

Figure 1
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CLIENT GUIDE TO **SURVEY SPECIFICATION FOR THE PROVISION OF ARCHITECTURAL SERVICES**

THE SURVEY ASSOCIATION

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The Survey Association's Client Guides are primarily aimed at other professionals such as engineers, architects, planners and clients in general. They are not intended to go 'in depth' into practical issues but to act as a basic guide on a topic and in particular, on procedures and regulations which may govern how aspects of the survey are carried out.

Introduction

When requesting a site survey, it is important that a detailed scope for the work is identified at project tender stage. This should include the survey boundary, the level and accuracy of the detail required, the coordinate and level datum that the survey needs to relate to, and the key deliverables. This will help the survey company deliver the project to the required specification, with the correct level of detail and within the stated time frame and budget of the contract.

Outlining the key elements above assists both the Architect (or client) requesting the survey and the survey practitioner carrying out the works. The importance of a cohesive relationship between the client and the surveyor will only serve to improve the end results of the project. Talking through the requirements with the surveyor, and discussing the reasons why the survey is needed, assists the surveyor in providing advice on specific elements, when necessary.

Survey Extents

When stipulating the survey extents for architectural services, it is worth considering what surrounds the specific area of interest and if there is anything in the vicinity that might affect the project. This is particularly important with underground and overhead services. If there are potential visibility or rights of light issues it may be advisable to collect additional information about adjoining areas.

Scale

There are many misconceptions regarding scale and taking time to consider what is required from the survey can save a lot of problems later. Scale generally dictates the level of detail in a survey. For example, if a survey is requested at 1:500 scale, a small service cover, 300mm wide, would occupy less than 1mm on paper, if plotted at that scale, and would therefore only need to be surveyed using one point in the centre. If the survey was requested at 1:100 scale, the cover would be shown at 3mm wide when plotted, and therefore should be surveyed in full to show the correct size and orientation. The larger the scale required, the longer the survey will take on site.

Figure 2
3D Model of Airport Infrastructure



Survey Control – Grid System

With any type of geospatial survey (topographical, underground utility, measured building or 3D laser scan), it is important that the control coordinates are established at the start of the project.

There are 3 main grid systems:

- **Arbitrary Grid:** A grid system that is "local" to the area of interest whereby all data collected in the survey is spatially correct and is spatially related. However, it is not referenced to the National Grid, but placed in an arbitrary position. e.g. based around a site origin of 1000m E, 500m N and 10m El.
- **Local Site Grid:** Certain projects need to be tied into an existing "local" grid system. This may be due to a previous survey in the same location and the requirement for the two data sets to be common to each other. It may also be because a common site grid is controlled by the site owner and all contractors must adhere to it. In many cases the local site grid has been derived via GNSS (Global Navigation Satellite Systems) observations to provide National Grid coordinates and then transformed to a local site grid using a scale factor.
- **National Grid:** For surveys required to be on the National Grid, it suggests that the client will overlay the plan onto digital background mapping, generally relating to Ordnance Survey (OS) and the client should be made aware of the limitations of OS mapping. Coordinates on the National Grid are based on a Transverse Mercator Projection and are at Mean Sea Level. To derive National Grid Coordinates all site measured distances will need to be corrected by applying a factor to reduce the distance to Mean Sea Level and a second factor to account for the projection local scale factor.

These corrections may be significant over large areas or sites at higher altitude and the effect is that distances scaled or derived from coordinates will be different to distances measured directly on site.

A scale factor applies a distance correction to account for the curvature of the earth – particularly important over large sites. The resultant effect of applying a scale factor transforms a flat earth dimension to one that accounts for the curvature. The net effect is that the plotted measurements will be different to the ground measurements.

