Version 1.4.1

STRUCTURAL HEALTH MONITORING

Step By Step Software Guide

PARALLEL SEISMIC

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1.0 STEP-BY-STEP GUIDE TO SHM SOFTWARE INSTALLATION

The Windows SHM software is a real-time data acquisition program designed for use in collecting data for Parallel Seismic (PS), Ultra Seismic (US), and Vibration Monitoring tests. This quick guide covers step-by-step data acquisition, data analysis and output generation to IXFoundation®.

The following five (5) steps are necessary to install the SHM software:

1. Run "Setup.exe" from the install CD
2. Type any numbers for Serial Number – it is not assigned.
3. Follow the default setup
4. After finishing the installation, the "SHM.exe" file will be put on your harddrive c:\program files\olson instruments\SHM. A shortcut will also be created on your desktop.
5. Copy "SHMdefault.prm" file from the CD to the root directory in the Freedom Data PC hard drive and/or your personal computer

Once the SHM software has been installed, the testing can begin. For the purposes of this manual only the parameters appropriate for PS and US testing will be discussed. Also, the only exporting function that will be discussed is exporting the data to IXFoundation® because this is the program used to analyze these types of data.

2.0 DATA ACQUISITION

2.0 DATA ACQUISITION

1. To run the SHM software, simply execute "SHM.exe". The software will be loaded with the default parameters from "shmdefault.prm" and the following screen will appear.

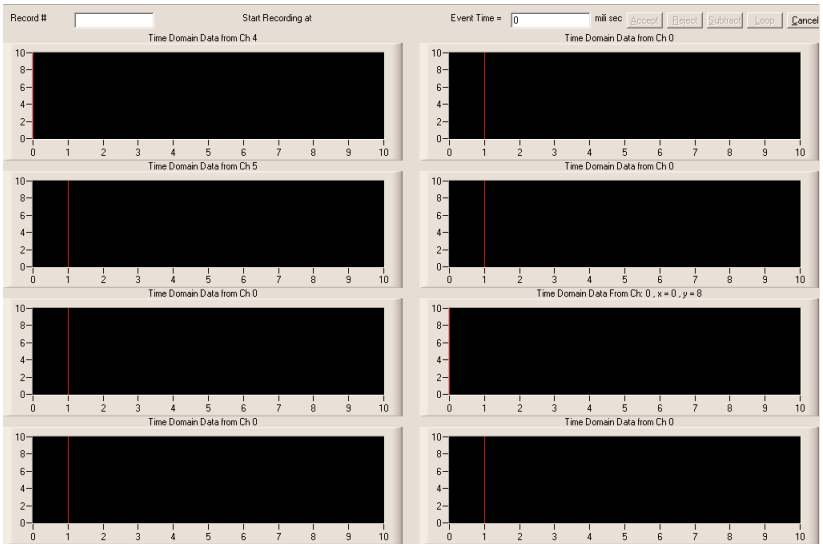

Figure 1: SHM Start-up Screen

2. Next the data parameters must be set. To do this, go to "Acquisition/Parameter Setup". A dialog box as shown in Figure 1 should appear on the screen. It should be noted that these are common values used by Olson Engineering. However, each test location may require different parameters. For more information, please consult Olson Engineering technical support.

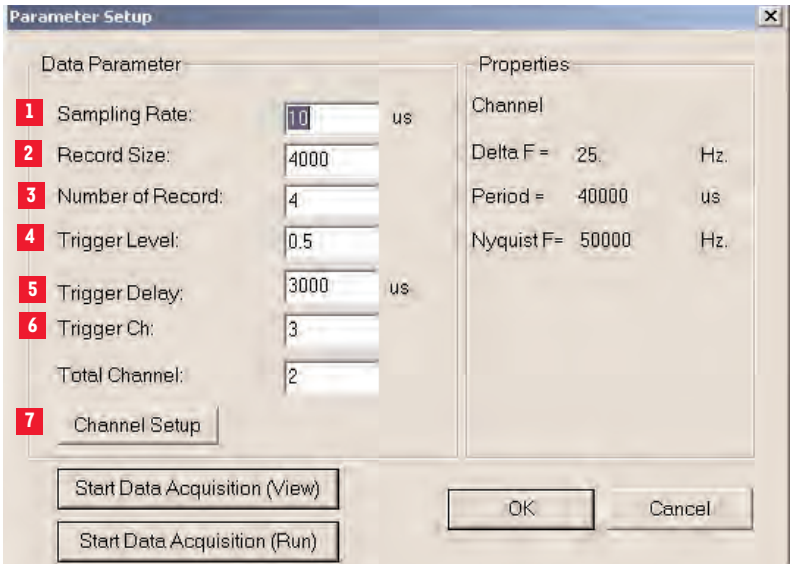

Figure 2: Parameter Input Screen

2.0 DATA ACQUISITION

There are 7 parameters effecting the SHM data acquisition (refer to figure 2 on previus page):

