ACCA Manual J Load Calculations

Understanding what is needed to do a proper load calc

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Objectives Of A Load Calculation

§ To determine the proper sizing of HVAC equipment for a structure (Block Load)

§ To determine the heating & cooling requirements for individual rooms (room by room load)

- Determine Proper Duct Design

Why Bother Sizing?

§ Obviously don’t want one to small

§ Avoid Callbacks

§ So just make it real big

Why Bigger Is Not Better

§ Higher initial cost
§ Higher operating costs
§ Cycling reduces your efficiency
§ Cycling wears out sooner
§ Cycling reduces dehumidification

Most Homes Are Oversized

- § PG&E Study 53% of A/C units
  - § Oversized by 12,000 BTUs (1ton)
- § Pacific Northwest Labs 1/3 of A/C units
  - § Oversized by 12,000 BTU’s (1ton)
- § Fort Collins CO
  - § On Average Furnaces were oversized by more then 150%
  - § On Average A/C units were oversized by more then 175%

Every House Has To Have Ventilation

- How much air does a home need?
- How does it get it's air?
- What is Infiltration?
- Three Types (Natural, Mechanical, Ventilation)

New Construction Mistakes

New Construction Mistakes

§ The Infiltration always is a guess!!!
- The house is not finished
- Construction mistakes cannot be taken into account

§ Same plan is used for multiple subdivisions
- Orientation on lot could be different
- Outdoor shading can change
- But equipment is still the same (A/C issues more)

§ Looking at worst case scenarios
- Not adding indoor shading factors
- In many cases add up to ½ ton

New Construction Mistakes

- Not Evaluating Overhangs & Benefits
  - They skip these as it seems like a minor detail
  - But in many cases this can reduce up to 1 ton (2500 sq ft)
- Assuming Duct & Envelope Leakage Equivalent
  - Increase ACH to compensate for duct leakage
  - Don’t take into effect that you can have both duct and envelope leakage, or only one of each
- Using the wrong Infiltration rate
  - Assuming code ventilation as Infiltration

New Construction Mistakes

§ Actually just assume leaky construction
- They don’t take into account that building may be tight
- But in many cases this can reduce up to 1 ton (2500 sq ft)

§ All of this can lead to improper sizing of HVAC Equipment

Retrofit Mistakes

The Customer Wanted a Bigger One

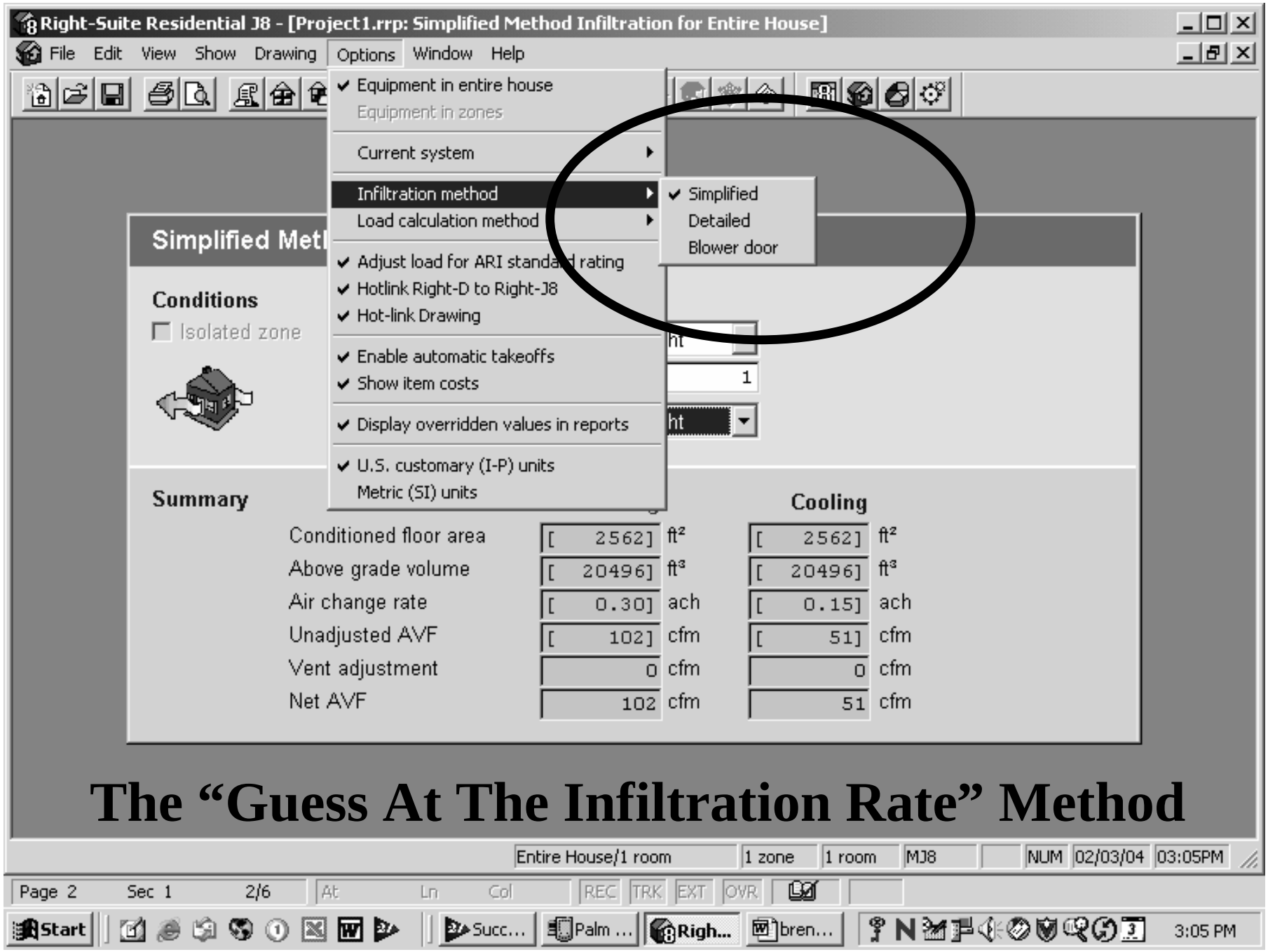
- Hot/cool room problem
- Old unit couldn't keep up: was dirty w. wrong charge, now the new clean bigger unit is way oversized
- Customer wants to be able to get to 68^{o} because of sweating
- Wanted greater pull down capability when home from work
- Just thought bigger would be better

