

Masonry vs. The Storm:

Building for Resilience

**Presented by:
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WHO ARE OUR PRESENTERS?



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Masonry Association of Florida

WHO WE ARE

The Masonry Association of Florida (MAF) is a not-for-profit trade association dedicated to expanding the market share of masonry construction in Florida. Masonry construction dominates the construction industry because of its adaptability to the Florida climate. One of the most durable building products available, masonry resists storms, termites and mold, while reducing energy costs, maintenance and noise. The MAF is a coalition of Florida masonry industry professionals who believe it's time to bring our industry together.



THE MAF OFFERS

- Professional Education (Architects, Engineers, Contractors & Building Inspectors)
- Masonry Apprentice Training
- Technical Assistance through our Engineering Help Desk & Technical Library
- For more: www.floridamasonry.com

Florida Concrete Masonry Education Council



Masonry Education and Advocacy

The Florida Concrete Masonry Education Council was created as a non-profit corporation under Rick Scott. Operating as a direct-support organization of the Dept. of Economic Opportunity.

Its directives include:

- Plan, implement and conduct programs of education in the field of concrete masonry
- Develop and improve access to education for individuals seeking employment in the field of concrete masonry
- Develop and implement outreach programs to ensure diversity among individuals trained in the programs
- Coordinate educational programs with national programs and programs of other states
- Inform and educate the public about the sustainability and economic benefits of concrete masonry products
- Develop, implement and monitor a system for the collection of self-imposed voluntary assessment on each concrete masonry unit produced and sold by the concrete manufacturers in the state

Block Strong Initiative



www.blockstrong.com

Designed to make sure everyone - consumer, construction professional and designer understand the vital link between quality building materials and the health and safety of people living and working in the homes and structures that they design and build. It also aids prospective homebuyers in their search for knowledge on the best products for their homes.

Oldcastle Divisions



Oldcastle Building Envelope



Oldcastle Infrastructure

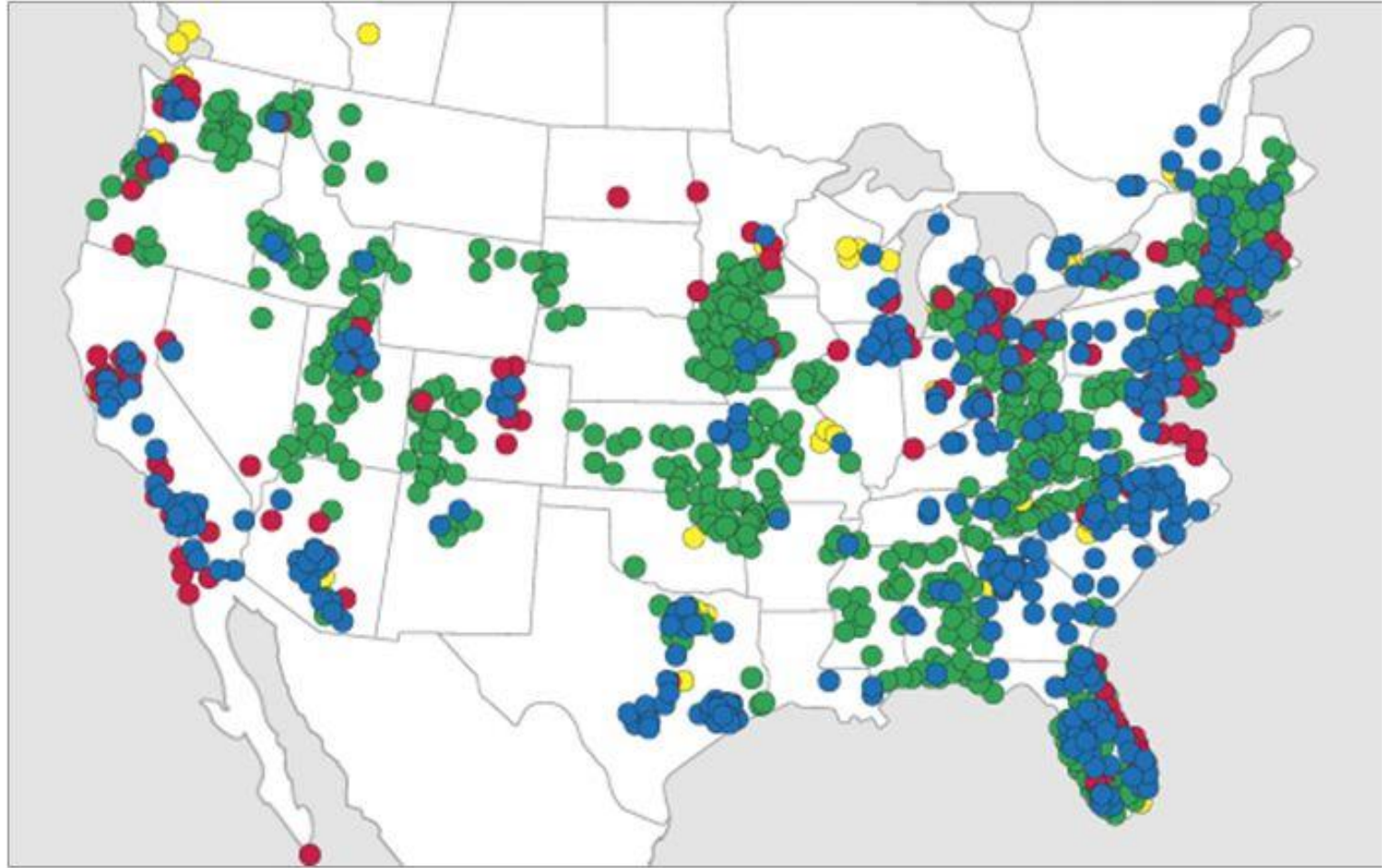


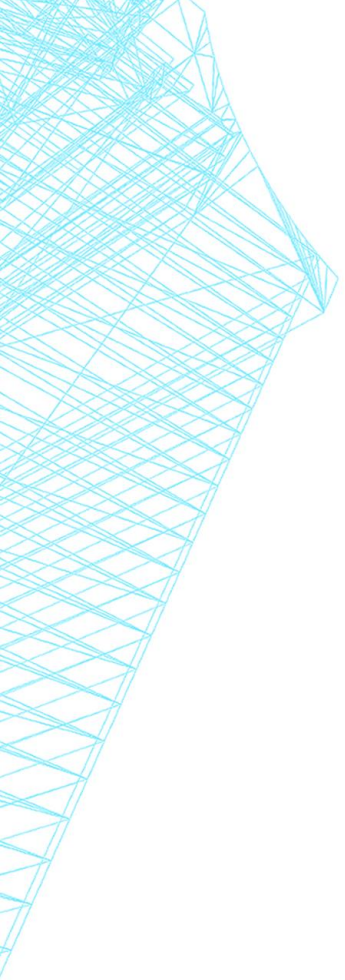
Oldcastle APG



Oldcastle Materials

Oldcastle Locations





Oldcastle APG is a registered provider with the American Institute of Architects Continuing Education Systems. Credit earned upon completion of this program will be reported to CES Records for AIA members. Certificates of Completion for non-AIA members are available on request. This program is registered with the AIA/CES for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing or dealing in any material or product. Questions related to specific materials, methods and services will be addressed at the conclusion of this presentation. In order to maintain a high-quality learning experience for our members, a **REQUIRED**, course evaluation will be distributed and collected at the end of this education session.