1. Sampling Rate: means how often (in time domain) the system will acquire data. In this case, the default was set at 10 microseconds.This means the system will acquire data at 10 microsecond intervals.
2. Record Size: is number of sampling points for each waveform. The higher this value, the more data acquired in each waveform (also dependent on Sampling Rate).
3. Number of Record: is a total number of data records you want to save for averaging
4. Trigger Level: is the minimum signal amplitude to trigger data acquisition
5. Trigger Delay: is amount of time before the triggering point that data collection starts
6. Trigger Ch: is the channel that the data acquisition triggers on
7. Channel Setup: is the place to turn on the channels used in data acquisition. A dialog box similar to Figure 3 should appear on your screen (supporting up to 16 channels) for channel setup. The chan nels that are planned for use in data acquisition need to be checked. Their transducers, components, calibration and unit need to be set correctly. Once the parameter setup is complete, data parameters should be saved by going to "Acquisition/Save Data Parameter" to ensure that these parameters can be loaded with the SHM program.

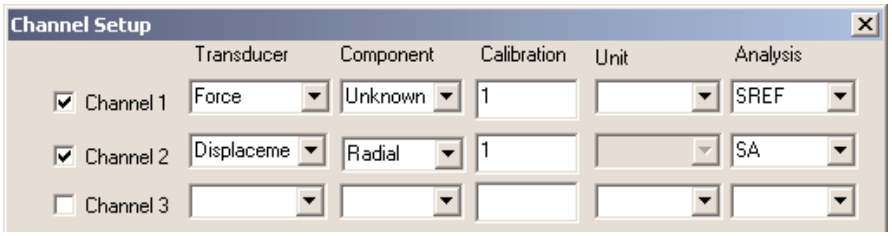

Figure 3: Channel Setup Dialog Box with Appropriate Inputs for Parallel Seismic Testing

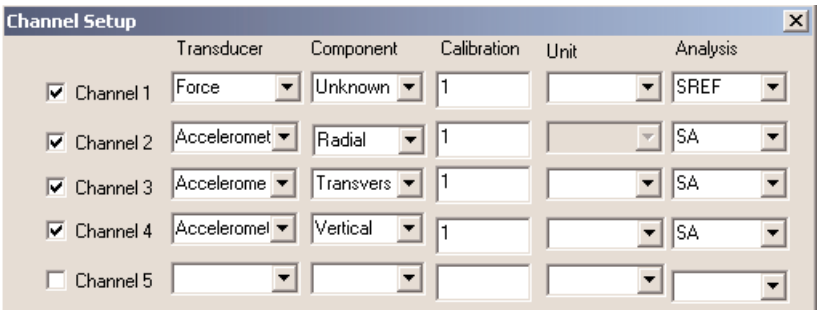

Figure 4: Channel Setup Dialog box with Appropriate Inputs for Ultra Seismic Testing

It should be noted that the units and calibration for each of the test methods may be slightly different. Figures 4 and 5 are only meant to serve as examples. All parameters in channel setup should be set after consulting Olson Engineering.

2.0 DATA ACQUISITION

3. Once the parameters and channels are set to the appropriate values, the filenames must be established for the testing. This is done by clicking on FILE/ FILENAME SETUP, see Figure 5. After selecting "Setup Filename" from the "File" menu, the following input screen will appear.

