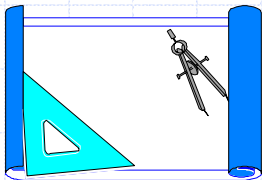
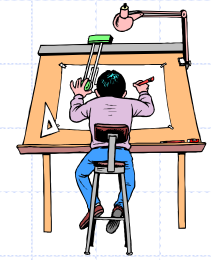


Fire and Life Safety Issues for Building Professionals

Carl D. Wren, P.E.
Chief Engineer
Austin Fire Department

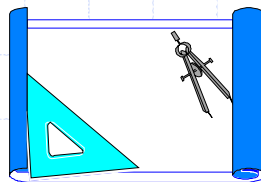
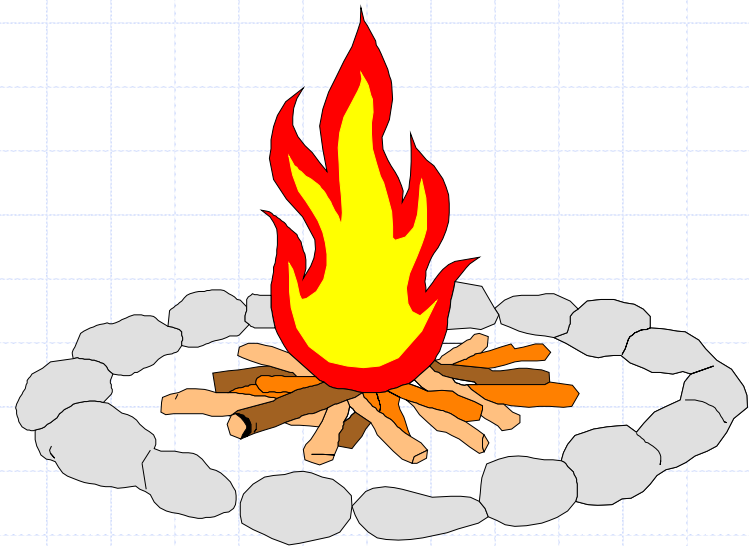


Fire Behavior – Fire Dynamics

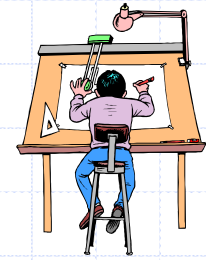


◆ FIRE

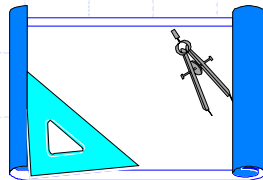
a rapid (exponential growth), self sustaining oxidation process accompanied by the evolution of heat and light of varying intensities



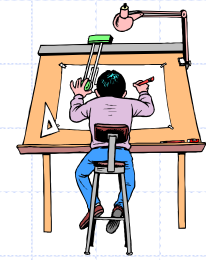
Fire Behavior – Fire Dynamics



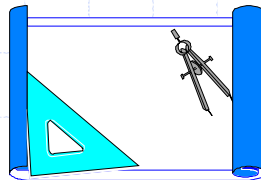
- ◆ Human viability is affected by multiple products of combustion:
 - Heat (thermal burns, respiratory damage)
 - Smoke (particulate, vapor, and gaseous)
 - ◆ Effects include toxins and reduced visibility
 - Oxygen deprivation
- ◆ Products of combustion vary by fuel but always include CO



