COMPARISON OF

RESIDENTIAL ENERGY CODES

OREGON
WASHINGTON
IDAHO
MONTANA
CALIFORNIA

ENERGY EFFICIENT INDUSTRIAL HOUSING RESEARCH PROGRAM

CENTER FOR HOUSING INNOVATION
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CONTENTS

1.0 EXECUTIVE SUMMARY

The objective of this investigation is to gain an understanding of the code requirements in order to gauge the task of developing an energy code compliance tool for use by industrialized housing producers. Although this pilot study was limited to 5 states we expect it is representative of other regions of the U.S. This document reduces the various code material to a format facilitating direct comparison and analysis. Included are tabulations of code requirements by component or code issue, a tabulation of code jurisdictions and a direct comparison of the codes. All identifiable regional, state, and local codes for the Oregon, Washington, Idaho, Montana and California are included in this investigation with the exception of Missoula, Montana which uses the Model Energy Code.

The development of a broadly applicable computer code compliance tool is an ambitious endeavor. Issues impacting such a development include changing jurisdictional concerns, evolving code restrictiveness and complexity, variations in methodologies, variations in specific component treatments and the incorporation of innovations in building technology. These issues require a program format which is sophisticated enough to adequately address all the specifics while remaining easily adaptable to the evolution of the energy codes. In addition, the compliance tool would require a process to insure program reliability. This credibility would be essential if the computer analysis is to be accepted by the code officials in the many jurisdictions.

This investigation determines that the general approach to regulating energy consumption in buildings is consistent across the codes investigated. All have a prescriptive method for simple compliance where the proposed design must meet the prescribed heat transfer coefficient value (U) for each component. All except Montana allow for more flexibility through a performance option which is dependent on an envelope heat transfer rate (BTU / Hr F) for the whole building. This method allows for adjustments to the individual component 'U' values as long as the overall heat transfer rate for the building remains below the target. Additionally most codes offer an energy budget method which utilizes engineering calculations and computer programs to determine an overall energy performance similar to the performance method. This is the most flexible compliance method which allows incorporation of design issues such as solar gain and thermal mass.

Further investigation into the specific requirements for the individual components reveals a more complex situation. The various codes have unique methods for evaluating the many energy consuming aspects of residential design. Below grade walls and slabs, for example, are considered as one component in the 1987 Northwest Energy Code. The Washington code however treats the below grade walls and slabs separately. In another example, some codes consider walls as a system, including windows and doors, while others consider these components separately prescribing individual thermal performance requirements. Climate considerations are also significant in the comparisons of the many codes. While Oregon has only one zone throughout the state, Washington has two, the Northwest Energy Code three, and California employs sixteen.

Another significant consideration is the maintenance required for a code compliance tool. The program must be current with respect to the many code revisions and jurisdictional changes. New technology in such areas as HVAC systems, stress skin panels, and glazing must be interpreted and incorporated in a timely manner. The necessity of prompt and thorough communication throughout the building industry increases when one considers the dynamic nature of the energy code environment. While most codes appear to be on three year revision cycles, these cycles do not run concurrently and are dependent on the legislative process of their state government. As energy concerns increase these revisions are becoming more rather than less complex. To illustrate this observation one must only compare the highly developed California energy code with some of the less developed energy codes in states which have not yet grappled with this issue.

Computer based energy code compliance tools are now widely available. The Wattsun program, developed and maintained by the Washington State Energy Office, serves as a residential energy code compliance tool for building inspectors throughout the Northwest. In California, energy performance programs have become integral to the certification process. Calpas and Sunday are two programs frequently utilized. With this proliferation of computer applications throughout the building industry, it is a short conceptual step, but a substantial implementation step to the combination of different computer applications into one program. Particularly attractive is the inclusion of energy code compliance capability into computer aided design programs.

2.0 INTRODUCTION

The proliferation of computers into the building industry opens many options for the injection of energy conservation issues into the design process. One significant opportunity is the development of an energy code compliance tool which can be combined with a design program to provide information on energy and code implications of design decisions as they are being considered. The objective of this investigation is to gain an understanding of the code requirements in order to gauge the task of developing an energy code compliance tool for use by industrialized housing producers.

The regulatory methodology used throughout the Northwest and California is described in the code compliance section. All of the codes use a similar approach to regulating building design. Typically three compliance options are available: prescriptive, performance and energy budget. These methods allow various degrees of design flexibility which are accompanied by variations in the complexity of the compliance tool.

The component requirements of each code are presented in the 'Residential Energy Code Data' section. This includes a detailed tabulation allowing direct comparison of the various codes by building element. These tables provide an understanding of the variations across the codes investigated and should aid a programmer in understanding the complexities involved in modeling each code issue. Information explaining the code jurisdictions is also included in this section. Table 3.1a documents the percentage of households affected by the codes investigated, and figure 3.1a provides a geographical representation of the code jurisdictions.

An overall comparison of the codes is presented in the 'Energy Code Comparison by Building Component' section. A simple design is subjected to each of the codes and the approximate envelope heat loss (steady-state) is determined and tabulated in figure 4.0a. Table 4.0a allows a numerical comparison of the code requirements by many of the components considered in the code comparison process.

Due to the broad range of this investigation a fair number of inconsistencies and confusions were encountered. While most of these were resolved, the code material and references are provided with this report to assist in further clarifications. It should be understood that while this document is a good source for comprehending the relationship of the codes and their methodology, it is not a code compliance tool. The appropriate codes for the various jurisdictions are the sole reference and authority for determining energy code compliance.

2.0 CODE COMPLIANCE

The methodology of code compliance is similar throughout the Northwest and California. It is based on meeting the code requirements through one of three methods: prescriptive, performance or energy budget. The builder must decide which compliance method is best suited for the design.

3.1 PRESCRIPTIVE METHOD

The prescriptive compliance method requires adherence to heat transfer coefficient (U) values and area restrictions applied to a relatively short list of design features. This often precludes such features such as skylights and passive solar glazing designs. In many cases more than one set of criteria are available. These are referred to as 'compliance paths.' The 1992 Oregon code will offer nine compliance paths which allow a range of residential designs including some passive solar elements and log homes.

The paths are based on cost effectiveness as well energy efficiency. Therefore the codes do not specify an overall energy consumption limit such as a BTU / Hr Sq-Ft value. Each design will have an unique energy performance dependent on its size, configuration, and in most cases, geographic location.

3.2 PERFORMANCE METHOD

The proposed design must meet an envelope heat loss value. The heat transfer coefficient (U) prescribed by the code for each component is multiplied by the component's area (A). The overall heat loss target value is determined by adding the UA values of all the design components such as walls, glazing, ceilings and doors. This target must be met by the actual envelope heat loss value of the proposed design determined by using the actual 'U' values specified in the design (see figure 4.0a and the Wattsun runs in section 5.0). This method is more flexible allowing inclusion of a broader range of design features. For example, less efficient wall systems may be permissible if more efficient glazing is specified. In addition, passive solar elements typically will receive some credit toward meeting the code.

The California energy code uses a variation of this method referred to as the point system. This calculation method is based on one of the prescriptive paths and assigns points, positive or negative, for deviation from the base path. Taking the raised floor for an example, R 30 insulation in this component receives a point value of +3, a credit for exceeding the prescriptive requirement of R 19. The use of R 19 receives a point value of 0. An uninsulated floor receives a point value of -19. These values are summed to determine if the proposed design qualifies. A positive or zero value for the building indicates compliance. By this method any components which receive a negative value must be balanced by other components with positive values. This method includes many additional considerations such as glazing issues and thermal mass. Refer to the 'Energy Conservation Manual for New Residential Buildings,' available from the California Energy Commission for more information on this compliance method.

3.3 ENERGY BUDGET METHOD

With this method the proposed design must meet an overall energy budget similar to but more involved than the prescriptive method. It allows any design whose annual energy loads are certified by engineering calculations to be less than the same building using the prescribed insulation levels. This certification typically involves the use of programs such as Wattsun (Northwest) or Calpas (California). The energy issues involved will include infiltration, mass, solar orientation and HVAC efficiencies.

California has developed a guideline for the qualification of compliance calculation methods. This is available in the 'Alternative Calculation Methods Approval Manual for the Low-Rise Residential Building Energy Efficiency Standards,' which applies to engineered calculations as well as computer programs. The Northwest states have not developed a certification method (due to a lack of demand). The preferred method is to compare the output of new methods of calculation to an accepted program such as Wattsun for verification.

4.0 RESIDENTIAL ENERGY CODE DATA

4.1 RESIDENTIAL ENERGY CODE JURISDICTIONS

This investigation considers all the energy codes enforced in California, Idaho, Montana, Oregon, and Washington with the lone exception of Missoula, Montana which is governed by the Model Energy Code (not investigated in this report). The Oregon and Washington state codes cover almost 80% of the households within the Northwest region. Their total however represents less than a third of the households governed by the California energy code. All these codes together cover about 15% of the households in the country.

In Oregon and California one code governs the entire state. However, in some cases more than one code may be used within a state. For electrically heated homes the 1991 Washington State Energy Code covers only 16% of the state while the Northwest Energy Code governs the majority. However jurisdictions using the Northwest Energy Code are expected to adopt the Washington code after the BPA incentive program expires in December 1991. In another example the Northwest Energy Code governs 30% of the electrically heated households in Idaho while the Idaho state code governs close to 70%.

The implications of this complex regulatory environment on a region-wide computer compliance tool are significant. There are a wide range of issues to be considered and more than 100 jurisdictions to track. To complicate the process, all of the codes experience revisions on independent schedules. In the past the revisions were generally implemented on three year cycles. However this is dependent on the state's legislative process. The California code was revised in 1984 then again in 1988. The Oregon code was revised in 1985, 1988, and will experience a major shift in methodology in the 1992 revision. In addition the jurisdictions continue to shift, fortunately toward a uniform state code. Seattle for example has adopted the Washington state code, and other localities are expected to follow suit.

Figure 4.1 - 1

NORTHWEST AND CALIFORNIA ENERGY CODE JURISDICTIONS

These codes apply throughout their state unless noted under 'Exceptions'.

California - 'Building Energy Efficiency Standards,' 1988 Editions.
Idaho - 'Idaho Residential Energy Standards,'1991.
Montana - 'Administrative Rules of Montana,' 1990.
Oregon - 'State of Oregon 1990 Edition One and Two Family Dwelling Specialty Code,' 1990.
Washington - 'Washington State Energy Code,' Chapter 51-11 WAC.

EXCEPTIONS: (none in California and Oregon)

- O Tacoma, Washington: Tacoma Energy Code.
- ◉ Missoula, Montana: Model Energy Code.
- ● Idaho cities using the 'Northwest Energy Code'.
- ▨ Idaho and Washinton counties using the 'Northwest Energy Code': (see attached list).

Energy Code Jurisdictions Demographics[1]	Residential Energy Code Jurisdictions					
	Area (sq-mi)[2]	%	Population[3]	%	Households[4]	%
Wash. State Code	66,511	17.0%	4,462,000	49.7%	1,691,000	49.6%
Tacoma Code	----	----	158,950	1.8%	63,400	1.8%
Oregon Code	96,184	24.6%	2,698,000	30.0%	1,044,000	30.7%
Idaho State Code	82412	21.1%	1,002,000	11.2%	354,000	10.4%
NW Energy Code	43,218	11.1%	3,937,090	43.8%	1,459,387	42.8%
Montana State Code	145,388	37.2%	819,000	9.1%	318,600	9.3%
Model Energy Code	----	----	33,960	0.4%	13,600	0.4%
Totals (NWest)[5]	390,495	100%	8,981,000	100%	3,407,600	100%
California	156,299		26,981,000		9,616,000	
U.S.A.	3,539,289		241,078,000		87,489,000	

Notes: 1-These figures include entire area and population within the jurisdictions, derived from census data. They do not reflect actual structures built to the specific code.
2- Geographic area of jurisdiction.
3 Total population within jurisdiction area.
4- A household is a house, apartment or single room occupied as separate living quarters.
5- NW Energy Code figures are included in the Washington and Idaho data.

