



Subgrade Preparation for Concrete Pads:

A Factual Overview

Concrete Pad Subgrade Prep: Quick-Read Summary

The key facts at a glance

Full explanation and sources in the accompanying white paper

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Why it matters

- Concrete is only as good as the ground under it. The soil beneath the slab — the subgrade — is the pad's foundation; uneven support is what cracks concrete.
- Standards require preparing it first. Published guidance calls for a uniform base, compacted to a specified density at the correct soil moisture, before any concrete is poured.

How the soil is prepared

- Moisture is the key. Soil packs tightest near its “optimum moisture” (set by the standard Proctor tests). Too dry, and it will not compact — leaving a weak, uneven base.
- Dry, hard soil: loosen it (till/aerate), add water to the right moisture, mix out dry pockets, and compact.
- Expansive clay: shrinks and cracks when dry and swells when wet; it is compacted slightly above optimum, and uneven swelling can crack or tilt a slab.

Why the two sites differ

- Semi-arid site, deep groundwater: the soil is dry and hard — add water to reach optimum, then compact.
- Coastal site, shallow water table: the soil is already wet — adding water will not work. Dry it back or dig out and replace the soft material with clean fill, manage the groundwater, and watch for long-term settlement of soft, saturated clay.

In brief

Every site needs the same result — a firm, uniform base compacted at the soil's correct moisture before the pour. Dry sites get there by adding water; wet sites over a shallow water table get there by removing it. The right treatment for any specific pad is set by that site's geotechnical investigation and engineer.



Subgrade Preparation for Concrete Pads: A Factual Overview

A plain-language summary of the published facts and sources
Compiled from published engineering standards and industry sources
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When a large concrete slab or equipment pad is built, the soil beneath it — the subgrade — is prepared before any concrete is placed. This document explains, in everyday terms, why the condition of that soil affects the concrete above it, and what published engineering standards and industry sources say about preparing it. It also covers why the right preparation differs between dry sites with deep groundwater and wet sites with a shallow water table.

The one thing to know first

Concrete performs only as well as the ground beneath it. Published guidance treats the subgrade as the slab's foundation and calls for it to be uniform and compacted to a specified density, at the correct soil moisture, before concrete is placed. [1]

Why the subgrade matters

Guidance for concrete floors and slabs-on-ground identifies the subgrade as the supporting foundation for the slab and calls for a uniform, well-compacted subgrade, with moisture and density requirements verified before concrete is placed [1]. Non-uniform support beneath a slab is associated with cracking and differential settlement [6]. For a heavy pad carrying concentrated loads, uneven support is a structural concern.

Compaction and soil moisture

Standard laboratory tests establish, for a given soil, its maximum dry density and the optimum moisture content at which that density is reached [2]. A soil compacted at or near its optimum moisture reaches its specified density; the same soil compacted well below optimum does not reach that density for equivalent effort [3]. Field compaction is commonly required as a percentage of the maximum dry density [4].

When the soil is dry and hard

Published earthwork guidance describes soil below its optimum moisture as having too much friction between particles to pack tightly, which produces poor compaction and a weak base. The described corrective process is moisture conditioning: aerating or turning over the top layer of soil, applying water, and mixing it so the moisture is uniform with no dry pockets, then compacting to the specified density [8].



Expansive (shrink-swell) soils

Expansive clays change volume with moisture: they shrink and crack as they dry and swell as they later take on water [5]. Guidance notes that soils compacted dry of optimum later absorb water and expand, and recommends compacting expansive soils at 1 to 3 percent above optimum moisture [4]. Differential swelling beneath a slab is associated with cracking, uplift, and tilting of the concrete [9].

When the water table is shallow

Where groundwater is near the surface, the subgrade may already be at or above its optimum moisture. Saturated fine-grained soils cannot be densified by adding water and may deform, or “pump,” under compaction equipment, and soft saturated clays consolidate under sustained load, producing settlement over time. Measures described for these conditions include drying the soil back, over-excavation and replacement with select structural fill, chemical stabilization such as lime or cement treatment, geosynthetic reinforcement, and management of groundwater during construction [7] [10].

