HOME BUILDERS FEDERATION

HBF SAP Forum:

A Review of SAP, its outputs and influences on design

REPORT

HBF SAP Forum: A review of SAP

August 2011

HBF SAP Forum: A review of SAP (Standard Assessment Procedure), its outputs and influences on design

Executive Summary

Compliance with Building Regulations, in particular Parts L1a and, in some respects, Part F, relies on the outputs generated from the SAP approved software. As such it has been recognised that SAP tools have demonstrated themselves to be a most influential tool both in gaining compliance and also influencing the direction a house builder may take due to output results. Indeed it is the only tool to demonstrate compliance.

The previous 2 revisions of Part L have presented the industry with problems surrounding the issuing of revised SAP software. In both these issues delays have occurred and software was not delivered in a timely manner to allow models to be run and applications made to Building Control bodies to demonstrate compliance.

Ownership of SAP has caused varied debate but we are informed that the responsibility for SAP lies with DECC and that BRE are the current approved contractor, appointed by DCLG to administrate, check and review, not only their own, but other software packages. This process over the previous 2 releases has seen various debates over issues of deliverability of the available packages, with blame being laid at each other's door for the failure to deliver a robust package on time. This is something that clearly has to be reviewed to ensure a robust package is delivered within the timescales expected.

We also need to remember that a number of assumptions and predictions are made by house builders on the back of modelling carried out using the SAP software. These predictions are continually called into question as a result of the constant updates and changes to conventions within the software packages. This in turn leads to a lack of confidence and affects viabilities and long term land investments. All of this has the ability to impact on housing delivery.

In recent months DCLG have raised concerns over 'Design' Vs. 'As Built' performance. This has, however, mainly been based on limited site investigations and research on developments constructed several years ago and that do not adhere to current practices. The scale and type of investigations is questionable, not least because of the weight they appear to wield on influencing our future direction. As such it was felt that due to the importance and influence SAP places on house builders and building control bodies, we need to first understand how the outputs influence design and, ultimately, compliance.

With this in mind HBF set up a SAP Forum to look into the current approved SAP software packages, compare the outputs from common data input and provide recommendations. This paper sets out the initial findings from the group and some recommendations for consideration prior to the consultation on the revised Part L due in December 2011.

Timescales and funding for this project have been limited and contributors to the group have given their time freely and are acknowledged at the end of this report. As such the report looks to identify some of the key areas of concern or where further investigation is required.

The group's recommendations are listed at the end of this report and we would ask that these are seriously considered.

It was not part of the group's remit but the issue of regional weather was raised and discussed many times. This has been discussed in many other groups and forums with no firm conclusions being reached. The Zero Carbon Hub's report on Carbon Compliance (February 2011) came to no conclusion on this.

It was generally felt by the group that national weather data should remain.

This is a very important issue which needs to be concluded before any consultation re Part L 2013 is released. It is also vitally important that the Part L 2013 consultation has the updated version of SAP in order that it can be considered correctly.

Evidence for 2013

Process

Due to problems encountered in previous releases of Part L and associated software it was felt that the only way to bring this to DCLG's (and indeed other partners') attention was to look at, what we will call, a couple of 'standard house types' from an end-users' perspective (i.e. assessors and house builders).

A group was therefore established which consisted of house builders and accredited assessors, but not software providers or any other interested parties. We thought this was an important part of the process to enable us to understand the issues first hand without influence from SAP providers or any other interested parties.

The intention of the group was to test and compare the three main software packages; NHER, Elmhurst and Stroma, against a couple of different house types to see if, in the first instance, there were differences between the outputs from each package and how this may ultimately affect the 'Design' Vs. 'As Built' performance.

Note – The purpose of this work is to illustrate the problems/variances/challenges that the various software packages produce. This work is not intended to favour any particular software; all of the software packages reviewed have been passed by the BRE and are accepted as approved software for the use of building regulations compliance at design stage and completion.

It was recognised early on in the process that input errors can be an influencing factor on the final outputs and potential compliance, which in reality may not be the case if found to be incorrect. As such it was felt that for this exercise controlled input would be undertaken (spec, linear thermal bridges, areas etc) to limit such instances, but in reality this will never be the case.

SAP

Before we look at the various outputs from the 3 software packages it is necessary to understand how they first get assessed and approved for use and the role they subsequently play.

As noted above, some confusion exists over the approval and sign-off process which has led to debates over the delivery of software that is robust and issued in a timely manner. There are also questions regarding who is ultimately responsible: BRE, DECC, DCLG or other?

BRE are the current SAP contractor approved by DCLG to formulate and produce a programme to assess the building's performance including services for compliance with the Building Regulations, in particular part L1A.

The tool is based on theory developed by the use of: assessment procedures, which may or may not have been tested; manufacturers' data; and, 'as built' performance data on limited and not necessarily up to date dwellings built within the UK. As a result of the limited research data from adequate field trials a number of assumptions have been made within the SAP programmes, some of which have been highlighted below:

Manufacturers' data has been, in a number of cases, based on factory tests rather than substantive field testing:

- Hot water usage;
- Occupancy levels relative to floor area;
- Party wall bypass, based on limited trials but implemented;
- Low energy lighting performance;
- Conventions;
- Controls.

This means that even before we get to the comparison element, the programme itself is subject to variation in 'Design' Vs. 'As Built' variances because of the assumptions that have been made. There is the potential to address some of these issues but further research and investment will be required.

In light of the above it was felt that the industry were unclear how some of the calculations, algorithms and assumptions etc. are derived. There needs to be complete transparency and openness surrounding these issues as this would instil confidence in SAP.

