



Bonneagar Iompair Éireann
Transport Infrastructure Ireland

TII Publications



Notes for Guidance on the Method of Measurement for Road Works Series MMNG 600 - Earthworks

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About TII

Transport Infrastructure Ireland (TII) is responsible for managing and improving the country's national road and light rail networks.

About TII Publications

TII maintains an online suite of technical publications, which is managed through the TII Publications website. The contents of TII Publications is clearly split into 'Standards' and 'Technical' documentation. All documentation for implementation on TII schemes is collectively referred to as TII Publications (Standards), and all other documentation within the system is collectively referred to as TII Publications (Technical). This system replaces the NRA Design Manual for Roads and Bridges (NRA DMRB) and the NRA Manual of Contract Documents for Road Works (NRA MCDRW).

Document Attributes

Each document within TII Publications has a range of attributes associated with it, which allows for efficient access and retrieval of the document from the website. These attributes are also contained on the inside cover of each current document, for reference. For migration of documents from the NRA and RPA to the new system, each current document was assigned with new outer front and rear covers. Apart from the covers, and inside cover pages, the documents contain the same information as previously within the NRA or RPA systems, including historical references such as those contained within NRA DMRB and NRA MCDRW.

Document Attributes

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NRA DMRB and MCDRW References

For all documents that existed within the NRA DMRB or the NRA MCDRW prior to the launch of TII Publications, the NRA document reference used previously is listed above under 'historical reference'. The TII Publication Number also shown above now supersedes this historical reference. All historical references within this document are deemed to be replaced by the TII Publication Number. For the equivalent TII Publication Number for all other historical references contained within this document, please refer to the TII Publications website.

***SERIES 600:* EARTHWORKS**

1 General

The Engineer should retain the obligations for the classification, sampling and testing of earthworks materials. Where, following consultation with the NRA, the Engineer decides that the Contractor should have the obligations in respect of classification of earthworks materials then these obligations include sampling and testing in accordance with the directions given in the Contract. The Contractor has overall responsibility to provide acceptable earthworks materials as defined in the Contract both when classification and determination of acceptability is done by the Engineer and when it is done by the Contractor.

If the Contractor opts to process unacceptable material to render it acceptable for use in the Works (as opposed to when the Engineer has specified that this should take place) then measurement shall be as though the unacceptable material had been disposed of and acceptable material of the class rendered acceptable, imported. If the Contract requires that unacceptable material is processed to render it acceptable then that material is measured as treatment of unacceptable material Class UI and then considered to be acceptable material arising from the Site.

2 Processing Materials

When the Engineer decides to assess and designate material within the excavation which can be processed into acceptable material for general fill or selected fill, he should state the class or classes of acceptable material with which the processed material must comply.

The class of the processed material should be specified and the location of its excavation should be shown on the Drawings and referenced.

The sequence of measurement items is as follows:

- i) Excavation of unacceptable material Class UI (in cutting etc.)
- ii) Extra over excavation for excavation in Hard Material in cutting and other excavations
- iii) Processing of unacceptable material Class UI to acceptable material stated class or classes
- iv) Deposition of acceptable material (in embankments etc.)
- v) Compaction of acceptable material (in embankments etc.)

The earthworks schedules may require additional items under the fill sections depending on Specification and deposition requirements.

3 Compaction and Deposition of Fill

The volume of material measured in Compaction of Fill should include the quantities measured in Imported Fill and Deposition of Fill.

The quantity of material measured in Deposition of Fill should relate only to the acceptable material arising from the Site including material so arising as unacceptable but required to be processed to become acceptable and not that measured in Imported Fill.

4 Geological Terms

Excavated material which comes within the definition of acceptable material should be billed as stated in the MMRW/LSID and not described by a geological term or common name, e.g. chalk.

5 Alternative Types of Pavement

Where the Contract provides for alternative Types of Pavement a separate Earthworks Bill of Quantities is required to correspond with each alternative Type of Pavement. The tenderer is required to price and extend the Earthworks Bill which applies to each Type of Pavement.

6 Capping

The material required and detailed in the Contract for use as capping may be obtained from various specified classes of material. This material should not be billed as "capping" material but should be as described in the MMRW and LSID under the appropriate feature classification for acceptable material.

7 Hard Material

This note gives general guidance on the way Hard Material should be dealt with when included in contract documentation.

The definition of Hard Material in the MMRW has evolved over a period of time and it should not be changed. The inclusion of the definition in contract documentation effectively excludes all other forms of definition. The aim is to achieve consistency of approach throughout the country. There are two parts to the definition and in general they should be compatible.

The excavation of Hard Material has been recognised in the MMRW as warranting measurement as extra over normal excavation because of the relative cost of the removal of such material.

