

CHAPTER 2

GENERAL IGrds CONCEPTS

The power of IGrds rests in the fact that the designer uses convenient tools to define a complete three dimensional model of a project. This opens the door to access the model to make computations, extract dimensions and quantities, and produce graphic presentations. The IGrds/IG Option can operate in both 2D and 3D graphic files. IGrds Geometry 3D strings and/or renderable 3D facets representing the design and bridge ends can be displayed in 3D graphic files. One of the many graphic presentations possible is an isometric view of the model. Figure 2-1 represents such a model.

In either 2D or 3D graphic files, three traditional roadway engineering views are available: plan view, profile view and cross section view. In 3D files, these traditional views are shown in the top view.

- Plan View

Points, lines, arcs, chains, and horizontal alignments are defined by their plane coordinates (X,Y or North, East) (see Figure 2-2).

A second way to define points is by their station and offset from an existing horizontal alignment.

- Profile Plane

This is a vertical plane that follows a horizontal alignment. Points, lines and vertical alignments are defined by their station along a specified horizontal alignment and their elevation (see Figure 2-3).

- Cross Section Plane

This is a vertical plane which is perpendicular to a specified horizontal alignment at a specified station. Original, design, and final cross sections are described by the offsets and elevations of a series of points.

Design cross sections are defined by specifying template, sideslope, and median patterns (shapes) which IGrds combines into design sections (see Figure 2-4). How the system generates design sections is discussed in Chapter 6.

Almost every IGrds input, storage, or output uses these simple elements: plane coordinates, stations, offsets, and elevations. IGrds makes it easy for the user to define and use the three dimensional roadway model. The designer draws from external data and builds on previous input using IGrds tools.

