Guidance Note on the Field Identification and Classification of Geotechnical Observations

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Document Control

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1 Purpose

This document provides guidance for inspectors and approvers regarding geotechnical inspections on the Overseeing Organisation's strategic road network. It shows examples of features and defects together with recommended Feature Grade ratings. The guidance is intended to ensure a consistent approach to recording the condition of the asset and undertaking risk assessment and effective management of the asset. It is also useful as a training aid for new inspectors or approvers.

The Overseeing Organisation is Highways England.

2 Introduction

The Overseeing Organisation manages its highway geotechnical asset using a risk-based approach. In order to assess the level of risk it requires the condition of the asset to be determined. The condition of the asset is used for decision making at various levels; it is therefore very important to ensure that the assessment and reporting is correct and consistent across the network.

This Guidance Note complies with the terminology and principles set out in HD41/15 Maintenance of Highway Geotechnical Assets.

It should be noted that the examples provided in this Guidance Note are not exhaustive and in some cases a feature similar to that described may be more appropriately assigned an alternative classification.

3 Asset Terminology

The terminology used in HD41 has specific meaning. It is important to use the terms correctly to communicate information with respect to the asset inspection.

The following sets out the terms and meanings.

Geotechnical Asset: A geotechnical asset is defined in HD41/15 (Section 4) by its longitudinal and lateral extent. Note that the asset is not just the visible slope to the side of the carriageway; it also includes the ground beneath the carriageway. Also note that changes in the construction materials denote a new asset; these could be changes in earthwork materials, or reinforcing/retaining materials.

Characteristics: A property of a geotechnical asset.

These are generally visible elements of an asset. They can be geometry characteristics such slope length angle etc, or condition characteristics such as hummocky ground, toe bulge, dislocated trees etc.

Observation: Characteristic (or group of characteristics) located on a geotechnical asset.

This is a defined location having a start and end co-ordinate (which may be co-incidental) where the inspector decides that the characteristics of the asset are worth recording. This may be just to capture the geometry characteristics of part of an asset, or it may be to record the condition characteristics.

Feature: An observation that is assessed as requiring a feature grade.

This is a specific type of observation whereby the inspector has decided that the characteristics are such that a Feature Grading is required, i.e. a Feature Class and Feature Location Index will be recorded.

Feature Class: A classification applied to a feature to reflect its type and size.

Feature Location Index: An index applied to a feature to reflect its proximity to the network and 3rd party assets.

Feature Grade: Grading applied to a feature based on its feature classification and location index.

Defect: A feature observed within a geotechnical asset that is assigned Class 1 in accordance with this standard.

i.e. a Feature with a Feature Class of 1A or 1D.

A list of commonly used engineering terms are included in section 16, page 63.

Major Defect: A major defect cannot be explicitly defined in terms of dimensions or impact, however, typically a major defect will result in a fairly rapid intervention to make safe or repair, unless it is distant from the carriageway, or 3rd party assets.

Minor Defect: A defect that isn't a major defect.

4 Feature Class

One of the main aims of inspections is to provide condition information about the geotechnical asset. The observations made in the field are targeted at “defects”, areas ”at-risk” or areas of previously repaired defect. If the asset does not have any of these features then it is considered not to require intervention and is not classified.

Defects cover a variety of conditions and are broken down into classes 1A and 1D as follows:

- Class 1A - Major defects
- Class 1D - Minor defects

“At-risk” areas are designated Class 2 and areas of previous repairs or preventative works are assigned Class 3.

Note that Class 2 “at-risk” areas will typically be flagged as areas of potential hazard during desk studies and confirmed as “at-risk” in the field.

One of the main aims of this guide is to provide examples of Feature Classes so that the inspectors can categorise the features appropriately and consistently.

5 Feature Location Index

The location of a characteristic relative to other items of infrastructure is an important factor when assessing the risk to the network. The Feature Location Index is a combination of the physical location of the characteristic to assets and the criticality of the asset that is or is likely to be affected.

There are no defined terms for asset criticality, however the following types of criticality should be considered when deciding the Feature Location Index:

- safety criticality
- environmental criticality
- performance criticality

It may useful to include a description to explain the reasoning e.g.

- *"Back scar adjacent to safety barrier post- safety criticality"*
- "Leachate entering drainage system - environmental - criticality"
- "Subsidence likely to affect ride quality"

With the increasing use of smart motorways, it is very important to correctly assign the Feature Location Index. If a section of motorway is to become a managed motorway it will be necessary to revisit the observations and carry out a new set of assessments based on the new layout.

Note that when inspecting the asset, attention should be paid to land outside the highway boundary, especially where the road is on sidelong ground or in cutting. This is because instability can occur on neighbouring land resulting in material that either encroaches onto the highway or passes beneath the highway, moving the entire section of road. Such features are generally large in scale and may be picked up during desk studies carried out ahead of inspections.

6 Timeframe

To enable the Overseeing Organisation to actively manage deterioration of the asset, prediction of the condition of the asset must be made. The Overseeing Organisation has set a timeframe of 5 years to allow for a reasonable engineering prediction and to fit within government budget cycles.

Two timeframes are considered: Initial and Subsequent.

(1) **Initial** - Feature Class and Feature Location Index as observed in the field at the time of inspection.

(2) **Subsequent** - On the basis of the characteristics of Feature Class and Feature Location Index in the field, a subjective assessment is made of the potential deterioration of the feature, and hence the Class and Location Index that the feature may have in five years time.

7 Feature Grade

As described in Section 6, the Feature Grade is assigned over two time frames. The higher of the two values of Feature Grade is taken as the “HD41 Feature Grade”, which is used to determine the required intervention.

Care needs to be exercised when assessing the likelihood of deterioration within 5 years to avoid being over pessimistic. This is discussed further in the section Pessimism Bias.

Note the nomenclature of the assessment of Feature Grade does not use risk terminology, it uses an index number. This is to avoid confusion when using a risk assessment process that takes into consideration other factors such as network criticality.

The Feature Grade Matrix tables from HD41/15 are presented below:

Initial Feature Grade Assessment				
Location Index	Class			
	1A	1D	2	3
A	5	4	3	1
B	5	3	3	1
C	4	3	2	1
D	3	2	1	1

Table 6-3 Initial Feature Grade

Subsequent Feature Grade Assessment				
Location Index	Assessed Class			
	1A	1D	2	3
A	4	3	1	1
B	4	2	1	1
C	3	2	1	1
D	2	1	1	1

Table 6-4 Subsequent Feature Grade

Figure 1 Feature Grade matrix tables from HD41/15 cl. 6.12 and 6.14

The assessment process is shown in Figure 2 of HD41/15. It is also shown overleaf:

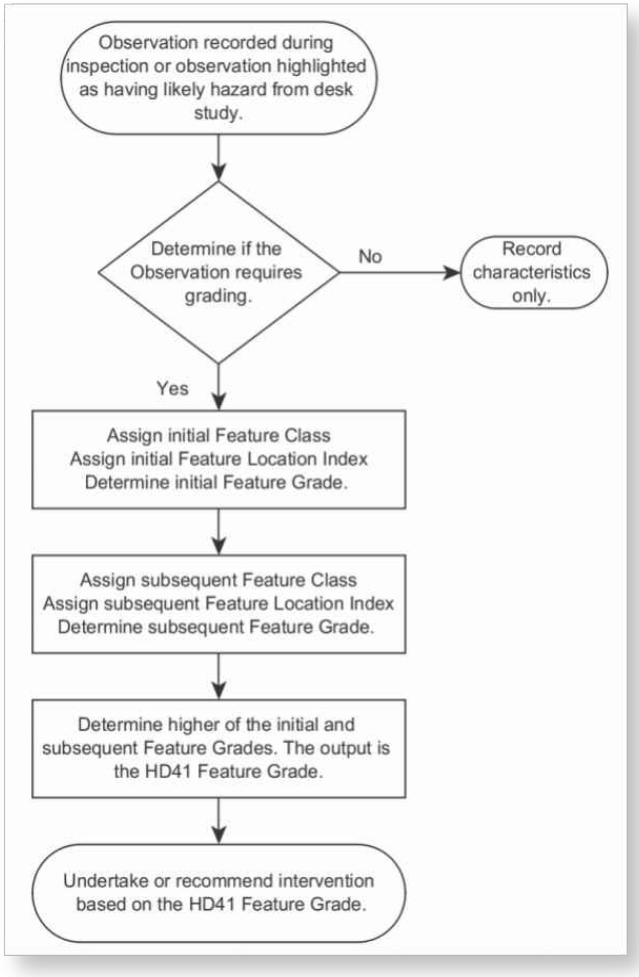


Figure 2 Feature Grading Process to determine the requirement for immediate geotechnical interventions (Figure 2 of HD41/15)

8 Pessimism Bias

Experience has shown that when assessing the Class of defect there is a tendency to be over-pessimistic, especially by those who are new to inspections. This is partly due to a lack of perspective of what constitutes a defect and what characteristics represent an area “at-risk”. For example animal burrows caused by rabbits are usually assessed as being minor defects, whereas invariably there is no actual visible defect (i.e signs of soil slip or subsidence). In this case the earthwork is merely “at-risk” and should be assigned a Feature Class 2. The same principle applies to seepage in rock cuttings.

There is also a tendency to unconsciously increase the classification of the Feature due to its location. For example a minor slip at the back of the safety fence is incorrectly assessed as a major (1A) slip because of the proximity of the fence. This leads to an over-pessimistic risk rating because the importance of the location will have effectively been applied twice when the Feature Grade is assessed.

Caution should also be exercised when assigning a Class 1A defect based on a number of characteristics. It’s not simply the case that more than one characteristic automatically

gives rise to a Class 1A defect. The number and importance of the characteristics need to be of sufficient scale to warrant a major defect.

Pessimism can also occur when assessing the Subsequent (five year) Feature Grade. It is tempting to assume that every tension crack or small back scar will transform into a major slip within 5 years. Experience has shown that this is rarely the case. Major slips tend to happen rapidly and incipient characteristics generally mark the start of progressive minor failures. The questions to ask are: (1) Is it likely that the feature will develop into a major defect, and (2) is it likely that this will happen within 5 years.

Approvers in particular should be aware of "pessimism bias" and should make adjustment to the Feature Grading of the defect if required. Site visits should be considered to confirm higher grade defects if there is insufficient photographic or quantitative evidence.

9 Non Geotechnical Defects

When carrying out inspections it makes sense to observe all defects, not just geotechnical-related defects. However care should be taken not to record all highway defects as geotechnical defects, otherwise, because the defects may also be picked up by colleagues looking after other assets such as drainage or road pavements the defect will be double counted and the condition of the network will be assumed to be worse than it actually is.

The defect that's most often misreported is carriageway cracking. Cracking of the footway, back of kerb and sometimes the carriageway is a common feature of trunk roads. It can occur where the road crosses outcrops of high plasticity clay and there is adjacent vegetation, or where there is a lack of kerb edge restraint. This cracking is generally caused because the road has inadequate construction thickness for the underlying soil conditions. Even though the soil conditions may be partly to blame for the defect it should not necessarily be treated as a geotechnical problem as it will normally be identified during a highway condition survey and the repair will be led by the highways team, not the geotechnical team (although they should have input into the design of the reconstruction). See example observations on page 46.

Carriageway defects that don't have an obvious geotechnical cause may be recorded **but should not be classified as a geotechnical defect** i.e. not Class 1. The class should either be left blank or if there is the possibility that there is a geotechnical cause an "at-risk" class assigned (Class 2) if appropriate. The defect must be reported to the relevant asset manager as soon as possible.

Note that local protocols may vary so it would be worth checking with the highways maintenance team.

Safety-critical defects such as poorly backfilled excavations behind a safety fence should be recorded. However because they are not necessarily a geotechnical-related defect they need not be assigned a defect classification. The successful performance of a safety barrier or any other structure relies on the site conditions matching the design assumptions. If you have any concerns that the site conditions don't appear to be "normal" e.g. the verge width behind a safety barrier is inadequate, or the foundations to a sign base are exposed, this should be noted and the relevant asset manager informed.

Approvers should question whether the defect is geotechnically related before approving a

defect classification.

10 Animal Burrows

The incorrect classification of animal burrows can have have a major affect on the reported condition of the network, because animal burrows are found along considerable lengths of the network.

Generally, unless there is visible evidence of slip failure or subsidence, areas of animal burrows should be classed as Initial Class 2 “at-risk” features. This should prompt more frequent inspections during which the observation can be monitored (see section 14)

11 Seepage

Seepage is not necessarily a defect in itself, it may be a naturally occurring characteristic typically found at the base of soil or rock slopes. In fact the presence of seepage is an indicator that the slope is draining, and may not be detrimental to the design, especially in rock slopes. The exceptions would be seepage at the top of a retaining wall that had blocked weep holes, or seepage on a cutting slope or embankment where the inspector suspects that the design did not allow for water discharging onto the face of the slope, i.e. no provision for slope drainage had been made. Seepage may also be caused by defective drainage.

Seepage should be recorded, but it should not be assigned a Feature Grade unless there is good reason to suspect that it is likely to cause instability, either by itself or in combination with other characteristics. Then is should be assigned an Initial Class 2 “at-risk” classification.

12 Design Feature or Repair?

Feature Classes 2 and 3 are intended to denote areas of “at-risk” asset. Class 3 includes areas of failure that have been repaired, such as a clay slope slip that has been removed and replaced with granular material.

The inspector needs to exercise caution to avoid those features that have been installed as part of the design process in the original earthwork, being described as “at-risk”. For example herringbone drains may have been installed to increase the factor of safety to an acceptable level in a new section of cutting, or a low gabion or crib retaining wall or a reinforced soil slope may have been constructed during a widening scheme. These should not be recorded as Class 2 or 3 features.

However, if a defect is observed in one part of a reinforced soil slope, or gabion wall etc. the remainder of the feature may reasonably be classified as Initial Class 2 (“at-risk”) if the cause of the defect is due to problems such as poor materials, design or construction.

