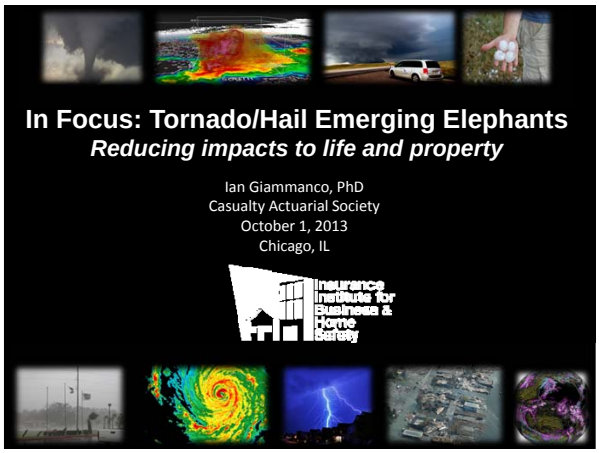


In Focus: Tornado/Hail Emerging Elephants

Reducing impacts to life and property

Ian Giammanco, PhD
Casualty Actuarial Society
October 1, 2013
Chicago, IL

Insurance Institute for Business & Home Safety

Structures: What do we design for?

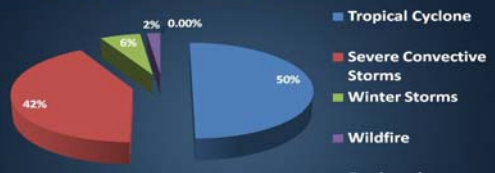
Codes are MINIMUM design standards!

- Along the Gulf and East Coast of the US, hurricane winds govern the design standards
- Thunderstorm winds control the wind climate and design standards across the rest of the country
- We do not account for hail or tornadoes in "non-engineered" structures

e.g. Residential construction, low-rise commercial etc…

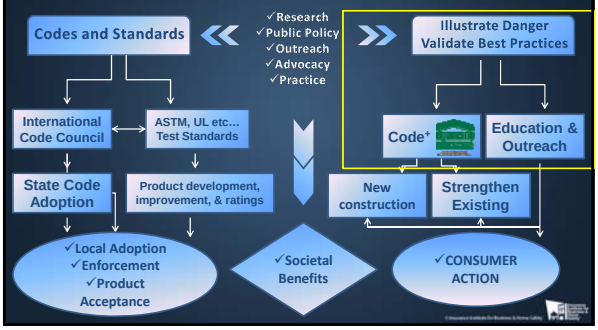
THE PROBLEM

Where do the losses come from



HOW DO WE SOLVE THE PROBLEM?

GOAL: Make severe weather events like a "bump in the road to society…"



EXAMPLE: HURRICANE

Performance Comparison: Commercial

Common Practice

- ❑Common building practices (1970's-1990's)
- ❑Not to current coastal building code
- ❑ Nailed roof connections
- ❑Only corners reinforced and sides of openings
- ❑Fasteners only on roof seams

Enhanced Construction

- ✓Code-Plus
- ✓Reinforcement – 8ft spacing along long walls and openings
- ✓ Screw roof connections
- ✓**Continuous load path**
  Roof-to-wall-to-floor-to-foundation
- ✓Fasteners on roof seams AND perimeter

EXAMPLE: HURRICANE –Wind

EXAMPLE: HURRICANE –Wind

What happened…

✓ Both structures survived 127 mph gusts with no internal pressurization

❑ 2x4 launched at window to simulate debris impact

❑***Common Practice Building***: roof detaches from wall due to uplift from internal pressurization

❑Failure of ***Common Practice Building*** at a gust wind speed of 105 mph (85 mph sustained wind)

✓***Stronger Building*** survives another 127 mph gust even with breeched window and internal pressurization

EXAMPLE: HURRICANE –Wind

So… what's the cost difference?

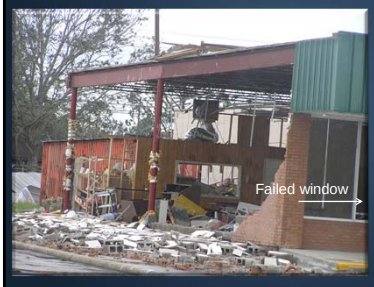
- **Flashing and roof membrane attachment enhancements: $850**
- **Roll-up Door – wind locks: $350**
- **Wall reinforcing and concrete: $1,250**
- **Anchorage of roof top equipment: $650**

These are things that you can't see…
"What you get is what you inspect…"

TOTAL $3,100

EXAMPLE: HURRICANE –Wind

Look familiar??