Survey Control – Level Datum

It is also important to understand the level datum required for the survey and there are generally 3 datums which can be stipulated:

- **Arbitrary Datum:** A level datum which is 'local' to the survey and is purely arbitrary. e.g. 100m
- **Site Datum:** As with the local site grid, the project could specify an existing site datum – either from a historical survey or where a specific feature has a set level. A point to note is that in some cases a local vertical shift would need to be applied. For example, in London a local vertical datum shift can be applied to avoid the underground network. Always seek advice from a Geospatial professional if you require support on whether a local vertical shift would need to be applied.
- **Ordnance Datum Newlyn (ODN):** Historically, Ordnance Survey Bench Marks (OSBMs) have been used to provide a level datum across the UK. These are located at regular intervals across the country and all tie back to one location – Newlyn in Cornwall. OSBMs are no longer maintained and can no longer be relied on to provide a consistent accuracy across the UK. GNSS observations are now the standard method of providing heights above mean sea level.

The extent of the survey control network is also of importance. For example, if a project dictates both topographical survey elements, as well as internal measured building survey elements, then it may well be that the topographical survey is required to be

of a level of accuracy of 1:500, while the measured building survey is required to be 1:100. As such the accuracy of the survey control on that site must accommodate the higher level of accuracy.

The RICS Professional Guidance Measured Surveys of Land, Buildings and Utilities, 3rd Edition provides a specification guide from which the project survey control can be based. When using this document, particular attention should be paid to the accuracy bands and what impact these have on the project. Seek guidance from a Geospatial Professional when referencing these accuracy bands to understand the commercial and programme impact.

Also, it is worth considering whether the associated measured building survey is required to be connected, semi-connected or unconnected, as the extents of the control network may be greater if a fully connected survey is required. For more detail see TSA Client Guide, Measured Building Surveys.

Underground Utilities

The higher the level of detail required in a survey, the higher the associated cost of the survey. As there are various levels of information which can be collected in underground utility tracing the client needs to specify what is appropriate to facilitate the completion of the design/ and or works. In general, the more invasive the technique, the higher the associated cost. A standard requirement may be that manhole or inspection cover locations, and pipes in and pipes out are shown on the topographical survey. The specification may extend beyond this, to also include electricity and/or gas network locations. Additional tools and methods may have to be deployed, at an associated cost, to accurately trace the electrical/gas services. The Publicly Available Standard (PAS); PAS128:2014 is a detailed specification guide giving advice and best practice when specifying surveys of this type. The introduction of PAS 256 aims to make organisations aware of good practice around the collection, recording, maintaining and sharing of information and data related to buried assets. It is recommended that these standards should be adopted when specifying the surveying of buried services on your project.

For more detail see the Further Information section of this guide.

Topographical Surveys

The most important initial consideration when specifying a topographical survey is the scale of the data to be reported.

Two important factors which have a direct relationship with scale are (1) the level of detail collected and (2) the accuracy of that data. Most medium sized surveys are normally captured at a scale of 1:200 or 1:500. Larger site surveys may well be captured at 1:1250 or even 1:2500. Features shown on a 1:2500 scale map or plan will have an associated accuracy of +/- 2.5m, whereas on a 1:200 map or plan the accuracy will be higher – in the region of +/- 60mm. Both plans are fit for purpose because they have been specified at a certain scale and the accuracy is a direct result of that defined scale.

The level of detail required must also be taken into account. If, for example the requirement is for the spacing of a grid of spot levels on a topographical survey to be at five metre intervals. then a scale of 1:200, needs to be specified. On a 1:500 survey the grid spacing will increase to ten metres.

The TSA Survey Specification for Architects references the type of features to be collected. It is important to specify the features required so that the correct data is presented in the defined deliverable. For example, it is standard to pick up kerb channels, but it may not be standard to collect the levels on the top of the kerb stone. Likewise, if trees are required on the survey, it is worth considering whether the diameter, the canopy extents and the height are needed, or if the diameter and canopy is sufficient. The species may also be relevant and whilst most surveyors will be able to identify the most common trees, the additional services of an arboriculturist may be required.

