

Upres
**Underground
Structure Analysis
(Buried Pipe or Tunnel)**

CivilTech Software

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UPRES FOR WINDOWS SOFTWARE MANUAL

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CHAPTER 1 INTRODUCTION

About the Program

The Upres program (previously called Tunnel) is used to calculate the stress and deflection of underground structures. It has a friendly user interface which makes the program easy to learn and use. It also has a powerful pull down menu bar which is on the top of the screen and is very easy to operate. The commands shown on the menu bar are arranged in the familiar Microsoft style. Mouse and keyboard are used for data input and retrieval; shortcut keys are provided for quick operation.

After you execute the program, the graphical output is provided as a visual aid to confirm the correctness of the input data. The graphics presentation can be shown on the screen and can also be printed as a high-resolution hard copy. The program has an automatic error check, which detects whether the input data is reasonable. If the data is out of range, the program will warn the user to make a correction.

About the Manual

This manual:

- 1) Describes software operation and hardware configuration
- 2) Introduces theory and methods of calculation used in the program (the user should be familiar with design theory)
- 3) Describes each input and output parameter
- 4) Provides typical example problems

About the Company

CivilTech Software is a subsidiary of CivilTech Corporation. CivilTech Software employs engineers with experience in structural, geotechnical, and software engineering. These engineers have many years of experience in design and analysis in these fields as well as in special studies including seismic analysis, soil-structure interaction, and finite element analysis. Together, CivilTech has developed a series of engineering programs, which are efficient, easy to learn, engineering orientated, practical, and accurate.

The series of CivilTech Software includes SHORING, HEAVE, Lpres, Epres, Tunnel, Buried Structures, All-Pile, Boring Log, and Pinned Pile and Lab Testing programs. These programs are widely used in the US and around the world.

For more information, visit our website at <http://www.civiltech.com>.



CHAPTER 2 INSTALLATION AND QUICK START

Quick Start

<i>Setup</i>	<p>Insert the setup Disk into floppy drive A: or B:.</p> <p>In Windows 3.1, go to the [FILE] menu and select [RUN].</p> <p>In Windows 95/ NT press <START> and select [RUN].</p> <p>Type: A: install or B: install</p> <p>Press <OK> then follow the directions on the screen. The installation program will automatically create an icon called Upres on your Windows screen. Don't forget, when you first start the program it will be in an unregistered mode. To register the software see the process in the Registration Section below.</p>
<i>Configuration</i>	<p>Hardware configuration uses your Window's settings. However, you can change your configuration later in Windows. To change the configuration, check your Windows manual.</p>
<i>Starting the Program</i>	<p>Double click the icon called Upres from your Windows screen.</p>
<i>Running the Calculation</i>	<p>Press <Graph> on the tool bar or press the F6 key to see graphical results.</p> <p>Press <Report> or F7 to see the report.</p>
<i>View and Print Results</i>	<p>After <Graph>, a Preview window appears. You can zoom in, zoom out, shift pages, and print.</p>
<i>Quit Program</i>	<p>Press [Exit] from the [File] menu or Ctrl+X.</p>



Registration

You will need to register your copy of this software to use its full capabilities. When you first start the program, a Registration Window will appear (as shown in Figure 2-1.) If you do not register at this time you can always open this window which is located under the [HELP] menu and the option [REGISTER]. After your registration has been accepted this window disappears.

The Registration Code is included with the shipment of the software. If you are the legal owner of the software and do not have the Code, call, fax or email us your Serial Number from the Registration Window. We will give you the Registration Code. Enter the Code, your firm's name, and your name in the Registration Window. If you have done everything correctly you should see a message box, which tells you the registration has been accepted.



Figure 2-1 Registration Window

Menu Command

The following text describes the purpose of each command under the menu item.

File Menu

The [File] menu provides easy data file handling tools.

- New** To clear all the old data from the screen, and provide a blank work space so you can begin a new job. Every time you open the program, the program provides you with a new untitled file. If the file name is **Untitled** you have to name the file before you save it. (See **Save** below).
- Open** To open an existing file saved previously in the hard disk. A dialog box with a list of files will show on the screen. Select the file you want and click open. If you change your mind, press **Esc** or cancel button.
- Save** Occasionally you should save the file you are working on to avoid losing data. To save the working file you can press the shortcut key F10, or pull down the file menu and click on *[Save]* or *[Save As]*. If the file is untitled, the program will automatically switch to the *[Save As]* command and ask you to provide a file name to save file.



