INDIAN WELLS
CALIFORNIA

GUIDELINES FOR GEOTECHNICAL & GEOLOGIC REPORTS

Professional geotechnical and geologic reports are required for all single family and multi-family residential projects and all commercial projects unless the requirement is specifically waived by the Building Official. The City refers developers, home owners, and consultants to the *County of Riverside, Transportation and Land Management Agency, Building and Safety Department, Planning Department, and Transportation Department Technical Guidelines (Part III, Section1)* for reference, basic guidelines and general information that should be included in geotechnical and geologic reports for residential development:

COUNTY OF RIVERSIDE
2000 (Edition) *TECHNICAL GUIDELINES FOR REVIEW OF GEOTECHNICAL AND GEOLOGIC REPORTS*

http://www.rctlma.org/building/content/docs/technical_guide_geotechnical_geologic_reports.pdf

The County guidelines present the basic contents for geotechnical/geologic reports in the County of Riverside and should be utilized for determining the content of professional geotechnical and geologic reports. Other guides should include the applicable California Building Code and California Geologic Survey Special Publications 42 and 117A. However, the City of Indian Wells has specific geotechnical and geologic constraints that require evaluation and mitigation. These include:

- Land subsidence http://pubs.usgs.gov/sir/2007/5251/pdf/sir_2007-5251.pdf documented by the USGS
- Localized shallow low density silts
- Localized loose (weak zone) soil profiles
- Presence and depth of existing documented or undocumented fill
- Hydroconsolidation potential of native soils
- Areal subsidence potential, including the presence of damaging fissures and associated differential settlement
- Seismic induced settlement for liquefaction and dry sand
- Effects of artificially applied water, perched groundwater, and liquefaction
- Rockfall or rolling boulder hazards near bedrock areas
- Settlement in transition areas of bedrock/fill and areas of differing thicknesses of fill
- Long-term instability of graded slopes
- Lateral spreading potential from buried bedrock ridges

Civil Engineer of Record Requirements

Building designs are typically not fully completed when grading plans are submitted for review to the City of Indian Wells. Accordingly, the Civil Engineer of Record (EOR) in conjunction with the Geotechnical EOR should mitigate low density soils, land subsidence, intermittent weak zone sections (as present) and hydrocollapsible soil conditions by grading design (i.e. overexcavation, water saturation and/or recompaction).

Geotechnical Engineer of Record Requirements

The Geotechnical EOR shall provide grading recommendations, estimation of post grading total settlement and differential settlement for buildings based on a Schmertmann analysis or equal and/or hydrocollapse/consolidation potential as applicable. The analysis as applicable, based on soil type, shall not exceed the allowed Structural EOR stated total and differential settlement design criteria and structures shall accommodate at least 1 1/4 inches of differential settlement over a 50 feet distance expressed as an angular distortion of 1:480. In higher risk areas, including locations adjacent to the Whitewater River and adjacent hillsides, structures should be designed to accommodate at least 1 7/8 inches of differential settlement over a 50 feet distance expressed as an angular distortion of 1:320. Geologic and engineering analysis shall be provided to confirm that angular distortion does not exceed the stated limits. Where substantiated by appropriate engineering analysis, less restrictive angular distortion ratios and anticipated differential settlements can be considered, subject to City approval. The Geotechnical EOR shall also determine the total Collapse Potential of identified dry to moist soils. The Geotechnical EOR shall base foundation design recommendations on saturated conditions.

Structural Engineer of Record Requirements

The Structural EOR shall design the foundation system to meet all geotechnical requirements including: maximum allowable total and differential settlement, seismic forces and soils bearing pressure limitations for the building(s). Prior to building permit release, the City of Indian Wells shall be supplied with a confirming Structural EOR letter documenting the Structural EOR foundation design solution method pursuant to the Geotechnical EOR recommendations. The approval letter should accept the Geotechnical EOR foundation recommendations and verify that the foundation system is designed to accommodate the total and differential settlements. The Structural EOR letter should also indicate that the Structural and Geotechnical reviews are integrated into the final building designs.

In conjunction with the County of Riverside Technical Guidelines, the City of Indian Wells has adopted the following specific policies:

1.0 Subsidence and Settlement

Subsidence and settlement from deep-seated alluvial profiles have at least three origins. These include seismic induced liquefaction, seismic induced dry sand subsidence, and areal subsidence from groundwater (or other) withdrawal (which may include tensional fissures). The consultant shall:

1.1 Address the potential for areal subsidence associated with groundwater withdrawal, including presentation of information where the site is within a subsidence area as designated by the United States Geologic Survey and County of Riverside. Professional opinions shall be provided with respect to the potential for damaging fissuring and the consultant shall provide recommendations for mitigation, where appropriate.