Measured Building Surveys

There are many component areas that make up a measured building survey and the key requested deliverables are discussed in turn below. As previously highlighted in earlier sections, one of the key considerations is scale as this will in turn influence the accuracy and the level of detail. The accompanying advisory specification document highlights the elements that may need to be included within the survey requirements.

- **Plans:** Plans can take the form of Floor Plans, Roof Plans and Reflected Ceiling Plans. A basic floor plan survey will include items such as the walls, and main features associated with those walls, like the window and door locations. The scale specified will determine if additional information associated with those features is included, such as door head heights and/or window sill and head heights. Most basic surveys will also include stairs, beams and sanitary ware as a minimum. Providing a clear and unambiguous specification ensures there is no room for doubt and all parties understand what is required. Most land surveyors will only show features that are visible. For example, in the case of a wall, the location and relative position within the measured space is shown, but it is unlikely that the composition of that wall will be recorded. (See BIM-ready Model section). Roof plans will show the pitch directions, chimney positions and any other features attached to the roof structure. Reflected ceiling plans are a little less common as part of a basic survey but will again adhere to the standard parameters as discussed above.

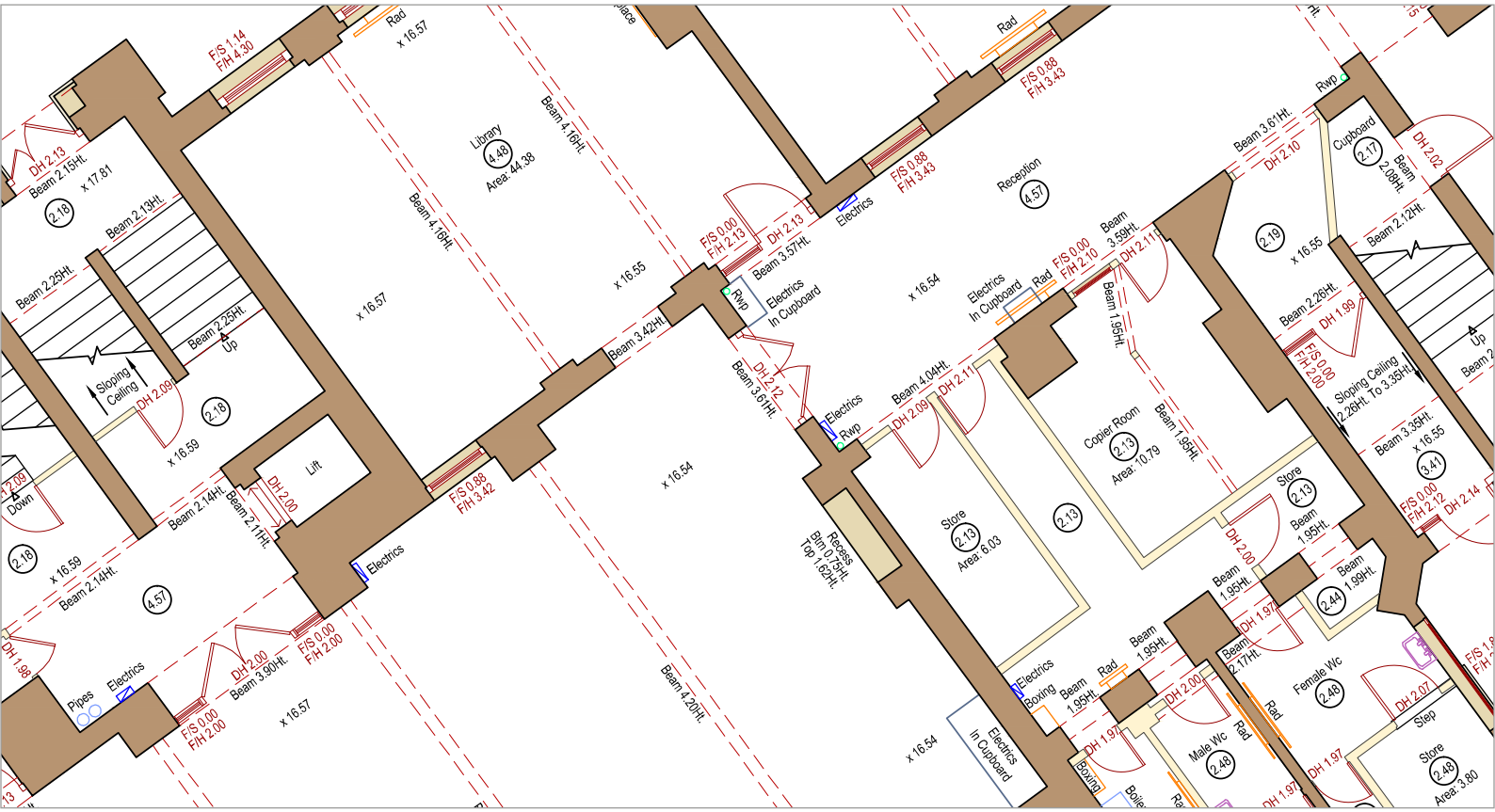


Figure 3
Sample 2D Floor Plan

- **Elevations:** The level of detail required may be dictated by scale. Broadly, there are two requested levels of detail (1) Only the main structure is captured – such as building lines, roof detail, window and door openings (2) As (1) but additional information relating to door and fenestration detail is shown. On larger scale drawings, e.g. 1:50 or 1:20 it may be requested that every stone or brick is recorded to provide condition report information.



