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ENERGY CODE COMPLIANCE USING COMCHECK

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INTRODUCTION

COM*check* (ref. 1) is a computer program developed specifically for building compliance with nationally recognized energy codes. Using compliance software may provide more design flexibility when compared to prescriptive table requirements. For example, parameters such as fenestration area can be increased and the additional energy demand offset by increasing roof or wall insulation levels. In addition, once the basic building description has been entered into the program and saved, design changes and/or the building location can be quickly modified, and compliance immediately redetermined. COM*check* has another advantage in that various national and state codes are included within the program, making it easy for designers who work in several states to be able to use the same compliance tool for many different project locations.

After the building data is entered, COM*check* indicates whether the proposed building envelope passes or fails the chosen energy code requirements. The program is available for downloading from: http://www.energycodes.gov/comcheck/ez_download.stm.

This TEK provides a basic overview of the program as well as some guidance on concrete masonry building envelope compliance.

APPLICABILITY

COM*check* was developed by the United States Department of Energy for commercial building energy code compliance. By selecting the *Code* tab on the main menu (see the top row on Figure 1), the program enables the user to choose the code and year for compliance. Currently, the following codes are included in COM*check*:

- the *International Energy Conservation Code* (ref. 2), IECC (1998, 2000, 2001, 2003, 2004 and 2006 editions),
- ASHRAE Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings* (ref. 3) (1989, 1999, 2001 and 2004 editions), and
- state energy codes for Georgia, Massachusetts, Minnesota, New York and Vermont.

COM*check* is applicable to all buildings other than low-rise residential, i.e., most commercial, industrial, hotels and educational buildings as well as residential buildings over three stories in height. For low-rise residential buildings, the program RES*check* (ref. 4) can be downloaded from http://www.energycodes.gov/rescheck/.

BUILDING ENVELOPE COMPLIANCE

After choosing the appropriate code, the next screen displayed, the *Project* screen, enables the user to enter the building location (which determines climate) and the building use category, such as school, office or restaurant (which determines the internal heat loads, such as lighting loads). The building gross floor area is also entered on the *Project* screen. Note that for multi-story buildings, the total area of all floors is entered, while for single story buildings, the gross floor area is generally equal to roof area. The user can also add descriptive text about the building, client and location.

After the basic information has been entered, the user chooses the *Envelope* tab to display the envelope compliance screen (see Figure 1). Building envelope data input for COM*check* is straightforward. The user describes the building envelope, component by component, from a series of drop-down menus.

Individual envelope elements (roof, skylight, exterior wall, etc.) are chosen from the row above the data table. Then, the table is filled in with a description of each element, the element size, R-values or U-factors to describe the steady-state resistance to heat transfer, and solar heat gain coefficient (SHGC) for windows.

When the building envelope has been completely described, the software combines this input with the weather data embedded in the program to perform a location-specific analysis.

