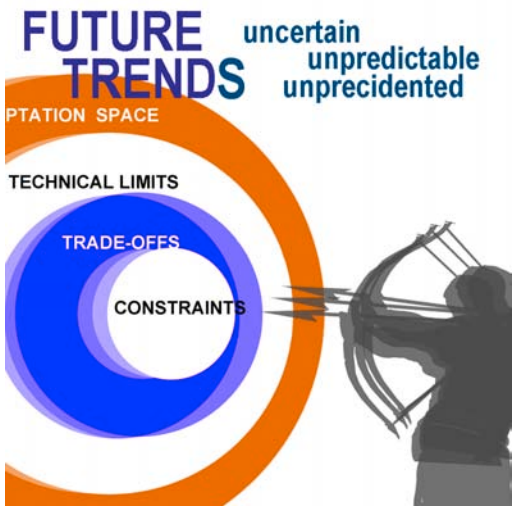
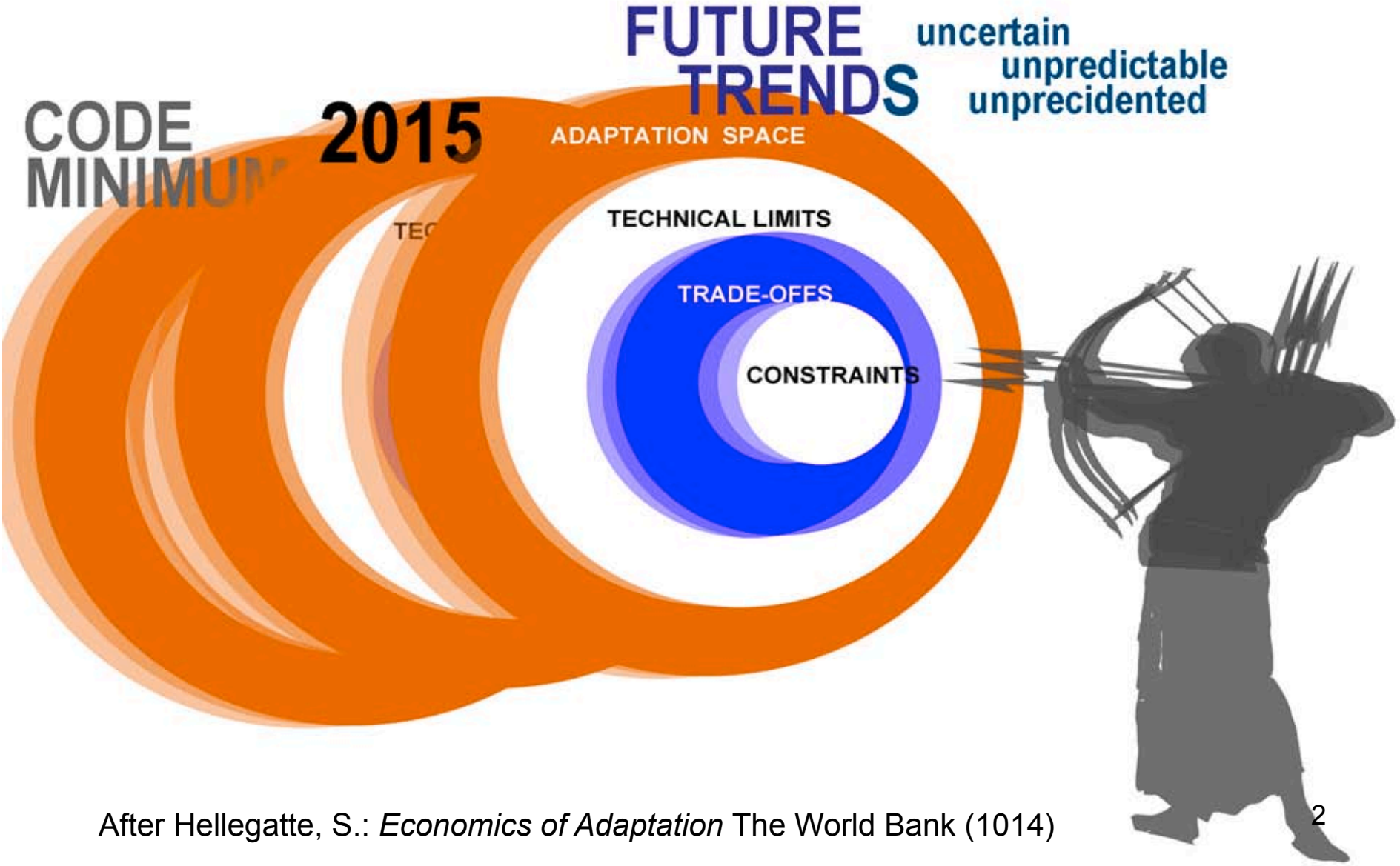


Donald Watson, FAIA

1 - Moving targets
2 - Complex systems
3 - Who owns the solution?

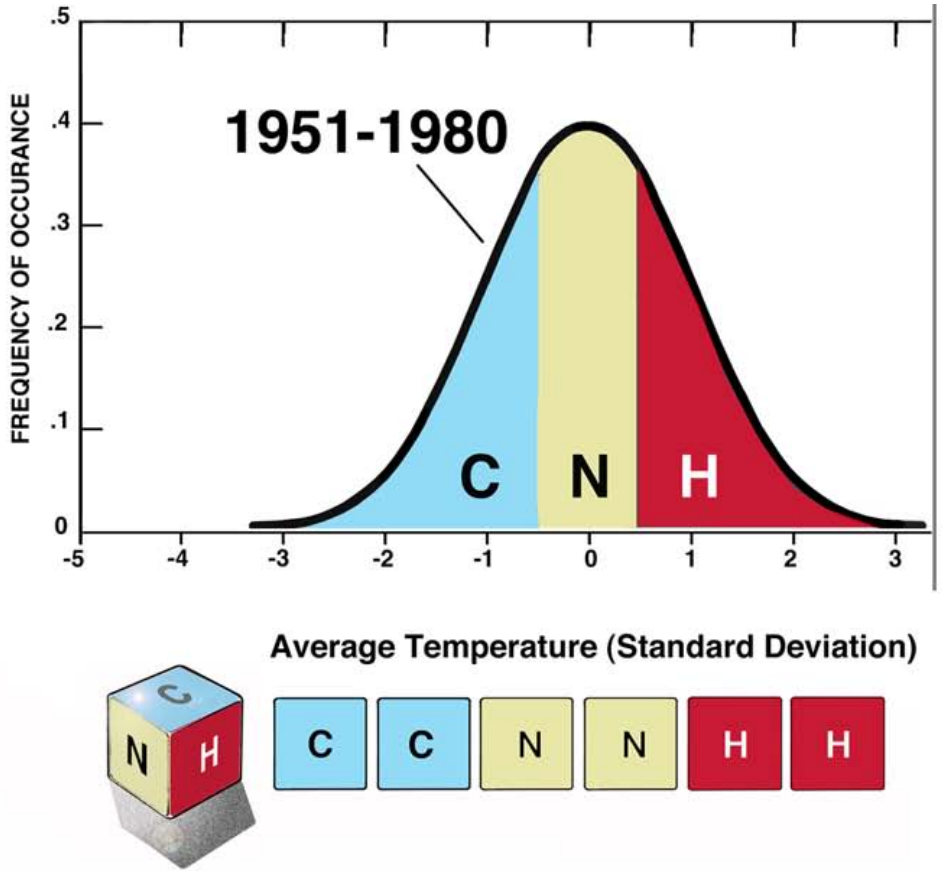
1 - Moving targets

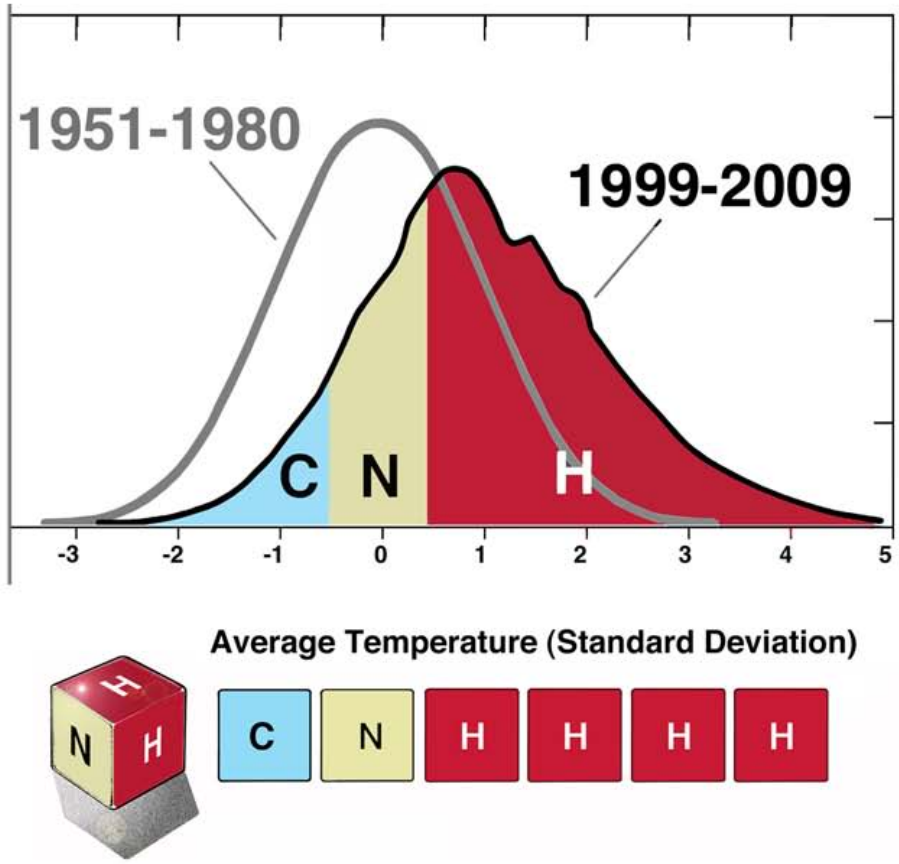


After Hellegatte, S.: *Economics of Adaptation* The World Bank (1014)

1 - Moving targets

HEAT



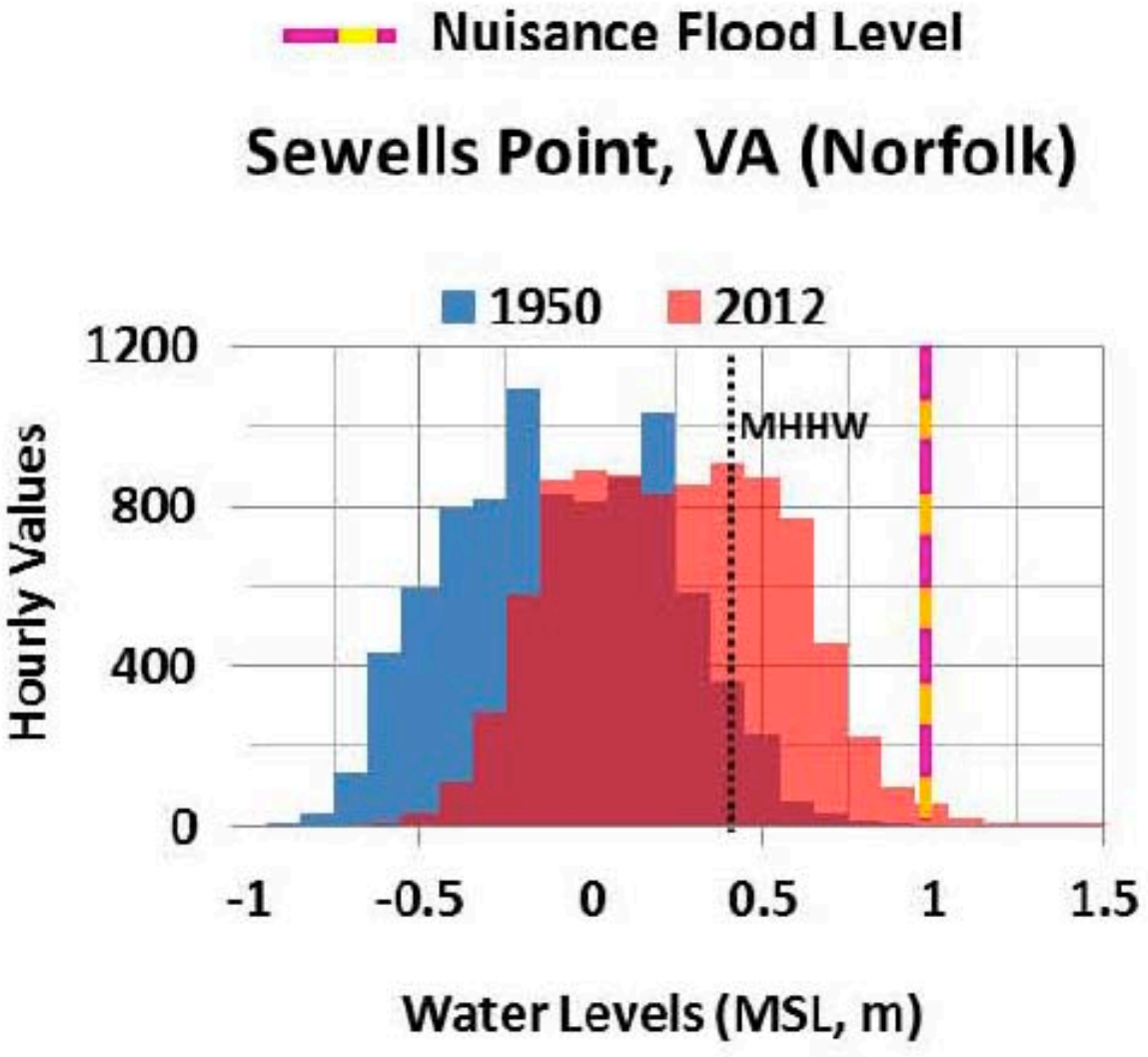


SHIFT IN DISTRIBUTION OF AVERAGE SUMMER TEMPERATURES

DATA: James Hansen *Proceedings National Academy of Sciences* www.pnas.org/content

1 - Moving targets

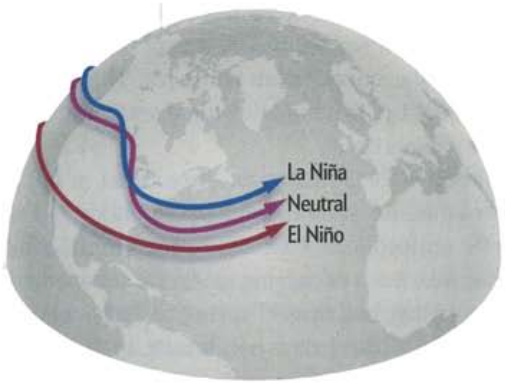
SEA LEVEL RISE



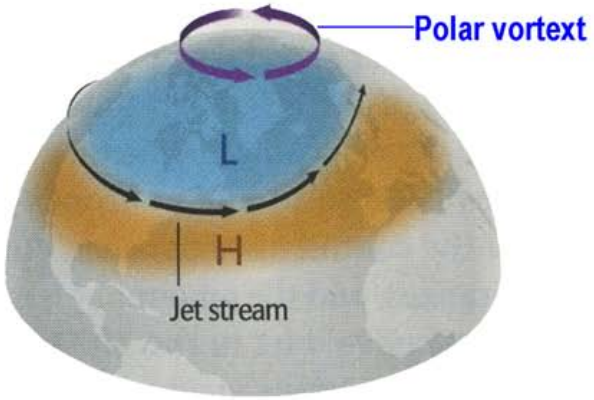
Daily exceedances/year above local NOAA NWS nuisance flood level (elevation threshold). www.**noaa**news.**noaa**.gov/stories2014/20141218_sealevelrise.html

1 - Moving targets

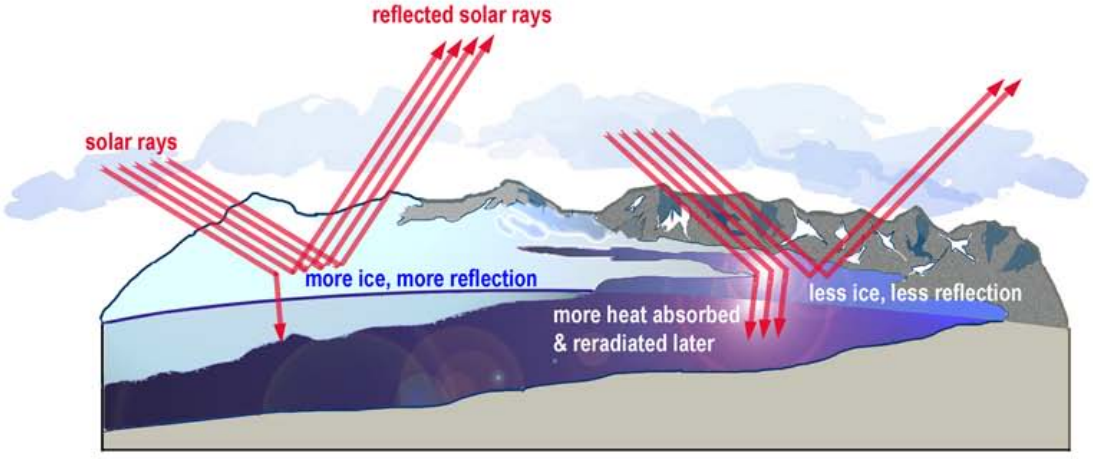
EXTREME HEAT & COLD



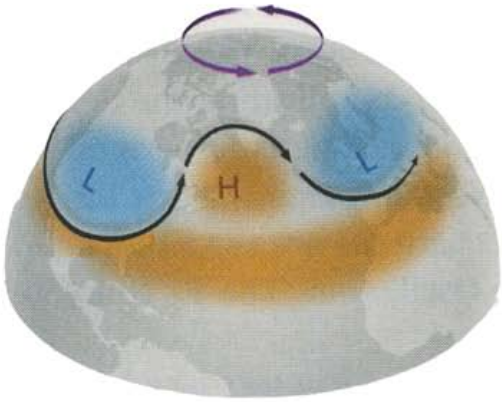
ATMOSPHERIC OSCILLATION



positive phase - stronger winds



LESS ICE, WEAKER WINDS around the Pole

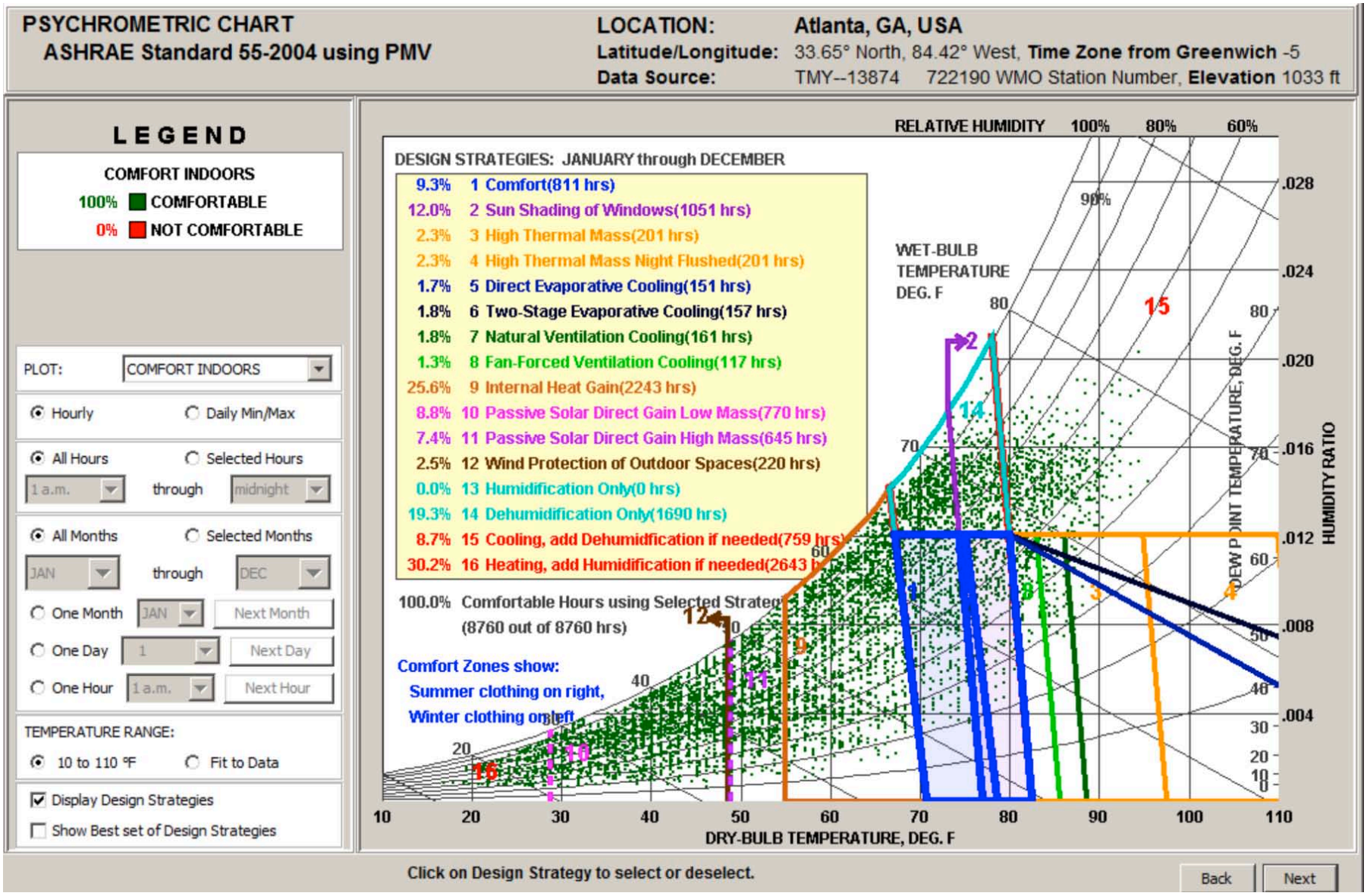


negative phase - weaker winds

ARCTIC OSCILLATION

Masters, J. "The Jet Stream is Getting Weird" *Scientific American* Dec. 2014

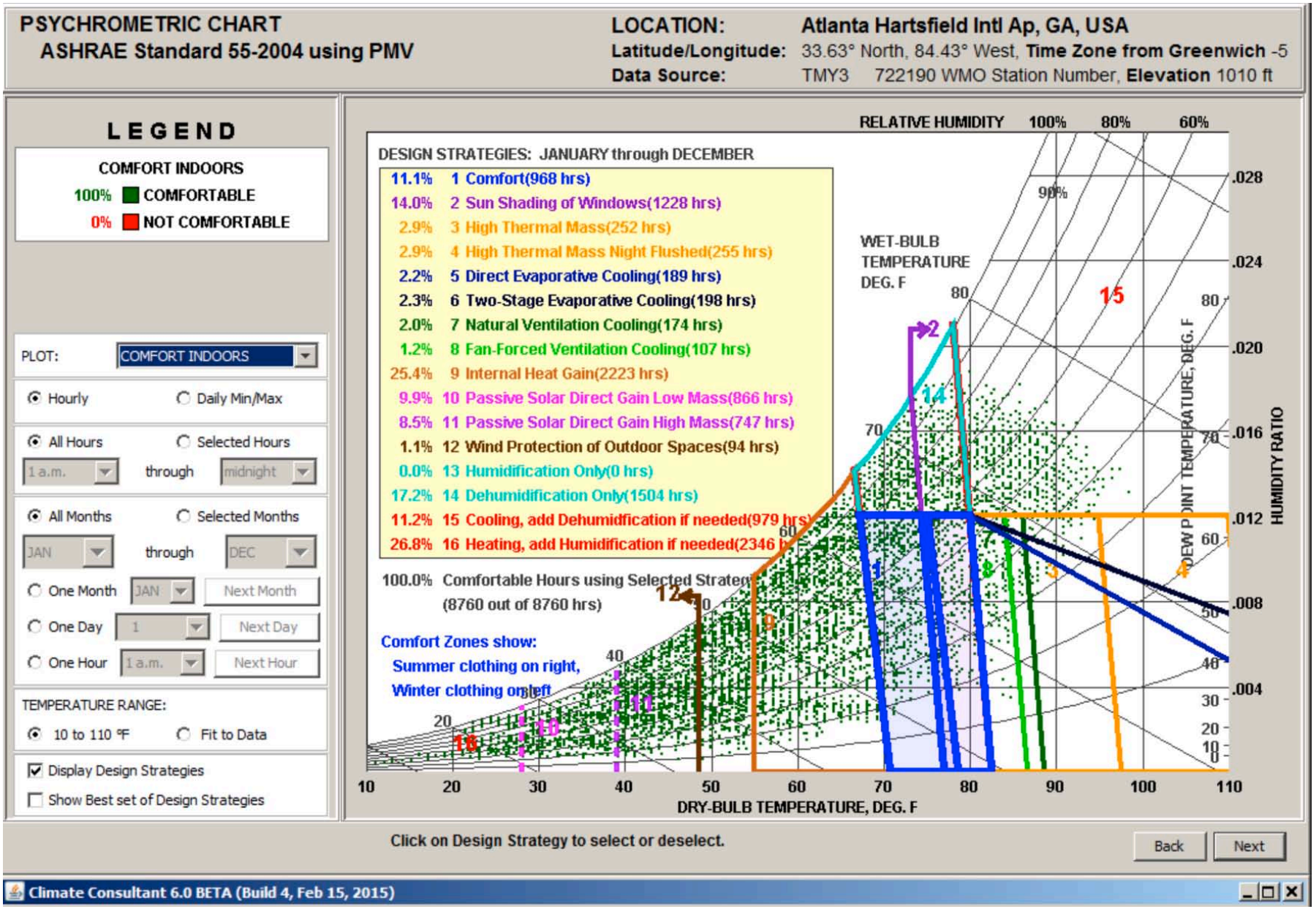
Psychrometric chart ATLANTA – TMY1974 CLIMATE CONSULTANT



Milne, Murray *Climate Consultant* (2015) / Watson, D. and K. Labs *Climatic Design* (1984)
http://climate-consultant.software.informer.com/download/

Psychrometric chart ATLANTA – TMY2005

CLIMATE CONSULTANT



http://climate-consultant.software.informer.com/download/

	ATLANTA	TMY 1 1974	TMY3 2005	% delta	passive HEAT	passive COOL	decrease HEAT	increase AC
1	Comfort	9.3	11.1	1.8	1.8	1.8	1.8	
2	Sunshade windows	12.0	14.0	2.0		2.0		2.0
3	High mass	2.3	2.9	0.6		0.6		
4	High mass w/ night flushing	2.3	2.9	0.6		0.6		
5	Direct evaporative cooling	1.7	2.2	0.5		0.5		
6	2-stage evaporative cooling	1.8	2.3	0.5				0.5
7	Natural ventilation	1.8	2.0	0.2		0.2		
8	Fan-induced ventilation	1.3	1.2	-0.1				0.1
9	Internal heat gain	25.8	25.4	-0.4		0.4		
10	Passive - direct gain	8.8	9.9	1.1	1.1			
11	Passive - high mass	7.4	8.5	1.1	1.1			
12	Wind protection outside	2.5	1.1	-1.4				
14	Dehumidification only	19.3	17.2	-2.1				2.1
15	Cooling + Dehumidification	8.7	11.2	2.5				2.5
16	Heating + Humidification	30.2	26.8	-3.4			3.4	
				12.5	4.0	6.1	5.2	7.2

from 1974 to 2005

5.2% decrease HEATING REQUIREMENT

7.2% increase AIR CONDITIONING REQUIREMENT

4.0% increase PASSIVE HEATING POTENTIAL

6.1% increase PASSIVE COOLING POTENTIAL

2 - Complex systems

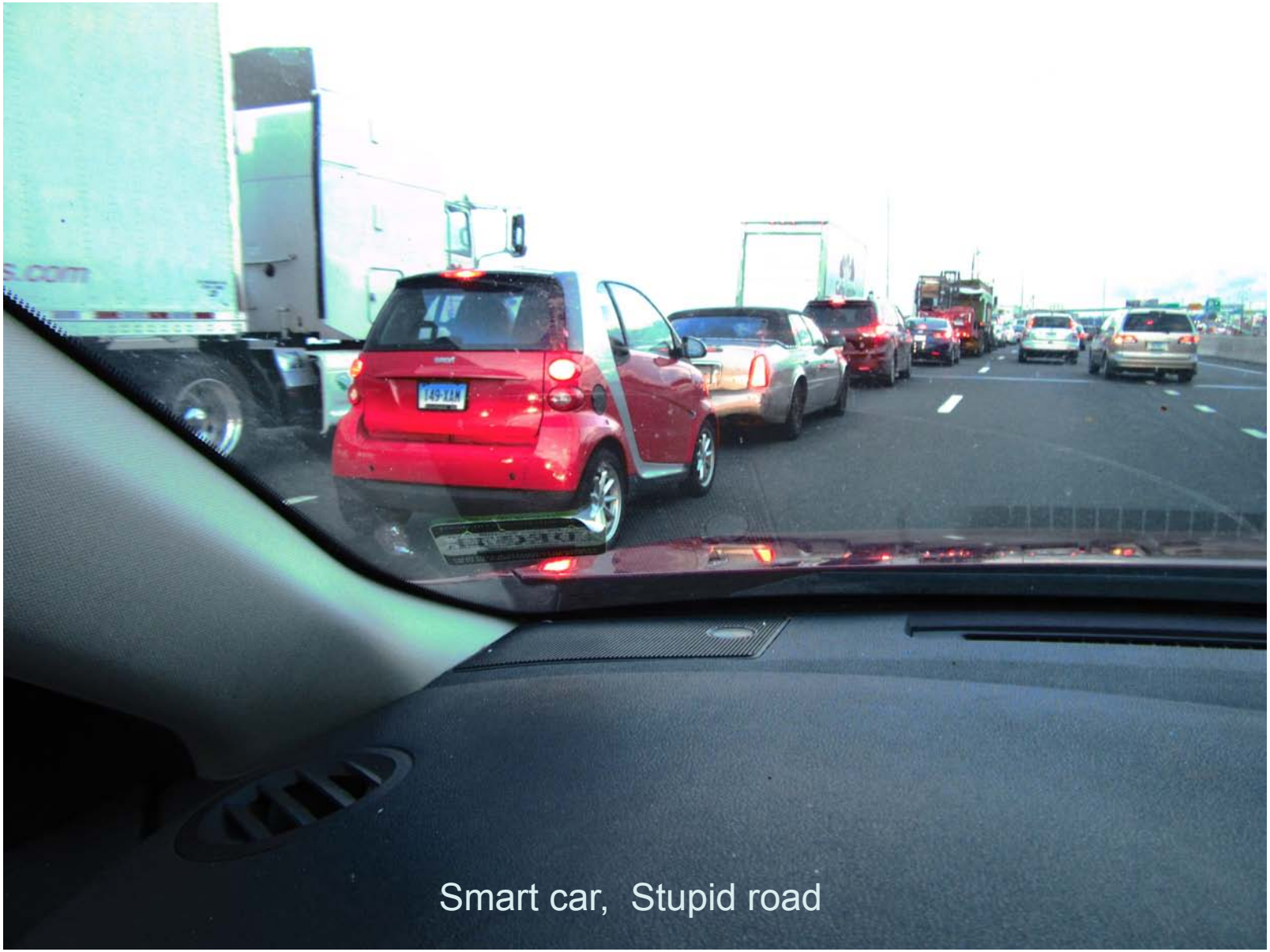
2 - Complex systems

Power
Water
Sewer
Waste
Debris
Transport
Communication
Fire / police / EMS
Pollution
Health emergency
Business interruption

