National Institute of Standards and Technology
Technology Administration, U.S. Department of Commerce

November 2004

Contacts: Alex Maranghides (scientific/technical inquires)
(301)975-4886
alexander.maranghides@nist.gov

John Blair (media inquires)
(301) 975-4261
john.blair@nist.gov

FACT SHEET

NIST Lab Experiments Simulate House-to-House Fire Spread

In recent full-scale laboratory experiments at the Commerce Department's National Institute of Standards and Technology (NIST), it took less than 80 seconds for flames exiting from a simulated house with combustible exterior walls and a window to ignite a similar "house" 1.8 meters (6 feet) away. In another experiment involving the same setup, the flames from one simulated house again reached the second, but this time a gypsum barrier protected the interior of the adjacent building from being damaged. These results are of great interest because building codes in many communities in the United States allow structures with window openings and combustible exteriors to be built as close together as the test "houses."

The two tests were part of a NIST Building and Fire Research Laboratory (BFRL) program to develop computer models that better predict the spread of fire in communities. The computer fire modeling and visualization programs, developed by BFRL engineers, are the Fire Dynamic Simulator (FDS) and Smokeview. FDS numerically models the movement of smoke and hot gases from a fire, predicting gas temperatures, heat fluxes, gas velocities and sprinkler activation times. The Smokeview program graphically depicts this information.

FDS and Smokeview are being used by both fire investigators studying fire behaviors, and by builders and architects evaluating the response of detection equipment to fires. Once incorporated into the FDS program and portrayed with Smokeview, data from the house-to-house fire tests will allow fire protection engineers, fire code officials and firefighters to better understand fire spread potential in tightly built communities.

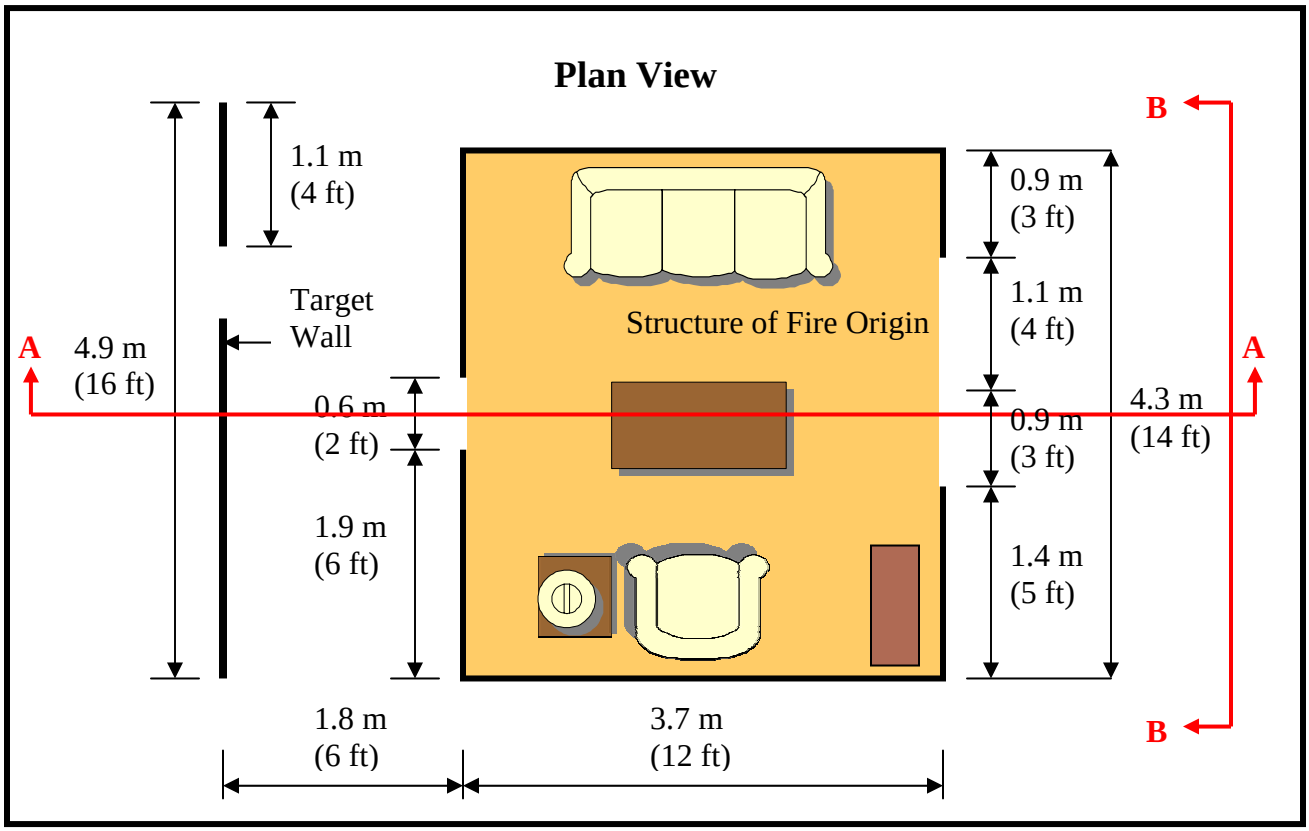
The tests conducted at NIST address several, but not all flame spread scenarios. Researchers note that house construction type, separation distance, placement and size of windows and effects of weather can influence ignition and flame spread between structures. The findings of the two tests warrant further experiments and research. NIST will evaluate plans for additional experiments once analysis of these first two tests is completed.