Products are one of the biggest obstacles that restrict SAP in its current form. That is, SAP can be a barrier to getting new energy efficient products specified within developments. This barrier can manifest itself in two distinct forms:

Firstly, products need to be approved for use within the SAP tool. This in itself is not a bad thing but where a product has certification under other schemes or European standards one would question whether such barriers should be in place. Unfortunately the result of this restriction means that design solutions can only focus on what has been approved and can not consider other options. This therefore has a direct influence on design.

Secondly, the cost of approval for products within SAP can restrict new products coming to the market. A number of products get presented to house builders through the course of the year some of which are produced by relatively small firms. The problem is that the starting point for house builders tends to be “is the product approved” or “can it be modelled within SAP”. In many cases this means that a number of new products can not be brought forward because of the costs associated with gaining BRE approval and/or because it can not be modelled. This has the unfortunate affect of restricting the introduction of new products into the market and driving down competition and similarly restricting design solutions.

Therefore solutions have to be found to streamline the approval process and enable more products to come to the market and not just restrict this to the larger players with substantial financial backing. This becomes even more critical the closer we get to zero carbon.

SAP conventions have proved problematic even as recently as April 2011. SAP conventions and their use through Appendix K have raised some concerns. When the SAP programmes were released back in October 2010 a number of conventions were omitted from the list of linear thermal bridges. This meant that assessors had to ignore those that were not available and just use those referred to in Appendix K. Unfortunately the introduction of new conventions in April has lead to units that had previously been designed to pass now achieving a fail because of the default figures that have been posted. This is clearly not an acceptable solution.

Even now the conventions do not account for all of the junctions and some of those that have been introduced, in particular rooms in the roof, do not seem to deal with all of the various elements or interactions. There is a belief that this is in part due to the fact that no house builder representation is made on the conventions group or indeed many of the others. This means that many items that seem practical on paper may not be deliverable in reality. The way in which some of the linear bridge lengths are calculated also needs to be reviewed. Bay windows for instance do not appear to be calculated correctly as incorrect lengths are assumed. This is an area that needs to be addressed and better representation given to house builders is necessary if we are to really understand what the practical solutions are and ‘Design’ Vs. ‘As Built’ performance. A pattern book would help this process.

Smart control seems to have been changed and benefits that were previously recognised have been removed or become benefit neutral. This can be seen with the issues that surround load compensation, weather compensation and enhanced load compensation. It would appear that the benefits for the first two have changed and do change dependent on the system used. Load compensation appears to have no benefit anymore and weather compensator gets removed when

Flue Gas Heat Recovery (FGHR) is used. It is unclear as to the reasoning behind this. There is a belief that this was changed without being consulted upon and it does affect the performance of the units. This again seems to be an area where a lack of transparency is apparent and there has been a lack of consultation with the house building industry. If house builders understand the reason why the change has been made they may have more confidence in the outputs and reasoning.

In addition to the above, and following conversations with manufacturers, it would appear that an enhanced load compensator or similar is not available. It seems strange to include for a product not available and therefore not tested/approved.

Water usage is an area that should be investigated further. At present the packages contain a tick box for less the 125 l/p/d. If it is not ticked the consumption goes up. However under the requirements for Part G we have to design to less than 125 l/p/d anyway. The other issue here is how much water usage is for hot water and at what temperature? We need to be clear which parts need to be included and which ones can be discounted. For instance baths, showers, sinks and basins all require hot water but can be either blended with cold water or not. Washing machines and dishwashers are not included in any other part of the calculations for energy use etc. so should also be excluded.

Bath water is also restricted to less than 48^{o}C. Has this also been taken into account within the calculations? This needs clarification.

We then have the issue of designing to less than 125 l/p/d. This occurs on 'Code for Sustainable Homes' sites but no allowance or adjustment can be made to the figures within the SAP programme. Similarly the figures will vary upon product specification and water harvesting systems that may be used. So the table should be able to reflect the actual figures that are proposed and achieved for the design solution. Pumps for harvesting systems do not appear to be counted nor do electric showers.

The various software deal with technologies and smart controls in different ways. Flue Gas Heat recovery for instance is already calculated via the products characteristics database in Elmhurst & Stroma so no additional calculation is required. NHER, however, requires input via appendix Q. This in turn further adds to the possibility of user input error. This also means that weather compensation is allowed in the NHER software and can be counted whereas in the others this is automatically removed. This can lead to differing results between the various packages.

There are a few other differences between the software packages - such as how ventilation, in particular fans, are dealt with and what is greyed out or not. Some packages allow you to calculate the Thermal Mass Parameter (TMP) but others do not. There are no problems with this if you only use one package but it can lead to variations when compared side by side with other packages.

Regional weather has been discussed at length by the group and it was generally felt that national weather data should remain. This could be revised in future, and may be the subject of a separate report in which further investigations could be undertaken and greater detail given.

U value calculations have been identified as another area where differences occur. Conventions for these, in particular those identified by Leeds Metropolitan University, such as timber frame, highlight

such concerns. It was therefore felt by the group that a review of this process should be carried for all element types.

Approval of SAP Software

The consultation for changes to Part L requires usable software to enable the industry to confidently assess the outputs and make predictions regarding costs and viabilities moving forward. Unfortunately the previous consultation failed to deliver such a package and software was still being updated and changed right up to the formal issue of the revised regulations in October 2010.

A consultation is however just that and as such is subject to change. The problem for the industry is that continual changes and updates through the process leave them with little confidence in the final outcome and also incurs considerable costs. Therefore a meaningful consultation should be accompanied by a robust and usable piece of software. Moving towards zero carbon it is critical that we have a robust piece of SAP software to use and model in order to make any meaningful response to the consultation.

