

Technology and Environment 1

M4X01974

FROM FOUNDATIONS TO GROUND FLOORS

Learning Outcomes

Aim

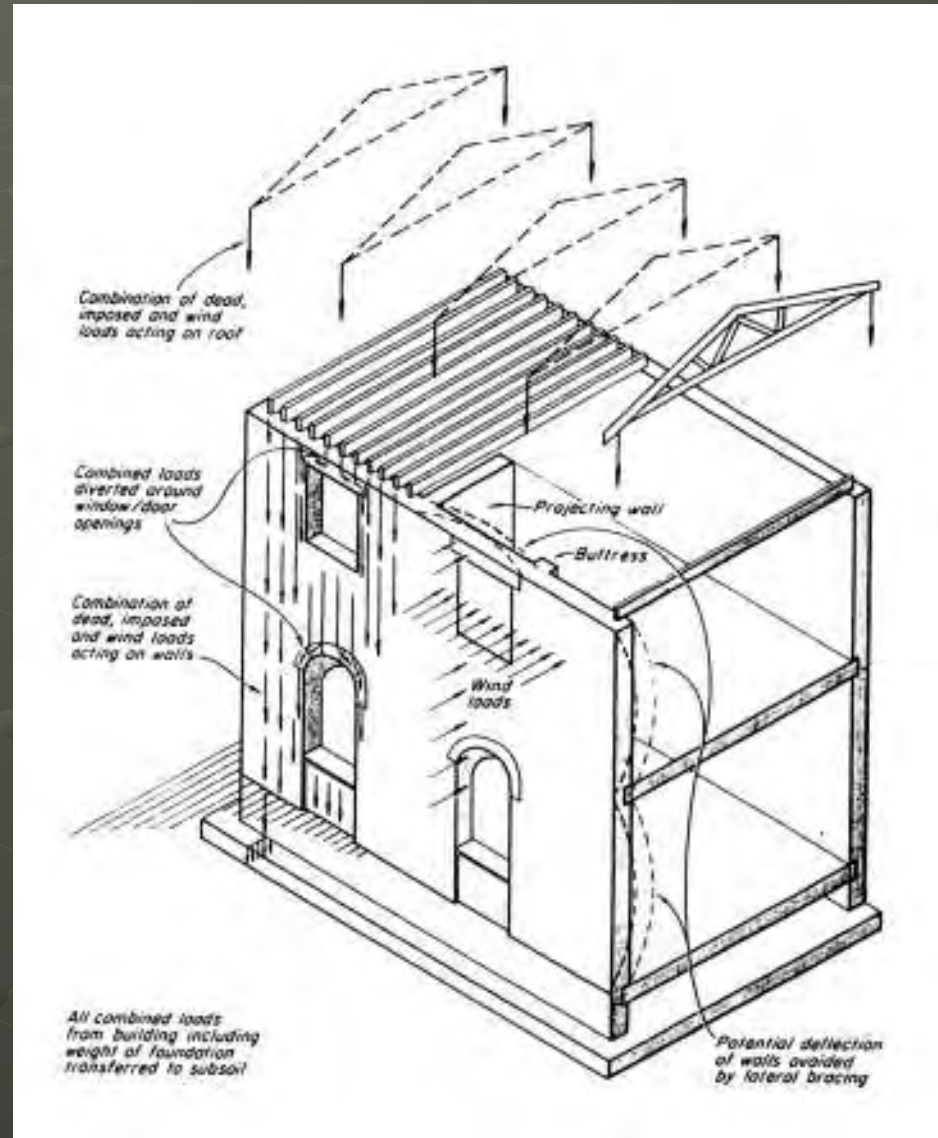
- To introduce the topic area of foundations for low rise domestic buildings

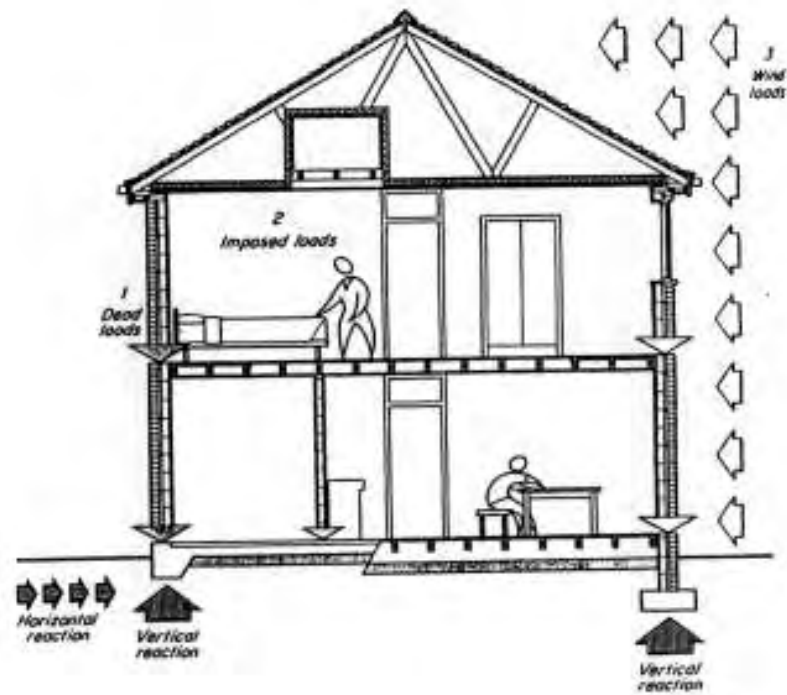
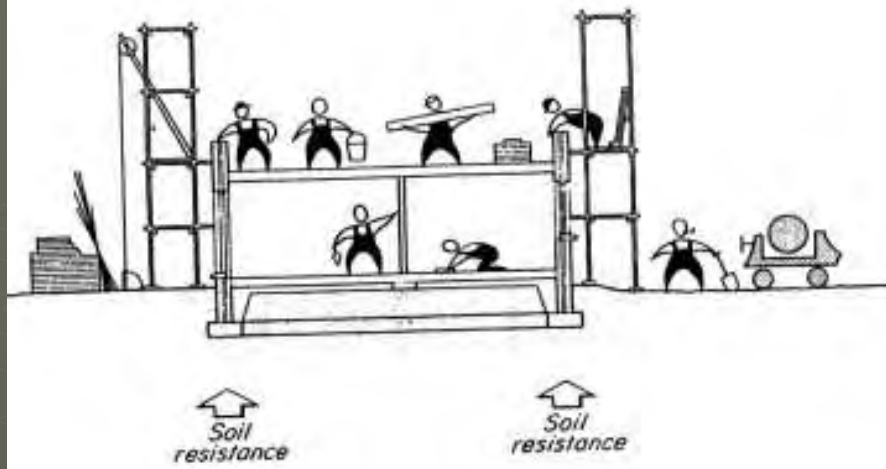
Learning objectives

- To understand the performance requirements of foundations
- How design technology responds to these requirements and influences the choice of foundation type.

FOUNDATIONS

- Primary Function
- To be designed to spread the dead and superimposed loads of the building over sufficient ground to avoid settlement.





