

# Survey of Foel Lwyd

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## **1) Introduction**

Foel Lwyd, (Hill 2036, Section 30B, OS 1:50000 Map 115, OS 1:25000 Map 17E, Grid Ref. SH720723), is currently listed as a “Dewey” and “Sim” and is situated in the Northern Carneddau. This hill was visited by two of the authors on 29 January 2011. Even with Abney levels, the location of the summit could not be identified exactly.

The purpose of this survey was to identify the summit position using automatic level and staff and to make an accurate height measurement. A “Sim” is a hill in Britain and Ireland with a height of 600m or greater and a drop exceeding 30m. Therefore with a marked spot height of 603m, the height measurement will confirm the Sim status of Foel Lwyd.

## **2) Equipment used and Conditions for Survey**

Ground surveys to determine the position of the summit were carried out using a Leica NA730 Professional Automatic level (X30 telescopic system)/tripod system and a “1m” E-staff extendable to 5m.

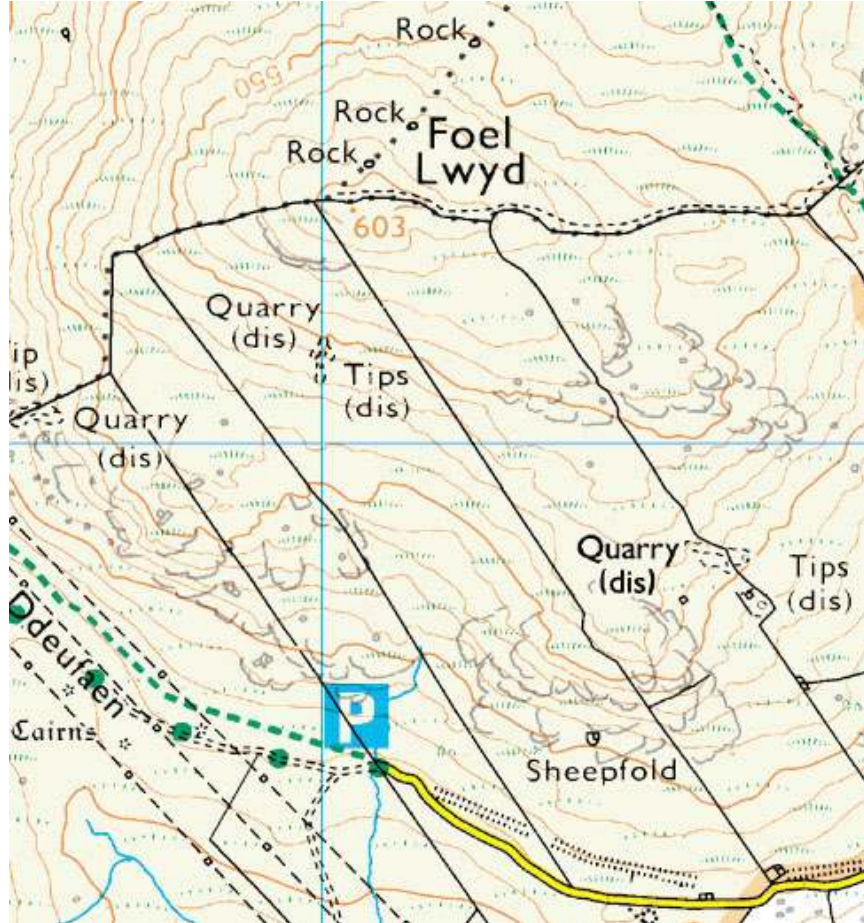
Absolute height was measured using a Leica Viva GS15 Professional GNSS receiver. It is a dual-frequency, 24-channel instrument, which means it can lock on to a maximum of 12 satellites and receive two signals (at different frequencies) from each of these satellites. The latter feature reduces inaccuracies that result from atmospheric degradation of the satellite signal. As a stand-alone instrument, it is capable of giving position and height to an accuracy of about one and five metres respectively. Note that a hand-held GPS receiver can only receive up to 12 satellites and each at a single frequency and therefore it has a poorer positional accuracy of +/-5m and a height accuracy of no better than 10 metres. Despite the on-board features of the receiver, there are still sources that create residual errors. To obtain accurate positions and heights, corrections were made to the GPS data via imported RINEX data from the Ordnance Survey which was post-processed using Leica Geo Office Version 7.01 software.

