

INSTALLING SEWERS AND WATER MAINS: AN EDUCATIONAL CD-ROM

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1. Introduction

The objective of this paper is to describe a CD-ROM based PowerPoint® presentation of the installation of sanitary sewers and water mains. This presentation is used in a senior-level design-oriented class on water distribution and wastewater collection systems required for Civil Engineering students at the University of Tennessee, Knoxville. The paper will discuss the contents and organization of the presentation and give example screen shots.

2. Rationale for a CD-ROM based presentation of the installation of sanitary sewers and water mains

Students learn and understand best when they can visualize the facilities and processes that they are studying. Pictures and diagrams in textbooks help but they are few in number and lack dimensions of depth, time, and color. For a design-oriented class on water distribution and wastewater collection systems, students should have an understanding of and feel for how pipes are actually put into the ground and what materials and appurtenances are used. It would be very beneficial for students to actually visit construction sites, but the time required to do this is a strong barrier. The next best thing is to provide students a rich array of photos and videos that can be used in or out of class and shows all aspects of the installation. The hardware and software are readily available at modest cost for digitizing photos and videos and incorporating them into one of several available presentation software products. Moreover, the videos allow students to understand non-static aspects such as “belling” the pipe, tapping a pipe, and placing aggregate into the trench. An in class presentation of these kinds of details never fails to stimulate a barrage of questions.

3. Description of CD-ROM based presentation

Several local sewer line and water main construction sites were visited with permission by the Knoxville Utilities Board. Pictures and video were taken at these sites and digitized with a slide scanner and a video capture card. The pictures and video were then incorporated into a PowerPoint® slide presentation. The presentation has a total of 92 slides of which 17 are information and navigational slides, 64 are photos, and 11 are videos. The user clicks on arrows and buttons to navigate through the various slides and stages of the installation process.

To show how the presentation works, Figure 1 shows the main menu of the program which