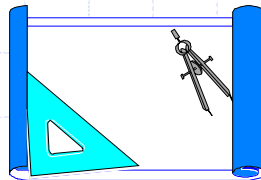
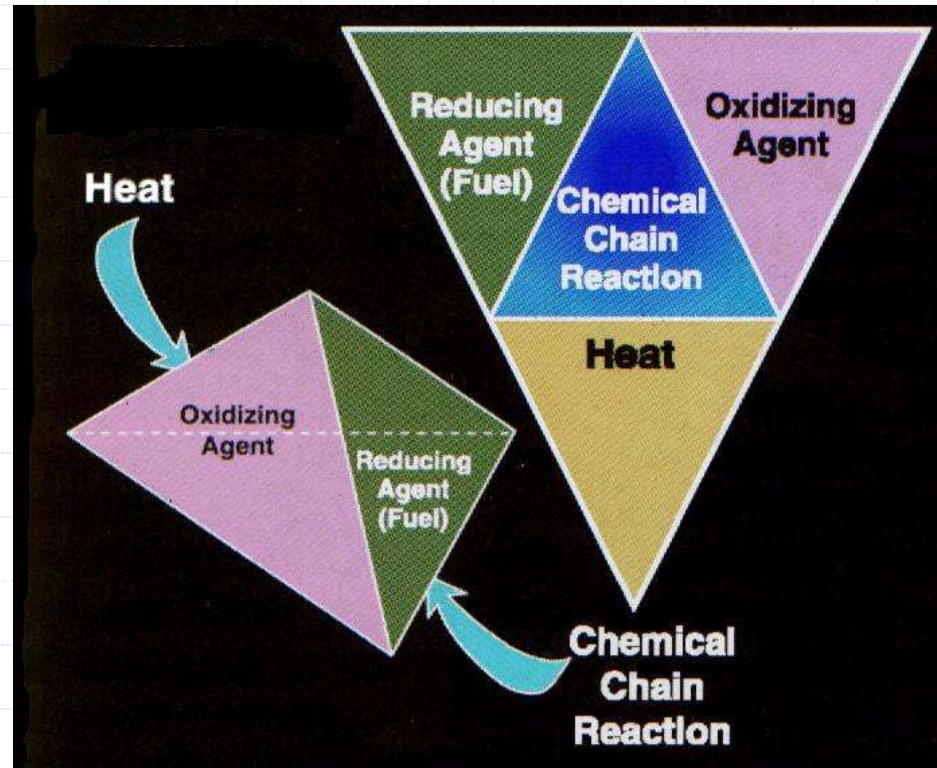
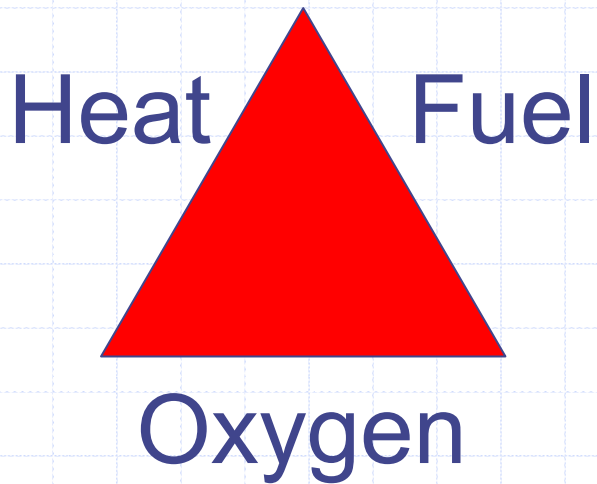
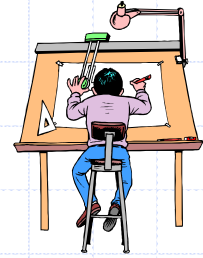
Fire Behavior – Fire Dynamics



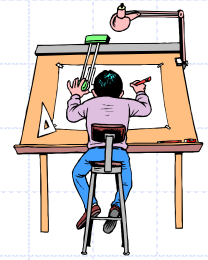
- ◆ Fire can be self limiting in common situations. Controlling Factors Are:
 - Available Fuel Supply (furniture, structure, other contents)
 - Available Oxidizer – Ventilated Fire or Unventilated Fire; Chemical Oxidizers
- ◆ Design, Construction and Occupancy can contribute to these limitations (types and continuity of fuels and oxidizers)



