Energy Conservation and Mold Prevention at Ft. Polk Barracks
10 top items

1. Building air tightness

- Building envelop shall be retrofitted in such a way that allows for a continuous air barrier to control air leakage into, or out of, the building to reduce sensible and latent load
- Performance of the continuous air barrier for the opaque building envelope shall be demonstrated by the tests, that will demonstrate that the air leakage rate the building envelope does not exceed 0.25cfm/ft2 at a pressure differential of 0.3" w.g.(75 Pa) in accordance with ASTM's E 779 (2003) or E-1827-96 (2002). Accomplish tests using either pressurization or depressurization or both. Divide the volume of air leakage in cfm @ 0.3" w.g. (L/s @ 75 Pa) by the area of the pressure boundary of the building, including roof or ceiling, walls and floor to produce the air leakage rate in cfm/ft2 @ 0.3" w.g. (L/s.m2 @ 75 Pa).

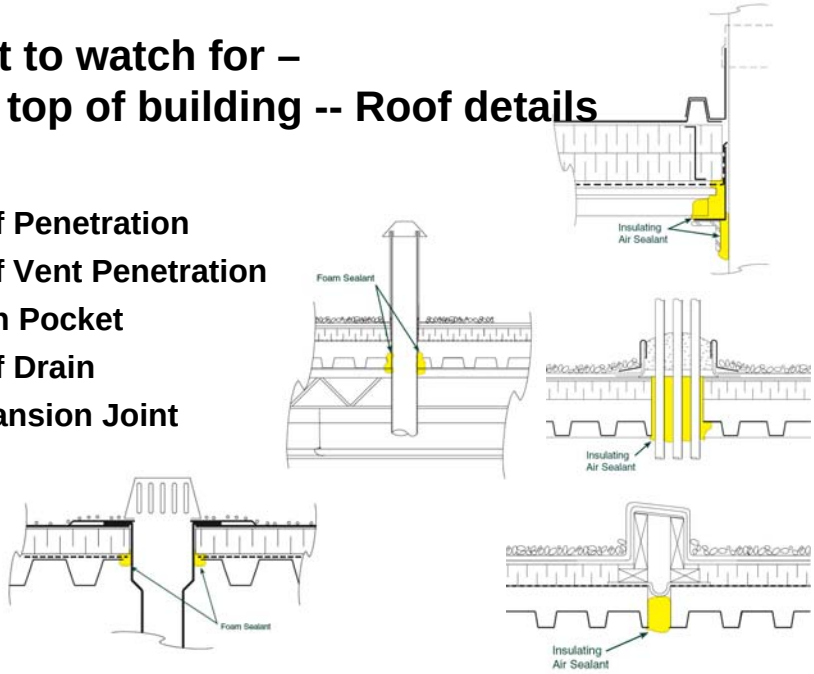
Some Observations of Recent Retrofits

While some holes for new pipes through pipe-chase walls are much larger than the size of these pipes,

Holes from old pipes are left open

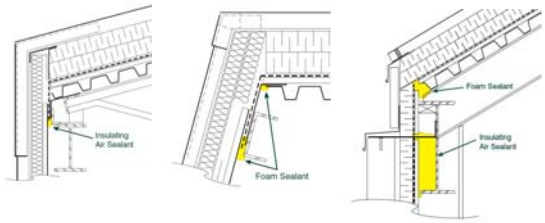
What to watch for –
Seal top of building -- Roof details

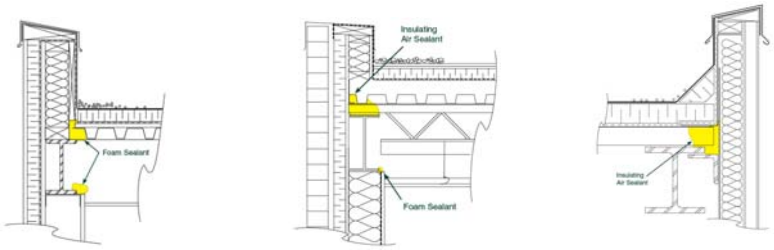
Roof Penetration
Roof Vent Penetration
Pitch Pocket
Roof Drain
Expansion Joint



