Break-out 1 (Room A – Full Notes) – Future Vision of Resilient Communities and How We Get There

Define Disaster Resilient Community

- Define in Hierarchy
  1. Can you get back to where you are?
  2. Ability to recover to where you should be?
  3. Cost to region/community is sustainable/long-term
  4. Can you recover to re-obtain competitive posture? Port example

- Fully functioning in short period of time
- Define disaster recovery plan & team; who should do what? Plan in advance.
- Performance measures
- Define what constitutes disaster resilience – need general acceptance standard
- Capacity to enjoy well being – environmental, social, economic
- Disaster resilient communities should have redundancy and be interconnected with adjacent communities
- Multi-hazard

Challenges

- People have a short memory of disasters – internalizing hazards
- Resilience sustained in good economic times and bad
- View of codes as "job killers"
- Education to get desired action – rebuild stronger

How to Identify Resilient Community

- Average Annual lost benefit/cost analysis
- Economic Modeling – Community
- Urban planning input/ concepts
- Disaster resilience plan in place
- Modern building code in place and enforced – IRC-IBC
- Established partnerships – State/Fed/Local gov, private, non-profit
- Where community leader understand resilience and apply – land-use, permitting

- Private sector buy-into value of resilience
- Demonstrably lower losses than comparable communities
- Population sense of community and willing to invest
- Communications and business continuity during and after an event

Gaps in Current Knowledge

- Apply at community vs. individual
- Ability to keep residential updated inexpensively
- Lifeline, utilities, trees – efficiently
- Definition of Disaster Recovery Team, Planning, Training, Funding, Communications
- Need cost-effective retrofit techniques – flood & seismic
- More tools/incentives – tax credits
- How to recognize/measure resiliency as part of appraisal
- Simulation tools for recovery - how get healthcare in, etc.
- How to – Land-use planning to reduce hazards – foster political will
- Prediction of hazard – loss of power vs. underground utilities
- Wind distribution
- Wide-spread uncertainty of disaster resiliency definition
- Is it green, energy efficient, sustainable?
    - So broad that concept is difficult to address
- Quantify disparity re: perception of risk vs. actual risk
- Multi-hazard – localized, integrated, policy
- Effect of climate change
- Combined impact of multi-hazard stressers
    - Wind, Surge, Wave, Flood Interaction
    - Interdependancy of systems – water, utilities
- Technical definition of forces and response – storm surge and waves
- Performance of transportation lifelines
- Short-term risk prediction – size of storm
- How to get technical knowledge to citizens – perception of risk
- What does a disaster victim think re: resilience – why are certain choices made?
- Post-disaster is qualitative vs. quantitative – need statistical analysis

Break-out 2 (Room A) – Gaps in Current Knowledge and Research Needs

Group A: Wind Hazard
Moderator: Chris Letchford
Reporter: Peter Vickery
Presentation: Partha Sarkar

Grand Challenge

1.Provide relevant knowledge and simulation of extreme wind events (hurricanes, downbursts and tornados) for disaster recovery

2.Define joint hazard characteristics of
- *Wind/surge*
- *Wind/temperature*
- *Wind/rain*
- *Wind/debris*

4.Characterize non-conventional wind events

5.How to integrate new research facilities into practice

6.Develop databases of all wind hazards

7.Understanding frequency, intensity, spatial and temporal characteristics of damaging winds
- *What can we measure?*

8. NCEES for wind-integrated management (NCWES)
Shared resources for wind engineering

9.Climate change impact on wind hazards

Gaps in Current Knowledge

- *Non-stationary transient events (e.g. downbursts, tornados are largely undocumented)*
- *Coastal transition of hurricane wind fields from deep water to shallow water to land*
- *Impact of fresh water flooding on exposure and wind field*
- *Insufficient data/poorly documented databases*
- *Understanding air-sea interaction*
- *Only synoptic winds in current code; incorporate provision for non-conventional wind hazards*

