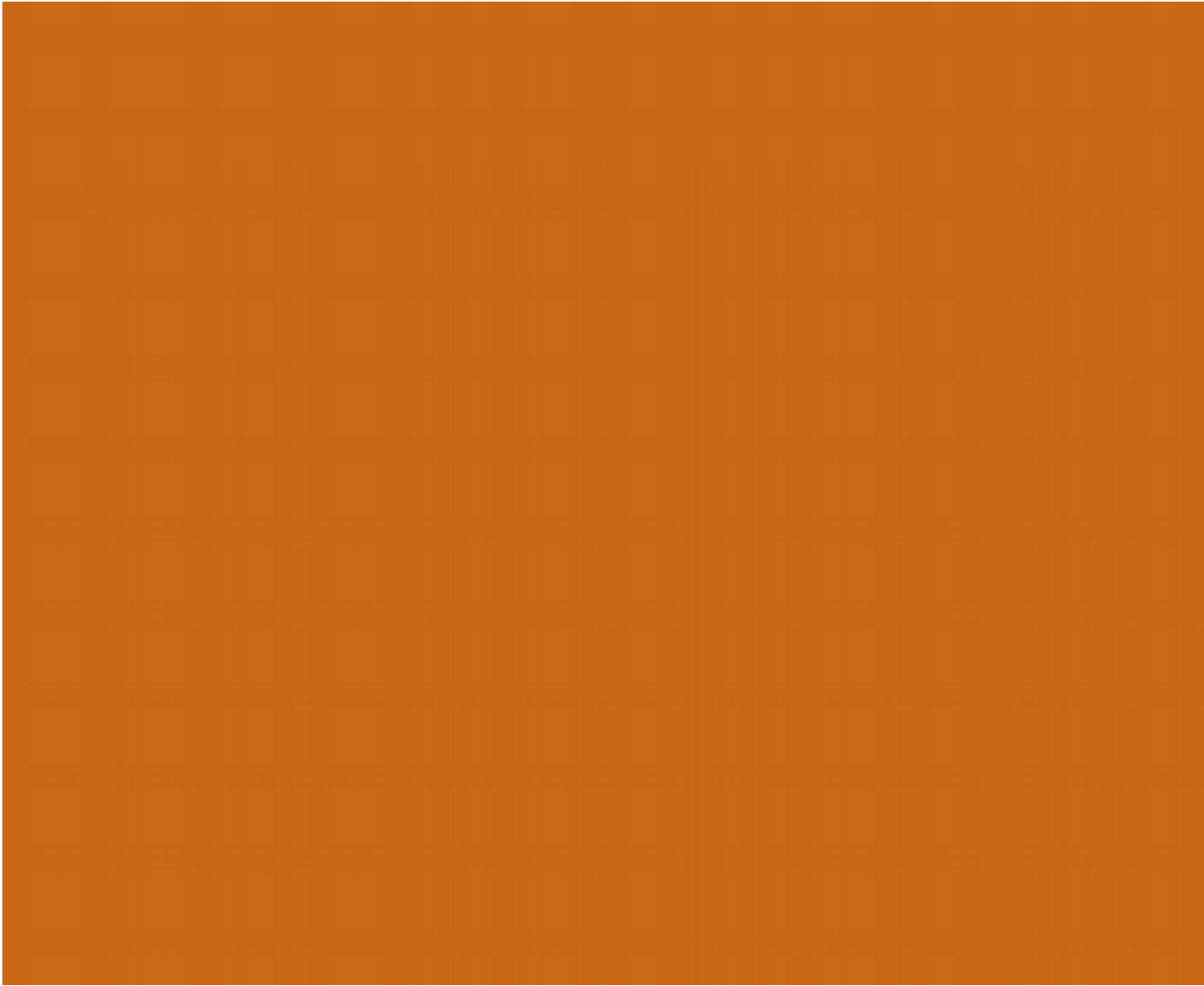




# **FIRE INVESTIGATION & FORENSICS**

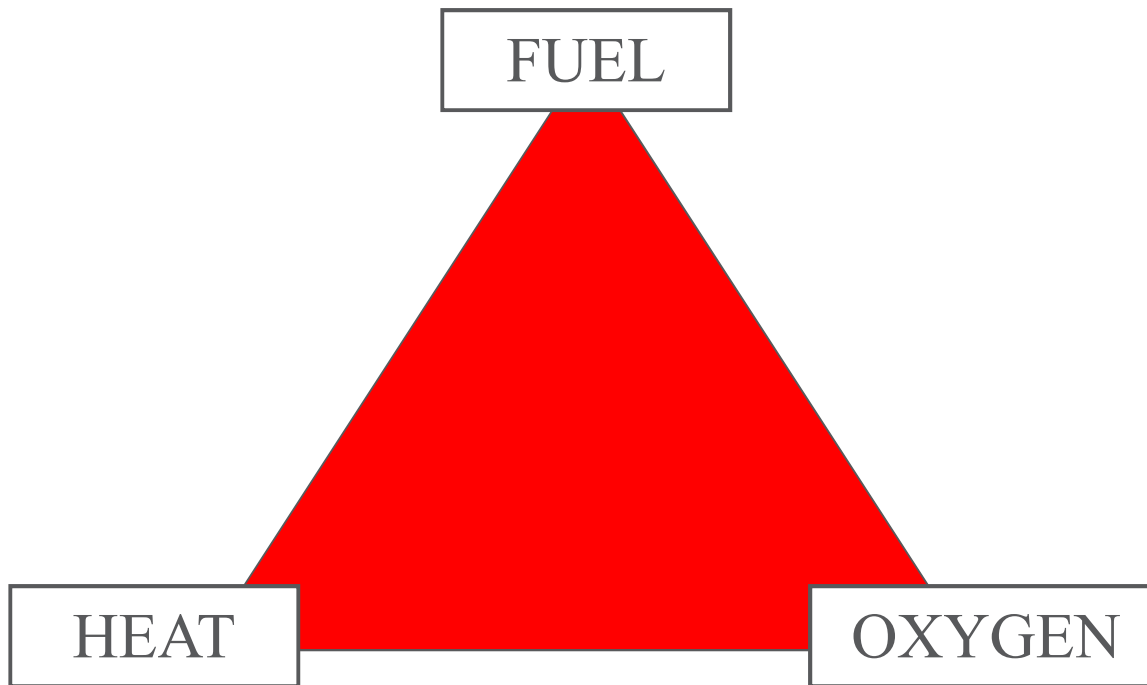


# 1893 Chicago World's Fair



