Welcome

Managing HVAC in High Performance Buildings
Hello my name is....

• Performance Construction Manager, Mitsubishi Electric Trane HVAC
• Former Director of Construction, Habitat for Humanity of Catawba Valley
• Former Sustainable Building Specialist, Habitat for Humanity International
• Licensed General Contractor
• HERS Rater
• EEBA Board Member
Performance Construction Team

- Chad Gillespie, Senior Manager
- Rob Howard, Southeast Regional Mgr
  - Scott Simmons, Virginia
  - David Paschall, Georgia
- Mike Schaefer, Central
- Kimberly Llewellyn, Southwest
- Shawn LeMons, Colorado
- Ken Johnson, California
- Greg Davenport, Northwest
Performance Construction Priorities

• Comfort
  • Individual room control
  • Quiet operation

• Health
  • Ductless (or less duct)
  • Filtration
  • Ventilation
  • Dehumidification

• Efficiency
  • Variable Refrigerant Flow
  • Inverter compressor
Performance Construction Goals

• Energy code compliance
• ERI performance path
• HERS score

<table>
<thead>
<tr>
<th>Climates</th>
<th>2015 IECC HERS Index Scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zone 1 — 2</td>
<td>52</td>
</tr>
<tr>
<td>Zone 3</td>
<td>51</td>
</tr>
<tr>
<td>Zone 4</td>
<td>54</td>
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<tr>
<td>Zone 5</td>
<td>55</td>
</tr>
<tr>
<td>Zone 6</td>
<td>54</td>
</tr>
<tr>
<td>Zone 7 — 8</td>
<td>53</td>
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</tbody>
</table>
Performance Construction Goals

• Certification Programs
  • ENERGY STAR
  • EPA Indoor airPLUS
  • DOE Zero Energy Ready
  • Passive House
  • Net-Zero
Performance Construction Process

• Design
  • Do the math!

• Build
  • Quality installation

• Perform
  • Commission
  • Monitor
  • Maintain
Changes impacting HVAC Design

• Energy Codes
  • All new homes are tighter and better insulated
  • Mechanical ventilation is now required
  • How do we deal with ventilation loads?

• Load Profiles
  • Peak Loads vs Partial Loads
  • Sensible Heat Ratios
  • Equipment Selection

• Climate
  • Is the weather data in our energy models accurate?
Good News: some things have not changed
Residential HVAC Design Process

- Manual J
- Manual S
- Manual D
- Manual T
- Manual DHP?
- Manual LLH
Low Load Homes

• High Performance Homes have extremely low *sensible* loads (1000-1500 square feet/ton)
• Latent loads remain fairly constant
• Partial load runtime has increased
• HVAC equipment selection is more difficult
• Mechanical ventilation is now required
• How do we handle the ventilation load?
• Supplemental dehumidification may be required
Issues With Oversizing

• What is the problem with oversized HVAC equipment?

Photo courtesy of Energy Vanguard
HVAC Design Without Borders

• Tear Down the Walls
• Interior walls divide us and make HVAC design really challenging
Designing with Ductless

- Room by room load calculation
- Creating comfort zones
- What about small bedrooms and bathrooms?
Ductless Options

• Floor mount
• Wall mount
• Ceiling mount
Air Distribution Strategies

- Exhaust fans (-)
- Transfer fans (+)
- Inline fans (+)
Mechanical Ventilation

- Exhaust fans (-)
- Supply fans (+)
- ERV or HRV (+/-)
Whole House Filtration

• MERV 13 or HEPA
• 150-240 CFM Fan
• Supply and Return
Horizontal Ducted

• Low static (SEZ)
• Mid static (PEAD)
# Diamond System Builder

<table>
<thead>
<tr>
<th>Indoor Units:</th>
<th>1 / 1 to 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity:</td>
<td>12 / 6 to 12 (100.0%)</td>
</tr>
<tr>
<td>* Connectable capacity is not actual capacity.</td>
<td></td>
</tr>
<tr>
<td>Total Pipe Length:</td>
<td>32.9 / 65.0 feet</td>
</tr>
</tbody>
</table>

## Correction Factors

<table>
<thead>
<tr>
<th>Factor</th>
<th>Value 1</th>
<th>Value 2</th>
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</thead>
<tbody>
<tr>
<td>Temperature</td>
<td>0.97</td>
<td>1.00</td>
</tr>
<tr>
<td>Piping Length</td>
<td>0.98</td>
<td>0.99</td>
</tr>
<tr>
<td>Defrosting</td>
<td>-</td>
<td>1.00</td>
</tr>
<tr>
<td>User Derate</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Total Derate</td>
<td>0.95</td>
<td>0.99</td>
</tr>
<tr>
<td>Additional Refrigerant</td>
<td>0.1 lb</td>
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</tr>
<tr>
<td>Total Refrigerant Amount</td>
<td>2.7 lb</td>
<td></td>
</tr>
</tbody>
</table>

