Transport for London

London Underground

Category 1 Standard

S1050 Civil Engineering - Common Requirements

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1 Purpose

1.1 This standard sets out the generic requirements that apply to civil engineering assets, and is to be read in conjunction with LU Standard S1538 and the appropriate LU Civil Engineering Standards as shown below:

Number	Title
S1051	Civil Engineering – Bridge Structures
S1052	Civil Engineering – Gravity Drainage Systems
S1053	Civil Engineering – Building and Station Structures
S1054	Civil Engineering – Earth Structures
S1055	Civil Engineering – Deep Tube Tunnels and Shafts
S1056	Civil Engineering – Pumping Systems
S1057	Civil Engineering – Miscellaneous Assets

1.2 A supporting LU Guidance Document G050 “Civil Engineering – Common Requirements” gives guidance and explanation of the requirements given in this Standard.

2 Scope

2.1 This Standard applies to all civil engineering assets and sets out the following generic requirements:

a) Competence;

b) Technical approval, processes and assurance;

c) Design of service fixings and connections for new structures;

d) Ground investigations;

e) Management of sub-standard assets;

f) Ground movement impact on railway and adjacent structures;

g) Use of tall plant on or near the railway;

h) Use of temporary works, scaffolding and hoardings near the railway;

i) Piling and similar processes;

j) Adjacent and Shared Structures;

k) Asset and structure identification;

l) Condition assessment and certification;

m) Structural materials;

n) Cutting, grinding, drilling, fixing to and supporting from existing structures and inspection access;

o) Decommissioning, demolition and site clearance;

p) Access covers;

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q) Service crossings;

r) Evidence of compliance;

s) Risk.

2.2 This standard does not cover works by Outside Parties undertaking work on their own land other than when referred to in the LU Standard S1023 “Infrastructure Protection”.

2.3 There are references within this document to the LU process for Temporary Works and Asset Condition Assessment and Certification. It is however acceptable for other companies within TfL to follow their own equivalent approved process.

3 Requirements

3.1 Competence

3.1.1 All staff and suppliers carrying out works in civil engineering asset areas shall be competent to undertake these tasks.

3.1.2 Suppliers shall have a Competence Management System in accordance with the published guidance on developing and maintaining staff competence for use in the railway industry – Developing and Maintaining Staff Competence. Railway Safety Publication 1. ORR 2007.

3.1.3 A Safety Critical Work licensing system in accordance with the requirements of LU Standard S1548 (Safety Critical Work) shall be in place for all ‘Safety Critical’ civil engineering activities as defined by The Railways and Other Guided Transport Systems (Safety) Regulations 2006.

3.1.4 Only a Civil Engineering Safety Critical Licensed person shall be permitted to certify the return to use of civil engineering assets to passenger service.

Note:	This activity may not necessarily involve the civil engineering Safety Critical Licensed person carrying out any maintenance or repair work personally but the level of supervision or the ability to check the work done must be such that the Civil Engineering Safety Critical Licensed person can confidently return to use the civil engineering assets to passenger service.

3.1.5 Inspections of civil engineering assets shall be carried out by suitably experienced and qualified staff. The note below clarifies by what is meant by “qualified staff”.

Note:	A minimum of Technician Member of the Institution of Civil Engineers, or equivalent, with suitable and current civil engineering asset inspection experience is required and experience with working in the LU railway environment is preferable.

3.2 Technical Approval, Processes and Assurance

3.2.1 General

3.2.1.1 Conceptual Design Statements (CDS), in accordance with LU Standard S1538 “Assurance”, shall be developed for the design of all new, strengthened or renewed civil engineering assets. The requirements for a CDS relating to temporary works are given in LU Standard S1062 “Temporary Works”.

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Note:	Guidance on the production, submission and approval in principle (AIP) of civil engineering related CDS in support of the specific requirements of S1538 is given in LU Guidance Document G050.

3.2.1.3 Proposed amendment to a CDS that has been "approved in principle" will require technical justification and the approval of the LU Profession Head or an accredited Civil Engineer.

