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16. Abstract

This report documents the review of currently available RDS/IGrds™ training materials, survey of training needs, and development of self-instructional training materials to satisfy the most critical identified need. New users of IGrds™ require training in operating engineering workstations, the Microstation computer graphics software, and RDS. Training materials and courses are available to provide effective training in these areas. IGrds™ training responsibilities are shared by the TxDOT Districts and the Division of Automation, D-19. The Districts are responsible for introductory level training, and D-19 provides intermediate training in IGrds™ applications. The TxDOT has no formal training materials for introductory level IGrds™ training and, as a result, the quality of training varies among the districts and limits the effectiveness of the intermediate-level training. Therefore, the focus of this study was the development of two types of introductory training materials: (1) a 13-minute slide/audiotape presentation that provides a brief introduction to "The Role of IGrds™ in the Design of Texas Highways," and (2) self-instructional "IGrds™ Practice Problems" that provide new users with instructions and practice problems to become acquainted with each IGrds™ command currently used in the Department.

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DEVELOPMENT OF RDS/IGrds™ SELF-INSTRUCTIONAL COURSE MATERIALS

by

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METRIC (SI*) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
in	inches	2.54	centimetres	cm
ft	feet	0.3048	metres	m
yd	yards	0.914	metres	m
mi	miles	1.61	kilometres	km
AREA				
in^2	square inches	645.2	centimetres squared	cm^2
ft^2	square feet	0.0929	metres squared	m^2
yd^2	square yards	0.836	metres squared	m^2
mi^2	square miles	2.59	kilometres squared	km^2
ac	acres	0.395	hectares	ha
MASS (weight)				
oz	ounces	28.35	grams	g
lb	pounds	0.454	kilograms	kg
T	short tons (2000 lb)	0.907	megagrams	Mg
VOLUME				
fl oz	fluid ounces	29.57	millilitres	mL
gal	gallons	3.785	litres	L
ft^3	cubic feet	0.0328	metres cubed	m^3
yd^3	cubic yards	0.0765	metres cubed	m^3

NOTE: Volumes greater than 1000 L shall be shown in m^3.

TEMPERATURE (exact)

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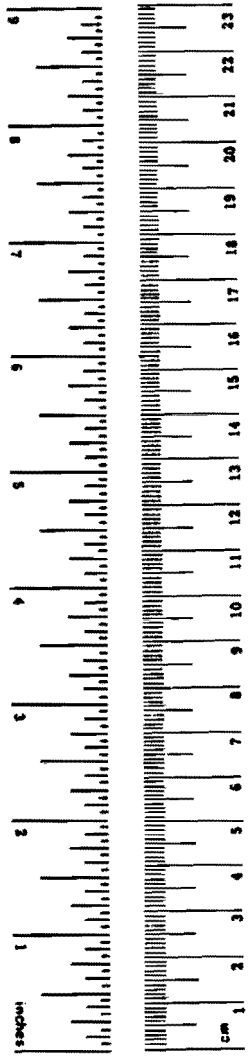

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
LENGTH				
mm	millimetres	0.039	inches	in
m	metres	3.28	feet	ft
m	metres	1.09	yards	yd
km	kilometres	0.621	miles	mi
AREA				
mm^2	millimetres squared	0.0016	square inches	in^2
m^2	metres squared	10.764	square feet	ft^2
km^2	kilometres squared	0.39	square miles	mi^2
ha	hectores (10 000 m^2)	2.53	acres	ac
MASS (weight)				
g	grams	0.0353	ounces	oz
kg	kilograms	2.205	pounds	lb
Mg	megagrams (1 000 kg)	1.103	short tons	T
VOLUME				
mL	millilitres	0.034	fluid ounces	fl oz
L	litres	0.264	gallons	gal
m^3	metres cubed	35.315	cubic feet	ft^3
m^3	metres cubed	1.308	cubic yards	yd^3

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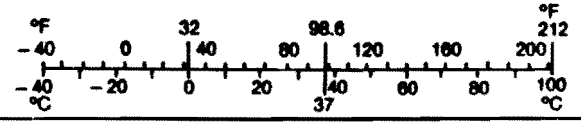

These factors conform to the requirement of FHWA Order 5190.1A.

* SI is the symbol for the International System of Measurements

ACKNOWLEDGMENTS

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Finally, the authors acknowledge the Intergraph Corporation whose permanent loan of equipment to the Civil Engineering Department, Texas A&M University, provided the hardware and software upgrades that were essential to the conduct of this study. Tommie F. Howell, TxDOT Automation Engineer, and James T. P. Yao, Head of the Civil Engineering Department, provided essential support for the loan. Duane Guidry (Sales Representative), Tom Clemons (District Sales Manager), and Don Ameen (Regional Director) are gratefully acknowledged for their efforts to gain approval of the equipment loan within the Intergraph Corporation.

SUMMARY OF FINDINGS

This report documents the review of currently available RDS/IGrds™ training materials, survey of training needs, and development of self-instructional training materials to satisfy the most critical identified need. The review included materials developed by the TxDOT, AASHTO, California Department of Transportation, and Intergraph Corporation. Seventeen district personnel (engineers and technicians) were surveyed to obtain a critique of available training courses and materials and to identify preferred IGrds™ training media.

New users of IGrds™ require training in operating engineering workstations, the Microstation computer graphics software, and RDS. Training materials and courses are available to provide effective training in these areas. IGrds™ training responsibilities are shared by the districts and the Division of Automation, D-19. The Districts are responsible for introductory level training, and D-19 provides intermediate training in IGrds™ applications.

The TxDOT has no formal training materials for introductory level IGrds™ training and, as a result, the quality of training varies among the districts and limits the effectiveness of the intermediate-level training. Therefore, the focus of this study was the development of two types of introductory training materials: (1) a 13-minute slide/audiotape presentation that provides a brief introduction to "The Role of IGrds™ in the Design of Texas Highways," and (2) self-instructional "IGrds™ Practice Problems" that provide new users with instructions and practice problems to become acquainted with each IGrds™ command currently used in the Department.