Masonry versus the Storm: Building for Resilience

ECH-STRUC-2001

Approved for 1 HSW Credit Hour

Intermediate Level

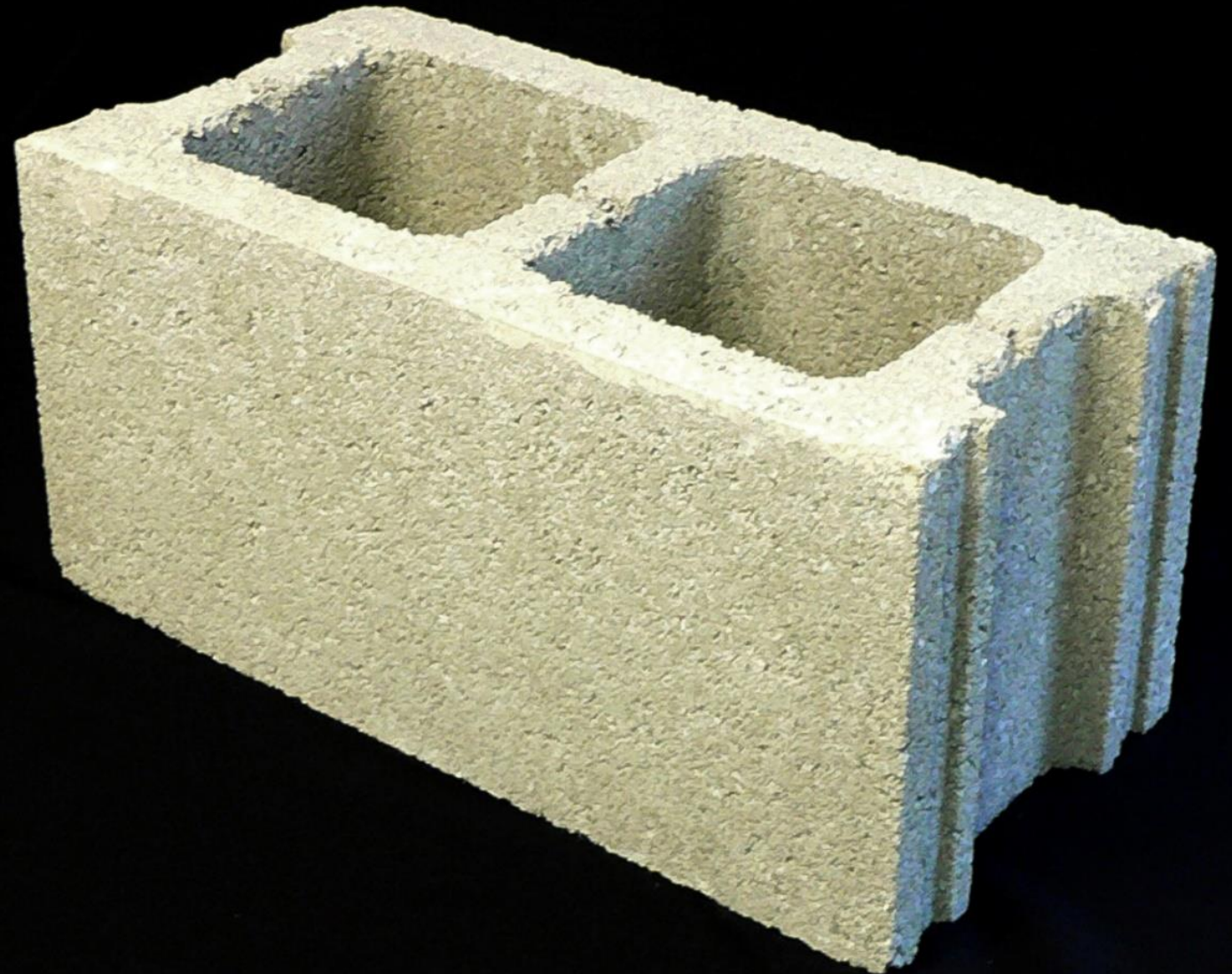
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- **Identify Concrete masonry's inherently sustainable qualities.**
- **Discuss Resiliency and the USRC's three dimensions of safety, damage and recovery, as well as how resilient design is gaining momentum as a complimentary focus to the US Green Building Council's sustainable design.**
- **Review "Lessons Learned" regarding design and construction failures during several past hurricanes and tornadoes.**
- **Learn How the use of concrete masonry products can potentially contribute to sustainable and economical building projects.**

Learning Objectives

Concrete Masonry Units



Dry Cast Manufacturing Process

- Dry cast manufacturing has been around for over 100 years
- Very dry mixture of aggregates, cement, and water (6% moisture content)
- Color admixture/integral water repellent integrated in the mix
- Mix consolidated by intense pressure until concrete is densely compacted
- Zero slump: product is immediately formed and removed from mold box
- Cures in a high humidity environment for 24 hours
- Increased mold durability

Early Block Machine

- Started developing concrete block right after Revolutionary War.
- Hand tamp, one at a time.
- Sears & Roebuck Catalog



Modern Block Machine

- Fully automated
- Produces 1200 8" Block equivalents *per hour*



Sustainability and Resiliency

Sustainability and resilience are compatible concepts, but they're not the same thing. An ideal community, economy or business will be both sustainable and resilient. However, either can exist without the other.



Sustainable practices contribute to resilience, and both are the ultimate goals of a healthy society.

Sustainable Elements of Concrete Masonry Units

People. Planet. Prosperity.