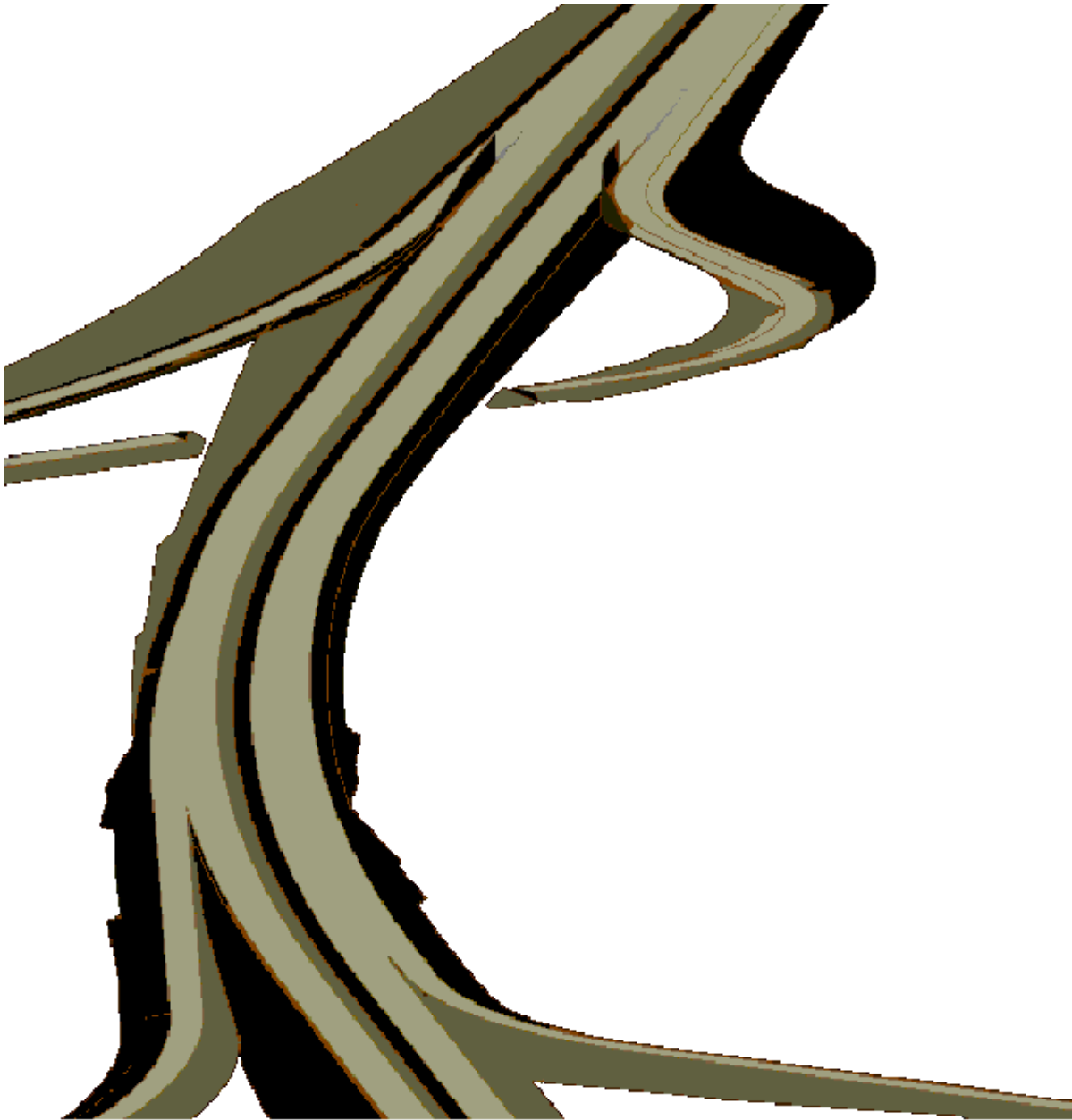


Figure 2-1 - Three Dimensional Model

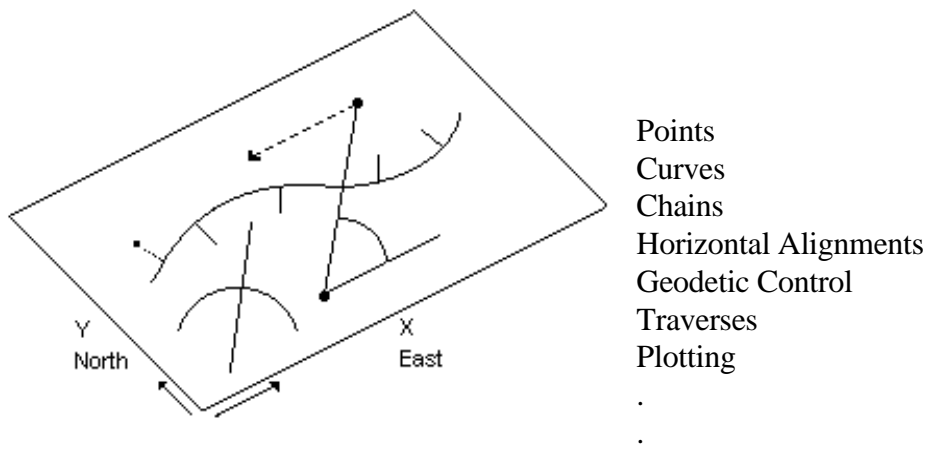


Figure 2-2 - Horizontal Plane Coordinates

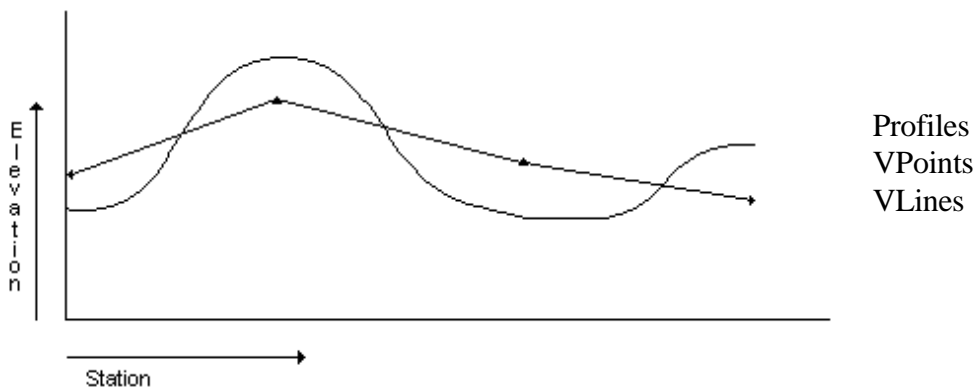
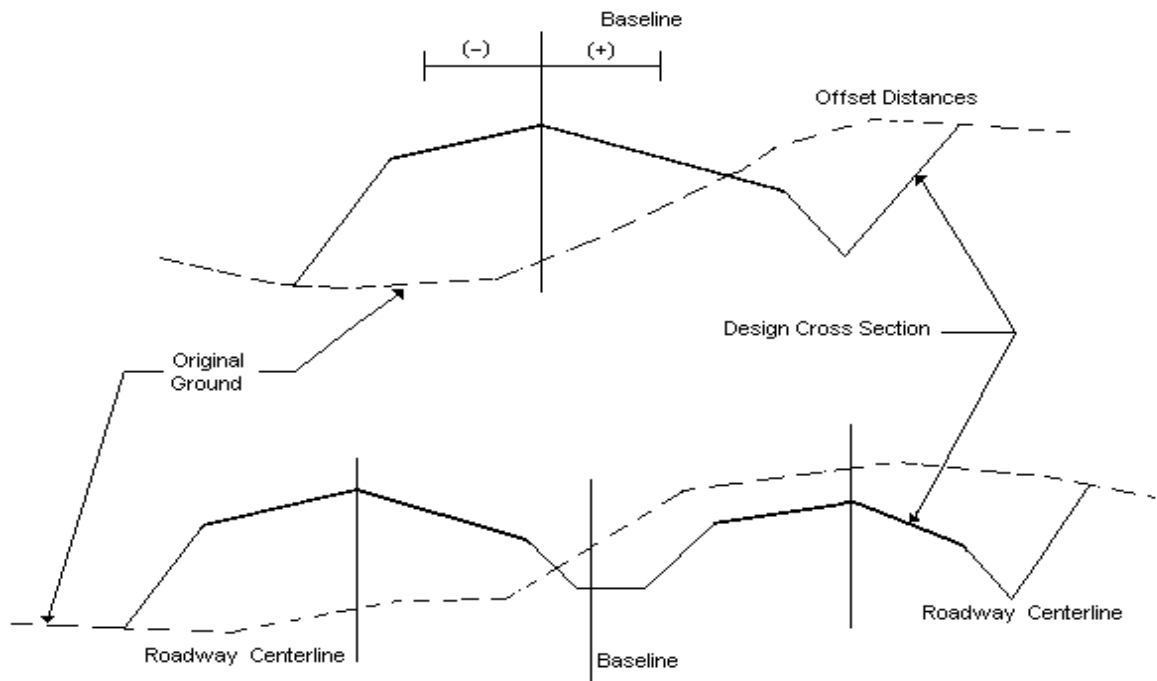