Table 4.1 - 1

JURISDICTIONS OPERATING UNDER THE NW ENERGY CODE (9/91)
Electrically Heated Homes Only

WASHINGTON:

Adams	Ione	Poulsbo
Arlington	Kennewick	Pullman
Battleground	King County	Quincy
Benton County	Kitsap County	Redmond
Blaine	LaCenter	Republic
Bremerton	Lacey	Richland
Bridgeport	Lake Stevens	Ridgefield
Brier	Lincoln County	Royal City
Camas	Lynnwood	Snohomish County
Cathlamet	Marysville	Snoqualmie
Clallam County PUD	Mason County PUD	Soap Lake
Clark County	Metaline Falls	Spokane
Columbia County	Mill Creek	Spokane County
Conconully	Milton	Stanwood
Connell	Monroe	Sultan
Cosmopolis	Montesano	Tacoma
Cusick	Moses Lake	Thurston County
Eatonville	Mulkilteo	Tonasket
Edmonds	Newport	Twisp
Ephrata	Okanogan	Vancouver
Everett	Okanogan County	Warden
Ferry County	Omak	Washougal
Fife	Orville	Westport
Fircrest	Pateros	Winslow
Franklin County	Pend Oreille County	Winthrop
Grand Coulee	Pierce County	Yacolt
Granite Falls	Port Angeles	
Grant County	Port Orchard	
Grays Harbor County		

IDAHO:

Bonneville County	Declo	Latah County
Bingham County	Albion	Bonner County
Idaho Falls	Rupert	Sandpoint
Iona	Burley	Priest Point
Ucon	Moscow	Ponderay
Blackfoot	Bonners Ferry	East Hope
Franklin	Orofino	Koonenai (city)
Ammon	Nez Perce Tribe	Clark Fork
Shelby	Kootenai County	Dover
Minidoka County	Harrison	Hope
Heyburn	Soda Springs	Oldtown
Minidoka (city)	Nampa	Post Falls

Utilities using the 'Model Conservation Standards' as a utility hook-up policy:
Bonners Ferry, Rupert, Burley

Table 4.1 - 2

4.2 RESIDENTIAL ENERGY CODE SUMMARIES

These summaries are comprehensive tabulations of the prescriptive and performance compliance requirements of the California and Northwest region codes. It is intended to aid in the comparison of these codes to facilitate the development of a computer compliance program. This material also clarifies much of the documentation and provides easier reference for specific building components and issues. The summaries organize the code requirements by energy code issue, glazing, skylight, infiltration, etc. This provides an understanding of the range of issues involved in a code compliance tool applicable to all of these codes.

The information in these tables is organized under four headings: 'Codes,' 'Information,' 'Variable,' and 'Notes.' The first column, 'Codes,' lists the references for each issue within each code. The 'Information' column offers brief descriptions of the requirements for each of the components. While an general understanding can be drawn from this information, the actual code, referenced in the first column, must be consulted for a complete explanation. The third column, 'Variable,' is intended to provide the programmer with a feel for the variables required to begin modeling that component. The 'notes' provide further clarification of the issues involved for each component under each code.

The overall code compliance methodology as described under section 2.0 is consistent with all the codes except Montana, which uses only the prescriptive method, and California, which uses the point system for the performance method. However the treatment of the individual components varies significantly. Below grade walls, for example, experience a broad range of treatment. The Super Good Cents criteria bases performance on wall depth, while the 1987 Northwest Energy Code uses a value based solely on the perimeter length. Other codes treat below grade wall as above grade wall or make no reference to this component at all. Similarly, variations are illustrated with the overall wall 'U' values required for the Oregon '88 and Tacoma '87 codes and the different treatments of vaulted ceilings and skylights. The skylights may be modeled as ceiling area in the target house (making compliance more difficult), or as glazing area, as with the Northwest Energy Code and Washington state code. The 1992

Oregon code is unique in assigning a specific 'U' value for skylights.

Other issues which experience extreme variation in treatment are climate zones and compliance paths. Many codes provide a number of compliance options allowing limited flexibility in design (passive solar features, log construction etc.). The 1992 version of the Oregon code offers nine. Others have fewer or in some cases only one set of prescriptive requirements. Climate zones further complicate the process. The number of climate zones varies from one in Oregon, to sixteen in California.

In summary, while the general approach is similar, the specific requirements vary significantly between the codes. A code compliance tool would be required to accommodate all these complexities. While including the various requirements it must remain flexible enough to allow the updates required by the periodic code revisions.

Residential Energy Code Summary

Definition of Terms

Ceiling:	Requirements are dependent on the type of ceiling, flat or vaulted.
Compliance Paths:	Component thermal performance requirements are listed for the prescriptive compliance method. Frequently more than one prescriptive path is provided allowing more flexibility in design.
Climate Zones:	Frequently the design requirements depend on the climate of the building location. These are based on the Heating Degree Days (HDD) of the location.
Design Temperatures:	The setpoint temperatures are provided for heating and cooling seasons.
Doors:	This component is sometimes included in the wall requirements. Distinctions may be made between the main door and other entries.

Ductwork:	Issues involve duct routing and duct insulation requirements.
Floors:	Floors are dependent on the type of space below. Slab on grade floors are treated differently than floors over a crawlspace.
Glazing:	Typically this component is assigned a maximum glazing area as a percentage of the floor area in addition to a heat transfer coefficient value.
Heating Equipment	The efficiencies are specified with several codes. In one case the efficiency determines the insulation requirements.
Infiltration:	This consideration is dependent on the type of construction and is independent of the ventilation requirements.
Internal gain:	The internal gain values for occupants, lights and equipment are provided for use in the energy budget compliance method.
Lighting:	Lighting requirements are not a part of the residential energy codes.
Slab Below Grade:	The requirement specifies a 'R' value of the slab edge insulation or an 'F' value for the perimeter heat loss per foot. It is often dependent on basement depth and may be considered with the below grade wall.
Slab-On Grade:	Similar to Slab-Below Grade.

Skylight:	The performance method target typically does not specify a value for skylights. Some codes consider the skylight area as ceiling area for the target determination. Other codes treat the skylight area as glazing with corresponding 'U' values and area restrictions.
Solar Access:	This consideration addresses the requirements for incorporation of passive solar features. These include minimum access to solar exposure, percentages of south glazing, and treatment of solar glazing areas.
Thermal Mass:	Thermal mass may be a consideration with the codes which allow passive solar design options.
Ventilation:	Typically there are two methods for applying ventilation requirements, room and whole house. Values are provided in cubic feet per minute and air changes per hour.
Walls Above Grade:	Wall insulation requirements specifying either 'R' or 'U' values are specified by the energy code. Some codes include the doors and windows in the overall heat transfer calculation of the wall system.
Walls Below Grade:	This component dependent on several issues and methodologies. Typically a 'U' value based on basement depth is specified. In one case a perimeter heat transfer coefficient (F) is specified for both the slab and wall. This term is multiplied by the perimeter length (ft) to determine the heat loss for that component.
Water heaters:	Some codes specify the required equipment efficiencies. California includes the water heating energy budget in the performance method target calculation.

RESIDENTIAL ENERGY CODE SUMMARY

CEILINGS

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3 Table 5.1	Prescriptive: Tables 6.1-3; R38, 49A; Flat (All Zones) R30; Vaulted (All Zones) Performance: U = 0.021, 0.032 No differentiation betwn flat and vltd	Location, Option, U, A, R, Flat / Vltd	
WASH '91 WAC 51-11 Tables 6.1-6.4 Table 5.1	Presc: Table 6.1-6.4: R = 30, 38, 38A, 49A, 60A Perf: Table 5-1: U = 0.031, 0.034, 0.036	Location, Option, Fuel, Log Home, Flat / Vltd, U, A, R	
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Pg 1.30	Presc: SGC pg 6.1 SCG Spec 1.2 (MCS): R38, R49A Perf: Table Pg 1.30 U =0.020, 0.027, 0.031	Location, Flat / Vaulted, U, A, R	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc: Table 53-P Perf: R38 Flat R30 Vaulted	Option, R, Flat/ Vaulted, U, A	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303	Presc / Perf High Eff Htg Sys: R30 (Flat) R19 (Vaulted) Other Htg Sys: R38 (Flat) R19 (Vaulted)	U, A, R, Flat / Vaulted, Htg System	
IDAHO '90 IRES Builders' Guide	Presc. / Perf: R38, Flat R30, Vaulted	R, Flat / Vaulted	
MONTANA '90 Administrative Code of Montana, 8.70.104	Prescriptive only: R38	R	
TACOMA '87 Tacoma Energy Code Sec 600, Table 6-1 Sec 403, Table 4-2	Presc: R30, 38 Perf: U = 0.026, 0.035 (overall including skylight)	Htng System, R, U, A	
CALIFORNIA '88 Building Energy Efficiency Standards, Table 2-53 Z1-16	Presc: R19 - 38 Perf: R30 - 38 No reference to vaulted ceilings	R, U, A	

RESIDENTIAL ENERGY CODE SUMMARY

COMPLIANCE PATHS			U = BTU / Hr-Sq.Ft- F
CODE	**INFORMATION**	**VARIABLE**	**NOTES**
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3	Prescriptive: 4 Paths Performance: 1 Path	Insulation, Passive solar, Ht pump	Energy budget method allowed
WASH '91 WAC 51-11 Tables 6.1-6.4	Presc: 8 Paths Perf: 1 Path	Htg fuel, Glzg area, Log home	Energy budget method allowed
S.G. CENTS '91 1991 SGC Specs 1.2, 6.1	Presc/Perf: 1 Path		Energy budget method allowed
ORE '92 CABO One and Two Family Dwelling Specialty Code	Presc: 9 Paths Perf: 1 Path, Based on Prescriptive path 1	Passive solar design, Log home	Energy budget method allowed
ORE '88 CABO One and Two Family Dwelling Specialty Code	Presc / Perf: 1 Path		Energy budget method allowed
IDAHO '90 IRES Builders' Guide	Presc / Perf: 1 Path		Energy budget method not allowed
MONTANA '90 Administrative Rules of Montana 8.70.104	Presc / Perf: 1 Path		Energy budget method not allowed
TACOMA '87 Tacoma Energy Code Sec 403, Table 4.1	Presc: 4 Paths Perf: 3 Paths	Heating system	Energy budget method allowed
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16 Sec 5351.(b).2	Presc: 5 Paths Perf: 2 Paths (Energy budget method allowed)		Performance paths are based on presc. paths D and E

RESIDENTIAL ENERGY CODE SUMMARY

CLIMATE ZONES	U = BTU / Hr-Sq.Ft- F		
CODE	**INFORMATION**	**VARIABLE**	**NOTES**
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3, SGC RCR Manual Sec 1, Pg 1	Prescriptive / Performance: 3 Climate Zones based on HDD Zone 1: <6000 HDD Zone 2: 6000 - 8000 HDD Zone 3: > 8000 HDD	Location	
WASH '91 WAC 51-11 Tables 6.1-6.4.	Presc / Perf: 2 Climate Zones defined by county based on HDD	Location	
S.G. CENTS '91 1991 SGC RCR Sec 1, Pg 1	Presc / Perf: 3 Climate Zones Zone 1: < 6000 HDD Zone 2: 6000 - 8000 HDD Zone 3: > 8000 HDD	Location	
ORE '92 CABO One and Two Family Dwelling Specialty Code	Presc / Perf: No Climate Zones		
ORE '88 CABO One and Two Family Dwelling Specialty Code,	Presc / Perf: No Climate Zones		
IDAHO '90 IRES Builders' Guide	Presc. / Perf: No Climate Zones		
MONTANA '90 Administrative Rules of Montana 8.70.104	Presc. / Perf: No Climate Zones		
TACOMA '87 Tacoma Energy Code	Presc. / Perf: No Climate Zones		
CALIFORNIA '88 Building Energy Efficiency Standards, Fig 2.53G	Presc / Perf: 16 Climate Zones	Location	

