Objects that Obstruct Residential Sprinklers

Victoria B Valentine, P.E.

Manager of Product Standards

FPRF – Orlando, FL

January 26, 2005

NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

Outline

- *Problem Statement*
- *Modeling*
  - Methodology
  - FDS Models
- *Conclusions*
- *Future Testing*

NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

Problem Statement

- *Residential sprinklers are lacking guidelines on standard obstructions found in most dwelling units*

Project Overview

- *Phase 1: Model residential spaces with common obstructions for sprinkler activation times*
- *Phase 2: Full scale testing to verify model results*
- *Phase 3: Amend Standards as necessary based on project results*

Phase 1 Methodology

- *Examine activation times for sprinklers with typical dwelling unit obstructions*
  - Kitchen
  - Living room
  - Bedroom
- *Create further models for residential obstruction proposals to NFPA 13R and 13D*

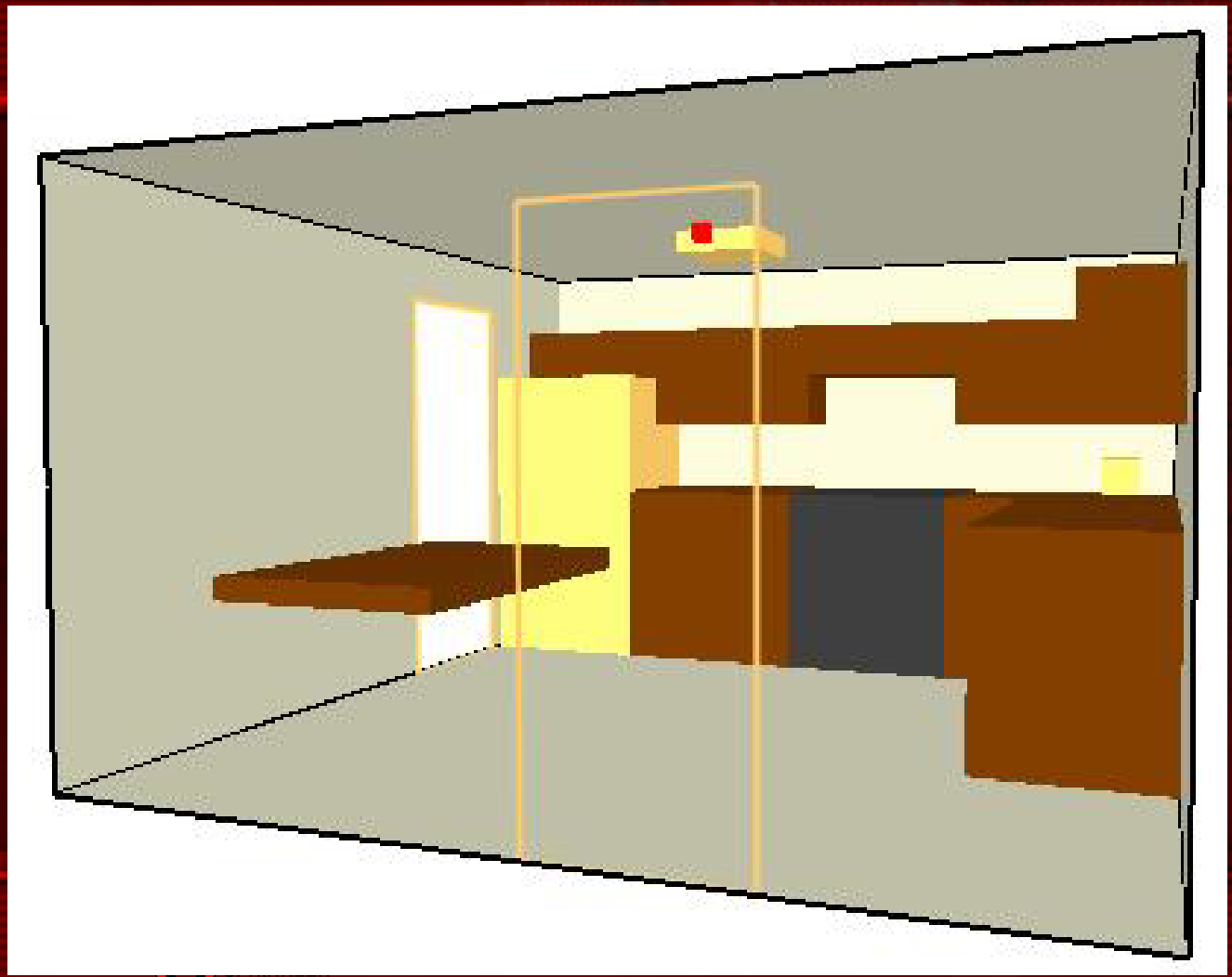
FDS Modeling

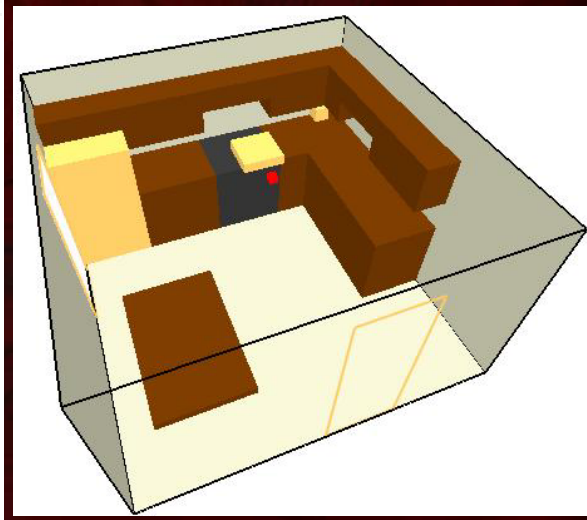
- *Fire Dynamic Simulator (FDS) version 3.1 by NIST*
- *Grid used: 0.1 m x 0.1 m x 0.1 m*
- *Kitchen*
- *Living Room*
- *Bedroom*