- Save As** If you want to save a new untitled file or change the file name of an opened file, you should use the *[Save As]* command. A dialog box appears to ask you the file name you want to use. You may type up to 8 letters for file name. Don't type "." and extension. A legal file name cannot contain "# ". If the file name is not valid, another dialog box appears to warn you. You can enter a valid name or click *[Cancel]* to go back.
- Exit** To quit the program. A dialog box will appear. You can click <YES> to quit the program or <NO> to go back to the program.
- Run Menu** To run the program. It has the same function as the <RUN> button.
- Help Menu** Provides help information for your convenience.

Changing Firm or User Data

You are now able to easily change your Firm and User Name that the program is registered under. Please bear in mind that if the software is to change companies the current owner should contact us about reregistering it. This will allow you to remain eligible for upgrades and support.

To change the registered Firm and User Name, click on the <Help> and then <Register> on the upper menu bar. Enter in the new name of company and user name with the current registration code. (If your old code no longer works, contact us for a new one.)

You will then need to quit and restart the program. This change will take effect for all of the CivilTech Software for Windows programs (Shoring, Epres, and Lpres.)



Preview and Print Screen

The preview and print screen shown in Figure 2-2.

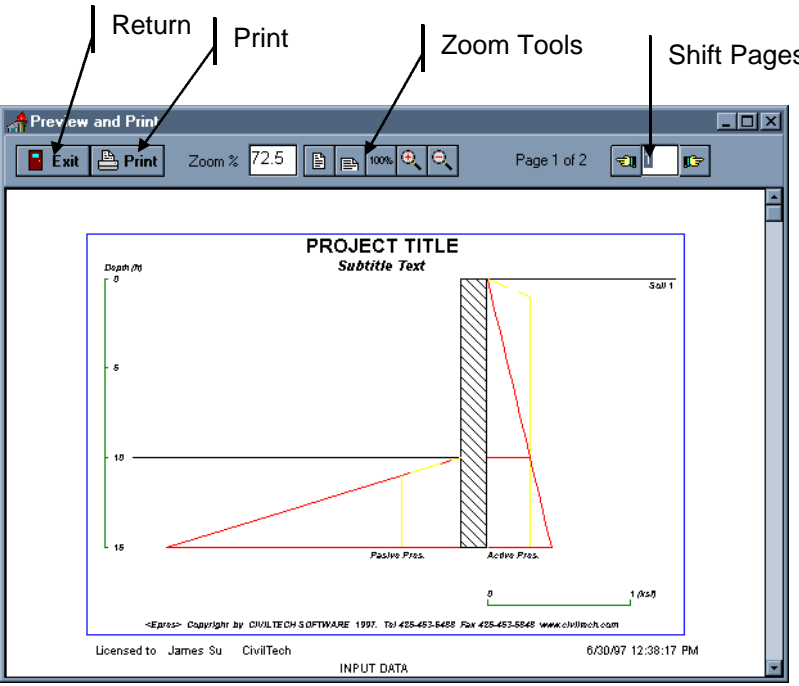


Figure Chapter 2 -1 Preview and Print Screen

CHAPTER 3 RUNNING THE PROGRAM

Data Input

The data needed for calculation basically consists of two pages. The graphical definition is illustrated on the right side of each page.

Input Page 1 (Figure 3-1)

