

ORDINANCE NO. 4753

AN ORDINANCE relating to the King County Building Code; amending Ordinance 3647, Section 6, and K.C.C. 16.04.050 and adopting the "King County Energy Code" effective July 1, 1980.

BE IT ORDAINED BY THE COUNCIL OF KING COUNTY:

NEW SECTION SECTION 1. Purpose. Adoption and implementation of the King County Energy Code will:

1. Promote public awareness of the need for energy conservation.
2. Commit the region to real, practical conservation measures in an area of known cost effectiveness, i.e., built into construction of new developments.
3. Make a significant step towards reduced energy dependence in the future for our community by lowering the growth rate in energy consumption.
4. Establish a record on concerted energy conservation efforts in this region on a cooperative basis, to demonstrate to the State and Federal governments that we will act on our own and should be given credit for it.
5. Promote area-wide consistency in standards to minimize the confusion in the construction industry and to encourage other jurisdictions in their consideration of the Code for possible adoption.
6. Permit alternative methods of meeting Code requirements in order to encourage innovative design and construction techniques.

NEW SECTION SECTION 2. Findings. The King County Council hereby finds that:

1. The Energy Conservation Comprehensive Plan Amendment adopted by Ordinance 3649 called for the development of a building code amendment for energy efficiency in new construction.
2. The Council, in Motion 3804, called upon the King County Building Code Advisory and Appeals Board and the County Executive to review the Seattle/King County Code Study and to recommend

1 a Building Code amendment for Energy Conservation.

2 3. The County participated in the code development process
3 of the Seattle Task Force, and assisted in the analysis of the
4 Code on energy use and economic impacts of the Code.

5 4. Cooperation between Seattle and King County in the code
6 development process and in the adoption of comparable energy
7 codes benefits the construction industry, minimized unneeded dupli-
8 cation of effort and public cost, and encourages adoption by other
9 jurisdictions within the County area.

10 5. The King County Energy Code is the initial effort to
11 establish a comprehensive set of building code standards for new
12 construction. It is anticipated that the Code and the Design
13 and Construction Practices Manual will require updating as new
14 additions and modifications become available at the international,
15 national, state and local levels, particularly in the areas of
16 performance standards, ventilation standards, solar and renewable
17 energy allowances, and delivered energy efficiency considerations.

18 SECTION 3. Supplements adopted amended. Ordinance 3647,
19 Section 6, and K.C.C. 16.04.050 are hereby amended as follows:
20 The King County supplements to the adopted 1976 editions of the
21 Uniform Building Code, Uniform Mechanical Code, Uniform Housing
22 Code, and Uniform Code for the Abatement of Dangerous Buildings,
23 are adopted as part of the Code ((†)). Chapter 53, Thermal
24 Performance (Insulation)" of the "Official King County Supplement
25 to the 1976 Uniform Building Code" is hereby repealed, effective
26 July 1, 1980 and the King County Energy Code attached to this
27 ordinance is hereby adopted, effective July 1, 1980, as part of
28 the code; as such they constitute county regulation for any
29 activity subject to the code.

30 NEW SECTION SECTION 4. Inspection and Enforcement.

31 (A) Enforcement. The Manager of the Division of Building
32 and Land Development is authorized to enforce the provisions of
33 this Chapter and any rules and regulations promulgated thereunder,

1 pursuant to the enforcement and penalty provisions of Title 23 of
2 the King County Code.

3 (B) General. All construction or work for which a permit
4 is required shall be subject to inspection by the Manager of the
5 Division of Building and Land Development.

6 (C) Authority. The Manager of the Division of Building and
7 Land Development is authorized and directed to enforce this Chap-
8 ter. The Manager of the Division of Building and Land Development
9 is authorized to promulgate, adopt, and issue those rules and
10 regulations necessary to the effective and efficient administration
11 of this Chapter.

12 (D) Plan reviews and inspections. All buildings constructed
13 under the provisions of this Chapter are subject to a final in-
14 spection for compliance with this Chapter. The Manager of the
15 Division of Building and Land Development has the authority to
16 establish rules and procedures for accepting at the option of the
17 applicant an affidavit of substantial compliance with this Chapter
18 in lieu of plan reviews and/or inspections.

19 NEW SECTION SECTION 5. Design and Construction Practices
20 Manual. The King County Executive shall provide for the prepara-
21 tion of a design and construction practices manual to help build-
22 ing contractors, individuals building their own residences, pro-
23 fessionals involved in building siting, design and construction
24 and other interested persons, such as college students, understand
25 and comply with the code by providing clear instructions and
26 explanations of the code's requirements. A draft design and con-
27 struction practices manual shall be available by April 15, 1980 to
28 involved and interested building design and construction parties,
29 including those of record who testified on the proposed code before
30 the King County Council and its energy committee. The manual shall
31 be officially delivered to the King County Council by April 15, 1980
32 for review and comment. The Council will have until May 30, 1980
33 to indicate its recommendations on the draft manual to the County

1 Executive. The County Executive's final version, as may be revised
2 from the draft, shall be complete and available to the public by
3 no later than June 29, 1980.

4 The manual shall include or reference, but not be limited
5 to, the following:

6 (A) A manual format which is convenient to use, well indexed,
7 flexible enough to allow the insertion of revisions and updates,
8 with chapter number and title noted on each chapter page for ease
9 of reference, and full reference on each page as to its revision
10 number and date.

11 (B) A statement of intent as to the conditions for and fre-
12 quency of manual update.

13 (C) A brief discussion of the key properties of energy, heat,
14 R-values, U-values, first and second laws of thermodynamics and
15 "delivered energy efficiency" (source energy).

16 (D) A definitions section assist the wide range of intended
17 users in understanding the code's application.

18 (E) Data on materials, systems, standard building types,
19 County climate factors and variations, explanation of procedures
20 for calculating heat loss coefficients (U-values), peak and total
21 energy use and inclusion of tables and formulas now in the code.

22 (F) Details of compliance, procedures and information for
23 submitting building plans and specifications.

24 (G) An explanation of the treatment of underground walls in
25 building envelop calculations with allowance for the insulating
26 value of soils.

27 (H) Flexible guidelines to encourage passive solar collection
28 and storage that are equivalent to code standards. The passive
29 solar section of the manual shall include, but not be limited to,
30 a discussion of alternative methods, designs, materials, and
31 equipment for south-facing, single-glazed windows that reliably
32 provide an equivalent net heat gain from solar energy as compared
33 to south-facing double-glazed windows over the heating season,

1 including examples for compliance with the provisions of Sub-
2 section 5304.03 (b)1 and Subsection 5306.01(d) 2.A. of the attached
3 King County Energy Code.

4 (I) Calculation procedures for complying with Section 5305
5 "Building Design by Systems Analysis and Building Utilizing Non-
6 Depletable Energy Sources," the alternative design section of the
7 attached code, including a clarification of the terms "similate"
8 and "simulation" in Subsection 5305.03 (b) "Analysis Procedures".

9 NEW SECTION SECTION 6. Comparison with State Standards.

10 The County Executive shall monitor and coordinate with the Washing-
11 ton State Building Code Advisory Council and the appropriate Wash-
12 ington State House and Senate Committees in its adoption of a
13 state-wide thermal efficiency and lighting code in order to
14 prepare and present to the King County Council by June 2, 1980 a
15 report on the significant differences between the attached King
16 County Energy Code and the State Energy Code, as it is available
17 at that time. The report shall:

18 A. Identify State standards that exceed, or will likely
19 exceed, upon taking effect prior to June 30, 1980, the standards
20 of the King County Energy Code.

21 B. Identify State standards that are, or are likely to be
22 reduced below the standards of the King County Energy Code, upon
23 taking effect prior to June 30, 1980, provide an assessment of the
24 technical and economic justification for the reduced standards,
25 and give the Executive's recommended changes to the Council for
26 amending the County Energy Code.

27 NEW SECTION SECTION 7. Code Revision. The County Executive
28 shall present to the King County Council by no later than December
29 31, 1981 an evaluation of the Energy Code's implementation and
30 make recommendations for needed revisions. The evaluation shall
31 include consideration of adopted County energy conservation
32 policies, the effectiveness of one year's application of the
33 Energy Code, the development and refinement of thermal efficiency

standards at the international, national, state and local levels and the increased awareness of the need for achieving better energy utilization efficiencies in King County.

