

CESMM4

Civil Engineering Standard Method of Measurement

Fourth edition, revised

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Section 1

Definitions

- 1.1.** In this document and in Bills of Quantities prepared according to the procedure set forth herein the following words and expressions have the meanings hereby assigned to them, except where the context otherwise requires.
- 1.2.** The word 'work' includes work to be carried out, goods, materials and services to be supplied, and the liabilities, obligations and risks to be undertaken by the contractor under the Contract.
- 1.3.** The contract administrator may be the employer, his agent or his representative.
- 1.4.** The expression 'expressly required' means shown on the Drawings, described in the Specification or instructed by the contract administrator pursuant to the Contract.
- 1.5.** 'Bill of Quantities' means a list of items giving brief identifying descriptions and estimated quantities of the work comprised in a contract.
- 1.6.** 'Daywork' means the method of valuing work on the basis of time spent by the operatives, the materials used and the plant employed.
- 1.7.** 'Work Classification' means the Work Classification set out in section 8.
- 1.8.** 'Original Surface' means the surface of the ground before any work has been carried out.
- 1.9.** 'Final Surface' means the surface indicated on the Drawings to which excavation is to be carried out.
- 1.10.** 'Commencing Surface' means, in relation to an item in a Bill of Quantities, the surface of the ground before any work covered by the item has been carried out. 'Commencing Surface' means, in relation to a group of items in a Bill of Quantities for work in different materials in an excavation or a bored, drilled or driven hole, the surface of the ground before any work covered by any item in the group has been carried out.
- 1.11.** 'Excavated Surface' means, in relation to an item in a Bill of Quantities, the surface to which excavation included in the work covered by the item is to be carried out. 'Excavated Surface' means, in relation to a group of items in a Bill of Quantities for excavation in different materials, the surface to which excavation included in the work covered by any item in the group is to be carried out.
- 1.12.** A dash between two dimensions means a range of dimensions which includes all dimensions exceeding that preceding the dash but not exceeding that following the dash.

Section 8

Work classification

- Class A: General items, 14
- Class B: Ground investigation, 18
- Class C: Geotechnical and other specialist processes, 26
- Class D: Demolition and site clearance, 30
- Class E: Earthworks, 32
- Class F: In situ concrete, 38
- Class G: Concrete ancillaries, 42
- Class H: Precast concrete, 46
- Class I: Pipework – pipes, 48
- Class J: Pipework – fittings and valves, 50
- Class K: Pipework – manholes and pipework ancillaries, 52
- Class L: Pipework – supports and protection, ancillaries to laying and excavation, 56
- Class M: Structural metalwork, 60
- Class N: Miscellaneous metalwork, 62
- Class O: Timber, 64
- Class P: Piles, 66
- Class Q: Piling ancillaries, 70
- Class R: Roads and pavings, 74
- Class S: Rail track, 78
- Class T: Tunnels, 84
- Class U: Brickwork, blockwork and masonry, 90
- Class V: Painting, 94
- Class W: Waterproofing, 96
- Class X: Miscellaneous work, 98
- Class Y: Sewer and water main renovation and ancillary works, 100
- Class Z: Simple building works incidental to civil engineering works, 104

CLASS C: GEOTECHNICAL AND OTHER SPECIALIST PROCESSES

Includes: Geotechnical processes for altering the properties of soils and rocks
Other specialist processes as listed

Excludes: Compaction (included in class E)
Grouting carried out from within tunnels, shafts and other subterranean cavities (included in class T)
Grouting carried out from within sewers (included in class Y)

