June 2005

The North Carolina Department of Transportation

Plan Reading Course

EMPLOYEE'S NAME

PLAN READING COURSE

SSC 030

JUNE 2005

This course is designed to be completed in three months.
Your completion date is _____.

Materials needed: Lead Pencil
Engineer's Scale (Either triangular or flat)

ACKNOWLEDGEMENTS

This course was developed by the North Carolina Department of Transportation (NCDOT) because of a determined need for Highway Personnel to be able to read, interpret, and relate to a standard set of highway construction plans.

Several sources were consulted during the development of this Plan Reading Course.

Special thanks to the various branches and units responsible for the 2005 update of the Plan Reading Course. The branches and units consist of: Roadway Design Unit, Geotechnical Engineering Unit, Location and Surveys Unit, Structure Design Unit, Hydraulics Unit, Roadside Environmental Unit, Construction Unit, Training and Development Section, Traffic Control Unit, Traffic Engineering and Safety Systems Branch, and Right of Way Branch.

PURPOSE OF THE COURSE

Objectives – The objectives of this Plan Reading Course are to present a step by step procedure to:

1. teach you how to read, interpret, and relate to a standard set of highway construction plans;
2. help you identify and interpret symbols used in a standard set of plans; and
3. interpret a set of plans in non-technical terms to laymen (property owners and others).

Scope - The Plan Reading Course is different from the ordinary "textbook", with which you may be familiar. The subject matter is arranged so that the student may work at his/her own pace. Each part of the course builds on the information that precedes it and prepares you for the information that follows. Most of the sections present new information. Some sections review important facts that have been introduced to you earlier in the course.

Application - This self-instructional Plan Reading Course has four distinct applications:

1. As a highway Plan Reading Course for presently employed personnel in Roadway Design, Structure Design, Construction, Right of Way and Utilities.

2. As a training course in Plan Reading for new employees.

3. As a refresher course for existing employees.

4. As a highway Plan Reading Course for any highway employee whose duties involve the reading and interpretation of highway plans

Upon *completion* of this Plan Reading Course, a comprehensive examination will be given to the student. If the student passes the comprehensive examination, other applicable courses, which are a continuation of specific information for technicians in Construction, Roadway Design, Structure Design, Location and Surveys, and Traffic Engineering, may be requested. Right of Way personnel will end their study of plan reading at the end of this course.

HOW TO USE THIS MATERIAL

Start at the beginning. Even though you might already know some of the basic information, it will be a good review for you to start on Page 1-1 and work your way through the book. Make certain you thoroughly understand what you are doing before going on to the next part of the book.

Complete each of the questions in this book and check your answers in Appendix G. If you miss an answer, be sure to go back and study the information that you missed. **NEVER LEAVE AN ANSWER WRONG** - research studies show that once you learn incorrect information, it is difficult to go back and re-learn the information correctly - so **CORRECT ALL ERRORS** that you make.

This book has been assigned to you, an employee of the North Carolina Department of Transportation and becomes your property. When you finish this course, it is suggested that you keep this book as a reference source, or use it later as a "refresher" course in highway Plan Reading.

This course contains two different parts:

One - The MANUAL you are now reading.

Two - PLAN SHEETS – The construction plans are assembled from a combination of two (2) sets of plans, U-2582B and U-2582A. This is a ***partial*** set of construction plans and the selected sheets are bound together in the order of their plan sheet numbers, with the U-2582A Structure Plans, in the back of the bound set. The following plan sheets should be included:

Plan Sheet Number	**Plan Sheet**
1	Title Sheet
1A	Index of Sheets
1B	Conventional Symbols
2, 2A	Typical Sections
2G, 2H	Detail of Guardrail Placement
2M, 2N	Cable Guiderail
3 (both sheets)	Summary of Quantities
3A, 3B, 3E	List of Pipe, Endwalls, etc.
3F	Guardrail Summary
3G	Double Face Cable Guiderail Summary
3H	Summary of Earthwork
4-9, 12, 13	Plan Sheets
18 thru 20	Profile Sheets
TCP-1 thru TCP-5	Traffic Control Plans
PM-1 thru PM-2	Pavement Marking Plans
EC-1, 6, 16	Erosion Control Plans
RF-1	Reforestation Plans
SIGN-1 thru SIGN-2, 5, 9, 11	Signing Plans
SIG. 1, 10, 12, 18, 28	Signal Plans
UC-1 thru UC-3	Utility Construction Plans
UO-1 thru UO-2	Utility By Others
X-30 thru X-35	Cross Sections
C-5 thru C-7	Culvert Plans
S-1, 5, 12, 25-28	Structure Plans

LOOK TO BE SURE YOU HAVE THESE. LOOK NOW.

NOTE: A complete set of construction plans is available that covers the entire project.

GET SET

You will learn to read plans by actually doing just that. This course manual will show you how. Your sample plan sheets have been **reduced to half their original** size. This is done so you can handle them easily -keep this fact in mind as you read the sheets.

Be sure to **FOLLOW THE DIRECTIONS CAREFULLY**. Do exactly what the book tells you to do -try not to skip anything. Even though you may know some parts of this book, it will be good review for you.

ARE YOU READY? Get a couple of pencils with erasers on them and begin. Try to devote as much of your spare time as you can for this course. If you "layoff" a week or so, you may have to start over again - so devote as much time as you can for as many evenings as you can until you complete the course.

GOOD LUCK!

GOOF SHEET

While studying this course, you will aid future students and contribute to the improvement of instructional material by recording on this sheet any technical mistakes and printing errors that you encounter.

INSTRUCTIONS:

1. As you work through the course, record mistakes and printing errors as you encounter them.

2. If you record any mistakes or printing errors, return this sheet to us.

3. Do not use this sheet for asking questions or making comments that require a reply. Please write a separate letter for such questions or comments.

4. Do not use this sheet for comments and opinions on the quality of the course. An evaluation questionnaire is included with the course for that purpose in Appendix H.

I noted the following mistakes and/or printing errors.

Page #	Paragraph	Remarks

Use additional sheets if necessary.

Please mail this sheet to:

ATTN: DOT Training Section
State of North Carolina
Department of Transportation
Box 25201
Raleigh, NC 27611

SPECIAL NOTE REGARDING A SET OF PLANS

Although not a part of the drawings, the Specifications, Supplemental Specifications, Standard Special Provisions, and all supplementary documents are essential parts of the contract, and a requirement occurring in one is as binding as though occurring in all. In case of discrepancy,

- calculated dimensions shall govern over scaled dimensions;
- supplemental or special provision specifications shall govern over standard specifications;
- plans shall govern over supplemental specifications and standard specifications;
- standard special provisions shall govern over plans, supplemental specifications, and standard specifications; and,
- project special provisions shall govern over standard special provisions, plans, supplemental specifications, and standard specifications.

SAFETY

As an employee of the North Carolina Department of Transportation, it is your responsibility to direct your concern to one goal - to provide the traveling public with the best and safest roadway system that can be constructed. With this goal constantly in mind, it is the responsibility of each Department of Transportation employee to observe, suggest, and act to achieve a safe system of roadways throughout the State. Regardless of a specific assigned duty, it is the responsibility of all employees of the North Carolina Department of Transportation (NCDOT) and Division of Highways (DOH), to call to his/her supervisor's attention, any item, whether in design or construction, that appears to be an obvious hazard to the traveling public or to the health and safety of other state employees. Safety is our business and will remain as one of the primary factors in designing and constructing a highway.

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APPENDICES

CHAPTER ONE: TITLE SHEET AND STATIONING

A. TITLE SHEET (Identification)

The Front Sheet on a set of plans is called the **TITLE** SHEET. It tells you the Title (or name) of the project (roadway or structure to be built). It shows you the geographical location of the project, what the project consists of (grading, drainage, paving, culverts, etc.), design data, length of roadway, length of structures (bridges or culverts over 20' wide), and the total length of the project in miles.

1. DESCRIPTION

Open your sample set of plans (TIP # U-2582B) to the **TITLE SHEET** and read the following **description** of the project:

STATE OF NORTH CAROLINA

DIVISION OF HIGHWAYS

WAKE COUNTY

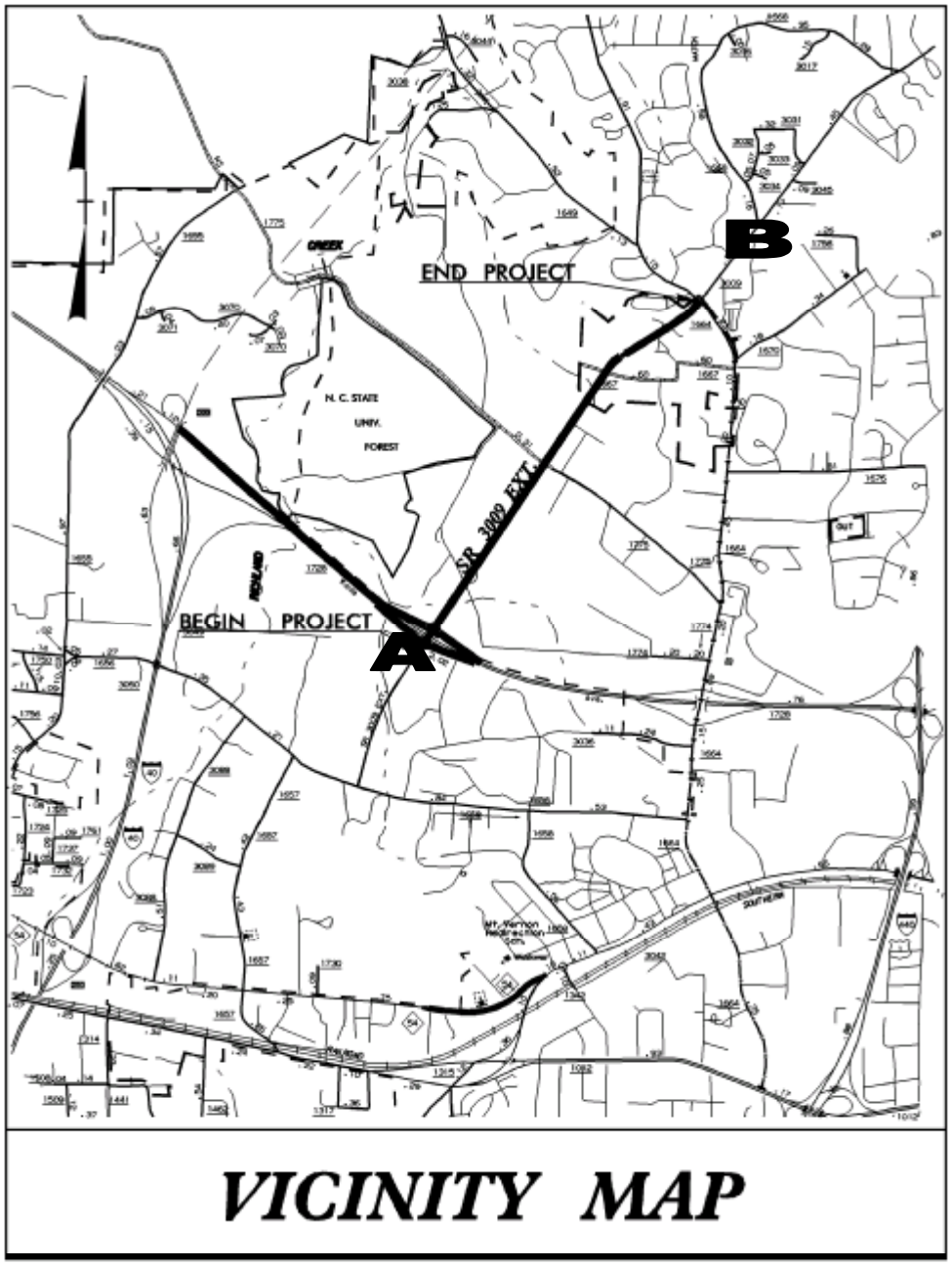
LOCATION: ***EDWARDS MILL ROAD EXTENSION (SR 3009) FROM SOUTH OF WADE AVENUE (SR 1728) TO DURALEIGH ROAD (SR 1664)***

TYPE OF WORK: ***GRADING, PAVING, DRAINAGE, CULVERTS, SIGNING, AND SIGNALS***

*Note: For unfamiliar words or terms, turn to Appendix D.

2. LOCATION MAP

In the upper left corner of the Title Sheet is a **VICINITY** MAP of the general geographical area of the project. This map shows the beginning and the ending of the project.

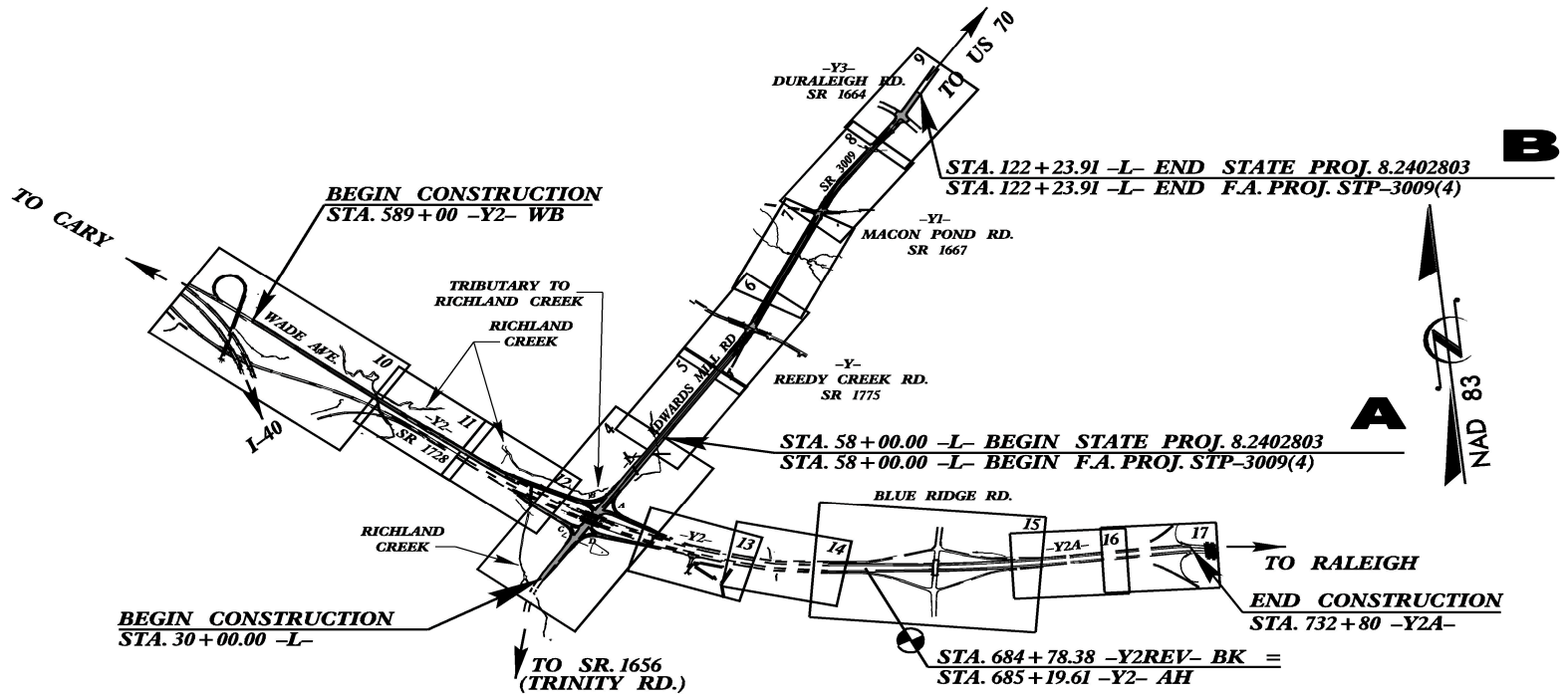


VICINITY MAP
OF
PROJECT 8.2402803, U-2582B

A. Beginning of the Project
B. Ending of the Project

3. LAYOUT VIEW

In the center of the Title Sheet, is a LAYOUT VIEW. This View shows the beginning station' A' and the ending station' B' of the project.



A. Beginning Station of the Project (Sta. 58+00.00 -L-)

B. Ending Station of the Project (Sta. 122+23.91 -L-)

Note: The Layout above is a "PLAN VIEW" of the project. You will be exposed to a PLAN VIEW later in this book. If you were flying in an airplane over this project and looked down, this graphic representation or the PLAN VIEW is what you would see. Also note that certain parts of the project are "blocked off" and each "block" is given a number in its upper right corner. These "block" numbers are the numbers of the Plan Sheets. For example, if you wanted to see a detail of the Interchange area, you would turn to Plan Sheet 4 in your Sample Set of Plans. (See the number 4 in the upper right corner of the "block").

4. PROJECT IDENTIFICATION

Now look in the upper right corner of the Title Sheet and see the box like the one shown below. Each Title Sheet on a set of plans has a similar box for standard identification of a set of plans for a given project.

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	U–2582B	D 1	

STATE PROJ. NO.	F. A. PROJ. NO. C	DESCRIPTION
A 8.2402802	MASTP–STP–3009(3)	P.E., R/W, UTILS.
B 8.2402803	STP–3009(4)	CONST.

A. This is the number assigned to this particular project and indicates that number is to be used for preliminary engineering (P.E), right of way (R/W), and utility (UTILS.) costs.

B. This is the number assigned to this particular project and indicates that number is to be used for construction (CONST.) costs.

C. These are numbers assigned to this particular project and indicate that the Federal Highway Administration (FHW A) is participating in this project.

D. The Title Sheet will always be SHEET #1 of any project. When you are referred to a Plan Sheet, this is where you should look for the plan sheet number.

Now look at the left margin of the Title Sheet. The Project Number is written in the lower left margin and the Transportation Improvement Program (TIP) Number is in the upper left margin. Projects are more commonly referred to by the TIP Number for Design and Project Number for Construction.

*Note: For unfamiliar words or terms, turn to Appendix D.

5. SPECIFICATIONS & APPROVALS

Look next at the lower center part of the Title Sheet and see:

1995 STANDARD SPECIFICATIONS

This statement means that the Standard Specifications for Roads and Structures of the North Carolina Department of Transportation and Division of Highways, including changes and supplemental specifications listed in the proposal, govern this project. The 1995 Specifications are to be used with this set of plans, even if more recent standard specifications have been issued.

Also in the lower center of the Title Sheet is the name of the Project Engineer and the Project Design Engineer that prepared this set of plans and the letting date for the particular project.

APPROVALS - Along the lower right side of the Title Sheet, you will find where this set of plans has been approved by the State Design Engineer.

Approval of the roadway design by the Roadway Design Engineer and hydraulic design by the Hydraulics Engineer are also located here.

F.H.W.A. **APPROVAL** – In the lower right hand corner of the Title Sheet, a space has been provided for the approval signature of the appropriate Federal Highway Administration official.

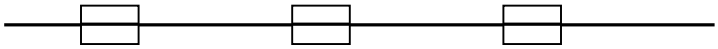
6. INDEX OF SHEETS

The Index of Sheets shows a list of each sheet or series of sheets in the entire set of plans. See Sheet No. 1A in the plans.

7. CONVENTIONAL SYMBOLS AND ABBREVIATIONS

Conventional Symbols

Look next at the Conventional Symbols located on Sheet 1B. These Conventional Symbols will always be the same on any set of plans you might see. For example, the symbol for a proposed chain link fence will always look like:



Highway plans are a means of communicating the thoughts of the designer to other interested parties. Each symbol on a set of highway plans is important to the engineer, technician, or person who uses the plans. One need not be an engineer to read plans, but it is necessary to learn the meaning of **CONVENTIONAL SYMBOLS** used in order to understand what the plan means.

For a more complete listing of Conventional Symbols, see Sheet 1B in the plans.

Abbreviations

It is often necessary to abbreviate words on plan sheets. Some standard abbreviations are:

ABC	=	Aggregate Base Course
RCP	=	Reinforced Concrete Pipe
C&G	=	Curb and Gutter
CL. 'B'	=	Class B Stone
R/W	=	Right of Way
EMBT	=	Embankment
PDE	=	Permanent Drainage Easement

If you run across an abbreviation you don't understand, turn to Appendix E in the back of this book.

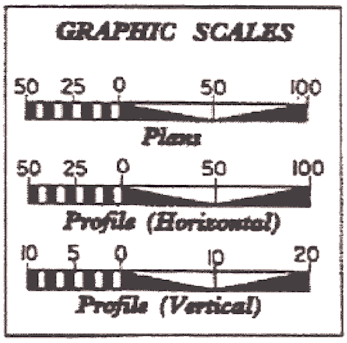
Use Sheet 1B and Appendix E to complete these questions:

The symbol △ means: _____
The symbol ◊ means: _____
JB is an abbreviation for: _____
Topo is an abbreviation for: _____

Now turn to Appendix G (page G-1) in the back of this book and check your answers.

8. GRAPHIC SCALES

Look next at the **GRAPHIC SCALES** on the Title Sheet (lower corner). The items and lines on plan sheets are drawn to "scale" or exact length so that they represent a real distance on the ground or a **dimension** of a real object.



On **"full-size plan"** sheets, the scale is:

Plan Sheet		1" = 50 feet; 1" = 20'; or 1" = 100'
Profile Sheet	(Horiz.)	1" = 50 feet or 1" = 100'
	(Vert.)	1" = 5 feet or 1" = 10'

The original plans for this project have a scale of 1" = 50'. Therefore, on these ½ size sheets, ½" = 50 feet and 1" = 100 feet (Plans). This ½ reduction applies to all scales on your sheets. Since there may be some distortion in the reduction process, you should measure by the ***Graphic Scale*** on the Title Sheet.

See if you can answer these questions on scales:

1. If 1" = 100' then 4" = _____
2. If 1" = 10' then ½"= _____
3. If 1" = 1000' then 2 ½"= _____
4. If 1" = 100' then 3 ¼"= _____

Turn to Appendix G (page G-1) in the back of this book and check your answers. If you missed more than one question, turn to Appendix F for some more help on scales.

9. DESIGN DATA

The design of a highway is based on traffic data for that particular highway.

The DESIGN DATA appears on the TITLE SHEET. Look at your ***Title Sheet*** and see the following information:

DESIGN DATA

ADT 2000	**=**	**20,300**
ADT 2025	**=**	**49,100**
DHV	**=**	**11 %**
D	**=**	**62 %**
T	**=**	**5 % ***
V	**=**	**50 mph**

*** TTST 2 % DUAL 3 %**

See Appendix D for definitions of terms.

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10. PROJECT LENGTH

The length of each project appears on the Title Sheet (see lower center). The length is normally shown for the roadway, the structures, and combined roadway-structure length.

11. CONTROL OF ACCESS

A note appears on the Title Sheet stating the type of controlled access. *"This is a controlled access project with access being limited to interchanges."* Or, *"This is a partial controlled access project with access being limited to points shown on the plans."* No note is required for a non-controlled project. This is a non-controlled project; therefore no note is shown.

12. GENERAL NOTES

Turn to Plan Sheet 1A. This sheet shows the *General Notes* (in the center) which contain information that cannot be shown by a "picture" in other sections of the plans.

B. STATIONING

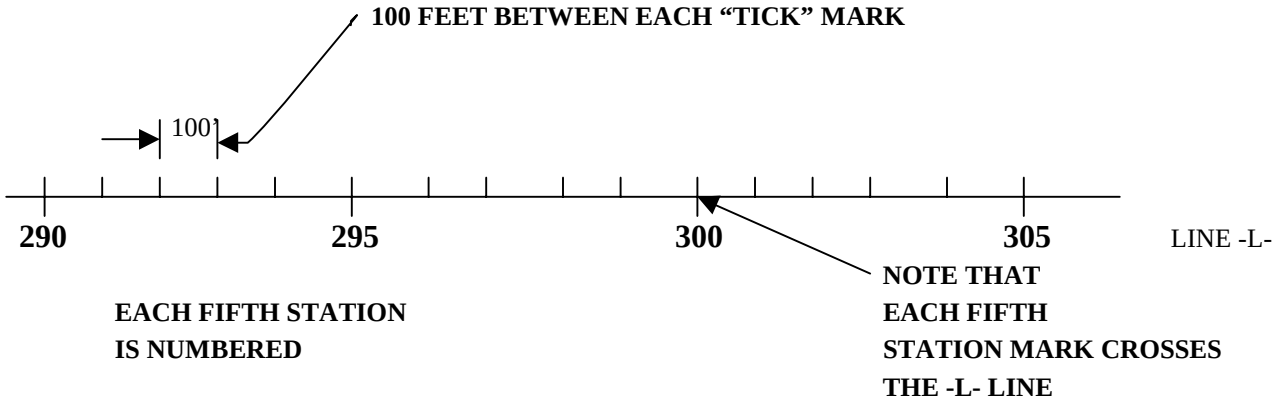
Since STATIONING is fundamental to highway plans, a discussion of ***stationing*** should be offered before you get involved with the plans. A station is the HORIZONTAL UNIT OF MEASUREMENT along the SURVEY LINE of a project, and is defined as 100'. Distances are measured and points are identified on plans with reference to *station numbers.* Highway stationing might be compared with a rope having knots at 100-foot intervals. The beginning end of the rope being Station 10+00, the first knot at 100 feet being Station No. 11+00, and so on.

Station numbers usually ***increase*** from the beginning of the project to the end of the project. Also, stationing usually runs from the ***South to the North*** or from the ***West to the East.***

The beginning station of a project is usually arbitrary. It quite often will start with 10+00 or 100+00.

Since all "items" on the PLAN are referenced to the SURVEY LINE, any particular item can be located by giving its stationing and the perpendicular distance left or right of the SURVEY LINE.

The length of the project may be determined by subtracting the beginning station from the end station and multiplying by 100. For instance, if a project *begins* at station 650+00 and *ends* at station 920+00, the length is (920 - 650) x 100 = 27,000 feet. This length can easily be converted to miles by dividing 5280 feet per mile.



* Note: The survey line is indicated on plans as either: Survey Line, Line -L-, or Centerline.

THINK of STATIONS in this way:

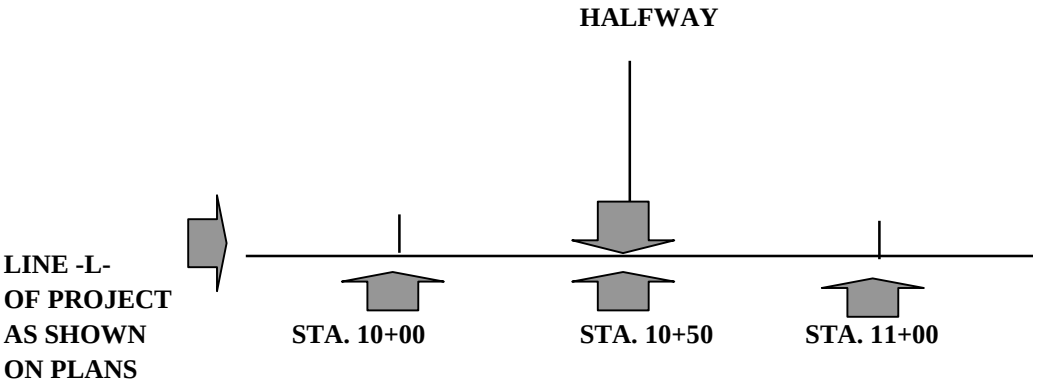
Just as 12 inches make 1 foot, 100 feet make 1 station. It is 100 feet from Station 1+00 to Station 2+00, or from Station 493+00, to Station 494+00, etc.

Write the answer:

How many feet make 1 station? _____

Did you write 100 in the blank above? If not, do that now.

Since it is 100 feet from one station to the next, 50 feet is halfway from one station to the next. To show this location, you must write +50 after the station number.



Any point between two stations is shown in the same way. For example, 2 feet ahead of Station 10+00 is written Station 10+02. Numbers less than 10 are indicated as 01, 02, 03, etc., and 99 feet ahead of Station 10+00 is written as Station 10+99. 100 feet ahead of Station 10+00 is Station 11+00. To show that a point is exactly on a station, +00 is usually written after the station number. This means plus "no" feet.

To find the distance between two stations, simply subtract the lower station from the higher one, IGNORING THE PLUS SIGN. You'll get the answer in feet.

To find the distance from Station 20+60 to Station 12+80, you can write the numbers like this:

$$\begin{array}{r} 2060 \\ -1280 \\ \hline 780 \text{ feet} \end{array}$$

It is 780 feet from Station 20+60 to Station 12+80. To check this:

From Station 12+80 to 13+00	=	20 feet
From Station 13+00 to 20+00 (7 stations)	=	700 feet
From Station 20+00 to 20+60	=	60 feet
Total		780 feet

You do these:

1. The distance from Station 14+10 to 15+00 is _____ feet.

$$\begin{array}{r} 1500 \\ -\ 1410 \\ \hline \end{array}$$

2. The distance from Station 80+10 to 85+20 is _____ feet.

3. The distance between Station 48+76.2 and Station 51+24.8 is _____ feet.

Turn to Appendix G (page G-1) and check your answers. Did you answer each question correctly? If not, find your mistake and correct it.

On the Plan Sheets, the ***Station Numbers*** are usually written along the ***Survey Line***. Stationing is sometimes along a *baseline*, or along one lane of a multiple lane highway. On a project, **AHEAD** means in the direction in which Station Numbers ***increase*** (usually toward the **END** of a project). **BACK** means in the direction in which Station Numbers ***decrease*** (usually toward the **Beginning** of the project).

Look at your **TITLE SHEET** again at the "Project Layout". Note that this Project begins at Station 58+00.00 (some minor construction begins behind at Station 30+00.00) and ends at Station 122+23.91.

1. How far is it from Station 65+00 to Station 66+00? _____ feet

2. How far is it from Station 58+00 to Station 58+69? _____ feet

3. How far is it from Station 78+84.44 to Station 99+59.95? _____ feet

4. What is the Station number of a point on Line -L- 50 feet AHEAD of Station 75+00?
   _____

5. What is the Station number of a point 50 feet BACK of Station 75+00?
   _____

6. What is the distance between Station 60+50 and Station 61+50?
   _____

Now turn to Appendix G (page G-1) and check your answers. Never leave an answer wrong - ALWAYS correct a wrong answer.

Generally station numbers progress (increase) from **WEST to EAST** or from **SOUTH to NORTH**. Since highways curve and change direction, the above statement is not always true on any one segment of the road.

REMEMBER!

When you say ***AHEAD*** *you* mean towards a higher or "up" station.

When you say ***BA CK*** *you* mean towards a lower or "down" station.

1. BASELINE SURVEYS

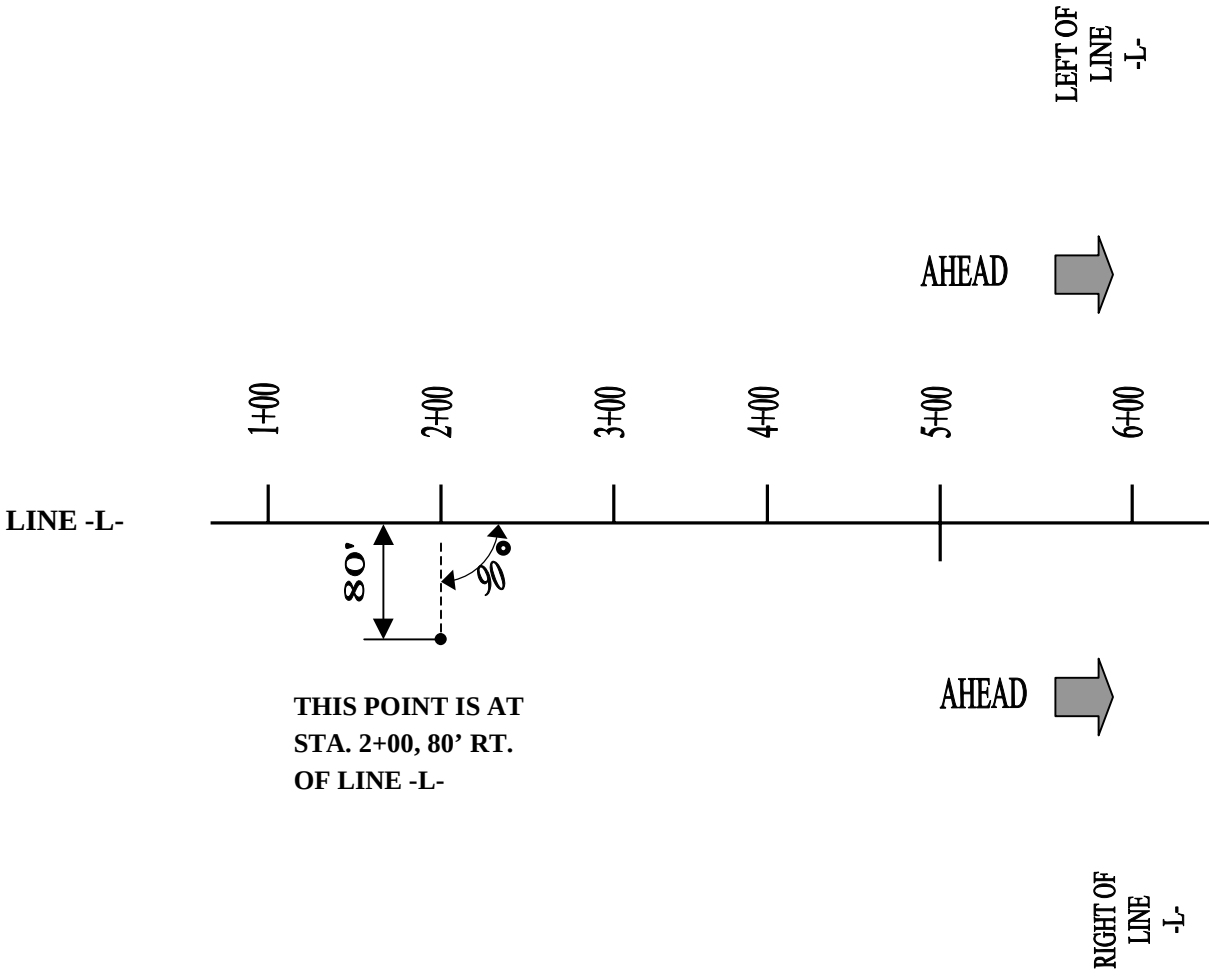
On all new project surveys, the Location & Surveys Unit is generating ***baseline surveys***. The purpose of baseline surveys, as opposed to traditional alignment surveys, is to reduce the amount of time spent *hubbing*, *staking* and profiling a proposed alignment, which may be revised. Baseline surveys also provide the ability to traverse around an object (tree or building) rather than stake an alignment through these objects. The Route Location engineer and the field crew are free to concentrate on the important aspects of the survey (data collection, accuracy, thoroughness of data, etc.) rather than concerning themselves with setting points at specific locations, or staying out of traffic on a busy road.

Most baselines consist of baseline PIs/control points and connecting tangents. They are normally located near the existing or proposed alignment. Baseline PIs/control points are identified with a solid black diamond. They are labeled with the baseline PI number, baseline station, offset distance from the associated design line measured perpendicular from the design line, and the corresponding design line station. Normally only the baseline PIs are on final construction plans without the connecting tangents; while both tangents and baseline PIs may be present on earlier stages of the plans.

*Note: For unfamiliar words or terms, turn to Appendix D.

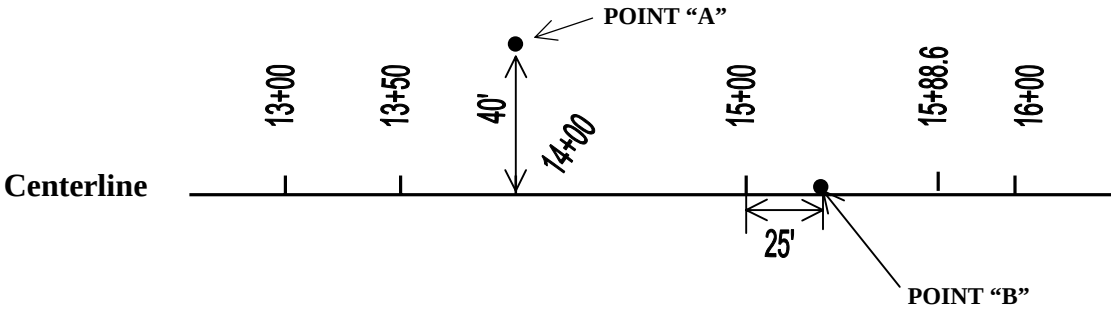
Any point pertaining to a project may be located on the ground and on the plans by its Station and the number of feet **LEFT or RIGHT** of (-L-) the survey line. Left and Right of (-L-), the survey line is oriented as if you were facing **AHEAD.**

See this below:



2. QUESTIONS ON STATIONING

Do **NOT** look back at any pages in this manual until you have written the answers to all the questions below. Refer to the sketch below as needed.



1. What is the station location of Point A on the sketch above? _____

2. What is the station location of Point B on the sketch above? _____

3. Station numbers generally increase toward the _____

4. How far (in feet) is Sta. 15+88.60 from Sta. 15+00? _____

5. Is Sta. 13+00 ahead of or back of Sta. 14+00? _____

6. How far is it from Sta. 13+50 to Sta. 16+00? _____

Turn to Appendix G (page G-1) and check your answers very carefully. If you make a mistake, go back and review the pages that presented that part. Be sure you **UNDERSTAND** any corrections you make.

3. DETERMINATION OF THE PROJECT LENGTH

WITH THE INTRODUCTION OF BASELINES, you can subtract the beginning station from the end station and have the length of the PROJECT in feet.

A project ends at station	701+50.00
It begins at station	409+69.00
	291+81.00 feet

You can change feet to miles as follows:

$$29{,}181 \text{ ft.} \times \frac{1 \text{ mile}}{5{,}280 \text{ ft.}} = 5.527 \text{ miles}$$

Number of feet in one mile:

5,280 feet = 1 mile

NOW, calculate the roadway length of this project.

Project ends at station _____

Project begins at station _____

Change feet to miles:

_____ feet X $\frac{1 \text{ mile}}{5{,}280 \text{ ft.}}$ = _____ miles

Verify this length with the length of roadway shown on the **Title Sheet**.

CHAPTER TWO: VIEWS

A. VIEWS

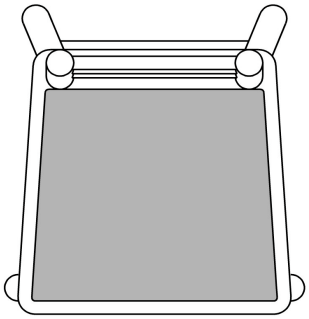
Before going any further, you need to know more about the different viewing angles from which various things are shown in a set of plans. A **VIEW** is the way you look at or "see" the different items that are shown on a set of plans.

A ***view*** may show something observed from the inside or from the outside. These views are drawn to give you clear and complete pictures of how the fence, pipe, ditch, culvert, etc., should be built or placed. To get the information you need, you must be able to look at the view and "see" what is being pictured. You need to know from which angle the item is shown. To help you do this, this page and the next show an item that you are familiar with - a chair. Because you already know what a chair looks like, you should have no trouble with the various views shown.

This is a ***PLAN*** showing a chair

1. A PLAN VIEW - is a view from directly ***ABOVE*** the object.

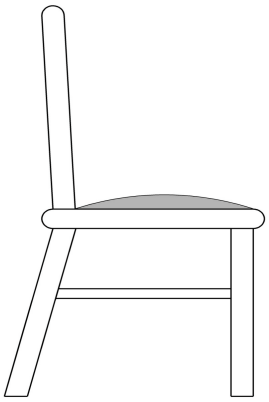
(A Top view looking ***DOWN*** on the chair)



Some parts of the chair you would *NOT* see. (The legs and cross-pieces would be hidden by the seat and you would not see them.)

Now look at the set of plans you were given with this material. The first sheet or ***TITLE SHEET*** (Sheet No.1) shows a ***PLAN VIEW*** of the entire project. If you were flying an airplane high over this project and looked down, the ***PLAN VIEW*** *is* what you would see.

2. SIDE ELEVATION

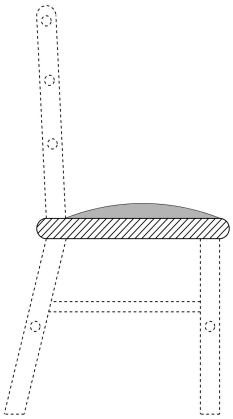


3. REAR ELEVATION

These views show the ***elevation*** (height) of the chair from the ***side*** and ***rear***. The view might also be shown from the other side or from the front.

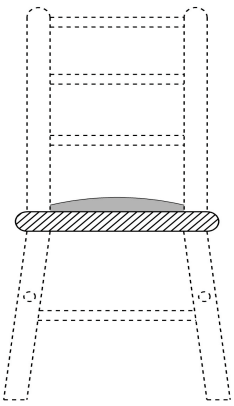
4. LONGITUDINAL CROSS SECTION

(Sliced Lengthwise)



As you face the side of the chair, a section has been "sliced" away. You see the inside of the seat from the side. Also note the inside of the cross-pieces at the top and bottom of the chair.

5. FRONTAL CROSS SECTION



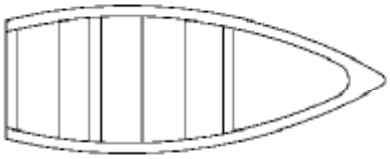
As you face the front of the chair, a section has been "sliced" away. Here the chair was sliced across the seat. You see the layers (cushions and seat) inside the seat. The rest of the chair, shown by the dotted lines is ***behind*** the point where the "slice" was made.

