Report

www.bsria.co.uk

Sample SAP Calculations

Report 50478/2
October 2007

Carried out for: **Dunbrik Flues**
Ferry Lane
Stanley
Wakefield
WF3 4LT

Compiled by: David Bleicher

No. of pages: 1 of text

Appendix: None

Quality Approved: *Nigel Anderson*

BSRIA Limited
Old Bracknell Lane West, Bracknell, Berkshire RG12 7AH UK
T: +44 (0)1344 465600 F: +44 (0)1344 465626
E: bsria@bsria.co.uk W: www.bsria.co.uk

CONTENTS

1 INTRODUCTION 4

1.1 Purpose 4
1.2 Background 4

2 METHODOLOGY 5

3 CONCLUSION 6

1 INTRODUCTION

1.1 PURPOSE

To establish the effect that different combinations of secondary heating appliance and flue have on Building Regulations compliance for a typical house.

1.2 BACKGROUND

Building Regulations require that CO_2 emission rate calculations are calculated for all new buildings and that these meet a target. For dwellings, the Dwelling CO_2 emission rate (DER) and the Target CO_2 Emission Rate (TER) are both calculated using SAP 2005. The TER is fixed for any building of a given dimensions, orientation and primary heating fuel. The DER varies depending on certain design features including fabric U-values, plant efficiency, and the presence of any flues or chimneys.

For all dwellings, SAP assumes that 10% of the heating load is handled by a secondary heating appliance. If the design does not incorporate a secondary heating appliance, SAP assumes that electric room heaters will be used. If the design does incorporate a secondary heating appliance, SAP requires the fuel type and efficiency of the actual appliance to be input. This has an effect on the DER.

Gas or wood fired secondary appliances require a flue or chimney, and SAP takes account of the additional infiltration resulting from these. SAP assumes an airflow rate of $20m^3$/hour for each flue, and $40m^3$/hour for each chimney. A closable chimney is treated as a flue, i.e. an airflow rate of $20m^3$/hour is assumed. The presence of a flue or chimney has an effect on the DER.

2 METHODOLOGY

Dimensions and design features of a typical 3-bedroom gas-heated house (referred to as the default house) were entered into SuperHeat SAP software. As no secondary heating appliance was specified, SAP assumed electric room heaters. Other design features were set such that DER for the house was equal to the TER, in other words the house achieves Building Regulations compliance but no more. The DER (equal to the TER) is stated in the table below. Selected design features of the default house are as follows:

Wall U-value: 0.24W/m^2K (equivalent to a cavity wall with 76mm board insulation)
Primary Heating Boiler Efficiency: 89.1% (Energy efficiency band B)
Air leakage rate: 8m^3/(h.m^2)@50Pa

Further SAP calculations were carried out on the same house, but with different combinations of secondary heating appliance and flue. As no changes were made to the dimensions, orientation and primary heating fuel, the TER remained constant throughout the exercise, only the DER changed. The DER for each appliance/flue combination is stated in the table below. In cases where the DER is less than the TER (i.e. surpassing Building Regulations compliance), the table gives examples of design changes which would result in the DER being equal to the TER. In cases where the DER was greater than the TER (i.e. failing Building Regulations), the table below gives examples of design changes which would make the house compliant.

Secondary Heating		**Flue or Chimney**	**DER (Before design changes)**	**Design changes resulting in DER=TER**
Fuel	**Efficiency**			
Electricity	100%	N/A	22.32kgCO_2/m^2.y (=DER)	N/A (Default House)
Gas	40%	Flue	23.08kgCO_2/m^2.y (Fail)	Boiler efficiency improved to 91.3% and air leakage rate reduced to 6m^3/(h.m^2)@50Pa
Gas	63%	Flue	22.18kgCO_2/m^2.y (Surpass)	Air leakage rate increased to 8.5m^3/(h.m^2)@50Pa
Gas	85%	Flue	21.77kgCO_2/m^2.y (Surpass)	Wall U-value increased to 0.28W/m^2K
Wood	32%	Closable Chimney	21.00kgCO_2/m^2.y (surpass)	Wall U-value increased to 0.30W/m^2K and boiler efficiency reduced to 86.1%
Wood	32%	Open Chimney	21.28kgCO_2/m^2.y (Surpass)	Wall U-value increased to 0.27W/m^2K and boiler efficiency reduced to 86.1%
Wood	65%	Closable Chimney	20.80kgCO_2/m^2.y (Surpass)	Wall U-value increased to 0.31W/m^2K and boiler efficiency reduced to 86.1%
Wood	65%	Open Chimney	21.07kgCO_2/m^2.y (Surpass)	Wall U-value increased to 0.29W/m^2K and boiler efficiency reduced to 86.1%

3 CONCLUSION

Changing the fuel type, efficiency, and flue type of a secondary heating appliance has a definite effect on Building Regulations compliance. For 6 out of the 7 scenarios the effect was positive i.e. the CO_2 emissions decreased and hence other design features could be relaxed while still complying. On one of the scenarios, the effect was negative i.e. the CO_2 emissions increased and hence other design features had to be improved in order to make the house compliant.