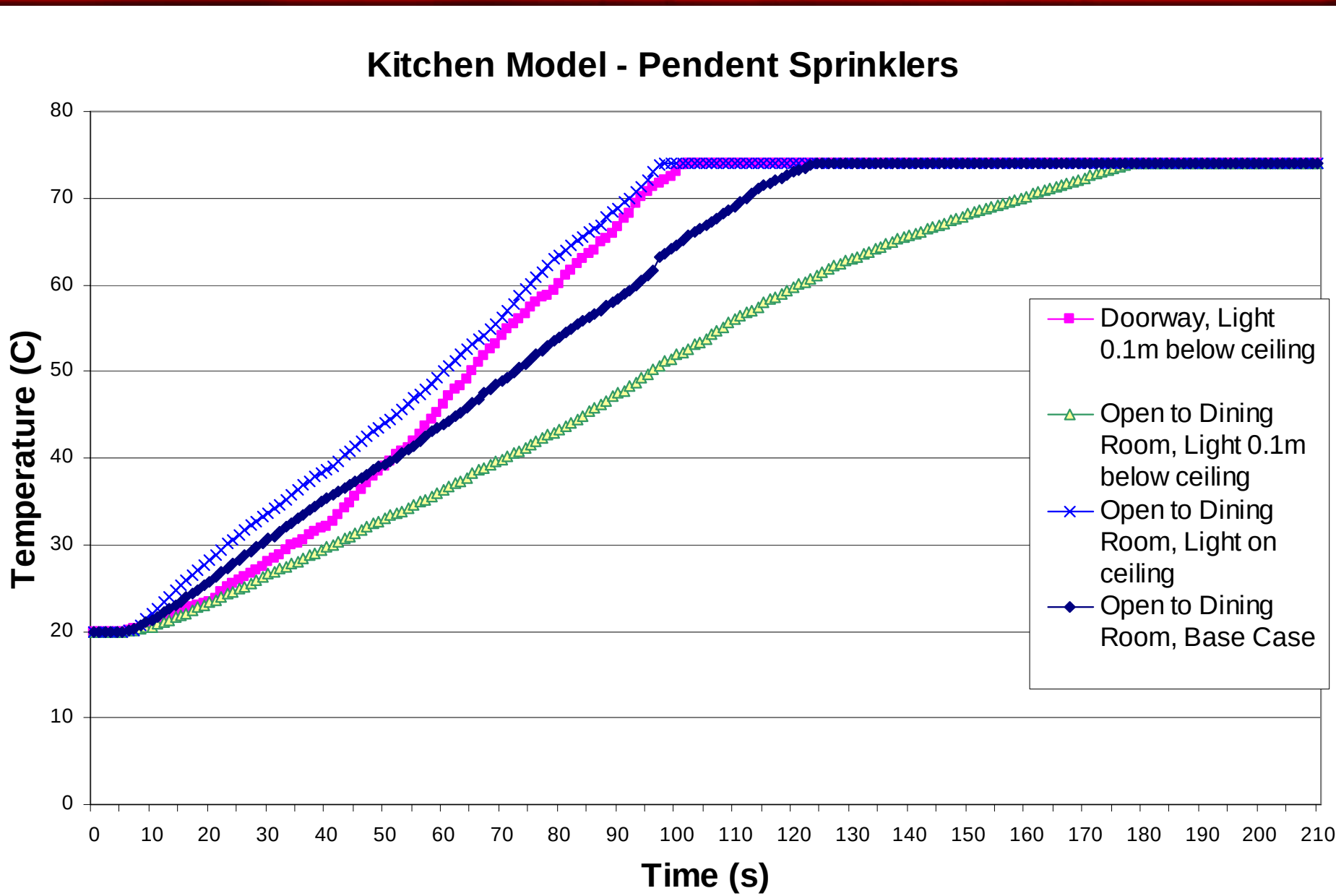
Kitchen Model

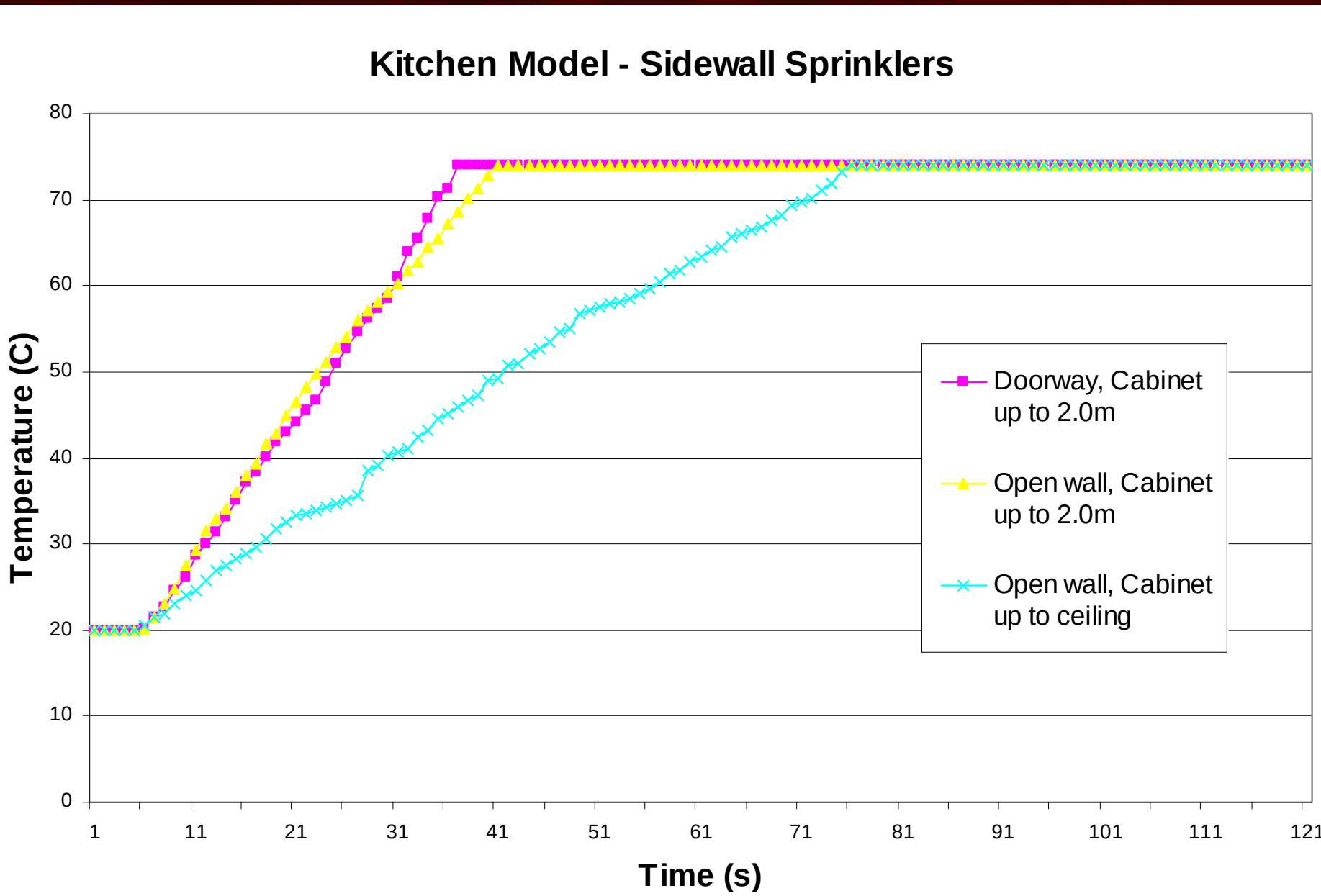
- *4 m x 4 m (13.1 ft x 13.1 ft)*
- *5-minute run*
- *Contents*
  - Cabinets along two walls (oak), Table (oak), Stove (sheet metal), Refrigerator (plastic)
- *Ignition represents small appliance on countertop*