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DESIGN TEMPERATURES

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Sec 402.6.3	Prescriptive / Performance: NA Energy Budget: Heating: 65 F Cooling: 78 F		
WASH '91 WAC 53-11, Sec 402.1.3	Prescriptive / Performance: NA Energy Budget: Heating: 65 F Cooling: 78 F		
S.G. CENTS '91 1991 SGC Spec. Sec 1.2 RCR Manual Pg 1.30	Prescriptive / Performance: NA Energy Budget: Heating: 65 F Cooling: 78 F		
ORE '92 CABO One and Two Family Dwelling Specialty Code, Oregon Dept of Energy	Prescriptive / Performance: NA Energy Budget: Standard Eneginéering Practice		
ORE '88 CABO One and Two Family Dwelling Specialty Code	No Reference		
IDAHO '90 IRES Builders' Guide	No Refernce		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 602(d) Table 4-16	Prescriptive / Performance: NA Energy Budget: Heating: 70 F Cooling: 78 F		
CALIFORNIA '88 Building Energy Efficiency Standards, Sec 2-5303(a)	Prescriptive / Performance: NA Energy Budget: Heating: 70 F Cooling: 78 F		

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DOORS		U = BTU / Hr-Sq.Ft- F	
CODE	**INFORMATION**	**VARIABLE**	**NOTES**
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3 Table 5.1	Presc: U =0.190, 0.22 Perf: U = 0.190 (All Zones)	Option, U, A	
WASH '91 WAC 51-11 Tables 6.1-6.5 Table 5.1	Presc: Tables 6.1-6.5: U = 0.20, 0.40, 0.14 Perf: Table 5-1: U = 0.20, 0.40	Location, Option, Fuel, Log home, U, A	
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Pg 6.1 SGC RCR Pg 1.30	Presc: SGC pg 6.1 SCG Spec 1.2 (MCS): U =0.19 Perf: U =0.19 (All Zones)	Location, U, A	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc: Table 53-P; U = 0.20, 0.54 Perf: Table 53-P, Path 1; U = 0.54; A = 24 sq-ft max (Main Entry) U = 0.20 (Other Entries)	Option, Main Door, Other Entry, Log Home U , A	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303.C.Exception 2	Presc: U = 0.54 (All Sys) Perf: $U_O = (UA_W)+(UA_D)+(UA_G) / A_O$ $U_O =< 0.171$	U wall, U door, U glazing, A_W A_D, A_G	
IDAHO '90 IRES Builders' Guide	Presc. / Perf: U = 0.22	U, A	
MONTANA '90 Administrative Rules of Montana 8.70.104	Prescriptive only: R2	R	
TACOMA '87 Tacoma Energy Code Sec 600, Table 6.1 Sec 427, Eq 2	Presc: R5, 2.5 Pref: See 'Wall- Above Grade'	Heating System, R	
CALIFORNIA '88 Building Energy Efficiency Standards Tables 2-53 Z: 1-16	Presc / Perf: See 'Walls - Above Grade'	U, A	

DUCTWORK

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Sec 503.9.1	Prescriptive / Performance: R11- in conditioned space	R, Duct Location	
WASH '91 WAC 53-11, Sec 503.9 Table 5-11	Presc. / Perf: R-8: Min Insulation	R	
S.G. CENTS '91 1991 SGC Spec. Sec 1.2 RCR Manual Pg 1.30	Presc. / Perf: R-11	R	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Code Pamphlet # 16	Presc. / Perf: R-8		
ORE '88 CABO One and Two Family Dwelling Specialty Code, Table 53-K Pg 248.U	Table 53.K	R, Location, Htg Sys	
IDAHO '90 IRES Builders' Guide	No Reference		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 602(d) Table 4-16	Presc / Perf: R5,7 (Table 4-16)	R, Duct Location	
CALIFORNIA '88 Building Energy Efficiency Standards	Presc / Perf: No Reference		

RESIDENTIAL ENERGY CODE SUMMARY

FLOORS

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3 Table 5.1; Pg 59	Prescriptive: R 19, 30 Performance: U = 0.029 (All Zones)	Location, Option, R, U, A	
WASH '91 WAC 51-11 Tables 6.1-6.4 Table 5.1	Presc: Tables 6.1-6.4; R 19, 25, 30 Perf: Table 5-1; U = 0.029, 0.041	Location, Option, Fuel, Log Home, R, U, A	
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Sec 6.1 SGC RCR Pg 1.30	Presc: SGC pg 6.1 SCG Spec 1.2 (MCS): U = 0.029 Perf: U = 0.029 (All Zones)	Location, U, A, R	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc: R21, 25, 30 Perf: R25	Path, R, U, A	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303.C.Exception	Presc/Perf: R19; See Sec 5303.C.Excep.	R, U, A	
IDAHO '90 IRES Builders' Guide	Presc /Perf: R19	R, U, A	
MONTANA '90 Adminstrative Rules of Montana 8.70.104	Prescriptive only: R19	R	
TACOMA '87 Tacoma Energy Code Sec 600, Table 6-1 Sec 403, Table 4-2	Presc: R19, 30 Perf: U = 0.034, 0.055 (exposed) U=0.05, 0.055 (enclosed)	Htg Sys, exposed/ enclosed, U, A, R	
CALIFORNIA '88 Building Energy Efficiency Standards Tables 2-53 Z: 1-16	Presc: R11, 19 Perf: R19	R, U, A, Location, Option	

RESIDENTIAL ENERGY CODE SUMMARY

GLAZING

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3 Table 5.1	Presc: Tables 6.1, 6.2, 6.3; U =0.40, 0.50, 0.60 Limit on % Glz w.r.t. Floor Area Solar Gain Credit Perf: U =0.39 (All Zones)	Location, Option, A glz, A flr	
WASH '91 WAC 51-11 Tables 6.1-6.4 Table 5.1	Presc: Tables 6.1-6.4 Perf: Table 5-1: U = 0.400-0.650 A = .15 A (floor)	Location, Option, Fuel, U, A glz, A floor	
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Sec 6.1 SGC RCR Pg 1.30	Presc: SGC pg 6.1 SCG Spec 2.1 (MCS): U =0.40 Perf: U =0.39 A = .15 A(Floor) (All Zones)	Location, U, A glz, A floor	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc: U = 0.40, 0.50, 0.60 Perf: U = 0.40 A = .15 A (Floor)	Option, U, A glz, A floor	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Pg 248 J, K Eq 53-1	Presc / Perf If A <=.17 A (floor) then U =0.65 If A > .17 A (floor) then Use Eq 53-1 U_O= (UA_W)+(UA_D)+(UA_G) / A_O U_O=< 0.171	U, A glz, A floor, A_W, A_D, A_G	
IDAHO '90 IRES Builders' Guide	Presc. / Perf: U =.65 A < .17 A (Floor)	U, A glz, A floor	
MONTANA '90 Administrative Rules of Montana, 8.70.104	Prescriptive only: Double Glazed required		
TACOMA '87 Tacoma Energy Code Sec 600, Table 6.1 Sed 427, Eq 2	Presc: U = 0.40, 0.60, 0.75, 0.90 Min. Layers: Double Max Area = 15-21% of Floor Area Perf: See 'Wall - Above Grade'	U, A floor, Htg Sys	See Skylight criteria
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16	Presc: U =1.10 , 0.65 Perf: U =0.65	U , A wall, A glz (south), Shading	Restrictions: Max area, Max non South Min South, Shading

RESIDENTIAL ENERGY CODE SUMMARY

HEATING EQUIPMENT

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Sec 503.4 Tables 6.1, 6.2, 6.3	Prescriptive: HT Pump min HSPF = 6.8 (Option 3) Performance: See Sec 503.4.2 Energy Budget: HSPF= 6.8	HSPF	
WASH '91 WAC 51-11 Sec 503.4 Sec 402.1.3	Presc / Perf: See Sec 503.4 Gas Heat: AFUE = 0.78 Minimum Heat Pump: HSPF = 6.80 (See Table 5.7) Energy Budget: AFUE = 0.78	AFUE HSPF	Heating Sys tradeoffs allowed.
S.G. CENTS '91 1991 SGC RCR Manual, Specs, Sec 3.1	Presc / Perf: (Must be electric) Ht Pumps w/ capacity > 1.3 Tons: HSPF>= 6.8 BTU Hr/Watt Ht Pumps w/ capacity =< 1.3 Tons: HSPF >= 6.0 BTU Hr / Watt COP >= 3.0	HSPF COP	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Oregon Dept of Energy	Presc. / Perf. / Energy Budget Ht Pumps: HSPF =6.8 Gas: AFUE = 78%		
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303	Presc / Perf Heating equipment determines requirements, see "exceptions" under Sec 5303		
IDAHO '90 IRES Builders' Guide	No Reference		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code	Presc / Perf: Efficiency of system determines compliance path required.		
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16	Presc: Gas 71% Ht Pump: See Sec 2-53Z1-16 Perf: Gas 72% Ht Pump: ACOP = 2.5 See Sec 253Z1-16	ACOP	

RESIDENTIAL ENERGY CODE SUMMARY

INFILTRATION		U = BTU / Hr-Sq.Ft- F	
CODE	**INFORMATION**	**VARIABLE**	**NOTES**
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3 Sec 603 Table 5.1; Pg 59	Presc: Tables 6.1, 6.2, 6.3: ACH = .35 Perf: ACH = 0.35 Standard Framing Q = (ACH) (Vol) (Cp) (D) = UA Cp = Spec Heat, D=Density	Location, Adv / Std Frmg, ACH, Vol, Cp, D, Option	
WASH '91 WAC 51-11 Sec 605.3 Sec 502.4	Presc / Pref: Construction Specification		
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Pg 1.29 See 1991 Sgc Spec Sec 2.3.1	Presc: SGC pg 6.1 SCG Spec 1.2 (MCS) Perf: ACH = 0.35 Standard Framing ACH = 0.20 Advance Q/ T= UA= (ACH)(Vol)(C)	ACH, Vol, C, Framing	C=0.018, 0.0168, 0.0162; See RCR Pg1.29
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc / Perf: Air Leakage: Windows: 0.37 CFM/ Ft of crack Swinging Doors: 0.37 CFM/Sq-Ft Door Sliding Doors: 0.37 CFM/Sq-Ft Door		
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303.e.1	Presc / Perf: Air Leakage: Windows: 0.37 CFM/ Ft of crack Swinging Doors: 0.37 CFM/Sq-Ft Door Sliding Doors: 0.37 CFM/Sq-Ft Door	CFM, A ,L	
IDAHO '90 IRES Builders' Guide	No Reference		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 405	Presc: No Reference Perf: Construction specifications Sec 405		
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16	Presc / Perf: Continuous Barrier Air to Air Ht Exchanger See Table 2-53Z1-16		

RESIDENTIAL ENERGY CODE SUMMARY

INTERNAL GAIN

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Sec 402.6.3	Prescriptive/Performance: None, See Sec 601.1 Energy Budget: Internal Gain = 3000 BTU / Hr (Lights, Appliances, Occupants)	Q	
WASH '91 WAC 51-11 Sec 402.1.3.	Presc: N/A Perf: No Reference Energy Budget: 3000 BTU / Hr	Q	
S.G. CENTS '91 1991 SGC Design Qualification Pg 3.29	Presc / Perf: None Energy Budget: Internal Gain = 3000 BTU / Hr	Q	
ORE '92 CABO One and Two Family Dwelling Specialty Code,	Presc / Perf: None Energy Budget: Standard Engineering Practice		
ORE '88 CABO One and Two Family Dwelling Specialty Code	No Referemce		
IDAHO '90 IRES Builders' Guide	No Reference		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code	Presc / Perf: No Reference		
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z:1-16	No Reference		

