Residential Heating And Cooling Loads Component Analysis 615662

Manual J 8th Edition is the national ANSI-recognized standard for producing HVAC equipment sizing loads for single-family detached homes, small multi-unit structures, condominiums, town houses, and manufactured homes. This new version incorporates the complete Abridged Edition of Manual J. The manual provides quick supplemental details as well as supporting reference tables and appendices. A proper load calculation, performed in accordance with the Manual J 8th Edition procedure, is required by national building codes and most state and local jurisdictions.

The energy performance of skylights is similar to that of windows in admitting solar heat gain, while at the same time providing a pathway for convective and conductive heat transfer through the building envelope. Since skylights are typically installed at angles ranging from 0 ° to 45 °, and differ from windows in both their construction and operation, their conductive and convective heat gains or losses, as well as solar heat gain, will differ for the same rough opening and thermal characteristics. The objective of this work is to quantify the impact of solar gain through skylights on building heating and cooling loads in 45 climates, and to develop a method for including these data into the SP53 residential loads data base previously developed by LBL in support of DOE's Automated Residential Energy Standard (ARES) program. The authors used the DOE-2.1C program to simulate the heating and cooling loads of a prototypical residential building while varying the size and solar characteristics of skylights and windows. The results are presented as Skylight Solar Loads, which are the contribution of solar gains through skylights to the overall building heating and cooling loads, and as Skylight Solar Load Ratios, which are the ratios of skylight solar loads to those for windows with the same orientation. The study shows that skylight solar loads are larger than those for windows in both heating and cooling. Skylight solar cooling loads are from three to four times greater than those for windows regardless of the skylight tilt, except for those facing north. These cooling loads are largest for south-facing skylights at a tilt angle of approximately 20 °, and drop off at higher tilts and other orientations.

Rules of Thumb

Updating the ASHRAE/ACCA Residential Heating and Cooling Load Calculation Procedures and Data

An Introduction to Solcost

ANSI/ACCA 2 Manual J8AE - 2016 Residential Load Calculation (8th Edition - AE)

Residential Building Energy Use and HVAC System Comparison Study

This study seeks to expand the range of climates and conditions in which free cooling from an economizer can replace air conditioning power consumption in residential applications. To explore this issue, we first discretize a simple building model in space and in time. We then solve the associated energy and mass balances for the estimated hourly heating and cooling loads and humidity conditions with respect to an annual climate profile. We propose a forecast-based algorithm to control the rate of outdoor airflow brought in by an economizer, in response to the upcoming cooling load to be experienced by the interior airspace. The algorithm takes advantage of a range of acceptable temperatures for thermal comfort by precooling the envelope overnight to delay the onset of cooling demand during the day. In order to consider the highest potential benefit from such an algorithm, we bypass the considerable problem of forecast accuracy by basing the inputs on the upcoming cooling load according to an initial simulation of the full year. On the whole, even with the forecast-based control, the results of the study have much in common with previous findings in the literature. Precooling works better to reduce cooling load in cases of higher thermal and moisture mass, but a humid climate severely restricts when free cooling is beneficial. For the example house considered here with the Austin climate and other assumptions, the effect of the proposed forecast-based economizer control was to greatly reduce the indoor air cooling load while greatly increasing the number of annual hours of unacceptably high indoor humidity. When we adjusted the forecast-based algorithm to avoid the excess humidity, the remaining reduction in cooling load was not significant. To investigate further how a forecast-based economizer could reduce cooling load in humid climates, the principal task should be to extend the control algorithm to forecast and manage upcoming indoor humidity levels in the same fashion as was done in this study for indoor air temperature.

