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Teaching Center

(Garage)

Insulating Concrete Form (ICF) building system**:**

- 6" concrete within 2.5" insulating foam forms, with plastic connectors and steel rebar reinforcement
- High impact resistance, good safe room system
- R-22 continuous wall insulation – highly energy-efficient
- Fast construction, little waste
- No need for wall drainage plane, vapor retarder, air barrier
- Treated window bucks, roof framing for termite resistance
- Cost 2-7% more than standard wood frame

Slab on grade just above base flood elevation (BFE) with:

- Extra durable plastic sheeting under slab and grade beams prevents moisture wicking to walls, flooring
- Low water-to-cement ratio (<.47) + reusable wet curing blanket – increases strength, prevents curl
- Fly ash, slag, cement mix – recycled content, adds strength

- Post tension system for expansive soils – to prevent spreading of cracks (Note: expect concrete to crack)

Plumbing:

- Torchless crimped copper pipe fittings - fast, safe
- Low-flow, power assist toilets – in wall, low noise
- Low-flow urinal with *smart* sensor valve
- Hands-free & universal design faucets, sink

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Roof:

- Borate-treated wood for termite resistance
- Grid marked decking for fast, precise installation
- Synthetic roofing felt
    - Extremely tear resistant (withstood Katrina and Rita)
    - Lightweight, fast installation, 180 day UV exposure
- Standing seam metal roofing, no exposed fasteners
    - "cool color" hi-tech pigment reflects heat like light color
    - long life, recycled content, wind resistant

Design:

- Hip roof sheds water away, shades all sides
- Detached garage protects home from auto exhaust, chemicals
    - Also creates breezeway for screen porch

Fortified features (to resist 130 mph wind & flood damage):

- Steel rebar ties concrete walls to slab
- Top plate connected with anchor bolts in concrete wall

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- Hurricane plates, straps wrapped over each rafter anchor roof
- Hip roof naturally more wind resistant
- Ring shank nails, close nailing pattern secure roof decking
- Roof decking seams sealed with bitumen roof tape (secondary water barrier from storm water damage)
- High-wind & impact rated garage door, doors, windows
- "Dry floodproofed" bottom 3 ft. exterior
- Flood resistant materials – concrete, rigid foam, paperless drywall, stucco

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Energy saving features of Teaching Center:

Passive solar (sun control)

- "Cool Roof" – solar reflective with high emissivity (painted metal)
- Radiant barrier coating under roof deck
- Roof overhangs shade windows, walls – hip roof
- Low-e glass (SHGC < 0.4)

Tight construction

- concrete walls plus air sealed openings and ceiling
- ICAT recessed lights & surface mount lighting

Continuous insulation

- R-22 continuous foam walls
- R-38 stabilized cellulose over ceiling
- Insulated doors, windows

Efficient HVAC & HW systems

- SEER 18, two-stage A/C with ozone-friendly refrigerant
- Gas tankless water heater – for both water AND air
    - space saving, no standby loss – 30-50% more efficient
    - endless hot water, whole house, no temp. fluctuation

- used with heat exchanger to heat air (without furnace)

- Fresh air duct & smart flow controller for good IAQ
- Small dehumidifier for healthy RH < 50% (when cooling not needed)

Efficient lighting & appliances

- High color fluorescent fixtures, compact fluorescent lamps
  - 2/3 less energy, 2/3 less heat, appealing light
- Energy Star refrigerator, dehumidifier

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EAST Wing
(Dining, Home office, part of kitchen)

Structural Insulated Panel System (SIPS)

- Factory made panels of insulating foam core with ½ in. thick oriented strand board (OSB) panel skins
    - Borate-treated EPS foam & OSB for termite resistance
    - Panels form structure and insulation in one step
    - Openings lined with studs
    - Panel size from 4 x 8 to 8 x 24 ft.
    - Precut chases for wiring
- Very fast assembly with less skilled labor, fewer trades – but requires crane to lift large panels
- Can be fully precut in factory or openings cut on site
- Highly energy efficient system
    - Continuous insulation (no gaps from framing) outperforms higher R-values between studs
    - Creates air-tight building envelope
    - Panels glued and nailed to insulated spline joints
- High strength, stability, shear resistance