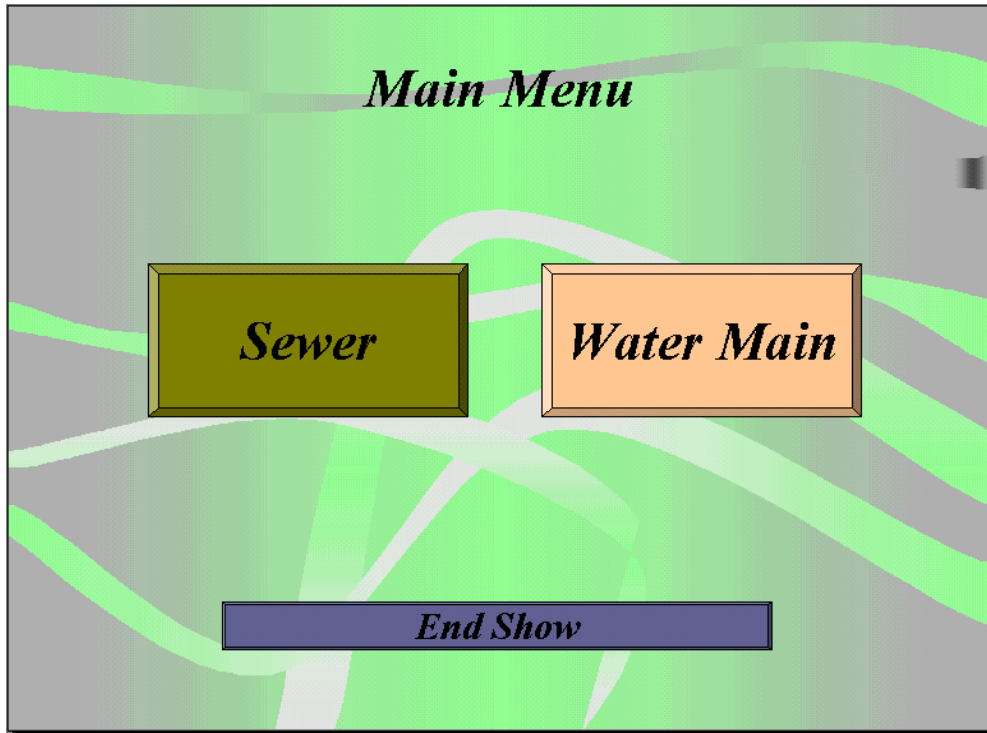


Figure 1. Main menu

occurs after several title and acknowledgment slides. The user then might click on the button labeled “*Sewer*” and see the slide shown in Figure 2 which is the sewer menu. (There is an almost identical water menu.) The sewer menu has several buttons arranged vertically in chronological order of the construction steps, e.g., digging the trench is the first step and is the first button. Several buttons at the bottom show miscellaneous installation aspects. The user could also navigate back to the main menu (home button) or end the show by clicking the appropriate buttons. The user could work sequentially through these menus or navigate randomly through the slides. If for example the user clicked on the “Backfilling” button, then the backfilling menu shown in Figure 3 appears. By clicking the corresponding button, the user can choose to look at a series of pictures as shown in Figure 4 or a video. Figure 4 shows the first slide for backfilling which is a photo of a trench box along with textual narration on backfilling with aggregate. By clicking on the right arrow, the user goes through a series of slides on backfilling. All of the video slides are similar to the one shown in Figure 5, which in this case is a slide from the “making joints” menu. Clicking on the initial picture starts and stops the video which has audio too. The total time required to go through all the photos, video, and text is roughly one hour which makes it well suited for use in a class lecture. A complete list of all the slides and videos is given below:

I. Sewer

- (a) Digging a trench
 1. Track hoe digging the trench
 2. Digging a trench (*video*)

