PART 4

Measurement Case Studies

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

Chapter 13
New Rules of Measurement: NRM1

This chapter concerns the application of the NRM1 rules to the preparation of the works estimate part of an order of cost estimate for a proposed new crematorium, which is to replace an existing facility that no longer meets modern emission standards.

The design is to be developed by the client to RIBA Plan of Work 2013 Stage 3. The contract is to be awarded on a design and build, 70/30 quality/price cost reimbursement basis, with preliminaries and profit as per a Framework Agreement. A 0/100 'pain/gain' arrangement weighted in favour of the client organisation will be included in the contract.

13.1 Project details

Figure 13.1 shows the site plan and general arrangement of the crematorium.

The design concept for the main building is based on three interlinking 'ellipses'. To the east there is an open utility area enclosed with a curved boundary wall and access gates and to the east there is a separate Book of Remembrance building linked to the main building with a partially covered walkway.

The roof is timber framed, with a plywood-boarded insulated deck and single ply roofing membrane, designed to mimic a standing seam roof.

There is a new one-way road system, car parking for 55 vehicles and the site is to be extensively landscaping and planted.

13.2 Accommodation

The main building consists of:

1. Ground floor:
   - Area 1:
     - Entrance.
     - Waiting area.
     - Public toilets.
     - Offices and ancillary rooms.

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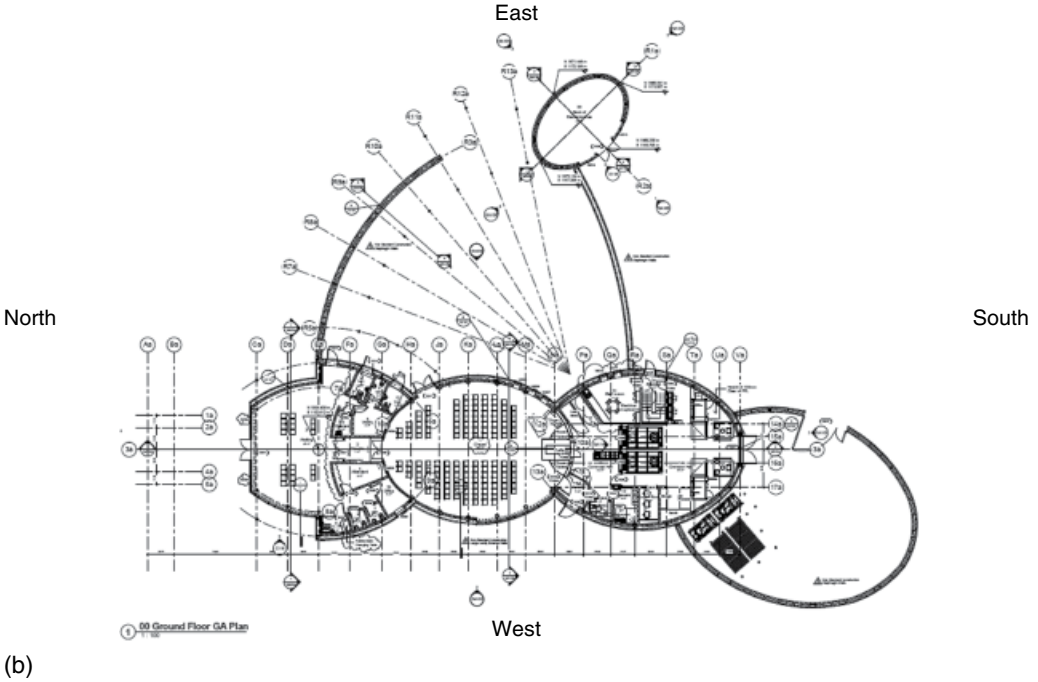
(a)



(b)

Figure 13.1 (a) Site plan and (b) general arrangement. Reproduced with the kind permission of Kier Construction.

- Area 2:
  - Chapel.
- Area 3:
  - Committal hall and cremator hall.
  - Staff rooms and toilets.

