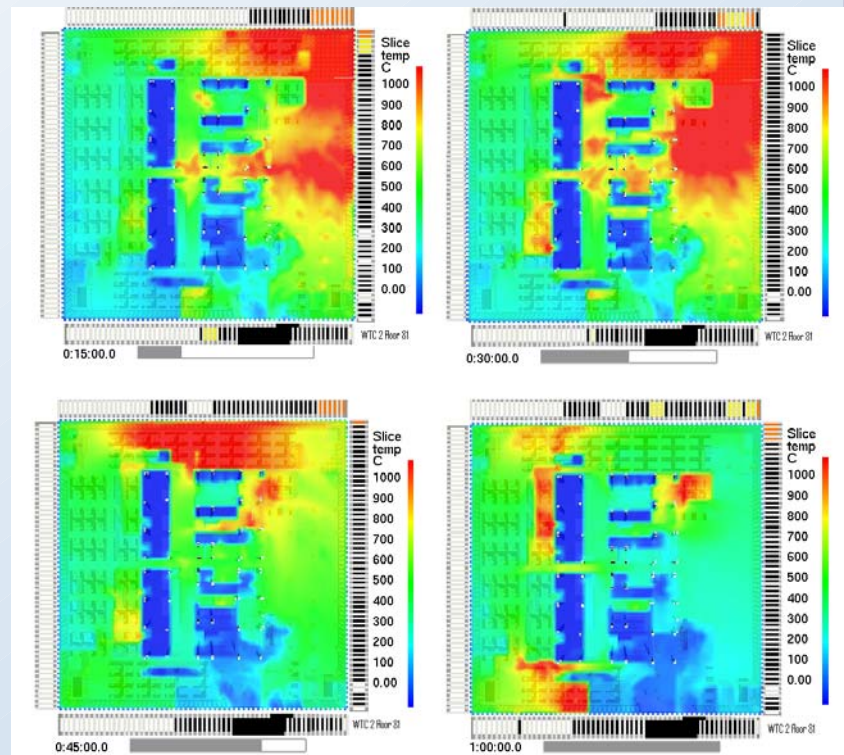
WTC 2, 81st Floor, Sensitivity Analysis

Combustible Load more critical in WTC 2

Realistic Case



More Severe



Summary

- Fire simulations of WTC 1 relatively insensitive to combustibles
- Fire simulations of WTC 2 more sensitive to combustibles, barriers, aircraft damage
- Fires in WTC 1 spread around building more quickly and more predictably than fires in WTC 2
- Fires in WTC 2 confined to impact area – increased difficulty for modeling
- 20 kg/m² (4 lb/ft²) combustible load consistent with 1.5 h fire
- Temperature predictions consistent with experiments at NIST and elsewhere

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Thank you

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