

COMPARISON OF *WINDOWS* AND *DOS* VERSIONS OF THE DOE2 IN SIMULATING A PASSIVE BUILDING

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ABSTRACT *Visual DOE is a Windows interface version of the DOE2 simulation program. Its purpose is to help save time in writing BDL input for the simulation. As its calculation engine is the same as DOE2 in the DOS version, DOE should result in the same output as the DOS version. However, difficulties arise in identifying the building's configurations, materials and construction and systems in the two input versions. While modeling a simple one-story "passive" building, it was difficult to get a good match in the simulation results in the two versions. Furthermore, using the Windows version of DOE is not as simple as it should be. For example, it was harder to model a simple "pitched" roof using the Windows version than in the DOS version. Similar problems have occurred in dealing with issues such as "shading". The problem with shading devices is the difficulty in modeling the configuration of the shading, resulting in errors in calculating the correct solar gain. As a result, it is necessary for the Windows users to create an input file, run the program to generate a BDL file, freeze the BDL generator, modify the BDL manually, and then run again using the modified BDL.*

Even after such modifications, the match between DOS and the Windows versions of DOE-2 was not consistent. Comparing the simulations of the two versions with measured data, when the buildings were closed and un-shaded, show better a match with the Windows version. On the other hand, when the same buildings were shaded, the Windows version showed a poorer match with the measured data. In simulation sequences of days with varying climatic conditions, the Visual DOE's output was lower than the DOS output on some days and higher on other days.

1 Introduction

The Pala research facility was constructed by San Diego Gas and Electric (SDG & E) company in Pala, near San Diego, California in 1981-1982 to study passive solar heating. It was later available for use by UCLA investigators to study ventilation cooling options. The experimentation in 1993-1994 aimed to evaluate the effect of thermal mass, under different conditions of ventilation, shading and envelope color, on the potential for reducing the indoor daytime temperatures. In addition, the experimental data in this research was previously compared to the simulation output by the DOE-2 computer model for the same building details and weather conditions by Givoni, B. and T. Labib (1997). The DOS version of the DOE-2.1E (Winklemann, F.C. et al, 1994) was used. The objective of this paper is to compare the simulation output using the Windows version of DOE (VISDOE 2.5)(Eley Associates, 1996) to the experimental data, and comparing with the previous results of the simulation output, using the DOS version. Both versions use DOE2.1E as a simulation engine.

2 Configuration of the building

The experimental setup consisted of two buildings out of the eight built on site. The two buildings which were used in the previous DOE-2 simulations, were a low and a high mass buildings at the west and east location on the site.

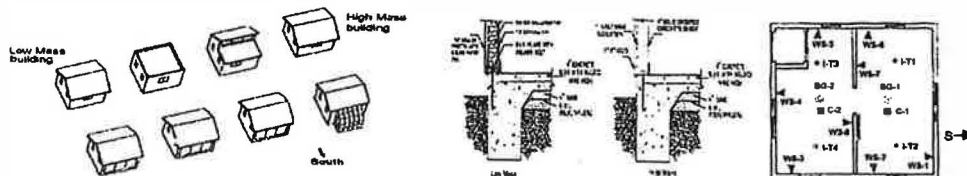


Fig.1 Configuration of the passive buildings in Pala, San Diego

Fig.1 shows the layout of the passive buildings in the test site, construction details and the location of thermocouples and other sensors measuring indoor environment inside each test-cell. In this paper, only the results of the comparison of simulation of high mass buildings are discussed.

3 Design details of the Pala high mass building

The materials used in simulating the high mass construction in both versions are compared in Table 1.

Table 1 Design details used in DOS and Windows versions of DOE2

Construction	Materials
Exterior Wall	(1) Stucco 2.54 cm (2) Polyurethane, Expanded, 2.54 cm. (3) CMU Heavy Weight. 10.2 cm Concrete Filled
Interior Wall	(4) Heavy Weight Dried Aggregated 10.2 cm.
Floor Slab	(5) 10 cm. Concrete Slab with Welded Wire Mesh (6) 10 cm. Sand (7) 6 mm. Polyethylene
Roof	(8) Asphalt Tile (9) Building Paper, Permeable Felt (10) Plywood 1.6 cm.
Ceiling	(11) Mineral Wool/Fiber Batt, R-3.3 (12) Gypsum Board 1.9 cm.
Glazing	Single Clear 3 mm.

