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Building AMERICA
U.S. Department of Energy

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Consortium for Advanced Residential Buildings

Predicting Envelope Leakage in Attached Dwellings

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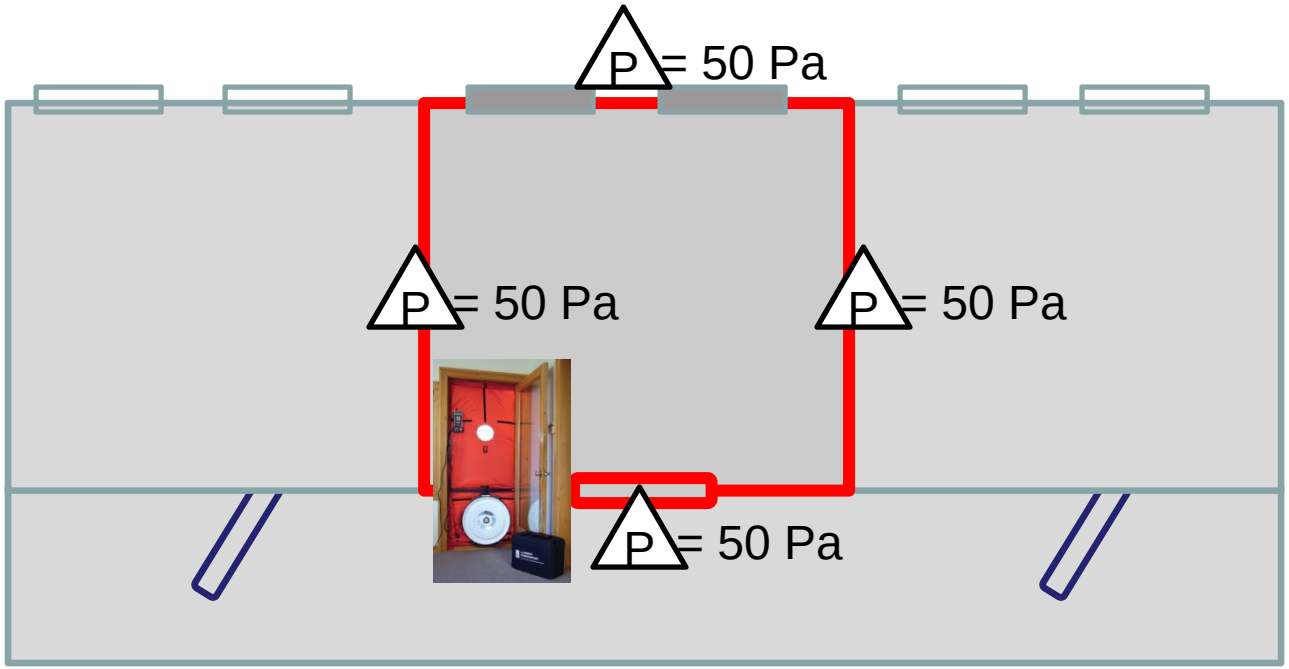
Presentation Outline

- Objectives
- What we accomplished last year
- What we plan to do this year

Why do we do blower door testing?

