

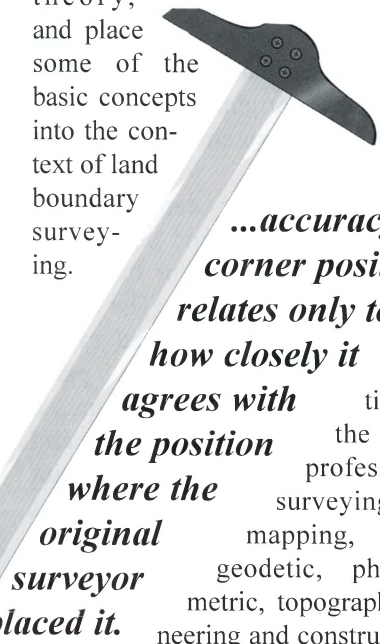
On Property Corners And Measurement Science

By Dr. Ben Buckner, LS, PE

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This article is the fifth in an ongoing series of articles by Dr. Ben Buckner entitled *Nature of Measurement*, printed in the *Professional Surveyor Magazine* beginning in March 1997

In the first four parts of the Nature of Measurement series, we explained the basic science of measurement. With this as background, it is appropriate to postpone further discussion of measurement theory, and place some of the basic concepts into the context of land boundary surveying.



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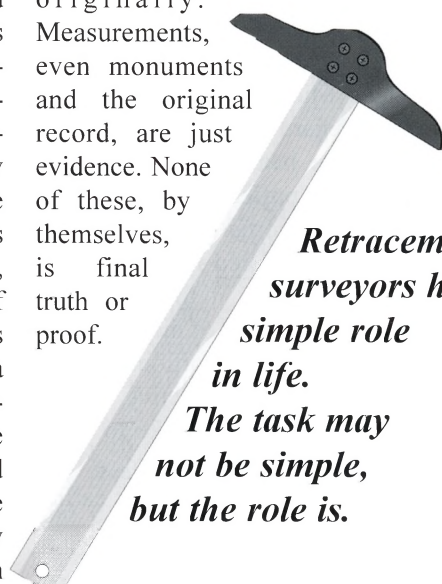
Most specialties within the broad profession of surveying and mapping, such as geodetic, photogrammetric, topographic, engineering and construction surveying, as well as cartography and land information systems, are concerned primarily with measurements and portrayal of three dimensional, earth-related data. Thus, the science of measurement as it affects specifications and standards on the accuracy of data sources, data gathering and data portrayal, is the primary body of science employed in these specialties. In land boundary surveying, however, we have an additional concern. This is accuracy in position of property corners, which depends on something besides measurement accuracy.

ACCURACY OF A PROPERTY CORNER

The “something” is evidence of where the corner was located by the original surveyor. Starting as far back as the Land Act of 1800 regarding public land surveys, and much earlier in boundary cases for other land systems, accuracy of a corner position relates only to how closely it

agrees with the position where the original surveyor placed it. This means, for example, the location where an iron pipe monument came to rest after the last whack of the original surveyor's sledgehammer or where a stone rested on the day of the original survey. The accurate position is not where that surveyor mathematically or otherwise intended it to be, the precise coordinate position resulting from a weighted least-squares adjustment of the original (or subsequent) data, the position of the monument if disturbed, or the position of a new monument set by a later surveyor who may have ignored some original evidence. Where it existed in the field is controlling over dimensions and other citations in the description. “Truth” is only found in where the corner was monumented originally.

Measurements, even monuments and the original record, are just evidence. None of these, by themselves, is final truth or proof.



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The original surveyor has no problem determining truth. He or she is the “alpha and the omega” on this. That surveyor has a responsibility to obey the intent of the conveyance, and to preserve the position of the corner monuments by several means (including accurate measurements). But as time passes and property owners acquiesce in the set lines, that surveyor is forgiven for mistakes, errors, ambiguities in interpreting intent, making measurements, setting monuments

and preparing descriptions. The retracement surveyor inherits the problem of determining what the original surveyor left as evidence for the corner being investigated. Retracement surveyors have a simple role in life. The task may not be simple, but the role is.

CORNER VS. MONUMENT

In order to better understand the points being made here, it is important to differentiate between “corner” and “monument.” A corner is a point where a property line changes direction, or the point of intersection of two or more boundary lines. A monument is a physical marker, marking or natural feature identifying the location of a property corner found in place, set or otherwise marked to preserve and perpetuate the position of the described and surveyed corner. A monument marks, or identifies, and helps perpetuate the location of a corner. A monument is vulnerable to disturbance and is never permanent. The corner is permanent and unalterable, unless altered by deed or other legal means. A monument, or evidence of one, may or may not exist at a corner. One may never have been set. Or, all evidence of the original may have been destroyed. Yet the corner, being described in a legal description and made part of a deed, does exist. Records, verbal and other physical evidence are supposed to be sought and used.