Kitchen Model

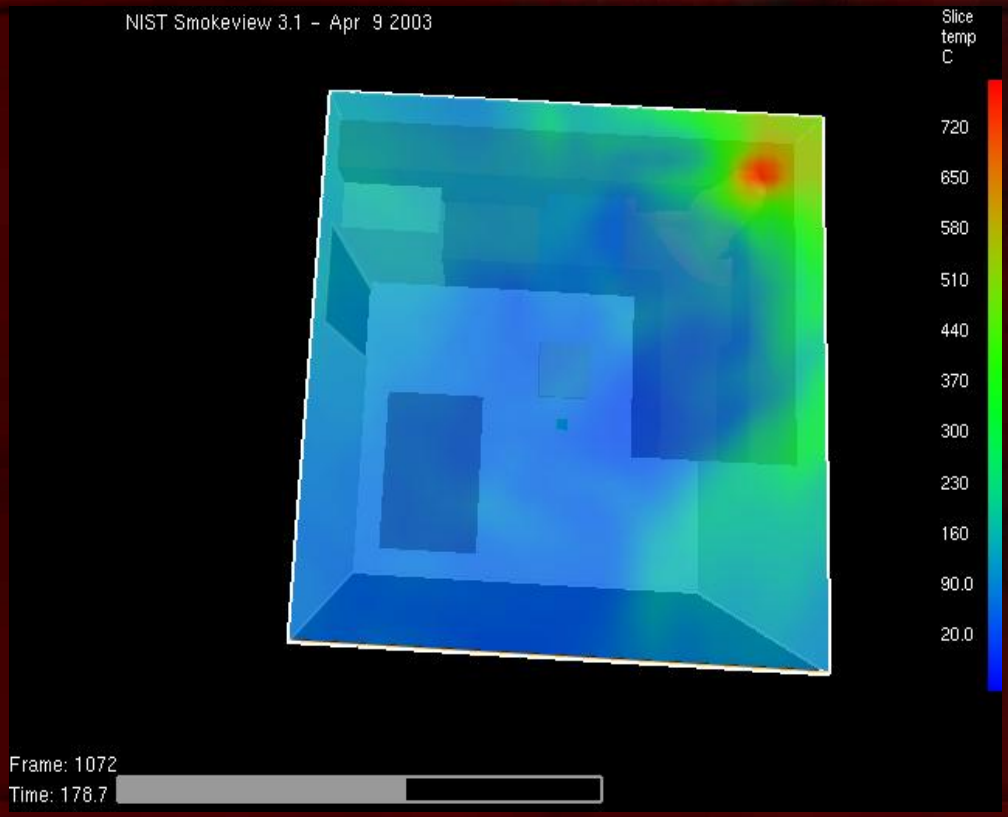


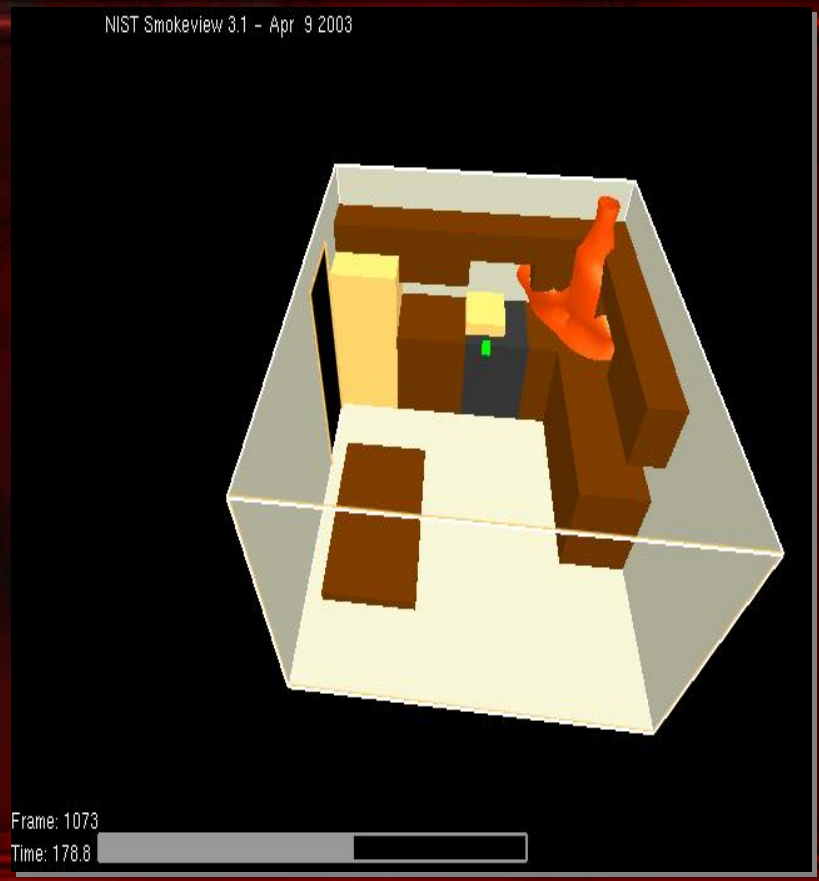



Kitchen Model - Pendent Sprinklers
Temperature (C)
0
10
20
30
40
50
60
70
80
Time (s)
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
Doorway, Light 0.1m below ceiling
Open to Dining Room, Light 0.1m below ceiling
Open to Dining Room, Light on ceiling
Open to Dining Room, Base Case


Kitchen Model - Sidewall Sprinklers
Temperature (C)
80
70
60
50
40
30
20
10
0
1
11
21
31
41
51
61
71
81
91
101
111
121
Time (s)
Doorway, Cabinet up to 2.0m
Open wall, Cabinet up to 2.0m
Open wall, Cabinet up to ceiling

Kitchen Model



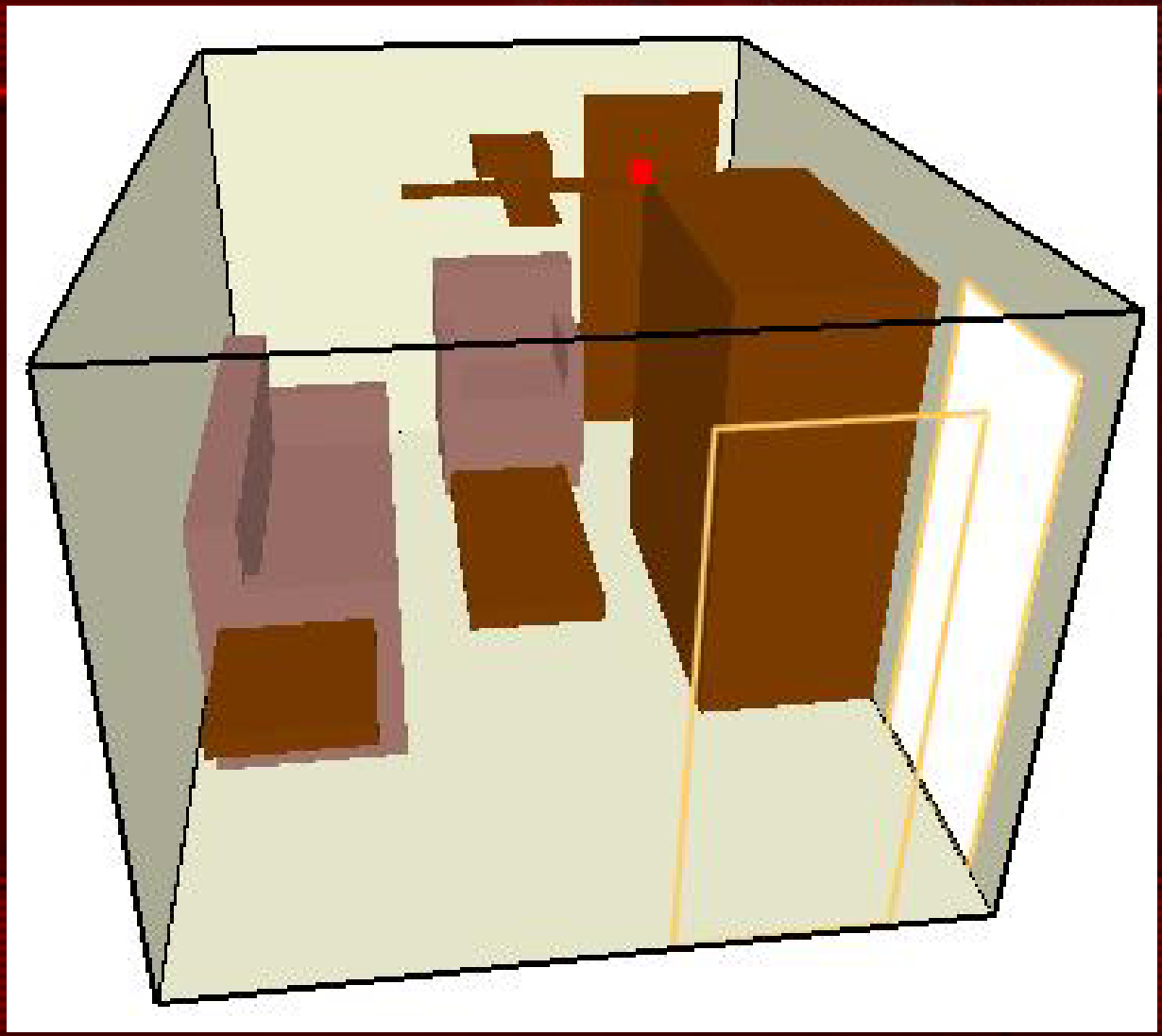


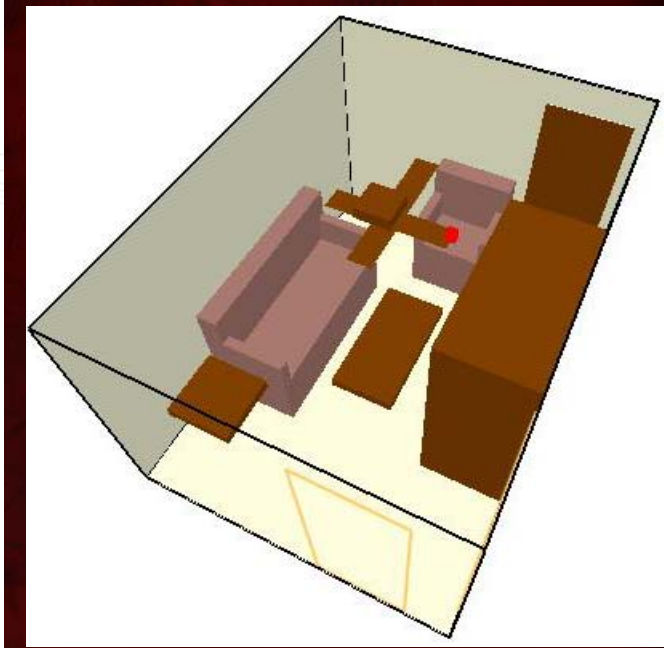
NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