Seal top of building -- Roof and roof intersection details

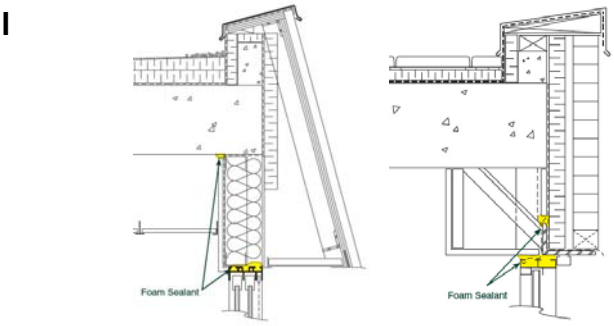
- Sloped Metal Roof
- Flat Metal Roof
- Roof/Wall at Gutter
- Roof/Wall at Parapet
- Roof at Masonry Wall
- Siding at Roof/Wall

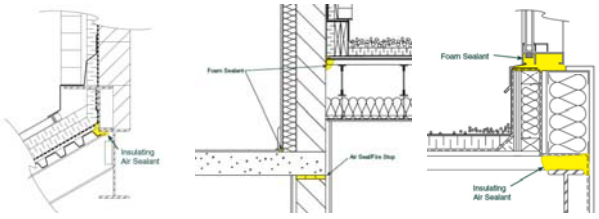




Seal top of building -- Roof and roof intersection details

- Mansard Roof/Wall
- Curtain Wall Head
- Metal Roof/Wall Junction
- Intermediate Roof
- Low Roof/Wall Junction





Seal bottom of building

All exit and entry doors

- **Weatherstrip**

Pipe and cable penetrations

- **Seal with appropriate fire stopping materials (foam and mortar)**

Seal bottom of building

1. **All service penetration - Seal with appropriate fire stopping system.**
2. **Door bottoms - Weatherstrip**
3. **Soffits - Install drywall to block soffits and seal with foam or caulking.**

Seal bottom of building

- Below grade
- Service hatches **- Weatherstrip**
- Sprinkler hangers **- Seal drywall penetrations with fire stopping system.**
- Core wall oblique slab junction **- Seal**
- **with fire stopping system.**

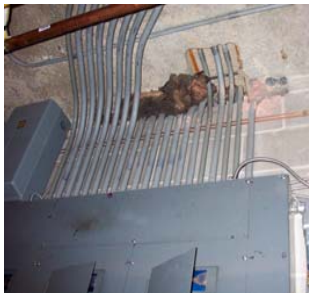
Seal vertical shafts

Fire exit doors - **Weatherstrip**

Fire hose cabinets - **Caulk pipe penetrations and joints**

Seal vertical shafts

- Plumbing stacks - **Firestop and smoke seal**
- Service penetrations - **Firestop and smoke seal**
- All electrical, plumbing, mechanical and communications ducts, pipes and stacks - **Firestop and smoke seal.**

Seal vertical shafts

Shafts, conduit - Firestop and smoke seal


Seal vertical shafts

Hallway and room pressurization shafts - **Caulk or foam perimeter or ducting**

Garbage chute-access hatches - **Weatherstrip and caulk**

Seal vertical shafts

Elevator cables - **Pin, caulking, and rivets**

Service hatches - **Weatherstrip**

Seal vertical shafts

Cable raceways - **Firestop and smoke seal**

Ventilation shafts - **Pin, support beams and caulking**

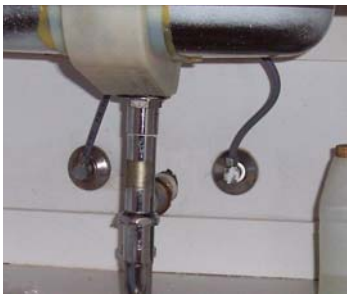
Miscellaneous shafts - **Half-inch plate steel**