ANSI/ACCA 2 Manual J8AE - 2016 Residential Load Calculation (8th Edition - AE)

San Francisco residential energy consumption

Boston residential energy consumption

The Applicability of the Residential Energy Consumption Analyses to Various Geographic Areas

Residential Energy Consumption, Single Family Housing

Energy Research Abstracts

An extensive data base of residential energy use generated with the DOE-2.1A simulation code provides an opportunity for correlating building loads predicted by an hourly simulation model to commonly used climatic parameters such as heating and cooling degree-days, and to newer parameters such as insolation-days and latent enthalpy-days. The identification of reliable climatic parameters for estimating cooling loads and the incremental loads for individual building components, such as changing ceiling and wall R-values, infiltration rates or window areas is emphasized.

This is PDF download.ASHRAE Research Project RP-1199 developed two new residential heating and cooling loads calculation procedures:Residential Heat Balance (RHB), a detailed heat balance method that requires computer implementation; andResidential Load Factor (RLF), a simplified procedure suitable for hand or spreadsheet use.

Chicago residential energy consumption

Climatic Indicators for Estimating Residential Heating and Cooling Loads

Manual J - Residential Load Calculation

Development of an Integrated Residential Heating, Ventilation, Cooling, and Dehumidification System for Residences

Detailed Geographical Analysis

Ongoing research on quantifying the cooling loads in residential buildings, particularly buildings with passive solar heating systems, is described, along with the computer simulation model used for calculating cooling loads. A sample of interim results is also presented. The objective of the research is to develop a simple analysis method, useful early in design, to estimate the annual cooling energy requirement of a given building.

The objective of this study was to evaluate alternative heating and cooling approaches for a non-typical residence including geothermal and radiant floor heating technology. The analysis included four main components: estimating the design heating and cooling loads of the home, developing alternative approaches for heating and cooling the residence, designing an hourly energy use and heating, ventilating, and air conditioning (HVAC) system performance simulation model for the home over a period of one year, and estimating economic factors for each alternative system. Four alternative approaches for conditioning the case study home were developed and evaluated. These alternatives include systems that utilize either a water-to-air ground-source geothermal heat pump or a liquid-propane gas furnace for the forced air conditioning and either an electric boiler, liquid propane boiler, or a water-to-water ground-source geothermal heat pump for hydronic heating. Using the design heating and cooling loads on the home, specific equipment for each alternative was selected. The hourly energy demand on the home was simulated considering conduction heat transfer through the structure, solar loads, infiltration effects, and internal gain. The HVAC system model estimates the hourly performance of each alternative system given the hourly demand on the home. In addition, the approximate monthly and annual costs associated with each system were determined. Typical Meteorological Year (TMY2) data was used to estimate hourly weather and solar conditions expected at the geographical location of the home over a one year period. The economics for each alternative approach was evaluated based on a life-cycle-cost analysis. All annual expenses and savings for each approach were estimated over the assumed life of each system. The present-value and payback-period for each system was determined and compared. It was found that the approach utilizing a ground-source geothermal heat pump and electric hydronic boiler would be the most economical.

A Case Study of a Residential Villa

Denver residential energy consumption

Guidelines for Building Services

A Study and Review of Existing Data to Develop a Standard Methodology for Residential Heating and Cooling Load Calculations -- RP 342