1.2 Provide a geologic lineament analysis using aerial photograph reviews to evaluate the presence or past presence of fissuring in the vicinity of the building site.

1.3 Address the potential for liquefaction induced settlement and cyclic softening based upon current or future groundwater elevations/depths (whichever is anticipated to be higher) as well as evaluate the potential for new perched groundwater conditions assuming the presence of shallow silt or clay beds that may trap artificially applied water. Discussion should be provided in regard to the potential for future groundwater levels to rise. Earthquake acceleration and magnitude values used in the analysis shall take into consideration the proximity of the San Andreas fault, including magnitudes associated with multi-segment displacements from San Bernardino to the Salton Sea. The entire soil column within at least 50 feet of the ground surface shall be evaluated. The resulting cumulative settlement shall be considered to be applied at the evaluated ground surface.

1.4 Address dry sand and seismic-induced settlement based on similar parameters as stated above. Differentiate these calculated settlements from static settlement which may be presented.

1.5 Damaging fissuring is present along the southwest side of the Coachella Valley. Therefore, based upon the Consultants analysis, if the potential for fissuring is postulated, based upon the location of the site within known subsidence zones, it is expected that the consultant shall provide discussion regarding potential differential settlement and settlement analysis to be used in design.

1.6 Evaluate soils for low density, hydroconsolidation potential, expansion potential, and corrosion potential.

1.6.1 Low density soils are susceptible to settlement due to the addition of structural loads and/or fill. Low density soils should be removed, compacted, or remediated through ground improvement or structural design to minimize settlement.

1.6.2 Native soils can be subject to hydroconsolidation, whereby upon wetting the natural cementation of the soils breaks down and consolidation occurs. This is often the result of landscape irrigation, damaged water lines, or percolation of water from the surface. Soil columns with cumulative collapse potentials in excess of 2% at anticipated loads shall be remediated such that the anticipated settlements for the structure can be accommodated. If non-remediation of any soil layer is proposed, analysis shall be provided which substantiates non-remediation.

1.6.3 Representative samples of susceptible soils within the upper 30 feet shall be evaluated by laboratory testing, at a minimum.

1.6.4 Structures should be designed to accommodate at least 1 1/4 inches of differential settlement over a 50 feet distance expressed as an angular distortion of 1:480. In higher risk areas, including locations adjacent to the Whitewater River and adjacent hillsides, structures should be designed to accommodate at least 1 7/8 inches of differential settlement over a 50 feet distance expressed as an angular distortion of 1:320. Geologic and engineering analysis shall be provided to confirm that angular distortion does not exceed the stated limits. Where the above condition cannot be met by commonly accepted grading design practices, alternative ground improvement techniques with substantiating calculations or a statement from the structural engineer of record stating that the presented angular distortion can be accommodated through structural design must be provided. If substantiated by appropriate engineering analysis, less restrictive angular distortion ratios and anticipated differential settlements can be considered, subject to City approval.

1.6.5 The consultant shall provide laboratory data and engineering analysis to substantiate remedial grading recommendations. Target in-place density values shall be provided to assist the consultant and contractor during remedial grading to verify that the depth of recommended remedial grading has been achieved to the satisfaction of the consultant and City. In-place density value(s) shall be based upon comparisons to actual in-place soil densities, compaction characteristics (ASTM D 1557), consolidation/collapse tests, and engineering judgment. Therefore, an adequate testing program for each site is required to allow the consultant to develop reasonable and supportable recommendations.

2.0 Existing Fill

2.1 Geotechnical and geologic reports should adequately address the presence; thickness and lateral extent of existing fills across the site. The depths of fill under the proposed area of improvements should be based upon an adequate number of exploration points to clearly substantiate soil profiles under and adjacent to planned structures or improvements.

2.2 Transition conditions or areas of unequal depth of fill should be clearly depicted on cross sections.

2.3 All undocumented fill within improvement areas or potential influence of the proposed improvements shall be removed as part of the remedial grading process.

2.4 If existing fill is documented, based on readily available and reproducible reports, the geotechnical consultant of record for the current project must either accept the fill (based upon testing) or reject the fill and recommend removal. All previous documentation of the engineered fill shall be provided to the City with a statement of acceptance by the current geotechnical consultant.

