

QUALITATIVE Sampling v Statistical Analysis v Daubert

“The core of the scientific method for all quantitative and qualitative surveys consists of a puzzle-solving strategy or methodology...”

A common tactic used by attorneys seeking to discredit an expert’s typical evaluation of building envelope construction or performance is to argue that the only valid approach for forensic surveys is the blind ‘simple random sampling’ (SRS) that most of us were taught in our high school or college science classes. To better evaluate this assertion, it is helpful to list several key elements of the basic SRS protocol:

- a. Sampling locations are pre-determined randomly; the sampler has no discretion in the selection process;
- b. Every member of the ‘population’ being sampled has the same chance to be selected; and
- c. The results of any particular sample cannot be used to shape the course of the continued sampling.

Upon only brief review, the experienced construction professional can identify potentially critical hindrances to truly random statistical sampling of buildings, including:

- a. Aesthetic or logistical constraints imposed by the building owner or occupants;
- b. Physical or legal limitations on access;

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- c. High costs imposed by an inflexible sampling design; and
- d. The typical non-random distribution of construction defects.

Further, any SRS design requirement that data obtained during the course of the sampling cannot be used to guide the immediate additional sampling represents a flagrant waste of the building envelope professional’s forensic expertise. In contrast, the industry standard for forensic evaluations of building envelope performance is ASTM E 2128, *Standard Guide for Evaluating Water Leakage of Building Walls*,¹ which prescribes a purposeful investigation that entails an orderly accumulation of information in such a manner that each step enhances and supplements the information gathered in the preceding step. Clearly, the purposeful sampling methodology described within ASTM E 2128 is not consistent with the tenets of probability sampling and its various statistical siblings (collectively, *quantitative sampling*), as exemplified by the SRS ideal, and therefore may be subject to claims that it does not satisfy the rules of evidence that

require an expert’s sampling methodology and testimony to be based upon “scientifically valid” principles (see *Daubert v. Merrell Dow Pharmaceuticals, Inc.*).

In response, a rigorously peer-reviewed paper published in the Journal of ASTM International, *Qualitative Sampling of the Building Envelope for Water Leakage*,² demonstrates that the survey protocol prescribed by ASTM E 2128 is fully consistent with *qualitative sampling* methodology validated within the social sciences.

Seminal standards in the field of qualitative inquiry review the different logics that undergird the quantitative and qualitative sampling methodologies. While quantitative methods generally require a large randomly selected sample set, qualitative inquiry typically focuses in depth on relatively small samples, even single cases (N=1), selected purposefully. Not only do the sampling techniques differ, but the very logic of each approach is unique because their purpose is different:

- a. The logic and power of random sampling derive from statistical probability theory—a random and statistically representative sample set controls for selection bias and permits confident generalization from the sampling to a larger population.

b. In contrast, what would be ‘bias’ in statistical sampling, and therefore a weakness, becomes intended focus in qualitative sampling, and therefore a strength. The logic and power of purposeful sampling lie in selecting *information-rich* samples for step-by-step evaluation of issues of central importance to the purpose of the inquiry.

While the goal of quantitative sampling is to evaluate levels of *statistical significance*, the methodology of qualitative inquiry is to produce findings that have *substantive significance*—which refers to the strength and importance of a meaningful relationship. In determining substantive significance, both the analyst and the reviewers must address these kinds of questions:

- a. How solid, coherent, and consistent is the qualitative evidence in support of the expert’s findings?
- b. To what extent and in what ways do the findings further a deep understanding of the observed conditions?
- c. How well do the findings define and correlate causal relationships in a manner that maximizes understanding of the various processes and phenomena of interest that are occurring within the population?

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d. To what extent are the expert's findings consistent with knowledge derived from other sources?

The sampling design for qualitative surveys typically is fluid, capitalizing on early learning to guide subsequent direction. Qualitative researchers begin by identifying information-rich data sources that can be expected to maximize understanding of the observable conditions. As the survey progresses, new conditions and sampling questions emerge that may confirm, enrich, modify or challenge the researcher's understanding of the observed phenomena. Qualitative sampling represents an inductive process in which the researcher searches for patterns and builds abstractions, concepts, hypotheses and theories from emerging details.