Research Needs

- *Study of downbursts, tornados and gust fronts*
- *Methods of field measurements*
- *Simulation tools (numerical and physical)*
- *Rational characterization of complex terrain and urban topography*
- *Integration of meteorology and wind engineering communities*
- *Better computer based simulations (CFD)*
- *Predict hurricane mean wind*

Grand Challenge (Themes)

- *Characterize* wind hazards (hurricanes, downbursts, downslope winds, tornados)*
  - *Characterize joint hazards*
  - *Climate change impacts*
- *Manage knowledge/data and research/testing facilities*
  - *Incorporate into design codes*
  - *Pre-code research based tech guidance*

* *Understanding frequency, intensity, spatial and temporal characteristics of damaging winds*

Research Needs (Summary)

- *Field Measurements*
  - *Validate models*
- *Develop/Improve models (numerical and physical)*
  - *Hurricanes, downbursts, tornados, orographic*
- *Integrate across wind community (meteorology and wind engineering)*

Break-Out Session 1 (Room B) – Future Vision of Resilient Communities and How We Get There

Community Leader: Jon Galsworthy
Reporter: Dorothy Reed

"We know a lot but we are not practicing it."

Gaps in Current Knowledge

• Lack of community-based approach in our design practice
•Why is the infrastructure not operable? What is missing? Technical and non-technical aspects. Rural vs. urban.
•Who decides how quickly a community "comes back"?
•Case studies on resilient and non-resilient communities need to be further investigated.
•Public awareness and knowledge of natural hazards
•Influence of climate change
•Nature of Interdependency
•Lack of outreach and education of the public in response plans

Define Disaster Resilient Community

•One that sustains all hazards and remains liveable
•One that remains a community beyond the event
•Metric: % of the population that remains or returns within one year
•Tax base and revenues continuity
•Business continuity
One that practices effective risk management

How to Identify Resilient Community

•Remain- Repair- Return within a specific time frame
•Adaptable
•Defined codes and standards
•Addressed vulnerabilities
•Community health and participation
•Public/ community/ business leaders need to be well-prepared

Break-out 2 (Room B) – Gaps in Current Knowledge and Research Needs

Wind Loading Group

Moderator – Jon Galsworthy
Spokesman – Don Scott

"What's blowing in the Wind"

Wind Loading Group – Grand Challenge

- Beyond static loads, educate on the dynamic effects
- Develop practical CFD method
- Cyber Based Discovery and Inovation in Wind Engineering
- Consistent Wind Design parameters in the standard
- How do we connect what's happening on the "leading edge" with practice?

Wind Loading Group – Gaps in Current Knowledge

- Wind-Borne Debris
- Thunderstorm, Tornado profiles & relationship w/ Pressure Coefficients
- Understanding how to model damping
- Response of Instrumented buildings
- Non-linear transient wind events
- Understanding uncertainty

Wind Loading Group – Research Needs

- Develop a standard for CFD
- Develop benchmark test case or cases to validate results
- Include uncertainty analysis
- Education of CFD (Tech-Brief)
- Develop a robust CFD tool for industry use (5 to 10 year process)
- Better wind load data into the Standard
- Current data is 30 years old

- Loads on Other Structures, different shaped buildings

Break-out 1 (Room C) – Future Vision of Resilient Communities and How We Get There

Define disaster-resilient community

- Maintains basic human needs after the event
- Minimal losses and disruption in structure, infrastructure, and functionality minimal population loss/displacement ability to adapt (e.g. climate change, population growth, etc.)