Below is an **OLD BOAT**. Five views are shown of it. **WRITE** the name of the view above each one. HERE ARE THE NAMES: "CROSS SECTION", "LONGITUDINAL CROSS SECTION", "PLAN", "REAR ELEVATION", “SIDE ELEVATION".

FIT THE VIEW TO THE BOAT! Look back on pages 2-1 and 2-2 if you need to.

1. _____

(Fill In)



(Hint From the top)

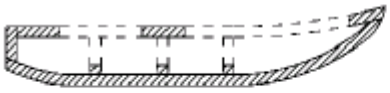
2. _____

(Fill In)

(Hint A section has been sliced away, cross the boat)

3. _____

(Fill In)



(Hint–A section has been sliced away, longways)

4. _____

(Fill In)

(Hint–You're looking at it from the side)

5. _____

(Fill In)

(Hint–Rear view)

Turn to Appendix G, page G–1

If you missed any of the names of the views on the preceding page, be sure you **CORRECT** them. Make sure you **UNDERSTAND** your corrections. If you need to, turn back and read pages 2-1, 2-2, and 2-3.

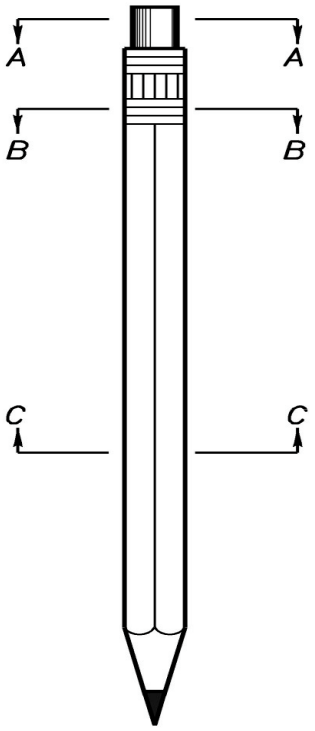
When you are reading plans, you will not be required to name the views. However, you should know what the names ***mean*** so that when looking at a plan, you will know whether you are seeing the item from the ***REAR*** *(rear* elevation), from the ***INSIDE*** (cross section), etc. This will help you "see" the item better.

Of course, the actual views on a set of plans also give dimensions, materials used in construction, and many other construction details.

The ***ELEVATIONS*** generally show the item from the ***OUTSIDE***. These views are usually very clear drawings, almost like a picture.

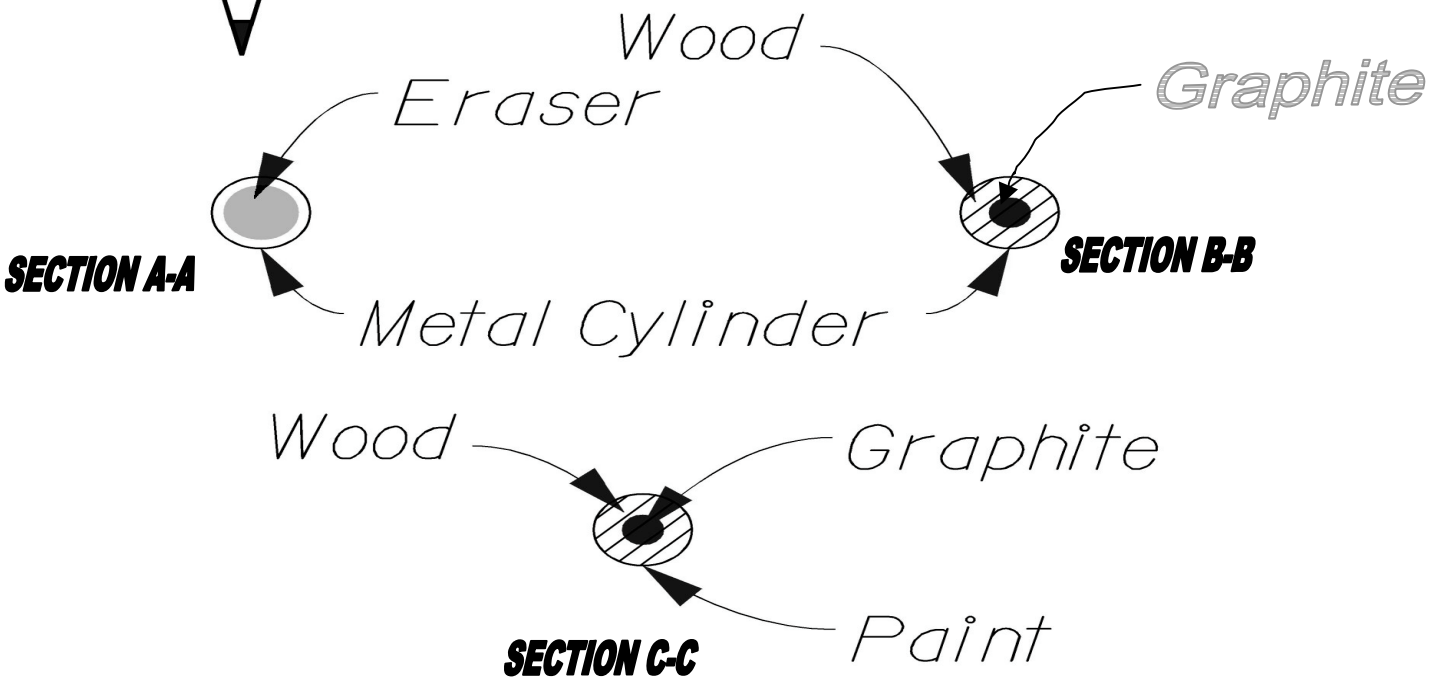
The ***CROSS-SECTIONS*** always show an inside view --something has been "sliced" away to show you how the inside part should be. These slices may be made at any point and would be compared to cutting an apple into two parts with a knife. The next pages show you how you can generally tell where the section is (where the "cut" was made).

Suppose for example, sections of a pencil were used to show the inside materials at different places along the length. See how this is shown below.



The lines between the letters A–A, B–B, and C–C show where the section is taken. The arrows on the ends of the lines like these, ⌐¬, show which way you're looking toward when you look at the section.

The sections, labeled A–A, B–B, C–C, etc to correspond with the letters on the overall diagram, will always be close by. See Below



Write the answers to the following questions by looking at the "pencil" on the preceding page. (Page 2-5).

1. Consider the eraser end the "back" of the pencil and the pointed end the "front". Is elevation A-A looking toward the back or the front of the pencil? _____

2. What direction are you looking toward in section B-B? _____
   In section C-C? _____

3. In section C-C, what material is shown in the center of the pencil? _____ What material surrounds the graphite? _____

4. In Section C-C, is the graphite in front of or behind the eraser? _____

Now turn to Appendix G (page G-l) and check your answers. Correct any errors - be sure you understand your corrections.

B. TYPICAL SECTIONS

The **TYPICAL SECTION** is a picture, with dimensions, of how a cross-sectional view of the roadway would appear after construction of the roadway is completed.

On the following page is an idealized roadway typical section with the various elements identified. Study this drawing and become familiar with the various items that are identified.

Now turn to **PLAN SHEET 2A** and look at Typical Section No. 2. Here are some of the significant features you should know about a Typical Section:

1. This is a multi-lane divided roadway with curb and gutter (R1) on the outside.

2. The ***travel lane*** on each roadway is 12' wide.

3. There is a 12' *paved shoulder (12' PS)* on the outside of each roadway and a 12' raised island cover (R4) in the median.

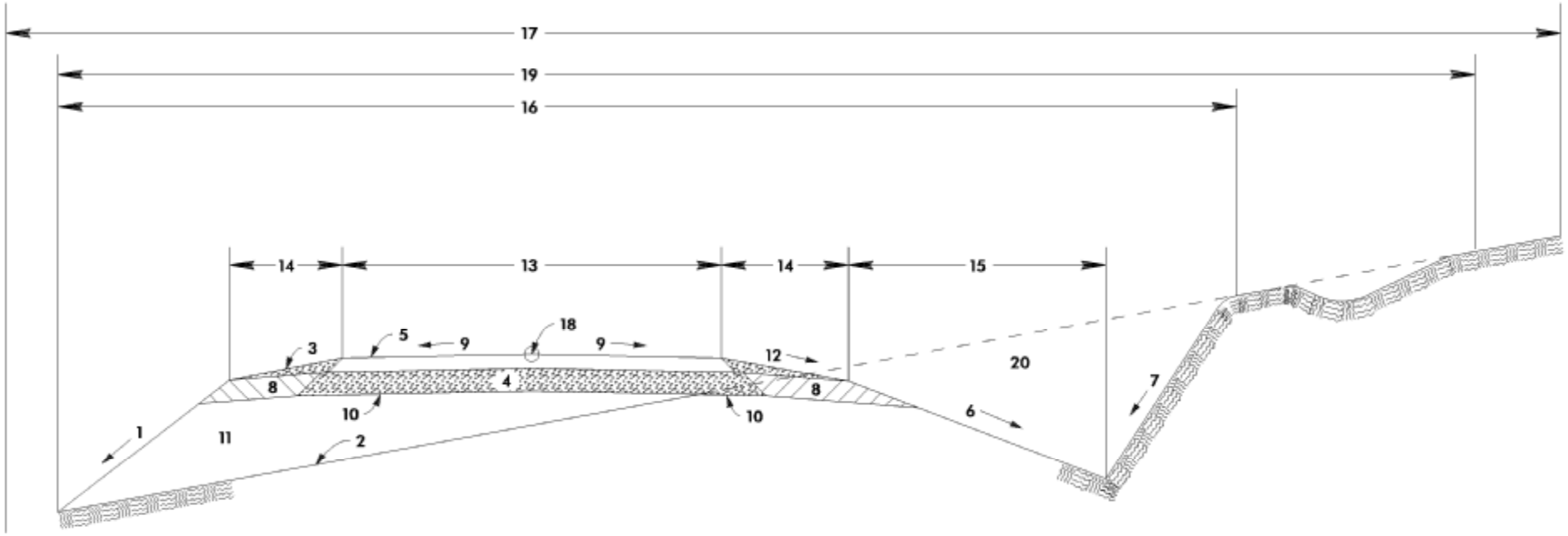
4. The ***Grade Point*** *is* at the median edge of pavement.
   (Note: On Typical Section Nos. 3 and 4, the grade point is at the centerline of the median.)

5. The ***location*** *(stations)* where the typical section is to be used is shown.

6. The ***slope*** of a roadway section consists of both the horizontal and vertical components. For example, a 2:1 slope indicates a horizontal component of 2 and a vertical component of 1. Thus the 2:1 slope is 2 feet in the horizontal and 1 foot in the vertical directions.

The ***right*** and ***left*** sides of ***Typical Section No.* 3** illustrate how the roadway is to be constructed in *a* ***fill*** or ***cut*** area. We will talk in more detail about "cut" and "fill" later.

Note: For ***definitions*** of unfamiliar terms or words, turn to APPENDIX D.



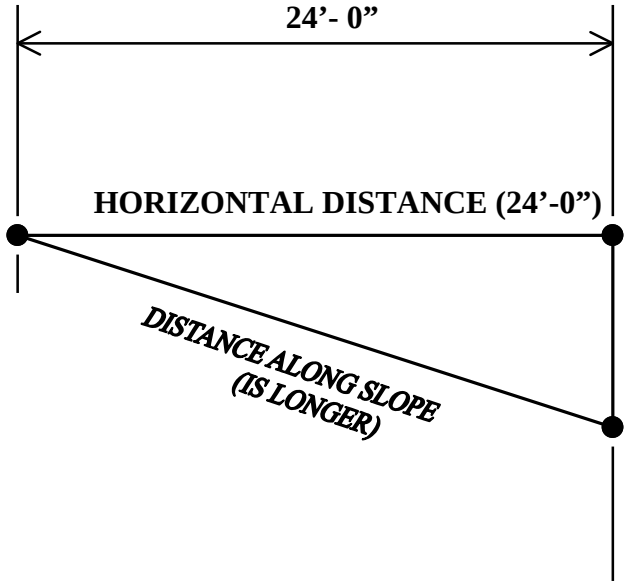
1	– FILL SLOPE	11	– EMBANKMENT
2	– ORIGINAL GROUND	12	– SHOULDER SLOPE
3	– SHOULDER SURFACING	13	– TRAVEL LANES
4	– BASE COURSE	14	– SHOULDER
5	– SURFACE COURSE	15	– DITCH OR FRONT SLOPE
6	– FRONT SLOPE (SIDE)	16	– SLOPE STAKE LIMITS
7	– CUT SLOPE OR BACK SLOPE	17	– RIGHT OF WAY
8	– SHOULDER BASE	18	– GRADE POINT
9	– CROWN SLOPE	19	– CONSTRUCTION LIMITS
10	– SUBGRADE	20	– EXCAVATION

TYPICAL ROADWAY SECTION

1. HORIZONTAL DISTANCE

IMPORTANT -The dimensions given for Typical Sections are HORIZONTAL dimensions. This means that the distances are ***not*** measured along the slopes of the roadway. For example, the distance from the median edge of the right lane of Typical Section No. 2, to the edge of the travel lane is written as 24'. The distance measured along the **0.02** (foot per foot) slope would be slightly longer than 24'. The sketch below exaggerates that difference to make it clear for you.

(Median Edge of the Right Lane)



All of the dimensions shown by level lines are **HORIZONTAL DISTANCES**.

Explanation of ***slopes*** will be discussed later in this book.

2. PAVEMENT SCHEDULE

Look on Plan Sheet Number 2 at the PAVEMENT SCHEDULE for the Typical Sections. This schedule tells you the type of pavement to be used for the typical sections. The letters of the schedule correspond to the circled letters used on the Typical Section, which indicate the various pavement items that make up a particular Typical Section. For example, find C1 on Typical Section No. 1, and then read in the Pavement Schedule the composition of C1. You should read that C1 is composed of: Prop. Approx. 1.25" Asphalt Concrete Surface Course, Type S9.5B. (See Appendix E for meaning of abbreviations).

Note: Certain items that appear in the Pavement Schedule may not be needed on Plan Sheet 2A, but would show up on other Typical Section Plan Sheets. For instance, C2 is not needed on Plan Sheet 2A, but would be on another Plan Sheet of Typical Sections.

3. QUESTIONS ON TYPICAL SECTIONS

Look at Plan Sheet 2A, Typical Section No. 4, to find the answers to the questions below. (If you need help in understanding, turn to Appendix D – Definitions - in the back of this book.)

1. What is the total thickness of the pavement structure for Typical Section No. 4? _____

2. How wide is the median? _____

3. What does the symbol R2 stand for? _____

4. What is the slope required on the pavement? _____

5. How many lanes are in each direction for this roadway? _____

6. What is the maximum fill slope? _____

Now turn to Appendix G (page G-1) and check your answers. If you missed any of the above questions, be sure you understand why you made the mistake, and correct your answers.

CHAPTER THREE: SUMMARY OF QUANTITIES

Turn next to the **SUMMARY OF QUANTITIES** found on Plan Sheet 3.

The Summary of Quantities shows the total quantities (or amounts) of all *items* included in this particular contract. These quantities are used by the State in preparing the engineers' estimates and are used by the contractors in preparing their bids for this project.

There are various other types of summaries that may be included in a set of highway plans. For example, summaries for: guardrail, pavement removal, drainage, shoulder drains, underdrains, etc. For those included in the project plans accompanying this course, refer to the Index Sheet, Sheet lA.

Use Plan Sheet 3 to answer the questions below:

1. How many tons of Asphalt Concrete Base Course, Type B25.0C, are included in this project? _____

2. How many linear feet of Steel Beam Guardrail are included in this project? _____

3. How many Masonry Drainage Structures (listed per each) are included in this project? _____

4. How many square yards of 6" Concrete Driveways are included in this project? ._____

Note: Other summary sheets showing location and quantities of specific items (drainage, guardrail, etc.) normally follow Plan Sheet 3. The "Summary of Quantities" Sheet is **always** Plan Sheet 3.

Turn to Appendix G (page G-1) and check your answers very carefully. If you made any mistakes, read the Summary of Quantities again to see where you were wrong. Always correct your errors.

CHAPTER FOUR: STANDARDS & DETAILS

A. INTERSECTION DETAILS

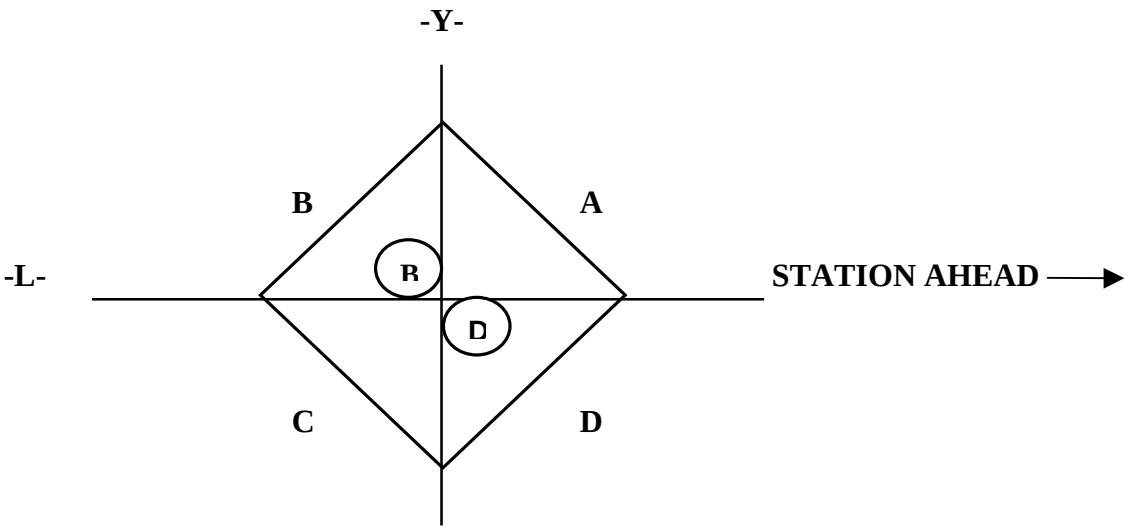
The intersection details are larger views of intersections that show detailed information that could not easily be shown on the smaller Plan and Profile sheets. Such information would include type and location of traffic islands, turning lanes, and other construction details. There are no intersection details included in this project.

B. INTERCHANGE DETAILS

Turn to Plan Sheet 4. This sheet shows details of the proposed interchange of Line -L- (Edwards Mill Road Extension) and Line -Y2- (Wade Avenue).

Also shown in the lower right corner of Plan Sheet 4 is the design traffic diagram. The figures indicate estimated traffic movements for the years 2000 and 2025.

Each ramp in an interchange is identified by a letter designation. These are usually assigned as shown below:



Ramps or loops may be designated as Ramp A, Ramp B, Loop B, Loop D, etc.

C. STANDARD DRAWINGS

Turn back to Plan Sheet 1A. You will note that the Standard Drawings are listed separately from the Index of Sheets. This is because they will be found in the Roadway Standard Drawings Manual. They are used for the construction of various items in the project.

CHAPTER FIVE: PLAN AND PROFILE SHEETS

Now you are ready to begin reading a major part of a set of plans - the **PLAN SHEETS AND PROFILE SHEETS.** All projects have separate plan and profile sheets to improve clarity.

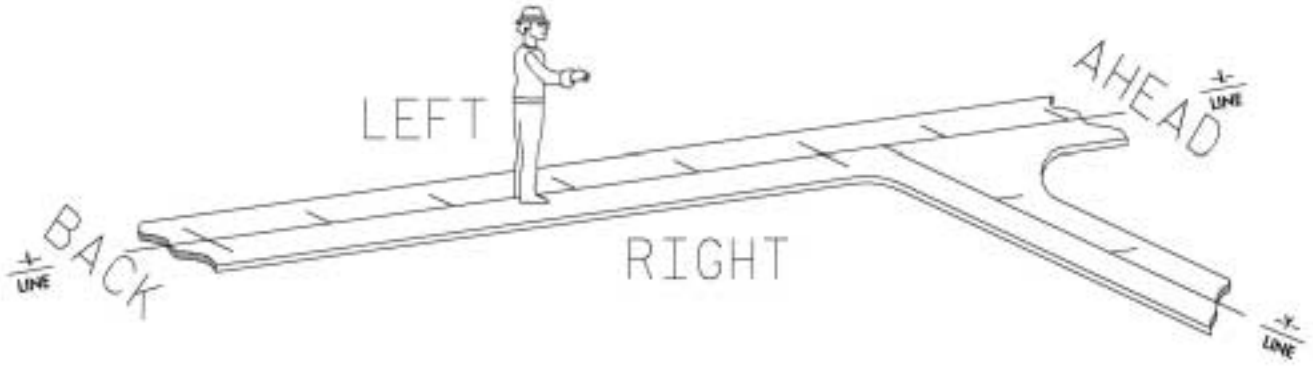
These sheets give a **PLAN VIEW** and a **PROFILE VIEW** of the entire project. They normally begin with the *lowest* station number at the ***beginning*** of the project and show all the roadway ahead to the ***end*** of the project.

A. PLAN VIEW

1. EXPLANATION

Remember that a **PLAN VIEW** shows the roadway as if you were flying over the project in an airplane and looking down. Turn to Plan Sheet 4 - the beginning Plan Sheet of this project. On this plan sheet, the **PAVEMENT LINES** (edges of the pavement) are shown. You can also see the **SURVEY LINE** (or the "L" line) running from the left of the sheet ***"ahead"*** to the right of the sheet, then continuing on to Plan Sheet 5. The ***top*** of the Plan Sheet (above -L-) is considered ***left*** of the Survey Line. ***Below*** Line -L- *is* considered ***right*** of the Survey Line, as though you were standing on the Survey Line facing AHEAD.

See the illustration below:



Notice on the above illustration, a -Y -line intersects the -L-line. Survey lines for roads other than the main line (L line) are usually designated as "Y -Lines".

Remember - Throughout this course and when speaking of plans - LEFT refers to ***LEFT of Line -L-*** and RIGHT refers to ***RIGHT of Line -L-*** as shown above, NOT left and right on the Plan Sheet.

On all highway construction plans and right of way plans, there is an arrow-like symbol indicating North. The directions of all control and boundary lines are in reference to this North Arrow.

The direction of a Survey Line as you are advancing in stationing, as expressed by a bearing, defines the relationship between the direction of the survey line and a North-South line.

It is customary to orient drawings so the North direction is to the TOP of the plan. However, since plans for a complete highway project can seldom be confined to a single sheet, and must be a series of sheets, it is an accepted practice to make the plans extend from left to right without regard to the North direction. Look again at Plan Sheet 4 and see the NORTH ARROW at the top right part of the Sheet. Remember that Station Numbers ***usually*** increase from SOUTH to NORTH or WEST to EAST.

Note also on your reduced plan sheets, in the PLAN VIEW, the *actual* scale is 1" = 100' (Note: The *actual* scale on Plan Sheet 4 is 1" = 200' due the interchange detail). In the PROFILE VIEW (Vertical Alignment), the *actual* scale is 1" = 20' (Vertical), 1" = 100' (Horizontal). Keep this difference in mind when you look at the Vertical Alignment sections of the Plan Sheets.

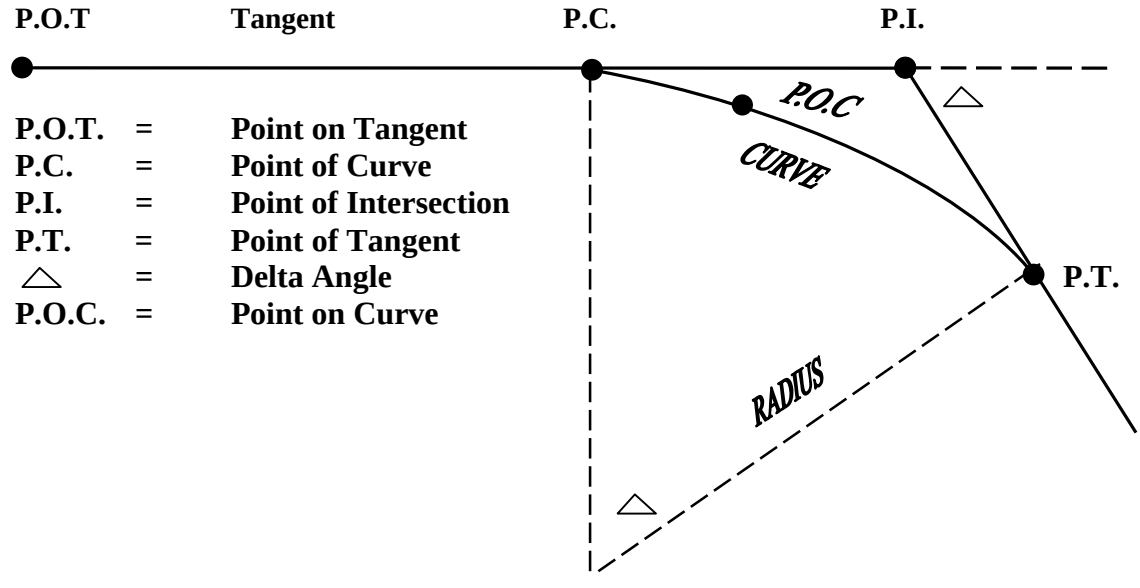
* Note: See APPENDIX D for definition of unfamiliar words or terms.

2. HORIZONTAL ALIGNMENT

Horizontal Alignment consists of tangents and curves and shows a ***Plan View*** of the direction of the roadway. Plan Sheet 4 shows the Horizontal Alignment – Profile Sheets 18-20 show the Vertical Alignment. (Vertical Alignment will be discussed later)

a. ***Tangent*** -is any straight segment of the alignment or a straight segment of roadway
b. ***Circular Curve***-is an arc (segment of a circle) joining two tangents

TYPICAL NOMENCLATURE



Turn to Plan Sheet 6 and see the **CURVE DATA**.

-L-

PIs Sta. 75+23.14	**PI Sta. 77+49.45**	**PIs Sta. 79+75.52**
Θs = 1°45'00.0"	**△ = 5°35'00.0" (LT.)**	**Θs = 1°45'00.0"**
Ls = 200.00'	**D = 1°45'00.0"**	**Ls = 200.00'**
LT = 133.34'	**L = 319.05'**	**LT = 133.34'**
ST = 66.67'	**T = 159.65'**	**ST = 66.67'**
	R = 3,274.04'	
	SE = 03	

P.I.s	=	Point of Intersection of Spiral
P.I.	=	Point of Intersection of Curve
Θs	=	Spiral Angle
△	=	Delta Angle of the Curve
Ls	=	Length of Spiral
LT	=	Long Tangent
ST	=	Short Tangent
D	=	Degree of Curve
L	=	Length of Curve
R	=	Radius of Curve
T	=	Tangent

Equations: PC Station = PI Station – Tangent (PC = PI – T)
PT Station = PC Station + Length of Curve (PT = PC + L)

Example: PC = 7749.45 – 159.65 = 75+89.80

Questions on horizontal Alignment:

1. At what Station does State Project 8.2402803 begin? _____

2. Is the Horizontal Alignment from Sta. 58+00 to Sta. 71+50 on Plan Sheet 5 on a tangent or curve? _____

3. What do we call sheets that give Horizontal Alignment Information? _____

Answer these questions: (from the CURVE DATA on Plan Sheet 8)

4. What is the Station of the P.C. for the Curve at P.I. Station 14+80.44 –Y1-? _____

5. What is the Degree of Curve for this curve? _____

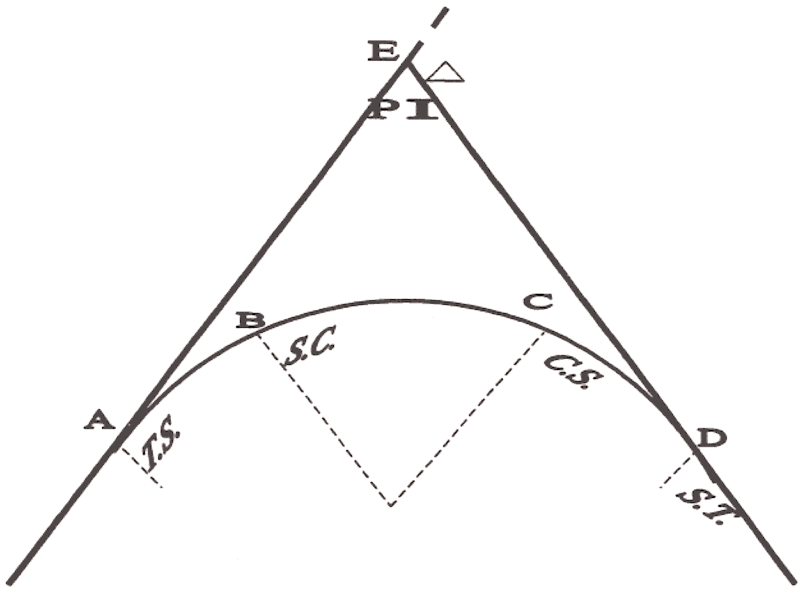
6. What is the Station of the PT for the curve at P.I. Sta. 17+62.15 –Y1-? _____

Turn to APPENDIX G (page G-1) and check your answers.

Note: For ***definitions*** of unfamiliar terms or words, turn to APPENDIX D.

c. ***Spiral Curves*** *-(transition curves*) are introduced for the purpose of connecting a ***tangent*** with a ***circular*** *curve* in such a manner that the steering change from tangent to curve takes place gradually.

*A **spiral** is* a curve in which the degree of curve increases directly with the length of curve measured from the point where the curve leaves the tangent. The degree of curve is zero at the ***tangent (T.S. or S.T.)*** and, at the point at which the ***spiral*** meets the circular curve ***(S.C. or C.S.)***, it is equal to the degree of circular curve.



T.S.	=	TANGENT TO SPIRAL
S.C.	=	SPIRAL TO CURVE
C.S.	=	CURVE TO SPIRAL
S.T.	=	SPIRAL TO TANGENT
△	=	DELTA ANGLE

SEE SAMPLE CURVE DATA FOR THE -L- LINE ON PLAN SHEET 6.

Now turn to Plan Sheet 8 and look at the CURVE DATA. ***Superelevation (SE)*** is typically not shown in the curve data if the super transition is standard. This is the case for this project. If the super transition is non-standard, then the transition is shown on the plan sheets.

d. ***Superelevation of Curves*** -"Superelevation" may be defined as the rotating or banking of the roadway CROSS SECTION to overcome the centrifugal force that acts on the motor vehicle while it is traversing ***curved sections***. In other words, when you are in a curve, your car tends to be thrown to the outside of the curve. So, to overcome centrifugal force, the normal roadway cross section will be "tilted" to the superelevated cross section. This tilting is accomplished by rotating the cross section about the inner edge of the pavement for divided highways, so the inner edge retains its normal grade, but the centerline grade is varied. On 2 lane pavements, the tilting is accomplished by rotating the section about the point of grade, normally the center of the pavement.

The distance required for accomplishing the transition from a NORMAL to a SUPERELEVATED SECTION is a sum of the **"Runoff"** and the **"Runout"**, and is a function of the design speed, degree of curvature, and the rate of superelevation. See Standard Nos.100.01 and 100.02 in the Roadway Standard Drawings manual to see the elevation for 2 lane pavements and divided highways.

Answer these questions: (See Plan Sheet 8, -L- Station for the answers)

1. What is the Station of the C.S. (curve to spiral) for this curve? _____

2. What is the length of the radius for this curve? _____

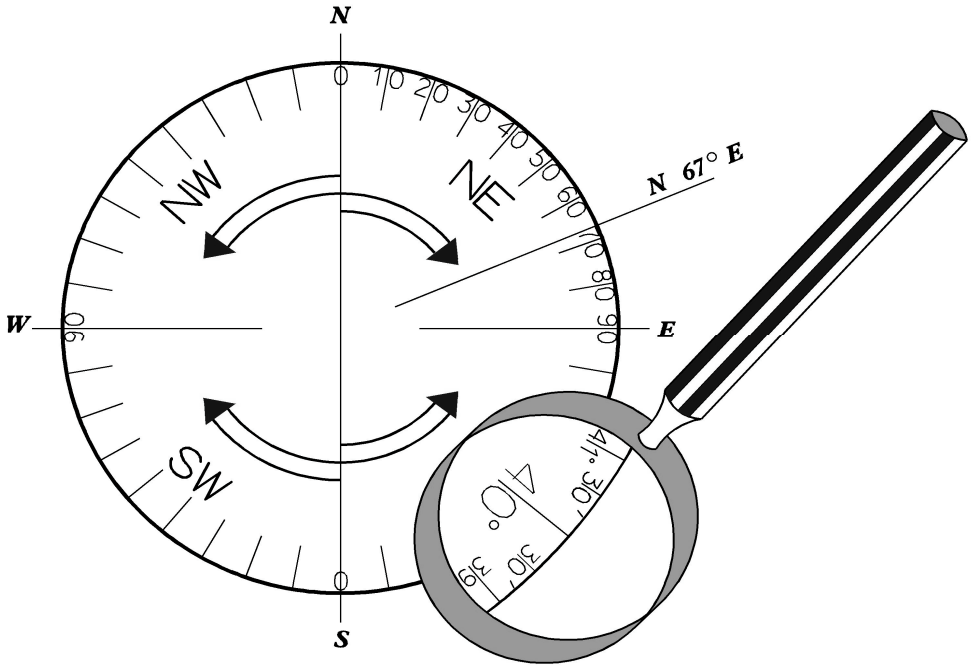
3. What is the SUPERELEVATION for this curve? _____

Turn to Appendix G (page G-l) and check your answers.

e. ***Bearings*** are used on a set of plans to indicate ***direction*** of the SURVEY LINE and *direction* of PROPERTY LINES.

All Bearings on the plans must be accurately described as to direction, in degrees, minutes and seconds. It is not sufficient to describe a line or bearing simply as Northeast or Southwest. The bearing must be described in terms of degrees, minutes and seconds in the direction in which the line is progressing. The accuracy of calculations is dependent on exact measurements of distances and bearings. A bearing might be written as N 65° 15' 00" E.

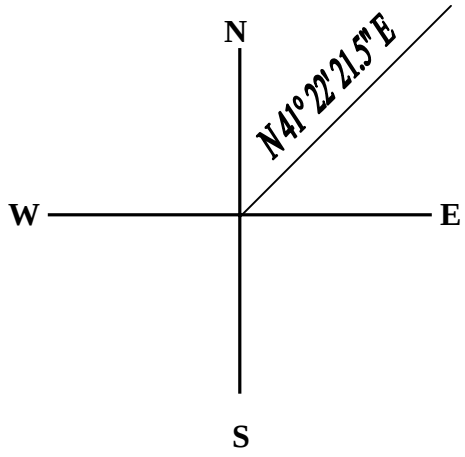
There are 360 degrees in a full circle. There are 60 minutes for each degree and 60 seconds in each minute. When shown as a compass circle, the circle is divided at North, East, West and South points, into four sections of 90° each. The four 90° sections are called QUADRANTS and designated: Northeast (NE), Northwest (NW), Southeast (SE), and Southwest (SW). This is illustrated by the sketch that follows:



Bearings are the angular measurement of a line running East or West of due North; and East or West of due South. Bearings do not go beyond 89° 59' 59" (read: 89 degrees, 59 minutes, 59 seconds), so after that they are either due East or due West, or in another quadrant. Due East is 90°00'00" of due North.

--

Turn to Plan Sheet No.5 and note that the bearing N 41° 22' 21.5" E is shown on Line -L- in reference to the North Arrow. This means that this line is running 41 degrees, 22 minutes, and 21.5 seconds East of due North.



Answer these questions using Plan Sheet 7.

1. What is the Bearing of the property line that runs right of -L- Station 95+85 +/- for property owner, Ronald S. Harrison? _____

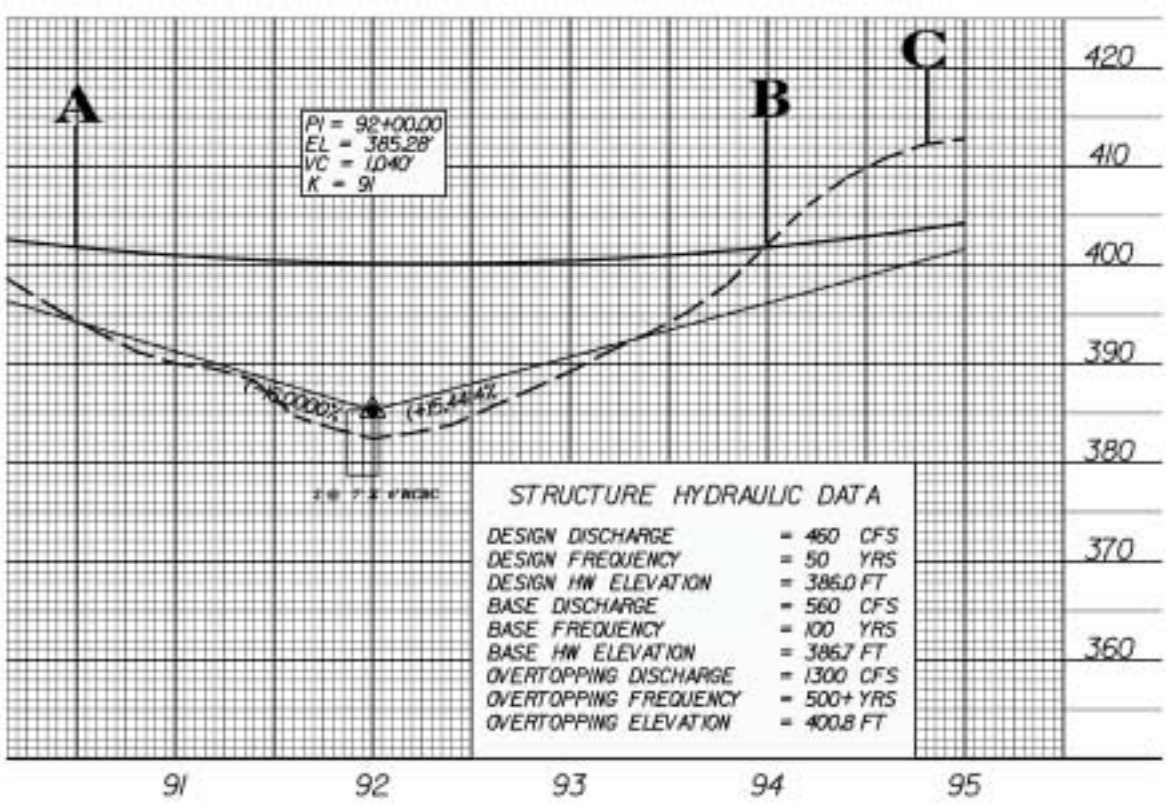
2. What angle does this bearing make with the due North direction?
_____

Turn to Appendix G (page G-1) and check your answers.

B. VERTICAL ALIGNMENT

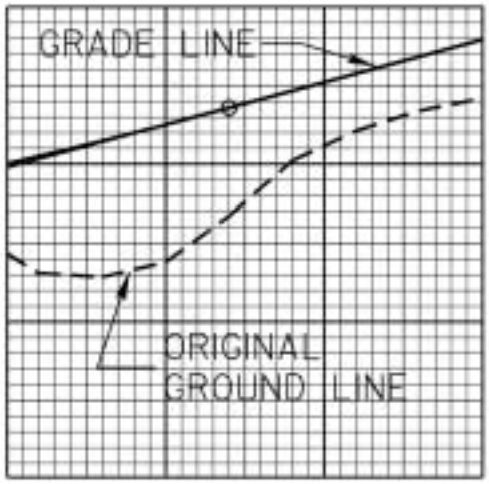
Now turn to Profile Sheet 18. The next few pages in this book are about the **PROFILE VIEWS** (or Vertical Alignment).

A **PROFILE** is like a "cross" section along the length of the roadway, rather than left to right across the roadway. NOTE: The profile shows ***Vertical alignment*** (Grade Line) along the roadway (at the centerline, survey line (Line L), or other line). The cut or fill at a point on the profile does not necessarily mean that the cut or fill will be the same at any other point on the cross section. For instance, the left side of the roadway might be in a "cut" section, while the right side might be in a "fill" section.

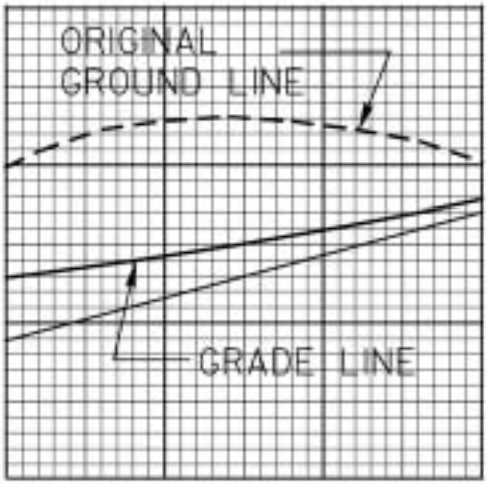


The Original Ground Line shows how the land was ***before*** construction began. When the Original Ground Line is ***higher*** than the Proposed Grade Line, you can see that some ground must be "CUT away" (B to C in above sketch). We call this a CUT AREA. When the Original Ground is ***below*** the Proposed Grade Line (A to B in above sketch), you can see that the area must be "filled in" to reach the elevation needed. We call this a FILL AREA. This CUT and FILL is the same as you will see on the cross sections.

A



B



In Sketch A above, is the area beneath the Grade Line in a cut or fill? _____

You should have written FILL in the blank above. The ***original ground line*** is ***lower*** than the grade line. The area must be "filled in" to reach the elevation shown by the grade line.

Does the majority of Sketch B above show a cut or fill area? _____

You should have Written CUT in the blank above. The ***original ground*** is ***higher*** than the specified elevation of the Profile Grade Line. The ground must be "cut" away to get to the Profile Grade Line.

