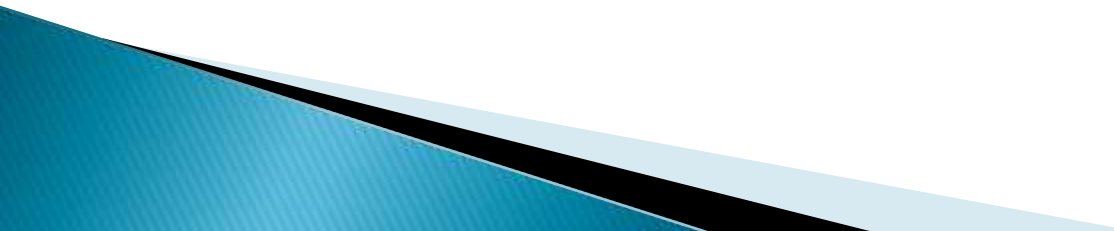


History of Fire and Fire Codes

A collaboration of historic fires and subsequent fire code changes.

History of Fire and Fire Codes

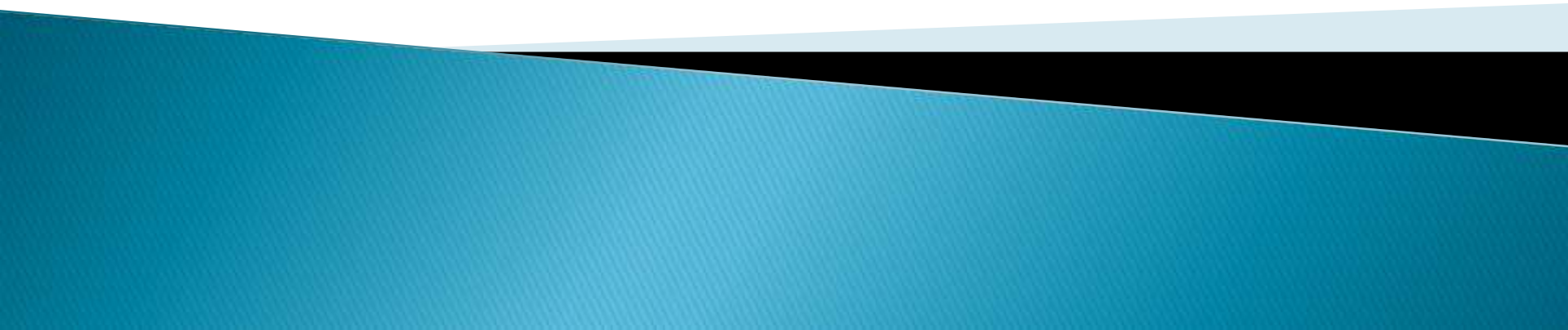
- ▶ Since its inception, fire has been a vital part of humankind's existence and survival.
 - ▶ Years of experience, incidents, tragedies, and education has helped evolve how people handle, control, prevent, contain, and to provide the safest conditions for all with the phenomenon known as fire.
 - ▶ Agencies such as the National Fire Protection Association (NFPA), the International Code Council (ICC), Underwriter's Laboratories (U.L.) have been monumental in the development of codes that limit the devastating effect that fire creates.
- 

State Fire Marshal

“We think 100 dead in a fire conflagration is behind us...yet one only has to look to the Rhode Island night club in 2003 when over 100 people died because of sound proofing foam put all over the walls and covering emergency exits. We can still see the lack of fire code enforcement still costs hundreds of lives. Can you imagine 100 people dying in a single fire in 2003? The hardest part of my job is convincing people enforcing fire codes matter.”

–Ray Reynolds
Iowa State Fire Marshal

WHY CODES AND ENFORCEMENT MATTER



The Great Fire of Rome

64 AD

The Great Fire of Rome

- ▶ Rome burned in 64 AD
- ▶ Narrow streets, tall buildings, combustible building materials, and common walled buildings contributed to the fire's devastation.
- ▶ Emperor Nero created a new urban plan.
- ▶ Wider streets, restrictions on the height of houses; no common walls of buildings and homes that were constructed with fire resistant material such as stone instead of wooden pillars.



First American Fire Ordinance 1631

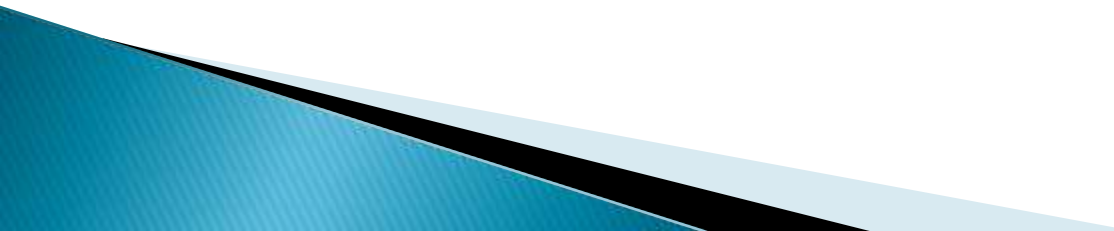
It all began in Boston

- ▶ Boston, Massachusetts, 1631, John Winthrop, Governor of Boston, outlawed the building of wooden chimneys and thatched roofs of homes as each of these were found to cause more fires and dangerous fires throughout the community.
- ▶ This became the first American Building Code.



First American Fire Wardens 1648

First Fire Wardens

- ▶ Governor of New Amsterdam (New York City), appointed 4 fire wardens in 1648 which was the first organized fire prevention inspections in America.
 - ▶ The Fire Wardens were allowed to inspect every home in the city for proper cleaning and construction of chimneys.
 - ▶ If fires were started due to negligent cleaning or construction of chimneys and fire places, the Fire Wardens could issue fines to the home owners.
- 

Great Fire of London 1666

Great Fire of London

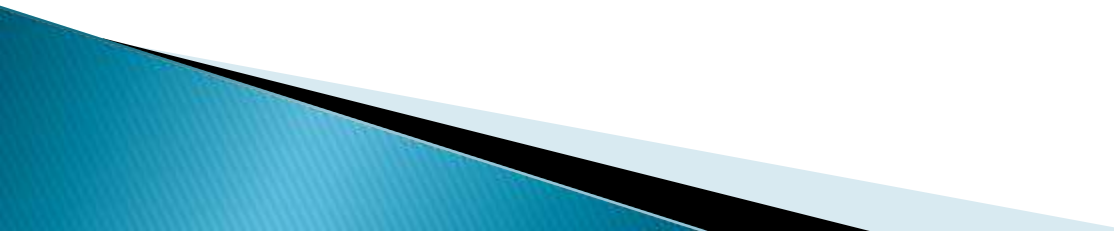


- ▶ Fire started in a bakery.
- ▶ Small distance between buildings, the combustible material used, and several hindrances of the fire fighting caused major damage.

DEATH AND DAMAGE TOLL

- ▶ This fire unofficially killed only 6 people, however, this number is in dispute as it is believed the poor and middle class deaths were not recorded.
- ▶ 13,200 homes, 87 churches, and most of the City Authority Buildings (approximately 80% of the city).

Effects of the Great Fire of London

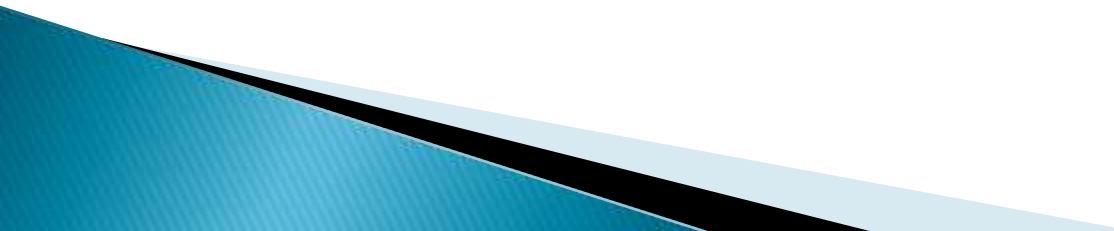
- ▶ This fire caused an interest in developing a hand-pumper form of fire suppression apparatus.
 - ▶ Even with the amount of damage, after much debate, the city was rebuilt using the same type of building plans and spacing as before.
- 

America's First Paid Firefighters

1679



Paid Firefighters

- ▶ After a large fire in Boston, Thomas Atkins was appointed as the First Fire Chief.
 - ▶ The first paid firefighters were hired in 1679 in Boston, Massachusetts.
 - ▶ In 2008, according to the Bureau of Labor Statistics, there were approximately 365,600 paid firefighters.
- 

First Volunteer Fire Department

1736

First Union Fire Company



- ▶ December 7, 1736–First Union Fire Company established in Philadelphia, Pennsylvania by Benjamin Franklin.
- ▶ Good will or amateur men agreed to respond to fires and attempt to extinguish the fires.
- ▶ Use of strong bags, baskets, and (more commonly) leather buckets coined the phrase the “Bucket Brigade.”
- ▶ Homeowners required to provide a bucket on their doorsteps for the first arriving volunteers to use.
- ▶ Approximately 30 men made up the first volunteer fire department.