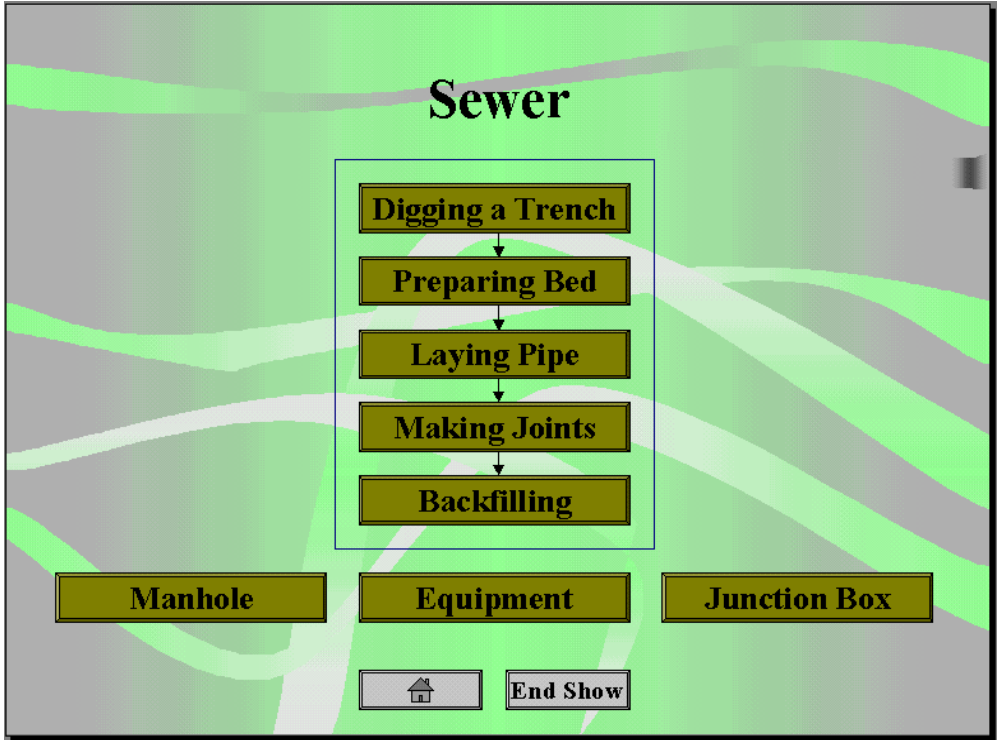


Figure 2. Sewer menu

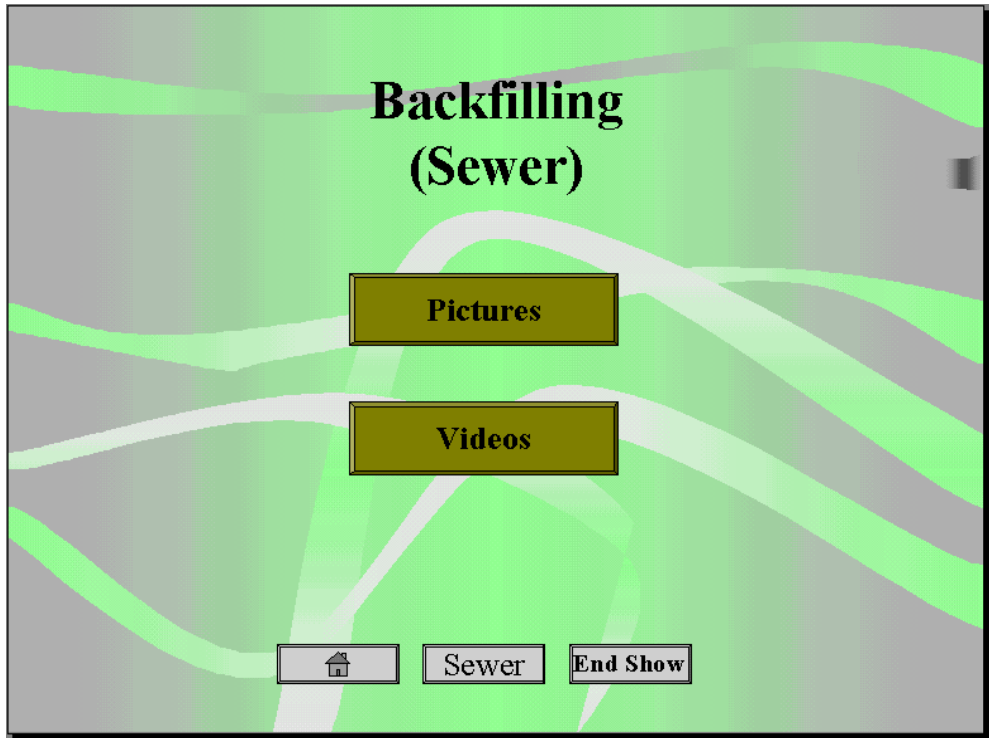


Figure 3. Backfilling menu

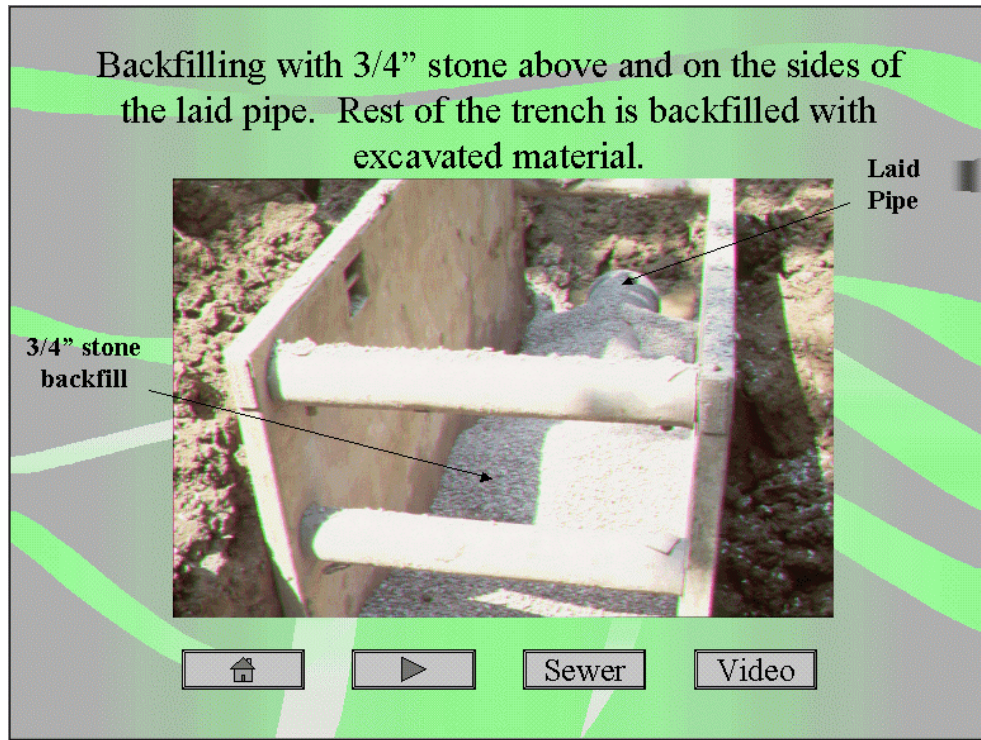


Figure 4. Backfilling using a trench box



Figure 5. Video of making sewer pipe joints

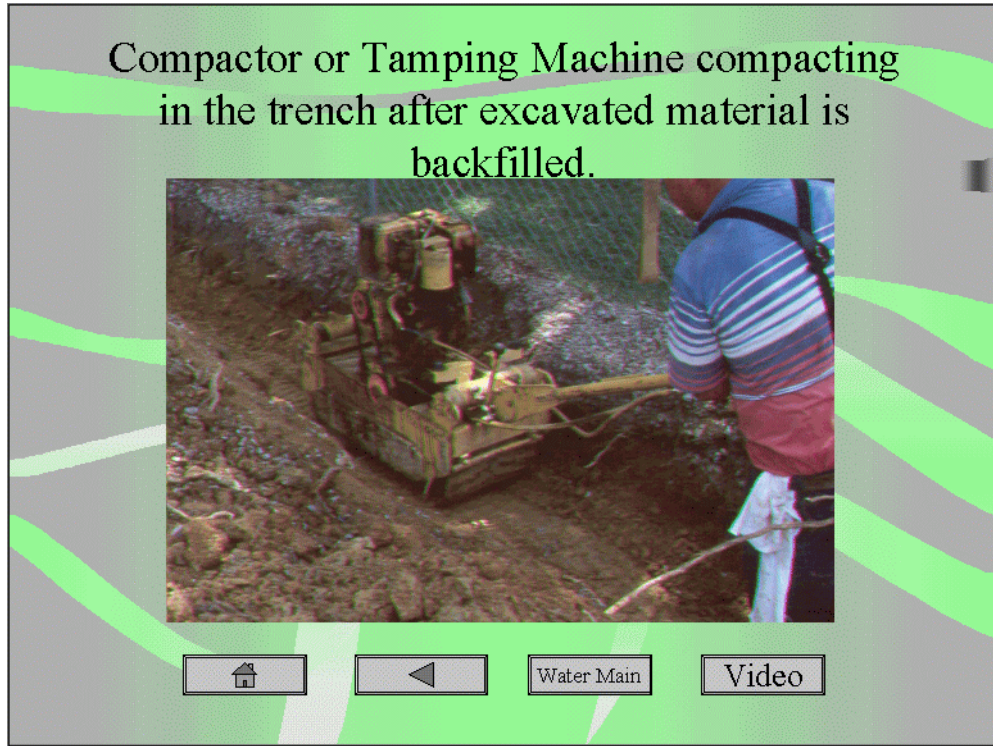


Figure 6. Compacting backfill in water main installation

- (b) Preparing bed
 1. Preparing bedding for the pipe
 2. Bedding for the pipe - view 1
 3. Bedding for the pipe - view 2
 4. Bedding for the pipe (*video*)
- (c) Laying pipe
 1. 24" Ductile iron pipe ready for lowering in the trench
 2. Lowering 24" ductile iron pipe in the trench - view 1
 3. Lowering 24" ductile iron pipe in the trench - view 2
 4. Lowering (laying) 24" ductile iron pipe in the trench (*video*)
- (d) Making joints
 1. Bell end of the pipe
 2. Bell end of the pipe (Also shown is the lubricant that makes the smooth slip joint)
 3. Slip joint 24" ductile iron pipe
 4. Making joints (*video*)
- (e) Backfilling
 1. Backfilling with 3/4" stone above and on the sides of the laid pipe
 2. Backfilling with 3/4" stone above and on the sides of the laid pipe
 3. Backfilling (*video*)
- (f) Manhole
 1. Existing brick manhole
 2. Inside of existing brick manhole
 3. Precast concrete manhole

4. The bottom portion of precast concrete manhole which sits on the top of existing pipe
 5. Laser equipment inside manhole (*video*)
- (g) Equipment
1. Trench box - view 1
 2. Trench box - view 2
 3. Track hoes
 4. Track hoe's bucket
- (h) Junction box
