This report is made on behalf of BRE. By receiving the report and acting on it, the client - or any third party relying on it - accepts that no individual is personally liable in contract, tort or breach of statutory duty (including negligence).
Executive Summary

This report identifies that the Trinity College and its Design Team have undertaken a significant series of testing and evaluation to endeavour to set out a strategy that will deliver not only their own objectives of a more modern and functional surrounding for their students, but also minimise the risk to the existing structure as a consequence of their improvement measures.

This report was commissioned to provide an independent review of this strategy, proposals and assessment to provide comment on it achieving a successful outcome, with regard to an acceptable level of risk to the existing structure and fabric as a consequence of the proposed measures.

Subsequent to the release of the initial report 282-275 a review meeting was held at Cambridge Council offices to discuss ways forward and request further clarification on a number of points.

The addendum at the rear of this report sets out the revised recommendations and conclusions formed by the BRE subsequent to that meeting and receipt of the additional information.

The main findings of this report subsequent to that meeting and the receipt of additional clarification and reports are that the Design Team have clarified and altered certain elements to provide greater comfort on the risk to the building fabric. This included confirmation on the weather data used for the analysis, coupled with clarification of the in situ monitoring of conditions, the removal of the services to the new void and outputs on the thermal bridging on the reveal details.

This report sets out that in our opinion with the production of a mitigation strategy and a robust mechanism for reporting and evaluation of said data, that the application and strategy of the Trinity College is achievable, and that from a technical point of view the application should be conditionally approved, subject to final agreement on the wording and mechanism of the mitigation strategy.
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Introduction

Trinity College is within the historic core of the City of Cambridge Conservation Area No.1 (Central) and is situated on the western side of Trinity Street accommodating the area of land between Trinity Street and Queens Road (map at enclosure 1). The buildings of Trinity College itself comprise of four courts, Great Court, Angel Court, Nevile’s Court and New Court. The submitted Listed Building Consent application is for New Court, which provides student accommodation, along with accommodation for Fellows of the College.

New Court no longer provides the range and types of rooms that the College now need and fails to meet expected standards for sanitary provision, service installations and thermal or acoustic performance. The internal finishes are tired and in need of repair or renewal and some key elements of the external fabric are due for periodic replacement.

Pre-application discussions have been on-going between the College, English Heritage and Conservation Officers from the City Council for approximately 2 years.

A Listed Building Consent application has been submitted. The application reference is 12/0836/LBC and the documents may be viewed using the Council’s website www.cambridge.gov.uk/planningpublicaccess.

This application is for the refurbishment of New Court, which is a Grade I listed building (listing description attached at enclosure 2). The application description is;

Refurbishment of student accommodation and offices, to include the provision of accessible and en-suite study bedrooms and teaching rooms; installation of insulated internal lining; refurbishment of windows; upgrades to services; installation of photovoltaic panels and ground source heat pump; replacement external render; and alterations to Garret Hostel Lane elevation (south).

These works are needed in order to form an exemplar project for:

- The resolution of key issues facing the integration of sustainability and heritage, through the adoption of an exemplary methodology for consultation and collaboration as well as in development of appropriate technical and architectural solutions;
- The integration of renewable technologies in sensitive historic environments; and
- An approach to update the internal environment in order to accord with Trinity College’s standards and students expectations.

The proposed refurbishment works comprise of a large number of internal alterations and refurbishments. However, the two elements that cause concern to City Council Officers and advisors at English Heritage are:

1. The alterations to the windows of the building, which face into the internal courtyard of New Court; and
2. The internal installation of all external walls of the building fronting into the courtyard.

Discussions have been on-going between all parties in an attempt to resolve these concerns prior to the submission of the application in order for the applicant to be as certain as possible, that the proposed development is supported by Officers and advisors. These discussions have not been completely
conclusive that there will be no adverse impact upon historic fabric balanced against the potential advantage in sustainable development/energy efficiency terms.

However, in order to support the College’s case for refurbishment, monitoring studies have been undertaken for the past 2 years to analyse the existing thermal performance of the buildings. The buildings have also been modelled with the proposed refurbishment measures in order to demonstrate the strengths of undertaking this suite of works.