2 - Complex systems

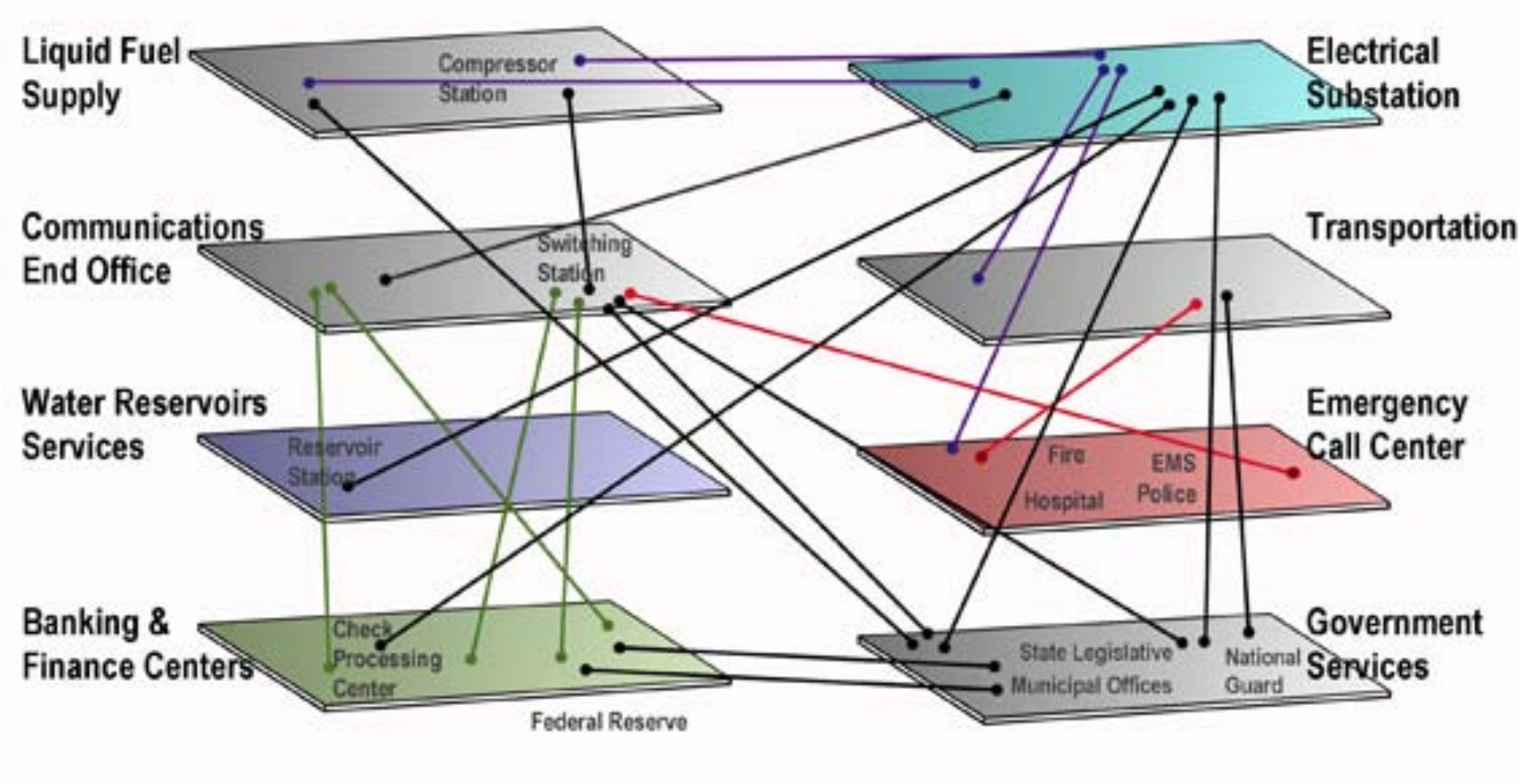
Flood-resistant house, flood-prone site

2 - Complex systems



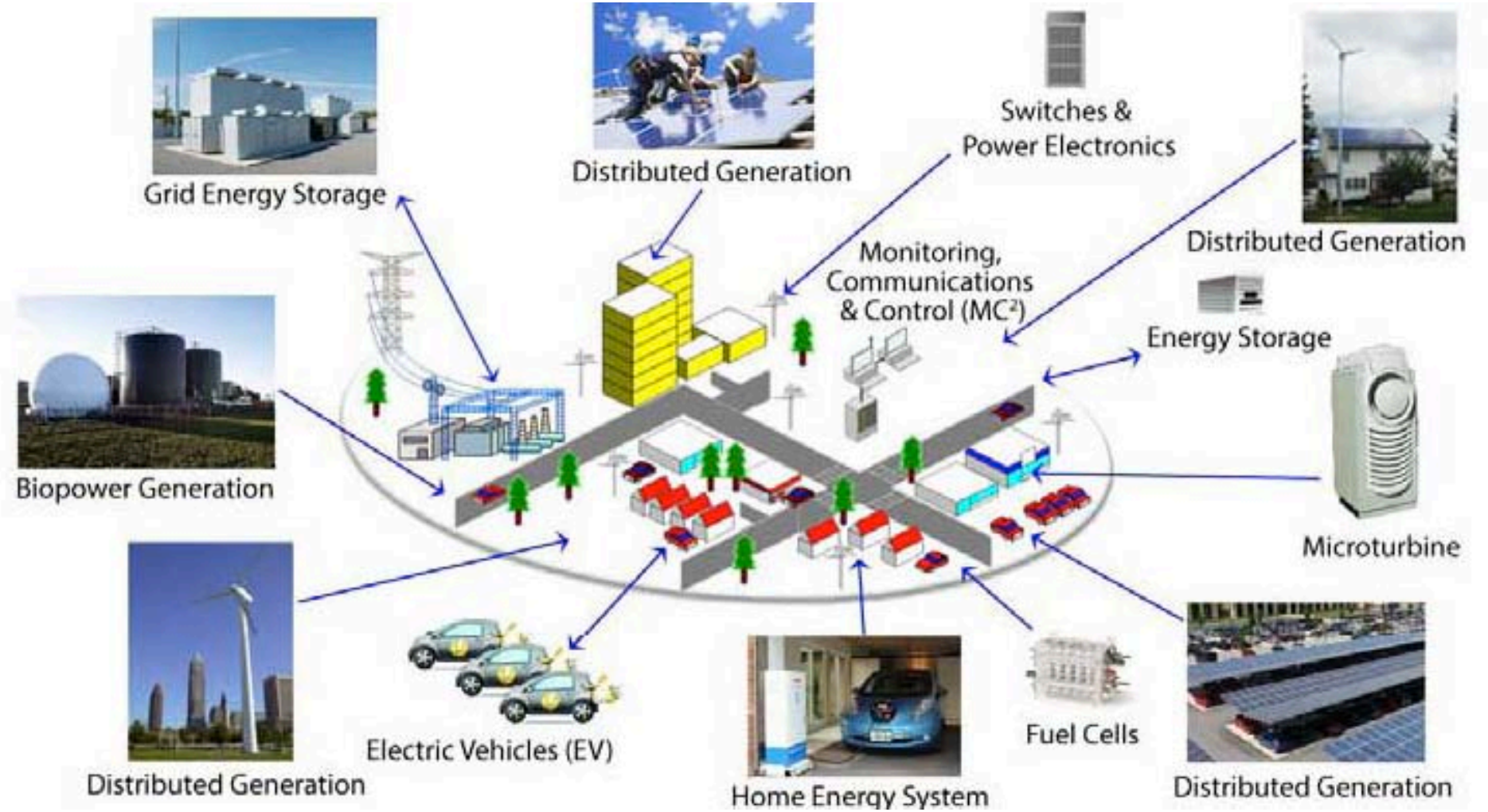
Smart car, Stupid road

2 - Complex systems

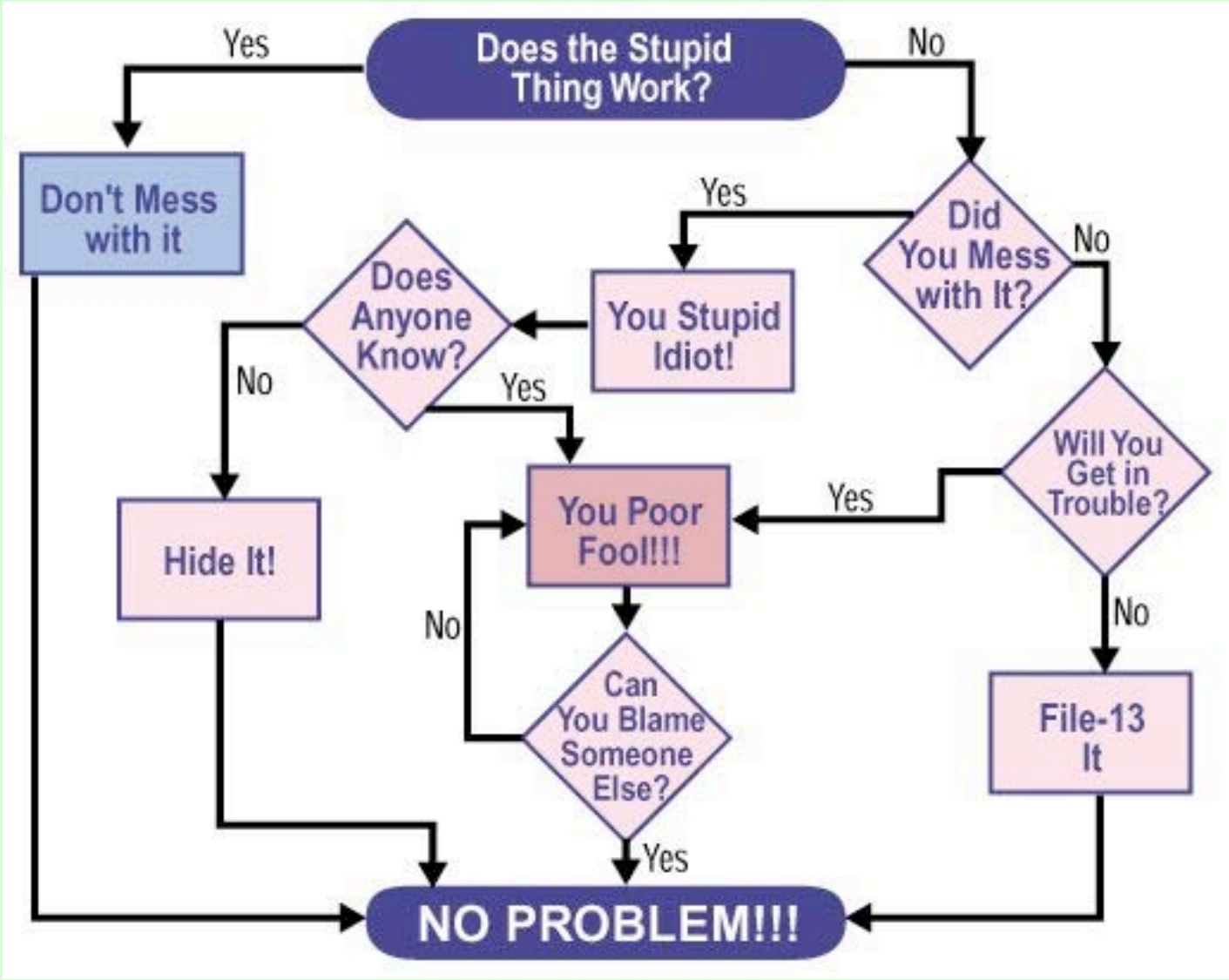


after: U.S. DHS National Infrastructure Protection Plan (NIPP) www.dhs.gov/xprevprot

2 - Complex systems: and what to do about it



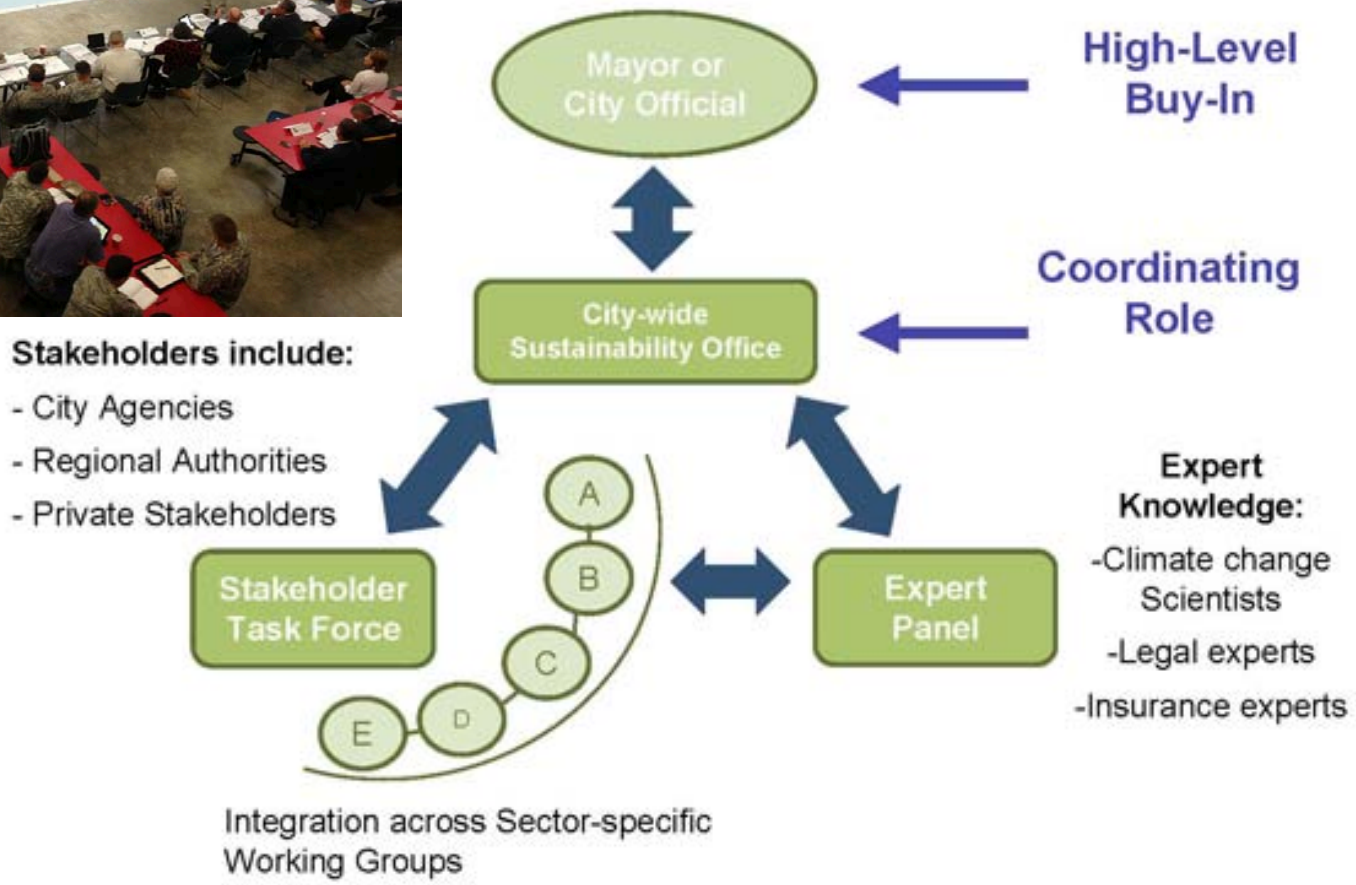
3 - Who owns the problem?



3 - Who owns the solution?

L: PHOTO: Thomas Frey, Eur. PA: St. Goarshausen, Germany June 4, 2013
R: Bold Concept for Post-Sandy Manhattan Prof. Roy Strickland, U. Michigan M.U.D.

3 - Who owns the solution?



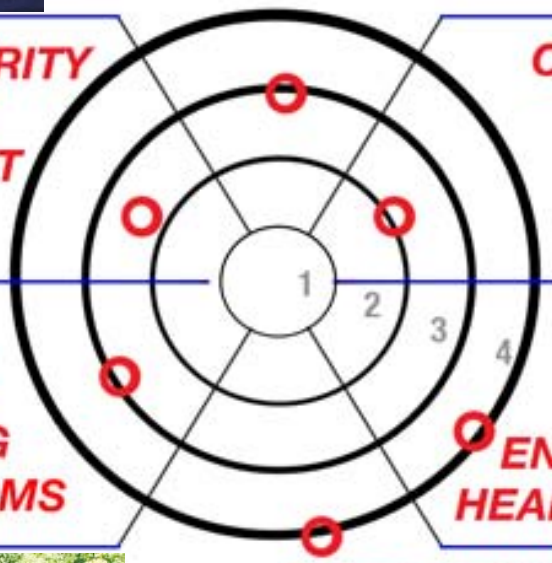
New York Acad. of Sciences (2010) *Climate Change Adaptation in NYC*
www.nyas.org/annals/climate-change-adaptation

Community Planning for Resilience

ECONOMIC DEVELOPMENT / ENTERPRISE

SAFETY / SECURITY EMERGENCY MANAG'T

COMMUNITY SERVICES



NATURAL DISASTER:
- FLOODING
- STORMS

ENVIRONMENTAL HEALTH / JUSTICE

ENERGY/WASTE/ENVIRON'T CLIMATE ACTION

1 On target
2 Best practices
3 Up to standards
4 Ways to go yet

STATUS & GOALS

Beyond Code

1 Building codes represent only minimum standard of compliance.

2 Complying with code does not guarantee that a building or site will be free from damage or destruction in a natural hazard event….

3 …nor that it will not cause harm to public health, safety of welfare.

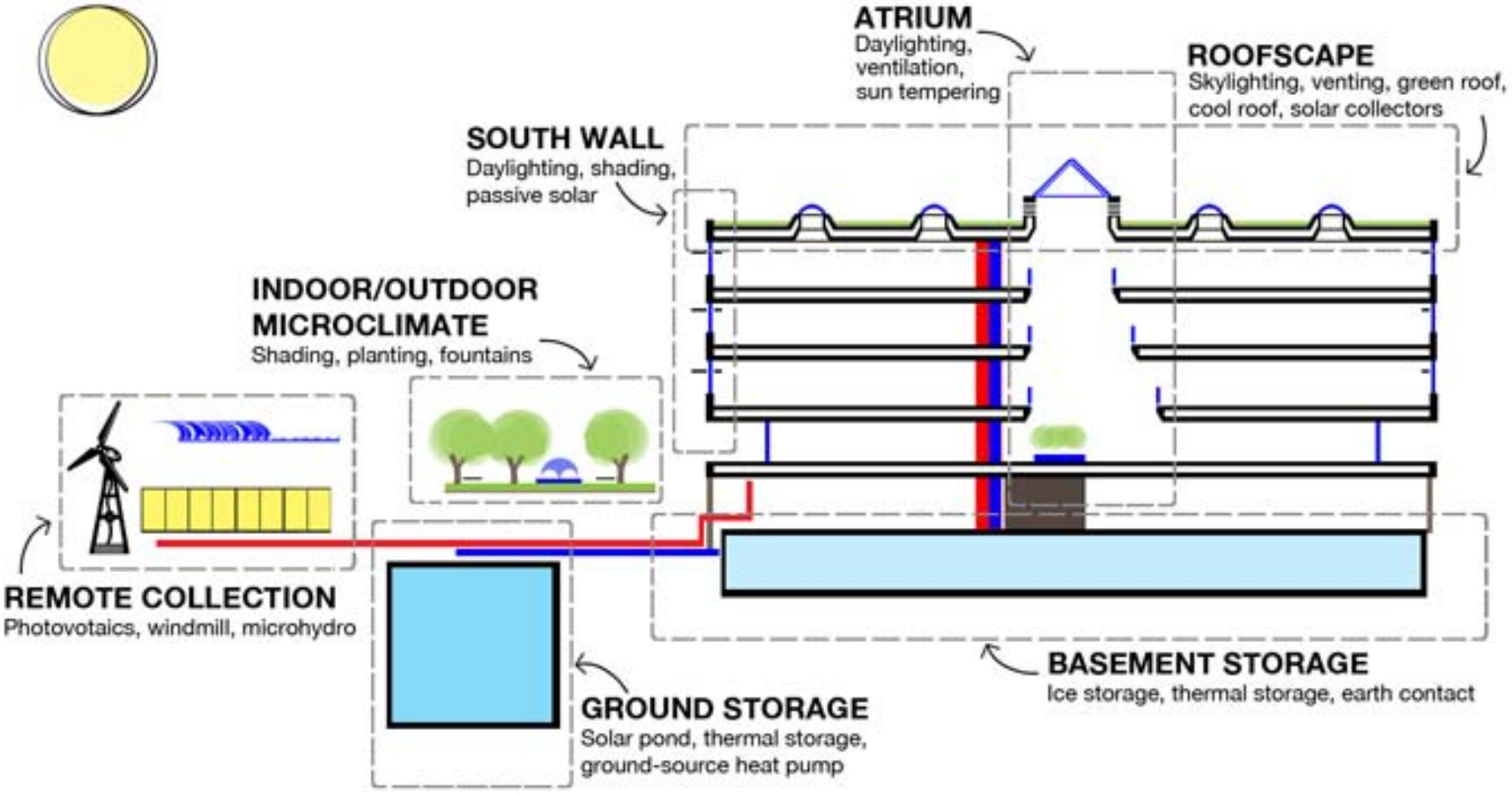
4 Code-complying buildings have been substantially damaged or destroyed in recent storm events.

5 Hazard-resistant design represent an evolving body of knowledge and building science,

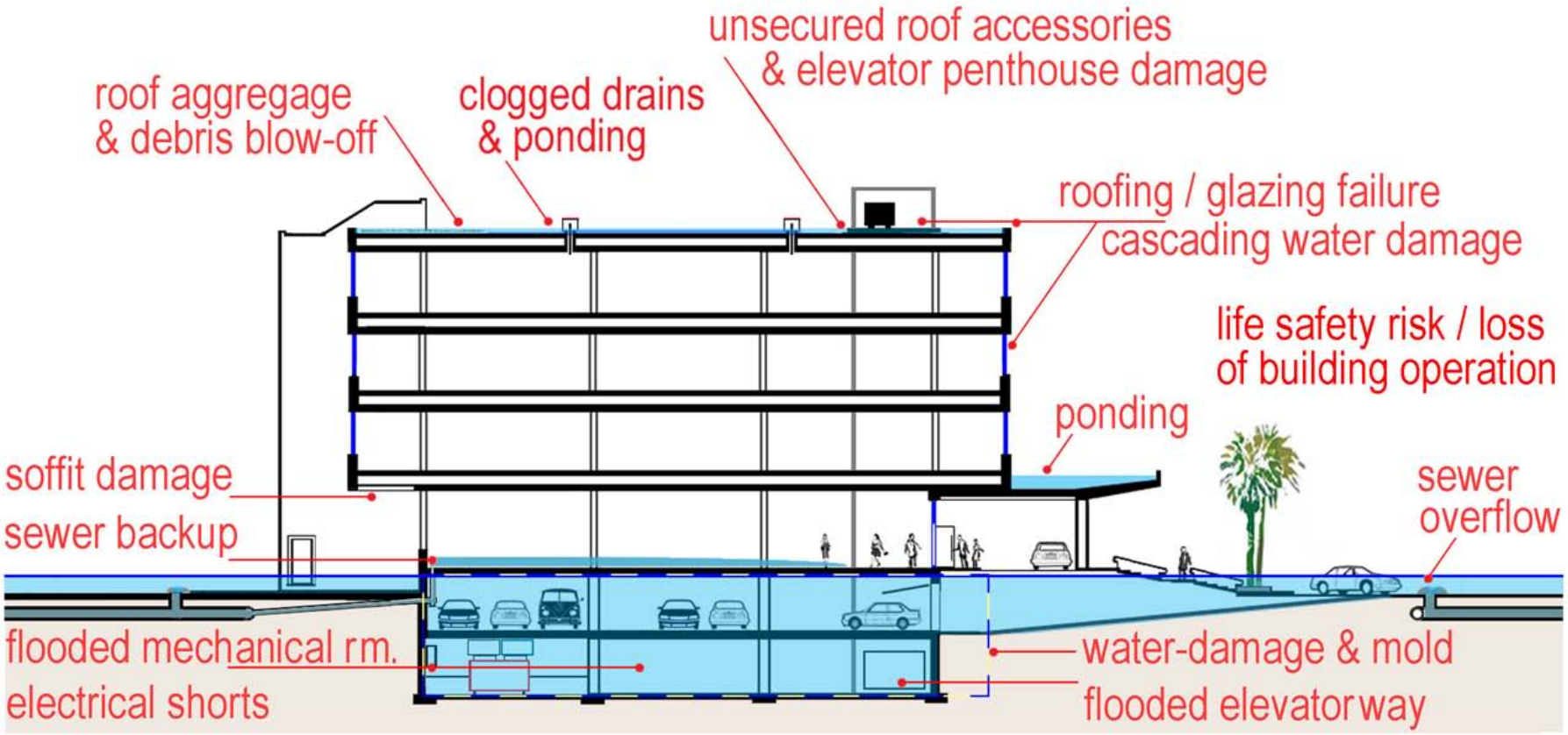
6 Additional assessments of site and community hazards / risks can be documented based on existing conditions and precautionary design.

Net Zero Design

BUILDING SCALE



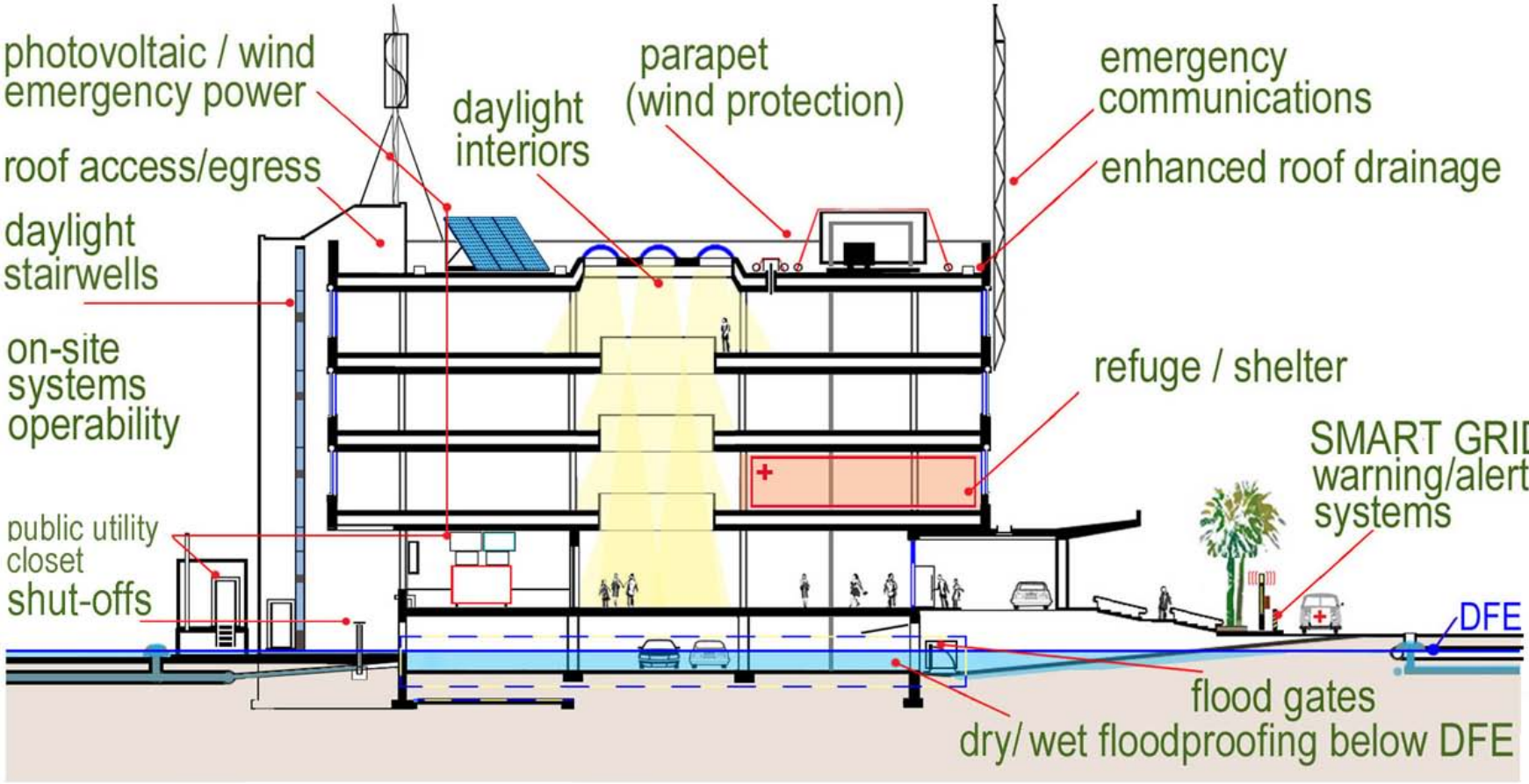
Resilient building - Retrofit



EXISTING BUILDING A ZONES

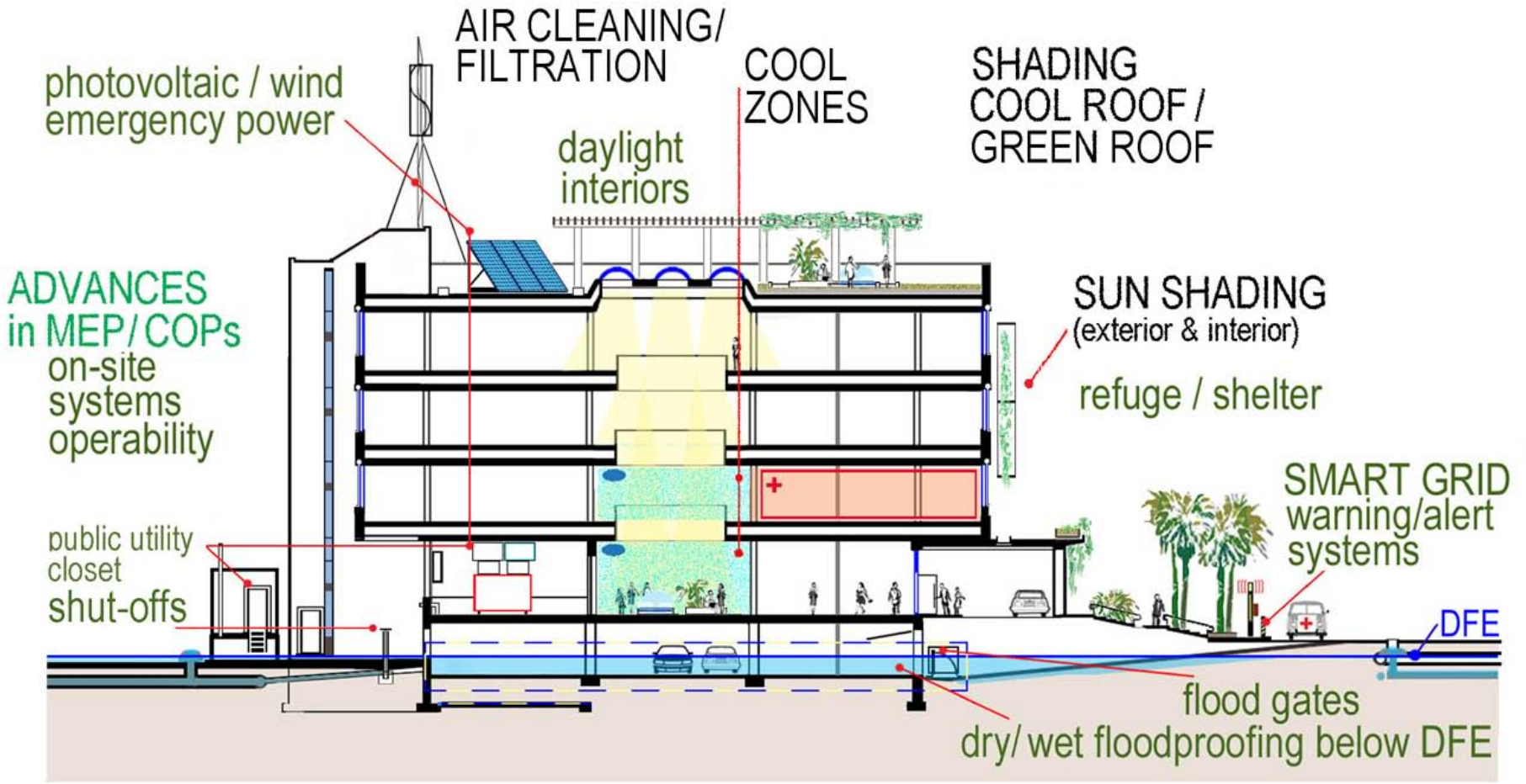
FLOOD VULNERABILITIES

Design for flood resilience



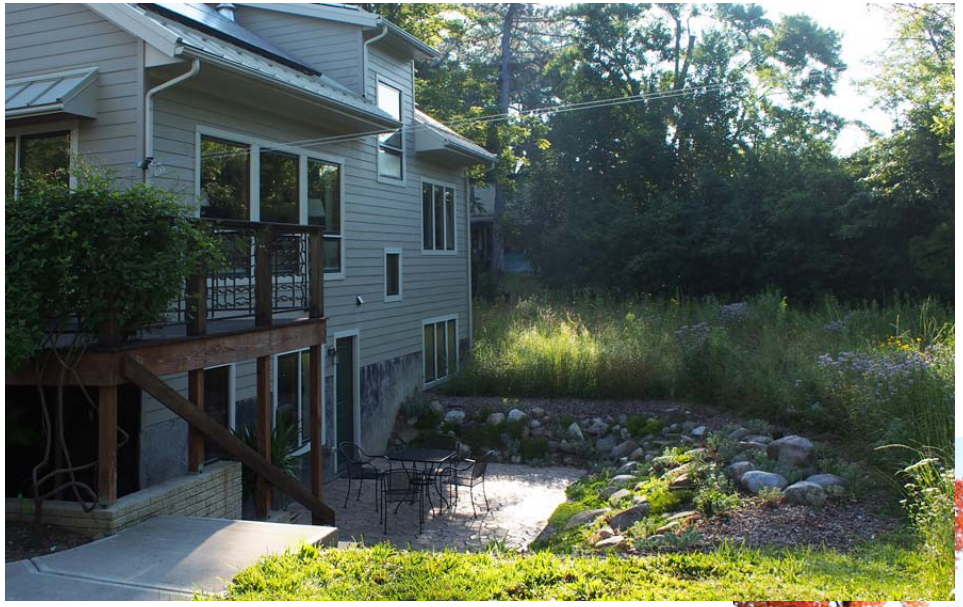
FLOOD INNOVATIONS

Design for climate resilience



HEAT + FLOOD INNOVATIONS

Energy • Food • Water



Bioclimatic design
Passive & active solar
Energy / food positive
Zero carbon
Zero landfill waste
Organic garden
Tall grass prairie
Fish pond / water reserve
International recognition

Trail Magic Home • Carl and Mary McDaniel
*https://oncampus.oberlin.edu/source/articles/2008/.../welcome-**trail-magic***