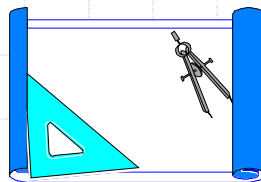
Fire Triangle or Tetrahedron



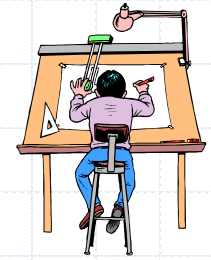
Heat Transfer



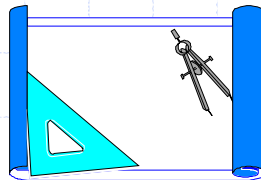
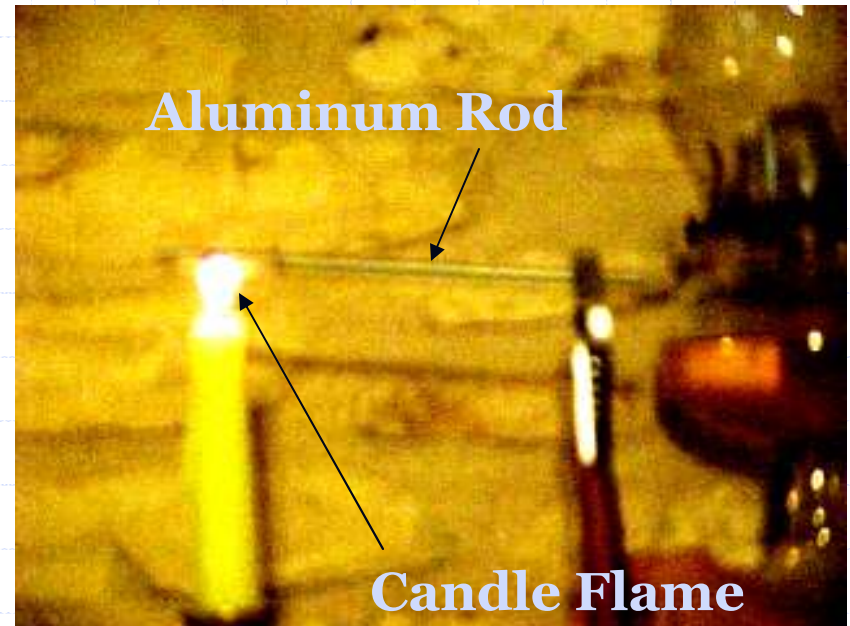
- ◆ Energy tends to move toward equilibrium – a body or material at a higher energy state will tend to transfer energy to a body (or bodies) at a lower energy state(s)
- ◆ Heat Energy is transferred from a warm or more energetic body to a cooler or less energetic body by one of three mechanisms
 - conduction, convection, or radiation



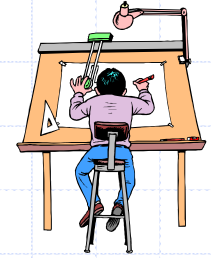
Simple Heat Transfer - Conduction



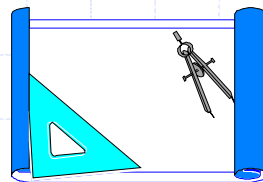
- ◆ Occurs when a body is heated as a result of direct contact with a heat source
- ◆ Primary cause for fire spread early in fires
- ◆ Fire spread by heating a pipe in one room and starting a fire in another room



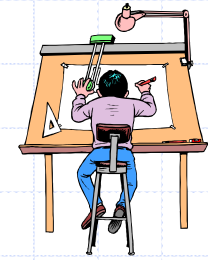
Simple Heat Transfer - Convection



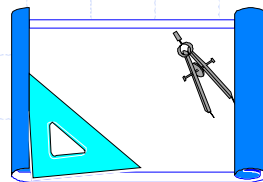
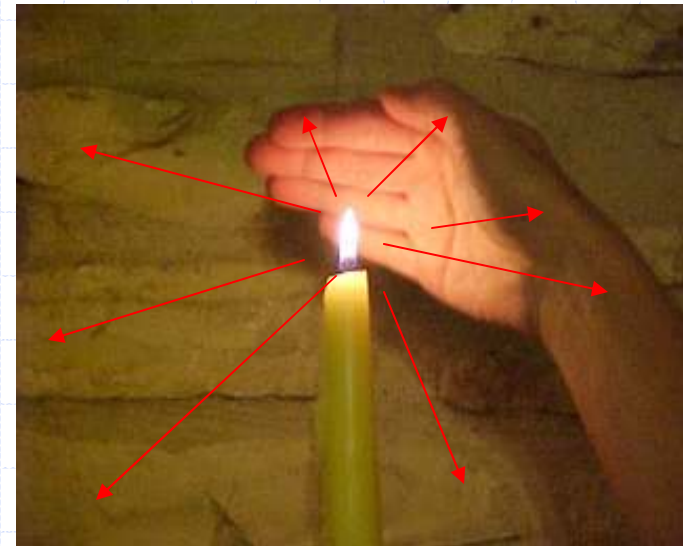
- ◆ Transfer of heat energy by movement of heated liquids or gasses
- ◆ Heat you feel when your hand is above a candle/match
- ◆ Produces thermal layering
- ◆ Also can cause fire extension between floors