1. Reinforced cement concrete junction box for 48" sewer line - view 1
 2. Reinforced cement concrete junction box for 48" sewer line - view 2
 3. Installing invert in the junction box
 4. Junction box with invert

II. Water main

- (a) Digging a trench
1. Back hoe digging a trench
 2. Back hoe digging a trench for 8" ductile iron water main
 3. Digging a trench (*video*)
- (b) Preparing the pipe
1. Tapping machine
 2. Tapping machine making hole
 3. Hole made for the tap by the tapping machine
 4. Service tap
 5. Service tap mounted on 8" ductile iron pipe
 6. Preparing the pipe (*video*)
- (c) Laying pipe
1. Picture showing the bottom of the trench where the pipe will be installed
 2. Lowering pipe in the trench - view 1
 3. Lowering pipe in the trench - view 2
 4. Laying the pipe (*video*)
- (d) Making joints
1. Picture showing the bell end of the pipe
 2. Applying lubricant to make a smooth slip joint
 3. Picture shows the joined pipe in trench
 4. Making joint or "belling the pipe" (*video*)
- (e) Backfilling
1. Backfilling trench with the excavated material
 2. Backfilling trench with the excavated material (continued)
 3. Compactor or tamping machine compacting in the trench
 4. Backfilling (*video*)
- (f) Existing obstructions
1. 48" Water main under electric conduit and 12" water main
 2. 48" Water main going under electric conduit - view 1
 3. 48" Water main going under electric conduit - view 2
 4. Picture showing the multiple obstructions while installing new water line

(g) Equipment

1. Back hoe
