Measuring Walls in Accordance with ARM4 - An Introductory Demonstration

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Introduction
The structure of a building is usually broken down into a number of separate elements. Structural work comprises the primary structural carcass above the substructure, including all secondary items and finishes which are integral with the structure. The “National Standard Building Elements for Design Cost Control Procedures (See next slide) breaks down the structure into the following elements.

(21) External Walls
(22) Internal Walls
(23) Floors, Galleries
(24) Stairs, Ramps
(27) Roofs
(28) Frames

This unit deals with the measurement of walls.

THE MEASUREMENT OF EXTERNAL WALLS
Walls are categorised and measured in two separate elements.
(21) External Walls, and
(22) Internal Walls;

There is usually little problem in identifying which walls are external and which are internal. External walls include gable ends and it is common practice to measure chimneys in this element. Some buildings also have attached garages or conservatory type projections at ground or lower levels. In these instances cavity or solid walls may 'become internal' at lower levels. In these situations the surveyor may take a practical approach and measure these internal cavity walls in the external wall section.
The National Standard Building Elements

In Ireland the measurement of new building work is typically organised in accordance with The National Standard Building Elements for Design Cost Control Procedures (NSBE). (ERV, 1993) Elements are defined as ‘that part of the building, which always performs the same function irrespective of design or specification’. The object of the NSBE is to enable design teams to adopt, on a national basis, a common approach to the building process. The Elements stipulate what is included and excluded from each element, which helps design teams coordinate their work and allows the measurement of the work to be divided up among teams while ensuring that all aspects of the building works are fully covered in the Bill of Quantities. External walls comprise the following:

<table>
<thead>
<tr>
<th>Include</th>
<th>Exclude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walls, however formed</td>
<td>Chimneys which are integral with building frame</td>
</tr>
<tr>
<td>Cladding and curtain walling</td>
<td>Insulation integral with applied finishes</td>
</tr>
<tr>
<td>Continuous screens and continuous</td>
<td>Doors and windows where not</td>
</tr>
<tr>
<td>shop-fronts</td>
<td>integral with wall structure</td>
</tr>
<tr>
<td>Bracing, rails, studding,</td>
<td>Chimneys</td>
</tr>
<tr>
<td>Insulation within walls.</td>
<td></td>
</tr>
<tr>
<td>Copings, sills, lintels.</td>
<td>Ducts</td>
</tr>
<tr>
<td>Damp-proof courses and tanking.</td>
<td></td>
</tr>
<tr>
<td>Integral chimneys and ducts.</td>
<td></td>
</tr>
<tr>
<td>Integral doors and windows.</td>
<td></td>
</tr>
<tr>
<td>Integral finishes</td>
<td></td>
</tr>
</tbody>
</table>

The Table of Elements in this slide shows that Structure work comprises a number of discrete elements. ‘External Walls is coded ‘(21) External Walls’
The Elevations
Plan & Section

Opening:
- WTA: 1800x1200
- WTB: 900x1200
- WTC: 1200x1200
- D1: 900x2100
- D2: 1500x2100
The Details

Head Detail Front Elevation

Head Detail Rear Elevation

Jamb Detail

“bridging” cill to close cavity

Sill Detail

Detail at Eaves
The Specifications

CONCRETE WORK.

Precast Concrete

- Lintels: Spanlite or equal approved prestressed 100x65mm high to rear wall openings, allow 225mm building in at ends
- Cills: 30N10; standard profile 225x150mm high reinforced with 2 Nr 12mm diameter mild steel bars; fair rubbed finish to exposed faces. Allow 100mm building in at ends

BRICKWORK and BLOCKWORK

Brickwork

- Kingscourt red rustic facing bricks; 215x102.5x65mm; in gauged mortar (1:1:6), half lap stretcher bond, fair finish one side pointed with a bucket handled joint finish.

Blockwork

- Solid concrete blockwork to IS EN 771-3 2011; 440x215x100mm in gauged mortar (1:1:6) in stretcher bond to external cavity walls and internal walls

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**Forming cavities**

- 100mm wide cavity; stainless steel wall ties at 450 mm vertical and 900mm horizontal centres; insulated with 60mm Kingspan ‘Thermawall’ TW52 insulation.
- Closing cavity at eaves with block on flat
- Closing cavity at raking verges with natural slate
- Closing cavity at jambs ‘L’ shaped closer blocks
- Cills to bridge cavity wall.

**Damp proof course**

‘Hyload or equal approved damp proof course; allow 225mm laps.