| FIRST DIVISION | SECOND DIVISION | THIRD DIVISION |
|--|---|---|
| | | |
| <p>1 Drilling for grout holes through material other than rock or artificial hard material</p> <p>2 Drilling for grout holes through rock or artificial hard material</p> <p>3 Driving injection pipes for grout holes</p> | <p>1 Vertically downwards</p> <p>2 Downwards at an angle 0–45° to the vertical</p> <p>3 Horizontally or downwards at an angle less than 45° to the horizontal</p> <p>4 Upwards at an angle 0–45° to the horizontal</p> <p>5 Upwards at an angle less than 45° to the vertical</p> | <p>1 In holes of depth:</p> <p>not exceeding 5 m m</p> <p>2 5–10 m m</p> <p>3 10–20 m m</p> <p>4 20–30 m m</p> <p>5 30–40 m m</p> <p>6 stated exceeding 40 m m</p> |
| 4 Grout holes materials and injection | <p>1 Number of holes nr</p> <p>2 Number of stages nr</p> <p>3 Single water pressure tests nr</p> <p>4 Multiple water pressure tests nr</p> <p>5 Materials t</p> | <p>1 Cement</p> <p>2 Pulverized fuel ash</p> <p>3 Sand</p> <p>4 Pea gravel</p> <p>5 Bentonite</p> <p>6 Chemicals</p> |
| | 6 Injection | <p>1 Number of injections nr</p> <p>2 Neat cement grout t</p> <p>3 Cement and stated filler grout t</p> <p>4 Chemical grout t</p> <p>5 Other stated grout t</p> <p>6 Single packer settings nr</p> <p>7 Double packer settings nr</p> |
| 5 Diaphragm walls | <p>1 Excavation in material other than rock or artificial hard material m³</p> <p>2 Excavation in rock m³</p> <p>3 Excavation in artificial hard material m³</p> | <p>1 Maximum depth:</p> <p>not exceeding 5 m</p> <p>2 5–10 m</p> <p>3 10–15 m</p> <p>4 15–20 m</p> <p>5 20–25 m</p> <p>6 25–30 m</p> <p>7 stated exceeding 30 m</p> |
| | 4 Concrete m ³ | |
| | <p>5 Plain round steel bar reinforcement t</p> <p>6 Deformed high yield steel bar reinforcement t</p> | <p>1 Nominal size: 6 mm</p> <p>2 8 mm</p> <p>3 10 mm</p> <p>4 12 mm</p> <p>5 16 mm</p> <p>6 20 mm</p> <p>7 25 mm</p> <p>8 32 mm or greater</p> |
| | <p>7 Waterproofed joints sum</p> <p>8 Guide walls m</p> | |

| MEASUREMENT RULES | DEFINITION RULES | COVERAGE RULES | ADDITIONAL DESCRIPTION RULES |
|---|---|----------------|---|
| <p>M3 Columns and piers integral with a wall shall be measured as part of the wall, except where expressly required to be cast separately.</p> <p>M4 Beams integral with a slab shall be measured as part of the slab, except where expressly required to be cast separately.</p> | <p>D7 Prestressed concrete which is also reinforced shall be classed as <i>prestressed concrete</i>.</p> <p>D8 The thickness used for classification of <i>blinding</i> shall be the minimum thickness.</p> <p>D9 The thickness used for classification of <i>ground slabs</i>, <i>suspended slabs</i> and <i>walls</i> shall exclude the additional thickness of integral beams, columns, piers and other projections.</p> <p>D10 Concrete in <i>suspended slabs</i> and <i>walls</i> less than 1 m wide or long shall be classed as concrete in <i>beams</i> and <i>columns</i> respectively.</p> <p>D11 Beams shall be classed as <i>special beam sections</i> where their cross-section profiles are rectangular or approximately rectangular over less than 4/5 of their length or where they are of box or other composite section.</p> <p>D12 Sprayed concrete shall be designated as other concrete forms.</p> <p>D13 Reinforcing materials added to the mix for sprayed concrete shall not be classed as reinforcement.</p> | | <p>A8 Item descriptions for <i>placing of concrete</i> which is expressly required to be placed against an excavated surface (other than blinding) shall so state.</p> <p>A9 The cross-sectional dimensions of <i>special beam sections</i> shall be stated in item descriptions, except where a beam type or mark number is stated for which dimensions are given on the Drawings.</p> <p>A10 Item descriptions for components classed as <i>other concrete forms</i> shall identify the work and include one of the following</p> <ul style="list-style-type: none"> (a) the principal dimensions (b) a type or mark number for which principal dimensions are given on the Drawings (c) a statement locating the work for which principal dimensions are given on the Drawings. <p>A11 Item descriptions for sprayed concrete support shall state the specification of the concrete and whether it is reinforced and the minimum thickness.</p> |

