

UNITED STATES MARINE CORPS

ENGINEER INSTRUCTION COMPANY
MARINE CORPS DETACHMENT
14183 EAST 8TH ST
FORT LEONARD WOOD, MO 65473-8963

LESSON PLAN

GRADE CONTROL SYSTEM (GCS)

EAC-DO1

ENGINEER ASSISTANT CHIEF COURSE

A16EAV1

REVISED 08/01/2014

APPROVED BY _____

DATE _____

INTRODUCTION

(10 Min)

(On CS #1 / ON VIDEO, "GPS MACHINE CONTROL DONE BY MCS")

INSTRUCTORS NOTE

Use the following link in the slide to play: <http://www.trimble-productivity.com/youtubevideos/TrimbleConstruction/favorites>
Above URL is hyperlinked on CS #1

(OFF VIDEO, "GPS MACHINE CONTROL DONE BY MCS")

1. **GAIN ATTENTION**: Seeing your approved civil design, be it a road, helicopter landing zone, runway, taxiway, parking/staging lot, on site actually being constructed is rewarding. Before seeing this, however, your project, designed in Terramodel/Trimble Business Center and its related data, will have to be uploaded to a data card that will be inserted into the heavy equipments' onboard Trimble Control Box. Trimble's Site Vision Office will be the software we will use to make that happen.

(On CS #2)

2. **OVERVIEW**: Good morning/afternoon class my name is _____, the purpose of this lesson is to provide you with the fundamental knowledge to successfully navigate through Site Vision Office and properly load your civil design into the Grade Control System 900 (GCS900). This lesson will enable you to integrate your mission of horizontal and vertical design production with Heavy Equipments' earthwork, such as: grading, excavating, and compacting, through their use of Trimble's 3D Machine Control Grade Control GCS900.

INSTRUCTORS NOTE

Introduce the learning objectives by having the students read them from the Presentation or Student Outline.

(On CS #3)

3. **LEARNING OBJECTIVES**

a. **TERMINAL LEARNING OBJECTIVE**. Given a survey set general purpose (GP), completed horizontal construction design, data transfer device, corresponding heavy equipment and references, prepare the Grade Control System (GCS) to integrate design data into (GCS) to guide construction quality control. (1361-SRVY-2002)

(On CS #4, #5)

b. **ENABLING LEARNING OBJECTIVES**

(1). Given a survey set general purpose (GP), completed horizontal construction design, data transfer device, and references, export file to Trimble Business Center/ TerraModel per the TM 09130B-OR/1. (1361-SRVY-2002a)

(2). Given a survey set general purpose (GP), completed horizontal construction design, data transfer device, and references, process digital terrain model in Trimble Business Center/ TerraModel per the TM 09130B-OR/1. (1361-SRVY-2002b)

(3). Given a survey set general purpose (GP), completed horizontal construction design, data transfer device, and references, upload file into data transfer device per the TM 09130B-OR/1. (1361-SRVY-2002c)

(4). Given a survey set general purpose (GP), completed horizontal construction design, data transfer device, corresponding heavy equipment and references, establish communication between base station and heavy equipment per the TM 09130B-OR/1 & TM 11907B-OR. (1361-SRVY-2002d)

(5). Given a survey set general purpose (GP), completed horizontal construction design, data transfer device, corresponding heavy equipment and references, conduct blade calibration per the TM 09130B-OR/1 & TM 11907B-OR. (1361-SRVY-2002e)

(On CS #6)

4. **METHOD/MEDIA**: This lesson will be presented by lecture, demonstration, and practical application. I will be aided by computer supported instruction through slides and the dry erase board. During the demonstration, you will follow the procedures as I demonstrate them on the computer.

INSTRUCTORS NOTE

Explain lesson critique forms to students.

(On CS #7)

5. **EVALUATION**: A performance examination, covering the material in this lesson, will be administered at the end of this period of instruction as noted on your training schedule.

INSTRUCTORS NOTE

Refer the students to the training schedule to give the exact date of the exam.

(On CS #8)

6. **SAFETY/CEASE TRAINING (CT) BRIEF**. If at any time you the student see anything that is unsafe or are told by an instructor to stop, STOP IMMEDIATELY. In the event of fire, we will consolidate outside where the pavilion is located at and account for everyone. In the event of a tornado, the passageway on the first deck of Brown Hall will be our consolidation area. Safety at this course is paramount.

INSTRUCTORS NOTE

Read ORA worksheet to the students.

(On CS #9)

TRANSITION: Are there any questions on what we will be covering, or how you will be evaluated? We will begin by discussing Trimble's Site Vision Office software.

BODY: **(15 hr 45 min)**

(On CS #10-12)

1. **SITE VISION OFFICE**. (15 Min) Site Vision Office is an easy to use data management tool for the Trimble GCS900 Machine Control System. It is designed for the site data manager and engineer. SVO Office was developed for use on all machine types. SVO is simple and efficient transferring and checking design data. It is ideal software to:

- Manage data, designs, sub-designs, and data card content
- Log all data transactions
- Provide a complete record of design usage
- Ensure operators have correct information to maximize productivity.

(On CS #13)

a. **Uses.** Earthwork contractors and civil engineers can:

(1) Import designs from other CAD packages and translate them into the Site Vision format.