From the building description (Givoni and Labib 1997), the total window area of each building is about 4.6 m², divided equally between the east, west, south and the north walls. Originally windows were without any shading. However, in the latter phase of experiment, a shading device was added. It consisted of sheets of reflective insulation attached to the walls above the windows and stretched outward and downward to a fixed support at the level of the window sills. Its width was wider than the width of the window by 5 cm. Windows on all sides except the northern one were shaded.

4 Preparation of the input files in VISDOE

There are several modes inside the windows version of DOE that the users must input information before the simulation can be run. They generally are the same information data as needed in the DOS version. However, with its graphic interface, input was supposed to be easier.

The input windows in VISDOE are (1) Graphic editor (2) Plant only runs (3) Schedule maker (4) Construction builder (5) Fenestration editor (6) Climate editor (7) Utility rates editor (8) Equipment editor (9) Hourly report editor

In the **graphic editor**, the users can easily define the building's outline, stories, and other façade details using mouse drag and drop and Windows menu bars. However, it appeared to work perfectly for the block-like shape of elevation. In this project, the building has a pitch roof. This caused some difficulty in assigning the building's configuration. The users need an "advanced mode" in order to accomplish a drawing of a very simple roof shape, which when compared to assigning BDL in normal DOS mode, can be considered rather complicated.

Also, since this building contained 2 rooms separated by an interior partition, the users required extra effort to use 2 custom blocks to create one room with an interior partition. Then, one of the walls created has to be removed outside the windows mode. Moreover, in drawing these zones using mouse drag and drop on a plane as a CAD program works, it is not flexible enough to input the 'decimal' dimension. The dimensions on this drawing pad had to follow the multiple of the dimension of the snap grid. Therefore, to make sure the building's dimensions were accurate, the user must repeat in an advanced mode to correct each number manually.

This shows drawbacks in using this Windows version of DOE. First, this advanced mode is not transparent for the normal users. Only assistance from technical support could direct the users to know how to fix it. Secondly, to fix a number or a shape of the building outside the Windows interface is a cumbersome task. This results in more work instead of less as is illustrated in Figs. 2 and 3.

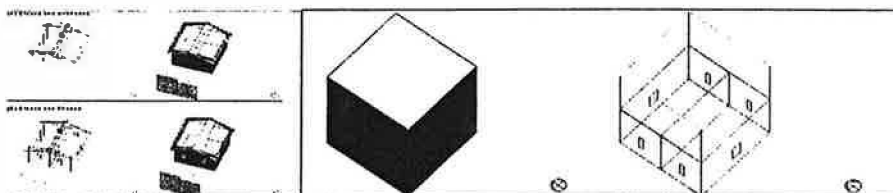


Fig.2 The drawing of the buildings from input BDL using DRAWBDL program compared to the initial drawing which graphic editor windows in VISDOE produced (using the same program to plot)

The left side of Fig.2 shows the graphics of the buildings drawn from the input through DOE-2 DOS version. Since in the DOS version, there is no graphic presentation, this DRAWBDL program is an add-in program for presenting the building's configuration visually in the DOS version. Both conditions of closed & unshaded and shaded are shown.

The right side of Fig.2 shows the graphics of the building drawn from the input through the graphic editor mode in VISDOE before being fixed in an advanced mode outside the window interface. It can be seen that the building configuration is very different from the actual one. To make two drawings identical it requires additional work outside the normal Windows. The fix was done by editing the text of the input files, which should not be the task when using the windows interface program.

