



UNITED STATES GENERAL ACCOUNTING OFFICE  
WASHINGTON, D.C. 20548

RESOURCES AND ECONOMIC  
DEVELOPMENT DIVISION

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The Honorable  
The Secretary of Housing and  
Urban Development



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Dear Mr. Secretary:

As part of our continuing review of mortgage financing activities administered by HUD, we are surveying the housing field to determine ways in which HUD may help promote greater energy conservation.

The survey is directed primarily at (1) evaluating the adequacy of HUD's minimum property standards for achieving maximum energy conservation in single-family housing and (2) identifying measures HUD could implement to help reduce residential energy use.

We interviewed HUD central office officials responsible for administering HUD's minimum property standards, as well as officials involved in HUD's energy research programs. We also met with other Federal agency officials involved with energy conservation and officials from utility companies and the building industry. We reviewed HUD's minimum property standards and various energy conservation studies and publications prepared by Federal agencies and private organizations.

Our work to date indicates that the thermal requirements of HUD's minimum property standards could be strengthened to achieve greater energy conservation in new single-family homes and thermal standards are needed for existing single-family homes.

HUD's MINIMUM PROPERTY STANDARDS

HUD requires that properties financed with the aid of any of its mortgage insurance activities meet certain property standards. These are the minimum standards HUD considers necessary in planning, constructing, and developing a property to be insured by HUD. Standards have been developed for one- and two-family units (referred to as single-family homes in this report) and multifamily dwellings.

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The Department of Agriculture and the Veterans Administration also require that new homes insured under their mortgage insurance programs comply with HUD standards. HUD, Agriculture, and the Veterans Administration insured about 30 percent of the single-family homes built in the United States in fiscal years 1971-73. Although HUD standards apply only to federally insured housing, their impact on all housing is substantial because of their widespread influence on lenders, appraisers, developers, builders, and local zoning authorities.

Thermal standards for single-family homes

HUD standards for single-family homes, established in November 1966, were revised in June 1971. These revised standards set forth the maximum allowable heat loss and gain for new homes to be insured by HUD. The heat loss allowable, in British thermal units per hour (BTUH), depends on the size of the home. Allowable heat gain (in BTUH) varies with size and with the climate. For example, under HUD standards, the maximum heat loss allowable for a house of 1,500 square feet of space is 49,100 BTUH. If the same house is to be air-conditioned and is in a geographical area having a design dry bulb temperature of 95 degrees Fahrenheit, the maximum heat gain cannot exceed 29,600 BTUH.

The standards do not

- specify the quantity of insulation to be placed in walls and ceilings which a builder must comply with in constructing a heated or cooled house and
- require that tinted or thermal glass panes or storm windows and doors be used.

Before construction, a builder must submit to HUD a schedule showing the estimated heat loss and gain for a home. This estimate is based on such factors as building materials, climate, and a standard estimate of the normal air leakage through openings, such as those around doors and windows. HUD officials at the central office said that during HUD field office inspections, the inspectors do not determine compliance with the thermal standards. These officials--as well as an official of Hittman Associates, Inc., a Washington area consulting firm which has performed a number of housing studies for HUD--stated that it is impractical to enforce HUD standards because special test equipment, not commercially available, and weather data are needed to determine how much heat a residence will lose or gain after it is constructed.

Thermal standards for single-family homes need strengthening

Two studies<sup>1/</sup> made on thermal insulation for residential construction showed that significant energy could be saved in single-family homes by strengthening HUD's thermal standards.

The Oak Ridge National Laboratory made the first study, under contract with the National Science Foundation, to determine savings in energy and utility costs from applying various amounts of home thermal insulation. Climatic conditions for three cities, representing equal-population regions of the country, were included. In each region, energy consumption and annual costs to a homeowner were determined using various amounts of insulation and assuming gas or electric heat, with and without air-conditioning. The types of thermal treatment considered included glass fiber insulation of various commercial thicknesses for walls and ceilings and storm windows.

This study and our discussions with an official from the Oak Ridge National Laboratory showed that homeowners could save on energy and utility costs if homes were insulated to an economic optimum point rather than to HUD standards. The economic optimum point is the point at which the annual savings to the homeowner in utility costs--after subtracting the additional annual mortgage payments required by the initial investment in added insulating material--is maximized. The savings, by geographical locations, were as follows.

