Can we have the best of both worlds?

We need to decide: what is the acceptable difference between distance measured on the **ground** and distance measured on the **map**.

Local **'flat earth'** grids only work over a very small area. If your work area extends beyond a kilometre you can no longer use a localised flat earth grid. However, you could define your own local map projection with a small (negligible, but acceptable) scale-factor. It is relatively easy to convert data between your local projection and the national grid.

If you are designing a long linear feature, it will usually have its own reference system – chainage (i.e. distance from a known starting point), along the feature and offset perpendicular to the feature. You could introduce a variable scale-factor, so that chainage corresponds with what you measure on the ground. An even neater solution would be to use what is commonly known as **'snake'** projection: this dynamically converts between chainage and grid co-ordinates on large, generally linear projects.

Whatever you do, make sure your **local** grid co-ordinates cannot be confused with **national** grid co-ordinates.

It's important to get your grids right. If in doubt ask a Chartered Land Surveyor. RICS' Geomatics World journal (2007-08) published more in-depth articles on datums, map projections and snake projections.

More information can be found at www.pvpubs.com/magazines.asp

This client guide is one of a series from the MAPP Panel of RICS geomatics, the full series and professional guidance can be downloaded from www.rics.org/mappp

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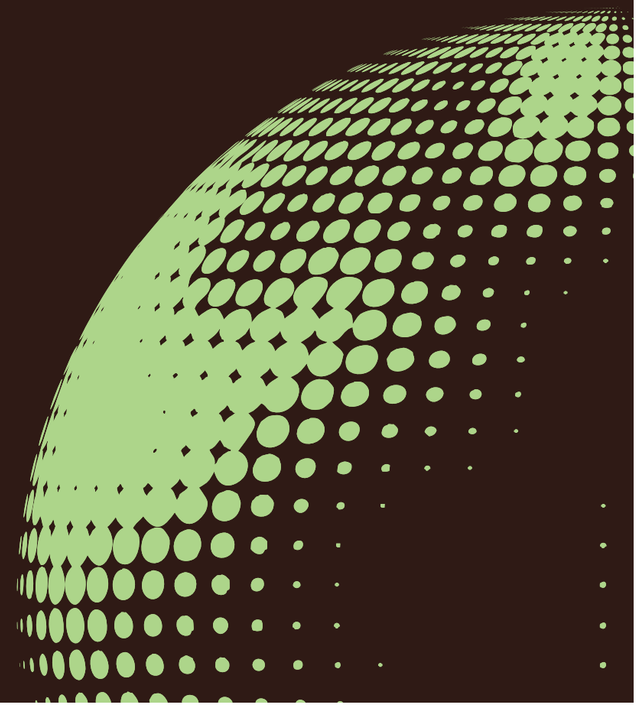
Geomatics client guides

Map Projection Scale-Factor

Avoid the potential dangers of scale-factor



Are you an architect, engineer, developer or builder?

If you use large-scale topographic survey information or mapping, it is essential to understand the effects that one particular function of map projections – **scale-factor** – can have upon distances and dimensions.

Map projections are used throughout the world, so the principles discussed here are generally applicable worldwide. This client guide features an example from Great Britain, where the need for a wider community of users to understand the issue of scale-factor distortion has become more critical in recent years.

Why is the distance that I measure on the ground not the same as the distance that I measure off my map?

The most likely cause is that the difference is due to the effect of the projection scale-factor.

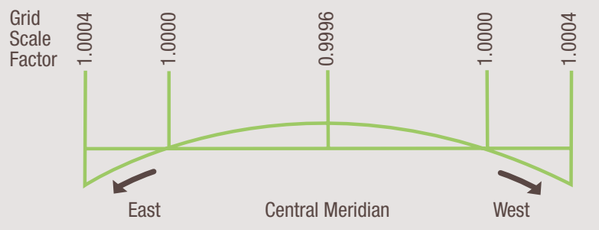


Diagram 1: This basic survey diagram shows the age-old problem of how to mathematically reconcile a spherical surface (Earth) with a flat sheet of paper (Map). This is the central dichotomy at the heart of scale-factor issues.

Depicting a **curved** surface (such as the Earth) on a **flat** surface (such as on paper or in a digital representation of it), is a problem that surveyors solve using **map projections**. Map projections are not new and have been in common use for centuries. However, what *is* new is the increasingly widespread use of **'projected'** survey information. This has come about for **two** key reasons:

Firstly, professionals are making increasing use of **large-scale digital mapping data** supplied by national mapping agencies. For example, in Great Britain, Ordnance Survey (**ordnancesurvey.co.uk**) provides geodata referenced to a map projection known as **British National Grid**. In most places, there will be a difference between a distance measured on the ground. This difference is known as **scale-error** or **scale-factor distortion**. It is variable depending upon location in the country, and can affect measurements by an amount ranging between zero and 4cms every 100m.

Secondly, until recently, it was very costly to produce maps in the British National Grid – so almost all surveys for private clients were drawn on local **'flat earth'** grids. Local grids are specifically designed to ensure that ground and map distances agree. This is common practice when the survey is for a small local area, and is used as the basis for design or setting-out. Due to the increasing use of technology such as GPS, it has become easier and cheaper to provide surveys in the British National Grid; and this is becoming more common.

If you don't understand the issue of scale-error and the role of the scale-factor you could face some serious difficulties. This could result in expensive and time-consuming mistakes such as incorrect boundaries or construction in the wrong place!

For impartial expert advice contact a Chartered Land Surveyor in your area by visiting **ricsfirms.com**

So, why don't we continue surveying using local grids?

Design and construction drawings are usually based on a **local grid system** aligned to the orientation of new construction works. This eases design and construction.

But it is awkward to determine an accurate orientation to grid north, and if the survey control points (that are vital for setting-out new construction works) are destroyed it can be difficult and an inaccurate process to re-install them.

It's also more difficult to relate the survey to other features relevant to the site – for example: utilities, neighbouring buildings and infrastructure. This is increasingly important, as the integration of data from different sources using geographical information technology becomes commonplace.

If the site is large (more than a kilometre or so), scale differences across the site may start to become a problem on a 'flat earth' grid.

So can we design a site on the National Grid?

Yes we could. Also, if we did, there would be advantages as the site would be directly related to its neighbours and local infrastructure, and would be orientated accurately to (grid) north. It would also:

- occupy a unique co-ordinated position in Great Britain
- be easier to revise and update, and
- be easier to re-establish survey control points if they were destroyed.

However, it would be more awkward to use in practice. You would have to continually take into account potential scale-factor distortions between design dimensions, setting out and final as-built surveys. Unless you are well-organised, it would be easy to make mistakes.