Post consultation, however, the BRE produced their final software which was deemed to satisfy the requirements for a compliance tool for Building Regulations purposes. This software was then released to the software houses to create their own packages which in turn needed to be submitted to the BRE for approval.

As part of the approval process, software providers are required to submit 150 test cases for consideration. This means that each provider, in this case NHER, Elmhurst and Stroma all have to submit feedback and 150 cases each; some 450 test cases for consideration on top of the work BRE would have already produced. This does not include abortive tests. This seems to be a very long-winded, time consuming and costly way to get software into the market.

At present the current system for approval requires 4 companies (including BRE) to effectively carry out the same process. We would argue that this is not an efficient way of delivering a piece of software to the industry. An alternative to this approach would be to just produce one piece of software that would be used by all. This in turn could save considerable costs and money for the industry as a whole.

Updates and EPCs

Updates and EPCs are a real cause for frustration and lack of confidence in the whole process, which leads to an additional cost burden. Since the issue of the approved software packages in October 2010, we have been subjected to 5 updates from NHER, 6 updates from Elmhurst and a surprising 19 updates from Stroma. We do understand that some of these could simply be textual issues but a number have changed the outputs of previously modelled units. One of the most significant of these was the introduction of the new conventions for party walls and room in the roof configuration.

Constant changes to software, even if bugs exist, cause great concern to the industry. Confidence is lost in the ability to accurately predict the performance of dwellings and what level of cost needs to be attributed to developments where the new regulations will apply.

The changes can also contribute to vast amounts of abortive costs being incurred primarily and unfairly by the developer. For instance a developer may have to pay to run hundreds and, possibly, thousands of iterations for a particular range of houses they have within their portfolio. This can be seen in the work carried out by the ZCH on Carbon Compliance.

The aim of these outputs is to formulate a cost effective solution that would be applicable to the majority of the house builder's portfolio and create a direction for which the company intends to pursue. Late changes, such as those introduced in April, have the potential of rendering all of those iterations non-compliant. Now that the change has occurred the house builder has to review their position again. The review will result in further models being tested which could potentially change the previously agreed direction of the business. If the latter were to occur deals could also be affected which could affect the supply chain and projected future sales. Unfortunately the software houses, or indeed BRE which carried out the initial checks, do not seem to be accountable and it is left to the house builder and assessor to agree new fees. This is far from satisfactory and is an area in which, to date, considerable money has been lost and this is set to continue if the current process continues.

Design SAP and final EPCs are also influenced by this process. A number of plots are still being constructed to 2006 regulations. Yet these initial calculations were produced on previous software. Therefore, how can an EPC accurately represent the performance of a dwelling which has to go through a conversion process prior to issuing the certificate which does not really reflect the dwelling constructed?

EPCs have a problem with communal type systems as has been discussed in a meeting with DCLG in August 2010. Particular concerns exist where communal systems, such as PV on roof spaces to apartments, is calculated to meet the demand required for all, but then solely fed into the landlords' supply. This means that a pass can be achieved but occupants fail to receive the benefit unless the landlord reduces its management fee. This is all in accordance with legislation, but the EPC will be incorrect for the dwelling itself.

One of the key issues here is the lock down of the SAP programmes and how updates have to be automatically loaded onto systems. Once a software has been released it must remain constant unless real concerns are raised over the outputs and bugs found. In this instance there must be a mechanism in place to approve the dwellings on the basis of how they were calculated. Similarly the EPC should also be locked into the version initially used to avoid confusion. Transitional arrangements and lock down of software must be reviewed urgently to prevent further failures. SAP and EPC must relate to the submission for Building Regulations and to remain throughout the life of that development in accordance with other sections of regulation.

Modelling and Outputs

The modelling was carried out in two stages. Firstly, the group of assessors agreed standard input criteria for a typical terraced dwelling. The reason for this was to try and limit variations in input so that the packages could be assessed more easily. The initial findings can be found in Table 1 below:

What we can see from the initial table of results is that although controlled measurements were agreed, variations still occurred in the outputs. In some of these cases it was felt that the outputs were so varied that further checks needed to be undertaken before we proceed to the other types. Of main concern was how they dealt with ventilation and different types of technology.

With this in mind the assessors all agreed to sit down and run through each line from the calculation sheets to identify were the differences lay. This was a very time consuming process but did highlight some of the interpretation and input issues raised above.

This process will not normally be undertaken and hence shows certain vulnerabilities in how the packages are used and the interpretation and assumptions made in parts of the assessments.

Once the checks had been made the iterations were re run for type A and then repeated for types B & C. These results can be found in Tables 2, 3 & 4

Note: For ease of reference a couple of boxes in Table 1 have been shaded to show how the outputs varied and the influence that this may have made to the type of solution employed to gain compliance or the lowest CO_2 levels.