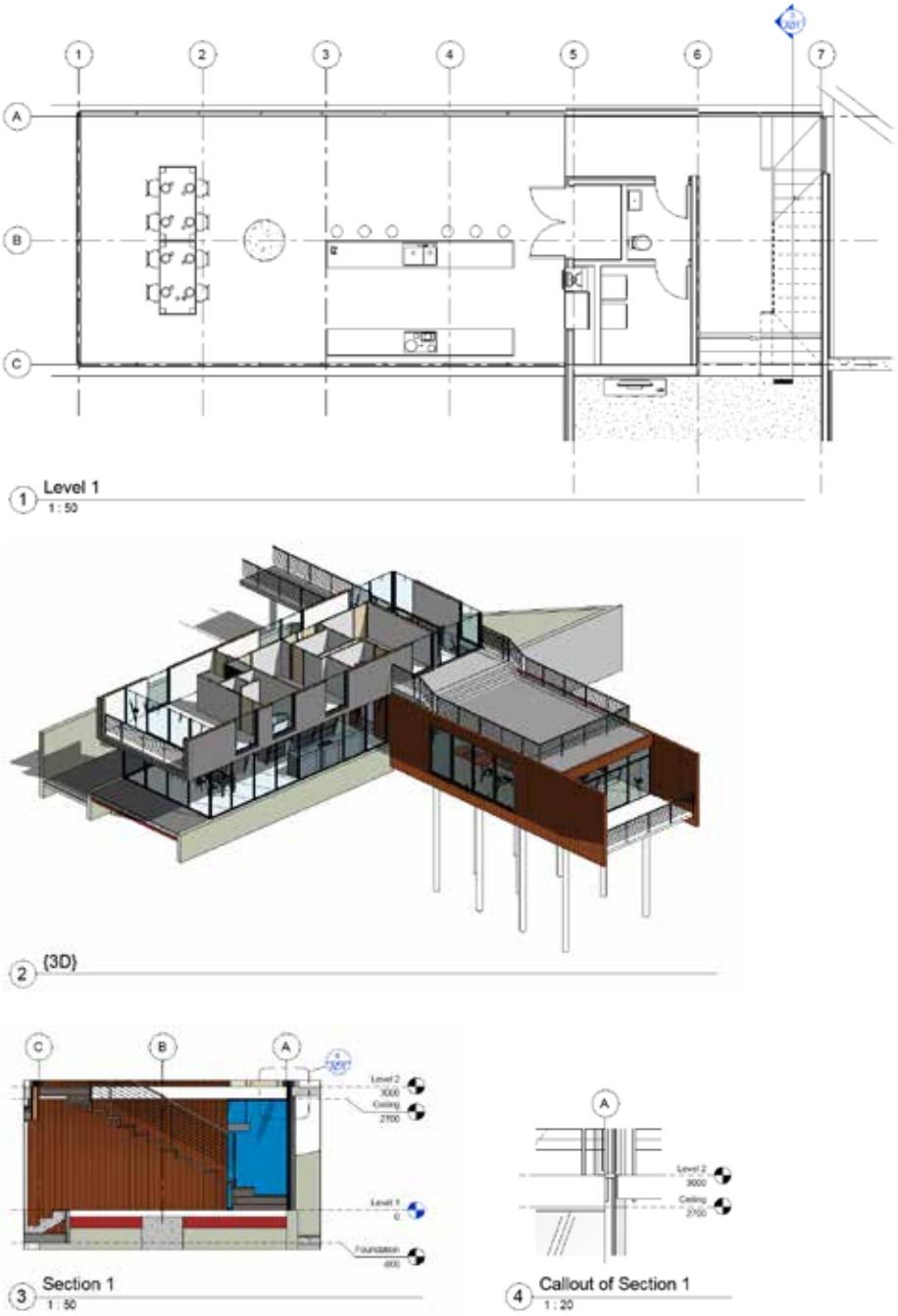
Figure 4
2D Elevation from 3D Model

- **Sections:** It is important that the location of the sections be defined before the data capture element of the survey is complete. The main structural elements of the section can normally be extracted from the elevation and floor plan information. If a large scale is specified e.g. 1:20 then additional information will need to be recorded, such as skirting board profiles. If data away from the immediate section is required to be shown, then the representation of data in the fore/background will need to be specified also.

- **3D Solid Model:** Due to enhanced data capture techniques, such as 3D laser scanning and UAVs, the ability to capture 3D data is becoming easier and also more cost-effective. As a result, a more popular request is for a full 3D solid model of the site. This may comprise both the topography and the building itself. A full 3D model will be potentially more complete than sections and plans, as the entire form of the building will be shown. Many of the points raised above, such as information in the fore/background along a section line, will be superfluous as that information will be contained within the model. Full detail may only be required in certain areas. Survey costs can therefore be controlled by specifying the appropriate level of detail in specific areas, rather than a blanket approach across the whole site.