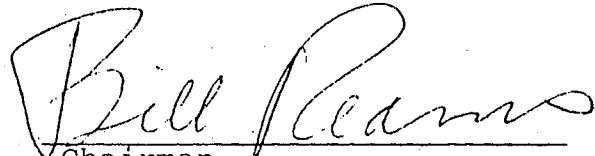
NEW SECTION SECTION 8. Severability. If any provision of this ordinance or its application to any person or circumstance is held invalid, the remainder of this ordinance or the application of the provision to other person or circumstances shall not be affected.

NEW SECTION SECTION 9. The attached King County Energy Code shall take effect and be in force on July 1, 1980.

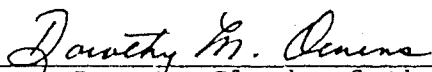
INTRODUCED AND READ for the first time this 19th day of February, 1980.

PASSED this 3rd day of March, 1980.

KING COUNTY COUNCIL
KING COUNTY, WASHINGTON


Chairman

ATTEST:


Deputy Clerk of the Council

APPROVED this 10th day of March, 1980.


KING COUNTY EXECUTIVE

Randy Revelle
King County Executive

King County Courthouse
Seattle, Washington 98104
(206) 344-4040
DEC 31 PM 12:30

December 31, 1981

The Honorable Paul Barden
Chairman, King County Council
B U I L D I N G

RE: Ordinance 4753

Dear Councilman Barden:

Section 7 of Ordinance 4753 requires the County Executive to present to the King County Council by December 31, 1981 an evaluation of the King County Energy Code's implementation with recommendations for needed revisions. The enclosure included with this letter responds to that requirement, and includes an evaluation of the Energy Code and summary explanations of specific recommended changes for the code.

In addition to submitting these required materials to the County Council, I have forwarded the recommended code changes to the King County Building Code Advisory Committee for their review. Upon completion of their review, I will transmit to the County Council a proposed ordinance for review and adoption of the recommended changes.

I am also directing the Building and Land Development Division and the Office of Energy Management to consider several areas of concern which may have an impact on local energy costs, and county energy code standards and their implementation. These concerns include:

1. The need, if any, for substantive changes in design criteria and thermal and equipment efficiency standards due to recent changes in energy costs and building technology developments;
2. The implications of the Pacific Northwest Electric Power Planning and Conservation Act;
3. The implications to this region of federal deregulation of the natural gas industry and the Trans-Canada pipeline;

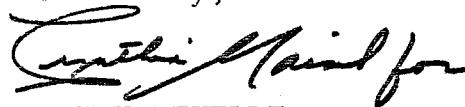
The Honorable Paul Barden
December 31, 1981
Page 2

4. The desire to promote, to greatest extent practicable, uniformity of code standards between neighboring local governments; and
5. The uncertainty of actual field compliance with the present Energy Code.

It is also anticipated that several major county building code revisions will be brought to the County Council for consideration and adoption in mid-1982 to reflect changes made in the 1982 Uniform Building Code. It is my hope that the above mentioned concerns can be adequately considered within this timeframe to enable any resulting energy code changes to be incorporated into that general code revision cycle. Staff resources are limited, however, within the Building and Land Development Division and the Office of Energy Management to address these concerns. I am, therefore, hopeful that we may be able to obtain assistance from local utilities in addressing these concerns especially with regard to field compliance with the presently adopted Energy Code.

I look forward to working with you on continued improvements to the Energy Code. If there are any questions or other concerns regarding this report or the Energy Code in general, please do not hesitate to contact me.

Sincerely,



RANDY REVELLE
King County Executive

RR:jb

Enclosure

cc: County Council Members
Cork Gildow, Chairman, King County Building Code Advisory
Committee
Gary Tusberg, Director, Planning and Community Development
ATTN: Ron McConnell, Acting Manager, Building and Land
Development Division
Ronald E. Quist, Director, Office of Energy Management

EVALUATION OF THE KING COUNTY ENERGY
CODE'S IMPLEMENTATION, AND
RECOMMENDATIONS FOR NEEDED REVISIONS

On March 10, 1980, the County Council adopted the King County Energy Code by Ordinance 4753, which included the following:

Section 7, Code Revision. The County Executive shall present to the King County Council by no later than December 31, 1981, an evaluation of the Energy Code's implementation and make recommendations for needed revisions. The evaluation shall include consideration of adopted County energy conservation policies, the effectiveness of one year's application of the Energy Code, the development and refinement of thermal efficiency standards at the international, national, state and local levels and the increased awareness of the need for achieving better energy utilization efficiencies for King County.

This report is in response to this requirement, separately addressing each of the elements of the above cited section. The last portion of the report provides, in summary format, the presently recommended code changes, which are being concurrently transmitted to the King County Building Code Advisory Committee for their review and recommendation. It is anticipated that other potential revisions might be identified during this review.

1. King County Energy Conservation Policies:

The Energy Management Plan for King County was recently adopted to become effective in April, 1982. The Energy Management Plan recognizes that most new construction occurs and will continue to occur in unincorporated King County. The majority of the energy savings will be realized as the result of conservation measures imposed through Energy Code requirements. For instance, 30 percent of expended energy is used in residences, one-half of which is used for space heating. Insulation and more efficient furnaces could reduce that energy use by 50 percent. The energy policies of the Management Plan not only support the use of the Energy Code, but encourage technical assistance and solar energy.

Consequently, Building and Land Development Division's administration of the Energy Code is directed to readily provide technical assistance on code compliance, insulation methods, and passive solar applications.

2. Effectiveness of One Year's Application of the Energy Code:

a. All building permits are now issued in compliance with the Energy Code. Detailed plan checks are performed on insulation levels and amounts of glazing.

b. The Division's staffing level does not allow inspection of the insulation, but rather relies on a self-certification. Since there has not been a review of the certification's effectiveness, we are unable to evaluate that aspect of the Energy Code. We are concerned that many of the inexpensive techniques to seal the buildings are not being properly carried out.

c. The Energy Code adoption required the publication of a technical manual. Approximately 50 copies have been distributed. That volume is low; however, Seattle had a similar publication six months earlier and the State Energy office distributed a free manual and conducted public workshops. Since all three codes are similar, it is reasonable that the engineers and architects chose not to pay the \$10.00 fee we are required to charge.

d. The "Computer Assisted Energy Code Enforcement Program" grant funded study has been completed. Computer assisted software was developed, and a computer was donated by the technical consultants, Dynalogic Incorporated. In addition to checking plans for compliance with the Energy Code, the computer program makes the evaluation of alternative amounts of insulation extremely simple and rapid. Further, the application and effectiveness of passive solar use can be similarly computed. The computer program is a design tool as well as an enforcement assist and is available in the public domain.

3. Thermal Efficiency Standards, Development and Refinement:

The most current national standard (ASHRAE 90A - 1980 Revisions to ASHRAE 90 - 75) have been reviewed and compared with both Seattle and King County requirements. No significant changes have been made; both Seattle and King County have comparable requirements. Although some changes to the national standard are more restrictive, King County requirements continue to meet or exceed the standards.

We have reviewed the changes adopted in WAC 51-12 by the State. Many of these changes were the result of King County testimony during the State Building Code Advisory Committee consideration. One item of note at the state level is a change in the Washington State Energy Code for masonry wall insulation. This exception is not substantiated with technical data, but was approved as a "temporary exception" for economic reasons. Technical studies were mandated to be finished by June 30, 1983. We question the probability of substantiating technical studies, and recommend that the King County Code not be changed until such technical studies prove the need.

4. Increased Awareness for Better Energy Use Efficiencies:

There is an increase in awareness of the need for energy conservation. The energy coordinator in Building and Land Development Division has 15 to 20 substantive discussions per week with customers. Nearly half of those discussions involve computer examination of alternative construction and insulation methods.

5. Recommended Changes and Revisions to the Existing Code:

The recommended changes to the existing code are summarized in the following table. The changes are largely clarifications of requirements; no substantive amendments are recommended:

TABLE OF PROPOSED ENERGY CODE REVISIONS

Section 5301.02(b)2 (Exempt Buildings):

This amendment would add the phrase "by a depletable energy source", which will make the King County Energy Code in compliance with the current changes in the State Energy Code.

Section 5302.01 (Definitions):

This amendment will add a definition of "accepted engineering practice." The definition will cite procedures developed by a nationally recognized professional organization, one developed by an equipment manufacturer and approved by the Building Official, or one which results from an approved computer simulation model.