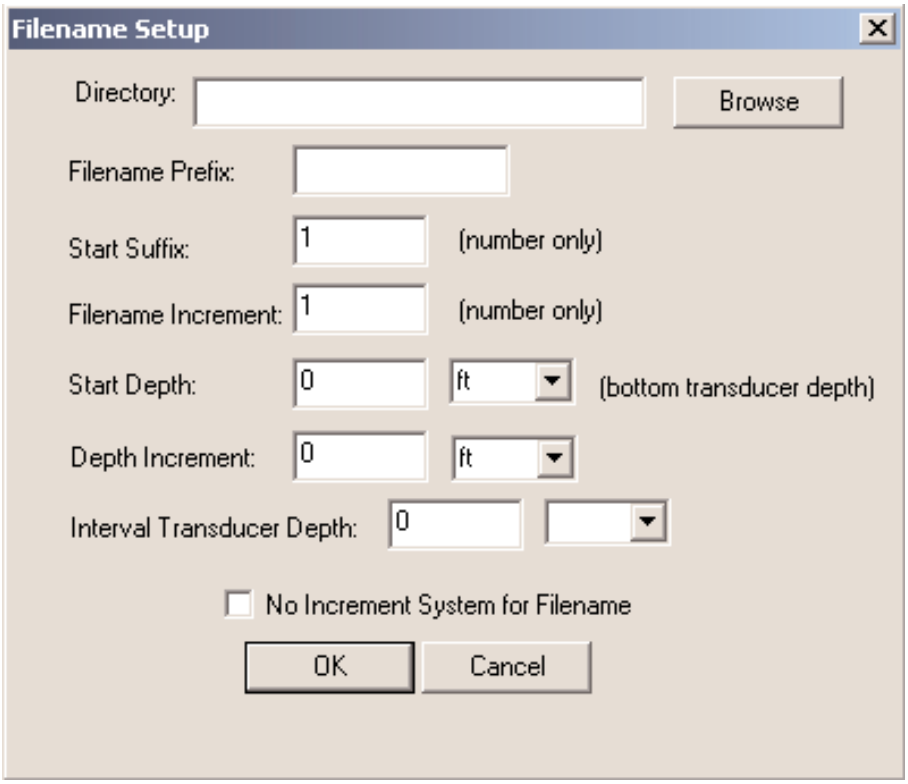

Figure 5: Filename Setup Parameters

Directory: indicates the designated file where the data will be saved. This will be set by either typing in the directory name or using the browse button. If the user decides to use the browse button, then the directory must be made prior to setting the filename.

Filename Prefix: will be used throughout the data acquisition until a new filename setup is set. It is important to note that the Filename prefix cannot contain spaces and must be short (no more than four characters in length).

Start Suffix: and Filename Increment: describe the first suffix number used with the first test and the increment used for increasing the suffix. For instance, if the first test was saved in a filename "Test1" then the second test will be saved in a filename "Test2" for these given parameters.

Start Depth: and Depth Increment: describe the initial depth and the increment at which the depth will be increased or decreased. If the depth of the transducer is set correctly in "Start Depth" and "Depth Increment", depths will be assigned automatically to each test. If the transducer will be moving from top to bottom, use a negative depth increment. If the transducer will be moving from bottom to top, use a positive depth increment.

4. To properly set up the equipment please refer to the "Hardware Step-by-Step Setup Guides" for each individual test method.

   NOTE: If performing Parallel Seismic and the hardware is properly set up, the hydrophone needs to be inserted into a water-filled borehole to the desired depth. If performing Ultra Seismic, the tri-axial accelerometer must be mounted to the structural member using the coupling grease. Remember to properly orient your accelerometer according to your channel setup for x, y, and z.

5. Once the equipment is ready to perform the test, the user may simply press F2 to start data acquisition. At this time the gain must be set for acquisition. Please refer to **Section 3.0** for further details on this procedure.

6. The program is now ready to acquire data. Using the 3lb instrumented hammer strike the structural member. This signal will be received by the hydrophone or the tri-axial accelerometer.

7. After starting the data acquisition, the software will wait for the trigger signal. If the signal level on the user-selected trigger channel is above the trigger level (or more negative, if a negative trigger value is selected), the software will show all the acquired data on the screen. In this step, the user should click on Accept or Reject to accept and reject the signal (for "View Mode"), see Figure 6. The data acquisition will stop when it acquired complete records (as set in "Number of Records").

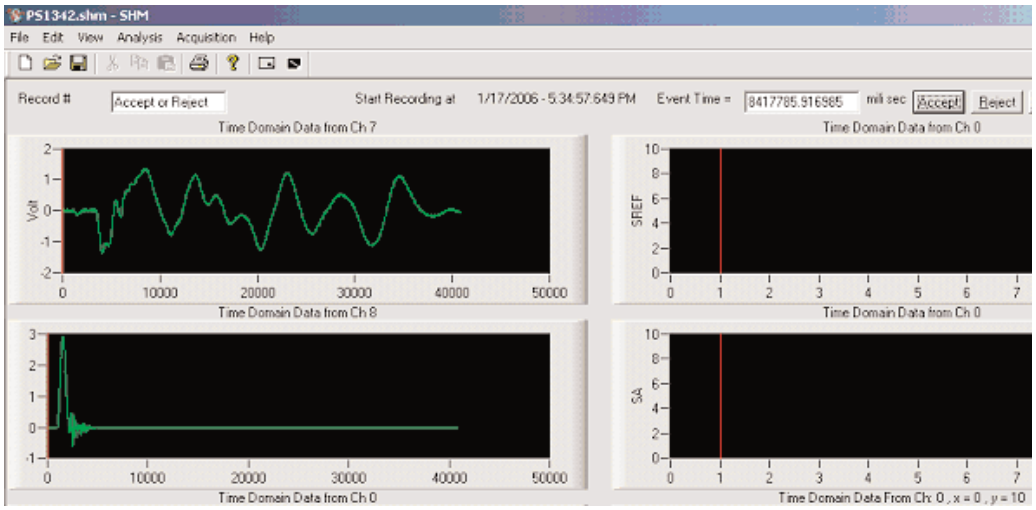

Figure 6: Accept or Reject Data

8. After the data acquisition is complete, continue another acquisition by pressing **F2** and the filename and its depth will be set accordingly. Be sure to move the hydrophone to the appropriate depth if performing PS testing before pressing **F2**. If you are performing US testing, move and mount the accelerometer before pressing **F2**.

3.0 GAIN CONTROL

3.0 Gain Control

Once the program starts data acquisition, the program uses automatic digital gain. The program will decide from the current acquired data if the gain needs to be increased or decreased for each channel. However, manual gain can be set if desired by going to "Acquisition/Manual Gain". Then the gain from each channel can be set manually, see Figure 7. Once the gain is set manually, the automatic gaining feature will no longer apply.