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- Little construction waste – less to landfills
- OSB is efficient use of renewable wood resource
- Cost 0-3% more than standard wood frame
    - higher material cost, lower labor & finance costs
    - transportation cost – distance from factory matters
    - simple designs on 4 ft. grid, model plans cost less

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SIPS Roof and Attic:

Two options exhibited:

- SIPS ceiling creates airtight, fully insulated, walkable attic floor (see attic over home office from exhibit room)
- SIPS roof creates unvented, semi-air conditioned attic (see attic over dining area in exhibit room)
    - No HVAC, duct losses + climate-controlled storage space

Weather Barriers:

- Triple sill gasket – air seal plus adhesive flashing in one
- Hot-humid climate housewrap installed shingle fashion
    - Water vapor retarder (ideal 6 perm, semi-permeable)
    - Strong, tear-resistant, well fastened
        - Withstood Katrina and Rita
    - Non-perforated; surfactants won't cause leakage
- Plastic window sill pan flashing with sloped channels drains to outside (see semi-circle window in exhibit room)
    - Protects vulnerable corners, sills from water leaks
    - Fast, easy installation; no need for slope, backdam

- Mortar dropping collection system behind brick veneer to protect weep hole drainage

SIPS Energy-saving features:

- Exceptionally air-tight system without added air barrier
- Continuous insulation throughout building envelope
  - 4 in. wall = R-15 - outperforms R-19 between studs
  - 8 in. panels (R-30) for roof (see exhibit room over dining) or ceiling (see attic floor over home office)

Fortified **SIPS features** (to resist 130 mph wind & flood damage)**:**

Walls:

- Anchor bolts tie bottom plate to slab every 16 in.
- Metal connector plates secure wall panels to sole plate to resist both uplift and shear (racking) forces
- Panels provide inherent resistance to lateral wind forces

Roofs:

- Hurricane straps tie wall panels and plates to rafters, wrap over every rafter (framed roof over home office)

- Close spacing of fastening screws tie roof panels to wall panels
- Rafter 2x8 splines between roof panels extend full length of roof porch overhang
- Peel & stick membrane roof underlayment – secondary water barrier for storm protection
- Breezeway roof reinforced with micro-laminated beams and bolted through both building walls for high uplift resistance

Mid-Section of House (Living Area)

Conventional wood framing with high-performance details:

Wall Framing:

- Laminated strand lumber (LSL) 2x4 studs spaced 16 in. o.c.
    - Straight, precise & stronger; great for high ceilings and "balloon framing" of gable end walls (foundation to roof)
    - No warped rejects, so less waste; efficient use of local natural wood resource
    - Made with borates for termite resistance
- Engineered wood I-beam ceiling joists
    - Straight, uniform; minimize 2nd floor squeaks
    - High strength, stiffness, very long spans
    - Alternative to 2x12 lumber from old growth forests
    - Ends sprayed with borate treatment for termite protection
- 15/32 in. plywood wall sheathing
    - factory borate treated for termite protection of structure

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Roof framing:

- Borate treated 2x8 in. rafters, spaced 24 in. o.c.
  - Ridge beam and collar ties**;** designed for semi-conditioned, accessible attic (see exhibit room)
  - Supports weight of roof tile, space for R-30 insulation
- 19/32 in. borate treated plywood decking (termite protection)
  - grid marked for faster, precise installation
- Attic knee walls detailed same as walls

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Energy-saving building details:

Passive solar (sun control):

- Ventilated roof tile – elevated on battens, vented birdstops
- Overhangs, porch for every season; cross ventilation design
- House, window oriented for max. S & N exposure, min. E & W
- South overhang shades summer sun, admits winter sun
- Energy-star, low-e windows, doors (SHGC < 0.4)

Tight Construction and Continuous Insulation:

- Walls: Continuous R-5 exterior rigid foam boards in addition to R-13 wall cavity insulation
    - Back wall: foil-faced Iso board is also radiant barrier behind cementious siding (installed with air space)
    - Front wall: *drainable* EIFS with borate treated EPS foam
    - Both walls**:** sprayed cellulose insulation between studs provides full coverage, no voids or compression
        - contains borates for fire and termite resistance
        - made from recycled newspaper