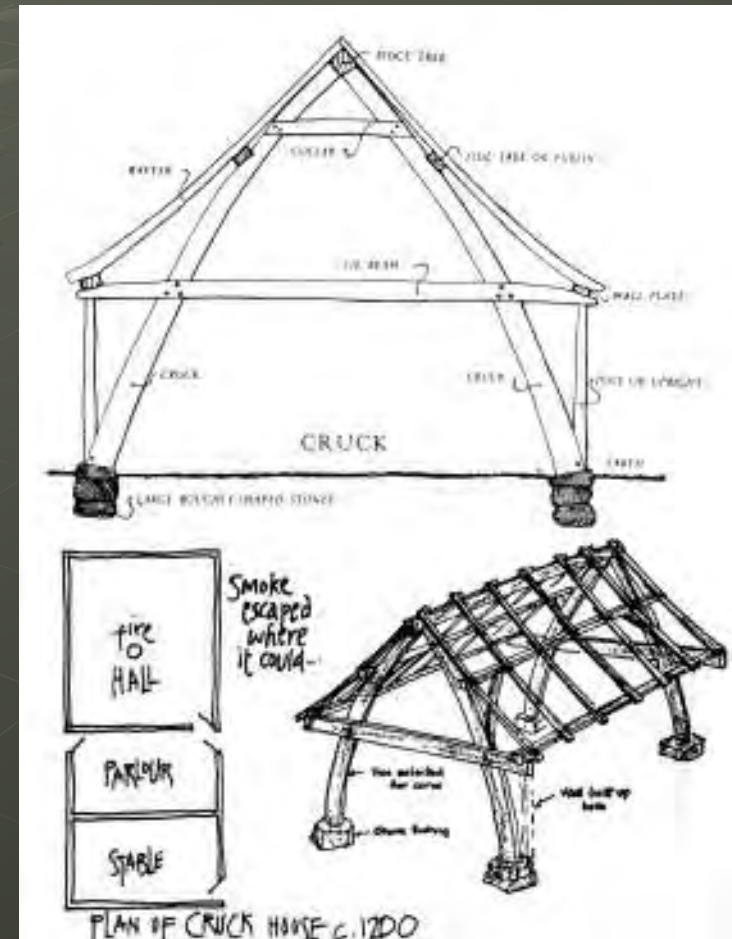
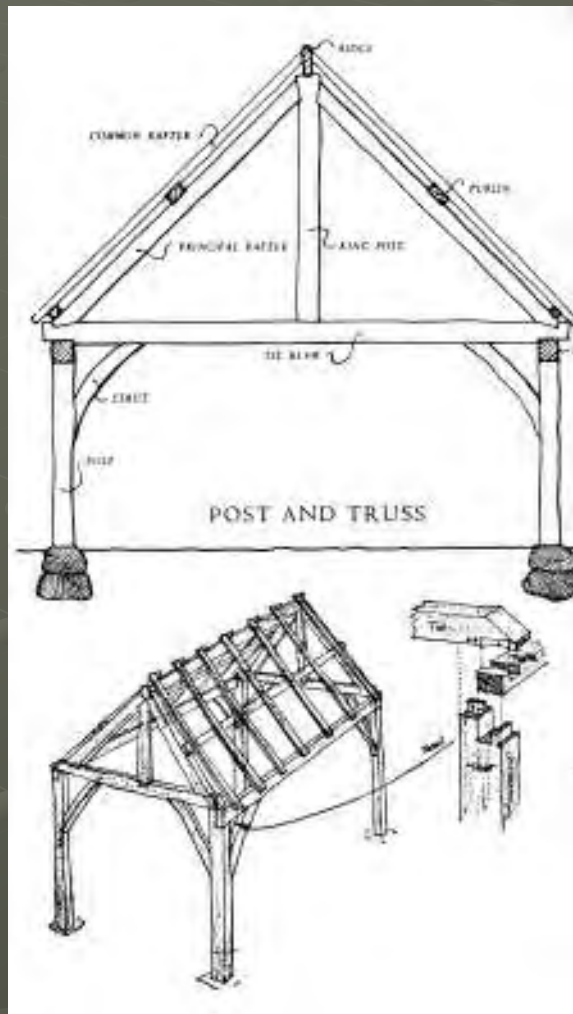
Foundations

- **Foundation design until recent times has always been very much a matter of inspired guesswork based on a background of past experience. Over the last 100 years, foundation design has become extremely scientific in its approach.**

Vernacular Buildings

- Traditional vernacular brick foundations- solid brick or stone walls were built progressively wider to form a wide base to spread the load below ground.

Early Timber Frame Construction



Little Moreton Hall



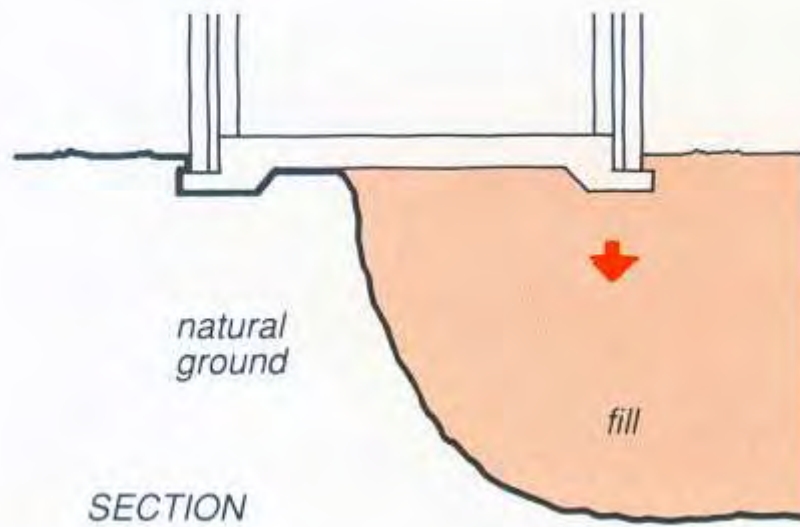
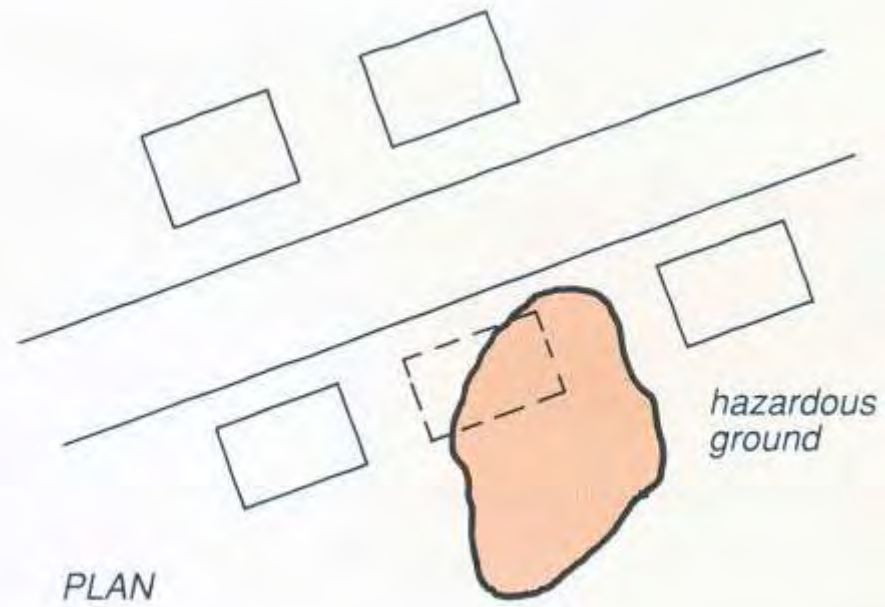
Little Hall Lavenham



SITE SURVEY

● NOTE:

- The site survey is the most important aspect of structural design and it is usually neglected by the client. The results of a poor survey can be disastrous.



SITE SURVEY

- The main objective of a site survey with regard to foundation selection and design are:
- Exact and accurate survey of site dimensions, levels and contour.
- Water flow on the site; well drained, marshy, streams.
- Signs of trouble; ground movement, cracks, land-fill.
- Position of underground services.
- Extent of neighbouring building foundations.
- Likely position of the structure, with regards to appearance, details and economics.
- Underlying ground strata and conditions, including bearing capacity.

