

Maryland State Highway Administration

MicroStation V8 CAD Standards Manual



SHA IDS CAD Standards Subcommittee

July 2004

Preface by Neil J. Pedersen, Administrator

It gives me great pleasure to introduce the latest edition of the *SHA CAD Standards: 2004 Edition*. A great deal of work and coordination went into this manual's development. The IDS Team was instrumental in pulling resources together from across SHA and the consultant community. The involvement of representatives from across SHA on the SHA IDS CAD Subcommittee was a key factor. And finally, the membership of the Consulting Engineering Council of Maryland volunteered its time and provided valuable incite and feedback on the SHA IDS CAD Subcommittee.



Whether you work at SHA to produce CAD drawings, or are a consultant responsible for design drawing deliverables on SHA projects, this latest edition of the *SHA CAD Standards* outlines the best practices you must adhere to for all SHA-related engineering work.



Available with this manual is a CD containing support files such as standard borders, seed files, cell libraries, and a menu bar application to help deploy and adhere to standards on SHA projects. The Standards and associated support files are also available on the SHA Web site.


The standards have been developed to work for you and should be considered a living document that will evolve over time to better serve you. Should you have any questions, concerns, or suggestions for improving the content, feel free to contact the SHA IDS Team at ids@sha.state.md.us.

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This chapter introduces the contents of *SHA CAD Standards: 2004 Edition*. Readers will also identify the people who developed the SHA CAD Standards. This chapter's two major sections are listed below:

- [About this Manual](#) describes the intended audience, the purpose of this manual, a chapter-by-chapter summary, typographic conventions, bundled compact disc contents, a glossary, and changes since the last version.
- [Acknowledgments and Contributions](#) introduces the IDS Team and the CAD Standards Subcommittee, whose members developed the Standards.

About This Manual

This manual was completely rewritten to include all CAD documentation previously used throughout SHA. We hope that this manual will serve as the single information source related to the use of CAD at SHA, regardless of the Office and Division you serve.

This manual also marks SHA's migration to the V8 generation of MicroStation and related engineering design add-ons and custom applications. Whether you are looking for information on drawing setup, element symbology tables, productivity tools, printing, redlining procedures, or other CAD topics, flip through these pages. You are sure to find the answers here.

The IDS Team is committed to updating this manual regularly to respond to the changing needs of our industry, including new developments in CAD and related technologies that encompass MicroStation and ProjectWise. We would love to hear from you. Please contact the IDS Team (ids@sha.state.md.us) with your comments and suggestions.

The Audience

This manual serves the needs of several CAD users:

Designers and Engineers at SHA: If you are a new SHA employee beginning your first project, this manual will help you become familiar with the design workflow, especially those aspects related to CAD. If you have designed projects for years and find yourself explaining the same processes to new designers and engineers, we hope that you will rely on this manual to help with such training.

Regardless of your experience level, you should find the information easy to locate and presented in a manner that can be put to use right away.

Engineering Consultants: If you are a consultant tasked with a project for SHA, you will find all the drawing setup procedures necessary to create new MicroStation design files. You will also find tables that will help you use provided tools to set the desired symbology (level, color, weight, and style) for design elements. Following the guidelines set in this manual will ensure that the drawings you produce are consistent with current SHA CAD Standards.

Construction Contractors: As a contractor, your job is to read design drawings for constructing highways, bridges, traffic signs, and hydraulic and ancillary structures. Though not as relevant to your needs, this manual will help you better understand the drawing setup, especially when you are called upon to prepare shop drawings, changed field condition sketches, redline drawings, and the like.

Purpose

The purpose of this manual and its associated electronic files and tools is threefold:

1) Quality of Deliverables: These Standards are built upon SHA's several decades in the successful design and construction of highway and traffic projects statewide. The documentation of this solid foundation of past experience ensures that the deliverables you produce based upon them are of a superior quality.

2) Efficiency in Design through Tools: The cell libraries, menu files, Standard details, and other files that accompany this manual are designed to help you quickly place standard graphical elements with just a click or two. Additionally, custom design tools and macros let you more efficiently create design elements, including drainage structures, traffic signals, right-of-way plats, bridge detail sheets, and more in your drawings.

3) Consistency between Offices and among Consultants: By using the details, symbols, seed files, and notes presented in these Standards, you ensure that drawings you create conform to SHA's requirements and are consistent—regardless of who works on them.

By properly using the concepts and tools outlined in this manual, you will be better equipped to produce high-quality CAD drawings more efficiently and consistently.

Typographic Conventions

Subject areas are easy to find by noting the typography. For example, regular content appears in 12-point Times Roman. Chapter titles appear in the 18-point bold Arial font. Main chapter headings use the 14-point bold Arial font. Chapter subsections are italicized and use the 14-point bold Arial font. Bulleted-list subheads use Arial 11-point bold.

E-mail addresses appear as hyperlinked text. When referencing Web sites, the 12-point Courier New font is used. Sections with programming code and filenames also employ 12-point Courier New for easier reading. The Glossary included in Appendix A helps readers locate specific meanings of terms.

The “What’s Next?” portion at the end of each chapter summarizes the next chapter’s contents. The “Notes” section provides space for users to take notes.

Bundled Compact Disc Contents

The root directory of the compact disc contains the file `toc.htm` that describes the directory organization and the accompanying files, including border files, cell libraries, font and line style resource files, custom tools, workspace files, and element symbology tables.

Changes since the Last Version

It is worthwhile to note the content changes of this book since SHA released the last comprehensive CAD Standards in 1995. Since that release, new technologies and Standards have been adopted. This manual has been updated to describe these revisions and additions to the CAD Standards, below:

- Upgrade to MicroStation V8
- Standard workspace development
- File naming and level naming
- Adoption of ProjectWise and its integration with MicroStation V8
- More concentrated focus on tools and add-ons
- Changes to CAD terms used in the CAD Standards
- Standardized plotting methods
- Drafting workflow guidelines
- History of CAD at SHA

Acknowledgments and Contributions

The development of CAD Standards for an organization the size and scope of SHA requires sponsorship, effort, and contributions from numerous sources. The SHA IDS Team led the development effort and coordinated feedback from across the entire organization and from its consultant community.

The following section about the IDS Team and the IDS Initiative at SHA is based upon the preface signed by Neil Pedersen and Doug Rose in 2001 for the IDS Strategic Plan.

SHA IDS Team

To help the organization improve its design production procedures and processes, the SHA Chief Engineer's office sponsored a production forum in late 1999 to solicit innovative employee ideas.

The forum was an intensive one-day event and was comprised of engineering teams assigned the task of discussing the ways and means that design production could be improved. One team focused on using Information Technology to automate and improve design and production processes. The team identified the need to nurture a program that has become the IDS Initiative.

This Initiative went through a gestation period during which, with backing from senior management at SHA, an informal team gathered to develop a strategic plan to identify its role and scope. This team conducted research, set up pilot projects, increased awareness of issues, and developed useful design tools.

Recognizing that the results of the IDS Initiative had the potential to make an enormous impact on the whole organization, Doug Rose and Neil Pedersen decided to formalize the initiative and assign it a full-time manager. Michael Lynch accepted the challenge to keep the IDS Initiative on track. He began his tenure as the manager of the IDS Team on August 1, 2001 in the Office of Highway Development.

SHA IDS CAD Standards Subcommittee

The development of this edition of the SHA CAD Standards was among several important initiatives undertaken by the IDS Team. An IDS CAD Standards Subcommittee was formed to represent CAD users and managers across the entire SHA community and from its consultant community, represented by the Consulting Engineering Council of Maryland.

The following table lists members of the SHA IDS CAD Standards Subcommittee. They supported the IDS Team by providing valuable technical insight into SHA's needs and approved the content of these Standards.

Name	Representing
Adrian Van DeLangerijt	CEC Johnson, Mirmiran & Thompson
Alex Soutar	OFIT Information Technology Division
Amy K. Beall	OOTS Traffic Engineering Design Division
April Parsons	Maryland Transit Authority (RK&K)
Barb Henry	IDS Team (E3Synergy)
Barb Solberg	Office of Highway Development
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Bill Carver	OPPE Project Planning Division
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Bradley Sorrell	Maryland Department of Transportation
Brian Crocetti	Office of Highway Development
Brian Lawrence	District 6
Cheri Wyckoff	CEC McCormick, Taylor & Associates
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Cyrus McCall	CEC McCormick, Taylor & Associates
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Maurice Price	Office of Maintenance
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Mike Lloyd	District 7
Mike Lynch	IDS Manager
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Ranjit Sahai	IDS Team (RAM Consulting Corporation)
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Salvatore Cross	CEC Century Engineering
Scott Rose	Maryland Transit Administration (RK&K)
Shari Lance	CEC McCormick, Taylor & Associates
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T.J. Spampinato	Office of Environmental Design
Todd Lawrence	District 6
Tony Crawford	SHA, District 6
William (John) Gover	Office of Highway Development

Content Developers

The following people contributed to the writing of this manual and to the development of these revised Standards.

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Chris Fleming	IDS Team (Sabra, Wang & Associates)
Cyrus McCall	IDS Team (McCormick Taylor)

Name	Representing
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Karl Sumwalt	IDS Team (RAM Consulting Corporation)
Mark Van Wert	IDS Team (E3Synergy, RAM)
Michael Lynch	IDS Team (RAM Consulting Corporation)
Michael Tucker	IDS Team (RAM Consulting Corporation)
Nellie Mikhalyuk	IDS Team (Sabra, Wang & Associates)
Ranjit Sahai	IDS Team (RAM Consulting Corporation)

Tool Development

The following organizations contributed to the development of various custom tools and programs that are included with the new standards: Alpha Corp, E3Synergy, ECO Integration, KCI, RAM Consulting Corp, RK&K, University of Maryland

Special Thanks

The following individuals deserve special thanks for their tireless efforts in testing the and providing feedback. Any oversights in the standards will not be for lack of effort on their part.

Name	Representing
Chuck Rheault	CEC Greenman-Pedersen, Inc.
Dawn Wyatt	CEC Wilson T. Ballard Company
Jeff Redding	CEC Gannett Fleming
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Michael Tucker	IDS Team (RAM Consulting Corporation)
Philip Mashuda	CEC Johnson Mirmiran & Thompson
Salvatore Cross	CEC Century Engineering
Sharon Yohn	OHD Highway Design Division
Teresa Milton	OHD Highway Design Division

What's Next?

Chapter 1 provides an introduction to the SHA Workspace, which delivers the new CAD Standards in the MicroStation V8 environment. Minimum system requirements are detailed. Administrators will learn how to set up the Workspace for their office, and users will learn how to use the Workspace Options.

Notes 

Chapter 1

SHA Workspace

This chapter provides an introduction to the SHA Workspace that has been developed for use with MicroStation V8. This workspace helps users manage the V8 drafting environment by delivering standard elements such as resource files, cells and level libraries, as well as several custom tools and macros developed by SHA for V8. Details are provided for both users and administrators. This chapter's major sections are listed below:

- [Minimum System Requirements](#)
- [Using the SHA Workspace](#) shows the MicroStation Manager window and what Workspace Options should be selected to obtain the new V8 CAD Standards.
- [Workspace Setup](#) provides instructions on how to install the Workspace, with notes for both [Internal SHA Users](#) and [External Consultant Users](#).
- [Workspace Options](#) explains how MicroStation's Workspace Options are being implemented at SHA, including [User](#), [Project](#) and [Interface](#).

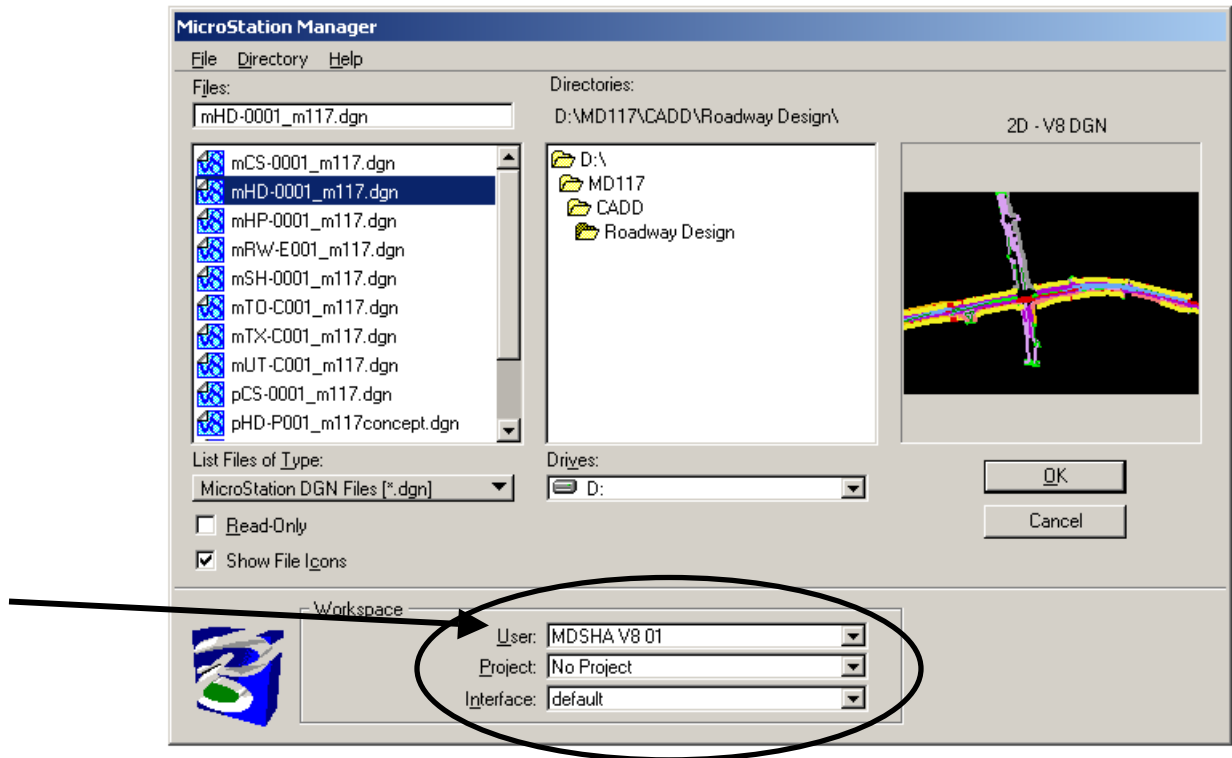
Minimum System Requirements

The July 2004 release of the V8 CAD Standards has been designed to run on **MicroStation V8.01.02.15**. Earlier versions may experience errors trying to run certain custom tools. Please refer to Bentley documentation for product system requirements.

Please note that Bentley's latest release of V8 – **MicroStation 2004** – has not been thoroughly tested in this workspace, though no obvious problems have yet been found. Users are encouraged to migrate to MicroStation 2004 at their discretion. As improvements are made to the workspace to take advantage of new software features (e.g. Model Annotation Scale), periodic workspace updates will be provided.

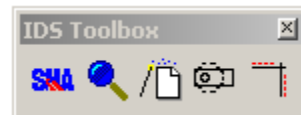
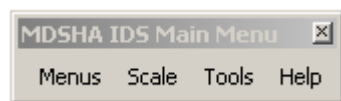
Using the SHA Workspace

When you first start MicroStation using the SHA Workspace, the MicroStation Manager dialog box will appear with various options in the Workspace section:



NOTE: Generally speaking, the only option that ever need be selected is that of **User**, to determine the proper CAD Standard version. As of July 2004, the User workspace that should be used for new projects is “**MDSHA_V8_01**”. For notes on other User Options, refer to the [Workspace Options](#) section.

Upon loading the MicroStation, the user will immediately know that they are in the SHA Workspace by the presence of the [MDSHA IDS Main Menu](#) and [IDS Toolbox](#).



The **Main Menu** has pulldowns that allow the user to select additional [discipline-specific menus](#), set drawing scale factors, and access various custom tools to assist in the drafting process.

Workspace Setup

Internal SHA Users

Within SHA, the V8 workspace has been implemented across the local area network. This ensures that all CAD workstations have access to the latest version of tools and settings as they are developed. For instance, if a resource file has been updated, it need not be installed on each computer, but simply added to the network workspace for all users to receive the update.

To setup the network workspace on a user's machine, perform the following steps:

- 1) **Install** MicroStation V8
- 2) **Copy** the **mslocal.cfg** file from the LAN Workspace directory...

ex: SHA HQ, use S:\CADD\Workspace\mslocal.cfg

- 3) and **Paste** to overwrite the mslocal.cfg file on the local machine...

typically C:\Program Files\Bentley\Program\MicroStation\config\mslocal.cfg

This will redirect the workspace root to the network location. Not only will resource files and other standard files be maintained on the network, but a directory will automatically be created for each user to store the following custom support files:

- user preference (UPF) files
- user interface (M01) files
- function key menu (MNU) files
- custom configuration (CFG) files

Storing these files on the network promotes portability of each user's custom settings. If a user moves to a new workstation or has their current workstation rebuilt, all settings will be retained. Note also that this is a one-time setup. If new standards are released in the future, they will automatically pass to the user.

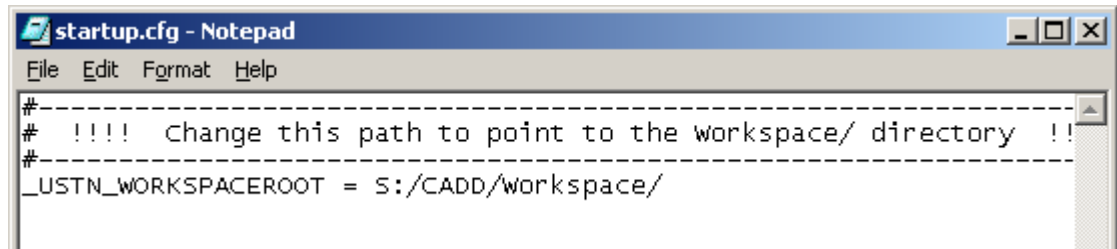
External Users (Consultants)

For external consultant users, the SHA workspace is provided on the accompanying CD, and is also available for web download. The workspace provides the core functionality of SHA's network workspace, minus certain CAD management aspects (e.g. UPF files are not routed to the network). Care has been taken to ensure that the installation will not disrupt corporate workspaces if it is run as delivered.

NOTE: It is recommended that the SHA workspace be installed on the network, although installation on the local machine will also work.

- 1) Unzip the files to a network or local directory.

2) Open the file “..\Workspace\startup.cfg” in a text editor.

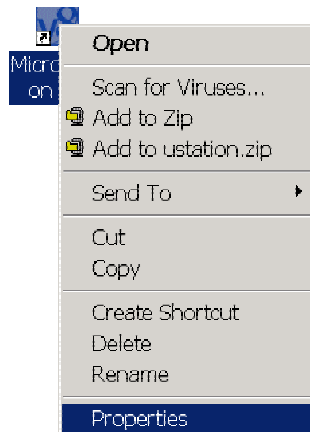


3) Redefine the **_USTN_WORKSPACEROOT** variable to point to the location of the Workspace folder as determined in step 1, then save and close the file.

4) Create a **desktop shortcut** to V8.



5) Right-click the shortcut and select **Properties**.



6) When the Properties box opens, append the following text to the Target field (note that it begins with a space):

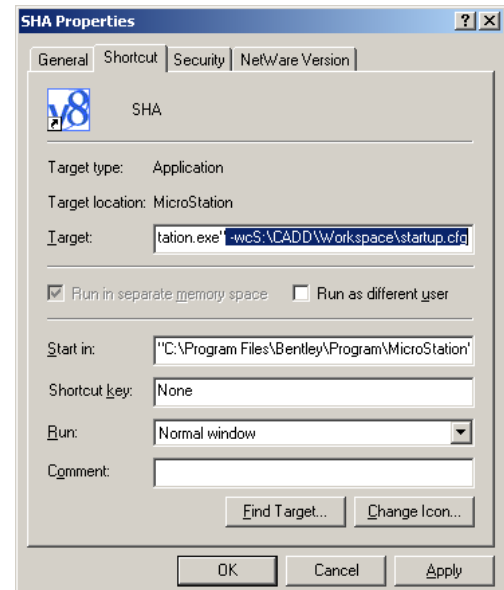
`-wc [path]\Workspace\startup.cfg`

where *[path]* defines the full directory path of the Workspace.

ex: `-wcS:\CADD\Workspace\startup.cfg`

Click **OK**.

You should now have a desktop shortcut that will launch the SHA Workspace. Users should take care to always load design files for SHA projects through the shortcut, else the following workspace options will not be available.



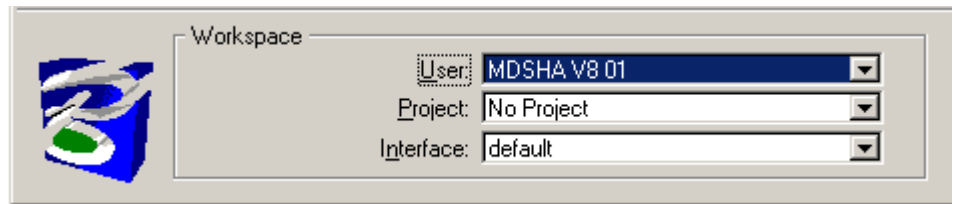
Workspace Options

The combination of [User](#), [Project](#), and [Interface](#) determines the user's working environment for MicroStation. The significance of these options is explained below.

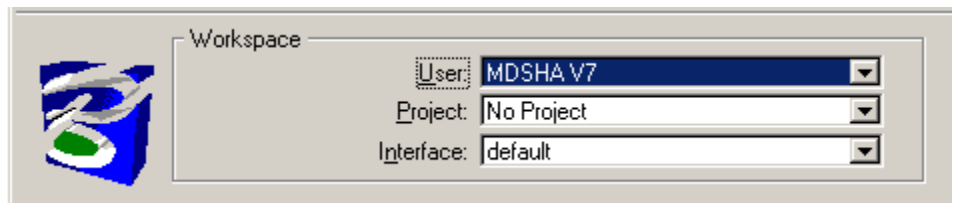
User

In the SHA Workspace, choice of user determines what version of the CAD Standards will be delivered. The initial release of the V8 standards provides two users: "MDSHA V7" and "MDSHA V8 01". As new CAD standards are released in the future, new User options will be added. The advantage of this method is to maintain legacy standards for use on old projects as needed.

MDSHA V8 01: This option delivers the new V8 CAD standards and should be selected for any new projects that are to be performed using the V8 design file format (unlimited named levels, etc). V7 files will always be opened as read/only.

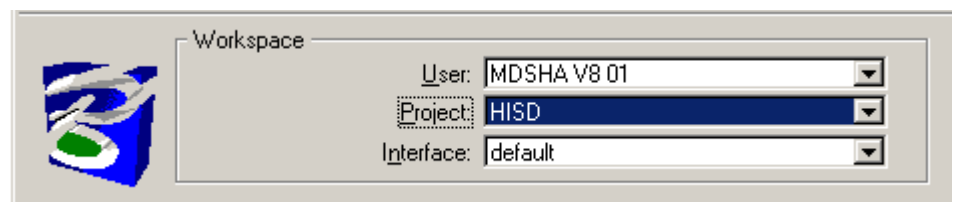


MDSHA V7: Allows editing of V7 files (via the V7 Workmode) using the old SHA CAD Standards for MicroStation J. This option is ideal for working on old projects in the old standards and viewing legacy CAD files. Should **NOT** be used for projects in V8!!!



Project

The SHA Workspace does not rely on the Project setting to manage project design files and resources. Rather, this setting is used in-house by some divisions to define certain discipline-specific settings and standards. For instance, the Highway Information Systems Division (HISD) has their own Project setting to deliver additional resource files not needed by the design divisions.

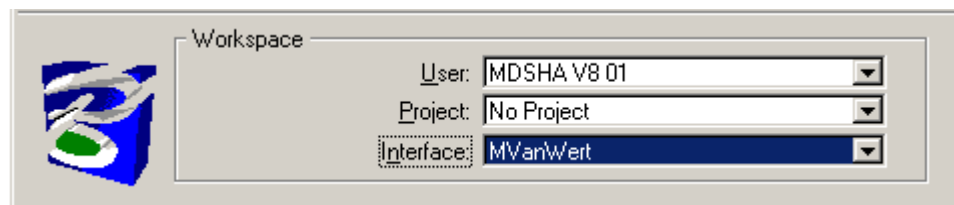


NOTE: For most SHA users, the Project setting will be preset based on user login and does not need to be changed! Possible exception may be TEDD users.