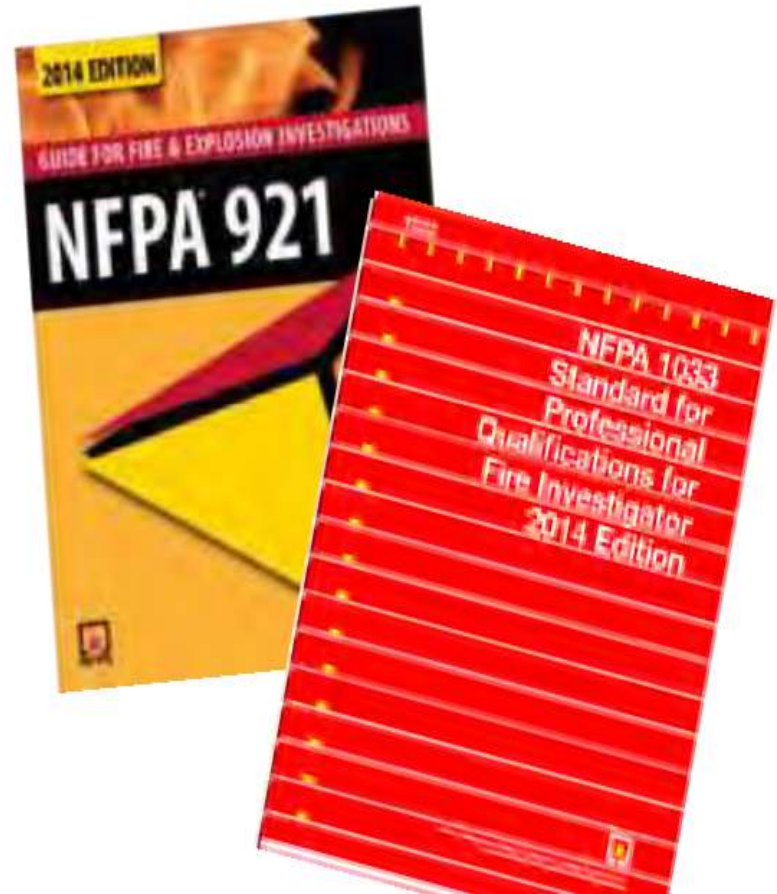
# The Chemistry of Fire

The **FIRE TRIANGLE** represents the **three** elements needed for fire to occur: heat, fuel, and oxygen.



