



Building and Fire Research

at the
National Institute of Standards and
Technology

Standards in Trade Workshop for China on Fire
Protection for the Built Environment

September 21, 2004

Dr. S. Shyam Sunder
Acting Deputy Director

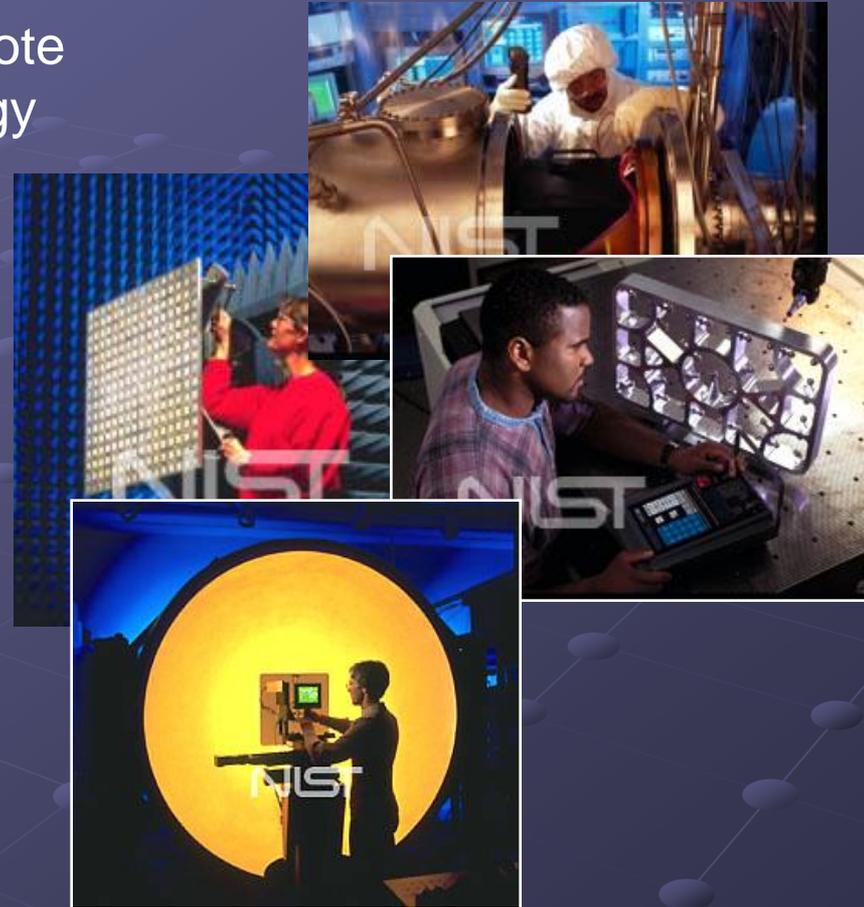


NIST: A Unique Mission and Assets

NIST's mission is to develop and promote measurement, standards, and technology to enhance productivity, facilitate trade, and improve the quality of life.

NIST Assets Include:

- 3,000 employees
- 1,600 associates
- \$825 million FY 2003 operating budget
- NIST Laboratories
- Advanced Technology Program
- Manufacturing Extension Partnership
- Baldrige National Quality Award



