



KING'S BLOCK - 1816

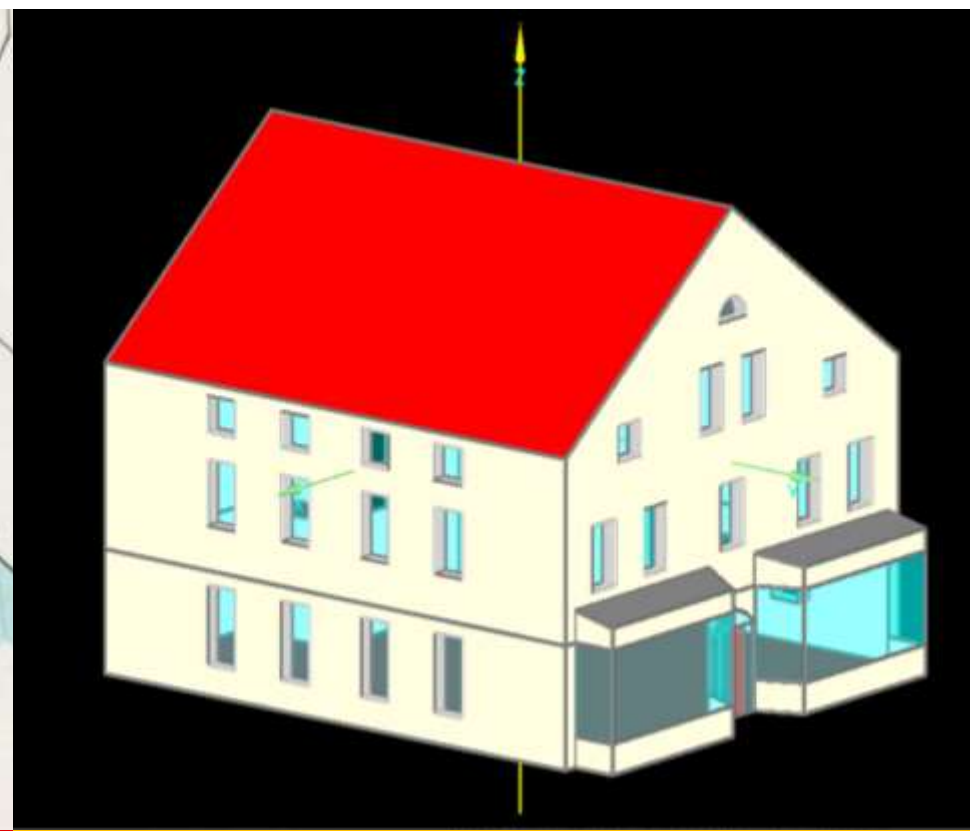
PASSIVE HOUSE RETROFIT – 2021-2023

PHIUS RETROFIT SUMMIT

MARCH 2023



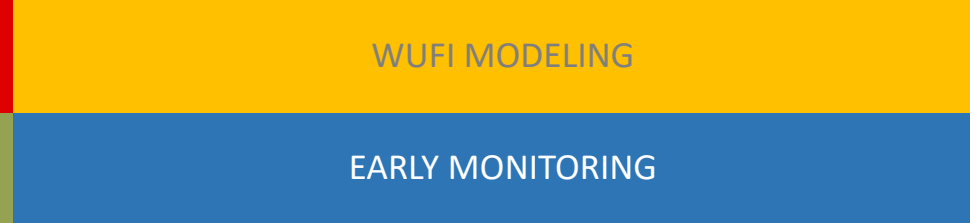
DESIGN WITHIN HISTORIC DISTRICT



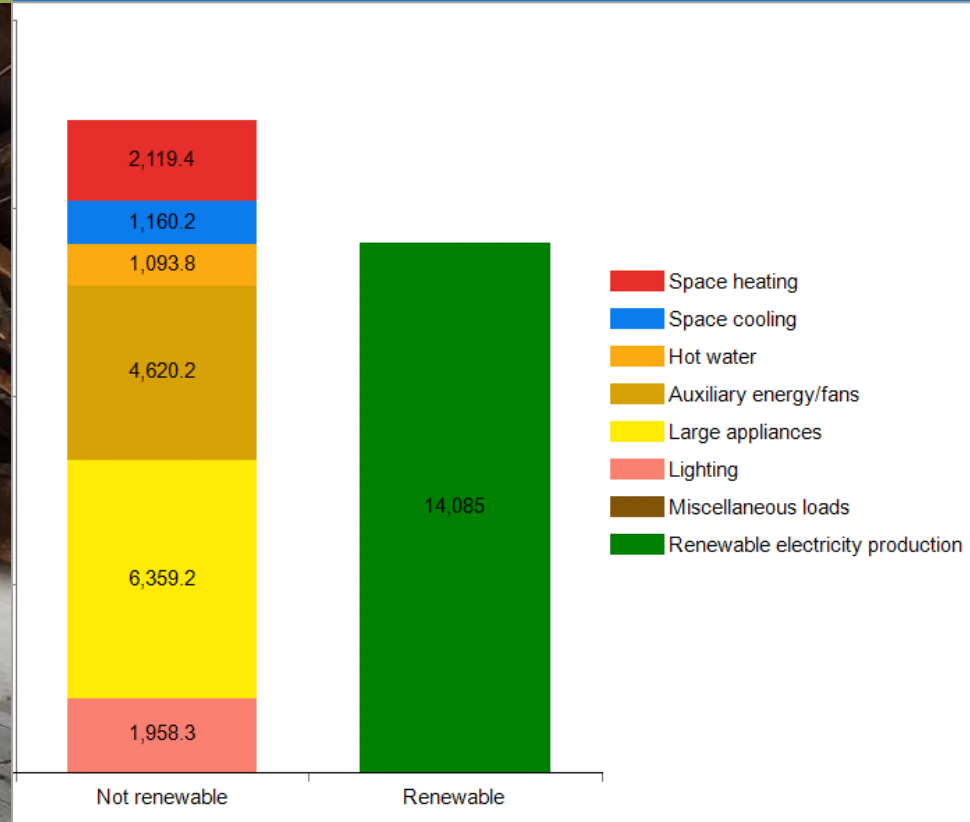
WUFI MODELING



CONSTRUCTION

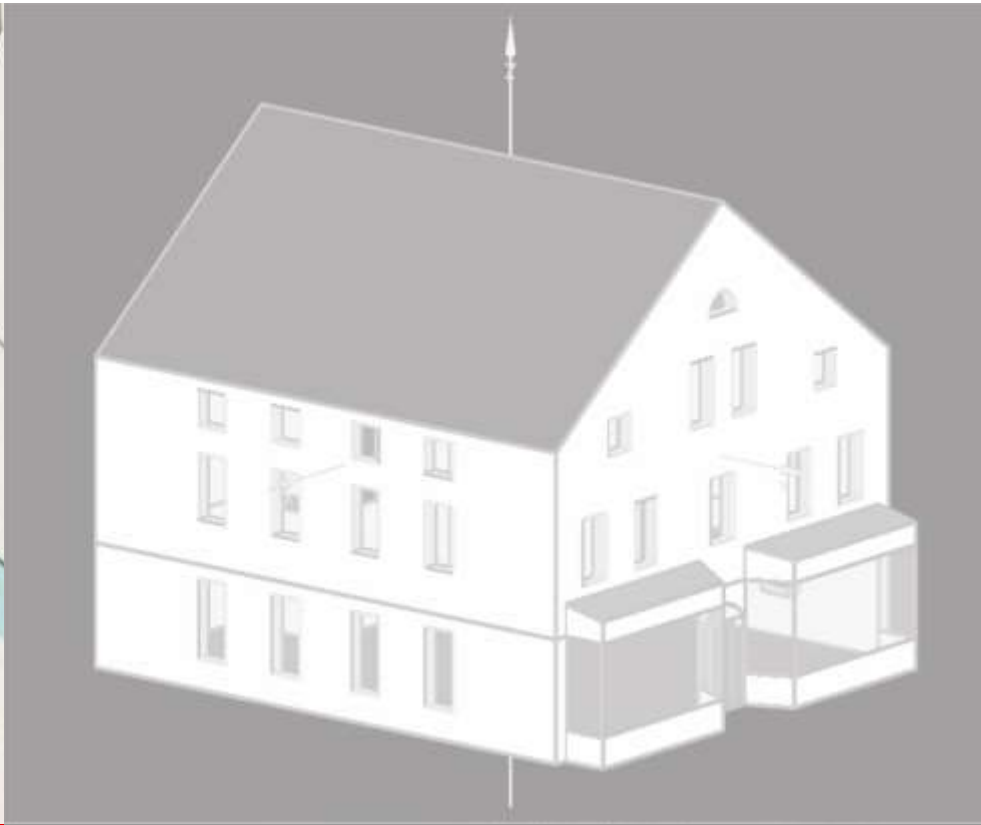


EARLY MONITORING





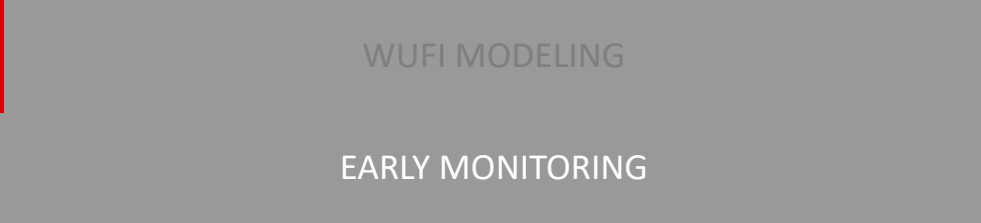
DESIGN WITHIN HISTORIC DISTRICT



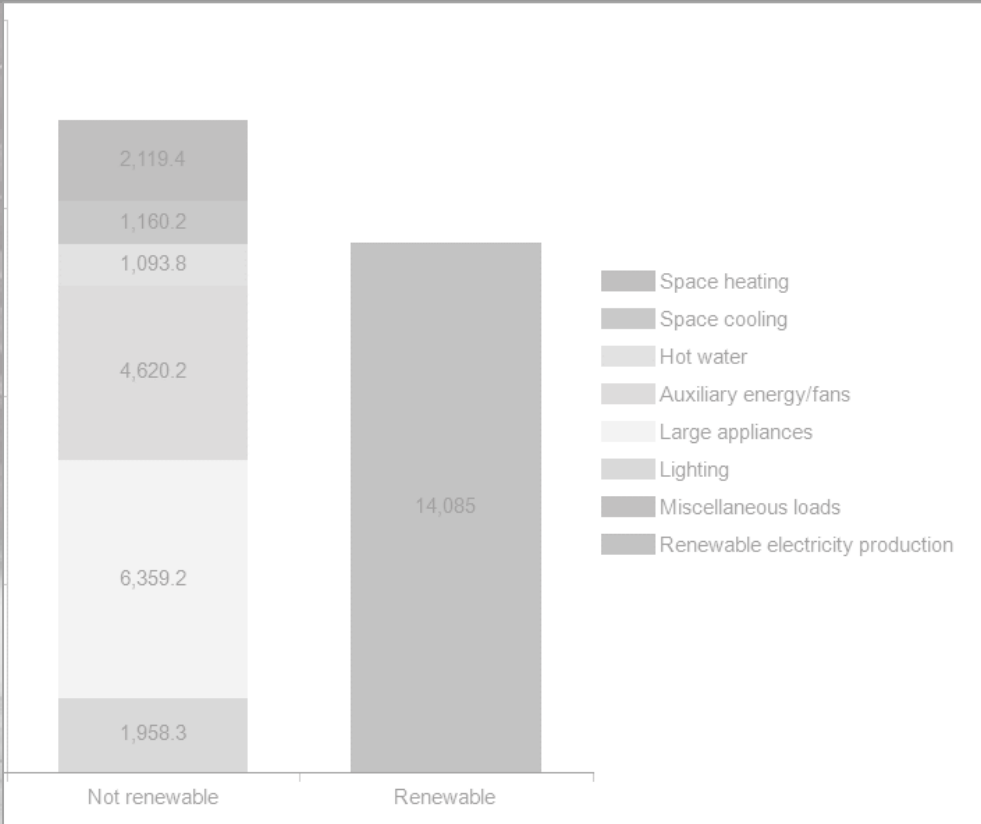
WUFI MODELING



CONSTRUCTION



EARLY MONITORING

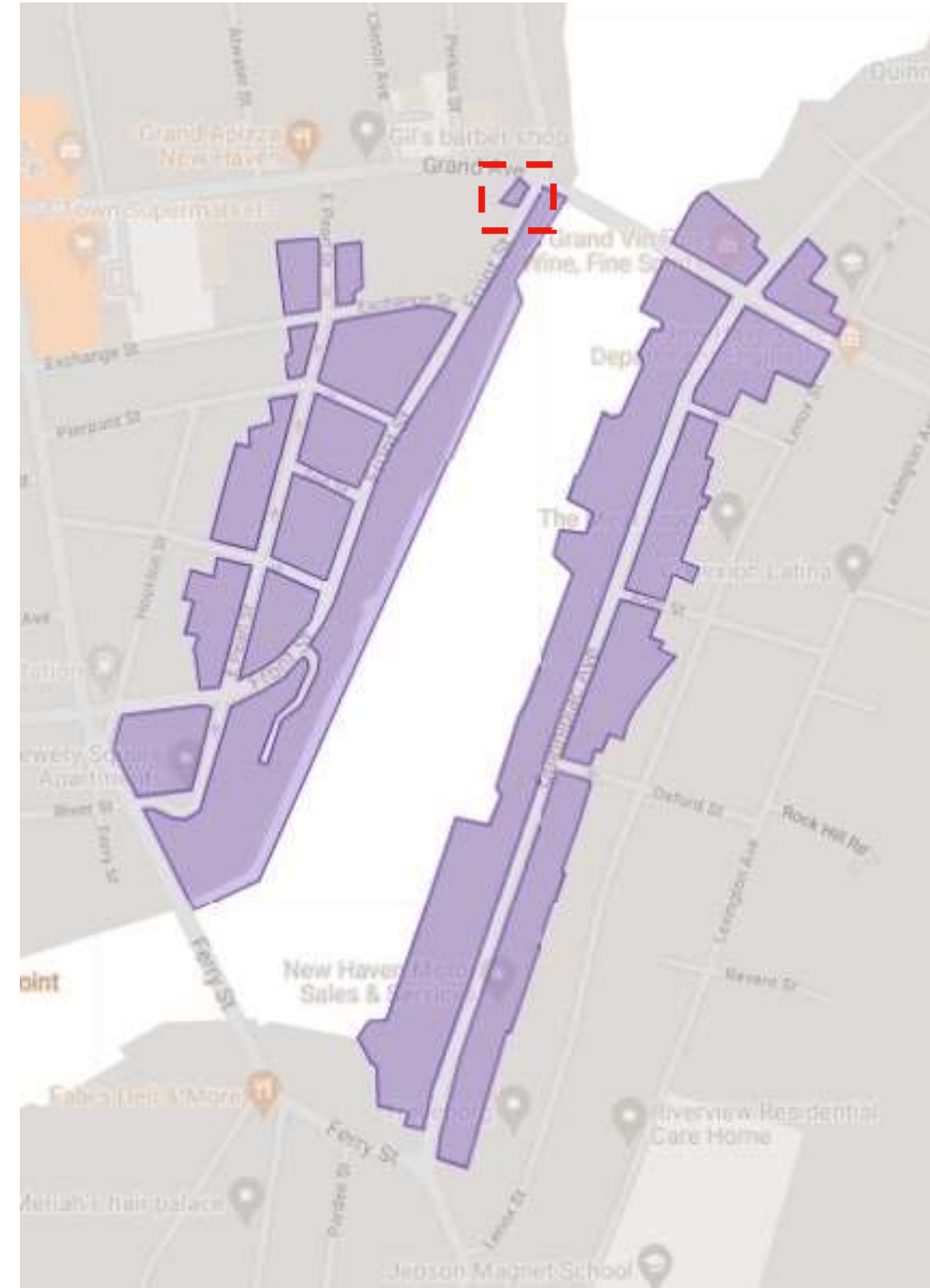


HISTORIC COMMERCIAL PHUS RETROFITS

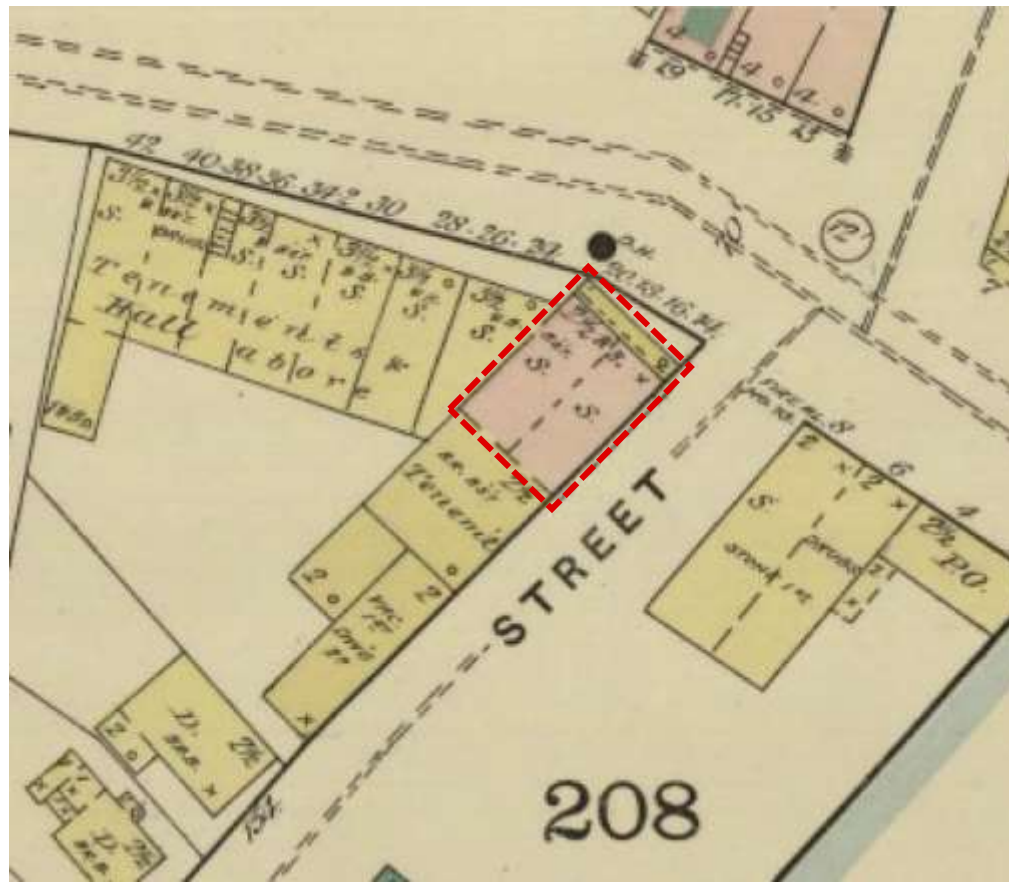


PROPERTY IN PROJECT SCOPE

14 (20) GRAND AVENUE



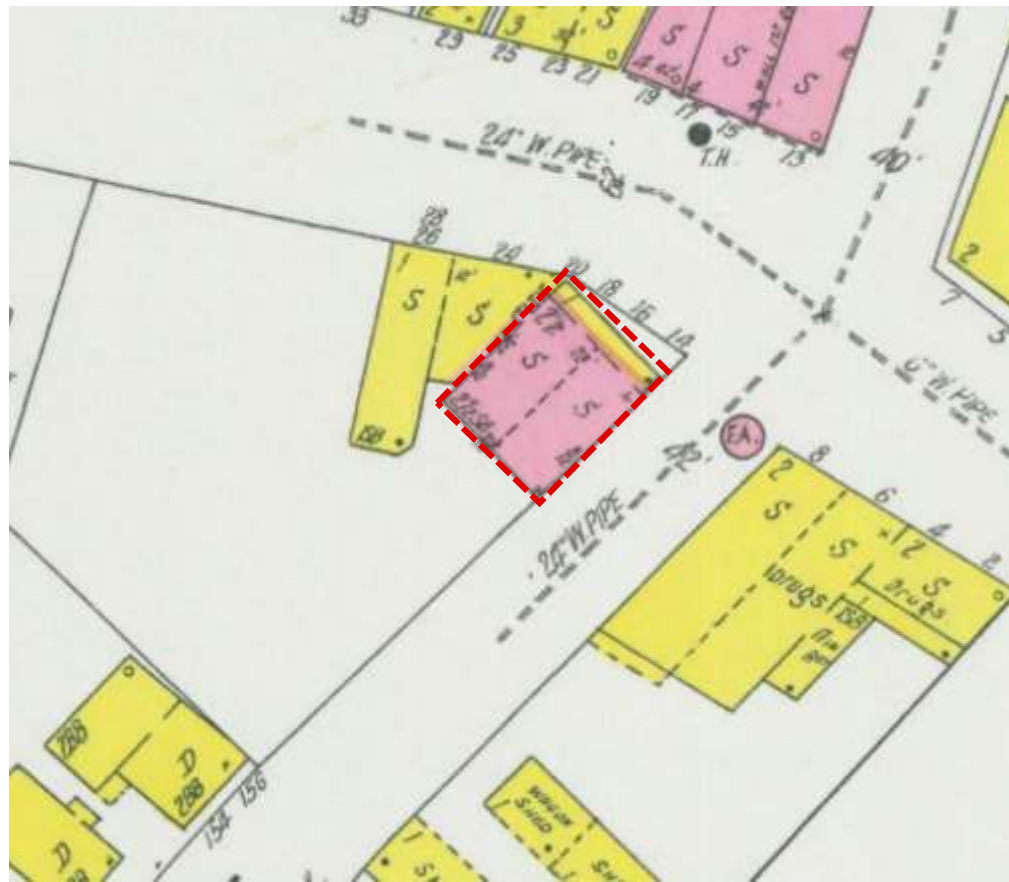
1886



1901

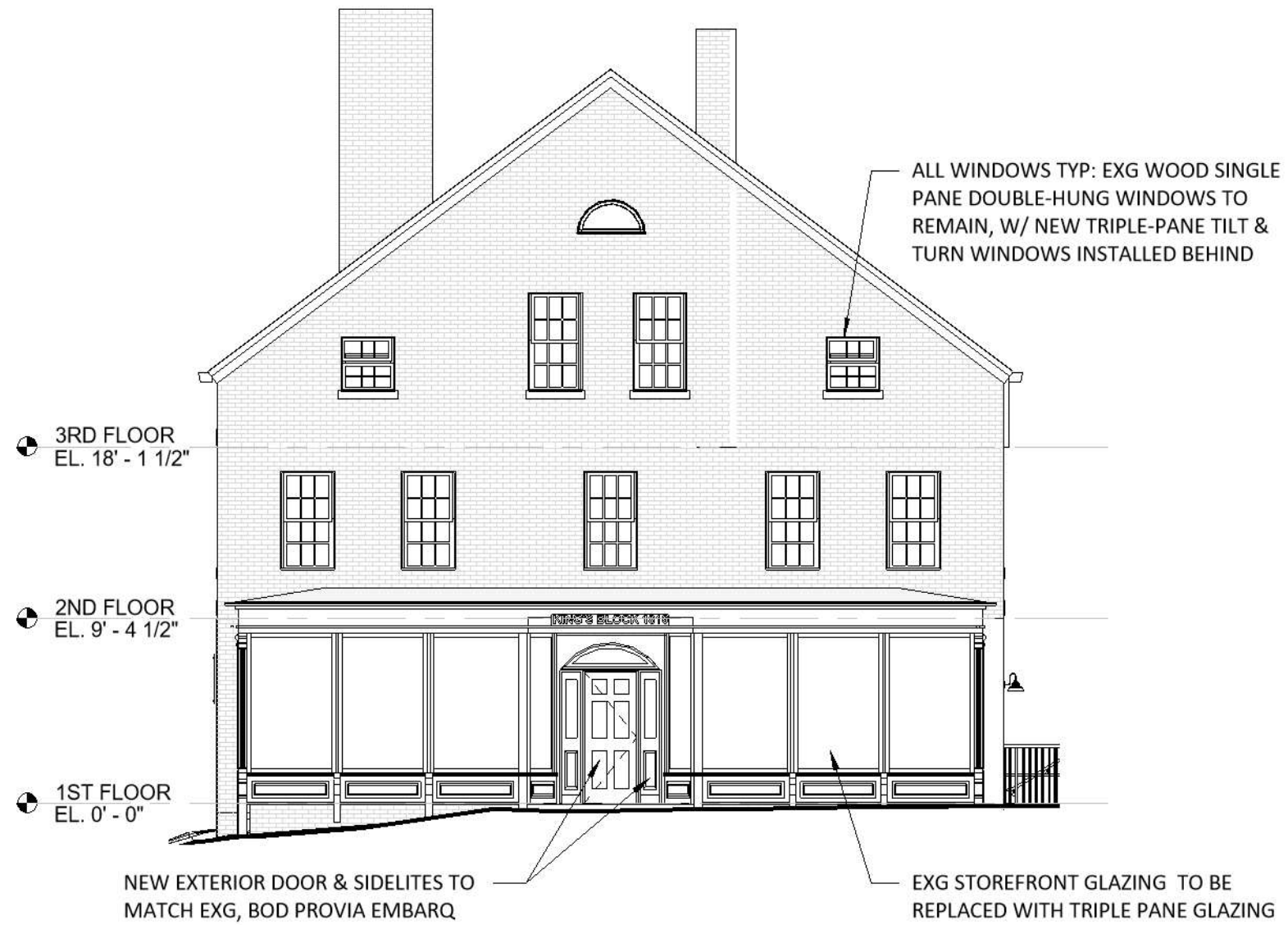


1924



1973





PROPOSED NORTH ELEVATION
 1/8" = 1'-0"



