COMPUTER GRAPHICS AND PUBLIC HEARINGS

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Computer-generated graphic displays can be used by transportation agencies to inform the public about certain aspects of a project before, during, and after a public hearing. These displays may be passive, or they may be generated interactively at a computer graphics display. In addition, some information may be presented as computer-generated animation. The application areas of passive computer graphics include mapping, land use plots, perspective views of facilities, origin and destination study plots, and environmental study plots. Interactive computer graphics may be used in these same areas, but the parameters used to create a plot may be changed to quickly create a new display. Animation has been used to simulate driving along or flying over a project. Current technology allows computer graphics to be used in the public hearing process. Future developments in computer graphics hardware and software should allow displays to be created that are more aesthetically pleasing and cost effective.

•SINCE the adoption of the 1968 Federal-Aid Highway Act, transportation agencies have placed more importance on public interaction at public hearings. In the past, public hearings were used only to inform the public of impending projects. However, the current emphasis in public hearings is not only to inform the public but also to allow for interaction between the community and the transportation agency. Information must be presented clearly and understandably to facilitate interaction.

A 1970 study of the public hearing procedure in Virginia identified 5 problem areas in public hearings (1).

1. Plans for the proposed project are not easily accessible to the community before a public hearing.
2. Highway hearings are too formal and technical.
3. The procedure for receiving testimony tends to intimidate some citizens.
4. Visual aids should be upgraded.
5. Publicity for future public hearings needs to be improved.

Observations of public hearings in other states indicate that these problems are not unique to Virginia.

Based on an analysis of these problem areas, a new public hearing strategy was proposed. The following are among the recommendations included in this new strategy (1):

1. Project plans and someone to explain them should be available at a convenient location;
2. Engineers should be provided to informally answer questions before the hearing;
3. More imaginative visual aids should be used; and
4. Appropriate action should be taken on important feedback from citizens.

Because pictures are at least as effective as words in explaining many things, some form of computer-generated graphics may be used to help the transportation agency fulfill these 4 recommendations. This paper will review the possible uses of passive, interactive, and animated graphics in public hearings. Some new technological

improvements that may help make computer graphics presentations more aesthetically pleasing and cost effective will be discussed.

PASSIVE GRAPHICS

Passive computer graphic displays do not allow user interaction and may be produced before a public hearing. Many software packages currently exist that can provide graphical output suitable for use at a public hearing. Included in these packages are mapping, perspective plotting, and transportation-engineering-related programs.

Several programs exist that perform mapping functions and that may be useful before, during, and after a public hearing to show the public the orientation, layout, and some specific details of a proposed project. Contour maps may be produced that show the terrain features with the roadway superimposed. Three-dimensional perspectives of a region and drainage maps may also be produced by computer graphics for use in public hearings (2). It should be noted that many of the new plotters can use more than 1 ink color; this ability could be taken advantage of to produce more pleasing maps.

Land parcel plots giving some form of the legal descriptions of parcels in the vicinity of a project may also be of interest to citizens in the project area. These plots may be produced by special programs or may be produced by general coordinate geometry programs (3). Producing land parcel plots by computer can simplify other public hearing processes. For example, if a land parcel data base is created, it is possible to maintain the owner of a parcel, his or her address, and any other pertinent information on the data base. This data base may then be searched to categorize the parcels or to gather statistics on the land in the vicinity of the project. The data base may also be used to create a mailing list so that the landowners may be informed of a future public hearing.

Land use plots are typically produced with programs like SYMAP (4), and they may be printer plots or inked drawings. More imaginative plots can be created by using different color inks and by producing some plots on a clear plastic so that an overlay technique can be used when presenting the material.

Perspective plots may be produced to show a view of a highway based on terrain and roadway data. Programs have been developed that allow for the automatic generation of perspective views based on the coordinates of the viewer's position and the point at which he or she is looking (5, 6). Figure 1 shows a sample plot from 1 of these programs (5). This technique has been used for several projects. One application included the visual analysis of the environmental impact of a project (7).

An extension of this technique allows a computer-generated perspective view to be superimposed on a photograph of the roadway terrain (8). These montages may be more aesthetically pleasing and realistic than views produced entirely by a computer. Figure 2 shows a computer-generated roadway perspective superimposed on a photograph; for purposes of comparison, a photograph of the actual roadway after construction is included. The computer-generated picture can be made to look even more realistic by deleting cross-sectional lines and adding colors and striping.

The perspective view technique has been extended to include the structures on a project. A perspective plotting program has been converted to plot perspective views of highway structures as shown in Figure 3 (9). This program can be used to generate views of other structures such as pedestrian overpasses, buildings, and elevated guideways for transportation facilities. These plots also can be made more realistic with coloring and shading. It should be noted that, as development continues on this process, it will be possible to superimpose perspective views of structures on photographs of the terrain.