Seal vertical shafts

Electrical and other service shafts - **Firestop and smoke seal**

Seal vertical shafts

Plumbing penetrations - **Caulk or foam with one-component polyurethane**

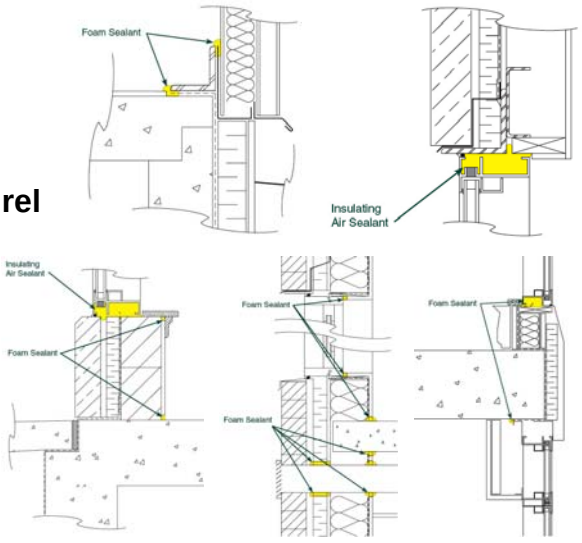


Seal outside walls and openings

Window weatherstripping

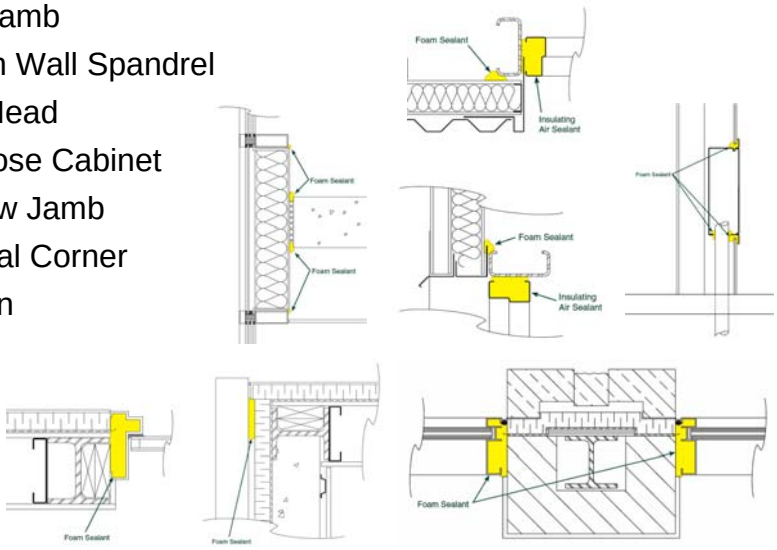
Seal outside walls and openings -- window details

- **Siding at Grade**
- **Window Head**
- **Window Sill**
- **Intermediate Floor**
- **Curtain Wall Spandrel**



Seal outside walls and openings -- window details

- Door Jamb
- Curtain Wall Spandrel
- Door Head
- Fire Hose Cabinet
- Window Jamb
- External Corner
- Column



Compartmentalize

Internal and special purpose rooms - **Weatherstrip**

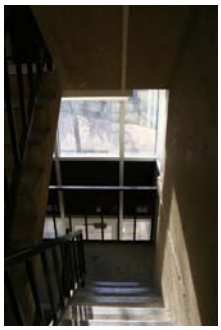
Mechanical room doors - **Weatherstrip, smoke seal and firestop conduit penetrations**

2. Use inoperable advanced windows to reduce latent load and sensible load on cooling/heating system

Window Default Performance Values (Aluminum-framed window is recommended option for regions whith hurricane considerations						
#	Glazing type	Frame type	U-factor (imp./metric)	SHGC	VT	AL (imp./metric)
A	2-pane, low-solar-gain low-E	Aluminum, thermal break	0.47 / 2.7	0.33	0.55	0.2 / 0.06

