Virtual Safety Training

Scott Fuller and Jason Davis
Auburn University
Auburn, Alabama

Safety training has developed in a variety of mediums and delivery vehicles. Workers now can train via video, digital video, CDROM, and even online. Our ability to package this information in useful, effective, and even entertaining delivery systems has increased the effectiveness of safety training (Overheul, 2001). The Multimedia Tool Box Talk is a web-based quick reference safety guide and training tool. The goal was to develop a web-based media guide where contractors across the nation can find free, clear, and concise information on various safety issues/topics. In addition, the intended outcome of this effort was to provide an efficient and effective way to locate and interpret crucial safety information while at the jobsite. This is accomplished through the use of things such as OSHA standard information, real life construction pictures, video clips, and frequently asked contractor questions. It can be a great resource to assist in safety planning, education and training for construction personnel.

Key Words: Construction Safety Training, Virtual Training, Multimedia Tool Box Talk, Web-based training.

Introduction

This paper will demonstrate that safety education does not have to be costly or time consuming. For this project, educational technology helped make a difference in a positive way. A web-based quick reference safety guide was developed. The purpose of this reference guide is not to reconstruct what OSHA has already established, instead provide an efficient way to locate and interpret crucial safety information. The goal was to develop a web-based media guide where contractors across the nation can have a free, clear, and concise reference guide on various safety issues.

Every year, 100 to 400 people are killed in the United States by trench cave-ins and 1,000 to 4,000 are injured. Construction job site incidents exceed that number by more than double. On average, workers that are killed by cave-ins are male, 20 to 30 years of age and have had no training. Most deaths occur in trenches that are 5 to 15 feet in depth. Deaths are usually attributed to suffocating, crushing, losing circulation or in some cases, being struck by falling objects (Underground Construction, 2000). Even so, there is something about construction that attracts, fascinates, and excites just about everyone. It is hard to walk past a construction site and not turn and look at what is going on. Some people come back the next day to watch. Others build careers out of this seemingly natural interest (Heulke, 2001).

Some of this attraction for construction might indeed be natural. Think about the similarities between our human construction activities and those of other social and communal mammals and insects. What might initially appear to be chaotic comings and goings of prairie dogs, birds, bees,

and ants turns out to be the necessary ingredients for constructing elaborate systems of travel, storage, breeding, living, and sleeping spaces. Whether driven by innate biological impulses to produce honey or a 100-story skyscraper, the process is the same: a series of individual tasks add up to infrastructure, shelter, and the satisfaction of need (Heulke, 2001).

The construction industry requires steady nerve, good coordination and the ability to perform under difficult, often hazardous, circumstances, but construction work does not have to be hazardous (Construction Safety Talks for Supervisors, 1976). However, the risk of work-related injuries and fatalities for construction workers is greater than for any other U.S. industry (Wichita Business Journal, 2001).

Unfortunately, construction safety is often overlooked or sacrificed due to time or money restraints. Yes, safety costs money, but what is the alternative cost if safety is neglected? Construction safety deals with actions that managers at all levels can take to create an organizational setting in which workers will be trained and motivated to perform safe, productive construction work (Levitt, R., & Samelson, N., 1987).

The Portable Multimedia Tool Box Talk web page will be linked to http://cadc.frontpage.auburn.edu/content/ToolboxTalk/ for quick and easy access. A complete safety index relating to various safety hazards as outlined by OSHA was created. In this project, each subject within the index is called a "module". The following modules were fully developed:

1. Hand Tools
2. Electrical Shock Prevention
3. Fall Protection (Barriers)
4. Trenching/Excavation
5. Scaffolding
6. Ladders
7. Mobile Crane
8. Crane Signaling
9. Personal Safety Equipment

The content of this website was organized so the viewer can maximize his/her learning experience. The following are the steps one should take in viewing each module:

Step 1: A **Picture Library** has been created without any feedback for the user. The goal is to have the viewer look at the pictures and identify potential problems or to identify the correct method of installation.

Step 2: A **FAQ & Terms** page has been developed for the viewer to read and understand the questions and answers as it relates to OSHA's Federal Code of Regulations.

Step 3: A **Slideshow** presentation has been created for the viewer to see some of the common errors that occur on the jobsite. The presentation is an extension of the **Picture Library**; the main difference is feedback has been provided.

Literature Review

On December 29, 1970, President Richard M. Nixon signed the Occupational Safety and Health Act of 1970, also known as the Williams-Steiger Act in honor of the two men who pressed so hard for its passage. OSHA published its first consensus standards on May 29, 1971. Some of those standards, including permissible exposure limits for more than 400 toxic substances, remain in effect today. Others have been updated or expanded through public rulemaking, dropped as unnecessary or overly specific, or amended to clarify their intent. OSHA offers financially and risk free onsite consultation to help employers identify and correct workplace hazards (http://www.osha.gov/as/opa/osha-at-30.html).

In the 1980s, OSHA changed gears and started to prioritize and focus on minimizing regulatory burdens. OSHA's goal was to provide a balanced mix of enforcement, education and training, standard-setting, and consultation activities. Major new health standards introduced during the 80's included requirements to provide employees access to medical and exposure records maintained by their employers; hazard communication; and more stringent requirements for asbestos, ethylene oxide, formaldehyde, and benzene. Safety standards covered a wide range of issues such as updated fire protection and electrical safety, field sanitation in agriculture, grain handling, hazardous waste operations and emergency response, and lockout/tagout of hazardous energy sources (http://www.osha.gov/as/opa/osha-at-30.html).

OSHA in the third decade again shifted gears and started to re-examine its goals as part of overall government reinvention. OSHA looked for ways to better manage its resources and increase its overall impact in reducing workplace injuries, illnesses, and deaths. Basically, OSHA understood that the resources that they had were not being used in the most effective and efficient way. OSHA concentrated its efforts towards optimizations and efficiency. OSHA was focused on reducing red tape, streamlining standard-setting, and inspecting workplaces that most needed help in protecting employees all while trying to create a partnership atmosphere with the construction industry in order to change attitudes about OSHA and safety. The emphasis was on results. As part of its reinvention effort, the agency reorganized its area offices to provide rapid response to worker complaints and workplace tragedies, as well as to focus on long-term strategies to lower job-related fatalities, injuries, and illnesses. OSHA instituted a phone-fax policy to speed the resolution of complaints and focus investigation resources on the most serious problems (www.osha.gov).

The standards that were published during the 90's relied on a performance-oriented approach. Major safety standards included process safety management, permit-required confined spaces, fall protection in construction, electrical safety-related work practices, and scaffolds. "OSHA broke new ground in 1991 by introducing a blood borne pathogens standard to address biological hazards. OSHA also issued guidelines for preventing workplace violence in health care and social services work and in late-night retail establishments" (http://www.osha.gov/as/opa/osha-at-30.html).

In 2000, OSHA was broadening its educational and training efforts. OSHA introduced compliance assistance specialists to join every area office to provide safety seminars, training,

and guidance to employers and employees upon request. More and more the agency used its website to provide information to its customers. Nearly 1.4 million visitors use the site each month for a total of 23 million hits. In addition to the website, OSHA is providing distance learning options via satellite and computer to provide broader access to worker safety and health training (http://www.osha.gov/as/opa/osha-at-30.html).

OSHA has changed drastically in the past three decades and has apparently made a difference. The U.S. occupational injury rate is 40 percent lower than when OSHA was created in 1971. Deaths from occupational injuries are at an all-time low, 60 percent lower than 30 years ago. Although progress has been made, its work is far from done (http://www.osha.gov/as/opa/osha-at-30.html).

Safety training has developed in a variety of mediums and delivery vehicles. Workers now can train on video, digital video, CDROM, and even online. Industry knowledge about ergonomics, biological hazards, industrial hygiene, and safe work practices has significantly grown. Our ability to package this information in useful, effective, and even entertaining delivery systems has increased the effectiveness of safety training. For example, we often take the personal computer for granted. The PC has been part of the safety revolution. One need only think of the ability for safety managers to keep up-to-date records on the safety training of all employees, and access this information quickly, to understand one positive change that has encouraged a culture of safety to emerge (Overheul, 2001).