- Band between levels insulated, sealed with spray foam
- Penetrations foam sealed
- Attic: Unvented, cathedralized, semi-air conditioned attic
    - R-30 airtight spray foam under roof, not attic floor
        - roof-wall intersection blocked and foam sealed
    - Ducts, air handler within conditioned space (no gas)
        - Prevents typical 30% A/C/heat loss (in vented attics)
            - Allows downsized A/C – can save enough $ to offset cost of energy upgrades (net zero cost)
    - Clean, conditioned storage space

HVAC and HW systems:

- Geothermal heat pump (serves east half of house)
    - Highest efficiency – EER 21-24, dual capacity
    - Cools & heats via closed loop, exhibited 2 ways:
        - in ground (in 200 ft. deep vertical bore hole)
        - in pond (via stainless steel plate heat exchanger)

  - No back-up heat source needed
  - Ozone friendly 410A refrigerant
- Ductwork within conditioned space – short, efficient layout
  - Rigid trunk, sealed with mastic (not duct tape)
  - No need to run to exterior walls with low-e windows
- Hot water reclaim system
  - Free hot water when geothermal running
  - With high efficiency electric water heater tank
- Fresh air intake with flow controller for *controlled, filtered* ventilation needed for healthy air quality
- Whole house dehumidifier for optimal healthy RH <50%
  - independent humidistat
  - maintain RH even when cooling not needed
  - draws air from interior, delivers to HVAC supply ducts
- In-line kitchen exhaust system
  - Quiet, powerful removal of cooking steam, odors
- Direct vent gas fireplace – sealed combustion
  - Fresh air duct, not indoor air, feeds fire – saves energy
  - No backdrafting – protects indoor air quality

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Weather Barriers:

- Sill gasket (2 types) seals bottom plate to slab – saves energy
- Back wall: foil-faced Iso foam board with taped seams
    - drainage plane, vapor barrier, air barrier & radiant barrier
- Front wall: crinkled housewrap (drainage plane) behind EPS foam board (vapor retarder) & synthetic stucco (air barrier)
- Window flashing & installation to drain water leaks to outside
    - Sill backdam, adhesive flashing tape + corner guards
    - all layered shingle fashion
    - no tape on bottom flange so leaks drain to exterior

***Fortified* features** (to resist 130 mph wind & flood damage)**:**

- 15/32 in. plywood on exterior walls, close nailing pattern
- Connectors form continuous load path -- ties roof to foundation
    - Anchor bolts w/ 3 in. washers hold sole plate to slab

- Hurricane hardware connects each stud to sole plates
- Metal straps tie 1st story to attic kneewalls
- Metal twist straps tie porch columns, headers to roof rafters; hurricane clips connect kneewalls to rafters
- Roof ridge straps connect front to back rafters

- Roof: 19/32 in. plywood roof decking
  - ring shank nails, 6 in. spacing, 4 in. at gable end
  - Peel and stick membrane roof underlayment
  - Tile roofing – 2 screws/tile + clips on first course
- Elevated slab cap foundation (see details in west wing)
  - Assorted impact rated window, door protections

Througout the House

Termite Protections, varied options and levels:

- Longest lasting chemical soil treatment under foundation
- Steel mesh termite barriers at pipe penetrations and perimeter
- Borate or copper treated wood products and foam insulation products used throughout outer building envelope
- Penetrating borate sprayed on bottom 2 ft. of untreated interior wood walls, ends of ceiling joists
- Copper azole treated deck framing and rails
- Non-metallic pressure treated wood decking – eco-friendly
- Foundation min. 8 in. above grade

Moisture Controls, varied options used:

- Housewrap drainage plane installed shingle fashion
- Drainage space between housewrap and cladding
- Gasketed flashing panels or boots sealing each wall & roof penetration, shingle fashion with housewrap or roofing felt
- Window, door sill and corner flashing

- Window and door head flashing
- Weep screeds or holes at base of exterior wall claddings
- Decay resistant materials
- Moisture barriers between foundation and framing (to prevent wicking up to wood)
- Exterior water vapor retarders
- No vinyl wallpaper (*breathable* interior wall treatments)

