Site Engineering Guide

ORDANCE SURVEY: NATIONAL GRID & BENCH MARKS

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ORDNANCE SURVEY: NATIONAL GRID & BENCH MARKS

INTRODUCTION

The Ordnance Survey formed in 1791 is the national mapping agency for Great Britain and is both a self-funding government department and one of the world's largest map producers. The name of the agency reflects the military purpose of the organisation when first formed to map Britain during the Napoleonic war when the threat of invasion existed. The logo for the Ordnance Survey even to this day features the former War Departments board arrow heraldic mark.

The objective of the agency is to satisfy the national interest and customer need for accurate and readily available geospatial information and mapping. The Ordnance Survey maintains and manages a definitive record of all features of both the natural and built environment along with boundary lines.

ORDNANCE SURVEY NATIONAL GRID

All Ordnance Survey maps have the national grid imposed over them as a result of a re-survey which was carried out in 1938, the national grid which covers the whole of Great Britain which can be seen in the figure 1. The national grid is a symmetrical network of parallel lines crossing at right angles. The axis's of the grid are 2° west line of longitude and the 49° north line of latitude, the intersection of these two lines forms the true origin of the national grid.

The 49° north line of latitude was chosen as the axis for the national grid as the whole of Great Britain is north of the line and the 2° west line as it runs approximately central through the whole of the country and as a result of this is called the central median. This means that the grid coordinates west of the central median would be negative whilst point's mainland of Scotland would have north coordinates in excess of 1000kilometers.

Therefore in the interests of keeping all east –west coordinates positive and all north coordinates less than 1000, the origin was relocated just southwest of the Sicily Isles, this point is called the false origin.

This means that any position in Great Britain can be known by its Eastings and Northings which are the distances east and north from the false origin. A series of 100km squares cover Great Britain, each 500km block has a prefix letter H, J, N, O, S or T comprising of 25 squares each 100km, each square then has a further prefix letter applied from the alphabet which refers to the south west corner of the square, with the letter L expelled. This can be clearly seen in Figure 1.

National Grid is now defined by the ETRS89 coordinates of the Ordnance Survey National GPS network plus the OSTN02™ transformation.