The City Council have specialist advisors within our Conservation Department, who are capable of assessing the impact of the proposed alterations on the aesthetic appearance of the property. However, we require specialist assistance in reviewing the technical strategies that will be submitted with the application. We require a qualified judgement of the objectives within the strategies and if in your professional opinion, the strategy would achieve these objectives. We do not require an analysis of how you may have undertaken the project differently or for you to re-run the information.

2. Services required;

Cambridge City Council will lead in negotiations with the Applicant(s) but are seeking an experienced Sustainability Technical Consultant to undertake the following role;

Stage One:

1. Be available from the middle of August 2012 to review the submitted technical data. The review must include the following;

- To review the objectives that the strategy anticipates the proposed development to achieve;
- To review the chosen strategy and make a qualified judgement as to whether the strategy achieves the specified objectives;
- To assess if the chosen strategy will have any adverse impacts upon the listed buildings such as possible condensation behind the insulated wall lining;
- To provide a conclusion and in the event that your professional opinion does not accord with the submitted strategy, to provide a suggested way forward for resolution; and
- To advise a schedule for the future monitoring of the building in order to assess the ‘real use’ performance of the building.

2. To provide a written report to Cambridge City Council of the appointed consultant’s review of the strategy (and to clarify any aspects of this as required). This report must be submitted to the Council within 28 working days of the Consultant’s receipt of all the required information from the Council;

3. To provide on-going advice and support to the Council as required on any points of clarification during the Council’s consideration of the application(s) and/or negotiation with the applicant(s);

4. To provide on–going advice and support to the Council as required in respect of any amendments made to either or both applications by the applicants;

5. To attend and support the Council as required at the Council’s Planning Committee, in relation to the findings of the assessment. This will be no more than half a day’s work. The forthcoming Committee meetings are;

   September 19th 2012
   October 17th 2012
   14th November 2012

This report forms Stage One of the Council’s requirements.
Description of the project

To undertake the review of the work completed by the Design Team (5th Studio, Beacon Planning, Max Fordham LLP, Gleeds, Cambridge Architectural Research, and Cambridge University Archaeological Institute) it has been necessary to review all the documentation, Wufi modelling, and material testing carried out, and submitted as evidence to support the Planning Application, this has been supplemented by a site visit undertaken on the 13th September 2012 attended by representatives of the Council and Design Team to understand and appreciate the context of the building and the measures proposed.

Discussions and early clarification was ascertained during the site visit on a number of issues, including:

- Rationale behind the upgrading of the building, including the requirement to reduce the heating load
- Use of Wufi 1D v5 – and assumptions made in the parameters of data input
- The creation of the weather file, using an in situ weather station, to calibrate the weather file for the modelling, against the use of the climate file created using Meteonorm
- Detailing of the windows and party/separating walls
- Proposed heating strategy
- Examination of the mock room created by Trinity College
- Ventilation strategy and location of ducting, including undercuts to door furniture
- Current condition of the rooms, including finishes and fixtures

In addition to the above issues, the visit allowed a greater understanding of the building layout, shelter provided by adjacent structures, and alterations that had been undertaken subsequent to the original construction.

Given the protracted discussions between the interested parties the importance of impartiality is evident to assess the level of risk to the existing structure, a dispassionate view of the strategy proposed by Trinity College and its professional representatives, and the likelihood of a successful outcome from this strategy and approach.

Subsequent to the issues raised above this secondary report includes the revision of the additional information submitted:

- Climate files
- Monitoring details
- Construction details revised for service void

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1 Meteonorm – software which is commonly used to create weather files of localised conditions based on historic weather data.
- Material sampling information
Findings

The findings of this work are set out below and are shown in 5 stages;

- The strategy and approach taken, including the parameters and metrics used to assess risk.
- Assumptions used in the modelling and approach to climatic considerations
- Detailing and make up of proposed improvements
- Ventilation strategy
- Assessment of Results

Strategy

The approach undertaken by the Design Team has been to step back from the accepted norm for assessing risk from condensation and mould growth, and the Design Team acknowledges and addresses the limitations of the current methodology in the UK for assessing condensation risk and mould growth, namely utilising a theoretical steady state calculation using the Glaser Method\(^2\), this methodology is widely accepted as being unacceptable and inaccurate when assessing risk to existing structures from the effect of wind driven rain and exposure, and the subsequent risk of condensation and mould growth both in the structure and surface of the structure. Therefore the approach utilised was to use an advanced computer programme; WUFI\(^3\) (developed by the Fraunhofer Institute, Germany) it is the international industry standard transient heat and moisture simulation tool for assessing condensation and mould risk in walls, and its use is becoming more widespread when looking to improve the performance of historic walls.

