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June 6, 2006**No: 2004 OSSC 1311.1
2004 Oregon Structural Specialty Code**

Code Section: OSSC 1311.1**Code Edition:** 2004 Oregon Structural Specialty Code (OSSC)**Date:** Original: 5/25/1999 Updated: 5/6/2007**Subject:** Whole Building Approach**Question:** Should the public domain energy simulation computer program DOE2.1E and the Oregon Department of Energy, May 1995 publication *Methodology for Compliance Using the Whole Building Approach* be approved to demonstrate and verify energy conservation compliance for buildings and structures other than Group R occupancies, three stories or less in height, under Section 1311.1 of the Oregon Structural Specialty Code.**Answer:** Yes.**Analysis:** Oregon Structural Specialty Code (OSSC), Chapter 13, "Other Building provisions" regulates energy conservation requirements within buildings and structures, other than Group R occupancies, three stories and less in height. The code requirements cover the building or structural envelope; mechanical systems including heating, ventilating and air conditioning systems; and lighting systems. These provisions became effective October 1, 1998. Chapter 13 allows energy conservation compliance in two ways. Prescriptive provisions are in Sections 1312 through 1317. Under this path the builder follows predetermined requirements that are matched to provide the necessary energy efficiency designed into the code. Section 1311.1 allows an alternate design method using a "whole-building approach" (WBA). Under WBA a building or structure must be designed so the entire building or structure's annual energy consumption will not exceed that of a similar building using similar forms of energy modeled according to prescriptive requirements of the code. The WBA allows innovative and unique building design. DOE2.1E and the Oregon Department of Energy, May 1995 publication, *Methodology for Compliance Using the Whole Building Approach*, has been proposed as a method to demonstrate and verify compliance with the WBA in Chapter 13. (1) To determine compliance with the alternate design method under the new code, the Technical Work Group (TWG) established criteria for evaluating computer programs to simulate annual 1 energy usage. The criteria required that programs: Provide an hourly thermal simulation which models all of the energy related systems in the building, including envelope components, HVAC systems, lighting systems, transportation, refrigeration, water heating and other equipment. Compute the thermal loads and the system's energy consumption and central plant energy usage for each hour of the year for a full 8,760 hours.

Be readily available and cost effective to run. Have algorithms and input structures that are in the public domain, making the items available for public review. Be able to compute the cost of energy to the end user. Have verification by actual building energy consumption. Have capability to model day-lighting of buildings. (2) The TWG reviewed various programs designed to simulate annual energy usage. DOE2.1 E met all criteria established by TWG for comparing energy measures.

(3) DOE2.1E is a nationally-recognized standard computer program for performing energy analysis on buildings.

DOE2.1 has 20 years of development and has been widely used by industry for over 15 years. DOE2.1 is accepted for determining energy efficiency by the American Society of Heating, Refrigerating, and Air-conditioning Engineers (ASHRAE) Standard 90.1 1997, State of California (Title 24, Part 6, Chapter 1 Building Energy Efficiency standards); and State of Washington (Non-Residential Code--Reference Standard 29). Oregon utilities have used DOE2 for work on commercial design programs for more than 10 years and use the program to verify energy efficiency and justify its energy efficiency loans.

(4) The DOE2.1 program is validated for accuracy both in controlled laboratory studies and in comparison with actual detailed building metered energy use. DOE2.1E accuracy is detailed in the DOE2.1E Users Manual, 1994. Actual building metered energy use is documented through *Commercial Hourly End-Use Study*, Seattle City Light, 1984-1987 and *Energy Edge Program*, Bonneville Power Administration, 1985-1994.

DOE2 is also validated by comparisons with actual building total energy use throughout the Northwest in utility program evaluations. Utility program evaluations include *Pacific Corp Energy Fin Answer Impact Evaluation 1994*; *Portland General Electric Energy Smart Design Program Impact Evaluation 1994*; *Northwest New Commercial Evaluation Project*, Bonneville Power, Puget Power, Seattle City Light and Idaho Power, 1994.

(5) Additionally, DOE2.1E provides the necessary level of detail to adequately model all energy consuming systems in the building. Specifically:

DOE2 provides detailed modeling of all envelope components, virtually all commercially available HVAC systems, and central plant systems such as chilled water and steam systems.

Version 2.1E, the latest version, includes day-lighting, evaporative cooling, and refrigeration systems. Other features have been refined and verified on an ongoing basis over the years.