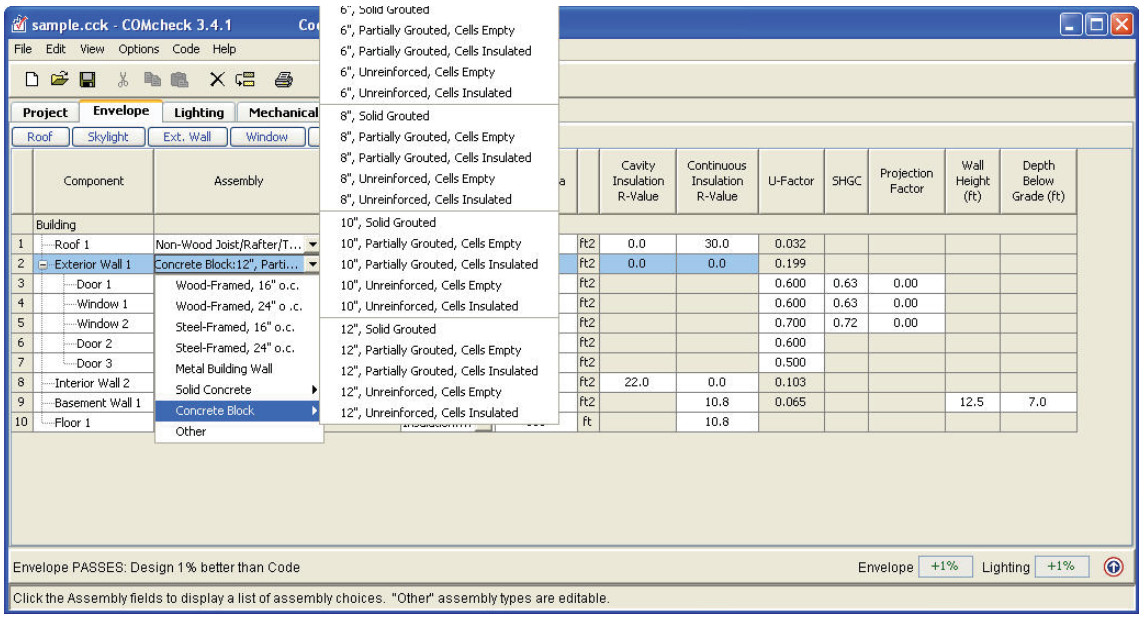

Figure 1—COMcheck Building Envelope Compliance Screen

The output is a pass/fail rating (in the lower left-hand corner of the screen), along with an indication of how close the proposed building is to meeting the specified code requirements. In Figure 1, the proposed building exceeds the minimum code requirements by 1%. This percentage can help the designer understand the building envelope's sensitivity to various design changes and help optimize building components.

If the program returns *Fails*, one or more envelope parameters can be quickly modified and compliance immediately redetermined. Thus, the user can choose from various ways to improve the envelope performance, whether it be in the roof insulation, high-performance glazing or wall performance, based on the economics of the products involved and on other project goals or restrictions.

Above-Grade Concrete Masonry Walls

Figure 1 shows the above-grade concrete masonry wall options within COM*check* that can be used to demonstrate compliance with the 2006 IECC. Note that the specific walls listed may vary with the code chosen for compliance.

COM*check* contains a database of precalculated thermal properties for various systems. As a result, once the user chooses a masonry wall construction, the program applies an associated R-value and, for masonry walls, a heat storage capacity describing the wall's thermal mass. Figure 1 shows that COM*check* includes various single wythe concrete masonry walls, with or without insulation in the ungrouted cells, as follows:

- *Concrete Block, Solid Grouted* applies to fully grouted masonry walls. The R-value of any insulation installed between furring should be entered under the *Cavity Insulation R-Value* column, while the R-value of continuous insulation should be entered under the *Continuous Insulation R-Value* column.
- *Concrete Block, Partially Grouted, Cells Empty* applies to masonry with at least 50% of the masonry cells free of grout (see Table 1) and no insulation in the ungrouted cells. As for solid masonry, the R-value of any insulation installed between furring should be entered under the *Cavity Insulation R-Value* column, while the R-value of continuous insulation should be entered under the *Continuous Insulation R-Value* column.
- *Concrete Block, Partially Grouted, Cells Insulated* applies to masonry with at least 50% of the masonry cells free of grout (see Table 1) and integral insulation, i.e. insulation in the ungrouted cells. Masonry core insulation is typically molded polystyrene inserts, expanded perlite or vermiculite granular fills or foams (see *Insulating Concrete Masonry*

Table 1—Percent Grouted Area for Partially Grouted Concrete Masonry Walls

Horizontal grout spacing, in. (mm)	Vertical grout spacing, in. (mm)					
	no vert. grout	48 (1,219)	40 (1,016)	32 (813)	24 (610)	16 (406)
no horiz. grout	0%	17%	20%	25%	33%	50%
48 (1,219)	17%	31%	33%	37%	44%	58%
40 (1,016)	20%	33%	36%	40%	47%	60%
32 (813)	25%	37%	40%	44%	50%	63%
24 (610)	33%	44%	47%	50%	56%	67%
16 (406)	50%	58%	60%	63%	67%	75%

Walls, TEK 6-11 (ref. 5), for more information on insulating concrete masonry walls). Although the R-value of this cell insulation is already accounted for in the program and need not be entered by the user, note that the U-factor included in COM*check* for cell-insulated concrete masonry is conservative. Often, the actual wall U-factor will be lower (i.e., R-value will be higher) than that reflected in the program. In these cases, ASHRAE 90.1 can be used for compliance (see below). Additional insulation installed on the interior or exterior side of the masonry, such as EIFS or insulation between furring, should be entered separately in the *Continuous Insulation R-Value* or *Cavity Insulation R-Value* column, respectively.

- *Concrete Block, Unreinforced, Cells Empty* applies to masonry without reinforcement and without insulation in the ungrouted cells. Although by definition these walls do not include reinforcement, up to 50% of the masonry cells are permitted to be grout-filled (see Table 1).
- *Concrete Block, Unreinforced, Cells Insulated* applies to masonry without reinforcement and with insulation in the cells.