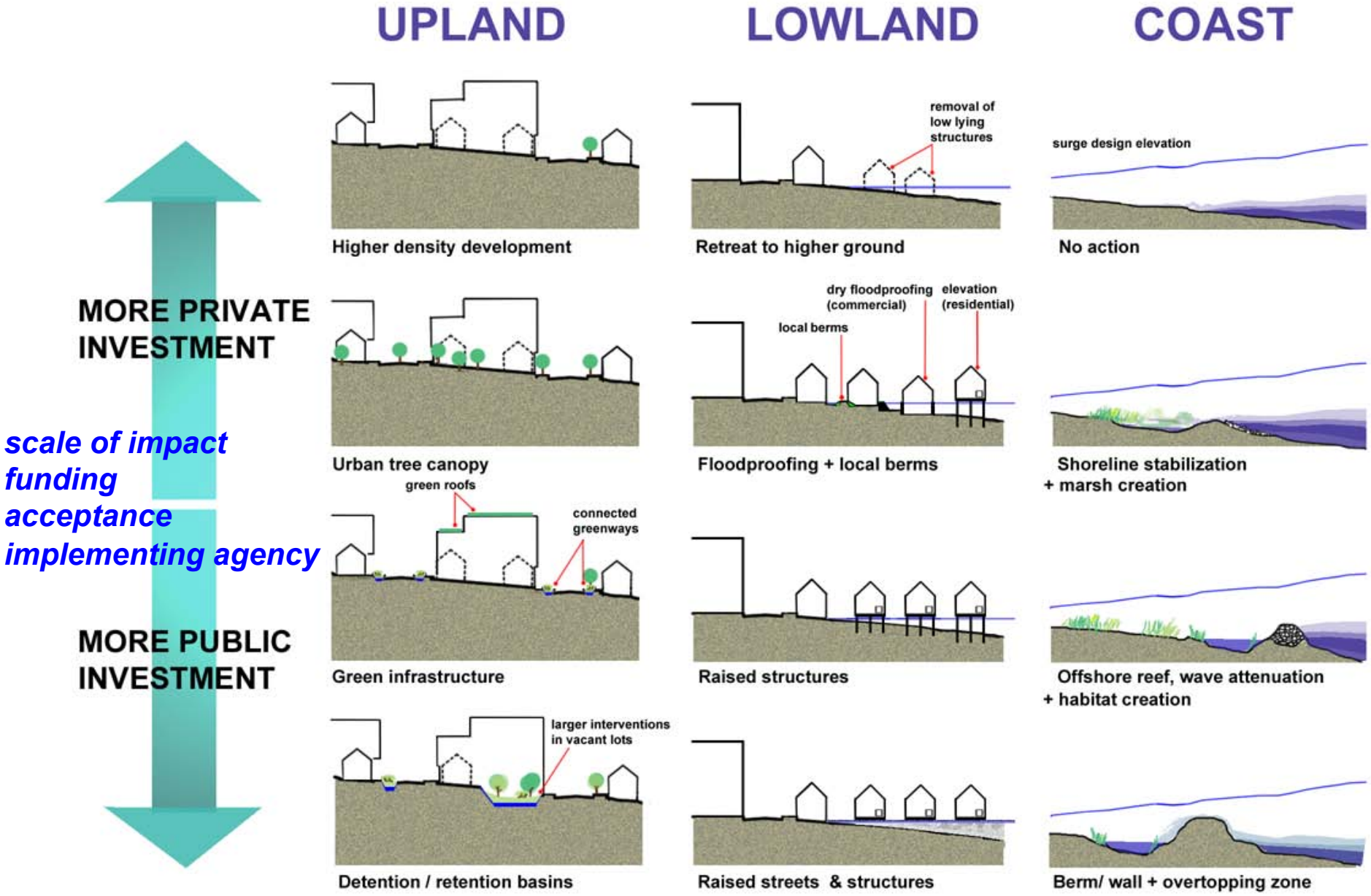
Livable Communities

Urban Center District Zoning Addison Circle Texas
Municipal Investment $ 7 million
Private Sector $320 million
Planners: RTKL

New Urbanist Form-Based Zoning Seaside Florida
Planners: Duany/Plater-Zyberk

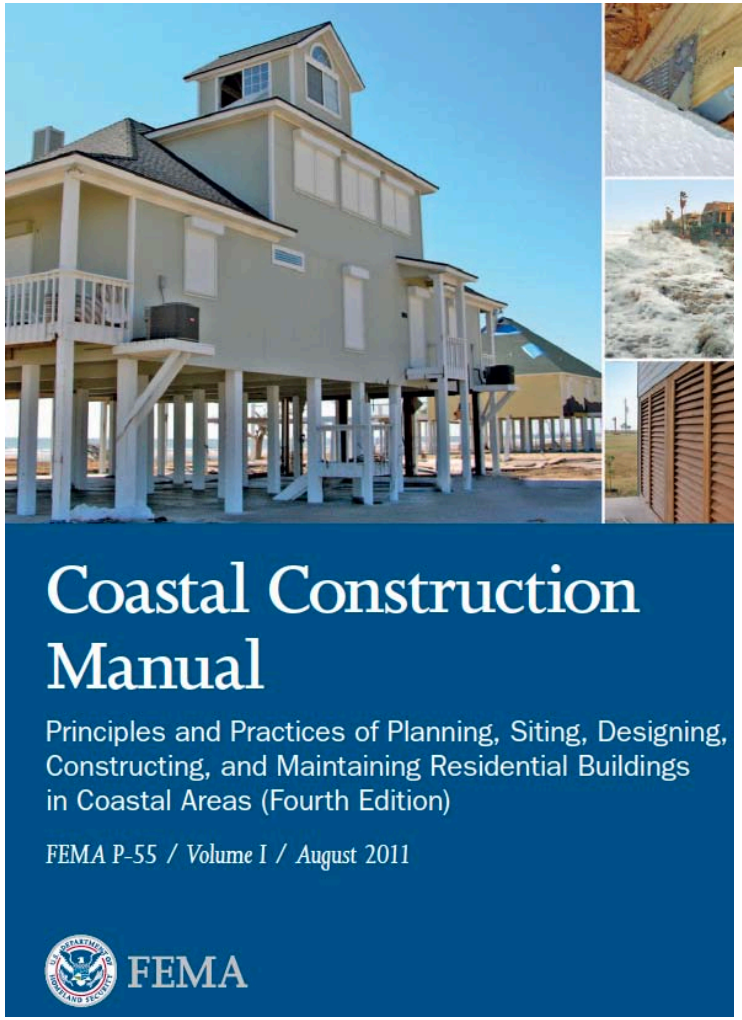
Urban District zoning
Mix-use
Walkable / bikable
Traffic calming
Green infrastructure
Green roofs
Flood resistant design
Conservation/ restoration

PHOTOS: [L] RTKL Architects, www.BetterCities.net; [R] Philosophyandthecity



US HUD Rebuild By Design *Resilient Bridgeport* Waggonner & Ball Architects
http://resilientbridgeport.com ILLUSTRATION: D. Watson

RESOURCES

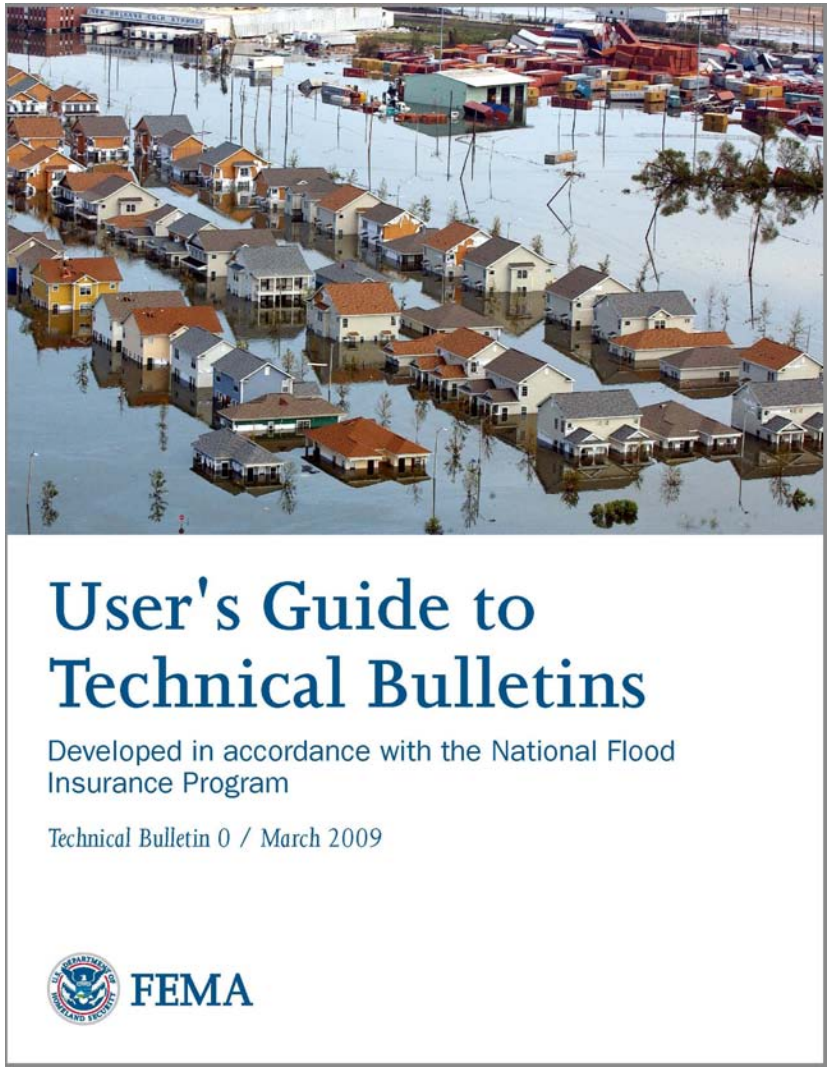


WARNING

Meeting minimum regulatory and code requirements for the siting, design, and construction of a building does not guarantee that the building will be safe from all hazard effects. Risk to the building still exists. It is up to the designer and building owner to determine the amount of acceptable risk to the building.

FEMA Coastal Construction Manual • www.**fema**.gov/media-library/assets/documents/3293

RESOURCES

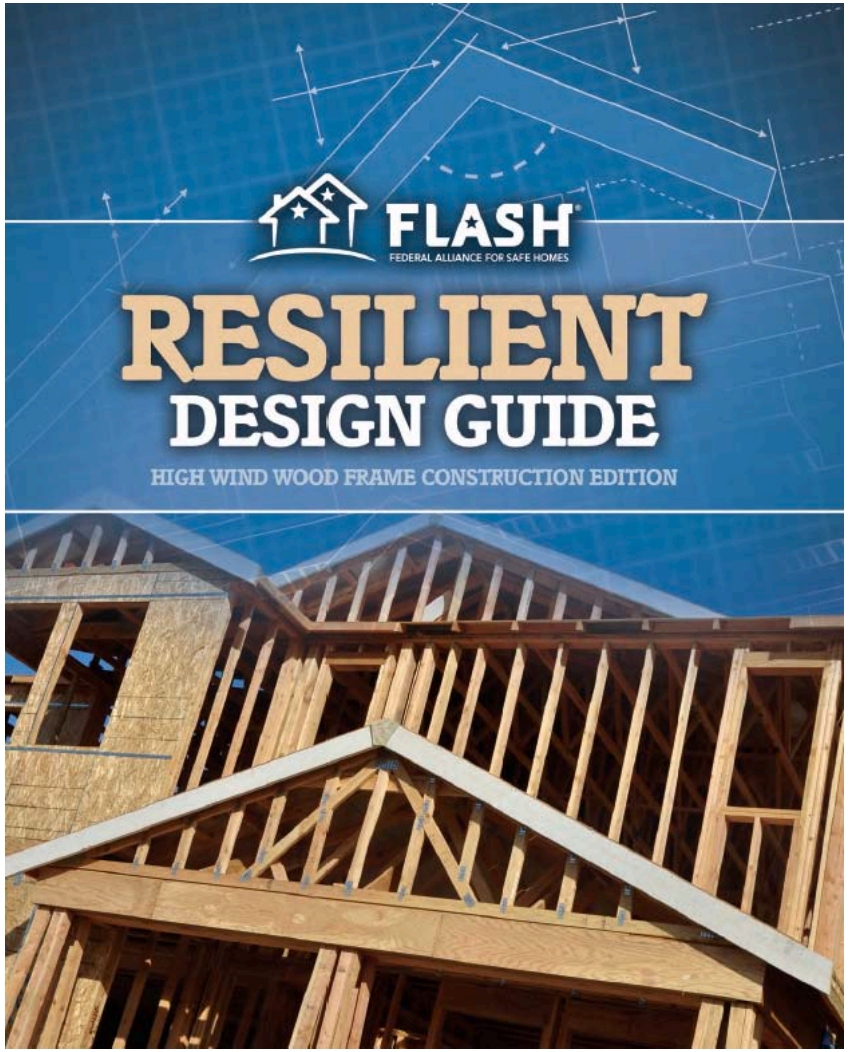


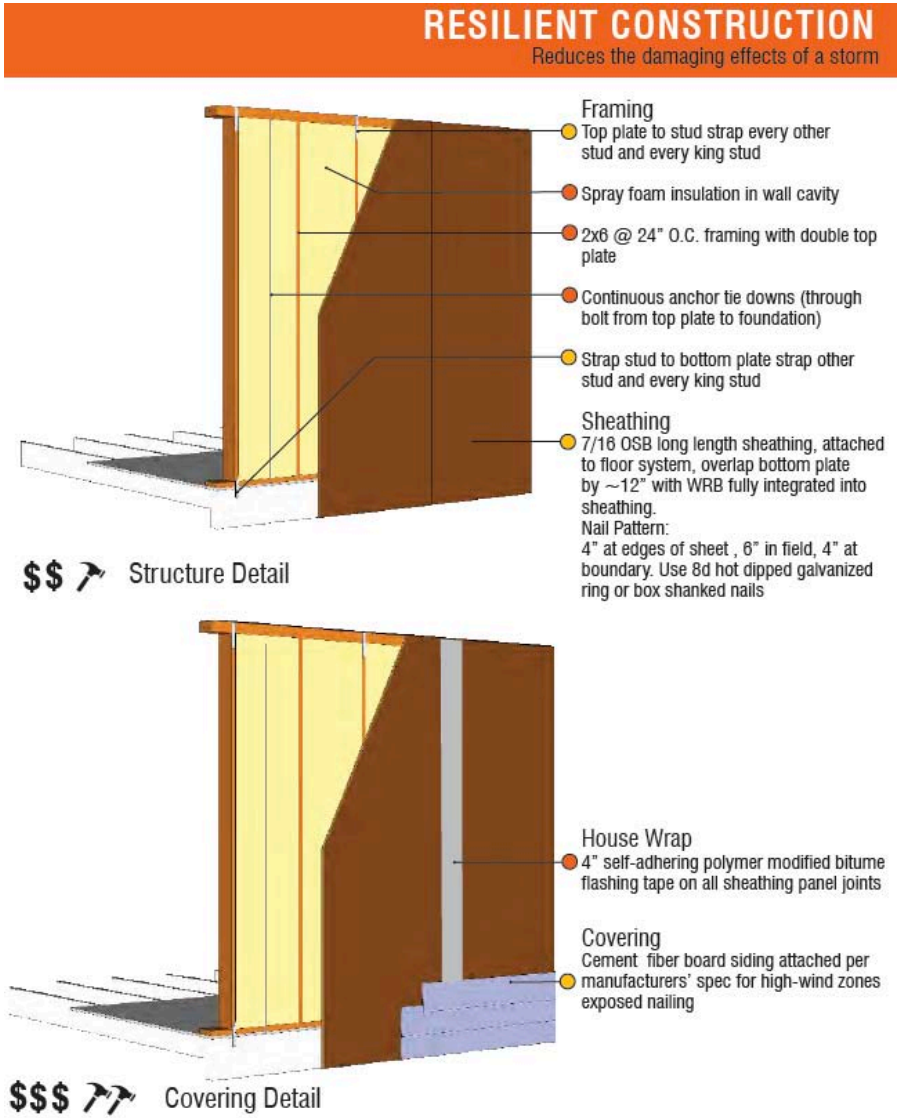
FEMA / NFIP TECHNICAL BULLETINS

0 - User's Guide to Technical Bulletins
1 - Openings in Walls of Enclosures
2 - Flood Damage-Resistant Materials
3 - Non-Residential Floodproofing
4 - Elevator Installation
5 - Free-of-Obstruction Requirements
6 - Below-Grade Parking Requirements
7 - Wet Floodproofing Requirements
8 - Corrosion Protection for Metal Connectors
9 - Design and Construction of Breakaway Walls
10 - Structures Built On Fill
11 - Crawlspace Construction in SFHAs

FEMA *Technical Bulletins* • https://www.fema.gov/nfip-technical-bulletins

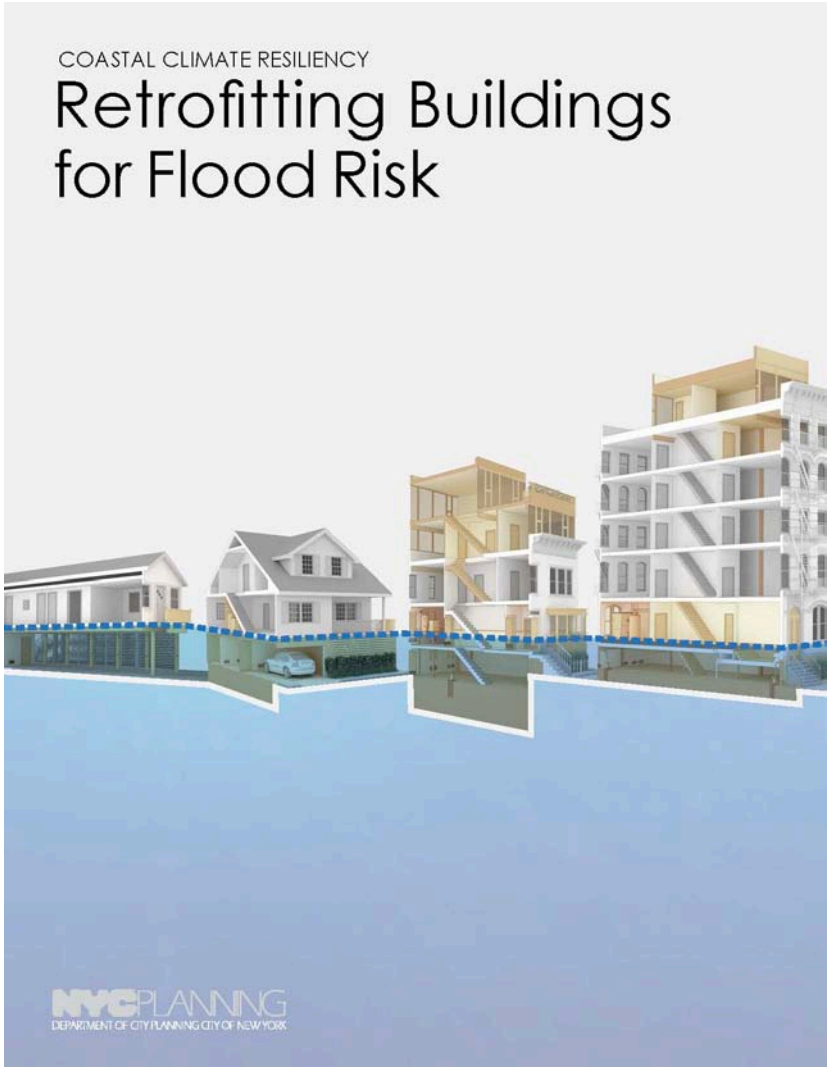
RESOURCES

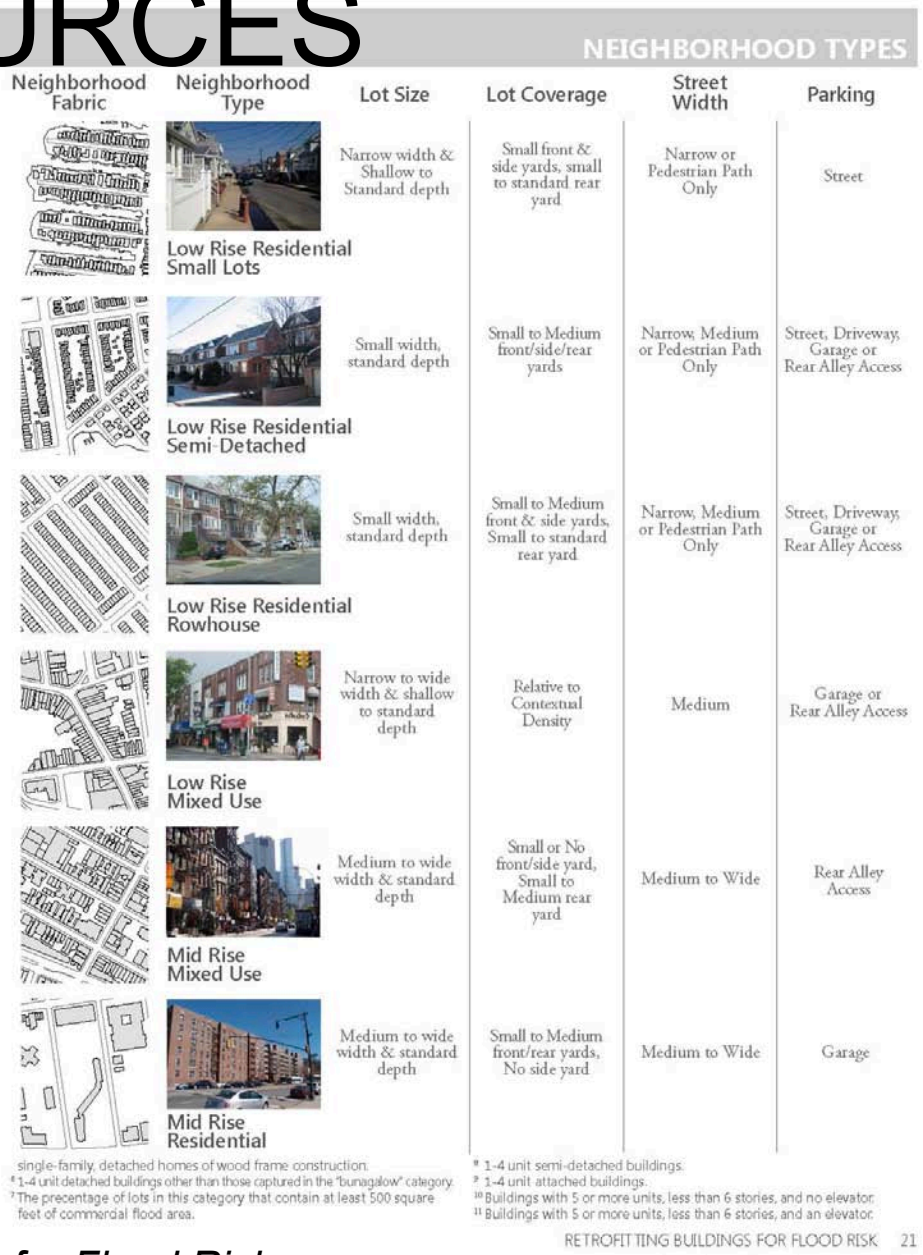




FLASH Resilient Design Guide • *www.*Flash.org/resilientdesignguide.pdf

RESOURCES





NEIGHBORHOOD TYPES

Neighborhood Fabric	Neighborhood Type	Lot Size	Lot Coverage	Street Width	Parking
	Low Rise Residential Small Lots	Narrow width & Shallow to Standard depth	Small front & side yards, small to standard rear yard	Narrow or Pedestrian Path Only	Street
	Low Rise Residential Semi-Detached	Small width, standard depth	Small to Medium front/side/rear yards	Narrow, Medium or Pedestrian Path Only	Street, Driveway, Garage or Rear Alley Access
	Low Rise Residential Rowhouse	Small width, standard depth	Small to Medium front & side yards, Small to standard rear yard	Narrow, Medium or Pedestrian Path Only	Street, Driveway, Garage or Rear Alley Access
	Low Rise Mixed Use	Narrow to wide width & shallow to standard depth	Relative to Contextual Density	Medium	Garage or Rear Alley Access
	Mid Rise Mixed Use	Medium to wide width & standard depth	Small or No front/side yard, Small to Medium rear yard	Medium to Wide	Rear Alley Access
	Mid Rise Residential	Medium to wide width & standard depth	Small to Medium front/rear yards, No side yard	Medium to Wide	Garage

single-family, detached homes of wood frame construction.
[6] 1-4 unit detached buildings other than those captured in the "bunagalow" category.
[7] The precentage of lots in this category that contain at least 500 square feet of commercial flood area.
[8] 1-4 unit semi-detached buildings.
[9] 1-4 unit attached buildings.
[10] Buildings with 5 or more units, less than 6 stories, and no elevator.
[11] Buildings with 5 or more units, less than 6 stories, and an elevator.

New York City Planning *Retrofitting Buildings for Flood Risk*
www1.nyc.gov/site/planning/plans/retrofitting-buildings

RESOURCES

WP 03: Checklists for building and planning for resilience and sustainability

© Donald Watson, FAIA e-mail: EarthRise001@SBCglobal.net
UPDATED: 1 August 2016

1 **CHECKLISTS FOR ARCHITECTS / ENGINEERS. CONSTRUCTION & FACILITY MANAGERS**
Guideline documents for planning, design and construction of facilities and sites.
ARCHITECTURAL SERVICES related to disaster risk reduction (DRR)
DRR RETROFIT CHECKLIST
WHY MITIGATION PRACTITIONERS A&E HAVE A HIGHER STANDARD OF CARE
ENTERPRISE FOUNDATION Criteria for HEALTHY LIVING ENVIRONMENT
RESILIENT DESIGN: A Checklist of Actions
OVERVIEW LEED for New Construction v.2.2 Project Checklist

WP 03: Checklists for building and planning for resilience and sustainability

© Donald Watson, FAIA e-mail: EarthRise001@SBCglobal.net
UPDATED: 1 August 2016

1 CHECKLISTS FOR ARCHITECTS / ENGINEERS. CONSTRUCTION & FACILITY MANAGERS
Guideline documents for planning, design and construction of facilities and sites.
ARCHITECTURAL SERVICES related to disaster risk reduction (DRR)
DRR RETROFIT CHECKLIST
WHY MITIGATION PRACTITIONERS A&E HAVE A HIGHER STANDARD OF CARE
ENTERPRISE FOUNDATION Criteria for HEALTHY LIVING ENVIRONMENT
RESILIENT DESIGN: A Checklist of Actions
OVERVIEW LEED for New Construction v.2.2 Project Checklist

2 COMMUNITY ENGAGEMENT
References for "whole community," and stakeholder engagement, defined as part of FEMA Natural Hazard Mitigation, Programs for Public Information (PPI), and NFIP Community Rating System programs.

3 COMPREHENSIVE PLANNING & ZONING CHECKLISTS
State-of-art references that promote sustainability in planning and building standards and practices.

ADDITIONAL RESOURCES
- OARS List Organizations Addressing Resilience and Sustainability www.TheOARSlist.com
- Coastl area site and building Evaluation in Donald Watson and Michele Adams, P.E. *Design for Flooding* (Wiley 2011).
- NEW: Alex Wilson et al. US GBC LEED "PILOT CREDITS" for Resilient Design
  Source: http://www.resilientdesign.org/leed-pilot-credits-on-resilient-design-adopted/

SHORT TAKES

A SAFE & RESILIENT COMMUNITY

Source: "Understanding Community Resilience and Program Factors That Strengthen Them"," International Federation of Red Cross and Red Crescent Societies, Geneva, 2012

1. ***Is knowledgeable and healthy. It has the ability to assess, manage, and monitor its risks. It can learn new skills and build on past experiences.***
2. ***Is organized. It has the capacity to identify problems, establish priorities, and act.***
3. ***Is connected. It has relationships with external actors (family, friends, faith groups, government) who provide a wider supportive environment and supply goods and services when needed.***
4. ***Has infrastructure and services. It has strong housing, transport, power, water, and sanitation systems. It has the ability to maintain, repair, and renovate them.***
5. ***Has economic opportunities. It has a diverse range of employment and income opportunities and financial services. It is flexible and reSourceful and has the capacity to accept uncertainty and respond (proactively) to change.***
6. ***Can manage its natural assets. It recognizes their value and has the ability to protect, enhance, and maintain them.***

RISK ANALYSIS

Source: The World Bank Understanding Risk (UR) November 2014

Achieving resilience requires public policy makers, business leaders, and researchers to translate the current science into action and collaborate to accelerate the understanding of the evolving risk. In summary, measures to reduce risk should have a "trigger point" for implementation where cost effective measures of resilience are reasonable and actionable.

1. Climate science is not a long-term weather forecast. Climate trends have to be expressed in probabilistic terms due to the high degree of variability in what we observe as weather.

2. The specific hazards and the time frame of change are important.

3. Risk is currently driven by economic factors.

4. The need for energy is the driving factor of economic growth. Population growth and urbanization will continue to increase demand for energy in the most available and cost effective forms. Energy is the key challenge in terms of efficiency and overall business value stability.

5. There is a space full of opportunity for improved economic growth and reduced risk… Innovation (of all types) that is firmly in this space is yet another economic opportunity. [p. 10-11]

Source: Trevor Maynard, Head of Exposure Management and Reinsurance, Lloyds of London

1. Concentrate effort on the largest risks.

2. Base analysis on the best available information: where science is available, use it.

3. Avoid the dangers of averaging, which can understate or obscure extreme risks.

4. Carry out continual reassessment of the risk.

5. Include human factors and the possibility of human error and the risks arising from human behavior.

6. Take account of uncertainty by ensuring that the risks with the largest impacts are considered, even if their probability is very low or is itself uncertain.

WHAT INDIVIDUAL PRACTITIONERS CAN DO

- **Be informed of emerging practices, including professional responsibilities and liabilities.**
- **Document risks of natural hazards of project and site.**
- **Establish office practice protocols to review drawings and specifications for hazard & risk criteria.**
- **Keep records of risk analysis, engineering calculations and design decisions.**
- **Engage expertise of qualified consultants with special technical knowledge appropriate to project.**
- **Obtain formal sign-offs of communications that inform clients fully and formally of risks.**

1 CHECKLISTS TO GUIDE ARCHITECTS / ENGINEERS. CONSTRUCTION & FACILITY MANAGERS
Guidance for planning, design and construction of facilities and sites.

ARCHITECTURAL SERVICE related to disaster risk reduction (DRR)
Source: Compiled by Donald Watson, FAIA

PRE-DESIGN / PROGRAM VERIFICATION (Additional services)
- Document risks, code requirements, and recommended safety measures.
- Define building commissioning and maintenance protocols (NIC or IC?)
- Define w/ Owner on financial prospectus (life of property value & investment).

SCHEMATIC DESIGN (Basic services)
- Integrated design for risk assessment / "table top" scenarios
- Rapid prototyping of design options
- Confirmation of "prototype" vs. "established standard."

Facilities Operation & Management (Owner)
- Define/test emergency evacuation/access.
- Define threat preparation procedures: floodgates, pumps, removals.
- Define recovery procedures (pumping, drying, replacement).

RETROFIT CHECKLIST
References: US GBC Resiliency Task Force; FTA Emergency Relief Program;
John Squerciati, FEMA 942 Hurricane Sandy in NJNY Nov. 2013 Critical Facilities.

A&E
- Remove/Elevate or protect subgrade equipment and critical functions.*
  * triage non-essential services.
- Design appropriate combination of dryfloodproofing and wetfloodproofing.
- Elevate or floodproof elevator equipment.
- Protect emergency power / water systems.

M/E/P
- Install flood/other risk monitors/alarms (mold, corrosion).
- Install flotation / implosion protection fuel/storage tanks.
- Waterproof across all subgrade utility connections & equipment.
- Install backflow valves/cut outs, clean outs all water/sewer connects.
- Install sump pumps w/ emergency power.

Facilities Operation & Management (Owner)
- Define / test emergency evacuation/access.
- Define threat preparation procedures: floodgates, pumps, removals.
- Define recovery procedures (pumping, drying, replacement).

WHY MITIGATION PRACTITIONERS A&E HAVE A HIGHER STANDARD OF CARE
Source: Watson, Donald: Standard of Care (Working Paper 03)

- **Current codes and standards are in process of development, following new storm impacts and FEMA model regulations / IC updates.**
- **Not all jurisdictions fully or adequately reference or enforce their Codes.**
- **Responsible climate science experts state that design assumptions about climate trends, including Sea Level Rise, may underestimate probable events.**
- **ACSE and other standards setting organizations, including FEMA, state that meeting current codes and standards is a prerequisite, but not a complete professional standard of care in providing A&E services for buildings and sites.**

Standard of Care
Definition [1 Legal dictionary]: The watchfulness, attention, caution and prudence that a reasonable person in the circumstances would exercise. If a person's actions do not meet this standard of care, then his/her acts fail to meet the duty of care, which all people (supposedly) have toward others. Failure to meet the standard is negligence, and any damages resulting there from may be claimed in a lawsuit by the injured party. The problem is that the "standard" is often a subjective issue upon which reasonable people can differ.
Definition [2 Business Dictionary]: Ethical or legal duty of a professional to exercise the level of care, diligence, and skill prescribed in the code of practice of his or her profession, or as other professionals in the same discipline would in the same or similar circumstances.

ENTERPRISE FOUNDATION Criteria for HEALTHY LIVING ENVIRONMENT
Source: Enterprise Foundation Green Communities Criteria Checklist.
(selected items only related to energy conservation and healthy indoor environmental criteria).
Enterprise Foundation has a rating system that follows these criteria for funding evaluation.

7.2 Environmentally Preferable Flooring
Do not install carpets in entryways, laundry rooms, bathrooms, kitchens / kitchenettes, utility rooms, and all rooms of ground-connected floors. Any carpet products used must meet the Carpet and Rug Institute's Green Label or Green Label Plus certification for carpet, pad, and carpet adhesives. Any hard surface flooring products used must be either ceramic tile, unfinished hardwood floors, ***OR*** in compliance with the Scientific Certification System's Floor Score program criteria.
7.3 Environmentally Preferable Flooring: Alternative Sources
Use non-vinyl, non-carpet floor coverings in all rooms of building.
7.4a Exhaust Fans: Bathroom *(New Construction and Substantial Rehab only)*
Install Energy Star–labeled bathroom fans that exhaust to the outdoors, are connected to a light switch, and are equipped with a humidistat sensor, timer, or other control (e.g., occupancy sensor, delay off switch, ventilation controller).
7.4b Exhaust Fans: Bathroom *(Moderate Rehab only)*
Install Energy Star–labeled bathroom fans that exhaust to the outdoors, are connected to a light switch, and are equipped with a humidistat sensor, timer, or other control (e.g., occupancy sensor, delay off switch, ventilation controller).
7.5a Exhaust Fans: Kitchen *(New Construction and Substantial Rehab only)*
Install power-vented fans or range hoods that exhaust to the exterior at the appropriate CFM rate, per ASHRAE 62.2, or install a central ventilation system with rooftop fans that meet efficiency criteria.
7.5b Exhaust Fans: Kitchen *(Moderate Rehab only)*
Install power-vented fans or range hoods that exhaust to the exterior at the appropriate CFM rate, per ASHRAE 62.2, or install a central ventilation system with rooftop fans that meet efficiency criteria.