Low Environmental Impact

Life Cycle Costs

Increased Energy
Efficiencies

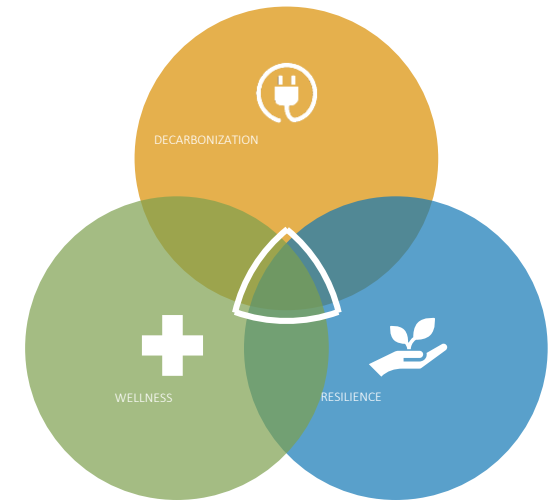
Decreased Carbon
Emissions

Sound Attenuation

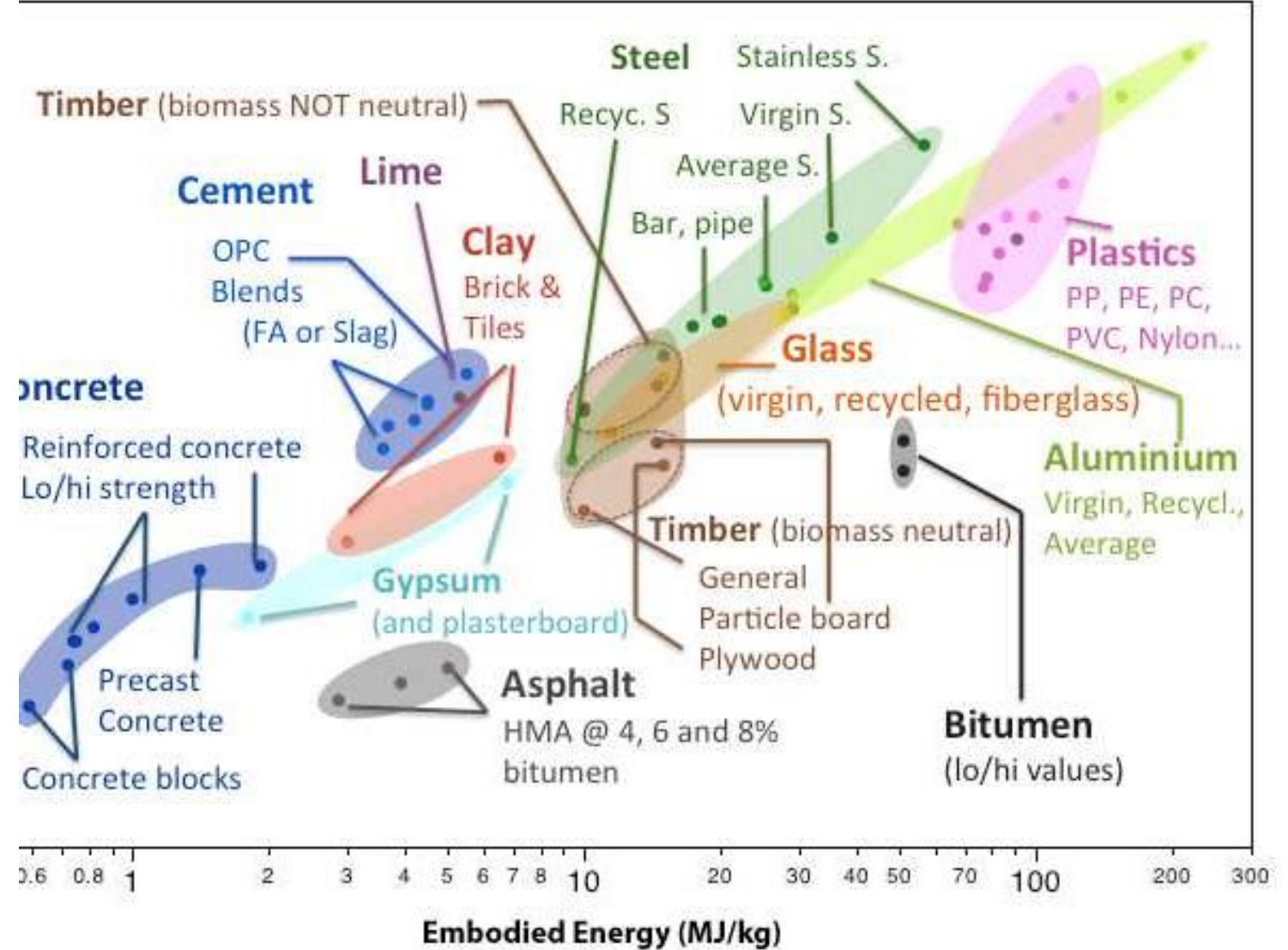
Indoor Air Quality

Fire Resistance

Overall Resilient Envelope



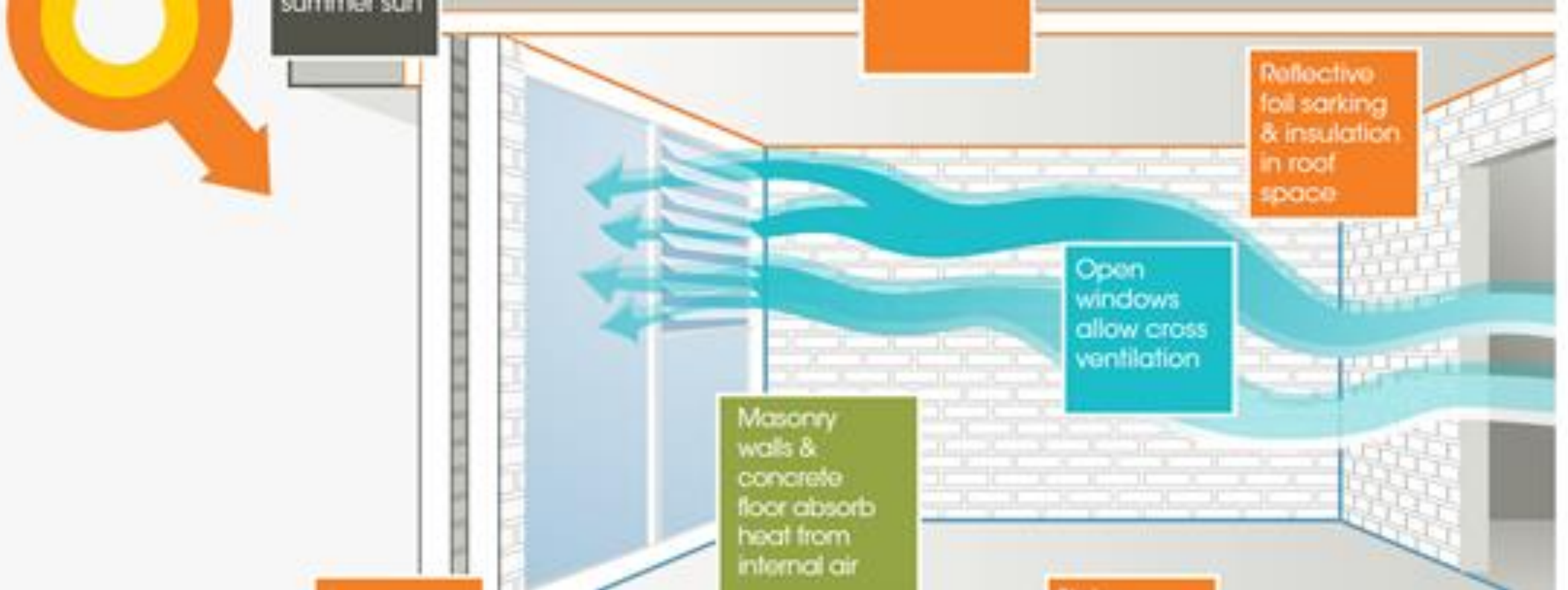
Embodied Energy of Building Materials





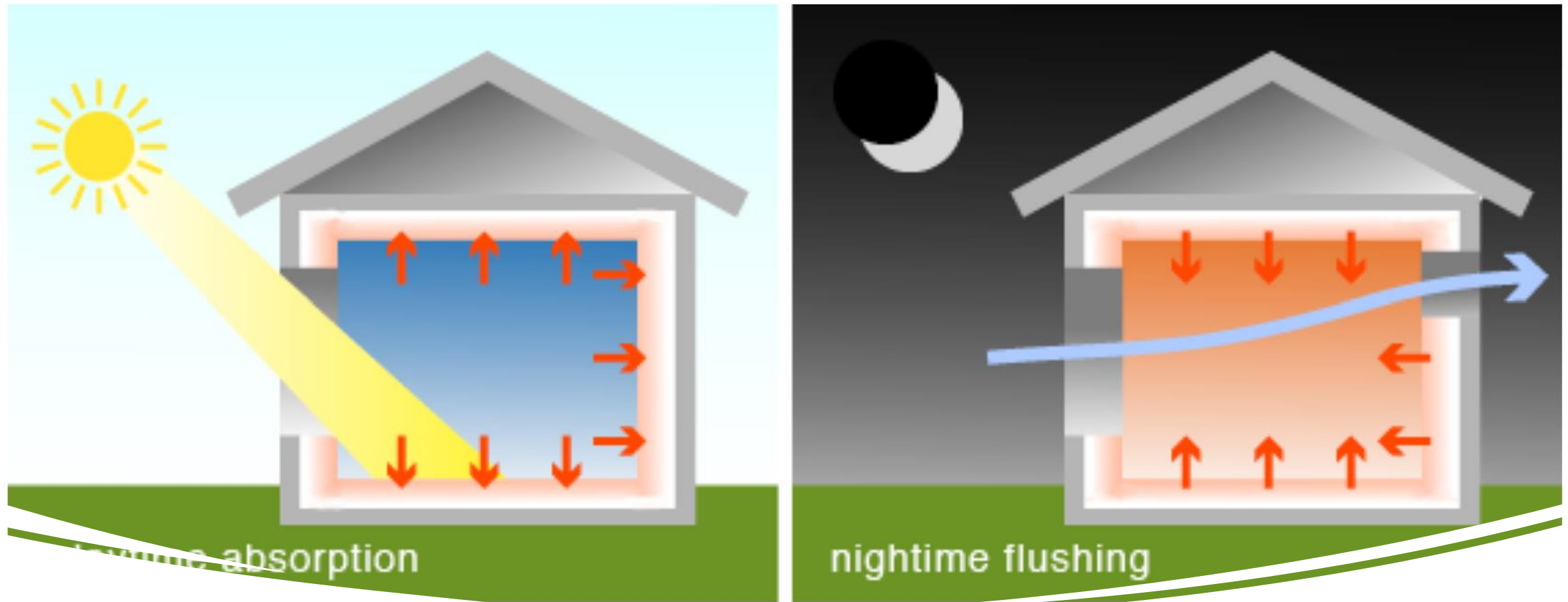
What Does “Low
Life Cycle Cost”
Really Imply?

