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Module:	Digital Surveying and Highway Design
Module Code:	ACBA4017
Submission Date:	23/07/2026
Assignment Title:	Building Survey

Contents

1. Planning the Survey	
Introduction	page 3
Purpose of the Survey	page 3
Survey Area	page 4
Site Assessment	page 4-5
Risk Assessment.....	page 5
2. Practical	pages 6-8
Appendix 1 – Site Survey Images.....	pages 7-8
3. Measurement and Analysis	page 9
4. Reference List.....	page 12

Planning the Survey

Introduction

This survey plan outlines the methodology and preparation needed to undertake a manual and digital survey of a section of the first-floor communal area within the UWTSD IQ Building, SA1. The surveying project will focus on practical application of modern surveying methods and technologies. We will be comparing the traditional method of manual measuring using tape measure and handheld laser measurer, to digital data capture using a Lecia BLK2GO handheld laser scanner (*Blk2go support | leica geosystems. 92025*). The data collected from the laser scanner will be processed into a point cloud, enabling us to extract the building and area dimensions and compare them to our manually recorded results.

Planning the survey effectively, is critical to ensuring that the survey data is accurate, reliable and collected safely. The survey plan considers the purpose of the survey, extent of the survey, site logistics and equipment requirements as well as outlining any potential health and safety concerns.

Purpose of the Survey

The purpose of this survey is to capture the internal dimensions of a designated section of the first-floor communal area within the IQ building. The aim is to produce an accurate representation of the internal layout through both traditional measurement and modern laser scanning technology.

The manual survey involves measuring the structural and permanent features of the area using steel tape measures and handheld laser distance meters. Our measurements have included wall lengths, column dimensions, door openings, and radiators and other permanent fixtures. We have not considered ceiling height for the purpose of the survey.

The 2nd phase of the survey will be undertaken using a Lecia BLK2GO handheld laser scanner, capturing the data and measurements from the exact same area. The scanner samples and records millions of individual measurements to pre-determined set millimetre spacing. Using these measurements the scanner creates a three-dimensional image of the measured environment. The point cloud data then gets processed using specialist software to extract the measurements and dimensions, which we will use to compare against our manually captured data.

The survey provides us with an opportunity to assess the advantages and disadvantages of the traditional surveying methods compared to the digital technology.

Survey Area Definition

Our survey is confined to a pre-determined section of the first-floor communal area within the IQ building at Swansea SA1. The area to be surveyed includes:

- Internal walls
- Door Openings/widths
- Permanent fixtures and fittings, specifically to walls.
- Structural columns

All movable furniture, equipment and people are not considered permanent objects for the survey and are not considered when taking our manual measurements. Some of these items may end up being captured when undertaking the laser scanning where this cannot be avoided, however we will take this into consideration when processing the point cloud data processing and remove these readings where necessary.

The level of detail required should be sufficient to accurately plot the measurements against a floor plan provided. Details such as ceiling height, lighting fixtures, and other electrical fittings are deemed out of scope for this exercise and are not considered.

The manual survey should hopefully achieve measurements accurate enough for standard basic internal building surveys, where as the BLK20 scanner will capture the entire space from top to bottom, capturing reliable data for us to extract for comparison.

Site Assessment

Prior to starting the survey, a site assessment will be undertaken to ensure everyone is familiar with the area and to identify any potential issues that may arise.

Access to the survey is via the main entrance to the building and up to the first floor. There are no further areas requiring additional permission to access all areas of the survey. All full-time students are currently on leave, therefore foot traffic to the communal areas should be minimal, there should be no interference to normal university proceedings.

For the manual survey, handheld laser distance measurers will be used where longer or inaccessible measurements are required, and tape measures will be utilised for the shorter dimensions.

The laser scanning requires a slow continuous movement throughout the survey area ensuring simultaneous localisation and mapping (SLAM). (*What is SLAM? 2025*)

The operator of the scanner should follow a planned route which covers all areas of the entire communal area, avoiding any sudden or sharp movements. The operator will be required to overlap in sections, and this should assist determining as accurate measurements as possible when breaking down the cloud point data.

The lighting conditions in the area of the survey are deemed adequate given the survey is being undertaken mid-morning, there will be natural daylight via windows, as well as artificial lighting overhead. The lighting itself should not affect the laser scanning, but enable the operator when walking the route, as well as the team in taking the manual measurements.

Windows and other large reflective surfaces can impact the scan and reduce scan quality by providing incomplete data. Given glass is transparent, the laser beams may pass through the surface or reflect unpredictably, and as a result the scanner may capture points beyond the glass or surface or generate incomplete point cloud data. (*PointSCAN. 2024*).