2. Back hoe front end bucket
3. Front end loader with 8" ductile iron pipe
4. Compactor or tamping machine
5. Picture showing the hoe ram
6. Sheep foot roller compacting 30" ditch line
7. Sterilizing 30" and 48" water main with chlorine gas

(h) Bends, tees, reducers, etc.

1. 48" water main, 48"-45° bend
2. 48" X 30" tie-in
3. Picture showing tee and bend
4. 48" Tee, 48"X30" reducer, 30" valve,
5. 30"X45° Downward bend
6. Vertical bend
7. 12" Spacer on 12" ductile iron water line inside 24" casing for line under railroad
8. Picture showing the concrete kicker behind 48"X24" tee
9. Picture showing the concrete kicker behind 48"-45° bend
10. 48" Ductile iron water line with 48" butterfly valve
11. Picture showing tee and valve
12. Temporary 48" plug in line

4. Student response

The instructors have used the PowerPoint® presentation in class and the students have received it very well. Students tend to enjoy these kinds of computer based visual learning tools.

5. Problems and Planned Improvements

When this project was undertaken, the power of computers was more limited and precluded larger video. The standard choice at the time was 1/4 screen video. As resources allow, the authors would like to increase the size of the video.

6. Availability

This PowerPoint® presentation can be obtained at nominal cost by writing to Dr. R. Bruce Robinson, 73 Perkins Hall, The University of Tennessee, Knoxville, TN 37996 or e-mail at rbr@utk.edu.

7. Acknowledgments

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