(6) DOE2.1E has literally hundreds of input parameters, most of which cover items that are not directly regulated by the Energy Code. As a result, it is difficult to interpret whether the proposed building design uses equivalent amounts of energy due to improvements in the building design or whether this simply reflects changes in non-related inputs such as occupancy levels and operation schedules. There are also many different ways to model code-related features which may have unintended and inappropriate impacts on the modeling results. In order to focus the issue to energy conservation, industry standards, utility programs and other state code agencies produced detailed modeling specifications. The Building Energy Cost Budget Method contained in ASHRAE Standard 90.1-1997 is an accepted industry standard. Utility programs include *Guidelines for Energy Simulation of Commercial Buildings*, Bonneville Power Administration, March 1992 and *Pacific/Utah Power Energy Fin Answer ECM Modeling Guidelines*, February 1994.

Other state code agency guidelines include *Alternate Calculation Method for Compliance with Title 24*, California Energy Commission, 1992 and Reference Standard 29, *Commercial Building Design by Systems Analysis*, Washington

Non-Residential Energy Code, April 1994.

(7) The TWG developed the following protocols to assure that the DOE2.1E modeling demonstrates compliance with the code. It must: Provide clear identification of components used to trade against non-complying components. Spell out field inspection protocols for traded components. Check non-traded components for compliance with code, agreement with standard engineering practice and for similarity between the base case code building and the proposed building design. Review each input to the simulation to insure that it complies with standard DOE2.1E modeling practice. Be able to remodel the building if the building design changes during construction, to determine if the building still complies with code. Evaluate all custom algorithms to insure that appropriate engineering practice was used.

(8) A method to focus the modeling to Oregon Energy Code compliance was developed by the WBA Subcommittee of the TWG incorporating procedures from ASHRAE, California, Washington and northwest utility programs. The publication entitled *Methodology for Compliance Using the Whole Building Approach*, published by ODOE in connection with both the TWG and Energy Committee, meets the guidelines.

(9) Special skills are required to review a building design for compliance based on modeling using DOE2.1 E and the Methodology. These include:
Demonstrated ability in using the DOE2.1E (or prior versions of DOE2) simulation program.

Ability to model basic commercial features, such as internal gains, multiple zones, central HVAC, envelope measures which affect thermal transmission, window shading coefficients, and more complex systems such as refrigeration system heat recovery, heat pumps, and building mass. Experience in the use of building simulation models. Proficiency in the application of energy code requirements. Familiarity with code enforcement practices.

Demonstrated direct involvement in the design of constructed office type buildings, commercial or institutional buildings or equivalent experiences.

This interpretation deals with approving a means and method to demonstrate compliance with an alternate design and construction method and is within the scope of ORS 455.060.

Choice of means and method for demonstrating compliance. The means and method selected must allow compliance with the whole building approach in 2004 OSSC Section 1311.1. As relevant, it provides, "[applicants using alternate building systems and equipment design shall demonstrate that the whole building annual energy consumption will not exceed that used by similar buildings using similar forms of energy designed in accordance with the prescriptive requirements of 2004 OSSC Chapter 13]."

The criteria established by the TWG was reasonably designed to evaluate and select a computer program that would reasonably model code regulated items to determine annual building energy consumption as specified under 2004 OSSC Section 1311. 1.

Selection of DOE 2.1E. The board relies on the fact the program has credibility based on its use by ASHRAE, various states and industry and its use by utilities to justify funding of energy conservation measures. It has gone through testing, review and improvements over its 20 years of use. The board believes the program is adequate and accurate based on studies comparing DOE2.1 modeled energy consumption with actual building energy use under a variety of conditions and buildings across the northwest region.

Selection of focus mechanism. DOE2.1E must be focused to provide data that will demonstrate compliance with WBA. This is accomplished by the ODOE Methodology by specifying input parameters that are used in the simulation. The ODOE "methodology" was developed specifically for use with 2004 OSSC

Section 1311.1 and is based on similar processes used in California, Washington and the ASHRAE standard.

The guidelines adopted for the development of the Methodology are reasonably designed to focus on the Oregon requirements.

The methodology is reasonable. Knowledge and skills required by persons reviewing DOE2.1E and the Methodology are provided so a jurisdiction can examine the qualifications of persons reviewing supporting documentation or providing verifications. The board recommends that the enforcing jurisdictions ask for and review the qualifications of persons reviewing WBA documentation for code compliance and act accordingly.

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