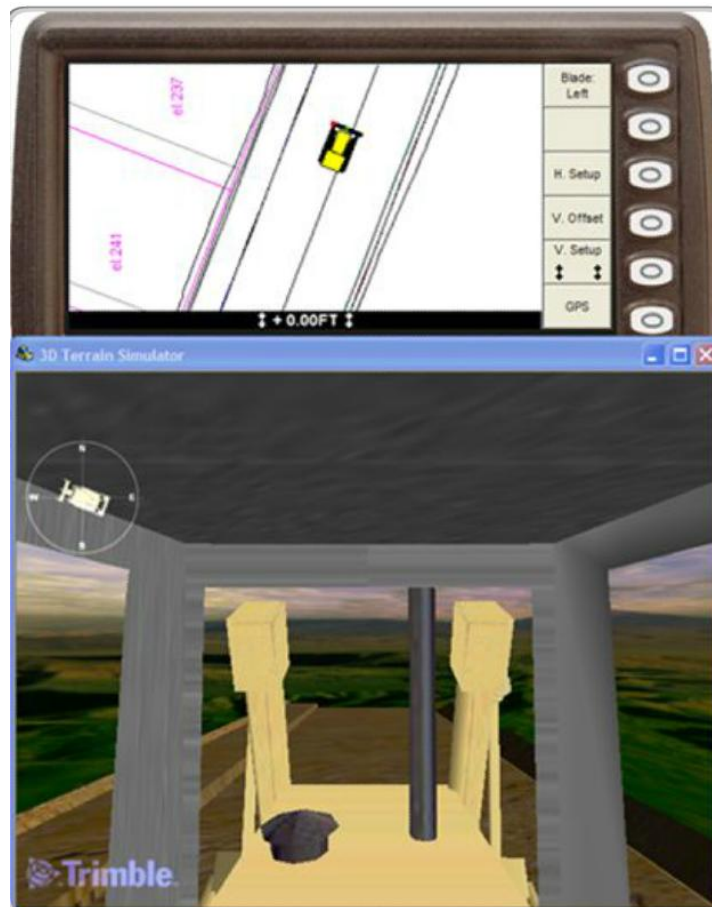
(2) Run validation checks.

(3) View any profile and check spot heights for inconsistencies for more confidence in the data.

(4) Break verified data into smaller subsets to copy to data cards for use on machines with GCS900 installed.

(On CS #14)

b. **3D Design Simulation.** 3D design simulation makes it simple to visually check the data before you leave the office. Using the simulation you can drive a virtual machine over the design, and the SVO screens display the same as it does in the machine on the job site.



(On CS #15)

c. **Data Transfer/Import/Export.** It's easy to transfer data from CAD and design software packages using SVO. Most major CAD/design software such as Terramodel, Paydirt Sitework, AutoCAD, GEOPAK, and Insite are compatible with SVO and it can import data from a wide range of formats. You can also export from SVO to other leading design packages.

(On CS #16)

TRANSITION: Are there any questions at this time?

OPPORTUNITY FOR QUESTIONS:

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning importing and exporting design data? (Answer students' questions.)
2. **QUESTIONS TO THE CLASS:** If there are no more questions for me then I have some for you.

a. Who uses SVO?

ANSWER: Earthwork contractors and civil engineers.

b. What other software is SVO compatible with?

ANSWER: Most major CAD/design software.

TRANSITION: Now that we know what SVO is let's look at how we are going to use it.

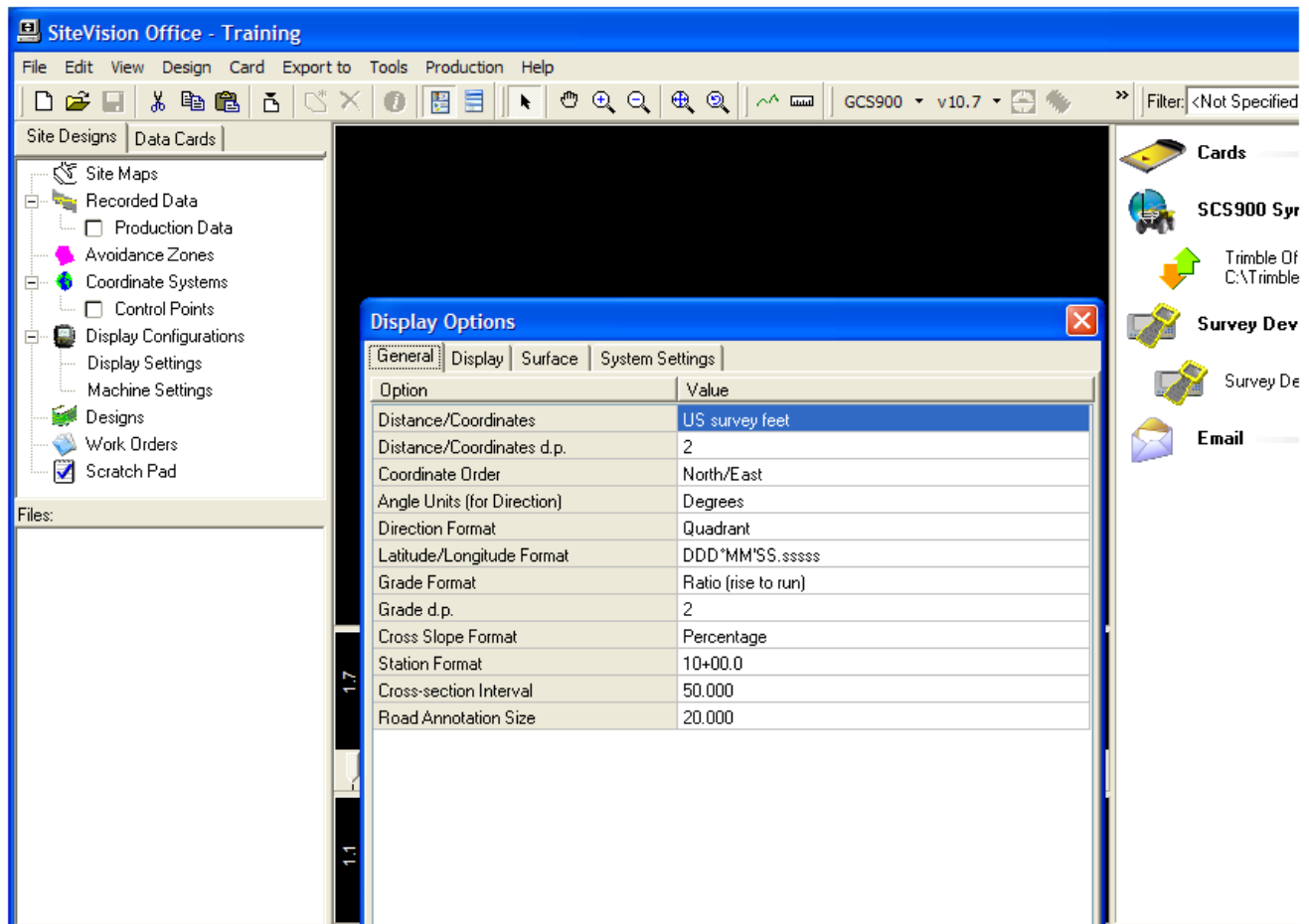
(On CS #17)