The Contractor Wanted A Bigger One

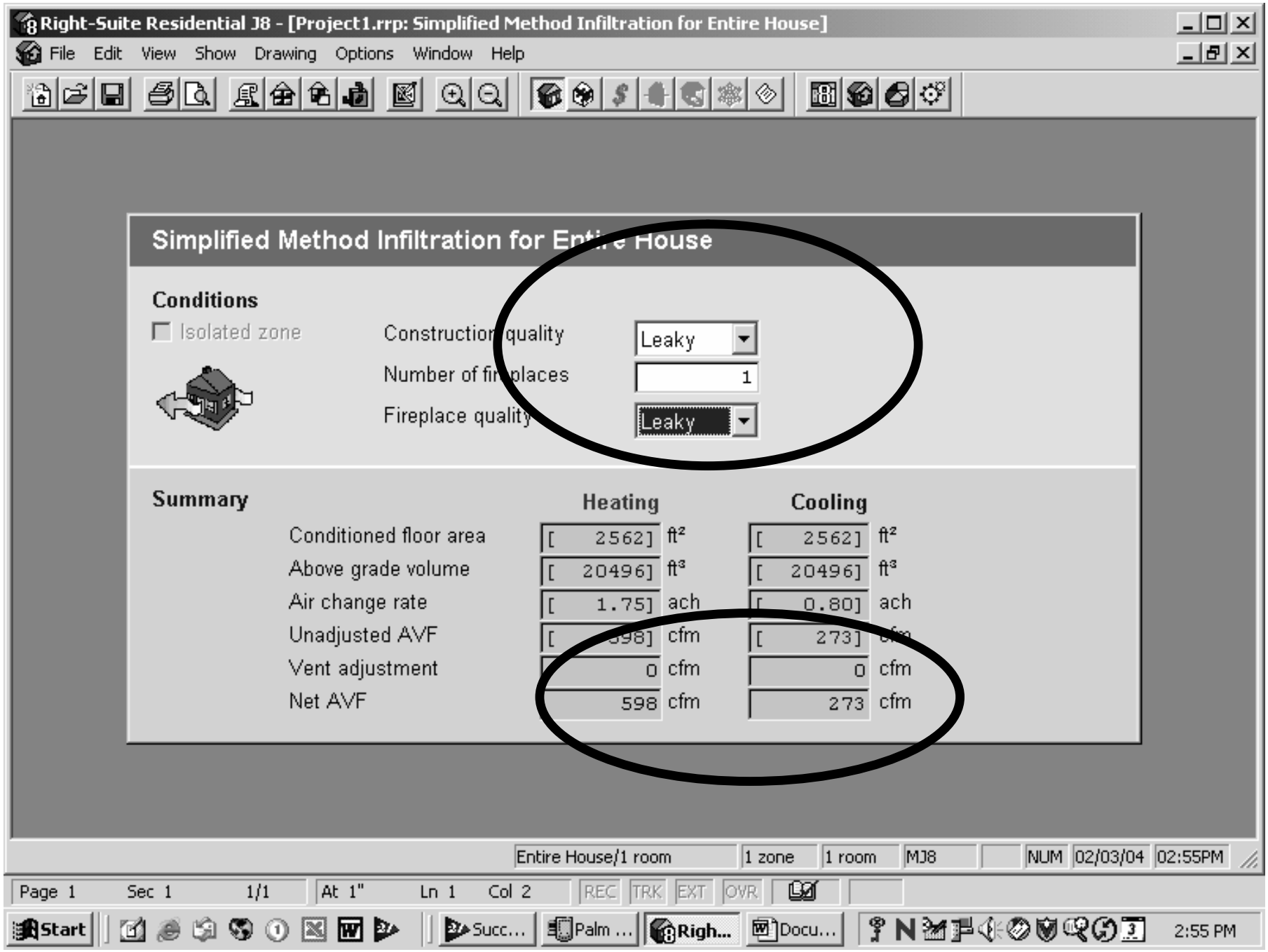
- Contractor sold customer on it based on bigger is better, to avoid call backs
- Rules of thumb (that are not correct)
  - 500 ft2 per ton
  - 1 cfm/ft2
  - Latent = 1.3 x sensible
- Sold what was “on hand”
- Did bad load calc
  - mistakes, orientation, shading
  - multiple safety factors

