Carlson UPDATE

The Official Newsletter of Carlson Software, Inc.

Fall 2005

## Note From the President

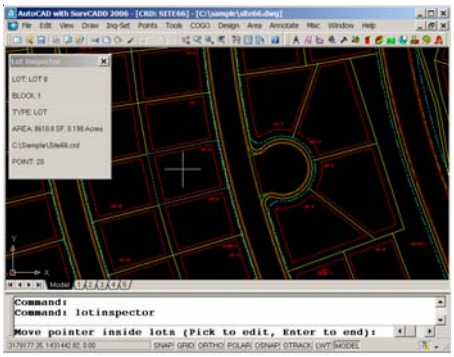
Carlson Software has brought out several new products in 2005 and continues to push forward as a software leader in the survey, civil engineering, mining and construction markets. Starting with surveying, we released Carlson SurvCE 1.5 early in 2005, and are now up to Release 1.5.008.4 as of this printing. Carlson SurvCE drives virtually all GPS and total stations, including robotics. It has emerged as a market leader, with growing worldwide popularity. We've also developed our own data collector: The Carlson Explorer. We offer the Carlson Explorer I and have recently introduced the Carlson Explorer II, priced slightly higher but offering more memory (256 Mb) and a weather-resistant IP65 rating.

Back at the office, we have released Carlson SurvCADD 2006 and Carlson Survey 2006, and updated the other AutoCAD OEM-engine products (Carlson Roads 2006 and Carlson Field 2006). In January, we released the breakthrough Carlson Takeoff — another OEM product designed specifically for the construction estimation market. Also in January, we released Carlson Grade, a machine control product we refer to as having "4 alls" — it works with all GPS and TPS equipment, has all applications (mining, construction, landfills), works on all heavy equipment (dozers, motor graders, excavators, draglines, even barges for pile driving) and handles all operating systems (Windows, Linux, Windows CE on demand). No straightjacket, it is just right for your machine control needs.

These exciting new products have propelled a tremendous company growth (doubling of revenues in two years). But we know this growth really is based on relationships — our relationship with you, the customer, and our many authorized resellers worldwide. We are determined to provide the highest service that we can with free, "real live" technical support and on-site training on request. We've got much more in the works, so stay tuned for what's next!

## Carlson SurvCADD 2006: New Features

Carlson SurvCADD 2006 was released on March 29, 2005 as a significant upgrade that is fully compatible with AutoCAD 2006 and earlier releases of AutoCAD, back to AutoCAD 2000. Two new modules made their debut with Carlson SurvCADD 2006 — Carlson Natural Regrade for land reclamation and Carlson Takeoff for construction estimation. Both modules represent major technology breakthroughs.




New Lot Inspector Feature in Carlson SurvCADD 2006

The Carlson Natural Regrade module uses advanced algorithms, implementing the science of hydrogeomorphology to regrade disturbed land into natural landforms based on rules for drainage density, stream profiles and sinuosity. Complete terrain models are created with 3D polylines defining ridges and stream courses. By design, these steady-state landforms minimize erosion. Carlson Natural Regrade applies to mine reclamation and any major land disturbance.

The Carlson Takeoff module of Carlson SurvCADD, in combination with the "basic 3" modules, offers construction estimators digitizing from paper plans, but adds unique tools to "elevate" drawings to correct 3D positions. Carlson Takeoff is typically purchased as a "stand-alone" product. For information on Carlson Takeoff, please refer to pages 2 and 3. Other Carlson SurvCADD improvements include:

- Label Overlap Avoidance in Auto-Annotate
- Faster triangulation and new "TIN" file format for triangulated surfaces
- Fast Editing of Pads designed by TIN file, with instant redraw after moving pad position or pad vertices, or after entry of new slopes or pad elevations
- New Lot File Inspector showing Lot data in real-time
- Quick Profile with real-time drag and update — use also to check ground slopes
- Contour Labels can mask underlying screen entities for crisper drafting
- For Hydrology, energy and hydraulic grade lines can be drawn and sewer pipe networks can now be viewed in 3D, in addition to profile view.
- Drawing Cleanup — removes duplicated polylines, empty layers, converts LDD contours to standard polylines and, in general, "fixes" drawings for efficient use in Carlson SurvCADD

Carlson SurvCADD 2006 has over 100 new commands and over 300 distinct improvements that save keystrokes and speed up work.

