Supporting Technical Education Teaching:

**Curriculum Resources**

Teaching Guide

Topic: Calculating construction costs

# Version information

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| **Topic** | Calculating construction costs |
| **Specification coverage** | **Content area 9: Construction and the built environment industry** 9.5.1, 9.5.2 |

This resource is part of a series of materials to support technical education teaching. The approach to developing the materials draws from research led by Professor Kevin Orr that sets out a model for understanding of technical education pedagogy.

The curriculum development begins with the knowledge that students are working to learn and apply. Teachers draw from their subject and industry expertise, and their knowledge of their students, to make decisions about the core concepts the curriculum will focus on, how they will sequence these concepts, and the activities that are selected to support students’ learning. The decisions behind the resources suggested in this topic are the result of choices made by the curriculum development team, which will be reviewed and improved by teachers’ decision-making and ongoing reflection in their own circumstances.

The materials also seek to support teachers in bringing classroom and industry closer together, by providing assets that draw from authentic industry materials, and using opportunities to capture workplace practice that can be shared with students.

HEALTH AND SAFETY

It is assumed that activities outlined in this Teaching Guide will be undertaken in suitable facilities or work areas and that good practices, appropriate use policies and procedures will be observed. Teachers should consult their employers’ risk assessments before use and consider whether any modification is necessary for the particular circumstances of their own class/institution.

Acknowledgements

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**Contents**

[**Introduction**](#_heading=h.lzcz94czpx8z)

[Topic purpose 5](#_heading=h.hd5pgacqahyp)

[Industry importance 5](#_heading=h.koo3gzwy77js)

[Industry links 6](#_heading=h.uobgzerm3kvv)

[Prior learning 7](#_heading=h.9mgykr39xsst)

[Accessibility 7](#_heading=h.qjo1nwitvikc)

[**Learning outcomes and specification coverage 8**](#_heading=h.ja998ks3s9tm)

[**Lesson guidance 10**](#_heading=h.33tgq79hs6te)

[Lesson 1: Calculating unit rates 10](#_heading=h.u8n25xf4kzzu)

[*Preparation 10*](#_heading=h.ajhe5ab3i9q7)

[*Activity guide 11*](#_heading=h.my4nl93vc1vw)

[Lesson 2: Bills of quantities 16](#_heading=h.lqlgigdqu8oc)

[*Preparation 16*](#_heading=h.yb5cacooif66)

[*Activity guide 16*](#_heading=h.bcjp5dqsfazm)

[**Weblinks and resources 21**](#_heading=h.7r28c6rizu4d)

[**Terms of use and disclaimer of liability 23**](#_heading=h.rydonaqoa2bn)

**Introduction**

This document for teachers outlines both the topic area covered, and approach to using the suite of resources and assets for each lesson. Unless otherwise stated, definitions of key terms have been developed by the authoring team and reviewed in the context of the activities. Teachers may choose to revise definitions as necessary and should review the content in advance of delivery to ensure it is appropriate for learners.

# Topic purpose

A strong understanding of a range of mathematical techniques is essential for students wishing to pursue a career in design and surveying. This topic gives students an insight into budgeting and financial planning within the construction industry. As this topic has a mathematical focus, there is an expectation that all students have a sound understanding of GCSE maths (see prior learning section for more detail).

This topic contains two lessons each of which is assumed to be 1.5 hours. Each is broken down to provide teacher flexibility on the depth covered in the activities; lessons can also be split over multiple shorter lessons if required. Teachers may want to adapt the suggested sequencing of concepts and activities as appropriate for the students and circumstances. In summary:

* Lesson 1 introduces students to the role of an estimator and a quantity surveyor, the different costs involved in a building, and calculating unit costs.
* Lesson 2 introduces students to the importance of accurate cost estimation in the construction industry and the purpose of a Bill of Quantities (BoQ).

Although the focus of this topic is primarily maths, there are opportunities to build several essential skills that are developed during the course and general competencies for English and digital. These are listed in learning outcomes and specification coverage section.

The content in these lessons can be reinforced throughout the course to support students’ learning. For example, during their placements many students will use mathematics to calculate cost. They will use formulas to estimate material quantities needed for construction, such as bricks, concrete, or steel. By applying unit rates, they can calculate the total cost of materials and labour. Students may also use percentage calculations to determine profit margins, account for contingencies or wastage. Additionally, they may need to estimate time-related costs, such as wages or equipment rentals, by applying multiplication and addition to forecast daily or weekly costs.

Building up a unit rate requires students to use a multi-step maths calculation. This topic aims to support students in using this concept by including detailed worked examples in the slide deck and providing practice questions for students to complete using the same steps as the worked example.

# Industry importance

Knowledge and control of construction costs is essential in delivering competitive tenders and profitable projects.

BOQ are produced before a project goes out to tender following a standard method of measurement such as Royal Institution of Chartered Surveyors (RICS) *New Rules of Measurement (NRM): Detailed measurement for building works* (October 2021) and are used to calculate competitive tenders and support cost management in construction projects.

BoQ allow the estimator to determine an accurate cost to construct a given project, which allows a construction company to have confidence in their tender price and increase the likelihood of a profitable project outcome. This cost information can then be used to set initial project budgets.

Controlling costs is essential for a construction project to stay on budget and meet its financial objectives. Mismanagement of resources can lead to delays, increased expenses and financial strain on the construction company and the client.

*“Using maths in calculating construction costs is about applying principles and undertaking manual checks. Proficiency in understanding the basics is key in project management to minimise wastage and costs.”*

***Nick Boyle, Technical Director at Balfour Beatty***

# Industry links

Quantity surveying

* The Royal Institution of Chartered Surveyors (RICS) is the professional body for chartered surveyors, and provides insights, reports and articles on topics including construction, property and land management. These materials can be used to provide students with a professional perspective on construction issues in the built environment: [www.rics.org/news-insights/insights](http://www.rics.org/news-insights/insights)
  + Career information and a description of the role can be found here: [www.rics.org/surveyor-careers/surveying/what-surveyors-do/what-is-a-quantity-surveyor](https://www.rics.org/surveyor-careers/surveying/what-surveyors-do/what-is-a-quantity-surveyor)
* Designing Buildings Wiki is a reliable reference source for UK-based terms approved and updated by Chartered Institute of Builders (CIOB): [www.designingbuildings.co.uk/wiki/Home](http://www.designingbuildings.co.uk/wiki/Home)
* Other common standards methods of measurement:
  + Civil Engineering Standard Method of Measurement, Fourth Edition (CESMM4) information from the Institute of Civil Engineers: <https://www.ice.org.uk/areas-of-interest/infrastructure-delivery/civil-engineering-standard-measurement>
  + Information regarding methods of measurement for highway works from the Standards for Highways: <https://www.standardsforhighways.co.uk/search?q&pageNumber=1&suite=MCHW&discipline&mchwVolume=4&mchwSection>

General mathematics resources

* BBC Bitesize (maths section) offers clear explanations, revision notes and quizzes on various mathematical topics: [www.bbc.co.uk/bitesize/subjects/z38pycw](http://www.bbc.co.uk/bitesize/subjects/z38pycw)
* Maths is Fun is a user-friendly platform that covers mathematical concepts with simple explanations, puzzles and interactive activities: [www.mathsisfun.com](http://www.mathsisfun.com)
* NRICH maths offers problem-solving challenges and activities suitable for learners aiming to stretch their mathematical thinking: [nrich.maths.org](http://nrich.maths.org)
* Oak National Academy is a source of material suitable for revising material from KS4: [www.thenational.academy/teachers/key-stages/ks4/subjects/maths/programmes](http://www.thenational.academy/teachers/key-stages/ks4/subjects/maths/programmes)

# Prior learning

Students should have already covered section 3.3 of the specification:

**3.3 Students must understand measurement standards, guidance and practice, including measurement rules, their scope and application for design surveying and planning**

3.3.1 New Rules of Measurement: NRM1, NRM2, NRM3.

3.3.2 Civil Engineering Standard Method of Measurement, Fourth Edition (CESMM4)

3.3.3 International Construction Measurement Standards (ICMS)

Additionally, as this topic introduces key mathematical skills used in the construction industry, students do need to be familiar with how to:

* calculate the area, volume and perimeter of a range of 2D and 3D shapes;
* calculate percentages of amounts;
* round to the nearest whole number.

These are core concepts taught in GCSE maths (at both higher and foundation level), but some students may need to be reminded of how to perform these calculations. Suitable websites are listed above.

For more information on our other teaching topics to support T Levels in Construction, please visit <https://www.technicaleducatonnetworks.org.uk>

# Accessibility

The teaching materials have been designed to provide teachers with a flexible framework, including different approaches to activities, suggested consolidation activities to further embed knowledge, and adaptable study questions to assess learning. As with all resources, teachers will wish to consider the specific needs of their students when using the materials, including Special Educational Needs and Disabilities (SEND). This will be particularly important for students who have dyscalculia − more information can be found on the Dyscalculia Association website. Although content has been reviewed, accessibility in externally linked resources cannot be guaranteed.

Students' base level of construction knowledge may affect how much explanation is needed to make appropriate industry links. Drawing on the students' own experiences, including from their industry placements, will support this. Students' understanding of the world of work will be varied, which may mean they find applying the content to an industry environment challenging. Engaging in whole group discussions where appropriate and sharing your own and students' experiences will help expose students to different approaches. Visits from local people working in different areas of construction is strongly encouraged.

**Learning outcomes and specification coverage**

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| **Lesson** | **Learning outcomes** | **Specification coverage** | **Skills and general competencies** | **Links to other specification content** |
| **1** | Students will be able to:   * Identify the different costs involved in a construction project * Outline the roles of a quantity surveyor and an estimator * Calculate material and labour costs * Calculate unit rates | **9.5.1** Calculation of all-in rates for materials, labour and plant are completed  **9.5.2** Use of rate tables, standard price books, historical rates | Skills  **CS3** Follow standard processes to produce unit rates, Bills of Quantities (BOQ) and their costing documentation  General competencies  English:  **E2** Present information and ideas  **E5** Synthesise information  Maths:  **M2** Estimate, calculate and spot errors  **M3** Work with proportion  **M4** Use rules and formulae  **M5** Process data  **M8** Communicate using mathematics  **M9** Cost a project  Digital:  **D3** Communicate and collaborate | Supports preparation for the Employer Set Project  **3.3** Students must understand measurement standards, guidance and practice, including measurement rules, their scope and application for design surveying and planning  **9.4** Students must understand the principles and application of quantification and costing  **9.6.1** Construction professionals (quantity surveyors (main contractors and professional)  **13.5.1** Commercial risk for clients and contractors:   * client risk – ensuring funding, potential profit analysis * contractor risk at tender stage – the need for an accurate bill of quantities, safety margins, timescales.   **14.4** Students must understand the implications of the law of contract for construction projects, including the scope of types of contract |
| **2** | Students will be able to:   * Explain the importance of accurate cost estimation in the construction industry * Describe the purpose of a Bill of Quantities (BoQ) and explain how it supports cost management in construction projects * Complete the pricing of a BoQ using provided unit rates | **9.5.1** Calculation of all-in rates for materials, labour and plant are completed  **9.5.2** Use of rate tables, standard price books, historical rates | Skills  **CS1** Produce reports and presentations for construction professionals, clients or for non-technical audiences such as the public  **CS3** Follow standard processes to produce unit rates, Bills of Quantities (BoQ) and their costing documentation  General competencies  English:  **E2** Present information and ideas  **E5** Synthesise information  Maths:  **M2** Estimate, calculate and spot errors  **M4** Use rules and formulae  **M5** Process data  **M8** Communicate using mathematics  **M9** Cost a project  Digital:  **D3** Communicate and collaborate | Supports learners in preparation for the Occupational Specialisms: CEK3.3 and BSDS3.5  **3.3.1** New Rules of Measurement (NRM): NRM 1, NRM 2, NRM 3  **3.3.2** Civil Engineering Standard Method of Measurement, Fourth Edition (CESMM4)  **3.3** Students must understand measurement standards, guidance and practice, including measurement rules, their scope and application for design surveying and planning  **3.6.1** Rules of measurement and contractual implications: Standard Methods of Measurement – the use of the Standard Methods of Measurement (SMM) rules in the production of quantities  **9.4** Students must understand the principles and application of quantification and costing  **13.4.3** Documentation required for procurement and tendering, and how to create texts for different purposes and audiences  **13.5.1** Commercial risk for clients and contractors:   * client risk – ensuring funding, potential profit analysis * contractor risk at tender stage – the need for an accurate bill of quantities, safety margins, timescales.   **14.4** Students must understand the implications of the law of contract for construction projects, including the scope of types of contract |

**Lesson guidance**

# Lesson 1: Calculating unit rates

This lesson introduces students to a quantity surveyor and their role managing both the financial and contractual aspects of a construction project, ensuring smooth progress from start to finish.

Students will consider the costs involved with a construction project, focusing on labour and materials, including the importance of adding in a wastage factor. They will practise calculating a unit rate for basic construction elements, such as building a wall.

The timings provided are a guideline: teachers may wish to spend more time on some activities.

## Preparation

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| **Resources provided** | * L1 Slide deck * L1 Introduction Worksheet * L1 Introduction Worksheet answers * L1 Activity 1 Worksheet * L1 Activity 1 Worksheet answers * L1 Activity 3 Reference sheet * L1 Activity 3 Worksheet (scaffolded) * L1 Activity 3 Worksheet * L1 Activity 3 Worked solutions * L1 Consolidation Worksheet * L1 Consolidation Worksheet answer |
| **Equipment needed** | Projector, whiteboard, worksheets, writing tools, calculators, internet access for research activity and tape measure. |
| **Prior learning** | Students should be familiar with these core concepts covered in GCSE maths:   * Calculating the area and perimeter of a range of 2D shapes * Calculating the volume of 3D shapes * Calculating percentages of amounts * Rounding to the nearest whole number |
| **Common misconceptions** | * Preliminary costs only cover things that need to be done before the work commences. In fact, preliminaries cover work before, during and after construction. * You only need to buy the exact amount of a product to complete a job. In fact, you need to add on additional amounts for breakages and waste, for example when materials need to be cut to fit. |
| **Accessibility** | * You may wish to use pair-work to help students of different abilities to support one another. * Students’ prior maths knowledge may vary. Consider holding a drop-in session to provide additional support in essential maths skills, such as rounding to the nearest whole number and calculating percentages of an amount. * Two worksheets are provided with differing levels of support to perform rate calculations; the first has a high degree of scaffolding. * Seek to ensure wide representation for any case studies used. |

## Activity guide

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| **Introduction**  SUGGESTED TIME:  20 minutes  Resources:   * L1 Slide deck – slides 2–11 * L1 Introduction worksheet * L1 Introduction answers | * Introduce the lesson objectives on slide 2. In order to gauge understanding and experience of the students, use slide 3 to discuss why they think cost control is important and if they know of any roles in the construction industry that involve managing costs. * Show slide 4. Give students 2 minutes to list some costs that a building site might generate. * Split students into small groups. Ask them to collate their lists and categorise these into different types of costs. Present slide 5 as an example of a category grouping. Students may have developed different categories. * When discussing plant costs, consider mentioning possible consumables, such as fuel, lubes and AdBlue. When discussing labour costs, mention operators for the construction plant and other staff, such as vehicle marshals and slingers. * Consider also mentioning the costs related to subcontracts; main contractors will subcontract specialist works. * Explain that a Bill of Quantities is a document that details the costs involved in a project. These will be looked at in detail in the next lesson. * When looking at preliminary costs, to address the common misconception, make sure that students are aware that this does not just cover costs before a project begins. Preliminaries coverage is extensive and is detailed in the NRM: <https://www.rics.org/content/dam/ricsglobal/documents/standards/october_2021_nrm_2.pdf>(pages 51–119). * Explain that NRM 1 focuses on cost estimation and budget planning during the early stages of a construction project, whereas NRM 2 gives guidance on measuring and calculating building works for the BoQ. Show slide 6 which shows an extract from the NRM 2 document. * Use slides 7 and 8 to explain valuations and variations. * When discussing how and why costs are monitored (slide 7), consider explaining that this is not the only approach; contracts can be administered in other ways, such as by lump sum (where work is agreed for a fixed total price) or paid vs. activity schedule (where payments are made as each activity is complete). * Mention that retention percentages aren’t always used. Explain that they are a form of financial security which enables the client to ensure that work is completed properly, and any defects are corrected. There is a defect liability period, which is a set time (usually between 12 and 24 months) after a construction project has finished, where the contractor is responsible for revolving defects. * Explain that interim payments are necessary payments made to contractors as the work proceeds. If necessary, give an example of a variation: if the contract and scope of work had already been agreed, the client deciding to add an attic bedroom to the home would be a variation. * Show slide 9 and explain why controlling and managing costs is vital to the success of a project. * Using slide 10 and the example of building a new residential building or a commercial space, discuss with students why it is important to manage costs:   + Explain that Biodiversity Net Gain (BNG) means builders must make sure their developments leave nature in a better state than before construction.   + Explain that the Building Safety Act (BSA) focuses on making buildings safer. This is particularly important due to recent tragedies like the Grenfell Tower fire. The BSA sets stricter rules for construction.   + Mention that global issues and political changes can also create new challenges. Examples of these are Brexit and the COVID-19 pandemic. * Show slide 11 which explains how the challenges can be managed and introduces the roles students will learn about in the first activity. Students should then watch the video interview that summarises why it is important to accurately estimate and manage costs in industry (<https://vimeo.com/1104064715/e1cf2c67fc>). They can make notes during the video using the Introduction worksheet. Answers are supplied. |
| **Activity 1: Roles**  Suggested time:  15 minutes  Resources:   * L1 Slide deck – slides 12–15 * L1 Activity 1 Worksheet * L1 Activity 1 Worksheet answers | * A key figure in managing and controlling the costs that were discussed in the introduction is the quantity surveyor (QS). The abbreviation QS will be used in the slides so ensure students are aware of this. * Show the quantity surveyor interview video on slide 12 (<https://vimeo.com/1104064839/4c215420ba>). Ask students to take notes while they watch the video using Activity 1 Worksheet which allows them to structure their notes. Answers are provided. * Students might not be familiar with the term ‘fair market value’, which is used by the interviewee. Clarify that this means the reasonable and competitive cost taking into account factors such as location. * If students are interested in career pathways, they can find out more about Associate and Chartered QS status here <https://www.rics.org/surveyor-careers/surveying/what-surveyors-do/what-is-a-quantity-surveyor> * Students could also watch this video: <https://youtu.be/IUuRwIL3y38> explaining reasons why the role of a QS is key for any construction project, from a client’s perspective. The second reason listed in this video is regarding NEC and JCT contracts. For more information about these construction contracts see the *Law and contracts in construction* topic from the Technical Education Network: <https://www.technicaleducationnetworks.org.uk/construction/law-and-contracts-in-construction/> * Once students have watched the QS videos, ask them to summarise the role. Slide 13 gives a detailed answer and slide 14 lists their responsibilities. * Discuss that a typical day for a QS involves a mix of office and site-based work. For example, they may:   + review project documentation and budgets;   + update cost reports and track expenditures against the initial estimates;   + attend site meetings to discuss any design changes or unforeseen conditions that could impact costs;   + prepare a valuation report for the client, ensuring that the project remains financially on track;   + liaise with subcontractors to clarify pricing, assess work completed, and certify payments. * Show slide 15 which summarises the role of an estimator. * If time allows, ask students to research the role of a buyer in construction. |
| **Activity 2: Understanding costs**  Suggested time:  20 minutes  Resources:   * L1 Slide deck – slides 16–22 | * This activity is designed to get students to look in detail at the costs associated with a construction project. * Display slide 16. Organise students into small groups and allow them 5 minutes to make a list of all the different trades that work on a building site. Ask them to rank these by hourly fee in descending order. They should aim to use any knowledge they’ve gained from the course and their placements. If required, allow them to use online research. * Show slide 17. In their groups, or as a class, ask students to discuss and compare their answers. Prompt them to suggest why they think prices vary. For example, level of skill/qualifications required. The rates are taken from: [www.checkatrade.com/blog/cost-guides/how-much-do-tradespeople-cost/](http://www.checkatrade.com/blog/cost-guides/how-much-do-tradespeople-cost/) and: [www.jobsite.co.uk/jobs/plant-operator](http://www.jobsite.co.uk/jobs/plant-operator) * Use slides 18–19 to introduce the concept of ‘all-in’ labour rates. Note that the CITB levy is the Construction Industry Training Board (CITB) levy, which is a contribution paid by construction industry employers to fund training and development within the sector. Slide 19 shows an example of how an all-in labour rate may be calculated. Students can read more about the Construction Industry Joint Council (CIJC) here: <https://cijcemployers.co.uk/> and the National Agreement for the Engineering Construction Industry (NAECI) here: <https://www.njceci.org.uk/national-agreement/> * Ask students to think of any other costs that may need to be considered. Other costs might include travel costs, subsistence, working away from home payments, bonuses, etc. * Encourage students to think about plant costs. Ask them to think about what machinery may be needed on a construction site and then reveal the answers on slide 20. Ask students to estimate what these machines may cost. Reveal the costs on slide 21 and compare these with the student’s answers. * Finally, show slide 22 which demonstrates a sample of material costs. The table is an example to illustrate the type of information that would be needed to calculate a unit cost. In reality, this may vary. For example, for simplicity, bricks are priced by the 1000 but cannot be bought as a unit of 1000 due to variation between manufacturer pack sizes (380, 430, 504 and 600 being typical pack sizes). * Explain that different building suppliers sell different materials in different quantities. Some will allow you to purchase a single item whereas others require you to buy them in set quantities. When buying materials, there are often minimum quantities that need to be bought. |
| **Activity 3: Calculating unit rates**  Suggested time:  25 minutes  Resources:   * L1 Slide deck – slides 23–36 * L1 Activity 3 Reference sheet * L1 Activity 3 Worksheet * L1 Activity 3 Worksheet (scaffolded) * L1 Activity 3 Worked solutions | * This activity will introduce students to calculating unit costs for particular materials. The activity allows students to use the CS3 skill of following standard processes to produce unit rates. * Using slide 23, explain to students that in construction, a unit rate refers to the cost per unit of measurement for a particular activity or material. For example, the cost per square metre of wall built or of a cubic metre of concrete poured. * Use slide 24 to highlight that the calculation considers coverage and wastage of materials as well as labour constants (slide 25). Address the misconception that you can just order the exact amount you need; instead, it is important to factor in an additional amount of material to cover the event of error or breakages. Note that in industry, labour constants might sometimes be referred to differently, such as 'outputs', 'production rates' or ‘productivity norms'. * Note that wastage can vary depending on size. For example, a 6 m2 wall will usually have a higher percentage of wastage than a larger 60 m2 wall. (This is not always the case if using irregular shapes.) * Use the video on slide 26 (<https://vimeo.com/1103437896>), and/or slides 27–29 to introduce the steps you would follow to ‘build up’ the unit rate for building a length of brickwork. * Hand out copies of Activity 3 Reference sheet. This sheet has the data needed for both the worked examples and the worksheets. * Point out that the wastage percentage varies for different materials. For bricks and mortar, it is 5%, but for wall ties it is only 2.5%. This factor is included in any costing tables, so they must check the value they need to use. * A second worked example is provided on slides 30–31 showing finding a unit rate for forming cavities which can be used if students require further guidance on using the technique. * At this stage, students should just focus on calculating unit rates. Their insertion into the BoQ and subsequent multiplying by the quantity to produce a total amount is covered in the next lesson but is shown in the first example to provide the full context for using unit rates. * Explain that most unit rate calculations are now performed using computer estimating systems (slide 32). * Students will practise calculating unit rates using Activity 3 Worksheet on slide 33. There are two levels of the worksheet; one includes scaffolding which some students may find helpful, and one does not. Remind students they should refer to the reference sheet to look up the costs for material and labour. * Teachers can transfer the data from the deck into a spreadsheet to perform/mirror the calculations. Students could use the spreadsheet to perform some of the exercises and complete the others manually (see below). Students who are more advanced with maths and Excel could develop a spreadsheet themselves. * This activity can be completed individually or in small groups. If students are completing the activity in groups, ask them to divide the tasks. For example, one person could look at labour costs, another at materials. They should combine their answers to work out the total cost of the work per unit. The tasks could then be switched around for the next scenario. This mimics real-life team-based cost estimation and offers a practical understanding of how multiple stakeholders contribute to project cost management. * Display the answers using slide 34 or hand out the answer sheet so students can mark their own work. * As a class, discuss the ways a contractor may be able to reduce costs. Compare students’ suggestions with the information on slides 35–36. |
| **Plenary**  Suggested time:  10 minutes  Resources:   * L1 Slide deck – slides 37–38 | * Display slide 37 and ask students what challenges they faced when calculating costs. This will allow them to reflect on their work and identify any areas for improvement. * Instruct students to write three top tips they should remember when performing a unit rate calculation. Prompt them to think about factors such as including all costs, understanding material wastage and calculating labour rates correctly. * Group students into pairs and ask them to share their tips with their partner. Together they should create a final list of three to five tips that includes the most important points from each of their notes. * Review the responses provided by students and consolidate the learning from the lesson using slide 38. |
| **Follow-up/consolidation** (to be completed outside of lesson)  Suggested time:  30 minutes  Resources:   * L1 Slide deck – slide 39 * L1 Consolidation Worksheet * L1 Consolidation Worksheet answer | * Show slide 39 and share the Consolidation worksheet. Task students with calculating a unit rate for repointing a section of external brick wall at their college/school. * Students should accurately measure a section of an external brick wall to determine the area that requires repointing. Then they should calculate a rate for repointing this section based on the size of the wall, material requirements and estimated labour costs. Students could complete this task in pairs. * An example answer is provided (L1 Consolidation Worksheet answer). This could be used for self-assessment or used for peer-review. |

# Lesson 2: Bills of quantities

This lesson looks in detail at bills of quantities (BoQ). Students will gain an understanding of the role and importance of accurate cost estimation in the construction industry and learn how a BoQ supports cost management. Students will get an insight into budgeting and financial planning within the construction industry.

Students practise completing pricing sections of a BoQ and complete some research to learn about the construction standards quantity surveyors must abide to when producing these documents.

## Preparation

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| **Resources provided** | * L2 Slide deck * L2 Activity 1 Worksheet * L2 Activity 1 Worksheet answers * L2 Activity 1 Case study * L2 Activity 2 Worksheet * L2 Activity 2 Poster checklist |
| **Equipment needed** | Projector, whiteboard, worksheets, writing tools, calculators, internet access for research activity, method/equipment for displaying posters in classroom |
| **Prior learning** | * Students should be able to calculate unit rates for construction elements |
| **Common misconceptions** | * When calculating the number of materials, you can buy parts of bags/bits of block, rather than rounding the materials up to buy whole blocks/bags/boxes. In fact, you need to take into account buying in set quantities. * You only need to buy the exact amount of a product to complete a job. In fact, you need to add on additional amounts for breakages and waste, for example when materials need to be cut to fit. |
| **Accessibility** | * You may wish to use pair work to help students of different abilities to support one another. * Seek to ensure wide representation for any case studies used. |

## Activity guide

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| **Introduction**  SUGGESTED TIME:  10 minutes  Resources:   * L2 Slide deck – slides 2–3 | * Introduce the lesson objectives using slide 2 of the slide deck. * Remind students that many costs are involved in a construction project which must be planned and accounted for before a project begins. * Show slide 3 and in small groups, ask students to make a list of the costs that are associated with building a new swimming pool. Ask students to sort these into the four main categories of construction costs.   + Material costs: *concrete, tiles, pipes, reinforcing steel bar (rebar)*   + Labour costs: *tiler, plumber, electrician*   + Plant costs: *excavator, concrete mixer*   + Preliminary costs: *site fencing* * When discussing material costs, check that students remember that they need to add on a wastage allowance and that in some examples, they must round up calculations to buy set numbers of materials, e.g. ten tiles to a pack. You could debunk a misconception further here by asking students to think of the additional wastage on an irregular shaped swimming pool. * As a class, compile a list of reasons why it is important to accurately work out the costs involved in a construction project. For example, the client can budget appropriately, no delays, all materials are available when needed and in the correct quantities. | |
| **Activity 1: Bill of Quantities (BoQ)**  Suggested time:  50 minutes  Resources:   * L2 Slide deck – slides 4–16 * L2 Activity 1 Worksheet * L2 Activity 1 Worksheet answers * L2 Activity 1 Case study | * Activity 1 can be considered in three sections:   + understanding a BoQ and their use,   + completing calculations involved in a BoQ,   + evaluating the use of a BoQ in practice.   Please note: A fictional BoQ is used throughout this activity. Consider using a real BoQ to illustrate a specific construction project alongside the given example.  Understanding a BoQ and their use (10 minutes)   * This activity introduces students to a BoQ and how their use supports cost management in construction projects. * Use the video and summary on slide 4 to describe a BoQ: <https://youtu.be/ouhkzuULHnA> * Explain that they are detailed documents used in the construction industry. Mention that BoQ are unique to each project, but some details can be the same. For example, superstructures when the same house type is used on different projects, but substructures and external works will always be bespoke to the project. * Use slide 5 to explain how the BoQ serves as a basis for tendering. * Explain that BoQs are large documents, often several hundred pages in length. Use slide 6 to introduce the main types of BoQ. Trade BoQ and Elemental BoQ use firm details, whereas approximate BoQs use provisional information. Discuss the differences between the types of BoQ using slide 7. * Show the example of a trade BOQ on slides 8 and 9. Highlight that each section details the type and quantity of materials needed, the type of work required, and sometimes the unit rates for each item. This level of detail helps in maintaining transparency in costing, comparing bids from different contractors, and controlling costs during the project's execution. * Present slide 10 which shows an example final summary in a BoQ. Explain that a well-prepared BoQ is important for project managers and quantity surveyors, as it provides a clear guide for budgeting, ordering materials and tracking project expenses.   Completing calculations involved in a BoQ (20 minutes)   * Use slide 11 to introduce how to complete the pricing section of a BoQ for constructing a brick wall. This would form part of the masonry section. Ask students to think back to their last lesson and recall what a unit rate might include when estimating the cost of constructing a brick wall. For example, the price of each brick, the amount of mortar needed per brick, the labour cost to lay each brick and additional costs like scaffolding and waste disposal. Highlight that a wastage factor is important as an exact amount for what is needed will not be sufficient in the event of breakages. * To address the misconception that any quantity of a material can be bought, remind students that most materials can only be purchased as full bags or blocks and so they may need to round the quantity needed up to a purchasable amount. * Explain the calculation. Students should calculate that the 100 square metres of brick work would cost £5000. Tell students that this calculation is performed for each item in the list. This systematic approach helps contractors and clients clearly understand the breakdown of costs, manage budgets effectively, and compare quotes from different contractors. Using standardised unit rates also ensures consistency and accuracy in cost estimations.  Ask students to think about how long a BoQ would be valid. Prompt them to think about changes in labour costs (for example, linked to the budget) and resource costs (for example, linked to inflation). It is important to point out that fluctuating material and labour costs impact project budgets, so a BoQ needs regular updating to reflect these changes.Using the exercises in Activtiy 1 Worksheet (and slide 12), students practise pricing a BoQ. They can check their answers on slides 13–15 or using Activity 1 Worksheet answers. This activity provides an opportunity to address skill CS3 to follow standard processes to produce unit rates and BoQ.Ask students what challenges they encountered in completing the pricing section of the BoQ. If appropriate, provide further clarification and allow repeat practise in any areas students found difficult.Alternatively, transfer the activity into a spreadsheet. Students could use the spreadsheet to complete some (or all) of the exercises with any remaining done manually. Evaluating the use of a BoQ in practice (20 minutes) Show slide 16. Explain to students that in construction, when you use a BoQ, the work is often remeasured on site as part of a valuation activity. Ask them to read Activity 1 Case study. In pairs, students should role play the discussion that would take place between the contractor and the subcontractor.Discuss the case study as a class. Ask students to feedback their thoughts after the role play: How much did they think the client should pay?  * Explain that if a BoQ is wrong then the outcome is that whoever prepared the document would have to 'bear' the cost of the mistake unless the contract had a clause that reallocated the risk. |
| **Activity 2: New Rules of Measurement (NRM)**  Suggested time:  20 minutes  Resources:   * L2 Slide deck – slides 17–18 * L2 Activity 2 Worksheet * L2 Activity 2 Poster checklist | This activity will introduce students to the standards used in construction to prepare a BoQ. This activity is optional and is intended to reinforce prior learning. It introduces students to the standards used in construction to prepare a BoQ.Use slide 17 to explain the purpose of a Standard Method of Measurement (SMM).  * Show slide 18. Explain that in the UK, the New Rules of Measurement (NRM) is a widely adopted standard that details the measurement rules for different types of works ensuring a consistent framework for all stakeholders in the construction process: [www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/nrm](https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/nrm) * Students should already have an understanding of NRM as this was covered earlier in the course. Activity 2 Worksheet can be used to help students recall their prior knowledge and fill any gaps in their learning. This activity can help students develop their CS1 skill of producing reports and presentations. * To help students to build their digital skills, students could be encouraged to use open AI responsibly. Students who use AI should make sure that they check their answers to make sure that they align with job roles, laws and regulations in the UK. Encourage students to use prompts such as, “Describe three differences between the NRM 1 and NRM 2 versions of the NRM for construction professionals in England”, in order to understand these different methods.  Using their research, instruct students to create an A1 poster explaining what NRM are and why they are important in construction. The poster should present the information with the goal of ensuring everyone understands why using NRM is essential for planning and controlling cost on a project.Students could use the Activity 2 Poster checklist to help them check their posters and evaluate what they might have missed out. Once complete, teachers may choose to display the posters in the classroom.Use the posters as an opportunity for students to peer assess. Students rotate around the classroom marking the posters against the checklist. Students’ assessment of posters could be shared, and the class can discuss the strengths of individual posters. |
| **Plenary**  Suggested time:  10 minutes  Resources:   * L2 Slide deck – slides 19–20 | * Explain to students that the example BoQs they have seen throughout this lesson have used simple explanations. In practice, these descriptions need to be very detailed to clearly outline the required work.  Students should understand that as they learn more about SMM, there are specific rules for how these descriptions should be presented.Review the example provided on slide 19 and ask students to suggest the similarities and differences with the examples used earlier in the lesson.Example points for discussion:  * + Both state unit, quantity, rate and total amount.   + Both break tasks into parts.   + More detailed description of task includes references to diagrams/disposal of material not just excavating.   + Rate per unit given in pounds and pence.  Show slide 20 and review what students have learned in this lesson. |
| **Follow-up/consolidation** (to be completed outside of lesson)  Suggested time:  30 minutes  Resources:   * L2 Slide deck – slides 21–22 | * Organise students into small groups and ask them to produce their own section of a BoQ for a specific task, such as wiring an extension or replacing a flat roof, taking relevant information from the earlier exercises. They can decide on the format of their BoQ. In a future lesson, they could present to other groups and provide feedback. For example:   + Were all costs included?   + Was the BoQ presented clearly?   + Did it have a timescale for which it was valid?   + Did the descriptions meet the NRM requirements?   This task gives students another opportunity to develop their core skills of producing reports and participating in groups to produce solutions to construction problems.   * Alternatively, if students have created a poster as part of the optional activity, they should reflect on the content of their poster and what they have learned about BoQs and cost control. * Instruct them to watch this video which explains NRM: <https://youtu.be/1QUhFYUwuyg>, and then write a couple of paragraphs summarising what they have learned, what they did well and what improvements they could make. |

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| Teaching Guide page 3 | <https://qualifications.pearson.com/en/qualifications/t-levels/design-surveying-and-planning-for-construction-2025.html> | Pearson\* | July 2025 |
| Teaching Guide page 3 | [www.technicaleducationnetworks.org.uk](http://www.technicaleducationnetworks.org.uk) | Technical Education Networks | July 2025 |
| Teaching Guide page 6 | [www.rics.org/news-insights/insights](http://www.rics.org/news-insights/insights) (with permission) | RICS | July 2025 |
| Teaching Guide page 6 and 12 | [www.rics.org/surveyor-careers/surveying/what-surveyors-do/what-is-a-quantity-surveyor](http://www.rics.org/surveyor-careers/surveying/what-surveyors-do/what-is-a-quantity-surveyor) (with permission) | RICS | July 2025 |
| Teaching Guide page 6 | [www.designingbuildings.co.uk/wiki/Home](http://www.designingbuildings.co.uk/wiki/Home) | Designing Buildings | July 2025 |
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| Teaching Guide page 6 | [www.mathsisfun.com](http://www.mathsisfun.com) (with permission) | Maths is Fun | July 2025 |
| Teaching Guide page 6 | [nrich.maths.org](http://nrich.maths.org) (with permission) | NRICH Maths | July 2025 |
| Teaching Guide page 7 | [www.thenational.academy/teachers/key-stages/ks4/subjects/maths/programmes](http://www.thenational.academy/teachers/key-stages/ks4/subjects/maths/programmes) (with permission) | Oak National Academy | July 2025 |
| Teaching Guide page 11 | <https://www.rics.org/content/dam/ricsglobal/documents/standards/october_2021_nrm_2.pdf>(with permission) | RICS | July 2025 |
| Teaching Guide page 12 | <https://youtu.be/IUuRwIL3y38> (with permission) | Metroun Quantity Surveying / YouTube | July 2025 |
| Teaching Guide page 13 | [www.checkatrade.com/blog/cost-guides/how-much-do-tradespeople-cost/](http://www.checkatrade.com/blog/cost-guides/how-much-do-tradespeople-cost/) (with permission) | Checkatrade | July 2025 |
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| Teaching Guide page 13 | <https://cijcemployers.co.uk/> (with permission) | CIJC | July 2025 |
| Teaching Guide page 13 | <https://www.njceci.org.uk/national-agreement/> (with permission) | NJCECI | July 2025 |
| Teaching Guide page 17, Lesson 2 slide 4 | <https://youtu.be/ouhkzuULHnA> (with permission) | Metroun Quantity Surveying / YouTube | July 2025 |
| Teaching Guide page 19, Lesson 2 Activity 2 Worksheet | [www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/nrm](https://www.rics.org/profession-standards/rics-standards-and-guidance/sector-standards/construction-standards/nrm) (with permission) | RICS | July 2025 |
| Teaching Guide page 20, Lesson 2 slide 22 | <https://youtu.be/1QUhFYUwuyg> (with permission) | Metroun Quantity Surveying / YouTube | July 2025 |

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