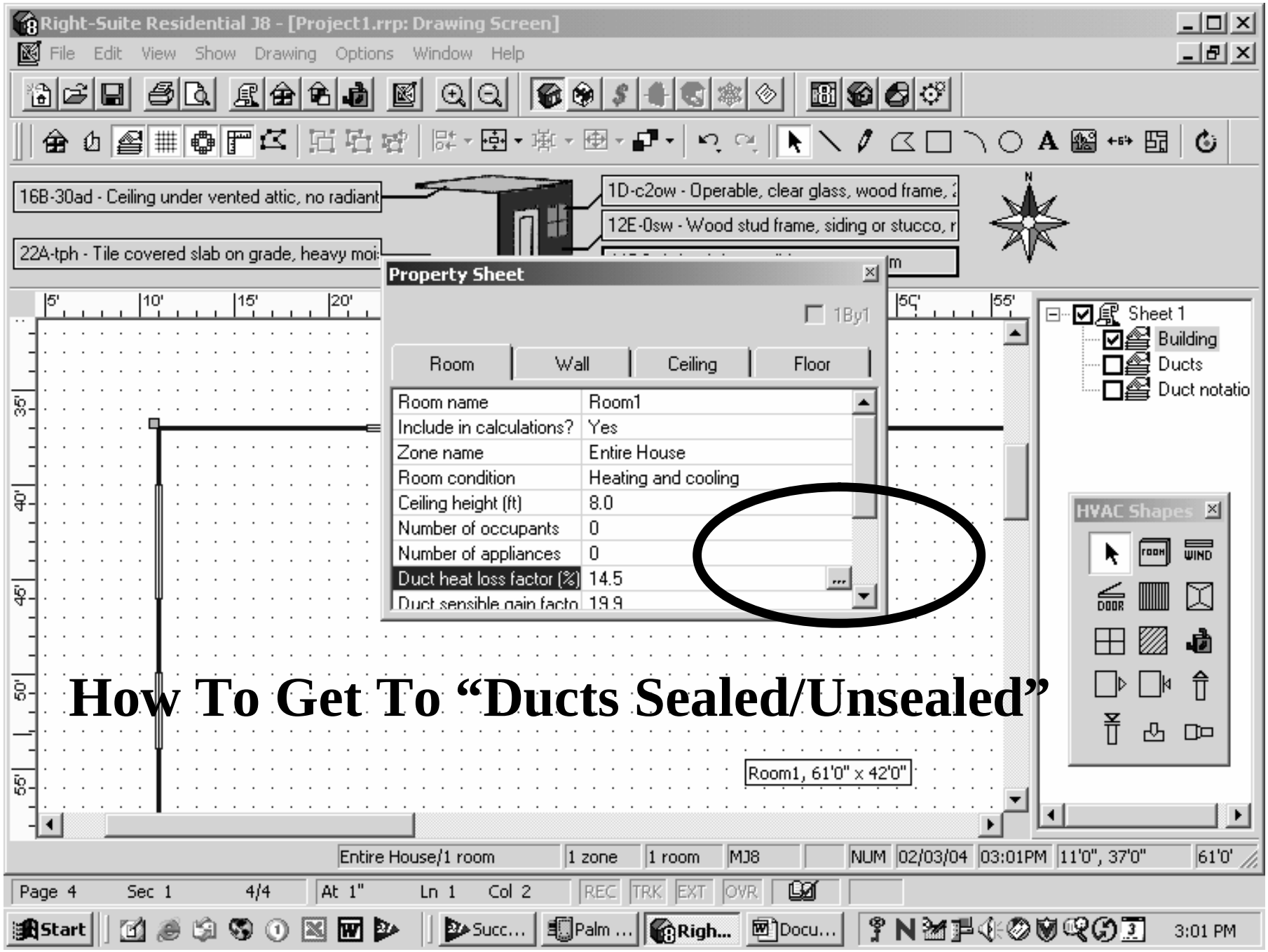
"It's OK To Guess Air Infiltration Rates For ACCA Manual J"

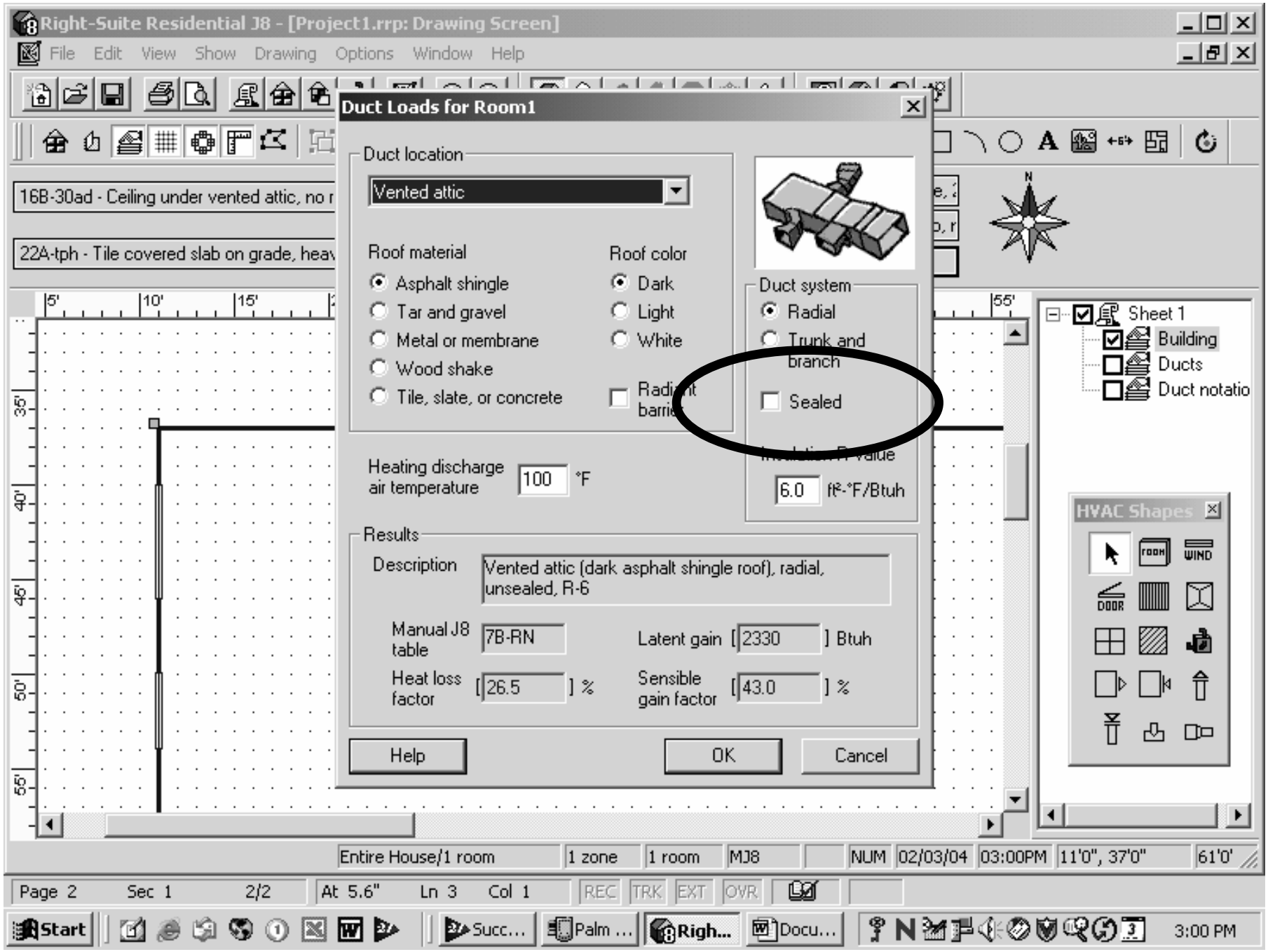
- We Measure Walls To Within An Inch, Then Guess At Infiltration Equal To 30% to 40% Of The Load!
- Duct Leakage To Outside A Major Factor
- If You Don’t Test, You Don’t Know
- Manual J Now Has Blower Door Test Inputs

