SUBJECT

BUILDING TECHNOLOGY I

site work & shallow foundations

DATE **FALL 2013**

PROFESSOR **MONTGOMERY**

FOUNDATIONS

spread the load into the earth

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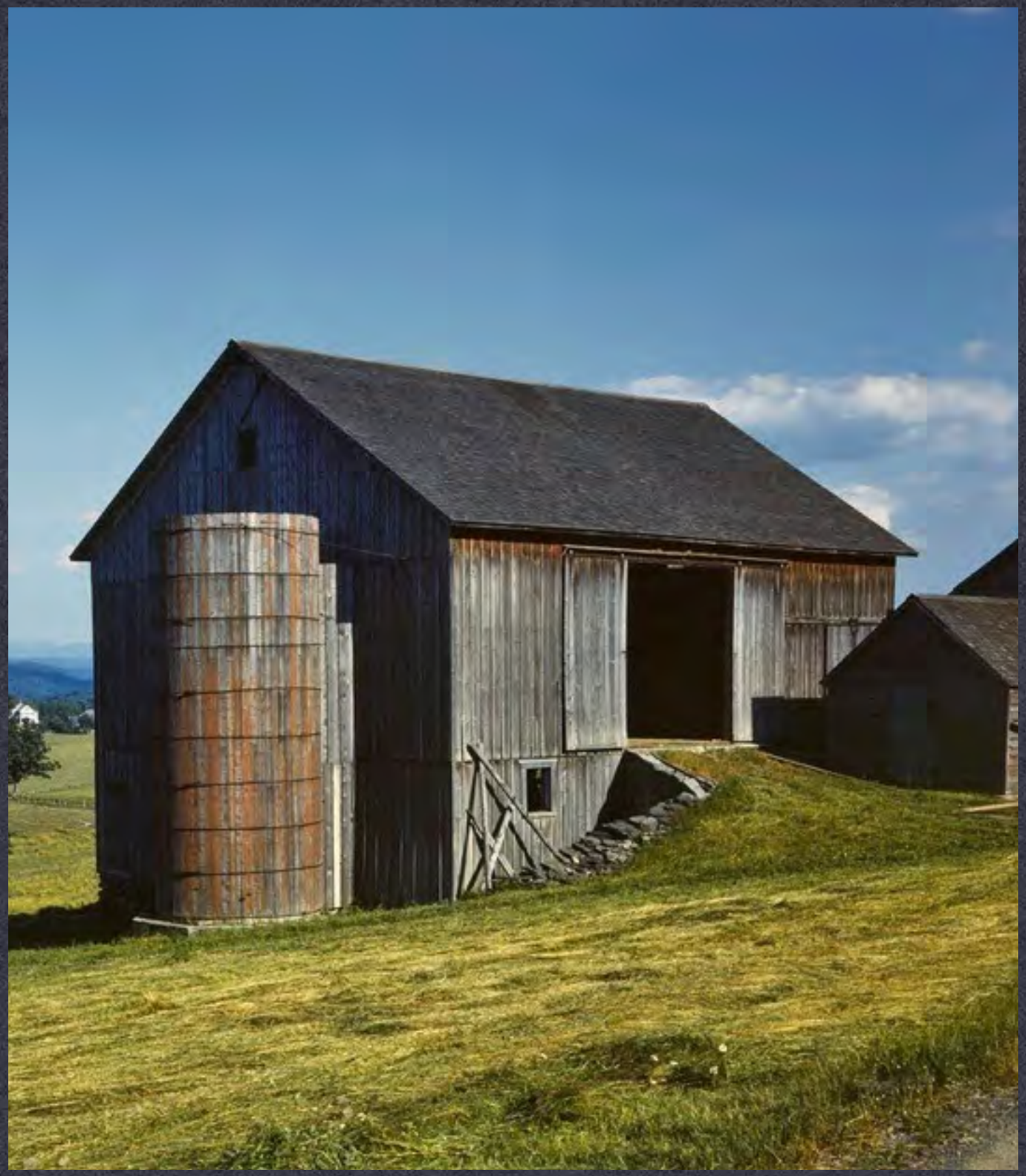

this week

objective:

overview of the function of foundations and the process of designing foundations

- foundation requirements
- foundation settlement
- earth materials
- geotechnical investigation
- excavation & shoring
- shallow foundations
- water proofing foundations

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foundation loads

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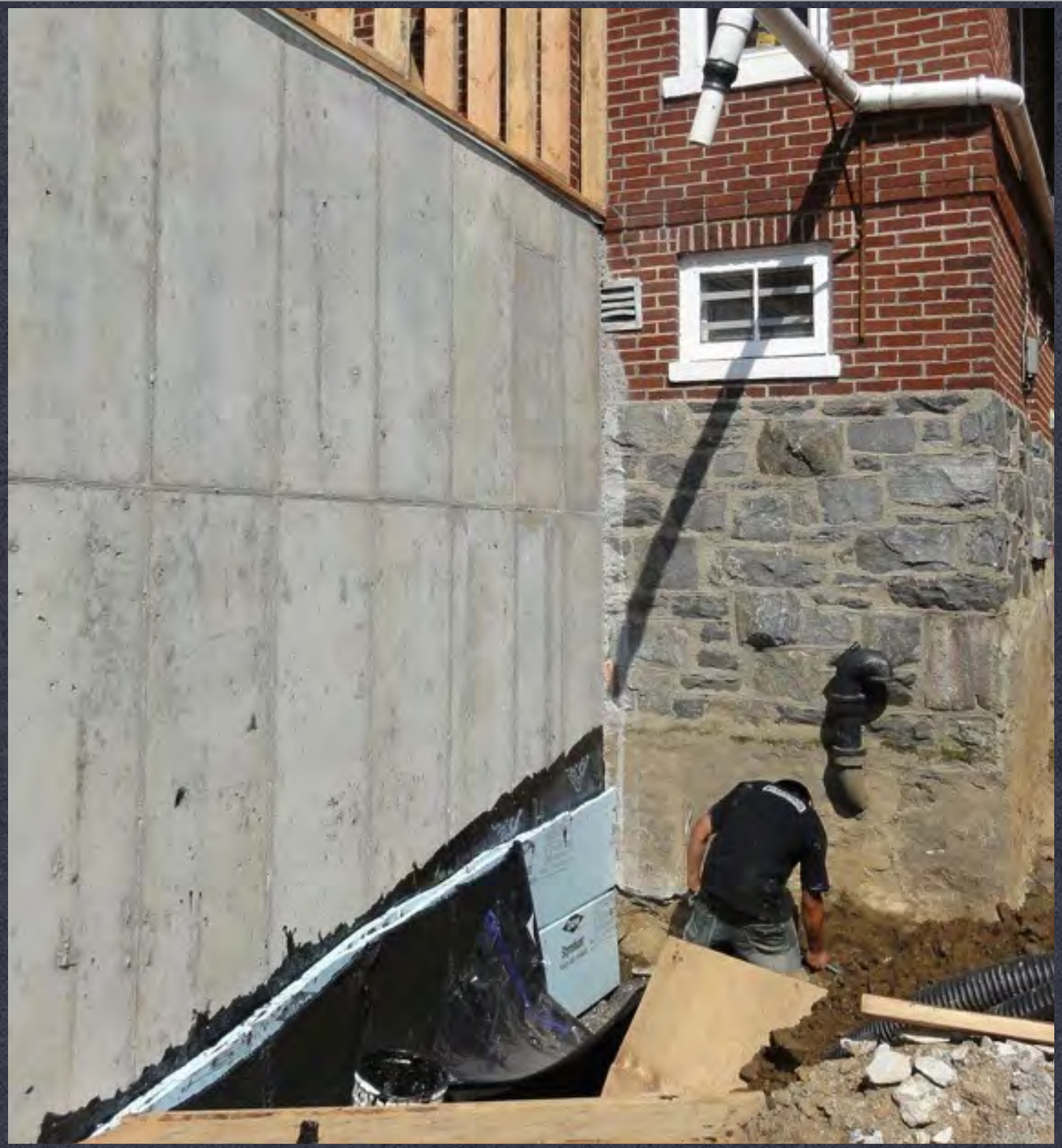

FOUNDATIONS MUST SUPPORT ALL POSSIBLE LOADS:

- DEAD LOADS
- LIVE LOADS
- RAIN & SNOW LOADS
- WIND LOADS
- SEISMIC LOADS
- SOIL & HYDROSTATIC PRESSURE

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FOUNDATIONS MUST MEET FOLLOWING THREE GENERAL REQUIREMENTS:

1. MUST BE SAFE AGAINST STRUCTURAL FAILURE THAT COULD RESULT IN COLLAPSE

2. MUST NOT SETTLE DURING LIFE OF BUILDING IN SUCH A WAY THAT WOULD DAMAGE STRUCTURE OR IMPAIR FUNCTION

3.MUST BE FEASIBLE, ECONOMICAL, & PRACTICAL (WITH NO IMPACT ON NEIGHBORS)

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settlement

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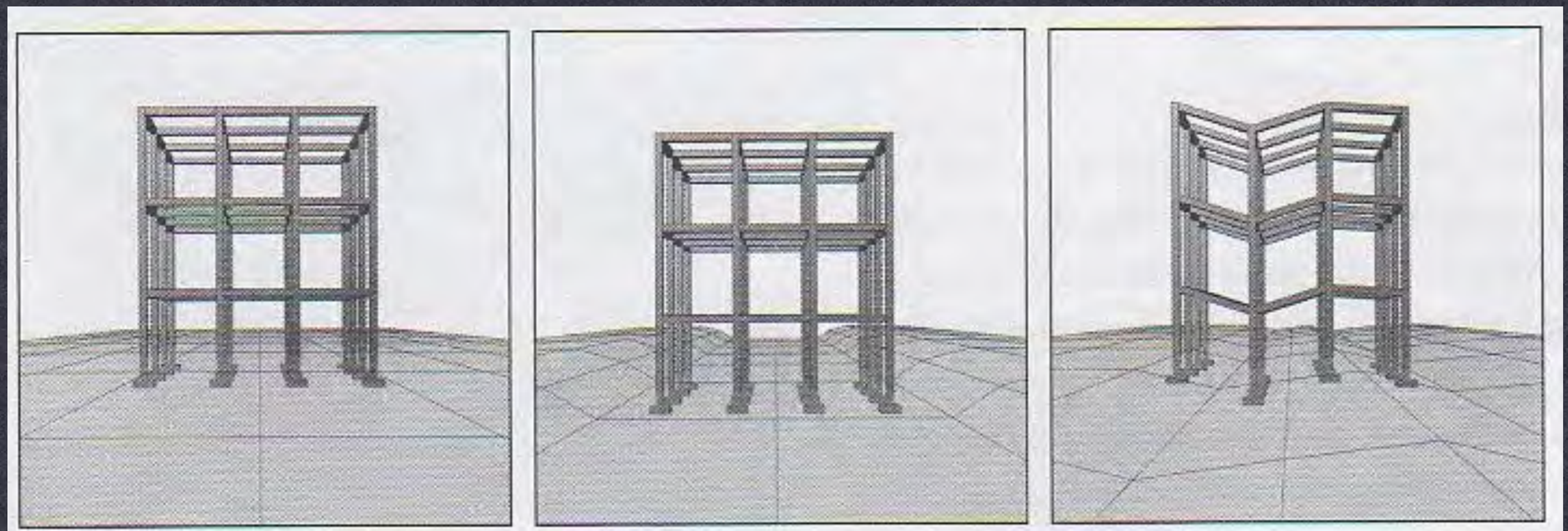

