Chapter 6
New Rules of Measurement: NRM2

6.1 Introduction

NRM2 is part of the suite of documents that make up the RICS New Rules of Measurement. Its full title is *NRM2: Detailed measurement for building works*, and it became operative on 1 January 2013. NRM2 replaces the *Standard Method of Measurement of Building Works (SMM)* that has been used in the United Kingdom since the first edition was published in 1922. Consequently, NRM2 replaces the existing Standard Method of Measurement of Building Works 7th Edition (SMM7) that has been in use since its publication in 1988.

NRM2 has been developed to provide a modern, detailed set of measurement rules for the production of bills of quantities (BQ) and priced schedules of rates for capital building works or maintenance works. It sits between NRM1: *Order of cost estimating and cost planning for capital building works* and NRM3: *Order of cost estimating and cost planning for capital building maintenance works*. Together, the three documents are intended to provide measurement rules for the effective cost management of construction projects throughout their life cycle.

6.1.1 Standard methods of measurement

Standard methods of measurement in the building sector of the construction industry have a long history. The first SMM was published in 1922 and there have been seven editions all told. Some of these are remembered with fondness by users, whilst others have disappeared into the mists of time and are long forgotten. The original purpose of SMMs was to facilitate the production of BQ based on an agreed method of measurement that everyone understood. The creation of standardised BQ benefitted both the industry and construction clients to the extent that tendering costs were lower, tenders received from contractors were more consistent than hitherto, a clear definition of what was included in the tender price could be obtained, and work executed on-site could be remeasured (if desired) using the same agreed principles of measurement.

Managing Measurement Risk in Building and Civil Engineering, First Edition. Peter Williams.

Subsequent editions have introduced ideas, 'modern' at the time, of using standard phraseology for the framing of bill descriptions, and SMM7 was devised with the use of IT in mind and was arranged in accordance with a Common Arrangement of Work Sections (CAWS) rather than the traditional work sections or trades.

Few will mourn the passing of SMM7 (the author included) which, conventional wisdom suggests, has become out of step with the industry and with modern methods of procurement. It remains to be seen, however, whether NRM2 will achieve the popularity of previous editions of the SMM such as the well-regarded (and still used) SMM6. A book consisting of more than 300 pages, variously presented in portrait and (annoyingly) in the landscape style of SMM7 and costing £45 (or subscription to isurv for the interactive version), is not a step in the right direction, despite the 'free' PDF download available to RICS members. Nonetheless, the shortcomings of SMM7 have at least been recognised by RICS Quantity Surveying and Construction Professional Group, and a Measurement Initiative Steering Group concluded *that significant improvements were required*.

With any new method of measurement, comparison with the previous edition is the traditional means of identifying differences in general methodology and measurement detail. NRM2, however, is an entirely new set of measurement rules, and thus, the approach taken in this book is to identify 'risk issues' in order to draw attention to key factors that could influence BQ preparation, tender pricing or potential claims that might arise during the ensuing contract. Notwithstanding, it is hoped that the reader will forgive the occasional backward glance at SMM7 for old time's sake!

6.1.2 International appeal

Many countries around the world, including the Republic of Ireland, the Republic of South Africa, Australia and New Zealand, have developed their own methods of measurement. Invariably, these have been based on UK SMMs but bespoked to local construction methods and practice.

NRM2 Paragraph 1.3.4 states that the *coordinated set of rules and underlying philosophy behind each section* of the RICS New Rules of Measurement *have worldwide application* despite being based on UK practice. No doubt this is true, but no set of measurement rules can be viewed in isolation from the law of the country in which it is used or the method of procurement and conditions of contract that will be used for an individual project.

In view of the wide variety of procurement methods and standard conditions of contract available in various countries, this chapter will focus on the JCT 2011 Standard Building Contract with Quantities and Approximate Quantities used, respectively, for lump sum and measure and value contracts in the United Kingdom.

Prior to NRM2 coming into force, the standard method of measurement referred to in these contracts was the SMM7.

6.1.3 Rules of measurement

The advent of NRM2 marks the passing into history of the phrase 'standard method of measurement', at least for building works in the United Kingdom, and the industry now has a set of new 'rules of measurement' to familiarise itself with. Just what the distinction between the two is remains to be seen as no clarification can be found in the Foreword to NRM2 which claims that it *provides a uniform basis for measuring and describing building works and embodies the essentials of good practice* just as General rules Paragraph 1.1 of SMM7 did.

Speaking of SMM7, it may be useful to compare the 'bulk' of the two documents:

Main section	Pages in SMM7	Pages in NRM2	Variance
General	5	43	+38
Main contract preliminaries	6	50	+44
Subcontract preliminaries	0	20	+20
Measured Work Sections	154	141	–13
Appendices	6	17	+11
Totals	**171**	**271**	**+100**

The 'General' section of NRM2 is much more verbose than its SMM7 counterpart and it is a shame that this material was not kept separate (say, in an appendix). This would have made the general rules much clearer and also provide a useful reference resource for students and practitioners alike.

Notwithstanding the new work section dealing with subcontract preliminaries, a more than sevenfold increase in the number of pages for the measurement of main contract preliminaries is quite beyond reason, whereas the 9% reduction in the measured work sections is to be applauded albeit insufficient. However, the striking similarity with SMM7 in much of the work section content is disappointing.

6.1.4 Amendments to JCT contracts

According to the JCT NRM Update issued in August 2012, all relevant JCT contracts and subcontracts entered into on or after 1 January 2013 should be using NRM2 instead of SMM7. This has necessitated the issue of amendments to the following contracts:

- Standard Building Contract – SBC/Q, SBC/AQ, SBC/XQ.
- Intermediate Building Contract – IC and ICD versions.
- Construction Management Trade Contract.
- Standard Building Sub-Contract – SBCSub/D/C and SBCSub/C.
- Design and Build Sub-Contract – DBSub/C.
- Intermediate Sub-Contract – ICSub/D/C and ICSub/C.
- Intermediate Named Sub-Contract – ICSub/NAM/C.
- Management Works Contract – MCWC/C.

The implications of these amendments for the Standard Building Contract (SBC/Q) 2011 are to remove reference to the phrase 'Standard Method of Measurement' and replace it with 'Measurement Rules'. In particular:

- Clause 1.1 – the definition of provisional sum:
  - **Delete** 'General Rule 10 of the Standard Method of Measurement'.
  - **Insert** 'Paragraph 2.9.1 of the Measurement Rules'.
- Clause 1.1 – definition of Standard Method of Measurement:
  - **Delete** the definition of 'Standard Method of Measurement'.
  - **Insert:**

'Measurement rules: the RICS New Rules of Measurement – Detailed Measurement for Building Works (NRM2), in the form published at the Base Date, unless otherwise stated in the Contract [Bills/Documents]*.'

* Delete as applicable

- Clause 1.4, etc.
  - Either insert the following in clause 1.4.6:
    - 'references to the Standard Method of Measurement shall be read as reference to the Measurement Rules'
  - Or in each of the following clauses, delete 'Standard Method of Measurement' and insert 'Measurement Rules':
    - 2.13.1
    - 2.14.1
    - 5.6.3.3.

Similar amendments apply to the other JCT contracts and subcontracts albeit that the Construction Management Trade Contract requires:

- A choice to be made between the RICS New Rules of Measurement, the Civil Engineering Standard Method of Measurement (CESMM) or another method of measurement as the basis for preparing the Bills of quantities.
- Revisions to the definitions of 'Defined Provisional Sum' and 'Provisional Sum' contained in the Trade Contract.

It is interesting to note that, where BQ are to be used, the Construction Management Trade Contract relies on the NRM2 definitions of 'Defined Provisional Sum' and 'Provisional Sum' as contained within NRM2 Paragraphs 2.9.1.2 and 2.9.1, respectively, and not Paragraph 1.6.3: *Definitions* and that these definitions shall apply irrespective of the method of measurement used.

The JCT NRM Update suggests that the modifications proposed may be incorporated in the various contracts and subcontracts either:

- By amending the contract document, initialling each amendment and executing the contract accordingly
  or
- By attaching the Update to the Contract and inserting an Article to the effect that the Contract Agreement and Conditions are modified as set out in the New Rules of Measurement Update.

6.2 What is NRM2?

The Foreword to NRM2 explains that NRM2 grew out of a perception that there were *problems associated with the measurement of building works at all stages of the design and construction process* and that *significant improvements were required*.

From this research grew a suite of three documents that are intended to cover *all aspects of the measurement and description of a building project from – 'cradle to grave'*. These documents are:

- NRM1: Order of cost estimating and cost planning for capital building works.
- NRM2: Detailed measurement for building works.
- NRM3: Order of cost estimating and cost planning for building maintenance works.

NRM2 is intended to:

- Provide fundamental guidance on the quantification and description of building works for the purpose of preparing:
  - BQ.
  - Quantified schedules of works.

- Provide a sound basis for designing and developing standard of bespoke schedules of rates.
- Provide direction on how to deal with items that are unquantifiable, such as:
  - Preliminaries.
  - Overheads and profit.
  - Contractor-designed works.
  - Risk transfer.
  - Fluctuations.
- Provide a uniform basis for measuring and describing building works.
- Embody the essentials of good practice.

NRM2 is part of the RICS 'Black Book' suite of guidance notes that define good technical standards for quantity surveying and construction professionals.

6.3 Status of NRM2

Unlike previous editions of the SMM, which were silent on this issue, the status of NRM2 is expressly covered in Part 1.1: *Introduction*.

This explains that the RICS New Rules of Measurement in general, and NRM2 in particular, have been given the status of an **RICS guidance note** which is defined as a *document that provides users with recommendations for accepted good practice as followed by competent and conscientious practitioners*. The status of NRM2 is therefore *recommended good practice*.

From this inclusion, it is clear that those responsible for drafting NRM2 were mindful of the increasing tendency towards litigating against construction professionals, such as architects, engineers and surveyors, and that there have been a number of cases where quantity surveyors have been involved in multimillion £ claims for negligent cost planning, cost advice, certification and measurement.

The status of NRM documents, and the standards expected of their users, is discussed, in detail, in Chapter 5.

6.3.1 Negligence

The *Introduction* to NRM2 makes it clear that conforming to the practices recommended in the document should provide *at least a partial defence to an allegation of negligence* and that non-compliance with recommended practice should only be undertaken with justification as a court, tribunal or RICS Disciplinary Panel may ask for an explanation as to why recommended practice was not adopted.

The test applied in cases of professional negligence is, as Patten (2003) suggests, **whether the quantity surveyor acted with the skill and care expected of a reasonably competent member of his profession**, and NRM2 confirms that a court or tribunal may take account of the contents of guidance notes as being indicative of 'reasonable competence'.

However, NRM2 – *Introduction* also states that *where*, within NRM2, *recommendations are made for specific professional tasks, these are intended to represent 'best practice'* which, in the opinion of the RICS, *meet a high standard of professional competence*, that is, a higher standard than that demanded by the courts. This issue is developed in detail in Chapter 5.

Risk Issue

NRM2 – *Introduction* is unclear as to whom the need to comply with an RICS guidance note refers and variously refers to 'members', 'surveyor' and 'user'. Conventionally, the most likely litigant in cases of professional negligence is the employer who, having engaged a professional quantity surveyor, feels that he has received inadequate professional advice or services.

Patten (2003) suggests that quantity surveyors engaged by the employer have less to fear from contractors as, unlike architects and engineers, they do not normally have a certification role. Thus, where the employer is forced into insolvency due to over-certification, based on a quantity surveyor's valuation of the work in progress, the contractor is unlikely to have a claim following the judgement in *Pacific Associates Inc. v Baxter*[1] which held that there was no duty of care owed to the contractor to prevent economic loss in such circumstances.

A more likely possibility is **contribution proceedings** taken against a quantity surveyor by an architect or engineer who has been sued by the employer for negligent certification. In such cases, a 'contribution' may be sought should it be established that the quantity surveyor's measurement or valuation was negligent.

Notwithstanding the foregoing, the popularity of design and build and drawings and specification procurement, and the decline in the use of formal PQS-produced bills of quantities, means that it is subcontractors who may be potential litigants where NRM2-based documents are poorly, inaccurately or misrepresentatively drafted. Consequently, a main contractor or, perhaps, an employer-engaged construction manager may have something to fear should NRM2-based work packages or composite items prove to be misleading.

6.3.2 Pre-action protocol for construction and engineering disputes

The importance of this issue of negligence is not to be understated in that the UK Ministry of Justice has seen fit to publish a *Pre-Action Protocol for Construction and Engineering Disputes* (Ministry of Justice, 2012) that applies to construction and engineering disputes including those involving professional negligence claims against architects, engineers and quantity surveyors. The intention of the protocol is to ensure that:

- The parties are clear as to the issues in dispute.
- Information has been exchanged in a timely and efficient manner.
- The parties have met and have attempted to arrive at a resolution without re-sort to litigation.
- Should litigation ensue, it can proceed in an efficient manner.

The status of NRM2 as a guidance note is not to be taken lightly!

6.4 NRM2 structure

In addition to its Foreword, Acknowledgements and Introduction, NRM2 comprises:

- Part 1: General.
- Part 2: Rules for detailed measurement of building works.
- Part 3: Tabulated rules of measurement for building works.
- Appendices.

NRM2 Part 1, in common with Part 2, contains a considerable amount of dialogue that is more in keeping with a textbook than a standard method of measurement. As a consequence, it is tempting to 'skip' some of the text in order to get into the 'meat' of the rules of measurement themselves. This would be a mistake as there are a number of 'gems' in Parts 1 and 2 that deserve careful consideration, especially in the context of what might be loosely termed 'risk issues'.

Navigating NRM2 is easy. Each of the three main parts and seven appendices has a hierarchy of numbered paragraphs. For example, Part 2: *Rules for detailed measurement of building works* has 17 paragraphs, most of which are subdivided into sub-paragraphs. The paragraph numbering structure is akin to a work breakdown structure (WBS) with a series of levels. Some paragraphs have a title or heading and some do not. Table 6.1 (Section 6.8.1) illustrates how the paragraph numbering system works.

6.5 Part 1: general

This part of NRM2 is both contextual and explanatory:

- Measurement is contextualised in terms of the design process relative to two common process models – the RIBA Plan of Work and the OGC Gateway Process (see Chapter 4).
- The purpose, use and structure of NRM2 are explained.
- Symbols and abbreviations used in NRM2 are explained.
- Some 33 words and phrases used later on in the document are defined.

Risk Issue

The status of Part 1: *General* is unclear.

Parts 2 and 3 are clearly entitled 'rules', but Part 1 does not have 'rules' in its title (unlike SMM7: General rules). Paragraph 1.1.1, however, does state that Part 1 *explains the symbols, abbreviations and definitions used in the rules*, and, as such, it may be the case that Part 1 carries the status of 'rules'.

This is an important distinction because, where there is doubt in interpreting the 'rules' in Parts 2 and 3, the definitions in Part 1 may well assume a key clarification role, especially if there is a dispute, as to the meaning of the rules of measurement.

6.5.1 Measurement in context with the RIBA Plan of Work and OGC Gateway Process

NRM2 Paragraph 1.2 briefly explains the methodology of the RIBA Plan of Work and the OGC Gateway Process and identifies the point at which measurement is carried out for the purposes of producing BQ, quantified schedules of works or quantified work schedules. This point is defined as RIBA Work Stage G (Tender Documentation). This is the traditional point when such documentation would be prepared – when the design is sufficiently well developed – but this fails to acknowledge that pricing documents are prepared at much earlier stages in non-traditional procurement methodologies.

In this context, it is disappointing to note that Part 3: *Tabulated rules of measurement for building works*, bears striking similarity to SMM7, and it would seem that a golden opportunity has been overlooked to design a much simpler and less detailed standard method of measurement that could be used by a variety of 'users' in a number of procurement situations.

Risk Issue

Notwithstanding the above, NRM2 Rule 3.3.3.12 provides for the creation of composite items where separate components or sub-components may be combined to form a single item. Such items would be 'user defined' and, as such, may potentially lead to a dispute or litigation should the description of a composite item lack clarity as to item coverage (see also Section 6.10.1).

6.5.2 Purpose of NRM2

The stated purpose of NRM2 is explained in Paragraph 1.3 which is to:

- Provide a standard set of measurement rules for the procurement of building works that:
  - Are *understandable by all those involved in a construction project, including the employer*.
  - Facilitate *communication between the design/project team and the employer*.
  - Set out information requirements *from the employer* and *consultants to enable a BQ to be prepared*.
  - Deal *with the quantification of non-measurable work items, contractor designed works and risks*.
  - *Create a coordinated set of rules and underlying philosophy* that will *have worldwide application*.

6.5.3 Use of NRM2

Paragraph 1.4 explains that the RICS New Rules of Measurement:

- Provide the means to measure building work in a structured and consistent way.
- Represent *the essentials of good practice*.
- Address the production of BQ for entire projects and for discrete work packages.
- Can also be used to prepare:
  - Quantified schedules of works.
  - Quantified work schedules.
  - Standard and bespoke schedules of rates for:
    - Discrete contracts.
    - Term contracts.
    - Framework agreements.

Nowhere within NRM2 are the terms 'quantified schedules of works' and 'quantified work schedules' defined. In fact, Part 2: *Rules for detailed measurement of building works* is completely given over to BQ production without reference to other forms of documentation.

The unit of measurement adopted in NRM2 is the metric system with a point (.) as a decimal marker and a comma (,) as a thousands spacer.

6.5.4 Structure of NRM2

Paragraph 1.5 expands on the structure of NRM2 with particular reference to Parts 1, 2 and 3 and the Appendices. There is no dialogue of importance here, and there seems to be little point in this inclusion which is no more than an expanded list of contents.

6.5.5 Symbols, abbreviations and definitions

Paragraph 1.6 consists of:

- 1.6.1: Symbols used for measurement.
- 1.6.2: Abbreviations.
- 1.6.3: Definitions.

Paragraphs 1.6.1 and 1.6.2 are self-explanatory, but Paragraph 1.6.3 contains a number of important definitions, some of which deserve particular mention.

6.6 Definitions

NRM2 Paragraph 1.6.3: *Definitions* provides a list of 33 words or phrases used in the document which should be understood. Some of these definitions are self-explanatory, whilst others are significant either because they are:

- important in terms of the rules of measurement

or because they are:

- ill defined or could lead to confusion or even dispute.

A number of the definitions raise risk issues that ought to be carefully considered by users of NRM2, and thus, this section concentrates on 19 definitions that are considered to be important.

6.6.1 Bill of quantities

This is defined as *a list of items*, with *detailed identifying descriptions* and *firm quantities*.

Risk Issue

This is a misleading definition because it excludes the very likely possibility that the bills of quantities might contain provisional quantities or defined/undefined provisional sums. These terms are defined later on in Paragraph 1.6.3.

There is no definition of bills of approximate quantities although these are specifically mentioned in Paragraph 2.4.3 in the context of types of bills of quantities.

6.6.2 Daywork

This is defined as a *means of valuing work on the basis of time spent by the contractor's workpeople, the materials used and the plant employed.*

Risk Issue

This definition is at odds with a further definition given in Paragraph 2.13.3.1 which refers to contractor's employees. Employees are engaged on a contract of service or employment contract, and this excludes subcontractors.

There is no mention of the RICS *Definition of Prime Cost of Daywork for Building Work*, or any other definition for that matter, nor is reference made to a definition of prime cost (PC) of daywork in Paragraph 2.13.3 which expands on the subject of daywork. This may be a reflection of the 'neutrality' of NRM2 which is intended to be used in other jurisdictions beyond the United Kingdom.

Paragraph 2.13.3.2 states that if a schedule of dayworks is incorporated into the BQ, then a statement as to how the contractor will be paid is to be given in the preliminaries bill or schedule of dayworks.

Risk Issue

Paragraph 2.13.3.2 sounds like a 'rule'.

However, payment terms are the normal province of the conditions of contract, and care needs to be taken in complying with Paragraph 2.13.3.2 in order to avoid a conflict between the conditions and the contract bills.

Paragraph 2.13.3.3 requires that *the method of calculating labour time charge rates…for work carried out outside of normal hours (i.e. non-productive time)* *shall be defined* in the schedule of dayworks and that the definition of 'normal working hours' *shall be given* in either the preliminaries bill or schedule of dayworks. This is a sensible inclusion as it is often a 'bone of contention' as to what constitutes 'premium time' (e.g. weekend working).

6.6.3 Defined provisional sum

This definition is the same as that given in General Rule 10.3 of SMM7 and relates to the expenditure of sums for work that is envisaged but cannot be accurately quantified due to incomplete design. The nature, location, scope and extent of the work, together with indicative quantities and any specific limitations, *shall be* provided.

This definition should be read in conjunction with Paragraph 2.9.1: *Provisional sums* and, in particular, with Paragraph 2.9.1.2 which provides an amplified definition of the term 'defined provisional sum'.

There seems little point having a definition of a term that has to be redefined elsewhere in the document, however.

6.6.4 Design team

In NRM2, this *means architects, engineers and technology specialists* who have responsibility for the conceptual design of a building or structure and for its development into drawings, specifications and instructions for construction and associated purposes.

The 'design team' is defined as being part of the 'project team', but the term 'project team' is not defined in NRM2. Unless quantity surveyors are 'technology specialists', they would appear not to be members of the design team nor, would it seem, are contractors or subcontractors who may nevertheless contribute to the design concept and its development under some methods of procurement.

The reasoning for this bizarre definition is obscure as the term 'design team' is not used anywhere in NRM2. Paradoxically, the terms 'project team' and 'employer's project team' are used in several places, but neither term merits a definition. Even more strange is the lack of a definition for the 'quantity surveyor/cost manager' who has a number of defined duties under NRM2. The quantity surveyor is identified in Article 4 of JCT 2011.

Paragraph 2.7: *Preliminaries* of NRM2 explains how the 'preliminaries' section of a BQ might be set out and quantified. Paragraph 2.7.3.1: *Information and requirements* is stated as being the descriptive part of the main contract preliminaries which sets out, inter alia, the names and contact details of the 'employer' and the 'employer's project team'.

Risk Issue

The 'employer's project team' may well include the architect and other designers, the (CDM) principal designer, the quantity surveyor, maybe a clerk of works or inspector and, possibly, personnel within the employer's organisation that deal with accounts and payments and other administrative matters.

Care needs to be exercised in defining just who is included in the 'employer's project team' in order to make sure that the list includes those named in the Articles of Agreement in the contract who have particular duties or authority under the contract (see, e.g. the Articles of Agreement in JCT 2011 and in particular Articles 3–5).

Being a statutory appointment that must be made by the employer under CDM Regulation 5(1)(b) and named in JCT 2011 Article 6, the question arises as to whether or not the principal contractor is a member of the 'employer's project team'.

6.6.5 Director's adjustment

This refers to *a reduction or addition to the tender price* compiled by the contractor's estimating team *offered by the director(s)*.

The use of the word 'offered' implies something capable of being accepted or refused, but the true meaning is undoubtedly that of a final adjustment to the tender figure which constitutes the contractor's 'offer' which the employer may subsequently accept or reject. The positioning of the apostrophe in the heading *Director's Adjustment* implies the action of a single director, whereas the definition contemplates more than one.

Paragraph 2.13.2 expands on the reasons for a director's adjustment where it is also stated that *separate provision is to be incorporated* in the BQ *for the contractor to insert a 'director's adjustment'*; Appendices D and E show how this might be achieved in a pricing summary template.

NRM2 does not explain whether the director's adjustment is:

- To be regarded as an adjustment to the BQ rates.
- To be added to or deducted from interim payments in proportion to the value of work carried out and the contract sum.
- A lump sum to be added or deducted at final account stage.

Risk Issue

Nowhere in NRM2 is there a rule stating how the director's adjustment is to be applied when it comes to interim payments, the valuation of variations, the expenditure of provisional sums or calculation of the final account.

This is an important omission as, without such a rule, the contract administrator (as certifier) and/or the quantity surveyor (as valuer) could be liable to:

- The employer for negligent certification should the contractor be overpaid.
- The contractor for breach of duty of trust should the contractor be underpaid.

A comparison of the implications of the various methods for dealing with the director's adjustment post-contract is provided in Chapter 14, Section 14.2.

6.6.6 Employer

This term is taken to mean 'the employer' in the normally accepted sense in construction contracts, or it could mean 'end user' or someone with delegated powers in central government, such as 'senior responsible owner' or 'project sponsor'.

This definition would seem to be of most importance in relation to the provision of information for measurement purposes (NRM2: Paragraph 2.14 refers).

6.6.7 Fixed charge

This relates to work where the cost is unrelated to duration.

Fixed charges appear as a 'pricing method' in Part 3: *Tabulated rules of measurement* in the Part B: *Pricing schedule* of Preliminaries (main contract) and Preliminaries (work package contract). See also 6.6.16.

6.6.8 Main contractor

This is another curious definition because, whilst the term 'main contractor' is used in NRM2, the predominant reference is to 'the contractor'.

Risk Issue

The distinction is important because 'the contractor' has specific duties in Part 3 of NRM2 including the provision of documents relating to the design, production information, as-built drawings and documents required before practical completion (Tabulated Work Section 1.6.3 refers).

The definition makes no distinction between the main contractor (under the civil contract) and the principal contractor (who carries the statutory duty under the CDM Regulations). Very often, the main contractor and the principal contractor are one and the same, but there are occasions when the statutory duty is undertaken by another party (the employer or a contractor appointed as a construction manager, for instance).

The inclusion within the definition of the term 'prime contractor' reflects current practice in central government procurement.

6.6.9 Main contract preliminaries

This is defined as *items that cannot be allocated to a specific element, sub-element or component*.

This definition is taken from NRM1 and fails to refer to the NRM2 phrase *item or work to be measured*.

In terms of NRM2, preliminaries would consist, *inter alia*, of items that cannot be allocated to a specific measured item in the BQ, irrespective of the format of the BQ (i.e. elemental, work section, work package). Therefore, even in an elemental BQ, which would be subdivided into elements and sub-elements, the BQ would contain items described in accordance with NRM2 (i.e. items or work to be measured), and the NRM1 'component' level of detail would not apply.

Notwithstanding, items/work and components are measurable items, and preliminaries are non-measurable except in units of time or money.

The definition specifically excludes *costs associated with subcontractors' or work package contractors' preliminaries* from the main contract preliminaries. This statement merits some

consideration because the contractor needs to be sure where to price his subcontractors' preliminaries (if there are any) because:

- Subcontractor preliminaries need to be included somewhere in the contractor's tender.
- The contractor may prefer to separately identify subcontractor preliminaries as they may be material to the valuation of a variation or a claim.
- The contractor may wish to include subcontractor preliminaries in the method-related charges.

Domestic subcontractors who carry out traditional 'trades', such as joinery, plastering and painting, do not normally price any preliminaries items in their quotations, but others do. Piling subcontractors can have significant fixed and time-related charges to consider as can those responsible for formwork and structural concrete packages, structural steelwork erection, installation of heating and air-conditioning plant, etc.

Risk Issue

Normal practice is that main contractors price their subcontractors' preliminaries in either the measured rates or in the main contract preliminaries. However, NRM2 poses some challenges to convention because these two places are specifically excluded by NRM2 for pricing subcontractor/work package contractor preliminaries, namely,

- The *costs associated with subcontractors' or work package contractors' preliminaries* are excluded from the main contract preliminaries in the definition.
- The coverage rule for measured items of work does not include subcontractors' preliminaries items *unless specifically stated otherwise in the BQ* (NRM2 Paragraph 3.3.3.13 refers).

For more on work package contract preliminaries, see Section 6.6.19.

6.6.10 Overheads and profit

This is defined to mean:

- *The contractor's costs associated with head office administration apportioned to each building contract* plus
- *The main contractor's return on capital investment.*

This definition is entirely misleading.

To begin with, the definitions of 'overheads' and 'profit' are well understood in the industry:

- Overheads

The Chartered Institute of Building (CIOB, 2009) *Code of Estimating Practice* defines 'head office overheads' as *the incidental costs of running a business as a whole*. This implies much more than the costs of administration as stated in the NRM2 definition and includes directors' salaries, company cars, company pension contributions, auditing fees and the cost of financing working capital. In the annual accounts, head office overheads are normally classed as 'administration expenses' which, together with any interest repayments on borrowings, makes up the 'overhead'. This is entirely consistent with the CIOB definition.

- Profit

Contractors' profit is normally expressed as a percentage of annual turnover and not as return on capital employed. Return on capital employed is often used as a financial ratio in accounting

circles and, by investors, as a measure of the how efficiently working capital has been used; it is not a consideration at tender stage nor is it normally used as a means of adding profit to a contractor's tender.

Secondly, contractors do not necessarily apportion overheads to *building* contracts – the contractor may undertake all sorts of other work as well which will attract an overhead allowance.

Thirdly, profit, when added as a 'markup' on BQ rates, is invariably added as a percentage related to turnover and not to the return on capital invested in the business.

Paragraph 2.11.1 states that:

- Provision shall be made in the BQ to enable the contractor to apply a percentage for overheads and profit on:
  - Preliminaries.
  - Measured work.
  - Risk allowances.
  - Work relating to the expenditure of provisional sum.

Paragraph 2.11.2 says that 'overheads' and 'profit' can be treated as two separate items.

What Paragraph 2.11 does not say is:

- Where the percentage addition shall be inserted in the BQ; Appendices D and E are templates provided in NRM2 which show this as being on the final summary, but there is no rule to this effect, however.
- That provision could be made at the end of each work section, if desired, without breaching the rules of measurement.
- That provision for a percentage shall be a separate percentage for each listed item (i.e. preliminaries, measured work, etc.).
- Whether or not the contractor is obliged to insert a percentage.

Adding to the confusion, Paragraph 3.3.3.13 says that each component/item in the BQ shall *be deemed to include*:

(7) *Establishment charges* – normally a synonym for 'overheads'

Risk Issue

The definition of overheads and profit is likely to lead to disagreement at best and disputes at worst.

It is misleading, wrong in parts and conflicts with other parts of NRM2, particularly when read in conjunction with Paragraphs 2.11 and 3.3.3.13.

The issue of 'overheads and profit' is further discussed in Section 6.7.11 of this chapter.

6.6.11 Prime cost sum

This is *a sum of money included in a unit rate to be expended on materials or goods from suppliers*. This is a 'supply-only' rate for materials or goods whose precise quality is unknown.

Presumably, whilst the precise quality is not known, the precise quantity is. The PC sum excludes the cost of fixing, fees, preliminaries, overheads and profit, etc.

In the specific paragraph (3.3.7) that deals with the NRM2 procedure where the exact type of product or component is not specified, the term 'PC sum' is not used. In this paragraph, the term 'PC item' is used, and it seems that this is the term that should be used in the relevant item description.

The idea of the contractor pricing work using a PC sum for the cost of materials is not new. The process is that the contractor prices the item using the PC sum as the basis for the cost of materials/goods (e.g. PC sum of £700/thousand for facing bricks), and he then adds any ancillary costs (such as mortar), labour, plant (cement mixer) and margin. When the exact quality (and cost) of the materials in question is known, the unit rate is adjusted by omitting the PC sum (say, £700) and adding back the actual cost (say, £590/thousand).

This is pretty straightforward contract administration, but it is a process that worked in the days when the expenditure of PC sums was catered for in the JCT standard contract. This is now not the case and, consequently, there may be problems with administering such items in the context of the interface between NRM2 and the conditions of this particular form of contract.

Risk Issue

Clause 3.10 of JCT 2011 SBC/Q requires the contractor to comply with instructions which the architect/contract administrator is expressly empowered to give.

The JCT 2011 SBC/Q contains no provision for PC sums, whether included in a unit rate or otherwise, nor is there an express power for the architect/contract administrator to issue instructions regarding the expenditure of PC sums.

Clause 3.16 deals with architect/contract administrator instructions regarding the expenditure of provisional sums only.

On the face of it, the obvious way round the problem is to adjust the PC sum by issuing a variation instruction under Clause 5.1 of JCT 2011 SBC/Q. However, the definition of 'variation' in Clauses 5.1.1 and 5.1.2 does not provide for such circumstances.

Clause 5.1.1 refers to *the alteration or modification of the design, quality or quantity of the Works*, and Clause 5.1.2 deals with *the imposition by the Employer of any obligations or restrictions* regarding issues such as access to the site, limitations of working space or working hours or the execution or completion of the work in any specific order.

This definition needs to be read in conjunction with Rules 3.3.7 and 3.3.3.13 of the Tabulated rules of measurement.

6.6.12 Provisional quantity

This is defined to mean *a quantity which cannot be accurately determined (i.e. an estimate of the quantity)*.

The definition is clear enough, but NRM2 is not at all clear on the general use and application of provisional quantities which practitioners will remember are referred to as 'approximate quantities' in SMM7.

The definition of 'provisional quantity' needs to be read in conjunction with Paragraph 2.4: *Types of bill of quantities* and Paragraph 3.3.8 of NRM2 which are discussed in Section 6.7.4 of this chapter.

6.6.13 Provisional sum

This is defined as a sum of money that is set aside to carry out work that cannot be described and quantified in accordance with Part 3: *Tabulated rules of measurement for building works*.

The definition says that a provisional sum *will be* identified as 'defined' or 'undefined' not shall be as is required by General Rule 10.2 of SMM7 and by NRM2 Rule 2.9.1.1.

It is disappointing that the definition is so imprecise and that users of NRM2 are obliged to search for a further definition, in Paragraph 2.6.7, only to find out that the rules relating to

provisional sums are to be found in yet another paragraph of the document. Paragraph 2.6.7.3 stipulates that the rules are given in Paragraph 2.9.1.

NRM2 Paragraph 2.9.1.1 specifies that work items that cannot be measured in accordance with the tabulated rules of measurement *shall be* given as a 'provisional sum' and that the work shall be identified as 'defined work' or 'undefined work' as appropriate.

See also Section 6.7.9 on provisional sums.

6.6.14 Residual risk (or retained risk)

This *means the risks retained by the employer.*

Just why there is a need for this definition is unclear as, nowhere in NRM2, are such risks defined or otherwise identified. Additionally, it would seem that there is no mechanism within the measurement rules for the contractor to be notified as to exactly what these risks are.

Paragraph 2.10.4.1 gives a clue such that residual risks retained by the employer are represented by risk allowances in the cost plan. Conventionally, such risks are translated into the BQ by means of provisional quantities, provisional sums or contingency allowances, but there is no mechanism in NRM2 for this to happen.

Other clues are to be found in the Appendices:

- Appendix D
  The template for a condensed 'pricing summary' provides for 'risks' under cost centre 11.0, but these are not defined.
- Appendix E
  Similarly, the expanded 'pricing summary' template includes 'risks' under cost centre 10.0, but no detail is given.
- Appendix F
  A template for a 'schedule of construction risks' is provided, but these would appear to be risks borne by the contractor and not those retained by the employer.

Paragraph 2.10.4.2 indicates that the contractor may be approached to undertake such risks at a premium, but there is no suggestion within NRM2 as to how this might be done or how the contractor might be asked to price such risks at tender stage. Under JCT 2011 SBC/Q, this might be taken to indicate that the contractor may be asked to provide a 'variation quotation' for undertaking employer's retained risks; the contractor, however, has the right to object under the contract conditions and, with proper notice, is not required to provide a quotation.

Paragraph 2.10: *Risks* should be consulted for additional information albeit that it casts very little light on the foregoing.

6.6.15 Subcontractor

This *means a contractor employed by the main contractor* to carry out *specific work* and is a synonym for *specialist, works, trade, work package and labour-only contractors.*

The question as to whether a 'subcontractor' is a 'work package contractor' in respect of preliminaries is discussed in Sections 6.6.18 and 6.6.19.

6.6.16 Time-related charge

This relates to work where the cost is dependent on duration.

Fixed and time-related costs in construction are normally regarded as 'preliminaries' or site 'oncosts' which are items largely concerned with the management of a project and the way that

the contractor intends to carry out the works. In the United States, this is called 'means and methods' which rather graphically conjures up the idea of the resources and practicalities of how the job will be done.

The significance of the definition of fixed and time-related costs is to be found via the somewhat tortuous route of:

- Part 3: *Tabulated rules of measurement for building works*
  - Tabulated work sections
    1. Preliminaries (main contract)
       Part B: Pricing schedule
    1.1 Employer's requirements
    1.2 Main contractor's cost items.

This 'pricing schedule' provides a list of preliminaries items where the 'pricing method' is stated as 'fixed charge', 'time-related charge' or sometimes both.

6.6.17 Undefined provisional sum

This is a sum of money provided for work where the nature, location, scope and other information requirements of a defined provisional sum cannot be stated. Unlike General Rule 10.5 of SMM7, the NRM2 definition clarifies that undefined provisional sums are *for work that is not completely designed*.

Part 2: *Rules for detailed measurement of building works* also provides information about provisional sums (Paragraph 2.6.7 refers). However, no actual rules are stated here, and thus, it is necessary to look at Paragraph 2.9.1: *Provisional sums* to discover how provisional sums are to be dealt with in the BQ. As if there was not enough unnecessary dialogue in NRM2, Paragraph 2.9.1 goes on to repeat all of the definitions relating to provisional sums that can be found in Paragraph 1.6.3: *Definitions*.

The reader has to search for the important bit about provisional sums which is to be found in Paragraph 2.9.1.3 where it is stated that the work to which defined provisional sums apply *shall be deemed* to have been allowed for in the contractor's *programming, planning and pricing* [of] *preliminaries*.

Political correctness having now arrived in a standard method of measurement for the first (and hopefully the last) time means that 'his' or 'her' is used in Paragraph 2.9.1.3 when referring to the contractor!

Risk Issue

This is not the sort of imprecise language usually found in a standard method of measurement, and perhaps a sharp barrister could make capital out of the fact that most standard contracts refer to the contractor as 'he' and that many contractors are limited companies and therefore merit the sobriquet of 'it' (i.e. a legal entity, not a person)!

6.6.18 Work package contractor

Inexplicably, a distinction is drawn between 'subcontractor' and 'work package contractor' who is defined as *a specialist contractor who undertakes particular identifiable aspects of work*.

Just why this should be so is somewhat confusing as the definition of 'subcontractor' includes work package contractors (Paragraph 1.6.3 refers).

The definition concludes by explaining that *works contractors* (i.e. not work package contractors) *may be employed directly by the employer or by the main contractor* according to the *contract strategy* employed. This would appear to fit with management contracting and construction management procurement in particular.

6.6.19 Work package contract preliminaries

These are defined as *preliminaries that relate specifically to the work that is to be carried out by a work package contractor*. Part 3: *Tabulated Work Section – Preliminaries* makes specific provision for the separate pricing of work package contract preliminaries.

NRM2 Paragraph 2.7.4 explains that work package contract preliminaries consist of two components:

1. *Information*
   The descriptive part of work package contract preliminaries where general information is to be found such as the project particulars and description of the works.
2. *Pricing schedule*
   Where the work package contractor prices the preliminaries items relating to the particular work package in question.

NRM2 is not exactly crystal clear as to how, or in what circumstances, work package contract preliminaries are employed. Paragraph 2.7.4.2 seems to suggest that work package contract preliminaries represent part of a work package tender submission together with measured items of work that relate to the particular work package in question which, if the tender is successful, will form part of the subsequent work package contract.

It is difficult to see this happening for a traditionally tendered contract as it is the employer's quantity surveyor/cost manager who must determine the number and content of the work packages as Paragraph 2.15.3.1(3) of NRM2 suggests. Consequently, work package contract preliminaries are most likely to arise for contracts procured on a management contracting or construction management basis where the management contractor or construction manager is appointed on a fee-only basis.

This issue is discussed further in 6.7.7.

6.7 Part 2: Rules for detailed measurement of building works

6.7.1 Introduction

Notwithstanding Part 1: *General* Paragraph 1.1.1, Part 2 of NRM2 is devoted exclusively to the preparation of BQ of various sorts. Little mention is made of schedules of works or work schedules despite the claim in Paragraph 1.3.2 that the purpose of NRM2 is also to provide rules for the preparation of schedules of works (quantified) and to develop bespoke and standard schedules of rates.

Paragraph 2.1.1 explains that Part 2 of the rules:

- Describes the purposes and uses of NRM2.
- Describes the types of BQ.
- Gives guidance on the composition and preparation of BQ.
- Defines the information required to enable a BQ to be prepared.
- Sets out the rules of measurement of building items.
- Sets out the rules for dealing with:
  - Preliminaries.
  - Non-measurable works (provisional sums – see Paragraph 2.6.7).

- Contractor-designed works.
- Risks.
- Overheads and profit.
- Credits.

Paragraph 2.1.2 states that Part 2 of the rules:

- Deals with other aspects of BQ production including:
  - Price fluctuations.
  - Director's adjustments.
  - Daywork.
  - VAT.
- Provides guidance on:
  - The codification of BQ.
  - The use of BQ for cost control and cost management.
  - The analysis of a BQ to provide cost data.

Part 2 is, therefore, a combination of descriptions, guidance, definitions and rules.

Whilst much of this information is no doubt well intentioned, most practitioners will need to quickly, easily and unequivocally understand the rules of measurement so that:

- BQ can be structured correctly.
- The work involved in a project can be described clearly and consistently and measured accurately.

To do this, it is necessary to do a lot of reading in order to distinguish 'optional' descriptive text and guidance (bearing in mind the status claimed for NRM2) from the actual rules of measurement that must be followed. Without clear rules of measurement that must be followed and, above all, are clear to all those concerned, there is no point in having a standard method of measurement.

A starting point to discover where the rules of measurement are to be found is in Paragraph 2.6: *Composition of a bill of quantities* albeit that a considerable amount of reading is needed to find them:

- 2.6.5: *Measured work* – The rules are given in Paragraph 2.8.
- 2.6.6: *Risks* – The rules are given in Paragraph 2.10.
- 2.6.7: *Provisional sums* – The rules are given in Paragraph 2.9.1.
- 2.6.8: *Credits* (for materials arising from the works) – The rules are given in Paragraph 2.12.
- 2.6.9: *Dayworks (Provisional)* – The rules are given in Paragraph 2.13.3.

Inexplicably, there is no reference to 'rules' in Paragraph 2.6.4: *Preliminaries*, and precious little of the content of this paragraph even approaches the status of a rule. Paragraph 2.6.4.3 does say that *the quantification of preliminaries is dealt with in paragraph 2.7*, but this is hardly a rule. Even the lengthy Paragraph 2.7: *Preliminaries* contains only two items that vaguely resemble rules.

However, the penultimate paragraph of Paragraph 2.7.3.2 imposes the following duties on the quantity surveyor/cost manager:

- Instruct the main contractor to return a full and detailed breakdown of the total price for preliminaries with the tender.
- Request that this information is appended to the priced BQ.
- Ensure that the supporting calculations are presented in an easy-to-read and logical format.
- Instruct the main contractor to ascertain the price for preliminaries in accordance with the rules of measurement for main contractor's preliminaries – Part B (pricing schedule) of Table 1 (preliminaries (main contract) at Part 3: *Tabulated rules for measurement* of these rules).

- Make it clear to the main contractor *that costs relating to items that are not specifically identified in* [the] *full and detailed breakdown will be deemed to have no cost implications or have been included elsewhere within (the) rates and prices*.

As far as Paragraph 2.7.4: *Preliminaries* (works package contract) is concerned, Paragraph 2.7.4.2 emphasises that *it is essential* for the work package contractor to be *instructed to provide a full and detailed breakdown* that clearly shows how the *price for each* [preliminaries] *item has been calculated* and *how the total price for preliminaries* has been arrived at. The paragraph stops short of imposing this duty on the quantity surveyor/cost manager.

Consequently, the Part 2 obligatory rules of measurement (or reference thereto) are to be found in:

- 2.7 Preliminaries.
- 2.8 Measurement rules for building works.
- 2.9 Non-measurable works.
  - 2.9.2 Contractor-designed works.
  - 2.9.4 Works to be carried out by statutory undertakers.
- 2.10 Risks.
  - 2.10.1 Risks generally.
  - 2.10.2 Risk transfer to the contractor.
  - 2.10.3 Risk sharing by both employer and contractor.
- 2.11 Overheads and profit.
- 2.13 Other considerations.
  - 2.13.1 Price fluctuations.
  - 2.13.2 Director's adjustment.
  - 2.13.3 Dayworks (provisional).
- 2.14 Information requirements for measurement.
  - 2.14.3 Specification.
  - 2.14.4 Drawn information.
  - 2.14.5 Schedules.
  - 2.14.6 Reports and other information.

To some, the foregoing observations may appear 'picky' albeit that they are genuinely meant to be constructive. Had Part 2 not been entitled 'Rules for detailed measurement of building works', there would have been no room for criticism because much of the text provides sensible and logical guidance and information. However, Part 2 does have 'Rules' in its title, and it is a shame that these rules have not been more clearly identified.

Consequently, there is little point concentrating on the remainder of Part 2 here as this would simply be a reiteration of the contents of NRM2 Part 2 save to say that Paragraphs 2.7 and 2.8 are worth reading because they explain good practice in the composition of the various components of a BQ.

What follows, therefore, is purely concerned with issues arising from the rules of measurement as stated under Paragraphs 2.7–2.14 inclusive. The one exception is Paragraph 2.4: *Types of bills of quantities* which is material to both Paragraph 1.6.3: *Definitions* and Paragraph 3.3.8: *Procedure where quantity of work cannot be accurately determined* despite containing no actual rules.

6.7.2 Purpose of bills of quantities

Paragraph 2.2.1 explains that the primary purposes of BQ are:

- As a tender document.
- As a contract document which is used for:
  - The valuation of work carried out so that interim payments can be made to the contractor.
  - The valuation of varied work.

It further explains that a BQ is a coordinated list of items with identifying descriptions and quantities. There are no 'rules' in this paragraph.

Whilst BQ (and the like) have a number of other important purposes, NRM2 classifies these as 'benefits'.

6.7.3 Benefits of BQ

The benefits accruing from BQ are explained in Paragraph 2.3.1 which also points out the need for one party or the other to quantify the extent of the works at some stage irrespective of the chosen procurement strategy. This could be:

- The employer's quantity surveyor/cost manager.
- The main contractor.
- Work package contractors.

Again, there are no 'rules' in this paragraph.

6.7.4 Types of BQ

Paragraph 2.4 distinguishes between two types of BQ:

- Firm BQ (Paragraph 2.4.2).
- Approximate BQ (Paragraph 2.4.3).

Firm BQ

Paragraph 2.4.2.1 explains that the reliability of tender prices *will increase in relation to the accuracy of the quantities provided*. The paragraph also explains that the final cost of a project will be equal to the tender price should there be no design changes, but that such changes will happen in practice, and therefore, the BQ will provide a good basis for the cost control of the project.

Following on from this, Paragraph 2.4.2.2 says that *the firmer the bill of quantities the better it will be a means of financial control*. This tends to beg the question as to whether there may be degrees of firmness in firm BQ.

Risk Issue

Nowhere under Paragraph 2.4.2 is the issue of provisional quantities mentioned. There is no suggestion that firm bills of quantities should be anything other than 'firm' albeit that there may be a question relating to the degree of firmness from BQ to BQ.

Rule 10.1 of SMM7 requires that quantities that cannot be accurately determined shall be identified as an approximate quantity and that an estimate of the quantity shall be given.

In NRM2, we have to look to Paragraph 3.3.8: *Procedure where quantity of work cannot be accurately determined* to discover an equivalent provision.

Approximate BQ

Paragraph 2.4.3.1 explains that approximate BQ are used in circumstances where there is *insufficient detail* to enable a firm BQ to be prepared or where the time and cost of doing so are not warranted. The paragraph further explains that approximate BQ lead to contracts that are

subject to remeasurement on completion and warns of the greater variability of outturn cost compared to a firm BQ.

Paragraph 2.4.3.3 stresses that, whilst the quantities in an approximate BQ may be approximate, *the descriptions of work items should be correct*.

Paragraph 3.3.8

Paragraph 3.3.8 of NRM2 relates to the *procedure where the quantity of work cannot be accurately determined*.

It is not at all clear whether this may be viewed as a reference to both provisional quantities in the 'firm BQ' and the 'approximate' quantities in the 'approximate BQ' described in Paragraph 2.4 of NRM2.

Paragraph 3.3.8.1 states that, where the quantity of work cannot be accurately determined, *an estimate of the quantity shall be given and identified as a 'provisional quantity'*.

The quantities in an 'approximate BQ' cannot, by definition, be accurate, and thus, Paragraph 3.3.8.1 could be interpreted as referring to both 'firm' and 'approximate' BQ. If this is the case, then the provisions of Paragraph 3.3.8.2 may equally apply to 'approximate' BQ; this states that *the 'approximate quantity' shall be substituted by the 'firm quantity' measured* for work items identified as a 'provisional quantity', once the work has been remeasured.

Paragraph 3.3.8.2 also requires that differences between the *provisional quantity* and the *firm quantity* of less than 20% shall not warrant a review of the BQ rate but variances in excess of this will.

However, NRM2 Paragraph 3.3.8.2 is unclear as to whether or not the '20% rule' shall also apply to the review of the tender rates in approximate BQ as well as those contained in firm BQ.

Risk Issue

The NRM2 20% rule is at odds with both the valuation rules for variations in JCT contracts and the compensation event clause in NEC3 ECC Option B Clause 60.4.

JCT 2011 SBC/Q Clause 5.1.1, for instance, defines changes in quantity as a variation, and, as such, they are subject to the hierarchy of valuation rules in the contract, that is:

- BQ rates if appropriate.
- Based on BQ rates if not.
- Fair rates.
- Daywork.

It is for the contract administrator, in discussion with the contractor, who decides what is fair and reasonable.

In the ECC, there is a clear rule determining whether or not a change in quantity is a compensation event:

- The change in quantity must not be as a result of a change to the works information (i.e. not a variation).
- There must be a change in the defined cost per unit quantity (i.e. the contractor must show that unit costs changed as a result of the quantity change) and
- The final quantity × BQ rate must be more than 0.5% of the total of the prices at the contract date (i.e. the tender total).

Risk Issue

Without some amendment to the contract, the NRM2 '20% rule' would be ineffective.

6.7.5 Preparation of BQ

Paragraph 2.5 explains the stages in a project at which BQ are prepared:

- Using the RIBA Plan of Work process model, NRM2 states that BQ will be prepared at Work Stage G (Tender Documentation). Since publication of NRM2, the new RIBA Plan of Work 2013 has been rolled out and thus, whilst BQ preparation will depend upon the chosen procurement method, it is likely to take place either at Stage 3: *Developed design* or Stage 4: *Technical design*.
- If the OGC Gateway process model is used, NRM2 states that BQ production will be *an intrinsic part of Gateway 3C (Investment Decision)*.

Whatever the case, Paragraph 2.5.2 emphasises that BQ production is reliant on the availability of technical designs and specifications in sufficient detail, and, to this end, Paragraph 2.5.4 refers to the information requirements for measurement listed in Paragraph 2.14 which comprises:

- Specification.
- Drawn information.
- Schedules.
- Reports and other information.

Whilst there are no 'rules' in Paragraph 2.5, a useful explanation as to who is likely to quantify the building works for a variety of procurement methods is given at Paragraph 2.5.5 and Figure 2.1 of NRM2.

6.7.6 Composition of BQ

Paragraph 2.6, whilst containing no 'rules', is informative because it identifies and explains the constituent parts of a BQ:

- Form of tender.
- Summary/main summary.
- Preliminaries.
- Measured work.
- Risks.
- Provisional sums.
- Credits.
- Dayworks.
- Annexes.

Paragraph 2.6.2.1 explains that the form of tender may be a separate document which would be necessary where a priced BQ is not submitted at tender stage.

Paragraph 2.6.3.1 provides a comprehensive list of items that should make up a final summary, but, strangely for a method of measurement based on work sections, the 'measured works' given in the example are shown in elemental BQ format (presumably for brevity).

In this regard, Paragraph 2.6.5.1 draws attention to the main part of the BQ (the measured works) and states that *the quantities and descriptions of items should be determined in accordance with the tabulated rules in measurement in Part 3*. The term 'should be' is somewhat less emphatic than the 'shall be' found in most other methods of measurement and implies that the bill compiler has some choice in the matter. This could lead to problems.

Risk Issue

The bill of quantities is normally a contract document, and the method of measurement used for its preparation is stated in the form of contract (e.g. JCT 2011 Clauses 1.1 and 2.13.1).

Where NRM2 is stated as being the 'Measurement Rules' in the contract, the parties are entitled to expect that the bill of quantities has been prepared in accordance with these rules in order to give certainty to the contract.

It may be the case, provided the item description is clear and unambiguous, that the legal axiom that the particular (i.e. the item description) should override the general (i.e. the method of measurement) may prevail. Alternatively, it may be that a departure from the method of measurement could be construed as a discrepancy between documents (e.g. between the BQ and the drawings) meriting an appropriate architect's instruction.

Depending upon the seriousness of the departure from the measurement rules, non-compliant item descriptions and quantities could be construed as a misrepresentation that could lead to a claim for damages.

In any event, contractors will always find ways to start an argument, and so it is inadvisable to gift them an opportunity by not following the measurement rules closely.

Paragraph 2.6.5.2 directs the reader to Paragraph 2.8 where we are informed that *the rules relating to the quantification and description of measured work are given*. Paragraph 2.8 contains no rules of any sort, however, and merely points the way to Part 3: *Tabulated rules of measurement for building works*. The point of Paragraph 2.8 is a mystery known only to the authors of NRM2!

For information on how item descriptions shall be presented in BQ and how quantities shall be determined, refer to NRM2 Paragraph 3.3 and to Section 6.9.3 of this chapter.

6.7.7 Preliminaries

Paragraph 2.7 represents the starting point for understanding how 'preliminaries' are provided for in NRM2, and this needs to be read in conjunction with Part 3: *Tabulated Work Sections – Preliminaries*.

Paragraph 2.7.1 firstly explains that preliminaries for the most part represent *the cost of administering a project* and the provision of *items that are not included in the rates for measured work*.

Paragraph 2.7.2 then identifies two types of preliminaries:

1. Preliminaries (main contract).
2. Preliminaries (work package contract).

The content of main contract preliminaries is detailed in Paragraphs 2.7.3.1 and 2.7.3.2, and the content of work package contract preliminaries is identified in Paragraphs 2.7.4.1 and 2.7.4.2. In both cases, preliminaries consist of:

- *Information.*
- *Pricing schedule.*

There are no 'rules' in Paragraph 2.7 except, perhaps, for:

- Paragraph 2.7.3.2: *The preliminaries bill is therefore to include a pricing schedule….*
- Paragraph 2.7.4.2: *The preliminaries bill for a works package shall comprise a pricing schedule….*

There is no explanation in NRM2 as to when a BQ shall include a preliminaries (main contract) bill and when a preliminaries (work package contract) bill shall be included.

It can only be presumed that:

- For **traditional** procurement:
  - There will only be a preliminaries (main contract) bill irrespective of whether the BQ is structured in work sections or elementally.
- For **management contracting** procurement:
  - The management contractor will be appointed on the basis of a preliminaries (main contract) bill and management fee.
  - The measured work will be based on work packages, and therefore, a preliminaries (work package contract) bill will precede the measured work section for each of the work packages.
- For **construction management** procurement:
  - The construction manager will be appointed on the basis of an agreed fee.
  - Each work package will have a preliminaries (work package contract) bill preceding the measured items.
  - The site infrastructure preliminaries will be provided by:
    - The employer or
    - The construction manager on the basis of a priced preliminaries (main contract) bill or
    - One of the work package contractors, who will be asked to price both a preliminaries (main contract) bill and a preliminaries (work package contract) bill.
- For **framework** procurement:
  - The Tier 1 contractor will price a preliminaries (main contract) bill.
  - The Tier 2/3 contractors will price a preliminaries (work package contract) bill.

The pricing schedule for preliminaries (main contract) is in two parts:

- Employer's requirements comprising items listed and defined in Part A of Table 1 of Part 3: *Tabulated rules of measurement*.
- Contractor's main cost items comprising items listed and defined in Part B of Table 1 of Part 3: *Tabulated rules of measurement*.

The pricing schedule for Preliminaries (work package contract) is similarly subdivided.

For the contractor's main cost items, the quantity surveyor/cost manager is required by Paragraph 2.7.3.2 to:

- *Obtain a full and detailed breakdown* of the preliminaries that:
  - *clearly identifies the items,*
  - *shows how the price for each item has been calculated and*
  - *how the total price for preliminaries has been calculated.*

In order to do this, the quantity surveyor/cost manager is required to:

1. *instruct the main contractor to return along with his or her tender a full and detailed breakdown* of the main contractor's *total price* for preliminaries in order to show how this has been calculated.
2. request that the main contractor *append this information to his* [but not her!] *priced bill of quantities*.
3. *ensure that* the main contractor's *detailed supporting calculations* are presented *in an easy-to-read and logical format* by

4. further instructing the main contractor to *ascertain the price for preliminaries* according to Part B of Table 1 of Part 3: *Tabulated rules of measurement*.
5. *make it clear to the main contractor* that:
   a) *costs relating to items that are not specifically identified by the main contractor* in the detailed breakdown *will be deemed to have no cost implications* or
   b) *have been included elsewhere* in the rates and prices.

The quantity surveyor/cost manager is to achieve requirements 1–4 *as part of the conditions of tender* and requirement *5 in the preliminaries bill and/or preliminaries pricing schedule*.

Risk Issue

The requirement for a full and detailed breakdown refers to the contractor's total price for preliminaries, but it would be misleading to assume that this means the total of the preliminaries bill.

On careful reading of the penultimate three paragraphs of Paragraph 2.7.3.2, it is clear that the quantity surveyor/cost manager's duty is to require a much more detailed breakdown of the contractor's preliminaries than a series of lump sums attached to the relevant preliminaries items listed in Part B of Table 1 of Part 3: *Tabulated rules of measurement*.

Why? Because:

a) If the 'Part B' list included in the preliminaries (main contract) bill was a sufficiently full and detailed breakdown, then why ask the contractor to append the breakdown to his priced bill of quantities? It would already be in the bill of quantities
b) The quantity surveyor/cost manager's duty is to:
   - Obtain a full and detailed breakdown of the preliminaries that:
     - clearly identifies the items,
     - shows how the price for each item has been calculated and
     - how the total price for preliminaries has been calculated.

It would seem, therefore, that the intention of Paragraph 2.7.3.2 may be to obtain a breakdown of each of the lump sums priced by the contractor in the preliminaries (main contract) bill and that it is the quantity surveyor/cost manager's duty to obtain this information.

For preliminaries (work package contract), Paragraph 2.7.4.2 explains that the 'information' and 'pricing schedule' are also to be drafted in accordance with Parts A and B of Table 1 of Part 3: *Tabulated rules of measurement*, respectively. Additionally, the final paragraph of Paragraph 2.7.4.2 says that:

- *It is essential that the work package contractor is instructed to provide a full and detailed breakdown* of the preliminaries that:
  - *clearly identifies the items*,
  - *shows how the price for each item has been calculated and*
  - *how the total price for preliminaries has been calculated*.

Risk Issue

In the case of preliminaries (work package contract), the duty to obtain *a full and detailed breakdown* falls on no one.

Work package tenders will normally be invited by the main contractor, and it could, therefore, be his duty to obtain the necessary pricing information. On the other hand, the quantity surveyor/cost manager will normally be responsible for vetting work package tenders, and so it could equally be argued to be his/her duty.

Another agenda item for the pre-contract meeting!

6.7.8 Measurement rules for building works

Paragraph 2.8 is brief. It merely says that the rules for measuring building work *are set out in the tabulated rules of measurement…at Part 3…of these rules.*

This paragraph is more of a pointer than a rule and indicates where to find the detailed rules of measurement which apply to the quantification of measured items of work.

6.7.9 Non-measurable works

Non-measurable works consist of:

- Provisional sums.
- Contractor-designed works.
- Risks.
- Works to be carried out by statutory undertakers.

Provisional Sums

Empirical evidence suggests that the vast majority of construction projects are not fully designed before tenders are invited. This may be the result of a conscious decision to choose a particular procurement strategy or, more normally, may be a function of the desire to start work on-site as early as possible for commercial, practical or other reasons. In any event, unforeseen work, or work envisaged but not designed, may need to be catered for in the contract documentation.

The usual way to do this is to include provisional sums in the BQ (or other pricing document) which serve the purpose of:

- Making a provision in the tender price or tender total.
- Alerting tenderers to the likelihood of additional work during the contract period.
- Giving the contract administrator a sum of money to expend pursuant to the particular terms of the contract which provides the authority to issue instructions as to how the money is to be spent.

NRM2 provides for this eventuality by providing a set of rules which explain the meaning of the phrase 'provisional sum' and by stipulating how such sums shall be defined in the contract bills. This idea was first introduced in SMM7 in order to add certainty to tender submissions, to reduce the disruptive effect of unforeseen work during the contract and to avoid costly disputes later on when the claims start flowing. The NRM2 rules concerning provisional sums are to be found in:

Paragraph 2.9.1.1	*Where building components/items cannot be measured and described in accordance with the tabulated rules of measurement they shall be given as a 'provisional sum' and identified as either 'defined work' or 'undefined work' as appropriate.*
Paragraph 2.9.1.2	*for defined work…the following shall be provided:* ■ *the nature and construction of the work* ■ *a statement of how and where the work is fixed to the building and what other work is to be fixed thereto* ■ *a quantity or quantities which indicate the scope and extent of the work* ■ *any specific limitations identified.*
Paragraph 2.9.1.4	Where *any aspect of the information required by Paragraph 2.9.1.2* cannot be given, *work shall be described as an 'undefined' provisional sum….*

Paragraph 2.9.1.5	Where a provisional sum *does not comprise the information required under 2.9.1.2* it *shall be construed as a provisional sum for undefined work* irrespective that it was described as defined work in the BQ.
Paragraph 2.9.1.6	*Provisional sums shall be exclusive of overheads and profit. Separate provision is to be made in the BQ for overheads and profit.*

The impact of these rules is to be found in:

Paragraph 2.9.1.3	Where the contractor *shall be deemed to have made due allowance* in the programming and planning (of the works) and in the pricing of the preliminaries items for provisional sums for 'defined work'.
Paragraph 2.9.1.4	Where the contractor *will be deemed not to have made* such allowances in respect of provisional sums for 'undefined work'.

This means that 'defined work' is to be included in the contractor's master programme and sequenced with the other items of work that have been measured according to the *Tabulated rules of measurement for building works*.

Risk Issue

Under the JCT SBC/Q 2011 contract, the expenditure of provisional sums for defined work does not rank as:

- A relevant event for an extension of time (Clause 2.29.2.1).
- A relevant matter for loss and expense (Clause 4.2.4.2.1).

Notwithstanding the above, where a provisional sum is described in the BQ as being for 'defined work', but the information required by Paragraph 2.9.1.2 is not provided, the item *shall be construed as a provisional sum for 'undefined work'*.

As far as the valuation of the work carried out under a provisional sum is concerned, normal practice is that the quantity surveyor will value the work according to the valuation rules in the contract (e.g. JCT SBC/Q 2011 Clause 5.2.1). It is also normal practice to use applicable BQ rates as the basis for such valuation, or as the basis for establishing 'fair rates', pursuant to the Valuation Rules (JCT SBC/Q 2011 5.6 1).

However, it should be carefully noted that Paragraph 2.9.1.6 states that provisional sums *shall be exclusive of overheads and profit* and that *separate provision* for overheads and profit on provisional sums *is to be made* in the BQ. This is an unusual feature of NRM2 as provisional sums are normally valued using BQ rates which traditionally include for overheads and profit.

Paragraph 2.9.1.6 also makes reference to Paragraph 2.11 which states provision *shall be made* in the BQ for the contractor to price overheads and profit on:

- Defined provisional sums.
- Undefined provisional sums.

Whilst this provision is a departure from normally accepted practice in the industry, Paragraphs 2.9.1.6 and 2.11 are quite clear that provisional sums exclude overheads and profit. Paragraph 2.11 is also quite clear that overheads and profit may be treated as separate items when required.

This provision should be read in conjunction with the definition of 'overheads and profit' in Paragraph 1.6.3 and also Paragraph 2.6.3.1 which provides an example of a BQ summary (for an elemental BQ); this clearly shows provision of a separate item for overheads and profit.

Notably, however, overheads and profit is not mentioned in Paragraph 2.6: *Composition of a bill of quantities* nor do they warrant an explanatory paragraph in Paragraph 2.6.3: *Summary (or main summary)*.

Appendices D and E do, however, provide templates for the pricing summary in elemental BQ (condensed and expanded versions) where the main contractor's overheads and profit is given as a separate item to be priced as a percentage. Notably, the percentage is to be applied *after* the provision for provisional sums and risks has been added to the total of building works and main contractor's preliminaries. Consequently, this is contrary to Paragraph 2.9.1.6 which states that *separate provision* for overheads and profit on provisional sums *is to be made* in the BQ.

As far as BQ based on either work section or work package layout formats are concerned, there is no template provided. However, Appendix A does give guidance on the preparation of BQ for a variety of breakdown structures for BQ albeit that no mention is made of the main contractor's overheads and profit. Paragraph A.12: *Price summary* of Appendix A does, nonetheless, suggest that the *structure of pricing summaries* for BQ other than those in elemental format *should follow the same principles* as those provided in Appendices D and E.

A further template is provided at Appendix F which includes a *schedule of provisional sums*, but no mention is made of main contractor's overheads and profit. This leaves the BQ compiler with the dilemma of deciding whether to provide an 'overheads and profit' item with the list of provisional sums or to include it in the main summary.

Added to this, a further issue arises in that Paragraph 3.3.3.13 states that, *unless specifically otherwise stated in the BQ or in these rules* – presumably the Part 3 rules – *each building component/item shall be deemed to include*:

(7) *establishment charges*

The term 'establishment charges' is normally taken to be a synonym for 'overheads', but the term 'establishment charges, overheads and profit' is also used. If 'establishment charges' are taken to mean the cost of running the head office establishment, then 'overheads' must refer to the other indirect costs of running a contracting business. It is, therefore, less than clear as to the meaning of Paragraph 3.3.3.13(7) or whether the BQ rates for components/items include overheads or not. One thing is clear – rates do not include for profit.

The lack of clarity as to how provisional items are to be billed leaves BQ compilers and contractors with a number of issues to resolve.

Risk Issue

As provisional sums are clearly not components/items within the meaning of NRM2 Part 3, care must be taken both when compiling bills of quantities, and when pricing provisional sums, at tender stage and also when valuing defined or undefined work arising from the expenditure of provisional sums during the contract:

- To ensure that overheads are not priced into measured items AND provisional sums as this will inflate the tender price.
- To ensure that work carried out under defined or undefined provisional sums is not overvalued by including overheads twice in the calculations.

BQ compilers, therefore, have a number of choices:

- Perhaps the simplest choice is include an item for overheads and profit in the main summary but insert it before the provisional sums total and then qualify the BQ to the extent that Paragraph 3.3.3.13 (measured items) is deemed to exclude establishment charges; rates and prices in the BQ will then be priced net, and a separate item for overheads and profit on provisional sums can then be inserted in the provisional sums section of the BQ in accordance with Paragraph 2.9.1.6.

- Include an item for overheads and profit in the main summary and trust to luck that the main contractor will exclude overheads (and profit) on measured items (i.e. the BQ rates and prices will be net).
- Include an item for overheads and profit in the main summary and qualify the BQ to the extent that Paragraph 3.3.3.13 (measured items) is deemed to exclude establishment charges; rates and prices in the BQ will then be priced net.
- Omit the overheads and profit item from the main summary, provide an item for overheads and profit in the 'preliminaries' section, make sure that provisional sums have separate items for overheads and profit (in accordance with Paragraph 2.9.1.6) and then qualify the BQ to the extent that Paragraph 3.3.3.13 (measured items) is deemed to include establishment charges *and* profit; rates and prices in the BQ will then be priced gross.
- Include an item for overheads and profit in the main summary and leave it to chance that the contractor will do all the necessary calculations to arrive at a competitive price.

Contractors will, no doubt, price the BQ exactly how they wish to, but they also have choices:

- Price overheads (and profit) with the defined/undefined provisional sums, if an item (or items) is (are) provided for this purpose, price the measured work items and preliminaries gross leaving the main summary overheads and profit item marked 'included' (rates and prices in the BQ will therefore be gross).
- If there is no overheads and profit item with the defined/undefined provisional sums, price the main summary overheads and profit item as a percentage and price the measured work items and preliminaries net (rates and prices in the BQ will therefore be net).
- Price the main summary overheads and profit item as a percentage and exclude overheads from the measured work items (rates and prices in the BQ will therefore be net).

Contractors will need to choose whether to:

- Reveal their overheads and profit percentage by pricing the main summary overheads and profit item as a percentage.
- Price the measured work items and preliminaries gross and mark the main summary item as 'included'.
- Allocate their overheads and profit to selected BQ items/preliminaries in order to maximise cash flow and/or commercial opportunity.
- If provisional sums are billed with a separate item for overheads and profit, price the required percentage for overheads and profit and then either price the main summary overheads and profit item, or mark it included, and price the measured work items and preliminaries gross.

Contractor-Designed Works

Partial contractor design is a 'halfway house' between a traditional lump sum and measure and value contract, with architect/engineer design, and full contractor design and build. It is a popular method for procuring a specialist design for a part or parts of a project, and there are a number of advantages for the employer with this approach:

- The overall design integrity is kept under the control of an employer-engaged architect or engineer.
- A competitive tender can be obtained which fulfils the employer's requirements.
- The choice of the successful tenderer can be informed by the various responses to the employer's contractor-design requirements along with the price/time/quality bid.
- The design risk for such part(s) is shifted to the contractor who, whether subcontracting the work or not, becomes responsible to the employer for the sufficiency of the design as well as the construction of that part of the project.

- The employer obtains a specialist design (e.g. a structural frame or roof) without the complexities of nomination; nomination is not now available under the JCT SBC/Q 2011 contract.
- A detailed price breakdown can be obtained by careful structuring of the tender BQ which is contained in the contractors' responses.

A number of standard contracts facilitate this method of procuring the design including JCT SBC/Q 2011 and the ICC – Measurement Version. However, whilst NRM2 is not the only method of measurement that specifically provides for partial contractor design of the works (MMHW does as well), the authors are to be applauded for this inclusion, despite some unfortunate shortcomings.

Whilst NRM2 is not contract specific, it is pretty clear that the JCT SBC/Q 2011 contract was in mind when the rules of measurement were drafted. There is clear reference to the phrase 'contractor designed portion' (CDP) in NRM2 albeit that JCT SBC/Q 2011 refers to contractor's designed portion. Whether this is intentional or a drafting or proofreading error is not clear.

NRM2 Paragraph 2.9.2 deals specifically where the contractor (or, more likely, a subcontractor) is to design part of the works:

Paragraph 2.9.2.1	Where any work is *not clearly identified as contractor designed works*, the employer *shall be deemed responsible* for such works.
Paragraph 2.9.2.3	Where discrete parts of a building are to be designed by the contractor, *the work items shall be identified as 'contractor designed works'.*
Paragraph 2.9.2.5	Should contractor-designed works be capable of being *measured and described in accordance with the tabulated rules of measurement*, a preamble is to be given such that performance objectives or criteria are *clearly defined*.
Paragraph 2.9.2.6	Where contractor-designed works are a *complete element or works package, … the works are to be measured and described as one or more item. The number of items is at the discretion of the quantity surveyor/cost manager but must be sufficient to provide an analysis of the price….* The rule emphasises that it is essential that the quantity surveyor/cost manager obtains a detailed breakdown of the contractor's price.
Paragraph 2.9.2.7	This rule states that *the quantity surveyor/cost manager is to obtain details of performance objectives and/or criteria from the relevant design consultant.*
Paragraph 2.9.2.8	Contractor-designed works *shall be deemed to include*: ■ all costs included in Rule 3.3.3.13 and ■ *all costs in connection with* the design and design management ■ design and construction risks ■ due allowance in the programme and planning *for all design works*.

In any event, the NRM2 rules dealing with such works need to be read in conjunction with the terms of the specific form of contract to be used for the procurement of the project; for the purposes of this section, the JCT SBC/Q 2011 contract will be referred to.

JCT SBC/Q 2011 is a lump sum contract with the option to have the contractor, or his preferred subcontractor, design a specific part or parts of the work if desired. This is achieved via the traditional procurement process where, after successfully tendering for the job, a contract will be entered into by the parties, that is, the employer and the contractor.

Partial contractor design is provided for in various places within the JCT SBC/Q 2011 contract as indicated below:

- Articles of Agreement:
  - Recitals.
  - Articles.
  - Contract Particulars Part 1.
- Conditions:
  - Sections 1–9 (of 9).
  - Schedules 1 and 5 (of 7).

NRM2 Paragraph 2.9.2.1 states that the employer *shall be deemed responsible* for works that are *not clearly identified as contractor designed works*. What this means is unclear. It may simply mean that the employer is responsible for the design of works that are not to be designed by the contractor, or it could be construed to have a wider meaning. What the difference is between 'identified' and 'clearly identified' is equally unclear as Paragraph 2.9.2.3 says that *where the contractor is required to take responsibility for the design of discrete parts of the building* such work items *shall be identified* (NB: not 'clearly' identified) *as 'contractor designed works'*.

As far as the measurement of contractor-designed work, and the provision of a means of pricing such work, is concerned, Paragraph 2.9.2.4 states that *the method of quantifying contractor designed work* depends upon *the nature of the work*. This statement is not especially helpful, and the reader is left to discover for himself/herself the two methods of quantification tucked away in Paragraphs 2.9.2.5 and 2.9.2.6:

- NRM2 Paragraph 2.9.2.5 deals with work that can be measured according to the tabulated rules of measurement. Two examples of such work are given – windows and precast concrete components – the list is no more exhaustive than that. In addition to the detailed quantities, a preamble to the work items is required that states the performance objectives or criteria that are to be met by the contractor; these are *required … to be clearly defined*. Additionally, detailed documents defining the performance objectives or criteria to be met are to be included in an annex to the BQ and *clearly cross-referenced in the preamble*. In short, the required structure is:
  1. A preamble stating the performance objectives or criteria.
  2. Work items measured in detail in accordance with the tabulated rules of measurement.
  3. An annex containing detailed documents defining the performance objectives or criteria.
- Paragraph 2.9.2.6 concerns contractor-designed work when it comprises *a complete element or works package*; the entire electrical and mechanical engineering service for a building is given as an example of this. In this case, the works are to be measured and described as one or more item with the number of items being *at the discretion of the quantity surveyor/cost manager*. In any event, the number of items must be sufficient to provide an analysis of the contractor's price for such work. Where the BQ is in elemental format, the elements will be those defined in *NRM1: Order of cost estimating and cost planning for capital building works*.

  The paragraph further requires that, *irrespective of the structure of the analysis*, it is essential to obtain *a full and detailed breakdown that clearly shows how the contractor has calculated his price for each item in the analysis*. This duty falls upon the quantity surveyor/cost manager, but how this can be achieved in one item is left to the imagination! Clearly, it is impossible to have one item and a detailed breakdown, and thus, the choices are either:
  - Take a 'punt' on what the contractor will design and provide a list of suitable items to be priced or
  - Ask tenderers for a detailed breakdown of the lump sum price in a Preamble to the Bill of Quantities.

There is no mention of performance objectives or criteria in this paragraph which is a somewhat startling omission unless the intention is to employ a prescriptive specification.

Risks

Paragraph 2.9.3 simply points to Paragraph 2.10 where the *method for dealing with the employer's residual risks* at the BQ production stage is to be found.

Works to be carried out by statutory undertakers

Paragraph 2.9.4.1	Such works are to be given as a 'provisional sum'.
Paragraph 2.9.4.2	The contractor *is to be deemed to have made due allowance in his programming, planning and pricing of preliminaries for all general attendance on statutory undertakers.*
	Risk Issue The term 'general attendance' is not defined in NRM2 Paragraph 1.6.3: *Definitions* or elsewhere.
Paragraph 2.9.4.3	Provisional sums for statutory undertakers' work *are to be exclusive of overheads and profit* which is to be provided for separately under Rule 2.11.

6.7.10 Risks

Paragraph 2.10 is subdivided into:

- Risks generally.
- Risk transfer to the contractor.
- Risk sharing by both employer and contractor.
- Risk retention by the employer.

Whilst generally comprising dialogue, there are some important rules in this paragraph.

2.10.1	**Risks generally**
Paragraph 2.10.1.2	Where there are remaining risks present at the time that the works are to be quantified, *a risk response* will be needed which *will take the form of one or more of the following*: ■ Risk transfer to the contractor. ■ Risk sharing by both employer and contractor. ■ Risk retention by the employer.

This paragraph is acknowledgement that NRM2 does not recognise the concept of 'contingency allowance' and that a more considered approach is needed in order to provide for the unexpected.

2.10.2	**Risk transfer to the contractor**
Paragraph 2.10.2.3	Where the contractor is to manage specific risks, they *are to be fully described* and *are to be listed in the BQ* under the heading of 'schedule of construction risks'.

It should be noted that the risks are *to be fully described* so that it is clear:

- What risks the contractor is required to manage.
- What services and/or works the employer is paying for.

The distinction between such risks and defined/undefined provisional sums is not clear.

Appendix F contains a template for including risks in the BQ, but no examples of the sort of things that might be covered are given. In view of the 'textbook' style of NRM2, this is somewhat of a disappointment.

Paragraph 2.10.2.4	The contractor *will be deemed to have made due allowance* for programming, planning and pricing preliminaries *in his risk allowances*.

This paragraph puts 'risks' between undefined and defined provisional sums in the hierarchy of non-measurable work items.

Paragraph 2.10.2.5	Risk allowances *shall be exclusive of overheads and profit* for which a separate provision *should be made* in accordance with Rule 2.11.

2.10.3 Risk sharing by both employer and contractor

Paragraph 2.10.3.2	Shared risks *will normally be dealt with using 'provisional quantities'*.

Risk Issue

Where provisional quantities are used, the **pricing risk** is to be taken by the contractor and the **quantity risk** by the employer.

On the face of it, this seems equitable, but careful consideration needs to be paid to the contractor's right to a re-rate should the provisional quantities prove to be inaccurate.

2.10.4 Risk retention by the employer

Paragraph 2.10.4.1 merely states the obvious that the employer (or the project team) may retain and manage certain risks and that these will have been (or should have been) included in the cost plan. Paragraph 2.10.4.3 points out that 'retained risks' are not necessarily controllable.

Interestingly, Paragraph 2.10.4.2 suggests that the employer may like to find out what premium the contractor will charge for resolving a 'retained risk'. This will then give the employer a choice:

- Pass on the risk to the contractor at a price.
- Retain the risk.

If it is decided to pass on the risk, Paragraph 2.10.4.2 requires this to be *dealt with as a risk transfer in accordance with Paragraph 2.10.2*. Risks that the contractor is required to manage are to be:

- Fully described and transparent.
- Listed in the BQ under the heading of 'schedule of construction risks'.

- Deemed to include due allowance for programming, planning and pricing preliminaries in his risk allowances and
- Shall be exclusive of overheads and profit for which separate provision should be made.

6.7.11 Overheads and Profit

Paragraph 2.11.1

Provision shall be made in the BQ for the contractor to apply a percentage for overheads and profit on the following:

- Preliminaries.
- Measured work, including contractor-designed work.
- Risk allowances.
- Work resulting from the expenditure of provisional sums:
  - Defined provisional sums.
  - Undefined provisional sums.
  - Works to be undertaken by statutory undertakers.

Paragraph 2.11.2

When required, 'overheads' and 'profit' *can be treated as two separate cost items*.

This provision is unique to NRM2, and contractors will need to be extremely cautious when pricing a tender document containing this provision. The following 'risk issues' should serve to indicate why.

Risk Issue

There are no rules within NRM2 stating how this provision will be administered or how the contractor will be paid, particularly regarding variations and the expenditure of provisional sums.

Risk Issue

Bearing in mind the shortcomings of the definition of overheads and profit in Paragraph 1.6.3, there remains a great deal of uncertainty as to the precise meaning of 'overheads' and 'profit' and, therefore, how such shortcomings will play out in terms of the financial administration of the contract.

Risk Issue

Paragraph 3.3.3.13 of NRM2 states that the component parts of BQ items shall include:

- Establishment charges.
- Cost of compliance with legislation, including health and safety legislation and disposal of waste.

Read in conjunction with Paragraph 3.3.3.13, Paragraph 2.11 is unclear because:

- 'Establishment charges' is an acknowledged synonym for 'overheads' or may be taken to mean 'head office overheads' when the phrase 'establishment charges, overheads and profit' is used.
- Compliance with health and safety and waste disposal legislation is normally considered a 'preliminaries' item.

Just how a contractor is supposed to price the unit rates and preliminaries items is therefore less than certain as is the question of how variations will be valued based on BQ rates.

Risk Issue

Many contractors apply a different 'margin' to their BQ rates according to whether the work items in question are the contractor's own work or the work of subcontractors or whether they are preliminaries items.

It is not clear from Paragraph 2.11.1 whether the 'overheads and profit' percentage would be applied individually to each of the totals for preliminaries, measured work, risk allowances and provisional sums or whether the percentage would be applied as a 'global' percentage. Appendices D and E give the impression that a place would be provided in the final summary for the percentage, and therefore, it would be a 'global' percentage.

Risk Issue

Many contractors like to distribute their 'margin' disproportionately throughout the BQ. This is done in order to take advantage of under-/over-measured BQ items or mistakes (commercial opportunity) or to front-load items in order to improve cash flow. Disaggregating overheads and profit from unit rates and other BQ items will mean that the contractor will be unable to do this.

Risk Issue

The reasoning behind disaggregating overheads and profit might work in a partnering context where the overheads and profit allowances could be protected (or 'ring-fenced') in order to encourage proactive value and risk management. Exactly how this might be achieved is not clear.

For a traditional contract, NRM2 is not clear as to whether or not overheads and profit would be subject to remeasurement. On the face of it, the presumption is that if work were to be omitted from the contract by way of a variation, then the contractor's overheads and profit recovery would automatically be less than expected as a result of the application of the percentage to the remaining work.

However, many contractors (and indeed PQSs) work on the basis that variations are valued to reflect loss of overheads and profit. This is probably justified because contractors budget for overheads and profit recovery on contracts and variations of omission can lead to serious under-recovery. In any event, it is sensible to reflect loss of overheads and profit in the valuation of variations of omission as a 'least cost' way of avoiding expensive disputes.

Notwithstanding the foregoing, Paragraph 2.11.1 merely states that *provision shall be made in the bill of quantities for the contractor to apply their percentage addition for 'overheads and profit'*. There is no rule as to where this provision shall be made in the BQ because the pricing summaries given in Appendices D and E are not mandatory. Consequently, there would appear to be nothing to prevent:

- Making a provision for overheads and profit at the end of each relevant section of the BQ, that is, preliminaries, measured work, risk allowances and provisional sums.
- Tenderers from pricing the BQ rates and prices 'gross' and ignoring the BQ provision for overheads and profit.
- Tenderers pricing the rates and prices 'gross' whilst also stating their OH&P percentage in the pricing summary and writing 'included' in the extension column.

6.7.12 Credits

NRM2 Paragraph 2.12.1 acknowledges that the issue of 'credits' only normally arises on projects where there is an element of refurbishment, rehabilitation or demolition of existing buildings or structures. This is not to say that such work is uncommon – quite the contrary – but that the term 'credits' applies where materials, components, equipment and the like are generated for disposal or recycling and the owner/client/employer is content to relinquish ownership to the contractor.

Some projects may generate large quantities of valuable materials, and, in some cases, the entire project may be 'credit driven' due to the intrinsic value of such materials. Whatever the case, the topic of 'credits' should not be passed over lightly as there are several strategies available to the property owner which should be considered when measuring and drafting a BQ:

- Surplus materials become the property of the contractor who may dispose of, recycle or sell the items.
- Surplus materials (or parts thereof) remain the property of the employer, and the contractor is required to reuse them in the works.
- Surplus materials (or parts thereof) remain the property of the employer and are set aside for reuse elsewhere (e.g. on another project).
- Surplus materials are disposed of by the contractor who may then recycle or sell the items, but the employer is credited for their value.

In NRM2, Paragraph 2.12.2 perceives two ways of dealing with 'credit items':

- A list of items is inserted into the BQ, and this is priced by the contractor on the basis of the value that may be attached to the items in question.
- Tenderers may be invited to submit a list of items with their tenders indicating the value of each of the items on the list.

There is no suggestion in NRM2 that a special work section should be created for credit items and, apart from providing a simple template for 'credits' in Appendix F, NRM2 takes the subject no further. Appendices D and E (for elemental BQ) each show a template for a pricing summary with an item called 'credit (for retained arisings)' shown as having a negative value (i.e. a credit), but, otherwise, the BQ compiler is left to decide just how to deal with the alternatives proposed by Paragraph 2.12.2.

Traditionally, demolitions and alterations were included in BQ by providing a work section called 'spot items', 'demolitions and alterations' or 'works to be priced on-site' (where the tenderers walk around the site and make an 'on-the-spot' assessment of cost/value). SMM7 and now NRM2 provide specific sections for such work, but neither Work Section 3: *Demolitions* nor Work Section 4: *Alterations, repairs and conversion* makes any provision for 'credits'. Each of these work sections refers to 'recycling' and to 'retained materials' and to 'materials to remain the property of the employer' but not to 'credits'.

As far as drafting the BQ is concerned, conventional practice is to provide two cash columns in the appropriate work section so that tenderers may price the cost of the work entailed, and any credit value, for specific items of work. This might be a good 'fit' with NRM2 because both the total of the work section and the total of credits could be carried to the pricing summary and separately identified as illustrated in NRM2 Appendices D and E. The other possibility would be to repeat appropriate work section items in a 'credits' section (NRM2 Appendix F refers) which tenderers could then price.

Risk Issue

Note 3 of the first table of Work Section 4: *Alterations, repairs and conversion* states that *all materials arising from these works become the property of the contractor unless otherwise stated.*

There is no similar note in Work Section 3: *Demolitions* which is surprising as items such as structural steelwork, bar reinforcement, copper and the like can have considerable 'scrap' value.

BQ compilers would be well advised to make sure that the issue of 'ownership' of materials arising from the site is well defined somewhere in the contract documents and that suitable 'notwithstanding' caveats are included where any of the NRM2 rules are not to apply.

6.7.13 Other considerations

Paragraph 2.13.1

Price fluctuations

This rule distinguishes between 'fixed price contracts' and 'fluctuating price contracts' where, on the one hand, the contractor takes the risk for price increases during the contract and, on the other, the employer undertakes to pay for such increases under some sort of price fluctuation agreement. Paragraph 2.13.1 recognises that most standard forms of contract contain provisions for either alternative by means of including or deleting specific relevant clauses.

Where the conditions of contract do not incorporate price fluctuations provisions, Paragraph 2.13.1.2 (1) states that *separate provision is to be incorporated in the bills of quantities* so that the contractor can *tender his fixed price adjustment*. This *is to be referred to as the 'main contractor's fixed price adjustment' or the 'work package contractor's fixed price adjustment'* as appropriate.

Risk Issue

The quantity surveyor/cost manager, when preparing the bills of quantities, shall ensure that the conditions of contract do not contain any provision relating to the recovery of price fluctuations.

2.13.2 Director's adjustment

Paragraph 2.13.2.1

This rule requires that *a separate provision is to be incorporated in the bills of quantities* so that the contractor can insert a director's adjustment.

Risk Issue

Where the director's adjustment results in a reduction in the tender price, the BQ rates would normally be reduced in proportion to the amount of the reduction and the total value of the BQ items. Where the adjustment is an addition to the tender price, the converse would be the case. Such an adjustment is important to ensure that:

- The contractor is neither underpaid nor overpaid when it comes to interim payments.
- The final account is corrected accordingly when the contract is complete.

There is no such rule in NRM2 dealing with the adjustment of the BQ rates, or other items, to take account of the director's adjustment in which case the director's adjustment presumably would have to be treated as a lump sum adjustment that bears no relationship to the contract sum or the eventual final account figure.

2.13.3 Dayworks (provisional)

Paragraph 2.13.3.2

This rule provides the option that *a schedule of dayworks is to be incorporated in the bills of quantities* but only if required.

Paragraph 2.13.3.3

The method of calculating the labour time charge for work carried out in normal working hours *shall be defined in the schedule of dayworks* and *the definition of normal working hours shall be given in either the preliminaries bill or the schedule of dayworks*.

Risk Issue

The employer may be exposed to risk if a daywork schedule is not included in the bills of quantities.

Most standard conditions of contract provide for varied work to be valued on a daywork basis where it cannot be valued by measurement or revised rates.

It is quite probable that very few contracts are completed without some daywork being carried out, and so it would be prudent to include a daywork schedule to ensure that competitive rates are obtained for such work.

Risk Issue

Paradoxically, as far as subcontracts or work package contracts are concerned, it is not unknown for the main contractor to refuse to accept the concept of daywork, especially where the main contractor is unable to pass on such costs to the employer or, as a contra-charge, to another subcontractor.

In such circumstances, subcontractors would be unwise to enter into a subcontract without an agreed daywork schedule.

Disagreements over daywork are common in subcontracting, and very often the only solution for the subcontractor is to agree a 'horse deal' or take the matter to adjudication.

Paragraph 2.13.3.4

This rule states that *the total amount included for daywork by the contractor shall be omitted from the contract sum* and that the *rates and percentage additions included in the BQ shall be used* to value works *authorised to be valued on a daywork basis*.

This is a contract administration issue for which there is usually a provision in the form of contract.

Paragraph 2.13.3.4

Note:

The note to Rule 2.13.3.4 provides guidance such that the monetary total of a schedule of dayworks *can be* included *or* excluded from the contract sum.

When included in the contract sum, the daywork *is to be* treated as a provisional sum, and when excluded, *it shall be clearly stated* that the daywork rates/percentages tendered *are included in the contract*.

The wording of Rule 2.13.3.4 is curious.

Presumably, *the total amount included for daywork by the contractor* refers to a provisional sum or provisional number of hours included in the BQ that have been priced by the contractor using the tendered daywork rates.

Seemingly, reference to the valuation of authorised daywork is in the context of interim payments and, more particularly, settlement of the final account. If so, the conditions of contract should also be referred to as there are normally protocols for each written into the contract.

The note to Rule 2.13.3.4 is more instructive although it is again curious that a note should contain rules as to the treatment of daywork in relation to the contract.

Paragraph 2.13.4 — Rule 2.13.4 is unequivocal.
VAT *shall be excluded* from the BQ, but, where required by the employer, a VAT assessment *can be incorporated* in the form of tender.

6.7.14 *Information requirements for measurement*

For a section with 'requirements' in the title, there are few 'requirements' and no rules at all.

Paragraph 2.14.2 — This paragraph explains that certain information *will be required* by the quantity surveyor/cost manager when preparing BQ. Four main classes of information are listed:

- Specification.
- Drawings.
- Schedules.
- Reports and other information.

Just who is to supply this information is not defined, but Paragraph 2.14.6 does refer to some employer's requirements and policy documents and to details of *any planning conditions and informatives that the contractor is required to comply with*.

2.14.3 Specification

This lengthy paragraph is largely given over to explaining the two main types of specification that are used – **prescriptive** and **performance** specifications.

Paragraph 2.14.3.2 (1) — Where prescriptive specifications are used and any materials are not named, *reference will be made to published materials* such as British or other country-specific standards.

Paragraph 2.14.3.2 (2) — Where performance specifications are used, *the benefit to the employer is that design will not need to be advanced…before inviting tenders from contractors*.

2.14.4 Drawn information

Paragraph 2.14.4.1 — Drawn information *is required to* **describe** *the assembly of the building, as well as any temporary works.*

Risk Issue

This is a very misleading statement that concerns the complex issues of 'design intent' and 'design liability'.

According to a reference given by Crotty (2012), Pittman (2003) maintains that ambiguity in design is necessary so that the architect may express his/her broad design intent in sufficiently clear terms so as to enable a contractor to construct the building whilst at the same time avoiding giving explicit instructions for how to do so. Pittman (2003) goes on to say that ambiguity is necessary in order to minimise the architect's liability should something go wrong during the construction process.

This view resonates with the general law which provides a clear understanding of the obligations of employers, architects and engineers for the 'buildability' of a design.

For instance, in *Oldschool v Gleeson (Construction) (1976)*,* his Honour Judge Stabb QC stated that *It seems abundantly plain that the duty of care of an architect or of a consulting engineer in no way extends into the area of how the work is carried out*.

Furthermore, the general law position is that an employer under a construction contract does not impliedly warrant the fitness of the site to enable the contractor to complete the work† nor does he warrant the feasibility of the design set out in the contract documents.‡

In *Clayton v Woodman & Sons Ltd [1962]*,§ a personal injury case, Pearson L.J. said that t*he architect is engaged as the agent of the owner* and that *his function is to make sure that…the owner will have a building properly constructed in accordance with the contract* and that the *architect does not undertake to advise the builder…as to how he should carry out his building operations.* In the same case, the judgement also stated that *inter alia, it might be suggested that the fault of the architect was in not advising the builder…as to how the work required by the specification should be executed. If he had done so, the architect would have been stepping out of his own province and into that of the builder.*

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* *Oldschool v Gleeson (Construction)* (1976) 4 B.L.R. 103 D.C.
† *Appleby v Myers* (1867) L.R. 2 C.P. 651.
‡ *Thorn v London Corporation* (1876) 1 App. Cas. 120.
§ *Clayton v Woodman & Son (Builders)* Ltd [1962] 1 W.L.R. 585 at 593 (CA).

Paragraph 2.14.4.1

Drawings shall be to a suitable scale.

Self-evidently but, nonetheless, a rule is warranted.

2.14.5 Schedules

Paragraph 2.14.5.1

Schedules *shall be deemed to be drawings* where they *provide the information required by the tabulated rules*.

This rule is necessary because the first two rows of each work section of Part 3: *Tabulated rules of measurement for building work* concern the drawn information ('drawings') required for measurement purposes.

The list of schedules given is stated as *not definitive or exhaustive, but simply a guide*.

2.14.6	Reports and other information
	A long list of information that may possibly be required for the preparation of BQ is given. There are no rules save to say that such reports and other information *may* include *details of planning conditions or informatives that the contractor is required to comply with.* The list is *not meant to be definitive or exhaustive, but merely a guide* intended to be used by the quantity surveyor/cost manager.

6.7.15 Codification of BQ

NRM2 Paragraph 2.15 is devoted to an explanation of:

- The different types of BQ breakdown structures.
- How to code BQ.

On the face of it, these are relatively straightforward aspects of BQ production, but the six pages of NRM2 that deal with these topics are, to say the least, challenging. So much so that a special section (Section 6.8) has been provided in this chapter to try to unravel and explain how it is all intended to work.

Suffice to say that, if the authors of NRM2 had followed the advice of Albert Einstein, the world would be a much simpler place:

> *Most of the fundamental ideas of science are essentially simple, and may, as a rule, be expressed in a language comprehensible to everyone.*

6.7.16 Cost management/control

The main purpose of this part of NRM2 is to explain the cost planning and cost control process and the important part that BQ play in it. There are no rules as such, but there are one or two issues that merit consideration.

Paragraph 2.16.3	Post-tender estimate The timing and role of the post-tender estimate are explained, but, more particularly, it is emphasised that the quantity surveyor/cost manager *should include a summary of the post-tender estimate(s) when reporting the outcome of the tendering process to the employer.*
Paragraph 2.16.5	Pricing variations This paragraph states that *the rates in a priced bill of quantities provide a basis for the valuation of varied work.*
	Risk Issue Whilst this statement may be to some extent true, it is not entirely correct in a legal context. It is the **contract conditions** that determine how varied work is to be valued and different contracts do this in different ways. The provisions for the valuation of variations in the JCT 2011 SBC/Q contrast sharply with the ECC compensation event arrangements, for example.

Risk Issue

As far as **approximate quantities** are concerned, JCT2011SBC/Q states that the rates stated in the contract bills shall be the basis of valuation provided that the quantities stated represent a reasonably accurate forecast. Where this is not the case, a fair allowance shall be made to reflect the difference between the estimated quantity and the actual quantity.

NRM2 Rule 3.3.8.2 provides a mechanism for this 'fair allowance', but it should be noted that NRM2 refers to 'provisional quantities', whereas JCT2011SBC/Q refers to 'approximate quantities'.

NRM2 also states that 'pro rata' and 'analogous' rates can be derived from the priced BQ in order to price components not specifically measured in the BQ. In all practical senses, this can be likened to the 'fair rates and prices' valuation process stipulated in the JCT conditions.

6.7.17 Analysis, collection and storage of cost data

Paragraph 2.17.1 emphasises the value of the *real-time cost data* that priced BQ provide, and 2.17.2 explains that this information can be used in a variety of ways.

This is little more than informative and there are no measurement rules in 2.17, or any other rules for that matter, despite the implication to the contrary in the title of Part 2: *Rules for detailed measurement of building works*.

6.8 Codification of bills of quantities

This section of Chapter 6 is somewhat lengthy for the simple reason that the codification system and classification tables in NRM2 are complicated and poorly explained and, frankly, do not work terribly well.

The easy fix is to allow a measurement software package to do the work.

The problem with this approach is that some software packages do code the items in the take-off, but they do not code the BQ as suggested by NRM2 Paragraph 2.15.3.1. It also has to be said that there are 'glitches' in some of the measurement software packages, perhaps because NRM2 is new and the coding is complex, but, in any event, a competent professional should understand what these packages are doing, and this requires an understanding of the NRM2 system and its frailties.

6.8.1 Work breakdown structure

The basis of both the NRM1 and NRM2 coding systems is the work breakdown structure (WBS), and consequently, it is imperative to understand how a WBS works in order to make the most of the flexibility offered by the New Rules of Measurement.

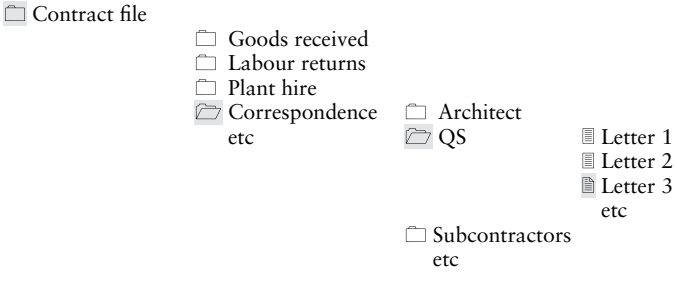
WBS is defined in NRM2 Paragraph 1.6.3: *Definitions*:

> ***Work breakdown structure (WBS)*** *– is used to sub-divide a building project into meaningful elements or work packages.*

A WBS is *a tree structure that starts with the end objective* and is then successively sub-divided *into the main components and sub-components that make up the entire building*

project (Paragraph 2.15.1.1). This provides a *hierarchical breakdown* of the project similar to a filing system as illustrated in Table 6.1

Table 6.1 Hierarchical structure.



In NRM2, WBS is used in the context of BQ and therefore refers to the way that the BQ is subdivided. The advantage of a WBS is that, appropriately coded, measured items can be sorted into the desired BQ format using suitable software with a multiple sort facility, rather like shuffling a pack of playing cards. Additionally, the priced BQ items can be related back to the original cost plan in order to reconcile tenders received with the intended spend profile for the project.

This also means that a BQ that has been structured in a certain way can be restructured into any other BQ format desired by virtue of the WBS coding system. This facility is not only useful for the quantity surveyor/cost manager but also for the contractor who, furnished with the coded BQ and suitable software, could convert a BQ based on traditional work sections into one based on work packages in order to obtain subcontract prices.

6.8.2 Cost breakdown structure

The usefulness of the WBS becomes evident when the contractor has priced the BQ. The existence of competitive market rates enables the actual cost of elements or work sections or, alternatively, work packages, to be compared with the 'theoretical' cost plan allowances developed during the design stage. This is the point at which a WBS becomes a cost breakdown structure (CBS) which is defined in NRM2 Paragraph 1.6.3:

> ***Cost breakdown structure (CBS)*** *– is the financial breakdown of a building project into cost targets for elements or work packages.*

A CBS is basically a WBS with money attached to the items in the breakdown structure. Therefore, a cost plan WBS becomes a CBS when it has been priced by the quantity surveyor/cost manager, and a BQ WBS becomes a CBS when the BQ has been priced by the contractor.

6.8.3 BQ Structures

A BQ is essentially an output from the measurement process. This may be carried out by a quantity surveyor/cost manager working for the employer or may be undertaken by a contractor or subcontractor working from drawings provided during the tendering period. Consequently, a BQ could be for an entire project or for a number of projects within an overarching project, or it could be a small part of a project such as a trade (e.g. painting and decorating) or work package (e.g. groundworks).

The starting point for coding any BQ is the codification of the measured items included in the take-off. Lee et al. (2014) warn that coding measured items on paper for later entry into measurement packages is prone to error but that building descriptions from standard libraries, and

direct entry of dimensions using software packages, provide a reliable record of the logic used for the quantity take-off.

Once the measured items have been coded, the BQ can be prepared. Software packages that offer standard libraries of descriptions will code measured items automatically as item descriptions are chosen from the library menus, and this will then enable a BQ to be produced based on the chosen method of measurement library. Some software packages allow BQ to be sorted in a variety of ways. In NRM2, there are three different ways that BQ can be structured as shown in Table 6.2.

Table 6.2 Bill of quantities (BQ) structures.

NRM2 BQ structures					
Elemental		**Work Section**		**Work package**	
Ref	**Element**	**Ref**	**Work Section**	**Ref**	**Work package**
1	Preliminaries (main contract)	1	Preliminaries (main contract)	1	Preliminaries (main contract)
2	Facilitating works	3	Demolitions	3	Demolition works
3	Substructure	5	Excavation and filling	4	Groundworks
4	Superstructure	7	Piling	5	Piling
5	Internal finishes	11	In situ concrete works	6	Concrete works
	Etc.		Etc.		Etc.
NB					
a	This is the NRM1 default structure	a	This is the NRM2 default structure	a	This structure is defined by the user
b	The reference numbers are taken from NRM2 Appendix A Figure A.1	b	The reference numbers are taken from NRM2 Appendix A Figure A.2	b	The reference numbers are taken from NRM2 Appendix A Figures A.3
c	Each element may be subdivided into finer levels of detail	c	Each Work Section may be subdivided into finer levels of detail	c	Each work package may be subdivided into finer levels of detail
				d	Any other breakdown structure and/or reference numbering may be chosen

According to NRM2 Appendix A.1.3, the elemental breakdown structure *makes it easier for the quantity surveyor/cost manager to analyse a contractor's tender price and collect real-time cost data*, whereas the work sectional breakdown structure *is often preferred by contractors for the purpose of pricing as all like products and components are grouped together*.

The work package breakdown is seemingly *used by contractors to procure packages of work from their supply chain*.

6.8.4 NRM2 Part 3: Tabulated rules of measurement for building works

NRM2 *Part 3: Tabulated rules of measurement for building works* consists of 41 work sections which includes preliminaries (Work Section 1). The structure of each of the 40 measured work sections comprises:

- A main title (numbered).
- In most work sections, there is one or more subheading indicating the categories of work that are included in the work section (no numbering).

- Tables specifying the drawings and other information that must be provided, a list of deemed included items, etc. (no numbering).
- A greyed-out heading under which there is:
  - A column of items to be measured (numbered) followed by
  - Three columns (Levels 1, 2 and 3) of descriptive features (numbered) and
  - A final column consisting of notes, comments and glossary (numbered).

This is illustrated in Table 6.3 which is extracted from Work Section 5: *Excavating and filling*.

The list of measured items is effectively a 'spreadsheet' which is read both vertically and horizontally.

Table 6.3 Work Section structure.

5. Excavating and filling **Site clearance/preparation** **Excavations** **Disposal** **Fillings** **Membranes**					
Omitted for clarity					
Omitted for clarity					
Item or work to be measured	**Unit**	**Level 1**	**Level 2**	**Level 3**	**Level 4**
6. Excavation	m^3	1. Bulk excavation	1. Not exceeding 2 m deep 2. Over 2 m not exceeding 4 m deep 3. And thereafter in stages of 2 m	1. Details of obstructions in ground to be stated	*Omitted for clarity*
	m^3	2. Foundation excavation			

Looking at Table 6.3, it is tempting to think that the NRM2 classification structure (i.e. *Tabulated rules*) is designed to enable each BQ item to be given a discrete reference or code when combined with the relevant descriptive features listed. Such a code would distinguish measured items one from another and facilitate re-sorting should a different BQ layout be required. Thus, any individual measured item could have a maximum of five digits in its unique code.

For example, an item of **excavation for foundations 1.5 m deep** would theoretically create a code of **5.6.2.1**. If the same item was to be measured where there were **boulders or old foundations** present in the ground, the code could be **5.6.2.1.1** using the additional Level 3 code.

However, NRM2 states that:

- *for the quantity surveyor/cost manager to manage the cost plan during the procurement and construction phases of the building project…, the codification framework used for* ***cost planning*** *must be used as the basis for the codification of building components/items in the bill of quantities (BQ).*

This is an unusual and confusing feature of NRM2, a consequence of which is that:

- NRM2 requires BQ to be coded using the codes in the NRM1 classification tables and not those of NRM2 but only when there is a cost plan in place and it is desired to relate the priced BQ back to the cost plan or when a BQ is required with an elemental breakdown structure.

The net effect of this is that NRM2 has a third objective as regards BQ coding to add to the two discussed in Chapter 4:

- *Objective 1*
  So that each item can be distinguished from other items in the BQ.
- *Objective 2*
  In order that the distinguishing characteristics of each item may be traced back to their origin, that is, the method of measurement used.
- *Objective 3*
  To ensure that the BQ is coded in such a way as to relate it back to the design stage cost plan.

As a result, where there is a cost plan in place, but a BQ with a work section or work package breakdown structure is required, the BQ must also be coded with NRM1 codes. However, pursuant to NRM2 Paragraphs 2.15.3.1(2) and (3), a distinguishing suffix must be added to the primary (NRM1) code. The idea here is to be able to re-sort the work section or work package items into an elemental format so that the priced tender can be reconciled with the cost plan.

Consequently,

- The work sections and the measured items therein will be those defined in NRM2 Part 3: *Tabulated rules*, but they will have an NRM1 code and a suffix.
- The work packages and the measured items will be those defined by the quantity surveyor/cost manager (or the contractor), but they will have an NRM1 code and a suffix.

In circumstances where there is no cost plan, or it is not desired to reconcile priced tenders with a cost plan:

- An elemental BQ will be coded with NRM1 codes because NRM1 is organised by elements and NRM2 is based on work sections.
- A work section BQ can be coded in any way that the bill compiler desires because there is no system of coding in NRM2 other than that described in Paragraph 2.15.
- A work package BQ can be coded as desired because there is no rule in NRM2 to determine what the coding should be.

It is quite understandable that NRM2 should seek to satisfy Objective 3 as, amongst other benefits, the full functionality of software such as CATO can be used to re-sort BQ and analyse tenders.

What is difficult to appreciate, however, is why NRM2 should be exclusively concerned with Objective 3 when it is clear that contractors, subcontractors and others may also wish to create BQ but without a cost plan being in place. Such users would also need a suitable coding system in order to reference and audit measured items and to restructure BQ from work section to work package format as required.

The codification of BQ under NRM2 is not straightforward therefore, and three issues need to be considered in order to understand the system:

1. The codification of the quantity take-off (i.e. the measured items on the dimension sheets).
2. The practicalities of coding measured items.
3. The codification of the finished BQ in order to achieve Objective 3.

This is easier said than done as NRM2 is most unclear and, to a certain extent, misleading due to mistakes in the worked examples provided in NRM2 Part 2.

6.8.5 Coding the quantity take-off

The obvious place to look for guidance on coding measured items in NRM2 is Paragraph 2.15: *Codification of bill of quantities*, but despite being six pages long, this does not actually explain how to code BQ using the codes in NRM2 *Part 3: Tabulated rules of measurement for*

building works, nor does it offer an explanation of how to code measured items in the quantity take-off.

Ostrowski (2013) clearly believes that a quantity take-off should be referenced using NRM2 codes and both CATO and QSPro use the Part 3 classification tables as a hierarchy for building item descriptions. Without criticising Ostrowski, his worked examples clearly demonstrate the weaknesses of the NRM2 classification tables, and both CATO and QSPro adopt different approaches to formulating item descriptions more akin to SMM7.

The fault here lies with the authors of NRM2 because, not only are the classification tables badly organised, there is no explanation of how to code NRM2 measured items in Paragraph 2.15 or anywhere else in NRM2 for that matter. This is left to the user to work out for himself/herself, unlike SMM7 which provides a simple and understandable explanation of how to use the classification tables (in General Rule 2).

Another place to look for guidance is Appendix A: *Guidance on the preparation of bill of quantities*. This explains, *inter alia*, that BQ may have an elemental breakdown structure or, alternatively, a work section or work package structure. It also provides examples of typical BQ formats for each of the three breakdown structures. Looking at Appendix A.4, it becomes immediately obvious that the items shown are not coded in accordance with either NRM1 or NRM2 and that the coding used is a simple cascade or WBS which, when checked against NRM1 and NRM2, has little relevance to either document.

Finally, guidance may be sought from NRM2 Part 3: *Tabulated rules of measurement for building works* and Paragraph 3.2: *Use of tabulated rules of measurement for building works* in particular, but this provides no help either.

Under Paragraph 3.3: *Measurement rules for building works*, there is some limited help in the form of Paragraph 3.3.3.3 which informs us that:

Descriptions shall state:

- *the building components/items being measured (taken from the first column of the tabulated rules) and*
- *include all Level 1, 2 and 3 information (taken from the third, fourth and fifth columns respectively) applicable to that item.*
- *Where applicable, the relevant information from column five shall be included in the description.*

The conclusion to be drawn from Paragraph 3.3.3.3 is that:

- There is, in fact, no requirement to take only one descriptive feature from each column (Levels 1, 2 and 3).
- Item descriptions may be compiled on a 'pick-and-mix' basis, provided that all relevant descriptive features are included.

Consequently, there is seemingly, at best, only a partial but inconsistent NRM2 coding system for quantity take-off or for the production of BQ. In fact, Paragraph 2.15.3.1 makes it clear that BQ should be coded for the primary purpose of relating the priced BQ back to the cost plan by using NRM1 identification numbers as the primary code for an elemental BQ and the addition of suffixes as a secondary code should a work section or work package BQ be preferred.

In practical terms, this means purchasing both NRM1 and NRM2 (total cost circa £90), having both documents open at the same time in order to code the BQ and a great deal of extra time and effort. This is quite bizarre.

Having said all that, there is no reason why the NRM2 code numbering cannot be used in whatever fashion the user wishes, ignoring NRM1 altogether, and the leading QS software providers seem to have taken this approach. However, if it is desired to create measured items with accompanying NRM2 codes, there are further problems in that a number of the work sections

in Part 3: *Tabulated rules of measurement for building works* are arranged in a way that prevents the creation of unique codes for certain items of work. This issue is discussed in Section 6.8.6.

6.8.6 NRM2 coding: Practicalities

Coding measured items of work using the NRM2 classification tables is, *prima facie*, straightforward, but, in several work sections, there are instances where it is impossible to assign a unique code to measured items. This arises when more than one of the descriptive features under the Level 1, 2 and 3 columns are needed to describe items fully. The following example will illustrate the point:

> *A 150mm diameter uPVC push-fit pipe is to be laid in a trench with an average depth of 1.25m on a granular bed and surround. The trench backfill is to be MOT Type 1 sub-base. The drain is to be laid in water bearing ground adjacent to an existing building.*

Table 6.4 shows part of NRM2 *Work Section 34: Drainage below ground*, and this indicates that drain runs are measured in linear metres. The item coverage is extensive and includes excavation, disposal, earthwork support, levelling trench bottoms, backfilling, pipes and pipe bedding and so on.

Table 6.4 Work Section 34 (part).

34 Drainage below ground **Storm water drain systems** **Foul drain systems** **Pumped drain systems** **Land drainage**					
Omitted for clarity					
Omitted for clarity					
Item or work to be measured	**Unit**	**Level 1**	**Level 2**	**Level 3**	**Level 4**
1. Drain runs	m	1. Average trench depth in 500mm increments 2. Type and nominal diameter of pipe 3. Multiple pipes stating number and nominal diameter of pipes	1. Method of jointing pipes 2. Pipe bedding and or surround details stated 3. Type of backfill if not obtained from the excavations	1. Vertical 2. Curved 3. Below groundwater level 4. Next to existing roadway or path 5. Next to existing building 6. Specified multiple handling details stated 7. Disposal of excavated material where not at the discretion of the contractor: details stated	*Omitted for clarity*

The item to be measured, that is, 'drain runs', can be seen in the table of measured items, and this has the code number 34.1. As far as the addition of further descriptive features is concerned, NRM2 Paragraph 3.3.3.3 stipulates that *all Level 1, 2 and 3 information… applicable* shall be included in the items descriptions.

This is clear enough but Table 6.5 illustrates that, at Level 1, two of the three choices available would be needed to describe the item of drainage, that is, trench depth and pipe diameter. At Level 2, all of the choices are required, and at Level 3, several of the choices are needed to describe the item. This means that a discrete code cannot be assigned to the item at Levels 1, 2 and 3.

Table 6.5 Level 1, 2 and 3 information.

Level 1		Level 2		Level 3	
1	Average trench depth exceeding 1.00 m not exceeding 1.50 m	1	Push-fit	3	Below groundwater level
2	150 mm diameter uPVC pipe	2	Granular bed and surround	5	Next to existing building
		3	MOT Type 1 sub-base trench backfill	7	Location of disposal point if not at the contractor's discretion

The resulting measured item is demonstrated in Figure 6.1.

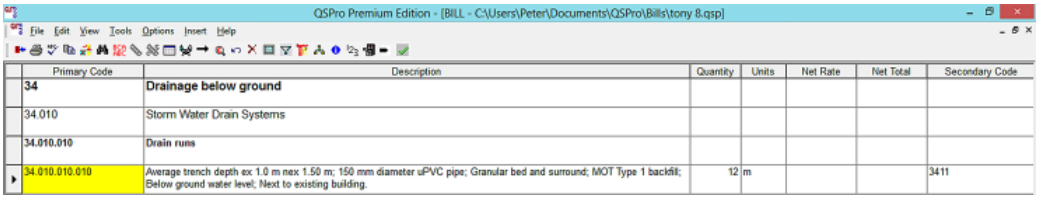


Figure 6.1 Measured item.

Risk Issue

There is no simple solution to this problem as NRM2 does not have a system for dealing with such situations. There is not even an official 'asterisk (*) system', such as in SMM7, which is used when a measured item description requires all of the items listed in a column to be chosen.

Consequently, it is impossible to give certain measured items a unique code without devising a supplementary coding system. This would seem to defeat the object of NRM2 coding as the BQ compiler would be spending more time coding that taking-off quantities!

Another solution would be to amend the method of measurement in a similar way to CESMM Class I: Pipework – Pipes. This would mean that the Level 1, 2 and 3 descriptors would be:

- Type of pipe.
- Diameter.
- Depth of trench.

Other descriptors would be included in column five (notes, comments and glossary).
This anomaly makes nonsense of the work breakdown structure principle underpinning NRM2.

This problem arises in several work sections including (3) Demolitions, (6) Ground remediation and soil stabilisation, (14) Masonry and (23) Windows, screens and lights as well as (34) Drainage below ground.

6.8.7 Coding the BQ

BQ can potentially be produced at any stage in a construction project by any participant using any breakdown structure, for instance:

- By the employer's quantity surveyor/cost manager at the usual stage in the traditional procurement process.
- By a professional quantity surveyor (PQS) or contractor or both, early in the design process, in order to develop a target cost.
- By a contractor, early in the design process, as part of a two-stage design and build tender.
- For a design and build project in order for the main contractor to obtain quotations from subcontractors.
- By subcontractors or work package contractors when invited to submit tenders on a 'drawings and specification' basis.
- By a main contractor or a subcontractor/work package contractor, at any time during or after the design stage, where partial contractor design is envisaged.

Consequently, it is not necessarily the PQS who produces the BQ – it depends on the procurement method used.

NRM2 Paragraph 2.15 provides the rule set for coding BQ, but it doesn't work in the way that might be imagined.

It may be helpful to understand that Paragraph 2.15.3.1(1) of NRM2 is worded in such a way as to give the impression that the procurement route will be a traditional one or, in other words, that there will be a cost plan prepared by the employer's quantity surveyor/cost manager who will then assume responsibility for preparation of the BQ, and that this is the starting point of the NRM2 coding system.

Paradoxically, however, the authors of NRM2 specifically designed the rules of measurement to be flexible enough to be used for a variety of purposes and by a variety of users at various stages of the design and construction process employing various methods of procurement. They haven't made it easy to do so.

All the problems with the NRM2 coding system stem from the fact that it is largely directed at the quantity surveyor/cost manager who, having produced a cost plan, wishes to code the BQ in such a way that the contractor's pricing can be related back to the cost plan for cost management purposes. The importance of the collection of cost data is emphasised in several places in NRM2, and in Paragraph 2.3.1 and Appendix A.1.3(a) in particular, which both state that the priced BQ is *one of the best sources of real-time cost data*.

In point of fact, there are several instances within the text of NRM2 where it is obvious that the collection of contractors' pricing data is the main driving force behind NRM2 rather than providing *a standard set of measurement rules for the procurement of building works that are understandable by all those involved in a construction project* (NRM2 Paragraph 1.3.1) with the flexibility to suit a variety of procurement circumstances.

It must be said that, for many years, contractors have provided 'free' cost information to PQSs in the form of priced tenders.

This data is used as the basis for the BCIS cost information database which the RICS sells back to the industry on a subscription basis, admittedly with some added value. Builders' price books also use this 'free' data, and the authors of NRM2 confirm how valuable this *real-time cost data* is (Paragraph 2.17.1 refers). For the many contractors and

subcontractors who will be supplying this 'free' information, this is a bit of a 'kick in the teeth', especially as NRM1 does not even define them as members of the 'project team'. However, we digress!

In order to understand the NRM2 coding system, it is vital to appreciate that:

1. The Paragraph 2.15 explanation of the coding system in NRM2 exclusively relates to the coding of BQ using the NRM1 coding system.
2. This is because there is a presumption in NRM2 that an elemental cost plan has been prepared with codes based on *NRM1: Order of cost estimating and cost planning for capital building works* when coding items for NRM2-based BQ.
3. When measuring work using NRM2, and when there is a cost plan in place, the eventual BQ codes are driven by the NRM1 coding system and not by those of NRM2.

Consequently, anyone wishing to code a BQ that has been measured in accordance with the NRM2 *Tabulated rules* will be obliged to code the items using NRM1 codes and not those in NRM2 if it is desired to electronically rearrange the priced BQ from work section/work package format to elemental cost plan format. This strange anomaly arises because:

- NRM2 Paragraph 2.15.2.2 says that:
  - *the codification framework used for cost planning must be used as the basis for the codification of building components/items in the bill of quantities (BQ).*
- NRM2 Paragraph 2.15.3.1(2) says that:
  - where a work section bill of quantities is required *it is essential that the work sectional breakdown structure can be easily reconciled with the original cost plan breakdown structure.*
- NRM2 Paragraph 2.15.3.1(2) says that:
  - where a work package bill of quantities is required, the primary code is *that used for BQ based on an elemental breakdown structure.*

Albeit that NRM2 Paragraph 2.15 is purely concerned with the task of producing BQ codes that will enable an elemental, work section or work package BQ to be re-sorted into an elemental cost plan (NRM1) format:

- The measured items of work will be measured in accordance with the NRM2 rules of measurement.
- All item descriptions and units of measurement will be as per NRM2.
- Whichever BQ structure is chosen, it will contain exactly the same items, descriptions and quantities based on the NRM2 *Tabulated rules of measurement.*

Therefore, in order to re-sort the priced BQ into elemental cost plan format, each item of work needs to be coded with an NRM1 unique code.

NRM2 Paragraph 2.15.3.1(1) states that *the resultant* (NRM1) *codes can be inserted in the right-hand column of the bill paper or in brackets after the bill description*. This is not the normal place for the item code, which usually appears in the left-hand column of the bill paper, and the NRM1 code should not be confused with the code generated by the measurement process. It is this code which is used to create the bill pages and to distinguish the BQ items one from another. This additional code will be needed to help the computer package to allocate the items to the appropriate headings so that a BQ can be produced for tender purposes. It will probably be an alpha/numeric code following custom and practice.

The distinction between elemental, work section and work package BQ is simply that the measured items will be allocated to different headings and subheadings in the relevant BQ format and will therefore be in a different order. Preliminaries are an exception and this section of the BQ will look the same irrespective of the BQ structure chosen.

As previously discussed, where there is no cost plan or where the user simply wishes to produce a BQ (e.g. for a single work package or to establish a target cost), there is no alternative coding system in NRM2 or any explanation of how to:

- Code measured items in accordance with NRM2 during the taking-off process.
- Code the BQ items using a WBS.
- Amend/restructure the coded items so as to produce elemental, work section or work package BQ as required.

6.8.8 Coding an elemental BQ

The WBS for an elemental BQ is based on the group elements used for cost planning which are to be found in NRM1: *Order of cost estimating and cost planning for capital building works*. Once again, however, confusion reigns!

NRM1 Paragraph 4.4.2 explains the coding system, and this is illustrated in NRM1 Appendix E. This is underpinned by NRM1 Paragraph 4.2.3 which explains that the NRM1 Part 4: *Tabulated rules of measurement* is based on four principal levels. Paragraph 4.4.2 informs, however, that *further code levels can be added to suit user requirements*.

The NRM1 coding system is summarised in Table 6.6.

Table 6.6 NRM1 coding system.

				Example	
Level	**Description**	**Function**	**Code defined by**	**Ref**	
1	Group element	The primary headings in a cost plan. Group elements 0–8 represent building works, and 9–14 are for preliminaries, fees, risk allowances, etc.	Identification numbers in NRM1 tabulated measurement rules	2	Superstructure
2	Element	Part of a group element. There may be several elements that make up a group element	Identification numbers in NRM1 tabulated measurement rules	1	Frame
3	Sub-element	Part of an element. There may be several sub-elements that make up an element	Identification numbers in NRM1 tabulated measurement rules	4	Concrete frames
4	Component	Building work items that are part of a sub-element. There may be several components that make up a sub-element	User: • NRM1 does not pretend to list all possible components within a sub-element • User-defined codes should be sequential within the sub-element	1 2 3	Columns Beams Walls
5*	Sub-component	Where a component needs to be subdivided in more detail	User: • Columns, beams and walls may need to be subdivided into their constituent parts	1 2 3	Concrete Formwork Reinforcement
Example		**Formwork to reinforced concrete beams**		**Code**	**2.1.4.2.2**

*Further levels may be introduced as desired in order to provide each item with a unique code.

This simple and logical WBS starts to get complicated and confusing when we turn to NRM2 in order to find out how to code an elemental BQ with codes from the cost plan (in order to be able to re-sort the priced BQ into cost plan format once tenders have been received).

NRM2 Paragraph 2.15.3.1 suggests that *five to six levels of code are considered sufficient in cost planning*, and it lists *the main identification numbers* as illustrated in Table 6.7.

Table 6.7 The main identification numbers.

Level	Description	Identification number
0	Project number	User defined
1	Cost plan number	User defined but not required for a single cost plan
2	Group element	Predefined by NRM1
3	Element	Predefined by NRM1
4	Sub-element	Predefined by NRM1
5	Component	User defined

However, it can be seen that the identification numbers for the various levels are now different to those used in NRM1. This is because NRM2 introduces the idea of a project code (Level 0) and a cost plan code/reference number (Level 1), neither of which is mentioned in NRM1. Consequently, the group element, element and sub-element identification numbers now become Levels 2, 3 and 4, respectively, instead of 1, 2 and 3!

Moving swiftly on, NRM2 Paragraph 2.15.3.1 adds that a further level (Level 6) *will need to be introduced for each sub-component of a component that is to be measured in accordance with NRM2*. NRM2 Figure 2.3 illustrates how this can be done with reference to the example of a pile cap. There are, disappointingly, several errors in NRM2 Figure 2.3, and these are identified in Table 6.8.

The net effect of all this is that:

- The **group elements** provide the section headings for the BQ.
- The **elements** and **sub-elements** provide the various headings and subheadings within each section.
- The NRM1 components and sub-components are the items that will be measured under NRM2.
- The NRM2 classification tables refer to measured items as *items or work to be measured*.
- The 'pile caps' component is not a measured item under NRM2.
- Therefore, the items to be measured under NRM2 are the sub-components:
  - Work Section 5: *Excavating and filling*
    - **Excavation.**
    - **Disposal.**
  - Work Section 11: *In situ concrete works*
    - **Concrete.**
    - **Formwork.**
    - **Reinforcement.**
- Each of these items will be coded with the relevant NRM1 code.

The NRM2 quantity take-off for the pile cap items is illustrated in Figure 6.2.

These items would be billed under the **Substructure** group element as shown in Figure 6.3 which also shows that all items are allocated the same (NRM1) code, that is, 1.1.2.12.

6.8.9 Coding a work section BQ

NRM2 Part 3: *Tabulated rules of measurement for building works* is structured using a work sectional breakdown structure. There are 41 work sections with the first being devoted to preliminaries and the remaining 40 to the creation of measurement rules for a variety of building

Table 6.8 Analysis of NRM2 Figure 2.3.

Level	Description	Item	Resultant ID No. codes in NRM2		Notes
0	Project no.		DPB27		The project and bill ID references have been omitted from resultant NRM2 codes for clarity
1	Bill no.	Bill no. 3	3		
2	Group element/ BQ no.	Substructure	1		Correct
3	Element	Foundations	1		The element name in NRM1 is Substructure
4	Sub-element	Piled foundations	2		a. Incorrect b. 'Piled foundations' is a component heading within the sub-element of 'Specialist foundations' in NRM1 c. Therefore, the sub-element is Specialist foundations
5	Component	Pile cap	1		a. The component description in NRM1 is Piled foundations: Pile caps b. The component reference in NRM1 is 2 not 1
6	Sub-component	Excavation	1	1.1.2.1.1	a. The codes given in NRM2 Figure 2.3 are correct but with some reservation (see b iii) b. The fourth digit of the codes is shown shaded because: i. They are user defined ii. The reference used is (1), whereas the component reference in NRM1 is 12 iii. Although this code is user defined, it makes little sense to use (1) as a reference because there are several components listed under 'Piled foundations' that will also be included in the cost plan c. The final digits of the codes are 'user defined' and could equally be alpha or numeric
6	Sub-component	Disposal	2	1.1.2.1.2	
6	Sub-component	Concrete	3	1.1.2.1.3	
6	Sub-component	Formwork	4	1.1.2.1.4	
6	Sub-component	Reinforcement	5	1.1.2.1.5	

components/items. It should be noted that the preliminaries work section is divided into two parts – main contract preliminaries and work package contract preliminaries.

Each work section is referenced with a serial number (e.g. 14 Masonry), and, within each work section, the *item or work to be measured* and the Level 1, 2 and 3 descriptors also have a reference number. The *item or work to be measured* is the equivalent of *component* in NRM1.

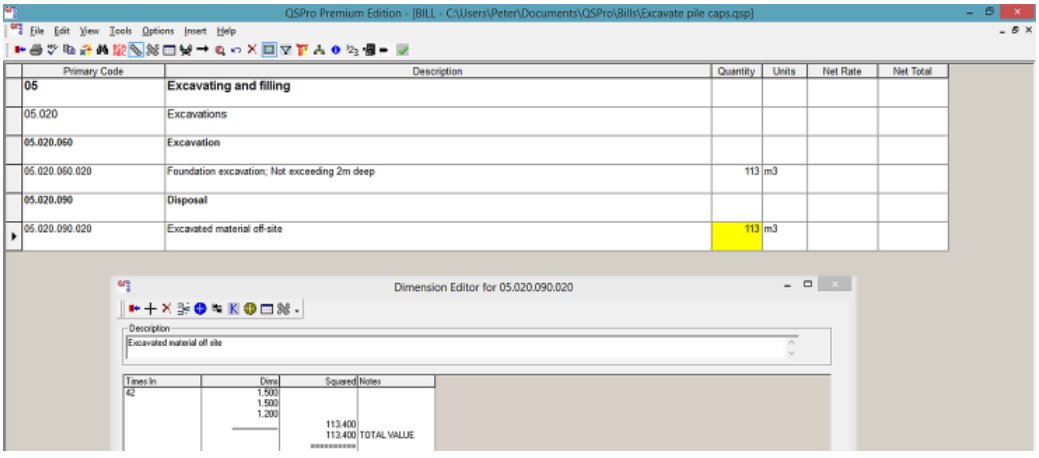


Figure 6.2 Quantity take-off for pile cap excavation.

Part 2

1 - SUBSTRUCTURE

		Qty	Unit	Rate	£	p
	Excavating and filling					
	Excavations					
	Excavation, commencing 500 mm below ground level					
A	Foundation excavation; not exceeding 2m deep [1.1.2.12]	141	m3			
	Disposal					
B	Excavated material off-site [1.1.2.12]	141	m3			
	'In situ' concrete works					
	Reinforced in situ concrete; C25					
A	Horizontal work; in structures [1.1.2.12]	96	m3			
	Formwork					
	Sides of foundations and bases					
B	> 500 high [1.1.2.12]	256	m2			
	Reinforcement					
	Mild steel bars					
C	Nominal size 10 mm [1.1.2.12]	4.50	t			

Figure 6.3 Billing of pile cap items.

NRM2 Paragraph 2.15.3.1(2) deals with the coding of BQ based on work sections, but, once again, the recommended way to code items assumes that the work section BQ is to be reconciled with the cost plan once priced tenders have been received.

As a result, the method recommended by the NRM2 rules is to:

- Use a primary code equivalent to that used for a BQ based on an elemental WBS.
- Add a secondary code which acts as a suffix to the primary code.

The primary code would be derived from NRM1, and the secondary code would be the work section serial number taken from NRM2. Figure 6.4 shows a masonry item taken from Group element 2: *Superstructure* in the cost plan. It can be seen that this is a 'composite' item comprising brickwork, blockwork and cavity insulation and that the item has an NRM1 code of 2.5.1.1.

The ensuing code for the billed items in the work section BQ would be the NRM1 code (2.5.1.1) with the addition of the work section serial number (14), that is, 2.5.1.1/14. This code would be applied to all the items in Work Section 14 included within the external walls component of sub-element 2.5.1 in the cost plan because:

- The item for **external walls** in the cost plan is a 'composite' item.
- The work included in the **external walls** component is measured in detail in NRM2 Work Section 14.

This is illustrated in Figure 6.5.

Should there be no cost plan in place, or if it is not desired to relate the priced BQ to a cost plan, then the codes for the work section BQ would be any code that the bill compiler wishes to use. In all practicality, the NRM2 codes would normally be used (despite their frailties), and the BQ items would be coded as shown in the left-hand column of Table 6.9.

6.8.10 Coding a work package BQ

The third and final BQ WBS in NRM2 is the work package breakdown structure. This is where all the NRM2 measured items of work that would otherwise be included in several work sections

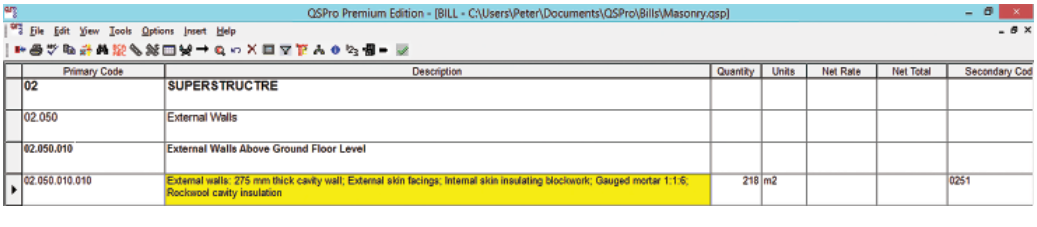


Figure 6.4 Coding – 1.

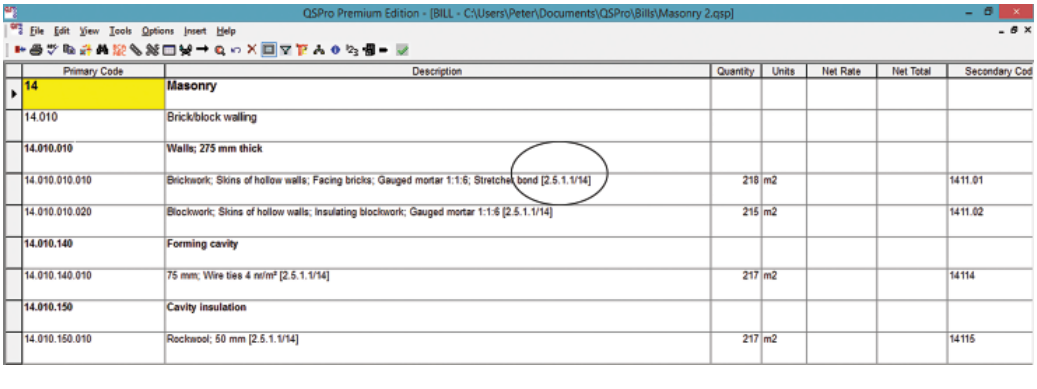


Figure 6.5 Coding – 2.

Table 6.9 Coding – 3.

Item	Code	Ref	NRM2 source	Item descriptor
Brickwork	**14.1.1.1.1**	14	Work Section 14	**Masonry**
		1	Subheading (unnumbered)	**Brick/block walling**
		1	Measured item	**Walls**
		1	Level 1	**Brickwork**
		1	Level 2	**Skins of hollow wall**
Blockwork	**14.1.1.2.1**	14	Work Section 14	**Masonry**
		1	Subheading (unnumbered)	**Brick/block walling**
		1	Measured item	**Walls**
		2	Level 1	**Blockwork**
		1	Level 2	**Skins of hollow wall**
Form cavity	**14.1.14.1**	14	Work Section 14	**Masonry**
		1	Subheading (unnumbered)	**Brick/block walling**
		14	Measured item	**Forming cavity**
		1	Level 1	**Width and method of forming**
Cavity insulation	**14.1.15.1**	14	Work Section 14	**Masonry**
		1	Subheading (unnumbered)	**Brick/block walling**
		15	Measured item	**Cavity insulation**
		1	Level 1	**Type and thickness**

are collected together in one work package according to the perception of risk and in order to facilitate procurement of the work in question.

A simple example of this might be where a large site is to be developed with a hypermarket, access roads and car parking. The first job will be to reduce the levels on the site and to install the main surface water and foul sewers prior to commencing the building and external works.

In a work section BQ, the excavation work and drainage would be measured in Work Sections 5: *Excavating and filling* and 34: D*rainage below ground*. Assuming, however, that a work package is to be compiled for this work, all the measured items from Work Sections 5 and 34 would be collected in a work package that might be called 'Site works'. Consequently, one of the sections within the BQ would have the title of **Site works**, and this might be given the reference number 02, for example.

In trying to follow what the authors of NRM2 intended, it is interesting to note that the emphasis in NRM2 Paragraph 2.15.3.1(3) is different to that in Paragraphs 2.15.3.1(1) and (2). In the latter two paragraphs, the guidance on coding focuses on coding the BQ so that the priced BQ can later be related back to the elemental cost plan.

In Paragraph 2.15.3.1(3), however, the emphasis is on the restructuring of cost plans from elements to work packages which seems to indicate that the priced work package BQ would be compared to a work package-based cost plan. This resonates with NRM1 Paragraph 4.5.1 which suggests that cost plans can be coded in such a way that *the works allocated to elements and sub-elements can be reallocated to the applicable work package*.

This is somewhat confusing as NRM2 Paragraph 2.15.3.1(3) later goes on to say that the number and content of work packages will have to be carefully considered by the quantity surveyor/cost manager *before commencing the preparation of the bill of quantities* as opposed to before the cost plan is commenced.

In any event, Paragraph 2.15.3.1(3) points out that the primary code used for the measured items in the work package BQ should be the code that would have been used for an elemental BQ with the addition of a suffix to indicate to which work package the relevant items belong.

Assuming that a work package **02 Site works** is to be compiled for the bulk excavation and main drainage for our major hypermarket development, the contents of the work package may be expected to contain the following items of work:

- Removal of topsoil over the site and disposal to stock piles for reuse.
- Reduced level excavation and disposal off-site.
- Connections to existing sewers.
- Main foul and surface water drainage and manholes.

In order to code the elemental cost plan, the first job is to find the above items in NRM1. Then, they will have to be coded with appropriate NRM1 codes. Table 6.10 illustrates where to find the various items in NRM1.

It should be noted that some of the items of work are not specifically measured in NRM1 and, therefore, cannot be given a precise code. Removal of topsoil and disposal to spoil heaps on-site, for instance, are included in the *Lowest floor construction* sub-element of the *Substructure* group element (along with lots of other work items). These items, therefore, cannot be separately identified and, as such, cannot be coded for transfer into the work package.

Table 6.10 Coding – 4.

Item	Group element		Sub-element		Code
Removal of topsoil over the site area	1	Substructure	1.1.3	Lowest floor construction	No specific item
	8	External works	8.1.2	Preparatory groundworks	No specific item
			8.2.1	Roads, paths, pavings and surfacings	No specific item
			8.2.2	Special surfacings and pavings	No specific item
Stockpiling the topsoil for future use (e.g. landscaping)	1	Substructure	1.1.3	Lowest floor construction	No specific item
	8	External works	8.1.2	Preparatory groundworks	No specific item
			8.2.1	Roads, paths, pavings and surfacings	No specific item
			8.2.2	Special surfacings and pavings	No specific item
Bulk excavation to reduce levels over the site	1	Substructure	1.1.3	Lowest floor construction	No specific item
	8	External works	8.1.2	Preparatory groundworks	No specific item
			8.2.1	Roads, paths, pavings and surfacings	No specific item
			8.2.2	Special surfacings and pavings	No specific item
Disposal of excavated material off-site	1	Substructure	1.1.3	Lowest floor construction	No specific item
	8	External works	8.1.2	Preparatory groundworks	No specific item
			8.2.1	Roads, paths, pavings and surfacings	No specific item
			8.2.2	Special surfacings and pavings	No specific item
Connections to existing sewers	8	External works	8.6.1	Surface water and foul drainage	8.6.1.1
Main surface water drainage and manholes					8.6.1.2
Main foul water drainage and manholes					8.6.1.2
Manholes					8.6.1.5

This problem illustrates that the work package items (i.e. the NRM2 items) must be identified first and then coded to the cost plan and not vice versa. Thus, the structure of the work package must be determined, and then the items can be coded with the NRM1 codes. These codes will be the elemental codes derived from NRM1 which means, therefore, that the BQ items, when re-sorted, will re-sort into an elemental cost plan and not a work package cost plan. If a work package cost plan is required, the NRM1 codes will have to be supplemented with a suffix relating to the work package (in this case 02) following the guidance in NRM1 Paragraph 4.5.1. Consequently, the primary code will identify the group element/sub-element/component and the suffix will direct the items into the correct work package (i.e. 02).

In order to code the BQ items with the appropriate NRM1 codes and a suffix, however, the NRM2 measured items will have to be taken off in such a way that they can be identified with a specific group element/sub-element/component.

This adds a further layer of complication in that the topsoil excavation and disposal items, for instance, would have to be split between the *Substructure* and *External works* group elements and further split into the appropriate sub-elements in order to allocate the correct NRM1 code.

A way round this would be to allocate all of the quantities measured to one item in the cost plan (e.g. Group element 8: *External works* could include Site preparation works, Preparatory groundworks, Forming new site contours and adjusting existing site levels). All of the items could then be coded 8.1.2.1/02, and the bulk excavation could be coded 8.1.2.2/02 (see Table 6.11).

Table 6.11 Work package coding – 1.

02 SITE WORKS					Excavating and filling		
			Qty	Unit	Rate	£	p
	Excavating and filling						
	Excavations						
	Site preparation						
A	Remove topsoil: Average 150 mm deep [8.1.2.1/02]		135888	m2			
	Excavation; Commencing level 150 mm below existing ground level						
B	Bulk excavation; Over 2m not exceeding 4m deep [8.1.2.2/02]		298954	m3			
	Disposals						
	Disposal						
C	Excavated material off site [8.1.2.2/02]		298954	m3			
	Retaining excavated material on site						
D	Top soil; To temporary spoil heaps; Average distance 250 m [8.1.2.1/02]		20383	m3			

This problem doesn't arise, thankfully, with some of the other measured items.

Drainage runs, *manholes* and *connections to existing sewers*, for instance, are specifically measured items under NRM1 Element 8.6: *External drainage* as they are under NRM2 Work Section 34: *Drainage below ground*. This is illustrated in Table 6.12.

Table 6.12 Work package coding – 2.

02 SITE WORKS		Drainage below ground				
		Qty	Unit	Rate	£	p
	Drainage below ground					
	Storm Water Drain Systems					
	Drain runs					
A	Average trench depth 2.0 m; Precast concrete pipe 450 mm diameter; Granular pipe bedding and surround [8.6.1.2/02]	78	m			
B	Average trench depth 2.5 m; Precast concrete pipe 450 mm diameter; Granular pipe bedding and surround [8.6.1.2/02]	46	m			
	Connections					
C	Local authority sewer; Depth 3.0 m [8.6.1.1/02]	1	it			
	Foul Drain Systems					
	Drain runs					
D	Average trench depth 2.50 m; Precast concrete pipe 300 mm diameter; Granular pipe bedding and surround [8.6.1.2/02]	61	m			
E	Average trench depth 3.0 m; Precast concrete pipe					

As if the coding of elemental and work section BQ were not complicated enough, the coding of work package BQ is even more tortuous.

Risk Issue

Unless this author is sadly mistaken, the BQ coding arrangements in NRM2 are horribly complicated.

If the NRM family of documents is to be adopted as recommended best practice in line with their status as RICS guidance notes, QS professionals may find themselves having to justify to clients the amount of time and effort needed to code items back to the cost plan and the level of fee charged for this work.

It may well be concluded that the cost is not justifiable, and thus, the PQS will then have to wrestle with the conundrum 'do I follow the NRM or do I take the risk of having to justify an alternative approach before a court or other tribunal?'

6.9 Part 3: Tabulated rules of measurement for building works

6.9.1 Introduction

NRM2 Paragraph 3.1.1 explains that Part 3 of the rules is made up of:

- The information and requirements for main contractor and work package contractor preliminaries.
- The rules for preparing the preliminaries pricing schedule.
- The rules of measurement applying to building components and items.

Paragraph 3.1.2 states that Part 3 explains how the tabulated rules are used, and Paragraph 3.1.3 makes the two-part statement that:

- *Bill of quantities (BQ) are to fully describe and accurately represent the quantity and quality of the works to be carried out.*
- *More detail than is required by these rules should be given where necessary to define the precise nature and extent of the required work.*

These statements stop short of their SMM7 General Rule 1.1 equivalents which both use the word 'shall' in order to emphasise that they are, in fact , 'rules' to be followed rather than discretionary options.

However, Paragraph 3.1.3 is, in fact, made redundant by the later Paragraph 3.3.1 which does use the word 'shall', and it can only be concluded, therefore, that the entire Paragraph 3.1 is to be ignored as consisting of purely 'throwaway remarks' that have no importance or meaning within the tabulated rules.

6.9.2 Use of tabulated rules of measurement for building works

Paragraph 3.2 explains how the rules of measurement are structured and that they are set out in tables. In particular, Paragraph 3.2.1.1 states that the tables are divided into two categories:

- Preliminaries.
- Measurement of building components/items.

This is, in fact, misleading.

There is no categorisation under Part 3: *Tabulated Work Sections* which merely comprises 41 work sections of which 'preliminaries' is Work Section 1. There is categorisation within Work Section 1, however, which comprises preliminaries (main contract) and preliminaries (work package contract), both of which are divided into Parts A (information and requirements) and B (pricing schedule).

This is explained in NRM2 Paragraphs 3.2.2.1 and 3.2.2.2 and illustrated in Table 6.13.

Table 6.13 Classification of preliminaries.

Work Section	Subsection	Part		Purpose
1	Preliminaries (main contract)	A	Information and requirements	The descriptive part of preliminaries
		B	Pricing schedule	The part where preliminaries prices are inserted by the contractor
	Preliminaries (work package contract)	A	Information and requirements	The descriptive part of preliminaries
		B	Pricing schedule	The part where preliminaries prices are inserted by the work package contractor

The distinction between Work Section 1 and the remaining 40 work sections is that:

- The tables relating to Preliminaries have different layouts.
- There are two types of table in Work Section 1.

Paragraphs 3.2.1.2–6 are self-explanatory, but careful note should be taken of:

- Paragraph 3.2.1.4
  Horizontal lines divide the tables and rules into zones to which different rules apply.
- Paragraph 3.2.1.4
  A broken line (-----) between units of measurement or measurement rules *denotes a choice of units or choice of ways of measuring the work*. The best method to suit the situation *shall be* chosen.

Tables: Preliminaries

Paragraphs 3.2.2.3 and 3.2.2.4 explain the function of the various columns in the tables for *information and requirements* and for the *pricing schedule*. These explanations apply to both preliminaries (main contract) and preliminaries (work package contract).

Both *Part A: Information and requirements* and *Part B: Pricing schedule* comprise a number of tables, each of which has a heading that indicates the subject matter of the table in question. This is illustrated in Table 6.14.

Table 6.14 Tables: preliminaries.

1 Preliminaries (main contract)
Part A: Information requirements
1.7 Employer's requirements: management of the works

Subheading 1	Subheading 2	Information requirements	Supplementary information/notes
Preliminaries items to be considered	Sub-items to be considered	Information which shall be included	Information that might be needed

1 Preliminaries (main contract)
Part B: Pricing schedule
1.1 Employer's requirements
1.1.1 Site accommodation

Component	Included/notes on pricing	Unit	Pricing method	Excluded
Preliminaries items to be considered	The sub-item of preliminaries items to be considered		Stipulates if the component is a: • Fixed charge • Time-related charge • Combination of both	Describes items excluded from a component

In *Part A: Information and requirements*, it should be noted that:

- Subheadings 1 and 2 list items to be considered; consequently, these items are optional and will be chosen, or not used, according to the requirements of the project.

- The 'Information requirements' column lists information that shall be included should the particular item or sub-item be included in the schedule of preliminaries.
- The 'Supplementary information/notes' column is an *aide-memoire* that provides additional information that might be needed in preliminaries descriptions and guidance on the drafting of preliminaries statements.

In *Part B: Pricing schedule*, it should be noted that:

- The items listed under the headings 'Component' and 'Included/notes on pricing' are optional and will be chosen, or not used, according to the requirements of the project.
- The heading 'Pricing method' provides for items to be priced as 'fixed' or 'time-related' charges or both.
- The 'Excluded' column identifies items that are not included in a component.

Tables: Building Components/Items

Paragraph 3.2.3 is an important part of NRM2 because it states that the rules of measurement are laid out in tables and also explains how the tables work. It does not, however, explain how to formulate item descriptions from the classification tables which is dealt with in Paragraph 3.3.3 and in Paragraph 3.3.3.3 in particular.

Paragraph 3.2.3.1 lists the 40 Work Sections, other than preliminaries, that appear in Part 3 of the document, whilst Paragraph 3.2.3.2 explains the structure of the tables that are used for items of measured work.

Each work section (e.g. Carpentry) has:

- A reference number (e.g. 16).
- A title (e.g. Carpentry).
- A list of the types of work included in the Work Section, for example:
  - Timber framing.
  - Timber first fixings.
  - Timber, metal and plastic boarding, sheeting, decking, casings and linings.
  - Metal and plastic accessories.
- A two-part table:
  - Information requirements and general rules.
  - Items or work to be measured together with descriptive features (*Levels 1, 2 and 3*) and *notes, comments and glossary.*

The NRM2 tabular layout for Work Sections 2–41 is illustrated in Table 6.15.

Each work section has a reference number and title, and it is this title that forms the *heading* needed for each work section as required by NRM2 Paragraph 3.3.3.1.

The list of items below the title is interesting. There is no reference to this list in the text of NRM2, and, at first glance, it would appear that its function is little more than informative. Its importance is explored in Section 6.9.3 (Descriptions) of this chapter.

The next part of the table layout consists of two rows which are read from right to left. They set out:

- Drawings:
  - required for measurement purposes.
  - that *shall accompany the bill of quantities when issued.*
- Mandatory information:
  - *that is to be provided in each Work Section.*
- Minimum information *that shall be shown:*
  - *on the drawings or*
  - *any other document that accompany each Work Section.*

Table 6.15 Tables: building components/items.

Ref no	**Title**				
	List of types of work included in the Work Section				
Drawings that must accompany this section of measurement	NOT USED	For example: General arrangement drawings Site survey Plans Sections	**Mandatory information to be provided**	For example: Specification information	**Notes, commentary and glossary** For example: Description rules Explanatory rules
Minimum information that must be shown on the drawings that accompany this section of measurement	NOT USED	For example: Extent, position or location of the work	**Works and materials deemed included**	For example: Items not measured but understood to be included in the measured item	Additional measurement rules
Item or work to be measured	**Unit**	**Level 1**	**Level 2**	**Level 3**	**Notes, commentary and glossary**
Components/items	m, m^2, m^3, etc.	⟸	Item descriptors that shall be included where applicable	⟹	Relevant information that shall be included in item descriptions
Horizontal lines that denote units of measurement and/or descriptive features that apply to the particular component/ item residing between the lines					
	Broken line denotes a choice of unit				

- Works and materials:
  - *that are not measured* but are
  - *deemed to be included* in the components/items measured.

Following the first two rows are six columns that are to be read vertically:

- Building component/items to be measured are in the first column followed by:
- Units of measurement followed by:
- three columns (Levels 1–3) listing:
  1. Information.
  2. Supporting information.
  3. Further supporting information:
     - *That shall be included* in the item descriptions.
- Levels 2 and 3 also contain any additional dimension requirements *which shall be included* in the item descriptions.
- The final column:
  - *Explains* what is *deemed to be included* in specific items.
  - *Clarifies the approach to quantification and description* of items.
  - Defines *specific terms and phrases used* in any particular component/item.

There are three work sections which have a slight, but important, variation to this layout: Work Sections 11, 22 and 41. The difference is easily missed.

Work Sections 11, 22 and 41 introduce intermediate rows in the table which contain headings. They are not highlighted but nevertheless represent 'subheadings' in the classification that must be observed. Referring to Table 6.16, it can be seen that there is a row in between the preceding two rows and the following six columns described earlier. In Work Section 11: *In situ concrete*, for instance, there are four headings that must be used to distinguish between various types of concrete work – Plain in situ concrete, Reinforced in situ concrete, Fibre-reinforced in situ concrete and Sprayed in situ concrete.

Paragraph 3.2.3.2 culminates with a statement which says that the list of building components/items in the tables represents those commonly encountered in building work but that they *are not intended to be exhaustive*. Curiously, the reader is not directed as to what to do when items not listed are to be measured. In such circumstances, it is necessary to trawl through two more pages to discover Paragraph 3.3.5 which provides appropriate guidance (see also later in Section 6.9.3: *Measurable work not covered by the tabulated rules*).

Further 'trawling' is needed to discover that descriptions for components/items to be measured are to be compiled using all Level 1, 2 and 3 information and also, where, applicable, information contained in the *Notes, commentary and glossary* column (column five) (Paragraph 3.3.3.3 refers).

6.9.3 Measurement rules for building works

Paragraph 3.3.1 corrects the imprecise Paragraph 3.1.3 and emphasises that the BQ *shall fully describe and accurately represent the quantity and quality of works to be carried out* and that, where necessary, additional detail *shall be given* in order to ensure that *the precise nature and extent* of the works is conveyed.

Bill compilers should carefully heed these rules as the implications of not doing so could be serious and costly.

Table 6.16 Intermediate headings.

Ref no	**Title**				
Drawings that must accompany this section of measurement	NOT USED	For example: General arrangement drawings	**Mandatory information to be provided**	For example: Specification information	**Notes, commentary and glossary** For example: Description rules Explanatory rules
Minimum information that must be shown on the drawings that accompany this section of measurement	NOT USED	For example: Extent, position or location of the work	**Works and materials deemed included**	For example: Items not measured but understood to be included in the measured item	Additional measurement rules
Item or work to be measured	**Unit**	**Level 1**	**Level 2**	**Level 3**	**Notes, commentary and glossary**
Headings that distinguish between various types of work to be measured For example: **Work Section 11: In situ concrete** Plain in situ concrete Reinforced in situ concrete Fibre-reinforced in situ concrete Sprayed in situ concrete					
Work to be measured such as mass concrete	m^2	Concrete thickness	Use of concrete such as filling voids or trench filling	Further description such as whether the concrete is poured against earth or unblinded hardcore	Additional description or deemed to be included rules or whether different types of concrete may be aggregated

Risk Issue

It is not inconceivable that a bill of quantities either:

- Does not fully describe or accurately represent the work to be carried out

or

- Lacks detail that could or should have been given

or

- Both

It is arguable that such shortcomings are not covered by the term 'variation' (e.g. JCT 2011 Clause 5.1.1) and that they could, in fact, constitute a misleading statement that could lead to a claim for damages either:

- Under the Misrepresentation Act 1967 or
- In tort on the principle of *Hedley Byrne & Co Ltd v Heller & Partners* (1963).

It is also possible that a breach of contract (e.g. under Clause 2.13.1 of JCT 2011) may be claimed as such shortcomings would not be in accordance with the Rules of measurement.

An important issue arises in Paragraph 3.3.1 is that there is no statement that *the rules apply to measurement of proposed work and executed work* such as may be found, for example, in General Rule 1.2 of SMM7.

This may be an oversight, or it may have been a conscious decision by the authors of NRM2 that the JCT 2011 SBC/Q (a lump sum contract) would be the default contract to use with NRM2. As such, JCT 2011 Clause 5.6.1.3 states that the measurement of variations *shall be in accordance with the same principles as those governing the preparation of the Contract Bills* referred in Clause 2.13.

Clause 2.13 concerns preparation of the contract bills, and Clause 2.13.1 refers expressly to the *Measurement Rules* (i.e. NRM2) pursuant to the JCT August 2012 NRM Update.

Risk Issue

Without a clause stating that *the rules apply to measurement of proposed work and executed work*, there is no express or implied undertaking that executed work (i.e. work actually carried out) shall be measured in accordance with the New Rules of Measurement (see Chapter 12).

There is no problem with the JCT lump sum contract, because remeasured work is dealt with as a variation, but care needs to be exercised in deciding how the omission of such a rule may play out should non-JCT forms of contract be used in conjunction with NRM2.

Quantities

Paragraph 3.3.2 provides 'rules' for the measurement and billing of items and for dealing with voids. These rules concern issues such as the following:

- Work shall be measured net as fixed in position.
- Laps, joints, seams and the like shall be deemed included in the net quantity (thereby avoiding the need for repetitive 'coverage' rules in the work sections).
- Quantities to be given to the nearest whole number (or unity where less than 1) with the exception that items measured in tonnes are to be given to two places of decimals.
- The treatment of deductions for voids and the like.

Descriptions

The writing of item descriptions is, arguably, the most important part of any standard method of measurement as this is where the ability of the bill compiler to formulate descriptions that *fully describe and accurately represent the quantity and quality of the works to be carried out* (Paragraph 3.1.3) is tested.

In order to satisfy this requirement, the BQ needs to be laid out in the manner prescribed by the method of measurement, and the item descriptions need to include all the descriptive features delineated in the classification tables.

To begin with, NRM2 Paragraph 3.3.3.1 requires that *each Work Section shall have*:

- A heading.
- A description stating the *nature and location of the work*.

This is a significant departure from SMM7 General Rule 4.5 which states that a description of the nature and location of the work is to be provided *unless evident from the drawn or other information required to be provided by these rules*. In other words, where the nature and location of the work is clear from the drawings or other document(s) provided (e.g. specification), a description does not have to be provided in the BQ under SMM7.

Next, it is conventional to subdivide BQ work sections into distinct parts where related items may be arranged together. This is usually done by using subheadings. NRM2 is silent on this issue except in Appendix A.3(2)(b) which refers to *Subdivisions*, but even here the guidance is most unclear.

Risk Issue

BQ compilers will be faced with an additional administrative burden in dealing with this requirement which seems unnecessarily onerous and, in some work sections, is a duplication of effort.

In Work Sections **5: Excavation** and **33: Drainage above ground**, for instance, locational information is expressly required to be given in the **Mandatory information to be provided** part of the Work Section table. In Work Section 5, Paragraph 3.3.3.1 is specifically referred to. This is not the case, however, in Work Section 33.

An additional consideration is that the Paragraph 3.3.3.1 requirement may also offer contractors the opportunity to make a claim for additional payment where the description is:

- Not given.
- Unclear.
- Inaccurate or misleading.

The simplest way round the problem would appear to be to:

- Include a 'notwithstanding' clause in the BQ.
- Add a caveat to the Paragraph 3.3.3.1 requirement.
- In NEC3 ECC Options B and D, add an amendment to the method of measurement in Part 1 of the Contract Data.

Appendix A.3(2) refers to the order of items in work section BQ:

- Appendix A.3(2)(a) requires that the BQ is firstly divided into Work Sections.
- Appendix A.3(2)(b) requires that there shall be subdivisions:
  - (i) Of work sections as contained in *NRM2: Detailed measurement for building works*[7].
  - (ii) As required by *NRM2: Detailed measurement for building works*,[2] such as *external paintwork*.

Appendix A.3(2), therefore, infers that the order of items in BQ should be hierarchically subdivided into headings and subheadings, and this resonates to some extent with NRM2 Paragraph 3.3.3.2 which refers to *headings for groups of components/items*. It could thus be argued – but NRM2 is not at all clear on the matter – that within each work section, there will be groupings of items under subheadings.

If this is the case, then Appendix A.3(2)(b)(i) might be suggesting that the source of these subheadings is the list of items that appears under the main title of each work section. The only problem with this idea is that the list is not referenced at all and therefore would seem to be outside of the WBS propounded by NRM2.

The other type of subdivision referred to in A.3(2)(b)(ii) is where it is required by the *Tabulated rules* – the example of *external painting* is given. This makes less sense because *external painting* is a descriptive feature of Work Section 29: *Decoration* at Level 2 and, as such, makes up part of an item description. For example, *external painting to general surfaces over 300 mm girth* would have a reference of 29.1.2.2.

The authors of QSPro seem to have been persuaded by the first idea of subdivision as not only have they chosen to use the list of items under the main work section headings as work section subdivisions but have also given this subheading a code or reference number as illustrated in Figure 6.6.

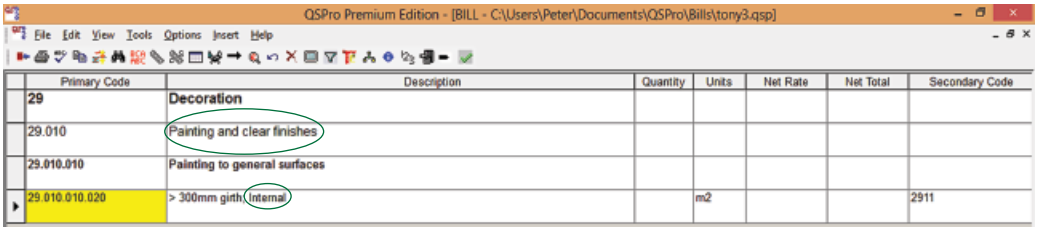


Figure 6.6 Approaches to subdivision – 1.

It should be noted that:

- The use of the NRM2 subheadings in this example is similar to the subheadings used in SMM7.
- The SMM7 subheadings are coded.
- The code used in the QSPro example is consistent with the idea of a WBS proposed in NRM2.
- The introduction of a code for these subheadings is not contrary to the rules of NRM2 because there are no rules that apply to the coding of measured work items.
- NRM2 only has a coding system for BQ items where it is desired to link them to an elemental cost plan.

CATO, on the other hand, employs the idea of a blank level under the main work section heading to enable the user to insert any subheading desired as illustrated in Figure 6.7. Again, this is consistent with the WBS of NRM2.

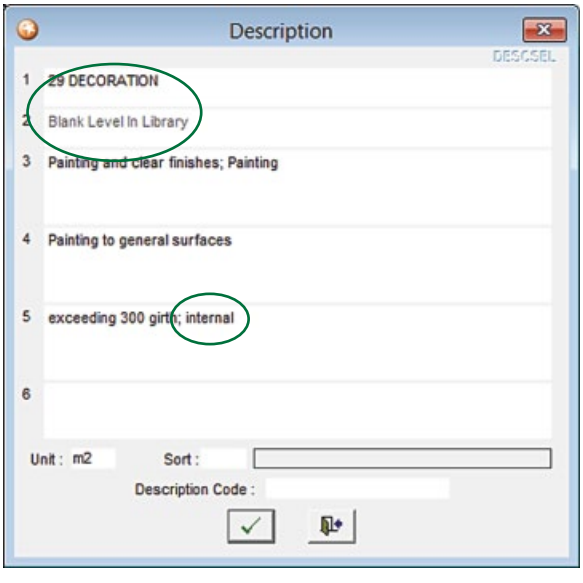


Figure 6.7 Approaches to subdivision – 2.

In passing, it will be noted that:

- The QSPro and CATO codes are slightly different which is consistent with the 'no rule' arrangement within NRM2 as regards the coding of measured items (as opposed to the coding of BQ items).
- Neither QSPro nor CATO use a subheading to distinguish *internal and external paintwork*. This is contrary to NRM2 Appendix A.3(2)(b)(ii), but as this appendix is entitled 'Guidance', it is not a rule and can thus be ignored. The main thing is that the BQ item is properly described.

Moving swiftly on!

Turning to the writing of item descriptions, this is covered in three paragraphs:

- Paragraph 3.3.3.3:
  - the component/item to be measured is to be *taken from the first column of the tabulated rules.*
  - *all of the level 1, 2 and 3 information (taken from the third, fourth and fifth columns respectively)* applicable to the item shall be included.
  - *relevant information from column five*[3] *shall be included* where applicable.
- Paragraph 3.3.3.4:
  - Item descriptions shall include:
    - *the type and quality of the material.*
    - *critical dimensions* of the materials concerned.
    - the method of fixing or installation *where not at the discretion of the contractor.*
    - the character of the background that the material is to be fixed to.
- Paragraph 3.3.3.5:
  - The character of background material stated is to be chosen from a list of six types:
    1. *timber* (including boards).
    2. *plastics.*
    3. *masonry* (including brick, concrete, block, etc.).
    4. *metal* (any).
    5. *metal-faced timber or plastics* and
    6. *vulnerable materials* (such as glass, marble, tiles etc).

Therefore, when fixing plasterboard to a concrete background, this is to be stated as 'masonry' because the term 'masonry' includes concrete.

Paragraph 3.3.3.10 is an interesting one as it has its origins in SMM7 General Rule 4.2 but is slightly different in meaning. The SMM7 rule is clear in that item descriptions in the BQ have to be drawn from the three columns of the classification tables, together with supplementary information from the Supplementary information column of the tables. Where necessary, however, the same information may be given on a drawing or in a specification so long as *a precise and unique cross reference is given* in the BQ item description.

In NRM2, however, *information required by these rules may be given* in another document (e.g. specification or catalogue – no mention of drawings) provided that *a precise and unique cross reference* is given. This sounds much the same as the SMM7 rule, but the underlined words *by these rules* mean that the derogation applies to all the rules in Part 3 and not simply the rules in Paragraphs 3.3.3.3 and 3.1.3 which are the SMM7 equivalents.

Risk Issue

Paragraph 3.3.3.10 could involve the tenderer in all sorts of additional research to discover what a BQ item means.

This might require a search of the NBS or other specifications as well as searching out manufacturers' catalogues and the like as there is no provision in NRM2 that requires such information to be given.

Paragraphs 3.3.3.11 and 3.3.3.12 are important from the perspective of what to measure where a composite item could be construed. This could arise where, for instance, 12.5 mm plasterboard is to be fixed to walls on timber battens. In such circumstances, there are two ways to proceed:

1. Paragraph 3.3.3.11 requires that:
   - The timber battens and the plasterboard shall be measured and described separately.
2. However, Paragraph 3.3.3.12 states that:
   - A single composite item could be billed providing that the item description is unequivocal as to what is included in the item.

Assuming the first method is adopted, i.e. where the component items are to be measured separately, the item descriptions would be made up as follows:

- The timber battens are measured in Work Section 16: *Carpentry*:
  - The item reference is, therefore [16.3.1.2]:
    - 3 – Backing timber.
    - 1 – Nominal size 25 mm × 38 mm.
    - 2 – Battens.
- The plasterboard is measured in Work Section 28: *Floor, wall, ceiling and roof finishes*:
  - The item reference is, therefore [28.7.2]:
    - 7 – Walls; 12.5 mm plasterboard.
    - 2 – exceeding 600 mm wide.

As to what is deemed to be included in a component or item, reference must be made to Paragraph 3.3.3.13 which is broadly similar to SMM7 General Rule 4.6 but with one notable exception. SMM7 deems that the contractor's *establishment charges, overheads and profit* is included, whereas NRM2 states that only *establishment charges* are included in any building component/item. The reasoning for this is that the *Main contractor's overheads and profit* is to be stated as a separate item (%) in the final summary of the BQ under NRM2.

There may well be justifiable reasons why overheads and profit should be disaggregated from BQ rates and prices where, perhaps, there is a partnering agreement and the main contractor's margin is to be protected or 'ring-fenced'. In normal circumstances, however, no contractor in their right mind will wish to divulge such confidential information, and most contractors, it is suggested, will price the BQ in exactly the way that they wish to price it.

Risk Issue

Neither SMM7 nor NRM2 is clear on the distinction between establishment charges and overheads, but, in SMM7 at least, it is quite clear to all concerned that the BQ items are priced 'gross'.

NRM2 Paragraph 3.3.3.13, however, leaves considerable doubt in the mind both as to what the distinction is and what is deemed included in any particular BQ rate.

The question arises, therefore, as to how variations to the contract should be valued when overheads and profit have been priced separately but the BQ item is nevertheless deemed to include establishment charges (i.e. overheads).

Work of special types

Paragraph 3.3.4.1 requires that work of a particular type *shall be separately identified*, and Paragraph 3.3.4.2 stipulates that *specific details* of such work shall be provided *at the start of each applicable Work Section*. The rules detailed in Paragraph 3.3.4.1 must be read in conjunction with

the rules of measurement given in the various work sections (Paragraph 3.3.4.3). Work of special types includes:

- Work to existing buildings.
- Work to be carried out and subsequently removed.
- Work outside the curtilage of the site.
- Work carried out in extraordinary conditions, such as work in or under water, tidal work and compressed air working.

Risk Issue

Where work of special types is to be included in the BQ, Paragraph 3.3.4.4 requires that details of additional preliminaries *shall be given in the description*.

It is not clear, however, whether:

- The *description* referred to is an overall description or a preamble that precedes the measured items of work if, indeed, they are to be separately billed.
- This is meant to be a pointer to additional items that have been included in Work Section 1: *Preliminaries*.

Measurable work not covered by the tabulated rules

Occasions arise where the tabulated rules of measurement do not cover the items to be measured.

A pedestrian underpass giving access to a new shopping centre development may have to be tunnelled under an existing highway, for instance. Such circumstances are provided for in NRM2 under Paragraph 3.3.5 which suggests two possible solutions:

- Paragraph 3.3.5.1:
  - Use the rules for similar work.
  - Clearly state and fully define the rules adopted in either:
    - The preliminaries or
    - With the relevant BQ items.
  - Ensure, *as far as possible*, that the rules adopted conform to the tabulated rules of measurement for similar items.
- Paragraph 3.3.5.2:
  - Use 'bespoke' rules of measurement.
  - The rules adopted shall be *reiterated in full* in either:
    - The preliminaries or
    - In the BQ above the relevant items.

The use of the word *reiterated* is puzzling because this means 'repeated' or 'restated', implying, perhaps, that the rules may not actually be 'bespoke' (tailor-made, adapted, customised) but may already exist in another document. This might suggest, for instance, that such 'bespoke' rules may be derived from another standard method of measurement (such as CESMM4).

There would seem little point in reiterating the rules from another standard method of measurement when a simple cross reference to the relevant section(s) of the document could be used instead.

Procedure where work cannot be quantified

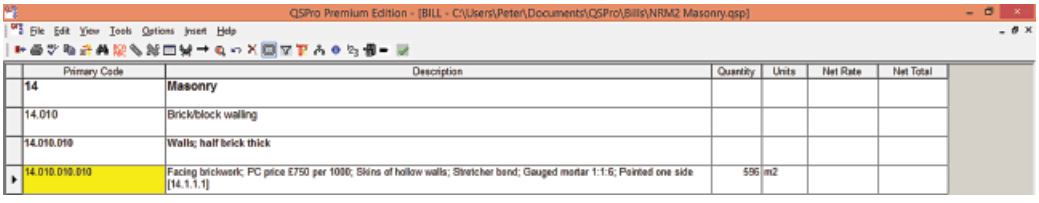
Paragraph 3.3.6 refers the reader to Paragraph 2.9 of the rules where detailed guidance for such circumstances is provided. Section 6.7.9 of this book discusses the issues arising from Paragraph 2.9.

Procedure where exact type of product or component is not specified

It is quite common to find that a BQ is produced at a point in time when the technical design is insufficiently developed to enable certain materials or products to be precisely identified so that the contractor can price a competitive rate. This situation is normally overcome by providing the contractor with a 'price' for the material in question which can then be used for building up the unit rate. This approach has the dual advantage that:

- The BQ compiler can complete the BQ to a reasonable level of accuracy.
- A competitive rate can be obtained from the contractor which has to be adjusted for the material element only once the precise specification is established.

Under NRM2 Paragraph 3.3.7.1, an estimated price for the product or component in question *shall be given* in the item description and this shall be stated as a *PC price*. An example is provided in Figure 6.8 which shows a PC price for facing bricks.



	Masonry		
	Brick/block walling		
	Walls; half brick thick		
A	Facing brickwork; PC price £750 per 1000; Skins of hollow walls; Stretcher bond; Gauged mortar 1:1:6; Pointed one side [14.1.1.1]	596	m2

Figure 6.8 Prime cost item.

Paragraph 3.3.7.3 states that *PC prices shall exclude any allowance for the contractor's overheads and profit;* this is because *provision shall be made* in the BQ for the pricing of overheads and profit in accordance with the Paragraph 2.11 item in the final summary.

Where a PC price is to be incorporated into a BQ rate, the contractor *shall be deemed* by Paragraph 3.3.7.2 to have allowed in the rate for all the items listed in Paragraph 3.3.3.13; this list includes (7) *establishment charges*.

Notwithstanding the above, the PC price arrangement in NRM2 is problematic as discussed earlier in Section 6.6.11.

Procedure where quantity of work cannot be accurately determined

Paragraph 3.3.8 deals with situations where items are to be inserted into the measured work sections of a BQ which can be described in accordance with the tabulated rules of measurement *but* the quantity cannot be measured precisely.

Paragraph 3.3.8.1 requires that *an estimate of the quantity* of such work *shall be given and identified as a 'provisional quantity'*. There is no guidance as to how this should be done, but custom and practice indicates that the word 'provisional' is given in brackets at the end of the item description.

Risk Issue

Paragraph 3.3.8.2 goes on to say that provisional quantities *shall be subject to remeasurement when they have been completed.*

This could be taken to mean that:

- Incomplete work items shall not be remeasured.
- The contractor's progress payments shall be based on the BQ and not actual quantities.
- Progress payments may not accurately reflect the quantity of work carried out.
- Actual cost may be greater than actual value until such time as the work is completed and remeasured.
- There may be a delay of several weeks, if not months, until the contractor receives the correct payment for work in progress.
- The employer's quantity surveyor/cost manager is obliged to undertake a remeasure as soon as the work has been completed.

Paragraph 3.3.8.2 also says that where there is a 'provisional quantity', *the 'approximate quantity' shall be substituted by the 'firm quantity' measured*. There is no definition of either of these terms in NRM2, and their use is both superfluous and confusing as, in any event, the paragraph concludes with a procedure for dealing with differences between the 'provisional quantity' and the 'firm quantity'.

Risk Issue

The distinction between 'provisional' and 'firm' quantities is important for contractors.

Where the conditions of contract state that NRM2 is the applicable standard method of measurement, NRM2 Paragraph 3.3.8.2 introduces the notion of a 'rule' (the '20% rule') for dealing with variations between provisional quantities and the eventual remeasured quantity.

This provision in NRM2 may lead to a conflict with the prevailing conditions of contract for the project, even where JCT conditions are used.

Paragraph 3.3.8 is far more complex than its counterpart General Rule: 10.1 in SMM7 and is discussed further in Chapter 12 in the context of final accounts.

6.10 Tabulated work sections

The *Tabulated work sections* part of NRM2 is a huge disappointment.

When the CESMM was first published in 1990, the industry was faced with something novel and new, and the old standard method was soon confined to history. With NRM2, the same impact could have been achieved, and, at the same time, a building standard method of measurement aligned to the exiting world of BIM could have been produced.

What has been achieved is arguably an improvement on SMM7, but the overall effect leaves the feeling that SMM7 is still with us but wearing a different 'coat'. This is, of course, a personal view, and other commentators may well have a different opinion, but reading the tabulated rules, there are a lot of similarities with SMM7 that do not bear repeating in this book.

The *Tabulated work sections* in NRM2 provide the specific rules for measuring excavation, concrete work, brickwork, plastering and the like which are known as components/items in NRM2. The work sections appear in Part 3: *Tabulated rules of measurement for building works*

of NRM2 and, more particularly, may be found under Paragraph 3.3: *Measurement rules for building works – Tabulated Work Sections*.

There are 41 tabulated work sections, including preliminaries, which is subdivided into:

- Preliminaries (main contract).
- Preliminaries (work package contract).

The tabulated work sections must be read in conjunction with the preceding text in NRM2 Parts 1, 2 and 3 which set the scene for how building work is to be measured and billed.

6.10.1 Changing from SMM7 to NRM2

It is not the function of this book to provide a line-by-line comparison between NRM2 and SMM7, but comparisons are, nonetheless, inevitable when changing from one method of measurement to another. Some of the differences are, therefore, highlighted in this part of the book, especially where the differences raise risk issues.

Although there are some significant differences between NRM2 and SMM7, it will no doubt be comforting for SMM7 users to find that much of the content of the NRM2 *Tabulated Work Sections* has been 'cut and pasted' from its predecessor and that the NRM2 rules of measurement are fairly easy to follow. However, the implications of how the rules work and how they differ from SMM7, despite the striking similarities, may not be so evident.

Lee et al. (2014) provide a useful overview of the differences between SMM7 and NRM2, presented in a tabular format, which is also available at the free *Designing Buildings Wiki* knowledge base.[4] This comparison identifies the SMM7 Work Section reference and the NRM2 equivalent as illustrated in Table 6.17.

Table 6.17 SMM7 v NRM2.

Ref	SMM7	Ref	NRM2
D	Groundwork	5	Excavation and filling
D20.2	Excavating	5.6	Rules now simplified into either bulk excavation or foundation excavation with depth ranges now only in 2 m stages
		5.7	Earthwork support has been simplified in that it is now only measured where specifically called for in the contract documents (specification)

Adapted from Lee et al. (2014).

Of particular concern with NRM2 are the alarming deficiencies in item coverage that appear in several work sections which leave the bill compiler with a problem as to how to formulate item descriptions that *fully describe and accurately represent the quantity* (NRM2 Paragraph 3.3.1) of the work concerned.

Risk Issue

The crucial difference between NRM2 and SMM7 is the way that item descriptions are compiled.

Lee et al. (2014) suggest that *the framing of descriptions is…not as simple following these new rules* and counsel that *care should be taken to ensure that each description adequately reflects the work to be priced.*

This is good advice as it is easy to be seduced into thinking that the NRM2 classification tables work the same way as those in SMM7. They don't, and incomplete, or even misleading, item descriptions could result from such a misunderstanding along with all that this implies.

It is important to remember, therefore, that the NRM2 classification table structure is quite different from that of SMM7.

The tables are not hierarchical and item descriptions are framed differently to those of SMM7, albeit that the NRM2 structure and numbering system may persuade otherwise. This important difference is illustrated in Table 6.18.

Table 6.18 Framing descriptions.

NRM2		**SMM7**	
Paragraph 3.3.3.3	Descriptions shall **state the building components/items being measured** (taken **from the first column** of the tabulated rules) **and** include **all Level 1, 2 and 3 information** (**taken from the third, fourth and fifth columns**, respectively) **applicable** to that item. **Where applicable**, the relevant **information from column five** shall be included in the description	General Rule 2.6	Each item description shall identify the work with respect to **one descriptive feature** drawn **from each of the first three columns** in the classification table **and as many of the descriptive features in the fourth column as are applicable** to the item

Each NRM2 Work Section lists the item or work to be measured and the attendant unit of measurement, but the Level 1, 2 and 3 descriptors provide 'information' to describe the item and not a hierarchy from which item descriptions are formulated. It is worth reiterating that NRM2 Paragraph 3.3.3.3 is instrumental to formulating item descriptions and that:

- the component/item to be measured is to be *taken from the first column of the tabulated rules*.
- *all of the level 1, 2 and 3 information* applicable to the item shall be included.
- *relevant information from column five shall be included* where applicable.

Therefore, whilst there is no rule to prevent the NRM2 tables from being used hierarchically, and it can be in some instances, the system is essentially a 'pick-and-mix' arrangement with the emphasis on creating items descriptions that fully describe the work concerned.

This creates some problems with library-based measurement software, which are essentially hierarchical in the way they work. With NRM2, a great deal more editing of item descriptions is needed in some instances, and this might been viewed by some practitioners as a backward step.

6.10.2 NRM2 and measurement

The measurement process using NRM2 is no different to using any other method of measurement, irrespective of whether traditional 'dim' sheets, cut and shuffle, on-screen measurement or measurement from a BIM model is used.

What must be carefully considered, however, is the final output required, that is, the BQ.

NRM2 Paragraph 2.15.1.2 envisages three principal breakdown structures for BQ:

1. Elemental breakdown structure – where each section of the BQ is represented by a group element as defined in *NRM1: Order of cost estimating and cost planning for capital building works* (e.g. substructure, superstructure, internal finishes, etc.).
2. Work sectional breakdown structure – where the BQ is divided into work sections as defined in NRM2 (e.g. excavating and filling, piling, in situ concrete works, etc.).

3. Work package breakdown structure – where the BQ is divided into work packages which might be a specific 'trade' (e.g. plastering, painting and decorating) or a single package made up of a number of 'trades' (e.g. concrete works comprising formwork, rebar and in situ concrete trades). The work packages may be defined either by the employer, the quantity surveyor or by the contractor according to the procurement method chosen.

Further detail on these BQ breakdown structures is given in Paragraph A.1 of Appendix A.

Consequently, a means of re-sorting the take-off into one of these BQ formats must be anticipated. This could be done by using the traditional 'take-off-abstract-bill' system, by the 'cut and shuffle' method or by the bill sort facility within a measurement software package.

However, a coding system must also be thought about, and this would not be the same as the codes generated by using the tabulated work section references. Some sort of additional prefixing and suffixing, as suggested in NRM2 Paragraph 2.15, would be needed to arrive at the desired BQ format.

6.10.3 Phraseology

There are some words and phrases that appear in this part of Chapter 6 that do not appear in NRM2:

Bill compiler – This means the person responsible for preparing the BQ who could be the *quantity surveyor/cost manager* or *surveyor* referred to in NRM2 but could equally be a main contractor's or subcontractor's quantity surveyor.

Descriptor – This refers to the Level 1, 2 and 3 choices for creating item descriptions which are referred to in NRM2 Paragraph 3.3.3.3 as *information*.

General notes – This refers to the information given in the first two rows of each Work Section where the *mandatory information to be provided* and *works and materials deemed included* lists reside. These notes have general application to the whole of the relevant work section.

Notes – This refers to the *Notes, comments and glossary* given in the sixth column of the classification tables. These notes have particular application to the items, units and levels included within the boundaries of the solid horizontal lines drawn across the classification table.

6.10.4 Preliminaries

Most standard methods of measurement, including SMM7, CESMM4, MMHW and POM(I), take a simple and pragmatic approach to the 'preliminaries bill', four pages in CESMM4 and six pages in SMM7 being sufficient to:

- Briefly describe the works and the contract particulars.
- Specify the employers' requirements relating to the management, supervision and control of the works.
- Provide a place for the contractor to price general cost items such as site supervision, temporary accommodation and method-related charges.

Traditionally, the 'preliminaries bill' is the first 'bill' in the BQ for several logical reasons:

- Preliminaries is usually the first work section in the standard method of measurement.
- Part of the preliminaries bill provides essential 'general' information about the project which the contractor needs to read first before starting any pricing:
  - The identity of the employer and his consultants.
  - The conditions of contract and any amendments thereto.

  - The information about start and completion dates.
  - The rate of liquidated and ascertained damages.
- The 'general' part of the preliminaries bill will alert tenderers to any specific conditions, hazards, restrictions or employer-imposed limitations on how the contractor may go about planning and organising the works.
- The priced part of the preliminaries bill 'overarches' the measured work as it is largely linked to the contractor's intended programme and proposed method of working.
- The priced method-related charges 'overarch' specific bill items as they represent the fixed costs associated with particular measured work items.

NRM2 Preliminaries structure

The approach to 'preliminaries' in NRM2 is more complex:

- Work Section 1: *Preliminaries* spans 70 pages of text with a further 3½ pages of explanation, guidance and rules in NRM2 Paragraphs 2.7 and 3.2.2.
- There are two categories in Work Section 1:
  - Main contract preliminaries.
  - Work package preliminaries.
- Each category has two distinct parts:
  - *Part A: Information requirements.*
  - *Part B: Pricing schedule.*
- NRM2 Appendices B and C provide the bill compiler with a choice of formats for the layout of the preliminaries section in the BQ:
  - Condensed version.
  - Expanded version.
- According to NRM2 Paragraph 2.7.3.2, the bill compiler *should*, as part of the conditions of tender, *instruct the main contractor to return* with his tender *a full and detailed breakdown* of how the price for preliminaries has been calculated which should be appended to the priced BQ.

Part of the reasoning for this complexity is revealed in Paragraph 3.2.2.4(1) which explains that the 'pricing schedule' tables for preliminaries are structured so that *the contractor's pricing of preliminaries are captured under a number of headings*. This resonates with much of the *raison d'etre* of NRM2 which is the collection of contractors' pricing data for cost planning purposes as discussed earlier in Section 6.8.7.

Preliminaries (Main Contract)

The NRM2 preliminaries (main contract) work section is, at first glance, daunting because it is extremely long and detailed. However, it can be broken down into 'bite-sized' chunks:

- **Part A: Information and requirements:**
  Part A is straightforward with nothing to measure. Its purpose is to describe the project, identify the conditions of contract and the names the participants, provide information about the site and existing buildings and list the drawings and pre-construction information.
- **Part B: Pricing schedule:**
  Part B is in two parts:
  - Employer's requirements (B 1.1)
    - Part B 1.1 identifies the employer's site accommodation requirements, should separate facilities from those of the contractor be needed.
    - It also identifies the site records to be provided by the contractor and certain completion and post-completion issues such as handover requirements and operational and maintenance matters.

- Main contractor's cost items (B 1.2)
  - Part B 1.2 lists the main contractor's preliminaries items.
    - The main contractor's pricing schedule can be:
      - Condensed (NRM2: Appendix B) (see Table 6.19).
      - Expanded (NRM2: Appendix C).

It should be noted that there is seemingly no compulsion to use any or all of the expanded NRM2 preliminaries headings as Paragraph 3.2.2.4 explains that the 'Component' column of the pricing schedule *lists the preliminaries items to be considered under each main heading*.

The billing of Part A is a straightforward 'word-processing' exercise to be added to the BQ outside the measurement package. Notwithstanding, QSPro does provide the NRM2 Part A 'menu' as an *aide-memoire*.

Table 6.19 Pricing schedule – main contract preliminaries (condensed).

Ref	Component (condensed list)	Time-related charges	Fixed charges	Total charges	Component (expanded list) example
	Preliminaries – Main contractor's cost items				
A	Management and staff				
B	Site establishment				
C	Temporary services				
D	Safety and environmental protection				
E	Control and protection				
F	**Mechanical plant**				• Generally
G	Temporary works				• Tower cranes
H	Site records				• Mobile cranes
I	Completion and post-completion requirements				• Hoists • Access plant • Concrete plant
J	Cleaning				• Other plant
K	Fees and charges				
L	Insurances, bonds, guarantees and warranties				
	Totals				
	Carried to pricing summary				

Preliminaries (Work Package Contract)

The preliminaries section for work package contracts follows the same pattern as for the main contract preliminaries, but Parts A and B are much briefer in content.

There is no provision within the Part B: *Pricing schedule* for 'employer's requirements', and this would seem to indicate that work package contracts are intended to come under the supervision

of either a main contractor, a Tier 1 contractor or a 'supervising' work package contractor who will price a preliminaries (main contract) bill.

Measurement Units

In both the main contract and work package contract sections of Tabulated Work Section 1: *Preliminaries*, the Part B: *Pricing schedule* is measurable.

Common units of measurement include *week*, *item*, *nr*, m^2 and *m*. Alongside the 'Unit' is a column headed 'Pricing method' which indicates whether specific preliminaries items are to be priced by a *fixed charge* or a *time-related charge* or both. So far, so good!

Turning to NRM2 Appendices B and C, templates suggesting the manner in which the pricing schedule is to be laid out are supplied. These are in a 'spreadsheet' format as indicated in Table 6.20.

Table 6.20 Template for preliminaries.

Cost centre	Component	Time-related charges	Fixed charges	Total charges
		£ p	£ p	£ p
1.2	Main contractor's cost items			
1.2.1	Management and staff			
1.2.1.1	Project specific management and staff	A	B	A+B
1.2.2	Site establishment			
1.2.2.1	Site accommodation	C	D	C+D
1.2.3	Temporary services			
1.2.3.1	Temporary water supply	E	F	E+F
1.2.3.3	Temporary electricity supply	G	H	G+H
1.2.3.5	Temporary drainage	I	J	I+J
1.2.4	Security			
1.2.4.1	Security staff	K	L	K+L
1.2.4.3	Hoardings, fences and gates Etc.	M	N	M+N

The 'spreadsheets' provide columns for inserting prices for time-related and fixed charges and total charges, as indicated in Table 6.20. There are, however, no quantity, unit and rate columns which is a departure from convention.

Whether it should be assumed that lump sums are to be priced in these columns, or whether tenderers are meant to contrive their own columns, is not clear.

Both QSPro and CATO present the pricing schedule in a 'traditional' BQ format. In CATO, each item is accorded a unit, as illustrated in Table 6.21, the default quantity being '1'. Presumably, it is intended that each tenderer completes the quantities for each preliminaries item according to their intended programme and method of working.

An alternative to this approach would be to follow the NRM2 Appendix B and C layout at tender stage. The units of measurement would then come into play at a later stage when the contractor's *full and detailed breakdown* of the preliminaries is prepared (as required by NRM2 Paragraph 2.7.3.2).

Table 6.21 Pricing schedule (part) – main contract preliminaries.

					£	p
	1 PRELIMINARIES (MAIN CONTRACT) : PRICING SCHEDULE					
	1.2 MAIN CONTRACTOR'S COST ITEMS					
	1.2.1 Management and staff					
	Project-specific management and staff					
A	time-related charge; construction manager	1	week			
	1.2.2 Site establishment					
	Site accommodation; offices					
B	fixed charge; purchase charges	ITEM				
C	time-related charge; hire charges	1	week			
	1.2.3 Temporary services					
	Temporary water supply					
D	fixed charge; temporary connections	1	nr			
E	time-related charge; temporary connections	1	nr			

This would seem logical, as only the contractor would be able to measure the quantities of items such as site accommodation, temporary works or hoardings, etc., to the level of detail indicated in NRM2.

Risk Issue

Contractors must be prepared to compile a *full and detailed breakdown* of their preliminaries at tender stage and *append this information to* [the] *priced bill of quantities*. Under NRM2, the quantity surveyor/cost manager (PQS) is under a duty to ask for this information and, undoubtedly, will (NRM2 Paragraph 2.7.3.2 refers).

If this is the case, the breakdown will have to comply with NRM2 Work Section 1 and be measured in the units stipulated.

This will require a great deal more time and effort than pricing preliminaries under SMM7, or any other method of measurement for that matter.

Temporary Works

The *pricing schedule* of the main contract preliminaries of Work Section 1 provides for the contractor's pricing of temporary works, including:

- **Site accommodation:** *Temporary works in connection with site establishment* (e.g. bases and foundations).
- **Mechanical plant:** *Tower cranes* (e.g. temporary bases).
- **Site services:** *Temporary works* (e.g. temporary screens and façade retention works).

Similar, but not the same, provisions are included in the work package contract *pricing schedule*.

Temporary works are also provided for at 1.2.8: *Temporary works* of the main contract *pricing schedule*. They are categorised as:

1. Access scaffolding.
2. Temporary works.

Access scaffolding (1) includes *Common user access scaffolding*, but scaffolding specific to works packages and scaffold inspections are excluded (see 1.2.5). Temporary works (2) includes *Common user temporary works* such as:

- Support scaffolding and propping.
- Crash decks.
- Temporary protection to trees and vegetation.
- Floodlights.

Expressly excluded from this classification are:

- Temporary earthwork support (EWS) to basement excavations – presumably because basement excavation is measured under 5: *Excavation and filling* and EWS is deemed included.
- Temporary props and walings to support contiguous bored piled walls of basement excavations – inexplicably because such temporary works are not deemed included in either 5: *Excavation and filling* or 7: *Piling*.

However, there is no provision anywhere in the NRM2: *Preliminaries* pricing schedules for the contractor to price method-related charges, especially those in connection with excavation, geotechnical works and drainage:

- Earthwork support and working space are not measured under NRM2, and excavation and filling for temporary works is *deemed included* (see Work Section 5: *Excavation and filling*):
  - **NB**: Earthwork support **is measured** where not at the contractor's discretion (e.g. where designed by the employer's engineer and shown on the drawings).
- Earthwork support is also *deemed included* in Work Sections 9: *Diaphragm walls and embedded retaining walls*, 10: *Crib walls, gabions and reinforced earth*, 8: *Underpinning* and 34: *Drainage below ground*.
- Temporary works in connection with 3: *Demolitions*, 4: *Alterations, repairs and conservation* and 8: *Underpinning* are also *deemed included*.

Risk Issue

Under SMM7, where site conditions warranted the use of steel sheet piling, this was a measurable item by default, under D32.2, whether or not its use was at the contractor's discretion. The consequences of this were:

Advantages

- Reduced risk for the contractor
- The avoidance of a loss and expense claim
- A tender price not unnecessarily inflated by a contractor risk allowance for sheet piling that might not be required

Disadvantages

- Increased risk for the employer
- A legitimate claim for an extension of time (with costs) as a variation is a relevant event
- The problem of agreeing suitable rates for the piling work

Considering the detailed scrutiny that NRM2 places on the pricing of the contractor's preliminaries, it is unlikely that the contractor will 'get away with' pricing method-related charges in the temporary works parts of the preliminaries bill, and so the question arises as to just where they can be priced:

Under NRM2, the situation would be different as steel sheet piling is not measurable unless specified in the contract:

Advantages	Disadvantages
■ Reduced risk for the employer	■ Increased risk for the contractor ■ A tender price inflated by a contractor risk allowance for sheet piling that might not be required ■ An inevitable loss and expense claim if the bore-hole data is inaccurate or misrepresented or if an experienced contractor could not have foreseen the need for steel sheet piling ■ A legitimate claim for an extension of time (with costs) as part of the entitlement

- The quantity surveyor/cost manager could create a subset to 1.2.8: *Temporary works*, and this would appear to be in accordance with NRM2 (NRM2 Paragraph 3.2.2.4 4 refers).
- They could be included in the *schedule of construction risks* (NRM2: Appendix F) prepared by the quantity surveyor/cost manager and would then appear in the BQ *pricing summary*.
- The *schedule of construction risks* could be partially or fully left blank for the contractor to complete.
- The contractor could price the items in the rates.

Risk Issue

In view of the cost of temporary works to deep excavations, basements and the like and to the support of existing buildings and façades, contractors need to be alert as to how the bill of quantities has been prepared and where these items may be priced.

It is likely that such items will be scrutinised much more than under SMM7, and there is also the attendant risk that method-related charges apportioned to BQ rates may be under-recovered should the measured items be admeasured or varied.

6.10.5 Off-Site Manufactured Materials, Components or Buildings

Work Section 2 largely deals with the measurement of proprietary building components, units or structures that are manufactured off-site and then delivered to site for final incorporation into the building.

In providing this work section, NRM2 has embraced the trend towards modular system building for providing pre-finished fully serviced hotel bedroom and bathroom pods and the like which are designed and factory-built using BIM design and coordination methods. The advantages of defect-free construction, just-in-time delivery and fast track erection sequences are obvious.

The NRM2 Work Section 2 preamble makes it clear that the measured items are fully inclusive and include transport to site, fixing in position and connection to services. The work section *Notes* also make it clear that other work ancillary to the items measured in Work Section 2 is to be measured elsewhere. This would include such work as the provision of plumbing and electrical installations up to but excluding the final connection.

Measurement and description of the work items are straightforward. For an item of 256 nr bathroom pods for a new hotel, the NRM2 item code is 2.3.1.1, and the item might be billed as illustrated in Table 6.22.

Table 6.22 Off-site manufactured component.

					£	p
	2 OFF-SITE MANUFACTURED MATERIALS, COMPONENTS OR BUILDINGS					
	Component; Messrs Acme Bathroom pod; Metal studding; Bolted to structure					
	Prefabricated building units; toilet/bathroom units					
A	1.76 x 2.15 x 2.27 overall dimensions	256	nr			

6.10.6 Demolitions

Demolition of all existing structures, individual structures or parts of structures are itemised (3.1.*) as is decontamination of the site, such as the removal of hazardous materials (3.4.*).

The contractor is advised to visit the site and *the surveyor* is required to provide additional information concerning temporary works *if not readily ascertained from the drawings*. The temporary works concerned are measured items (3.3.*.*.*) and could well be extensive.

Part 2

Risk Issue

There is no definition of who *the surveyor* is in NRM2 Paragraph 1.6.3, despite there being a clear duty to provide supplementary information to tenderers.

As the supplementary information may be required to convey *the full extent and scope* of the work, it might be assumed that the quantity surveyor/cost manager will undertake the duty.

In view of what might have to be measured, the duty could well be onerous.

Temporary works other than these items are *deemed included*. This might include temporary propping between floors, propping openings and refuse chutes.

Disposal of debris is *deemed included*.

6.10.7 Alterations, Repairs and Conservation

'Spot items' – measured in previous methods of measurement, including SMM7 – do not appear in NRM2. Instead, provision is made for the measurement of a variety of works of adaption, alteration, repair and renovation, all of which are to be measured in detail.

A choice of units of measurement is available, and, in a number of instances, the notes dictate that this shall be at *the discretion of the surveyor*.

Risk Issue

In common with Work Section 3: *Demolitions, the surveyor* has a duty to provide supplementary information to tenderers without there being a definition of who *the surveyor* is.

This duty applies to Temporary works (4.24.*.*.*) where there appears to be a typographical error with the word 'Roads'. This should be a Level 1 descriptor (4.24.4) and not a work item.

6.10.8 Excavating and Filling

Excavation

The measurement rules dealing with excavation have changed, both in terms of the types of excavation and the depth categories.

Excavation is now classed as *bulk excavation* and *foundation excavation* only with stage depths to be given in 2 m steps and any obstructions in the ground to be stated. Obstructions are nothing to do with ground conditions but relate to piles and manholes that must remain undisturbed during the excavations. Strangely, Note 5.6.1.*.2 only relates to bulk excavation.

Bulk excavation includes excavating to form basements, pools, ponds and the like, and each may be described separately if desired (5.6.1.* Note 1). Foundation excavation includes strip and pad foundations, pile caps and *all other types of foundations* (5.6.2.* Note 1) which may equally be measured separately (5.6.2.* Note 2).

This is all somewhat prosaic but, more important, is the issue of excavation and filling to working space or earthwork support.

Filling

Filling, with both excavated material and imported fill, is classed as less than or exceeding 500 mm, with the exception of imported blinding not exceeding 50 mm thick.

Excavation and Filling to Working Space and Earthwork Support

Working space is not measured in NRM2, and neither is earthwork support, unless specified or instructed (see 5.8.*). However, where the type of backfill to *the extra space taken up by working space or earthwork support* is not left to the discretion of the contractor, then an allowance shall be made in the quantities for excavation and filling (see Note 3 in Work Section 5 'General rules'). The same rule applies to the 'extra over' items measured under 5.7.*.

Consequently, if a drawing note or specification clause specifies that the contractor shall backfill working space, and/or the space taken up by earthwork support, with a particular type of fill, then both the additional excavation and additional fill would be measurable. There is no stated limit to the type of fill that might be specified, and therefore, a provision for *backfilling with selected excavated material* would seem to be caught by this measurement rule.

This would be the case even if the choice of working space or earthwork support provision was at the contractor's discretion.

Risk Issue

This is an impossible item for the quantity surveyor/cost manager to measure unless a provisional quantity is to be given in the BQ.

As there is no provision within NRM2 to measure a provisional item exclusively for the excavation and filling of working space/earthwork support, the additional quantities would have to be added to the general excavation and filling items. This would make the entire excavation and filling quantity 'provisional'.

If so, the provisional quantity would be subject to the provisions of NRM2 Paragraph 3.3.8.2 which would also mean subjecting the provisional quantity to the '20% rule' test for a possible re-rate to the item.

Hard Materials

The breaking up of rock, and other hard materials, is measured extra over all types of excavation, irrespective of depth, in m^3 under 5.7.2.* The SMM7 categories of breaking out 'existing materials' and 'existing hard pavings' have disappeared, with the latter having moved to the site preparation item (5.5.3.*)

This is a straightforward measurement item except that the usual 'chestnut' of the definition of 'rock' must be considered.

In NRM2, 'rock' is slightly different to the SMM7 definition, being:

> *any hard material which is of such size or* ***location*** *that it can only be removed by the use of wedges,* ***rock hammers****, special plant or explosives*; the differences are highlighted in bold. (Note 1 of item 5.7.2.1)

- This is not a geological definition and therefore, even if the strata to be removed comes within a geological definition of rock, such material is not to be measured as 'rock' if its size or location enables it to be removed with normal excavating plant not deemed to be *special*.

Risk Issue

Note 3 of item 5.7.2.1 is less precise, because whilst this states that *degraded or friable rock that can be scraped out by the excavator bucket does not constitute rock*, it also implies that, if the excavator being used on-site is not 'man enough' to dig the rock, it will be measured as rock should a larger machine have to be brought to site, as, presumably, this would qualify as 'special plant'.

Note 2 of item 5.7.2.1 limits rock to:

1. *A boulder ≤5 m^3* or
2. *one that can be lifted out in the bucket of an excavator.*

There are problems with this provision of NRM2.

Risk Issue

1. The first part of the provision says that a boulder less than, but more importantly equal to 5 m3, is not classed as rock. The cube root of 5 is 1.71, and therefore, a boulder measuring up to 1.71 m × 1.71 m × 1.71 m is not classed as rock according to Note 2. This must be a mistake (suggest 0.5 m^3).
2. As for the second part, the ability of an excavator to pick up a boulder in its bucket is a matter of opinion, and not a matter of fact, and is a test that requires the presence of an employer's representative on-site at a precise moment in time. Methods of measurement depend on rules that are clear and definitive, and this provision is neither.

Contractors should be wary of this provision and would be wise to look for a 'notwithstanding NRM2' preamble that at least deals with the first part of Note 2 more sensibly.

Support to Faces of Excavation

Earthwork support, or more correctly *support to faces of excavation*, is not measurable under Work Section 5: *Excavating and filling* unless:

- Support to the faces of excavation is not at the contractor's discretion (General note) and is specified in the contract documents (Note 5.8.1) or is instructed by the contract administrator during the course of the works (Note 5.8.1).

Risk Issue

It would be unwise for contractors to assume that the existence of a provision in Work Section 5, to measure support to faces of excavation, is similar to the SMM7 D20 *Definition Rule* D5. This provides for interlocking steel piling to be measured if this means of earthwork support should become necessary when on-site.

The D5 rule was a relief granted to the contractor who knew, when pricing the earthwork support item measured in the contract bills, that the item coverage did not include interlocking steel piling.

It is submitted that the NRM2 provision is not the same as SMM7 D20 *Definition Rule* D5 and would be used only where:

Pre-contract

1. The engineer wishes to employ an earth support system compatible with or integral with the foundation design (e.g. a contiguous piled wall or diaphragm wall).
2. The employer wishes to relieve the contractor of the below-ground risk for earthwork support.
3. The employer's insurers are not prepared to risk the possibility of relieving adjacent buildings of their support on the basis of a contractor's design.
4. The cost of the earth support system and its design would disproportionate to the value of the remainder of the works.
5. Contractor design is either unwanted or impractical in view of the time allowed for tendering.

Post-contract

1. Ground conditions were misrepresented in the tender documents.
2. Ground conditions on-site were such that an experienced contractor could not have anticipated them.

The NRM2 measured item is for the *Support to the face(s) of excavation where not at the discretion of the contractor*, measured in m^2, with the location and method of forming the support stated.

It is strange, therefore, at the Level 3 descriptor, to find that the method of forming the support is to be stated in the item description only *where not left to the discretion of the contractor*.

This could imply that:

- The support system has been designed by the employer's engineer, and there is a drawing and specification for the work (i.e. no contractor discretion).
- The engineer has prepared more than one design (i.e. not at the contractor's discretion) with the choice being left to the contractor (i.e. at the contractor's discretion).
- There could be a performance specification with the tender documents (i.e. not at the contractor's discretion), and the method of forming the support is to be left to the contractor (i.e. at the contractor's discretion).
- The engineer decides that site conditions are such that the contractor's choice of earth support system (i.e. contractor discretion) was forced upon him by unforeseen ground conditions (i.e. not really at the contractor's discretion).

Water and Water-Bearing Ground

Excavation in water-bearing ground poses a significant risk for contractors both at tender stage and during construction. At tender stage, tenderers need to be sure that they are competing on

a 'level playing field', and during construction, contractors need to know where their tender risk allowance stops and grounds for a legitimate entitlement claim begin.

Some standard conditions of contract make the issue clear, and both the ECC and ICC forms place the risk firmly with the contractor up to the point where an experienced contractor could not have judged the prevailing ground conditions. The JCT forms are silent on the issue, and this places the risk for dealing with below groundwater squarely with the contractor according to case law. Traditionally, however, JCT contracts are used in conjunction with SMM7 which grants contractors relief from certain ground conditions via the rules of measurement.

The rules of measurement dealing with water-bearing ground are more complex under NRM2, however, as the comparison with SMM7 in Table 6.23 indicates.

Table 6.23 Water-bearing ground – SMM7 v NRM2.

SMM7			NRM2		
Item ref.	**Measured item**		**Item ref.**	**Measured item**	
D20.3.1	Extra over excavation for excavating below groundwater level	m^3	5.7.1.3	Extra over for excavating below groundwater level	m^3
			5.7.1.5	Extra over for excavating in unstable ground[5]	m^3
D20.7.*.*.2	Earthwork support belowground water level[1]	m^2			
D20.7.*.*.3	Earthwork support; unstable ground[1,2]	m^2			
			5.8.*	Support to faces of excavation where not at the discretion of the contractor	m^2
D20.8.2	Disposal of groundwater[3]	Item	5.9.1.*	Disposal of groundwater	item
D32.2.*	Interlocking steel piling is measured if needed[4]	m^2			
			6.1.*	Site dewatering	Item

Notes

[1] Measured full depth of excavation

[2] Unstable ground is running silt, running sand, loose **gravel** and the like

[3] Only measured where there is a corresponding D20.3.1 item

[4] D20 Definition Rule D5

[5] Unstable ground is running silt, running sand, loose **ground** and the like

Under NRM2, the measurement of items for excavating and filling are deemed to include for disposal of surface water as per the 'general rules' of Work Section 5. This does not include dealing with **groundwater** which is a measurable item *Extra over all types of excavation irrespective of depth* (5.7.1.*).

Groundwater is defined in Work Section 5.7.1 Note 2 as *any water encountered below the established water table level*, excluding water arising from streams, broken drains, culverts or surface flooding, and also excludes running water from springs, streams or rivers. The water table is required to be re-established at the time each excavation is carried out, and this becomes the *post-contract ground water level* as per Work Section 5 'general rules'.

Also measurable in Work Section 5 is *Excavating in unstable ground*, which is measured extra over all types of excavation (5.7.1.5). Unstable ground is defined as *running silt, running sand, loose ground and the like* (Note 4 of 5.7.1.5 refers).

In water-bearing ground, running silt and running sand, groundwater is naturally present, and, as such, tenderers could rightly expect to see a measured item in the BQ according to the rules of Work Section 5. The same could be expected for unstable ground conditions, which condition is also measurable under Work Section 5.

However, the quantity surveyor/cost manager is faced with a potential problem when measuring work of this nature because:

- water-bearing ground is not necessarily unstable and
- unstable ground is not necessarily water bearing, but the two conditions could be present in the same excavation.

A further issue with NRM2 is that Work Section 6: *Ground remediation and soil stabilisation* provides a measurable item for site dewatering, whether or not the choice of dewatering method is at the contractor's discretion.

Dealing with water and water-bearing ground is a tricky measurement issue in NRM2, and it is felt that a case study might help to explain the complex issues and provide a worked example of how this problem could be dealt with. Consequently, Chapter 14 is devoted to measuring the excavation items relating to a deep basement to be excavated in difficult ground.

Disposal

Work Section 5.9 contains two measurable items:

5.9.1 Groundwater:

- Unlike SMM7, the disposal of surface water is not measurable in NRM2 but is *deemed included* in Work Section 5 'general rules'. The disposal of groundwater, on the other hand, is measurable, stating the depth below original ground level and any known polluted water (5.9.1.*).
- This item needs to be read carefully in conjunction with measurable items for extra over for excavating in water-bearing ground (5.7.1.3–5) and with 6.1.*.1.* – site dewatering (Section 6.10.8.2 refers).
- Unlike SMM7 (as well used phrase in this chapter!), there is no measurement rule in NRM2 that limits the measurement of a disposal of groundwater item to the measurement of a corresponding item for extra over for excavating below groundwater level (SMM7 D20.8 M12 refers).

5.9.2 Excavated material off-site:

- Excavated material to be disposed of off-site is measured in m^3, with a stated destination if not left to the contractor's discretion.
- Material for disposal that is a 'controlled waste' also has to be classified as hazardous or non-hazardous, but there is no classification of 'inert' waste.
- The only real issue with the 5.9.2.* disposal item in NRM2 is the lack of a unit of measurement. Ostrowski (2013) believes that disposal off-site should be measured as an 'item' because this is the unit of measurement for the other 'disposal' item – 5.9.1.* disposal of groundwater. However, as there is a solid line between the two items, the unit of measurement is not shared (see NRM2 Paragraph 3.2.1.4), and there can be no presumed common unit of measurement.

- Common sense would indicate that the unit of measurement should be m^3 as, not only is m^3 the unit of measurement for excavation, but it is also custom and practice in the industry across all common methods of measurement. In Work Section 7: *Piling*, disposal of excavated material is measured in m^3, and the common library-based software packages adopt the same pragmatic approach.

Risk Issue

The lack of a unit of measurement in a standard method of measurement is not so much a major drama as an inconvenience.

Clearly, if the quantity surveyor/cost manager adopts a unit of measurement that is contrary to the rules, this would be an issue, unless highlighted in a preamble to the bill of quantities.

Should there be no unit of measurement stated in the method of measurement, no measurement unit adopted could be contrary to the rules, by definition, but it might be prudent to clarify the chosen unit in a preamble.

6.10.9 Ground Remediation and Soil Stabilisation

To SMM7 aficionados, NRM2 Work Section 6 is 'new' as there were no specific rules for ground investigation, soil stabilisation or site dewatering in the outgoing method of measurement. By contrast, the NRM2 provisions reflect modern geotechnics by providing measurement rules for ground freezing, gas venting, soil nailing, ground anchors, pressure grouting and the like.

Dynamic deep compaction (DDC), used for compacting weak soils on marginal sites, is also included (*Compacting*: 6.9.*.1). This technique can improve the subsoil to the extent that shallow foundations can replace the need for piling and deep excavation, following treatment. As with other geotechnical process, DDC is designed to a performance specification, and the rules of measurement reflect the need to state the method and extent of treatment required.

There is little technical detail provided in the NRM2 item descriptor tables, and library-based measurement packages leave the bill compiler to 'fill in the blanks' with such detailed design and specification information as may be available. Table 6.24 illustrates how an item description may be 'fleshed out' according to the rules of measurement.

Table 6.24 Ground remediation.

				£	p
	6 GROUND REMEDIATION AND SOIL STABILISATION				
	Compacting				
	Generally				
A	Dynamic deep compaction; Site areas A and B; Drawing No BD137/D; 10 tonne compactor; Fall height 15 m; Five drops per pass to grid pattern; Three passes	11808	m2		

Site Dewatering

Site dewatering is now a measurable item.

The method of disposal of water may be at the contractor's discretion or, alternatively, may be stated in the item description, as shown in Table 6.25, together with both the pre-contract water level and the level to which groundwater must be lowered and maintained.

Table 6.25 Site dewatering.

					£	p
	6 GROUND REMEDIATION AND SOIL STABILISATION					
	Site dewatering					
	Well point dewatering					
A	area of site to be dewatered 950 m2; maximum depth of boreholes 4.5 m; pre-contract water level 109.75 m; water level to be lowered to 105.25 m	ITEM				

The coding for such an item would be 6.1.*.1.* as both Level 1 and 3 item descriptors are required to complete the description. It is a frailty of the NRM2 classification system that, if there are unwanted choices within the item descriptor 'levels', coding is impossible beyond the point where the unwanted choices reside.

More to the point, however, is the relationship of 6.1: *Site dewatering* to the items for extra over excavation for excavating in water-bearing and unstable ground in 5.7.1.4/5: *Excavating and filling*.

6.10.10 Piling

The measurement rules for piling have been simplified in NRM2 (Work Section 7) with the different pile types collected sensibly in one place. Steel sheet piling has also been added to this new 'family', and vibro-compacted piles and trench fill make a welcome appearance.

Risk Issue

There is no item coverage in Work Section 7 for props and walings to sheet piled or contiguous piled walls.

This is no different to the provisions of SMM7, but it is surprising that this deficiency has not been redressed in NRM2, particularly as the *Preliminaries* Work Section 1.2.8.2 (Note 6), expressly excludes *props and walings to support contiguous bored pile walls of basement excavations* from its item coverage.

Clearly, the authors of NRM2 have thought about the 'props and walings' issue, and it is a shame that an opportunity has been missed.

Cutting off the tops of piles, and preparation of rebar for pile caps and ground beams, has, logically, been moved to Work Section 5: *Excavating and filling* (5.20.1 refers) as this work is not usually carried out by piling contractors.

6.10.11 *Underpinning*

Work Section 8: *Underpinning* is unrecognisable compared with SMM7.

Gone is the detailed measurement of what might be called 'traditional' underpinning to be replaced with a single item, 8.1: *Underpinning*. At Level 1, descriptors can be chosen for *foundations*, *walls* and *bases*, and, at Level 2, scope for a description of the work is provided.

A possible BQ description for a traditional underpinning item is illustrated in Table 6.26.

Table 6.26 Underpinning – 1.

		Qty	Unit	Rate	£	p
	Underpinning					
	Underpinning to existing basement; Class C30 concrete foundation; One brick thick common brickwork in CM 1:3; Pinned to existing foundation; Backfill excavation with Type 2 Sub-base					
	Underpinning					
A	Foundations; Class C30 concrete	82	m			
B	Walls; One brick thick common bricks in CM 1:3	82	m			

However, the rules of measurement are not exactly crystal clear as to what these items actually mean because, whilst the *deemed included* list is a lengthy 12 items, and comprises temporary support, excavation, earthwork support and backfilling, the Level 1 descriptors (*foundations*, *walls* and *bases*) have no accompanying notes or item coverage guidance. Therefore,

- Is the foundation item meant to include all the *deemed included* items?
- Is the wall item meant to include some of them (e.g. cutting away existing foundations/footings, preparing the underside of existing work)?

An alternative way of describing the same item of work is shown in Table 6.27, which may be considered more satisfactory in terms of the *deemed included* items but may be more difficult to value.

Table 6.27 Underpinning – 2.

					£	p
	8 UNDERPINNING					
	Underpinning					
	Underpinning to existing basement; Class C30 concrete foundation; One brick thick common brickwork in CM 1:3; Pinned to existing foundation; Backfill excavation with Type 2 Sub-base					
A	foundations; 2 deep; 1.5 m maximum width	48	m			

Risk Issue

It may seem trivial, but when it comes to valuing work in progress and, especially, variations, it is important to understand what is included in the contractor's rates.

Of relevance is Note 1 in the 'general rules' which says that extensive underpinning work *may be measured separately in accordance with the rules of the relevant trades or Work Sections*, provided that the work is described as '*in underpinning*'. Underpinning with mini-piling would come under this rule.

Strangely, the Note 1 comment is repeated underneath 8.1.*, whereafter items for concrete, formwork, reinforcement, brickwork or blockwork and tanking are provided, along with appropriate units.

6.10.12 Diaphragm Walls and Embedded Retaining Walls

In Work Section 9, it is no longer necessary to measure *excavation and disposal* items for diaphragm walls (SMM7 D40.1 refers) as NRM2 includes this in the list of *deemed included* items.

Backfilling is also included in the item coverage, but there is no specific mention of backfilling empty trenches.

Risk Issue

Of particular concern is that guide walls are not measured in NRM2, nor are they mentioned in the *deemed included* list.

This is a glaring omission of a significant cost item.

The quantity surveyor/cost manager may wish to consider two options to deal with this issue:

- Ensure that relevant information is shown on the drawings to indicate the *extent of work* as provided in the general rules to the Work Section.
- Provide information using the Level 2 descriptor: *details and method of construction.*

A means of ensuring clarity to the contractor's pricing is essential as it might be difficult to resist a claim should the item coverage remain unclear.

In this regard, guide walls are measured in CESMM4 Class C.5.8. They are not measured in the MMHW, but MMHW Chapter III: *General directions* states that *The rates and prices entered in the Bill of Quantities shall be deemed to be the full inclusive value of the work* and this includes *Temporary Works*. NRM2 clearly needs some clarification.

6.10.13 In Situ Concrete Works

Not being tied anymore to the CAWS has enabled NRM2 to make substantial changes to the measurement of concrete work.

Firstly, in situ concrete and precast concrete have gone their separate ways into Work Sections 11 and 12/13, respectively.

Next, in situ concrete is not now measured in terms of structural components (e.g. floors, beams, columns, etc.) but is described as horizontal, sloping or vertical work. It is also now clear that *mass concrete* is any un-reinforced concrete not measured elsewhere and that concrete is cast into formwork *unless otherwise described* (using the Level 3 descriptor provided in the classification table).

The notes to Work Section 11: *In situ concrete works* are important as they identify what horizontal, sloping and vertical work consist of. This is because the work section classification is very much 'slimmed down' and is not at all clear. Table 6.28 illustrates what may be found under each class of in situ concrete work.

It must be stressed that the 'mass concrete' classification is not exclusive and that mass concrete may be measured under horizontal, sloping or vertical work where appropriate. For instance, an un-reinforced concrete ramp would be measured under 'sloping work' and not 'mass concrete'.

Table 6.28 Classification of in situ concrete work.

In situ concrete			
Mass concrete	**Horizontal work**	**Sloping work**	**Vertical work**
• Any un-reinforced bulk concrete not measured elsewhere	• Blinding	• Blinding	• Columns, attached columns and column casings
	• Beds	• Beds	• Walls
	• Foundations	• Slabs	• Retaining walls
	• Pile caps	• Steps and staircases	• Filling to hollow walls
	• Column bases	• Kerbs	• Parapets or upstand beams (where height ≤3 × width)
	• Ground beams	• Copings	
	• Slabs	• Attached beams	
	• Landings	• Upstands	
	• Beams, attached beams and beam casings	• Shear heads	
	• Shear heads		
	• Upstands (where height ≤3 × width)		
	• Kerbs		
	• Copings		

The Work Section 11 notes also indicate that each type of concrete work can be aggregated or measured separately. If separate items are to be given (e.g. for columns, walls and retaining walls), an additional item descriptor to those provided in the classification table will be needed as illustrated in Table 6.29.

Table 6.29 In situ concrete – additional description.

	'In-situ' concrete works		
	Reinforced in-situ concrete; Class C30		
A	Vertical work; <= 300 thick; In structures; Columns	9	m3
B	Vertical work; <= 300 thick; In structures; Attached columns	2	m3
C	Vertical work; <= 300 thick; In structures; Walls	18	m3

Formwork items are classified differently to in situ concrete, and NRM2 reintroduces the idea of structural components in this part of Work Section 11. Consequently, formwork is measured variously to sides of **foundations**, to soffits of **horizontal work**, to sides and soffits of attached **beams** and to sides of isolated **columns**.

Whilst more concise than SMM7, with a number of minor items now confined to a *deemed included* list, the formwork section of NRM2 still, surprisingly, requires plain and suspended wall kickers to be measured, whilst other kickers are *deemed included*.

6.10.14 Structural Metalwork

Work Section 15: *Structural metalwork*, which includes structural steelwork and structural aluminium work, has some major changes compared with SMM7 G10–G12.

Taking structural steelwork as an example, the NRM2 classification has rationalised and simplified the provisions of SMM7, but framed members are still subdivided into fabrication and erection. Isolated members are still measured separately but have been assimilated more sensibly in the work section.

The weight classification has changed – there are now four levels instead of three as previously – and the classification of members has been rationalised at Level 3. The identification of castellated, tapered, curved and hollow members has been relegated to the *Notes, comments and glossary* column, and so, where applicable, NRM2 Paragraph 3.3.3.3 applies. There is no place for portal frames, but Note 7 does refer to *compound fabrications*.

Fittings were included in the mass of steel in SMM7, but they are now measured separately, stating whether they are to framed or isolated members. Measurement of fittings is either by calculated weight (15.5.1) or percentage (15.5.2). No distinction is made between fittings as part of fabrication and those fixed on-site.

Risk Issue

If a percentage is used, this will need to be marked PROVISIONAL in accordance with NRM2 Paragraph 3.3.8.1 and remeasured on completion as per Paragraph 3.3.8.2.

The 20% rule (Paragraph 3.3.8.2) will thus apply.

Measurement of steelwork is subdivided as before into *fabrication* and *permanent erection on-site*, but this is where the similarity to SMM7 ends, as Table 6.30 demonstrates:

- Trial erection has been afforded a completely separate status from the erection of framed members (15.13.1) but is only measured when NOT at the contractor's discretion.
- Permanent erection is now deemed to include delivery to site.
- Permanent erection is also deemed include all **specified** operations subsequent to fabrication.
- The site drilling of holes and site welding are not deemed included and must be assumed to qualify as specified operations subsequent to fabrication.

A simplified example of the measurement of structural steelwork is provided in Figure 6.9 which also illustrates (a) framed members, (b–d) typical fittings and (e) holding down bolts.

Profiled Metal Decking

This is an interesting topic that merits some detailed comparison with SMM7.

Profiled metal decking is essentially a means of supporting a cast in situ concrete suspended slab during construction. It remains in place once the concrete has set and, to all intents and purposes, acts as 'permanent formwork' in the same way that proprietary open mesh expanded metal sheets do.

Profiled metal decking may be attached to the structural steel frame by shot firing or using self-tapping screws or may be welded through the deck to the steelwork with shear stud connectors.

From a measurement perspective, the method of fixing profiled metal decking is crucial because certain methods do not create a floor that is a composite structural union between the concrete slab and the steel frame and others (e.g. shear stud connectors) do.

Table 6.30 Structural steelwork – framed.

SMM7		NRM2			
Rules		**Works and materials deemed included**		**Mandatory information to be provided**	
D1	Fabrication includes all operations up to and including delivery to site	3	Permanent erection is deemed to include all **specified** operations subsequent to fabrication including delivery to site	2	Specification describing fabrication, welding, testing, erection and everything else necessary to complete the installation
D5	Erection includes all operations subsequent to fabrication			**NB**: From the above, it would appear that welding and testing are as much not part of fabrication as erection	
M1	The mass of framing includes all components and fittings of the same material		An allowance for fittings is separately measured, either by weight or a percentage		
NB: It is assumed that 'fabrication' would normally include: • Cutting steel members to length, including splay cuts • Drilling holes for shop and site fixing • Attaching cleats, brackets, etc. by bolting or welding (but see NB above)					
Summary					
	Fabrication		**Transport**	**Erection**	
SMM7	G10 1.* Fabrication		G10.2.1 Trial erection	G10.2.2 Permanent erection	
NRM2	15.1.*.*.* Fabrication		15.13.* Trial erection	15.2.*.*.* Permanent erection	

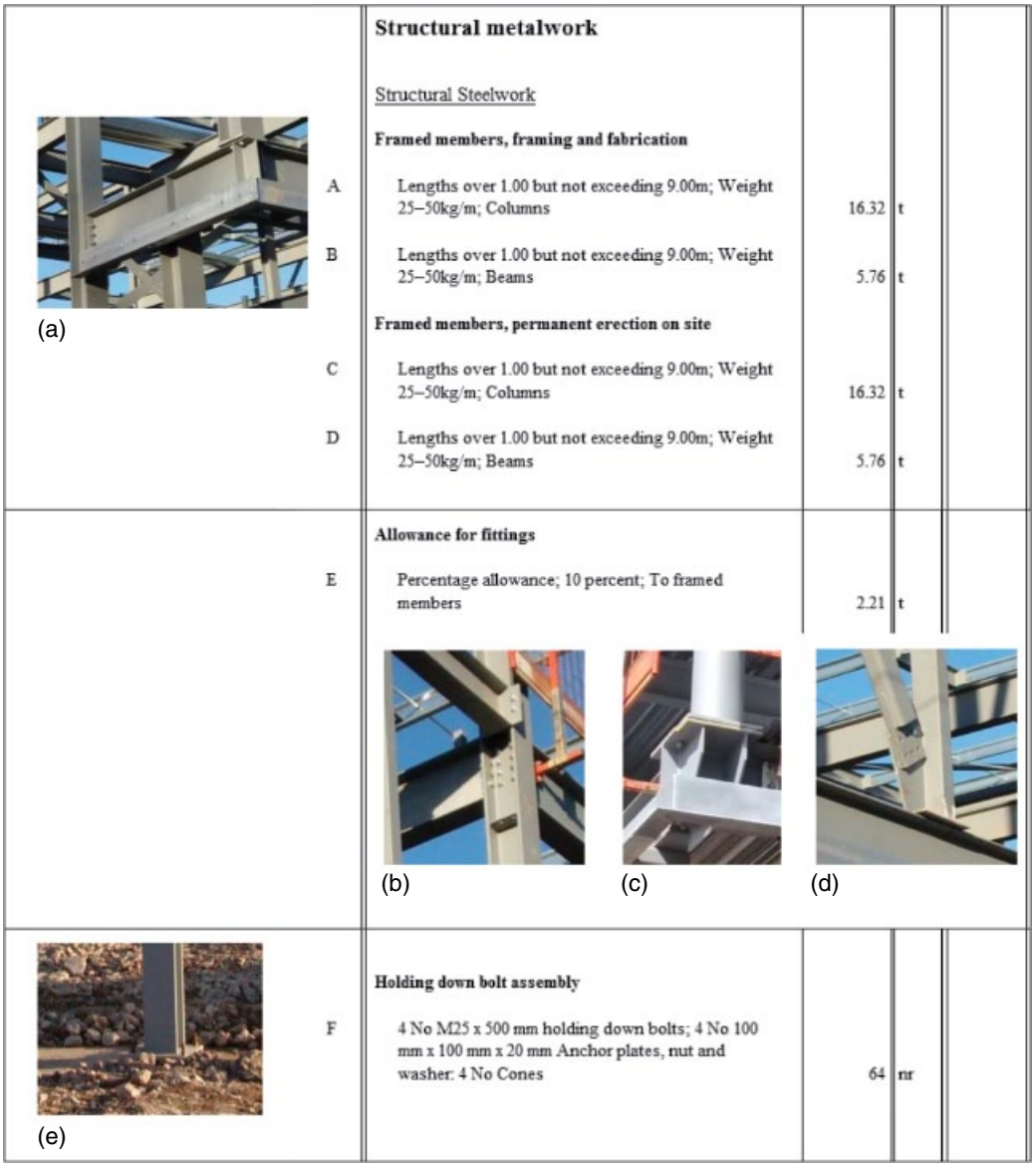
In SMM7, permanent formwork is a measured in two places:

- E20: *Formwork to in situ concrete.*
- G10: *Structural steel framing.*

Therefore,

- When permanent formwork to slabs is *structurally integral with the framing*, it is measured under G10.3.1, with the method of fixing stated.
- But when permanent formwork is simply *designed to remain in position*, it is measured in accordance with E20.8.*.*.4.

This is fairly straightforward, but SMM7 also provides the option of measuring profiled metal decking under G30: *Metal profiled sheet decking* with no test as to whether it is fixed



(a)		**Structural metalwork**		
		Structural Steelwork		
		Framed members, framing and fabrication		
	A	Lengths over 1.00 but not exceeding 9.00m; Weight 25–50kg/m; Columns	16.32	t
	B	Lengths over 1.00 but not exceeding 9.00m; Weight 25–50kg/m; Beams	5.76	t
		Framed members, permanent erection on site		
	C	Lengths over 1.00 but not exceeding 9.00m; Weight 25–50kg/m; Columns	16.32	t
	D	Lengths over 1.00 but not exceeding 9.00m; Weight 25–50kg/m; Beams	5.76	t
		Allowance for fittings		
	E	Percentage allowance; 10 percent; To framed members	2.21	t
		(b) (c) (d)		
(e)		**Holding down bolt assembly**		
	F	4 No M25 x 500 mm holding down bolts; 4 No 100 mm x 100 mm x 20 mm Anchor plates, nut and washer: 4 No Cones	64	nr

Figure 6.9 Structural steelwork – framed.

in a way that it will be *structurally integral with the framing*. On-site or off-site labours, such as holes and notches, are also measured under G30.3.*.*.

The three situations are illustrated in Figure 6.10.

Thankfully, this confusing issue has been simplified in NRM2, which measures permanent formwork under Work Section 11.15.*.* (General note 4 refers), but permanent formwork that is integral with the framing is described as *profiled metal decking* and measured under Work Section 15.8.*: *Structural metalwork*. The options are illustrated in Table 6.31.

There is an added complication, however, in the form of 15.8.* Note 1 which states that:

- Profiled metal decking *is only measured here* (i.e. Work Section 15.8.*) *when it forms part of the structural steel package otherwise it would be measured in accordance with the rules for permanent formwork* (i.e. 11.15.*.*).

SMM7

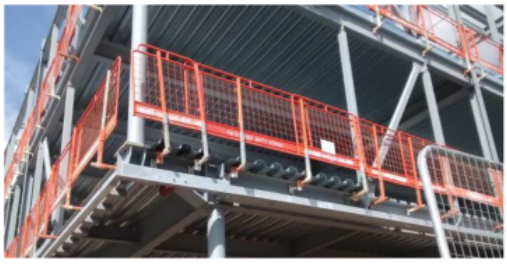
	Permanent formwork (E20.8.*.*.4)				Permanent formwork (G10.3.1)		
	IN - SITU CONCRETE/ LARGE PRECAST CONCRETE				**STRUCTURAL/CARCASSING METAL/TIMBER**		
	E20: FORMWORK FOR IN SITU CONCRETE				G10: STRUCTURAL STEEL FRAMING		
	Formwork and basic finish				**Permananent formwork**		
	Soffits of slabs; horizontal						
A	slab thickness 200 - 300; height to soffit 3.00 - 4.50m; Permanent	6018	m2	A	Galvanised steel troughed decking; Richard Lees Ribdeck 60; 1.2mm gauge; 5m span; Welded; Shear stud connectors at 330mm centres	6018	m2
					Or		
					**Metal decking (G30.3.*.*)**		
					G30: METAL PROFILED SHEET DECKING		
					Galvanised steel troughed decking; Richard Lees Ribdeck 60; 1.2mm gauge		
					Decking; fixing to steel beams at 200 centres with 95 long x 19 diameter shear studs; drilling holes		
				A	decking	6018	m2
					Extra over for		
				B	holes 150mm diameter; formed on site	12	Nr
				C	notches 300mm x 150mm; formed on site	28	Nr

Figure 6.10 Profiled decking/permanent formwork – SMM7.

Table 6.31 Profiled decking/permanent formwork – NRM2.

NRM2

	Permanent formwork (11.15.*.*)				Permanent formwork or Metal decking (15.8.*)		
	'In-situ' concrete works				**Structural metalwork**		
	Formwork				Structural Steelwork		
	Soffits of horizontal work				**Profiled metal decking, Richard Lees Ribdeck 60; 1.2mm gauge**		
A	For concrete <= 300 thick; Propping over 3m but not exceeding 4.5m high	6018	m2	A	Height not exceeding 5.00m; Shear studs: 19mm x 200mm; 5m span; 330mm centres; Welded	6018	m2

A further issue is that edge trims to profiled metal decking are measured extra over item 15.8.* but are not joined with Note 1.

Risk Issue

In a traditional tendering situation, the bill compiler cannot possibly make the judgement as to how each tenderer will package the work as there are several options:

- Include the profiled metal decking with the structural steelwork work package.
- Separately package the profiled metal decking to a specialist installer.
- Include the profiled metal decking in the concreting work package with/without the through-deck welding work.
- Install the profiled metal decking with own labour and sublet the through-deck welding work.

6.10.15 Precast/Composite Concrete

The use of the forward slash (/) – also called slant, oblique or solidus – in the title of Work Section 12 is a carry-over from SMM7 (E60: Precast/Composite concrete decking).

Without being over-pedantic, the use of this symbol in SMM7 indicates a choice between precast and composite concrete decking and, therefore, may be taken to have the meaning 'or'. In NRM2, however, precast concrete decking is measured under Work Section 13, and precast/composite concrete decking is measured under Work Section 12. Consequently, the (/) symbol is more likely to indicate composite concrete construction that includes an element of precast concrete rather than a choice between the two.

The term 'composite construction' is used to describe any method of construction that combines two or more dissimilar materials to form an element of construction such as a wall, partition, decking or floor.

In Work Section 12, a composite concrete floor comprising precast concrete planks and in situ concrete topping incorporating either fibre or mesh fabric reinforcement would be coded as 12.2.1.1.

Risk Issue

The Level 2 code (2) should be used because there is nowhere else in NRM2 to provide a description of the in situ concrete element:

- The Work Section 11 'deemed included' preamble does not mention in situ concrete.
- Work Section 11: *In situ concrete works* does not cover composite work.
- The notes to Work Section 11.2 – *Horizontal work* refer to coffered and troughed slabs but not to composite slabs.

6.10.16 Suspended Ceilings

Work Section 30: *Suspended ceilings* largely follows the layout of SMM7 K40: *Suspended ceilings* but with some additions and omissions from the list of measured items.

Risk Issue

A glaring omission from Work Section 30 is the lack of a *deemed included* rule to cover the suspension system for suspended ceilings.

This is *deemed included* in K40 Coverage Rule C1, but there is no similar rule in NRM2. *Mandatory information to be provided* requirements in NRM2 include details of the *construction of suspension framing and systems*, but this is not an item coverage rule.

This issue may need to be clarified with a 'notwithstanding' provision in the bill of quantities.

Alternatively, it could be argued that a suspended ceiling cannot, by definition, be 'suspended' without a suspension system, and therefore, this constitutes an *implied included* rather than a *deemed included* item.

6.10.17 Drainage Below Ground

Work Section 34: *Drainage below ground* is significantly different to the equivalent R12: *Drainage below ground* in SMM7.

Drain Runs

The first notable change is that 'drain runs' are now measured as composite items and are no longer measured in detail, that is, with excavation measured separately from beds, pipes, etc.

From the point of view of coding the take-off, this work section is very badly organised as discussed in detail in Section 6.8.6 of this chapter. Notwithstanding this, library-based software houses have taken the pragmatic, and helpful, view of creating a hierarchical structure to the formulation of item descriptions for 'drain runs' as illustrated in Table 6.32.

Table 6.32 Formulating item descriptions for 'drain runs'.

				£	p
	34 DRAINAGE BELOW GROUND				
	Storm water drain systems				
	Drain runs				
A	average trench depth 1.50 m; push fit joints; pipe bedding and or surround; granular; Type 1 sub-base backfill; below ground water level	27	m		

Risk Issue

A fundamental flaw in the classification table is that neither the item to be described (34.1.*: *Drain runs*) nor the list of *work and materials deemed included* mentions excavation. The deemed included list includes earthwork support, trimming of excavations, backfilling and disposal but not excavation. (NB: The same problem applies to chambers under 34.6–10.*)

This is to be contrasted with SMM7 which employs the same item coverage list but also uses the phrase *excavating trenches* in the first column of the classification table and measures *Excavation* to chambers.

Consequently, unless 'excavation' is to be considered an implied term of Work Section 34, this issue needs to be clarified, perhaps in a preamble to the bill of quantities.

Depth classifications for drain runs are now in 500 mm increments with the average depth for each drain run being calculated without reference to the maximum depth. A sensible clarification is that measurements are now taken between the external faces of manholes.

Risk Issue

However, there is no requirement to state a commencing surface for excavation which, under SMM7, had to be stated where more than 250 mm *below existing ground level* (R12.1.*.*.1).

Once again, perhaps a preamble note would clear this up.

A number of extra over items are provided in Work Section 34, including extra over for breaking out hard materials. Note 2 of 34.2 defines 'hard material' as:

> *any hard material which is of such a size, position or consistency that it can only be removed by special plant or explosives*.

This definition differs from the definition of 'rock' in Work Section 5: *Excavating and filling*, in that it refers to the broader category of 'hard material' and also makes no reference to the use of *wedges* or *rock hammers* as a 'test of hardness'. It should be noted that SMM7 defined *rock* but not hard material.

Risk Issue

The logic for defining 'hard material' in this way, rather than using the 'rock' definition in Work Section 5, is hard to fathom.

The authors of NRM2 chose not to define the likes of concrete and masonry as 'hard material' in Work Section 5, perhaps on the basis that there is usually no argument in determining the presence of such materials in excavations, so why make the distinction in the drainage work section?

A further curiosity is the dependence on *special plant or explosives* as the 'test of hardness'.

Most contractors would use excavator-mounted hydraulic breakers where possible, which would classify as *rock hammers*, but *special plant* is much more difficult to define (and agree with the contractor!), and the use of *explosives* is rare and often specifically prohibited.

At this point, it might be prudent to "*ask the audience or 'phone a friend*" or, alternatively, take care of the issue (once again!) in a preamble.

The width of trenches for the purpose of 'extra over' items is to be taken in the designed width of the trench bed or, where there is no bed, the nominal pipe diameter +300 mm. The minimum width of 500 mm only applies where there is no bed, unlike SMM7, where the minimum applies in both cases.

Chambers

Chambers are now measured as composite items in NRM2, and the arduous chore of measuring all the components thereof is reduced to the less arduous, but still time-consuming, chore of providing a detailed item description.

Risk Issue

The item descriptors, and the 'general' item coverage for chambers, exclude excavation for chambers as discussed earlier, and whilst 'extra over' for *breaking out hard materials* is measured, there is no definition in the side notes to Work Section 34.12.

Rocker pipes are deemed included in the items for chambers (34.6–11 Note 2), but, quite bizarrely, step irons are measured separately under 'Sundries' (34.13.1.1).

Just why the authors of NRM2 chose not to measure manholes and other chambers by reference to standard construction details, thereby avoiding the need for detailed descriptions, is puzzling to say the least, but, then again, this entire work section is a bit of a disaster!

NB: Homework for authors of NRM2:

Compare and contrast the provisions of NRM2 Work Section 34 with Classes I – L of CESMM4.

6.10.18 Builder's Work in Connection with Mechanical, Electrical and Transportation Installations

Apart from being a welcome addition to the rules of measurement, this 'Cinderella' work section, unfortunately, merits attention only for its shortcomings.

Risk Issue

- No *deemed include* list in the 'general' rules.
- No mention of 'excavation' in the measurement of underground service runs.
- No item coverage for chambers.
- No list of 'sundries' to chambers.

On reaching Work Section 41, perhaps the authors of NRM2 had 'run out of steam'!

Notes

1. *Pacific Associates v Baxter* [1990] Q.B. 993 (CA).
2. That is, *NRM2: Tabulated rules of measurement for building works.*
3. This is thought to be a mistake and should read ***six***.
4. http://www.designingbuildings.co.uk/wiki/Comparison_of_SMM7_with_NRM2 (accessed 26 March 2015).

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