A first-stage WUFI assessment was produced by Max Fordham in January 2011, using the standard materials database from the WUFI tool, and a generic weather data file created by Meteonorm, in conjunction with the initial measurements of in structures current ability to retain heat, air-tightness, and moisture and thermal monitoring that had been carried out by Cambridge Architectural Research in Spring 2010.

The initial modelling methodology, outcomes and risk assessments formed the basis for initial conversations with the College, English Heritage and the City Council as well as with the technical advisers to these bodies. This initial modelling highlighted the location and cause of greatest risk to the fabric of the building, and resulted in an identified need to obtain a more accurate understanding of the actual materials used in the construction of the Building.

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\(^3\) Wufi – Dynamic Heat and Moisture Transference software
subsequent analysis of a sample of bricks believed to be representative of the makeup of the walls of the College were tested and analysed by Glasgow Caledonian University (GCU), with a remit to report on a set or parameters that would be needed by the Wufi software to undertake the 2nd stage analysis.

In addition the design team acknowledged the need to understand the current conditions, relative humidity levels within the structure, and the temperature of the surface of the structure, this would enable a more accurate assessment of the effect of applying thermal insulation.

The final element of this analysis was to ascertain the current ability of the fabric to retain heat, expressed as a u-value (W/m²°C). There is a growing belief and a body of evidence that demonstrates clearly that in reality walls actually perform better, from a point of their ability to retain heat, than previously accepted or calculated, and that this additional level of performance can result in a reduced need for high levels of insulation thickness to deliver the same energy performance. This has been recently acknowledged by the Department of Energy and Climate Change within the UK Government and is currently part of an ongoing consultation⁴.

The use of an open strand insulation such as the products referred to in this report are a tried and tested solution to the challenge of improving the performance of a historic wall, often referred to as a “breathing wall”, this term is in our opinion misleading but there is no doubt that historic walls which consist of a lime based mortar and older porous bricks do allow the passage of heat and moisture from external to internal environments or vice versa, which should not be unduly impeded, or removed, without very careful consideration.

Assumptions used in the modelling and approach to climatic considerations

The initial assumptions undertake in this project was to create a generic climate file using a bespoke piece of software called Meteonorm, and in many applications including historic buildings this is common and widespread, when using Wufi to assess the risk to the structure. As referee to in the report Meteonorm can be over conservative in its prediction of local weather. If no local weather station is in close proximity to the location of the building its works on a triangulation of the closet weather stations available and calculates a generic weather scenario. In applications such as those being considered for New Court, Trinity College, best practice would require the locating of a weather station on site and for a representative sample of actual weather data be collected to enable a recalibration of the weather file in Wufi to closer represent the conditions in the actual location.


The BRE acknowledges that the performance of many structures may be underestimated using current calculation methods, particularly in historic walls, and that the testing undertaking in this project reflects what is currently held to be true within industry.
The weather data and monitoring over the building has been undertaken over the winter of 2011/12 and is ongoing.

The BRE supports the use of a Local Weather station to ascertain the actual climatic conditions to create the weather file for Wufi Modelling. It also acknowledges that the weather data created by Meteonorm can be unrepresentative, but it is felt that the length of time for the collection of monitoring data is insufficient to provide any more of a realistic prediction of climatic conditions given the unusually dry winter recently experienced, and that this phenomenon covers the period of time used for the data collection and recalibration of the original weather file for the 2nd stage assessment, and is in all likelihood unrepresentative of the climatic conditions that will be experienced.

Ventilation Strategy

As reported by Natural Building Technologies in the Technical Paper Appendices, New Court is currently heated to a high internal temperature during the heating period, resulting in a dry building fabric.

Changing the specification and operation of New Court from a high energy input building to a low energy input building carries risks which must be identified and mitigated through careful design.

Occupants report that windows are often opened for prolonged periods to help maintain comfort, due to perceived excessive temperatures. These high ventilation rates will almost certainly be contributing to the drying effects of the current heating regime.

Lowering the internal temperature, as is expected in the post-refurbishment heating regime, will likely result in fewer windows being opened, potentially resulting in higher RH levels. Lower air temperatures and high RH levels will generally increase the comfort of occupants however, but poses a possible risk to the building fabric.

Care must be taken to ensure RH levels are kept within standard operating boundaries through controlled ventilation.

As is currently expected in the refurbishment plans, changing the heat source to underfloor heating with greater occupant control to maintain lower internal temperatures, coupled with shorter/intermittent heating periods could also contribute to an increased RH.

All of the issues raised by NBT are valid and relevant; the Design Team has proposed the installation of a Mechanical Ventilation Heat Recovery System (MVHR), which when commissioned and tested can alleviate many of these concerns and issues. The issue which remain uncertain and pose the greatest element of risk to the building is the behaviour and heating requirements of the occupants.

The BRE support and acknowledge the importance and the use of MVHR to control the internal environment but still have concerns over the interaction between the occupant behaviour and the risk to the structure caused by elevated levels of relative humidity caused by lower internal temperatures being required.
Ventilation and the Service Panels

It is the intention of the Design team to introduce a ventilated air gap between the insulation layer proposed and the wood panelling finish, this will effectively act in a dual role, firstly to provide ventilation between the wood panelling and secondly to allow the discreet placing of services (electric cables and duct work etc).

To understand the implications of creating this void it is important to appreciate the principle in which the proposed insulation operates most effectively.

This is described clearly in the Technical Paper Appendices on page 23 of the Max Fordham report

“The working principle of Pavadentro insulation is to allow wall moisture to dry to the internal environment via convection at the internal wall surface. Timber lining panels installed against the walls to conceal services may reduce the effectiveness of this drying mechanism by limiting air movement and providing additional resistance to vapour diffusion. The additional thermal resistance of the panel itself, and of any air trapped between the furniture and the wall, can also affect the thermal gradient through the structure”.

“The lining is fixed to the wall via vertical timber battens to a high strength Fermacell gypsum lining board. The vertical battens create a 120mm void between the Fermacell board and the timber panel. The proposed service linings vary in height and width in each room; but within rooms that are between 2.8 and 2.6m high these are never more than 2.1m high and frequently no more than window cill height”

“The degree of air movement in the void will have a significant effect on the conditions in the wall. A well ventilated air gap can be assumed to be at the room condition, and therefore the lining panel itself will be hydrothermally separated from the wall”.

Effectively this means that the introduction of the air gap will separate the insulation from the finish panelling allowing the insulation to operate as designed.

The report also proceeds to mention the limitations and risks of this approach

“The significance of the risk of the associated with the timber lining panel, and the effectiveness of the solution proposed, is complicated by a number of factors:
• Variable extent and height of lining
• Variation in batten spacing
• Position and usage of wall-mounted light fittings
• Flow characteristics of the top and bottom edge openings

The associated effects of these variables on laminar airflow in the cavity may be significant. Computational fluid dynamics could be undertaken to explore this further, but would require assumptions to be made that, with such a degree of uncertainty, could affect the outcome disproportionately. The analysis in this report typically employs a conservative yet pragmatic approach to uncertainty. Bearing this in mind a decision has been taken to construct the service linings as currently proposed, monitoring the air conditions behind these on site and to review these monitoring outcomes from the first phase works, to refine and adjust the design of the service linings to Phase 2 onwards if necessary”.

In principle the solution put forward is accepted by the BRE as being pragmatic and reasonable when considered in isolation and assessed as being the only risk to the structure, but concerns are held that the required ventilation rate to the void can be achieved in reality and maintained.
Assessment of Results

Under present climate conditions, joist ends and timber elements in the floor voids are shown to be at risk of surface mould growth – albeit within the margins of uncertainty regarding type of substrate – however the 20% moisture content required for timber rot is not shown to occur. If surface mould growth is currently occurring on these elements, it is not visibly evident and does not appear to have led to degradation of the structure. The medium emissions climate change scenario shows an increased future risk of moisture ingress as a result of wind driven rain to the south and west facades. Action may be required in future to protect the more vulnerable facades from exposure to rain, particularly Garret Hostel Lane.

In the opinion of the BRE any proposals should include a reasonable assumption of increased relative humidity levels in the wall and timber, based on changes in climate. Previous references in the report refer to a unusually dry winter period, and unusually high and constant level of space heating currently used, it is believed that these factors are affecting the results given in the analysis, and additional subsequent analysis should be undertaken.
Conclusion and recommendations

In conclusion the BRE finds much to support and commend in this study and application, but notwithstanding this view, there are a number of assumptions and principles that we cannot support.

The assumption that the brick samples used in the 2nd stage analysis is representative of the makeup of the existing structure, and in particular the wall along Garret Lane – which on Page 26 of the Technical Paper: Study of the conditions of the existing fabric and the effects of an insulated wall lining: In-situ measurement, thermal and moisture modelling, proposed monitoring methodologies and results, the Design Team acknowledge is

“at high level of wide variability of quality and properties of the bricks within the walls, the irregularity of the original construction and the potential dangers of any extrapolation of the performance of the brickwork construction from single samples or results”:

It is the view of the BRE that the factor of certainty that the brick material makeup used in the modelling is insufficient, and in all probability may not accurately reflect the likely range of brick make up and material content within the structure. And in particular Garret Lane, we therefore would recommend additional testing and analysis of the available materials is undertaken to provide additional comfort on the representative nature of the sampling.

There is the assumption that the level of insulation proposed of 60mm throughout the building is acceptable and poses little risk to the structure. Yet on page 40 of the Technical Paper there is reference to the following,

“60mm of Pavadentro is found to be acceptable for most walls. For south and west facing walls there is found to be a small risk of mould growing conditions within the wall if insulated with 60mm of Pavadentro, but the continuous period of these conditions occurring is shown not to be long enough for the initial spore germination to occur”. And it refers in Page 40 of the Technical paper that “With wind-driven rain as the main source of moisture ingress, it is found that orientation, wall thickness and external render are the most significant variables for determining the risk to the walls. The south-facing bare brick façade on Garret Hostel Lane is shown to be most vulnerable to moisture related damage due to its south-facing, unrendered external façade. West facing rendered and stone-faced facades are also shown to be vulnerable. That the risk is greatest in the Garret Lane Elevation, and may require future works”

It is the view of the BRE that the initial statement does not address fully the risk to the structure and is not consistent with other assumptions and statements within the documentation which refers to an “unusually dry wall content” an “unusually high and constant level of space heating currently used”, it is in our opinion felt that the unusually dry winter of 2011/12 and the uncharacteristic heating patterns within the building has resulted in a moisture content within the structure which is not representative, and that the works only relate to the current typical state, and does not sufficiently take into account the effect of any future climate change, and subsequent risk, in particular to the acknowledged elevation of the building most at risk, where the greatest level of uncertainty of material make up is experienced, namely Garret Lane.
There is the assumption that the design ventilation requirement for the gap behind the Service Lining Panels will be achieved, yet there is acknowledgement by NBT and Max Fordham that this is not guaranteed, but purely a pragmatic approach to the technical issue, and that should the design ventilation rate not be achieved then it could have a detrimental effect on the performance of the insulation levels and type proposed.

It is proposed that the head of the insulated lining is cut back to reveal the extant, historic cornice line and it has been noted that, in other circumstances, this might constitute a ‘cold-bridge’ and lead to condensation and risk of mould development and deterioration of the fabric or its decorative repair.

The nature of the existing fabric and proposed improvements to the ventilation of the spaces combine to negate this risk. The existing wall construction has a U-value of c.0.7 W/m2.K. This tends to increase the temperature of the internal wall interface relative to a more standard, thinner wall, on experience of which cold-bridge concerns have popularly developed.

It has been conservatively calculated that under standard UK design conditions (-4°C external, 21°C internal) that the internal wall interface will be approximately 18°C. In order for condensation to occur at this interface the dew point of the internal air would have to exceed this temperature.

The BRE can find no calculations, modelling of evidence to support this presumption within the information submitted as part of the application, and without this supplementary information cannot support this premise as it is not an occurrence evidenced in our experience. Even in historic walls of the dimension at New Court this element of the structure still poses a risk of Cold Bridging. In addition on Page 4 of the NBT Technical Guidance when using Pavadentro™ Insulation indicates a requirement for a return along any dividing or party wall to a length of 250mm with a thickness not more than 20mm thinner than the main insulation material.

Safety Strategy

The application expresses there will be a requirement to extensively monitor the monitor to inform the College and wider Heritage sector, but does little to offer comfort that the strategy will protect the existing structure, should the areas highlighted in this section of the report come to fruition the only solution with be the removal of the cause of the failure, this is likely to be either that the ventilation proposed to the external wall structure and the dry lining does not achieve the required rate, with the event of mould growth and condensation formation, that the occupants of the rooms, require an internal temperature in excess of 21°C, or that the cross ventilation of the rooms via the proposed undercut is blocked either intentionally or accidentally to reduce perceived draughts.
The desire to reduce the heating load in the building to such an extent where a Heat Pump is capable of delivering the required space heating, has in our opinion obscured the potential risk to the fabric and likelihood of a successful outcome to the strategy employed. Resulting in a strategy that has an elevated risk attached to the condition of the fabric.

**Over all Conclusion**

It is the view of the BRE that the issues and proposals referred to in this section if taken on an individual basis, would present a reasonable level of risk to the structure that could be managed through close observation, but taken as an entirety and as a cumulative risk they present an unacceptable level of uncertainty that the Design Strategy could be delivered without risk to the condition of the existing structure. And therefore in its current state we cannot confirm that the Strategy could deliver the required level of assurance that the structure and fabric of New Court, Trinity College would not be compromised by the works proposed in the documentation and supporting evidence submitted.

We do not believe there to be any fundamental flaws in the approach, but we do believe there is insufficient data on the material composition within the structure (Garret Lane in particular), that the weather file used is insufficiently robust and representative, and that there is uncertainty that the ventilation strategy is achievable to the new service void area.
Recommendations

The recommendations of this report are

- That a larger and more representative sampling of the brick materials present in garret lane are analysed to ensure a true representation of the likely makeup of the structure. It is suggested, that samples in 20 different locations along the perimeter of the wall in Garret Lane, and at 4 different depths, and 4 different heights in the structure would provide the added robustness to the sampling size of the brick material used when constructed. We acknowledge that this may be problematic as the structure is Listed, but is essential to ensure the most representative material sample is used in the modelling.

- That more robust research and analysis of the achievable ventilation to the Service Lining Panels is undertaken, or that alternative method of integrating the services into the building is designed, which obviates the need to create an air gap, thus allowing the insulation and lime plaster finish to function as intended with no interference from obstructions.

- That a longer period of weather data is collected to create a more robust weather file, it is suggested that at least 1 full year of data is collected and then compared with the historical weather data used in Meteonorm to reflect the most relevant climate data for the modelling.

- That an allowance to all the detailing and assessment of performance is made for the medium scenario of climate change and predicted in UKCPO9

- That evidence is submitted that substantiates the omission of insulating the reveals, party and diving walls

- That the monitoring continues of the moisture content and surface temperature of the walls to ascertain whether the unusual winter season experienced and the high internal space heating regime is affecting the assessment of the risk to the walls and structure

- Additional analysis of the condition of the timbers in Garret Lane should be undertaken over regular periods of time

- That discussions are held between all parties to explore the potential, and setting a terms of reference for conditioning an approval of the application, based on the recommendations contained in this report. In particular a condition would be required that the additional sampling results were analysed, and subsequent remodelling using Wufi undertaken to provide comfort to Cambridge Council that the results were accurate and truly reflective, if the additional weather data period has not been undertaken then two models would need to be submitted, using both the Meteonorm climate file and the corrected version used in this application.
References


DECC Consultation – the benefits of Home Insulation


Wufi 1D v 5 WUFI® is a member of the software family which allows realistic calculation of the transient coupled one- and two dimensional heat and moisture transport in multi-layer building components exposed to natural weather. It is based on the newest findings regarding vapour diffusion and liquid transport in building materials and has been validated by detailed comparison with measurements obtained in the laboratory and on IBP’s outdoor testing field.

Meteonorm - is a comprehensive meteorological reference. It gives access to meteorological data for solar applications, and allows the creation of weather files for a range of assessment software including Wufi

NBT – Refurbishment and Conservation NBT Pavadento Wood fibre board for internal insulation of exterior walls -

(no date of publication)
Addendum – Revised Assessment Results

This section of the report sets out the revised assessment undertaken by the BRE on the likelihood of a successful outcome to the strategy set out by the Design Team regarding improvements to New Court, Trinity College, Cambridge.

The initial findings set out in the earlier sections of this report sets out a number of concerns expressed by the BRE as part of its assessment of the likely successful outcome of the strategy proposed for the works to New Court. These being

- The BRE supports the use of a Local Weather station to ascertain the actual climatic conditions to create the weather file for Wufi Modelling. It also acknowledges that the weather data created by Meteonorm can be unrepresentative, but it is felt that the length of time for the collection of monitoring data is insufficient to provide any more of a realistic prediction of climatic conditions given the unusually dry winter recently experienced, and that this phenomenon covers the period of time used for the data collection and recalibration of the original weather file for the 2nd stage assessment, and is in all likelihood unrepresentative of the climatic conditions that will be experienced.

  The climate data sets forwarded to the BRE by the Design team have clarified the issue set out in the above concern, and indicate that the climate file used for the modelling, has been created using Meteonorm, and is as far as can anticipated the most accurate weather data available.

- It is the view of the BRE that the factor of certainty that the brick material makeup used in the modelling is insufficient, and in all probability may not accurately reflect the likely range of brick make up and material content within the structure. And in particular Garret Lane, we therefore would recommend additional testing and analysis of the available materials is undertaken to provide additional comfort on the representative nature of the sampling.

  On review of the information available this is the only area where there is still a degree of uncertainty on the actual material make up of the bricks, in particular those used in the Garret Lane wall. It is the opinion of the BRE that the most practical way forward is to ensure that a robust mechanism for reporting on the conditions of the wall, by way of in situ monitoring and the creation of a mitigation strategy is an acceptable method for dealing with this risk.

  It is felt unlikely that any sample size would result in a definitive understanding of the range of brick materials used in the Garret Lane wall, and the in situ monitoring in conjunction with a robust mitigation strategy is a practical solution.
In principle the solution put forward is accepted by the BRE as being pragmatic and reasonable when considered in isolation and assessed as being the only risk to the structure, but concerns are held that the required ventilation rate to the void can be achieved in reality and maintained.

The revised details produced by the Design Team, NEW-D-21-10 C indicate the removal of the services from the new void. It is the opinion of the BRE that the revised detail and the in situ monitoring of the service void for air changes is acceptable and practicable.

The BRE can find no calculations, modelling of evidence to support this presumption within the information submitted as part of the application and without this supplementary information cannot support this premise as it is not an occurrence evidenced in our experience. Even in historic walls of the dimension at New Court this element of the structure still poses a risk of Cold Bridging. In addition on Page 4 of the NBT Technical Guidance when using Pavadentro™ Insulation indicates a requirement for a return along any dividing or party wall to a length of 250mm with a thickness not more than 20mm thinner than the main insulation material.

The documentation and modelling results forwarded to the BRE by the Design team - TRINITY NEW COURT – SURFACE CONDENSATION RISK AT INTERNAL PARTITION WALLS 18/10/12 – REVISION B, indicates that the omission of insulation to the reveal details will not result in an elevated risk to the structure and is therefore acceptable. It is however important that the in situ modelling is designed monitor and report that the parameters used in the modelling are achieved and maintained.

The desire to reduce the heating load in the building to such an extent where a Heat Pump is capable of delivering the required space heating, has in our opinion obscured the potential risk to the fabric and likelihood of a successful outcome to the strategy employed. Resulting in a strategy that has an elevated risk attached to the condition of the fabric.

Assurances given by the Design Team and a review of the supplementary and original evidence produced indicates that the use of a Heat Pump has not resulted in an approach which poses a risk to the fabric of the New Court structure.

That an allowance to all the detailing and assessment of performance is made for the medium scenario of climate change and predicted in UKCPO9

An allowance of future climate change has been used in the modelling which equates to the Medium Risk scenario in the UKCP09 report.
In conclusion it is the view of the BRE that the strategy set out by the Design Team for the improvement of the fabric to New Court, Trinity College; Cambridge is achievable, based on the production of a robust mitigation strategy that clearly reports on the findings and outputs of the in situ monitoring. As stated in the initial report the risk to the structure and fabric of New Court was elevated due to the cumulative effect of multiple risks, this via the production of additional material and clarification has now been reduced to a single risk based on assumptions made of the actual materials used in the Garret lane wall, the in situ monitoring and mitigation strategy will in our opinion result in this being a manageable risk.

The draft version supplied as part of the additional information provides a good baseline for discussions and agreement by all parties concerned, and has no obvious omissions, it will however be necessary for the fine detail to be agreed and the process put in place before any work commences.