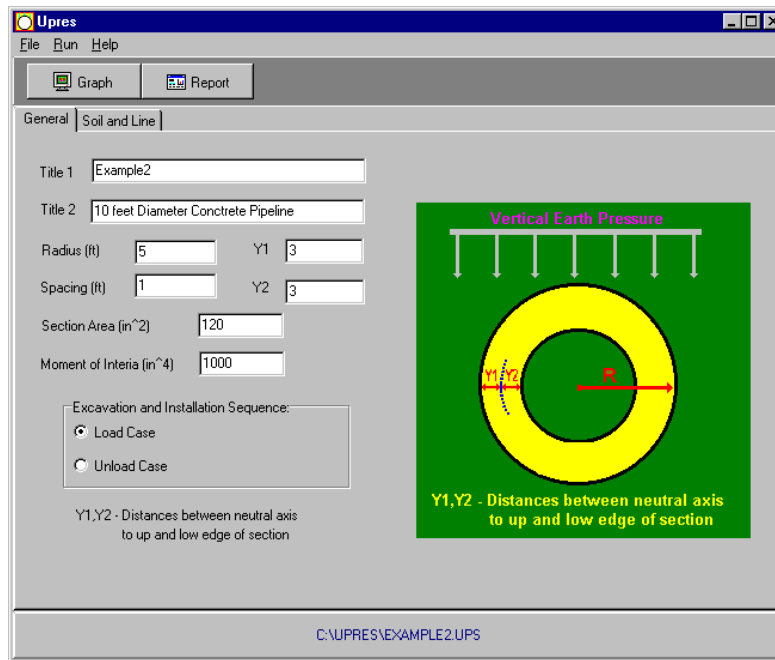


Figure 3-1 Input Page 1

- | | |
|--------------------------|--|
| Title 1 | Title 1: This is the top line where you can put the title or the project name |
| Title 2 | Title 2: This is the second line where you can put the sub-title to make a description or expression. |
| Radius | The radius of tunnel or pipe in feet. |
| Spacing | The spacing of the lining. For concrete tunnel or pipe, unit spacing, one foot can be used. For lagging and I-beam spacing, input the I-beam spacing. Unit is one foot. (See Figure 3-3) |
| Section Area | The section area is inch^2 . For concrete tunnel or pipe, use one foot width. For lagging and I-beam systems, use section area of the I-beam. |
| Moment of inertia | The moment of inertia of the structure. Use one-foot width for concrete tunnel or pipe. Use moment of inertia for I-beam. Unit is inch^4 . |
| Y1 | Y1 (inch) is the distance between neutral axis to outside edge of the section. |



Y2

Y2 (inch) is the distance between neutral axis to inner edge of the section.

Option 1

Excavation and Installation Sequence.

Load case: the tunnel or pipe has been installed before the load of the ground is applied. For example: in an open cut and cover construction, the tunnel has been installed in a deep trench. Then the soils are back-filled and the tunnel is covered by the soils.

Unload case: the soil or rock has been excavated in a circular hole and then the lining is installed. The stress on the hole is zero before the lining is installed.

Input Page 2 (Figure 3-2)

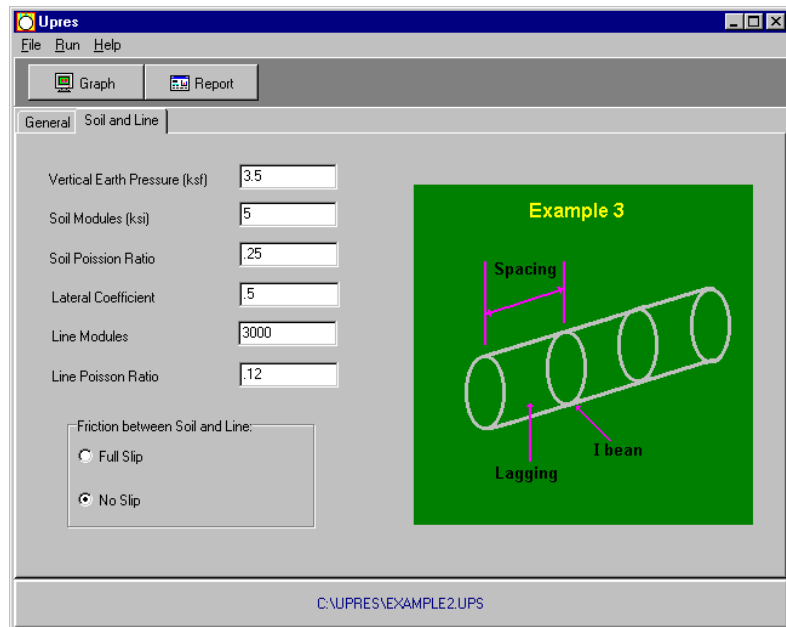


Figure 3-2 Input Page 2

Vertical Pressure

Vertical earth pressure (the overburden pressure) at the center of tunnel. Unit is in KSF.

Soil Modulus

Modulus of the surrounding medium or ground in KSI.

Soil Poisson Ratio

Poisson ratio of the ground.

Lateral Coefficient

Lateral coefficient (K). The ratio of vertical pressure/horizontal pressure ($K=P_v/P_h$). No units.

Liner Modulus

Modulus of the lining. Units in KSI.

Liner Poisson Ratio

Poisson ratio of the lining.

Option 2

Friction between Ground and Lining.

Full-slip situation: it is assumed that the friction or shear is zero between ground and lining.

No-slip situation: it is assumed that full friction between ground and lining is developed.

Data Output

The output shows the following results:

- Theta:** The angle from the spring line, counter-clockwise is 0° at spring line and 90° at crown.
- Thrust:** The axial force in the lining.
- Moment:** The moment in the lining.
- f (OR):** The stress in outside fiber. Positive sign is in compression.
- f (IR):** The stress in inner fiber. Positive sign is in compression.
- DISP.U:** The deflection of lining in radius direction. Positive sign is a deflection towards center of lining.
- DISP.V:** Shear deflection of lining in tangent direction.

