Commercial System Design
Part I

“Inside the Building” Design Process

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Disclaimer

This presentation will mention specific software tools and products by name for those individuals that desire to investigate them further.

The presenter notes that these are not the only tools and products available to practitioners, but they are examples of tools available to our industry.

Their inclusion by the presenter is for information only and does not represent any endorsement or certification by IGSHPA or the presenter.
Presentation Overview

• Where to begin?
• Is this project “for real”?
• System Concepts
• Energy Modeling Tools
• System (Inside the Building) Design Tools
• Design Communication
• Ready for GHX design?! (covered in Part II)
Is this project a good fit for a GeoX application?

• Owner’s Project Requirements/OPR
• Is there motivation for a non-fossil fuel solution?
  • Carbon footprint and/or energy cost reduction?
• Any Thermal Load Synergies?
  • Space Cooling along with Domestic Hot Water or other heating loads?
• Site characteristics
• Financial
  • What criteria will the client apply? LCC? Simple Payback? First Cost?
  • Are financial incentives available?
Early Analysis Tools

• Hydronics Industry Alliance/IAPMO – BEST™
  • Compares GSHP to other HVAC Options

• GeoFease LLC – ProFease™
  • Fast, conceptual design of GHX – not for final design
  • Establish project viability very rapidly
**BEST** – **B**uilding **E**fficiency **S**ystem **T**ool

https://www.iapmo.org/hiac/design-team/using-the-best-tool#
geoFease - ProFease™

- Prebuilt energy models in various locations
- Minimal inputs needed (no energy model. Just building type and area)
- Generates an hourly load profile and conceptual VGHX
- Suggests optimization options
- Estimates:
  - First cost
  - Operating cost
  - ROI
  - NPV
  - Simple Payback
  - CO₂ emissions reductions
- Automatically prepares a professional report

https://www.geofease.com/products/profease/
GeoX Option is a Go! What’s next?

System configuration

- Unitary or incremental (decentralized) heat pumps?
- Central heat pumps? If retrofit, what temperature HW/CHW?
- Ventilation? DOAS? ERV? DCV? Level of filtration (MERV 13)?
- Heat Pump Loop Fluid – Min/Max Temperatures & Type?
Central HP Options

4-pipe Configuration
- More options (+)
- More controls (-)
- More piping etc. (-)

6-pipe Configuration
- Fewer options (-)
- Less controls (+)
- Less piping (+)
- Some mix fluids (+/-)

4-pipe System
Requires additional valves and/or HX’s to connect to source/sink.

6-pipe System
Centralized HP’s making HW, DHW & CHW

PolyTherm Chiller/Heater (Heat Pump)

Thermal Highway

Zone-Level HP’s

GHX TES
ATL DES
Energy Modeling – Is a **MUST DO**!

This is the next step following peak heating/cooling load calculations.

- **Why?**
  - Necessary for earth heat exchanger design (unless it’s not…)
  - It will drive system design depending on heating/cooling load dominance

- **Most common errors:**
  - Failure to input operating schedules (people, lights, equipment, thermostats)
  - Failure to do full 8,760 hourly simulation (many do only a *reduced year*)
  - Failure to consider other thermal loads (domestic HW, snow melt, pools, etc.)

- **Common software tools:**
  - Carrier Hourly Analysis Program (HAP)
  - Trane TRACE® 700 (transitioning to TRACE® 3D Plus)
Carrier Hourly Analysis Program (HAP)

• Available through www.carrier.com
• Allows building and system design optimization
  • Building envelope (windows, insulation, etc.)
  • Energy recovery, etc.
• Can add other loads like Domestic HW
• Provides peak loads for equipment sizing and selection
• Outputs hourly cooling and heating loads
Trane TRACE® 700 (TRACE® 3D Plus)

- Available through [www.trane.com](http://www.trane.com)
- Uses DOE EnergyPlus engine
- Allows building and system design optimization
  - Building envelope (windows, insulation, etc.)
  - Energy recovery, etc.
  - Parametric simulations and Sensitivity Results
- Can add other loads like Domestic HW
- Provides peak loads for equipment sizing and selection
- Outputs hourly cooling and heating loads
System Design Tools

• Autodesk® Revit® - I’m not a “CADD” guy, so nothing to add

• HVAC SOLUTION
  • Hydronic & Air Flow Schematics
    • Automatic pipe sizing, pressure drop calculations, etc.
    • Generates equipment schedules and Bill of Materials
    • Import PDF backgrounds to “trace” over
    • Switch from schematic to plan view
    • Output PDF or DXF files
    • Can transfer intelligent object data to Revit®
HVAC SOLUTION

Annual Conference, December 14-16, 2021 – Nashville, TN

https://www.hvacsolution.com/
Design Communication

Minimum (in my opinion):

• Heat pump schedule (including fluid type and temperatures for GHX design)
• Circulating pumps and hydronic specialties schedule (approximate head for now)
• Flow schematic with pipe sizing
• Specifications
• Control Sequence (if needed)
Ready for GHX Design?! 

- Have hourly heating/cooling loads? 
- Considered and included hourly “other” thermal loads? 
- Have identified the type/configuration of earth thermal coupling? 
- Completed a Formation Thermal Conductivity Test? (cover in Part II) 
- Identified desired Min/Max Heat Pump Loop Fluid temperatures and fluid type? 
- Have identified on the project site the desired GHX location & bounds?
Questions?

Thank you!

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