Site Investigation

Local place names may provide useful clues to the history or specific characteristics of the locality.

WATER LANE

**BRICKFIELD
COTTAGE**

Ditches, open trenches, excavations and workings can provide useful information about conditions below ground level.

Speak to local authoritative sources such as the Local Authority, NHBC Regional Office, Water Authority, British Coal, etc. Visit the County Records Office and Libraries.

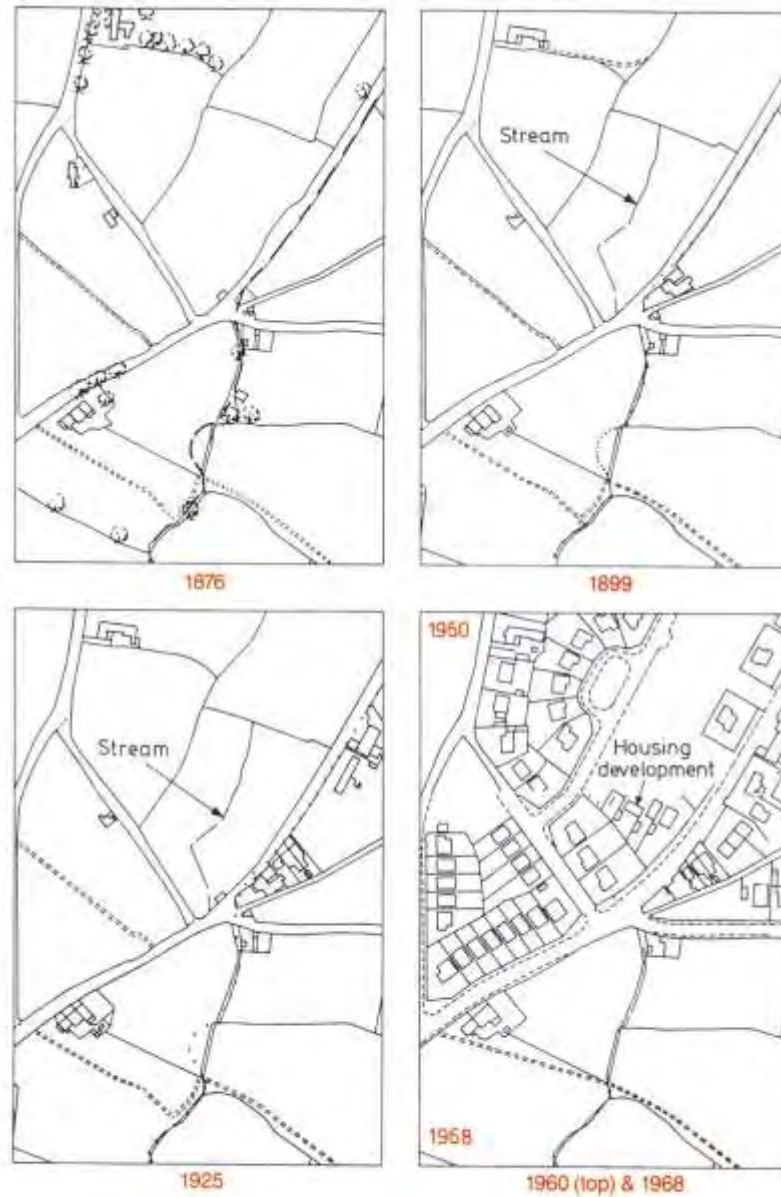
Speak to local residents -

'... and I know you won't believe me, but we used to catch fish there before the council filled it in.'

'A few years back there was a tip in the area.'

Information gained verbally can often complement visual observations to give a better understanding of the site.

Old Maps



Extracts from the 25 inches to one mile maps of Biddulph Moor, Staffordshire from: Site Investigation, London, Granada 1982 by Clayton, Simons and Matthews. Large scale Ordnance Survey maps.

Ground Water

ground water

A high water table, temporary or permanent, may cause uneven settlement as well as problems of chemical attack on building elements and difficulties during construction. A site which appears wet should, if possible, be inspected during, or shortly after, heavy rain.



Is a high water table indicated, eg bounciness under foot?



Is there an old water course?



Are there any signs of flooding?



Are there any reeds or water-loving flowers?



Are there any springs, ponds, wells, ditches, streams?



What is the likely variation of the water table over the site?



Is there anything indicating soil or water acidity?

Sloping Ground

Land instability

sloping ground



What is the significance of any abrupt changes in slope?



Are there any valley bottoms or depressions which may be soft or filled?

land instability



Is there evidence of overburden on slopes?



Is there excavation at the base of a slope?



Are there signs of landslide or erosion of slopes?



Are there signs of local subsidence?



Are there any signs of landslide, eg tilting trees, posts or walls?

Vegetation Ground type

vegetation on and near the site

Because of their water demand, large trees and dense vegetation affect the moisture content of the soil where they are growing, causing some clays and silty clays to shrink and swell as the moisture content decreases and increases. If major vegetation is removed, it may take many years for the soil to stabilise. The nature of the vegetation should be recorded to aid identification.



What are the species, height, girth (at one metre above ground level) and condition of the trees?



What are the species, height, spread and condition of hedges and scrub on clay?



Is there evidence of former trees, hedges or scrub on clay?

type of ground



What is the basic type of ground?



Is there any evidence of peat, silt or other soft, highly compressible material at or below the surface?



Is there evidence of imported soil, tipped material or rubbish? Is it hot? Does it have an odour?



Does cracking or stickiness of the surface occur which could indicate a shrinkable sub-soil?



Are there sudden changes in conditions, eg clay to chalk or soil to rock?

Simple field tests for sub-soil are listed in Appendix 4.1-B.

FOUNDATION SELECTION AND DESIGN

- 1.** To provide an allowable amount of settlement in the soil.
- 2.** To prevent an unacceptable an unacceptable amount of differential settlement occurring in the building.
- 3.** To avoid using unreliable or weak ground by carrying loads down to deeper 'sound' material. Must be free from organic material that could rot and create voids in the ground.
- 4.** To accommodate movements of the ground due to swelling and shrinkage. The base of the foundation must be below the frost line (generally 900mm)
- 5.** To withstand attack from corrosive elements in the soil or water.
- 6.** To withstand water pressure.

FOUNDATIONS

- **Factors affecting foundation design**
 - **site conditions**
 - **is the land suitable to build on, load carrying capacity etc...**
 - **selection and design.**
 - **most efficient method of transferring load from the structure in to the ground.**