Hard Material is defined for measurement purposes only, in Chapter I Definitions, paragraph 1(i) as one or both of the following:

- i) material so designated in the Preambles to Bill of Quantities;
- ii) material which requires the use of blasting, breakers or splitters for its removal but excluding individual masses less than 0.20 cubic metres.

Sub-paragraph (ii) of the definition outlines the means of determining the volume of Hard Material when circumstances preclude the use of sub-paragraph (i). These circumstances should be rare. At the time of tender the Contractor is told in the documents what material is to be expected and he is deemed to have supplemented this by inspection in accordance with Clause 11 of the Conditions of Contract. At the time of tender the Engineer should designate which strata or deposits are to be measured as being Hard Material; bound materials in existing pavements and the like will always be Hard Material. In bulk earthworks, materials which in the Engineer's judgment may reasonably be removed by using conventional rippers, taking into account factors such as the location and extent of the excavation, the size of the project and other limitations, should not be designated as Hard Material.

If the material found during the course of construction is that which was shown at the time of tender, or could be ascertained by inspection in accordance with Clause 11, then admeasurement should follow the same designations irrespective of the actual hardness of the material. If the material found in the course of construction is not as described in the tender documents or apparent by inspection, the Contractor may raise a claim if permitted under the Conditions of Contract. It

will then be for the Contractor to demonstrate that the material could not reasonably have been foreseen and that extra costs had arisen, according to the terms of that Clause.

Difficulties can arise when the extent of designated strata is not clear. Soils are widely variable and the interface between strata can be indistinct: fragmented Hard Materials might gradually merge with other soils for example. The points to which the measurements of Hard Material strata are taken may then be ascertained by the application of sub-paragraph (ii) above. At the time of tender the Engineer has to make a judgment regarding the extent of designated strata. In the course of construction a similar judgment will be required based upon observations in the field. Hard Material is only measured separately in Series 500: Drainage and Series 600: Earthworks. It is not likely that the application of sub-paragraph (ii) above will cause problems of measurement under Series 500. Drainage excavation usually will be done with backhoes appropriate to the size of the trench and it is unlikely that the Contractor would use other plant unless it was essential. The extent of the designated strata therefore should be apparent from performance and only a limited amount of judgment would be required. In bulk earthworks the position might not be so clear. For example, the Contractor might be excavating by means of scrapers and in areas where designated Hard Material strata are shown the scrapers might be augmented by other plant; the extent to which such plant is actually used would not show the limit of the Hard Material strata and the Engineer would have to give a decision on the extent of the designated strata.

Preamble 13 to the Bill of Quantities sets out three methods of designating Hard Material for measurement purposes:

- a) designated strata
- b) designated deposits with limits shown on the Drawings
- c) existing pavements, footways, paved areas and foundations.

The selection of (a) or (b) above is achieved by applying professional judgment to borehole data and other sources of information to determine those identifiable strata and deposits which are likely to create significant costs relative to the excavation of other materials in the Works. It is intended that the results of this judgment should be included in the Contract.

The compiler should ensure that only one method of designation is used for any particular material. Once a strata or deposit has been designated as Hard Material it is not subject to reclassification. Conversely, the fact that a material similar to that designated as Hard Material in a deposit within defined limits shown on the Drawings, may be found elsewhere does not indicate that it will be measured as Hard Material in the other location.

Designation of material as Hard Material is for measurement purposes and is not intended to indicate that the material has any particular level of strength, bearing capacity or other characteristic.

Where Hard Material is designated by reference to named strata alone the total quantity excavated from within those strata is subject to admeasurement. Where deposits are designated by limits shown on the Drawings, that volume is measured and paid for as Hard Material. For both methods of designation the material actually excavated may not fall within the definition of Hard Material as set out in sub-paragraph 1(i)(ii) of Chapter 1. Hard Material designated under Preamble 13(c), i.e. existing pavements, footways, paved areas and foundations is subject to admeasurement but excluding any unbound materials within the pavement, footway, paved area, or foundation.

Notwithstanding the means of designating Hard Material, care must be taken to ensure that the quantity inserted in the Bill of Quantities is consistent with the information made available to the Contractor.

8 Crib Walling, Reinforced Earth Structures and Anchored Earth Structures

When designed by the Contractor, these structures are to be measured under Series 2500. The references throughout Series 600 to these structures are included only to allow the Contractor to produce the priced schedules of quantities required by Preamble 16 to the Bill of Quantities.