13 Hazard Areas

The inspector may come across observations that have been tagged as possibly lying within a hazardous area, e.g. an area liable to subsidence. The inspector should make a judgment whether these should be classified as Initial Class 2 “at-risk”. Typically there

should be some evidence of characteristics to support the classification such as an uneven road surface.

14 Quantitative Monitoring

14.1 When to use the quantitative defect measurements

Quantitative measurement should normally be carried out to record information on geotechnical defects. Defects are defined as observations that have an assigned Class 1 (1A or 1D). There are no standard rates for deterioration of a geotechnical asset so recording quantitative information is important to manage individual assets and to provide a body of knowledge that may help to inform decisions in the future.

Quantitative measurements may also be carried out on Class 2 and 3 observations.

14.2 Defect measurement types

It is important to understand that the quantitative defect measurement data that can be recorded relates to a single characteristic. For example, if the measurements refer to a series of more than one tension crack within the observation, quantitative details of only one of those cracks may be recorded (typically, the largest). Where more than one tension crack exists within an observation, and the tension cracks do not overlap longitudinally (see Figure 3), consideration should be given to splitting the observation into two, thus allowing quantitative data to be recorded against each. Where the tension cracks do

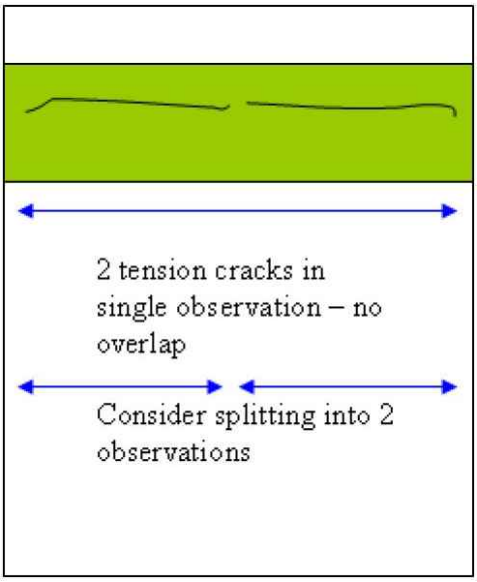


Figure 3 Non overlapping observation

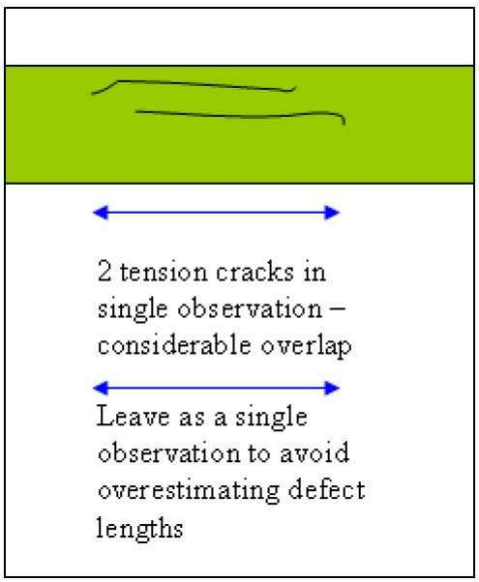


Figure 4 Overlapping observation

significantly overlap longitudinally (see Figure 4), the observation should not be split, as this will lead to over-estimation of the length of defects recorded.

In the case shown in Figure 4, the tension crack considered to be the most important

should be recorded. In order to ensure that consistent measurements are taken in cases such as this (particularly if monitoring is undertaken by more than one person), consideration should be given to physically marking the feature being monitored, with a numbered peg or similar.

14.3 Definition of measurements

The allocation of measured values to features (both geotechnical features and water features) is outlined in Table 1 (page 23). The measured values are:

- Volume of failed material (m³)
    - Maximum
    - Length (m)
    - Breadth (m)
    - Depth (m)
- Density (number per m²)
- Misalignment
    - Horizontal (m)
    - Vertical (m)
    - Angular distortion (degrees)
- Flow rate (litres/min)
    - Minimum
- Distance to feature from datum point

These values are discussed in more detail below, and their applicability considered.

Where one measured value is entered against a feature, it is mandatory that all values are entered (e.g. if you enter the length of ponding, you must also enter the breadth and depth).

Against each instance of quantitative details being recorded for a selected characteristic, it is recommended to enter a text comment. This can be used to record commentary on the details of that measurement, it is not intended to record details of the entire observation.

An example would be the recording of the volume of failed material due to ravelling in a rock cutting. If, between monitoring inspections, clearance of the material has been undertaken, a comment can be entered against the latest measurement to explain that this has occurred.

14.4 Volume of failed material (m³)

Features applicable to: Wedge/block failure, Planar failure, Slope Bulge, Ravelling, Toe Debris

The volume of failed material should be recorded as a total volume for the particular observation being measured. It is recognised that this measurement may be challenging to record with any great degree of accuracy in certain cases (see for example Figure 5). Where possible, measurements should be taken using a tape to record each dimension, and a volume calculated.

Where the material is small size (such as in Figure 5), reference to recognisable volumes may prove useful, for example:

Figure 5 Ravelled material from a rock slope

- 'Standard' 25kg bag of Portland Cement – approx. 0.015 m³
- Large bulk aggregate bag (from builders merchants) – approx. 0.9m³
- Standard concrete mixer wagon – approx.. 6m³

14.5 Maximum values

i Length, Breadth and Depth (m)

Features applicable to: Wedge/block failure, Planar failure, Subsidence, Slip, Terracing (depth only), Cracked Pavement, Tension Cracks, Desiccation, Ponding, Erosion

The length, breadth and depth metrics can be employed in a number of ways.

For defects relating to failed rock slopes (e.g. wedge/block failure and planar failure), the length, breadth and depth relates to the dimensions of the largest failed block.

For defects relating to cracking (e.g. cracked pavement, tension cracks and desiccation), the length, breadth and depth relates to:

- The length of the largest, or most significant crack, parallel to the road direction (for tension cracks), or the length of the area of desiccation cracking parallel to the road direction,
- The aperture of the largest, or most significant crack (recorded in the breadth field), at its maximum width

- The depth of the largest, or most significant crack, at its maximum depth

If an observation is to be monitored over a length of time, and potentially by different inspectors, it may be prudent to mark the measurement locations in some way (such as by a peg or other marker).

For defects relating to subsidence, ponding or erosion, the length, breadth and depth relate to:

- The length of the defect, parallel to the road direction,
- The breadth of the defect at its maximum point,
- The depth of the subsidence depression, or the ponding or erosion feature at its maximum point.

For soil slips (see Figure 6), the length, breadth and depth relate to:

- The length of the slip, parallel to the road direction,
- The breadth of the slip at its maximum point, either measured from the backscarp to the outer extent of the slope toe, or as a width of the backscar, depending on the slip morphology and which measurement is considered most appropriate. The measurement method used should be recorded, to ensure that future monitoring is undertaken in a repeatable manner. This measurement is taken as a slope length (i.e. measured by a tape parallel to the ground surface, not as a horizontal plan measurement),
- The depth of the slip, from the top of the backscarp to the top of the failed material below the backscarp.