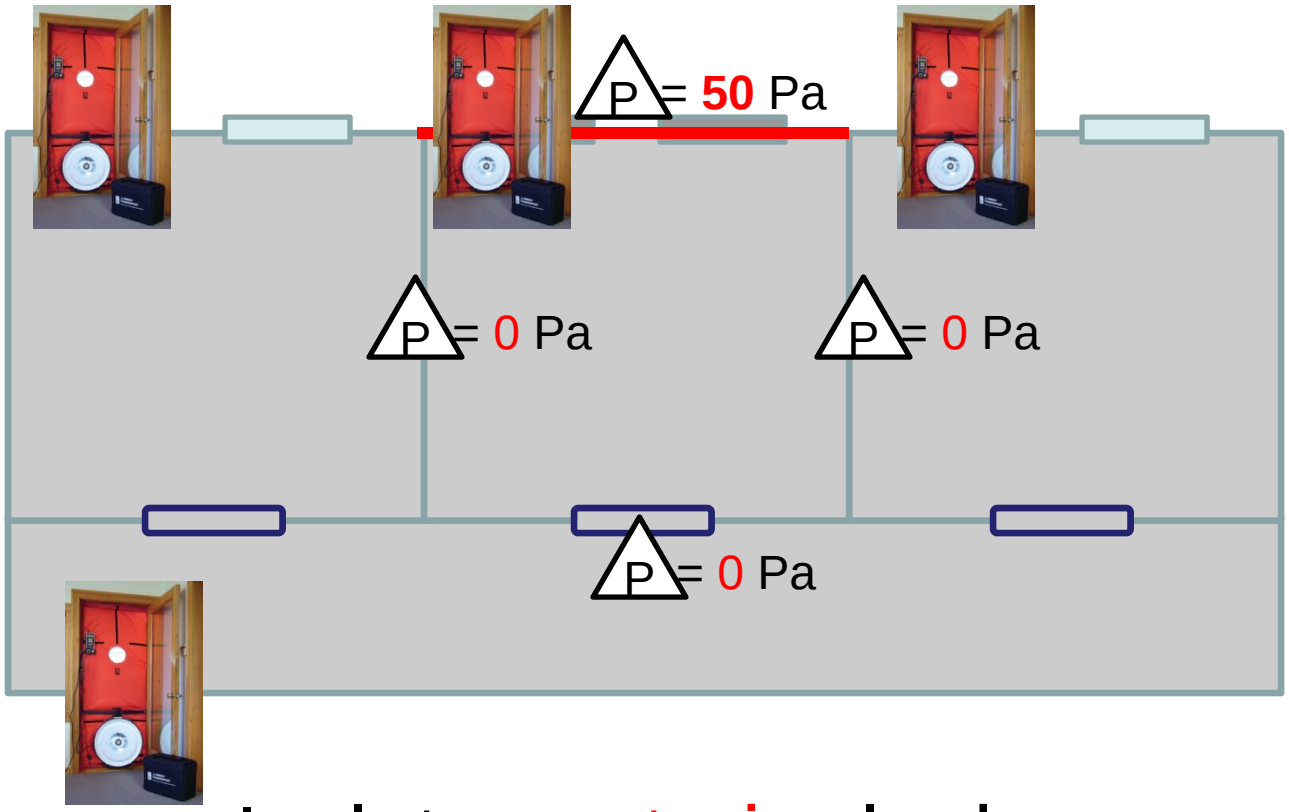
- Compliance to some standard
- Identify opportunity for reducing energy use
- Identify opportunity for improving IAQ
- Measure implementation verification

Total (or Solo) Leakage Test



Open windows, open doors, same test pressure across whole envelope.
If pressure across envelope at any point is different from test pressure by less than 5 Pa, not neccessary.

“Fully” Guarded Test



Isolates exterior leakage

What's the big deal?

- How we measure depends on why we're measuring – Total vs. Guarded
- It's not easy, especially in existing, occupied housing

Guidance is not clear

2012 IECC R402.4.1 Building thermal envelope

– R402.4.1.2 Testing

The building or dwelling unit shall be tested to achieve 5 ACH (CZ 1and 2) or 3 ACH (CZ 3-8) with a blower door at 50 Pascals.

Compartmentalization is the goal so use Total. It's faster and simpler. Spend less money on energy consultants and more on air sealing.

But is that the intent here?

Air Leakage Testing in Attached Dwellings

The Problem:

What air leakage value is used for quantifying energy impact?

The Research Objective:

Develop a simple tool for builders, raters, engineers and architects to predict air leakage to the outside based on a “solo” blower door test value and a few significant building specifications.

