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## Site investigation for low-rise building: the walk-over survey

The walk-over survey is an integral and important part of the site investigation process which should always be carried out. Used in conjunction with a good desk study (Digest 318), it provides valuable information which cannot be obtained in any other way.

The object of the survey is to check and make additions to the information already collected during the desk study. The site and its surrounding area should be visited and covered carefully on foot. Local authorities, local inhabitants and people working in the area, such as builders, electricity and gas workers, should be questioned to obtain the benefit of their local knowledge. A structured report is then produced from the information gathered at the site and from local enquiries.

Fig 1



**While on site, two types of work can be carried out:**

- **site inspection**
- **local enquiries**

**SITE INSPECTION**

The site inspection involves walking across the whole site, making full use of the information obtained during the desk study. It is useful to have available maps and photographs that have been obtained and it is necessary to prepare a special site map, at a suitably large scale. On this should be marked by hand the geology and other features of special interest that have been noticed during the desk study. During the site inspection the position of any further features (eg trees, hedges, pits, exploratory holes) can be marked on the map, and the existence of previously identified features can be confirmed. The site inspection should not be confined to the site itself, but should include the surrounding area and its building stock.

A number of simple tools needed on site are shown in Fig 2. Among them are:

- 20 m or 30 m tape *to measure the position of features of interest*
- Compass *to orientate map*
- Pocket penetrometer or hand vane *to measure the strength of soil samples*
- Abney level or Rabone Chesterman 'Angle finder' *to measure the ground slope angles in the area*
- Posthole auger, spade and polyethylene bags *for taking soil samples*
- Camera *for visual records.*

**The following types of information should be recorded in a notebook:**

- **Slope angles** These can be obtained more accurately during the site visit than from Ordnance Survey maps. An Abney level or a Rabone Chesterman 'Angle finder' can be used. Slope angles can be interpreted in terms of the types of materials underlying the site: for example, rocks stand steeper than clays (Fig 3). Very flat ground near streams or rivers is probably associated with soft or loose alluvium.
- **Instability** Record the presence of hummocky, broken or terraced ground (Fig 4), or boggy, poorly drained conditions on hill slopes: these features may be associated with landslips. Look also for trees with bent trunks. Except in very windy localities, trees normally grow vertically; ground movements will cause them to make a change in direction. Kinks in hedgelines may also be a sign of past movements (Fig 5).
- **Vegetation** If the site is on shrinkable clay, make a complete record of the position of all trees and shrubs on site, together with their approximate sizes, heights and girths and, if possible, their species. Record the position and size of hedges, and note the absence of any trees, shrubs or hedges indicated on previous air photographs or in the records.



**Fig 2** Simple tools needed on site



**Fig 3** Slope angles... 'rocks stand steeper than clays'



**Fig 4** Instability... 'hummocky ground'



**Fig 5** Instability... 'kinks in hedgelines'

- **Made ground** Note the position of any infilling being carried out at the time of the site visit. Look for areas that may have been previously filled, by comparing the available Ordnance Survey maps and air photographs with what can be seen on the site.
  
- **Structures** Examine structures in the area and on site and record signs of damage (Fig 6). (See Digest 251 for methods of assessing damage). Where possible, obtain information on the types of foundation commonly used in the area and of any problems encountered by other builders. Make notes of any structures that are marked on air photographs or maps but which no longer exist.
  
- **Soil and rock** Look for exposures of soils or rocks (for example, in such places as railway cuttings — Fig 7); if any are found, make careful descriptions of them and take samples in the plastics bags. Clearly mark the bags with identifying numbers and mark the position from which they are obtained on a site plan. Where soft soils are present on site it should be possible to make shallow holes using an auger to get some idea of their characteristics. Samples from these holes should be sealed in bags, for future reference. Refill holes to prevent injury to livestock.
  
- **Groundwater** Note the positions of springs, ponds and other water. The absence of features such as these, which are shown on Ordnance Survey or geological maps or air photographs, may indicate that fill has been placed on the site. If holes are made to examine soil conditions, the presence or absence of groundwater should be noted.
  
- **Mining and quarrying** Look for signs of mineral extraction in the area. These may include old mine buildings, derelict or hummocky land, surface depressions (Fig 8), evidence of infilling or spoil heaps.
  
- **Solution features** Land underlain by chalk or limestone may contain naturally occurring voids or pipes filled with soft soils; these can collapse or settle beneath a structure. This type of ground is associated with dry valleys and surface hollows (Fig 9), and with areas where streams disappear into the ground.
  
- **Access** Check the ease of access for drilling rigs or hydraulic excavators which might be needed for detailed ground investigation work. Record and take photographs of the condition of gates and tracks which this plant might use, so that any damage caused can be properly quantified.



**Fig 6** Structures... 'record signs of damage'



**Fig 7** Soil and rock... 'exposure of soils or rocks in railway cuttings'



**Fig 8** Mining and quarrying... 'surface depressions'



**Fig 9** Solution features... 'dry valleys and surface hollows'

### LOCAL ENQUIRIES

Enquiries involve talking to local people and visiting sources of reference material. These include: libraries, muniment rooms, county archives, local history societies, natural history societies (because they often have information on local geology), planning authorities, universities and polytechnics.