3.2.1.4 As part of the design for new works, including Strengthening and Renewal, a design compliance submission shall be prepared that describes and quantifies future management and maintenance required to achieve the Design Life of the relevant civil engineering asset.

3.2.1.5 The design compliance submission shall describe any requirements for instrumentation and monitoring including full details of purpose, installation requirements and frequency of readings.

3.2.1.6 The design compliance submission shall describe and quantify the interfaces with the track assets and other elements of the operating railway, existing services and drainage, adjacent works and adjacent planned works, including predictions of ground movements and assessment of potential damage to the railway and adjacent properties, facilities and structures, both in the short and long term and either directly or through the influence of groundwater.

3.2.1.7 The design compliance submission shall identify any constraints imposed by the design, plant restrictions or any other special conditions and factors.

Note:	Other items may be required in the design compliance submission on a case-by-case basis.

3.2.1.8 The design shall be presented in construction documents as a set of drawings, specifications and related documents containing all information necessary for:

a) construction;
b) operations;
c) maintenance; and
d) decommissioning.

3.2.1.9 All drawings shall include a Safety Health & Environmental (SHE) box. This box shall list residual risks from the design of structures or components which remain in the design. An example of a SHE box is shown in Attachment 7.5.

3.2.1.10 Copies of all reports, drawings, calculations and proforma produced as part of the civil engineering activities described in LU Civil Engineering Standards shall be recorded into a document management system in accordance with LU Standard 1-691 "Information" and in the CDM Health and Safety File.

3.2.1.11 All reports, drawings, calculations and proforma shall be retained for the life of the asset.

3.2.2 Analytical Assessments

3.2.2.1 An Analytical Assessment AIP document describing the proposed structural assessment methodology shall be approved by a LU accredited Civil Engineer prior to any Analytical Assessment of a civil asset. The AIP document shall describe the structural details, assessment criteria and proposed method of structural analysis.

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Note:	Guidance on the required format of the approval in principle document (AIP) for the analytical assessment of bridges, structures and deep tube tunnel assets is given in LU Guidance Document G050. An AIP document is not required for the Analytical Assessment of Earth Structure, Pumping Systems or Gravity Drainage Systems assets. The assessment requirements and methodology for these assets is comprehensively described in the relevant LU standards.

3.2.3 Ground Investigations

3.2.3.1 The scope of a Ground Investigation shall be approved by a LU Civil Engineer using a Ground Investigation AIP document.

Note:	Guidance on the required format of the AIP for a Ground Investigation is given in LU Guidance Document G050.

3.2.4 Completion and Handover of Maintenance, Strengthening and Renewal Work

3.2.4.1 The completion of Maintenance and Strengthening and Renewal works shall be controlled to ensure:

a) a competent person has certified that the works have been completed satisfactorily;

b) compliance with LU Standards is confirmed;

c) safety has not been impaired;

d) the reported Condition of the asset is updated in the ACAC/ACR process and Asset Register;

e) the functioning of the asset, or any other asset, is not impaired; and

f) asset management systems (i.e. databases) are updated.

Note:	A schedule of typical Maintenance activities for civil engineering assets is given in LU Guidance Document G050.

3.2.4.2 Maintenance Work Listings shall be produced annually, no later than 30 June, for Maintenance work carried out on each asset from the previous period 1 April to 31 March.

3.2.4.3 A Maintenance Work Annual Completion Certificate shall be produced and signed by a competent person in respect of specific asset groupings to confirm that the Maintenance works have been completed.