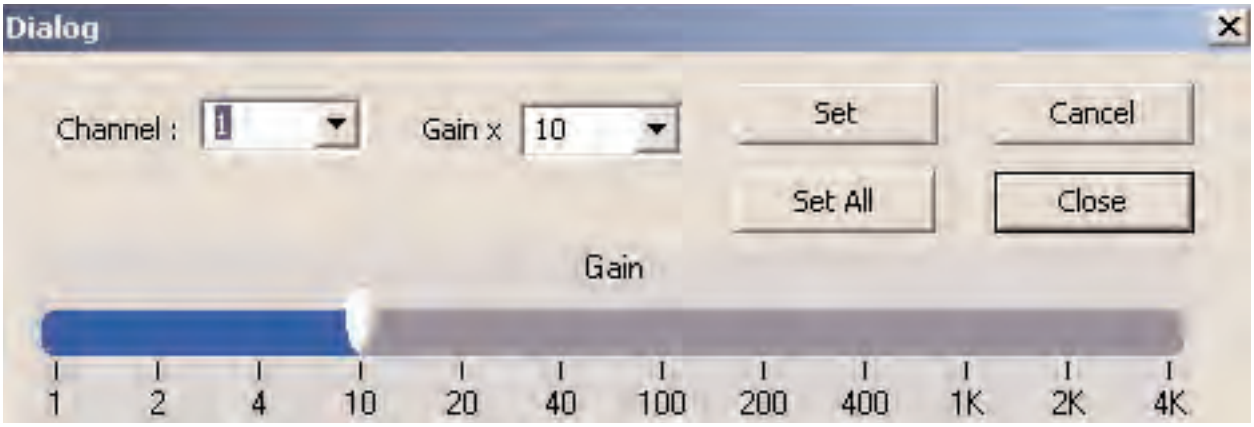

Figure 7: Setting the Gain

It should be noted that setting the gain too high will lead to clipping of the data. This will distort the results. For PS testing, remember that the gain must remain constant for all tests. Therefore, if the testing begins at the bottom of the borehole it is imperative that the gain not be set too high for those results that will be received from shallow depths.

4.0 Filter Function

If filtering is required for the SHM data, go to "Analysis/Filter" to set the desired filter parameter. The dialog box in Figure 8 should appear on your screen. There are four options for digital filtering; Butterworth, Chevbyshev, Elliptic and Inverse Chevbyshev. Digital filtering will be applied to all the data. To disable filtering, simply leave all the filter options unclicked. This filter may help eliminating unwanted low/high frequency noise. Note that filtering is applied only to the displayed data. The saved raw data has no filtering.

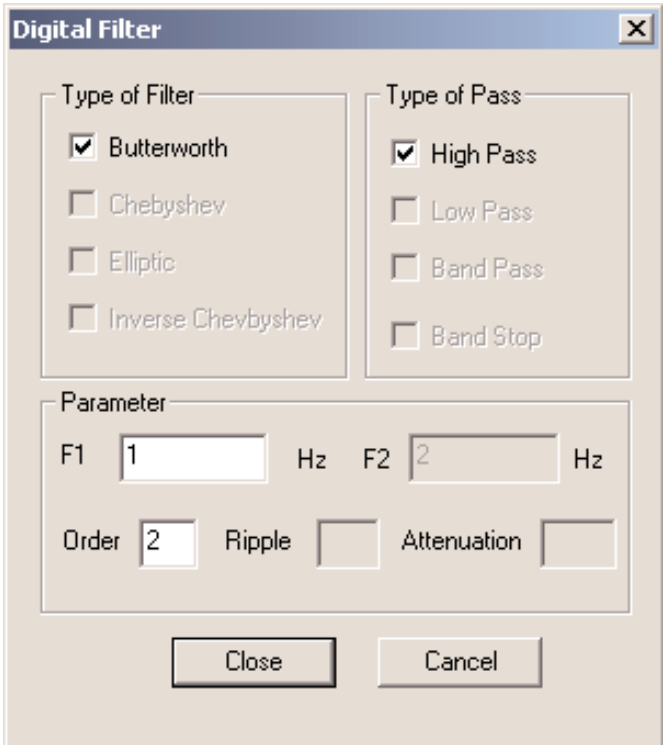

Figure 8: Digital Filtering

5.0 DATA EXPORTING

There are three options of exporting data. First is to export to IXFoundation®, second to the WinTFS® program and last to the ASCII file. The primary analysis of the PS and US tests will be performed in the IXFoundation Software that comes with the package.

To export data to IXFoundation® from SHM, go to "File/Export Data to Brigix/Automatic", see Figure 9. Then the dialog box as shown in Figure 14 should appear on your screen.