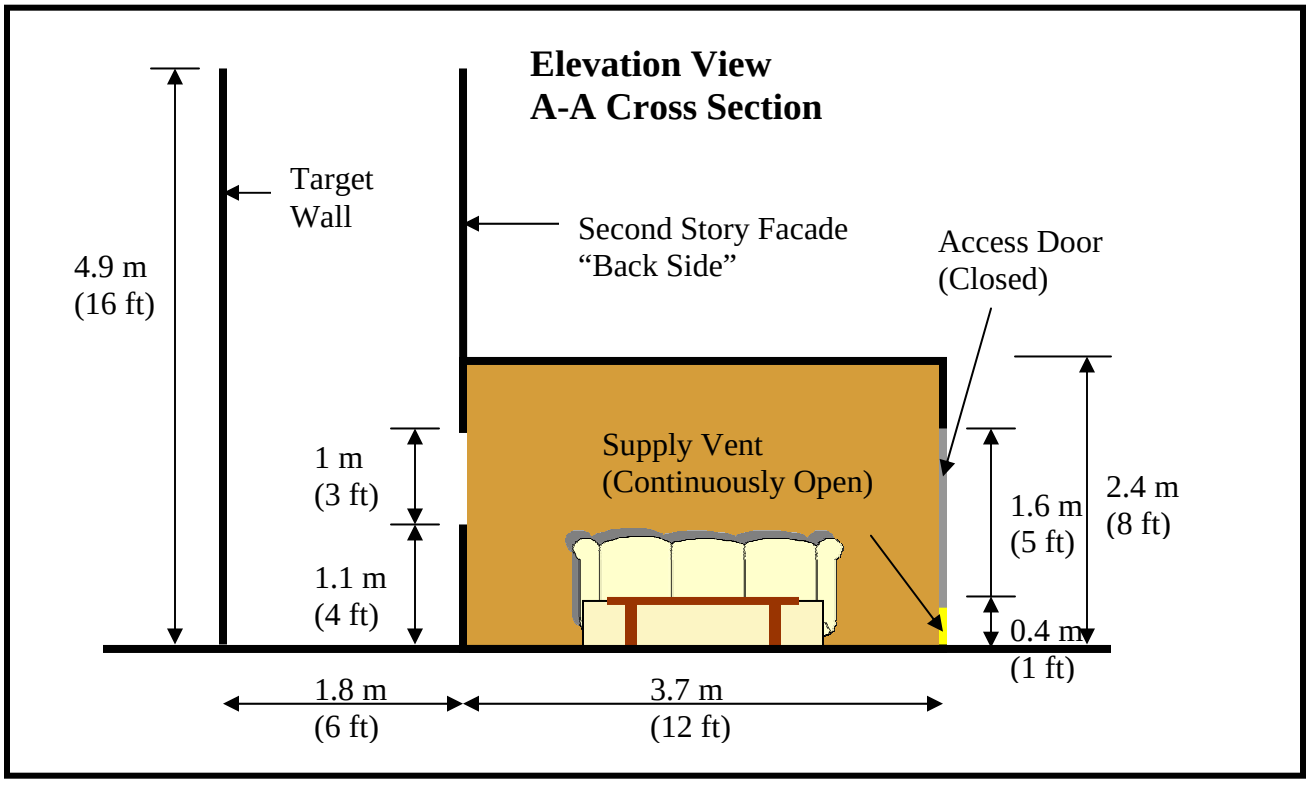
The experimental configuration and preliminary results are summarized as follows:

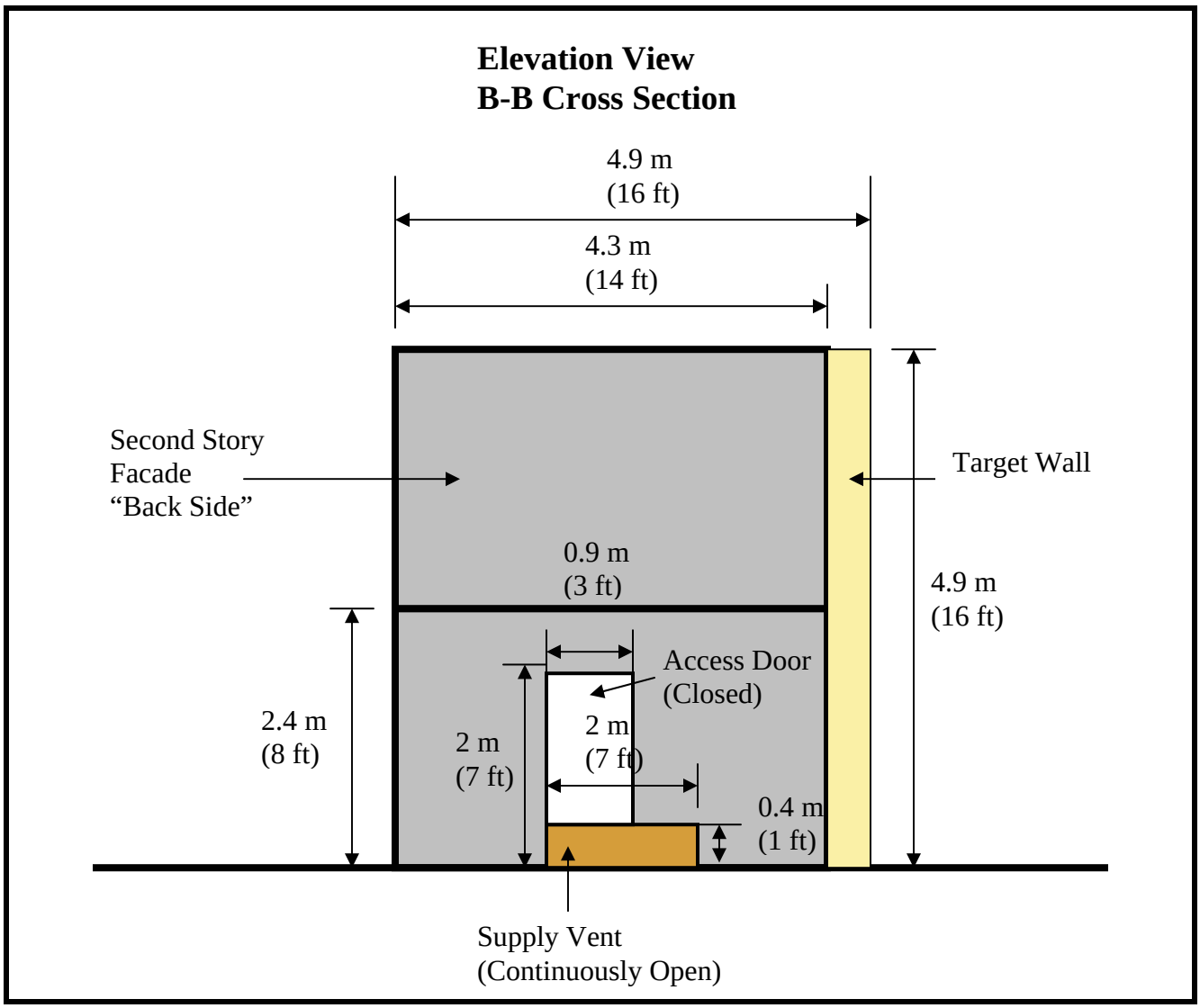
Structure of Fire Origin and Target Wall Design

