Draft of "Engineering and Survey - Exchange (EAS-E)" Data Format   (1999))

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My goal is to have AASHTO adopt and support this draft as a nationwide standard for transportation data.

Purpose:

1. Create a Human-friendly, human-readable, and human-editable, standard electronic engineering data format similar to pre-computer formats.
2. Use this standard format for the exchange of engineering data internal to a transportation agency.
3. Use this standard format for the exchange of civil engineering data external to the agency.
4. Promote the concept of a standard data format for engineering data.

Content:

1. Format is designed for the following types of data
2. Horizontal alignments
3. Vertical alignments
4. Cross sections (2 types)
5. Geometric data
6. DTM surface data

Goal:

1. Have AASHTO support, adopt and promote this standard format.
2. Reuse in-house and consultant design data.
3. Have standard design deliverables from design consultants.
4. Have standard electronic formats to deliver to design consultants.
5. Have standard electronic formats to deliver to survey contractors.

Scope of the format:

1. Must store all engineering data required to construct a highway project.
2. Usable for archiving project data both as built and as designed.
3. Independent of technology.
4. Readable through the course of time by both humans and computers.

Created by:

1. DOT's and consulting engineers.
2. Engineers and engineering computer programmers.
3. Private civil engineering software developers.

Uses/Benefits:

1. Standard exchange format between department divisions.
2. Standard exchange format between consultants and the department.
3. Standard archiving format.
4. Standard format for application development.
5. Common software components for application development.
6. Deliverable from design consultants.

Engineering and Survey - Exchange (EAS-E) data format

Abstract. Data exchange, sharing and archiving is a universal problem for Departments of Transportation. Unlike CAD where translators have been in place for years, engineering data lacks universal standards to enable electronic exchange. The lack of standards means the civil and transportation engineering data is proprietary. Thus, in most cases, manual transcribing is required to share data from division-to-division or from department-to-consultant. In addition, archiving this information puts the Department at risk of not being able to use this information in the future.

A consortium of DOT's, consultants and vendors was formed in June 1998 to define, document, prototype and disseminate standard engineering data formats. This non-proprietary file format, Engineering and Survey - Exchange (EAS-E) will enable vendors to provide importing and exporting engines within their proprietary software products which will survive the test of time. EAS-E will foster more efficient project work-flows by Departments of Transportation (DOT's), surveyors, design consultants, owners construction staff and construction contractors. The data of primary interest consists of:

- Horizontal alignments
- Vertical alignments
- Coordinate Geometry
- Cross Sections
- Surface Data

This paper will detail the suggested formats of the above data items at the time of publication.

Engineering Data exchange, sharing and archiving

Electronic engineering data has been around since the early days of computers. Some of the senior engineering professionals remember when engineering data was stored on computer cards. In the 1970's, paper cards were replaced with electronic ASCII card images. Engineering problems were input into card image files and executed in batch computer programs. Programs were written by in-house staff to improve productivity within an organization. Since fidelity of algorithms was a higher priority than standardizing input and data formats, there was no consistency between agencies. While organizations such as the Highway Engineering Exchange Program (HEEP) promoted the sharing of in-house software, each computer program had unique input formats and protocol. Data input files had a long shelf life because the ASCII input files could be retrieved at any time, edited and rerun.

Computer-Aided-Design (CAD) data files followed engineering data files by nearly two decades. In spite of this temporal gap, standard CAD data file formats were established in the formative years. Today, the two prominent proprietary formats are AutoCAD (.DWG) and MicroStation (.DGN). AutoCAD's .DWG file. As a matter of convenience, a DXF (Data Exchange Format) file format was developed by Autodesk to enable human reading of CAD data. This same format is used for bi-directional exchange between MicroStation and AutoCAD.

While there is still debate on the fidelity of CAD translations, they are used in production today because CAD is essential to civil engineering business. The same business drivers that fostered the popularity of DXF also apply to transportation engineering data. In transportation design, there are numerous suppliers of civil engineering software. Data content is essentially the same, but **data structures are unique for each software vendor**. It is very common for agencies and consultants to have civil engineering software from more than one vendor. Personal preference and price are two of the more common reasons for this disparity. In the process of performing projects, there is considerable re-entry of data in stepping through a field-to-finish workflow.

Background

In June 1998, a committee met to address the need for standard data formats. Specifically, the committee sought to define, document, and prototype a standard engineering data formats for the transportation industry. The initial committee members consisted of:

- Nebraska Department of Roads
- Oklahoma Department of Transportation
- Virginia Department of Transportation
- Henningson, Durham & Richardson, Inc. (HDR)
- Howard, Needles, Tammen, and Bergendoff (HNTB)
- Sverdrup Civil, Inc.
- CW Beilfuss & Associates Inc
- Intergraph Corporation

At this conference, the Engineering and Survey - Exchange (EAS-E) was established, and a technical draft of industry-standard data formats was initiated. The objective is to provide standard data formats that are easy to read by industry professionals and efficient to process by computer application software.

Data Requirements

One of the first topics of this conference was to discuss the data requirements. Some favored ASCII and others wanted a mixture of formats to include binary formats. In the interest of having readability by both humans and computers, the following objectives were identified as specific data requirements:

- **Text File Format** - A defined non-proprietary text format that is easy for an individual to read, online and in hard copy print.

- **Data Exchange/Data Sharing** - A standard way to share information within internal divisions and between firms, business partners, design consultants, and contractors. A standard file language that can be imported, exported, processed, and archived with any engineering design software package. A standard, industry-wide deliverable.

- **Construction Staking** – The format must contain all data necessary for project construction staking. And be a standard deliverable for road contractors.

- **Archive** - A cost effective way to store and preserve engineering data for future use.

Scope

The primary focus was to define a format that contains all data necessary for project staking and is easy to read by individuals and that could be efficiently processed by computer application software. With this objective in mind, the initial technical focus included the following engineering data components:

- Horizontal Alignments
- Vertical Alignments
- Cross Sections
- Coordinate Geometry Elements
- Digital Surface Data

The last item, digital surface data, reflects the increased popularity of digital terrain models (DTMs).