SLOPE STABILITY
EVALUATION AND ACCEPTANCE STANDARDS

A. Purpose.

This Information Bulletin is to provide uniform requirements for evaluation of and standards for acceptance of stability of slopes within the City of Los Angeles. These requirements include consideration of pertinent engineering geologic and soils engineering factors of the critical field conditions that may reasonably be expected at the project location. These requirements include documentation and recommendations needed to determine if the site as proposed to be developed has an acceptable level of stability.

B. Application.

A stability evaluation will be required for cut, fill and natural slopes whose gradient exceeds two horizontal to one vertical and for all slopes that expose incompetent bedrock or unfavorable geologic structure such as unsupported bedding or that contain evidence of prior instability or landslide activity. Analysis is to include deep-seated and surficial stability evaluation under static load conditions. Where the site is within a State of California Seismic Hazard Zone requiring investigation for seismically induced landslide or where the Department requests, a seismic slope stability analysis is required.

C. Safety Factor Required.

The Municipal Code specifies 1.5 as the minimum acceptable static factor of safety for cut, fill and buttress fill slopes. The minimum acceptable seismic factor of safety is 1.1. These standards will also apply to natural slopes.

A safety factor is defined as the quotient of the sum of forces tending to resist failure divided by the sum of forces tending to cause failure.

1. New buildings or additions to buildings may be constructed upon a site that is adjacent to cut, fill or natural slopes, provided:

   a. The slopes that could affect the safety or stability of the proposed construction shall have an evaluated factor of safety of at least 1.5 against deep-seated static failure.

   b. When the proposed construction consists of a new single-family residence or the value of the improvements (additions and/or remodeling) to an existing building exceeds 50 percent of the replacement value, then the entire site shall have a minimum factor of safety of 1.5.
slopes with a factor of safety less than 1.5 will not pose a hazard to the proposed construction, the site access or to adjacent property, the Department may consider waiving this requirement.

c. Where the slope ascends above the building or addition, the slope shall have an evaluated factor of safety of at least 1.5 against surficial failure, or adequately designed protective devices shall be provided that will protect the construction from the hazard of mud and debris flow. When protective devices are utilized, the owner shall record an affidavit with the Office of the County Recorder stating that specified areas of the site may be subject to mudflow hazard and notifying future owners of their responsibility to provide maintenance of the protective devices.

d. The Department may consider approving minor additions or alterations of less than 200 square feet to existing structures where the factor of safety is less than 1.5. In order to make a determination of the relative safety of the proposed addition/alterations, the Department may require reports from a geologist and soil engineer. The reports shall include slope stability calculations evaluating the extent of any hazards and provide recommendations for possible mitigation, as considered necessary by the Department.

e. When it is determined that the project is subject to the requirements of the State Seismic Hazards Mapping Act, the slopes affecting the proposed construction shall also have an evaluated factor of safety of at least 1.1 against deep-seated seismic slope failure.

D. Design of Protective Devices.

Protective devices shall be permanent structures designed to either isolate, contain, deflect or channelize any potential mud or debris flow. The design and construction details shall be based upon an estimate of the volume and location of displaced material made by a soils engineer or engineering geologist.

The devices shall be located so that any potential surficial failure will be confined to remote or unused portions of the property at least 15 feet from all structures unless such portions are designed as permanent channels to prevent the accumulation of mud and debris. Remote or unused portions of the property shall not include accessory areas such as pools, driveways, parking or landscaped areas. Mud and debris shall not be diverted onto adjoining property.

Provision shall be made for reasonable access to all areas which may need future maintenance.

E. Type of Analysis.

1. Deep-Seated Stability. Evaluation of slopes for safety factor against deep-seated failure shall be in general conformance with the following:

   a. The potential failure surface used in the analysis shall be composed of arcs, planes or other...
shapes considered to yield the lowest factor of safety and to be most appropriate to the soil and geologic site conditions. For reasonably homogeneous soils, an arcuate failure surface is considered adequate. In cohesive soils, a vertical tension crack may be used to aid in defining the potential failure surface. The potential failure surface having the lowest safety factor shall be used in the analysis.

b. Loadings to be considered are gravity loads of potential failure mass, seepage forces and external loads. The potential for hydraulic head is to be evaluated and its effects included when appropriate. Soils below the piezometric surface shall be assumed saturated.

c. An appropriate mathematical analysis method shall be chosen for the case analyzed. Simple planar failure surfaces can be analyzed by force equilibrium methods. Spencer’s Method shall include kinematically admissible (smoothly transitioning) surfaces and not be used with structural resisting elements. Bishop’s Method shall only be utilized for circular failure surfaces. Taylor’s Method shall only be utilized for homogeneous simple slopes.

d. In those cases where bedrock cannot be sampled due to rock hardness, the slope stability analysis may be omitted, provided the bedrock has no adverse structural conditions and an engineering geologist and a soils engineer present an evaluation based upon the bedrock competency.