2. **Create a New Site.** (10 Min) Site Vision Office organizes data into sites.

a. When a new site is created it contains:

- (1) Site Maps
- (2) Recorded terrain
- (3) Avoidance zones

- (4) Coordinate systems
- (5) Display configurations
- (6) Designs
- (7) Work orders



(On CS #18)

b. To create a new site you need to:

- (1) Start SVO.
- (2) Select the new site icon on the tool bar.

(3) Upon creation of a new site and the display options dialogue will appear.

(On CS #19)

TRANSITION: Are there any questions at this time?

OPPORTUNITY FOR QUESTIONS:

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning new site display on the SVO window? (Answer students' questions.)

2. **QUESTIONS TO THE CLASS:** If there are no more questions for me then I have some for you.

a. When a new site is created it what does it contain?

ANSWER: Site Maps, Recorded terrain, Avoidance zones, Coordinate systems, Display configurations, Designs, Work orders.

TRANSITION: Now that we know how to create a new site let's talk about the display options.

(On CS #20-22)

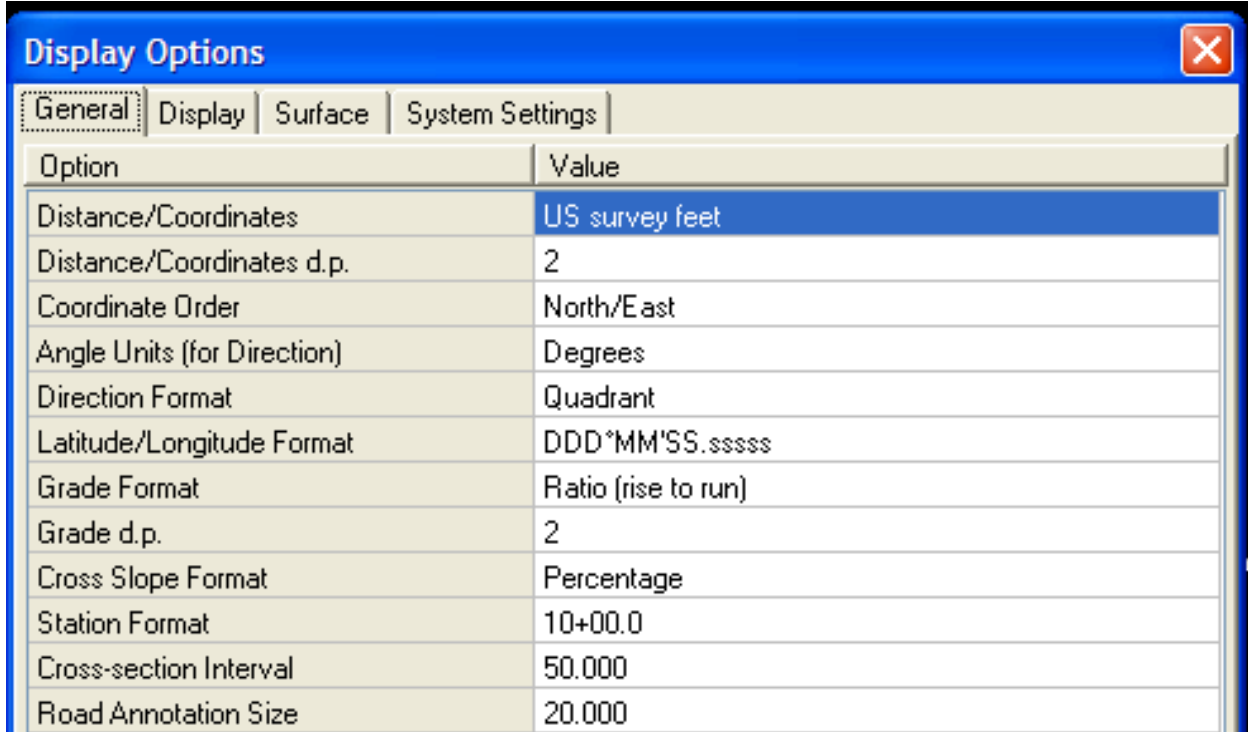
3. **DISPLAY OPTIONS. (25 min)** This is where you customize how a site looks in SVO. This is where you set the units and establish the look and feel for the site. Also when a new site is created the display options dialogue box appears. It has 4 tabs General, Display, Surface, Systems settings. When you are finished with the display options press the ok button. To return to the display options in the future to make changes once the site is already started you will have to select the tools pull down menu and then select display options.