Table 1 Initial Outputs

	House Type A		SAP software 1							SAP software 2							SAP software 3					
	Target Dwellings Emissions Rate	19.41							19.41							19.37						
	Floor Area M^2	71.43							71.43							71.43						
	Dwelling Emission Rate	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year
a.	Base Specification	21.75				1435	20.09	60.18	21.75				1435	20.09	59.83	21.38				1432	20.05	57.53
b.	Ventilation (balanced without heat recovery) SAP default	32.12	-10.37	-47.7%	-53.4%	2179	30.50	60.18	32.11	-10.36	-47.6%	-53.4%	2179	30.50	59.83	30.63	-9.25	-43.3%	-47.8%	2096	29.35	57.53
c.	Ventilation (balanced with heat recovery) SAP default	29.67	-7.92	-36.4%	-40.8%	2001	28.01	60.18	29.67	-7.92	-36.4%	-40.8%	2001	28.01	59.83	29.29	-7.91	-37.0%	-40.8%	1997	27.96	57.53
d.	Ventilation (centalised **whole** house extract) SAP default	24.84	-3.09	-14.2%	-15.9%	1656	23.18	60.18	24.84	-3.09	-14.2%	-15.9%	1655	23.18	59.83	24.47	-3.09	-14.5%	-16.0%	1653	23.14	57.53
e.	Ventilation (PIV from loft) SAP default	21.30	0.45	2.1%	2.3%	1403	19.64	60.18	21.75	0.00	0.0%	0.0%	1435	20.09	59.83	20.97	0.41	1.9%	2.1%	1403	19.65	57.53
f.	Ventilation (PIV from outside) SAP default	24.37	-2.62	-12.0%	-13.5%	1627	22.77	60.18	22.78	-1.03	-4.7%	-5.3%	1508	21.11	59.83	24.09	-2.71	-12.7%	-14.0%	1630	22.82	57.53
g.	Ventilation (decentralised whole house extract) SAP default	22.98	-1.23	-5.7%	-6.3%	1523	21.32	60.18	24.84	-3.09	-14.2%	-15.9%	1656	23.18	59.83	22.61	-1.23	-5.8%	-6.4%	1520	21.28	57.53
h.	Heating Controls (time and temperature zone control)	20.97	0.78	3.6%	4.0%	1391	19.47	60.18	20.97	0.78	3.6%	4.0%	1391	19.47	59.83	20.31	1.07	5.0%	5.5%	1370	19.18	57.53
i.	Heating Controls (delayed start thermostat)	21.51	0.24	1.1%	1.2%	1419	19.86	60.18	21.51	0.24	1.1%	1.2%	1419	19.86	59.83	21.14	0.24	1.1%	1.2%	1416	19.83	57.53
j.	Heating Controls (load compensator)	21.75	0.00	0.0%	0.0%	1435	20.09	60.18	21.75	0.00	0.0%	0.0%	1435	20.09	59.83	21.38	0.00	0.0%	0.0%	1432	20.05	57.53
k.	Heating Controls (weather compensator)	21.38	0.37	1.7%	1.9%	1412	19.77	60.18	21.38	0.37	1.7%	1.9%	1412	19.77	59.83	21.02	0.36	1.7%	1.9%	1410	19.74	57.53
l.	Heating Controls (enhanced load compensator)	21.38	0.37	1.7%	1.9%	1412	19.77	60.18	21.38	0.37	1.7%	1.9%	1412	19.77	59.83	21.02	0.36	1.7%	1.9%	1410	19.74	57.53
m.	PV - 3kWp - South - 30^0 - < 20% Overshading	2.68	19.07	87.7%	98.2%	73	1.02	60.18	2.68	19.07	87.7%	98.2%	73.00	1.02	59.83	2.31	19.07	89.2%	98.5%	70	0.98	57.53
n.	PV - 3kWp - SouthEast / South West - 30^0 - < 20% Overshading	3.50	18.25	83.9%	94.0%	131	1.84	60.18	3.50	18.25	83.9%	94.0%	131	1.84	59.83	3.13	18.25	85.4%	94.2%	128	1.80	57.53
o.	PV - 3kWp - East / West - 30^0 - < 20% Overshading	5.52	16.23	74.6%	83.6%	276	3.86	60.18	5.52	16.23	74.6%	83.6%	276	3.86	59.83	5.16	16.22	75.9%	83.7%	273	3.82	57.53
p.	Zennex Gas Saver GS-1	21.13	0.62	2.9%	3.2%	1394	19.51	60.18	21.13	0.62	2.9%	3.2%	1394	19.51	59.83	20.51	0.87	4.1%	4.5%	1366	19.12	57.53
q.	Alpha Flow Smart FS-50	21.13	0.62	2.9%	3.2%	1394	19.51	60.18	19.65	2.10	9.7%	10.8%	1286	18.00	59.83	20.05	1.33	6.2%	6.9%	1326	18.57	57.53
r.	Shower-Save RT1 (tray)	20.90	0.85	3.9%	4.4%	1374	19.24	60.18	20.01	1.74	8.0%	9.0%	1310	18.34	59.83	20.53	0.85	4.0%	4.4%	1368	19.15	57.53
s.	Shower-Save RV2 (vertical)	20.64	1.11	5.1%	5.7%	1356	18.98	60.18	19.41	2.34	10.8%	12.1%	962	13.47	59.83	20.27	1.11	5.2%	5.7%	1353	18.94	57.53
t.	Greenwood HRV2 (MVHR), DAP 5, Rigid Ductwork **(insulated)**	21.44	0.31	1.4%	1.6%	1415	19.81	60.18	21.44	0.31	1.4%	1.6%	1415	19.81	59.83	20.33	1.05	4.9%	5.4%	1360	19.03	55.66
u.	Greenwood CV2GIP (Decentrailised System 3), DAP 7, Flexi Duct **(kitchen through wall, bath in room)**	22.06	-0.31	-1.4%	-1.6%	1458	20.41	60.18	23.23	-1.48	-6.8%	-7.6%	1540	21.57	59.83	21.72	-0.34	-1.6%	-1.8%	1456	20.39	57.53