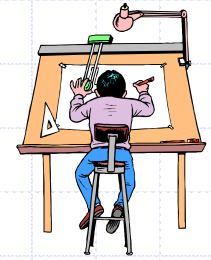
Simple Heat Transfer - Radiation



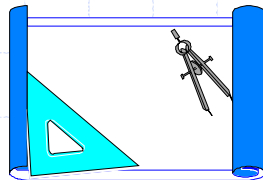
- ◆ Transfer of heat energy w/ only air as the intervening medium
- ◆ Holding your hand to the side of a candle
- ◆ Major problem. This frequently causes fire extension to other buildings



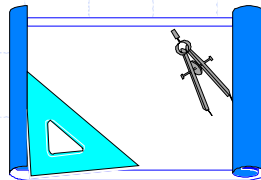
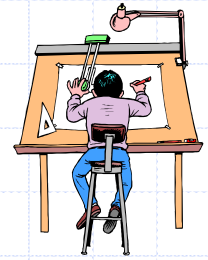
New Fire Safety Issues?



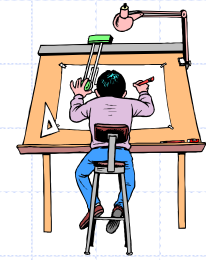
- ◆ I Believe Terrorism Now Should Be Treated As A Potential Event In the Life Span Of All Major Structures
- ◆ I Am No Longer Unusual In This Belief
- ◆ Delivery Of WMD Type Of Destruction Is Not Limited To Aircraft



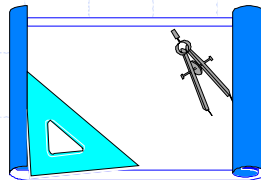
First High Rise Collapse Primarily Due to Fire



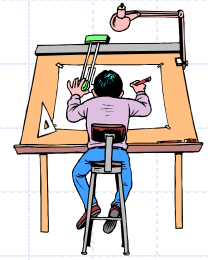
WTC – What Happened?



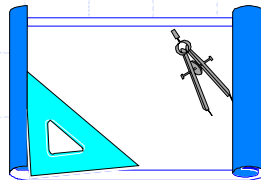
- ◆ Many “Experts” With Various Opinions
- ◆ Forensic Engineering
- ◆ Possible Contributing Factors
 - Fireproofing Issues
 - Load Distribution Realities and Changes
 - Exit Design and Arrangement
 - Fuels and Forces at Impact



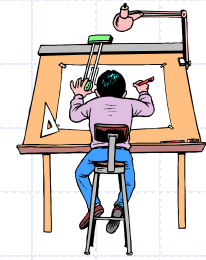
2009 Building and Fire Codes



- ◆ This is an overview of code changes and is not meant to be all encompassing
- ◆ If you have specific concerns or questions, feel free to call (contact information on the last slide)
- ◆ The goal is fire and life safety – not necessarily rigid “code compliance”

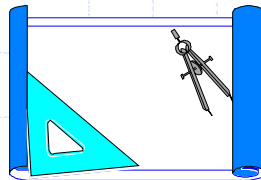


2009 Building and Fire Codes

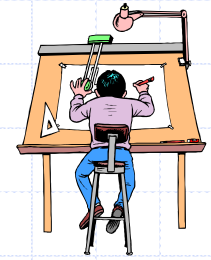


◆ New Buildings

- >120' Tall -> Fire Service Elevator
- >420' Tall (not R2) -> FF Access Stair
- >75' Tall -> Luminous Path Marking
- Support for Emergency Radio Communications
- Permitted use of elevators for emergency egress
- >75' Tall -> Remoteness or Separation of stair shafts and not just stair access

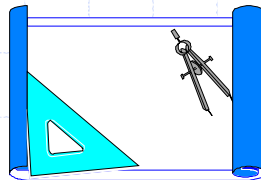


2009 Building and Fire Codes

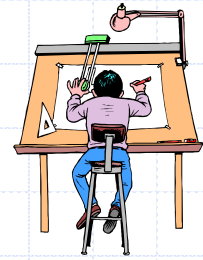


◆ New Buildings

- Impact resistant stair designs at $> 420'$ height
- $>75'$ Tall – increased bond strength for sprayed fire resistant materials
- $>420'$ Tall -> redundant sprinkler water supplies and sources
- Unprotected light weight construction marked to alert firefighters