Section 5302.07 (Definitions):

This will clarify the definition of gross wall area to include fully insulated foundation walls above and below grade. This reflects a change in the State Energy Code which requires basement walls to be insulated before they are credited for glass allowance.

Section 5304.03 Table 4 - 1 (Thermal Performance Criteria):

This will clarify the treatment of glazing in the table which previously was internally inconsistent. It will also change a notation on walls which previously unreasonably restricted log cabin type construction. Further, a change is recommended in the calculation procedure for single glazing. This change will also be discussed in Section 5306.01(d)1.

Section 5304.03(b)6 (Passive Solar Exemption):

This change will require the receiving thermal mass to be either within the space containing the qualifying glazing or

provided with an acceptable natural or mechanical means of transferring the heat. This change will place our current interpretation (and sensible passive solar design strategy) into code language.

Section 5304.11(c) (HVAC Equipment Performance Requirements):

This change will add an exception to the requirement for automatic vent dampers on central heating plant connecting vents, as follows: "This requirement does not apply to furnaces with pulse, condensing or induced draft systems which are specifically designed and labeled, or otherwise specified by manufacturer, for use without vent dampers." This change recognizes that some units may not be approved by manufacturer for use with vent dampers.

Section 5304.11(h)1 (Fireplaces):

This amendment will add an exception to the requirement for fireplace dampers in order to resolve a conflict with the Uniform Mechanical Code. The exception will read: "Fireplaces with gas logs installed in accordance with UMC 803 shall be equipped with tightly fitting glass or metal doors."

Section 5304.18(b)3 (Piping Insulation):

This correction will recognize that some piping may be used as a heat source and should not be insulated.

Section 5304.20(b)3 (Swimming Pools):

This change reflects a change in the State Energy Code relating to swimming pools. The new provision will require a label to be placed on pool heaters outlining proper energy conservation settings and techniques.

Section 5306.01(d)1 (Thermal Design Standards for Openings):

The current provision allows for one percent of the gross exterior wall area to be single glazed for decorative, security or unique architectural features. This change will allow that amount to be increased to two percent. This increase in allowed single glazing will then be treated in the same manner as skylights (areas multiplied by 2) in the calculation of heat loss.

Section 5306.01(d)2F (Passive Solar Exemption):

This change is the same as the change previously described in Section 5304.03(b)6. It requires that the thermal mass be in the same receiving area as its qualifying glazing.

Section 5306.02(a)2 (Combustion Heating Equipment):

Similar to the changes described in Section 5304.11(c) regarding the use of automatic vent dampers.

Section 5306.02(a)3A (Fireplaces):

This section is similar to Section 5304.11(h)1 in which an exception is made for gas logs in order to resolve a conflict with the Uniform Mechanical Code.

Section 5306.03(c) (Swimming Pools):

This change is similar to Section 5304.20(b)3 regarding label requirements on heated swimming pools.

Section 5306.03(e) (Piping Insulation):

This change will reflect changes to the State Energy Code to simplify the administration of piping insulation for recirculating systems.

Section 5306.03(g) (Water Heaters):

This change will deal with water heaters. It will remove the requirement that gas water heaters be wrapped with insulation, which has been in conflict with manufacturer requirements. The change will also accept all water heaters, electric or gas, which meet ASHRAE 90-75 requirements representing a tested level of energy conservation as well as labeling requirements.

Chapter 53

KING COUNTY ENERGY CODE

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Chapter 53

KING COUNTY ENERGY CODE

SECTION 5301 - ADMINISTRATIVE

SECTION 5302 - DEFINITIONS

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SECTION 5305 - BUILDING DESIGN BY SYSTEMS ANALYSIS AND BUILDING UTILIZING NON-DEPLETABLE ENERGY SOURCES (Alternate Design)

SECTION 5306 - PRESCRIPTIVE REQUIREMENTS APPROACH

Note: The provisions of this Chapter do not consider the efficiency of various energy forms as they are delivered to the building envelope ("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 Chapter will provide the most efficient use of available energy in new building construction.

SECTION 5301 -- ADMINISTRATIVE

Subsection 5301.00 Title This Chapter shall be known as the "King County Code for Energy Conservation in New Building Construction", and may be cited as such; and will be referred to herein as "The King County Energy Code" or "This Chapter".

Subsection 5301.01 Purposes The purpose of this Chapter is to provide minimum standards for new buildings and structures or portions thereof to achieve efficient use of energy. The purpose of this Chapter is also to provide for and promote the health, safety, and welfare of the general public, and not to create or otherwise establish or designate any particular class or group of persons who will or should be especially protected or benefited by the terms of this Chapter. This Chapter shall permit the use of alternate methods and innovative approaches and techniques to achieve its purposes.

Subsection 5301.02 Application and Scope (a) The requirements of this Chapter shall apply to all new buildings and structures, except as specifically exempted. This Chapter sets forth certain requirements for the design of exterior envelopes, heating, ventilating and air conditioning systems (HVAC), service water heating, electrical distribution and illuminating systems and equipment to achieve more efficient

(c) Maintenance Information: When equipment is supplied which requires preventive maintenance to maintain efficient operation, the owner shall be furnished with complete maintenance information and necessary 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 product and model.

Subsection 5301.05 Plans and Specifications. With each application for a building or mechanical permit, plans and specifications shall be submitted showing all information pertinent to the applicable sections of this Chapter. The building official may require plans and specifications be prepared by an engineer or architect licensed to practice by the State. All designs submitted under the provisions of Section 5305 shall be prepared by an engineer or architect licensed to practice by the State.

Submission of all pertinent information shall be a condition precedent to the processing of any of the above permits and approval of the submitted information shall be a condition precedent to the issuance of any of the above permits.

Subsection 5301.06 Details. The plans and specifications shall show in sufficient detail all pertinent data and features of the building and the equipment and systems as herein governed including but not limited to: exterior envelope component materials; U values of the respective elements including insulation; R values of insulating materials; size and type of apparatus and equipment; equipment and system controls and other pertinent data to indicate conformance with the requirements herein.

Subsection 5301.07 Inspections and Enforcement.

(a) Enforcement. The building official is authorized to enforce the provisions of this Chapter and any rules and regulations promulgated thereunder, pursuant to the enforcement and penalty provisions of Title 23 of the King County Code.

(b) General. All construction or work for which a permit is required shall be subject to inspection by the building official.

(c) Authority. The building official is authorized and directed to enforce this Chapter. The building official is authorized to promulgate, adopt, and issue those rules and regulations necessary to the effective and efficient administration of this Chapter.

(d) Plan Reviews and Inspections. All buildings constructed under the provisions of this Chapter are subject to a final inspection for compliance with this Chapter. The building official has the authority to establish rules and procedures for accepting, at the option of the applicant affidavits of substantial compliance with this Chapter in lieu of plan reviews and/or inspections.

CLERESTORY. A window placed high in a wall or projecting from a roof plane to admit daylight into the interior of a building.

COEFFICIENT OF PERFORMANCE (COP). See Subsection 5304.11 for various definitions of COP.

COMFORT ENVELOPE. The area on a psychometric chart enclosing all those conditions described in ASHRAE Standard 55-74 "Thermal Environmental Conditions for Human Occupancy."

CONDITIONED FLOOR AREA. The horizontal projection of that portion of interior space which is contained within exterior walls and which is conditioned directly or indirectly by an energy-using system.

Subsection 5302.04 D

DEGREE DAY, HEATING. A unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal heating load of a building in winter. For any one day, when the mean temperature is less than 65°F (18°C), there exist as many Degree Days as there are Fahrenheit (Celsius) degrees difference in temperature between the mean temperature for the day and 65°F (18°C).

Subsection 5302.05 E

ECONOMIZER CYCLE. A control sequence of a fan system that modulates the amount of outside air for the purpose of space cooling without using mechanical cooling.

EFFICIENCY, OVERALL SYSTEM. The ratio of the useful energy (at the point of use) to the thermal energy input for a designated time period, expressed in percent.

ENERGY. The capacity for doing work, taking a number of forms which may be transformed from one into another, such as thermal (heat), mechanical (work), electrical; in customary units, measured in kilowatt-hours (kwh) or British thermal units (Btu).

ENERGY EFFICIENCY RATIO (EER). The ratio of new cooling capacity in Btu/h to total rate of electric input in watts under designated operating conditions. When SI units are used this becomes equal to COP. (See COP).

ENERGY, NEW. (See NEW ENERGY).

ENERGY, RECOVERED. (See RECOVERED ENERGY).