Expert Meeting – March 2012

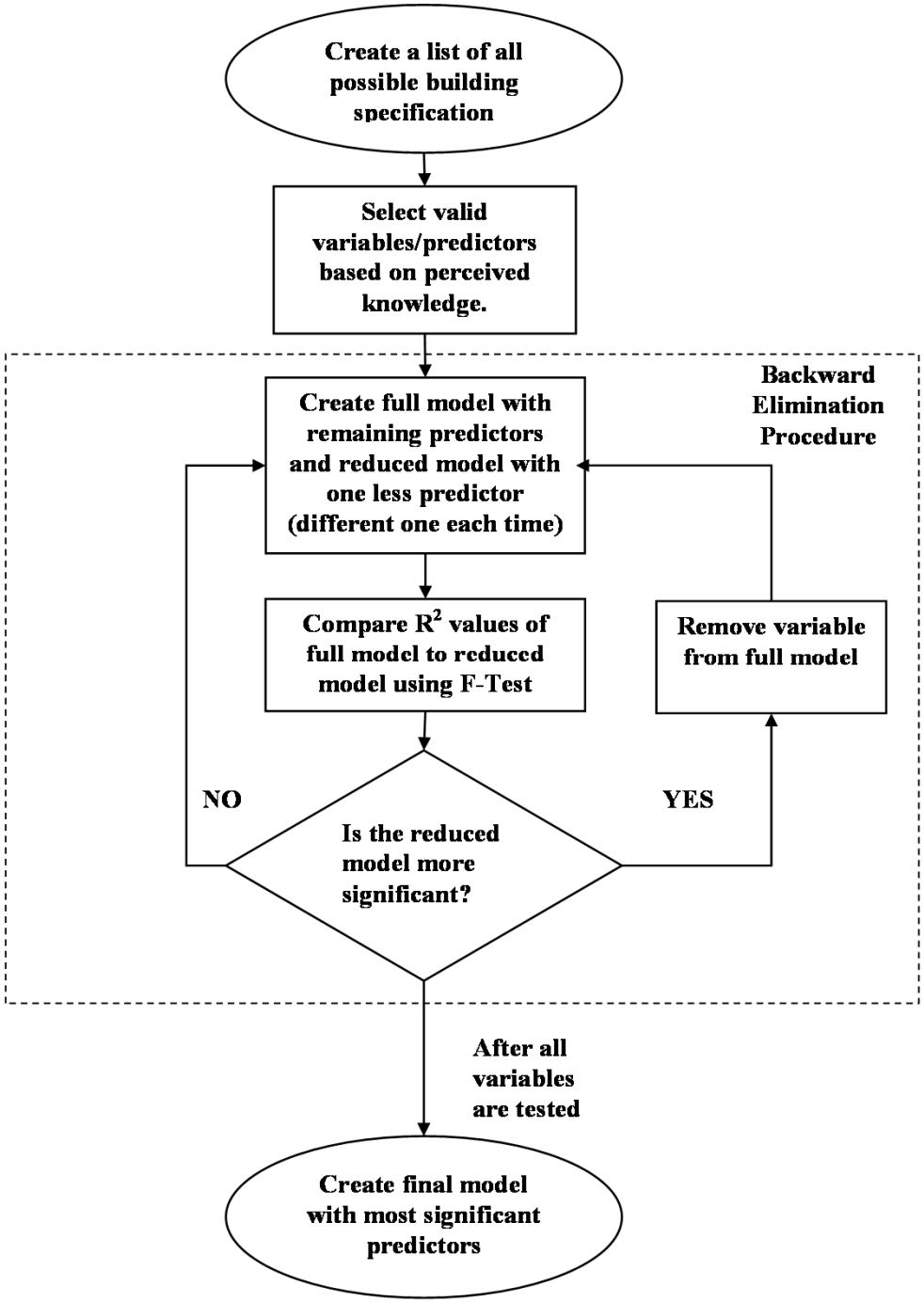
- For new construction, compartmentalization is the goal. The role of the blower door test is quality assurance.
- No method, even fully-guarded blower door testing, is perfect.
- Blower door testing is most valuable during the air sealing process to help find air leakage points.
- The value of extensive blower door testing as a component of the audit process is questionable.