Risk Assessment Summary

The survey will be undertaken within an occupied university building, posing several operational risks. Even though the full-time students are currently on leave, there will still be a number of public and staff operating within the area. The risk will be mitigated by maintaining awareness of any pedestrian movement within the vicinity. The laser and manual measuring will be undertaken in teams so multiple sets of eyes all operating in the same area.

Slips trips and falls is another factor to consider. All bags and equipment will be stored away in a separate room apart from when in use. Measuring tapes to be retracted when not in use.

Potential falls from height, given the works are being undertaken on the first floor, part of the survey spans across an elevated walkway across the top of a set of stairs. Extra care to be taken when measuring these areas. Measuring may involve leaning over or holding equipment over a barrier with a large drop down to the ground floor pedestrian areas. All laser measures and tape measures to use wrist straps if possible and measurements recorded on paper on local tables in the area.

Manual handling risks associated with transporting the survey equipment are low. The BLK2GO scanner and tablet devices are relatively light weight and will not be used a particularly long duration. However, during the scanning, the operator will be focused on the scanner rather than navigation of the area. To minimise the risk, the scanning route will be planned and the remaining members of the team involved can act as banksman to warn of any other potential hazards.

Practical

The on-site survey was successfully completed within the designated communal area on the first floor of the IQ Building SA1. The survey comprised of two survey methods. A traditional survey using tape measures and handheld laser distance meters, followed by a digital survey using a Leica BLK2GO handheld laser scanner. See images in appendix 1 below to evidence the area of the survey undertaken.

The survey generally proceeded as planned, with all necessary equipment available prior to the commencement. The survey team were provided with tape measures, handheld laser distance meters, pencils and paper, rulers, and of course the BLK2Go Laser scanner. The manual survey involved recording the dimensions of the walls, columns, door openings, and other permanent fixtures, where as the laser scanner captured all of the same data as well as producing a 3D point cloud.

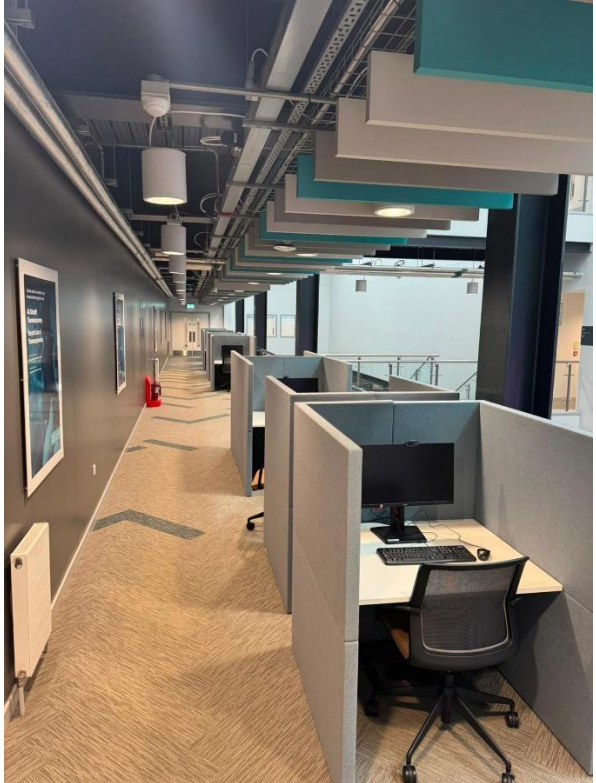
There was one significant last minute change that affected the survey. The original location for the survey had been scheduled to take place at the Dylan Thomas Centre in Swansea, which is a much older building without adequate air conditioning. Due to a red weather warning, the location was changed at short notice to the IQ building. This much newer university building provided a much more suitable environment given the air conditioning, reducing potential impact of the extreme temperatures on the personnel as well as the effect it may have on the equipment and laser scanners.

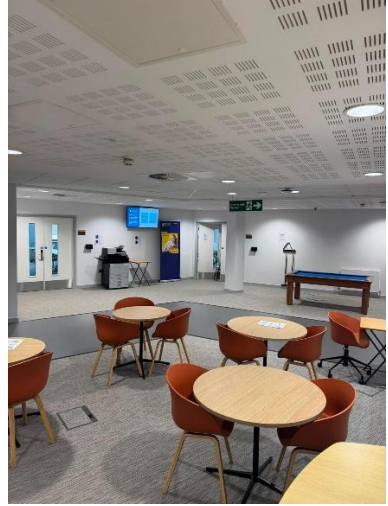
Even though the first floor was noticeably warmer than at ground floor levels, it was significantly cooler than the upper most levels and gave us suitable conditions to undertake the survey. There was ample drinking water available in multiple areas and air-conditioned spaces to take any breaks if required.