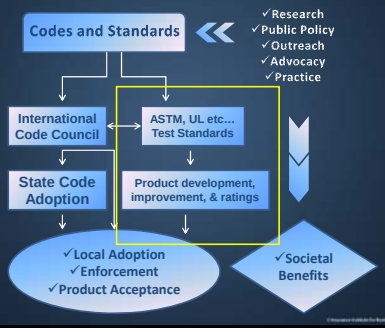
Failure observed in Winnie, TX

Hurricane Ike (2008)

Observed peak gust 97 mph

Not a design wind event!
Chambers County design wind speed is 110 mph 3-sec gust

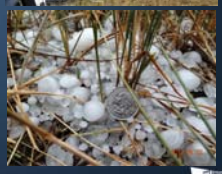
HOW DO WE SOLVE THE PROBLEM?



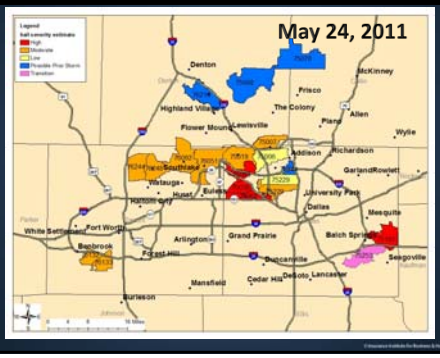
HAIL

What we know

- ✓Hail events are responsible for $800 million in losses per year
- ✓Standardized testing of new materials - UL, FM
- ✓Aged products are not performing in the field to their rating (when they were new)

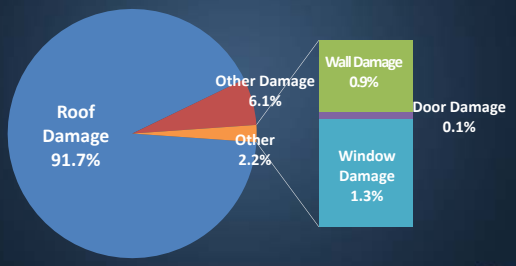


Hail: Claims Analysis

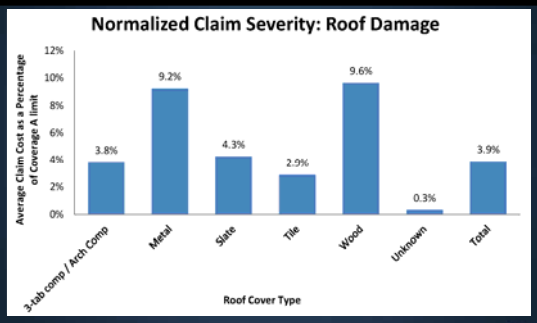


Hail: Claims Analysis

Distribution of Damage



Hail: Claims Analysis



Hail: Damage Predictability

Systematic approach to study:

1. Aging and climate effects
2. Materials—start with 3-tab and laminate asphalt shingles
3. IR vs. non-IR products
4. Structural vs. aesthetic damage
5. UL, FM, IBHS hailstone impacts
6. Material warranties
7. Roof pitch

Goal = Develop statistically based damage curves for size, density, and hardness of hailstones

Hail: Damage Predictability

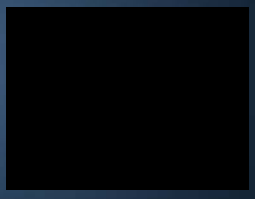
Making realistic hail stones

Density

- Artificial hailstones—varies from 0.45-1.1 g/cm3
- Natural hailstones—varies from 0.1-0.9 g/cm3 (historical studies)

Compressive Stress

- Artificial hailstones—varies from 3-308 psi
- Natural hailstones — 1-1097 psi (limited field dataset)

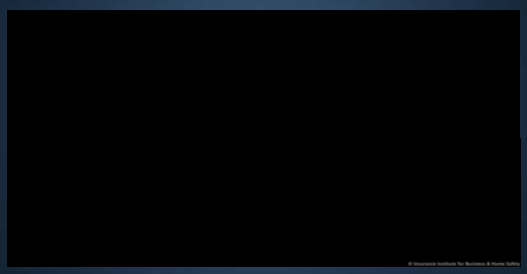


Hail: Full-system testing

System demonstration: Feb. 20, 2013

- **Comparison of performance of shingle types**
  - Impact-rated (Class 4) architectural asphalt shingles
  - Non-rated 3-tab asphalt shingles
  - Metal panel: two installation types
- **Soft metal materials**
- **Windows and door**