(On CS #23, #24)

a. **General Tab.** The General Tab contains:

- (1) Distance and Coordinate Units
- (2) Coordinate Order
- (3) Angle Units
- (4) Direction Format
- (5) Grade Format

(6) Station Format



Option	Value
Distance/Coordinates	US survey feet
Distance/Coordinates d.p.	2
Coordinate Order	North/East
Angle Units (for Direction)	Degrees
Direction Format	Quadrant
Latitude/Longitude Format	DDD°MM'SS.sssss
Grade Format	Ratio (rise to run)
Grade d.p.	2
Cross Slope Format	Percentage
Station Format	10+00.0
Cross-section Interval	50.000
Road Annotation Size	20.000

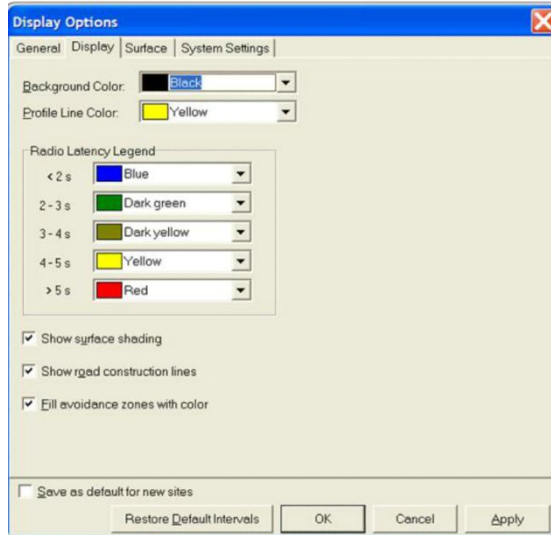
(7) To change the value within the general tab you will need to select the value and then select from the list of options.

(On CS #25)

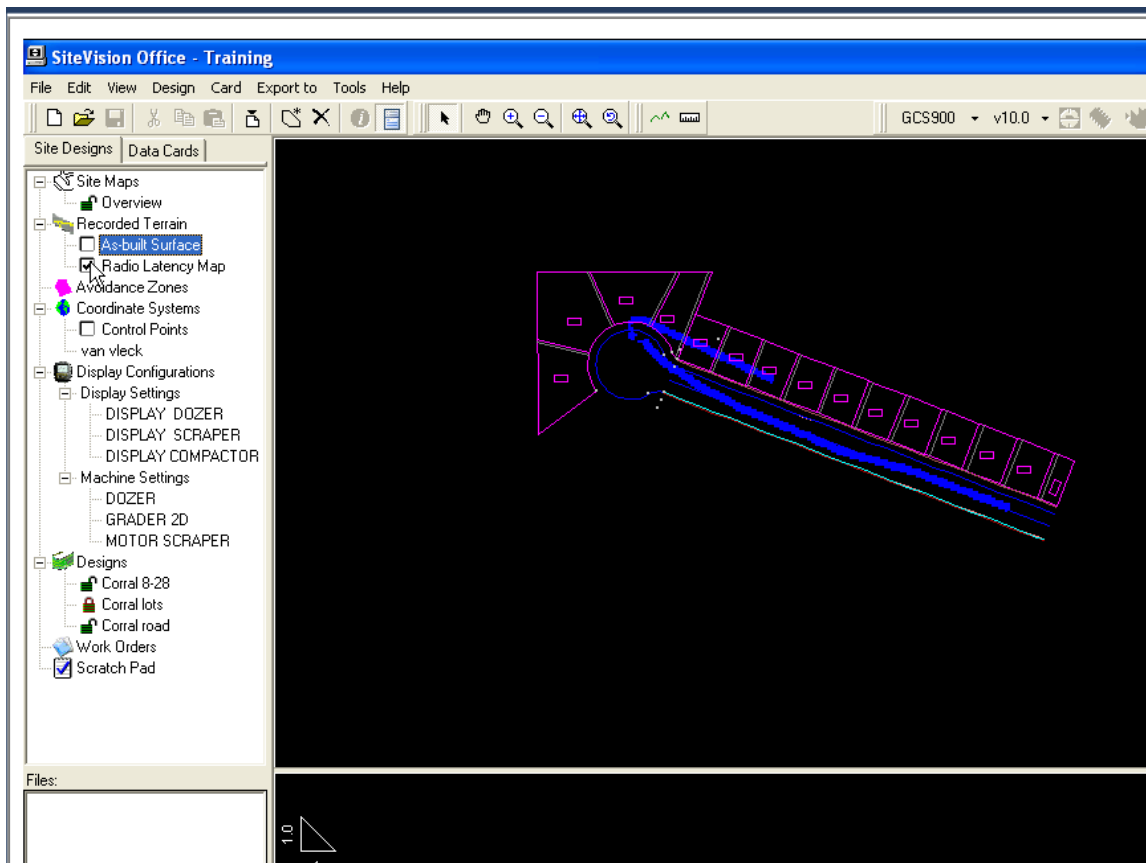
b. **Display Tab.** This is where you set the background and profile line colors for the plan view, cross-section view and the profile view.

