TOE-OF-FILL KEY

UPSLOPE SIDE OF KEY MAY REQUIRE EXTENSIVE EXCAVATION INTO ROCK

MINIMUM 2 FT EMBEDMENT INTO INTACT ROCK ZONE
Amount of Near-Surface Groundwater Increases Downslope due to aereal accretion. Weathered Zone generally increases downslope, mimicking groundwater flow patterns, and vice versa.

Cut Slope Needs to be mapped by Geologist.

Install subdrains to intercept weathered bedrock and base of colluvium.

Judgement required to assess compressibility of surficial materials left upon the bedrock.
Placement of Shear Keys

What's Wrong With This?

And This?

look at house pad locations

50'-60' = 90%

2.5" x 2 = 5.0"

1 3

subdrains
NATURAL SLOPE BEFORE GRADING

FILL OVER CUT SITUATION

THEORETICAL DAYLIGHT
ACTUAL DAYLIGHT POINT
ORIGINAL SLOPE
CUT

TOE OF KEY THRUST LINE @ 45°

FILL
A typical toe-of-fill key for the construction of a sidehill fill in siltstone or shale terrain. The toe-of-fill key frequently requires keying and benching through several feet of topsoil, several feet of colluvium, and several feet of bedrock creep in order to key into competent bedrock. Toe-of-fill keys 10-20 ft. deep are common in such areas. Note that the effective bearing point of this toe of fill (45 degrees from the horizontal) moves laterally downslope from the proposed grading plan toe.

FROM C. MICHAEL SCULLIN, 1983
EXCAVATION & GRADING CODE ADMINISTRATION, INSPECTION AND ENFORCEMENT
Structures founded upon fill as in Section A could be subject to damage resulting from differential settlement of fill. This damage potential can be reduced by overexcavation as shown in Section B. Drilled piers would also reduce this damage potential.
Structural control of slope form by underlying geology

- Dip slope
- Alluvium
- Colluvium
- Ridge outcrop
- Inclination of bedrock strata
OUT-OF-SLOPE DIP

DAYLIGHTED BLOCK MOVES ALONG GEOLOGIC DISCONTINUITY INTO EXCAVATED AREA
STABILITY FILL

Typ. 1 EQUIP WIDTH WIDE

subdrains optional

BACKSLOPE FAILURE

TEMPORARY 1:1 CUT

SLUMP
Brief Overview of Types of Slope Failures

Retrogressive Slump Blocks

Translational Slide

Circular Failure Surfaces in Clays

More Planar Failure Surfaces in Sandy Mtls or bedrock
Types of Buttress Fills

TOE BUTTRESS

Forces

\[ N = W \cos \alpha \]

Dead Weight \( W \) of buttress resists sliding thru

\[ F_s \] is lateral force exerted by landslide

Shear Strength \( S = (N-\mu) \tan \phi + c' \)

Excessive Groundwater Pressures Can Build Up Behind Toe Buttresses

Where:

\( \alpha \) = Slope inclination
\( N \) = Normal Force on Potential Slide Plane
\( \phi \) = Angle of Internal Friction of Soil
\( \mu \) = Water Pressure = \( \gamma \cdot w \cdot h \)
\( c' \) = Effective Cohesion of Soil

What Can Happen...

slide can shear thru uppermost portion of buttress

In this portion of buttress \( N \) is very small

Beware of Differential Settlement

Groundwater backing up?

Landslide debris consolidating under load of toe buttress. Groundwater backs up underneath
Typical Bedrock Landslide

Less Important
Highest lateral loads
Most Important
Area to Buttress
High lateral loads

AT-REST

PASSIVE

ACTIVE

low lateral loads

Slide Plane Sloped Most Steeplly
Slide Planes sloping back uphill

* headscarp graben areas are generally very dilated and loose. Fills on these areas will be subject to settlement

Most Geotechnical Practice recommends toe buttresses first, and tend to leave uphill portions of ancient landslide slip planes in-place. From a slope stability viewpoint, the toe area is inherently most stable, as the slip surfaces level out and turn uphill. Intercepting the slide plane and installing subdrainage is most critical where the slide plane is steeply inclined downslope. The effectiveness of the buttress is a function of overburden height and subdrainage. Highly cohesive soils better resist short-term earthquake loading.
NOTES:

1. Grub & scarify slope prior to earthwork activities. Minimum organic content 2% (by weight) in structural fill.

2. Benches/Excavation to extend a minimum of 0.50 feet beneath soil or regolith horizon at all locations. Bench widths are at the discretion of the contractor. The required depth of excavation is to be confirmed in the field during construction by either the soils engineer or the engineering geologist.

3. The maximum finish slope is to be 2:1 (horizontal to vertical).

COMPACTION: All structural fill is to be compacted to a minimum value of 90% relative compaction 0 to ASTM D1557-79.
CONCEPT OF "DEFENSE IN DEPTH" IN SETBACK AREAS

Take care not to load colluvium. Either remove thru excavation or install reinforced embankment.

Intermittent Channel

Colluvium

2.5:1 theoretical set-back

Bedrock

Lengthened piers

House cut pad

Sliver fills replaced by geogrid reinforced wall