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16. Abstract

This document provides instructions and practice problems to help new users of IGrds™ become acquainted with IGrds™ commands. Three lessons are provided: (1) horizontal alignment commands, (2) vertical alignment commands, and (3) general geometry commands. Each lesson consists of an instructions manual and an IGrds™ project file. The instructions manual provides a brief description of each command, a listing of the command prompts, and instructions for responding to those prompts. The IGrds™ project file contains a practice problem for each IGrds™ command. The lessons are self-instructional and self-paced. The goal was to raise the quality and consistency of the introductory IGrds™ training at the TxDOT District level so that individuals participating in the IGrds™ Workshop would have higher base knowledge levels.

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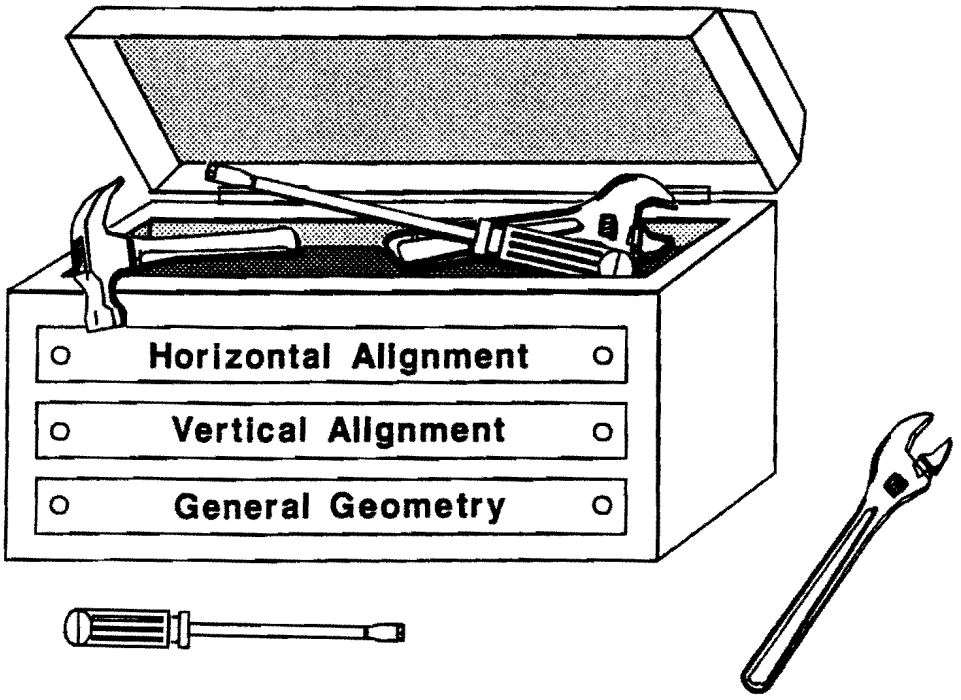
IGrds Practice Problems



Lesson 1: Horizontal Alignment

Lesson 2: Vertical Alignment

Lesson 3: General Geometry

IGrds™ Practice Problems

Lesson 1: Horizontal Alignment

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IGrds Practice Problems Diskette Instructions

The IGrds Practice Problems floppy diskette contains Design and Working files for Lessons 1, 2 and 3.

To copy the contents from the 5.25" floppy to your hard disk, use the TxDOT utility "burl". Make a subdirectory on your workstation, suggest "spigrds". Change directory to "spigrds" and use burl utility as follows from the dollar sign ("$"):

$ burl -rf <ret> (return for all defaults and contents will be copied).

If "burl" is not available, you may use the following command:

$ fr_flop | compress -d | cpio -ivcmd <ret>

In case some other type of floppy media is required, the above should be done and the data transferred to a workstation and copy data to the new floppy media using burl -bf to copy data to new floppy media.

NOTE: If files become corrupt and/or if you wish to go through lessons again, just copy files from floppy and start over.

If you experience problems, call your local Graphics Support person or your D-19 support person.

LESSON 1. General Purpose and Horizontal Alignment Commands

This lesson is the first of three lessons designed to provide instructions and practice problems to help new users of IGrds™ become acquainted with IGrds™ commands. The three lessons include: (1) horizontal alignment commands, (2) vertical alignment commands, and (3) general geometry commands. Each lesson consists of an instructions manual and an IGrds™ project file. The instructions manual provides a brief description of each command, a listing of the command prompts, and instructions for responding to those prompts. The IGrds™ project file contains a practice problem for each IGrds™ command. The lessons are self-instructional and self-paced. The goal was to raise the quality and consistency of the introductory IGrds™ training at the TxDOT District level so that individuals participating in the IGrds™ Workshop would have higher base knowledge levels. New users should also consult the "IGrds™ User Manual--IG Option," which is published by the American Association of State Highway and Transportation Officials.

This lesson will go through the individual commands used in the General Purpose menu and the Horizontal Alignment menu. This first group of commands to be discussed are the General Purpose commands. These commands are not directly related to any other IGrds subsystem, yet they are quite important to the user. General Purpose commands can be categorized as operational commands, which perform functions between IGrds subsystems, and switch commands, which set the status conditions for future commands.

To begin the practice exercises, key in **mce ha** at the unix $ prompt and "start IGrds." There are no exercises for the general purpose commands, as they primarily turn features on or off. The practice problems are used with the horizontal alignment commands in the second portion of this lesson. The first exercise begins on page 1-30; read only pages 1-2 through 1-29.

To perform the exercises, at the uSTN> prompt, key in **VI=XXX** when instructed, where XXX is the IGrds command number. Remember that IGrds requires all keyboard entries to be in UPPER case.

The first command to be used when starting an IGrds session on the workstation is **INITIALIZE IGRDS (201)**. Use this command when you start a project from "scratch". Do **NOT** use this command when continuing on a previously created project. This command creates a status file (.IGR) in the present working directory. This file stores the IGrds Working file name and other project-related parameters. It links the Graphics file with the IGrds Working files. This command also will initialize new IGrds Geometry files, set the system-defined default parameters, and set various parameters controlling data display.

Prompts	Response
1. **INITIALIZE STATUS FILE** **RESET - YES, DATA - NO**	DATA to keep the existing Status file, or **RESET** to create a new Status file. You must RESET the first time a Graphics file is used in IGrds.
2. **INITIALIZE GEOMETRY** **RESET - YES, DATA - NO**	DATA to keep the existing Geometry files. These must have the same name as the IGrds Working files, or **RESET** to create new Geometry files (.PNT), (.CRV), (.CHN), and to initialize geometry parameters.
3. **INITIALIZE RDXD** **RESET - YES, DATA - NO**	**DATA** to omit initialization, or RESET to initialize parameters for Roadway Design Cross Section Definition (RDXD).
4. **DATA - ACTIVE IGDS PARAMETERS** **RESET - DEFAULT IGRDS PARAMETERS**	DATA to keep the parameter values as they exist in the Graphics file, or **RESET** to use the default parameter values.

The default parameters are:

Cell Library = IGRDS.CEL

Active Angle = N90^0'0"E (Bearing Mode is default.)

Global Origin = Lower Left

Text String Justification = Left bottom

Text Node Display and Delay = OFF

Snap Lock = ON

Set element class to: = Primary

5. **ENTER NAME OF IGRDS WORKING FILE** — **Type** the name of the IGrds Working files to use with the Graphics file. The filename can be up to nine characters long; do not include the file type.

If this command executes properly, the message **IGRDS INITIALIZED AND STARTED** will appear in the prompt field.

NOTES

Another command that may be used at the beginning of an IGrds session is **START IGRDS (225)**. This command will execute start-up file management functions. It is to be used instead of **INITIALIZE IGRDS** when you re-enter a Graphics (.DGN) file in an IGrds session. There are no prompts for this command. If this command executes properly, the message **IGRDS STARTED SUCCESSFULLY** will appear in the prompt field.

At the conclusion of an IGrds session, use the **END IGRDS (202)** command. This may also be used to change Graphics files during an IGrds run, or to run RDEC or other applications software on the IGrds Working files without exiting the Graphics file. There are no prompts for this command. If the command executes properly, the message **IGRDS ENDED** will appear in the prompt field.

The next command that should be executed is **SET ACTIVE ROADWAY (205)**. This command will display and/or change the active roadway (i.e., active horizontal alignment or vertical reference line, A-Z). Several commands in IGrds require the user to enter a roadway ID. Some of these commands include an option that defaults to the active roadway.

Prompt		Response
1.	**ENTER RDWY, OR SELECT ALIGN. OR RESET FOR RDWY = X**	**Type** the ID of the active roadway (active reference line), or DATA on the active roadway (active reference line), or RESET to keep the current active roadway (active reference line) "X".

NOTES

To stop a command within IGrds, use the **CMD EXIT (212)** command. This command should be used to stop self-repeating commands. There are no prompts associated with this command. Execution of the command occurs with **DATA** on the command name.

IGrds provides a **HELP (207)** command to assist you with information on any commands on the IGrds menus. The complete message must be displayed before you can execute any other command. The HELP command is a self-repeating command.

Prompt	Response
1. **SELECT MENU BOX FOR HELP**	**DATA** on desired menu box for help information.

NOTES

The following command is used for reporting purposes. This command, **SAVE TO LIST FILE (204)**, will attach the (.TMP) temporary report file to the list (.LIS) file.

Prompt	Response
1. **ENTER LIST FILE OR RESET TO SAVE TO CURRENT LIST FILE**	Type the name of the new list file, or **RESET** to use the existing list file name.

Another command that may be used for reporting purposes is the **PROJECT FILE SUMMARY REPORT (203)** command. This will generate the summary report and write it to the (.TMP) temporary file. If AUTO LIST is on, the summary report is also written to the (.LIS) list file.

Prompt	Response
1. **RESET FOR PROJECT FILE SUMMARY**	**RESET** to create the summary report.

If you need to change IGrds parameters during a session on the workstation, use the **REVISE ACTIVE PARAMETERS (250)** command. IGrds must be running prior to executing this command. The changes to the parameters are temporary unless you save the changes with the SAVE FILE menu box. If the changes are not saved, they will be discarded upon ending IGrds or the graphics session. Changes to the parameters are made using the IGrds Parameter File Tutorial menu. This menu is placed on the screen in the tutorial view. An asterisk (*) in the data field indicates that the parameter may not be changed by the user.

One of the most important commands to be used is the **HORIZONTAL POSITION CALCULATION (206)** command. Execution of this command calculates the offset between roadway G (terrain center line) and roadways A-F. You must execute this command prior to displaying original profiles. Additionally, roadway G must be defined and the terrain cross sections must be stored in the IGrds station file (1.dat) before running this command. The horizontal position calculations are stored in the IGrds working station file (1.idx), an HPCAL report is placed in the temporary report file (.TMP), and any error or warning messages are placed in the error file (.ERR).

Prompt		Response
1.	**ENTER ROADWAY LETTER(S) X OR X-X, RESET FOR RDWY = X**	Type the letter of the desired roadway (A-F). Use the X-X format for more than one roadway, or **RESET** to perform the calculations on the active roadway "X".

Note: This command is on Texas vertical subsystem menu.

The remainder of the General Purpose commands are switch commands. The first of these is **TURN ON/OFF LABEL OPTION (208)**. This command will turn the label option on or off. The system default is LABEL OFF. The following commands may have labeling: CALCULATE STATION AND OFFSET; CALCULATE STATION, OFFSET, AND ELEVATION; COMPUTE/LABEL STATION AND ELEVATION; COMPUTE/LABEL PROFILE STATION AND ELEVATION; and CALCULATE AREA OF A SHAPE.

Prompts

1A.	**LABEL ON**	This message appears if the label option was off when this command was selected.
1B.	**LABEL OFF**	This message appears if the label option was on when this command was selected.

NOTES

The next switch command is **STACKED/LINEAR LABEL (209)**. This command controls whether the label information is written in one line (linear) or two lines (stacked). The system default is LABEL LINEAR.

Prompts

1A.	**LABEL STACKED**	This message appears if the label feature was LINEAR when this command was selected.
1B.	**LABEL LINEAR**	This message appears if the label feature was STACKED when this command was selected.

NOTES

The next switch command is **TURN ON/OFF LEADER LINES (210).** This command will control whether or not a leader line is included with a label. A leader line connects a label to the point being labeled. The system default is LEADER LINE OFF.

Prompts

1A.	**LEADER LINE ON**	This message appears if the LEADER LINE feature was off when this command was selected.
1B.	**LEADER LINE OFF**	This message appears if the LEADER LINE feature was on when this command was selected.

NOTES

Another switch command dealing with labeling is **TURN ON/OFF LEADER LINE TERMINATOR (211)**. This switch command controls whether or not the leader line has an arrowhead. The system default is LEADER LINE TERMINATOR OFF.

Prompts

1A.	**LEADER LINE TERMINATOR ON**	This message appears if the LEADER LINE TERMINATOR feature was off when this command was selected.
1B.	**LEADER LINE TERMINATOR OFF**	This message appears if the LEADER LINE TERMINATOR feature was off when this command was selected.

NOTES

The last switch command is **AUTO LIST ON/OFF (213).** This command tells IGrds whether or not to append the temporary report (.TMP) file to the list (.LIS) file. The current name of the list file is also displayed and may be changed by the user. The system default is AUTO LIST OFF.

Prompts		Response
1A.	**ENTER NEW FILE NAME** **RESET FOR LIST FILE = X**	Type the desired list file name, or **RESET** to keep the current list file name.
1B.	**AUTO LIST OFF**	This message will appear if AUTO LIST was on when this command was selected.

NOTES

The next portion of this lesson covers the commands within the Horizontal Alignment subsystem of IGrds. These horizontal alignment commands allow you to create alignments simultaneously in design and graphics files. A horizontal alignment is a series of intersecting tangents. The IGrds horizontal alignment commands place curves between adjacent tangents at interior points of intersection (PIs). The first PI in the alignment is established with the ADD HA PI command. Subsequent PIs may also be added with this command. INSERT HA PI may be used to place PIs between or prior to existing PIs. Once you have established, or modified your PIs, you must use the CREATE/UPDATE HA command. This will compute the properties of the alignment so that it may be displayed or used in other computations. After the alignment has been established, it may be used by IGrds with the general geometry commands (Lesson 3), and with the following horizontal alignment commands: IDENTIFY HA; IDENTIFY HA PI; CREATE HA REPORT; DRAW HA PIs; DRAW HA TANGENTS; DRAW HA; DRAW CROWN, CATCH, OR DITCH LINES; ANNOTATE HA; PLACE HA PI DATA; DELETE HA; and DELETE HA DISPLAYS.