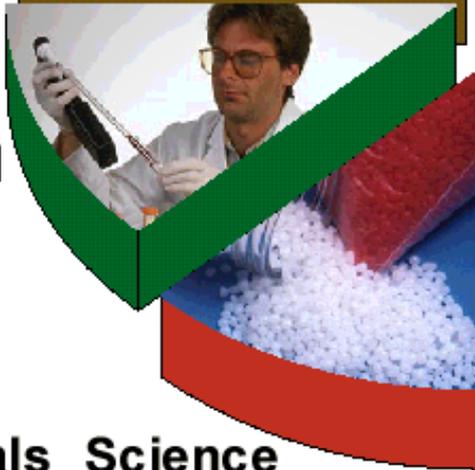
NIST's Intramural Laboratories

**Manufacturing
Engineering**

**Building and
Fire Research**

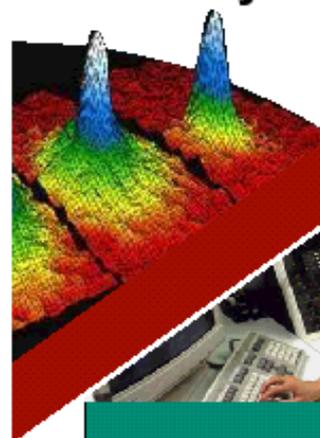


**Chemical
Science and
Technology**



**Materials Science
and Engineering**

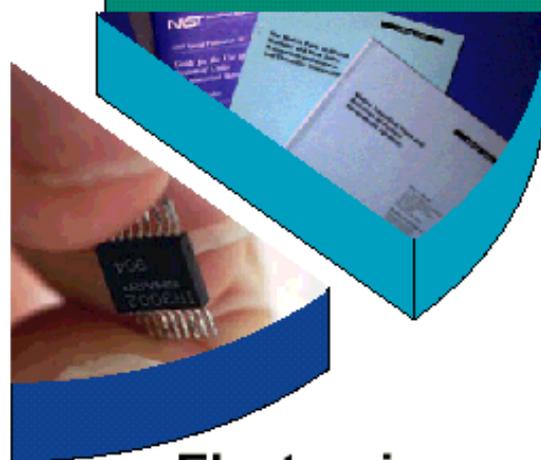
Physics



**Information
Technology**



**Technology
Services**



**Electronics and
Electrical Engineering**

World Renowned Scientists and Engineers



Bill Phillips
1997 *Nobel Prize in Physics*



Gregory Linteris
Flew 2 Space Shuttle Missions



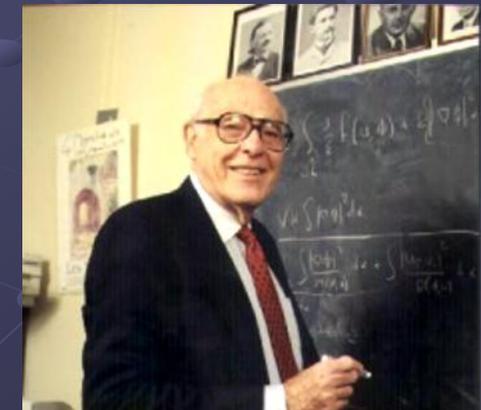
Johanna Sengers
2003 *Women in Science Awards and NAS Member*



Eric Cornell
2001 *Nobel Prize in Physics*



Deborah S. Jin
2003 MacArthur Fellowship '*Genius Grant*'



John Cahn
1998 *National Medal of Science*

Building and Fire Research Laboratory Goals

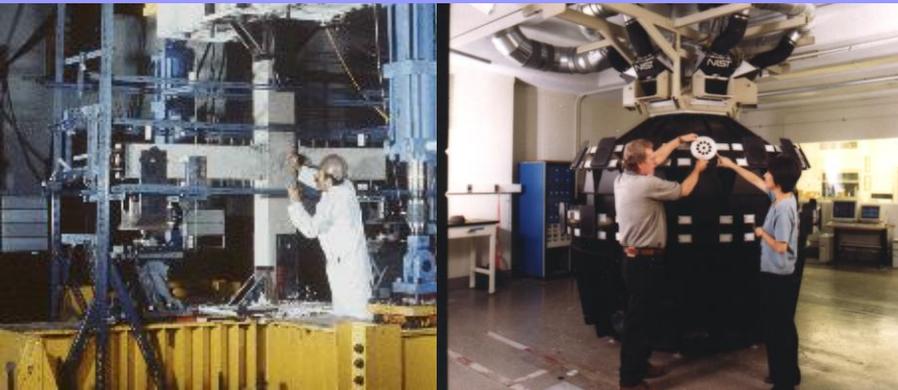
Homeland Security



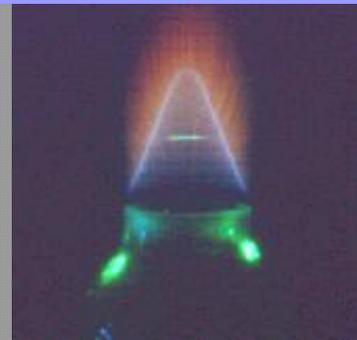
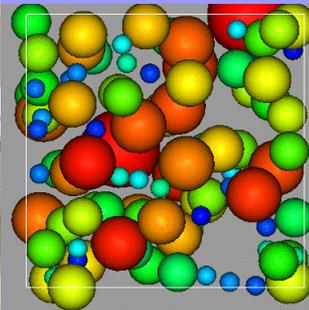
Enhanced Building Performance



High-Performance Construction Materials and Systems



Fire Loss Reduction



BFRL at a Glance

BFRL Mission

Meet the measurement and standards needs of the building and fire safety communities.