### *HIGHLIGHTS*

## Announcing Carlson Survey 2006, Carlson Roads 2006 and Carlson Field 2006

Carlson Survey 2006, Carlson Roads 2006 and Carlson Field 2006 (renamed from Tsunami) were released on July 15, 2005.

The OEM engine is still AutoCAD 2004, thus all three products are fully compatible with AutoCAD 2006 drawings.

All new features in Carlson Survey are found in Carlson SurvCADD as well. Some of particular interest, not mentioned earlier, include:

- Level note and total station raw data processing options, with more flexible reporting and graphics
- A complete project archive and recall command for saving all project files in one zip file
- More polyline utilities (eg. remove duplicate polylines, erase by closed polyline, inside or out)
- Double-clicking points on screen now launches the Edit Point Attributes command
- Line by Angle and Distance has been added
- 2D Align routine can now quickly re-scale and rotate a drawing in one step without impacting elevations
- New Deed Correlation fits surveyed data to deed calls
- Expanded 3D Viewer Window feature includes an image inspector which reports elevations of highlighted entities

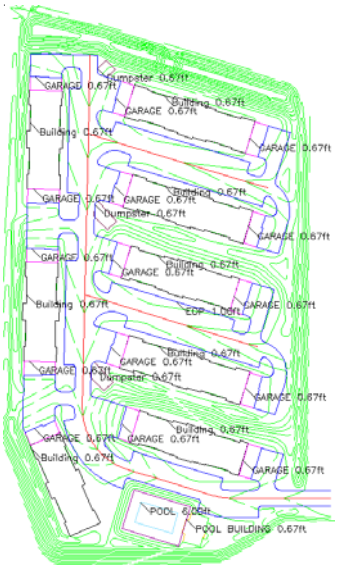
Carlson Roads now includes station equations. An especially useful addition is the graphic preview window on loading all centerlines, profiles and templates — you can verify that the file is the one intended. Profiles can now be designed by circular curve (popular in Europe), in addition to the standard parabolic curve (standard in the U.S.). Input-Edit Profile is fully graphic, with dynamic sag-crest calculations during entry and editing. Process Road Design allows for profile transfer from crown in divided highways to inside edge-of-pavement at "reverse crown", as a new option. Curb and median libraries can now be stored and recalled for use in new template design.

Carlson Field includes more equipment driver support, such as the Leica 1200. New features include an improved resection procedure.