There are two "switch" commands within the horizontal alignment module. These commands control which prompts appear in certain commands. The first "switch" command is **TURN ON/OFF EXTENDED FEATURES (216).** This activates the prompt for all of the extended features. The system default is EXTENDED FEATURES OFF. When the switch is on, the EXTENDED FEATURES prompts appear in the ADD HA PI, INSERT HA PI, and CREATE/UPDATE HA commands. The alignment listings in the CREATE/ UPDATE HA and CREATE HA REPORT commands are also controlled by this switch.

Prompts

1.	**EXTENDED FEATURES ON**	If the switch was off when this command was selected, this message appears in the prompt field.
2.	**EXTENDED FEATURES OFF**	If the switch was on when this command was selected, this message appears in the prompt field.

NOTES

The other "switch" command is **TURN ON/OFF SPIRAL PROMPTS (215).** The system default is SPIRAL PROMPTS OFF. If the switch is on, the SPIRAL PROMPTS appear in the ADD HA PI, INSERT HA PI, and REVISE HA PI commands.

Prompts

1A.	**SPIRAL PROMPTS ON**	If the spiral switch was off when this command was selected, this message appears in the prompt field.
1B.	**SPIRAL PROMPTS OFF**	If the spiral switch was on when this command was selected, this message appears in the prompt field.

NOTES

The first horizontal alignment command to be discussed is **DRAW HA (12)**. This will display all or part of the active roadway's horizontal alignment. If the message "NO ALIGNMENT DATA STORED" or "ALIGNMENT NOT CREATED PROPERLY" appears in the prompt field, use the CREATE/UPDATE HA command to recalculate the alignment in the Working files. For this practice problem, key in **VI = 12.**

Prompts		Response
1.	**ENTER STATION LIMITS (BEG,END)** **RESET-ENTIRE ALIG DATA-NEW RDWY**	Type the beginning and ending station of the desired portion of the alignment, or DATA to change active roadways and repeat the prompt, or **RESET** to select the entire alignment.
2.	**OLD HA GRAPHICS EXIST** **DATA - SAVE, RESET - NOT TO SAVE**	DATA to keep the existing graphics, or **RESET** to delete the existing graphics.

NOTES

The next command is **DRAW HA PIs (2)**. This command will display PIs from the IGrds Working files for the active roadway. (If the PIs do not fit on the screen, use the ZOOM OUT command in Graphics to view them on the screen). For this practice problem, key in **VI=2.**

Prompts		Response
1.	**ENTER ROADWAY LETTER** **RESET FOR RDWY = X**	Type the letter of desired roadway, or **RESET** to draw PIs for roadway X.
2.	**OLD PI GRAPHICS EXIST** **DATA - SAVE, RESET - NOT TO SAVE**	DATA to keep the existing graphics, or **RESET** to delete the existing graphics.

NOTES

After the PIs are drawn, you may use the **DRAW HA TANGENTS (13)** command to connect the PIs with straight lines. The command uses the PIs stored in the Working files to draw the tangents. This command can be executed without having the PIs displayed on the screen. For this practice problem, key in **VI = 13**.

Prompts	Response
1. **ENTER ROADWAY LETTER** **RESET FOR ROADWAY = X**	Type the roadway letter whose tangents you want drawn, or **RESET** to draw tangents for roadway X.
2. **OLD TANGENT GRAPHICS EXIST** **DATA - SAVE, RESET - NOT TO SAVE**	DATA to keep the existing tangents, or **RESET** to delete the existing tangents.

NOTES

The next command is **ANNOTATE HA (15).** This command will display the horizontal alignment annotation for the active roadway. The annotation information includes station tic marks, bearing labels, and station labels for the beginning station, PC, PT, station equations, and end stations. For this practice problem, key in **VI = 15.**

Prompts		Response
1.	**ENTER STATION LIMITS (BEG,END) RESET-ENTIRE ALIG DATA-NEW RDWY**	Type the beginning and ending station of the desired portion of the alignment, or DATA to change active roadways and repeat the prompt, or **RESET** to select the entire alignment.
2.	**RESET TO ACCEPT OR ENTER 1-2 → 1) TICS = N, N, 2) TX = N**	Type "1" to change tic mark spacing (Prompt 2A appears), or Type "2" to change text height (Prompt 2B appears), or **RESET** to accept the displayed parameters.
2A.	**ENTER TIC, TIC LABEL SPACING RESET FOR NO CHANGE**	Type the tic and tic label spacing, or RESET for no change.
2B.	**ENTER TEXT HEIGHT - RESET FOR NO CHANGE**	Type the new text height, or RESET to keep the same text height.
3.	**ENTER 1-6 TO DELETE LABELS 1) RAD, 2) BRNG, 3) EQ, 4)BEGIN, 5) END, 6) ALL RESET: ANNOTATE**	Type "1" to omit radial labels, or Type "2" to omit bearing labels, or Type "3" to omit station equations, or Type "4" to omit the beginning station label, or Type "5" to omit the ending station label, or Type "6" to omit all labels, or **RESET** to annotate the alignment.
4.	**OLD HA ANNOTATION EXIST DATA - SAVE, RESET - NOT TO SAVE**	DATA to keep the existing annotation, or **RESET** to delete the existing annotation.

NOTES

The **PLACE HA PI DATA (19)** command is used to display horizontal curve data for a selected horizontal alignment PI at a user-defined location. You may not use this command for a compound PI. This is a self-repeating command. Key in **VI=19** to practice this command.

Prompts		Response
1.	**SELECT PI OR ENTER NEW RDWY**	**DATA** on the desired PI, or Change the active roadway by typing the letter of the new roadway and repeat the prompt.
2.	**ACCEPT/REJECT → ROADWAY = X** **PI = N, ST = N, RAD = N, SP = N,N**	**DATA** to accept the selected PI, or RESET to reject the selected PI.
3.	**SELECT TEXT PLACEMENT POINT** **PI = N, ST = N, RAD = N, SP = N,N**	**DATA** at the point on the screen where the data will be displayed.

NOTES

Two different commands may be used to add PIs to your horizontal alignment. The first of these is **ADD HA PI (3)**. This command will add the first PI of the active alignment, or add PIs beyond any existing PIs. The new PIs are stored in the Working files and displayed on the graphics screen. The PI numbers are determined by the system. This is a self-repeating command. Key in **VI=3** to practice this command.

Prompts		Response
1.	**SELECT POINT OR ENTER X,Y (N,E) OR ENTER NEW RDWY**	**DATA** on existing geometry point, **DATA** to verify, or DATA to digitize a point where you want the PI to be placed, or Type the number of an existing geometry point in the IGrds Working file, whose coordinates will be used to place the PI, or Type the X and Y coordinates where the PI will be placed, or Change the active roadway by typing the letter of the new roadway and repeat the prompt.
2.	**ENTER PI STATION RESET FOR STATION = 0**	Type the beginning station for the first PI of an alignment, or **RESET** for beginning station of 0.
3.	**ENTER RADIUS, DEG OF CURVE OR SELECT ARC, RESET FOR RADIUS=X**	Type the desired radius in feet (0 for no curve), or Type the degree of curve in degrees, minutes, seconds (DD^MM'SS.SS" or DD MM SS.SS), or DATA on an existing arc with the desired radius, or **RESET** to use the previous radius, X.
4.	**ENTER IN, OUT SPIRAL LENGTHS (SPI,SPO) RESET FOR SPIRALS = 0** (If SPIRALS SWITCH is on)	Type the spiral in and out lengths, or **RESET** for no spirals.

5.	**DATA - ROUND VALUES/RESET - NO ROUND** **ENTER "H" - HOLD PI/"P" - HOLD P-LINE** (If EXTENDED FEATURES is on)	DATA for rounding values, or **RESET** for no rounding, Prompt 11 appears, or Type "P" to hold coordinates for P-Line, or Type "H" to hold coordinates for PI.
6.	**ENTER BEARING VALUE IN SECONDS (0-60)** **RESET FOR VALUE = 0** (If EXTENDED FEATURES is on)	Type the bearing rounding factor in seconds, or **RESET** for no rounding.
7.	**ENTER CURVE VALUE IN FEET (0-99)** **RESET FOR VALUE = 0** (If EXTENDED FEATURES is on)	Type the curve rounding factor in feet, or **RESET** for no rounding.
8.	**ENTER CONNECT VALUE (C OR P)** **RESET FOR BLANK** (If EXTENDED FEATURES is on)	Type "C" for CONNECT (Tangent Length = 0). Prompt 11 appears, or Type "P" for P-line (PI with no curve). Prompt 11 appears, or RESET for neither C or P. Prompt 10 appears.
9.	**ENTER TANGENT VALUE IN FEET (0-99)** **RESET FOR VALUE = 0** (If EXTENDED FEATURES is on)	Type the tangent rounding value in feet, or **RESET** for no rounding.
10.	**ADDING PI ...**	This message is displayed, the PI is placed in the IGrds Working files, and the PI is drawn on the screen.
11.	**ENTER 2ND RADIUS, COMP SPIRAL LENGTH** **RESET FOR NO COMPOUND CURVE DATA** (If EXTENDED FEATURES is on)	Type the second radius or degree of curve and the compound spiral length, separated by a comma, or **RESET** for no compound curve data pertaining to this PI.
12.	**ENTER CURVE LENGTH, NUMBER (1/2)** (If EXTENDED FEATURES is on)	**Type** the desired fixed curve length and the curve number to be fixed (1 or 2), separated by a comma.

After adding PIs to your alignment, you must use the **CREATE/UPDATE HA (10)** command. This performs horizontal alignment calculations for the active roadway using the current PIs stored in the IGrds Working files. As a result of these calculations, the existing alignment is updated, or a new alignment is created if none previously existed. If there are no errors, an alignment listing is placed in the temporary report file (.TMP) and the alignment is displayed. For this practice problem, key in **VI = 10.**

Prompts		Response
1.	**ENTER ROADWAY** **RESET FOR ROADWAY = X**	Type the letter of the roadway to be created or updated; or **RESET** to create or update roadway X.
2.	**DATA TO ALSO CREATE CHAIN** **RESET FOR NO CHAIN**	DATA to create a geometry chain with the alignment; or **RESET** for no chain.
3.	**ENTER NEW CHAIN NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type the ID number of the new chain; or **RESET** for the next available ID number.
4.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT** **GEOMETRY ELEMENT ALREADY DEFINED** This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.	Type a new ID number; or **DATA** to use the next available number; or RESET to delete the old element and reuse the ID number.
5.	**OLD HA GRAPHICS EXIST** **DATA - SAVE, RESET - NOT TO SAVE**	DATA to save the existing graphics; or **RESET** to delete the existing graphics.

NOTES

The other command that may be used to add PIs to the alignment is **INSERT HA PI (4)**. This will add a PI between two existing PIs, or before the beginning PI of the active roadway. The system will assign a PI number for the new PI. This is a self-repeating command. Key in **VI=4** to practice this command.

	Prompts	Response
1.	**SELECT AHEAD PI OR ENTER NEW RDWY**	**DATA** on the existing PI that follows the new PI, or Change the active roadway by typing the letter of the new roadway and repeat the prompt.
2.	**ACCEPT/REJECT → RDWY = X** **PI = N, ST = N, RAD = N, SP = N,N**	**DATA** to accept this PI, or RESET to reject this PI.
3.	**SELECT POINT OR ENTER X,Y** **OR ENTER NEW RDWY**	**DATA** at the desired location on the screen, or Type the coordinates of the PI to be inserted, or Change the active roadway and restart the command.
4.	**ENTER PI STATION** **RESET FOR STATION = 0**	Type the station of the new PI, or **RESET** to a station of 0.
5.	**ENTER RADIUS, OR DEG OF CURVE** **OR SELECT ARC, OR RESET FOR RADIUS=X**	Type the desired radius in feet (0 for no curve), or Type the degree of curve in degrees, minutes, seconds (DD^MM'SS.SS" or DD MM SS.SS), or DATA on an existing arc with the desired radius, or **RESET** to use the previous radius, X.
6.	**ENTER IN, OUT SPIRAL LENGTHS** **(SPI,SPO) RESET FOR SPIRALS = 0** (If SPIRALS SWITCH is on)	Type the spiral in and out lengths, or **RESET** for no spirals.
7.	**DATA - ROUND VALUES/RESET - NO ROUND** **ENTER "H" - HOLD PI/"P" - HOLD P-LINE** (If EXTENDED FEATURES is on)	DATA for rounding values, or **RESET** for no rounding, and to not hold the PI, or Type "P" to hold coordinates for P-Line, or Type "H" to hold coordinates for PI.

8.	**ENTER BEARING VALUE IN SECONDS (0-60)** **RESET FOR VALUE = 0** (If EXTENDED FEATURES is on)	Type the bearing rounding factor in seconds, or **RESET** for no rounding.
9.	**ENTER CURVE VALUE IN FEET (0-99)** **RESET FOR VALUE = 0** (If EXTENDED FEATURES is on)	Type the curve rounding factor in feet, or **RESET** for no rounding.
10.	**ENTER CONNECT VALUE (C OR P)** **RESET FOR BLANK** (If EXTENDED FEATURES is on)	Type "C" for CONNECT (Tangent Length = 0). Prompt 11 appears, or Type "P" for P-line (PI with no curve). Prompt 11 appears, or RESET for neither C or P. Prompt 10 appears.
11.	**ENTER TANGENT VALUE IN FEET (0-99)** **RESET FOR VALUE = 0** (If EXTENDED FEATURES is on)	Type the tangent rounding value in feet, or **RESET** for no rounding.
12.	**ADDING PI ...**	This message is displayed, the PI is placed in the IGrds working files, and the PI is drawn on the screen.
13.	**ENTER 2ND RADIUS, COMP SPIRAL LENGTH** **RESET FOR NO COMPOUND CURVE DATA** (If EXTENDED FEATURES is on)	Type the second radius or degree of curve and the compound spiral length, separated by a comma, or **RESET** for no compound curve data pertaining to this PI.
14.	**ENTER CURVE LENGTH, NUMBER (1/2)** (If EXTENDED FEATURES is on)	**Type** the desired fixed curve length and the curve number to be fixed (1 or 2), separated by a comma.