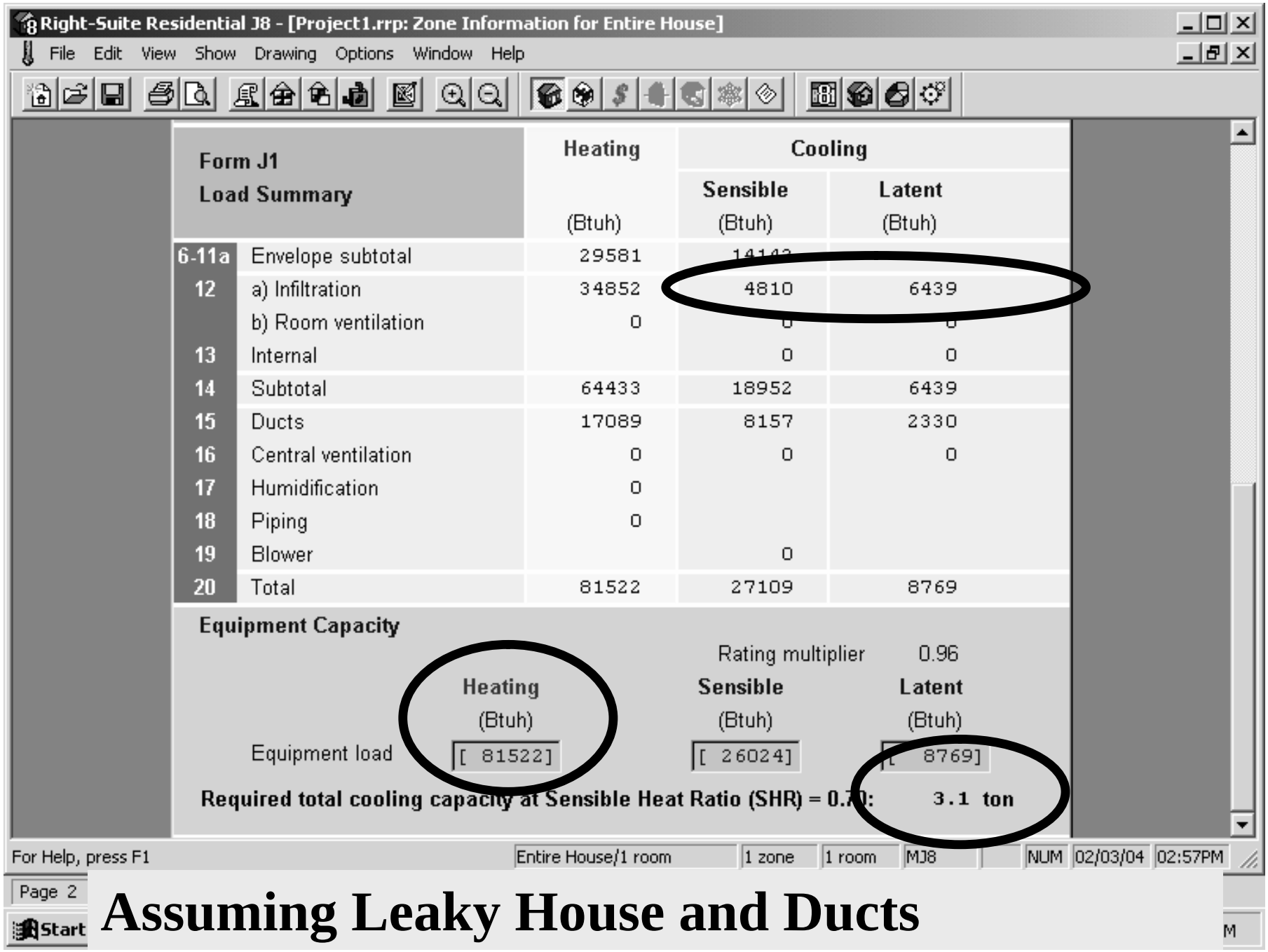


The "Guess At The Infiltration Rate" Method

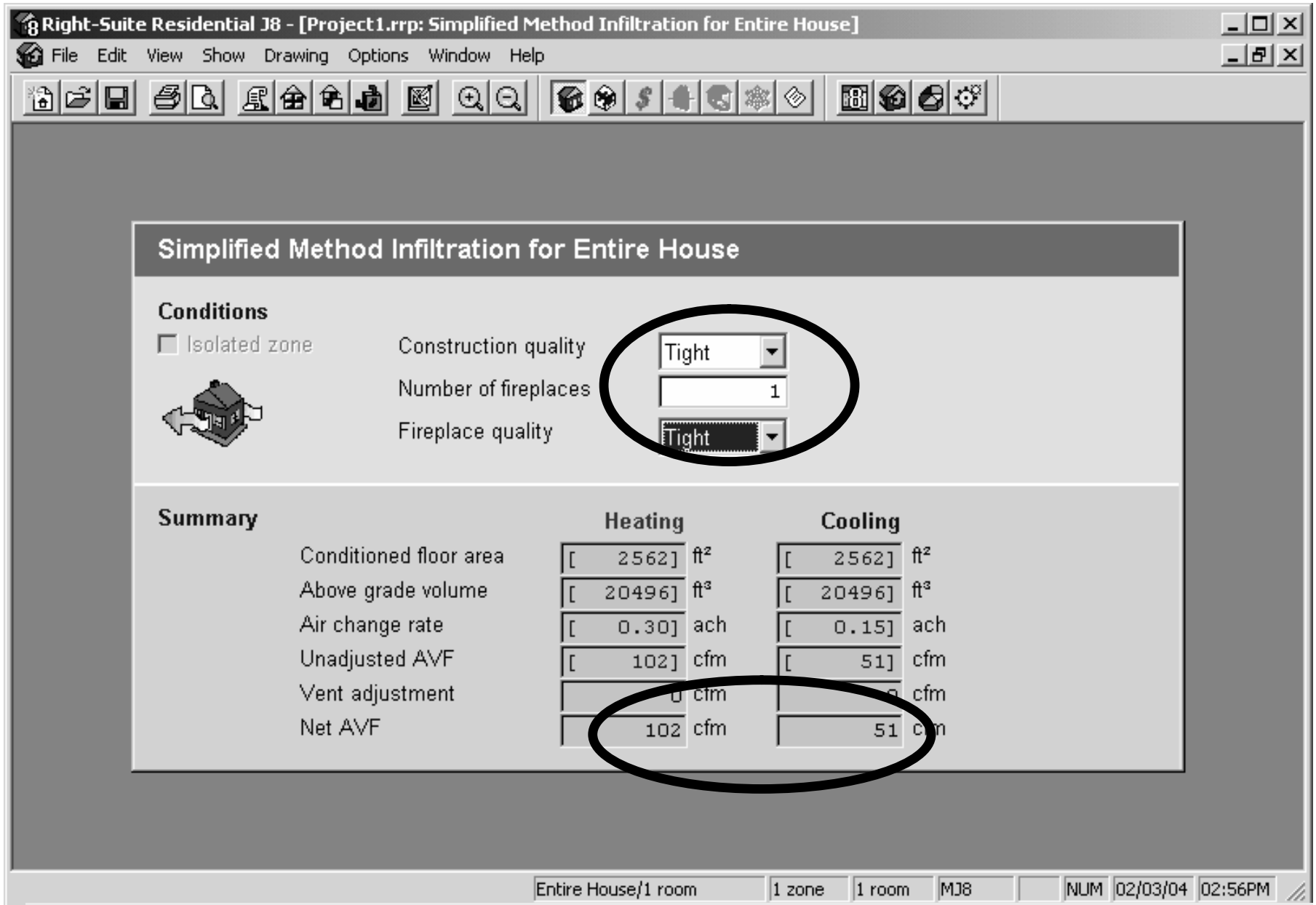

Right-Suite Residential J8 - [Project1.rrp: Simplified Method Infiltration for Entire House]
File Edit View Show Drawing Options Window Help
Simplified Method Infiltration for Entire House
Conditions
Isolated zone
Construction quality
Leaky
Number of fireplaces
1
Fireplace quality
Leaky
Summary
Heating
Cooling
Conditioned floor area
[2562] ft²
[2562] ft²
Above grade volume
[20496] ft³
[20496] ft³
Air change rate
[1.75] ach
[0.80] ach
Unadjusted AVF
cfm
[273] cfm
Vent adjustment
0 cfm
0 cfm
Net AVF
598 cfm
273 cfm
Entire House/1 room
1 zone
1 room
MJ8
NUM
02/03/04
02:55PM
Page 1
Sec 1
1/1
At 1"
Ln 1
Col 2
REC
TRK
EXT
OVR
Start
Succ...
Palm ...
Righ...
Docu...
2:55 PM


Right-Suite Residential J8 - [Project1.rrp: Drawing Screen]
File Edit View Show Drawing Options Window Help
16B-30ad - Ceiling under vented attic, no radiant
22A-tph - Tile covered slab on grade, heavy moi
1D-c2ow - Operable, clear glass, wood frame,
12E-0sw - Wood stud frame, siding or stucco, r
Property Sheet
1By1
Room
Wall
Ceiling
Floor
Room name
Room1
Include in calculations?
Yes
Zone name
Entire House
Room condition
Heating and cooling
Ceiling height (ft)
8.0
Number of occupants
0
Number of appliances
0
Duct heat loss factor (%)
14.5
Duct sensible gain facto
19.9
Sheet 1
Building
Ducts
Duct notatio
HVAC Shapes
How To Get To “Ducts Sealed/Unsealed”
Room1, 61'0" x 42'0"
Entire House/1 room
1 zone
1 room
MJ8
NUM
02/03/04
03:01PM
11'0", 37'0"
61'0'
Page 4
Sec 1
4/4
At 1"
Ln 1
Col 2
REC
TRK
EXT
OVR
Start
3:01 PM