2. First floor:
   - Area 3:
     - Air handling plant and other M&E installations.

13.3 Gross internal floor area

At the early design stages, NRM1 Paragraph 2.6 suggests that either the cost per square metre of gross internal floor area (GIFA) or cost per functional unit would be appropriate estimating methods. NRM1 Appendix B suggests commonly used units of measurement for order of cost estimating, but being fairly uncommon, there is no suggested unit for crematoria.

NRM1 Paragraph 2.3 suggests that the accuracy of an order of cost estimate is dependent on the quality of information provided to the quantity surveyor/cost manager and Paragraph 2.3.2(b), in particular, requires that a schedule of GIFAs and an accommodation schedule should be provided by the architect.

This information is often provided on the drawings but should be regarded with suspicion. Designers are prone not to indicate all floor areas on the drawings, and there is never any guarantee that schedules of accommodation are complete or that they include all corridors and the like.

In this particular case study, there is some variance between the stated floor areas, especially for ground floor area 3 and the floor above, although they are identical.

13.4 Calculating GIFA

More often than not, even just as a basic check, it is good practice to carry out a simple floor area take-off.

This is quickly performed using on-screen measurement software such as the Causeway CATO suite.

For the purposes of this case study, Buildsoft Cubit has been used, and Figure 13.2 shows the floor plans and polyline area measurements obtained. Table 13.1 provides a work breakdown structure for the main building together with respective GIFAs. The GIFA total of 662 m^2 represents a difference of +32 m^2 compared to the areas stated on the drawings.

On-screen measurement is especially useful where complex or unorthodox shapes are to be measured, as in this case, and accurate answers can be obtained quickly at the click of a mouse.

13.5 Special design features

Crematoria are not 'run-of-the-mill' buildings, and new ones are both few and far between and often designed imaginatively and sensitively, as in this case study. Finding comparable elemental cost analyses for suitable historic cost data is difficult, therefore, and even if one can be found, a good deal of interpretation would be needed on the part of the cost planner.

Comparative cost analysis data, and indicative costs per square metre, always need to be viewed in the light of the individuality of the design, and this is especially true with regard to this case study. Amongst the design features that need to be accounted for are:

- The ellipsoid floor plans.
- Curved wall construction.
- Complex interface between walls and roofs.
- Special roof configuration.
- High quality of internal finishes.
- Under floor heating.
- Extensive boundary walling.
- Extensive roadworks and landscaping.