BFRL Vision

The source of critical tools - metrics, models, and knowledge - used to modernize the building and fire safety communities.

Key Facts

155 full time staff (126 professional)

\$44 million annual budget

Unique facilities including:

Integrating Sphere UV exposure chamber; Tri-directional test facility; 12 million pound testing machine; Solar tracker; Large scale fire test facility; Environmental chambers

The Nation's federal civilian laboratory dedicated to building and fire safety

BFRL at a Glance

BFRL Goals

High Performance Construction Materials and Systems: to enable scientific and technology-based innovation to modernize and enhance the performance of construction materials and systems.

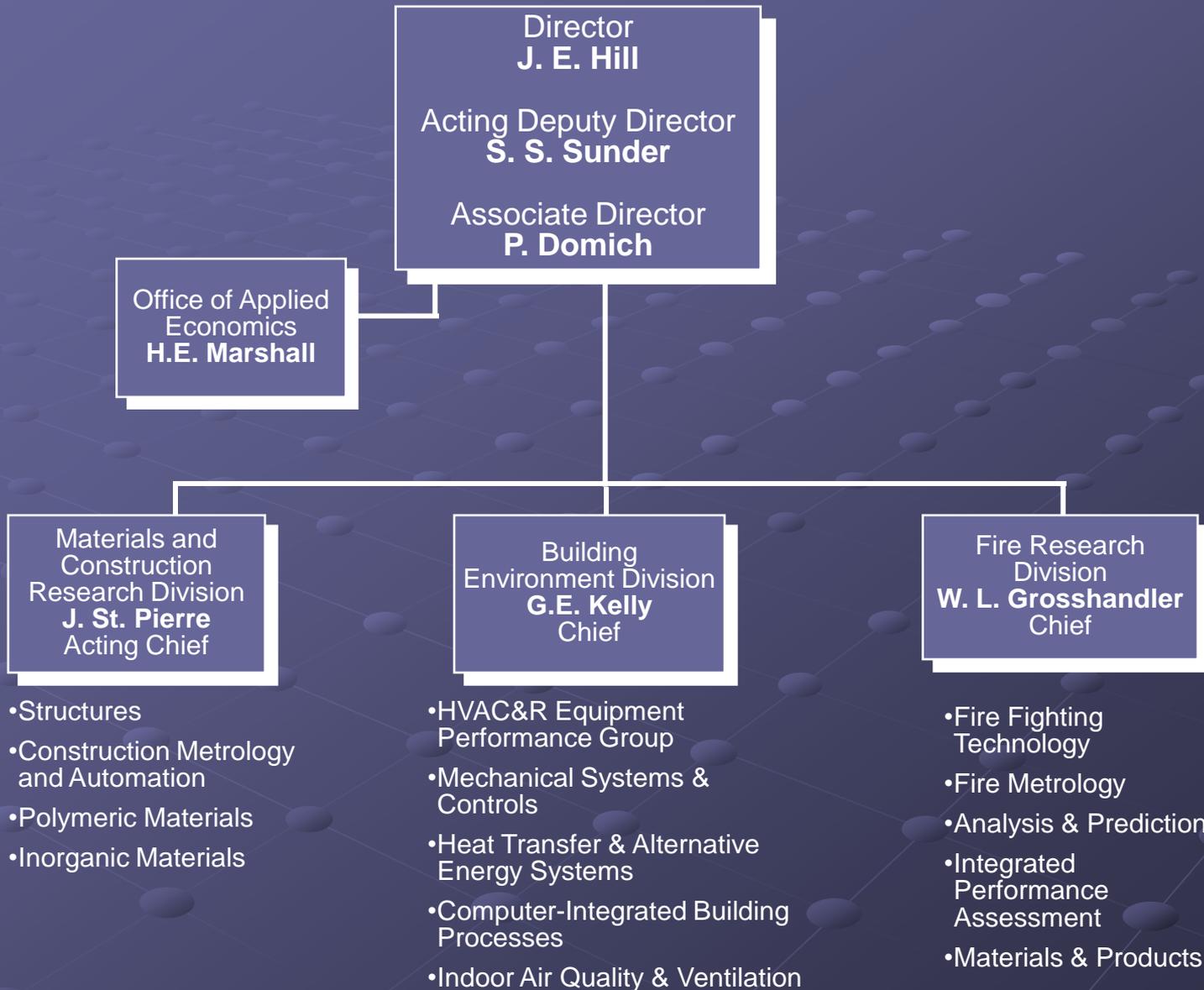
Enhanced Building Performance: to provide the means to assure buildings work (better) throughout their useful lives. The strategy for meeting this goal is to provide knowledge, measurements and tools to optimize building life cycle performance.