# Fire Investigation Guidelines

- ◆ In the fire investigation field, a “*standard of care*” is the formal process an investigator follows when examining a scene and rendering an opinion as to its origin, cause and responsibility
- ◆ *NFPA 921* (2014 ed.) and *NFPA 1033* (2014 ed.) are the prevailing standards of care that fire investigation experts use as “*best practices*”



# Fire Investigation Basics

## NFPA 921: Guide for Fire and Explosion Investigations

- Work from the least damaged areas to the most heavily damaged areas.
- Document with notes, photographs, and videos.
- Collect evidence (accelerant samples, fire items, and other crime scene evidence.)
- Interview witnesses
- Determine the point of origin and the heat source(s).
- Hypothesize the reasons for the fire using scientific method .



# Accident or Arson?

## Accidental Nature

- Heating System / Electrical appliances
- Lightning
- Children playing with matches
- Smoking

## Non-Accidental Nature

- Odors – Gas, kerosene, or other accelerants
- Furnishing – Removal of personal objects and valuables
- Locked windows, blocked doors
- Two or more points of origin
- Look for inverted v-patterns (can be a sign that an accelerant was used)
- Floors charred – Can indicate use of an accelerant



# Fire investigation

## Point of Origin (POO)

- Defined as where the fire originated.
- Cause of fire may be near the POO.
- Fire usually burns longer at POO.
- If accelerants or ignition devices used, they may be present at the POO.
- Multiple POO's MAY indicate arson.
- “V” patterns usually point to the POO.

## Interior Examination

- Work backward in relation to fire travel and from least to most damage.
- Extensive ceiling damages may be present above the POO.
- In accidental fires, floor damage is limited in respect to the ceiling damage.





# Investigating suspects

Symptoms of ignitable liquid use

Burn injuries to the hands,  
face, legs or hair of a  
suspect/witness.



# Fire Clues

**Point of Origin** – Burn patterns and other damage can help determine the point of origin, or the location where the fire started.

**V-Patterns** - Fire burns up, in a V-shaped pattern, so a fire that starts at an outlet against a wall leaves a char pattern that points to the origin.

- A very narrow V-shape might indicate a fire that was hotter than normal, such as one helped along by an accelerant.
- A wide V-shape might indicate a fire that was slow burning.
- A U-shape could indicate that there was a "pool of origin" rather than a point of origin, such as might be caused by, say, a puddle of gasoline.