Table 2

	House Type A		SAP software 1							SAP software 2							SAP software 3						
	Target Dwellings Emissions Rate	19.41							19.41							19.41							
	Floor Area M^2	71.43							71.43							71.43							
	Dwelling Emission Rate	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year
a.	Base Specification	21.41				1434	20.08	57.67	21.41				1434	20.08	57.66	21.41				1434	20.08	57.68
b.	Ventilation (balanced without heat recovery) SAP default	30.67	-9.26	-43.3%	-47.7%	2099	29.38	57.67	30.67	-9.26	-43.3%	-47.7%	2099	29.38	57.66	30.67	-9.26	-43.3%	-47.7%	2099	29.38	57.68
c.	Ventilation (balanced with heat recovery) SAP default	29.32	-7.91	-36.9%	-40.8%	1999	27.98	57.67	29.32	-7.91	-36.9%	-40.8%	1999	27.98	57.66	29.32	-7.91	-36.9%	-40.8%	1999	27.99	57.68
d.	Ventilation (centalised whole house extract) SAP default	24.50	-3.09	-14.4%	-15.9%	1655	23.17	57.67	24.50	-3.09	-14.4%	-15.9%	1655	23.17	57.66	24.50	-3.09	-14.4%	-15.9%	1655	23.17	57.68
e.	Ventilation (PIV from loft) SAP default	21.00	0.41	1.9%	2.1%	1405	19.67	57.67	21.00	0.41	1.9%	2.1%	1405	19.67	57.66	21.00	0.41	1.9%	2.1%	1405	19.67	57.68
f.	Ventilation (PIV from outside) SAP default	24.12	-2.71	-12.7%	-14.0%	1631	22.84	57.67	24.12	-2.71	-12.7%	-14.0%	1632	22.84	57.66	24.12	-2.71	-12.7%	-14.0%	1632	22.84	57.68
g.	Ventilation (decentralised whole house extract) SAP default	22.64	-1.23	-5.7%	-6.3%	1522	21.30	57.67	24.50	-3.09	-14.4%	-15.9%	1655	23.17	57.66	22.64	-1.23	-5.7%	-6.3%	1522	21.31	57.68
h.	Heating Controls (time and temperature zone control)	20.36	1.05	4.9%	5.4%	1373	19.22	57.67	20.36	1.05	4.9%	5.4%	1373	19.22	57.66	20.36	1.05	4.9%	5.4%	1373	19.23	57.68
i.	Heating Controls (delayed start thermostat)	21.17	0.24	1.1%	1.2%	1418	19.86	57.67	21.17	0.24	1.1%	1.2%	1418	19.86	57.66	21.17	0.24	1.1%	1.2%	1418	19.86	57.68
j.	Heating Controls (load compensator)	21.41	0.00	0.0%	0.0%	1434	20.08	57.67	21.41	0.00	0.0%	0.0%	1434	20.08	57.66	21.41	0.00	0.0%	0.0%	1434	20.08	57.68
k.	Heating Controls (weather compensator)	21.05	0.36	1.7%	1.9%	1411	19.76	57.67	21.05	0.36	1.7%	1.9%	1411	19.76	57.66	21.05	0.36	1.7%	1.9%	1412	19.76	57.68
l.	Heating Controls (enhanced load compensator)	21.05	0.36	1.7%	1.9%	1411	19.76	57.67	21.05	0.36	1.7%	1.9%	1411	19.76	57.66	21.05	0.36	1.7%	1.9%	1412	19.76	57.68
m.	PV - 3kWp - South - 30^0 - < 20% Overshading	2.34	19.07	89.1%	98.2%	72	1.01	57.67	2.34	19.07	89.1%	98.2%	72	1.01	57.66	2.34	19.07	89.1%	98.2%	72	1.01	57.68
n.	PV - 3kWp - SouthEast / South West - 30^0 - < 20% Overshading	3.16	18.25	85.2%	94.0%	130	1.82	57.67	3.16	18.25	85.2%	94.0%	130	1.82	57.66	3.16	18.25	85.2%	94.0%	130	1.83	57.68
o.	PV - 3kWp - East / West - 30^0 - < 20% Overshading	5.18	16.23	75.8%	83.6%	275	3.85	57.67	5.18	16.23	75.8%	83.6%	275	3.85	57.66	5.19	16.22	75.8%	83.6%	275	3.85	57.68
p.	Zennex Gas Saver GS-1	20.80	0.61	2.8%	3.1%	1393	19.50	57.67	20.80	0.61	2.8%	3.1%	1393	19.50	57.66	20.83	0.58	2.7%	3.0%	1393	19.50	57.68
q.	Alpha Flow Smart FS-50	19.89	1.52	7.1%	7.8%	1325	18.55	57.67	19.89	1.52	7.1%	7.8%	1325	18.55	57.66	19.98	1.43	6.7%	7.4%	1329	18.60	57.68
r.	Shower-Save RT1 (tray)	20.07	1.34	6.3%	6.9%	1338	18.74	57.67	20.07	1.34	6.3%	6.9%	1338	18.74	57.66	20.28	1.13	5.3%	5.8%	1354	18.95	57.68
s.	Shower-Save RV2 (vertical)	20.30	1.11	5.2%	5.7%	1355	18.97	57.67	20.30	1.11	5.2%	5.7%	1355	18.97	57.66	19.64	1.77	8.3%	9.1%	1308	18.31	57.68
t.	Greenwood HRV2 (MVHR), DAP 5, Rigid Ductwork (insulated)	20.38	1.03	4.8%	5.3%	1362	19.07	57.67	20.38	1.03	4.8%	5.3%	1362	19.07	55.79	20.38	1.03	4.8%	5.3%	1363	19.07	55.80
u.	Greenwood CV2GIP (Decentrailised System 3), DAP 7, Flexi Duct (kitchen through wall, bath in room)	21.68	-0.27	-1.3%	-1.4%	1453	20.35	57.67	21.68	-0.27	-1.3%	-1.4%	1453	20.35	57.66	21.68	-0.27	-1.3%	-1.4%	1453	20.35	57.68