Paperless drywall – flood, termite & mold damage resistant

Plumbing

- PEX flexible piping
    - Fewer joints, fewer leaks, resistant to freeze breakage
    - Manifold layout provides faster hot water, saves energy
- PEX fire sprinkler system – lower cost
- PEX radiant floor heating system in Master bath – efficiently warms cold tile in winter, radiant heat comfort
- On demand hot water recirculating system
    - fast hot water, cuts water waste

- activated by motion sensor in bathrooms, push button in kitchen

Advanced Wiring and Automation

- Structured wiring for data, voice, video throughout house
  - Multi-cable with Cat 5, coaxial and fiber optics to "future-proof" home wiring, fast data, wide broadband
  - control center can be upgraded (closet under stairs)
  - security – video surveillance, intercom
  - safety & convenience – programmed lighting controls
  - wireless internet throughout house
  - home theater surround sound, music to BR & porches

Universal Design features:

- clearances for wheelchair access, 5 ft. turning radius in kitchen and bathrooms
- lower switches, higher outlets, offset controls for easy reach
- multiple counter heights, knee space, toe space, removable cabinets

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West Wing

(Bedrooms, bathrooms, upstairs offices)

Advanced Framing (Optimum Value Engineered):

- 2x6, 24 in. o.c. spacing, aligned stack framing
- 3-stud corners and t-joints that allow insulation
    - drywall clips instead of extra wood
- Energy-efficient (R-19 without rigid foam, fewer gaps)
- Strong, with less lumber
- borate pressure treated 2x6 southern pine – local resource, termite resistant
- similar in cost to conventional framing, yet outperforms
    - fewer pieces, less labor
    - easier hurricane connections (studs, joists, rafters align)
- LSL band joists between levels – strong, straight, borate treated

Interior framing materials:

- Finger-joint 2x4's southern pine for interior partitions
    - Straight, no rejects, so less waste
    - Efficient use of local wood resource

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- Trimmable open web floor trusses with finger joints
  - Allows jobsite adjustment
  - Long spans
  - Openings for wiring, ducts, etc.
- Engineered stair risers
  - stronger, premarked, requires less skill and time
  - uses 2x6 stringer, instead of 2x12

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Sheathings

- Grid marked, foil faced OSB roof decking
    - Radiant barrier keeps vented attic cooler
- Front: Borate treated plywood
    - termite resistant with standard nails
- Back: Copper treated OSB (need corrosion resistant fasteners)
    - Highly resistant to termites, mold, moisture, decay
- Side (MBa): Copper treated, foil faced OSB, seams taped
    - Vapor barrier, radiant barrier, drainage plane all in one
    - Vapor barrier best practice with brick veneer to resist heat driven moisture into wall

Weather Barriers

- Front: 2 layers behind 3-coat stucco for drainage plane
    - crinkled housewrap creates drainage gaps
    - building paper layer bonds to stucco (vapor retarder)
    - stucco provides air barrier, not moisture barrier
- Back: housewrap and rain screen behind siding

- vapor retarder (perm 6) housewrap
- seams taped, top and bottom sealed (air barrier)
- mesh wrap maintains drainage gap behind siding
- water managed pre-formed corner trim for siding

- Window flashings – to drain leaks to outside
  - Flexible, formable adhesive sill flashing membrane
    - fast, easy installation; durable adhesive
    - seamless sill corner protection
  - Flashing tapes – sequence, corner patches important

Foundations, 3 ways to elevate:

- Each are 3 ft. above base flood elevation (BFE) for lowest flood insurance premiums & cushion of safety
- Front – Slab cap on compacted fill inside stemwall
  - rebar reinforced concrete block (CMU) stemwalls on poured concrete footings
  - Resists pressure of floodwater
  - No crawl space, yet low impact on floodplain
  - Most expensive option
  - Durable plastic sheeting moisture barrier under slab **+** waterproofing between CMU & slab – stops wicking

