National Construction Safety Team Technical Investigation: The Station Nightclub, W. Warwick, RI

William Grosshandler

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

Overview

Where and what

- Station Nightclub, West Warwick, RI
- pyrotechnics ignited wall covering on stage
- rapid spread of flames and smoke
- captured on WPRI-TV video
- main entrance became blocked by people trying to escape
- 100 fatalities

Timing

- fire occurred 2/20/03
- NIST reconnaissance team on site 2/22/03
- report back to NIST director 2/25/03
- NCST established 2/27/03
  - W. Grosshandler, Chief, Fire Research Division, NIST (Lead Investigator)
  - N. Bryner, Leader, Fire Fighting Technology Group, NIST
  - D. Madrzykowski, Fire Fighting Technology Group, NIST
  - K. Kuntz, Fire Studies Specialist, FEMA/USFA
  - *C. Porreca, Boston Group Supervisor, Arson/Explosives, (ATF Liaison)*

Rationale to form Investigative Team

NIST Authorized by Act to assess building performance and emergency response and evacuation procedures in wake of building failures that result in high number of casualties:

- 100 people died in fire (one-in-three occupants)
- Rapid spread of fire and smoke requires technical investigation to determine how the life safety features of building may have impacted egress
- Depending upon findings, potential exists to mitigate future building failures like this with changes in building practices and/or building standards, codes, and regulations
- Technical competencies required for successful investigation are available at NIST and its community of collaborators
- Funds on hand are sufficient to conduct an investigation

Working with Local, State and Federal Officials

- MOUs established with other federal agencies, including ATF (description of role of ATF to be given by ***Chris Porreca***)
- MOU being discussed with National Association of State Fire Marshals (NASFM) to establish generic protocols
- Investigative priority relinquished to criminal investigation being conducted by RI Attorney General's office
- NCST investigation being conducted independently of criminal investigation

Evidence Repository

Warehouse

- materials removed from fire scene
- civil litigation evidence
- approximately 717 items (includes item held at NCST request)

Access efforts are on hold pending federal court's resolution of jurisdictional issues in civil action; NCST hopes to benefit in future from evidence in repository

Update on Specific Tasks

1. Establishment of initial conditions
2. Materials testing
3. Reconstruction of thermal and tenability environment
4. Determination of occupant behavior and egress
5. Documentation of emergency response
6. Examination of the impact of sprinklers on survivability
7. Identification of building and fire codes that warrant revision

1. Establishment of Initial Conditions

Documentation Acquired/Required

- Construction drawings on file for building
- Fire alarm system plan with type of heat detectors and location
- Recent photographs or videos of inside and outside of the building prior to fire

Geometry (75% established)

- Dimensioned Floor Plan
- Vent locations, doors, windows, and HVACDoor locations
- Ceiling height above stage and in sunroom (configuration and construction)

Materials and Building Contents (20% established)

- Ceiling Tiles – wood fiber based or non-combustible?
- Wall Lining – fraction covered by wood panel and fraction covered by foam?
- Sample of an acoustic foam for small scale tests on heat release properties
- Was more than one type of "foam" used; i.e. rigid foam as opposed to the flexible "egg crate" foam?
- Was foam painted or treated in any way?

2. Materials Testing

Objectives:

- Develop source term data for modeling
- Assess material burning behavior to determine a correlation to the materials in the nightclub

Current Approach:

- Cone Calorimeter
- Corner Experiments
- Ignition Experiments
- Compartment Experiment

Future Considerations:

- Comparative Experiments with actual samples from scene

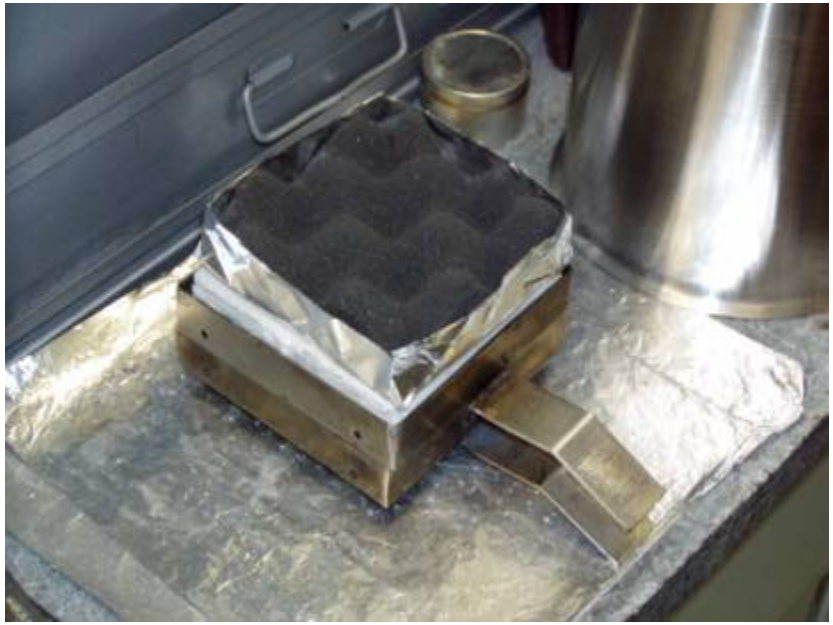
Cone Calorimeter Experiments

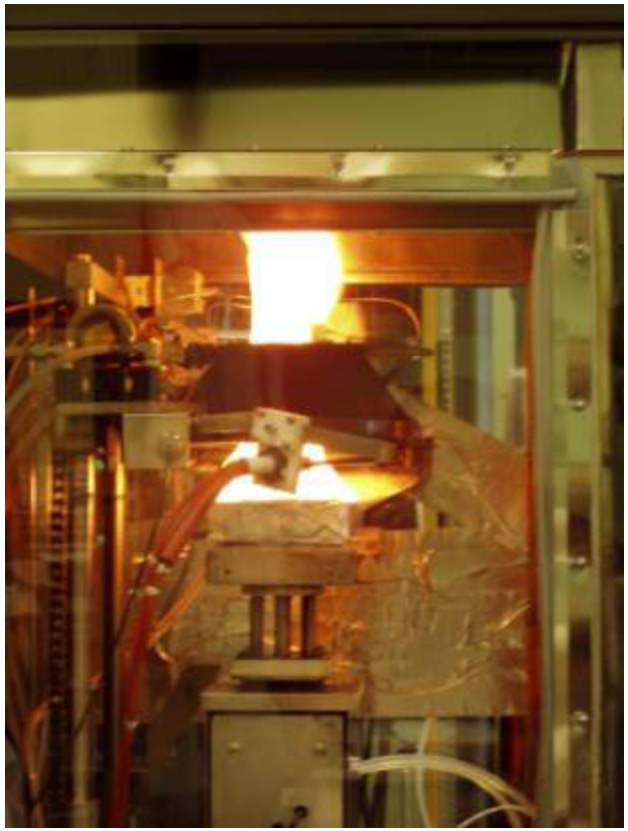
3 types of convoluted foam have been tested

2 – ether based polyurethane foams

1 – ester based FR polyurethane foam

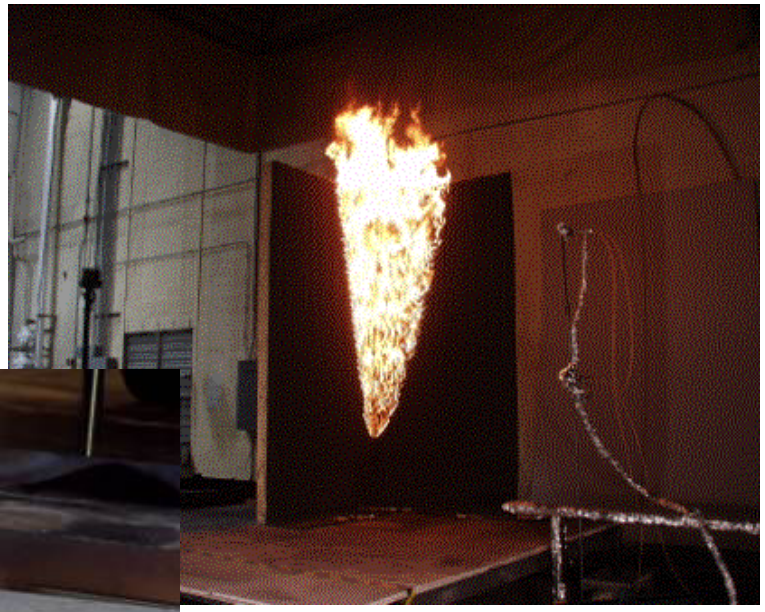
Incident Heat Flux: 35 and 70 kW/m^2





Panel Experiments

Small flame ignition
Inside and outside corner configurations
Measuring HRR, mass loss and heat flux



