



Radiant heating design and testing
by Leo Classen

A THESIS submitted to the Graduate Faculty In partial fulfillment of the requirements for the degree of Master of Science in Mechanical Engineering at Montana State College
Montana State University
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Abstract:

Radiant heating has been used In this locality for at least six years. Some of the early Installations were designed with a very limited knowledge of this type of heating. The success of these first Installations Indicates that radiant heating is versatile and that a simple design procedure should be possible. Many designs have been published, but most of these attack the problem from a mathematical viewpoint. Since none of these design procedures have been accepted by the average builder, The Engineering Experiment Station set up a research project to gather Information which would be useful In the application of radiant heating.

Chapter one presents the first step In this research.

The radiant heating laboratory was designed to represent an average residence heated by a floor panel. It served as a proving ground for the panel testing equipment. It also proved valuable as a laboratory for testing and comparing control systems and the products of various manufacturers which are on the market for panel Installations.

Chapter two deals with the application of the panel test to the Wessel residence. This test Indicates a Possible output of 52.7 Btu per sq ft hr at a panel surface temperature of 88° F. based on a 12 day test. The effect of this panel design and edge Insulation Is presented with suggestions for designing future Installations.

Chapter three Is the development and application of a design procedure for radiant heating with a floor panel. This procedure Is the result of research on radiant heating articles published by various authorities as well as the incorporation of information gained In the radiant heating laboratory and the Wessel residence test.

Chapter four, presents Information on the use of various floor covering materials with a floor panel. This is primarily a comparison test which shows the effect of using the various available floor coverings.

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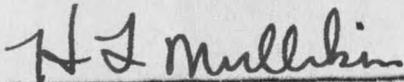
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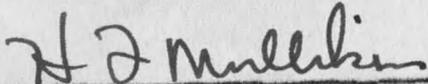
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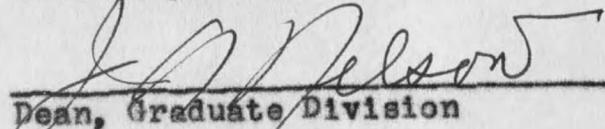
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Bozeman, Montana
June, 1951

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ABSTRACT

Radiant heating has been used in this locality for at least six years. Some of the early installations were designed with a very limited knowledge of this type of heating. The success of these first installations indicates that radiant heating is versatile and that a simple design procedure should be possible. Many designs have been published, but most of these attack the problem from a mathematical viewpoint. Since none of these design procedures have been accepted by the average builder, The Engineering Experiment Station set up a research project to gather information which would be useful in the application of radiant heating.

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CHAPTER I
INTRODUCTION

Panel heating has been a highly controversial subject for the past ten years. Most manufacturing companies, concerned with finding new fields for their products and many colleges have set up experiments to answer some of the many questions that baffle the individual considering such an installation. At the present time there are a number of methods available for designing a panel heating system. However a survey made of 30 installations in Montana showed that most of them were designed by employing the impressions given by some of the published methods and the experience of the designer or installer. Since most installations are residences and do not involve an expenditure that would warrant the employment of a heating consultant, the design is left to the installer who is in most cases a plumber. A survey of the plumbers in this area left the impression that most design procedures they studied were to long and involved, thus consuming more of their time than could be economically justified by the installation. As a result a rule of thumb was employed as it is in hot air and hot water systems. Most of these rules of thumb are a chosen figure of heat output per unit area used at the individual's discretion. A common figure used was 40 Btu per square foot of floor area. This figure seemed to yield good results as is born out by the number of installations still in operation. However, the figure started going up first to 45 and 50,

then to 80 and 100 Btu per square foot, thus again making it impossible to choose the best figure.

After a considerable amount of Research and study of the available data, no simple clear cut design procedure could be developed, so it was decided to set up a method for testing a panel to make available test data that would be helpful in making up a design procedure.

Means were not available for the construction of an ideal experimental residence, however after a cost analysis of the situation it was found that means were available for the construction of a small test bungalow which would serve as a proving ground for the equipment needed to test a panel as well as a testing laboratory for panel heating controls. This consisted of housing units donated by the college housing administration. See figures 1 and 2.

Design of the Radiant Heating Test Laboratory

Preliminary discussion revealed that two units would be necessary, one to house the boilers and testing instruments while the other served as a radiant heated room, utilizing a flow panel. The floor panel was designed as three separate units, so that the losses from each could be isolated and a comparison made of the edge and ground losses to the useful output of the top panel.

Most available sizes of pipe and tubing have been used as coils in floor panels; however, the tendency seemed to