Towards the end of the scan, the handheld laser scanner began to sound an audible warning due to becoming excessively warm. The prolonged usage by multiple survey teams combined with the unusually high temperatures likely caused the issue. Fortunately, most of the scan had already been completed, and this did not result in a loss of any data, and the scan was fully completed successfully.

Overall, the survey showed us the importance of flexibility when undertaking real world building surveys. Given the unexpected extreme weather conditions and the equipment related malfunction, with minor adjustments to the original plan, sufficient risk management and teamwork, we ensured that the survey objectives were met and the manual and digital survey data were collected as accurately as possible.

Appendix 1 – Site Survey Images

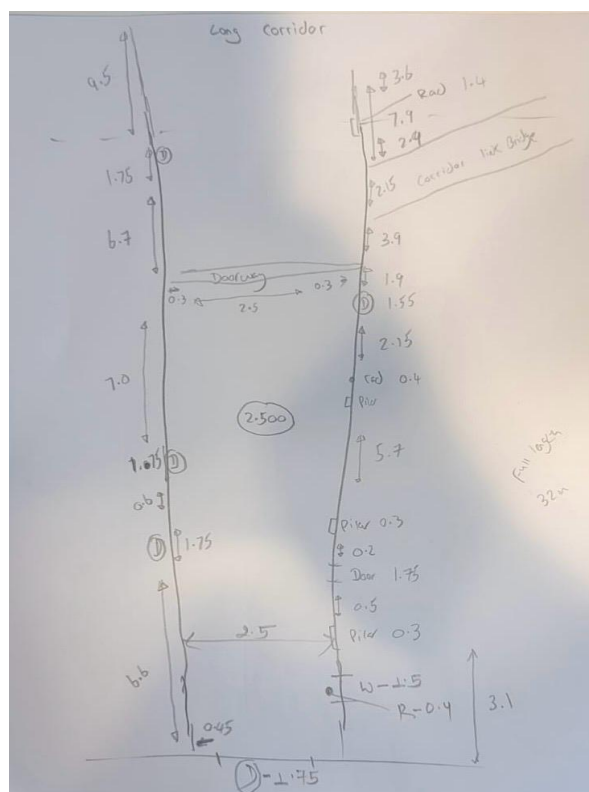
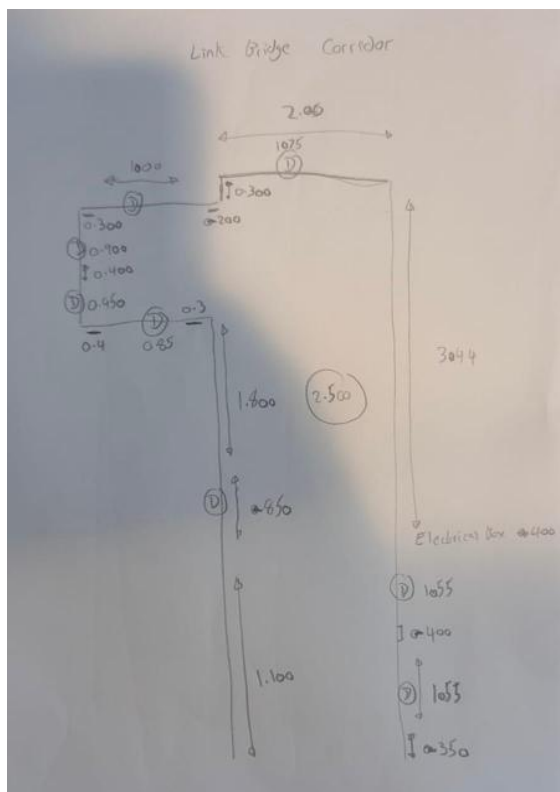
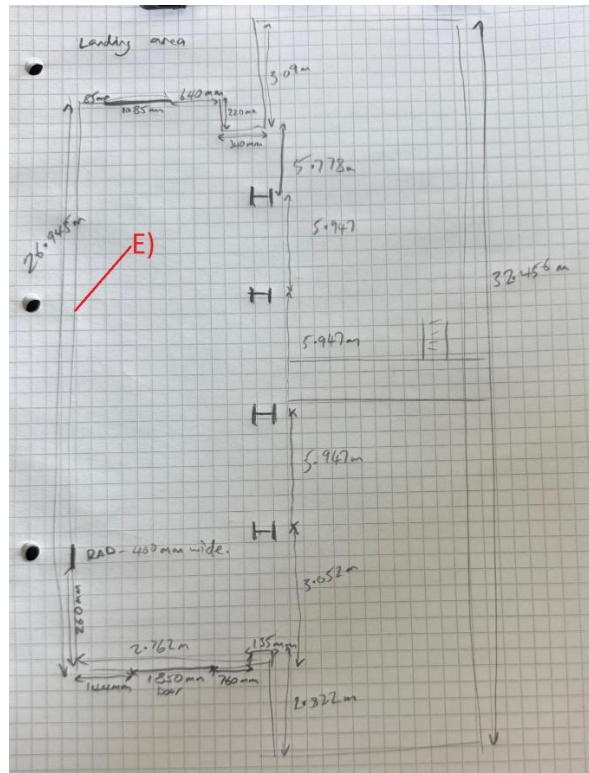
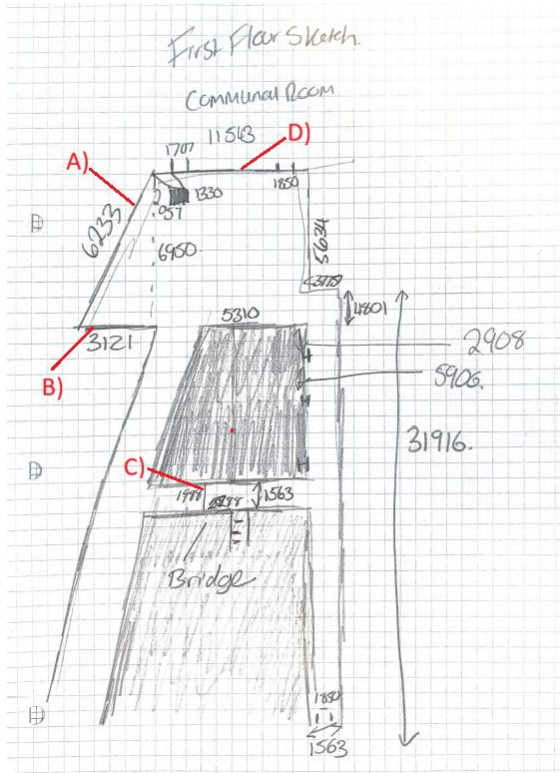