Last Year's Preliminary Study

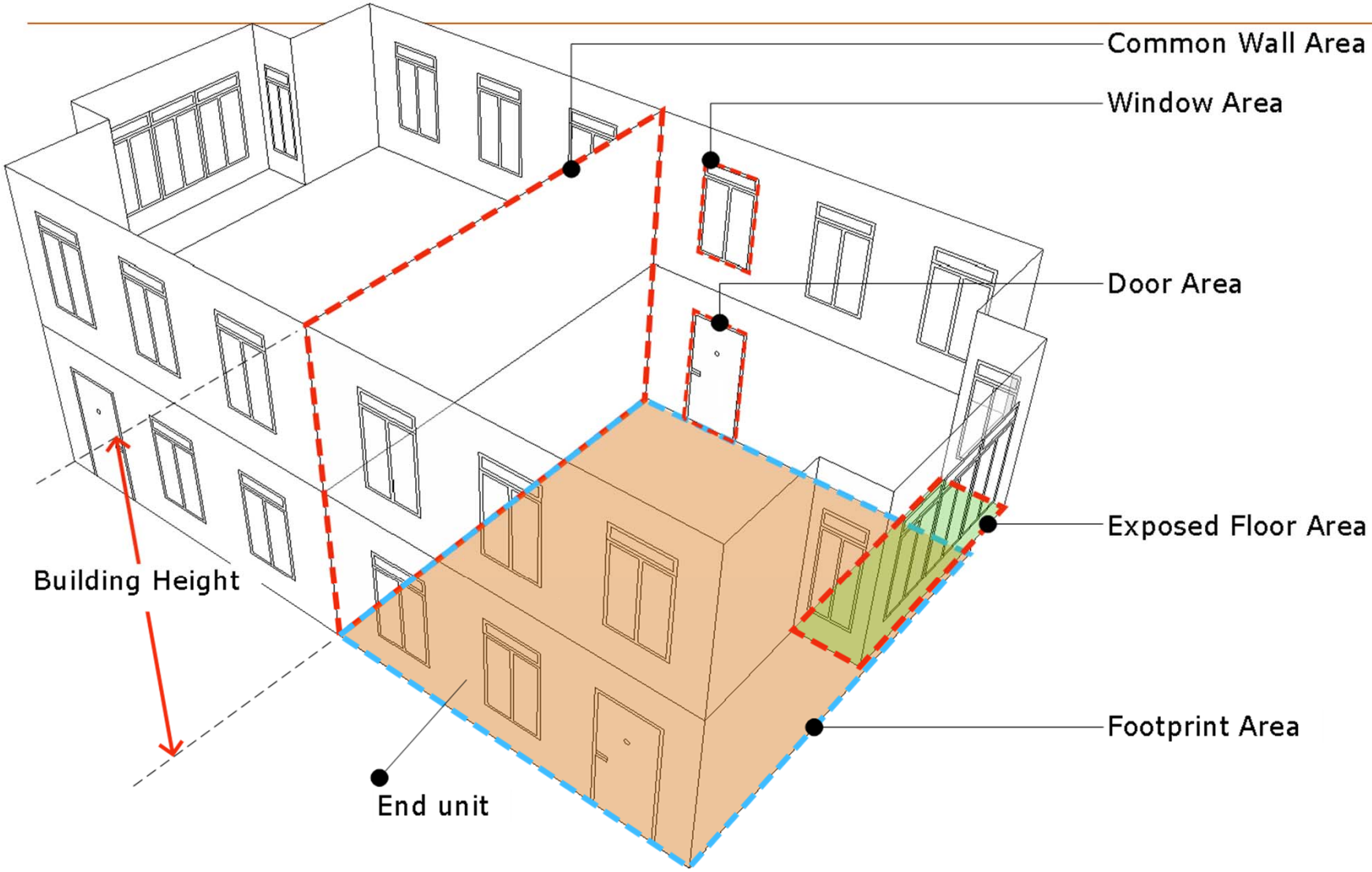
Thank You NRCERT Community Housing Partners!

Project	Location	Type of Building	Number of Buildings	Number of Units	Year of Construction
1	Winchester, VA	Garden style apartments	2	14	1989
2	Newport News, VA	Garden style apartments	5	35	1980
3	Roanoke, VA	Rowhouses	4	22	1970
4	Staten Island, NY	Duplex rowhouses	4	41	2010

The Process


Create a list of all possible building specification
Select valid variables/predictors based on perceived knowledge.
Backward Elimination Procedure
Create full model with remaining predictors and reduced model with one less predictor (different one each time)
Compare R^2 values of full model to reduced model using F-Test
Remove variable from full model
NO
YES
Is the reduced model more significant?
After all variables are tested
Create final model with most significant predictors

