

Quantifying Building Energy Efficiency: One-Point Efficiency Parameter (OPEP) Method

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Introduction

When it comes to measuring energy efficiency and insulation, we typically rely on a **mix of technical tests and performance evaluations**. These include:

1. **Measuring Insulation Performance** – Using **R-Value** (resistance to heat flow) and **U-Value** (heat loss).
2. **Air Tightness & Leakage Testing** – Conducted through the **Blower Door Test**, **Infrared Thermography**, and **Smoke Testing**.
3. **Thermal Performance & Energy Consumption Analysis** – Measured with **Heat Flux Sensors**, **Smart Meters**, and **Thermal Mass Analysis**.
4. **Window & Door Efficiency Evaluation** – Using **Solar Heat Gain Coefficient (SHGC)** and **Visible Transmittance (VT)**.
5. **Ventilation & Indoor Air Quality Monitoring** – Looking at **CO₂** and **Humidity Sensors**, plus **Duct Leakage Testing**.

These are great for professionals and detailed audits, but what if you just want a **quick and simple way** to check how well your home (or any building) holds heat? **That's where OPEP comes in.**

A Simple Trick: Checking Wall Temperature

Believe it or not, **you can get a good sense of a building's insulation efficiency just by measuring the surface temperature of an exterior-facing wall.**

Here's what you need:

- A **contact thermometer** or a **basic infrared temperature gauge**.
- The **room temperature** (from any thermostat).
- The **outdoor temperature** (from a thermostat or local weather report).

By comparing these three temperatures, **you can estimate how well a wall is insulated.**

A Note: While conducting measurements in one building using an infrared gauge, we decided to check the **floor and ceiling temperatures** as well. To our surprise, the difference was **7°F**! This highlights how heat distribution varies within a room and why insulation quality matters—not just in walls, but in floors and ceilings too.

One-Point Efficiency Parameter (OPEP)

The OPEP method is based on a simple idea: **the better the insulation, the closer the wall temperature will be to the indoor temperature.**

To make a meaningful comparison, we assume:

- The **wall is not exposed to direct sunlight** at the time of measurement.
- The **inside and outside temperatures are stable**.
- The **AC or heating system is keeping the indoor temperature steady**.

Using just three temperature readings, you can calculate an **efficiency parameter** that tells you how well a wall retains heat.

The formula is:

$$\text{OPEP} = 1 - |(T_{\text{wall}} - T_{\text{inside}}) / (T_{\text{inside}} - T_{\text{outside}})|^{1.5}$$

Where:

- T_{wall} = Surface temperature of the wall
- T_{inside} = Indoor air temperature
- T_{outside} = Outdoor air temperature

How to interpret the result?

- **Higher OPEP value** → **Better insulation**, meaning the wall holds heat well.
- **Lower OPEP value** → **Worse insulation**, meaning more energy is needed to maintain indoor temperature.

Comparing Two Houses Using OPEP

Want to see how two houses compare in terms of heating efficiency? **Just measure the wall temperature in both and calculate the OPEP!**

- The house with the **lower OPEP** is **losing more heat** and **spending more on energy**.
- The house with the **higher OPEP** is **better insulated** and more energy-efficient.

Bonus Tip: Check Your Windows!

If you want to **compare insulation between walls and windows**, measure the temperature of the **inside glass panel** and calculate its **OPEP separately**.

- If the **window OPEP** is **much lower than the wall OPEP**, it may be time to **upgrade to better-insulated windows**.

A Fun Experiment

Next time you visit someone's house, **try this**:

1. Touch the **wall** and then a **table** inside the same room.
2. If the wall feels **much colder than the table**, it's probably **losing a lot of heat**.
3. If it's close in temperature, **the insulation is doing its job**.

Now, with a quick calculation, **you can estimate how much they're spending on heating**—approximately, of course!

Conclusion & Practical Applications

The **OPEP method** is an **easy, practical, and low-cost** way to estimate insulation efficiency.

- **For professionals**, it serves as a **quick evaluation tool**—even without visiting a home in person!
- **For homeowners**, it helps **identify heat loss** and **potential cost savings** by improving insulation.

By applying OPEP, you can quickly **spot energy waste**, prioritize **insulation improvements**, and ultimately **reduce heating and cooling costs**—all with a **simple temperature check**!