A Millennial View of Fire Suppression: 16 Years on

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A Walk Through History
Thesis

Fire safety is a benefit provided by a society using tactics, including fire suppression, whose nature reflects the cultural priorities of the era rather than being a force by itself.
Preserve the Fire
When Fires Began

- First vegetation ~350 million years ago
- Ignition by lightning strikes, volcanoes
Not How It Happened

Fire is Invented
First Hominids

- Appeared ~3 to 5 million years ago
- Nomadic
- Recognized destruction from and benefits of fire
- Tool for trapping food
- Made food easier to eat
- Provided warmth
- Stopped by rain
The First Fire Culture

- “Capture” fire
  - domestic
  - martial
- Effort was to sustain fire
- All people “learned” fire
- Occasional burns or loss of possessions
Cro-Magnon People

- Number of people and standard of living increased following the last glacial age
- Fire could now be started
- “Towns” formed
  - Arable land exposed and cleared by fire
  - Fire used to capture and keep livestock
  - Fire used to bake clay and work metal
As Thak worked frantically to start a fire, a Cro-Magnon man, walking erect, approached the table and simply gave Theena a light.
Early Civilization

- First written records, ~5000 years ago in Mesopotamia
- Little mention of fire
  - two types of pictograms
    - intentional (common)
    - destructive (solemn)
- No mention of fire hazard or prevention
  - Handling fire - basic skill
  - Housing not too combustible and well separated
Code of Hammurabi

- Oldest known written laws (~1780 BC)
- Reflects serious crimes of the era
- No mention of arson or fire prevention
- Theft of goods during a fire punishable
- Destruction by fire was not a severe threat to the community
- Only weapon, water, was limited
Preserve the Community
Rome

- First formal building code
- Official fire brigade (and private ones too)
  - patrols
  - buckets
  - aqueducts
- Little organized fire control outside the city
- Over 40 conflagrations between 31 BC and 410 AD
Pre-industrial Europe

Numerous major urban fires

- London, 1212
- Venice, 1514
- London, 1666
- Rennes, 1720
New Technology

- Late 1600s: invention of the rollable fire hose
- 1725: pump design that could use this to deliver water faster and further
- Buckets and hand pumps still the main weapons

But now:
- Arson considered second only to murder
- Penalties for delays in sounding the alarm
Bringing Water by Hand
Large City Fires

- New York, 1835
- Hamburg, 1842
- Newcastle, 1854
- Chicago, 1871

- Life and property loss increased
Automatic Sprinkler

- Steam engine invented (1769)
- Steam-driven perforated pipe system (1812)
  - fusible link
  - self-opening valve
- New way to bring water to the fire
Self-propelled Fire Engine (1852)
San Francisco Fire (1906)

- “Last” major urban conflagration
  - less flammable construction
  - spreading of housing
  - improved fire fighting technology and procedures
Where Were We?

- 3 million years of hominid existence
- Water still the predominant fire suppressant
- Societal need + technology: save cities and structures, some people
- Next: save contents and people
- Lots to happen in next few years
Preserve the Property
Preserve the People
The First (Pre-)halon

- Cheap chlorine (early 1900s)
- $\text{CCl}_4$ (halon 104)
- 1st clean suppressant
- Used in grenades and pumps
- Toxicity concern
- Used into 1950s
More Halons

- CH$_3$Br (halon 1001) developed in 1930s
  - more toxic than CCl$_4$
- Germany developed CH$_2$ClBr (halon1011) in 1940s
- Army coined name “halon” in 1940s
  \[ C_a F_b Cl_{c} Br_{d} I_{e} \]
- Many tested at PRF in late 1940s
  - CF$_3$Br (1301) - total flooding
  - CF$_2$ClBr (1211) - directed application
Powders

- NaHCO$_3$ + Mg stearate (early 1900s)
  - efficient on liquid fires
  - not clean
  - not toxic
- Efficiency increased with decreasing particle size (1940s)
- KHCO$_3$ twice as effective
- Other salts examined but not as widely used
Where Were We?

- Little hands-on familiarity with safe use of fire
- Fire protection thus provided as part of the societal contract
- Societal values and technology: preserve people, property, buildings
Preserve the Environment
Stratospheric Ozone Depletion
Average global temperature in 1998 was higher than it has been for 1,000 years.
Groundwater Pollution

- Water applied to fire drains to ground
- Contaminated with fire byproducts
- Can contaminate water supply, streams
Fire Retardant Chemicals

- Added to products to reduce fire ignitions and burning rate
- Migration, persistence and toxicological issues for some of these
- Being restricted
Where Were We?

- Global threats identified
- New fire safety paradigm
  - prior: local fire safety bounds
  - now: world protection first
- Values: preserve environment; then people, property, buildings
Preserve Fire Safety
How Big is Fire?

- Extrapolated world fire costs and losses
  - ~ 100,000 lives
  - ~ 2 million serious injuries
  - ~ $200 billion property loss
  - > $2 trillion total cost
Fire Safety in Perspective

- Not a global issue like the environment, war, and food
- Expectation of government solutions to these
- Little recognition of fire cost magnitude
  - success at localizing the problem
  - fires exist and are put out
Forces in Motion

- Performance-based codes
- Integrated information & alert/actuation systems
- New fire protection technologies

- Tighter constraints (environment+)
- Compromise on harmonized product standards
- Increased fuel loads
- Limited implementation budgets
- Older population
Predictions - 2100

- Fire losses down worldwide
  - Wider adoption of building codes
  - Broader implementation of existing technologies
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- U.S. use of fire suppression
  - Residential: No major trends
  - Commercial:
    - Intelligent use of (less) water
    - Lower GWP suppressants
Ponder This