Conditions for the survey, which took place between 12.30hr and 15.15hr BST, were excellent. The weather was warm, about 20 degrees Celsius, with sunshine and good visibility. The wind was light and therefore had no effect on the survey.

### **2.1) Character of Hill**

Foel Lwyd is in the North East Carneddau and lies between Tal y Fan to its North East and Carnedd y Ddelw to the South West. These hills form a “ridge” to the West of the Conwy valley that links to the main North to South Carneddau ridge running from Abergwyngregyn (Aber) on the coast at Conwy Bay to Llyn Ogwen in the South. A minor road terminates at a small car park just south of the hill from where access can be gained easily. From this car park a wide track continues North West to Bwlch y Ddeufaen where a footpath leads to the top of the hill but on the Northern side of the summit wall. To the East of the summit, the wall is broken and that allows access to the highest

point on the South side of the wall. Most of the southern flanks and summit area of the hill are covered with quite high heather and boulders, with much of the latter arising from spoil from old quarries. This makes ascent of the hill from these slopes quite tedious. An extract of the OS 1:25000 map with summit features is shown below.



**2.2) The Summit Survey**

The summit area is traversed with a high dry stone wall running from West to East. Visually it was clear that the ground on the North side of this wall was lower and therefore the exact position of the summit lay on the South side of the wall. The Leica automatic level was set up at a convenient point on the South side of the wall and staff measurements were taken at high points in order to locate the exact summit position. This was the top of an embedded rock.

The Leica Viva GS15 was set up on a “short tripod” over the summit position and data were collected for 2 hours with an epoch time of 15 seconds. Photographs of the set up and the measured vertical offset of 0.215m are shown in the Appendix 1.

The ten-figure Grid References measured for the summit were:-

|                    |                |                           |
|--------------------|----------------|---------------------------|
| Garmin Montana 600 | SH 72041 72325 | Accuracy 3m Height = 604m |
| Garmin Oregon      | SH 72043 72325 | Accuracy 3m Height = 607m |

This was the same position that had been recorded as the summit by the Abney level survey carried out in Jan 2011. At that time the point near the wall at SH 72015 72340 was thought to be about the same height, but the staff measurements showed this point to be between 0.2 and 0.3m lower.

The position and height data for the summit that were recorded by the Leica Viva GS15 and post-processed with Leica GeoOffice 7.01 using the computed Tropospheric Model and imported OS RINEX data from the nearest eight OS Active Base stations were:-

| System | Easting    | error(1SD) | Northing   | error(1SD) | Height(m) | error(1SD) |
|--------|------------|------------|------------|------------|-----------|------------|
| GS15   | 272036.883 | 0.001      | 372323.426 | 0.002      | 600.122   | 0.006      |

### 3) Discussion of Results

The height of Foel Lwyd was measured to be 600.12m which is nearly 3m lower than the spot height of 603m currently on OS maps. The new data have been forwarded to OS and will appear as the new height of this hill.

Since the position of the summit was the top of an embedded rock which was easily identified and reproducible, there is negligible uncertainty in the height measurement in this respect. The main error in the height measurement is associated with the GPS measurement itself, and for 2 hours of data we would expect this to be within +/-0.05m (three times standard deviation).

### 4) Summary and Conclusions

The **summit** of **Foel Lwyd** is at grid reference \* **SH 72042 72325** and is the top of an embedded rock. Its **height** was measured to be **600.12+/-0.05m** and therefore its “**Sim**” status is **confirmed**.

\* NB average hand-held Garmin GPS grids are quoted in the summary.

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## Appendix 1

Leica Viva GS15 set up on short tripod over the summit of Foel Lwyd



Leica VivaGS15 vertical offset (0.215m) for summit measurement