IMPLEMENTATION STATEMENT

The principal finding of the review of currently available RDS/IGrds™ training materials and survey of IGrds™ training needs within the Department was the need for training materials to improve the quality and consistency of introductory-level IGrds™ training. Two sets of introductory-level training materials were developed: (1) an introductory slide/audio tape presentation entitled "The Role of IGrds™ in the Design of Texas Highways, and (2) self-instructional training materials entitled "IGrds™ Practice Problems" that provide instructions and practice problems for IGrds™ horizontal alignment, vertical alignment, and general geometry commands. The authors recommend that these materials be implemented into the Department's RDS/IGrds™ training program as soon as possible and IGrds™ Practice Problems be designated a prerequisite for the Division of Automation's intermediate-level IGrds™ Workshop.

DISCLAIMER

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1. INTRODUCTION

This report documents the results of Study No. 2-19-89/0-1241, "Development of RDS/IGrds™ Self-Instructional Course Materials." The study was undertaken to develop self-instructional course materials that would help satisfy some of the Department's training needs related to RDS (**R**oadway **D**esign **S**ystem) and IGrds™ (**I**nteractive **G**raphics **R**oadway **D**esign **S**ystem). Training needs that could be satisfied by self-instructional materials were identified through a review of currently available training materials and a survey of Texas Department of Transportation (TxDOT) personnel.

Two sets of materials were developed:

- A slide-audio tape presentation titled "The Role of IGrds™ in the Design of Texas Highways," and
- A series of computer-based practice problems for IGrds™ horizontal alignment, vertical alignment, and general geometry commands.

PROBLEM STATEMENT

RDS/IGrds™ is the TxDOT's principal roadway design system and will be used for this purpose for many years. It is also the basis for the new Automated Plan Preparation System that will further expedite plan preparation.

Advancements in computer-based technologies for roadway system planning, design, construction, operations, and management will place greater emphasis on the use of these and other computerized systems. Consequently, TxDOT engineers and technicians must develop adequate computer skills to keep up with the technological needs of the Department.

Formal training sessions are effective methods for advancing the knowledge base of engineers and technicians. Unfortunately, individuals do not learn how to operate a computer system or a certain software program with only formal instruction. Individuals cannot learn a computer system or software program without spending considerable time using the system. Trial-and-error often is the best method for learning.

Using self-instructional materials is a preferred method for training an individual to operate a computer system. However, only limited amounts of self-instructional materials are currently available for the RDS/IGrds™ software. The study documented herein was undertaken to identify any material that is currently available, to identify unmet training needs, and to develop self-instructional training materials for use by TxDOT engineers and technicians to help meet current training needs.

SCOPE AND OBJECTIVES

The scope of the study was defined in terms of the following objectives:

1. Review Available RDS/IGrds™ Training Materials;
2. Identify Scope, Objective, Audience, and Form for RDS/IGrds™ Self-Instructional Materials;
3. Develop Self-Instructional Materials;
4. Test the Effectiveness of the Self-Instructional Materials; and
5. Revise and Finalize the Self-Instructional Materials.

ORGANIZATION OF THE REPORT

Chapter 2 provides a brief review of available RDS/IGrds™ training materials. Chapter 3 summarizes the results of a survey of Department personnel regarding RDS/IGrds™ training needs and outlines a proposed training curriculum. Chapter 4 describes the slide-audio tape presentation that was developed. Chapter 5 documents "IGrds™ Practice Problems" for IGrds™ horizontal alignment, vertical alignment, and general geometry commands.

2. REVIEW OF AVAILABLE RDS/IGrds™ TRAINING MATERIALS

The first task of the study was to review RDS/IGrds™ training courses and materials currently available within the Department as well as from AASHTO, Intergraph Corporation, and other sources. The review was divided into three parts: (1) basic computer training, (2) RDS training, and (3) IGrds™ training.

BASIC COMPUTER TRAINING

The TxDOT Division of Automation, D-19, provides a variety of basic computer training. As microcomputer use at the high school and college levels has increased in recent years, so has the microcomputer literacy of new engineers and technicians joining the Department. This trend should continue. DOS-based systems have been by far the most widespread, although UNIX-based systems have been growing in popularity. Another trend that should be considered positive from the Department's point of view is that increasing numbers of engineering students are learning computer graphics. These trends should ease, but certainly not eliminate, the burden on the Department for basic computer training.

In general, however, most new users of IGrds™ in the Department currently will not have all of the following prerequisite computer skills:

1. VAX equipment and the VMS operating system;
2. Engineering workstations and the UNIX system; and
3. Intergraph's computer graphics packages (either VAX-based IGDS or workstation- and microcomputer-based Microstation).

D-19 personnel provide VAX and engineering workstation training. They appear to have adequate training materials for these purposes.

The Department is moving away from VAX-based systems and toward workstations; therefore, Microstation training is becoming increasingly important. Microstation training is the responsibility of the individual TxDOT Districts. Each District has several options for providing Microstation training, including IGDS training materials provided by D-19, Microstation PC training materials, UNIX-based Microstation training materials, and training programs offered at several colleges (i.e., Austin Community College and the University of Houston).

RDS TRAINING

D-19 has been providing RDS training for many years; its RDS training curriculum is well established and appears to be effective. The RDS training curriculum has three parts:

1. RDS Self-Instructional Course,
2. RDS Certification Exam, and
3. RDS Workshop.

The RDS Self-Instructional Course is a self-paced course that employees can take in their home office. The training materials include a training text (1) and forms book (2). The certification exam (3) is taken after completing the self-instructional course. The exam is submitted to D-19 for grading. The exam is a prerequisite for the RDS workshop and must be passed before taking the workshop. The RDS workshop is a week-long training course that emphasizes RDS applications.

IGrds™ TRAINING

IGrds™ is much newer than RDS, with the first formal training course taught in 1985. Originally, IGrds™ could be operated only on VAX-based computer equipment, which limited the number of personnel who could use it. Within the past two years, however, it has become possible to run IGrds™ on engineering workstations and to run Microstation on microcomputers, and the Department has been working toward equipping its residencies to use IGrds™. The number of workstations that run IGrds™ has increased to 400 in recent years, and plans call for that number to grow to 600. This growth has significantly increased the number of individuals with access to IGrds™; therefore, there has been an increased demand for IGrds™ training.