Determination of Heating and Cooling Loads for a Residential Dwelling

The Need and the Opportunity Codes such as ASHRAE 90.2 and IECC, and programs such as Energy Star and Builders Challenge, are causing new homes to be built to higher performance standards. As a result sensible cooling loads in new homes are going down, but indoor air quality prerogatives are causing ventilation rates and moisture loads to increase in humid climates. Conventional air conditioners are unable to provide the low sensible heat ratios that are needed to efficiently cool and dehumidify homes since dehumidification potential is strongly correlated with cooling system operating hours. The project team saw an opportunity to develop a system that is at least as effective as a conventional air conditioner plus dehumidifier, removes moisture without increasing the sensible load, reduces equipment cost by integrating components, and simplifies installation. Project Overview Prime contractor Davis Energy Group led a team in developing an Integrated Heating, Ventilation, Cooling, and Dehumidification (I-HVCD) system under the DOE SBIR program. Phase I and II SBIR project activities ran from July 2003 through December 2007. Tasks included: (1) Mechanical Design and Prototyping; (2) Controls Development; (3) Laboratory and Field Testing; and (4) Commercialization Activities Technology Description. Key components of the prototype I-HVCD system include an evaporator coil assembly, return and outdoor air damper, and controls. These are used in conjunction with conventional components that include a variable speed air handler or furnace, and a two-stage condensing unit. I-HVCD controls enable the system to operate in three distinct cooling modes to respond to indoor temperature and relative humidity (RH) levels. When sensible cooling loads are high, the system operates similar to a conventional system but varies supply airflow in response to indoor RH. In the second mode airflow is further reduced, and the reheat coil adds heat to the supply air. In the third mode, the reheat coil adds additional heat to maintain the supply air temperature close to the return air temperature (100% latent cooling). Project Outcomes Key Phase II objectives were to develop a pre-production version of the system and to demonstrate its performance in an actual house. The system was first tested in the laboratory and subsequently underwent field-testing at a new house in Gainesville, Florida. Field testing began in 2006 with monitoring of a 'conventional best practices' system that included a two stage air conditioner and Energy Star dehumidifier. In September 2007, the I-HVCD components were installed for testing. Both systems maintained uniform indoor temperatures, but indoor RH control was considerably better with the I-HVCD system. The daily variation from average indoor humidity conditions was less than 2% for the I-HVCD vs. 5-7% for the base case system. Data showed that the energy use of the two systems was comparable. Preliminary installed cost estimates suggest that production costs for the current I-HVCD integrated design would likely be lower than for competing systems that include a high efficiency air conditioner, dehumidifier, and fresh air ventilation system. Project Benefits This project verified that the I-HVCD refrigeration compacts are compact (for easy installation and retrofit) and can be installed with air conditioning equipment from a variety of manufacturers. Project results confirmed that the system can provide precise indoor temperature and RH control under a variety of climate conditions. The I-HVCD integrated approach offers numerous benefits including integrated control, easier installation, and reduced equipment maintenance needs. Work completed under this project represents a significant step towards product commercialization. Improved indoor RH control and fresh air ventilation are system attributes that will become increasingly important in the years ahead as building envelopes improve and sensible cooling loads continue to fall. Technologies like I-HVCD will be instrumental in meeting goals set by Building America and other programs to reduce energy use while improving the indoor environment. Next Steps The following steps are needed to bring the product to commercialization: (1) Value engineering to reduce costs; (2) Addition of zoning capability to improve marketability; (3) Fabrication and testing of additional prototypes; and (4) Identification of a manufacturer. Initial efforts to interest large air conditioner manufacturers has shown some interest, but the preferred path to market may be to employ a boutique manufacturer that markets to HVAC contractors. Distribution of the results of this work will improve opportunities for attracting manufacturers. Additional funding is needed to prepare the product for this final step.

This report examines typical residential heating and cooling loads for 24 southern cities and six other US cities. A 1536-square-foot house is examined, with concrete slab floor, frame construction, ventilated attic, and glazing area equivalent to 12% of the floor area. Five basic variations of this house were analyzed: two insulation levels with two compass orientations each, and a sun-tempered case. The building load calculations were based on a non-rigorous methodology typically used within the building community today. The estimated heating and cooling loads and the impact of insulation, orientation, and sun-tempering are illustrated with regional maps. Typical fuel costs and heating systems are also examined and shown to have a major role in determining whether the building design emphasis should be on heating or cooling.