(On CS #26)

(1). Set the radio latency legend. You will also need to set the radio latency legend. The radio latency legend is set for blue for all positions that are within 2 seconds. Data messages transmitted from the base station to the machine that arrives within two seconds. Anything that takes more than 2 seconds the GCS900 will not accept and the machine will turn off the cut and fills.



(a) Below is a graphical representation of the latency when the heavy equipment made passes on a particular earthwork for a road.



(On CS #27)

(b) Select the options to:

- 1 Show surface shading for all designs.
- 2 Show road construction lines.
- 3 Fill the avoidance zones with color.

(On CS #28)

TRANSITION: Are there any questions at this time?

OPPORTUNITY FOR QUESTIONS:

1. QUESTIONS FROM THE CLASS: Do you have any questions concerning the Display Options window once a new site is created? (Answer students' questions.)
2. QUESTIONS TO THE CLASS: If there are no more questions for me then I have some for you.

a. How many tabs are there in the display settings?

ANSWER: 4.

b. Name those four tabs?

ANSWER: General, Display, Surface, Systems settings.

TRANSITION: Now that we covered the Display Options we can talk about the views. What views do you think we will use for a horizontal project?

INSTRUCTORS NOTE

Explain each different view to the student and what its purpose is.

(On CS #29)

4. **VIEWS.** (20min) In SVO you will have three different views to work with. If you make changes in one view it automatically updates the other views. This allows you to check the design data. These views are:

(On CS #30)

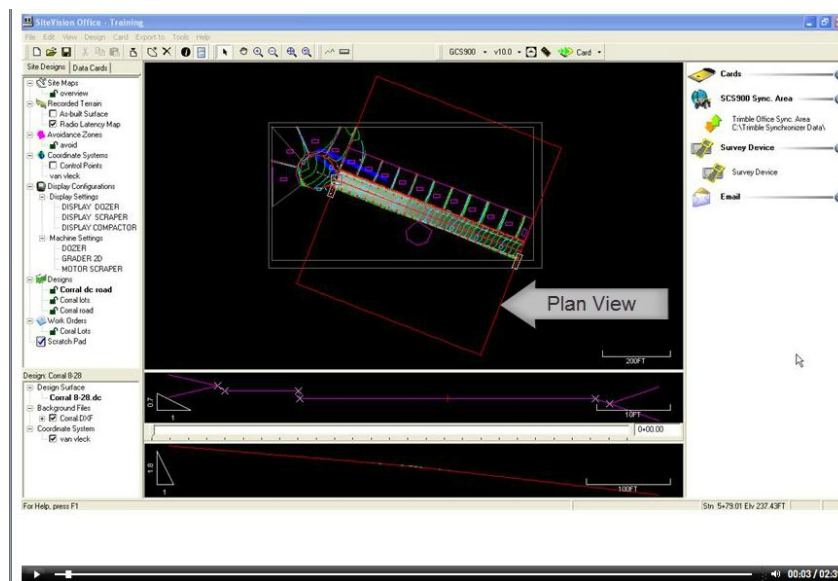
a. **Plan View.** The “birds-eye” view of your design site. It graphically displays the surface, recorded terrain, road, control points, and background files.

(1) You can navigate through your plan view by using the buttons located on the toolbar.

(2) When you have the cursor arrow on the plan view, the lower right corner of the window status bar will show the coordinates (Northing, Easting).

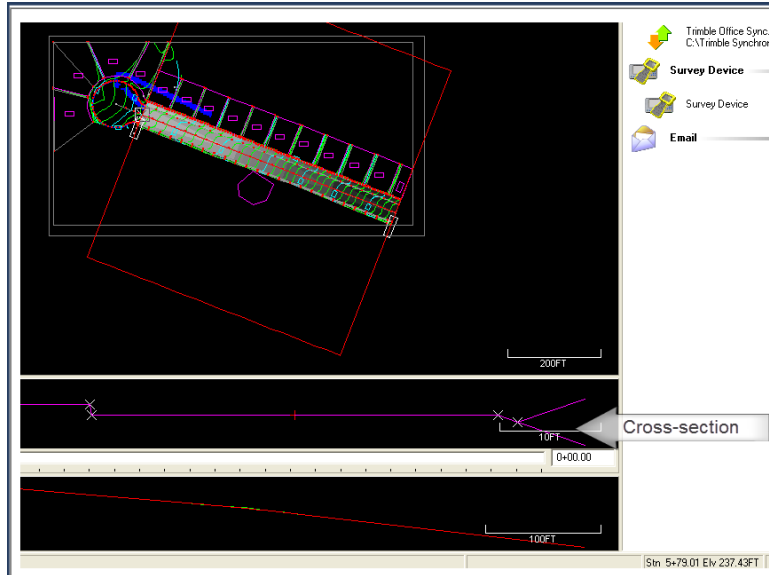
(3) If the cursor arrow is over a design surface, the elevation will also be displayed with the coordinates.

(4) The coordinates and elevation is confirmed by the *.dc file used. This is also shown in the status bar.