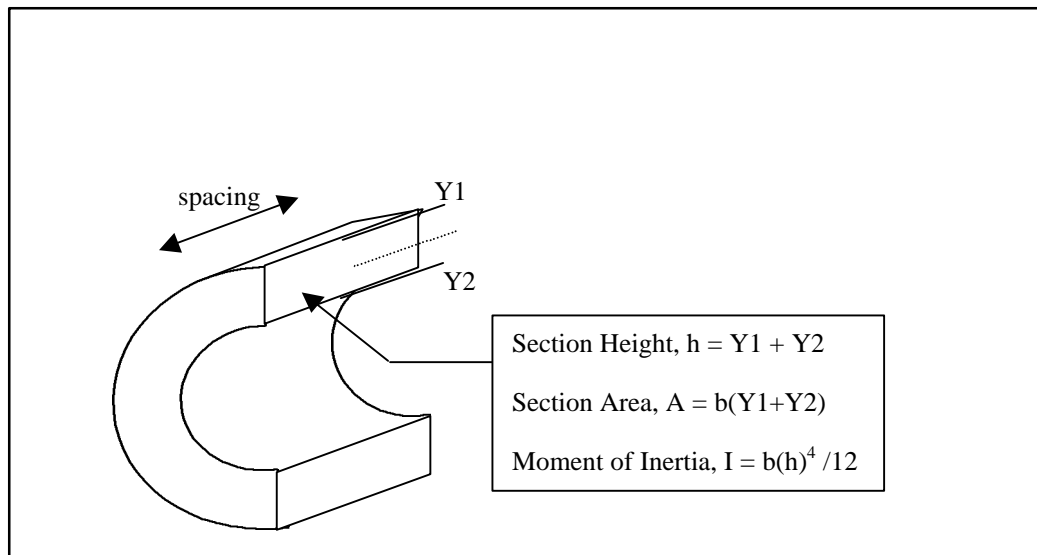


Figure 3-3 Input Definition

CHAPTER 4 CALCULATION METHOD

It is doubtful that the complex interrelationships among the nearly countless variables in any real tunneling problem can ever be rigorously analyzed, even using the most sophisticated numerical techniques. As an alternative approach, the simplified method focuses on the essential elements of very complicated physical phenomena in order to isolate the major factors that have an overriding influence on support loads. These factors are as follows:

1. Relative stiffness of the support and ground mass.
2. Spatial lag or delay of support construction behind tunnel face.
3. Yielding of ground mass as its shear strength is exceeded.

Using these factors, the intent of the program is to provide an analysis in which accentuated computation ease, coupled with sufficient accuracy, makes the simplified method a valuable and effective design tool. The program is based on the following materials:

1. *Improved design of tunnel supports, Volume 1 - Simplified analysis for ground-structure interaction in tunneling, C.W. Schwarts and H.H. Einstein, MIT, Department of Civil Engineering, Cambridge, MA 02139. Sponsored by U.S. Department of Transportation.*
2. *Guidelines for Tunnel Lining Design, Underground Technology Research Council of the ASCE Technical Council on Research, ASCE, 345 East 47th St., New York, NY 10017.*

Most elastic closed form models are based on the assumption that the ground is an infinite, elastic, homogeneous, isotropic medium. The interaction between the ground and a circular elastic, thin walled lining is assumed to occur under plane strain conditions. The models involve either full slip or no slip conditions along the ground-lining interface. Equations have been developed for interface conditions that involve a shear strength between that of full and no slip conditions. The magnitude of the vertical stress is assumed equal to the product of the soil unit weight, γ , and the depth to the longitudinal centerline of the tunnel, H . The increased stress from crown to invert is not considered so that the solutions are appropriate for deep tunnels.

The elastic models can be divided into two categories according to the conditions of in-situ stress that prevail when the lining is installed and loaded. Work by Morgan (1961), Muir Wood (1975), Curtis (1976), Ranken, Ghaboussi, and Hendron (1978), and Einstein and Schwartz (1979) has been based on lining response within a stressed ground mass. This condition is commonly referred to as excavation loading. Work by Burns and Richard (1964), Hoeg (1968), Peck, Hendron, and Mohraz (1972), Dar and Bates (1974), and Mohraz, et al. (1975) has been based on lining response in a ground



mass subjected to an externally applied pressure. This condition is commonly referred to as overpressure loading.

