Introduction

Elite Homes, Inc. is in the process of designing a new residential subdivision, Oakland Hills, to be constructed on a portion of a ±462-acre parcel located at 11333 Bardstown Creek Road in Metro Louisville, Kentucky. This parcel of land is rolling with some steeply sloping areas. Geologic reconnaissance was performed by Mactec and culminated in a report dated May 12, 2005. The report addressed a number of sinkholes that were identified and provided means of treatment of those karst features.

The site geology was discussed in detail in the report prepared by Mactec. Surface bedrock formations vary across the site and include Laurel Dolomite, The Osgood Formation, The Brassfield Formation, The Saluda Dolomite, The Bardstown Member and The Rowland Member of the Drakes Formation.

We were contracted by Elite Homes, Inc. to provide recommendations for dealing with construction on slopes with grades greater than 30 percent. Work was coordinated through Mr. Jim Mims, P.E. of Elite Homes, Inc.

Lots with 15- to 30-percent Slopes

Lots with or adjacent to 20- to 30-percent slopes include lots 28 to 37, lot 40, lot 70, lots 73 to 75, lots 98 through 103, lots 112 through 119 and lot 123. Lots 66 through 68 and 84 though 85 have 15- to 20-percent slopes.

Area of Lots 28 through 37 and 40

The area of lots 28 to 37 and 40 slope downward to the northwest. The slope across the lots is between 20- and 25-percent. There is no evidence of slope movement, i. e. no scarp, leaning trees consistent with a slide, erosion of the slope, tension cracks, etc.

Lots 66 through 68

The area of lots 66 through 68 slope 15- to 20-percent downward to the south. There is no evidence of slope movement, i. e. no scarp, leaning trees consistent with a slide, erosion of the slope, tension cracks, etc.

Lot 70 and 72 through 75

The area of lot 70 and 73 through 75 slope downward to the northwest. The slope across the lots is between 20- and 25-percent. There is no evidence of slope movement, i. e. no scarp, leaning trees consistent with a slide, erosion of the slope, tension cracks, etc.

Lots 84 and 85

The area of lot 84 and 85 slope downward to the northwest. The slope across the lots is about 15 percent and steepens to the west of these lots. There is no evidence of slope movement, i. e. no scarp, leaning trees consistent with a slide, erosion of the slope, tension cracks, etc.

Lots 98 and 103

The area of lots 98 through 103 slope downward to the southeast. The slope across the lots is up to 20 percent. There is no evidence of slope movement, i. e. no scarp, leaning trees consistent with a slide, erosion of the slope, tension cracks, etc.

Area of Lots 112 through 120

The area of lots 112 to 119 slopes downward to the west to a stream and pond well beyond the back of these lots. The slope across the lots is between 20- and 25-percent. There is no evidence of slope movement, i. e. no scape, leaning trees consistent with a slide, erosion of the slope, tension cracks, etc. The stream banks expose soil with large quantities of flagstone. Depth of soil is relatively shallow and rock outcrops are present elsewhere on the site.

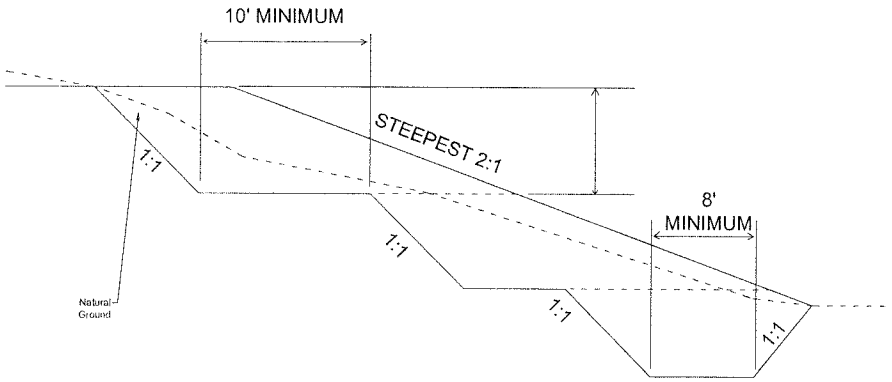
Lot 123

There is a slope that extends into the northwest corner of lot 123, though the slope across the bulk of the lot is relatively flat. Examination of the slope at immediately northwest of this lot found no evidence of slope movement, i. e. no scape, leaning trees consistent with a slide, erosion of the slope, tension cracks, etc.