Be sure to run the CREATE/UPDATE HA command after inserting the PI.

NOTES

To modify a PI, use the **REVISE HA PI (7)** command. This will allow you to modify a PI and its associated curve data in the IGrds Working files. Items that may be revised are the station, radius (degree of curve), spiral length, and coordinates. To change any other PI information, you must delete the PI and then insert the PI incorporating the desired changes. This is a self-repeating command. Key in **VI=7** to practice this command.

Prompts		Response
1.	**SELECT PI OR ENTER NEW RDWY**	**DATA** on PI to be revised, or Change the active roadway by typing the letter of the new roadway and repeat the prompt.
2.	**ACCEPT/REJECT → RDWY = X** **PI = N, ST = N, RAD = N, SP = N,N**	**DATA** to accept this PI, or RESET to reject this PI.
3.	**ENTER REVISION TYPE → 1-STA, 2-RAD/DC, 3-SPIRAL, 4-XY(NE), 5-SHOW PI DATA** **RESET: SAVE CHANGES, DATA: RESTART**	Type "1" to revise the PI station. Prompt 3A appears, or Type "2" to revise the radius or degree of curve. Prompt 3B appears, or Type "3" to revise in and/or out spirals. Prompt 3C appears, or Type "4" to revise the location of the PI. Prompt 3D appears, or Type "5" to display the PI data. Prompt 3E appears, or DATA to restart this prompt, or **RESET** to save the changes.
3A.	**ENTER PI STATION** **RESET FOR STATION = N**	RESET to use the existing station, or Type the new PI station. A station equation will be created if a station other than the beginning PI station is entered. Prompt 3 appears.

3B.	**ENTER RADIUS, OR DEG OF CURVE OR SELECT ARC, OR RESET FOR RADIUS=N**	Type the desired radius in feet, or Type the degree of curve in degrees, minutes, seconds (DD^MM'SS.SS" or DD MM SS.SS), or DATA on an existing arc with the desired radius, or **RESET** to use the previous radius, X. Prompt 3 appears.
3C.	**ENTER IN, OUT SPIRAL LENGTHS (SPI,SPO) RESET FOR SPIRALS = N,N**	Type the new spiral lengths, or **RESET** to use the existing spiral lengths. Prompt 3 appears.
3D.	**SELECT POINT OR ENTER X,Y (N,E) RESET FOR X,Y (N,E) = N,N**	DATA on an existing geometry point where a PI is desired, or DATA to digitize the new PI location, or Type the coordinates of the new PI, or **RESET** to use the existing coordinates. Prompt 3 appears.
3E.	**RESET TO CONTINUE RD = X, PI = N STA = N, X,Y (N,E) = N,N RADIUS = N, SPIRALS = N,N**	**RESET** to continue. Prompt 3 appears.

NOTES

There are two commands that may be used to identify elements from the display screen. The first of these is **IDENTIFY HA (14)**. This command will identify a horizontal alignment from the display screen. The alignment is highlighted, and its roadway letter is displayed in the prompt field. This is a self-repeating command. There is no exercise for this command.

Prompts		Response
1.	**SELECT ALIGNMENT**	**DATA** on the desired alignment.
2.	**SELECT ALIGNMENT** **ROADWAY = X**	The roadway letter of the selected roadway is shown in the prompt field.

NOTES

The other identification command is **IDENTIFY HA PI (9)**. This command will highlight a PI selected by the user and display it's roadway letter, PI number, station, radius, X,Y coordinates and spiral lengths. This is a self-repeating command. There is no exercise for this command.

	Prompts	Response
1.	**SELECT PI**	**DATA** on the desired PI.
2.	**DATA FOR NEW PI, RESET TO REJECT** **RD=X, PI=N, STA=N, RAD=N, SP=N,N** (If EXTENDED FEATURES is off)	DATA to select another PI, or RESET to reject this PI, and display any other PIs at this location.
2A.	**DATA FOR MORE INFO, RESET TO REJECT** **RD=X, PI=N, STA=N, RAD=N, SP=N,N** (If EXTENDED FEATURES is on)	**DATA** to display more information about the PI, or RESET to reject this PI, and display any other PIs at this location.
3	**SELECT PI** **TYPE=XXX, RAD2=N, TAN-RD=N, BRG-RD=N** **COMP SP=N, CV#&LEN=N,N** (If EXTENDED FEATURES is on and compound curve is used)	Choose another PI.

NOTES

Two different commands within IGrds may be used to create an alignment from existing elements. The first of these is **CREATE HA FROM CHAIN (28)**. This creates a new alignment that coincides with a stored geometry chain. New PIs and curve data are computed to produce the alignment. Existing HA PIs cannot be included in the new alignment. For this practice problem, key in **VI=28**.

	Prompts	Response
1.	**SELECT CHAIN**	**DATA** on an existing chain, **DATA** to verify, or Type the ID number of an existing chain.
2.	**LOCATE POINT NEAR BEGINNING OF HA**	**DATA** at a point near the beginning of the new alignment. This point establishes the direction of the alignment. The end of the chain closets to the point you choose is the beginning of the new alignment.
3.	**ENTER ROADWAY LETTER**	Type the roadway letter for the new alignment.
4	**ENTER BEGINNING STATION** **RESET FOR STATION = 0**	Type the beginning station of the new alignment, or **RESET** to begin with station 0.
5.	**DATA TO CREATE ALIGNMENT** **RESET TO EXIT**	**DATA** to create the alignment. The message "CREATING ALIGNMENT ...." appears in the prompt field, or RESET to exit without creating the alignment. The PIs created in the above steps remain in the files. The DRAW HA PIs command is used to display them.

NOTES

The other command to create an alignment from a previous alignment is **CREATE PARALLEL HA (25)**. In this case, the previously created alignments are called base roadways. You may only use roadways A - G with this command. The base alignment cannot have spirals. The new alignment that you create may not include any existing HA PIs. Key in **VI=25** to practice this command.

Prompts		Response
1.	**ENTER PARALLEL ROADWAY LETTER (A-G)**	**Type** the desired letter for the new alignment.
2.	**ENTER BEGIN STATION OF PARALLEL RDWY** **RESET TO USE BEGIN STATION OF BASE**	Type the beginning station for the new alignment, or **RESET** to use the base roadway's beginning station.
3.	**ENTER BASE RDWY LETTER (A-G)**	**Type** the letter of the base roadway.
4.	**ENTER BEGIN STATION ON BASE** **RESET TO USE BASE BEGINNING STATION**	Type the beginning station of the new alignment, or **RESET** to use the beginning station of the base roadway.
5.	**ENTER ENDING STATION ON BASE** **RESET TO USE BASE ENDING STATION**	Type the ending station of the new alignment, or **RESET** to use the ending station of the base roadway.
6.	**ENTER (+/-) OFFSET DISTANCE**	**Type** the "+/-" offset distance between the base roadway and the new alignment ("+" is to the right of the base roadway). The following message will be displayed in the prompt field: COLLECTING PARALLEL ALIGNMENT DATA...
7.	**DATA TO COMPUTE - OR -** **RESET FOR NEW BASE ROADWAY**	**DATA** to end data collection and begin computing the alignment. The following message will be displayed in the prompt field: CREATE PARALLEL ALIGNMENT DATA..., or RESET to return to Prompt 3 to choose a new base roadway.
8.	**DATA TO CREATE ALIGNMENT** **RESET TO EXIT**	**DATA** to compute the alignment. The following message will be displayed in the prompt field: CREATING ALIGNMENT..., or RESET to exit the command without creating an alignment. The PIs created by this command remain in the files. You may use the DRAW HA PIs command to view the PIs you created.

NOTES

The next command you may need to use is **DRAW CROWN, CATCH, OR DITCH LINES (30)**. This will display the crown, catch, and ditch point lines of a roadway from the IGrds Working files. Crown displays the left or right shoulder point line of the roadway. Catch displays the left or right catch point line of the roadway. Ditch displays the left or right ditch point line, with or without terrain. This is a self-repeating command. Key in **VI=30** to practice this command.

Prompts		Response
1.	**ENTER ROADWAY LETTER** (If active roadway is G)	**Type** the roadway letter whose crown, catch, or ditch point line you want displayed.
2.	**ENTER STA FOR RDWY G (BEG,END)** **RESET-ENTIRE ALIGN,DATA-NEW OFFSET RDWY**	Type the beginning and ending station of the portion of roadway G desired, or DATA to choose a different roadway, or **RESET** to select the entire alignment of roadway G.
3.	**ENTER 1) CROWN, 2) CATCH, 3) DITCH, 4) DITCHX**	Type "1" for a left or right crown line, or Type "2" for a left or right catch line, or Type "3" for a left or right ditch line without terrain, or Type "4" for a left or right ditch line with terrain.
4.	**ENTER L/R (LEFT OR RIGHT SIDE)** **RESET TO START OVER**	Type "L" to draw the line on the left side of the roadway, or Type "R" to draw the line on the right side of the roadway, or RESET to start over.

NOTES

To create a report of your horizontal alignment, use the **CREATE HA REPORT (11)** command. With this command, a listing of the horizontal alignment for a given roadway is placed in the temporary report file (.TMP). Type **VI=11** to practice this command.

Prompts		Response
1.	**ENTER ROADWAY LETTER(S)** **X OR X-X, RESET FOR ROADWAY = X**	Type the letter of the roadway or roadways whose alignment reports you want created, or **RESET** to create the alignment report for the active roadway, X.
2.	**RESET FOR EXTENDED FEATURES (FALO)** **DATA FOR *EXISTING* REPORT (HALO)** (If EXTENDED FEATURES is on)	RESET for a FALO listing, or DATA for a HALO listing.

NOTES

There are three commands within IGrds that are used to delete elements of horizontal alignments. The first of these is **DELETE HA PI (5)**. This command will delete one PI from the display **AND** from the Working files. There is no exercise for this command.

Prompts		Response
1.	**SELECT PI OR ENTER NEW RDWY**	**DATA** on the desired PI of the active roadway for deletion, or Change the active roadway by typing the letter of the new roadway and repeat the prompt.
2.	**ACCEPT/REJECT → RDWY = X** **PI=N, STATION=N, RADIUS=N, SP=N,N**	**DATA** to accept this PI, or RESET to reject this PI.

NOTES

The next deletion command is the **DELETE HA DISPLAYS (29)** command. This command will delete the display only of the horizontal alignment, the tangent lines, the annotation, or any combination of the three. Update the screen in graphics to see the items deleted. Type **VI=29** to practice this command.

Prompts		Response
1.	**SELECT DISPLAY ELEMENT TO DEL OR RESET FOR ALL OF RDWY = X**	DATA on the alignment, tangent lines, or annotation to be deleted. Prompt 1A appears, or RESET to delete the alignment, tangent lines, and annotation for roadway X.
1A.	**ACCEPT OR REJECT → ROADWAY = X TYPE = X**	**DATA** to accept the deletion of type X, or RESET to reject this deletion.
2.	**ENTER "DEL" TO VERIFY DELETION FOR ROADWAY = X**	**Type "DEL"** to delete, or Type anything else to end the command without deleting.

NOTES

The last deletion command is **DELETE HA (27)**. This command deletes the alignment, annotation, tangent lines, and PIs for a roadway from the display **AND** from the Working files. The screen must be updated in graphics to remove the annotation from the display. There is no exercise for this command.

Prompts	Response
1. **ENTER ROADWAY TO BE DELETED OR RESET FOR ROADWAY = X**	Type the letter of the roadway to be deleted, or **RESET** to delete the active roadway, X, or Use the EXIT command to stop the deletion.
2. **ENTER "DEL" TO VERIFY DELETION FOR ROADWAY = X**	**Type "DEL"** to perform the deletion, or Type anything else to end the command without performing the deletion.

NOTES

As mentioned earlier, to use geometry commands with a horizontal alignment, the most important command to use is the **CREATE GEOMETRY ELEMENTS FROM HORIZONTAL ALIGNMENT (498)** command. This command will create IGrds geometry elements for all or part of the horizontal alignment of the active roadway. Spirals will not be created with this command. This is a self-repeating command. Key in **VI=498** to practice this command.

Prompts	Response
1. **ENTER STATION LIMITS (BEG,END) RESET-ENTIRE ALIG DATA-NEW RDWY**	Type the desired beginning and ending station of the alignment; or DATA to change active roadways; or **RESET** to accept the entire alignment.
2. **DATA-CREATE GEOM PTS FROM HA RESET FOR NO PTS**	**DATA** to create geometry points for PI, PT, etc.; or RESET to not create geometry points.
3. **ENTER NUMBER FOR FIRST POINT RESET FOR DEFAULT**	Type in the ID number of the first new point; or **RESET** to use the next available ID number.
4. **ENTER NUMBER FOR FIRST ELEMENT RESET FOR DEFAULT**	Type the ID number for the new element; or **RESET** to use the next available ID number.

5. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**

   This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

   Type a new ID number; or

   DATA to use the next available number; or

   RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT POINT AT STATION AND OFFSET (408).** This command will place a point at a defined station and offset from a given horizontal alignment. This is a self-repeating command. Key in **VI=408** to practice this command.

Prompts		Response
1.	**ENTER STATION SSSSSS.SSSS - RESET FOR NEW ROADWAY**	**Type** the station of the new point on the active roadway; or RESET to change the active roadway and restart the command.
2.	**ENTER (+/-) OFFSET DISTANCE**	**Type** the desired offset distance from the existing alignment. A "+" indicates to the right, and a "-" indicates to the left of the alignment.
3.	**ENTER NEW POINT NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point; or **RESET** for the next available ID number.
4.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED** This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.	Type a new ID number; or **DATA** to use the next available number; or RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT LINE AT STATION AND DIRECTION (425)**. This will place a line through a horizontal alignment station at a specified direction. This is a self-repeating command. Key in **VI=425** to practice this command.

