



**I. Purpose**

The purpose of this building newsletter is to summarize the department’s policies and procedures relating to construction on expansive soil. When expansive soil is present at a building site, a special foundation design may be required. Parameters for this design are to be determined by a foundation investigation as described in Section 1804 of the Uniform Building Code.

**II. Responsibility**

When a new building is to be constructed, it is the responsibility of the site owner and the professional consultants involved in the design and construction to determine if expansive soil is present on the site. If it is unclear whether or not expansive soil is present, or the extent to which the potentially expansive soil might affect the new structure, then a licensed civil engineer should be retained to determine if expansive soil is a problem. Once the degree and quantity of expansive soil is determined, the proposed structure must be designed accordingly. In some cases it may be necessary to retain two engineers, one (soil engineer) to determine the extent of the expansive soil and provide design parameters, and another (structural engineer) to design the proposed building for the expansive soil per the soil engineer’s recommendations.

Prior to submission of the plans, owners, designers and contractors are strongly advised to take the opportunity to determine if there is an expansive soil problem.

**III. Preliminary Soil Report**

A preliminary soil report, prepared by a civil engineer licensed in the State of California, is required whenever expansive soil is present. A preliminary soil report is also recommended for all projects involving grading, new foundations, major site improvements or significant alteration to existing structures with foundation work. As a minimum, the report should include site preparation, allowable soil bearing values, expansion index test results and recommendations for foundation and slab design. Refer to the “Technical Guidelines for Geotechnical Reports” manual for a complete description of the requirements for a preliminary soil report, available at the 3rd floor Publications Sales area and at the 5th floor Maps and Records counter in the Development Services Center, 1222 First Avenue.

Whenever a preliminary soil report has not been submitted, it is important to note that a report may be required at the time of the foundation inspection. Costly

delays and alteration to the site and/or foundation could be avoided by obtaining a preliminary soil report during the design phase of the project.

If the building inspector suspects expansive soil on the site during the foundation inspection and a preliminary soil report has not been submitted, the building inspector may require the owner or contractor to retain a qualified civil engineer to provide a preliminary soil report with foundation recommendations before work can progress. The report could require resubmittal of plans to Plan Review Services to verify that the soil engineer’s recommendations have been incorporated in the foundation.

**IV. Expansive Soil Tests**

A. When the expansive characteristics of a soil are to be determined, the procedures shall be in accordance with one of the following methods:

1. UBC Standard No. 18-2. See UBC Section 1803.
2. San Diego County Code (Chapter 6, Division 7, Title 8). The County value multiplied by 10 equals the expansion index; for example, 3% by the County method is equal to an expansion index of 30 by UBC Standard No. 18-2.

B. When the expansion index is 20 or less and no special design recommendations are required, the following note should be placed on the foundation plan: “Expansion index has been determined to be 20 or less and no special design recommendations are required.

Soil Engineer \_\_\_\_\_,  
 Registration No. \_\_\_\_\_,  
 Company Name \_\_\_\_\_,  
 Date \_\_\_\_\_.”

C. When the expansion index is greater than 20, the soil engineer must make recommendations and the designer must incorporate these recommendations in the building design. The following note should be placed on the foundation plan: “Expansion index has been determined and recommendations of the soil engineer have been incorporated into these plans.

Soil Engineer \_\_\_\_\_,  
 Registration No. \_\_\_\_\_,  
 Company Name \_\_\_\_\_,  
 Date \_\_\_\_\_.”

## V. Building Design for Expansive Soil

When the expansion index is greater than 20, one of the following methods shall be used in the building design:

- A. A material solution may be used upon recommendation by the soil engineer. The expansive soil problem may be mitigated by removal of the expansive soil and replacement with a nonexpansive material. This solution may involve regrading the project site, or “mixing” expansive material with nonexpansive in order to lower the expansion index.

Alternatively, the expansive soil surrounding and under the building may be removed to an appropriate depth, replaced with another material and compacted.

- B. UBC Section 1815 is a design method for slab-on-ground foundations using nonprestressed steel.

Use of this standard shall be limited to buildings three stories or less in height in which gravity loads are transmitted to the foundation primarily by means of bearing walls constructed of masonry, wood or steel studs, and with or without masonry veneer.

- C. UBC Section 1815 is a design method for post-tensioned slabs-on-ground.

The same limitations specified in Item B of this section also apply.

- D. An alternate engineering design may be proposed. Sections 1804.4 and 1806.5 of the UBC give the building official the authority to consider alternate design procedures for expansive soil.

The following procedures may be used for a slab-on-grade system where gravity loads are transmitted to the foundation by means of bearing walls constructed of masonry, wood or steel studs:

1. Where the expansion index (EI) is 90 or less, the foundation design may be specified by prescriptive foundation recommendations contained in the project soil report. In this case, the soil report must contain specific recommendations for the foundation design. One possible example of these recommendations could be stated as follows:

“All footings must be a minimum of 18 inches into grade with two #5 reinforcing bars at the top and two #5 reinforcing bars at the bottom of each footing. All slabs are to be a minimum of 5 inches thick with supported #4 reinforcing bars 18 inches on center. The soil must be wetted to a specified moisture content and depth 24 hours prior to placement of concrete. The soil engineer must verify the correct soil moisture content prior to placement.”

The prescriptive recommendations in the soil report will generally be the time-tested foundation designs that have proven satisfactory after years of experience with the local climate and soil conditions. These recommendations are to be based upon the engineering judgement of the soil engineer for a particular site and structure.

The recommendations of the soil engineer must be incorporated into the building plans. The structure’s foundation plan must contain the detailed requirements specified in the soil report.

In order to ensure that the foundation plan has been detailed according to the soil engineer’s requirements, the foundation plan must be reviewed and signed by one or more licensed professionals. Alternatively, the soil engineer may submit a letter stating that he/she has reviewed and approved the foundation plan for the project.

If the building is to be constructed using the conventional construction provisions of Sections 2317 thru 2326 of the UBC and the plans have not otherwise been prepared by a licensed architect or engineer, then only the foundation plan needs to be reviewed and signed or a letter submitted by a licensed professional.

If the entire set of drawings has been prepared by a licensed designer, then that designer must incorporate the soil engineer’s recommendations into the foundation plan and sign the plan.

2. Where the expansion index (EI) is greater than 90, a more rigorous design procedure is required. This design is to be accomplished by licensed professionals, preferably by a soil engineer in conjunction with a structural engineer. The design must be based upon the expansion parameters of the soil system and the interaction of the soil and building foundation. The department has no prescribed design method, but instead will expect the licensed professionals involved to design the foundation using a rational design procedure based upon soil testing. Some factors which may need to be considered are listed below:
  - a. Site drainage
  - b. Soil expansion and contraction
  - c. Applied pressure due to soil expansion
  - d. Allowable slab cracking
  - e. Soil moisture content at concrete placement
  - f. Slab/footing design for imposed building loads
  - g. Type of reinforcing
  - h. Slab and footing stiffness
  - i. Effect of utility trenches
  - j. Need for vapor barriers