On the Profile View, the Profile Grade Line is usually shown by a heavy dark line. It is regular and smooth, as the top of the roadway must be. The original ground line is usually irregular since the original ground is irregular (or bumpy) ***before*** construction begins.

The primary purpose of the Profile is to show the relationship between the ***Proposed Grade Line*** and the ***Original Ground Line***. .

The **PROPOSED GRADE LINE** (PGL) is a graphical representation (picture) of the proposed elevations of the roadway at designated points. The Typical Section will indicate at what point the elevations shown on the PGL refer. Example: Turn to Plan Sheet 2A, Typical Section No. 3, and note that the Grade Point is on the centerline of the median.

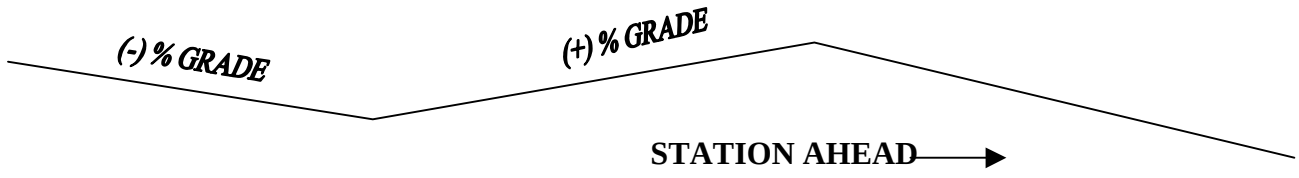
1. Elevations

Elevations are given in feet above an arbitrary datum plane (usually sea level). Look at the grade point of intersection (PI) on Profile Sheet 19. Note that the PI numbers are elevations (in feet) ***above*** sea level. At Station 78+85.00, for example, the elevation is 464.18 feet above sea level. The reference elevations are also located on the right and left edges of the grid. Reference points of known elevations, are set by the engineers so they measure differences in elevations (vertical distances). Sometimes, markers will be set in trees or on structures and their elevations determined and recorded. These markers are called BENCH MARKS (BM) and are shown by Numbers (BM #1, BM #2, etc.). These **BENCH MARKS** are listed on Profile Sheets. Look at Profile Sheet 19 and find BM #2. Note the following notation: "BM #2 RR Spike in base of 30" Oak -L- Sta. 79+25.79, 229.34' Rt. (BL Sta. 26+09, 223' Rt.) Elev. = 450.62' N 751661 E 2084741 (Nearest Ft.)

2. Grade

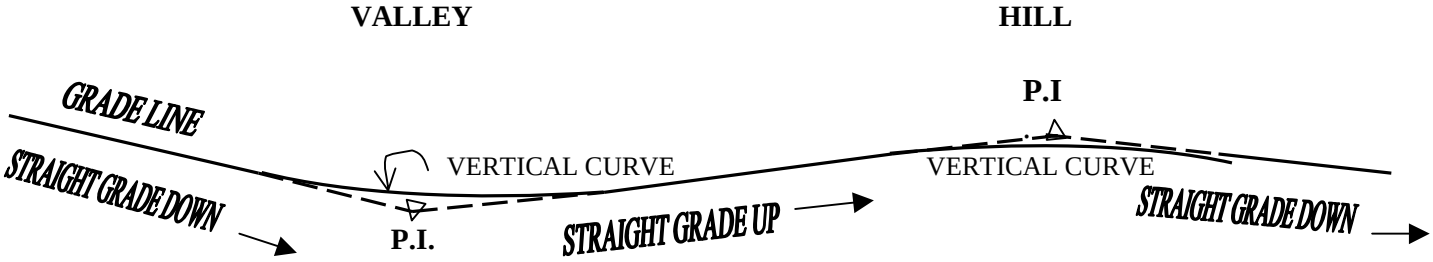
Grade is the slope of the roadway with a vertical rise or fall expressed as a percentage of the horizontal distance. That is, a +3% grade means a RISE of 3 feet per 100 feet of horizontal distance.

The grade is considered to be positive (+) or negative (-) depending upon whether it rises or falls as you proceed along the GRADE LINE in the direction of increasing stations. Look at Profile Sheet 19. What is the ***Grade*** at STA. 75+00? What is the ***Grade*** at STA. 82+00? You should have answered +3.0456% and –6.0000%. Although the GRADE LINE looks to be a hill & valley (crest & sag), the slope is only 3.0456% "uphill" and 6.000% "downhill".



3. Vertical Curves

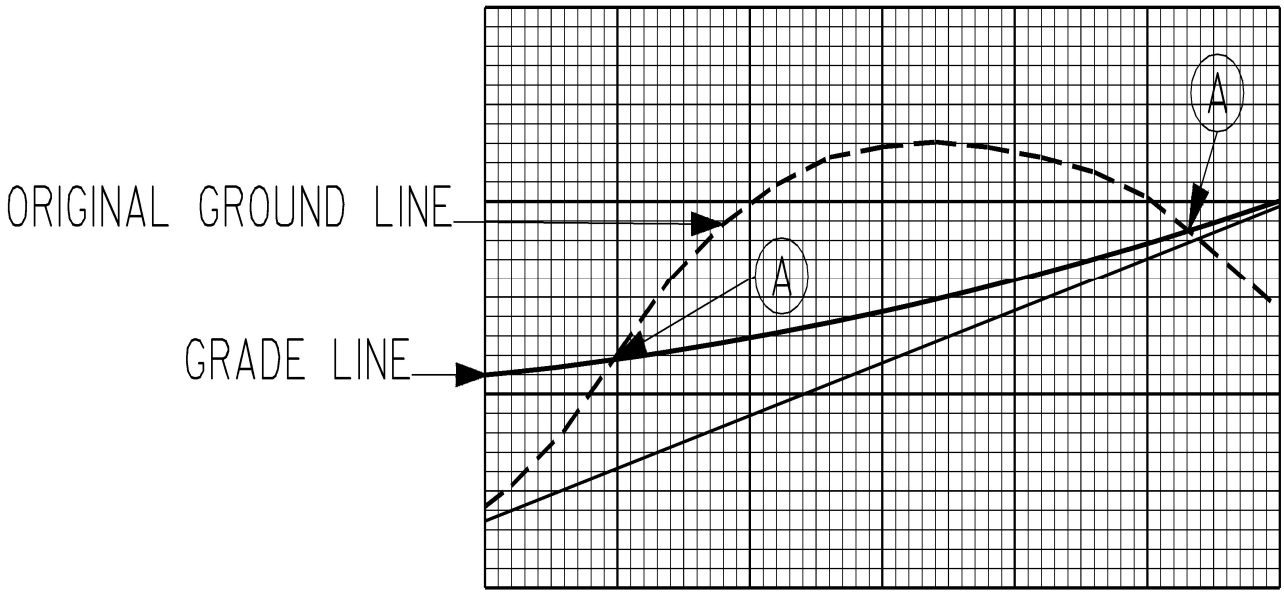
When the road goes over a hill or mountain (Crest), it must curve over the top, or, if it goes down in a valley (Sag), it will curve down and up, as shown below. These are VERTICAL (up and down) CURVES and are shown on the PROFILE SHEETS. Vertical Curves are parabolic in shape.



The P.I. (Point of Intersection) is shown by a small triangle at the intersection of the tangents. These P.I.'s are similar to the P.I.'s (Point of Intersection) for horizontal curves (turn back to page 5-2 and note this). See the P.I.'s on the sketch above. Notice that thc P.I.'s are NEVER on the actual grade. They will be either above grade or below grade.

4. Grade Point

The ***Grade Point*** is a point where the ***profile grade line*** crosses the ***original ground line*** (See sketch below). Point A shown in the sketch is a ***Grade Point***. These Grade Points are good locations for intersecting side roads or driveways since the amount of cut or fill will be small. However, the first consideration for locating side roads or driveways would be safety.



Turn to Plan Sheet 8.

The P.C. (Point of Curve) of the first curve on-Y1- (Macon Pond Road) is at Station 14+01.79.

1. What is the Station of the P.T. for this curve? _____
2. Which direction does the curve on -Y1- go? (right or left) _____
3. On which side of Line -L- does the curve begin? _____
4. How many minutes equal one (1) degree? _____
5. How many seconds equal one (1) minute? _____
6. Is the roadway section located left of Sta. 105+00 in cut or fill? _____
7. Is the roadway section located right of Sta. 108+00 in cut or fill? _____
8. What is the length of the last curve on -Y1-? _____
9. What are the Profile Sheet Numbers that represent this Plan Sheet? _____

Now look in your plans and answer these questions:

10. What is the P.I. (Point of Intersection) elevation at Station 92+00? _____
11. What is the elevation of the Profile Grade Line at Station 85+50? _____
12. At Station 106+50, what is the Grade? _____
13. If the property owner left of Sta. 98+00 on Line -L- asked you whether the proposed roadway adjacent to his property is in a "cut" or a "fill", what would you tell him? _____
14. How many feet of "fill" would there be to the PROFILE GRADE from the ORIGINAL GROUND at this station? _____

NOW CHECK YOUR ANSWERS BY TURNING TO APPENDIX G (page G-2).

HOW DID YOU DO? IF YOU MISSED ANY, BE SURE AND GO BACK TO SEE WHERE YOU WENT WRONG. CORRECT ANY ERRORS.

C. CONSTRUCTION ITEMS

In addition to showing the ***horizontal*** and ***vertical alignment*** discussed in the preceding sections, the PLAN and PROFILE Sheets contain a picture and a description of the work to be done on this project. In the following section, you will be given examples to help you locate these items on the Plan and Profile Sheets and on other sheets in the plans.

1. PAVING LIMITS

Paving Limits are the LENGTH and WIDTH of roadway to be paved on any portion of a project. Look now at Plan Sheet 4, Sta. 30+00.00 -L-, and you will see the following note: "POS -L- Station 30+00.00 – Begin Construction." Now turn to Plan Sheet 2A and see Typical Section No. 1. This section shows the ***Width of Pavement*** to be used on this survey line.

Question: How wide is the pavement on T .S. No.1? _____
Make certain you see this width on Plan Sheet 2A, Typical Section No.1.

NOW TURN TO APPENDIX G (page G-2) AND CHECK YOUR ANSWER.

2. EARTHWORK

Earthwork is the amount of "cut" and "fill" earth to be moved between particular stations. Earthwork is expressed in cubic yards. Areas to be "cut" will be expressed as excavation and areas to be "filled" will be expressed as embankment.

a. Construction Limits & Slope Stake Line

The lateral (side) limits of grading are shown on the PLAN Sheets by a dashed line and noted by -C- (cut) and -F- (fill). Find the SLOPE STAKE LINE on Plan Sheet 5. Notice on the right side of Sta. 65+50, the limits change from a "cut" section to a "fill" section. Follow along the slope stake line on Plan Sheet 7, right of Line -L-, and list the approximate stations where the earthwork changes from cut to fill or from fill to cut.

1. Sta. _____

2. Sta. _____

3. Sta. _____

TURN TO APPENDIX G (page G-2) AND CHECK YOUR ANSWERS.

The SLOPE STAKE LINE will not always be the same as the ***construction limits***. The exceptions would be where lateral ditches, berm ditches, etc., fall outside of the slope stake line.

b. Earthwork Summary

The EARTHWORK SUMMARY is normally shown in the No.3 series Plan Sheets (See Sheet 3H). These figures indicate the "summary" of earthwork volumes between different break points. Each Break Point is sub-totaled. Look at the Project Total. In this TOTAL, 88,587 cubic yards of ***unclassified excavation*** and 180,502 cubic yards of ***embankment material*** are needed. Therefore, the remaining 91,915 cubic yards of earthwork is classified as ***borrow –*** earth material needed to offset (balance) the remaining 91,915 cubic yards. This process is known as 'balancing' the earthwork. The embankment material provided at this location will help offset the unclassified excavation.

Look at Plan Sheet 3H for the answer to this question:

1. How much borrow material is required in the Summary from -L- Sta. 60+00 to Sta. 90+00?
   _____

TURN TO APPENDIX G (page G-2) AND CHECK YOUR ANSWER.

3. DRAINAGE

Look at Plan Sheet 5. In Plan View, note that storm drains are shown with heavy dark lines (see example of pipe at –L- Sta. 64+00). Also, the size of the pipe is written on the Plan View and additional pipe detail may be given on the Profile View. A drainage structure number is assigned to each drainage pipe or drainage structure. The Station, Length, Size, and Class of each pipe are noted in the " List of Pipe, Endwalls, etc." on Sheets 3A, 3B, and 3E of this project.

Example:

Look at Station 67+00 and notice a heavy dark line that extends across the entire roadway. See the note symbol ⬡ which indicates the drainage structure number. Now look in the List on Sheet 3B at Station 67+00 and note that 88 feet of 15" R.C. Pipe Class III is required from Structure Number 23 to Structure Number 22. Also, note that a Catch Basin is required with a grate and frame.

Answer these questions on Pipes:

1. What total length of pipe is required at Sta. 72+70? _____
2. What size of pipe is required at Sta. 64+00? _____
3. What class of pipe is required at Sta. 64+00? _____
4. What type of pipe is required at Sta. 64+00? _____

TURN TO APPENDIX G (page G-2) AND CAREFULLY CHECK YOUR ANSWERS.

A **NUMERICAL DRAINAGE LAYOUT** is used on most projects. The group of Structure Numbers 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, & 43 on Sheet 7 is an example of a complex drainage system. Structure Numbers 44A & 45 on Sheet 7 are examples of simple drainage systems.

Minor drainage structures consist of drop inlets, junction boxes, manholes, spring boxes, catch basins, and headwalls. Look at Sta. 67+00 on Sheet 5 and see the numbers and letters 2GI. Look at Sta. 90+50 on Sheet 7 and see CB at Structures 36 & 37. This indicates that catch basins in curb & gutter are required on each side of the –L- line.

Answer these questions:

1. On Plan Sheet 5, what type of inlet is proposed for the DROP INLETS at Station 67+00 –L-?
   _____
2. At –L- Station 88+00 left, what type of inlet or drainage structure is proposed at Structure 35?
   _____

TURN TO APPENDIX G (page G-2) AND CHECK YOUR ANSWERS.

Look on Plan Sheet 7 at Station 91+95 –L- and you will notice that a 2 @ 7'x 6' (Double Barrel) Reinforced Box Culvert is reflected. On the Profile Grade Line (Profile Sheet 19) you will see a rectangular box which indicates the approximate CENTERLINE INVERT ELEVATION of the culvert and the elevation of the top of the culvert. For the exact flow line elevations, it will be necessary to see the Culvert Plans for this project.

Note: You will be given more detailed information on culverts when you get to the "Structures" section of this course.

4. FENCING

Fencing is used along highways with controlled access points to keep persons and/or animals off the highway. Look at Sheet 1B and notice the conventional symbol for a Proposed Woven Wire Fence. Notice on Plan Sheet No.5, that the proposed woven wire fence on the right and left sides of -L- line, Sta. 59+00 continues along the proposed right of way line.

Answer the following questions by using Plan Sheet 5.

1. At approximately what station does the woven wire fence begin on the right side? _____

2. At approximately what station does the woven wire fence begin on the left side? _____

TURN TO APPENDIX G (page G-2) AND CHECK YOUR ANSWERS.

5. UTILITIES

Utilities are shown on the plans using symbols with appropriate annotation. Utilities include water mains, sanitary sewers, gas mains, underground power cables and conduits, underground telephone cables and conduits, underground television cables, and aerial power, telephone and CATV lines. Note that the aerial utility lines are not shown, but only the poles and towers to which they are attached are shown.

On **Plan Sheet 1A**, the general notes include a listing of all known utility owners on the project.

The construction plans show the various utility facilities as topographic features of the area.

The Utility Construction plans show any utility work that is to be performed by the highway Contractor as part of the highway construction. **Plan Sheet UC-2** is an example. Notice the proposed 12" DI water pipe along the -Y- line, Reedy Creek Road. The various pieces of the proposed water pipe are labeled in the boxed areas. Any details necessary to further describe the requirements for the proposed utility work will be shown.

The **Utilities By Others** plans show any utility work that is to be performed by others (usually by the utility owner). These plans are included as information to aid in the coordination of the highway construction work. Notice on **Plan Sheet UO-1**, the existing overhead power line to be relocated.

6. MISCELLANEOUS

a. Guardrail

Turn to Plan Sheet 1B of your sample set of plans and note that the Conventional Symbol for Guardrail is: Now look at Plan Sheet 5 at Station 70+75, left side, and notice that the proposed Guardrail is shown from Sta. 70+75 to 76+50. Turn to the Summary of Guardrail, on Sheet 3F, and see the breakdown of all Guardrail on this project. Sheet 3F shows Sta. to Sta., Rt. or Lt., Line, Linear Feet, and Bridge Anchor Units and Types. This Summary also shows the Grand Total of estimated quantities of Guardrail and etc., proposed on this project.

b. Cable Guiderail

Cable Guiderail is also shown in the Summary, and is typically used in the median of multilane highways. See Sheet 2M for additional information on Cable Guiderail.

Answer the following Questions:

1. On Plan Sheet 7, the Guardrail begins at -L- Sta. 90+50 on the left side. What Station does the guardrail end? _____

2. On Plan Sheet 12, one set of Cable Guiderail begins at -Y2- Sta. 631+76 in the median. What Station does this set of Guiderail end (See Plan Sheet 4)? _____

TURN TO APPENDIX G (page G-2) AND CHECK YOUR ANSWERS.

c. Right of Way Markers

Turn to Plan Sheet 1B of your sample set of plans. Under Conventional Symbols, note the sign for a "Right of Way Marker". Now turn to Plan Sheet 8 and look at the right side of Line "L", (Sta. 104+76.67), and you will see the symbol for the proposed right of way marker. Note locations where the right of way changes in width. Near the right of way markers, you will see the ***station plus*** and ***distance from the survey line*** shown. As an example, look at Sta. 104+76.67, right side (Plan Sheet 8). The notation means that the distance from the ***Survey Line*** is 75 feet and the station is *104+76.67*.

Answer the following questions:

1. How many *right of way markers* are proposed on the ***right*** side of the project from Sta. 95+00 to Sta. 110+00? _____

2. What is the distance from the Survey Line -L- to the right of way marker on the right side of Sta. 80+50? _____

TURN TO APPENDIX G (page G-2) AND CHECK YOUR ANSWERS.

D. EROSION AND SEDIMENTATION CONTROL

The Sedimentation Control Act of 1973 requires those persons engaged in land disturbing activities to plan and implement effective temporary and permanent control measures to prevent accelerated erosion and off-site sedimentation. The law prohibits visible off-site sedimentation from construction sites, but permits the land-disturber to determine the most economical and effective methods for erosion and sedimentation control. It should be noted that highway projects near wetlands, sensitive waters, trout streams, etc., are subject to regulatory review and permitting by various state and federal agencies, including the U. S. Army Corps of Engineers, the North Carolina Department of Environment and Natural Resources (DENR) and the U. S. Environmental Protection Agency. The Department of Transportation's commitment is to take all reasonable measures to protect all public and private property from siltation damage caused by any departmental activity. In order to meet these goals, the set of erosion and sedimentation plans are prepared consistent with current changes in the rules and regulations and utilize designs and design criteria for application of our program.

The plan prepared as discussed above utilizes some of the following erosion control devices: (A key to Erosion and Sediment Control Measures is found on the first Plan Sheet, Sheet EC-1).

(See Plan Sheet EC-6/Const. 7)

The Temporary Rock Sediment Dam, Type-B (TRSD-B), shown at Station 96+60 left of Line -L- is a small dam constructed of Class-B stone, lined with sediment control stone with a weir outlet and built-in sediment basin. This device is used at the outlet of a temporary diversion, temporary slope drain, temporary silt ditch, drainage ditch or channel to trap sediment before water runoff leaves the project site. This devise should not be used in a live stream.

The Temporary Rock Silt Check Type-A (TRSC-A), shown at the toe of the fill slope at Station 93+00 left of Line-L-, is used in the same manner as the temporary rock sediment dams. This measure, however, does not have a defined excavated sediment pit, but utilizes the base ditch or a natural formed area to trap sediment.

(See Plan Sheet EC-16/Const. 7)

A Temporary Silt Ditch (TSD) is shown at Station 98+00 left of Line -L-. This measure is used at the toe of fill slopes to divert sediment laden runoff into sediment basins, temporary rock sediment dams, temporary rock silt checks, and other sedimentation control measures. Note that a series of temporary rock silt checks Type-B (TRSC-B) is shown in the proposed temporary silt ditch. Type-B rock silt checks are used in ditches to prevent gullying by reducing water flow velocity.

A Temporary Slope Drain is shown at Station 92+00 left of the -L- line. A temporary slope drain is a flexible tubing or pipe used to carry concentrated runoff from the top to the bottom of a cut or fill slope without causing erosion along the slope. Slope drains are generally used in conjunction with an earth berm to convey runoff down the slope until permanent water disposal measures can be installed.

(See Plan Sheet EC-6/Const. 7)

This project includes an "Environmentally Sensitive Area"(ESA). This designation requires special procedures to be used for clearing and grubbing, temporary stream crossings, and grading operations within the area identified on the plans. This designation also requires special procedures to be used for seeding and mulching and staged seeding within the project. Specific instructions for working within an Environmentally Sensitive Area are found in the *Special Provisions* of the contract.

These erosion control devices are designed consistent with standards promulgated by the N.C. Sediment Control Commission. If implemented accurately and maintained after rainfall events, these devices, along with the other measures shown on the erosion control plans, will prevent off-site sediment damage until permanent vegetation is established.

ANSWER THE FOLLOWING QUESTIONS:

1. A temporary slope drain is used to carry concentrated runoff from the top to the bottom of a slope. _____ (True or False)

2. Temporary rock sediment dams constructed of Class-B stone and sediment control stone are used before they empty off the project site or into streams. _____ (True or False)

3. A _____ cover is the most effective way to protect against sedimentation and erosion. (temporary mulch, vegetative, topsoil)

4. What size stilling basin is used during the culvert construction sequence?
   a) 48 CY
   b) 24 CY
   c) 96 CY

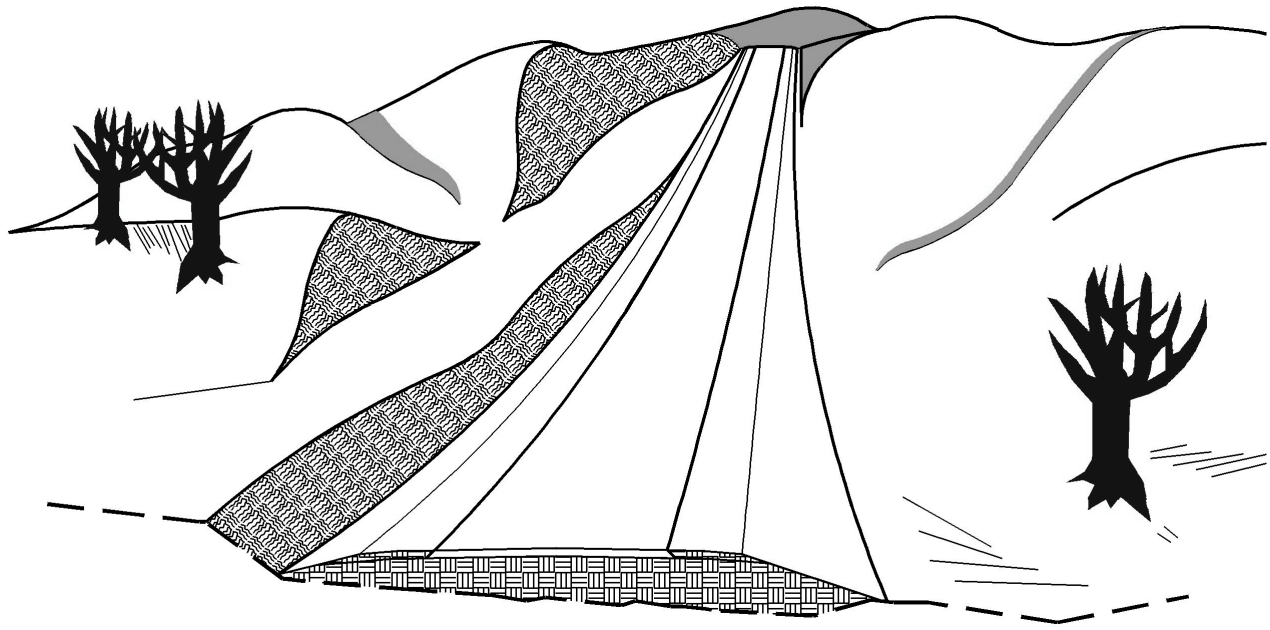
5. On Sheet EC-16/CONST. 7, how wide is the Neuse River Buffer Zone?
   a) 10 feet
   b) 50 feet
   c) 30 feet

TURN TO APPENDIX G (page G-2) AND CHECK YOUR ANSWERS.

CHAPTER SIX: CROSS SECTIONS

A. DEFINITIONS

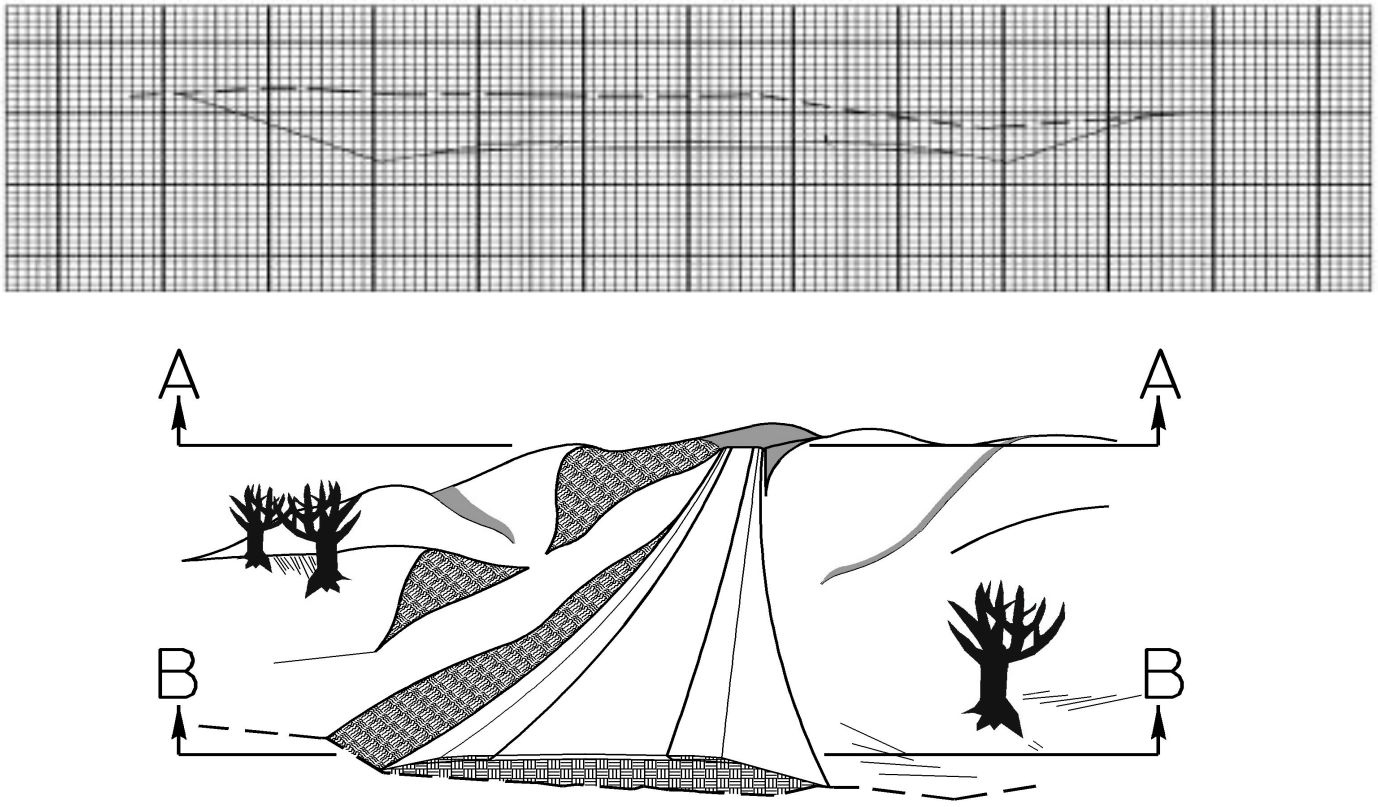
A typical terrain, which shows a two-lane roadway, is illustrated below and on the next page. This illustration can only be a general picture, but it does convey a third dimension, depth, which a plan view cannot show. Within the illustration, you can see one item of construction that is changing from station to station or foot to foot, and that item is earthwork (quantity of soil to be moved).



Earthwork is usually a major cost in highway construction. Its quantity, as well as many others, must be accounted for in the estimate prepared for the project. One method used to accomplish this is by using CROSS-SECTIONS. You will recall CROSS-SECTIONS were previously mentioned in the section of the Text called VIEWS.

Remember that the cross-section shows what you would see if the highway were cut at right angles to the centerline. See the illustration below with examples of cross-sections taken in cut and in fill.

SECTION A-A

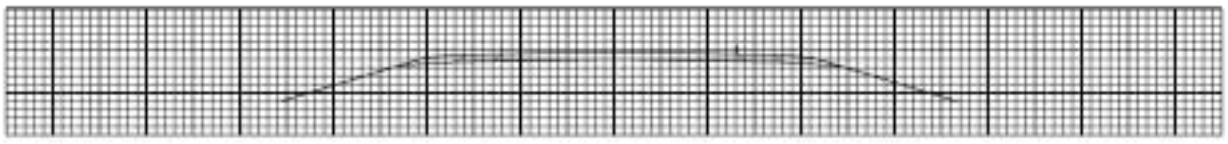


SECTION B-B

The cross section is not always all cut or all fill as shown above; it may also be part cut and part fill.

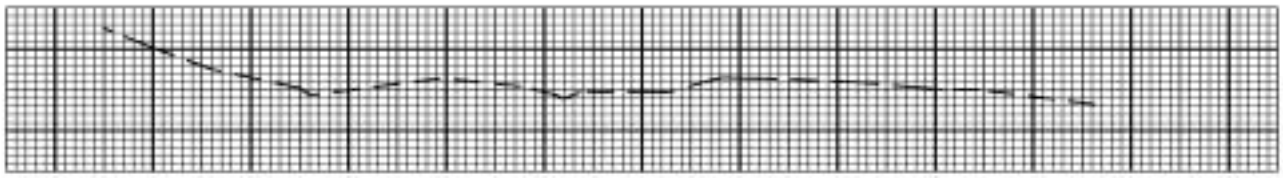
B. TYPICAL CROSS SECTIONS

Many factors are considered before combining a typical section of the roadway with a cross-section of the ground.



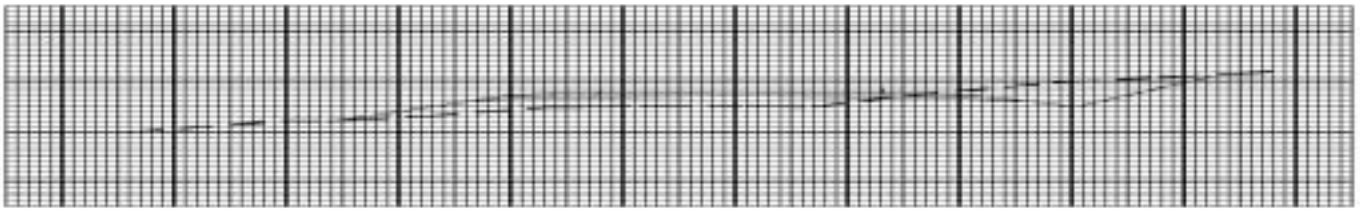
Typical Section

First, the typical section represents an end view of the pavement necessary to carry the type and volume of traffic established in the highway design.

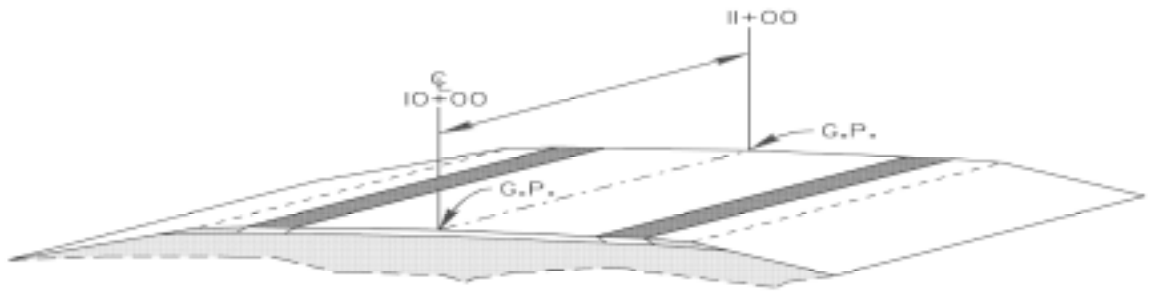


Existing Ground

Second, the cross section of the original ground is unique for every location along the centerline.

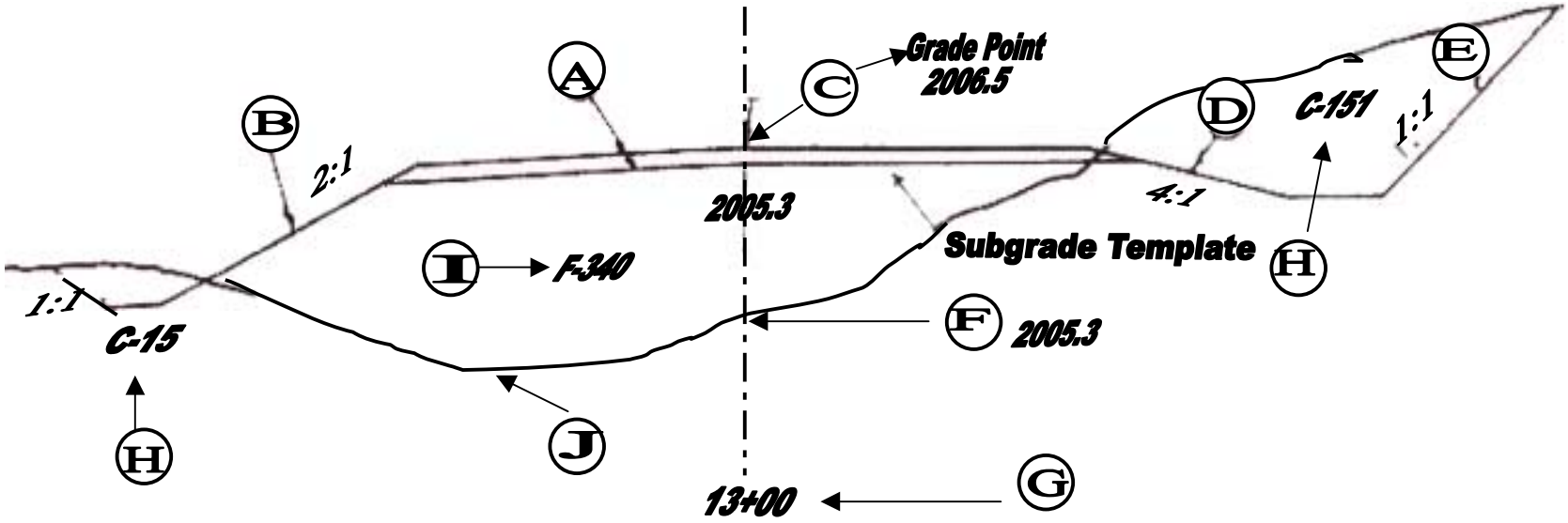


Third, by combining the typical section (referred to as the "template" when on a cross section) and the cross section of the original ground, a determination is made of the area of cut, fill, or both.



Fourth, the illustration above shows how the distance between cross sections is multiplied by an averaging of end areas to give a "volume" answer. The vertical point of reference for a typical section at a particular location along the roadway is called the Grade Point. Elevations change uniformly along the roadway and the line so formed is referred to as the Profile Grade Line.

TYPICAL CROSS SECTION



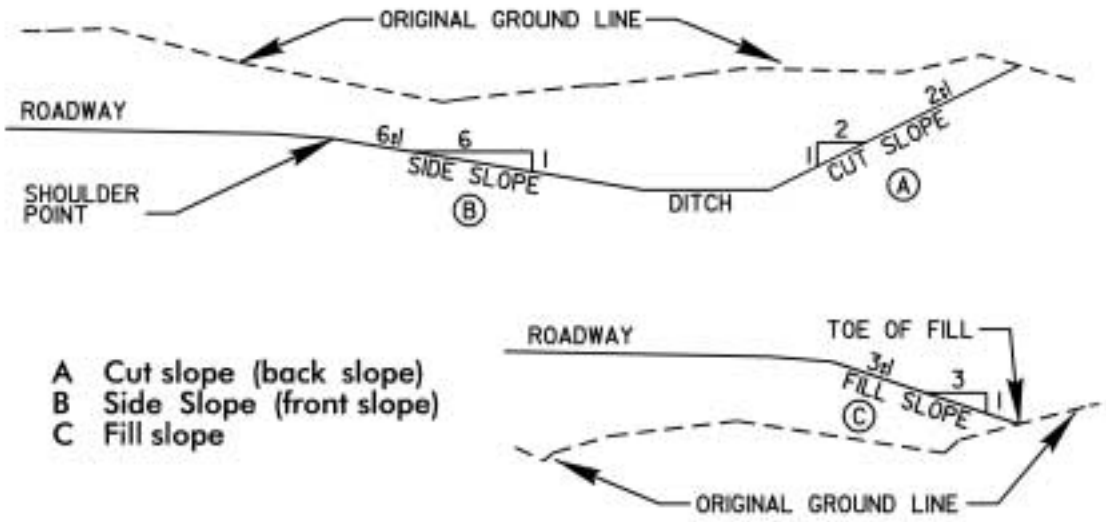
A	**TYPICAL SECTION TEMPLATE**
B	**FILL SLOPE**
C	**ELEVATION OF FINISHED ROADWAY @ CENTERLINE (GRADE POINT)**
D	**SIDE SLOPE (FRONT SLOPE)**
E	**CUT SLOPE (BACK SLOPE)**
F	**ELEVATION OF ORIGINAL GROUND LINE @ CENTERLINE**
G	**STATION NUMBER OF THIS PARTICULAR CROSS SECTION**
H	**AREA OF CUT (C.Y. PER 100 FT.)**
I	**AREA OF FILL (C.Y. PER 100 FT.)**
J	**ORIGINAL GROUND LINE**

C. GRADE

Now look at the Typical Cross Section on the preceding sheet (Sheet 6-4), and you will see the ***subgrade*** (top surface of the roadbed prepared as foundation for pavement) ***template*** plotted for this station. The subgrade is at EL. 2005.3. In a Profile View, the ***Profile Grade Line*** *is* plotted on the ***Finished Grade*** of the proposed surface, which is at EL. 2006.5. This particular section assumes a 1.2' pavement structure. Therefore, the cross-section template ***subgrade elevation*** at this point is 2006.5 (elevation) -1.2' (pavement structure) = 2005.3 elevation, which you see plotted on the cross section. Also, the ***Profile Grade Line*** is shown on the Typical Section and noted as "Grade Point".

D. SLOPES

Slopes are usually referred to as "cut slopes" (back slopes), "fill slopes", and "side slope" (front slopes). A ***cut slope*** *is* that portion of the roadway between the side drainage ditch and the top of the cut. *A* ***fill-slope*** *is* that portion of roadway between the shoulder point of the roadway and the ***toe*** of the fill. The ***side slope*** *is* that portion of the roadway between the shoulder point and the adjacent drainage ditch. These slopes are measured as a ratio of horizontal distance versus each foot of decrease or increase in elevation (height). Below are some views of the various slopes used on cross-sections.



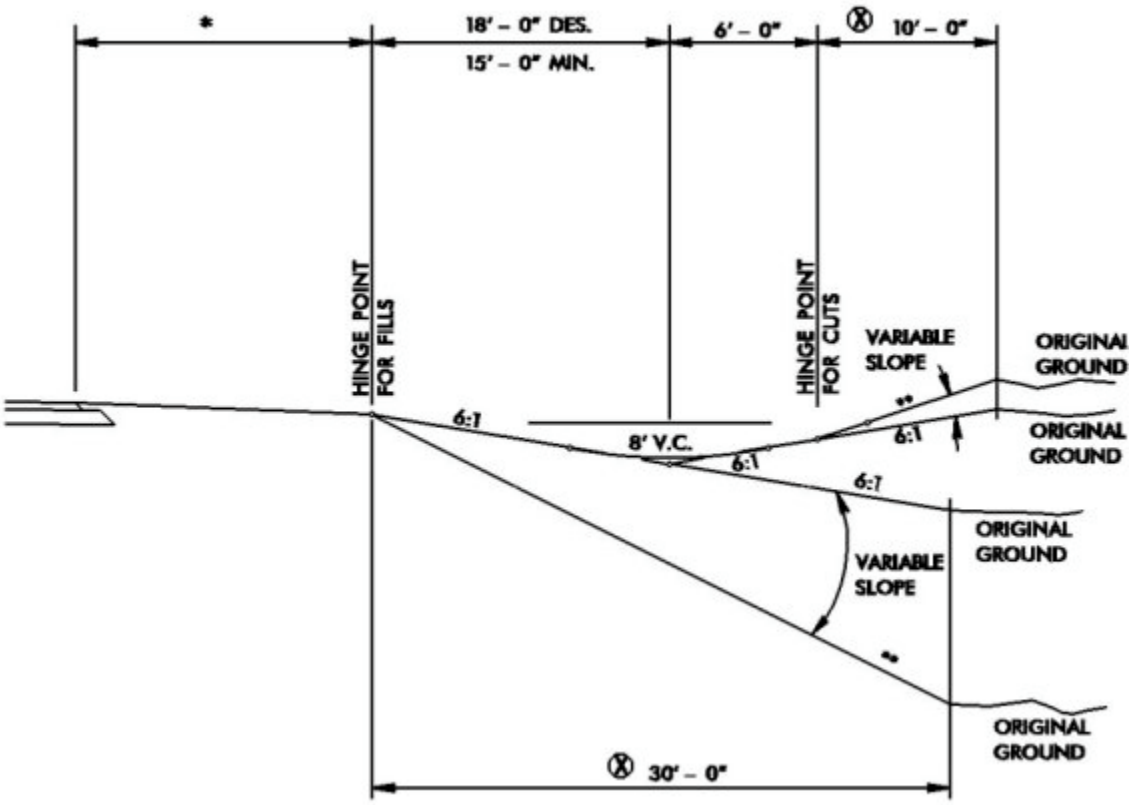
A 2:1 slope means that for every 2 feet of horizontal distance, the elevation (or vertical distance) increases (cut section) or decreases (fill section) 1 foot, depending on the type of slope shown in the preceding page.