7.6a Ventilation *(New Construction and Substantial Rehab only)*
Install a ventilation system for the dwelling unit capable of providing adequate fresh air per ASHRAE requirements for the building type.
7.6b Ventilation *(Moderate Rehab only)*
Install a ventilation system for the dwelling unit capable of providing adequate fresh air per ASHRAE requirements for the building type.
7.7 Clothes Dryer Exhaust
Clothes dryers must be exhausted directly to the outdoors using rigid-type duct work.
7.8 Combustion Equipment
Specify power-vented or direct vent equipment when installing new space and water-heating equipment in New Construction and any Substantial and Moderate Rehab projects.
7.9a Mold Prevention: Water Heaters
Provide adequate drainage for water heaters that includes drains or catch pans with drains piped to the exterior of the dwelling.
7.9b Mold Prevention: Surfaces
In bathrooms, kitchens, and laundry rooms, use materials that have durable, cleanable surfaces.
7.9c Mold Prevention: Tub and Shower Enclosures
Use non–paper-faced backing materials such as cement board, fiber cement board, or equivalent in bathrooms.
7.10 Vapor Barrier Strategies *(New Construction and Rehab Projects with foundation work only)*
Install vapor barriers that meet specified criteria appropriate for the foundation type.
7.11 Radon Mitigation *(New Construction and Substantial Rehab only)*
For New Construction in EPA Zone 1 and 2 areas, install passive radon-resistant features below the slab. For Substantial Rehab projects in those Zones, test for the presence of radon and mitigate if elevated levels exist.
7.12 Water Drainage *(New Construction and Rehab projects replacing assemblies called out in Criterion only)* Provide drainage of water away from windows, walls, and foundations by implementing list of techniques.
7.13 Garage Isolation
Follow list of criteria for projects with garages, including: provide a continuous air barrier between the conditioned (living) space and any garage space to prevent the migration of any contaminants into the living space, and install a CO alarm inside the house in the room with a door to the garage *and* outside all sleeping areas.
7.14 Integrated Pest Management
Seal all wall, floor, and joint penetrations with low-VOC caulking or other appropriate sealing methods to prevent pest entry.
7.15 Lead-Safe Work Practices *(Substantial and Moderate Rehab only)*
For properties built before 1978, use lead-safe work practices consistent with the EPA's Renovation, Repair, and Painting Regulation and applicable HUD requirements.
7.16 Smoke-Free Building
Implement and enforce a no smoking policy in all common, individual living areas, and with a 25-foot perimeter around the exterior of all residential buildings.

8.1 Building Maintenance Manual *(All Multifamily Projects)*
Provide a building maintenance manual that addresses maintenance schedules and other specific instructions related to the building's green features.
8.2 Resident Manual
Provide a guide for homeowners and renters that explains the intent, benefits, use, and maintenance of green building features.
8.3 Resident and Property Manager Orientation
Provide a comprehensive walk-through and orientation for residents and property managers using the

appropriate building maintenance or resident's manual.

8.4 Project Data Collection and Monitoring System

Collect and monitor project performance data on energy, water, and, if possible, healthy living environments for a minimum of five years.

Checklist: Resilient Design: A Checklist of Actions

Source: Alex Wilson Green Build

ALSO SEE: NEW: Alex Wilson et al. U.S. GBC LEED "PILOT CREDITS" for Resilient Design
Source: http://www.resilientdesign.org/leed-pilot-credits-on-resilient-design-adopted/

Ensure a home is safe in a storm

Avoid building in flood-prone areas: Always avoid building in 100-year flood zones, and try to avoid building in 500-year flood zones.

Design to stringent hurricane codes: Design to the Miami-Dade County Hurricane Code or comparable standards for resistance to wind and uplift.

Include a safe room: Include a safe room built to FEMA standards in the house or garage.

Build to resist or survive rain and flooding

Provide adequate overhang: Provide ample roof overhangs (24" minimum recommended) to keep rain away from walls.

Provide rainscreen: A rainscreen should be provided in the wall in all climates; this could be a full rainscreen created by strapping under siding, or a rainscreen housewrap.

Minimize the collection or amplification of stormwater: Provide for onsite infiltration of stormwater whenever possible; avoid curbs, relying instead on vegetated swales and infiltration basins.

Provide ample stormwater conveyance: When storm sewers and culverts are required, ensure that the diameter is suitable for the increasing stormwater flows
expected with climate change.

In coastal and flood-prone areas, elevate living space: Common practice in the Gulf Coast and other low-lying areas is to situate living space on the second floor, supported by piers; the lower-floor space is designed to get wet.

Consider breakaway lower-floor components: In areas where rising creeks, rivers, or coastal storm surges could inundate a foundation, provide breakaway components so that flowing water will not knock the building down.

Elevate electrical and mechanical equipment: Even where rising water is not a risk, basement flooding may occur from intense storms or a failing washing machine; always elevate mechanical and electrical equipment in basements.

Specify materials that can get wet and dry out: Use materials that can get wet and then be dried out without permanent damage, such as non-paper-faced drywall.

Build superinsulated envelopes

In cold climates, follow the 10-20-40-60 rule: In Climate Zones 5–7, provide a minimum R-10 under slabs, R-20 in foundation walls, R-40 in above-grade walls, and R-60 in attics or roofs. (Climate zones from DOE and the International Energy Conservation Code.)

In hot climates, follow the 5-10-20-60 rule: In Climates Zones 1–2, provide R-5 under slabs and on below-grade foundation walls; R-10 for above-grade foundation walls; R-20 for above-grade walls; and R-60 in attics or roofs. (For Climate Zones 3-4, choose intermediate levels of insulation.)

In cold climates, specify R-5 windows; lower in moderate climates: In Climate Zones 5–7, windows should have unit R-values (averaging edges as well as center-of-glass as per NFRC standards) of 5.0 or higher. In milder climates, unit R-values of at least 3.0 are acceptable (see guidelines below on solar gain and heat rejection).

Build airtight homes: Aim for 1.5 air changes per hour at 50 pascals or 0.15 CFM per square foot of building shell at 50 pascals in Climate Zones 5–7, as measured with a blower door. In milder climates, 2 ACH (0.2 CFM/sf of shell) at 50 pascals is adequate.

Incorporate passive solar design in heating climates
Orient building to optimize wintertime solar gain: Orient homes and other skin-dominated buildings on an east-west axis so that the glazing area is greater on the south (for direct-gain passive solar heating) than on the east or west.
Tune glazings by orientation: Use window glazings with high solar heat gain coefficient (SHGC) on the south orientation to maximize solar gain, even if the R-value of that glazing is lower than on other orientations.
Use modeling tools to optimize passive solar design: Use an energy design software package that does a good job at modeling passive solar design (e.g., Energy-10, Energy Plus, PHPP, REM-Design).
Provide thermal mass: Include adequate thermal mass within the thermal envelope to store solar heat and prevent overheating (slab or tile floor, brick wall facings, plaster walls, etc.); darker surfaces on thermal mass will improve solar absorption.

Minimize cooling loads in cooling climates
Orient buildings wisely: Orient homes and other skin-dominated buildings on an east-west axis to minimize exposure to low-angle sun that's hard to shade against.
Tune glazings by orientation: Use window glazings with low solar heat gain coefficient (SHGC) but high visible light transmittance on east and west orientations to limit solar gain.
Block unwanted solar gain: Use such strategies as porches, fixed overhangs, awnings, exterior roller shades, exterior plantings, and exterior roller blinds on the south, east, and west to limit unwanted solar gain.
Specify reflective, high-emissivity roofing: For steep-slope roofs, specify roofing with a solar reflectance index (SRI) of at least 29, and for low-slope roofing at least 78—certified by the Cool Roof Rating Council (www.coolroofs.org). These roofs are also more durable.
Consider a radiant barrier for unheated attics: Radiant-barrier roof sheathing or a suspended radiant barrier can reduce air temperatures in an unheated attic, reducing heat transfer into the conditioned space below.

Provide natural cooling
Provide operable windows: Install operable windows, even in commercial buildings (even if windows are to be kept closed during normal operation).
Channel breezes through the building: Design the building geometry to channel cooling breezes through the building; allow for convenient nighttime flushing.
Provide training on building ventilation: Provide guidance to building occupants on effective ventilation strategies, such as closing the building up during the day and opening it at night for "night flushing." Even if humidity concerns preclude natural ventilation during normal building operation, during times of emergency that higher humidity may be acceptable.

Maximize daylighting
Install clerestories, skylights, or windows high on walls: Use fenestration high on walls or roofs to bring daylight deep into rooms (but use care with skylights, especially, not to cause overheating).
Consider tubular skylights: Particularly for corridors and interior rooms, install tubular skylights to bring daylight through attics or upper-floor spaces (specify models that minimize heat loss).
Specify high-visible-transmittance glazing: To maximize the transmission of daylight, specify glazings with high visible light transmittance (VT or Tvis).

Reflect light deeper into rooms: Use light shelves or specially designed reflective-louvered blinds to reflect light deep into rooms (more appropriate in commercial buildings).
Paint interior ceilings and walls light colors: To improve internal distribution of daylight, use light-colored paints on ceilings and walls.

Provide backup renewable energy systems
Install wood stoves for backup heat: In rural areas without significant air pollution problems, install clean-burning wood stoves for backup heat.
Consider pellet stoves for backup heat: Particularly in high-pollution areas where wood stoves are not desirable, consider pellet stoves that have DC fans with kits or operation using battery power.
Install solar water heating: Provide solar water heating using a system that will operate without AC electricity (passive thermosiphon or integral-collector-storage system, or an active system with integral PV module for power).
Provide onsite renewables: A high level of resilience can be provided with a photovoltaic (PV) system that will operate when the utility grid is down (most net-metered, grid-connected systems will not work during a power outage); a battery bank will be needed for nighttime use, but a few inverters can provide daytime use of electricity during power outages.
Consider a site-charged electric vehicle: Oversize a PV system for the home and use excess power for charging an electric or plug-in-hybrid car.

Plan for water shortages
Maximize water conservation: Install high-efficiency plumbing fixtures: 1.28 gallon-per-flush toilets; 1.5 gallon-per-minute showerheads; 0.5 gallon-per-minute bathroom faucets. Using water efficiently is critically important if stored water is to be relied on in an emergency.
Consider composting toilets and waterless urinals : For even greater water savings in the right applications, install composting toilets and waterless urinals; these can be used during times with no water.
Avoid lawns: Landscape with plants adapted to the local climate that can survive droughts.
Develop a gravity-flow or hand-pump water Source: In rural areas, seek a traditional spring located above the building to provide for gravity-flow water delivery, or add a hand pump to an onsite well.
Store water onsite: Provide an onsite cistern or other long-term water storage; keep containers sealed and out of direct sun.
Provide rainwater harvesting: Install a rainwater harvesting system with storage; these can range from simple rain barrels to sophisticated systems with large cisterns and full water treatment; provide for gravity distribution if possible.

Address fire resistance and durability
Build for fire safety: Follow FEMA or other guidelines for safe construction practices in areas prone to wildfires.
Use only fire-resistant decking: Particularly in areas prone to wildfires or drought, use decking that resists combustion, such as sodium-silicate-treated wood, or install non-combustible stone or brick patios.
Install non-combustible cladding and fire-resistant construction details: Use non-combustible cladding in areas prone to wildfire or drought; design soffits and vents to prevent wind-borne ember entry; specify noncombustible metal or Class A fire-resistive roofing.
Plan for insect ranges to expand: Incorporate rigorous measures to control termites and other wood-boring insects whose ranges will expand. For example, use below-grade insulation that is impervious to insects, such as cellular glass, and consider borate-treated wood framing.

Prevent ice dams: Follow proper building science guidance on detailing to prevent ice dams on roofs (see www.buildingscience.com).

Consider resilience at the community scale
Create pedestrian-friendly communities: Make getting around without cars more feasible through traffic-calming measures and other features to improve walkability.
Provide bike lanes and paths: Making communities accessible to bicycle travel is one of the best ways to reduce dependence on cars.
Provide preferential parking for bikes and electric cars: Make car parking less convenient (and more expensive) and make bicycle and electric vehicle parking more convenient.
Encourage mixed-use, higher-density development: Mixed-use, high-density communities are inherently more walkable and less dependent on cars, and public transit is much more viable in these places.
Look to schools as resilient gathering places: Schools and other public spaces are typically designated as emergency shelters during extended power outages or other emergencies; these buildings should embody a wide range of resilience features.
Encourage smaller, locally owned businesses: Keeping more money circulating within a community may make more money available for emergency response, infrastructure improvements, and other aspects of resilience.
Consider "islandable" electric utility systems: Smaller municipal or private microgrids may be able to be isolated from the regional power grid during widespread outages.

Support local food production
Encourage home and community gardens: With back yards and vacant lots in cities, families can grow a significant percentage of their own food.
Protect open, arable land : Work through planning commissions and zoning bodies to protect open, arable land for long-term agricultural potential.
Encourage CSAs and other forms of agricultural business: Community-supported agriculture (CSA) operations connect farmers and their markets directly.
Remove impediments to farming: Review zoning bylaws and regulations that may restrict farming operations, such as backyard chickens, and remove unneeded impediments.

OVERVIEW LEED for New Construction v.2.2 Project Checklist
The list below is a short-form list to highlight items deserving design team attention.
Source: U.S.GBC www.usgbc.org/**LEED**

The following list indicates how a project is evaluated for LEED points.

Basic certification	**26-32 points**
Silver	**33-38 points**
Gold	**39-51 points**
Platinum	**52-69 points**

SUSTAINABLE SITES (14 points total)

PR 1 Construction Pollution Prevention	**Required for Certification**
Cr. 1 Site selection	**project site selection might qualify…depends**
Cr. 2 Density & Community Connectivity	**project layout does not qualify**
Cr. 3 Brownfield Redevelopment	**subject to site conditions**
Cr. 4.1 Alternative transport, public	**subject to development plan provision**
Cr. 4.2 Alternative transport, bike & changing rms	**plan to provide**
4.3 Alternative transport, fuel-efficient vehicles	**subject to development plan provision**
4.4 Parking capacity	**subject to development plan provision**

5.1 Site Develop: restore habitat	**landscape plan to provide**
5.2 Site Development: maximum open space	**subject to whether open space is accessible**
6.1 Stormwater development: quantity control	**attainable with BMPs**
6.2 Stormwater development: quality control	**subject to landscape and building provisions**
7.1 Heat Island effect	**subject to landscape/parking/paving plan**
7.2 Heat Island effect	**roof spec to provide**
8 Light pollution reduction	**subject to lighting specs**

WATER EFFICIENCY (5 points total)

Cr. 1.1 Reduce landscape water by 50%	**landscape to provide**
Cr. 1.2 No potable use for irrigation	**subject to development plan**
Cr. 2 Innovate waterwater technologies	**subject to feasibility/site stormwater**
Cr. 3.1 Water Use Reduction 20%	**subject to plumbing spec**
Cr. 3.2 Water Use Reduction 30%	**subject to development plan & use agreements**

ENERGY & ATMOSPHERE (17 points total)	**minimum of 2 points must be achieved**
PR 1 Fundamental Commissioning of Energy Systms	**Required for Certification**
PR 2 Minimum Energy Performance	**Required for Certification**
PR 3 Fundamental Refrigerant Management	**Required for Certification**
Cr. 1 Optimize Energy Performance	**subject to development plan & use agreements**
Cr. 1.6 Higher Energy Performance	**points subject to site layout & uses**
Cr. 2 On site renewable energy	**subject to development plan & use agreements**
Cr. 3 Enhanced commissioning	**subject to development plan/ construction contracts**
Cr. 4 Enhanced Refrigerant Management	**subject to construction / maintenance contracts**
Cr. 5 Measurement & Verification	**subject to construction / maintenance contracts**
Cr. 6 Green power	**subject to development plan & use agreements**

MATERIALS & RESOURCES ((13 points total)

PR 1 Storage and collection of recyclables	**Required for Certification**
Cr. 1.1 Building reuse	**new construction does not qualify**
Cr. 2.1 Construction Waste 50% diversion	**subject to construction contracts**
Cr. 2.2 Construction Waste 75% diversion	**subject to development plan/construction contracts**
Cr. 3.1 Materials Reuse 5%	**subject to development plan/design**
Cr. 3.2 Materials Reuse 10%	**subject to development plan/design**
Cr. 4.1 Recycled Content 10%	**achievable by design specifications**
Cr. 4.2 Recycled Content 20%	**subject to design specification**
Cr. 5.1 Regional Materials 10%	**subject to specifications/construction contracts**
Cr. 5.2 Regional Materials 20%	**subject to specifications/construction contracts**
Cr. 6 Rapidly Renewable Materials	**subject to specifications/construction contracts**
Cr. 7 Certified wood	**subject to specifications/construction contracts**

INDOOR ENVIRONMENTAL QUALITY (15 points total)

PR 1 Minimum IAQ Performance	**Required for Certification**
PR 2 Environmental Tobacco Smoke Control (ETS)	**Required for Certification**
Cr. 1 Outdoor Air Delivery Monitoring	**subject to HVAC design/maintenance**
Cr. 2 Increase ventilation	**subject to HVAC design/maintenance**
Cr. 3.1 Construction IAQ Management	**subject to construction/ fit-up contracts**
Cr. 3.2 Construction IAQ Management	**subject to construction/ fit-up contracts**
Cr. 4.1 Low-emitting Materials Adhesives	**subject to specifications/construction**
Cr. 4.2 Low-emitting Materials Paints	**subject to specifications/fit-up contracts**
Cr. 4.3 Low-emitting Materials carpets	**subject to specifications/fit-up contracts**

Cr. 4.4 Low-emitting Materials agrifiber products	**subject to specifications/fit-up contracts**
Cr. 5 Indoor Chemical & Pollutant Source Control	**subject to plan/fit-ups**
Cr. 6.1 Controllability of Systems lighting	**subject to design/maintenance/sublease contracts**
Cr. 6.2 Controllability of Systems thermal comfort	**subject to design/maintenance/sublease contracts**
Cr. 7.1 Thermal comfort design	**subject to design/envelope/HVAC**
Cr. 7.2 Thermal comfort verification	**subject to design/commissioning**
Cr. 8.1 Daylight & views 75% of spaces	**subject to plan, design, specifications**

INNOVATION & DESIGN PROCESS (5 points total)

Cr. 1 Innovation in design	**subject to development plan/design**
Cr. 2 LEED accredited Professional	**achieved by LEED professional on team**

■

2 COMMUNITY ENGAGEMENT

This section provides references for "whole community," and stakeholder engagement, defined as part of FEMA Natural Hazard Mitigation Program, Programs for Public Information (PPI and NFIP Community Rating System programs. The references outline actions for organizations and municipalities to fully engage community residences, property and business owners, and municipal officials in preparedness for natural disasters.

A conclusion supported by these references is that, ***to engage the "whole community" as recommended in FEMA NHMP guidance, a first and necessary component for each jurisdiction (municipality) is to establish local taskforce and/or teams***, comprised of municipal staff, community representatives, including specialists in natural hazards. The appointed teams would:

(1) support the responsibilities of the municipal staff,
(2) provide advice for local planning boards related to natural hazard mitigation,
(3) support municipal and private initiatives in funding, community education, and private-public sector partnerships to address community plans of economic development, natural hazards, climate action, and emergency preparedness.

These support functions could be assigned to public and private sector members of Conservation Commissions, Planning Boards or Emergency Management Operation Teams. ***The resilience and preparedness of a community can be most directly evaluated by looking at how clearly and effectively these planning groups are addressing these issues.***

FEMA (December, 2011a) *A Whole Community Approach to Emergency Management: Principles, Themes, and Pathways for Action.* Federal Emergency Management Agency, Washington, DC. (28 p.)
URL: www.fema.gov/media-library/assets/documents/23781

FEMA (December, 2011b) *Lessons in Community Recovery: Seven Years of Emergency Support Function #14 Long-Term Community Recovery from 2004 to 2011*. Federal Emergency Management Agency, Washington, DC. (76 p.)
URL: www.fema.gov/pdf/rebuild/ltrc/2011_report.pdf

CDC Foundation (October 2013). "Building a Learning Community and Body of Knowledge: Implementing a Whole Community Approach to Emergency Management." Centers for Disease Control and Prevention (CDC). Atlanta, GA: CDC Foundation. (37 p.)
URL: http://www.cdc.gov/phpr/documents/**whole_community**_program_october2013.pdf

FEMA (2013) *National Flood Insurance Program Community Rating System Coordinator's Manual.* FIA-15/2013. Washington, DC, Federal Emergency Management Administration. (615 p.)
URL: www.fema.gov/media-library/assets/documents/8768 Jan 15, 2015 =

Tulsa Partners (2014*) City of Tulsa Program for Public Information.* Tulsa OK: Tulsa Partners and R.D. Flanagan. December 2014 (53 p.)
URL: : /www.stmarysga.gov/department/community_development/ppi/Tulsa__OK_2014_PPI.pdf

CDC Foundation (2013). "Project Report: Building a Learning Community and Body of Knowledge by Implementing 'Whole Community' Approach to Emergency Management" Office of Public Health Preparedness and Response (OPHPR). Atlanta GA: Centers for Disease Control and Prevention. (37 p)
URL: www.cdc.gov/

CRSI (2011) *Steering Committee Final Report – A Roadmap to Increase Community Resilience*, August 2011, Community Resilience System Initiative (CRSI). Washington, DC: Community and Regional Resilience Institute. (p. 141)
URL: *www.resilientus.org/wp-content/uploads/2013/05/CRS-Final-Report.pdf*

FEMA (March 2013) *Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials.* Washington DC: U.S. Federal Emergency Management Administration. (84 pp.)
URL: www.fema.gov

FEMA (2011) *Local Mitigation Plan Review Guide* Oct. 1, 2011. Washington DC: U.S. Federal Emergency Management Administration. (45 pp.)
URL: www.fema.gov

Whole Community Philosophy

FEMA defines an overarching approach to involve the "Whole Community" as the process o fully engage members from all part of the community, in *breadth* of representation of all sectors, but also, *depth* of involvement, that is, participation in risk analysis and selection of priorities and projects.

FEMA (December, 2011a) *A Whole Community Approach to Emergency Management: Principles, Themes, and Pathways for Action.* FDOC 104-008-1. Federal Emergency Management Agency, Washington, DC (28 p.)
URL: www.fema.gov/media-library/assets/documents/23781

> *In a congressional testimony, the Administrator of the Federal Emergency Management Agency (FEMA), Craig Fugate, described today's reality as follows: "Government can and will continue to serve disaster survivors. However, we fully recognize that a government-centric approach to disaster management will not be enough to meet the challenges posed by a catastrophic incident. That is why we must fully engage our entire societal capacity...." To that end, FEMA initiated a national dialogue on a Whole Community approach to emergency management, an approach that many communities have used for years with great success, and one that has been gathering strength in jurisdictions across the Nation.* [p. 2]
>
> *As a concept, Whole Community is a means by which residents, emergency management practitioners, organizational and community leaders, and government officials can collectively understand and assess the needs of their respective communities and determine the best ways to organize and strengthen their assets, capacities, and interests. By doing so, a more effective path to societal security and resilience is built. In a sense, Whole Community is a philosophical approach on how to think about conducting emergency management.* [p. 3]
>
> *Whole Community Principles:*
> *§ Understand and meet the actual needs of the whole community. Community engagement can lead to a deeper understanding of the unique and diverse needs of a population, including its demographics, values, norms, community structures, networks, and relationships. The more we know about our communities, the better we can understand their real-life safety and sustaining needs and their motivations to participate in emergency management-related activities prior to an event.*
>
> *§ Engage and empower all parts of the community. Engaging the whole community and empowering local action will better position stakeholders to plan for and meet the actual needs of a community and strengthen the local capacity to deal with the consequences of all threats and hazards. This requires all members of the community to be part of the emergency management*

team, which should include diverse community members, social and community service groups and institutions, faith-based and disability groups, academia, professional associations, and the private and nonprofit sectors, while including government agencies who may not traditionally have been directly involved in emergency management. When the community is engaged in an authentic dialogue, it becomes empowered to identify its needs and reSources to address them.

§ Strengthen what works well in communities on a daily basis. A Whole Community approach to building community resilience requires finding ways to support and strengthen the institutions, assets, and networks that already work well in communities and are working to address issues that are important to community members on a daily basis. Existing structures and relationships that are present in the daily lives of individuals, families, businesses, and organizations before an incident occurs can be leveraged and empowered to act effectively during and after a disaster strikes.

Whole Community Strategic Themes:
§ Understand community complexity.
§ Recognize community capabilities and needs.
§ Foster relationships with community leaders.
§ Build and maintain partnerships.
§ Empower local action.
§ Leverage and strengthen social infrastructure, networks, and assets.

Understand Community "DNA"
Learn how communities' social activity is organized and how needs are met under normal conditions. A better understanding of how segments of the community resolve issues and make decisions—both with and without government as a player—helps uncover ways to better meet the actual needs of the whole community in times of crisis.
Recognize Community Capabilities and Broaden the Team
Recognize communities' private and civic capabilities, identify how they can contribute to improve pre- and post-event outcomes, and actively engage them in all aspects of the emergency management process.
Plan for the Real
Plan for what communities will really need should a severe event occur and not just for the existing reSources on hand.
Meet People Where They Are
Engage communities through the relationships that exist in everyday settings and around issues that already have their attention and drive their interactions. Connect the social, economic, and political structures that make up daily life to emergency management programs.
Build Trust through Participation
Successfully collaborating with community leaders to solve problems for non-emergency activities builds relationships and trust over time.
As trust is built, community leaders can provide insight into the needs and capabilities of a community and help to ramp up interest about emergency management programs that support resiliency.
Partners to Consider Engaging
[Extensive List of community stakeholders]
Create Space at the Table
Open up the planning table and engage in the processes of negotiation, discussion, and decision making that govern local residents under normal conditions.
Encourage community members to identify additional reSources and capabilities. Promote broader community participation in planning and empower local action to facilitate buy-in.
Let Public Participation Lead

Enable the public to lead, not follow, in identifying priorities, organizing support, implementing programs, and evaluating outcomes. Empower them to draw on their full potential in developing collective actions and solutions.

Strengthen Social Infrastructure

Align emergency management activities to support the institutions, assets, and networks that people turn to in order to solve problems on a daily basis.

FEMA (December, 2011b) *Lessons in Community Recovery: Seven Years of Emergency Support Function #14 Long-Term Community Recovery from 2004 to 2011*. Federal Emergency Management Agency, Washington, DC (76 p.)
URL: www.fema.gov/pdf/rebuild/ltrc/2011_report.pdf

The report is organized into three sections:
The first section, Achieving Disaster Recovery, establishes the context for community recovery by describing the process, the role of LTCR teams, and the elements known to facilitate a successful long-term recovery.
The second section, Recovery in Action, summarizes certain LTCR efforts and analyzes the common trends and lessons learned from community case studies.
The final section, Lessons for the Future, translates the understanding gained from these experiences into actions and guidance that can inform future community recovery efforts under the National Disaster Recovery Framework. [p. 5]

The following recommendations are based on lessons learned from multiple LTCR engagements, U.S. Government Accountability Office reports and Inspector General recommended actions.
1. Build capacity at all levels of government to successfully implement recovery concepts identified in the NDRF – Increase stakeholder capacity by engaging in training, exercises and planning in advance for recovery support at the local, state and federal level.
2. Prepare for recovery by developing pre-disaster plans and guidance – Develop plans and strategies that include roles and responsibilities to more fully prepare communities to address recovery challenges.
3. Encourage and support local ownership, leadership and management of the recovery process – Recovery must be owned at the local level if it is to be successful. Local involvement provides continuity, fosters trust in the process and encourages stakeholder participation and investment in recovery.
4. Foster and strengthen connectivity between all stakeholders to effectively leverage recovery reSources – A systematic method to connect local, state and federal stakeholders will ensure that reSources are optimized and recovery is expedited. [p. 3]

CDC Foundation (October 2013). "Building a Learning Community and Body of Knowledge: Implementing a Whole Community Approach to Emergency Management." Centers for Disease Control and Prevention (CDC). CDC Foundation, Atlanta GA. (37 p.)
URL: http://www.cdc.gov/phpr/documents/Whole_Community_Program _October 2013.pdf

FOSTERING A WHOLE COMMUNITY APPROACH

How do promising examples understand community complexity;

- *By using a community's available information systems and data at the neighborhood, city, or state-level (e.g., school data, city bus routes, city-conducted surveys;*
- *By recognizing and addressing all demographics of a population living, working, or visiting a community; demographics may include vulnerable populations (children, older adults, individuals with access or functional disabilities), those without private transportation, homeless*

population, refugees, and non-English speaking individuals;
- *By identifying and working closely with community members who can provide specific information about the community, its policies, and its organizations;*
- *By acknowledging the culture and the value system of the community;*
- *By using differences in levels of preparedness (perceived or actual) as a criterion to target services (e.g., rural versus urban preparedness, younger versus older populations;*
- *By becoming a subject matter expert on a community's landscape and potential risks.* [p. 7]

FEMA (2013) *National Flood Insurance Program Community Rating System Coordinator's Manual.* FIA-15/2013. Washington, DC, Federal Emergency Managament Administration. (615 p.)
URL: www.fema.gov/media-library/assets/documents/8768 Jan 15, 2015 =

FEMA Community Rating System (CRS) is a voluntary program by which communities enrolled in the National Flood Insurance Program (NFIP) can qualify for community-wide reductions in flood insurance. Measures that received points towards flood insurance reduction include public Information Activities.

> *The objective of the Community Rating System (CRS) is to reward communities that are doing more than meeting the minimum NFIP requirements to help their citizens prevent or reduce flood losses. The CRS also provides an incentive for communities to initiate new flood protection activities. The CRS Coordinator's Manual is the guidebook for the CRS and sets the criteria for CRS classification. It explains how the program operates, what is credited, and how credits are calculated. Although it is primarily a reference for CRS activities and credits, it can also help guide communities that want to design or improve their floodplain management programs.*

CRS Manual defines explicit measures:
Developing a master public information program: Activity 330
Reaching out to people about floods and flood protection: Activity 330
Providing detailed information on the potential for flooding and protecting against flood damage: Activity 320, Activity 350, and Activity 360
Libraries: Activity 350
Websites: Activity 350
Disseminating information on flood insurance: Activity 370 and Activity 330
Assisting with real estate disclosure: Activity 340.

> *Credit Criteria for PPI*
> *For CRS credit, the PPI must be developed according to a seven-step planning and public involvement process, similar to the process credited under Activity 510 (Floodplain Management Planning). There are seven steps to preparing a PPI:*
>
> *Step 1: Establish a PPI committee. The community's PPI must be developed by a committee of people from both inside and outside the local government. The number of participants and their identities is determined by the community, but the committee must:*
>
> - *Meet at least twice: once to review the assessment (step 2) and once to review the PPI document before it is sent to the governing body (step 6). More meetings are recommended to ensure adequate input from the committee members;*
> - *Comprise at least five people;*
> - *Include one or more representatives from the community's floodplain management office;*
> - *Include one or more representatives from the community's public information office.*

A multi-jurisdictional committee can prepare a PPI for several communities that want to work together. To receive this credit,

- *Each community wanting the credit must send at least two representatives to the regional committee,*
- *At least half of the community's representatives must be from outside the local government, and*
- *At least half of the representatives must attend ALL the meetings of the regional committee. In effect, there must be a quorum from each community. Remote attendance via a webinar that allows for everyone to talk is permissible. It is recommended that communities use existing committees, such as the floodplain management planning committee credited under Activity 510, in cases in which such organizations meet the above criteria.*

Step 2: Assess the community's public information needs. During this step, the committee delineates different target areas within the community, based on different flooding or development conditions. This may have been done as part of the community's floodplain management planning. The CRS Community Self Assessment, described in Section 240, is an online tool that can help identify target areas and audiences. Another documented process may suffice, provided that it includes an evaluation of the flood hazard(s) and the buildings exposed to the hazard(s), and identifies flood-prone target areas.
The assessment must also inventory existing public information and outreach efforts being conducted in the community. These should include non-flood programs, such as efforts to inform people about other hazards, automobile safety, home improvements, or other activities where the community could leverage attention to flood protection.

Step 3: Formulate messages. The public information messages needed for each target audience are determined. The PPI committee identifies a desired outcome for each message.

Step 4: Identify outreach projects to convey the messages. The committee considers what media to use to deliver the identified messages to the target audiences. This may include continuing or revising existing public information and outreach efforts that are already being conducted in the community. Step 4 must produce a list of specific projects and identify who is responsible for them and when they will be implemented. A multi-jurisdictional PPI must identify which communities benefit from each project.

Step 5: Examine other public information initiatives. The PPI committee looks at other public information activities in addition to outreach projects. This could include how to best set up a website on flood protection (Activity 350), what technical assistance is needed throughout the community (Activity 360), or how to publicize flood protection services (Activities 320, 350, and 360).

Step 6: Prepare the PPI document. The committee's work is recorded in a formal document. The PPI and the annual report that evaluates it can be stand-alone documents or they can be sections or chapters in a floodplain management or hazard mitigation plan credited under Activity 510. The document does not need to be a long, formal report. Much of the key information can be displayed in a spreadsheet, such as the example in Figure 330-2.