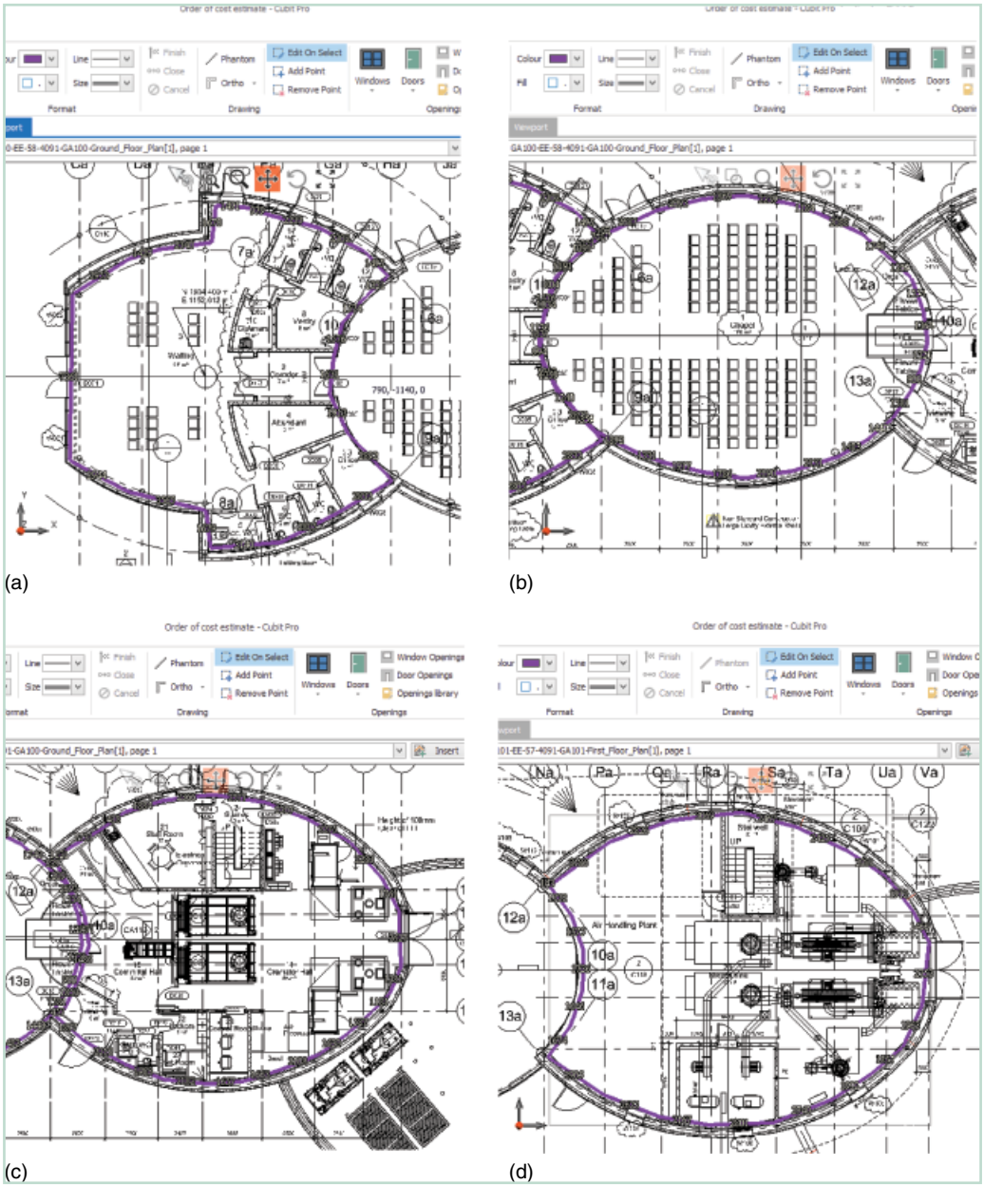
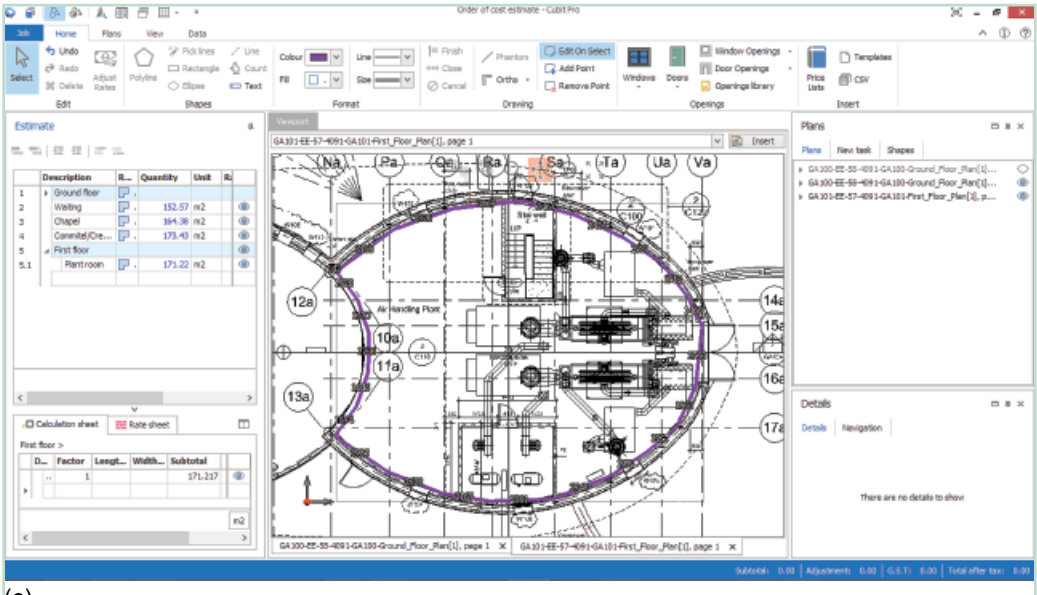


Figure 13.2 On-screen take-off – gross internal floor area. (a) Ground floor: Area A, (b) ground floor: Area B, (c) ground floor: Area C, (d) first floor: Plant room and (e) GIFAs in Buildsoft Cubit estimate screen. Reproduced with the kind permission of Kier Construction.