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| MEASUREMENT RULES | DEFINITION RULES | COVERAGE RULES | ADDITIONAL DESCRIPTION RULES |
|--|--|--|---|
| <p>M5 Driving extended piles shall be included in the measurement of the items for driven depth in class P.</p> <p>M10 Each group of items for <i>pile extensions</i> shall comprise</p> <p>(a) an item for the <i>number of pile extensions</i> (Q 6 4 *)</p> <p>(b) one or two items for the <i>length of pile extensions</i> divided into the ranges of length given in the second division (Q 6 5–6 *).</p> <p>M7 The <i>length of pile extensions</i> measured shall not include lengths formed from material arising from cutting off surplus lengths of other piles.</p> <p>M11 The lengths measured for <i>cutting off surplus lengths</i> of interlocking steel piles shall be the mean undeveloped horizontal lengths to be cut (including lengths occupied by special piles).</p> | <p>D5 The <i>section modulus</i> used for classification in the third division shall be the section modulus of the piles.</p> | <p>C5 Items for <i>pile extensions</i> shall be deemed to include the work necessary to attach the extension to the pile.</p> | <p>A6 Materials of which <i>pile extensions</i> are composed shall be stated in item descriptions for their <i>length</i>.</p> |
| <p>M12 <i>Obstructions</i> shall be measured only for breaking out rock or artificial hard material encountered above the founding stratum of bored piles.</p> | | | |
| | | | <p>A7 Item descriptions for <i>pile tests</i> shall identify those which are to preliminary piles.</p> <p>A8 Item descriptions for loading tests shall state the load. Where the load is applied to raking piles, item descriptions shall so state.</p> |
| | | | |

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CESMM4 Revised: Handbook

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Introduction

Financial control means control of money changing hands. Since money almost always changes hands in the opposite direction from that in which goods or services are supplied, it can be considered as the control of who provides what and at what price. This thought establishes a priced bill of quantities as the central vehicle for the financial control of a civil engineering contract. The bill of quantities is the agreed statement of the prices that will be paid for work done by the contractor for the client, and it shares with the drawings and the specification the responsibility for defining what has been agreed shall be done.

Control is usually based on a forecast. The difficulty of controlling something is proportional to the difficulty of predicting its behaviour. The points, finer and coarser, of the financial control of civil engineering contracts revolve around the difficulty that the client has in forecasting and defining to a contractor precisely and immutably what the contractor is required to do, and the difficulty the contractor has in forecasting precisely what the work will cost. To achieve effective control it is necessary to limit these difficulties as much as possible within reasonable limits of practicality. This means using as much precision as possible in defining the work to the contractor and in enabling them to forecast their cost as precisely as possible. These are the essential functions of bills of quantities. It is the essential function of a method of measurement to define how bills of quantities should be compiled so that they serve these two essential functions.

It is clear from this consideration that a bill of quantities works best if it is a model in words and numbers of the work in a contract. Such a model could be large, intricately detailed and reproducing the workings of the real thing in an exact representation. Alternatively, it could be as simple as possible while still reproducing accurately those aspects of the behaviour of the original that are relevant to the purposes for which the model is constructed.

The first purpose of a bill of quantities is to facilitate the estimating of the cost of work by a contractor when tendering. Considered as a model, it should therefore comprise a list of carefully described parameters on which the cost of the work to be done can be expected to depend. Clearly, these parameters should include the quantities of the work to be done in the course of the main construction operations. There is no point in listing those parameters whose influence on the total cost of the work is so small as to be masked by uncertainty in the forecasting of the cost of the major operations.

Other points of general application emerge from this principle of cost-significant parameters. The separation of design from construction in civil engineering contracts and the appointment of contractors on the basis of the lowest tender are the two features of the system that make it essential for a good set of parameters to be passed to contractors for pricing, and for a good set of priced parameters to be passed back to designers and employers. Only then can they design and plan with the benefit of realistic knowledge of how their decisions will affect construction costs. The less that contractual pressures cause distortion of the form of the prices exchanged from the form of actual construction costs, the better this object is served. It is very much in the interests of clients of the civil engineering industry, whether they are habitually or only occasionally in that role, that the distortion of actual cost parameters should be minimised in priced bills of quantities.

A client's most important decision is whether to proceed to construction or not. This decision, if it is not to be taken wrongly, must be based on an accurate forecast of contract price. Only if a

Section 2

General principles

The general principles in CESMM4 are a small group of rules and statements that set the scene for the detailed rules that follow. Where they are expressed in mandatory terms, they are rules of full significance; where they are expressed in less than mandatory terms, they give background to help interpretation of the rules.