3.2.4.4 The following details in respect of each Item of Work shall be recorded:

a) full description of the asset, each Item of Work undertaken and identifying asset references;

b) precise asset location, including full Location Coding System (LCS), asset control numbers and room numbers, as appropriate;

c) list of all concessions and written notices;

d) a list of references to any CDS and AIP, required by LU Standard S1538;

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e) any as-constructed drawings and calculations including any changes made to the design during construction;

f) update to CDM Health and Safety File (to include preventative maintenance recommendations, warranty and maintenance specifications, schedules, training manuals, manpower requirements, servicing, repair and support arrangements, as appropriate to the activity);

g) emergency equipment recommended or provided;

h) confirmation that, where maintenance works have resulted in a change in the asset inspection rating, an inspection has been carried out in accordance with LU Standard S1060 “Civil Engineering – Bridges and Structures Inspection Standard” or other appropriate LU Civil Engineering standard.

j) where work has been subject to The Railway and Other Guided Transport Systems (Safety) Regulations 2006; and

k) work which requires the agreement of the London Fire Emergency Planning Authority (LFEPA) or where LU Standard S1085 “Fire Safety of Materials” is applicable.

3.2.4.5 If the completion of works is not final but is partial or substantial, precise information shall be recorded in the CDM Health and Safety File, together with details of the work outstanding. All outstanding or qualified work shall be scheduled for completion or rectification.

3.3 Design of Service Fixings and Connections for New Structures

3.3.1 The design of new civil assets shall accommodate all other asset discipline needs and requirements, particularly the provision for fixing services to structures.

3.3.2 Designs shall ensure that predictable structural movements are not detrimental to services, utilities or finishes.

3.3.3 Provision shall be made for the attachment of services to structures without damage or impairment to functionality.

3.3.4 Design of fixings shall include precautions to prevent vibration induced loosening or failure.

3.3.5 The design shall be coordinated with the design of earthing of electrical equipment and stray current protection in accordance with LU Standard 1-106 “Earthing and Bonding of LU Electrical Networks”.

3.3.6 Structures shall be protected from bimetallic corrosion.

3.3.7 Where relevant structures shall be checked for fatigue failure conditions.

3.3.8 Where false ceilings are to be attached to civil structures, their fixings shall comply with the recommendations set down in the Association of Interior Specialists Construction Fixings Association Best Practice Guide – Selection and installation of top fixings for suspended ceilings.

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3.4 Ground Investigations

3.4.1 Ground Investigation information shall be obtained which is sufficient in scope and sophistication to provide the engineering characterisation of soils and groundwater conditions necessary for the inception, design and construction of new works and for the Strengthening and Renewal and Analytical Assessment of existing structures.

3.4.2 All Ground Investigations shall be undertaken in accordance with BS EN 1997-2.

3.4.3 Ground Investigation design shall be controlled and assured in accordance with Section 3.2 of this Standard.

Note:	Guidance on the content of a typical Ground Investigation is given in LU Guidance Document G050.

3.5 Management of Sub-Standard Assets

3.5.1 Immediate measures shall be taken to restrict the use and prevent access to Sub-Standard Assets.

Note:	Immediate steps include notification to the asset owner/steward, mitigation and removal from service.

3.5.2 Structure load restriction plates shall be fixed to each structure where loading is restricted to pedestrians and where plant and materials are prohibited (refer to LU Standard S1004 “Signage for Operational Purposes”).

3.5.3 A “Do Not Use” sign shall be fixed to identify structures that have been removed from service and access is prohibited (refer to LU Standard S1004 “Signage for Operational Purposes”).

3.6 Ground Movement Impact on Railway and Other Structures

3.6.1 Assessment and Mitigation Process

3.6.1.1 The Designer shall investigate the potential for ground movement associated with the design and possible construction methods using the process defined in Clause. 3.6.1.2 for the following purposes:

a) to assess risk of building damage by identifying those zones where the implementation of the design is likely to cause ground movements which will result in risk of Damage Category 2 ‘Slight’ being exceeded (see Table 1). To assess the risks of such degrees of damage occurring and either investigate alternative designs or advise interfacing Designers that alternatives need to be considered and modify the design as necessary. To undertake an assessment of the potential consequences where there is a significant likelihood that Risk of Damage Category 2 ‘Slight’ will be exceeded and identify specifically what the risks are. Design protective measures where necessary to mitigate against the risk of damage exceeding Risk of Damage Category 2;

b) to demonstrate that the environmental effects of excavation induced ground movements have been considered and taken account of in the design;

c) to assess the risk of damage to utilities and to design mitigation measures in agreement with the utility owner;

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d) to assess the effects of excavation to existing above-ground and underground infrastructure and to design suitable mitigation measures;

e) to indicate where property may require demolition or structural modification;

f) to enable the preparation of contingency plans to deal with residual risks.