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<sup>1/</sup>"The Value of Thermal Insulation in Residential Construction: Economics and the Conservation of Energy"  
(Oak Ridge, Tenn.: Oak Ridge National Laboratory, Dec. 1971)

"Residential Energy Consumption Single-Family Housing"  
(Columbia, Md.: Hittman Associates, Mar. 1973)

<u>Type of heat and air-conditioning</u>	<u>Percent of energy saved</u>		Homeowner's annual savings (note a)
	<u>Gas</u>	<u>Electricity</u>	
Southern region (Atlanta):			
Gas heat	17.8	(b)	(c)
Gas heat and electric air-conditioning	9.1	7.0	\$ 3
Electric heat	-	44.0	51
Electric heat and air-conditioning	-	32.2	42
Central region (New York):			
Gas heat	28.2	(b)	4
Gas heat and electric air-conditioning	34.2	17.8	9
Electric heat	-	34.6	80
Electric heat and air-conditioning	-	33.3	88
Northern region (Minneapolis):			
Gas heat	9.5	(b)	5
Gas heat and electric air-conditioning	9.5	7.9	6
Electric heat	-	9.0	39
Electric heat and air-conditioning	-	9.0	40

<sup>a</sup>Represents the amount by which annual savings in utility costs exceed the additional annual mortgage payments required by the initial investment in added insulating materials.

<sup>b</sup>Savings in electricity for furnace fan operation are nominal.

<sup>c</sup>Less than \$1.

A comparison of the insulation used to meet the economic optimum point with that typically used by builders to meet HUD heat loss and gain standards follows.

<u>Type of heat and air-conditioning</u>	<u>Insulation</u>					
	<u>Windows</u>		<u>Ceiling</u>		<u>Walls</u>	
	<u>Economic optimum</u>	<u>HUD</u>	<u>Economic optimum</u>	<u>HUD</u>	<u>Economic optimum</u>	<u>HUD</u>
Southern region (Atlanta):						
Gas heat	(a)	(a)	3-1/2"	3-1/2"	3-1/2"	-
Gas heat and electric air-conditioning	(a)	(a)	6	3-1/2	3-1/2	1-7/8"
Electric heat	(b)	(a)	6	3-1/2	3-1/2	-
Electric heat and air-conditioning	(b)	(a)	6	3-1/2	3-1/2	1-7/8
Central region (New York):						
Gas heat	(b)	(a)	3-1/2	3-1/2	3-1/2	1-7/8
Gas heat and electric air-conditioning	(b)	(a)	6	3-1/2	3-1/2	1-7/8
Electric heat	(b)	(a)	6	3-1/2	3-1/2	1-7/8
Electric heat and air-conditioning	(b)	(a)	6	3-1/2	3-1/2	1-7/8
Northern region (Minneapolis):						
Gas heat	(b)	(b)	6	3-1/2	3-1/2	1-7/8
Gas heat and electric air-conditioning	(b)	(b)	6	3-1/2	3-1/2	1-7/8
Electric heat	(b)	(b)	6	3-1/2	3-1/2	1-7/8
Electric heat and air-conditioning	(b)	(b)	6	3-1/2	3-1/2	1-7/8

<sup>a</sup>Plain windows.

<sup>b</sup>Storm windows.

We were advised by an official from the Oak Ridge National Laboratory that HUD's multifamily thermal standards are similar to those in the economic optimum point. He said similar savings in energy and utility costs could be realized if HUD would use its multifamily thermal standards for single-family homes.

This official, officials from HUD's central office, Hittman Associates, and the National Mineral Wool Association said single-family homes would be more energy efficient if they met HUD's multifamily standards. They said HUD's inspectors could more easily enforce the multifamily standards than the single-family standards because the multifamily standards identify, among other things, the insulation values for walls and ceilings which builders must meet in constructing multifamily units.

The Hittman study, made under HUD contract, was concerned with methods of conserving energy in new single-family homes. Detailed quantitative thermal analyses were performed on single-family homes in the Baltimore and Washington areas to identify the energy profile of a typical residence.

