Examiners' Report
Lead Examiner Feedback

January 2021

Pearson BTEC Nationals
In Construction and the Built Environment (20075K)
Unit 1: Construction Principles

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Introduction

This was the fifth series for the Unit 1 Construction Principles examination, with the examination being in the same format as both previous examinations, which is a traditional paper-based examination with a number of different styles of question. There was a relatively small cohort of learners entered for the examination compared to January 2020, mainly as a result of the impact of Covid-19. The impact of the pandemic was also evident in the responses provided by learners.

The question paper followed the format identified in both sets of sample assessment materials and also the past examinations. The focus of the paper being on a range of questions that assess construction materials, the application of mathematics and human comfort. The range of questions will change each examination series with the aim of covering all of the topics listed within the specification.

It is important for centres to remember that, due to nature of the specification, they will need to ensure that learners are given the opportunity to become familiar with the processes of producing written explanations, the approaches to adopt when answering extended writing questions and skills needed to address questions involving calculations.

The paper had 5 questions. Each question was based on construction related scenarios, with each question having multiple parts. Learners were required to demonstrate knowledge and understanding of a range of specification topics and to apply this knowledge to the specific question scenario. The examination is designed to offer as broad a coverage as possible for all areas of the unit content. Questions had varying weightings attached to them, with 1 to 4 marks for the lower demand questions and up to 12 marks for questions where an extended response was required, such as questions where information needed to be interpreted and knowledge drawn from multiple areas of the specification.

Each of the questions that involved calculations was marked using both method (M) marks and accuracy (A) marks, as shown in the mark scheme. The short open written response questions were point marked against mark schemes with linked responses being required for explain questions, whilst longer questions were assessed using a levels-based

mark scheme. One question was multiple choice for which learners had to select the correct answer from four alternative options.

Introduction to the Overall Performance of the Unit

Learner performance was generally consistent across the paper, with a general improvement to approaches when answering the longer open questions that are synoptic in nature. Whilst the level of performance overall was slightly lower than would normally be expected, there was evidence of good knowledge and understanding of construction principles from many learners. There was evidence of learners having been taught well across large parts of unit content, with most learners attempting the majority of the questions; it was however recognised that some questions which assessed new topic areas were often less well answered, potentially due to reduced face-to-face teaching during recent months. It was positive to see that there were examples of full marks being awarded for the majority of the shorter response questions, whilst in general the approach taken by learners for the longer questions was better than in previous examinations.

It is important that learners are given the opportunity to practice responding to shorter and/or lower demand questions as well as the applied calculation questions that relate to aspects of human comfort as exemplified in Learning Aim C. When completing calculations, it is important to show working as this allows access to 'method marks' should the solution be incorrect or only partial working be presented.

Learners responded well and provided clear responses to many of the questions in the examination with many being able to achieve marks allocated for identification for written 'explain' questions even where the lead point was not justified or expanded upon. Centres are reminded that to access both marks available for an explanation answers need to be linked with an identification point which is then developed.

It is important that learners are prepared fully for examinations and have the opportunity to practice questions of the various types that were used in this paper and other examination papers that are available.

Individual Questions

The following section considers each question on the paper, providing examples of learner responses and a brief commentary of why the responses gained the marks they did. This section should be considered with the examination paper and the corresponding mark scheme.

Question 1

This question was in five parts and was based around a scenario in which a developer has bought an apartment block that needs to be refurbished. Learners performed with mixed success across the five parts of the question.

1(a)

This question was generally answered well by learners, with a large proportion being able to identify that a hygrometer is used to measure humidity. This was a multiple choice question and learners were able to make an appropriate choice from the four options available to them, although thermometer was a common incorrect selection.

1(b)

Learners generally performed well on this question. Learners often gained one mark for recognition that humidity is caused by moisture in warm air. Many learners developed their description with statements related to the warm air making contact with cool surfaces and condensing, or that the warm air is not able to escape due to a lack of ventilation.

This response gained 2 marks.

Humidity has been identified as one of the causes of condensation in the apartments.

(b) Describe how humidity in the apartments could lead to condensation.

(2)

Humidity is when there is a lot of water particles in the air, these particles will hit colder surfaces of the apartment, causing water to form on the surface.

The learner has identified that humidity is where there is water in the air. They have developed their answer with respect to water forming when the particles hit cooler surfaces. This response is typical of a learner that has made a suitable connection to access the two marks available.

1(c)

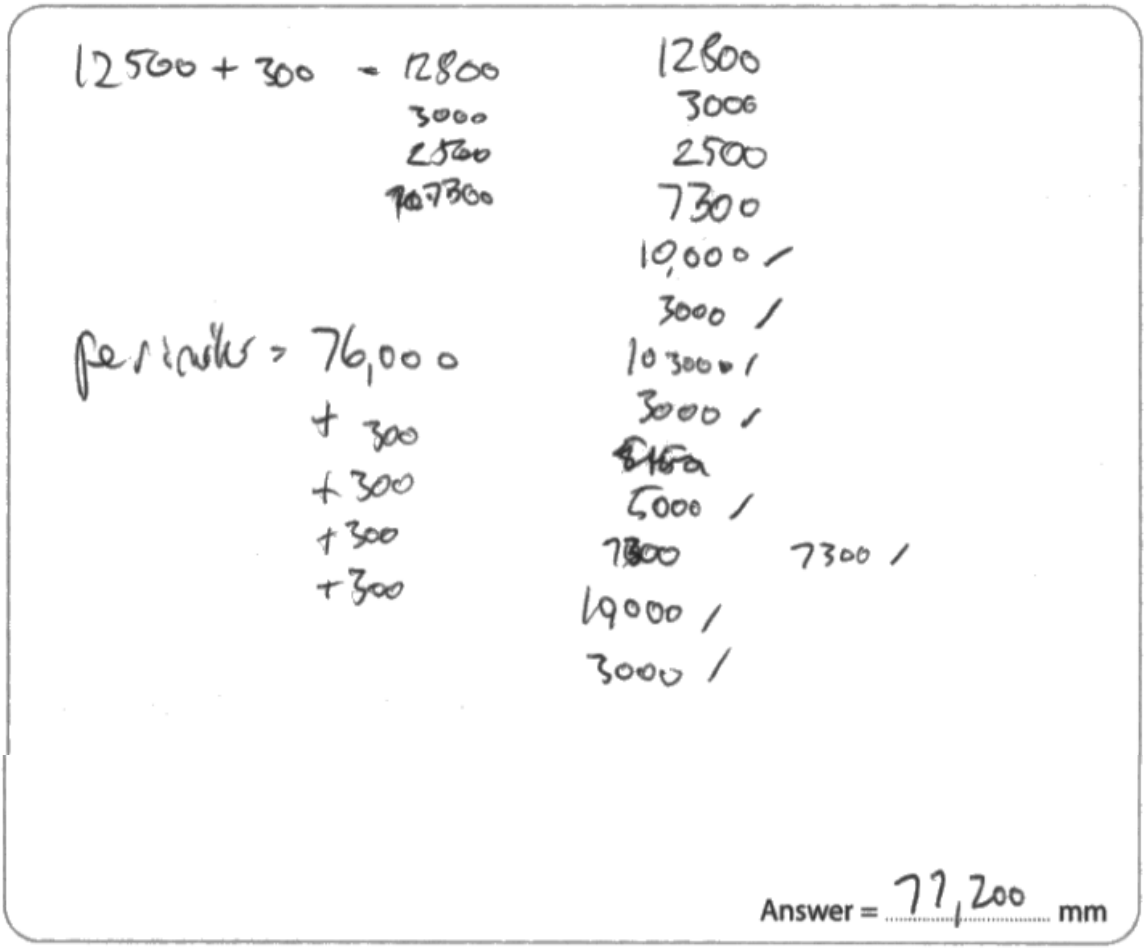
Learners generally performed with mixed success on this question. This was somewhat surprising as a question of the same form is included in the Sample Assessment Materials. Although a significant proportion of learners were able to calculate the perimeter of the building, there were learners who calculated the plan area of the roof instead.

Many learners did not progress beyond the first two marks for the perimeter, they tended to not make allowances for the internal and external corners of the roof which would affect the length of the centre line.

This response gained 5 marks.

(c) Calculate the centre line length of the soffit board.

(5)



The learner has calculated the perimeter of the roof (76, 000) and has determined the additional length of the centre line requirements based on the net quantity of external corners (based on 8 external corners and 4 internal corners), and have added 300mm for each corner to calculate the total length of the centre line of the soffit board.

1(d)

Learners performed well on this question. The majority of learners were able to identify a suitable reason for using uPVC for the soffit boards. Typically these would be related to durability, water resistance or weatherproof qualities of the boards. Many learners linked their answer to the application, for example making a connection between being waterproof and the boards therefore not rotting.

This response gained 2 marks.

The developer will be replacing the existing soffit boards with new ones manufactured from unplasticised polyvinyl chloride (uPVC).

(d) Explain **one** reason why uPVC is a suitable material for the soffit boards.

(2)

uPVC is water resistant. This is an advantage for the soffit boards as they will not degrade as quick - consequently making them last longer.

The learner has recognised that uPVC is water resistant. This has been linked with the boards not degrading, which is an appropriate expansion. They have then stated that this will allow the boards to last longer, which would have provided an alternative expansion point for the water resistant statement. As with all 'explain' questions, in order to gain both marks available there must be a linked response given by the learner.

1(e)

Many learners did not respond as well as expected on this part of the question, which was to explain how daylight factor may vary within a room. Many responses considered factors that would not be relevant, such as the orientation of the building or whether or not it is sunny. Learners continue to be under the misconception that daylight factor varies depending on the time of day rather than a measure based on an overcast sky.

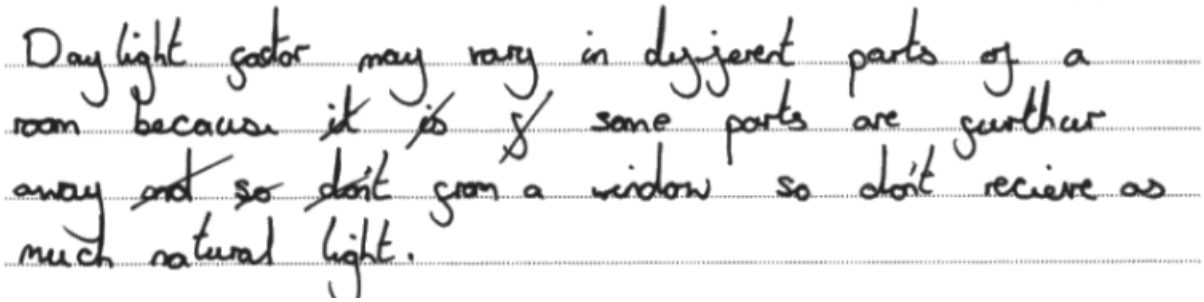
Those learners who did gain marks made reference to the distance from the window within the room, whether there are obstructions or the colour of internal finishes.

This response gained 2 marks.

External walls in the apartment block incorporate window openings.

(e) Explain **one** reason why the daylight factor may vary in different parts of a room.

(2)



The learner has recognised that the distance from the window will impact on the daylight factor within a room, and that parts of the room further away from the window will receive less light.

Question 2

This question was in four parts and was based around a scenario in which two storey extension was being built. The question stated that the extension would be a brick and block cavity wall and would have an external render. The latter factor was often missed by learners when answering question 2(a).

2(a)

This question was answered with some success by learners. Many recognised that common bricks were inexpensive compared to other types of brick, or that the aesthetics of the bricks were unimportant as they could take render well. Where learners did not gain the mark available they tended to focus on factors that were not relevant, or were incorrect. Answers such as good aesthetic properties to blend in with surrounding buildings were typical of those that did not achieve marks.

2(b)

Answers for part (b) tended to be better and more focussed, with many learners gaining at least one mark. Often this was for the load bearing capacity of high-density concrete blocks, or to a lesser extent recognition of the sound insulation they provided. In many cases these answers were an expansion of an appropriate property to allow learners to be awarded the second mark available. There were some learners who gave answers linked to moisture resistance or high thermal insulation which did not gain credit.

This response gained 2 marks.

(b) Explain **one** property of high-density concrete blocks that makes them suitable for the inner leaf of the cavity wall.

(2)

Very good compressive strength which will be able to support the wall from loads coming from above.

The learner has recognised that the blocks have a high compressive strength as their property. This is expanded on with reference to being able to support the wall and loadings. The two points are linked, and although not written exactly as represented in the mark scheme, is an appropriate interpretation.

2(c)

It was common for learners to achieve some marks for part (c), often by making reference to offices needing to be quite rooms due to the nature of the tasks that take place in them. References to the acoustic requirements of the kitchen tended to be weaker in comparison, however many learners scored well overall. A minority of learners misunderstood the question and included details of either other human comfort requirements such as temperatures, or physical requirements of the rooms such as telephone points and extractors in the kitchen.

This response gained 4 marks.

The kitchen and the office will have different acoustic requirements.

(c) Explain **two** reasons why the acoustic requirements of the rooms will differ.

1 A kitchen, with its equipment, can produce a lot of noise, which could cause discomfort to any other people in other rooms of the building.

2 An office would be required to be quiet as to avoid distractions from sounds produced in other rooms, to allow for concentration of the worker.

The learner has recognised that the kitchen is a noisy environment and the discomfort this could cause people in other rooms. They have stated that the office will need to be quite to allow the worker to concentrate. Both responses are relevant to the situation and have a link between the identified point and expansion.

2(d)

Learners tended to perform less well on this part of the question. They did not always recognise that there was a need to firstly calculate the intensity of the light source before applying the inverse square law of illuminance to calculate the level of illuminance on the desk.

Many learners used proportions to determine an answer, but did not take into account the squared distance. Some learners did gain credit for rearranging the formula for illuminance correctly.

This response gained 5 marks.

(d) The office will be illuminated using a single light source that will be located above where the desk area is expected to be. The surface of the desk will be 1.4 m from the light source.

The light source has an illuminance of 15 lux at a distance of 2 m.

Calculate the illuminance of the light on the desk.

(5)

$E = \frac{I}{d^2}$

$15 = \frac{I}{2^2}$

$15 \times 4 = I$

$I = 60$

$\frac{60}{1.4^2} = 30.61$ (2 d.p.)

The learner substituted values and rearranged the formula to calculate the intensity of the light source. This value has then been used with accuracy to determine the level of illuminance on the surface of the desk. This learner has shown good practice by including each stage of their working, this approach allows those learners who make errors to still access method marks for stages they have completed correctly.

Question 3

This question was in four parts. The scenario related to steel framed industrial buildings that have reinforced concrete floors and are divided in to a number of different rooms.

3(a)

This question was answered well by most learners. In general they were able to explain what an airborne sound is and compare this to an impact sound. There were some misconceptions amongst learners such as an airborne sound would last for longer, or that they were louder, however the majority gave a response that included an appropriate comparison. Some learners stated two points that were not related, for example stating that airborne sound is caused by speaking whilst impact sound travels through the structure of a building. In these cases only one mark could be awarded as the difference is not linked, ie both would need to state the source or the how the sound travels.

This response gained 2 marks.

The design of the industrial units will need to take into account comfort levels within the offices and staff rooms to reduce the effects of airborne and impact sounds.

(a) Explain **one** difference between airborne and impact sounds.

(2)

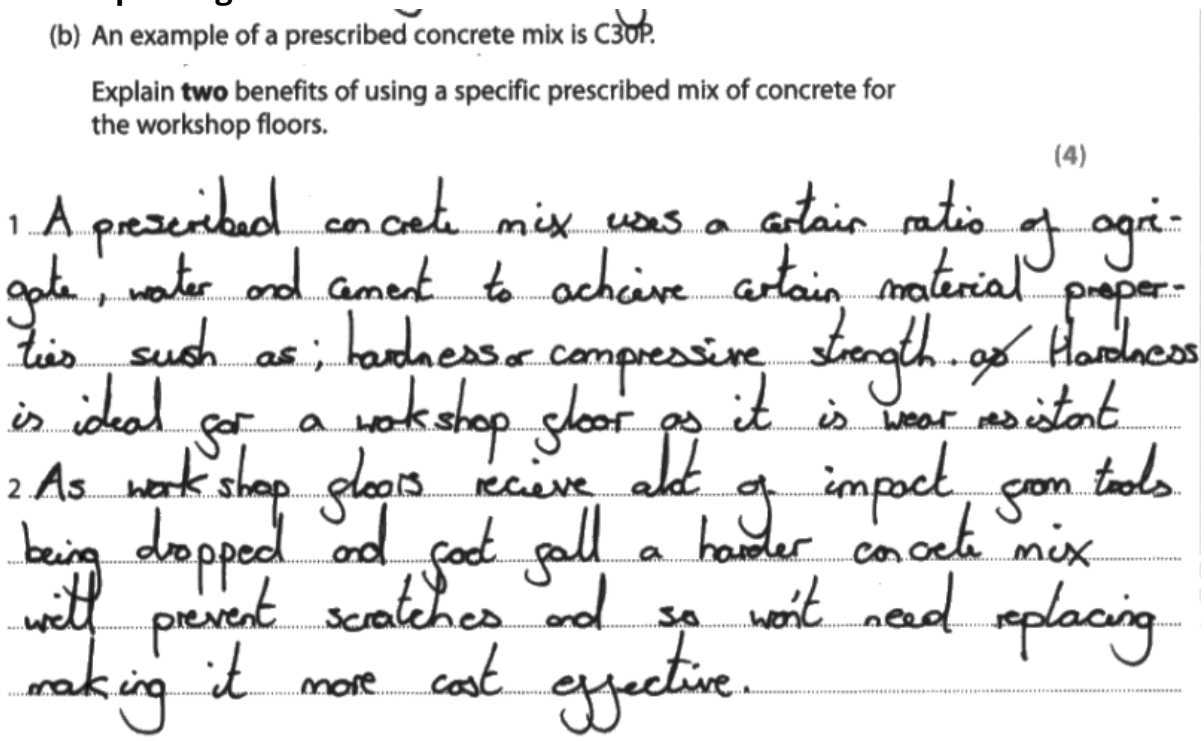
airborne sounds are sounds that start and travel through the air such as a speaker or people talking. Impact sounds are make from reverberations of something hitting something such as the floor or a wall

The learner has recognised that an airborne sound will originate from a source such as a speaker, or somebody talking, whilst an impact sound would be caused by something hitting a floor or wall. The difference links the origin of both types of sound, therefore both marks can be awarded.

3(b)

There was some confusion between design mixes and prescribed mixes in the responses given by learners. As a result, this question was answered less well than others. This is an area of the specification that has not been examined previously, therefore there was less familiarity with the concepts than perhaps some of the others that features on the examination. Where learners did gain marks they often gave answers which referenced the known ratios of constituent parts to achieve a desired strength, or that the concrete would meet the specified needs of the client.

This response gained 3 marks.



(b) An example of a prescribed concrete mix is C30P.

Explain **two** benefits of using a specific prescribed mix of concrete for the workshop floors.

(4)

1 A prescribed concrete mix uses a certain ratio of aggregate, water and cement to achieve certain material properties such as; hardness or compressive strength. as Hardness is ideal for a workshop floor as it is wear resistant

2 As work shop floors recieve alot of impact from tools being dropped and foot fall a harder concrete mix will prevent scratches and so won't need replacing making it more cost effective.

The learner has given two answers that have minimal overlap. This is a good approach to take as it means that there is more likelihood of being able to achieve two marks for each answer. The learner has been awarded two marks for their first response, linking proportions to known properties of the concrete once it has cured. The second response is awarded one mark as the answer relates to meeting the needs of the client, which is exemplified by not being damaged by impacts.

3(c)

Many learners gave generic responses to this question that could apply to which ever type of illumination was used in the industrial units. There were many responses which referenced the brightness of the lamps, or the number of lamps which would be needed. Such answers were often simply statements and were not expanded upon or justified.

Where learners did achieve marks they tended to focus on the longer life span offered by ballast lamps or the reduced energy consumption over their lifespan. A minority of learners recognised the more stable light output that is available.

This response gained 3 marks.

(c) The workshop areas in the industrial units will be lit using ballast lamps.

Explain **two** advantages of ballast lamps for lighting large areas such as workshops.

(4)

1 Ballast lamps have a long lasting life, this is an advantage as it will mean the lamps will have to be changed less frequently.

2 Ballast lamps have a high energy efficiency, this is also an advantage as it reduces the running costs of the building.

The two answers are quite brief, but focus on two different advantages. The first is a linked response between the lifespan of the lamps and reduced maintenance. This achieves 2 marks. The second response recognises the energy efficiency of the lamps but does not link this to a situation where they would be illuminated continuously. As such, only one mark is awarded.

3(d)

A wide range of responses were provided by learners, with a significant proportion achieving marks towards the top of mark band two. To reach this mark band answers needed to link together the types of loadings the structure would likely encounter, the sources of these loads and also the effect these would have on the structure. The higher scoring responses considered the types of loading in detail and developed this by investigating the effects of the loads. Answers were often supported by good technical knowledge that was applied to the situation. Where learners achieved marks at the lower end of the mark range this was often a result of answers being limited to discussing the difference between dead loads and imposed loads.

This is an extract from a Mark Band 2 response.

The structural frames of the industrial units will be constructed from high strength steel.

(d) Discuss the different types of loading which will be placed on the frame and why they need to be considered in the design.

(9)

There are many different loads that need to be considered when in the design, First is the dead load that will be on the frame. The dead load are the static loads from the build itself or any fixxed objects inside. You will have the compressive load on the vertical beams from roof or upper floors or the frame might fail. If the building can't support the dead loads then the frame will collapse. You must also considered any live loads the might be on the frame. Live loads are active load created by stuff like any people. These loads change or move meaning the load is not content. If live load that may effect the

In this extract the learner has recognised that there are dead loads due to the frame and the static loads resulting from fixed objects inside. They have stated that the roof will cause compressive loads in the columns and that if it is unable to support the dead loads the building could collapse. Similar comments have been made for live loads.
The extract, and the answer as a whole, is in the context of the question and the points made by the learner are described in some detail, hence a mark can be awarded in Mark Band 2.

Question 4

This question had two parts related to a scenario of a road bridge across a railway line. Details of the construction of the bridge were provided in the scenario, including the materials and structural form.

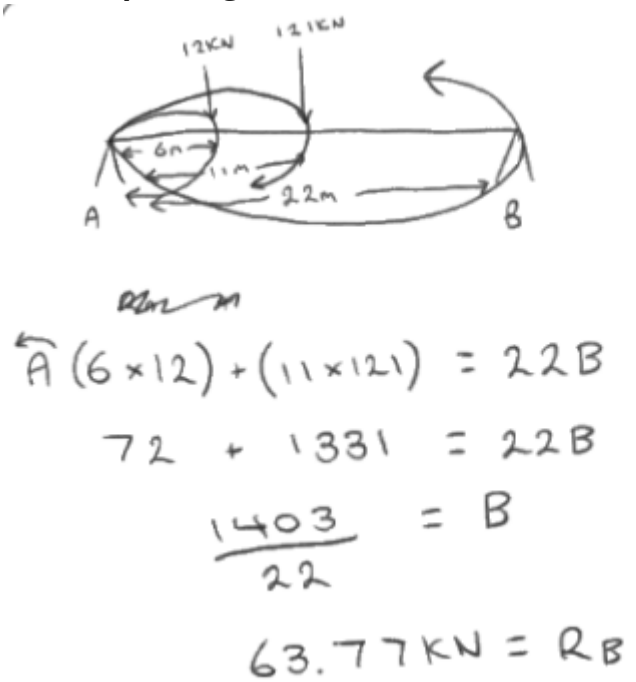
4(a)

Learners had mixed success with this question. There were some significant misunderstandings of the conventions used in the diagram, for example the uniformly distributed load (UDL) which is shown as being across the full length of the beam. Some learners interpreted the UDL as only being imposed on part of the beam despite this.

Some learners correctly identified the total loading due to the UDL but did not progress beyond this, or did not correctly identify the location on the beam where the loading would act when reduced to a point load.

There was some success with the application of moments, and some learners were able to access some marks.

This response gained 6 marks.



The learner has used a diagram to help them understand the processes that they intend to use. Some stages have not been shown, for example multiplying the UDL (5.5kN/m) by the length of the beam (22m) however they have shown 121 kN acting at the midpoint of the beam in their diagram.

They have then shown the moments around A, balancing the clockwise and anticlockwise values. The values have been simplified and rearranged correctly to determine the reaction force at B to an appropriate degree of precision.

4(b)

Learners performed better on part (b) of the question with a large number of learners identifying and explaining at least one property of Class B Engineering bricks that make them suitable for the piers of the bridge. Many answers related to compressive strength, impermeability or durability and were expanded on and justified. Some learners made reference to the potential use of the bricks for bridges over rivers which did not gain credit; this was perhaps due to a question on a past paper about a bridge over a river.

the location on the beam where the loading would act when reduced to a point load.

There was some success with the application of moments, and some learners were able to access some marks.

This response gained 3 marks.

The bridge piers will be constructed from Class B Engineering bricks.

(b) Explain **two** properties of Class B Engineering bricks that make them suitable for use in the piers of the bridge.

(4)

1 The bricks are reasonably weather resistant, thanks to their good abrasion resistance and water resistance. This means that the piers will be less susceptible to damage.

2 The bricks are high density with good compressive load bearing strength, meaning theey are able to support the dead and live loads of the bridge.

The learner has identified two points in their first answer – weather/water resistance and abrasion resistance. The expansion is not focussed on the application and therefore does not gain the second mark available. The second answer is however a linked response between compressive strength and the loadings that would be imposed by the bridge and can be awarded two marks. It is positive that the learner has focussed on two different properties which has given them more opportunity to gain all of the marks available.

Question 5

The final question on the paper is based around a scenario where a range of information is provided to learners. This includes information about construction details of a building and climatic information for the location where a building is located.

5(a)

The first part of this question related to why sulphate resistant cement may be needed in the location of the development. Many learners were able to recognise that this was due to the coastal location of the development and the possibility of sulphates in the air. A large proportion of learners were under the impression that protection would also be offered against high levels of rainfall or frost. A large proportion of learners were able to achieve some marks on this question.

This response achieved 4 marks.

(a) Explain **two** reasons why sulphate resistant cement may be required for this development.

(4)

1 Sulfates in the soil and ~~ground~~ ground will eat away at the concrete and mortar causing degregation if it wasit for the resistant cement.

2 The location is near the sea that mean you will get surpates ~~from~~ from the sea air coming in to the contact with the brick work with would effect normal mortar between the facing bricks

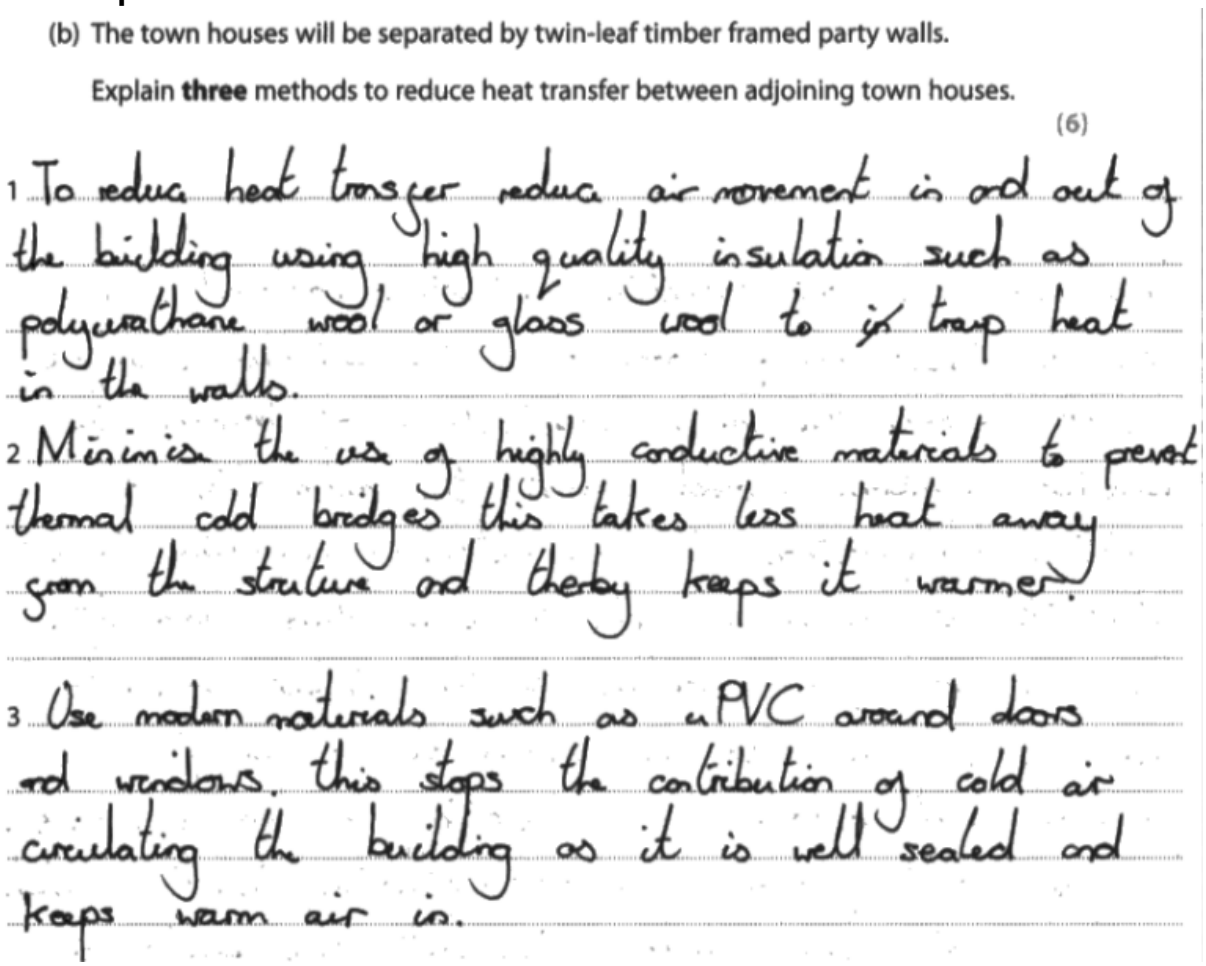
The learner has recognised that there could be sulphates in the soil that could cause degradation of the concrete foundations. They have also stated that sulphates could be carried in the air and affect the mortar in the brickwork. Both response have an identification point and an expansion, thus full marks can be awarded.

5(b)

Learners performed less well on the second part of the question, mainly as a result of repeating the same point several times. The focus of the question was how to prevent heat transfer from one town house to the next. The question provided details of the twin-leaf timber framed party walls between the town houses, therefore answers needed to relate to this construction

detail. A large number of learners made reference to using double glazing or loft insulation; these answers gained no credit as these would not affect heat transfer between the town houses.

This response achieved 4 marks.



(b) The town houses will be separated by twin-leaf timber framed party walls.

Explain **three** methods to reduce heat transfer between adjoining town houses.

(6)

1 To reduce heat transfer reduce air movement in and out of the building using high quality insulation such as polyurethane wool or glass wool to it trap heat in the walls.

2 Minimise the use of highly conductive materials to prevent thermal cold bridges this takes less heat away from the structure and thereby keeps it warmer.

3 Use modern materials such as uPVC around doors and windows. this stops the contribution of cold air circulating the building as it is well sealed and keeps warm air in.

The learner has stated that introducing insulation would trap heat in the walls and thus reduce air movement. They have also stated that thermal bridges could be minimised to prevent heat from transferring away from the home. Both of these are valid and justified statements and can be awarded 2 marks each. The final point relates to uPVC around windows; this is not appropriate for the party wall, hence no marks are awarded for this part of the response.

5(c)

This is the final question on the paper. When answering this question learners need to draw together aspects of information about the construction of the building and the local climate to provide an evaluation of the materials and processes used and their suitability for the location.

To achieve higher marks learners need to make suitable links between the information they have been provided with to justify the material used with respect to their properties and working characteristics. The answer should

cover each material and building element that has been included in the information booklet must be considered, with an answer that draws on the related underpinning knowledge from the unit content.

This is an extract from a response that gained a mark at the top of Mark Band 2.

(c) Evaluate the combined use of a timber frame, facing bricks, breather membrane, plywood, polyurethane insulation board and foil-backed plasterboard as materials for the external walls of the town houses.

(12)

facing bricks are durable and will mean that the buildings ~~to~~ can be protected from the ~~the~~ rain and heat ~~as~~ ~~they~~ ~~are~~ This means that the building will have a longer life. A Timber frame is Suitable as they are only domestic homes, which means the load is not too Substencial. However, ~~the~~ because the choosen location is ~~on~~ near the sea, the ~~Se~~ salty air could donage the facing bricks. Therefore, the houses can become faulty and may be an eyesore to look at. polyurethane insulation boards are also suitable as they provide good insulation for the house which will insure human

In this extract some of points made are relevant and there is some link to the situation in the question, for example reference to the location. Although not shown in the extract, most of the materials used for the construction have been covered. Whilst there are some pertinent points made, such as the effect of the environment on the bricks, the answer is unbalanced and does not have a conclusion. This limits the response to Mark Band 2.

Summary

Based on their performance on this paper, learners should:

- Attempt all questions on the paper as marks are often awarded for partial solutions.
- Show working in full for calculation as this allows access to method marks. If arithmetic errors are made then marks can still be awarded
- Avoid excessive, or inaccurate, rounding when completing calculation questions.
- Provide linked responses for 'explain' questions. An initial lead point should always be expanded upon with either an expansion or a justification.
- Where a question asks 'explain **two**', where possible the answers provided should focus on two unrelated points to allow maximum opportunity to achieve full marks.
- Develop answers for the longer open response questions, making use of the information provided in the scenario and the information booklet.
- Question papers are designed with sufficient space to provide answers that will achieve maximum marks; there is no need to add additional pages to the answer booklet.
- Centres are reminded that learners must not submit the information booklet with their answer booklets.