EXISTING NORTH ELEVATION
 Not to Scale



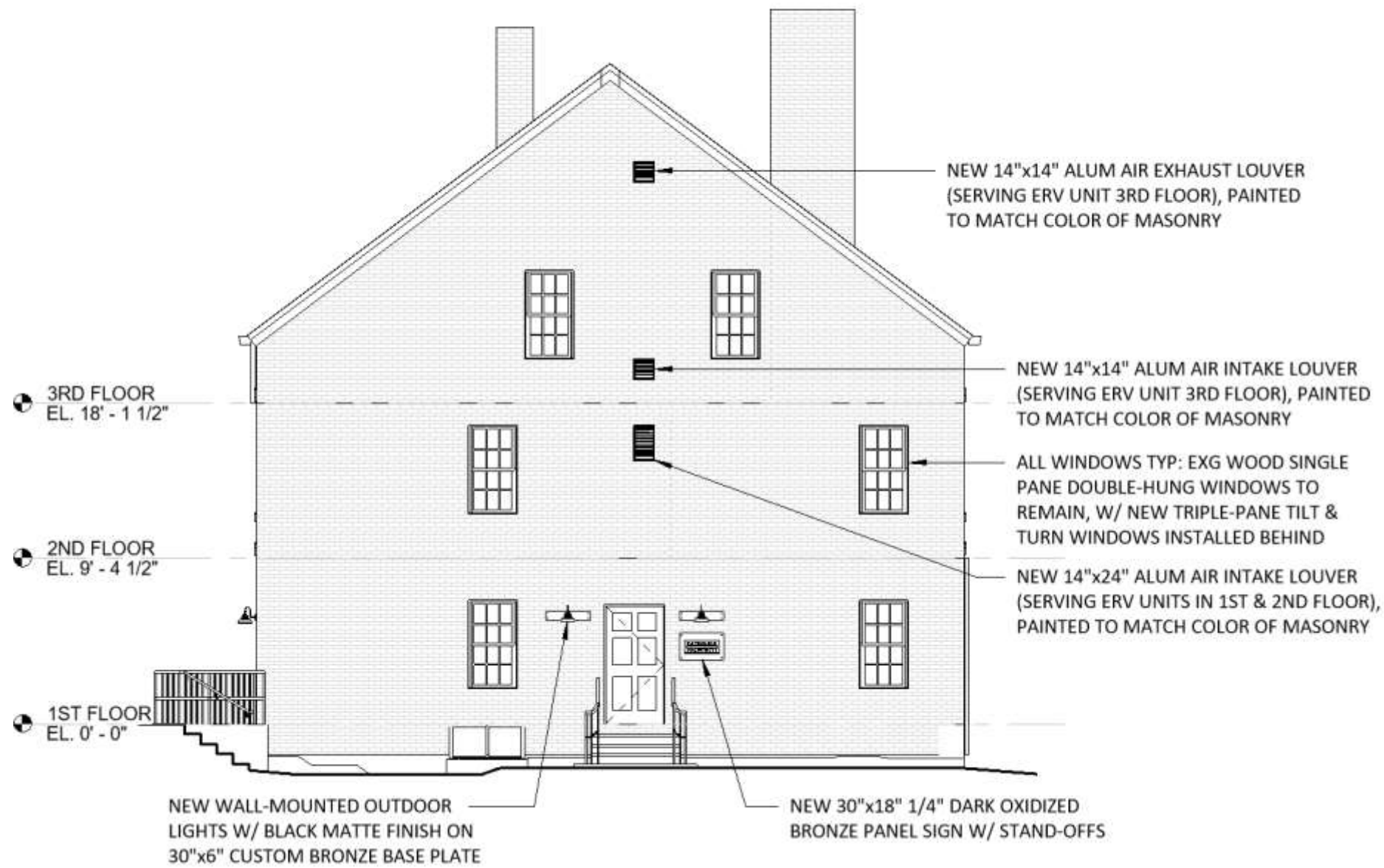
NEW 42"x30" 1/4" DARK OXIDIZED
BRONZE PANEL SIGN W/ STAND-OFFS

ALL WINDOWS TYP: EXG WOOD SINGLE
PANE DOUBLE-HUNG WINDOWS TO
REMAIN, W/ NEW TRIPLE-PANE TILT &
TURN WINDOWS INSTALLED BEHIND

PROPOSED WEST ELEVATION
1/8" = 1'-0"

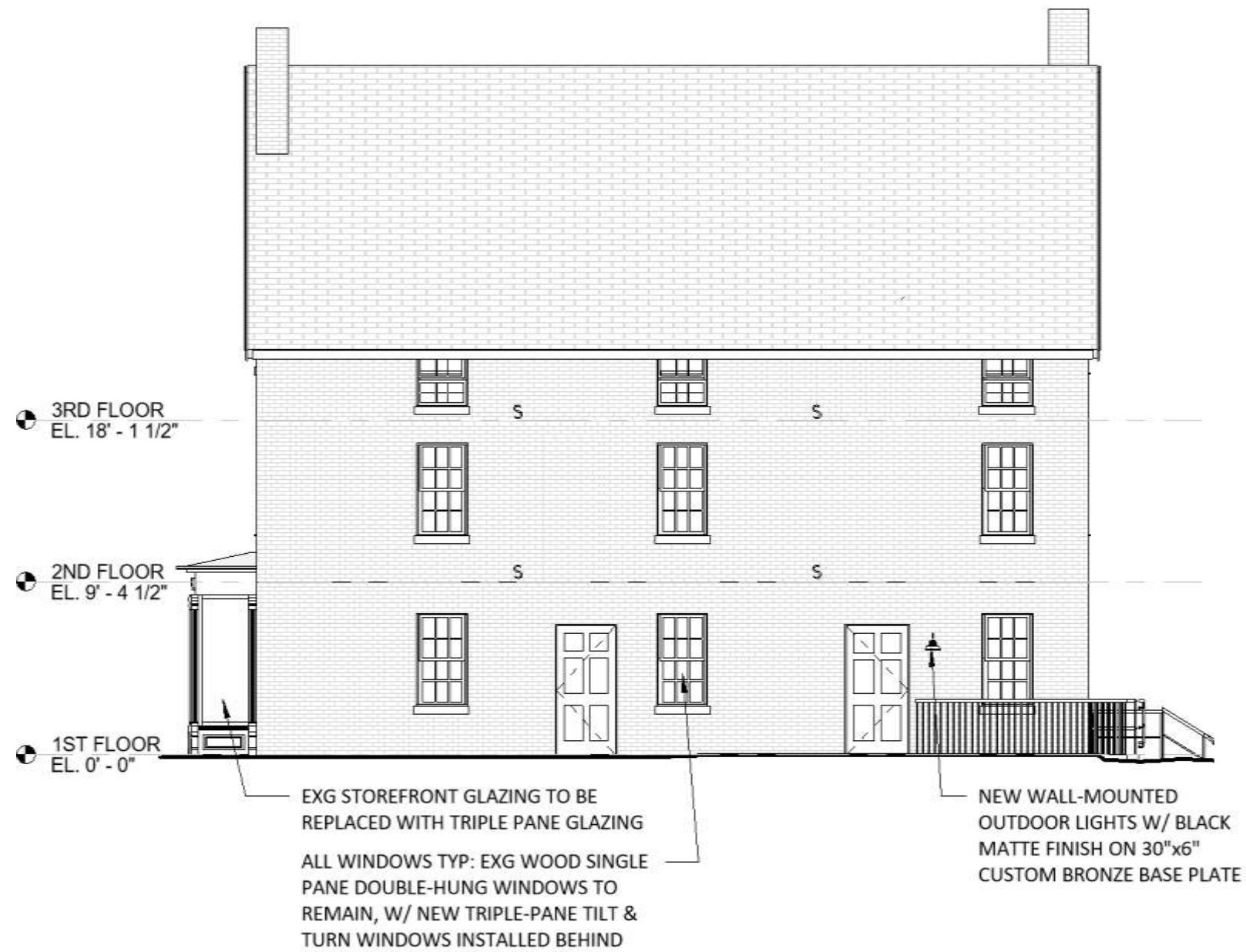


EXISTING WEST ELEVATION
Not to Scale



PROPOSED SOUTH ELEVATION
1/8" = 1'-0"

EXISTING SOUTH ELEVATION
Not to Scale



PROPOSED EAST ELEVATION
1/8" = 1'-0"

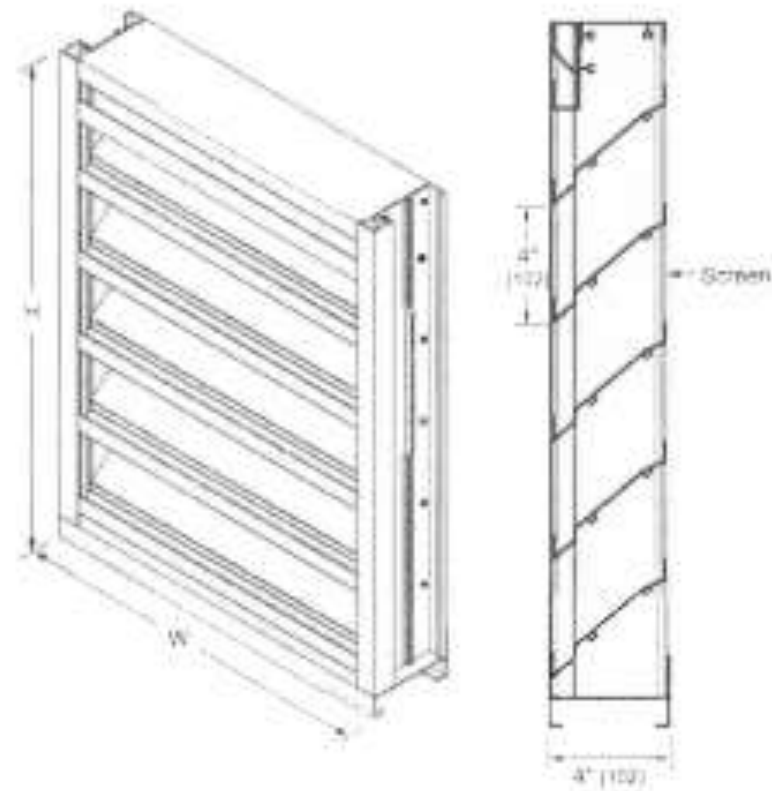


EXISTING EAST ELEVATION
Not to Scale



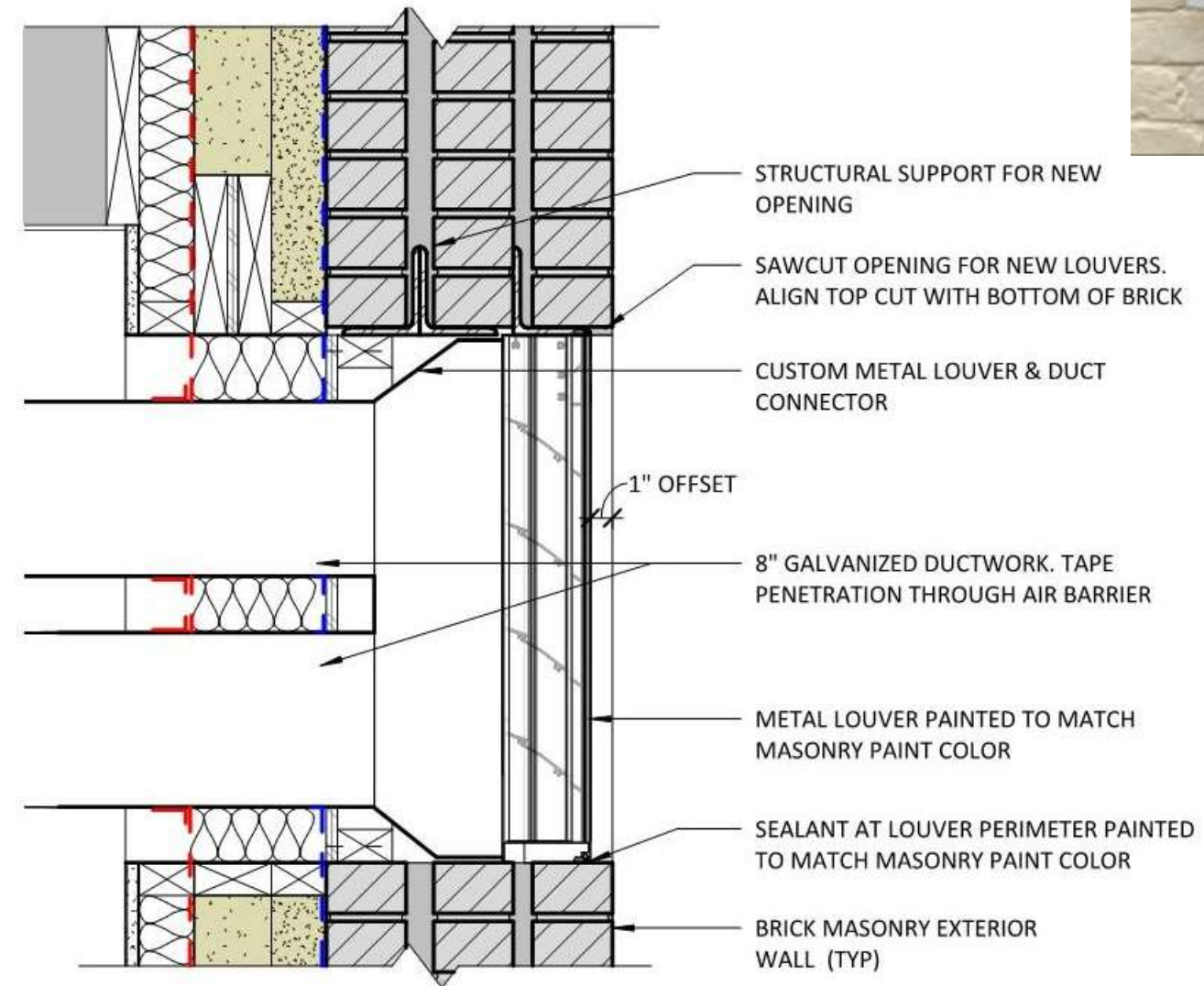
PROPOSED LOUVER

PAINTED MATTE TO MATCH EXISTING FACADE



NOTE: DIMENSIONS VARY. SEE ELEVATIONS

TYPICAL LOUVER SECTION



PROPOSED LOUVER SECTION
1-1/2" = 1'-0"

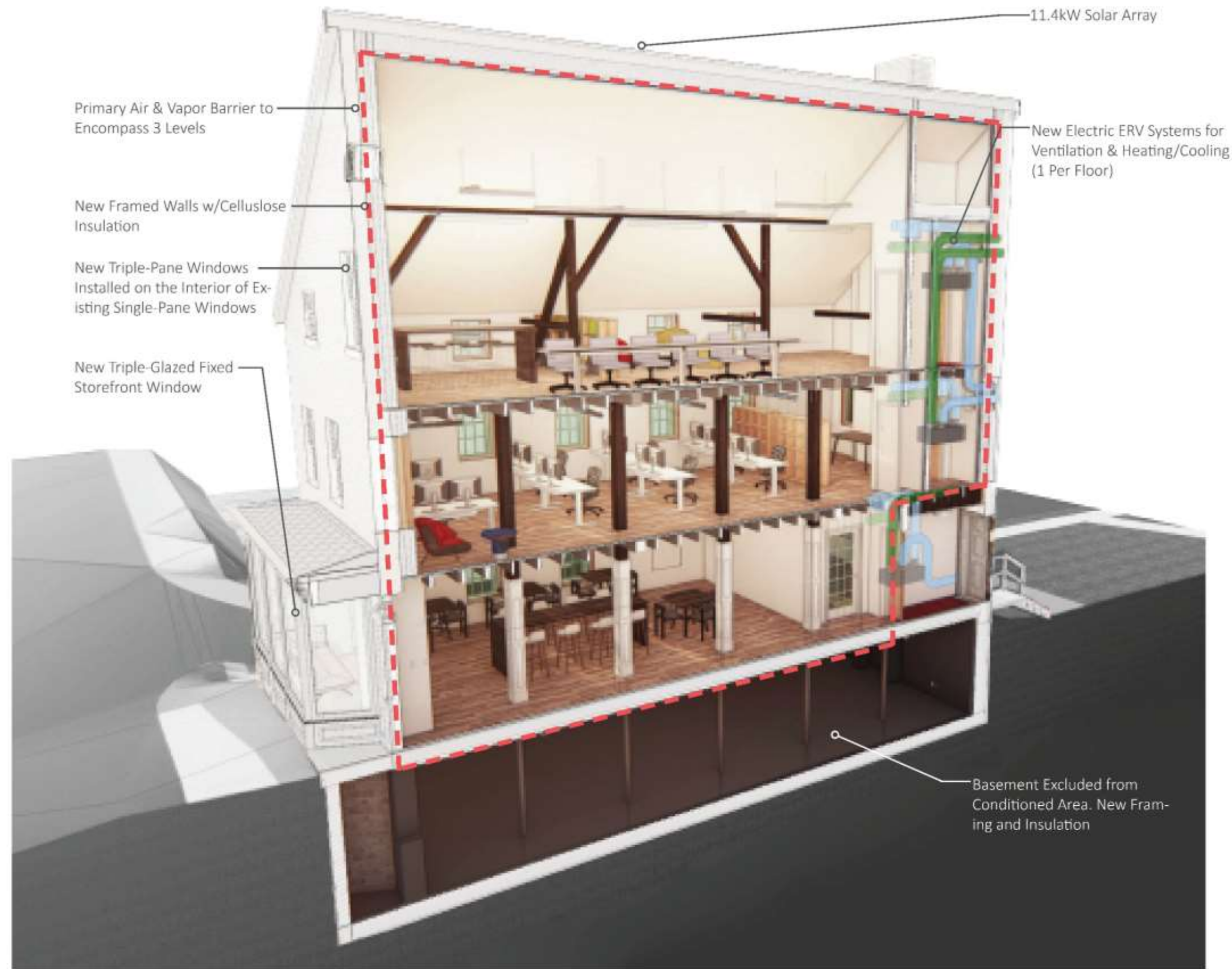
RESILIENCY & FLOOD ZONES

CONDITIONS

FIRST FLOOR ELEVATION IS OUTSIDE 100-YEAR FLOOD PLAIN

BASEMENT FLOOR LEVEL BELOW 100-YEAR FLOOD PLAIN





RESILIENCY & FLOOD ZONES

CONDITIONS

FIRST FLOOR ELEVATION IS OUTSIDE 100-YEAR FLOOD PLAIN

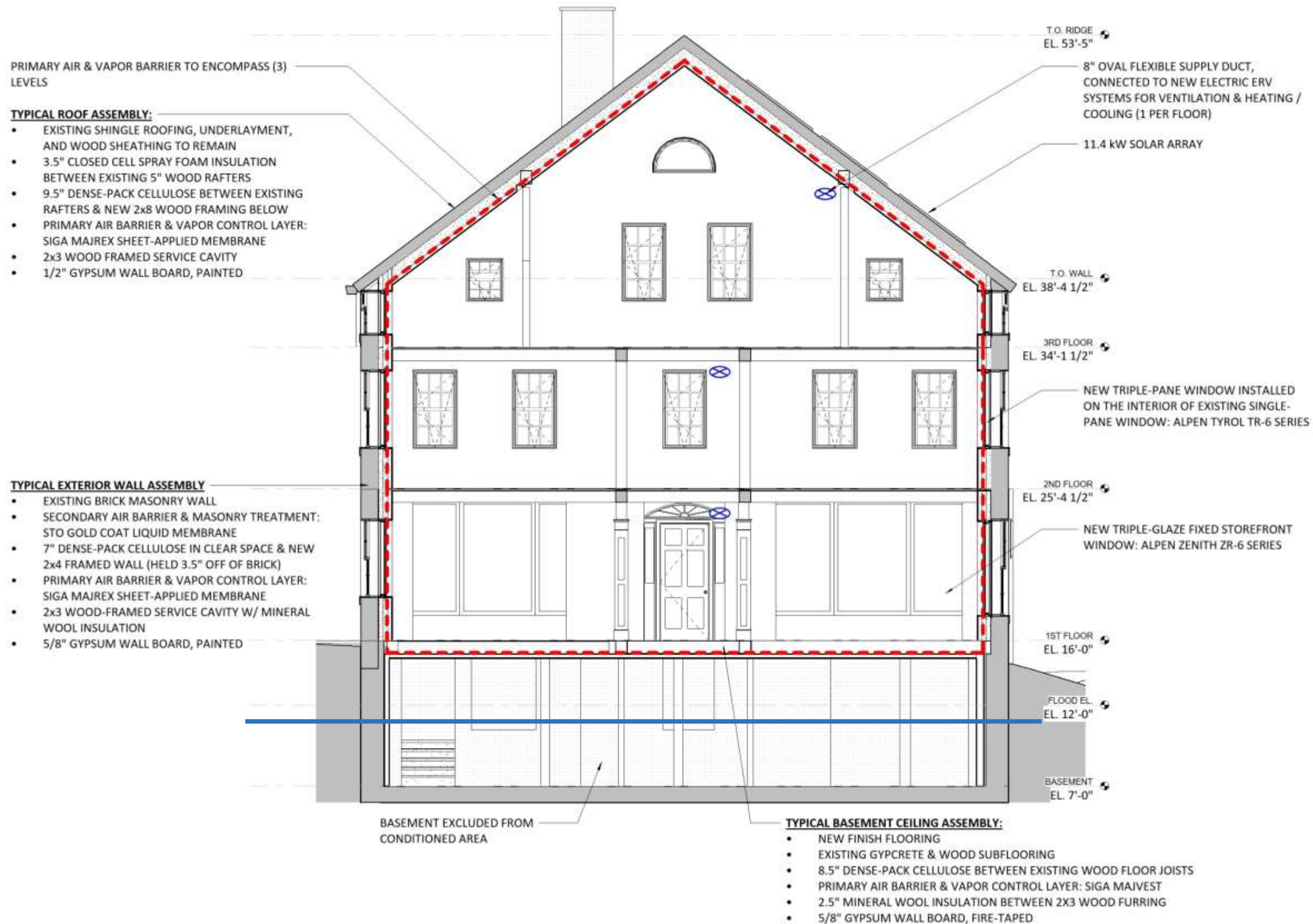
BASEMENT FLOOR LEVEL BELOW 100-YEAR FLOOD PLAIN