It is recognised that in many cases, the Length dimension is already inherently included for a defect by the recorded length entered when locating the defect observation. The length recorded using the new functionality is included to allow recording at a greater level of accuracy (certainly more accurate than recorded by most GPS equipment).

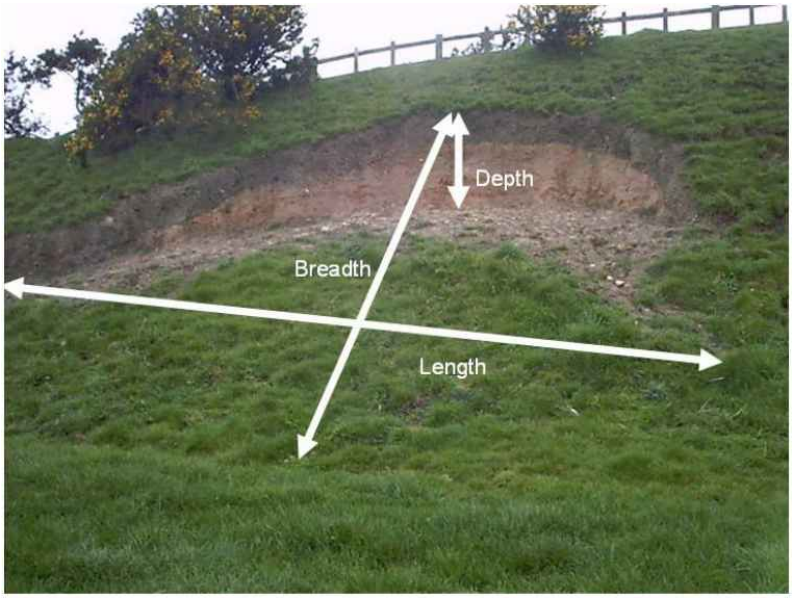


Figure 6 Length, breadth and depth of a soil slip

These measurement fields, particularly the breadth field can be used to record measurement of simple monitoring installations (such as solid pegs, installed into the ground either side of a slip backscarp). Where this type of monitoring is undertaken, it is recommended that a comment is recorded with each measurement.

ii Density (no. per m²)

Features applicable to: Desiccation, Animal Burrows

The density measurable is designed to record the intensity of features (desiccation cracks and animal burrows). It is intended to be used to record the maximum intensity of the feature within the extents of the defect. Simple measurement of the area of maximum cracking or burrowing should be carried out with a tape, and the number of features counted within the area. This should then be normalised to a per m² value.

To ensure accurate and reliable measurement, consideration should be given to marking out the measured area if practical, with pegs or similar markers.

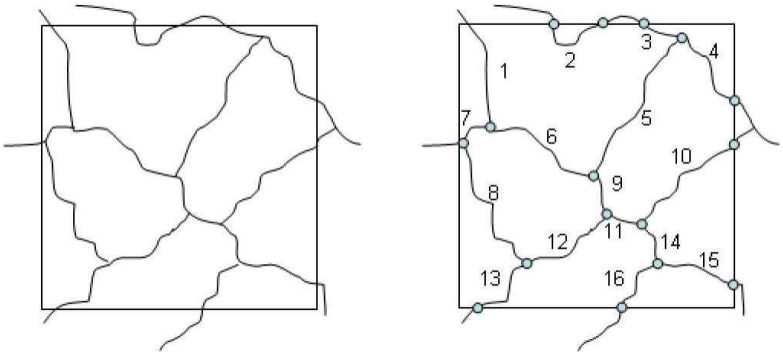


Figure 7 Suggested method for desiccation crack measurement

Measurement of desiccation cracking density is likely to be challenging in some cases, and an agreed and reproducible method should be employed for repeat visits to a defect. A suggested method would be to define each crack to be counted (within a defined area) as a single section of crack between ‘node’ points (which may be at the intersection between crack sections, or crack sections and the edge of the measured area). See Figure 7 for an example.

14.6 Misalignment values

i Horizontal and Vertical (m)

Features applicable to: Dislocated Fence/Barrier/Kerb

The horizontal and vertical misalignment measured valued are intended to allow measurement of the maximum misalignment of linear features (such as fences, safety barriers or kerbs). Care should be taken to ensure that any misalignment is due to a defect, and not the result of the poor installation of the measured feature. However, as it is recognised that the history of installation may not be known, if misalignment due to a geotechnical defect is suspected, measurements should be taken, and the monitoring over

time will determine if movement is ongoing.

The measurements, taken in the horizontal and vertical planes, should be taken at their maximum point, or at the point of maximum significance. To ensure accurate and reliable measurement, consideration should be given to marking out the measurement point if practical. One method of measurement that could be utilised is to stretch a taught line across the measured feature, from 'stable points, to create a datum line and measure the

Figure 8 Measurement of vertical misalignment

maximum misalignment to the feature from that line (see Figure 8).

ii Angular Distortion (Degrees)

Features applicable to: Distorted structure, Dislocated Trees, Dislocated Fence/Barrier/Kerb

This measurable is intended to record the maximum angular distortion of a feature from its intended orientation. In most cases, this will be a deviation from the vertical, but a horizontal element to the total misalignment can also be recorded (see Figure 9).

Many of the sighting clinometers used to determine slope angles in Geotechnical Asset inspections also have a dial that can be used to obtain accurate measurements. Alternatively, a compass with clinometer needle can be used.

Figure 9 Measurement of angular distortion of a fence post

14.7 Flow rate (litres/min)

Features applicable to: Leachate, Seepage

Measurement of the flow rate of natural water (seepage) or leachate can be recorded using the new quantitative defect measurement functionality. It is considered that the instances of measurable seepages of this kind are likely to be rare.

It is also recognised that this measurement may not be possible to a great degree of accuracy, but where the defect is particularly significant, accurate measure using timed collection of known volumes (bearing in mind that appropriate caution would be needed in the case of leachate or other contaminated liquids) or V-notches may be appropriate.

14.8 Minimum distance

Features applicable to: All geotechnical and water features

The minimum distance measurable is intended to give a measure of the proximity of the feature to common highway features that are static, and can hence act as datum points for measurement. The list of highway features provided is given below, with abbreviations in italics:

- Communications cabinet (m) - *Comms cabinet*
- Communications cable (m) - *Comms cable*
- Drainage (m)
- HA Boundary (m)
- Hardshoulder (m)
- Inhabited building(s) (m) - *Inhabited builds*
- Non-inhabited building(s) (m) - *Non-inhab builds*
- Pylon (m)
- Running lane (m)
- Safety barrier (m)
- Structure (m)
- Other (m)

These can be used to record a minimum distance relative to a datum point that is described.

In order to ensure that consistent measurements are taken (particularly if monitoring is undertaken by more than one person), consideration should be given to physically marking the measurement point of the feature (with a peg or similar) and the datum point.

14.9 Recording

Quantitative measurements should be supplemented by sketches, photographs and descriptions where necessary. Photographic evidence of the deterioration of a defect can provide a powerful addition to the factual data collected and recorded.