Pyrotechnics

"Gerbs"

- White color
- 15 second duration
- 15 foot Throw

Examine ignition properties

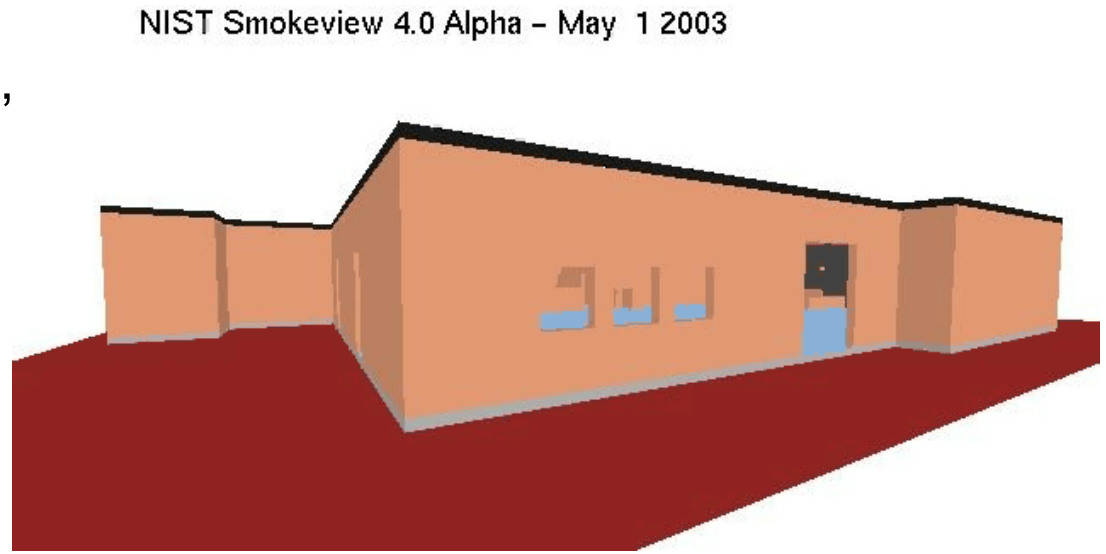
Plan to measure heat flux to surface

3. Reconstruction of Thermal and Tenability Environment

Construction

- Similar dimensions to stage area of nightclub (~ 36 ft x 24 ft x 13 ft high)
- Convoluted non-fire retarded polyurethane foam, plywood paneling
- Carpeted stage & drummer's platform, gypsum ceiling over dance floor area

Measurements: Temperature, CO, CO_2, O_2, HCN, Heat Flux, Heat Release Rate



4. Determination of Occupant Behavior and Egress

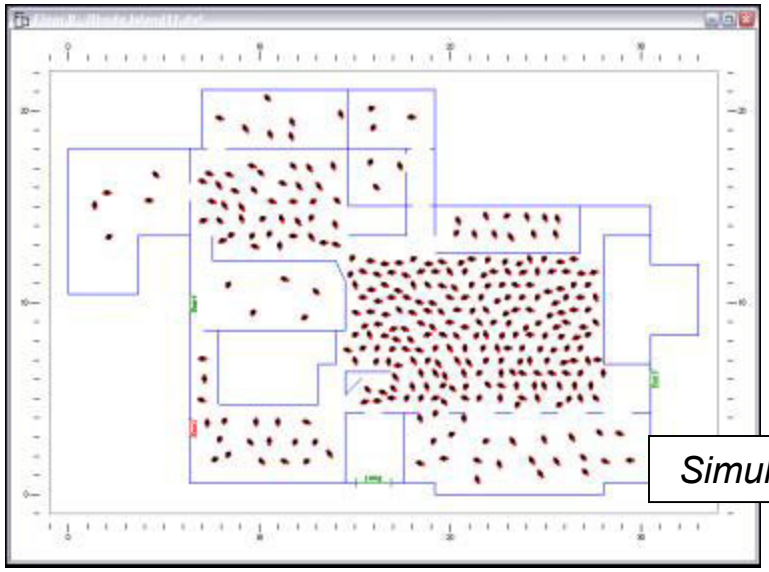
Objective: to better understand impediments to safe egress encountered by occupants

