STATE OF MINNESOTA
DEPARTMENT OF ENERGY, PLANNING & DEVELOPMENT
ENERGY DIVISION

In the matter of the Proposed Amendments to State Building Code of Rules 2MCAR §§ 1.16001 - 1.16008 Regarding Heat Loss, Ventilation and Climate Control

STATEMENT OF NEED AND REASONABLENESS

June, 1983

A. INTRODUCTION

In 1982, the Minnesota Legislature amended Statutes § 116J.19, Subd. 8 (Laws of Minnesota, 1982, Chapter 563) to read:

> "In recognition of the compelling need for energy conservation in order to safeguard the public health, safety and welfare, it is necessary to provide building design and construction standards consistent with the most efficient use of energy. Therefore, the commissioner shall, pursuant to chapter 14, adopt rules governing building design and construction standards regarding heat loss control, illumination and climate control. To the maximum extent practicable, the rules providing for the energy portions of the building code shall be based on and conform to model codes generally accepted throughout the United States. The rules shall apply to all new buildings and remodeling affecting heat loss control, illumination and climate control. The rules shall be economically feasible in that the resultant savings in energy procurement shall exceed the cost of the energy conserving requirements amortized over the life of the building. The rules adopted pursuant to this subdivision, shall be part of the state building code. Notwithstanding the provisions of this subdivision, all applications for approval of building specifications and plans may be submitted to the state building inspector as provided in section 16.862."

Pursuant to Minn. Stat. § 116J.19, Subd. 8, the Department of Energy, Planning and Development, Energy Division (hereafter "Energy") has proposed rules 2 MCAR §§ 1.16007 - 1.16008 and a repealer of rules 2 MCAR §§ 1.16001 - 1.16006 which are published in the State Register of June 27, 1983. This Statement of Need and Reasonableness will demonstrate both the need and reasonableness of these rules. This Statement of Need and Reasonableness will also demonstrate the authority of the Agency for adopting rules 2 MCAR §§ 1.16007 - 1.16008 and will demonstrate Energy has complied with all requirements of Minnesota Statutes Chapter 14, relating to rule making.

B. AUTHORITY FOR RULES PROPOSED

In 1975, the Minnesota Legislature enacted Laws 1975, Ch. 307 (MN Stat 116H.122, Subd. 4) to require the Commissioner of Administration, in consultation with the Director of the Energy Agency, to establish standards in the State Building Code regarding heat loss control, illumination and climate control.

Minn. Stat. § 116H.122, Subd. 4

> "In recognition of the compelling need for energy conservation in order to safeguard the public health, safety and welfare, it is necessary to provide building design and construction standards consistent with the most efficient use of energy. Therefore, the commissioner of administration, in consultation with the director, shall, no later than August 1, 1975, and pursuant to chapter 15, promulgate building design and construction standards regarding heat loss control, illumination and climate control. Such standards shall apply to all new buildings and remodeling affecting heat loss control, illumination and climate control. Such standards shall be economically feasible in that the resultant savings in energy procurement shall exceed the cost of the energy conserving requirements amortized over the life of the building. The standard shall become part of the state building code and be effective six months after promulgation."

In accordance with Minn. Stat. § 116H.122, Subd. 4, the Commissioner of Administration did promulgate rules, 2 MCAR §§ 1.16001 - 1.16006, known as "Design and Evaluation Criteria for Energy Conservation in New Buildings, Additions, Remodeled Elements of Buildings and Standards for Certain Existing Public Buildings" which became effective January 30, 1976.

Subsequently, the Commissioner of Administration followed Chapter 14 procedures to amend 2MCAR §§ 1.16001 - 1.16006 in 1977 and again in 1978.

Minn. Stat. § 116J.19, Subd. 8, which appears in the introduction Section of this Statement of Need and Reasonableness, effectively tranfers authority for making rules in the State Building code regarding heat loss control, illumination and climate control from the Commissioner of Administration to the Commissioner of the Energy. Since it is established that rules regarding heat loss control, illumination and climate control are established in 2 MCAR §§ 1.16001 - 1.16006, it therefore follows that the Commissioner of the Energy has authority to amend rules 2MCAR §§ 1.16001 - 1.16008.

C. COMPLIANCE WITH CHAPTER 14 RULE MAKING PROCEDURES

Compliance with applicable provisions of Minnesota Statutes §§ 14.01 to 14.70 by Energy in establishing Rules 2MCAR §§ 1.16007 - 1.16008 is demonstrated in Section C of this Statement of Need and Reasonableness.

§14.05 Authority

The authority for Energy to promulgate rules 2 MCAR §§ 1.16007 - 1.16008 is established in Section B "Authority For Rules Proposed" of this Statement of Need and Reasonableness.

§ 14.07 Subd. 2 Approval of Form

The Revisor of Statutes has assessed in the development of rules 2 MCAR §§ 1.16007 - 1.16008 through consultation of Mr. Craig Lindeke (Revisor of Statutes) with Mr. Bruce Nelson (Energy). Rules 2 MCAR §§ 1.16007 - 1.16008 have been presented to the Revisor of Statutes, and the revisor has isued a certification of approval of form and this certification was attached to the copy of the proposed rules delivered to the State Register.

§ 14.07 Subd. 3 Standards for Form

(1) See discussion under § 14.07 Subd. 5. below.
(2) See discussion under § 14.07 Subd. 4. below.
(3) To the extent practicable, plain language is used in rules 2 MCAR §§ 1.16007 - 1.16008, and technical language is avoided.
(4) Rules 2 MCAR § 1.16001 to 1.16008 are amended by using the exact procedure described in Minn. Stat. § 14.07 Subd. 3.(4).

§ 14.07 Subd. 4. Incorporations by Reference

Rule § 1.16008 adopts the Model Energy Code, 1983 Edition as publshed by the Council of American Building Officials by reference. This document is conveniently available to the public as demonstrated in the memorandum to the Revisor of Statutes (Attachment II).

§ 14.07 Subd. 5. Duplication of Statutory Language

Rules 2 MCAR §§ 1.16007 - 1.16008 minimize duplication of statutory language. Only rule 2 MCAR 1.16008, paragraphs Q. and BB. duplicate statutory language.

§ 14.10 Solicitation of Outside Information

Energy published a notice of intent to solicit outside opinion on its actions to revise rules 2 MCAR §§ 1.16001 - 1.16008 in 7 S.R. 963 and 7 S.R.999. Copies of these notices are attached as Attachments III and IV. All written material received in response to this notice is attached as Attachment V.

Energy has undertaken an extensive effort to solicit outside information, and to provide information about rule changes to interested persons as explained below.

First, Energy staff held several informal meetings on this matter with professional and trades organizations representing users of the energy code. A listing of these meetings appears as Attachment VI. During these meetings, Energy's new legislative authority to adopt rules 2 MCAR §§ 1.16007 - 1.16008 was explained, and a dialog on options for rule revisions held.

Second, Energy established an energy code advisory committee to review proposed rules 2 MCAR §§ 1.16007 - 1.16008. Notes from meetings of this advisory committee appears as Attachment VII.

Third, Energy submitted two articles on this matter to the Minnesota Builders Association Newsletter. Copies of these articles are attached as Attachment VIII.

In the matter of solicitation of outside information for revisions to rules 2 MCAR §§ 1.16007 - 1.16008, it has been shown that Energy has not only met, but far exceeded the minimum legal requirements.

§ 14.11 Fiscal Note on Rule in Notice

The adoption of rules 2 MCAR §§ 1.16007 - 1.16008 by Energy will require no expenditure of public monies by local public bodies. Rules 2 MCAR §§ 1.16007 - 1.16008 will be enforced as part of the State Building Code by local code officials, as prescribed in Minn. Stat. §§ 16.84 - 16.867. The proposed adoption of rules 2 MCAR §§ 1.16007 - 1.16008 will require no change in the nature or scope of the enforcement procedures for the State Building Code.

§ 14.23 Statement of Need and Reasonableness

This document constitutes the Statement of Need and Reasonableness for proposed rules 2 MCAR §§ 1.16007 - 1.16008. It will be available for at least 30 days following the date of publication of notice to all interested persons pursuant to Minn. Stat. 14.22.

D. NEED AND REASONABLENESS OF AMENDMENTS TO RULES 2 MCAR §§ 1.16001 - 1.16008 Rule 2-MCAR § 1.16007. The letters identifying paragraphs in this statement correlate with the letters used in this rule.

A. The authority paragraph cites the Minnesota Statute which gives the Energy Division authority to promulgate these rules. The citing of authority to promulgate rules is a required part of any rules promulgated.

B. Definitions are made in this paragraph for the terms "State Building Code" and "this code" or "the code." These abbreviated definitions are necessary because the terms are frequently used throughout rules 2 MCAR §§ 1.16007 - 1.16008.

Rule 2 MCAR § 1.16008. The letters identifying paragraphs in this statement correlate with the letters used in the rule.

A. This section incorporates the Model Energy Code, 1983 Edition, by references. Minnesota Statute § 116J.19, Subd. 8, (Laws of MN, 1982, Chap. 563) states, in part, "To the maximum extent practicable, the rules providing for the energy portions of the building code shall be based on and conform to model codes generally accepted throughout the United States." The Model Energy Code was prepared by the Council of American Building Officials with participation by Building Officials and Code Administrators International, Inc., International Conference of Building Officials, National Conference of State on Building Codes and Standards, and Southern Building Code Congress International Inc.. It is generally accepted throughout the United States, and so qualifies as appropriate to serve as a basis for these rules.

B. Section 101.3 of the Model Energy Code is amended to clearly define which buildings are to conform with the code. This amendment is made so that the application of the energy code will coincide with application of the State Building Code.

C. Section 101.3.2.4 is inserted in the Model Energy Code to include remodeled elements of buildings under application to existing buildings. This addition is made so that application of in the energy code will coincide with application of the State Building Code.

D. Section 105.1 of the Model Energy Code is amended to require inspections by building officials in accordance with 2 MCAR § 1.0111. The amendment is made so requirements are the same as in the State Building Code.

E. The addition of a definition of "building" is inserted. The reason for including this definition is to clearly delineate which buildings are covered by the code. The Model Energy Code has no definition of "building".

F. The definition of commercial parking facility is inserted in the Model Energy Code. It is made to show when amendment Q of the rules, relating to commercial parking facilities, applies. This definition is essentially the same as in the present energy code (See page 3 Attachment I). This language is inserted in these rules to make it readily accessible to building designers and building code officials.

G. The definition of heated space is amended to clarify the meaning of positive heat supply. The identical amendment exists in the current energy code. (See page 3 Attachment I).

H. The definition of Nondepletable Energy Sources is replaced with a definition of Renewable Energy Sources. The title of this definition is changed to reflect the more modern understanding of renewable energy sources that no energy source is nondepletable. The definition is modified to be similar to a definition of renewable energy sources given in Laws of Minnesota 1983, Chapter 289, Sec. 91, Subd. 7.

I. A definition of vapor barriers is included for use in amendment N relating to requirements for installation of vapor barriers. Attachment X substantiates the need and reasonableness of this amendment.

J. The footnote to the section defining exterior design conditions is amended by specifying 99 percent and 1 percent outdoor temperature values instead of the 97½ percent and 2½ percent values given in the Model Energy Code. This amendment is proposed with the strong urging of the Consulting Engineers Council (CEC) joint Energy and Codes committees. While the amended values would allow the design of larger HVAC systems, it is the CEC members' contention that the Model Energy Code values (which are identical to the present values in the present energy code) are not in fact used in practice. Thus, the amended values are a compromise in order to have values which all designers in the state will use.

The footnote to this section is also amended to include an additional reference. It states that degree day heating data shall be selected from

Standard RS-22. This standard is referenced because it is more current than the standard referenced in the Model Energy Code.

K. The amendment to this section makes this paragraph correlate with a new reference standard adopted in paragraph K. The language in the Model Energy Code refers to sections in ASHRAE Standard 62-73 that do not exist in the referenced standard ASHRAE Standard 62-1981. See Section FF. for an explanation of need and reasonableness of adopting Standard 62 - 1981.

L. The requirement for insulation on slab-on-grade floors for type R buildings is amended, as it is in the current Minnesota Energy Code (See page 3 Attachment I). This amendment changes the extent of the slab to be covered from a prescribed two foot depth to the design frost line. The reason for the amendment is that the State's definition of design frost line is not constant throughout the state and is greater than the 24" specified in the Model Energy Code.

M. The requirement of specific amounts of insulation on foundation walls amends the Model Energy Code. The reason for including these specifications is that foundation walls are a major heat loser in Minnesota homes, and that foundation wall insulation in new homes is common practice throughout the state. A demonstration of the need and reasonableness of foundation wall insulation requirements is provided in Attachment IX. A note is added to recommend that foundation walls insulated as required be designed to prevent damage due to frost action, which may be a problem, particularly in clay soils.

N. The vapor barrier installation specifications denoted here are consistant with current energy efficient construction practice in Minnesota. The need and reasonableness of this requirement is demonstrated in Attachment X. An exception is added permitting the vapor barrier to be discontinuous at the rim joist, since with current construction materials and practices it is very difficult to maintain a continuous vapor barrier there. A note is given recommending consideration of heat recovery ventilation if high moisture is expected to be a problem in the home.

O. The requirement for insulation on slab-on-grade floors for buildings other than Group R is amended, as it is in the current Minnesota Energy Code (See page 4 Attachment I). This amendment changes the extent of the slab to be covered from a prescribed two foot depth to the design frost line. The reason for the change is the State Building Codes' definition of design frost line is not constant throughout the state.

P. This section amends the table in the Model Energy Code for heating and cooling criteria for Group R, Residential Buildings. The table format remains the same in the proposed code but different U values have been inserted for Type A-1 buildings. The need and reasonableness of these numbers is demonstrated in Attachment XI. These requirements are consistant with common construction practice in Minnesota.

Footnotes 2, 4 and 5 are deleted since they all refer to conditions with much fewer Fahrenheit heating degree days than in Minnesota. Footnote 3 is also deleted and the need and reasonableness of this deletion is demonstrated in Attachment XII.

Q. The addition of a section specifying requirements for heated parking garages is carried over from the current Minnesota Energy Code (See page 4 Attachment I). It is a requirement mandated by Minn. Statute § 116J.20, Subd. 3. Statutory language is duplicated here to make it readily accessible to building designers and building code officials.

R. The section of the proposed code which inserts a paragraph specifying a maximum System Design Heating/Cooling Capacity is a carry over from the current Minnesota Energy Code (See page 5 Attachment I). The amendment was made in recognition that oversized heating and cooling systems have reduced efficiency.

Exception number 3 is in addition to the current code requirements that was included after discussion with the Consulting Engineers Council (CEC) Energy and Codes committees. It reflects the fact that systems employing automatic temperature set-back, and larger heating and cooling capacities to compensate for the pick-up needed, can reduce energy use compared to systems with no temperature set-back. Since the exception requires a registered professional engineer to show that the design capacity is no larger than is needed for pick-up, this entire provision should receive much more careful scrutiny than with the current code language.

S., U. and V. Three tables in the Model Energy Code are amended to change all minimum COP and EER values. The Model Energy Code is based on Standard 90A & B - 1980, published by the American Society of Heating, Refrigerating and Air Conditioning Engineers. Standard 90A specifies that the values of COP and EER in the Model Energy Code tables shall be required beginning January 1, 1980. However, Standard 90A also specifies that beginning January 1, 1984, new values (identical with those in amendments S, U and V shall be required. Copies of the relevant tables from ASHRAE Standard 90A appear in Attachment XIII.

Since it is proposed that these rules go into effect less than three months prior to January 1, 1984, it is reasonable that the higher efficiencies be required. In order to further examine the reasonableness of this amendment, phone calls were made to local HVAC equipment suppliers, including Thermex Corporation and Trane Corporation, to check on availability of equipment with these COP and EER values. According to the suppliers, such equipment is now available.

T. Table 5-5 in the Model Energy Code is amended to raise the minimum steady state combustion efficiency requirements of large boilers from 75 to 80 percent. This change was recommended by members of the Energy Code Advisory Committee and CEC Energy and Code committees. Phone conversations with local HVAC equipment suppliers, including Burner Service, Blue Rag Systems and Thermex Corporation all indicated that this was a reasonable change.