14.10 Monitoring report

The results from quantitative measurement of defects can be viewed in the Asset Information System. A monitoring report is available for download in a Comma Separated Value (CSV) format, suitable for use in spreadsheet software. The report has several sections:

- Header information
- A list of the observation inspection history, including which features were selected against each inspection
- A summary of quantitative defect measurements for each observation, where data has been recorded. This is presented with the inspection date, to allow rapid production of graphs of measurements over time.

		Max				Misalignment				Minimum
Feature	**Volume of failed material (m^3)**	**Length (m)**	**Breadth (m)**	**Depth (m)**	**Density (no. per m^2)**	**Horizontal (m)**	**Vertical (m)**	**Angular distortion (°)**	**Flow rate (l/min)**	**Distance from feature to datum (m)**
Main Feature Page										
Wedge/Block Failure	X	X	X	X						X
Planar Failure	X	X	X	X						X
Subsidence		X	X	X						X
Slip		X	X	X						X
Slope Bulge	X									X
Terracing				X						X
Ravelling	X									X
Toe Debris	X									X
Leachate									X	X
Cracked Pavement		X	X	X						X
Distorted Structure								X		X
Dislocated Trees								X		X
Disloc Fence/Barrier/kerb						X	X	X		X
Tension Cracks		X	X	X						X
Desiccation		X	X	X	X					X
Poor Backfilled Excavation										X
Unbackfilled Excavation										X
Animal Burrows					X					X
Debris Fence										X
Landfill in Proximity										X
Comms/Cable Trench										X
Other										X

		Max				Misalignment				Minimum
Feature	**Volume of failed material (m^3)**	**Length (m)**	**Breadth (m)**	**Depth (m)**	**Density (no. per m^2)**	**Horizontal (m)**	**Vertical (m)**	**Angular distortion (°)**	**Flow rate (l/min)**	**Distance from feature to datum (m)**
Main Feature Page										
Seepage									X	X
Marshy										X
Ponding		X	X	X						X
Erosion		X	X	X						X
Hydro Vegetation										X
High MC										X

Table 1 Feature and measured value matrix

15 Partial/complete Inspections

The risk-based approach to inspection frequency requires an understanding of the last compete inspection date. As the inspection regime is set at earthwork level the last complete inspection is taken as the last date where ALL observations relating to an earthwork have either been approved or superseded. Observations marked as preliminary will prevent the last inspected date being updated. Note that archived observations do not affect the last inspected date.

It is therefore important that all observations are approved in a timely manner to ensure the complete inspections are recorded.

16 Access Constraints

It is very important to record when it is not possible to inspect an asset to provide evidence to support a possible claim and also to flag that maintenance or special access may be required to fully manage the asset.

Typical reasons for limited or no access are:

- impenetrable vegetation
- ongoing (site) works
- roped access required

This information should be recorded in the field at the time of the inspection and any concerns the inspector may have should be raised with the Managing Agent Geotechnical Liaison Engineer for further action.

17 Height of Reinforcement

Some earthworks comprise two or more methods of construction (see page 61). This is increasingly the case where smart motorway schemes have required embankments or cuttings be steeped to gain additional carriageway width.

The method of recording an earthwork with reinforcement is as follows:

1. Record the slope geometry and characteristics (note the slope is the un-reinforced soil slope).
2. Record the type of reinforcement (e.g. retaining wall, gabions etc.)
3. Record the approximate percentage of the whole earthwork height that comprises the part that is reinforced.

The figure overleaf shows a example.

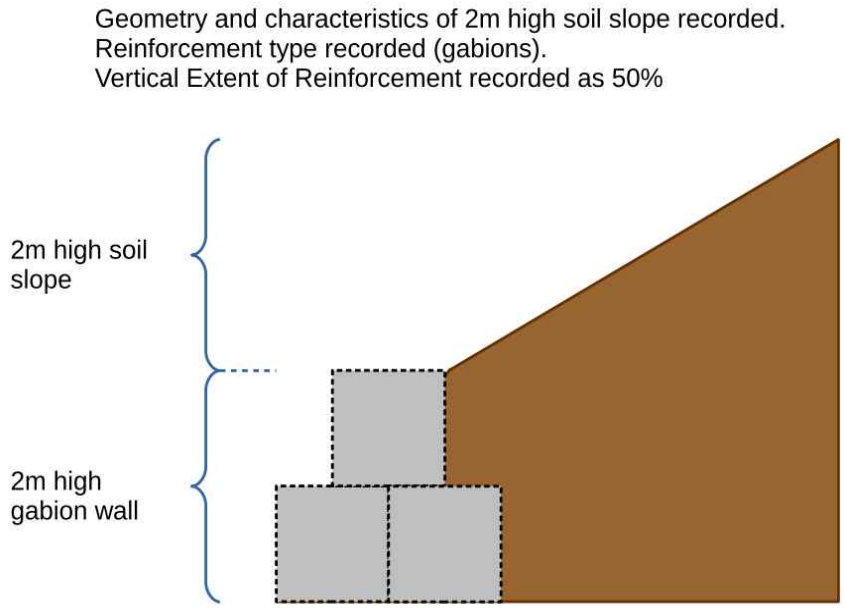


Figure 10 Example of a partially reinforced earthwork

18 Causal Hazards and Defect Triggers

When trying to identify reasons for defects it is important to understand the problems or hazards that existed in the vicinity of the defect and the trigger that finally caused the defect to occur. The difference between the two can be quite subtle and there may be more than one hazard or trigger. Examples are given below for illustration:

Scenario	Causal Hazard	Defect Trigger
A cutting slope has had “washout” after very heavy rain resulting in material being deposited on the carriageway.	Erosion of slope & inadequate drainage	Exceptional Rainfall
A hole has opened up in the central reservation, along a filter drain.	Cavities - natural & drainage damaged	Exceptional Rainfall
An embankment slope has a shallow slip defect.	Locally oversteepened slope	Unknown

Table 2 Examples of Causal Hazards and Defect Triggers

19 Maintenance Requirements

Where inspections show that maintenance is required this should be recorded. This maintenance may be one-off, or carried out at set intervals. Note that the maintenance may not be geotechnical maintenance, e.g. vegetation clearance.

Examples of maintenance activities are:

- Clear rock nets
- Vegetation clearance
- Monitoring

If the inspector is unsure of the maintenance requirement they should record that their assessment needs to be confirmed.

The Managing Agent Geotechnical Liaison Engineer should consider the need for maintenance requirements and raise the action with the relevant person. Some requirements may not be routine (e.g. monitoring) and may require approval by the Overseeing Organisation.

20 Example Observations

During inspections characteristics are recorded. These characteristics are illustrated in the following sections using photographs taken on Highways England's network. Where the characteristics are deemed to be a feature the feature has been assigned Class and Location Index, and a Feature Grades derived. There is also a commentary to explain the decision process. It should be remembered that the assessment process is subjective and there are sometimes areas where assessment opinions will differ.

Note:The recommended Feature Grades shown in the following section may not concur with those actually recorded in the geotechnical asset management system. This is partly due to assumptions having been made for the purposes of this document that may not actually exist on site and partly due to the changes between HD41/03 and HD41/15.

The term "5 Years" is synonymous with "Subsequent" in the examples.