Fire Loss Reduction: to enable engineered fire safety for people, products, and facilities; and enhance fire fighter effectiveness.

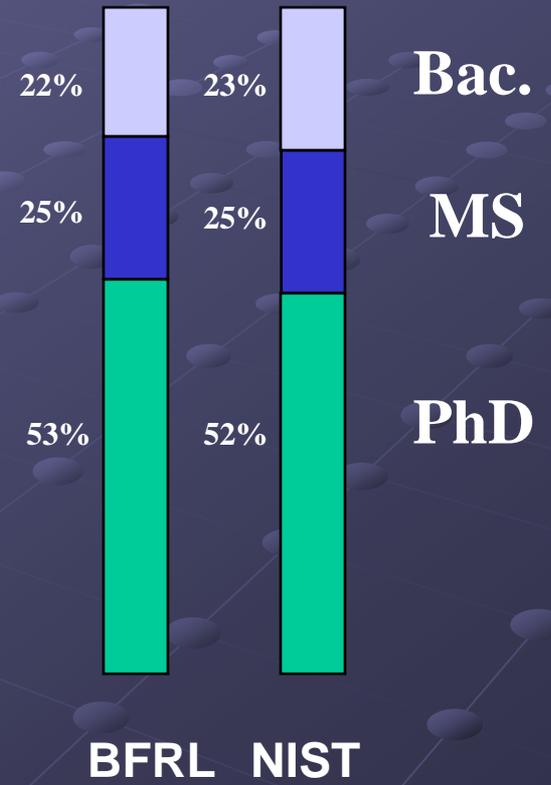
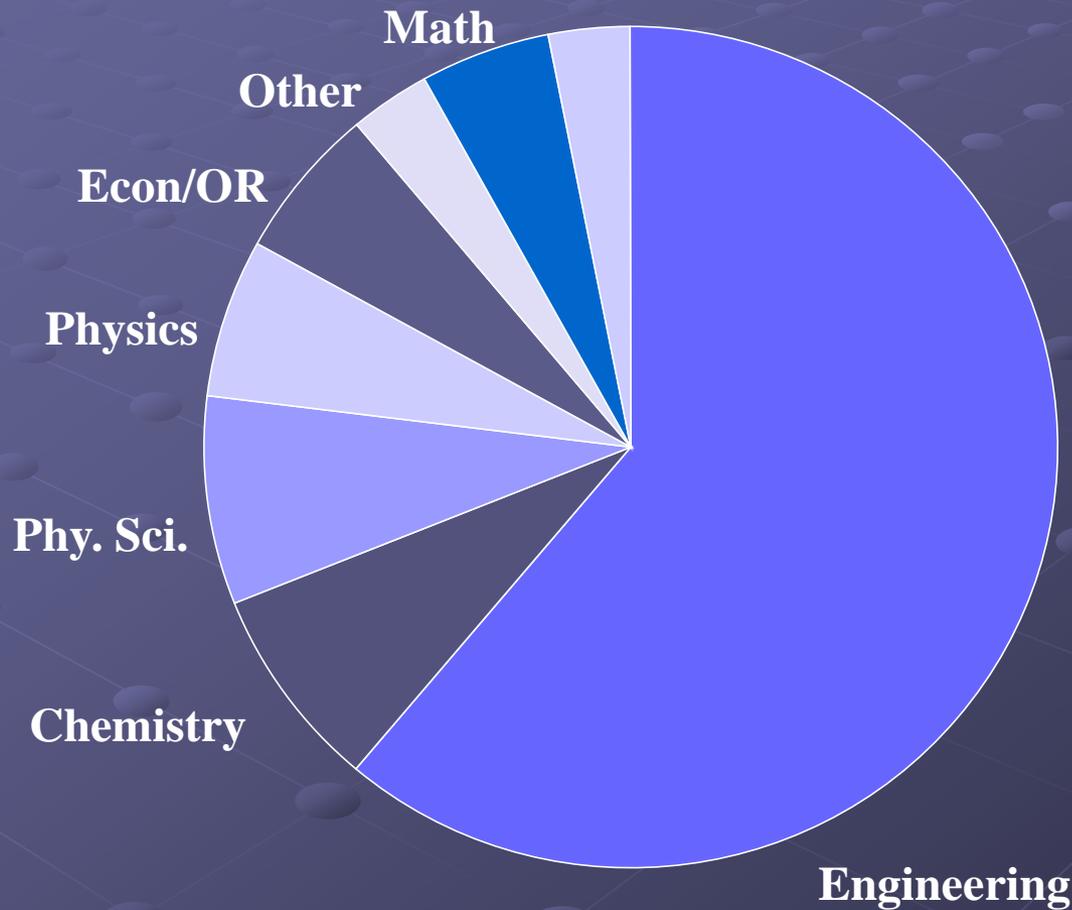
Homeland Security: to develop and implement the standards, technology, and practices needed for cost-effective improvements to the safety and security of buildings and building occupants, including evacuation, emergency response procedures, and threat mitigation.