Unlike probability sampling, there are no firm criteria for determining sample size in qualitative surveys. The appropriate sample size is determined by the quality of the observed data as it relates to the goal of the survey. If the key purpose is to maximize information, then

the survey may be terminated when no new information is forthcoming from the additional sampling; thus, data saturation may be the primary criterion. However, sample size for qualitative surveys also may depend simply on what you want to know, the purpose of the inquiry, what will be useful and will have credibility, and what can be done with available time and resources. In all such qualitative surveys, the quality and rigor of the resultant data and substantive findings is highly dependent on the skill, training, education, competence and integrity of the investigator.

In short, the substantive value of the qualitative inquiry depends on three distinct but related elements:

- a. Rigorous methods for doing fieldwork and collecting high-quality data.
- b. Ongoing, thorough and systematic analyses of these data.
- c. The credibility of the researcher.

All surveys, whether quantitative or qualitative, require the investigator to have training, integrity and credibility; however,

for qualitative surveys the abilities and qualities of the evaluator have increased importance because the processes of data collection and analysis do not rest upon a rigid statistically derived foundation. While statistical analysis follows formulas and rules, the core of qualitative analysis is composed of the insights, knowledge and conceptual capabilities of the experienced analyst.

As the final step in the qualitative survey process—after describing and interpreting the major patterns, themes and linkages that have emerged from the analysis—the expert investigator must, as a matter of intellectual integrity, look for data that support alternative themes and explanations for the observed conditions. Failure to find strong supporting evidence for opposing theories increases confidence in the researcher's original analysis. Closely related to such testing of rival explanations is the search for negative cases; comprehensive understanding of the perceived qualitative patterns is increased by considering the instances and cases that do not fit the pattern.

It is instructive to compare the above discussion of the fundamentals of qualitative sampling with the investigative methodology prescribed in ASTM E 2128. Section 11 of this standard includes, in part, the following protocol for carrying out a qualitative survey of the building envelope:

1. An evaluation is conducted in response to a problem situation and a non-performing wall, and may involve several techniques and procedures specifically adapted and applied in a systematic manner to diagnose a specific problem.
2. The information systematically accumulated in a leakage evaluation is analyzed as it is acquired. The new information may motivate a change in approach or focus for subsequent steps in the evaluation process.
3. The evaluator is expected to establish a cause and effect relationship between wall characteristics and observed leakage. This requires an appropriate selection of activities and a logical analysis and interpretation of the acquired information.

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4. The conclusions and findings from an evaluation must be rationally based on the activities and procedures undertaken and the information acquired, if they are to be considered legitimate and substantiated.

5. The record should be sufficiently complete so that any interested party can duplicate the evaluation program and acquire similar information. Notes on the analysis and interpretation of the acquired information should be clear and complete enough to be understood by any other building professional skilled in leakage evaluation.

In short, ASTM E 2128 presents an excellent and well-delineated overview of a qualitative 'evaluation program' used (in full or in part) by numerous first-rate building envelope professionals across North America. For the well-trained building envelope professional, general conformance with the survey protocols published within ASTM E 2128 constitutes a form of analytical rigor comparable to the validated tenets of qualitative analysis practiced within the social

science fields. If this survey process and its findings are reviewed during the course of litigation, the rules of evidence clearly have been satisfied when a building envelope expert's sampling methodology and analysis are founded upon ASTM E 2128.

It is important to recognize that qualitative and quantitative sampling methodologies constitute alternative, but not mutually exclusive, strategies for investigative research. The experienced, pragmatic investigator practices a situational responsiveness that recognizes that differing methods and techniques are appropriate for different circumstances. In the end, the core of the scientific method for all quantitative and qualitative surveys consists of a puzzle-solving strategy or methodology for analysis (or elimination) of rival explanations or hypotheses. This strategy may start its puzzle solving with hypothesis (i.e., quantitative analysis) or it may start with evidence (i.e., qualitative analysis). The quantitative survey begins by forming a hypothesis that can be evaluated statistically upon later collection of evidence, while the

qualitative survey starts the puzzle-solving process by collecting evidence from which substantive explanations will emerge. In both cases, the core of the scientific method is represented by the strategy of analysis of plausible rival hypotheses. ■

Notes:

¹www.astm.org.

²L. Houghton and C. Murphy, *Qualitative Sampling of the Building Envelope for Water Leakage*, Journal of ASTM International, Volume 4, Issue 9 (October 2007).

A critical reference resource for this article is Michael Quinn Patton's excellent book: Qualitative Research & Evaluation Methods (by Sage Publications).

Credit for the very insightful perspective regarding 'plausible rival hypotheses' belongs also to Donald Campbell for his widely acclaimed foreword to R. K. Yin's book: Case Study Research: Design and Methods (by Sage Publications).