Great Chicago Fire

1871

Great Chicago Fire



- ▶ America's fastest growing city in 1871 was Chicago.
- ▶ Rapid growing populations meant construction of city mainly was wood and other combustible material.
- ▶ The city had been facing a drought that brought high winds along with it.
- ▶ October 9, 1871 – Fire started in O'Leary Barn
 - Legend states the fire was started by Mrs. O'Leary's cow knocking a lantern over onto hay, however this has never been proven.
- ▶ 3 Fire Departments responded to the call.
 - Chicago FD, Milwaukee FD, and Cincinnati FD

Great Chicago Fire Cont...

- ▶ Firefighters were given wrong directions to the fire.
- ▶ High winds and wooden building construction allowed fire to grow and spread quickly to the heart of the city.
- ▶ The fire engulfed the Chicago Waterworks plant and brought firefighting efforts to a standstill.
- ▶ The fire burned until it ran out of fuel.

DEATH AND DAMAGE TOLL

- ▶ 250 people dead.
- ▶ Fire destroyed 1/3 of Chicago's buildings.

CODE CHANGES

- ▶ Fire and building codes in place for new spacing and construction materials required to be used for reconstruction.
- ▶ The first week of October as National Fire Prevention Week marks the anniversary of this fire.

Great Peshtigo Fire

1871

The Forgotten Fire

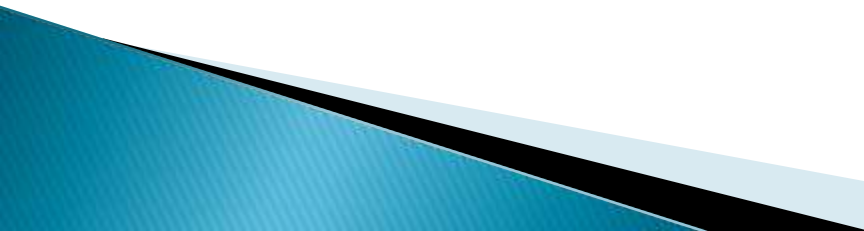
- ▶ The same day as the Great Chicago Fire and mostly forgotten due to the media attention of the Great Chicago fire.
- ▶ Deadliest fire in the United States
- ▶ Fire in Wisconsin and Michigan
- ▶ Hurricane force winds, droughts, and fire came together to create a “fire storm.”
- ▶ Towns constructed mainly of wood and sawdust covered the streets due to the local lumber industries.



Great Peshtigo Fire Cont...

- ▶ Fire spread quickly and people fled to the Great Lakes in effort to escape the blaze.
- ▶ Many lives were lost to drowning from residents trying to escape the blaze and many took their own lives.

DEATH AND DAMAGE TOLL

- ▶ Consumed approximately 23 towns, 1,000,000 acres of farms, forests, and sawmills.
 - ▶ Killed approximately 1,500 people.
- 

Great Boston Fire

1872

Great Boston Fire

- ▶ November 9, 1872
- ▶ Most buildings in Boston, Massachusetts were thought to be “Fire Proof.”
- ▶ Fire started in basement of 5 story warehouse.
- ▶ Boston Fire Department delayed due to horse distemperment and illness.
 - Firefighters had to haul equipment by hand.
- ▶ Fire jumped from “fire proof” building to “fire proof” building.
- ▶ Poor water supply for fire hydrants and inadequate fire hose streams only allowed water to reach the 3rd story of 5–7 story buildings.
- ▶ Fire breaks created by pulling down and imploding buildings in the path of the fire.
- ▶ Warships in the Boston Harbor caught fire and ignited the gunpowder and explosives.

Great Boston Fire cont....



- ▶ 1600 firefighters from 30 different cities responded to extinguish the fire.
- ▶ These firefighters were little help due to the fact there was not a standard fire hose coupling size and their couplings did not match other departments hoses.

DEATH AND DAMAGE TOLL

- ▶ 60 acres of buildings destroyed.
- ▶ 2 firefighters died in the fire.

CODE CHANGES:

- ▶ Boston improved the building codes and the inspections for proper building construction.

Automatic Sprinkler System

1812-1890

First Automatic Sprinkler System



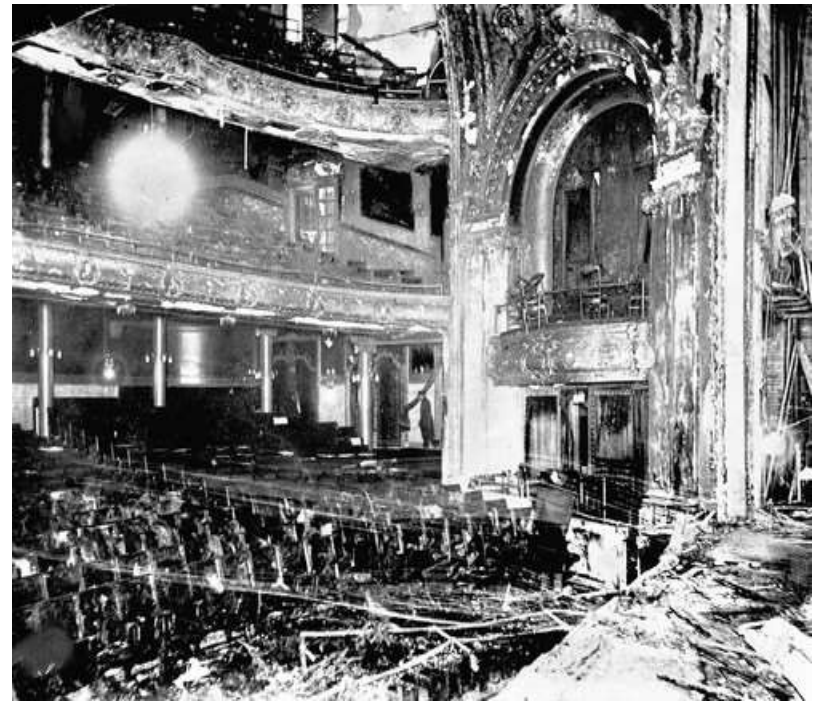
- ▶ Sprinkler system concept first designed in England 1812 in textile mills. These systems were not automatic sprinkler systems.
- ▶ First automatic sprinkler system was patented by Philip W. Pratt of Abington, MA in 1872.
- ▶ 1874–Henry S. Parmalee (New Haven, CT) invented first automatic sprinkler head and installed it on Pratt's automatic sprinkler system.
- ▶ 1881–Franklin Grinnell improved Pratt's and Parmalee's design of the automatic sprinkler system and patented the improved design.
- ▶ 1890–Grinnell designed a glass disk sprinkler head for his new system.
- ▶ The glass disk sprinkler head is still used today.

Iroquois Theater Fire

1903

Chicago-Iroquois Theater Fire

- ▶ Iroquois Theater in Chicago was believed to be “Absolutely Fireproof.”
- ▶ December 30, 1903– Theater packed to standing room only for the play “Mr. Bluebeard.”
- ▶ Second act– a spark from an arc light ignited a muslim curtain.
- ▶ Stage hand attempted to put out the fire unsuccessfully.
- ▶ Workers attempted to lower the asbestos curtain but it snags.
- ▶ Fire, smoke, and heat spread quickly through the theater.
- ▶ Patrons panicked and quickly moved towards the exit doors.
- ▶ The North exit doors were blocked by a curtain–when patrons eventually found the door, they were discouraged by an unfamiliar locking device.



Iroquois Theater Fire cont...

- ▶ The North exit doors were blocked by a curtain—when patrons eventually found the door, they were discouraged by an unfamiliar locking device.
- ▶ Other main exit doors opened against the flow of traffic (opened into the building).
- ▶ Dead end corridors and obstructed exits caused panic, pushing, jumping, and rushing for exits
- ▶ The backstage freight doors were opened for escape, however, they added oxygen to fuel the fire and create an enormous fireball.
- ▶ Wired and nailed shut vents above the stage sealed the smoke and heat in the Auditorium.
- ▶ Iron gates barred the exit stairways in the foyer for those patrons who did escape the auditorium.
- ▶ Many patrons' bodies, being overcome by heat, fire, smoke, asphyxiation, and crush injuries were piled up at these gates in the foyer.