3.6.1.2 A staged assessment process shall be followed to identify the risk and impact of construction activities on London Underground and third parties. Five stages have been identified to assess the impact and risk from project inception to completion. The initial stages are aimed at maximising the benefit from assessments, whilst the latter are about managing and recording the impact of construction. The five stages are:

3.6.2 Stage 1 – Scoping

3.6.2.1 Schedules and plans shall be prepared to identify all LU and Outside Party assets assessed to experience ground movement exceeding 1mm using conservative parameters.

Note:	Case studies validating the parameters appropriate for the assessment process may be found in the London Underground database of Core Asset Information.

3.6.3 Stage 2 – Initial Assessment

3.6.3.1 The designer shall carry out initial assessment calculations using simple empirically calibrated, methods and moderately conservative parameters to classify the risk of damage to assets. For building structures the risk should be classified in accordance with Table 1. For non-building infrastructure the level of risk should be determined by ensuring that deformations do not exceed tolerable values determined in consultation with the asset owner. These calculations shall be based on record drawings, where available and an inspection for assessment. Assets estimated to be a risk of damage greater than Category 2 –Slight or where damage exceeds the agreed tolerable limits require further detailed assessment at Stage 3. A schedule and plans of predicted damage shall be prepared.

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Building damage classification				
Damage Category	**Description of degree of damage+**	**Description of typical and likely forms of repair for typical masonry buildings**	**Approx. crack width* (mm)**	**Max. tensile strain %**
0	Negligible	Hairline cracks		<0.05
1	Very slight	Fine cracks easily treated during normal redecoration. Perhaps isolated slight fracture in building. Cracks in exterior visible upon close inspection	0.1 to 1.0	0.05 to 0.075
2	Slight	Cracks easily filled. Redecoration probably required. Several slight fractures inside building. Exterior cracks visible; some repainting may be required for weather-tightness. Doors and windows may stick slightly	1 to 5	0.075 to 0.15
3	Moderate	Cracks may require cutting out and patching. Recurrent cracks can be masked by suitable linings. Tuck pointing and possible replacement of a small amount of exterior brickwork may be required. Doors and windows sticking. Utility services may be interrupted. Weather tightness often impaired	5 to 15 or a number of cracks greater than 3	0.15 to 0.3
4	Severe	Extensive repair involving removal and replacement of walls especially over door and windows required. Window and door frames distorted. Floor slopes noticeably. Walls lean or bulge noticeably. Some loss of bearing in beams. Utility services disrupted.	15 to 25 but also depends on number of cracks	> 0.3
5	Very severe	Major repair required involving partial or complete reconstruction. Beams lose bearing, walls lean badly and required shoring. Windows broken by distortion. Danger of instability	Usually > 25 but depends on No. of cracks	

+ In assessing the degree of damage, account must be taken of its location in the building or structure.

* Crack width is only one aspect of damage and should not be used on its own as a direct measure of it.

Burland, J.P. and Wroth, C.P., Settlement of Buildings and Associated Damage, Proceedings of a Conference on the Settlement of Structures, Cambridge, 1974, pp 611 – 54 and 764 – 810;

Table 1: Building Damage Classification

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3.6.3.2 The heritage value of a Listed Building should be considered during the initial assessment by reviewing the sensitivity of the building structure and of any particular features together with the initial assessment calculations. The heritage assessment examines the following:

a) the sensitivity of the building / structure to ground movements and its ability to tolerate movement without significant distress. The potential for interaction with adjacent buildings / structures is also considered. A score within the range of 0-2 should be allocated to the building/structure in accordance with the criteria set out in Table 2;

b) the sensitivity to movement of particular features within the building / structure and how they might respond to ground movements. A score within the range of 0-2 should be allocated to the building in accordance with the criteria set out in Table 2.

