LEVERAGING NEW TECHNOLOGIES

NEW AND IMPROVED PRODUCTS WILL MAKE YOUR PROJECTS MORE PROFITABLE

TECHNOLOGY OFFERINGS

- **Total Stations**
- **LIDAR**
- **Photogrammetry**

INTRODUCTION

- **Our world has gone beyond a rover and machine control**
- **A corrected signal at the end of a cable or antenna**
- **What works the best?**
- **Product maturity**
- **Easy to learn, easy to use**
- **Integrate into the work flow**
- **Cost of ownership**

TOTAL STATIONS FOR CIVIL WORK

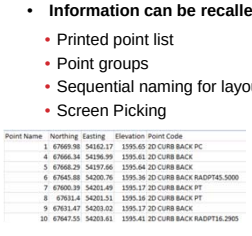
- **The price starts to make sense**
- **Best solution for detail work**
- **Best solution for precision machine control**
- **Some additional requirements that are not hard to learn**

THREE PHASES OF WORK

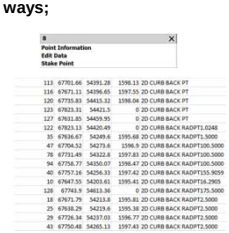
- **Pre-Process**
- **In-Process**
- **Post –Process**
- **Same steps apply for all positioning methods**

PRE-PROCESS PHASE

- **The best friend of a TS is point layout**
- **Information can be recalled in several ways;**
  - Printed point list
  - Point groups
  - Sequential naming for layout
  - Screen Picking



Point Name	Northing	Easting	Elevation	Point Code
1	67669.98	54162.17	1595.65	2D CURB BACK PC
4	67666.34	54196.99	1595.61	2D CURB BACK
5	67668.29	54197.66	1595.64	2D CURB BACK
6	67645.88	54200.76	1595.36	2D CURB BACK RADPT45.5000
7	67600.39	54201.49	1595.17	2D CURB BACK PT
8	67631.4	54201.51	1595.16	2D CURB BACK PT
9	67631.47	54203.02	1595.17	2D CURB BACK
10	67647.55	54203.61	1595.41	2D CURB BACK RADPT16.2905



Point Information
Edit Data
Stake Point

113	67701.66	54391.28	1598.13	2D CURB BACK PT
116	67671.11	54396.65	1597.55	2D CURB BACK PT
120	67735.83	54413.32	1598.04	2D CURB BACK PT
123	67823.31	54421.5	0	2D CURB BACK PT
127	67831.85	54459.95	0	2D CURB BACK PT
122	67823.13	54420.49	0	2D CURB BACK RADPT1.0248
35	67636.67	54249.6	1595.68	2D CURB BACK RADPT1.5000
47	67704.52	54273.6	1596.9	2D CURB BACK RADPT100.5000
78	67731.49	54122.8	1597.83	2D CURB BACK RADPT100.5000
94	67758.77	54350.07	1598.47	2D CURB BACK RADPT100.5000
40	67757.16	54256.33	1597.42	2D CURB BACK RADPT155.9059
10	67647.55	54203.61	1595.41	2D CURB BACK RADPT16.2905
128	67743.9	54613.36	0	2D CURB BACK RADPT175.5000
18	67671.79	54213.8	1595.81	2D CURB BACK RADPT2.5000
25	67638.29	54219.6	1595.38	2D CURB BACK RADPT2.5000
29	67726.34	54237.03	1596.77	2D CURB BACK RADPT2.5000
43	67750.48	54265.13	1597.43	2D CURB BACK RADPT2.5000

IN PROCESS PHASE

- **Setup TS**
- **Know your plan and have correct info loaded**
- **Site planning is critical**
- **TS needs line of sight**

TRIMBLE SPS 930 AND SCS900

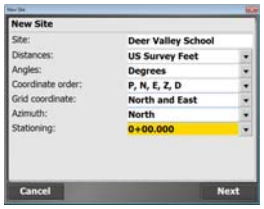
- **Universal Total Station**
  - Stakeout, topo, machine control and scanning
- **High accuracy and repeatability**
- **Long battery life**
- **Fast and agile tracking**