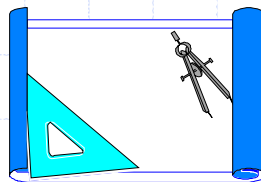


2009 Building and Fire Codes

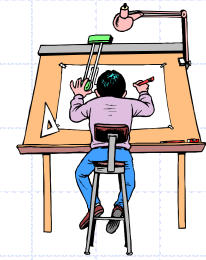


◆ Existing Buildings

- Unprotected light weight construction marked to alert firefighters
- >75' Tall -> Luminous Path Marking
- Support for Emergency Radio Communications (Likely only an issue for underground structures.)
- Exit Illumination for Assembly Occupancies

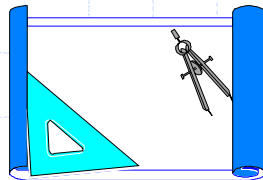


2009 Building and Fire Codes

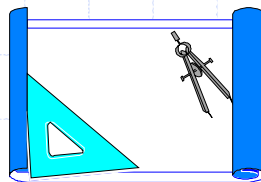
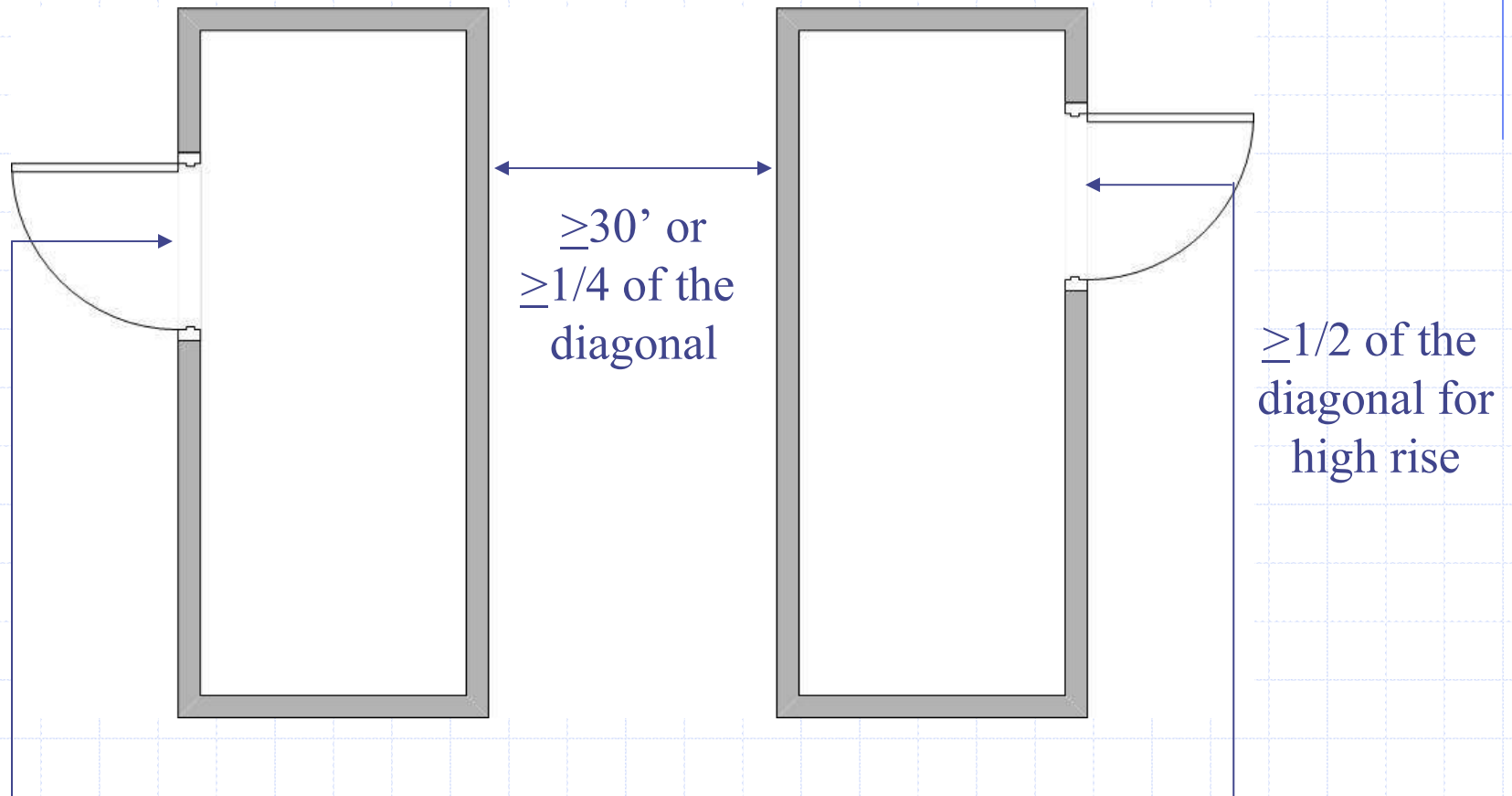
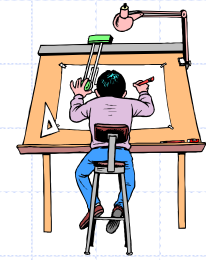