- Regionally Produced
- Recycled Materials Available
- Reusable
- Respectful of Environment



Energy Efficient

- High Thermal Mass
- Less Temperature Variations
- Thermal Conductivity



What is Thermal Mass?

- Due to concrete masonry units thermal mass, a building constructed with concrete block holds heat longer in cool weather, and cool air inside for longer periods, even in the dead of summer. With airtight walls, concrete block also reduces wall leaks, which prevents energy loss and could lower your heating and cooling bills by 50 percent.



Sound Attenuation

- Higher Sound Transmission Coefficients
- Superior Acoustical Absorption
- Additional Sound Absorbing Units Available



Indoor Air Quality

- Vapor Barrier
- Water Barrier
- Insulation
- Masonry products do not promote the growth of mold - period.



Fire Resistance

- Masonry materials don't burn.
- Detection
- Suppression
- Compartmentation

FIRE RESISTANCE RATINGS

PERFORMANCE RATING FOR MASONRY
WALLS

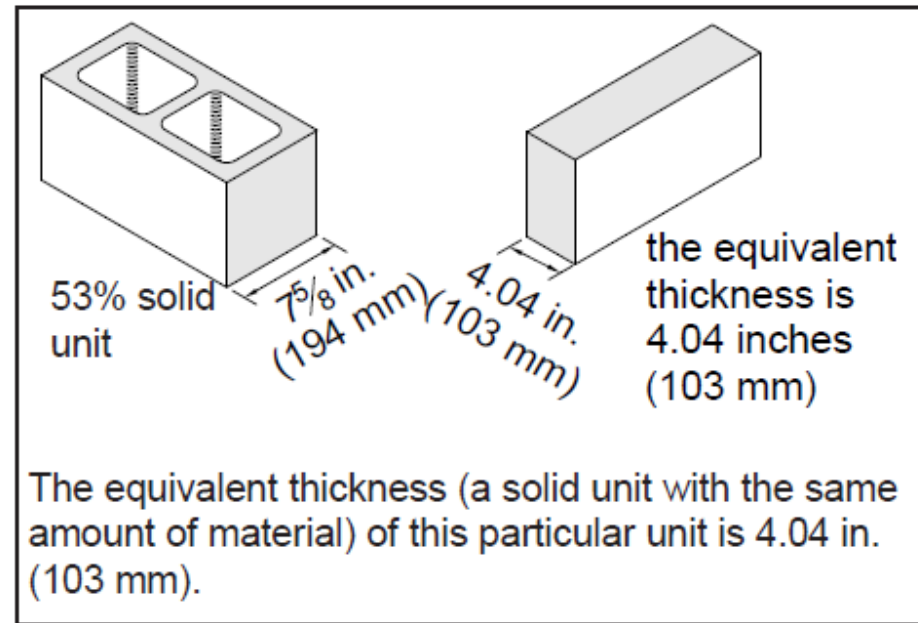
Thickness			Minimum Thickness		Solid Volume	Equivalent Solid Thickness	Fire Rating	Weight Per Unit Light
Nominal	Actual	Type	Shell Inches	Web Inches	Percent	Inches	Hours	Weight Pounds
4"	3 5/8"	hollow	1.00	1.00	72	2.61	1	23
6"	5 5/8"	hollow	1.12	1.00	61	3.43	1	29
		semi-solid	1.75	1.00	75	4.25	2	40
8"	7 5/8"	hollow	1.25	1.00	53	4.04	2	40
		semi-solid	2.25	1.25	80	6.10	4	43
10"	9 5/8"	hollow	1.50	1.12	54	5.18	3	51
12"	11 5/8"	hollow	1.50	1.25	52	6.05	4	54

ESTABLISHING EQUIVALENT THICKNESS

Equivalent Thickness:

Measure of the volume of concrete contained in a hollow unit if the holes were removed.

NCMA TEKnote 7-1C



CALCULATING FIRE RATING

Fire Resistance Rating Period of Concrete Masonry Assemblies

NCMA TEKnote 7-1C TABLE 1

Aggregate Type	Minimum Required Equivalent Thickness (in.) for fire resistance rating in Hours														
	4 Hour	3.75 Hour	3.5 Hour	3.25 Hour	3 Hour	2.75 Hour	2.5 Hour	2.25 Hour	2 Hour	1.75 Hour	1.5 Hour	1.25 Hour	1 Hour	.75 Hour	.5 Hour
Calcareous or Siliceous Gravel	6.2	6.0	5.8	5.5	5.3	5.0	4.8	4.5	4.2	3.9	3.6	3.2	2.8	2.4	2.0
Limestone, Cinders or Unexpanded Slag	5.9	5.7	5.5	5.2	5.0	4.8	4.5	4.3	4.0	3.7	3.4	3.1	2.7	2.3	1.9
Expanded Clay, Shale or Slate	5.1	4.9	4.8	4.6	4.4	4.2	4.0	3.8	3.6	3.4	3.3	2.9	2.6	2.2	1.8
Expanded Slag or Pumice	4.7	4.5	4.4	4.2	4.0	3.8	3.6	3.4	3.2	3.0	2.7	2.1	2.1	1.9	1.5

Resiliency: How Quick can we Recover?

NIBS Natural Hazard Mitigation Report (2018)



A Resilient Envelope: Safety and Security

- Impact Testing - NCMA National Concrete Masonry Association
- Masonry buildings are solid, highly impervious to impacts from man and nature
- Ideal as places of shelter and refuge.







Design and Construct for Resiliency

Reinforced concrete masonry has a long history of performance in seismic, fire and storm events – withstanding extreme forces and remaining stable.

Reinforced Concrete Masonry

- Earthquake Resistance
- Blast and Bullet Resistance
- Fire Resistance
- Flood Resistance
- Wind Resistance



Let's Talk Resiliency

According to the National Institute of Building Science (NIBS), along with the AIA and over 40 Leading Industry Professionals, have defined resilience as the “ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events. We do this through:

- Suitable Building Materials
- Proper Design Details
- Appropriate Construction Procedures
- Sound Maintenance Plans
- Progressive Building Codes

U.S. Resiliency Council

The vision for the USRC is that it will play a similar role that the U.S. Green Building council performs for sustainable design.