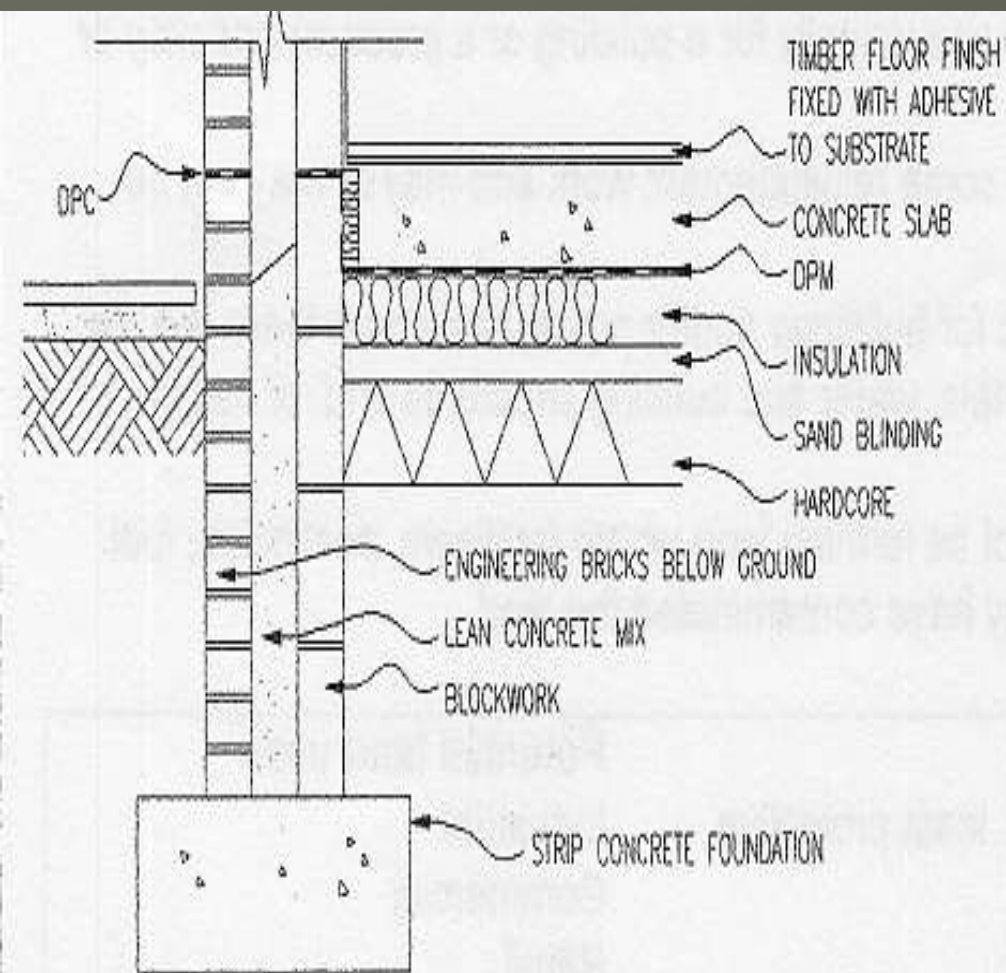
Foundation Types

- **There are five main forms of foundations, each with numerous variants**
- **Each foundation type are ideally suited to particular soil conditions and form of construction.**

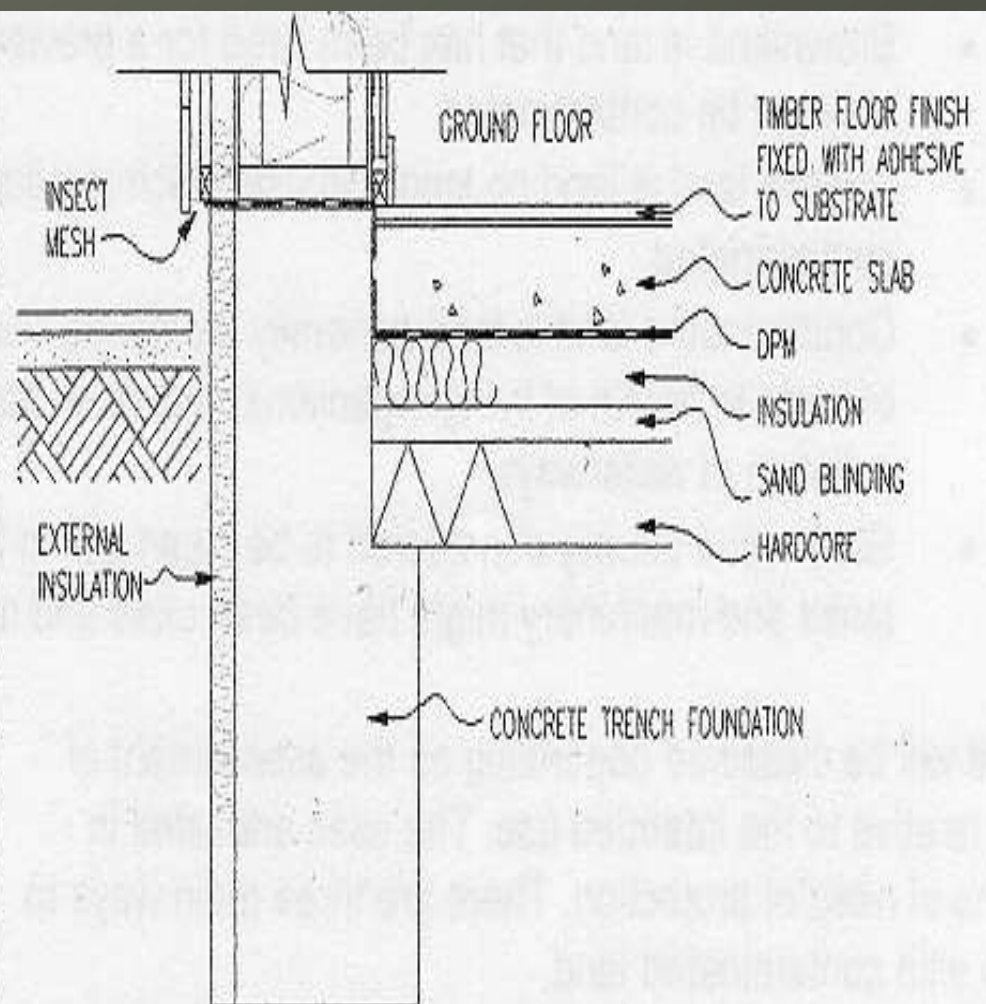
Foundation Types

● Strip and Trench Foundations

- Consisting of a mass concrete footing
- Unreinforced - although can be reinforced
- Suitable for supporting load-bearing walls on average to good capacity soils
- Not suitable for soft clay, silt, peat or poor infill ground
- Ideally suited to long line loads but can be locally thickened to accommodate concentrated loads
- Loads should ideally pass through the centre of the foundation



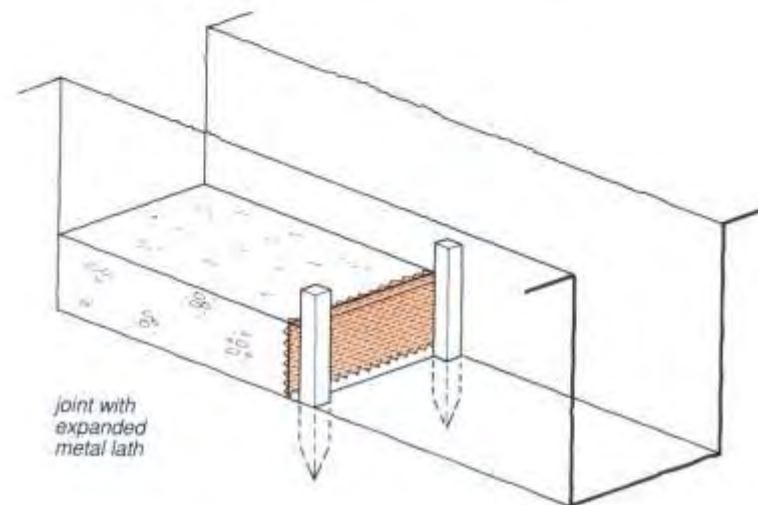
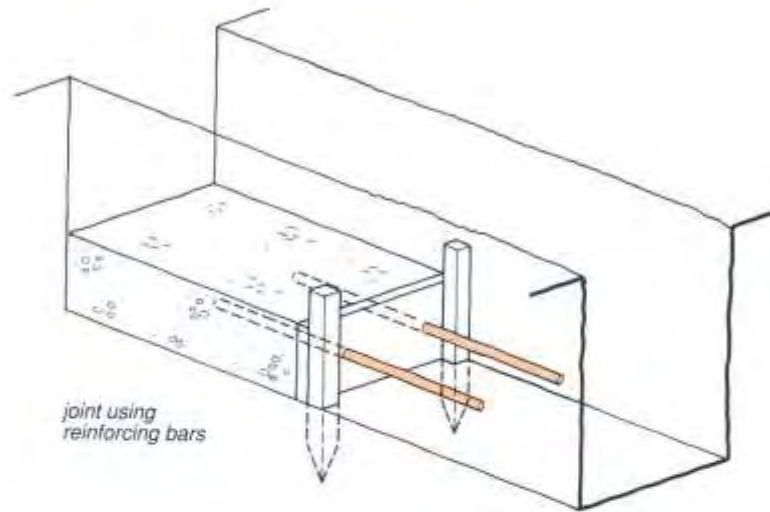
Strip foundation with cavity wall