Prompts		Response
1.	**ENTER STATION SSSSS.SSSS** **RESET FOR NEW ROADWAY**	**Type** the desired station on the active roadway; or RESET to change the active roadway and return to this prompt. *NOTE: Enter the station in decimal form. (20+25.5 is entered as 2025.5)*
2.	**KEY BEARING/ AZIMUTH/ SELECT LINE OR ENTER SKEW ANGLE**	**Type** the desired angle in the appropriate format: bearing - N30^15'12.3"W or N30 15 12.3W azimuth - 132^12'11.76" or 132 12 11.76 skew angle - L21^9'32.40"B or L21 9 32.40B; or DATA on an existing line; DATA to verify; or Type a line ID number.
3.	**SELECT APPROX. FIRST ENDPOINT OR ENTER (+/-) DISTANCE**	**DATA** to digitize an endpoint of the line; or Type a "+" or "-" distance from the reference station for one endpoint of the line.
4.	**SELECT APPROX. SECOND ENDPOINT OR ENTER (+/-) DISTANCE**	**DATA** to digitize the other endpoint of the line; or Type a "+" or "-" distance from the reference station for the other endpoint of the line.
5.	**ENTER NEW LINE NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new line; or **RESET** for the next available ID number.

6. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CALCULATE STATION AND OFFSET (483)**. This will compute the station and offset of a specified point relative to a horizontal alignment. The station and offset will be placed in the form of a text node at a location defined by the user. This is a self-repeating command. Key in **VI=483** to practice this command.

Prompts		Response
1.	**SELECT POINT** **RESET FOR NEW ROADWAY**	**DATA** on desired point; or Type the ID number of the desired point; or DATA to digitize the desired point; or Type the coordinates of the desired point. RESET to change the active roadway and return to this prompt.
2.	**SELECT TEXT PLACEMENT LOCATION** **RESET FOR NO LABEL** (If IGrds LABEL option is on)	**DATA** at text placement location; or RESET to not place the text label.

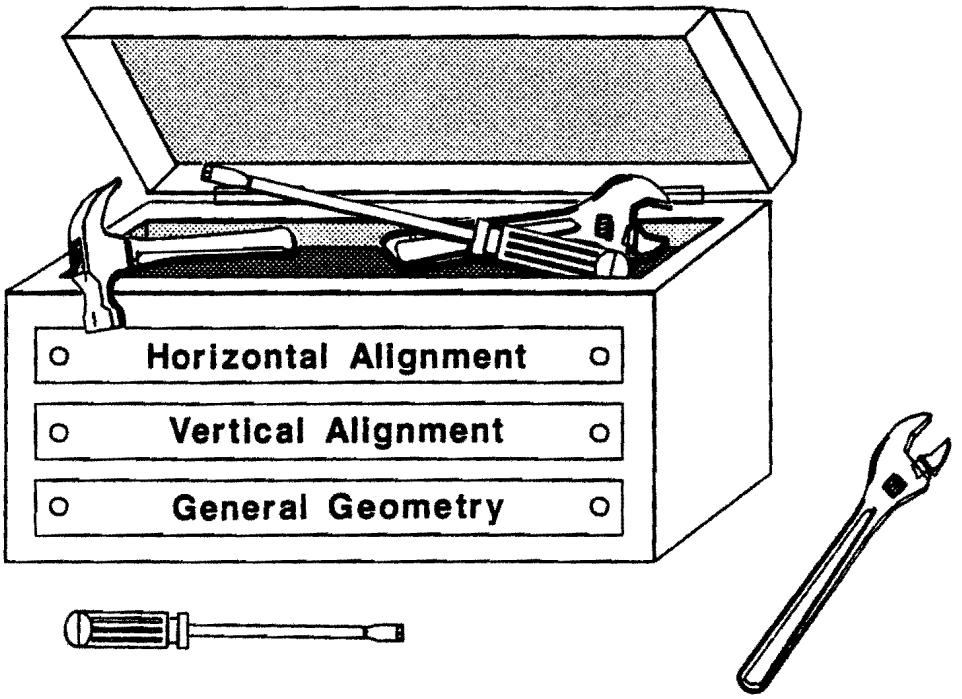
NOTES

The next command is a slight variation of the previous command. This command is called **CALCULATE STATION, OFFSET, AND ELEVATION (484).** This will compute the elevation, in addition to the station and offset of a user defined point with respect to a horizontal alignment. The results of the calculation are placed as a text node in a location defined by the user. This is a self-repeating command. There is no exercise for this command.

Prompts		Response
1.	**SELECT POINT** **RESET FOR NEW ROADWAY**	**DATA** on desired point; or Type the ID number of the desired point; or DATA to digitize the desired point; or Type the coordinates of the desired point. RESET to change active roadway and start over.
2.	**SELECT TEXT PLACEMENT LOCATION** **RESET FOR NO LABEL** (If IGrds LABEL option is on)	**DATA** at text placement location; or RESET to not place the text label.

NOTES

IGrds Practice Problems



Lesson 1: Horizontal Alignment

Lesson 2: Vertical Alignment

Lesson 3: General Geometry

IGrds™ Practice Problems

Lesson 2: Vertical Alignment

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LESSON 2. Vertical Alignment Commands

This lesson is the second of three lessons designed to provide instructions and practice problems to help new users of IGrds™ become acquainted with IGrds™ commands. The three lessons include: (1) horizontal alignment commands, (2) vertical alignment commands, and (3) general geometry commands. Each lesson consists of an instructions manual and an IGrds™ project file. The instructions manual provides a brief description of each command, a listing of the command prompts, and instructions for responding to those prompts. The IGrds™ project file contains a practice problem for each IGrds™ command. The lessons are self-instructional and self-paced. The goal was to raise the quality and consistency of the introductory IGrds™ training at the TxDOT District level so that individuals participating in the IGrds™ Workshop would have higher base knowledge levels. New users should also consult the "IGrds™ User Manual--IG Option," which is published by the American Association of State Highway and Transportation Officials.

The purpose of this lesson is to familiarize the student with the basic steps and commands used in creating, annotating, and revising geometric elements of the vertical alignment. The Vertical Alignment module within IGrds includes reference line commands, vertical points of intersection (VPI) commands, display commands, and annotation commands.

To begin the practice exercises, key in **mce va** at the unix $ prompt and "start IGrds." To perform the exercises, at the uSTN> prompt, key in **VI=XXX** when instructed, where XXX is the IGrds command number.

In order to perform vertical alignment commands, a horizontal alignment must be created and stored in IGrds Working files. The **HORIZONTAL POSITION CALCULATIONS** must be run prior to working with the vertical alignment commands. IGrds must be initialized and started prior to beginning with the vertical alignment commands.

The first command to be used when working with vertical alignments is **CREATE REFERENCE LINE (103).** This command displays a reference line for original and/or design profiles. To practice this command, type **VI=103.**

Prompts		Response
1.	**ENTER REFERENCE ROADWAY LETTER**	**Type** the letter of the desired roadway (A-Z). This is now the active roadway.
2.	**SELECT REF. LINE TYPE:** **DATA FOR CLIPPED,** **RESET FOR NO CLIPPING**	DATA to create a clipped reference line, or **RESET** to create a non-clipped reference line.

NOTE: A clipped reference line may not be modified after it has been created.

3.	**ENTER STATION LIMITS (BEG,END)** **RESET FOR HORIZONTAL ALIGNMENT LIMITS**	Type the beginning and ending stations desired (separated by a comma), or **RESET** to select the entire horizontal alignment.
4.	**SELECT ORIGIN OR ENTER X,Y (N,E)** **RESET FOR DEFAULT COORDINATES**	DATA at the desired location on the screen, or **Type** the X and Y coordinates for the desired location of the reference line, or RESET to accept the default coordinates.

The default X,Y coordinates are:

Roadway	X , Y
A	10000 , 10000
B	10000 , 110000
C	10000 , 210000
D	10000 , 310000
E	10000 , 410000
F	10000 , 510000
G	10000 , 610000

5.	**ENTER MIN,MAX ELEVATIONS** **RESET FOR DEFAULT RANGE XXX TO XXX**	Type the minimum and maximum elevations; or **RESET** to use the default elevations.
6.	**RESET - ACCEPT OR ENTER 1 - 3** **1)X:Y = X, 2) TICS=XXX,XXX, 3) EL SP=X**	**RESET** to accept the defaults, or Type 1, 2, or 3 to make the desired changes.

The reference line should now be visible on the graphics screen. If it is not visible, use the FIT command in Graphics to view the line.

NOTES

After the reference line has been created, the **DRAW VPIs (115)** command is used to display the VPIs from the Working file and stores them in the Graphics file. This command is not valid for a roadway G reference line. To practice this command, type **VI=115.**

Prompt	Response
1. **RESET TO DRAW VPIs FOR RDWY=X**	**RESET** to display VPIs for active roadway "X".

NOTES

Now that the reference line has been created successfully, we can draw the original profile with the **DRAW ORIGINAL PROFILE (106)** command. This command calculates and displays the original profile of a selected roadway. The active roadway is the same as that used to create the reference line. If the active reference line is for roadway G, then profiles for all roadways may be displayed. If it is for a roadway other than G, only that roadway's profile may be displayed. If the offset extends beyond the limits of the terrain data, the last terrain elevation on the cross-section is used and a message is written to the .ERR file. In order for this command to work, there must be terrain data stored in the IGrds Working files. To practice this command, type **VI=106.**

Prompts	Response
1A. **ENTER OFFSET DISTANCE** **RESET FOR OFFSET = 0.0** (For active roadways A-F)	Type the offset from the centerline ("-" indicates left, and "+" indicates right),or **RESET** to display the original profile.
1B. **ENTER ROADWAY OR OFFSET** RESET FOR OFFSET = 0.0 (For active roadway G)	Type the letter of the roadway whose original roadway you want to display, or Type the offset from the centerline of the reference roadway ("-" indicates left and "+" indicates right), or **RESET** to display the original profile for roadway G.

NOTES

The **COMPUTE GRADE (101)** command computes and displays the grade between two points on the active reference line. This is a self-repeating command. Type **VI=101** to practice this command.

Prompts		Response
1.	**SELECT POINT**	**DATA** on first point.
2.	**SELECT SECOND POINT**	**DATA** on second point.
3.	**SELECT SECOND POINT** **GRADE = N%**	The calculated grade is displayed in the prompt field. The previous second point becomes the first point for the next grade calculation. **DATA** on the new second point.

NOTES

If we want to identify the station and elevation of a certain point on the reference line, we can use the **COMPUTE/LABEL STATION AND ELEVATION (107)** command. This command displays the station and elevation of the specified point in the prompt fields of the screen. If the label option is on, a text location for this information can be defined as well. This is a self-repeating command. Type **VI=107** to practice this command.

Prompts		Response
1.	**SELECT POINT**	**DATA** on the point to be calculated.
2.	**SELECT TEXT PLACEMENT POINT** (If label option is "on".)	**DATA** at the point where the information is to be displayed.

NOTES

After the VPIs are displayed on the screen, the **DRAW VA TANGENTS (120)** command can be used. This command will display the tangent lines connecting the VPIs for the active roadway. You may either connect the VPIs in the Graphics file or the Working file. Type **VI = 120** to practice this command.

Prompt	Response
1. **ENTER DATA TO DRAW FROM GRAPHICS OR RESET TO DRAW FROM IGRDS WORKING FILES**	**DATA** to connect the VPIs from the Graphics file, or RESET to connect the VPIs from the IGrds Working file.

NOTES

The next step is to use the **DRAW VA DESIGN PROFILE (131)** command. This will display the vertical alignment (or an offset design profile) for active roadway (A-F) or (H-Z). If the active reference line is for roadway G, then profiles for all roadways may be displayed. If the active reference line is for a roadway other than G, only that roadway's design profile can be displayed. Type **VI=131** to practice this command.

Prompts		Response
1A.	**ENTER ROADWAY OR OFFSET RESET FOR RDWY = X** (For active roadways A-H)	Type the letter of the roadway whose vertical alignment is to be displayed, or Type the offset distance from the active roadway (X), or **RESET** to select roadway (X).
1B.	**ENTER OFFSET ROADWAY LETTER** (For active roadway G)	**Type** the offset roadway letter.
2.	**ENTER FACTOR FOR REDUCED CHORD RESET FOR FACTOR=1 (100 FT CHORD) LEGAL FACTORS: 1-5** (This prompt is only valid when an offset distance is entered)	Type the reduced chord factor (1-5), or **RESET** to select 100 ft chord lengths.

When the chord factor is increased, the chord lengths become smaller, which results in a smoother profile. Execution time increases as the chord lengths become smaller.

NOTES

Now that we have the vertical alignment drawn on the screen, we can annotate the alignment with the **ANNOTATE VA (117)** command. This command calculates and displays annotation information for the active roadway's design profile. This information consists of the PC and PT symbols, profile grade between VPIs, VPI stations, and elevations and curve lengths. Type **VI=117** to practice this command.

Prompts	Response
1. **ENTER TEXT HEIGHT** **RESET FOR TEXT HEIGHT = X**	Type text height in feet, or **RESET** to use text height "X".
2. **ENTER 1-3 FOR DELETE OPTIONS -** **1) VPI DATA, 2) PC/PT SYMBOLS,** **3) GRADES** **RESET: ANNOTATE**	Type "1" to omit VPI annotation, or Type "2" to omit PC and PT symbols, or Type "3" to omit profile grade between VPIs, or **RESET** to proceed with the annotation.

NOTES

Now we can continue by adding the vertical points of intersection (VPI) to our file. Two vertical geometry commands can be used in this process. These are the **PLACE VPOINT AT LOCATION** and **PLACE VLINE AT GRADE** commands.

The **PLACE VPOINT AT LOCATION (151)** command places an IGrds vertical geometry point (VPOINT) at a user-specified location in the Graphics file. This is a self-repeating command. Type **VI=151** to practice this command.

Prompts		Response
1.	**ACTIVE REF. ROADWAY = X** **ENTER STA, ELEV**	**Type** the desired station and elevation, or Change the active roadway and start over.
2.	**DATA FOR VPOINT LABEL** **RESET FOR NO LABEL**	DATA to label the VPOINT, or **RESET** for no label.

NOTES

The **PLACE VLINE AT GRADE (161)** command places an IGrds vertical geometry line (VLINE) at a specific grade from an existing VPOINT, or from a specific station and elevation in the Graphics file. This is a self-repeating command. Type **VI=161** to practice this command.