External consultants may continue to use the Project configuration as needed to define specific project working directories, etc. Note that SHA's use of ProjectWise should achieve this goal in-house.

Interface

The choice of Interface determines what custom pull down menus and toolboxes a user will receive. Within SHA, this setting will reflect the user's NT login name, which will allow individual customization.



NOTE: For all SHA users, the Interface setting will come up as default for first time use, then change to the NT login name for all future sessions!

For the consultant workspace, the user interface variable is not explicitly defined, so users should continue to see the same Interface options that they normally would.

What's Next?

Chapter 2 describes how to set up CAD files within MicroStation V8. Standard and nonstandard file types and file naming conventions are also explained. The chapter also discusses directory structures and storage spaces for SHA CAD files. The new file management system ProjectWise will be introduced, with instructions on how to use it within MicroStation.

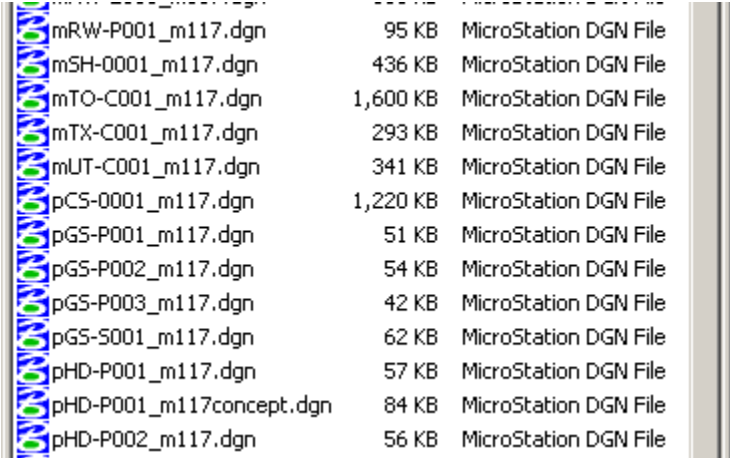
Notes 

This chapter explains SHA's new file naming convention for V8 CAD files, and provides basic information about file management, including use of ProjectWise. This chapter's two major sections are listed below:

- [File Naming Convention](#) provides details about how to name V8 CAD files. Topics include explanation of the [File Group](#) character, the [File Discipline](#) characters, and use of the [File Naming Wizard](#), which helps to make sense of the new convention.
- [File Management](#) provides information about how CAD files are organized and maintained at SHA, including the use of ProjectWise as well as the traditional CADD directory on the S:\ drive. Notes are also included on how users should deal with [Legacy CAD files](#) when making the transition to V8.

File Naming Convention

SHA has established a new file naming convention for use with V8 CAD files that follow the new standards. It was designed to provide a flexible file-naming structure that can accommodate all design disciplines at SHA, while signifying at a glance that the files were created using the V8 CAD Standards.



mRW-P001_m117.dgn	95 KB	MicroStation DGN File
mSH-0001_m117.dgn	436 KB	MicroStation DGN File
mTO-C001_m117.dgn	1,600 KB	MicroStation DGN File
mTX-C001_m117.dgn	293 KB	MicroStation DGN File
mUT-C001_m117.dgn	341 KB	MicroStation DGN File
pCS-0001_m117.dgn	1,220 KB	MicroStation DGN File
pGS-P001_m117.dgn	51 KB	MicroStation DGN File
pGS-P002_m117.dgn	54 KB	MicroStation DGN File
pGS-P003_m117.dgn	42 KB	MicroStation DGN File
pGS-S001_m117.dgn	62 KB	MicroStation DGN File
pHD-P001_m117.dgn	57 KB	MicroStation DGN File
pHD-P001_m117concept.dgn	84 KB	MicroStation DGN File
pHD-P002_m117.dgn	56 KB	MicroStation DGN File

Key to understanding the new naming convention is recognition that all CAD files can be categorized according to the general function they serve. For instance, some files serve solely as reference files, while others are intended for plotting. These categories are henceforth referred to as **File Groups**.

File Groups

File Group describes the general purpose that a file serves as part of the larger CAD production workflow. For instance, sheets and displays are often composed of various design files that are referenced into the master plotted file. The *File Group* essentially specifies whether or not a file functions as a reference file, or is in fact the final plotted output file.

File Group is identified by a single-letter abbreviation which is used as **the first character in the filename**. These *File Groups* are:

P - Print Files: These files are printed to deliver the final products of SHA CAD, whether they are contract documents, plan sheets, profile sheets, cross-section sheets, schedules, brochures, or wall displays—any file to be printed directly.

Reference Files

M - Model Files: Coordinately-correct reference files which form the basis for site design. These files will be referenced to final *Print files* (see above) and are often sub-categorized as *Existing* and *Proposed*.

D - Detail Files: Reference files that contain design details. Not to be confused with the actual plotted detail sheet, which would be a (P) Print file!

X - Miscellaneous Files: Reference files that do not fall easily into one of the other categories. This includes the Base Linen file and Layout / Motif file.

S - DGN Support/Work Files: Files that are critical to the CAD design process, but are neither plotted nor referenced into plan sheets. Such files may be necessary for use of design software (e.g. Geopak pattern and shape files) or may simply be used for engineering, calculations, and measurements by the designer.

The majority of files used in creating contract documents will be either an M-model file or a P-print file. An illustration of the CAD File Groups hierarchy with some example file types is displayed on the following page.

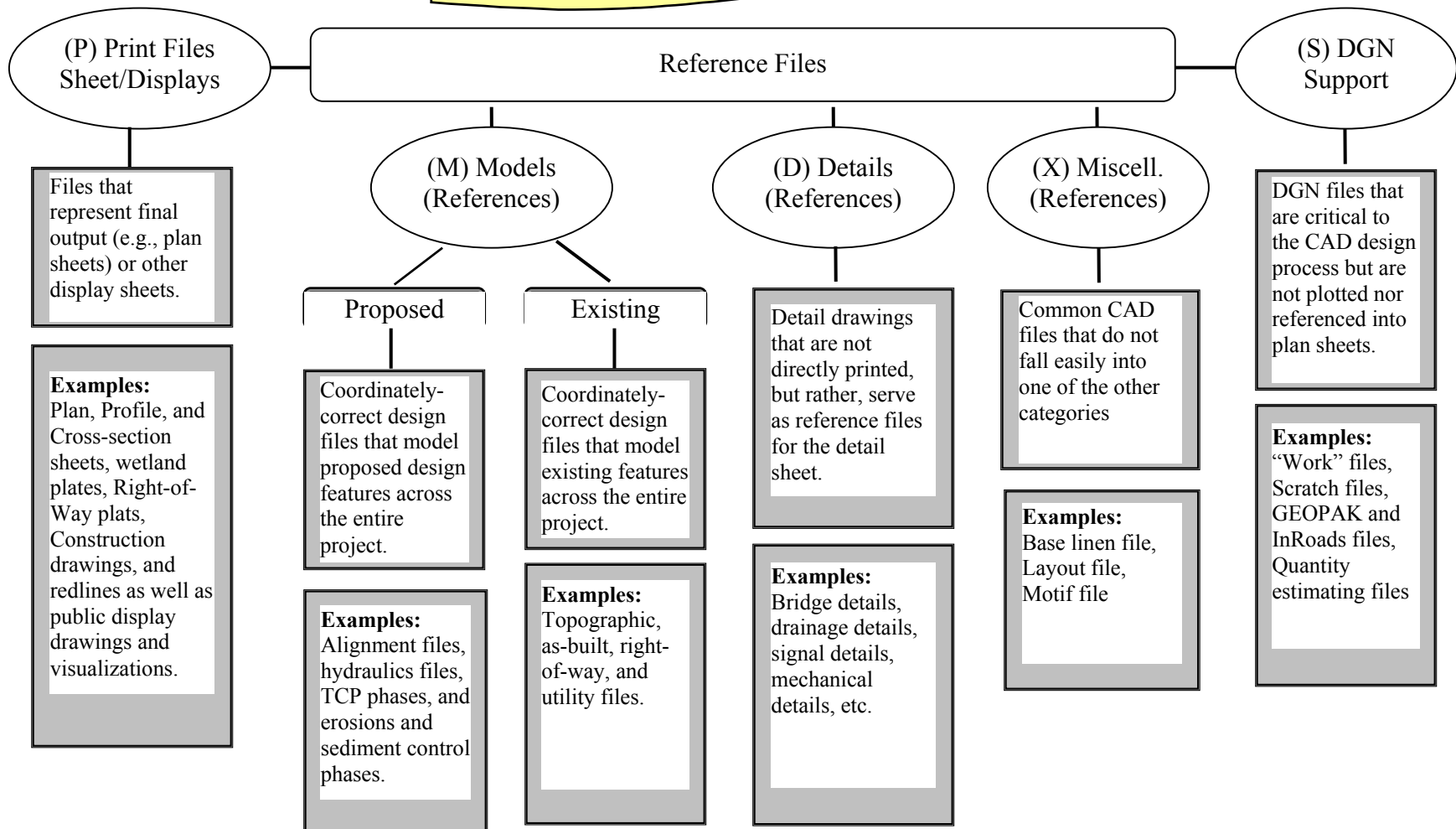
File Discipline

A *file discipline* describes, in the broadest sense, the discipline of information appearing within a particular design file. All SHA design file disciplines are designated with a basic **two-letter file abbreviation** used in the filename for identification.

Examples include Topography (TO), Highway Design (HD), Landscape Design (LD), and Signing (SN). A comprehensive list of file disciplines may be found in the [File Naming Wizard](#).

NOTE: For this edition of the CAD Standards, the CAD Standards Subcommittee has updated the list of standard File Disciplines. In most cases, the abbreviations are the same, though some have changed, and several new disciplines were added.

CAD File Groups



File Naming Summary

The IDS Team has developed a file naming convention that incorporates both the File Group and File Discipline into the name. While the first 3 characters are consistent for all CAD files, the exact format of the remaining characters will vary based on the File Group. And although filenames will be longer than 8 characters, the first 8 characters will still be unique within a given project.

PRINT FILES

pDD-TZZ_Project.dgn

Where **DD** = File Discipline (See Appendix G)

T = Sheet Type (see table at right)

ZZ = Sheet number

Project = Route #, Bridge #, TIMS #, etc

Sheet Type	T
Title sheet	T
Index sheet	I
Notes	N
Schedules	S
Plan sheet	P
Section sheet	X
Profile sheet	V
Detail sheet	D
Redlines	*R
As-Builts	A
Figure / Plate	F
Wall Display	W
Cartography/Mapping	M

REFERENCE FILES

Model (Ref) Files: mDD-AAZZ_Project.dgn

Where **DD** = File Discipline (See Appendix G)

AA = Alternate or version number

(00 indicates final design)

ZZ = ID for section of project

(00 indicates composite file)

Project = Route #, Bridge #, TIMS #, etc

Detail (Ref) Files: dDD-SSZZ_Project.dgn

Where **DD** = File Discipline (See Appendix G)

SS = Detail sheet number

ZZ = Sequence number

Project = Route #, Bridge #, TIMS #, etc

Miscellaneous Files: xDD-ZZZZ_Project.dgn

Where **DD** = File Discipline (See Appendix G)

ZZZZ = Optional descriptor characters

Project = Route #, Bridge #, TIMS #, etc

DGN SUPPORT/WORK FILES

sDD-ZZZZ_Project.dgn

Where **DD** = File Discipline (See Appendix G)

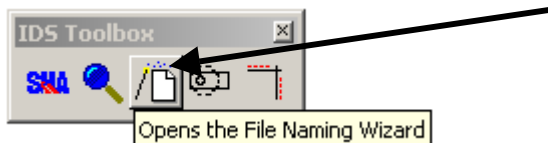
ZZZZ = Optional descriptor characters

Project = Route #, Bridge #, TIMS #, etc

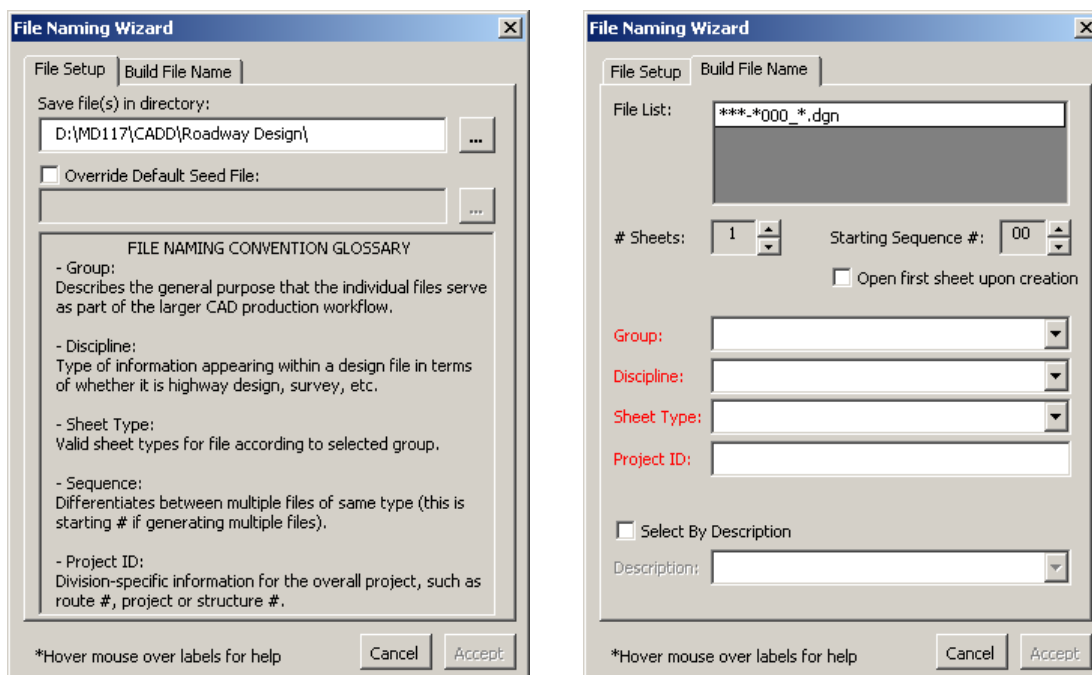
- **NOTE:** The filename extension for all CAD files should be the default “.dgn”

File Naming Wizard

In order to promote understanding of and adherence to the new file naming convention, a File Naming Wizard has been developed. Access the file naming wizard through the [IDS Tool Box](#) in the SHA workspace.



The wizard not only constructs the file name, but also creates one or multiple files in numbered sequence using standard seed files. Required fields are labeled in red text:



There are two methods to build a file name using the wizard:

1. Select by **Group, Discipline & Sheet Type**
2. Select by **Description**

Please refer to the [V8 CAD Standards Training Guide](#) for more information.

File Management

SHA has begun utilizing ProjectWise as the centralized project file management tool for use by both internal SHA and external consultants. This section provides basic guidance on how CAD files are to be organized, stored, and accessed by all interested parties. For more detailed information, please refer to ProjectWise documentation.

Directory Structure

SHA will use a standard Project Folder Template for all new projects in ProjectWise. The standard template is evolving with use. For the most current template, please refer to ProjectWise.

The Folder structure in ProjectWise was developed by the IDS Collaboration Subcommittee with input from both SHA and consultant project managers based on organizational needs and file security settings. Though consultants are not required to use this structure at their office, they will ultimately be responsible for ensuring that project files are imported into the correct ProjectWise Folder with correct reference files attached.

ProjectWise

ProjectWise acts as a file “librarian” by maintaining all project files in a centralized location. File access is controlled through file “check-in/check-out” procedures which guarantee that all project team members have access to the same up-to-date data, while at the same time preventing users from duplicating or overwriting each other’s work.

Furthermore, ProjectWise allows remote access of files across the internet. SHA envisions that this will become the primary method for consultants to receive and submit project files in the future.

For more information about the use of ProjectWise and the project template directory structure, refer to the ProjectWise documentation or [contact the IDS Team](#).

SHA CADD Server

In some instances, you may need to store files directly onto the SHACADD server. The path of the CADD server is S:\CADD\.. and is organized by division and district.

When organizing project files, keep the following guidelines in mind:

- Keep all design files belonging to one project together in the proper folder. They can be referenced easily if they are together. They may become disconnected reference files if they are not kept in the same folder. Do not modify files in any other way.
- Update reference files regularly to ensure the most current versions of all design files. Check the file folder on the server to see if any newer versions

exist. Also, keep updated versions of your files on the server so that others can update your files as their reference files.

Legacy CAD Files

Not all design files will be created from scratch. In addition to files accumulated, shared, and managed through ProjectWise, engineers may receive files from consultants or from other SHA Divisions. **Unless instructed otherwise, do not change any file names.**

Refer to the section in the appendix, "[Converting V7 Files to V8](#)" for more information on (1) whether or not to convert a project to V8 standards, and (2) if so, how to properly perform the conversion.

What's Next?

Chapter 3 provides specific details about SHA's standard settings and symbology elements, including standard seed files, color table, level names, fonts, etc. Information is provided about the use of new aspects of V8 (level libraries, level filters, text styles, DGN library) as well as a new CAD drafting technique that has been implemented: Drawing Scale.

Notes 

Chapter 3

Design Standards

This chapter provides specific details about SHA's standard settings and symbology elements, including standard seed files, color table, level names, fonts, etc. This chapter's major sections are listed below:

- [Seed Files](#) lists SHA's standard seed files for use with V8
- [Standard Settings](#) provides details about the settings contained in the standard seed files. This includes notes about Working Units, Survey Feet, Coordinate Readout, Drawing Scale (**NEW!**), Color Table, and DGN Libraries.
- [Standard Elements](#) provides information about the feature symbology that has been developed for the V8 standards, including level names, line weights, line styles, and text styles.
- [Custom Tools](#) provides an overview of some of the applications that have been developed as part of the IDS effort that are included in the workspace.

Seed Files

To ensure design file setup consistency, the following standard seed files have been created. These seeds should always be used as a basis for developing any new files, including cell libraries.

Seed File Name	Description
shaModelSeed2D.dgn	Standard 2D model
shaModelSeed3D.dgn	Standard 3D model

The following seed file has been developed for the Office of Bridge Development to create detail sheets in MicroStation 2004 (and in fact may be used for any detail design).

Seed File Name	Description
shaDetailSeed2D.dgn	Self-referenced 2D models at different scales

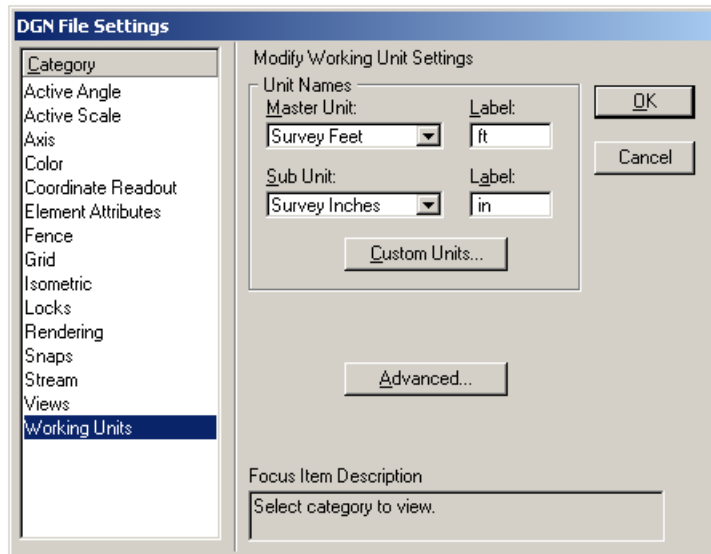
The seed consists of multiple V8 Models that are self-referenced at different scales to facilitate the creation of multiple details at different scales within the same file. (For more information on working with Multiple Models, refer to the [V8 CAD Standards Training Guide](#) in the Documentation directory of the Workspace.)

Standard Settings

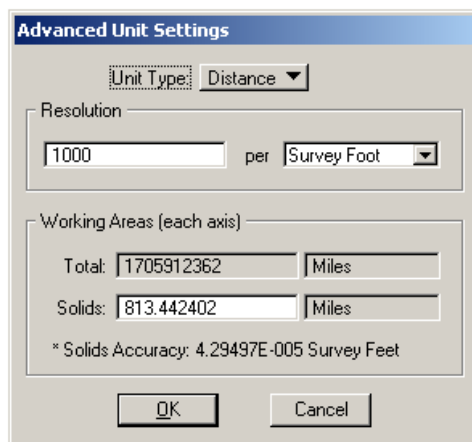
Working Units

All new V8 design files created for use on an SHA project shall conform to the following settings, which are incorporated in the seed files (unless otherwise noted):

Global Origin (2D): 0, 0
Global Origin (3D): 0, 0, 0
Master Unit (Label): Survey Feet (')
Sub Unit (Label): Survey Inch (")



Resolution: 1000 per Survey Foot
Solids Working Area: >375 Miles



Notes on V8 Working Units/Resolution

The MicroStation V8 file format represents a major change in the way that coordinate data is stored. The 32-bit integer-based design plane has been replaced by a double precision floating point coordinate system. This has the following practical effects:

1. **The V8 design plane is essentially infinite.**
2. **Positional accuracy in terms of master units is essentially unaffected by unit setup**

Whereas in V7, design files representing Maryland's coordinate grid were required to have resolution of 1000 position units per master unit, this is no longer the case. Units of resolution have been retained in the design file primarily as a means of maintaining compatibility with the V7 file formats. What's more, the floating point coordinate system has the following effect:

3. **Unlike Pre-V8 MicroStation, changing the working units does not affect the size of elements.**

In V7, if you were to draw an element measuring 10 ft, then changed the working units from feet to meters, the element would measure 10 m long. Now with V8, the same change from feet to meters would result in an element measuring 3.048 m.

While this is an important operational improvement, it has significant consequences for that way that SHA must set up their design files.

International Feet vs. US Survey Feet

By default, a "Foot" in MicroStation actually refers to an *International Foot*. However, the state plane coordinate system upon which all SHA roadway design jobs are based is measured in *US Survey Feet*.

International Feet: 1 foot = 0.3048000 m
US Survey Feet: 1 foot = 1200/3937 m \approx 0.3048006 m

The workspace contains a custom units definition file, *units.def*, that defines survey feet and controls the conversion of V7 files to V8.

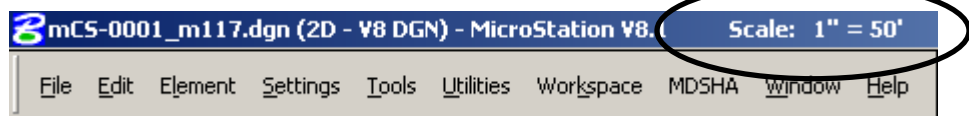
Coordinate Readout

The following coordinate readout settings are delivered in the standard seed files:

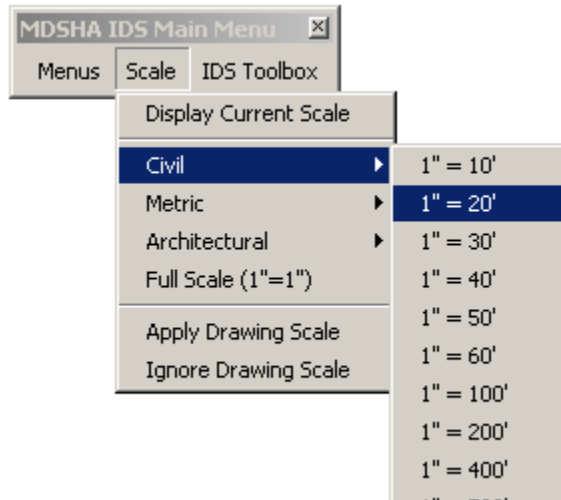
	<u>Models (2D/3D)</u>	<u>Details</u>
Coordinates Format:	Master Units	Working Units
Coordinates Accuracy:	0.1234	1/64
Angles Format:	DD.DDDD	DD.DDDD
Angles Mode:	Conventional	Conventional
Angles Accuracy:	0.1234	0.1234

Drawing Scale

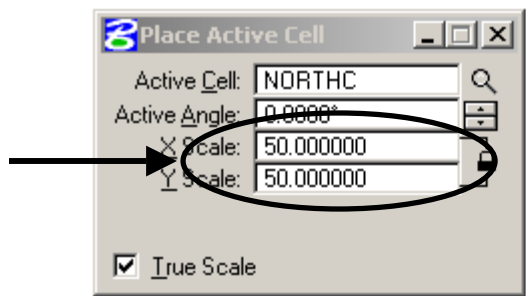
One of the key features of the new CAD Standards is the use of a drawing scale, which is displayed along the top of the MicroStation window. (If it does not appear in your window, select **Scale > Display Current Scale** from the Main Menu.)