For multi-jurisdictional programs, the document must show which communities benefit from which projects. For example, an inland community would not benefit from a project oriented to beachfront property owners, but all communities would benefit from articles in a regional newspaper about flood insurance. This documentation may be in the form of a matrix or table included in, or attached to, the PPI document. The PPI must be adopted by the community, through either:

- *Formal approval by the community's governing body, or*
- *Formal approval by another body or office of the community that has the authority and funding to implement the PPI, such as a flood control district.*

Step 7: Implement, monitor, and evaluate the program. The PPI committee meets at least annually to monitor the implementation of the outreach projects. The committee assesses whether the desired outcomes were achieved and what, if anything, should be changed. This work is described in an evaluation report that is prepared each year, sent to the governing body, and included in the annual recertification.

Tulsa Partners (2014*) City of Tulsa Program for Public Information.* Tulsa OK: Tulsa Partners and R.D. Flanagan. December 2014 (53 p.)
http://www.stmarysga.gov/department/community_development/ppi/Tulsa__OK_2014_PPI.pdf

An award-winning Public Information Program consists of 10 City of Tulsa employees and 15 non-local government representatives from the public and private sectors.

The Whole Community approach is the latest iteration of a long term trend to include citizen and private/nonprofit sector participation in minimizing disaster losses. Tulsa is, of course, no stranger to this trend. As an example, the City of Tulsa has regularly surpassed requirements for public information, education, and outreach for its Multi-Hazard Mitigation Plan and for the National Flood Insurance Program's (NFIP) Community Rating System (CRS). However, the need to engage citizens and the private sector often demands the review of old methods and development of new strategies in order to increase and keep stakeholders involved and engaged. [p. 1]

Target Areas affected by floods *(not in priority order*) [p. 5]
1. Areas subject to flooding by levee failure
2. Repetitive loss properties/areas
3. Areas within City Regulatory and Special Flood Hazard Areas
4. Areas outside City Regulatory and Special Flood Hazard Areas
5. Areas subject to flooding by a dam failure
Other Target Audiences for outreach
*6. Vulnerable Populations (as defined by City of Tulsa Multi-Hazard Mitigation Plan)**
7. Bankers/Lenders/Insurance/Builders/Real Estate Agents
8. Chambers of Commerce and Civic Groups
*9. Critical Facilities (as defined by City of Tulsa Multi-Hazard Mitigation Plan)***
10. Neighborhood Associations
** In the 2014 Multi-Hazard Mitigation Plan, page 24, "vulnerable populations" may include:*
• The elderly;
• People in poverty;
• People who speak a language other than English;
• People with mobility, hearing, visual or other physical disabilities;
• People with developmental or other cognitive disabilities;
• People with no access to private transportation;
• People with medical needs or medical/life support devices;
• people with pets.

Significant outreach activities subject to CRS [p. 12]
The PPI Committee has agreed to include the following activities in the Program for Public Information and to review annually projects associated with these outreach activities:

- *Activity 320 Publicity on Map information Service provided by City. (See under Projects and Initiatives / Outreach Projects table for areas 3 and 4 on pages 16 and 18.)*
- *Activity 330 In addition to Outreach Projects, this activity includes Flood Response Preparations-- a pre-flood plan for public information projects that will be implemented during and after a flood. This will be under development during the coming year, although there is initial work under Flood Response Projects table, pages 21-22.*
- *Activity 340 Disclosure of Flood Hazards—See Realtor's brochure under OP 7 under Builders and Realtors on page 19. Real estate agents will be involved in the development and distribution of this home hunters guide to check out the flood hazard before buying.*
- *Activity 350 Information provided through City of Tulsa flood control website: https://www.cityoftulsa.org/city-services/flood-control.aspx. (See under Outreach Projects table for areas 3 and 4 on pages 17 and 18.) The website will be reviewed to ensure that all PPI messages are included.*
- *Activity 360 Flood Protection Advice and Assistance, including after a site visit, offered through City of Tulsa. See reference under Areas 3 and 4, pages 16 and 18. The staff designated to provide this one-on-one technical assistance service to homeowners are familiar with structural / non-structural flood protection and mitigation measures including flood insurance. Reviewing program records, the PPI Committee will determine whether the service is being adequately promoted and used.*
- *Activity 360 Financial Assistance Advice-Providing information on all available Sources of assistance. This will be under development during the coming year.*
- *Activity 370 Flood Insurance Assessment and Flood Insurance Coverage improvement plan— this will be under development during the coming year. We currently know the percent of the floodplain properties that have coverage, amount of coverage and total value of those structures.*
- *Activity 420 Open Space Preservation: Educational materials and tours in open space areas that have identified natural floodplain function. Since keeping open space areas with a natural floodplain function is considered a low impact development strategy, this is included under Message H, with OP 8 for areas 3 and 4 on pages 16 and 17.*
- *Activity 540 Drainage System Maintenance: Publicizing regulations prohibiting dumping in streams and ditches. Information on this would be included in outreach projects tied to Message G: "Storm Drains are for Rain," protecting natural floodplain functions.*
- *Activity 610 Flood Warning and Response. Information on flood warning and response, including flood warning sirens, are included in Outreach Projects for Messages A, I and J, and are especially included in City of Tulsa website and City Life utility bill stuffers.*
- *Activity 620 Levees. See Area 1 on page 15. - Activity 630. Dams. See Area 5 on page 18.*

CDC Foundation (2013). "Project Report: Building a Learning Community and Body of Knowledge by Implementing 'Whole Community' Approach to Emergency Management" Office of Public Health Preparedness and Response (OPHPR). Atlanta GA: Centers for Disease Control and Prevention (37 p) URL: www.cdc.gov/

Building a Learning Community & Body of Knowledge

• Addressing all demographics of a population living, working, or visiting a community, including vulnerable populations.

• Working closely with community members who can provide specific information about the community, its policies, and its organizations.

• [Mentoring local] subject matter experts on a community's geographic landscape and potential risks.

CDC's Office of Public Health Preparedness and Response's (OPHPR) Learning Office is working on a pilot program to promote promising examples of existing community efforts that embody FEMA's whole community approach to emergency management.

CRITICAL ELEMENTS

- *Program leadership is persistent, responsive, knowledgeable and dedicated.*
- *Program leadership is passionate about the community they serve.*
- *Program leadership consists of a visionary and a realist. T*
- *There is dedicated staff or volunteers for relationship building.*
- *Program uses community extenders to engage communities.*
- *Programs and partners distribute uniform, consistent messages.*
- *Program uses "sparkplugs."*
- *Programs offer incentives as a mechanism to engage and maintain relationships.*
- *Programs host social community events.*
- *Programs consistently market and publicize efforts…*
- *Programs are creative, simple, and fun.*
- *Programs work with non-traditional partners* Programs utilize disasters as teachable moments.*
- *Programs strategically engage specific demographics to meet mission.*
- *Programs encourage friendly peer-pressure to empower action.*

CRSI (2011) *Steering Committee Final Report – A Roadmap to Increase Community Resilience*, August 2011, Community Resilience System Initiative (CRSI). Washington, DC: Community and Regional Resilience Institute (p. 141)
www.resilientus.org/wp-content/uploads/2013/05/CRS-Final-Report.pdf

Why Communities Need a Community Resilience System (CRS)
***Diffuse lessons –** The lessons from previous disasters and crises are long and varied but not easily accessible to the communities who want to learn from them and take action.*
Growing complexity within and between communities – This increased complexity stems from interdependencies, workforce mobility, and demographic shifts such as the retirement of the baby boomers and a more diverse younger generation.
New spectrum of threats facing communities – In addition to natural disasters and pandemics, communities face new threats such as terrorism, economic change, demographic shifts, and climate change impacts.
Increasingly constrained reSources – Demand for services and functions provided by local communities has continued to expand while the reSource base has remained relatively unchanged or diminished. Communities must make informed choices between supporting current needs and addressing future challenges.
Diverse stakeholders – Given the broad spectrum of individuals and groups who need to be involved in building a community's resilience, there is a need for a systems approach that can capture the contributions of these diverse groups and help communities collaboratively develop a path forward.
Conclusion
As this report describes, resilience building is an imperative for American communities and requires across-the-board participation from virtually all quarters of society. The CRSI has been an important player in initiating dialogue about the practicalities of community resilience and championing what is truly needed to improve communities' resilience to all manner of threats.
There is much more work to be done at the national, regional, and state levels to promote the CRS as a reSource, to improve it, and to continue the dialogue with diverse stakeholders that will help to facilitate both. [p. vii]

[beginning p. 22]
Stage 1 – Engage Community Leadership at Large
Five key questions:
1. What are the characteristics of the community?
2. What are the community's strengths and weaknesses?
3. What are the significant threats facing the community?
4. What are the community's critical assets, and which are at risk?
5. What reSources does the community have to recover, if it is disrupted or threatened?
Stage 2 – Perform a Resilience Assessment
Stage 3 – Develop a Shared Community Vision
Stage 4 – Action Planning
Stage 5 – Establish a Mechanism to Implement the Plan and Sustain the Program
Stage 6 – Evaluate and Revise the Community's Resilience Program

IV. OBSERVATIONS AND NEXT STEPS FOR INCREASING COMMUNITY RESILIENCE [p. 27]
Foster Cross-Sector Collaboration for Resilience
Strengthen Local Capacity for Greater Resilience
Make the Business Case for Resilience
Continue Resilience Research Efforts
Promote Resilience Awareness and Education

Guiding Principles [p. 45]
1. Community resilience begins with human capital (all community members, both public and private) and is the result of their daily activities.
2. The CRS will aid the community in understanding the tangibles (reSources and assets) as well as the intangibles (e.g., sense of place, cohesion, culture, etc.).
3. The CRS will help communities develop a pre-crisis vision, outline a path to achieve a "new normal" (future baseline), address the deficiencies of the "old normal" (pre-crisis baseline), and ultimately create a more resilient community.
4. The CRS will lead to "triple bottom line" outcomes involving the environment, human capital, and the economy.
5. The CRS will capture and reflect the needs and capabilities of the whole community. It will encourage and support community- and region-wide, cross-sector partnerships, and it will reflect the full fabric of the community.
6. The CRS will help communities understand, optimize, and leverage existing assets and interdependencies (local and regional) while simultaneously identifying and mitigating vulnerabilities in the aftermath of a crisis.
7. The CRS will help communities identify their cross-sector core leaders and networks of champions who are able to implement and manage efforts before, during, and after crises.
8. The CRS will be understandable to and usable by everyone in the community, whether experts or the general public.
9. The CRS will be flexible and agile enough to be adapted and applied in communities of different sizes with diverse forms of government, demographics, geography, and cultural identity.
10. Evaluating community resilience and providing rewards for continuous, incremental improvement will lead to greater community vitality.

FEMA (March 2013) Integrating Hazard Mitigation Into Local Planning: Case Studies and Tools for Community Officials. Washington DC: U.S. Federal Emergency Management Administration (84 pp.) URL: www.fema.gov

How to Plan Resilient Communities Through Integration
Step 1: Assess Your Community's Planning Framework with a Lens for Resilience
Step 2: Inform and Engage Local Leadership, Staff, and Stakeholders.
Step 3: Establish an Integration Agenda of Resilient Community Principles and Actions
Step 4: Be Opportunistic
Step 5: Monitor, Measure, Report, Repeat

Overcoming Obstacles to Successful Integration
Increasing Hazard Awareness and Understanding of Mitigation Solutions
Carefully Frame the Issue to Resonate with Your Community
Balancing the Appearance of Competing Priorities
Building Political Will..
Finding Incentives and Drivers for Integrated Planning
Expanding Local Capacity to Support Local ReSources
Building a Framework for Intergovernmental Coordination

§ Hazard mitigation plans are often developed or updated without the active participation or leadership of local planning and community development staff;
§ Local land use planners are less willing to embrace hazard mitigation planning as falling within their professional purview;
§ Hazard mitigation plans often include mitigation strategies or actions that are focused on a disconnected series of emergency services, structure or infrastructure protection projects, and public outreach initiatives, with less emphasis on non-structural measures available through local land use planning or policy alternatives;
§ Hazard mitigation plans are typically completed as stand-alone documents that cover multiple jurisdictions, and it is relatively uncommon for them to be directly linked or integrated with other community-specific planning tools such as comprehensive land use plans and development regulations.

FEMA (2011) *Local Mitigation Plan Review Guide* Oct. 1, 2011 . Washington, DC: Washington DC: U.S. Federal Emergency Management Administration. (45 pp.)
URL: www.fema.gov

1.1 PURPOSE OF LOCAL MITIGATION PLAN REVIEW GUIDE
The purpose of this *Local Mitigation Plan Review Guide* is to help Federal and State officials assess Local Mitigation Plans in a fair and consistent manner, and to ensure approved Local Mitigation Plans meet the requirements of the Stafford Act and Title 44 Code of Federal Regulations (CFR) §201.6.1
An important distinction must be made between the words "shall" and "should" in the Mitigation Planning regulation at 44 CFR Part 201. The Regulation Checklist only includes the requirements where the regulation uses the words "shall" and "must," and does not include the "should." When the word "should" is used, the item is strongly recommended to be included in the plan, but its absence will not cause FEMA to disapprove the plan.

4.1 ELEMENT A: PLANNING PROCESS *Requirements*
§201.6(b) An open public involvement process is essential to the development of an effective plan. In order to develop a more comprehensive approach to reducing the effects of natural disasters, the planning process shall include:
§201.6(b)(1) (1) An opportunity for the public to comment on the plan during the drafting stage and prior to plan approval;

§201.6(b)(2) (2) An opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, and agencies that have the authority to regulate development, as well as businesses, academia and other private and non-profit interests to be involved in the planning process; and
§201.6(b)(3) (3) Review and incorporation, if appropriate, of existing plans, studies, reports, and technical information.
§201.6(c)(1) [The plan shall document] the planning process used to develop the plan, including how it was prepared, who was involved in the process, and how the public was involved.
§201.6(c)(4)(i) [The plan maintenance process shall include a] section describing the method and schedule of monitoring, evaluating, and updating the mitigation plan within a five-year cycle.
§201.6(c)(4)(iii) [The plan maintenance process shall include a] discussion on how the community will continue public participation in the plan maintenance process.

(p. 15) ***Involved in the process*** *means engaged as participants and given the chance to provide input to affect the plan's content*. This is more than simply being invited or only adopting the plan.
A2. Does the Plan document an opportunity for neighboring communities, local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process? ***44 CFR 201.6(b)(2)***
a. The plan **must** identify all stakeholders involved or given an opportunity to be involved in the planning process. At a minimum, stakeholders **must** include:
1) Local and regional agencies involved in hazard mitigation activities;
2) Agencies that have the authority to regulate development; and
3) Neighboring communities.
An ***opportunity to be involved in the planning process*** *means that the stakeholders are engaged or invited as participants and given the chance to provide input to affect the plan's content.*
(p. 16) **A3. Does the Plan document how the public was involved in the planning process during the drafting stage?** ***44 CFR 201.6(b)(1) and 201.6(c)(1)***
Intent*: To ensure citizens understand what the community is doing on their behalf, and to provide a chance for input on community vulnerabilities and mitigation activities that will inform the plan's content. Public involvement is also an opportunity to educate the public about hazards and risks in the community, types of activities to mitigate those risks.*

3 COMPREHENSIVE PLANNING BENCHMARKING CHECKLISTS

This section reviews state-of-art references that promote sustainability in planning and building standards and practices.

There are many benchmarking references and best practices proposed to represent sustainability, disaster preparedness, and resilience goals and standards for planning and building regulations. These references are continually being updated and adopted into International Building Codes, representing recommendations and guidance, which may be adopted in whole or part by each State as State Building Codes. In addition, higher standards are promoted as "best practices" by various incentive systems, rating systems, and other recognition (awards) for accomplishment over and above regulatory minimum standards.

These references and checklists meet a variety of different purposes. They may be intended to promote best practices, to qualify for funding incentives, or may represent regulatory requirements for permitting. Best practices that demonstrate effective and affordable measures are often adopted into codes and regulations. That is, the measures currently promoted as "best practices" may anticipate what may be required in future as zoning and building code requirements.

Checklist	**Property**		**Community**		**Municipal**	**State/National**		
	1a	**1b**	**2a**	**2b**	**3a**	**3b**	**4a**	**4b**
USGBC 2013	√		√			√		*
NYSERDA CSC 2014	√	√	√	√	√	√	√	*
Yonkers 2014	√		√	√	√	√	√	*
Enterprise 2015	√	√						*
EcoDistricts 2016	√		√					
Kusler 2016			√		√			
RMLUI 2016	√		√		√			
Yudelson 2016	√		√			√		

* Checklist measures lists items defined in International Building Codes, including the International Green Construction Code, subject to future adoption in each State.

1 Property owner/business owner focus
1a Checklists to improve property and/or business operations
1b Measures required to qualify for funding for individual properties
2 Local community focus (for use in organizing local initiatives)
2a Measures that can serve as "targets" to activate local action
2b Measures required to qualify for funding for community scale projects
3 Municipal focus (for use in municipal administration)
3a Measures adopted as benchmarks for initiatives and regulatory review
3b Measures used for promotion of city public/private development
4 State/Regional/National (for use in administration at all levels of government)
4a Measures required to qualify for funding municipal/State projects
4b Measures required for regulatory review (e.g., State building codes)

Selected References: comprehensive planning
A representative set of checklist references, listed chronologically, are annotated below, selected because they are particularly useful for comprehensive planning and community plans.

[31] USGBC (2013) *Technical Guidance Manual for Sustainable Neighborhoods*
[32] NYSERDA (2014) *Climate Smart Communities Certification Manual*

[33] City of Yonkers, NY (2014) *Yonkers Green Development Workbook Checklist and Standards*.
[34] Enterprise Communities (updated 2015) *Enterprise Green Communities Criteria*
[35] EcoDistricts (2016) *EcoDistricts Protocol*
[36a] Kusler, Jon (2016) Protecting and Restoring Riparian Areas.
[36b] Kusler, Jon (2016) Model "Riparian" Protection Ordinance
[37] Rocky Mountain Land Use Institute (2016) Sustainable Community Development Code
[38] Yudelson, Jerry (2016) *Reinventing Green Building* Sustainability Key Performance Indicators

USGBC LEED-ND [31] is a common-cited reference as a rating system for evaluation of comprehensive plans, smart growth, and green development best practices. The emphasis of the LEED rating system has been upon energy. The LEED-UD enlarged the criteria to include Smart Growth and health as criteria for planning beyond the building scale. Its publisher, the U.S. Green Building Council, regularly updates the LEED documentation and criteria. Similar rating systems for buildings and land-use planning are promoted by other organizations, particularly in response to emerging requirements for GHG reduction and climate mitigation and adaptation.

The NYSERDA (2014) *Climate Smart Communities Certification Manual* [32] provides a more comprehensive set of measures. It provides a framework for funding to support the NYSERDA Cleaner Greener CSC Program.

The City of Yonkers adopted a Green Development Ordinance [33], implementing green standards for public and private construction. The City adopted the criteria and process developed by the Enterprise Communities Foundation [34]. Yonkers has successfully adopted green building standard by working in consultation with the local building industry and also streamlining permitting processes. The checklist is very simple and accepted by builders as an effective way to promote good building practices that demonstrate health and safety provisions.

The EcoDistricts Protocol [35] represents a voluntary approach to neighborhoods and districts, that is, smaller scale projects. As such the approach can guide grassroots and local organizations for projects of any scale.

Two recent papers published by the Association of State Wetland Managers [36a,b] provide research and language for ordinance and other zoning guidance for protection of wetlands, streams and waterways, compiled from lessons learned and legal search of national exemplars.

Rocky Mountain Land Use Institute Sustainable Community Development Code [37] has the goal of making the goals of sustainable development more easily applied to zoning and code practices. It defines a range of measures and goals, from entry-level to upper range more demanding than LEED-ND.

A recent book by Jerry Yudelson [38] represents a "very simple" visible approach, but very high standards. The approach has the advantage of being easily communicated and also allowing local community self-assessment, thus more economical for a project application than a fee-based certification process.

Annotated references

[31] USGBC (2013) *Technical Guidance Manual for Sustainable Neighborhoods: How to Use the LEED for Neighborhood Development Rating System to Evaluate and Amend Local Plans, Codes, and Policies.* USGBC / PACE Law Center (129 pp.)
URL:http://www.usgbc.org/sites/default/files/Technical%20Guid.%20Man.%20for%20Sust.%20Neighborhoods_2012_Part%20A_1f_web.pdf
Quoting from the Introduction to the Manual (p. 5):

> *The Land Use Law Center at Pace Law School, in conjunction with the USGBC, prepared this Technical Guidance Manual for Sustainable Neighborhoods for elected officials, local planners, and other professionals who work with municipalities to create sustainable neighborhoods. The LEED-ND rating system aligns the principles of smart growth, New Urbanism, and green building into a set of national standards for green planning and design at the neighborhood scale. As a result, the rating system represents the next evolution in the development of LEED and aims to push both the public and private sectors to look beyond the individual building to the larger community, recognizing that a building is only as green as its surroundings. LEED-ND allows local governments to achieve market transformation at a greater rate than ever before by making the "greenness" of a building as much about where it is as what it is. As our cities continue to thrive and our regions continue to urbanize, tools such as LEED-ND will play an ever-meaningful role in creating livable communities.* (p. 5)
> *The sections of the manual are designed to parallel a typical municipality's land development plans, regulations, and related policies. It begins by presenting strategies to integrate LEED-ND criteria into local planning policies as expressed in comprehensive plans and special area plans. It then presents strategies for incorporating LEED-ND criteria into traditional zoning code sections, site plan and subdivision regulations, and other land use development standards, including building and related codes. Finally, it introduces strategies for including LEED-ND criteria in non-regulatory initiatives, streamlining the project review and approval process, and providing incentives and assistance for sustainable neighborhood development.* (p. 5)

[32] NYSERDA (2014) *Climate Smart Communities Certification Manual* Version 2 (296 pp.)
URL: http://www.dec.ny.gov/docs/administration_pdf/certman.pdf
The CSC Certification Program is designed to encourage ongoing implementation of actions related to climate action mitigation of climate change through reduction of greenhouse gas emissions and adaptation to effects of climate change, and to recognize achievements of local governments.

> *Any local government whose legislative body adopts the Climate Smart Community Pledge is designated a Climate Smart Community. The certification program described in this manual provides information on a number of climate mitigation and adaptation actions. Communities can be awarded a specified number of points toward certification and the higher levels of bronze, silver and gold for each action they complete. In addition to accumulating a minimum number of points for to achieve each level of recognition, each community must complete a number of "priority" actions. This manual describes each action, the number of points that may be earned, minimum requirements and the documentation that must be submitted to earn points.* (p. 1-6)
>
> Town of Brighton signed the Climate Smart Community Pledge in 2013. The report describes the follow-on requirements to achieve certification as a NYS Climate Smart Community.
> 1. Pledge to be a Climate Smart Community
> 2, Set goals, inventory emissions, plan for climate action.
> 3, Decrease community energy use.
> 4. Increase community use of renewable energy
> 5. Realize benefits of recycling and other climate-smart solid waste management practices
> 6. Reduce greenhouse gas emissions through use of climate-smart land-use tools
> 7. Enhance community resilience and prepare for the effects of climate change
> 8. Support development of a green innovation economy
> 9. Inform and inspire the public.

[33] City of Yonkers, NY (2014) *Yonkers Green Development Workbook Checklist and Standards* September 2014 Yonkers: City of Yonkers Department of Planning and Development. (117 pp.)
URL: http://yonkersny.gov/home/showdocument?id=9801

Adopted by city ordinance 2014, the Standards apply to city-owned facilities and to private development in downtown Yonkers new construction and renovations. For other private development projects outside of the Downtown Districts, submitting a completed checklist with the site plan application is the only requirement, whereby compliance with the standards is encouraged, but is purely voluntary.

Follows Enterprise Community Guidelines (op. cit.)
This checklist provides an overview of the technical elements of the Yonkers Green Development Standards. To comply with the standards, the project must integrate all yes/no measures applicable to that construction type. In addition, New Construction projects must achieve 35 optional points and Substantial Rehab projects must achieve 30 optional points. Moderate Rehab projects must achieve a minimum of 20% of the optional points that are applicable to the project based on the project's scope. Refer to the Yonkers Green Development Workbook for details regarding each measure. (p. 6)
1: Integrative Design
1.1a Green Development Plan: Integrative Design Meeting(s)
1.1b Green Development Plan: Checklist Documentation
1.2a Universal Design

2: Location + Neighborhood Fabric
2.1 Sensitive Site Protection
2.2 Proximity to Services
2.3 Preservation of and Access to Open Space
2.4 Access to Public Transportation
2.5 Smart Site Location: Passive Solar Heating / Cooling
2.6 Brownfield Site
2.7 Access to Fresh, Local Foods

3: Site Improvements
3.1 Environmental Remediation
3.2 Erosion and Sedimentation Control
3.3 Landscaping
3.4 Efficient Irrigation and Water Reuse
3.5 Surface Stormwater Management
4: Water Conservation
4.1 Water-Conserving Fixtures
4.2 Advanced Water-Conserving Appliances and Fixtures
4.3 Water Reuse

5: Energy Efficiency
5.1 Building Performance Standards (for various residential types)
5.2 Additional Reductions in Energy Use
5.3 Sizing of Heating and Cooling Equipment
5.4 Energy Star Appliances
5.5a Efficient Lighting: Interior Units
5.5b Efficient Lighting: Common Areas and Emergency Lighting
5.5c Efficient Lighting: Exterior 5.6a Electricity Meter
5.6b Electricity Meter 5.7a Renewable Energy
5.7b Photovoltaic / Solar Hot Water Ready
5.8 Advanced Metering Infrastructure

6: Materials Beneficial to the Environment
6.1 Low / No VOC Paints and Primers
6.2 Low / No VOC Adhesives and Sealants 6.3 Construction Waste Management
6.4 Construction Waste Management 6.5 Recycling Storage
6.6 Recycled Content Material (All Projects)
6.7 Regional Material Selection
6.8 Certified, Salvaged, and Engineered Wood Products
6.9a Reduced Heat-Island Effect: Roofing
6.9b Reduced Heat-Island Effect: Paving

7: Healthy Living Environment
7.1 Composite Wood Products that Emit Low/ No Formaldehyde
7.2 Environmentally Preferable Flooring
7.3 Environmentally Preferable Flooring: Alternative Sources
7.4 Exhaust Fans: Bathroom
7.5 Exhaust Fans: Kitchen
7.6 Ventilation
7.7 Combustion Equipment
7.8 Mold Prevention: Water Heaters, Surfaces, Tub and Shower Enclosures
7.9 Vapor Barrier Strategies
7.10 Radon Mitigation
7.11 Water Drainage
7.12 Garage Isolation
7.13 Integrated Pest Management
7.14 Lead-Safe Work Practices

8: Operations + Maintenance
8.1 Building Maintenance Manual
8.2 Tenant Manual
8.3 Resident and Property Manager Orientation
8.4 Project Data Collection and Monitoring System

[34] Enterprise Communities (updated 2015) *Enterprise Green Communities Criteria: solutions and innovations* (168 pp.)
URL: http://www.enterprisecommunity.com/solutions-and-innovation/enterprise-green-communities/criteria
Green Communities™ a major initiative by Enterprise Community Partners (Enterprise) is a five-year, $555 million initiative to create more than 8,500 homes that deliver significant health, economic and environmental benefits for low-income families and communities. Criteria updated 2015 are suitable for all development types, including new Construction, substantial rehab, and Moderate Rehab (less than 50% aggregate area of the building) in both multifamily and single-family projects.

[35] Ecodistricts (2016) *Ecodistricts Protocol: Global performance standard that empowers sustainable neighborhood- and district-scale development.* Version 1.1. Portland OR: Ecodistricts (56 pp.)
URL: https://ecodistricts.org/wp-content/uploads/2016/05/ed-protocol-guide-V1-1B.pdf
The Ecodistricts Protocol and Certification program is promoted as a community-scale tool for fostering neighborhood- and district-scale sustainability. The Protocol is designed as a flexible framework rather than a prescriptive standard. Local district teams tailor the Protocol to local circumstances, set their own performance targets based on local conditions and aspirations, and measure progress against the Protocol Imperatives and Priorities.
Imperatives Commitment (p. 24)

Equity: This obligation is an equity commitment that describes how a district will embrace procedural, distributional, structural, and transgenerational equity in district activities.
Resilience: This obligation is a resilience commitment that describes how a district will work to withstand environmental, social, and economic stresses and shocks.
Climate Protection: This obligation is a climate protection commitment that describes how a district will strive for carbon neutrality.

District Assessment Plan Priorities & Objective Categories (p. 39-46)

Place: create inclusive and vibrant communities
engagement + inclusion, culture + identity, public spaces, housing

Prosperity: support education and economic opportunities that build prosperity and accelerate innovation
access to opportunity, economic development, innovation

Health + Wellbeing: nurture people's health and happiness:
active living, health, safety, food systems

Connectivity: build effective and equitable connections between people and places:
street network, mobility, digital network

Living Infrastructure: enable flourishing ecosystems and restore natural capital:
natural features, ecosystem health, connection with nature.

ReSource Restoration: moving towards a net positive world:
air, water, land

[36a] Kusler, Jon (2016) Protecting and Restoring Riparian Areas. Association of State Wetland Managers (12 pp.)
[36b] Kusler, Jon (2016) Model "Riparian" Protection Ordinance (17 pp.)
These two paper describe the functions and values of "riparian" areas, including functions and values of riparian area protections within legal requirements for policy- and rule-making, as well as specific measures by which states, local governments, federal agencies, and not for profit organizations can take to better protect and restore riparian areas. A model ordinance is provided, based on a national survey of applicable regulations.
Representative recommendations for local governments include:
Local governments should require building setbacks from rivers and streams as part of their comprehensive zoning, watershed management, or stormwater management regulations.
Local governments should amend existing floodplain and wetland ordinances to apply to riparian areas. They should also amend existing regulations to include ecological criteria for riparian areas.
Local governments should adopt special riparian protection regulations to prohibit or tightly control drainage, diking, and fills in riparian areas.
Local governments should include riparian protection as part of their floodplain management and disaster mitigation planning efforts.
Local governments should prepare and adopt greenway plans for riparian areas.

[37] Rocky Mountain Land Use Institute (2016) Sustainable Community Development Code: a code for the 21st century. Beta Version 1.1 (40 pp.)
The Beta 1.1 version is a DRAFT, with some sections ell developed, others to be completed. The overall framework is helpful as a summary of best practices and suggestions, including reference for local

code frameworks and adoptions. Special topics include open space to fulfill health criteria, wildfire, solar and wind energy system applications.
The code provides provisions for regulations that address each of the following topics:

Energy
Healthy Neighborhoods, Housing, Food Systems
Environmental Health and Natural reSources
Mobility
Natural Hazards
Urban Form/Community Character

The basic organization and approach to each topic is to examine relevant obstacles, incentives, and regulations. The Code identifies obstacles to achieving stated goals that might be found in a local zoning code (e.g., bans on solar panels as accessory uses). It suggests incentives that might be created to achieve a goal (e.g., increased density in a multi-family development that installs green roofs). A third focus is upon on regulations that might be adopted to ensure progress in a particular area (e.g., mandatory water-conserving landscape standards)

[38] Yudelson, Jerry (2016) *Reinventing Green Building* Sustainability Key Performance Indicators (KPIs)
URL: http://www.reinventinggreenbuilding.com/news/2016/5/24/sustainability-kpis
A rating system focusing on these Key Performance Indicators (KPIs), based on these criteria, using *absolute performance* as the measure, instead of *relative improvement.*
1. *Energy Use*—With a "net zero energy" goal (setting aside the likelihood that very few buildings will or can ever become "plus-energy" buildings), this will include both direct combustion (natural gas or diesel for water heating, for example) and indirect combustion (electricity), while incentivizing onsite production from renewables or biomass boilers.
2. *Water Use*—Recognizing that we are entering a time of global water scarcities, brought on by population growth, climate change, increasing water footprints from agriculture, cities and industry, we need to reduce water use to an average achieved by lowest-using developed countries.
3. *Waste Diversion*—Most U.S. urban waste recycling systems seem to have peaked at around 35 percent waste diversion from landfill. It seems reasonable then to assess green buildings by starting with 50 percent diversion as a higher goal and embracing a zero waste ideal for waste generation and disposal.
4. *Scope 3 Carbon Emissions*—Scope 3 emissions are essentially "induced" emissions from corporate travel, freight deliveries and employee commuting. All can be easily tracked on a monthly basis from vendor invoices (which can be formatted for upload to FTP sites and then "grabbed" by dashboard APIs) and quarterly or semi-annually from employee surveys. The goal is to encourage companies to reduce Scope 3 carbon emissions to zero through many means, including purchasing carbon offsets.
5. *Ecological Purchasing*—While it may be limited initially to office products and similar items bought from a handful of vendors, this measure would provide useful data. Some larger US office supply companies such as Staples and Office Depot have clear and valuable programs for labeling ecological products, which can then provide input to monthly invoices for determining the total percentage of purchases that meets these criteria. The goal is to get 100 percent ecological purchasing for ongoing operations.

■

FLASH®
FEDERAL ALLIANCE FOR SAFE HOMES

RESILIENT DESIGN GUIDE

HIGH WIND WOOD FRAME CONSTRUCTION EDITION

RESILIENT DESIGN GUIDE

HIGH WIND WOOD FRAME CONSTRUCTION

Twenty six percent (approximately 30 million) of U.S. households are in wind zones with an expected wind speed of 110 mph (3-second gust) or greater. Homes in these high wind zones should be designed and built to be strong and weather resistant to improve safety and reduce costly repairs following severe weather. This guide illustrates high wind building design and construction practices, beyond code practices and recommendations for added resiliency.