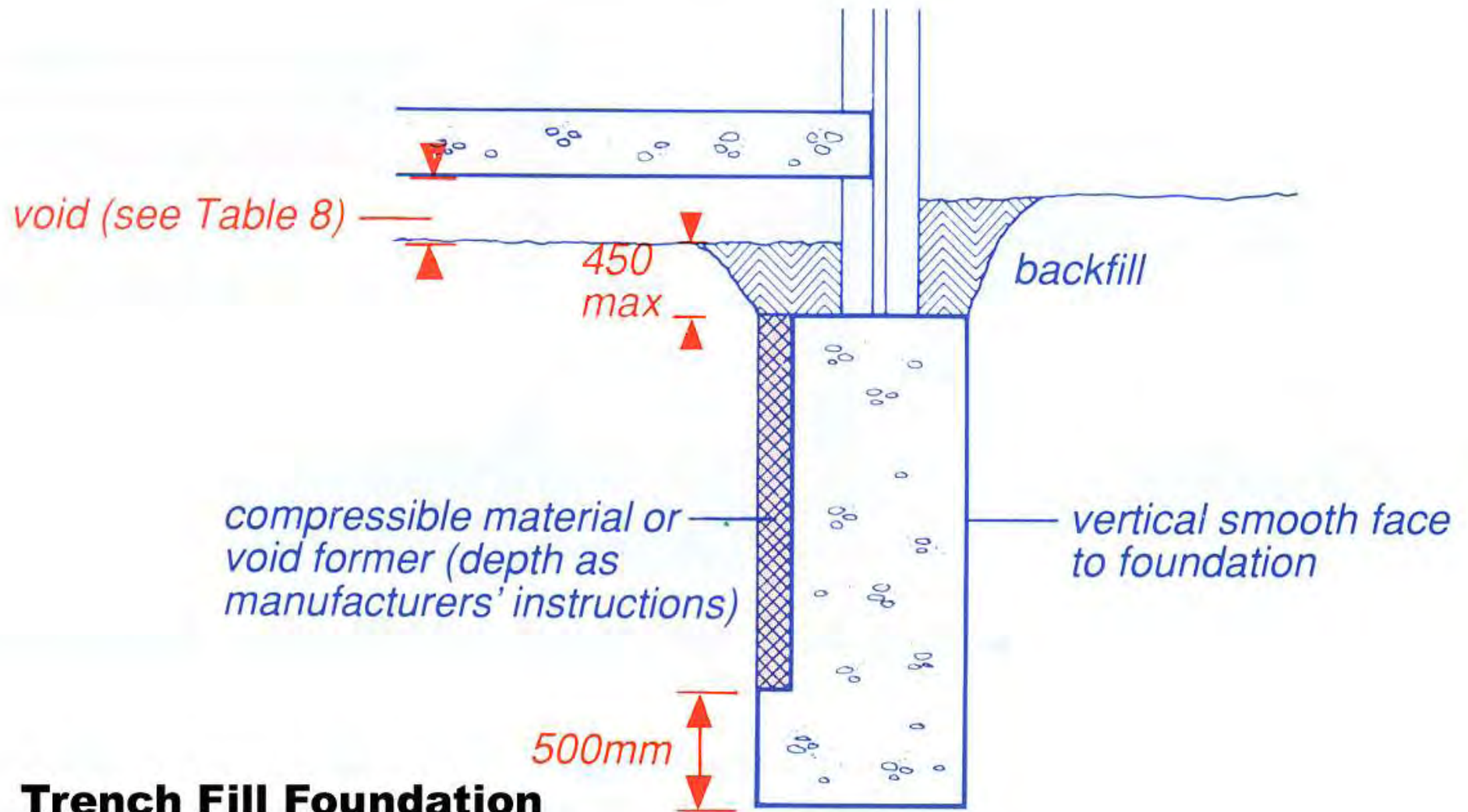


Trench foundation with timber frame

STRIP FOUNDATIONS

If construction joints are unavoidable, they should not be positioned near a return in the foundation. All shuttering should be removed before work continues beyond the construction joint. For strip foundations, construction joints may be formed by one of the methods shown below.

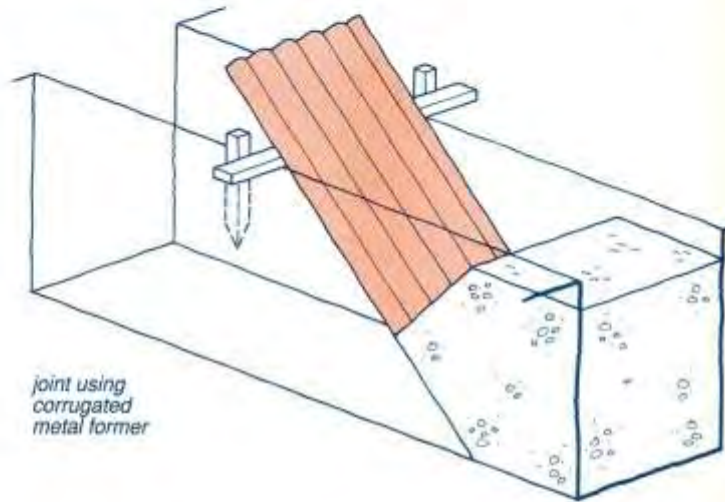




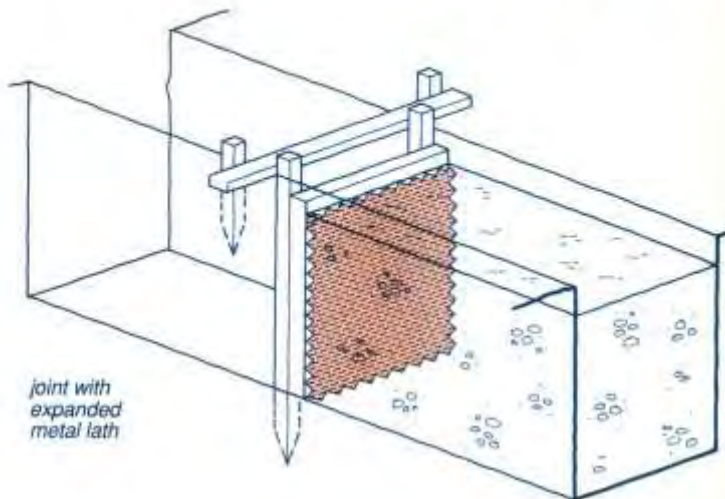
Trench Fill Foundation

TRENCH FILL FOUNDATIONS

It is important that concrete mix, workability and placement are maintained throughout a trench fill foundation. However, where a joint is unavoidable, it should not be positioned near a return in the foundation. Before work continues beyond the construction joint, all shuttering should be removed. Construction joints may be formed by one of the methods shown below.