E. HINGE POINT SLOPE DESIGN

The "Hinge Point" method of slope design is used on Rural Freeway Projects and many arterial projects wherever design considerations suggest its use and right of way is available. The hinge point method features variable slopes intersecting the original ground at a fixed distance from the edge of the pavement. Normal slope design methods use fixed slopes depending on cut or fill height.

The hinge point method has two major advantages. The first concerns safety since a wide area of reasonably flat slopes are available adjacent to the travel lanes for a recovery area for out-of-control vehicles. Secondly, these variable slopes blend more naturally into the existing topography presenting a more pleasing appearance.

(1) INTERSTATES, FREEWAYS, EXPRESSWAYS & OTHER FOUR LANE FACILITIES



* FOR SHOULDER WIDTHS, SEE ROADWAY DESIGN MANUAL, PART I, CHAPTER 1-4B, F-1

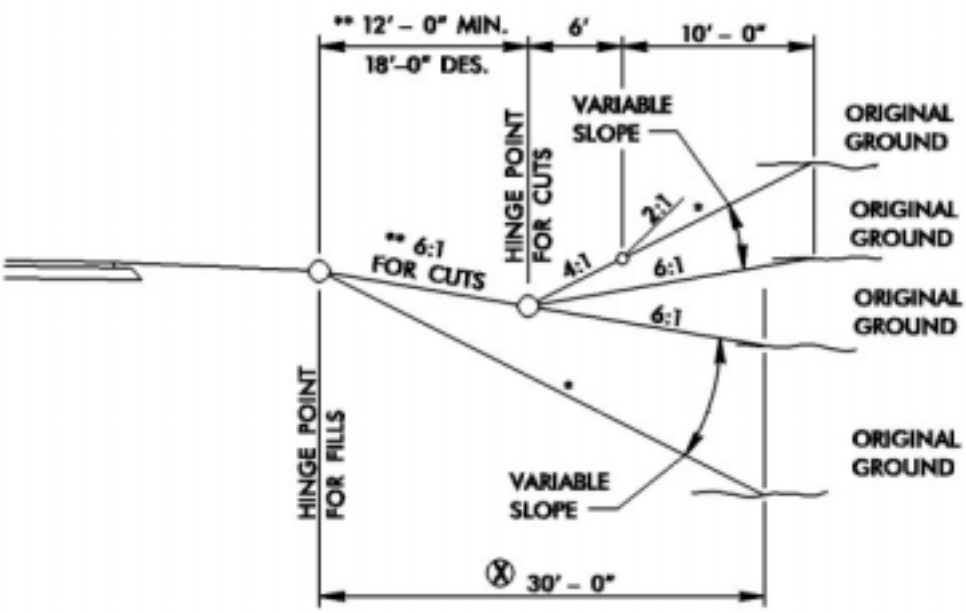
⊗ WHEN SLOPE STAKE POINT FALLS OUTSIDE THE HINGE POINT DISTANCE, MAINTAIN APPROPRIATE MAXIMUM OR MINIMUM SLOPE

** INTERSTATE SIDE SLOPES SHOULD NOT BE STEEPER THAN 2:1 EXCEPT IN ROCK EXCAVATION OR WHERE THERE ARE OTHER SPECIAL CONDITIONS

ON FREEWAYS AND EXPRESSWAYS, THE STEEPEST PRACTICAL SLOPES AS DETERMINED BY THE SOILS AND FOUNDATION SECTION SHOULD BE UTILIZED. NORMALLY, THESE SLOPES WILL RANGE FROM 1 ½:1 TO 2:1.

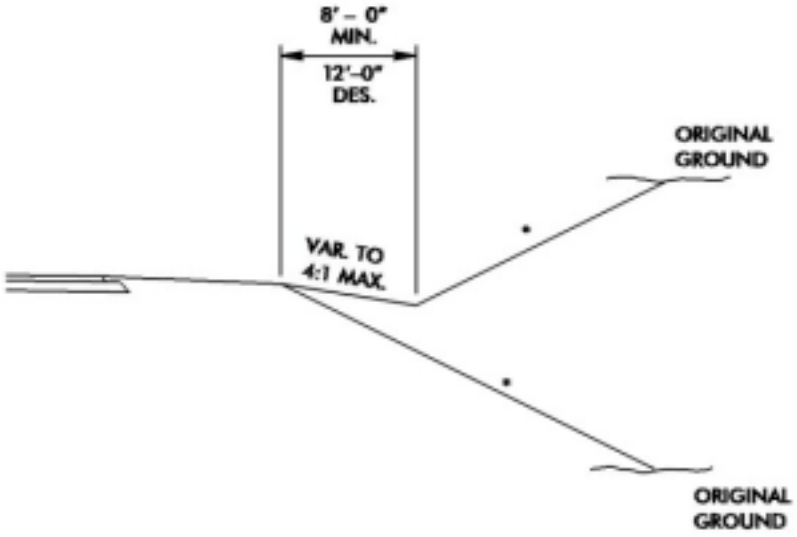
NOTE: THESE GUIDELINES ARE TO BE USED ALONG WITH SOUND ENGINEERING JUDGEMENT. SPECIAL CONDITIONS SUCH AS SOIL TYPE OR THE NEED FOR ADDITIONAL FILL MATERIAL MAY WARRANT THE USE OF FLATTER OR STEEPER SLOPES THAN THOSE SHOWN IN THESE RECOMMENDATIONS.

(2) ARTERIALS (OTHER THAN EXPRESSWAYS AND FOUR LANE FACILITIES), COLLECTORS, AND LOCALS (OVER 4000 ADT DESIGN YEAR TRAFFIC)



⊗ WHEN THESE DISTANCES INDICATE SLOPES OUTSIDE THE LIMITS 6:1 TO *, THE DISTANCE BECOMES VARIABLE AND THE MAXIMUM OR MINIMUM SLOPE MAINTAINED

(3) COLLECTORS AND LOCALS (4000 ADT OR LESS DESIGN YEAR TRAFFIC)



NOTES: (B AND C)

** MAY VARY TO SUIT DRAINAGE REQUIREMENTS. TWO-FOOT MINIMUM DITCH DEPTH IS REQUIRED TO COVER DRIVEWAY PIPE.

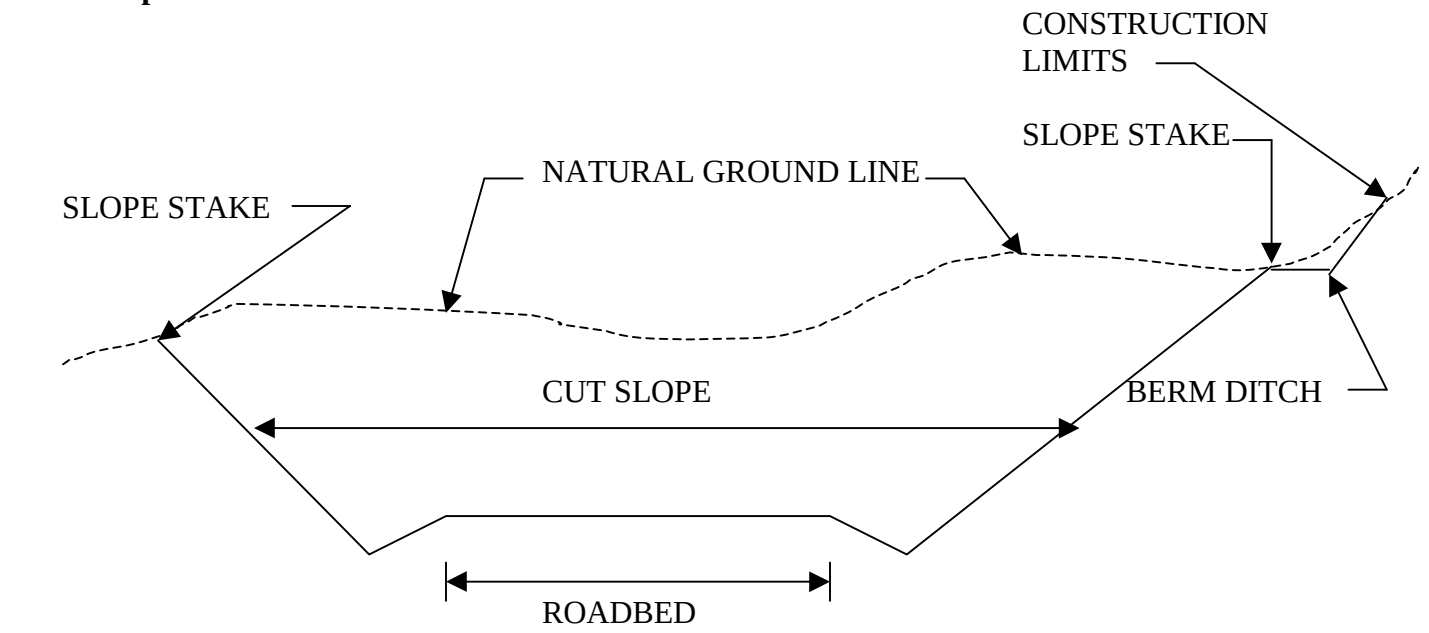
- THE STEEPEST PRACTICAL SLOPES AS DETERMINED BY THE SOILS AND FOUNDATION SECTION SHOULD BE UTILIZED. NORMALLY THESE SLOPES WILL RANGE FROM 1 ½:1 TO 2:1. A GUARDRAIL STUDY WILL BE REQUIRED FOR FILL SLOPES STEEPER THAN 3:1.

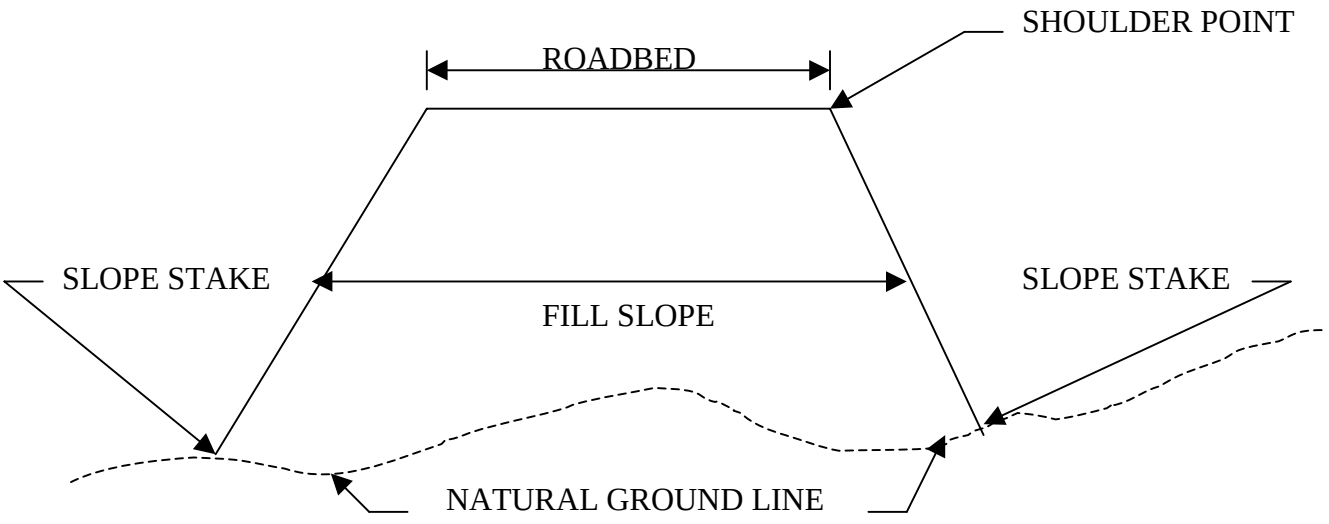
F. SLOPE STAKE LINE

These stakes contain information that tells the Contractor how much “cut” or “fill” is required from the point of the stake to the ditch line (or shoulder point) of the roadway, depending on whether the stake is in a cut or a fill section.

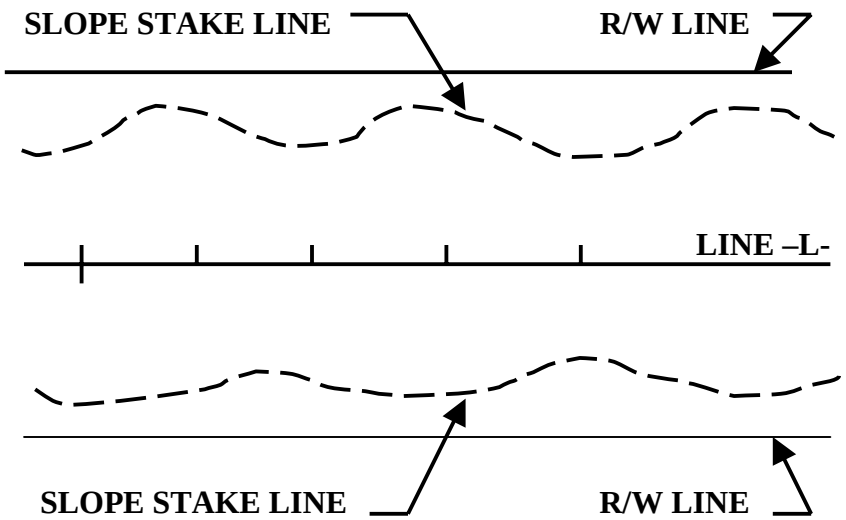
Slope stakes are placed at the point of intersection of the cut or fill slope and the natural ground line.

Example:





Example:



Now turn to Plan Sheet 8. Can you locate the slope stake lines? Locate -L- Sta. 105+00. Scale the distance from the -L- Line to the left slope stake line at this location. What is this distance? Place your answer here. _____

Now turn to Appendix G (page G-2) and check your answers.

G. SUMMARY OF EARTHWORK

Look now at Plan Sheet 3H – Summary of Earthwork. This sheet shows a breakdown of EARTHWORK on this particular project and consists of Station to Station (for each *****breakdown), Unclassified Excavation, Undercut Excavation, Embankment (Embt.), Borrow (excavation from outside the project), and Waste (excavated material not used in project construction). Notice that a "SUBTOTAL" is shown for each breakdown. These Subtotals are very important in showing the amount of each item as described above at the end of each breakdown. This Sheet also shows the GRAND TOTAL amount of each item.

Answer the following Questions:

1. How many cubic yards of unclassified excavation are proposed for this project? _____

2. Does the Summary of Earthwork on this project indicate more Borrow or Waste? _____

***** A "breakdown" may be determined by the distance that earth-moving equipment can reasonably move earth material (normally approximately 3000' – 3500'). The "breakdowns" are also determined by the presence of bridges because of the inability of earth moving equipment to cross.

Now turn to Appendix G (page G-2) and check your answers.

CHAPTER SEVEN: STRUCTURES

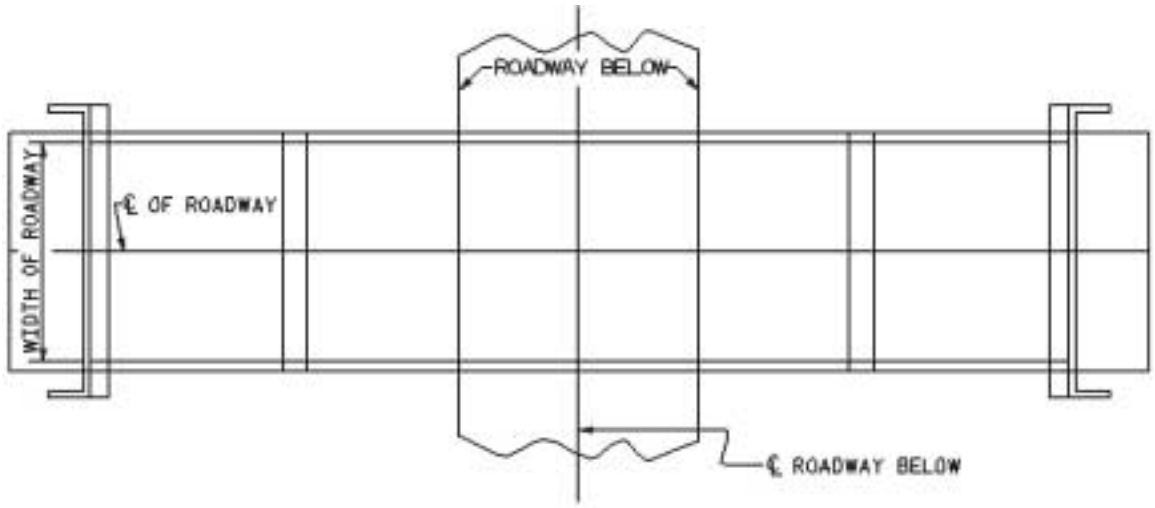
A. DEFINITION

Structures normally consist of bridges, culverts, or retaining walls. It is important that you become familiar with structures found in a set of plans.

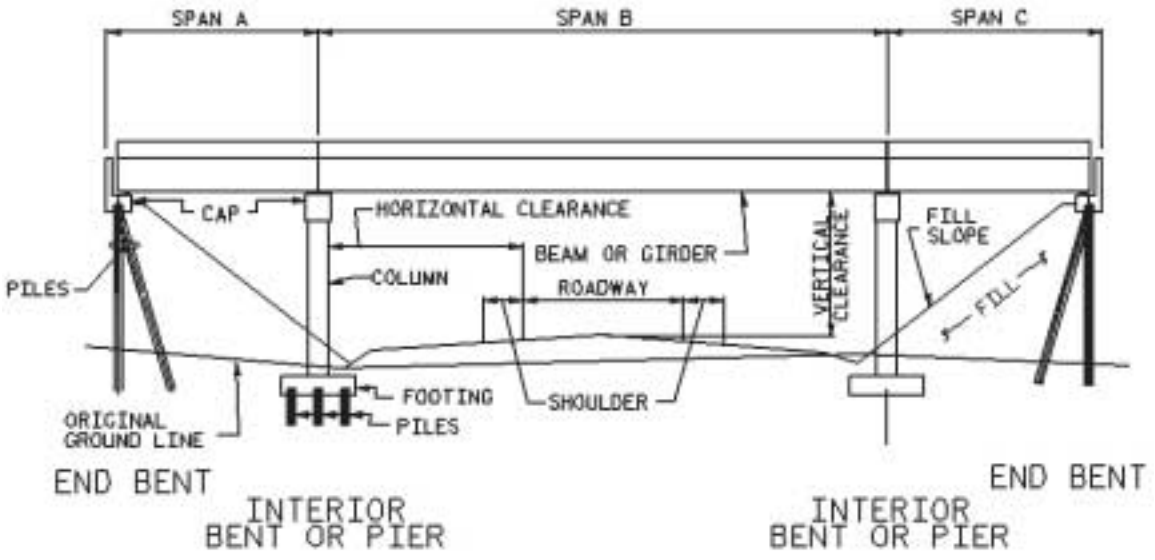
Plan Sheet 7, Sta. 91+95.00 -L-, shows a Reinforced Concrete Box Culvert (RCBC) Plan View. Plan Sheet 19 shows the Profile View.

B. BRIDGE

A ***bridge*** is constructed over a roadway, stream, railroad, or a combination of these. Shown on the following page are two views of a three-span bridge over a roadway. Look this structure over carefully.



PLAN VIEW OF BRIDGE



ELEVATION VIEW OF BRIDGE

Terms: (See Appendix D)

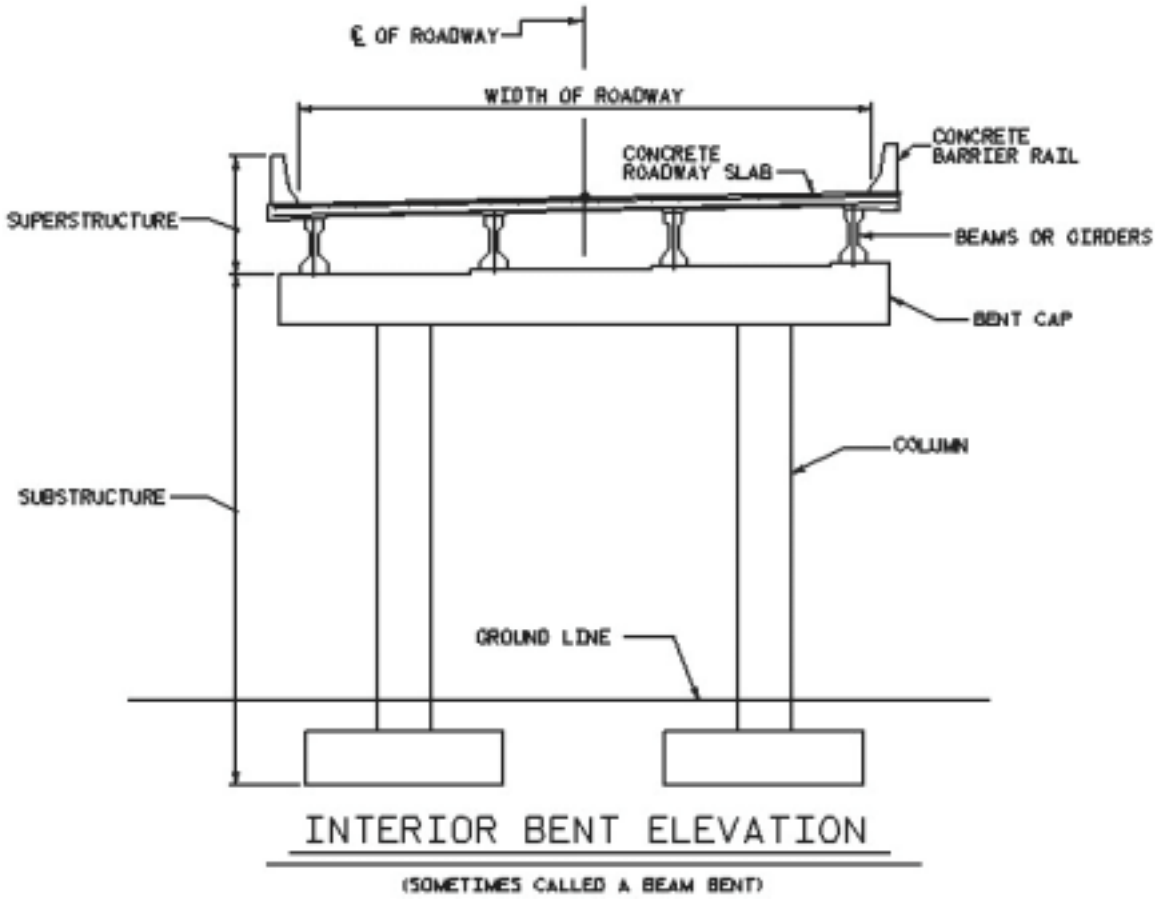
Piles - used in construction of a bridge when there is no firm material available to support a footing of a bridge bent. May be constructed of reinforced concrete or steel.

Footings - these support the columns and are constructed of reinforced concrete.

Beam or Girder – a structural element, usually horizontal, whose main function is to carry loads transverse to its longitudinal axis. Beams/Girders can be made of steel or concrete.

1. BENTS

The following are views of the most common types of ***Interior*** and ***End Bents*** that you will find in structure plans. The views reveal what you would see if you cut a section across a bridge, *between* bents.

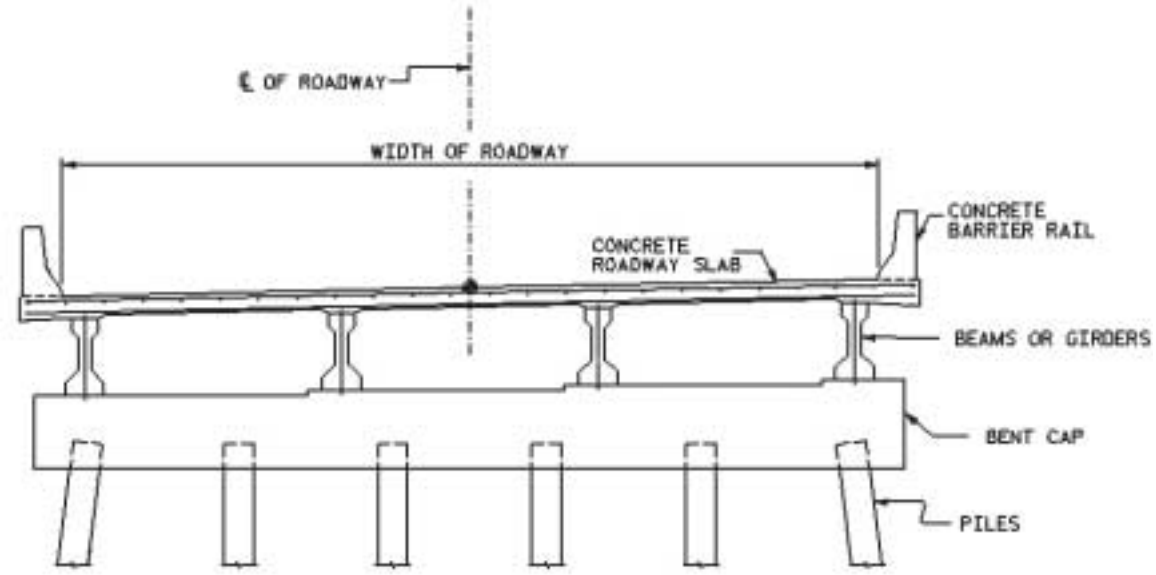


Terms: (See Appendix D)

> Superstructure - that part of the bridge that is above the top of the bent cap.
> Substructure - that part of the bridge that is below the top of the bent cap.

Turn to Plan Sheet S-1 (Plan Sheets for STRUCTURES & CULVERTS are numbered in the lower right corner). Note that the Substructure of the bridge at Station 41+30.61 -L- is shown (the *Superstructure* is not shown). All Bents are POST and BEAM BENTS with Pile Footing Foundations. Plan Sheets S-27 and S-28 show the Substructure for BENT #1.

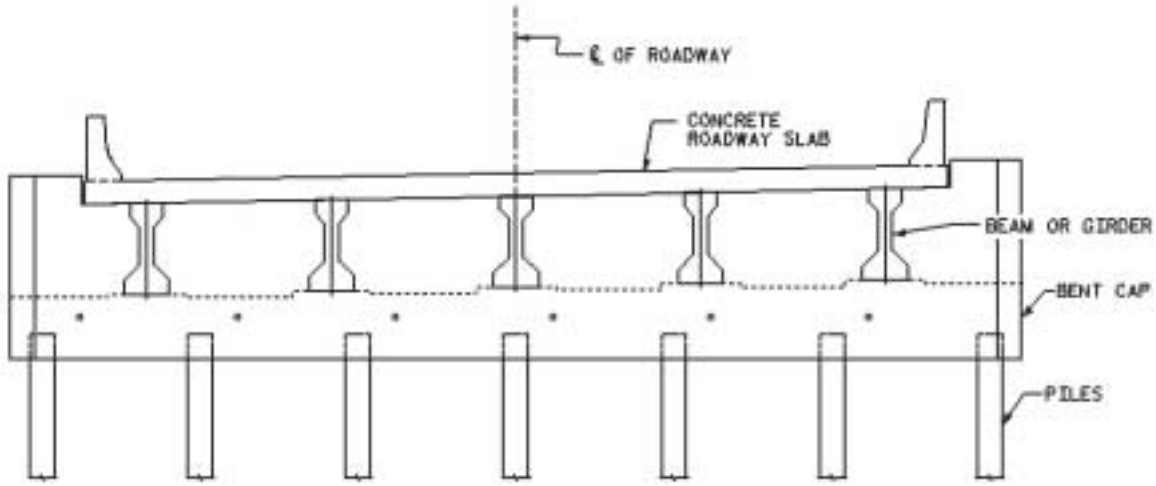
At times you will see a PILE INTERIOR BENT over a stream.



INTERIOR BENT ELEVATION

(SOMETIMES CALLED A BEAM BENT)

End bents are most often supported by piles driven into the ground.



PILE
END BENT ELEVATION

Turn to Plan Sheet S-1 which shows END BENT #1 and END BENT #2 as PILE END BENTS. Also, look at Plan Sheets S-25 and S-26 for END BENT #1.

Write the answers or fill in the blanks to the following questions:

1. The two main parts of a bridge are _____ and _____.
   (Hint- above & below bent cap)

2. The supporting members that hold up (directly support) the roadway slab and the traffic on this slab are _____ or _____.

3. The supporting members in question #2 are supported at each end by a _____ or _____.

4. The portions of the bridge that support the Superstructure are called _____.

5. What are the two types of bents that are shown in the Bent-Elevation views?
   _____ and _____.

6. Depending on the ground beneath, Bent Footings may be supported in two ways. These are _____ or _____.

7. What are the two types of piles normally used? _____ and _____.

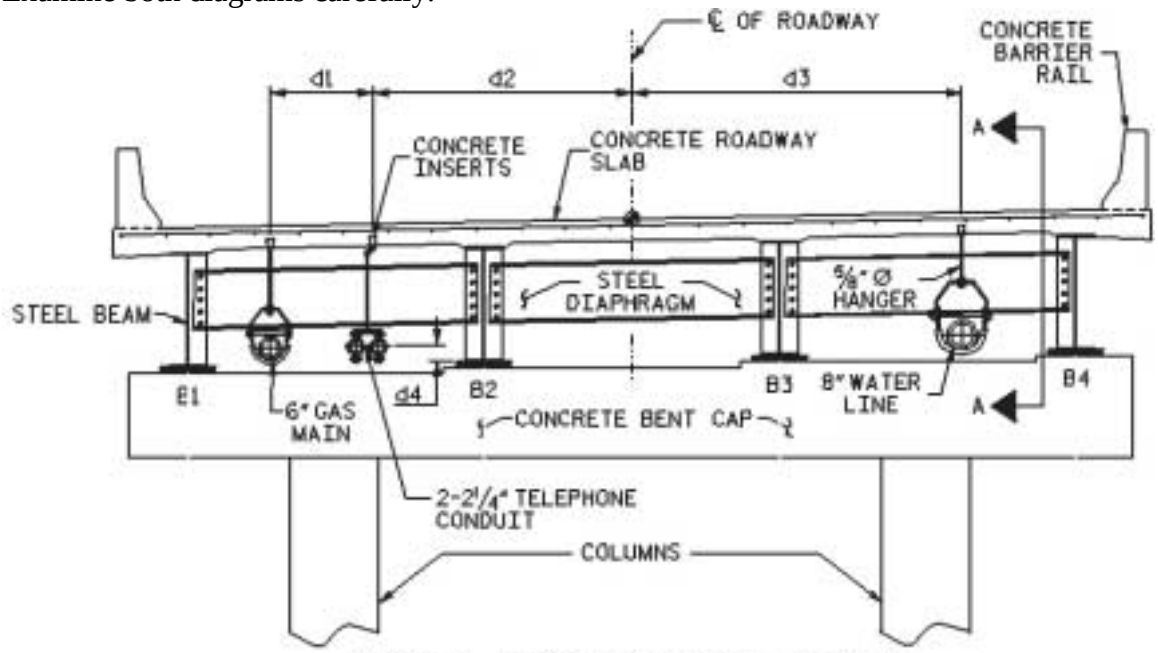
8. What are the materials that beams or girders are made of? _____ and _____.

Now turn to appendix G (page G-2) and check your answers. If you missed any, go back and find where you went wrong – always correct a wrong answer.

2. UTILITIES

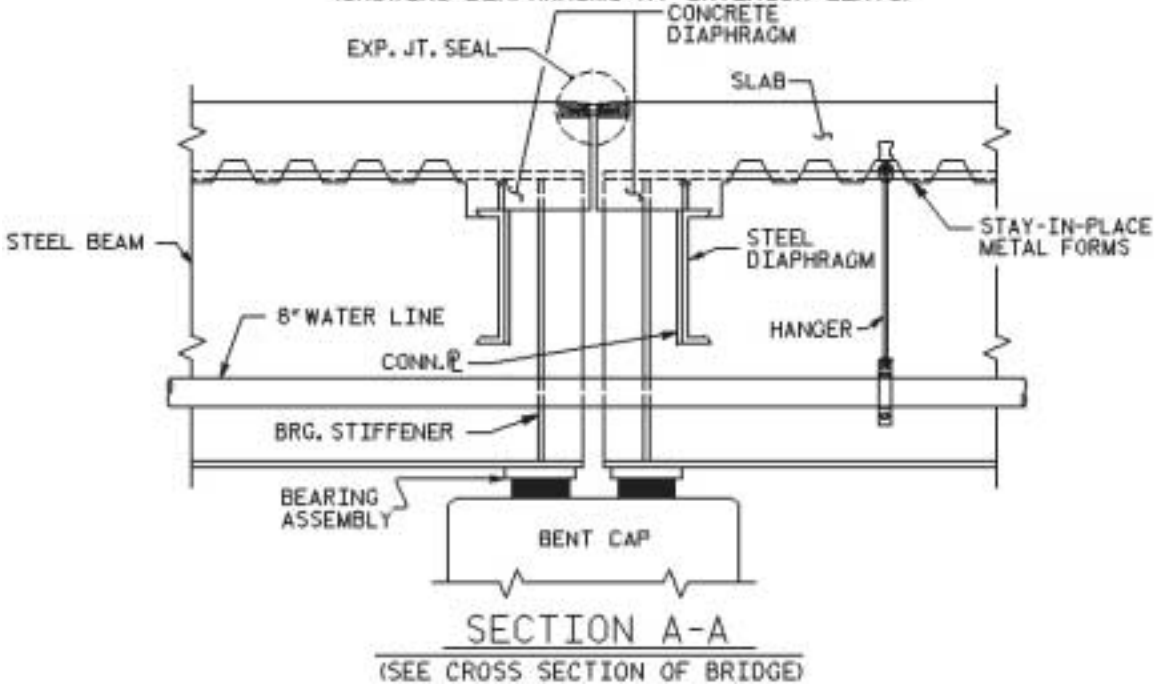
Often it is necessary for ***UTILITIES*** such as water lines, gas lines, telephone lines, power lines and others to cross the roadway spanned by a bridge. The diagrams below are "blown-up" cross-sections of a bridge. This is done to show you some parts you have not seen up to this point and to show how utilities are supported below a bridge slab.

Examine both diagrams carefully.



CROSS SECTION OF BRIDGE

(SHOWING DIAPHRAGMS AT INTERIOR BENTS)



SECTION A-A

(SEE CROSS SECTION OF BRIDGE)

Notice the following shown on the cross-section of a Bridge and in Section A-A (note that you are looking at a cross-sectional side view in Section A-A).

1. The concrete inserts are placed in the slab when the concrete is poured. The 5/8" hangers are then screwed into the bottom of the insert when the utility is put in place.

2. The utilities are normally placed inside the exterior beams and on top of the bottom flange so they cannot be readily seen by the traveling public.

3. The utilities must clear the steel diaphragm. At times the diaphragm may have to be adjusted up or down to permit the utility to be placed on the bridge.

4. The lines or conduits are normally located by the dimensions d1, d2, d3 and d4 as shown.

Write the answers or fill in the blanks to the following questions.

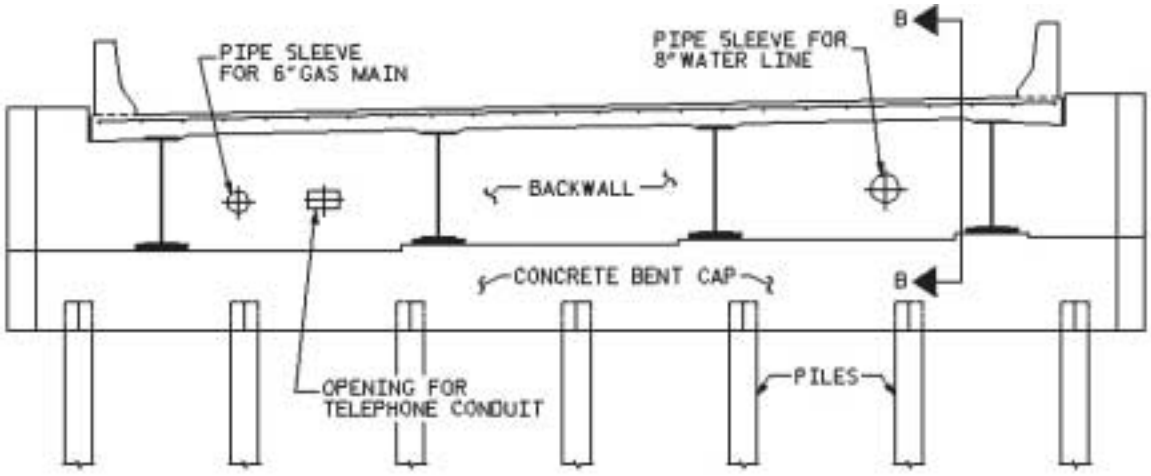
1. What three utilities are shown in the cross-section?
   (1) _____, (2) _____, (3) _____.

2. How many and what size telephone conduits are shown? _____ _____

Now turn to Appendix G (page G-2) and carefully check your answers to the above questions. If you missed any, turn back and find out where you went wrong.

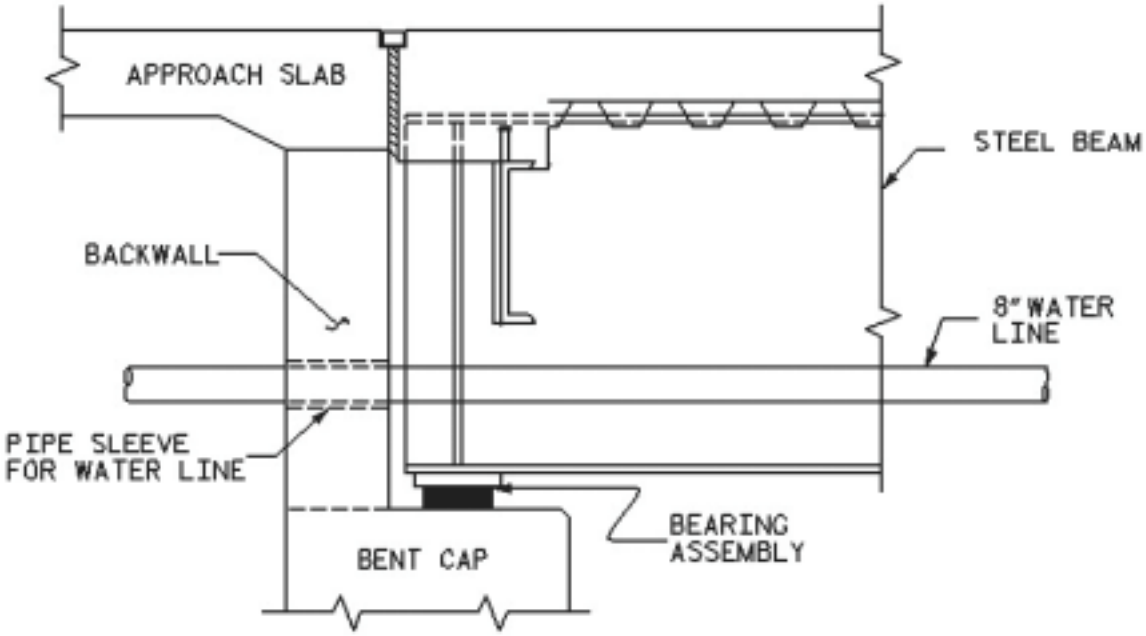
2. Utilities (cont.)

Shown below are views of a bridge. The top view is one looking at the beginning or the end of a bridge which shows the backwall that pipes and conduits must pass through. Examine each diagram carefully.



END ELEVATION AT END BENT

(SHOWING BACKWALL)



SECTION B-B

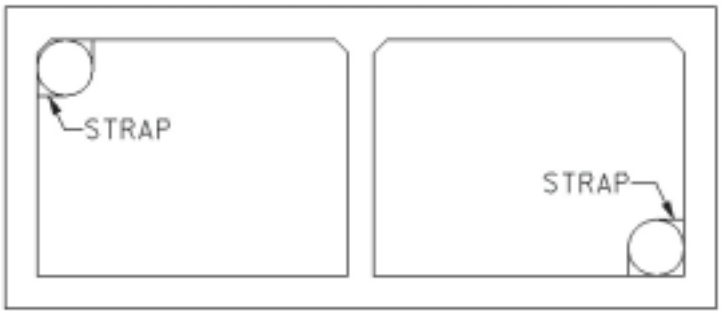
(SEE END ELEVATION AT END BENT)

Notice the following shown on the End Elevation and in Section B-B.