Recent studies indicate online delivery of safety training will dominate the market by 2005. There are many benefits for going online and using Internet-based technology for safety training. In the emerging global economy, companies must proactively respond in order to educate their employees properly. To maintain a competitive edge and increase profitability, companies succeed by reducing delivery costs and using advancements in technology to stay ahead of the learning curve. Online learning provides safety training and information on demand, when it's needed (Overheul, 2001).

Some of the benefits of Internet-based safety education are the same benefits as training with interactive CD-ROM programs: reduced training time, eliminated travel expenses for learners and instructors, and reduced learning facility costs. Scheduling training becomes easier as managers can select times that better suit their schedule or the worker's schedule. Yet online training differs from CD-ROM in that workers can access the same training program from any computer with Internet access, and workers can train on a single program from any work site anywhere around the world. Finally, as with interactive CD-ROM, each worker is capable of training according to his or her own pace, and workers can bookmark programs and go back to finish them whenever they desire (Overheul, 2001).

Methodology

The Multimedia Tool Box Talk website is designed with the onsite construction professional in mind. The construction industry is a very fast paced and extremely hazardous industry. The goal of this project is to provide a quick reference safety guide where the onsite construction team can

quickly and easily navigate and find answers to crucial safety questions. It was created based on a statistical analysis of the most frequently occurring construction related safety problems. OSHA has an all-encompassing safety website. This website was not designed to answer every safety question that one may have. It is important to understand that the Multimedia Tool Box Talk website is not a recreation of OSHA or the construction safety standards; it is simply a quick reference safety guide that offers a quick yet effective tutorial for the onsite construction staff.

Getting Started

The Multimedia Tool Box Talk website was created with Microsoft FrontPage 2000 and Abode Photoshop 6.0. Anyone with a basic understanding of both programs should have very little problem creating a site similar in scope and complexity. The theme that remained constant throughout the creation of this site was KEEP IT SIMPLE. This site could have been created with much more flare, but the content might have been overshadowed. Field personnel need the information not the aesthetics. The following sections will accurately account for the creation and content, which make up this site.

Content

The content for this website was obtained from OSHA's Federal Code of Regulations, as well as from OSHA's online safety index and numerous online safety sites, that were used as professional references. The first major challenge was to research and decide what subject matter should be included in the site. Once the information was accumulated, a total of 186 different subject matter web pages were created. For this website, each subject matter web page will be called a "module". Of the 186 modules that were created, nine modules were selected for research and development.

Navigation

Once the pages were created, the next major challenge was deciding how to organize and establish navigational controls throughout the site. Figure 1, shows how the navigation hierarchy was organized. Again, the governing thought throughout was to keep navigation simple as not to create barriers or confusion. If barriers exist due to complex navigational controls or complex designs, contractors will become disinterested and will not use the site regardless of the content the site contains.

Shown in Figures 2, 3, 4 and 5, are the home page, and the three indexes that were created: 1) Active Index, 2) Alphabetical Index, and 3) Project Index. Each index serves a specific purpose. The active index is used solely for navigation to the web pages that have been fully developed. The alphabetical index was created for contractors that have identified a concern and would like to navigate to the subject as quickly as possible. The project index was created for contractors that would like to review some safety procedures that pertain to a particular phase of the construction project. For example, if the contractor is preparing to break ground next week, the superintendent could easily review the module "Trenching and Excavation" under "Site Operations" before work actually starts.
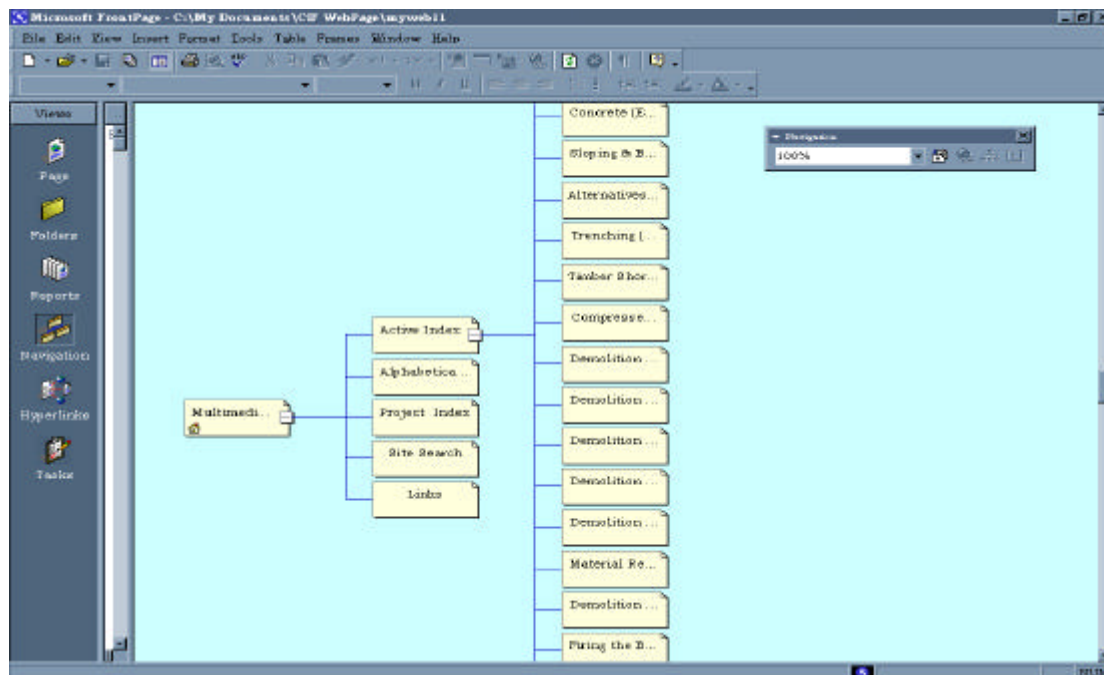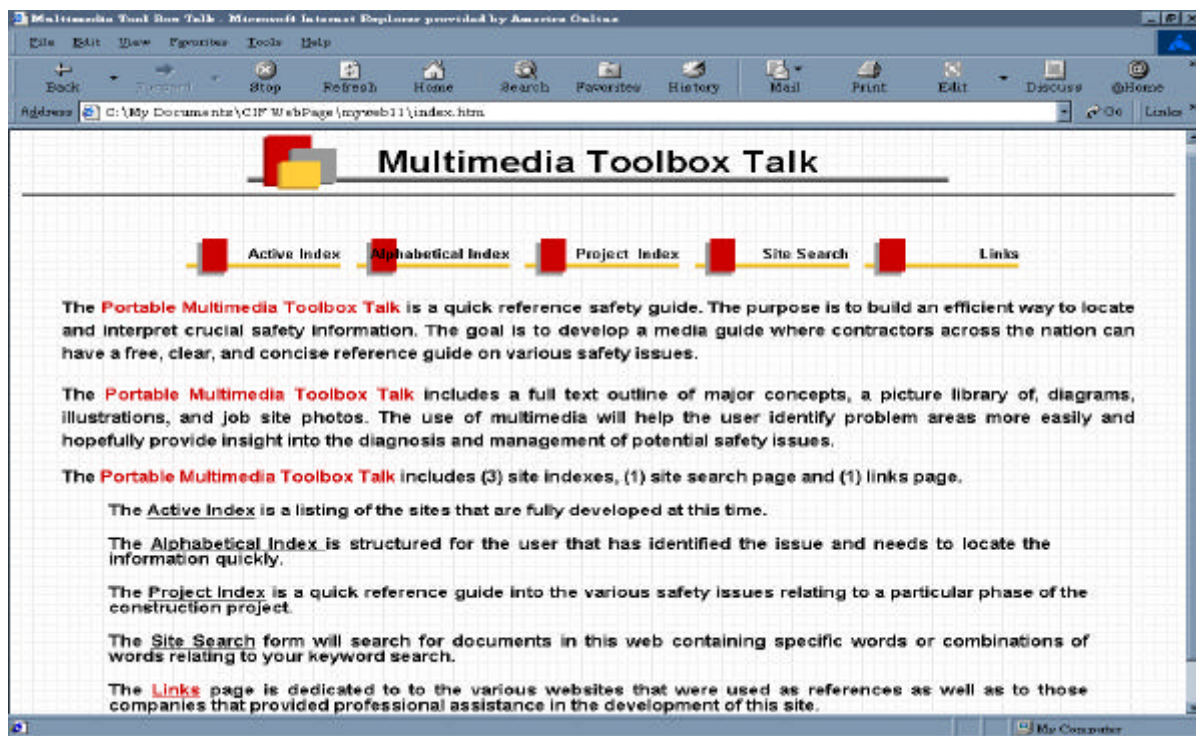
Figure 1: Site Navigation Hierarchy
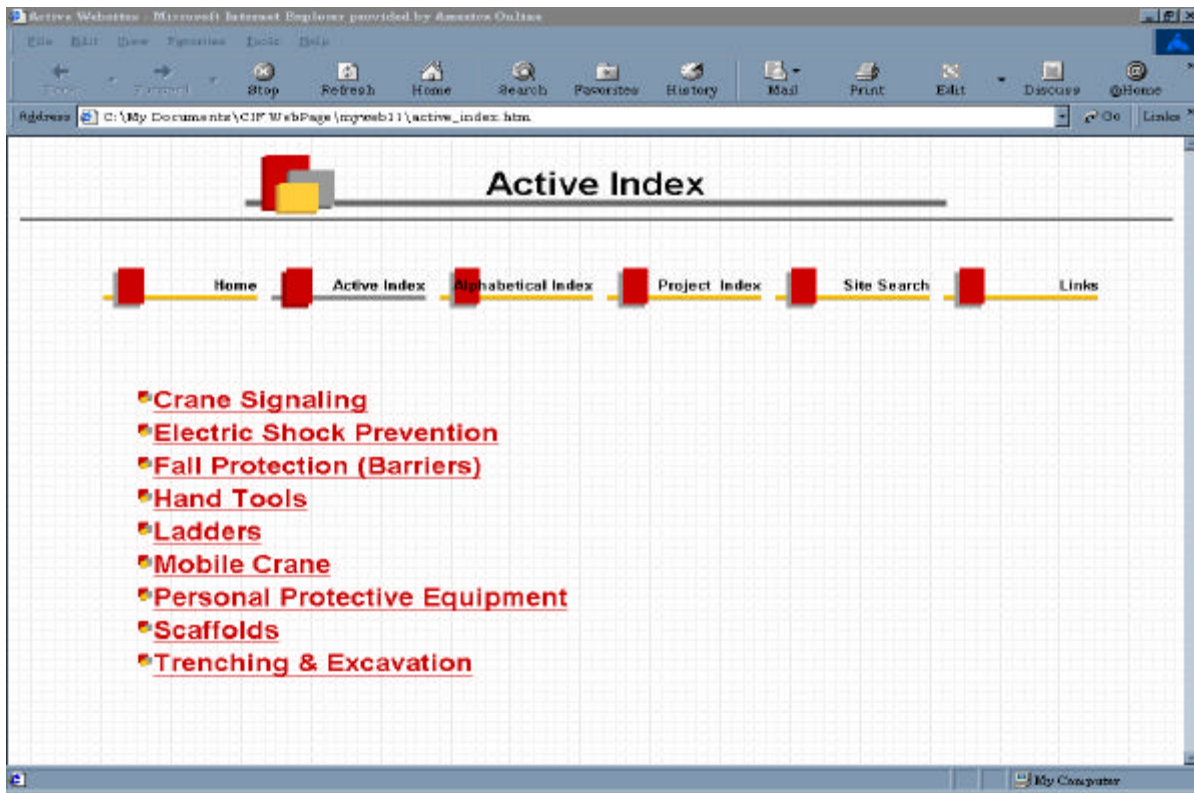