- **BIM-ready Model:** A BIM model is a parametric model and contains representations of the actual elements used to construct a building, along with geometry, spatial relationships and properties of building components. Surveyors are most commonly involved with the measurement of existing buildings where many of these elements are not readily visible or accessible. These models will generally be derived directly from registered 3D Laser Scans using proprietary BIM authoring software. The existing BIM and design BIM often depict different elements e.g. a wall may be shown in the design BIM, including its make up with cavity and insulation details, but the existing BIM, although parametric, will show only the correct geometry. Similarly, a suspended ceiling will most commonly show a nominal thickness in the existing BIM, whereas the design BIM may show all the structural details of the ceiling above. Scoping and specifying an existing BIM requires careful consideration by clients and most surveyors capable of delivering these models will have developed their own BIM Specification to assist this process. This, in conjunction with the client's specification, will inform the requirements for the deliverables.

Figure 5
Typical Views from BIM



Deliverables

The vast majority of data is now delivered in a digital format for use by other practitioners. There is a variety of digital formats and it is always best to specify the exact format, any specific layering convention required, along with version revisions for the data. Costly conversions can be avoided by specifying the requirements at the outset.

It is also worth considering the future compatibility of the data, particularly on long running projects. Software manufacturers are continuously developing their packages and annual releases are typical. Many consumers operate on a subscription service, therefore users tend to be up to date on the latest release.

