

# Chapter 2: Basic Civil Engineering

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Technical & Professional Knowledge for NICL AO (Scale I) 2026, Risk Engineer: Phase II (Main) exam

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# Chapter opener

## What this chapter covers

Civil engineering is about what structures are made of, how they are built, where they stand, what loads they carry and how water behaves around them. The fifteen units cover materials (2.2–2.5), construction (2.6–2.8), surveying (2.9–2.11), loads, codes and safety (2.1, 2.12–2.13) and fluid mechanics (2.14–2.15). Each unit has a **core** part and, where useful, a shaded **Optional recall** box; the 100 practice questions test only the core.

**Why civil basics matter to a risk engineer.** Whether a building survives a fire, an earthquake or years of dampness depends on what it is made of, how it is founded and how it was built.

## Learning objectives

After this chapter, you should be able to:

1. Recognise the branches of civil engineering, the role of BIS and the main Indian codes, and the units used in civil work.
2. Identify building stones and bricks: rock types, brick-earth constituents, brick size, tests and defects.
3. Describe lime and cement: manufacture, the main compounds and their roles, types and grades, tests and storage.
4. Explain aggregates, mortar and concrete: concrete grades, nominal and design mixes, the water–cement ratio, workability, curing and testing.
5. Recall how steel, timber and other materials are used, including why and where concrete is reinforced.
6. Name the components of a building, foundation types, masonry terms and bonds, and the ways dampness is prevented.
7. Apply basic surveying: scales, bearings, reduction of levels, contours, and the purpose of the total station, GNSS, remote sensing and GIS.
8. Classify loads, explain earthquake basics and seismic zoning, describe how materials behave in fire and how buildings are protected, and use FSI and floor-area terms under a stated definition.
9. Apply fluid properties, hydrostatic pressure, buoyancy and stability, continuity and Bernoulli's equation under their stated assumptions.

## Topic map

| Unit                                       | What you will learn                                    | Practice questions |
|--------------------------------------------|--------------------------------------------------------|--------------------|
| 2.1 Civil engineering, standards and units | Branches, BIS and Indian codes, units                  | Q1–Q4              |
| 2.2 Stones and bricks                      | Rock types, brick earth, brick size, tests and defects | Q5–Q10             |

| Unit                                           | What you will learn                                                        | Practice questions |
|------------------------------------------------|----------------------------------------------------------------------------|--------------------|
| 2.3 Lime and cement                            | Lime, cement compounds, types, grades and tests                            | Q11–Q18            |
| 2.4 Aggregates, mortar and concrete            | Aggregates, mortar, grades, mixes, w/c ratio, workability, curing, testing | Q19–Q28, Q91, Q92  |
| 2.5 Steel, timber and other materials          | Reinforcement, cover, timber, paint                                        | Q29–Q34            |
| 2.6 Building components and foundations        | Parts of a building, bearing capacity, settlement, foundation types        | Q35–Q40            |
| 2.7 Masonry and damp proofing                  | Brick terms and bonds, stone masonry, dampness                             | Q41–Q46            |
| 2.8 Floors, roofs, stairs, arches and finishes | Floors, slabs, stairs, arches, plaster and pointing                        | Q47–Q51            |
| 2.9 Surveying: principles, chain and compass   | Principles, scales, chains, bearings                                       | Q52–Q57, Q93, Q94  |
| 2.10 Levelling and contouring                  | Benchmarks, staff readings, reducing levels, contours                      | Q58–Q63, Q95       |
| 2.11 Modern surveying tools                    | Total station, GNSS, remote sensing, GIS                                   | Q64–Q68            |
| 2.12 Loads, earthquakes and seismic codes      | Loads, unit weights, earthquake terms, seismic zones                       | Q69–Q74, Q96       |
| 2.13 Fire safety and building regulations      | Materials in fire, fire protection, FSI, floor areas                       | Q75–Q80, Q97       |
| 2.14 Fluid properties and hydrostatics         | Viscosity, surface tension, pressure, buoyancy, metacentre                 | Q81–Q86, Q98, Q99  |
| 2.15 Fluid flow                                | Types of flow, continuity, Bernoulli, flow measurement                     | Q87–Q90, Q100      |

#### Exam context

- **The section:** 50 questions, 50 marks, 35 minutes: an *average* of 42 seconds a question.
- **Marking:** +1 correct, –0.25 wrong, 0 blank.
- **No calculators:** every number in this chapter's examples and numericals is chosen for mental arithmetic.

*Source: the NICL recruitment notice dated 07/10/2026, as transcribed for this book.*

### Should you guess?

If  $p$  is your honest chance of being right, the expected mark from answering is

$$\text{Expected mark} = p - 0.25(1 - p) = 1.25p - 0.25$$

The break-even point is  $p = 20\%$ , a blind pick among five options, so a blind guess is worth zero *on average*. If the options you rule out really are wrong and the rest are equally likely, one option out gives +0.063 per guess, two out +0.167, three out +0.375. Ruling out the right answer by mistake reverses the gain.