Figure 2-3 - Vertical Plane Coordinates



The plane is perpendicular to a specific baseline at a specific station.

Figure 2-4 - Cross Section Plane

COORDINATE SYSTEM

The plan view plane uses grid coordinates for locational reference purposes. The coordinate base may be any desired system (assumed, local, state plane, etc.). Within 3D graphic files, the elevation forms the third (Z) dimension.

An optional coordinate scale factor can be specified such that measured surface distances are automatically converted to the state plane or other established plane for storage and internal computations. Output can be surface or plane coordinates. The geodetic traverse process (IGrds/AN Option) converts earth surface measurements to established planes.

STATIONS AND OFFSETS

Stations and offsets can be used to locate points similar to grid coordinates. The two methods can be used interchangeably. Stations are a linear measurement along a horizontal alignment from a given point. Offsets are perpendicular distances left or right from an alignment. For Imperial unit projects, stations are expressed in 100 foot increments. For example, if the beginning of an alignment is assigned a station of 2 (or 2+00), a point on the alignment 333.33 feet ahead would be identified as station of 5+33.33 if there is no discontinuity in stationing (see equations). Metric unit projects may use either 100m or 1000m stationing.

Station designations must indicate which equations they follow.

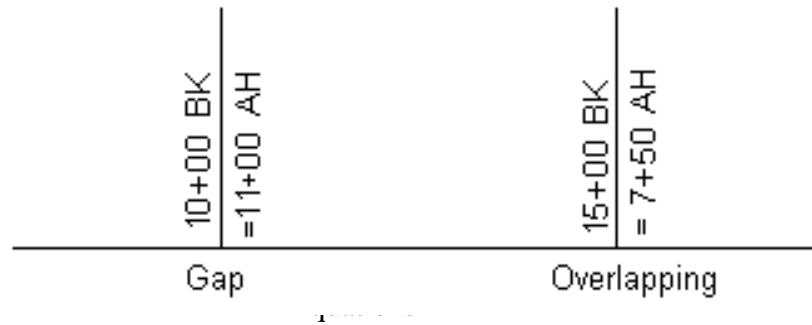
The station options are:

<u>Increment</u>	<u>Precision</u>	<u>Format</u>
100 feet	x.xx feet	12+10.33
100 meters	x.xxx meters	12+10.333
1000 meters	x.xxx meters	1+210.333

EQUATIONS

Equations are discontinuities in stationing, usually caused by constraints such as the necessity to meet the stationing of an existing road or because of shortening or lengthening due to realignment. There are two types of equations:

- Gap equations are defined as equations for which the ahead station has a larger number than the back station number, such as 10+00=11+00AH.
- Overlapping equations are defined as equations for which the ahead station has a smaller number than the back station, such as 15+00BK=7+50AH.



The system provides for introducing equations into the stationing for an alignment. Input must reflect equations, but internal computations and output are handled automatically. Equations are discussed in more detail in Appendix A.

IMPERIAL AND METRIC UNITS

IGrds works with both Imperial and Metric units for input and output. Project files must be initiated for the desired units and those units must be used throughout the project. A standalone utility is provided to convert files from Metric to Imperial and vice versa. See the Appendix L of this manual, the User Manual, and the System Manual for a complete description of this utility.