W. The section on low pressure duct construction is amended so that all supply and return ducts outside the conditioned space are sealed. The primary reason for the change from excepting return air ducts and supply ducts located within return air plenums is that these ducts are subject to air leakage just as much as others and, consequently, waste just as much energy

as others. Furthermore, according to members of the Energy Code Upgrade Advisory Committee, it is currently standard construction practice in Minnesota to seal all supply and return ducts.

X. The amendment to the section on pool covers requires their installation only on heated outdoor swimming pools and deletes the exception for those outdoor pools receiving over 20 percent of their heating energy from non-depletable resources. The change to requiring pool covers on only outdoor heated pools comes from consultation with experts and the Energy Code Advisory Committee. Also see Attachment XIV for the position of the Safety Services of American Red Cross regarding this change. An additional reason for deleting this requirement is that pool covers on indoor pools are not likely to be used in the opinion of all who commented on this provision.

The exception involving 20% of energy derived from renewable energy sources is deleted because a reliable calculation method that would prevent this provision as being used as a loophole is not specified.

Y. The requirement for swimming pool time clocks to run the pump in the Model Energy Code is deleted in the proposed code. The reasoning for this, is that according to engineers of the Energy Code Upgrade Advisory Committee, is that the time clock wouldn't be used and there is no indication that their installation results in saved energy. See Attachment XIV for the position of the American Red Cross on this change.

Z. The section on pipe insulation is amended to delete the exception which omits requirement of pipe insulation in circumstances where the heat loss does not increase annual energy requirements of the building. The deletion was made because there is no evidence that pipe insulation would not cost effectively save energy. Also, inclusion of this exception would result in unnecessary ambiguity in the code. In addition, insulating recirculating hot water pipe to the values required by the Model Energy Code is currently standard design practice in Minnesota.

AA. The requirement to equip lavatories in rest rooms of public facilities with devices to limit the outlet temperature to 110°F is deleted from the proposed code. The reason for the amendment is that such equipment is not commonly available and would not necessarily save energy. Attachment XV outlines in detail further reasons for this deletion.

BB. The section on Electric Energy Determination is amended to require that electrical service to individual dwelling units in buildings containing two or more units be separately metered, with individual metering readily accessible to the individual occupants. This is in compliance with Minnesota Statute § 116J.27, Subd. 8 and is included to make the language readily accessible to building designers and building code officials.

CC, DD, EE, and FF. These amendments maked the same changes for heating and cooling criteria as in amendments L, M and N. The reason for the change is to make the language in the Building Design by Acceptable Practice section equivalent to the Building Design by Component Performance Approach section of the Model Energy Code.

GG. This section inserts a table giving prescribed U values for portions of buildings in the Building Design by Acceptable Practice section. It is

included to provide a simplified method for a builder of one- and two-family homes to know whether or not a design meets the code. Attachment XVI demonstrates the equivalence of these numbers to the Building Design by Component Performance Section.

HH. This amendment makes the same changes for heated swimming pools as in amendments X and Y. This insures continuity throughout the code.

II. The same amendment is made here as in Part Z above. This insures continuity throughout the code.

JJ. RS-3 is changed to ASHRAE Standard 62-1981 Ventilation for Acceptable Indoor Air Quality because it is the most current standard dealing with ventilation. The standard given in the Model Energy Code is no longer in print. A letter from the ASHRAE Minnesota Chapter Energy Committee (Attachment XVII) demonstrates the need and reasonableness of this change.

KK. Referenced Standard RS-4 is changed to ASHRAE 55-1981 Thermal Environment Conditions for Human Occupancy for the same reasons cited above for amendment JJ.

LL. Referenced Standard RS-8 is changed to IES Lighting Handbook, 1981 Application Volume and 1981 Reference Volume, Illuminating Engineering Society (IES). The old standard is no longer in print. The attached letter from Jack Elliot, president of the Minnesota Chapter of the Illumination Engineering Society (Attachment XVIII) demonstrates the need and reasonableness of this change.

MM. A new standard is included in the list of referenced standards: RS-22 Monthly Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1951-80 Minnesota. The reason for this is its current temperature and degree day data; the existing energy code referenced outdated data from 1941-70.

NN. The address for ASHRAE and NWMA are made correct. The addresses listed in the Model Energy Code are incorrect.

OO. Figure 1 of the Model Energy Code is amended to change the title and delete the line labeled A1. The reason for this is that prescribed values for Type A1 houses are given in amendment P, and therefore the title is inappropriate and line labeled A1 on this graph is not applicable.

PP. The title of Figure 2 is amended to include only Type A2 buildings. Value for roof/ceilings for Type A1 buildings is given in amendments P and GG, so this figure is not applicable to them.

Repealer —

The rules that constitute the current Minnesota Energy Code are being repealed as a whole. Rules 2 MCAR §§ 1.16001 - 1.16007 adopt a different standard by reference and are substantially different from proposed rules 2 MCAR §§ 1.16007 - 1.16008. Repeating the rules 2MCAR §§ 1.16001 - 1.16006 and adopting completely new rules 2 MCAR §§ 1.16007 - 1.16008 results in the most clear and understandable rules.

E. INDEX OF ATTACHMENTS

I. Rules 2 MCAR §§ 1.16001 - 1.16006 (repealed).
II. Memorandum demonstrating that the Model Energy Code is conveniently available to the public.
III. State Register December 20, 1982, Page 963.
IV. State Register Decmeber 27, 1982, page 999.
V. All written material received in response to notice of intent to solicit outside opinion.
VI. List of discussion meetings regarding the Minnesota Energy Code upgrade.
VII. Notes from Energy Code upgrade Advisory Committee meetings.
VIII. Articles from Minnesota Builders Association Newsletter on the upgrade of the energy code.
IX. Study demonstrating the need and reasonableness of foundation wall insulation requirements.
X. Study demonstrating the need and reasonableness of vapor barrier amendments.
XI. Studies demonstrating the need and reasonableness of one-and two-family heating and cooling criteria amendments.
XII. Study demonstrating the need and reasonableness of deleting special requirements for cathedral ceilings.
XIII. Copy of tables 6.2, 6.4 and 6.5 from ASHRAE Standard 90A - 1980.
XIV. Letter from the American Red Cross on amendments regarding swimming pools.
XV. Memorandum to the Minnesota Council for the Handicapped on temperature controls on lavatories.
XVI. Desmonstration of equivelance of tables 6-11 to requirements in the Building design by Component Performance Approach Section.
XVII. Letter from the ASHRAE Energy Committee on the amendment to adopt a new ventilation standard.
XVIII. Letter from the Illuminating Engineering Society on the amendment to adopt a new edition of the IES Handbook.

ATTACHMENT I

MINNESOTA CODE OF AGENCY RULES

DEPARTMENT OF ADMINISTRATION

BUILDING CODE DIVISION

ENERGY CONSERVATION IN BUILDINGS

1978 Edition

Cite the Rule as:
(for example)
2 MCAR § 1.16001

Published by

OFFICE OF THE STATE REGISTER
DEPARTMENT OF ADMINISTRATION

Suite 203, 95 Sherburne Ave., St. Paul, Minnesota 55103

DEPARTMENT OF ADMINISTRATION

BUILDING CODE DIVISION

DESIGN AND EVALUATION CRITERIA
for
ENERGY CONSERVATION IN NEW BUILDINGS, ADDITIONS, REMODELED ELEMENTS OF BUILDINGS
and
STANDARDS FOR CERTAIN EXISTING PUBLIC BUILDINGS

§ 1.16001 Authorization. These rules are authorized by Minn. Stat. § 116H.12, subd. 4 (1974) and Minn. Stat. § 116H.121 (1976) and established through the rulemaking procedures set forth in Minn. Stat. §§ 15.0411 to 15.052 (Supp. 1975) in order to carry out the provisions of §§ 116H.12, subd. 4 and 116H.121, regarding energy conservation standards for design, evaluation and construction of all new buildings and the remodeling or reconstruction undertaken after the effective date of these rules. Additionally these rules are intended as the energy conservation standards for the survey of certain public buildings, defined by Statute as "buildings owned by the State and the University of Minnesota." These Rules constitute amendments to the State Building Code. In the event that these Rules differ with the State Building Code, these Rules shall govern in all cases not affecting safety and health requirements. Additionally these Rules and the Standard are intended to be used in the required survey of buildings owned by cities, counties and school districts. Compliance with these Rules and the referenced standards shall not be mandatory for existing buildings owned by the city, county or school district.

§ 1.16002 Enforcement.

A. Building Officials, in the municipality for which they are appointed, shall enforce these Rules.

B. In all other areas of the State these Rules shall be enforced by the Commissioner of Administration or his designated representatives. The fees for such enforcement shall be based on the schedule established in Chapter 3 of the Uniform Building Code, as adopted SBC 201 (2MCAR § 1.10201).

§ 1.16003 Purpose. The purpose of these Rules is to provide design requirements which will improve utilization of energy in new buildings, additions, remodeled elements of buildings and certain existing public buildings.

A. The requirements of these Rules are directed toward the design or modification of building envelopes to provide adequate thermal resistance and low air leakage and toward the design or redesign and selection of mechanical, electrical service, and illumination systems and equipment which will enable the effective use of energy in buildings.

B. It is intended that these Rules be flexible in order that designers be encouraged to use innovative approaches and techniques to achieve effective conservation of energy. More effective use of energy may be achieved by the use of alternate design solutions, which follow the specific requirements of Sections 10 and/or 11 of the Standard referenced in 2 MCAR § 1.16005.

C. It is intended that these Rules, and the referenced standard, by used in the design of new buildings, additions, for remodeled elements of existing buildings as well as being applicable to certain existing public buildings as defined in 2 MCAR § 1.16001. Compliance with the requirements should be determinable and be economically justifiable in the preconstruction stage by evaluation and analysis of design specifications, drawings and calculations.

D. These Rules are not intended to abridge any safety or health requirements.

§ 1.16004 Scope.

A. These Rules and the referenced Standard set forth requirements for the design of new buildings as enumerated below, covering their exterior envelopes and selection of their HVAC, service water heating, electrical distribution and illuminating systems, and equipment, for effective use of energy.

1. These Rules and the referenced Standard apply to new buildings, additions, remodeled elements as well as certain existing public buildings.

2. Buildings or portions thereof whose peak design rate of energy usage is less than 1 w/ft^2 (3.4 Btu/h ft^2)(10.8 w/m^2) of floor area for all purposes are excluded from the scope of this standard.

3. Certain other buildings or elements thereof may be exempt when design data are not available or not applicable. In these cases, the exemptions are specifically noted in the sections of the referenced Standard.

B. These Rules and the referenced Standard do not cover specific procedures for the operation, maintenance and use of buildings.

§ 1.16005 Adoption of ASHRAE Standard 90-75 by reference. Sections 3.0 through 11, attachments and appendices of the 1975 Edition of ASHRAE Standard 90-75, hereinafter referred to as Standard 90, as promulgated and published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., is incorporated by reference and hereby made part of the State Building Code and shall be subject to the following alterations and amendments.

Section 3 of Standard 90 is amended to read as follows:

A. Page 9, Definitions.

Heated space. Space, within a building, which is provided with a positive he supply to maintain air temperature of 50°F (10°C) or higher. This definiti is not to be construed to require the insulation of floor assemblies above ba ments or crawl spaced in Type A buildings provided with a positive heat su ply.

B. Page 10, Definitions.

Manufactured building. Delete in its entirety.

Mobile home. Delete in its entirety.

Commercial parking facility. Shall not include a parking facility wh s a purtenant to or a part of a residential building whether the individual dwel ing units are rented or owned by the occupants, and which is used primaril by the occupants and their guests.

New building. As used hereafter shall mean new buildings, additions, remod eled elements of buildings, and certain existing public buildings.

C. Page 12, 4.2.1.1.

In addition to the criteria set forth in this section, the proposed design shal consider energy conservation in determining the orientation of the buildin on its site; the geometric shape of the building; the building aspect ratio (rati of length to width); the number of stories for a given floor area requirement the thermal mass of the building; the exterior surface color; shading or reflec tions from adjacent structures, surrounding surfaces or vegetation; opportuni ties for natural ventilation; and wind direction and speed. Calculation pro cedures and information contained in Chapters 17-22 of the 1972 ASHRAE HANDBOOK OF FUNDAMENTALS[1-6] may be used as guidelines to evalu ate the above factors.

D. Page 12, Exterior Envelope Requirements.

4.2.7 The design of buildings for energy conservation shall not create conditions of accelerated deterioration from moisture condensation. Vapor barriers are required to maintain the thermal performance of required building insulation against cold weather water vapor condensation in all Type A Buildings (Perm Rating 1.0 maximum).

E. Page 18.

4.3.2.4 Slab-on-Grade Floors. For slab-on-grade floors, the thermal resistance of the insulation around the perimeter of the floor shall be as shown in Fig. 2. The insulation shall extend downward from the top of the slab to the design frost line or downward to the bottom of the slab then horizontally beneath the slab for an equivalent distance.

F. Page 18.

4.4.2.4 Slab-on-Grade Floors. For slab-on-grade floors, the thermal resistance of insulation around the perimeter of the floor shall be as shown in Fig. 2. The insulation shall extend downward from the top of the slab to the design frost line or downward to the bottom of the slab then horizontally beneath the slab for an equivalent distance.

G. Page 20.

5.2 Scope. This section covers determination of heating and cooling loads, design requirements, and control requirements for general comfort applications in new buildings. Criteria are established for insulating HVAC systems and for duct construction. EXCEPTIONS. Special applications, such as but not limited to hospitals, laboratories, thermally sensitive equipment, computer rooms and areas with open refrigerated display cases, are exempt from the requirements of this section. Where these special applications are described in the 1974 ASHRAE Handbook and Product Directory, Applications Volume[1], the criteria described there shall be used.

No enclosed structure or portion of an enclosed structure constructed after January 1, 1978 and used primarily as a commercial parking facility for three or more motor vehicles shall be heated. Incidental heating resulting from building exhaust air passing through a parking facility shall not be prohibited, provided that substantially all useful heat has previously been removed from the air.

H. Page 22, References—add Footnote 17.

17. "Monthly normals of temperature, precipitation and heating degree days 1941-70", U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service, National Climatic Center, Asheville, North Carolina, August, 1973.

I. Page 22, Exceptions.

Special applications, such as but not limited to hospitals, laboratories, thermally sensitive equipment, computer rooms and areas with open refrigerated display cases, are exempt from the requirements of this section. Where these special applications are described in the 1974 ASHRAE HANDBOOK & Product Directory, Applications Volume[1], the criteria described therein shall be used.

J. Page 23.

5.3.2.3 Ventilation. Ventilation air shall conform to ASHRAE Standard 62-73 "Natural and Mechanical Ventilation,"[6] Ventilation air quantities identified in SBC 7705 (2 MCAR § 1.17705) through SBC 7720 (2 MCAR § 1.17720) shall be used in lieu of those contained in Standard 62-73 whenever this will reduce ventilation air quantities.

K. Page 23.

5.3.2.5 System Design Heating/Cooling Capacity. The rated capacity of heating/cooling system at design conditions shall not be greater than 11 for heating, 100% for cooling at design output load calculated in accordar with Sec. 5.3, whenever appropriate equipment is available. Equipment signed for standby purposes is not included in this capacity limitation requi ment. The cooling capacity of heat pumps are exempt from this limitation.

L. Page 23.

5.4.3.1 One- and Two-Family Dwelling Units, Attached or Detached.

M. Page 25, Exceptions.

d. The use of outdoor air cooling may affect the operation of oth systems (such as return or exhaust air fans or areas with open refrigeratic display cases) so as to increase the overall energy consumption of the buil ing.

N. Page 32.

7.3.1.1 is deleted in its entirety.

O. Page 33.

7.3.1.2 is deleted in its entirety.

P. Page 33.

7.3.2 Combination Service Water Heating/Space Heating Boilers. Servic water heating equipment shall not be dependent on year-round operation o space heating boilers; that is, boilers that have as another function winte space heating.