- Comparison of life safety features in structure with requirements from the Life Safety Code.
- Egress of occupants calculation using simple hydraulic-type models as well as more complex behavior-based models to compare to tenability predictions from FDS.
- Examination of parameters that affected egress, including hazard recognition and response, location and identification of exits, condition of exits, and changing conditions inside structure (i.e. smoke and heat build-up, loss of lighting)

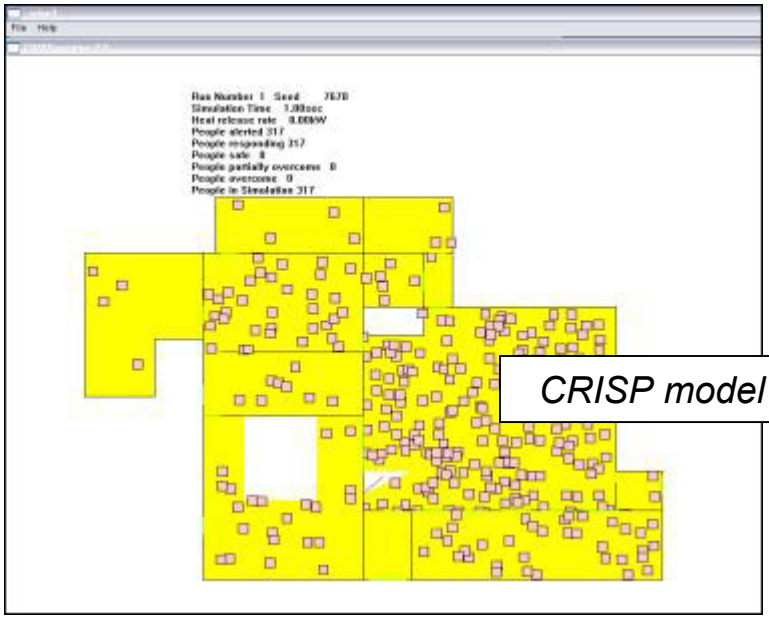
Preliminary Evacuation Calculations

Three evacuation models used in analysis

- Simulex
- CRISP
- EVACNET4



Simulex model



CRISP model

Preliminary Evacuation Calculations

Two hypothetical occupancy rates examined:

- **317** people; tables, chairs removed from 3 lounge areas
- **404** people (fire warden present); tables, chairs removed

2 different egress scenarios:

- All four exits available for use in evacuation
- 90% of occupants travel to front exit (familiar route); other 10% (staff) use all 4 exits

Results:

- All four exits available, 317 people: 100 – 128 seconds
- All four exits available, 404 people: 150 seconds
- 90% occupants to front exit, 317 people: 270 seconds
- Prediction of doorway pile-up beyond capability of all current models

Solicitation for Egress Study

Solicitation announced for experts to

- help document egress events (including building timeline from video and photographic records, field data, interviews conducted by the media, and other oral and written accounts from building occupants, emergency responders, and other witnesses);
- help document role of life safety features in the structure in assisting safe egress; and
- compare/contrast egress process and outcome to other similar events.

5. Documentation of Emergency Response (USFA lead)

Collect emergency response data in cooperation with local fire department to document procedures and operation of equipment; identify successful operations and technical difficulties.

6. Impact of Sprinklers on Survivability

Impact on survivability will be examined had sprinkler system been installed, all other conditions being the same.

7. Building and Fire Codes that Warrant Revision

- **Solicitation announced for experts to**

(1) review national model building and fire codes that would have governed the building design, construction, and modification of structural and fire safety systems;
(2) identify substantive and relevant differences, if any, among these historical requirements and provisions of current national model building and fire codes; and
(3) document practices and procedures used for the operation, maintenance of and modifications to structural and fire protection systems.

- **Team to recommend specific areas for improvement in model building and fire codes, standards and practices (as warranted) based upon technical findings from all tasks, possibly including**
  - **areas covered by Tentative Interim Amendments (TIAs) to NFPA 101-2003**
    - sprinklers in clubs with occupant loads > 300
    - crowd managers and staff training for occupant loads > 250
    - prohibit festival seating without approved life safety evaluation
  - **the role of the phenomenon of crowd-crush on minimum number and size of exits**
  - **guidance on inspection practices and design-in-depth for safety systems**