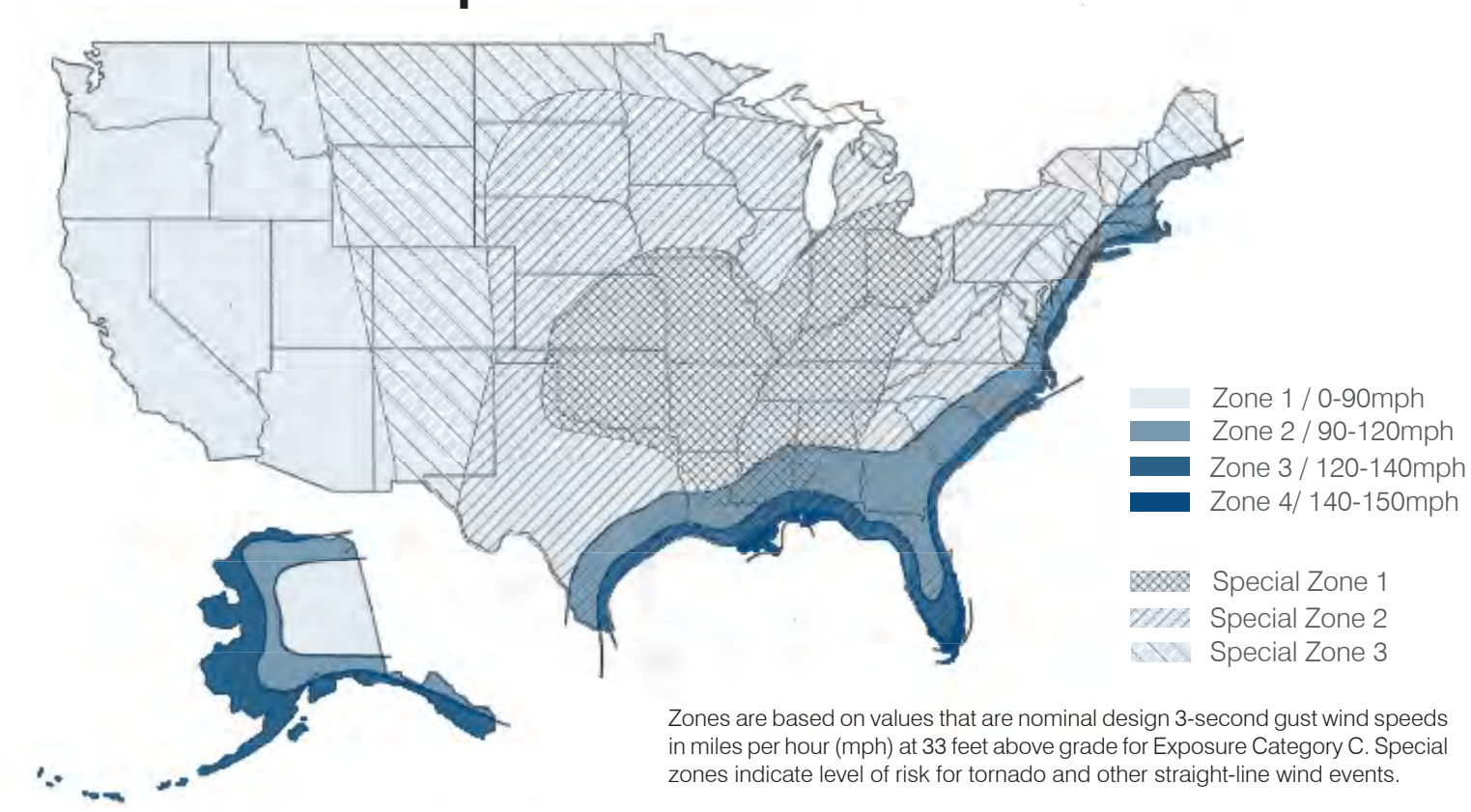
BUILDING CODES

The purpose of this guide is to provide information to designers and homebuilders about high wind construction while outlining options for enhanced resilience with affiliated costs and benefits. Building codes and practices vary throughout the U.S., so users of this guide should become familiar with local building codes and keep in mind that a home can be made more resilient by building beyond the building code. This guide will not detail all building code requirements, but will highlight beyond code and other proven ways to increase resilience.

WIND ZONES

Some building codes use different methods to calculate wind forces and the wind zone maps vary accordingly. For example the 3-second gust wind speed of 120 mph used in the International Building Code is equivalent to fastest mile wind speed of 104 mph used in other codes. The map used here is a general guide to wind zones. Detailed maps included with local building codes should be used for determining appropriate design wind speeds.

Wind Zone Map



Zones are based on values that are nominal design 3-second gust wind speeds in miles per hour (mph) at 33 feet above grade for Exposure Category C. Special zones indicate level of risk for tornado and other straight-line wind events.

Map produced by GCCDS for this guide from FEMA data to show both hurricane wind zones and tornado wind zone activities

The nonprofit Federal Alliance for Safe Homes (FLASH®) is the country's leading consumer advocate for strengthening homes and safeguarding families from natural and manmade disasters. The FLASH mission is to promote life safety, property protection and resilience by empowering the families with knowledge and resources for strengthening homes and safeguarding families from disasters of all kinds. www.flash.org

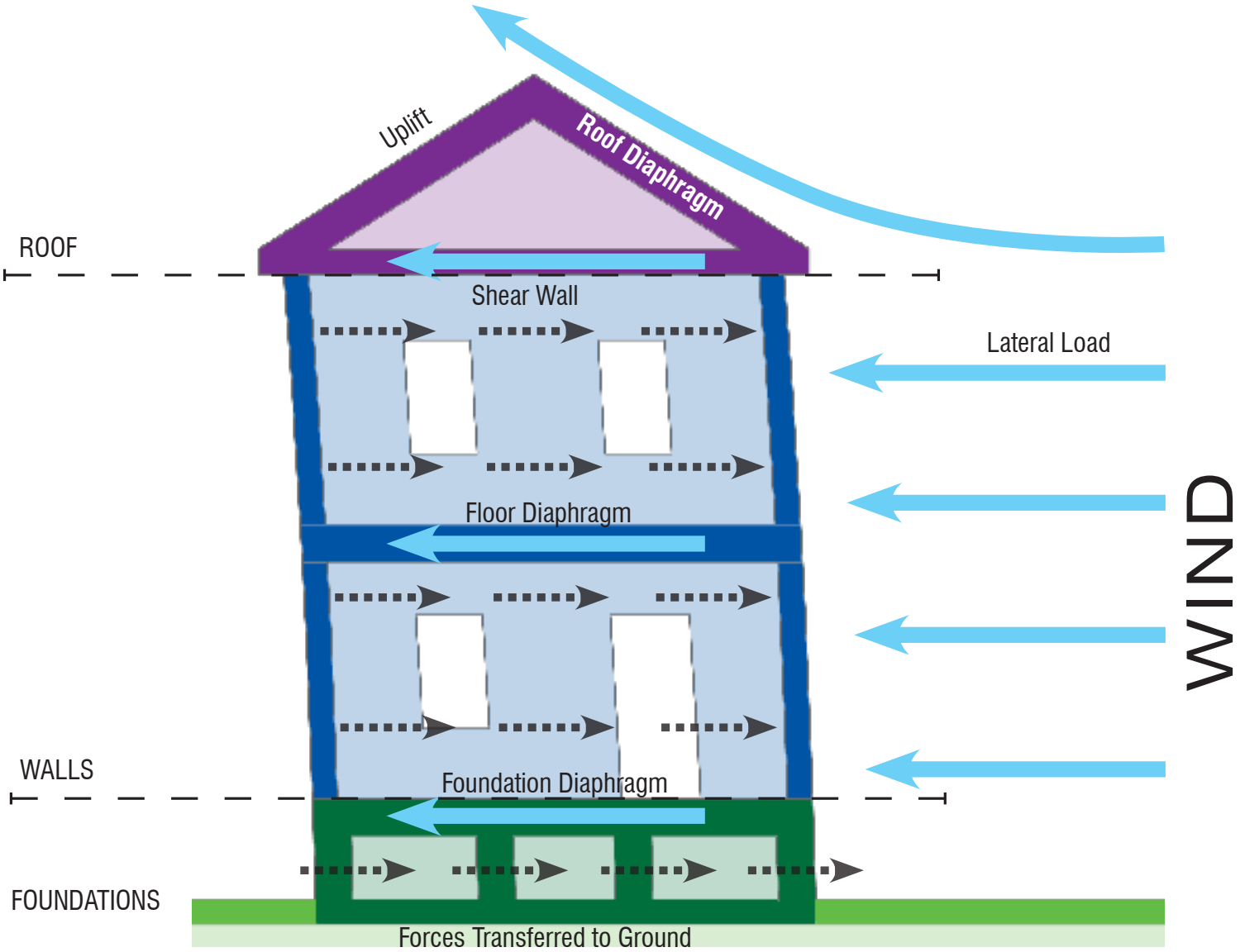
The Gulf Coast Community Design Studio (GCCDS) is a professional service and outreach program of Mississippi State University's College of Architecture, art + design. The GCCDS works through close, pragmatic partnerships with local organizations and communities, regional nonprofits, local governments, universities, developers and other partners across the country to help shape vibrant and resilient Gulf Coast communities. http://www.gccds.org/

Architecture for Humanity is a nonprofit design services firm founded in 1999. By building a more sustainable future through the power of professional design, Architecture for Humanity taps a network of more than 55,000 professionals willing to lend time and expertise to help those who would not otherwise be able to afford their services. They bring design, construction and development services where they are most critically needed. To learn more about Architecture for Humanity and support their work, go to www.architectureforhumanity.org

The purpose of this Resilient Design Guide is to provide architects, designers or even homeowners the information necessary to make any set of house plans useful for constructing a more wind resilient structure. The guide was developed during the course of a two-day charrette that brought together a cross-section of professionals from across the United States. The charrette allowed participants to tap into diverse knowledge and resources provided by professionals, including academics, architects, community outreach organizations, engineers, homebuilders, insurance professionals, manufacturers, product experts and other building professionals with practical experience before and after high wind disasters, including hurricanes and tornadoes. The group pooled their knowledge and experience to develop an outline for this guide with the goal to provide not only an overview of the "why," but the "how to" of resilient wind construction. The authors sincerely appreciate the many dedicated professionals that supported this guide.

House as a Whole System

Typically, the primary force from wind is lateral (sideways) force. For a wind of 150 mph, the wind force is approximately 42 pounds per square foot of wall area. If this load were equated to a roof load, it would compare to the weight of three feet of snow acting horizontally. Ordinary construction is designed to transfer the vertical loads of a house from the roof to the foundation and is typically inadequate to resist such high winds. Roof decking, shear walls, clips, straps, and anchor bolts work together to provide lateral support. In addition to lateral loads, winds produce uplift forces that act dynamically to pull the components of a house apart. The structural system that transfers the force from the walls down to the ground is a set of connected diaphragms – the roof and the floor decks are stiff horizontal diaphragms that transfer wall loads into vertical shear wall diaphragms. In the roof, floor and wall diaphragms, sheathing strength and nailing, as well as strong continuous boundary conditions such as double top plates, blocking and rim joists are essential details.



Roof | **Walls** | **Foundation** | **Site**

Construction Types Used in this Guide

ORDINARY CONSTRUCTION

Common wood-frame house construction is typically strong enough for wind speeds less than 100 mph. Ordinary wind design construction is illustrated in this guide to give a reference for the typical components of wood frame construction.

HIGH WIND CONSTRUCTION

Wind speeds above 100 mph require lateral strength from the roof to the foundation not provided by ordinary wind construction. High wind construction is illustrated in the pages of this guide to help explain what is generally required by various building codes to meet lateral and uplift load requirements for high wind construction standards.

RESILIENT CONSTRUCTION

Houses can be made more resilient by designing for a higher wind load because the safety factor will be increased, making house components more resistant to wind and rain during storms. Increased resilience construction is illustrated in this guide with information regarding costs and expected benefits of making homes more resilient.

These markers are used throughout the guide to indicate whether a building material is considered typical in high wind construction or represents an "increased resilience" construction upgrade.

$ This icon indicates the cost implication of different components from 1 to 5 with 1 representative of baseline construction costs.

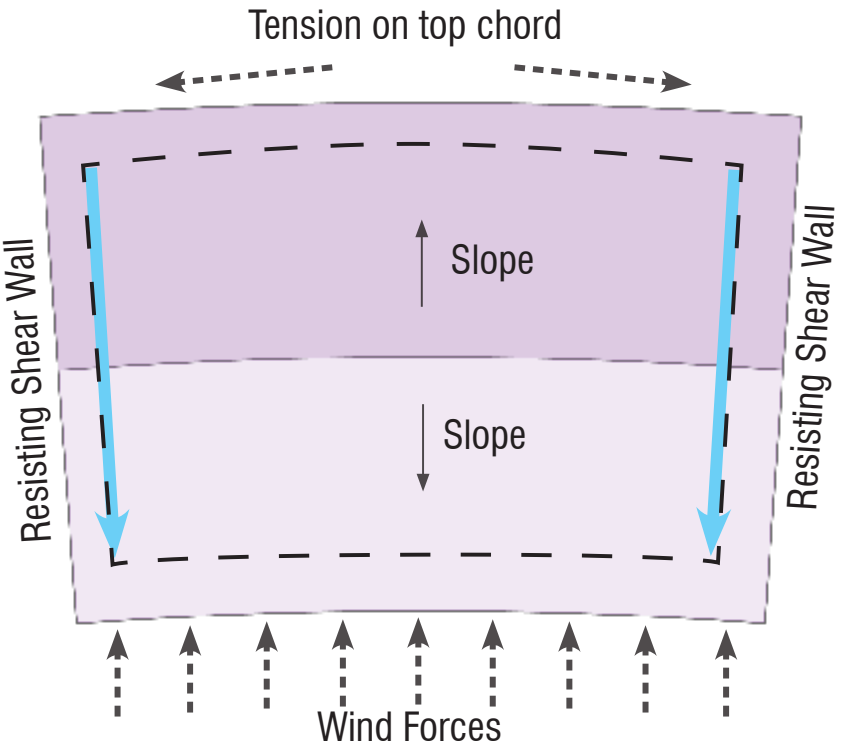
This icon indicates the construction implication and/or difficulty level from 1 to 5 scale with 1 representative of baseline for ease of construction need for specialized installation and ability for skilled labor to complete the work.

HOW A ROOF WORKS IN WIND

The roof is the primary structural element of the house, transferring the loads that act on the walls facing the wind into the walls that are parallel to the wind. The main structural components of a roof assembly include: 1) strong nailing of the roof deck to the framing, especially at the edges; 2) connection of the roof to shear walls with blocking; and 3) an unbroken double top plate on the shear walls that acts as a structural chord.

Roofs are highly exposed to wind and rain and need to be strong as an overall structural system as well as watertight at any given area on the roof. A resilient roof has two durable layers of protection designed for high winds that include roof covering and underlayment.

Overhead View of Roof



ROOF COMPONENTS

Coverings are the roof's first line of defense against wind and wind driven rain. Common residential coverings include asphalt shingles, concrete/clay tiles and metal panels.

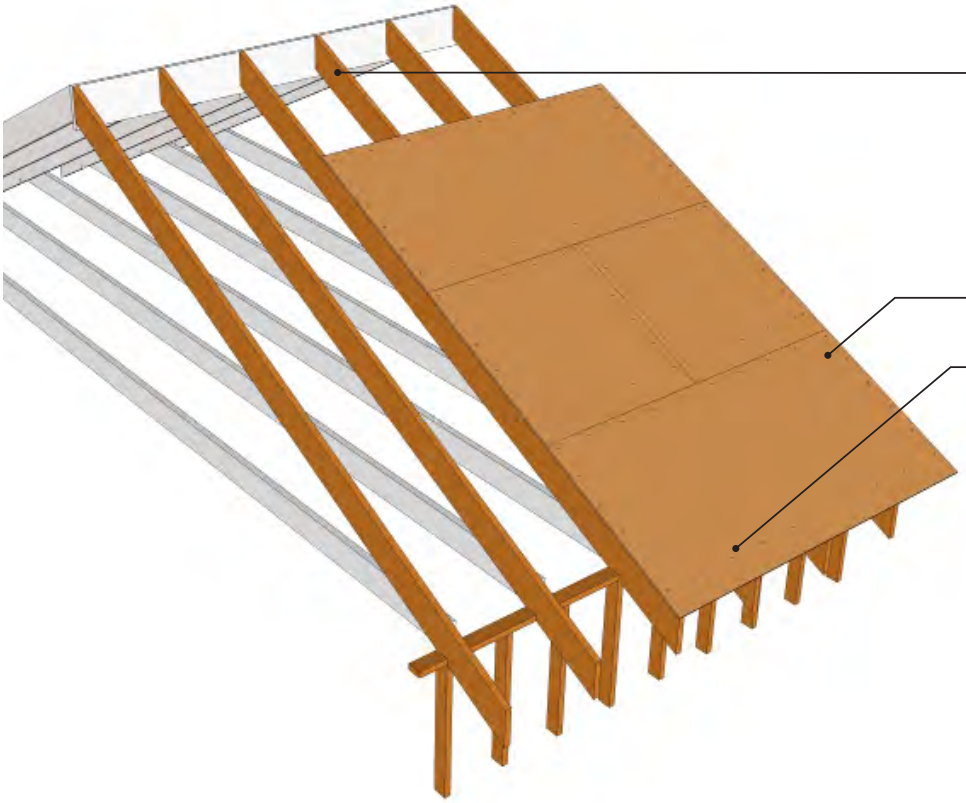
Underlayment is a secondary layer of roof covering designed to keep moisture from the decking. If a primary covering layer fails, properly installed underlayment will keep water from penetrating the roof and attic. Common underlayment includes 30 lb. felt or tar paper, self-adhesive membranes and membranes that are fully integrated into the decking.

Sheathing/decking is a structural component of a roof typically made of plywood or oriented strand board (OSB) panels. Decking is fastened to the top of the roof framing and makes the framing rigid, so it can transfer loads to the exterior walls.

Framing is the primary structural element of a roof. In this guide, residential framing is limited to wood rafters and wood trusses. Roof framing should be tied to the walls as part of a load path from the roof to the foundation.

ORDINARY CONSTRUCTION

Typical components of wood frame construction



Framing

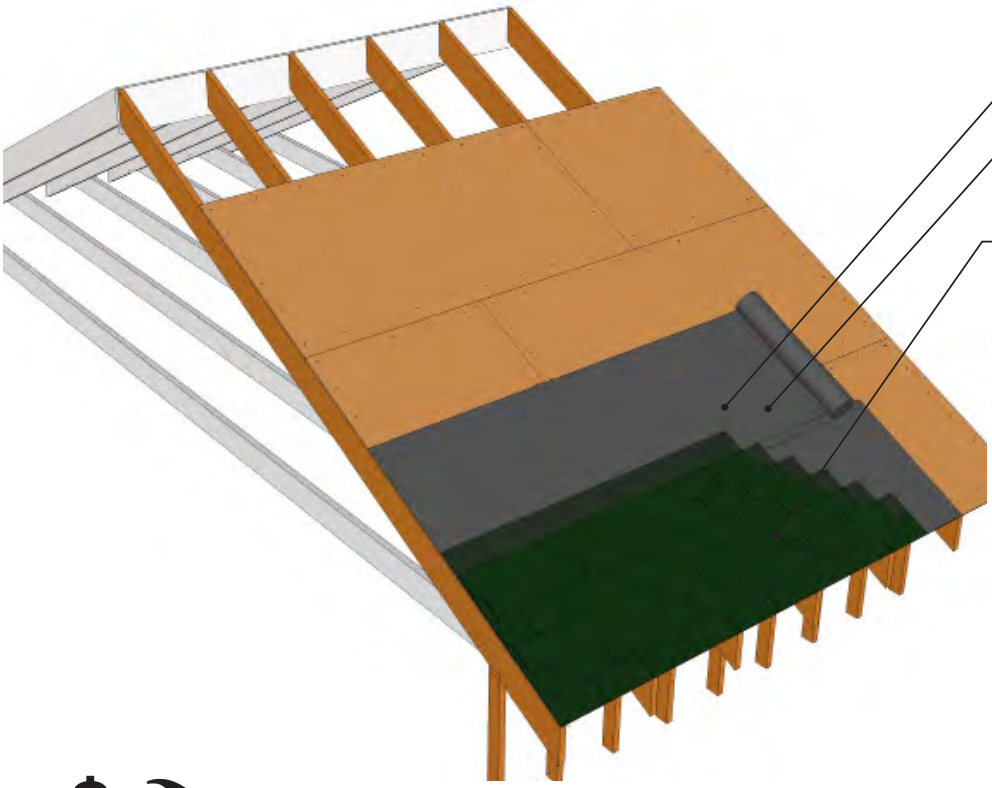
#2 grade 2x rafter & joist framing @ 24”O.C. or 2x engineered truss @ 24” O.C.

Decking

½” plywood/OSB decking

8d ring shank nails 6” O.C. edge 8” O.C. field

$ Structure Detail



Underlayment

30# lb. felt building/tar paper

Staple fastener

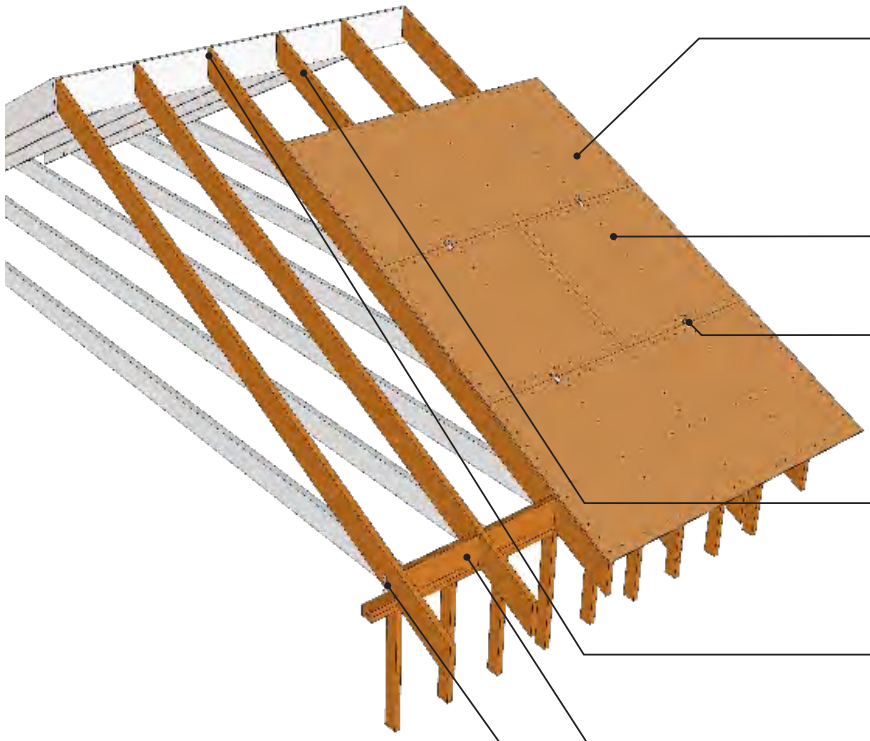
Coverings

Three tab shingle - 4 corrosion resistant nails per shingle

$ Covering Detail

HIGH WIND CONSTRUCTION

Generally required by various high-wind building codes



Decking

5/8” plywood/OSB decking (full sheet at eaves, ridges; no sheet narrower than 24” anywhere on the roof and no sheet shorter than 48” at rake edge)

10d ring shank fastener 4” O.C. at edge and eave blocking, 6” O.C. in field

Panel edge “H” clip spaced between framing member attachment

Framing

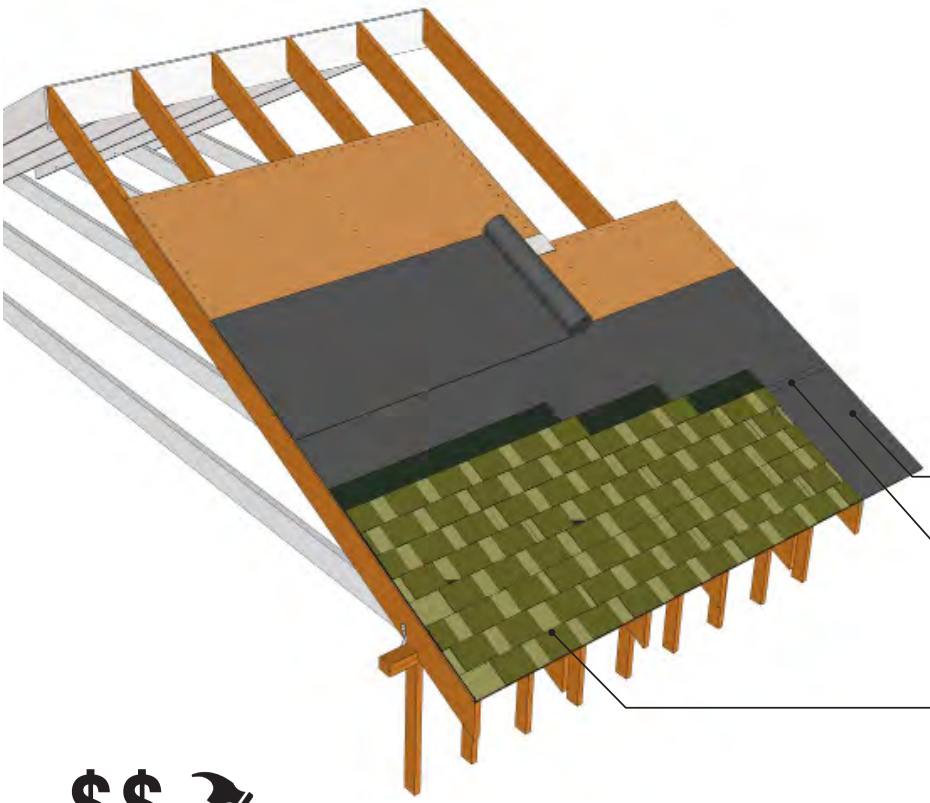
#2 grade 2x rafter & joist framing @ 24”O.C. or 2x engineered truss @ 24” O.C.

Metal strap tie at ridge installed before decking

2x eave blocking cut to match roof slope, installed before roof deck

Strap on every rafter/truss

$$ Structure Detail



Underlayment

30# lb. felt building/tar paper

Button cap fastener 9” O.C. edge 18” O.C. field

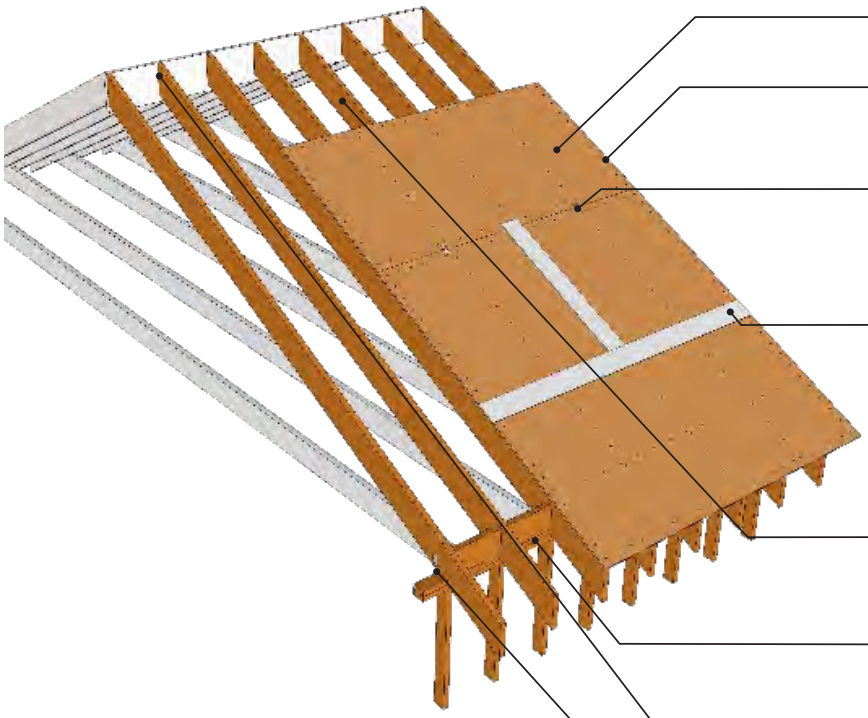
Coverings

High-Wind rated shingles
6 corrosion resistant nails per shingle

$$ Covering Detail

RESILIENT CONSTRUCTION

Reduces the damaging effects of a storm



$$ Structure Detail

Decking

5/8” plywood/OSB decking

10d ring shank fastener 4” O.C. at edge at eave blocking, 6” O.C. field

Panel edge “H” clip spaced between framing member attachment

4” self-adhering polymer modified bitume flashing tape and polyurethane spray foam adhesive at underside of decking at all framing and joints attachments

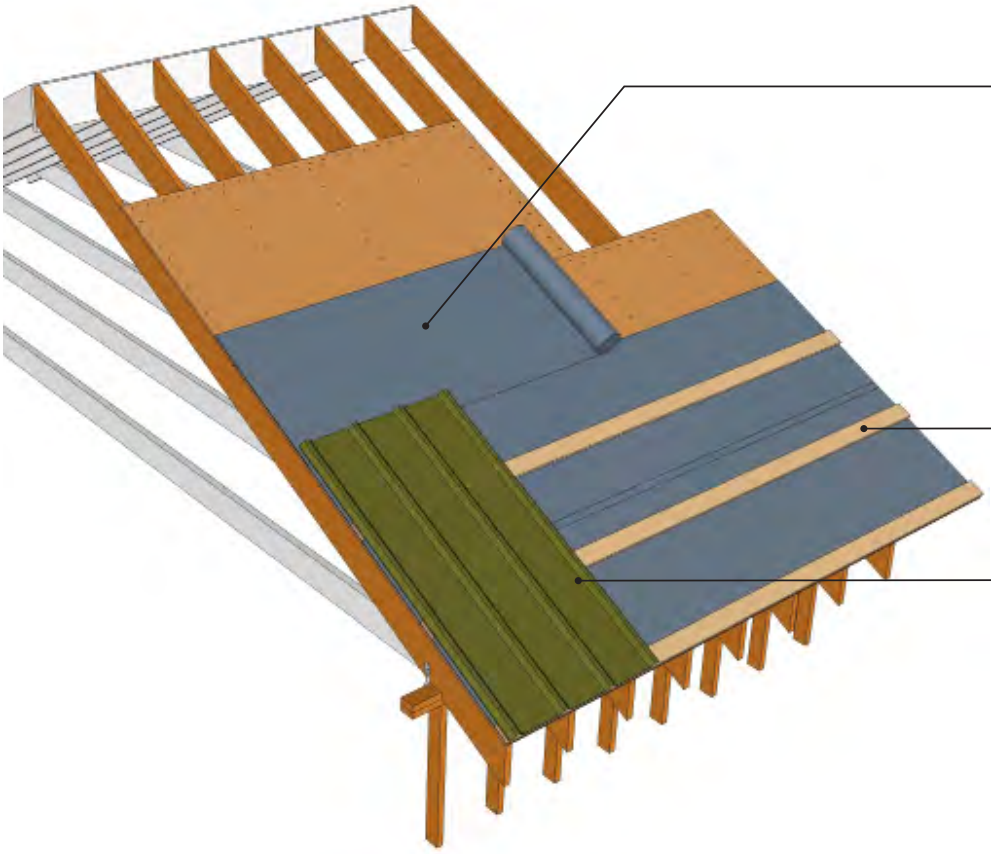
Framing

#2 grade 2x rafter & joist framing @ 16”O.C. or 2x engineered truss @ 16” O.C.

2x eave blocking cut to match roof slope, installed before roof deck

Metal strap tie at ridge installed before decking

Strap on every rafter/truss



$$$ Covering Detail

Underlayment

Self-adhering polymer modified bitumen membrane over entire roof deck

or

Self-adhering polymer modified bitume flashing tape on all decking panel joints. 30# lb. felt building/tar paper. Button cap fastener 9” O.C. edge 12” O.C. field

Coverings

On 1x4 wood (untreated) purlins fastened by 2 10d ring shank nails @ 12”O.C. into framing every other set

Metal Roof

screw down panel

Per manufacturers’ specification for increased wind load

or

Metal Panel/Standing Seam Metal Roof System

Per manufacturers’ specification for increased wind load

Concrete & Clay Tile Systems

Per manufacturers’ specification for increased wind load

SUPPLEMENTAL INFORMATION - ROOF

Hazards

Roofs are the most susceptible component of houses exposed to hurricane force winds. Typically, wind damage to roofs is caused by uplift forces (vertical), suctional and torsional forces (twisting) and horizontal pressures. Wind damage effects vary depending on the roof height, slope, siting and style. Steep roof systems generally fail at the ridge or along gable ends where wind forces are the highest. Low slope roofs typically fail at roof corners. According to information gathered by FEMA after major storms, the roof component damaged most often in high wind is the roof covering (shingle, tile, etc.), and the second most common damage is sheathing (e.g. plywood or OSB decking). Covering failure usually follows use of the incorrect type of fasteners, e.g. nail too small or absence of mechanical attachment on clay tiles, etc. Sheathing damage is more often the result of insufficient attachment, e.g. not enough nails in the nailing pattern. Once the failures occur, they not only expose buildings to water penetration, but also generate windborne debris. When roof systems fail during a hurricane or other high wind events, the rest of the home is weakened and becomes vulnerable to significant, progressive damage.

credit: FEMA

Ridges, Valleys and Accessories

Roof ridges often experience covering loss in hurricanes or severe windstorms, and vented ridge caps should be properly fastened to ensure adequate resistance. Low profile ridge vents are a good choice as they are less vulnerable in high wind events. Roof valleys are vulnerable in severe weather because they experience significant water flow that can lead to water infiltration. Special care should be taken to follow manufacturers' specifications to attach all roof elements, including accessories, equipment, solar panels and/or turbine roof vents.