At the risk of confusing the issues, it needs to be said that a boundary retracement surveyor is primarily looking for corners, not monuments. Monuments are just part of the evidence. The final conclusion is measurements relate to monuments; analysis of evidence relates to corners.

TWO BODIES OF KNOWLEDGE

From all this, we must conclude that some body of knowledge other than measurement science, must apply to locating property corners. Indeed, there

is! This second body of knowledge embraces law, primarily case law on boundaries and judicial rules of evidence, as well as history and other disciplines. The practice of this body of knowledge is detective work. The person practicing it is properly delving into forensic science more than measurement science. Let no one deny it - this other body of knowledge is as complex and interesting as that related to measurement error theory.

The "art" of surveying is not just a free-wheeling "I think I'll put it here today because I am licensed" act. It is making judgments. Property surveyors need complete knowledge of both the measurement science and the law on boundaries

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There are two different analytical processes each probably using a different area of the brain. This dual way of thinking can become confusing, even for seasoned surveyors. Most people seem to be able to think one way or the other. Crossing over into another way is difficult. In my opinion, truly professional surveyors know how to think both ways simultaneously, and can apply both bodies of knowledge to analyses.

We have two components of "truth" applicable to locating land boundary corners. One is measurement "truth"-accuracy of dimensions between physical features described; the other is evidentiary "truth"-accuracy of conclusions about the corner position, based on the evidence.

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THE MULFORD EFFECT

Possibly the most quoted book on land surveying this century is A. C. Mulford's *Boundaries Landmarks*. And, probably the most famous quote is from his preface, where he declares:

It is far more important to have faulty measurements on the place where the line exists, than an accurate measurement where the line does not exist at all.

I don't think Mulford intended for surveyors to disregard measurement accuracy. Yet, I have heard many surveyors quote this, get "puffed up" about their ability to put the corner back where the original surveyor placed it, and scoff at the idea of correcting it for systematic errors or doing any kind of measurement analysis other than proportionate measurement. My own perspective on the subject, and what I would like to think Mulford would say now if he knew how many surveyors have misused his earlier statement, is:

It is important to first locate the corner from analysis of all relevant evidence bearing on its original position, applying common law rules and principles and, after the corner is thus located and monumented, to perform accurate measurements between the monuments, to analyze the measurement uncertainty, and to make appropriate and theoretically correct statements about this uncertainty.

In this statement, use of measurements in

the first phase of restoring the corner is implicit, even though not expressly stated. If measurements are cited in a description or on a plat, they are part of the evidence. Where monuments are "called for," the case law dictates that measurements are secondary or informative, but they must be considered nevertheless. Therefore, analysis of their precision and accuracy becomes involved in the process of analyzing the evidence. Furthermore, when all other evidence of the corner is lost, measurements rise to the status of "controlling." Thus, the importance of accuracy and error control, both in the original measurements and in retraced measurements, cannot be denied.

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little more philosophical. Measurements embody the very meaning of surveying. Ignoring measurement accuracy and analysis is tantamount to a doctor ignoring medicine or a lawyer ignoring rules of evidence. Third, accuracy in measurement helps preserve the evidence for future generations. This may be the most important reason, since it affects both the public and the profession. It leaves the survey in better shape than before, to everybody's benefit. It is simply the professional and the "right" thing to do.

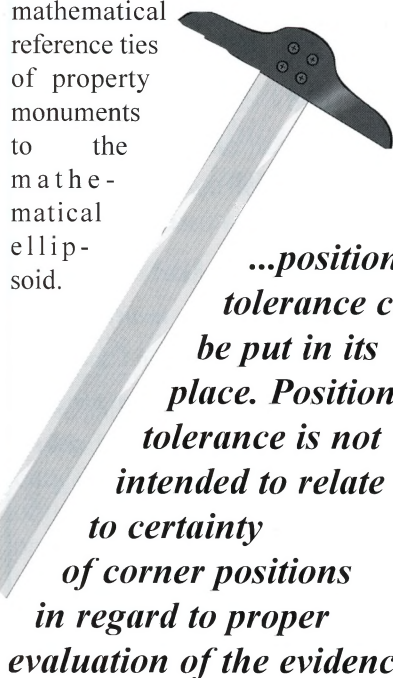
MEASUREMENTS AND MONUMENTS

Distances and directions must be made

with respect to something. Throughout land boundary surveying history, dimensions have referred to physical monuments cited in descriptions or on plats. Physical monuments are a convenience for surveyors and landowners, to enable them to visually perceive the property boundaries.