Figure 2: Home Page
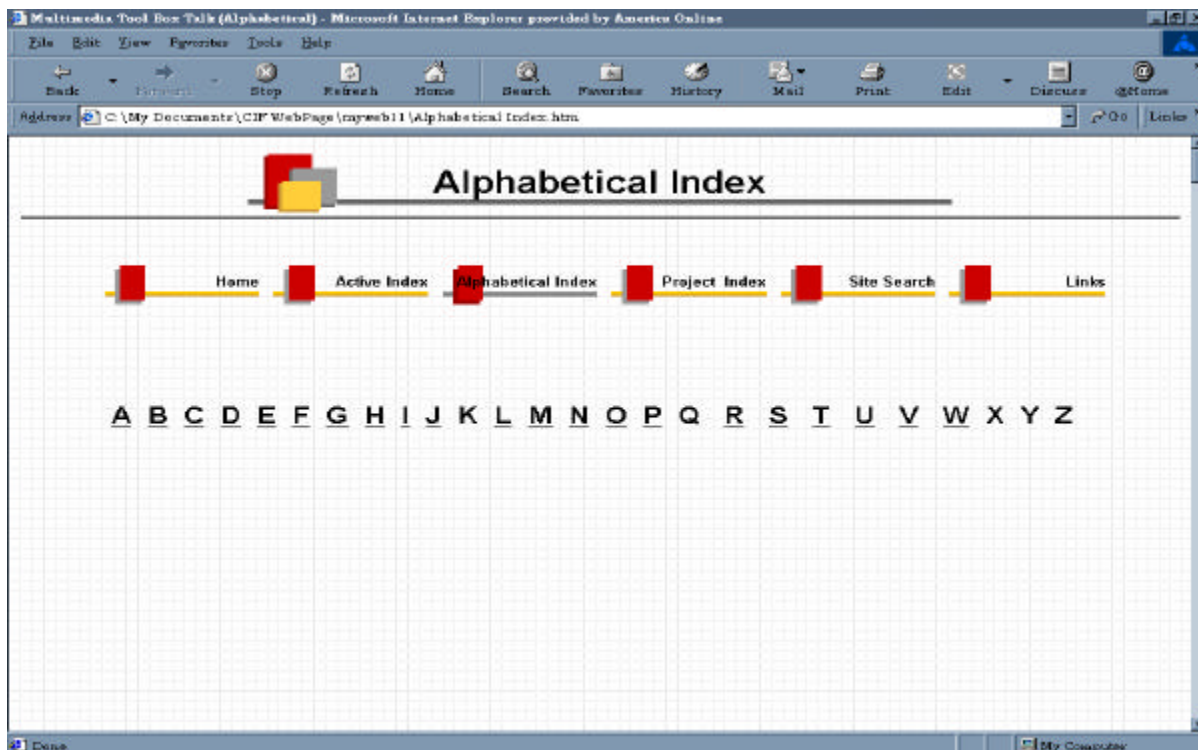
Figure 3: Active Index
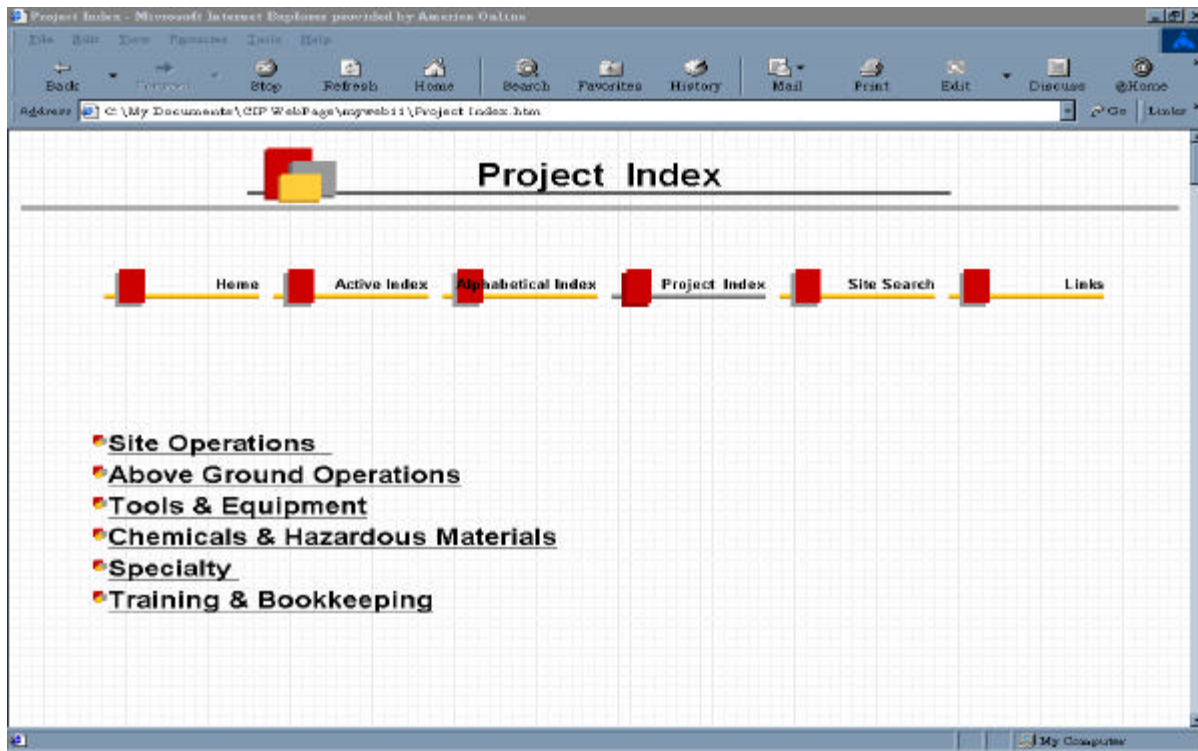