Q. Page 34.

7.8 Swimming Pools.

7.8.1 Heated swimming pools shall be equipped with controls to limit heating water temperatures to no more than 84°F (28.9°C).

R. Page 34.

8.6 Electric Energy Determination. In any multi-tenant residential building, provisions shall be made to separately determine the energy consumed by each tenant.

Electrical service to individual dwelling units in buildings containing two or more units shall be separately metered, with individual metering readily accessible to the individual occupants.

EXCEPTION: Buildings intended for occupancy primarily by persons who are 62 years of age or older or handicapped, or which contain a majority of units not equipped with complete kitchen facilities, shall be exempt from the provisions of this section.

S. Page 38.

ATTACHMENT A TO SECTION 9 (9.3.4.1)

T. Page 41.

ATTACHMENT B TO SECTION 9 (9.3.5)

U. Page 46.

ATTACHMENT C TO SECTION 9

V. Page 51.

Appendix I

W. Page 52.

Appendix II

X. Page 53.

Sheet Metal and Air Conditioning Contractors
National Association, Inc. (SMACNA)

8224 Old Courthouse Road
Vienna, VA 22108

Y. Page 53.

Appendix III is deleted in its entirety.

§ 1.16006 Required procedure for exemption.

A. Any person seeking exemption from the requirements of these Rules and the referenced Standard shall submit a request, supported by evaluation and documentation, to the Building Official of the municipality where the building permit is required.

B. In those areas of the State where the State Building Code does not apply, such request for exemption shall be submitted to the State Building Inspector, supported by same documentation as required by 2 MCAR §§ 1.16006 A.

ATTACHMENT II

3F-00008-03

STATE OF MINNESOTA

DEPARTMENT ENERGY, PLANNING AND DEVELOPMENT

Office Memorandum

TO: Craig Lindeke
Office of Revisor of Statutes

DATE: May 27, 1983

FROM: Bruce Nelson BN
Energy Division

PHONE: 296-8279

SUBJECT: Demonstration that the document incorporated by reference in proposed rule § 2 MCAR 1.16008 is conveniently available to the public.

This memorandum is persuant to the Minnesota Statutes § 14.07, Subd. 4 regarding incorporations by reference. Proposed rule § 2 MCAR 2.16008 incorporates by reference the Model Energy Code, 1983 Edition as published by the Council of American Building Officials. The Model Energy Code is conveniently available to the public for the reasons given below.

Copies of the Model Energy Code are available at five major public libraries distributed throughout the state. These libraries are:

Minnesota State Law Library
James J. Hill Reference Library
Minneapolis Public Library
Rochester Public Library
Duluth Public Library

Letters sent to each of these libraries forwarding the Model Energy Code (Attachment A) explained the importance of making this document conveniently available to the public. Each librarian was asked to call if for some reason they could not make these materials available for public use, but no librarian called with that problem.

The Model Energy Code is available for anyone to purchase for $5.00 (postpaid) from any of the following sources:

Building Officials and Code Administrators International, Inc. (BOCA)
17926 South Halsted Street
Homewood, Illinois 60430

International Conference of Building Officials (ICBO)
5360 South Workman Mill Road
Whittier, California 90601

National Conference of States On Building Codes and Standards (NCSBCS)
481 Carlisle Drive
Herndon, Virginia 22070

Southern Building Code Congress International, Inc. (SBCCI)
900 Montclair Road
Birmingham, Alabama 35213

Additionally, notice of the availability of the Model Energy Code is being published in several professional/trade association newsletters. Attachment B is an example of such a notice.

Please certify that the Model Energy Code is conveniently available to the public as required by Minnesota Statutes § 14.07, Subd. 4.

Energy Planning & Development

epd

Attachment A.

May 10, 1983

Marvin Anderson
Minnesota State Law Library
117 University Avenue
St. Paul, Minnesota 55155

ENERGY CODE MATERIALS

The Energy Division is providing information to the public about the Minnesota Energy Code. To make this information conveniently available to the public, I am sending your library complementary copies of the enclosed documents, which may soon be incorporated by reference into the Minnesota Building Code:

Model Energy Code - 1983 Edition, Council of American Building Code Officials
Energy Conservation in New Building Design, ASHRAE* Standard 90 A, B,C - 1980
Ventilation for Acceptable Indoor Air Quality, ASHRAE* Standard 62 - 1981

Your library was selected since it is at a key geographic location in the state. If it is not convenient to add these materials to your collection for public use, please contace me at 612/296-8902.

For your information, copies of the documents have been given to:

James J. Hill Reference Library
Minneapolis Public Library
Rochester Public Library
Duluth Public Library

Unfortunately, limited numbers of copies prohibit us from sending these documents to more public libraries. We appreciate your assistance in accepting these materials to provide information to the public about the Minnesota Building Code.

Sincerely,

Donna Slamkowski

Donna Slamkowski
Librarian

* American Society of Heating, Refrigerating and Air Conditioning Engineers

Attachment B

MSAIA COMMUNICATION

Minnesota Society American Institute of Architects

. . . . CAPSULE REPORT

MAY 1983

MINNESOTA ENERGY CODE

The Minnesota Energy Code is currently being revised by The Minnesota Energy Division. The Energy Division proposes adoption by reference of the Council of American Building Officials model energy code 1983 edition with amendments. Copies of the model energy code can be obtained from the International Conference of Building Officials, 5360 South Workman Mill Rd., Whittier, CA 90601, at $5 per copy.

Interested or affected persons or groups may submit statements of information or comment orally or in writing. Written statements of information and comment may be addressed to:

Greg Larson
Soil and Water Conservation Board
Department of Agriculture
90 West Plato Boulevard
St. Paul, MN 55107

Oral statements of information and comment will be received during regular business hours over the phone at (612) 296-3767, and in person at the above address.

All statements of information and comment must be received by January 15, 1983. Any written material received by the Board shall become part of the record.

December 9, 1982

Vernon F. Reinert
Executive Director

Department of Energy, Planning and Development Energy Division

Notice of Intent to Solicit Outside Opinion on Rules Relating to Heat Loss, Lighting and Climate Control in the State Building Code

Notice is hereby given that the Department of Energy, Planning and Development, Energy Division is seeking information and opinions from sources outside the division in preparing revisions to the State Building Code, 2 MCAR §§ 1.16001-16006. The authority for these rules is contained in Minn. Stat. § 116H.12, subd. 4 (1980), (Laws of Minnesota 1982, Chapter 563 Section 9).

Pursuant to this statute, the DEPD, Energy Division, is considering revisions to the State Building Code, including:

1. Replacement of adoption of ASHRAE Standard 90-75 by reference with adoption of ASHRAE Standards 90A-1980 and 90B-1980, by reference with the exceptions as noted below.

2. Replacement of insulation requirements for one- and two-family dwellings in the Minnesota Building Code with the requirements of the current Department of Housing and Urban Development (HUD) Minimum Property Standards for One-Two Family Dwellings.

3. Replacement of insulation requirements for all multi-family residential structures in the Minnesota Building Code with the requirements of the current HUD Minimum Property Standards for Multi-Family Housing.

4. Modification of ventilation requirements specified by the Minnesota Building Code to conform with the requirements of ASHRAE Standard 62-1981.

5. Including the minimum requirements for water heater efficiencies of ASHRAE Standard 90A-1980, Section 7.

Any person with information, comments or questions on the subject of the proposed rules should submit them either orally or in writing before January 31, 1983. Address correspondence to:

Department of Energy, Planning and Development
Energy Division
980 American Center Building
150 E. Kellogg Blvd.
St. Paul, MN 55101
Attn: Bruce Nelson
(612) 296-8279

The division expects to publish proposed rules in February, 1983. Written materials received will be made part of the record in the event that rules are proposed.

OFFICIAL NOTICES

Pursuant to the provisions of Minn. Stat. § 15.0412, subd. 6, an agency, in preparing proposed rules, may seek information or opinion from sources outside the agency. Notices of intent to solicit outside opinion must be published in the *State Register* and all interested persons afforded the opportunity to submit data or views on the subject, either orally or in writing.

The *State Register* also publishes other official notices of state agencies, notices of meetings, and matters of public interest.

Department of Energy, Planning and Development Energy Division

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The division expects to publish proposed rules in February, 1983. Written materials received will be made part of the record in the event that rules are proposed.

ATTACHMENT V

All written material received in responce to notice of intent to solicit outside opinion.

WRITTEN MATERIAL ATTACHED:

1.	Robert O. Brown Company	January 3, 1983
2.	Minnesota Chapter ASHRAE	January 4, 1983
3.	Dowell Consultants, Inc.	January 8, 1983
4.	Carroll T. Peterson	January 17, 1983
5.	Northern States Power Co.	January 27, 1983
6.	Technical Resource Design	February 4, 1983

ROBERT O. BROWN COMPANY
PROCESS AND ENERGY ENGINEERS AND CONSULTANTS
SUITE 200
6885 WASHINGTON AVENUE SOUTH
EDINA, MINNESOTA 55435

JAN 06 1983

January 3, 1983

Mr. Bruce Nelson
Dept. of Energy, Planning & Development
Energy Division
980 American Center Building
150 E. Kellogg Blvd.
St. Paul, MN 55101

RE: Proposed Rules - Energy Standards

Dear Bruce:

I have reviewed the Notice published (CITE 7 S.R. 963) regarding heat loss, lighting, and climate control in the State Building Code. We will be studying the referenced documents and expect to submit comments before January 31, 1983.

My only comments at this time are that my clients have found the previous standards "below common sense" levels and have always exercised their options to increase insulation values. Secondly - I hope enforcement can somehow be addressed again. I have had two experiences which indicate enforcement in the field is still not as critical on energy issues relative to plumbing and electrical etc. as might be desired.

Please accept my best wishes for the New Year and extend my greetings to the staff.

Sincerely yours,

Kevin Wm. Halbach, A.I.A.
Architect
ROBERT O. BROWN COMPANY

KWH/sk

Minnesota Chapter

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

JAN 06 1983

January 4, 1983

Mr. Bruce Nelson, Energy Division
Department of Energy, Planning,
and Development
980 American Center Building
150 E. Kellog Blvd.
St. Paul, MN 55101

Re: Proposed Revisions to the State Building Code
Relating to Energy

Dear Mr. Nelson:

As you know we heartily support the efforts of the Department of Energy, Planning, and Development to modify the State Building Code to reflect ASHRAE Standard 90-1980 and to incorporate ASHRAE Standard 62-1981.

While we all recognize that no standard is ideal for all applications, we believe these ASHRAE Standards represent a reasonable approach to increasing energy conservation in building design. We cannot endorse deviations from these Standards as you propose for consideration, though we recognize the intent of these deviations is to further the goal of energy conservation.

It is our suggestion that ASHRAE Standards 90-1980 and 62-1981 be adopted in appropriate form into the State Building Code and that the State consider incentive programs to encourage more efficient construction, where appropriate.

I hope these comments are useful to the Department, and I want to assure you that we will cooperate and assist you in any way we can to help improve the State Building Code.

Sincerely,

Gary C. Ashley
Chairman, Energy Management Committee

cc: Will Johnson
Ken Dowell
Dean Rafferty

Please reply to:

KENNETH F. DOWELL, P.E.
MECHANICAL ENGINEER
(612) 544-3711

DOWELL CONSULTANTS, INC.
4979 Olson Memorial Highway
Minneapolis, Minnesota 55422

JAN 10 1983

January 8, 1983

Mr. Bruce Nelson, Energy Division
Department of Energy, Planning and Development
980 American Center Building
150 East Kellog Blvd.
Saint Paul, Minnesota 55101

Re: Your proposed revisions to the State Building Code, relating to energy.

Dear Mr. Nelson:

I heartily support your efforts to update the Minnesota Energy Code.

This includes the five items listed in your proposed rules, as published in the register. As a Consulting Mechanical Engineer engaged in the design of energy consuming systems for buildings, I state the following opinions:

1. While the present code was a good "leap forward" when adopted, it is already inadequate for our climate and for a state that must import energy.

2. Buildings being built today use considerably more energy than necessary, and they can be designed more energy efficient without stress or undue additional cost.

3. Buildings are long life and are a commitment for the future when energy will be more scarce and expensive.

4. The updated ASHRAE standard 90-1980 would be a definite improvement over the present code, but in my opinion does not go quite far enough in some areas for our needs in this state.

5. Therefore, I concur with the intention of items 2 and 3 in your proposed rules which relate to residential type construction, and for the following reasons:
   a. The H.U.D. standards would result in more energy efficient buildings, and they are apparently proven to be practical.
   b. The residents of these structures who will directly or indirectly pay for the energy costs far into the future, by and large to not take part in the planning and financing of the structures. They need to be protected.

Kenneth Dowell
Kenneth F. Dowell

Carroll T. Peterson
3123 Hayes St, N.E.
Minneapolis, MN 55418
789-2219

January 17, 1983

JAN 19 1983

Mr. Bruce Nelson
Department of Energy, Planning and Development
Energy Division
980 American Center Building
150 E. Kellog Blvd.
St. Paul, MN 55101

Dear Mr. Nelson,

I was given your letter by the Minnesota Multi Housing Association and would like to comment on No. 4 of the "Fact Sheet on Opportunities and Issues", September, 1982.

> Proposal: Amend the Code to include energy requirements of the HUD Minimum Property Standards for multi-family dwellings (attached townhouses, low-rise apartment/condominium and high-rise apartment/condominium).

I believe tax incentives for insulation above proposed standards would benefit everyone. More specifically:

> Any insulation above the proposed requirements can be deducted by the builder or passed on to an investor.

200% of cost of insulation above the proposed standards can be deducted in first year (and recaptured at long term rates when building is sold), up to 2.5% of building's value. Other items eligible include triple or more glazing (the incremental cost over double glazing) and air to air heat exchangors. The 200% would help offset labor and materials involved in the extra insulation.

Rehabilitated structures should also be addressed and are probably the most important. Any insulation over a wall R value of about 14, ceiling over about R-28, glazing over double, and the use of an air to air heat exchangor can be deducted the same as new construction. The upper limit would be 2.5% of rehabilitation cost. (My understanding is that most extensive rehabilitation projects cost about the same as building new.)

Sincerely,

Carroll Peterson

Carroll T. Peterson

CTP/eo

JAN 28 1983

Northern States Power Company

414 Nicollet Mall
Minneapolis, Minnesota 55401
Telephone (612) 330-5500

January 27, 1983

Mr Bruce Nelson
Department of Energy Planning and Development
Energy Division
980 American Center Building
150 E Kellogg Boulevard
St Paul, MN 55101

Dear Mr Nelson

NSP supports your proposal cited in the State Register, Monday, December 20, 1982, page 963 to change the State Building Code to include the minimum requirements for water heater efficiencies of ASHRAE Standard 90A-1980, Section 7. Through operating our Appliance Rebate Program since March 1, 1982, we have become aware of the very cost-effective nature of energy efficient water heaters, especially electric ones.

Before beginning our Appliance Rebate Program, we collected sales data for 1981 from all the major distributors and manufactuer's representatives who market appliances covered under the program in Minnesota. This data indicated how many units of each model of product each distributor or manufacturer's represenative would sell in 1981, and what the size, energy efficiency rating and average retail cost of each model was. The sales reported to us from each source were aggregated to form an estimate of the total number of each type of product sold in the state in 1981. By checking these estimated aggregate annual state sales figures with those compliled by the Association of Home Appliance Manufacturers and the American Refrigeration Institute, the trade organizations for refrigeration and air conditioning products, we determined that the sales reported to us represented 75-95% of the total sales made of each of these products in Minnesota in 1981.

Unfortunately, the trade organiation for water heaters, the Gas Appliance Manufacturer's Association, does not compile state-by-state sales figures. However, we have sales data on electric water heaters from the manufacturer's representatives of each of the five major manufacturers of water heaters that account for the large majority of water heater sales. So this sales data should be quite representative of all electric water heaters sold in Minnesota in 1981.