RESIDENTIAL ENERGY CODE SUMMARY

LIGHTING			U = BTU / Hr-Sq.Ft- F
CODE	**INFORMATION**	**VARIABLE**	**NOTES**
N W ENRGY CODE '87 NWEC Sec 505.3	Presc. / Perf: R3 Occupancies Exempt		
WASH '91 WAC 51-11 Sec 608, Sec 505	Presc. / Perf: R3 Occupancies Exempt		
S.G. CENTS '91 SGC RCR Sec 6.1	Presc. / Perf: R 3 Occupancies Exempt		
ORE '92 CABO One and Two Family Dwelling Specialty Code, Code pamphlet #13.	Presc. / Perf: R3 Occupancies Exempt		Restrictions on recessed lighting fixtures.
ORE '88 CABO One and Two Family Dwelling Specialty Code	Presc. / Perf: R3 Occupancies Exempt		
IDAHO '90 IRES Builders' Guide	No Reference		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 426 Sec 604	Presc / Perf: Residential Buildings (R- 3) Exempt		
CALIFORNIA '88 Building Energy Efficiency Standards, Sec 2-5319(i)Exception 1	N o Requirements		

RESIDENTIAL ENERGY CODE SUMMARY

SLAB - BELOW GRADE		U = BTU / Hr-Sq.Ft- F	
CODE	**INFORMATION**	**VARIABLE**	**NOTES**
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3 Table 5.1	Prescriptive: Tables 6.1, 6.2, 6.3; R10, (All Zones) Performance: See 'Walls - Below Grade'	Location, Option, R, F, P	
WASH '91 WAC 51-11 Tables 6.1-6.4 Table 5.1	Presc: Tables 6.1-6.4: R10, 12 (see note: table6.1-4) Perf: Table 5-1; F = 0.57, 0.64, 0.69	Location, R, Option, Fuel, Log Home, F, P, Wall Dept	
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Sec 6.1 SGC RCR Pg 1.30	Presc: SGC pg 6.1 SCG Spec 1.2 (MCS) Perf: 2' : F = 0.61 (All Zones) 3.5' : F = 0.57 " 7' : F = 0.43 "	Location, A, F, P, Insul depth,	2', 3.5', 7' Refer to the wall depth
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc / Perf: R15 (All Paths)	Path, R, P, F	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303.C4 Table 53A	Presc / Perf: No Reference	R, P, F	
IDAHO '90 IRES Builders' Guide	Presc. / Perf: No Reference		
MONTANA '90 Administrative Rules of Montana, 8.70.104	Prescriptive only: R6	R	
TACOMA '87 Tacoma Energy Code Sec 600, Table 6-1 Sec 403	Presc / Perf: No Reference		
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16	Presc / Perf: R 7 (All Zones and Options)	Location, Option, R, F, P	

RESIDENTIAL ENERGY CODE SUMMARY

SKYLIGHT

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Sec 602.8.2.Exception 2 Sec 502.2, Sec 201.1 Defin. Table 5.1	Presc: No restriction provided area is doubled and added to total glzg area for compliance with max glzg area restriction. Perf: U = 0.39	U, A glz, A skylt	See Glzg Definition Sec 201.1
WASH '91 WAC 51-11 Sec 602.7, 201.1 Tables 6.1-.4 Table 5-1	Presc: Tables 6.1-6.4: (Glazing) Perf: Table 5-1: U = 0.400, 0.600, 0.650	Location, Option, Fuel, U, A	Uses glzng values
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Implimentation Guidelines Pg 1.27 SGC RCR Pg 1.30	Presc: SGC pg 6.1 SCG Spec 1.2 (MCS) Perf: Area of Skylight =0 in reference house.	Location, U, A	No skylight in reference house.
ORE '92 CABO One and Two Family Dwelling Specialty Code, Tables 53-P and O	Presc: U = 0.50 (All Options) A =< 0.02 A (Floor) Perf: U = 0.50 (All Options)	Option, U, A flr, A skylt	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5302, 5303.3, OREEP	Presc / Perf: U = 0.65 (Glzg value) If A (Glzg) > .17 A (Floor) -See Eq 53-1	U, A glz, A flr	See Glzg Definition Sec 5302
IDAHO '90 IRES Builders' Guide	Presc / Perf: Same as Glazing		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 601 (b) Sec 407, Eq 3	Presc: Area of skylight to be doubled for compliance with glzg area limitation. Table 6.1 (glz) U =0.40, 0.60, 0.75, 0.90 Presc: See 'Ceiling'	U, A Htg Sys	Uses glzng values
CALIFORNIA '88 Building Energy Efficiency Standards, Sec 2-5352(f)2.C	Considered as glazing included in area calc.	U, A	

RESIDENTIAL ENERGY CODE SUMMARY

SLAB - ON GRADE

U = BTU / Hr-Sq.Ft- F
F = BTU / Hr-Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3 Table 5.1	Presc: Tables 6.1, 6.2, 6.3; R10, (All Zones) Perf: Slab: F = .455 (All Zones)	Location, Option, R, F, P	
WASH '91 WAC 51-11 Tables 6.1-6.4 Table 5.1	Presc: Tables 6.1-6.4: R10 (Slab and Edge) Perf: Table 5-1; R =10 (prescribed) F = 0.54	Location, Option, Fuel, F, P, R	
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Sec 6.1 SGC RCR Pg 1.30	Presc: SGC pg 6.1 SCG Spec 1.2 (MCS): F =0.54 (R10) Perf: F =0.540 (All Zones)	Location, F, P, R, Insul depth	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc / Perf: Edge: R15 (All Paths)	Path, R, F, P	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303.C4 Table 53A	Presc / Perf: Table 53A	Location, R	
IDAHO '90 IRES Builders' Guide	Presc / Perf: R10; F =0.54	R, F	IRES Table p.3 R0: F = .73 R5: F = .58 R10: F = .54
MONTANA '90 Administrative Rules of Montana, 8.70.104	Prescriptive only: R6	R	
TACOMA '87 Tacoma Energy Code Sec 600, Table 6.1 Sec 403, Table 4.1	Presc: R8.10 Perf: R10, 8 (unheated) R12, 8 (heated)	Htg Sys, R, P, Heated/ Unheated	
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16	Presc / Perf: R7 (All Zones and Options)	Location, Option, R, F, P	

RESIDENTIAL ENERGY CODE SUMMARY

SOLAR ACCESS

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Table 6.1, 6.2, 6.3	Prescriptive: Option 3: Min 18% South Glzng Min Solar Glzng Performance: No Reference	A floor, A glz (South), Option	
WASH '91 WAC 51-11	No Reference		Wattsun reflects a benefit for Solar orientation.
S.G. CENTS '91 1991 SGC Specs, Sec 1.5	See Solar Access: Sec 1.5: If passive solar design access to a min of 80% direct solar exposure is required btwn 9am and 3pm.		
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc: Table 53-P 4 "Sun Tempered" paths, 50% Glazing Area on South Elev. Perf: No Reference	Option, A floor, A glz (South)	
ORE '88 CABO One and Two Family Dwelling Specialty Code	No Reference		
IDAHO '90 IRES Builders' Guide	No Refernce		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 402(d)	Presc: No Reference Perf: Glazing areas which meet passive solar criteria are not included in the gross wall area.		
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z:1-16 Sec 2-5351(f).3.	Presc: Table 2-53Z1-16 Sec2-5351(f).3. Perf: No Reference	A (Floor) A glz (South)	Restrictions: Max area, Max non South Min South Shading

RESIDENTIAL ENERGY CODE SUMMARY

THERMAL MASS

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Code: Sec 602.8.4. Code: Ch 5	Presc: Heat Storage Cap =10 BTU / Hr-F per Sq Ft of conditioned floor Space (Option 3 only) Perf: No Reference Energy Budget: Standard Engineering Practice	Location, Option, D, V, SH,HS	
WASH '91 WAC 51-11 Sec 602.1 Sec 502.1.1 Sec 402.1.3	Presc / Perf: No Reference Energy Budget: Standard Engineering Practice		
S.G. CENTS '91 1991 SGC Plan Review Pg 2.6	Presc / Perf: SGC pg 6.1 Energy Budget: Standard Engineering Practice		
ORE '92 CABO One and Two Family Dwelling Specialty Code,	Presc / Perf: No Reference Energy Budget: Standard Engineering Practice		
ORE '88 CABO One and Two Family Dwelling Specialty Code	Presc / Perf: No Reference Energy Budget: Standard Engineering Practice		
IDAHO '90 IRES Builders' Guide	No Reference		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 600 Sec 402(d)6	Presc: No Reference Perf: See Sec 402(d)6 for Passive Solar designrequirements Energy Budget: Standard Engineering Practice		
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16	Presc / Perf: See Tables 2-53Z1-16 Sec 2-5351(f).4		

RESIDENTIAL ENERGY CODE SUMMARY

VENTILATION

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Sec 604 Sec 502.1.8 Sec 502.4.3.6	Prescriptive: Sec 601.1, Reference Sec 5.2 of RS 22 Performance: (Exemption 502.4.3.6) Whole House: 10 CFM + 10CFM/ BR Bath: 50 CFM: Kitchen: 100CFM	CFM Rooms (number/type)	
WASH '91 WAC 51-11-13-304.1	General Requirements: Specific room - See Table 3 - 1 Whole house - See Table 3-2 2 bedrms = 50 cfm min 3 bedrms = 80 cfm min 4 bedrms = 100 cfm min	CFM Rooms (number/type)	
S.G. CENTS '91 1991 SGC Specs, Sec 4.3	General Requirements: SGC Spec 4.3 Standard Leakage Control: 10CFM+10CFM / BDRM Advanced: 15CFM+ 30 / M BDRM + 15 / BR	CFM Rooms (number/type)	
ORE '92 CABO One and Two Family Dwelling Specialty Code,	No Reference in Table 53-P, See the CABO '92 text.		
ORE '88 CABO One and Two Family Dwelling Specialty Code, Section R-203	General Requirements: Operable windows or 2 ACH for Habitable rooms 5 ACH for Bathrooms	Windows, ACH	
IDAHO '90 IRES Builders' Guide	No Reference in energy code		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference in energy code		
TACOMA '87 Tacoma Energy Code Sec 305 Table 3-1	Presc / Perf Living Area 10 CFM Bedrooms 10 CFM All Other 10 CFM Kitchen 100 CFM Bath 50 CFM	CFM Rooms (number/type)	
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16	Presc / Perf: 0.7 ACH	ACH	

RESIDENTIAL ENERGY CODE SUMMARY

WALLS - ABOVE GRADE

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Tables 6.1, 6.2, 6.3 Table 5.1	Prescriptive: Tables 6.1-6.3; R-19, 19A, 24, 24A, 26A, 30A Performance: Zone 1: U =0.057 Zone 2: U =0.043 Zone 3: U =0.040	Location, Option, U, A, R, Framing (Adv / Stnd)	
WASH '91 WAC 51-11 Tables 6.1-6.4 Table 5.1	Presc: Tables 6.1-6.4: Perf: Table 5-1: U = 0.044 - 0.062	Location, Option, Fuel, U, A	
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Sec 6.1 SGC RCR Pg 1.30	Presc: SCG Spec 1.2 (MCS): R19, 24A, 26A Perf: Zone 1: U = 0.058 Zone 2: U = 0.044 Zone 3: U = 0.040	Location, U, A	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc: Table 53-P; R15, 21, 24 Perf: R21; R18.5 w/Advanced construction or exterior rigid insulation.	Option, U, A, R, Adv Const, Rigid Insul	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303.C. Exception Sec 5303.C.1	Presc/ Perf: R11 High Eff. Htg Sys. R19 Other Htg Sys. $U_0 = (UA_W)+(UA_D)+(UA_G) / A_0$: $U_0 =< 0.171$	AFUE, COP U wall, U door, U glazing, A_W A_D, A_G, R	
IDAHO '90 IRES Builders' Guide	Presc. / Perf: R19	R	
MONTANA '90 Administrative Rules of Montana, 8.70.104	Prescriptive only: R19	R	
TACOMA '87 Tacoma Energy Code Sec 600, Table 6-1 Sec 403, Table 4-2	Presc: R19 Perf: U_0=(entire assembly): U_0 = 0.10, 0.18, 0.20; See Table 4.2 $U_0 = (UA_W)+(UA_D)+(UA_G) / A_0$	R, U wall, U door, U glazing, A_W A_D, A_G, Htg Sys	
CALIFORNIA '88 Building Energy Efficiency Standards, Tables 2-53 Z: 1-16	Presc: R11, R19 (Entire Wall Assembly) Plus Provisions for Thermal Mass Perf: R11, R19 Entire Wall Assembly	Location, Option, U, A, Thermal Mass	

