Guidance Note
As-Built Survey Reporting

Purpose

This guidance note details the minimum expectations for as-built survey reporting to enable members of CICES to produce a standard deliverable. This document can assist clients when specifying the requirements for as-built deliverables on construction contracts. The aim is to produce a base level which can apply across all industries rather than be a sector specific guide.

The note is split into the following sections:

- Why do as-built survey reporting?
- The as-built survey process
- Main report body
- Appendices and attachments
- Relevant standards
- Acronyms
- Associated CICES guidance
- Appendix A – Example template of progressive as-built survey

Why do as-built survey reporting?

A common response to a request for as-built records is that the asset has been installed to design, within the specified tolerance, and the BIM model can be used as the as-built record. This assumes that the BIM model is fully up to date and has captured all changes raised by site teams since the design was approved for construction. This may not be the case and what is built does not reflect what was designed. Accurate as-built survey records are essential to document what is installed and often a lack of them becomes a risk to later stages of construction and maintenance.

The as-built survey process

The general approach to as-built survey validation is the use of appropriate survey techniques to verify the constructed asset meets the design, to within the specified construction tolerance. The survey technique selected should be more accurate than the construction tolerance of the feature being verified. Examples may include:

- GNSS RTK check on a fence line or installed utilities
- UAV photogrammetry for coarse earthworks cut and fill
- Mobile mapping for highway alignment and street furniture
- Laser scanning for alignment surveys of tunnels
- Track measuring devices for rail alignment
- Total station, for a variety of dimensional observations relative to the design.

The as-built survey activities may be progressive, occurring as an ongoing activity during construction, or a final activity, or both. Progressive checks are critical for any infrastructure or services which will be buried or covered during the process of construction, such as underground utilities or structure foundations. If such activities are not undertaken at the appropriate time, significant costs may be incurred.

As-built survey can be particularly critical on any product or structure where coarse adjustments cannot be implemented, and only fine adjustments remain. This is to ensure that the construction element is fit for use in the next stage. For example, to prove a bridge deck meets the required design tolerance for a subsequent rail or highway installation.

The survey techniques used should be appropriate to the task, in order to fully capture the required dimensions including in absolute space (i.e. position within the coordinate system), in relative dimension (for example size or distance from another object), and the deviations from the design. Survey accuracy is therefore critical and should be sufficient that the construction tolerances can be proven. Furthermore, to ensure a robust assessment, results should present the maximum deviation between the design and the constructed element.

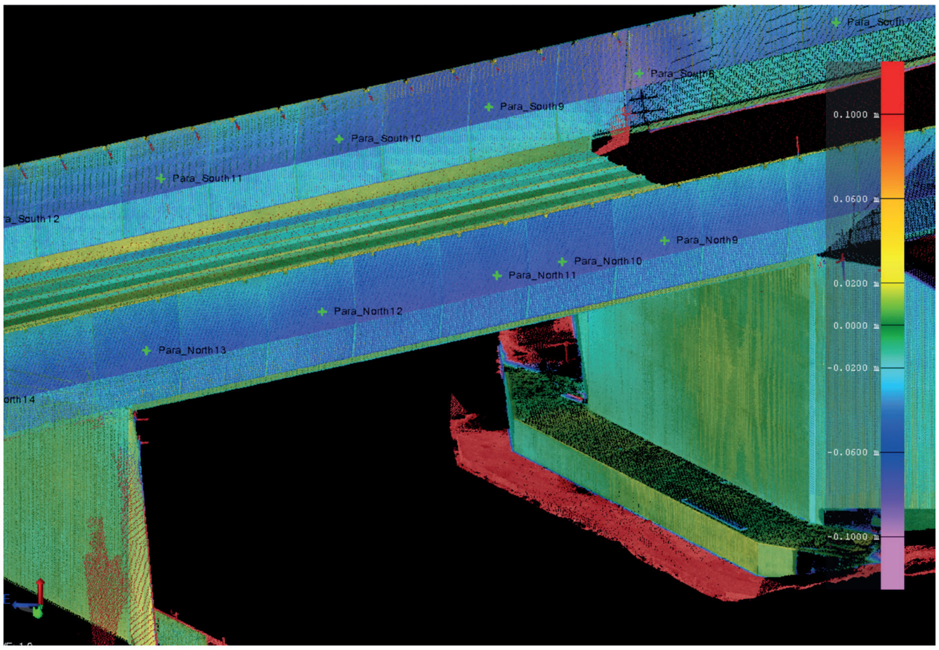

Figure 1 – Example: plot of deviations from design by comparison against a laser scan point cloud.

Survey control is a system of markers used to provide a positional framework for the dimensional control of construction projects. Without a system of survey control, that is appropriate to the works, the as-built process may have inadequate spatial links to the design. Consequently, the as-built process should be based upon an agreed and documented survey control system.

The as-built survey report should be a standard deliverable that provides evidence supporting quality, enabling issues to be escalated as needed, and also providing information to support later stages of construction and maintenance. The implementation of standardised and rigorous reporting procedures for progressive as-built evidence, from the project outset, will mitigate project risk (for example by reducing setting-out errors).

Survey records, such as instrument log files for setting-out and as-built, should always be rigorously retained and stored during and after the works. Even if not part of the final deliverables, such records and evidence form an audit trail of the work undertaken.