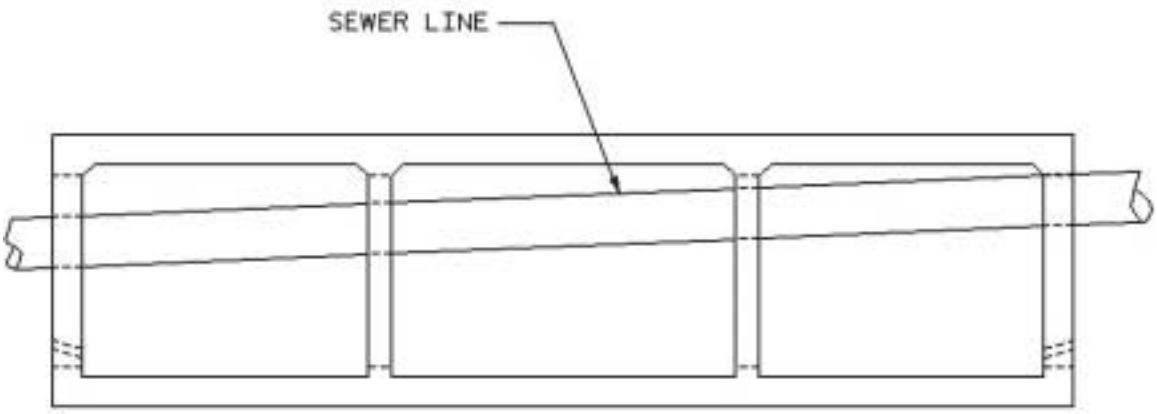
1. The Backwall that the utilities must pass through is a reinforced concrete wall that is cast in place after the end bent cap is poured.

2. Note the pipe sleeves that are cast in the backwall for the pipes to pass through. Also, note the opening that is left for the telephone conduits.

There are occasions when it is necessary for utility lines to be placed in the barrel of a box culvert. Two of these placements are illustrated in the first sectional view below. The utility pipes (gas or water) are supported or held in place by means of straps attached to the concrete slab and walls. Additional information about BOX CULVERTS is found on the following page.



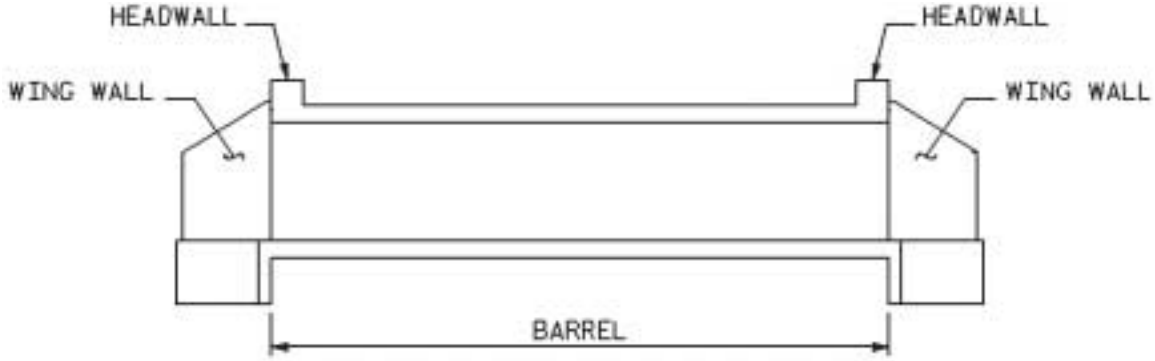
The next view shows a sewer line passing through the walls of a box culvert:



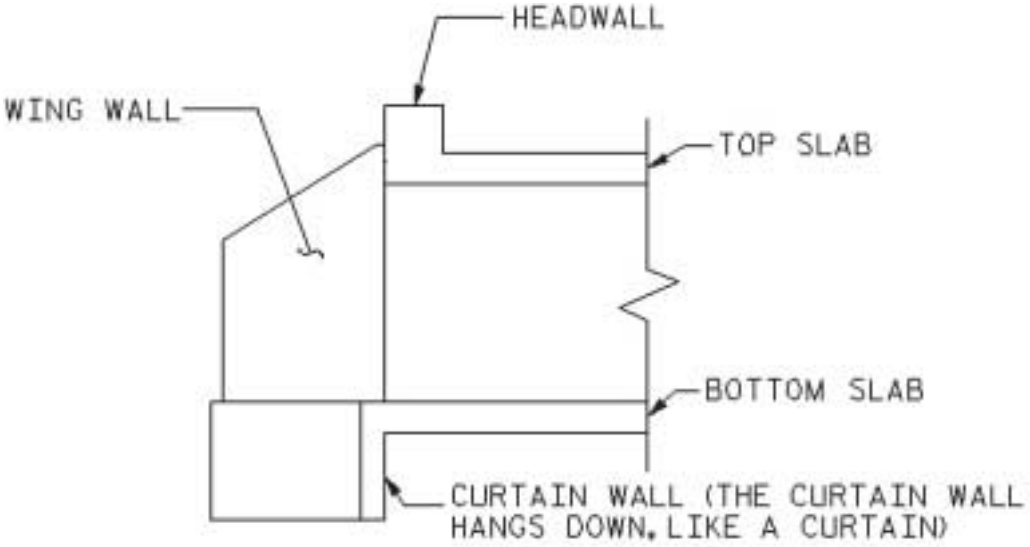
The placements shown above should be ***avoided*** whenever possible. Any obstructions in the barrels of a culvert will restrict the flow of water through the culvert and can cause trash and debris to accumulate in the culvert. It is quite possible that water would be backed up and that flooding would result from placing utility lines within a culvert barrel.

You need to know the **names** of the different culvert parts. **Examine the diagrams below very carefully.**

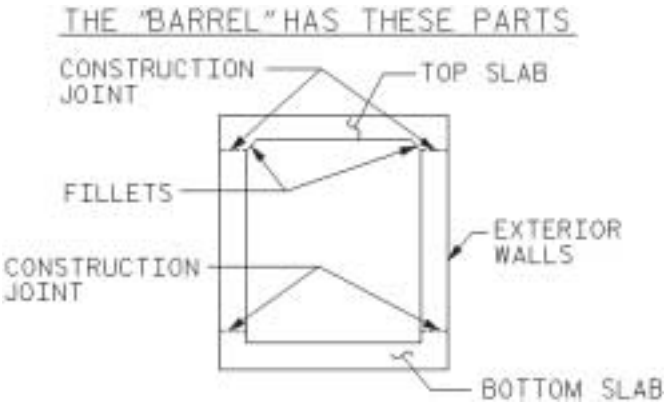
C. BOX CULVERTS

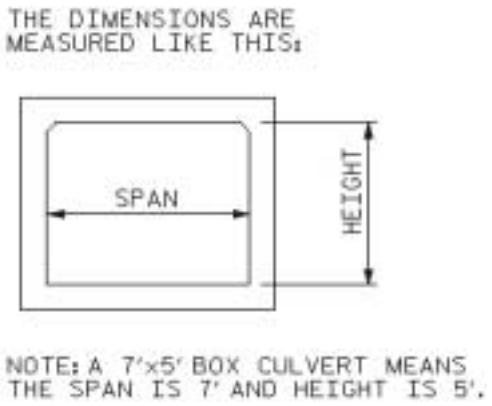


The barrel is shaped rather like a "square barrel." It may be long or short.

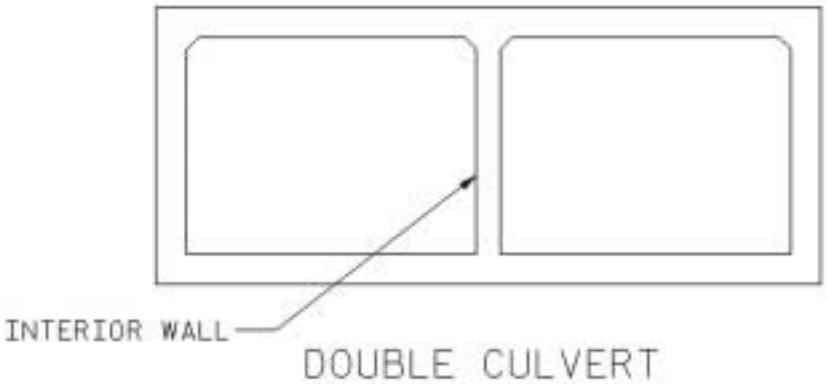


LONGITUDINAL CROSS SECTION

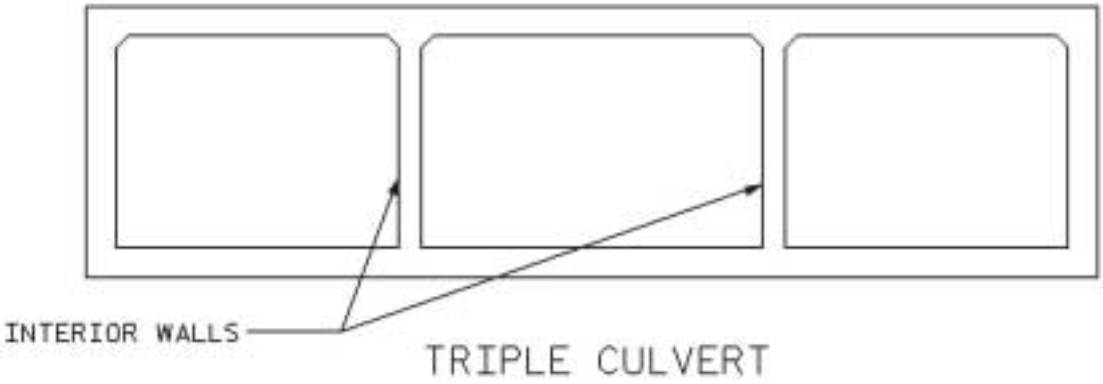




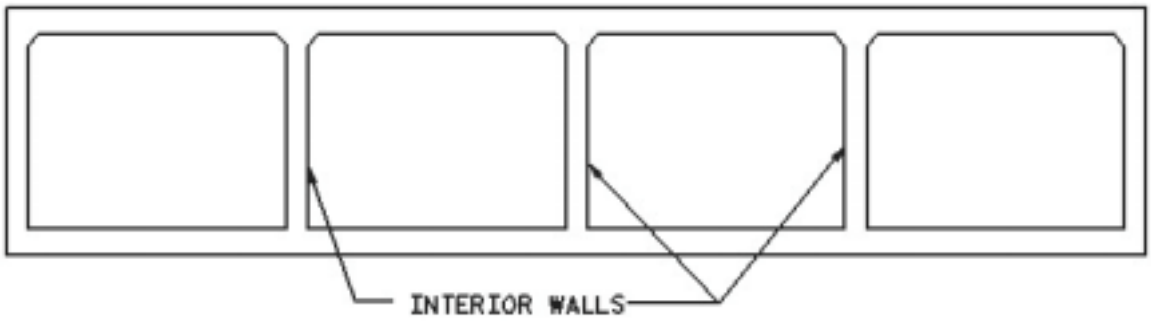
Culverts may also be built with more than one barrel. Shown below are examples of these.



DOUBLE CULVERT



TRIPLE CULVERT



QUADRUPLE CULVERT

Refer to Page 7-10 as you write the answers to the following questions:

1. What are the three MAJOR parts of a box culvert?
   a. _____ b. _____ c. _____

2. What "hangs down" below the bottom slab at each end of the barrel? _____

3. The barrel walls become _____ walls at each end of the barrel.

4. Is the horizontal or vertical distance considered to be the box culvert SPAN?
   _____

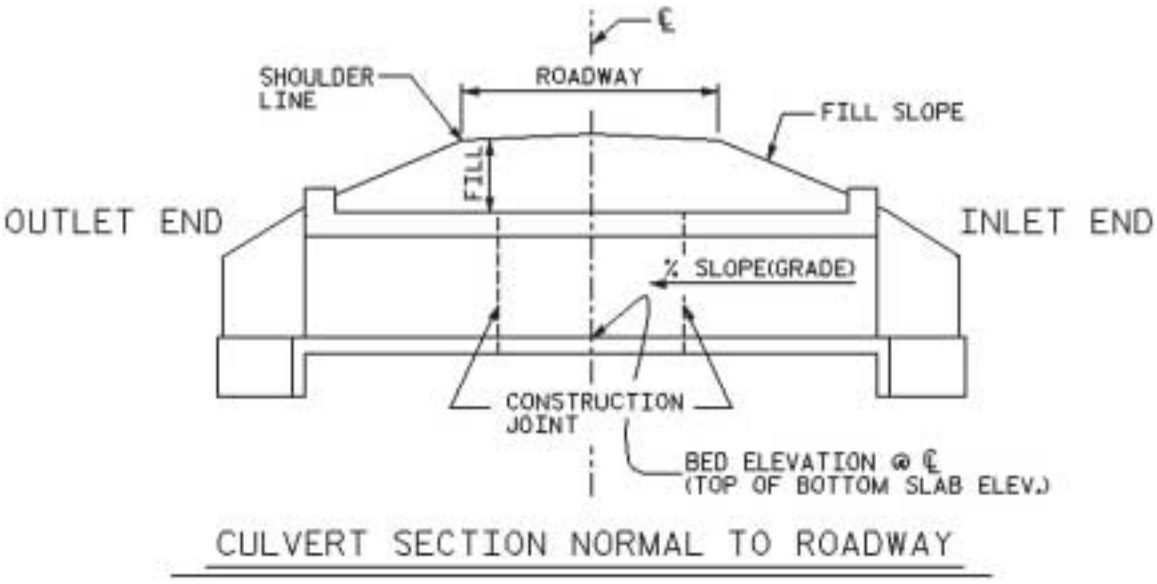
5. Is the horizontal or vertical distance considered to be the box culvert HEIGHT?
   _____

6. What is the SPAN and HEIGHT of each barrel of the DOUBLE 7' x 6' Box Culvert shown on Plan Sheet C-5? _____ and _____.

Now turn to Appendix G (page G-2) and find the answers to the above questions.

If you made a mistake, **ERASE IT.** Look back at Page 7-10 and see why you were wrong- then write in the **CORRECT ANSWER.**

NEVER LEAVE AN ANSWER WRONG! You're most likely to remember it the way you leave it.



1. LONGITUDINAL SECTION

Shown above is a LONGITUDINAL SECTION of a BOX CULVERT.

Notice these things particularly:

a) The **INLET** and **OUTLET** ends- water goes in the **INLET** and flows from the **OUTLET** end of a culvert. The **INLET** end is always the **HIGHER** end of the culvert.

b) The **BED ELEVATION,** also called **CENTERLINE CULVERT INVERT ELEVATION** - is the elevation of the top of the bottom slab shown at the centerline of the roadway, which is at least one foot below the existing stream bed elevation. This elevation is shown on all culvert plans in the location sketch.

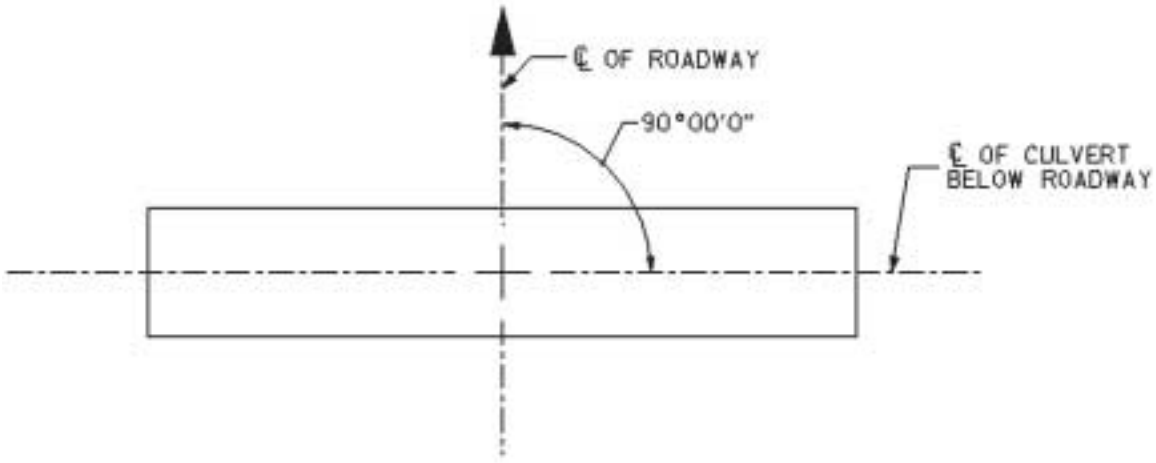
c) The **PERCENT OF SLOPE** for the culvert **BARREL** – This slope is shown in the longitudinal section on the Culvert Plan Sheet. Using this **% SLOPE**, the **BED ELEVATION**, and the distance to each end of the barrel – the **ELEVATIONS** at each end of the culvert can be computed.

d) The slope of the **FILL** – is from the back of the **HEADWALL** up towards the roadway.

e) The **CONSTRUCTION JOINTS** – show where one concrete pour ends and another begins. (A permitted construction joint is one that is optional.)

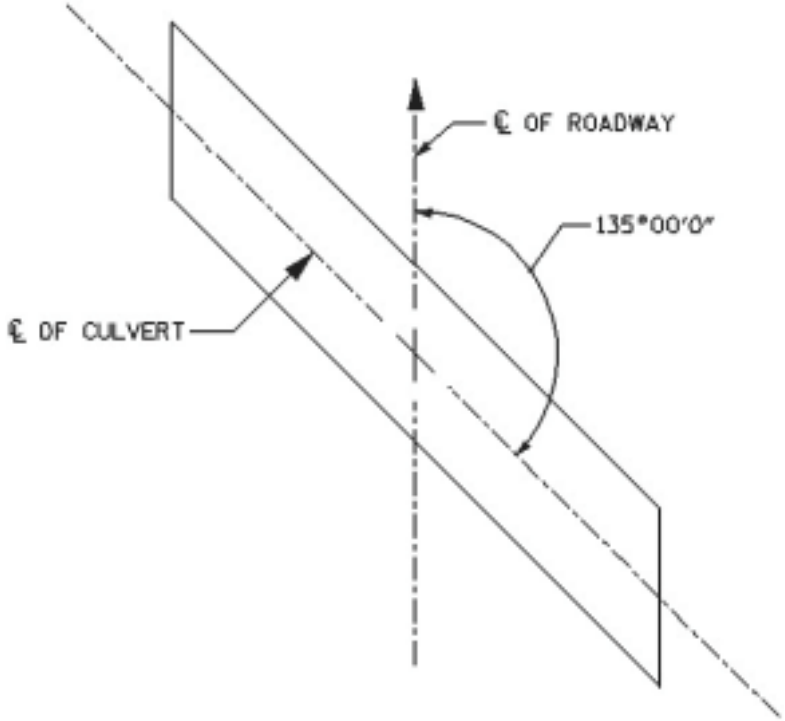
2. PLAN VIEW

Look at the **PLAN VIEW** (shown below) of the box culvert. Wing Walls and Headwalls are not shown. This Plan View shows the culvert from the TOP. See the centerline (℄) of the roadway. Notice that the culvert is on a line PERPENDICULAR to the roadway ℄. This culvert is said to be on a 90° SKEW.



90° SKEW

The **SKEW ANGLE** is the angle that the centerline of the culvert makes with the centerline of the roadway as measured in a clockwise direction from the centerline of the roadway to the centerline of the culvert when looking "ahead". See below for a diagram of a 135° skew angle.



135° SKEW

C. (Box Culvert – Cont.)

As you answer the questions below, refer to the preceding pages on CULVERTS.

1. The end of the culvert that the water goes IN is called the _____ end. This is the _____ end. (higher, lower)

2. The culvert slopes DOWN to the _____ end.

3. A place at which one concrete pour ends and joins another concrete pour is called a _____.

4. The toe of the fill slope meets the back of the _____.

5. A skew angle is the angle formed by what two lines? _____ and _____.

Turn to Plan Sheet C-6, U-2582B, of the Structure Plans and answer these questions:

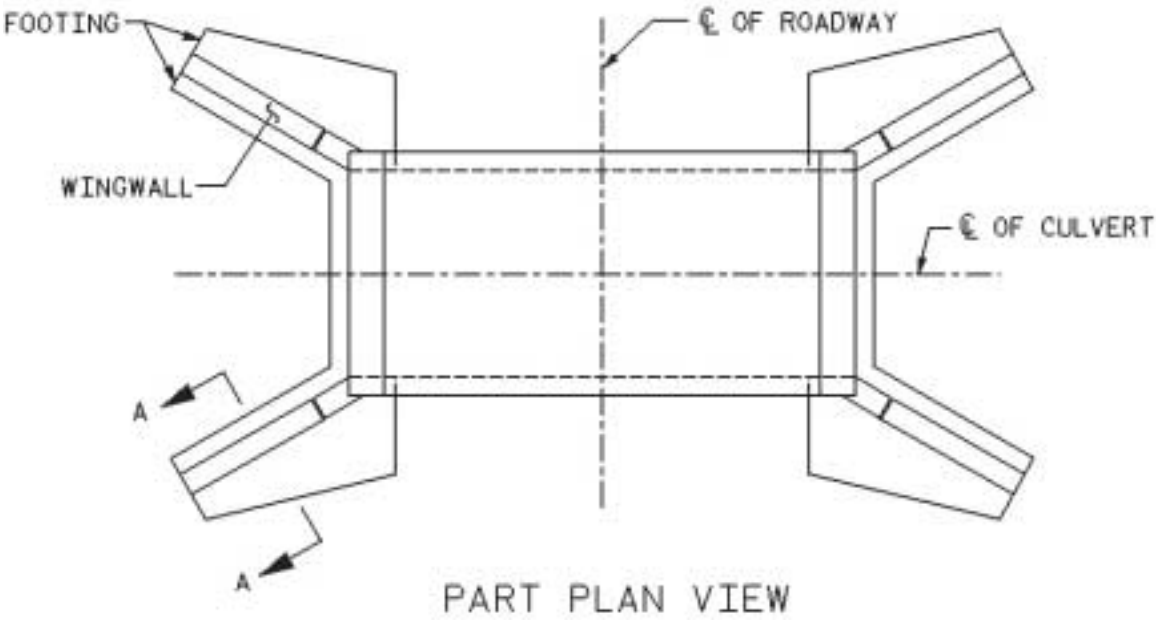
6. What is the SKEW ANGLE of the CULVERT as shown in the Plan Sketch? (HINT: It is also located in the Title Block.) _____

7. What is the Bed Elevation at Centerline? _____

Turn to Appendix G (page G-2) and check your answers.

3. WING WALLS

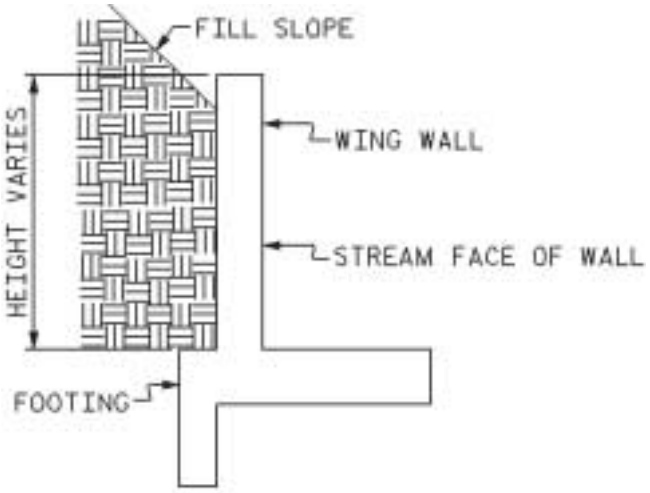
Up to this point we have been concerned mostly with the box culvert barrel. Let's look now at the **WING WALLS** and their relationship to the barrel.



PART PLAN VIEW

The purpose of wing walls is to keep the earth "fill" above the culvert from spilling into the streambed.

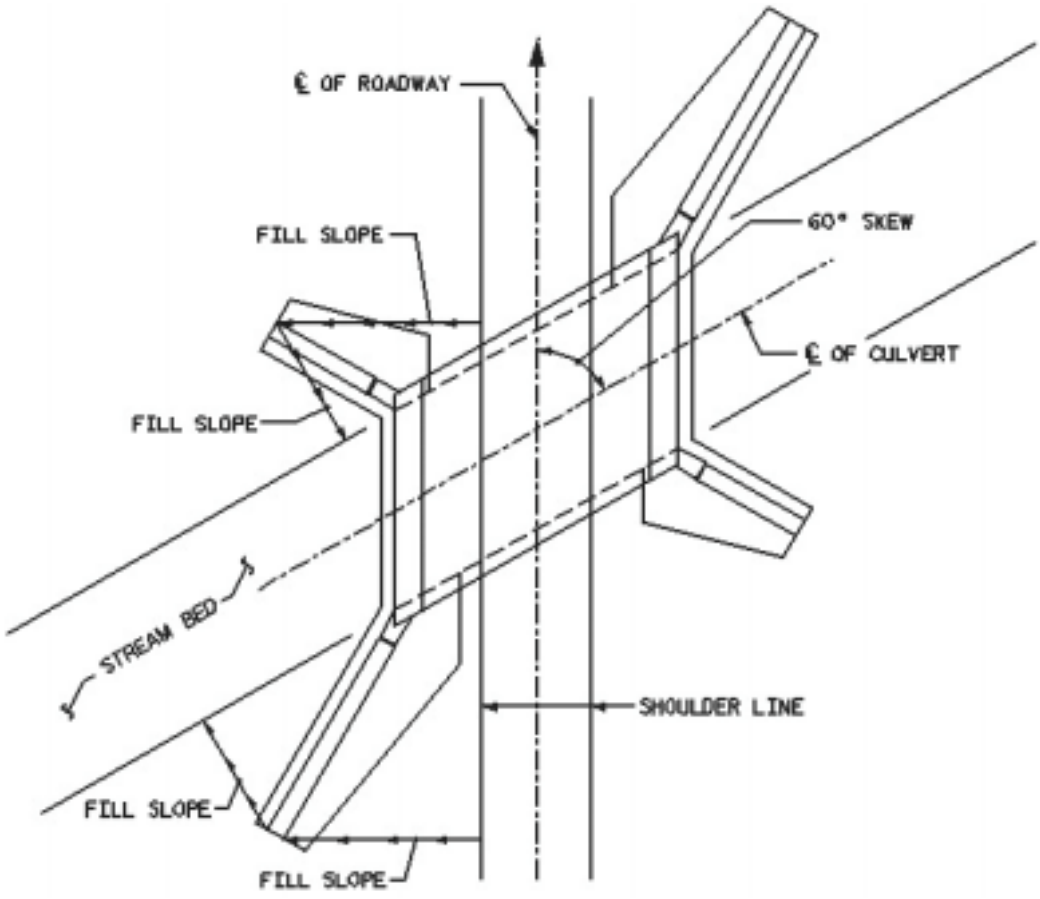
Shown below is a section of the wing wall on the above culvert.



SECTION A-A

Wing Walls are extensions of the barrel walls that flare out away from the stream.

Shown below is a box culvert on a 60° skew. Notice how one wing is shorter than the other.

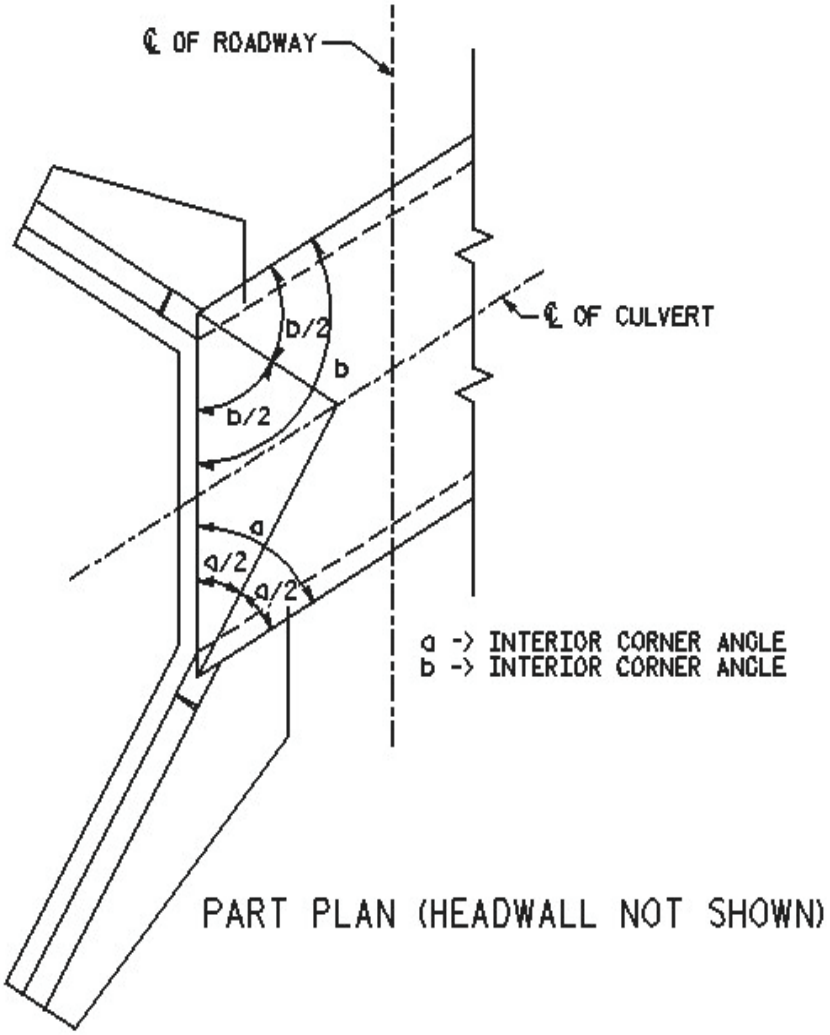


Note that the length of each wing is such that the fill slope, as indicated by the arrowed lines, proceeds down the slope from the shoulder line of the roadway, around the end of the wing, and then down to the edge of the streambed.

Therefore, the wing lengths will vary from culvert to culvert – depending upon the height of the culvert, the slope of the fill, and skew angle of the culvert.

Turn to Plan Sheet C-7 and notice the ***lengths*** of Wing W1 and Wing W2. These ***varying wing lengths*** are examples of short and long wings.

The angles that the wings make with the barrel are illustrated in the part plan shown below. Note that the wings are parallel to lines that bisect (cut in half) the interior corner angles of the culvert.



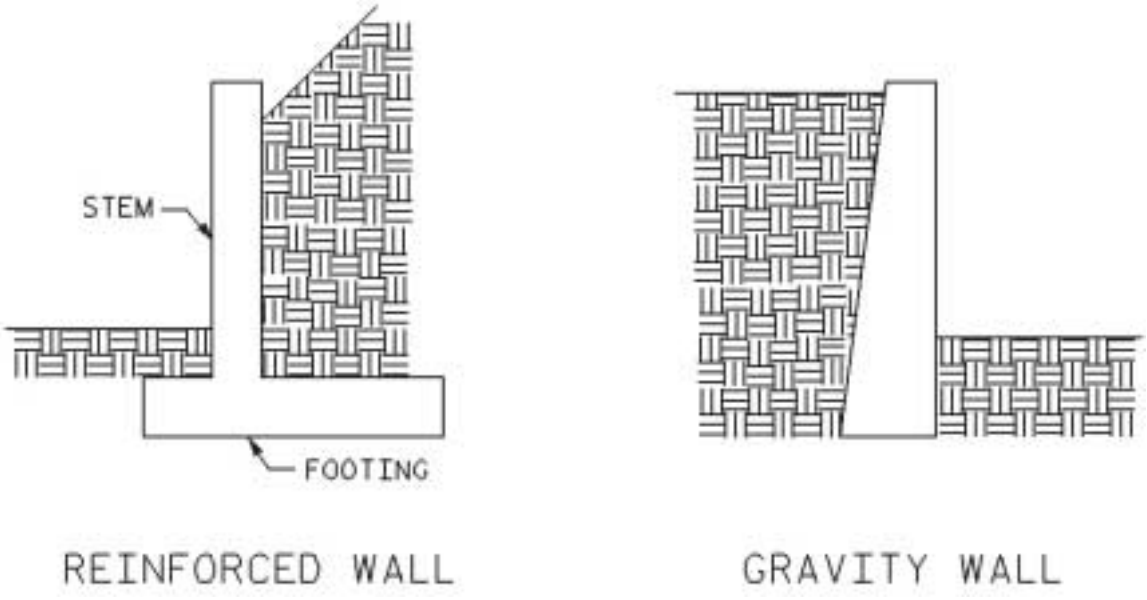
This procedure is the normal or standard method of establishing the direction of the wings.

There are special occasions (not very often) when the wings cannot be placed as shown in the "part plan" above. The plans will specify when (if) and how a variance occurs.

D. RETAINING WALLS

One other type of structure that you should become familiar with is a ***retaining wall***. As its name implies, this type of wall holds back earth. In highway work, a retaining wall is normally used to keep earth on property adjacent to a highway from falling onto the highway, or on the highway right of way, or to keep earth that supports a highway from falling outside the highway right of way.

A retaining wall will normally be one of the types shown below:



A reinforced concrete or brick wall is constructed of either concrete or brick and reinforcing steel. This type of wall utilizes the weight of the earth behind it and the ability of the stem in resisting the overturning force of the retained material. It is used for walls up to about 30 feet high.

A gravity wall is constructed either of concrete, brick, or an earth-filled bin. It retains the bank of earth entirely by its own weight. You will find that a gravity wall is used for low-height walls. Mechanically stabilized earth walls are also a type of gravity wall, but can be 80 to 100 feet high because metal straps embedded in the earth support the face of the wall.

Other types of walls that you may encounter are tied-back walls, mechanically stabilized earth walls, pile panel walls, and soil nail walls.

We will not take the space to describe each type of wall in this manual.

The main thing to remember is how the shape of each wall might affect the right of way line or the placement of a utility.

Write the answers or fill in the blanks to the following questions:

1. The two main types of retaining walls are (1) _____ (2) _____.

2. Which wall stays in place because of its own weight? _____

3. Which wall has a footing that extends on either side of the vertical wall? _____

4. A _____ wall can be used up to about 30 feet in height.

5. A concrete or brick gravity wall is used for _____ walls.

Now turn to Appendix G (page G-3) and carefully check your answers. How did you do? Great! Keep up the good work!!

CHAPTER EIGHT: RIGHT OF WAY

A. INTRODUCTION

In order to construct any highway, the Right of Way Branch must be successful in securing the land needed for right of way purposes. The Right of Way Agent, in most instances, is the first official contact that the property owner will have with the Department of Transportation. It is imperative that the Right of Way Agent be competent in highway plan reading so that he/she can properly interpret the plans for a highway project to the property owner.

The property owner, above anyone else, is most vitally concerned as to how a proposed highway will affect his own property. The Right of Way Agent will be required to answer questions concerning the plans, in addition to the general questions concerning the right of way acquisition procedure. On the initial contact with the property owner, it is of prime importance for the Right of Way Agent to properly interpret the highway plans for the owner, as well as explain other phases of the right of way acquisition procedure. The Right of Way Agent must be knowledgeable in all aspects of highway plan reading in order to properly interpret the plans.

Many times the owner will ask the Right of Way Agent questions regarding ingress (entrance into) and egress (exit from) a proposed highway, how cuts and fills will affect his property, and how his residence or business will be affected by the highway project. The farmer is particularly interested in such matters as how his fields and pastures will be divided by a proposed highway, how his woodland will be affected, how the access to water will be affected, and the appropriation and relocation of fencing. Farmers will also ask questions regarding the movement and protection of livestock, how the construction schedule of the project will affect his planting, growing, and harvesting seasons, and many other questions such as the appropriation of farm outbuildings and his access to the proposed highway facility. These are only a few of the questions that a Right of Way Agent may be asked by a property owner, and the importance of highway plan reading cannot be stressed too strongly. If a Right of Way Agent is hesitant about answering questions regarding the plans due to his/her lack of knowledge, the property owner may become defensive and then the Agent may have a difficult time settling the claim.

In urban areas, the Right of Way Agent should be particularly careful in noting the “cuts” and “fills” as indicated on the plans. Major “cuts” and “fills” can affect locations as to where driveways can be reconnected. It is entirely possible that the depth of a cut or the height of a fill could eliminate a driveway from being reconnected even though the project has no limited or control of access. Urban property owners are particularly interested in such matters as to the appropriation of landscaping, the nearness of a roadway dwelling or business, driveway re-connections, and parking on a proposed street. Property owners may have many more questions regarding highway construction. In many instances, a property owner will move a residence or commercial building that is located within the right of way limits of a highway project to a new location. The owner may move the buildings outside of the right of way on his remaining property, if he has enough property remaining after the right of way appropriation. For these reasons, it is imperative that the Right of Way Agent properly and accurately interprets the plans and read slope stakes.

The Right of Way Branch consists of a Negotiating Unit, Appraisal Unit, Utilities Unit, and an Administrative Unit. Highway plan reading is of vital importance to employees of all sections of the Right of Way Branch, and all employees should take full advantage of this Plan Reading Course.

B. RIGHT OF WAY TERMS AND DEFINITIONS (See Appendix D)

C. FINDING RIGHT OF WAY ON PLAN SHEETS

1. EXERCISE ONE

Plan Sheet 5 is an example of a plan sheet showing the beginning of the project. Carefully note the station numbers for the beginning of the project. On Plan Sheet 5, note the controlled access right of way on the left and right sides of the project. You will see the symbol for right of way fencing on the controlled access right of way. The right of way boundary is subject to full control or access with no ingress or egress to the highway being permitted on this plan sheet. On Plan Sheet 6, access is granted at the intersection of Edwards Mill Road and Reedy Creek Road. Ingress and egress is limited to the intersection in this area. Ingress and egress to the project is permitted east of the Macon Pond Road Intersection.

QUESTIONS FOR EXERCISE ONE

1. What is the beginning station number for State Project 8.2402803 (Refer to Title Sheet)? _____.

2. What is the Federal Aid number applicable to this project (Refer to Title Sheet)? _____

3. On Plan Sheet 7, who is the Property Owner for Parcel No. 2? _____

4. Ingress and egress will be permitted to the project from Parcels Nos. 8-10? _____ (True or False)

5. The proposed right of way marker or monument shown left of Station 106+76.67 –L- is located _____ feet from the survey line.

TURN TO APPENDIX G (page G-3) AND CHECK YOUR ANSWERS.

2. EXERCISE TWO

This project has some non-control of access. You will *not* find a NOTE on the Title Sheet in regards to control of access. Ingress and egress to the project would be allowed at intersections and by driveway permit, except at those points where it might be denied for safety reasons under police powers.

On Plan Sheet 7, you will note that there are easements required outside of the right of way. A permanent drainage easement is required left of Station 85+50 to Station 89+00, and left and right of the proposed 7' X 6' box culvert. You will also note that there is a temporary construction easement required right of Station 94+00 to Station 95+85+/-. These are examples of easements which are required beyond the normal right of way limits of the project.

QUESTIONS FOR EXERCISE TWO

1. A _____foot by _____ foot permanent drainage easement is required outside the right of way, right of Survey Line -L-, Station 90+00 to Station 93+25.

2. The southernmost corners of the permanent drainage easement located right of Survey Station 90+00 is located _____ feet and _____ feet from Survey Line L.

3. Is the easement located left of Station 96+05 to Station 96+75, Survey Line L, permanent, temporary, or both?_____

4. The construction easement required right of Station 94+00, Survey Line L, is what distance from the centerline? _____ feet.

5. There is a proposed right of way marker or monument located left Station 90+00, Survey Line L. _____ (True or False)

6. The owner of Parcel No. 4 is _____.

NOW TURN TO APPENDIX G (page G-3) AND CHECK YOUR ANSWERS.

CHAPTER NINE: GEOTECHNICAL APPLICATIONS

A. INTRODUCTION

With the exception of specific undercut and rock lines, geotechnical subsurface information is not shown on construction plans. It is made available to other design and construction units for use in the design of roadways and structures. Information is also available to contractors for use in evaluating subsurface conditions on a project. For general information purposes, it should be mentioned that borings to determine geologic subsurface conditions are not exclusive to bridge layouts. Borings along proposed and existing roadway alignments and structures are of equal importance in the information they supply for the planning, design, and construction of highways and related structures. The typical "Structure Subsurface Investigation" report submitted by the Geotechnical Engineering Unit contains a legend(s), plan view sheet(s), cross sections and/or profiles, boring logs, core logs (if needed), laboratory test results, core photographs, and site photographs. The report will be sealed by a licensed geologist or engineer on either the title sheet or the legend sheet.

B. LEGEND

The Geotechnical Legend sheet (Figures 1 and 2) is broken down into several sections including soil and rock information, symbols and abbreviations, project specific information, and, if it is our "Old Legend", a professional seal.

The soil and rock sections of the legend present notation and patterns used on the plan, profile, and cross section sheets to describe the subsurface investigation results. Symbols and abbreviations are commonly used on these sheets due to the amount of information presented in a limited amount of space. Some of the symbols and abbreviations will be covered in more detail later in the chapter.

For the "Old Legend" (Figure 1), the project specific section of the legend includes survey benchmarks, project numbers, location description, personnel assigned to the project, and a professional seal which is signed and dated. For the "New Legend" (Figures 2a and 2b), the project specific section of the legend includes survey benchmarks, drilling equipment used, and any special notes or symbols for the project. For "New Legend" projects, the project numbers, location description, personnel assigned to the project and a professional seal are all located on the title sheet.

A legend supplement (Figure 3) is inserted behind the "Old Legend" if rock core samples were collected. The supplement is used to describe rock quality notation listed on the logs. The "New Legend" already includes all of the rock quality notations and therefore does not need a supplement.