Underlayment & Coverings

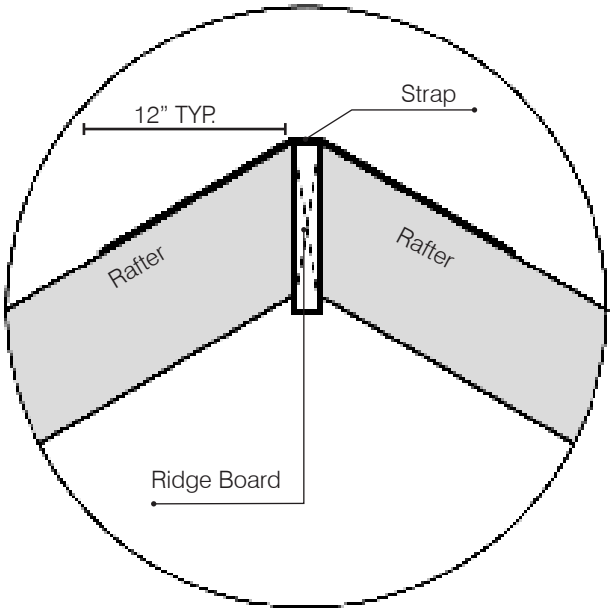
Underlayment should be securely fastened to roof decking independently of the roof covering fasteners. Staples are sometimes used to fasten underlayment materials such as building paper or felt based on the assumption that fasteners used to apply roof shingles on top will secure the underlayment. Unfortunately, in a high wind zone, roof shingles are often lost and this leaves inadequately attached underlayment that cannot prevent water intrusion through deck joints or nail holes. Using a fastener such as a button cap to secure the underlayment will help prevent water intrusion should the coverings fail. Peel-and-stick membrane products also offer superior protection when coverings are lost. Shingles are more wind resistant overall when installed using six vs. four nails. Metal and clay tile roof systems should always be attached using manufacturers' specifications for an increased wind load.

Nail Patterns

Nail patterns describe layout and spacing for a particular attachment of one component to another. Choose the type, size and amount of nails to achieve high wind resilience.

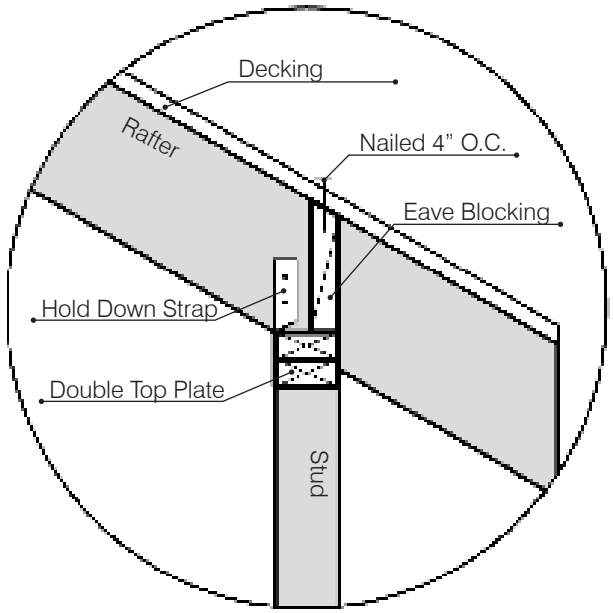
Gable End Wall

The rake is an overhang at the gable end wall that is particularly vulnerable to wind forces, so it should be adequately and properly attached to the rafters and top of the wall. Because the edge of the roof framing, decking, underlayment and coverings all meet at this location, it is critical to ensure the assembly is attached correctly to withstand wind forces. Gable end walls should be braced back into roof framing and must have a minimum of 7/16" structural sheathing.



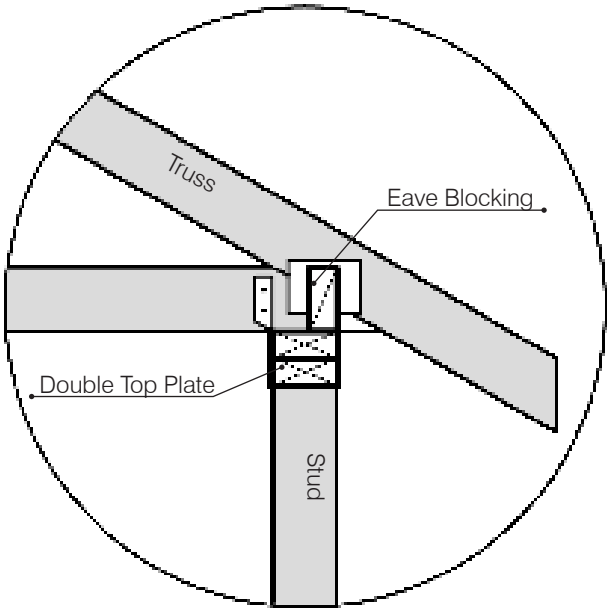
Rafter at Ridge Board

Typical construction practices include cutting out a ridge vent in the roof decking to allow for air to flow freely from inside the attic. This causes an unintended weakness while the vent allows air to flow, it also weakens the roof diaphragm at a critical location because the ridge board serves as a boundary of the roof diaphragm. When the decking is cut away for the vent, the decking is no longer connected between the rafters. Installing a strap or straps will strengthen the connection between rafters while still allowing for roof venting at the ridge.



Rafter at Top of Wall

Rafters attached to the top of a wall in a high wind zone should be fastened to the top plates of the wall with more than just framing nails. Typically, metal connectors, straps or clips, are specified to hold down the rafter. Eave blocking between the rafters in high winds does more than keep the birds out of the attic; it helps tie the roof diaphragm to the walls and keep the rafters from rolling due to lateral loads.

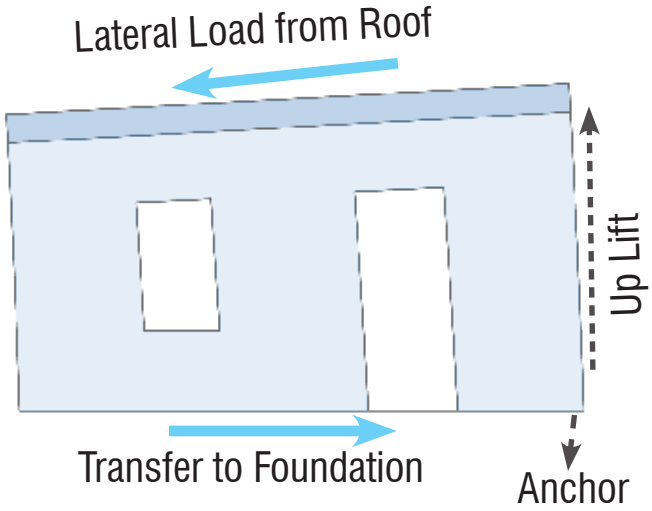


Truss at Top of Wall

When a truss attaches to the top of the wall, it is similar to a rafter in the hold down connection. A metal strap or clip is specified to hold down the truss in the same way a rafter is held down. The eave blocking detail is somewhat different. In most places, it is not required by code to have full eave blocking when trusses are used for the roof structure, however 2x4 blocks should be installed to help resist lateral loading.

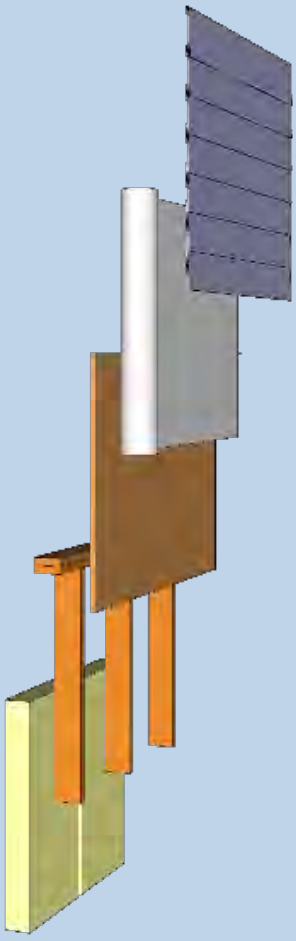
HOW A WALL WORKS IN WIND

Three types of wind forces act on walls--wind pressure perpendicular to the wall, lateral loads transferred from the roof to the foundation parallel to the wall, and uplift forces from the roof being lifted from the wall.
The **perpendicular wind force** acts as either positive or negative pressure and is greatest at the corners.
The largest wind load is the **parallel lateral load.** This load comes from the roof diaphragm transferred to a shear wall. A shear wall is sheathed with structural panels such as plywood and has critical attachment requirements to the roof and floor framing. Window openings and parts of the wall at corners and between windows that have a length less than 30% of the wall height are not considered part of the shear wall. As a result, windows spaced closely together and windows located closer than 3 feet from corners reduce the shear wall capacity and may require special engineering. The end walls of long, narrow homes are often inadequate shear walls. In such cases, one or multiple interior partitions must be built as shear walls.



High wind zone construction requires use of metal anchors, clips and straps to create a "continuous load path" from the roof to foundation. The well connected load path allows the structure to resist **uplift forces** because the attachments prevent the roof, wall framing and foundation from separating under uplift and lateral loads.

WALL COMPONENTS



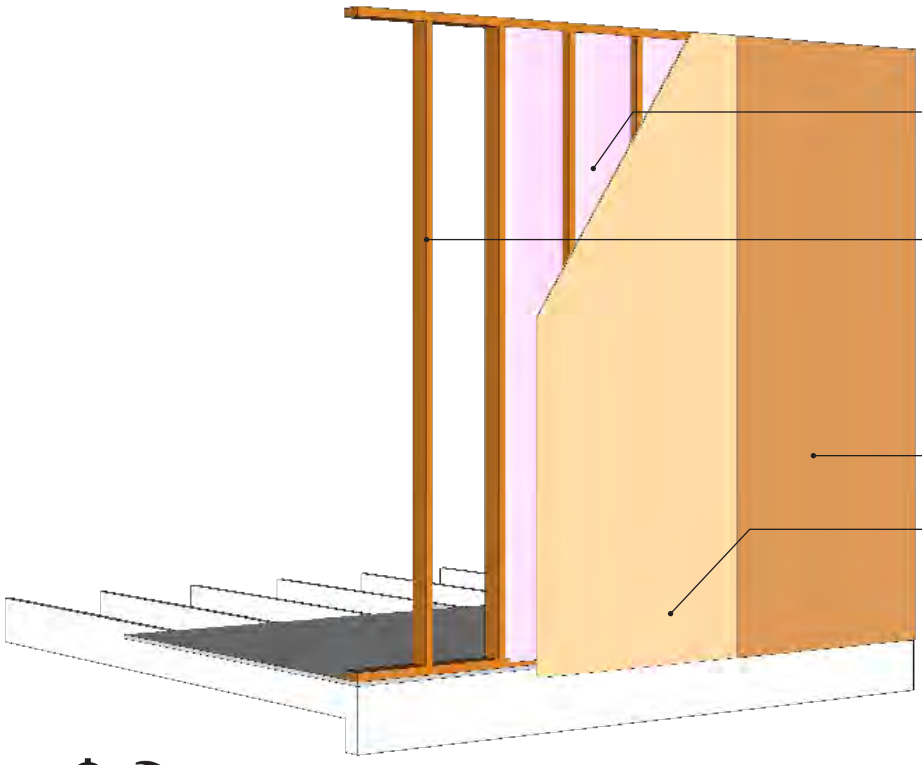
Wall covering, also known as cladding, is the outermost layer of the assembly. Unlike roofs, wall cladding is not sealed to moisture. Instead, cladding protects the water barrier layer beneath from damage. Common residential wall coverings include brick, cement fiber siding, stucco, vinyl and wood.

House wrap also known as weather resistive barrier (WRB) has the unique ability to stop water from penetrating to the sheathing while still allowing the wall to ventilate.

Sheathing provides lateral strength and serves as the base for the house wrap and flashing; and is part of the wall's thermal barrier. In high wind zones, sheathing is usually plywood or OSB. Following the specified nail pattern for the sheathing is critical to gain the proper strength.

Framing is the primary structural element of a wall and is most often 2x4 wood studs spaced at 16 inches. Some homes are built using advanced framing which uses 2x6 studs aligned with the roof rafters spaced at 24 inches. Advanced framing offers the advantages of energy and material conservation.

Insulation typically fills space between studs. There are three types of insulation used in homes, including batt, blown, or spray foam. All three types can achieve the thermal performance required by code; however, spray foam has structural and sealing advantages that add to resiliency of the home.



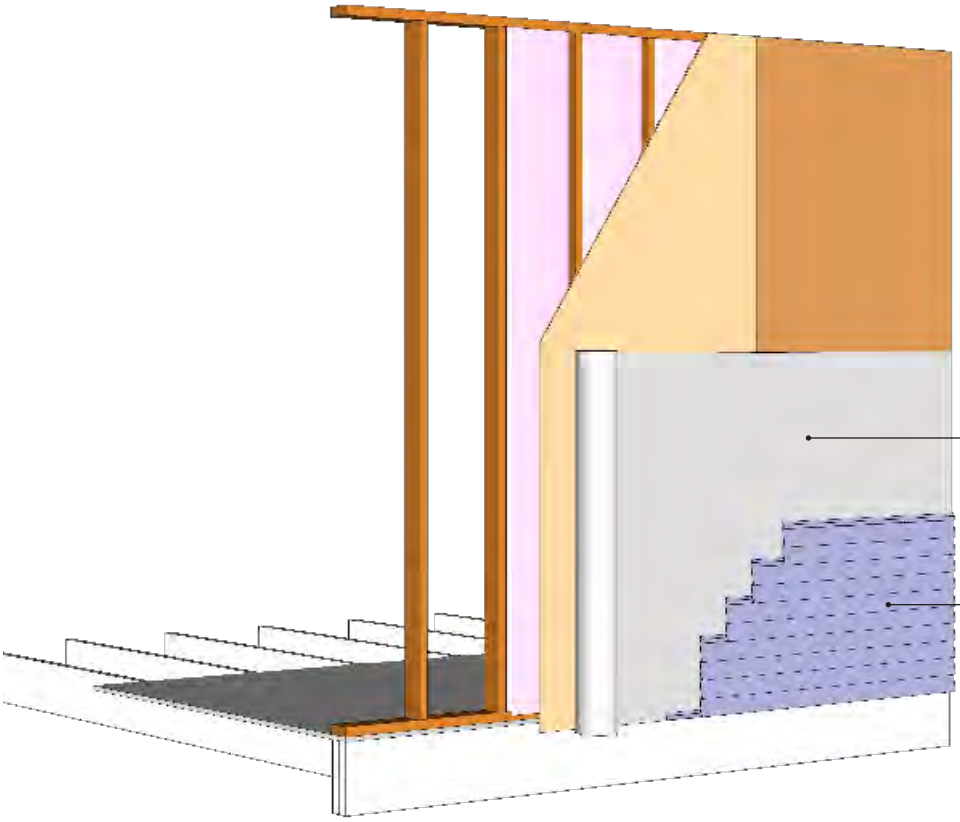
Framing
Batt insulation, lapped and stapled to inside of studs

2x4 @ 16” O.C. framing with single top plate

Sheathing
Plywood or OSB at all corners

Infill non-structural backing for rest of wall

$ Structure Detail



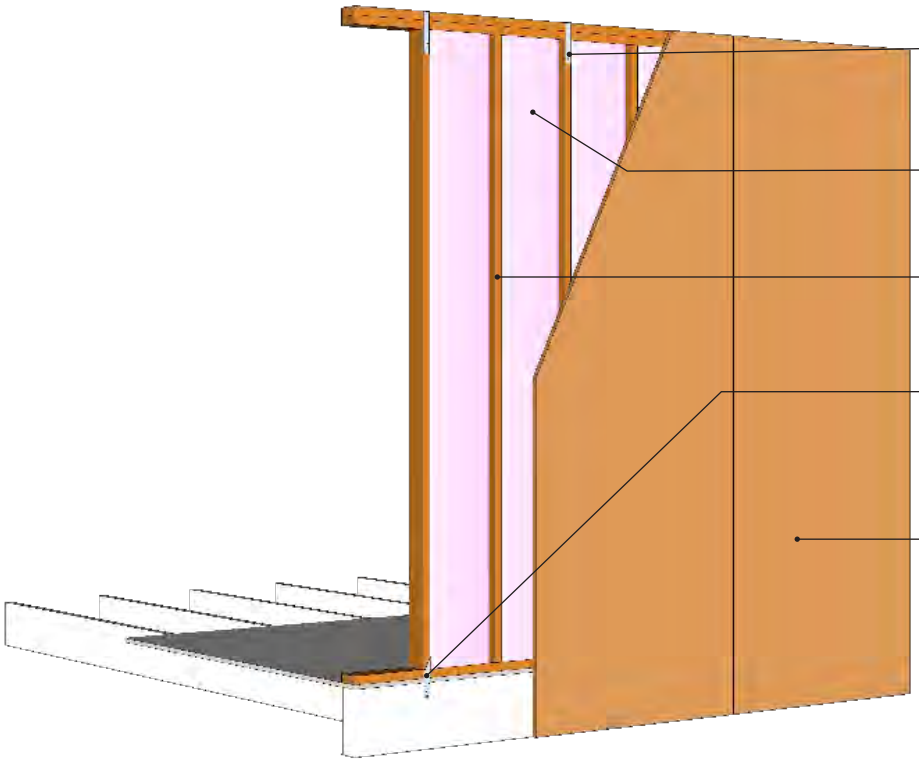
House Wrap
Building paper fastened with staples

Covering
Vinyl siding

$ Covering Detail

HIGH WIND CONSTRUCTION

Generally required by various high-wind building codes



Framing

Top plate strap every other stud and every king stud

Batt insulation, lapped and stapled to inside of studs

2x4 @ 16” O.C. framing with double top plate

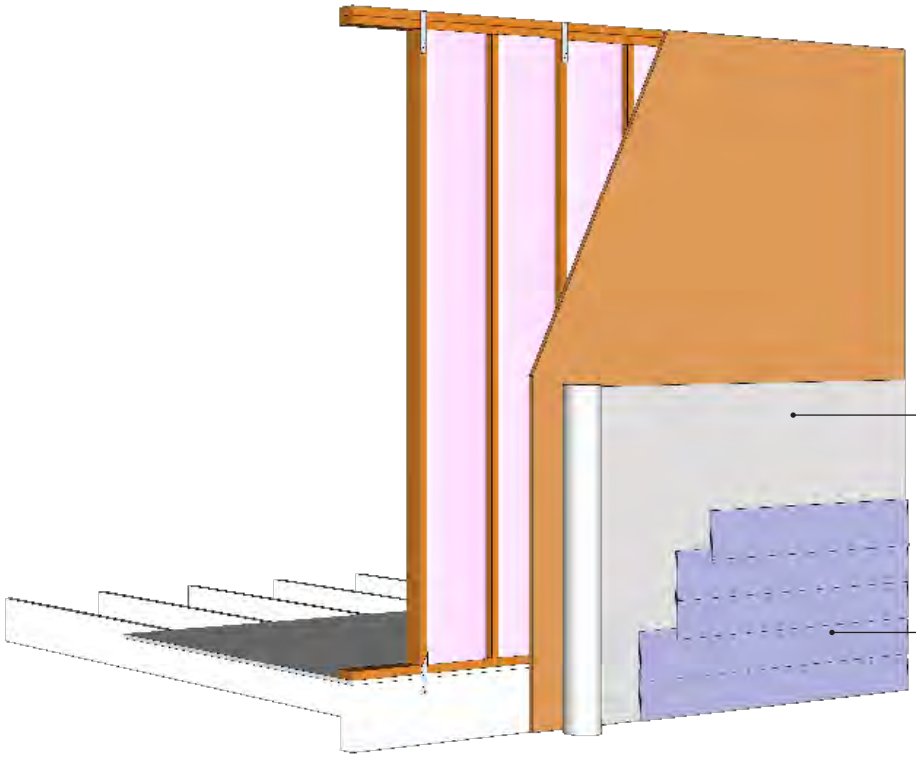
Stud to floor strap every other stud and every king stud.

Sheathing

7/16 OSB long length sheathing, attached to bottom plate for slab and rim joist for raised floor

Nail Pattern:
4” at edges of sheet , 6” in field, 4” at boundary. Use 8d hot dipped galvanized ring or box shanked nails

$ Structure Detail



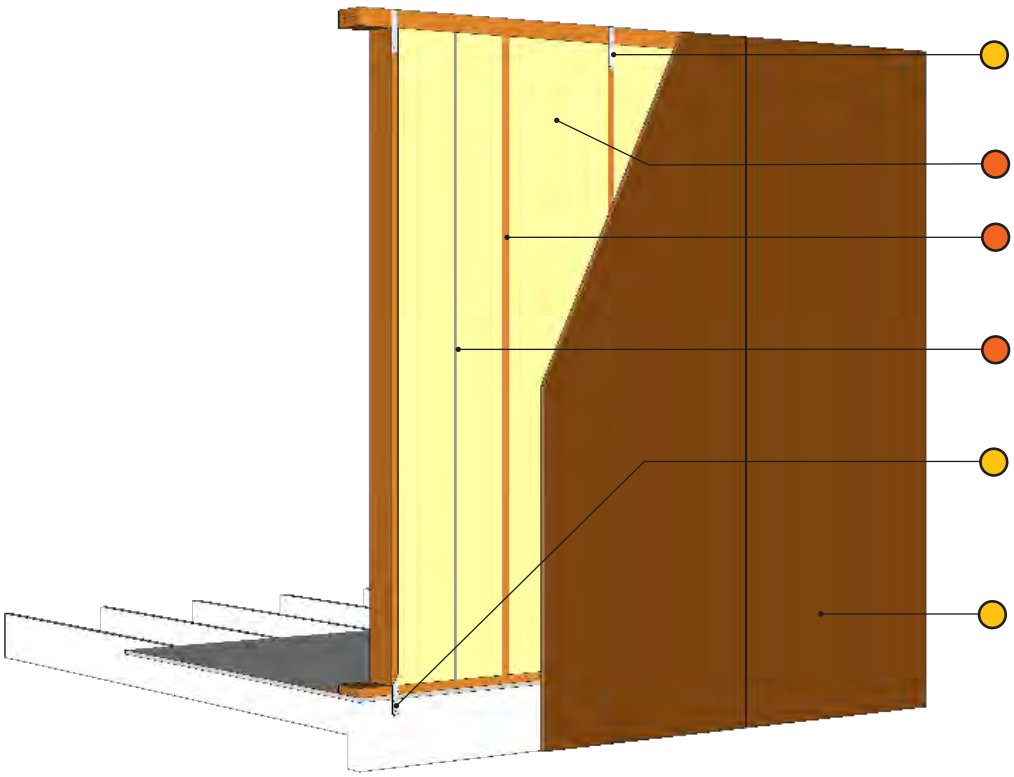
House Wrap

Vapor permeable WRB attached with 1” button cap @ 32” O.C. in each direction

Covering

Cement fiber board siding attached per manufacturers’ specifications for high-wind zones and blind nailed

$ Covering Detail



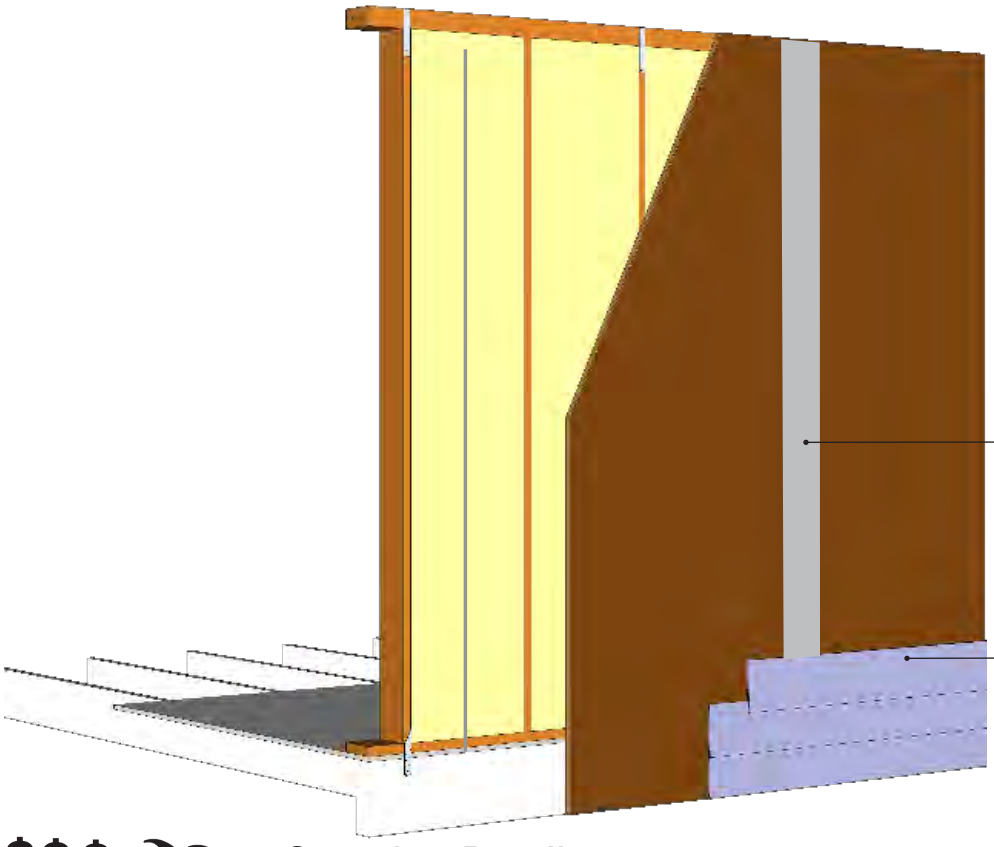
Framing

- Top plate to stud strap every other stud and every king stud
- Spray foam insulation in wall cavity
- 2x6 @ 24” O.C. framing with double top plate
- Continuous anchor tie downs (through bolt from top plate to foundation)
- Strap stud to bottom plate strap other stud and every king stud

Sheathing

- 7/16 OSB long length sheathing, attached to floor system, overlap bottom plate by ~12” with WRB fully integrated into sheathing.
  Nail Pattern:
  4” at edges of sheet , 6” in field, 4” at boundary. Use 8d hot dipped galvanized ring or box shanked nails

$$ Structure Detail



House Wrap

- 4” self-adhering polymer modified bitume flashing tape on all sheathing panel joints

Covering

- Cement fiber board siding attached per manufacturers’ spec for high-wind zones exposed nailing

$$$ Covering Detail

SUPPLEMENTAL INFORMATION - WALLS

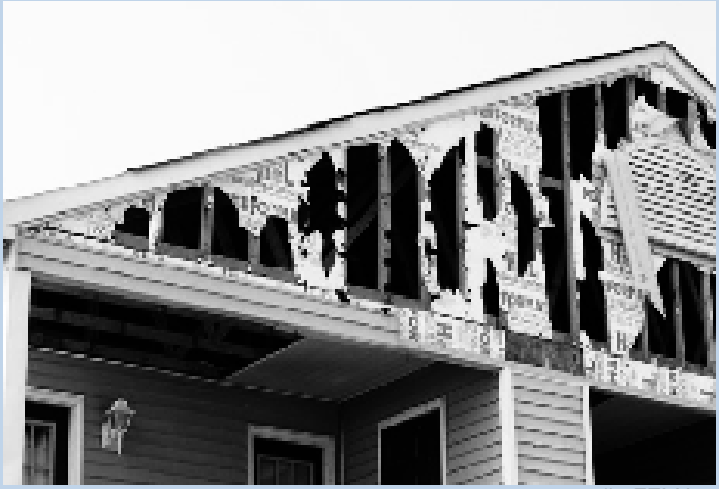
Hazards

CLADDING/COVERINGS LOSS – Siding of any type (wood, vinyl or cement fiber) can blow off a house and become damaging windborne debris. Once siding is blown off, vulnerable house wrap is quickly destroyed exposing the untreated wood sheathing that can suffer damage from wind driven rain.

IMPACT FROM WINDBORNE DEBRIS - Windborne debris impacts are difficult to anticipate, however, a well-constructed assembly with the proper sheathing and cladding attachments will help protect walls from flying debris.

WIND-DRIVEN WATER - When cladding is lost, the walls are vulnerable to wind driven water. A well attached weather resistive barrier can help to minimize moisture and water infiltration.

OPENINGS & PENETRATIONS – Door and window openings are commonly damaged by wind and wind driven water. Following specified installation instructions, using flashing and deploying locking mechanisms are all vital steps to make doors and windows wind resistant.



credit: FEMA

House Shape

The shape of a home is material to how it handles lateral loads. For instance, a square home has the same load in every direction because the size of the ends and sides are uniform. Conversely, a long narrow home will experience a much larger load on the long sides than on the short sides. Walls parallel to the lateral load need to be designed and built in a way that anticipates and handles this loading.

Shear Walls

Shear walls are structural walls that resist lateral forces acting on a house, and structural panels and framing are the primary components of a shear wall. In high wind zones, exterior walls are typically shear walls. In some cases, interior walls are designed as shear walls if the configuration of the home or size of openings requires more rigidity. Openings create weak points in shear walls and the shear wall strength is discounted for openings. Shear wall design is based on the height and length of a wall, the number and size of openings and the calculated lateral loads based on the specific wind zone location of the home. Shear walls have typical diaphragm nail patterns, e.g. 4" O.C. at edges and 6" O.C. in field. The shear walls must be properly attached to the roof and floor structure in order to properly transfer the loads to the foundation. Interior shear walls should attach to floor/foundation systems much like exterior walls attach to floor/foundation systems.

Eave Blocking

The method of eave blocking is a significant difference between typical construction and high wind zone construction. Typical eave blocking is commonly referred to as "bird blocking". However, proper blocking between joists performs an essential function as it transfers lateral loads from the roof deck to the shear walls. Eave blocking should be installed during framing before the roof decking is in place. Roof decking should be nailed to the blocking before underlayment is installed.

WINDOWS

Cladding and Covering

BRICK VENEER is popular as home cladding because it provides for low maintenance, however, it can be vulnerable to wind and wind driven water in high wind areas. Common brick veneers are secured with masonry ties tied back to the wood frame, however, problems can occur when not enough ties are used, ties are not fastened to the wood frame securely or corrosion sets in. In high wind zones, ties should be spaced closer together and attached through the sheathing to the framing. Also, using proper drainage and drying space will keep the ties and back side of the brick dry and less susceptible to moisture and corrosion.

VINYL SIDING is lightweight and susceptible to high wind damage. However, some manufacturers produce vinyl siding systems designed for high winds. Before using vinyl, ask local building suppliers for detailed product information and investigate the past product performance in your area.

FIBER CEMENT SIDING manufacturers provide for high wind by providing details for enhanced attachment with higher grade fasteners and closer placement. Roofing nails with larger heads are often specified in place of specialized "siding" nails. And, like masonry ties, fasteners should be attached to the wood frame behind the sheathing.

DP Ratings

Design Pressure (DP) Ratings on windows should not be confused with impact ratings as they are based solely on the wind load the windows are designed to withstand. DP Ratings and requirements vary by the home's wind zone location as well as window location in the wall. For example, DP rating requirements in the middle of the wall where pressure is lower are lower than those near the edges where pressure is greater. Refer to your local building authority to identify appropriate DP Ratings.

Impact Windows

Impact-resistant windows are tested and rated with large & small missile impacts. Windows are required to remain intact after impact, however glass breakage is allowed as along as the glass does not fall out of the window.

Large Missile = 6' nine lb. 2x4 fired at 50FT/S
Small Missile = 30 pieces of roof gravel fired at 80FT/S

When local building codes in high wind zones require impact-resistant windows, they often allow for product substitutions due to cost considerations.

Shutters, Panels, Etc.

Many products are available to work in place of, or supplement the strength of impact windows. Shutters or other protection decreases the chance of breaking glass.

Installation

Window installation is critical to window performance in the wall, so using the correct DP rating and impact resistance attributes will not matter if the installation is not correct. All window manufacturers specify the correct means of installation, and high wind resilience can be achieved by following the manufacturers' installation guidelines for increased wind load.

Self-adhered Flashing

Self-adhered flashing, commonly called "window tape," is vital to securely seal window openings. Tape should be installed after the window is secured in place from the bottom sections first and up to the top. Each section above should overlap the section below to create an effective drainage path.

SUPPLEMENTAL INFORMATION - DOORS

Doors are weak parts of the wall and must be detailed correctly to keep wind and wind driven rain out of the home. During a 130 mph wind (Category 4 hurricane), a typical 3' wide door will experience approximately 580 pounds of pressure. As with windows, the glass sections in doors are the most vulnerable. Door glass panels have their own DP and impact ratings although they are similar to windows ratings. Common areas where doors fail are outlined below:

Door to Jamb and Frame

Latch - A common weak point is the latch and lock because high winds can concentrate large forces on that single point. Many new door models have three and five point latching as opposed to the traditional single point at the latch and handle, , which creates a stronger door to door frame connection.

Hinges - The hinge side of the door is also a major concern. Door hinges need specific attachments to the door frame and door to ensure proper connection.

Jamb and Frame to wall - If the door jamb and frame are not properly attached to the structure, the door system will fail. All door manufacturers provide detailed specifications on how to attach the system to the structure of the home.

French Double Doors

Double doors often fail in high winds because they are weak where they come together, especially if they swing inward. Some units use a center post to create a stronger latch point, however, the post somewhat defeats the purpose of a double door configuration. More manufacturers are offering out-swinging double door models, and they are sometimes required by local building codes.

