NATIONAL CONCRETE MASONRY ASSOCIATION
Sustainable Concrete Products for Structures and Hardscapes

ENERGY CODE COMPLIANCE USING COMCHECK™

TEK 6-4B
Energy & IAQ   (2012)

INTRODUCTION

COM*check*™ (ref. 1) is software developed by the U.S. Department of Energy specifically for demonstrating compliance with nationally recognized energy codes. Versions are available for download (for various software platforms) as well as for online use. Using the tradeoff compliance method allowed by energy codes, such as COM*check* software, may provide more design flexibility when compared to prescriptive table requirements. For example, parameters such as fenestration area can be increased above the prescriptive limitations, and the additional energy demand offset by adjusting fenestration characteristics and/or 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 energy codes and energy standards 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 the percentage by which the proposed building envelope passes or fails the chosen energy code requirements. The program can be downloaded free of charge from: http://www.energycodes.gov/comcheck/download.stm. It is advisable to also review the known problems in COM*check,* which are documented on this same site.

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

APPLICABILITY

COM*check* enables the user to choose the code and year for compliance. This is a critical first step, as energy code requirements can be significantly different from one edition of the code to the next. If unknown, the local building department can provide this information. Currently, the following codes are included:
- the *International Energy Conservation Code* (ref. 2), IECC (2000, 2001, 2003, 2004, 2006 and 2009 editions),
- ASHRAE Standard 90.1, *Energy Standard for Buildings Except Low-Rise Residential Buildings* (ref. 3) (2001 2004, 2007 and 2010 editions), and
- state energy codes for New York, North Carolina, Oregon and Vermont, as well as for Puerto Rico.

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/download.stm.
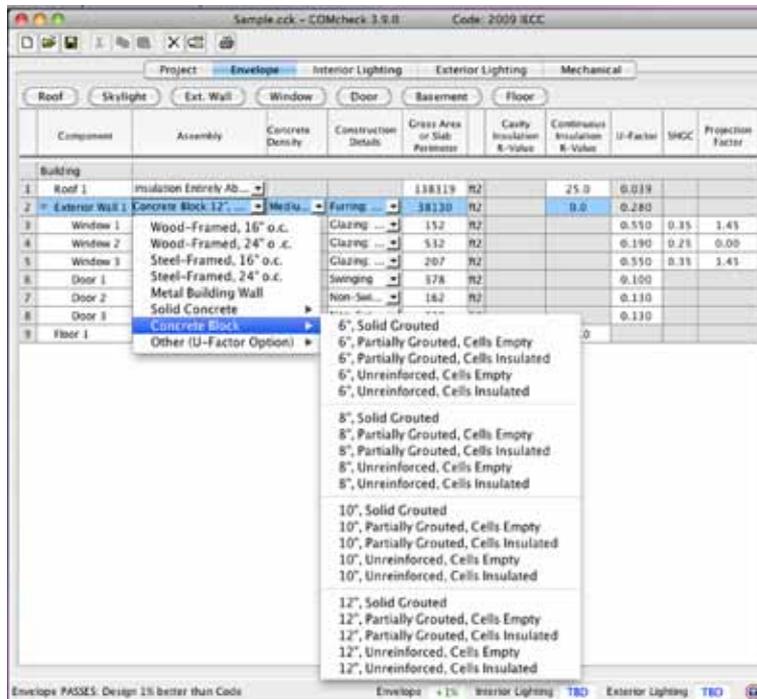
BUILDING ENVELOPE COMPLIANCE

After choosing the appropriate code, the *Project* screen is used 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's 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

Related TEK:

Keywords: building envelope, code compliance, COM*check*, energy codes, energy efficiency, software

Figure 1—COM*check* Building Envelope Compliance Screen Showing Drop-Down Menu for Above Grade Concrete Masonry Walls

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, either from a series of drop-down menus or from user-entered data.

Individual envelope elements (roof, skylight, exterior wall, etc.) are chosen from the row above the data table. Then, the table is populated 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.

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 2009 IECC. Note that the specific walls listed may vary somewhat 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 concrete block 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 or cells that are grouted no more than 32 in.

(813 mm) o.c. vertically and 48 in. (1,219 mm) o.c. horizontally, and with no insulation in the ungrouted cells. Similar to 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) or cells that are grouted no more than 32 in. (813 mm) o.c. vertically and 48 in. (1,219 mm) o.c. horizontally, and with 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 Walls*, TEK 6-11A (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, the user can enter their own wall performance data (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.
* *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 refs. 6 and 7 for R-values of concrete masonry walls). For example, a variety of special unit shapes have been developed to increase energy efficiency. These units often have reduced web areas to reduce heat loss due to thermal bridging through the webs. Even conventional concrete masonry units may have significantly better thermal performance than that assumed in COM*check*, because the thermal values in COM*check* for concrete masonry are conservative for many walls. R-values in the COM*check* database for concrete masonry with insulated cells are based on loose fill insulation, which has a relatively low R-value per inch of thickness. 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-per-

forming cell insulation systems, special unit shapes and/or less grout can demonstrate compliance by using the *Other* option from the exterior wall pull-down menu.

Note that when the *Other* and *Mass* options are chosen, the screen displays a new column for heat capacity (which allows COM*check* to distinguish masonry wall requirements from frame wall requirements when determining compliance). When custom data is entered using this option, the user enters both the overall U-factor of the wall (including all insulation and finish materials) as well as the wall heat capacity (see TEK 6-16A , *Heat Capacity (HC) Values for Concrete Masonry Walls*, ref. 8).

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. 9), 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 and heat capacity of the cavity wall (using TEKs 6-1B, *R-values of Multi-Wythe Concrete Masonry Walls* (ref. 7), and 6-16A or other data) and enter this data under the *Other* wall option described above.

Concrete Masonry Basement Walls

The 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 without large gaps, without being compressed, and that blown-in insulation is installed to the specified density, to help ensure that the rated R-value is achieved,
- fenestration and doors: certified to meet air leakage requirements, and
- air leakage: requires sealing, caulking, gasketing and/or weather-stripping at joints and penetrations to minimize energy losses and the associated moisture migration due to air leakage through the envelope.

LIGHTING AND MECHANICAL COMPLIANCE

In COM*check,* the mechanical, lighting and envelope compliance are independent of each other (i.e., improved HVAC performance cannot be used to help offset lighting or envelope requirements, for example). The lighting input has a similar format to the envelope, with various lighting fixture types, and drop-down menus for the ballast, number of lamps, wattage per fixture, etc. 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. The mandatory lighting requirements primarily cover 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.

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