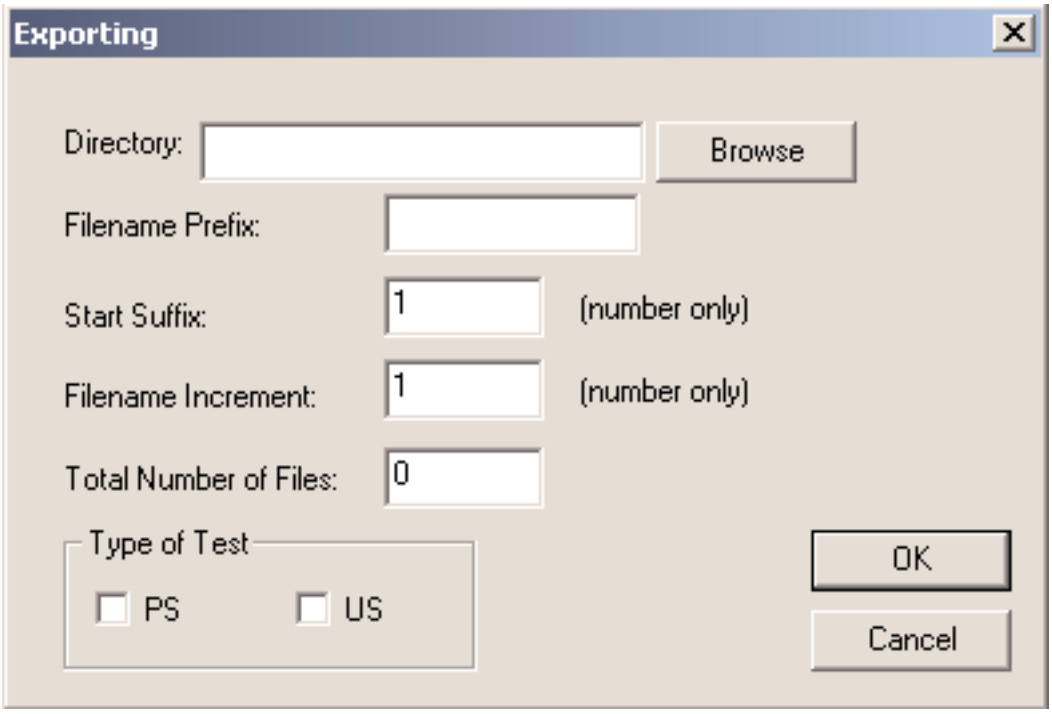

Figure 9: Exporting Information

The directory that contains the data from SHM must be selected. Use the Browse button to select the correct directory. Enter the prefix, start suffix, increment and total number of files (or tests). The following dialog box as shown in Figure 10 should appear on your screen. Then enter the output filename. Click OK to continue on to selecting the channels (as shown in Figure 11). In this dialog box, all the channels that were used in the data acquisition are activated. The user can turn on/off the channel if data from the channel is unwanted.

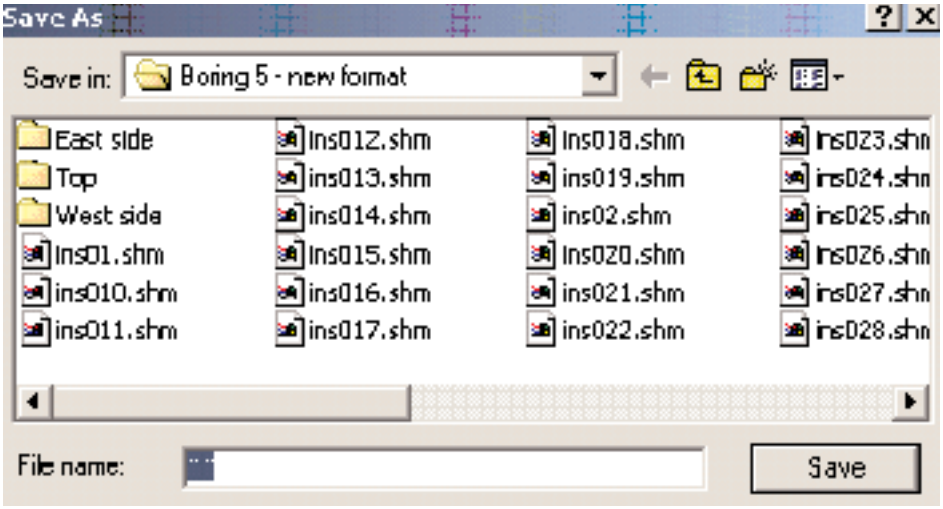

Figure 10: Saving Exported Data

Figure 11: Selecting Channels to Export

The data has now been exported from SHM format into a format compatible with IXFoundation®. The following steps will involve analyzing the PS and US data in this program

6.0 USING IXFOUNDATION®

1. To begin using IXFoundation®, simply click on the icon that appears on the desktop. See Figure 12, for icon image.

Figure 12: IXFoundation Icon

2. After the IXFoundation® software has opened, the user must import Olson Instruments Data. This is done by selecting File/ Import Olson Instruments Data.
3. Now the user must select the appropriate file for import. This file will be the same file that you created when exporting the data from SHM.
4. The program will now prompt the user to select the stacking parameters, refer to Figure 13. For PS and US data, the brute stack is usually chosen.