**Color of smoke** – Determine what type material was burning

**Color of flames** – Indicates at what temperature the fire was burning



# Fire Clues

**Glass** - Glass fragments, windows, and light bulbs can provide clues to a fire.

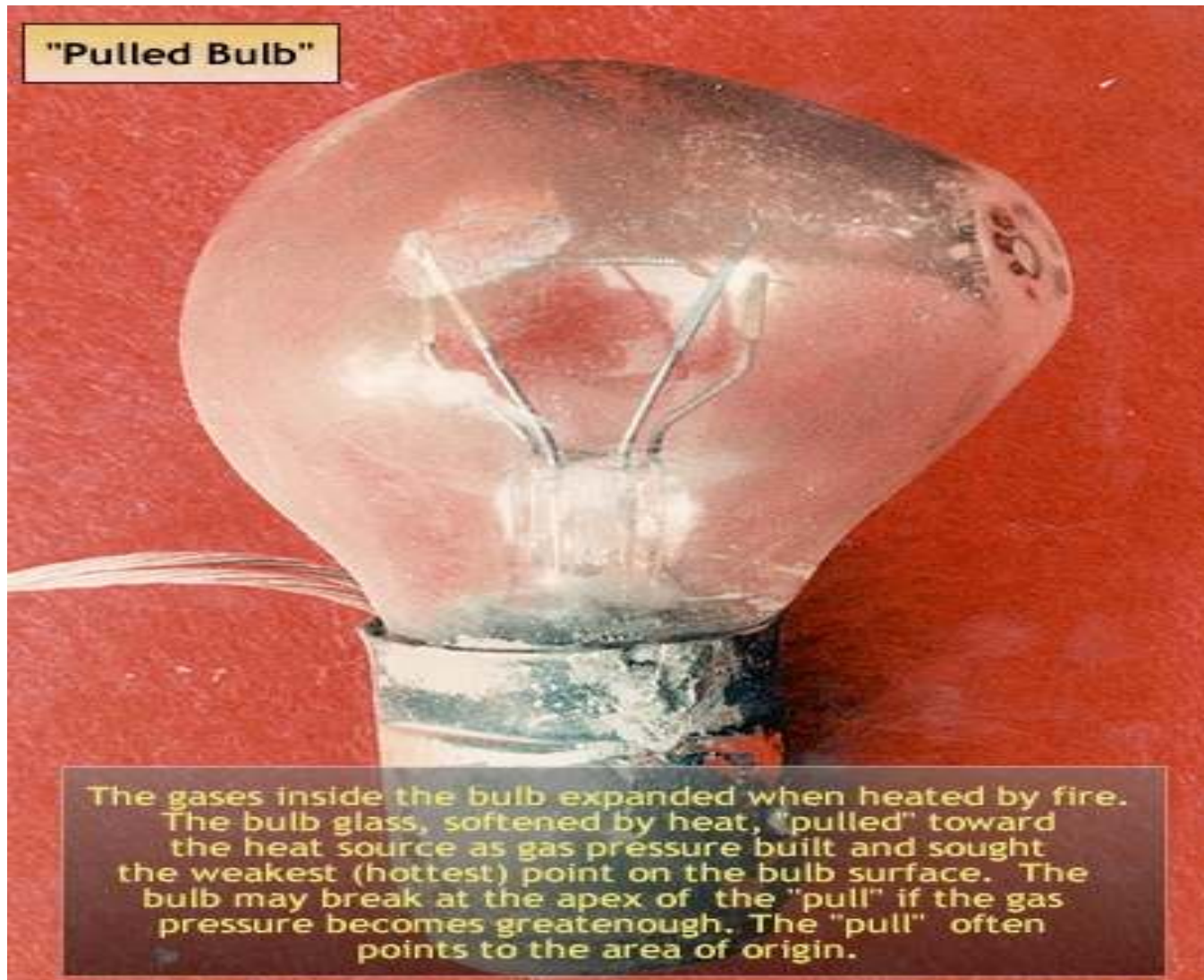
- The shattered or cracked glass of the windows can provide indications as to how a fire burned.
- A dark soot layer on the glass could indicate a slow, smoldering fire.
- Clear glass with an abnormal pattern of cracking could imply a very hot fire, possibly due to an accelerant.

**Chimney Effect** - Since fire burns upwards, there can be a "chimney effect" where the fire ignites at a point, the superheated gases rise upward and form a fireball, which continues straight up to burn a hole in the ceiling. If the roof is not entirely burnt, and the fire investigator finds such a hole, the origin of the fire could be directly underneath.



# Fire investigation

What clues might a fire investigator gain from this photograph?



# patterns

➤ **Char Patterns** – Created by very hot fires that burn very quickly and move fast along its path, so that there can be sharp lines between what is burned and what isn't.

- A char pattern on a door would help an investigator determine which side of the door the fire was on.
- A char pattern on the floor would help investigators determine the use of an accelerant and its path.





# patterns

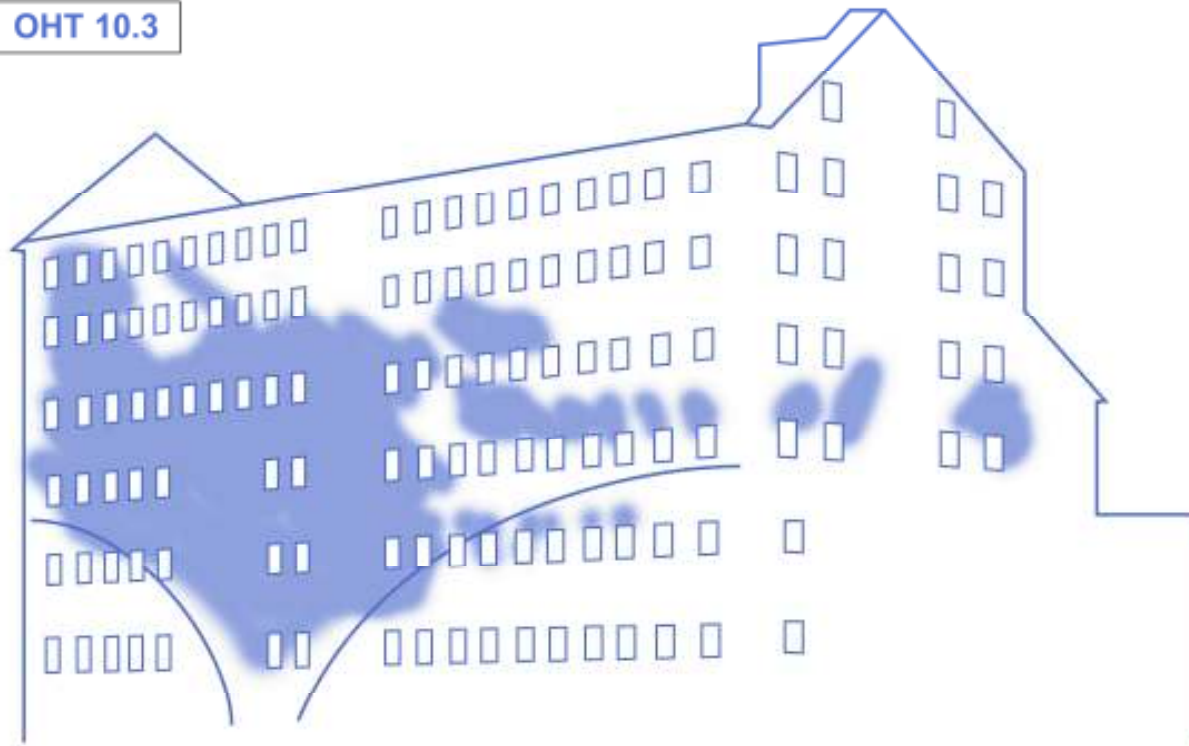
## Inverted Cone Pattern:



# patterns

## ➤ V-Patterns -

OHT 10.3



**Figure 10.5** V-shaped smoke damage evident when a burnt building is viewed as a whole from the outside

Jackson & Jackson: *Forensic Science*

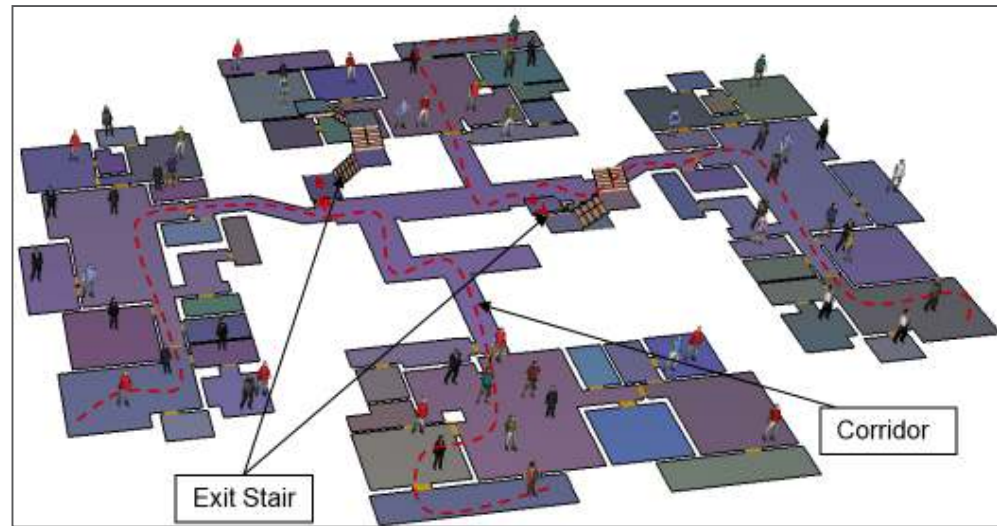
© Andrew R. W. Jackson and Julie M. Jackson 2004