Same goal, different conditions

Subgrade preparation is governed by a site’s groundwater depth and soil type. The published objective is the same everywhere — a firm, uniform base compacted to the specified density near the soil’s optimum moisture — but the moisture step runs in opposite directions:

- Semi-arid sites with deep groundwater: the subgrade is typically dry and hard; preparation adds moisture to reach optimum before compaction, and expansive clays add a shrink-swell consideration.
- Coastal or low-elevation sites with a shallow water table: the subgrade is typically wet; preparation manages moisture out of the soil or replaces and stabilizes it, and soft saturated clays add a settlement consideration.

Site-specific requirements are established by a geotechnical investigation (boring logs) and the project geotechnical engineer.

In brief

Concrete needs a firm, uniform base. Published standards call for the subgrade to be compacted to a specified density at the soil’s correct moisture before the pour. Dry, hard soil is conditioned by adding water and compacting; wet soil over a shallow water table is prepared by removing moisture or replacing and stabilizing the material.



Expansive clays add shrink-swell risk and soft saturated clays add settlement risk. The correct treatment for any specific site is set by a geotechnical investigation.

Sources

This overview is drawn from the following published standards and industry sources. Each can be reviewed directly at the link provided.

- [1] American Concrete Institute — ACI 302.1R, Guide for Concrete Floor and Slab Construction (subgrade uniformity, moisture and density before placement). [concrete.org — ACI 302.1R](https://concrete.org/publications/standards/aci302.1r)
 - [2] ASTM International — ASTM D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (Standard Proctor; optimum moisture and maximum dry density). [astm.org — ASTM D698](https://www.astm.org/standards/D698)
 - [3] ASTM International — ASTM D1557, Laboratory Compaction Characteristics of Soil Using Modified Effort (Modified Proctor). [astm.org — ASTM D1557](https://www.astm.org/standards/D1557)
 - [4] American Concrete Pavement Association — EB204, Subgrades and Subbases for Concrete Pavements (percent of maximum dry density; expansive soils compacted 1–3% above optimum, AASHTO T99). [wikipave.org — ACPA EB204](https://www.wikipave.org/EB204)
 - [5] GeoKinetics — Expansive Soils Mitigation: Chemistry, Risks, and Engineering (shrink- swell behavior of expansive clays). [geokinetics.com — Expansive Soils Mitigation](https://www.geokinetics.com/expansive-soils-mitigation)
 - [6] American Concrete Institute — ACI 360R, Guide to Design of Slabs-on-Ground (subgrade/subbase support of slabs). [concrete.org — ACI 360R](https://concrete.org/publications/standards/aci360r)
 - [7] Lime Association of Texas — Lime Treatment for Expansive Soils (moisture conditioning and chemical stabilization of expansive clay subgrades); presentation hosted on the Texas Department of Transportation (txdot.gov) site. [txdot.gov — Lime Treatment for Expansive Soils](https://www.txdot.gov/projects/soils/lime-treatment-for-expansive-soils)
- Industry and engineering references (application of these principles to large-pad and data- center earthwork):*
- [8] RSP Engineers — Moisture Conditioning Earthwork for Data Center Construction (aerate, add water, mix, and compact dry subgrade). [rspengineers.com — Moisture Conditioning Earthwork](https://www.rspengineers.com/moisture-conditioning-earthwork)
 - [9] RSP Engineers — Navigating the Challenges of Texas Expansive Soils for Data Center Development (differential heave; cracking and tilting of slabs). [rspengineers.com — Texas Expansive Soils](https://www.rspengineers.com/texas-expansive-soils)
 - [10] Buildermuse — Data Center Foundation Construction: Massive Concrete Demands (subgrade prepared to the structural engineer's bearing-capacity requirement; ground improvement over poor soils). [buildermuse.com — Data Center Foundations](https://www.builder-muse.com/data-center-foundations)