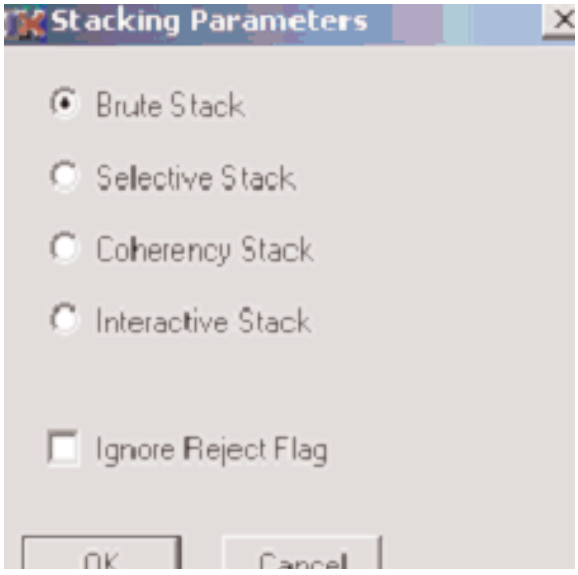

Figure 13: Stacking Parameters

5. The data will then be displayed on the screen. It may look different than Figure 14, if a stacking parameter other than brute stack was chosen.

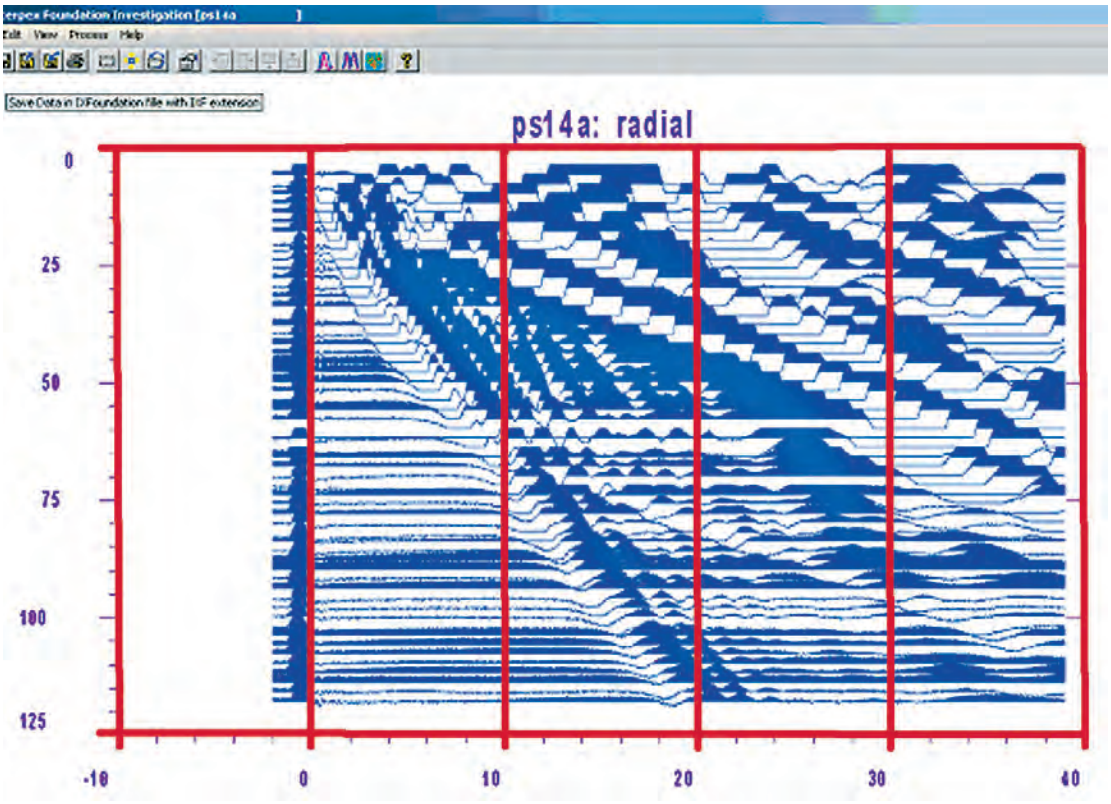

Figure 14: Display of Imported Data

6. Now that the imported data has been displayed, processing can begin. If the data quality is extremely good, this step may not be necessary. To begin processing, we first analyze the trace properties. This is done by selecting "View/ Trace Properties".

After selecting TRACE PROPERTIES, the Trace Plotting Parameter Dialog will appear, see Figure 15 on the next page.