3. Enclose stairways and Add Vestibules at the First Floor Entrances (reduce sensible and latent load) and extend stairway to the attic for HVAC system maintenance





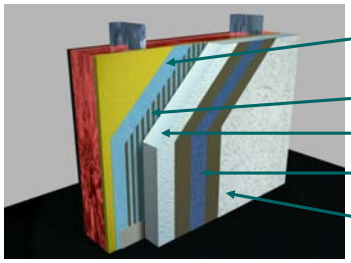
4. Enclose or Eliminate the Courtyard

- 4.1. Use the Courtyard space to increase room space. ..will also reduce energy losses/gains, reduce latent load on the building and will decrease the HVAC equipment size
- 4.2. Create an atrium by extending roof over the courtyard (attic shall be sealed) install solar tubes to provide light to internal rooms and supply air to the stairway for its heating and cooling


5. Insulate Ducts, Cold water and Chilled water pipes (no bare areas) to the level preventing condensation (surface temperature > DP).. Within the whole building space (even in chases)

6. Insulate external walls to reduce sensible load (use EIFS with a drainage)

Item	Component	Baseline (1)	30% Solution
Roof	Attic	R-30	R-40
	Surface reflectance	0.08	0.27
Walls	Light Weight Construction	R-13	R-20
Exposed Floors	Mass	R-4.2 c.i.	R-10 c.i.
Slabs	Unheated	NR (2)	NR (2)
Doors	Swinging	U-0.70	U-0.70
	Non-Swinging	U-1.45	U-1.45



Some Exterior Finish Options

7. Cool Roof

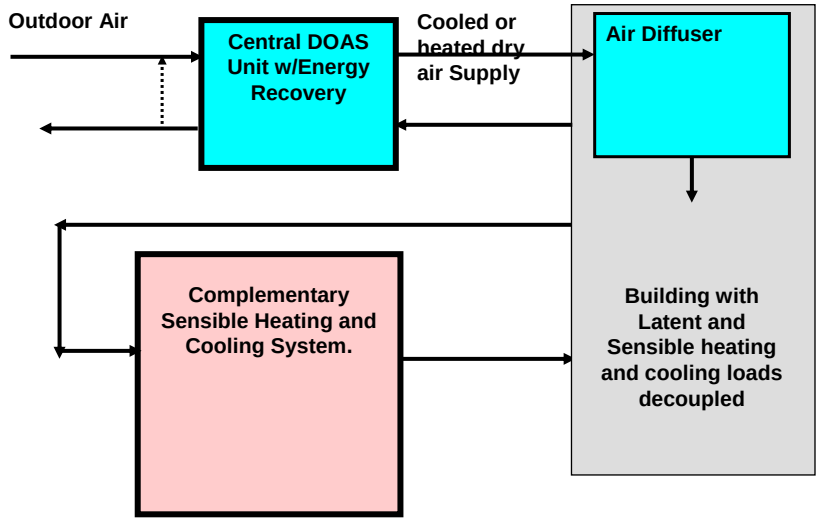
Steep-sloped roofs shall comply with the criteria for the US EPA's Energy Star Program Requirements for Roof Products – Eligibility Criteria. Metal roofs shall have an initial solar reflectance of at least 0.25 (with a three-year reflectance of at least 0.15).