In urban areas it may be desirable to develop a perspective view of the urban area before and after a project. Although it would be tedious to put in digit form the x, y, and z coordinates of all the structures in an urban area, a program is being developed that will allow the user to construct a display by combining objects from a predefined library of objects (10). For example, to define a simple building tower, one needs to specify only the 3 dimensions of the building and its position with reference to some

Figure 1. Computer-generated perspective view of highway.

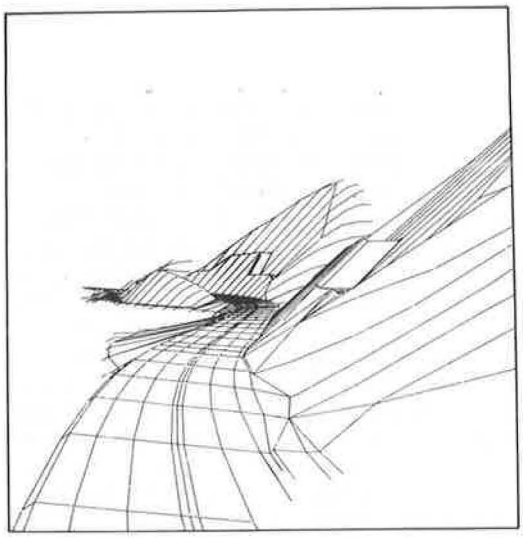


Figure 2. Montage view of highway.

Figure 3. Computer-generated perspective view of bridge.

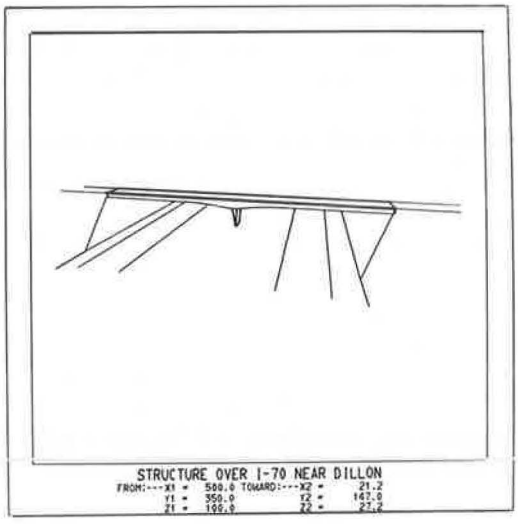


Figure 4. Highway perspective view on interactive graphics terminal.

global coordinate. By combining the appropriate objects, houses, trees, bridges, roadways, and buildings can be created to simulate the urban area. By using this technique, a perspective view of some part of an urban area could be created and then modified to show the area before and after a project.

Although the graphical output from many highway design programs may not be useful during a public hearing, it may be useful in discussions with the public before and after a hearing. For example, cross-sectional plots and slope stake plots may be of great interest to landowners whose properties are adjacent to the project right-of-way. The output of some transportation planning programs may be of interest to the public. Origin and destination study plots may be of general interest to the citizens in both urban and rural areas.

INTERACTIVE GRAPHICS

Interactive graphics programs exist that produce output quite similar to the programs identified in the previous section. Interactive programs allow parameters to be changed to rapidly generate a new view. Uses additional to those of passive graphics are suggested by rapid response to user inputs. All of the facilities of interactive graphics may not be necessary during a public hearing, but they may be useful before and after a hearing.

Generally, the same sort of mapping functions as those described in the passive graphics section may be performed with interactive graphics programs. The display screens of most interactive graphics devices are too small for displaying complex images. However, if a particular area of a map is of interest, it could be enlarged on the graphics terminal for further study.

Land use plotting programs could be used quite effectively from an interactive graphics terminal. For example, simple land use plots could be generated to acquaint participants with the plotting technique. Then more complex plots could be produced as the citizens learned the technique. Finally, plots based on user queries could be produced. A system is being developed in which interactive graphics is used to draw maps based on geographical references (11).

Perspective plots of roadways also can be produced in an interactive fashion as shown in Figure 4. The user of the graphics terminal may select the station and the height above and distance left or right from the centerline for both the viewing position and the point being viewed. The observer's viewing position may be moved to any station along the project, and the perspective view is displayed on the graphics terminal. In this fashion an engineer could show those at a public hearing what a proposed roadway would look like from many points along the project.