Prompts		Response
1.	**ENTER VLINE NUMBER** **RESET FOR NONE**	Type a VLINE number, or **RESET** for no VLINE number.
2.	**ENTER GRADE (%) OR** **SELECT VLINE**	**Type** desired grade (in percent), or Select a VLINE.
2A.	**PVLINE NO. (X)** **ACCEPT/REJECT** **GRADE = (X) %**	DATA to accept the selected VLINE, or RESET to reject the VLINE.
3.	**SELECT VPOINT OR** **ENTER STA, ELE**	**Type** the station and elevation for the starting point of the VLINE, or Select a VPOINT.
3A.	**VPNT NO. (X)** **ACCEPT/REJECT** **STA: (X) ELE: (X)**	DATA to accept VPOINT, or RESET to reject VPOINT.
4.	**SELECT APPROX. ENDING POINT**	**Digitize** an end point for the line.
5.	**DATA FOR VLINE LABEL** **RESET FOR NO LABEL**	DATA to label the VLINE number, or RESET for no label.

The remainder of the vertical geometry commands will be covered in Lesson 4. With these two commands, we are able to proceed with the placement of the VPIs.

NOTES

The **ADD VPI BY STATION AND ELEVATION (109)** command will add a VPI for the active roadway to the Graphics file. This is a self repeating command. Type **VI=109** to practice this command.

Prompts		Response
1.	**DIGITIZE POINT/ SELECT VPOINT/ ENTER STA,ELEV**	Select a VPOINT at the desired location of the new VPI, or **Type** in the station (S) and elevation (E) of the new VPI, or Digitize a point for the station and elevation of the new VPI.
2.	**ENTER VCL OR VCL1,VCL2 OR SELECT POINT ON CURVE, RESET-N,N**	Type the vertical curve length, or Type two curve lengths separated by a comma to use unsymmetrical curves, or **RESET** to select the displayed curve length, or Select point.
3.	**ENTER ELEVATION CORRECTION RESET FOR EC = N**	**Type** an elevation correction to designate the thickness of the surfacing material.

NOTES

After the VPI's have been created, the next command is **CREATE/UPDATE VA (116)**. This command calculates and stores the vertical alignment based on the VPIs previously entered. This command replaces the VPIs in the IGrds Working files for the active roadway with the displayed VPIs from the Graphics file, and displays the vertical alignment of the active roadway. Type **VI=116** to practice this command.

Prompt

1. **RESET TO CREATE/UPDATE VA**

   The message "CALCULATING VERTICAL ALIGNMENT" will appear in the prompt field while the alignment is being computed and displayed.

NOTES

The **ADD VPI BY GRADE (110)** command will add a VPI for the active roadway to the Graphics file. This is a self-repeating command. Type **VI=110** to practice this command.

Prompts		Response
1.	**SELECT REFERENCE VPI OR VPOINT**	Select the reference VPI or VPOINT to use with the grade to calculate the elevation of the new VPI.
2.	**ACCEPT/REJECT →** **RDWY=X,PI=N,STA=N,ELEV=N**	**DATA** to accept the VPI/VPOINT identified by the displayed data, or RESET to reject the VPI/VPOINT identified by the displayed data.
3.	**ENTER GRADE (%) OR SELECT VLINE**	**Type** the percentage grade (Remember to use "+" or "-"), or DATA on a VLINE with the desired grade.
4.	**ENTER OR SELECT STATION**	DATA on the VPI station to add, or **Type** the VPI station to add.
5.	**ENTER VCL OR VCL1,VCL2 OR** **SELECT POINT ON CURVE,** **RESET - N**	Type the vertical curve length, or Type two curve lengths, separated by a comma to use unsymmetrical curves, or Select point, or **RESET** to select the displayed curve length.
6.	**ENTER ELEVATION CORRECTION** **RESET FOR EC = N**	**Type** an elevation correction to represent the thickness of the surfacing material, or RESET to select the displayed value.

NOTES

The next sequence of commands will allow you to identify and modify information concerning your VPIs. The first command is **IDENTIFY VPI (108)**. This command displays the roadway letter, PI number, station, elevation, vertical curve length or lengths, and the elevation correction for a selected VPI. This is a self-repeating command. There is no exercise for this command.

Prompts		Response
1.	**SELECT VPI**	**DATA** on desired VPI
2.	**SELECT VPI** **RDWY=X, PI=N, STA=N, ELEV=N,** **VCL1=N, VCL2=N, EC=N**	

The system displays the VPI data for the selected VPI.

NOTES

Three commands are available for modifying VPIs. The first of these is the **MOVE VPI ALONG GRADE (129)** command. This command moves the selected VPI along a specified grade. This command can be performed by entering the grade, taking the grade from a VLINE, or calculating the grade between the desired VPI and a second VPI. This is a self-repeating command. Type **VI=129** to practice this command.

Prompts		Response
1.	**SELECT VPI**	**DATA** on desired VPI.
2.	**ACCEPT/REJECT →** **RDWY=X, PI=N, STA=N,** **ELEV=N, VCL1=N, VCL2=N,** **EC=N**	**DATA** to accept the identified VPI, or RESET to reject the VPI.
3.	**ENTER GRADE (%) OR** **SELECT VLINE OR** **SELECT 2ND VPI OR VPOINT**	**Type** the grade in percent, or DATA on a VLINE or VPOINT corresponding to the desired grade, or DATA on a second VPI to determine the grade.
3A.	**ACCEPT/REJECT →** **RDWY=X, PI=N, STA=N,** **ELEV=N, VCL1=N, VCL2=N,** **EC=N**	**DATA** to accept the VPI selected, or RESET to reject the VPI.
4.	**ENTER OR SELECT NEW STATION** **RESET TO START OVER**	**Type** the new station for the VPI, or DATA on screen for new station of VPI, or RESET to start over.

NOTES

The second of these commands is **REVISE VPI (112)**. This command changes the location and/or VPI data for a VPI in the Graphics file. This is a self-repeating command. Type **VI=112** to practice this command.

Prompts		Response
1.	**SELECT VPI**	**DATA** on VPI to be revised.
2.	**ACCEPT/REJECT →** **RDWY=X, PI=N, STA=N,** **ELEV=N, VCL1=N, VCL2=N,** **EC=N**	**DATA** to accept selected VPI, or RESET to reject selected VPI
3.	**ENTER REVISION TYPE →** **1-VCL, 2-EL.COR., 3-STA,EL,** **4-DISPLAY VPI DATA** **RESET: SAVE CHANGE**	**Type** the revision type "1" for vertical curve length "2" for elevation correction "3" for VPI station, or elevation "4" for VPI data display, or **RESET** to save the changes.
3A.	**ENTER VCL or VCL1,VCL2** **OR SELECT POINT ON CURVE,** **RESET-N**	Type vertical curve length, or Type two curve lengths separated by a comma, or Select point, or **RESET** to select the displayed curve length.
3B.	**ENTER ELEVATION CORRECTION** **RESET FOR ELEV. CORR.= N**	Type the elevation correction, or **RESET** to accept the displayed elevation correction.
3C.	**SELECT POINT, VPOINT** **OR ENTER STA, ELEV** **RESET FOR STA=N, EL=M**	Digitize point, or DATA on VPOINT, or Type station and elevation, or **RESET** for station "N" and elevation "M".
3D.	**RESET TO CONTINUE, RDWY=X** **PI=N, STA=N, ELEV=N,** **VCL1=N, VCL2=N, EC=N**	**RESET** to return to Prompt 3.

NOTES

The **DELETE VPI (113)** command removes a VPI from the Graphics file. The IGrds Working file is not modified until **CREATE/UPDATE VA** is executed. Type **VI=113** to practice this command.

Prompts		Response
1.	**SELECT VPI**	**DATA** on desired VPI.
2.	**ACCEPT/REJECT → RDWY=X,PI=N,STA=N, ELEV=N**	**DATA** to accept the VPI, or RESET to reject the VPI.

It is important to remember to use the **CREATE/UPDATE VA** command after making changes in the Graphics file in order for those changes to apply in the IGrds Working file.

NOTES

To view information pertaining to a particular VPI, use the **PLACE VPI DATA (127)** command. This displays vertical curve data for selected VPIs at a user-defined location on the screen. This is a self-repeating command. Type **VI=127** to practice this command.

Prompts		Response
1.	**ENTER TEXT HEIGHT** **RESET FOR TEXT HEIGHT = N**	Type the text height in feet, or **RESET** to accept text height "N".
2.	**SELECT VPI**	**DATA** on the desired VPI.
3.	**SELECT TEXT PLACEMENT POINT** **RDWY=X, PI=X, STA=X, ELEV=X**	**DATA** on screen at desired text location.

NOTES

Ditch profiles are drawn with the **DRAW DITCH PROFILE (133)** command. This command will display a ditch profile on either the left or the right side of the roadway. Original ground may be used in the calculation of the ditch profile. The active roadway is the same as the active roadway used to create the reference line. If roadway G is active, profiles for all roadways may be displayed. If any other roadway is active, only that roadway's profiles can be displayed. Type **VI = 133** to practice this command.

Prompt	Response
1. **ENTER DITCH TYPE OPTION →** **1) LD, 2) RD, 3) LX, 4) RX**	Type "1" for left ditch with design data, or Type "2" for right ditch with design data, or Type "3" for left ditch with original ground, or Type "4" for right ditch with original ground.

NOTES

As a mechanism for checking your work, the **IDENTIFY PROFILE (124)** command will help you by displaying the profile's roadway ID and type. There is no exercise for this command.

Prompts	Response
1. **SELECT PROFILE**	**DATA** on desired profile.
2. **SELECT PROFILE** **REFRD=X, TYPE=X, OFF=X, OFFRD=X**	

The reference roadway letter, the type of profile, the offset, and the offset roadway of the selected profile are displayed in the prompt fields.

At this point, if you discover that you have made an error, you can go back and correct it.

NOTES

To display the station and elevation of any point on the original or design profile of the active roadway, use the **COMPUTE/LABEL PROFILE STATION AND ELEVATION (126)** command. The station and elevation of the selected point will appear in the prompt fields of the graphic screen. If the label switch is on, then you may choose a location for the information. This is a self-repeating command. Type **VI=126** to practice this command.

	Prompts	Response
1.	**SELECT PROFILE**	**DATA** on the desired profile.
2.	**ACCEPT/REJECT →** **RDWY=X, TYPE=X, OFF=X, OFFRD=X**	**DATA** to accept the displayed information, or RESET to reject the information.
3.	**ENTER STATION OR SELECT POINT** **RESET TO SELECT NEW PROFILE** (If label option is "on")	Type the station in feet and decimal, or Select a point, or RESET to select a different profile.
4.	**SELECT TEXT PLACEMENT**	**DATA** at the text placement location.

NOTES

To annotate the elevations of a profile on the active reference line, use the **LABEL PROFILE ELEVATION (123)** command. The profile elevations are placed at intervals along the station (horizontal) axis. The elevations are written vertically to the left or right of the stations. The design profile elevations do not account for superelevation. You must specify an offset to account for superelevation. This is a self-repeating command. Type **VI=123** to practice this command.

	Prompts	Response
1.	**SELECT PROFILE**	**DATA** on desired profile.
2.	**ACCEPT/REJECT →** **RDWY=X,TYPE=X,OFF=n,OFFRD=X**	**DATA** to accept identified profile, or RESET to reject the profile and restart the command.
3.	**ENTER STATION INCREMENT** **RESET FOR 100.0**	Type the interval (in feet) between displayed annotation, or **RESET** to keep the interval at 100 feet.
4.	**SELECT LABEL VERTICAL POSITION** **RESET FOR DEFAULT**	Type an elevation for the annotation, or DATA at the elevation for the annotation, or **RESET** to select the default position, just above the reference line.
5.	**ENTER L OR R TO DEFINE** **LABEL HOR. POSITION** **RESET - NEW PROF.**	Type "L" to place the labels on the left of the station, or Type "R" to place the labels on the right of the station, or RESET to restart the command.

NOTES

To compare the difference between the design and original profile, use the **PROFILE ELEVATION DIFFERENCE (125)** command. This command calculates the elevation difference and annotates the difference at a specified interval along the station axis. The elevations are reported vertically to the left or right of the even stations. The design elevations do not account for superelevation. You must specify an offset to account for superelevation. You are able to specify a minimum or maximum tolerance between the profiles. The system will mark the differences that exceed the specified tolerance on the Graphic display and in the .TMP file. Type **VI=125** to practice this command.

Prompts		Response
1.	**SELECT DESIGN PROFILE**	**DATA** on the desired design profile.
2.	**ACCEPT/REJECT →** **RDWY=X,TYPE=X,OFF=X,OFFRD=X**	**DATA** to accept the displayed profile, or RESET to reject the displayed profile.
3.	**ENTER MIN ELEV DIFF CONSTRAINT:** **(RESET FOR NONE)**	Type the minimum elevation difference tolerance. Any elevation difference less than the tolerance will be marked with " ⌈" in the annotation. or **RESET** for no minimum tolerance.
4.	**ENTER MAX ELEV DIFF CONSTRAINT:**	Type the maximum elevation difference tolerance. Any elevation difference greater than the tolerance will be marked with a "→" in the annotation. or RESET to set 100 foot tolerance.
5.	**ENTER STATION INCREMENT** **RESET FOR 100.0**	Type the interval (in feet) between elevation difference annotations, or **RESET** to set 100.0 foot increments.

NOTES

The **DELETE PROFILE DISPLAYS (136)** command allows you to delete a vertical alignment and its VPIs from the active reference line. This command will also delete original profile displays. There is no exercise for this command.

Prompts	Response
1. **SELECT PROF. DISPLAY TO DELETE RESET-DELETE ALL DESIGN DISPLAYS FOR RD=X**	**DATA** on the profile to delete, or RESET to delete all vertical alignment displays of roadway "X". DATA on the original display to delete it.
1A. **ACCEPT/REJECT RDWY=X,TYPE=X,OFF=X,OFFRD=X**	**DATA** to accept the profile and delete, or RESET to reject the profile and exit.

This prompt appears only if RESET is the response to prompt 1.

2. **ENTER "DEL" TO VERIFY DELETION FOR ROADWAY = X**	**Type "DEL"** to allow the deletion, or Type any other character to abort the command.

NOTES

The last step in the process is **CREATE VA REPORT (122).** This command places the vertical alignment data for the specified roadway(s) in the .TMP file. The data reported includes VPI numbers, VPI stations, VPI elevations, vertical curve lengths, elevation corrections, external values, and grades. Type **VI=122** to practice this command.

Prompt	Response
1. **ENTER ROADWAY LETTER(S) X OR X-X, RESET FOR RDWY=(X)**	**Type** the desired roadway letter, or RESET for the active roadway.