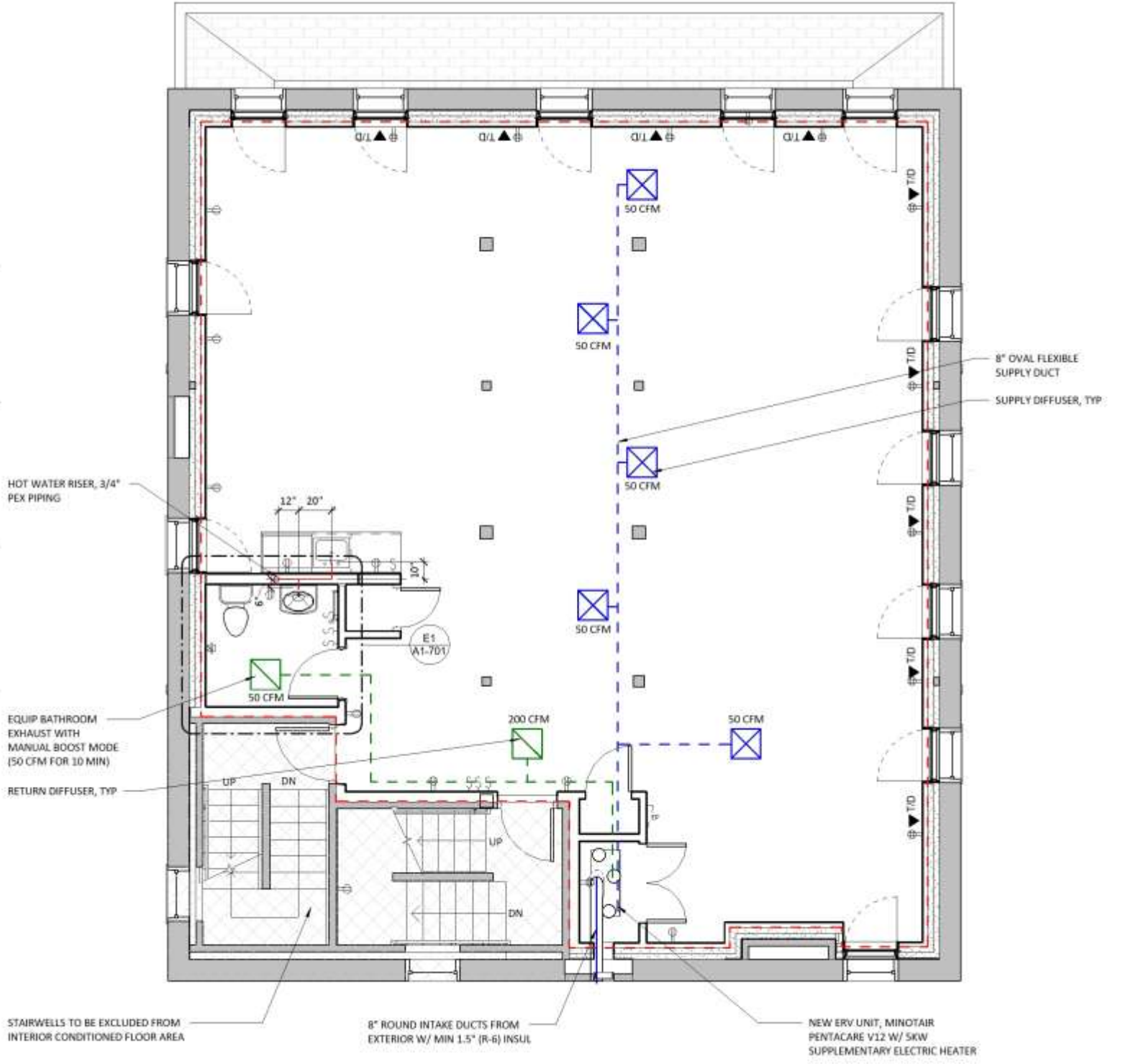
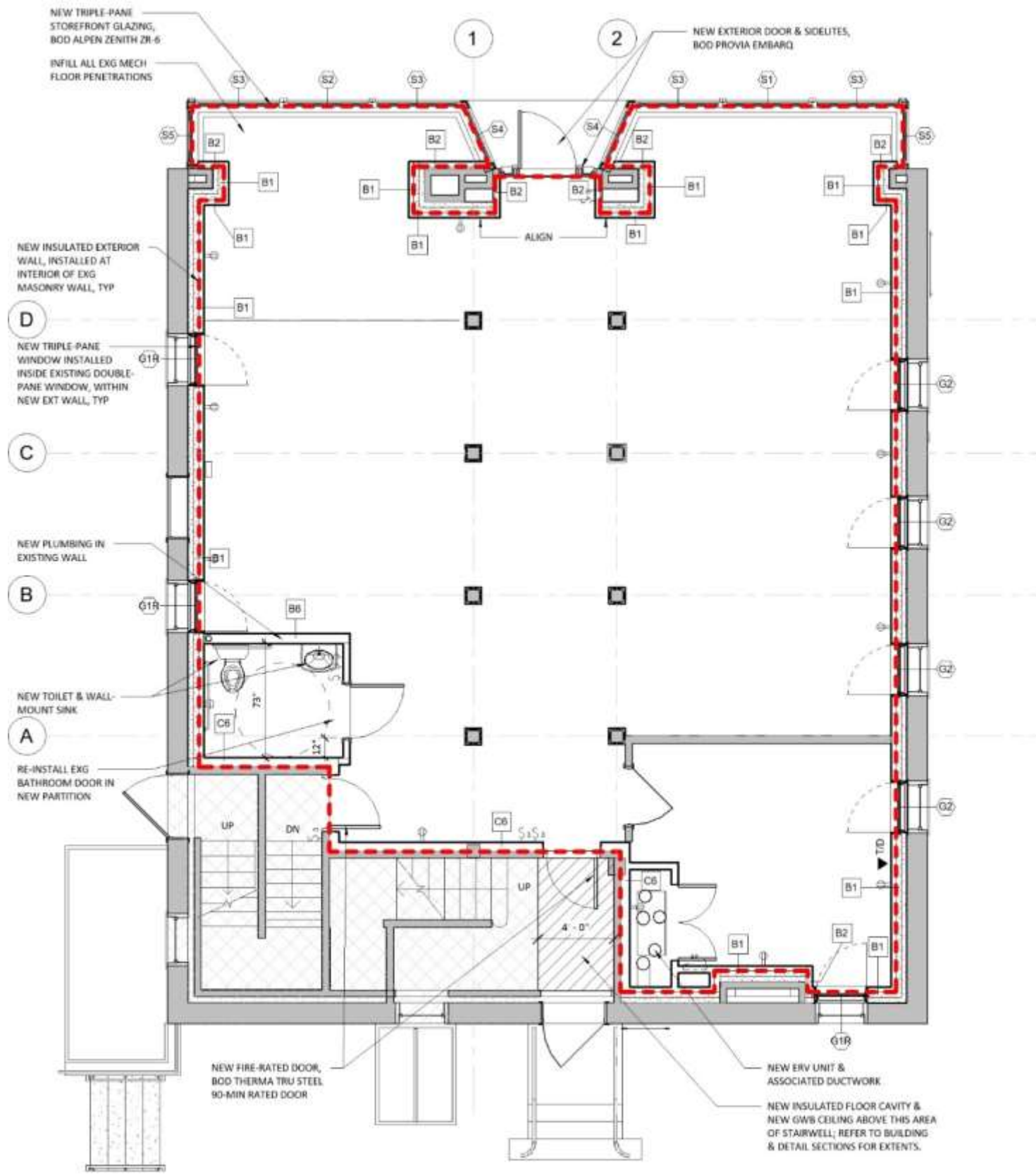
RESPONSE

MOVE MAJOR MECHANICAL SYSTEMS AND PROGRAM SPACE OUT OF BASEMENT

MOVE ELECTRICAL PANELS & EQUIPMENT ABOVE FLOOD ELEVATION

EXCLUDE BASEMENT FROM THERMAL ENVELOPE, WITH CARE TAKEN TO MANAGE HUMIDITY





RESILIENCY & FLOOD ZONES

CONDITIONS

FIRST FLOOR ELEVATION IS OUTSIDE 100-YEAR FLOOD PLAIN

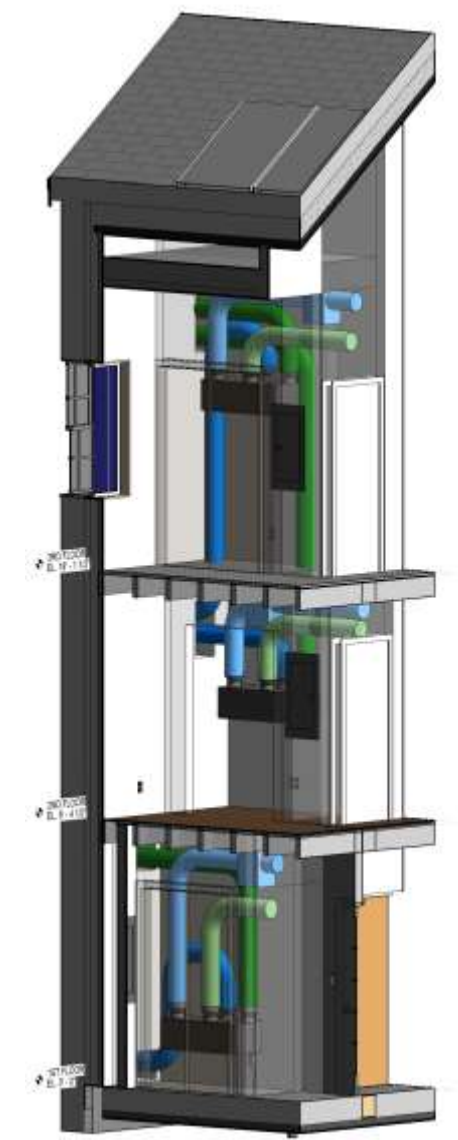
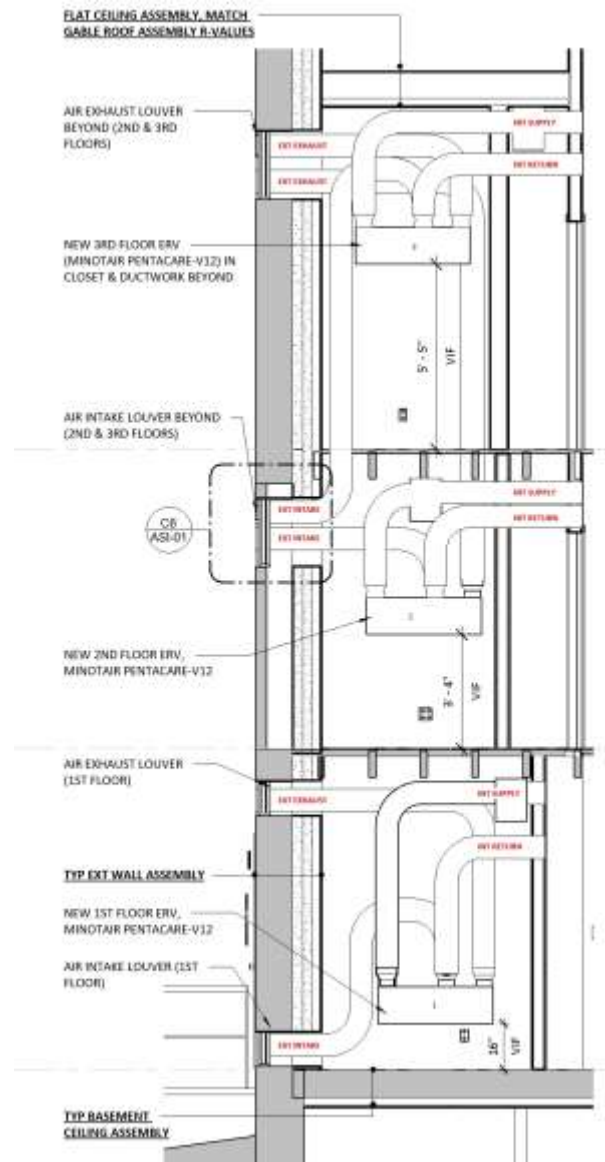
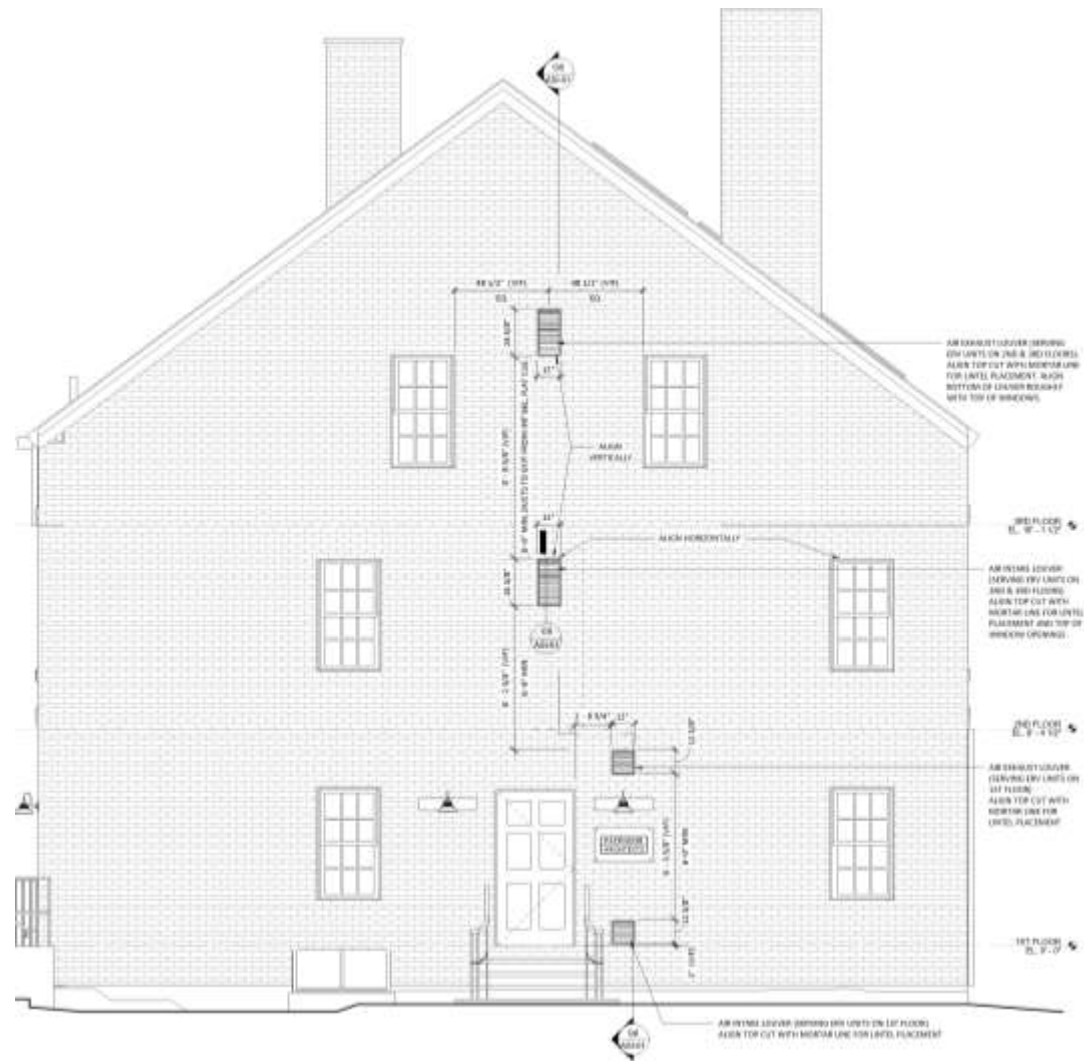
BASEMENT FLOOR LEVEL BELOW 100-YEAR FLOOD PLAIN

RESPONSE

MOVE MAJOR MECHANICAL SYSTEMS AND PROGRAM SPACE OUT OF BASEMENT

MOVE ELECTRICAL PANELS & EQUIPMENT ABOVE FLOOD ELEVATION

EXCLUDE BASEMENT FROM THERMAL ENVELOPE, WITH CARE TAKEN TO MANAGE HUMIDITY



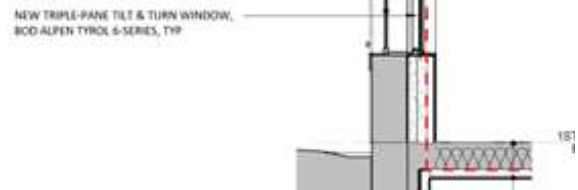
TYP. GABLE ROOF ASSEMBLY:

- NEW SHINGLE ROOFING & UNDERLAYMENT
- EXG WOOD SHEATHING, TAPE SEAMS W/ VAPOR PERMEABLE TAPE, BOD SIGA
- 3.5" CCF ON UNDERSIDE OF ROOF DECK
- 5.5" DENSE-PACK CELLULOSE INSUL BETWEEN EXG 5.5" WOOD RAFTERS & NEW 2x8 FRAMING BELOW, BOD GUTEX THERMOFIBER
- PRIMARY AIR BARRIER & VAPOR CONTROL LAYER, BOD SIGA MAJREX SHEET-APPLIED MEMBRANE
- 2x3 WD-FRAMED SERVICE CAVITY W/ MINERAL WOOL INSUL
- 5/8" GYPSUM WALL BOARD, PNT



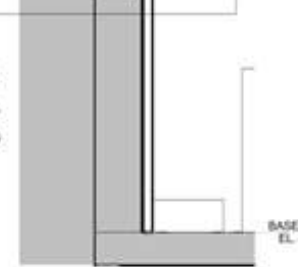
TYP. EXT WALL ASSEMBLY:

- EXG BRICK MASONRY WALL, WIDTH VARIES
- SECONDARY AIR BARRIER & MASONRY TREATMENT, BOD STD GOLD COAT LIQUID MEMBRANE
- DENSE-PACK CELLULOSE INSUL IN 3 1/2" CLEAR SPACE, BOD GUTEX THERMOFIBER
- 2x4 WD-FRAMED WALL W/ DENSE-PACK CELLULOSE INSUL BETWEEN STUDS, BOD GUTEX THERMOFIBER
- PRIMARY AIR BARRIER & VAPOR CONTROL LAYER, BOD SIGA MAJREX SHEET-APPLIED MEMBRANE
- 2x3 WD-FRAMED SERVICE CAVITY W/ MINERAL WOOL INSUL
- 5/8" GYPSUM WALL BOARD, PNT

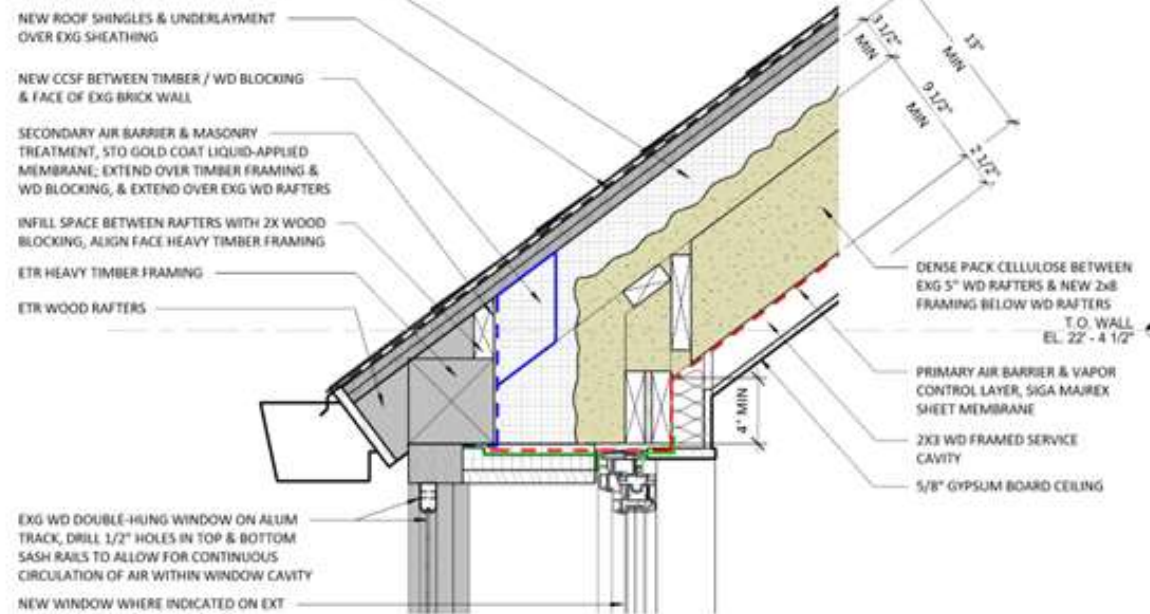


TYP. BASEMENT CEILING ASSEMBLY:

- EXG CORK FINISH FLOORING
- EXG GYPCRETE & WD SUBFLOOR
- 8.5" DENSE-PACK CELLULOSE BETWEEN EXISTING WD FLOOR JOISTS, BOD GUTEX THERMOFIBER
- PRIMARY AIR BARRIER & VAPOR CONTROL LAYER, BOD SIGA MAJVEST
- 2.5" MINERAL WOOL BETWEEN 2x3 WD FURRING
- 5/8" GWB, FIRE-TAPED

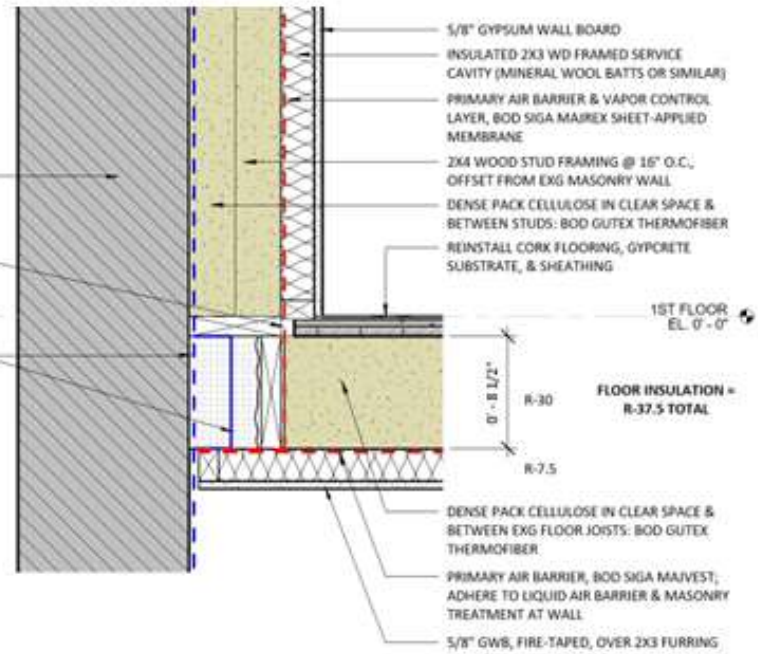


- 3.5" LAYER CLOSED-CELL SPRAY FOAM ON UNDERSIDE OF EXISTING ROOF SHEATHING
- NEW ROOF SHINGLES & UNDERLAYMENT OVER EXG SHEATHING
- NEW CCF BETWEEN TIMBER / WD BLOCKING & FACE OF EXG BRICK WALL

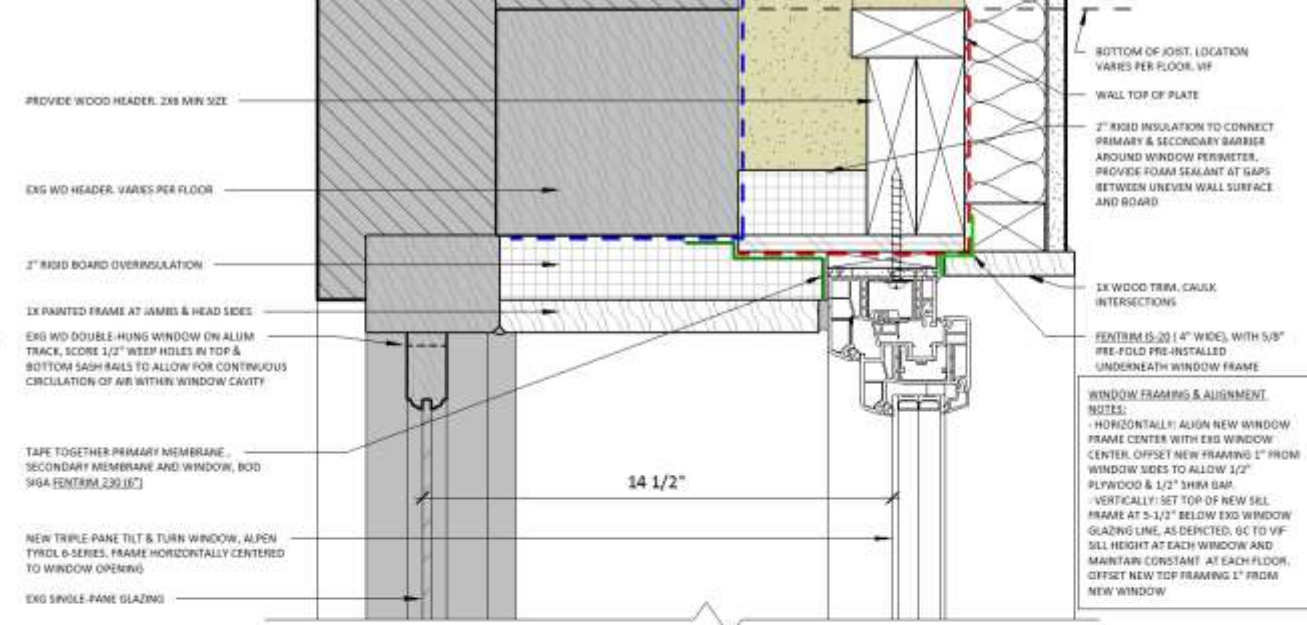


- SECONDARY AIR BARRIER & MASONRY TREATMENT, STD GOLD COAT LIQUID-APPLIED MEMBRANE, EXTEND OVER TIMBER FRAMING & WD BLOCKING, & EXTEND OVER EXG WD RAFTERS
- INFILL SPACE BETWEEN RAFTERS WITH 2x WOOD BLOCKING, ALIGN FACE HEAVY TIMBER FRAMING
- ETR HEAVY TIMBER FRAMING
- ETR WOOD RAFTERS
- DENSE PACK CELLULOSE BETWEEN EXG 5" WD RAFTERS & NEW 2x8 FRAMING BELOW WD RAFTERS
- T.O. WALL EL. 22' - 4 1/2"
- PRIMARY AIR BARRIER & VAPOR CONTROL LAYER, SIGA MAJREX SHEET MEMBRANE
- 2x3 WD FRAMED SERVICE CAVITY
- 5/8" GYPSUM BOARD CEILING
- EXG WD DOUBLE-HUNG WINDOW ON ALUM TRACK, DRILL 1/2" HOLES IN TOP & BOTTOM SASH RAILS TO ALLOW FOR CONTINUOUS CIRCULATION OF AIR WITHIN WINDOW CAVITY
- NEW WINDOW WHERE INDICATED ON EXT ELEVATIONS, ALPEN TYROL 6-SERIES

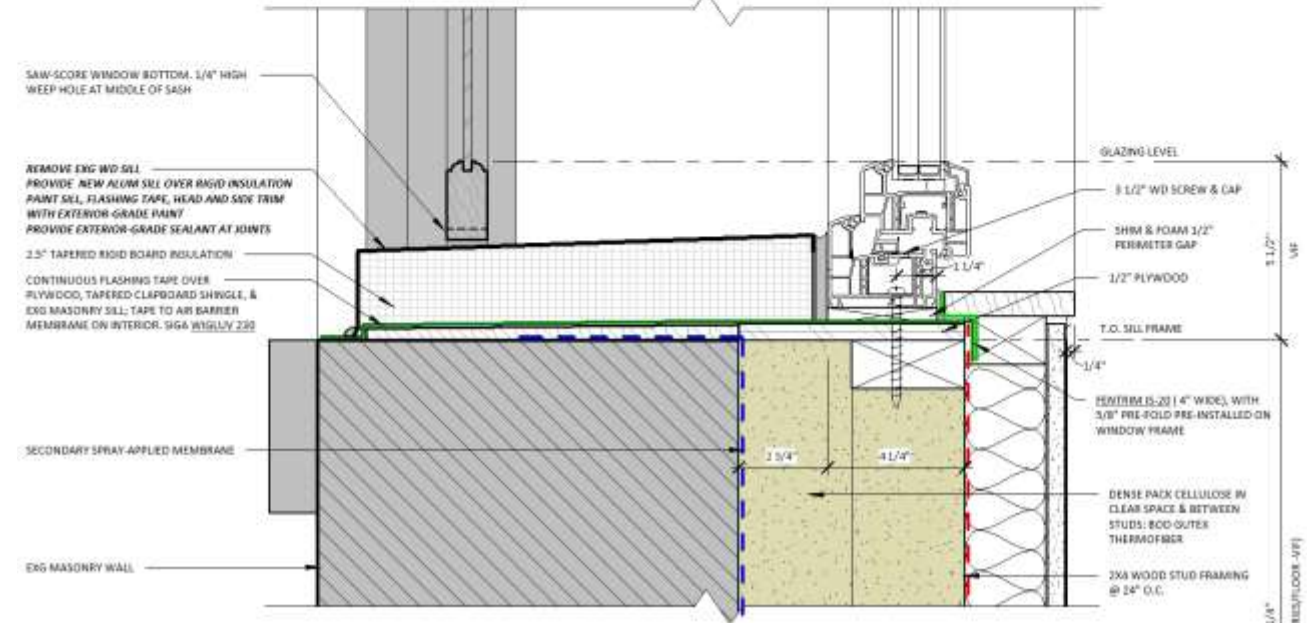
- EXG MASONRY WALL. REMOVE 3/8" INTERIOR PLASTER FINISH, APPLY STD GOLD COAT LIQUID-APPLIED MEMBRANE TO INTERIOR SURF OF MASONRY
- SAWCUT OPENING IN GYPCRETE SUBFLOOR & WOOD SHEATHING FOR PASSAGE OF PRIMARY AIR BARRIER BETWEEN FLOORS, TYP
- SECONDARY AIR BARRIER & MASONRY TREATMENT, BOD STD GOLD COAT LIQUID BARRIER OVER EXG JOISTS TO MAKE JOIST PENETRATIONS AIRTIGHT



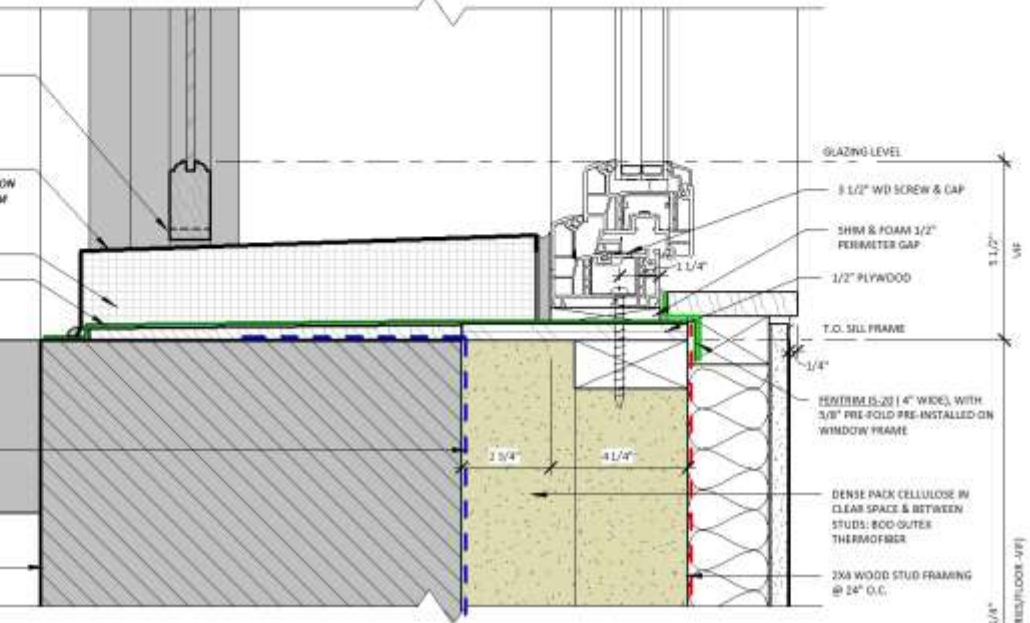
- PRIMARY AIR BARRIER & VAPOR CONTROL LAYER, SIGA MAJREX SHEET-APPLIED MEMBRANE
- FIELD CUT & SEAL TO EXG WOOD JOISTS WITH VAPOR OPEN TAPE, BOD SIGA ROSSAW 200



- PROVIDE WOOD HEADER, 2x8 MIN SIZE
- EXG WD HEADER, VARIES PER FLOOR
- 2" RIGID BOARD OVERINSULATION
- 1x PAINTED FRAME AT JAMBS & HEAD SIDES
- EXG WD DOUBLE-HUNG WINDOW ON ALUM TRACK, SCORE 1/2" WEEP HOLES IN TOP & BOTTOM SASH RAILS TO ALLOW FOR CONTINUOUS CIRCULATION OF AIR WITHIN WINDOW CAVITY
- TAPE TOGETHER PRIMARY MEMBRANE, SECONDARY MEMBRANE AND WINDOW, BOD SIGA INTERRA 230.187
- NEW TRIPLE-PANE TILT & TURN WINDOW, ALPEN TYROL 6-SERIES, FRAME HORIZONTALLY CENTERED TO WINDOW OPENING
- EXG SINGLE-PANE GLAZING

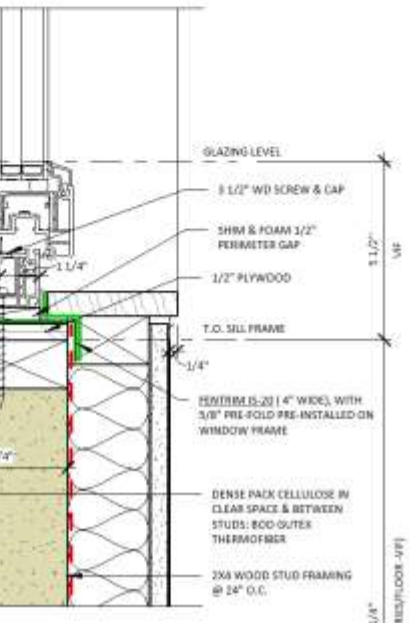


- SAW-CUT WINDOW BOTTOM, 1/4" HIGH WEEP HOLE AT MIDDLE OF SASH
- REMOVE EXG WD SILL
- PROVIDE NEW ALUM SILL OVER RIGID INSULATION
- PAINT SILL, FLASHING TAPE, HEAD AND SIDE TRIM WITH EXTERIOR-GRADE PAINT
- PROVIDE EXTERIOR-GRADE SEALANT AT JOINTS
- 2.5" TAPERED RIGID BOARD INSULATION
- CONTINUOUS FLASHING TAPE OVER PLYWOOD, TAPERED CLAPBOARD SHINGLE, & EXG MASONRY SILL; TAPE TO AIR BARRIER MEMBRANE ON INTERIOR, SIGA WISLEY 230
- SECONDARY SPRAY-APPLIED MEMBRANE
- EXG MASONRY WALL



- 5/8" GYPSUM WALL BOARD
- INSULATED 2x3 WD FRAMED SERVICE CAVITY (MINERAL WOOL BATTS OR SIMILAR)
- PRIMARY AIR BARRIER & VAPOR CONTROL LAYER, BOD SIGA MAJREX SHEET-APPLIED MEMBRANE
- 2x4 WOOD STUD FRAMING @ 16" O.C., OFFSET FROM EXG MASONRY WALL
- DENSE-PACK CELLULOSE IN CLEAR SPACE & BETWEEN STUDS: BOD GUTEX THERMOFIBER
- REINSTALL CORK FLOORING, GYPCRETE SUBSTRATE, & SHEATHING
- 1ST FLOOR EL. 0' - 0"
- FLOOR INSULATION = R-37.5 TOTAL
- 0' - 8 1/2" R-30
- 8' - 7.5
- DENSE-PACK CELLULOSE IN CLEAR SPACE & BETWEEN EXG FLOOR JOISTS: BOD GUTEX THERMOFIBER
- PRIMARY AIR BARRIER, BOD SIGA MAJVEST, ADHERE TO LIQUID AIR BARRIER & MASONRY TREATMENT AT WALL
- 5/8" GWB, FIRE-TAPED, OVER 2x3 FURRING

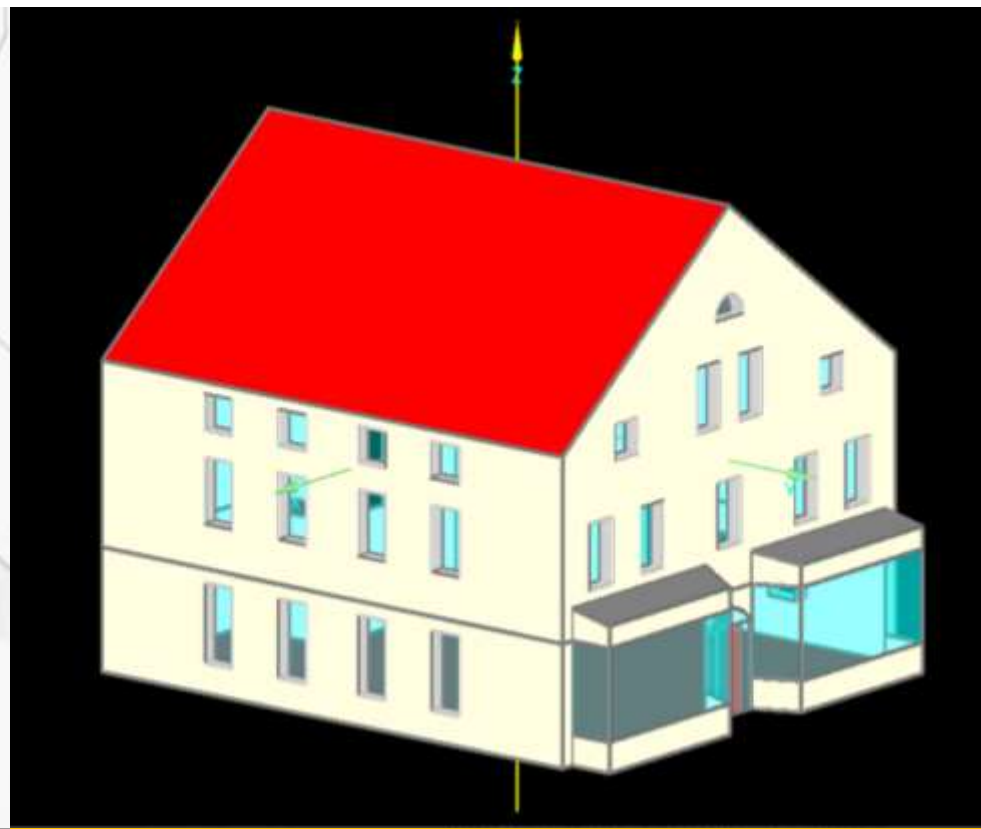
- REMOVE EXG WD SILL
- PROVIDE NEW ALUM SILL OVER RIGID INSULATION
- PAINT SILL, FLASHING TAPE, HEAD AND SIDE TRIM WITH EXTERIOR-GRADE PAINT
- PROVIDE EXTERIOR-GRADE SEALANT AT JOINTS
- 2.5" TAPERED RIGID BOARD INSULATION
- CONTINUOUS FLASHING TAPE OVER PLYWOOD, TAPERED CLAPBOARD SHINGLE, & EXG MASONRY SILL; TAPE TO AIR BARRIER MEMBRANE ON INTERIOR, SIGA WISLEY 230
- SECONDARY SPRAY-APPLIED MEMBRANE
- EXG MASONRY WALL



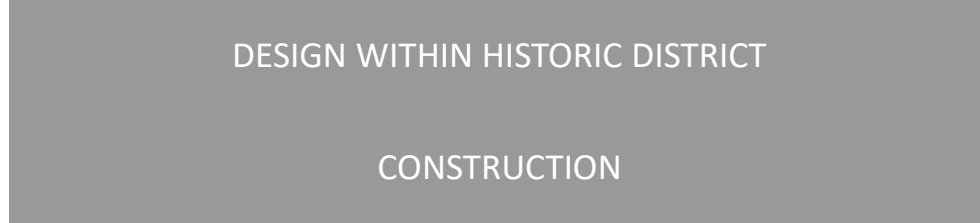
- BOTTOM OF JOIST, LOCATION VARIES PER FLOOR, V/F
- WALL TOP OF PLATE
- 2" RIGID INSULATION TO CONNECT PRIMARY & SECONDARY BARRIER AROUND WINDOW PERIMETER. PROVIDE FOAM SEALANT AT GAPS BETWEEN UNEVEN WALL SURFACE AND BOARD
- 1x WOOD TRIM, CAULK INTERSECTIONS
- FENESTRA IS-20 (4" WIDE), WITH 5/8" PRE-FOLD PRE-INSTALLED UNDERNEATH WINDOW FRAME
- WINDOW FRAMING & ALIGNMENT NOTES:
 - HORIZONTALLY: ALIGN NEW WINDOW FRAME CENTER WITH EXG WINDOW CENTER. OFFSET NEW FRAMING 1" FROM WINDOW SIDES TO ALLOW 1/2" PLYWOOD & 1/2" SHIM GAP
 - VERTICALLY: SET TOP OF NEW SILL FRAME AT 5-1/2" BELOW EXG WINDOW GLAZING LINE, AS DEPICTED. GC TO V/F SILL HEIGHT AT EACH WINDOW AND MAINTAIN CONSTANT AT EACH FLOOR. OFFSET NEW TOP FRAMING 1" FROM NEW WINDOW
- 14 1/2"
- GLAZING LEVEL
- 3 1/2" WD SCREW & CAP
- SHIM & FOAM 1/2" PERIMETER GAP
- 1/2" PLYWOOD
- T.O. SILL FRAME
- 1/4"
- FENESTRA IS-20 (4" WIDE), WITH 5/8" PRE-FOLD PRE-INSTALLED ON WINDOW FRAME
- DENSE-PACK CELLULOSE IN CLEAR SPACE & BETWEEN STUDS: BOD GUTEX THERMOFIBER
- 2x4 WOOD STUD FRAMING @ 24" O.C.
- 30.0/4" (VARIES/FLOOR V/F)