Roofing Type	Reflective Paint Color	Solar Reflectance	Thermal Emittance
Metal Paint	Terra Cotta	0.35	0.83
Metal Paint	Bright Red	0.35	0.83
Metal Paint	Beige/Off White	0.55	0.83
Metal Paint	Tan	0.45	0.83
Metal Paint	Dark Blue	0.25	0.83
Metal Paint	Medium to Light Blue	0.32	0.83
Metal Paint	Dark Brown	0.25	0.83
Metal Paint	Medium to Light Brown	0.32	0.83
Metal Paint	Dark Green	0.25	0.83
Metal Paint	Medium to Light Green	0.32	0.83
Metal Paint	White	0.65	0.83
Metal Paint	Bright White	0.70	0.83
Metal Paint	Black	0.25	0.83
Metal Paint	Dark Grey	0.25	0.83
Metal Paint	Medium to Light Grey	0.35	0.83

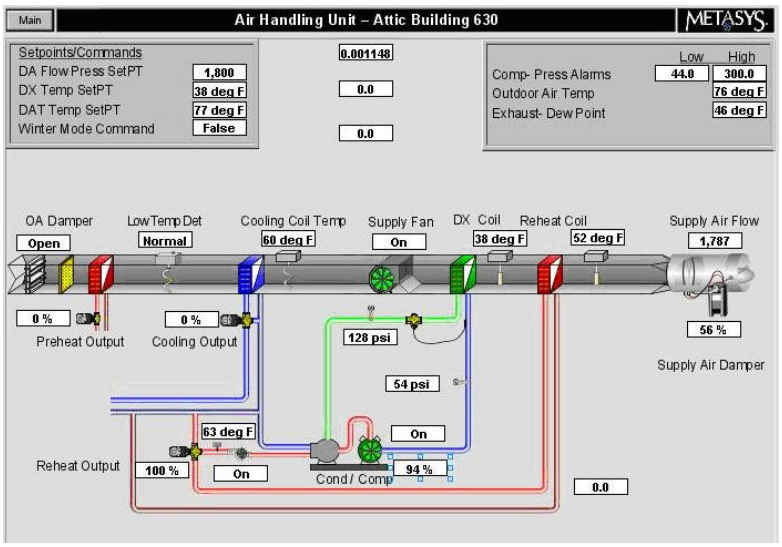
8. DOAS + Radiant Heating/Cooling System for Energy Conservation and Mold Control

- Heated by DOAS + radiant heating system with a hot water supply from the boiler/hot water tank
  - DOAS will provide neutral temperature air
  - Heating is provided by radiant system using heating water is at a low temperature (around 103° F) for heating and 62° F for cooling) heated
- Cooled by DOAS system + radiant cooling system:
  - Summer :
    - Air in DOAS is cooled using existing chilled water system in combination with a new DX system + reheated using condenser waste heat...makes air dry
    - Sensible cooling is provided by ceiling embedded radiant mats utilizing chilled water return from the DOAS system at 60oF.
  - Shoulder seasons
    - Radiant heating/cooling with a water supplied at a low temperature (around 103° F) for heating and 60° F for cooling
    - DX system with a reheat will be enough to provide DOAS air dehumidification

DOAS Schematic



Schematic of the DOAS Retrofit Option



Radiant Heating and Cooling System Vs. FCU

- FCU supplies air with a low temperature and creates a higher risk of condensation and mold
- FCU has mechanical parts which require more maintenance
- FCU requires lower chilled water T (45-50^{o}F Vs. 60^{o}F for radiant system) which creates a potential problem with condensation on piping/connection
- FCU supplies air with a lower temperature (55^{o}F) which creates a potential problem with condensation and mold on air diffuser and adjacent surfaces

Radiant Heating/Cooling System

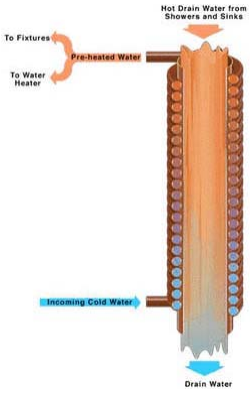
Installation of the capillary radiant heating/cooling system on the pre-finished surface

Two-side cooling mat detail with water feeding (or water return)