EXTERIOR ENVELOPE. (See BUILDING ENVELOPE).

Subsection 5302.06 F

FENESTRATION. Any light-transmitting opening in a building envelope, including glazing, interior and exterior shading devices, and integral sun control devices.

HVAC SYSTEM. A system that provides either collectively or individually the processes of comfort heating, ventilating, and/or air conditioning within or associated with a building.

Subsection 5302.09 I

INFILTRATION. The uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effects of wind and-or the effect of differences in the indoor and outdoor air density.

Subsection 5302.10 J (Reserved)

Subsection 5302.11 K (Reserved)

Subsection 5302.12 L

LUMINAIRE. A complete lighting unit consisting of a lamp or lamps together with the parts designated to distribute the light, to position and protect the lamps, and to connect the lamps to power supply.

Subsection 5302.13 M

MANUAL. Capable of being operated by personal intervention.

Subsection 5302.14 N

NEW ENERGY. Energy, other than recovered energy, utilized for the purpose of heating or cooling.

NON-DEPLETABLE ENERGY SOURCES. Sources of energy (excluding minerals) derived from incoming solar radiation, including lighting and photosynthetic processes; from phenomena resulting therefrom including wind, waves and tides, lake or pond thermal differences; and energy derived from the internal heat of the earth, including nocturnal thermal exchanges. Neither natural gas, oil, coal, nor any utility-supplied electricity shall be considered a non-depletable energy source.

Subsection 5302.15 O

OPAQUE AREAS. All exposed areas of a building envelope which enclose conditioned space, except openings for windows, skylights, doors and building service systems.

OUTSIDE AIR. Air taken from the outdoors and, therefore, not previously circulated through the HVAC system of a building or structure.

OVERALL SYSTEM EFFICIENCY. (See EFFICIENCY, OVERALL SYSTEM).

OVERALL THERMAL TRANSFER VALUE (OTTV). An overall coefficient of heat gain expressed in units of Btu per hour per square foot.

ROOF ELEMENT. A roof element shall be considered as all components of the roof/ceiling envelope through which heat flows, thereby creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated or mechanically cooled space.

ROOF AREA, GROSS AREA OF. The gross area of a roof element consists of the total interior surface of such element, including skylights exposed to the heated or mechanically cooled space.

ROOM AIR CONDITIONER. An encased assembly designed as a unit primarily for mounting in a window or through a wall, or as a console. It is designed primarily to provide free delivery of conditioned air to an enclosed space, room or zone. It includes a prime source of refrigeration for cooling and dehumidification and means for circulating and cleaning air, and may include means for ventilating and heating.

Subsection 5302.19 S

SEQUENCE. A consecutive series of operations.

SERVICE SYSTEMS. All energy-using systems in a building that are operated to provide services for the occupants or processes housed therein, including HVAC, service water heating, illumination, transportation, cooking or food preparation, laundering or similar functions.

SERVICE WATER HEATING. Supply of hot water for domestic or commercial purposes other than comfort heating.

SERVICE WATER HEATING DEMAND. The maximum design rate of energy withdrawal from a service water heating system in a designated period of time (usually an hour or a day).

SHADING COEFFICIENT (SC). The ratio of the solar heat gain through a glazing system to that of an unshaded single-pane of double strength window glass under the same set of conditions.

SHALL. Where shall is used in specific provision, that provision is mandatory.

SHOULD. Not mandatory but desirable as good practice.

SKYLIGHT. A clear or translucent panel or shape set in the plane of a roof to admit daylight into the interior of a building.

SLAB ON GRADE (In a Heated Space). Any slab including internally heated slabs poured in contact with the ground and which the top of the finished slab is less than 12 inches below the final elevation of the nearest exterior grade.

SOLAR ENERGY SOURCE. Source of thermal, chemical or electrical energy derived directly from conversion of incident solar radiation.

SPECIAL GLAZING. Glazing which has a maximum "U" value of 0.65. Insulating glass with at least one-quarter inch air space or approved storm sash will be considered to provide the "U" value required.

UNITARY HEAT PUMP. One or more factory-made assemblies which normally include an indoor conditioning coil, compressor(s) and outdoor coil or refrigerant-to-water heat exchanger, including means to provide both heating and cooling functions. It is designed to provide the functions of air-circulating, air cleaning, cooling and heating with controlled temperature, and dehumidifying, and may optionally include the function of humidifying. When such equipment is provided in more than one assembly, the separate assemblies shall be designed to be used together.

Subsection 5302.22 V

VENTILATION AIR. That portion of supply air which comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space. (See ASHRAE Standard 62-73).

Subsection 5302.23 W X Y Z

ZONE. A space or group of spaces within a building with heating and/or cooling requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

(b) Indoor design temperature shall be 70°F. for heating and 78°F. for cooling, except where the building official approves a higher indoor design temperature for health or safety reasons for a specific building.

(c) Indoor design relative humidity for heating shall not exceed 30 percent. For cooling, new energy shall not be used to control relative humidity in the range between 30 percent and 70 percent.

Subsection 5303.05 Ventilation. The ventilation air quantities specified in Chapter 11B of the King County Mechanical Code shall be used for design. The required outdoor air quantities shall be used as the basis for calculating the heating and cooling design loads.

Subsection 5303.06 Methods of Compliance. Buildings or structures which are subject to this chapter may satisfy its requirements either by application of a component performance approach (Section 5304), a system analysis approach (Section 5305), or in the case of low rise residential buildings and other buildings and structures containing less than 5000 square feet of gross floor area, a prescriptive requirements approach (Section 5306).

TABLE 4-1

Thermal Performance Criteria for Low-Rise Residential Buildings

ELEMENT	MODE	GROUP R-DIV 3	GROUP R-DIV. 1
Walls	Heating & Cooling (U Value)	.18	.21
Roof/ Ceiling	Heating & Cooling (U Value)	.045	.045
Floors over Unheated Spaces	Heating & Cooling (U Value)	.08	.08
Slab on Grade	Heating (R value)	4.25 (Unheated slab) 6.35 (Heated slab)	4.25 (Unheated slab) 6.35 (Heated slab)

2. Floors over unheated spaces shall not exceed the U_o value given in Table 4-1.

3. Slab on Grade Floor: For slab on grade floors, the thermal resistance of the insulation around the perimeter of the floor shall not be less than the value given in Table 4-1. The insulation shall extend downward from the top of the slab for a minimum distance of 24 inches for heated slabs and 12 inches for unheated slabs, or downward to the bottom of the slab then horizontally beneath the slab for a minimum total distance of 24 inches for heated slabs or 12 inches for unheated slabs.

4. Windows and doors and air leakage: (See Subsection 5304.05).

(b) Exemption for Passive Solar Features.

For full passive solar credit glazing areas which meet all of the following criteria may be exempted from the U_o calculations. For partial credit see the Design and Construction Practices Manual.

1. The glazing area must have either (1) a thermal transmittance (U) value of not greater than .65, or (2) be equipped with operable insulating shutters with a minimum R value of 5.0 if the thermal transmittance (U) value of the glazing area is greater than .65.

buildings other than low-rise residential buildings shall not exceed the values given in Table 4-2. Equations 1 and 2 shall be used to determine acceptable combinations of building components and thermal properties to meet this requirement for heating. Steady state U_w values for opaque wall sections may be corrected by multiplying by the appropriate M factor before the calculation of U_o in Equation 2 of this section. U_o and U_w are specified in units of $\frac{\text{Btu}}{\text{hr sq ft } ^\circ\text{F}}$.

TABLE 4-2

Thermal Performance Criteria for Buildings other than Low-Rise Residential.

ELEMENT	MODE	
Walls	Heating (U Value)	.30
	Cooling (OTTV)	35.4
Roof/ Ceiling	Heating Cooling(U_o Value)	.085
Floors over Unheated Spaces	Heating(U_o Value)	.080
Slab on Grade	Heating(R Value)	4.25 (Unheated slab)
		6.35 (Heated slab)

- Floors over unheated spaces shall not exceed the U_o value given in Table 4-2.
- Slab on Grade Floors: For slab on grade floors the thermal resistance of the insulation around the perimeter of the floor shall not be less than the value given in Table 4-2. The insulation shall extend downward from the top of the slab for a minimum distance of 24 inches, or downward to the bottom of the slab; then horizontally beneath the slab for a minimum total distance of 24 inches.