Our programs are identified, developed, carried out, the results implemented, and consequences measured in partnership with key customer organizations.

BUILDING AND FIRE RESEARCH LABORATORY ORGANIZATION



BFRL Professional Staff



A Few Historical Contributions

- Fire Hose Coupling standards.
- First model zoning ordinance.
- Fire Resistance tests, Time Temperature Curve. ASTM E119.
- Calculation of compounds in Portland Cement, R.H. Bogue.
- From 2x6's to 2x4's in the 1940's.
- Performance concept for standards and codes.
- Disaster investigations: San Fernando Earthquake, Kansas City Skywalk, ...
- HUD's "Operation Breakthrough."
- ASHRAE Standard 90: Energy Conservation in Buildings.
- Flammable fabrics.
- Residential smoke detectors UL 217.
- Guarded hot plate for thermal insulation.
- Fire Safety Evaluation Systems in NFPA Life Safety Code.
- BACnet standard for open systems integration of building systems.
- Sponsorship of FIATECH and the Capital Projects Technology Roadmap, (see www.fiatech.org).

How NIST products get into use in building practices, standards and codes.

- NIST *listens* to major national bodies to identify priority issues.
- NIST *organizes* workshops to define problem, approach and desired products.
- NIST and its partners *develop technical basis* for potential change to practice, standards or codes, typically in form of measurement, test method, performance prediction tool, etc.
- NIST generally, seeks *performance-based tools* and to foster open systems and processes, thus facilitate innovation and competitiveness.
- NIST participates in *international standardization* activities and works closely with overseas counterparts to maintain awareness, push open systems, spot barriers to trade.
- NIST works with intended users to *demonstrate value in use* of the emerging product.
- NIST *participates* in technical standards committees, and publicly disseminates NIST product.
- National professional, engineering, standards or code developing organizations adopt.
- Key players we are working with on the WTC Response are listed on a later slide.