Iroquois Theater Fire

DEATH AND DAMAGE TOLL

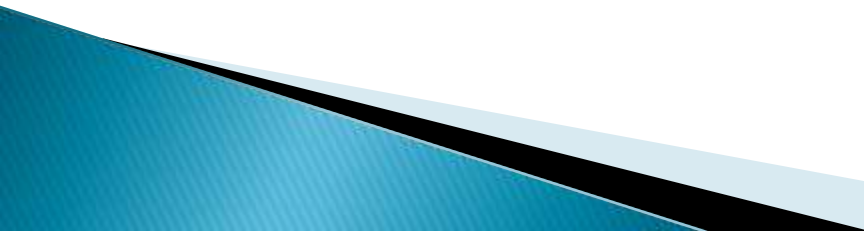
- ▶ The fire killed 602 people.
- ▶ The Iroquois Theater Fire is know as the **deadliest theater fire and single building fire** in the history of the United States.

CODE CHANGES

- ▶ This fire created federal and state standards for exiting pathways, exit doors, exit signs and markings, maximum seating, and the use of the panic bar.

Baltimore Fire 1904

Baltimore Fire

- ▶ On Sunday, February, 7, 1904 the Baltimore Fire Department received an automatic fire alarm indicating a fire in the basement at the John E Hurst & Company building.
 - ▶ When the fire department entered the building they noticed fire rolling across the ceiling and up an elevator shaft.
 - ▶ An explosion rocked the building shortly after the fire department observed the fire in the elevator shaft.
 - ▶ The explosion blew off the roof, shattered windows, and spread embers into the neighboring buildings.
 - ▶ The Washington, Philadelphia, New York, and several other fire departments were called for mutual aid.
 - ▶ The aiding fire departments found their hose couplings did not match the city's fire hydrants so in effort to get water, the hoses were wrapped with canvas to connect them.
- 

Baltimore Fire Continued...



- ▶ The fire departments created fire breaks by destroying buildings in the fire path with explosives.
- ▶ The firefighters inexperience with explosives caused more damage than it helped.

DAMAGE TOLL

- ▶ Fire burned for 30 hours, destroyed 2500 buildings equalling 80 blocks of the city.

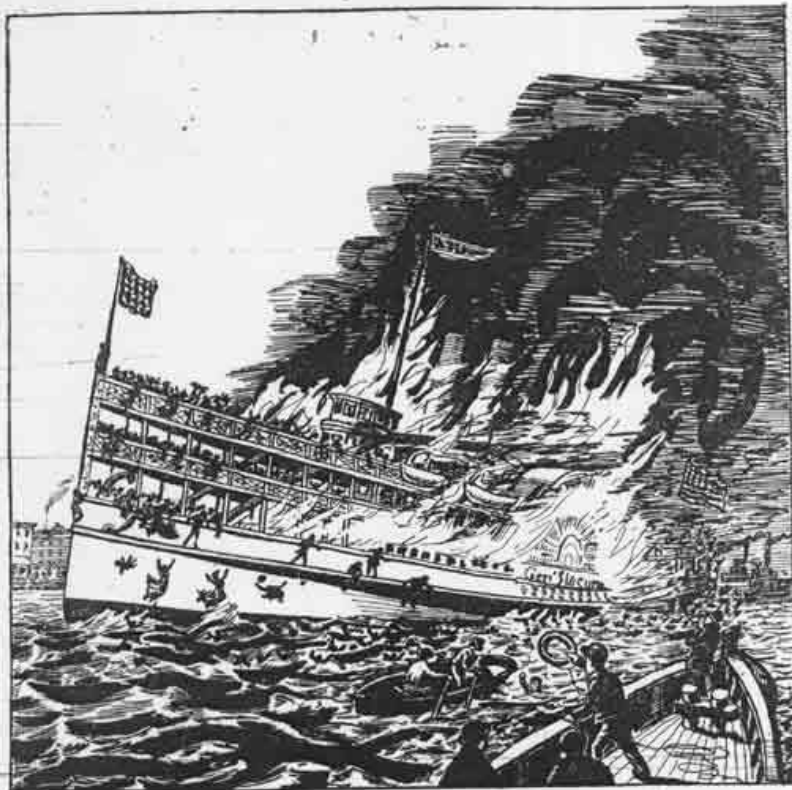
CODE CHANGES:

- ▶ National standard sizing for fire hose as 7 1/2" sized fire hose couplings.

**General Slocum Wheel
Boat Fire
1904**



Tragedy on the East River



BURNING OF THE GENERAL SLOCUM — Scene as She Passed North Brother Island

- ▶ General Slocum— side-wheeled passenger ship built and based in Brooklyn, NY.
- ▶ June 1904— St. Mark's Evangelical Lutheran Church members board the General Slocum for a day on the New York's East River.
- ▶ Fire found in forward hold compartment of the ship.
- ▶ Strong winds pushed the fire quickly through the ship.
- ▶ Life preservers were rotten, moldy fire hoses on board ruptured under the water pressure due to 13 years on board the ship and not protected from the elements.

General Slocum Ship Fire

- ▶ Crew lowered life boats improper and they capsized
- ▶ Crews were not trained for fire drills.
- ▶ The Captain failed to maneuver the ship into ground to allow the passengers to escape.

DEATH AND DAMAGE TOLL

- ▶ General Slocum sank near Hellgate, New York, 1030 passengers were dead.

CODE CHANGES:

- ▶ This tragic event brought about a standard of inspections on almost 300 ships in the New York Harbor.
- ▶ Federal and State regulations were set to test and improve emergency equipment on ships and to destroy any defective equipment found.

San Francisco Fire 1909

Earthquake Causes Fire

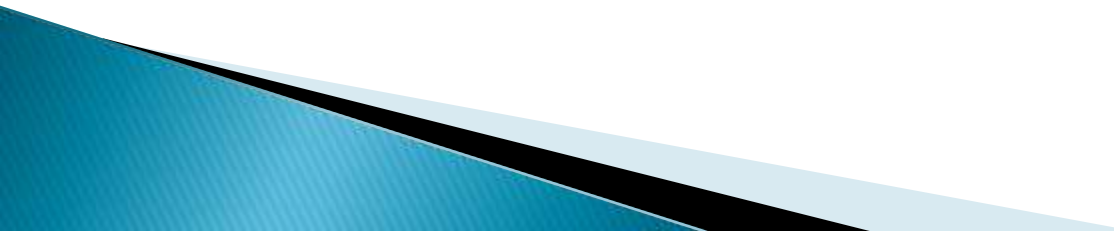


- ▶ April 18, 1909– San Francisco is rocked by a magnitude 7.9 earthquake.
- ▶ The quake ruptured water mains, collapsed buildings, and ruptured gas mains.
- ▶ Fires ignited throughout the city and are believed to have caused 90% of the overall damage to the city.
- ▶ Firefighters created fire breaks by destroying buildings with explosives but due to their unfamiliar use of explosives they created more problems than solved.

San Francisco Fire Continued...

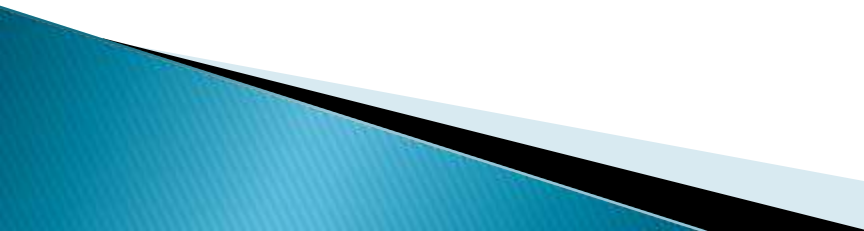
- ▶ Dynamite created more sparks and caused gas mains to ignite and jumped the fire breaks.
- ▶ Fire burned for 2 days.