◆ Existing Buildings

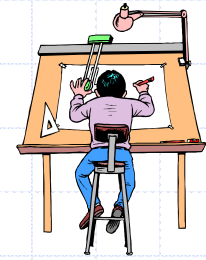
- Exit Illumination for Business Occupancies > 3 stories, with > 100 persons above/below exit discharge, total occupant load >1000
- Exit Illumination for F Occupancies With > 100 occupants
- Standpipes in Buildings >50' Above/Below Exit Discharge



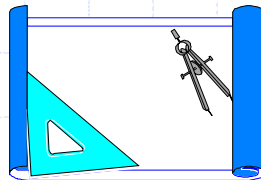
High Rise Exit Separation (New Buildings)



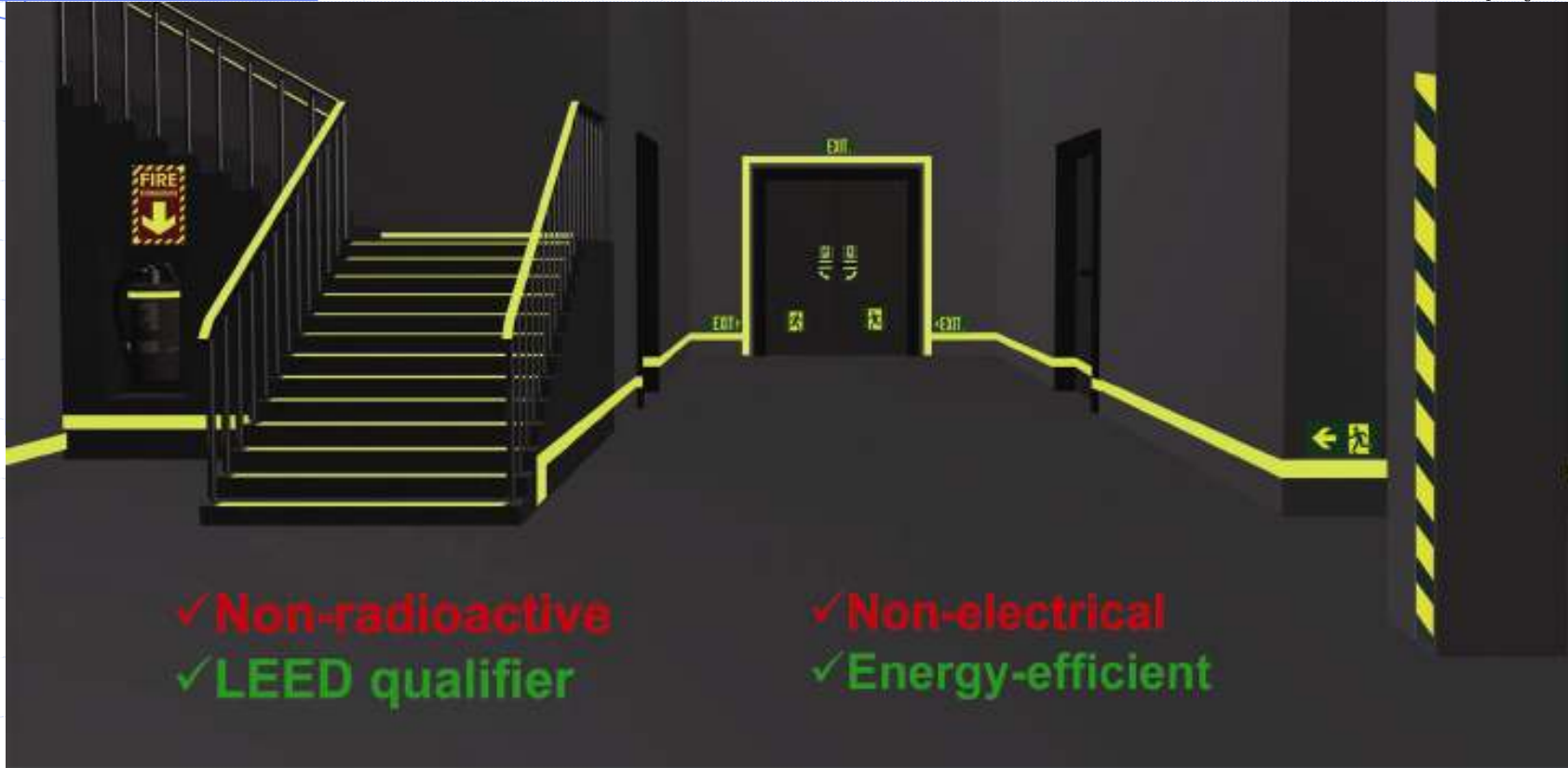
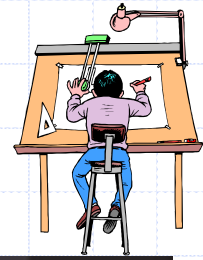
Sprayed Fire Resistant Coatings (New Construction)