Paper plots of survey data are still considered by many as the only deliverable, but technological advances mean it is now easier to take digital data to and from the field, thus negating the need for paper copies, though they may be required as part of a project archive.

Data archiving and the amount of data associated with a project should be considered. Many survey professionals will not provide the captured raw data. In the case of laser scan data, the point cloud will be retained by the surveyor and they will simply provide the requested deliverable. If this data is to be provided, it needs to be specified as it will not normally be included, free of charge. Survey practitioners tend not to keep site data indefinitely so if the data might be needed in the future, it is worth specifying as part of the deliverables, or setting a time period for the data to be made available. This is particularly commonplace in the case of laser scan data as only small sections might be used at any one time.

Data in any format, be it paper or digital, will still have been captured at a specific scale that was fit for purpose when initially specified. 1:1 drawing is simply not achievable as the accuracy of the majority of survey instruments is at best 1-2mm.

Security of the data set should be a key consideration of any scope and brief and a recommendation would be to use PAS 1192-5, which specifies requirements for security-minded management of BIM and digital built environments.

Summary

It is important that surveyors and architects have a sound basis for the specification and procurement of digital data to be used in architectural services.

It is clearly stated in the RIBA Plan of Works (Stage 1 – Preparation and Brief) that architects will have made the essential appointments for the design phase of the project, whether the team will eventually be just the architect and a builder, or a multidisciplinary team with architects, engineers, surveyors, contractors and sub-contractors.

The process of commissioning and successfully completing an architectural survey is straightforward if the guidelines above are followed. One key element is to use a survey company that has experience with this type of work, and this will ensure that survey data and deliverables contain everything needed to complete the overall design.

Further Information

For more information, please refer to the following supplementary documentation:

RICS Professional Guidance Measured Surveys of Land, Buildings and Utilities, 3rd Edition RICS Professional Guidance – Rights of Light, 2nd Edition

SURVEY4BIM – https://survey4bim.wordpress.com/

The Survey Association – Client Guide to Measured Building Surveys

The Survey Association – Client Guide to Topographical Surveys

The Survey Association – The Essential Guide to Utility Surveys Using PAS128:2014 Specification for Underground Utility Detection, Verification and Location

The Survey Association – Client Guide to Utility Surveys Using PAS128:2014 Specification for Underground Utility Detection, Verification and Location

Ordnance Survey – https://www.ordnancesurvey.co.uk/resources/maps-and-geographic-resources/the-national-grid.html

CICES Digital Plan of Works – https://www.cices.org/content/uploads/2013/05/Survey-and-the-Digital-Plan-of-Works.pdf

The Survey Association

Formed in 1979 as The UK Land and Hydrographic Association, TSA is now established as the representative organisation for UK private surveying firms. The Association's aims are:

- To provide a vehicle for members to act effectively together on agreed courses of action
- To promote the interests of the profession to all those who determine the economic and social conditions in which the industry operates
- To identify and represent the views of the industry.

Using a TSA member

By using a TSA member you can be assured that your project will get off to the best possible start. Whatever the size of project, you can be certain that TSA member companies are expert in the provision and management of spatially related data on which to base your concept, design and construction.

Professional attention from a TSA surveyor will reduce risk, repetition, possibly save you money and will ensure that your project receives the best possible attention.

TSA Contact Details

If you would like any more information about the TSA or its members or about other Information leaflets then please contact TSA at:

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Glossary – words, terms and acronyms

