Style and vintage as determinants of energy - costly faults in U.S. residential housing

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Summary

A major conclusion of Princeton's research in Twin Rivers townhouses was the quantitative significance of faulty but generic construction details in determining heat loss; in one townhouse a 67% reduction in annual space heat requirements was achieved by retrofits. We have now launched a program to catalogue the generic energy-related problems in other major geometric configurations of American homes. Our sampling strategy in the field emphasizes house vintage, which (because, nation-wide, construction methods and materials are remarkably uniform in a given year) strongly affects insulation level, use of vapor barriers, and sheathing material. Corrective measures for problem details will be developed.

Style et période en tant que déterminants des fautes coûteuses dans les bâtiments résidentiels aux Etats-Unis

Resumé

Une conclusion majeure de la recherche accomplie par l'université de Princeton sur les maisons à murs mitoyens de la ville de Twin Rivers fut que les détails de construction défectueux mais génériques ont une signification quantitative dans la détermination des pertes de chaleur. Une réduction des besoins annuels de chauffage de 67% dans une des maisons mitoyennes fut accomplie par des améliorations de construction. Nous avons maintenant lancé un programme pour cataloguer les problèmes génériques liés à l'énergie dans les autres configurations géometriques principales des maisons américaines. Notre stratégie de choix dans ce domaine met une emphase sur l'âge des maisons, qui (car, à travers les Etats-Unis, les methodes et les matériaux de construction sont remarquablement uniformes pour une année donnée) touche fortement le niveau d'isolant, l'usage des barrières à vapeur, et des matériaux de revêtement. Des mesures correctives pour les détails problematiques seront developpés.

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☆ Much of the heat loss of American houses can be traced to faulty details of design and construction. In one townhouse we achieved a 67% reduction in annual space heat requirements by retrofits that, aside from window insulation, primarily corrected numerous details that contributed to air leakage or permitted bypasses of existing insulation. We believe these details generalize to much of recent U.S. townhouse construction. We are now examining other kinds of houses and finding further heat wasting details that often appear to be generic to house types.

To give coherence to the catalogue of such details, it is useful to set up a simple classification of houses by vintage and style. Examination of the history of house building in the United States in this century reveals several related trends. House styles became less regionally peculiar and less diversified as the century progressed. Houses also tended to become geometrically simpler. These trends may well be linked to the rise of tract developments and the growing dominance of the residential construction industry by larger nonlocalized firms that used standardized products and methods. Custom construction gave way to speculative construction aimed at the market's common denominators of taste. Thus the part of the housing stock dating from the beginning of the century is more individual and eccentric than the later stock, which is often deplored for its machine-like uniformity.

A great many changes of style and construction practice in the U.S. coincided approximately with World War II. Classifying houses, therefore, into pre-war and post-war vintages tends to sort out many features related to energy use. In 1975 the U.S. housing stock comprised 67 million units. Of these, 46 million were single family houses and of the latter, 30 million were of post-war vintage.

Taking account of both vintage and shape, we arrived at the broad classification of detached houses into the seven types shown in the table below. The names we have assigned to the classes for convenience, while not very precise, do correspond roughly to common real estate parlance.

Stories	Pre-War	Post-war
1	"Rambler"	"Ranch"
1½	"Cape Cod"	
2	"Old Colonial"	"New Colonial"
> 2	"Victorian"	--
Split	--	"Split"

A third criterion that classifies houses by energy performance is climatic region. Houses in California are rather different from houses in New Jersey. On the average, California houses use as much heating fuel per square meter of floor space as New Jersey houses even though the climate is much milder in California. California houses, apparently, are built more loosely. Materials also vary somewhat with region. Thus masonry is more common in the southwest than elsewhere, expressing costs relative to wood and the benefit of thermal mass in a desert climate. Our studies for the present are confined to the moderately cold northeast. Extension of our results to other regions will require further study.

In view of the regional differences, it is not surprising to find that the proportions of houses in our seven classes vary with region. So far as we can tell from incomplete data, the proportions in the northeast are approximately these:

Rambler	7%
Ranch	18%
Cape Cod	14%
Old Colonial	18%
New Colonial	26%
Victorian	10%
Split	7%

In other parts of the country one-story houses are much more prevalent. The northeast also has the lowest percentage of newer houses.