Paragraph 2.1 points out that CESMM4 is intended to be used only in connection with civil engineering works or simple building works incidental to civil engineering works. This paragraph has been amended from that found in CESMM3 by removing reference to CESMM3 being used in conjunction with the ICE Conditions of Contract 6th Edition. In keeping with the stated contract-neutral objective, CESMM4 is now intended to be used in connection with any contract for civil engineering works that requires a bill of quantities: for example, the NEC Engineering and Construction Contract where Main Options B or D are used or the Infrastructure Conditions of Contract Measurement Version.

CESMM2 introduced a new Work Classification Z, setting out rules for measuring simple building works that are incidental to civil engineering works. Paragraph 2.2 explains the circumstances and limitations when using CESMM4 in connection with simple building works that are incidental to the dominant civil engineering works.

There is clearly no point in using CESMM4 if the work in a contract is not principally made up of the things that CESMM4 covers.

Paragraph 2.2 also deals with the problem of identifying and measuring work that is not covered by CESMM4, either because it is work outside the range of work that CESMM4 covers or because it is work not sufficiently common to justify its measurement being standardised in CESMM4. Work that is not covered by CESMM4 includes mechanical or electrical engineering works or building works other than those covered by class Z. No rules are given for itemisation, description or measurement of such work, but principles are given that should be followed. If the work needs to be measured, that is to say a quantity calculated, any special conventions for so doing that it is intended shall be used should be stated in the Preamble to the bill.

The last sentence of paragraph 2.2 says that non-civil engineering work outside the scope of CESMM4 that has to be covered shall be dealt with in the way that the compiler of the bill chooses, governed only by the need to give the itemisation and identification of work in item descriptions in sufficient detail to enable it to be priced adequately.

Paragraph 2.2 does not imply a standard method of measurement, because for this type of work there is no necessity for there to be a standard method. Thus, an entry in the Preamble to the bill that complies with this paragraph might refer to another standard method of measurement, such as the Royal Institution of Chartered Surveyors' NRM 2: Detailed Measurement for Capital Building Works, or it might state a measurement convention adopted for a particular work component. An example of this would be the measurement of large oil tanks associated with oil refinery installations. These are not mentioned in CESMM4 but they might have to be measured within a civil engineering contract. In such a case, the compiler of the bill would probably decide to measure the tanks by their mass of steel and might need to state related measurement conventions in the Preamble to the bill. These conventions might include the rules by which the mass of steel in the oil tank was to be calculated for payment.

**Class A:
General items**

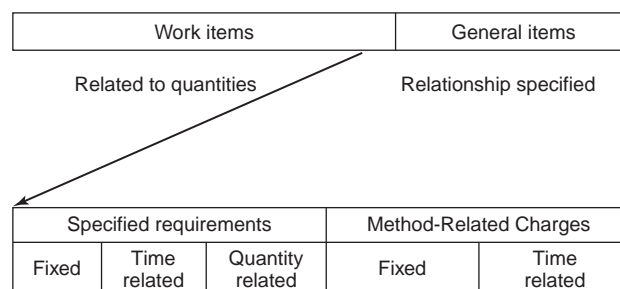
The introduction of the first edition of CESMM made the use of general items more purposeful than it was previously. General items include those items that were sometimes called preliminary items in the terminology of the building industry. They are now a group of prices in the contract that are general in the sense that either they are not related to the permanent works (such as items for services and facilities for the contract administrators) or they can conveniently be grouped under a heading that is general (such as items for Method-Related Charges or Provisional Sums).

CESMM4 defines cost relationships for general items very precisely. This is an example of the closer relationship of prices to construction costs that CESMM4 sets out to achieve. Figure 8.1 shows how the price-cost relationships for general items are arranged.

Bills prepared before the introduction of the first edition of CESMM assumed that all prices for measured work items were proportional to quantities, and that prices for general or preliminary items were not necessarily proportional to quantities. Since conditions of contract rarely if at all make reference to general or preliminary items, no agreement is assumed in the contract for any special interpretation of general or preliminary items as regards when they should be paid or in what circumstances varied. This formerly led to hesitance on the part of tenderers when pricing general items, and to uncertainty and contention in the settlement of accounts. A contractor could have explained that the large sum of money in the general items that was described in very broad terms was mainly for mobilisation costs and could have asked for the sum to be paid in the first certificate accordingly. Later, that contract could have been varied in such a way that the contractor found it helpful to explain that the sum was mainly to cover the continuing time-related cost of major plant and services. Accordingly, it would then have been increased to make it reasonable and applicable to the extended work. Perhaps such a clear-cut case has never happened in real life, but that it could happen demonstrates the problem. A traditional bill discouraged tenderers from pricing mobilisation costs in appropriate general items because of uncertainty about how the contract administrator would include them in certificates. It was safer to allow for such costs against the rates for that measured work that was bound to be done at the beginning of the construction period than to risk that the contract administrator would certify only the amount pro rata to the value of total measured work.