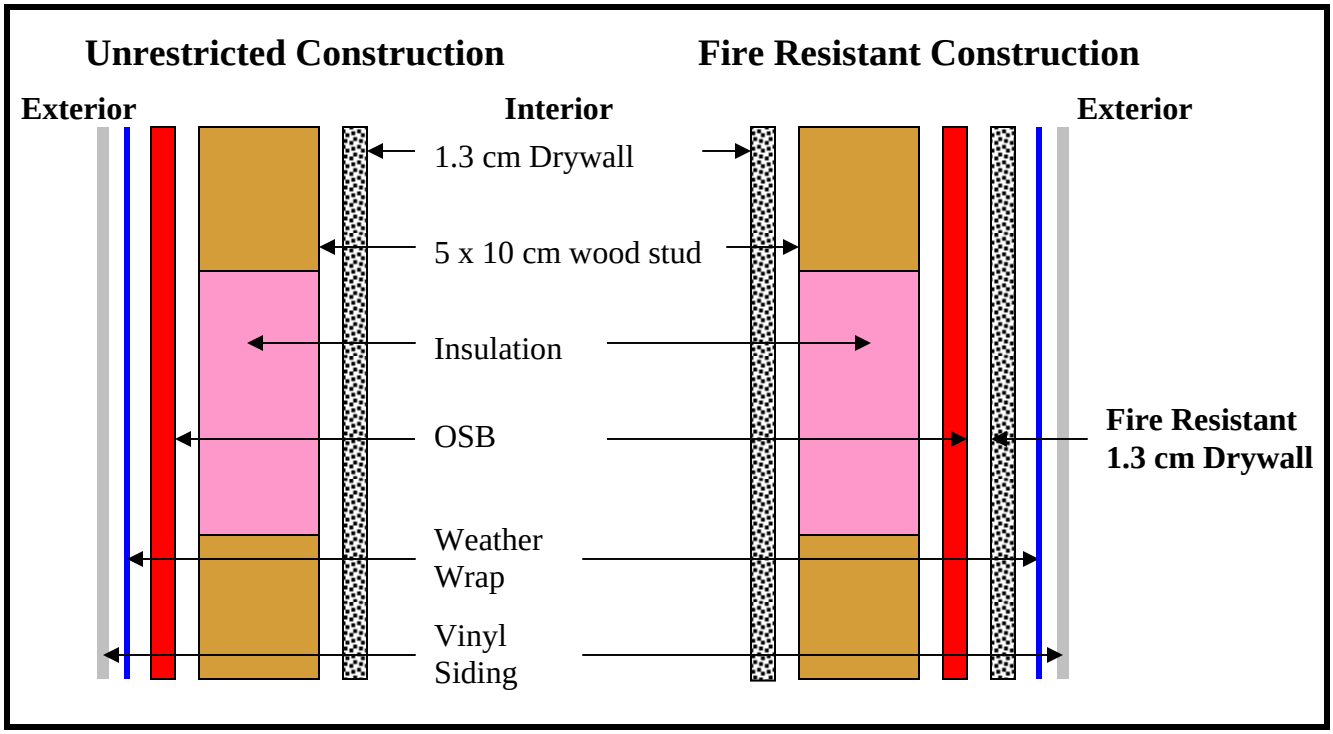
One 4.3 meters wide by 3.7 meters deep by 2.4 meters tall (14 feet wide by 12 feet deep by 8 feet tall) compartment was furnished (sofa, tables, arm chair, bookcase, wall paneling and carpet) and had a second story facade. A 4.9 meter by 4.9 meter (16 foot by 16 foot) two-story target wall, simulating an adjacent house, was placed 1.8 meters (6 feet) away from the enclosure. The enclosure had a window facing the two-story target wall. The two-story target wall also had a window. The windows were offset horizontally by 1.3 meters (4 feet) on center.