In some cases, the concrete masonry wall being used for the project is significantly different from those listed in the program (see ref. 6 for R-values of concrete masonry walls). For example, the R-values in COM*check* for concrete masonry with insulated cells are based on loose fill insulation. In addition, partially grouted walls are assumed to be grouted at 32 in. (813 mm) o.c. vertically *and* 48 in. (1,219 mm) o.c. horizontally. Buildings with masonry walls utilizing better-performing cell insulation systems and/or less grout can demonstrate compliance by either using ASHRAE 90.1 (which lists overall wall U-factors for compliance in addition to prescriptive insulation R-values), or by using the *Other* option from the exterior wall pull-down menu. Note that although the *Other* option displays a column for heat capacity (intended to allow COM*check* to distinguish masonry wall requirements from frame wall requirements when determining compliance), the program does not account for concrete masonry's thermal mass when *Other* is selected. (The thermal mass of concrete masonry walls is accounted for, however, when a masonry wall is selected from the program's pull-down menu.) Therefore, compliance can typically be more easily demonstrated using the ASHRAE 90.1 U-factor criteria. TEK 6-12C, *International Energy Conservation Code and Concrete Masonry* (ref. 7) provides further information on using this compliance approach.

When the building's exterior is constructed of more than one type of construction (one story is masonry and another is frame, for example), each construction type should be entered into the program as a separate wall. When all above grade exterior walls are the same construction, they can be entered into the program as a single wall, unless the optional wall orientation option is selected.

Choosing *Orientation* from the *Options* tab on the main program menu bar allows the user to enter solar orientation (north, east, south or west) for each exterior wall, and displays this information in an additional column on the *Envelope* screen. When *Orientation* is not selected, the building envelope assemblies are assumed to be equally distributed. Therefore, compliance results may be slightly different. Selecting *Orientation* may be an advantage when fenestration for the proposed building has been located to maximize energy efficiency (see *Passive Solar Design*, TEK 6-5A (ref. 8), for more detailed information).

Multi-Wythe Masonry Walls

Only single wythe masonry walls are explicitly included in the COM*check* drop-down menus. When using multi-wythe walls, such as a masonry cavity wall, the user has two options. The first is to select the backup masonry wythe from *COMcheck*'s drop-down menu, and enter the R-value of the cavity insulation under *Continuous Insulation R-Value*, which effectively ignores the masonry veneer. The second option is to determine the overall wall U-factor of the cavity wall (using *R-values of Multi-Wythe Concrete Masonry Walls*, TEK 6-1A (ref. 9) or other data) and use this to comply with the ASHRAE 90.1 prescriptive U-factor requirement.

Concrete Masonry Basement Walls

The concrete masonry wall types in COM*check* for basement walls are the same as those listed for above grade walls, and data entry is similar. In addition to gross wall area and continuous or cavity insulation R-values, for basement walls the user also enters the basement wall height and the depth below grade (i.e., average grade level to the depth of the basement floor). This information allows the program to account for basement walls that are partially above grade.

Additional Mandatory Requirements

In addition to passing COM*check*'s envelope criteria, there is a list of mandatory requirements that must be met. To access the mandatory requirements, choose *View* then *Mandatory Requirements* from the main program menu. After choosing the applicable code, the program displays a list of items that must be accomplished.

For the building envelope, these mandatory requirements include:

- installation of insulation: ensuring that insulation is installed continuously (without large gaps) and that blown-in insulation is installed to the specified density, to help ensure that the rated R-value is achieved,
- fenestration and doors: U-factors and solar heat gain coefficients (SHGCs) are determined using National Fenestration Rating Council methods,
- vapor retarder requirements as stated in the applicable energy code, and
- air leakage: requires caulking and weather-stripping to minimize energy losses and the associated moisture migration due to air leakage through the envelope, and in some cases stipulated maximum air leakage rates for some envelope components, such as doors and curtain walls.

LIGHTING AND MECHANICAL COMPLIANCE

Compliance for the lighting and mechanical systems has a similar format to that for the building envelope: a compli-

ance screen and a list of mandatory requirements. Note that the mechanical, lighting and envelope compliance are all independent of each other.

The lighting input is formatted similarly to envelope, with various lighting fixture types choices, and drop-down menus for the ballast, number of lamps, number of fixtures and wattage per fixture, which are used to develop the proposed lighting schedule. At the bottom of the screen the program produces a "Passes" or "Fails" message. Similar to the envelope compliance, any combination of lighting components can be used, as long as the total meets the lighting budget for the proposed building.

For lighting, the mandatory requirements cover primarily lighting controls and exterior lighting requirements.

Mechanical compliance for COM*check* is different from the envelope and lighting. The mechanical section generates a list of mandatory requirements based on the list of mechanical components input by the user. So, rather than producing a pass or fail message, the program generates a checklist of requirements that must be met. This compliance checklist covers items specific to the systems input into the program, as well as generic requirements, including heating & cooling controls, pipe and duct insulation, requirements for dampers and duct sealing.

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