*joint using
corrugated
metal former*



*joint with
expanded
metal lath*

Foundation Types

- Pad
- Suitable for concentrated loads
- Mass concrete generally or reinforced concrete for larger footings
- Square or rectangular

Foundation Types

● Pad



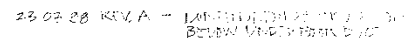
Foundation Types

- Raft
- Continuous reinforced concrete slab and footings under the whole building
- Applied loads are distributed over a large area to prevent over-stressing of the soil.
- Usually for buildings founded on weak soil- where bearing capacity is low and the risk of differential settlement is high
- For concentrated loads i.e. walls or columns the raft may be thickened locally

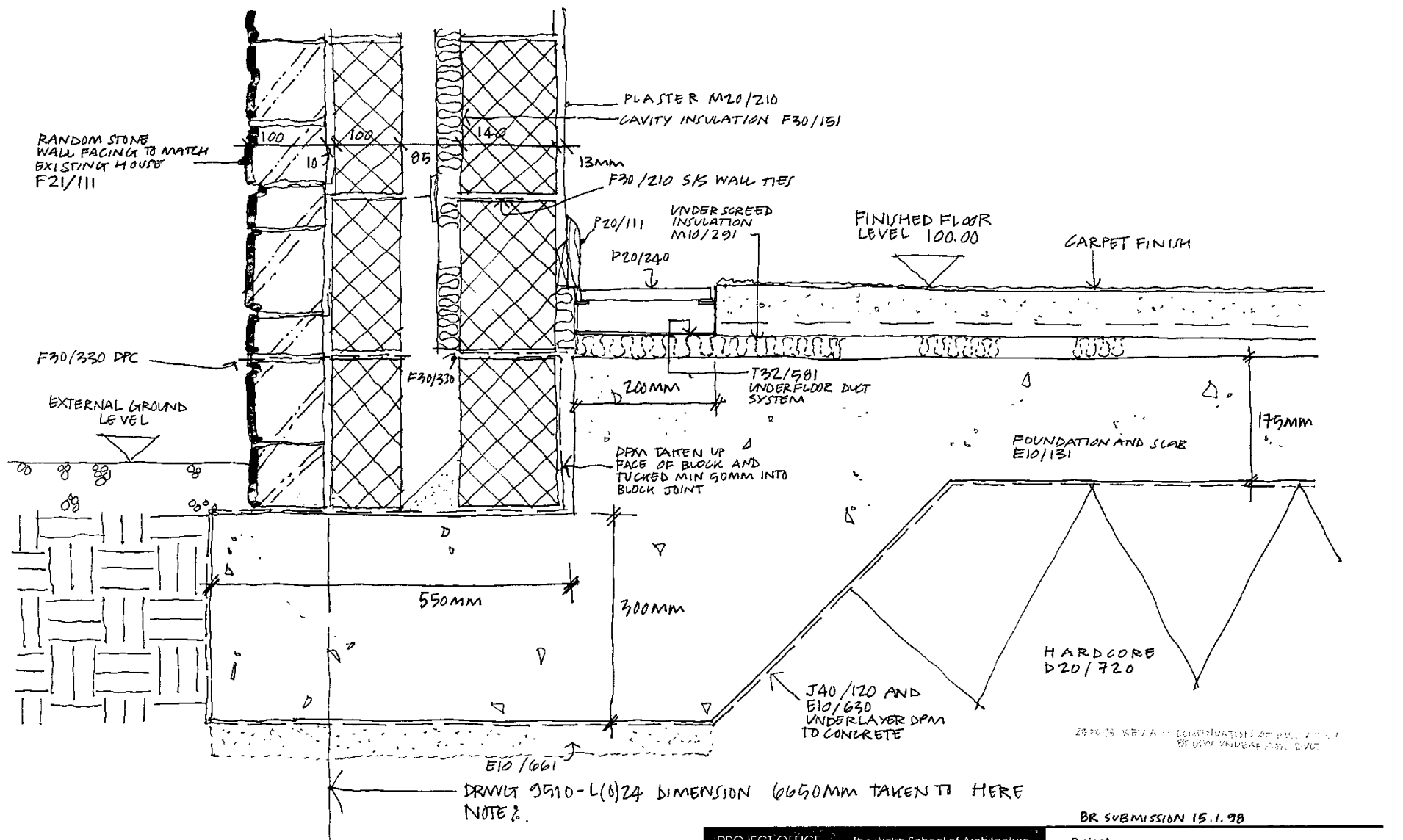








Directions: For each item, write the letter of the correct answer.



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Do not scale off this drawing Dimensions for fixed-in items to be taken from site