POST PROCESS PHASE

- **Download staked and TOPO data from the data collector**
- **Store in dated folders for retrieval later**
- **Verify the work done in the field**

ROBOT SETUP ON THE SITE

- **Setup is similar to a regular work order with SCS900**
- **Total Station specifics are intuitive and easy to go through**



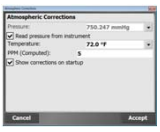
TYPES OF INSTRUMENTS

2 person gun

- Low initial price
- Easy set up means it gets used more
- Three second guns are OK for small sites
- One second is the width of a pencil lead at 100 meters

SPECIFICS FOR SETUP

Some new Windows to learn



ABOUT THE TARGET

- For initial setup, a pole and bipod will work well
- After the instrument is located you have options
- A short prism to ground distance is the best way to improve accuracy

ALL ABOUT POINTS

Points are the best way to locate any position in 2 or 3 dimensions

The TS has an advantage with locating points

Additional items beyond the surface can be located with a robot

BASIC LAYOUT

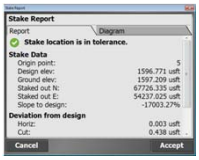
- The advantage of TS over GPS location is precision, repeatability and accuracy.
- Precision refers to the closeness of two or more measurements in relation to each other. This relates to layout

STAKING A POINT

Hold the cursor on a point to stake it

The instrument will provide navigation information in relation to itself.

You are able to set your desired accuracy and tolerance depending on what work is being performed.



BASIC LAYOUT

- Repeatability is the variation in measurements taken by a single person or instrument on the same item and under the same conditions. A measurement may be said to be repeatable when this variation is smaller than some agreed limit.
- Accuracy is the combination of precision and repeatability. This relates to checking into control points.

MAKE MEASURING EASIER

An engineers tape cut in 1 foot segments is an invaluable tool

Folding wood rules are available with decimal feet

The near/far and left/right distances can be moved with the one foot segment

Measurement is faster

PRECISION LAYOUT PROCEDURE

Set up the TS target so it is as close to the ground as possible

TOTAL STATION HEIGHT

- **Bring down the height of the tripod the instrument is mounted on**
- **This allows you to get over the point and place with greater accuracy**
- **Easier to start and finish the measurement on the ground**

SUMMARY

- **TS will hit the bulls eye on a consistent basis**
- **Environmental conditions are less of an issue**
- **But wait, there's more!**

TS THOUGHTS

- **One to one relationship**
- **Machine robots multi task but cost more**
- **The most versatile tool you may own**
- **Do you really need a total station?**

PRECISION LAYOUT

- **Accurate signal at the end of the cable**
- **Enough, proper information in the data collector**
- **Effective means to layout and retain**

ANOTHER WAY?

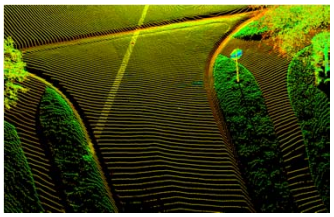
- **Topcon LN-100**
- **Strip away unnecessary elements found in total stations**
  - Sight component
  - 100 meter range
  - Keyboard
  - Tribrach
- **Auto level**
- **Localization**

PRODUCT SPECIFICS

- TS prices are better all the time
- LN-100 fills a gap for those without need for MC
- Same software in the office and field to prepare data
- TS can be a multi-tasker
- A scanning total station might be the answer

PRE PROCESS PHASE

- Plan scan locations
- Verify solid control
- Pre-load any available information



LIDAR

- Light detection and ranging
- Three types
  - Terrestrial
  - Mobile
  - Airborne
- For daily use, terrestrial is the most beneficial
- Mobile and airborne are advantages at the beginning or end of a project

