4D CAD Modeling: Visual Intelligence for Construction Management

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The 4D Concept

4D Models link components in 3D CAD models with activities from the design, procurement, and construction schedules. The resulting 4D production model of a project allows project stakeholders to view the planned construction of a facility over time on the screen and to review a 3D CAD model for any day, week, or month of the project.

4D CAD Benefits

4D models enable a diverse team of project participants to understand and comment on the project scope in a proactive and timely manner. They enable the exploration and improvement of the project executing strategy, improvements in constructibility with corresponding gains in on-site productivity, and the rapid identification and resolution of time-space conflicts. 4D CAD models have proven particularly helpful in projects that involve many stakeholders, in projects undergoing renovation during operation, and in projects with tight, urban site conditions.

For example, Walt Disney Imagineering used 4D models to plan the construction of the Paradise Pier portion of Disney's recently opened California Adventures in Anaheim, CA. Tight site conditions, a must-meet completion deadline, and many non-construction stakeholders made the project idea for the application of 4D project management. The 4D model enabled the project team to produce a better set of specifications and design drawings for the construction of the project, resulting in fewer unplanned change orders, a smaller construction team, and a comfortable completion of the project ahead of schedule. Figure 1 shows several snapshots from the 4D model built for this project.
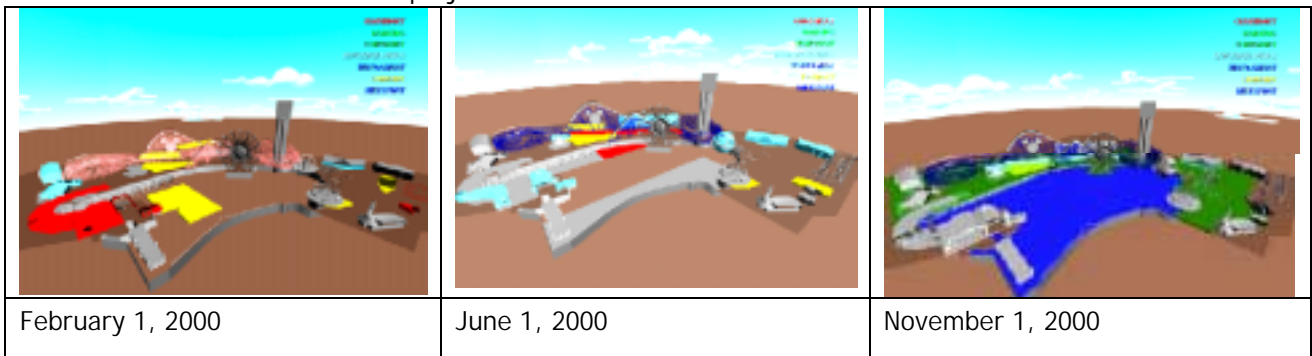

| February 1, 2000 | June 1, 2000 | November 1, 2000 |

Figure 1. 4D model snapshots

4D Modeling at Stanford University

Martin Fischer's research group has been helping public and private owners and contractors build 4D models on their projects since 1993. Projects include hospital renovations, concert halls, commercial buildings, theme parks, museums, and industrial facilities. See http://www.stanford.edu/group/4D for details on the group's research activities.