Currently, D-19 has two training courses: an IGrds™ workshop and a prerequisite course to Level III design training. Both courses assume that participants are familiar with RDS and have used IGrds™. The introductory IGrds™ training that is a prerequisite to these courses is the responsibility of the TxDOT Districts.

The manner in which introductory IGrds™ training is provided varies among the Districts. There are no formal training materials specifically for this purpose. Much of the training is hands-on, trial-and-error, and one-on-one, with personnel who have received formal training passing on what they learned and sharing course training materials with less experienced personnel. Another popular reference used in the training process is the AASHTO IG Option Reference Manual (4). AASHTO also provides a "Getting Started" document (5).

The IGrds™ workshop is a week-long training course, typically conducted at the D-13 Training Center in Austin. Its emphasis is on applications of IGrds™ (i.e., how to develop and/or revise alignments and prepare plan sheets using IGrds™). Participants are assumed to be familiar with the capabilities, command structure, and operating mechanics of IGrds™. Unfortunately, it has not been possible to strictly enforce these prerequisites and, as a result, the actual familiarity of many participants with IGrds™ has been inadequate. When participants lack the prerequisite knowledge, training must be conducted at a lower level and/or at a slower pace, which reduces the effectiveness of the workshop.

The prerequisite course to the Department's Level III design training was initiated in 1989. It is designed to provide engineers with the IGrds™ training they need to complete the Level III design training. This week-long course, which is also conducted at the D-13 Training Center in Austin, combines both basic engineering workstation and IGrds™ training.

One other set of training materials that merits mention was developed by the California Department of Transportation. California has an engineering workstation training document (6) and a three-volume RDS/IGrds™ training document. California uses Apollo (instead of Intergraph) workstations. Therefore, the engineering workstation training document has only limited applicability in Texas. The three-volume RDS/IGrds™ training document is organized as follows: Part I -- horizontal and vertical alignment, terrain, and general geometry; Part II -- templates, sideslopes, superelevations, chokers, earthwork volumes, and cross sections; and Part III -- advanced features of IGrds™ including design cross section modification, advanced general geometry, station equations, extended terrain features, special ditches, right-of-way/maximum slope intercepts, divided roadways, off-template points, extended earthwork volume features, and rehabilitation design for overlays and widening. Part I is similar to the materials currently used by the Department. Parts II and III cover IGrds™ features not currently used by the Department.

SUMMARY

The training needs for new IGrds™ users include familiarity with the use of engineering workstations, Microstation, and RDS in addition to IGrds™. D-19's training program for engineering workstations and RDS is well-established and has proven effective.

The TxDOT Districts are responsible for Microstation and introductory IGrds™ training. Several options are available for Microstation training. It does not appear, however, that adequate training materials are available to insure consistently high quality introductory IGrds™ training. As a result, the effectiveness of D-19's IGrds™ workshop has often been degraded by participants lacking the desired prerequisite knowledge. The survey results presented in Chapter 3 provide additional evaluation of available IGrds™ training.

3. SURVEY OF TRAINING NEEDS

This chapter summarizes the efforts in Task 2 of Study 1241 in which Department personnel were surveyed to identify the appropriate scope and audience for RDS/IGrds™ self-instructional materials. The methodology and results of the survey are summarized in the following sections.

SURVEY METHODOLOGY

The survey methodology involved mailing out questionnaires and then obtaining responses through telephone interviews. Questionnaires were mailed to both supervisory-level personnel and technicians. The questionnaires sent to the supervisory personnel and technicians differed slightly. Copies of the two questionnaires and the cover letter are included in Appendix A.

Mr. Cliff Powers (D-19) suggested the supervisory personnel to interview, and Mr. Al Frazier (D-19) suggested technicians who had attended an TxDOT IGrds™ training course in Austin. Seventeen District personnel were interviewed.

SURVEY RESULTS

Questions were asked in three areas: background information, IGrds™ training information, and preferred IGrds™ training media. Background information was requested from the survey participants concerning their position with the Department; their educational, design, and computer experience; and the role Intergraph equipment plays in their position. The section on IGrds™ training information focused on the type of training received and a critique of the training courses and materials. The third section of the questionnaire related to learning styles and training media.

Background Information

The TxDOT employees who participated in the survey included both engineers and technicians. The engineers' involvement with IGrds™ is primarily through the personnel they supervise, whereas the technicians surveyed spend most of their time at a workstation. The distribution of survey participants by position and training received is summarized in Table 1.

TABLE 1. SUMMARY OF POSITIONS HELD AND TRAINING RECEIVED BY SURVEY PARTICIPANTS

Position	IGrds™ Training			
	Level III Prerequisite	IGrds™ Workshop	None	Total
Engineer	3	1	1	5
Engineering Assistant	2	-	-	2
Graphics Coordinator	1	3	-	4
Technician	-	5	1	6
Total	6	9	2	17

The engineers included resident, design, and planning engineers. Their experience in design or with the Department ranged from five to 20 years. The engineering assistants had less than four years experience. The technicians included technicians at levels IV and V, engineering technicians, and graphics operators. Most of the technicians had less than five years experience. Two of the graphics coordinators had been with the Department less than three years and two between 28 and 30 years.

The educational backgrounds of the survey participants were consistent with their positions. All of the engineers and engineering assistants had bachelor-of-science degrees in civil engineering. Most of the technicians had some college experience. One graphics coordinator had an associate degree in computer graphics.

Only one of the five engineers surveyed uses Intergraph extensively; however, all supervise personnel who do. All of the engineering assistants, technicians, and graphics coordinators use IGrds™, IGDS, and/or Microstation extensively.

IGrds™ is used primarily to create and update alignments, prepare plans and profiles, establish right-of-way locations, and place miscellaneous design elements. The design cross section modification capability of IGrds™ is not used extensively by survey participants.