The categories and associated photographs are listed in Table 2. Note that not all features have example photographs. If you have photographs that you think will help demonstrate features or defects please email them to david.patterson@highways.gsi.gov.uk, using the subject line "GADManual", quoting the HAGDMS observation reference.

Table 3 Index of Features and Photographs

Soil Slip

1

General Description: Major rotational embankment slip showing back scar and toe bulge.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): B
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: This is clearly a major slope failure and requires immediate attention.

2

General Description: Major embankment soil slip showing clear back scar.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): C
Feature Grade (Initial): 4

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 3

HD41 Feature Grade: 4

Comment: The slip is greater than half the height of the embankment and is considered to be a major defect. It has therefore been assigned an Initial Feature Grade 1A. It is considered unlikely to affect the carriageway within 5 years therefore the location index remains C.

Soil Slip

3

General Description: Major embankment soil slip. Back scar is very close to the safety fence.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): A
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: This slip is major, hence the Class 1A rating. Other slips and minor features are present on the embankment. The verge at the back of the safety fence has been reduced and the barrier may not work as designed. This is a safety-critical defect and the relevant asset manager should be notified ASAP.

4

General Description: Shallow embankment Slip.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): C
Feature Grade (Initial): 4

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): B
Feature Grade (5 Year): 4

HD41 Feature Grade: 4

Comment: The current location index of this slip is recorded as C because it doesn't currently affect the carriageway and there is no safety fence.

Soil Slip

5

General Description: Cutting slip showing back scar and toe bulge encroaching onto the verge.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): C
Feature Grade (Initial): 4

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 4

Comment: The slip has not encroached onto the carriageway, therefore the current location index is C. This slip should be flagged for frequent inspections in case the toe moves towards the running lane.

6

General Description: Small cutting or embankment slip showing back scar and toe bulge.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): B
Feature Grade (5 Year): 4

HD41 Feature Grade: 4

Comment: The slip is localised and displacement is small. The engineer has judged that the slip is not affecting the safety barrier, but the relevant asset manager should be informed. The slip is likely to deteriorate to a major slip within 5 years and the location index has been raised to B. because it is considered likely to affect the safety barrier.

Soil Slip

7

General Description: Small embankment slip showing minor back scar. Safety barrier at crest.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 3

HD41 Feature Grade: 3

Comment: This slip is typical of many localised shallow slips on the network. This example is currently not directly affecting the safety barrier, however the 5 year assessment considers that it is likely that it will.

8

General Description: Embankment slip adjacent to a structure showing back scar and toe bulge.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): B
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 3

HD41 Feature Grade: 3

Comment: This localised slip is typical of those found adjacent to structures. The cause is an over-steep slope created to tie in the approach embankment to the structure. Although the slip is restricted to the earthwork, because of the proximity to the structure, the structures asset manager should be informed.

Soil Slip

9

General Description: Cutting slip showing back scar and toe bulge.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 4

Comment: The slip is localised and quite small, however in the opinion of the engineer, within 5 years it is likely that the slip will increase in size to a major soil slip and encroach onto the running lane and/or affect the structure/safety barrier. The 5 year assessment increases the Feature Grade. It would also be prudent to monitor the slope, taking quantitative readings of displacement and size.

Soil Slip - Dislocated Trees

10

General Description: Cutting slip showing back scar dislocated trees.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): C
Feature Grade (Initial): 4

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 3

HD41 Feature Grade: 4

Comment: The defect is the major soil slip, which has a clearly visible, large back scar. The dislocated trees are an indicator of soil movement. The shape of the trees and the overgrown nature of the back scar indicates that there was probably a single episode of movement, which has stabilised for the time being. The defect should be monitored.

11

General Description: Minor cutting slip showing hummocky ground and occasional dislocated trees.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The defect is the shallow soil movement indicated by the dislocated trees. The shape of the trees indicates that there are constant minor movements. The engineer has decided that the size of the defect is not likely to increase in 5 years and the location index will remain the same.

Soil Slip - Pavement Cracking

12

General Description: Soil Slip indicated by significant cracking in the hard shoulder.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): B
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: The cracking in the hard shoulder is very likely to be geotechnically related as opposed to a road pavement defect because of the significant vertical movement. Displacement is pronounced and requires immediate investigation.

13

General Description: Soil Slip indicated by arcuate cracking across the carriageway.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): A
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: The immediate cause of the cracking may not be clear, it could be non-geotechnical, i.e. a poorly backfilled trench, or backfill behind an abutment. The arcuate nature of the crack and vertical movement suggest that it may be related to soil movement so the engineer has classified it as a major geotechnical defect. Further inspection/investigation will be required to establish the cause of the cracking.

Soil Slip - Combination of Characteristics

14

General Description: Boundary fence showing evidence of lateral movement and a tension crack at the crest of the slope.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): D
Feature Grade (Initial): 3

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 4

Comment: The combination of the significant movement of the fence and the large size of the tension crack suggest that a major defect is likely, hence the 1A classification. In the opinion of the engineer the defect is likely to affect the carriageway in 5 years. The defects should be monitored quantitatively.

15

General Description: Barrier fence showing rotational movement and a tension crack behind the safety barrier. Localised defect.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): A
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: The combination of significant movement of the boundary fence and tension crack justifies the 1A classification of a major defect. The defect is likely to be safety-critical because it has compromised the performance of the safety barrier therefore the Location Index is A.. The relevant asset manager should be notified.

Soil Slip - Combination of Characteristics

16

General Description: Vertical movement of the safety barrier and carriageway.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): A
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: The photograph shows deformation of the safety barrier, but it also shows deformation of the solid white line, indicating that the defect is under the running lane, hence the "A" location Index. Because there is distortion to the safety barrier, the defect should be treated as safety-critical and the relevant asset manager informed.

Subsidence

17

General Description: Subsidence underneath the carriageway and safety fence.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): A
Feature Grade (Initial): 4

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 4

Comment: The defect is safety-critical because the performance of the safety fence and/or carriageway is very likely to have been compromised. The relevant asset manager should be notified.

18

General Description: Subsidence at the base of a sign.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): B
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): B
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: There is minor subsidence to a poorly cast sign base. There is also a comms/service cable at the top of the slope. The defect should be inspected frequently and the relevant asset manager informed of the condition.

Subsidence

18a

General Description: Subsidence in central reserve.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): A
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: The defect is safety-critical because the performance of the safety fence and/or carriageway has been compromised.

Ravelling

19

General Description: Cutting slip showing minor ravelling and fallen blocks.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The ravelling is minor and set back from the carriageway edge. The engineer has decided that it is unlikely to deteriorate within 5 years.

20

General Description: small fallen blocks of rock close to the carriageway.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 3

HD41 Feature Grade: 3

Comment: The fallen blocks of rock are not encroaching onto the carriageway at the time of inspection. The engineer considers that within 5 years the accumulation of blocks will eventually impinge onto the carriageway. This defect should be flagged for frequent monitoring.

Ravelling - Debris Fence

21

General Description: Ravelling, debris Fence working well.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The defect (ravelling) has been given a class 1D because of the size of the fallen blocks. The debris fence is deformed but working well. It should be noted that maintenance will be required to clear the debris in the fence.

