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Code of practice for the management of geotechnical data for ground engineering projects

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Contents

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Foreword

Publishing information

This British Standard is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 March 2014. It was prepared by Subcommittee B/526/3, *Site investigation and ground testing*. A list of organizations represented on this committee can be obtained on request to its secretary.

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As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its recommendations are expressed in sentences in which the principal auxiliary verb is "should".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

The word "should" is used to express recommendations of this standard. The word "may" is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word "can" is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

Introduction

Each ground engineering project requires the collection of data from different sources and in a range of formats. The collected data are processed and transferred throughout the supply chain to be used by a variety of people and organizations.

The management and delivery of these data needs to be defined and maintained throughout each project, integrating the requirements set out in the project specification together with the objectives of those who produce and those who use the data. This can be achieved by the introduction of a data management system based on an organization's data management policy, which is covered in this standard.

A data management system is applicable to geotechnical and environmental investigations, construction projects with activities such as piling, earthworks and tunnelling, monitoring and asset management.

The procedures described in this standard facilitate the management of geotechnical data for use in a BIM project in accordance with PAS 1192.

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1 Scope

This British Standard gives recommendations on the management of geotechnical data throughout the life cycle of civil engineering and building projects at both an organizational and project level.

It also gives recommendations on the collection, storage, archiving, sharing and transfer of logical data.

This British Standard is intended for engineering geologists, geotechnical and environmental engineers, geotechnical data managers, IT managers and project managers.

2 Terms and definitions

For the purposes of this British Standard, the following terms and definitions apply.

2.1 data manager
person responsible for the data management system

2.2 data management plan
method of stating the requirements for maintaining, performing or improving data management at an operational level

2.3 data steward
person responsible for carrying out the processes needed for the data management system

2.4 data store
repository of project data

NOTE An example of a data store is a computer database.

2.5 geotechnical data
facts or figures obtained from all phases of a geotechnical project, including derivations from other data

NOTE Facts and figures might include text, numbers and formulae.

2.6 logical data
data connected by location and/or time and not the representation or the evaluation of those data

2.7 organization
company and/or project team

2.8 validation
control technique used to detect data that are in the correct format and within acceptable limits

2.9 verification
act of checking transferred data, usually at the stage of input to a computer system, by comparing copies of the data before and after transfer

3 Data management principles

3.1 General

The geotechnical data management principles given in **3.2** to **3.7** should be implemented at the start of a project.

NOTE Further details on each principle are given in Annex A.

3.2 Data collection

Data should be collected at source, entered once and retained electronically, e.g. in a computer system. New data should be checked against collected data to ensure quality and compatibility. The time of the collection and transfer of data should be stated in the data management plan (**4.5**).

How and where the data are entered into the computer system should be stated in the data management plan.

If it is not possible to log data electronically at the source of collection, the data should be recorded manually in a paper-based format only once and then entered into a computer system.

3.3 Data storage

3.3.1 General

Data should be stored securely, backed-up and access carefully controlled.

3.3.2 Security

The data store should have controlled access, be regularly backed-up and have a disaster recovery plan.

The management of the store should define and incorporate user rights (i.e. writing, reading and editing). Data should be safeguarded from unauthorized access.

3.3.3 Version control

There should be a record of additions and changes to the data and each revision issued should be sequentially referenced and archived.

3.3.4 Consistency

Where data are stored in multiple systems or locations, such as field collection, laboratory and engineering, it should be consistent.

3.3.5 Status

The status of the data should be recorded (**A.2.2.4**).

3.4 Data archiving, retention and disposal

The requirements for data archiving, retention and disposal should be identified and documented in the data management plan. Archived data should be stored to ensure long-term readability.

NOTE Long-term readability might be achieved using non-proprietary or open standard formats.

3.5 Sharing and transferring data

To ensure the availability and widest use of geotechnical data, the following should be taken into account:

a) within the context of an organization: industry-standard exchange formats should be implemented;

*NOTE Details on industry-standard exchange formats are given in **A.2.4**.*

b) within the context of a project: strategies for data sharing and transfer should be agreed at the onset;

c) delivery timescales should be agreed at the start of a project;

d) the data receiver should be briefed on how the data have been evaluated and for what purpose; and

e) permission should be sought from the owner for the use of data by third parties, after an agreed confidentiality period.

3.6 Unique referencing of data

To avoid data duplication, each record should be identifiable using a unique reference.

NOTE A unique reference can be a combination of attributes, e.g. location and sample depth and sample type or pile reference and test number.

3.7 Data verification and validation

There should be repeatable methods of data verification and validation that are traceable and auditable.

Data verification and validation should be performed at input and export of data into a computer system and as required by the data management plan.

4 Data management system

4.1 General

A data management policy should be implemented using a data management system. The data management system should consist of a policy (**4.2**), strategy (**4.3**), manual (**4.4**) and plans (**4.5**).

4.2 Data management policy

An organization's management should authorize a data management policy. The scope of the policy should be appropriate to the nature and scale of the organization.

The policy should be clear in its aims, scope and responsibilities, and should include a commitment to continual improvement in data management. The policy should be reviewed on a regular basis and when significant changes occur in the organization's structure.

The policy should be compatible with other organizational policies, for example quality and IT policies.

NOTE The purpose of the policy is to provide a framework for managing data by setting data management objectives within the organization.

4.3 Data management strategy

The strategy should set out the goals and timescales of the organization and identify the types of resources (people, computer systems, software, etc.). The strategy should also define the key performance indicators (KPIs) and the critical success factors (CSFs).

NOTE 1 KPIs are measureable targets that evaluate success against the strategic goals.

NOTE 2 CSFs are elements required to deliver the strategy.

4.4 Data management manual

4.4.1 General

The manual should record how the organization approaches the management of geotechnical data. The "plan do check act" (PDCA) management method of continual improvement given in **4.4.1.1** to **4.4.1.4** should be used.

4.4.1.1 Plan

Areas for improvement should be identified. Processes, systems and resources should be put in place to address the improvements.

4.4.1.2 Do

The plan should be implemented and data collected for measuring success.

4.4.1.3 Check

The plan should be checked and reviewed to establish whether the solutions are providing the desired improvements.

4.4.1.4 Act

Areas where progress is not being made should be identified and a decision made as to whether action is required.

4.4.2 Preparing a data management manual

4.4.2.1 General

The organization should establish, document, implement and maintain a data management manual and commit to continually improve its effectiveness in accordance with the recommendations of this standard.

NOTE Individual projects might require a project-specific data management manual.

4.4.2.2 Roles and responsibilities

The manual should show the organization structure of the data management team(s) and their roles and responsibilities.

NOTE An organigram is a useful way of graphically representing the organization.

4.4.2.3 Register of data management plans

The data management manual should contain a register of all data management plans governed by the manual. The register should contain:

a) data management plan reference;

b) data management plan title;

c) author details (person and date); and

d) status.

4.4.2.4 Review

The data manager should review the data management system to ensure its continuing suitability, adequacy and effectiveness. The interval for review should be set out in the data management manual.

4.5 Data management plan

4.5.1 General

The data management plan should be prepared in accordance with the data management principles given in Clause **3.**

NOTE 1 The plan might relate to general business processes within an organization or project-specific activities to satisfy particular client or working requirements.

The plan should include the following:

a) aim of the plan;

b) work item(s); and

c) detailed breakdown of each work item.

NOTE 2 Separate plans might be required for different work items.

4.5.2 Aim of the plan

The data management plan should state the objective(s) of the project including limitations and/or boundaries at organizational or project level. The plan should take into account all phases of the project and their interactions (**A.4**).

NOTE 1 The plan may cover a specific area of work such as laboratory testing or remote monitoring.

NOTE 2 Clear boundaries are required to ensure that plans integrate and do not conflict with each other.

4.5.3 Work item(s)

Work items included in the plan should be listed together with the computer systems and software used.

NOTE 1 Work items might include tasks such as inputting data into laboratory data management computer systems or extracting data from data archive systems.

NOTE 2 Details for the management of data that are applicable to all tasks in the data management plan may be included in a summary section. These details might be related to data quality, data storage, data archive and disposal, and roles and responsibilities.

4.5.4 Detailed breakdown of each work item

A detailed breakdown of the tasks required under each work item should be specified.

For each task the following should be taken into account:

a) data collection, input and extraction;

b) verification and validation checks;

c) data storage;

d) computer systems and software (i.e. software name and version);

e) data transfer formats;

f) data transfer media;

g) timeliness; and

h) named roles and responsibilities (**A.3**).

Annex A (informative) Preparing a data management plan

A.1 General

This annex gives background information to assist in the preparation of a data management plan (**4.5**), including:

a) data principles (**A.2**);

b) data management roles (**A.3**); and

c) phases of a geotechnical project (**A.4**).

A.2 Data principles

A.2.1 Data collection

A.2.1.1 Method of data collection

The collection of data by electronic capture in the field can significantly reduce errors, especially if automated validation checks are included at the point of entry.

NOTE Errors can be reduced during data capture and editing, by restricting selectable data from a list of allowable values or by restricting values within limits as appropriate.

If paper-based data collection is used, pre-formatted sheets containing relevant fields can help to prevent missing data. The use of paper notebooks is discouraged because the data collected is generally unstructured.

A.2.1.2 Timeliness of data collection

The supply of data to support the rapid production of information, such as exploratory hole logs or readings for use in observation methods, might require automated data extract and import.

NOTE Automated data extraction and importation are more easily achieved if the data are structured. Good structuring and constraints on data make this process more efficient.

A.2.2 Data storage

A.2.2.1 Data security

Data security is required to protect commercial interests and includes:

a) control of access;

b) protection against malicious attack;

c) protection against system failure;

d) non-disclosure agreements; and

e) protection against destruction or loss of data.

The requirements for data security are generally proportional to the frequency of input/entry, the importance of the data and the reliability of the hardware. User access is normally controlled at role level and might be writing, reading and editing.

A.2.2.2 Version control

In addition to the principle given in **3.3.3**, different versions of the data may be applied at field, record or data set level depending on the needs of the project.

A.2.2.3 Consistency

Data consistency ensures that for any given version users see the same data. Measures such as restricting users to read-only rights can be used to ensure data consistency.

Data that are not consistent might be a significant risk to the project, especially at the design stage.

A.2.2.4 Status

The status of the data includes a check status and a release status.

Examples of a check status might be draft, preliminary or approved, whilst a release status might be tender, design, or archive. The status of the data can be defined at field, record or data set level.

A.2.3 Data archiving, retention and disposal

A.2.3.1 Archive

Data archive includes storage media, storage device(s), retrieval and usability. It might be different depending on the perspective of the organization.

A data provider such as a ground investigation contractor or laboratory might need the data to be archived and only accessed rarely, whereas a client organization might need archive data to be accessed by its supply chain partners on a daily basis.

Where regular access to the archive is required, the data may be held on a secure, proprietary system. Additional guidance might be available in the organization's data archive policy and strategy.

A.2.3.2 Retention and disposal

Retention and disposal of data might be necessary if the data are stored as hardcopy, or if the client or organization has specific record management policies that require data disposal after a defined period. Data retention might be determined by contract or statutory requirements.

If data are to be destroyed at the end of use, restrictions on the transfer of the data throughout the project may be appropriate. Destroying data once they have been transferred, for example by email or web-based file hosting, might not be possible. Guidance might be available in the organization's data disposal and retention policy and strategy.

A.2.4 Sharing and transferring data

Sharing data in a timely manner is important to minimize risks and maximize efficiency. The following examples illustrate how good data sharing and transfer can aid projects or commercial activities:

a) one-off data entry reduces transcription errors;

b) data entered at source is available for the life-cycle of the project;

c) data are consistent, i.e. designers are working on up-to-date information;

d) asset maintenance activities are facilitated because as-built data is available; and

e) use of an industry-standard data transfer format, such as the association of geotechnical and geo-environmental specialists data transfer format (AGS) or the federation of piling specialists (FPS) electronic pile schedule, formalizes the way data are transferred.

NOTE Use of spreadsheet files for data transfer is discouraged because they contain formatting information as well as data. Interoperability problems between spreadsheet software might be experienced.

A.2.5 Unique referencing of data

Uniqueness of data is important in the identification and management of records. For example, if two exploratory holes on the same site had the same identifier (e.g. BH1) there is a very high risk that other data would be assigned to the incorrect exploratory hole, increasing the risk of misinterpretation of the information. This also applies to all samples and tests.

NOTE 1 The importance of unique referencing is taken for granted by database administrators and designers. However, it is not always appreciated or communicated to the engineers and scientists.

NOTE 2 Unique referencing of data might be problematic where data sets from different sources are merged. Pre-processing might be required.

A.2.6 Data verification and validation

Data verification and validation are methods to check that data entered into a computer system are correct.

Validation is an automated check to ensure the data are between acceptable limits and in the correct format.

Verification is performed to ensure the data have been imported correctly, i.e. that the data in the destination system match the source.

A.3 Data management roles

A.3.1 General

A critical success factor in the management of data is responsibility regarding the stewardship of the data. The following roles may be assigned:

a) data manager; and

b) data steward.

A.3.2 Data manager

The data manager is responsible for:

a) implementing and maintaining the data management system;

b) creating and maintaining data management plans;

c) reporting to the organization on the performance of the data management system and any need for improvement; and

d) managing and supporting data stewards.

A.3.3 Data steward

Data stewards are responsible for:

a) carrying out the processes needed for the data management system;

b) carrying out work in accordance with the data management plan(s); and

c) reporting to the data manager on the performance of the data management system.

A.4 Phases of a geotechnical project

The preparation of a data management plan requires an understanding of the business processes, systems and data requirements, and the organizations involved.

NOTE 1 It is important to be aware of any project-specific requirements, such as strata codes, weathering codes, exploratory hole notation and data access requirements prior to compiling the data management plan.

The following phases of geotechnical data collection might be taken into account when preparing a data management plan:

a) desk studies and site reconnaissance;

b) site investigation;

c) design;

d) pre-construction monitoring;

e) construction and supervision;

f) monitoring and maintenance;

g) deposition of project reports and data in a central repository; and

h) decommissioning.

NOTE 2 Further details of these activities are given in BS 5930 and BS EN 1997-2.

NOTE 3 Swimlane diagrams (also known as cross-functional diagrams) can be very useful to document the steps, activities or processes in a workflow, especially where there are numerous organizations or systems involved. Recording the method and format of data transfer between the steps is helpful.

NOTE 4 Cause and effect, or fishbone diagrams, are a useful way of exploring why existing processes are not working or looking at potential causes of problems.

Bibliography

Standards publications

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 5930, *Code of practice for site investigations*

BS EN 1997-2, *Geotechnical design – Ground investigation and testing*

BS ISO 29481, *Building information models – Information delivery manual – Interaction framework*

PAS 1192, *Specification for information management for the capital/delivery phase of construction projects using building information modelling*

Further reading

BS 1192, *Collaborative production of architectural, engineering and construction information – Code of practice*

BS 7799-3, *Information security management systems – Guidelines for information security risk management*

PD ISO/TR 15489-2, *Information and documentation – Records management – Guidelines*

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