C. PLAN VIEW

Figure 4 is a plan view of the project as it traverses SR 3009 (Edwards Mill Road). Represented on this plan view are boreholes denoted by a circle with two shaded triangles inside. These borings are at each bent location along the proposed bridges. Geotechnical subsurface investigations are necessary at bridge sites in order to determine the best-suited bridge foundation based on the geological and engineering properties of the soil and rock encountered in test borings. Proposed bent locations are sometimes impossible to access with truck and/or ATV mounted drill machines due to existing structures, utilities, harsh terrain, and water conditions. It is sometimes necessary to offset or omit boring locations in such circumstances.

D. PROFILE

Figure 5 is a geologic profile which visually represents the subsurface soil and rock formations along the proposed alignment. Connecting the zones or layers in adjacent borings with a dashed boundary line depicts various soil and rock formations having similar geologic and engineering properties. Static groundwater is measured after a 24-hour or more period of time and represented on this profile by a shaded triangle. The date each static water level was taken is below each boring. This date is more often shown next to or below the shaded triangle. Each soil type encountered is represented by a different symbol that represents a grouping of AASHTO soil classifications. There are 12 AASHTO soil classifications, each having distinct engineering properties. In Figure 5, 3 classifications of soil were encountered plus the addition of weathered rock. The ellipse represents a density and soil strength test at 2.5’ and 5’ intervals in the borehole. This test is shown as a Standard Penetration Test (SPT). The numerical value associated with the SPT is most often referred to as the Blow Count or N-value. Each soil and/or rock type is given a written description of its physical soil properties that are derived from a combination of field notes and laboratory tests performed on soil samples taken in the field.

E. LOGS

1. BORING LOGS

A boring log (Figure 6) is generated for each boring location on the project. Some of the information on the log includes boring number and location, equipment used, boring depth, SPT blow counts, sample depth (SS-1 under the “SAMP. NO.” column), and soil and rock descriptions. Notice at a depth of 33.5 feet, blow counts of 8, 11, and 11 were recorded. By adding the last two blows (11 & 11) you get the Blows Per Foot (BPF) or N-value measurement of 22 which is displayed in the ellipse just below the ground water level on boring EB1-A EB in the profile (Figure 5).

2. CORE LOGS

A core log (Figure 7) is generated for a hole in which a rock core sample is taken. Two types of the information recorded on the core log are recovery (REC%) and rock quality (RQD%). Core recovery (REC%) is calculated by dividing the total length of rock recovered in the core barrel by the total length of the core run and expressed as a percent. An example would be if the core bit was advanced 3 feet (3' Run) but only 2.88 feet of rock was recovered then the REC% would be 2.88'/3' x 100% = 96%.

Rock Quality Designation (RQD%) is also recorded on the log by dividing by the total length of sound rock segments recovered that are longer than or equal to 4 inches of the total length of the core run as expressed as a percent. An example would be if the run was 3 feet and 2.61 feet of the rock recovered was greater than 4 inches, the RQD% would be 2.61'/3' x 100% = 87%.

F. LABORATORY TEST RESULTS

Soil samples taken in the field are submitted to the laboratory for testing. The summary report (Figure 8) from the laboratory is included in the Structure Subsurface Plans to display the soil properties as determined in the laboratory. Soil properties include moisture content, N-values, Atterberg limits, and grain size gradations. These soil properties are the basis for our design and construction recommendations.

G. PHOTOGRAPHS

Core and site photographs are often presented in geotechnical plans to aide in the description of the rock core samples and site conditions.

NORTH CAROLINA DIVISION OF HIGHWAYS

GEOTECHNICAL UNIT

SOIL AND ROCK CLASSIFICATION, LEGEND, AND ABBREVIATIONS

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)							SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2				A-4	A-5	A-6	A-7	A-1,A-2 A-3	A-4,A-5 A-6,A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6			
SYMBOL														
% PASSING #10	50 MX											GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
#40	30 MX	50 MX	51 MN											
#200	15 MX	25 MX	10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN			
(PASSING #40) LL				40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
PI	6 MX		N.P.	10 MX	10 MX	11 MN	11 MN	10 MX	10 MX	11 MN	11 MN			
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	NO MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAG. GRAVEL & SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				

* PI OF A-7-5 ≤ (LL-30); PI OF A-7-6 > (LL-30)

TEXTURE OR GRAIN SIZE

BOULDER	COBBLE	GRAVEL	COARSE SAND	FINE SAND	SILT	CLAY
GRAIN (MM)	305	75	2	0.25	0.05	0.005
SIZE (IN)	12"	3"				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	-SATURATED- (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL LIQUID LIMIT		
PLASTIC RANGE (PI)	-WET- (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL PLASTIC LIMIT		
OM OPTIMUM MOISTURE	-MOIST- (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL SHRINKAGE LIMIT		
	-DRY- (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

ROCK DESCRIPTION

IN THE BROADEST MEANING, HARD ROCK IS CONSIDERED TO BE THAT INDURATED EARTH MATERIAL WHICH CANNOT BE SAMPLED BY CONVENTIONAL SOIL SAMPLING TOOLS OR TECHNIQUES. THE BOUNDARY BETWEEN SOIL AND ROCK IS ARBITRARY. TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF 'WEATHERED ROCK'. FOR THE PURPOSE OF THIS INVESTIGATION, THESE MATERIALS ARE DIVIDED AS FOLLOWS:

TERM	SYMBOLS		DESCRIPTION
HARD ROCK (HR)	CORED ROCK	INFERRED ROCK LINE [2]	MATERIAL THAT CANNOT BE PENETRATED BY POWER AUGERS. EXCEPT IN THIN LEDGES, AND REQUIRES ROCK CORING TOOLS FOR OBTAINING A SAMPLE
WEATHERED ROCK (WR)		HARD WEATHERED ROCK (HWR)	MATERIAL THAT CAN BE PENETRATED WITH GREAT DIFFICULTY USING POWER AUGERS AND YIELDS SPT REFUSAL [1]
		SOFT WEATHERED ROCK (SWR)	MATERIAL THAT CAN BE PENETRATED WITH SOME DIFFICULTY USING POWER AUGERS AND YIELDS SPT VALUES > 100 BPF BUT < SPT REFUSAL

[1] SPT REFUSAL ≤ 1 INCH OF PENETRATION PER 50 BLOWS.

[2] AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH AUGERS COULD NO LONGER PENETRATE. THE HARD ROCK SYMBOL IS SHOWN WHEN ROCK IS CORED AND ONLY TO THAT DEPTH CORED. A DESCRIPTION OF ROCK IS GIVEN, INCLUDING:

CORE RECOVERY (REC.) - TOTAL LENGTH OF ROCK RECOVERED IN THE CORE BARREL DIVIDED BY THE TOTAL LENGTH OF THE CORE RUN TIMES 100%.

ROCK QUALITY DESIGNATION (RQD) - TOTAL LENGTH OF SOUND ROCK SEGMENTS RECOVERED THAT ARE LONGER THAN OR EQUAL TO 4" DIVIDED BY THE TOTAL LENGTH OF THE CORE RUN TIMES 100%.

SEAL

Signature

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTANCE (BLOWS PER FOOT)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (q_u) (TONS/FT^2)
GENERALLY GRANULAR MATERIAL	VERY LOOSE	< 4	N/A
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	
	DENSE	30 TO 50	
	VERY DENSE	> 50	
GENERALLY SILT-CLAY MATERIAL	VERY SOFT	< 2	< .25
	SOFT	2 TO 4	.25 TO .5
	MEDIUM STIFF	4 TO 8	.5 TO 1
	STIFF	8 TO 15	1 TO 2
	VERY STIFF	15 TO 30	2 TO 4
	HARD	> 30	> 4

GROUND WATER

- WATER LEVEL IN BORE HOLE { IMMEDIATELY AFTER DRILLING (G.A.D.) / ON AFTER DRILLING (_____ HRS.)
- STATIC WATER LEVEL (AFTER _____ HRS.)
- PERCHED WATER (PW), SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEPAGE

MISCELLANEOUS SYMBOLS AND ABBREVIATIONS

- ROADWAY EMBANKMENT WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL OTHER THAN ROADWAY EMBANKMENTS
- INFERRED SOIL BOUNDARIES
- 25' STRIKE AND DIP OF BEDS
- APPARENT DIP (NORMAL TO _____)
- ROD SOUNDING
- SPT / CPT / TEST BORING / VST
- AUGER BORING
- CORE BORING
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- SPT N-COUNT

SAMPLE DESIGNATIONS

- S-BULK SAMPLE
- SS-SPLIT SPOON SAMPLE
- ST-SHELBY TUBE SAMPLE
- RS-ROCK SAMPLE

ABBREVIATIONS

ALLUV.	ALLUVIUM	MIC.	MICACEOUS
AR	AUGER REFUSAL	MOT.	MOTTLED
BLDR.	BOULDER	NS	NO SAMPLE TAKEN
BPF	BLOWS PER FOOT	ORG.	ORGANIC
CALC.	CALCAREOUS	P.P.	POCKET PENETROMETER
CL.	CLAY	REF.	REFER TO
CLY.	CLAYEY	RES.	RESIDUAL
COB.	COBBLE	S.	SOFT
CSE.	COARSE	SAT.	SATURATED
DPT	DYNAMIC PENETRATION TEST	SD.	SAND
EST.	ESTIMATED	SDY.	SANDY
F.	FINE	SED(S).	SEDIMENT(S)
FIAD	FILLED AMED. AFTER DRILLING	SL.	SILT, SILTY
FOSS.	FOSSILIFEROUS	SLI.	SLIGHTLY
FRAC.	FRACTURED	SPT	STANDARD PENETRATION TEST
FRAG(S).	FRAGMENT(S)	TS.	TOPSOIL
GR.	GRAVEL	VST	VANE SHEAR TEST
GS	SPECIFIC GRAVITY	V.	VERY
GW	GROUND WATER	W/	WITH
MED.	MEDIUM		

BENCH MARK: _____

STATE PROJECT NO. _____

T.I.P. NO. _____ F.A. NO. _____

COUNTY _____ ROUTE _____

SITE DESCRIPTION _____

PROJECT GEOLOGIST _____ SUBMITTED BY _____

PERSONNEL _____

DATE SUBMITTED _____

REV. 8/11/98

Figure 1

ID	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
		2A	

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL UNIT
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED OR WEATHERED EARTH MATERIALS WHICH CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND WHICH YIELDS LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM AND BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

VERY STIFF, GRAY SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤35% PASSING #200)						SILT-CLAY MATERIALS (>35% PASSING #200)				ORGANIC MATERIALS		
GROUP	A-1		A-3	A-2			A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
CLASS.	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5, A-7-6		
SYMBOL													
% PASSING #10	50 MX										GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
#40	30 MX	50 MX	51 MN										
#200	15 MX	25 MX	10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN	36 MN	
LIQUID LIMIT	6 MX		N.P.	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	40 MX	41 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER	HIGHLY ORGANIC SOILS
PLASTIC INDEX				10 MX	10 MX	11 MN	11 MN	10 MX	10 MX	11 MN	11 MN		
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	No MX		
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS			
GENERAL RATING AS A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR			FAIR TO POOR	POOR	UNSUITABLE

P.I. OF A-7-5 ≤ L.L. - 30 ; P.I. OF A-7-6 > L.L. - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH (TONS/FT²)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	<4	N/A
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	
	DENSE	30 TO 50	
	VERY DENSE	>50	
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT	<2	<0.25
	SOFT	2 TO 4	0.25 TO 0.5
	MEDIUM STIFF	4 TO 8	0.5 TO 1
	STIFF	8 TO 15	1 TO 2
	VERY STIFF	15 TO 30	2 TO 4
	HARD	>30	>4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.0	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GRL)	COARSE SAND (CSE. SD.)	FINE SAND (F. SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12"	3"				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL - LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL - PLASTIC LIMIT		
OM - OPTIMUM MOISTURE	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL - SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NONPLASTIC	0-5	VERY LOW
LOW PLASTICITY	6-15	SLIGHT
MED. PLASTICITY	16-25	MEDIUM
HIGH PLASTICITY	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YEL-BRN, BLUE-GRAY) MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED- INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE
UNIFORM- INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)
GAP-GRADED- INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS ARE DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 30
MODERATELY COMPRESSIBLE	LIQUID LIMIT 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT-CLAY SOILS	OTHER MATERIAL	
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE	1 - 10%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE	10 - 20%
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME	20 - 35%
HIGHLY ORGANIC	>10%	>20%	HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING.
- STATIC WATER LEVEL AFTER 24 HOURS.
- PW - PERCHED WATER, SATURATED ZONE OR WATER BEARING STRATA
- SPRING OR SEEPAGE

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL OTHER THAN ROADWAY EMBANKMENTS
- INFERRED SOIL BOUNDARIES
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/425 DIP/DIP DIRECTION OF ROCK STRUCTURES
- SOUNDING ROD
- TEST BORING (WT, PW, DRY, SPT, CPT, VST, PMT)
- AUGER BORING
- CORE BORING
- MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- SPT N-VALUE
- REF - SPT REFUSAL

SAMPLE DESIGNATIONS:
- B - BULK SAMPLE
- SS - SPLIT SPOON SAMPLE
- ST - SHELBY TUBE SAMPLE
- RS - ROCK SAMPLE
- AT - RECOMPACTED TRIAXIAL SAMPLE
- CBR - CBR SAMPLE

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F. - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED
FRAGS. - FRAGMENTS
MED. - MEDIUM
PMT - PRESSUREMETER TEST
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT
W - MOISTURE CONTENT
V. - VERY
VST - VANE SHEAR TEST

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- ☐ MOBILE B-___
- ☐ BK-51
- ☐ CME-45
- ☐ CME-550
- ☐ PORTABLE HOIST
- ☐ OTHER _____
- ☐ OTHER _____

ADVANCING TOOLS:
- ☐ CLAY BITS
- ☐ 6" CONTINUOUS FLIGHT AUGER
- ☐ 8" HOLLOW AUGERS
- ☐ HARD FACED FINGER BITS
- ☐ TUNG.-CARBIDE INSERTS
- ☐ CASING ☐ W/ ADVANCER
- ☐ TRICONE _____" STEEL TEETH
- ☐ TRICONE _____" TUNG.-CARB.
- ☐ CORE BIT
- ☐ OTHER _____

HAMMER TYPE:
- ☐ AUTOMATIC ☐ MANUAL

CORE SIZE:
- ☐ -B-_____
- ☐ -N-_____
- ☐ -H-_____

HAND TOOLS:
- ☐ POST HOLE DIGGER
- ☐ HAND AUGER
- ☐ SOUNDING ROD
- ☐ VANE SHEAR TEST
- ☐ OTHER _____

REVISED 09/15/00

Figure 2a

ID	STATE PROJECT NO.	SHEET NO.	TOTAL SHEETS
		2B	

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL UNIT
SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT WHEN TESTED, WOULD YIELD SPT REFUSAL. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLOWS:

WEATHERED ROCK (WR)		NON-COASTAL PLAIN MATERIAL THAT YIELDS SPT N VALUES > 100 BLOWS PER FOOT.
CRYSTALLINE ROCK (CR)		FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)		FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)		COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V. SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED. SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES 'CLUNK' SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCKS EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGISTS PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGISTS PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGISTS PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FEET
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	> 4 FEET
THICKLY BEDDED	1.5 - 4 FEET
THINLY BEDDED	0.16 - 1.5 FEET
VERY THINLY BEDDED	0.03 - 0.16 FEET
THICKLY LAMINATED	0.008 - 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS WHICH HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC.

ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IS IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.

CALCAREOUS (CALC.) - SOILS WHICH CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (F.P.) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD.) - A MEASURE OF ROCK QUALITY DESCRIBED BY: TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL WHICH RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, WHICH HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (S*T) - NUMBER OF BLOWS (N OR B/P.F.) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS LESS THAN 0.1 FOOT PENETRATION WITH 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (S.R.Q.D.) - A MEASURE OF ROCK QUALITY DESCRIBED BY: TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (T.S.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK:

ELEVATION:

NOTES:

REVISED 09/15/00

Figure 2b

LEGEND SUPPLEMENT

In addition to the terms and abbreviations listed on the Legend Sheet, the following will be used to further describe rock quality on this project. Because of limited space on the logs, abbreviations are in parenthesis.

WEATHERING

Fresh	Rock fresh, crystals bright, few joints may show slight staining. Rock rings under hammer in crystalline.
Very Slight (V. SLI.)	Rock generally fresh, joints stained, some joints may show thin clay coatings if open, crystals on a broken specimen face shine brightly. Rock rings under hammer blows if of a crystalline nature.
Slight (SLI.)	Rock generally fresh, joints stained and discoloration extends into rock up to 25 mm (1 in.). Open joints may contain clay. In granitoid rocks some occasional feldspar crystals are dull and discolored.
Moderate (MOD.)	Significant portions of rock show discoloration and weathering effects. In granitoid rocks, most feldspars are dull and discolored, some show clay. Rock has dull sound under hammer blows and show significant loss of strength as compared with fresh rock.
Moderately Severe (MOD. SEV.)	All rock except quartz discolored or stained. In granitoid rocks, all feldspars dull and discolored and a majority sow kaolinization. Rock shows severe loss of strength & can be excavated with geologist's pick. Rock gives "clunk" sound when struck. **Comparable to hard weathered rock.**
Severe (SEV.)	All rocks except quartz discolored or stained. Rock "fabric" clear and evident but reduced in strength to strong soil. In granitoid rocks all feldspars are kaolinized to some extent. Some fragments of strong rock usually remain. **Comparable to soft weathered rock.**
Very Severe (V. SEV.)	All rock except quartz discolored or stained. Rock fabric elements are discernible but the mass is effectively reduced to soil status, with only fragments of strong rock remaining. Saprolite is an example of rock weathered to a degree such that only minor vestiges of the original rock fabric remain. **Comparable to soil.**
Complete	Rock reduced to soil. Rock fabric not discernible only in small and scattered concentrations. Quartz may be present as dikes or stringers. Saprolite is also an example. **Comparable to soil.**

ROCK CONTINUITY

Sound	Core pieces larger than 8 inches.
Slightly Fractured (SLI. FRAC.)-	Core pieces between 4 and 8 inches.
Moderately Fractured (MOD. FRAC.) -	Core pieces between 1 and 4 inches.
Extremely Fractured (EXT. FRAC.) -	Core pieces less than 1 inch.

JOINT SPACING

Average Discontinuity Spacing (ADS)
The average measured distance (in centimeters) between joints in the same set. Will not apply to individual joints.

JOINT THICKNESS

Average Discontinuity Thickness (ADT)
The average thickness or width of gap in the joint.

Figure 3

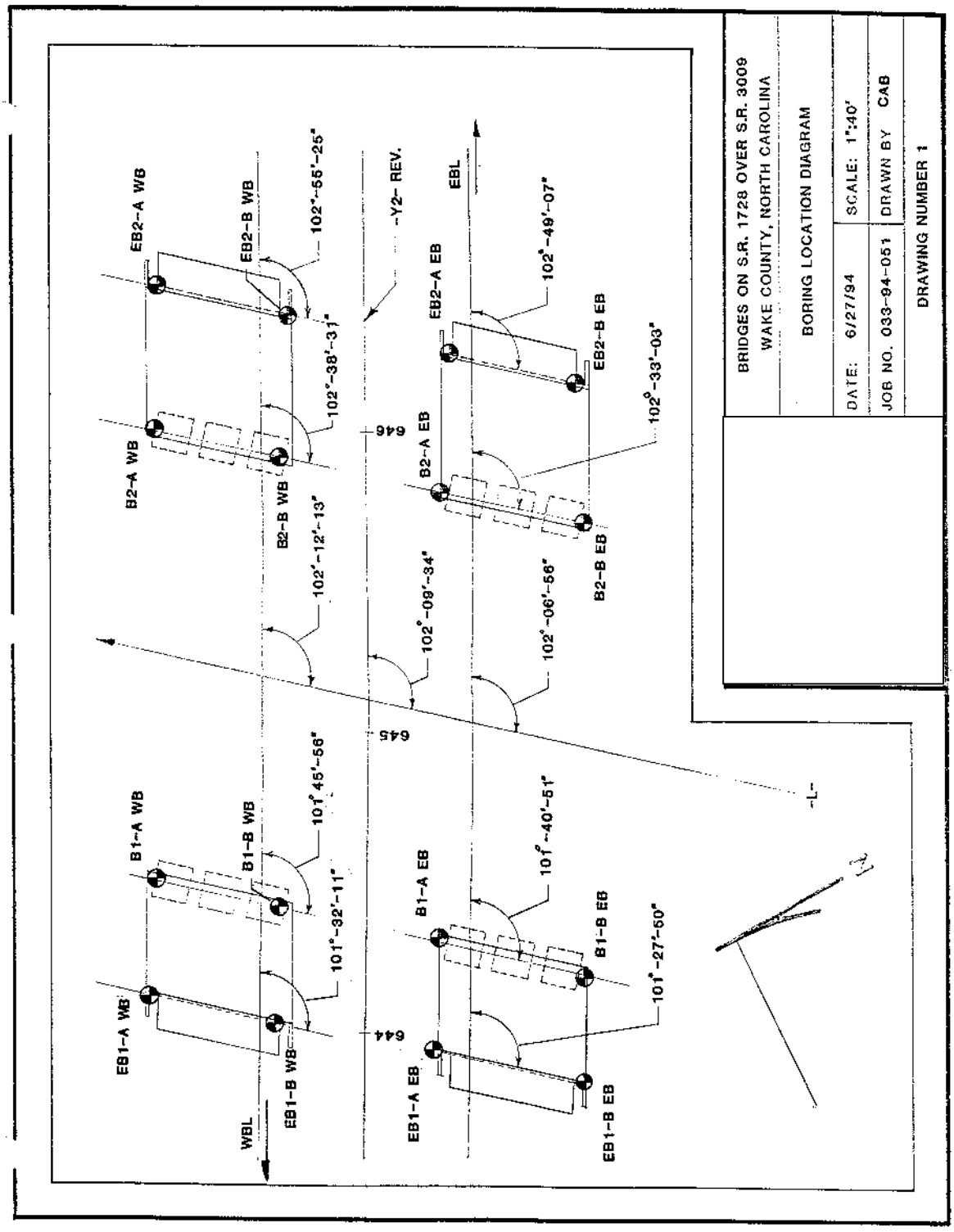

BRIDGES ON S.R. 1728 OVER S.R. 3009
WAKE COUNTY, NORTH CAROLINA
BORING LOCATION DIAGRAM
DATE: 6/27/94
SCALE: 1"=40'
JOB NO. 033-94-051
DRAWN BY CAB
DRAWING NUMBER 1
EB2-A WB
EB2-B WB
B2-A WB
B2-B WB
EB2-A EB
EB2-B EB
B2-A EB
B2-B EB
EBL
WBL
-Y2- REV.
-L-
646
645
644
102°-55'-25"
102°-38'-31"
102°-12'-13"
102°-09'-34"
102°-06'-56"
102°-49'-07"
102°-33'-03"
B1-A WB
B1-B WB
EB1-A WB
EB1-B WB
B1-A EB
B1-B EB
EB1-A EB
EB1-B EB
101°45'-56"
101°-32'-11"
101°-40'-51"
101°-27'-50"

Figure 4

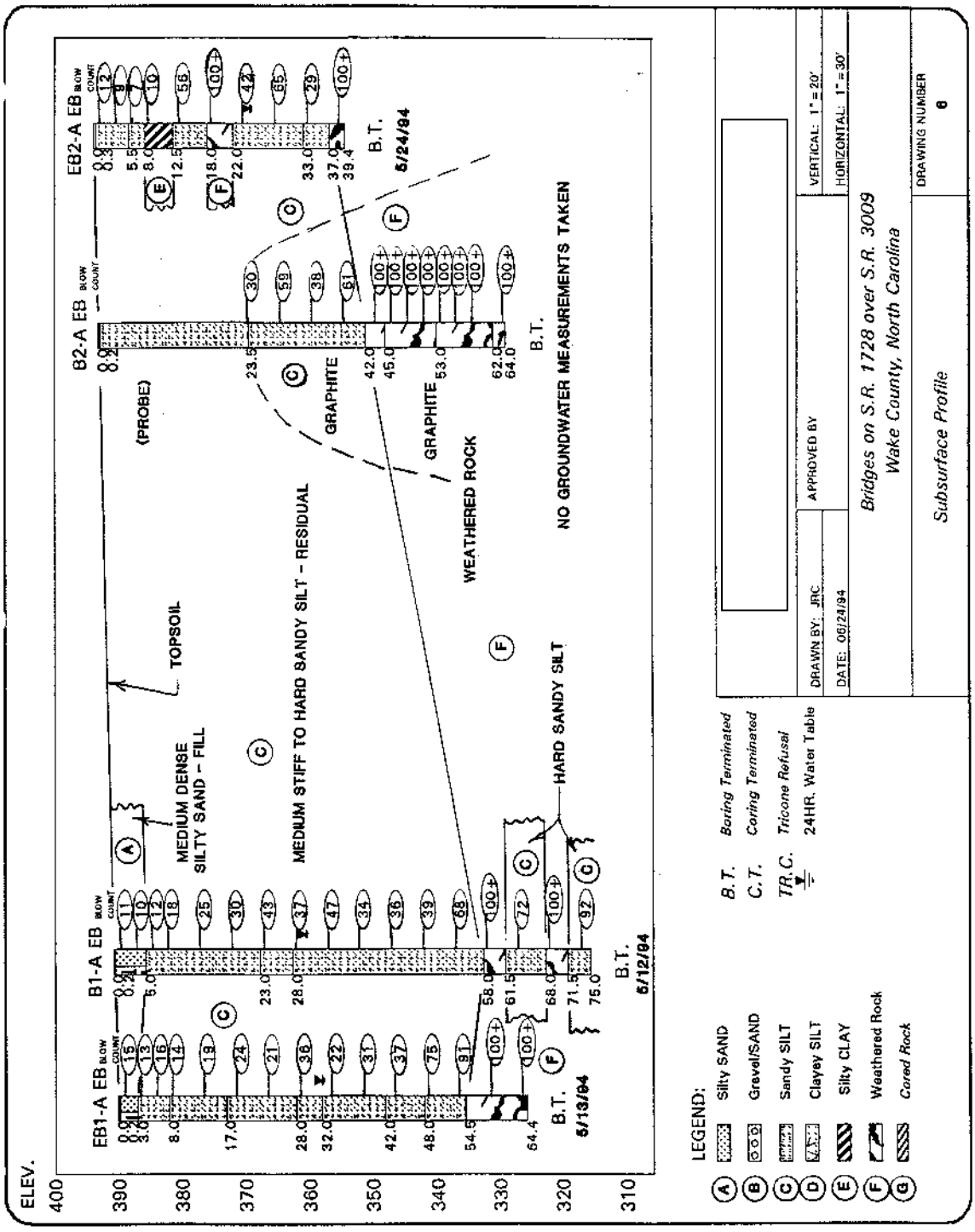

ELEV.
400
390
380
370
360
350
340
330
320
310
EB1-A EB BLOW COUNT
B1-A EB BLOW COUNT
EB2-A EB BLOW COUNT
B2-A EB BLOW COUNT
(PROBE)
TOPSOIL
MEDIUM DENSE SILTY SAND - FILL
MEDIUM STIFF TO HARD SANDY SILT - RESIDUAL
GRAPHITE
GRAPHITE
WEATHERED ROCK
HARD SANDY SILT
NO GROUNDWATER MEASUREMENTS TAKEN
B.T. 5/13/94
B.T. 5/12/94
B.T. 5/24/94
B.T.
LEGEND:
Silty SAND
Gravel/SAND
Sandy SILT
Clayey SILT
Silty CLAY
Weathered Rock
Cored Rock
B.T. Boring Terminated
C.T. Coring Terminated
TR.C. Tricone Refusal
24HR. Water Table
DRAWN BY: JRC
DATE: 06/24/94
APPROVED BY
VERTICAL: 1" = 20'
HORIZONTAL: 1" = 30'
Bridges on S.R. 1728 over S.R. 3009
Wake County, North Carolina
Subsurface Profile
DRAWING NUMBER
6

Figure 5

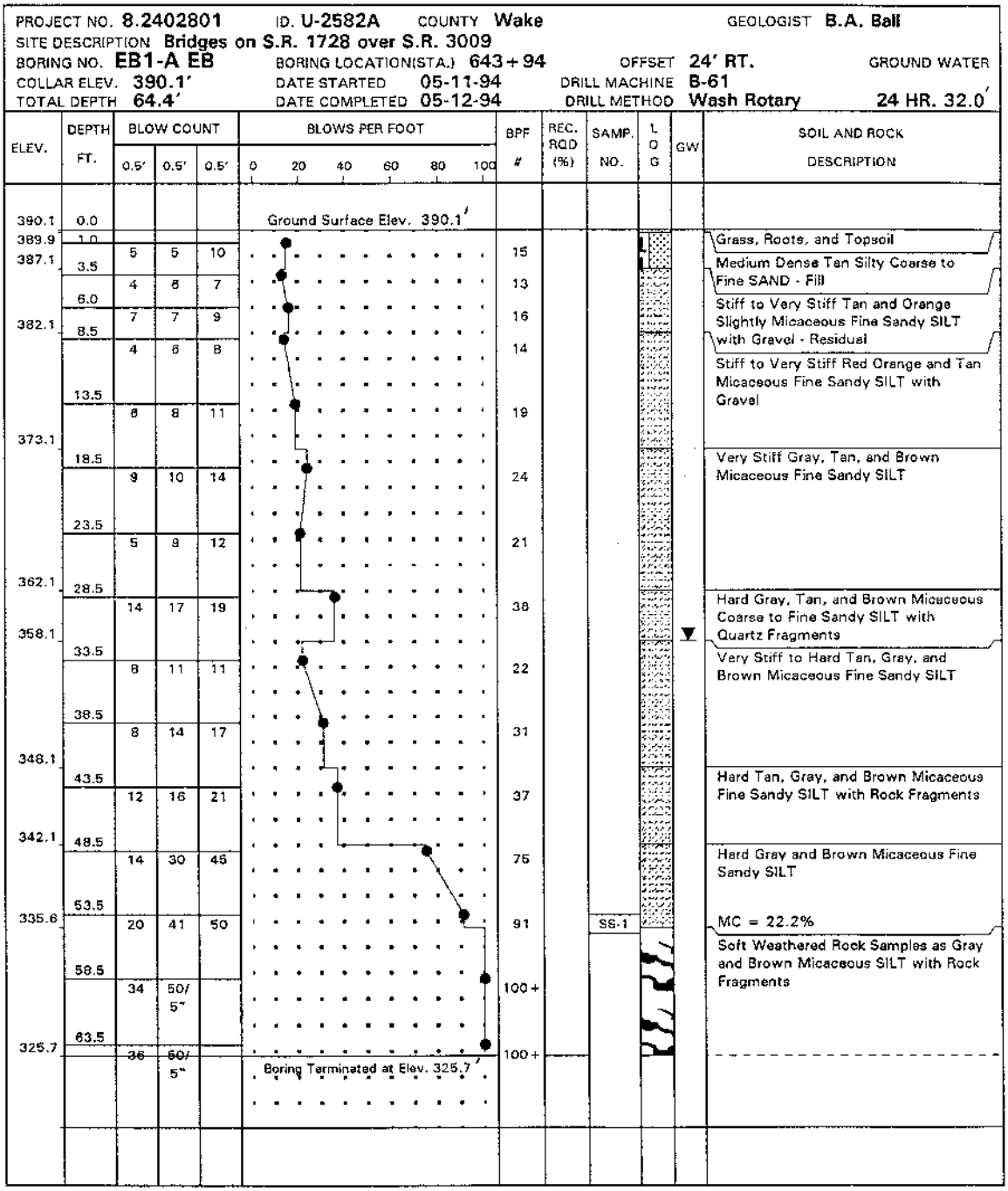

PROJECT NO. 8.2402801
ID. U-2582A
COUNTY Wake
GEOLOGIST B.A. Ball
SITE DESCRIPTION Bridges on S.R. 1728 over S.R. 3009
BORING NO. EB1-A EB
BORING LOCATION(STA.) 643+94
OFFSET 24' RT.
GROUND WATER
COLLAR ELEV. 390.1'
DATE STARTED 05-11-94
DRILL MACHINE B-61
TOTAL DEPTH 64.4'
DATE COMPLETED 05-12-94
DRILL METHOD Wash Rotary
24 HR. 32.0'
ELEV.
DEPTH FT.
BLOW COUNT
0.5' 0.5' 0.5'
BLOWS PER FOOT
0 20 40 60 80 100
BPF #
REC. RQD (%)
SAMP. NO.
LOG
GW
SOIL AND ROCK DESCRIPTION
390.1 0.0
Ground Surface Elev. 390.1'
389.9 1.0
Grass, Roots, and Topsoil
387.1 3.5
5 5 10
15
Medium Dense Tan Silty Coarse to Fine SAND - Fill
6.0
4 6 7
13
Stiff to Very Stiff Tan and Orange Slightly Micaceous Fine Sandy SILT with Gravel - Residual
382.1 8.5
7 7 9
16
13.5
4 6 8
14
Stiff to Very Stiff Red Orange and Tan Micaceous Fine Sandy SILT with Gravel
373.1 18.5
8 8 11
19
Very Stiff Gray, Tan, and Brown Micaceous Fine Sandy SILT
23.5
9 10 14
24
362.1 28.5
5 9 12
21
Hard Gray, Tan, and Brown Micaceous Coarse to Fine Sandy SILT with Quartz Fragments
358.1 33.5
14 17 19
38
38.5
8 11 11
22
Very Stiff to Hard Tan, Gray, and Brown Micaceous Fine Sandy SILT
348.1 43.5
8 14 17
31
Hard Tan, Gray, and Brown Micaceous Fine Sandy SILT with Rock Fragments
342.1 48.5
12 16 21
37
53.5
14 30 45
75
Hard Gray and Brown Micaceous Fine Sandy SILT
335.6 58.5
20 41 50
91
SS-1
MC = 22.2%
Soft Weathered Rock Samples as Gray and Brown Micaceous SILT with Rock Fragments
63.5
34 50/5"
100+
325.7
36 50/5"
100+
Boring Terminated at Elev. 325.7'

Figure 6

N.C.D.O.T. GEOTECHNICAL UNIT
CORE BORING REPORT

SHEET 22 OF 43

PROJECT NO. 8.2472701	ID. B-3601	COUNTY Alamance	GEOLOGIST P. Weaver/G. Licayan
SITE DESCRIPTION Bridge No. 94 Over the Haw River on SR 2158			GROUND WATER (ft)
BORING NO. B3-A	BORING LOCATION 26+61	OFFSET 18ft LT	ALIGNMENT -L-	0 HR. NA
COLLAR ELEV. 458.6 ft	NORTHING 828536.93	EASTING 1891169.28		24 HR. NA
TOTAL DEPTH 39.4 ft	DRILL MACHINE CME 45	DRILL METHOD Wash Drill/NQ Core	HAMMER TYPE 140 lb. Manual	
DATE STARTED 3/11/03	COMPLETED 3/12/03	SURFACE WATER DEPTH 4.5 ft.		
CORE SIZE NQ-2	TOTAL RUN 28.8 ft	DRILLER W. Whichard		

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
										Begin Coring @ 7.4 ft
451.2	7.4	2.0	6:30	(0.9)	(NA)		(0.9)	(NA)		451.2 WEATHERED ROCK: Brown, Greyish Green, and Black; Severely
449.2	9.4		6:30	45%			56%			449.6 Weathered; Medium Hard; Quartz Rich Metavolcanic Rock with Close to Very 7.4
			N=93				(0.0)	(NA)		Close Fracture Spacing 9.0
447.7	10.9	3.5	3:00/0.5	(2.4)	(1.3)		0%			447.1
			5:45	69%	37%	RS-2	(2.4)	(1.3)		Fragments of strong rock 11.5
444.2	14.4		6:30				80%	43%		SOIL: Hard; Brown and Green, Coarse to Fine Sandy, Silty CLAY 444.1
			4:30							CRYSTALLINE ROCK: White, Green to Grey, and Brown; Moderately 14.5
		5.0	3:30	(1.2)	(NA)		(4.7)	(NA)		Weathered; Moderately Hard to Hard; Quartz Rich Metavolcanic Rock with
			2:00	24%			50%			Very Close to Close Fracture Spacing
			2:30							
439.2	19.4		2:10							Abundant iron staining of fabric
			2:45							5 jts @ 0° to 10° with iron staining
438.4	20.2	4.2	N=100/0.8	(3.3)	(NA)					2 jts @ 30° with iron staining
			0:50/0.2	79%						3 jts @ 80° with iron staining
434.2	24.4		3:00							WEATHERED ROCK: Green and Brown; Severely Weathered; Moderately to
			5:00							Medium Hard Metavolcanic Rock with Close to Very Close Fracture Spacing
			4:15							433.1 25.5
433.3	25.3	1.4	4:30	(1.4)	(0.0)		(3.9)	(0.9)		Abundant iron staining of fabric
431.9	26.7	2.7	N=100/0.8	100%	0%		100%	23%		Abundant low to high angle fractures
			0:30/0.1	(2.7)	(0.9)					429.2
429.2	29.4		5:15	100%	33%					*Note: No water return 14.4 feet to 15.9 feet 29.4
		5.0	6:00/0.3	(4.8)	(2.3)		(9.7)	(6.0)		CRYSTALLINE ROCK: Brown and Greenish Grey; Moderately Weathered;
			3:15/0.7	96%	46%		97%	60%		Moderately Hard Metavolcanic Rock with Very Close to Close Fracture
			3:00							Spacing
424.2	34.4		4:00							
		5.0	4:30	(4.9)	(3.7)					Heavy iron staining of fabric
			4:15	98%	74%					All jts heavily iron stained
			5:15							Abundant high angle open and partially healed fractures
			3:40							
419.2	39.4		5:50							419.2 *Note: Core block at 26.7 feet 39.4
			7:15							CRYSTALLINE ROCK: Greenish Grey; Slightly to Very Slightly Weathered;
			7:30							Hard to Very Hard Metavolcanic Rock with Close to Moderately Close
			4:45							Fracture Spacing
			6:00							
			6:30							Very close fracture spacing 31.6 feet to 32.2 feet and 38.1 feet to 38.4 feet
										Series of 70° to 80° fractures around 30.1 feet
										Majority of fractures @ 40° to 50°
										Isolated 20° to 30° fractures
										*Note: No water return Runs 5 through 8
										Coring Terminated at 419.2 feet in Crystalline Rock: Metavolcanic Rock

NCDOT CORE SINGLE 07103004.GPJ NC_DOT.GDT 4/1/03

Figure 7

SUMMARY OF LABORATORY TEST DATA

Boring No.	Sample Depth (ft)	Sample Type*	Natural Moisture Content (%)	AASHTO Class.	N-Value (bps)	Atterberg Limits			Gradation Results						
						L.L.	P.L.	P.I.	Pass #10 Sieve	Pass #40 Sieve	Pass #200 Sieve	Coarse Sand (%)	Fine Sand (%)	Silt (%)	Clay (%)
EB1-A	53.5 - 55	SS-1	22.2	A-4	91	32	NP	NP	98	85	48	13	38	49	0
EB1-B	1.0 - 2.5	SS-2	19.3	A-5	15	41	36	5	100	96	74	4	22	49	25
	6.0 - 7.5	SS-3	5.7	A-2-4	31	24	NP	NP	76	41	18	46	30	24	0
B2-A	58.5 - 60	SS-4	15.1	A-2-4	100+	30	NP	NP	93	70	31	25	42	33	0
EB2-A	8.5 - 10	SS-5	25.2	A-7-5	10	43	31	12	71	61	36	14	35	40	11
EB2-B	13.5 - 15	SS-6	25.1	A-4	7	38	29	9	98	92	67	6	26	39	29

* SS= Split Spoon Sample (ASTM-D-1586)

Figure 8

CHAPTER TEN: TRAFFIC CONTROL PLAN

A. PURPOSE OF A TRAFFIC CONTROL PLAN

A Traffic Control Plan (TCP) is a plan for moving traffic safely through a specific highway, street workzone or project. These plans range in scope from very detailed TCP designs solely for a specific project to simply a reference to typical plans and/or a section of the Manual on Uniform Traffic Control Devices (MUTCD). The degree of detail in a TCP will depend on the project complexity, exposure to hazards, and traffic interference with construction activity.

B. THREE TYPES OF TRAFFIC CONTROL PLANS

When a plan is prepared, there are three types of Traffic Control Plans that can be developed. It may vary from a site specific traffic control plan to a very simple agreement. The three types of plans that are developed include an encroachment agreement, a resurfacing project, and the site-specific plan.

Now let's discuss in more detail the different types of plans which can be developed.

First, ***encroachment agreements*** are the least straightforward in terms of Traffic Control because the Contractor is responsible for all traffic control devices, safety, and the TCP itself. References to the MUTCD, the NC Supplement to the MUTCD, and possibly the Roadway Standard Drawings are basically the only TCP contained in most encroachment agreements.

Second, ***resurfacing projects*** are basically purchase order contracts or specifications written in contract proposal form. They may contain some safety and traffic control device requirements, but, for the most part, the TCP is left up to the contractor. In this case, the cost for traffic control is incidental to the other pay items in the contract.

Finally, the type of plan discussed in this course and the one that is used most often is the ***site-specific traffic control plan***. In this concept, all traffic control requirements are generally listed in some form. These plans incorporate some type of traffic control phasing, typical drawings, detailed drawings, and a pavement marking plan. We'll discuss this in greater detail later within the text.