**METALWORK**

**Lintels to external walls**

Catnic or equal approved pressed steel lintels; Catalogue reference CG 90/100 including integral insulation and cavity tray damp proof course; allow 225mm long building ends into walls
Measuring Walls at Gable Ends

Where there is a gable wall the procedure for measuring the walls can become quite tricky. Alan Packer (1991) illustrates the approach opposite:

Measure a box (or rectangle) based on the centre line x height to soffit level for each skin of the wall and cavity. Where the skins are both made of the same materials (both skins are brick or both are block) it is usually possible to measure this along the centre line of the cavity.

At eaves measure brickwork to close the cavity along the length of the soffits … it may it may be described as closing cavities horizontally and measured linear. Alternatively the cavity wall may be left open at eaves level and the blockwork inner skin raised independently to support the wall plate as (Stage 2 opposite). (details will vary depending on the circumstances). The wall plate is measured as part of the Roof.

Before measuring the triangular section of the gable end cavity walling at either end of the dwelling, it will be necessary to include a narrow band of cavity work to lift these end sections to the same height as the wall plate level (Stage 3 opposite).

The additional blockwork in the gables is calculated using the formula for the area of a triangle, i.e. half times the length of the base by the perpendicular height of the gable from eaves to ridge level (stage 4 opposite).
The Project Building

The building is a detached bungalow with brick faced front elevation and rendered block gable and rear elevations. The overall external dimensions are identified on the plan, see next slide, and the internal floor to ceiling height is shown on the section. Note the brick return on the gable walls.

Approach to Measurement

Study the drawings to identify any gaps and/or inconsistencies in the information. Where these occur the QS should inform the lead designer and issue a query sheets to address the issue.

Before taking off the walls it is good practice to draw up a to-take-list to make sure that no work is missed during the measurement. The surveyor should carefully read through the Concrete, Brickwork and Blockwork sections of ARM4 and pick out the items shown on the drawings and described in the specification. There may also be items such as insulation to be measured in the Woodwork section and steel lintels to be measured in the Metalwork section of ARM 4.
Before measuring the brick and block walls proper, there are often a number of incidental concrete work items to be measured. In this case the concrete backing to the cills (above) has been measured as concrete sundries in a similar manner to filling holes stating the number (36.20.4). Note the thickness of the concrete backing has been taken as 75-80mm wide. The quantity has been given as 1 cu.m despite the very small amount required. The associated formwork has been measured under the ‘Other items’ function heading in linear metres providing the details involved.
Measuring Precast Items

Precast Concrete Elements

Such as sills or lintels are counted giving a detailed description.

Where the items are standard products (such as ‘spanlite’ lintels) they can be described as such.

Where a ‘generic’ specification is provided details of the kind and quality of the concrete, the reinforcement and how the units are bedded and jointed must be described.
Spanlite lintels are specified for the rear elevation to the building. They are enumerated, giving a detailed description. The length of the lintel must include for the 225mm end bearing each side of the opening.

<table>
<thead>
<tr>
<th>Precast prestressed concrete</th>
<th>('Spanlite) or equal approved fair smooth rubbed finish on all exposed faces; bedding in gauged mortar</th>
<th>(1:1:6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lintels; 100 x 65 mm</td>
<td>1650 mm long</td>
<td>1950 mm long</td>
</tr>
<tr>
<td>2 Nr</td>
<td>2 Nr</td>
<td>2 Nr</td>
</tr>
<tr>
<td>W.T.C.</td>
<td>1200</td>
<td>1500</td>
</tr>
<tr>
<td>Ends 2/225 450 1650</td>
<td>DT2 2/225 450 1650</td>
<td>2/225 450 1950</td>
</tr>
<tr>
<td>2 2 both leaves</td>
<td>2 2</td>
<td>2 2</td>
</tr>
<tr>
<td>2250 mm long</td>
<td>2 Nr</td>
<td>2 Nr</td>
</tr>
<tr>
<td>1800</td>
<td>UTA 2/225 450</td>
<td>2250</td>
</tr>
</tbody>
</table>
Specification particulars required for brickwork include:

- Kind quality and size of bricks or blocks;
- Type of bond;
- Composition and mix of mortar;
- Surface finish;
- and Type of pointing

Wall thicknesses must be stated – a half brick thick wall is 103mm thick. Walls are measured in **square metres**.

An **overall length** of the brickwork is built up by adding the length of the front elevation (7650mm) to the two 450mm returns on the gable end, - giving a subtotal of 8550mm. This is then adjusted to figure out the centreline of the brickwork by deducting 2 corners (2x2x½ the thickness (103mm) of the brick to give and adjustment of 206mm and an overall length of 8344mm this is rounded back to 8.34m and transferred into the dimension column.