DEATH AND DAMAGE TOLL

- ▶ 450 people died
 - ▶ Approximately 300, 000 people were left homeless.
- 

Triangle Waist Company Fire 1911

Triangle Waist Company Fire

- ▶ The Triangle Shirtwaist Factory was on the 8th, 9th, and 10th floors of the Asch Building in New York, New York.
 - ▶ The factory employed approximately 500 workers– mostly women
 - ▶ Saturday, March 25, 1911–fire started from a scrap bin under one of the cutter's tables on the 8th floor from what the Fire Marshal believed was an un-extinguished match or cigarette.
 - ▶ Workers on the 10th floor notified via telephone by another employee
 - ▶ No fire alarm system or any other audible alarm was available to notify employees on the 9th floor
 - ▶ Fire prevented workers from escaping one fire escape to Greene Street.
 - ▶ The Washington Square stairwell exit was locked.
 - ▶ Many workers escaped by going to the roof, others jammed into the 2 freight elevators.
- 

Triangle Waistcoat Factory Fire



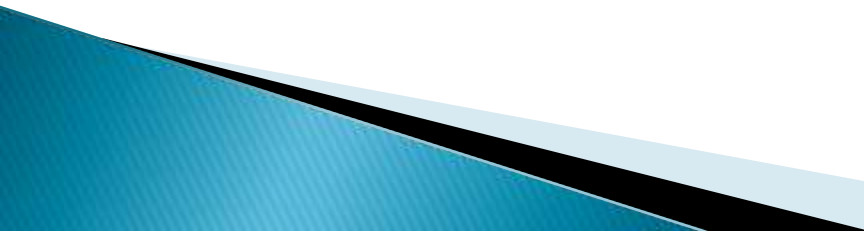
- ▶ The fire escape was flimsy and poorly-anchored and broke under the weight of the employees crowding onto it, causing the workers to fall the hundred feet to the ground.
- ▶ Workers began to jump from windows, the fire escapes, and even pried open the elevator doors and jumped down the elevator shaft.
- ▶ New York Fire Department was unable to stop the flames as they had no ladders that reached beyond the 6th floor.

Triangle Coat Factory

DEATH TOLL

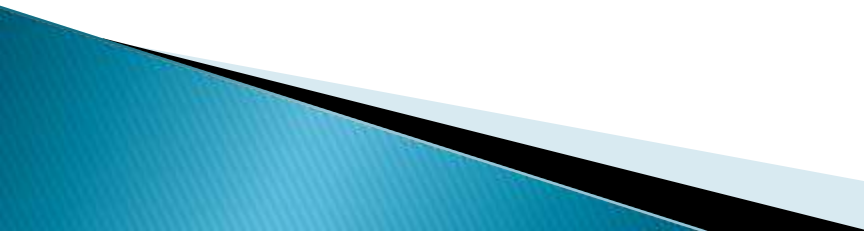
- ▶ 146 people died from asphyxiation, burns, blunt force trauma, or a combination of the 3.

CODE CHANGES

- ▶ Fire proofing, sprinkler systems, improved exiting from high-rises, and development of the NFPA 101 (Life Safety Code)
 - ▶ Developed the New York City Bureau of Fire Protection.
- 

Cleveland Clinic Hospital Fire 1929

Cleveland Clinic Hospital Fire

- ▶ The Cleveland Clinic in Cleveland, Ohio was an 8 year old, 4 story building that was occupied by 300 people.
 - ▶ X-Ray film was stored in the basement—highly flammable film in this time period.
 - ▶ X-Ray film caught fire.
 - ▶ Fire door failed to work properly and allowed the poisonous yellow smoke to pass throughout the building via ventilation shafts and stairways.
 - ▶ Firemen unable to enter building due to toxic fumes.
- 

Cleveland Clinic Hospital Continued...

- ▶ A large explosion ripped through the building and blew out the skylight.
- ▶ Stairways and exits were blocked by panicked patients.

DEATH AND DAMAGE TOLL

- ▶ 121 people died—most due to the toxic fumes.
- ▶ Deadliest hospital fire in the United States.

CODE CHANGES

- ▶ Safety film required for all x-ray film.

Ohio Penitentiary Fire 1930

Ohio Penitentiary Fire

- ▶ The Ohio State Penitentiary was built as a “Fire Proof” prison and built to house 1500 inmates.
- ▶ The prison was remodeling and expanding the West Block (“Big Block”) to make room for the 4,300 prisoners it housed.
- ▶ April 21, 1930– A candle ignited oily rags that were left on the wooden scaffolding from the renovations.
- ▶ Fire was noticed just after the prisoners were locked into the cells for the evening.
- ▶ Toxic fumes, carbon monoxide, and flames spread throughout the cell block.
- ▶ Prisoners screamed and pleaded for release.
- ▶ Warden, Preston E. Thomas, refused to allow the release of the prisoners until the Ohio National Guard arrived for fear of a riot.
- ▶ National Guard arrived 30 minutes after the fire started.
- ▶ Prisoners released upon arrival of the National Guard.

Ohio State Penitentiary Fire

DEATH AND DAMAGE TOLL

- ▶ 320 prisoners died and 130 were seriously injured.

CODE CHANGES

- ▶ From this fire, new fire codes were adopted for Jails and Prisons under the National Fire Protection Association (NFPA) Life Safety Code (NFPA 101).
- ▶ Include but are not limited to requiring new and existing correctional facilities to be constructed of limited- or non-combustible materials and to be provided with automatic sprinkler and/or fire alarm detection systems.

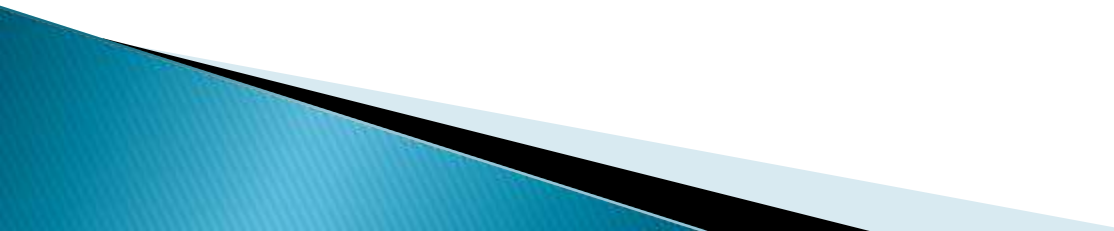


Ohio State Penitentiary Morgue lined with bodies

SS Morro Castle Fire

1934

Luxury Cruise Ship Catches Fire

- ▶ Morro Castle– Luxury cruise ship out of New York, New York
 - ▶ September 8, 1934– On the way back to New York City from Havana.
 - ▶ Within 20 minutes of the discovery of the fire, the fire spread to the main electrical room.
 - ▶ Ship in total darkness.
 - ▶ Passengers and crew could not find the way to the exits.
 - ▶ Passengers and crew jumped from the ship to avoid fire– many drowned due to the weather conditions.
 - ▶ Most of the ship was engulfed in fire within 30 minutes.
 - ▶ 6 of 12 life boats were launched with a total of 85 passengers.
- 

SS Morro Castle Fire Continued...

DEATH AND DAMAGE TOLL

- ▶ Bodies washed up on shores along the coastline
- ▶ 135 people were killed.

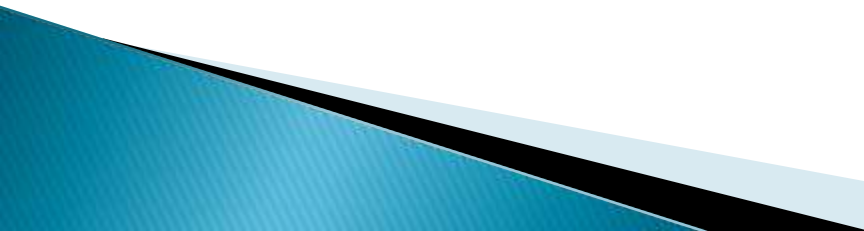
CODE CHANGES

- ▶ This tragedy led to stricter safety standards for ships, including focusing on fire drills, the use of fire resistant materials, automatic fire doors, ship-wide fire alarms, emergency generators, and crew training for fire fighting.

Rhythm Club Fire

1940

Rhythm Club Fire

- ▶ The Rhythm Club in Natchez, Mississippi was crowded with 300 people on the night of April 23, 1940.
 - ▶ At 11:30 p.m. a fire started in the front of the main entrance door.
 - ▶ The fire quickly engulfed the single story building due to the flammable decorations used.
 - ▶ Spanish moss was used and hung off the rafters. The methane gas generated from the moss fueled the fire and destroyed the building within an hour.
 - ▶ Windows were boarded up to prevent people from sneaking into the club.
 - ▶ People panicked and pushed towards the only exit—that opened into the building.
- 

Rhythm Club Fire Continued...