IGrds™ Training Information

Table 1 also summarizes the IGrds™ training received by the survey participants. Six of the survey participants attended the Level III Prerequisite Training Course (including three of the five engineers, the two engineering assistants, and one graphics coordinator). Nine participants attended the Basic IGrds™ Workshop (including one engineer, three graphics coordinators, and five technicians). Two participants (one engineer and one technician) have not received formal training.

Most of the survey participants had some experience with computers and computer graphics prior to receiving IGrds™ training. Most spent some time with IGrds™ before attending a training course, working either on their own or with the help of someone in their office.

The survey participants spoke positively about the training they received and about the course instructors. Most believed that the training was effective and that the topics covered were appropriate. The use of hands-on exercises was considered very important. These exercises gave the student an opportunity to practice and fine tune their skills and taught them commands they had not used previously.

The negative feedback about the hands-on exercises in the course dealt with the lack of time to complete the exercises, difficulties resulting from sharing a workstation, and the number and type of exercises. Several technicians indicated that the training course provided a good overview, but that they did not have enough time to learn everything they believed was necessary. Sharing workstations also seemed to be a problem. Many of the survey participants believe that individuals experienced with IGrds™ tended to hoard the workstation keyboard, thus not allowing the other participants sufficient time to practice. The criticisms about the number and type of exercises included there were not enough exercises, there was no ditch profile exercise, the exercises were too simple and not "real world" enough, and the exercises did not provide opportunities to learn how to correct mistakes. To overcome these problems, several participants suggested that the courses should be longer and that fewer people attend each course in order to maximize the amount of time individuals could spend practicing. One participant suggested that trainees bring projects from their offices to use as practice problems.

Comments on the level of the technical content of the courses varied. The survey participants with little experience prior to attending a training course had trouble following the terminology and believed the content was too advanced. More experienced participants believed the content was too basic and wanted to learn more advanced and less frequently used commands. Several participants suggested that different levels of training should be provided for beginning, intermediate, and advanced users.

The TxDOT training materials are used wherever applicable, but according to most of the supervisors, the examples provided do not apply to many of the problems they face. Most of the technicians, however, indicated that they frequently used the training materials for references and that the materials were well prepared. However, they also believe the examples included are too simple and have no practical correlation to their actual design problems. The AASHTO IG Option Reference Manual is the most accepted means of extracting information relative to specific commands and IGrds™ logic structure.

IGrds™ Preferred Training Media

Figures 1 through 6 summarize the learning preferences and opinions on training media expressed by the survey participants. Most of the survey participants prefer to learn through hands-on exercises rather than listening to or watching someone else. By practicing, they believe one comprehends and retains more than by listening or watching in an academic environment. Some individuals expressed a preference for watching or listening to someone else and then practicing.

In accordance with this basic finding, most of the survey participants believed that a videotape or on-line, interactive simulation could be helpful but that these media could serve only a limited role in the training process. Suggested uses of a videotape were to introduce new people to the system and to refresh and update personnel, particularly supervisors. Several individuals suggested that if videotaped training materials were used, they should be structured to provide opportunities for practicing the skills being presented. Similarly, the most frequently suggested use of on-line, interactive simulation was for new users of the system. Negative comments were that such simulations were boring and hard to follow, that they show what to do but do not explain why, that they show only perfect examples and not how to correct mistakes, and that they could not replace classroom instruction.

In general, survey participants agree that by going away from the office for training, one can be in a better frame of mind to learn. There are too many distractions in the office environment that impair the person's learning capabilities. Self-paced training in the office also lacks a mechanism for immediate feedback, which most survey participants considered important. Some of the supervisory personnel commented, however, that training in the office could be less time consuming.

Summary

The comments of the survey participants suggest that the existing training courses are effective, but there is room for improvement. The criticisms and suggestions are summarized in the following findings:

- Personnel come to training courses with a wide range of experience with IGrds™ and, therefore, the technical content is too difficult for some and too basic for others. Different levels of training may be required.

- Engineers and technicians use IGrds™ in different ways and, therefore, their training needs differ.

- Practicing through hands-on exercises is the way most of the personnel interviewed prefer to learn. Additional and more realistic exercises are desired.