In the accompanying chart, an analysis is presented of the above-

mentioned sales data with respect to the average purchase costs and operation costs of energy-efficient vs. standard electric water heaters. It shows that consumers will realize substantial operating cost savings by the purchase of an efficient electric water heater. It further shows that the added costs of the efficient models are not substantial when compared to the operating cost savings they would cause. Indeed, we see that using a straightforward simple payback analysis, the added costs of an energy-efficient water heater will be recovered by the consumer through reduced operating costs within five years for all sizes of electric water heaters, and within two or less years for all but one size of the product.

However, despite the very cost-effective nature of energy-efficient electric water heaters, only slightly more than 20% of all the electric water heaters sold in Minnesota in 1981 were efficient models. We believe that this is a substantial instance of market failure, which would most effectively be corrected by the adoption of the proposed regulation. Energy-efficient electric water heaters cause no reduction in utility to the consumer, yet offer the substantial cost savings outlined above. The state and society would also benefit through having to use less natural resources to supply its citizens' water heating needs.

Furthermore, we believe that the proposed regulation would be a more effective method of increasing the efficiency of water heaters being sold than a market-oriented approach such as that used in our Appliance Rebate Program. The reasons for this opinion have to do with the causes of the market failure. It is our understanding that the relatively small percentage of efficient water heaters sold occurs for mostly two reasons:

1) The large majority of water heater sales occur when a consumer's existing water heater breaks. Thus, since replacing a water heater is an unexpected expense for consumers, they want to minimize that expense, and hence shop for the least expensive water heater to replace their broken one with. The are either unaware of or unconcerned about the substantial operating cost savings they could realize with an efficient water heater.

2) Plumbers and water heater retailers, faced with a very price-conscious customer, often strive to give him or her the lowest quote they can over the phone in order to get their business. They often do not even mention the fact that they carry different kinds of water heaters, and that although energy efficient ones cost a little more to buy then standard models, they will save the consumer money on their fuel bill.

Thus, the reasons for the market failure do not lend themselves to easy correction. An effort like the Appliance Rebate Program certainly can have an effect on the percentage of high-efficiency water heater sales. By advertising the benefits of efficient water heaters to consumers, and by giving water heater vendors an extra sales tool to market the products, progress certainly can

be made. However, it is certainly a slow and painstaking process, and it is not likely to result in 100% efficient water heater sales. For example, although we have not done a thorough analysis of the subject, the initial indications are that the Appliance Rebate Program has caused the percentage of high-efficiency electric water heaters being sold to increase from 21% to 25-35%. This is certainly a significant achievement, but it is also very much less than what the proposed regulation could do. So in view of the benefits to the customer and the state of having all the water heaters sold be energy-efficient models in a much more rapid fashion that would occur from market-oriented efforts, we support the adoption of the proposed regulation.

Sincerely

Randy Gunn

Randy Gunn
Demonstration Project Consultant

CC K H Wietecki
W M Thometz

Electric Water Heaters - Operating Costs and Price Information for Minnesota in 1981

First Hour Rating	# Sold 1981	% High Efficiency	Sales-weighted Average Costs Std. Units	Sales-weighted Average Costs Efficiency Units	Average Annual Energy Costs Std. Unit[1]	Average Annual Energy Costs Efficient Units[1]	Average Payback of Efficient Units Years[2]
35-42	1600	7	150	210	321	282	1.4
43-47	100	3	260	270	304	286	0.5
48-53	3400	12	160	260	328	282	2.0
54-64	35800	22	190	260	332	283	1.3
65-74	200	35	270	300	352	290	0.4
75-86	3900	27	290	390	369	298	1.3
87-99	0	-	-	-	-	-	-
100-114	500	20	450	570	355	331	4.6
Total	45500	21	200	280	334	285	1.5

[1] Based on a national average electric rate of 4.97¢/KWH, as appears on the FTC Energy Guide Labels.

[2] Calculated by dividing the differences in purchase price by the difference in operating cost, after the operating cost difference has been raised by a factor of 1.08, the ratio of NSP's year-round average electric rate, 5.38¢/KWH, to the national average rate. Simple paybacks are used.

TECHNICAL RESOURCE DESIGN
3223 Fourteenth Avenue South Minneapolis, MN 55407 612/729-0154

4 February 1983

Mr. Bruce Nelson
Department of Energy, Planning and Development
American Center Building
160 E. Kellogg Blvd.
St. Paul, MN 55101

Dear Bruce:

As you know, I will be unable to attend the next meeting of the energy code advisory committee, as I will be out of town. Not knowing exactly what the adgenda will include, I wanted to convey to you some of my concerns about multi-family buildings before the meeting.

It is difficult for multi-family building owners to get the capital for major improvements once a building has been built. Thus, the best time to consider energy conservation is before construction (or else at the time of sale, when the building is being refinanced). Multi-family owners do not in general have the same incentives for energy conservation as single-family owners because they can pass energy costs on to tenants with no penalty, especially in tight rental markets. The only conservation improvements most multi-family owners will make are those with exceptional paybacks (less than 3 years). For these reasons, the concept of the code as a "floor", above which builders and owners set their own energy standards, is not as applicable in multi-family housing as in single-family.

I am enclosing a memo that George Peterson and I drew up for a meeting with May Hutchinson a few months ago. In it, we outlined what we thought were important energy conserving features in new multi-family housing. These recommendations deal with the mechanical systems. I would like to make one comment about the envelope: Most multi-family buildings are now built with roof-joists, a single set of joists with the ceiling attached to one side and the roof deck to the other. Because there is no attic cavity, increasing insulation levels at a later date is not economically feasible. This is a short sighted practice. I would prefer a return to the older type of flat roof construction with separate ceiling and roof joists.

I would be glad to talk with you about these observations after I return March 1, or at the March meeting of the committee.

Sincerely,

Martha J. Hewett
President

MEMORANDUM

To: May Hutchinson, Minnesota Housing Finance Agency
From: George Peterson, Minneapolis Energy Coordination Office
Re: Energy Conservation Standards for Multi-Family Buildings
Date: November 17, 1982

Over the past year, the Minneapolis Energy Coordination Office has been developing an energy manangement program for 5 to 50 unit multi-family buildings. Based on our experience with retrofits, we believe that any standards for new construction of multi-family buildings should address building mechanical systems in detail.

Key items that should be addressed are outlined below:

BOILER EFFICIENCY

No true high efficiency boilers with outputs sufficient to heat larger multi-family buildings are currently available. However, the following standards are achievable and would represent an improvement over typical installations:

1. the boiler should have at least five square feet of heat exchange surface per horsepower,
2. the steady state efficiency as measured after installation by an independent test should be 80% or better,
3. the boiler should have a positive inflow shutoff or power draft.

BOILER CONTROLS

1. Every space heating boiler should have an outdoor reset and an outdoor cutout.

HEATING DISTRIBUTION SYSTEM

1. Each unit should be a separate heating zone and should have a thermostatic zone control device.
2. All piping in unheated areas, including the boiler room, must be insulated.
3. All piping in hallways and basements should be insulated, although to a somewhat lower level.
4. The heating system piping should be installed in a way that will facilitate later addition of submetering for individual apartments. Specifically, the entrance and exit to each apartment should be readily accessible to a plumber via access panels.

DOMESTIC HOT WATER

1. Domestic hot water should be heated by a "heat exchanger" type boiler (such as the Burkay or Bryan) with storage in a separate tank.
2. The storage tank should be insulated.
3. Low flow showerheads and sink aerators should be installed in all units.

APPLIANCE EFFICIENCY

1. High efficiencies should be required for all air conditioners, refrigerators or stoves installed by the builder.

LIGHTING

1. Lighting in common spaces should be flourescent.
2. Outdoor lighting should be operated by a light-sensitive controller.

The Energy Office is willing to provide input to MHFA in developing standards to address these issues.

ATTACHMENT VI

DEPARTMENT OF ENERGY, PLANNING AND DEVELOPMENT

ENERGY DIVISION

Minnesota Energy Code Upgrade Discussion Meetings

Date	Organization/Committee
07/29/82	Minnesota Society of Architects (Energy Steering Committee)
08/06/82	Building Codes Division
10/20/82	Minnesota Builders Association (Legislative Committee)
10/20/82	Housing Energy Learning Program Committee
11/18/82	ASHRAE (Energy Committee- Legislative Sub-committee)
11/23/82	Minnesota Builders Association/ (Legislation Committee)
11/10/82	Minnesota Society of Architects (Building Codes Committee)
11/23/82	Minnesota Builders Association
01/19/83	Energy Codes Advisory Committee
02/10/83	Twin City Energy Engineers
02/25/83	Minnesota Society of Architects (Energy Committee)
02/25/83	Northwest Building Officials
03/14/83	Consulting Engineers Council
03/16/83	Housing Energy Learning Program Committee
03/24/83	Energy Codes Advisory Committee
03/31/83	Energy Codes Advisory Sub-committee
04/06/83	St. Paul Area Builders Association Board
04/12/83	Energy Codes Advisory Sub-committee
04/26/83	Energy Codes Advisory Committee
05/03/83	St. Paul Area Builders Association (Special meeting)
05/17/83	Energy Codes Advisory Sub-Committee
05/31/83	Consulting Engineers Council (Energy and Codes joint meeting)

ATTACHMENT VII

MEETING NOTES

ENERGY CODE ADVISORY COMMITTEE

JANUARY 19, 1983

The meeting convened at 10:00 a.m. in the Veterans Service Building, downtown St. Paul.

Attendees:	Kenneth Dowell	- American Society of Heating, Refrigerating and Air Conditioning Engineers
	Jack Elliott	- Illuminating Engineering Society
	Chuck Schulz	- St. Paul Area Builders Association
	Don Pates	- Minnesota Society of Architects
	Martha Hewett	- National Association of Housing and Redevelopment Officials
	Duane Grace	- Minnesota Department of Administration Building Codes Division
	Don Johnson	- Minnesota Department of Administration Energy Conservation Division
	Jim Carlson	- Insulation Contractors Association Northwest
	Wally Thometz	- Northern States Power
	Sam Stewart	- Sam Stewart and Associates
	Frank Frison	- National Electrical Contractors Association
	John Armstrong	- DEPD, Energy Division
	Cheryl Belford	- DEPD, Energy Division
	Steve Klossner	- DEPD, Energy Division
	Jackie Lind	- DEPD, Energy Division
	Bruce Nelson	- DEPD, Energy Division

John Armstrong presented the background history of the Energy Code. The Energy Division has legislative authority to establish the standards. The Energy Code should provide good, current, reasonable minimum standards. Although the unincorporated areas of 76 counties have rejected the Minnesota Building Code, the majority of state residents live in counties where the Code is in effect.

Discussion revolved around the issue: Is the present Code acceptable or not?

The majority of committee members felt the Code should be updated. Further research is needed in the following areas:

1. What are other states doing regarding an energy code?
2. In particular, what energy codes are enforced in bordering states?

3. What results do other states have with energy codes?

Bruce Nelson then discussed the criteria set by legislation for developing an Energy Code. The major points are that the building code shall be based on model codes generally accepted throughout the U.S. and the rules shall be economically feasible in that energy savings shall exceed the cost of energy conserving requirements amortized over the life of the building.

Current options for format are ASHRAE 90A-1980 and the Model Energy Code.

The code should be easy to use, as well as consistent with current practice.

An economic analysis of a single family dwelling meeting various code requirements was shown. All options meet the legislative requirements.

John Armstrong asked for further suggestions for other types of economic analysis. Discussion included the following points:

* Although the Minneapolis College was built to ASHRAE 90-75 specifications, it uses more energy than other similar buildings. Suggested the key is in the operation and maintenance of the building.
* A national energy policy would perhaps be more desirable.
* Using less than 25 years could be used to demonstrate savings. Seven could be used as a turn-around number.
* Using a cash-flow basis for an economic analysis was suggested.
* The figures must be very reliable to show total savings. Furthermore, dollars used to build must be paid back. . . cost of borrowing these dollars makes it too expensive to build.
* Question raised regarding what kind of analysis is necessary to show the legislature? and the public and private sectors?
* Also pointed out need to test if standards will hold up for both residential and commercial buildings.

Bruce Nelson discussed changes in ASHRAE standards by section.

* Section 5 -- Ventilation Requirements
  Debate centered on smoking/non-smoking specifications and how this could be enforced.
* Section 6 -- HVAC Equipment
  Section of Comparison Paper referred to for discussion.
* Section 7 -- Water Heating
  It was pointed out that equipment is currently on the market to meet ASHRAE 90A-1980 standards. Previously, equipment was not available to meet ASHRAE 90-75 standards.
* Section 9 -- Lighting
  Code will recommend using the simple procedure to calculate Lighting Power Budgets. These are workable standards and easy to use.
  IES currently considers the age of the users and the task performed in determining lighting requirements. Specific foot candles are not used; rather a range is suggested.
* Sections 10 and 11 are unchanged.

Summary of documents being prepared for Energy Code were presented including the rules, a Statement of Need and Reasonableness, a comparison paper, and a brochure.

General discussion of Energy Code followed:

* Suggestion to use ASHRAE 90A-1980 or the Model Energy Code, whichever is stricter. Much dissent among committee members on this issue.
* A comparison of various options regarding the code is necessary. Looking at the Model Energy Code would be useful since it is written more clearly than ASHRAE standards.
* The building community is now familiar with ASHRAE 90-75, so perhaps adopting ASHRAE 90A-1980 would make the code easier to use.
* There are enforcement difficulties associated with 90-75. Code officials sometimes do not understand the language or have differing interpretations.
* Model Codes follow other standards and do not lead. ASHRAE is constantly updated, which is an advantage.

John Armstrong reminded the committee that these are minimum standards. Discussion following pointed out the need to educate the lending community that minimum standards are not the maximum allowed.

People have a dollar figure in mind when budgeting a house. The buyer of a house must be shown the total picture of cost of building and consequences of this in later monthly payments.

Discussion of R-values followed. Questions raised about measuring R-values. Problem is where R-value is measured in a building. This should be spelled out in code.

Potential reactions of legislators must be considered. Example of controversy in mandating smoke detectors was cited -- legislators seem reluctant to mandate items which will cost money, even if amount is small.

Advantages brought up of doing an infra-red scan as a guarantee for architects and builders to detect otherwise unnoticed areas. Questions raised as to whether infra-red scans can be mandated.

John Armstrong summed up session by pointing out three key issues for committee members to consider:

1. The code language must be decided -- ASHRAE or Model Energy Code.
2. Can higher R-values for walls and ceilings of one and two family homes be in Energy Code?
   In addition, should 7-year paybacks be used and how should the cost of money be dealt with in these calculations?
3. How are surrounding states dealing with this issue?
   Can ASHRAE standard 62-1981 be accepted regarding ventilation standards?

Questions arose about possibility of taking the non-controversial route for rule adoption.

Meeting was adjourned at 12:20 p.m.

MEETING NOTES

ENERGY CODE ADVISORY COMMITTEE

March 24, 1983

The meeting convened at 10:00 a.m. in the Veterans Service Building, downtown St. Paul.

Attendees:	David Robinson	- Consultant
	Kenneth Dowell	- American Society of Heating, Refrigerating and Air Conditioning Engineers
	Ralph Corwin	- Minnesota Society of Architects
	Ellen Hart	- National Association of Housing and Redevelopment Officials
	William C. Poppert	- Twin City Energy Engineers
	Duane Grace	- Minnesota Department of Administration Building Codes Division
	Jan Gasterland	- Northwest Building Code Officials
	Don Johnson	- Minnesota Department of Administration Energy Conservation Division
	Frank Mach	- Northern States Power
	Wally Thometz	- Northern States Power
	Sam Stewart	- Sam Stewart and Associates
	Frank Frison	- National Electrical Contractors Association
	Ray McMann	- International Brotherhood of Electrical Workers
	John Armstrong	- DEDP, Energy Division
	Cheryl Belford	- DEPD, Energy Division
	Rosanne Gronseth	- DEPD, Energy Division
	Jackie Lind	- DEPD, Energy Division
	Bruce Nelson	- DEPD, Energy Division

A list of criteria for revisions to the Minnesota Energy Code was distributed and discussed. What is meant by "life of the building" was discussed. A question was raised about intent of the phrase "conforms to model codes" -- can we use more stringent standards? The response was that we are mandating minimum standards and anyone can build beyond these if they prefer.