So what have we learned so far? First, the *degree of detail* in a traffic control plan will depend on the project complexity, exposure to hazards, and traffic interference with construction activity. Also, there are three types of TCP's which an engineer may develop: encroachment agreements, resurfacing projects, and site-specific plans.

C. ELEMENTS OF A TRAFFIC CONTROL PLAN

Two main elements of a TCP are references (contract proposal, Roadway Standard Drawings and N.C. Standard Specifications for Roads and Structures) and the actual plan sheets.

1. REFERENCES

The references listed above are not included in the plan package, but are integral parts of the entire TCP. The contract proposal contains information such as intermediate contract times, contract restrictions and specific traffic control specifications. The Roadway Standard Drawings are referred to within the construction phasing, general and project notes, and detail drawings that are located in the actual plan sheets. Reference to the Roadway Standard Drawings eliminates the inclusion of typical drawings in the plan set that are generally applicable to any project. Finally, Section 150 and Division 11 of the 2002 N.C. Standard Specifications for Roads and Structures provide a general overview of the maintenance of traffic not specifically discussed within the actual plan sheets and the requirements of the traffic control devices.

2. PLAN SHEETS

Now, let's take a look at a Traffic Control Plan.

The plan sheets of a Traffic Control Plan are labeled TCP-sheets in the upper right hand title block and are made up of five basic parts: title sheet, project notes, construction phasing, detail drawings, and miscellaneous sheets. Flip through the plan sheets of this project until you reach Sheet No. TCP-1

a. Title Sheet

Like the front sheet on a set of roadway plans, the front sheet of a TCP is also called the Title Sheet. It generally consists of a legend, person(s) responsible for design, list of Roadway Standard Drawings, and an Index of Sheets. Where room allows, the project notes and a temporary pavement marking schedule may be included on the title sheet.

Take a look at the legend located always on the title sheet (TCP-1). You may be wondering, "Wasn't this discussed earlier in the Roadway Design Section?" Yes and No. This legend functions the same as the Conventional Symbols sheet of the roadway plan, but is used only for TCP, and is found only on the title sheet of the TCP. It reflects all devices shown on the TCP sheets. Any devices not shown in the legend shall be labeled as they appear within the TCP. These symbols will usually be the same on any set of TCP you might see with minor exceptions. For example, the symbol for cone will always look like:

The name of the person(s) responsible for the design can always be found in the lower right hand side of the plan sheet along with the engineer's seal. A professional engineer must seal all plans. Names of NCDOT contact person(s) can also be found in the lower right hand side.

Exercise: (See TCP-1)

1. Who is the Traffic Control Project Engineer on this project?

   _____

Turn to Appendix G (page G-3) and check your answers.

b. Project Notes

Now, take a look at the general notes located on Sheet TCP-2. These notes apply at all times to the entire construction phasing and details of the TCP; therefore, they are not referenced individually throughout the plan sheets and are only found on the Project Notes sheet (usually TCP-2). A set of General Notes (alphabetically listed) will appear on the Project Notes sheet for all projects. Additional general notes tailored to a particular project may be added to this list continuing the alphabetical listing. Use of General Notes that pertains to the entire project will minimize the number of project notes referred to within the phasing.

Exercise:

1. Which note tells the contractor that he is to provide all detour signing?

   _____

Turn to Appendix G (page G-3) and check your answers.

On the other hand, Local Notes, which are numerically listed, are specific to the Traffic Control phasing. They are referred to only for specific situations within the construction phasing and on corresponding detail drawings. If a note is seldom used, it will be written out where it applies in the construction phasing or details. The list of Local Project Notes is normally found on Sheet TCP-2, directly following the General Project Notes.

Exercise: (See TCP's)

1. Which Project Notes apply to pavement markings? _____

2. Look at Project Notes and determine which Roadway Standard Drawings (Rdwy. Std. Dwg.) No. is used for pavement markings? _____

Turn to Appendix G (page G-3) and check your answers.

c. Construction Phasing

Now, turn to the Phase I Phasing located on Sheet TCP-4. Phasing is a clear and concise step-by-step write-up telling the contractor where to begin and how to proceed toward completion of the project, while maintaining traffic. It is also the one element of the TCP that ties every other part together. While it communicates to the contractor how to maintain traffic during various stages of construction, the construction phasing also references the project notes, Roadway Standard Drawings, intermediate contract times, and any detail or typical drawings found within the TCP.

Notice how the phasing is written in an outline form. Most importantly, the phasing details how to physically switch traffic from one traffic pattern to the next. Construction phasing may be composed of a number of phases, with each phase required to be completed in order, before proceeding to the next phase. Each phase is composed of a number of steps. All the steps in each phase are required to be completed in order, before proceeding to the next phase. In other words, the phasing sequence PHASE I must be completed before PHASE II, etc. and STEP 1 must be completed before STEP 2 in each phase, except if otherwise noted. Let's call this outline form the ***phase-step method***.

Exercise:

1. Take for example this phasing sequence:
   PHASE I, STEP 1
   PHASE I, STEP 4
   PHASE II, STEP 1

   Is this outline in proper format? ___ If not, which phase(s) and step(s) are missing? ___

2. In which phase and step do the traffic control plans tell the contractor to begin paving of Edward Mills Rd. from Sta 43+90 +/- to 78+10 +/- & from Sta 79+40 +/- to 111+20 +/-?
   _____

Turn to Appendix G (page G-3) and check your answers.

Another outline form, ***area-phase-step*** method is also composed of a number of phases. Each area is composed of a number of phases, and each phase may be composed of a number of steps. Phases and steps are required to be followed in numerical order. The requirements of each step in a phase are to be met before the phase will be considered complete. Work may be performed simultaneously in all phases of an individual area, except if otherwise noted.

Improper word usage in the phasing creates loopholes that contractors may use to their advantage.

Take a look at PHASE I, STEP 1:

"STEP 1- INSTALL -Y- LINE WORK ZONE ADVANCE WARNING...."

Traffic Control Notes and Phasing is now written almost entirely in the active voice such as this. However, there are cases where it is desirable to be more specific:

"WILL" is used in the phasing to state that the State Forces will do a certain construction activity at their discretion. ***"MAY"*** is used when we are allowing the contractor to begin a certain step of work at his discretion (see notes under Phase II).

Exercise:

1. Before what phase ____, step ____do we state work on Wade Ave and Duraleigh Rd. may be performed concurrently?

Turn to the Appendix G (page G-3) and check your answers.

d. Detail Drawing

In this particular TCP we have two types of details, **typical** details (sometimes referred to as general), and **special** details.

Typical details in a TCP are detailed drawings that show how to handle similar situations, whether it may be placing traffic control devices, placing intermediate pavement marking, shifting traffic, etc. Dimensions, traffic control devices, reference to project notes and Roadway Standard Drawings remain constant in a typical detail, except the location where the typical detail applies.

A sample of detail drawings is shown in this traffic control plan. Sheet TCP-5 is called a special detail. It is only applicable to the specific area shown in the detail.

Exercise: (See TCP-5)

1. On this sheet, where does construction on -Y1- begin _____ and end _____?

Turn to Appendix G (page G-3) and check your answers.

Other details used in a Traffic Control Plan may include: an overview of a particular construction stage or Phase (such as on TCP-3); typical drawings (same as typical details except typical drawings are applicable to any project, and may later be included in the Roadway Standard Drawings); special barrier details; Iowa weave details; and traffic control device details.

e. Miscellaneous Sheets

Several miscellaneous sheets are included in other projects. Examples of miscellaneous sheets are: sheets showing sign designs for nonstandard construction signs to be furnished by the Contractor, off-site detours where the contractor will install signs; and special coordination with plans from other units, such as, crossover pavement design or structure staging, which are specific to the project.

f. Miscellaneous Information on Plan Sheets

TITLE SHEET (TCP-1)
- always label sheet TCP-1 in upper right hand title block.
- Construction number and TIP number are always located along the left hand side of the page.

DETAIL SHEETS (TCP-3 THRU TCP-5)
- lower right hand title block should contain description, “PHASING”,”PHASE AND/OR STEP”, “DETAIL,” etc., if applicable.
- reference to sheet with project notes if applicable.
- reference to sheet with pavement marking schedule if applicable.
- bearings of drawings should be the same as those on roadway plan indicated by north arrow.

Exercise:

1. Which traffic control plan sheet refers to:

   a. Phase I, Phasing _____

   b. Temporary pavement marking schedule? _____

   c. Phase I, Step 2, Detail _____

Turn to Appendix G (page G-3) and check your answers.

CHAPTER ELEVEN: PAVEMENT MARKING PLAN

A. PURPOSE OF A PAVEMENT MARKING PLAN

The purpose of a Pavement Marking (PM) Plan is to show how traffic will be operating on a facility at the completion of a project in a clear and understandable manner. A plan is needed when a Contractor is required to place pavement markings on the final wearing surface and there are situations that cannot be described fully by the Roadway Standard Drawings. Signalized intersections, for instance, require a pavement-marking plan to locate the placement of Stop Bars. If a project is not redesigned and is simply rehabilitation and/or an overlay resurfacing type project without any widening, a full-fledged PM Plan is usually not required. Instead, reference can be made in the construction phasing to replace existing markings using Roadway Standard Drawings Nos. 1205.01 thru 1253.01. Clarity and neatness are of utmost importance since many people are involved in reading these plans during the design and construction stages of the project.

B. ELEMENTS OF A PAVEMENT MARKING PLAN

A Pavement Marking (PM) Plan consists of several elements such as references (Roadway Standard Drawings and N.C. Standard Specifications) and the plan sheets which are made up of detail drawings (actual pavement marking drawings, typical drawings, symbol details, etc.) labeled as PM-sheets in the upper right hand title block. The PM Plan shows the types and locations of pavement marking lines, and/or symbols, and/or pavement markers, and delineation of the final wearing surface of a roadway. The Pavement Marking Plan is part of the Traffic Control Plan package and is located after the TCP sheets.

1. REFERENCES

The references listed above are not included in the plan package, but are integral parts of the entire PM Plan. The Roadway Standard Drawings are referred to on the plan sheets and eliminate the inclusion of typical drawings in the plan set that are generally applicable to any project.

The N.C. Standard Specifications provide detailed and exact statements of construction requirements (materials, construction methods, measurements, and payment) for pavement marking and pavement markers.

2. PLAN SHEETS

Before we look at the PM Plan, look at the roadway plans. Identify the type of facility, and try to get a preliminary picture of how the final pavement marking will look. Usually, as in this case, the roadway plan has thin solid lines indicating where lanes should be, and shows painted islands and marked out areas. The roadway plans for this project also show lane arrows indicating traffic movement. However, these lane configurations shown on the roadway plans shall in no way supersede the pavement marking that is shown in the PM Plan. The Roadway Design Unit normally shows the lane configuration arrows where they have added turn lanes at intersections, and these should not be confused with pavement marking turn arrow symbols.

Before moving on, be sure to look at the roadway plans thoroughly.

Now that you have an idea of how the final pavement marking will look on this facility, let's take a look at the PM Plan for this project. Flip through the plan sheets until you reach Sheet PM-1 (located directly after the TCP sheets). As mentioned earlier, the PM Plan shows the types and locations of pavement markings lines, and/or symbols, and/or pavement markers on the final wearing surface of a roadway through the use of references and detail drawings.

a. Pavement Marking Schedule

In Chapter Ten, we briefly mentioned that the pavement marking schedule is sometimes located on the Traffic Control Plan Title Sheet, is referred to within the TCP Plan, and may include both temporary and final pavement marking schedules. Sometimes the schedule may be located elsewhere in the TCP Plan. On larger roadway plans, which include a Pavement Marking Plan, we have a separate final pavement-marking schedule in the PM Plan. Notice on TCP-3, that the Temporary Pavement Marking Schedule shows quantities of all temporary markings from all Phases. Turn back to PM-1 and look at the Final Pavement Marking Schedule. The Pavement Marking Schedule can be considered as a legend for the PM Plan where the symbols for the types of pavement markings are listed in the first column. All types of pavement markings and pavement markers are referred to with a letter in the Pavement Marking Schedule. The second column lists the pay items, as you will find them listed in the Summary of Quantities on Plan Sheet 3 of the roadway plans. The third column lists a description for each pay item. (More recent plans will include quantity breakdowns and totals for each pay item).

Before we continue our discussion of the PM Plan, let's practice reading the Pavement Marking Schedules.

Exercise: (See TCP-3, PM-1)

Refer to the Pavement Marking Schedules and complete the following exercise.

1. a) Which symbol denotes a temporary 4" WHITE LANE LINE that is WHITE PAINT?
   _____

   b) Which symbol denotes a permanent 4" SOLID LANE LINE that is THERMO?
   _____

2. a) Which symbol denotes a THERMO, WHITE 4" X 2' MINISKIP?
   _____

   b) Whish symbol denotes a PAINT, WHITE 4" X 2' MINISKIP?
   _____

Turn to Appendix G (page G-3) and check your answer.

b. Pavement Marking Details

Let's go to Sheet PM-2. This sheet shows the pavement marking detail for the -L- line (Edward Mill Rd.) from Sta. 30+00 to 50+00. Notice that the pavement marking changes at 34+95 +/- from mini skips to a solid lane line. Other changes in PM will be noted at station location.

If you turn back to Sheet PM-1 and refer to the pavement marking schedule for the descriptions of **TA, TB, TC** and **TD**, you will find: a 4" white thermo edgeline, a 4" yellow thermo edgeline, a 4" X 10' white thermo skip, and a 4" X 2' white thermo miniskip. Many others are represented along with their quantities. The beginning and ending stations for the pavement markings will be shown throughout the Pavement Marking Plan.

Exercise: (See PM-1 and PM-2)

1. What pavement marking(s) is/are beginning and/or ending at Ramp A, Station 14+00?
   _____

2. What type of pavement marking is denoted by the symbols T2 and UA?
   _____

Turn to Appendix G (page G-3) and check your answer.

In Chapter 10, we discussed the function of typical details within the TCP. Typical details may also be used in the PM Plan for similar pavement marking and marker situations throughout the plans that are not covered in the Roadway Standard Drawings.

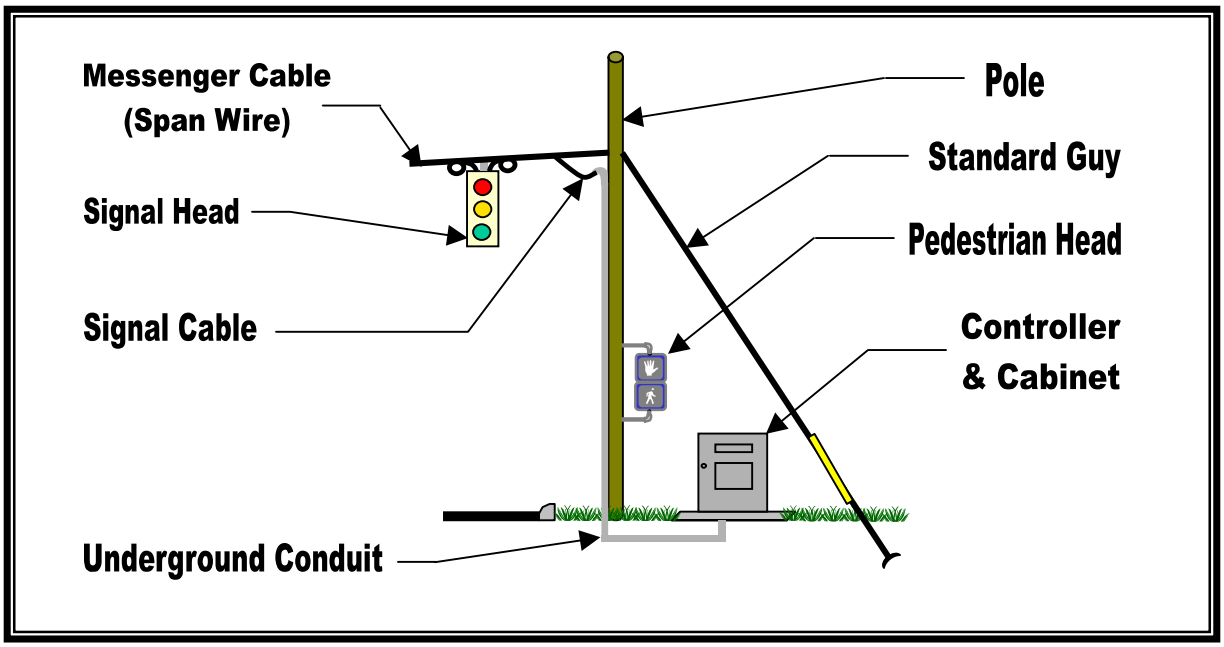
CHAPTER TWELVE: TRAFFIC SIGNALS

A. PURPOSE OF TRAFFIC SIGNALS

Traffic signals, by definition, are power operated traffic control devices, which alternately direct traffic to stop and proceed. Traffic signals are installed on travel ways where potentially hazardous situations exist or where other traffic control devices (signs and markings) do not provide adequate control. Traffic signals are used to control vehicle and pedestrian "right of way" by alternately directing traffic to stop and proceed. From your package of sample plans, locate Sig. Sheet 10.

B. THE PARTS OF A TRAFFIC SIGNAL

The figure below depicts a simple signal span.



1. Base Map

A **"base map"** for a typical traffic signal plan shows the edge of pavement or curb and gutter as well as other physical elements such as pavement markings, sidewalks, and lane movements. Also included on the base map are the speed limit and grade for each approach.

2. Glossary

Find the following items on the drawing of the simple signal span shown above.

- **Messenger Cable (Span Wire)** – A cable used to support traffic signal heads, signal cable, and signs. In some instances, metal mast arms may be substituted. Most signal installations are made of more than one signal span, placed in various arrangements.

- **Signal Heads** – These are the displays that direct the motorists whether to stop or go. They consist of one or more signal faces contained within the associated signal housings.

- **Controller and Cabinet** – The cabinet houses the controller and other associated equipment. The controller is the device that controls the sequence and duration of the displays on the traffic signal heads. The cabinets come in two mounting configurations: pole mounted, attached to a signal pole and suspended off of the ground, and base mounted, installed on a concrete pad on the ground.

- **Pedestrian Head** (with pushbutton) – This consists of a signal face that displays when to walk and when not to walk, as well as a pushbutton that allows pedestrians to place a request for right of way.

- **Signal Poles**-Wood, steel, or concrete poles that hold up the span wire or mast arms.

- **Standard Guy**- The guy wire is used to provide stability to the wood poles in a signal installation.

- **Signal Cable**- An electrical cable used to supply current from the controller to the signal heads.

- **Detector Lead-in**- The electrical cable which serves to connect the loop wire to the detector unit in the controller cabinet.

- **Underground Conduit**- Used to protect the detector lead-in, which runs from the loop detector to the controller.

- **Pull Box-** (Junction box)- A container usually placed underground with a removable top flush with ground level that serves as a location for splicing loop wire together to lead-in wire or to allow for the pulling of cable through conduits.

Many of the items in this glossary are located in the legend. Using the "**Legend**" on your signal plan, draw in next to each of the glossary items the corresponding proposed symbol.

3. Protected vs. Permitted

When an approach has left turning traffic with no oncoming traffic opposing it, we refer to it as **"protected" or "exclusive."** This turn has **"right of way"**, meaning that no other movement has the right to oppose it. These movements are usually signalized with an arrow. When we refer to a movement as **"permitted,"** we are referring to the mode in which left turning traffic is allowed to move but must yield to other traffic.

4. Signal Face ID

The **"Signal Face ID"** depicts the size and type of signal head to be used, along with the types of arrow and ball lenses to be used.

Locate the Signal Face ID on Sig. Sheet 10 and draw signal heads here.

Turn to Appendix G (page G-4) and check your answer.

5. Table of Operations

The **" Table of Operations"** indicates the displays illuminated for each signal head during each right of way phase. It is typically located over the Signal Face ID. It corresponds with the information provided in the **"Standard Signal Face Clearances"** chart, which shows the color sequences that the signal face will go through to change to a different display.

In the space below, draw the display on Signal Head 42 on Sig. Sheet 10 during phase 2+5.

Turn to Appendix G (page G-4) and check your answer.

6. Phasing Diagram

The **"Phasing diagram"** on a signal plan indicates which movements are given right of way during each phase (designated by the Greek letter phi (ϕ)) of the cycle. It also shows phase sequences allowed by the controller. It is typically shown in the upper left corner.

What movements are occurring in phase 2+6 on Sig. Sheet 10? Draw and explain.

_____

_____

Turn to Appendix G (page G-4) and check your answer.

7. Types of Detection and the Detection Chart

A traffic actuated signal installation uses detectors to determine when vehicles are present or are approaching an intersection. The most common method of vehicle detection is the inductive loop detector, but out of pavement detection is becoming more widespread.

a. Types of Detection

In Pavement Detection

- **Inductive Loops-**

A loop is formed by placing a number of turns of wire in a slot sawed in the pavement. When an electrical current passes through this wire, an electrical field (flux) is created. Metal in a vehicle passing over the loop disrupts this field by changing the inductance. This disruption is registered and a call is placed to the controller.

Out of Pavement Detection

These methods are practical for high volume intersections and bridge applications where cutting into the bridge deck could harm the structure. They are also good during construction where traffic shifts. Also, these methods of detection reduce maintenance costs and are much safer due to the fact that personnel do not have to go into the roadway to make a loop repair.

- **Microwave**

Microwave detectors use a microwave beam to detect the motion of a vehicle. Microwave vehicle detectors are used where it may be impractical or cost prohibitive to use an inductive loop, such as on a bridge deck. Also, this method reduces future loop maintenance costs.

- **Video Imaging (or Machine Vision)**

This system detects vehicles by processing images obtained through video cameras located at an intersection and providing outputs to the signal controller. Video imaging systems may be used when lead-in cable is difficult to maintain during lengthy time frames or when flexibility to move detection areas is needed such as for temporary signal configurations during numerous construction phases.

Basic Methods of Detection

- Extend (Stretch) - A detection scheme which uses the extend feature of the detector unit and passage time on the controller to reduce the probability of vehicles being caught in the "dilemma zone" (the distance back from the stop line where a driver is uncertain whether to decelerate and stop his vehicle or continue and pass through the intersection when given a yellow light).
- Volume Density - A detection scheme with a variable passage time and a variable minimum green time programmed into the controller. It reduces the probability of vehicles being caught in the dilemma zone as well as allows the signal installation to be more traffic responsive.

• Presence - Detection at the stop bar set up to detect vehicles for the entire duration that they are sitting on top of or in the detection zone.

b. Detection Chart

Detection charts differ between different kinds of controllers and different kinds of detection systems. For the purpose of this course, we will use the common **"Loop & Detector Unit Installation Chart"** as found on Sig. Sheet 10 of your signal plans.

Information on loop installations is contained in the Loop Installation Chart. This chart has two sides, the loop side and the detector unit side. The loop side shows vital details about the loop such as the size and location of each detector loop in relationship to the stop bar, the number of turns of wire, and whether it is new or not. The detector unit side will show the phase numbers that pertain to the loop, whether it has any special timing features that need to be programmed into the detector unit, what phases the unit will place calls in, and whether the detector will inhibit delay during the green interval of the phase which it calls.

Locate Sig. Sheet 10.

What kind of detection is being used? _____
Which loops are existing? _____
Which detectors are existing? _____
In the northbound left turn lane (on Duraleigh Road), how may turns of wire are being used in the loop shown?_____
What loop number is this? _____
What phases does it work in? _____
Does it have any special timing features? _____
What are they? _____

Turn to Appendix G (page G-4) and check your answer.

8. Timing Chart

The last commonly found chart on your signal plans is the **"Timing Chart".** This chart shows the timing to be set on the controller for each signal phase interval. It also shows what recall and detector memory positions are to be set on the controller.

You will notice that the timing chart is broken into different columns, one for each different phase movement.

Below are brief explanations of the different times commonly shown in the timing chart:
- Minimum Green - Also known as the initial interval; it is the minimum amount of time an indication stays green.
- Passage/Gap-It is a time threshold that the controller will allow to occur before terminating the phase. For example, on Sig. Sheet 10, the passage/gap time for Phase 2 is 2 seconds. This

means that vehicles can pass over the detector for this phase at intervals of 2 seconds or less and the controller will hold the green for this phase.

- Yellow Change Interval- The amount of time a yellow indication will display following the right of way (or green) interval.
- Red Clearance- The amount of time following the yellow change interval in which all approaches display red indications.
- Maximum 1 (Max 1)- The maximum green time for a phase after an actuation by a conflicting phase.
- Recall Position-Programmable function that tells the controller that a call is automatically assumed for that phase.
- Vehicle Call Memory- If locked, tells the controller to remember a call after the vehicle has left the detection zone until right of way has been satisfied for the call. Non-lock means the controller will drop the call after the vehicle leaves the detection zone.

There are two major timing methods you will find for signals, pre-timed and actuated. The main difference between the two is that pre-timed operation has a fixed green time (minimum = maximum) and no passage/gap. Pre-timed operation does not vary the green times based on demand, whereas actuated operation has a variable green based on traffic demand.

C. TEMPORARY DESIGN

When a traffic signal becomes part of a Transportation Improvement Program (TIP) or major construction design, the construction has a major impact on a signal design. For these reasons, signal plans are coordinated with the Traffic Control Phasing plans for the different construction phases.

Find Sig. Sheets 10 and 12. On Sig. 10, a temporary shift of traffic is occurring on this project. The Traffic Control Plans have all of the traffic on Edwards Mill Road reduced to two lanes of traffic to provide for the construction. Signal heads 41 and 42 have been positioned to align them with their associated lanes. Microwave detection is being used on the west leg of Edwards Mill Road.

Now look at Sig. Sheet 12. This sheet contains the final design for this traffic signal. Signal heads 41 and 42 have been repositioned on the span wire to allow for appropriate alignment with the lanes. Heads 71 and 72 have been added to the span wire. This phase requires all of the loops to be newly cut and installed in their final positions.

D. COMMUNICATIONS CABLE AND CONDUIT ROUTING PLANS

In metropolitan areas, it is not unusual to have a cluster of signalized intersections located in close proximity to one another or located along a highly traveled corridor. In these instances, it is desirable to provide some mechanism to control the individual intersection, but to also control them is such a way that the motoring public can progress through a cluster of intersections with as few interruptions and/or delays as possible.

One such method of controlling the progression of traffic is via the implementation of timing plans based on known time-of-day traffic patterns. However, it is more desirable to provide timing plans that can respond to traffic demands not just based on time-of-day, but also on the traffic demand that is present at any given time. In order to make a cluster of signals respond to actual traffic demands, we find it is necessary to provide some means for the individual signalized intersections to share the road sensor data they are collecting with their neighboring signalized intersections. To allow the sharing of this information, we interconnect the intersections with communications cable, typically fiber optics or twisted pair type cables. If traffic can be controlled to allow progression from one intersection to another without stopping, everyone will benefit. Air pollution will be reduced and drivers get to their destinations sooner.

The following information provides some insight as to how to read and understand a set of **"COMMUNICATIONS CABLE AND CONDUIT ROUTING PLANS".** Look in your set of plans**.**

Sig. Sheet 18 is the CONSTRUCTION NOTES SHEET. It is a compilation of commonly used construction notes that inform the Contractor how to construct the project. The notes are arranged in groups represented by different symbols and are explained in more detail below.

GROUP A (Notes 1-6)

This grouping of notes specifies the various types of communication cable that are to be used on a project or segment of the project. This is the communications medium in which the data will travel through to arrive at its destination. In most cases, especially with new systems, we install fiber optics communications cable. However, in some instances, we install twisted pair communications cable if there is an existing system that uses the older copper type communications cable.

Fiber optic cable is our preferred choice of communications cable. Fiber optic cable is immune to lightning because it has essentially no metallic conductors. This, in-turn, helps to save the cable, as well as saves the expensive equipment attached to it.

GROUP B (Notes 7-17)

This grouping of notes specifies the various types of risers and conduits to use throughout a project. Risers are used when the communications cable is to transverse up or down a pole. Weatherheads are used for copper communications cable and Sealing Bushing for fiber optic communications cable.

If the communications cable is to be installed underground, it is installed in a conduit. Normally PVC type conduit is installed unless a situation arises that requires the Contractor to place a conduit under an existing road or driveway. In these instances, the Contractor is instructed to bore and jack a Rigid Galvanized Steel Conduit under the road or driveway. The Rigid Galvanized Steel Conduit provides additional protection that the PVC conduit cannot provide.

Multi-cell Conduit is a conduit system that consists of more than one conduit. It is very useful when the need for additional conduits are required.

GROUP C (Notes 18-22)
This grouping of notes gives direction to installing the communicants cable in either a riser or conduit. It also directs the Contractor how a particular conduit or riser is to enter an existing or new intersection controller cabinet.

GROUP D (Notes 23-30)
This grouping of notes addresses what equipment is necessary to terminate the communications cable. Based on the particulars of the traffic signal system, splice cabinets and/or aerial/underground splice enclosures are normally only used in the larger systems.

GROUP E (Notes 31-32)
This grouping of notes addresses the installation of the signal cabinet foundation. The signal cabinet foundation is a concrete pad upon which the cabinet will be located.

GROUP F (Notes 33-35)
This grouping of notes addresses the installation of CCTV (Closed Circuit Television) Cameras. These cameras will allow personnel in the central control center for the system to observe operations at specific locations.

GROUP G (Notes 36-38)
This grouping of notes addresses the installation of pull boxes. Standard size pull boxes are used for copper communications cable while oversized pull boxes are used for fiber optic cable.

GROUP H (Notes 39-40)
This grouping addresses the installation of poles. Whenever a communications cable is installed aerially, circumstances may require a new pole to be installed.

GROUP I (Notes 41-43)
This grouping of notes addresses the installation of guy assemblies. Guy assemblies are used to support a pole when the pulling forces created by the communications cable being attached to a pole line suddenly changes direction, alters its course, or even transverses a pole.

GROUP J (Notes 44-46)
This grouping of notes addresses the installation of new messenger cable as well as the removal of existing communications cable and messenger cable. Messenger cable is used to support the communications cable between poles.

GROUP K (Note 47)
This note indicates where telephone service should be installed in the system. The telephone service will be provided at one of the controller locations to allow the system information to be accessed through a modem.

GROUP L (Notes 48-50)
This grouping addresses notes for the installation of spare communications cable either in the signal controller cabinet or in an aerial type installation. The term “snow shoes” is figurative in that the hardware that holds the cable in place looks like “snow shoes”. Delineator markers are

installed whenever underground segments of communications cable are installed along the roadway. The delineator alerts construction crews that fiber optic cable is installed underground nearby.

GROUP M (Notes 51-53)
This grouping consists of notes describing how the Contractor is to install the communications cable to a messenger cable on an aerial installation. Lashing refers to the process of physically attaching or banding the communications cable, using a thin wire, to an existing or new messenger cable.

E. CONSTRUCTION NOTE SYMBOLOGY KEY

The information provided in the "Construction Note Symbology Key" is used in conjunction with the notes indicated in "Group A" and "Group B." As shown in the Key, the information to the left details how many cables or conduits/riders are to be installed at any given location. While the information on the right details how many conductors are present in each cable or the size of the conduit/riser to be installed.

F. COMMUNICATIONS CABLE AND CONDUIT ROUTING PLANS

Sig. Sheet 28 shows an example of "Communications Cable Routing Plans." These plans describe to the Contractor in detail how to build the project, with regards to installing the communications cable. Please take this time to review the construction plans. Look at the Construction notes and study how they are used to relay the necessary construction information.

QUESTIONS

Refer to **Sig. Sheet 28** to answer the following questions:

1. How is the aerial communications cable to enter the controller cabinet? _____

2. How many pull boxes are installed on this sheet? _____

3. Where is the CCTV camera to be mounted? _____

Turn to Appendix G (page G-4) and check your answers.

G. UTILITY MAKE READY PLANS

To interconnect signalized intersections with fiber optic or twisted pair type cables, the communications cable must be attached to existing utility poles or new poles or routed in conduit underground. When attaching to poles that are shared by multiple utilities, i.e. CATV, phone, etc., designated attachment points must be maintained.

Separation between the various utilities is governed by the National Electrical Safety Code (NESC). Typically the standard attachment points are:

1. The separation distance from a power company's neutral conductor must be 40 inches or more.
2. The separation between the bottom of a power company's transformer must be a minimum of 30 inches, provided you still maintain 40 inches separation between the neutral.
3. All other non-current carrying conductors must be separated by a minimum of 12 inches. (In all cases above, the bottom utility must maintain a minimum vertical clearance above the ground or roadway of 18 feet.)

To determine if these attachment points are possible at each pole, a "Utility Make-Ready Walk thru" of the project is conducted using telescoping measuring rods or impulse laser instruments to document the existing attachment points at each pole. As a rule of thumb, NCDOT prefers to be the highest non-current carrying conductor on the utility pole (40 inches below power). However, this is not always the case depending on available funds.

The NCDOT prefers to be the highest non-current carrying conductor due to the fact that the other utilities such as CATV and phone will most likely in the future be adding additional cables. If these other utilities were above our communications, then we would have to make adjustments to accommodate them. It is also very rare that the NCDOT would be adding additional cable due to the fact that our data demands do not change once our cable is installed, as compared to that of a local utility such as phone or CATV.

If it is not possible for an adjustment to be made due to "too much clutter" on the pole or the minimum vertical clearance above the ground cannot be maintained, then a pole change out is requested or an alternate route or underground conduit is considered.

CONCLUSION

Traffic Signal design is a highly dynamic field. The plan layout and design standards have changed rapidly over recent years, but the basic information we desire to express is the same, safety for the traveling motorist and pedestrian.

CHAPTER THIRTEEN: HIGHWAY SIGNING PLANS

A. HIGHWAY SIGNING PLANS OVERVIEW

Refer to the sample signing plan sheets from this project, which is a part of this course. Plan sheets included are typical of those in a complete set of signing plans.

Sign-1 is the overview of the project. This sheet shows the project limits on a non-scaled map. This page also has an index to show how the following sheets are grouped.

Sign-2 is the "Summary of Quantities" sheet, which contains the individual pay items for the signing work. If signing is a stand-alone project, the summary of quantities will include pay items for mobilization and traffic control. This sheet also refers to typical sheets in the NCDOT Roadway Standard Drawings.

Sign-5 is a standard “E” sheet. This sheet shows the quantity for the standard Type E-signs used on this project. Each sign has a standard number and size and will show the number of “U” channel posts used to erect the sign.

Sign-9 and Sign-11 are representative of signing plan sheets which show the location of "existing", "proposed", and "future" signs. Note the symbols used to represent the actual sign locations. They indicate the use of single or multiple supports; however, the actual number of supports and sign offsets must be obtained from the support chart. Individual sign faces are shown, and signs to be installed by the contractor are numbered.

All signs that are greater than144” in width or greater than 48” in height are Type A signs. All signs that are less than or equal to 144” in width or less than or equal to 48” in height are Type B signs. Ground mounted Type A and B signs are numbered starting with "101". Overhead sign numbering begins with " 1", and if a panel is installed above or below a sign, letters are also used. An example overhead sign number would be 12B and the panel above it would be 12A.

Exit gore signs are numbered starting with "201".

Type "D" signs are numbered starting with "301". These smaller signs are commonly used on ramps and on crossing "Y" lines.

Type "E" signs are standard regulatory and warning signs contained in the "Manual on Uniform Traffic Control Devices" (MUTCD), and these are numbered starting with "401

Type "F" signs are route marker assemblies and are numbered starting with "501".

B. THE "MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES"

The "Manual" is the document that Traffic Engineers rely for guidance in highway signing, signal design, and pavement marking. The MUTCD is published by the Federal Highway Administration, but the content is controlled by the National Committee on Uniform Traffic Control Devices, of which AASHTO is a member. A companion publication entitled "Standard Highway Signs" gives detailed design information on the standard signs that appear in the MUTCD.

Part II of the MUTCD, **"SIGNS"** contains the basic rules for signing roadways used throughout the United States. North Carolina has adopted the MUTCD as a guideline along with associated State supplements. The Parts of most importance to technicians designing freeway and expressway signing are contained in Parts 2E and 2F.

C. "STANDARD SPECIFICATIONS FOR ROADS AND STRUCTURES"

The "Standard Specifications for Roads and Structures" contains specifications for materials used in signing work and describes the standard "pay items" used in signing plans. It contains specifications for highway sign materials including sign fabrication, erection, and removal; and materials used in sign fabrication, including the reflective sign sheeting.

Refer to the Standard Specifications for additional information about the materials used for signs and supports.

D. GUIDE SIGNING COPY DETERMINATION AND DESIGN

A large part of the work of developing highway signing plans is the process of determining the location and messages that will go on guide signs on freeways and expressways. Consideration must be given to the proper spacing of signs to allow for driver comprehension and avoid message overloading. Guide signs are routinely placed at 800 foot intervals. Signs on ramps and crossing "Y" lines may be as close as 100 feet, depending on operating speeds at the various locations.

Choosing proper letter sizes for signs is important for the sign to be read from appropriate distances. A rule of thumb is to have 1 inch of letter height for each 50 feet of visibility.

E. OTHER SIGNING PLACEMENT

Standard drawings are used by the Signing Unit to assist with proper placement of all signs. Consider first the placement of required major guide signs, the advance guide signs, exit direction guide signs, exit gore signs, supplemental guide signs, and logo signing. Next locate any required warning signs, such as lane drop signs and ramp or exit speed warning signs. Then locate regulatory signs, such as speed limit signs, and finally locate other informational signs, such as distance signs.

Locate required signing on the ramps and "Y" lines using a similar order of placement. Route junction and destination signing is important for motorists approaching a freeway, so these types of signs must be carefully considered. Review to Sign-9 and Sign-11 at this time to study the placement of the different sign types.

F. SIGN SUPPORT DESIGNS

The Type "D", "E", and "F" signs are installed on 3 pound per foot "U" channel post supports that are considered breakaway when no more than 2 supports are used in any 7 foot path.

G. COMPLETION OF HIGHWAY SIGNING PS&E PACKAGE

Once the signing plans are complete, specifications and any required special provisions for non-standard bid items, or non-standard construction details must be written, and an engineer's estimate prepared. This information is referred to as the Plan Specification and Estimates (PS&E) package. A supervising engineer reviews the package, and when all revisions are made, the engineer seals the plans. The package is then submitted to the Design Services Unit for inclusion into a complete project bid package.

H. CONSTRUCTION OVERSIGHT

The Signing Section has responsibilities even after the projects are awarded. It is the Section's responsibility to place orders for highway signs to the North Carolina Department of Corrections if the project has State furnished signs. Signs are ordered after the Resident Engineer has conferred with the signing subcontractor and determined the date signs will be required. The contractors are responsible for the condition of the signs when they acquire them from Correction Enterprises until project acceptance, so they often attempt to minimize this time.

The Signing Section must be available to make any project revisions requested by the Resident Engineer. Most notably, the Resident is required to “field verify” sign support elevations. This often results in minor revisions to the support charts in the signing plans.

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CROSS REFERENCE INDEX

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APPENDIX B
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APPENDIX D
TERMS AND DEFINITIONS

-A-

A.A.S.H.T.O - American Association of State Highway and Transportation Officials. A regulatory organization consisting of professionals from each of the state's highway and transportation departments. AASHTO governs the design and specifications of the highways and is responsible in assigning route numbers for the U.S. route system. .

Abandonment - the act of the cessation (stoppage) of use of right of way with no intention to reclaim or use the right of way again for highway purposes.

Abutting Landowners - the owners whose land adjoins (abut) the adjacent land.

Acceleration Lane - a connecting lane leading from a ramp to a freeway and designed to enable the motorists to merge into freeway traffic at highway speed.

Acquisition or Taking - the acquiring of a property in its entirety or a portion thereof for highway purposes

Acre - a measure of land area- 160 square rods- 10 square chains- 4840 square yards- 43,560 square feet.

ADT (current) - Average Daily Traffic- the total volume during a given time period (in whole days), greater than one day and less than one year, divided by the number of days in that time period.

ADT (design year) – Design Year Average Daily Traffic – the general unit of measure for projected average daily traffic to some future design year. Usually the design year is about 20 years from the date of beginning construction. For example, in the design year 2025, it is estimated that the average daily traffic will be 49,100 vehicles traveling the highway (ADT 2025 = 49,100).

A.B.C. - Aggregate Base Course- crushed stone used as a part of the roadway base to support the pavement.

Alignment - see " Horizontal Alignment" and "Vertical Alignment".

All Red Interval - the time of display of a red indication for all intersection approaches following a yellow interval to permit vehicles or pedestrians sufficient time to clear an intersection before opposing vehicles receive a green *indication.*

Angle - the figure formed by the intersection of two straight lines.

Arc- a segment of a circle.

Azimuth - direction to or toward an object, measured as an angle in the horizontal plane. In surveying, the azimuth is measured clockwise from the North.

APPENDIX D
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-B-

Backfill **-** material used to replace (or the act of replacing) material used during the construction of a project.

Back Plate **-** a black metal plate attached to a signal head used for the sole purpose of increasing target value of the signal face (used when signal face is not readily visible to motorists due to competing background lighting such as commercial signs and lights, sunlight, etc.)

Backslope **-** that portion of roadway between the side drainage ditch and the top of the cut- usually measured as a ratio of horizontal distance versus vertical distance, i.e., 4 to 1 (4:1) slope.

Barrel **-** the part of a pipe or culvert that water flows through.

Base Course **-** a part of the pavement structure between the surface course and the subgrade.

Beam - a structural element, usually horizontal, whose main function is to carry loads transverse to its longitudinal axis. These loads usually cause bending of the beam member. A beam may rest its end on a cap/bend. Beams can be made of steel or concrete.