Project 1241
Learning Preference

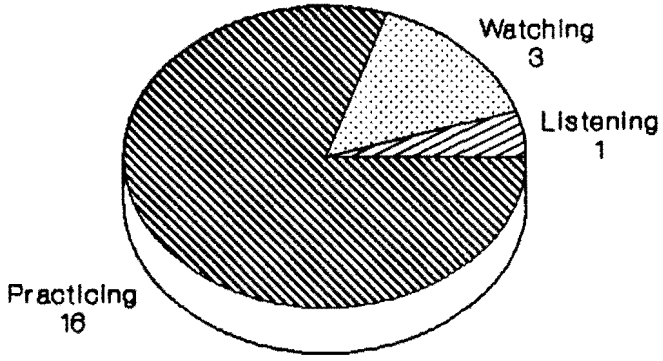

Figure 1

Project 1241
Hands On Exercises Important

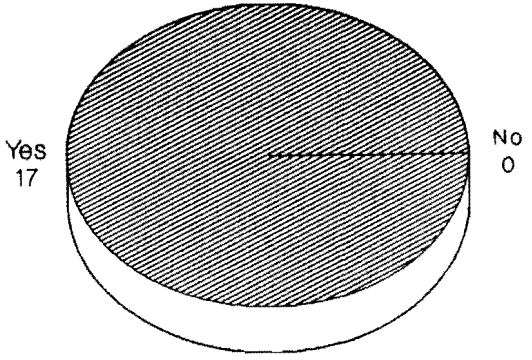

Figure 2

Project 1241
Learn By Watching Video

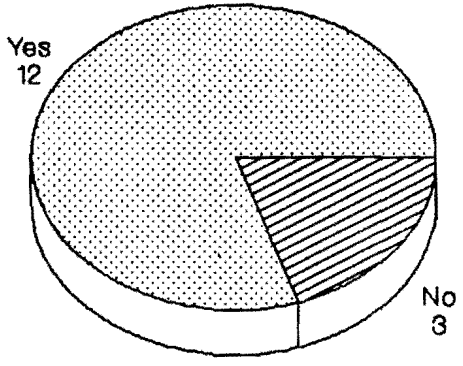

Figure 3

Project 1241
Learn By On Line Simulation

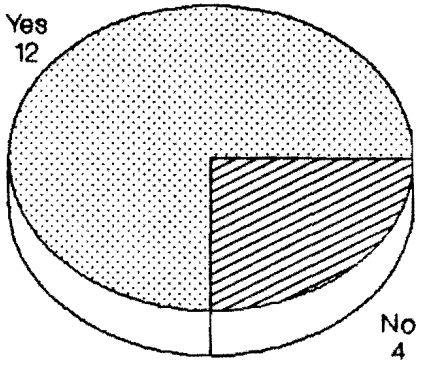

Figure 4

Project 1241
Learning Location

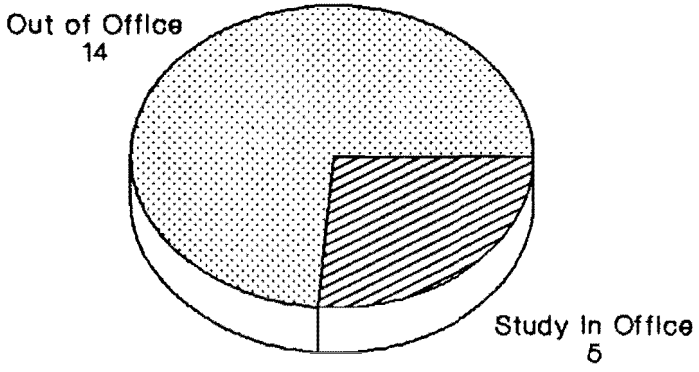

Figure 5

Project 1241
Feedback Importance

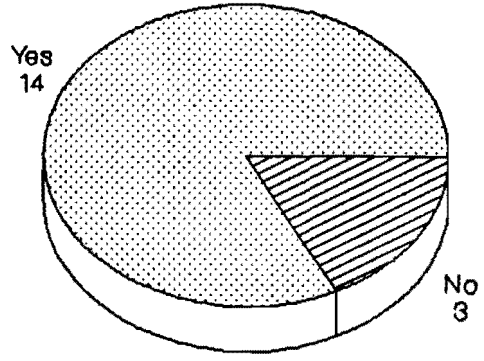

Figure 6

- Videotapes and on-screen tutorials/simulations could play a limited role in IGrds™ training, primarily for new users or supervisory personnel, but they cannot replace classroom training.

- The training materials are not easy to use as reference documents. The AASHTO IG Option Reference Manual appears to be preferred by those who have it.

PROPOSED TRAINING CURRICULUM

This section proposes an IGrds™ training curriculum based on the review of available training materials in Chapter 2 and the results of the training needs survey in this chapter. It appears that the current engineering workstation and RDS training programs are adequate and effective. The principal weakness that was identified was the need for more levels of IGrds™ training -- both introductory and advanced.

Figure 7 illustrates the proposed curriculum. The curriculum includes the requisite computer and computer graphics training as well as current RDS training. Three levels of IGrds™ training are proposed: **introductory**, **intermediate**, and **advanced**. The focus of this study was on developing self-instructional materials that could provide more consistency in the introductory IGrds™ training provided by the Districts. D-19's existing IGrds™ workshop would serve as the intermediate training course for IGrds™ applications. It is also proposed that one or more advanced applications training programs be developed in the future. Given the current status of IGrds™ availability and training, however, the current focus should be on the introductory and intermediate levels.