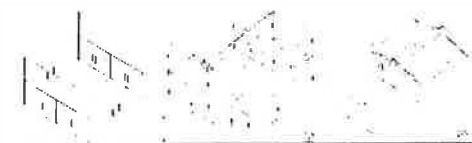


Fig.3 The drawing of the building in the process of fixing in VISDOE advanced mode

Fig.3 shows the drawing of the building before and after being fixed using VISDOE advance mode. This process can be done by using any text editor. It seemed to be easier if the user can import his or her input file from a DOS version and run it on this VISDOE program. Unfortunately, this program did not allow the users to do so. The users need to go through several input screens inside the Windows interface and from there, they can alter the input as required.

In the **plant and schedule maker**, the authors found it very easy and user-friendly. Since in this part, the traditional schedule input in a DOS version is tedious. Under the window interface, users can adjust and modify the schedule by using mouse clicks and techniques of scroll bars to identify the hour, day and seasons use of the system. However, for this project, all plant equipment, as well as occupants' schedules are set to zero or as a floating condition. There are some system defaults and schedules that were obligatory to be selected by this program. Nonetheless, all conditions were maintained as a floating condition as much as possible.

In the **construction builder**, the construction materials are listed and can be selected by a windows drop-down menu. The DOE code for building materials is hidden under this user interface; yet can be seen in the print out of the input files. This is convenient for the users, as they can pick and choose what suits their building materials without bothering about manual coding. For this project, the authors used the drop-down menu to choose the materials from the list according to the building specifications. The program also allows the users to build their own set of material library by specifying the material's thermal properties, size and type.

Nevertheless, one drawback in using this kind of materials' list arises when there are several material types in one panel of a wall. The users cannot separate the material panels in the same walls, unless it is fixed outside the Windows mode. When in the DOS version, the users can specify the coordinates and size of each panel of material on a wall, and all materials are assembled into one wall.

In the **climate editor**, the Windows version allowed the users to import the weather data file into the program. Therefore, in this project, the same weather data file, used previously in the DOS version, was also used in the VISDOE simulation.

In the **fenestration, utility rates and equipment editors**, every item is set as a default when its schedule had already been set to zero or floating conditions. This is to try and eliminate the conditioning system as much as possible.

In this project, the **hourly report** is very important, as it is needed to compare results of the simulation with the measured data, which is recorded in an hourly scale.

5 Comparison of simulated results: VISDOE and DOE 2.1E (DOS version)

Before comparing the results of windows and DOS version, the results from VISDOE were compared against the measured data, as seen in Fig.4.

In Fig.4, the first four legends (I-T₁-I-T₄) stand for 4 temperature sensors for both rooms in the building. The other two legends (ZONE1—Temp & ZONE2—Temp) represent simulated temperature from VISDOE. The left graph shows the results of simulation under initial input through Windows interface. The right graph shows the results of simulation after correction for material details and system specification in an advanced mode. On the left graph, It is shown that the simulation was an underestimate. This was due to several factors. First, the roof was not yet "fixed" and also other details of the roof and system specifications were needed to take care of. Secondly, systems and schedules of the building were needed to be carefully input to represent the actual passive conditions. All these fixes had to be done in

advanced mode outside the Windows interface. On the right graph, it can be seen that the prediction from VISDOE after the alterations was quite close to the measured data.

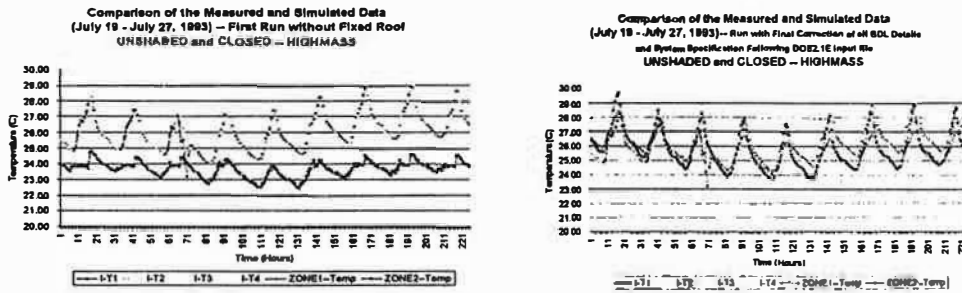


Fig.4 Comparison of measured and simulated: unshaded ,closed, high mass building (first and final runs)

The next step is to compare the VISDOE simulation results to the DOE DOS version, as shown in Figs.5 and 6.