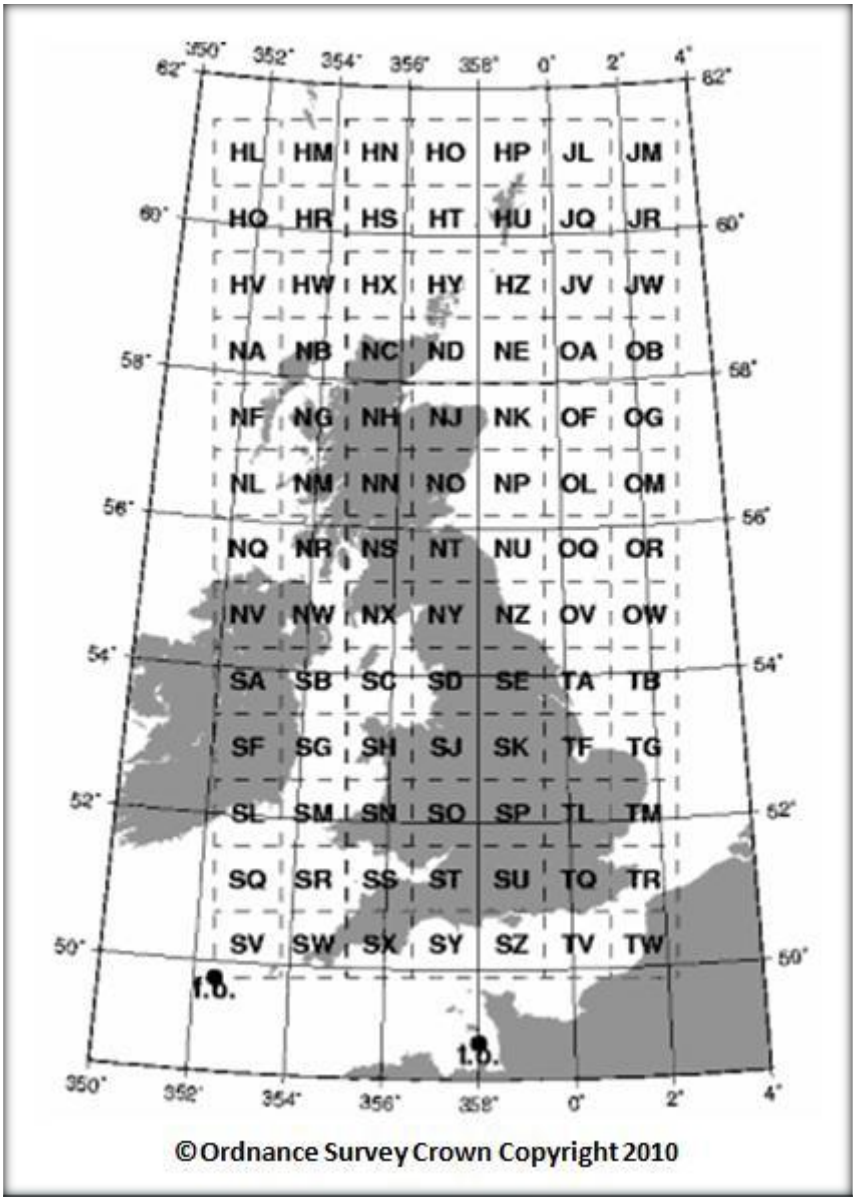


Figure 1

TIP

In Great Britain coordinates are expressed in the format Eastings, Northings (E, N) however in United States etc they work in the Northings, Eastings format. So if using software from another country, check the format

BENCH MARKS

Ordnance Survey Bench Marks (BM's) are survey marks created by the Ordnance Survey to record height above Ordnance Datum. Most commonly the bench marks appear on structures or semi permanent features.

Bench marks where a known height above mean sea level as measured at Newlyn in Cornwall the Ordnance Datum Newlyn or ODN for short. This is the national height system for mainland Great Britain and is the reference frame for heights above mean sea level. This height system is visible on the ground in the form of a network of approximately 190

Fundamental Bench Marks (FBMs). From these 190 FBMs tens of thousands of lower order Bench Marks where created.

The Ordnance Survey formally maintained the lower order Bench Marks although no maintenance or field checks have been conducted for the last 30 years. Ground movement throughout Great Britain has varied between regions, the reason why the Bench Marks need to be regularly checked to maintain their accuracy, although areas of former mining activity have seen the most ground movement.

The network of 500,000 lower order Bench Marks has not been maintained due to the cost in comparison to benefits of modern technology in the form of Global Positioning System. As a result the Ordnance Survey have removed Bench Mark values from many of its products and no longer offers the Bench Mark list for sale, although the bench mark lists are available free of charge from:

www.ordnancesurvey.co.uk/benchmarks

A number of groups not associated with the Ordnance Survey also publish details of Bench Marks on the internet and details of their condition and availability. One such website is:

http://www.bench-marks.org.uk/

The lower order Bench Marks continue to be lost due to redevelopment or erosion and whilst the Ordnance Survey is not maintaining them it is also not destroying them. Whilst the accuracy of the lower order Bench Marks is questionable as they have not been field checked for at least 30 years they can prove to be useful for checking purposes or as a historical comparison method.

TYPES OF BENCH MARK

With over 500,000 in existence throughout the country the probability is that you've passed one without realising.

Flush Brackets

These are brass rectangular plates measuring 90 x 175mm, found cemented into the face of buildings at intervals of approximately 1.5km or in the sides of triangulation pillars. Each bracket features a large boss and a cavity created to allow the plate and boss to be cemented in place in line with the face of the building or pillar.

Each flush bracket features a unique serial number which can be used to identify the Bench Mark; figure 2 is a pictured of one such Bench Mark and its serial number G5139.
Figure 3 shows the special bracket required to take a reading from the Bench Mark.