How to identify a resilient community

- strong code enforcement
- community specific
- historical data
- well-maintained infrastructure

Gaps in current knowledge

- how much is lost w/ age deterioration
- lack of understanding of common failures
- lost market share
- quantification of all definitions in "define"
- uncertainty quantification at all levels
- prior knowledge of true cost of nonresiliency (cost to make it resilient)
- coordination of efforts
- systems/multi-scale approach (design or operation)
- loss of resliency over time
- socio-economic impact

Additional important comments

- The needs of the community must be met quickly after the event in order for that community to be resilient.
- The businesses in the community must have some high level of resiliency in order to encourage citizens to return and rebuild
- The community must encourage a strict adherence to updated codes
- More communication is necessary between different levels (federal vs state, state

vs county, county gov't versus community)

Break-out 2 (Room C) – Gaps in Current Knowledge and Research Needs

Grand Challenge

- Getting customers to demand higher performance through education
- Getting citizens and legislators to embrace building codes as standards rather than nuisances
- Better understanding of design process
- Focus on resistance

Gaps in Current Knowledge

- Lack of education about and understanding of risk/overall cost
- Performance of non-engineered structures vs engineered
- Defining failure with limit states
- Understanding resistance and load-bearing discrepancies between wind-tunnel tests, field tests and forensic data collection
- How to design new, better structures while still incorporating outdated buildings

Research Needs

- Improving field test methods to get more accurate, consistent data
- Research on the interactivity of different building materials
- Research on load path
- Increase evaluation/research on existing building stock
- Research on where failures happen
- Improve existing test methods

Break-Out 1 (Room D) – Future Vision of Resilient Communities and How We Get There

Define Disaster Resilient Community

Sustain central services and maintain growth after a natural disaster w/o much need for external assistance. Prepared and prepared to survive and assist community. Capacity to recover, minimize death, dollars and downtime. Be aware of disasters procedures and can execute, recover quickly w/little economic and social disruption. Quickly return to normality and normal function. Prepared to survive. Withstand w/minimum disruption to functionality. 95% of services returned within 36 hours. Understanding anticipated risks and taking mitigation actions. Is guided and supported. Recover w/least resources and time. involved in making decisions and understanding the risk from disasters.

How to Identify Resilient Community

Has identified risks, planning and emergency planning. Documentable preparations and plans, look @ post disaster; education, building standards. Proper building codes, disaster procedures, aware community, identified leadership. One that acknowledges deficiencies and have developed resources to restore. Minimizes damage and losses. Analysis of buildings, infrastructure and utilities. Planned EM response and recovery plan. Difficult to observe because more identification should be done via a systemeatic analysis of threats. Public official awareness of deficiencies and threats. How have similar communities performed and prepared. Direct complarison. Analog evaluation of how similar communities have performed.

Gaps in Current Knowledge

Ways to get property owners to take action, get communities to fund/take action, private sector assumption of risks. May not be known prior, related to experience, training and mitigation. Quantify surge loads, wave loads, approaches to incorporating into infrastructure. Community awareness and education, defined vocabulary for damage documentation (efficient and uniform). Conditions of existing building stock and evaluations for expectations. Understanding of resources needed to return to functionality. Proper action of private sector. To assess structures damaged by the event. Different return periods for statistical analysis of fire, flood, wind. Performance based design for wind and flood. Accuracy of wind loads. Applying advanced science to social problems. Impact of climate change. Resistance metrics; standards and codes adoption focus on life safety, not resilience. Measuring impact & define performance based approach. Effects of multiple hazards. How to encourage building resilient communities. Air-Sea interaction. Bottom friction characterization, turbulence, we need to better describe local conditions. Turbulence theory loading. "True" nature of cost/benefit resilience implementation. Assessment of community awareness. Future hazards and impacts of development. Small scale variation of flood conditions

Break-out 2 (Room D) – Gaps in Current Knowledge and Research Needs

Overall Summary of Important Topics

- Imp roved measurement and modeling of overland flow: time histories and prediction of waves, surge, velocities, sediment, debris, scour, etc.
- Probabilistic risk in all forms including short term, climatological, for changing future conditions, and for all important parameters
- Coupled physically based modeling of events including wind, surge, waves, rain, sediment transport, etc.
- Improved depth-damage-fragility functions that explicitly include wave height, water depth, velocity, etc.