Figure 4: Alphabetical Index

Figure 5: Project Index

This site also includes a Site Search page. This feature was added to further help the user to identify and retrieve the exact information that is needed. Instructions have been added so the user may use several different search language combinations. For example, a user has to simply type in electric shock prevention in the search dialog box and then click on Start Search. This help feature will return all pages that contain the words electric shock prevention.

Developing the Modules

There were nine modules that were developed fully for this website. They include: Crane Signaling, Electric Shock Prevention, Fall Protection (Barriers), Hand Tools, Ladders, Mobile Cranes, Personal Protective Equipment, Scaffolding and Trenching & Excavation. The modules include a picture library, slideshow presentation, and a frequently asked questions page. The modules have been organized so the viewer can maximize his/her learning experience. The following are the actual instructions that are included at the beginning of each module:

Step 1: A Picture Library has been created without any feedback for the user. The goal is to have the viewer look at the pictures and identify potential problems or to identify the correct method of installation.

Step 2: A FAQ & Terms page has been developed for the viewer to read and understand the questions and answers as it relates to OSHA's Federal Code of Regulations.

16

Step 3: A Slideshow presentation has been created for the viewer to see some of the common errors that occur on the jobsite. The presentation is an extension of the Picture Library, the main difference is feedback has been provided.

Picture Library

The Picture Library is considered the backbone of the website. The goal was to bring actual project conditions to life by showing photos of problem areas encountered on the job. This site could not have been accomplished without the help from Beers Construction Company and Brasfield and Gorrie. A total of 503 pictures were collected from these companies. The next task was to scan all of the photographs to create a digital image. The digital images were edited with Adobe Photoshop 6.0. The best feature of this program is the ability to reduce the file size of an image. For example, the average size for all the scanned images were 1.5 megabytes, after the image was edited the size usually reduced to 45 kilobytes. This was a major concern due to the fact that many contractors still use a regular telephone connection or 56K connection. If a contractor attempted to open a 1.5-megabyte picture on a 56k connection, it would take 15 minutes to open. When editing photos the ten-second rule was used. If a photo took longer than ten seconds to open a photo, the file size of the image had to be reduced. The following is the process that was used to reduce the file size of the digital images.

The first step is to select the image to edit. Once the image is open, choose the file, and select Save for Web from the cascading file menu as illustrated by Figure 6. By clicking on the Save
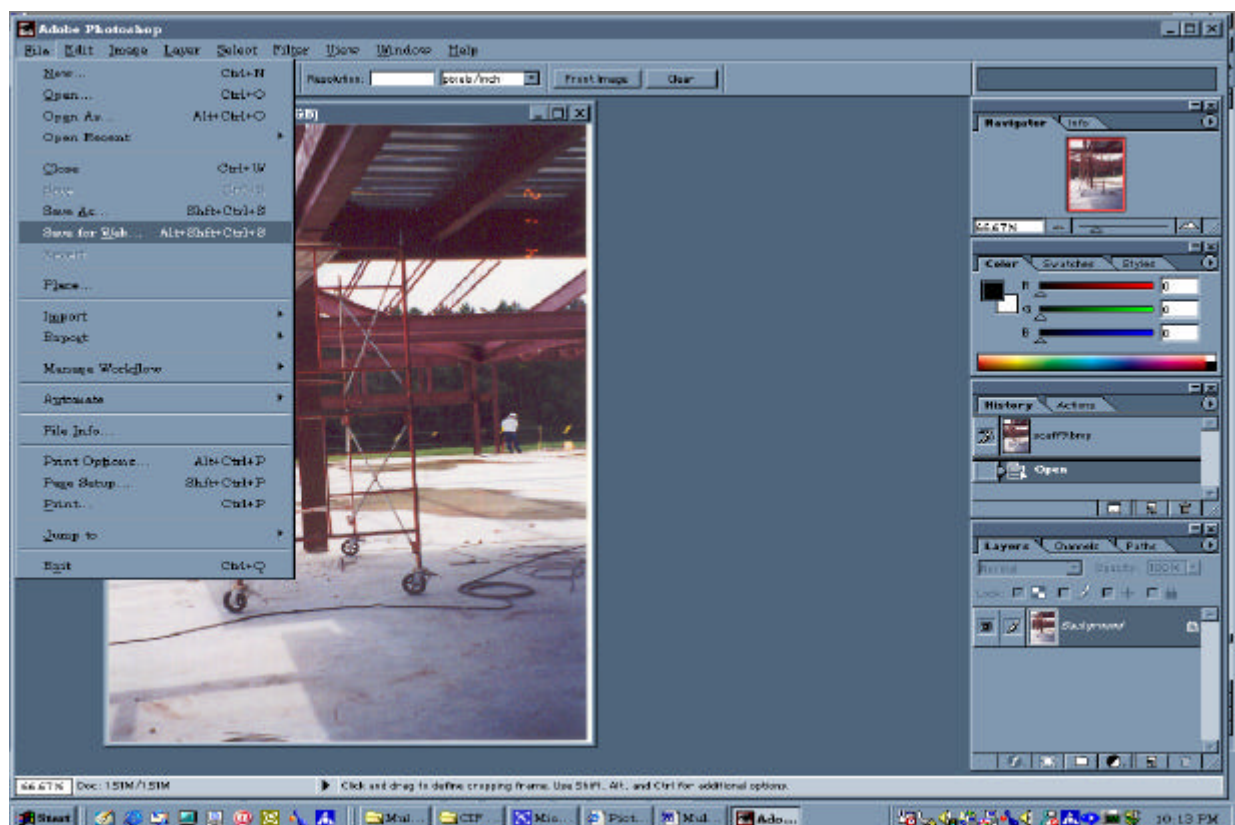

Figure 6: Save for Web

17

for Web option, the user has the option of three different quality photos. The image size for this picture ranges from 1.5 megabytes as the largest to 24.33 kilobytes for the smallest. A unique feature that Adobe provides is showing how long it will take to open a 1.5-megabyte image with a 56k connection. Also, the user has the option to either progressively load the picture from the web, meaning that the picture will show up instantly and will continually become clearer as the download completes.