Total cycle times vary from months to decades

National Construction Safety Team Act

PL 107-231

- Authorizes Director of NIST to launch teams, when practicable, within 48 hours of building failures.
- Tailored to events involving substantial loss of life or that posed significant potential for substantial loss of life – e.g., extreme natural events (earthquakes, hurricane, tornado, flood, etc.), building fires, failure during construction or in active use, act of terrorism, Presidential disaster declaration, activation of National Response Plan
- Modeled by Congress after NTSB: establishes national capability to investigate major building failures that has not previously existed.
- Fills void, broadly supported, will facilitate beneficial changes in practice, standards and codes.
 - NIST is the designated lead agency to assess:
 - Building performance
 - Emergency response
 - Evacuation procedures
 - Authorities include...
 - Entry/Inspection, Collection of evidence
 - Subpoena, Briefings, Hearings, Witnesses
 - Priority (except for NTSB and criminal acts)

**BPAT
Recommendations**

**Govt.
Industry
Professional
Academic
Inputs/Actions**

**Public
Inputs/
Efforts**

**WTC
Investigation**

**WTC
Response Plan**

**Research &
Development**

**Dissemination
and Technical
Assistance Program**

**Guidance and Tools for
Improved Practices**

**Technical Basis for Improved
Building and Fire Codes
and Standards**

**Owners, Contractors, Designers,
Emergency Responders and
Regulatory Authorities**

**Standards and Code Development
Organizations**

WTC Investigation Plan

BPAT
Recommendations

Government
Industry
Professional
Academic
Inputs/Actions

Public Inputs/
Efforts

Identify
Technical
Issues &
Major
Hypotheses

**Objective 1: How WTC
buildings 1, 2, & 7
collapsed**

**Objective 2:
Procedures and practices
used in design, construction,
operation, and maintenance of
WTC Buildings**

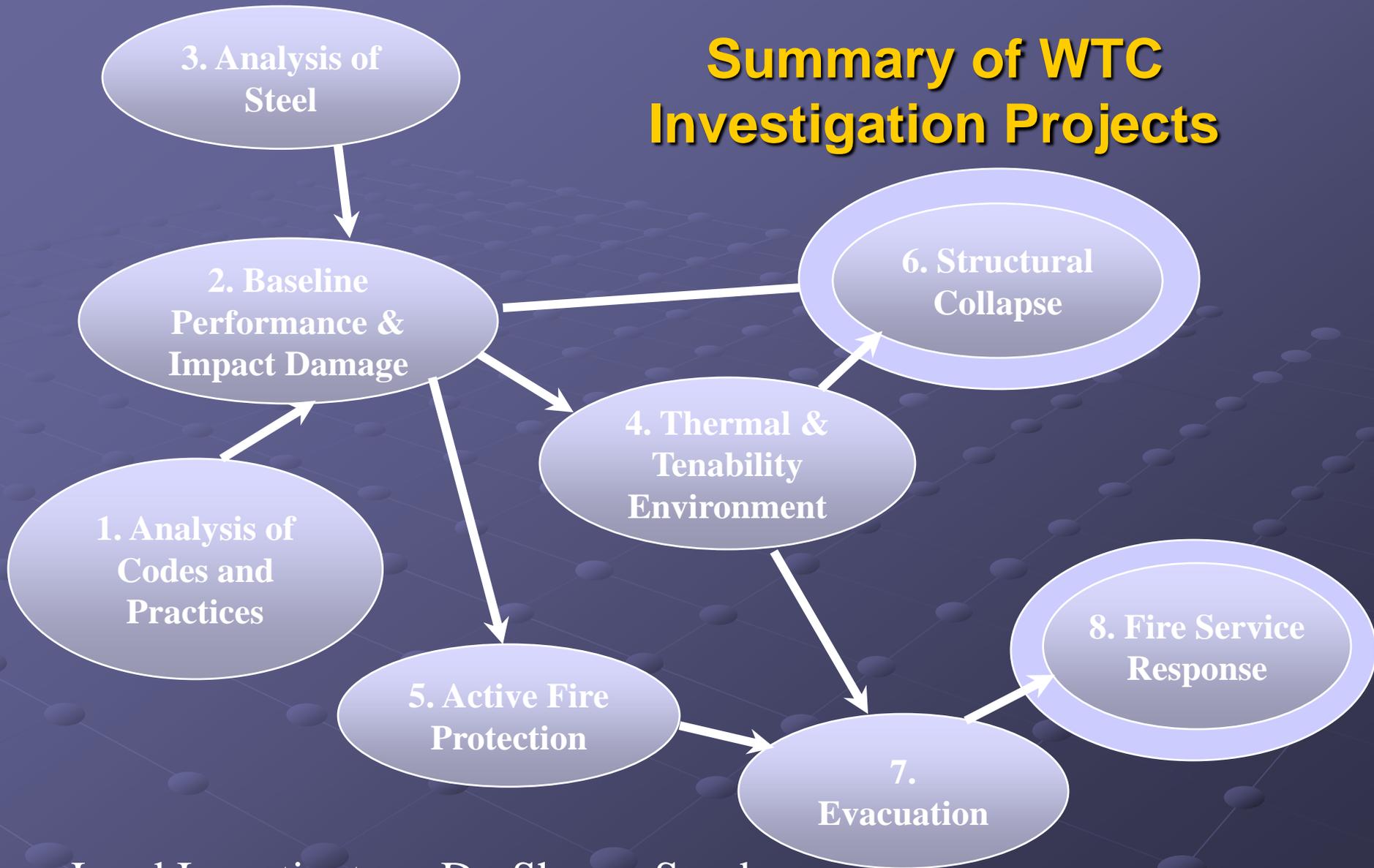
**Objective 3: Role of location on
injuries and fatalities**