Table 3

	House Type B		SAP software 1							SAP software 2							SAP software 3						
	Target Dwellings Emissions Rate	18.41							18.41							18.41							
	Floor Area M^2	134.28							134.28							134.28							
	Dwelling Emission Rate	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year
a.	Base Specification	19.36				2441	18.18	61.89	19.36				2441	18.18	61.89	19.36				2441	18.18	61.89
b.	Ventilation (balanced without heat recovery) SAP default	28.50	-9.14	-47.2%	-49.6%	3677	27.38	61.89	28.50	-9.14	-47.2%	-49.6%	3677	27.38	61.89	28.50	-9.14	-47.2%	-49.6%	3677	27.38	61.89
c.	Ventilation (balanced with heat recovery) SAP default	27.27	-7.91	-40.9%	-43.0%	3503	26.09	61.89	27.27	-7.91	-40.9%	-43.0%	3503	26.09	61.89	27.27	-7.91	-40.9%	-43.0%	3503	26.09	61.89
d.	Ventilation (centalised whole house extract) SAP default	22.50	-3.14	-16.2%	-17.1%	2863	21.32	61.89	22.50	-3.14	-16.2%	-17.1%	2863	21.32	61.89	22.50	-3.14	-16.2%	-17.1%	2863	21.32	61.89
e.	Ventilation (PIV from loft) SAP default	19.05	0.31	1.6%	1.7%	2399	17.86	61.89	19.05	0.31	1.6%	1.7%	2399	17.86	61.89	19.05	0.31	1.6%	1.7%	2399	17.86	61.89
f.	Ventilation (PIV from outside) SAP default	22.07	-2.71	-14.0%	-14.7%	2811	20.93	61.89	22.07	-2.71	-14.0%	-14.7%	2811	20.93	61.89	22.07	-2.71	-14.0%	-14.7%	2811	20.93	61.89
g.	Ventilation (decentralised whole house extract) SAP default	20.66	-1.30	-6.7%	-7.1%	2615	19.47	61.89	22.50	-3.14	-16.2%	-17.1%	2863	21.32	61.89	20.66	-1.30	-6.7%	-7.1%	2615	19.47	61.89
h.	Heating Controls (time and temperature zone control)	17.93	1.43	7.4%	7.8%	2275	16.94	61.89	17.93	1.43	7.4%	7.8%	2275	16.94	61.89	17.93	1.43	7.4%	7.8%	2275	16.94	61.89
i.	Heating Controls (delayed start thermostat)	19.10	0.26	1.3%	1.4%	2407	17.93	61.89	19.10	0.26	1.3%	1.4%	2407	17.93	61.89	19.10	0.26	1.3%	1.4%	2407	17.93	61.89
j.	Heating Controls (load compensator)	19.36	0.00	0.0%	0.0%	2441	18.18	61.89	19.36	0.00	0.0%	0.0%	2441	18.18	61.89	19.36	0.00	0.0%	0.0%	2441	18.18	61.89
k.	Heating Controls (weather compensator)	18.94	0.42	2.2%	2.3%	2390	17.80	61.89	18.94	0.42	2.2%	2.3%	2309	17.80	61.89	18.94	0.42	2.2%	2.3%	2390	17.80	61.89
l.	Heating Controls (enhanced load compensator)	18.94	0.42	2.2%	2.3%	2390	17.80	61.89	18.94	0.42	2.2%	2.3%	2309	17.80	61.89	18.94	0.42	2.2%	2.3%	2390	17.80	61.89
m.	PV - 3kWp - South - 30^0 - < 20% Overshading	9.21	10.15	52.4%	55.1%	1078	8.03	61.89	9.21	10.15	52.4%	55.1%	1078	8.03	61.89	9.21	10.15	52.4%	55.1%	1079	8.03	61.89
n.	PV - 3kWp - SouthEast / South West - 30^0 - < 20% Overshading	9.65	9.71	50.2%	52.7%	1137	8.47	61.89	9.65	9.71	50.2%	52.7%	1137	8.47	61.89	9.65	9.71	50.2%	52.7%	1137	8.47	61.89
o.	PV - 3kWp - East / West - 30^0 - < 20% Overshading	10.73	8.63	44.6%	46.9%	1282	9.54	61.89	10.73	8.63	44.6%	46.9%	1282	9.54	61.89	10.73	8.63	44.6%	46.9%	1282	9.54	61.89
p.	Zennex Gas Saver GS-1	18.86	0.50	2.6%	2.7%	2376	17.70	61.89	18.86	0.50	2.6%	2.7%	2376	17.70	61.89	18.88	0.48	2.5%	2.6%	2376	17.69	61.89
q.	Alpha Flow Smart FS-50	18.38	0.98	5.1%	5.3%	2310	17.20	61.89	18.38	0.98	5.1%	5.3%	2310	17.20	61.89	18.42	0.94	4.9%	5.1%	2313	17.23	61.89
r.	Shower-Save RT1 (tray)	18.93	0.43	2.2%	2.3%	2386	82.19	61.89	18.93	0.43	2.2%	2.3%	2383	17.75	61.89	19.01	0.35	1.8%	1.9%	2394	17.83	61.89
s.	Shower-Save RV2 (vertical)	19.00	0.36	1.9%	2.0%	2393	17.82	61.89	19.00	0.36	1.9%	2.0%	2393	17.82	61.89	18.81	0.55	2.8%	3.0%	2367	17.63	61.89
t.	Greenwood HRV2 (MVHR), DAP 5, Rigid Ductwork (insulated)	18.43	0.93	4.8%	5.1%	2315	17.24	61.89	18.43	0.93	4.8%	5.1%	2315	17.24	60.25	18.43	0.93	4.8%	5.1%	2315	17.24	60.25
u.	Greenwood CV2GIP (Decentrailised System 3), DAP 7, Flexi Duct (kitchen through wall, bath in room)	19.79	-0.43	-2.2%	-2.3%	2499	18.61	61.89	19.79	-0.43	-2.2%	-2.3%	2499	18.61	61.89	19.79	-0.43	-2.2%	-2.3%	2499	18.61	61.89