It will provide a non-profit organization to promote and implement a rating system and educate the public about seismic and other hazard risks such as hurricanes and tornadoes associated with buildings.

U.S. Resiliency Council – The Future

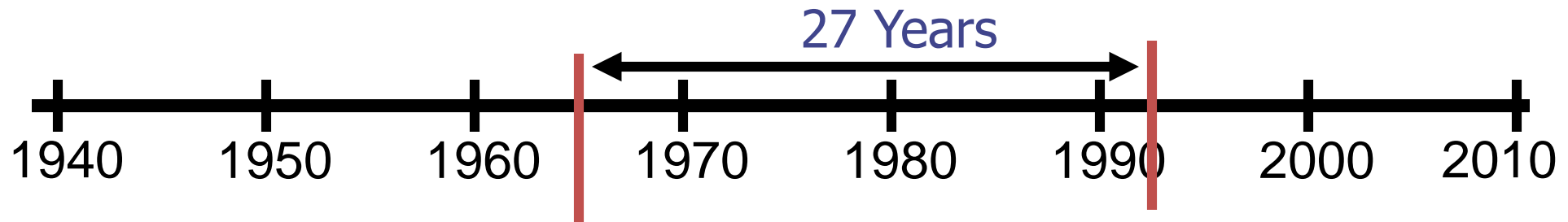
- Multiple dimensions including safety, damage and downtime
- Hazard levels consistent with current codes
- A quality control and qualification system
- A requirement that licensed engineers produce ratings for commercial buildings

From
Yesterday to
Today....



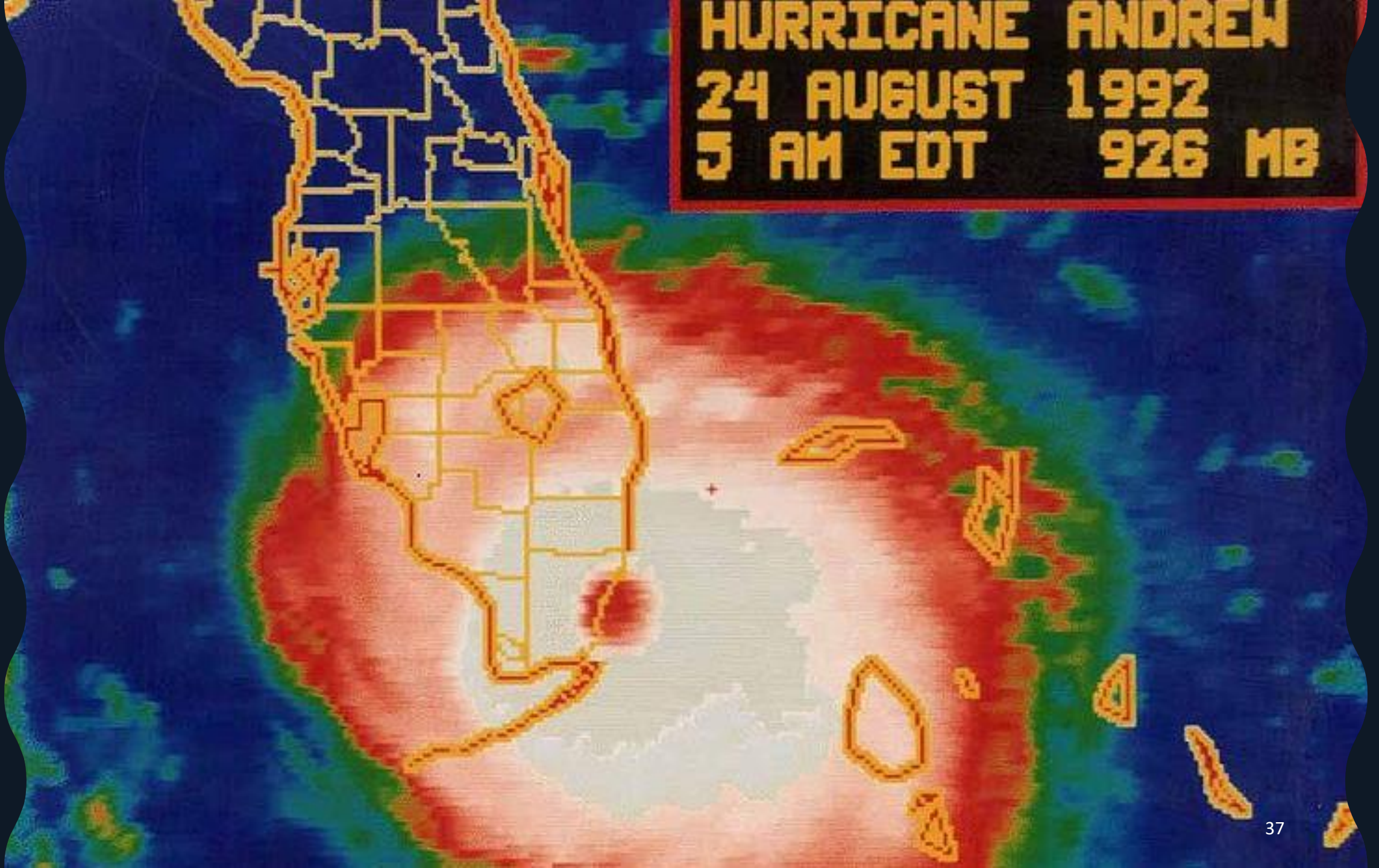
The Rise of Inferior Building Products

Between 1965 and 1992 there were
no significant hurricanes in South
Florida.



Earlier restrictions prohibiting wood frame construction were
rescinded when lumber industry threatened a lawsuit
claiming discrimination against materials