**Objective 4:
Building codes,
standards, and
practices that
warrant revision**

Technical
findings and
recommendations

Dissemination
& deployment
of findings
via R&D and DTAP

Summary of WTC Investigation Projects



Lead Investigator - Dr. Shyam Sunder

Safety of Threatened Buildings R&D Program

Objective: To provide a technical foundation that supports improvements to codes, standards, and practices that reduce the impact of extreme threats to the safety of buildings, their occupants and emergency responders.

Major Outcomes:

- **Increased Structural Integrity**
- **Enhanced Fire Resistance**
- **Improved Emergency Egress & Access**
- **Building & Emergency Equipment Standards & Guidelines**

Safety of Threatened Buildings R&D Program

Increased Structural Integrity Enhanced Fire Resistance



Prevention of Progressive Collapse

To develop and implement performance criteria for codes and standards, tools, and practical guidance for prevention of progressive structural collapse.



Fire Safe Building Structures

To develop and implement verified and improved standards, tools, methodology and guidance for the fire safety design and retrofit of concrete and steel structures.

Fire Protective Coatings for Structural Steel - Predictive criteria for selection of fire protective coatings to accelerate development of materials with reduced vulnerability to extreme events.



Fire Resistance of Uncoated Structural Steel - Develop efficient test method for evaluating fire resistance of steel; Benefits of FR steel not adequately tested under ASTM E119

Fire Resistance of Building Partitions

Technical basis for accurate measurement & prediction methodologies for inclusion of fire resistance properties of walls, floors & ceilings in performance-based fire safety design

Safety of Threatened Buildings R&D Program

Improved Emergency Egress & Access

Occupant Behavior and Egress
Reliable predictions of time to egress

Emergency Use of Elevators
Technical and procedural means to allow use of elevators during emergencies for evacuation of occupants with disabilities from, and for first responder access to, high rise buildings



Building & Emergency Equipment Stds & Guidelines

Equipment Standards for First Responders - Technologies that enhance building information transfer to support informed fire fighting decisions

Standard Information Models
Standard building information models that facilitate simulation of building system behavior during adverse events

Technologies for Building Operations in CBR Attacks - Analysis tools and guidance for assessment and subsequent reductions in vulnerability of buildings to CBR attacks

Cost-effective Risk Management Tools
User-friendly tool for building owners/managers to aid in selection of cost-effective strategies for management of terrorist and environmental risks





Industry-Led Dissemination and Technical Assistance Program



● **Concept:**

Engage leaders of the construction and building community in assuring timely implementation of needed changes to practices, standards, and codes.

● **Functions:**

Provide inputs and participate in developing best practices, guidance and tools for vulnerability assessment and reduction, guidance on standards and codes needs.

Timely adoption, dissemination, and use of investigation recommendations and R&D outputs.

● **Partners:**

Codes and standards developers, e.g., ICC, NFPA, ASME, ASTM...

Professional, engineering organizations, e.g., IAFC, ASCE, SFPE, AIA, AGC...

Industrial/trade bodies, e.g. CII, FIATECH, CERF, NIBS,...

Contact Info

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