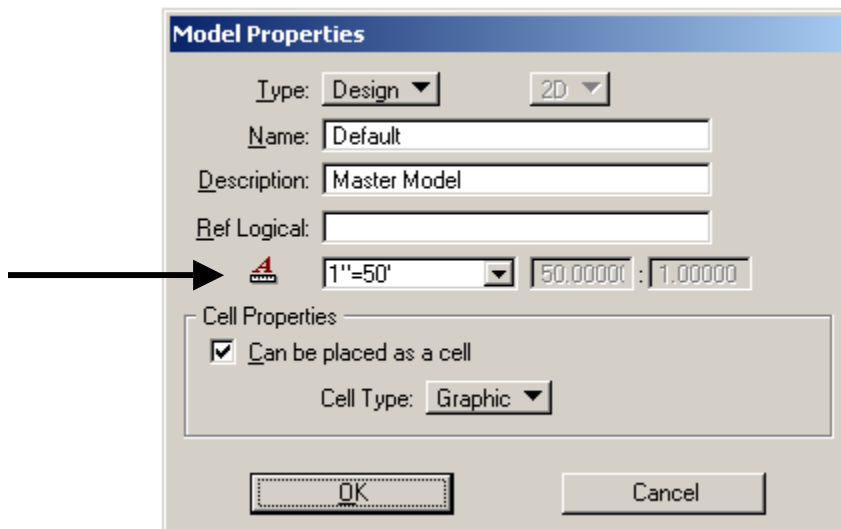
Drawing scale may be changed by selecting the appropriate scale factor from the *Main Menu* pulldown. The scale factor is stored with the file.



All scale-dependent drawing elements – i.e. text, cells, & linestyles – have been defined in the new CAD Standards at a unit (1:1) scale. The element is then scaled up or down by the drawing scale factor when it is selected from a barmenu. This helps maintain consistency of scale-dependent drawing features, regardless of the scale being used.



Programming Note: Before processing any scaling commands, the SHA Workspace checks what version of MicroStation is being used (V8.1 or 2004). If it is **V8.1**, the active *Line Style Scale Factor* is used as the default drawing scale. If it is **2004 or later**, the *Model Annotation Scale* of the active model is used as the default drawing scale. The same *Main Menu > Scale >* pulldown sets the scale factor for both

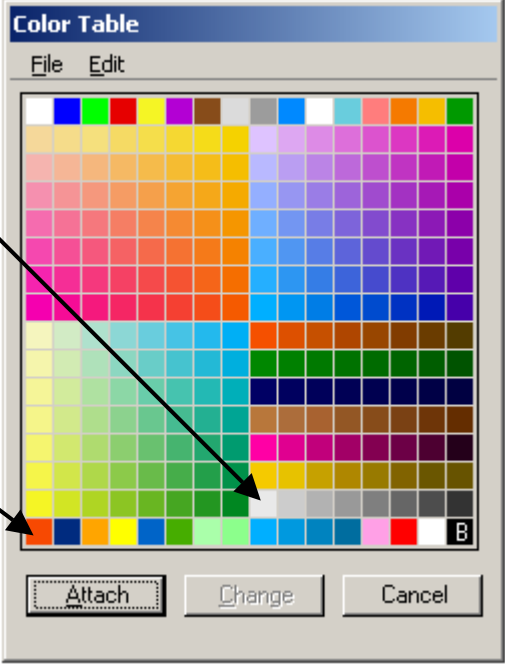


This is a new feature in MS 2004, and has the advantage of being applied at the Model level (as opposed to the linestyle scale factor, which is applied across all models in a file.)

Color Table

The standard color table for all SHA design projects is **ClorMdSha.tbl**. This color table defines the RGB values for the MicroStation colors 0-255. The monochromatic (black & white) pen tables have been set up for use with this table such that all colors plot as black, with the exception of those color values defined below.

Gray Scale	232	Gray 10%
	233	Gray 20%
	234	Gray 30% - Shading
	235	Gray 40%
	236	Gray 50% - Linework
	237	Gray 60%
	238	Gray 70%
	239	Gray 80%
True Color	240	SHA Logo Orange
	241	SHA Logo Blue
	242	Orange
	243	Yellow
	244	Blue
	246	Green Shading
	247	Green Lines
	252	Red Shading
	253	Red Lines
	254	White to block items out



Refer to the chapter on [Plotting](#) for more details.

DGN Library

One of the major new changes to V8 is the use of **DGN Library** files (DGNLIBS) to maintain and deliver CAD Standards. Such standards can include the following:

- Levels
- Level Filters
- Text Styles
- Dimension Styles
- Cells

The DGNLIB provides these standard items to the user, but locks them from being edited, thus helping to maintain Standards. At this time, only [level filters](#) are being maintained in SHA's standard DGNLIB. All other standard elements are delivered in some other fashion. Please refer to the relevant sections below for more information. Once the new CAD Standards mature through testing and use, more of the above items will likely be put into DGNLIBS.

Standard Elements

This section describes MicroStation features and the related CAD Standards that must be followed to maintain consistency across all design files.

Features

A *feature* corresponds in a very specific manner to a single type of design information contained within a file type. A feature defines not only a specific piece of information, but also how it is to appear within the design file. A single file type may contain hundreds of features, each with its own unique set of graphical parameters.

The IDS Team has completed a comprehensive survey of all features in use by SHA. These features are maintained in the IDSIM database, along with all primary attributes (level, color, weight, and style) and secondary attributes (including text size, font, etc). The feature definitions are maintained by division CAD reps.

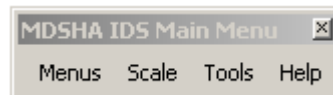
The most important parameters assigned to a feature are level, color, weight, and style. Many other parameters, such as text font, text size, and so on may be defined for a particular feature, but these extra parameters are not necessarily used for identification purposes. ***By definition, two elements belong to the same feature whenever they have the same cell name or level, color, weight, and style, even if other parameters may be different.***

Barmenus

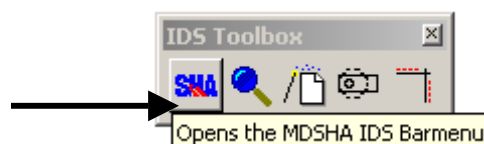
As a general rule the barmenus are used to find the standard *symbology* (level, color, style, and weight) for any item that is contained in the file. If you need an item and can't find it in the barmenus or [Feature Search tool](#), contact your CAD manager, or email IDS@sha.state.md.us. A new feature might need to be added.

Main Menu

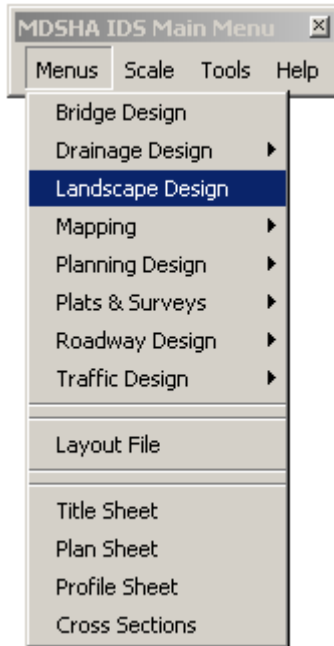
Upon entering the SHA workspace, the *Main Menu* will appear, along with the IDS Toolbox. The *Main Menu* contains key pulldown commands that are applicable to any file in the workspace.



NOTE: The *Main Menu* should always remain loaded. If it has been unloaded or is not visible, select the **SHA** icon from the *IDS Toolbox* to reload, or key-in "mdl load shabarmenu".



- The **Menus** pulldown contains links to [discipline-specific menus](#):



Selecting one of the items from the Menus pulldown does the following:

- 1) Unloads the current discipline-specific menu
- 2) Unloads the attached level libraries
- 3) Loads the selected discipline-specific menu
- 4) Loads the appropriate level libraries.

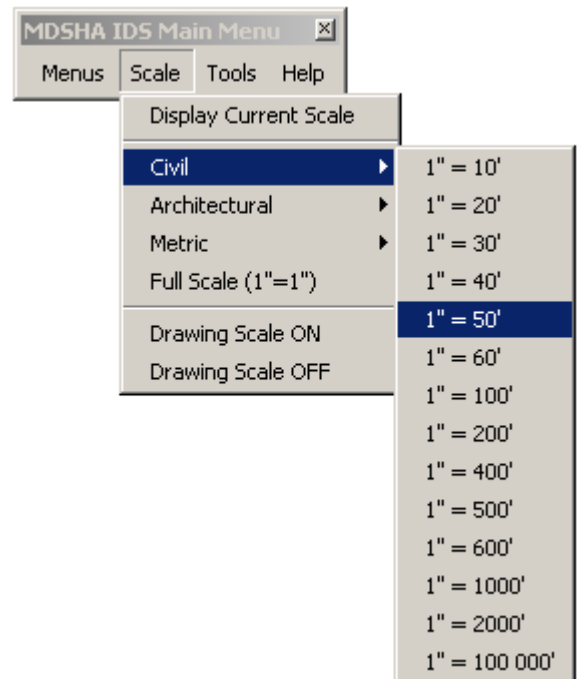
- The **Scale** pulldown contains commands that allow you to set the file's [drawing scale](#). Typically this is done once, at the time the file is first created. The active scale will be displayed along the top of the MicroStation window.



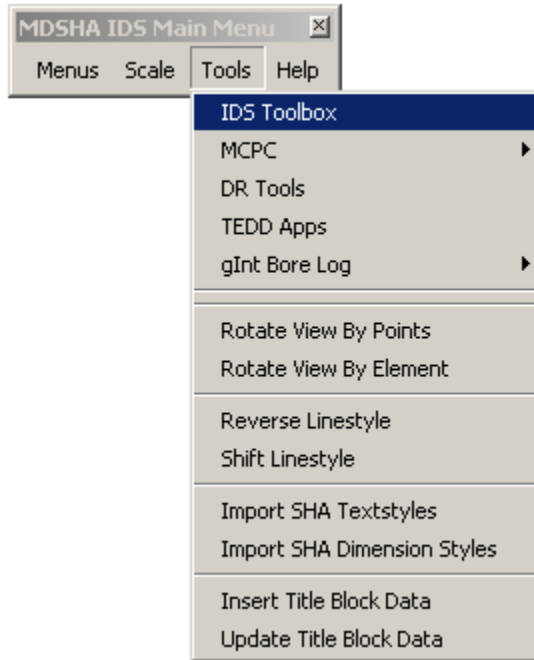
MicroStation V8.1 – This version uses the *Linestyle Scale Factor* as the de facto drawing scale

MicroStation 2004 – This version uses the *Model Annotation Scale* as the de facto drawing scale.

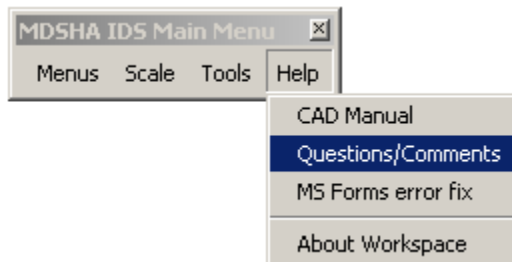
NOTE – when first opening a file in 2004, it may be necessary to reset the drawing scale and the Text Styles (*Tools > Import SHA Text Styles*) if the file was originally created using V8.1



- The **Tools** pulldown contains links to various drafting tools, both [custom](#) developed and MicroStation delivered.



- The **Help** pulldown contains links to the CAD Manual, as well as information about the current version of the Workspace.



Discipline/File Specific Menus

Many additional barmenus have been created based on file discipline (e.g. Roadway Design, Drainage Design, etc) or general file type (e.g. Plan Sheet, Title Sheet). When a file is first opened, the workspace checks the file name to see if it follows the standard file naming convention. If there is a match, the appropriate barmenu will be automatically loaded, along with any associated level libraries. As noted above, these barmenus may also be called from the [Main Menu](#).

Levels

Levels are named slots for graphical elements in a file whose display can be turned on or off. This allows users to have lots of information saved in one file, even if the material does not all need to be used or viewed at the same time. MicroStation V8 allows you to define an unlimited number of named levels.

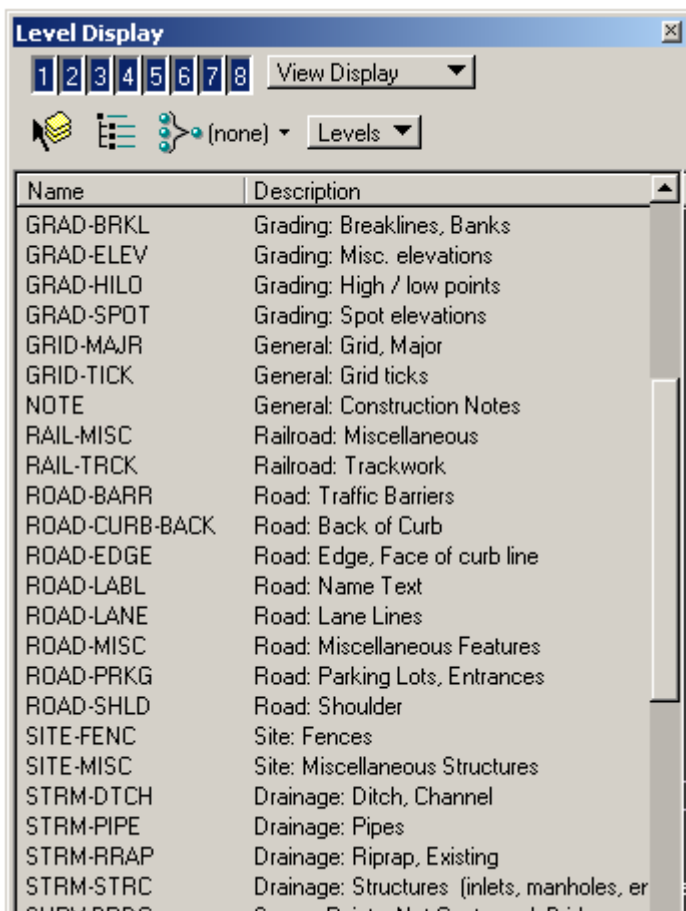
Level Names

SHA's V8 level naming convention is based on the guidelines set forth by the National CAD Standards, with changes as needed to accommodate a civil transportation workflow:

MAJR-MINR-SUBM

Where: **MAJR** = 4-character Major Group
MINR = 4-character Minor Group
SUBM = 4-character Sub-Minor Group

Examples:



Level Library for Topographic File

Level Libraries

Level names are managed by attaching **level libraries**. When a barmenu is selected, the appropriate level library is attached. The library remains attached if you close and reopen the file. Note that when level libraries are detached, or if the file is opened outside of the standard SHA workspace, used levels will still appear while unused levels will not.

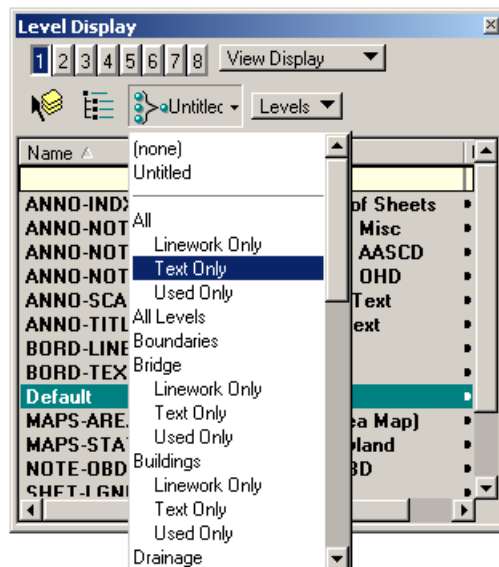
Level libraries have the ability to define level names and descriptions and also the *By Level Symbology* and *Override Symbology* for each level. (Note that *By Level Symbology* has not been adopted in these Standards). All these attributes are currently maintained for each level library in the IDSIM database, which can then generate the actual level library files in CSV format. Therefore if a level name needs to be modified, all level libraries using that level can be quickly regenerated.

It is important to mention that levels are currently not enforced via [DGN Libraries](#). For the initial rollout of V8 it was deemed simpler to create individual level libraries for each file and attach them each as needed with the appropriate Barmenu. Users also have the option to create new levels as needed, and are encouraged to forward needs and suggestions to ids@sha.state.md.us.

Level Filters

Level filters serve two purposes: (1) to limit the number of levels that appear in a level list, and (2) to turn groups of levels on and off when needed. The latter application is especially useful for controlling level display of attached reference files.

A standard set of level filters has been created based on the set of new level names. These standard filters are maintained in the *levelfilters.dgnlib* file. User may create their own filters that are either temporary or stored in the DGN file (through the level manager). Refer to the [V8 CAD Standards Training Manual](#) in the Workspace/Documentation/ directory for more information.



Line Weights

In previous versions of the standards, plotted line thicknesses were never formally defined. As a result, plots tended to have slightly different appearance depending on which plotter was used, plotting software, driver, pen table, etc. The new V8 CAD Standards attempts to correct this oversight by assigning plotted line thicknesses to MicroStation weights 0-15 in accordance with industry standard drafting pens.

MicroStation Weight	Full Size Thickness (mm)	Koh-i-nor Pen Size	Half Size Thickness (mm)
wt = 0	0.18	0000	0.09
wt = 1	0.25	000	0.125
wt = 2	0.30	00	0.15
wt = 3	0.35	0	0.175
wt = 4	0.50	1	0.25
wt = 5	0.60	2	0.30
wt = 6	0.70	2.5	0.35
wt = 7	0.80	3	0.40
wt = 8	1.00	3.5	0.50
wt = 9	1.20	4	0.60
wt = 10	1.40	5	0.70
wt = 11	1.70	6	0.85
wt = 12	2.50	8	1.25
wt = 13	3.80	10	1.90
wt = 14	5.00	12	2.50
wt = 15	6.35	14	3.175

Standard pen tables for Iplot and PLT files for MicroStation plotting with the above line thicknesses defined are delivered in the Workspace. (Refer to the [Plotting](#) chapter for more details.) In reality, most standard drafting can and should be accomplished using line weights 0-6, as the weights above 6 become extremely thick.

Thin Lines (wt = 0). Thin lines should be used for depicting background object lines, centerlines, hidden lines, and most patterning symbols.

Medium Lines (wt = 1). Medium lines should be used for depicting dimension leaders/witness lines, dimension lines, dimension text, text for notes/callouts, schedule boxes/charts, text inside schedules, minor object lines, line terminators (arrowheads, dots, and slashes), and note leader lines.

Medium Thick Lines (wt = 2,3). Medium thick lines are the default line weight for drawing most objects. Medium thick lines should also be used for section titles.

Thick Lines (wt = 4). Thick lines should be used for minor title underlining, text for titles, and object lines requiring special emphasis.

Extra Thick Lines (wt = 6). Extra thick lines should be used sparingly. Extra thick widths are appropriate for use as elevation grade lines, building footprints, or top of grade lines on section/foundation details.

Line Styles

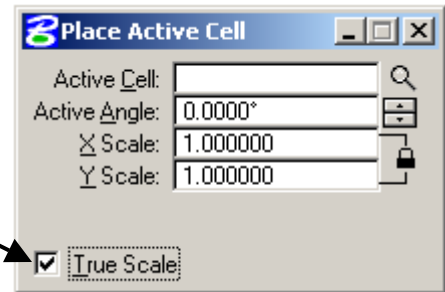
The fundamental change in the approach to working with line styles has been to “unitize” the size of those styles that should be scale-dependent. This includes such styles as the Woods Line, and any style that contains text. When these styles are used in a drawing, they must be scaled up or down according to the [drawing scale](#) (e.g., times 50 for 50-scale).

This appropriate scale factor is applied automatically when these styles are selected from a barmenu. However, if they are selected through the usual active attribute interface, they may appear incorrect in the drawing because of an improperly set scale or an on/off toggle that was pressed accidentally. When this happens, use the commands under the [Main Menu](#) to apply or remove the scale factor setting. (**Main > Scale > Drawing Scale ON**, and so on.)

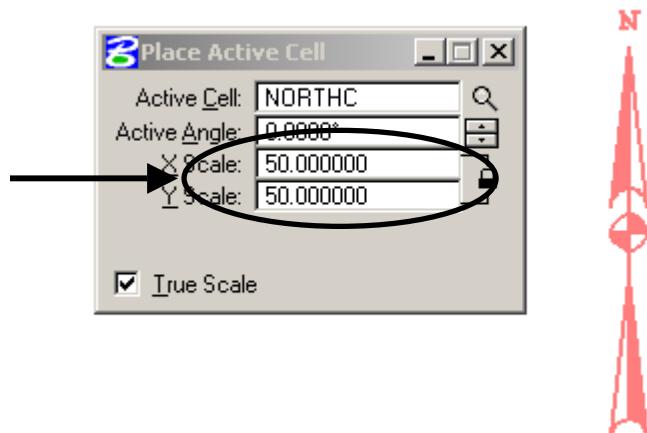
Cells

One of the key changes to use of cells in V8 is the ability to place cells at **True Scale**. This means that if a cell was drawn to be 1 foot wide, if placed in a metric drawing it would measure 0.3048 m. Similarly, V8 will rectify the size of cells drawn in files with different [units of resolution](#).

All of SHA’s standard V8 cells have been created with units of resolution to match the standard seed files (meaning that they will always be true scale). Nevertheless, it is still recommended that users keep the *True Scale* checkbox turned on at all times just in case.



As with the linestyles, note that most symbol-type cells (i.e. scale-dependent) have been created at a unit size for easy placement. For these cells, the **active scale** should be set to match the [drawing scale](#) (i.e. 1”=50’). When selected from one of the [barmenus](#), the correct active scale will be applied automatically.



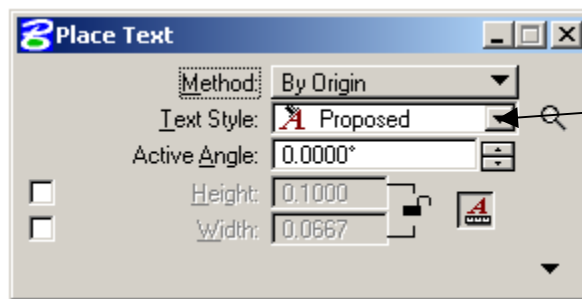
Fonts

The 95 CAD Standards had a single resource file (*shafonts.rsc*) that contained all fonts. This library has been broken down into several smaller libraries for manageability. In order to maintain compatibility with legacy CAD files, all fonts from the 95 standards have been preserved in the file *sha_font_legacy.rsc*.

However, in order to achieve more consistent plan sets, the following standard fonts are recommended for use:

1 – Working:	Proportional font
10/43 – Leroy:	Filled font
3 – Engineering:	Monospaced font
42 – font042:	Block font
2 – Fancy:	Serifed font

Use of these fonts is being encouraged through their implementation as Text Styles.