22

General Description: Ravelling. A debris fence has been working well but is now full.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 3

HD41 Feature Grade: 3

Comment: The defect is considered to be minor. The debris fence should be inspected and programmed for maintenance/replacement as soon as possible.

Terracing

23

General Description: Minor Terracing.

Recommended Class (Initial): 2
Recommended Location Index (Initial): C
Feature Grade (Initial): 2

Recommended Class (5 Year): 2
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 1

HD41 Feature Grade: 2

Comment: Terracing is a common feature of over-steep slopes, especially on weak rock formations and soil slopes. The feature has been classified as “at-risk” rather than a defect, because it is a common slope evolution process.

Tension Crack

24

General Description: Cutting slope showing tension crack at crest.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): D
Feature Grade (Initial): 2

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 4

Comment: The tension crack is at the top of a cutting. The defect considered minor at the time of the inspection due to its limited extent, however in the opinion of the engineer the tension crack is likely to develop into a major defect within 5 years that will affect the carriageway. The defect should be monitored taking quantitative readings.

25

General Description: Minor tension crack on embankment slope.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

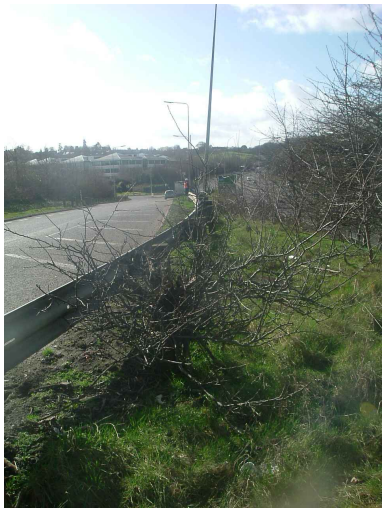
HD41 Feature Grade: 3

Comment: Because tension cracks can be an early indicator of slips, the crack width should be monitored, taking quantitative readings.

Distorted Structure

26

General Description: The inspector has noticed that a lighting column has rotated The cause is unknown.



Recommended Class (Initial): 2
Recommended Location Index (Initial): C
Feature Grade (Initial): 2

Recommended Class (5 Year): 2
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 1

HD41 Feature Grade: 2

Comment: The exact cause of the movement of the lighting column is uncertain (poor foundations, vehicle impact, or ground movement), so the classification of the observation has been assigned 2 ("at-risk"). The relevant asset manager should be informed and a detailed inspection carried out.

27

General Description: Distorted crib wall.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The crib wall structure has become distorted and is not working properly. The structures asset manager should be informed.

Leachate

28

General Description: Diesel leaking onto a cutting slope from an adjacent land owner.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): B
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: Whilst this defect isn't "geotechnical" it is unlikely to be recorded elsewhere, therefore it is appropriate to record it and classify it on the geotechnical asset management system. The defect should be brought to the attention of the relevant technical expert ASAP.

Desiccation features

29

General Description: Small cracks in ground surface.

Recommended Class (Initial): 2
Recommended Location Index (Initial): C
Feature Grade (Initial: 2

Recommended Class (5 Year): 2
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 1

HD41 Feature Grade: 2

Comment: Desiccation cracks are often found in soil during prolonged periods of dry weather. They rarely pose a problem on their own. It may be an indication that the soil is susceptible to shrinkage and swelling, so adjacent structures should be investigated.

Toe Debris

30

General Description: Mud flow debris at the base of a cutting slope.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): A
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: The debris has washed out of the slope following a heavy rain event. It has blocked a part of the carriageway. The risk rating could be carried out again once the incident has been cleared up. The 5 year risk rating assumes that the flood event will occur again in 5 years.

31

General Description: Debris from a localised cutting slope failure encroaching under a safety barrier.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): A
Feature Grade (Initial): 4

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 4

Comment: Soil has washed out/slipped under the safety barrier. The vegetation indicates that it is an old feature that may have stabilised. It is a safety-critical defect because the safety barrier is compromised so the relevant asset manager should be notified. A geotechnical engineer should be involved in the design of any works to repair the barrier as it will involve removal of material from the toe of the slip.

Animal Burrows

32

General Description: Embankment showing rabbit burrows.

Recommended Class (Initial): 2
Recommended Location Index (Initial): C
Feature Grade (Initial): 2

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

HD41 Feature Grade: 2

Comment: The rabbit burrows have fresh soil around the entrances, indicating that the warren is active, but there is no sign of a defect to the carriageway or slope. The engineer considers it likely that within 5 years the rabbit burrows are likely to cause a minor defect. The site should be quantitatively monitored to determine whether the warren is getting larger.

33

General Description: Wooded cutting slope showing badger activity.

Recommended Class (Initial): 2
Recommended Location Index (Initial): C
Feature Grade (Initial): 2

Recommended Class (5 Year): 2
Recommended Location Index (5 Year): B
Feature Grade (5 Year): 1

HD41 Feature Grade: 2

Comment: Badger setts can be distinguished from rabbit warrens by significant amounts of spoil around the entrances. The advice of an environmental expert indicates that the sett is unlikely to increase in size over 5 years. The sett should be quantitatively monitored and the environmental expert informed of any changes.

Poorly Backfilled Trench

34

General Description: Collapsed/poorly backfilled Trench.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): B
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): B
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The trench is a hazard for road users who may need to seek refuge behind the safety barrier. The relevant asset manager should be informed.

Communications Trench

35

General Description: Exposed communications cable at the top of an embankment slope.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The engineer has decided that the defect is not likely to be a major defect within 5 years. The relevant comms asset manager should be informed.

Landfilling

36

General Description: Landfilling operations adjacent to the carriageway.

Recommended Class (Initial): 2
Recommended Location Index (Initial): C
Feature Grade (Initial): 2

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

HD41 Feature Grade: 2

Comment: At this site the landfill operations weren't being controlled properly. There is no current defect, but the engineer has assessed the site to be "at-risk" (2) The relevant property/planning manager should be notified immediately.

Reinforcement

37

General Description: Revetment showing broken gabion mats.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): D
Feature Grade (Initial): 3

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): D
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The gabion mats forming the base of the revetment have broken. The revetment is quite a distance from the carriageway. Monitoring is recommended, especially after storm events.

38

General Description: Break in geogrid/mesh protecting the rock slope.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): C
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: It appears that the geogrid has been broken by a vehicle running into the slope. The site should be monitored.

Reinforcement

39

General Description: Counterfort drain installed as a preventative measure.

Recommended Class (Initial): 3
Recommended Location Index (Initial): C
Feature Grade (Initial): 1

Recommended Class (5 Year): 3
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 1

HD41 Feature Grade: 1

Comment: The soil slope has had preventative works carried out. Counterfort slope drains have been installed.

40

General Description: Embankment granular repair

Recommended Class (Initial): 3
Recommended Location Index (Initial): C
Feature Grade (Initial): 1

Recommended Class (5 Year): 3
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 1

HD41 Feature Grade: 1

Comment: A soil embankment has been repaired using excavation and granular replacement.

Reinforcement

41

General Description: Embankment slope repair using gabion baskets.