  - Low water-cement ratio (<.47), wet curing blanket – for higher strength & reduced curl
  - recycled fly ash, slag, cement mix – adds strength
- MBa – <u>wood subfloor on stemwall foundation (crawl space)</u>
  - CMU stem walls with flood vents (within 1 ft. of grade) to prevent damage from floodwater pressure
    - flood activated vents exhibited – louvered & insulated
  - Crawlspace ground higher than surrounding grade
  - Spray foam insulation (air barrier) + plastic ground cover
    - 2 types – open & closed cell being moisture monitored (research)
- MBR – <u>wood subfloor on piers and beams (open)</u>
  - lowest cost option
  - spray foam perimeter rim (air seal) + foil faced rigid foam board insulation encasing joists, taped seams
- <u>Steel mesh termite barrier</u> blocks hidden pathways
  - pipe collars, tops of piers and stemwalls

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Energy saving features of west wing:

Passive solar (sun control)

- Radiant barrier roof decking (2nd story), cool color metal roof
- Foil faced sheathing behind west brick veneer (radiant barrier)
- Little west glass, Bahamas shutters
- Energy Star Low-e windows, doors (SHGC < 0.4)

Tight construction

- exterior air barriers (stucco, taped sheathing, sealed wrap)
- foam sealed penetrations
- thin sheathing behind tubs, sealed to drywall
- Airtight Drywall Approach in MBR (sealed drywall)
- airtight attic access stair

Continuous insulation

- R-19 spray cellulose in 2x6 walls
- R-38 blown fiberglass over ceiling, with vent baffles

Efficient HVAC system

- SEER 16, dual fuel air source heat pump
    - 90% AFUE gas back up heat (good for north La.)
- Fresh air duct & smart flow controller for good IAQ
- Ducts in conditioned space

- dropped ceiling below sealed insulated ceiling,
- between floors through open web joists

- Air transfer grilles with light, sound baffles prevent pressure imbalances – protects air quality, saves energy, comfort

Efficient lighting & appliances

- High color fluorescent fixtures

***Fortified* features** (to resist 130 mph wind & flood damage)**:**

- 15/32 in. structural wall sheathing for shear (racking) resistance
  - all exterior walls + load bearing interior walls that are subject to wind forces
  - placed to span, thus tie 1st to 2nd level
  - blocking added to provide framing at all edges
  - 10d nails spaced 6 in. along long edges, double row along short edges, 12 in. across field of each panel
- Hurricane connectors tie roof to foundation:
  - 5/8 in. anchor bolts with 3 in. washers, 16 in. spacing, tie sole plate to slab
  - corner hold-downs resist sliding, tilting forces
  - Hurricane straps tie wood subfloors to piers, stemwall
  - Stud to plate connectors tie walls to foundation

  - Straps connect 2nd story to 1st story, studs to top plates
  - u-shaped rafter straps to top plates reinforce notched rafters, roof overhang from high uplift forces
  - porch columns strapped to piers and roof beam
- 19/32 in. OSB roof decking
  - Ring shank nails (8d), spaced 6 in.
- Peel and stick membrane roof underlayment
  - High performance tested – for adhesive tile installation
  - Primer applied to decking for optimal adhesion
- 6:12 moderate slope hip roof – more wind resistant
- wind borne debris protection:
  - impact rated windows, door (MBR)
  - impact rated shutters – varied types

Safe Room MBR closet:

- Moderate level (not FEMA standard), low cost storm shelter
  - Separate safe room ceiling
  - 2 layers ¾ in. plywood sheathing
  - Hurricane connectors – slab to studs to ceiling joists

- Hidden impact-resistant pocket door (+ cosmetic door) and swing impact door to water heater closet

MBR Deck

- Copper azole treated for outdoor exposure (framing, rails)
- Non-metallic pressured treated decking – eco-friendly
- Deck protector tape protects hardware from corrosion

Roofs

- Concrete tile (2nd story) installed with foam adhesive, large patty under each tile for high wind resistance
  - Roll ridge vent system with water barrier
  - More impact resistant, lower cost than clay
  - Long lasting roof
- Standing seam metal roofing (MBR and MBa)
  - Long lasting, recycled content
  - Cool color pigment, solar reflective
  - No exposed fasteners, less leak prone