(a) **Building before settlement occurs**

(b) **Uniform settlement**

(c) **Differential settlement**

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EARTH MATERIALS ARE CLASSIFIED ACCORDING TO:

- PARTICLE SIZE
- PRESENCE OF ORGANIC CONTENT
- SENSITIVITY TO MOISTURE CONTENT

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geotechnical (subsurface) investigation

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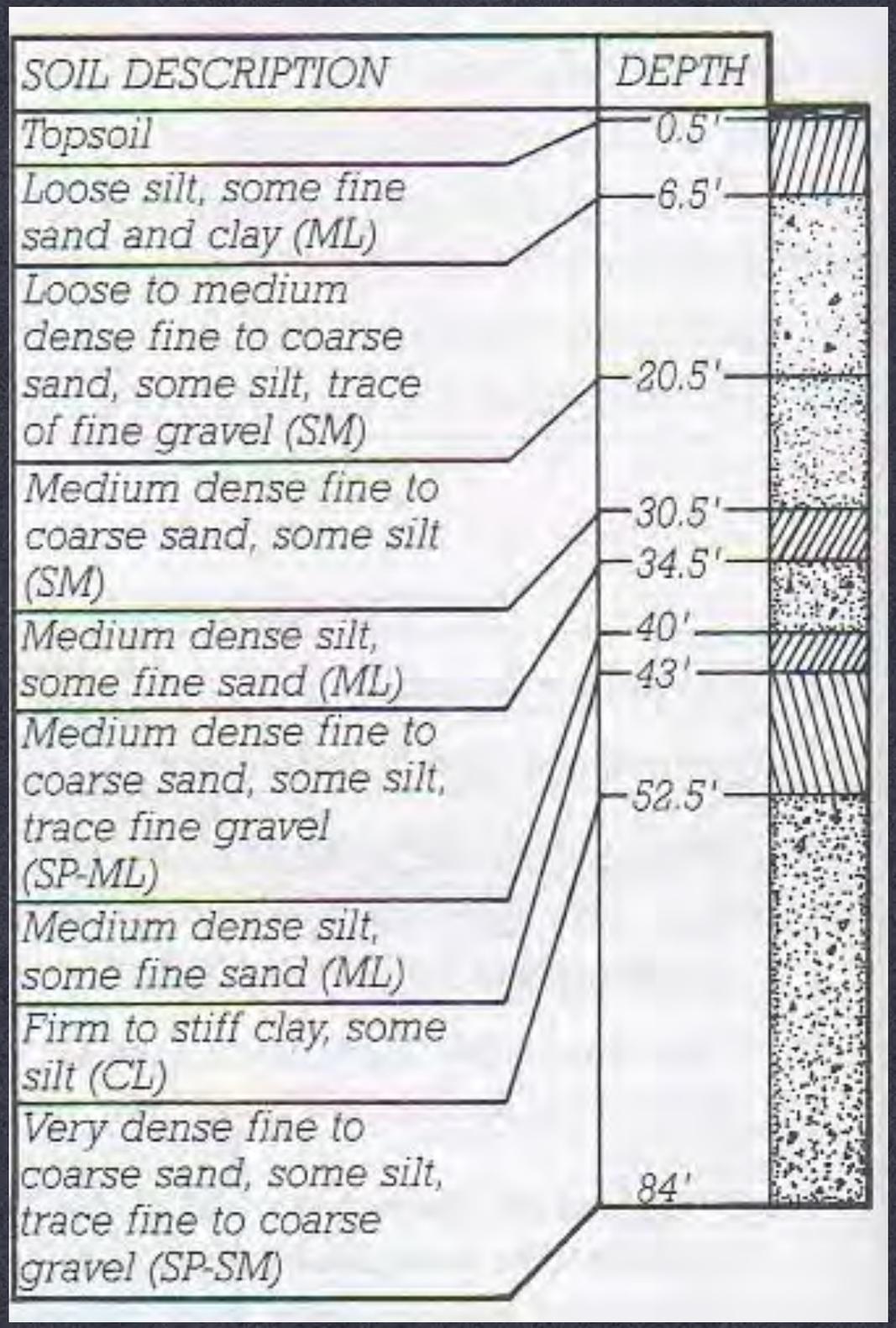

DETERMINE SOIL AND WATER CONDITIONS BENEATH THE SITE:

- DIG A TEST PIT (VIABLE UP TO 16’ DEPTH)
- CORE DRILL TEST BORING (DEPTH LIMIT BASED ON REACH OF EQUIPMENT)

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geotechnical (subsurface) investigation

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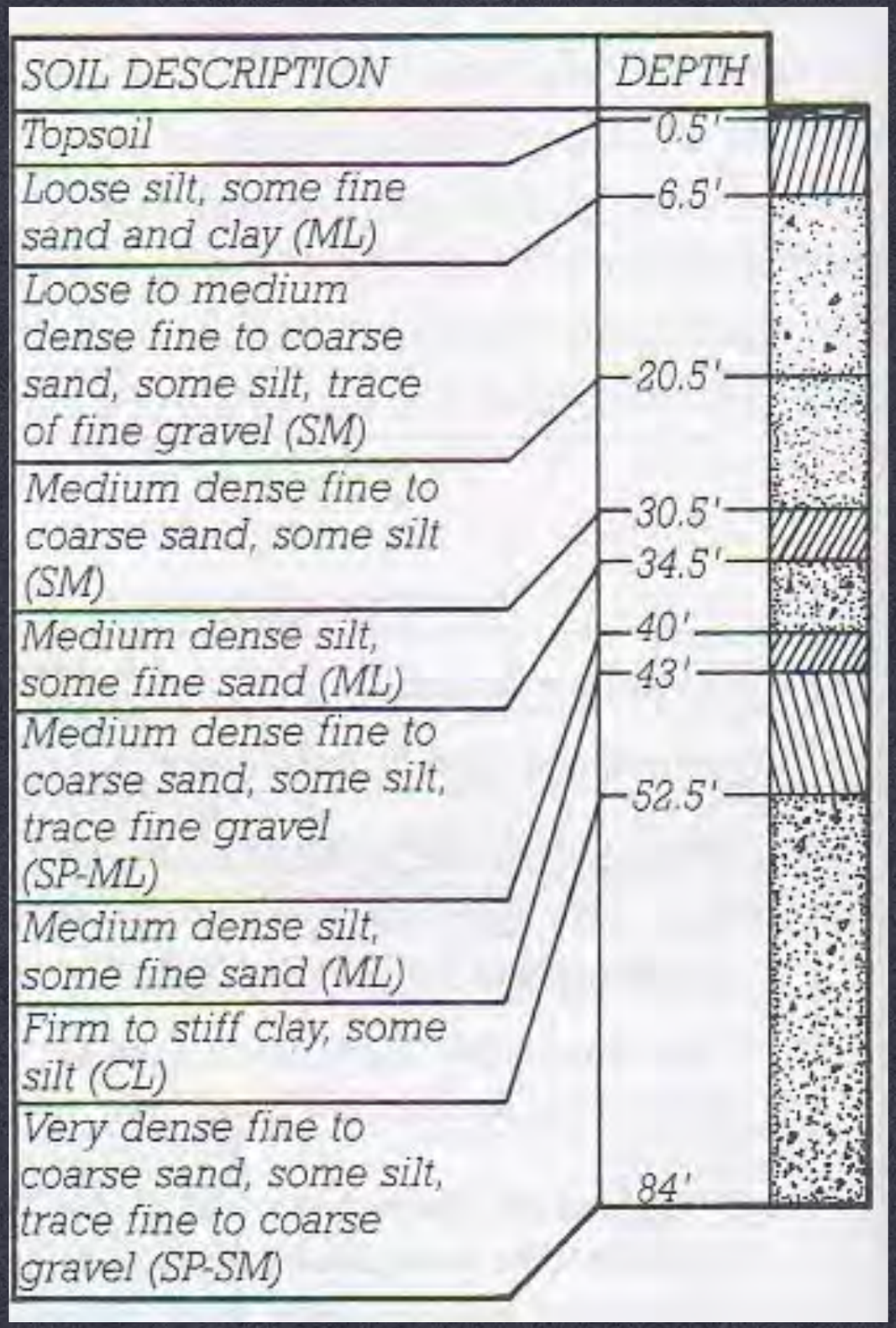

USE TEST PIT OR TEST BORING TO DETERMINE:

- **WATER TABLE (WHERE SOIL IS SATURATED)**
- **SAMPLES TAKEN TO A LABORATORY EXAMINE THE PROPERTIES OF THE EARTH MATERIALS BENEATH THE SITE**