Using houses drawn from the classes tabulated above, we are undertaking a series of case studies in which corrective measures for energy problems will be developed and tested. The case studies will serve as foci for a series of publications, one for each type of house, in which the results of tests on various energy conservation measures will be reported. Discus-

sions of problem details that are not associated with a particular class of houses (e.g. patio doors) will be either cross-referenced or duplicated in more than one report. We hope in this way to reach a wide audience with useful information organized in a convenient way.

Acknowledgement

The authors wish to acknowledge the funding by the Office of Buildings and Community Systems, Conservation and Solar Applications of the United State Department of Energy - Contract No. EE-S-02-4288. The support and encouragement on the part of Howard Ross is greatly appreciated.

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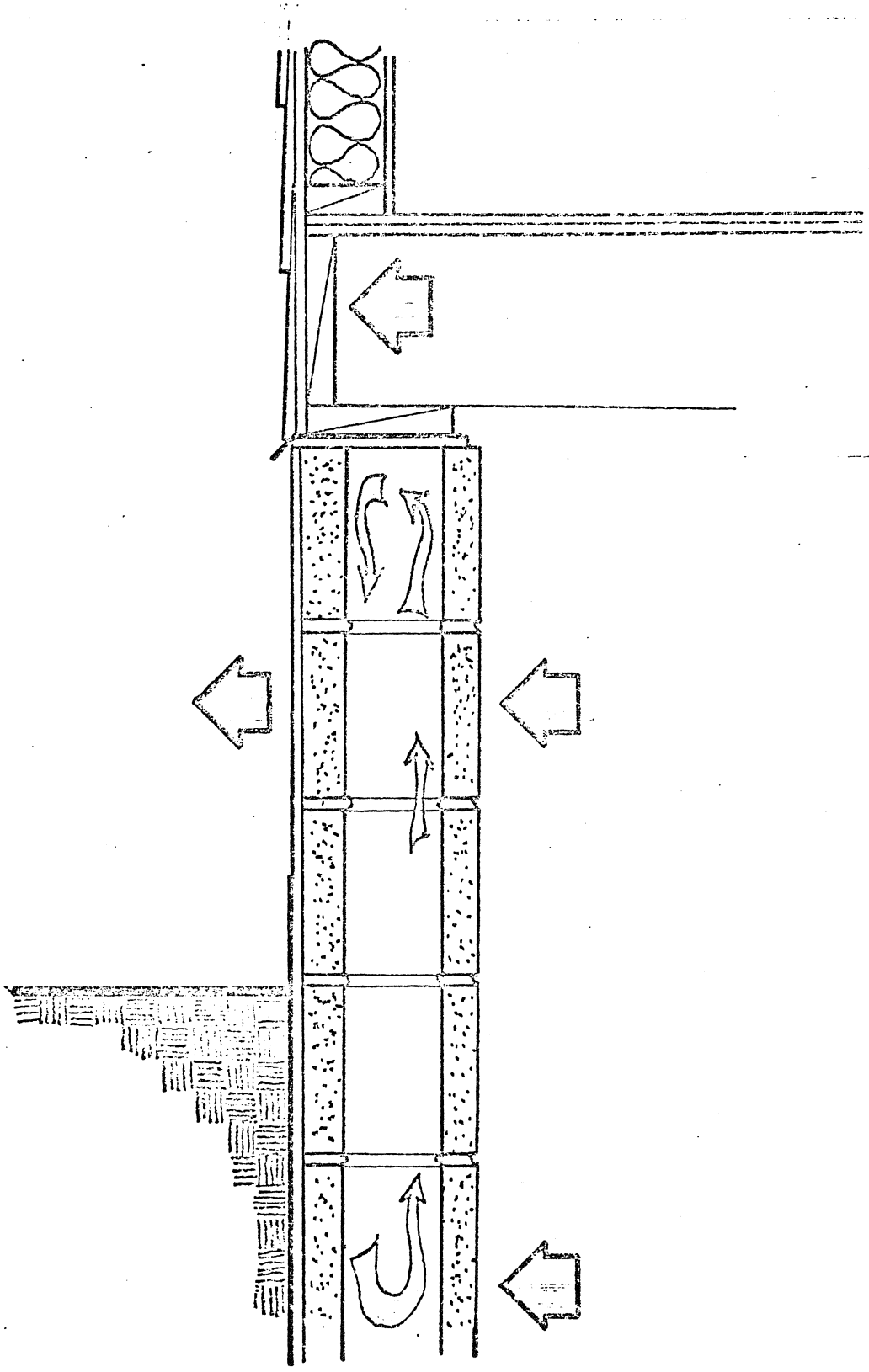

Figure 1. Much heat is lost through post-war basement walls for two reasons: (1) The band joist is usually not insulated; (2) the hollow block walls allow the formation of internal convection currents that increase heat transfer to the outside.