9 Typical Earthworks Schedules

The schedules shown overleaf illustrate information to be provided by the Engineer and incorporated in the Contract. The sub-division of the schedules should be based on substantial changes in the type of construction or at major physical obstructions. For example a sub-division may be appropriate in the roadworks schedule where a major cut/fill interface is reached or where an area of embankment is to be surcharged. The information provided should include the following;

The total net volume of each cut area (neglecting bulking or shrinkage) including:

- a) estimated net volume of Class 5A material to be removed;
- b) estimated net volume of acceptable material;
- c) estimated net volume of unacceptable material above and below formation level including the volume to be processed to render it acceptable;
- d) the Class and estimated net volume of fill to replace any excavation required below formation level.

The total net volume of fill in each fill area (neglecting bulking or shrinkage) including:

- a) estimated net volume of topsoil to be removed, if any;
- b) estimated net volume of unacceptable material below existing ground level to be removed including the volume to be processed to render it acceptable;
- c) the Class and estimated net volume of fill required above and below existing ground level;
- d) the Class, location and estimated net volume of capping material required or stabilisation of subgrade to form capping.

10 Ground Water Lowering

This item is for use when the Engineer has either designed the method of de-watering or specified the reduced water level. It is not intended for the normal Site drainage as specified under General Requirements (Clause 602 of SRW).

11 Trial Pits

The item for excavation of trial pits should be used for specific trial pits specified in the Contract or ordered by the Engineer during the currency of the Works. It is not intended for the various testing and sampling required by the Contract and scheduled in Appendix 1/5 or 1/6. Trial pits excavated for the sole purpose of classification of earthworks materials are not to be measured as these are covered by Preamble 2(vii) to the Bill of Quantities; however, the extent of sampling should be defined in the tender document.

12 Perforation of Redundant Slabs, Basements and the Like

The location and extent of perforation required should be detailed in Appendix 2/1.

13 Geotextiles

Laps which are described in the Specification are included in item coverage for geotextiles and not measured separately. The measurement of geotextile shall be the developed area of the geotextile and this will include turn ups at edges, returns for anchorages and laps shown on the drawings.

14 Stated Class of Imported Material

Bill compilers should not utilise Group 1 Feature 2, stated class of imported material, when excavated acceptable materials Classes 1 to 4 arising from site are inadequate or not present to satisfy the specific requirements of placement of acceptable material in particular locations. Any shortfall of acceptable materials Class 1 to 4 should be measured within Group 1 Feature 1.

It is the responsibility of the compiler to make the appropriate engineering judgement in balancing those classes or sub-classes of acceptable materials that are available to the Contractor from excavations measured in Series 600 to the quantity of acceptable materials required for placement in the Works.

16 Imported Topsoil and Topsoiling

When there is a shortfall of site won topsoil and the need to measure items for imported topsoil is identified then corresponding items for topsoiling should be measured in accordance with paragraphs 77 to 81. This measurement should include for the placing of topsoil Class 5A excavated from within the site and the placing of imported topsoil Class

17 Processing of Unacceptable Material Class U1

The quantity of material in processing of unacceptable material Class U1 shall not include unacceptable material to be improved by the use of lime or cement to produce general fill.

18 Soil Improvement

The quantity to be measured under soil improvement is the volume of improved soil irrespective of the method of improvement.

The term 'fill' when used in relation to soil improvement shall include all classes of material.

TYPICAL ROADWORKS EARTHWORKS SCHEDULE

		Fill				LOCATION	Excavation																					
		Land-scaping	Selected Granular	Selected cohesive	Total Fill Material		5A	Acceptable		Unacceptable				Total Excavation other than Class 5A (including processed U1 material)	E.O. Hard Material	Processing of Class U1												
		4	6A 6B 6C 6F 6G	7I			1	2 Above Earthworks Outline 3 Below Earthworks Outline	4 Total Acceptable other than Class 5A (to include processed U1 material)	5 Above Earthworks Outline 6 Below Earthworks Outline	7 Above Earthworks Outline 8 Below Earthworks Outline	9	10	11	12 Embankments, etc.	13 Strengthened Embankments	14 On Sub-base, Capping, etc.	15 Environmental Bunds, Screening Mounds	16 Fill to Landscape Areas	17 Starter Layer (Below Water)	18 Starter Layer (Coarse)	19 Starter Layer	20 Capping	21 Fill to Gabions	22 Capping	23 Total Fill Material		
						List as appropriate:																						
						Roadworks Main Carriageway (Chainages)																						
						Surcharge (Chainages)																						
						Interchanges (List)																						
						Side Roads (List)																						
						Watercourses Each New Watercourse																						
						Each Enlarged Watercourse																						
						Intercepting Ditches																						
						Clearing																						
						Other , such as farm access roads, accommodation works, service areas																						
						Sub-totals																						
						ROADWORKS TOTALS																						



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