(e)

Figure 13.2 (*Continued*)

Table 13.1 Gross internal floor area (GIFA).

	Description	R...	Quantity	Unit	Rate	...	Total
1	Ground floor						
1.1	Waiting		152.57	m2			
1.2	Chapel		164.38	m2			
1.3	Committal/Cremator		173.43	m2			
2	First floor						
2.1	Plant room		171.22	m2			
3	TOTAL		661.60	m2			

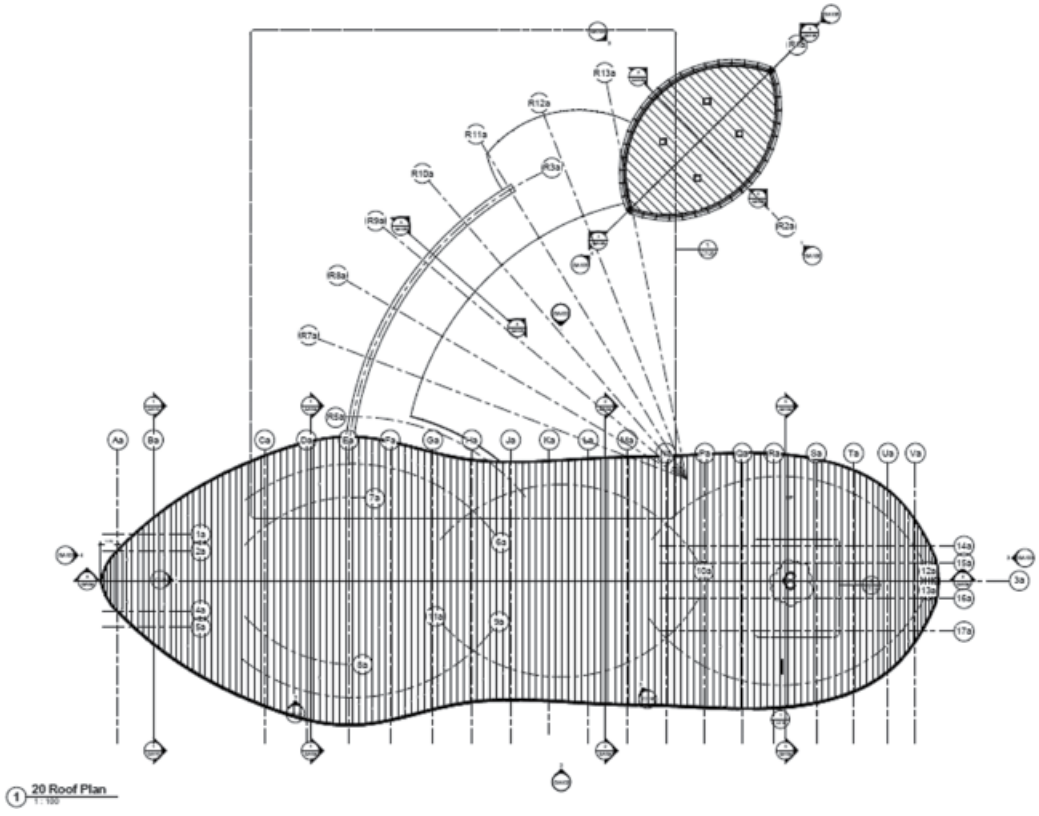
13.6 GIFA measurement rules

When using the GIFA as the basis of calculation, the measurement rules for order of cost estimating are those laid down in the RICS *Code of Measuring Practice* as stipulated in NRM1 Paragraph 2.6.1(a)(ii).