Duane Grace reviewed the rules proposed by the Building Codes Division. A question was raised about deleting sections of old Energy Code -- must strike outs be shown? Another question was raised about stating a blanket repeal of old rules. These technical points will be checked out.

The proposed ventilation standard was discussed by ASHRAE representative Ken Dowell. A question was raised about possible conflicts with Health Code specifications regarding ventilation. It was pointed out that the CABO Model Energy Code must be amended because it references the old ASHRAE 62-1973. Flexibility is allowed in this standard.

The study of energy standards for one- and two-family buildings was presented by Dave Robinson. The "Cost of Energy Features" column on Table 3 was questioned. The assumption of 75% furnace efficiency was also questioned.

The Energy Code Comparison Paper was discussed. One suggestion was that it be made briefer. Committee members were asked to consider how this document could be made most useful for members of their respective organizations. A suggestion was made to index margins and go into more depth for some particular items. A request was made for an easy-to-read publication with recommendations for values more stringent than in new Energy Code.

A partial list of potentially controversial issues was made. Unvented space heater manufacturers may try to amend the code to allow their products.

- swimming pool covers
- swimming pool temperatures
- interaction of energy rules with Health Department rules
- furnace efficiency of 75% too low.

A sub-committee of Don Johnson, Ellen Hart and Warren Hallberg, representing the Consulting Engineers Council, will meet with Bruce Nelson to go through the Code in detail and identify further potential controversial issues.

John Armstrong concluded the session by summarizing as follows:

- To facilitate the rule-making process, groups which could raise controversies should be contacted now.
- ASHRAE 62-1981 is desirable for a ventilation standard.
- For one- and two-family standards, HUD-MPS or ASHRAE values must be decided and included.
- The Energy Code Comparison Paper should be shortened.
- Controversial issues should be identified and addressed.

The next Energy Code Advisory Committee meeting will be held April 14, 1983 at 10:00 a.m.

The meeting concluded at 12:20 p.m. with lunch.

COMPARISON OF PROPOSED CODES:
DO THEY MEET THE PROPOSED CRITERIA?

CRITERIA	CABO	ASHRAE
1. conforms to model energy codes in the U.S.	is a model code	not a code, but a standard set by industry
2. economically feasible	meets criteria	meets criteria
3. conforms to other Energy Division rules	meets criteria	meets criteria
4. consistent with current building practices	refers to ASHRAE	is current practice
5. permits design flexibility	permits flexibility	permits flexibility
6. easily interpreted by code officials and building designers	builders have input in writing code	no builder input in writing standards
7. documents economical and readily available	$5.00	$14.50
8. organization of contents familiar to users	slight relearning required	users familiar with document now
9. ease of explaining in statement of need and reasonableness	meets criteria	meets criteria
10. amenable for future changes	building officials have input to changes	revised by ASHRAE committee

CONCLUSIONS OF DISCUSSION

CABO has advantages in criteria 1, 3, and 10.

ASHRAE has advantages in criteria 8.

Both codes have equal advantages in the remaining criteria.

MEETING NOTES

ENERGY CODE ADVISORY COMMITTEE

April 26, 1983

The meeting convened at 10:00 a.m. in the Veterans Service Building, downtown St. Paul.

Attendees:		
	Don Pates	Minn. Society of Architects
	Jack Elliot	Hunt Electric, IES
	Duane Grace	Minn. Dept. of Administration Building Codes Division
	Kenneth Dowell	ASHRAE
	George Kernkamp	Burlington Northern
	Gregory Ostrovsky	Energy Conservation Division
	Don Johnson	Dept. of Administration Energy Conservation Division
	John Bass	CEC Energy Committee
	Jan Gasterland	Northwest Building Code Officials
	Bob Pollock	Twin City Insulation
	John Armstrong	DEPD, Energy Division
	Jackie Lind	DEPD, Energy Division
	Cheryl Belford	DEPD, Energy Division
	Bruce Nelson	DEPD, Energy Division

Don Johnson reported Energy Code Sub-committee meeting findings. Some difficulties exist in interpreting the Model Energy Code. CABO must be contacted for these interpretations. Written notes for that meeting will be prepared. Suggested that the Model Energy Code may not be adopted by reference if enough changes are proposed.

Report on the development of residential standards followed. The multi-housing association currently uses the HUD-MPS and would support it in the new code.

Rule-making process was explained. For non-controversial process, after publication of rules, no public hearing is necessary if fewer than 7 requests for a public hearing are received. Suggestion was made that if major changes are proposed, a public hearing may be necessary to be fair. Another suggestion was that there is currently a wave of apathy regarding any building code.

Review of criteria and list of non-controversial issues followed. Items which attendees felt might be controversial include: ASHRAE Standard 62-1981(ventilation), ASHRAE Standard 55-1981 (thermal environment), 1 & 2 family walls, 1 & 2 family foundation walls, large furnace/boiler efficiency of 80%.

EVALUATION OF NON-CONTROVERSIAL ISSUES

ITEM	DISCUSSION
1. Adopt by reference Model Energy Code, 1983 Edition	non-controversial
2. Reference ASHRAE Standard 62-1981 (ventilation)	Problems result when using standard from viewpoint of consultant, designer, owner, occupant because all may have different uses in mind. ASHRAE committee debating issue of smoking area ventilation-they should review their criteria be June and give results.
3. Reference ASHRAE Standard 55-1981 (thermal environment)	More analysis is required by ASHRAE committee.
4. Reference IES Lighting Handbook	non-controversial
5. Vapor barrier definition	Issue must be addressed. Problem with new definition is that prescriptive standards are used, ex. tape is specified, but there are other effective ways of sealing. Suggestion to use performance standards; infiltration as a purpose should be mentioned.
6. 1 & 2 family roof/ ceiling (U=0.926) a. deletion of vaulted ceiling exception	exception never used in Minnesota, non-controversial
7. 1 & 2 family walls (U-0.11)	Feelings that this will be controversial because 2 x 6 walls or foam insulation will be required. Cost-effectiveness questioned. Reminder that code should set minimum standards.
8. 1 & 2 family foundation walls	Will be controversial (see 7)
9. Multi-family roof/ ceiling (U=.05 over 3 stories)	non-controversial, currently using HUD-MPS standards

10. Heating/cooling system capacity (115%/100%)	non-controversial
11. Large furnace/boiler efficiency = 80%	Needs market research-are these available now? Suggestion to leave at 75% as the minimum standard.
12. Water heater efficiency requirements	non-controversial
13. Swimming pools a. heated pool covers outdoor only b. delete time clocks	Present code has maximum temperature of 84°F that would be deleted. Must make code acceptable to pool users-will they use a cover?
14. Delete faucet temperature controllers	Water should be set at 110°F now, but this is difficult to enforce. Question as to whether or not this setting is even cost-effective.

Energy code education assumptions were reviewed. Concern, if any, of the financial community was questioned.
Committee would like two outcomes emphasized:

1. Code users know what the new code requirements are and where they differ from the old requirements.
2. Designers and builders know and apply proper techniques to meet code requirements without secondary problems.

Non-code areas of the state should also be informed of new Emergy Code.

Strategies for Energy Code Education were discussed.
Suggestions were made to hold seminars for continuing education credits. Reminder that speakers must "talk the language" of code users. Forms must be useful.
Networks should be used. MECA chapters and other professional groups could find their own instructors if the Energy Division could put the course together.
Overheads would be helpful, but accompanying handouts are essential.
University of Minnesota courses would reach audience who build their own houses. AVTIs would reach contractors and others.
Energy Code is enforced through inspections and check sheets.
Education about Energy Code can be assisted by groups offering in-kind assistance, financial, and use of their networks.

Concluding remarks regarding controversial vs. non-controversial hearing: Proposing non-controversial hearing would mean losing only 30 days if a hearing were to be requested.

Future advisory committee tasks were identified:

- Education
- Space Heating Issue
- Infiltration Control
- Performance ideas
  - Home Energy Rating System

Meeting was adjourned at 12:00 p.m.

ATTACHMENT VIII

MINNESOTA STATE BUILDERS ASSOCIATION

NEWSLETTER

666 Transfer Road St. Paul, Minnesota 55114 (612) 646-7959

Volume 2 No 3 April 1983

WHAT'S NEW IN ENERGY?

As many of you know, new Energy Code rules are currently being developed by the Minnesota Energy Division. At this point, the Energy Division would like to inform the building community about the possible changes. A new code should be in place by the end of 1983.

Presently the Energy Code incorporates the American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE) Standard 90-75 by reference. In developing the new code, the Energy Division basically has the option of adopting the new ASHRAE Standard 90A-1980 by reference or of adopting the Model Energy Code from the Council of American Building Officials.

Since 1976 when the Energy Code first went into effect, there has been a substantial rise in fuel prices compared to construction costs. Furthermore, cost-effective energy conservation measures for new homes are better understood at the present time. Thus the building industry is already insulating single family houses to levels higher than minimum requirements because they are more cost-effective in the completed house.

Changes to the existing Energy Code regarding one and two-family residences would include the following:

* The minimum ceiling insulation is changed from R-20 or R-25 in the present code to R-38.

* The average opaque wall requirement would be R-20, with the maximum total area of windows and sliding glass doors being 15 percent of above grade wall area.

* Foundation wall insulation would be required, equal to that set for several years by the Farmers Home Administration. Either the entire foundation wall must be insulated to R-6, or if just the upper half of the wall is insulated, it must be R-10.

* The requirement for a vapor barrier is modified to reflect the discovery some years ago of its importance in saving energy by stopping air infiltration. Requirements for overlapping the vapor barrier and repairing tears are added.

* The requirement that the furnace size is no larger than 115% of the calculated heat load of the house would be retained in the proposed code.

* Energy efficient water heaters (those meeting ASHRAE requirements) have been demonstrated to have quick paybacks, but are not included in the present Energy Code because they were not widely available. Since they are now widely available in all sizes, they will be included in the proposed code.

* Finally, calculations are simplified to allow home designers to meet prescriptive requirements such as maximum window area. However, design by component performance (overall wall U value) and alternate design (for solar, etc.) will still be possible.

In summary, these proposed requirements would combine to provide an Energy Code that is economically attractive. Even when the cost of adding these proposed energy saving features is considered, our analysis has shown that the first year cost of owning the home will be less than the cost of owning a home built to the current Energy Code.

While adopting these standards as minimum requirements would be an improvement over the present code, builders wishing to provide their customers with even more efficient homes would be able to use super-insulation techniques.

The Energy Code proposals are still being developed and comments from any interested parties are welcome. Contact Bruce Nelson, Project Manager, at (612)296-8279.

MINNESOTA STATE BUILDERS ASSOCIATION

NEWSLETTER

666 Transfer Road | St. Paul, Minnesota 55114 | (612)646-7959

Volume 2 No 4 | May 1983

WHAT'S NEW IN ENERGY -- UPDATE

Last month's article by the State Energy Division on proposed energy code changes generated several questions and comments from members. This update will elaborate on a couple of points not explained in the previous article, and will highlight changes made to the code proposals as a result of discussions with the Builders Association.

The April article illustrated only the new proscriptive approach for calculating one- and two-family building envelope requirements. The component performance approach is also in the proposed code. For one- and two-family walls the overall "U" value requirement of 0.11 can be achieved by any combination of window areas and wall sections desired. The ceiling "U" value of 0.026 does not mean the entire ceiling must be R-38. If certain areas of the ceiling are not R-38 (vaulted areas, for example), then insulation in other parts of the ceiling or the walls can be increased to make up the difference. This also applies to the perimeter areas where the roof prevents installation of full depth insulation. The proposed code has been modified to more clearly explain this.

Concern was also expressed about the application of the energy code to a remodeling project. As in the past, the energy code only applies to the remodeled elements of the building.

The code also applies to multi-family, commercial and institutional building types. Proposed envelope requirements for multi-family buildings vary with degree days, but for the Twin Cities area the requirements are U 0.033 for ceilings and U 0.23 for walls.

Once the code rules are adopted, adequate time will be given before they take effect so that all concerned can become familiar with the new provisions. The effective date is expected sometime after the State Builders Association Convention in October. An information session is being planned for that event.

SF-00006-02

ATTACHMENT IX

STATE OF MINNESOTA

Office Memorandum

DEPARTMENT DEPD, Energy Division

TO : Bruce Nelson, P.E., Senior Engineer

DATE: June 1, 1983

FROM : Rosanne Gronseth, Research Assistant

PHONE: 297-2496

SUBJECT: Need and Reasonableness for Requiring Foundation Wall Insulation

Background

The current Minnesota Energy Code does not require below grade foundation wall insulation. The code, based on the standard ASHRAE 90-75, defines the overall thermal transmittance for walls based on those walls that enclose heated space and are exposed to outdoor air.

The proposed code is adapted from the Model Energy Code, prepared by the Council of American Building Officials, and based on ASHRAE 90A-1980. This ASHRAE standard deletes the stipulation that walls be exposed to outdoor air, and so calculation of overall thermal transmittance must include walls below grade. The Model Energy Code, however, retains the definition from ASHRAE 90-75. The proposed code does not amend this, but does include additional requirements for foundation wall insulation. These requirements reflect those made by the HUD Minimum Property Standards and the Farmer's Home Administration.

Two options are available. The first option requires that the foundation wall be insulated to achieve a value of R6 for the full height of the wall. The second requires that the foundation wall be insulated to a value of R10 down to the design frostline. These R values are interpreted to include the composite of the wall section. Furthermore, if the building is designed on systems analysis, insulation may be omitted from foundation walls if other components of the house make up for the increased heat loss.

These requirements differ from ASHRAE 90A-1980 in that ASHRAE requires below grade U values to be calculated for each foot of depth below grade and an average value taken. That U value must then be multiplied by the temperature difference ratic (design temperature difference between inside air and the ground divided by design temperature difference between inside air and outside air). The required R value can then be calculated.

The choice for below grade R values in the proposed code is based on several factors. First, it is much easier for the building designer to use these values than to struggle through the calculations mentioned above. Prescribed R values will greatly simplify the design process. Another factor is the proven cost effectiveness of increased insulation in buildings. This is extremely important for an energy poor state such as Minnesota.

Need

The need for foundation wall insulation is apparent in the fact that a large portion of heat loss from homes could be prevented. And a reduction in heat loss means a reduction in the amount spent on fuel. Dollars saved through smaller fuel bills can only benefit homeowners and the State.

DEPD conducted a study this year, "Analysis of Heating Cost for Four Building Standards", which includes analysis of the present energy code. The results indicate that, in a house built to conform with the current energy code, the below grade heat loss represents 40% of the total annual heat loss of the building. In a house built in accordance with the proposed code, however, below grade heat loss represents only 27% of the total annual heat loss of the building, even though other portions of the house are more insulated. This indicates that the issue of whether to insulate foundation walls is a significant one, and that measures can be taken to effectively reduce the amount of below grade heat loss.

Table 1 indicates that the extra cost required to insulate foundation walls will be absorbed within five years. After that time a net cost savings will be realized. If costs were calculated using annual mortgage increments, the payback would be even sooner. Furthermore, a house built according to the present code requires approximately 120 MBtu/year for space heat. With the proposed code, 24 MBtu/year are saved strictly by adding foundation wall insulation. Therefore, if five houses were built according to the proposed code, enough energy would be saved to heat one house for a year that was built under the current code.

Table 1 - Cost Analysis of Foundation Wall Insulation

	Present Code	Proposed Code	Cost Savings
Below grade wall UXA (Btu/hr/F)[1]	175	87	
Below grade floor UXA (Btu/hr/F)	27	27	
Total ground temperature dependent losses per year for ΔT=30F for 273 days (Mbtu)	40	22	
Annual fuel use for below grade space (for 75% annual fuel efficiency) (MBtu)	53	29	
Annual Cost - (for natural gas)			
1983 ($5.69/MBtu)[2]	$302	$165	$137
1984 ($6.13/MBtu)	$325	$178	$147
1985 ($6.50/MBtu)	$345	$189	$156
1986 ($6.88/MBtu)	$365	$200	$165
1987 ($7.42/MBtu)	$393	$215	$178
			$783
Total cost to insulate foundation wall (materials and labor)[3]	$ 0	$776	

This data clearly shows that not only is there a need for basement wall insulation, its installation is also cost-effective. The dollars saved in fuel costs as a result of foundation wall insulation will be extremely beneficial to all concerned.