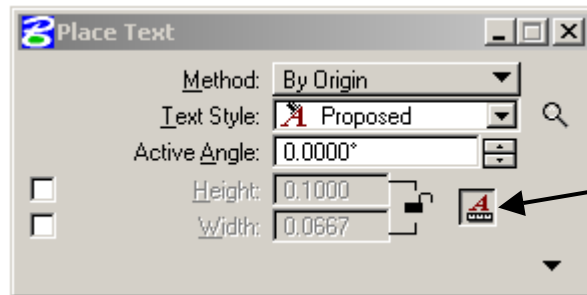
Text Styles

MicroStation V8 has introduced a new feature to facilitate the placement of text – [Text Styles](#). Standard text styles can be created which preset font, text height, text width, etc., for quick and easy placement. The SHA Workspace takes advantage of Text Styles in the following ways:

One of the primary advantages of Text Styles, aside from maintaining consistent appearance of text, is the ability to propagate the drawing scale to the size of the text. So long as the [Drawing Scale](#) has been properly set from the Main Menu, the size of the text will match. In MicroStation 2004, this is achieved by enabling the *Model Annotation Scale Lock*.

- Sample text styles have been placed in the seed files. Note that these are currently not locked for editing by a DGNLIB file.
- Text Styles are automatically scaled by the active [Drawing Scale](#), as follows:

- **MS V8.1** – changing the drawing scale via the Main bar menu triggers a macro that scales the text size of all text styles in the file by an appropriate factor.
- **MS 2004** – text styles are maintained at unit size (1"=1'), but will be scaled at the time of placement if the *Model Annotation Scale Lock* is enabled.



NOTE: In *V8.1*, if a user changes the drawing scale of a file that already contains text, the macro will break the association of the text with the text style used to create it. However, this will not change the appearance of text.

In *2004*, the user will be asked if the drawing scale should be applied to existing text... the recommended response is NO.

Importing Standard Text Styles

If a file was not created based on a standard seed file, it will not contain proper text style definitions. (This is common for files converted to V8 from an earlier version.) Similarly, if a file was begun in V8.1 and later worked on in 2004, there will likely be a disconnect with text size (owing to use of the Model Annotation Scale Factor).

To address both of these issues, a command has been added to the Main Menu that will import the standard SHA text styles, scaling them as appropriate. (**Main > IDS Toolbox > Import SHA Textstyles**) Be careful, however, because this action will delete any custom text styles you may have created.

Dimension Styles

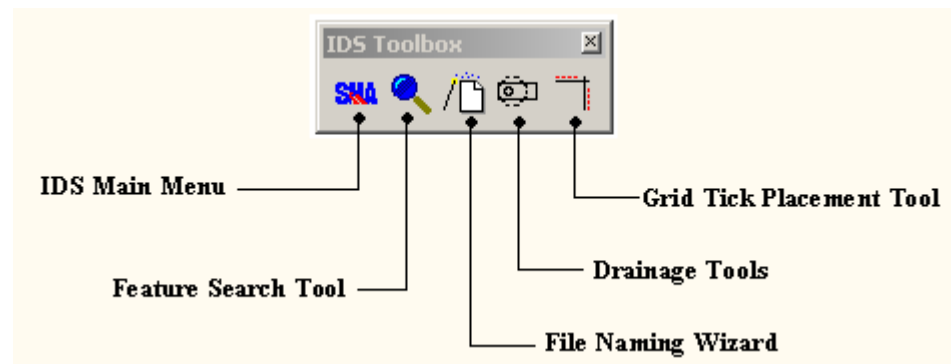
Dimension Styles are another new item to the SHA Standards. Several sample styles have been created for use: *Architectural*, *Structural*, *Civil*, *Detail*, and *Survey*. These styles are currently maintained in the seed file rather than the DGNLIB so as not to lock them from editing in case a user needs to change a terminator or the number of decimal places. As with the Text Styles, missing Dimension Styles may be imported to a file from the Main Menu (**Main > IDS Toolbox > Import SHA Dimension Styles**). Once these styles have been refined through use, they may be added to the DGNLIB file.

Custom Tools

This section describes the custom applications and tools available through the SHA Workspace. Some were created in-house or through consultants. All are intended to simplify, standardize, and make the creation of CAD drawings more efficient.

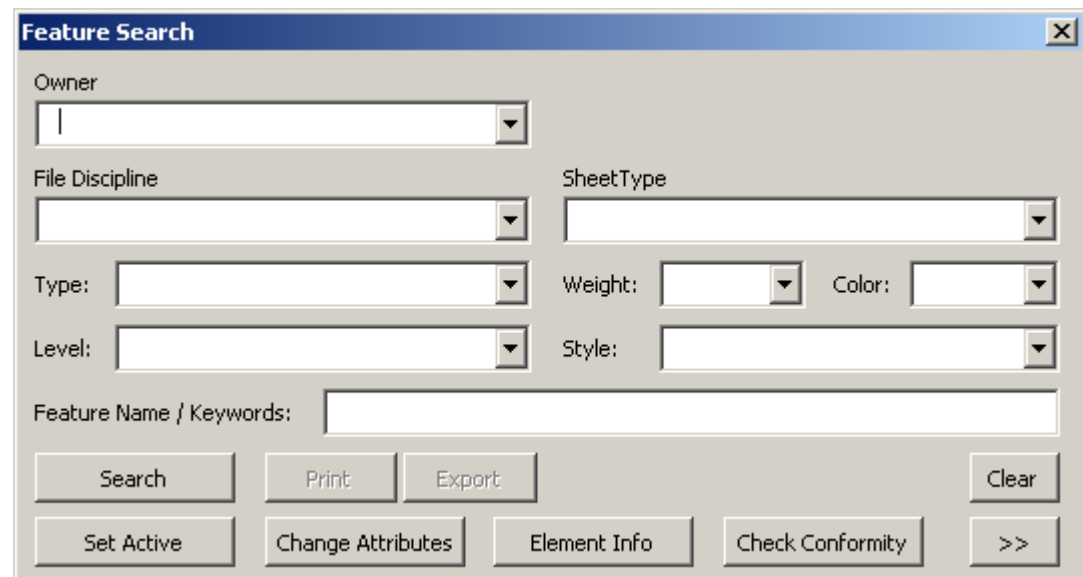
IDS Toolbox

IDS Toolbox is a collection of MicroStation V8 tools that have been developed for SHA. This toolbox is automatically loaded by the workspace. If it is unloaded or not visible, select *Tools > IDS Toolbox* from the *Main Menu*, or key-in “mdl load idstb”



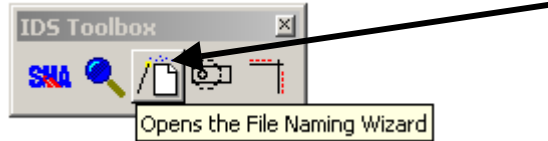
Feature Search Tool

The FEATURE SEARCH tool is an interface developed to help browse the CAD Standards for unknown symbology settings.



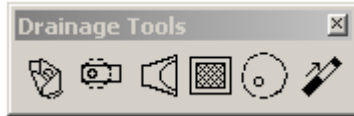
File Naming Wizard

The FILE NAMING WIZARD helps users create files using the new file naming convention. Refer to the “[File Naming Convention](#)” section of this chapter for more information. Activate the File Naming Wizard from the IDS Toolbox.



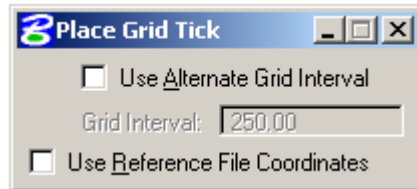
Drainage Tools

DRAINAGE TOOLS is a Tool Box containing multiple commands used for placing storm drain items, including inlets, pipes, manholes, end walls, and end sections.



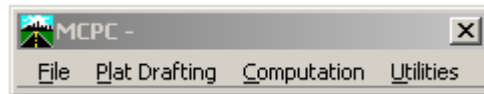
Grid Tick Placement Tool

The GRID TICK PLACEMENT TOOL assists the user in placing grid ticks on plan sheets. By default, the grid ticks are locked to a grid interval of 250 ft. Place from one to three grid ticks. Size of the tick is automatically scaled according to the file's [drawing scale](#).



MCPC

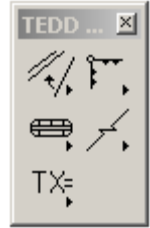
MCPC is a longstanding SHA application developed for the Plats & Surveys Division to assist in the development of property lines and plats. MCPC requires an InRoads license in order to operate.



NOTE: The version of MCPC included on the CD will only run on MicroStation V8.1 with InRoads V8.4. A recompiled version for MicroStation 2004 will be available in the summer of 2004. Check

TEDD Apps

TEDDAPPS contains a series of commands developed for the Office of Traffic & Safety's Traffic Engineering Design Division to assist in the development of their construction documents.



gINT Borlog

The GINT (GEOTECHNICAL INTEGRATOR) BORLOG TOOL is a productivity tool developed by IDS for the purpose of placing soils information into Contract Plans.



gINT is a database containing soils information that is maintained by the Geotechnical Explorations Division of SHA's Office of Material and Technology. *gINT Borlog* reads soils information contained in a *gINT* file and generates soil profiles and soils test data tables, which may then be placed onto the Profile Sheets of Contract Plans.

What's Next?

Chapter 4 provides basic drafting guidelines. Some of the information is specific to use of MicroStation V8, while other information is more universal. It is hoped that the information contained in the chapter will prove helpful to drafters both new and old.

Notes 

Chapter 4

Drafting Guidelines

This chapter provides discussion and information about various drafting guidelines and procedures when composing contract documents. This chapter's major sections are listed below:

- [SHA Border File](#) discusses use of the standard D-size border file developed for creation of contract documents at SHA.
- [Reference Files](#) contains basic information about attaching reference files in MicroStation V8, providing recommendations for using the new settings.
- [Text Placement: Model vs. Print Files](#) discusses the proper placement of text in design files.
- [Addenda Procedures](#) contains basic workflow information about the creation of addenda.
- [Redline Revision Procedures](#) contains basic workflow information about the creation of redline drawings.

SHA Border File

In order to promote title block integration with ProjectWise, a single border file has been developed for all disciplines across SHA. This file is located in the *Workspace/Standards/MDSHA_V8_01/dgn/Borders/* directory and is named **xBL-BORDER.dgn**

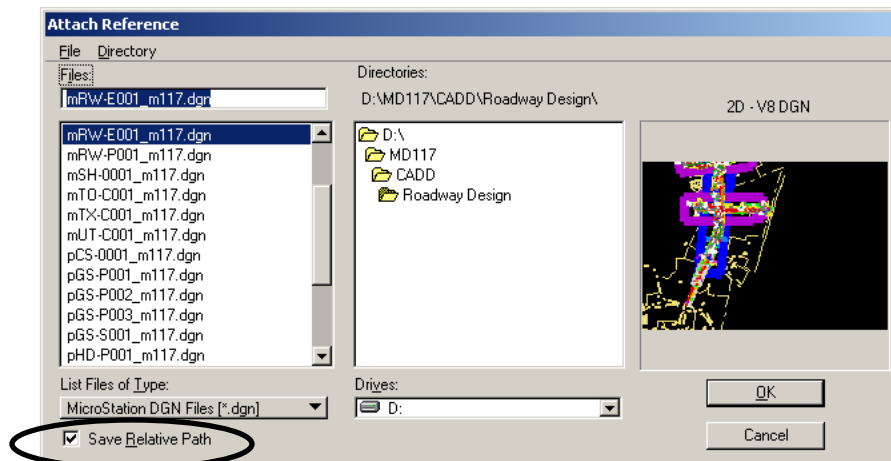
The border file has individual saved views created to deliver discipline-specific settings. When the border file is attached to the plan sheet as a reference file, the appropriate saved view should be selected. The borders and standard sheets provided in the workspace are drawn to the conventional 1" = 1' scale and should be scaled up or down accordingly when attached. Please refer to the [V8 CAD Standards Training Guide](#) for more information.

Reference Files

Many interface changes have been made to the way in which reference files are attached. The following recommendations are provided to help you understand the new settings.

Save Relative Path

SHA recommends all users enable this check box, as it assists with ProjectWise integration. It remembers the directory location of the reference file relative to the directory of the active file, thereby promoting portability of the project working directory. This setting will not interfere with the MS_RFDIR variable.

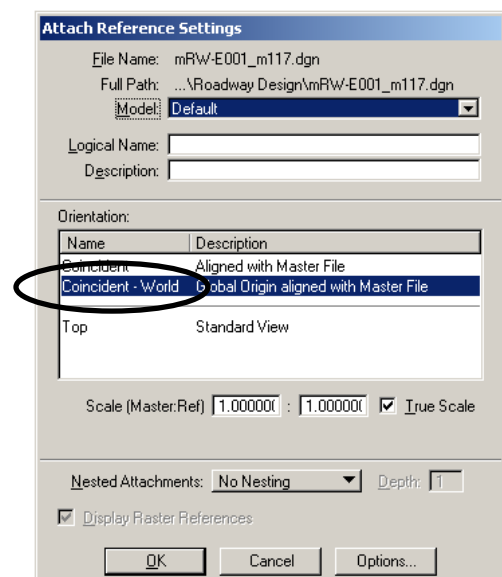


Note that this setting has essentially replaced the *Save Full Path* option of earlier versions, which is no longer an option. Rather, MicroStation V8 searches for reference file attachments in the following manner:

1. active directory
2. relative path directory
3. MS_RFDIR directory
4. full path directory

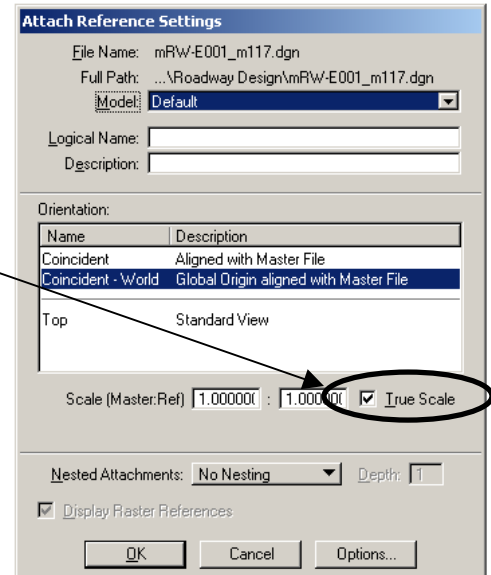
Coincident-World

This setting adjusts reference files with different Global Origins. The Workspace is set up by default to attach coincident-world orientation. *It is recommended that this option always be enabled.*



True Scale

This setting adjusts reference files with different Units of Resolution. As with Coincident-World, *it is recommended that this option always be enabled.*



3D and 2D Design Files

MicroStation V8 now allows 3D files to be referenced into 2D files! This means that under no circumstances should topo files, grading files, or other 3D files be “squashed” to 2D to accommodate referencing into a 2D plan sheet.

Such practice, while common to the V7 workflow, creates the undesirable issue of having multiple versions of the same file in production. If the information in the file needs to change, there is small likelihood that the changes will be made uniformly to both. Sooner or later, confusion arises as to which copy of the file reflects the most up-to-date information.

Repeat: there is no longer a good reason to convert 3D files to 2D. Don't do it! If need be, set your active depth to zero and activate the Depth Lock.

Text Placement: Model vs. Print Files

Annotation text belongs in the [Print](#) file whenever possible. However there are instances when text must be placed in the [Model](#) file. This usually occurs for items that can be annotated across the entire job, (usually with InRoads or GEOPAK), such as topo text or alignment stationing.

The advantage of placing text items in the Model file is that as the design is refined, the changes can be made globally to the entire project. The disadvantage is that text in a given Model file often overlaps with text in another Model file, both of which are referenced into the same plan sheet. When this occurs, the recommended workflow is to resolve the text conflict in the Print file, **NOT** in the Model file. As follows:

1. Identify the text item that is least likely to change (e.g. topo text labels)
2. Copy all the text from the level on which the conflicting text is located into the Print file (i.e. plan sheet)

3. Turn off the Model file level containing the conflicting text.
4. Resolve the text conflict in the Print file.

Note that all text in a given model file should be at the same scale. 50'=1" is used for most projects, and topo is generated at that scale unless a specific request is made in advance.

It sometimes occurs that a designer requires the same annotation for different scales (e.g. geometry sheet stationing, wetland plates). Given the ability in MicroStation 2004 to set the Annotation Scale at the model level, designers are encouraged to create a separate model within the same DGN file that is reserved solely for the text at the alternate scale.

Addenda Procedures

Addenda are changes that are made to contract documents after their official publication. Addenda at SHA are typically for contract plans; however, the same concept may also apply to various other published files such as wetland permit plates, public brochures etc., where changes must be tracked for customers reviewing the documents.

Addenda for Contract Documents

In the case of contract plans and specifications, these are typically changes that are to be published after the advertisement of the project. All changes in this phase of the files must be tracked. Drawing elements may be modified, deleted, or added to the files, but each edit must be marked with the addenda symbol using the proper number of the Addendum. This includes changes that may have been cosmetic only. The sheet Border file revision box must also note the Addendum Symbol with proper number, and the date the addendum is to be published. This date will be provided by the Project Manager. For example:

REVISIONS	
2	Addendum No.2 - 01/27/03
3	Addendum No.3 - 02/06/03
4	Addendum No.4 - 02/20/03

Changes to the plan sheet must be described, per sheet, in the documentation that will be accompanying the published plans. The accompanying documentation should have a clear description of all changes that are on each sheet. For example:

<u>Sheet No.</u>	<u>Description</u>
13	<p>EXTENDED limits of concrete paving section on MD 43 to Station 535+50±.</p> <p>CHANGED “Existing MD 43 Mainline Partial-Depth Patching” detail to “Existing MD 43 Mainline Full-Depth Composite Patching”.</p> <p>CHANGED “Modified Type ‘A’ Curb & Gutter” to “Modified Type ‘A’ Combination Curb & Gutter”.</p> <p>DELETED vertical line between the curb and gutter in the “Modified Type ‘A’ Combination Curb & Gutter” detail.</p>
16	<p>ADDED bearings on BGE Access Road Table between stations 4+98.94 and 5+29.22; 8+67.58 and 9+81.67; 18+47.89 and 19+04.18; 22+75.68 and 23+16.38.</p>

NOTE: CAD Changes that affect Project Pay Quantities must also be documented as changes to the Schedule of Prices.

Pen and Ink Changes

Addenda may also include “Pen and Ink changes” These changes are typically minor where SHA directs the contractors to modify the plans using their own pen and ink. **These changes should also be made to the CAD Files**, however SHA is not providing a revised hard copy plan sheet for the change. These changes are typically directed as noted in this example:

Note: The Attention of Prospective Bidders Is Directed To The Following Pen And Ink Change. The Contractor Is Directed To The Make The Following Pen And Ink Change To The Contract Document. Corrected sheets will not be provided.

<u>Sheet No.</u>	<u>Description</u>
2	<p>Change Sheet Numbers 660, 661, and 664 to 773, 774, and 777 respectively.</p> <p>Renumber plan sheet 660 of 664 to 773 of 777.</p>
661	<p>Renumber plan sheet 661 of 664 to 774 of 777.</p> <p>Renumber plan sheet 664 of 664 to 777 of 777.</p>

Redline Revision Procedures

Redlining refers to making changes to bid documents that have been created in the design phase. Once these drawings have been through bid opening, redlining begins. Almost always, a construction project encounters unforeseen building issues. The redlining process makes these changes formally and in writing.

NOTE: As of this writing, recommended redlining procedures are not available. This section will be updated in the coming months.

What's Next?

Chapter 5 provides information about standard plotting techniques. SHA has defined standard thicknesses for plotted line weights, as well as stroke lengths for standard line styles 1-7. The chapter provides information about the base pen tables and plot drivers included in the workspace to help generate uniform plots regardless of the plotting software used.

Notes 

One of the primary goals of the CAD Standards effort is to enable the creation of uniform plots sets. It often happens that plots can not be reproduced from a set of CAD files, only because the current owner is unaware of how the original plots were created, or does not have access to the pen tables/plot drivers that were used.

This chapter describes the plotting procedures to be used at SHA. *Plotting* refers to using a printer or large-format plotter to print hard copy on paper from CAD drawings. Plots can be created with either I-PLOT or Standard MicroStation plotting. Resources provided in the V8 Standards for both methods are described in this chapter. I-PLOT is commonly used at SHA, but most consultants do not use it. In order to provide a Standard for baseline plotting, plot drivers were created for standard MicroStation plotting, including both mono and full-color plans.

This chapter has five sections, as listed below:

- [Plotting Standards](#) formalizes the plotting weights and line styles that should be used when producing SHA plans from CAD files.
- [Using I-Plot](#) details proper use of I-Plot, including: using pen tables, how to work with I-plot organizer, modify plot layouts, set Display parameters, attach IPARM files, and submit a plot job.
- [Standard MicroStation Plotting](#) covers pen tables, identifying the plotting area, verifying the plotter, setting the scale, and more.
- [Using the I-Plot Monochrome Raster Offline Driver](#) details how to use SHA's in-house driver to generate full-size black-and-white TIF images that look just like plan sheets.
- [Generating Images](#) describes some methods for generating image files from MicroStation.

Plotting Standards

SHA is attempting for the first time to standardize plotting characteristics for contract documents. These parameters include the plotted line thickness (in inches) for standard MicroStation weights 0-15, and the stroke lengths (in inches) for standard MicroStation line styles 1-7. The goal is to establish a baseline by which any plots can be duplicated using any plotting method. The standard plot drivers and IPLOT pen tables included in the Workspace should serve as a basis for achieving this result.

Large-format Plotters: A roll-feed machine (typically 36-inch rolls) for the production of larger drawings could be inkjet or thermal. These print a standard-size 34 x 22-inch sheet from MicroStation for all construction documents and plans. Other sizes are used for large wall-display boards.

	IPLOT pen table	MicroStation plot driver
B/W	FullMono.pen	FullMono.plt
Color	FullColor.pen	FullColor.plt

Standard-format LaserJet and Inkjet Printers: Half-size plans are often required (17 x 11-inch, tabloid). This is also used in the production of plats, smaller drawings, and related documents.

	IPLOT pen table	MicroStation plot driver
B/W	HalfMono.pen	HalfMono.plt
Color	HalfColor.pen	HalfColor.plt

Line Widths

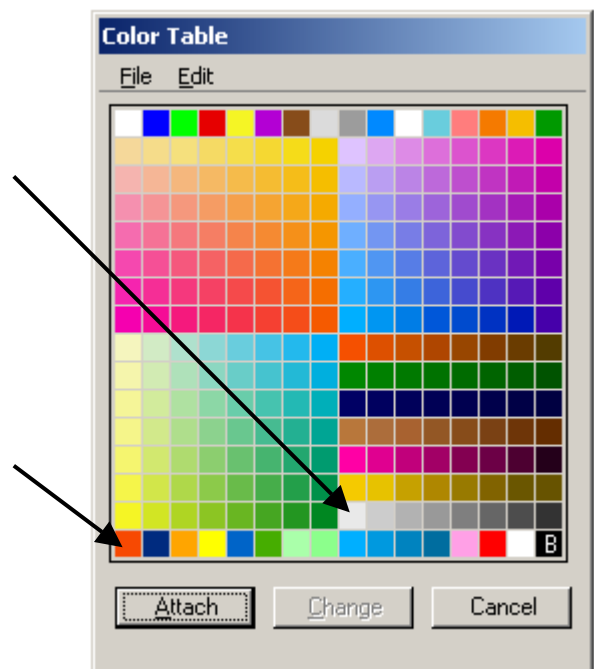
Aside from the new level names, one of the biggest differences in SHA's new V8 CAD Standards is the establishment of plotted line thicknesses. In the past, the line thicknesses that appeared on plots were often at the mercy of the plotter. SHA has attempted to correct this by hard coding the plotted line thicknesses into the new MicroStation plot drivers and IPLOT pen tables. Line weights 0-12 have been re-defined to correspond with the thicknesses of traditional drafting pens, as follows:

MicroStation Weight	Full Size Thickness (mm)	Koh-i-nor Pen Size	Half Size Thickness (mm)
wt = 0	0.18	0000	0.09
wt = 1	0.25	000	0.125
wt = 2	0.30	00	0.15
wt = 3	0.35	0	0.175
wt = 4	0.50	1	0.25
wt = 5	0.60	2	0.30
wt = 6	0.70	2.5	0.35
wt = 7	0.80	3	0.40
wt = 8	1.00	3.5	0.50
wt = 9	1.20	4	0.60
wt = 10	1.40	5	0.70
wt = 11	1.70	6	0.85
wt = 12	2.50	8	1.25
wt = 13	3.80	10	1.90
wt = 14	5.00	12	2.50
wt = 15	6.35	14	3.175

Color Table

The standard color table for all SHA design projects is **ClorMdSha.tbl**. This color table defines the RGB values for the MicroStation colors 0-255. The monochromatic (black & white) pen tables have been set up for use with this table such that all colors plot as black, with the exception of those color values defined below.