TERM	EXPLANATION
Control network	A control network is the framework of survey stations whose coordinates (typically vertical and horizontal) have been precisely determined and are often considered definitive.
Survey control	The physical markers or point features of known coordinates, often referred to as permanent ground markers or PGMs. Survey control is typically made up of a number of points observed along interconnected baselines. They are used for setting out or mapping all other features to the established grid. Survey control is generally classified as primary, secondary or tertiary depending on its importance in defining a grid and/or its accuracy for use in surveying or setting out.
Arbitrary Grid	A reference system developed when there is no grid available with known positions.
Local Grid	A survey grid chosen for the size of site with relatively small numbers and usually a scale factor of exactly 1.
National Grid	The map reference system used to identify the position of any feature on an Ordnance Survey map.
Transverse Mercator projection	An adaptation of the standard Mercator projection where the regular Mercator projection is transversed (rotated) 90° in azimuth. Used in the UK mapping system UTM (Universal Transverse Mercator) projection is paired with a reliable geodetic datum providing high accuracy in zones less than a few degrees in east and west extent.
Map Scale	The relationship between distance on a map and the corresponding distance on the ground. Often displayed as a ratio.
Scale factor	A scale factor is created by using a map projection to represent the curved earth on a flat piece of paper. These are often applied to surveys utilising National Grid co-ordinates.

Level datum	A surface to which elevations, heights or depths on a map or chart are related.
Arbitrary datum	A point whose coordinate and direction are not known. Has an agreed value.

SITE DATUM

ODN	Ordnance Datum (Newlyn). Defined as the vertical datum for the National grid.
OSBM	Ordnance Survey Bench marks (OSBMs) are survey marks made by Ordnance Survey to record height above Ordnance Datum.
GNSS	Global Navigation Satellite System is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. Examples are GPS, GLONASS, Galileo and Beidou.
RICS	The Royal Institution of Chartered Surveyors is a professional body promoting and enforcing the highest international standards in the valuation, management and development of land, real estate, construction and infrastructure.

CONNECTED, SEMI-CONNECTED, UNCONNECTED BUILDING SURVEY

Fully connected building survey	All floors are instrumentally related to a common survey control framework for maximum accuracy and ensuring vertical relationship between floors.
Semi connected building survey	One floor (usually ground floor) is instrumentally related to a common survey control framework and other floors are related using common detail such as the outside building line and stairwells.
Unconnected building survey	Does not allow one part of a building to be related to another area. In general, these simple plans are suitable for building layout plans, area calculations, space planning, lease plans, fire escape route plans, etc
PAS	Publicly Available Specification is a standardisation document that closely resembles a formal standard in structure and format, but which has a different development model.
PAS 128:2014	The British Standards Institution (BSI), Publicly Available Specification for underground utility detection, verification and location (128). Released in the year 2014, Ensuring accurate information is recorded regarding the location of underground utilities to a consistent standard.
PAS 256	The British Standards Institution (BSI), Publicly Available Specification for Buried assets. This PAS provides recommendations for capturing, recording and maintaining information about these assets, as well as the timely sharing of this information in a commercially-sensitive and security-minded way.

BIM *(Wiki Definition)*	Building information modelling (BIM) is a process involving the generation and management of digital representations of physical and functional characteristics of places. Building information models (BIMs) are files (often but not always in proprietary formats and containing proprietary data) which can be exchanged or networked to support decision-making about a place.
BIM *(AutoDesk/ Geospatialworld.net Definition)*	BIM (Building Information Modelling) is an intelligent 3D model-based process that gives architecture, engineering, and construction (AEC) professionals the insight and tools to more efficiently plan, design, construct, and manage buildings and infrastructure.
BIM – ready models	A 'BIM-Ready model' is a 3D building model containing embedded parametric detail. The amount of detail will generally be dictated by the survey specification and can range from a simple mass model of the building [LOD1] to a highly detailed survey model containing well defined architectural and structural elements [LOD4]. Because of the embedded detail care must be taken when exporting and sharing the data files of 'BIM-ready models' as some file formats will not preserve the entirety of embedded information.
BIM specification	A set of standards to streamline and ensure BIM projects are successfully completed in the most efficient and professional manner.
UAVs	Unmanned Aerial Vehicles, often referred to as SUAs (Small Unmanned Aircraft) or Drones.

Document Revision History

Issue 1	August 2019	Original document