## Conditions (°F)

### Cooling

- Indoor DB: 75.0
- Humidity: 59.0%
- Indoor WB: 64.9
- Outdoor DB: 97.0

### Heating

- Indoor DB: 70.0
- Outdoor DB: 9.0
- Humidity: 50.0%
- Outdoor WB: 6.9

## System 1

- MUZ-FH12NA
- MSZ-FH12NA
- Pipe Dia. Liquid / Gas: 1/4 / 3/8
- Pipe Length (Elbows): 30.0 ft (3)
- Clg. Total (Sens.): 11,350 BTU/h (8,501 BTU/h)
- Htg. Total: 13,521 BTU/h
# Diamond System Builder

## Indoor Units and Capacity
- Indoor Units: 3 / 2 to 3
- Capacity: 30 / 15 to 30
- Connectable capacity not actual capacity
- Total Pipe Length: 100.0 / 230.0 feet
- Furthest Actual: 40.0 / 82.0 feet
- Furthest Equiv.: 40.0 / 82.0 feet

## Correction Factors
- Outdoor Unit Capacity: 1.00 / 1.00
- Temperature: 0.97 / 0.99
- Piping Length: 0.99 / 1.00
- Defrosting: - / 0.95
- User Derate: 1.00 / 1.00
- Total Derate: 0.96 / 0.94
- Additional Refrigerant: 0.0 lb
- Total Refrigerant Amount: 8.8 lb

## Conditions (°F)
### Cooling
- Indoor DB 75.0
- Humidity 59.0%
- Indoor WB 64.9
- Outdoor DB 95.0

### Heating
- Indoor DB 70.0
- Outdoor DB 21.0
- Humidity 72.8%
- Outdoor WB 19.3

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![Diagram](attachment:image.png)

- **Pipe Dia. Liquid / Gas**
- **Model Number**
- **Clg. Total (Sens.)**
- **Htg. Total**

<table>
<thead>
<tr>
<th>Pipe Length (Elbows)</th>
<th>Group / Room / Tag Ref</th>
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</thead>
<tbody>
<tr>
<td>1/4 / 3/8</td>
<td>N/A / 2 / Master Bedroom</td>
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<tr>
<td>30.0 ft (4)</td>
<td>11,048 BTU/h (7,729 BTU/h)</td>
</tr>
<tr>
<td></td>
<td>10,700 BTU/h</td>
</tr>
<tr>
<td>1/4 / 3/8</td>
<td>N/A / 3 / Living Room</td>
</tr>
<tr>
<td>30.0 ft (4)</td>
<td>5,529 BTU/h (4,858 BTU/h)</td>
</tr>
<tr>
<td></td>
<td>5,444 BTU/h</td>
</tr>
<tr>
<td>1/4 / 3/8</td>
<td>N/A / 4 / Second Floor</td>
</tr>
<tr>
<td>40.0 ft (4)</td>
<td>10,947 BTU/h (7,687 BTU/h)</td>
</tr>
<tr>
<td></td>
<td>10,680 BTU/h</td>
</tr>
</tbody>
</table>
Comfort Zones

• Main Level

- Rest of House Heating 28201 Cooling 25002
  Recommend 2.5 ton air handler

- Master Zone Heating 9815 Cooling 5510
  Recommend 1 ton horizontal ducted unit for master zone

- Living Zone Heating 5339 Cooling 3852
  Recommend 1/2 ton ductless heat pump for living zone

SVZ-KP30NA
N/A / 1 / Great Room
25,912 BTU/h (20,920 BTU/h)
30,913 BTU/h

MSZ-FH06NA
N/A / 3 / Living Room
5,529 BTU/h (4,858 BTU/h)
5,444 BTU/h
Comfort Zones

• Second Floor

- Bed 1: Heating 10500, Cooling 8836
- Bed 2: Heating 3649, Cooling 3529
- Bed 3: Heating 3041, Cooling 2753
- Bed 4: Heating 3810, Cooling 2554

Recommend 1 ton horizontal ducted unit for upstairs zone.

10,947 BTU/h (7,687 BTU/h)
10,680 BTU/h

SEZ-KD12NA4R1.TH

N/A / 4 / Second Floor
Zoned Comfort Solutions

- Customized comfort
- Healthy Indoor Air Quality
- Multiple points of filtration
- Mechanical ventilation
- Moisture management
- Controls integration
- Energy efficiency for lower utility bills
Performance Builder Program

• Loyalty program for builders including:
  • Training and technical assistance
  • Marketing support (case studies, spotlight videos)
  • Equipment discounts and rebates
  • Model home program
  • Extended warranty program
Performance Contractors Wanted

• We are seeking Performance Contractors for design, installation, and commissioning of Zoned Comfort Solutions in high performance homes

• Our team will provide the training and technical support to help you succeed
What’s in it for builders?

• No ducts = no duct leakage + no duct testing
• Lower HERS scores
• Energy code compliance
• Certification goals
• Fewer call backs
• Happy customers
2019 Housing Innovation Awards
Thank you!

Rob Howard, Regional Manager, Performance Construction
rhoward@hvac.mea.com

Save the dates for next year:

HIGH PERFORMANCE HOME SUMMIT 2020
SEPT 29 - OCT 1 \ DENVER