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frost line depth

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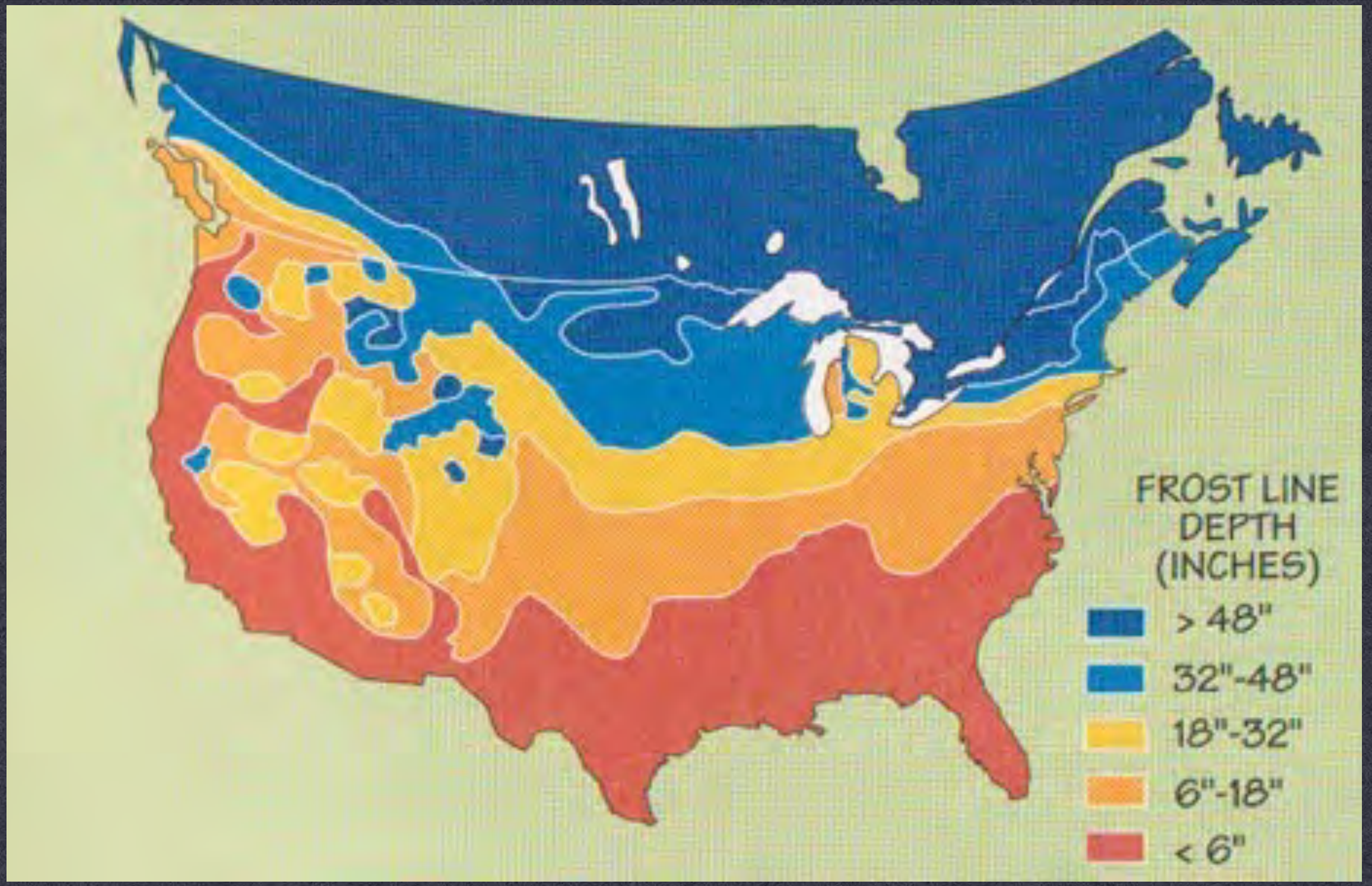

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TABLE 1804.2
ALLOWABLE FOUNDATION AND LATERAL PRESSURE

CLASS OF MATERIALS	ALLOWABLE FOUNDATION PRESSURE (psf)[d]	LATERAL BEARING (psf/f below natural grade)[d]	LATERAL SLIDING	
			Coefficient of friction[a]	Resistance (psf)[b]
1. Crystalline bedrock	12,000	1,200	0.70	—
2. Sedimentary and foliated rock	4,000	400	0.35	—
3. Sandy gravel and/or gravel (GW and GP)	3,000	200	0.35	—
4. Sand, silty sand, clayey sand, silty gravel and clayey gravel (SW, SP, SM, SC, GM and GC)	2,000	150	0.25	—
5. Clay, sandy clay, silty clay, clayey silt, silt and sandy silt (CL, ML, MH and CH)	1,500[c]	100	—	130

For SI: 1 pound per square foot = 0.0479 kPa, 1 pound per square foot per foot = 0.157 kPa/m.

a. Coefficient to be multiplied by the dead load.

b. Lateral sliding resistance value to be multiplied by the contact area, as limited by Section 1804.3.

c. Where the building official determines that in-place soils with an allowable bearing capacity of less than 1,500 psf are likely to be present at the site, the allowable bearing capacity shall be determined by a soils investigation.

d. An increase of one-third is permitted when considering load combinations, including wind or earthquake loads, as permitted by Section 1605.3.2.

ON SITE AND LABORATORY INVESTIGATION CAN DETERMINE:

- **THE ALLOWABLE FOUNDATION PRESSURE FOR THE GIVEN EARTH MATERIALS BENEATH THE SITE**

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EXCAVATION PROCESS:

A. SLOPED / LAID BACK EXCAVATION

i. ANGLE OF REPOSE

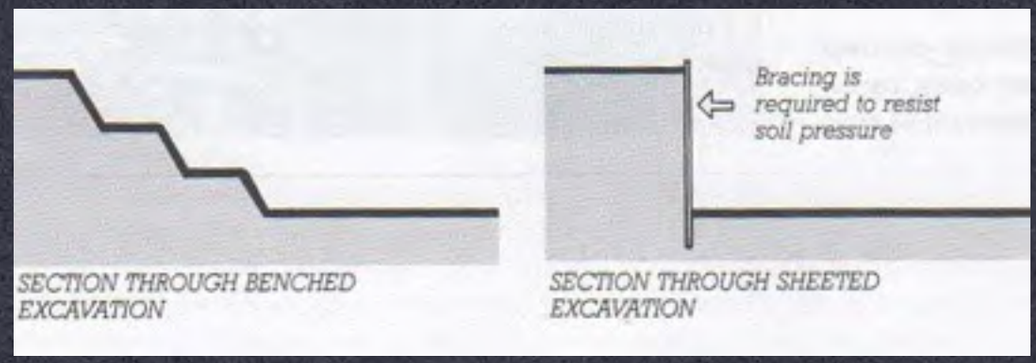
B. BENCHED EXCAVATION

C. SLOPE SUPPORT/SHORING

i. SOLDIER BEAMS & LAGGING

ii. SHEET PILING

iii. SLURRY WALL



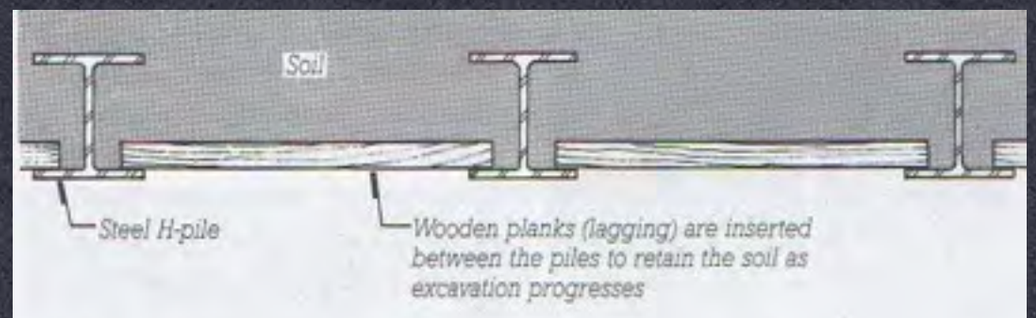


FIGURE 2.10
Soldier beams and lagging, seen in horizontal section.

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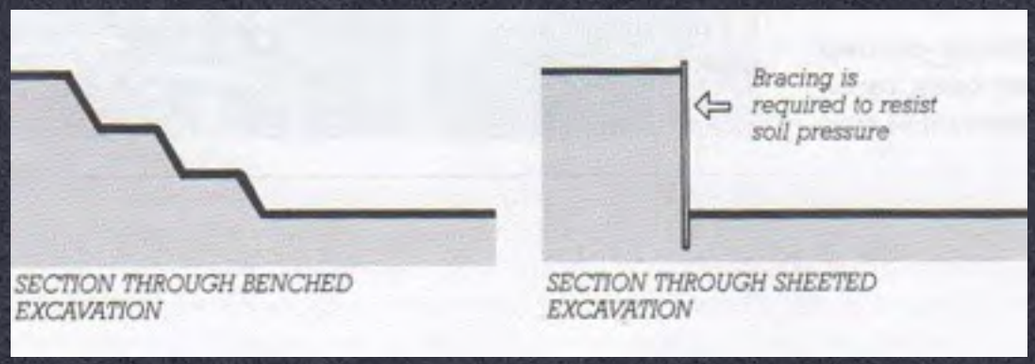

FIGURE 2.10
Soldier beams and lagging, seen in horizontal section.

SOLDIER BEAMS & LAGGING

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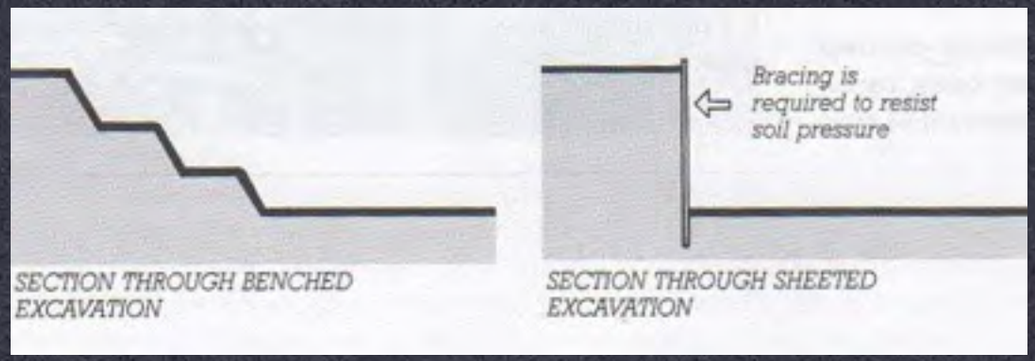