The scores for each of the two categories (a) and (b) should be added to the category determined in Clause 3.6.1.4.1 to inform the decision making process. In general, Listed Buildings which score a total of 3 or higher should be subject to further assessment as part of the Stage 3 – Detailed Assessment. Buildings that score a total of 2 or less are predicted to suffer a degree of damage which may be easily repairable using standard conservation based techniques and hence no protective measures for the building's particular features should be required. However, ultimately the professional judgement of engineering and historic building specialists should be used to determine whether additional analysis is required.

Score	Criteria	
	Sensitivity of the structure to ground movements and interaction with adjacent buildings	**Sensitivity to movement of particular features within the building**
0	Masonry building with lime mortar not surrounded by other buildings. Uniform facades with no particular large openings.	No particular sensitive features
1	Buildings of delicate structural form or buildings sandwiched between modern framed buildings which are much stiffer, perhaps with one or more significant openings.	Brittle finishes, e.g. tight-jointed masonry, which are susceptible to small movements and difficult to repair.
2	Buildings which, by their structural form, will tend to concentrate all their movements in one location.	Finishes which if damaged will have a significant effect on the heritage of the building, e.g. cracks through frescos.

Table 2: Scoring for Sensitivity Assessment of Listed Buildings

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3.6.4 Stage 3 - Detailed Assessment and Mitigation Design

3.6.4.1 The Designer shall carry out detailed assessments of structures that will be affected by the works so that any monitoring works and mitigation works can be designed and implemented.

3.6.4.2 For structures at risk of exceeding Damage Risk Category 2 (Slight) the designer shall undertake a detailed assessment (more rigorous) to determine:

a) the influence of the structure and its foundations on the predicted ground movements;

b) the volume loss at which the risk of damage to the structure (or any sensitive finishes/features) is 'slight' or better;

c) whether this volume loss may be achieved by the proposed excavation design/control measures;

d) any special control measures required to reduce the predicted damage to acceptable levels (i.e. Risk Category 2 'slight' damage category or below) such as significantly higher face pressures with EPBM tunnelling and the practicality of these;

e) the amount of ground movement that the structure (and or any sensitive finishes/features) can accommodate without exceeding Damage Risk Category 2 or any other agreed damage level;

f) the level of residual risk if intrusive mitigation measures are not implemented.

3.6.4.3 The detailed assessments should include a number of iterations to determine how the risk of damage to a building may be reduced. Asset-specific empirical models shall be prepared successively using moderately conservative and best estimate parameters. If after these iterations the use of empirical methods do not reduce the risk of building damage to acceptable levels (i.e. Damage Category 2 'slight' damage category and below), the damage assessment shall be refined by increasing the sophistication of the analysis with the aim of reducing the risk of asset damage to acceptable levels and to eliminate the asset from further assessment.

3.6.4.4 If the risk of damage cannot be shown to be reduced by detailed assessment to acceptable levels, then mitigation measures shall be designed.

3.6.4.5 The primary means of settlement mitigation shall be practical measures to control ground movement by good design and construction practice. This could include staged excavation sequences within sprayed concrete lining (SCL) works, ground treatment, face stabilisation, spiling / face dowels, increasing face pressure when using an tunnel boring machine (TBM), adopting stiffer walls/propping for rectangular shafts etc.

3.6.4.6 In the event that physical mitigation measures are still required (i.e. to control building damage to Damage Category 2 or less or to meet the Asset Owners requirements), the Designer shall seek to obtain the Asset Owners approval.

3.6.4.7 The Designer shall also undertake a comparative risk assessment to demonstrate that the risks associated with installation/implementation of any intrusive mitigation measures (such as compensation grouting) are no worse than the risks associated with the base case.

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3.6.4.8 The relevant Local Authority and English Heritage shall be consulted on the results of the Listed Building assessment reports and the proposals for protective measures, if any are required. English Heritage shall also be consulted in relation to Listed Buildings where they would normally be notified or consulted on planning applications or listed building consent applications.