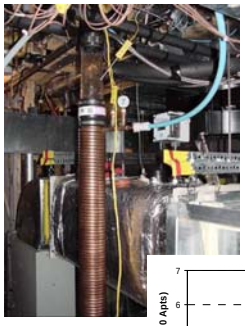
Radiant Heating/Cooling System

- **The chilled ceiling can provide capacity up to 25 Btu/sq.ft. This capacity is generally sufficient if the building is sufficiently insulated and has a DOAS**
- **Pipes and fittings are made out of polypropylene (plastic). Cooling and heating by Capillary Tubes is not new to the HVAC industry. It was used for commercial and institutional projects over Europe since last fifteen years. Has at least 2 suppliers BEKA, USA and KaRo. See www.beka-klima.de for list of completed projects.**
- **The capillary tubes (material only) for drywall/plaster or concrete is around $6.00/sq.ft. Additional $ 8.00/sq.ft. will be for installation.**

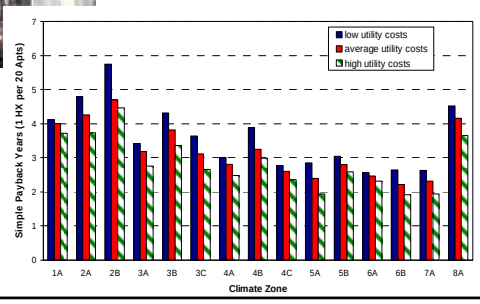
9. Shower Grey Water Heat Recovery



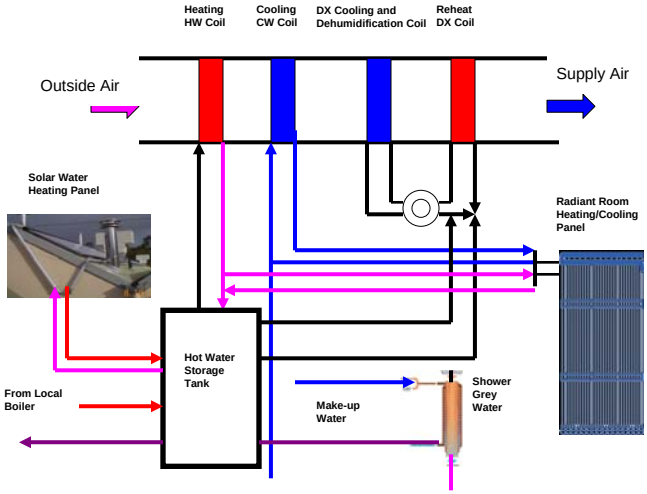
GFX system schematics



GFX system installation example

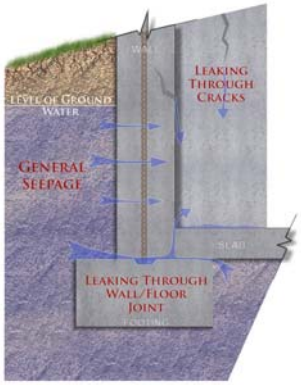


Barrack Energy Efficient Heating and Cooling Concept

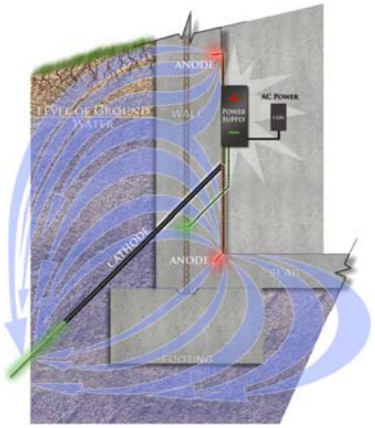


10. Water drainage from the building and electro-osmosis to control vertical water migration

Electro-Osmotic Pulse



Typical water entry



Typical EOP Installation

EOP at Fort Jackson, SC

Before EOP Installed

After EOP Installed

Cost of EOP Installation

- Cost per linear foot to install EOP
  - $50.00-$70.00
  - 1998 Cost Comparison
    - Trench and Drain: $315.20
    - EOP: $186.75

Contact Information

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Engineer Research and Development Center
Construction Engineering Research Laboratory
Energy Branch

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