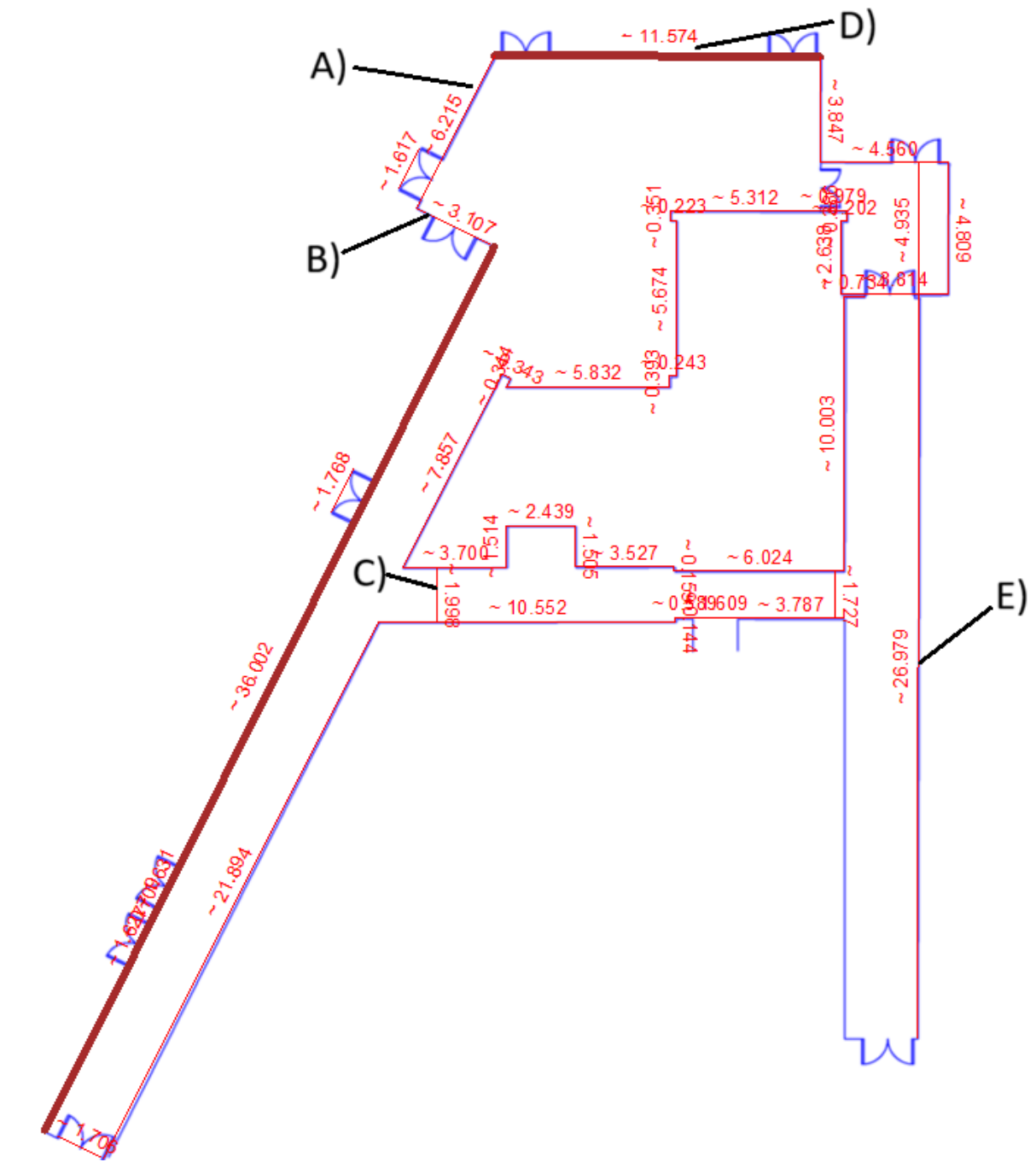
Measurement and Analysis

Please see below images including the laser scanner dimensions annotated to the floor plans, and some hand sketches from the manual measurement undertaken.

Manual Measurement



Laser Scanner Measurement



The annotated floor plans above show the results of the 3D laser scan of the same area. To compare the two surveying methods, I have selected five sample measurements labelled A-E, from different areas of the survey. These measurements were taken manually using a tape measure and laser distance meter and the differences are shown in the table below.

Sample	Laser Measurement (m)	Manual Measurement (m)	Discrepancy (mm)
A	6.215	6.233	0.018
B	3.107	3.121	0.014
C	1.998	1.988	-0.01
D	11.574	11.543	-0.031
E	26.979	26.945	-0.034

As you can see from the results of these samples, the discrepancy between the laser scans and our manual measurements is minimal, just a couple of mm variance across all samples. These small differences would be considered acceptable for most measured building surveys. They show us that both techniques can produce reliable information when undertaken correctly. The door openings and door leaf dimensions did not vary as they are manufactured to set dimensions and installed in prefabricated door frames. The laser scan results provided did not capture fixtures and fittings such as radiators, columns etc. so we could not compare those effectively.

As expected, the shorter measurements produced the smallest discrepancies, as there is reduced chance of error. The longer measurements show slightly more variance although, still only display marginal differences. This is likely to be caused by many factors, including inaccuracies placing the tape measure and keeping them straight over longer distances, reading the tape measure or laser measure incorrectly, aligning the laser meter in the precise location for the laser to hit the desired surface, even manually recording the measurements incorrectly.