3.6.4.9 When considering the need and type of protective measures for Listed Buildings, due regard should be given to the sensitivity of the particular features of the building which are of architectural or historic interest and the sensitivity of the structure of the building to ground movement. Where the assessment highlights potential damage to the features of the building which it will be difficult or impossible to repair and/or if that damage will have a significant effect on its heritage value, the assessment may recommend appropriate measures to safeguard those features either in-situ or by temporary removal and storage off-site if those with relevant interest(s) in the building consent.

3.6.4.10 The form of monitoring of Listed Buildings should be determined based on the results of the assessment process.

3.6.4.11 Where repair works are necessary they will require the consent of those with relevant interest(s) in the building.

3.6.4.12 For railway track and track support structures the designer shall:

a) review the track surveys (including specifying additional surveys if required) and establish that ground movement can be accommodated without exceeding track standard operational tolerance in conjunction with the relevant Infrastructure Manager;

b) identify locations where fettling of the track is required pre construction and /or during construction to ensure the track geometry and clearances are acceptable.

3.6.4.13 The designer shall prepare plans and sections showing the zone of influence of the works that is defined by ground movements exceeding 1mm.

3.6.4.1.4 The designer shall develop an instrumentation and monitoring plan to validate that ground movements within the zone of influence are in accordance with design assumptions and that the infrastructure remains within acceptable limits. The designer shall ensure that there is a clear distinction between parameters measured to confirm the change in any parameter is in accordance with the design and parameters measured to limit damage to the assets. This plan shall identify the minimum period of time required to obtain base line data for each monitoring point. Instrumentation adjacent to the railway, which will remain in place during traffic hours, shall conform to LU Standards S1156 “Gauging and Clearances”, S1193 “Electromagnetic Compatibility (EMC) with LU Signalling System Assets” and S1085 “Fire Safety Performance of Materials”.

Note:	A competent engineer responsible for the works shall consider those factors which may influence the monitoring data and shall determine an appropriate period and frequency for baseline monitoring. This decision making process will include an element of engineering judgement to account for the possible effects of any underlying environmental trends in the assets under consideration.

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3.6.4.15 The designer shall demonstrate that the monitoring system complies with the British Tunnelling Society Monitoring Underground Construction best practice guide.

Note:	A review of the monitoring system against the checklists provided in Appendix B of the BTS Monitoring Underground Construction best practice guide may be used as a tool to demonstrate compliance.

3.6.4.16 The detailed assessments shall define the control limits that need to be imposed on the TBM/SCL excavation in the zone of influence. The designer shall state these control measures on drawings and specifications.

3.6.4.17 The designer shall identify the critical parameters to be monitored and define the Asset Control Limits based on:

a) the ability of the asset or structure to withstand ground movement investigated during the assessments carried out in Stage 2 and 3.

b) the risk to London Underground and third party operations

3.6.4.18 The designer shall link the Asset Control Limits to actions within the Emergency Preparedness Plan.

3.6.4.19 The Instrumentation and Monitoring Plan and Emergency preparedness Plan shall be agreed with the relevant Asset Owner.

3.6.5 Stage 4 – Construction

3.6.5.1 Contingency plans shall be developed and agreed with Outside Parties to cover the risks posed to LU and the Outside Parties before commencement of the construction activity.

3.6.5.2 Contingency plans shall be implemented where the results of monitoring or inspection so indicate.

3.6.5.3 Ground movement and construction progress records shall be maintained and reported in regular reviews when construction processes are taking place within the zone of influence.

3.6.5.4 Predictions and assumptions made during design in respect of both ground movement and the effects which such ground movement will have on LU and adjacent assets shall be verified by measurement during construction.

3.6.6 Stage 5 – Completion and Close-out

3.6.6.1 After ground movement has stopped as confirmed by instrumentation the designer shall prepare a “Completion Report”. This shall include the following:

a) details of any modifications/mitigation measures to the existing structure;

b) graphs that show the ground movement and construction progress over time with at least 3 months duration of readings which show no change;

c) a schedule showing actual movement compared to predicted movement;

d) a schedule of defects recording only the exceptions (changes) identified during the post construction defects survey;

e) details of any remedial works undertaken;

f) as-built records (including any temporary works remaining in situ).