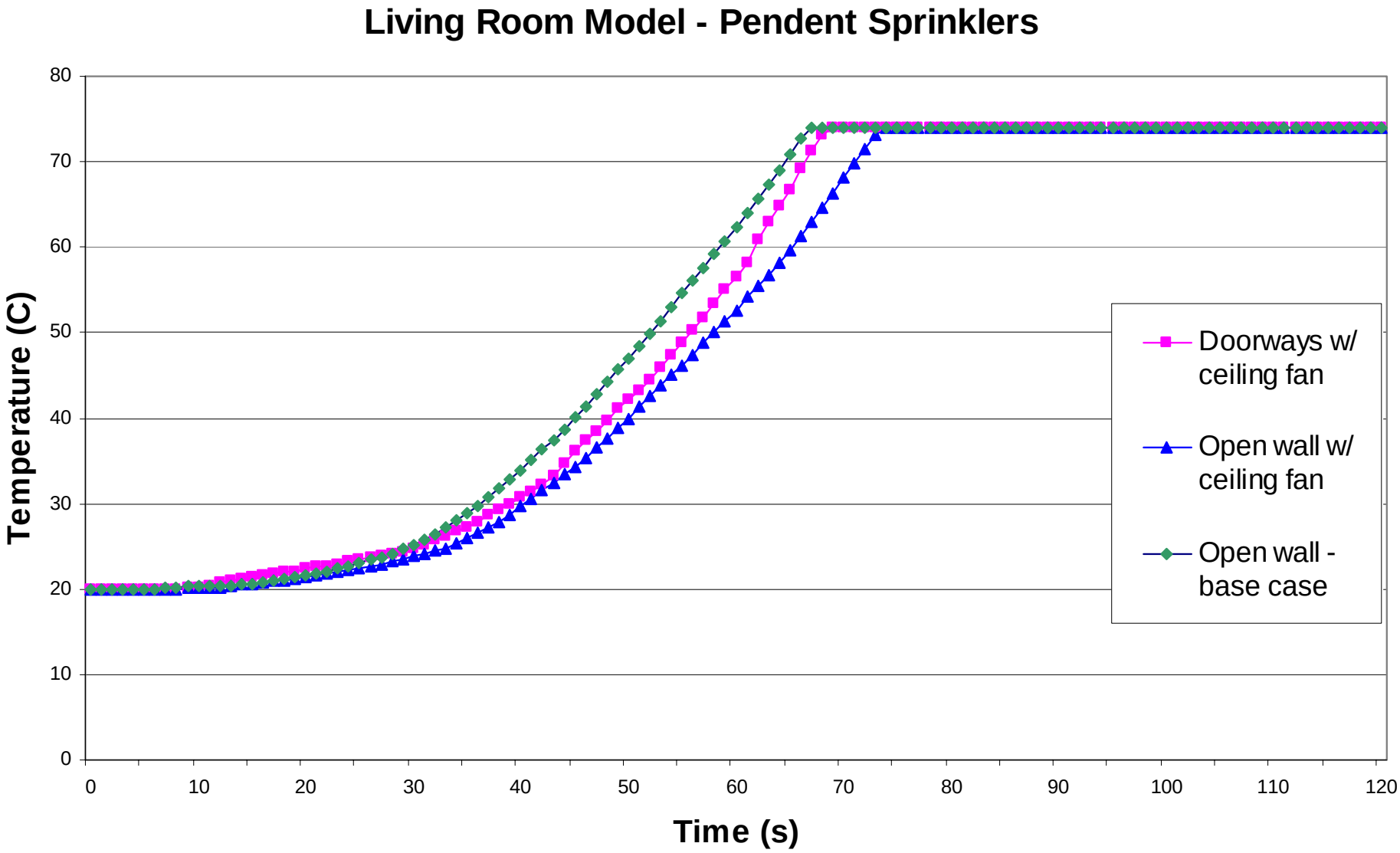
Living Room Model 1

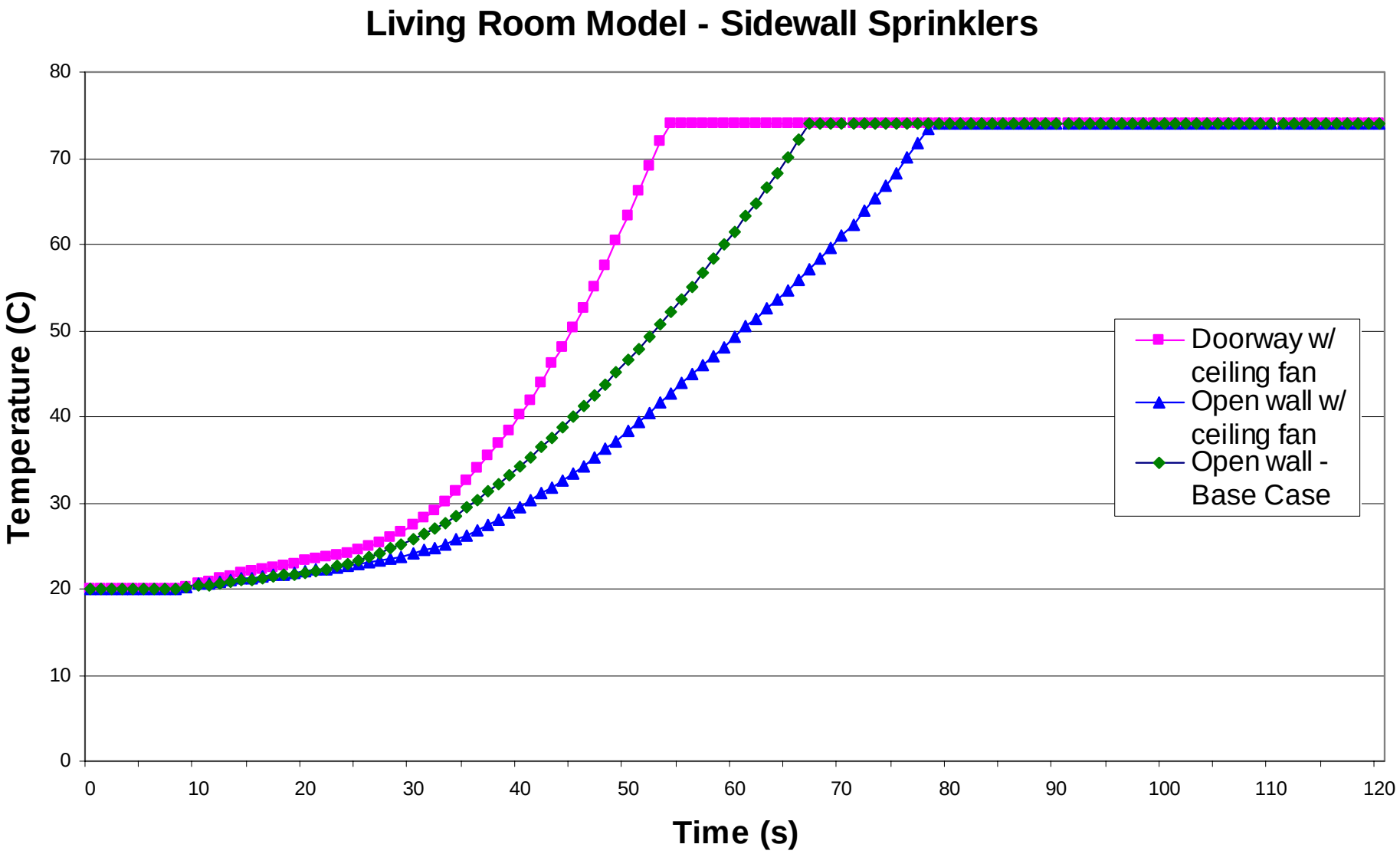
- *4 m x 3 m (13.1 ft x 9.8 ft)*
- *5-minute run*
- *Contents*
  - Sofa and chair (upholstery)
  - Coffee table and end table (oak)
  - Entertainment center (oak)
- *Ignition represents cigarette on upholstery*