RESIDENTIAL ENERGY CODE SUMMARY

WALLS - BELOW GRADE

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Tables 6.1,6.2, 6.3 Table 5.1; Pg 59 Sec 502.2	Prescriptive: Tables 6.1, 6.2, 6.3; R10, 12, 15, 19 Performance: Slab: F = .750 for slab and wall combined (All Zones).	Location, Option, R, U, A	
WASH '91 WAC 51-11 Tables 6.1-6.4 Table 5.1	Presc: Tables 6.1, 6.2, 6.3, 6.4: Exterior R10, 12 Interior: R15, 19, 21 Perf: Table 5-1; Exterior: U=0.05-0.07; F=0.42-0.60 Interior: U=0.037-0.043; F=0.57-0.69	Location, Option, Fuel, Log Home, R, U, A, F, P, Wall Depth	
S.G. CENTS '91 1991 SGC Specs, Sec 1.2 SGC RCR Sec 6.1 SGC RCR Pg 1.30	Presc: SGC pg 6.1 SCG Spec 1.2 (MCS) Perf: 2' : U = 0.045; F = 0.61 (All Zones) 3.5' : U = 0.042; F = 0.57 " 7' : U = 0.038; F = 0.43 "	Location, U, A, F, P, Wall Depth	
ORE '92 CABO One and Two Family Dwelling Specialty Code, Table 53-P	Presc: R21 (All Paths) Perf: R21	Path, R, U, A	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5303 Pg 248.J &K	Presc: R11 (All Zones) Perf: R11 (All Zones)	R	Not included in prescriptive UA target calc.
IDAHO '90 IRES Builders' Guide	Presc / Perf: R10	R, U, A	
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 600, Table 6.1 Sec 403	Presc / Perf: No Reference		
CALIFORNIA '88 Building Energy Efficiency Standards, Calif. Hotline	Same as 'Above Grade'		

ENERGY BUDGET AND GENERAL REQUIREMENTS

WATER HEATING

U = BTU / Hr-Sq.Ft- F

CODE	INFORMATION	VARIABLE	NOTES
N W ENRGY CODE '87 NWEC Sec 504.1	Prescriptive / Performance: See Sec 504.1		
WASH '91 WAC 51-11 Sec 402.1.3 Sec 504.1	Presc / Perf: See Sec 504.1		
S.G. CENTS '91 1991 SGC Specs, Sec 2.8	Presc / Perf / Energy Budget: Electric Wtr Htrs 0-59 Gal: EF = 0.91 60-90 Gal: EF = 0.88 91-120 Gal: EF = 0.83	Capacity, Efficiency	
ORE '92 CABO One and Two Family Dwelling Specialty Code,	No reference	Q	
ORE '88 CABO One and Two Family Dwelling Specialty Code, Sec 5308	Piping Heat Loss =< 25 BTU / Hr		
IDAHO '90 IRES Builders' Guide	No Reference		
MONTANA '90 Administrative Rules of Montana, 8.70.104	No Reference		
TACOMA '87 Tacoma Energy Code Sec 603 Sec 420	Presc / Perf: General system and installationrequiremints		
CALIFORNIA '88 Building Energy Efficiency Standards, Sec 2-5353(b) Pg 161 Table 2-53Y	Performance: See Sec 2-5351.b.1 Table 2-53Y for specific water htg budget.	Q	

5.0 ENERGY CODE COMPARISON BY BUILDING COMPONENT

The performance compliance method has been applied to the California and the Northwest region codes to illustrate both this method of compliance and to generate a direct comparison of the codes. This required the selection of common components avoiding issues such as infiltration, glazing area restrictions, and below grade walls. The treatment of these issues varies significantly. All of the targets are dependent on house design and location and are derived using the same house design, fuel type and an equivalent location (based on heating degree day data). The narrowness of this comparison should be considered when interpreting the results. Other comparisons using another set of parameters would reveal different relationships between the codes.

The table provides the target 'UA' values required by the various codes when applied to the example house. The wide range of values illustrates the variation across the region. In this comparison the NW Energy Code is 28% more restrictive than the currently employed Oregon code (1988). The 1992 Oregon code will be 27% tighter than the current Oregon code illustrating the changing regulatory environment of energy codes in this region.

This work is similar to Wattsun 5.1 calculations. The Wattsun print-outs included in the next section list the area and component specifics of the proposed house used in this analysis. The results from the Wattsun program differ from this work due to the inclusion of different components and issues.

ENERGY CODE COMPARISON BY BUILDING COMPONENT	**Performance 'U' Values: Target 'UA' Calculations for Performance Code Compliance** Based on a 1500 Sq-Ft electrically heated house in Portland (or equivalent location).										
	NW Enrgy Code '90	Wash Enrgy Code '91	Super Good Cents '91	Oregon Code '92	Oregon Code '88	Idaho IRES Code '90	Montana[d] Admin. Rules 12/90	Tacoma Code '87	Hud[e] Home Guide	Calif Code '88	Notes: 'U' = BTU/Hr Sq-Ft F; 'F' = BTU/Ht Ft F; *-Not included in Target 'UA' calculations.
Compl. Paths[1]	4 /1	8 / 1	- /1	9 / 1	1	1	1	4 / 3	----	5 / 2	1 Prescriptive / Performance
Climate Zones	3	2	3	none	none	none	none	none	----	16	2 F value to be used with perimeter length.
Walls- Above Grd	0.057	0.062	0.058	0.060	0.171[a]	0.065	0.065	0.180[b]	0.045	0.065[c]	
Walls-Below Grd	0.750[2]	0.037	0.038	0.033	0.054	0.056	0.570[2]	0.540[2]	0.193	0.065	3 Value assumed for a double glazed window.
Doors	0.190	0.400	0.190	0.200	0.171[a]	0.220	0.500	0.180[b]	0.200	0.065[c]	
Glazing	0.390	0.400	0.390	0.400	0.171[a]	0.650	0.650[3]	0.180[b]	0.580	0.650	4 There is no reference to below grade walls. The salb on grade value is used.
Ceiling Flat	0.032	0.036	0.031	0.031	0.031	0.031	0.031	0.026	0.031	0.031	
Vaulted*	0.032	0.034	0.027	0.034	0.049	0.034	0.027	0.026	0.031	0.027	
Skylight	0.390	0.400	0.031	0.500	0.650	0.650	0.65[3]	0.026	0.031	0.650	5 These values are for comparison of the codes. They do not reflect anticipated energy consumption.
Vaulted*		0.400	0.027		0.650	0.650					
Floor*	0.029	0.041	0.029	0.034	0.040	0.040	0.040	0.034	0.037	0.040	
Slab Below Grade	0.455	0.570	0.430	0.500	0.607[4]	0.540	0.570[4]	0.540[4]	0.460[4]	0.560[4]	
On Grade*	0.750	0.540	0.540	0.500	0.607	0.540	0.570	0.540	0.460	0.560	
Target 'UA'[5] (BTU/Hr-F)	355.74	371.54	336.10	361.40	493.44	443.77	412.71	410.22	541.60	449.16	

a- Oregon code: overall wall U < 0.171.
b- Tacoma code: overall wall U =<0.180.
c- California code: overall wall U =<0.065; includes doors.
d- Montana uses the prescriptive compliance method only.
e- HUD Home Minimum Property Standards (HUD loans).

Table 5.0 - 1

ENERGY CODE COMPARISON BY BUILDING COMPONENT

Calculation Spreadsheet

	C	D	E	F	G	H	I	J	K	L	M	N
7			NW Cd '87	Wash Cd '91	S G Cents '91	Oregon Cd '92	Oregon Cd '85	Idaho Cd '90	Montana '90	Tacoma '87	Hud Home Gde	Calif. Cd '88
8												
9	A-Wall Abv Gd (Sq-Ft)		1269	1269	1269	1269	1269	1269	1269	1269	1269	1269
10	U-Abv Gd (BTU/Hr Sq-Ft F)		0.057	0.058	0.058	0.06	0.171	0.065	0.053	0.18	0.045	0.065
11	UA-Abv Gd (BTU / Hr F)		72.333	73.602	73.602	76.14	216.999	82.485	67.257	228.42	57.105	82.485
12												
13	A-Wall Blw Gd (Ft or Sq-Ft)		160	1120	1120	1120	1120	1120	160	160	1120	1120
14	U-Wall Blw Gd		0.75	0.037	0.038	0.033	0.054	0.056	0.57	0.54	0.193	0.053
15	UA-Wall Blw Gd (BTU/Hr F)		120	41.44	42.56	36.96	60.48	62.72	91.2	86.4	216.16	59.36
16												
17	A-Door		84	84	84	84	84	84	84	84	84	84
18	U-Door		0.19	0.2	0.19	0.2	0.171	0.22	0.5	0.18	0.2	0.065
19	UA-Door (BTU/Hr F)		15.96	16.8	15.96	16.8	14.364	18.48	42	15.12	16.8	5.46
20												
21	A-Glazing		225	225	225	225	225	225	225	225	225	225
22	U-Glazing		0.39	0.4	0.39	0.4	0.171	0.65	0.65	0.18	0.58	0.65
23	UA-Glazing (BTU/Hr F)		87.75	90	87.75	90	38.475	146.25	146.25	40.5	130.5	146.25
24												
25												
26	A-Ceiling		1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
27	U-Ceiling		0.032	0.031	0.031	0.031	0.031	0.031	0.031	0.026	0.031	0.031
28	UA-Ceiling (BTU/Hr F)		48	46.5	46.5	46.5	46.5	46.5	46.5	39	46.5	46.5
29												
30	A-Skylight		30	30	30	30	30	30	30	30	30	30
31	U-Skylight		0.39	0.4	0.031	0.5	0.65	0.031	0.65	0.026	0.031	0.65
32	UA-Skylight (BTU/Hr F)		11.7	12	0.93	15	19.5	0.93	19.5	0.78	0.93	19.5
33												
34	P-Slab	(Ft)	160	160	160	160	160	160	160	160	160	160
35	F-Slab	(BTU/Hr Ft F)	0.75	0.57	0.43	0.5	0.607	0.54	0.57	0.54	0.46	0.56
36	Equiv. UA Slab	(BTU/Hr F)	120	91.2	68.8	80	97.12	86.4	91.2	86.4	73.6	89.6
37	(Slab Edge)											
38	Total UA Target											
39	(BTU / Hr-F)		355.74	371.54	336.10	361.40	493.44	443.77	412.71	410.22	541.60	449.16

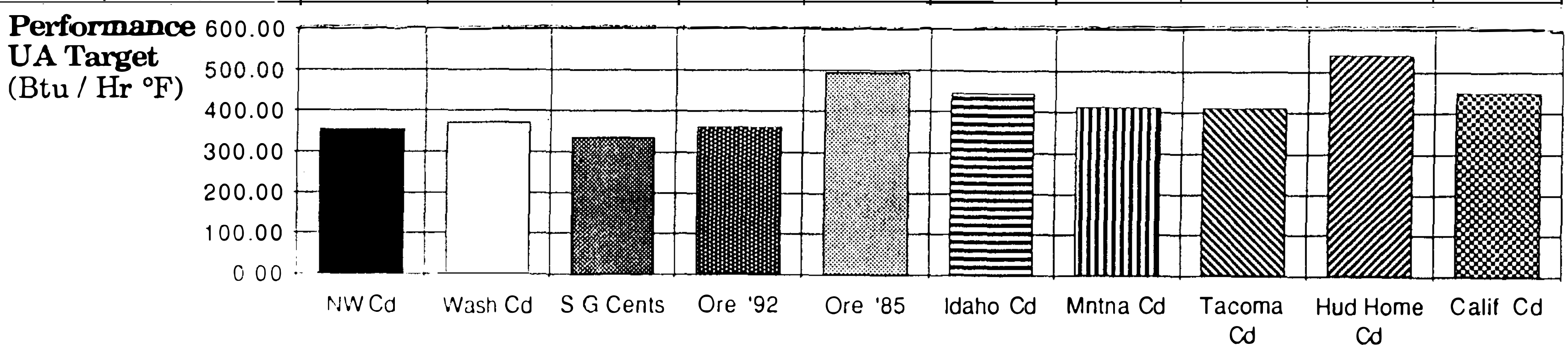

Figure 5.0 -1

6.0 WATTSUN 5.1 ENERGY CODE COMPLIANCE PROGRAM

The Wattsun code compliance tool is maintained by the Washington State Energy Office through funding from the Bonneville Power Authority. It is used by building inspectors in many jurisdictions for energy code compliance and is therefore a good reference for code investigations.