Hail: Full-system testing



Hail: Damage Predictability Age effects

- **For all specimen panels, 5-minute sampling frequency of:**
  - Temperature of shingle surface at center of panel
  - Temperature between shingles and underlayment at center of panel
  - Temperature between underlayment and deck at center of panel
- **Six specimens with additional measurements:**
  - Temperature and relative humidity inside attic
  - Shingle surface temperature measurements at rakes, eaves, and edges

Hail: Hypothetical Example

Primary | Modeler | Reinsurer

Hypothetical Example: Hail Research for Impact Resistant Shingles
"For a brand X shingle"

Hypothetical Lab Test Results:
- ✓ Lab tests show little/no discernible damage with 1" hail
- ✓ Lab tests show cosmetic damage with 2" hail
- ✓ Lab tests show fracture of shingles with 3" hail

Questions from Modeling Firm:
- Do lab results match real world results? How can we establish this?
- How does carrier data quality impact the application of research?
- How do the modelers quantify impact of other related perils? Wind / water
- Models perform relative analysis. How does shingle performance compare with the baseline standard shingle test results?
- How does claim settlement process impact payout? Loss Amplification?
- Does radar data inaccuracies bias the study results?

Hail: Hypothetical Example Application of research

Hail	Shingle Type	Lab Results	Sample from Hypotheical Study				Model Firm
			Carrier A	Carrier B	Carrier C	Selected	
1"	3 Tab Shingle	1.00	1.00	~~1.00~~	1.00	1.00	1.00
	Architectural	0.80	0.85	~~0.95~~	0.83	0.84	0.84
	Impact Resistant	0.78	n/a	n/a	n/a	n/a	0.82
2"	3 Tab Shingle	1.00	1.00	~~1.00~~	1.00	1.00	1.00
	Architectural	0.90	0.92	~~0.98~~	0.94	0.96	0.95
	Impact Resistant	0.88	n/a	n/a	n/a	n/a	0.93
3"	3 Tab Shingle	1.00	1.00	~~1.00~~	1.00	1.00	1.00
	Architectural	0.98	0.99	~~1.00~~	1.00	1.00	0.99
	Impact Resistant	0.95	n/a	n/a	n/a	n/a	0.98

Questions to ask…
> How does your company validate accuracy of roof type info? 3rd Party, Inspection or Self Reported
> Has your company U/W process changed over time? If yes describe
> Does your company capture age of roof separately from age of home?

Potential to include in 3rd Party Models:
> Modeling firm can utilize the Lab Research, Claim Study and Proprietary research to select a Mean Damage Ratio
> Next generation models will include the ability for carriers to customize damage ratios

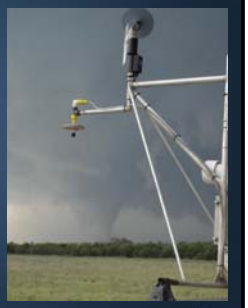
TORNADO: What can we do?

❑ We do not account for tornadoes in our minimum design standard for "non-engineered" structures

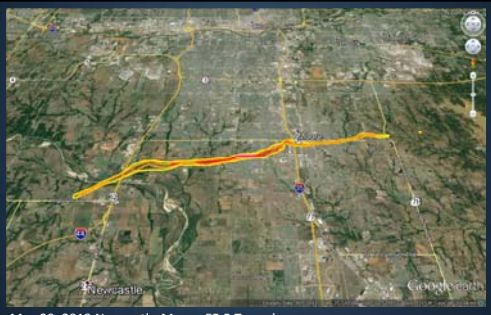
✓ Can we build to withstand tornadoes? YES

✓Is it currently economical to build homes to completely withstand tornadoes? NO

❑Can best practices used in other high wind regimes help reduce the swath of damage? We think so!



TORNADO: Reducing the swath?



May 20, 2013 Newcastle-Moore EF-5 Tornado

TORNADO: Reducing the swath?

Damage is progressive
It has to start somewhere

Improved codes
Code+ construction

✓Continuous load path

Roof → Wall → Floor → Foundation

✓ Strengthen openings
Garage doors, chimneys, windows

Multi-hazard: Performance based design The Future??

- ✓ Systems-based design approach
- ✓ Building performance against all aspects of a hazard

EXAMPLE: HURRICANE
1) Wind loads
2) Protected openings
3) Water intrusion
4) Storm-surge → elevation

EXAMPLE: WILDFIRE
1) Defensible space
2) Material selection
3) Ember entry
4) Fire suppression systems