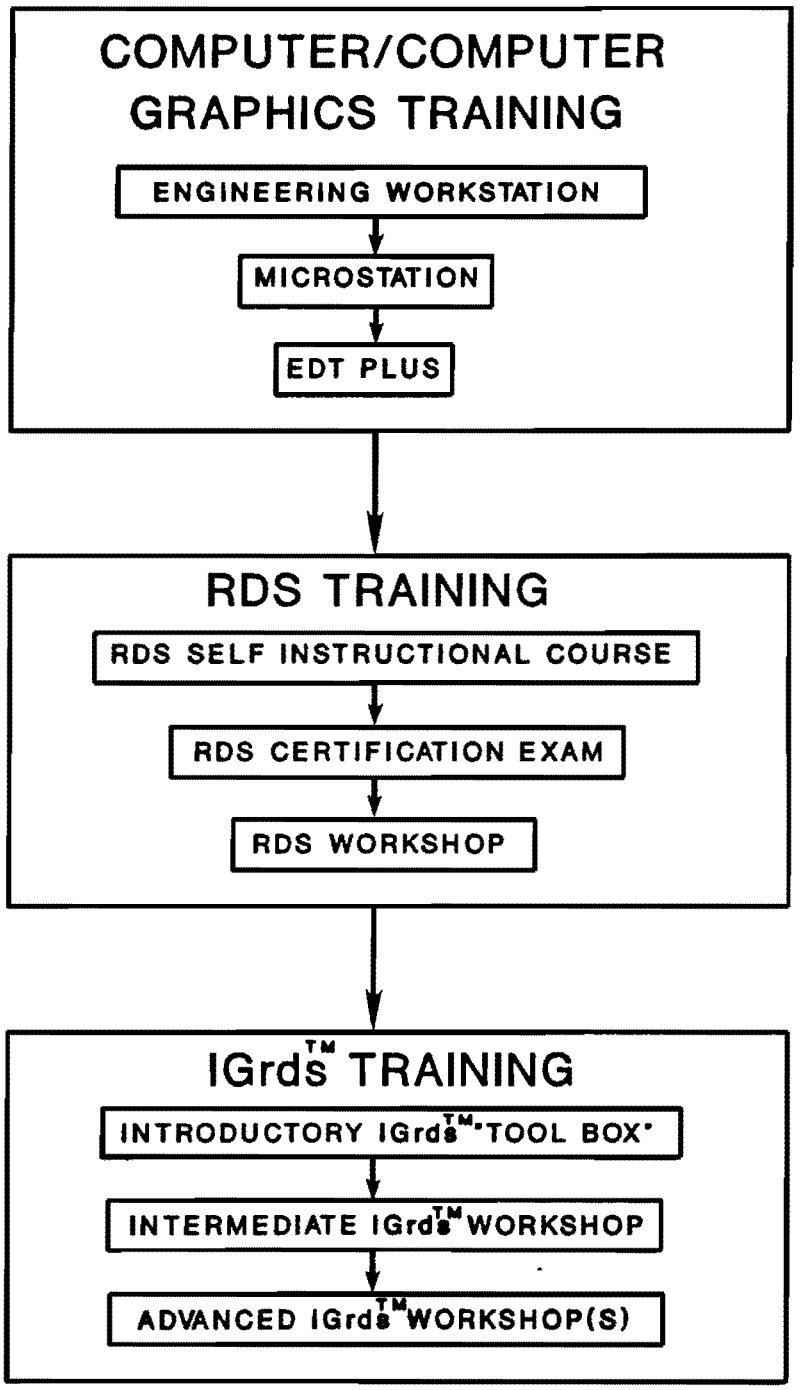

FIGURE 7. PROPOSED IGrds™ TRAINING CURRICULUM

4. IGrds™ SLIDE SHOW

Introductory training materials for new IGrds™ users in the Department were identified as the most critical training need. Therefore, the focus of Study 1241 was the development of two types of training materials: (1) an introductory slide/audio tape presentation (7) and (2) self-instructional materials covering IGrds™ commands (8). Chapter 4 briefly describes the objective and format of the slide presentation. Chapter 5 documents the self-instructional materials.

OBJECTIVE

The objective of the slide presentation was to provide new Department employees who will use IGrds™ a brief introduction to the roadway design process and the role played by IGrds™. In that capacity, it might be used in the Department's Level I design training. It was also envisioned for use as a public information tool.

DESCRIPTION

The slide presentation was titled "The Role of IGrds™ in the Design of Texas Roadways." It consists of an 80-slide carousel, a 13-minute audio tape, and the printed text of the narrative. The slide carousel and audio tape can operate automatically, that is, the audio tape has inaudible tones that will automatically advance the slides in sync with the narration. Alternatively, the slides can be used independently, and a presenter can either read the text or provide an original narration. The slides include words, pictures, and computer graphics.

The slide presentation is organized as follows:

1. Introduction

2. Roadway Design Process
   a. Preliminary engineering and route studies
   b. Location, preliminary design, and determination of right-of-way and schematic requirements
   c. Preparation of right-of-way data
   d. Plans, specifications, and estimates

3. Design Tools
   a. Manual tools of the past
   b. New technologies of the present
   c. Aerial photography and satellite surveying
   d. RDS
   e. IGrds™

4. IGrds™
    a. Role of IGrds™ in the design process
    b. Major processes of IGrds™
    c. Horizontal alignment commands
    d. Vertical alignment commands
    e. Computer equipment
    f. Training

5. IGrds™ PRACTICE PROBLEMS

The most critical training need that was identified through the review of currently available training materials and the survey of Department personnel was for self-instructional materials that the Districts could use to provide introductory training for new users of IGrds™. The materials that were developed are entitled "IGrds™ Practice Problems" but are also referred to by the nickname IGrds™ Toolbox because they are designed to help new users become acquainted with the individual tools (i.e., commands) that are available within IGrds™.

OBJECTIVE

The objective of the "IGrds™ Practice Problems" was to provide new users with instructions and practice problems to become acquainted with each IGrds™ command currently used in the Department. The materials were intended to be self-instructional and self-paced (i.e., individuals should be able to go through the materials independently at their own paces in their own offices). The goal was to raise the quality and consistency of the introductory IGrds™ training at the TxDOT District level so that individuals participating in the IGrds™ Workshop would have higher base knowledge levels.

Users of the "IGrds™ Practice Problems" are assumed to have been through engineering workstation, Microstation, and RDS training.

DESCRIPTION

The "IGrds™ Practice Problems" are organized into three lessons:

1. Horizontal Alignment Commands,
2. Vertical Alignment Commands, and
3. General Geometry Commands.

Each lesson consists of an instructions manual and an IGrds™ project file. The instructions manual provides a brief description of each command, a listing of the command prompts, and instructions for responding to those prompts. The IGrds™ project file contains a practice problem for each IGrds™ command.

The process of going through the lessons is straightforward. The user follows the directions provided in the instructions manual to get into the proper project file and to start IGrds™. Then, for each command, the user reads the brief description of the command, which also identifies the view within the project file that contains the practice problem for that command. Figure 8 illustrates the instructions provided for one command. The user enters the command to go to that view.

COMMAND 7: REVISE P.I.

MOVE TO LEVEL 51

FOR ROADWAY B
REVISE THE PI SHOWN

CHANGE THE DEGREE OF CURVE

FROM 1° 15' TO 4° 30'10"

CHANGE THE X,Y COORDINATES

TO X = 3257175, Y = 408000

CMD EXIT, THEN
CREATE/UPDATE HA AFTER

MAKING THESE REVISIONS

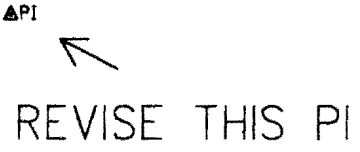

FIGURE 8.
EXAMPLE OF INSTRUCTORS MANUAL PAGE FROM IGrds™ PRACTICE PROBLEMS

Figure 9 is an example of the screen for one practice problem. The screen describes the problem that the user is supposed to solve and illustrates the intended solution. The user's solution to the practice problem should trace over the solution illustrated on the screen. If the user is uncertain about how to respond to the command prompts, he/she may refer back to the directions in the instructions manual. The user is also encouraged to experiment with any other options within the command that are not used to solve the practice problem.

Users can spend as much time as they like with each command and repeat the practice problems as many times as they like. The three lessons can be taken separately or in one sitting. The minimum time required per lesson is approximately one hour (assuming the user reads all instructions and solves each practice problem only once using the directions provided).

It is recommended that successful completion of the "IGrds™ Practice Problems" be a prerequisite for the IGrds™ Workshop. Successful completion of the practice problems would insure that participants had at least some familiarity and experience with IGrds™ commands. This would allow the workshop to be conducted at the desired technical level.