The study concluded that 32 percent of the energy used in a typical Baltimore or Washington area home could be saved by increasing the thermal characteristics above those HUD required. The changes consisted of adding storm windows and doors, increasing insulation in walls, and reducing the window area by 25 percent. Although the study did not consider ceiling insulation, a Hittman official estimated that increasing ceiling insulation to 6 inches would increase energy savings to 40 percent.

To achieve the 32-percent energy savings, the price of the home would increase by \$550; but the homeowner's utility bills would be reduced by \$77 a year. Assuming a 25-year mortgage at 9 percent interest, the \$550 investment would cost the homeowner about \$56 a year for the life of the mortgage. However, the homeowner would have a net annual savings of \$21 (\$77 - \$56), or a total savings of \$525, over the life of the mortgage, returning almost 100 percent on his investment.

#### Conclusion

On the basis of the Oak Ridge National Laboratory and Hittman studies and our discussions with HUD officials and others, we conclude that thermal standards comparable to those established for multifamily dwellings are needed for single-family homes.

#### Recommendation

We recommend that the Secretary of HUD direct the Assistant Secretary for Housing Production and Mortgage Credit to revise the current thermal standards for single-family homes to at least equal the multifamily standards.

Proposed action by HUD

We provided responsible HUD officials with the material in this report and discussed with them our conclusion and recommendation. They generally agreed with our findings and stated that HUD will soon revise its thermal standards for single-family homes to exceed those of multifamily dwellings.

If properly implemented, the proposed revision would accomplish the intent of our recommendation.

STANDARDS NEEDED FOR EXISTING HOMES

The Federal Government--HUD, Agriculture, and the Veterans Administration--insured, during fiscal years 1971 through 1973, a total of about 2.8 million units of single-family housing, of which 1.6 million or 57 percent, were existing units. The total mortgage amount insured on the 1.6 million existing units was \$30.3 billion.

Although the existing housing stock accounts for a large portion of the total homes insured by the Federal Government and HUD has announced that it plans to make greater use of existing homes in meeting the National housing goals, no Federal energy conservation measures or thermal standards have been established for existing housing.

The Oak Ridge National Laboratory and Hittman studies show that significant energy savings could be realized in older homes by installing (1) storm windows and doors, (2) additional insulation in ceilings, (3) gas instead of electric appliances, and (4) high performance air-conditioning units.

According to the Hittman study, an alternative to using storm windows and doors is applying or improving weatherstripping around windows and doors. This approach would save less energy than if storm windows and doors are used, but weatherstripping is cheaper and easier to install. The National Bureau of Standards has stated that weatherstripping and caulking around windows could reduce annual energy consumption for home heating by 15 to 30 percent.

Conclusion

Because of the significant volume of existing housing being insured by the Federal Government, HUD's plans to make greater use of existing homes in meeting the National housing goals, and the potential to achieve significant energy savings in such housing, HUD should establish thermal standards for existing homes to be insured under Federal programs.

Recommendation

We recommend that the Secretary of HUD direct the Assistant Secretary for Housing Production and Mortgage Credit to establish thermal standards for existing housing to be insured under Federal programs.

Proposed action by HUD

We discussed this matter with HUD officials who provided us with a copy of proposed thermal standards for existing homes. The proposed standards would generally require storm windows and doors and various amounts of insulation in ceilings and under floors above unheated areas.

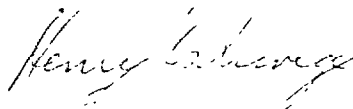
If properly implemented the proposed standards should accomplish the intent of our recommendation. We believe, however, that the proposed standards should also include criteria for caulking and weatherstripping.

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We would be pleased to discuss with you or members of your staff any of the above matters and would appreciate receiving your comments on any action taken or planned with regard to the matters discussed in this report.

We are sending copies of this report to the Secretary of Agriculture, the Administrators of Veterans Affairs and of the Federal Energy Office, your Inspector General, and the Assistant Secretary for Housing Production and Mortgage Credit. We are also sending copies to the House and Senate Committees on Appropriations, Government Operations, and Interior and Insular Affairs; the Senate Committees on Banking, Housing, and Urban Affairs and Commerce; and the House Committees on Banking and Currency, Interstate and Foreign Commerce, and Science and Astronautics.

Sincerely yours,



Henry Eschwege  
Director

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