## Carlson Takeoff: The Future of Construction Estimation

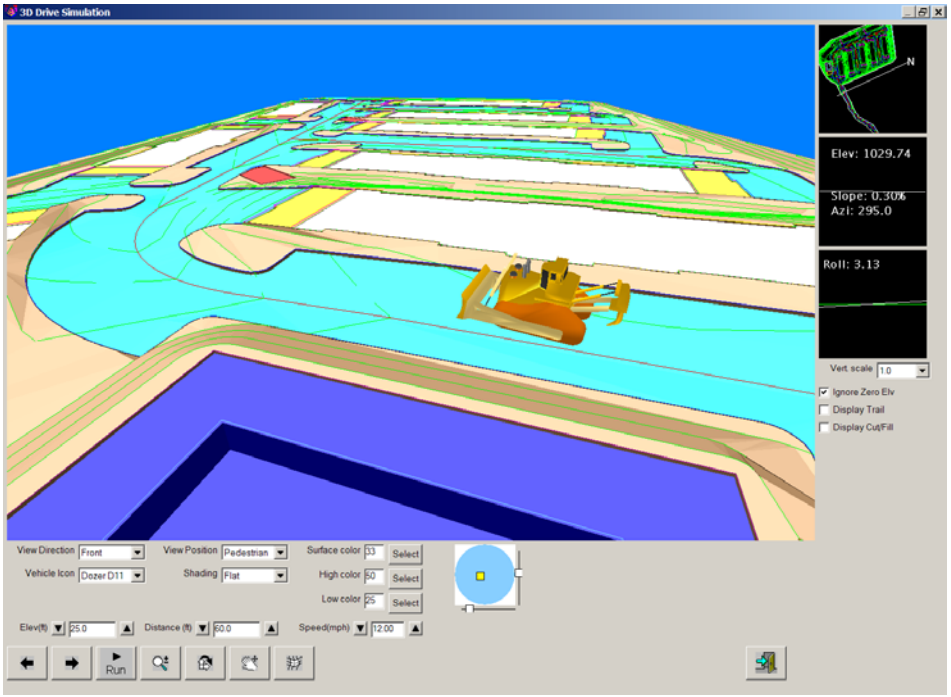
Because so many drawings are available now in electronic form, the challenge has moved away from digitizing to "correcting" drawings for 3D accuracy. Carlson Takeoff represents the future of construction estimation. Entire curb lines defined by leaders with elevations can be converted to 3D by selecting one sample leader line. Special "region" logic autodetects inside and outside loops for parking with subgrades and for topsoil removal, eliminating "causeways" to accomplish exclusion polylines. Volumes are triangulation-based for maximum accuracy. Carlson Takeoff also offers a high-quality 3D graphic drive-through option for verifying grade. Everything can be verified by hatching, from topsoil replacement to subgrade areas to cut/fill in the form of blue/red shading.

If you have "paper plans", Carlson Takeoff offers standard digitizing of both plan views and cross sections using the GTCO digitizer (others can also be configured). Cross sections can then be turned into contours in plan view in seconds, using Sections to 3D Polylines followed by Triangulate & Contour. Carlson Takeoff works by identifying existing and design surfaces by layer name, then defining which closed polylines represent surfaces that should be dropped




Site plan view with contours and subgrade areas

for subgrade, or used to define topsoil removal or replacement. Outputs include cut and fill, topsoil quantities, material quantities associated with paving and buildings,




Resulting Carlson Takeoff Site Model in 3D Drive Simulation Viewer

and "counts" of items such as grates, valves and manholes.

Carlson Takeoff is another "OEM" product that takes advantage of the AutoCAD engine — so all the power commands of vertice gripping and moving, "snapping", copying and editing are available to the user, not to mention the unrivalled AutoCAD graphic engine itself.

Carlson Takeoff makes short work of estimation and also feeds 3D machine control. And not only does it do classic dirtwork but it has entire pulldown menus dedicated to rock borings (for rock, sand and other material quantities), to trenching and to road design. Carlson Takeoff, with a list price of $9000, is the complete solution.

## Carlson *Tech Tips*

### DTM Surfaces for Estimating and Machine Control: Hybrid Road and Contour DTMs

There is a new challenge facing contractors, and the surveyors and engineers who work for them. The challenge is to produce accurate digital terrain models (DTMs) for dirtwork estimating and even more so for machine control. Industry forecasters estimate that within five years, the majority of earthwork on large projects will be conducted by machine control methods using precise DTMs loaded on computers in the cabs of the heavy equipment. Never has it been more essential to have the tools and skills to make these dead-accurate DTMs.

In a perfect world, the DTMs would come ready-made from the project design engineer or the DOT bidding the work. But this isn't happening. In nearly all cases, you need to make the terrain models yourself from the paper plans or digital drawings. So let's talk about a typical subdivision project and how you must use both road and contour-based techniques to complete the work accurately. The methods outlined will be those found in Carlson SurvCADD, but the same routines can be found in Carlson Takeoff or the combination of Carlson Survey and Carlson Roads, used together.

Consider the everyday, commonplace subdivision condo development shown in the below-left graphic on this page.