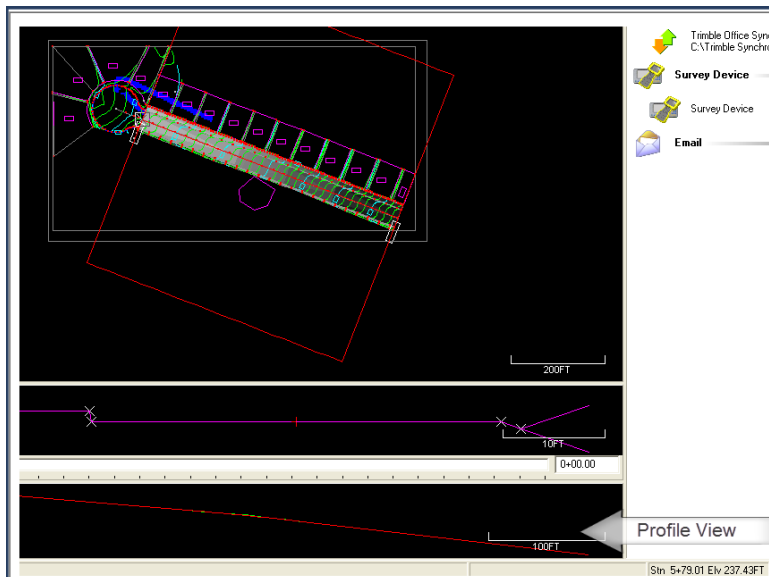
(On CS #31)

b. **Cross-Section View.** It graphically displays the cross section of your design. Below example displays a particular road cross section at station 0+00.00.



(On CS #32, #33)

c. **Profile View**. This view appears below your cross-section view.



(1) In the profile view, you can also perform commands very similar to the Trimble Terramodel "Quick DTM profile" command button found in the toolbar. As you know, this allows you to quickly verify existing and design surface elevations. In SVO, to draw a profile:

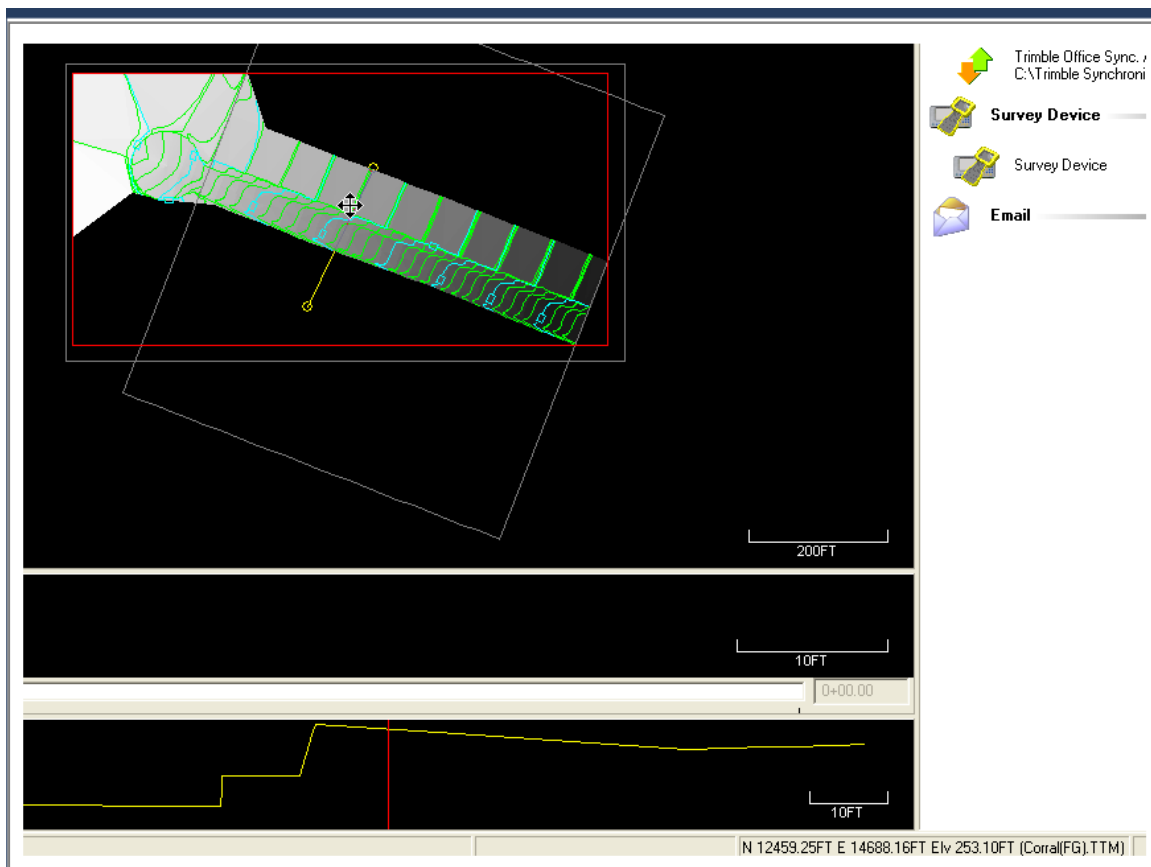
(a) Select a design to display in the Site Design Tab.

(b) Select the profile button in the tool bar.

(c) In the Plan View, click and hold the left mouse button and drag the mouse across the surface of your selected design. Then release the left mouse button.

(d) The profile is displayed in the profile view.

(2) The profile you created is a "dynamic" profile. Meaning, you can position the cursor arrow over the profile line you created. Click, hold and drag the profile line and the profile view will dynamically change.



(On CS #34)

TRANSITION: Are there any questions at this time?

OPPORTUNITY FOR QUESTIONS:

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning SVO View Window panes? (Answer students' questions.)