Living Room Model 1

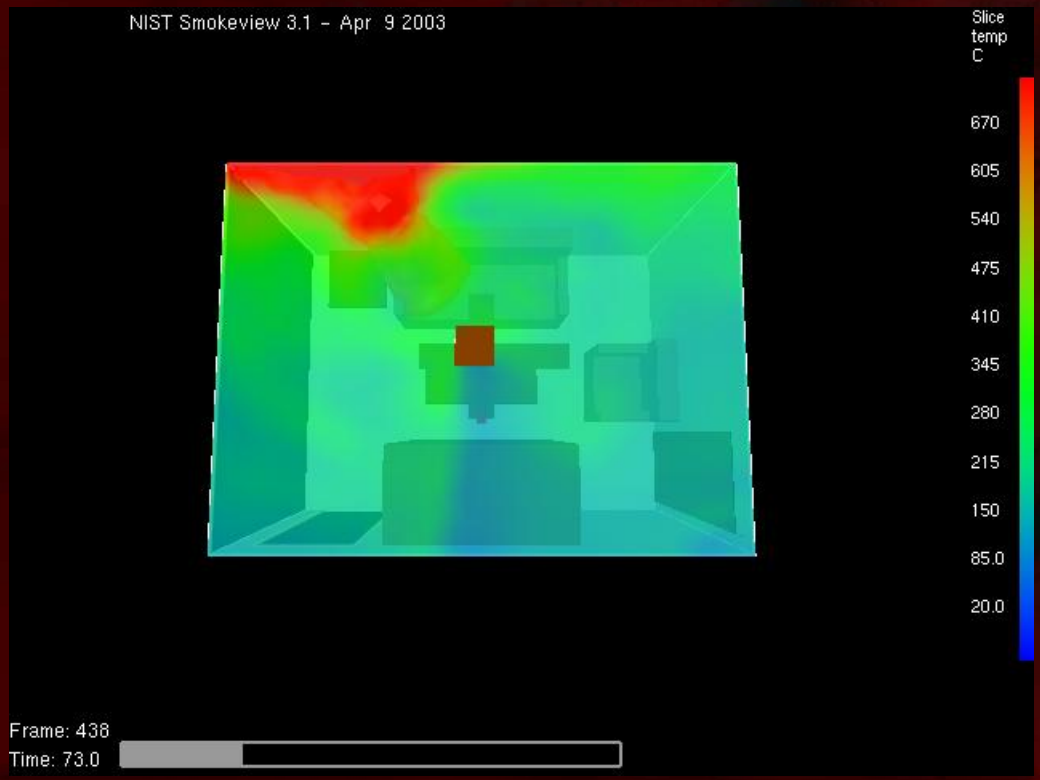


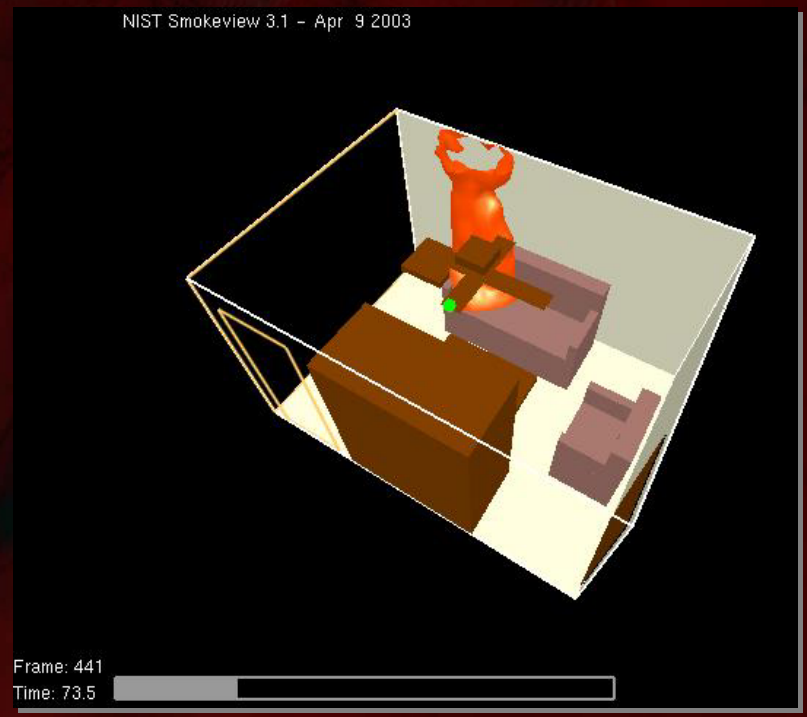



Living Room Model - Pendent Sprinklers
Temperature (C)
Time (s)
0
10
20
30
40
50
60
70
80
90
100
110
120
Doorways w/ ceiling fan
Open wall w/ ceiling fan
Open wall - base case


Living Room Model - Sidewall Sprinklers
Temperature (C)
Time (s)
0
10
20
30
40
50
60
70
80
90
100
110
120
Doorway w/ ceiling fan
Open wall w/ ceiling fan
Open wall - Base Case