BR SUBMISSION 15.1.98

Project CADOC HOUSE CAERLEON

Drawing SECTION EXT WALL/FOUNDATION
GRIDLINE 1 FROM DD TO LL

Scale 1:5 Drawn by JS Checked

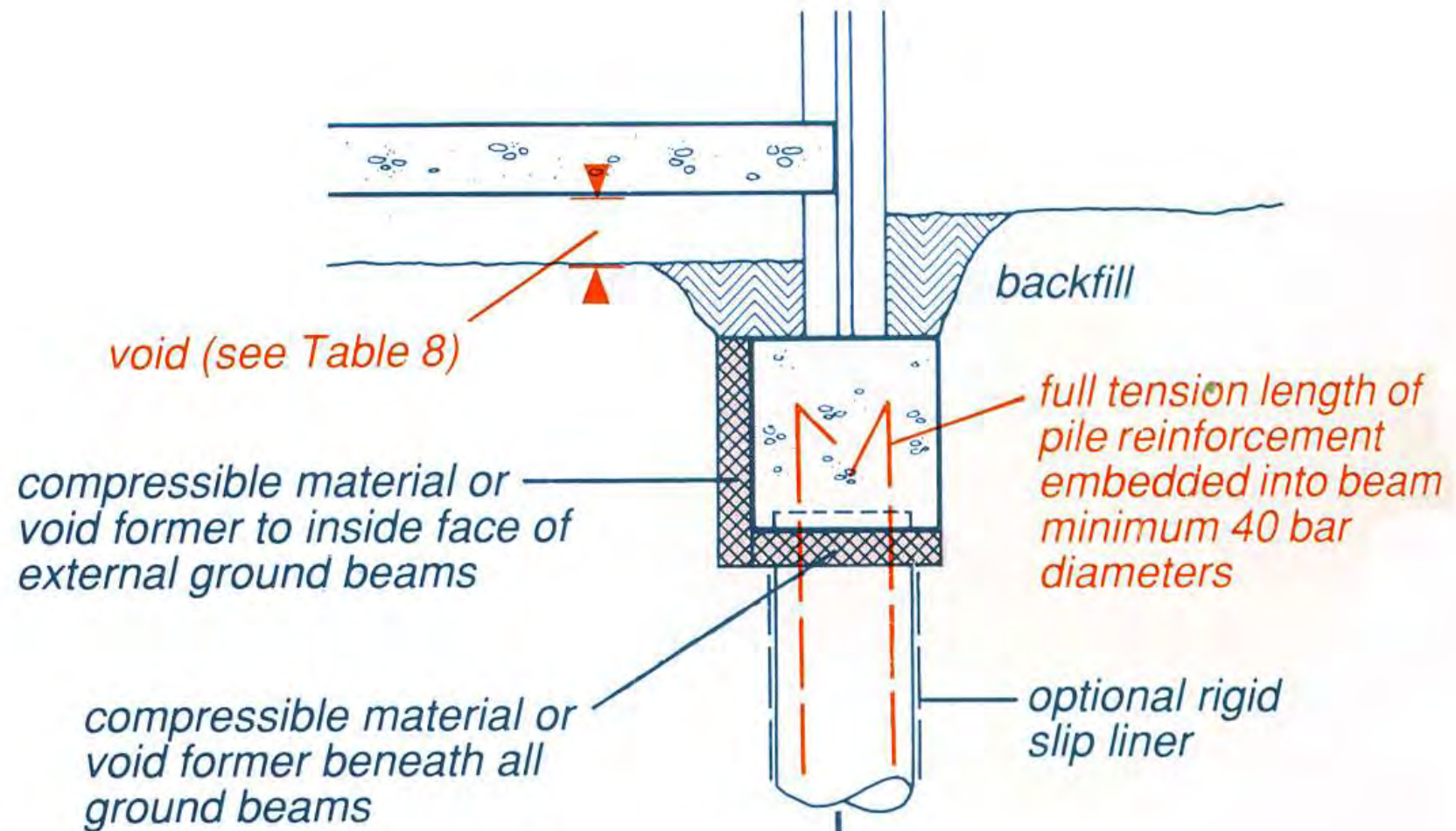
Date OCT 97 Drawing No. 9501A(1)02

A

Foundation Types

● Piled

- Piles are used when the imposed load of the building cannot be spread over the available area of the site due to weak soil.
- Piles carry the weight of the building down to strata that is capable of providing the necessary support.
- Piles can be thought of as columns taking compressive loads.



Pile and Ground Beam Foundation

Foundation Types

● Piled



-
- Architectural section drawing of a building's external envelope. The drawing shows a cross-section of a wall and roof assembly. Key components and labels include:
- Roof Structure:** Shows a sloped roof with insulation and structural elements. Labels include "ROOF INSULATION", "ROOF STRUCTURE", and "ROOF FINISH".
 - Wall Assembly:** Shows a vertical wall section with insulation and structural elements. Labels include "WALL INSULATION", "WALL STRUCTURE", and "WALL FINISH".
 - Window/Door Details:** Shows a window or door opening with a frame and various components. Labels include "WINDOW FRAME", "GLASS", "SEALANT", and "HINGES".
 - Foundation/Slab:** Shows the base of the wall and floor assembly. Labels include "FOUNDATION", "SLAB", and "FLOOR FINISH".
 - Dimensions:** Various dimensions are indicated, such as "1.00 M", "0.50 M", and "0.25 M".
 - Materials and Construction:** Labels specify materials and construction methods, such as "CONCRETE", "BRICK", "INSULATION", and "PLASTER".
 - Section Line:** A section line is shown at the bottom, labeled "SECTION" and "EXTERNAL ENVELOPE".
- The drawing is a detailed technical representation of the building's external envelope, showing the relationship between different materials and components in a cross-section view.