2. QUESTIONS TO THE CLASS: If there are no more questions for me then I have some for you.

a. How many views can you work with for your particular project site?

ANSWER: 3.

b. Name those three different views?

ANSWER: Plan View, Cross-Section View, Profile View.

TRANSITION: Now that we know the different views of your project site in SVO, let's take a ten minute break. Let's discuss how we are going to use it.

(On CS #35)

(BREAK 10 Min)

TRANSITION: Any more questions before discussing how we are going to use what we have learned so far?

(On CS #36)

5. **IMPORT DATA**. (5min) You will have to import design data from Terramodel such as linework, surface data, roading data, your coordinate systems, the machine display settings, and machine settings. The machine display settings and machine settings refers to the heavy equipment, such as: 120M Motor Grader, 850JR MCT Dozer, 621B Scraper, etc. that will use your imported data. Once you have imported your required design data you can edit it in SVO in the site design tab.

TRANSITION: Now that we know what data to import and how to edit it we need to export the data so that it can be used by Heavy Equipment.

(On CS #37)

6. **EXPORT DATA**. (5min) You can export your data to the GCS900 Grade Control System, a SCS900 Site Controller, or a Trimble Survey Controller (TSC). Normally you will be required to transfer the data to the data card that is provided to you from the Heavy equipment section. For applications within the Marine

Corps we will normally load the info onto the GCS900 or the TSC. The card actually belongs to the equipment so it is HE's responsibility to provide you with the card but you are responsible for loading the data to it. Once the data is loaded onto the card you give the card back to HE and they load it into the equipment.

INTERIM TRANSITION: Now that we have covered how to load the data onto a data card, are there any questions before we go through the demonstration.

(On CS #38)

INSTRUCTORS NOTE:

Introduce the following Demonstration.

DEMONSTRATION. (1 Hr) Gather the students' attention to the presentation/computer screen for a demonstration of the Trimble SVO design import and export.

STUDENT ROLE: Observe the Trimble SVO design import and export procedures.

INSTRUCTOR(s) ROLE: Visually demonstrate, by presentation, aided by components of the Survey Set GP, illustration and/or actual samples, to the students, design data import and export procedure using the Trimble Site Vision Office Software.

1. **SAFETY BRIEF:** No safety concerns with this class.

2. **SUPERVISION & GUIDANCE:** Ensure all students can see material being presented.

DEBRIEF: Now that I have demonstrated road and helicopter landing zone design data import into the Trimble Site Vision Office software and export to the data card that the 1345 Heavy Equipment operator will use for his 3D Machine Control.

INSTRUCTOR INSTRUCTIONS FOR DEMO Present to the students a completed Terramodel road and pad (HLZ) design, in order to relate design files to be imported and exported to/from the SVO. Open SVO office on the Instructor computer and demonstrate the steps for creating a data card in SVO.

Site Vision Office Instructions

Importing:

1. Launch SVO
2. Create a new Site: File/New Site
3. Type in a name for the site. Check the path where it is to be saved to.
4. Check the settings under the General tab.
5. On the display tab, set the Background to white.
6. Deselect Show Surface Shading
7. Deselect Show road construction lines
8. On the Surface tab, deselect Show contours and show triangles.
9. Nothing to change on the System settings tab.
10. Pick Apply then OK.
11. Use the Import File command to begin importing the required files.
12. From the Linetype tab select Linework from Terramodel Project file.
13. Browse to the correct Terramodel file. Pick all layers you want imported to display linework.
14. Import from the Roads tab the SVD design from Terramodel Project file.
15. Browse and select the correct Terramodel project file. Then review and select the correct road.
16. From the Field tab, import a coordinate system from file. Select the .dc file which contains your correct site calibration.
17. When prompted to apply the coordinate system to unlocked designs, pick YES.

Exporting:

18. Prepare to export the designs to a card.

19. From the top left, make sure the Site designs tab is selected.

20. Pick the design to export. This activates other commands and makes them available.

21. From the Export To pulldown menu, select GCS900.

22. Version is 10.0. Export to the CARD. Pick OK.

23. Browse to where you want to create the card and files. Pick OK.

24. Your card is created. You can now copy the files onto a CF card.

Verification:

25. Guide students to the site folder created and open up the "export" folder.

26. The minimum file type extensions that will enable the Trimble GCS900 to work are: *.svd, *.svl, *.cfg

27. Ensure the student see those files in the export folder.

(On CS #39)

TRANSITION: You have just seen a demonstration of SVO, are there any questions at this time? Answer the students' questions.

OPPORTUNITY FOR QUESTIONS:

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning importing and exporting design data? (Answer students' questions.)

2. **QUESTIONS TO THE CLASS:** If there are no more questions for me then I have some for you.

a. What can you export the data to?

ANSWER: Either a GCS900 Grade Control System, SCS900 Site Controller or a TSC.

b. Who is responsible for loading the card into the HE?

ANSWER: The Heavy Equipment Operator.

TRANSITION: Now that you have seen the demonstration in SVO import and export, are there any further questions before we take a 10 minute break? When we come back, we will discuss communication establishment and blade calibration.

(On CS #40)

(Break - 10 Min)

TRANSITION: Next we will discuss communication establishment and blade calibration.