Living Room Model 1



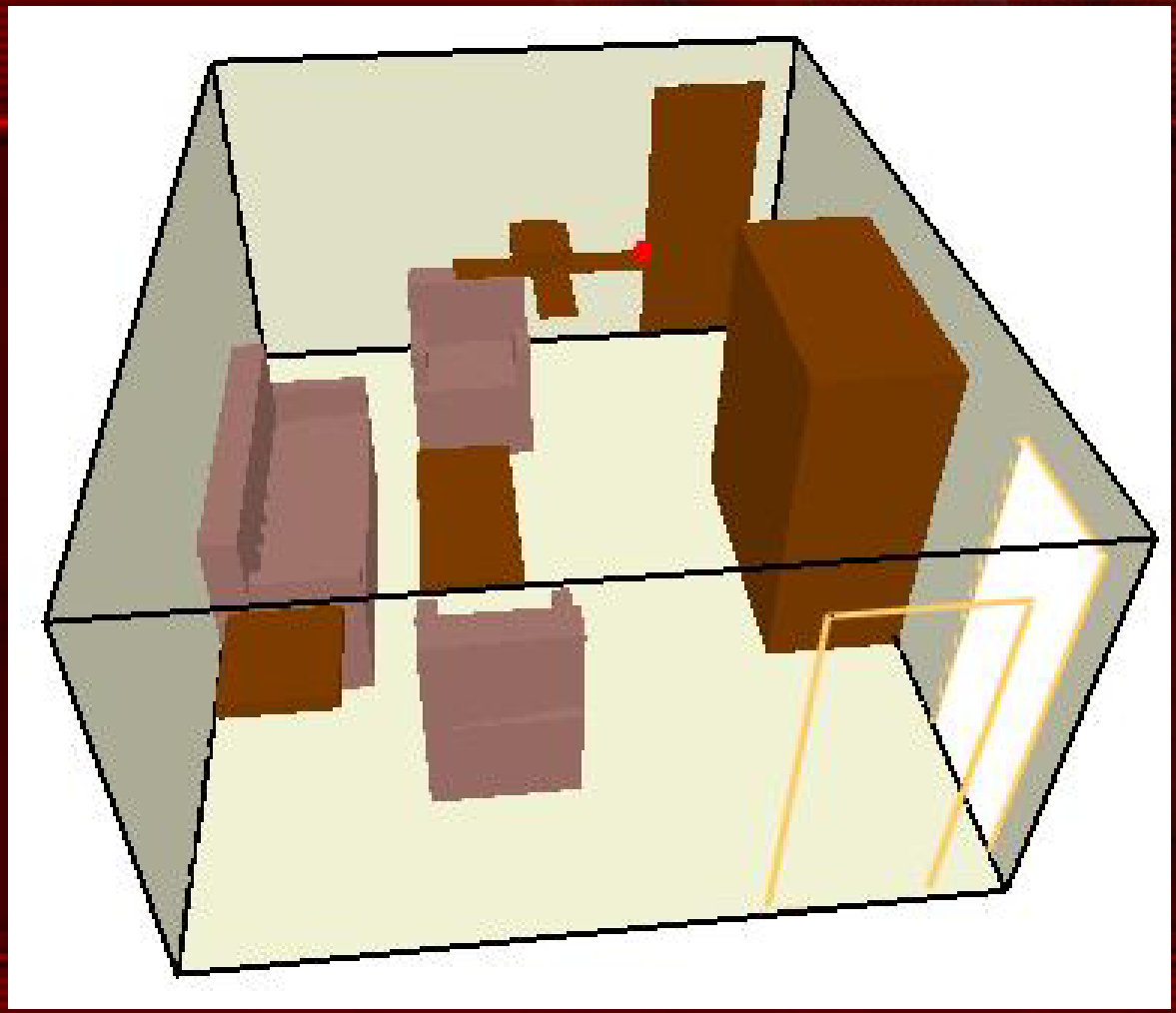


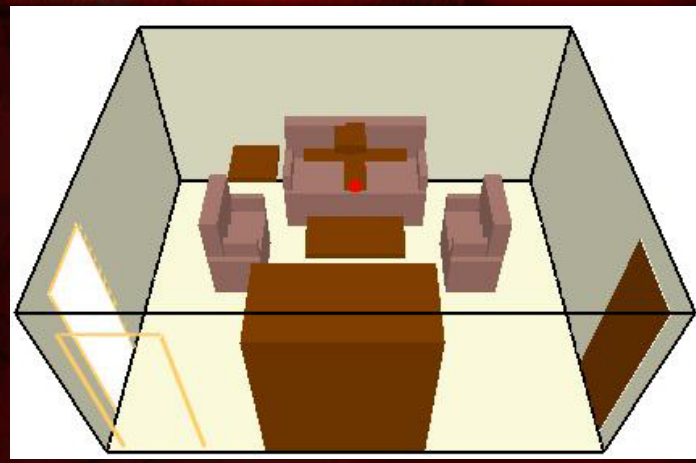
NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

Living Room Model 2

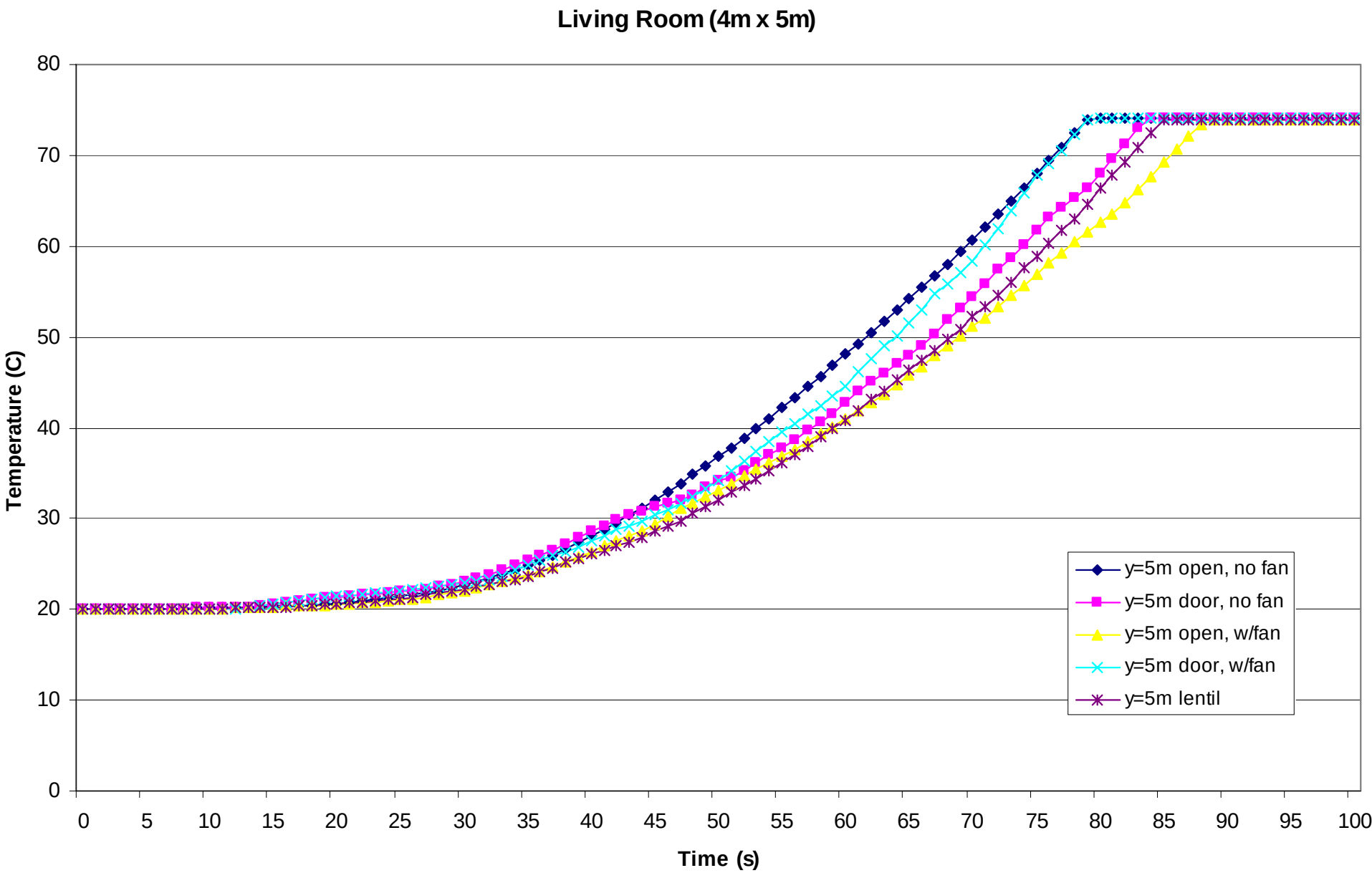
- *5 m x 4 m (16.4 ft x 13.1 ft)*
- *5-minute run*
- *Contents*
  - Sofa and chairs (upholstery)
  - Coffee table and end table (oak)
  - Entertainment center (oak)
- *Ignition represents cigarette on upholstery*