The intent of the program is to determine the compliance of a proposed design relative to a similar design built to the prescriptive requirements of the governing energy code. This program allows both the performance and energy budget methods of compliance. It is not intended to determine the projected energy performance of a design. Nor should the results be used to compare the codes. Each code has unique component considerations which precludes direct comparison with this program. The 1985 Oregon Code, for example requires R-11 insulation for the below grade wall. The Wattsun program lists this value but does not include the component in the target UA determination. Therefore the performance target UA value is smaller than the Super Good Cents value, though the Super Good Cents code is significantly more strict.

The following printouts are an example of Wattsun runs applied to a 1500 Sq-Ft house sited in Portland, Oregon.

WATTSUN 5.1   1987 NORTHWEST ENERGY CODE COMPLIANCE REPORT   06/11/91

FILE: C:\WATTSUN5\DEMO 1.WS   HOUSE ID:

Site:
:
Homeowner:
Mail:

Builder:
Address:

Analyst:
Jurisdiction:
Utility:

Floor Area: 1500 ft2

Weather Data: Portland, OR
Climate Zone: 1

The PROPOSED design *COMPLIES* with 1987 Northwest Energy Code.

	REFERENCE	PROPOSED	
COMPONENT PERFORMANCE	476	546	Btu/hr-F
ENERGY BUDGET	6.59	3.75	kWh/ft2-yr

REFERENCE DESIGN

Component	Reference Value	X	Area =	UA
BG Wall	U-0.038		1120	42.6
BG Slab	F-0.430		160ft	68.8
Floor	U-0.029		1500	43.5
Glazing @15%	U-0.390		225.0	87.8
Doors	U-0.190		84.0	16.0
AG Wall	U-0.057		1269	72.3
Skylights	U-0.032		30.0	1.0
Ceiling	U-0.032		1500	48.0
Infiltration	ACH-0.350		15000ft3	96.1
	Reference UA			476

PROPOSED DESIGN COMPONENTS

Component	Description	Value	X	Area =	UA
BG Wall	R19 batt 7' depth w/TB	U-0.038		1120	42.6
BG Slab		F-0.430		160ft	68.8
Floor	R22 vented Joist 16oc	U-0.037		1500	55.5
Glazing @16%	2G1 Wood 1/2"	U-0.540		202.5	105.3*
Doors	Wood 1-3/4" solid panel	U-0.390		84.0	31.9*
AG Wall	R19 STD Lap Wood	U-0.062		1291	80.0
Skylights	2G1 Wood 1/2"	U-0.650		15.0	9.3*

Items in parentheses not included in COMPONENT PERFORMANCE totals.
* Denotes adjusted UA to reflect 7-1/2 mph wind speed.

	2G1 Wood w/EAC 1/2"	U-0.690	15.0	9.8*
Ceiling	R38 blown Attic STD baffled	U-0.031	1500	46.5
Infiltration	Standard Air Sealing	ACH-0.350	15000ft3	96.1
		Proposed UA		546
Struc Mass	Light Frame, Sheetrock walls	M-3.000	1500	4500.0

HEATING/COOLING/VENTILATING SYSTEMS

	PROPOSED
Heating System Type:	Heat Pump: Air Source
Make:	HP Air Source Default
Model:	
System Efficiency:	6.8 HSPF
Modified Efficiency:	166 %
Heating Load(at 47F dt):	26102 Btu/hr
System Size:	23214 Btu/hr
Maximum Size @150%:	11.5 kW
Auxiliary:	3.0 kW
HP Balance Point:	35 F
Average Annual Heat:	8154 kwh
Annual Cost:	$ 448
Ventilation Type:	Non-Heat Recovery
Option:	Option 1
Cooling Load(at 8F dt):	21952 Btu/hr
Recommended Size @125%:	2.5 tons
Solar Access:	Unshaded w/solar access

PROPOSED DUCT SYSTEM

	Location	Avg Rvalue	Surface Area
SUPPLY	Attic or garage	R-11.0	300.0 ft2
RETURN	Attic or garage	R-11.0	60.0 ft2

GLAZING ORIENTATION

	PROPOSED		PROPOSED
South:	202.5 ft2	North:	0.0 ft2
Southeast:	0.0	Northwest:	0.0
East:	0.0	West:	0.0
Northeast:	0.0	Southwest:	0.0

WATTSUN 5.1   1991 WA STATE ENERGY CODE COMPLIANCE REPORT   06/05/91

FILE: C:\WATTSUN5\DEMO 1.WS   HOUSE ID:

Site:	Analyst:
:	Jurisdiction:
	Utility:
Homeowner:	
Mail:	Floor Area: 1500 ft2
Builder:	Weather Data: Portland, OR
Address:	Climate Zone: 1

The PROPOSED design *COMPLIES* with 1991 WA State Energy Code.

	REFERENCE	PROPOSED	
COMPONENT PERFORMANCE	508	456	Btu/hr-F
ENERGY BUDGET	4.94	3.89	kWh/ft2-yr

REFERENCE DESIGN

Component	Reference Value	X	Area =	UA
BG Wall	U-0.037		1120	41.4
BG Slab	F-0.570		160ft	91.2
Floor	U-0.041		1500	61.5
Glazing @15%	U-0.650		225.0	146.3
Doors	U-0.400		84.0	33.6
AG Wall	U-0.062		1269	78.6
Skylights	U-0.036		30.0	1.1
Ceiling	U-0.036		1500	54.0
Infiltration	--		--	--
	Reference UA			508

PROPOSED DESIGN COMPONENTS

Component	Description	Value	X	Area =	[illegible]
BG Wall	R19 batt 7' depth w/TB	U-0.038		1120	[illegible]
BG Slab		F-0.430		160ft	[illegible]
Floor	R22 vented Joist 16oc	U-0.037		1500	[illegible]
Glazing @16%	2G1 Wood 1/2"	U-0.540		202.5	[illegible]
Doors	Wood 1-3/4" solid panel	U-0.390		84.0	[illegible]
AG Wall	R19 STD Lap Wood	U-0.062		1291	[illegible]
Skylights	2G1 Wood 1/2"	U-0.650		15.0	[illegible]
	2G1 Wood w/EAC 1/2"	U-0.690		15.0	[illegible]

Items in parentheses not included in COMPONENT PERFORMANCE totals.

WATTSUN 5.1 — 1991 SUPER GOOD CENTS COMPLIANCE REPORT — 06/05/91

FILE: C:\WATTSUN5\DEMO 1.WS — HOUSE ID:

Site:		Analyst:	
:		Jurisdiction:	
		Utility:	
Homeowner:			
Mail:		Floor Area:	1500 ft2
Builder:		Weather Data:	Portland, OR
Address:		Climate Zone:	1

The PROPOSED design *COMPLIES* with 1991 Super Good Cents.

	REFERENCE	PROPOSED	
COMPONENT PERFORMANCE	476	546	Btu/hr-F
ENERGY BUDGET	6.58	3.75	kWh/ft2-yr

REFERENCE DESIGN

Component	Reference Value	X Area =	UA
BG Wall	U-0.038	1120	42.6
BG Slab	F-0.430	160ft	68.8
Floor	U-0.029	1500	43.5
Glazing @15%	U-0.390	225.0	87.8
Doors	U-0.190	84.0	16.0
AG Wall	U-0.058	1269	73.6
Skylights	U-0.031	30.0	0.9
Ceiling	U-0.031	1500	46.5
Infiltration	ACH-0.350	15000ft3	96.1
	Reference UA		476

PROPOSED DESIGN COMPONENTS

Component	Description	Value	X Area =	UA
BG Wall	R19 batt 7' depth w/TB	U-0.038	1120	42.6
BG Slab		F-0.430	160ft	68.8
Floor	R22 vented Joist 16oc	U-0.037	1500	55.5
Glazing @16%	2G1 Wood 1/2"	U-0.540	202.5	105.3*
Doors	Wood 1-3/4" solid panel	U-0.390	84.0	31.9*
AG Wall	R19 STD Lap Wood	U-0.062	1291	80.0
Skylights	2G1 Wood 1/2"	U-0.650	15.0	9.3*

Items in parentheses not included in COMPONENT PERFORMANCE totals.
* Denotes adjusted UA to reflect 7-1/2 mph wind speed.

WATTSUN 5.1 1985 OREGON UBC, CHAPTER 53 COMPLIANCE REPORT 06/05/91

FILE: C:\WATTSUN5\DEMO 1.WS HOUSE ID:

Site:		Analyst:	
:		Jurisdiction:	
		Utility:	
Homeowner:			
Mail:		Floor Area:	1500 ft2
Builder:		Weather Data:	Portland, OR
Address:		Climate Zone:	1

The PROPOSED design *COMPLIES* with 1985 Oregon UBC, Chapter 53.

	REFERENCE	PROPOSED	
COMPONENT PERFORMANCE	385	344	Btu/hr-F
ENERGY BUDGET	13.22	4.14	kWh/ft2-yr

REFERENCE DESIGN

Component	Reference Value	X	Area =	UA
BG Wall	R-11		--	--
Floor	U-0.048		1500	72.0
Glazing @15%	U-0.171		225.0	38.5
Doors	U-0.171		84.0	14.4
AG Wall	U-0.171		1269	216.9
Skylights	U-0.028		30.0	0.8
Ceiling	U-0.028		1500	42.0
Infiltration	--		--	--
	Reference UA			385

PROPOSED DESIGN COMPONENTS

Component	Description	Value	X	Area =	UA
BG Wall	R19 batt 7' depth w/TB	R-19.000		1120	(111.4)
Floor	R22 vented Joist 16oc	U-0.037		1500	55.5
Glazing @16%	2G1 Wood 1/2"	U-0.540		202.5	109.4
Doors	Wood 1-3/4" solid panel	U-0.390		84.0	32.8
AG Wall	R19 STD Lap Wood	U-0.062		1291	80.0
Skylights	2G1 Wood 1/2"	U-0.650		15.0	9.8
	2G1 Wood w/EAC 1/2"	U-0.690		15.0	10.4
Ceiling	R38 blown Attic STD baffled	U-0.031		1500	46.5
Infiltration	Standard Air Sealing	ACH-0.350		15000ft3	(96.1)
		Proposed UA			344

Items in parentheses not included in COMPONENT PERFORMANCE totals.

WATTSUN 5.1 1990 IDAHO RES. ENERGY STANDARD COMPLIANCE REPORT 06/05/91

FILE: C:\WATTSUN5\DEMO 1.WS HOUSE ID:

Site:		Analyst:	
		Jurisdiction:	
		Utility:	
Homeowner:			
Mail:		Floor Area:	1500 ft2
Builder:		Weather Data:	Portland, OR
Address:		Climate Zone:	1

The PROPOSED design *COMPLIES* with 1990 Idaho Res. Energy Standard.

	REFERENCE	PROPOSED	
COMPONENT PERFORMANCE	601	448	Btu/hr-F
ENERGY BUDGET	***	***	kWh/ft2-yr

REFERENCE DESIGN

Component	Reference Value	X Area =	UA
BG Wall	U-0.056	1120	62.7
BG Slab	F-0.420	160ft	67.2
Floor	U-0.109	1500	163.5
Glazing @17%	U-0.650	255.0	165.8
Doors	U-0.220	84.0	18.5
AG Wall	U-0.065	1239	80.5
Skylights	U-0.031	30.0	0.9
Ceiling	U-0.031	1500	46.5
Infiltration	--	--	--
	Reference UA		601

PROPOSED DESIGN COMPONENTS

Component	Description	Value	X Area =	UA
BG Wall	R19 batt 7' depth w/TB	U-0.038	1120	42.6
BG Slab		F-0.430	160ft	68.8
Floor	R22 vented Joist 16oc	U-0.037	1500	55.5
Glazing @16%	2G1 Wood 1/2"	U-0.540	202.5	109.4
Doors	Wood 1-3/4" solid panel	U-0.390	84.0	32.8
AG Wall	R19 STD Lap Wood	U-0.062	1291	80.0
Skylights	2G1 Wood 1/2"	U-0.650	15.0	9.8
	2G1 Wood w/EAC 1/2"	U-0.690	15.0	10.4

Items in parentheses not included in COMPONENT PERFORMANCE totals.