Gray Scale	232	Gray 10%
	233	Gray 20%
	234	Gray 30% - Shading
	235	Gray 40%
	236	Gray 50% - Linework
	237	Gray 60%
	238	Gray 70%
	239	Gray 80%
True Color	240	SHA Logo Orange
	241	SHA Logo Blue
	242	Orange
	243	Yellow
	244	Blue
	246	Green Shading
	247	Green Lines
	252	Red Shading
	253	Red Lines
	254	White to block items out

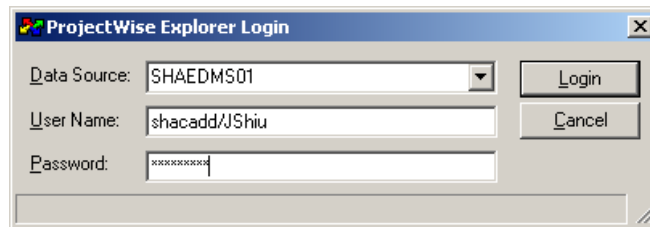


Using IPLOT

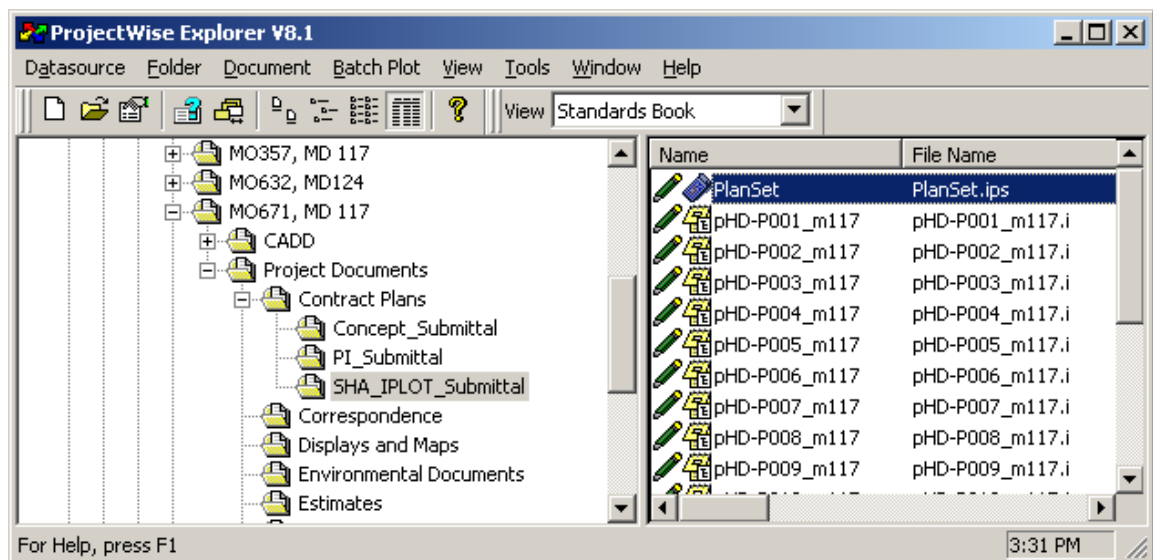
Creating Plots using IPLOT Organizer

This section explains how to take advantage of IPLOT Organizer to batch plot selected IPLOT metafiles (.i) without going through MicroStation. It will maintain the consistent look and feel for the plots regardless of where you are once you are in ProjectWise.

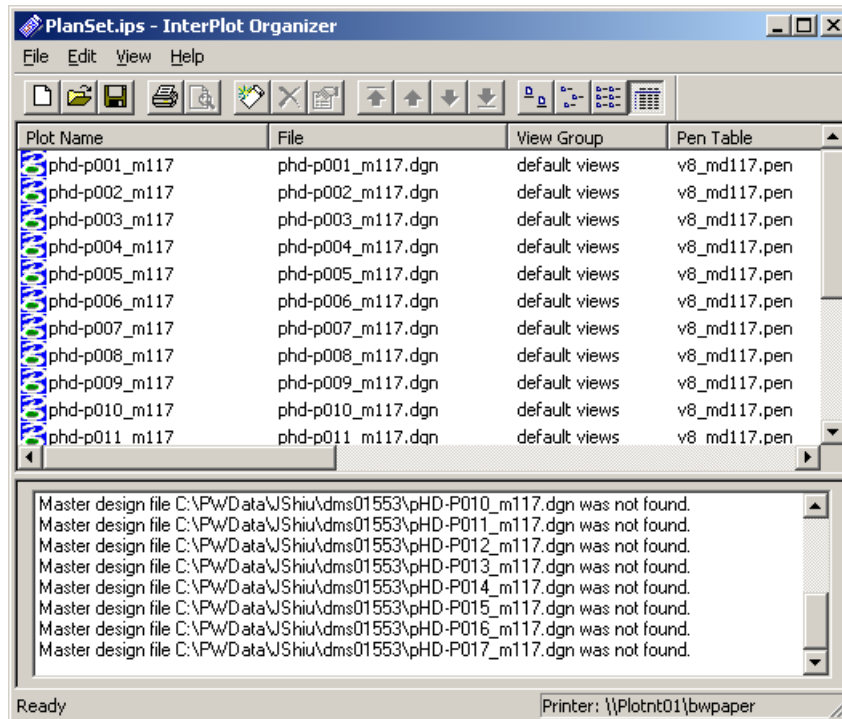
1. Login to ProjectWise with you login and Password as shown below: (Replace with your login name and password)



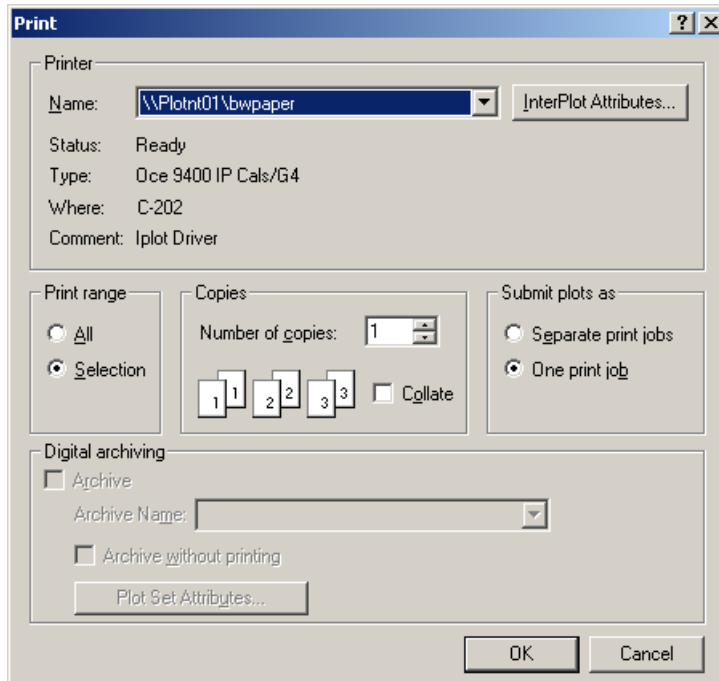
2. Navigate to **Project Documents > Contract Plans > SHA_IPLOT_Submittal**.



3. Open **PlotSet**, which is **IPLOT Organizer** data file (.ips), to view the IPLOT metafiles created and stored within this set shown below:

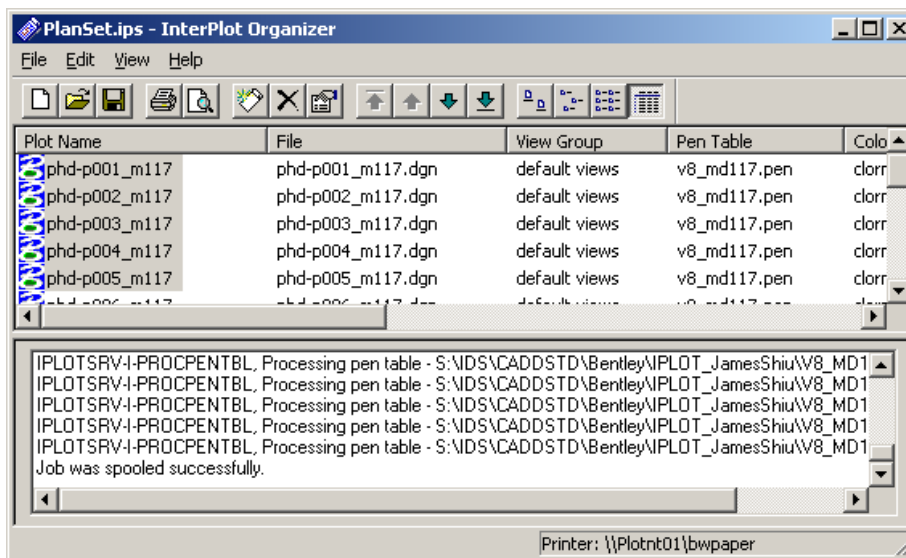


4. It is **OK** to see the messages “....dgn file was not found” because the master files may not be **COPIED OUT**.
5. Navigate ProjectWise folder structure to the folder, which contains the master design files. For example, the folder for this plot is “**Roadway Design**”.
6. Select the **MASTER** Files using <**Control**> or <**Shift**> while selecting the files.
7. Right click and choose “**Copy Out**”
8. To verify the result, right-click an **IPLLOT** metafile (.i) and choose **Preview**.
9. To plot the **IPLLOT** metafiles, right-click the file and choose **Plot...**
10. The **Print** dialog box opens:



11. Confirm the **Printer Name** and click **OK** to continue

12. The plot files will be sent with message shown as follows:



NOTE: If the line style or fonts are not correct, right-click the IPlot metafile (.i) and select **Properties** dialog box to verify the Workspace Name. The **Workspace**, **color table**, and **pen table** can be automatically set with IPlot.

Standard MicroStation Plotting

There are three steps to generating prints or plots of your drawings using MicroStation's standard plotting capabilities:

- Identify the portion of the design file to be plotted.
- Select the appropriate plotting device.
- Transmit the drawing to the plotter.

Identify Plotting Area:

The area you wish to plot can be identified by one of two methods: **Plot by View**, or **Plot by Fence**, the most common. Follow these steps to identify your plot area:

1. **Place a fence, or arrange within a view**, the portion of the drawing you wish to plot. If you need to plot to a scale, you must place a fence around the sheet border.
2. **Start the plot process** by keying in PLOT or PRINT in the key-in window. Alternatively, you may press the accelerator key CTRL, + the P key. Alternatively, you may select the **Print/Plot** command from the **File** pull-down menu.
3. **Examine the status line on the Plot dialog box** to ensure that "**Fence (View n)**" displays if you intend to plot contents within a fence you'd placed earlier. Otherwise, it will display "**View n**".

Plot Drivers

Plot drivers determine how the MicroStation elements are translated to the printer, including exact colors and the thickness of various line weights. After identifying the plotting area, you need to select a plotter driver. The following drivers are delivered in the V8 Standards for various uses.

FullMono.PLT – For plan sheet production. This will plot all colors, regardless of how they are displayed, as black, except for the following:

Color #	Plotted Color	Color #	Plotted Color
232	Dark Gray	241	SHA logo blue
233	Gray	242	Orange
234	Gray	243	Yellow
235	Gray	244	Blue
236	Medium Gray	246	Light Green
237	Gray	247	Green
238	Gray	252	Light Red
239	Light Gray	253	Red
240	SHA logo orange	254	White

HalfMono.PLT – Identical to FullMono.PLT. However, line weights are scaled for 11 x 17-inch prints.

FullColor.PLT – For full-sized sheets. Colors print as they appear on screen.

HalfColor.PLT – Identical to FullColor.PLT. However, line weights are scaled for 11 x 17-inch prints.

The active driver name displays in the **Plot** dialog box, next to the icons. You will normally use “**printer.plt**” for your plots. This driver maps to the Windows system printer driver. If you want to change the plotter driver so that you do not have to use the Windows system printer, follow these steps:

1. Click the **Plotter Driver** button, the icon farthest to the right.
2. From the **Select Plotter Driver File** dialog box, select the appropriate plotter driver. By doing that, you are indirectly selecting the size of the plot you are going to generate.

Specify Plot Size:

With the correct plotter selected, the next step is to verify the size of the plot. This is done via the **Page Setup** icon on the plot dialog box. The Page Size field allows you to select your plot output size.

Set Scale Factor:

You can set the scale factor in two different ways:

1. Key in the master units to plotter units directly.
2. Key in the size as a percentage of normal, and let MicroStation calculate the scale.

Keep in mind that **this is the ratio of design file master units to plotting units**. This means that if you are plotting a drawing created using feet, and the scale is 4 feet per inch, this results in a final ration of 48:1 (48 inches, the drawing submit, to 1 inch of paper).

The scale factor and the four fields in the **Margins** section of the **Plot Layout** dialog box are interlinked. When you change one, the other values are automatically updated to reflect the change.

Maximize Plot (Optional):

Sometimes you may want to plot the contents of a fence or a view at the maximum size of the plotter’s chosen paper size. You can achieve that by enabling the **Maximize** check box. This results in the chosen drawing area being plotted to the extents of the plotter’s page size. This is also the default condition, when you first enter the Plot dialog box.

Center Plot (Optional):

The **Center to Page** check box shifts the entire plotted area to the center of the chosen page size. In many cases, the plot area you have selected doesn't use the same height-to-width ratio as the page size. Using the **Center to Page** option makes the final plot look more like a finished drawing and may eliminate the need to trim the paper plot after the fact.

Rotate 90:

The **Rotate 90 Degrees** option on the **Page Setup** dialog box is similar to a portrait/landscape option on printer drivers. Many times your design will fit more economically on a sheet of paper if you rotate it 90 degrees.

Plot Options:

The **Plot Options** icon brings up a list of additional options for plotting your drawing. Some of the options could be dimmed, because they are displayed just for information. If you want to modify any, you will need to do it in the **View Attribute** dialog box in the **Settings** menu.

Preview Your Drawing Plot:

Before actually generating your plot, you have the option to preview its appearance right in the Plot window. This is done via the Preview Refresh icon. This is very helpful for seeing the effect of line weight definitions within the plot driver file and other key data.

Transmit Drawing to Plotter:

Follow the next two steps to create the plot:

1. Click on the Plot icon, which launches the plot if "printer.plt" was your driver.
2. If a driver other than "printer.plt" is selected, you are prompted for the filename into which the plot data will be placed. The default extension of this file is .000. MicroStation will then create a plot instruction data file for processing by the plotter later.

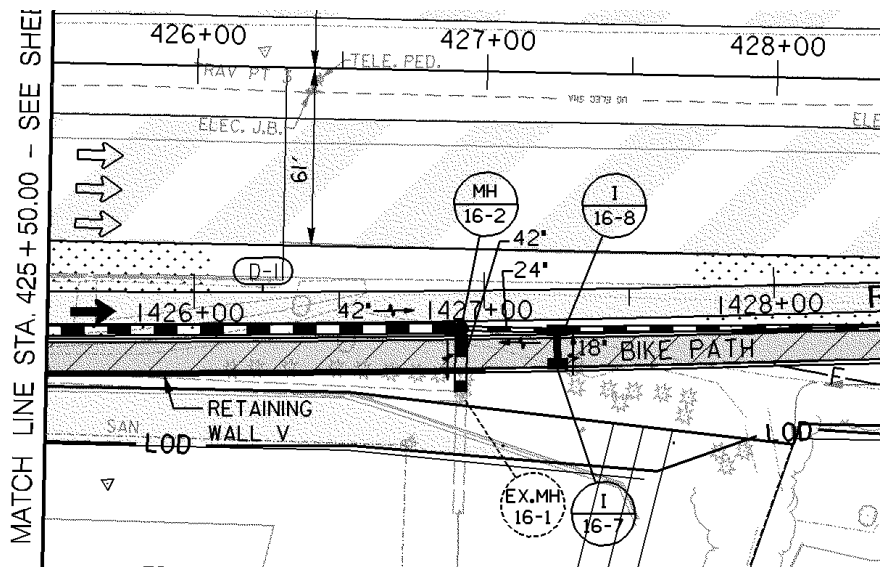
The most common method for transferring plot data to the plotter is to use MicroStation's PlotFile batch program. From the DOS prompt, key in PLOTFILE *filename* and hit Enter. **While transmitting the plot file to the plotter, the computer will not be available for other work.**

Using the HD BW Image Printer (I-Plot Monochrome Raster Offline Driver)

The HD BW Image Printer creates a TIF file, and is the preferred solution to generate full-size black-and-white images that look just like plan sheets. The process is identical to plotting, except the printer is selected as the **HD BW IMAGE** on **HDDPLOTPC**. If you were to plot the images that the driver generates by using any standard image editing program on the same size paper it will very closely match the prints that were generated, including pen tables and any effects applied through I-PLOT or a MicroStation .PLT file.

You can actually print from any windows software to **HD BW Image**, such as Excel, Word, or PowerPoint.

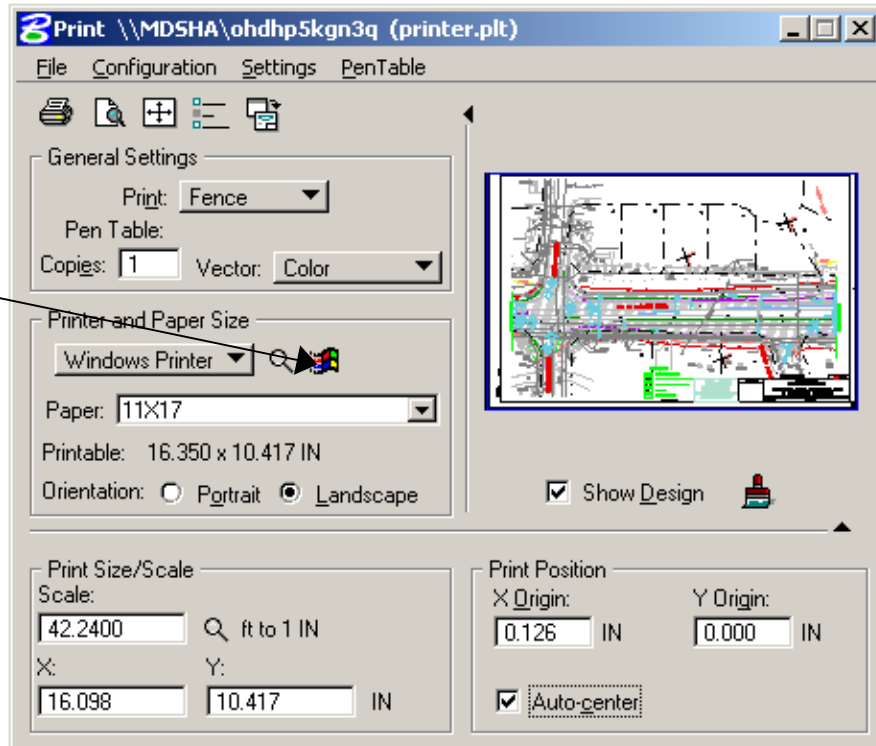
The resolution is high enough for full-size plots with clear text and symbols, and the file size is small enough to run the files through an Internet Web viewer or put hundreds of plan sheet images on a single compact disc. The small file size for such a high resolution is accomplished because the driver generates a Monochrome (Black and White only) image. However, it goes further than strictly turning all colors into solid black. The driver transforms shades of gray or colors into finely speckled black. From a distance, the speckles appear gray.



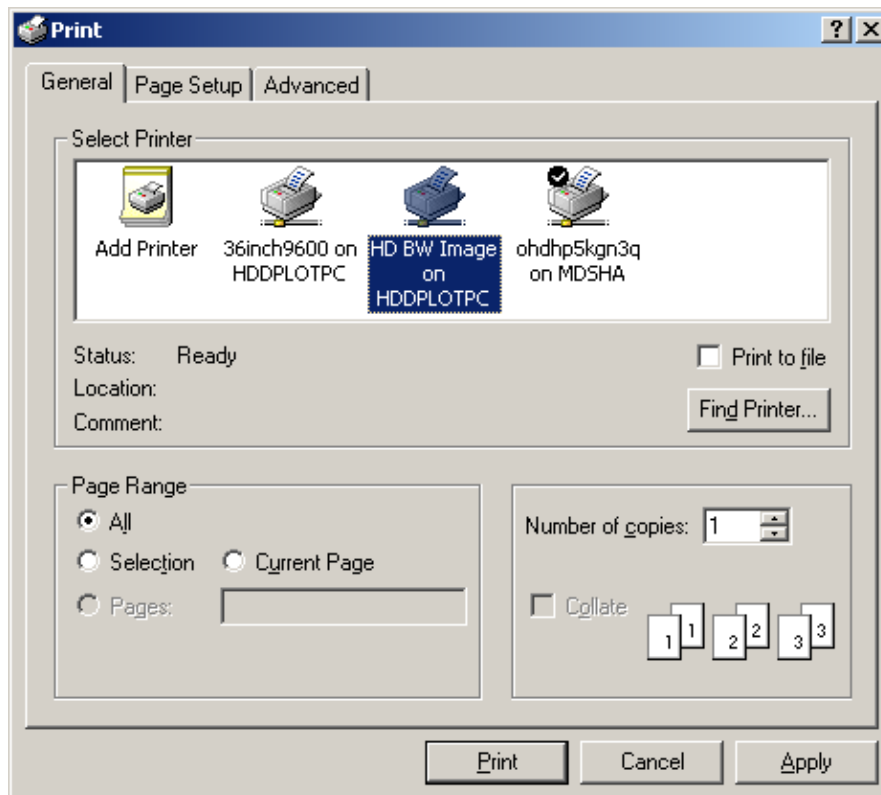
A printed plot document using an HD BW Image Printer

The process is identical to plotting, except the printer is selected as the **HD BW IMAGE** on **HDDPLOTPC**.