4D Interface

An interactive, easy-to-learn and use, and flexible 4D modeling software has been developed over the last 42 months in collaboration between Walt Disney Imagineering and the Martin Fischer's research group at the Center for Integrated Facility Engineering (http://cife.stanford.edu) at Stanford University. Figure 2 shows the interface to the 4D software, which runs on the Windows platform.
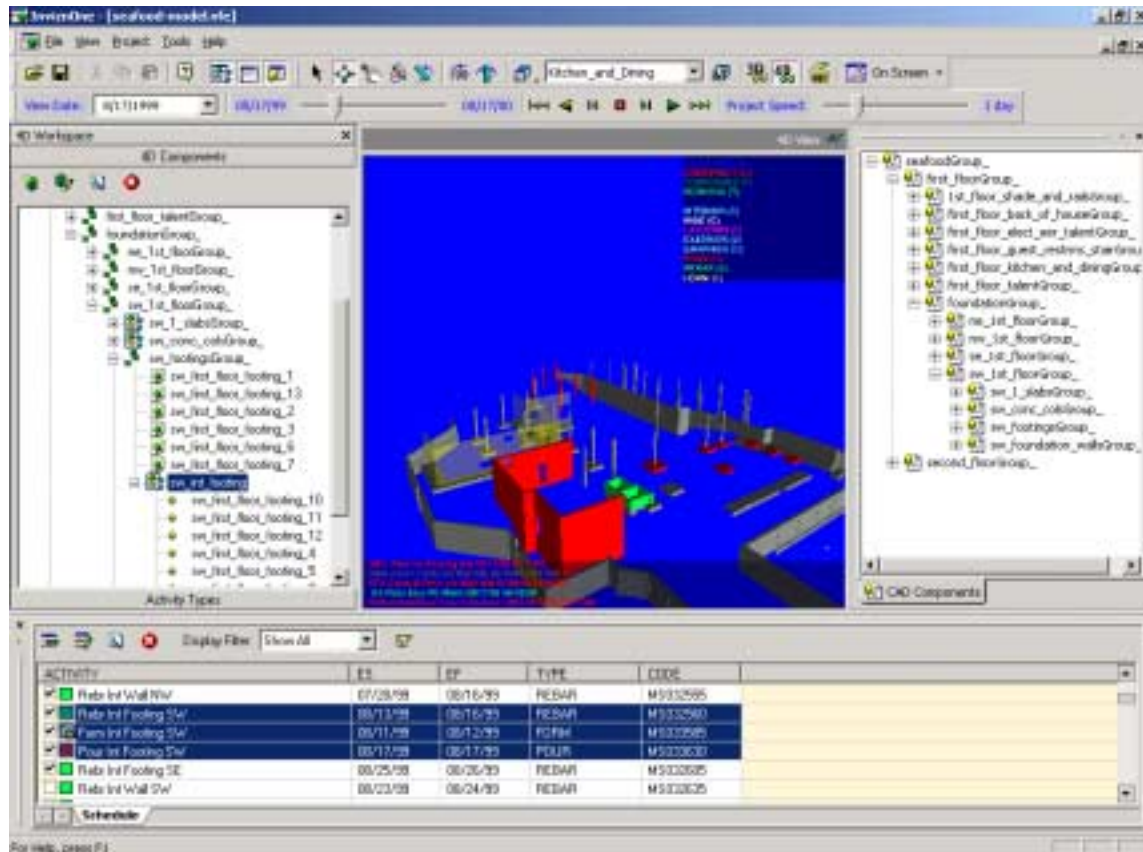
Figure 2. 4D Model Interface.

The top part of the interface contains the time and space controls to orient and position the 3D model in the central window and to move through time in various ways (selecting a date, moving the time slider, or using the video-like controls). Users can also select the speed (intervals) for displaying the model. Here, the speed is set to 1 day, meaning that the 4D View window will show the activities that will take place on the various 3D components day by day. The CAD Components window shows the hierarchical organization of the 3D components that make up the building. This 3D model organization is imported from a vrml file produced by any 3D modeling software. The Schedule window shows the activities that are needed to build the project. The colored boxes next to the activity names indicate the color in which a particular type of activity will be displayed in the 4D View window. The activities and corresponding fields are imported from scheduling software like Microsoft Project or Primavera's Project Planner. The 4D Components window shows the 4D components organized hierarchically. A 4D component is one or several CAD components (copied from the CAD components window) that is linked to one or several activities from the schedule. As mentioned, users control the display of the 4D model with the controls at the top of the interface. They can also select components or groups of components in the CAD Components or 4D Components windows and show only parts of the building. In the 4D Components window the 4D component 'sw_int_footing' is highlighted. It is a collection of individual footings. In the Schedule window the activities needed to build the footing are highlighted (rebar, forming, pouring [of concrete]). The 4D View window shows the pouring of the concrete for these footings on Aug. 8, 1999 as well as other activities scheduled for that day.

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