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How new standards for geotechnical and environmental site investigation and design could enable more sustainable developments

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Agenda

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- Concrete
- Current Situation
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- Changes in Policy - BS10175
- Integrated Investigations
- Potential Benefits & Implications
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Introduction

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- Geo-Environmental Services Limited is an independent practice of geotechnical engineers, environmental consultants and investigation contractors
- A trusted and established supplier of geotechnical and environmental services since 1996 for:
  - **Utilities**
  - **Housing Development**
  - **Rail and Transport**
  - **Commercial Development and Civil Engineering**
  - **Public Sector**

The Pressures Facing the Industry

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Demand for Services
- Availability of mortgages
- Cut backs in public spending

Inflation
- Cost of services and materials used by our suppliers
- Profit margins of our clients

Less Work More Competition

Cost of Projects and Timescales

Cost of Projects & Acceptance of Costs

Cost of Projects and Training

New Companies More Competition

Policy
- Focus on brownfield development
- Changes in planning procedures

Changes in standards
- Geotechnical design
- Contaminated sites investigations

Unemployment
- More people setting up independently

Concrete

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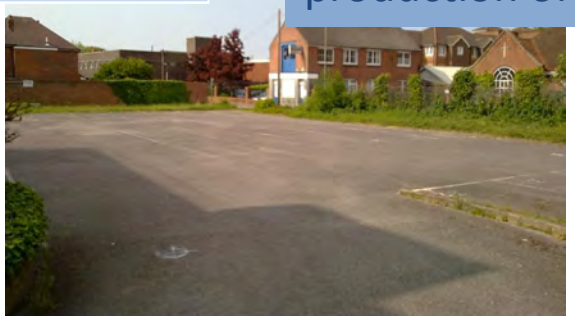
Majority of developments use large volumes of concrete in their foundations, particularly where more complex/difficult ground conditions are involved.

Cement manufacture accounts for 3-4% of global man made CO_2, with additional emissions of CO_2 through the quarrying and transportation of materials used in the production of concrete.



According to DEFRA the average UK citizen is responsible for creation of 11.1 tonnes of CO_2 equivalent.

Government target to cut this to 2 tonnes of CO_2 equivalent by 2050 Therefore a significant change in behaviour/practices required

Use of fly ash or blast furnace slag in concrete mixes can reduce carbon footprint of concrete by up to 50% (ICE V1.6a)

Current Situation

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Speed of construction – Conservative designs

Limited knowledge or experience of ground improvement techniques

Insufficient ground investigation. Site investigations for ground improvement requires a greater emphasis on engineering properties of Made Ground and near surface weaker zones of natural soils.

Sustainable Developments

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Some case studies undertaken indicate ground improvement techniques offer 50%-75% reductions in CO2 emissions when compared to traditional foundations. Often other benefits as well:

Lower costs

Reduction in use of resources

Re-use of recycled concrete i.e. In vibro stone columns.

Shortened construction programme

Detailed site investigation is required in order to design economic ground improvement schemes. The introduction of the Eurocode 7 standard and changes to BS10175 standard could provide the catalyst for this.

Changes in Policy- Eurocode 7

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- The standard has been adopted across most of Europe.
- Mandatory in UK on larger public sector projects since April 2010
- There are two parts to the new standard:

Part I – General basis for the geotechnical aspects of the design of buildings and civil engineering works

Part II – Requirements for the execution, interpretation and use of results of laboratory and field tests to assist in the geotechnical design of structures

Key Changes in Practice - Spacing of Investigation Points

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Structure	Definition	Spacing	Arrangement
High-rise & industrial	-	15-40m	Grid
Large area	-	≤ 60m	Grid
Linear	Roads, railways, channels, pipelines, dikes, tunnels, retaining walls	20-200m	-
Dams & weirs	-	25-75m	Vertical sections
Special	Bridges, stacks, machinery foundations	2-6 per foundation	