The next step in the development of this site was the actual creation of the picture library. Once the pictures were edited, it was a repetitive action. FrontPage simplifies this process by allowing the user to search for the pictures to be inserted. In order to save space and reduce the layout to one page, all of the pictures that were inserted were thumb nailed. This means that the pictures were reduced in size, but are hyper linked to a larger clearer image. This took a great deal of time to do since each picture had to be inserted one at a time. A total of 414 pictures make up the picture libraries for all nine modules. Figure 7, on the next page shows a typical layout of a picture library and a thumbnail picture after it has been chosen to view by the user.

Frequently Asked Questions

The content for the Frequently Asked Questions section was derived from actual statistical analysis of the most common problems that OSHA officials encounter through onsite field inspections by using the areas with the most frequent OSHA violations. This information was invaluable to the completion of the project. Without this information, content would have been arbitrary and meaningless. This information helped to build credibility for the content that was added to the site. After accumulating this data, OSHA's Federal Code of Regulations titled Labor, Part 1926, which was revised July 1, 1999, was used as the main reference. The purpose of this section was to turn OSHA standards into commonly asked questions.
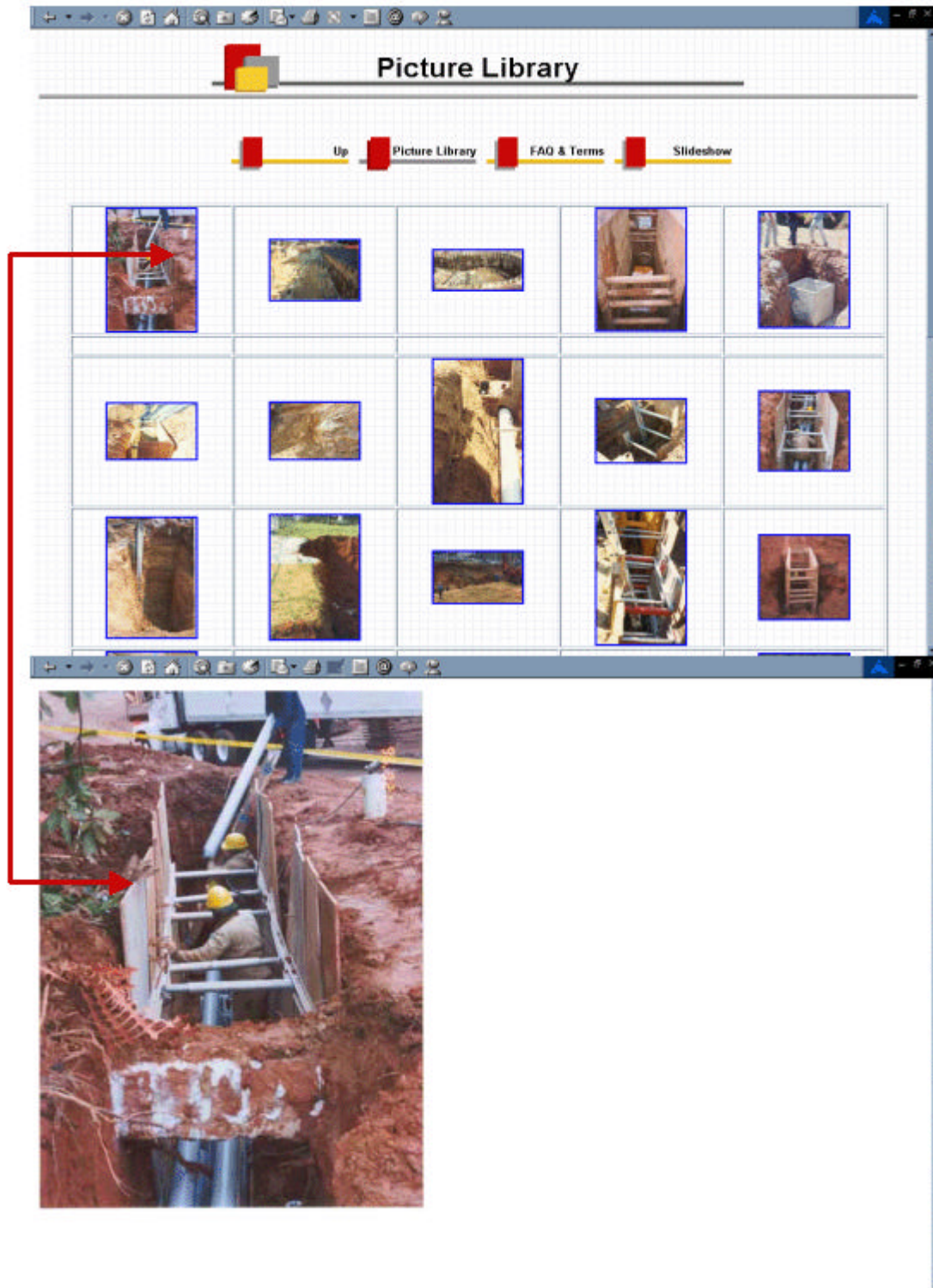
Figure 7: Picture Library & Sample Thumbnail

The purpose of the Slide Show Presentation section is to provide the construction professional a chance to review a set of pictures with specific feedback related to the picture. A picture is worth a thousand words, especially when the picture identifies deficiencies or problems that could possibly turn into a life or death situation for an employee. All the slideshow presentations are fairly short in length. The duration of each slideshow ranges from 2 to 5 minutes. The duration of the slideshow was important. In order to maintain and keep the construction professional's attention; the slideshow had to be specific and quick. The slideshows were created with Microsoft PowerPoint 2000. The creation of the presentations was basically problem free, however, the trick was how to import and open the presentation within FrontPage. The next section will present the actual creation of a html slideshow and how to import and open the slideshow within FrontPage:

Step 1. Create the PowerPoint presentation.

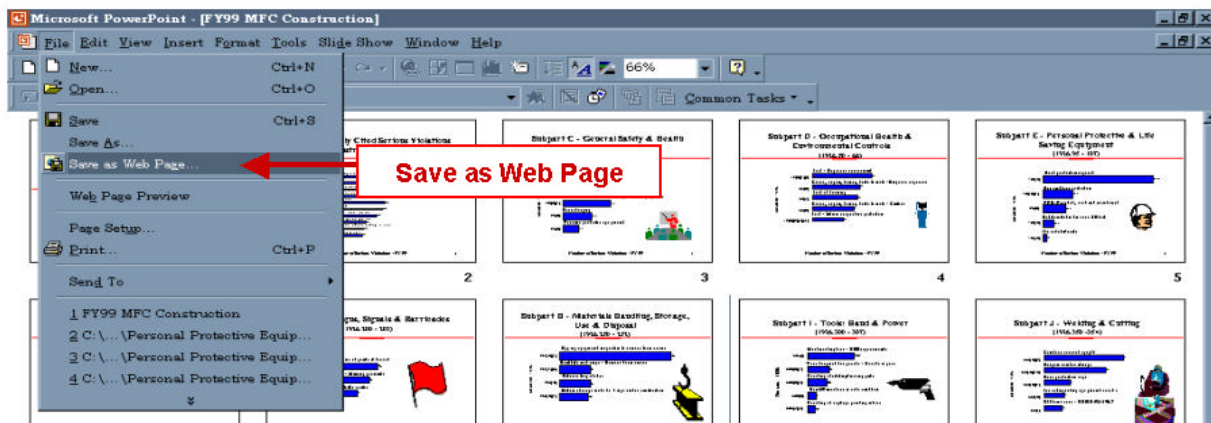**Step 2**. Once the presentation has been saved for the last time, choose File, and then Save as Web Page (Figure 8).