Site Preparation and Earthwork

The topography of this property is rolling with some slopes exceeding 30 percent, resulting in substantial cuts and fills. When fill is to be placed on an existing slope it is imperative that the existing slope be benched as shown in the diagram at the top of the following page to prevent the formation of a plane of weakness along which a slope failure can develop. Benching will have to be

adjusted as necessary, in consultation with this office, where limestone bedrock is encountered that prevents benching as shown from being achieved.



All fill should be placed in lifts not exceeding 8 inches in uncompacted thickness and must be compacted to at least 98 percent of the soils maximum dry density as determined by the Standard Proctor (ASTM D-698). Soil moisture content should be within 2 percent of optimum as determined from the Standard Proctor.

Soil from any off-site borrow sources should be tested and approved by this office prior to being used on the site. Satisfactory borrow materials are those falling in one of the following classifications: GC, SM, SC, ML, or CL. Soil types MH, CH and OH soils and peat are unsatisfactory borrow materials.

The face of an inclined embankment cannot be compacted as densely as the interior fill because the outer slope deforms more elastically under load. This low-density zone tends to foster plant growth. Unfortunately, a heavy mat of vegetation is often formed with greater permeability than the underlying fill that can result in shallow slips of the vegetated surface downward. To prevent this from occurring one of three procedures must be followed in finishing the fill slope. These are: 1) trimming; 2) embedment of geotextile; or 3) emplacement of deep rooting woody vegetation.

Trimming requires that the fill be placed 18 inches beyond the final fill point. Once fill is complete the top 18 inches of soil must be bladed-off the slope to be removed for use as fill elsewhere.

Embedment of geotextiles requires that a woven-geotextile of uniaxial geogrid be placed vertically every two feet along the outer edge of the fill. This slope reinforcement must extend at least five feet in from the outer edge of the slope.

Soil fill must be no steeper than 2-horizontal to 1-vertical in order that it remain stable. Where there is a sharp angle in the slope, such as near the corner of a building or pavement corner, the slope must be no steeper than 2.5 to 1. If the slope is to be mowed with normal lawncare equipment, it should be no steeper than 3 to 1.

The placement of compacted fill should be carried out by an experienced excavator with the proper materials. The excavator must be prepared to adapt his procedures, equipment and materials to the type of project, to weather conditions, and the structural requirements of the engineer. Methods and materials used in summer may not be applicable in winter; soil used in proposed fill may require wetting or drying for proper placement and compaction. Conditions may also vary during the course of a project or in different areas of this site. These needs should be addressed in the project drawings and specifications.

During freezing conditions, the fill must **not** be frozen when delivered to the site. It also must not be allowed to freeze during or after compaction. Since the ability to work the soil while keeping it from freezing depends in part on the soil type, the specifications should require the contractor to submit a sample of his proposed fill before construction starts, for laboratory testing. If the soil engineer determines that it is not suitable, it should be rejected. In general, silty sand, clayey sand, and cohesive/semi-cohesive soils should not be used as fill under freezing conditions. All frozen soil of any type should be rejected for use as compacted fill.

It is important that compacted fill be protected from freezing after it is placed. The excavator should be required to submit a plan for protecting the soil. The plan should include details on the type and amount of material (straw, blankets, extra loose fill, topsoil, etc.) proposed for use as frost protection. The need to protect the soil from freezing is ongoing throughout construction and applies both before **and** after concrete is placed, until backfilling for final frost protection is completed. Foundations placed on frozen soil can experience heaving and significant settlement, rotation, or other movement as the soil thaws. Such movement can also occur if the soil is allowed to freeze **after** the concrete is placed and then allowed to thaw. The higher the percentage of fines (clay and silt) in the fill, the more critical is the need for protection from freezing.

The contractor should be required to adjust the moisture content of the soil to within a narrow range near the optimum moisture content (as defined by the applicable Proctor or AASHTO Test). In general, fill should be placed within 2% of optimum moisture. The need for moisture control is more critical as the percentage of fines increases. Naturally occurring cohesive/semi-cohesive soil are often much wetter than the optimum. Placing and attempting to compact such soils to the specified density may be difficult. Even if compacted to the specified

density, excessively wet soils may not be suitable as pavement subgrades due to pumping under applied load. This is especially true when wet cohesive/semi-cohesive soil is used as backfill in utility trenches and like situations. Excessively wet soil in thick fill sections may cause post-construction settlement beyond that estimated for fill placed at or near (±2%) the optimum moisture content.