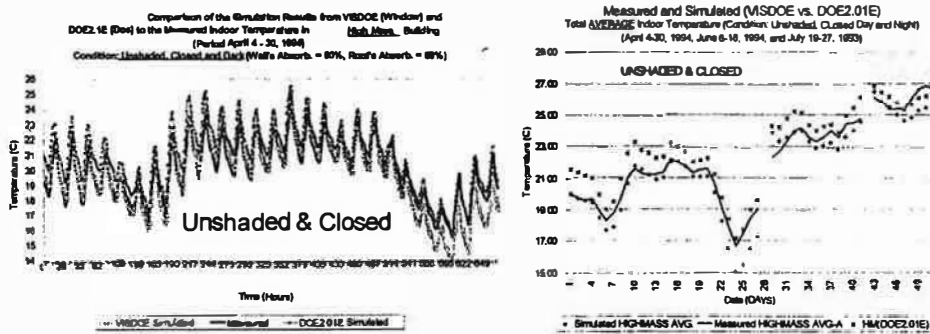


Fig.5 Comparison of simulation results from VISDOE (Windows) and DOE2.1E (DOS) to measured indoor temperatures in the high mass building when "unshaded and closed"

In Fig.5, the left graph shows the comparison of daily pattern in hourly units of the indoor air temperature under "unshaded and closed" condition from the measurement and two simulated results. The right graph shows the comparison of daily average indoor air temperature among them. It can be seen that in the unshaded phase, the simulation using VISDOE can result in a better prediction than that using DOE during some period but less accurate in another period. This shows inconsistency of the prediction using a different input method, although overall both of them can give quite satisfactory results.

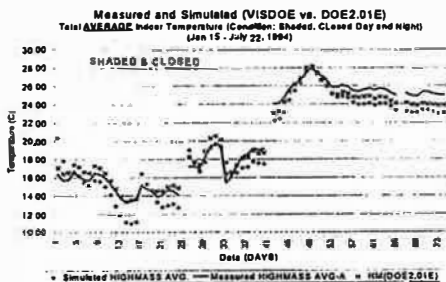


Fig.6 Comparison of simulation results from VISDOE (Windows) and DOE2.1E (DOS) to measured indoor temperature in the high mass building when "shaded and closed"

In Fig.6, the left graph shows the same as in Fig.5, but under "shaded and closed" condition. In the shaded condition, VISDOE shows more inconsistency in the prediction. Moreover, the results using DOE seemed to be more accurate since the users can adjust all parameters manually when dealing with shading, reflection and so on. In VISDOE, although there is a specific window dealing solely with exterior shading devices, which the user can specify, visible reflectance, ground reflectance, and determine if the shading device is reflective or none. There is no place to specify the materials of the shading device and also it allows the shading device to have only one reflective surface (either inside or outside). This can affect the calculation of the correct solar gain.

6 Discussion and conclusion

- (1) Design description on BDL is the first initial and major important factor in running the simulation. It is obvious that to simulate a simple building using the Windows version of DOE2, there is no less difficulty in assigning appropriate BDL for it. Moreover, when the building is small and its performance is easily affected by small alterations of building configuration, it is harder to use a general description under Windows interface without special treatment.
- (2) Although the authors tried to match most of the BDL for both runs, the results gained from these simulations did not seem to present good consistency.
- (3) Since the buildings in this project were "passive", there were many problems in defining the plant units and schedules in use.
- (4) For the shaded case, there were numerous other factors to correct before the building was simulated. Therefore, in the Windows version, the results are more unreliable.
- (5) It can be concluded that simulating the same passive building using a Windows and a DOS version will not give the same output, although the simulation engine of both programs is the same. This is because the major factor of simulating output is BDL and other parameters that require user input. The Windows version of DOE2 attempted to ease the users from labored tasks of BDL input. However, the opposite occurred in simulating a simple passive building as it was more difficult and time-consuming.
- (6) The authors concluded that as a result of this investigation the Windows version of DOE is not a viable alternative to a DOS version when a passive building is simulated.

7 References

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