IN PROCESS

- Set up and localize
- Set scan parameters
- Execute scan
- Move and repeat

LEICA SCAN STATION C10

- Onboard or PC control
- GPS and prism options
- Fast setup and relocation
- Field verify scan results

POST PROCESSING

- Raw scan data can contain millions of points
- Initial import and file transfer requires serious hardware
- Processed data is easier to work with
- Civil contractors can rely on coarse scan parameters

SUMMARY

- Hardware gets cheaper all the time
- Buy terrestrial, contract mobile and aerial
- Proprietary software will process data faster, it can be expensive
- Best solution for crew safety
- Images can be integrated into scan data in post

PRE PROCESS WORK

- Datumate is a robust software
- Verify control, enough good points on the site well marked
- Properly calibrated camera

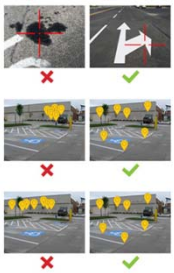
CONTRACTING SCANS

- Know what level of detail required
- Roadway renovation requires high density
- As-built imaging needs detail in congested areas, relaxed collection in graded areas
- Request RAW data and processed scans
- Work with RAW data to learn processing in order to bring in house

IN PROCESS

Measuring control points

- Choose **clearly defined** control points
- Accurately measure **position and elevation** of control points, **better than 2 cm accuracy**
- **Scatter** the control points across the survey area
- Choose control points on **more than one plane**



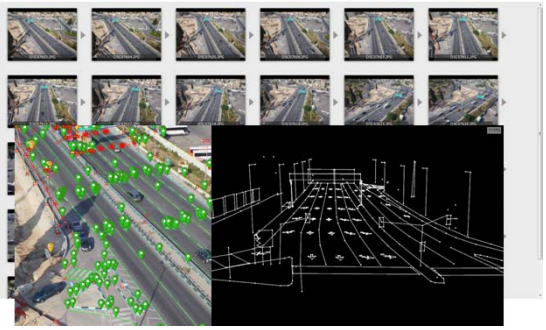
PHOTOGRAMMETRY

- Making measurements from photographs
- Technology has been used in GIS for years
- New software and processes make it viable for accurate civil site measurement

POST PROCESSING

- Better collection results in better data
- Import images
- Program will stitch and align to control
- Check accuracy
- Acquire point elevations
- Draw 3D polylines
- View reports
- Connect to AutoCAD or export file

THE PROCESS



PRE PROCESS

- 2 orange cones and a way to get them 25 feet apart

SUMMARY

- Datumate is stable and has a lot of features
- Major upgrades still occurring
- Easy to learn
- Reasonable upgrade cost
- Highly dependent on quality of field data collection

IN PROCESS

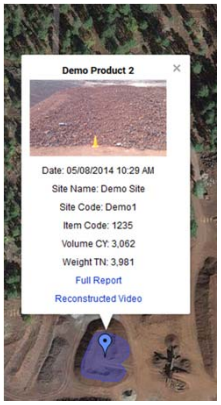
- Set up cones
- Open app on phone
- Walk the perimeter of the pile, overlaping the length of the cones with the scan

STOCKPILE REPORTS

- Volumes from your mobile phone
- Quick turnaround
- Reasonable cost

POST PROCESS

- Upload scan from phone
- Results are returned



SUMMARY

- **Quick and easy**
- **Pay per pile**
- **Quantity discounts**
- **Accurate**

QUESTIONS

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THE TAKE HOME MESSAGE

- **Our industry is moving beyond a base and rover**
- **Developers are giving us tools we never knew we needed**
- **Software is becoming more intuitive**
- **Profit margins will get skinnier as work increases**

HOW TO EVALUATE YOUR NEEDS

- **Defer to accuracy first, then speed**
- **Make one move at a time**
- **Bring the product into your work flow from pre to post before adding additional assets**
- **Verify the true cost of ownership**
  - Initial purchase
  - Additional software
  - Hardware and software maintenance
  - Product maturity and life cycle