DEATH AND DAMAGE TOLL

- ▶ 209 people died from smoke inhalation, crushing injuries, and burns

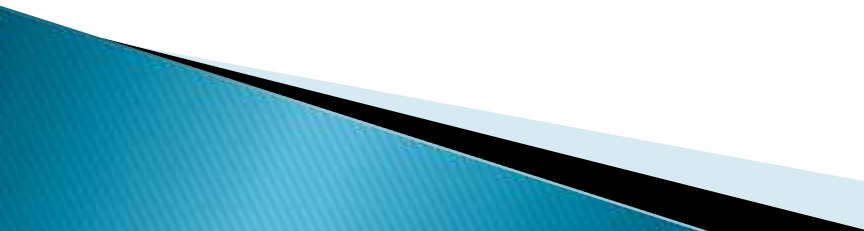
CODE CHANGES

- ▶ Standards for number of fire exits required
- ▶ Additional standards for door swing requirement.
- ▶ Interior finish standards

Cocoanut Grove Night
Club Fire
1942



Cocoanut Grove Night Club Fire

- ▶ Boston Fire Department inspected building 8 days prior to fire.
 - ▶ Building was recently under construction, rooms had a confusing floor plan, interior decorations were cloth, paper, bamboo, ceiling covered with stain fabric, and simulated leather and wood covered walls.
 - ▶ Occupancy rating of club was 600
 - ▶ November 28, 1942–club was crowded with over 1,000 people.
 - ▶ A match ignites the gauze draperies in the Melody Lounge located in the basement.
 - ▶ The building was completely involved with fire within 5 minutes.
 - ▶ Basement single exit stairwell was blocked within 2 minutes by the crowd, smoke, and fire.
 - ▶ Exits were locked or welded shut, opened inward or jammed, and the revolving doors were blocked due to the rush of the guests to escape.
 - ▶ The lighting system failed.
- 

Cocoanut Grove Night Club Fire cont...

DEATH AND DAMAGE TOLL

- ▶ 200 people died at the 2 revolving doors.
- ▶ A total of 492 people died in the fire and 200 people injured.

CODE CHANGES

- ▶ Outward swinging doors.
- ▶ Fire suppression systems
- ▶ Collapsible revolving doors.
- ▶ Number of exit doors
- ▶ Battery operated emergency lighting.
- ▶ Exit access width
- ▶ Construction materials
- ▶ Limitations on interior furnishings
- ▶ Additions of codes to the Life Safety Code.



Knights of Columbus Hall
Fire
1942



Knights of Columbus Hall Fire

- ▶ Saturday, December 12, 1942–Knights of Columbus (hostel in Newfoundland, Canada) housed many soldiers fighting World War II.
- ▶ Building housed 500 people at the time the fire started.
- ▶ Windows boarded up for war blackout purposes.
- ▶ Doors locked and barred from the exterior.
- ▶ Arson fire started in building's Dance Hall.
- ▶ Fire spread quickly through the building.

DEATH AND DAMAGE TOLL

- ▶ 100 people killed–many were soldiers
- ▶ 107 people injured.

CODE CHANGES

- ▶ Standards for locking doors and windows.

Ringling Brothers Circus
Tent Fire
1944



Fire Under the Big Top

- ▶ Tent was 520 feet long—World's largest circus tent.
- ▶ Waterproofed with a mixture of 6,000 gallons of white gas and 18,000 pounds of paraffin.
- ▶ Tent had 7,500 people of 13,000 capacity.
- ▶ No fire extinguishers and the nearest fire hydrant was 900 feet away.
- ▶ Tent caught fire and quickly spread to the roof from the highly flammable waterproofing.
- ▶ Guests fled for the exits as flaming pieces of canvas dropped onto them.
- ▶ 2 exits were blocked.
- ▶ Crowd caused a stampede.
- ▶ Tent fully involved within 10 minutes.

Ringling Brothers Circus Tent Fire Cont...



DEATH AND DAMAGE TOLL

- ▶ Bodies of circus goers were piled 4–5 bodies high. Some survivors found underneath the bodies.
- ▶ Over 100 children and 69 adults were killed in the fire.

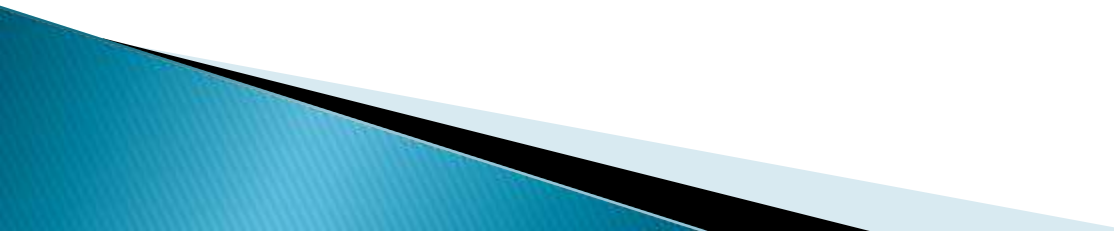
CODE CHANGES

- ▶ NFPA Standard 102 was developed (Grandstands, Folding and Telescopic Seating, Tents, and Membrane Structures)
- ▶ This code is also reflected in the 2000 International Building Code and 2003 NFPA 5000.

Winecoff Hotel Fire

1946

Winecoff Hotel Fire

- ▶ 15 story hotel built in 1913 in Atlanta, Georgia under the “European” design and touted to be fire proof. Square design with elevators and stairwells located in the center. Walls were covered with burlap and wallpaper.
 - ▶ No fire alarm system, no suppression system, and no fire escapes.
 - ▶ Building passed recent fire inspection.
- 

Winecoff Hotel Fire

- ▶ December 7, 1946– Elevator operator noticed smoke on the 3rd floor but didn't know fire had engulfed the 3–5 floors.
- ▶ Fire spread quickly through the upper floors.
- ▶ Hotel guests began to panic, some made sheet ropes to scale to the ground, other made ladder bridges to other buildings, many jumped from their room windows.



Winecoff Hotel Fire cont...



- ▶ Room temperatures exceeded 1,500 degrees Fahrenheit.
- ▶ Fire department was delayed due to falling bodies they had to avoid.

DEATH AND DAMAGE TOLL

- ▶ Fire killed 120 and known as Worst U.S. Hotel Fire of the 20th Century.
- ▶ Fire extinguished 6 hours after it began.

CODE CHANGES

- ▶ Locations of fire exits
- ▶ Fire suppression systems and fire alarm system

Texas City SS Grandcamp
Fire
1947

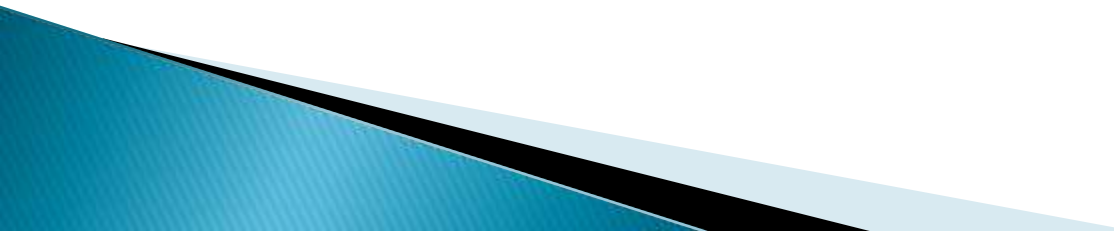


Cargo Hold Explodes



- ▶ The SS Grandcamp had just been loaded with approximately 2,300 tons of ammonium nitrate (a highly explosive material).
- ▶ At 8:10 a.m. on April 16, 1947, smoke was seen coming from the cargo hold of the SS Grand Camp docked at the Port of Texas in Texas City, Texas.
- ▶ The Captain called for the crew to steam the hold (piping steam into the hold to extinguish fire while preserving the cargo).
- ▶ Spectators noted the water around the ship was being to boil from the heat and the cargo hold and deck began to bulge.
- ▶ Volunteer Firefighters responded shortly after the fire was found.
- ▶ At 9:12 a.m. the ammonium nitrate exploded.

Texas City SS Grandcamp Fire Continued...

- ▶ A 15-foot shockwave was felt over nearly 100 miles away.
 - ▶ The blast leveled almost 1,000 buildings, blew 2 airplanes out of the sky, ignited ships nearby, and ignited refineries and chemical tanks on the shoreline.
 - ▶ Windows were shattered in Houston, Texas (40 miles away), people in Louisiana (250 miles away) felt the shock, and people in Galveston, Texas were forced to their knees from the shockwave.
 - ▶ 6,350 tons of the SS Grandcamp's steel and anchor were blown into the air. Most of the steel reached supersonic speed as it blew from the ship.
- 

Texas City SS Grandcamp Devastation

City Blocks Levelled



City Fire Truck Destroyed



View from Galveston



Texas City SS Grandcamp Fire Continued...



DEATH AND DAMAGE TOLL

- ▶ Estimates of casualties came to 567 people; however, the blast caused many victims to burn to ashes or were blown to bits causing an official total to be underestimated.
- ▶ Texas City's entire Volunteer Fire Department was killed in the initial explosion.
- ▶ The fire burned for 3 days, leaving approximately 3000 injured and causing \$400 million in property loss.