The act of only adding a flue increases the DER by approximately $0.28 kgCO_2/m^2.y$, and the act of adding a chimney increases the DER by approximately $0.60 kgCO_2/m^2.y$. All other increases or decreases in the DER seen in the scenarios above can be accounted for by the fuel type and efficiency of the secondary heating appliance. Even though all gas or wood fired appliances have an efficiency of less than 100%, they still produce less CO_2 emissions than an electric secondary heating appliance. This is because SAP uses lower emissions factors for gas and wood than for electricity. Emissions factors used by SAP are as follows:

Mains Gas:	0.194 kg CO_2/kWh
Wood (logs, pellets or chips):	0.025 kg CO_2/kWh
Mains electricity:	0.422 kg CO_2/kWh

As can be seen, the emissions factor for gas is less than half that for electricity. This is essentially because of the inefficiency inherent in all fossil-fuel fired power stations. The emissions factor for wood is a fraction of that for electricity because wood is a biomass fuel and hence any CO_2 emissions released in burning the fuel represent CO_2 that was recently absorbed from the atmosphere. The emissions factor for wood represents emissions produced in the harvesting, processing and transport of the fuel.

It should be noted that it is only with a particularly inefficient gas-fired secondary heating appliance that the DER is higher than for the default house with an electric secondary heating appliance.

BSRIA is a consultancy, test and research organisation helping construction and building services companies to become more efficient and effective.

Our 128-strong team of building services experts can provide the best solutions to the most searching problems ensuring complete confidentiality and individual service at all times.

Working with BSRIA gives you confidence in design, added value in manufacture, competitive advantage in marketing and strategy, profitable construction, effective commissioning and accurate measurement, and efficient building operation and maintenance.

BSRIA membership enables organisations to demonstrate that they are leading the industry through innovation and best practice.

Across all activities

Instrument solutions
Hire
Calibration
Sales
On site services
Training

Information
IBSEDEX – building services abstracts
Enquiry service
Library
Push information (2006)

Publications
Hard copy
On line

Training
Specialist topics:
Whole life costing
Introduction to building services
Variable speed pumping

Facilitation and workshops
Relationships
Partnering workshops
Team building

Secretariat support
BSETG
Co-Construct
Constructing Excellence

Technical authoring

Committee facilitation and support

Research management

Expert witness work

Design

Design quality and process guidance

Design validation
Physical modelling
Thermal modelling
CFD
BREEAM assessments

Proof of performance testing
Standard & bespoke tests
(see list under manufacture)

Whole life costing
Life cycle analysis

Consultancy in:
Air tightness
Cooling of IT rooms

Sustainability
Grey water
Water conservation
Renewables
Control strategies

Specialist enclosure testing
Museum display cabinets

Construct

Site productivity improvement
Measurement
Lessons learned database
Modular training, feedback and toolbox talks
Pocket project handbooks

Management
KPIs
Publications
Consultancy and mentoring
Training

Approval inspections
Thermal imaging of fabric
Raised floor leakage test
Building envelope leakage test (for Part L)
Roof inspections
Fire stop testing
Offsite fabrication
Proof of performance and installability
(see also design)

Operate

Strategic Services
Maintenance strategy
Business focussed maintenance schedules
Building management systems
Procurement advice
O&M benchmarking
Health and safety audit

Energy efficiency assessments
Building MOTs
Energy audits
Control system surveys

Water and air quality

Internal environment monitoring
Comfort measurement
Sick building syndrome assessment
Indoor air quality
Pollution monitoring

Plant and system investigations
Troubleshooting
Performance checks
Maintenance tasks

Site surveys and condition monitoring
Plant condition surveys
Vibration and sound
Non-destructive testing
Magnetic field
Thermal imaging
(failures - electrical plant, damp, underfloor heating, chilled ceilings)
Ultrasonic pipe work testing
Power quality
Electrical surveys
Magnetic field survey
Lighting level and control survey
For due diligence and legal compliance

Manufacture

Testing and certification to recognised standards
Air cleaners
Air filters
Air handling units
Air heaters
Atomising oil nozzles
Axial fans
Blockwork porosity
Boilers
Chilled ceilings
Chillers
Coolers and condensers
Displacement ventilation
Ductwork
Expansion vessels
Fan coils
Fire valves
Flue lining systems
Fume cupboards
Louvres
Metal flues, chimneys, fittings and terminals
Radiators
Refrigeration equipment
Smoke and fume extraction fans

Testing thermal performance, emissions, EMC, MTBF, noise

Testing to client requirements

Energy labelling

Product failure analysis

Standards development
Writing
Evaluating
Publishing

Design of test facilities

Support for new product development

Management & Marketing

Business strategy
Strategic planning
Bespoke assignments, or one day consultancies
Procurement advice
Bid support
Business Performance Forum
Supply chain management

Partnering workshops

Marketing strategy - *confidential studies on:*
Market entry
Acquisition
New product development
Technical appraisal
Distributions and pricing strategy

Market research - size and structure of markets
Heating, air conditioning, plumbing and sanitaryware, controls, renewables, structured cabling, FM and contracting
Confidential studies
Published reports
Global studies annually
In depth studies
Statistics clubs

Attitudinal studies

Customer research
Customer satisfaction
Product acceptability
Understanding clients' needs

Market research techniques used:
Focus groups
Personal interview
Desk research
Telephone, fax and web surveys
Questionnaire design