Reasonableness

Minnesota Statute § 16.83, covering the policy and purpose of the State Building Code, says, "The construction of buildings should be permitted at the least possible cost consistent with recognized standards of health and safety." The cost-effectiveness of foundation wall insulation is an important factor in its reasonableness. The potential dollars saved on fuel significantly outweigh the initial cost to insulate. In addition, lowering heat loss contributes to minimizing the cost of the structure over its life.

While the cost-effectiveness is an extremely favorabel argument supporting foundation wall insulation, there has also been a suggestion that there is a less than favorable aspect. That suggestion is that insulated foundation walls are susceptible to frost heave, particularly in clay soils. The concern is that, without heat loss through the walls, the soil adjacent to the foundation will freeze, exerting pressure on the wall.

Investigation[4] has revealed that there are two factors that contribute to frost heave of foundation walls - poor drainage and water flow between the concrete block and soil. The problem of poor drainage can be dealt with by several methods. First of all, it is important to backfill with a non-frost-susceptible soil to the maximum depth of frost penetration. One rule-of-thumb for determining non-susceptibility is that non-uniform soils should have less than 3% of the grains smaller than 0.02 mm. Other methods for improving drainage include installation of gutters and downspout extensions to prevent water ponding around the foundation.

Water flow between the concrete block and the soil is a problem because if freezing of the soil occurs it will adfreeze to the wall. They will be frozen together. There are ways to prevent this, however. One way is to waterproof the wall. Placing rigid insulation on the outside of the foundation also inhibits water flow. This insulation will also act as a cushion if some soil heaving does occur.

Further supporting the assertion that foundation heaving is unlikely is the fact that FmHA has had these requirements for foundation walls since 1978. Since that time approximately 4,000 homes have been built in Minnesota to conform to their standards, with no reported problems associated with frost heave. In addition, income limits for FmHA funding demonstrate the need for energy efficiency in low cost housing.

Additional supporting evidence comes from a building permit official from Moorhead. Clay soil is common in that area, however most foundations are insulated. Furthermore, most are constructed of poured, reinforced concrete. There have been no reported cases of the foundation walls cracking, though. The proposed code includes a note, however, recommending that design should be such to prevent damage due to frost action in clay soils.

Finally, if for any reason it is desired to omit foundation wall insulation, the proposed code provides two acceptable alternatives. First is provision for trade off between roof and wall insulation (some areas may have reduced amounts of insulation if other areas are increased). The second is building design on systems analysis, which may be used to achieve a design equivalent to foundation wall insulation.

In light of these findings, it apperas that requiring basement wall insulation will not result in more cases of damaged foundations. DEPD does make several recommendations, however, to enhance protection from frost heave. They include: provide good drainage around the foundation, waterproof the foundation wall, place insulation on the outside of the wall, and possibly place polyethylene over the insulation to keep it dry. Good drainage will reduce the amount of water in the soil. The insulation will absorb some pressure, should freezing occur, in addition to retarding water flow between the wall and soil.

To summarize, the addition of foundation wall insulation is both needed and reasonable. The reduction in heat loss is substantial, resulting in much needed fuel savings. Foundation wall insulation is also cost-effective, having a payback period fo less than five years. Any problems associated with basement wall insulation appear unlikely, however alternatives are available if its omission is desired. Consequently, there appears to be no reason not to require foundation wall insulation. There are, however, many reasons that favor it, not least of which is the economic benefit to the people of Minnesota.

References

1) "Analysis of Costs for Four Building Standards", DEPD, January 1983.
2) DEPD Fuel Projections, January 1983.
3) "Analysis of Added Costs for Two Building Standards", DEPD, May 1983.
4) Information from:
"Basic Concepts of Frost Heaving", ASHRAE, 1981.
"Earth Sheltered Structures Fact Sheet", Nos. 03, 06; Underground Space Center, U of MN, 1980-81.
"Area Frost Heave Problems in Building Construction", Braun Engineering Testing, Inc., 1978.

ANALYSIS OF PROPOSED VAPOR BARRIER STANDARD

May, 1983

Introduction

This study has been prepared in support of the current Energy Code upgrade being conducted by the Energy Division of the Minnesota Department of Energy, Planning and Development. The quantitative results provided by this study will be included as a part of the Statement of Need and Reasonableness for the proposed code. This report presents a definition of what is meant by a vapor barrier material and a criteria for the installation of a vapor barrier in a residential structure. The added cost of complying to this new criteria and the energy savings to be expected are presented, and an estimated simple payback period of slightly less than two and one-half years is obtained.

Proposed Vapor Barrier Standard

The following definition and criteria for the vapor barrier in residential buildings is proposed.

Definition of vapor barrier

A material resistant to water vapor passage with a maximum perm rating of 0.1 grain/hr-ft^2-in Hg.

Criteria for vapor barrier in residential buildings

The design of buildings for energy conservation shall not create conditions of accelerated deterioration from moisture condensation. A vapor barrier shall be installed on the interior side or on the warm side of the dew point at winter design conditions of each building envelope surface. The vapor barrier shall be continuous with all joints overlapped and made over solid blocking. The vapor barrier shall be continuous and uninterrupted by framing at dropped ceiling and soffit areas. All electrical and plumbing runs through the vapor barrier shall be sealed. Rips and punctures in the vapor barrier shall be patched.

Exception: A continuous vapor barrier is not required at the rim joist.

Analysis and Discussion

The vapor barrier definition which includes a perm rating of .1 implies that if polyethylene is used as a vapor barrier that it must be at least 4 mils thick (.004 inches). Other materials which qualify under this definition are aluminum foil and cross laminated polyethylene sheeting.

The above criteria add four basic tasks to the work of installing a vapor barrier in residential buildings. These tasks are as follows:

- Installation of solid blocking for vapor barrier joints (2),
- Installation of vapor barrier before dropped ceilings and soffits are framed (1),
- Sealing of electrical and plumbing runs which penetrate the vapor barrier (2), and
- Patching rips and punctures (1).

In consultation with two Twin City builders, the total labor required to meet the above criteria has been estimated to be 6 hours with the hours to complete each task above shown in parentheses. For a labor rate of

$18.50/hour plus $50.00 for materials the total contractor cost to complete these additional tasks is estimated to be $161.00.

The energy savings provided by this additional effort are estimated by assuming that the annual average air change rate is reduced from 1/2 to 1/4 air changes per hour. A useful relation for this analysis is that for a house with an 8 ft. ceiling the thermal integrity factor (TIF) is 3.5 Btu/ft^2-°F-d for an infiltration rate of one air change per hour (ACH). Because of this a reduction of 1/4 ACH provided by an improved vapor barrier would reduce the TIF by .88 Btu/ft^2-°F-d. Assuming air leakage heat loss from the above grade portion only (1205 ft^2) and a heating season of 8159 Fahrenheit heating degree days as used previously yields an energy saving of 8.7 MBtu/season. A present value analysis based on the above cost and energy savings is presented in Table 1.

Table 1. Present Value Analysis for Upgraded Vapor Barrier

Annual Energy Savings (MBtu)	Annual Fuel Savings[1] (MBtu)	Annual Savings[2] ($)	Net Present Value of Savings[3] ($)		Additional Cost to Build ($)
			25 years	50 years	
8.7	11.6	66	1,149	1,698	161

Notes: 1) For 75 percent annual fuel efficiency
2) For natural gas costing $5.69/MCF, and 1 million Btu per MCF.
3) For a 3 percent real discount rate.

The annual fuel use was calculated by assuming an annual fuel conversion efficiency of 75 percent. The annual heating cost was calculated using the current price of natural gas at $5.69/MCF, and assuming a heat content of 1 million Btu per MCF.

In order to examine the cost effectiveness of this proposed standard, the net present value of the expected energy savings was calculated for 25 and 50 year time periods. For this calculation, a real discount rate of 3 percent was used. Thus, the actual discount rate was set to be 3 percent greater than the fuel inflation rate over the time period considered. This is judged to be conservative since many people would probably accept a real discount rate of 0 percent when investing in energy conservation. Standard economic formulas were used, and uniform present worth factors of 17.41 and 25.73 were calculated for the 25 and 50 year time periods, respectively.

Table 1 shows that the present value of the future fuel savings due to an upgraded vapor barrier are about seven to ten times its cost, and that the simple payback is just a little under two and one-half years. Thus, based on this analysis the proposed standard appears to be very cost effective.

ATTACHMENT XI

The Minnesota Department of Energy, Planning & Development

epd

ANALYSIS OF HEATING COST FOR FOUR BUILDING STANDARDS

February, 1983

Introduction

This study has been prepared in support of the current Energy Code upgrade being conducted by the Energy Division of the Minnesota Department of Energy, Planning and Development. The quantitative results provided by this study will be included as a part of the Statement of Need and Reasonableness for the proposed code. This report presents the results of heat loss calculations on a 1330 square foot 3 bedroom ranch house with a heated basement for four different building standards: ASHRAE 90-75, ASHRAE 90A-1980, HUD-MPS, and superinsulation. The house used is the "Plan 1002" built by several secondary and post-secondary construction trades programs throughout the state.

The net present value of the energy savings for each of these houses compared with the ASHRAE 90-75 standard has been completed for time horizons of 25 and 50 years. For natural gas costing $5.69/MCF and a real discount rate of 3 percent, the net present value of savings exceeds the estimated extra required building costs for all cases.

Heat Loss Calculation

The space heat energy requirement for each standard was calculated using ASHRAE handbook techniques. The structure was divided into above grade and below grade portions and these were treated separately. The heat loss from the above grade portion is determined by the ambient outdoor temperature, while the heat loss from the below grade portion is determined by some average ground temperature.

The data used for these calculations and the results obtained are shown in Tables 1 and 2. The number of heating degree-days shown, 8159, is the normal for Minneapolis-St. Paul International Airport. The ground temperature dependent losses were calculated using an average temperature difference of 30°F, equal to an indoor temperature of 65°F minus the average outdoor air temperature of 35°F for a 273 day heating season. Solar gains have not been included, but are assumed to be the same for each structure. In addition, a standard internal heat gain for people and appliances of 50,000 Btu per day was assumed for each structure.

Description of Standards Examined

The current building code, based on ASHRAE Standard 90-75, was used as the basis of comparison for the three remaining standards examined in this study.*

The ASHRAE Standard 90-75 can be met with 2 x 4 framing for R-14 walls, R-25 ceiling insulation, double glazed windows and uninsulated basement walls. In this standard the gross area of exterior walls is defined to include all areas that enclose heated space and are exposed to outdoor air. The average U_o value of the exterior walls do not exceed 0.185 Btu/hr-ft^2-°F for a 8159 heating degree-day climate (Minneapolis-St. Paul).

ASHRAE Standard 90A-1980 is much like ASHRAE Standard 90-75, except that R-30 ceiling insulation is required and that the maximum value for the average U_o value of the exterior walls is reduced from 0.185 to 0.155 Btu/hr-ft^2-°F. Most significant, however, is a new definition of gross area of exterior walls. Exterior walls are those enclosing a heated area regardless of whether that area is exposed to outdoor air or not. This implies that if basements are heated, they must also be insulated. A simple way to meet this standard is to apply an R-5 insulating board outside the foundation wall of the house from the footing

* Figure 1 illustrates the typical residential construction used for these four energy standards.

to the botton of the rim joist. That is, insulate the entire basement wall, both below and above grade. This combination of insulation for the ASHRAE Standard 90A-1980 is shown in Table 1.

The U.S. Department of Housing and Urban Development - Minimum Property Standard for One- and Two-Family Dwellings (HUD-MPS) requires R-38 ceiling insulation and R-20 woodframe walls. Since it is based on the same gross wall area definition as ASHRAE 90A-1980, and because it stipulates an average U_o value of 0.11 Btu/hr-ft^2-^{o}F for the exterior walls, it requires a minimum of R-10 foundation insulation.

The superinsulated case demonstrates that even greater amounts of insulation are cost effective on a life-cycle basis. The values of insulation shown are not part of a formalized standard, but are recommendations that have grown out of the Energy Division's State Superinsulated Housing Demonstration Program.

Economic Analysis

The annual fuel use for each house was calculated by assuming an annual fuel conversion efficiency of 75 percent. The annual heating cost was calculated using the current price of natural gas at $5.69/MCF, and assuming a heat content of 1MBtu per MCF.

In order to compare the heating costs of each insulation alternative, the net present value of the cost to heat each structure was calculated for 25 and 50 year time periods in Table 3. For this calculation, a real discount rate of 3 percent was used. Thus, the actual discount rate was set to be 3 percent greater than the fuel inflation rate over the time period considered. This is judged to be conservative since many people would probably accept a real discount rate of 0 percent when investing in energy conservation. Standard economic formulas were used. Uniform present worth factors of 17.41 and 25.73 were calculated for the 25 and 50 year time periods, respectively.

Table 3 shows the net present value of fuel savings with respect to ASHRAE Standard 90-75 in columns 6 and 7, and includes the estimated additional costs to build to the standards in column 8. In each case shown, the net present value of the fuel savings exceeds the estimated additional building cost, showing that each option is cost effective. Even if the additional cost of the HUD-MPS structure were three times greater than that estimated, the standard would be cost effective for even the 25 year time period.

Tables 4 and 5 show cash flow analyses of the three energy efficient structures as compared to a house built to ASHRAE Standard 90-75 requirements for gas and electric heat, respectively. The "annual mortgage increment" on these tables is the additional mortgage amount required to cover the "Additional Cost to Build" on Table 3. A 30-year fixed rate mortgage at 12 percent interest is assumed for these calculations.

The sum of this mortgage increment and the annual calculated fuel cost for each house is listed on Tables 4 and 5. Table 4 shows that the most economical gas heated house in the first ten years of ownership would be built to HUD Minimum Property Standards. Table 5 shows that the most economical electric heated house in the first ten years of ownership would be built to superinsulation standards.

Conclusions

This study has proven that a new home purchaser will benefit economically if the structure is built to HUD-MPS or superinsulation standards rather than ASHRAE 90-75 or ASHRAE 90A-1980 standards. These economic advantages result when either cash flow in the first ten years or net present cost over the lifetime of the structure is considered.

TABLE 1 HEAT LOSS SUMMARY FOR 3 BR RANCH HOUSE (PLAN B)

	Description of Surface	AREA (ft^2)	ASHRAE 90-75[3] U (BTU/hr/ft^2/°F)	ASHRAE 90-75[3] U x Area (BTU/hr/°F)	ASHRAE 90A-1980 U (BTU/hr/ft^2/°F)	ASHRAE 90A-1980 U x Area (Btu/hr/°F)	HUD-MPS U (BTU/hr/ft^2/°F)	HUD-MPS UxArea (Btu/hr/°F)	SUPERINSULATION U (Btu/hr/ft^2/°F)	SUPERINSULATION UxArea (Btu/hr/°F)
1										
2	Ceiling	1205	.04	48	.033	40	.026	31	.016	19
3										
4	Frame wall	888 (920)[1]	.069	61	.069	61	.05	44	.029	27
5										
6	Framing	157 (125)	.13	20	.13	20	.11	17	.057	7
7										
8	Rim joist	120	.069	8	.069	8	.05	6	.049	6
9										
10	Blockwall above grade	152	.51	78	.14	21	.10	15	.041	6
11										
12	Doors	40	.26	10	.26	10	.32	13	.125	5
13										
14	Windows	185	.5	93	.5	93	.47	87	.35	65
15										
16	Total above grade UA			318		253		213		135
17										
18	Infiltration[2]		.5 ACH	182	.5 ACH	182	.5 ACH	182	.25 ACH	91
19										
20	Below grade wall	152 (Ft) (perimeter)	1.15[3]	175	.62[4]	94	.45[5]	68	.29[6]	44
21										
22	Below grade floor	1180 (Ft)	.023[7]	27	.023	27	.023	27	.020	24
23										
24										
25										

NOTES: 1) For superinsulated case only.
2) For 20,250 ft^3 volume.
3) From 1981 ASHRAE Fundamentals, Page 25.7, Table 3, Uninsulated wall, Heat loss for unit length ofwall.
4) R-4.17 insulation.
5) R-8.34 insulation.
6) R-16.68 insulation, by extrapolation.
7) ibid, Table 4.