HURRICANE ANDREW
24 AUGUST 1992
5 AM EDT 926 MB





Hurricane Andrew





Hurricane Andrew



Hurricane Andrew





Hurricane Andrew





Hurricane Andrew



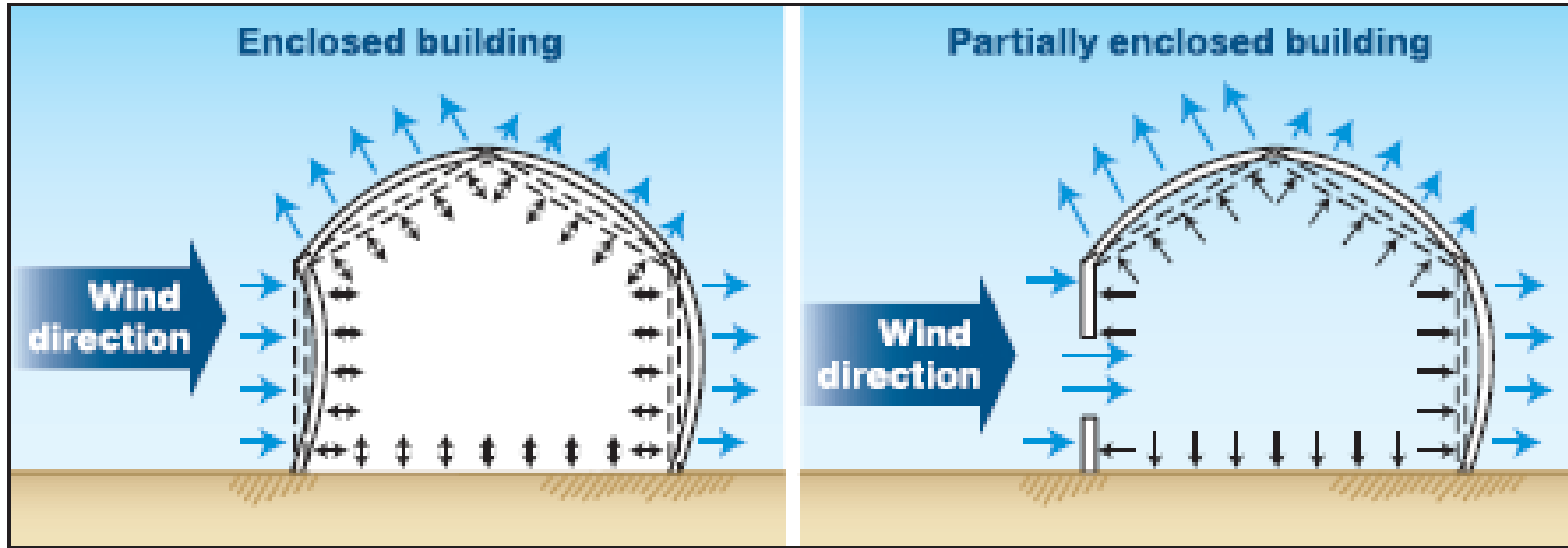
Hurricane Andrew



Hurricane Andrew



Hurricane Andrew

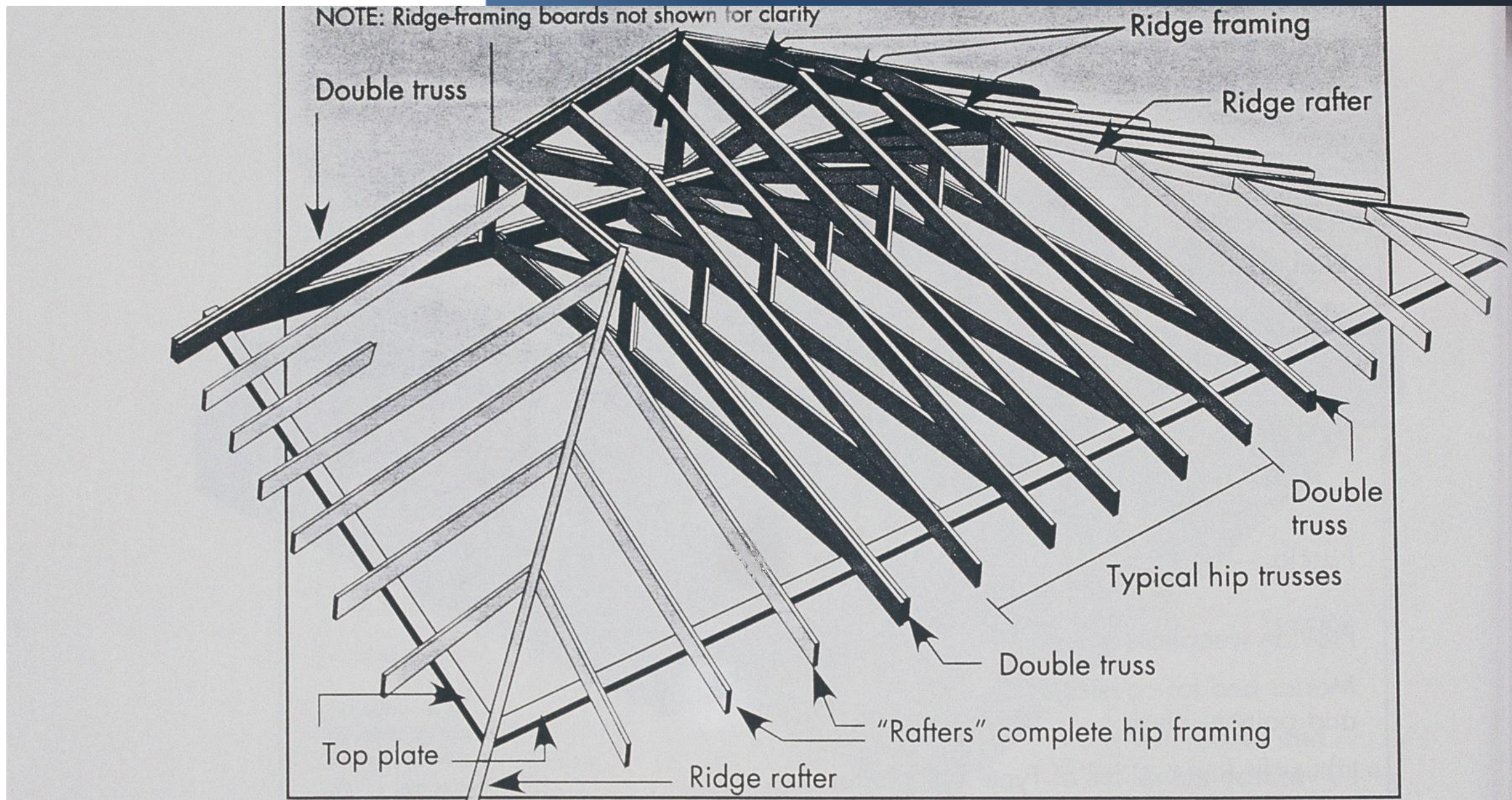


Wall Design Considerations

- A common problem during a major wind event is the failure of connections.
- This failure could be a breach in the building envelope, such as broken windows, doors or partial roof failure.
- Internal pressurization and resulting building failure due to design winds entering an opening in the windward wall.

Side Wall Failure





Lessons from Hurricane Andrew

Designing Masonry for Wind Loads

Design Failures

- Bond beam design for uplift
- Roof connection at top of wall for lateral wall stability
- Proper bar laps and embedment

Construction Failures

- Roof connection at top of wall for lateral wall stability
- Proper steel placement and bar lapping
- Proper grouting of cells

1998 Florida Tornadoes

- Tornado Damage Assessment
- by
- Jim Gulde, CSI
- and
- Joe Belcher, CBO



1998 Florida Tornadoes

On the night of February 22, 1998
powerful tornadoes ripped through
Central Florida killing 42 people.



No deaths occurred in masonry homes - All
those killed were in light frame manufactured
homes or trailers.



All Built Pre-Hurricane Andrew
“Flamingo Lakes”

1998 Florida Tornadoes

- Typical Failure:
- 1. Envelope is breached
- 2. Sheathing lifts off
- 3. Bond beam deflects upward – wall falls out
- 4. Bond beam deflects downward



1998 Florida Tornadoes

- CG6-11
- Photograph of the Felt Grout Stop



1998 Florida Tornadoes *“Parsons Pond”*

- Parsons Pond are just to the East of Flamingo Lakes destruction.
- All homes were construction in accordance with the SSTD-10-93: the Hurricane Resistant Construction Standard.
- First three homes were wood frame.
- All of the remaining homes were block.



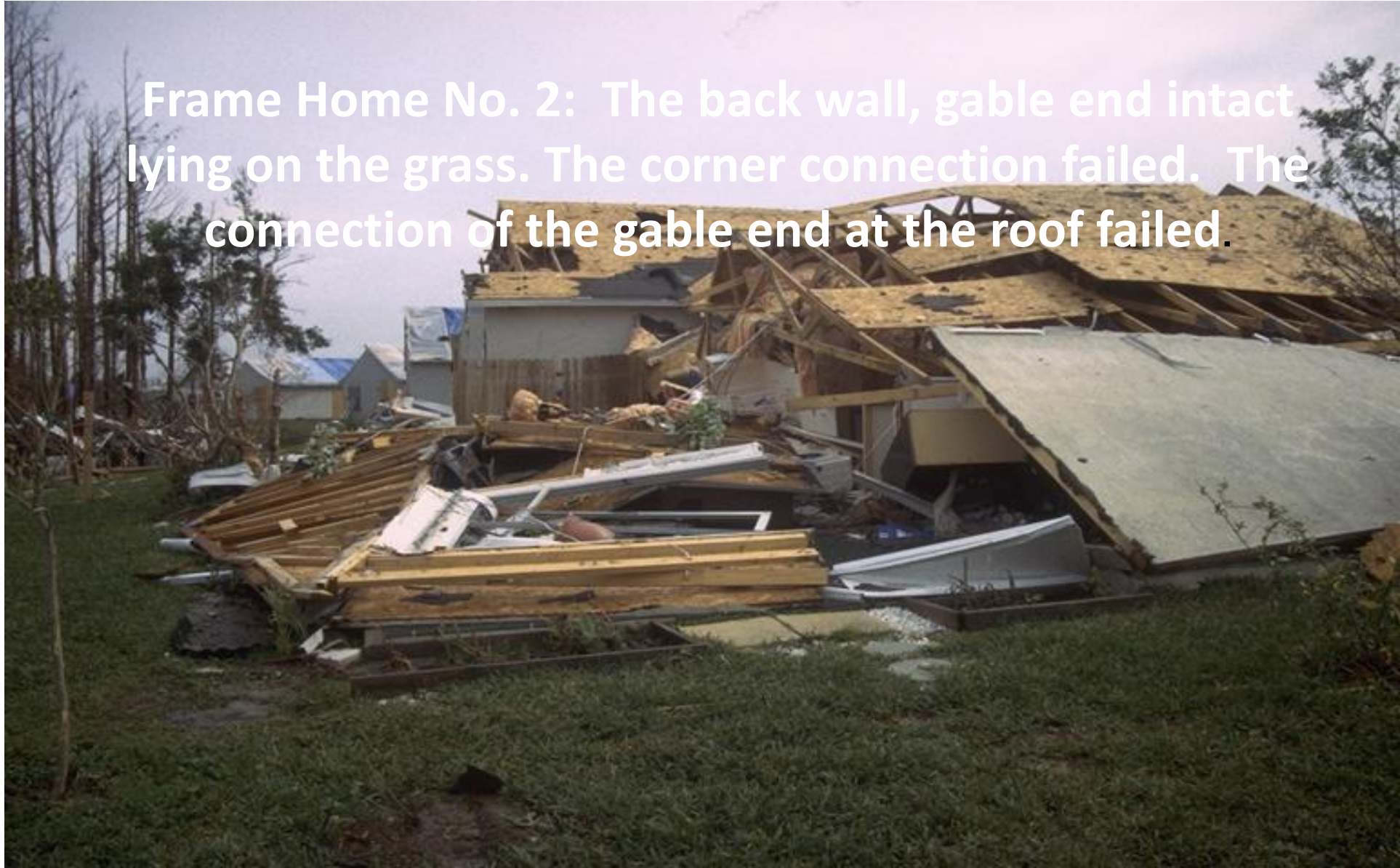
1998 Florida Tornadoes Parsons Pond

- Frame Home #1:
Complete Collapse
- Both front and back
ends completely
separated from the side
walls.

1998 Florida Tornadoes

Parsons Pond

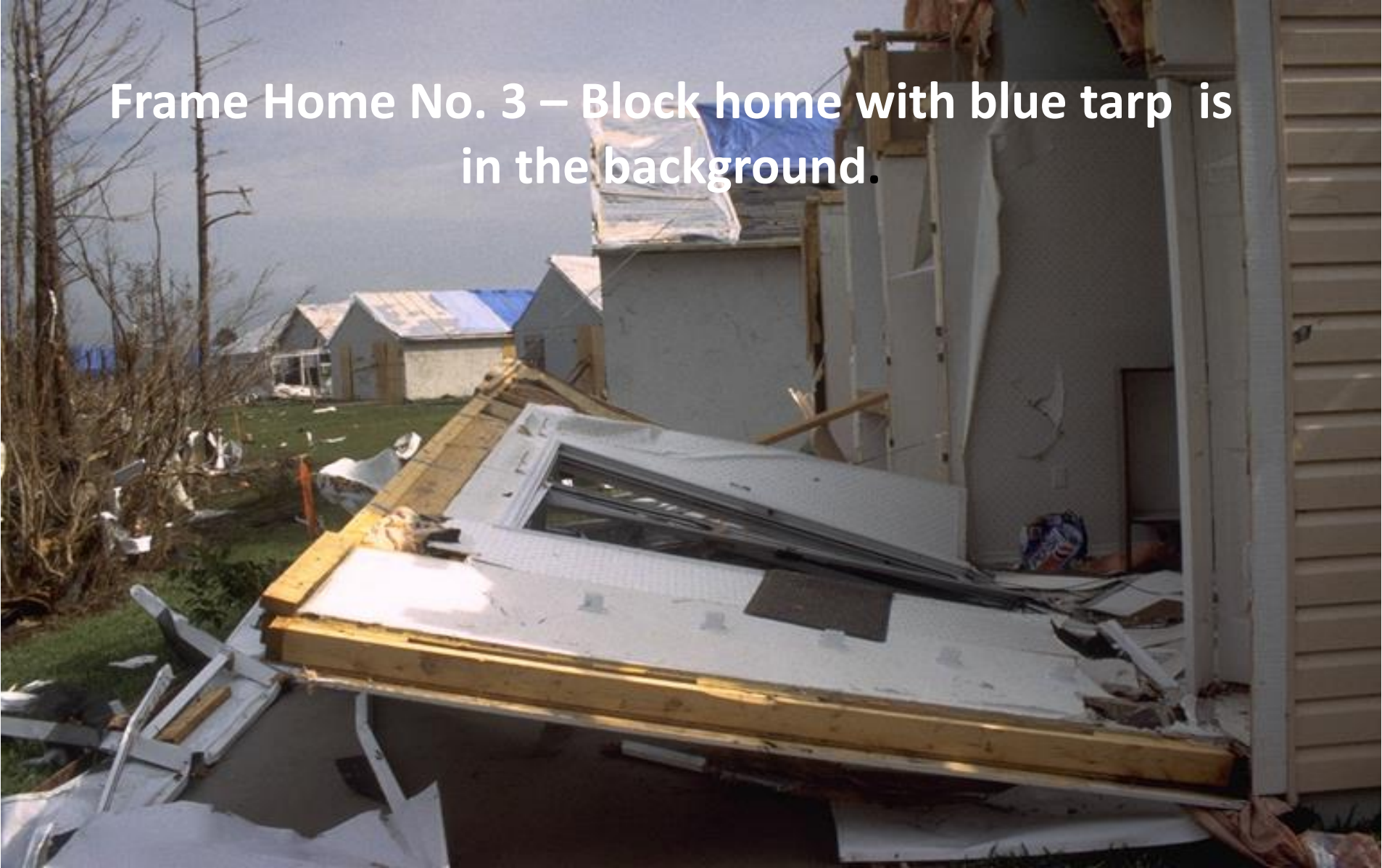
Frame Home No. 2: The back wall, gable end intact lying on the grass. The corner connection failed. The connection of the gable end at the roof failed.



1998 Florida Tornadoes

Parsons Pond

Frame Home No. 3 – Block home with blue tarp is in the background.