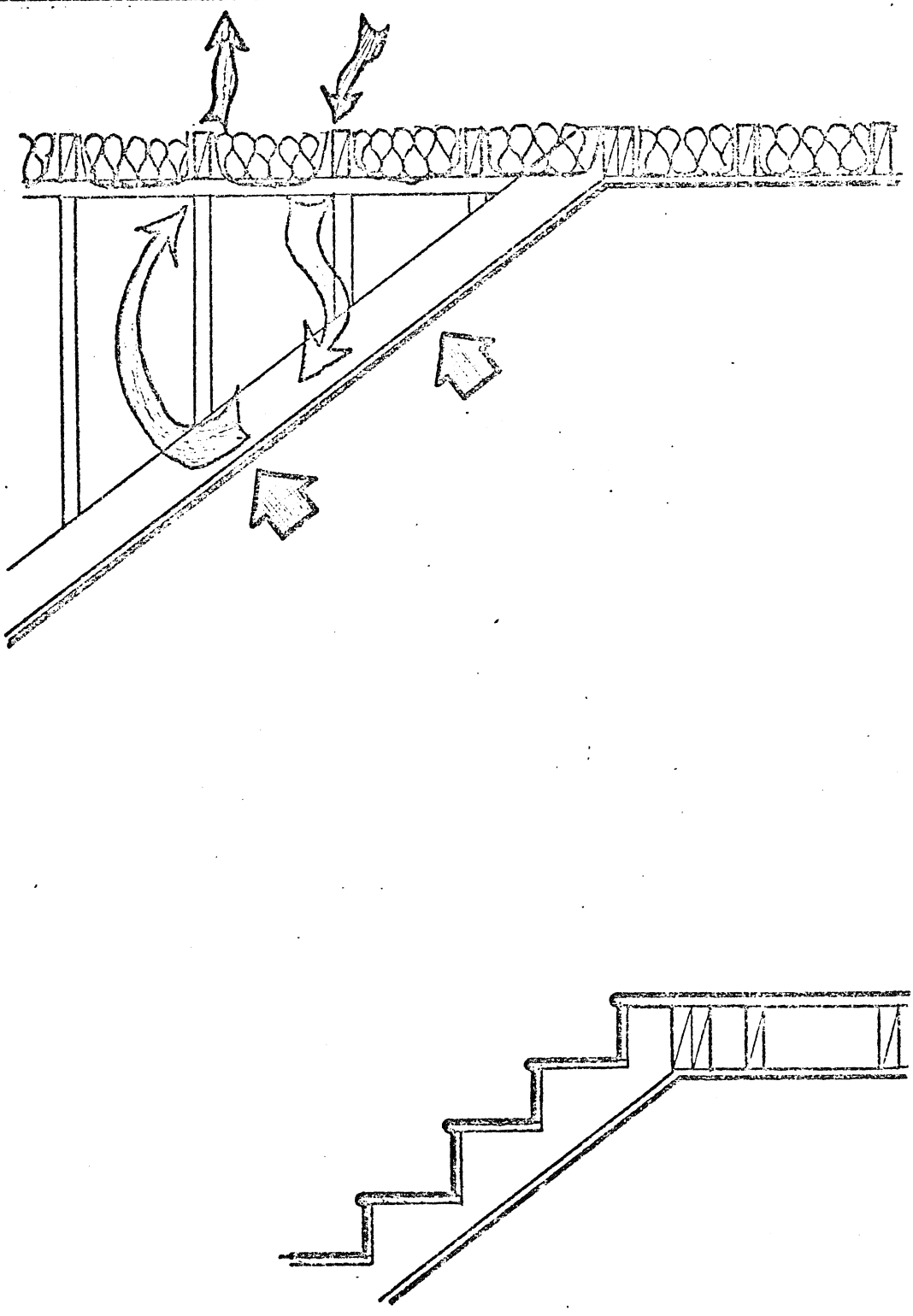

Figure 2. Spaces adjoining attics allow cold air to come in contact with the gypsum board, thus increasing heat loss.