(On CS #41)

7. **ESTABLISH COMMUNICATION. (15 Min)** In order for the Grade Control System 900 (GCS900) to work, you must establish communication between the base station and the heavy equipment (grader, dozer, etc.). You will have to ensure that you give the correct coordinates that you used for your survey and design data to HE for them to load into their base station. This base station has an external receiver called the Trimble Site Positioning System 852 (SPS852). You should be present when he sets up their base station to ensure that it is done correctly and that they are on the correct frequency and have the correct coordinates. The base station that comes with the GCS900 belongs to HE and its setup is the responsibility of the Heavy Equipment Operator but it is a good idea as a chief to ensure that they know how to set this up and establish the communication between their base and the GCS900 installed in the heavy equipment.



TRANSITION: Are there any questions concerning establishing communication? Now let's talk about blade calibration.

(On CS #42)

8. **BLADE CALIBRATION.** (10 min) Before any earth is moved you must conduct a blade calibration. This will ensure that the heavy equipment being used is properly calibrated to its GCS900 equipment that is installed. Blade calibration is the responsibility of the Heavy Equipment Operator but it is a good idea for you the chief to ensure that they do this as it is often times a forgotten step.

(On CS #43)

TRANSITION: We have just covered establishing communication and blade calibration. Are there any questions?

OPPORTUNITY FOR QUESTIONS:

1. **QUESTIONS FROM THE CLASS:** Do you have any questions concerning establishing communication and blade calibration? Answer students' questions.

2. **QUESTIONS TO THE CLASS:**

a. Whose responsibility is it to provide the correct coordinates on the base station for the vertical and horizontal control of a particular horizontal construction mission?

ANSWER: The 1361 Engineer Assistant is the responsible personnel in providing correct coordinates where the base station will be set-up on.

b. Who is responsible in conducting Blade Calibration on a particular Trimble 3D Machine Control GCS900 enabled heavy equipment?

ANSWER: The 1345 Heavy Equipment Operator is responsible in conducting blade calibration on a particular heavy equipment he will be operating.

TRANSITION: Are there any more questions before going into the practical applications.

(On CS #44)

INSTRUCTORS NOTE

Introduce the following tutorial/Practical Application.

STUDENT TUTORIAL/PRACTICAL APPLICATION (2 HOURS)

At this time launch the Site Vision Office tutorial from the Trimble Ltd. website, Trimble Knowledge Network Learning Center (http://www.trimblelms.com/tr_open_main_main.asp) and lead the entire class through the tutorial. Allow **(2 hours)** for this.

INTERIM TRANSITION: Are there any questions from the tutorial you have just completed? Answer the students' questions. At this time, let's take a ten minute break.

(On CS #45)

(Break - 10 Min)

(On CS #46)

INSTRUCTORS NOTE

Introduce the following practical application.

PRACTICAL APPLICATION: (10.5 Hrs)

Have the students take the GPS gear outside and conduct control and topographic surveys. Once the surveys are completed they will load their data into Terramodel and design a horizontal construction project. Have the students conduct Trimble Site Vision Office (SVO) software in the classroom importing and exporting horizontal construction project files produced in the

Trimble Terramodel software. In the field, with the Trimble Site Positioning System Modular Receiver (SPS852), set-up and input coordinates on a particular project control point. In the field, locate a suitable spot for H.E. blade calibration area.

PRACTICE: With completed road and pad designs, conduct import and export procedures with the Trimble SVO software. With correct project control point coordinates, input data into the Trimble SPS852. Establish blade calibration area for the 1345 Heavy Equipment Operator.

PROVIDE-HELP: Ensure students have all training aids, such as: Laptops with Trimble Terramodel, Trimble Site Vision Software, and references. Ensure coordination with the EEIC Marine Unique Section has been completed for the temporary loan of the Trimble SPS852. Walk around the classroom and aid the students in their design data import and export. Remind them that these practical exercises will be part of their examination. Answer all questions the students may have.

SAFETY BRIEF: No safety concerns with this class.

SUPERVISION & GUIDANCE: Be sure to follow the step by step directions covered in your student outline, from the tutorial, and from the demonstration presented earlier.

DEBRIEF: Now that we have conducted SVO import and upload procedures, verified that pertinent files are in the data card, ensured correct coordinates are inputted in the SPS852 and created an area for heavy equipment blade calibration, you as a 1361 Engineer Assistant Chief will be confident that your horizontal design product will integrate with the Heavy Equipment Trimble 3D Machine Control.

TRANSITION: You have just spent the last 13 hours conducting practical applications.

(On CS #47)

OPPORTUNITY FOR QUESTIONS:

1. **QUESTIONS FROM THE CLASS**: Do you have any questions concerning the practical exercises you have just completed? Answer students' questions.

2. **QUESTIONS TO THE CLASS**:

a. How many file types are needed for heavy equipment 3D Machine Control to work?

ANSWER: Three

b. What are the minimum file type extensions needed for heavy equipment 3D Machine Control to work?

ANSWER: *.svl, *.svd and *.cfg file type extensions.

(On CS #48)

Summary:

(5 Min)

In this period of instruction we have covered Site Vision Office, who uses it, what they use it for, how to create a new site, the display options, views, site design tab, how to import and export data how to establish communication between the base and rovers and who conducts a blade calibration. Please turn in your IRFs and take a break.

(Break - 10 Min)

REFERENCES:

Earthmoving Operations	MCRP 3-17.7I
Trimble 5900-06-ENG GCS900 Operators TM 11907B-OR Manual	TM 09130B-OR/1 &
Grade Control System Users Manual TM 11907B-OR	OEM, GCS Users Manual
Site Vision Office Getting Started Guide ENG Ver 7.40	Trimble# 43422-10-
Trimble Terra Model User Guide Model	OEM, Trimble Terra