1998 Florida Tornadoes

Parsons Pond

Results of missile (automobile) impact:
Belcher, CBO, is viewing the displacement of the
masonry in the area of the impact.



*Lessons from
1998 Florida
Tornadoes*

Designing Masonry for Wind Loads

**Masonry Design Failures in Post Andrew
structures (Built to SSTD 10-93).**

None!

2007 Florida Tornadoes

- Tornado Damage Assessment
- by
- Joe Belcher, CBO
- and
- Don Beers, P.E.



2007 Florida Tornadoes

Between 3 and 4 am on February 2,
2007 tornadoes ripped through
Central Florida killing 21 people.



Again, nearly all those killed were in light
frame manufactured homes
or trailers.

2007 Florida Tornadoes



2007 Florida Tornadoes



2007 Florida Tornadoes



2007 Florida Tornadoes

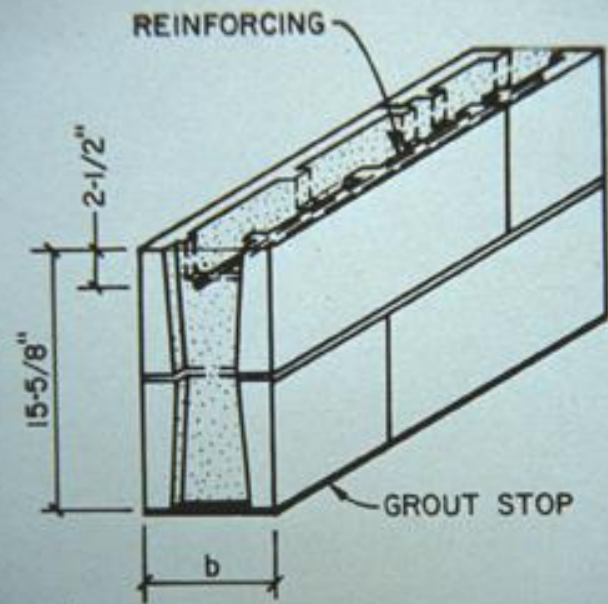


2007 Florida Tornadoes

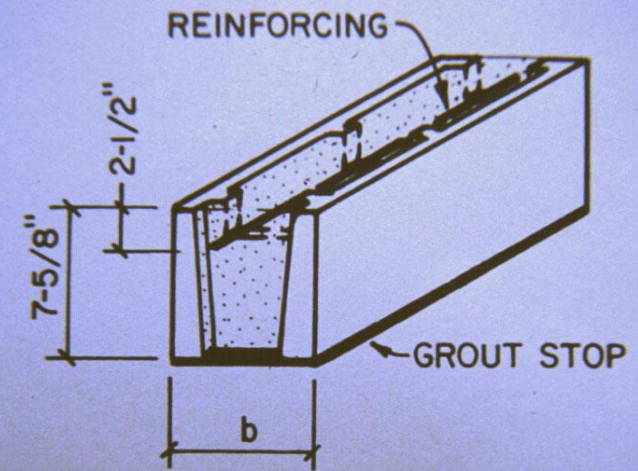


2007 Florida Tornadoes





MASONRY BOND BEAM TYPE "B"



MASONRY BOND BEAM TYPE "K"

A blue decorative shape on the left side of the slide, featuring a wavy bottom edge.

Lessons from 2007 Tornadoes

Designing Masonry for Wind Loads

Masonry Design Failures

- 8" Bond beam
 - Embedment of Verticals into Bond Beam
(use 16" bond Beam)

2017 Hurricane Irma Damage Report

Don Beers, Adrian Engineering,
Inc.

Joe Belcher, JDB Code Services,
Inc.

Pat McLaughlin,
McLaughlin
Management Assoc.,
Inc



2017 Hurricane Irma

The strongest storm on record to exist in the open Atlantic region, Irma caused widespread and catastrophic damage before making its landfall in the Florida Keys on September 10, 2017.



The World Meteorological Organization retired the name *Irma* from its rotating naming lists due to the extensive damage and loss of life in the northeastern Caribbean and the United States, particularly in Florida.

2017 Hurricane Irma

- During our review of damage from Hurricane Irma, both up in Jacksonville and throughout SW Florida and the Keys, we found only two instances of failed masonry – regardless of age.
 - An old unreinforced wall fell over in Naples.
 - An old unreinforced masonry home got washed away by storm surge (1811 Long Beach Drive, Big Pine Key).



2017 Hurricane Irma



2017 Hurricane Irma

561 Blackbeard Road, Little Torch Key



2017 Hurricane Irma

2017 Hurricane Irma



The area highlighted within the panel extends from 491 to 711 W Indies Drive on Ramrod Key.

Within that area 8 wood frame homes were totally destroyed. There was no damage to any concrete masonry home along W Indies Drive other than minor roof damage.



2017 Hurricane Irma





2017 Hurricane Irma



2017 Hurricane Irma



2017 Hurricane Irma



2017 Hurricane Irma




- Light-frame wood construction did not perform as expected. Heavy-frame masonry construction performed
- All structural connections in coastal environments need to convert from galvanized to stainless steel connections
- Light gauge metal cladding and exterior insulation and finishing systems (EIFS) had failed with Irma wind speeds
- Irma was not a code event – did not test the code. Winds < 125 mph
- Tornado / Microbursts occurred pushing winds gust over 130 mph.
- Codes need to adopt ICC 600-2014 (Hurricane Resistant Residential Construction methods)
- Codes need to adopt more parity between heavy and light frame materials.

Conclusions from Irma – We Need to Prepare Now!

An aerial photograph showing the aftermath of a hurricane. The landscape is covered in a thick layer of debris, including wood, metal, and other unidentifiable fragments. Large areas of land are submerged in water, indicating significant flooding. The ocean is visible in the background, with a dark, overcast sky above it. The overall scene depicts a state of total devastation.

Hurricane Michael...What's next?



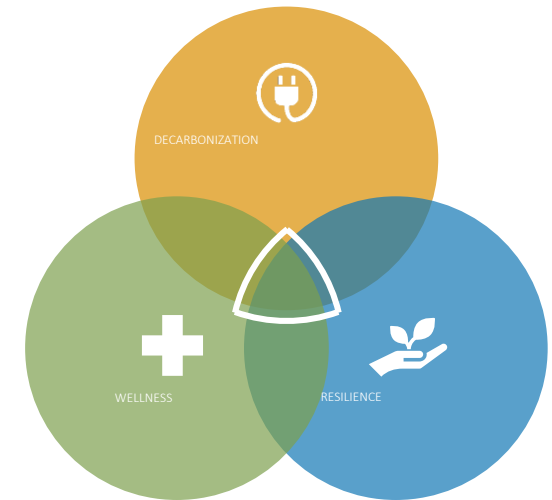
Modern Masonry not only offers significant advances in strength, energy efficiencies and aesthetic flexibilities, but has the ability to resist the impacts of our extreme weather conditions.



Recap Sustainability

People. Planet. Prosperity.

- Masonry systems are especially suited to provide resistance to natural and man-made hazards.
- Masonry has the necessary hardness and mass to resist the high winds and flying debris of tornadoes and hurricanes.
- Masonry can significantly reduce the energy usage of a building.
- Masonry is durable, resilient and requires little maintenance.





Plan for the Future!

- Architectural concrete masonry units speak the balance of durability, safety, beauty and sustainability.
- Advocate the necessity for maintaining strong codes governing the construction of all types of wall systems.



Thank you!