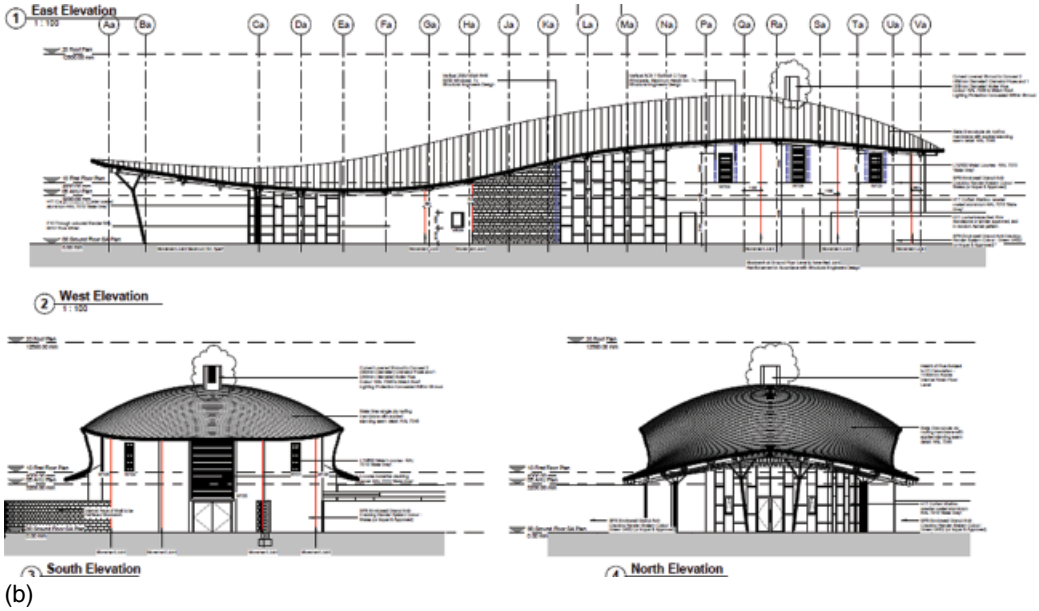
The code is reproduced in the NRM1 appendices and is discussed in Chapter 5, but GIFA is the sum of the areas at each floor level measured to the internal face of the perimeter walls.

13.7 Roof

The list of inclusions and exclusions in the *Code of Measuring Practice* is of particular interest to this case study and, especially, with regard to the crematorium roof which is shown in Figure 13.3. Here, it can be seen that the roof cantilevers beyond the building line at the north end and effectively forms a canopy over the front entrance to the crematorium.



(a)



(b)

Figure 13.3 Crematorium roof. (a) Roof plan and (b) Elevations. Reproduced with the kind permission of Kier Construction.

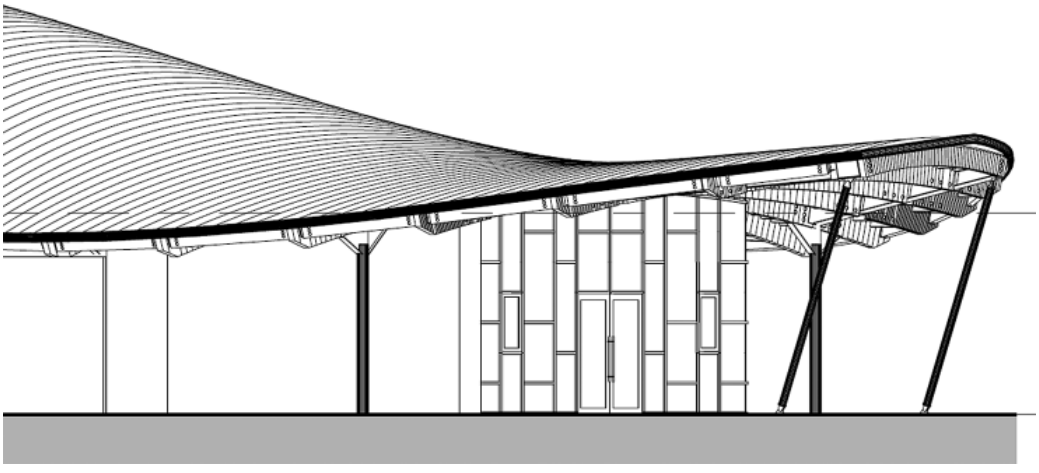


Figure 13.4 Entrance canopy. Reproduced with the kind permission of Kier Construction.