WATTSUN 5.1 HUD ENERGY EFFICIENT HOME GUIDELINE COMPLIANCE REPORT 06/05/91

FILE: C:\WATTSUN5\DEMO 1.WS HOUSE ID:

Site:		Analyst:	
:		Jurisdiction:	
		Utility:	
Homeowner:			
Mail:		Floor Area:	1500 ft2
Builder:		Weather Data:	Portland, OR
Address:		Climate Zone:	1

The PROPOSED design *COMPLIES* with HUD Energy Efficient Home Guideline.

	REFERENCE	PROPOSED	
COMPONENT PERFORMANCE	693	552	Btu/hr-F
ENERGY BUDGET	12.35	3.81	kWh/ft2-yr

REFERENCE DESIGN

Component	Reference Value	X Area =	UA
BG Wall	U-0.193	1120	216.2
BG Slab	F-0.460	160ft	73.6
Floor	U-0.037	1500	55.5
Glazing @15%	U-0.580	225.0	130.5
Doors	U-0.200	84.0	16.8
AG Wall	U-0.045	1269	57.1
Skylights	U-0.031	30.0	0.9
Ceiling	U-0.031	1500	46.5
Infiltration	ACH-0.350	15000ft3	96.1
	Reference UA		693

PROPOSED DESIGN COMPONENTS

Component	Description	Value	X Area =	UA
BG Wall	R19 batt 7' depth w/TB	U-0.038	1120	42.6
BG Slab		F-0.430	160ft	68.8
Floor	R22 vented Joist 16oc	U-0.037	1500	55.5
Glazing @16%	2G1 Wood 1/2"	U-0.540	202.5	109.4
Doors	Wood 1-3/4" solid panel	U-0.390	84.0	32.8
AG Wall	R19 STD Lap Wood	U-0.062	1291	80.0
Skylights	2G1 Wood 1/2"	U-0.650	15.0	9.8
	2G1 Wood w/EAC 1/2"	U-0.690	15.0	10.4

Items in parentheses not included in COMPONENT PERFORMANCE totals.

Site:		Analyst:	
:		Jurisdiction:	
		Utility:	
Homeowner:			
Mail:		Floor Area:	1500 ft2
Builder:		Weather Data:	Portland, OR
Address:		Climate Zone:	1

The PROPOSED design *COMPLIES* with 1987 Tacoma Energy Code.

	REFERENCE	PROPOSED	
COMPONENT PERFORMANCE	576	456	Btu/hr-F
ENERGY BUDGET	11.61	3.89	kWh/ft2-yr

REFERENCE DESIGN

Component	Reference Value	X Area =	UA
BG Wall	U-0.180	1120	201.6
BG Slab	F-0.000	160ft	0.0
Floor	U-0.034	1500	51.0
Glazing @15%	U-0.180	225.0	40.5
Doors	U-0.180	84.0	15.1
AG Wall	U-0.180	1269	228.3
Skylights	U-0.026	30.0	0.8
Ceiling	U-0.026	1500	39.0
Infiltration	---	---	--
	Reference UA		57[illegible]

PROPOSED DESIGN COMPONENTS

Component	Description	Value	X Area =	[illegible]
BG Wall	R19 batt 7' depth w/TB	U-0.038	1120	[illegible]
BG Slab		F-0.430	160ft	[illegible]
Floor	R22 vented Joist 16oc	U-0.037	1500	[illegible]
Glazing @16%	2G1 Wood 1/2"	U-0.540	202.5	[illegible]
Doors	Wood 1-3/4" solid panel	U-0.390	84.0	[illegible]
AG Wall	R19 STD Lap Wood	U-0.062	1291	[illegible]
Skylights	2G1 Wood 1/2"	U-0.650	15.0	[illegible]
	2G1 Wood w/EAC 1/2"	U-0.690	15.0	[illegible]

Items in parentheses not included in COMPONENT PERFORMANCE totals.

7.0 CONCLUSIONS

The development of a broadly applicable computer code compliance tool is an ambitious endeavor. Issues impacting such a development include changing jurisdictional concerns, evolving code restrictiveness and complexity, variations in methodologies, variations in specific component concerns and the incorporation of innovations in building technology. These issues require a program format which is sophisticated enough to adequately address all the specifics while remaining easily adaptable to the evolution of the energy codes. In addition the program would require a permanent staff to insure program reliability. This credibility would be essential if the computer analysis is to be accepted by the code officials in the many jurisdictions.

The general approach to regulating design and building practices are consistent across the codes investigated. All have a prescriptive method for simple compliance which limit design latitude. All except Montana allow for more flexibility through a performance option which evaluates compliance based on the overall envelope performance rather than individual components. Additionally they offer the energy budget method which requires engineering calculations typically utilizing a program designed for that purpose. The Wattsun program developed and maintained by the Washington State Energy Office is such a tool. Similarly California has authorized a number of programs for proof of compliance using the energy budget approach.

Investigation into the specific treatment of the various components yields a more complicated comparison. The codes often treat similar components uniquely. Many codes do not make special provisions for skylights for example, or require overall performance levels for a component system such as a wall assembly. The Tacoma and 1988 Oregon codes include the doors and glazing in the wall 'U' value.

To further complicate the process, frequently a number of climate zones exist, each with its own set of prescriptive and performance requirements. California has sixteen, the Northwest Energy Code three, and the Washington energy code has two.

Innovations in the building industry introduces additional concerns. These products must be evaluated for their heat transfer characteristics and their impact on the building system. The results of such analysis must then be incorporated into the regulatory system. With over 100 jurisdictions in this survey alone one could imagine the different interpretations which might arise if code officials made determinations based on product literature from the many manufacturers.

The maintenance of a code compliance program requires effective communication throughout the industry of the assumptions made about building innovations. The treatment of stress skin panels is an example. Product literature suggests heat transfer characteristics and envelope tightness. In reality the heat transfer characteristics change with temperature and density of the foam core, and air tightness depends on fabrication and erection practices. The Wattsun program chose one 'U' value (based on ASHRAE literature) for these assemblies and makes an assumption about the air tightness.

The necessity of thorough communication increases when considering the dynamic nature of the energy code environment. Historically these codes are revised on three year cycles. Unfortunately these cycles are not concurrent. If design decisions are to be based on information from a compliance tool, that tool must be up to date. A computer compliance tool with broad applicability would require constant update. The Washington State Energy Office for example, must devote a substantial amount of resources to the maintenance of the Wattsun program which supports seven codes in the Northwest region.

In conclusion, while there are no conceptual or technical barriers to the development of a broadly applicable computer energy code compliance tool, its development would be an ambitious undertaking. This report has laid out the many issues involved in supporting such an effort. The major concerns are the logistics of implementing and maintaining such a tool where credibility is paramount. Appropriate interpretation and currentness must be guaranteed if the building industry and code officials are to encourage its use within the building environment.

8.0 ACKNOWLEDGMENTS

This work was completed with the critical support of many energy professionals in the Northwest and California. Particularly important were the contributions of Hank Date with the Washington State Energy Office, Bruce Maeda of the California Energy Commission, Jeff Harris of the Northwest Power Planning Council, Bob Hoppie of the Idaho State Energy Division, Jim Brown of the Montana Building Code Division, and John Kaufman, Gary Curtis and Cindy Brown of the Oregon Department of Energy. A special thanks to Kristin Harmon for comments clarifying this work.

9.0 REFERENCES

Bonneville Power Authority	(503) 230-3000
California Energy Commission	
Energy Hotline	(916) 654-5106
Energy Efficiency and Local Assistance Division	(916) 654-4077
Publications	(916) 654-5200
Idaho State Energy Division	(208) 327-7910
Montana Building Code Department	
Energy Division	(406) 444-6697
Northwest Power Planning Council	(800) 222-3355
Oregon Department of Energy	(800) 221-8035
Washington State Energy Office	(206) 956-2000
Tacoma Energy Department	(206) 383-9655

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Appendix A.1

Northwest Energy Code

NORTHWEST ENERGY CODE

(Complete Code Version)

JUNE 1987

Amendments to the MODEL ENERGY CODE to be
equivalent to the Model Conservation Standards

CHANGES TO NWEC

The following are changes to the 1987 edition of the Northwest Energy Code. The references are to the complete code edition (orange pages). Equivalent sections of the UBC compatible code (blue pages) would also apply.

1. Delete all reference to "*and other buildings less than 5000 sq ft*" from Chapters 4 and 5 as follows:

SECTION	Page
402.1	29
402.6	31
502.1.5	36
502.2	38
502.4.3.6 Exception	42
502.4.4	42
503.2.3	44
Table 5-1	59
Table 5-2	59

Reference to other buildings less than 5000 sq ft in chapter 6 shall remain.

2. Add an exception to 502.1.6.2 (page 36) as follows:

Exception: Where determined by the building official due to climatic conditions, ventilated roof/ceiling assemblies with an average minimum depth above the insulation of 12".

3. Add to section 502.1.7.2 (page 37):

In R1 and R3 occupancies the builder shall provide written notification to the owner that radon monitoring is available. The indoor air quality information shall also be provided by the builder.

Exception: Where specifically adopted, appendix section 901 may be used.

4. Add new section 502.1.7.3 (page 37) to read:

Underfloor ventilation shall be provided in accordance with UBC section 2516(c)6 but shall not be less than 1 square foot for each 300 square feet of under-floor area.

5. Change existing section 502.1.7.3 (page 37) to 502.1.7.4.

FOREWORD

The development of this "Northwest Energy Code" which are amendments to the Model Energy Code, 1986 edition, was sponsored by the Bonneville Power Administration (BPA). Information on this document may be obtained from BPA, PO Box 3621, Portland, OR 97208.

This document contains amendments to the Council of American Building Officials' (CABO) Model Energy Code (MEC), 1986 Edition. A copy of the MEC can be obtained from CABO at 1201 One Skyline Place, 5205 Leesburg Pike, Falls Church, Virginia 22041, telephone (703)931-4533; International Conference of Building Officials (ICBO) 5360 South Workman Mill Road, Whittier, CA 90601; Northwest Regional Office ICBO, 2122 - 112th Avenue N.E., Suite B-300, Bellevue, WA 98004, telephone (206)451-9541;

This code has been designed to be as compatible as possible with state and local regulations and is intended to stand alone as a code for those who desire a complete energy code. For those who want a document designed as if it were a chapter in the "Uniform Building Code" a related document has been prepared by BPA and is available from the Northwest ICBO Office.

Symbols:

~~this text is~~: this line-out means that the MEC language is deleted.

—>: this arrow means that more than one deletion has been made.

| this is language developed by BPA.

Where none of the above symbols occur, the text is exactly reprinted from the MEC.

DISCLAIMER

The Bonneville Power Administration acknowledges that although these amendments use the same format as The Model Energy Code, 1986 edition, published and copyrighted by CABO, the technical requirements contained therein ARE NOT THE SAME AS THE MODEL ENERGY CODE and are NOT based on a national consensus. These amendments are designed to be used with and compatible with the Model Energy Code, 1986 edition. The provisions of this code do not consider the efficiency of various energy forms as they are delivered to the building envelope, i.e., delivered energy efficiency. The appropriate factor for delivered energy--efficiency should be considered prior to the selection of the mechanical, electrical, illumination systems, and energy form for specific uses. A determination of delivered energy efficiencies when used in conjunction with this code will provide the most efficient use of available energy in new building construction.