Figure 8: Save as Web Page

Step 3. As seen in Figure 9**,** clicking on Save as Web Page will bring the dialog box up. At this point the user is given the option to save the html formatted presentation. It is a good idea to create a new folder that will hold only the html files. This is recommended because FrontPage imports everything that is contained within a folder. If the same folder is used, the original PowerPoint presentation will be imported. Once the new folder has been created, simply click Save and the html files will be created. Note the slideshow presentation will not work unless it has been saved as a web page.
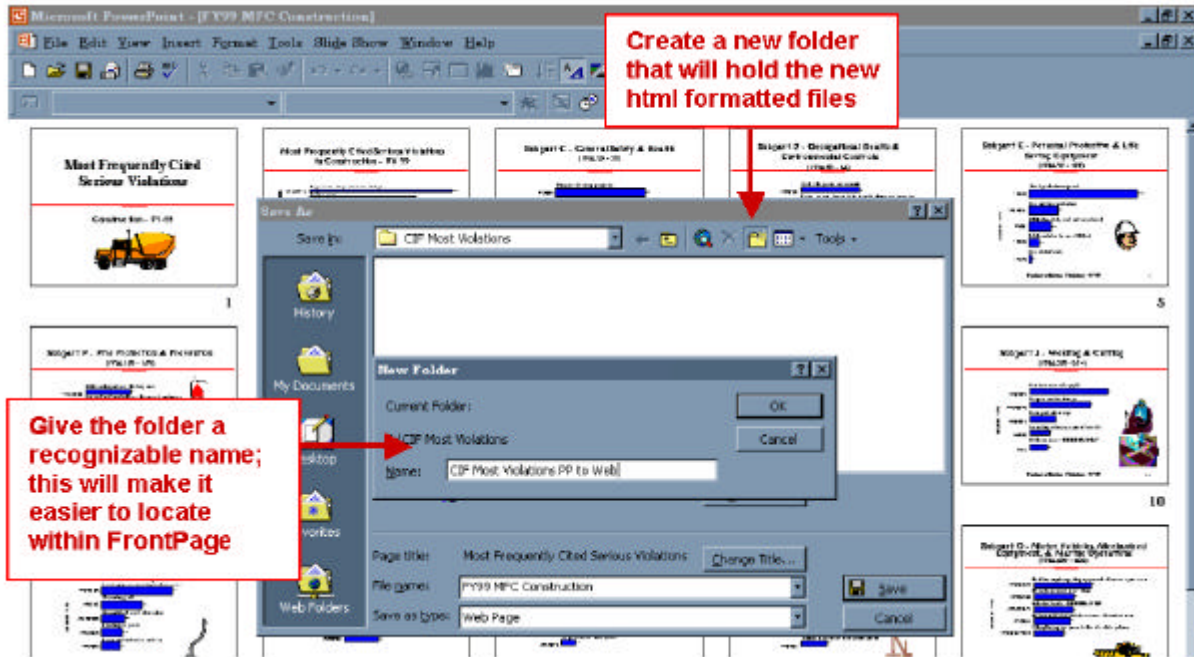
Figure 9: Saving Instructions

Step 4. After the presentation has been saved as a web page, locate the folder where the files were sent. Figure 10, shows the folder should contain one folder and a html formatted file. <u>It is important that both files stay together</u>. The folder contains the individual slides that make up the presentation and the html file is the actual start prompt. This file starts the slideshow.
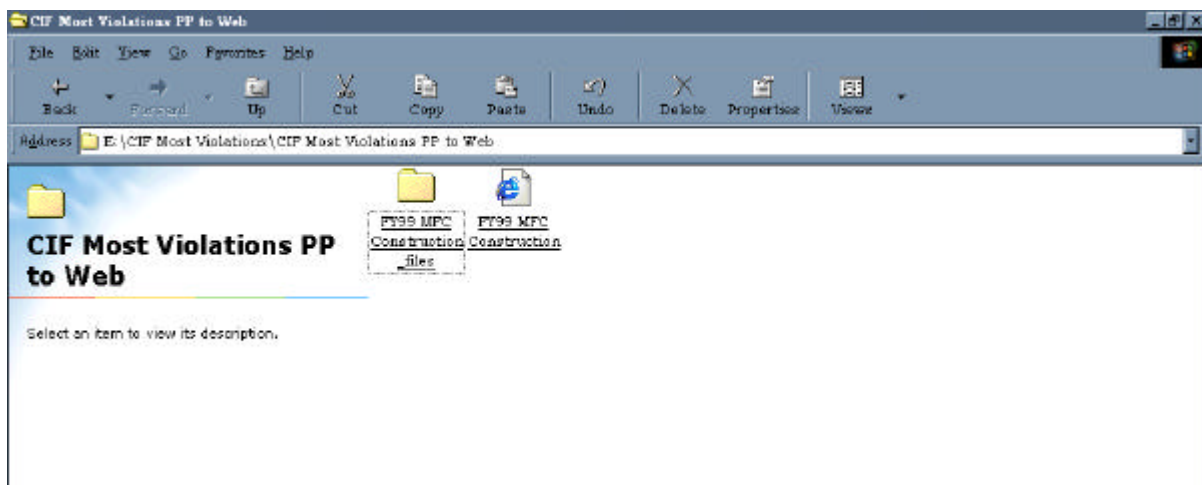

Figure 10: Locating the New HTML Files

Step 5. Figure 11, illustrates the next step after locating the files is to import the entire folder into FrontPage. This is relatively easy, simply open the web page, click on File, then choose Import from the cascading file menu.
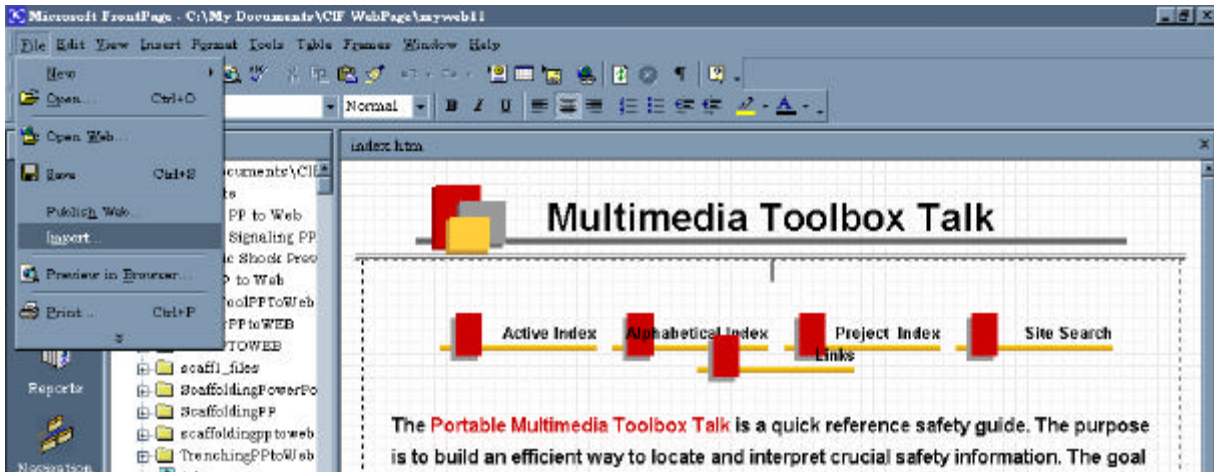
Figure 11: Importing the Slideshow into FrontPage