Beams or Girders **-** these are placed lengthwise along the bridge (parallel to the centerline of the bridge) with each end resting on the BENT CAP

Bearing **-** 1) A method used to express direction. The bearing of a line is the angle and direction, which the line makes with respect to a North-South, East-West line.
2) The part of a bridge that bears weight or acts as support (of a girder).

Bed (Centerline Culvert Invert) Elevation of a Culvert **-** the elevation of the top of the bottom slab of a culvert at the centerline of the roadway, which is at least one foot below the existing stream bed elevation.

B.M.**- Bench Mark** - a point of known elevation; usually a mark of some durable material such as a stone, a concrete post, or a bronze plate that serves as a reference point in running a line of levels for the determination of an elevation.

Bent **-** it consists of the END CAP, COLUMN, FOOTING, and the PILES beneath the footing or the bent cap and the piles supporting the cap (in some instances, there are no columns or footings-such as a stream crossing). End Bents normally use piles.

Bent Cap **-** a part of a bridge –constructed of reinforced concrete and supported by means of either columns or piles.

Bent Caps **-** these are constructed of reinforced concrete and are supported either by means of concrete or steel piles or by means of reinforced concrete columns

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Berm Ditch **-** an open watercourse constructed along the top of the cut slopes for the collection and handling of offsite surface drainage.

Borrow **-** suitable material from sources outside the project limits used primarily for embankments.

Borrow Pit **-** an area (pit) from which suitable material from sources outside the project limits is excavated. This material is generally used for embankments.

Boundary **-** that which fixes (or indicates) a limit of extent to a parcel of land.

Box Culvert**-** see "*Culvert*"

Bridge **-** a structure having a span over twenty feet, erected over a roadway, stream, railroad, depression, or combination of these. (Multiple lines of pipe culverts, regardless of their length, are not considered to be a bridge).

Buffer Zone **-** a vegetation strip or zone maintained along a river, stream, or lake. This zone is intended to to reduce velocity of flow to a surface water and allow for removal of pollutants prior to their deposit in sensitive waters.

-C-

Cabinet **-** an enclosure for housing the controller and its associated equipment.

Call **-** a registration of demand for traffic to the traffic signal controller unit.

Catch Basin **-** an opening into a storm drain system suitable for use in a curb and gutter section; a combination of grate and curb opening.

Cattle Pass **-** an opening under a roadway allowing access and movement of livestock from one side of the road to another. The opening usually consists of a pipe or box culvert.

Centerline **-** the longitudinal mid-point of all contiguous travel lanes. Surveyed stations are normally on the centerline of travel lanes or median.

Channel Change **-**a man-made change or diversion in the natural flow of a body of water– or a man-made change of flow in the channel of a ditch, stream, creek, or river.

Circular Curve **-** an arc (segment) of a circle.

Class (III), (IV) **-** the strength indicator for a concrete pipe. Class IV pipe will withstand greater loads than Class III pipe.

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Clearance Interval - the yellow plus all red indication interval time to advise motorists or pedestrians of an end to right of way and allow a safe stop or to permit a vehicle already in the intersection to safely clear the intersection.

Clearing - the work done by the contractor to remove and dispose of all trees, stumps, brush, trash, buildings, fence, signs, etc. within the limits of the project.

Coarse Aggregate Base Course (C.A.B.C.) - crushed stone used as a part of the roadway base to support the pavement.

Collar- a concrete band used to join two dissimilar pipes. A collar may be used to accommodate an angular turn.

Color Sequence Chart - a chart showing which signal lens is illuminated in each signal head during every possible signal interval of a cycle.

Communication Line - a utility.

Concrete Pipe, Reinforced Concrete Pipe: - drainage pipe made of reinforced concrete.

Condemned Property - property that has been acquired for highway purposes by the exercise of the right or power of eminent domain (stoppage).

Construction Easement - an easement which extends to the farthest limits of construction, beyond the right of way; usually temporary.

Construction Items - work items to be performed on a project, i.e., paving limits, grading, structures, etc.

Construction Joint - the place where one concrete pour ends and another begins.

Construction Limits - the limits shown on the plan by symbols which designate the limits of construction as well as the lateral (side) limits of grading.

Contract - an agreement between two or more persons or parties to build a section of roadway or structure.

Control - a system of points with established horizontal positions or elevations, or both, which are used as fixed references in positioning and correlating map features.

Control of Access - C/A - the condition whereby the NCDOT controls the use of the right of way (R/W) which property owners or occupants of abutting property enter or leave a highway. A line designated as C/A, which indicates no access from property adjacent to the R/W, will be allowed. A fence is usually constructed along the C/A line. (See also Limited Access)

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Conventional Symbols **-** symbols used by the designer to convey a meaning in reading a set of plans. A conventional symbol will represent quantities, items or things.

Coordinated Signals **-** signal installation at two or more locations, which operate together in such a manner as to allow traffic along the major street to flow through the intersections after passing through the first.

Coordinates **-** 1) grid coordinates – a plan rectangular coordinate system based on, and mathematically adjusted to, a map projection so that geographic positions in terms of latitude and longitude can be readily transformed onto plane coordinates, and the computations relating to them made by the ordinary methods of plane surveying.
2) state plane coordinates – a series of grid coordinates systems prepared by the Federal Government for the entire United States, with a separate system for each state.

Corrugated Metal Pipe, Corrugated Steel Pipe **-** rigid drainage pipe, made of aluminum or steel.

Cross Section - a view of an object where the object has been "sliced away" – produced by a vertical plane cutting through the roadway at right angles to the centerline showing the profile of existing and proposed earth.

Crown - the transverse slope on the finished surface of a roadway.

Cul-De-Sac **-** a street or road which is open at one end only - with special provision for turning around at the closed end.

Culture **-** features of the terrain that have been constructed by man. Included are such items as roads, buildings, canals, boundary lines, and in a broad sense, all names and legends on plan map.

Culvert **-** a structure not classified as a bridge which provides an opening under a roadway- usually for water drainage - normally a box culvert (square or rectangular) or a pipe culvert (round or oval).

Curtain Wall - a concrete wall extending below the slab of a culvert at each end of the culvert to prevent scouring (erosion) action below the slab. Or, a concrete wall at each end of a bridge extending from the bridge slab down to the end of the bent cap.

Curve- an arc (segment) of a circle.

Cut- a term used to describe an excavation or removal of earth.

Cut Slope **-** this is the outermost slope that connects the proposed ditch to the existing ground. The slope beneath a bridge can also be a cut slope. This would be the case where the bridge is to be built on an existing roadway and the earth below the bridge must be removed to provide for the roadway below.

Cycle- see Time Cycle.

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-D-

D – see "Directional Factor".

Datum Plane - 1) horizontal datum – the geodetic position (latitude and longitude) of reference assigned to an area: North American Datum of 1927, North American Datum of 1983, or a local datum. 2) vertical datum – any level surface taken as a surface of reference (i.e. mean sea level.)

Deed of Easement – an instrument by which a right is acquired by the NCDOT to use or control property for highway purposes.

Deflection - 1) a change in the horizontal direction of a line, the magnitude of which is expressed in degrees. 2) a displacement of a structural member or system under load.

Degree - a unit of angular measurement - a degree represents $1/360^{th}$ part of a circle.

Degree of Curve – the number of degrees of angular measure at the center of a circle subtended by a chord 100 feet in length. In highway surveying, a 100-foot arc is sometimes used instead of a 100-foot chord.

Delay Detection – the ability of a detector to delay its output for a predetermined length of time after the vehicle enters the detection zone.

Delineation – the method of providing positive guidance to the vehicle operator in accordance with the alignment of the highway. See also MUTCD (3D-1) and NCDOT Delineation Policy.

Delineators – light-reflecting devices mounted at the side of the roadway, in series, indicating the roadway alignment, effective for night and wet/night guidance. See also MUTCD (3D-1) and NCDOT Delineation Policy.

Delta Angle – represented by the symbol $\triangle$; it is the angle formed by the intersection of the forward and back tangent.

DENR – (N.C. Department of Environment and Natural Resources) is the lead stewardship agency for the preservation and protection of North Carolina's outstanding natural resources. The organization, which has offices from the mountains to the coast, administers regulatory programs designed to protect air quality, land quality, water quality, and the public's health. DENR's Land Quality section has delegated sedimentation and erosion control responsibilities to the Department of Transportation related to construction activities within highway right of way. DENR's Water Quality section issues permits to the Department of Transportation for impacts to buffer zones and surface water impacts.

Design Data – a summary of some of the criteria used in the design of highways. See Title Sheet.

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Design Hour Volume (DHV) – the 30th highest hourly volume of the design year. The design volume represents the "load" that the highway must accommodate. It is one factor in determining the required number of lanes and other geometric features. The DHV is shown as a percentage (generally 8%-12%) in the "Design Data" which is applied to the ADT.

Design Speed – the maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern.

Detector Loop - a loop of electrical wire placed in the roadway for vehicle detection.

Detour – an alternate route utilizing onsite and/or offsite facilities when provided by the plans, contract, or as directed by the engineer to facilitate highway construction.

DHV – see "Design Hour Volume".

Diaphragm – steel or concrete members found on a bridge which are used to connect beams or girders together for the purpose of distributing loads to all supporting members. Diaphragms are normally placed perpendicular to the beam of the bridge.

Directional Factor (D) – the percentage of traffic traveling in the direction of major flow during the peak hours. Expressed as a percentage (i.e., 60%) and multiplied by the ADT.

Ditch Slope – see Side Slope.

Ditch – an open course constructed for the collection and handling of surface water drainage.

Drainage Easement – an instrument or easement granting the NCDOT the necessary property beyond the right of way limits as shown on the plans to provide for proper drainage of a roadway.

Drop Inlet. – an opening into a storm drain system suitable for use in areas subject to pedestrian traffic; may be used as yard inlets behind curb & gutter and in driveways as long as traffic bearing drainage structures are used.

DUAL – single-unit trucks with at least one dual-tired axle. Expressed as a percentage of total trucks.

-E-

Earthwork - amount of cut and fill earth to be worked with between any two specific stations (measured in cubic yards of earth).

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Earthwork Sheet - a plan sheet showing the amount of cut and/or fill at each station on the project.

Easement – a property right to use or control the real property of another person – may be temporary or permanent.

Edit – the process of checking a map or chart in its various stages of preparation to insure accuracy, completeness, and correct preparation.

Egress – the act of leaving; exit.

Elevation – the vertical distance from the datum (usually mean sea level) to a point or object on the earth's surface.

Embankment – a wall of material, such as dirt, to raise the height of a roadway

Eminent Domain - the acquisition of private property for public use by virtue of the superior dominion of the government over all lands within its jurisdiction.

Encroachment – the use of highway right of way by private persons for an indefinite term with or without permission, usually involving man-made obstructions either above or below the highway.

End Bent – the part of a bridge, on either end, that supports the beams.

Environmentally Sensitive Area - often noted as ESA. The "Environmentally Sensitive Area" shall be defined as a 50 foot buffer zone on both sides of the stream (or depression), measured from top of stream bank, (or center of depression). Only clearing operations (not grubbing) shall be allowed in this buffer zone until immediately prior to beginning grading operations. Erosion control devices shall be installed immediately following the clearing operation. Upon grading operations, all work should be continued to a level of completion and stabilization.

Error of Closure – the amount by which a quantity obtained by a series of related measurements differ from the true or fixed value of the same quantity.

-F-

Federal Highway Administration (FHWA) – the office within the Department of Transportation in the U.S Government which reviews, recommends, and approves the details concerning Federal participation on our highway system.

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Fee Simple Title - absolute ownership of a property, including also the unlimited right to control same for any purpose whatsoever.

Fence – an item, usually made of woven wire, to keep persons or animals off a controlled access roadway.

Fill – use of material (usually earth or gravel) to equalize or raise the topography to a certain elevation; to build up with fill; to fill low ground with sand, gravel, or earth.

Fill Slope – that portion of a roadway embankment between the shoulder point and where the embankment (fill) intersects natural ground (the toe of the slope).

Finished Grade Line – proposed elevations along the finished surface of the roadway.

Footing – the part of a structure located under a column, wall or other structural member that distributes loads from that member into the supporting soil; it is usually constructed of reinforced concrete.

Footings – these support the columns and are constructed of reinforced concrete and are supported either by piles or firm soil. Footings are not seen once the bridge has been constructed, as they will be covered with earth.

Front Elevation – a view from the front side of an object.

Funnel Drain (Slope Drain)- a metal storm drain designed to convey water from a paved or unpaved roadway down a slope to a point of disposal.

-G-

Gage – the thickness specification for corrugated steel pipe used in drainage applications (6Gage, 14 Gage) (cmp, csp)

General Notes – a list of stipulations that commonly and appropriately apply to all projects, but are not typical to any project. General notes alone should not be considered comprehensive for any project.

Grade – the slope of the roadway with a vertical rise or fall expressed as a percentage of the horizontal distance such as: a 3% grade means a vertical rise of 3 feet per 100 feet of horizontal distance.

Grade Point – the point where the proposed grade is referenced/tied to the typical section. It can also be the point where the profile crosses the original ground line.

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Grated Drop Inlet – an opening into a storm system suitable for use in areas both subject to pedestrian traffic and not subject to pedestrian traffic; may be used in roadway cut ditches, non-curbed shoulders, adjacent to barriers, and other off-roadway locations. (2" or less opening when subject to pedestrian traffic.)

"Green Arrow" – illumination of a green arrow lens.

"Green Ball" – illumination of a circular green lens.

Grid – two sets of parallel lines intersecting at right angles and forming squares; the grid that is superimposed on maps, charts, and other similar representations of the earth's surface in an accurate and consistent manner to permit identification of ground locations.

Grubbing – usually associated with clearing, removal of roots and vegetating mass prior to starting earthwork.

Guardrail – a protective barrier (usually a steel rail) placed between the travel lane of the roadway and a safety hazard (such as high fill, bridge piers, etc.).

Guiderail – a protective barrier (usually a steel cable) placed in the median between opposing travel lanes of the roadway to protect from cross median crashes.

-H-

Hanger – usually located below a bridge to hold a water line, gas line, or telephone line.

Headwall – that part of a culvert that retains fill at the inlet end of a culvert.

High Quality Waters - often noted as HQW. This designation requires special procedures to be used during the design and construction phases of project development.

Horizontal Alignment – a series of tangents and curves on the "Plan View" which show the path of the road.

Horizontal Dimensions – measurements on a Typical Section from the centerline of the roadway to the various control points on the cross section. The slope is not taken into consideration in a horizontal distance – all horizontal measurements are level lines.

-I-

Index of Sheets – a brief summary of each sheet or series of sheets in a set of plans.

Ingress – the act of entering.

APPENDIX D
TERMS AND DEFINITIONS

Inlet – a minor drainage structure: 1) Drop inlet , 2) Median drop inlet (2GI, double grate inlet).

Inlet of a Culvert – the culvert section that the water enters.

Insert – an item embedded in the concrete of a structure; a hanger screwed into an insert to hold a water line, gas line, telephone conduit, or (sometimes) a guardrail.

Interchange – the junction of a freeway and another road containing ramps and /or loops. To provide access control, interchanges keep the traffic flowing on the freeway but there may be some restrictions on the connecting routes. A complete interchange provides movements in all directions; a partial interchange has some missing connections.

Interior Bent – the part of a bridge supporting the beam.

Intermediate Contract Time (Days / Months) – the number of calendar days or months inclusive between the date of availability and the completion date, as set forth in the special provisions, including authorized extensions to the intermediate completion time.

Intermediate Contract Time (Hours) - the number of hours inclusive between the time of availability and the intermediate completion time, as set forth in the special provisions, including authorized extensions to the intermediate completion time.

Intermediate Pavement Markings – pavement marking lines and symbols used to direct and control the movement of traffic during specific construction stages until final pavement markings can be placed according to project traffic control plans.

Intersection – 1) a place where two roads join at a common point,
2) a place where two lines join at a common point.

Intersection Details – sheets in a set of plans showing a larger view of detailed information of the proposed intersection on a particular project.

Interval – any of several divisions of the time cycle during which signal indications do not change.

Isolated Signal – a signal installation which operates independently of any other signal installation within the vicinity.

-J-

Junction Box – a structure in storm drain systems used to join two different sizes of pipe or to accommodate significant turns in same size pipes, where access for maintenance is not necessary, and when a water inlet is not required. If access is required, a manhole cover may be added to the junction box or a manhole may be used in place of a junction box.

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TERMS AND DEFINITIONS

-L-

Latitude – (plane surveying) – the perpendicular distance in a horizontal plane of a point from an east-west axis of reference.

Layout View – larger than the location map, this layout view is found on the Title Sheet of the plans, and shows the beginning station and the ending station of the project.

Legend – a description, explanation, table of symbols, and other information, printed on a map to provide a better understanding and interpretation.

Level Control – a series of benchmarks or other points of known elevation, established throughout a project.

Limited Access – ingress (entrance to) and egress (exit from) to/from a highway are at points designated by the NCDOT. A limited access highway is one that has some restrictions on accessing the highway, but is not fully access controlled like a freeway. See also *Control of Access*

Line -

a) Centerline – line indicating the division of the roadway between traffic traveling in opposite directions (not necessarily the center of the roadway).
b) Channelizing Line – a line that directs traffic and indicates that traffic should not cross but may proceed on either side.
c) Edgeline – a line which indicates the edge of roadway.
d) Lane Line – a line separating two lanes of traffic in the same direction.
e) Stop Line or Stop Bar – a line, which indicates where vehicles should stop when directed by a traffic control device.

Line L – survey line designation. See Survey Line

Liquidated Damages – the sum of money in the amount stipulated in the special provisions that is charged against the contractor for each calendar day/month, each hour, or portion thereof that work described in the special provisions remains incomplete after the expiration of the completion date, intermediate completion date, or the intermediate completion time shown in the special provisions, not as a penalty, but as liquidated damages.

Location Map – a small map found on the Title Sheet showing the location of the project (the beginning and the ending of the project).

Longitude – a linear or angular distance measured east or west from a reference meridian on a sphere or spheroid.

Longitudinal Cross Section - a view of the side of an object that has been "sliced away."

Loop Defector – a device that senses a change in the inductance of its wire loop (detector loop) caused by a vehicle moving over the loop.

APPENDIX D
TERMS AND DEFINITIONS

Loop Installation Chart – a chart showing the size and location of each detector loop in relation to the stop bar for that lane, the number of turns needed to make the detector loop, the signal phase the detector loop will control, the amplifier to which the detector loop is connected, and a list of special features that a detector should have.

-M-

Manhole – an opening into a storm drain system used for physical access only. May be used alone or to serve as a junction box.

Maximum Green Interval – the maximum green indication time displayed for a phase.

Minimum Green Interval – minimum green indication time displayed for a phase.

Median – the center section of divided highway, which separates the traffic lanes in one direction from the traffic lanes in the opposite direction.

Median Edge of Pavement – the inside pavement edge (or line) on a divided highway.

Mile – a measure of distance equaling 5,280 feet.

Minor Drainage Structure – an inlet, junction box, manhole, spring box, or catch basin.

MUTCD – (Manual on Uniform Traffic Control Devices) – published by the U. S. Government. The MUTCD sets forth the National Standards, guidelines, and policies for the design of traffic control devices and their utilization.

-N-

Natural Ground Line – see *Original Ground Line*

Non-Metallic Drums – traffic control devices used most commonly to channelize or delineate traffic flow but may also be used singly or in groups to mark specific hazards. They should be approximately 36" in height and a minimum of 18" in diameter with appropriate markings attached (reflectorized strips) constructed of non-metal forgiving materials.

North Arrow – on all construction and right of way plans, there is an arrow-like symbol with the point indicating North. The directions of all control and boundary lines are in reference to this North- South arrow.

NCDOT – North Carolina Department of Transportation.

APPENDIX D
TERMS AND DEFINITIONS

N.C. Supplement to the MUTCD – a document containing standards, guidelines, and policies for traffic control devices not contained in the MUTCD, which are approved by the NCDOT, or required by N.C. General Statues. Should there be points of disagreement between this supplement and the MUTCD, the MUTCD should prevail.

-O-

Obliteration – a term that means to render an existing roadway impassable to highway traffic.

Original Ground Line – line showing how the land was before construction began.

Outlet of a Culvert – the end of a culvert where the water exits.

Overlay Resurfacing - to lay or place a new layer of asphalt over the existing pavement surface.

Ownership – the legal right of possession of real or personal property. Ownership of property designated on the plans is shown by the owner's name appearing in print on the plans.

-P-

Parcel Number – the number designated on the plans generally enclosed by a circle, which designates a parcel or tract of land

Partial Take – the acquiring of a portion of a property for highway purposes.

Part Plan – a plan view of an item when only a part of the item is shown.

Partial Control of Access – similar to Limited Access in that the Department of Transportation will give preference to "through" traffic; however, access connection may be provided with selected public roads. There may be grade crossings and some private driveway connections allowed at designated locations.

Passage Gap – the time the controller extends the green time, after one vehicle crosses a detector.

Pavement Line – the edge of the travelway on a roadway.

Pavement Markers – devices used as supplementary positioning guides or in some cases, as substitution for other types of markings. The color of the markers should conform to the color of the substitute. See also MUTCD and Roadway Standard Drawings.

APPENDIX D
TERMS AND DEFINITIONS

Pavement Markings – paint, thermoplastic, tape, epoxy, etc in the form of lines and symbols applied to the pavement surface to provide direction and control for traffic movements in accordance with the plans and specifications. Pavement markings may serve to supplement the regulations or warnings of other devices such as traffic signs and signals. See also NCDOT Standard Specifications and Roadway Standard Drawings.

Pavement Schedule - a list showing the type and quantity of pavement to be used in a Typical Section.

Paving Limits – the total length and width to be paved on any portion of a project.

Pedestrian Clearance Interval – the time display of the flashing "Don't Walk" indication following the "Walk" interval.

Pedestrian Signal Head – signal indication advising pedestrians to "Walk" or "Don't Walk".

Permanent Easement – easement in perpetuity (indefinitely) which gives the NCDOT the right to utilize property for an unlimited time.

Perpendicular – a line at right angles to a given line or plane

Personal Property - the right or interest in personal things which are movable or transferable from one place to another.

Phase – a part of the time cycle where one or more traffic movements receive the right of way.

Phasing – project phasing is a clear and concise step-by-step write-up telling the contractor where to begin and how to proceed toward the completion of a project. The main objective is to communicate to the contractor how to safely maintain traffic during the various stages of construction. (See also Traffic Control, Pavement and Delineation Guidelines.)

Phasing Diagram – a diagram showing the number of lanes/movements that are going/stopped during each phase of the cycle. It also shows which lanes/movements are being detected during each phase and the type of detection (pulse or presence) used for the movement. It shows which phase the signal may progress to during the cycle.

Piles – used in the construction of a bridge when there is no firm material available to support a footing of a bridge bent.

Planimetric Map – a map which presents only the horizontal positions for the features represented, distinguished by the omission of contour lines.

Plan Sheet – a sheet in a set of plans showing the "Plan View" of the part of the particular project.

Plan View – a two-dimensional view showing length and width from directly above the object or project.

Plug – a concrete, brick, or flowable fill termination to a pipe storm drain.

Pre timed Signal Controller – a type of control mechanism which operates on a predetermined time schedule allotting a fixed amount of time to each phase in the sequence

Profile Grade – a longitudinal view of the roadway showing the engineered (designed) "up and down" (crest and sag) of the roadway.

Profile Grade Line – the trace of a vertical plane intersecting the top surface of the proposed roadway (wearing surface) usually along the longitudinal centerline of the roadbed.

Profile View – longitudinal view of a roadway showing an elevation of the original ground line and the elevation of the proposed roadway or structure.

Project – a specific planned undertaking for the construction of a roadway or structure.

Property Lines – the boundaries or limits outlining the ownership of a tract or parcel of land.

-R-

Real Property – the rights and interests in land and those items or things of a permanent nature affixed to the land and generally whatever is growing upon the land.

Rear elevation – a view from the backside of an object.

"Red Arrow" – illumination of a red arrow lens.

Rehabilitation of Asphalt – the restoration of existing asphalt to its original design capacities.

Reinforced Concrete Pipe – storm drain pipe made of concrete with steel reinforcing

Retaining Wall – a vertical wall usually constructed adjacent (abutting) to the roadbed. It is designed to resist the lateral displacement of soil, water, or any other type of material.

Right of Access – the right of ingress (entering into) or egress (leaving from) to/from a highway from/to an abutting property.

Right of Way – a term denoting land, interest therein, or property, which is acquired for highway purposes.

Right of Way Boundary or Limits – the limits or boundaries as shown on the plans which show how much property is to be acquired for the right of way in order to properly construct a roadway.

Right of Way Plans – plans which contain all necessary information for the acquisition of right of way as found on design plans, with the addition of any information that may be helpful in the acquisition of right of way.

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TERMS AND DEFINITIONS

Rip Rap – rock protection used for slope protection, to control scouring at pipe outlets or to line ditches to control erosion. Rip Rap comes in four sizes: Class A, B, I & II.

River Basin - the entire geographical area drained by a river and its tributaries.

Roadway – the graded portion of a highway upon which the base course, surface course, shoulders and median are constructed.

Roadway Cross Section – a view of a roadway showing the inside of the roadway "sliced away" or cut at right angles to the highway

Roadway Standard Drawing(s) – typical drawings that have become standardized for the purpose of establishing common criteria by which roadway projects are constructed. Reference to the Roadway Standard Drawings eliminates the inclusion of typical drawings in the plan set that are generally applicable to any project.

Runoff – 1) distance required to accomplish transition from a *flat* to a *superelevated* section of roadway.
2) water flowing from the surface area of a drainage basin.

Runout – distance required to accomplish transition from a normal crown to a flat section of roadway.

-S-

Scale - the measurement (length) used on a set of plans to represent a larger measurement. For instance, 1" in a set of plans may represent 100'.

Shoulder – the portion of roadway adjacent to the traveled surface for accommodation of stopped vehicles for emergency use, and for lateral (side) support of base and surface courses.

Shrinkage – when earth material is taken from its original position and placed in a fill area, it is compacted. Shrinkage takes place due to the decrease in volume from the fill being compacted.

Side Elevation – a view from the right or left side of an object.

Side Slope – the horizontal to vertical ratio of any slope.

Sight Distance – the length of roadway visible to the driver of a vehicle at any given point (on the roadway) when the view is unobstructed; that area or property designated on the plans to be acquired for sight distance purposes in order to ensure the driver an unobstructed view.

Signal Controller – a controller is the complete timing mechanism which controls the signal phases at an intersection.

APPENDIX D
TERMS AND DEFINITIONS

Signal Detector – a device by which vehicles or pedestrians are enabled to register their presence with a traffic actuated controller.

a) ***Presence Detector*** – a type of detector that will send a pulse to the controller the instant a vehicle is detected and will continue to send this as long as the vehicle remains within the detection field.

b) ***Pulse Detector*** – the ability of a vehicle detector to detect the passage of a moving vehicle through the detection zone and to ignore the presence of a stopped vehicle in the detection zone.

Signal Face – the part of a traffic control signal provided for controlling traffic movements in a single direction.

Signal Head – an assembly containing one or more signal faces.

Signal Face Identification Chart – a pictorial chart showing what each signal face will look like and the size of the lenses used to make up the signal face. Each signal face is given a number for cross-reference to other parts of the signal plan.

Signal Indication – the illumination of a signal head.

Signal Lens – part of the signal head section which redirects the light coming from the light source.

Signal System – two or more signal installations operating in coordination.

Skew Angle – the angle that a pipe, culvert, bridge, or other structure makes with the centerline of the roadway as measured in a clockwise station ahead direction from the centerline.

Slope – a ratio of horizontal distance versus a per foot decrease or increase in vertical distance (elevation). See also Grade.

Slope Stake – a stake that contains information that tells the contractor how "cut" or "fill" is required from the point of the stake to the ditch line (or shoulder point) of the roadway.

Span – the distance between supports, which is the centerline of a beam, column, or joist girder. A portion of a bridge made up of a slab and beams that cross over the roadway or stream below. The span is supported at each end by bents or abutments. A culvert span is that portion of the top slab between the wall of a barrel.

Spring Box – a drainage device used to reduce subgrade moisture content where a source of spring water is known or thought to convey a designed storm drain system.

Standard Drawings – a separately published group of plan sheets for the construction of a variety of items in a project.

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TERMS AND DEFINITIONS

Standard Specifications – a book published by the NCDOT, which gives various standards for a variety of items.

State Forces – employees of the state who are responsible for performing highway maintenance work and contract work which is not included as part of the contractor's duties and obligations.

Station – the horizontal measurement along the survey line of a project (normally from West to East, or South to North). Stations are measured in 100' intervals. Used as a location, a station is a designated point on the project.

Stretch Detection – the ability of a traffic signal detector to continue its output for a predetermined length of time following an actuation and after the vehicle leaves the detection zone.

Structure – a mechanism designed and built of various parts jointed together in some definite manner to carry loads and resist forces. Usually a bridge, a culvert, or a retaining wall.

Subgrade – the top surface of a roadbed that is prepared as a foundation for the pavement structure.

Subgrade of a Bridge – the part of the bridge below the top of the bent cap.

Summary of Quantities – a plan sheet which shows the total amount of all items included in a particular contract.

Superelevation – the elevation required on the surface of a pavement in order to overcome the centrifugal force that acts on a motor vehicle; the difference in elevation between the edges of a traffic lane applied where curves in the roadway alignment are used.

Superstructure (of a Bridge) – that part of a bridge that is above the top of the bent cap.

Surface Course – the top layer of the pavement structure.

Survey Line – a line established by surveying to mark the location of a highway.

Symbol – a conventional sign used in writing or printing which represents quantities, items, or things.

-T-

T – Truck percentage - multiply this factor by the ADT to determine the amount of heavy vehicles in the daily traffic, or by the DHV to determine the number of heavy vehicles in the hourly v volume of vehicles.

TCP - (Traffic Control Plan) – a plan for handling traffic through a specific highway or street, work zone, or project. These plans range in scope from very detailed TCP designs solely for a specific project to simply a reference to typical plans and/or a section of the MUTCD.

APPENDIX D
TERMS AND DEFINITIONS

Tangent – any straight section of the roadway (alignment). A tangent to a curve is a line that touches the curve at one point and is also at right angles to the radius at the point of contact with the curve.

Temporary Easement – an easement granted to the NCDOT on a temporary basis usually for a specified time and a specified purpose. A right for the NCDOT to use lands during construction which, upon completion, the right reverts to the owner.

Temporary Rock Sediment Dam, Type-B **-** noted as TRSD-B, a small dam with a weir outlet and built-in sediment basin used to trap sediment before water runoff leaves the project site.

Temporary Rock Silt Check Type-A **-** noted as TRSC-A, a small dam with a weir outlet that uses a naturally formed storage area (rather than an excavated pit) to trap sediment before water runoff leaves the project site.

Temporary Silt Ditch **-** noted as TSD a small ditch or channel that intercepts water flow from slopes and directs the runoff into a basin, sediment dam and/or rock silt check.

Temporary Slope Drain **-** a flexible tubing or pipe used to carry concentrated runoff from the top to the bottom of a cut or fill slope without causing erosion along the slope.

The Location of Monuments and Ties in Relation to Property Line – those locations designated on the plans by distance from and/or reference to a point on the survey line which designates the location of a property line intersecting a right of way boundary or which designates the location of a right of way monument on the right of way boundary.

Time Cycle – the time period required for one complete sequence of signal indications.

Timing Chart – a chart showing the timing to be set on the controller for each phase interval. It also shows what memory position should be set on the controller for each phase.

Title Sheet – the front sheet on a set of plans which describes the project, shows the location of the project, gives the general layout of project, and other information (always sheet #1 in a set of plans).

Topographic map – a map which represents the horizontal and vertical positions of the features represented, distinguished by the addition of contours to show mountains, valleys, and plains.

Tort Liability – a liability of committing a wrongful behavior (aside from breach of contract) for which a civil action can be filed; the liability of the unprivileged commission (or omission) of an whereby another person incurs loss of life or injury; such breach of duty as resulting in damage to the plaintiff.

Total Take – the acquiring of a property in its entirety for highway purposes.

APPENDIX D
TERMS AND DEFINITIONS

Traffic Actuated Signal Controller – a type of controller in which the intervals are varied in accordance with the demands of traffic registered by the detectors.

a) ***Fully Actuated Signal*** – a type of traffic actuated signal in which means are provided for detection on all approaches.
b) ***Pedestrian Actuated Signal*** – a type of traffic control system which may be actuated by a pedestrian.
c) ***Semi-Actuated Signal*** – a type of traffic control signal in which means are provided for detection in one or more, but not all approaches to the intersection.

Traffic Control Devices – all signs, signals, markings and devices places on, over, or adjacent to a street or highway by authority of a public body or official having jurisdiction to regulate, warn, or guide traffic. (Refer to MUTCD, NCMUTCD, Roadway Standard Drawings and the NC Standard Specifications)

Traffic Signal – any power operated traffic control device by which traffic is alternately directed to stop or proceed.

Travel Lanes – lanes in which vehicles move.

TTST – (truck, tractor, and semi-trailer) are multi-unit tracks, including both single and twin-trailer rigs. Expressed as a percentage of total trucks.

Type III Barricades – portable or fixed traffic control devices having three rails with appropriate markings and are used to control traffic by closing, restricting, or delineating all or portions of the right of way.

Typical Section – a cross-sectional view of a roadway showing how the roadway would appear after it is completed.

-U-

Utility – physical plant and operating facilities which provide public or private utilities consisting mainly of communication lines, electric power lines, gas lines, water mains, sewer mains, and other pipe lines, and the supporting structures for these facilities.

-V-

V – this is the design speed of the project, which is a minimum of 5 mph above the anticipated posted speed.

Vertical – perpendicular to the plan of the horizon or to a primary axis.

Vertical Alignment – see *Profile View.*

Vertical Curve – a parabolic curve drawn tangent to intersecting grade lines to provide a smooth transition from one grade to another.

View – the way you look at or "see" various items that are shown in a set of plans.

Visor (Hood) – the part of the signal head section which protects the lens face from direct sunlight.

Volume-Density – a type of vehicle detection with a variable passage-gap time and variable minimum green.

-W-

Waste – that portion of excavated material from a project that is not used in the construction of the project.

Waste Area – an area or location in which excess or unsuitable material obtained during construction is deposited.

Weir – a dam placed across flowing water to raise or divert the water or used to regulate the flow.

Wetland - a lowland area, such as a marsh or swamp that is saturated with moisture, especially when regarded as the natural habitat of wildlife: *a program to preserve our state's wetlands.*

Wing Wall – a part of a culvert that extends at an angle to keep earth from spilling into the streambed.

Work Zone – any continuous tract or area of a roadway in which construction or maintenance is being performed.

-XYZ-

Yellow or Warning Interval – the time of display of the signal indication following the green interval.

Y-Line – the designation used on a survey line for side roads.

APPENDIX E
ABBREVIATIONS

A

Aband - abandoned
ABC - aggregate base course
Ac - acre
ADT - average daily traffic
AH- ahead
Asph - asphalt
Ave- avenue
Az - azimuth

B

B- barn
Bd- board
Bdy - boundary
Beg - begin
BK - back
Bldg - building
BLK - block
Blvd - boulevard
BM - bench mark
Br - bridge, branch
Brg – bearing
BR – bare root
BST - bituminous surface treatment
Bus - business
BW - barbed wire
BZ – buffer zone

C

C- curb
C/A - control of access
CABC - coarse aggregate base course
CB - catch basin
Cem - cemetery
CH - courthouse
Ch - church
CHL - chain link (fence)
CL (III), (IV) -class (III), (IV)
CM - corrugated metal
CMB - concrete median barrier
CMP - corrugated metal pipe
Co -county
Comb - combination
Conc - concrete
Const - construction
Coord - coordinate
CP, RCP -concrete pipe, reinforced concrete pipe
Cr - creek
CS - corrugated steel
CSP - corrugated steel pipe
CY - cubic yards

D

$\triangle$- delta angle
D - dwelling, degree of curve
DI - drop inlet
Dist - district
Div - division
Dr- drive

E

E - East
El- electric, elevated
Elev - elevation
EM – embankment
EXCAV - excavation
Expwy - expressway
Ext - extension
Exp - expansion

F

F - frame, face of curb
Fd - ford
For- forest
FR - frame
Ft - fort
Fwy - freeway
Fy - ferry

APPENDIX E
ABBREVIATIONS

G

GA - gauge
Gals-gallons
G - garage, gutter
GI - grated inlet -
GI, 2GI, 3GI - grated drop inlet
Gr - gravel

H

H - hydrant
Hdqtrs - headquarters
Horiz - horizontal
Hosp - hospital
HPT - horizontal photo tie
HQW – high quality water
H Tr - house trailer
Hwy – highway

I

ID - inside diameter
Ind - Indian
IP - iron pin
ISBD - one story brick dwelling
ISFD -one story frame dwelling

J

JB - junction box
Junc - junction
Jt. – joint

L

L - lake, line, location, lane
Lbs- pounds
Ldg - landing
LF - linear feet
LH - lighthouse
LS - lump sum
Lt – left

M

M - masonry
Max- maximum

Med- median
MH - manhole
Mi -mile
Mil-military
Min- minimum
Mon - monument
MP - milepost
Mt - mount
Mtn- mountain
Mts – mountains

N

N - North
Nat - national
NBL - northbound lane
NDI - narrow drop inlet
No- number

O

Obs - observation
OH - outside toilet, outhouse
Orch – orchard

P

P - property line
Pav't - pavement
PC - point of curve
Pd- pond
PG - profile grade point
PGL - profile grade line
PH - powerhouse
PI - point of intersection of tangents,
point of vertical intersection
PINC - point of intersection - no curve
PIS - point of intersection of tangent (spiral)

APPENDIX E
ABBREVIATIONS

PIST-A – pipe inlet sediment tray type-A
Pk - peak
Pkwy - parkway
PL - property line
PO - post office
POC- point on curve
POS - point on spiral
PP - power pole
PRC - point of reverse curve
Priv - private
Prop - proposed
PT- point of tangent
Pt - point
PVC - polyvinyl chloride (pipe), point of vertical curvature
PVT - point of vertical tangency

R

R - river
RC - reinforced concrete
RCP - reinforced concrete pipe
RCBC - reinforced concrete box culvert
Rd - road
Rem - remove
Res - reservation, reservoir
RR - railroad
Rt - right
R/W – right of way

S

S - sewer, shack, shed, South, storm, strand
SB - spring box
SBL - southbound lane
Sch – school
SE - superelevation
Spr - spring
Sq. Yd. - square yards
SR - secondary road
SS - sanitary sewer
St - street
Sta - station
Stk - stock
SY - square yards

T

TBM - temporary bench mark
TC – terra cotta
TD – temporary diversion
Temp – temporary
Topo – topography
TP – telephone pole
Trans – transmission
TSD – temporary silt ditch

U

UC – under construction
UG – underground
UNCL – unclassified

V

V - valve
VA - vertical angle
VC - vertical curve, viterous clay
Vert - vertical
VPT - vertical photo tie

W

W - water, well, well house, West
WL - water level
WM - water main, water meter
WW - waterworks, woven wire

XYZ

X Sects - crosssections
Y-line - survey line for side road

APPENDIX F
SCALES

Roadway and Structure plans are drawn to scale in order that they might be presented on easy-to-use sheets. Roadway plans are normally drawn with an engineer's scale while structure plans use both engineer's and architect's scales.

The engineer's scale is one that expresses "scale" as 1 inch = 10 feet, 1 inch = 20 feet, 1 inch = 50 feet, 1 inch = 1 mile, etc. It is usually 1-foot long and may be triangular or flat. The scales are divided into decimal parts of an inch such as 1/10 inch, 1/20 inch, etc. The triangular or six-sided scale has scales with 10, 20, 30, 40, 50, and 60 divisions to the inch.

The architect's scale expresses scale as 1 inch = 1 foot, 1/2 inch = 1 foot, etc. This indicates that one inch on the drawing would be equal to 1 foot of the actual structure, or 1/2 inch on the drawing would equal 1 foot of the actual structure. This scale is usually 1 foot long and may be triangular or flat. The scales are divided into fractions of inches such as 1/8, 1/4, 1/2, 3/4, etc.

Some drawings are made on scales larger than objects. Drawings of small objects are sometimes made two or three times larger than actual size for clearness. Architect's scale may have scales of 1 ½:1, 3:1, etc., meaning one and one-half times actual size, three times actual size, etc.

APPENDIX H
Evaluation Questionnaire

We would like your reaction to this course to improve future editions of this book. By giving us the benefit of your experience in taking this course and by your constructive suggestions for improvement, you can assist us in this endeavor. Also, future students of the Plan Reading Course will benefit from your suggestions.

Please complete this form and return it with your completed examination for this course. BE AS SPECIFIC AS POSSIBLE.

1. ADEQUACY OF TEXT MATERIAL

It is intended that the text materials for this course provide you with the basic understanding of Highway Plan Reading. Give us your comments on any subject area you feel did not go into enough detail to help you completely understand the material.

2. SUITABILITY OF EXAMINATION

Examinations are intended to test by sampling your knowledge of the major points covered in the course. If you think this objective was missed, give us your comments.

3. GENERAL REACTION TO THE COURSE

Give us your general reaction to this course and any specified suggestions for improvement not previously covered. (If you need more space, please use the back of this sheet.)

North Carolina Department of
Transportation
P.O. Box 25201
Raleigh, North Carolina 27611
ATTENTION: DOT Training Section

Date:_____.

_____
(PRINT NAME)

_____
(POSITION – JOB TITLE)

_____
(DIVISION)