6.0 USING IXFoundation®

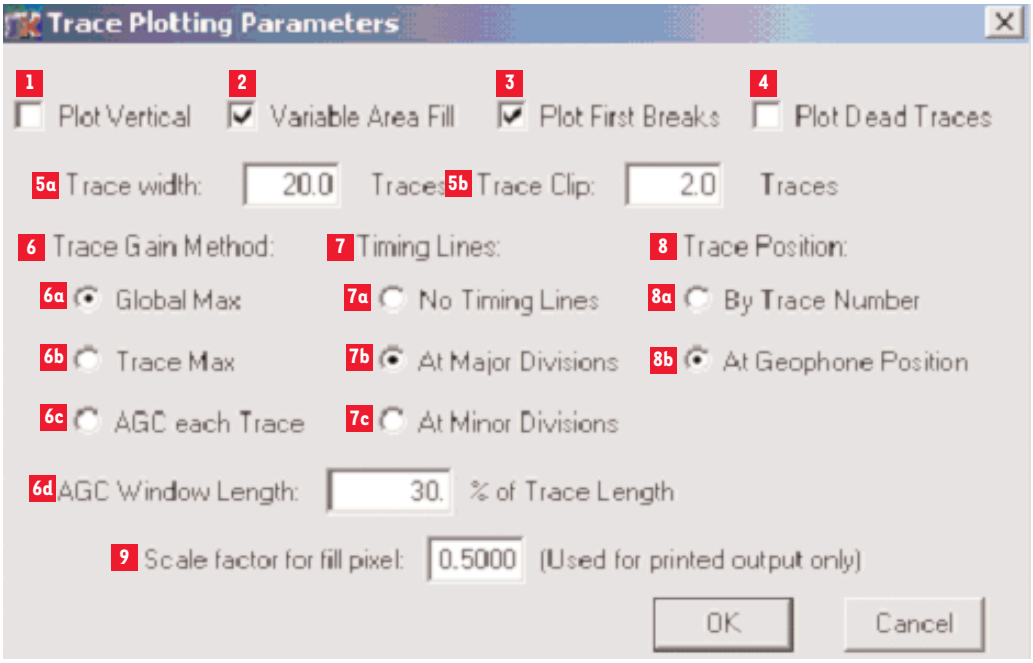

Figure 15: Trace Plotting Parameters

There are nine (9) main parameter fields available in the "Trace Plotting Parameters" dialog box. Each of these is discussed below:

1. "Plot Vertical" should not be selected for bridge foundation data because of the match between the structure and the trace displays.
2. "Variable Area Fill" fills the positive areas of the trazces if selected.
3. "Plot First Breaks" are plotted if they exist and are selected.
4. "Dead Traces" are plotted in a different color if Plot Dead Traces is selected.
5. "Trace Width"(5a) and "Clip"(5b) both default to 2.0 trace widths. Selecting width of 1.0 means there will be no overlap between any traces. Selecting width more than 1 but selecting clip of 1.0 means that traces will be amplified to overlap but none of the overlapping sections will be displayed.
6. Trace Gain Methods are:
   (6a) "Global Max" (max value of all traces combined),
   (6b) "Trace Max" (max of trace being plotted) or
   (6c) "AGC" for each trace.
   (6d) "AGC" window is specified as a percentage of trace length.

7. Timing lines can be plotted at major divisions, major and minor divisions, or not at all.
8. Trace position can be by trace number or at receiver depth.
9. Scale factor for fill pixel is designed mostly for making printed displays look good. The value to use will be dependent on your printer. This number cannot be greater than 1. If the variable area fill on your printer has gaps in it, reduce this value.

7. Once the Trace Properties are set to the user's preferences, the data can then be filtered. This is done by selecting "Process" and then one of the filtering options. This option allows the user to filter either by frequency alone or frequency and wave number. For more information concerning the details of Bandpass and FK filtering refer to the Wave Theory and Processing document.

8. The last step involves interpreting the data, to find the bottom of the structural element. In good quality data, there is a clean break in first arrivals, indicating the bottom of the element. When this change of slope or change in move-out velocity is identified, then the velocities can be fit to the data. This is done by right clicking with the mouse at the top left corner of the slope and bringing the mouse down the screen so that the line rests on the first arrival. Then the user should release the mouse button and select the appropriate name for the velocity. It should be noted at this time that the foundation velocity (the upper portion of the data) must be designated as the soil data and that the soil velocity (the lower portion of the data) must be designated as the foundation velocity. This is due to a glitch in the program that has not currently been fixed by its manufacturer. Please see Figures 16 and 17 for interpreted examples.