Figure 8.1 shows how CESMM4 overcomes this problem. All the prices for permanent works generated by classes B to Z are either directly related to a measurable quantity of work or are sums related to the extent and nature of a self-contained item. The prices for other work covered by class A are defined as either quantity related, time related or fixed. The relationship for each item is stated in its description, so that the ordinary processes of interim payment and adjustment specified in the conditions of contract can be applied to them rationally and realistically. Prices are controlled more predictably and with a closer relationship to actual cost. The main division of general items is shown in the first-division descriptive features of class A. The bill compiler should give items for all the obligations required by the contract and all the services

Figure 8.1 All prices against items in Bills of Quantities compiled using CESMM4 have an assumed relationship to cost. This relationship is either to quantities that can be observed in the physical work itself (quantity-proportional unit rates), to time (Time-Related Charges) or to neither quantity nor time (Fixed Charges). This diagram shows where the items that embody these three relationships are to be found in CESMM4



Schedule of changes in CESMM3

Class I

1. New classification of materials in the first division provided in line with common modern practice.
2. Excavation carried out by hand measured separately.

Class J

3. New classification of materials in the first division provided in line with common modern practice.
4. Rules concerning straight specials now expanded.
5. Fittings and valves on relined mains measured separately.

Class K

6. Coverage rules for manholes and other chambers revised.
7. Excavation carried out by hand measured separately.
8. Nominal trench width for piped French and rubble drains defined.

Class L

9. Excavation carried out by hand measured separately.
10. Rules for beds, haunches and surrounds of the same material amended.

Schedule of changes in CESMM4

Class I

1. Clarification of the measurement rule where more than one pipe is expressly required to be laid in one trench.
2. The requirement to state British Standard specifications no longer required in the description of pipes.

Class J

3. The requirement to state British Standard specifications no longer required in the description of pipe fittings.

Class K

None.

Class L

None.

STRUCTURAL METALWORK

| Number | Item description | Unit | Quantity | Rate | Amount | |
|------------|--|----------------|----------|------|--------|---|
| | | | | | £ | p |
| | <u>STRUCTURAL METALWORK.</u> <u>Conveyor gantry example C, steel grade 43A.</u> <u>Fabrication of members for frames; straight on plan.</u> | | | | | |
| M311 | Columns. | t | 1.4 | | | |
| M321 | Beams. | t | 0.9 | | | |
| M351 | Roof trusses comprising single 70 × 70 × 8 mm angle rafters and 50 × 50 × 6 mm internal and bottom ties. | t | 0.9 | | | |
| M353 | Built-up side girders cambered comprising two single 150 × 90 × 12 mm angles top boom, two single 150 × 75 × 12 mm angles bottom boom with verticals 70 × 70 × 8 mm angles, diagonals 70 × 70 × 8 mm, 80 × 80 × 8 mm and 90 × 90 × 10 mm angles. | t | 2.6 | | | |
| M361 | Bracings, purlins and cladding rails. | t | 1.7 | | | |
| M370 | Grillages. | t | 0.4 | | | |
| M380 | Anchorage and holding-bolt assemblies comprising 4 nr 450 × 24 bolts with plates 150 × 150 × 10 mm. | nr | 4 | | | |
| | <u>Erection of conveyor gantry.</u> | | | | | |
| M620 | Frame members. | t | 7.9 | | | |
| M632 | Site bolts black diameter 16–20 mm. | nr | 150 | | | |
| M662 | HSFG load-indicating bolts diameter 16–20 mm with washers. | nr | 84 | | | |
| | <u>Conveyor gantry example C, steel grade 43A.</u> <u>Off-site surface treatment.</u> | | | | | |
| M810 | Blast cleaning as specification clause M2/38. | m ² | 241 | | | |
| M870 | Painting one coat zinc epoxy primer. | m ² | 241 | | | |
| | | | | | | |
| PAGE TOTAL | | | | | | |