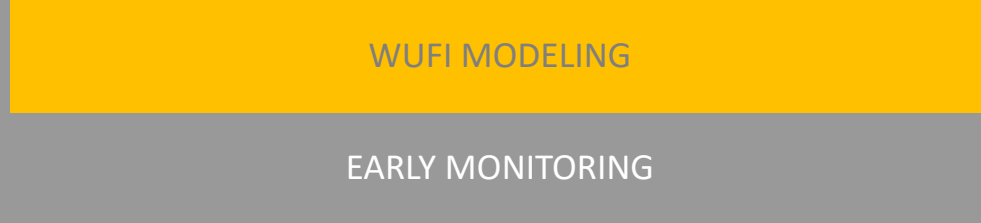
DESIGN WITHIN HISTORIC DISTRICT



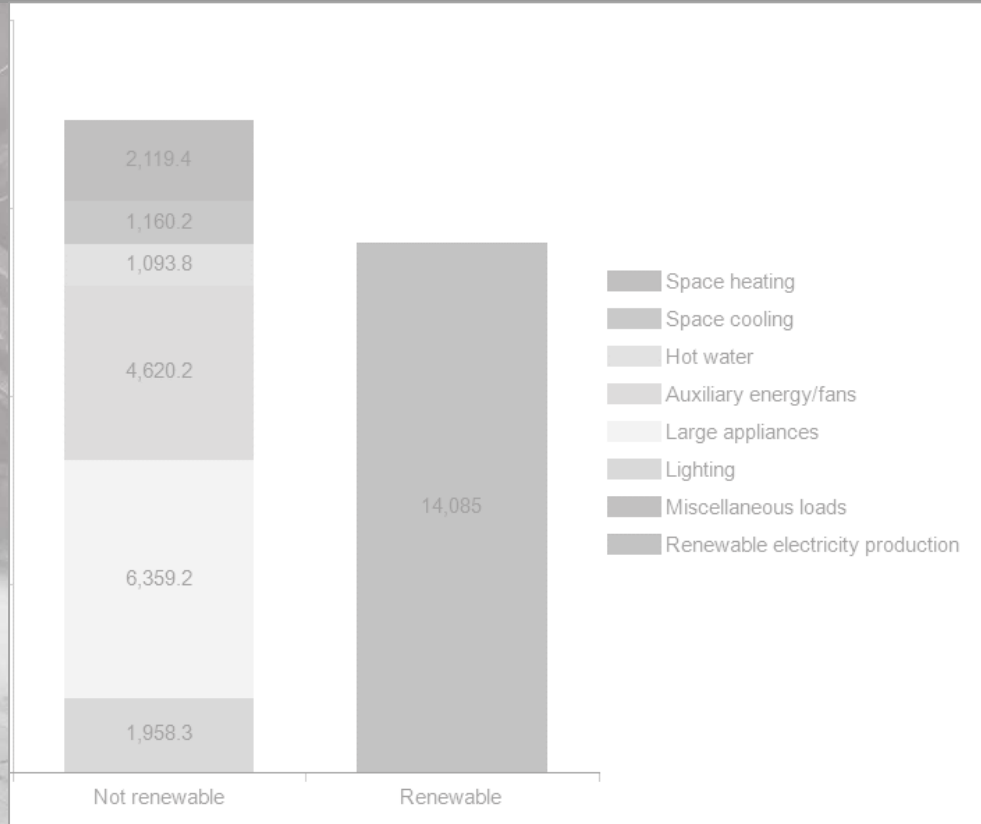
WUFI MODELING



CONSTRUCTION



EARLY MONITORING



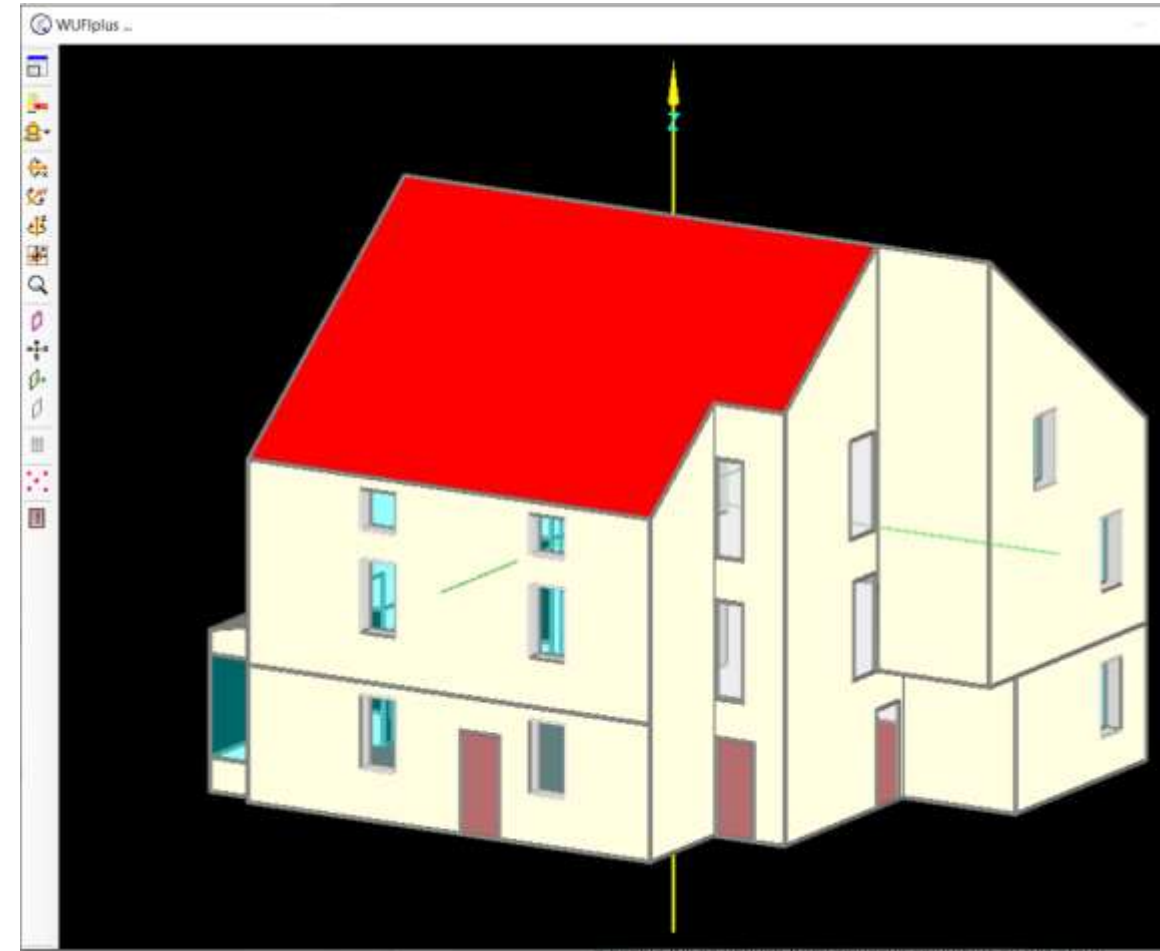
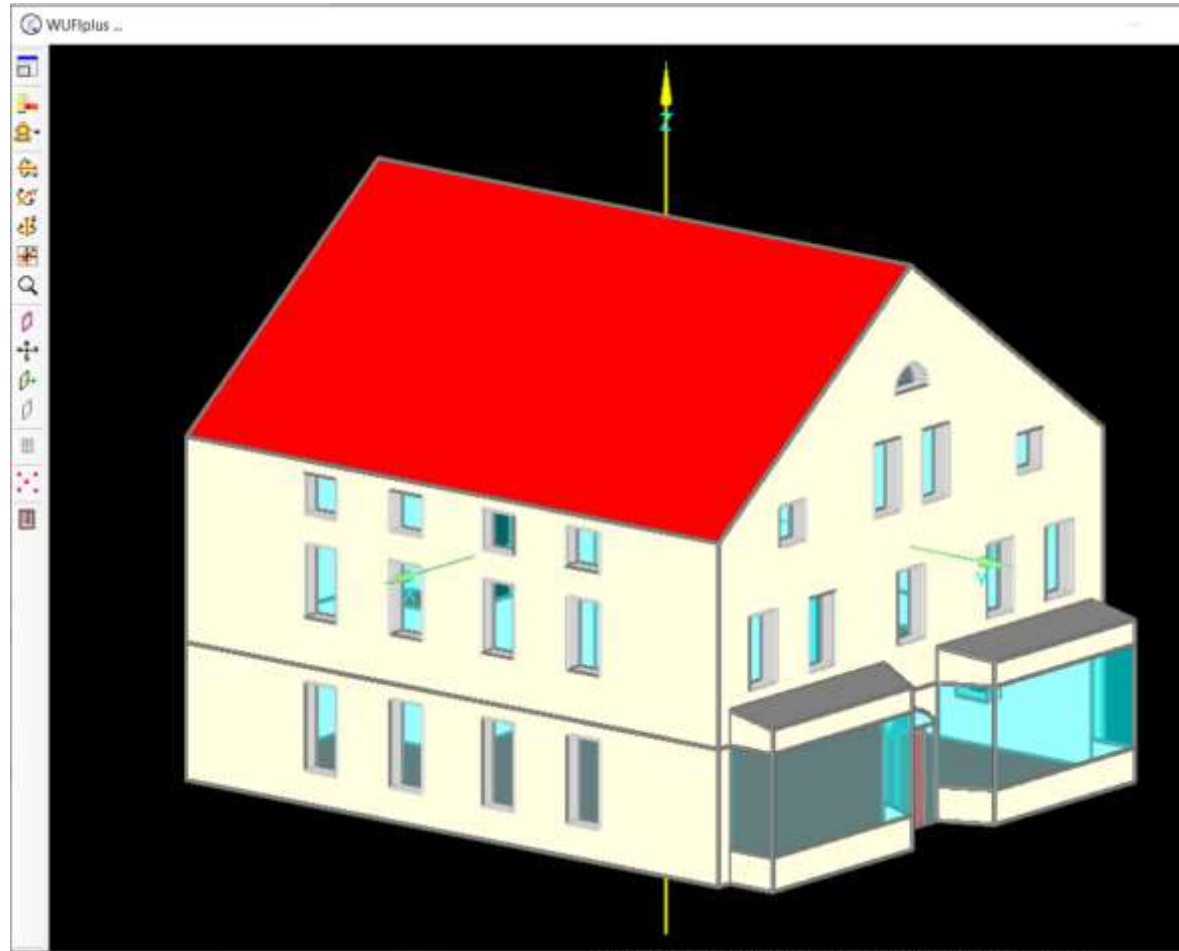
WUFI MODELING

OCCUPANCY

ELECTRICAL LOADS

MECHANICAL SYSTEM

RENEWABLES



OCCUPANCY

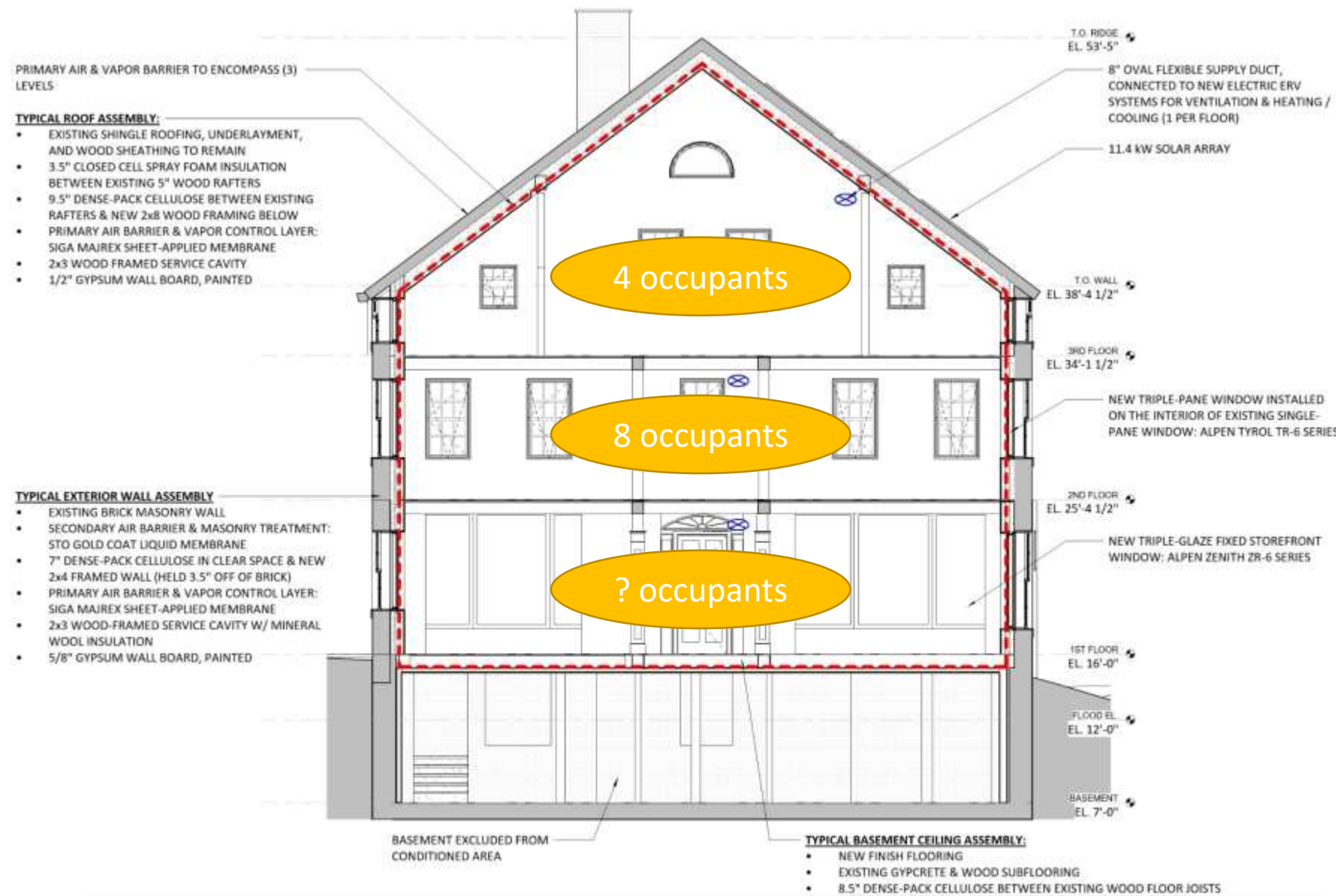
OFFICE / ADMINISTRATIVE OCCUPANCY

FLUCTUATING / EVOLVING OCCUANT LOAD OVER TIME; SPACE IS NOT FULLY LEASED OUT YET

CALCULATED OCCUPANT QUANTITY = 4

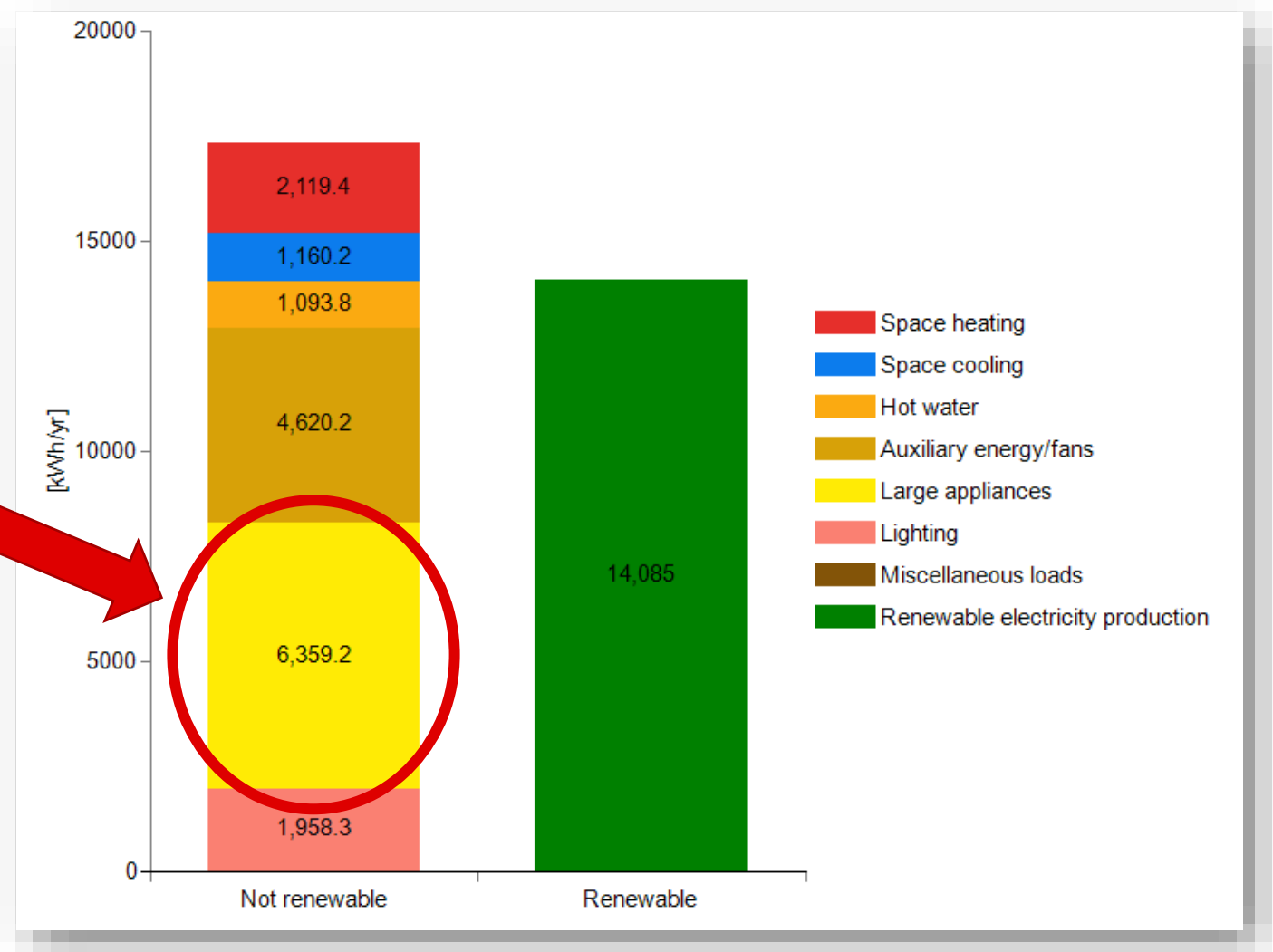
PROJECTED OCCUPANCY OF 18, UTILIZE SPACE 9 HOURS / DAY, 250 DAYS / YEAR

COORDINATION W/ PHIUS TO DETERMINE



Inner load / occupancy

Occupant quantity	4			
Humidity sources	[lb/(ft ² hr)] 0.00041			
Additional data				
Heat loss due to evaporation (per person)	[Btu/hr] 51.1821			
Heat loss due to flushing toilets (cold water)	No			
Number of flush toilets	3			
Toilet utilization pattern	Pattern 1: Standard Utilization			
Use default values for school	No			
Name	Utilization pattern	Activity of persons	Occupant quantity	Floor area of utilization zone [ft ²]
Floor 1-3 Occupancy	Pattern 1: Standard Utilization	Adult, sitting	18	



ELECTRICAL LOADS

AVOID UNDERESTIMATING... AND OVERESTIMATING!