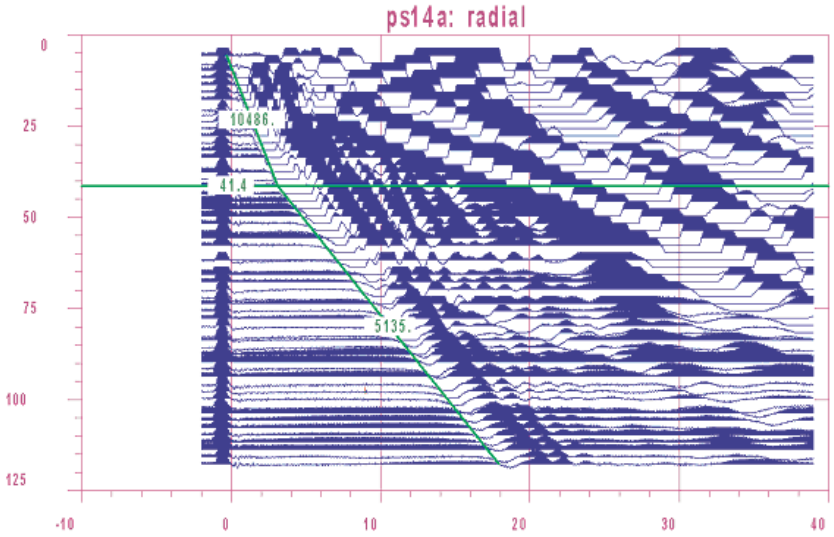

Figure 16: PS Interpreted Example

6.0 USING IXFoundation®

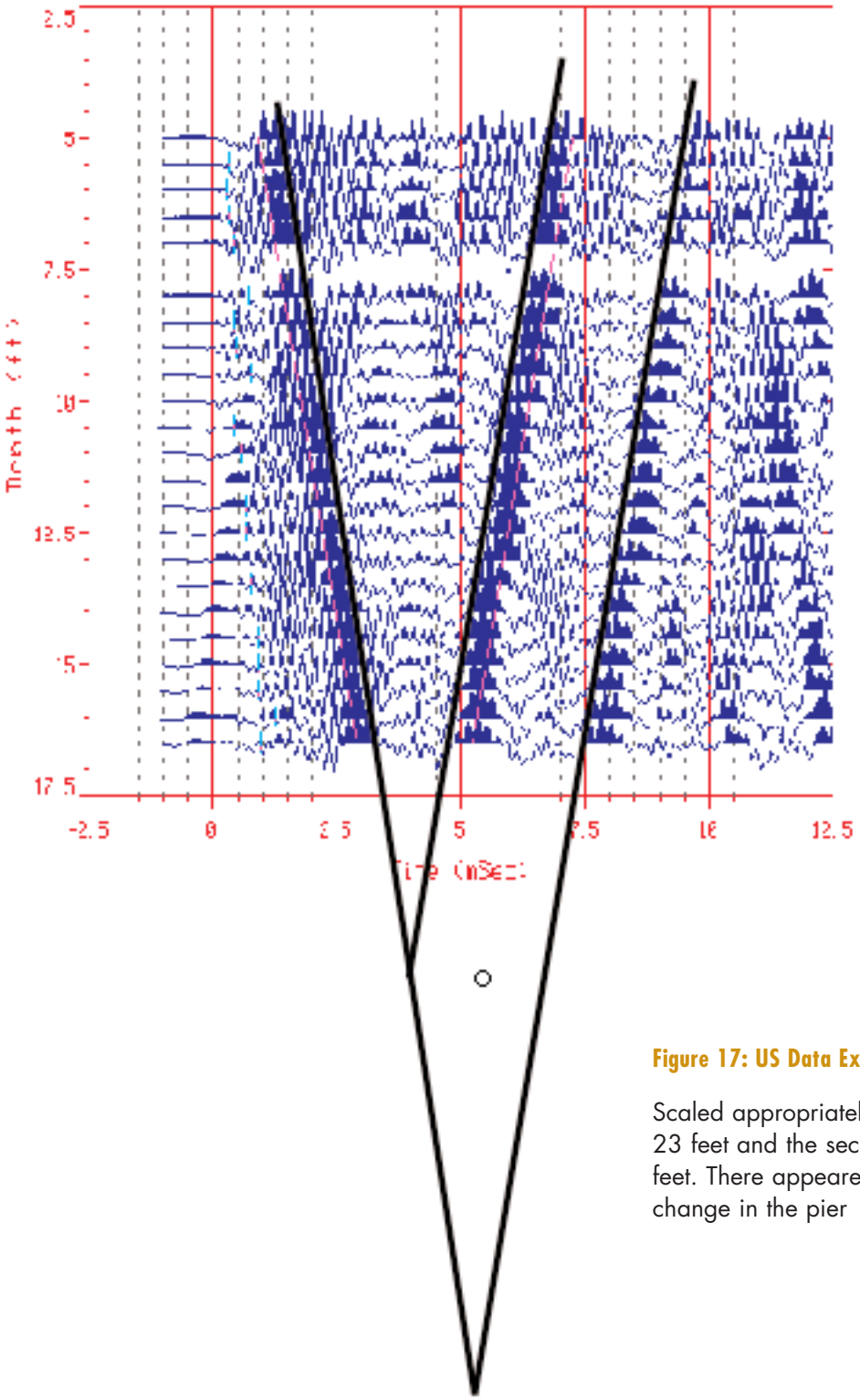

Figure 17: US Data Example

Scaled appropriately, the first echo is at 23 feet and the second echo is at 30.5 feet. There appeared to be a material change in the pier

NOTES

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