Respect Science: The Scientific Method in Architecture

By Thomas Beck, AIA, NCARB

The application of the Scientific Method is not just for science. The Scientific Method arguably helped propel us out of the Dark Ages. For those of us rusty in our understanding of what the Scientific Method is, here is a summary.

1. Purpose: State the problem, or ask a question.
2. State goals and objectives.
3. Hypothesize solutions.
4. Arrange parameters.
5. Test the hypothesis.

Variations exist, the above is the outline taught in the University of Colorado Undergraduate School of Architecture, College of Environmental Design.

Some believe architecture is art, not science. While creativity is very much an element of good architecture, like science it is a field of problem solving. Both require visualizing something that does not yet exist in physical space, in architecture a building, in science perhaps a vaccine. Applying the Scientific Method assists keeping on track, and in developing hypothesis followed by testing, preventing dysfunctional buildings from being constructed.

Architects are tasked with a broad range of problems to be solved for every project they design. The essential elements of shelter and protection must be considered. The location of the structure, sun, snow, rain, run-off, wind, wildlife and neighbors. Acoustical conditions effect our experience of architecture. Soaring entryways, cozy sleeping quarters, kitchens which invite families to interact, all are the result of both creative and scientific problem solving.

Knowledge of current technologies, sustainable and healthy materials, the effects of lighting and color choice on our moods, all play a part in the good questions an architect must pose both to him/herself and to clients.

The choices an architect makes also can have a huge impact on our climate. A previous TW Beck Architects project can illustrate an example of how the Scientific Method is applied for an off-grid, energy efficient custom home.

- Purpose: Can I build a 6,000 square foot home on a 155-acre property at 8000 foot elevation with an indoor lap pool, four bedrooms, full gourmet kitchen, radiant heat flooring, and make the entire project off-grid?
- Goals and objectives/research: involved wind power, solar power options, back-up power options, energy efficient appliances, heating methodology, insulation, eco-friendly recycled glass tile, bamboo flooring, thermal mass heating and cooling solutions.
- Hypothesis: That a 6,000 square foot custom home can be built with sustainable materials, building standards, construction techniques, off-grid and provide all of the luxury amenities expected in such a home. That the home can be designed to integrate into the hillside and not disturb a beautiful rock outcropping, but still maintain the 180 degree vista, without losing the passive and active solar benefits.

- Parameters: Included wind turbines and solar roof tiles for energy production; passive solar; concrete roof tiles produced with custom color to blend with local rock formations and Lumpy Ridge; structural slab for thermal mass with south facing passive solar exposure; swimming pool room built with structural slab and radiant heat, which solved issue of humidity in the room; indoor lap pool capacity of 10,000 gallons provided water to an outdoor fire hydrant, acting as a storage tank in case of wildfire; acoustical insulation using shredded recycled blue jeans; gourmet kitchen with energy saving appliances, a generator shed containing batteries for storage and back-up gas generator.
- Test the hypothesis: The building was constructed with owner/architect funding. Some previously untested techniques, such as the structural slab with radiant heat, proved successful. We learned that the thermal mass worked well, but the lead acid batteries were the weak link. Battery technology has improved since 2000 but is still expensive. We would definitely do solar electric again, but the integrated solar electric tiles, while they look great, are not worth the cost. The overall project was a successful one, helping the owner find good alternatives to the cost of bringing power lines to the home. The cost of the renewable energy alternatives was an immediate payback, as the power lines would have been close to double the cost. Over time the considerable savings in the electric bill will be tremendous.

All of the solar photovoltaic (P.V.), wind, batteries and back up generator were completed for approximately 65k, much less than the estimate to run power lines several miles. The cost of these technologies has dropped, so materials cost for solar P.V. would be much lower in 2020. As battery technologies evolve and improve the energy storage issues of going totally off-grid will be resolved.

Buildings consume a lot of energy. According to Alliance to Save Energy, buildings represent 40% of our total energy use, and 70% of electricity. They also emit over 1/3 of U.S. greenhouse gas emissions. Architecture can help address this problem. Architects can apply the Scientific Method starting with the question “Can we impact climate change by achieving net zero in our buildings?” We know the answer is yes.

Beck, Thomas W. “Respect Science: The Scientific Method in Architecture”, *Estes Park Trail Gazette,* Friday, August 14, 2020, Page 6A, https://www.eptrail.com/2020/08/19/guest-column-respect-science-the-scientific-method-in-architecture/