SIGNIFICANCE OF "LARGE APPLIANCES", AND SPECIFICALLY COMPUTERS

SECOND LARGEST AREA – AUXILIARY ENERGY & FANS

LARGE APPLIANCES

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft² yr]
Dishwasher	330	0.1	1,125.9	0.3
Refrigerator	715.4	0.2	2,440.8	0.6
User defined	107.3	0	365.9	0.1
User defined	57.8	0	197	0
PC	2,593.7	0.6	8,849.2	2.2
Monitor	529.9	0.1	1,807.8	0.4
Printer	308.3	0.1	1,051.7	0.3
Server	1,559.3	0.4	5,320	1.3
Telephone system	157.7	0	538	0.1
Total	6,359.2	1.6	21,696.3	5.4





MECHANICAL SYSTEM

MINOTAIR PENTACARE V12 ON EACH FLOOR

COORDINATION WITH PHIUS, MINOTAIR, & PATRIQUIN TO CONFIRM HOW TO MODEL

ALL-IN-ONE HEATING / COOLING / VENTILATION / DEHUMIDIFICATION

ALTERNATING VENTILATION MODE & CONDITIONING MODE

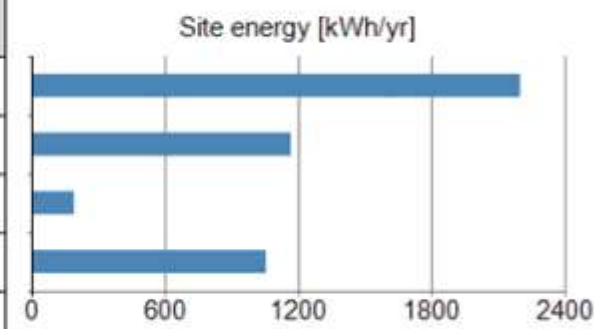
VENTILATION MODE = NEW SUPPLY AIR

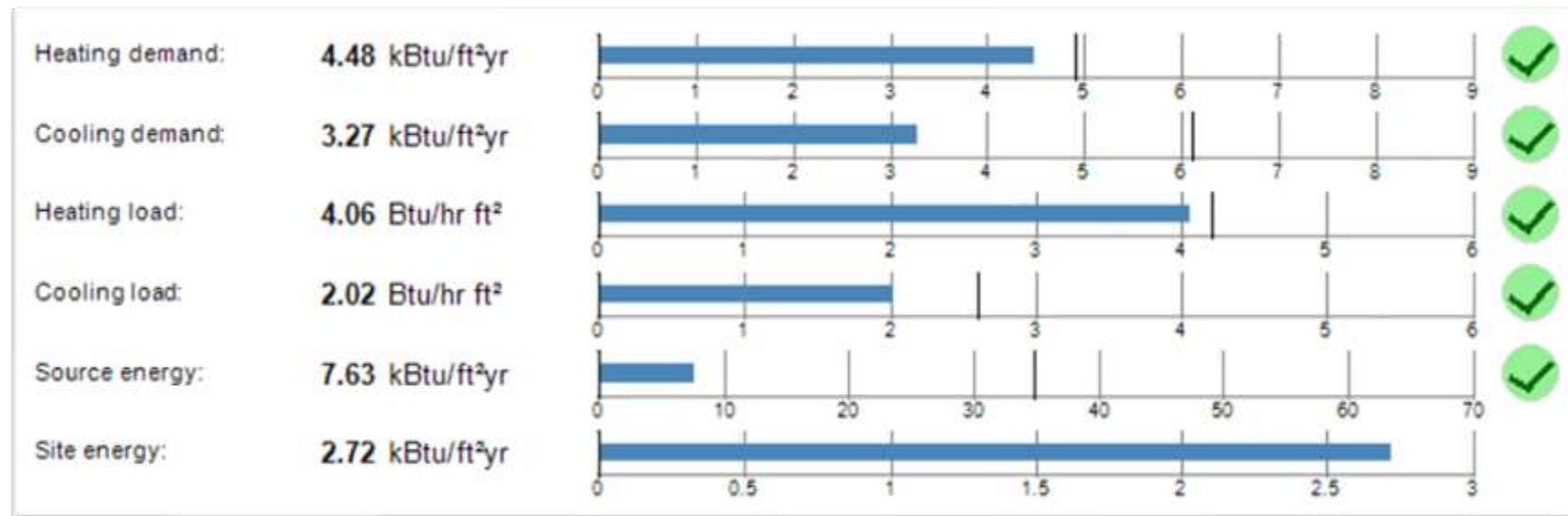
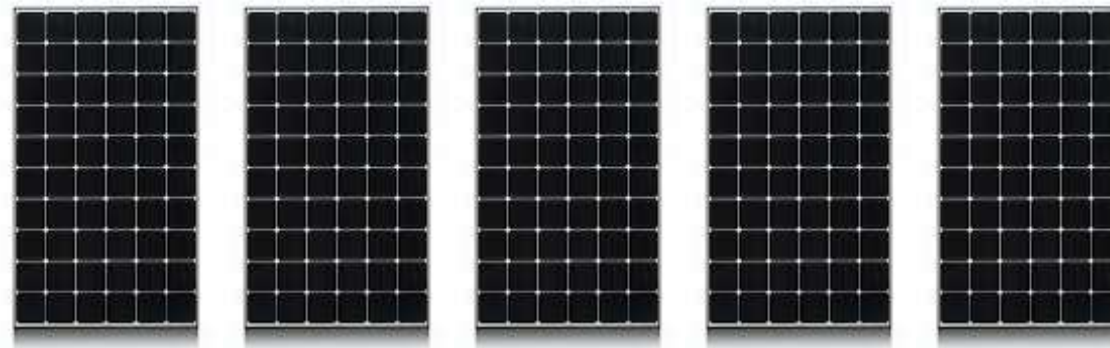
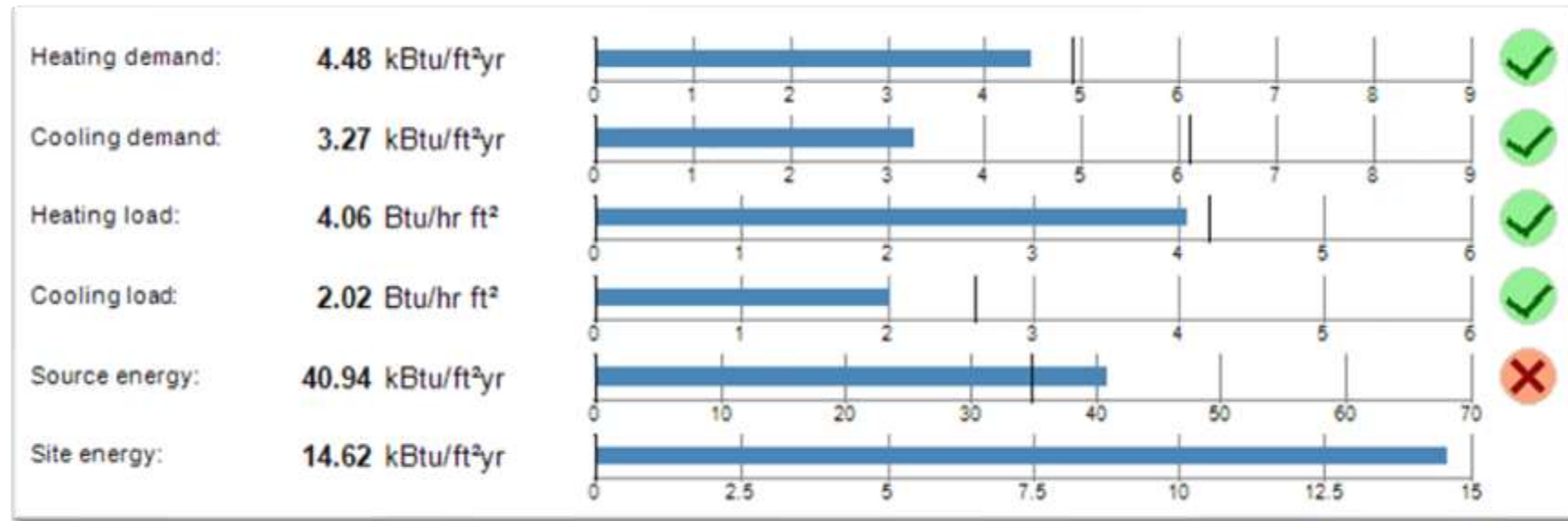
CONDITIONING MODE = RECIRCULATED SUPPLY AIR

FAN = MAJOR FACTOR IN ENERGY USE

AUXILIARY ENERGY/FANS

Type	Site Energy [kWh/yr]	Specific site energy [kWh/ft ² yr]	Site Energy [kBtu/yr]	Specific Site Energy [kBtu/ft ² yr]
Other	2,199.6	0.5	7,504.7	1.9
Ventilation winter	1,171.1	0.3	3,995.5	1
Ventilation Defrost	194.2	0	662.7	0.2
Ventilation summer	1,055.3	0.3	3,600.3	0.9
Total	4,620.2	1.1	15,763.3	3.9