Evaluation of Heating Loads in Old Residential Structures

Novel System Design for Residential Heating and Cooling Load Shift Using PCM Filled Plate Heat Exchanger and Auxiliaries for Economic Benefit and Demand Side Management

The Department of Energy's Fiscal Year 1997 Budget Request for Energy Efficiency and Renewable Energy and Fossil Energy Programs

Residential Heating and Cooling Loads Component Analysis

Houston residential energy consumption

This paper presents the results of a study investigating the effects of window U-value changes on residential cooling loads. We used the DOE-2. I D energy analysis simulation program to analyze the hourly, daily, monthly, and annual cooling loads as a function of window U-value. The performance of a prototypical single-story house was examined in three locations: hot and humid, Miami FL; hot and dry, Phoenix AZ; and a heating-dominated location with a mildly hot and humid summer, Madison WI. Our results show that when comparing windows with identical orientation, size, and shading coefficient, higher U-value windows often yield lower annual cooling loads, but lower U-value windows yield lower peak cooling loads. This occurs because the window with the higher U-value conducts more heat from inside the residence to the outside during morning and evening hours when the outside air temperature is often lower than the inside air temperature; and, a lower U-value window conducts less heat from outside to inside during summer afternoon peak cooling hours. The absolute effects are relatively small when compared to total annual cooling which is typically dominated by window solar heat gain effects, latent loads, and intemal loads. The U-value effect on cooling is also small when compared to both the effects of U-value and solar heat gain on heating load. Our modeling assumed that U-value and solar heat gain could be independently controlled. In fact, reducing window conductance to the levels used in this study implies adding a second glazing layer which always reduces solar heat gain, thus reducing annual cooling. Thus, when we compare realistic options, e.g., single pane clear to double pane clear, or single pane tinted to double pane tinted, the double pane unit shows lower annual cooling, as well as lower peak loads.

This thesis describes a novel system that is being developed that utilizes latent thermal energy storage (LTES) to shift residential heating and cooling loads, between 2-4 hr. time periods, away from the electrical power grid (during the utilities' peak demand period) for the main purpose of residential demand-side-management. More and more utilities are now offering residential time-of-day rates (and load interrupt programs) to help improve their load factor as a means to curtail the building of new power generating stations, and will only increase in time with greater implementation and the enabling use of smart meters. TES is ideally suited to capitalize on this fact and stands ready in this proposed new system; running the HVAC equipment during the time of excess system capacity and storing the "hot or cold energy created" in the PCM for later use during the peak system demand period will improve the system's load. This thesis describes the proposed system and the equipment layout along with its operating strategy. In addition to being modular in design and thus allowing for all different size homes, another major key feature of the proposed system is that it is of the "plug-in" type which utilizes the current cooling and heating hardware of the existing home, and as such, is equally applicable to new home construction or retrofits. This thesis also presents the economics of the system and potential benefits to the home owner, more specifically, simple calculations are given showing the estimated monthly operating cost savings when using this TES system with residential time-of-day (TD) rates, over that of the home operating without TES and running on the standard residential service (RS) rate structure. This thesis document provides the detailed mathematical formulation for the solution of planar moving boundary problems using enhanced enthalpy method with given fixed temperature and insulated boundary conditions. The solution methodology and results, obtained using numerical solution, are presented and described thoroughly in this document. Additionally, numerical solution's convergence, grid sensitivity analysis and MATLAB code validation have been presented in this document.

Version 2. 5

Cooling and Heating Load Calculation Manual

Miami residential energy consumption

8th Edition, Full

Atlanta Residential Energy Consumption

The utilization of direct solar gains in buildings can be affected by operating profiles, such as schedules for internal gains, thermostat controls, and ventilation rates. Building energy analysis methods use various assumptions about these profiles. This paper describes the effects of typical internal gain assumptions in energy calculations. The results of this study indicate that calculations of annual heating and cooling loads are sensitive to internal gains, but in most cases are relatively insensitive to hourly variation in internal gains.

Comparison of Solar Heat Pump Systems to Conventional Methods for Residential Heating, Cooling, and Water Heating

Window U-value Effects on Residential Cooling Load

A New Simplified Design Method for Residential and Light Commercial Solar Heating and Cooling

Dynamic Performance of a Residential Air-to-air Heat Pump

Load Calculation for Residential Winter and Summer Air Conditioning