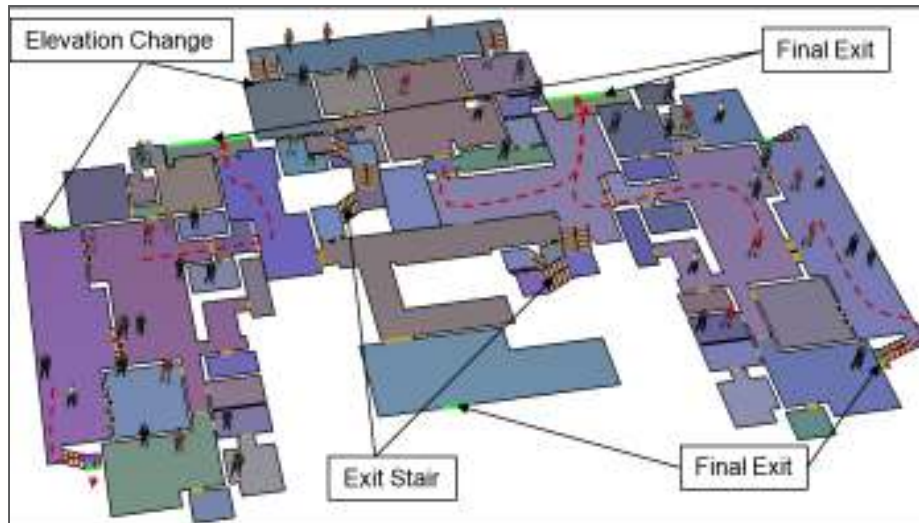
# SIMULATION

Typical Floor Level with random loaded occupants

Occupants utilizing stairs



Ground Level with random loaded occupants



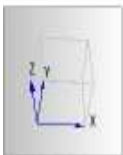
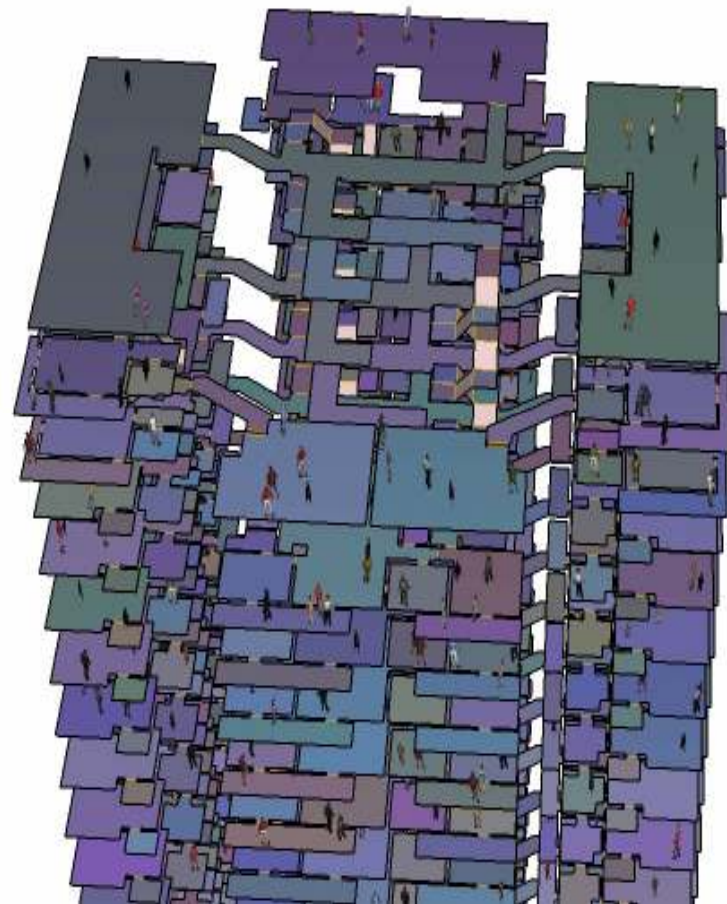
Building Section with random loaded occupants utilizing stairs





# Sample Egress Model

Exited: 0/1589



0.0





**THANK YOU**