St. Anthony Hospital Fire

1949

St. Anthony Hospital Fire

- ▶ St. Anthony Hospital in Effingham, Illinois was a two-story lumber and brick building built with combustible laundry chutes, soundproofing, 2 wooden fire stairwells (without separation between floors), oil cloth covered walls, and cellulose fiberboard.
- ▶ Hospital not equipped with a fire alarm system or automatic sprinkler system.
- ▶ The Hospital had just been freshly painted– paints and oils were stored in the basement.
- ▶ Built to hold 100 beds but on April 4, 1949, there were 128 people in the hospital.
- ▶ One nun smelled smoke on 3rd floor and raised an alarm with the Night Superintendent and Chief Engineer.
- ▶ Fire department was dispatched as the Chief Engineer attempted to extinguish the fire with portable fire extinguishers.
- ▶ Fire spread rapidly through building due to the fresh paint and the lack of fire stops or fire separation. This made evacuation of all patients impossible.

St. Anthony Hospital Continued...

- ▶ Fire department was on scene within 10 minutes and found the building fully involved with fire.



DEATH AND DAMAGE TOLL

- ▶ Fire killed 74 people including 11 newborn infants in the nursery located on the 2nd floor.

CODE CHANGES

- ▶ This fire led to several fire code changes for hospitals and healthcare facilities throughout the nation.
- ▶ Fire barriers, smoke barriers, and fire resistant stairway enclosures required in hospitals.

General Motors Plant Fire 1953

General Motors Plant Fire

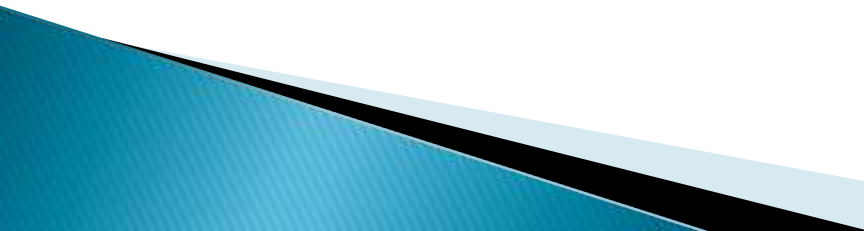
- ▶ General Motors Plant in Livonia, Michigan
- ▶ Open building design greater than 34 acres in size (1.5 million square feet) and 866 feet wide.
- ▶ Building was only 20% sprinkled, there were no fire walls or partitions, no roof vents, and unprotected steel roof trusses.
- ▶ Fire started when a cutting torch ignited conveyor drip pan oil.
- ▶ Fire spread quickly through the open room.
- ▶ Smoke, heat, and fire were trapped in the building due to no roof vents.
- ▶ Fire hose streams only penetrated 75 feet into the 866 feet wide building.
- ▶ Roof trusses failed quickly and allowed melted roof asphalt to fuel the fire.

General Motors Plant Fire Cont...

DEATH AND DAMAGE TOLL

- ▶ Fire killed 6 workers
- ▶ \$35 million damaged caused

CODE CHANGES

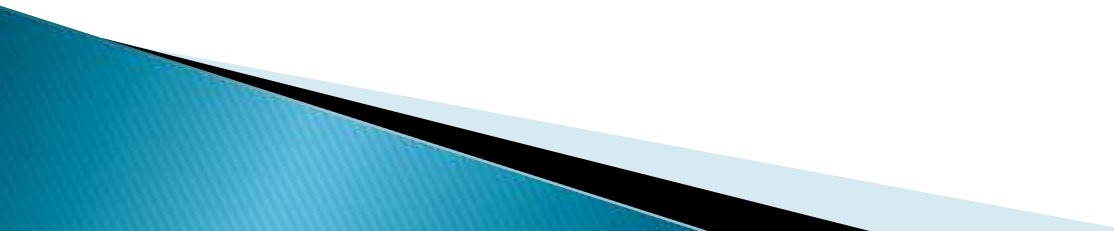
- ▶ Restrictions on roof tar build up
 - ▶ Separation of hazardous operations
 - ▶ Sprinkler requirements in Industrial buildings.
 - ▶ Fire coating for steel frame trusses
 - ▶ Automatic fire doors
 - ▶ NFPA 204–Guide for Smoke and Heat Venting.
- 

Our Lady of the Angel's
School Fire
1958



Our Lady of the Angel's School Fire

THE BUILDING:

- ▶ Built in 1910 and remodeled in 1958, the Our Lady of the Angels Catholic grade school held approximately 1,300 students.
 - ▶ School passed fire inspection 2 months prior to the fire.
 - ▶ Due to grandfather clause—school did not have an automatic fire alarm or sprinkler system. Stairwells and doors were not fire resistant. The interior furnishings were combustible and coated with a flammable sealant.
 - ▶ Building did have a manual fire alarm pull station, only 2 pull stations located in the school (in the South wing).
 - ▶ The 4 extinguishers in the North wing of the school were mounted over 7 feet off the ground, making them inaccessible to all students and most adults.
 - ▶ Single fire escape from second floor required passing through main corridor to reach.
 - ▶ The windows from the second floor were 25 feet off the ground due to the unusually high 12-foot ceilings.
- 

Our Lady of the Angels Fire Continued...



THE FIRE

- ▶ At approximately 2:00 p.m., December 1, 1958– Fire starts in the basement in a cardboard trash barrel in the North stairwell.
- ▶ Fire burned for 30 minutes before being discovered.
- ▶ Combustible stairwell and interior finishing caught fire and spread to the 2nd floor and Attic through the stairwell and an unprotected pipe run.
- ▶ Fire spread through the main corridor on the 2nd floor–making it impassible to get the fire escape.
- ▶ Students unable to escape to the fire escape pushed and pulled to get to the 25–feet high windows...and jumped.

Our Lady of the Angels Fire Continued...

- ▶ Fire Department arrived within 4 minutes of notification (34 minutes after the fire had first began) however they were delayed due to:
 - Incorrect directions to the address
 - A locked gate on the South Side of the building.
- ▶ The 3-foot high window sills proved difficult or impossible for some of the smaller kids to climb for escape.
- ▶ More than 160 children were rescued by firefighters.
- ▶ When the fire was extinguished, firefighters carried bodies of children and nuns out of the burned building.



Our Lady of the Angels Fire Outcome

DEATH AND DAMAGE TOLL

- ▶ 92 Children and 3 Nuns perished in the fire

CODE CHANGES

- ▶ Due to a grandfathering clause, the Our Lady of the Angels school did not have to comply with all the new fire codes and standards that newly constructed schools were required to comply with.
- ▶ School fire safety regulations and standards were overhauled and enacted throughout the nation and over 1000 schools were re-inspected for compliance.
- ▶ Such changes include but are not limited to the requirement of fire alarms, automatic sprinkler systems, self-closing exit doors opening outward, window egress heights, 1 hour fire resistance rated walls, dedicated emergency lighting, separation of heating devices, and fire doors at stairwells.

Los Angeles Wildfire 1961

Los Angeles Wildfire

- ▶ November 6–7, 1961–brush fire found the Sherman Oaks.
- ▶ 60 mph winds carried fire to other structures.
- ▶ Most homes were built with wooden roof shingles that allowed the fire to jump from structure to structure.
- ▶ 3,500 residents were evacuated.
- ▶ More than 2,500 firefighters fought blaze for 12 hours.

DAMAGE TOLL

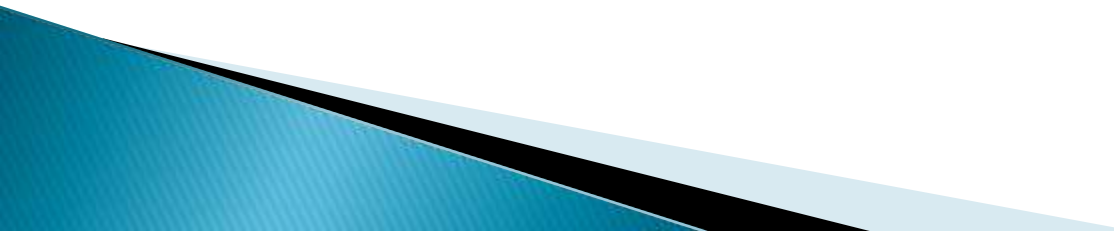
- ▶ 16,090 acres, 420 houses, and 190 other structures burned.

CODE CHANGES

- ▶ Homes to be built with fire resistant shingled roofs.