The biggest advantage of the 3D laser scanning is the speed at which the data is collected, capturing millions of measurements points during, and creating a highly detailed digital scan of the area. After completion of the survey, all dimensions can be extracted using the relevant software, without any need to return to site to obtain further information and measurements. This is incredibly useful if you were to require further information at a later stage.

Traditional measurement is far more time consuming. A surveyor would require physical access to all areas to obtain the dimensions, whilst simultaneously recording all measurements by hand and produce sketches, which could later be converted into drawings. This process is far more likely to produce errors and if any measurements are missed, there will be a requirement to return to site, arrange access etc. which may be problematic.

Despite the numerous advantages of the laser scanning, the system is not without errors sometimes. The accuracy of the result depends on multiple factors. Correct survey planning, sufficient overlap of the scan positions, and errors in post processing of the cloud point data. Reflective surfaces and glazing as mentioned earlier, and unseen areas or recesses hidden from the lasers line of sight can also produce incomplete or inaccurate cloud point data, meaning further measurements and visits may end up being required.

Laser scanning equipment and the software required to process the data also come at a significant cost compared to what is required for the traditional surveying method, it would also require specialist training to understand and use the equipment correctly and efficiently.

Overall, both methods produced comparable results within the surveys. However, given the considerable reduction in survey time, the comprehensive level of data obtained, and the ability to revisit and tweak the digital image at any point in time, the 3D laser scanning provides far more advantages over the traditional measurement for most modern surveys, especially for larger more complex buildings. Manual measurement remains a valid technique especially for hidden or concealed areas where a laser scanner cannot reliably capture the information.

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