Figure 2: OS Bench Mark G5139

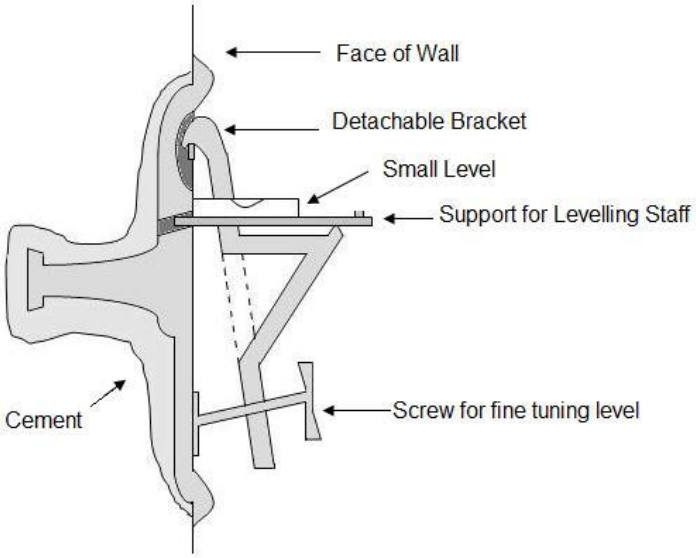


Figure 3: Required fitting for using the Flush Bracket

Cut Bench Marks

Cut Bench Marks can be divided into two types, horizontal and vertical surface types.

Vertical surface Bench Marks look like figure 4a and measure approximately 0.1 x 0.1m in size. They will be found approximately 0.45m above ground level on the faces of buildings, bridges, milestones and gate posts etc.

The level of the bench mark is measured to the centre of the V shaped horizontal bar and in some instances may have a copper bolt set in the middle of the mark.

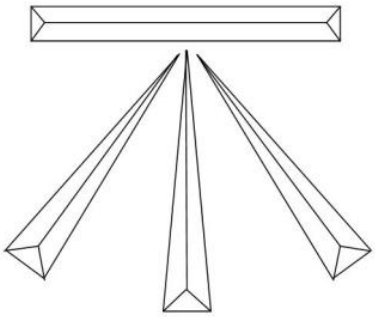


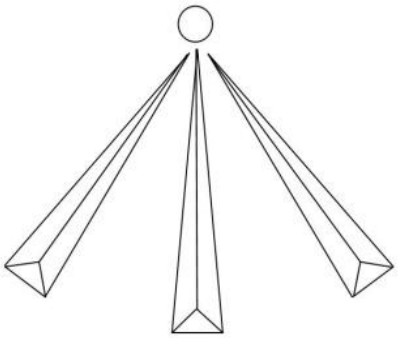
Figure 4a: (Left) Vertical Cut BM
Figure 4b: (Above, Right) Cut Benchmark on Milestone

Horizontal surface Bench Marks look like figure 5 and can be found on the bridges, steps, parapet walls etc. As opposed to the vertical type they do not feature a horizontal bar.

Instead a brass or steel rounded head of a rivet is the point to take your measurement from. Some other Bench marks do not feature the rivet but instead a small hole in which a 5/8" ball bearing can be positioned from which to measure from.

Obviously this type of Bench Mark is more prone to erosion.

Figure 5 (Right): Horizontal Cut BM



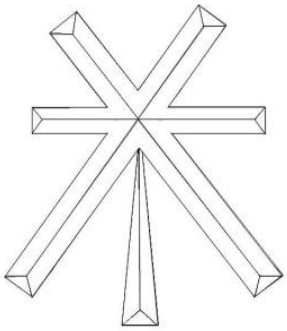
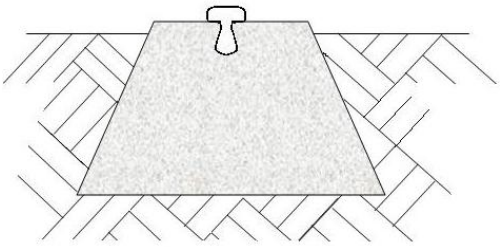


Figure 6 shows a cancelled or redundant Bench Mark that has been deemed unsuitable due to reliability or replaced by another in and around the location.

Figure 6: Cancelled BM

Bolt Bench Marks

Established on horizontal surfaces, bolt Bench Marks where created in location which did not have a suitable location for either a flush bracket or a cut mark. The bolt made of brass with a mushroom shaped head and engraved with O.S.B.M. and an arrow pointing to the centre of the head was typically found in living rock, the foundations of buildings or bridge abutments, steps or alternatively a concrete block similar to that shown in figure 7.