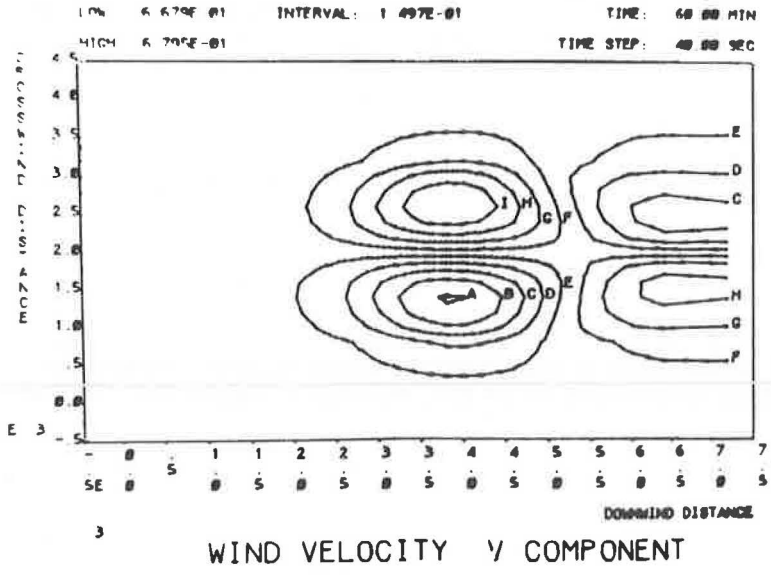
The bridge plotting program may be used in much the same manner as the roadway viewing program. The program operates interactively. The user specifies the viewing position and the point to be viewed. A perspective view of the bridge then is generated and displayed at the terminal. The user may then reposition the viewing positions to generate different views of the structure. The user also may display views of other structures on the project. Figure 5 shows a perspective plot of a bridge on an interactive graphic terminal.

Some of the existing design and analysis programs have some interactive graphic capabilities that may be of use either before or after a public hearing. These programs cover transportation planning (12, 13, 14, 15), structural analysis (16, 17), and soil mechanics (18, 19).

The transportation agency that is using interactive graphics in any part of the public hearing process should take steps to ensure that the public will be learning about some feature of a project rather than learning about some feature of a computer graphics system. The use of interactive computer graphics also should be planned carefully to minimize adverse reaction to small display screens, computer failures, and green displays.

Figure 5. Bridge perspective view on interactive graphics terminal.

Figure 6. Air pollution contours.



ANIMATION

Computer-generated animations of certain aspects of a transportation facility may be quite helpful in a public hearing. For example, driving down a proposed highway has been animated by using the roadway perspective view programs. By the appropriate use of these programs, a movie can be produced that simulates driving down or flying over the length of a proposed project.

Animation techniques could also be used in some environmental impact areas. For example, it may be desirable to show the pollution levels generated by a highway in a particular area as a function of time. Figure 6 shows an air pollution contour display. An animation could be produced by using an air pollution modeling program to generate pollution level contours for discrete time steps. A few film frames taken of the contours at each time step allow a movie to be made that will show the change of the contours as a function of time (20).

OTHER EFFORTS

Several other activities have defined or are attempting to define the role of computer graphics in planning. Some of the developments suggested by these groups may be of general interest to those participating in public hearings.

A Harvard University report (21) examines the function and use of aesthetic criteria in highway development. In the report a methodology is developed that integrates visual and behavioral criteria for more complete planning.

Another report (22), by the National Science Foundation, is of interest. This report surveys several research and development activities that are using some form of computer graphics in regional policy making or planning.

FUTURE DEVELOPMENTS

Current research in computer graphics hardware and software indicates that better graphical output will be achieved at a lower cost. The PLATO plasma display currently allows color slides to be overlaid and mixed with computer-generated graphic images on the screen of the display (23).

Raster-scan graphics devices are being developed that will allow color pictures to be generated at a relatively low cost (24). Extensive software development needs to be undertaken to make these newer devices usable by transportation agencies.

In the future, direct video mixing of videotapes of the terrain of a proposed highway alignment and a computer-generated view of the proposed roadway may be possible.

All of these developments will allow more realistic computer graphics images to be generated more efficiently. Existing software packages will have to be modified and new packages will have to be developed to enable transportation engineers to use these devices.

CONCLUSIONS

This paper has indicated how existing computer graphics packages can be used in the public hearing process. The applications are classified according to passive, interactive, and animated techniques. Not all of the programs listed are of use in a formal public hearing; some programs may be used better before or after hearings.

Computer-generated graphic displays should be used in public hearings if they show a feature of a project better than other techniques do. However, care should be taken to ensure that the public is not overwhelmed by the complexity of graphics devices or graphical techniques. The important point is that the transportation facility rather than the graphics system should be emphasized.

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