The *Code of Measuring Practice* specifically excludes canopies from the GIFA calculation, and a decision must, therefore, be made whether to:

- Adjust the chosen range of costs per square metre for the order of cost estimate to include for the cost of the additional roof area or
- Treat this particular section of the roof as a canopy, measured separately in the order of cost estimate

It can be seen from the elevations in Figure 13.3, and from Figure 13.4, that the roof over the entrance to the crematorium has vertical supports outside the footprint of the building and, it must be imagined, that this support has a foundation.

Some clues as to how this item may be dealt with can be found in NRM1 Part 4: *Tabulated rules of measurement for elemental cost planning*:

- Element 2.3.1 Roof structure:
  - Note 9 – canopies to external **areas** are included in sub-element 8.8.2: *Ancillary buildings and structures*.
  - Note 10 – canopies to external **doors** are to be included in sub-element 2.6.2: *External doors*.

The question now arises, is the crematorium canopy to an external area or to an external door?

In effect, it could be construed as both, but Measurement Rule C1 of Element 2.3.1.1 states that *the area measured for pitched roofs is the area of the roof on plan, to the extremities of the eaves*. This implies that the roof over the main entrance is not a canopy, but this doesn't necessarily mean that the structure supporting the cantilevered roof is part of the frame of the building.

Element 2.1.1: *Steel frames* is silent on the issue, except for Note 3 which says that *roof trusses which can be separated from the frame* shall be included in sub-element 2.3.1: *Roof structure*, which brings us full circle back to the canopy issue.

The conclusion from a measurement point of view is, probably, that:

a) The roof is part of Element 2.3: *Roof*.
b) The canopy support structure is not part of the frame but is either:
  (i) Part of 2.6.2: *External doors* on the basis of Note 9 (providing protection to external doors) or
  (ii) Part of 8.8.2: *Ancillary buildings and structures* as a canopy to an external area

Having exhausted the logic of NRM1, common sense must prevail on the basis that (b)i is the likelier option, as it is hard to be convinced that the canopy structure is an ancillary building or structure. This issue will assume even greater importance when it comes to the cost plan.

13.8 Works cost estimate

Taking the foregoing into account, the works cost estimate part of the order of cost estimate can now be put together.

When compiling the works cost estimate, a historic elemental cost analysis needs to be chosen where the costs of preliminaries and external works are not distributed amongst the elements. These costs need to be stripped out of the analysis so that contract specific figures can be calculated and added back into the estimate.

It will be seen in Table 13.2 that such adjustments have been made to the building works estimate as well as for:

- The ellipsoid floor plans and curved wall construction.
- The complex interface between walls and roofs.
- The special roof design and cantilever.
- The high specification.
- The canopy support structure.

Table 13.2 Works cost estimate.

Order of cost estimate for new crematorium							
Reference	**Constituent**	**Quantity**	**Unit**	**Rate (£)**	**Subtotals (£)**	**Subtotals (£)**	**Total (£)**
a	Facilitating works estimate						
b	Building works estimate	662	m^2	4 000		2 648 000	
	Adjustments						
	Curved work	7.5	%	2 648 000	198 600		
	Complex roof	662	m^2	100	66 200		
	Specification	5	%	2 648 000	132 400		
	Canopy structure				10 000		
	External works and landscaping				300 000	707 200	
						3 355 200	
c	Main contractor's preliminaries estimate	11	%			369 072	
d	Subtotal					3 724 272	
e	Main contractor's overheads and profit estimate	7	%			260 699	
f	**Works cost estimate**						**3 984 971**