Key Changes in Practice - Minimum Investigation Depths

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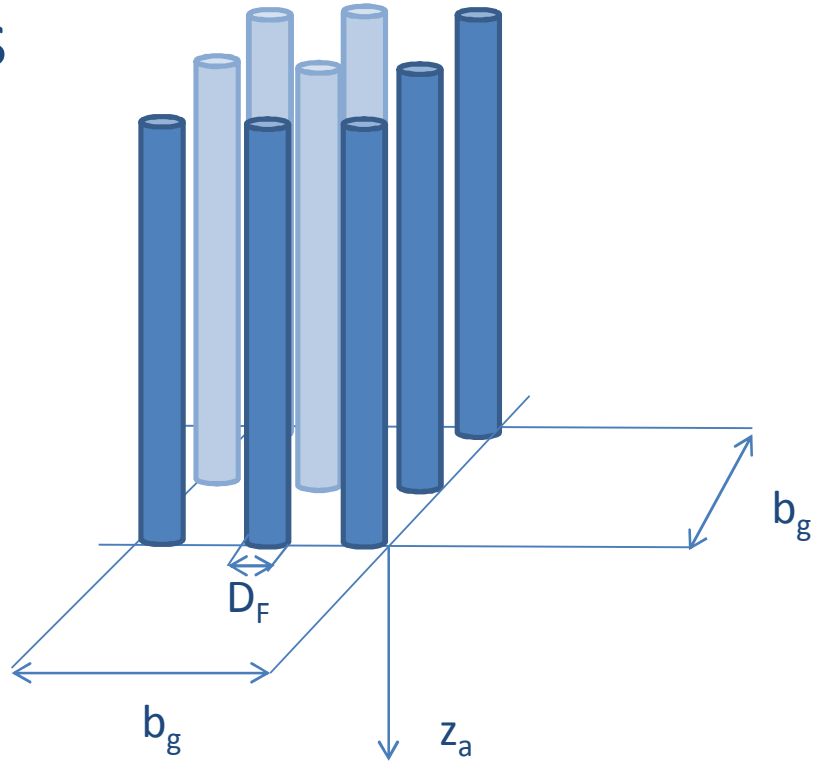
Piles

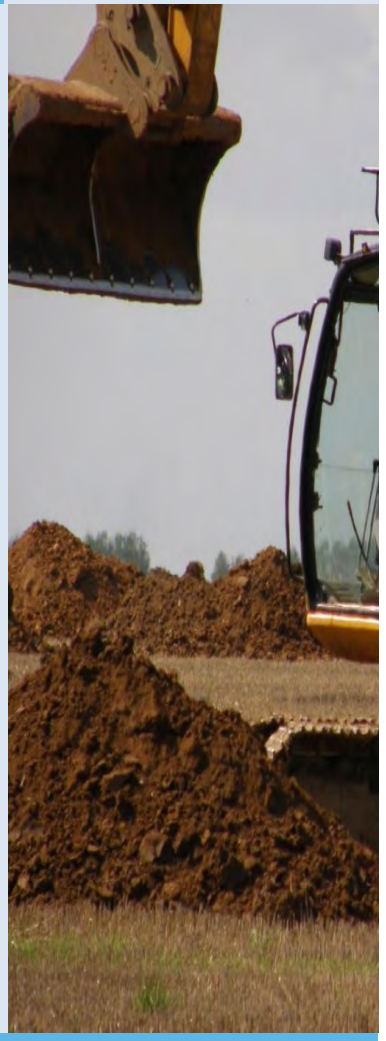


Recommended minimum depth of investigation beneath deepest pile is the max of:

$z_a \geq b_g$

$z_a \geq 3D_F$

$z_a \geq 5m$



Key Changes in Practice – Limit State Design

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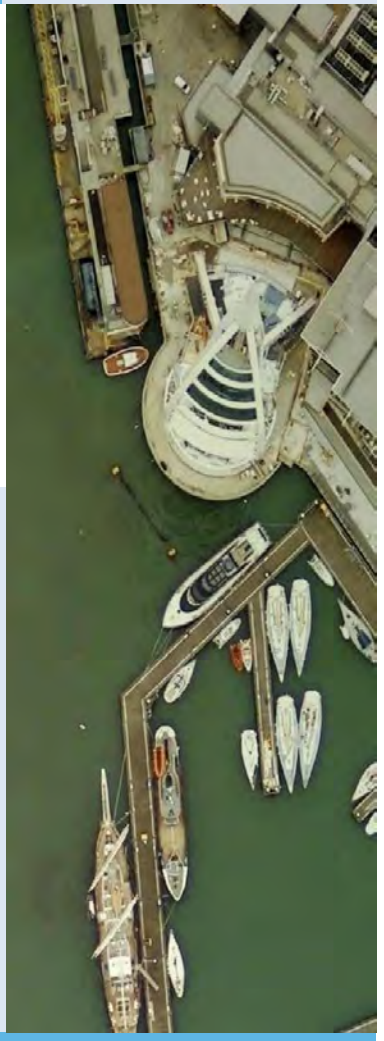
- **Historically, an allowable bearing pressure (equivalent of serviceability limit state) was calculated by applying a lumped factor of safety of 3 to ultimate bearing capacity.**

- **Going forward the new Eurocode 7 standard requires detailed knowledge of both building actions and ground resistance to calculate ultimate limit states and serviceability limit states using partial factors.**



Changes in policy - revisions to BS10175

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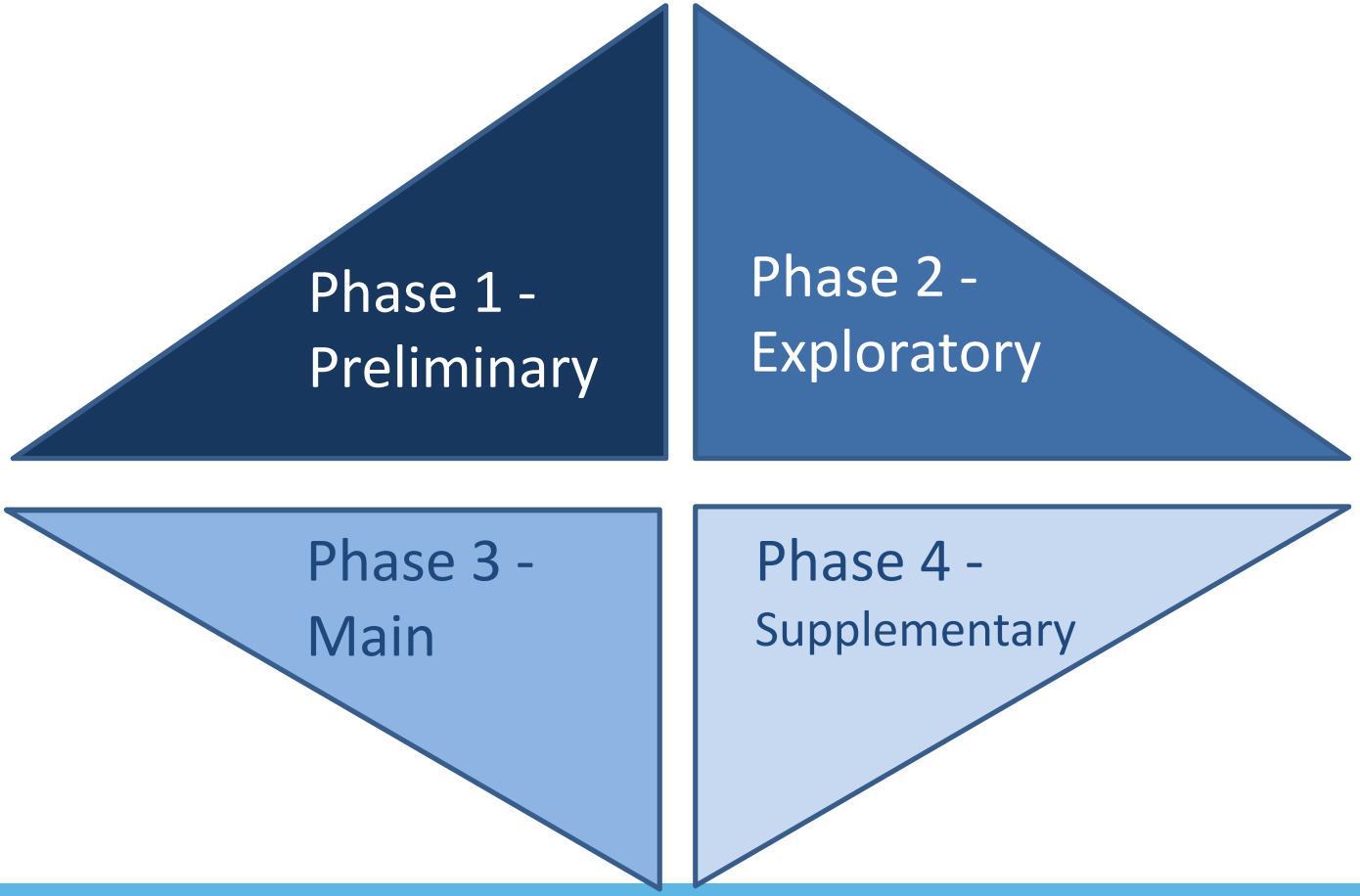
Changes in terminology – 4 phases of investigation