GENERAL SUPPORT FEATURES

IGrds includes several support features which predefine or augment data entry and establish user agency conventions and defaults. These features are discussed briefly in the following subsections and in detail in the System Manual.

IGrds Project .ini File

The IGrds Project .ini file contains information pertinent to an IGrds project. The purpose of the file is to store general information related to how the project was created and which external files were used to effect the design. This allows non-design data aspects (i.e., data stored in working files) of the project to be archived along with the project. The .ini file is part of the IGrds working file set and stores information such as the following:

- Design standards used for the project
- Station increment for station tools last used for the project
- Auto reverse length last used for the project
- Design Data Manager defaults used for the project
- Horizontal and Vertical alignment defaults used for the project
- DTM surface(s) last used for the project

The contents of the .ini file define the current default behavior for a given project. It is automatically updated if any of the information is changed by the user.

Parameter Files and Cell Libraries

The IGrds parameter file contains organizational and user defined values for the graphical representation of design and drafting data. Three classes of data are presently included in the parameter file:

- System Setup Values - Units Label ("ft" (Imperial) or "m" (Metric)), NE,XY, etc.
- Option Flag Settings (Initial) - Label (On/Off), Auto List (On/Off), etc.
- Graphical Data Representation - Alignment Level, Reference Line Color, Annotation Options, etc.

There are four files and two cell libraries which provide project level options for precision options and the option for Imperial or Metric units. They are:

parameter files:	parset.hi	(for precision of 100, Imperial)
	parset.ti	(for precision of 1000, Imperial)
	parset.hm	(for precision of 100, Metric)
	parset.tm	(for precision of 1000, Metric)
cell libraries:	ig100.cel	(for precision of 100)
	ig1000.cel	(for precision of 1000)

These parameter files and cell libraries can be modified by user agencies to meet their needs and preferences. The precision and units must be selected at the beginning of a project.

Template, Sideslope and Median Shape Libraries

Template, sideslope and median definitions (shapes) are key data elements in IGrds. Predefined definitions can be imported into individual project files for use. The import capability allows for replacement or merging of shape data. Definitions can also be exported to/from project files to libraries.

Material Criteria Tables

The material criteria table (subsurf.mct) defines material information which may be linked with subsurface strata and used in the creation of design cross sections and the computation of volumes by material.

Feature Tables

IGrds geometry elements can optionally carry a feature code definition which links it with the feature table. This is in addition to the standard geometry element definition. A feature may be a point (tree, manhole), linear length (guardrail, telephone line), or an area (area of parcel taken, quantity of curing material per area of pavement). The purpose of features codes is to:

- associate geometric elements with physical features,
- create alternative planimetric display of geometry elements,
- create summary listings of features, and
- compute quantity listings of features.

IGrds geometry elements may be displayed with specified colors, line codes, line weights, symbols, and on specified levels, depending on how the feature code was filled out in the feature table.

Feature codes are usually assigned to geometry elements as they are defined. Alternately, processes are provided for assigning feature codes to geometry elements after element creation and for displaying or listing elements by feature codes.

Feature tables are provided for both Imperial and Metric projects.

Design Criteria Table

The design criteria table (ha.tbl) contains AASHTO Green Book standards for horizontal and vertical alignment related data in both Metric and Imperial units. The table is partitioned into two divisions one representing the 1990 and 1994 standards and the other the 2001 standards. The standard to be used is stored in the .ini file, discussed above. The table contains horizontal curvature and superelevation criteria for rural, high speed urban and low speed urban design. It also contains criteria used in solving transition length calculations for all design conditions. Criteria used in determining if and how much pavement widening is required for a sharp horizontal curve are included as well. Sight distance criteria are included (stopping, decision and passing) for automatic vertical curve length calculations. This design criteria table is an ASCII editable file that can be customized by user agencies whenever the agency's standards differ from the AASHTO standards.

IGrds Data Import/Export

XML - A facility to export data from IGrds into the XML format using the LandXML schema. The XML export facility allows for the export of geometry points, lines, arcs, and chains, horizontal and vertical alignments, and design cross section data.

SDMS® - A facility to import and export data to and from the AASHTO Survey Data Management Systems (SDMS) file format is a feature within IGrds. The SDMS import facility allows for the import of geometry points, lines, and chains, horizontal and vertical alignments, and terrain data into IGrds working files. The SDMS export facility allows the export of geometry points, lines, and chains, horizontal and vertical alignments, and design cross section data into SDMS files.

Free Form Point Data - A facility to import free form point data is also provided. The process allows the user to specify which fields should be read and what order they should be read in for use by IGrds geometry.

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