Coordinates represent measurements with respect to an origin that is often outside the local survey area. Coordinates, whether geodetic, geocentric, local geodetic horizon or state plane, represent mathematical

reference ties of property monuments to the mathematical ellipsoid.



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But, none of the monuments, even those presumably set to represent the corners, are the corners themselves, nor are the coordinate reference ties. As a collection of physical objects and measured data, they are but evidence of the corners.

A WORD ON POSITIONAL TOLERANCE

The controversy and sometimes emotional reactions to ideas such as "positional tolerance" are grounded in misunderstanding of the need to consider both the science of measurements and the art of evaluation of evidence. The controversy is also caused by some basic misunderstanding about the difference between a corner and a monument, and on the historical and cultural importance placed on physical monuments. Some of it is just fear of having to deal with anything different.

If all we've said thus far has been digest-

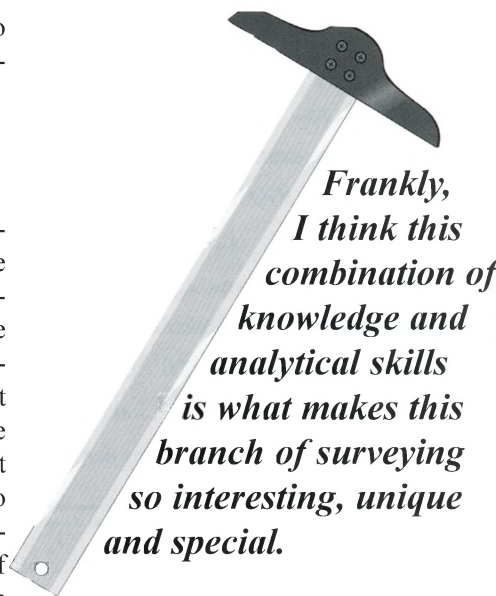
ed, positional tolerance can be put in its place. Positional tolerance is not intended to relate to certainty of corner positions in regard to proper evaluation of the evidence. It should be viewed as referring only to the accuracy and level of certainty of measurements as related to the positions of the monuments purportedly marking the corners relative to each other, to a specified control monument, or to a geodetic or other datum. Positional tolerance is just another way of expressing uncertainties in measurement, for the sake of preserving evidence of the relative positions of interdependent corners in a land survey, and for expressing the measurement integrity of the survey.

Any surveyors who would certify to a positional tolerance of a corner are being foolish, unless they have somehow learned to quantify judgment. "As per evaluation of the evidence" cannot be placed into the context of error ellipses or statistical level of certainty. Personally, I think we need to keep the two certifications or declarations separate, and also that there are probably ways other than positional tolerance to describe measurement quality (the subject of another discussion, perhaps).

TOWARD TRUE PROFESSIONAL SURVEYING

Besides the cases of complete incompetence, where some surveyors fail to use either adequate evidence or proper measurement analysis, I think there are three common failings being made in retracements. In each, the surveyor is getting it partly right but neglects something. The first is the practice of using measurement and calculations almost exclusively to determine or establish "correct" positions. This is the failing that Chief Justice Thomas M. Cooley addressed in his famous statements over 100 years ago. It is the same failing that many "Total Station/COGO Jockeys" still have today. The second failing is to disregard measurements as an aid to help gain a preponderance of evidence or a "best fit" solution in difficult situations. The third is to do a fair job on the evidence, perhaps even integrating measurement analysis to help gain a preponderance, but to do shoddy work in correcting for

systematic errors and controlling random errors in the new measurements, and/or even just leaving the old, inaccurate measurements in the deed or on the plat. We must learn to combine measurement science with rules of evidence and forensic science, in order to both find original corner positions and preserve them for future generations. Frankly, I think this combination of knowledge and analytical skills is what makes this branch of surveying so interesting, unique and special. When a land surveyor develops both areas of expertise, and has the ability to switch automatically from one to the other, that surveyor is a true professional. Such a surveyor towers above land surveyors who neglect some of the analysis and evidence, is more well rounded than geodetic surveyors who are prone to look only at the positional accuracy, and is certainly broader and more analytical than most lawyers who haven't gotten past the difference between a measurement and a count. Land surveying, what a wonderfully complex and interesting profession!



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Dr. Ben Buckner - is an educator, author, seminar presenter with Surveyors' Educational Seminars and a Contributing Editor for the Professional Surveyor magazine.