**Standards used.** IS 456:2000, IS 269:2015, IS 1786:2008, IS 875 (Parts 1–5), IS 1893 (Part 1):2016 and SP 7:2026. Edition status checked on 10 October 2026. Where an older edition is named (bricks), the value is from that edition. Older books and question banks may quote earlier editions; where an older value is still widely quoted, the chapter says so.

## How to use this chapter

Read a unit and its worked examples, try that unit's questions and check the key; use the revision kit before attempting all 100. Leave the Optional boxes for a second reading.

## Conventions used in this chapter

- **Units:** SI throughout; levels in metres to three decimals.  $g = 9.81 \text{ m/s}^2$  in the theory; numerals state  $g = 10 \text{ m/s}^2$ .
- **Level books:** an intermediate sight is written in full in the text and as "I.S." in level-book tables.
- **Symbols that differ from Chapter 1.** In the fluid units (2.14–2.15),  $\mu$  is dynamic viscosity,  $\nu$  kinematic viscosity and  $\gamma$  specific weight. (In Chapter 1 they were the coefficient of friction, Poisson's ratio and shear strain.)
- **Abbreviations:** BIS Bureau of Indian Standards; PCC plain cement concrete; RCC reinforced cement concrete; OPC ordinary Portland cement; PPC Portland pozzolana cement; PSC Portland slag cement; w/c water–cement ratio; FM fineness modulus; DPC damp-proof course; RL reduced level; BS backsight; FS foresight; HI height of instrument; WCB whole-circle bearing; QB quadrantal bearing; RF representative fraction; EDM electronic distance measurement; GNSS global navigation satellite system; GIS geographic information system; FSI floor space index; FAR floor area ratio; RERA Real Estate (Regulation and Development) Act, 2016.

## 2.1 Civil engineering, standards and units

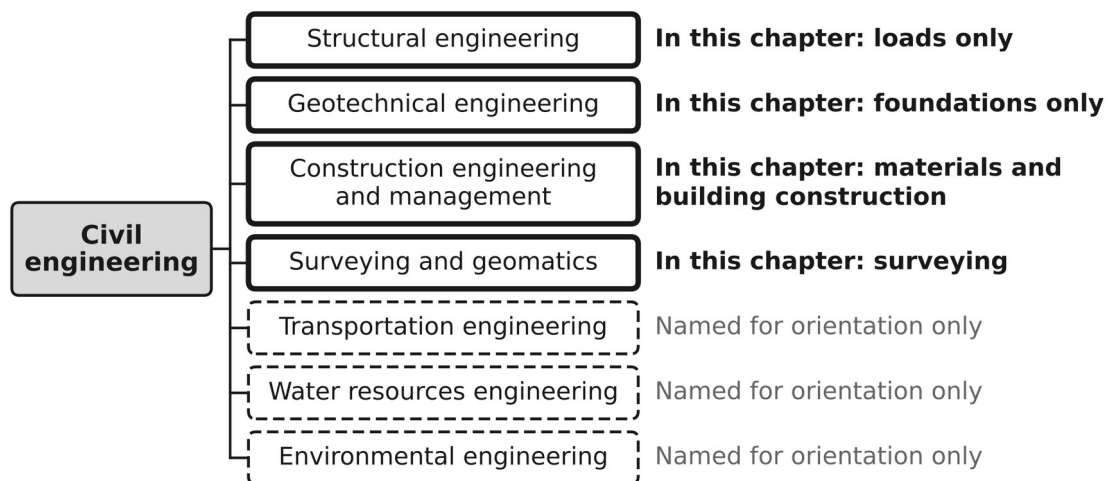
**In a nutshell.** Civil engineering plans, designs and builds the structures and services a society runs on. In India its rules of practice are set out in Indian Standards published by BIS.

### 2.1.1 Scope and branches

Civil engineering covers a wide family of work:

- **Structural engineering:** designing buildings, bridges and towers to carry their loads safely.
- **Geotechnical engineering:** the behaviour of **soils and rocks**, and the design of **foundations**, slopes and retaining walls.
- **Construction engineering and management:** materials, methods, planning and site safety.
- **Surveying and geomatics:** measuring and mapping the land.
- **Transportation engineering:** roads, railways, airports and traffic.
- **Water resources engineering:** dams, canals, irrigation and flood control.
- **Environmental engineering:** water supply, sewage and solid waste.

This chapter covers materials, construction, surveying, loads and safety, and fluid mechanics. The other branches are named here only for orientation.



*Heavy solid border = covered in this chapter; dashed border = named for orientation only. Fluid mechanics (2.14–2.15) underlies water resources and environmental engineering.*

**Figure 2.1. Branches of civil engineering.** A tree with the seven branches, the ones covered in this chapter marked by label.

### 2.1.2 Indian standards and codes

The **Bureau of Indian Standards (BIS)** is India's national standards body. It publishes **Indian Standards**, written "IS" followed by a number and the year of the edition, such as IS 456:2000. Two kinds matter here:

- a **code of practice** gives rules for design or construction (IS 456 for concrete, IS 1893 for earthquake-resistant design);
- a **specification** gives requirements a material or product must meet (IS 269 for cement, IS 1786 for reinforcing bars).