Table 4

	House Type C		SAP software 1							SAP software 2							SAP software 3						
	Target Dwellings Emissions Rate	18.12							18.12							18.12							
	Floor Area M^2	123.56							123.56							123.56							
	Dwelling Emission Rate	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year	DER	Individual Improvement in DER	Individual Saving over DER %	Individual Saving to TER %	CO_2 Emissions kg/year	CO_2 Emissions Rate kg/m^2/year	FEE kWh/m^2/year
a.	Base Specification	19.41				2253	18.23	60.84	19.41				2253	18.23	60.84	19.41				2253	18.23	60.84
b.	Ventilation (balanced without heat recovery) SAP default	29.38	-9.97	-51.4%	-55.0%	3492	28.26	60.84	29.38	-9.97	-51.4%	-55.0%	3492	28.26	60.84	29.38	-9.97	-51.4%	-55.0%	3492	28.26	60.84
c.	Ventilation (balanced with heat recovery) SAP default	28.03	-8.62	-44.4%	-47.6%	3318	26.86	60.84	28.03	-8.62	-44.4%	-47.6%	3318	26.86	60.84	28.03	-8.62	-44.4%	-47.6%	3318	26.86	60.84
d.	Ventilation (centalised whole house extract) SAP default	22.84	-3.43	-17.7%	-18.9%	2677	21.66	60.84	22.84	-3.43	-17.7%	-18.9%	2677	21.66	60.84	22.84	-3.43	-17.7%	-18.9%	2677	21.66	60.84
e.	Ventilation (PIV from loft) SAP default	19.07	0.34	1.8%	1.9%	2211	17.90	60.84	19.07	0.34	1.8%	1.9%	2211	17.90	60.84	19.07	0.34	1.8%	1.9%	2211	17.90	60.84
f.	Ventilation (PIV from outside) SAP default	22.39	-2.98	-15.4%	-16.4%	2627	21.26	60.84	22.39	-2.98	-15.4%	-16.4%	2627	21.26	60.84	22.39	-2.98	-15.4%	-16.4%	2627	21.26	60.84
g.	Ventilation (decentralised whole house extract) SAP default	20.83	-1.42	-7.3%	-7.8%	2428	19.65	60.84	22.84	-3.43	-17.7%	-18.9%	2677	21.66	60.84	20.83	-1.42	-7.3%	-7.8%	2428	19.65	60.84
h.	Heating Controls (time and temperature zone control)	17.98	1.43	7.4%	7.9%	2101	17.00	60.84	17.98	1.43	7.4%	7.9%	2101	17.00	60.84	17.98	1.43	7.4%	7.9%	2101	17.00	60.84
i.	Heating Controls (delayed start thermostat)	19.15	0.26	1.3%	1.4%	2222	17.98	60.84	19.15	0.26	1.3%	1.4%	2222	17.98	60.84	19.15	0.26	1.3%	1.4%	2222	17.99	60.84
j.	Heating Controls (load compensator)	19.41	0.00	0.0%	0.0%	2253	18.23	60.84	19.41	0.00	0.0%	0.0%	2253	18.23	60.84	19.41	0.00	0.0%	0.0%	2253	18.23	60.84
k.	Heating Controls (weather compensator)	19.01	0.40	2.1%	2.2%	2208	17.87	60.84	19.01	0.40	2.1%	2.2%	2208	17.87	60.84	19.01	0.40	2.1%	2.2%	2208	17.87	60.84
l.	Heating Controls (enhanced load compensator)	19.01	0.40	2.1%	2.2%	2208	17.87	60.84	19.01	0.40	2.1%	2.2%	2208	17.87	60.84	19.01	0.40	2.1%	2.2%	2208	17.87	60.84
m.	PV - 3kWp - South - 30^0 - < 20% Overshading	8.39	11.02	56.8%	60.8%	891	7.21	60.84	8.38	11.03	56.8%	60.9%	891	7.21	60.84	8.39	11.02	56.8%	60.8%	891	7.21	60.84
n.	PV - 3kWp - SouthEast / South West - 30^0 - < 20% Overshading	8.86	10.55	54.4%	58.2%	949	7.68	60.84	8.86	10.55	54.4%	58.2%	949	7.68	60.84	8.86	10.55	54.4%	58.2%	949	7.68	60.84
o.	PV - 3kWp - East / West - 30^0 - < 20% Overshading	10.03	9.38	48.3%	51.8%	1094	8.85	60.84	10.03	9.38	48.3%	51.8%	1094	8.85	60.84	10.03	9.38	48.3%	51.8%	1094	8.85	60.84
p.	Zennex Gas Saver GS-1	18.89	0.52	2.7%	2.9%	2192	17.74	60.84	18.89	0.52	2.7%	2.9%	2192	17.74	60.84	18.92	0.49	2.5%	2.7%	2192	17.74	60.84
q.	Alpha Flow Smart FS-50	18.37	1.04	5.4%	5.7%	2125	17.20	60.84	18.37	1.04	5.4%	5.7%	2125	17.20	60.84	18.42	0.99	5.1%	5.5%	2128	17.22	60.84
r.	Shower-Save RT1 (tray)	18.95	0.46	2.4%	2.5%	2195	17.77	60.84	18.94	0.47	2.4%	2.6%	2195	17.77	60.84	19.03	0.38	2.0%	2.1%	2206	17.86	60.84
s.	Shower-Save RV2 (vertical)	19.02	0.39	2.0%	2.2%	2205	17.85	60.84	19.02	0.39	2.0%	2.2%	2205	17.85	60.84	18.82	0.59	3.0%	3.3%	2180	17.64	60.84
t.	Greenwood HRV2 (MVHR), DAP 5, Rigid Ductwork (insulated)	18.42	0.99	5.1%	5.5%	2130	17.24	60.84	18.42	0.99	5.1%	5.5%	2130	17.24	59.07	18.42	0.99	5.1%	5.5%	2130	17.24	59.07
u.	Greenwood CV2GIP (Decentrailised System 3), DAP 7, Flexi Duct (kitchen through wall, bath in room)	19.79	-0.38	-2.0%	-2.1%	2300	18.62	60.84	19.79	-0.38	-2.0%	-2.1%	2300	18.62	60.84	19.79	-0.38	-2.0%	-2.1%	2300	18.62	60.84

