In 2012 I wanted to do two things: MAKE an affordable, multi-family Passive House.
for 5 years I was frustrated

AND THEN

Bridget Bardot

The Pope

Jane Fonda

Looks like my parents

AND

a Bocce Court
WRIGHT HOUSE - SHELBURNE, VT  36 Senior Dwelling Units + Common
- Near Passive House Air Tightness
- R60 Parking Garage Ceiling & Roof
- R21 Stud Cavity + R7.5 Continuous Foam
- Hydronic Heat (Natural Gas)
- ASHP Cooling - Critical in our Elm success
- Central ERV
- U=.28 Windows

LET’S TRY, BUT: Only If it Doesn’t Cost Any More
and……probably no bocce court

Our Lucky Star
Started from solid baseline

The commitment to comfort for senior population meant we were already making a pretty good building.

We did not know at the beginning if we were Passive House, or not.
Simultaneously stunned and terrified by beauty
Stimulated toward the spiritual
Overtaxed by indeterminacy
Threatened with annihilation
Reassured by God.

When they said ‘Try’, I felt the Sublime.  COULD WE DO IT?
Overtaxed by indeterminacy

OUR NON-PROFIT WORLD
• Can’t take a year - 4 - 6 months from funding to bidding
• Can’t afford roomfuls of people iterating
• Need familiar systems with local service and track record
• Can’t increase budget (well....just a little bit)
• Design(quickly) that could be Passive House, or not—based on costs

PASSIVE HOUSE
logical, straightforward, iterative
design, model, test, cost
refine systems & details
hone the Solution

What I Heard___TIME
a full year. many team meetings
for many hours.....iterating

THE ORCHARDS AT ORENCO -1st Multi-Family Passive House in US
Ankrom, Moisan Architects, Inc. Michael Bonn - Project Architect Photo - Casey Braunger

BREWER, MAINE
CWS Architects—Thornton Tomasetti

ITERATIVE PROCESS
Angels Dancing On The Head Of A Pin
WHAT WE DID
First Sketches

ELM PLACE  30 Dwelling Units + Common
- Site - Narrow, angled, east/west primary, need strong street facade
- Agglomeration of cells - 2 story shifted box over parking
- Common spaces go a little crazy outside the box
- Wright House + Standard framing with add ons
- Energy Model - Benefits of surface to volume ratio of large structure
- It was possible - Some scaling back, some up and down

CATHEDRAL
Agglomeration of simple cells
Go a little crazy for important spaces
Good recipe for Passive House

CSC commits, CM & MEP and rest of team assembled
PAUSE
REALITY CHECK

CM 1st Estimate
1M Over Budget!

Deleting PH was not the problem.

Market Conditions
Soils/seismic 120k Etc.

BUILDING MEAN & LEAN CRASH DIET

- Reduced footprint by about 4,000 sf, shrunk program & common space
- 3” polyiso foam on exterior wall ILO 9 1/4” truss joists w. dense pack
- Batt/foam under roof deck ILO foam above roof deck - More later
- Forgo color upgrade on uPVC windows - white only
- Wish Items moved to contingency:
  Gypcrete, emergency generator, 20kw photo voltaics, parking garage screen,
  sun shades on south windows, additional shelving/cabinets/counters etc.,
  bocce court, pergola, exercise path, landscaping, fireplaces, grill.
WALL SECTIONS & DETAIL

- Essential boxiness maintained with a bit of wild and crazy guy stuff
- Foundation - Shocked at the amount of foam
- Floor Trusses - Very deep for up/down central ERV duct
- Garage Edge - SIP Panel and overhang 2x6 for thermal break.
- Walls - Standard with upgrades - R21 + R18 continuous polyiso.
Elm Place Details: Thermal Bridges

Biggest TB Garage to Floor: needed 3D Therm Modeling

Was biggest unknown until the modeling was done
WHAT TO DO
with the flat roof

SURPRISE, SURPRISE

ROOF CONFIGURATION & INSULATION
- R70 Foam + taper easy but no fun environmentally or economically
- 50/50 w. Fiberglass - Trusses too deep; still a lot of foam
- Can’t suspend fiberglass, ES 3.0 requires insulation to be in contact
- Cellulose/Vent truss - Can’t vent across 60’ flat roof
- PHIUS modeling allowed complicated, proportional mix of spray/batt
- This saved us about $60,000

HIDING CONDENSERS & ERV
- Have only done cooling ASHP so the 18” extra height was a surprise
- Some is context, less visible from a tight streetscape
- High parapet works, but shades PV as well as looking massive
- We moved some and are still wrestling with the rest

WHERE MORE ITERATION COULD HELP
WHAT WE DID
the final iteration

TYPICAL SECTION
- Large building surface/volume ratio allows cost effective R-Values
- Foundation - Limited Area - Luckily - Because that is a lot of foam
- Garage - Isolated with batts - columns are TB but relatively minor
- Walls - I-Joists/dense pack not cost effective but 3” polyiso is
- Air Barrier - Zip sheathing—Weather Barrier - Siga membrane
- Windows - R7.8 uPVC tilt/turn a big boost.
- Center windows in wall simplifies calcs
- Main Public Doors - Passive House aluminum or uPVC
- Roof - Batt and foam challenge - not satisfying
- Ventilation - Central ERV w. backup gas
- Heat/Cool - ASHP, delete hydronic. Natural gas DHW, 25 KW PV
- PHIUS Pre-Certification after bidding but before construction.
VARIOUS
• Siga total system support and refining details with contractors
• Prefab framing added some gaps that weren't in the shop drawings
• Attention to penetrations - CM & subs entered the spirit

WINDOWS & DOOR ADVENTURE
• Two different cultures in terms of bidding, available information etc.
• Coordinating hardware is difficult
• Websites are nearly worthless for information and details
THE NASTY BITS - SURPRISE, SURPRISE

THERMALLY BROKEN, FIRE RATED DOOR
According to website, but shop drawings…….Just joking

TRASH CHUTE - BIG HOLE IN BUILDING
Manufacturer’s zero interest - Two small fire rated doors are quite leaky

GARAGE COLUMN - THERMAL BRIDGE EVEN WITH R2 FABREEKA
Multiple connections. Stub column only one connection/TB

LAUNDRY DRYER MAKEUP AIR - HOLE IN WALL
No commercial condensing, individual interlocked dampers

AIR SEALING BETWEEN UNITS - NOT JUST ENVELOPE
Passed. Better with minor extra attention at party/corridor.

WHAT TO DO

taking the hit

THE LESSON
Exceed the PH standard and then you can take a few hits and still certify
CATHEDRAL SQUARE CALCULATIONS

Cold Cash

Size
Conditioned, 10,000 sf garage not included

29,340 sf
PHIUS 27,836sf

Base Bid 5.39M $183 sf
Without Site 4.99M $170 sf
Delete Seismic 4.87M $165 sf

427k Upgrades 5.81M $198 sf
Without Site 5.41M $184 sf
Delete Seismic 5.29M $180 sf

Our market with garage amortized has been: $175 - $190 sf

MONEY, HONEY......

Architect, MEP & PH consultant all donated time! Surprise, surprise.

Probably missing a few granular items - window bucks vs. flange etc.

- Starting from high baseline
- Program includes cooling
- Small incremental construction cost, especially when building program includes cooling
- Increased soft costs
- Elm Place: 1-2% Passive House upcharge

Incremental Construction Cost
Exterior insulation $20,045
Roof insulation $32,340
Upgrade windows & doors (triple pane, Uwindow 0.13, R7.7) $27,179
Mitsubishi hyperheat system for heating and cooling $423,796
Delete hydronic heating system $256,845
Delete minisplits for cooling $206,053
Increased attention to air sealing $23,137
Total $63,600

Key Cost Assumptions:
- Starting from high baseline
- Program includes cooling

Total PH Cost
Incremental const. cost $63,600
Incremental architectural fees $13,000
PH modeling fees $13,000
PH certification $21,000
Total $110,600

% of Total Const. Cost 2.06%
INTERIOR VIEWS

COMMON ROOM & LOBBY
LESSONS & CHALLENGES

• Surface/Volume of simple, large building easier to meet the model.

• Simple systems, exceed standard, take a few hits with the nasty bits: trash chute—ERV efficiency—fire rated doors - garage columns

• Foundation Foam - All Foam - is always a challenge.

• Flat Roof - Still struggling.

• Visual impacts of ASHP & ERV - Take more care.

• Laundry make up air.

• Windows - Tilt turn, or…….

• Elevator Electric Useage - Traction vs. hydraulic, but big upcharge.
Specific building demands with reference to the treated floor area

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<td>71% of 6.6 kBTu/(sq ft*yr)</td>
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NEXT TIME
will be easier
The phone rang. Cindy, Miranda and Katie from Cathedral Square. Do you have a minute to talk? Oh, boy, what I have done now?.............Pause. We'd like to add the bocce court & pergola.
This concludes The American Institute of Architects Continuing Education Systems Course

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