House at Lege Cap-Ferret



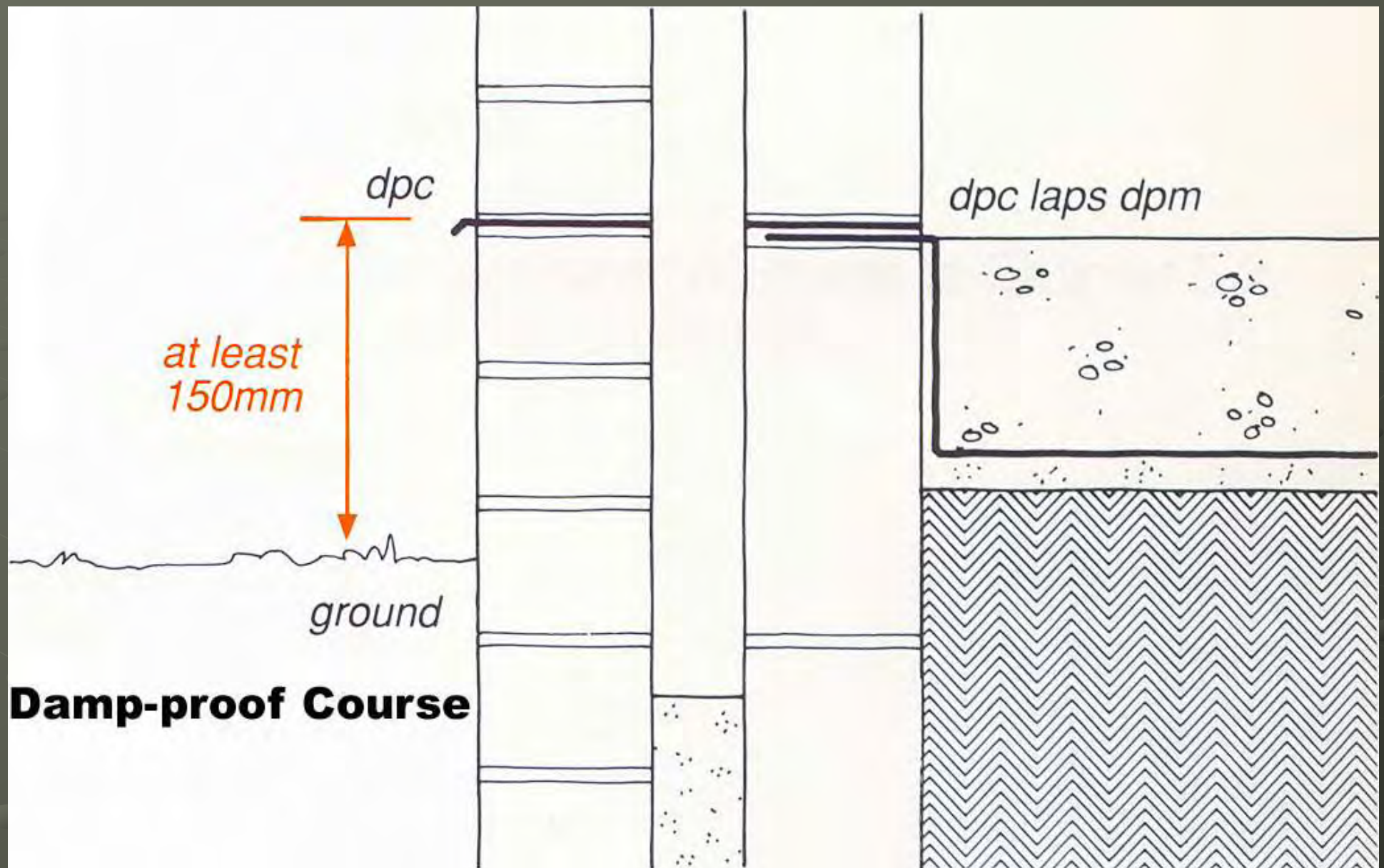
Newman House

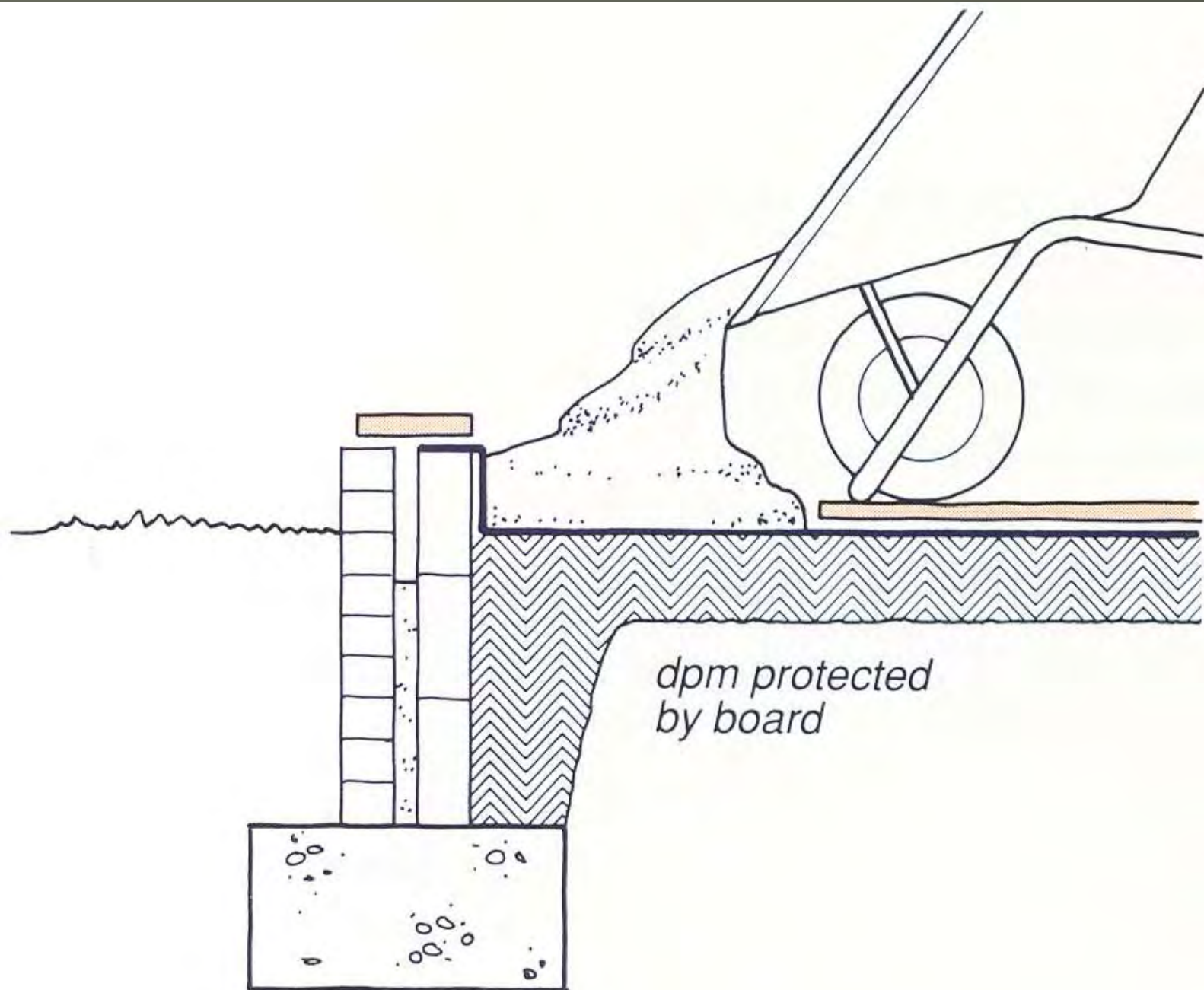


Foundation Types

● Buoyancy

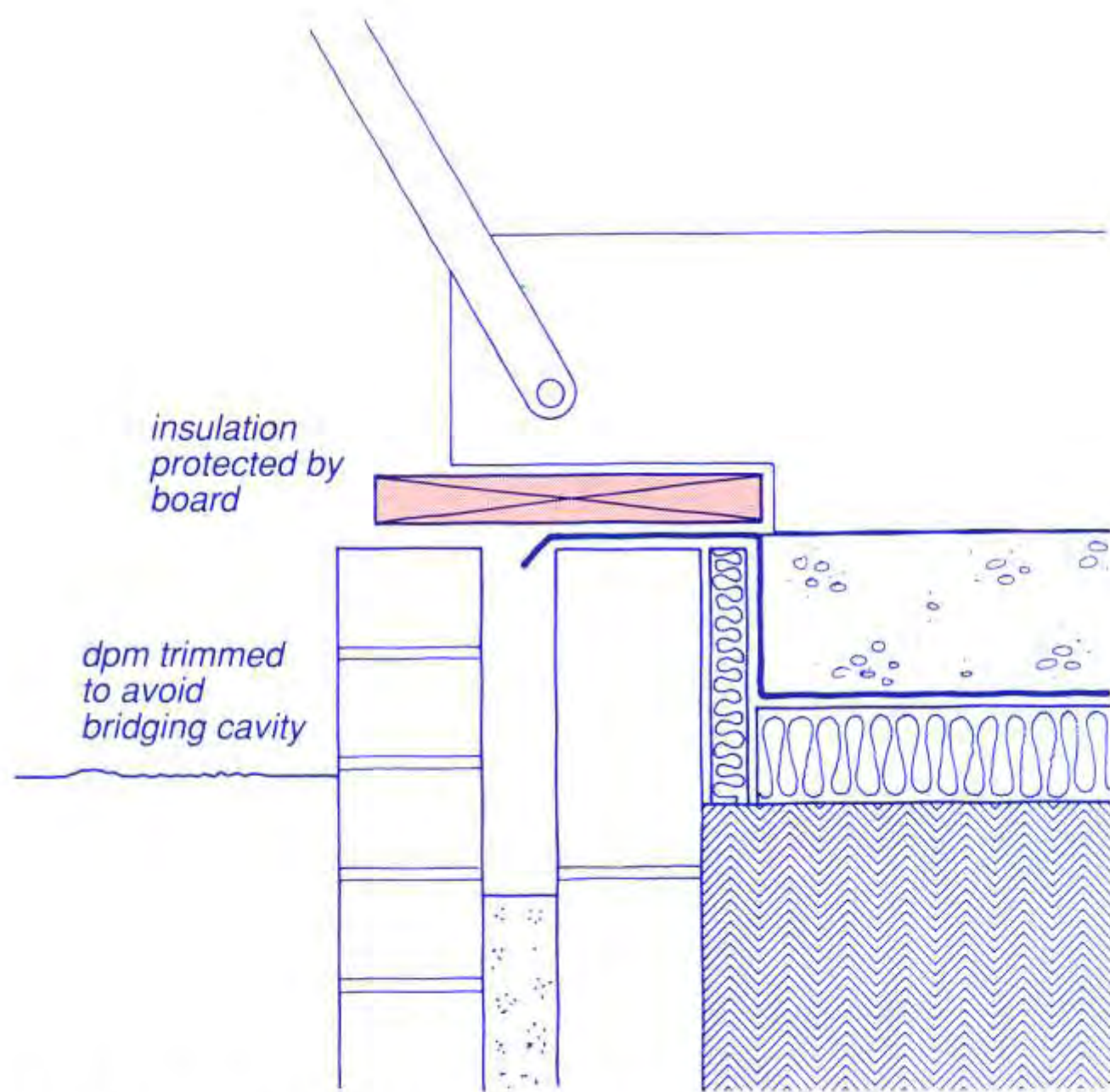
- Used when bearing capacity of the soil is low near the surface and the load cannot be spread due to confined space.
- Large basement which behaves like a large tank on which the building floats.
- The weight of the building replaces the weight of the excavated soil.





*dpm protected
by board*

Laying the slab



Thermal Insulation

References for further reading

- ***GUIDED STUDY***

- ***Chapter 2 of Understanding Buildings by E. Reid (Longman)***

- ***Chapter 17 of Introduction to Building by D. Osbourn (Mitchell's)***

- ***Chapter 4 of Structure and Fabric 1 by J.S. Foster (Longman)***

TYPICAL QUESTIONS

- Describe how you would undertake a site survey and explain its overall purpose.
- Discuss the advantages and disadvantages of three types of foundations, outlining when they may be used in construction.