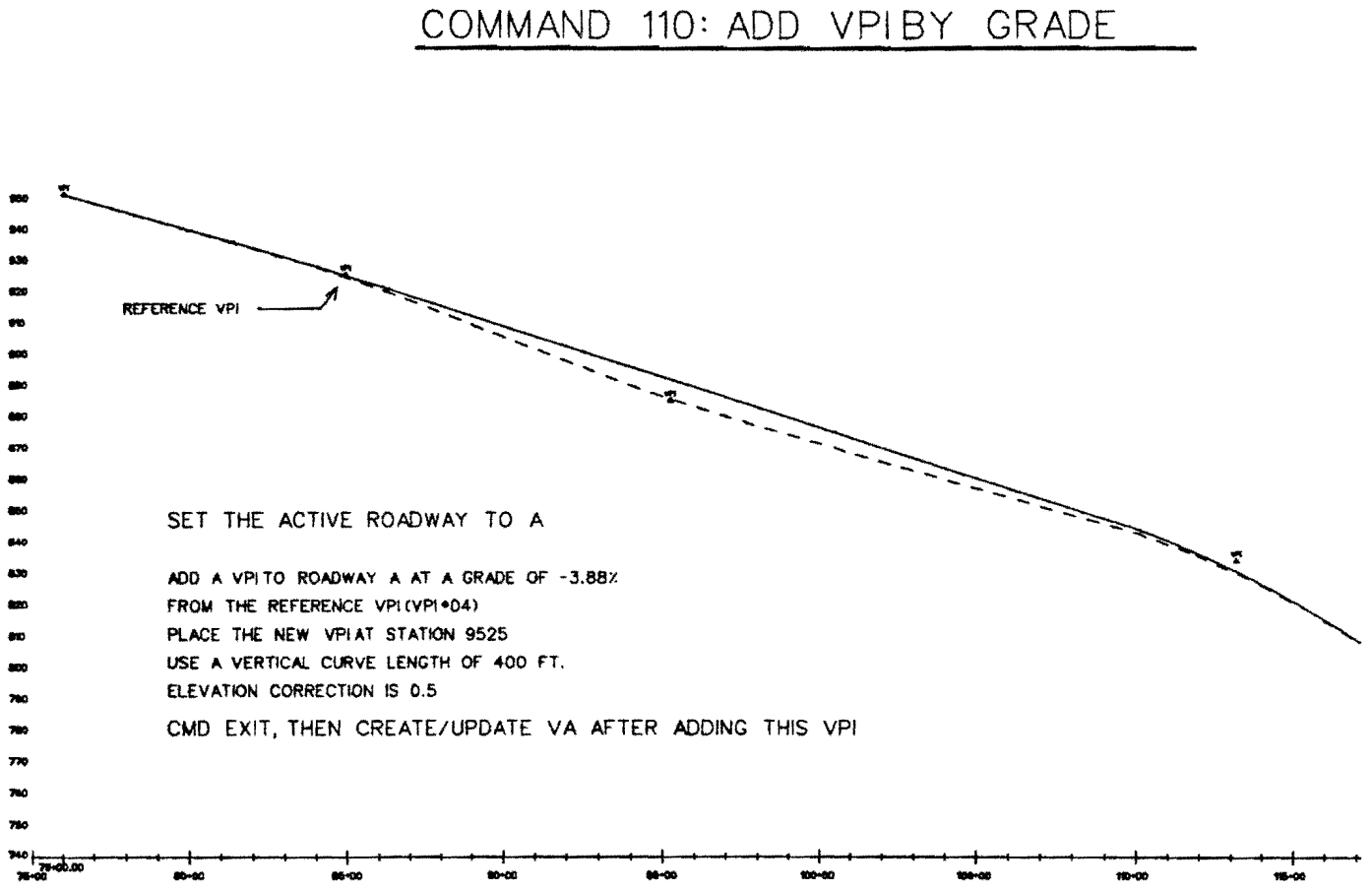

FIGURE 9.
EXAMPLE OF IGrds™ PRACTICE PROBLEM SCREEN FOR ONE COMMAND

6. SUMMARY AND RECOMMENDATIONS

This report documents the findings of a review of currently available RDS/IGrds™ training materials and a survey of training needs and describes two new sets of training materials that were developed in response to those findings.

New users of IGrds™ need basic training in engineering workstations, the Microstation computer graphics software, and RDS as a prerequisite to IGrds™ training. D-19 has established an effective program for meeting these training needs.

IGrds™ training responsibilities are shared by the TxDOT Districts and D-19. Currently, the Districts are responsible for introductory IGrds™ training, and D-19 provides intermediate training on IGrds™ applications.

The Department has no formal training materials for the introductory IGrds™ training. As a result, there is not a consistently high quality of training throughout the Department. This problem also tends to degrade the effectiveness of D-19's IGrds™ Workshop and its objective of providing intermediate-level training. When participants lack adequate introductory training and experience, it is necessary to conduct the workshop at a lower technical level and/or at a slower pace than intended.

The need for more advanced training than the current IGrds™ workshop was also identified by several survey participants. Part of the desire for more advanced training stems from the need to "water down" the IGrds™ Workshop due to participants' limited familiarity with IGrds™. However, even if the workshop were conducted at the intended level, more advanced follow-up training would still be desirable.

The review of currently available training materials and survey of training needs indicate that the most critical deficiency in the current IGrds™ training program was the lack of adequate materials to help the Districts provide an adequate level of introductory IGrds™ training. Therefore, the focus of this study was on the development of materials for that purpose.

Two sets of materials were developed in response to the identified need for introductory IGrds™ training materials:

1. An introductory slide/audio tape presentation, and
2. Self-instructional materials covering IGrds™ commands.

The slide/audio tape presentation, titled "The Role of IGrds™ in the Design of Texas Roadways," provides a brief introduction to the roadway design process and the role of IGrds™ in that process. The target audience is prospective new users of IGrds™ within the Department.