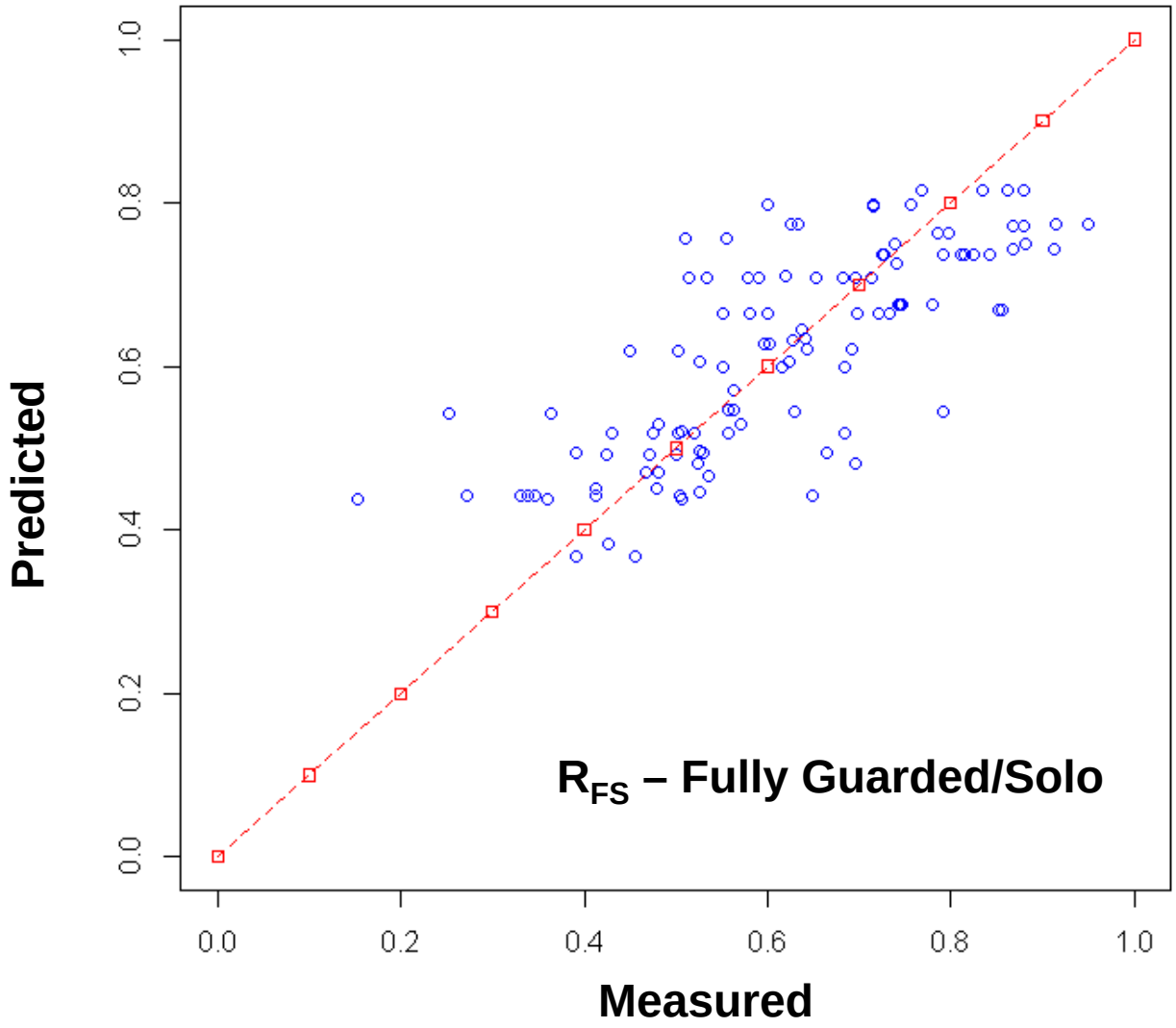
Characteristics



Preliminary Predictors

- Common Wall / Total Surface Area (RCWTSA)
- Window Area / Exposed Surface Area (RWATESA)
- Unit Location
  - End or Interior
- Duct Location
  - Conditioned Space, Unconditioned Space, No Ducts
- Unit Level
  - Bottom Floor, Top Floor, Middle Floor