RENEWABLES

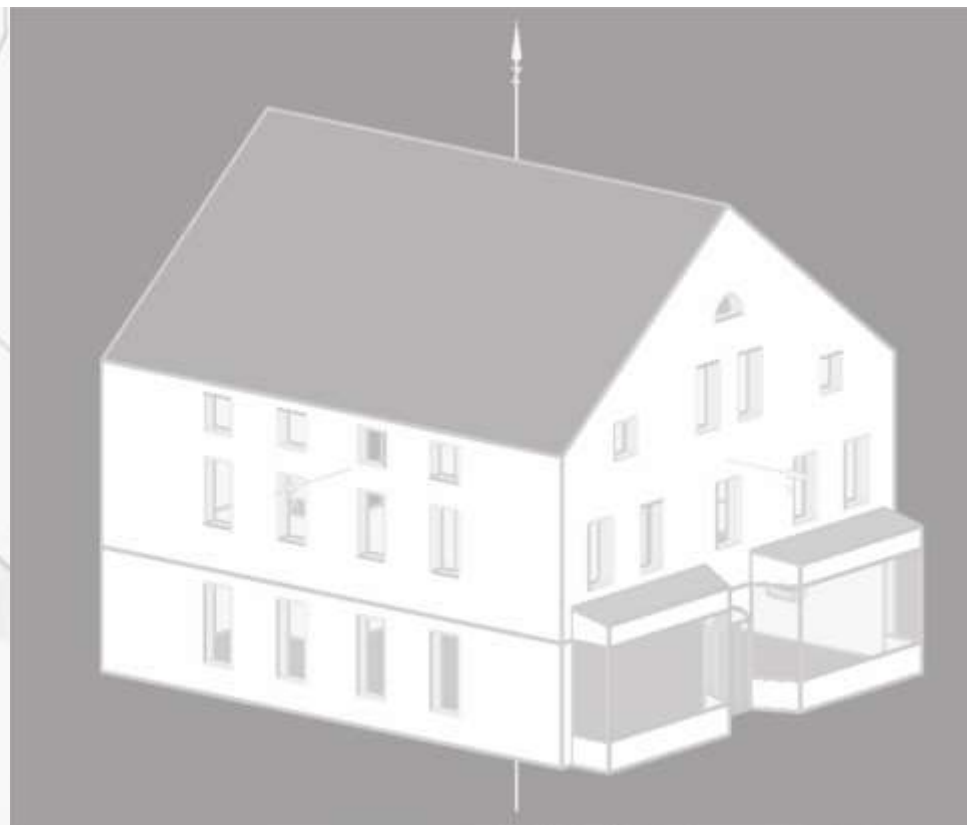
MET HEATING / COOLING TARGETS, BUT EXCEEDED SOURCE ENERGY

11.4 KW ROOFTOP PV ARRAY (FILLING ROOF) SAVED THE DAY!

ALSO CONSIDERED RECS & OFF-SITE SOLAR



DESIGN WITHIN HISTORIC DISTRICT

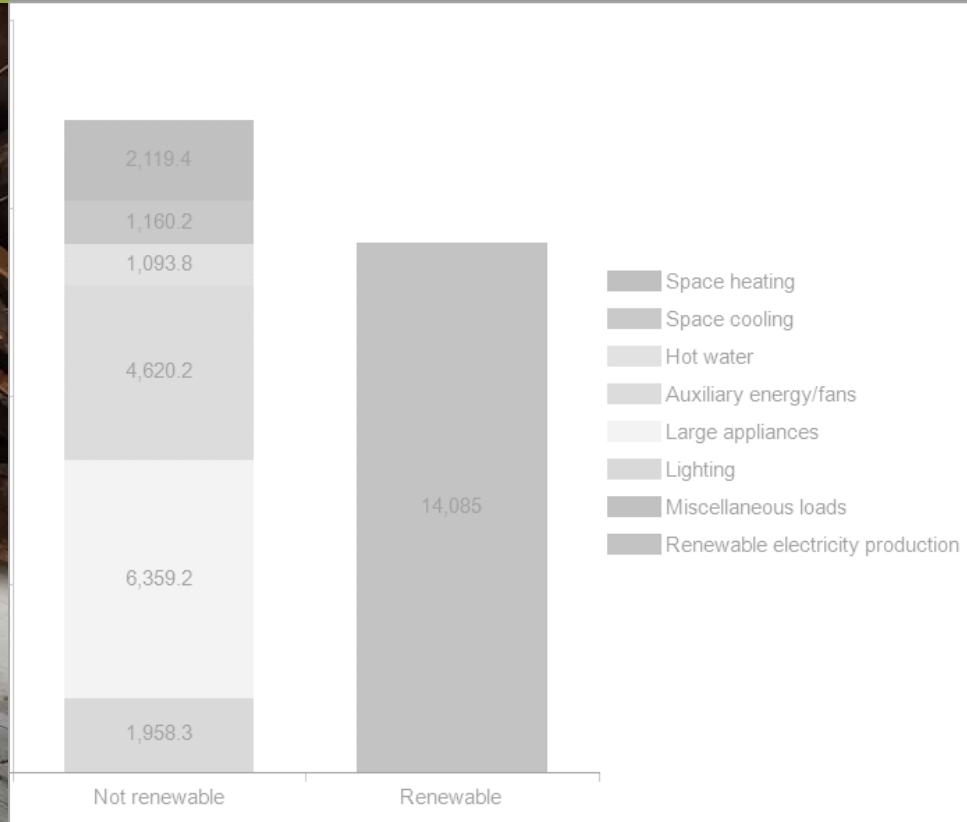


WUFI MODELING

CONSTRUCTION



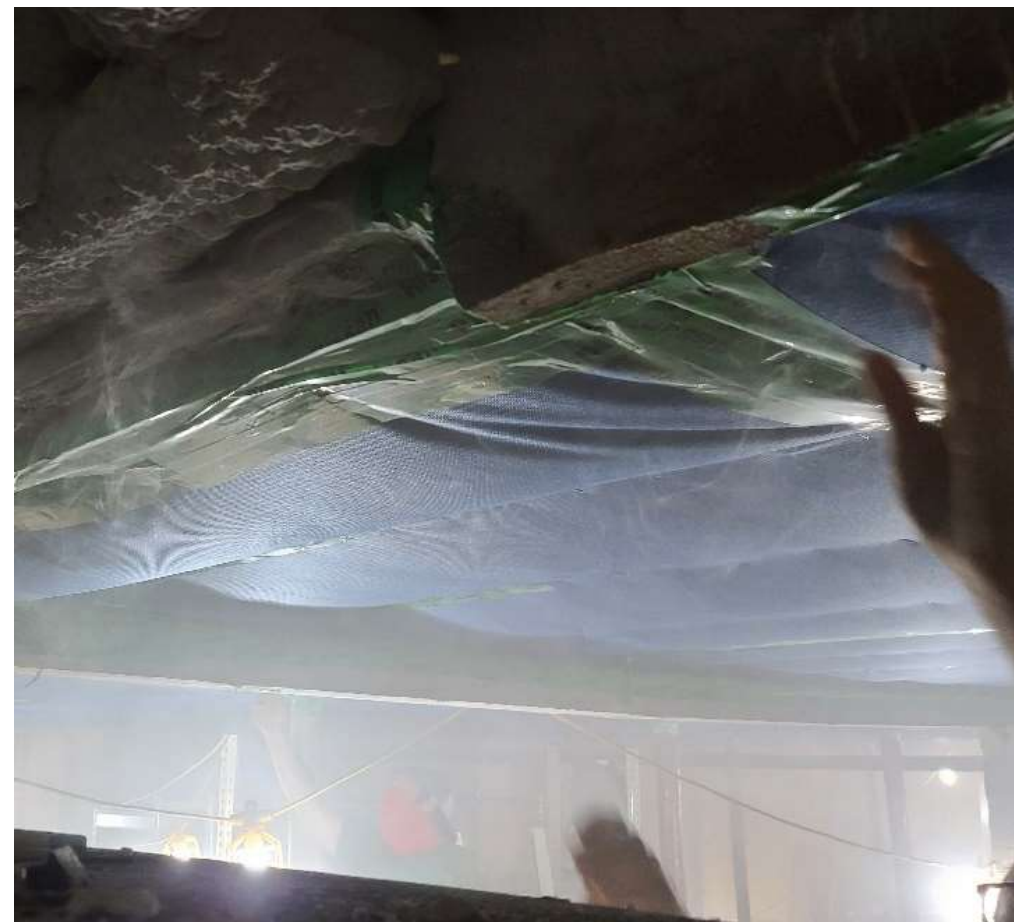
EARLY MONITORING









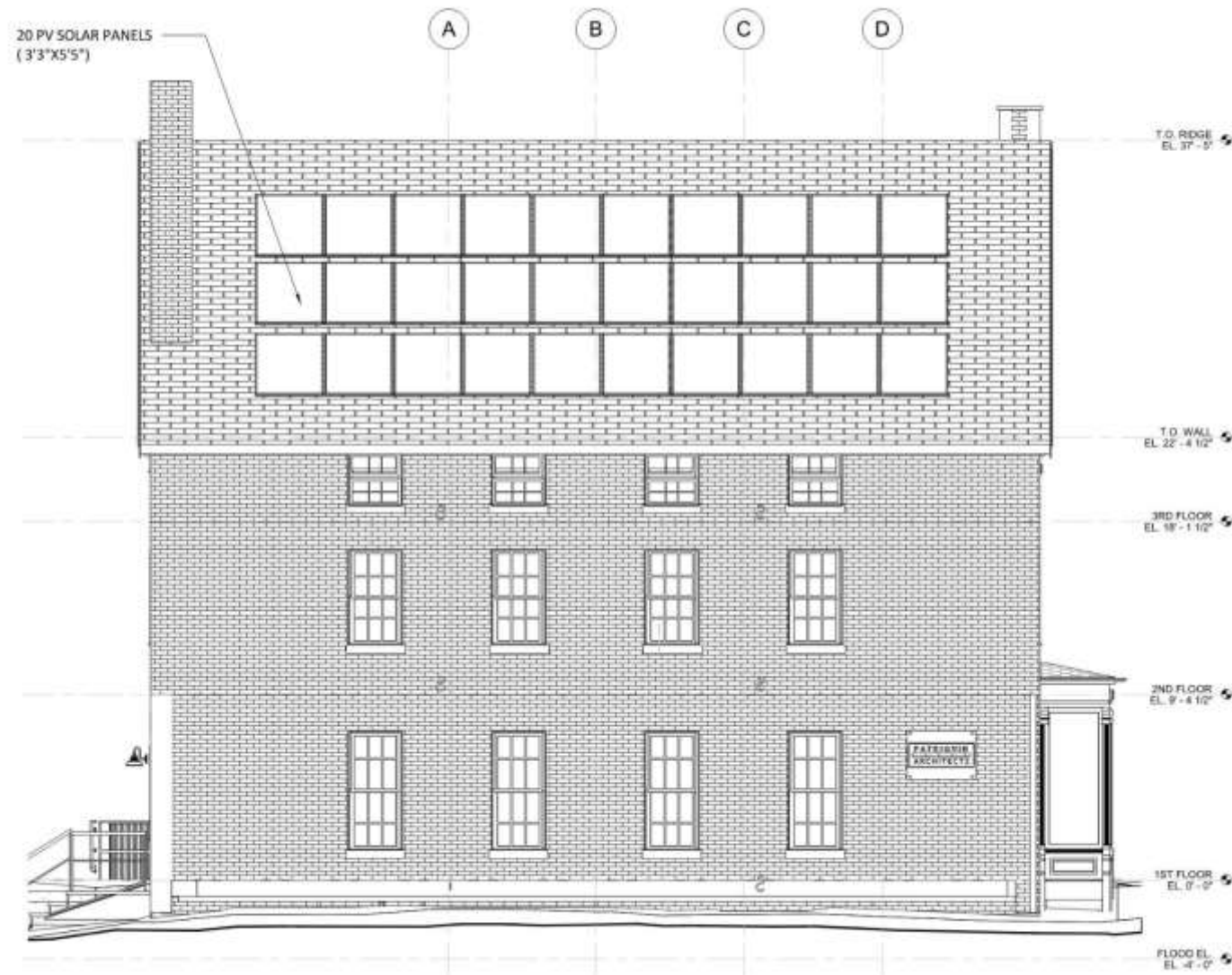












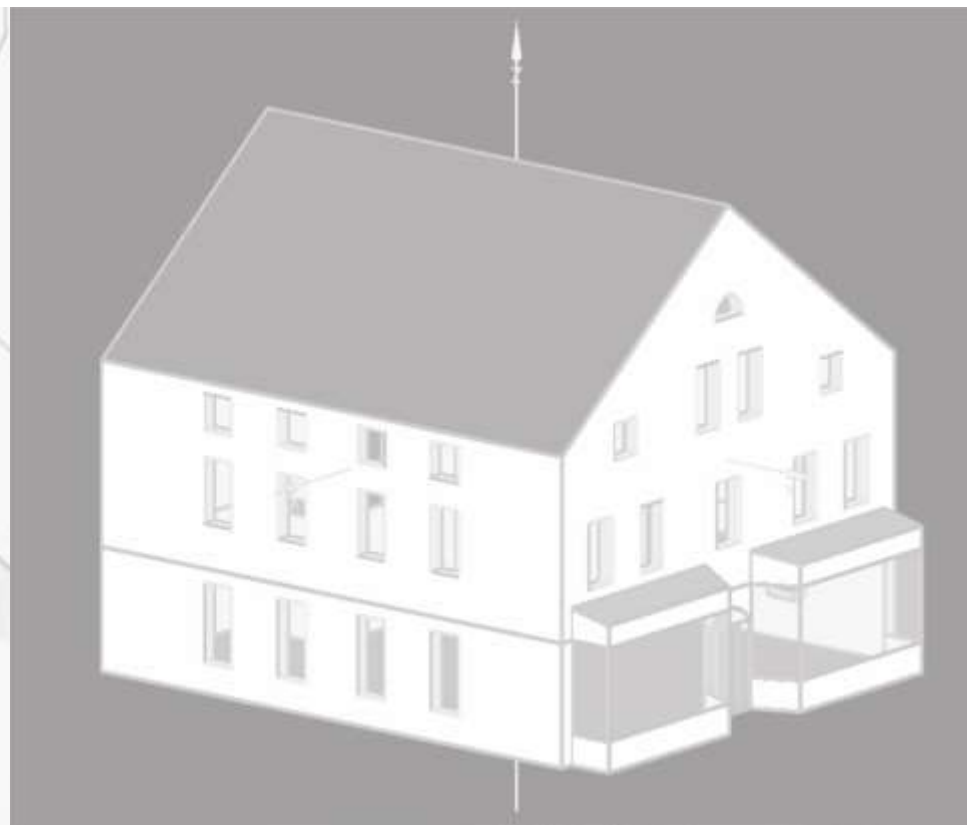
PROPOSED EAST ELEVATION



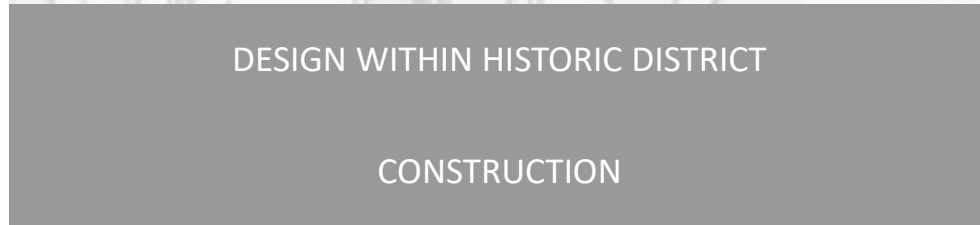
EXISTING EAST ELEVATION



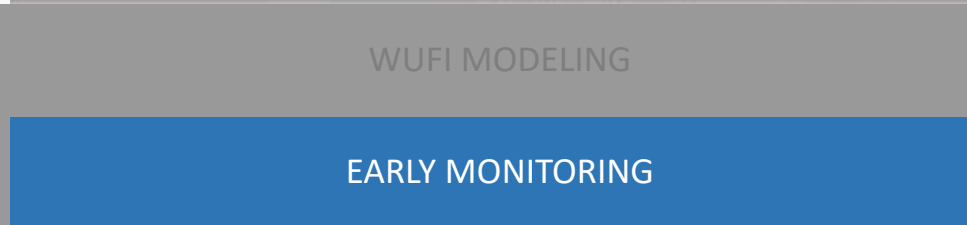
DESIGN WITHIN HISTORIC DISTRICT



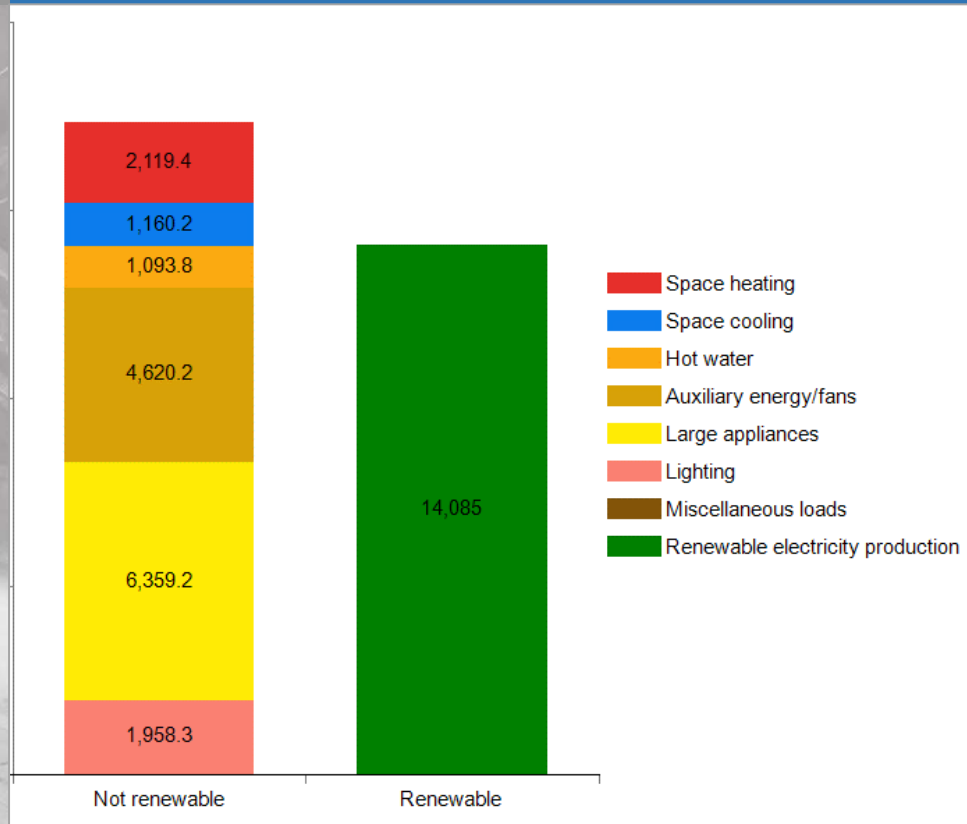
WUFI MODELING

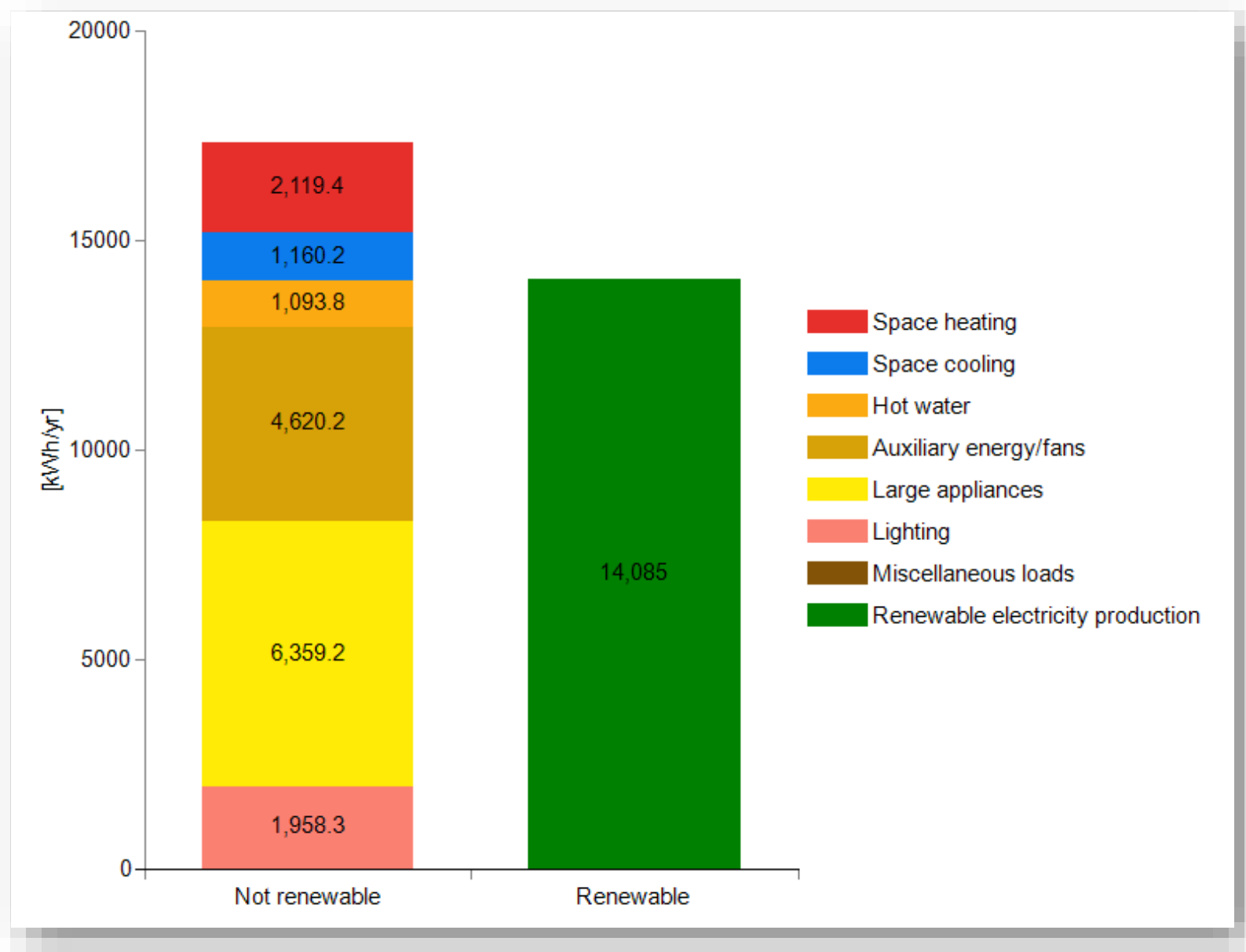


CONSTRUCTION

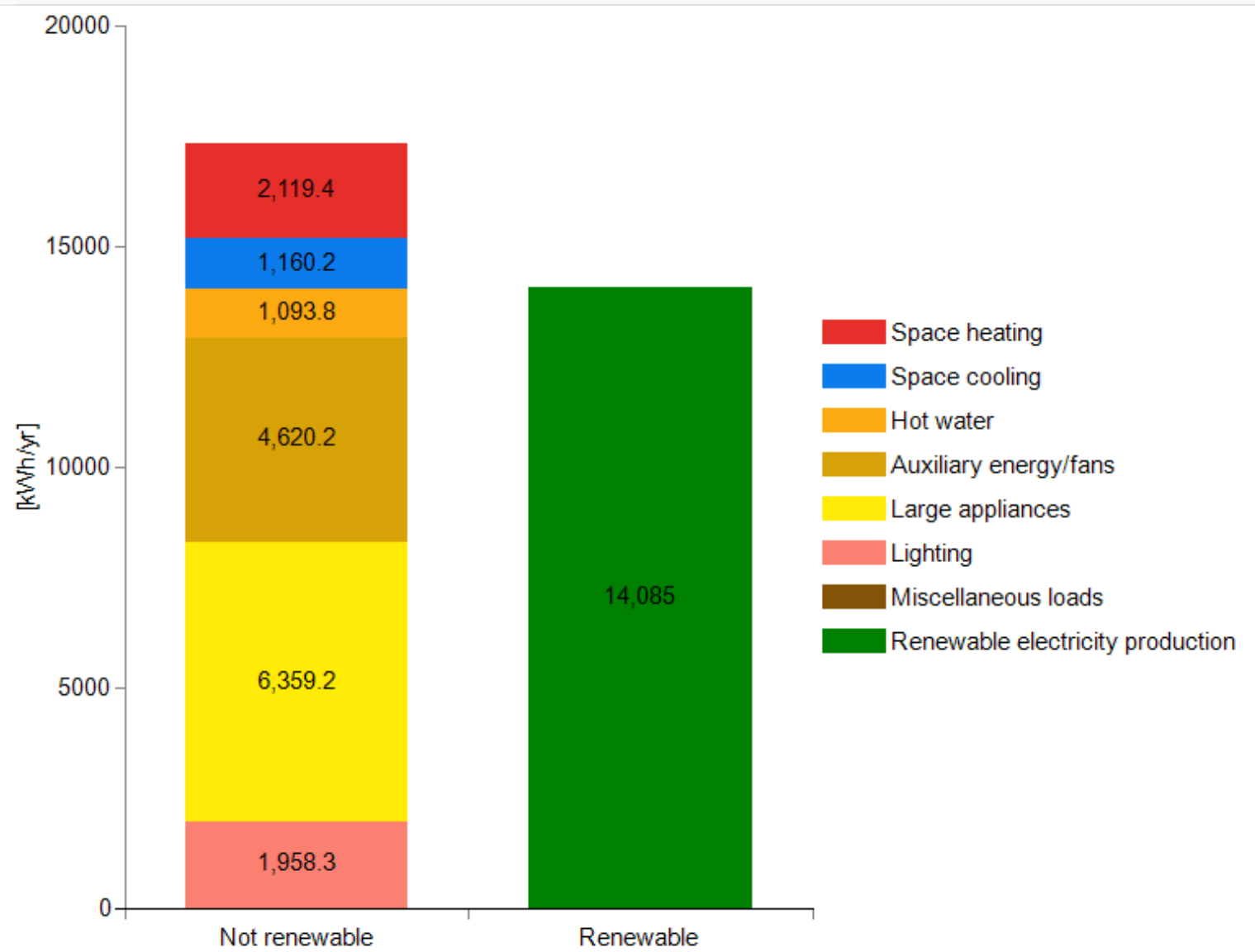


EARLY MONITORING

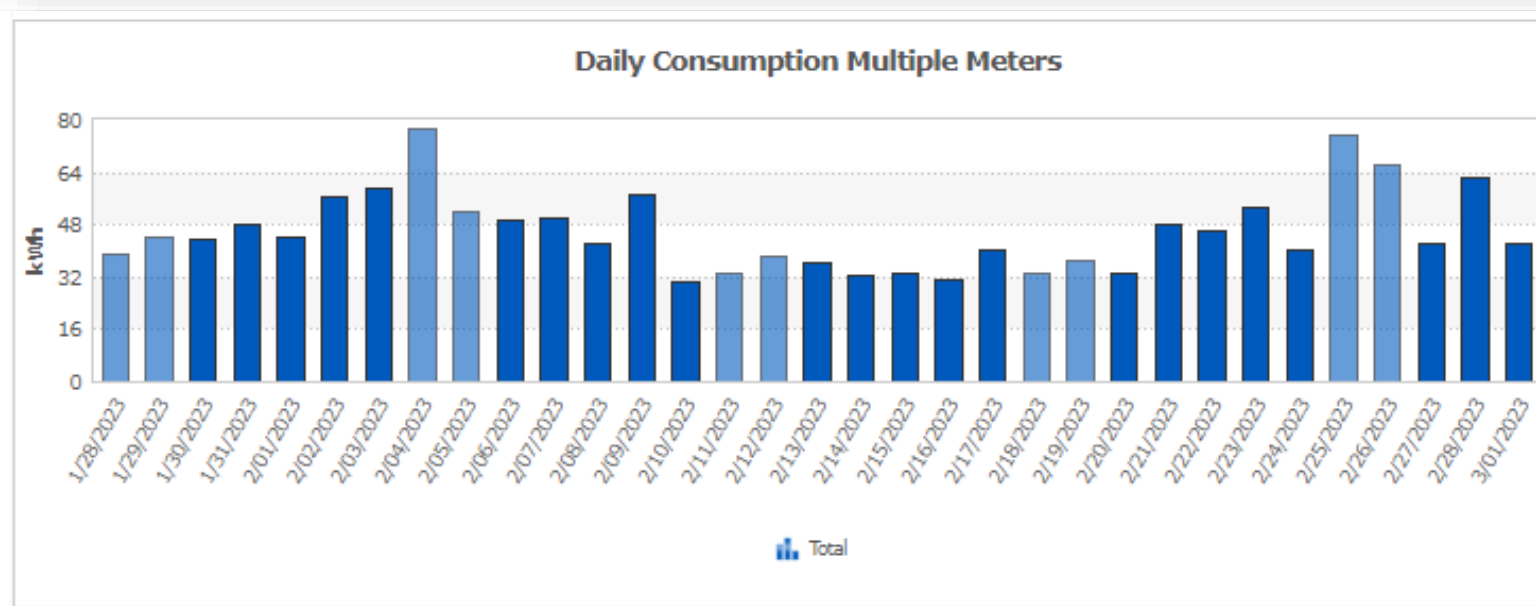




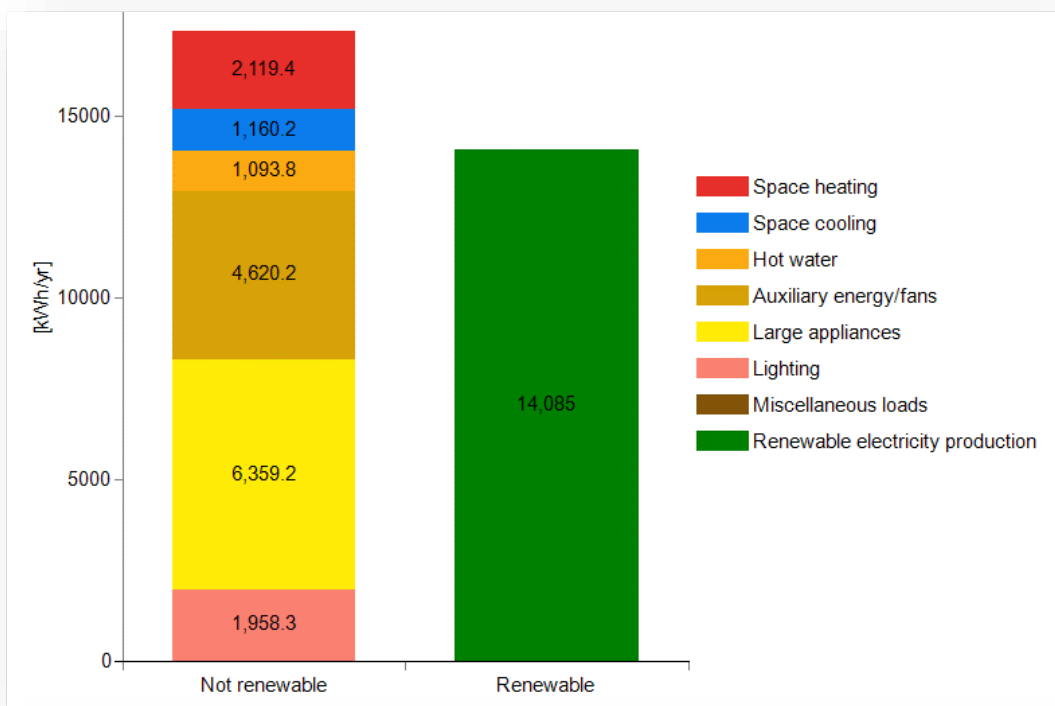
SITE ENERGY REQUIRED (modeled):
 17,311 kWh per year
= 47.43 kWh per day



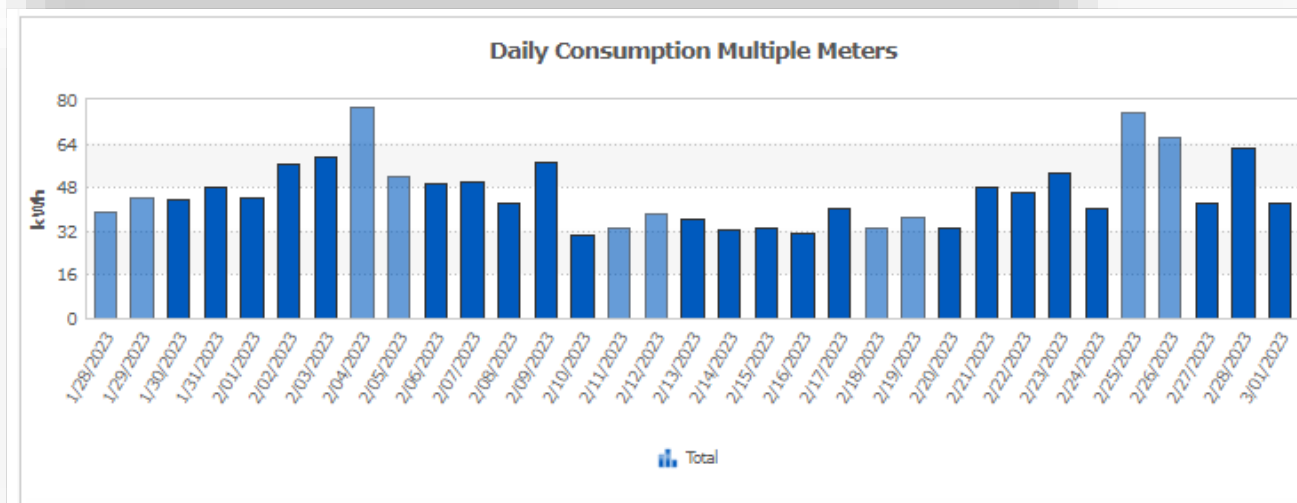
SITE ENERGY REQUIRED (modeled):
 17,311 kWh per year
= 47.43 kWh per day



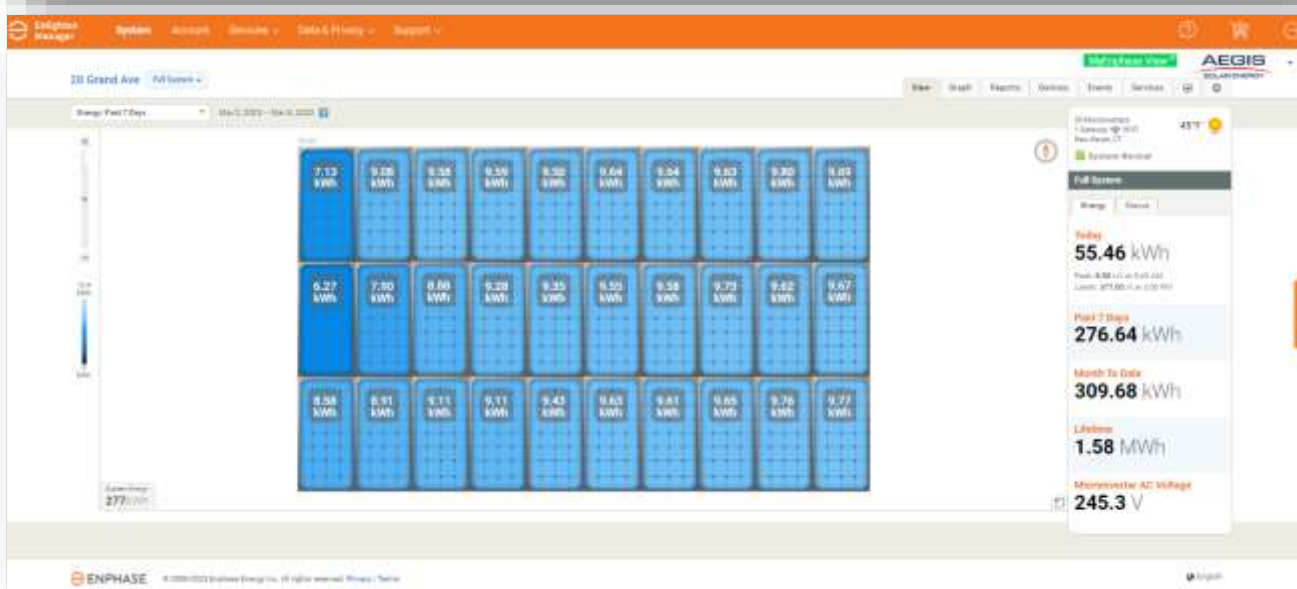
SITE ENERGY USED (utility bill usage 6 months):
 9,879 kWh
 =19,758 kWh per year
= 54.13 kWh per day



SITE ENERGY REQUIRED (modeled):
 17,311 kWh per year
= 47.43 kWh per day



SITE ENERGY USED (utility bill usage 6 months):
 9,879 kWh
 =19,758 kWh per year (extrapolated)
= 54.13 kWh per day



SITE ENERGY PRODUCED (PV energy, 1 week):
= 43.9 - 56.8 kWh per day

Exterior restrictions: no removal of 'historic fabric'

SHPO stance on triple pane windows

Internal wall insulation

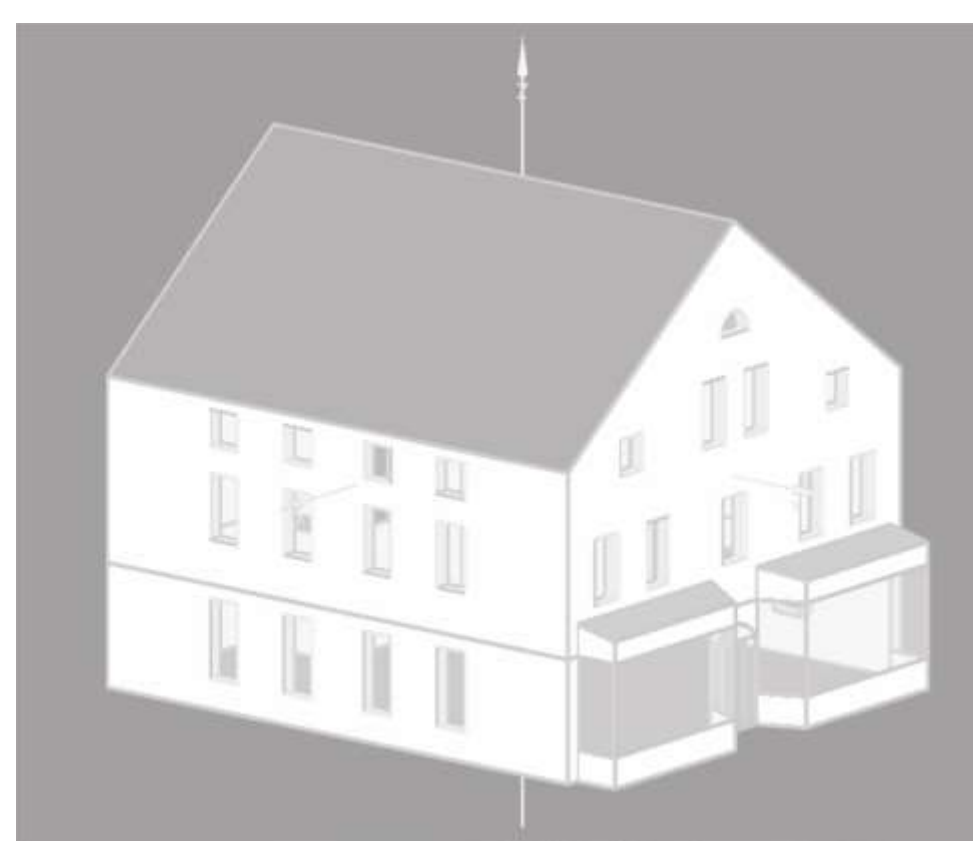
New interior windows, keeping existing windows as 'screen'