Structure of Fire Origin and Target Wall


Plan View
B
1.1 m
(4 ft)
0.9 m
(3 ft)
Target
Wall
Structure of Fire Origin
1.1 m
(4 ft)
A
4.9 m
(16 ft)
A
0.6 m
(2 ft)
0.9 m
(3 ft)
4.3 m
(14 ft)
1.9 m
(6 ft)
1.4 m
(5 ft)
1.8 m
(6 ft)
3.7 m
(12 ft)
B


Elevation View
A-A Cross Section
Target
Wall
Second Story Facade
“Back Side”
Access Door
(Closed)
4.9 m
(16 ft)
Supply Vent
(Continuously Open)
1 m
(3 ft)
1.6 m
(5 ft)
2.4 m
(8 ft)
1.1 m
(4 ft)
0.4 m
(1 ft)
1.8 m
(6 ft)
3.7 m
(12 ft)


Elevation View
B-B Cross Section
4.9 m
(16 ft)
4.3 m
(14 ft)
Second Story
Facade
"Back Side"
Target Wall
0.9 m
(3 ft)
4.9 m
(16 ft)
Access Door
(Closed)
2.4 m
(8 ft)
2 m
(7 ft)
2 m
(7 ft)
0.4 m
(1 ft)
Supply Vent
(Continuously Open)


Unrestricted Construction
Fire Resistant Construction
Exterior
Interior
Exterior
1.3 cm Drywall
5 x 10 cm wood stud
Insulation
OSB
Weather
Wrap
Vinyl
Siding
Fire Resistant
1.3 cm Drywall

Unrestricted Construction Experiment

The structure of fire origin and the target wall both were assembled using unrestricted construction. Going from inside to the outside were: drywall, wood studding, oriented strand board (OSB), weather wrap and vinyl siding. The area between wood studs was filed with fiberglass insulation.

At ignition, the window was closed and the access door was set ajar. The fire was initiated on one side of the sofa. Three minutes and 42 seconds after ignition, the window broke. The door was then secured while the supply vent remained open providing ambient air to the fire. The flames exiting the window impinged on the target structure within seconds. On the target wall and second story facade, the vinyl siding and weather wrap melted away with little contribution to the total energy release.

The oriented strand board of the target wall ignited five minutes after ignition, or approximately eighty seconds after the fire exited the structure of origin. The experiment was terminated at that point.

Unrestricted Construction Experiment: Target Wall OSB Ignited 1 min 20 sec. after Window Failure

Fire Resistant Construction Experiment

The main difference between the first and the second experiment was the introduction of a fire resistant barrier between the OSB and the weather wrap. The fire resistant barrier used on both structures was 1.3 millimeter (1/2 inch) thick drywall. NIST recognizes that placing gypsum board on an exterior wall is not really an option, but that it is a simple means to demonstrate the value of a fire resistance level at least equal to what a gypsum board would provide.

Approximately three minutes and 38 seconds after ignition the window failed. This was nearly the same time as during the previous experiment. Fifteen second later, the flames were impinging on the target wall. The fire went through a transition period of one minute

Fire Resistant Construction Experiment: 9 Minutes after Window Failure – Target Wall OSB not Ignited

45 seconds where only hot gases (no flames) were exiting the structure. At approximately six minutes after ignition, flames resumed. At 14 minutes and 25 seconds after ignition, the fire was extinguished. In this experiment, the fire resistant barrier prevented ignition of the OSB even after approximately nine minutes of direct flame impingement on the target structure.

Timeline

Event	Time (min:sec)	
	Unrestricted Construction	**Fire Resistant Construction**
Ignition	00:00	00:00
Window breakage	03:42	03:38
Flames begin impinging of target wall	03:51	03:53
Smoke exiting structure(no flames)	Not Applicable	04:09-05:42
Flames resume	Not Applicable	05:43
Fire extinguished by firefighting team	05:00	14:45
Flame impingement duration on target wall	01:09	09:18
OSB ignited on target wall	Yes	No

Summary

The experiments illustrated how a fire resistant barrier can, in the scenario tested, slow down flame spread between two structures separated by just 1.8 meters (6 feet). The scenarios tested where not the worst possible cases. Flame spread between structures is a complex process primarily affected by structure construction type, structure separation distance, placement and size of windows and weather conditions. Data collected from these experiments will be used to calibrate the NIST FDS model. The model can then be used to predict fire spread in residential communities.

FDS Simulation of Experiment