- **Local builders** May be able to provide information on the ground problems and typical foundation designs of the area.
- **Local authorities** Will have extensive experience of building in their area and will be able to comment on general ground conditions, the possibility of flooding, any occurrences of structural damage in the area associated with ground movement, and previous site use. County councils normally employ a minerals officer who can be consulted about mining and quarrying activity.
- **Public utilities** Utilities such as gas, electricity and telephone will give information on the position of their services in and around the site — see Fig 10. These services must be avoided during ground investigation; they may need to be re-routed during development.
- **Libraries and archives** They hold records and maps of the site showing the position of old field boundaries, ponds, streams and pits or quarries (some of which may have been removed or infilled). These records can usually be hand copied.

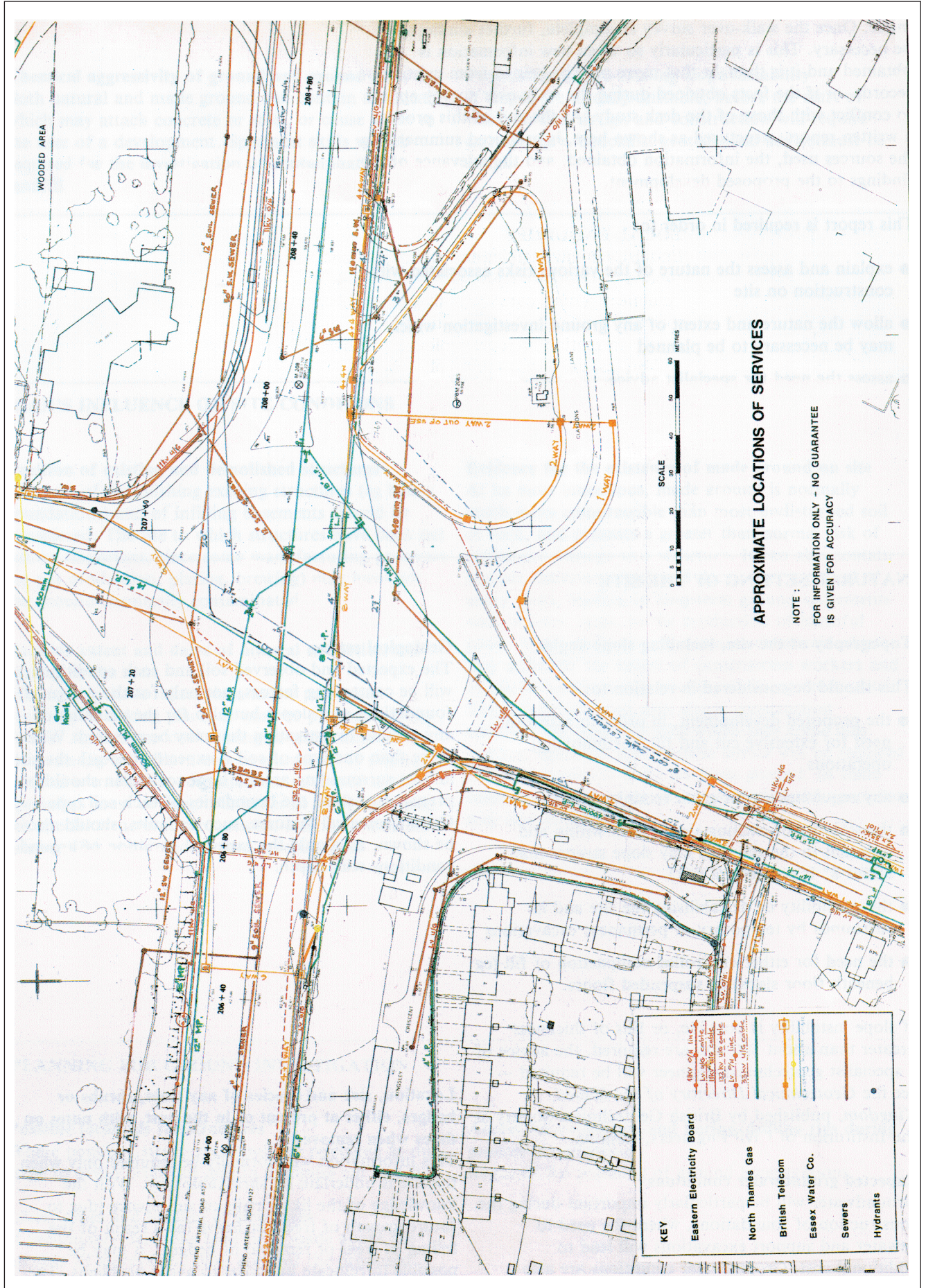


Fig 10 Map of services in an urban area — courtesy of Ove Arup & Partners

## THE REPORT

The desk study must be carried out before the walk-over survey is made. Once the walk-over survey is complete, further studies may be necessary. This is particularly so when new information is obtained and it is thought that more may be gained from existing records, or if the facts obtained during the walk-over survey appear to conflict with those of the desk study. At the end of this process a written report, structured as shown here, is produced summarising the sources used, the information obtained, and the relevance of the findings to the proposed development.