Overpressure loading implies that the lining is installed before external loads are applied. This assumption is suitable for simulating the effects of external blasting and the placement of fill above a previously constructed tunnel. Models developed on the basis of overpressure loading do not simulate the most frequently encountered situation in which lining is constructed in soil or rock subjected to in-situ stresses. In general, models based on overpressure loading result in higher values of thrust and moment compared to those based on excavation loading.

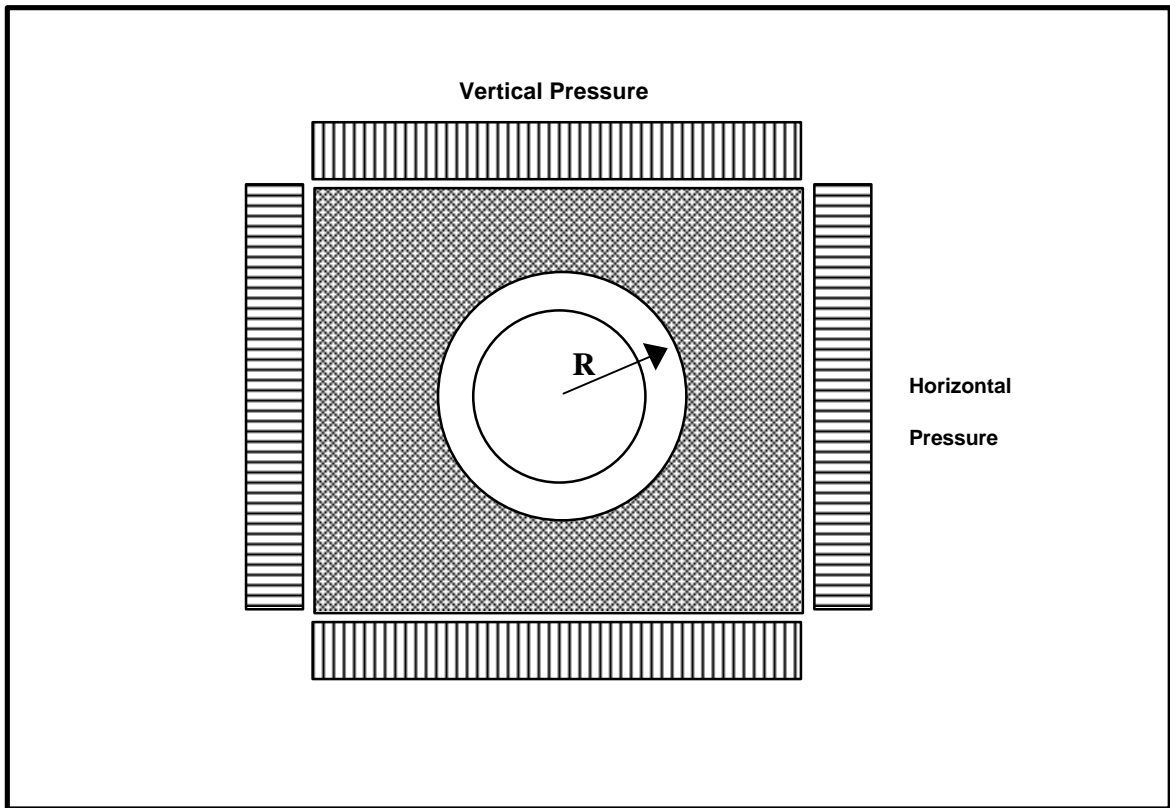


Figure 4-1 Lining in the medium

CHAPTER 5 EXAMPLES

This chapter presents a few examples with different soil and water conditions. These examples are intended to let users know how to use the program.

Example 1

18' diameter tunnel

The tunnel is supported by 8 in. thick shotcrete. The depth of the tunnel is 38 feet. Vertical pressure is estimated in the range of 4 to 4.2 ksf. Unload Condition and No-slip case (there is friction between ground and lining) are assumed for the analysis.

Example 1

5' diameter concrete pipeline

The pipe is buried 10 feet in the ground. The vertical pressure is about 1.2 ksf. The concrete pipe is 6 in. thick. The calculated maximum movement is 0.8 k-ft/ft. The thrust is 2.3 kip/ft at crown and 4.37 kip/ft at spring line.

Example 3

12' diameter tunnel with lagging and I-beam system.

The tunnel is supported by I-beam in 6' spacing. Timber lagging is used between the beams to support the ground. The beam is W14X159 with area of 46 in² and Moment of Inertia of 1900 in⁴.