What we are now able to present (in Tables 2, 3 & 4) is a more consistent set of results between all of the packages, only showing variation between a few of the elements, again those dealing with technology types.

It should be stressed that we only managed to achieve these results after comparison checks were made which would not normally be the case. One assessor would predominantly use one package.

However we can be clear that the way in which the packages are set up is open to interpretation, input error and the need to really understand the full extent of the products specified. This should of course be the case but in reality it was felt that manufacturers will need to play a bigger part in simplifying the system inputs or at least enter into far more in depth dialogue with their customers.

You could argue that these errors will be ironed out during the auditing process for each assessor. However some of the findings may not be picked up even by the auditor if the process appears to have been followed correctly. If errors are found it is understood that a percentage difference is applied from which, providing the cumulative errors do not add up to more than a 5% difference, the assessment stands. This 5% difference again affects the 'Design' Vs. 'As Built' performance which is currently being discussed.

The audit process, at present, is only carried out upon completion (at EPC stage). This means that developments built over several years may not have errors identified if the random sampling (2%) has not picked up any dwellings from this development. Therefore, potentially, many dwellings could be affected. This process needs to be reviewed in order to have checks carried out at design stage to limit potential non compliance issues.

Recommendations

- The SAP methodology and software programme needs to be fully reviewed and all processes and conventions re-visited;
- House builders are not included on the conventions group or any other group and this should be addressed to ensure all relevant industry party views are considered;
- SAP and then EPCs must be locked down at the point of submission for Building Regulations approval;
- SAP updates can not be allowed unless measures have been put in place to deal with plots and developments where assessments have already been carried out;
- No consultation can take place to vary the standards for 2013 without a solid evidence base, including assured performance and a robust SAP or similar tool;
- U value conventions and lambda values for certain products are set to change. This has to be carefully considered as this could change the results;

- Alternatives should be explored for approval of products, such as approval by Universities or other accredited bodies;

- One software package and not multiple packages should be considered to limit the differences that currently exist;

- The industry should not be subjected to another incomplete implementation of a regulation change due to second tier information and tools not being fully available for the valid evaluation of any proposed changes in the forthcoming 2013 consultation.

Conclusion

This process has identified that the programme does not account for all elements of the dwelling and a number of assumptions have been made. This, coupled with possibly incorrect U value calculations, manufacturer's data, user input and assumption, leads us to believe that the current process for input needs to be reviewed. This in turn will help to highlight if there are any gaps in 'as built' performance which appears to be the current perception.

Progression to 2013, and indeed any consultation that promotes change, can not take place in our opinion without further work being carried out on the SAP programme itself and considerable work on assured performance. Without this data we will just proceed forward without really understanding where we actually are at this moment in time with regards to energy efficient housing. It would therefore not seem right to proceed without understanding this current position.

We may find from the research that we are nowhere near where we should be. If this is the case then the targets and goals set for 2016 may have to be reviewed further, which could further increase the costs to house building. Unfortunately this is all down to data collection and research which is desperately required before we move on with trying to project any further improvements.

About HBF

The Home Builders Federation (HBF) is the representative body of the home building industry in England and Wales. The HBF's 300 member firms account for some 80% of all new homes built in England and Wales in any one year, and include companies of all sizes, ranging from multi-national, household names through regionally based businesses to small local companies.

Contact us
Home Builders Federation Ltd
1st Floor Byron House
7-9 St James's Street
London SW1A 1EE
Tel: 020 7960 1620
Fax: 020 7960 1601
Email: info@hbf.co.uk
Website: www.hbf.co.uk

Acknowledgements

Dale Saunders, Group Chairman (Taylor Wimpey)
Craig Ferrans (Miller Homes)
Esther Taylor (AES Southern)
Jon Bodington (AES Southern)
Dave Mitchell (HBF)
Marc Primaroh (McCarthy & Stone)
Kendrick Jackson (KJ Tech Services)
Matthew Hurd (Energy & Design)