Step 6. At this point a dialog box will come up asking to either import a file or an entire folder. Import the entire folder that was created. Choose the Add Folder option and another screen will appear. This screen allows the user to locate the folder that is to be imported. Once the folder has been selected click "Ok" and the folder will be imported into FrontPage.
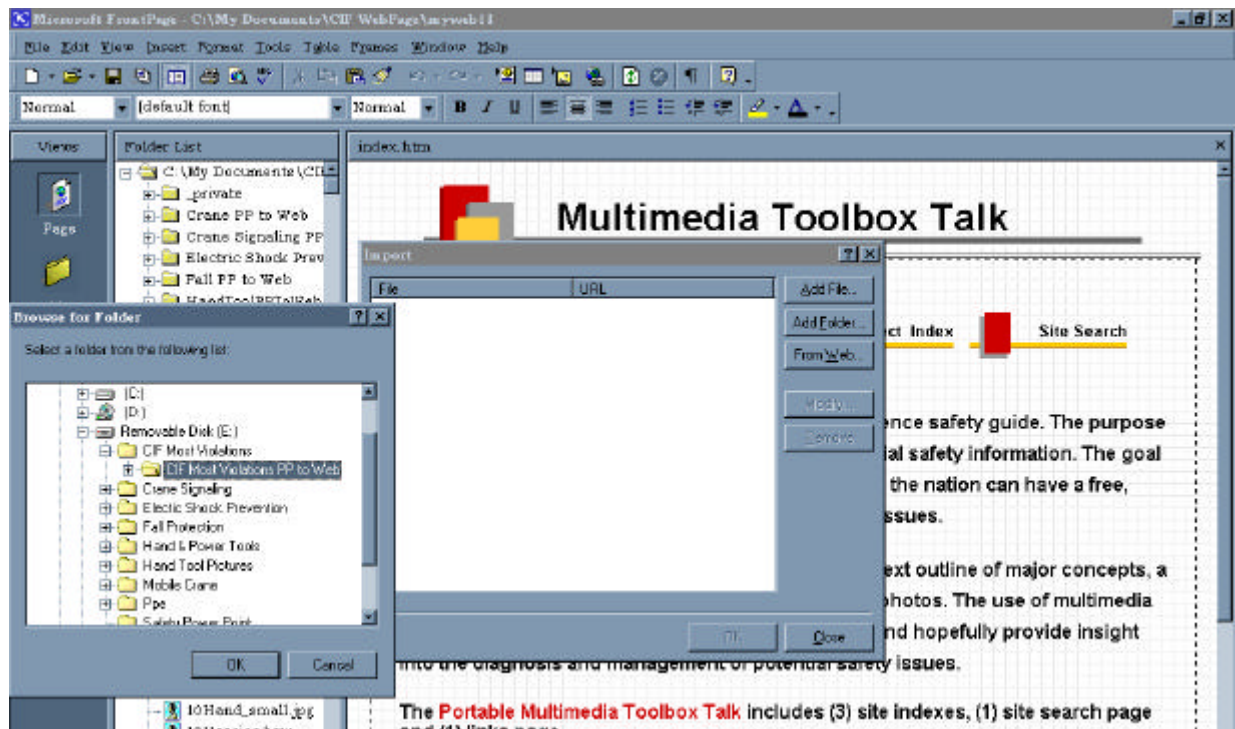

Figure 12: Importing the File into FrontPage

Step 7. The next step is to locate the imported folder, shown in Figure 13. Scroll down to the bottom of the page. The previously imported folder will appear. Simply drag and drop the html-formatted file into the page where it needs to appear.
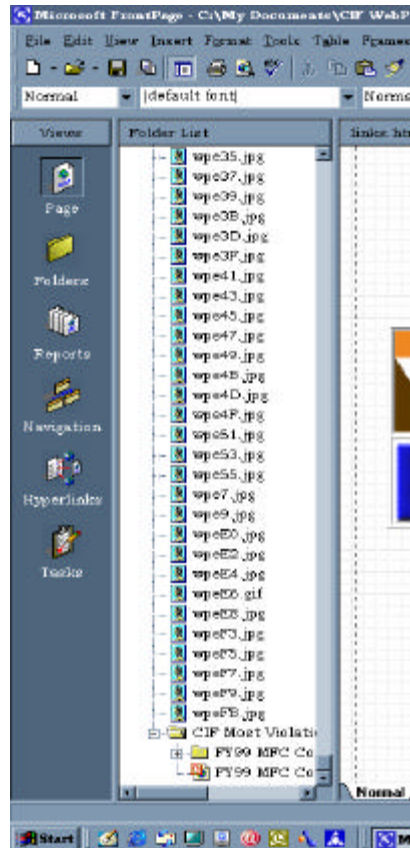
Figure 13: Locating the Imported File

Step 8. As seen in Figure 14, the final step is to drag and drop the file into a web page. By doing this a hyperlink will automatically be created. This hyperlink will automatically run the slideshow presentation that has been created.
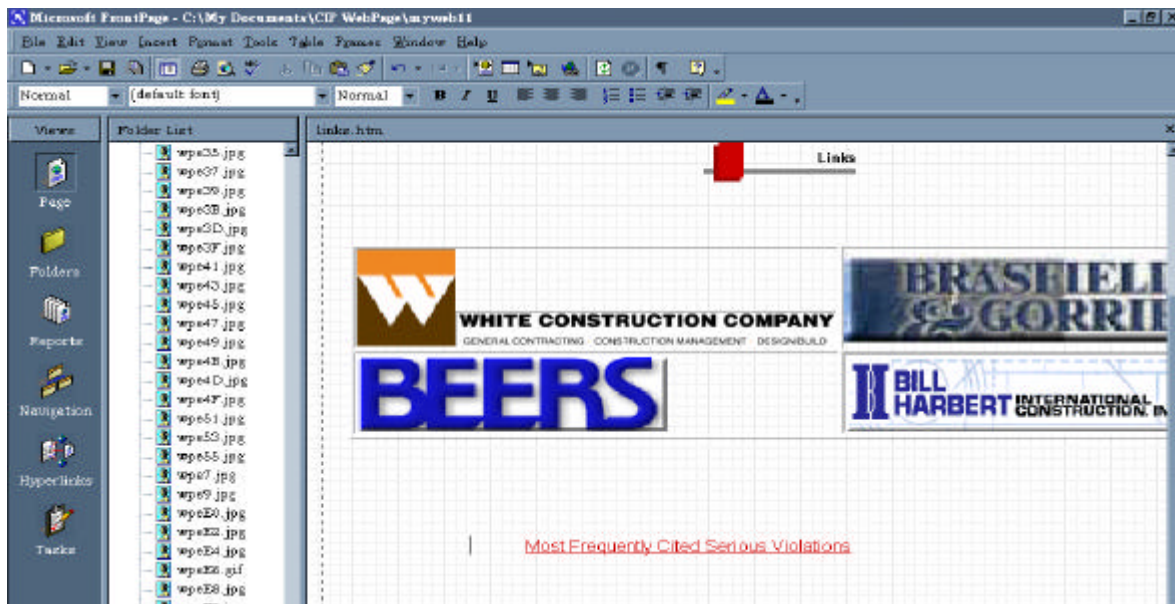