When using MicroStation's standard **File > Print** command, select the following:

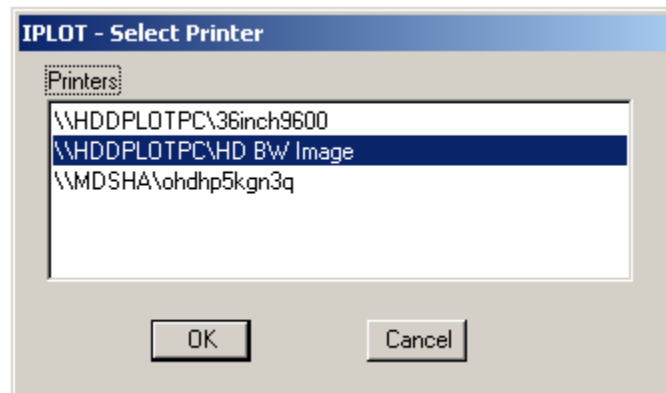
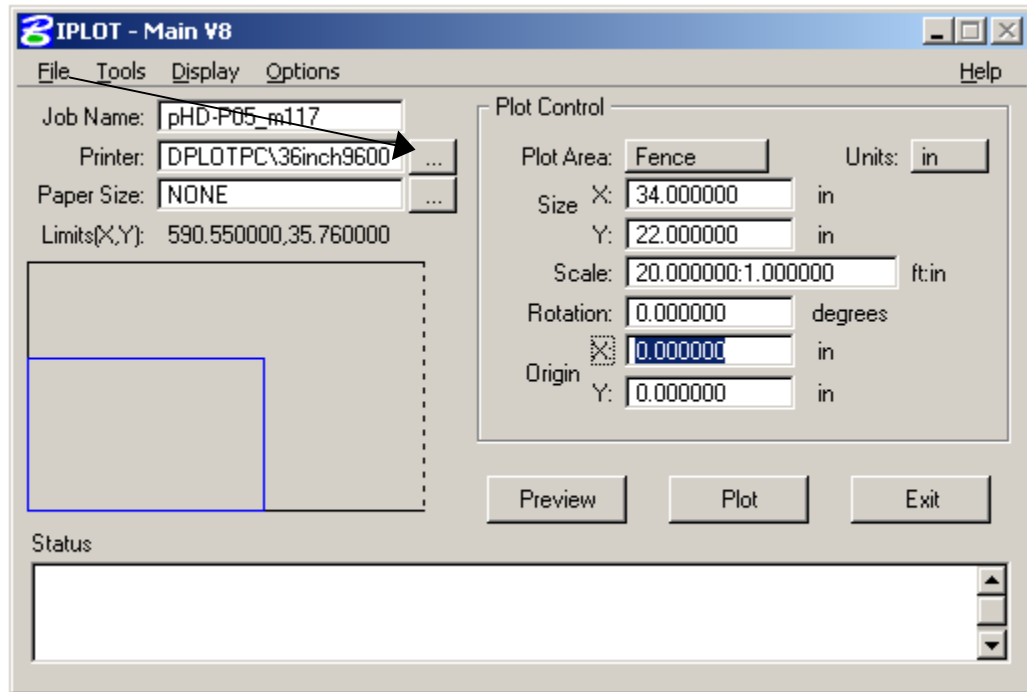


Printing a fence using a Windows printer



Selecting the appropriate printer

When using MicroStation's add-on **I-PLOT** printing software, select the following:



You can also use the **InterPlot Organizer** to print out an entire job. In any case, the images will be created in the folder called **HD BW Image**.

IMPORTANT: Once the files are generated at this location, they should be copied to the appropriate project directory. **ONCE A WEEK, THE FILES IN THIS FOLDER WILL BE AUTOMATICALLY DELETED WITH NO PRIOR NOTICE.**

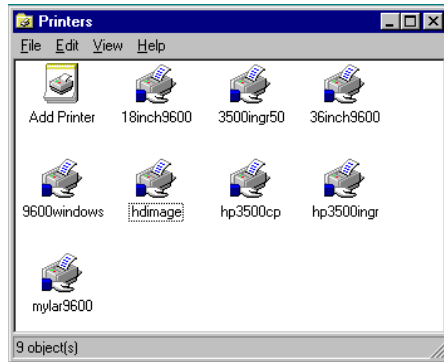
In addition to the folder where images are printed out, the Administrator implements several important settings on the plot server, outlined in **Appendix A**, pages 5-13 to 5-17.

Admin Settings for I-Plot Monochrome Raster Offline Driver

HD BW Image is the I-Plot Monochrome Raster Offline Driver printer. While numerous settings exist, here we explain:

- Setting a File-Naming Pattern
- Creating a custom-size plan sheet

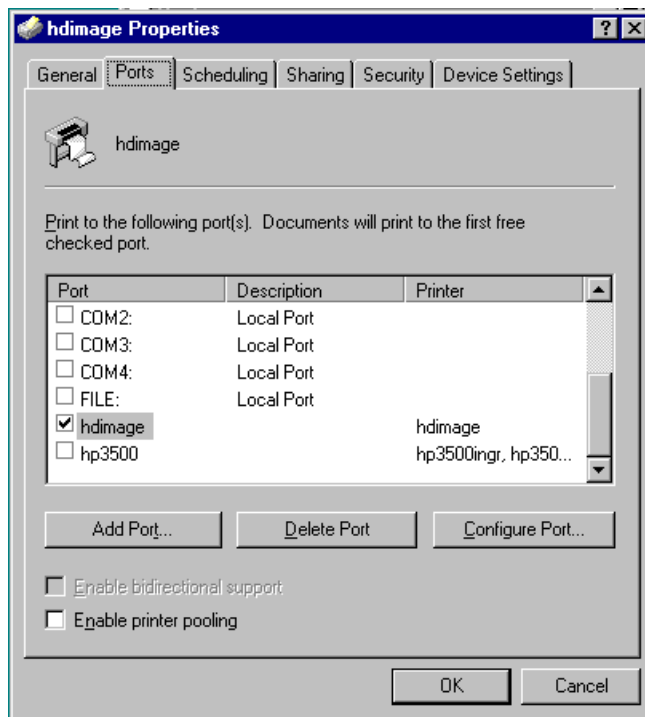
All the settings are accessed through the **Control Panel>Printers**.



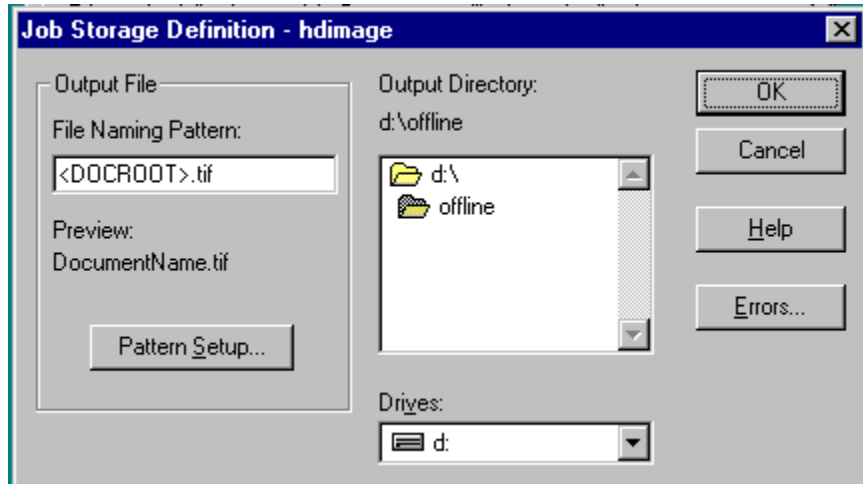
Right-click on the correct Printer, and select **Properties**.

Setting a File-Naming Pattern

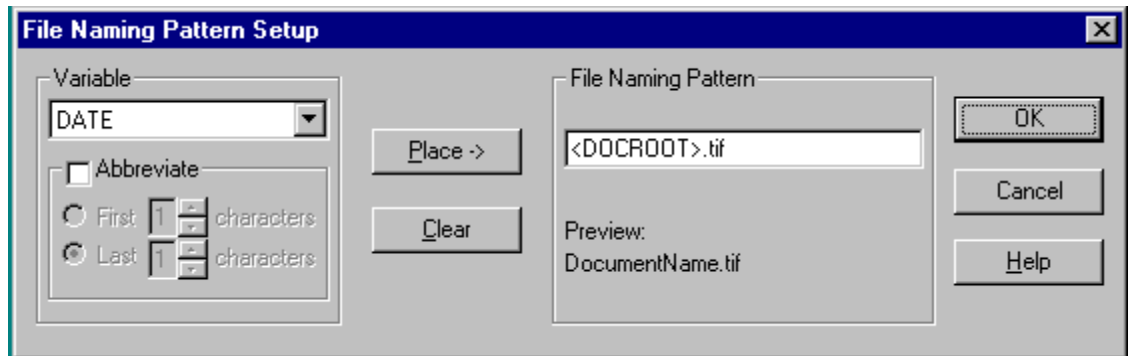
Make sure you are on the **Ports** tab, as shown below.



Highlight **HDImage** and select **Configure Port**.



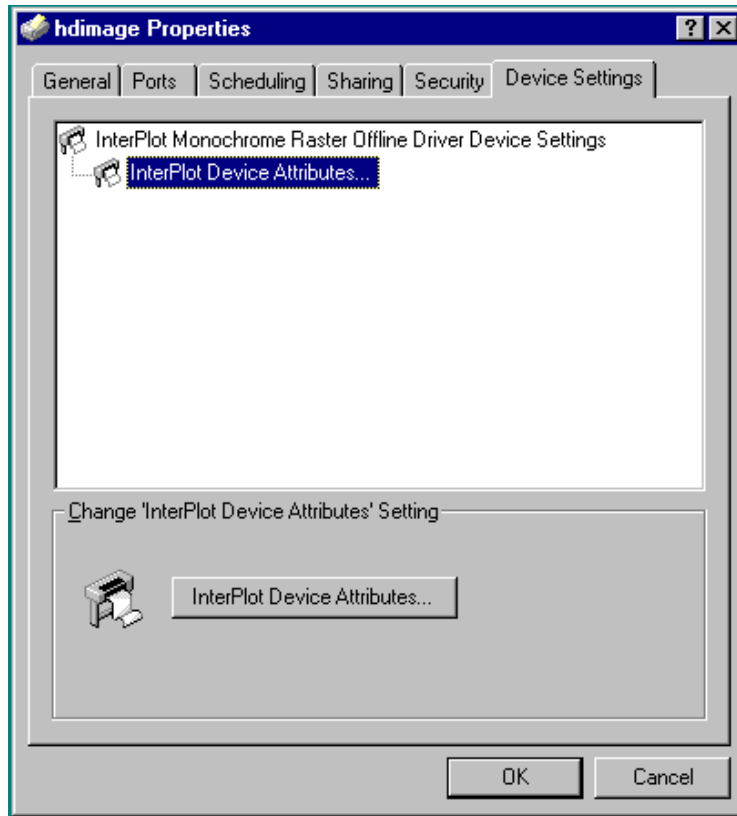
The menu above shows the current directory where TIFs will be stored as well as the Naming Pattern for files that are generated through the printer, which is to use the DOCROOT, or filename without extension, and add the .tif extension at the end. Select **Pattern Setup** to change these settings.



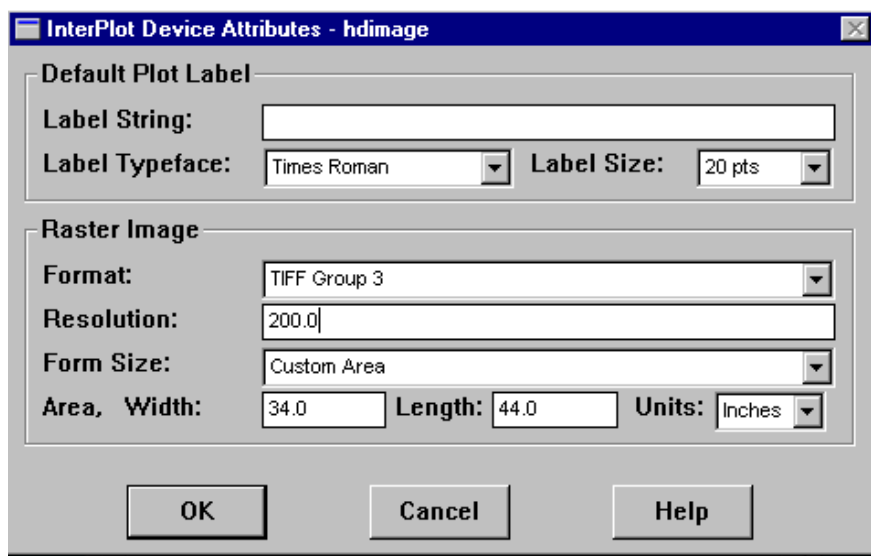
You can use any combination of variable names to create your pattern. Use the **Help** tab for explanations of the variables. You may also type characters; in the case below, the .TIF was added so that the file automatically receives the correct file extension.

Setting a Custom Page Size

Make sure you are on the **Device Settings** tab of the printer **Properties** window as shown below.



Select **InterPlot Device Attributes**, and you can set up a custom size using the menu below.



Generating Images from MicroStation Files

Typically, drawings are printed and reviewed, and often users need to create an electronic image of the drawing. This provides the ability to share the information, saves money on paper and ink, and allows for a faster distribution with no delivery charges.

Depending on the purpose, you may want to generate the entire project, a drawing sheet, or a close-up view to focus on an issue. Some applications include:

- Creating an archive of construction documents that can be printed from any image software
- E-mailing sheets or views for fast review and action
- Inserting pictures of drawings into other documents (Word, PowerPoint, CorelDraw, PhotoShop, and so on)
- Renderings/Displays

Three ways to generate images from CAD files will be discussed.

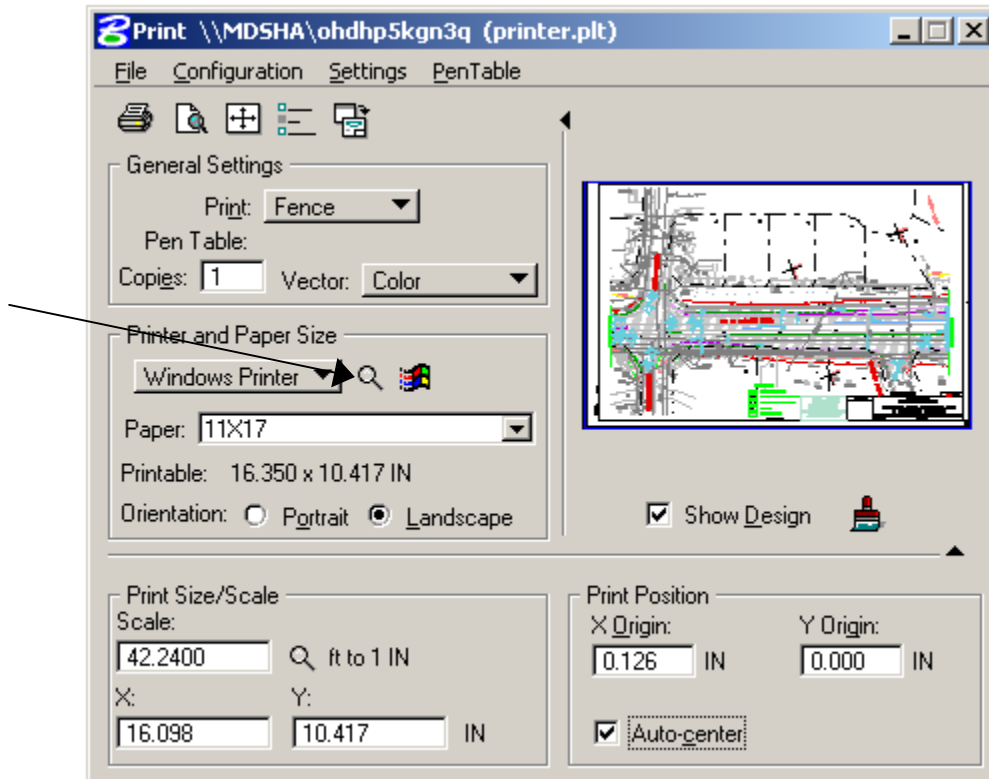
- Using the HD BW Image Printer (I-Plot Monochrome Raster Offline Driver)
- Using a customized Image Plot Driver (PLT)
- Using **Utilities>Image>Save**

Using a Customized Image Plot Driver (PLT)

Through MicroStation's Standard Print dialog box, the user selects a .PLT file. Most consider .PLT files as a way to select the printer, but you can also select drivers that produce images. The TIFF.PLT that was delivered with MicroStation was customized in three forms, all of which plot in landscape view and in full color.

These generate plots that appear with similar line thickness and appearance as a normal plot, including white background.

When using MicroStation's standard **File>Print**, select the following:



Depending on the application, select one of the following:

TIFF_22by34INCH.PLT – Produces high-resolution images that contain 200 dpi when printed at 22 by 34 inches. File size is **high** – around 2250 KB.

TIFF_11by17INCH.PLT – Produces high-resolution images that contain 200 dpi when printed at 11 x 17 inches. File size is **moderate** – around 800 KB.

TIFF_PPT.PLT – Produces images that are 1024 x 768 pixels in size, which is appropriate for PowerPoint presentations, inserting smaller images in documents, or e-mails. File size is **low** – around 140 KB.

Using Utilities>Image>Save

This is useful primarily in 3D renderings as the various rendering shadings (e.g., ray trace) are available. It has been applied to 2D drawings using wireframe shading to generate plotlike images.

The results will be WYSIWYG, except that you can generate an image of as high a resolution as you desire.



A saved, full-color product using Utilities>Image>Save

What's Next?

The remaining sections of the manual are appendices providing various information. Appendix A contains a glossary of terms and abbreviations for help deciphering what you have just read.

Notes

Appendix A

Glossary

This glossary was developed to ensure that terms were consistent in this manual and with SHA practices, recognizing that meanings may differ when used outside the context of these Standards.

Term or Abbreviation	Definition
Attribute	Property, such as color or style, of an element or entity
Addendum	Making a change to a construction project. See Redlining.
AutoCAD	Computer-aided design software that runs on personal computers
Barmenu	In V8, “Barmenu” itself is a freely available and customized MicroStation Development Language application. The executable file extension is *.ma. They set symbology and initiate standard commands for drawing elements, also known as features. The features are arranged in a logical hierarchy on the Barmenu. Different File Disciplines and Purposes will have their own Barmenus, and each Barmenu should contain only those features belonging in a specific file.
Base lines	Borders. This term was used in the hand-drafting days.
CAD	Computer Aided Design and Drafting
CADD	See CAD, the more commonly used abbreviation
Category Code Number	A cell description convention consisting of two numbers enclosed in parentheses, which permits programmers to create and write utilities which count cells and tabulate them based on more than one thousand Category Code Numbers.
CEC	Consulting Engineers Council
Cell	A complex element composed of a group of primitive or other complex elements that is stored in a cell library for repeated placement.
Cell Library	A file used to store cells. To access cells in a cell library, the library must be attached to the active DGN file, except if the Cell Selector dialog box is used.
Check-In	Process of restoring a checked-out file to the server

Term or Abbreviation	Definition
Check-Out	Process of copying a file from the server for exclusive editing rights
Clip	To divide an area, elements, or portions of elements in a design for manipulation or display
Clip/Clipping Boundary	A boundary (established with a fence or from a named view) that separates the part of a reference that is displayed from the part that is hidden.
Clip Mask	Used with the Raster Manager or Reference tools, a clip mask allows you to clip out a portion of the image. Masking can be used, for example, to clear an area for text display.
CSV File	Comma-separated values file: The CSV file format is an interchange format for tabular data, such as the contents of a flat file database or a table in a relational database. In this text file format, the first line contains the database field (column) names separated by commas. Each successive line corresponds to a database record (row). On each such line, commas separate the subject record's field values.
Design Rules	Component interactions that provide flags for the designer when a design does not meet SHA design criteria.
Detail	A file type used to sketch identifying construction or design details
Dimension Styles (Attributes)	Three new ones have been created: Civil, Structural, and COGO, the coordinate geometry programming language. These are the settings for all components of dimension elements, including text (color, weight, font, height, and width), lines (color, style, weight, and alternates), and level.
Discipline-specific Seed File	A template used to create CAD drawings. It's a blank design file with appropriate SHA-specific working units and other settings to create custom files for each Division's use.
Display	Final product of CAD files intended for plotting, including any plan, profile, and cross section sheets, schedules, wall displays, and other files.
Drawing Scale	Drawing scale helps to maintain consistency of scale-dependent drawing features, regardless of the scale used, including text, line styles, and cells.
DTM	Digital Terrain Model
DWG	A file extension denoting drawing files
DGN	A design file in MicroStation/J and version 7
DGNLIB	In MicroStation V8, the Design File Library
EAPD	Engineering Access Permits Division

Term or Abbreviation	Definition
EWO	Extra Work Order. It refers to changes in a construction project.
EIM	Engineering Information Management
Export	To send data from an application to another source
Feature	Single type of design information within a file type. Uniquely identifiable by its level, color, weight, and style.
Feature Owner	Office or Division that is designated as an owner of a CAD feature and defines its attributes.
Feature Stakeholder	Office or Division that should be consulted by a Feature Owner when defining its attributes.
Feature User	An engineer or designer who uses a feature when creating a drawing.
File Discipline	Broadly describes, the discipline of information appearing within a particular design file in terms of whether it is highway design, survey, drainage design, signage, or pavement marking.
File Group	Groups under which file types are categorized.
File Group	Describes the general purpose that the individual files serve as part of the larger CAD production workflow: Model, Existing, Proposed, Detail, Print, and DGN Support
File Type	A CAD file containing a specific type of information, namely, Model, Display, or Detail.
Fence	A polygonal boundary that designates multiple elements for simultaneous manipulation using fence tools.
HD File	In the V8 Standards, a Horizontal Design file, encompassing the horizontal location of the road centerline, edges, sidewalks, cut/fill, and other design elements. It replaces an HA file in V7.
HDD	Highway Design Division
HHD	Highway Hydraulics Division
IDS	Integrated Design System
IDSIM	Integrated Design System Information Manager. It maintains the list of CAD features with their unique symbology (color, level, weight, and so on). IDSIM tracks changes as they are made to the Standards, allowing for version control (version 1.0, version 2.0, etc.). IDSIM facilitates adherence to the standards by allowing CAD Managers to design, modify, and generate *.MDF files that drive the Barmenu.
IDS Tool Box	A group of MicroStation add-ons. It is not a single item, but a collection of SHA-specific programs.
IFB	Invitation For Bid

Term or Abbreviation	Definition
IGDS	Interactive Graphics Design System, the software that ran on Intergraph VAX-based CAD systems
InRoads and GEOPAK	Civil engineering add-on programs used with MicroStation
I-PLOT	A MicroStation add-on that allows for greater usability in plotting
InterPlot	Bentley's digital plotting management program
InterPlot Organizer	MicroStation plot organizer that allows you to print out an entire job.
I-PLOT Plus	An improved version of I-PLOT that automatically calculates the other value to maintain the aspect ratio of the plot.
IPARM	A file containing plot parameters and other data. An IPARM file must be created before executing a plot.
Key-in/key in	An instruction entered into the Key-in window to control MicroStation. Most key-ins have graphical user interface (GUI) control equivalents. To "key in" means to enter this information manually.
Levels	Named slots for information in a file. MicroStation V8 allows the user to create an unlimited number of levels. Their display can toggle on or off, allowing users to have lots of information saved in one file, even if the material does not need to be used or viewed at the same time.
Level Filters	Level filters limit the number of levels that appear in a level list. They also turn groups of levels on and off when needed.
Line Style	A part of the symbology of an element, for example, whether a line is solid, continuous dashes, dots and dashes, and so on. Each element can have its own line style or each can be defined by separate symbology. You can create custom line styles.
Metafile	A file that creates or defines other files. It's commonly used when creating directories.
MDL	MicroStation Development Language. The extension of the executable file is .MA.
.MDF	File extension for a MicroStation Database File
MDSHA/SHA	Maryland State Highway Administration/State Highway Administration
MicroStation V8	Version 8 of the MicroStation CAD software
MicroStation J	Version 7 of the MicroStation CAD software
Model Files	Coordinately accurate drawings, usually in 3D format
Non-DGN Support	Files critical to CAD design, but are not themselves CAD files
OBD	Office of Bridge Development

Term or Abbreviation	Definition
OED	Office of Environmental Design
OOC	Office of Construction
OMT	Office of Materials and Technology
OFIT	Office of Finance and Information Technology
OHD	Office of Highway Development
OOTS	Office of Traffic and Safety
OPPE	Office of Planning and Preliminary Engineering
ORE	Office of Real Estate
PPD	Project Planning Division
Plan Sheets	Same as Detail Sheets. They show all the design work for a project.
Plotter	An instrument that graphs the final output of a MicroStation drawing
PLT/.PLT	A customized image plot driver/a plot file extension
Plotting	<i>Plotting</i> refers to using a printer or large-format plotter to print hard copy on paper from CAD drawings.
PlotFile	A MicroStation batch program that transfers plot data to the plotter
Print Files	Files where all text, such as tables and construction schedules, should be placed that cannot be directly referenced from a Model file.
ProjectWise	An EIM system that manages file version control and tracking
PSD	Plats and Surveys Division
Redlining	The process of making changes to a construction site, which involves a great deal of coordination and paperwork
Reference File	A design file attached to an active design file. Elements in a reference file cannot be manipulated.
Seat	Refers to software license
Settings Manager	A settings file is an import or export file that stores all settings for a particular conversion as they were when the settings file was created or last saved. Also, a type of module data (".stg" files) that specifies active settings and drawing tool selections; used with the Select Settings window. The Settings Manager oversees all this.
Sheet file	A large design file printed in hard copy, similar to architectural plans
State	The last known or current status of an application or process
Storage Area	A designated directory for storing files
Sub-feature	When two different types of design information share the same level, color, weight, and style, but differ by some other parameters (e.g., text size or cell name)

Term or Abbreviation	Definition
Symbology	Refers to level, color, style, and weight of a drawing object
TEDD	Traffic Engineering and Design Division
Text Styles	New to V8, text styles are used to apply standard text attributes to newly created text. The active Text Style applies to placed text, annotations, tags, and other element types that use text.
.TIF or .TIFF	Tagged Image File Format
Tool Frames	A tool box that has smaller tool boxes
Topo Files	Topology. Files containing maps and surveying information
Vault	File storage spaces for engineering documents
Wireframe	A display mode in which surfaces are displayed as their outlines, and elements behind surfaces are displayed as though the surfaces did not exist.
Work Area	Workspaces with the same measurements in a file
Work files	Nonstandard files used for engineering, calculations, and measurements by the designer. They are scrap paper and a backup of the person's work
Workflow	A defined sequence of procedures
Workmode	An operating mode of MicroStation, such as DGN, DWG, and V7 workmodes
Workspace	A custom MicroStation environment or configuration
Workspace Preferences Menu	The menu SHA employees use to set up individual MicroStation workspace
Working Units	Real-world units that the design plane is configured to.
Working Unit Settings	The settings that designate the working units and working resolution.