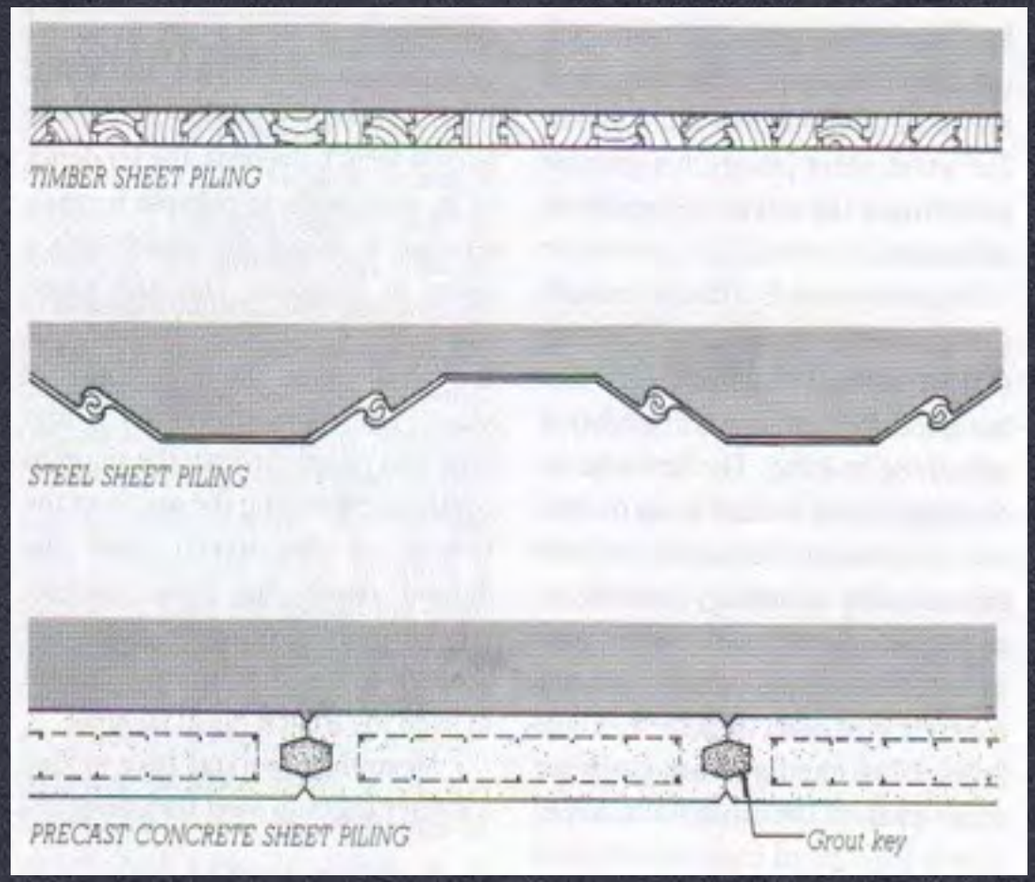

SHEET PILING

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SHEET PILING

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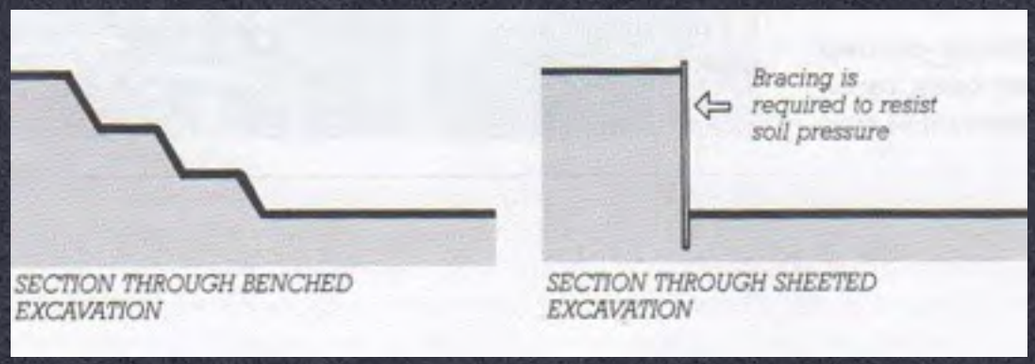

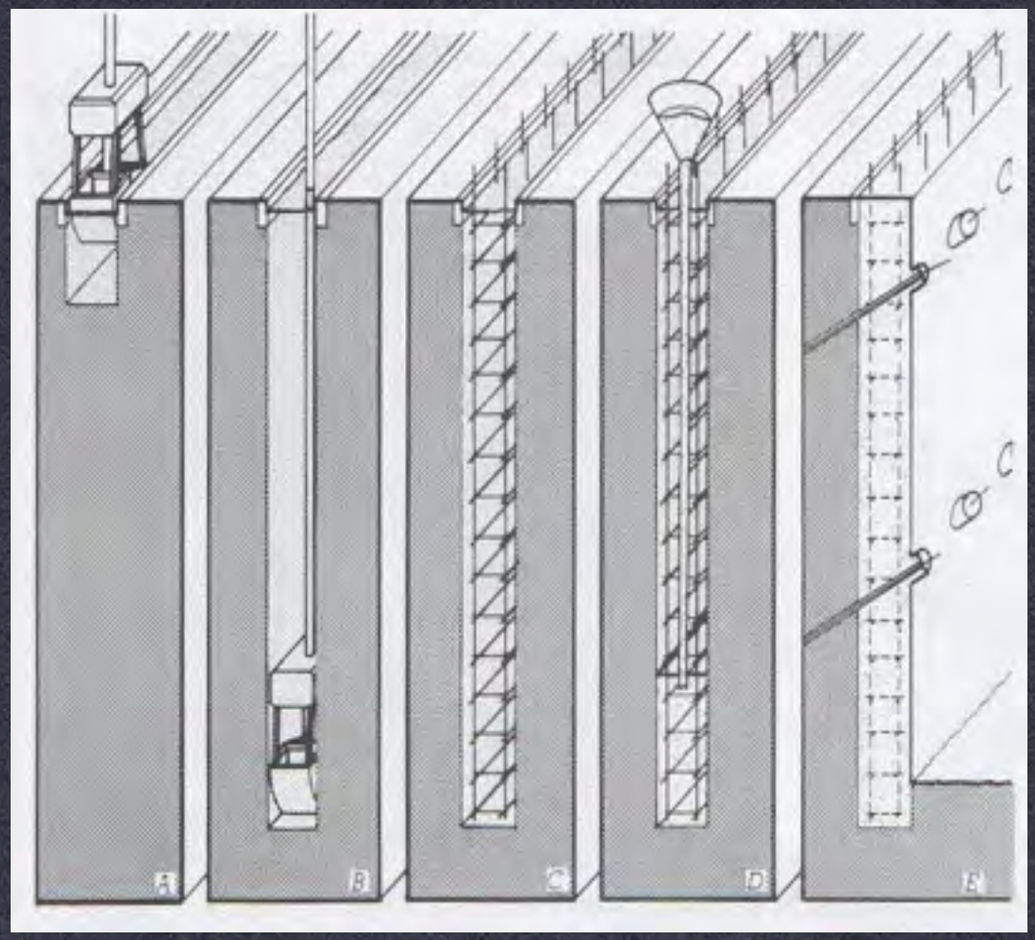

SLURRY WALL

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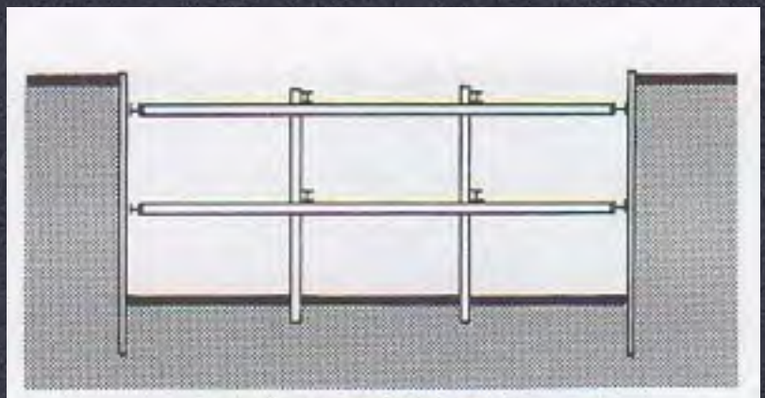
SLOPE SUPPORT

D. BRACING

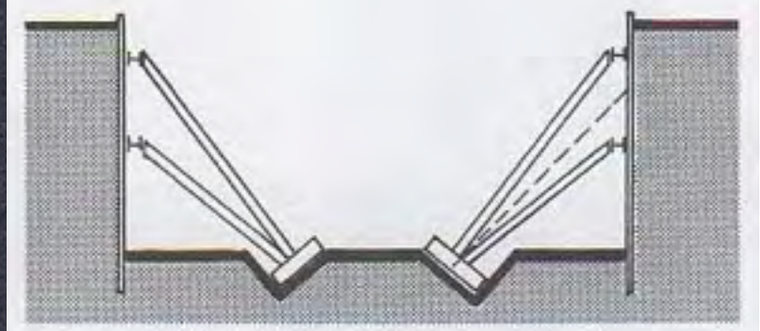
i. CROSSLOT BRACING

ii.RAKERS

iii.TIEBACKS



CROSSLOT BRACING



RAKERS

TIEBACKS

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SLURRY WALL W/ TIEBACKS

RAKERS

CROSSLOT BRACING

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spread the load into the earth

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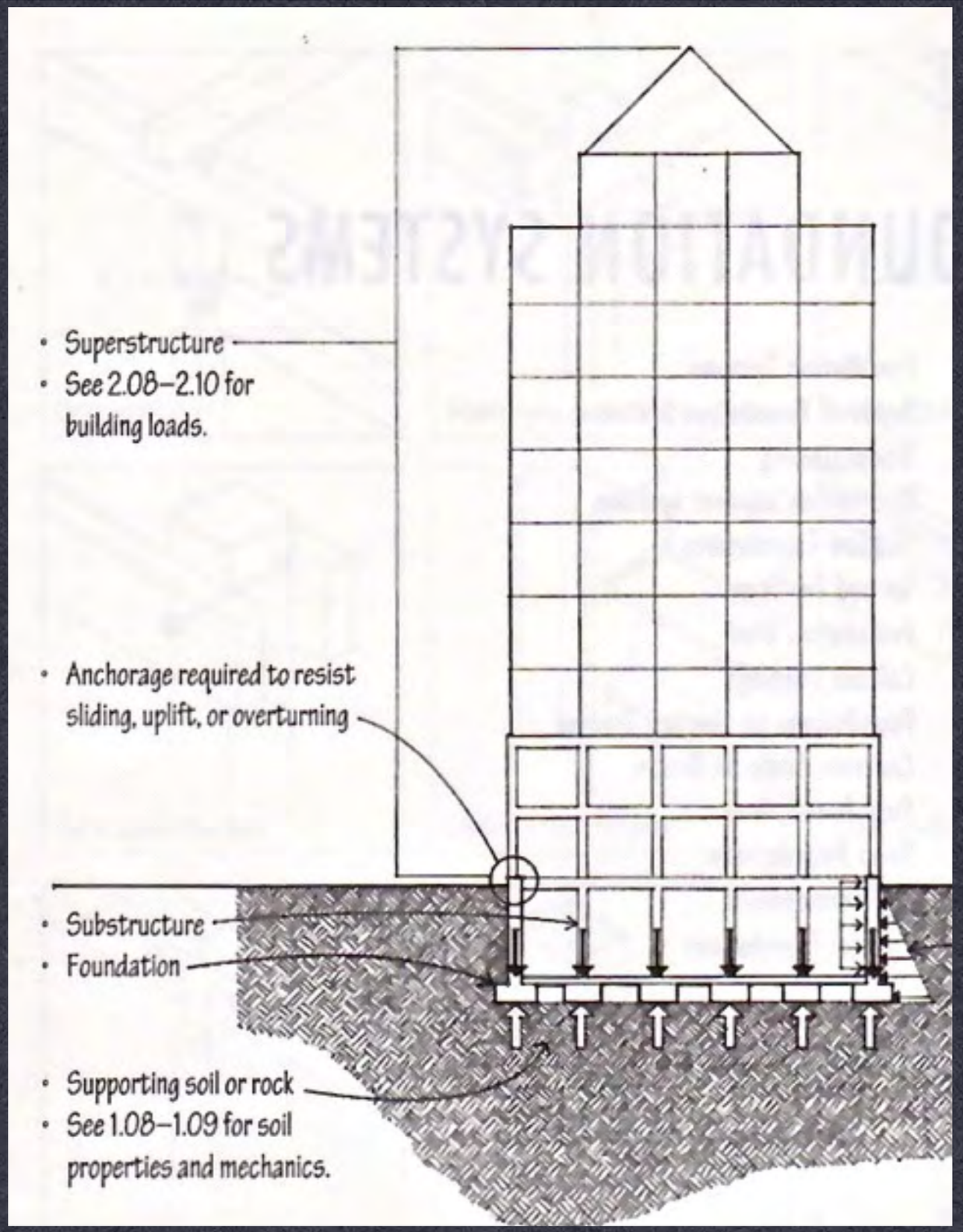