EQUATION 2

$$U_o = \frac{U_w A_w + U_g A_g + U_d A_d + \dots}{A}$$

Where:

U_o = the average or combined transmittance of the gross exterior wall, floor or roof/ceiling assembly area. (Except slabs on grade.)

A = the gross exterior wall, floor or roof/ceiling assembly area.

U_w = the thermal transmittance of the components of the opaque wall, floor or roof/ceiling assembly area.

A_w = opaque wall, floor or roof/ceiling assembly area.

U_g = the thermal transmittance of the glazing (window or skylight) area.

A_g = glazing area.

U_d = the thermal transmittance of the door, or similar opening.

A_d = door area.

NOTE: Where more than one type of wall, window, roof/ceiling, door and skylight is used, the U and A terms for those items shall be expanded into sub-elements as: $U_{w1} A_{w1} + U_{w2} A_{w2} + U_{w3} A_{w3} + \dots$ etc.

EQUATION 3

$$OTTV = \frac{(U_w A_w TD_{EQ}) + (A_f SFSC) + (U_f A_f \Delta t)}{A}$$

Where:

OTTV = average or combined thermal transfer value in $\frac{\text{Btu}}{\text{hr. sq. ft.}}$

A = gross exterior wall.

U_w = U value of opaque wall (all elements)

A_w = opaque wall area

U_f = U value of the fenestration area

A_f = fenestration area

3. Meeting rails of sectional doors and meeting stiles or rails of bi-parting doors shall be provided with standard weather seals or astragals.
4. Revolving doors shall be weatherstripped at the head and stiles.
5. Pairs of doors shall be provided with weatherstripping or astragals at the meeting stile.

Doors which comply with the infiltration requirements of Table 4-3 shall be deemed to comply with the foregoing criteria.

(d) All exterior windows shall be designed to limit air leakage into or from the building envelope, and shall have air infiltration rates no greater than those shown in Table 4-3.

TABLE 4-3

ALLOWABLE AIR INFILTRATION RATES

WINDOWS	RESIDENTIAL DOORS	COMMERCIAL DOORS
(cfm per lineal foot of operable sash crack)	(cfm per sq. ft. of door area)	(cfm per lin.ft. of crack)
	sliding glass entrance	Swinging, sliding, Revolving
0.5	0.5 1.00	11.0

Compliance with the criteria for air leakage of all types of doors shall be determined by Standard ASTM E 283-73, Standard Method of Test for Rate of Air Leakage through exterior windows, curtain walls and doors.

EXCEPTION: Site built and millwork shop made wooden sash are exempt from testing but shall be made tightly fitting. Fixed lights shall have glass retained by stops with sealant or caulking all around. Operating sash shall have weatherstripping working against overlapping trim, and a closer/latch which will hold the sash closed. The window frame to framing crack shall be made tight with caulking, overlapping membrane, or other approved technique.

(e) Required fire doors with a fire resistant rating over (1) hour, and fire windows are exempt from this subsection.

Subsection 5304.06. Building Mechanical Systems. The following subsections cover the determination of heating and cooling loads, design requirements, and equipment and component performance and control requirements. Requirements are established for insulating HVAC systems and for duct construction.

(e) **Recooling Systems:** Systems in which heated air is recooled, directly or indirectly, to maintain space temperature shall be provided with control that will automatically reset the temperature to which the supply air is heated to the lowest and/or optimum level that will satisfy the zone requiring the warmest air. The system design shall limit the use of new energy for recooling of heated air to 15% of the total system heating capacity.

(f) A multiple zone HVAC system that employs reheating or recooling for control of not more than 5,000 ft.³/min., or 20 percent of the total supply air for the building, whichever is less, shall be exempt from the supply air temperature reset requirement of paragraphs (c) through (g).

(g) Concurrent operation of independent heating and cooling systems serving common spaces and requiring the use of new energy for heating or cooling shall be minimized by one or both of the following:

1. By providing sequential temperature control of both heating and cooling capacity in each zone.
2. By limiting the heating energy input through automatic reset control of the heating medium temperature (or energy input rate) to only that necessary to offset heat loss due to transmission and infiltration and, where applicable, to heat the ventilation air supply to the space.

Subsection 5304.10 Energy Recovery. Consideration shall be given to the use of recovery systems which will conserve energy (provided the amount expended is less than the amount recovered) when the energy transfer potential and the operating hours are considered.

Subsection 5304.11. HVAC Equipment Performance Requirements. (a) The requirement of this subsection applies to equipment and component performance for heating, ventilating and airconditioning systems. Where equipment efficiency levels are specified, approved data furnished by the equipment supplier or certified under a nationally recognized certification program or rating procedure shall be used to satisfy these requirements. Equipment efficiencies shall be based on the standard rating conditions shown in Tables 4-8A, 4-8B and 4-8C.

(b) **HVAC-System Heating Equipment Heat Pumps-Heating Mode:** Heat pumps whose energy input is entirely electric shall have a coefficient of performance (COP heating, as defined herein) not less than the values shown in Table 4-4.

1. These requirements apply to, but are not limited to, unitary heat pumps (air source and water source) in the heating mode and to heat pumps in the packaged terminal air-conditioner and room air-conditioner forms in the heating mode. Field assembled unitary heat pumps, consisting of one or more components, shall comply with this subsection.
2. **Coefficient of Performance (COP) Heating:** The ratio of the rate of net heat output to the rate of total energy input, expressed in consistent units and under designated rating conditions.

1. These requirements apply to, but are not limited to unitary cooling equipment (air-cooled, water-cooled and evaporatively-cooled); the cooling mode of unitary and packaged heat pumps (air source and water source); packaged terminal air-conditioners; and room air-conditioners.

EXCEPTION: These requirements do not apply to equipment used for refrigerated food or florists' and nurseries' coolers.

2. Coefficient of Performance (COP) Cooling: The ratio of the rate of net heat removal to the rate of total energy input, expressed in consistent units and under designated rating conditions.

The rate of new heat renewal shall be defined as the change in the total heat contents of the air entering and leaving the equipment (without reheat).

Total energy input shall be determined by combining the energy inputs to all elements of the equipment, including but not limited to compressor(s), pump(s), supply-air fan(s), return-air fan(s), condenser-air fan(s), cooling-tower fan(s), circulating water pump(s), and the HVAC-System equipment control circuit.

(f) Applied HVAC-System Components, Electrically Operated, Cooling Mode. HVAC-system components, as listed in Table 4-6 whose energy input is entirely electric, shall show a Coefficient of Performance (COP) cooling, as defined herein, and not less than the values shown in Table 4-6.

1. Coefficient of Performance (COP) Cooling. The ratio of the rate of net heat removal to the rate of total energy input, expressed in consistent units and under designated rating conditions.

The rate of net heat removal is defined as the difference in total heat contents of the water or refrigerant entering and leaving the component.

Total energy input shall be determined by combining the energy inputs to all elements and accessories of the component, including but not limited to, compressor(s), internal circulating pump(s), condenser-air fan(s), evaporative-condenser cooling water pump(s), purge, and the HVAC-system component control circuit.

(g) HVAC-System Equipment - Heat Operated Cooling Mode. Efficiency Limitation Equipment: Heat operated cooling equipment shall show a (COP) cooling not less than the values shown in Table 4-7. These requirements apply to, but are not limited to, absorption equipment, engine driven equipment, and turbine driven equipment.

- (f) When all space cooling is accomplished by a circulating liquid which transfers space heat directly or indirectly to a heat rejection device such as a cooling tower without the use of a refrigeration system.

Subsection 5304.15. Controls. (a) Temperature Control: Each HVAC system shall be provided with at least one thermostat for the regulation of temperature.

Where used to control both heating and cooling, each thermostat shall be capable of being set from 55-85 degrees F and shall be capable of operating the system heating and cooling in sequence. It shall be adjustable to provide a temperature range of up to 10 degrees F between full heating and full cooling, except as allowed in Subsection 5304.09(g).

(b) Humidity Control. If an HVAC system is equipped with a means for adding moisture to maintain specific selected relative humidities in spaces or zones, a humidistat shall be provided. This device shall be capable of being set to prevent new energy from being used to produce space relative humidity above 30 percent rh. Where a humidistat is used in an HVAC system for controlling moisture removal to maintain specific selected relative humidities in spaces or zones, it shall be capable of being set to prevent new energy from being used to produce a space relative humidity below 60 percent relative humidity.

EXCEPTION: Special occupancies requiring different relative humidities may be permitted by the Building Official.

(c) Zoning for Temperature Control.