Appendix B

Engineering and Design Workflow

The Maryland State Highway Administration manages all facets of the state highway network—from planning and design, to construction, operations, and maintenance.

The primary types of project documents fall under the main categories of specifications, estimates, and bid drawings. *Specifications* are a collection of bid items needed in project construction. They cover accepted construction parameters and the approved products to use, as determined by the *Category Code Book* and *Book of Standards*, common references that contractors use. *Estimates* outline the cost of the entire project, broken down by item. Engineers create *CAD drawings* to solicit bids based on proposed designs and alternates. Most importantly, they are visual representations of the projects. Traffic signs, roads, bridges, Metro stations, and other infrastructures cannot happen without them. It is crucial to establish standards and automation tools for the production of all of these documents. The myriad benefits are obvious.

SHA's planning and design offices use CAD extensively to create concept and detail drawings of proposed construction projects. Construction, operations, and maintenance offices use the products created by CAD, specifically engineering drawings, to build, operate, and maintain highways and associated structures.

The design cycle for a large project, such as building interstates or bridges, can take up to two years. This meticulous work covers surveying, calculating engineering computations, and creating CAD files. A CAD file is a MicroStation file with the .DGN extension, or it can be an AutoCAD file with the extension .DXF. SHA only uses MicroStation.

Large projects can have eight to twelve such teams working on them. A team in any given discipline is usually three people: a supervisory engineer and two supporting engineers, each with varying years of experience. The Traffic Division alone handles 400 signal design projects every year. Single-person teams handle small projects like traffic lights. These might take up to four weeks to complete. The administrative support staff provides all teams with assistance as needed in preparing contracts and bids, maintaining meeting calendars, making telephone calls, and more.

Entry-level engineers are expected to have a civil-engineering background and the ability to read technical drawings, and perform the required computations to determine alignments, soil and concrete strength-based member sizes, cross sections, cut/fill areas—anything that the specific project requires. As time progresses,

engineers and all other employees should develop a working knowledge of the finances involved, zoning restrictions, and state, county, and municipal budgets. In addition, they should be able to describe basic procedures.

Designing a highway requires input from several disciplines. For example, highway planners explore various alternatives within the context of constraints imposed by a specific project and its environments. Highway design engineers develop horizontal and vertical alignments for highway centerlines to ensure they meet regulatory and safety guidelines. Hydraulic engineers design storm drain systems to ensure that highways do not flood during rainstorms. Bridge engineers design bridges across streets and waterways to bypass obstructions and create interchanges. Traffic engineers design traffic signs, streetlights, and pavement markings. Surveyors take measurements of existing terrain to help engineers conduct design studies. Geotechnical experts test soils and construction materials to ensure they meet design requirements and specifications.

Considering the diversity of expertise needed in the creation of engineering design drawings, many specialized workgroups collaborate daily. To provide a sense of the effort required for the design of complex projects, here is an example. A large highway design project can take up to two years in the design phase, with involvement from nearly thirty engineers working full time. The Woodrow Wilson Bridge project will take ten years to complete. The number of design drawings for a complex project can reach a thousand.

Clearly, people from diverse disciplines must work together on highway projects. The quality of collaboration between design disciplines dictates whether a project will succeed, both in terms of the quality of coordinated drawings produced and the reduction of construction errors and omissions.

These CAD Standards were developed to facilitate collaboration among disciplines and improve the quality of CAD deliverables, namely engineering drawings.

This chapter has three major sections, as listed below.

- **Office Responsibilities** introduces you to the various offices within SHA and their roles and responsibilities.
- **Engineering Workflow across SHA Offices** explains the CAD workflow and which types of drawings are typically created by which disciplines. It explains the collaboration software that SHA adopted to facilitate inter-Departmental interaction.
- **Collaboration Tools** describes the benefits that can accrue from using these Standards: the development of easy-to-use productivity-enhancing tools. This section identifies the basis for using CAD and the software used in engineering design.

Office Responsibilities

A working knowledge of the interrelationship of SHA Divisions, Offices and their specific functions offers a broader awareness of the Administration's mission and public service while promoting a greater level of teamwork. Here is an overview of the responsibilities of each SHA Office:

- **The Office of Planning and Preliminary Engineering (OPPE)** prepares maps. OPPE coordinates statewide transportation planning with federal, state, and local agencies, and conducts preliminary engineering and alternate analyses for budget planning purposes.
- **The Office of Highway Development (OHD)** designs highway and support structures like drainage systems along the selected alternative to meet design guidelines. They conduct surveys to provide detailed topographic maps for design. With six Divisions—Highway Design, Highway Hydraulics, Design Technical Services, Communication Design, Plats and Surveys, and Engineering Access Permits, OHD oversees projects from the program stage until they are advertised for construction.
- **The Office of Bridge Development (OBD)** designs bridges and other structures such as retaining walls and noisewalls, ensuring quality and safety while employing the latest technologies.
- **The Office of Environmental Design (OED)** deals with highway-related environmental concerns, including sound barriers, retaining walls, landscapes, forests, wetland mitigation, byways, rest areas, and more.
- **District Offices** perform design, construction, safety, and maintenance for highways falling under their jurisdictions.
- **The Office of Maintenance (OOM)** is charged with the upkeep of state streets and highways.
- **The Office of Materials and Technology (OMT)** tests materials for the planning, design, construction, and maintenance offices, focusing on safety and durability. Contractors might use hot-mix asphalt, concrete, metals, structural coatings, and the like to build highways and structures.
- **The Office of Traffic and Safety (OOTS)** designs lights, traffic signals, street signs, and traffic control devices and promotes highway safety.
- **The Office of Construction (OOC)** deploys inspectors to investigate and rate contractor effectiveness, ensuring project quality and safety.
- **The Office of Real Estate (ORE)** deals with legal issues related to right-of-way acquisitions and property plats.

- **The Office of CHART and ITS Development** deploys and monitors intelligent transportation systems (ITS), such as cameras and sensors, to promote intelligent traffic adjustments to maximize infrastructure usage.

Engineering Workflow across SHA Offices

Each Division developed its own discipline-specific workflows that contain specialized processes that occur solely within its section. This workflow must be adhered to in conjunction with these CAD Standards.

Some Divisions have processes so specialized and separate from the rest of SHA that they have deemed in the past that the scope of their CAD design resides outside these rules. For example, OBD deals only with bridge structures, and other Divisions require only bridge outlines in their drawings, allowing OBD to stay apart from the SHA CAD Standards. While valid reasons exist for this, the IDS Team strongly encourages using this CAD Standards manual wherever possible.

Before work can be assigned to contractors for construction, it is SHA's responsibility to conduct surveys and collect any relevant data and permits.

Planning Phase: Project Planning Division, Engineering Access Permits Division, et al.

A typical SHA project must first be evaluated to check that project work is possible without disrupting existing structures, topological features, or crossing outside proper boundaries.

Field surveys and property boundary information are essential to developing a good foundation for any project. The Plats and Surveys Division (PSD) is the primary surveyor and collector of topological data at the site of proposed project work and maintains a repository of up-to-date survey data. Their primary functions include the identification of topographic features and property boundaries that can influence the design and costs of projects as well as property impacts. When all the survey data is collected, PSD produces a Digital Terrain Model (DTM) that other Divisions will use.

When a project is in the planning phase, surveys are less detailed. However, they may include aerial photography and photogrammetric maps. These are not as accurate as ground surveys, but they are less expensive. This is money well saved, since the project may not be approved for design for several years. Property maps in the planning phase are from approximate tax maps. Legally binding property maps for final designs are generated later.

The planning phase encompasses functions like the development and acquisition of engineering mapping, preliminary engineering, and acquisition of required permits to perform project work. Various construction proposals intended to solve transportation problems are studied, such as the Intercounty Connector (ICC). The impacts and benefits of such construction are evaluated, and a preferred solution is selected for the design phase.

The Project Planning Division takes on the project production activities necessary for obtaining federal and state agency approvals that allow a project to advance to the design phase. The Engineering Access Permits Division (EAPD) also assists in planning by processing permits pertaining to state highway access.

Design Phase: Highway Design Division, Office of Traffic and Safety, et al.

When a project is approved for design, it moves out of the Project Planning Division and into the hands of the Office of Highway Development. The Plats and Surveys Division provides a more detailed ground survey as necessary, including a topographic map and a DTM.

The designer's primary job at this point is to produce final construction documents for the chosen alternate. The designer generates a centerline with horizontal and vertical alignment of the corridors and intersections to be constructed, usually with InRoads or GEOPAK design software.

In designing the *corridor*—another term for a road, highway, street, avenue or related term—the designer generates a centerline with horizontal and vertical alignment with InRoads or GEOPAK design software. Horizontal alignments are commonly tangents and arcs. Vertical alignments are usually tangents and parabolas. One advantage of using InRoads or GEOPAK is that in the final construction documents, all items and quantities are staked out relative to the centerline in terms of a *station* (the distance along the alignment) and *offset* (the perpendicular distance from the alignment). The design software calculates these values, which eliminates the need for the designer to take manual measurements.

Another use of the design software is to create a typical proposed cross section and push it along the alignment at station intervals. The intersection with the existing DTM is calculated at each interval to determine the cut/fill lines. A DTM can be created that represents the proposed construction. Rendering and visualization of the model may also produce something for community presentations and alternate selection.

What is now known as a Horizontal Alignment (HA) file in the V7 Standard was renamed to a Horizontal Design (HD) file in the new V8 Standards. This avoids confusion that only the alignment data should be in the file. All of the information about the horizontal location of the road (centerline, edges, sidewalks, cut/fill, etc) is contained in the Horizontal Design (HD) file. Once the HD file is set, the Plats and Surveys Division will see that legally binding right-of-way lines are drawn up for all affected properties. Based on this information, the Office of Real Estate will negotiate with property holders.

It is crucial that all files in V8 use the new file-naming convention in Chapter 2 to facilitate the collaboration between designers of different disciplines. While the Highway Design Division creates an HD file, other related auxiliary structures that need to be shown on the same printed sheets are created by their respective Divisions-

i.e. inlets and pipes are drawn by Highway Hydraulics, signs and pavement marking are drawn by the Traffic Engineering Design Division, etc. These are all attached to the plot file as reference files.

Collaboration Tools

Over the past few years, SHA adopted several tools to manage engineering documents. Collaborative technologies of various systems make up the Engineering Information Management (EIM) System, an idea the IDS Team embraces. The addition of such tools facilitates process workflow and improved internal and external communications.

ProjectWise V8

ProjectWise is the Engineering Information Management solution SHA began deploying in Fall 2003. The ProjectWise application supports potentially disparate workflows by managing its secure file repository using check-out and check-in procedures in real-time operations. Decentralized engineering content is consolidated into a single location to ensure that all project team members have access to the correct data when they need it.

Furthermore, ProjectWise is designed to handle MicroStation DGN and AutoCAD DWG files, as well as other business file formats such as MS Office files. Refer to ProjectWise documentation for detailed instructions on using ProjectWise.

MicroStation V8

MicroStation V8 is the current version of Bentley's CAD software adopted by SHA. The upgrade from MicroStation J to MicroStation V8 marks a new milestone in CAD technologies, introducing several new features:

- File format change;
- Changes to clipping plot files for easier manipulation;
- Unlimited levels associated to a file.

Details on standardizing MicroStation CAD drawings appear in Chapters 1. SHA's V8 standards are designed to work with **MicroStation Version 08.01.02.15** or later.

Civil Engineering Applications

SHA uses two civil design software applications, **InRoads** and **GEOPAK**, on top of its CAD drawings. SHA is currently seeking to standardize on one of the two packages in order to lend focus to future development efforts.

GIS Attributes

GIS Attribute flags are necessary to create the needed GIS layers from the CAD File. These features must be accommodated. Such features include traffic signals, storm drains, and culverts.

Custom software to support workflows will make it easier to work together. Numerous custom utilities, such as Bar Menus, IDS Toolbox, gINT Blog, MCPC, and several others are delivered with the Standards. These utilities simplify adherence to Standards while promoting consistency and efficiency.

These tools automate the process of creating and drafting project plans. They ensure that the plotted final result will be consistent and legible. By developing the files consistently, we are imparting “intelligence” into the files. In other words, the various items in the file are coded consistently with a knowledge base that tells us what the items are representing. This intelligence is the foundation for further application development that relies on scanning the file for the features based on the consistent end product. Some examples are below:

- **Estimating:** Adherence to CAD Standards feature tables accommodates developing Engineering Estimates from the files, as each feature can be identified and quantified by its unique symbology.
- **Specifications/IFB Generation:** CAD Standards accommodate developing an Invitation for Bids or Specifications Book from features used in the design files. For example, if CAD features are designed consistently throughout the project plans, each is assigned a number in a central repository, and users select only what they need.
- **Design Rules:** CAD Standards accommodate Design Rules. *Design Rules* are the component interactions that provide flags for the designer when a design does not meet SHA design criteria. For example, during the placement of a signal pole, a flag appears, indicating that it is too close to the curb line and does not meet SHA criteria. Therefore, it must be placed in a new location.

What's Next?

Chapter 2 covers

Notes

Appendix C

History of CAD at SHA

The Maryland State Highway Administration (SHA) is the largest agency within the Maryland Department of Transportation. Its headquarters office in downtown Baltimore is home to the Office of Administration, Office of Finance and Program Management, Office of the Chief Engineer of Operations, and the Office of Planning and Engineering. SHA maintains several other buildings in the Baltimore area that house various parts of its Engineering and Operations sections.

Additionally, SHA operates seven District offices to serve the local needs of Western Maryland, the Frederick Metropolitan Area, the Washington Metropolitan Area, the Baltimore Metropolitan Area, the Northern and Eastern Shores, the Southern Eastern Shore, and Southern Maryland.

Considering the size of the organization and the geographic distance between Offices, the task of unifying procedures and processes was quite a challenge.

1986 – Two Independent CAD Initiatives at SHA

Drafting SHA's engineering plans for highway construction and rehabilitation projects is a significant task. Up until 1986, this job was accomplished by draftspersons using paper and pencil. Engineers developed the design through analyses and computations and worked with draftspersons to put it together on a drafting board as a construction document. As the design progressed, modifications were carefully made directly on the original paper plan with pencil and eraser.

OOTS Selects AutoCAD on PCs

The Office of Traffic and Safety (OOTS) watched the growth of PC-based CAD software. In mid-1986, OOTS decided to bring in approximately fifteen IBM PCs and four D-size pen plotters to run AutoCAD for drafting traffic-engineering plans.

OOTS selected AutoCAD running on PCs because it was cheaper than IGDS (Interactive Graphics Design System), the leading CAD solution at the time that ran on Digital VAX minicomputers.

Headquarters Selects IGDS on VAX Minicomputers

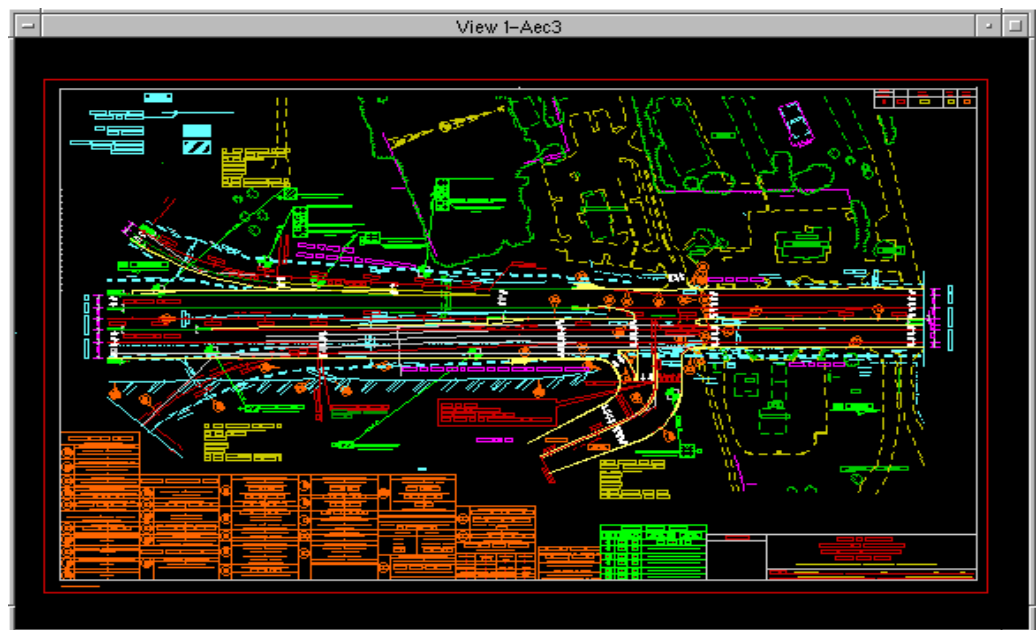
SHA's headquarters office also had been watching the CAD industry and investigating various alternatives to assist its engineering plan preparation efforts.

After much deliberation, it opted for IGDS, the solution already adopted by several DOTs. IGDS offered three-dimensional design and multiuser capabilities well suited to organizations the size of SHA.

In November 1986, the SHA headquarters office ordered two VAX 11/785 minicomputers connected to six Intergraph 32c workstations, one InterView workstation, and one high-speed electrostatic plotter.

1988 – The First 100 Percent CAD Project at SHA

In July 1988, after a couple years of running smaller pilot projects, SHA undertook its first major highway project that would be completed entirely in CAD. It was a six-month project for the reconstruction of the US 13 interchange at Salisbury, Maryland. The project plan as seen within the CAD software is shown below.



The first SHA All-CAD Project: US 13 Interchange Reconstruction at Salisbury, Maryland.

All highway design drawings for the project were drawn in IGDS software at the headquarters office. OOTS staff created all project traffic-engineering drawings in AutoCAD software.

Although IGDS and AutoCAD are both CAD software systems, they are completely incompatible. They each use different file formats, font files, symbol libraries, and customization languages. IGDS cannot work with AutoCAD files and vice versa. This incompatibility meant that one of the two systems would be phased out over time.

IGDS Proves More Functional

Intergraph, the developer of IGDS that was later named MicroStation, developed numerous civil, survey, and highway engineering design modules for its software.

The survey module, for instance, could download data from a survey gun and automatically create a topographical plan for a site. Use of the survey module represented dramatic time savings because one did not have to print data, run coordinate geometry computations, and then painstakingly draw pavement edges, curb lines, and trees.

The availability of the survey add-on design module won over the Plats and Surveys Division to IGDS. As more and more projects began to be done in CAD, the offices regularly using CAD by 1991 included Cartography, Planning, Bridge Design, Landscape Architecture, Plats and Surveys, Highway Design, Soils and Foundations.

In 1989, experienced users formed a CAD working committee. They met monthly to discuss CAD-related issues and address problems. All departments using CAD were involved. The most significant problem was compatibility between CAD files generated by the downtown office and OOTS. Because file format translations were labor-intensive and not good enough, the committee initiated a “no-translations” policy. AutoCAD users would re-create base drawings already in MicroStation.

Though in the beginning the number of AutoCAD users was more than MicroStation users, the numbers weighed in favor of MicroStation as its use at headquarters grew. By 1990, the number of MicroStation users was several times larger than AutoCAD users.

When the seven district offices needed to use CAD, senior management felt that because of the popularity of AutoCAD in the marketplace and at community colleges, it might be better to implement AutoCAD at the district level. Each District Office received one AutoCAD seat on a PC. The move toward adoption of AutoCAD had limited success in two years. Because of file format incompatibility issues, district CAD users requested MicroStation.

By 1991, SHA had two hundred MicroStation users and thirty-five AutoCAD users. In July 1991, when MicroStation 4 came to the PC, employees attended numerous training classes in it throughout SHA, including OOTS. MicroStation became the official SHA CAD platform, and AutoCAD was phased out. A transition team formed to help AutoCAD users migrate to MicroStation. The transition involved translating AutoCAD drawings and symbols to MicroStation design files and cell libraries, along with a port of custom AutoCAD tools to equivalent MicroStation tools.

Development of SHA CAD Standards

On April 9, 1991, the first SHA CAD Feature Table was released—the first attempt at standardizing how MicroStation should be used at SHA. The guidelines required users to place a specific feature (curb line, pavement marking, utility line, pavement edge, and so on) with a specific color, thickness, and line style on a specific drawing level. Because conforming to standards required extra effort, the adoption of the feature table was sporadic at best.

In 1992, SHA managers saw a clear need to standardize CAD. They sponsored a Quality Team consisting of users from the Highway Design Division, Plats and Surveys, Project Planning, Environmental Design, and the Landscape Architecture Division. The goal was to make CAD Standards user-friendly. Participation was mandatory, and brainstorming sessions were held regularly.

In 1993, SHA released its formal CAD Standards that documented a workflow heavily based on reference files to facilitate data sharing. File types were defined, cell libraries were created, font files were compiled, Standard borders were developed, and standard color tables were generated. Also, a custom application called CADSTD was commissioned to facilitate the adherence to the feature tables.

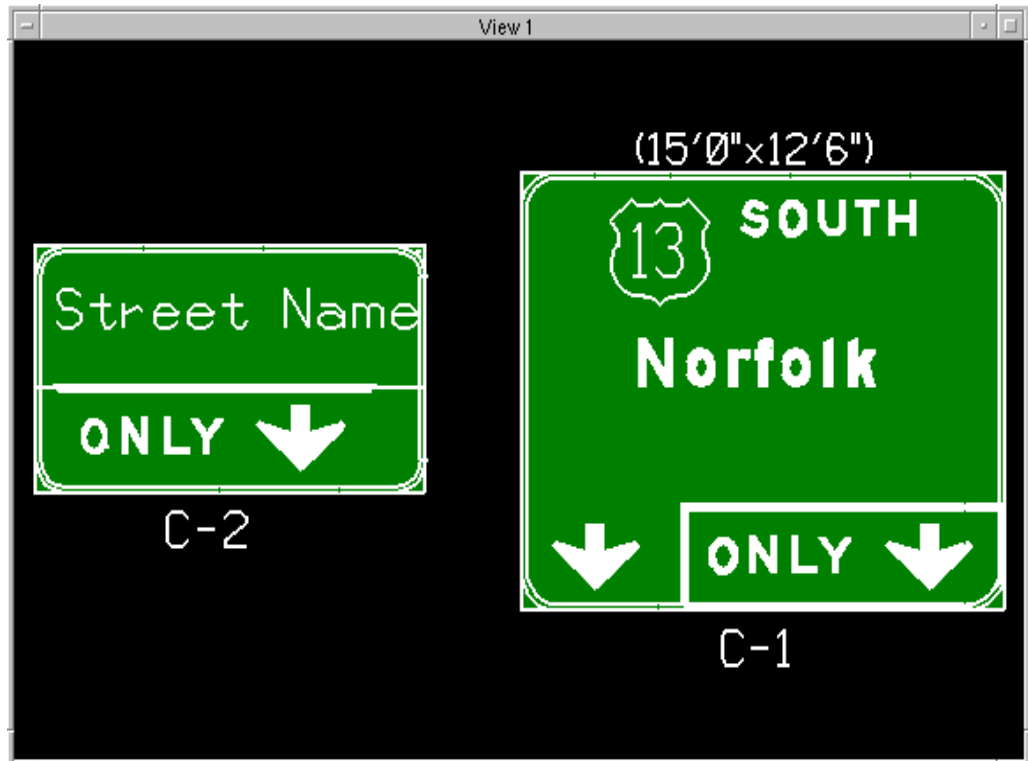


The CADSTD program facilitates adherence to SHA feature tables.