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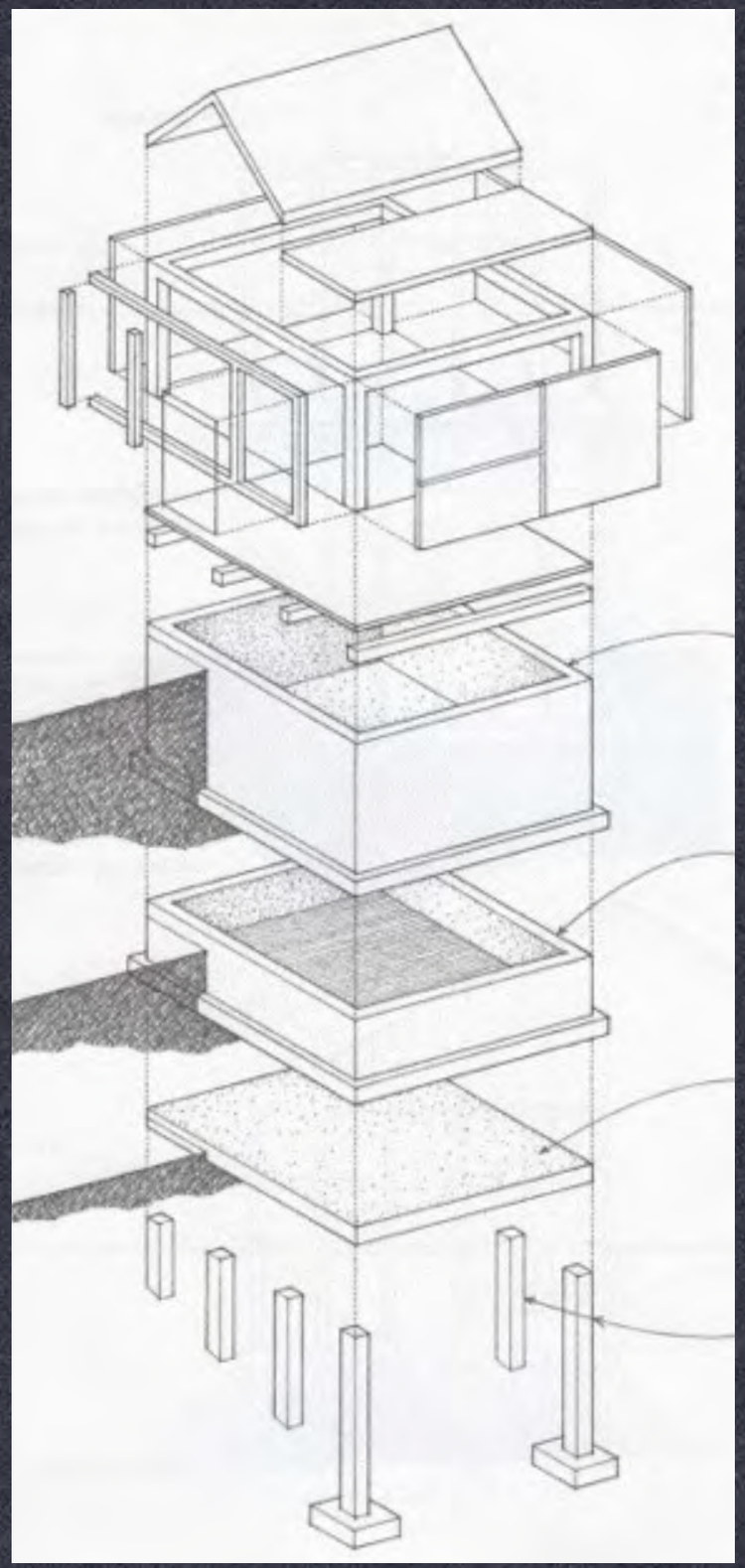

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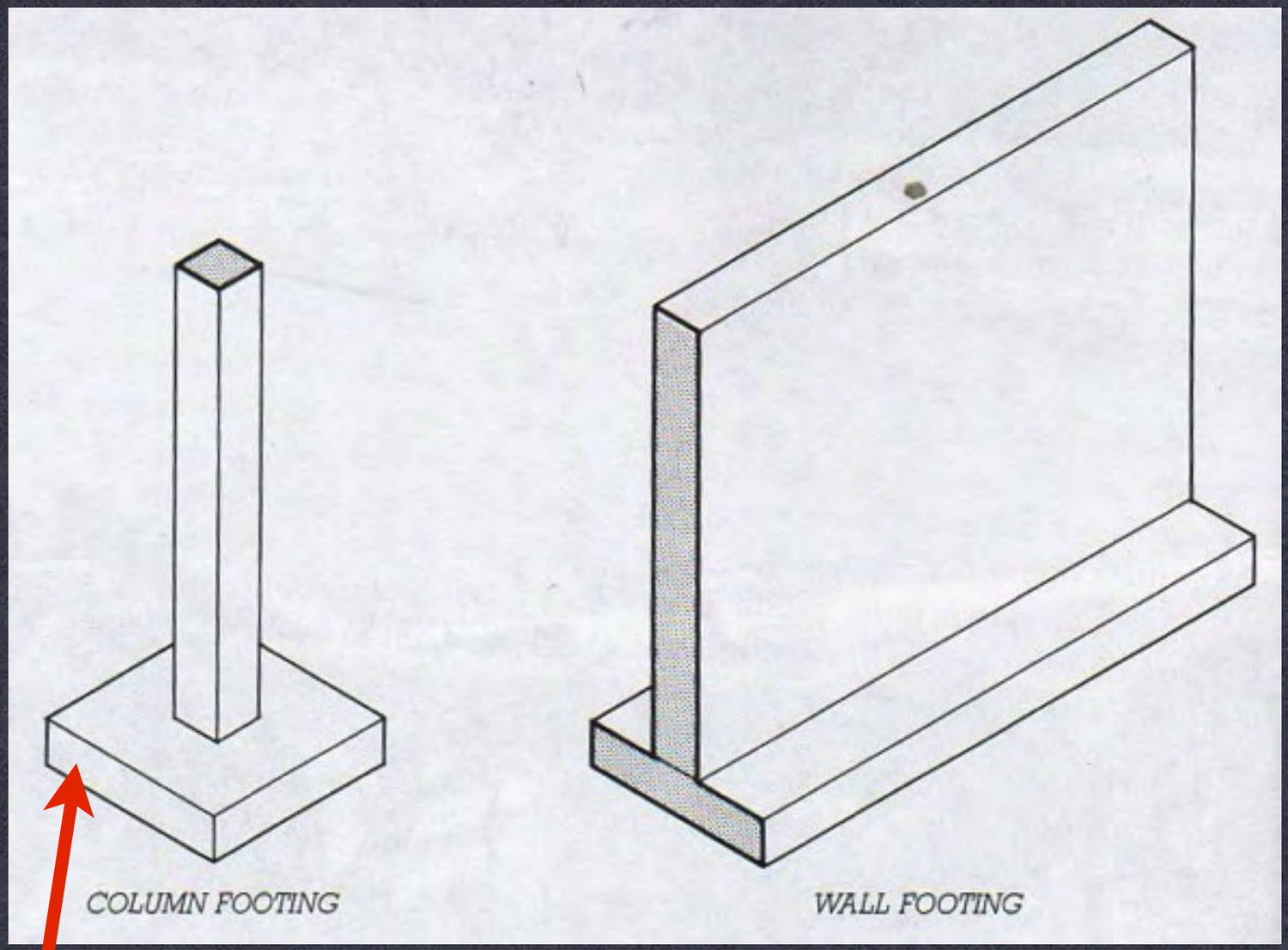
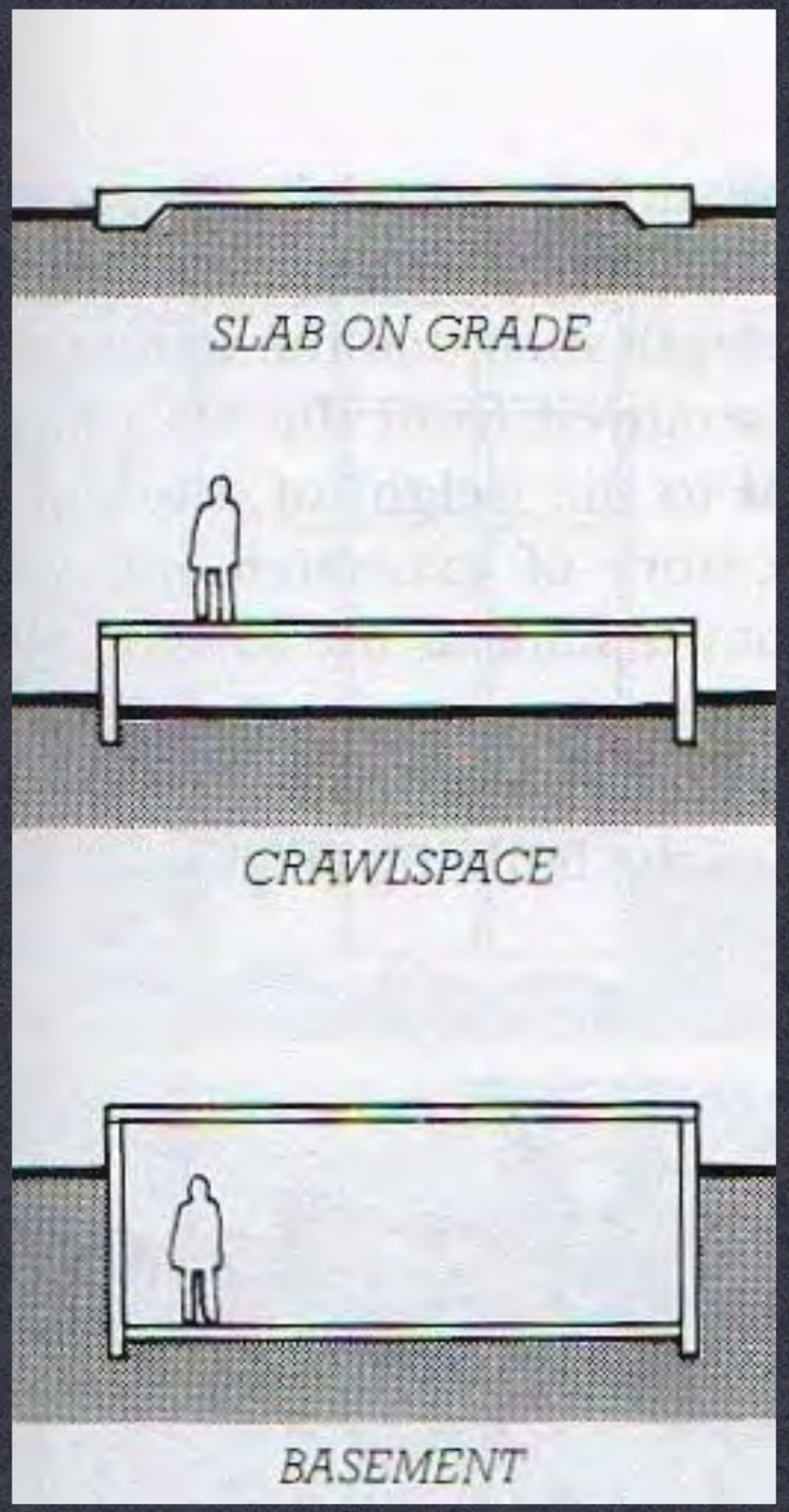