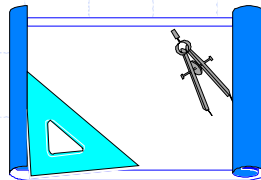
- ◆ The durability of fire resistive coatings addressed by increased bond strength



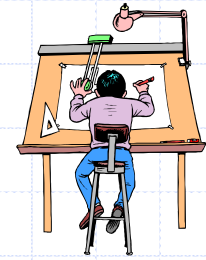
Luminous Exit Markings (All High Rise Buildings)



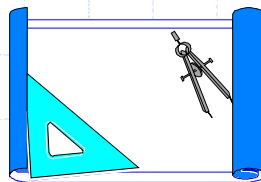
Graphic copyright: American PERMALIGHT® - used with permission



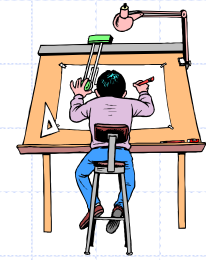
Standpipe – Existing Buildings



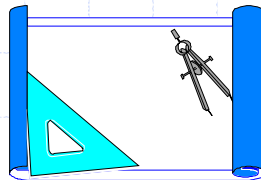
- ◆ Required when there is an occupied floor level < 50 feet above or below the level of fire department access
- ◆ Not likely to be a common problem – historically required for all buildings ≥ 4 stories tall



New Fire Safety Issues?



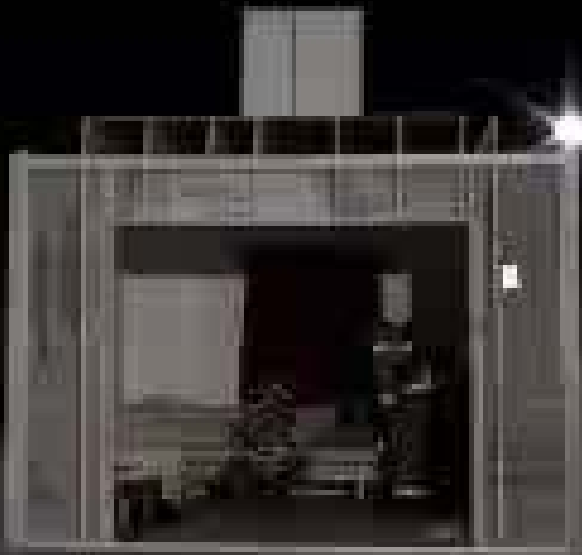
- ◆ We Live In And Work In Structures Different From That Of The 1960s – even the 1980s
- ◆ Engineered Structural Members Subject To Rapid Failure Without Warning (McDonald's, Basement Floor/Ceiling)
- ◆ Furnishings Have Higher Heat Release Rates (Workstations, Upholstery, Foams)