The height of the brickwork is figured by taking the floor to ceiling height (2500mm) shown on the section and adjusting it for the thickness of the wallplate (75mm) and the height of the cavity closer (100) – These adjustment produce a height of 2325mm. - This is rounded up to 2,33mm and transferred into the dimension column.

The overall area is then adjusted for the external doors and window and openings.

**Note** the measurement rules for walls state that ‘no deduction shall be made for lintels and the like’ – this explains why the cills are not deducted from the area of the brickwork.
### Brick Detailing

A soldier course has been taken over the openings on the front elevation. Flush features such as bands and soldier courses are measured as **extra over** the brickwork or blockwork on which they occur in **linear metres** giving a detailed description.

**Extra over** means the additional cost over the work which has just been measured. You do not adjust the measurements of the main work for the detail.

### Labours on brickwork

Labours on brickwork include rough and fair cutting, vertical fair internal and external angles, raking out of joints, returns, ends, angles, labours in eaves filling and building in ends. This is measured as an item.
Measuring the block walls

The block walls are measured square metres in the same way as the brickwork on the previous slide. The approach taken here has been to measure both skins of the cavity walls as being in blockwork in the first instance and then to adjust these for the window and external door openings as these exceed ½ sq.m. in area. Finally, there is the deduction for the net area of the brickwork which has already been measured on the previous slide.

Refer to slide 7 for how the gable strip and gable end is measured.

Note the term ‘wall’ includes skins of cavity walls. The inner leaf of the cavity wall is measured in this Element of the works (i.e it is not considered to be an internal wall).

Note the measurement rules for walls state that ‘no deduction shall be made for lintels and the like’ – this explains why the cills are not deducted from the area of the blockwork.
Labours on brickwork include rough and fair cutting, vertical fair internal and external angles, raking out of joints, returns, ends, angles, labours in eaves filling and building in ends. This is measured as an item.

**Forming Cavities**

Forming cavities is measured in m², along the centreline of the cavity stating the width of the cavity, the description of the type and spacing of wall ties and a detailed specification of any insulation.
Closing Cavities

Closing cavities is required to be measured in linear metres giving the width of the cavity and the method of closing. Note that the first description includes for the block closer at the top of the wall along the front and back elevations. Similarly a slate is used to close the cavity along the rake of the gable.
### Closing Cavities Jambs

Measured in linear metres and the method of closing in this instance by using a special closer blocks at the jambs of the windows and external doors.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>COTTAGE</td>
<td>2/9</td>
<td></td>
</tr>
<tr>
<td>100 mm wide; at jambs with 'L' shaped closer blocks returned across the cavity; 20 mm expanded polystyrene insulation</td>
<td>18 m</td>
<td></td>
</tr>
</tbody>
</table>

#### Closing at heads of openings

- Bitumen felt, sheets lead or copper built in as dpc
- Cavity closer blocks
- Window frame
- Inside face of wall
Damp Proof Courses

Damp proof courses are described giving details of the kind and quality of the materials.

Descriptions of dpcs must state the extent of laps and whether they are horizontal, vertical, raking, stepped or curved.

They are separated into three different categories which governs how they are to be measured.

- not exceeding 225mm measured in linear metres;
- exceeding 225mm measured in square metres
- or cavity trays measured in linear metres giving a detailed description.
Cavity Trays

Are measured in linear metres giving a detailed description. This is provided here by stating the girth of the tray. Note how this is built up by use of a ‘waste calculation.'
Metal Ancillaries

Items such as lintels and sills are enumerated giving a detailed description. This is usually by reference to a product catalogue.

225mm bearing on the walls have been added at each end to the various structural openings in order to calculate the length of the lintel.
Element (22)
Internal Walls, Partitions

‘Spanlite’Lintels
Partition Walls
Labours on Blockwork
Spanlite lintels
Spanlite lintels are required above the five doors. They are enumerated, giving a detailed description.
The length of the lintel must include for the 225mm end bearing each side of the opening.

Block partitions
The same rules measurement apply here as with the external wall blockwork measured above.
The measurement approach taken here is to simplify the arrangement by ‘shifting’ some of the walls so that they align to become a ‘spine’ wall which runs through the length of the house and two ‘rib’ walls which run from the front to the back of the house. Note the thickness of the spine wall (100mm) is deducted from the overall front to back measurement when measuring the ‘rib’ walls.
Labours

Labours on blockwork include rough and fair cutting, vertical fair internal and external angles, raking out of joints, returns, ends, angles, labours in eaves filling and building in ends.