SPREAD FOOTING SITS UNDER VERTICAL FOUNDATION WALL OR COLUMN



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shallow foundations: footings

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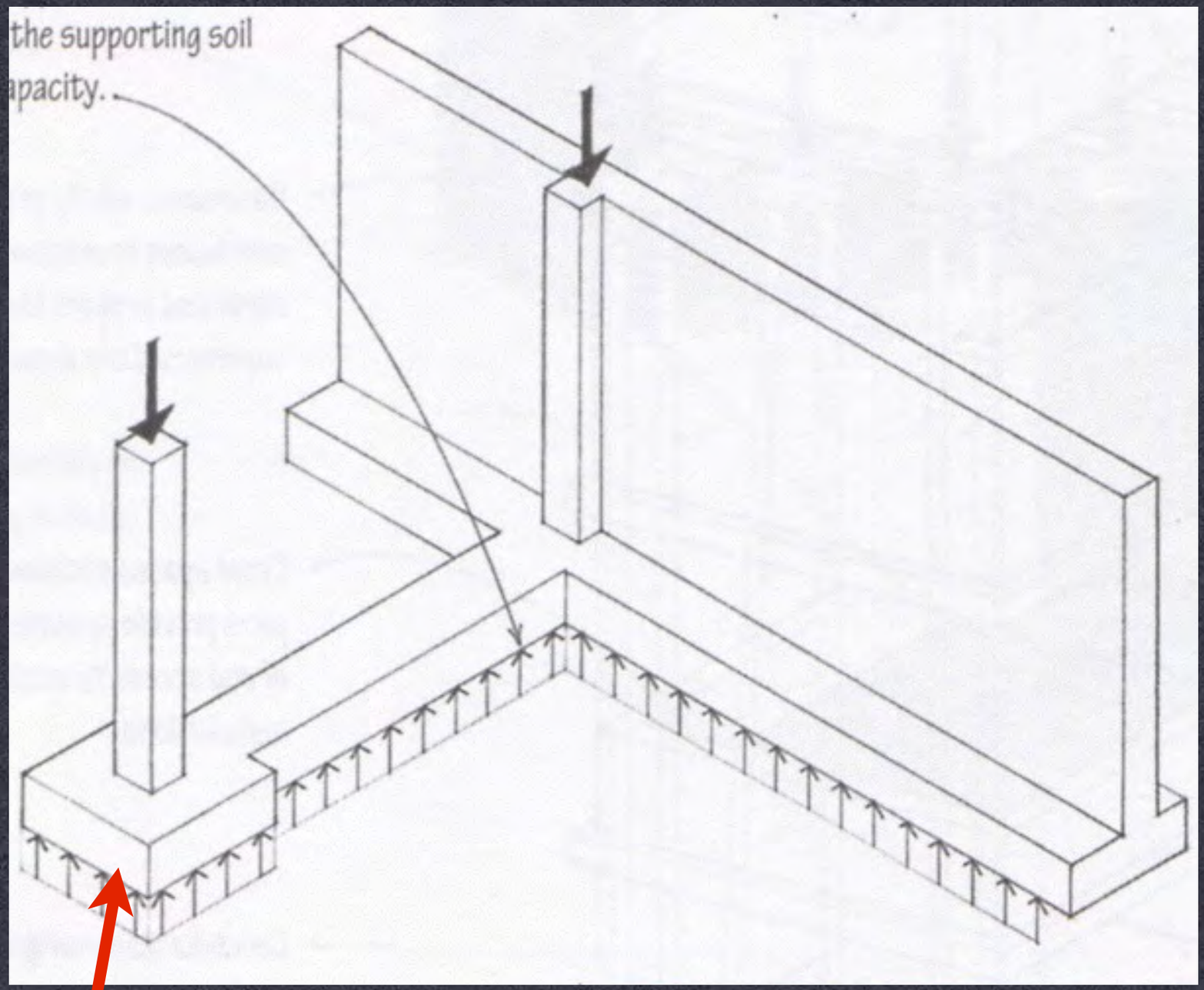

SPREAD FOOTING SITS UNDER VERTICAL FOUNDATION WALL OR COLUMN

TAKE LOAD OF STRUCTURE ABOVE AND SPREAD IT ONTO THE EARTH MATERIAL BELOW.

THE WIDTH OF THE SPREAD FOOTING IS DETERMINED BY THE ALLOWABLE BEARING PRESSURE

THE DEPTH IS DETERMINED BY FROST LINE (MINIMAL DEPTH) IN COMBINATION WITH POTENTIAL FOR USEFUL BASEMENT SPACE

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shallow foundations: footings

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FOUNDATIONS

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shallow foundations: footings

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FOUNDATIONS shallow foundations: footing + wall + slab

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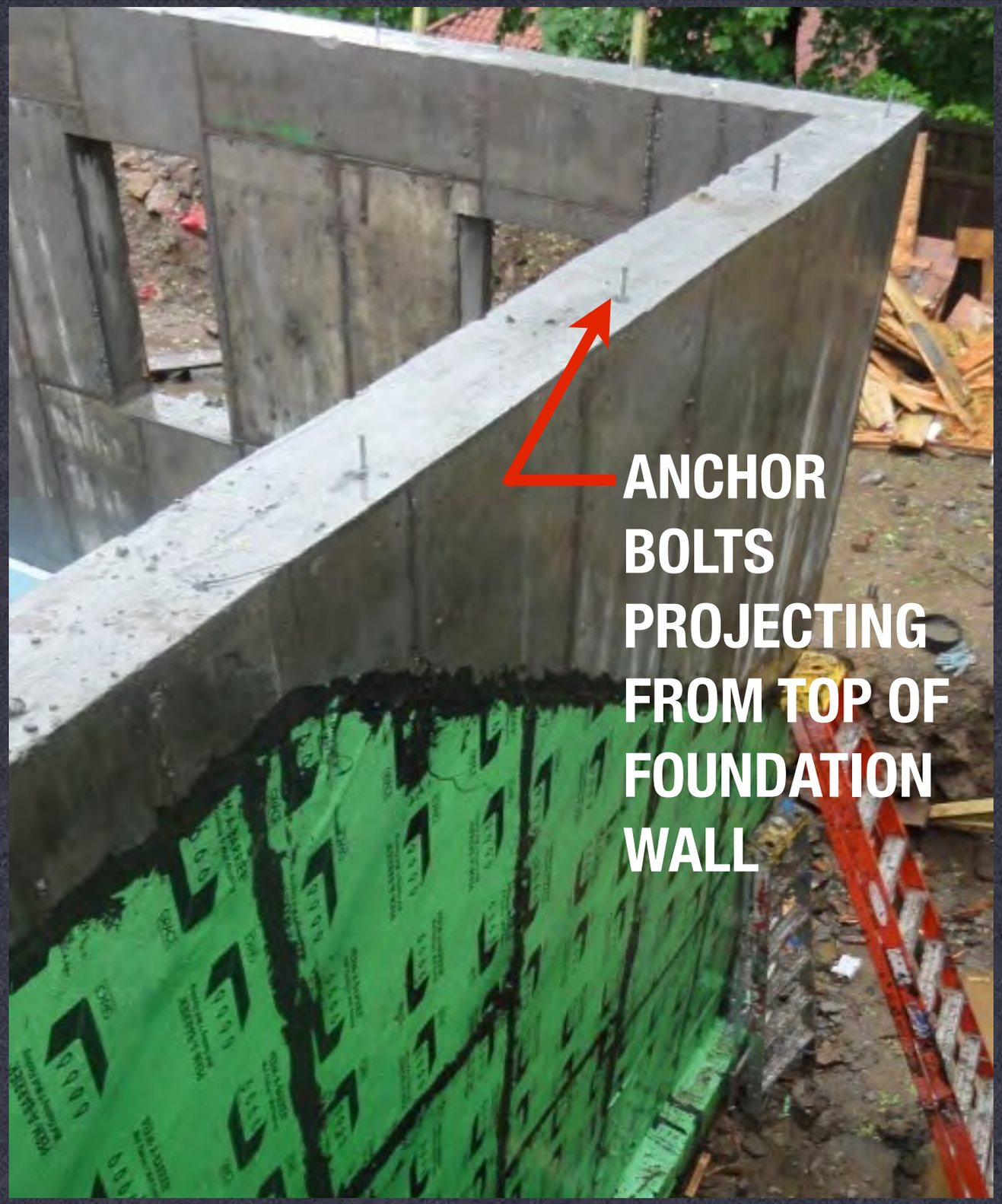