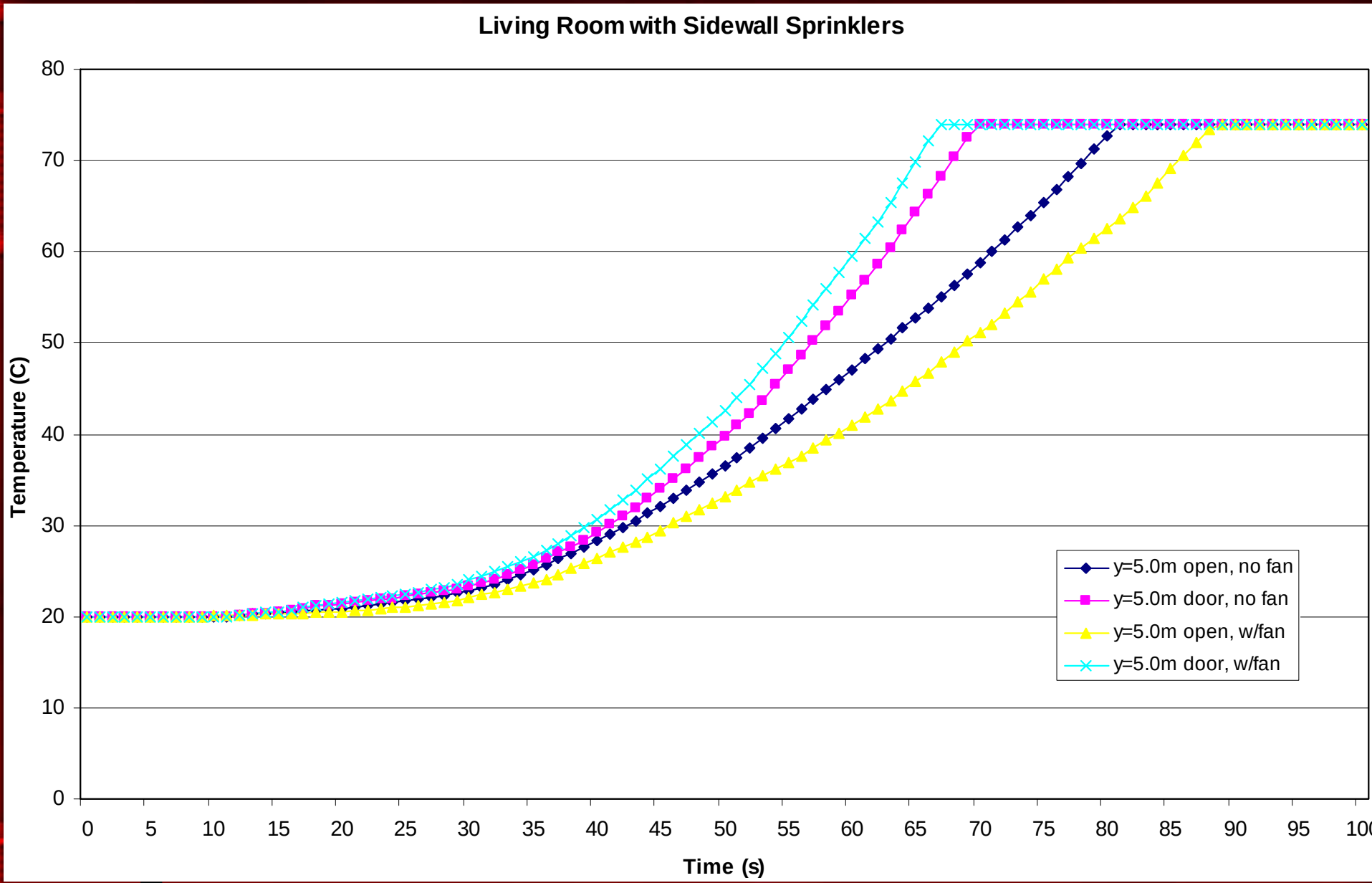
Living Room Model 2



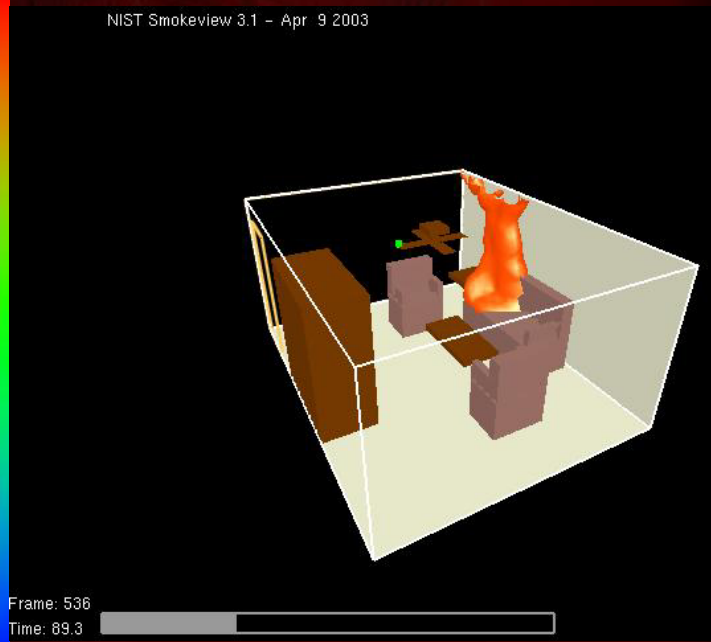


NATIONAL FIRE SPRINKLER ASSOCIATION, INC.


Living Room (4m x 5m)
Temperature (C)
Time (s)
0
10
20
30
40
50
60
70
80
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
y=5m open, no fan
y=5m door, no fan
y=5m open, w/fan
y=5m door, w/fan
y=5m lentil


Living Room with Sidewall Sprinklers
Temperature (C)
Time (s)
0
10
20
30
40
50
60
70
80
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
y=5.0m open, no fan
y=5.0m door, no fan
y=5.0m open, w/fan
y=5.0m door, w/fan

Living Room Model 2

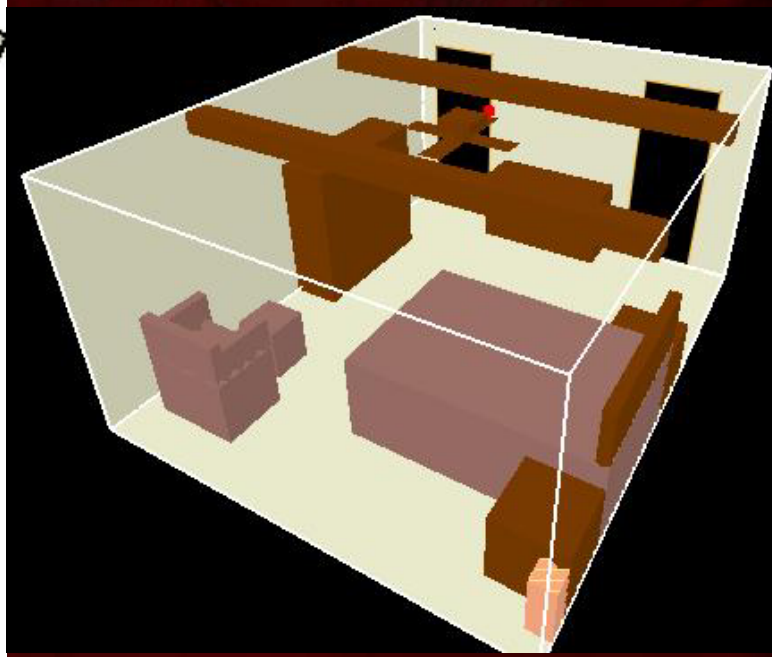


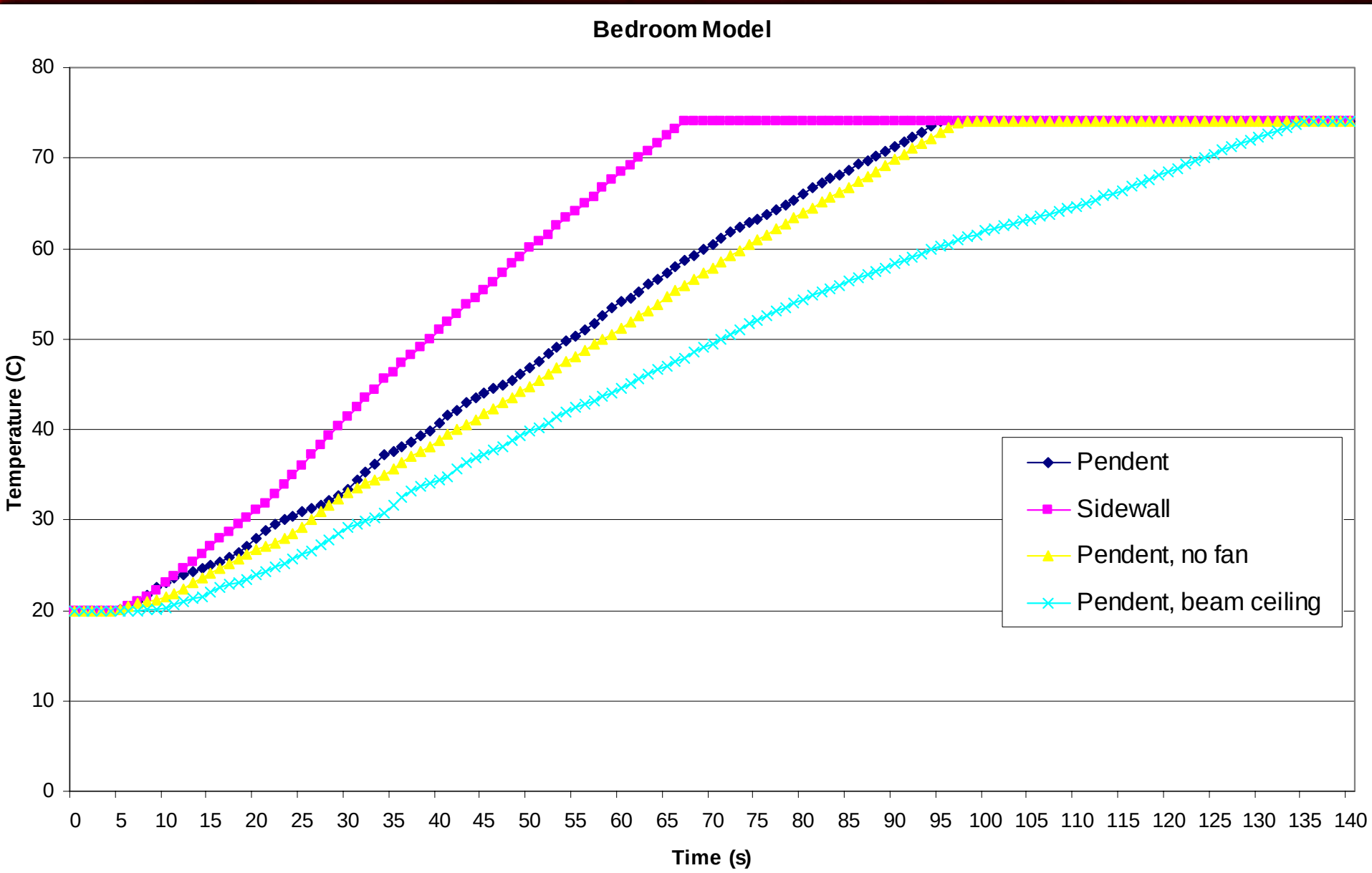
NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