Figure 14: Creating the Slideshow Hyperlink

23

Step 9. Once the hyperlink has been created, the slideshow can be viewed within FrontPage. The presentation can be viewed one of two ways, either manually or through time elapse transitions. To have the presentation run automatically, the presentation must be formatted within PowerPoint before it is saved as a web page.
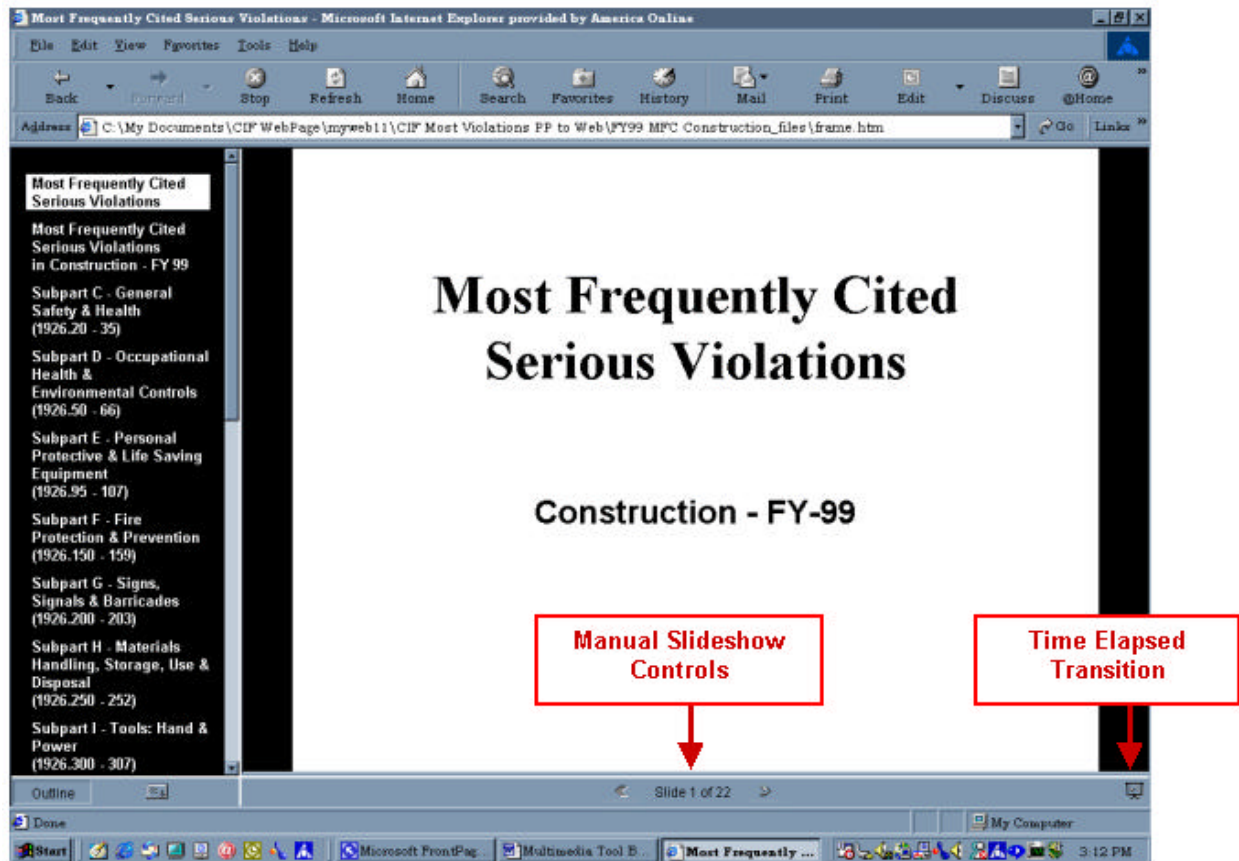

Figure 15: Previewing the Slideshow

Results

The creation of the Multimedia Tool Box Talk website was quite a challenge. This project was started in January of 2001. Several barriers had to be overcome in order to create a website that would provide meaningful content to construction personnel. Again, the goal was to produce a quick referenced tutorial website where contractors across the country could come and review free, clear and concise safety information. Overall, the site's navigational controls and content were organized so that contractors could efficiently and effectively help train and educate construction personnel about construction safety. The creation of the three site indexes, as well as the site search page, help to improve navigation through the site. The picture library was built to serve two purposes. First, contractors can review the pictures and identify potential hazards, and secondly, the pictures are formatted so the contractors can easily print, add comments and hopefully discuss the problems in detail with workers in the field. The statistical analysis of the most frequently cited serious violations from OSHA helped to solidify and reduce ambiguity in

creating the "frequently asked question" pages. The addition of the slideshow presentations further addresses potential safety problems encountered in the field. The combination of a digital image showing a commonly occurring safety violation, along with OSHA's safety standards, help to further explain and give recognition to problem areas.

It should be noted that not all of the modules that were created were equivalent in scope. For example, the module that was created for trenching and excavation is significantly more complex than the module that was created for hand tools. The trenching and excavation section is not a simple contractor tutorial. The goal was to create every module so that a quick review could be accomplished within ten minutes. This, however, was not the case with trenching and excavation. In order for a contractor to feel confident that all the information had been reviewed thoroughly under trenching and excavation, the contractor would need to spend close to an hour reviewing the picture library, the frequently asked questions, and the slideshow presentation.

The Multimedia Tool Box Talk website is organized in a particular manner. It cannot be stressed enough that if the contractor does not read the instructions on how to properly navigate through the site, his or her chances to reap the full learning benefit of the site will significantly be reduced. The contractor should review the picture library first to see if he or she can identify potential problems, then move to the "frequently asked questions" to understand what OSHA requires, and finally view the slideshow presentation. The slideshow presentation is the culmination of the picture library and the frequently asked questions. It combines a picture with the standard.

Conclusions

One way in which people change the world is by making new tools. As a dramatic example of changing the world by making new tools, think about the creation of the Internet. Changing the world in this way can involve changing people's minds, and can entail imposing one's will to some extent, but it is mostly about enabling other people to change by giving them tools to do so (Hillis, 2000).

The Multimedia Tool Box Talk is certainly a tool. The advent of the Internet has provided many people with an innovative tool in which to learn. The biggest advantage of the Internet is that learning is not dependent upon location, an institution or a person. Learning can be facilitated at home, in the office or on the road. Hopefully the tools that are learned through the Internet will provide opportunities to create new tools. The Internet is still undergoing an evolutionary process, much in the same way any new technology does. As more research and work is done on this Multimedia Tool Box Talk, it will also experience radical changes, hopefully these changes will promote and make an individuals' learning experience much more beneficial. The following sections provide recommendations to try to build upon the Multimedia Tool Box Talk's foundation.

Video is another means by which learning can be facilitated. It is the author's recommendation that brief video clips be included within this site. For example, a video could be created showing contractors how to assemble scaffolding. By adding video two benefits are gained, the person or

persons producing the video learn through hands on experience and the contractors are provided with a brief tutorial for workers in the field.

During the conceptual phase of this project, the scope of work could not then be fully realized. A recommendation is that complex modules be broken down into subparts. The trenching and excavation module is entirely too complex to have in one module and keep one's attention. This module should have been broken down according to soil type, equipments, and preventative measures. By breaking the larger, more complex standards down into smaller subparts the user might better retain what has been reviewed.

For website maintenance and future education, a recommendation is to incorporate this site into the curriculum for an undergraduate construction safety class. This site provides a modern way to make safety education interesting and hands-on. Students can take a hands-on approach by going to jobsites and taking digital photos of various work conditions. Once the photos have been taken, students could research in detail common problems associated with a particular safety issue. The students could also be responsible for collecting the video clips. On top of the safety training, the students will gain a better understanding of technology. By allowing the students to constantly add safety content to the site, it will continually be updated and maintained.

References

Construction workers face highest occupational risks. (2001). Wichita Business Journal. 16, (19), p. 23

Figura, S. (1996). *OSHA through time: an insider's portrait*. Occupational Hazards, 58, (4), p. 37-45

Heulke, E. (2001). *Building safe construction habits*. Industrial Safety & Hygiene News. 35, (6), p. 32

Hillis, D. (2000). *Changing the world*. Whole Earth. 103, p. 9-12

History of BLS safety and health statistical. (2001). *Programs Bureau of Labor Statistics*. [WWW document]. URL http://Stats.bls.gov/oshhist.htm

Levitt, R., & Samelson, N. (1987). *Construction Safety Management*. New York: McGraw-Hill.

OSHA at 30: three decades of progress in occupational safety and health (2001). Occupational Safety and Health Administration, U.S. Department of Labor. [WWW document]. URL http://www.osha.gov/as/opa/osha-at-30.html

OSHA history, purposes and activities. (2001). The National Ag Safety Database. [WWW document]. URL http://www.cdc.gov/niosh/nasd/nasdhome.html

OSHA's Mission: Over 100 million workers count on OSHA. (2001). Occupational Safety and Health Administration, U.S. Department of Labor. [WWW document]. URL
http://www.osha.gov/as/opa/osha-at-30.html

Overheul, V. (2001). *20 years of safety*. Occupational Health & Safety. 70, (6), p. 70-74
Safety training proves effective. (2000). Underground Construction. 55, (4), p. 56-57

The National Ag Safety Database. [WWW document]. URL
http://www.cdc.gov/niosh/nasd/nasdhome.html