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3.6.7 Schedule of Defects

3.6.7.1 A schedule of defects shall be recorded for all buildings, structures, utilities and facilities and Outside Party assets predicted to experience ground movement exceeding 1mm prior to the start of construction.

Note:	Guidance on the content of a typical defects survey is given in LU Guidance Document G050.

3.7 The Use of Tall Plant on or Near the Railway

3.7.1 The Supplier shall control and ensure the safe operation of cranes and other tall plant on or near the railway. Piling rigs which are less than 3.5m in height when drilling are not classified as tall plant with respect to this clause.

Note:	Requirements for tall plant being operated by Outside Parties are given in LU Standard S1023 “Infrastructure Protection”.

3.7.2 The design and operation of cranes and other tall plant shall comply with BS EN 13001-2 and BS 7121

3.7.3 During traffic hours the use of any cranes or other tall plant adjacent to the railway must be approved to enable the risks to the operating railway to be properly managed. Approval must be sought from the Profession Head - Civil Engineering to permit any tall plant to be set up or to lift or carry loads in such a way that any part of the tall plant, equipment or loads carried could enter or adversely affect any zone in which LU has a concern, as identified by the Critical Boundary. This applies to tall plant in normal operation and in any abnormal state which is deemed to include, but is not limited to, mechanical failure, collapse, toppling or failure of supporting ground.

Note:	Examples of the Critical Boundary and Critical Boundary diagrams for typical types of crane and other tall plant on or near the railway are shown in Attachment 7.1 and 7.2 respectively.

3.7.4 An Application for Approval to use Tall Plant shall be made to the Profession Head - Civil Engineering on the form shown in Attachment 7.4. The applicant must provide all the information requested, including details of the plant, the method of use, an assessment of the risks to railway assets and operations, and the proposed control and mitigation of those risks. Drawings to illustrate the position of the plant showing the zones of potential interaction in relation to railway assets and the Critical Boundary are also required. The risks from plant assembly, rigging, de-rigging and removal must be considered separately from plant operation.

3.7.5 Where lifting or carrying loads is proposed during traffic hours over sections of the railway which are nominally protected by a bridge, covered way, near surface tunnel or other structure, that structure shall be assessed by the Supplier for its capability to withstand the load or the crane falling on the structure, or both. The assessment shall identify all risks, giving details of proposed mitigating measures and operational methodology. If the structure has insufficient capacity an Application for Approval to use Tall Plant shall be made.

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3.7.6 The Use of Other Plant on or Near the Railway

3.7.6.1 Rail vehicle cranes operating on the LU Infrastructure shall be subject to formal assessment as defined in LU Standard S1171 "All Plant – Acceptance Use and Maintenance". Rail cranes which are required to travel during Traffic Hours either self propelled or as part of a Train (On-Track Machines) are required to comply with the technical requirements of LU Standard S1172 "On-Track Machines – Design and Acceptance". Rail cranes which are only able or intended to operate in Possessions or Specified Areas (On-Track Plant) are required to comply with the technical requirements of LU Standard S1173 "On-Track Plant – Design and Acceptance".

3.7.6.2 Non-Railborne Plant, including lifting appliances, operating within LU Infrastructure shall require Plant acceptance as defined in LU Standards S1171 "All Plant – Acceptance Use and Maintenance" and S1174 "Non-Railborne Plant -Design and Acceptance".

Note: LU Standard S1171 requires formal acceptance for Non-Railborne Plant operating within LU Infrastructure excluding the interior of enclosed premises that are not accessible to the Company's customers and to fully enclosed worksites and construction sites that are located away from the track and separated from the track by a physical barrier which is clear of the Structure Profile and sufficiently extensive and robust to prevent Plant interfering with the safe and reliable operation of the railway.

