

Why STEP Warmfloor™ Is More Efficient

Now, it is scientifically proven that STEP Warmfloor™ is approx. **2.5 times** more efficient than heating cables.

According to a recent study STEP Warmfloor™ was measured to be significantly more efficient than other heating systems.

Francesco Schiavone, PhD, (PhD, BEng (Mech) – University of Florence, Italy, Senior Research Associate – Royal Melbourne Institute of Technology, Australia) compared the heat transmission from STEP Warmfloor™ self-regulating heating element with electric cable systems and water tubing systems.

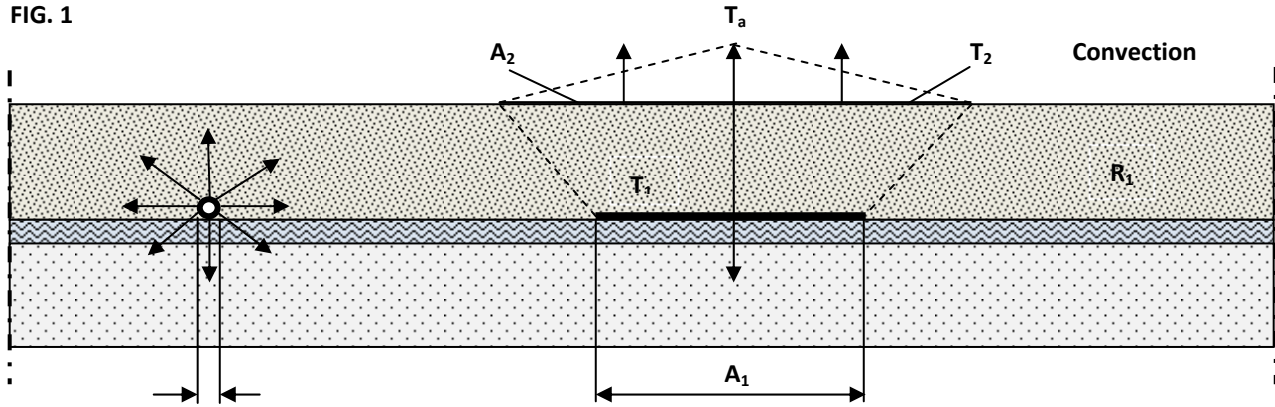


Fig. 1 shows a cross sectional area of a floor with a cable or tubing and STEP Warmfloor™ flat element.

According to Newton's law, the rate of heat transfer to the surrounding air is proportional to the floor exposed area (A) and to the difference between the floor temperature and the air temperature. For the conservation of energy, the heat transfer for conduction equals the heat for convection, and in a simplified equation:

$$Q \propto A_1 \cdot R_1(T_2 - T_1) = A_2 \cdot k(T_a - T_2)$$

Where:

- k is the thermal conductivity (constant)
- R_1 is thermal resistance of floor
- T_1 is the temperature of heating element
- T_2 is the temperature of floor surface
- T_a is the ambient temperature
- A_1 is the surface area of heating element
- A_2 is the surface area of heat generated from heating element

Consider typical values for heating a square foot with $R_1 = 2 \cdot \text{h ft}^2 \text{ } ^\circ\text{F} \cdot \text{Btu}^{-1}$, $T_2 = 75 \text{ } ^\circ\text{F}$ and $T_a = 70 \text{ } ^\circ\text{F}$.

STEP Warmfloor™ Flat Element Width = 1 ft Length = 1 ft	Electric Cable Diameter = 0.07 in Length = 4 ft (double-wire, 3 inches spacing)	Water Tubing Diameter = 0.5 in Length = 2 ft (6 inches spacing)
$A_1 = 1 \text{ ft} \cdot 1 \text{ ft} = 1 \text{ ft}^2$ $T_1 = 80 \text{ } ^\circ\text{F}$	$A_1 = 4 \text{ ft} \cdot 0.0058 \text{ ft} = 0.023 \text{ ft}^2$ $T_1 = 160 \text{ } ^\circ\text{F}$	$A_1 = 2 \text{ ft} \cdot 0.0416 \text{ ft} = 0.083 \text{ ft}^2$ $T_1 = 104 \text{ } ^\circ\text{F}$ (water temperature)
$1 \text{ ft}^2 \cdot 2 \cdot \text{h ft}^2 \text{ } ^\circ\text{F} \cdot \text{Btu}^{-1} (75 \text{ } ^\circ\text{F} - 80 \text{ } ^\circ\text{F})$ $= A_2 \cdot k(70 \text{ } ^\circ\text{F} - 75 \text{ } ^\circ\text{F})$ $\therefore A_2 \cdot k = 2 \text{ ft}^2$	$0.023 \text{ ft}^2 \cdot 2 \cdot \text{h ft}^2 \text{ } ^\circ\text{F} \cdot \text{Btu}^{-1} (75 \text{ } ^\circ\text{F} - 160 \text{ } ^\circ\text{F})$ $= A_2 \cdot k(70 \text{ } ^\circ\text{F} - 75 \text{ } ^\circ\text{F})$ $\therefore A_2 \cdot k = 0.78 \text{ ft}^2$	$0.083 \text{ ft}^2 \cdot 2 \cdot \text{h ft}^2 \text{ } ^\circ\text{F} \cdot \text{Btu}^{-1} (75 \text{ } ^\circ\text{F} - 104 \text{ } ^\circ\text{F})$ $= A_2 \cdot k(70 \text{ } ^\circ\text{F} - 75 \text{ } ^\circ\text{F})$ $\therefore A_2 \cdot k = 0.96 \text{ ft}^2$

Note: Since k is constant, we may assume $k = 1 \text{ Btu h } \cdot \text{ } ^\circ\text{F}^{-1} \cdot \text{ft}^{-2}$, leaving the above values of A_2 to be 2 ft^2 , 0.788 ft^2 and 0.96 ft^2 respectively.

A typical total heating installation with the **STEP Warmfloor™** system requires:

$$4.5 \text{ W/ft}^2$$

To give the same heat output, an **Electric Cable** system would require:

$$2 \text{ ft}^2 / 0.78 \text{ ft}^2 = 2.5 \text{ times more wattage; which would be } 4.5 \text{ W/ft}^2 \times 2.5 =$$

$$11.25 \text{ W/ft}^2$$

While a **Water Tubing** system would require:

$$2 \text{ ft}^2 / 0.96 \text{ ft}^2 = 2.08 \text{ times more wattage; which would be } 4.5 \text{ W/ft}^2 \times 2.08 =$$

$$9.36 \text{ W/ft}^2$$