NOTES

The **DELETE VA (130)** command will delete the vertical alignment from the IGrds Working files and Graphics file. Update the screen to remove the alignment graphically. There is no exercise for this command.

Prompts		Response
1.	**RESET TO DELETE DATA FOR RDWY X**	**RESET** to delete vertical alignment for roadway "X".
2.	**ENTER "DEL" TO VERIFY DELETION FOR ROADWAY = X**	**Type "DEL"** to delete the alignment, or Type anything else to abort the command.

NOTES

There are four different commands that may be used to modify an existing reference line. The first command is **DELETE REFERENCE LINE (105).** It may be used with both clipped and non-clipped refernce lines. This command deletes the active reference line with tic marks, station labels, and vertical elevation scale. Any data that is displayed on the reference line will not be deleted by this command. There is no exercise for this command.

Prompt	Response
1. **RESET TO DELETE REFERENCE LINE FOR RDWY=X**	RESET to delete the active refernce line, or Use the **EXIT** command to cancel.

NOTES

The reference line can be relocated on the graphics screen using the **RELOCATE REFERENCE LINE (134)** command. With this command, you can relocate a reference line and all its associated data from one location on the screen to another. Type **VI=134** to practice this command.

Prompts		Response
1.	**ENTER ROADWAY LETTER** **RESET FOR ACTIVE ROADWAY=X**	Type the letter of the roadway whose reference line you want to relocate, or **RESET** to accept the reference line for the curent active roadway.
2.	**SELECT FIRST CORNER OF FENCE**	**DATA** at the location of the first corner of the fence. Select the corner so that all of the data associated with the reference line is included inside the fence.
3.	**SELECT SECOND CORNER OF FENCE**	**DATA** at the location of the opposite corner of your fence, remembering to include all the associated data inside the fence.
4.	**DATA TO KEEP FENCE LOCATION** **RESET FOR NEW FENCE LOCATION**	**DATA** to accept your fence, or RESET to reject this fence. Rejecting this fence will return you to the second prompt, and allow you to choose a different fence location.
5.	**SELECT LOCATION OF NEW REF. LINE ORIGIN**	**DATA** at the desired new location of the reference line origin.

Note: If you need to modify your reference line, it is generally easier to use the DELETE REFERENCE LINE command to delete the reference line, and then recreate the reference line incorporating the modifications.

NOTES

The **MOVE REFERENCE LINE (104)** command can be used to modify a non-clipped reference line. This command allows you to move the horizontal and vertical scale of the active reference line. Using this command repositions the reference scale only. The origin, vertical alignment, and profile displays are not repositioned. There is no exercise for this command.

Prompt	Response
1. **SELECT OR ENTER STA, ELEV OR RESET - FOR ORIGINAL ORIGIN**	**Type** the station and elevation of the new scale location, or RESET to cancel this command.

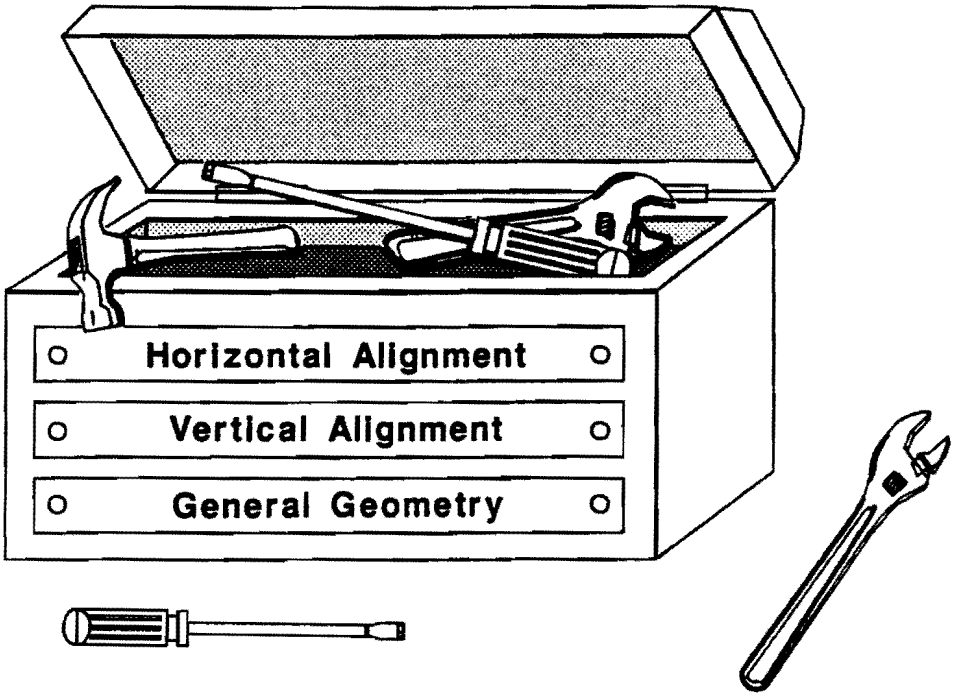
NOTES

The **EXTEND/SHORTEN REFERENCE LINE (102)** command is used to extend and/or shorten the horizontal and/or vertical scales of a non-clipped reference line. There is no exercise for this command.

Prompts		Response
1.	**ENTER NEW STATION RANGE RESET FOR EXTENT OF VPI STATIONS**	Type the range of desired stations for the horizontal scale, or **RESET** to accept the entire profile.
2.	**ENTER NEW ELEVATION RANGE RESET FOR EXTENT OF VPI ELEVATIONS**	Type the desired range of elevations for the vertical scale, or **RESET** to accept the complete range of VPI elevations.

NOTES

IGrds Practice Problems



Lesson 1: Horizontal Alignment

Lesson 2: Vertical Alignment

Lesson 3: General Geometry

IGrds™ Practice Problems

Lesson 3: General Geometry

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LESSON 3. USING GENERAL GEOMETRY COMMANDS

This lesson is the third of three lessons designed to provide instructions and practice problems to help new users of IGrds™ become acquainted with IGrds™ commands. The three lessons include: (1) horizontal alignment commands, (2) vertical alignment commands, and (3) general geometry commands. Each lesson consists of an instructions manual and an IGrds™ project file. The instructions manual provides a brief description of each command, a listing of the command prompts, and instructions for responding to those prompts. The IGrds™ project file contains a practice problem for each IGrds™ command. The lessons are self-instructional and self-paced. The goal was to raise the quality and consistency of the introductory IGrds™ training at the TxDOT District level so that individuals participating in the IGrds™ Workshop would have higher base knowledge levels. New users should also consult the "IGrds™ User Manual--IG Option," which is published by the American Association of State Highway and Transportation Officials.

This lesson will allow you to practice using general geometry commands within IGrds. These geometry commands establish points, lines, arcs, chains, and shapes, and display them on the graphics screen. The elements created with these commands can then be used in other geometry computations, such as those related to horizontal alignments.

General geometry commands will either create elements, perform calculations, or perform user service routines. The user service routines include identifying and labeling elements, deleting elements, and transferring points to and from IGrds Working files.

Most of these commands will not work directly on a horizontal alignment. Before you use these commands when working with an alignment, you must first use the **CREATE GEOMETRY ELEMENTS FROM HORIZONTAL ALIGNMENT** command to break the alignment into geometric elements.

The IGrds Geometry files consist of a point file (.PNT), a curve file (.CRV), and a chain file (.CHN). These files are associated with the IGrds Working files.

To begin the exercises associated with this lesson, key in **mce geom** at the unix $ prompt and "start IGrds." To perform the exercises, at the uSTN> prompt, key in **VI=XXX** when instructed, where XXX is the IGrds command number. Remember that IGrds requires that all keyboard entries be UPPER case.

Two commands are used to toggle the numbering and labeling switches. The first of these is **AUTOMATIC ELEMENT NUMBERING SWITCH (493).** This toggles the switch that controls the automatic numbering of elements, and if you are prompted for an element number when constructing new elements. There is no exercise for this command.

The other command is the **AUTOMATIC ELEMENT LABELING SWITCH (494)**. This command toggles the switch controlling the automatic labeling of elements, and whether or not new elements are to be labeled. There is no exercise for this command.

The first group of geometry commands are those that create elements. These are further separated into commands that create points, lines, arcs, chains, and shapes. The first command to be discussed is **CONSTRUCT POINT AT LOCATION (400)**. This will create a geometry point at a defined location. This command is self-repeating, allowing for multiple entry of points. For this practice problem key in **VI=400.**

Prompts		Response
1.	**ENTER X,Y (N,E) OR DIGITIZE LOCATION**	Type the X,Y coordinates 11600, ; or **DATA** at desired location.
2.	**ENTER NEW POINT NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type the ID number for the new point; or **RESET** for the next available ID number.

3. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
   GEOMETRY ELEMENT ALREADY DEFINED

   This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

   Type a new ID number; or

   DATA to use the next available number; or

   RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT POINT ON ELEMENT (401).** This command will place a point directly on the desired element. For this practice problem, key in **VI=401.**

Prompts		Response
1.	**SELECT LOCATION ON ELEMENT**	**DATA** at the desired location on the desired element. The point will be placed on the highlighted element. **DATA** to verify the element or **RESET** to select a different element.
2.	**ENTER NEW POINT NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point; or **RESET** for the next available ID number.
3.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT** **GEOMETRY ELEMENT ALREADY DEFINED**	

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT POINT AT ENDPOINT/KEYPOINT OF ELEMENT (402)**. This will construct a point at an endpoint(s) or at the keypoint(s) of an element or an optional offset element. An example of a keypoint is the center point of an arc. For this practice problem, key in **VI=402.**

Prompts	Response
1. **SELECT KEYPOINT OF ELEMENT OFFSET OPTIONAL**	**DATA** on desired element will highlight the element, verify the highlighted element with DATA or through typed entry; or *If you use DATA to verify:* *For Lines, Arcs, and Chain Components--The end point closest to the selected point is placed.* *For Chains--Points are placed at the ends of all components and at the center points of arc components.* *You may also verify by typing:* *An offset (for Lines and Arcs)--The offset end point is placed closest to the selected point.* *"CP" (for Arcs)--The point will be placed at the centerpoint of the arc.* Type the ID number of the desired element. The offset distance should be typed after the ID number separated by a "," or "/". (Example: L24,-12 or L34/20)
2A. **ENTER B (BEGINNING) OR E (END) OR A (ALL)** (If a line ID number was entered).	Type B for a point at the beginning; or Type E for a point at the end; or Type A for both points.
2B. **ENTER PC, PT, CP (CENTERPOINT), OR A (ALL)** (If an arc ID number was entered.)	Type PC for a point at the point of curvature; or Type PT for a point at the point of tangency; or Type CP for a point at the centerpoint; or Type A for all three points.

3. **ENTER NEW POINT NUMBER**
RESET FOR DEFAULT
(If auto-numbering is off)

Type an ID number for the new point; or

RESET for the next available ID number.

For chains, the ID number is the first point number of the series of points in the chain.

4. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT POINT AT INTERSECTION OF TWO ELEMENTS (403)**. This will place a geometry point at an intersection of two geometric elements. For this practice problem, key in **VI=403**.

Prompts		Response
1.	**SELECT FIRST ELEMENT OFFSET OPTIONAL**	**DATA** on first element; **DATA** or type offset distance to verify; or
		Type element ID number.
2.	**SELECT SECOND ELEMENT OFFSET OPTIONAL**	**DATA** on second element; **DATA** or type offset distance to verify; or
		Type element ID number.
3.	**DIGITIZE POINT NEAR INTERSECTION** (If both elements were selected by ID numbers)	**DATA** at desired point placement.
4.	**ENTER NEW POINT NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point; or **RESET** for the next available ID number.
5.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**	
	This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.	
		Type a new ID number; or
		DATA to use the next available number; or
		RESET to delete the old element and reuse the ID number.

NOTES

The next command to be discussed is **CONSTRUCT POINT ALONG ELEMENT FROM POINT ON ELEMENT (404)**. This command will place a point at a specified distance and offset from a point on the element. For this practice problem, key in **VI=404.**

Prompts		Response
1.	**SELECT ELEMENT**	**DATA** on desired element; **DATA** to verify; or Type the element ID number.
2.	**SELECT POINT ON ELEMENT**	Type the point ID number; or DATA to digitize a point on the element; or **DATA** on a specific point on the element; **DATA** to verify the point.
3.	**ENTER (+ OR -)DISTANCE, OFFSET**	**Type** the distance along the element, preceded by the direction ("+" is toward the end of the element, "-" is toward the beginning). Prompt 3A will appear if no direction is specified.
3A.	**DIGITIZE DIRECTION OF NEW POINT**	**DATA** to the left or right of the original point.
4.	**ENTER NEW POINT NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point; or **RESET** for the next available ID number.

5. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT POINT PROJECTED TO ELEMENT (PERPENDICULAR) (405).** This will place a point along a perpendicular line to the desired element. The perpendicular to the element is defined by the point chosen as the projecting point. The point placed by this command may be located anywhere along the perpendicular line. For this practice problem, key in **VI=405.**

Prompts		Response
1.	**SELECT ELEMENT** **OFFSET OPTIONAL**	**DATA** on desired element; verify with **DATA** or by typing an offset distance; or Type the element ID number.
2.	**SELECT PROJECTING POINT**	**DATA** on desired point; or Type the point ID number; or DATA to digitize a new point; or Type the coordinates of the point.
3.	**ENTER NEW POINT NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point; or **RESET** for the next available ID number.

4. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CREATE POINT AT DISTANCE AND DIRECTION FROM POINT (406)**. This will place a new point at a specified distance and bearing from a defined location. This is a self-repeating command. This is similar to traversing. For this practice problem, key in **VI=406**.

Prompts		Response
1.	**SELECT POINT**	**DATA** on existing point; or Type the ID number of the desired point; or DATA to create a new point; or Type the coordinates of the new point.
2.	**KEY BEARING/AZIMUTH/SELECT LINE** **RESET TO START OVER**	**Type** a bearing format; or Type an azimuth format; or Type a line ID number; or DATA to select a line for direction; DATA to verify; or RESET to return to Prompt 1 for selecting a new reference point.
3.	**ENTER DISTANCE,OFFSET**	**Type** the desired distance with "+" or "-" to indicate direction ("+" is assumed).
4.	**ENTER NEW POINT NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point; or **RESET** for the next available ID number.
5.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT** **GEOMETRY ELEMENT ALREADY DEFINED**	

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

	Type a new ID number; or **DATA** to use the next available number; or RESET to delete the old element and reuse the ID number.