1. One and Two-Family Dwellings: At least one thermostat for regulation of space temperature shall be provided for each separate HVAC system. In addition, a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating and/or cooling input to each zone or floor not controlled by a thermostat.
2. Multi-Family Dwellings: For multi-family dwellings, each individual dwelling unit shall be considered separately and shall meet the above requirements. Spaces other than living units shall meet the requirements of Subsection 5304.15(c)(3).
3. All Other Types of Buildings or Occupancies: At least one thermostat for regulation of space temperature shall be provided for:
 - A. Each separate HVAC system.
 - B. Each separate zone as defined in Section 5302. As a minimum each floor of a building shall be considered as a separate zone. In a multi-story building where

Subsection 5304.17. Duct Construction. All duct work shall be constructed, sized and erected in accordance with the King County Mechanical Code.

Subsection 5304.18. Piping Insulation. All piping installed to serve buildings and within buildings shall be thermally insulated in accordance with Table 4-10, except as stated herein, (for service water heating systems, see Subsection 5304.19).

(a) Other Insulation Thickness: Insulation thickness in Table 4-10 is based on insulation having thermal resistance in the range of 4.0 to 4.6 per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having R values less than 4.0 per inch, or may be reduced for materials having R values greater than 4.6 per inch.

1. For materials with thermal resistance greater than $R = 4.6$ per inch, the minimum insulation thickness may be reduced as follows:

$$\frac{4.6 \times \text{Table 4-10 thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

2. For materials with thermal resistance less than $R = 4.0$ per inch, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \times \text{Table 4-10 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

(b) EXCEPTIONS: Piping insulation is not required in any of the following cases:

1. Piping installed within unitary HVAC equipment.
2. Piping at temperatures between 55°F and 100°F.
3. When the heat loss and/or heat gain of the piping, without insulation, does not increase the energy requirements of the building.

(c) Additional insulation with vapor barriers shall be provided to prevent condensation where required.

Subsection 5304.19. Service Water Heating. (a) General: Hot water for domestic, sanitary and swimming pool purposes shall be generated and delivered in a manner conducive to saving heat energy.

(b) Scope: The purpose of the following provisions is to provide criteria for design and equipment selection that will produce energy savings when applied to service water heating.

Subsection 5304.20. Water Heaters, Storage Tanks, Boilers, and Piping. (a) Performance Efficiency.

turning off the energy supplied to the main burner(s) of all other types of service water heating systems.

3. Swimming Pools:

Heated swimming pools shall be equipped with:

- A. Controls which allow water temperature to be regulated from the maximum design temperature down to 65°F;
- B. An ON-OFF switch for the pool heater, mounted for easy access to allow shutting off the operation of the heater without adjusting the thermostat setting and to allow restarting without relighting a pilot light; and
- C. A pool cover at the surface of the water.

Subsection 5304.21. Pump Operation. Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off, automatically or manually, when the hot water system is not in operation.

Subsection 5304.22. Pipe Insulation. For recirculation systems, piping heat loss shall be limited to a maximum of 25 Btu/hr./ft.² of external pipe surface for underground piping. Maximum heat loss shall be determined at a ΔT equal to the maximum water temperature minus a design ambient temperature no higher than 65°F.

Subsection 5304.23. Conservation of Hot Water. (a) Showers: Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 3 gpm per shower head.

(b) Lavatories in restrooms of public facilities shall be equipped with outlet devices which limit the flow of hot water to a maximum of 0.5 gpm.

Subsection 5304.24. Electrical Power - General. Electrical distribution and lighting systems shall be designed for efficient distribution and use of electrical energy from the service entrance to and at the points of use as provided herein.

Subsection 5304.25. Electrical Distribution. (a) Power Factor. Utilization equipment, rated greater than 1,000 W and lighting equipment greater than 15W, with an inductive reactance load component, shall have a power factor of not less than 85 percent under rated load conditions. Power factor of less than 85 percent shall be corrected to at least 90 percent under rated load conditions. Power factor corrective devices, installed to comply with this Chapter, shall be switched with the utilization equipment, when a leading power factor would result.

(b) Voltage Drop. In any building, the maximum total voltage drop shall not exceed 3 percent in branch circuits or feeders, for a total of 5 percent to the farthest outlet based on steady state design load conditions.

EXCEPTIONS: Vacant building space or open unoccupied areas need not meet the provisions of the switching requirements until tenant occupancy is determined.

Subsection 5304.26. Lighting Power Budget. A lighting power budget is the upper limit of the power to be available to provide lighting needs in accordance with the criteria specified herein.

The lighting power budget for a building shall be the sum of the power limits computed for all lighted interior and exterior spaces and shall be determined in accordance with the procedures specified in this section.

(a) The installed lighting wattage in the building shall not exceed the budget level calculated in this subsection. The budget wattage level shall be the sum of the interior budget calculated in accordance with subsection (b) and the exterior budget calculated in accordance with subsection (c). Lighting wattage includes lamp and ballast wattage.

(b) The interior lighting budget shall be calculated by multiplying the gross building area, in square feet, by the appropriate unit power budget, in watts per square foot, specified in Table 4-11.

The lighting power budget shall be based on the primary occupancy for which the space within the building is intended. If multiple occupancies are intended the lighting power budget for each type of occupancy shall be separately calculated and summed to obtain the lighting budget for the interior spaces of the building. In cases where a lighting plan for only a portion of a building is submitted, the interior lighting budget shall be based on the gross floor area covered by the plan.

Power required for trickle-charging for battery-powered emergency lighting may be excluded from the interior power budget.

(c) The exterior lighting budget shall be calculated by multiplying the building perimeter in feet by 7.5 watts per foot. An allowance for outdoor parking lighting may be added at 0.05 watts per square foot of parking area.

(d) Lighting for the following applications shall be exempted from inclusion in the calculation of this section when approved by the Building Official.

1. Stage lighting, entertainment, or audiovisual presentations where the lighting is an essential technical element for the function performed.
2. Lighting for medical and dental tasks.
3. Lighting in areas specifically designed for visually handicapped people.

TABLE 4-6

Applied HVAC System Components, Electrically Driven Water Chillers, and Compressor and Condenser Units-Minimum EER and COP-Cooling

COMPONENT	CONDENSING MEANS	AIR		WATER		EVAP.	
		EER	COP	EER	COP	EER	COP
Self-contained Water chillers	Centrifugal	7.8	2.3	13.6	4.0		
	Positive Displacement	7.5	2.2	11.6	3.4		
Condenserless Water chillers	Positive Displacement	9.5	2.8	11.6	3.4		
	Positive Displacement	8.5	2.5	11.9	3.5	11.9	3.5

NOTE: When tested at the standard rating conditions specified in Table 4-8A, 4-8B and 4-8C.

TABLE 4-7

HVAC-System Heat-Operated Cooling Equipment

$$\text{Minimum COP} = \frac{\text{Net Cooling Output}}{\text{Total Heat Input (Electrical Auxiliary Inputs Excluded)}}$$

HEAT SOURCE	MINIMUM COP
Direct fired (gas, oil)	0.48
Indirect fired (steam, hot water)	0.68

TABLE 4-8C

Applied HVAC System Components
Standard Rating Conditions--Cooling

ITEM		Centrifugal or Self-Contained Reciprocating Water-Chiller	Condenserless Reciprocating Water-Chiller
Leaving Chilled Water Temp.	F	44	44
Entering Chilled Water Temp.	F	54	54
Leaving Condenser Water Temp.	F	95	--
Entering Water Temp.	F	85	--
Non-Ferrous Tubes	*	0.0005	0.0005
Fouling Factor, Water Steel Tubes	*	0.0010	0.0010
Fouling Factor, Refrigerant	*	0.0000	0.0000
Condenser Ambient (Air or Evap.Cooled)	F	95db/75wb	--
Compressor Saturated	Water Cooled (or Evap. Cooled)	F	--
	Air Cooled	F	105
Discharge Temp.		F	--
			120

Standard Ratings are at sea level.