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SAMPLE ORDINANCE FOR ADOPTION OF THE

NORTHWEST ENERGY CODE AND STANDARDS

ORDINANCE NO.____

An ordinance of the ___(jurisdiction)___ adopting the 1987 edition of the Northwest Energy Code and the 1987 edition of the Northwest Energy Code Standards regulating the use of electrical energy in all buildings or structures in the ___(jurisdiction)__; providing for penalties for the violation thereof, repealing Ordinance No. _____ of the ___(jurisdiction)___ and all other ordinances and parts of the ordinances in conflict therewith.

The ___(governing body)__of the ___(jurisdiction)___does ordain as follows:

Section 1. That certain documents, three (3) copies of which are on file and are open for inspection of the public in the office of the ___(jurisdiction's keeper of records)___of the __jurisdiction__, being marked and designated as:

Northwest Energy Code 1987 edition, published by the Bonneville Power Administration and Standards listed in Chapter 8 of this specified Northwest Energy Code, including the Appendix Chapters ________. (Fill in the applicable Appendix chapters--see code section 103, last paragraph.)

Section 2. (Incorporate penalties for violations. See Section 205).

Section 3. That Ordinance No. _____ of ___(jurisdiction)_ entitled (fill in the title of building ordinance or ordinances in effect at the present time) and all other ordinances or parts of ordinances in conflict herewith are hereby repealed.

Section 4. That if any section, subsection, sentence, clause or phrase of this ordinance is, for any reason, held to be invalid or unconstitutional, such decision shall not affect the validity or constitutionality of the remaining portions of this ordinance. The ___(governing body)___hereby declares that it would have passed this ordinance, and each section, subsection, clause or phrase hereof, irrespective of the fact that any one or more sections, subsections, sentences, clauses and phrases be declared unconstitutional.

Section 5. That the ___(jurisdiction's keeper of records)_ is hereby ordered and directed to cause this ordinance to be published. (An additional provision may be required to direct the number of times the ordinance is to be published and to specify that it is to be in a newspaper in general circulation.

Posting may also be required.)

Section 6. That this ordinance and the rules, regulations, provisions, requirements, orders and matters established and adopted hereby shall take effect and be in full force and effect __(time period)____from and after the date of its final passage and adoption.

CHAPTER 1

ADMINISTRATION AND ENFORCEMENT

SECTION 101

SCOPE AND GENERAL REQUIREMENTS

101.1 Title

This code shall be known as the Northwest Energy Code, and may be cited as such. It is referred to herein as "this code".

101.2 Intent

The provisions of this code shall regulate the design of building envelopes for adequate thermal resistance and low air leakage and the design and selection of mechanical, electrical, service water heating and illumination systems and equipment which will enable effective use of electric energy in ~~new~~ building construction.

It is intended that these provisions provide flexibility to permit the use of innovative approaches and techniques to achieve effective utilization of electric energy. These provisions are structured to permit compliance with the intent of this code by any one of the ~~three~~ four paths of design:

1. A systems approach for the entire building and its energy-using subsystems,Chapter 4; or

2. A component performance approach for various building elements and mechanical systems and components, Chapter 5; or

3. ~~Specified-acceptable-practice~~, A prescriptive requirements approach, Chapter 6; or

4. A component point system approach, Chapter 7.

Subject to the limits which apply to each Chapter compliance with any one of these paths meets the intent of this code. ~~This code is not intended to abridge safety, health or environmental requirements required under other applicable codes or ordinances~~.

This code is intended to supplement the provisions of the Uniform Building Code, the Uniform Mechanical Code, and the National Electric Code, and in case of conflict between this code and any of those codes with respect to the efficient use of electricity, the provisions of those codes shall apply. In any

case where a Federal, state or local code or regulation exceeds this code's requirements with respect to securing more efficient use of electric energy, that code or regulation shall apply.

101.3 Scope

This code sets forth minimum requirements for the design of new buildings and structures or portions thereof and additions, alterations and repair to existing buildings that provide facilities or shelter for public assembly, educational, business, mercantile, institutional, storage and residential occupancies, as well as those portions of factory and industrial occupancies, designed primarily for human occupancy by regulating their exterior envelopes and the selection of their HVAC, service water heating, electrical distribution and illuminating systems and equipment for effective use of electric energy.

Buildings shall be designed to comply with the requirements of Chapter 4, 5, 6, or 7 of this code.

Wherever in this code reference is made to the appendix, the provisions in the appendix shall not apply unless specifically adopted.

101.3.1 Exempt Buildings. Buildings and structures or portions thereof meeting any of the following criteria shall be exempt from the building envelope requirements of Section 502, 602, and 702. However, the energy usage from all sources shall be included in any analysis performed pursuant to Chapter 4.

101.3.1.1 Buildings and structures or portions thereof whose peak design rate of energy usage is less than 3.4 Btu/h per square foot or 1.0 watt per square foot of floor area for ~~all purposes~~ space conditioning requirements.

101.3.1.2 Buildings and structures or portions thereof which are neither heated or cooled according to the definitions in Chapter 2, provided that any space heating equipment which is installed complies with all of the following criteria:

a. Sized for a maximum interior design temperature of less than 50 degrees F.
b. Equipped with thermostatic control which is manufactured to have a maximum temperature setting of 50°F or less

101.3.2 Application to Existing Buildings.

101.3.2.1 Additions, alterations and repairs to existing buildings. Additions, alterations and repairs may be made to existing buildings or structures ~~may be made to such buildings or~~

~~structures~~ without making the entire building or structure comply provided that the new addition alteration or repair shall conform to the provisions of this code as they relate to new construction. ~~The Building Official may approve designs of alterations or repairs which do not fully conform with all of the requirements of this code where in his/her opinion full conformance is physically impossible and/or economically impractical and (1) the alteration or repair improves the electric energy efficiency of the building, or (2) the alteration or repair is energy efficient and is necessary for the health, safety, and welfare of the general public.~~ Where the structural elements of the altered portions of roof/ceiling, wall or floor are not being replaced, these elements shall be deemed to comply with this Code if all the cavities exposed during construction are filled to the full depth with batt insulation or insulation having an equivalent nominal R value while for roof/ceiling, maintaining the required space for ventilation. Existing roof/ceilings, walls and floors without framing cavities need not be insulated.

101.3.2.2 **Lighting.** Those parts of lighting systems which are altered or replaced in buildings initially constructed to the requirements of this code shall comply with Section 505.4. In addition, other remodels or replacements which affect the lighting system of a floor shall also comply with the lighting power budgets specified in Section 505.3.

101.3.2.3 Historic buildings. Historic buildings are exempt from this code. This exemption shall apply to those buildings which have been specifically designated as historically significant by the state or local governing body, or listed in "The National Register of Historic Places" or which have been determined to be eligible for listing.

101.3.2.4 **Change of occupancy.** A change in the occupancy or use of an existing building or structure constructed under this code which would require an increase in demand for ~~either fossil fuel or~~ electrical energy supply shall not be permitted unless such building or structure is made to comply with the requirements of this code.

101.3.2.5 **Moved Buildings.** Buildings or structures moved into or within the jurisdiction shall comply with the envelope insulation provisions of this code for new buildings or structures when the cavities of the roof/ceiling, wall or floor elements are accessible or exposed & Sec 101.3.2.1 if it applies.

EXCEPTION: The ceiling cavity need not be filled to more than the full depth of the space available including adequate space for ventilation.

101.3.3 **Mixed Occupancy.** When a building houses more than one occupancy, each portion of the building shall conform to the requirements for the occupancy housed therein. Where minor accessory uses do not occupy more than 10 percent of the area of any floor of a building, the major use shall be considered the building occupancy.

SECTION 102

MATERIALS AND EQUIPMENT

102.1 Identification

Materials and equipment shall be identified in order to show compliance with this code.

102.2 Maintenance Information

Required regular maintenance actions shall be clearly stated and incorporated on a readily accessible label. Such label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of product. Maintenance instructions shall be furnished for equipment which requires preventative maintenance for efficient operation.

SECTION 103
ALTERNATE MATERIALS—METHOD OF CONSTRUCTION, DESIGN OR INSULATING SYSTEMS

103.1 Alternate Materials and Methods of Construction

The provisions of this code are not intended to prevent the use of any material, method of construction, design or insulating system not specifically prescribed herein, provided that such construction, design or insulating system has been approved by the building official as meeting the intent of the code.

The building official may approve any such alternate, provided he finds that the proposed design is satisfactory and complies with the provisions of this code and that the material, method or work offered is, for the purpose intended, at least the equivalent of that prescribed in this code in suitability, strength, effectiveness, fire resistance, durability, safety and sanitation.

The building official shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding its use. The details of any action granting approval of an alternate shall be recorded and entered in the files of the code enforcement agency.

103.2 Tests

Whenever there is insufficient evidence of compliance with any of the provisions in this code or evidence that any material or construction does not conform to the requirements of this code, the building official may require tests as proof of compliance to be made at no expense to this jurisdiction.

Test methods shall be as specified by this code or by other recognized test standards. If there are no recognized and accepted test methods for the proposed alternate, the building official shall determine test procedures.

All tests shall be made by an approved agency. Reports of such tests shall be retained by the building official for the period required for the retention of public records.

103.3 Board of Appeals

In order to determine the suitability of alternate materials and methods of construction and to provide for reasonable interpretations of this code, there shall be and is hereby created a Board of Appeals consisting of members who are qualified by experience and training to pass upon matters pertaining to building construction and who are not employees of the jurisdiction. The building official shall be an ex officio member of and shall act as secretary to said board. The Board of Appeals shall be appointed by the governing body and shall hold office at its pleasure. The board shall adopt rules of procedure for conducting its business and shall render all decisions and findings in writing to the appellant with a duplicate copy to the building official.

SECTION 104
PLANS AND SPECIFICATIONS

104.1 General

With each application for a building permit, and when required by the building official, plans and specifications shall be submitted. The building official may require plans and specifications to be prepared by an engineer or architect licensed to practice by the state. (Designs submitted under the provisions of Chapter 4 for other than low rise R-3 occupancies shall be prepared by an engineer or architect licensed to practice by the state.)

104.2 Details

The plans and specifications shall show in sufficient detail pertinent data and features of the building and the equipment and systems as herein governed, including, but not limited to: design criteria, exterior envelope component materials, U values of the envelope systems, R values of insulating materials, size and type of apparatus and equipment, equipment and systems controls and other pertinent data to indicate conformance with the requirements of the code.

SECTION 105

ENFORCEMENT AND INSPECTIONS

105.1 General

Construction or work for which a permit is required shall be subject to inspection by the building official.

105.2 Approvals Required

No work shall be done on any part of the building or structure beyond the point indicated in each successive inspection without first obtaining the written approval of the building official. No construction shall be concealed without inspection approval.

105.3 Final Inspection

There shall be a final inspection and approval for buildings when completed and ready for occupancy.

105.4 Reinspection

The building official may cause a structure to be reinspected.

SECTION 106

VALIDITY

If a section, subsection, sentence, clause or phrase of this code is, for any reason, held to be unconstitutional, such decision shall not affect the validity of the remaining portions of this code.

SECTION 107

VIOLATIONS

It shall be unlawful for any person, firm or corporation to erect, construct, enlarge, alter, repair, move, improve, remove convert or demolish, equip, use, occupy or maintain any building or structure or cause or permit the same to done in violation of this code.

SECTION 108

LIABILITY

The building official, or his authorized representative charged with the enforcement of this code, acting in good faith and without malice in the discharge of his duties, shall not thereby render himself personally liable for any damage that may accrue to persons or property as a result of any act or by reason of any act or omission in the discharge of his duties. Any suit brought against the building official or employee because of such act or omission performed by him in the enforcement of any provision of such codes shall be defended by this jurisdiction until final termination of such proceedings, and any judgment resulting therefrom shall be assumed by this jurisdiction.

This code shall not be construed to relieve from or lessen the responsibility of any person owning, operating or controlling any building or structure for any damages to persons or property caused by defects, nor shall the code enforcement agency or its parent jurisdiction be held as assuming any such liability by reason of the inspections authorized by this code or any certificates of inspection issued under this code.