To establish the dirt grades to be created by dozers and motor graders, there are about ten DTM concepts that this one plan view graphic illustrates:

1. When you have roads, you must use design files for accuracy and cannot use contours, which will "miss" high and low points and will not reveal subgrade. Erase all contours within the known road template region (as shown at below left) and create new 3D polylines using road design features. The dark perimeter line for Lakeside Drive could be used to "Erase Inside" all contours.

2. For roads that don't follow fixed template widths, use "Template Point Centerline" to assign polyline alignments to one or more key template IDs, to enable lane widening and contracting.

3. If the roads have superelevation (as evidenced from the contours or cross sections), then you need to create superelevation files for the roads, either direct from the plan information provided, or estimated "from centerline" using trial and error on design speeds.

4. At Road Intersections, the elevations of edge-of-pavements and other features must be transitioned, one method being 2D to 3D polyline by Start-End Elevation.

5. For Road Islands, subgrades typically are graded straight through the island, and the islands are backfilled later. For machine control subgrade DTMs, simply ignore.

6. For pads, create pad polyline perimeters (try Shrinkwrap or Draw Building Envelope) for the area to be cut for foundation grade, including the working area for the footers, and set these pad polylines to the correct subgrade elevations.

7. For areas between pads and roads, use design contours for grade, considering topsoil backfill if necessary.

8. Adjust or back off contours at contact with road 3D polylines, as needed. Back off contours near pads for transitional grading.

9. Where spot elevations are provided, be sure they are nodes or inserts at the correct elevation for modeling.

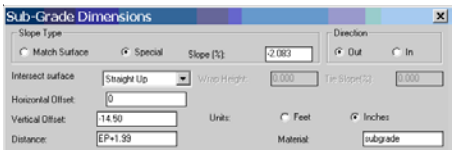
10. Identify and define "No Work" areas as closed polylines, inside which final and existing contours match, to reduce unnecessary grading. Trees can be saved in these areas, and for earthwork, the closed polylines can be used as "exclusion" polylines.


Sample Subdivision Condomium Development

#### Use Road Design Files

Start by removing contours and other inaccurate 3D elements inside the shoulder points of the roadways. Then create the basic three road design files for each road — centerline, profile and template. If you

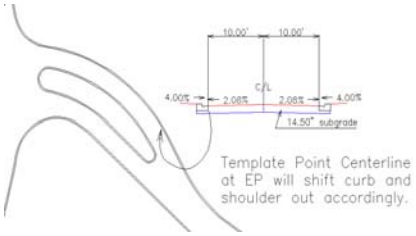
can obtain digital drawings, capture the centerlines using the command Polyline to Centerline File. It is necessary to enter the profiles and templates from design information. The template is the most critical item and is entered using Design Template. If the lane widths vary on the template, then it is important that the subgrade dimensions not be set to fixed offsets but be referenced to a template element which will respond to lane width changes, as shown below:




Note a couple subtleties here: First, the subgrade is set at a fixed slope of -2.083%, not paralleling the surface, and second, the subgrade continues out to not 12' (the back of curb in normal template) but to EP+1.99, which would follow the edge-of-pavement and add 2' for the curb, as the EP template ID point moves in or out with lane widening. The -2.083% slope continues under the curb, in this way, even if the curb is laid level. And by going only 1.99 feet, not 2.00, a subgrade point is created that does not mathematically match the top back of curb, creating a slight lean-back (batter slope) and no DTM conflicts for differing elevations at the same point.

### Lane Width Changes with "Template Point Centerlines"

Carlson Roads can be made to widen by assigning alignments to template points. If the driving lane defined by EP widens, but the curb and shoulder remain the same width, then by assigning a centerline alignment to the EP point, all template points at and beyond EP will shift out. This feature "strings" IDs along a fixed centerline and is sometimes referred to as




the "string" method of road design. The procedure is to use the drawn polylines for the right and left edge-of-pavement, and break them off where they either extend beyond the centerline in question or merge back into a normal offset. Then choose the command Polyline to Centerline File, and store named polylines for the EP offsets where they diverge from the normal template. Use Reverse Polyline under Polyline Utilities to double-check that they are going in the correct direction, same as the main road centerline. Then select Assign Template Point Centerline, and complete the dialog as shown. The template point centerline file is another of the "design files", supplementing the basic 3: centerline, profile,

## New Faces at Carlson Software

Carlson Software has more than doubled in size since the last published newsletter. Although we do not have enough space in this newsletter to mention all of the new staff here, we can update you on some of the more recent hires.

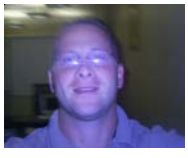
**Brian Hammer** joined Carlson Software from Kay Construction and works in tech support out of the Boston. Brian is well versed in Carlson products from his work in both construction and survey. Brian is the voice of Carlson Software in the new Carlson Takeoff video, among his other talents. bhammer@carlsonsw.com

Speaking of the voice of Carlson Software, **Jana Heath** has joined us in Maysville as our full-time receptionist. Jana worked with Bruce Carlson from 1981 to 1983 when Bruce had a survey and engineering consulting business. jheath@carlsonsw.com

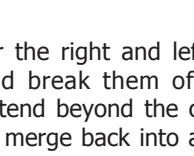
**John Gerber** signed on from Michigan Laser in the Technical Support, Training and Testing ("3T") Division of Carlson Software. John has a strong background in Topcon equipment and how it interfaces Carlson SurvCE, and is already fielding the tough questions on the office products as well. John works out of Maysville, KY. jgerber@carlsonsw.com

**Michael Burenkov** comes to Carlson Software from Boston University fresh from his Masters degree program in Point Cloud Software Technology. Michael contributes to the DTM engines of Carlson SurvCADD and Survey, and has made major contributions to the Elevate features of Carlson Takeoff, and is the driving force behind the soon-to-be-released Carlson Point Cloud software.

**Shan Lu** joined Carlson Software directly after receiving her Masters from Tufts University in Computer Science and civil engineering applications. She is specializing in the Carlson SurvCADD Hydrology Module at present, with major enhancements in the works, including "spread" analysis based on precise DTMs for water flow in streets and across grates in different storm events.

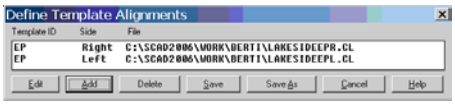


**Ken Trent** has joined Carlson Software from the SMI team within Eagle Point. After a year assisting the machine control team, Ken is now a major contributor in the SurvCE programming group, along with Carrie Morton, Romeo Alexandru and Adam Messer. Ken brings tremendous survey expertise to Carlson.



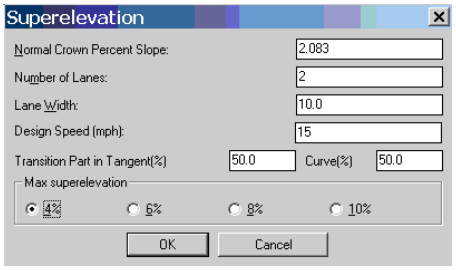
**Mike Jarjosa** joined Carlson Software from Cincinnati Financial Corp. and has a background in IT project management. Mike is currently handling IT and collections in the Maysville office.

template.

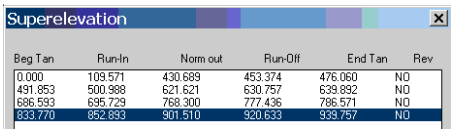



**SuperElevation Files May be Needed**

Though many subdivision roads do not "tilt" through a curve into superelevation, many others do. The quickest way to see this is study the design contours on roads through curves. If they are not symmetrical about the centerline, crowning in the middle, but run straight across at an angle, the road is in superelevation. If the project has superelevation design data, enter it directly in the command Input-Edit SuperElevation. If not, study cross sections, or study the contours themselves, to estimate superelevation for each curve. Then using the command Input-Edit SuperElevation, answer "Yes" to use Centerline File, select the corresponding centerline, and experiment with design speeds and their resulting impact on superelevation slopes:



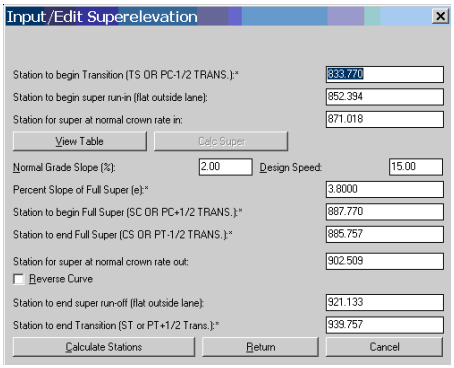

If the designers chose modest superelevation for the curves, you may find that design speeds as low as 15 mph (shown above) lead to matching superelevation results in the dialogs that follow:




Any one of the curves can then be selected and edited further for precise entry of superelevation slopes and transition stations.

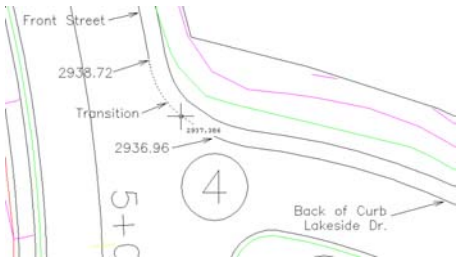
You could change the superelevation from 3.8% to just 3% if desired, to match the cross sections, and then select Calculate Stations to recalculate the transitional stations of flat outside lane and reverse crown.

When superelevation is involved, to make precise subgrades, these steps are unavoidable. Now we have five design files: centerline, profile, template, template point centerline and superelevation.




**Transitioning Road Intersections**

If a main road such as Front Street intersects with a side road such as Lakeside Drive, there will be a curving transitional segment between the Front Street normal template offset and the lane widening or normal template of the side street. Consider the back of curb 3D polyline. If the endpoints of the Front Street and Lakeside Drive 3D polylines are known, then if a 2D polyline is drawn for the transitional segment, it can be lifted to 3D by the command 2D to 3D Polyline by Start-End Elevation. Enter the elevations and the transitional 3D polyline is created, which can then be "inspected" using Drawing Inspector, as shown below:




**Set Building Pads to the Dozer Grading Elevation**

Although some dozer operators want final surface grades, and enter vertical offsets in the field, dirtwork estimation requires and many operators prefer true subgrade elevations for the building pads. This is especially the case when drive-in basements must be excavated and large building pads are involved such as for condominiums. You can use Shrinkwrap by Gap or Bound methods (under Draw) to create the building pad outer boundary, if it is composed of different lines and layers. If you want a purely rectangular subgrade for grading, use the new Draw Building Envelope command. If the building pad has multiple elevations (below), create distinct 3D pads at slight offset, to allow for transitional grading. This can be done by drawing single dividing lines and using Pad Polyline by Interior Text under Elevate, with interior offset.

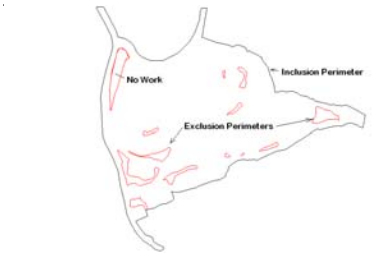
Be sure to deduct for the stone and concrete dimensions to create the true subgrade elevation for earthwork and as requested by the grading contractor for machine control. Trim or Offset the external contour polylines to allow a transitional surface. Verify that the spot elevations shown are at their correct "Z" elevation. Elevate pads or spot elevations one at a time by the Change Elevation command. If you have Carlson Takeoff, use the Elevate Spot Elevations option to elevate all spot elevations in one selection set.


**Earthwork and DTM Files by Inclusion/Exclusion Perimeters**

Once the final drawing has been prepared with accurate contours, building pads, spot elevations and road 3D polylines, a final surface triangulation file can be created for earthwork and for machine control grading. Inclusion perimeters are essential for accurate earthwork, and useful when making DTMs because they will report "Off Site" or at least report no cut/fill when the operator drives outside the inclusion area. Exclusion perimeters are useful to eliminate any earthwork calculation

in that zone. They even have application in machine control.

Using Carlson SurvCADD, Carlson Takeoff and even Carlson Survey, you can output a ".PLN" grading file to Carlson Grade, and can select the exclusion perimeters as warning zones to flash a warning to the operator that he is in a "NO WORK" zone.




In Carlson SurvCADD 2006, you can make two types of triangulation files: TIN or FLT. Carlson SurvCE and Carlson Grade will calculate cut and fill to FLT files and Carlson SurvCE will also work with the new TIN file format. Volumes by Triangulation uses both TIN or FLT.

### TIN File Utilities

If you create precise subgrades for roads and building pads and even driveway surfaces, but need to drop all other standard contour areas by 0.5' for topsoil replacement, you can either choose to lower the contours on the drawing 0.5' using Change Elevation (Difference option), or leave the contours untouched, and use TIN File Utilities to load up the TIN for the site, and then drop the topsoiled area by 0.5', based on selecting closed polylines.

### Sending DTMS to Other Grading Software

Although Carlson SurvCADD, Carlson Takeoff and Carlson Survey feed grading files to Carlson Grade seamlessly, the best way to feed other grading software is to get all 3D polylines, contours, building pad polylines and spot elevations correct, then draw 3D Faces of the DTM using Triangulate and Contour, found in all three packages. Isolate to that new layer containing the 3D Faces, and wblock out the 3D Faces into a new drawing. Then make a DXF of the new drawing (a DXF of 3D Faces). That is the common currency of DTMs, usable by virtually any third party grading software.

## Carlson SurvCE 1.50 Released on May 12, 2004

Carlson SurvCE 1.5 was released over one year ago, and the current build is 1.50.008.4. The highly popular Carlson SurvCE 1.5 data collection product expanded on Carlson SurvCE 1.21 with many new highway features as well as updated drivers for the Leica 1200, Topcon Hiper Plus and other new equipment on the market.

Some additions included:

- Template Stakeout allows slope staking from any selected point
- Dynamic, "any-station" Slope Staking as well as by interval
- New "Spiral Only" element in Centerline Entry
- GPS Base Station Position is Stored in Monitor, Reference Tab
- GPS 2-Point No Scale, Rotate Only Option
- Thorough, worldwide GPS projection list
- Icon to switch from prism to reflectorless "on-the-fly"
- New optimized Virtual Keyboard for PDAs
- 400-Circle (Grads/Gons) for Europe and International Sales
- Instrument Save and Recall Icon for Quick Re-Configuration
- Reciprocal Calculations "on-the-fly" and in Process Raw Data
- Linework Re-Processing by Field-to-Finish after editing
- Elevation Difference by Design Files (template, H/V alignments)
- Wireless, Bluetooth and cellular-accessed Reference Station compatibility
- New, simplified backsight screen
- Powers the Carlson Explorer and the new Carlson Explorer II

## New CG Survey 7.0 Released on March, 2005

The theme of the CG 7.0 release is to convince all CG Survey for DOS users to convert to CG Survey 7.0 for AutoCAD.

All the major DOS features have been converted, and there is a new routine that imports the old DOS PL1/PL2 drawing files directly into AutoCad while keeping the intelligent CG graphic entities (no DXF conversion).

Other added features include:

- New Fit Structure Routine
- Uses AutoCad 2004 engine and reads AutoCad 2005/2006 files
- New Multi-Draw feature that will draw lines
- CG7 for AutoCAD has new "Point API" that will read-write both C&G-style and Carlson-style point files
- Includes the Drawing Inspector, a popular entity review feature in Carlson Survey and Carlson SurvCADD
- Graphical Traverse display within the Raw Data Editor

The Carlson Explorer II:
Powered with Carlson SurvCE

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