3.7.6.3 Where tall plant is proposed for use outside the Critical Boundary but with the potential to affect railway operations in normal use or an abnormal state, the need for Plant Acceptance as defined in LU Standard S1171 shall be considered. The potential risks involved must be assessed and included in the Application for Approval to use Tall Plant. The assessment must include, but not be limited to, consideration of the following risks to LU;

- increased emissions;
- increased fire risk;
- noise and nuisance ;
- hazardous substances;
- detrimental effects on LUs Power, Signalling and Communications systems;
- additional hazards in the event of adverse weather conditions.

A clear indication of the intention to apply for Plant Acceptance as defined in LU Standard S1171 shall be included on the Application for Approval to use Tall Plant, in the area indicated.

3.8 The Use of Temporary Works, Scaffolding and Hoardings Near the Railway

3.8.1 The Supplier shall control and ensure the safe erection, use and dismantling of temporary works, scaffolding, and hoardings, in, on or around the railway by complying with the requirements contained in LU Standard S1062 "Temporary Works" and S1027 "Site Hoarding, Fencing and Barriers".

3.8.2 Temporary works and scaffolding adjacent to the railway, which will remain in place during traffic hours, shall conform to LU Standard S1156 (Gauging and Clearances).

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3.9 Piling and Similar Processes

3.9.1 Driven piling shall be no closer than 15m from an LU substructure or tunnel. Piles which are installed by a non-percussive push in process shall be treated as bored piles.

3.9.2 Bored piles, diaphragm wall construction, jet grouting, ground investigation boring and similar processes shall not be constructed within the piling exclusion zone shown in Figure 1.

3.9.3 Bored piles shall not be under-reamed such that under-reaming encroaches into the exclusion zone defined in 3.6.11.2.

Note:	Information on studies carried out by LU on the impact of piling on adjacent infrastructure is given in LU Guidance Document G050.

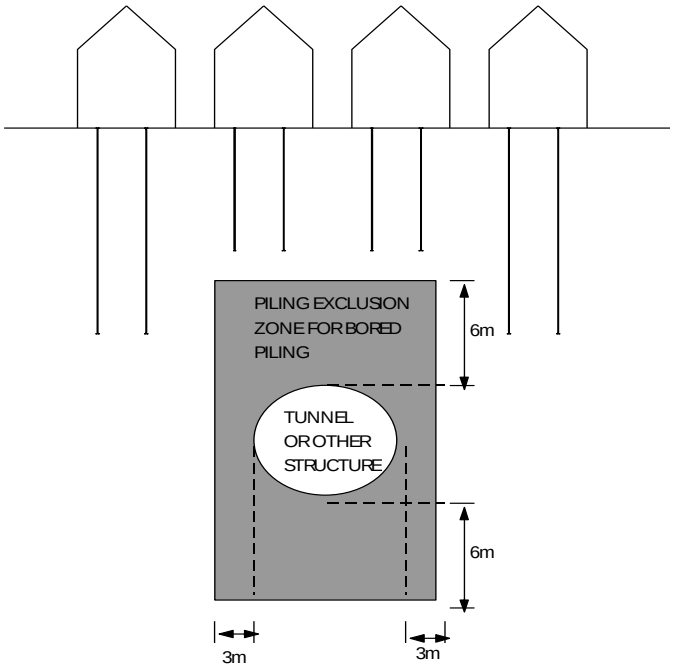

Figure 1 - Piling exclusion zone

3.10 Adjacent and Shared Structures

3.10.1 When a LU structure is to be constructed adjacent to existing Outside Party infrastructure (including buildings, structures, foundations, utilities and facilities), structural arrangements shall be made such that the LU structure and the existing Outside Party infrastructure are kept structurally independent of each other to allow the respective infrastructure to be independently maintained, repaired, modified, refurbished, demolished, rebuilt and replaced.

3.10.2 Were possible and practical, new mixed developments of both railway and commercial structures shall be designed such that structural arrangements allow for the railway and commercial development to be independently maintained, repaired, refurbished, demolished, rebuilt and replaced leaving the other structure functionally intact.

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