Comparison of Room Furnishings

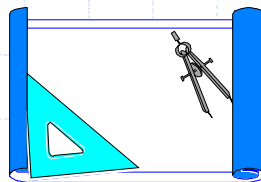
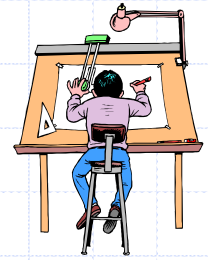
Legacy Room

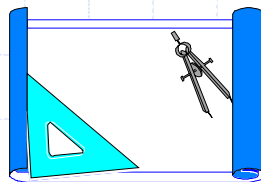
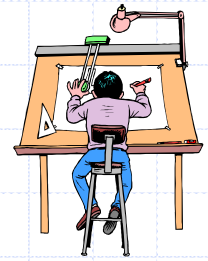
Modern Room



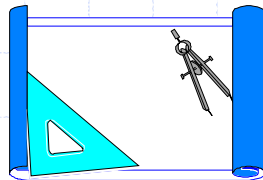
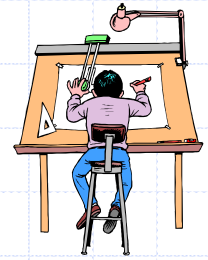
Underwriters Laboratories

00:00

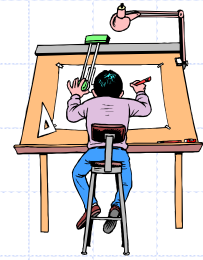




Unprotected Light Weight Construction – Address Marking



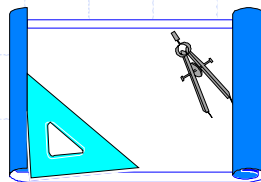
Unprotected Light Weight Construction – Address Marking



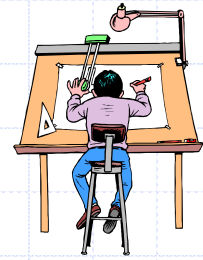
316.6 Unprotected Construction Presenting Hazards To Firefighters. Structures, regardless of occupancy, employing construction methods or materials that have been shown by experience or testing to be associated with early failure or failure with little or no warning under fire exposure shall be identified as potentially hazardous to responding firefighters by the premises identification in accordance with Section 505.3.

Exceptions:

1. Buildings protected throughout by automatic fire sprinklers in accordance with Sections 903.3.1.1, 903.3.1.2 or 903.3.1.3.
2. Buildings with a noncombustible or limited combustible membrane that shields the floor or roof construction materials from fire exposure. Such membranes may be constructed using gypsum wallboard of at least 1/2" nominal thickness, cementous fiberboard of at least 1/4" nominal thickness, or fire retardant treated wood (FRTW) of at least 1/2" nominal thickness.



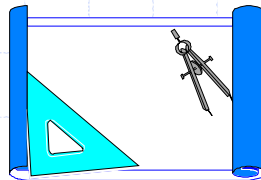
Unprotected Light Weight Construction – Address Marking



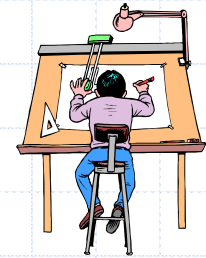
316.6.1 Unprotected Construction Presenting Hazards To Firefighters in Existing Buildings. When existing buildings, including residential structures, are identified as employing construction methods or materials that have been shown by experience or testing to be associated with early failure or failure with little or no warning under fire exposure, the premises identification markings shall be revised to achieve compliance with Section 505.3.

Exceptions:

1. Buildings protected throughout by automatic fire sprinklers in accordance with Sections 903.3.1.1, 903.3.1.2 or 903.3.1.3.
2. Buildings with a noncombustible or limited combustible membrane that shields the floor or roof construction materials from fire exposure. Such membranes may be constructed using gypsum wallboard of at least 1/2" nominal thickness, cementous fiberboard of at least 1/4" nominal thickness, or fire retardant treated wood (FRTW) of at least 1/2" nominal thickness.



What Are They Thinking?



The rule of thumb of the emergency services – risk versus benefit – risk (invest) a lot for a life (maybe even another life) – risk little for little gain

We cannot and will not eliminate all risk but high risk is a big risk/investment