2.5 Where acceptable fills are present or where remedial or mass grading will create fills under the improvements, the total depth of engineered fill under the structure foundations and proposed total loading shall not result in an angular distortion ratio greater than 1:480. Where this condition cannot be met, alternative ground improvement techniques with substantiating calculations or a statement from the structural engineer of record stating that the presented angular distortion can be accommodated through structural design must be provided.

2.5.1 Where transition conditions are acceptable to the City, the ratio of maximum to minimum fill thickness under individual structures should not exceed 2:1 (i.e. if the maximum fill thickness under the structure, as measured by a 1:1 projection from the base of slab to the base of the fill is equal to 10 feet, the minimum thickness of fill under the remainder of the project, where transition conditions exist, shall be 5 feet or more) unless calculation is provided whereby the calculated angular distortion satisfies the criteria above. Structural mitigation of fill differentials shall be reviewed on a case by case basis.

2.5.2 Cut areas shall be over-excavated to achieve a fill thickness of at least ½ the maximum fill thickness under the structure or at least 5 feet, as measured from the base of the slab.

2.6 Remedial grading should extend outward of exterior foundations at least 5 feet or equal to the total depth of fill, whichever is greater, as measured from the base (bottom) of the remedial grading outward. Where property lines or existing structures prohibit the required limits of remedial grading, then the consultant shall

provide alternate recommendations for remedial grading, deepening the footings, or other means, such as tiebacks or slot cutting to support boundary limits of excavation or adjacent improvements. Temporary cut slopes shall be demonstrated to have a minimum 1.2 factor of safety.

3.0 Rockfall Hazards and Bedrock Proximity

3.1 Where residential lots or building sites are located at or near the toe of existing hillsides where bedrock is present, the consultant shall provide a geologic evaluation of the hillside condition, including analysis for rockfall hazards onto the building pad, access routes, and common areas where property damage, personal injury, and/or access restrictions to emergency vehicles could occur.

3.1.1 The analysis shall include estimates of boulder sizes, run-out distances, velocities, and design recommendations for mitigation.

3.1.2 Analysis shall include kinematic analysis for wedge failures and the potential for generation of newly displaced boulders.

3.2 Where residential lots are in proximity of bedrock areas and where the lot is within an alluvial/bedrock transition, the consultant shall evaluate the differential settlement potential under the proposed improvements. Foundations for alluvial/bedrock conditions shall be designed to accommodate an angular distortion ratio of 1:240 unless the consultants demonstrate that the approved design level distortion ratio can be accommodated by structural design. Adequate exploration is required to characterize the subsurface profiles with geologic cross sections, based on site specific exploration, included in the report.

4.0 Slope Stability

4.1 Natural and graded slopes shall be evaluated with respect to gross and surficial stability. Refer to the referenced County guidelines for minimum requirements for slope stability analysis.

4.1.1 Natural slopes in the proximity of the pad shall be evaluated for static and pseudostatic stability, including potentials for rockfalls, lateral spreading, and debris flows.

4.1.2 Where debris flows are a potential, the consultant shall evaluate the estimated quantity of debris and design mitigation systems that will accommodate at least 1.5 times that amount. Means for maintenance and debris removal shall also be provided.

4.1.3 Adequate topographic maps shall be used in developing cross sections for stability analysis. Topographic maps shall encompass the entire adjacent slope.

4.1.4 Where cut slopes or back-cuts for retaining walls are excavated into bedrock areas, the project engineering geologist/geotechnical engineer shall evaluate the potential for wedge failures, translational failures, and planar surcharges (wall design).

4.1.5 Minimum static factors of safety for static and surficial analysis shall be 1.5.

4.1.6 Minimum pseudostatic factor of safety shall be 1.1. Minimum horizontal seismic coefficient for pseudostatic analysis shall be based upon recommendations provided within California Geological Survey Special Publication 117A due to the proximity of the San Andreas fault.

4.2 Graded slopes higher than 10 feet shall be analyzed. All alluvial cuts and fill slopes less than 10 feet high shall also be analyzed unless finished at a 3:1 (h:v) or flatter slope. Recommendations should be provided for slope protection and maintenance.

These guidelines are intended to address a wide range of issues. The consultant is expected to exercise professional judgment and experience in preparing geotechnical reports for the submittal to the City of Indian Wells. It is expected that the consultant will provide adequate substantiation of their opinions and recommendations based upon exploration data, laboratory testing, and currently accepted methods of analysis. The requirements contained within are intended to supplement the current referenced documents. Where new information, techniques or codes are developed and adopted by the local agency which are more stringent than that presented, those requirements shall govern where applicable.