Using ASCE 38 to populate a 3-D Utility Map

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ASCE: Chair Positions – ASCE 38, Utility Engineering Committee, Construction Standards Council Chair Emeritus, Codes & Standards Board Committee
Member – Utility As-Built Standard, Board Committee for Technical Advancement, EJCDC, Codes & Standards Board Committee Liaison – Geomatics Division, Forensic Engineering Division
Silent on any mention of depth / elevation / “z” except of Utility Quality Level A

QLA must be obtained through survey of exposed utility

Inference and interpretation was that no indications of depth could be placed unless it came from exposure.

Correct interpretation is that “z” values can be placed on any utility information, but only QLA can have an accuracy as an attribute.
ASCE 38 (new addition) will say:

- Place notes on the plans explaining the origin and qualifiers of any depth information depicted on the plans. See Appendix for additional information on vertical information / depth.
BIM & 3-D Design becoming more prevalent
Where will the “z” attribute for utility data come from?

- As-built it as it goes in
  - Did we capture accurate “z”?
  - Were the “z” points sufficient in number?
  - How reliable was the person / technique for capturing?
  - If it’s wrong, who’s responsible?

- Methods?
  - Lidar
  - Photo-referencing
  - GPS / conventional survey
What about existing Utilities already in the ground?

- Where can we get “z” data?
  - Test holes
  - Known measurable points other than test holes
  - Geophysics
  - Records
  - Make it up based upon some rationale
    - Guess
    - Historical knowledge
    - Algorithms
Where can you get accurate data other than test holes?

- Enter Basements
- Know relationship between basement ceiling and outside ground
- Measure pipes / cables coming in wall to known reference

Only gives a single depth point that's valid
Where can you get accurate data other than test holes?

Measure down at valves

Top of valve, Not top of pipe

Filled with dirt

Sources of error: depth not elevation, Are you on the pipe?
Where can you get accurate data other than test holes?

Measure Down In Vaults
All these data can be accurate, but they are only Single Points
How do we Connect The Points?

INTERPOLATION METHODS

Does this look like any kind of piping system you’ve ever seen?
All these data can be accurate, but they are only Single Points.

Point-to-Point Constant Grade

Is this any better?
All these data can be accurate, but they are only Single Points

The 50% Constant Grade Method
SO WHICH METHOD IS RIGHT?
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So it’s Obvious That we need to Fill in the Gaps with Something Better Than Existing CADD Program Solutions

- Geophysics Offers a Solution
  - Cannot put an accuracy to any “z” values
  - What is the “z” data density? (cost and time and process)
  - What are the Q.A. procedures to check the values?
  - How do we depict?
All Geophysics are not created equal

- **GPR**
  - Relative "Accuracy" INCREASES

- **Sondes**
  - Relative Ability to Image Utilities INCREASES

- **Pipe & Cable Locators**
Relative “Accuracies” / Relative Effectiveness

- **GPR**
  - +/- ½ Foot : < 40% in good soils

- **Sondes**
  - +/- 1 Foot : < 1%

- **Pipe & Cable Locators**
  - Too variable to say: 80%

- Relative “Accuracy” INCREASES
- Relative Ability to Image Utilities INCREASES
Depth Records

DANGER

WILL ROBINSON,
DANGER
Without Method Differentiation, the Whole Purpose of ASCE 38 is Moot. Decreased Ability to Manage Risk

Image incorporates main street data point cloud, with a combination of various undifferentiated methods of populating the “z” RECORDS / TEST HOLES / GEOPHYSICS / FILL IN THE GAPS
Individual Utility Profiles are easy to Differentiate
3-D Models Less So

- Error of “z” compounded with error of ground topo elevation
- How do you depict various types of geophysics methods, test holes, measure-downs, and records in this 3-D view?
For a 3-D map “as good as it gets…..”

- Perform all possible measure-downs
  - Document sources of error and correction (dirt in valve, top of valve, basement/ground interface)
- Use all possible appropriate geophysics
  - Training of technicians in how to recognize “good versus bad” depth readings absolutely critical
  - Need robust Q.A. program to check values in field and office
  - Need to differentiate geophysical methods for every single line, point, or polygon
- Reliance on automated CAD algorithms dangerous
- Need adequate ground-truthing / QLA data for correlations