Changes in Policy - BS10175

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Revision in recommended sampling densities:

- Phase 2 – reduced from 50-100m to 25-50m
- Phase 3 – changed from 20-25m to 10-25m

Integrated Investigations

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Many investigations are integrated i.e. Geotechnical and environmental.

Must ensure that neither investigation is compromised by either depth or location of exploratory holes

Combining guideline sampling frequency of two standards will result in more detailed investigations

Implications

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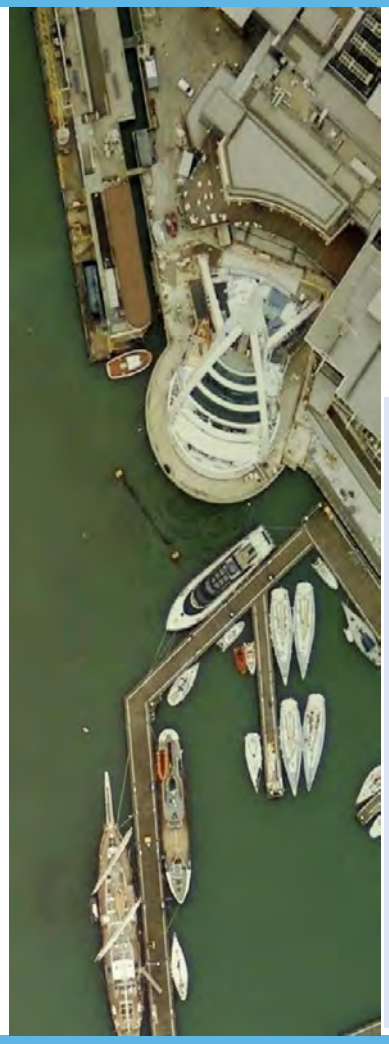
Opportunity to consider a broader range of investigation techniques. CPT rigs are very cost effective in terms of obtaining the parameters required for ground improvement techniques such as vibro-stone columns



The requirements in the new standards generally require more detailed investigation.

Limit state design offers potential for overall lower FoS for structures than historically used – providing a suitable number of boreholes and samples have been tested.

Potential Benefits

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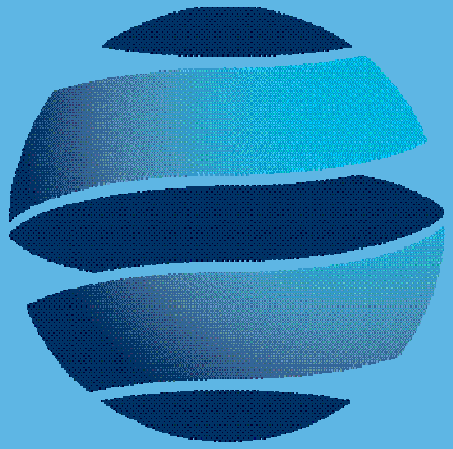
- De-risked sites – more investigation lowers probability of unforseen ground conditions
- Reduction in concrete use – Limit state design in conjunction with more detailed investigation
- Opportunity to consider more sustainable foundation solutions such as ground improvement



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Thank You Any Questions?

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