Apollo 1 Fire 1967

Apollo 1 Space Shuttle Fire

- ▶ January 27, 1967– Apollo 1 Space Shuttle is manned by 3 astronauts (Lt Col. Virgil Grissom, Lt. Col Edward White, and Lt. Col Bruce Chaffee) and ready for launch.
 - ▶ Oxygen is heavily used in the command module, the rockets, and the astronauts space suits.
 - ▶ 6:30 p.m.– The crew were seated horizontally in the Command Module going through checklists when a voltage transient was recorded.
 - ▶ Movement of the crew was recorded on the microphones and recorders inside the module and the space suits.
 - ▶ Moments after the voltage transient was recorded, “We’ve got fire in the cockpit” was recorded.
 - ▶ A painful scream was heard on the microphone followed by the abrupt end of transmission.
- 

Apollo 1 Fire Continued...



- ▶ 17 seconds after the initial call of a fire in the cockpit was recorded, the cabin ruptured under the pressure of the gases from the over-pressurized command module.
- ▶ Thick toxic smoke, intense heat, the explosion, and other issues slowed the ground crew's advance to the command module.
- ▶ In the amount of time it took to open the inner and outer hatches, the fire had extinguished itself.

Apollo 1 Fire Continued...



- ▶ Smoke cleared and allowed the ground crew to find the bodies of the 3 astronauts.
- ▶ Fire had partially melted the nylon space suits and hoses that connected them to the life support system.
- ▶ Grissom's and White's suits were fused together and Chaffee's body was found still strapped in his right seat.
- ▶ The astronauts would not have been able to open the inner hatch due to the overpressurization of the command module.

Apollo 1 Fire

DEATH AND DAMAGE TOLL

- ▶ 3 astronauts died and \$75 million in damage occurred.

CODE CHANGES:

- ▶ Further review of the catastrophe resulted in improved fire safety for space travel and led to higher safety standards for commercial air planes.



Houston Railroad “BLEVE” Fire 1971

Houston BLEVE Fire

- ▶ October 19, 1971 – A railroad car containing vinyl chloride caught fire.
- ▶ Houston Volunteer FD responds.
- ▶ Nearest fire hydrant located $\frac{1}{4}$ mile away from tank and has to be relayed.
- ▶ The rail road car explodes from the pressure of the vapor build up from the heat of the fire.
- ▶ The explosion creates a 1000 ft gas and fire ball.

DEATH AND DAMAGE TOLL

- ▶ 1 Firefighter is killed, at least 27 Firefighters injured.
- ▶ Term BLEVE (Boiling Liquid Expanding Vapor Explosion) is coined.

Beverly Hills Supper Club
Fire
1977



Beverly Hills Supper Club Fire

- ▶ The Beverly Hills Supper Club (South Gate, Kentucky) was a very popular dance club in 1977.
- ▶ The club had a fire inspection by the state fire marshal 4 months prior to the fire.
- ▶ Deficient electrical wiring was found including aluminum wiring.
- ▶ May 28, 1977– The Zebra Room was packed with guests from a wedding party and the building was packed with approximately 3,000 guests (well over capacity)
- ▶ Guests stated the room was getting too hot but the fire was not found until approximately 25 minutes after the wedding party had left and the Zebra Room doors were closed.
- ▶ At 9:01 p.m.– Staff members found the Zebra Room full of thick smoke and heat. They notified the fire department of the issue.
- ▶ Firefighters were on scene approximately 3 minutes after receiving the call.

Beverly Hills Supper Club Fire Continued...

- ▶ The Cabaret Room (a larger assembly room) was filled to more than 3 times its capacity (1,300 people) for a show.
- ▶ 9:08 p.m.– Staff notify guests in the Cabaret Room of the fire and ask them to leave the building. Some guests left while others stayed.
- ▶ 9:10 p.m.–The fire spreads to the Cabaret Room. Guests that stayed, against the warning of the fire, quickly panicked and pushed for the doors.
- ▶ Firefighting efforts were concentrated on the Cabaret Room as there were still people inside.
- ▶ 12:00 a.m.– The roof of the Supper Club collapses—removing any thoughts or hopes of survivors left inside.



Beverly Hills Supper Club Fire Continued...

- ▶ Deficient wiring, insufficient fire exits (17 existing exits of 28 required exits), overcrowding, poorly marked exit pathways, lack of fire walls, combustible furnishings, no fire alarm system, and no sprinkler system were just some of the reasons why this fire spread so quickly.

DEATH AND DAMAGE TOLL

- ▶ 167 people perished in this fire
- ▶ 130 people injured.

CODE CHANGES

- ▶ Sprinklers required in nightclubs and public assembly areas over 300 capacity.
- ▶ Aluminum electrical wiring banned.
- ▶ This was the first fire where the scene was preserved for investigation.

MGM Grand Hotel Fire 1980

MGM Grand Hotel Fire

- ▶ November 21, 1980–MGM Grand Hotel in Las Vegas, Nevada was a 26–story resort that housed approximately 5,000 people and 2,000 hotel rooms.
- ▶ Due to an exception, the MGM Grand Hotel was not protected by a sprinkler system...much to the dismay of the local fire marshal.
- ▶ A fire broke out at 7:00 a.m. in The Deli, a well known restaurant in the MGM Grand.
- ▶ Fire was caused by electrical wires in the walls.
- ▶ Smoke and fire spread rapidly throughout the building due to lack of separation in the stairwells, elevators, and seismic joints..
- ▶ The Clark County Fire Department was dispatched and was the first agency on scene. The North Las Vegas Fire Department, the Las Vegas Fire and Rescue, and the Henderson Fire Department were also dispatched.

MGM Grand Hotel Fire Continued...



- ▶ The fire mainly damaged the 2nd floor casino and the adjacent restaurants.
- ▶ Most of the deaths were due to smoke inhalation on the upper floors of the hotel.


DEATH AND DAMAGE TOLL

- ▶ 84 people were killed in the fire and 650 people and 14 firefighters were injured.

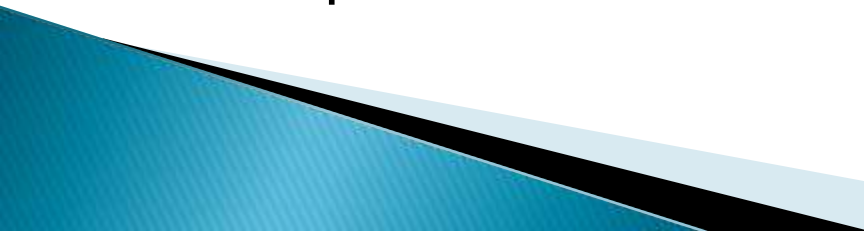
CODE CHANGES:

- ▶ Las Vegas required a complete retro fit of sprinklers within casinos throughout the city.
- ▶ First fire to bring the fact that smoke kills more people than fire does into light.

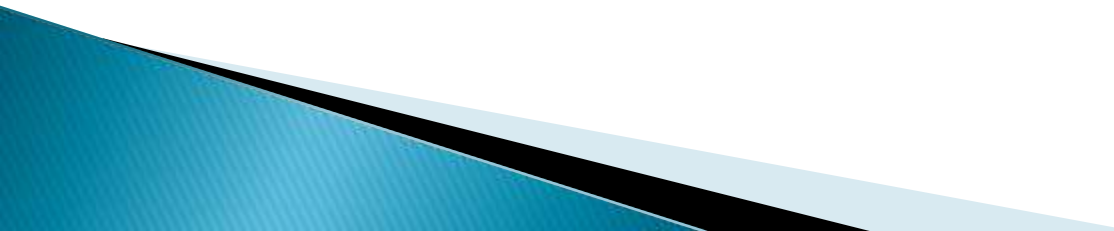
**The Station Nightclub
Fire
2003**



The Station Nightclub Fire

- ▶ Located in West Warwick, Rhode Island and built in 1946.
 - ▶ The Club, a wood frame structure, was equipped with non-fire resistant soundproof foam boards to limit the noise level.
 - ▶ This soundproofing board was 2.5 inches thick and was considered the lowest quality soundproofing board.
 - ▶ Soundproofing board obstructed a couple exits.
 - ▶ The building was equipped with an automatic fire alarm system.
 - ▶ Building not equipped with a sprinkler system due to an overlooked code requirement when the building changed occupancies...which required a sprinkler system to be installed as it no longer met a code exception.
- 

Station Nightclub Fire Continued...

- ▶ There were 462 occupants in a building built for only 300.
 - ▶ The building had 4 working exits.
 - ▶ Building had passed the annual fire inspection.
 - ▶ On February 20, 2003 the band “Great White” was playing at the club.
 - ▶ The band used pyrotechnics without obtaining a required permit from the city.
 - ▶ The band used pyrotechnics without obtaining a required permit from the city.
 - ▶ The band tour manager ignited a set of pyrotechnics during the show.
- 

Station Nightclub Fire Continued...