Bedroom Model

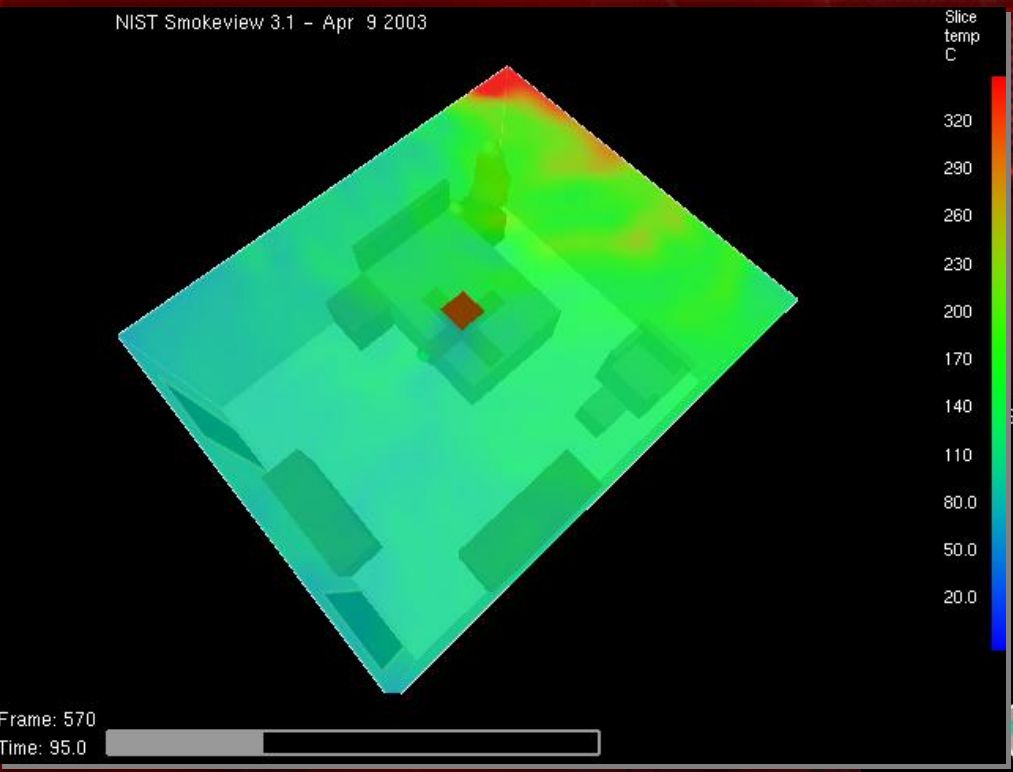
- *4 m x 5 m (13.1 ft x 16.4 ft)*
- *5-minute run*
- *Contents*
  - Bed, chair, and ottoman (upholstery)
  - Night stands (oak)
  - Bureau and dresser (oak)
- *Ignition represents small trash can fire*

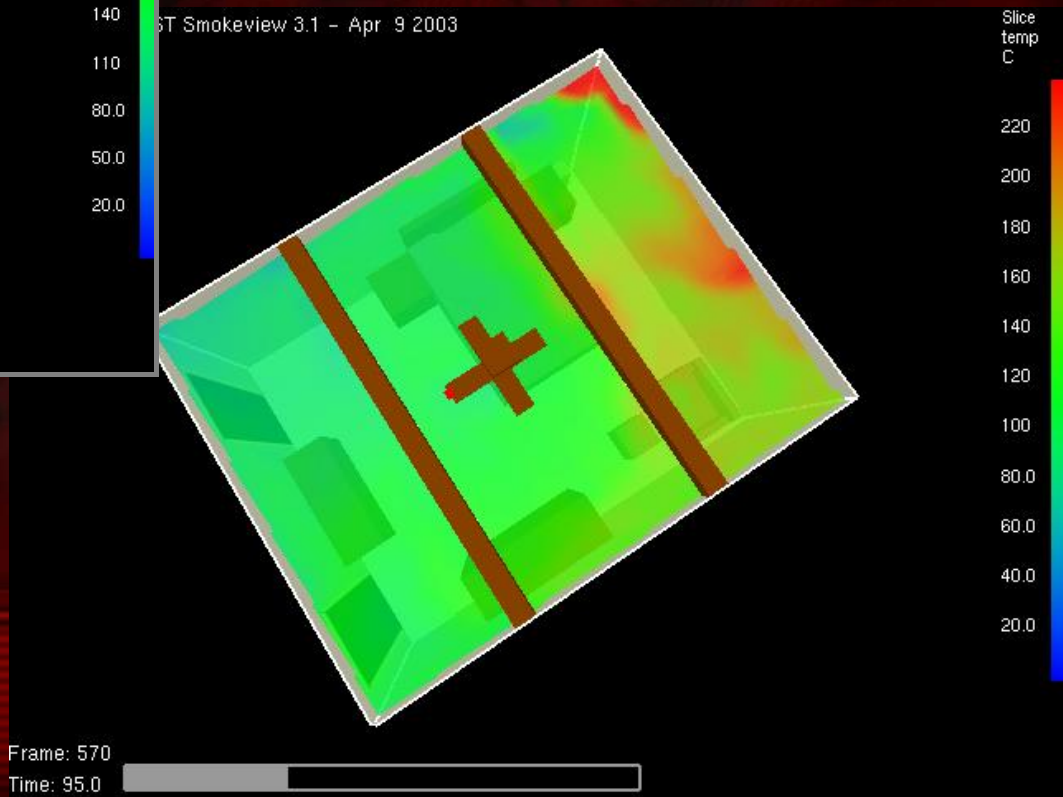
Bedroom Model




Bedroom Model
Temperature (C)
Time (s)
0
10
20
30
40
50
60
70
80
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125
130
135
140
Pendent
Sidewall
Pendent, no fan
Pendent, beam ceiling

Bedroom Model





NATIONAL FIRE SPRINKLER ASSOCIATION, INC.

Phase 1 Conclusions

- *Activation times appear reasonable to provide life safety*
- *Fire testing is needed to investigate water delivery of the obstructed sprinklers*

Future Work

- *Analyze exact placement of sprinkler in kitchen model*
- *Examine initial fire sizes used in all models*
- *Examine slope ceiling applications both with and without obstructions*
- *Full Scale Testing*

Acknowledgements

Kenneth E. Isman, NFSA

John A. Schwille, UL

Thank you!

www.nfsa.org

NATIONAL FIRE SPRINKLER ASSOCIATION, INC.