*h ft F/Btu

TABLE 4-10

Minimum Pipe Insulation

PIPING SYSTEM TYPES	FLUID TEMPER- ATURE RANGE, F	INSULATION THICKNESS IN INCHES FOR PIPE SIZES					
		RUN- OUTS UP TO 2"	1" AND LESS	1-1/4 TO 2"	2-1/2 TO 4"	5" TO 6"	8" AND LARGER
HEATING SYSTEMS							
Steam and Hot Water							
High Pressure/ Temp.	306-450	1-1/2	1-1/2	2	2-1/2	3-1/2	3-1/2
Med. Pressure/ Temp.	251-305	1-1/2	1-1/2	2	2-1/2	3	3
Low Pressure/ Temp.	201-250	1	1	1-1/2	1-1/2	2	2
Low Temp.	120-200	1/2	3/4	1	1	1	1-1/2
Steam Condensate (for Feed Water)	Any	1	1	1	1-1/2	1-1/2	2
COOLING SYSTEMS							
Chilled Water Refrigerant, or Brine	40-55	1/2	1/2	3/4	1	1	1
	Below 40	1	1	1-1/2	1-1/2	1-1/2	1-1/2

SECTION 5305 -- BUILDING DESIGN BY SYSTEMS ANALYSIS AND BUILDING
UTILIZING NON-DEPLETABLE ENERGY SOURCES

(Alternate Design)

Subsection 5305.00. General. This section establishes design criteria in terms of total energy use by a building including all of its systems.

Subsection 5305.01. Energy Analysis. Compliance with this subsection will require an analysis of annual energy use.

A building designed in accordance with this chapter (the "alternative design building") will comply with this chapter if the annual energy consumption is not greater than that of a building of similar design (a "standard design") whose enclosure elements and energy consuming systems are designed in accordance with Section 5304. The calculated energy consumption of the alternative design shall be subject to a limitation in the improvement credited to any individual building system as outlined in subsection 5305.03.

"Building of similar design" shall mean a building utilizing the same energy sources(s) for the same functions and having equal floor area, environmental requirements, occupancy, climate data and usage schedule. Inputs to the energy analysis relating to occupancy and usage shall correspond to the expected occupancy and usage of the building.

The alternative design shall incorporate the applicable provisions of Subsection 5304.15 (mechanical system controls), Subsection 5304.20(b) (water temperature control), and Subsection 5304.25(c) (lighting switching).

Subsection 5305.02. Design. The standard design, conforming to the criteria of Section 5304 and the proposed alternative design shall be designed on a common basis as specified herein.

The comparison of total energy usage shall be expressed in Btu input per square foot of gross floor area per year for the standard design and the alternative design. Comparison of similar elements, systems or components shall be expressed in dimensions or terms accepted by standard engineering practice.

If the proposed alternative design results in an increase in consumption of one energy source and a decrease in another energy source, even though similar sources are used for similar purposes, the difference in each energy source shall be converted to equivalent energy units for purposes of comparing the total energy used.

Subsection 5305.03. Analysis Procedure. The analysis of the annual energy usage of the standard design and the proposed alternative building and system design shall meet the following criteria:

- (a) The building heating/cooling load calculation procedure used for annual energy consumption analysis shall be of sufficient detail to

- (e) Mechanical equipment: Design capacity, part load profile.
- (f) Building loads: Internal heat generation, lighting, equipment, number of people during occupied and unoccupied periods.

Subsection 5305.05. Documentation. A proposed alternative design submitted under this chapter shall be accompanied by an energy analysis comparison report. The report shall provide sufficient technical detail on the two buildings and their systems and on the data used in and resulting from the comparative analysis to certify that both the analysis and the designs meet the criteria of this chapter.

The documentation shall demonstrate that the analysis used is consistent with accepted techniques and procedures.

EXCEPTION: Proposed alternative designs for single family and two family dwellings and for commercial and industrial structures having the indoor temperature controlled from a single point need not provide the energy usage analysis for a full year. A comparison of energy consumption between the alternative design and the standard design in a manner which follows approved engineering practices and standards, as approved by the Building Official, shall be provided.

Subsection 5305.06. Buildings Utilizing Non-Depletable Energy. (a) Buildings utilizing solar, geothermal, wind or other non-depletable energy sources for all or part of its energy source shall meet the requirements of this chapter, except such non-depletable energy may be excluded from the total annual energy consumption attributed to the alternative design building by this section.

(b) To qualify for this exclusion, such non-depletable energy must be derived from a specific collection, storage and distribution system. The solar energy passing through windows shall also be considered as qualifying if such windows are provided with (1) operable insulating shutters or other devices which, when drawn or closed, shall reduce maximum outward heat flows to those permitted in subsection 5304.02(a) and Subsection 5304.04(a) and, (2) the window areas are shaded or otherwise protected from the direct rays of the sun during periods when cooling is required.

(c) This subsection shall also apply to nocturnal or passive cooling processes in lieu of energy consuming processes.

(d) All other criteria covered in this Section and Section 5304 shall apply to the proposed alternative designs utilizing non-depletable sources of energy.

Subsection 5305.07. Documentation - Buildings Using Non-Depletable Energy Sources. Proposed alternative designs, submitted as requests for exception to the standard design criteria shall be accompanied by an energy analysis, as specified in this Section. The report shall provide sufficient technical detail on the alternative building and system designs and on the data employed in and resulting from the comparative analysis to verify that both the analysis and the designs meet the criteria of Section 5304 and this Section.

SECTION 5306 -- PRESCRIPTIVE REQUIREMENTS APPROACH

Subsection 5306.00. General. (a) This Section establishes design criteria in terms of prescribed requirements for building construction.

(b) The requirements contained in this part are applicable only to buildings less than 5000 square feet in gross floor area or dwelling units of three stories or less in height. Other methods may be used provided a satisfactory design is submitted showing compliance with the performance standards of this chapter.

(c) (Reserved)

(d) Installed insulation having a minimum "R" value as specified in this Section shall be accepted as providing the corresponding required "U" value.

(e) The stated U_o value of any one element of a building, such as roof/ceiling, wall or floor, may be increased and the U_o value for other components decreased provided that the overall heat gain or loss for the entire building envelope does not exceed the total resulting from the conformance to the stated U_o values.

Subsection 5306.01. Building Envelope Requirements.

(a) Walls. The opaque exterior wall sections and the interior walls exposed to unheated spaces shall have a thermal transmittance "U"-value not to exceed the value specified in Table 6-1.

(b) Roof/Ceiling. The roof/ceiling assembly shall have a thermal transmittance "U" value not to exceed the value specified for the indicated type of construction in Table 6-1.

(c) Thermal Design Standards for Floors.

1. Slab on grade Floors in Heated Spaces. Slab-on-grade floors shall be provided with insulation having a minimum "R" value of 4.25 installed a minimum of 12 inches vertically or horizontally at the perimeter. Slabs internally heated or with perimeter heat ducts in the slab shall be provided with insulation having a minimum "R" value of 6.35 installed a minimum of 24 inches vertically or horizontally at the perimeter.

2. Floor Sections. Floor sections over unheated spaces, such as unheated basements, unheated garages or ventilated crawl spaces, shall be constructed to comply with the required values as specified in Table 6-2.

TABLE 6-1

Maximum Allowed "U" for Ceilings and Walls, and Corresponding Minimum "R" Values of Added Insulation for Various Construction

Flat Roof Decks and Ceilings (1)		Walls (2)	
"U"	"R"	"U"	"R"
0.045	19	0.08	11

NOTES:

- (1) Enclosed joist or rafter spaces formed where ceilings are applied directly to the underside of roof joists or rafters must have joists or rafters of sufficient size to provide a minimum of one inch clear vented air space above the insulation.
- (2) Concrete or masonry foundation walls of "unfinished basements" need not be insulated until finished, provided that any frame cripple walls shall comply with the insulation requirements of this Table. Insulation installed shall comply with the requirements of this table.

TABLE 6-2

Maximum Allowed "U" Values of Floor Sections Over Unheated Areas, and Corresponding Minimum "R" Values of Added Insulation

Structural Slab		Wood and Steel Framing	
"U"	"R"	"U"	"R"
0.12	7	0.08	9

EXCEPTION: Insulation may be omitted from floor over heated basements, heated garages, or under floor areas used as plenums if foundation walls are insulated in accordance with subsection 5306.01(a). The insulation shall be attached in a permanent manner.

(d) Thermal Design Standards for Openings.

1. Special glazing shall be required for all exterior windows, except that 1% of the gross exterior wall area may be single glazed if approved by the building official for decorative, security or unique architectural features. If glazing area exceeds 20% of the gross exterior wall area, then the calculation procedure of Subsection 5304.03 must be used.