Left: Figure 7: OSBM on a concrete block with an enlarged head view

FUNDAMENTAL BENCH MARKS (FBM's)

The 190 FBM's however are still being maintained by the Ordnance Survey and utilised, they form part of our link to the ODN, the details of FBM's are not published on the internet and access to the information is only available from the Ordnance Survey and will be considered on a case by case basis.

Fundamental Bench Marks are described by J.B. Harley, Ordnance Survey Maps: A Descriptive Manual 1975 as marks that have been constructed at specially selected sites where foundations can be set on stable strata such as bedrock. In this way the likelihood of movement of the mark is minimised. They provide a stable network for levelling and there is

approximately one every 40km. Each FBM consists of a buried chamber with a brass bolt set in the top of a granite pillar. Figure 8 is a diagram of the construction of a FBM. The position and height above Ordnance Survey Newlyn Datum is known.

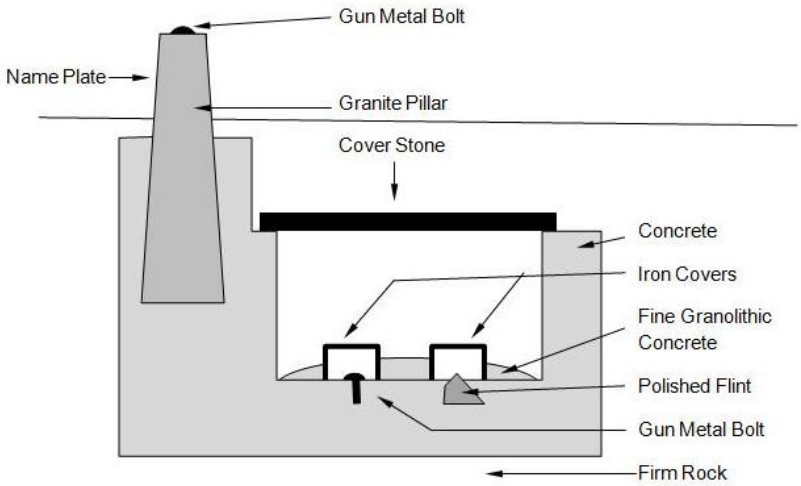


Figure 8: FBM Construction

FBM's should not be confused with triangulation pillars or trig points as they are otherwise known as, which were placed on top of prominent hills and mountings from 1935 onwards to aid in the accurate retriangulation of Great Britain. When the network of trig points was complete it was possible to see in clear weather at least two others. A target or a theodolite could be positioned on top of the trig point to survey the surrounding trig points. The trig points are no longer maintained as with the Bench Marks for the same reasons, many of which are now slowly being lost through erosion and redevelopment. Figure 9 is of a trig Point.

Right: Figure 9: Triangulation Pillar S2793: Parrenthorn

Concrete markers used to identify the presence of underground telecommunication cables, which were erected by the General Post Office (GPO) as shown in Figure 10. Also feature the War Department's broad arrow and should not be confused as being connected with the Ordnance Survey Newlyn Datum. They have no connection with the Ordnance Survey.

Left: Figure 10 Former GPO marker

GLOBAL POSITIONING SYSTEM (GPS)

The preferred method of heighting used by Ordnance Survey is Global Positioning System (GPS) and the OSGM02™ which is the height transformation between the European Terrestrial Reference System 1989 (ETRS89) and the national height datum. For this reason the OS now maintains over 110 permanent GPS stations in the OS Net® for use by surveyors and engineers. The position and altitude of these GPS stations is continuously monitored, the position of your onsite GPS receivers data can then be compared with that received at the OS Net® stations to obtain the coordinates of your receiver in the ETRS89 format, then a correction factor is published by the Ordnance Survey to calculate the height component.

Using GPS effectively every measurement is retaking a level on a point, for this reason the results obtain will reflect the inaccuracies as a result of any seasonal or long term ground movements. This effectively means that a high accuracy can be obtained using GPS over the whole National Grid but low accuracy over short distances e.g. on a site.

It is recommended that GPS be used to establish control on site and then more traditional methods of surveying be used to transfer that control around the site.