SHA requires consultants to use its CAD Standards on engineering projects. Many SHA Divisions also use them to a degree. Feedback was compiled over the next two years from in-house and consultant users. Revised SHA CAD Standards were issued in 1995.

NOTE: The 1995 Edition of the SHA CAD Standards is the current official release of the document. A 1998 effort to release an update was never completed.

Various offices, such as the Office of Bridge Development and the Office of Traffic and Safety, have developed their own CAD guidelines. They have also developed custom tools to enhance CAD productivity, as shown in the figure below.



The custom SIGNT00L at OOTS simplifies the creation of traffic signs in CAD.

In 1999, the Chief Engineer's office sponsored a productivity forum where SHA engineers met to brainstorm ideas for improving the organization's productivity. The Information Technology team identified the use of CAD at SHA as a prime target for attention. A sub-team's informal studies led to the findings and recommendations in the forum report.

Simultaneously, the Office of Highway Development, in conjunction with the University of Maryland, was investigating a program to develop engineers' estimates from CAD files. The study determined that the technology was feasible; however, SHA CAD Standards lacked the detail to support such software. Again, this led to the conclusion that SHA needed to update and revise its CAD Standards. Furthermore, SHA was receiving feedback from its consulting engineering community indicating the need for SHA to comply with and upgrade its CAD Standards.

The offices of the SHA Deputy Administrator and the SHA Chief Engineer took an active interest in the findings and recommendations. They saw the value of proposing an Integrated Design System that embraces earlier CAD Standards initiatives and seeks to implement them throughout the organization.

Maintaining and Developing CAD Standards with Evolving Technology

The release of MicroStation V8 is a significant milestone in CAD software evolution. It brings about a file format change and removes many limitations posed by the

earlier file format. Furthermore, its integration with ProjectWise V8 brings together a more unified workflow throughout SHA. As SHA prepared for its migration to V8, management and employees realized it was time to update CAD Standards as well. The SHA IDS (Integrated Design System) Team managed by Mike Lynch, P.E., was asked to develop and release a new edition of CAD Standards.

The various Divisions within SHA have different workflows. In the absence of a universal Standard at SHA, each Division developed its own preferred methods of working that address specific needs. In some cases, these methods are firmly established and rigorously applied, while others have more informal Standards that are essentially shared and taught by word of mouth.

CAD practices play a major part in the workflow at SHA. It is important that an established base of CAD Standards exist from which to draw upon in order to move forward in the workflow. Almost all jobs are part of a larger effort where the work performed by one team directly affects others, whether it remains in the Division, spans across Divisions, or goes to a consultant for completion. Therefore, if CAD drawing Standards have not been maintained or are improperly used, one party's work burdens someone else.

Furthermore, as a result of advances in CAD technology and the ever-constant process of developing and refining workflow at SHA, the CAD Standards must adapt over time to newer and better technologies. These CAD Standards have been developed through extensive meetings across all sections of SHA and through much consideration toward the development of a uniform set of CAD Standards that will fit within the workflows of all involved.

Appendix D

Converting V7 Files to V8

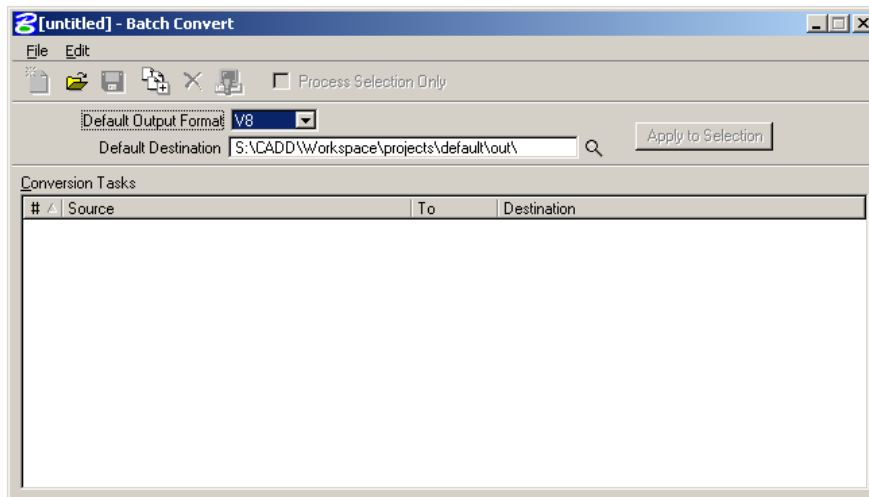
Purpose

This section details the necessary steps to convert a set of MicroStation J files (V7) to the V8 file format for use with SHA's V8 CAD Standards. Key to the process is the use of a **CSV Remapping** file to ensure that such standard elements as levels, weights, & line styles match the new V8 standards. Of these, mapping the line styles is most critical because the V8 resource files have changed and **old custom line styles will not appear correctly otherwise**.

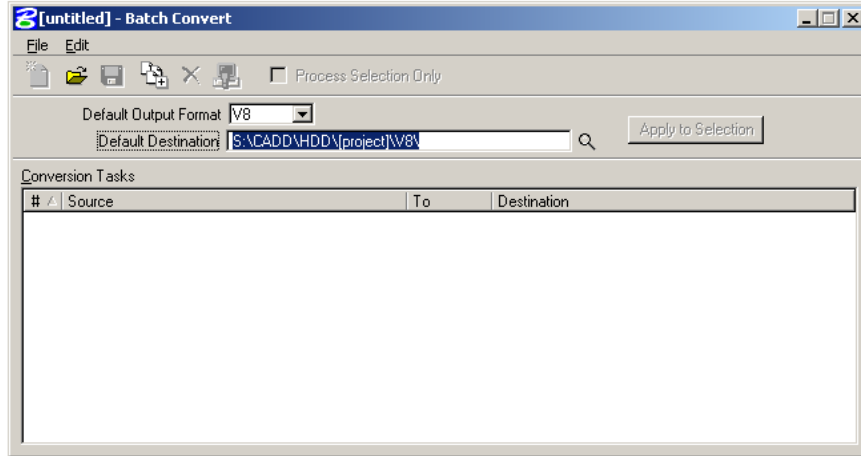
NOTE: Converting project files should only be done at the discretion of the project manager!

Procedure

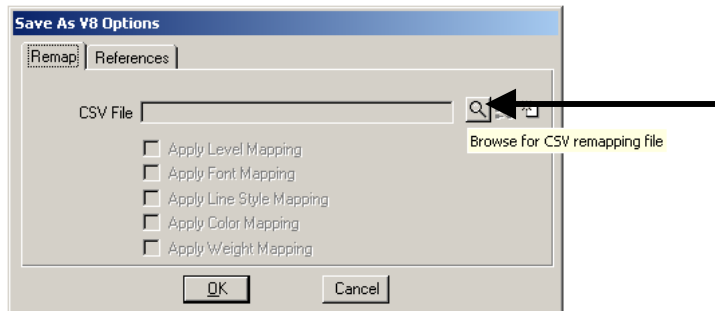
1. Start MicroStation V8 and open any file. If the file is V7 and you are asked to convert to V8, **always choose NO**. Remapping tables **must** be used for successful conversion.
2. Select **Utilities > Batch Converter...**



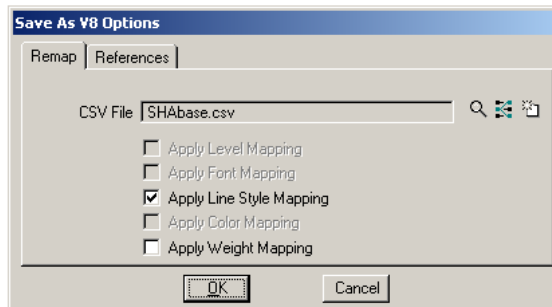
3. Set the **Default Output Format** to **V8**.
4. Set the **Default Destination** directory (it is recommended that you create a “V8” folder in your project directory for this purpose)



5. Select **Edit > V8 Save Options...**



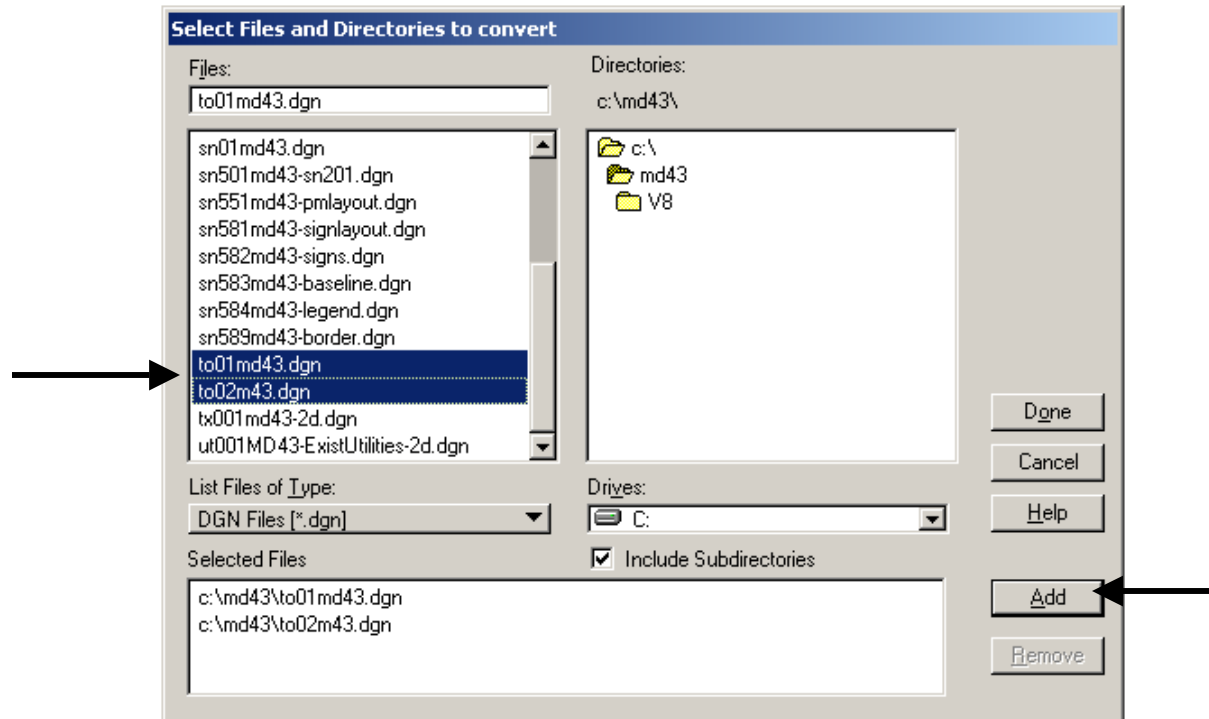
6. Click the **Browse** button (magnifying glass).
7. Select the appropriate CSV file for the files you wish to convert (refer to the section of this document, “**Selecting a CSV File**”). Base files have been created for your use and are located in the `..\Workspace\Standards\MDSHA_V8\data\` directory.
8. Check the boxes next to the standard elements you wish to map. (At a minimum you should have “**Apply Line Style Mapping**” checked on. Fields that are disabled do not have any remapping defined in the selected CSV table.)



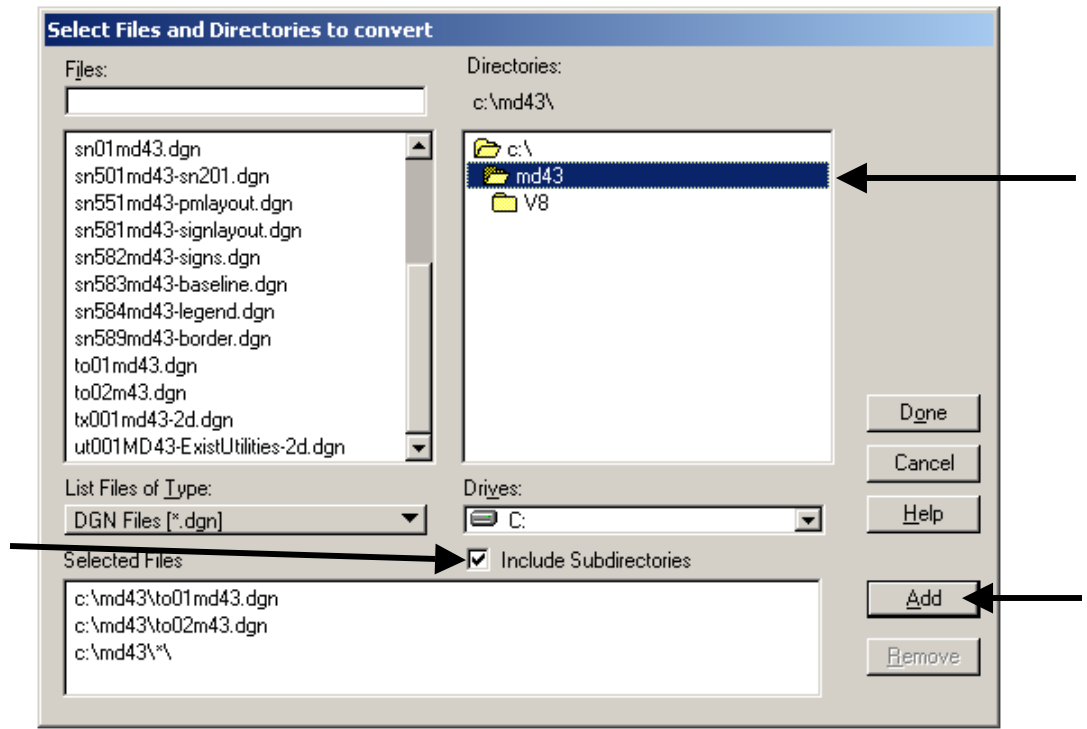
9. Click **OK**.
10. Return to the Batch Convert window and select **Edit > Add Files...**

11. Select individual files or entire directories and click **Add** to move them to the bottom window.

Example 1: Single or Multiple Files

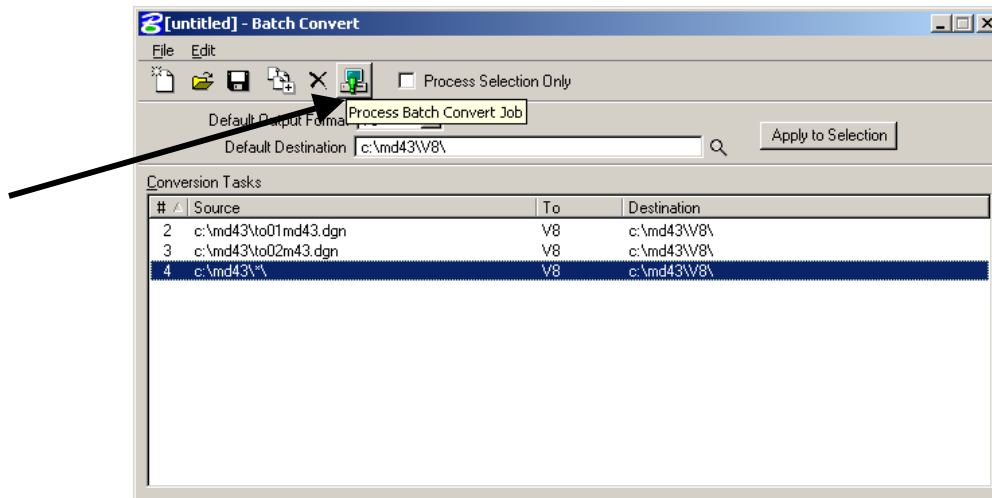


Example 2: Entire Directory, including Subdirectories

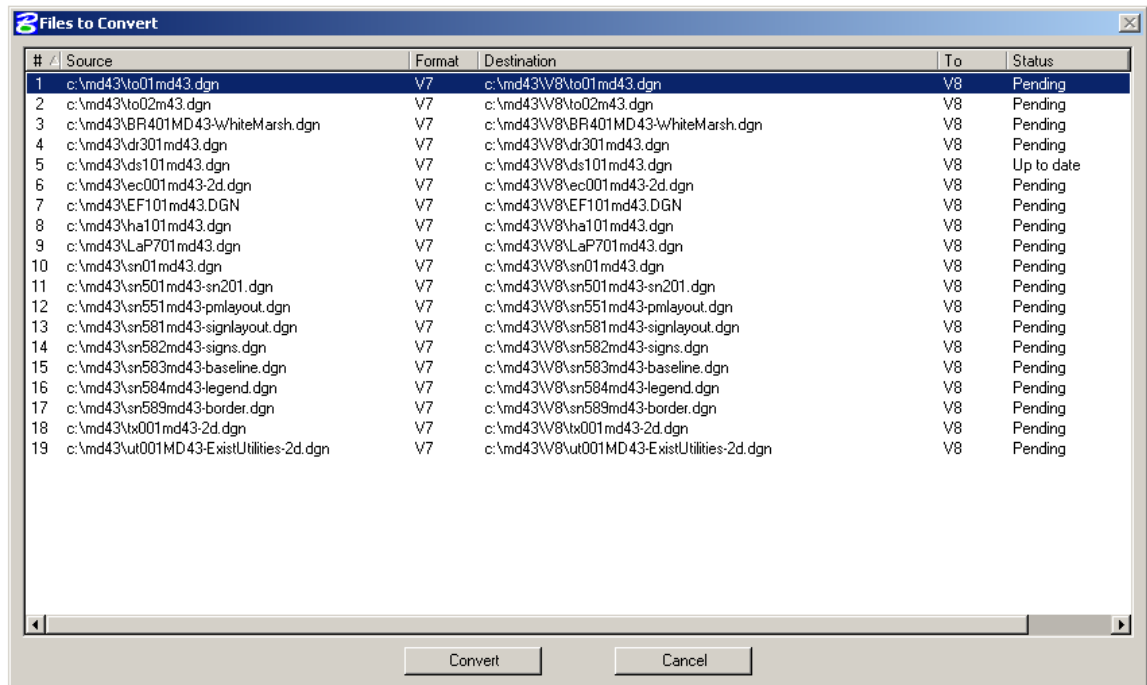


12. When all files have been selected, click **Done**.

13. Return to the Batch Convert window and select **Process Batch Convert Job**



14. When the Files to Convert window appears, check to make sure you have selected the correct files, then click **Convert**.



One by one you should see the text in the **Status** column change to **Converted**.

When finished, open and examine the files to make sure conversion was successful.

If not, delete all V8 files from the destination directory before trying again.

Be sure to **rename V8 files** to fit the V8 file naming convention! The new V8 workspace contains a **File Naming Wizard** tool to help with the process.

Selecting a CSV File

Several sample CSV files have been created to help get you started. These are located in the **S:\CADD\Workspace\Standards\MDSHA_V8\data** directory.

Mapping Entire Projects

The file to use as a starting point is **SHABase.csv** – this is a generic remapping file that may be used for any file type since it does not take levels into account. Only line styles and weights have been set up for conversion.

Advantage: This is ideal for mapping entire project directories at once while still meeting the minimum criteria for using the V8 CAD Standards workspace.

Disadvantage: Numbered Levels will remain in the converted file (as Level 1, Level 2, etc). These level names can be converted by hand at a later time as needed.

Mapping Individual Files


Some CSV files have been set up to convert specific file types (e.g. TO, HA, etc). While the TO file is generally good for all topo (owing to consistently applied V7 standards), other mapping files must be checked prior to use to ensure that the level-number-to-level-name definitions are consistent with the standard used by the current project. (That is, if the V7 file doesn't follow any particular level standard, then neither will the V8 output file.)

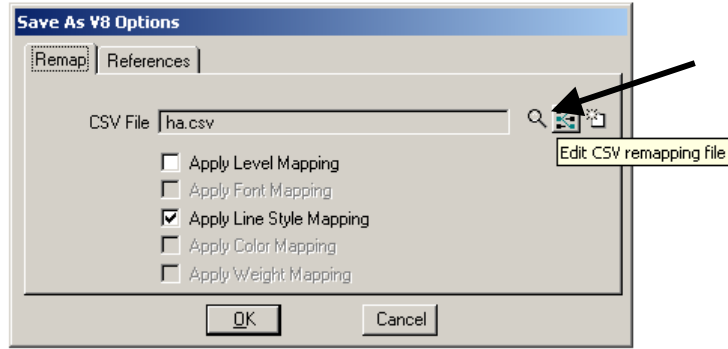
In most cases, the file-specific CSV files already contain the standard V8 level names and descriptions. However, it is necessary for a project team member to check that the V7 level numbers match the project standards.

Advantage: Works well for projects that have files which follow a consistent level standard. The resulting V8 files will have a level structure that more closely matches the new standards. This may be more worthwhile for projects that are just underway and will be around for a long period of time rather than those nearing completion.

Disadvantage: A significant time investment may be required to get the level mapping correct for each file type in the project. A separate batch conversion must be run for each file type.

Procedure:

- 1) If the CSV file exists for the file you wish to map, use Windows Explorer to copy it to your project directory. If not, copy the SHABase.csv file to your local machine and rename it to match the correct file type.
- 2) Use the Batch Converter to open the new CSV file (steps 1-6, above)
- 3) Click the **Edit** button .



- 4) Examine the V8OutputLevel and Description columns, then input the appropriate level number in the Level column, using the format: %%1, %%2, %%3. (i.e. %%1 = Level 1, %%2 = Level 2, etc.)

	A	B	I	M	N	O
1						
2						
3		Level Mapping Table				
4		<input type="checkbox"/> Show Optional Columns				
5						
6		Level	V8OutputLevel	Required	Description	Number
7			BLDG	0	Site: Building	618
8			BLDG-DIMS	0	Site: Building, Dimension	628
9			BLDG-LABL	0	Site: Building ID Labels	619
10			BLDG-TEXT	0	Site: Building Annotation	620
11		%%3	BLIN	0	Alignment: Baseline	500
12			BLIN-DATA	0	Alignment: Curve Data, E	529
13		%%60	BLIN-STAN	0	Alignment: Baseline Sta	501
14			BLIN-TEXT	0	Alignment: Cardinal Text	502
15			CFLL	0	Road: Cut & Fill	503
16			PATH-HBKR	0	Path: Hiker-Biker Path	625
17			PATH-SDWK	0	Path: Sidewalk	614
18			PATH-SDWK-FILL	0	Path: Sidewalk, Filled Pa	626
19			PVMT-FULL	0	Road: Pavement Shading	525
20			PVMT-OVER	0	Road: Pavement Shading	526
21			PVMT-REMV	0	Road: Pavement Shading	519
22			ROAD-BARR	0	Road: Traffic Barriers	600
23		%%4	ROAD-CURB-BACK	0	Road: Back of Curb lines	507
24		%%4	ROAD-CURB-GPAN	0	Road: Road, Gutter Pan	531
25			ROAD-DIMS	0	Road: Lane Dimensionin	530
26		%%4	ROAD-EDGE	0	Road: Edge, Face of cur	510

If there are situations where features on one level have since been broken into multiple levels (see level 4 for edge of road, curb, & gutter pan in the figure above), you have a choice:

Either **(A)** decide on the most appropriate level for all features to map to (probably ROAD-EDGE in this case, leaving the others blank), or **(B)** click the **Show Optional Columns** button at the upper left and add modifiers for Color, Weight & Style to distinguish between features.

- 5) When finished, **Save** and **Close** the file, then test your remapping table by completing steps 8-14 on pages 2-4 of this document.