NOTES

The next point command is **CONSTRUCT POINT BY DISTANCE AND ANGLE (407).** This will establish a point at a defined distance and angle from two other points. This is a self-repeating command that works similar to traversing, using the new point as the transit point and the previous transit point as the back sight point. IGrds will return you to the third prompt, unless an offset is specified, whereby you are returned to the first prompt. For this practice problem, key in **VI=407.**

Prompts		Response
1.	**SELECT BACK SIGHT POINT**	**DATA** on existing point; or Type the ID number of the desired point; or DATA to create a point; or Type the coordinates of the desired point.
2.	**SELECT TRANSIT POINT**	**DATA** on existing point; or Type the ID number of the desired point; or DATA to create a point; or Type the coordinates of the desired point.
3.	**ENTER ANGLE, DEFLECT ANGLE, SKEW RESET TO START OVER**	**Type** the desired angle in angle, deflection, or skew format: Angle- +44^12'10.11" or 44 12 10.11 Deflection- D64^12'10.11"R or D64 12 10.11R Skew- L34^12'10.11"F or L34 12 10.11F ; or RESET to return to Prompt 1 and start over.
4.	**ENTER DISTANCE, OFFSET**	**Type** the desired distance with "+" or "-" to indicate direction ("+" is assumed).
5.	**ENTER NEW POINT NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point; or **RESET** for the next available ID number.

6. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next two commands can be used to place points or lines relative to existing arcs. The first is **CONSTRUCT POINT/LINE TANGENT TO ARC FROM POINT OFF ARC (418).** This command places a point tangent to an arc from a point. Placing this point defines the line from the point through the point of tangency. For this practice problem, key in **VI=418.**

Prompts		Response
1.	**SELECT ARC AT APPROX. POINT OF TANGENCY OFFSET OPTIONAL**	**DATA** on the desired arc; verify with **DATA** or by typing an offset distance; or Type the ID number of the desired arc.
2.	**SELECT POINT OFF ARC**	**DATA** to select an existing point; or Type the point ID number; or DATA to digitize a new point; or Type the coordinates of the desired point.
3.	**KEY 1 - FIRST PNT; 2 - SECOND PNT** (If an arc ID was entered)	Indicate the desired point of tangency by typing "1" for the first point of the arc, or "2" for the second point.
4.	**ENTER NEW POINT NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point; or **RESET** for the next available ID number.
5A.	**ENTER LINE ID, RESET FOR DEFAULT, DATA FOR NO LINE** (If auto-numbering is off)	Type a line number; or DATA for no line; or RESET for next available line number.
5B.	**RESET FOR LINE, DATA FOR NO LINE** (If auto-numbering is on)	DATA for no line; or RESET for a line.

6. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The second command is **CONSTRUCT POINTS/LINE TANGENT TO TWO ARCS (419).** This command will place two points tangent to two specified arcs. For this practice problem, key in **VI=419.**

Prompts		Response
1.	**SELECT FIRST ARC** **OFFSET OPTIONAL**	**DATA** on desired first arc at the point of tangency; verify with DATA or by typing an offset distance; or Type the ID number of the first arc.
2.	**SELECT SECOND ARC** **OFFSET OPTIONAL**	**DATA** on desired second arc at the point of tangency; verify with DATA or by typing an offset distance; or Type the ID number of the second arc.
3.	**ENTER TANG OPTION (1-4)** (If either arc ID was entered)	**Type** the number (1-4) corresponding to the desired tangent option.
4.	**ENTER NUMBER FOR FIRST POINT** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point on the first arc; or **RESET** for the next available ID number.
5.	**ENTER NUMBER FOR SECOND POINT** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new point on the second arc; or **RESET** for the next available ID number.
6A.	**ENTER LINE ID, RESET FOR DEFAULT,** **DATA FOR NO LINE** (If auto-numbering is off)	Type a line number; or DATA for no line; or RESET for next available line number.
6B.	**RESET FOR LINE, DATA FOR NO LINE** (If auto-numbering is on)	DATA for no line; or RESET for a line.

7. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next group of commands are for creating geometry lines within IGrds. The first command is **CONSTRUCT LINE BETWEEN TWO POINTS (420)**. This command will place a line between two specified points. It will also display the bearing and distance of the line. This is a self-repeating command, allowing you to chain points together. For this practice problem, key in **VI=420**.

Prompts		Response
1.	**SELECT FIRST POINT**	**DATA** on desired start point; or
		Type the ID number of the start point; or
		DATA to digitize the start point; or
		Type the coordinates of the start point.
2.	**SELECT SECOND POINT** **RESET TO START OVER**	**DATA** on desired second point; or
		Type the ID number of the second point; or
		DATA to digitize the second point; or
		Type the coordinates of the second point; or
		RESET to start over at Prompt 1.
3.	**ENTER (+/-) OFFSET DISTANCE** **RESET FOR NO OFFSET**	Type an offset distance; or
		RESET for no offset.
4.	**ENTER NEW LINE NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new line; or
		RESET for the next available ID number.

5. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT LINE PERPENDICULAR TO ELEMENT (421).** This will place a line perpendicular to an element through a defined point. The line will be created even if it does not intersect the element. For this practice problem, key in **VI=421.**

Prompts		Response
1.	**SELECT ELEMENT**	**DATA** on desired element; **DATA** to verify; or
		Type the ID number of the desired element.
2.	**SELECT POINT**	**DATA** on the desired point; or
		Type the ID number of the desired point; or
		DATA to digitize a point; or
		Type the coordinates of the desired point.
3.	**SELECT APPROX. BEGINNING POINT OR ENTER DISTANCE**	**DATA** to digitize the start point of the line; or
		Type a distance from the point to start the line.
4.	**DIGITIZE POINT OF DIRECTION FOR LINE** (If a distance is entered in Prompt 3)	**DATA** to indicate the direction of the line from the start point.
5.	**SELECT APPROX. ENDING POINT OR ENTER DISTANCE**	**DATA** to digitize the end point of the line; or
		Type a distance from the point to end the line.
6.	**DIGITIZE POINT OF DIRECTION FOR LINE** (If a distance is entered in Prompt 5)	**DATA** to indicate the direction of the line from the start point.
7.	**ENTER NEW LINE NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new line; or **RESET** for the next available ID number.

8. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT LINE AT ANGLE TO ELEMENT (422).** This will place a line at an angle, deflection angle, or skew angle to an element through a specified point. For this practice problem, key in **VI=422.**

Prompts		Response
1.	**SELECT ELEMENT**	**DATA** on desired element; **DATA** to verify; or Type the ID number of the desired element.
2.	**SELECT POINT**	**DATA** on the desired point; or Type the ID number of the desired point; or DATA to digitize a point; or Type the coordinates of the desired point.
3.	**ENTER ANGLE,SKEW OR DEFLECT**	**Type** the desired angle in angle, deflection or skew format: Angle- +44^12'10.11" or 44 12 10.11 Deflection- D64^12'10.11"R or D64 12 10.11R Skew- L34^12'10.11"F or L34 12 10.11F
4.	**SELECT APPROX. BEGINNING POINT OR ENTER DISTANCE**	**DATA** to digitize the start point of the line; or Type a distance from the point to start the line.
5.	**DIGITIZE POINT OF DIRECTION FOR LINE** (If a distance is entered in Prompt 4)	**DATA** to indicate the direction of the line from the start point.
6.	**SELECT APPROX. ENDING POINT OR ENTER DISTANCE**	**DATA** to digitize the end point of the line; or Type a distance from the point to end the line.
7.	**DIGITIZE POINT OF DIRECTION FOR LINE** (If a distance is entered in Prompt 6)	**DATA** to indicate the direction of the line from the start point.
8.	**ENTER NEW LINE NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new line; or **RESET** for the next available ID number.

9. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT LINE THROUGH POINT AT BEARING OR AZIMUTH (423)**. A line will be placed at a specified bearing through a point. For this practice problem, key in **VI=423**.

Prompts		Response
1.	**SELECT POINT**	**DATA** on the desired point; or
		Type the ID number of the desired point; or
		DATA to digitize a point; or
		Type the coordinates of the desired point.
2.	**KEY BEARING/ AZIMUTH/ SELECT LINE**	**Type** the desired direction in bearing or azimuth format:
		bearing - N34^12'10.11"E or N34 12 10.11E
		azimuth - 194^12'10.11" or 194 12 10.11 ; or
		Type the ID number of the desired line; or
		DATA on a line for direction; DATA to verify.
3.	**SELECT APPROX. FIRST ENDPOINT OR ENTER (+/-) DISTANCE**	**DATA** to digitize an endpoint of the new line; or
		Type a "+" or "-" distance from the selected point ("+" is assumed if no sign is entered).
4.	**SELECT APPROX. SECOND ENDPOINT OR ENTER (+/-) DISTANCE**	**DATA** to digitize an endpoint of the new line; or
		Type a "+" or "-" distance from the selected point ("+" is assumed if no sign is entered).
5.	**ENTER NEW LINE NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new line; or **RESET** for the next available ID number.

6. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT LINE TANGENT TO ARC AT POINT ON ARC (424).** This will place a tangent line from a point on an arc a specified distance or to an endpoint. For this practice problem, key in **VI=424.**

Prompts		Response
1.	**SELECT ARC**	**DATA** on desired arc; **DATA** to verify; or
		Type the ID number of the desired arc.
2.	**SELECT POINT ON ARC**	**DATA** on desired point; or
		Type the ID number of the desired point; or
		DATA to digitize a point on the arc; or
		Type the coordinates of a point on the arc.
3.	**SELECT APPROX. ENDPOINT OR ENTER DISTANCE**	**DATA** to digitize an endpoint of the line; or
		Type a distance for the length of the line.
4.	**DIGITIZE POINT OF DIRECTION FOR LINE** (If a distance is entered in Prompt 3)	**DATA** to indicate the direction of the line.
5.	**ENTER NEW LINE NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new line; or
		RESET for the next available ID number.

6. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**

   This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

   Type a new ID number; or

   DATA to use the next available number; or

   RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT LINE THROUGH SERIES OF POINTS (426).** This command will place a "least squares fit" line through a series of points. The least squares line is based on north coordinates only. The east coordinates of the first and last points entered provide the boundary for the line. For this practice problem, key in **VI=426.**

Prompts		Response
1.	**SELECT POINT - RESET TO END POINT SELECTION**	**DATA** to digitize point locations; or DATA to select point ID numbers; DATA to verify the ID numbers; or Type desired point ID numbers. **RESET** to end point selection. This prompt will repeat until you RESET.
2.	**ENTER NEW LINE NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new line; or **RESET** for the next available ID number.

3. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**

   This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

   Type a new ID number; or

   DATA to use the next available number; or

   RESET to delete the old element and reuse the ID number.

NOTES

The next group of commands deal with the placement of arcs. The largest arc that can be created with IGrds is 180 degrees. The first command is **CONSTRUCT ARC BY CENTER, RADIUS AND ENDPOINTS (440).** This will create an arc based on a center point, a radius, and two endpoints to define the arc length. For this practice problem, key in **VI=440.**

Prompts		Response
1.	**SELECT CENTER POINT**	**DATA** on desired point; or
		Type ID number of desired point; or
		DATA to digitize a point; or
		Type the coordinates of the desired point.
2.	**ENTER RADIUS, DEGREE OF CURVE OR SELECT POINT/ARC**	Type the desired radius in feet; or
		Type the degree of curve in degrees, minutes, seconds form (DD^MM'SS.SS" or DD MM SS.SS); or
		DATA on an existing arc. IGrds will use this arc's radius; or
		Type the ID number of an existing arc; or
		Define a point on the new arc by: DATA on an existing point, typing an existing point ID number, DATA to digitize a point, or typing the coordinates of a point.
3.	**SELECT BEGINNING POINT**	**DATA** on desired beginning point; or
		Type ID number of desired point; or
		DATA to digitize the beginning point; or
		Type the coordinates of the desired beginning point.
4.	**SELECT ENDING POINT**	**DATA** on desired ending point; or
		Type ID number of desired point; or
		DATA to digitize the ending point; or
		Type the coordinates of the desired ending point.

5. **ENTER NEW ARC NUMBER**
RESET FOR DEFAULT
(If auto-numbering is off)

Type an ID number for the new arc; or

RESET for the next available ID number.

6. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next arc placing command is **CONSTRUCT ARC BY (+/-) RADIUS AND ENDPOINTS (PC/PT) (441).** This command will place the arc given the radius and the endpoints. For this practice problem, key in **VI=441.**

Prompts		Response
1.	**SELECT FIRST POINT (PC)**	**DATA** on desired point; or Type the ID number of the desired point; or DATA to digitize a point; or Type the coordinates of the desired point.
2.	**SELECT SECOND POINT (PT)**	**DATA** on desired point; or Type the ID number of the desired point; or DATA to digitize a point; or Type the coordinates of the desired point.
3.	**ENTER (+/-) RADIUS OR DEGREE OF CURVE** **(+)RADIUS = RIGHT, (-)RADIUS = LEFT**	**Type** a "+" or "-" radius in feet. A positive radius means that the center is to the right of the chord connecting the PC and PT. A positive radius is assumed if no sign is entered; or Type the degree of curve in degrees, minutes, seconds form (DD^MM'SS.SS" or DD MM SS.SS).
4.	**ENTER NEW ARC NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new arc; or **RESET** for the next available ID number.
5.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT** **GEOMETRY ELEMENT ALREADY DEFINED**	This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element. Type a new ID number; or **DATA** to use the next available number; or RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT ARC TANGENT TO TWO LINES (442).** This will place an arc tangent to two specified lines. The arc will be drawn from the first line to the second line. An approximate center point must be specified to have a unique solution. For this practice problem, key in **VI=442.**

Prompts		Response
1.	**SELECT FIRST LINE OFFSET OPTIONAL**	**DATA** on desired first line; verify line with **DATA** or by typing an offset distance; or Type the ID number of the desired line.
2.	**SELECT SECOND LINE OFFSET OPTIONAL**	**DATA** on desired second line; verify line with **DATA** or by typing an offset distance; or Type the ID number of the desired line.
3.	**ENTER RADIUS, DEGREE OF CURVE OR SELECT ARC**	**Type** a radius in feet; or Type the degree of curve in degrees, minutes, seconds form (DD^MM'SS.SS" or DD MM SS.SS); or DATA on a different arc with the desired radius; DATA to verify the arc.
4.	**DIGITIZE POINT NEAR CENTER POINT**	**DATA** at the approximate center point for the arc.
5.	**ENTER NEW ARC NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new arc; or **RESET** for the next available ID number.

6. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT ARC TANGENT TO LINE (443).** This will create an arc tangent to a line through a point on that line. For this practice problem, key in **VI=443.**

Prompts		Response
1.	**SELECT LINE**	**DATA** on desired line; **DATA** to verify; or Type the ID number of the desired line.
2.	**SELECT POINT OF TANGENCY**	**DATA** on desired point; or Type the ID number of the desired point; or DATA to digitize a point; or Type the coordinates of the desired point.
3.	**ENTER RADIUS, DEGREE OF CURVE OR SELECT ARC**	**Type** a radius in feet; or Type the degree of curve in degrees, minutes, seconds form (DD^MM'SS.SS" or DD MM SS.SS); or DATA on a different arc with the desired radius; DATA to verify the arc.
4.	**ENTER ARC LENGTH OR DELTA ANGLE**	**Type** the desired arc length; or Type the desired delta angle (degrees, minutes, seconds).
5.	**DIGITIZE A POINT INDICATING THE DIRECTION OF THE ARC**	**DATA** to digitize a point showing desired arc direction.
6.	**ENTER NEW ARC NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type an ID number for the new arc; or **RESET** for the next available ID number.

7. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command can be used with both arcs and lines. This command is **CONSTRUCT LINE/ARC PARALLEL TO EXISTING LINE/ARC (455).** This will place a line or arc parallel to an existing line or arc, and store that line or arc in the IGrds Geometry file. For this practice problem, key in **VI=455.**

Prompts		Response
1.	**SELECT ELEMENT**	**DATA** on desired line or arc; **DATA** to verify; or
		Type the ID number of the desired element.
2.	**SELECT POINT/ENTER (+/-) OFFSET**	DATA on desired offset point; or
		Type the ID number of the desired offset point; or
		DATA to digitize an offset point; or
		Type the coordinates of the desired offset point; or
		Type the desired "+" or "-" offset distance.
3.	**DIGITIZE POINT IN OFFSET DIRECTION** (If no sign is entered in Prompt 2)	**DATA** in direction of new element.
4.	**DIGITIZE APPROX. BEG. POINT** **RESET FOR DEFAULT**	DATA on desired beginning point; or
		RESET to copy the segment.
5.	**DIGITIZE APPROX. END. POINT** (If a beginning point is selected in Prompt 4)	DATA on desired ending point.
6A.	**ENTER NEW ARC NUMBER** **RESET FOR DEFAULT**	Type an ID number for the new arc; or
	(If auto-numbering is off and an arc is desired)	**RESET** for the next available ID number.
6B.	**ENTER NEW LINE NUMBER** **RESET FOR DEFAULT**	Type an ID number for the new line; or
	(If auto-numbering is off and a line is desired)	**RESET** for the next available ID number.

7. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT**
GEOMETRY ELEMENT ALREADY DEFINED

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command is used to create a circle in IGrds. This command is **CONSTRUCT CIRCLE BY CENTER AND RADIUS (444).** This will create a circle given a radius and center point, degree of curvature, or defining a point on the circle. For this practice problem, key in **VI=444.**

Prompts		Response
1.	**SELECT CENTER POINT**	**DATA** on desired center point; or
		Type the ID number of the desired center point; or
		DATA to digitize a center point; or
		Type the coordinates of the desired center point.
2.	**ENTER RADIUS, DEGREE OF CURVE OR SELECT POINT/ARC**	**Type** a radius in feet; or
		Type the degree of curve in degrees, minutes, seconds form (DD^MM'SS.SS" or DD MM SS.SS); or
		DATA to select an arc with the desired radius; DATA to verify; or
		Type the ID number of an arc with the desired radius; or
		Define a point on the arc by DATA, ID number, or typing the coordinates.
3.	**ENTER NEW CIRCLE NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type the ID number of the new circle; or **RESET** for the next available ID number.

4. **KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**

This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.

Type a new ID number; or

DATA to use the next available number; or

RESET to delete the old element and reuse the ID number.

NOTES

The next command, **CONSTRUCT CHAIN (460)**, is used to create chains. A chain is a group of geometric elements. A chain may be defined by selection and by entering ID numbers of the elements to be included. The maximum number of elements in a chain is eight if selected with the DATA button and 24 if entered directly. For this practice problem, key in **VI=460.**

Prompts		Response
1.	**SELECT ELEMENT**	**DATA** on desired first element; **DATA** to verify; or Type the ID number of the first element.
2.	**SELECT NEXT ELEMENT- RESET TO END CHAIN** This prompt will repeat until you RESET.	**DATA** on next element; **DATA** to verify; or Type the ID number of the next element. or **RESET** to stop this command.
3.	**ENTER NEW CHAIN NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type the ID number of the new chain; or **RESET** for the next available ID number.
4.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED** This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.	Type a new ID number; or **DATA** to use the next available number; or RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT CHAIN PARALLEL TO EXISTING CHAIN (462).** This will create a chain that is parallel to an existing chain and store the new chain in the IGrds Geometry file. For this practice problem, key in **VI=462.**

Prompts		Response
1.	**SELECT CHAIN**	**DATA** on desired chain; **DATA** to verify; or Type the ID number of the desired chain.
2.	**ENTER (+/-) OFFSET**	**Type** the offset distance.
3.	**ENTER NEW CHAIN NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type the ID number of the new chain; or **RESET** for the next available ID number.
4.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT** **GEOMETRY ELEMENT ALREADY DEFINED** This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.	Type a new ID number; or **DATA** to use the next available number; or RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CONSTRUCT SHAPE (461)**. This command will build a shape from existing geometric elements. The area of the shape can then be computed. A shape can consist of up to eight elements selected with the DATA button or 24 elements entered with the keyboard. For this practice problem, key in **VI=461**.

Prompts		Response
1.	**SELECT FIRST SHAPE ELEMENT**	**DATA** on the desired first element of the shape; **DATA** to verify the element; or
		Type the ID number of the desired first element.
2.	**SELECT NEXT ELEMENT** **RESET TO END SHAPE**	**DATA** on the next element; **DATA** to verify; or
		Type the ID number of the next element. or
		RESET to end creation of the shape.
	This prompt will repeat until you RESET.	
3.	**ENTER NEW SHAPE NUMBER** **RESET FOR DEFAULT** (If auto-numbering is off)	Type the ID number of the new shape; or **RESET** for the next available ID number.
4.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT** **GEOMETRY ELEMENT ALREADY DEFINED**	
	This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.	
		Type a new ID number; or
		DATA to use the next available number; or
		RESET to delete the old element and reuse the ID number.

NOTES

The next group of commands perform calculations on previously created geometric elements. The first of these is **CALCULATE AREA OF A SHAPE (485)**. This will perform the calculation and label the shape with the area (if the LABEL OPTION is on). For this practice problem, key in **VI=485.**

Prompts		Response
1.	**SELECT SHAPE**	**DATA** on desired shape; **DATA** to verify.
2.	**SELECT TEXT PLACEMENT LOCATION RESET FOR NO LABEL**	**DATA** at desired start point of text; RESET for calculation only.

NOTES

The next command is **CALCULATE CLOSURE OF A SHAPE (486)**. This command will build a shape from existing geometric elements, and then calculate the closure of the shape. The closure includes latitude error, departure error, and ratio of precision. The closure of an existing shape may also be calculated with this command. For this practice problem, key in **VI=486.**

Prompts		Response
1.	**SELECT FIRST SHAPE ELEMENT OR SELECT SHAPE**	**DATA** on desired element or shape; **DATA** to verify; or Type the ID number of the desired element.
2.	**SELECT NEXT ELEMENT RESET TO END SHAPE**	**DATA** on next element; **DATA** to verify; or Type the ID number of the next element. or **RESET** to stop this command.
	This prompt will repeat until you RESET.	
3.	**ENTER NEW SHAPE NUMBER RESET FOR DEFAULT** (If auto-numbering is off)	Type the ID number of the new shape; or **RESET** for the next available ID number.
4.	**KEY NEW ID/RESET-OVERWRITE/DATA-DEFAULT GEOMETRY ELEMENT ALREADY DEFINED**	
	This prompt will tell you that the geometry ID number chosen had previously been assigned to another geometry element.	
		Type a new ID number; or **DATA** to use the next available number; or RESET to delete the old element and reuse the ID number.

NOTES

The next command is **CALCULATE BEARING AND DISTANCE (480)**. This command will calculate the bearing and the distance between two points specified by the user. This is a "self-repeating" command allowing you to chain points together using the last point of one calculation for the first point in the next calculation. For this practice problem, key in **VI=480.**

Prompts	Response
1. **SELECT FIRST POINT**	**DATA** on desired first point; or Type the ID number of the desired point; or DATA to digitize the desired point; or Type the coordinates of the desired point.
2. **SELECT SECOND POINT** **RESET TO START OVER**	**DATA** on desired second point; or Type the ID number of the desired point; or DATA to digitize the desired point; or Type the coordinates of the desired point; RESET to return to the first prompt.

NOTES

The next command is **CALCULATE ANGLE BETWEEN THREE POINTS (481).** This command will calculate and display both the clockwise and counterclockwise angles defined by three user defined points. The clockwise angle is displayed first. For this practice problem, key in **VI=481.**

Prompts		Response
1.	**SELECT FIRST POINT**	**DATA** on desired point; or
		Type the ID number of the desired point; or
		DATA to digitize the desired point; or
		Type the coordinates of the desired point.
2.	**SELECT VERTEX POINT**	**DATA** on desired vertex point; or
		Type the ID number of the desired vertex point; or
		DATA to digitize the desired vertex point; or
		Type the coordinates of the desired vertex point.
3.	**SELECT THIRD POINT**	**DATA** on desired third point; or
		Type the ID number of the desired third point; or
		DATA to digitize the desired third point; or
		Type the coordinates of the desired third point.

NOTES

The next command is **CALCULATE ANGLE BETWEEN TWO LINES (482).** This command will calculate and display the clockwise and counterclockwise angle between two lines selected by the user. For this practice problem, key in **VI=482.**

Prompts		Response
1.	**SELECT FIRST LINE**	**DATA** on desired first line; **DATA** to verify; or Type the ID number of the first line.
2.	**SELECT SECOND LINE**	**DATA** on desired second line; **DATA** to verify; or Type the ID number of the second line.

NOTES

The next two commands can be used to modify the lengths of lines and arcs. The first of these is **EXTEND OR SHORTEN LINE (471)**. For this practice problem, key in **VI=471**.

Prompts		Response
1.	**SELECT LINE**	**DATA** on desired line near the endpoint to be modified; **DATA** to verify.
2.	**ENTER (+/-)DISTANCE OR DIG. POINT**	DATA at location for new endpoint; or Type the desired "+" or "-" distance to lengthen or shorten the line.

NOTES

The second of these commands is **EXTEND OR SHORTEN ARC (474).** With this command, you may create an arc with a delta angle greater than 180 degrees. For this practice problem, key in **VI=474.**

Prompts		Response
1.	**SELECT ARC**	**DATA** on desired arc near endpoint to be modified; **DATA** to verify the arc.
2.	**ENTER (+/-) DISTANCE OR DIG. POINT/KEY IN ANGLE**	DATA on new end point; or **Type** the desired "+" or "-" distance to lengthen or shorten the arc; or Type the desired "+" or "-" delta angle to lengthen or shorten the arc.

NOTES

The last group of commands perform user service routines. The first of these commands is **IDENTIFY AND LABEL GEOMETRIC ELEMENTS (473).** This command will identify, label, and display pertinent information about each selected element. For this practice problem, key in **VI=473.**

Prompts		Response
1.	**SELECT GEOMETRIC ELEMENT**	**DATA** on desired element; **DATA** to verify.
2.	**DATA FOR LABEL - RESET FOR NO LABEL**	**DATA** to place the element label; or RESET to no label on the element.

NOTES

The next command is **DELETE GEOMETRIC ELEMENT (470)**. This command will remove a geometric element from the IGrds Geometry file and from the Graphics file. There is no exercise for this command.

Prompt		Response
1.	**SELECT ELEMENT OR ENTER LIST**	**DATA** on desired element(s); **DATA** to verify; or
		Type the ID number of the desired element; or
		Type a list of element ID numbers to delete; or
		Type a range of element ID numbers to delete; or
		Type a combination of a list(s) and range(s) of element ID numbers to delete.

Note: Use "Delete Element/Delete Fence" from regular Graphics menu to delete from Graphics file only. They may be redisplayed with "Display IGrds Geometry."

NOTES

The next two commands create reports that will be placed in the temporary report file (.TMP). The first command is **CREATE POINT/LINE/ARC REPORT (499)**. The report will include point coordinates, bearing, distance, beginning and ending coordinates of lines, and arc length, radius, and beginning, ending, and centerpoint coordinates of arcs, as selected by the user. There is no exercise for this command.

Prompt	Response
1. **ENTER ELEMENT ID NUMBER(S)**	Type the desired element ID number; or Type a list of ID numbers of desired elements; or Type a range of element ID numbers; or Type a combination of list(s) and range(s) of element ID numbers.

NOTES

The other reporting command is **CREATE CHAIN TRAVERSE REPORT (487)**. This report will include distance, bearing, arc length, departure, latitude, X,Y (N,E) coordinates, and the radius in a specified chain. It will also include beginning and ending tangent bearings, beginning and ending radial bearings, and the central angle if an arc is included in the chain. There is no exercise for this command.

Prompt	Response
1. **SELECT CHAIN**	**DATA** on desired chain; **DATA** to verify; or Type the ID number of the desired chain.

NOTES

The last command is **DISPLAY IGRDS GEOMETRY FILE (492).** This command will retrieve points, lines, arcs, chains, and shapes from the IGrds Geometry file and displays them on the graphics screen. The items retrieved from the Geometry file are specified by the user. There is no exercise for this command.

Prompt	Response
1. **ENTER ELEMENT ID NUMBER(S)**	**Type** the ID number of the desired element to be retrieved; or Type a range of element ID numbers to be retrieved; or Type a list of element ID numbers to be retrieved; or Type a list and range of element ID numbers to be retrieved.

NOTES