Garage Doors

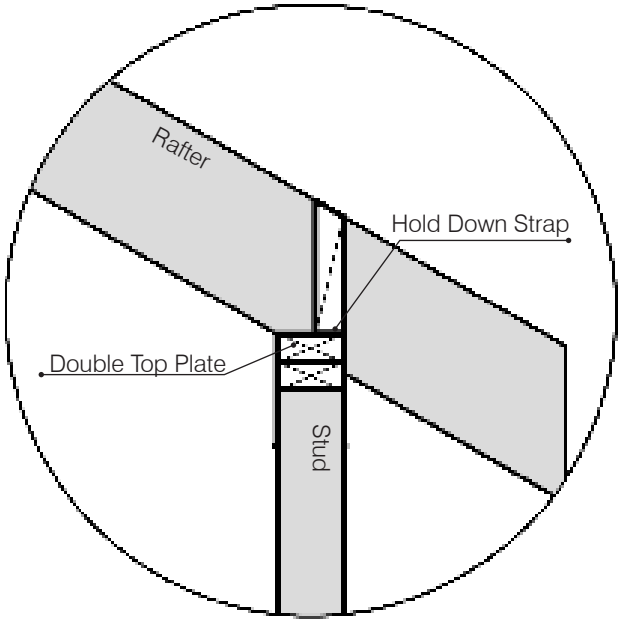
Like doors and windows, garage doors are a weak part of the wall, especially because most garages are designed to make the door opening as wide as possible. This wide opening requires a strong door frame that is commonly referred to as a "moment frame". The wind load on a garage door is substantial. A typical 10'x10', single car garage door is subject to more than 6000 lbs. of pressure in 130 mph winds. Garage doors must be rated for pressures associated with the site design wind speed and exposure category. Garage doors are commonly made of thin sheet metal, fiberglass or similar materials so that they are lightweight for efficient lifting. As a result, they are vulnerable to damage by wind forces and windborne debris. Glass panels in garage doors are not recommended because they introduce additional weakness and glass panel, wind rated garage doors are expensive options for typical residential construction. Roll up doors are often connected at only a few critical points. The concentrated loads on the edges must be accounted for when attaching garage doors. Anchoring into the wall is vital just as it is for windows and doors. Thresholds poured into the garage slab or installed onto the garage floor help keep out wind-driven water.

Wind-Driven Water

Seal - Doors should be properly flashed and sealed for both wind and wind driven water. All four sides of the door should seal tight to the frame, and all four sides of the frame should be sealed tight to the structure. A combination of flashing and sealers such as caulking, foam and silicone should be used.

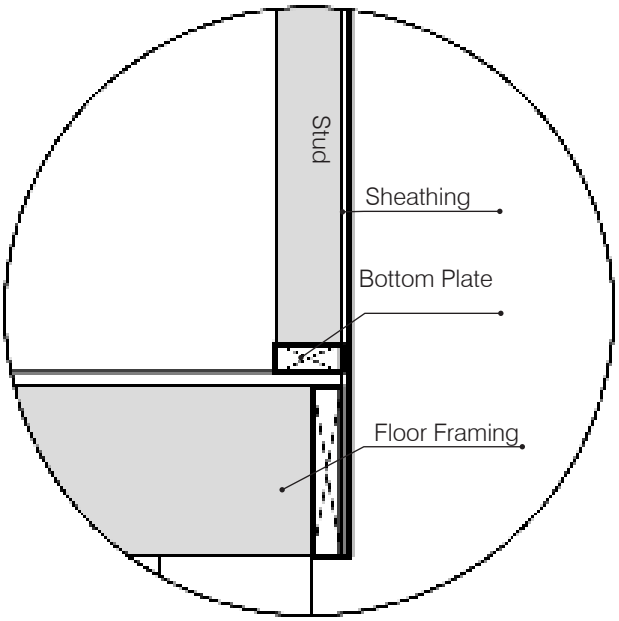
Thresholds -The threshold is the bottom of the door frame and provides transition from outside to inside. Thresholds can be particularly vulnerable to wind driven water. Sealing the bottom of the threshold to the door frame is important and is often overlooked at the time of installation.

WALL CONNECTIONS



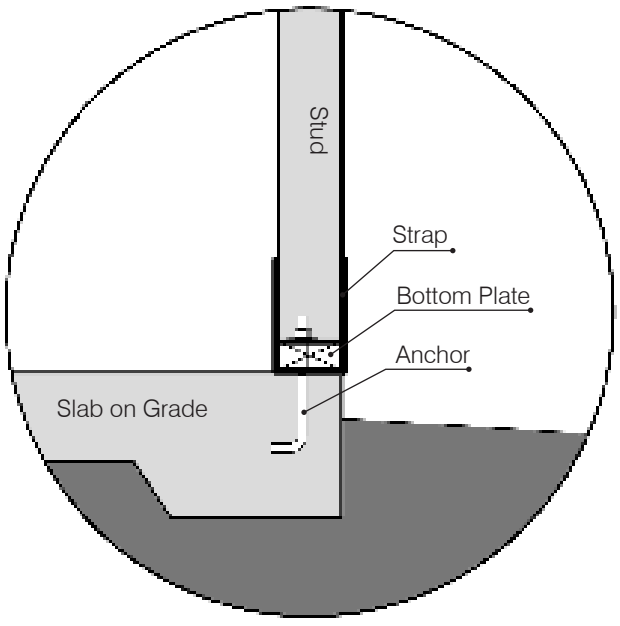
Top of Wall

The top chord of the wall is made of two 2x4 framing members. The top plate is doubled so that the strength of the chord is not lost at splices. Wind forces on the face of the wall pull the top plate from the stud. Hold down straps keep the top plate from overturning when an uplift force is acting on the roof structure. A hold down strap that wraps over the top and connects to both sides of the stud is recommended.



Wall at Raised Floor

The wall at a raised floor should use longer sheathing, known as a combined use wood structural panel, to overlap the bottom plate and attach to the floor framing members. This creates a connection from the top of the wall to the bottom of the floor framing. Additional straps can be used to strengthen the connection of the wall to the floor framing.



Wall at Slab on Grade

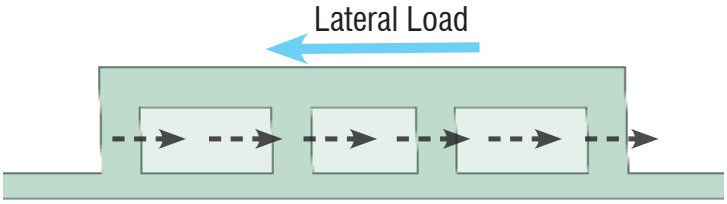
Just like the double top plate, the bottom plate, or sole plate, needs to be attached to the wall studs so they act as one structural element. There are metal straps and clips that help with this. The other major connection point is the bottom plate to the slab or grade beam. This connection is made with an anchor bolt that usually is embedded in the concrete when it is poured. Epoxy-set anchors can be used as retrofits if the concrete slab has already been poured or if there is a missing or misaligned anchor.

HOW FOUNDATIONS WORK IN WIND

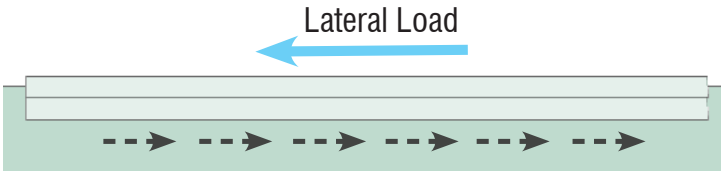
The primary structural role of the floor and foundation is to transfer the lateral loads into the ground. The accumulated forces at foundations from high winds are significant and the effects of such forces are increased in homes that are built on tall piers, a common practice in coastal flood zones. Elevated piers, which are built in the ground, or piles, which are driven into the ground, are generally eight or more feet deep depending on the soil capacity and should be designed by an engineer.

In a two-story home, the second floor deck is a stiff horizontal diaphragm that transfers the loads on the walls facing the wind to the wall parallel to the wind.

Whether the foundation is a slab-on-grade or a framed floor, the attachment of the walls to the floor is one of the most important structural details as this anchor condition transfers the lateral and uplift wind loads from the wall to the floor.

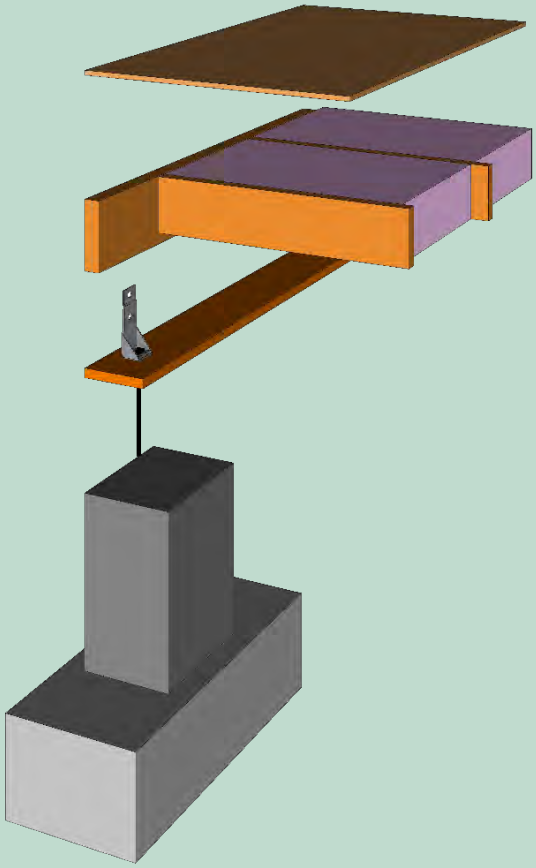


Elevated Foundation



Slab on Grade Foundation

FOUNDATION COMPONENTS



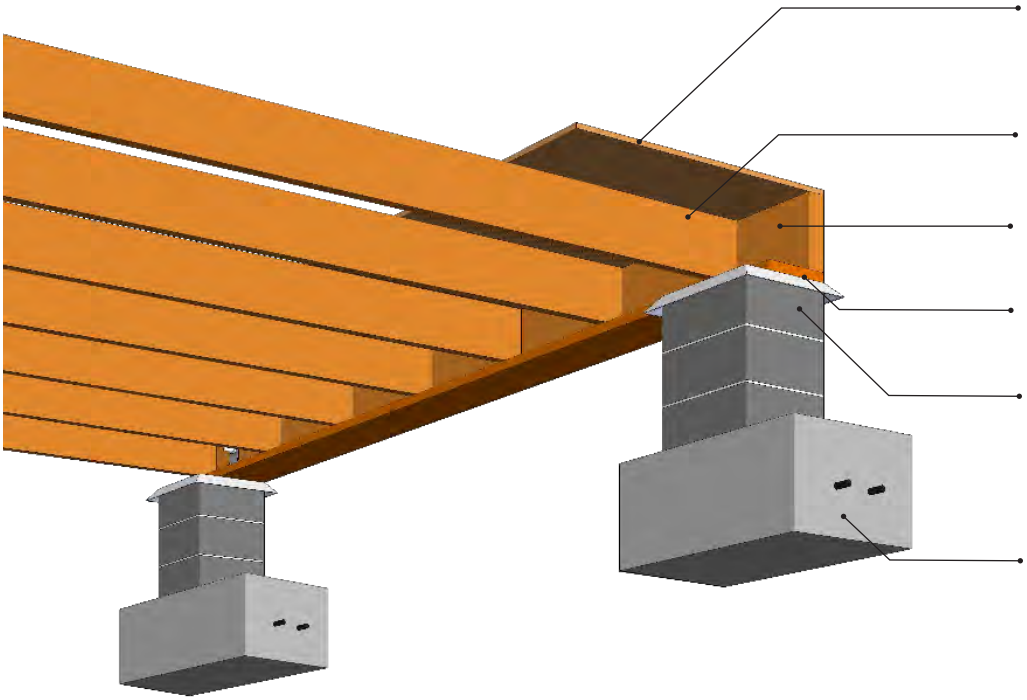
The **subfloor** is a horizontal diaphragm for either a ground floor or upper floor. As with the roof and wall sheathing, the strength of the plywood or OSB and the strength of the attachments are important. Floor decking is often glued as well as fastened to the floor framing.

Floor framing is typically 2x10, 2x12 or engineered lumber. The size of the framing is determined by the spans and floor loads.

Insulation in raised floors should be tight to the underside of the decking unless another "air barrier" is created at a different location, e.g. the bottom of the framing members. Rigid insulation and spray foam insulation are recommended in high wind zones to secure insulation as these two types of applications are less vulnerable than batt and blown-in insulation.

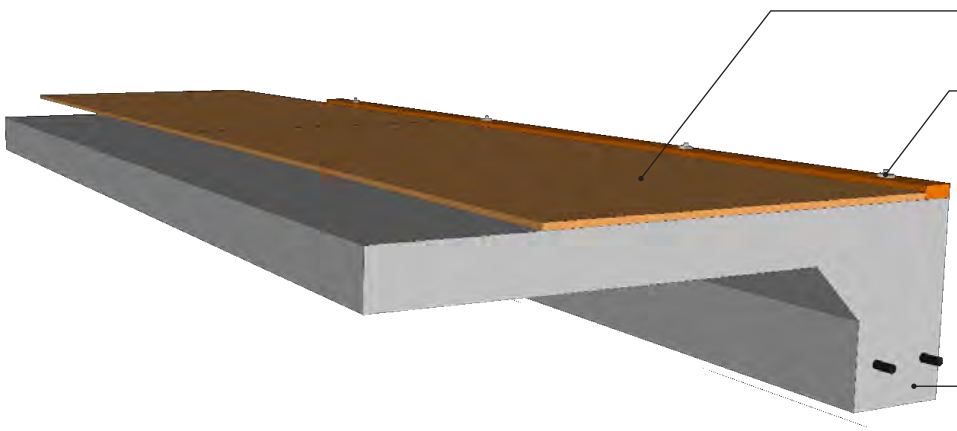
Sill Plates are **anchored** to the foundation with anchor bolts cast into the foundation. The spacing and size of the anchor bolts are determined by the lateral loads.

Houses have various **foundation** systems. A slab-on-grade is the floor and the foundation when it is used. If the floor is elevated or has a crawl space, the foundation consists of a vertical member and a footing. The vertical member is either a stem wall or a pier, which is typically reinforced concrete block or cast-in-place concrete. The footing type depends upon the soil strength and whether the home is elevated. Typical footings are either spot footings under each pier, continuous spread footings for a stem wall or combined piers, or deep foundations such as concrete piers or driven piles.



- 3/4” tongue and groove sub floor (glued and nailed to framing)
- 2x floor joists (depth is span dependent)
- 2x double rim joist/beam
- Sill plate with anchor bolts
- Concrete masonry unit piers filled with continuous rebar tied into foundation per local code
- 24”x24” spread footings w/ rebar, sized and designed by engineer based on soil conditions.

$ Raised Floor

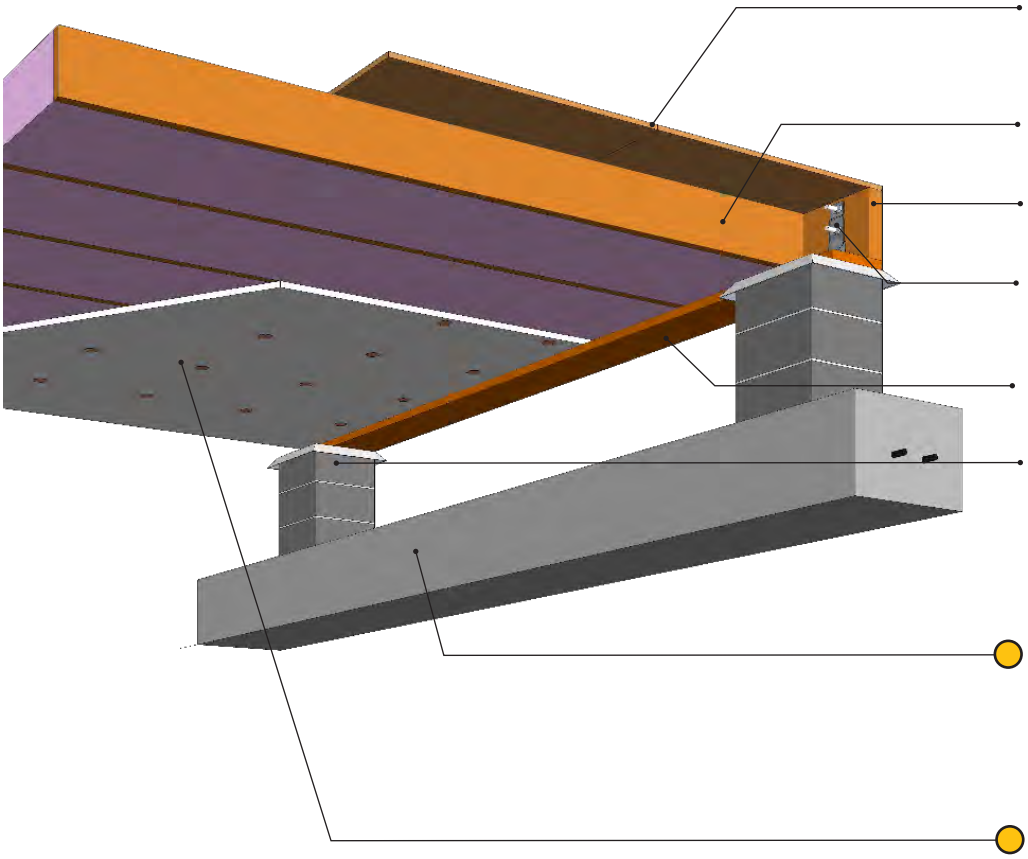


- Flooring
- Anchor bolts from slab into bottom plate ½” “J” bolts @ 48” O.C. + 1 “J” bolt within 12” of corners
- Reinforced slab and grade beam sized and designed by engineer

$ Slab on Grade

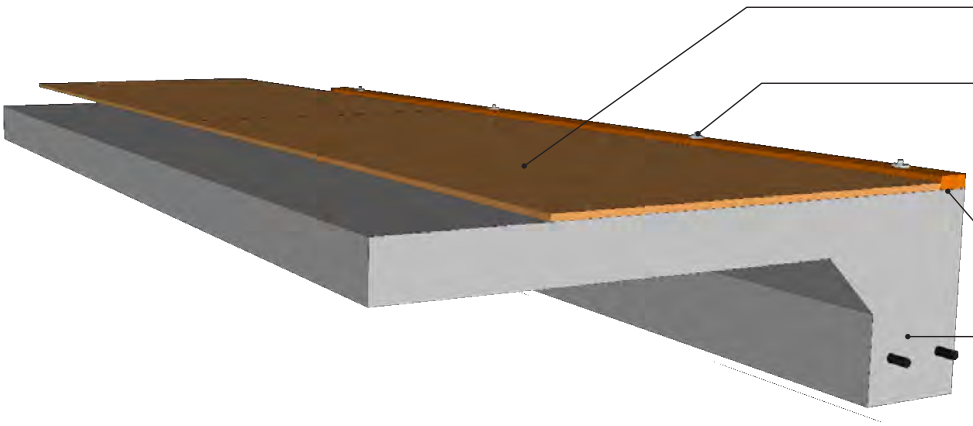
HIGH WIND CONSTRUCTION

Generally required by various high-wind building codes



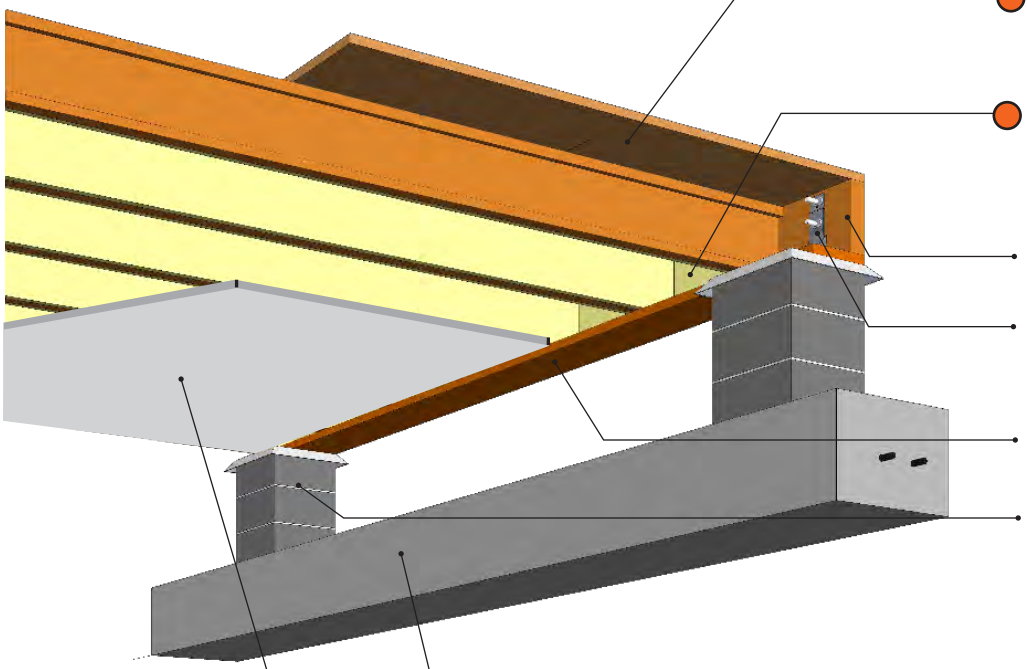
- 3/4” tongue and groove sub floor (glued and nailed to framing)
- 2x floor joists (depth is span dependent)
- 2x double rim joist and beam
- Hold down bolted through bottom plate and bolted into foundation.
- Sill plate with anchor bolts
- Concrete masonry unit piers or continuous wall filled with continuous rebar tied into foundation per local code sized and designed by engineer.
- Continuous footings per design professional. A continuous footing is a stiffer foundation and makes the house more rigid and stronger in high winds.
- Batt insulation covered with vapor barrior attached with button caps

$$ Raised Floor



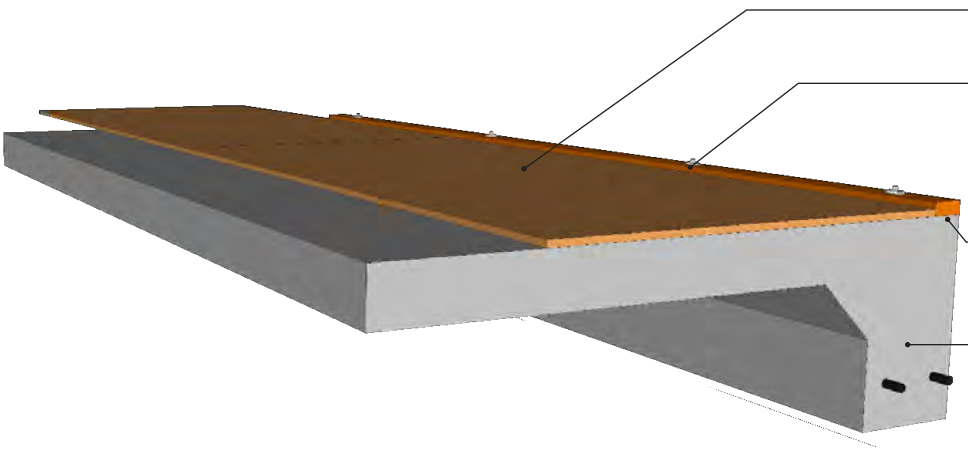
- Flooring
- Anchor bolts from slab into bottom plate 5/8” “J” bolts @ 18” O.C. + 1 “J” bolt within 12” of corners
- Foam gasket between foundation and bottom plate
- Reinforced slab and grade beam sized and designed by engineer.

$ Slab on Grade



- 1-1/8” tongue and groove sub floor attached with screws and adhesive
- Engineered floor joists (stronger, straighter, and more stable than solid wood)
- 2x double bottom plate
- Hold down bolted through bottom plate and bolted into foundation.
- Sill plate with anchor bolts
- Concrete masonry unit piers or continuous wall filled with continuous rebar tied into foundation per local code, sized and designed by engineer.
- Continuous footings per design professional. A continuous footing is a stiffer foundation and makes the house more rigid and stronger in high winds.
- Fiber cement panels with batten strip

$$$ Raised Floor



- Flooring
- Anchor bolts from slab into bottom plate 5/8” “J” bolts @ 16” O.C. + 1 “J” bolt within 12” of corners
- Foam gasket between foundation and bottom plate
- Reinforced slab and grade beam, sized and designed by engineer.

$ Slab on Grade

SUPLEMENTAL INFORMATION - FLOORS & FOUNDATIONS

Hazards

Floors and foundations are generally more susceptible to flood damage than from wind damage during storms. Many high wind locations are also coastal flood zones, and those zones require elevated homes. Unfortunately, elevated foundations significantly increase the wind hazard of a home because the lateral loads acting on the home cause a substantial overturn when forces exert pressure on piers. Added foundation height increases the load exponentially. Thus, the connection from the wall to the foundation is critical to resist overturning.

credit: FEMA

Flooring

Subfloors for raised floors are typically plywood and OSB panels. They are typically between ¾" and 1 1/8" thick and attached with a polyurethane construction sub-floor adhesive.

Nailing Patterns

Recommended floor sheathing nail patterns are 4" at edges of exterior walls, 6" at panel edges and 8" in the field

Slab on Grade Foundations

Slab on grade floors and foundations are poured at the same time and form a monolithic structure. Walls are anchored into the foundation at the edges and thickened slabs or grade beams can be installed where extra structure is needed.

In high wind zones, anchor bolts are typically required at 18" O.C., however since 18" spacing is out of sync with typical 16" spaced studs, 16" anchor bolt spacing is recommended.

Interior Shear Walls

Interior shear walls should be fastened to the floor or foundation. If on a slab, the interior shear walls should have anchor bolts in the slab similar to the exterior walls. If on a raised foundation, hold down straps help to connect the wall to the floor and roof framing.

RESILIENT LANDSCAPE

Hazards

Falling trees account for most of the major wind damage to houses in hurricanes. In storms like Hurricane Katrina with wind speed more than 120 MPH, approximately 20% of the urban trees toppled. In Hurricane Andrew, 38% of the affected trees toppled. Beyond wind intensity, other storm factors influencing tree damage include:

- **Amount and duration of rain**
- **Tree species, age and condition**
- **Soil characteristics**

Even though it is not possible to build a home strong enough to withstand the impact of a large tree, it is possible to plan and maintain landscapes that reduce the risk of trees falling on a home. Certain species are more vulnerable to wind damage such as various southern pine, pecan, red oak and water oak. Moreover, as every tree has an inherent life span, older trees of species with shorter life spans are most susceptible to storm damage.

Landscaping

Trees benefit homeowners by beautifying the yard, attracting songbirds, providing protection from wind and noise and by shading the yard and home. However, falling trees and limbs are often the source of storm damage to homes. Three factors regarding trees should be considered, including condition, location and species. Limbs on healthy trees that hang over the roof should be trimmed back and any unhealthy or unstable trees should be removed.

In addition to trees, a resilient landscape takes into account manmade elements that might cause damage from wind such as fences, flag poles, lawn furniture and light fixtures. These elements, as well as building components such as gutters, downspouts and exterior air conditioning equipment, should be secured.

Auxiliary Structures (Gazebos, Pavilions, Pergolas)

Outdoor covered structures are usually supported by horizontal beam members sitting on vertical columns which must be correctly connected to the foundation to prevent uplift and wind damage.

Resilient Home Systems - Standby Generators

The most common result of wind storms is loss of electrical power due to trees and limbs falling on power lines. Ideally, electrical services run underground to reduce risk of power outages and communities benefit from efforts to invest in more resilient power infrastructure. For the individual homeowner, loss of electrical power is not only inconvenient, but the lack of air conditioning allows mold growth inside the home. A resilient home is prepared for loss of power with interior finishes that don't support mold growth, good natural ventilation, and a standby generator to provide power for a minimal amount of air conditioning.

Loss of electrical power in a neighborhood can also affects the water and sewage system. Sewage check valves and back flow preventers can be used on homes to guard against contamination from systems that might not operate normally after a disaster

Placement Details

Install the generator set

- -Outdoors
- -Near the incoming gas service
- -Near the main electrical panel(s)
- -On a flat, level mounting area

Important placement guidelines

- -The recommended distance from a structure is dependent on state and local codes.
- -Locate the generator set so that the hot exhaust does not blow on plants or other combustible materials. No plants, shrubs, or other combustible materials are allowed within 1.2 m (4 ft.) of the exhaust end of the generator set.
- -Do not install the generator set where exhaust gas could accumulate and seep inside or be drawn into a potentially occupied building. Furnace and other similar intakes must be at least 3 m (10 ft.) from the exhaust end of the generator set.
- -Do not locate the generator set near patios, decks, play areas, or animal shelters.
- -Do not install the composite mounting pad directly on grass, wood, or other combustible materials. Clear all combustible materials, including plants and shrubs, building materials, and lawn furniture, from an area at least 1.2 m (4 ft.) beyond the exhaust end of the generator.
- -In flood hazard areas, locate the generator and its control systems above the highest expected flood level
- -In high wind areas, the generator should be securely mounted to a concrete pad according to the mounting instructions in the installation manual.

Roof

Spray Foam

When applied to the underside of the roof deck, closed-cell spray polyurethane foam insulation had various characteristics to provide a sealed rood deck and secondary water barrier performance.

Properly applied spray foam can be considered as an impermeable insulation. Controlled air permeability helps to prevent and control bulk water entry which created a sealed roof deck. Spray foam can also be considered a water/secondary resistive barrier and also provide support against wind uplift and racking.

For resilient construction consider applying a 3” minimum full insulating layer between roof rafters/trusses.

For more information and product resources please visit www.flash.org/basf/rdghouse.pdf

Metal Roofing Options

For further information on the different types of metal roofing systems visit:

www.facilitiesnet.com/roofing/article/Metal-Roofs-Compare-the-Different-Systems--9806#
www.unioncorrugating.com/all_products.html
www.metalroofing.com/v2/content/metal-roofing/index.cfm?
www.metalroofing.com/v2/content/guide/types/

Walls

Connectors and Straps

For information how to choose metal connectors and fasteners, visit www.strongtie.com.

Alternate Construction Methods

This guide focuses on standard wood frame construction methods. For more information about alternative construction methods such as masonry, steel frame, factory-assembled or panelized construction systems, visit:

LTH Steel Structures www.lthsteelstructures.com/building-types/steel-framing-kits-custom-homes
National Association of Home Builders www.nahb.org
Manufacturers Home Institute www.manufacturedhousing.org
Structural Insulated Panel Association www.sips.org
Residential Advantage Building Systems www.resadvan.com
ICFA - Insulating Concrete Form Association www.forms.org
NCMA - National Concrete Masonry Association www.ncma.org
PCI - Precast/Prestressed Concrete Institute www.pci.org

Floors and Foundation

Engineered Floor Framing Systems
For more information about engineered floor framing systems visit:

www.buildgp.com/engineered-lumber

Concrete and Rebar
For further information about concrete construction and to find out more about alternative construction methods using concrete please visit:

Portland Cement Association www.cement.org
Concrete Reinforcing Steel Institute www.crsi.org

Landscape

Auxiliary Structures
These covered structures are usually supported by horizontal beam members sitting on vertical columns, which must be correctly connect to the foundation to prevent uplift and wind damage.

Standby Power Generation
For more information visit www.kohlergenerators.com

References

Home Builders Guide to Coastal Construction
Technical Fact Sheet Series
FEMA P-499/ December 2012
www.fema.gov/media-library/assets/documents/6131

Mitigation Assessment Team Report
Hurricane Katrina in the Gulf Coast
Building Performance Observations, Recommendations, and Technical Guidance
FEMA 549 / July 2006
www.fema.gov/media-library/assets/documents/4069

ACKNOWLEDGEMENTS

We would like to thank and recognize the following individuals and their respective organizations for their donation of expertise, time and commitment to the creation and publication of the Resilient Design Guide. Their generosity and passion for making America a more disaster-resilient nation are evident in their unconditional support for this project.

Charette Participants

Illya Azaroff, AIA	PLUS LAB architects + experimentation
Greg Beste, AIA	Halliwell Engineering Associates
Lance Jay Brown, FAIA	Center for Architecture
Nathan Butler, AIA	HKS
Brandon Dake, AIA	Dake Wells Architecture
Kathleen Dorgan, AIA	Dorgan Architecture and Planning
Jeff Feid	State Farm Insurance Companies
Rose Grant, AIA	State Farm Insurance Companies
Sarah Grider, Assoc. AIA	Gulf Coast Community Design Studio
Mike Grote	Gulf Coast Community Design Studio
Barbara Harrison	Federal Alliance for Safe Homes (FLASH)
Michael Lingerfelt, FAIA	Lingerfelt International
Bruce McCullen	McCullen Consulting
Rachel Minnery, AIA	Architecture for Humanity
Brian Oman	BASF
Freddy Paige	Clemson University
David Perkes, AIA	Gulf Coast Community Design Studio
Jeff Seabold, AIA	Seabold Architectural Studio
Randy Shackelford, PE	Simpson Strong-Tie Co.
Tim Smail	Federal Alliance for Safe Homes (FLASH)
Donn Thompson, AIA	Portland Cement Association
Melanie Tydrich	Kohler Co.
Emily Van Court, Assoc. AIA	Center for Building Excellence

Charette Review Committee

Thomas Allen	Reedy Creek
Roy Eden	City of Orlando
Mike Rimoldi, MPA, CBO, CFM, CBC	Hillsborough County, FL
Ismael Rodriquez	The Home Depot
Daniel Smith	University of Florida
Mike Welch	Habitat for Humanity
Cletus Yoder	Mennonite Disaster Services

Resilient Design Guide Reviewers

Illya Azaroff, AIA	PLUS LAB architects + experimentation
Lance Jay Brown, FAIA	Center for Architecture
Leslie Chapman-Henderson (Copy Editor)	Federal Alliance for Safe Homes (FLASH)
Audrey Galo	Architecture for Humanity
Rose Grant, AIA	State Farm Insurance Companies
Russ Griffith	Habitat for Humanity
Bruce McCullen	McCullen Consulting
Rachel Minnery, AIA	Architecture for Humanity
Brian Oman	BASF
Randy Shackelford, PE	Simpson Strong-Tie Co.
Melanie Tydrich	Kohler Co.

FLASH®

FEDERAL ALLIANCE FOR SAFE HOMES

WWW.FLASH.ORG