2. Surficial Stability. Evaluation of the slope surface for safety factor against surficial failure shall be based either on analysis procedures for an infinite slope with seepage parallel to the slope surface or on other methods approved by the Department. For the infinite slope analysis, the assumed depth of soil saturation shall be a minimum of three feet and consistent with the depth to firm bedrock. Soil strength characteristics used in analysis are to be obtained from representative samples of surficial soils that are tested under conditions approximating saturation.

3. Seismic Stability. Pseudo-static acceleration of 0.15g with a factor of safety of 1.1 shall be the minimum acceptable for seismic stability of slopes. Seismic stability shall be demonstrated in accordance with California Division of Mines and Geology Special Publication S.P.117.

F. Material Properties.

The soil engineer shall use sound judgment in the selection of appropriate samples and in the determination of shear strength characteristics befitting the present and anticipated future slope conditions. To best accomplish this phase of the analysis, the project engineering geologist shall advise the soil engineer on pertinent geologic conditions and materials observed during the site investigation. The following guidelines are provided for evaluating soil properties:

1. Soil properties, including unit weight and shear strength parameters (cohesion and friction angle), shall be based on field and laboratory tests. Tests shall be made on an appropriate number of
samples removed from test pits that represent the material in a particular slope. At least one test shall be made on the weakest plane or material in the area under test and shall be made in the direction of anticipated slippage.

2. Testing of earth materials shall be performed by an approved soil testing laboratory in accordance with Section 98.0503 of the Code.

3. Shear strength parameters used in stability evaluations may be based upon peak test values where appropriate. Parameters not exceeding residual test values shall be used for previous landslides, along shale bedding planes, highly distorted bedrock, overconsolidated fissured clays and for organic topsoil zone under fill.

4. Prior to shear tests, samples are to be soaked to approximate a saturated moisture content. Saturated shear tests shall be performed with the samples inundated in water during testing. Shearing strain rates/conditions are to be consistent with the material types and drainage conditions used in analyses.

5. An arbitrary residual angle of shearing resistance of six degrees and cohesion of 75 pounds per square foot may be used to represent the strength on shale bedding and in landslide debris in lieu of parameters determined by laboratory testing.

6. Analysis of failures of existing slopes that are similar to the slope under consideration in terms of location, configuration, height, geology and materials may be used to establish shear strength parameters.

7. Soil strength characteristics of off-site slope materials may be based upon tests of similar materials or nearby properties when both the engineering geologist and the soil engineer demonstrate a basis for assuming that the off-site materials possess strength characteristics equivalent to the material tested.

G. Contents of Reports.

A Geotechnical Report shall be submitted to the Department which complies with applicable portions of the standard guidelines adopted as California Division of Mines and Geology Notes Number 44 and the following items:

1. Recommendations for site development that will provide at least the level of stability specified in Section C (above) of this Rule.

2. An assessment of potential geotechnical hazards affecting the site.

3. A statement regarding location of potential ground water that may develop within the slope during
and/or after major storm seasons and measures needed for ongoing stability.


5. A plot plan and a topo plan showing locations of test pits and the areas they are assumed to represent.

6. A complete description of shear test procedures and test specimens.

7. Shear strength plots that include the identification of sample tested, whether values reflect peak or residual strengths, shearing strain rate, moisture content at time of testing, and approximate degree of saturation.

8. Comment on sample selection and a stated opinion that the samples tested represent the weakest material profile along with the potential failure path.

9. Calculations and failure surface cross sections used in stability evaluations.

10. General comments as to the stability of slopes from the effects of earthquakes concerning ground rupture, landslides and differential movement.

11. Detailed log of earth materials observed in test hole borings and test trenches to include characteristics such as bedding attitudes, joint spacing, fault zones, location of bentonite beds, etc.

12. Recommended drainage devices, including subdrain systems below fills and behind stabilization structures.