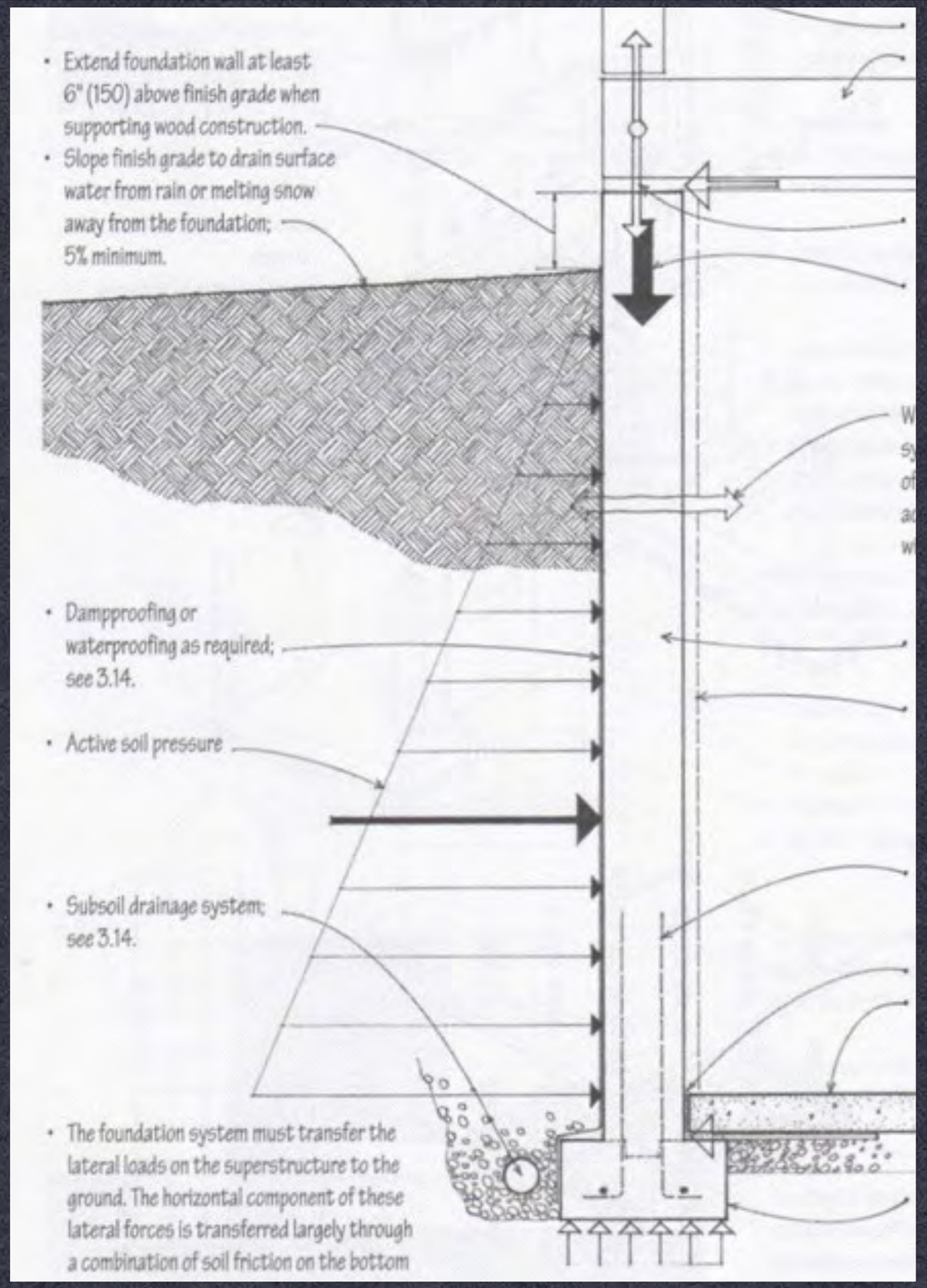

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foundation wall: transition to wood frame

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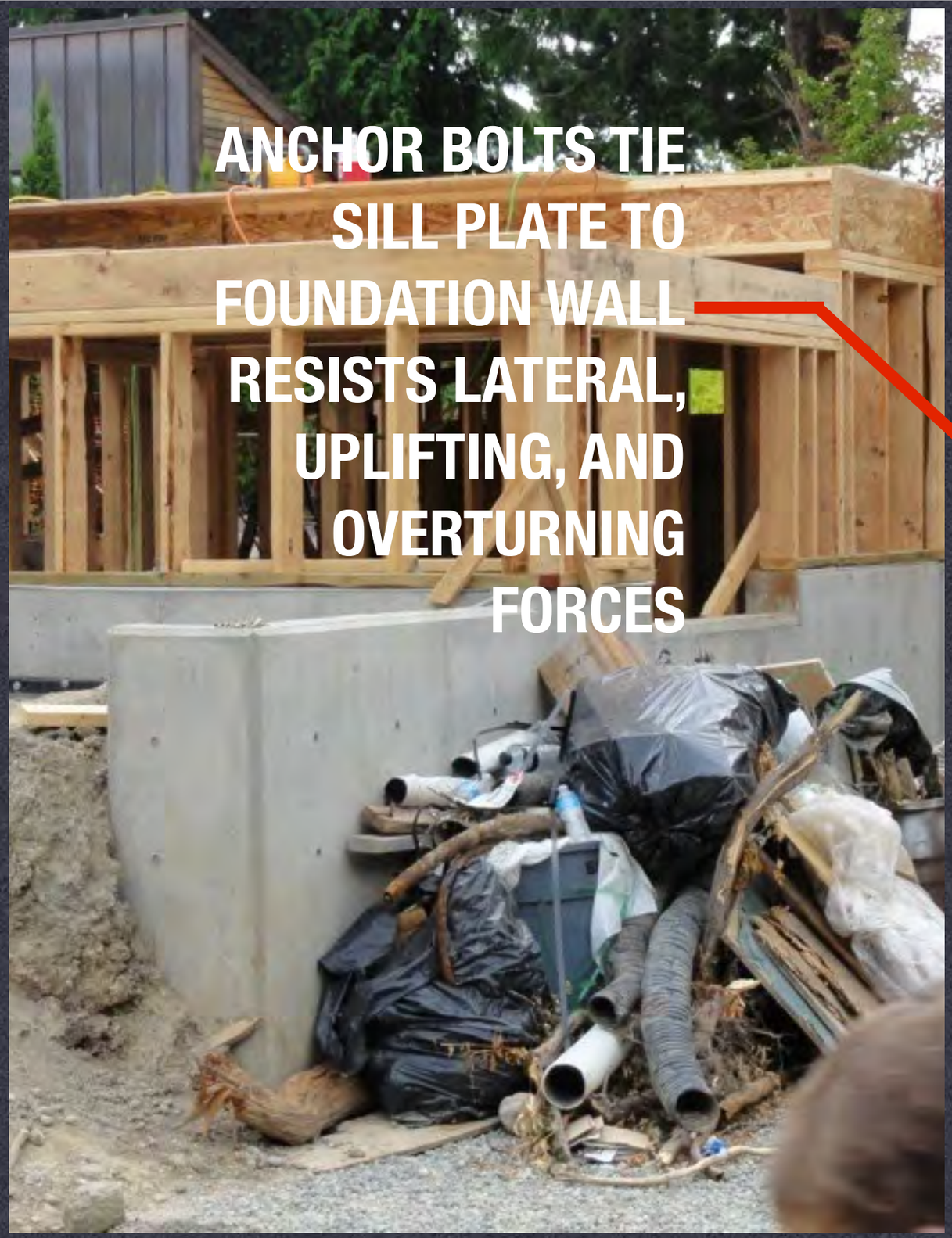

FOUNDATIONS

waterproofing foundations: footing drains

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FOUNDATIONS

waterproofing foundations: footing drains

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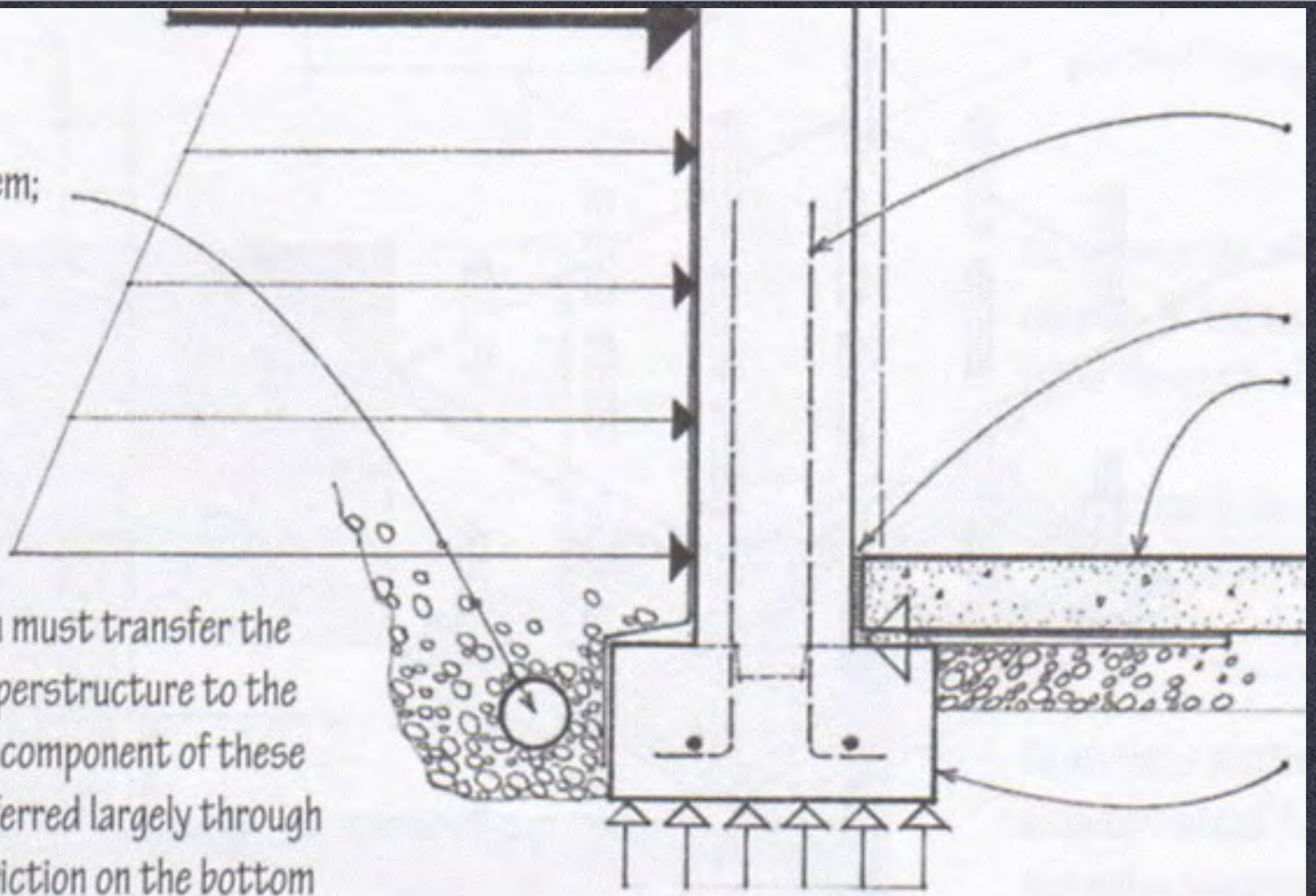
- Subsoil drainage system; see 3.14.