Grand Challenges

- How to estimate risk for rare events?
- How to consider impact of climate change?
- How to design to resist multi-hazards and develop multi-hazard model?
- How to consider wind and inundation joint risk?
- How to get more damage data?
- Joint prob of wind, surge, rainfall for multi-hazards
- Physics based vs statistical methods – not constrained by historical data. Comparison
- Connecting physically-based models to damage data
- Assess probability functions of hurricane characteristics and determine uncertainties
- Physics-based aspects of surge modeling: 2D vs 3D
- Cost-efficient, physics-based 3D modeling. Fully coupled wave-surge-rainfall systems.
- Understanding overland hydrodynamic transport during an extreme flooding event
    - Flood characteristics in nearshore – wave, surge
    - 3D nearshore hydrodynamics
    - Flow through built and natural environment
    - Time dependency (bldg destruction)
    - Sediment transport: scour, erosion, recovery
    - Generation and transport of debris

  - o Ecological impacts and recovery. Oils spills, groundwater contamination
- Predicting characteristics of overland waves and surge
- Assessment and communication of risk
- Relationship between hazard and response
- Long term climatology
- Wind forcing overland – partitioning between roughness elements and water
- Overland dissipation of waves and surge
- What is the wave forcing to elevated residences?
- What is the resistance of elevated residences?
- What is the risk to transportation lifelines?
- How can we reduce wave and surge hazard?
- Investigate alternatives to horizontal evacuation – mitigate hazards
- Understand failure modes in more detail for wide degrees of damage
- Load history – intensity and velocity
- Effects on infrastructure – site specifics
- Efficiencies parallel vs perpendicular bldg siting
- Scour and characteristics. Performance.
- Emergency response tied to design criteria
- Probabilistic debris loading and characterization
- Geomechanics of soil-water interface during overland flow
- Low cost hazard profiling
- Describing and measuring physical characteristics of coastal overland flooding sufficient for planning and design of bldgs infrastructure and communities
- Move from depth-damage functions to fragility approach for structures
- Foundation depth
- Be able to determine what hazard conditions were associated with a particular failure or damage
- Time histories of flood conditions
- Defining future condition scenarios
- Coincidence of different parameters: surge, waves, rainfall and effects
- How will we map these hazards?
- What do hurricanes look like overland and in coastal region?
- Need water velocity measurements overland – collocated wind, water velocity, wind, surface elevation measurements – rapid deployment option

Break-out 1 (Room E) – Future Vision of Resilient Communities and How We Get There

Define Disaster Resilient Community

A disaster resistant community is one that is able to function immediately or to recover quickly after a disaster event.

How to Identify Resilient Community

Disaster resistant communities can be identified through the use of a multidisciplinary, systems-based stress test at the community level.

Gaps in Current Knowledge

- Education about systems-based construction of disaster resistant communities is lacking and needs to be improved.
- Current predictive models do not always give accurate predictions of damage, resulting in incorrect or inadequate preparation.
- Accurate models are difficult to develop as they require a very large fault tree to simulate interconnectedness.
- Loss estimates are a step in the right direction, but aren't sufficient to describe or understand resilience.

Break-out 2 (Room E) – Gaps in Current Knowledge and Research Needs

Gaps in Current Knowledge

- Current wave load models were developed for offshore use, not coastal
- Mapping programs must be updated; lack of funding
- Probabilistic flood maps with depth and flow solutions defined with sufficient detail for prescriptive as well as performance-based methodologies.
- Relationship between long-term coastal erosion and long-term sea level rise.
- Effects of climate change on frequency and intensity of coastal storms.
- Structures designed based on past disasters rather than possible extremes of weather
- Current scour models model a single wave on a simple environment such as a beach rather than long-duration surges in complex environments such as urban areas.
- Sufficient data about scour environments (e.g. grain size) is not available.
- Lack of validated model to consider combined effects of hurricane wind, storm surge, and waves.

Research Needs

- Improved flood depth damage functions and relationships for structures in coastal areas
- Ability to predict flow velocity of storm surge (site-specific)
- Additional validation of storm surge and wave models from future hurricane events
- Retrofitting existing infrastructure for increased resiliency
- Performance-based design criteria for building and non-building structures.