Table 2. Total Annual Space Heat for 3 Bedroom Ranch House (Plan B)

	ASHRAE 90-75		ASHRAE 90A-1980		HUD-MPS		Superinsulation	
	Hourly Heat Loss	Annual Heat Loss						
Description of Heat Loss/Gain	(Btu/hr-^{o}F)	(MBtu)	(Btu/hr-^{o}F)	(MBtu)	(Btu/hr-^{o}F)	(MBtu)	(Btu/hr-^{o}F)	(MBtu)
Above grade surfaces	318		253		213		135	
Infiltration	182		182		182		91	
Total air temperature dependent losses per year for 8159HDD		98		85		77		44
Below grade walls	175		94		68		44	
Below grade floors	27		27		27		24	
Total ground temperature dependent losses per year for $\Delta T=30^{o}F$ for 273 days		40		24		19		13
Internal gains per year (50,000 Btu/day for 273 days)		14		14		14		14
Total space heat energy per year (MBtu)		124		95		82		43

Table 3. Present Value Analysis for 3 Bedroom Ranch House (Plan B)

Standard	Annual Energy Use (MBtu)	Annual Fuel Use[1] (MBtu)	Annual Fuel Cost[2] ($)	Net Present Fuel Cost[3] 25 Years	Net Present Fuel Cost[3] 50 Years	Net Present Fuel Savings 25 Years	Net Present Fuel Savings 50 Years	Additional Cost to Build ($)[4]
ASHRAE 90-75	124	165	939	16,350	24,160	-0-	-0-	-0-
ASHRAE 90A-1980	95	127	723	12,590	18,600	3,760	5,560	750
HUD-MPS	82	109	620	10,800	15,950	5,550	8,210	1,500
Superinsulation	43	57	324	5,640	8,340	10,710	15,820	6,700

NOTES: 1) For 75% annual fuel efficiency. No solar gain included.

2) For natural gas at $5.69/MCF, and 1 MBtu per MCF.

3) For a 3% real discount rate.

4) Estimated.

Table 4. Cash Flow Analysis For Three Bedroom House

Gas Heat

YEAR	FUEL COST** $/MBtu	ASHRAE 90-75	ASHRAE 90A-1980	HUD-MPS	SUPER-INSULATION
		ANNUAL MORTGAGE INCREMENT*			
		$0	$93	$185	$827
		ANNUAL MORTGAGE INCREMENT PLUS FUEL			
1983	$ 5.69	$938	$ 815	$ 805	$1151
1984	6.13	1011	871	853	1176
1985	6.50	1072	918	893	1197
1986	6.88	1135	966	934	1219
1987	7.42	1224	1035	994	1249
1988	8.03	1324	1112	1060	1284
1989	8.71	1437	1199	1134	1323
1990	9.48	1564	1296	1218	1367
1991	10.25	1691	1394	1302	1411
1992	11.02	1818	1492	1386	1455

*Assuming a 12% mortgage - 30 year fixed rate.

**Department of Energy, Planning and Development, January 1983

Table 5. Cash Flow Analysis For Three Bedroom House

Electric Heat

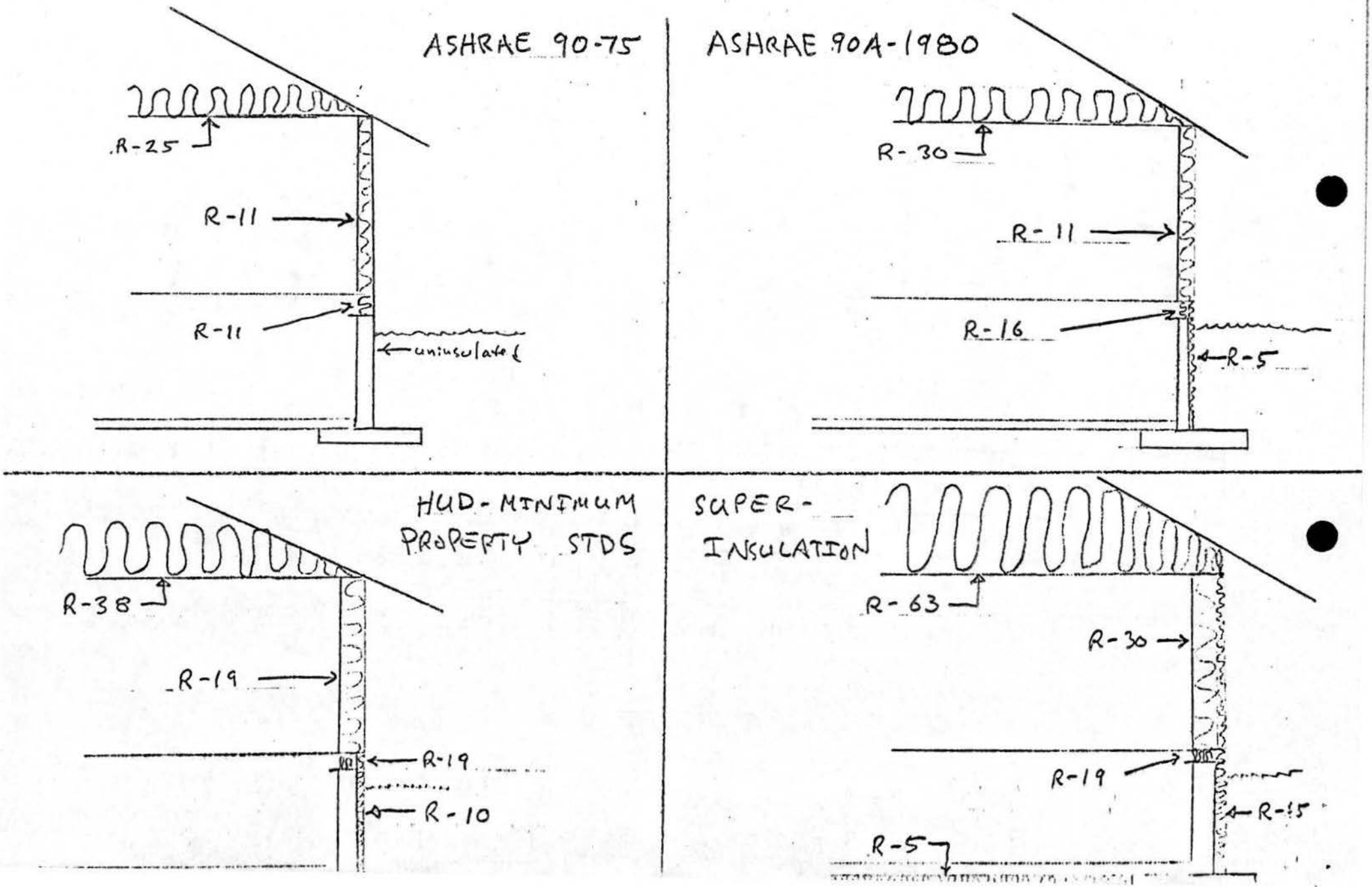
YEAR	FUEL COST** $/MBtu	ASHRAE 90-75	ASHRAE 90A-1980	HUD-MPS	SUPER-INSULATION
		ANNUAL MORTGAGE INCREMENT*			
		$0	$93	$185	$827
		ANNUAL MORTGAGE INCREMENT PLUS FUEL			
1983	$17.52	$2172	$1757	$1621	$1580
1984	18.34	2274	1835	1688	1615
1985	19.19	2379	1917	1758	1652
1986	19.99	2478	1992	1824	1686
1987	20.90	2591	2078	1898	1725
1988	22.30	2765	2211	2013	1785
1989	23.28	2886	2304	2093	1828
1990	24.52	3040	2422	2195	1881
1991	25.51	3163	2516	2276	1923
1992	27.00	3348	2658	2399	1988

*Assuming a 12% mortgage - 30 year fixed rate.

**Department of Energy, Planning and Development, January 1983

FIGURE 1

TYPICAL RESIDENTIAL CONSTRUCTION FOR FOUR ENERGY STANDARDS



ANALYSIS OF ADDED COSTS FOR TWO BUILDING STANDARDS

May, 1983

Introduction

This study has been prepared in support of the current Energy Code upgrade being conducted by the Energy Division of the Minnesota Department of Energy, Planning and Development. The quantitative results provided by this study will be included as a part of the Statement of Need and Reasonableness for the proposed code. This report presents the results of an analysis of the additional costs to build a 1330 square foot 3 bedroom ranch house to two different upgraded building standards: ASHRAE 90A-1980 and HUD-MPS. The comparison standard used was the current code, ASHRAE 90-75, and the cost calculation was based on house plan 1002 that is frequently built by several secondary and post-secondary construction trades programs throughout the state.

Analysis and Discussion

Added costs to build house plan 1002 to the ASHRAE 90A-1980 and HUD-MPS levels of insulation rather than the current ASHRAE 90-1975 standard were estimated using building costs furnished by Marv Anderson Homes. These costs and the construction techniques used to meet the proposed standards are shown in Table 1.

The R-values shown in Table 1 are for fully insulated ceiling or wall cross-sections only and do not include adjustments for framing materials. The base

case wall is taken to be 2 x 4 faming with 25/32" sheathing and R-11 fiberglass batt insulation. This remains the same for ASHRAE 90A-1980, but is upgraded to about R-20 for the HUD-MPS case. In this case two options are presented. A 2 x 6 frame wall with 25/32" sheathing and R-19 fiberglass batt insulation, and a 2 x 4 frame wall with 1" polystyrene sheathing and R-13 fiberglass batt insulation. The ceiling and foundation insulation levels are increased as shown by simply applying more insulation without changes in framing or construction design. Costs shown include the extra labor and material required for each technique used. Costs are included for the following: 1) jam extensions for the 2 x 6 HUD-MPS wall section, 2) bracing for use with the HUD-MPS polystyrene sheathing option, and 3) protective fiberglass skirting for above grade portions of polystyrene insulation applied over the foundation wall.

From Table 1 it can be seen that the added costs are about $850 and from $1700 to $1800 for the ASHRAE 90A-1980 Standard and the two HUD-MPS options respectively. These costs are only about $100 and $200 to $300 more than originally stated and therefore are still much less than the net present value of the fuel savings calculated earlier for the ASHRAE 90A-1980 and HUD-MPS Standards. Because of this, these building options are still cost effective on a net present value basis. Another option that is also available for the HUD-MPS wall section would be to omit the 25/32" fiber board sheathing. This would result in a savings of about $272 for the 2 x 6 wall option.

TABLE 1. Added Cost to Build House Plan 1002

Surface	ASHRAE 90-75		ASHRAE 90A-1980			HUD-MPS		
	R Value	Construction	R Value	Construction	Added Cost ($)	R Value	Construction	Added Cost ($)
Ceiling	25	Blown fiberglass	30	Blown fiberglass	72	38.5	Blown fiberglass	205
Frame Wall	15.2	½" gypsum board, 2 x 4 framing, 25/32" fiberboard sheathing, R-11 fiberglass batt	15.2	Same as ASHRAE 90-75	-0-	23.2	5/8" gypsum board, 2 x 6 framing, 25/32" fiberboard sheathing, R-19 fiberglass batt, extension jams	413
						20.1	½" gypsum board, 2 x 4 framing, 1" polystyrene sheathing, R-13 fiberglass batt, bracing	305
Block wall	2.0	Uninsulated block wall	7.0	1" polystyrene over full wall, fiberglass skirt above grade	776	12.0	2" polystyrene over full wall, fiberglass skirt above grade	1,201
Total Added Cost					$848		2 x 6 wall	$1,819
							2 x 4 wall	$1,711

RTS
ROBINSON TECHNICAL SERVICES

ANALYSIS OF ELIMINATING THE CATHEDRAL CEILING EXCEPTION

May, 1983

Introduction

This study has been prepared in support of the current Energy Code upgrade being conducted by the Energy Division of the Minnesota Department of Energy, Planning and Development. The quantitative results provided by this study will be included as a part of the Statement of Need and Reasonableness for the proposed code. This report presents the results of an analysis on a 1330 square foot 3 bedroom ranch house built with two ceiling options: cathedral ceiling in living room only; and cathedral ceiling in living room, plus kitchen and dining areas. The house used for this analysis is Plan 1002 built by several secondary and post-secondary construction trades programs throughout the state.

The purpose of this analysis is to examine the costs and benefits of removing the following exception from section 4.3.2.2 of the current ASHRAE 90-75 building code.

> Exception. Roof/ceiling assemblies in which the finished interior surface is essentially the under side of the roof deck, such as a wooden cathedral ceiling, may have a U_o value not to exceed 0.08 Btu/h-ft^2-^{o}F (0.45 W/m^{2}K) for any Heating Degree Day area.

Without this exception in effect the combined thermal transmittance value (U_o value) for roof/ceilings shall not exceed .04 Btu/h-ft^2-^{o}F for areas with more than 8000 Fahrenheit Heating Degree Days.

Performance and Cost Analysis

The analysis was carried out for twelve different cases as shown in Table 1. Two vaulted ceiling areas for each building standard were examined with and without the exception in effect. These cases are listed in the first three columns of Table 1. With the exception effect the overall U_o value was taken to be .08 Btu/hr-ft^2-^{o}F, and the standard construction area was assigned a U value equal to that prescribed by each standard. The vaulted construction U values were then calculated so that overall U_o value would be achieved. Without the exception in effect the overall U_o values were taken to be those prescribed by each standard, and the vaulted construction was assigned a U value of .06 Btu/hr-ft^2-^{o}F. This U value (R value = 16.7) was used since it implies a rigid insulation thickness of about 3 inches, which was assumed to be the practical limit for current building practice. With these U values given the U values required for the standard construction areas were calculated. For the larger vaulted areas without the exception in effect the amount of insulation required in the standard construction areas became very large and the HUD-MPS case proved impossible, since a negative U value was required. If the limit of 3 inches of rigid insulation is removed another set of options becomes available. Based on first principles an economically optimum set of U values may be determined using a Lagrange optimization technique. These U values are shown on the right side of Table 1, and are those individual U values which provide the required overall U_o value for the least cost to insulate. For the living room only case the least cost values range from 11% to 0% less than those calculated conventionally. However, for the second case of a larger vaulted area (about 50% of the total ceiling area), the difference between the least cost to insulate and the previously calculated cost becomes

much greater for each case. For this method the HUD-MPS can be met for a cost of $1557, if about 5" of rigid insulation is applied to the vaulted ceiling area, and R-60 insulation is applied to the remainder of the ceiling. In this case a vaulted ceiling truss designed to accommodate R-38 insulation (U = .026) might be a more practical design solution.

Economic Analysis and Discussion

Table 2 shows the results of an economic analysis based on the results presented in Table 1. The annual fuel use for each option was calculated by assuming an annual fuel conversion efficiency of 75 percent. The annual fuel cost was calculated using the current price of natural gas at $5.69/MCF, and assuming a heat content of 1 million Btu per MCF.

In order to evaluate the annual savings of each insulation alternative, the net present value of the annual savings for each option was calculated for 25 and 50 year time periods. For this calculation, a real discount rate of 3 percent was used. Thus, the actual discount rate was set to be 3 percent greater than the fuel inflation rate over the time period considered. This is judged to be conservative since many people would probably accept a real discount rate of 0 percent when investing in energy conservation. Standard economic formulas were used, and uniform present worth factors of 17.41 and 25.73 were calculated for the 25 and 50 year time periods, respectively.