- The foundation system must transfer the lateral loads on the superstructure to the ground. The horizontal component of these lateral forces is transferred largely through a combination of soil friction on the bottom of footings and the development of passive soil pressure on the sides of footings and foundation walls.

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FOUNDATION WATERPROOFING

MULTI-LAYER SYSTEMS PROVIDE INSULATION AND SAFE CHANNELING OF WATER TO FOOTING DRAINS

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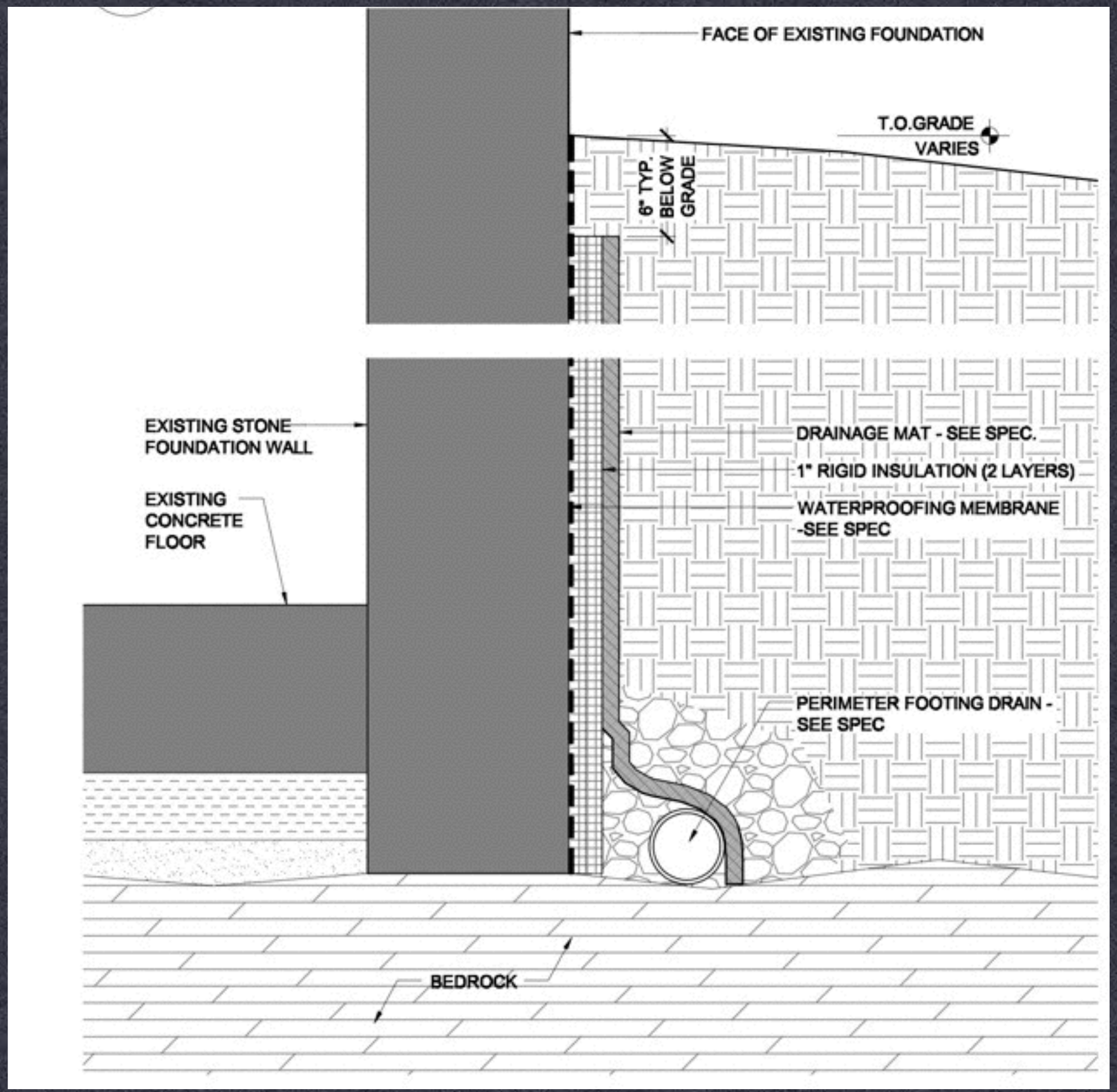

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designing foundations

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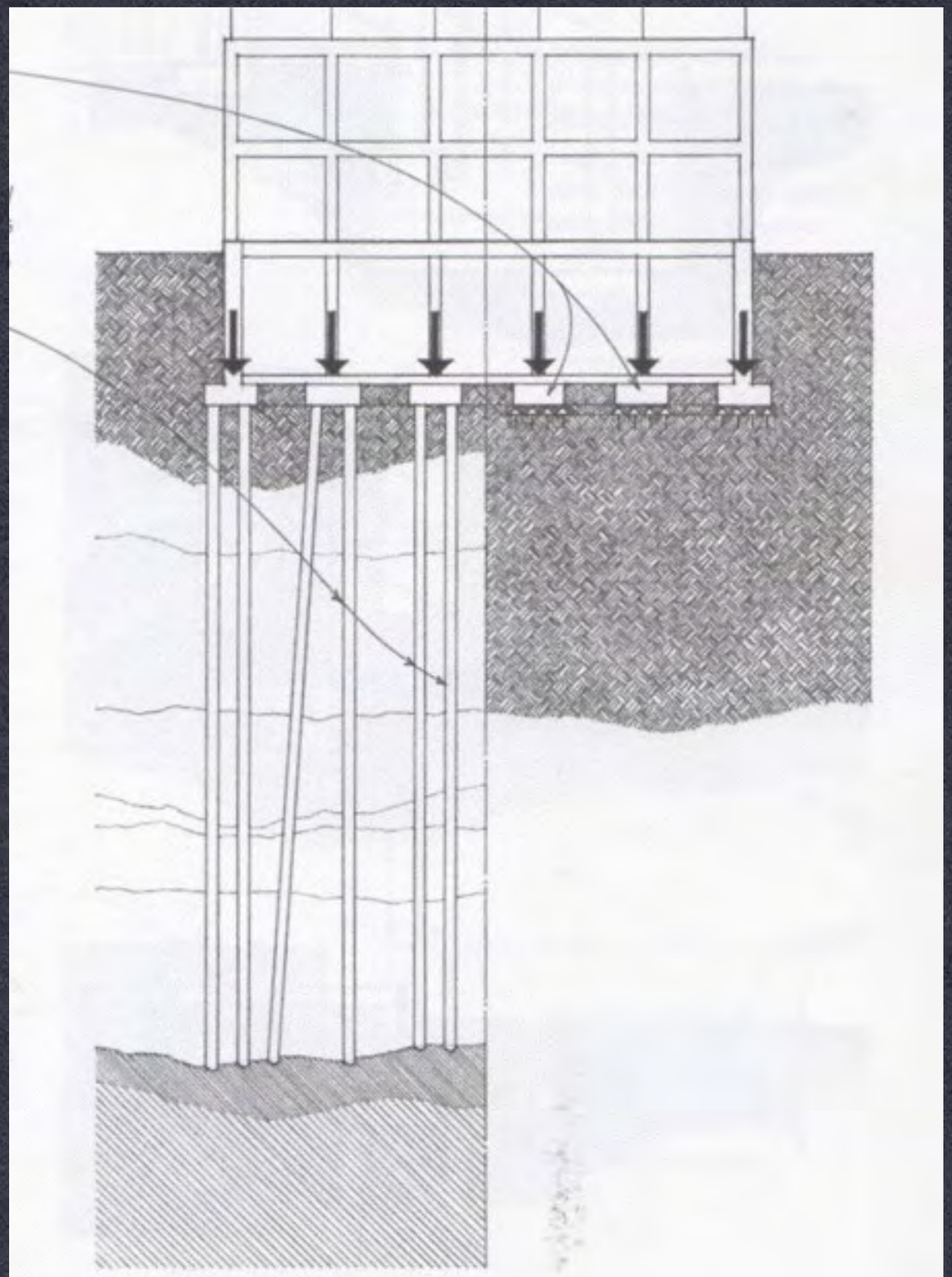

DESIGN THRESHOLDS TO CONSIDER:

1. WATER TABLE DEPTH
2. SITE BOUNDARIES AND NEIGHBORING STRUCTURES
3. INCREASED BUILDING LOADS ON FOUNDATIONS (DUE TO HEIGHT)
4. LOCATION AND QUALITY OF BEARING MATERIALS UNDER THE SITE

wrap up

FOUNDATIONS ARE THE FIRST CRITICAL ELEMENT OF THE STRUCTURE OF ALL BUILDINGS. ALL BUILDINGS MUST TRANSFER THEIR LOAD SAFELY TO THE EARTH AND RESIST FORCES OVER THE LIFETIME OF THE STRUCTURE.

- all foundation design starts with investigation of the earth under the building site
- the geotechnical engineer write a report on the site conditions and makes recommendations to the architect and structural engineer
- the configuration of foundations reflects the conditions of the earth under the site as well as the structure rising into the sky.