Multi-Variable Linear Regression Results



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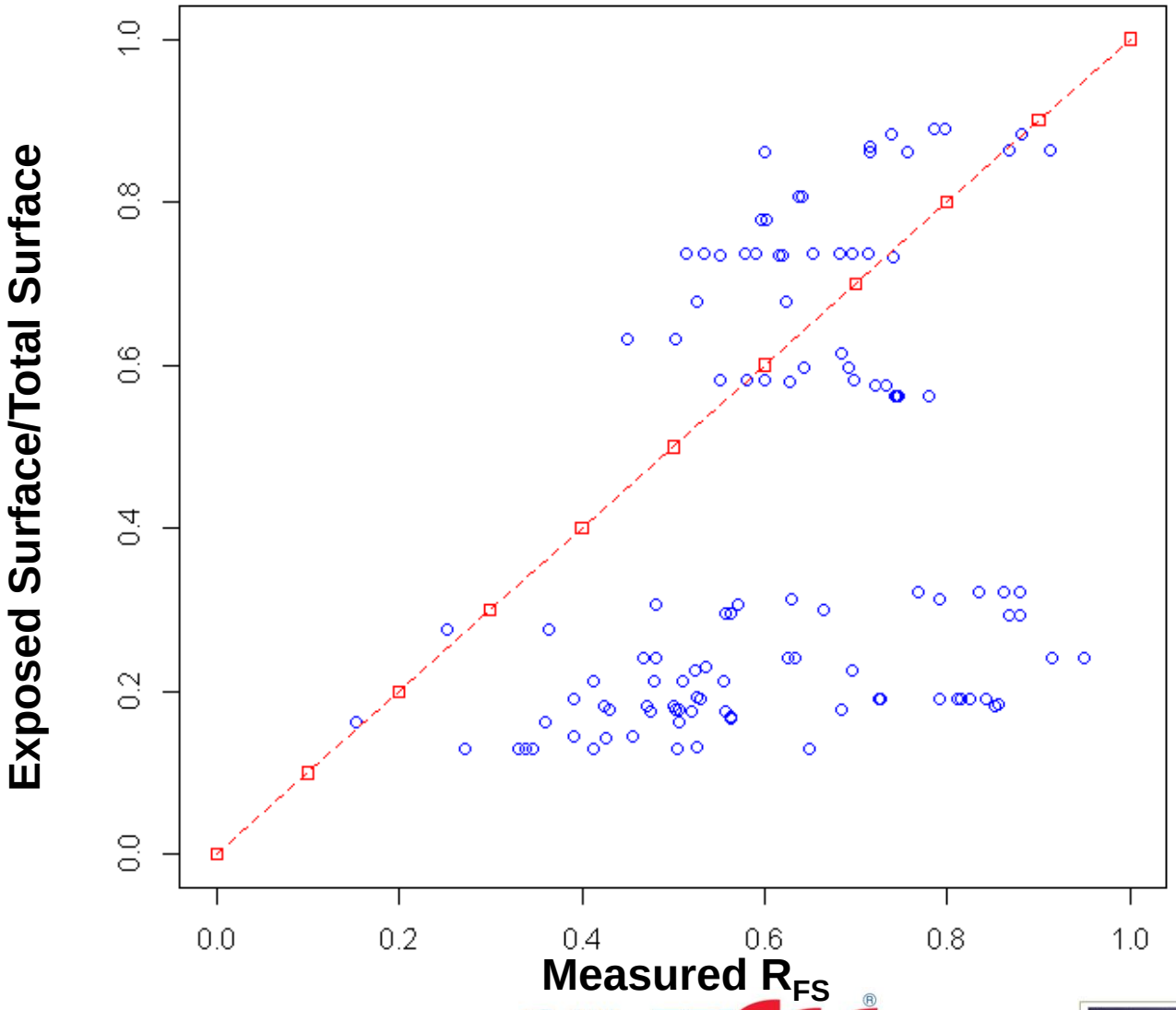
Area Weighted Approach



Next Steps – This Year

- Collect more data
  - Different regions
  - Different building types and construction
- Perform the analyses again
  - Different predictors likely
- Check the validity of the predictive model

WE NEED DATA!

- Blower door test data
  - Guarded and Total for the same unit
- Unit and building characteristic data
  - Drawings
  - Photos
  - Model input summaries

WE NEED DATA !!

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Thank you.