This report is required in order to:

- explain and assess the nature of the various risks associated with construction on site
- allow the nature and extent of any ground investigation which may be necessary to be planned
- assess the need for specialist advice.

### NATURAL SETTING OF THE SITE

#### Topography of the site, including slope angles

This should be considered in relation to:

- the proposed development, in order to assess the need for extensive cut and fill (earthmoving) operations
- any requirements for earth retaining walls
- the stability of existing slopes both within and adjacent to the site (any clay slope steeper than about 8° is a potential risk)
- the possibility of destabilising the site and its surrounds by temporary or permanent excavations
- the need for either controlled compaction of fill (eg beneath floor slabs) or suspended floors.

If slope instability is possible, or fills of thickness greater than about 500 mm are required, the advice of a specialist geotechnical engineer will be required — see the *Geotechnical Directory of the United Kingdom*, published by British Geotechnical Society at the Institution of Civil Engineers, London.

#### Expected groundwater conditions

Groundwater will be particularly important during the construction of foundations, where the need to dewater and support excavations will lead to additional cost. Groundwater conditions are also important in assessing the effects of trees on shrinkable clays, and chemical attack on concrete. Groundwater conditions have a profound effect on the pressures applied to earth retaining structures and basements, and upon the stability of slopes.

#### Geological setting

The expected and observed soil and rock conditions will be controlling factors, not only for the design of foundations and slopes but also for the planning of any ground investigation that may be required. When more than one type of soil is expected beneath the site and its surrounding area, a large scale plan should be prepared to show the boundaries of each soil type. Other geological features, such as faults, should also be shown, as should the expected variation of ground conditions with depth.

#### Location, size and species of any trees, shrubs or hedges, either at present or in the past, with notes on dates when removed

This information will normally be required only when the site is underlain by shrinkable clay. With the knowledge of the likely risks of subsidence (due to future growth of trees) or heave (as a result of the felling of trees or removal of hedges), it may be possible to relocate buildings to avoid problems. The extent of desiccation is affected by the size and type of tree, as well as its condition, (see Digest 298) and it is also greatly affected by the groundwater conditions on site. Specialist arboricultural advice may be required.

**NATURAL GROUND HAZARDS**

**Chemical aggressivity of ground and groundwater**

Both natural and made ground can contain chemicals which may attack concrete or steel, or cause harm to the user of a development. Specialist skills will be required for the investigation of contaminated landfill.

**Probability of pre-existing slope instability**

If slopes are already unstable, before the start of work on site, design and construction will require extreme care. Specialist geotechnical advice must be sought.

**MAN'S INFLUENCE ON SITE CONDITIONS**

**Position of existing and demolished structures**

The cost of demolishing existing structures (eg heavy foundations) and of infilling basements should be considered. The use to which structures have been put will be important, since some manufacturing processes (eg gas production, plating, brewing) may have left the ground chemically contaminated.

**Possible extent and dates of mineral extraction and mining in the area**

Mining may have taken place in the past, may currently be taking place, or may be planned for the future. Apart from coal mining, a wide range of minerals (eg salt, flint) may be extracted. If mining or mineral extraction is suspected the advice of mining specialists must be sought in order to assess the need for special structural precautions, and for a detailed mining desk study and

ground investigation.

**Evidence for the existence of made ground on site**

At its most innocuous, made ground is normally much more compressible than most undisturbed soil or rock, and presents a greater than normal risk of settlement damage to a structure. It can also contain organic materials which will decay over a period of many years, leading to long-term ground settlements and, in some cases, to the production of harmful gases. Some made ground contains chemicals which may endanger the health of construction workers and of people subsequently working or living on the site. These chemicals may also attack construction materials (eg concrete) with which they come into contact. Specialist geotechnical advice will be required if it is necessary to build on made ground. In some cases, the advice of an environmental health specialist may also be needed.

**PLANNING FOR GROUND INVESTIGATION**

**Possible locations for structures**

Where possible, structures should be relocated at this stage to avoid problems and to minimise cut and fill.

**Likely types and loading of structures**

If preliminary decisions have been made about the number of storeys and plan areas of the proposed structures, together with their loading and tolerance to differential settlement, soil conditions may suggest the use of a particular type of foundation (eg piling). This needs to be known before planning of a ground investigation takes place, since it affects the depth and extent of investigation.

**Access for excavators and boring/drilling rigs during ground investigation**

Required for planning of ground investigations.

**Position of services (eg electricity, water, gas, telephone, sewers)**

Required for planning of ground investigations and for services for the development.



**Other BRE Digests**

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- 322 Site investigation for low-rise building: procurement

**Addresses**

The Institution of Civil Engineers,  
Great George Street,  
London SW1P 3AA.  
01-222 7722

The British Geotechnical Society at the ICE — *see above*

The Association of Ground Investigation Specialists  
c/o Wembley Laboratories,  
Printing House Lane,  
Hayes,  
Middx UB3 1AP.  
01-561 0326

The Institution of Geologists,  
Burlington House,  
Piccadilly,  
London W1V 0JU.  
01-734 0751

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