This guidance note is intended to provide a minimum level of expected evidence of survey records for as-built verification. It can be adapted to requirements as needed. Procedures for activities such as resolved non-compliances, technical queries, or updating design models, are not covered in this document.

Main report body

The as-built survey report should include as a minimum:

- Front sheet including:
    - Company details
    - Project
    - Name, location and structure number of as-built survey
    - Document number and report date
    - Prepared by/Checked by/Approved by
- List of applicable standards/specifications/plans (e.g. ITP)
- Design references, AFC design drawing number
- Asset name/element identifier
- Construction tolerance(s)

- Personnel
- List of all equipment used and link to the calibration certificates in appendix
- Date and times of observations including periods of site works
- Environmental observations such as temperature, pressure
- Survey control used (may be a reference to a control schedule and revision number)
- Set-up position quality (such as resection quality, and before and after check points)
- Table of deviations between design and construction (including minimum/maximum values)
- Graphical plots of deviations where applicable
- Reference to marked up CAD/BIM/GIS outputs as required
- Site notes/commentary
- Tolerance assessment (including non-compliance reference where relevant)

The report should be understandable and clear to all stakeholders.

Appendices and attachments

Appendices may include the following:

- Calibration certificates for all equipment, service reports from recognised instrument supplier, and check and adjust records for all equipment used
- Survey data e.g. point cloud or CAD format data
- Survey control listing/schedule
- Site sketch (where applicable) and/or tabulated photographs
- Instrument log file(s)

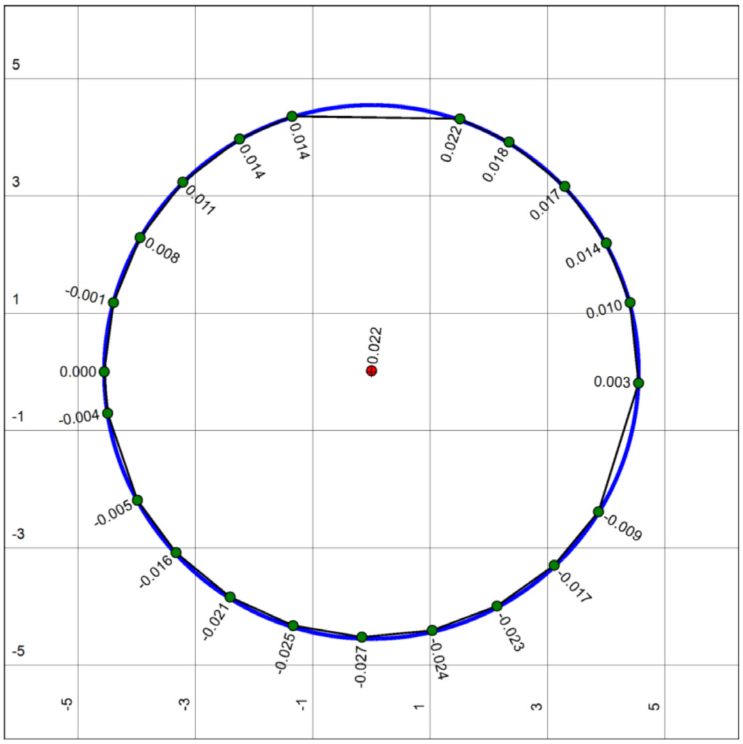

Figure 2 – Example: as-built deviation of a tunnel section.

Relevant standards

- UK Highways – GG951
- UK HS2 - Railway Survey Standard HS2-HS2-GL-STD-000-000001
- UK Network Rail - NR/L2/TRK/3100
- UK RICS - Measured surveys of land, buildings and utilities

Acronyms

AFC	Approved for Construction
BIM	Building Information Modelling
CAD	Computer Aided Design
CICES	Chartered Institution of Civil Engineering Surveyors
GIS	Geographical Information Systems
GNSS	Global Navigation Satellite Systems
ITP	Inspection and Test Plan
PGM	Permanent Ground Marker
RTK	Realtime Kinematic
UAV	Uncrewed Aerial Vehicle

Associated CICES guidance

- Guidance Note Survey Control Reports

Appendix A – Example template of progressive as-built survey

As-built survey report		Org logo	
Report Number			
Project and Asset Information		**Survey Information**	
Project		Survey Date/Time	
Asset Name		Surveyor Name(s)	
Asset ID		Instrument Type	
Design Ref		Serial Number	
ITP Ref		Control Schedule	
		Instrument Log File	

Survey control set-up (e.g. check shots and resection residuals)

Station	Deviation Easting	Deviation Northing	Deviation Height	Quality Pass/Fail
CHK01				
PGM01				
PGM02				
PGM03				
CHK02				

Station diagram and location sketch

Construction tolerances

Horizontal		Vertical	

As-built deviations

PID	Design Values			Survey Values			Deviations		
	E	N	H	E	N	H	dE	dN	dH

As-built deviation summary

Maximum deviation (2D vector)	
Maximum deviation (Height)	

As-built deviation plan	
Summary	
Notes:	Tolerance assessment: Noncompliance reference:
Signed: Role: Date:	Signed: Role: Date:

This guide has been produced by the Geospatial Engineering Practices Committee of the Chartered Institution of Civil Engineering Surveyors

Endorsed by

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