The economic feasibility of each option is evaluated by comparing the present value of the future fuel savings to the additional cost required to build a roof/ceiling without having the exception in effect. The additional cost to build was calculated using the least cost results, since they yield a larger

additional cost to build and therefore provide a more conservative estimate of economic feasibility. For the cases using a 3" maximum amount of rigid insulation all cases except the larger vaulted area HUD-MPS case are economically feasible. The simple paybacks range from 5 to 9 years, except for the large vaulted area ASHRAE 90A-1980 case which is just feasible and has a simple payback of 17.1 years. For the cases using an unrestricted thickness of rigid insulation the smaller vaulted area results are nearly the same as the restricted thickness cases. There are, however, rather large differences for the larger vaulted area cases. Here the least cost to build the ASHRAE 90A-1980 case is much smaller, and the HUD-MPS case can actually be built. The simple payback periods for these cases range from 7 to 11 years. However, as stated before the large amounts of insulation required might make it more practical to use vaulted ceiling trusses for these cases.

Table 1. Heat Loss Summary with and without Ceiling Insulation Exception

Case	Geometry	Code	Area (ft^2)		U(Btu/hr-ft^2-°F)		Ave U_o[2]	Total U_oA_o	Energy Use[3]	Cost to Insulate[1]	Optimum U Values for least cost (Btu/hr-ft^2-°F)		Least Cost to Insulate[1]
			Vaulted Constr.	Standard Constr.	Vaulted Constr.	Standard Constr.	(Btu/hr-ft^2-°F)	(Btu/hr-°F)	(MBtu)	($)	Vaulted Constr.	Standard Constr.	($)
With Exception	Living room only	ASHRAE 90-75	294	911	.20	.040	.080	96.40	18.9	430	.129	.064	350[4]
		ASHRAE 90A-1980	294	911	.23	.033	.080	96.40	18.9	491	.129	.064	350[4]
		HUD-MPS	294	911	NA	.026	NA						
	Living room plus kitchen and dining	ASHRAE 90-75	594	611	.12	.040	.080	96.40	18.9	526	.107	.054	503[4]
		ASHRAE 90A-1980	594	611	.13	.033	.080	96.40	18.9	552	.107	.054	503[4]
		HUD-MPS	594	611	NA	.026	NA						
Without Exception	Living room only	ASHRAE 90-75	294	911	.060	.034	.040	48.20	9.4	696	.065	.032	698
		ASHRAE 90A-1980	294	911	.060	.024	.033	39.77	7.8	863	.053	.026	858
		HUD-MPS	294	911	.060	.015	.026	31.33	6.1	1205	.042	.021	1071
	Living room plus kitchen and dining	ASHRAE 90-75	594	611	.060	.021	.040	48.20	9.4	1030	.054	.027	999
		ASHRAE 90A-1980	594	611	.060	.0068	.033	39.77	7.8	1942	.044	.022	1227
		HUD-MPS	594	611	.060	(.0071)	.026	31.33	6.1	*[5]	.035	.017	1557

1) Assume \$.06/ft^2-R for vaulted construction, \$.015/ft^2-R for standard construction
2) For a total area of 1205 ft^2
3) For 8159 HDD/Season and $E=24(U_oA_o)(HDD) = (195,816)\ U_oA_o$
4) Basis cost for economic analysis
5) Not possible, since a negative U value is required

Table 2. Economic Analysis for Ceiling Insulation Exception

Case	Geometry	Code	Annual Energy Use (MBtu)	Annual Fuel Use[1] (MBtu)	Annual Fuel Cost[2] ($)	Annual Fuel Savings ($)	Net Present Value of Fuel Savings[3] 25 years	Net Present Value of Fuel Savings[3] 50 years	3" Maximum Rigid Insulation Addtl. Cost to Build($)	3" Maximum Rigid Insulation Simple Payback (years)	Unrestricted Rigid Insulation Least Cost to Build($)	Unrestricted Rigid Insulation Simple Payback (years)
With Exception	Living room only	ASHRAE 90-75	18.9	25.2	143	-0-			-0-			
		ASHRAE 90A-1980	18.9	25.2	143	-0-			-0-			
	Living room plus kitchen and dining	ASHRAE 90-75	18.9	25.2	143	-0-			-0-			
		ASHRAE 90A-1980	18.9	25.2	143	-0-			-0-			
Without Exception	Living room only	ASHRAE 90-75	9.4	12.5	71	72	1254	1853	346	4.8	348	4.8
		ASHRAE 90A-1980	7.8	10.4	59	84	1463	2161	513	6.1	508	6.0
		HUD-MPS	6.1	8.1	46	97	1689	2496	855	8.8	721	7.4
	Living room plus kitchen and dining	ASHRAE 90-75	9.4	12.5	71	72	1254	1853	527	7.3	496	6.9
		ASHRAE 90A-1980	7.8	10.4	59	84	1463	2161	1439	17.1	724	8.6
		HUD-MPS	6.1	8.1	46	97	1689	2496	*4	*4	1054	10.9

Notes:
1) For 75% annual efficiency
2) For natural gas at $5.69/Mcf, and 1 million Btu per Mcf
3) For a 3% real discount rate
4) Not possible, since a negative U value is required

Table 6.2
HVAC System Equipment, Electrically Driven[1]
Minimum COP (EER)—(Cooling)[2,3,4,5]

	Standard Rating Capacities			
	Under 19 kW (65,000 Btu/h)		19 kW (65,000 Btu/h) and Over	
Effective Date	Air-Cooled	Evap. or Water Cooled	Air-Cooled	Evap. or Water Cooled
Beginning January 1, 1980	1.99 (6.8)	—	2.20 (7.5)	—
Beginning January 1, 1984	2.28 (7.8)	2.58 (8.8)	2.40 (8.2)[6]	2.69 (9.2)

1. Applies to equipment as listed for Table 6.1. All performances at sea level.
2. EER is Energy Efficiency Ratio, defined in Sec. 3; COP is defined in 6.3.3.
3. The Department of Energy has established required test procedures for single-phased, air-cooled residential central air-conditioners under 19 kW (65,000 Btu/h) in capacity, which have been incorporated into ARI Standard 210-79. EER (COP) values in Table 6.2 are based on Test A of the DOE Test Procedures.
4. Any minimum efficiency standard(s) promulgated by the Fedral Government may supersede minimum values, for the products to which they apply, established in this Table. See 2.3.
5. For Room Air-Conditioners, DOE will base its weighted average annual efficiency on EER determined in accordance with ANSI Z 234.1-1972.
6. Applies when return-air fans are not included under the manufacturer's model No. When return-air fans are included, the required minimum values are 2.34 (8.0).

Table 6.4
Applied HVAC System Components, Electrically Driven[1]
Minimum COP (EER)—Cooling[2]

		Water Chilling Packages				Hydronic Heat Pumps	
	Types	Condenser Included		Condenserless		Water Source	
Condenser Cooling Means		Air	Water	Air	Water	Under 19 kW (65,000 Btu/h)	19 kW (65,000 Btu/h) and Over
Beginning January 1, 1980	C	2.28 (7.8)[4]	3.98 (13.6)[4]	—	—	—	—
	R	2.20 (7.5)	3.40 (11.6)	2.78 (9.5)	3.40 (11.6)	—	—
Beginning January 1. 1984	C	2.34 (8.0)[4]	4.04 (13.8)[4]	—	—	2.64 (9.0)	2.75 (9.4)
	R	2.46 (8.4)	3.51 (12.0)	2.90 (9.9)	3.51 (12.0)	—	—

1. Applies to equipment as listed in Table 6.3.1. All performances at sea level.
2. Performance of Water-Chilling packages does not include energy to drive chilled-water and condenser-water pumps, or cooling-tower fans; for Hydronic Heat Pumps it does not include the energy to drive circulating water pump(s) and cooling-tower fan(s), but does include the conditioned supply-air fan-motor energy when included as part of the model number of the heat pump. The system designer shall determine the amount of the non-included energies and take them into account in determining the HVAC System COP (EER) and annual energy consumption.
3. C = Centrifugal or Rotary Type (ARI Standard 550-77)
   R = Reciprocating Type (ARI Standard 590-76).
4. Where double-bundle heat recovery is employed on centrifugal or screw compressor units, a lower EER is acceptable, provided that the gain by heat exchange exceeds the loss by lower EER; See 5.9.

Table 6.5
Applied HVAC System Components, Electrically Driven
Condensing Units 19 kW (65,000 Btu/h) and Over[1]
Minimum COP (EER)—Cooling[2]

	Positive Displacement		
Condensing Means	**Air**	**Evaporative**	**Water**
Beginning January 1, 1980	2.50 (8.5)	3.48 (11.9)	3.48 (11.9)
Beginning January 1, 1984	2.78 (9.5)	3.66 (12.5)	3.66 (12.5)

1. Per ARI Standard 520-78 for Positive Displacement Refrigerant Compressors, Compressor Units and Condensing Units.
2. Based on Standard Rating Capacity at Conditions in Table 6.3.2 and at sea level.

Table 6.10
HVAC System Heating Equipment and System Components, Electrically Driven (Heat Pumps)[1,2]
Minimum COP[3]

	Air-Source		Water-Source
Heat Source Entering Temperature °C (F)	8.3 DB/6.1 WB (47 DB/43 WB)	−8.3 DB/−9.4 WB (17 DB/15 WB)	15.6 (70)
Beginning January 1, 1980	2.5	1.5	2.5
Beginning January 1, 1984	2.7	1.8	3.0

[1]Equipment as listed in Table 6.9. All performances at sea level and exclude supplementary heat.
[2]"Equipment" here refers to central heat pumps, both air-source and water-source; "Components" refers to water-source heat pumps in hydronic systems.
[3]For both central and hydronic system water-source heat pumps, the COP values in the table do not include the power consumed by the water pump. In order to determine total system performance, it is the system designer's responsibility to take this power consumption into account. In addition, new (fossil fuel or electric) energy supplied to a boiler or other water heating device to restore the water-source temperature entering the heat pump shall be taken into account by the system designer. (See 6.7.3.1).
[4]Any minimum efficiency standard(s) promulgated by the Federal Government may supersede such minimum values established in this Table. See 2.3.

JUN 01 1983

ATTACHMENT XIV

American Red Cross

St. Paul Area Chapter
100 South Robert Street
St. Paul, Minnesota 55107
(612) 291-6789

May 27, 1983

Bruce Nelson
State Energy Division
980 American Center Building
150 E. Kellogg Blvd.
St. Paul, Minnesota 55101

Dear Bruce:

This letter is in regards to a recent phone discussion that you and I had concerning some of the recommendations listed in the Model Energy Code. I am unable to speak on these issues as a Red Cross representative because the Red Cross does not have any information or requirements regarding these subjects. I can respond as a current Water Safety Instructor and a former Pool Director involved with both indoor and outdoor pools.

#504.5.2

The most current information that I have seen on pool covers is still inconclusive regarding major energy savings. Many individuals who maintain pools would see an energy savings if they were merely given some tips on how to save energy around their pool. Some improvements in energy savings may only have occurred because pool personnel were more aware. I am also very concerned about the safety issue. People have drowned in and around pool covers. Pool personnel may give up quality when purchasing pool covers due to budget problems.

#504.5.2 exception

I don't have much to comment on here other than that heat losses at night are higher irregardless of heating techniques.

#504.5.3

Pumps generally are running all of the time except when the filters get dirty enough that they shut down, or a decision is made to clean them before the system shuts down. This is gauged by bather load and environmental conditions, not by the time of day or peak demand periods. Most pools cannot be shut down for very long without

significant problems with chemical balances. Heating systems are also set up according to bather loads and environmental conditions. Saving energy and maintaining a cooler pool, may mean lower attendance. Pool personnel like to make changes in chemicals and the adding of water (which demands more from the heaters) during slow swimming times which may or may not be peak demand times. Since many pools are maintained by non-professional pool personnel such as, janitors or young people just working there for the summer, there probably would not be compliance with this regulation in most situations.

Hope this information is helpful.

Sincerely,

Kay Owens

Kay Owens, Assistant Director
Safety Services

ATTACHMENT XV

SF-00006-03

STATE OF MINNESOTA

Office Memorandum

DEPARTMENT DEPD - Energy Division

TO: Susan Lasoff
MN Council for the Handicapped

DATE: 6/6/83

FROM: Bruce Nelson

PHONE: 6-8279

SUBJECT: Energy Code Rules: Deletion of Requirement for Lavatories in Restrooms of Public Facilities to be Equipped With Devices Which Limit Outlet Temperatute to a Maximum of 110° F.

My reason for deleting this requirement is that such devices, if even available, would be too expensive to justify the slight energy savings that would result. However, after phone conversations with yourself, it was indicated that this requirement should not be deleted for separate lavatories for use by physically handicapped persons because of danger of burns for persons with impaired temperature sensitivity. I understand the handicapped provisions of the Minnesota Building Code contain a recommendation for such devices.

I subsequently consulted two local authorities on housing for the handicapped for their recommendations on this matter. Mr. Michael Bjerkesett, of the National Handicapped Housing Institute was familiar with this recommendation, but was not sure if devices to do this were available. He said that he does not see the need for such a requirement for lavatories for the handicapped at this time. Mr. Harold Kreivel, an architect specializing in handicapped buildings, said he was aware of "expensive mixing values for showers" that may meet this requirement, but he had not seen them applied to lavatories. He felt that the technology to meet this requirement is not yet available, and he recommended that this requirement not be made for lavatories for handicapped persons. Additional conversations I have had with members of the Consulting Engineers Council, Energy Committee have indicated similar understandings about the unavailability of these devices for lavatories.

As a result of these investigations, it is apparent that the forementioned requirement is not reasonable to include in the Energy Code at this time. As I mentioned, the Energy Code will be upgraded from time-to-time in the future, so there will be opportunities to include requirements as technology makes them feasible.

ATTACHMENT XVI

Demonstration of Equivalence of Table 6-11 To Requirements in the Building Design By Component Performance Approach Section

Example house:

1200 ft^2 one-story 8 ft. walls 1 ft. rim joist

perimeter = 1400 ft.

wall area = 1400 x 9 = 12,600 ft^2

Component performance U_o value requirement = 0.11

walls - insulated cavity	U.05
framing	U.10 (10% of opague wall)
net	.90 x .05 + .10 x .10 = 0.056
windows	U.50
sliding glass doors	U.69
doors	U.47 (assume 41.25 ft^2)

Case 1 - No sliding glass door

12% windows

0.50 x 0.12 x 12,600 (windows)
+ 0.47 x 41.25 (doors)
+ 0.056 x (12600 x .88 - 41.25) (opaque walls)

Case 2 - With 8' x 7.5' sliding glass door

10% windows, 60 ft^2 glass door

0.69 x 60 (sliding glass door)
+ 0.50 x (.10 x 12,600 - 60) (windows)
+ 0.47 x 41.25 (door)
+ 0.056 x (12,600 x .90 - 41.25) (opaque walls)
÷ 12,600 = .10 U_o

ATTACHMENT XVII

Minnesota Chapter

JUN 24 1983

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS, INC.

June 22, 1983

Mr. Bruce Nelson, Energy Division -
Department of Energy, Planning, and Development
980 American Center Building
150 E. Kellog Blvd.
St. Paul, MN 55101

RE: Proposed Revisions to the State Building Code
Relating to Energy

Dear Mr. Nelson:

The ASHRAE Energy Management Committee of the Minnesota Chapter is pleased that we were able to be represented on the Code Advisory Committee for the Energy Division.

We are impressed with the thoroughness with which the Agency has approached the subject of Energy Conservation in the process of updating the Energy Code. We wish to commend your efforts.

Adoption of the "Model Energy Code", (with certain necessary modifications), meets with our approval particularly since its content is based on ASHRAE 90A-1980, and includes by reference other ASHRAE and appropriate National Standards.

These references, which are defined in Section 701.0, includes ASHRAE 62-1981, "Ventilation For Acceptable Indoor Air Quality", ASHRAE 55-1981, "Thermal Environmental Conditions For Human Occupancy", the four ASHRAE "Handbooks", and others.

While the "Model Energy Code" is a good basis for Energy Conservation and for The Minnesota Code, every opportunity should be taken to emphasize that it be considered as minimum. Any education program on the code should seek to impress designers, builders and owners that the code requirements are minimum and that there can be long term economic benefits from exceeding the code requirements.

Sincerely,

Gary C. Ashley
Energy Management Committee Chairman

CC: Kenneth Dowell
Dean Rafferty

Please reply to: