

# Chapter 14

## New Rules of Measurement: NRM2

### 14.1 Excavation in unstable water-bearing ground

Further to Chapter 6, Paragraph 6.10.8, this case study relates to the measurement of suitable items for the excavation of a deep basement.

The basement is 45.750 m × 25.750 m on plan as indicated in Figure 14.1 and is of reinforced concrete construction, comprising:

- 300 mm diameter augered piles (60 nr perimeter; 32 nr internal).
- 1.5 m<sup>2</sup> × 1.0 m deep pile caps.
- Integral perimeter ground beams 1.5 m × 1.0 m in cross section.
- Inner ground beams 0.8 m × 0.6 m in cross section.
- 300 mm thick reinforced concrete walls.

The borehole information in Figure 14.1 shows that the basement is to be constructed in unstable soil and that the water table is 1.5 m below existing ground level.

In order to deal with the measurement issues raised by NRM2, it might be informative to begin with SMM7!

#### 14.1.1 SMM7 rules

The measurement of excavation in water-bearing ground under SMM7 is straightforward. If water is present in the ground, the measurable items are:

- Extra over excavation D20.3.1.
- Earthwork support D20.7.\*.\*.2 or D20.7.\*.\*.3 if the ground is unstable and water bearing.
- Disposal D20.8.2.
- If conditions on-site are worse than envisaged at tender stage, omit the earthwork support item D20.7.\*.\*.2 and add sheet piling D32.2.\*.

The contractor then decides how to carry out the work, short of sheet piling, and must include in his tender sum for a dewatering system to remove groundwater (e.g. pumping, well-points, etc.).

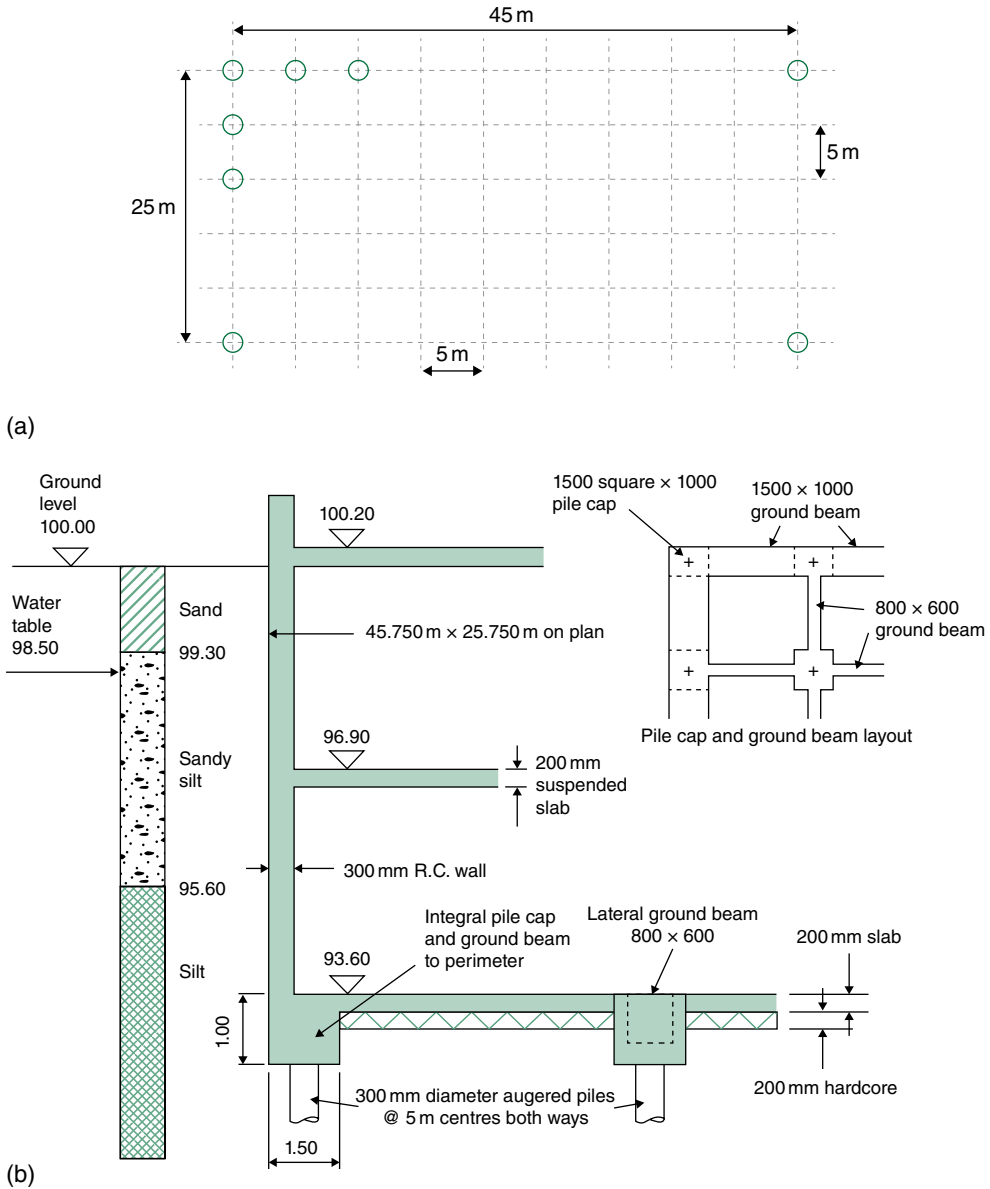


Figure 14.1 Deep basement. (a) Pile layout and (b) Cross section of basement.

### 14.1.2 NRM2 rules

NRM2 Work Section 5: *Excavation and filling* is the starting point for measuring the excavation items for the basement. As discussed in Chapter 6, the rules are more complex than SMM7:

- Basement excavation is measured as bulk excavation under 5.6.1.\* (refer to Note 1).
- Excavation below **groundwater** is measured as *extra over all types of excavation irrespective of depth* (5.7.1.3).
- *Excavating in unstable ground* is also measured as *extra over all types of excavation* under 5.7.1.5.
- Disposal of groundwater is measured under 5.9.1.\*.
- Disposal of excavated material is measured under 5.5.2.\*.

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.

Unstable ground is defined as:

- Running silt, running sand, loose ground and the like (refer to Note 4 of 5.7.1.5).

An added complication to the above is that NRM2 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 (refer to 6.1.\*.\*).

### 14.1.3 NRM2 measurement issues

In water-bearing ground, excavation item 5.7.1.3 would be measured, but where the ground is unstable, item 5.7.1.5 (excavating in unstable ground) also comes into consideration.

There is no earthwork support item to measure, unless specified in the contract documents, but an item for disposal of groundwater is needed (5.9.1.\*). A further item for site dewatering is also required under NRM2 6.1.\*.

Under NRM2, the quantity surveyor/cost manager has a dilemma:

- How to describe unstable water-bearing ground.
- Whether to measure an item of support to excavations not at the contractor's discretion (e.g. sheet piling) and/or make a suggestion to the architect/engineer.
- Whether to measure a site dewatering item as well as an item for disposal of groundwater.

Tenderers also have a dilemma:

- If there is no measured item for site dewatering, what is the item coverage for the disposal of groundwater item (e.g. normal pumping or well-point dewatering)?
- If there is a measured item for site dewatering, what is the disposal of groundwater item for?
- If there is an item for excavating in water-bearing ground, but no measured item for site dewatering or support to excavations not at the contractor's discretion, should the tender price include for sheet piling?

### 14.1.4 Possible approaches to NRM2

Under SMM7, there was no problem if both water-bearing ground and unstable ground were present because there was no item measurable for unstable ground – only for excavating below groundwater level.

In NRM2, however, there is no rule as to how these items should be measured and several approaches might be taken:

<u>Method 1</u>	Measure the entire excavation below water table as 'below groundwater level' and include a further item for excavating in unstable ground.
<i>Problem:</i>	This would create an 'extra over an extra over', that is, double counting.
<u>Method 2</u>	Measure the two volumes separately.
<i>Problem:</i>	This would avoid double counting but might give tenderers the impression that the two volumes are in different excavations or in different parts of the site, which could well be misleading. Tenderers could also be misled because unstable ground is not necessarily water bearing and thus the item description would not be complete.
<u>Method 3</u>	Measure the entire volume as an extra over item for excavating below groundwater level and ignore the unstable ground item.
<i>Problem:</i>	This might appear a better idea (consistent with SMM7), but would not comply with NRM2 as tenderers would be denied pricing an unstable ground item; this could have implications for the choice of earthwork support, for overbreak, for additional disposal and filling requirements and could also lead to a measurement claim.

<u>Method 4</u>	Measure an item for extra over all types of excavation for excavating below groundwater level and include reference to unstable ground in the item description.
<i>Problem:</i>	This is not how the library-based software systems work and creation of an item description like this is effectively a 'rogue item'.

### 14.1.5 Site dewatering

The next question is whether an item for site dewatering should be measured in addition to items for extra over excavation for excavating below water table and in (water-bearing) unstable ground.

This was not the case with SMM7 as there was no provision for measuring site dewatering.

Within the rules of NRM2, it would appear that if excavations in water-bearing ground require site dewatering, then an appropriate item is measurable. This would be a matter for the quantity surveyor/cost manager's judgement when preparing the tender documents.

If, however, the quantity surveyor/cost manager decides not to include an item for site dewatering in the bill of quantities, but site dewatering is nonetheless required on-site, then the question arises as to whether the contractor would be entitled to a measured item by default and extra payment as a result.

Should the provisions of SMM7 for measuring steel sheet piling (if required on-site) be taken as a precedent, it would appear that a site dewatering item should be measured under NRM2. Under the JCT 2011 SBC/Q, this would constitute a variation and would thus be subject to the valuation rules in the contract.

It would be a fair assumption on the part of the contractor, therefore, that the extra over items measured under NRM2 Work Section 5.7.1.\* exclude the cost of site dewatering, as this is a measurable item.

The 'extra over' excavation item would consequently represent only the additional degree of difficulty in excavating below the water table, and possibly in unstable ground, together with the cost of additional overbreak, disposal and backfill, but not the cost of site dewatering.

### 14.1.6 Earthwork support

Whilst earthwork support is not measured in Work Section 5: *Excavating and filling*, it is measured where not at the contractor's discretion.

Earthwork support would be measured in two circumstances with regard to the basement excavations following Note 1 under NRM2 5.8.1.1:

- If it is felt sensible at tender stage, a bill of quantities item could be included for, say, steel sheet piling in order to reduce the contractor's risk and avoid a potential claim if the ground conditions are not exactly as indicated in the borehole logs.
- Earthwork support could be measured pursuant to a contract administrator's instruction should prevailing site conditions warrant it.

### 14.1.7 Worked example

A worked example of how the issues discussed above may be resolved is demonstrated in the bill of quantities presented in Table 14.1. This assumes that Method 4, described in Paragraph 14.1.4, is adopted as the most sensible approach for describing the work concerned.

The various Dim Sheets that accompany the bill of quantities items are included in Table 14.2, and the relevant side casts are shown in Figure 14.2.

**Table 14.1** Bill of quantities – deep basement excavation.

			£	p
<b><u>5 EXCAVATING AND FILLING</u></b>				
<u>Excavation</u>				
Bulk excavation				
A	over 6 m not exceeding 8 m deep	8011	m3	
Foundation excavation; commencing 6.8 below original ground level				
B	over 6 m not exceeding 8 m deep	212	m3	
<u>Extra over all types of excavation irrespective of depth</u>				
Excavating in				
C	below ground water level; unstable ground	6455	m3	
<u>Disposal</u>				
Excavated material off site				
D	generally	8223	m3	

## Excavation items

<b><u>6 GROUND REMEDIATION AND SOIL STABILISATION</u></b>				
<u>Site dewatering: wellpoint dewatering</u>				
[Description]				
E	area of site to be dewatered 1178 m2; pre-contract water level 98.50 m; water level to be lowered to 92.60 m	ITEM		

## Site dewatering item

## 14.2 NRM2 Director's adjustment

Chapter 6 identifies a number of issues concerning the Director's Adjustment item that is provided on the pricing summary sheet of the bill of quantities under NRM2.

The adjustment is intended as a means of changing the tender sum prior to submission of the tender rather than having to make wholesale changes to the rates and prices in the bill of quantities. This is a sensible arrangement (following CESMM) as the tender figure is invariably decided at the last minute when changes to the priced bills would be difficult to make.

Unlike CESMM, NRM2 provides no rules for dealing with the Director's Adjustment item at the post-contract stage, and this may lead to problems when negotiating the final account.

Table 14.3 illustrates three ways of dealing with the Director’s Adjustment item at final account stage based upon a tender sum of £1 183 000 for a lump sum contract, assuming that JCT 2011 standard conditions apply:

1. A lump sum adjustment.
2. An adjustment in proportion to the net value of measured work carried out divided by the net value of measured work at tender stage.
3. An adjustment in proportion to the gross value of measured work carried out divided by the net value of measured work at tender stage.

Net value is the value of work excluding the contractor’s overheads and profit margin, and gross value is where the contractor’s overheads and profit are included. Self-evidently, the tender allowances for provisional sums and risks have been omitted from the contract sum in the final account figures. This is because the actual value of any work instructed would be added to the contract sum, as is normal practice when preparing a final account for a lump sum contract.

It can be seen that each method of adjusting the contract sum results in a different answer leading to the conclusion that:

- a) There will be an argument about this when attempting to settle the final account.
- b) The prudent approach would be to include a preamble in the bill of quantities detailing exactly how the Director’s Adjustment should be dealt with post-contract.

**Table 14.2** Dim Sheets.

5 EXCAVATING AND FILLING		Unit: m3	Sort:	Sheet: 1
Excavation Bulk excavation over 6 m not exceeding 8 m deep				
Item Code:				
	45.750			
	25.750			
	6.800			
	=====	80 10.825	(A1) depth	
		-----		
		80 10.825		
	=====			

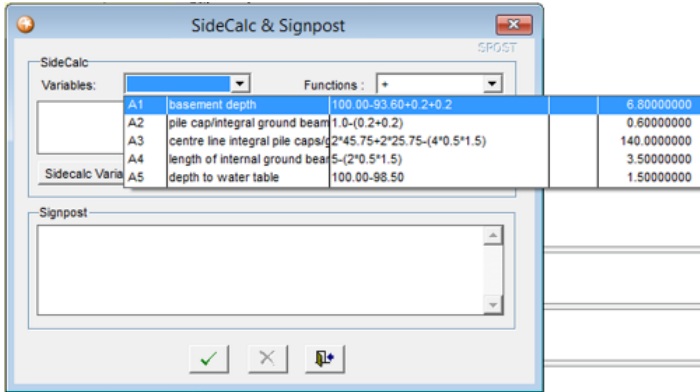
  

Foundation excavation; commencing 6.8 below original ground level over 6 m not exceeding 8 m deep		Unit: m3	Sort:	Sheet: 2
Item Code:				
	140.000			
	1.500			
	0.600			
	=====	126.000	(A3) external pile caps/ground beams	
8/4/	1.500		(A2) depth	
	1.500			
	0.600			
	=====	43.200	(A2) depth	
4/9/	3.500		(A4) internal ground beams	
	0.800			
	0.200			
	=====	20.160		
8/5/	3.500			
	0.800			
	0.200			
	=====	22.400		
		-----		
		211.760		
	=====			



**Table 14.2** (Continued)

<b>6 GROUND REMEDIATION AND SOIL STABILISATION</b>			
Site dewatering; wellpoint dewatering			
[Description]			
area of site to be dewatered 1178 m <sup>2</sup> ; pre-contract water level 98.50 m; water level to be lowered to 92.60 m			
Unit:	IT	Sort:	Sheet: 6
Item Code:			



**Figure 14.2** Side casts.

**Table 14.3** Director's Adjustment pre- and post-contract.

Item	Tender	Final account		
		A (lump sum adjustment)	B (adjustment in proportion to net* measured work value)	C (adjustment in proportion to gross** value)
Measured work	1 000 000	1 200 000	1 200 000	1 200 000
Prov sums (defined/ undefined)	50 000	0	0	0
Risks	30 000	0	0	0
	1 080 000	1 200 000	1 200 000	1 200 000
OH&P 10%	108 000	120 000	120 000	120 000
Subtotal	1 188 000	1 320 000	1 320 000	1 320 000
Director's Adjustment ±	(15 000)	(15 000)	15 000 × 1.2/1.0 (18 000)	15 000 × 1.32/1.0 19 800
Subtotal	1 173 000	1 305 000	1 302 000	1 300 200
Dayworks	10 000	12 000	12 000	12 000
<b>Total</b>	<b>1 183 000</b>	<b>1 317 000</b>	<b>1 314 000</b>	<b>1 312 200</b>
Variance		0	3 000	4 800

\*Excluding OH&P.

\*\*Including OH&P.