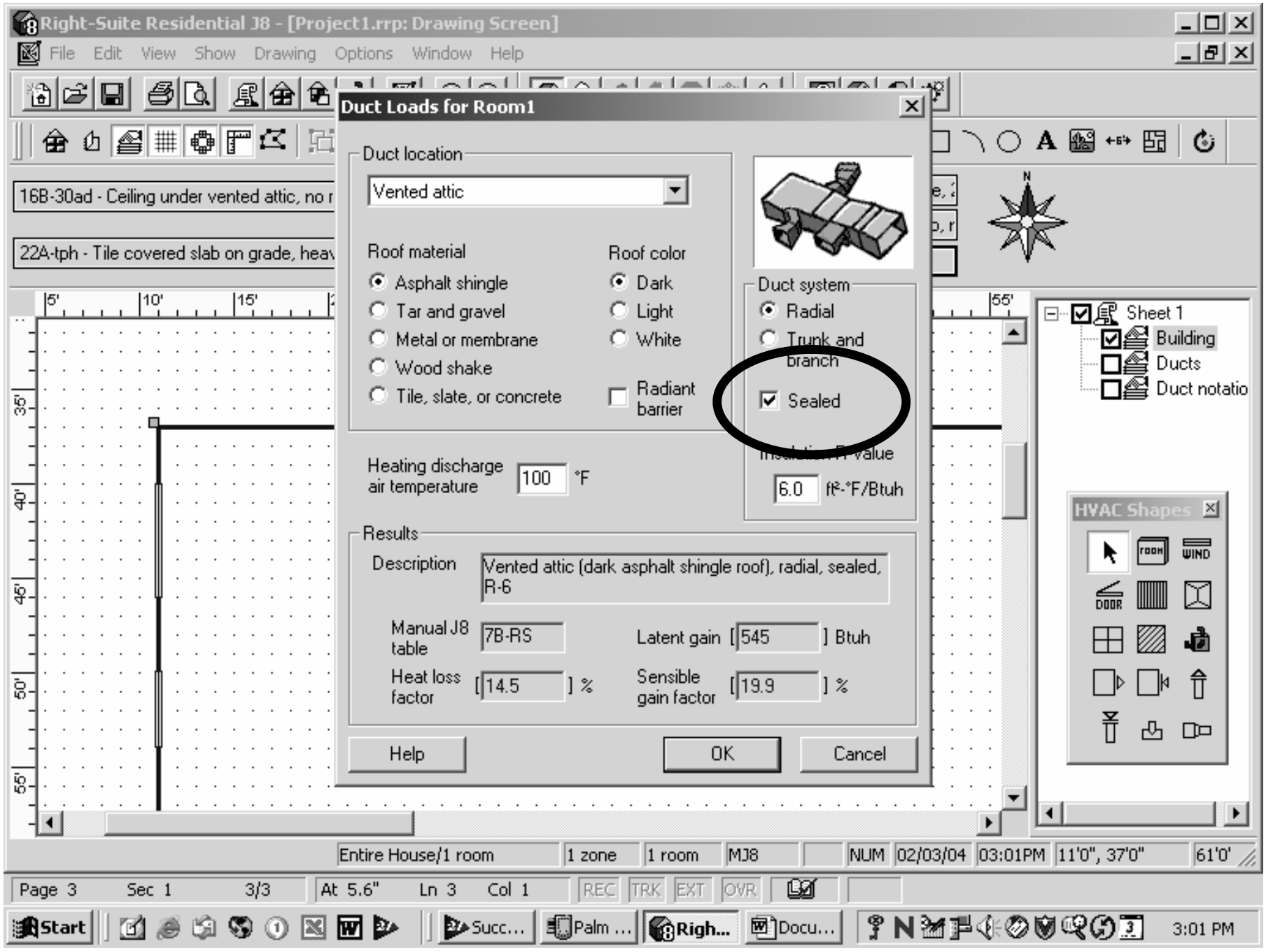

Right-Suite Residential J8 - [Project1.rrp: Drawing Screen]
File Edit View Show Drawing Options Window Help
Duct Loads for Room1
Duct location
Vented attic
Roof material
Asphalt shingle
Tar and gravel
Metal or membrane
Wood shake
Tile, slate, or concrete
Roof color
Dark
Light
White
Duct system
Radial
Trunk and branch
Sealed
Heating discharge air temperature
100
°F
6.0
ft²-°F/Btuh
Results
Description
Vented attic (dark asphalt shingle roof), radial, unsealed, R-6
Manual J8 table
7B-RN
Latent gain
2330
Btuh
Heat loss factor
26.5
%
Sensible gain factor
43.0
%
Help
OK
Cancel
16B-30ad - Ceiling under vented attic, no r
22A-tph - Tile covered slab on grade, heav
Sheet 1
Building
Ducts
Duct notatio
HVAC Shapes
Entire House/1 room
1 zone
1 room
MJ8
NUM
02/03/04
03:00PM
11'0", 37'0"
61'0'
Page 2
Sec 1
2/2
At 5.6"
Ln 3
Col 1
REC
TRK
EXT
OVR
Start
3:00 PM



Assuming Leaky House and Ducts



Now Let's Assume The House & Ducts Are Tight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Vented attic
Roof material
Asphalt shingle
Tar and gravel
Metal or membrane
Wood shake
Tile, slate, or concrete
Roof color
Dark
Light
White
Radiant barrier
Duct system
Radial
Trunk and branch
Sealed
6.0 ft²-°F/Btuh
Heating discharge air temperature 100 °F
Results
Description Vented attic (dark asphalt shingle roof), radial, sealed, R-6
Manual J8 table 7B-RS
Latent gain [545] Btuh
Heat loss factor [14.5] %
Sensible gain factor [19.9] %
Help
OK
Cancel
16B-30ad - Ceiling under vented attic, no r
22A-tph - Tile covered slab on grade, heav
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Building
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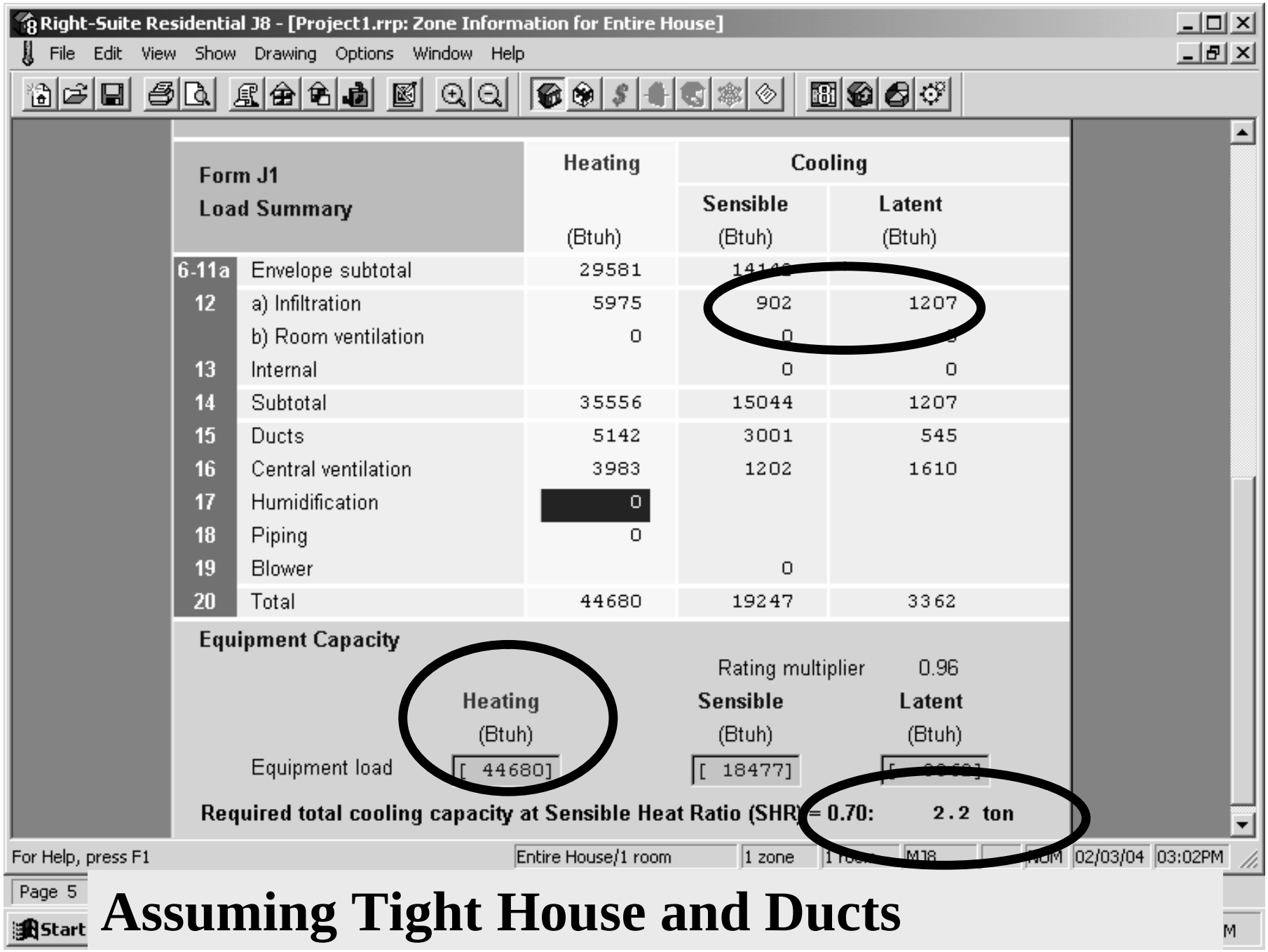
NUM
02/03/04
03:01PM
11'0", 37'0"
61'0'
Page 3 Sec 1 3/3
At 5.6" Ln 3 Col 1
REC TRK EXT OVR
Start
3:01 PM



Assuming Tight House and Ducts

Software Test Data

Software today can tell…

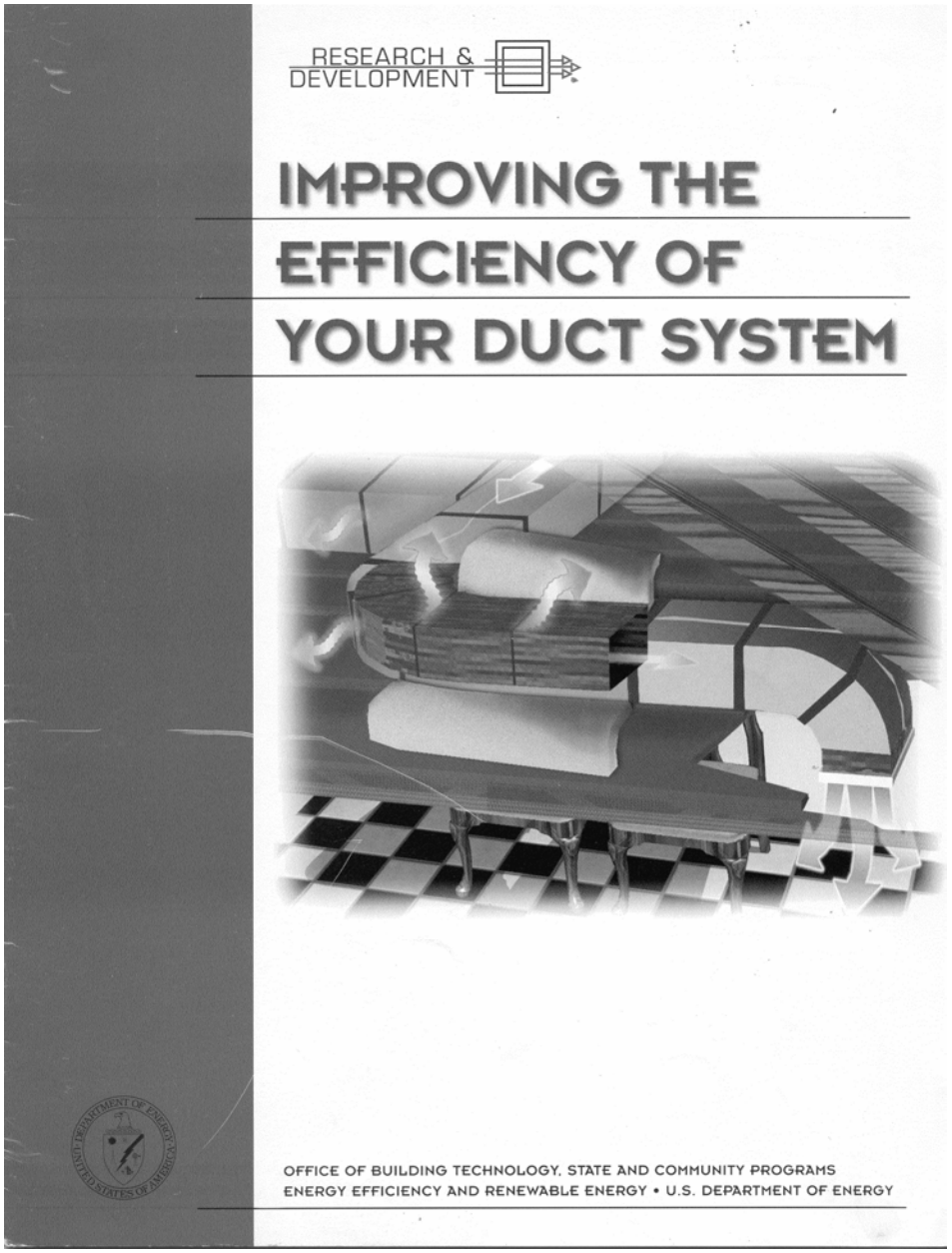
- How Big the hole is in the house
- What the air changes are
- How much water we need to add or remove to keep the home at the right humidity levels
- How much duct leakage we have
- How many CFMs are needed to positively pressurize the home

Missing Insulation & Thermal Bypass Issues

You need to put in the correct insulation levels and note missing insulation along with thermal bypasses

We Know Attic
Duct Systems
Wastes Energy!
But How Much?

Department of Energy Report



COMPONENTS OF THE DUCT SYSTEM

A duct system is a branching network of round or rectangular tubes — generally constructed of

conditioner, or heat pump) contains a fan that forces heated or cooled air into supply ducts leading to the

ENERGY LOSSES AND COSTS

Typical duct systems lose 25 to 40 percent of the heating or cooling energy put out by the central furnace, heat pump, or air conditioner. Homes with ducts in a protected area such as a basement may lose somewhat less than this, while some other types of systems (such as attic ducts in hot, humid climates) often lose more.

based on the national average use of natural gas and electricity for central heating and cooling at national average energy cost of 70 cents per them, and 8 cents per kilowatt-hour. With these savings, the cost to seal and insulate the ducts would most likely be paid for after three years. These estimates apply to retrofitting

heat the cold air outside the ducts. If the ducts are in an attic or vented crawl space that is nearly as cold as the outdoors, this heat is completely lost. If the ducts are in a basement, some of the heat lost from the ducts may be recaptured by warming the basement ceiling enough to reduce the heat lost from the house.

an existing home. For
ductwork would be ac
potential savings woul
to install sealant and i
less than one year.

Duct systems lose ene
of heat from the warm

Duct Leakage % Loss Can Be Much Greater Than Usually Thought

§ Researchers have determined that a 10% return leak from a 120 degree attic causes a 30% drop in the air conditioner’s capacity and efficiency.

Understanding Pressure Imbalances

Pressure imbalances can cause hot or cold rooms

Pressure imbalances can cause hot or cold air to be brought into the home

“Air Balancing Can Solve Hot and Cold Rooms”

“To be able to balance a system, it must be balance-able.”

Balancing Duct Systems

- § Must Be Sized Properly
- § Must Be Airtight (Fall within the standards)
- § Must Have Balancing Dampers
- § Must Have Returns In Every Room
- § Must Have Room By Room H/C Load

Knowing How To Do Load Calc

- Just running software can not guarantee proper sizing
- You have to understand both on new construction and retrofit what Manual J assumes and expects
- Without testing existing structures you are still only guessing
- Bottom Line…don’t guess…know

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