The self-instructional materials, titled "IGrds™ Practice Problems," are intended for use by the Districts in fulfilling their introductory IGrds™ training responsibilities. The objective of the practice problems was to provide new users with instructions and practice problems to become acquainted with each IGrds™ command currently used in the Department. The materials are divided into three separate lessons for (1) horizontal alignment commands, (2) vertical alignment commands, and (3) general geometry commands. Each lesson includes an instructions manual and an IGrds™ project file that can be used by individuals at their own pace in their own office. Successful completion of the "IGrds™ Practice Problems" should be a prerequisite for the IGrds™ Workshop, which provides intermediate-level training on IGrds™ applications.

REFERENCES

1. "Roadway Design System Self-Instructional Course Training Text." Federal Highway Administration, November 1973.

2. "Roadway Design System Self-Instructional Course Forms Book." Federal Highway Administration, November 1973.

3. "Roadway Design System Self-Instructional Course Certification Exam." Federal Highway Administration, November 1973.

4. "IGrds™ User Manual -- IG Option." American Association of State Highway and Transportation Officials, 1989.

5. "Getting Started in IGrds™." American Association of State Highway and Transportation Officials, 1989.

6. "Interactive Graphics Roadway Design System." California Department of Transportation, CADD Development Unit, January 1989.

7. "The Role of IGrds™ in the Design of Texas Highways." Report No. 1241-1. Texas Department of Transportation, January 1991.

8. "IGrds™ Practice Problems." Report No. 1241-2. Texas Department of Transportation, June 1991.

APPENDIX A.

SURVEY QUESTIONNAIRE AND COVER LETTER

Date

RE: Development of IGrds Training Materials

Dear :

The Texas Transportation Institute, in cooperation with SDHPT D-19, is attempting to develop new IGrds self-instruction training materials for use by SDHPT engineers and technicians. Mr. Cliff Powers recommended you as a candidate for an interview by TTI. Your responses to the questions asked will be used as the basis for the development of the type of training materials and the topics to be addressed. Your input, therefore, is critical to the success of the project.

We will call you in the near future to arrange a convenient time for a telephone interview. In order to make the interview process as easy for you as possible, I have attached the questionnaire we will follow during the interview. You do not need to write out your answers or return the questionnaire to me. Instead, simply review the questions to become familiar with the type of information we will be asking you about during the telephone interview.

I certainly appreciate you willingness to cooperate with us in this worthwhile project. We look forward to contacting you in the near future.

Sincerely,

Raymond A. Krammes, Ph.D., P.E.
Assistant Research Engineer
Co-Principal Investigator

JDB/sp

Project Questionnaire - Technicians/Operators
SDHPT - Project 1241 Development of IGrds Training Materials

Background Information

1. What is your present position? How long? What are your responsibilities?
2. What is your educational background?
3. What role does Intergraph equipment (and IGrds specifically) play in your present position? How many hours per week (on average) do you work on Intergraph? What do you use it to do?

IGrds Training Information

1. What formal training have you received in the use of IGrds?
2. What exposure to IGrds did you have before the formal training?
3. What computer training or experience did you have prior to working with IGrds?
4. What design experience did you have prior to working with IGrds?
5. What was good/bad about the training you received?
6. What written training materials were used? What was good/bad about the written training materials?
7. What "hands-on" exercises were used? What was good/bad about these exercises? Did they give you the kind of experience you need in your job?
8. What IGrds reference manuals do you have in your office? How often do you refer to them? What type of information do you most frequently look for in the IGrds reference manual (e.g., command groupings, operating sequences, active attributes, command descriptions, glossary)? What is good/bad about the IGrds reference manuals? Is it easy to find answers to your questions?

Preferred IGrds Training Media

1. What suggestions do you have for improving IGrds training courses, training materials, lab exercises, and reference manuals? What kind of information do you desire to have available to you? What methods of presentation (videotape, on-screen tutorials, etc.) would be most effective?
2. How do you prefer to learn? By reading, listening, watching, or practicing? To learn how to use IGrds, are hands-on exercises helpful?
3. Could you learn how to use IGrds by watching proper procedures demonstrated on a videotape?
4. Would an on-line, interactive simulation be helpful in learning specific IGrds tasks?
5. Could you learn how to use IGrds through self-study materials taken in your office, or would you prefer to learn at a location away from your office?
6. When you are practicing IGrds tasks in a learning environment, is it important to receive immediate feedback on how well you are doing?

Project Questionnaire - Supervisors
SDHPT - Project 1241 Development of IGrds Training Materials

Background Information

1. What is your present position? What are your responsibilities in that position?
2. What is your educational background? Design background? Computer background?
3. What role does Intergraph equipment (and IGrds specifically) play in your present position? Do you use it personally? Do people you supervise use it? How many people use it? How extensively? And, what do they use it to do (e.g., design, drafting, plan preparation)?

IGrds Training Experience

1. What formal training have you personally received in the use of IGrds?
2. Did the training that you received teach you what you need to know in your position? What part of the training was useful to you? What wasn't useful? What kind of training did you need that wasn't provided?
3. What training in the use of IGrds have the people you supervise received?
4. How effective was the training they received? What did they learn that was useful? What did they learn that wasn't useful? What didn't they learn that they need to know?
5. Were the written training materials helpful to you during the training process? To the people you supervise?
6. What types of problems do you and the people you supervise encounter in using IGrds? How do you/they resolve those problems? Are the reference manuals and written training materials easy to use when you encounter problems?

IGrds Preferred Training Media

1. What suggestions do you have for improving the Department's IGrds training courses, training materials, and reference manuals in order to make your section's use of IGrds more productive?
2. How do you prefer to learn? By reading, listening, watching, or practicing? To learn how to use IGrds, are hands-on exercises helpful?
3. Could you learn how to use IGrds by watching proper procedures demonstrated on a videotape?
4. Would an on-line, interactive simulation be helpful in learning specific IGrds tasks?
5. Could you learn how to use IGrds through self-study materials taken in your office, or would you prefer to learn at a location away from your office?
6. When you are practicing IGrds tasks in a learning environment, is it important to receive immediate feedback on how well you are doing?