Recommended Class (Initial): 3
Recommended Location Index (Initial): C
Feature Grade (Initial): 1

Recommended Class (5 Year): 3
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 1

HD41 Feature Grade: 1

Comment: A defect has been repaired using gabion baskets.

Other Defects

42

General Description: Washout/settlement around a structure.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): B
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): B
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The photos appears to show that soil has been washed under a structure. The Structures asset manager should be notified. The cause of the washout would need to be traced.

43

General Description: Localised washout from a drainage defect on an embankment.

Recommended Class (Initial): 1A
Recommended Location Index (Initial): A
Feature Grade (Initial): 5

Recommended Class (5 Year): 1A
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 4

HD41 Feature Grade: 5

Comment: The washout has been caused by a drainage defect. The running lane is very close to the unsupported slope and the safety barrier has been undermined so the location index has been set to A. The defect is safety-critical and the relevant asset managers should be informed.

Other Defects

44

General Description: Settlement/erosion of soil to a sign base.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): B
Feature Grade (Initial): 3

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): B
Feature Grade (5 Year): 2

HD41 Feature Grade: 3

Comment: The soil has settled or eroded away from the sign base. The stability of the structure may be compromised so the relevant asset manager should be notified immediately.

45

General Description: Seepage at the base of a soil cutting

Recommended Class (Initial): 2
Recommended Location Index (Initial): C
Feature Grade (Initial): 2

Recommended Class (5 Year): 2
Recommended Location Index (5 Year): C
Feature Grade (5 Year): 1

HD41 Feature Grade: 2

Comment: The photograph shows seepage together with hydrophilic vegetation, suggesting that the seepage is constant and not due to a single rainfall event.

Other Defects

46

General Description: Paving slab revetment broken by road traffic accident.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): A
Feature Grade (Initial): 4

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 3

HD41 Feature Grade: 4

Comment: It appears that the paving slab revetment has been broken by an RTA and observations indicate that the site may be subject to frequent incidents. The warning measures (traffic cones) are encroaching onto the running lane so a location index of A has been assigned. The structures asset manager should probably be informed, even though it is technically not a structure.

47

General Description: Low height stone retaining wall/revetment is damaged.

Recommended Class (Initial): 1D
Recommended Location Index (Initial): A
Feature Grade (Initial): 4

Recommended Class (5 Year): 1D
Recommended Location Index (5 Year): A
Feature Grade (5 Year): 3

HD41 Feature Grade: 4

Comment: The wall/revetment has deteriorated and fallen blocks may present a hazard. The relevant asset manager should be informed and the site monitored.

Non-Geotechnical Pavement Cracking

48

General Description: Minor cracking of the carriageway.

Recommended Class (Initial): N/A
Recommended Location Index (Initial): N/A
Feature Grade (Initial): N/A

Recommended Class (5 Year): N/A
Recommended Location Index (5 Year): N/A
Feature Grade (5 Year): N/A

HD41 Feature Grade: N/A

Comment: The cracking is minor, and almost certainly due to poor pavement edge construction and/or specification. It is not a geotechnical defect, but should be reported to the relevant asset manager.

49

General Description: Longitudinal cracking in the footway and in the carriageway.

Recommended Class (Initial): N/A
Recommended Location Index (Initial): N/A
Feature Grade (Initial): N/A

Recommended Class (5 Year): N/A
Recommended Location Index (5 Year): N/A
Feature Grade (5 Year): N/A

HD41 Feature Grade: N/A

Comment: The cracking is due to shrinkage of the soil caused by moisture demand from the adjacent trees. Because there is no underlying geotechnical feature such as a slip, the responsibility for maintenance of the carriageway and footway rests with the highways team. To record this as a geotechnical feature as a defect would be “double counting”. However it could be recorded and not assigned a class or risk rating. It would be prudent to inform the highways team and provide input into the design of the reconstruction.

Non Backfilled Excavation

50

General Description: Non-backfilled excavation.

Recommended Class (Initial): N/A
Recommended Location Index (Initial): N/A
Feature Grade (Initial): N/A

Recommended Class (5 Year): N/A
Recommended Location Index (5 Year): N/A
Feature Grade (5 Year): N/A

HD41 Feature Grade: N/A

Comment: The excavation is behind a safety barrier and adjacent to a lamp post on an at-grade section. It is a minor, non-geotechnical defect, but it is safety-critical, especially to road users who may need to seek refuge behind the safety barrier. It must be reported to the relevant asset manager. If the excavation was at the crest of an embankment and could cause instability by collect of water and discharge into the slope it should be treated as a geotechnical defect.

Drainage Observations

Lined Ditch **51**

Unlined Ditch **52**

Damage/defects to the side walls and the partial blockage should be reported to the Asset Manager.

Herring bone drainage **53**

These drains are part of the design of the slope. They should be recorded but feature grade assigned because they are not part of a repair.

Reinforcement Observations

Gabions **54**

Note that these were installed as part of the original slope design and therefore do not need to have a feature grade assessment.

Crib Wall **55**

This crib wall was designed as part of widening works. It is not a slope repair and therefore does not need have a feature grade assessment.

Seepage Observations

Water Seepage from a rock. **56**

This seepage is not a defect, it's a naturally occurring feature. It should be recorded as an observation, and monitored, especially if there are down-slope hazards.

Ponding **57**

Erosion **58**

21 Engineering glossary

The following terms are used by structural and drainage engineers to describe features of structures or other objects. It is useful for inspectors to understand the meaning of the terms to ensure effective communication, when describing defects.

Abutment - The end supports of an arch or a bridge.

Bank Seat - An abutment on the top of a soil slope**.**

Counterfort Drain - a deep drain, backfilled with gravel. The drain is deep enough to cut into a competent layer.

Crown - The underside of (the top) of a pipe.

Defect - Any feature which compromises the original design or function of an earthwork. (this definition is specific to geotechnical asset management)

Gabion - A mesh box (normally steel) filled with large diameter stones.

Herringbone Drain - A shallow drain, backfilled with gravel, cut into a slope, with branches to pick up water. In plan it resembles the backbone of a fish.

Invert - The bottom of the inside of a pipe or structure (opposite to soffit)

Parapet - The safety barrier that is installed on the edge of a bridge or on a retaining wall or similar structure where there is a vertical drop

Reinforced Soil Slope - a slope (<70°) containing materials other than soil, e.g. geogrid, fibres etc.

Revetment - thin sloping structure protecting an earth bank, often found underneath bridge bank seats.

Soffit - The underside of (the top) a structure. Sometime used for pipes.

Spandrel wall - The wall on the outer surface of an arch.

Weep Hole - Hole in the face of a retaining structure, generally near the base, to allow water pressure to dissipate.

If there are other terms you would like to see included please email them to support@hagdms.com, with the subject line “GADManual”.

22 References

Documents that are relevant to this Guidance Note are listed below.

- Highways Agency (2015). HD41/15: Maintenance of Highway Geotechnical Assets. Design Manual for Roads and Bridges. Volume 4. Section 1. Part 3. (Download from www.dft.gov.uk/ha/standards/)
- HAGDMS / HADDMS User Manual *

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