Structures with less than 10% of the gross exterior wall area in glazing can be exempted from the preceding requirements of this part 1 of subsection (d) if any one of the following conditions is met:

- A. All glazing within 45° of true north represents less than 1% of the gross exterior wall area.
 - B. All glazing within 45° of true north is special glazing.
 - C. At least 40% of the glazing is within 30° of true south.
2. Exemptions for Passive Solar Features.

For full credit glazing area which meets the following requirements may be excluded from the glazed area percentage calculation of part 1 of this subsection (d). For partial credit see the Design and Construction Practices Manual. The requirements establish criteria for solar access during the heating season, resistance to heat loss, and the provision of heat storage capacity within the insulated walls, either as part of a passive solar design or as part of the ordinary building floor, walls, or ceiling.

- A. The area must be double-glazed. Single-glazed windows that are installed with insulating treatments that reliably provide an equivalent net heat gain over the heating season compared to double-glazed windows under the same conditions, i.e. the difference between total solar heat gain and overall heat loss is the same in both cases, shall also qualify for exemption under part 2 of this subsection (d).

- B. The glazing must be oriented within 22-1/2 degrees of due south.
- C. The glazing must be untinted, non-reflecting glass.
- D. The glazing must receive direct solar exposure for 50% of the hours between 9:00 a.m. and 3:00 p.m. on December 21.
- E. The glazing must receive direct solar exposure for 85% of the hours between 9:00 a.m. and 3:00 p.m. on March 21.
- F. For each square foot of exempt glazing, the building must contain a heat storage capacity equivalent to 150 Btu/day, located inside the insulated shell of the structure, and not covered with insulation materials such as carpet yielding an R value of 1.0 or greater. Heat storage capacity is calculated as specified in subsection 5304.03(b)6.

High thermal capacity materials such as masonry or water or ordinary building components may be used to provide thermal storage.

- G. Compliance with all the requirements of Subsection 5304.03(b) will be taken as compliance with the above criteria for exempt glazing.

3. All skylights shall be double-glazed.

(e) Air Leakage.

- 1. Windows and Doors. All windows and doors shall conform to the air infiltration requirements specified in subsection 5304.05. Site built windows shall be constructed to minimize leakage.

EXCEPTION: Required fire doors with a fire resistance rating over one (1) hour and fire windows are exempt from this subsection.

- 2. Exterior joints around windows and door frames, openings between walls and foundations, between walls and roof and between wall panels; openings at penetrations of utility services through walls, floors and roofs; and all other such openings in the building envelope shall be sealed, caulked, gasketed, or weather stripped to limit air leakage.

- (f) Vapor Barriers. A ground cover of 4 mil. (0.004") polyethylene or equivalent, lapped one foot at each joint and extended up the foundation wall to at least the outside ground line, is required at crawl spaces.

An approved vapor barrier shall be properly installed in roof decks, in enclosed rafter spaces formed where ceilings are applied directly to the underside of roof, rafters and at exterior walls.

- (g) General Insulation Requirements. Loose Fill. Blown or poured loose fill insulation may be used in attic spaces where the slope of the roof is not less than 2 1/2 feet in 12 feet and there is at least 30 inches of clear distance from the top of the bottom chord of the truss or ceiling joist to the underside of the roof sheathing at the roof ridge. When eave vents are installed, baffling of the vent openings shall be provided so as to deflect the incoming air above the surface of the insulation. Baffles shall be in place at the time of framing inspection.

Subsection 5306.02. Building Mechanical Systems - General. All HVAC devices, components and their elements shall conform to the requirements of this subsection, where:

(a) Heating and Mechanical Cooling Devices.

1. All heating and mechanical cooling devices shall meet the required efficiency factor specified herein or in tables 4-4, 4-5, 4-6 and 4-7, for the specific type of device.
2. Combustion Heating Equipment. All gas and oil fired central comfort heating equipment shall show a minimum combustion efficiency of 75 percent at maximum rated output. Gas and oil fired room or space heaters shall show a minimum combustion efficiency of 70 percent at maximum rated output. Combustion efficiency is defined as 100 percent minus stack losses in percent of heat input. Stack losses are:
 - A. Loss due to sensible heat in dry flue gas.
 - B. Loss due to incomplete combustion.
 - C. Loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the flue.

Flues must be equipped with an approved automatic damper.

3. Fireplaces. Site-built fireplaces shall be provided with:
 - A. Tightly-fitting flue dampers, operated with a readily accessible manual or approved automatic control.
 - B. An outside source for combustion air. The duct shall be at least six square inches in area, and shall be provided with a readily operable damper.

4. Calculation of Heating and Cooling Loads. Heating and cooling design loads for the purpose of sizing HVAC systems are required and shall be calculated in accordance with accepted engineering practice. The design parameters specified in Section 5303 shall apply for all computations.

HVAC equipment for low-rise residential buildings shall be sized no greater than 125% of the design load as calculated above. If the selected manufacturer does not provide equipment in the range of 115% to 125% of the design load, the next size larger than 125% may be used. All associated ductwork shall be sized to meet minimum airflow requirements as determined by the load calculation.

(b) Temperature Control.

Each heating system shall be provided with at least one thermostat for the regulation of temperature. Each thermostat shall be capable of being set as follows:

Where used to control heating only - 55-75°

Where used to control cooling only - 70-85°

Where used to control both heating and cooling, it shall conform to the requirements of subsection 5304.15.

(c) Zoning for Temperature Control

1. Group R - Division 3 Occupancy - detached one and two family dwellings

At least one thermostat for regulation of space temperature shall be provided for each separate HVAC system. In addition, a readily accessible manual or automatic means shall be provided to partially restrict or shut off the heating or cooling input to each zone or floor.

EXCEPTION: Nonconditioned basements and garages

2. Group R - Division 1 Occupancy - all other residential buildings three stories or less.

For multi-family dwellings, each individual dwelling unit shall be considered separately and shall meet the requirements of subsection 5306.02. Spaces other than living units shall meet the requirements of subsection 5306.02(c)1.

3. Control Setback and Shutoff: Group R - Division 3 and Group R - Division 1 Occupancy

The thermostat required in (a) and (b) shall provide an automatic means for reducing the energy required for

heating and cooling during periods of non-use or reduced need such as, an automatic night setback thermostat for sleeping hours. Lowering thermostat set points to reduce energy consumption of heating systems shall not cause energy to be expended to reach the reduced setting.

4. Duct Insulation.

All ducts, plenums and enclosures installed in or on buildings shall be thermally insulated and constructed in accordance with Subsection 5304.16.

5. Pipe Insulation.

All piping installed to serve building or within buildings shall be thermally insulated in accordance with Table 4-10.

EXCEPTION: For service water heating systems, see Subsection 5306.03.

Subsection 5306.03. Service Water Heating. Water heating storage tanks, boilers and piping for all water heating systems shall be installed in accordance with the following:

(a) Temperature Controls.

Service water heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use.

(b) Shut-down.

A separate switch or individual circuit breaker shall be provided to permit turning off the energy supplied to electric service water heating systems. A separate valve shall be provided to permit turning off the energy supplied to the main burner(s) of all other types of service water heating systems.

(c) Swimming Pools

Heated swimming pools shall be equipped with:

1. Controls which allow water temperature to be regulated from the maximum design temperature down to 65°F;
2. An ON-OFF switch for the pool heater, mounted for easy access to allow shutting off the operation of the heater without adjusting the thermostat setting and to allow restarting without relighting a pilot light; and
3. A pool cover at the surface of the water.

(d) Pump Operation.

Circulating hot water systems shall be arranged so that the circulating pump(s) can be conveniently turned off, automatically or manually, when the hot water system is not in operation.

(e) Insulation.

For recirculating systems, piping heat loss shall be limited to a maximum of 25 Btu/hr.ft.² of external pipe surface for above ground piping and a maximum of 35 Btu/hr.ft.² of external pipe surface for underground piping. Maximum heat loss shall be determined at a temperature differential equal to the maximum water temperature minus a design ambient temperature no higher than 65°F.

(f) Showers.

Showers used for other than safety reasons shall be equipped with flow control devices to limit total flow to a maximum of 3 gpm per shower head.

(g) Water Heater.

When a water heater is installed in an unheated space, an insulation wrap shall be added to all water heaters if necessary to bring the total insulation value to R-16.

Subsection 5306.04. Electrical Power and Lighting. The electrical power distribution and lighting systems shall conform to the requirements of subsection 5304.24, et seq.

EXCEPTION: One and Two-family detached dwellings and the dwelling portion of Multi-family buildings are exempt from the requirements of this subsection.