Interior roof insulation

Basement disconnection from rest of building

Stairwell outside of PHIUS envelope due to width restrictions

Relationship of basement to street level has changed over time, creating awkward detailing

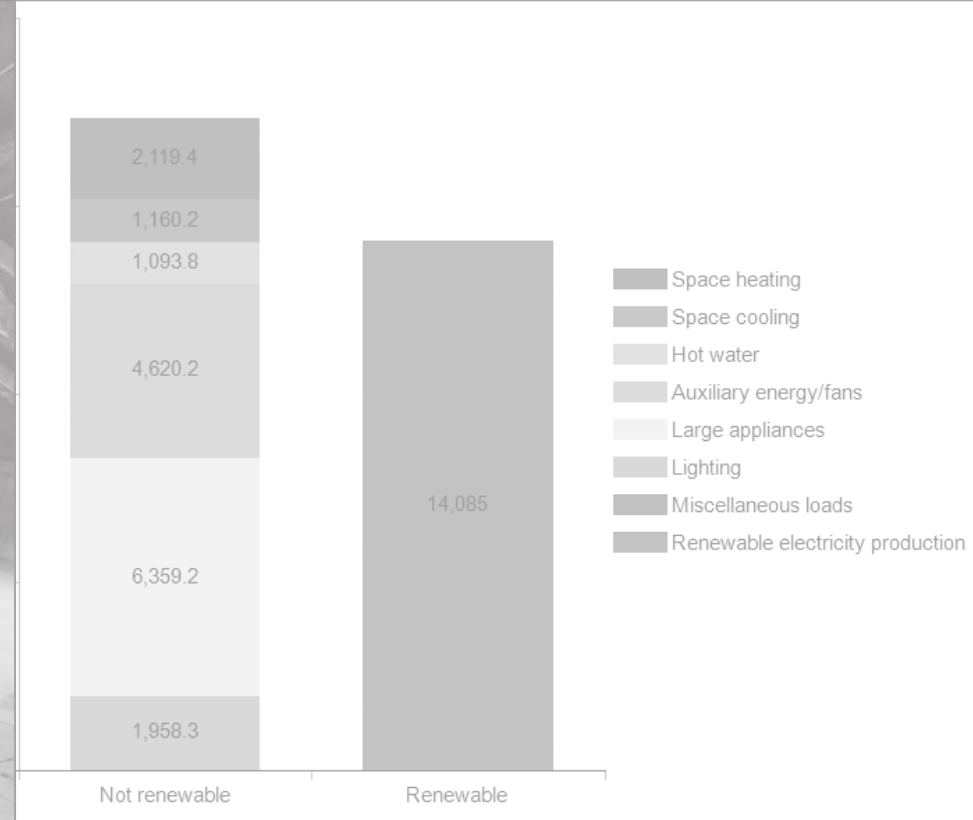


DESIGN WITHIN HISTORIC DISTRICT

WUFI MODELING

CONSTRUCTION

EARLY MONITORING





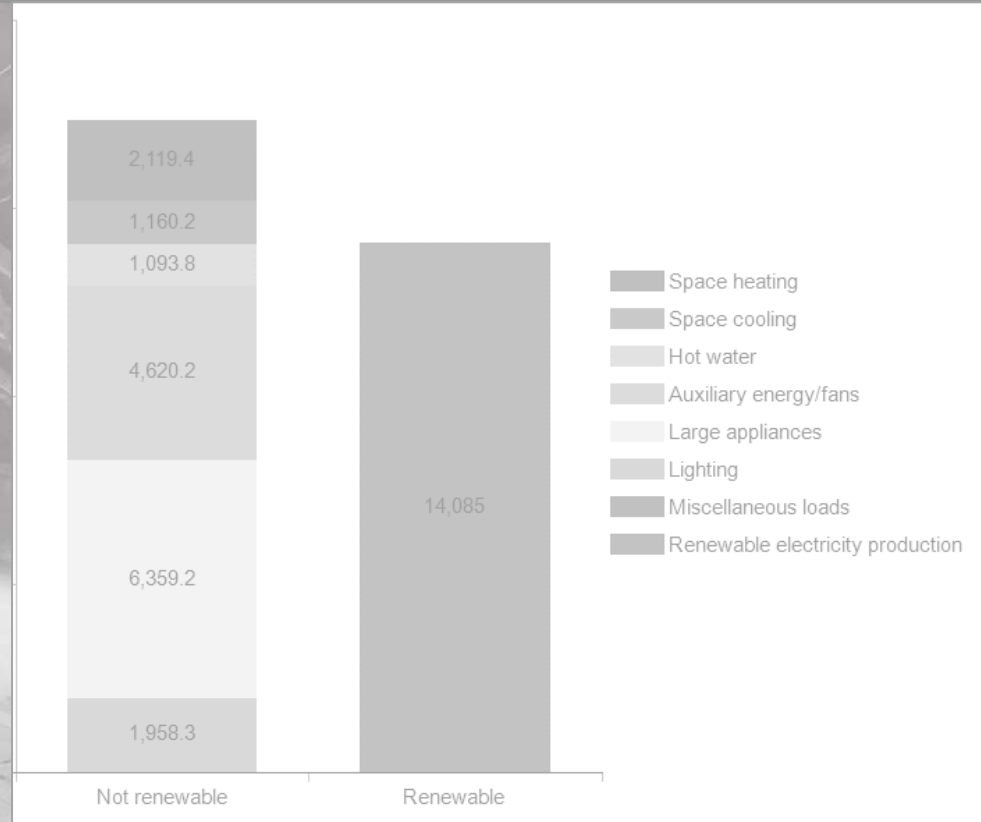
- Number of occupants?
- Type of occupancy in multi-tenancy with unknown tenants
- Plug loads can be a large part of energy: ie computers
- Modeling lowest and highest occupancy summer and winter
- Modeling a newer mechanical system (ventilation vs recirculation model)
- Modeling as whole building or 3 separate tenancies?

DESIGN WITHIN HISTORIC DISTRICT

WUFI MODELING

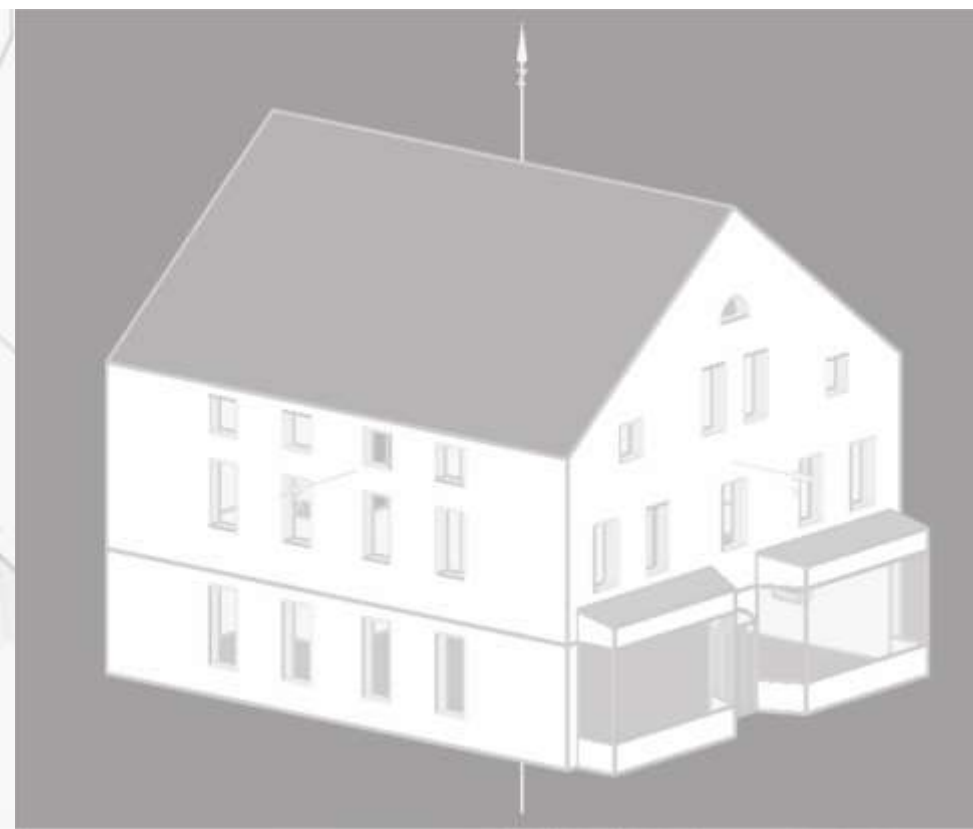
CONSTRUCTION

EARLY MONITORING





DESIGN WITHIN HISTORIC DISTRICT

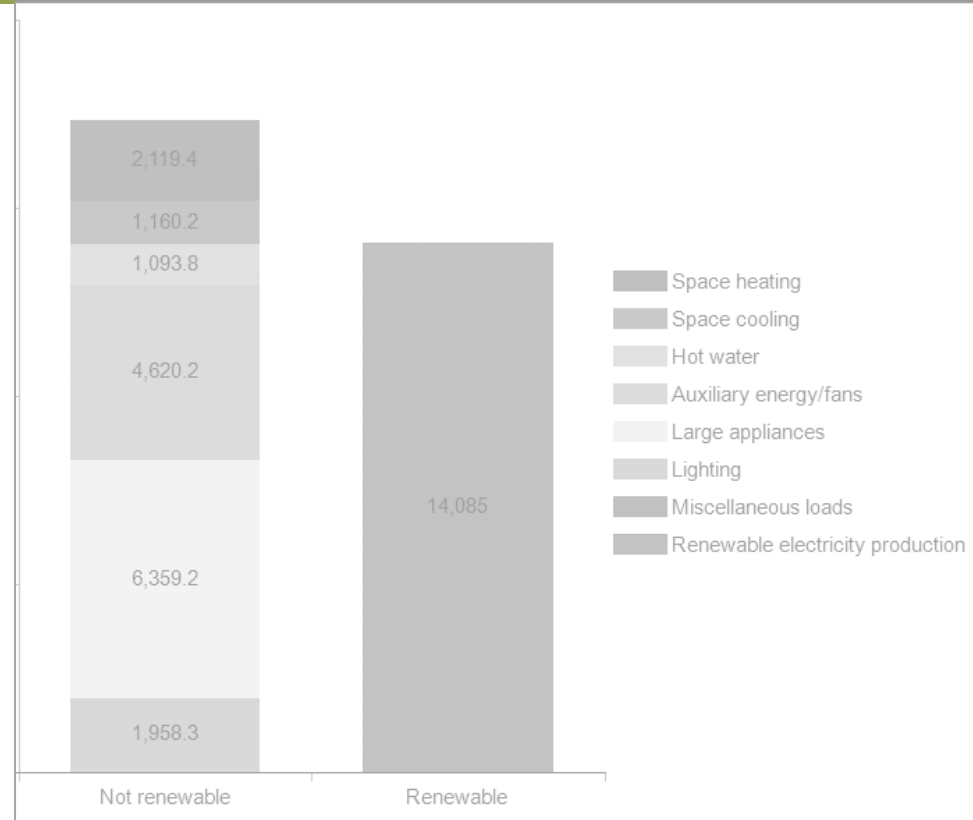


WUFI MODELING

CONSTRUCTION

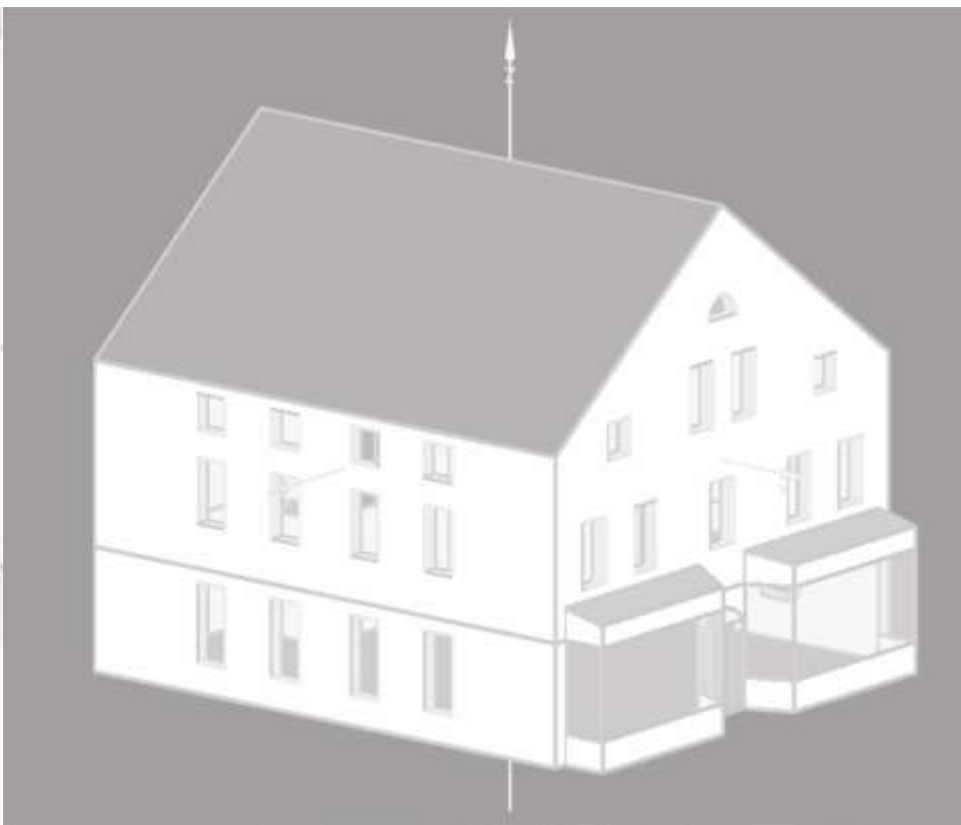
EARLY MONITORING

- Exposing structure: unforeseen conditions
- Minimizing use of foam: storefront, eaves, underside of roof
- Air leakage in unusual conditions
- Air leakage through masonry and wood members
- Structure is not plumb – structural repairs, insulation uneven
- Pivoting when conditions require it – interface with PHIUS, hygrothermal analysis

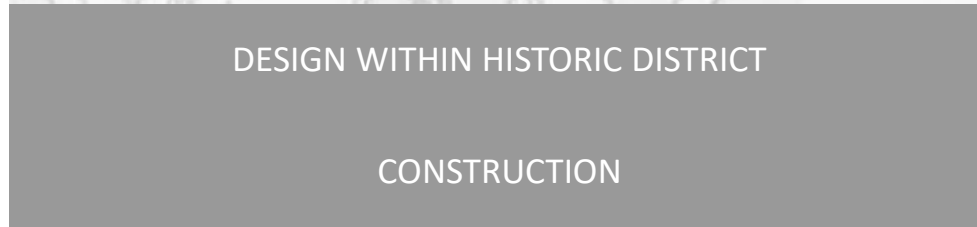




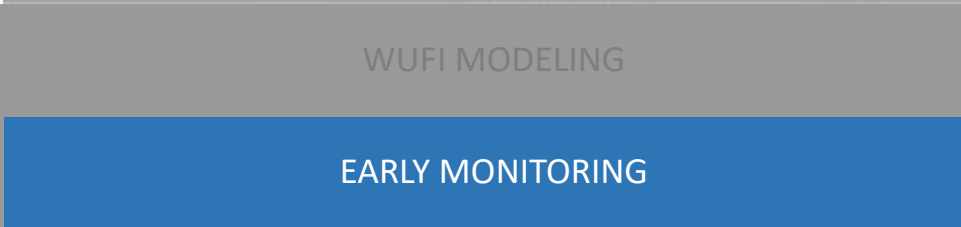
DESIGN WITHIN HISTORIC DISTRICT



WUFI MODELING



CONSTRUCTION



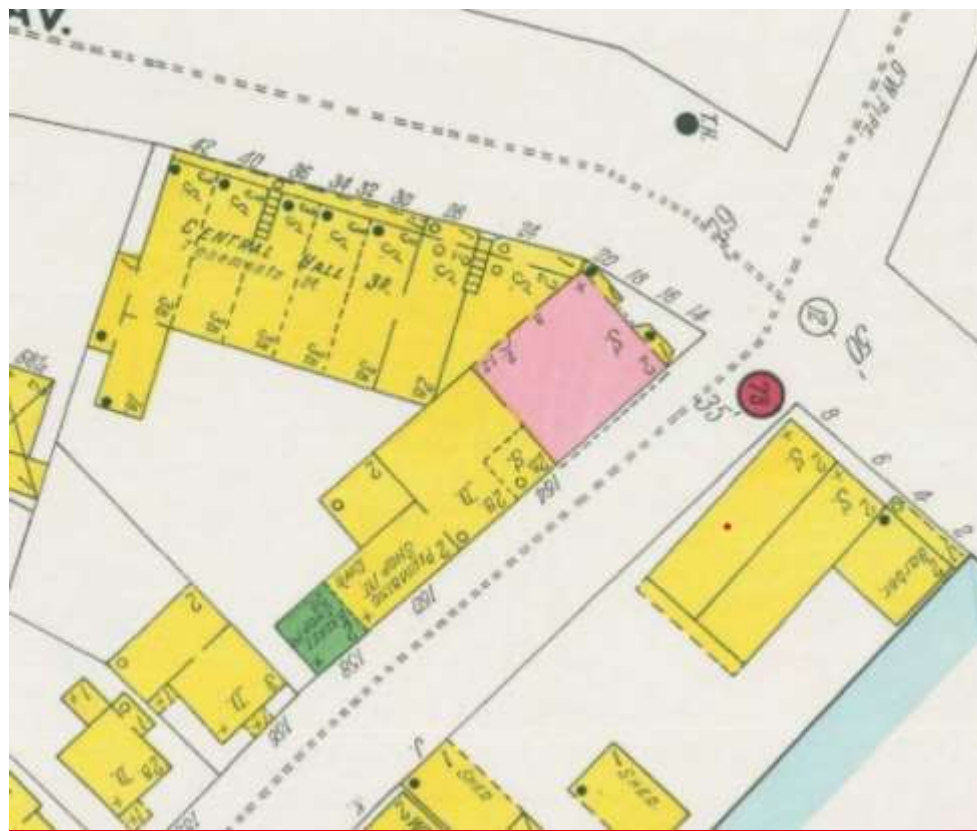
EARLY MONITORING



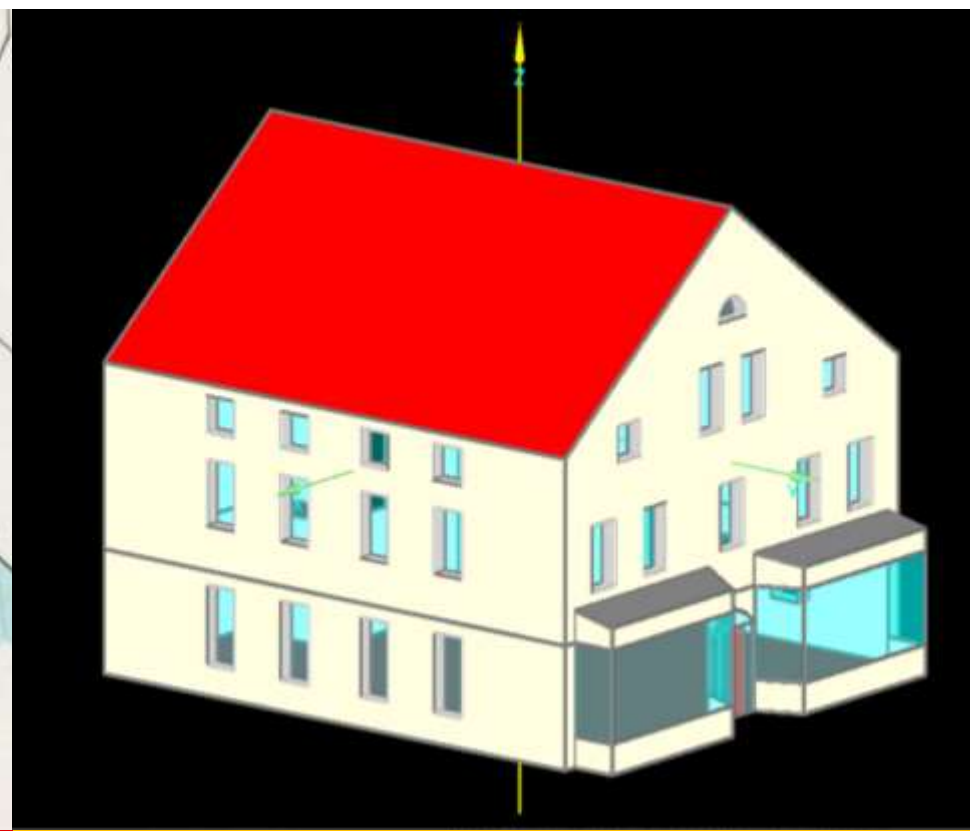
Energy Required – unknown uses & occupancies, with vacancies and unusual patterns (meetings, etc)

Energy Used – plug loads, especially equipment such as computers and servers, make a difference

Energy Produced – new system requires adjustments, connectivity, at least one year’s worth of data helpful



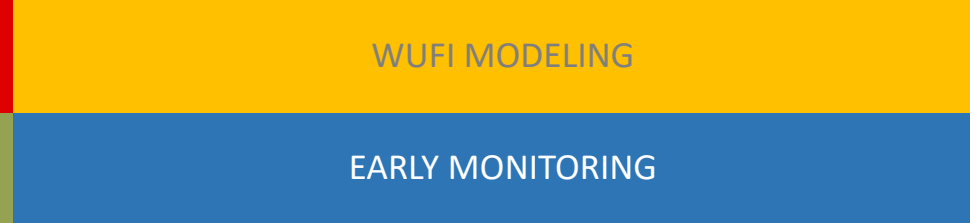
DESIGN WITHIN HISTORIC DISTRICT



WUFI MODELING



CONSTRUCTION



EARLY MONITORING