- ▶ Sparks from the pyrotechnics reached the ceiling and eventually hit the non-fire resistant soundproof boards.
- ▶ The soundproof boards caught fire.
- ▶ The flames were believed to be part of the act until the spectators realized the flames and smoke were out of control.
- ▶ In less than a minute, the stage was completely involved in flames.
- ▶ The crowd, band members, and staff started to rush towards the doors.

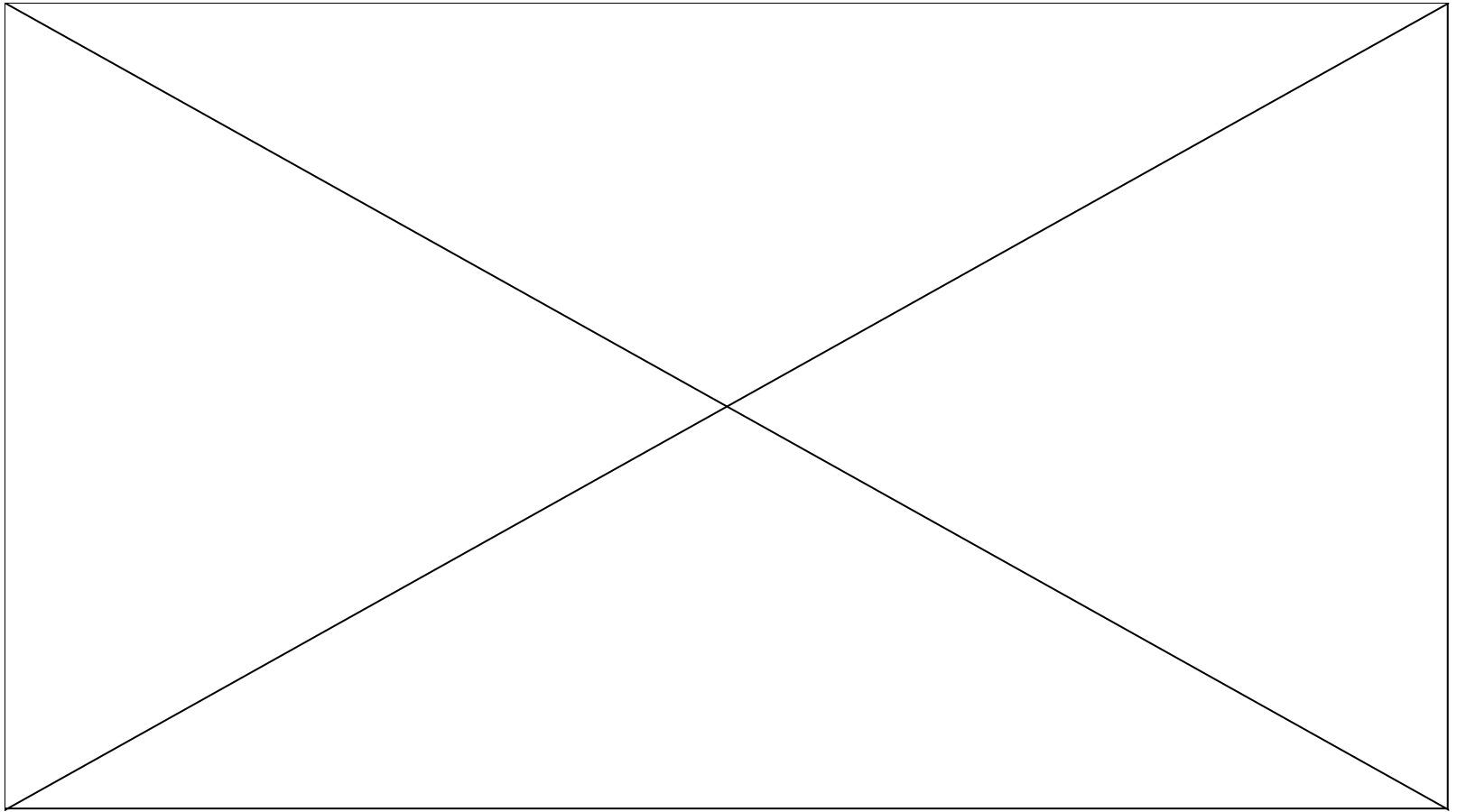
Station Nightclub Fire Continued...

- ▶ The fire alarm activated as the stage became fully involved with fire.
- ▶ Burning soundproofing foam created dense, toxic smoke throughout building.
- ▶ No emergency lighting units within the building.
- ▶ Most people rushed for the Main Front Door entrance.
- ▶ The Front Door was ultimately blocked due to the rush for the door.
- ▶ Fire engulfed the club within approximately 3 minutes.
- ▶ Due to the stampede for the exits, many were killed or injured.
- ▶ Burns, smoke inhalation, and blunt force trauma from trampling were the main causes of death in this fire.

DEATH AND DAMAGE TOLL

- ▶ 100 killed and approximately 230 injured.

Station Nightclub Fire



Video from [You-Tube.com](https://www.youtube.com)

Station Nightclub Fire Continued...

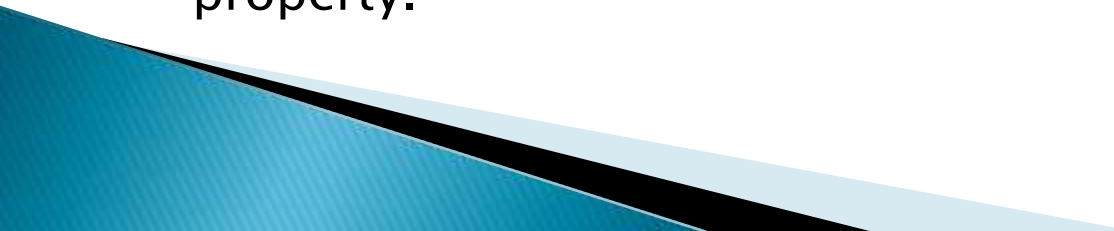
CODE CHANGES

- ▶ NFPA– new standard requires sprinkler systems in new clubs with 50 or more occupants and existing clubs with 100 or more occupant load.
- ▶ Boston banned indoor fireworks.
- ▶ Rhode Island–new regulations
 - Banned indoor pyrotechnics in <1,000 person limited assembly occupancies.
 - Sprinklers required by 7/1/05 in nightclubs with >300 occupant load.
 - Sprinklers required by 7/1/06 in nightclubs with >150 occupant load.
 - Eliminated “grandfather clause” and required old buildings to come up to new code compliance.
 - Low-level exit signage required in all nightclubs.
 - Allowed fire authorities to inspect and close any clubs that violated fire code.

The Remains of the Station Nightclub



Overall

- ▶ Fire Code Officials work to ensure the buildings are properly protected, exits are properly accessible, extinguishing systems and alarm systems are functioning properly, and all systems and services within facilities are properly maintained in order to ensure the buildings are as safe as possible for all occupants.
 - ▶ Tragedies can be avoided when property owners and code enforcement officials work together.
 - ▶ It takes people changing their perspective regarding fire safety in order to avoid fire catastrophes.
 - ▶ “It’s been this way for 20 years” is not an excuse for deficiencies that could save lives and property when corrected.
 - ▶ In the end, the fire service goals are to preserve lives and property.
- 

NFPA Standards History

- ▶ A full history of the National Fire Protection Association (NFPA) inception and standards can be found at:

<http://www.nfpa.org/assets/files/pdf/HistoryNFPACodesStandards.pdf>

Iowa State Fire Marshal's Office



“Through promotion and enforcement of fire safety regulations, training, building code provisions, and arson investigations, this division helps reduce the loss of life and property by fire”

Iowa Department of Public Safety



"In partnership with the people of Iowa, with integrity, pride, professionalism provide services for all people promoting public safety and enhancing the quality of life."

Picture References:

- ispilledthebeans.com
- <http://sbbtm.com/>
- Wikipedia.com
- firefightercentral.com
- www.lessignets.com/
- www.library.wisc.edu/
- <http://commons.wikimedia.org>
- journeytofirefighter.com/
- symonsez.files.wordpress.com
- <http://nltaylor.net>
- www.clemson.edu
- symonsez.files.wordpress.com
- www.ohiohistorycentral.org
- firstin.files.wordpress.com
- www3.gendisasters.com
- <http://www.wusa9.com>
- <http://blog.ktnxbi.com>
- <http://www.tsl.state.tx.us>
- www.local1259iaff.org
- blogs.chron.com/
- www3.gendisasters.com
- www.catalyst-chicago.org
- <http://2.bp.blogspot.com/history.nasa.gov>
- <http://science.ksc.nasa.gov>
- <http://www-tc.pbs.org>
- www.hollywoodtoday.net
- www.youtube.com