

CHAPTER 6 SLOPE STABILITY (LANDSLIDES)

6.1 INTRODUCTION

The presence of very steep hillslopes in the BVI produce conditions favorable to slope instability and the development activities on these slopes further increases the potential for the occurrence of landslides. In the BVI landslides occur infrequently, generally as a result of prolonged intense rainfall. Because of the relatively small size and infrequent occurrence of landslides in the BVI, they do not pose a serious threat to life or property. The general characteristic of slope stability problems in the BVI is described.

6.2 OCCURRENCE AND MECHANISMS

Despite the steep hillslopes which characterise the landscape throughout the BVI, naturally occurring landslides are uncommon due to a combination of geomorphic factors. These naturally occurring landslides are restricted to cliffs along the coastline which are constantly undermined by wave action particularly along the northeastern coast of Tortola. The more serious problems relating to slope stability arise as a result of the modification of hillslopes for development purposes. The more common development activities are agriculture, and the construction of buildings and roads of which the latter create the most problems. Soil erosion is the main result of agricultural activity on steep hillslopes in the BVI.

Hillslopes in the BVI are covered by a very thin soil layer usually not greater than 3 feet thick and as a result deep seated rotational landslides do not occur. Landslides within the soil layer are restricted to very small soil slippages which occur when the soil layer slides over the underlying bedrock after intense rainfall, **Plate 6.1**. These small landslides occur mainly along road cuts and are sometimes large enough to block the flow of traffic.

Therefore although they are not big enough to cause any serious structural damage they can bring down utility poles, and generally disrupt activities. These landslides are easily cleared by small earthmoving equipment in a couple of hours.

PLATE 6.1: Small landslide along road cut

Hazards Of The BVI

The more common form of landslides occurring in the BVI are rock falls and rock slides which involves movement of the bedrock itself. These landslides take place along steep cuts made into the hillside usually for building foundations or road construction. In these situations lateral support is removed from the rock mass and movement occurs along discontinuities within the rock mass such as fractures and bedding planes. Under the most favorable conditions the bedding planes of the rock mass slopes into the cut in the hillside such that one layer of rock can slide downwards over the underlying layers. This situation is seen along the main road to West End along the south coast of Tortola, **Plate 6.2**.

In general the volcanoclastic bedrock which underlies much of Tortola and other parts of the BVI is thinly bedded and highly fractured but not extensively weathered. Because these rocks slope to the south very steeply and are vertical in many places, favorable conditions for rock slippage exist mainly along the south coast roads where very high cuts into the slope have been made for road construction. In places these road cuts are up to 50 feet high and it appears that blasting of bedrock for the construction of this road has further weakened the rock mass by shattering. In most other places where cuts of up to 15 feet have been made for house and road construction, there is no evidence of instability, and no significant failures have occurred under these conditions.

Rainfall triggers the landslides which occur in the BVI although spontaneous rock falls take place along some road cuts primarily those sections which are inherently unstable, which are described above. The absence of a thick soil layer discourages the percolation of rainfall which instead flows over the slopes as runoff. The effect of this is to prevent the build up of high pore water pressures within the slope materials and therefore the internal cohesion of the slope materials is maintained. However in the event of intense prolonged rainfall numerous small rock falls, soil and debris slides will occur along road cuts particularly the coastal roads. A few large rockfalls will occur along road cuts the especially along the south coast West End road.

High magnitude earthquakes also have the potential to trigger landslides in the BVI. Like rainfall triggered failures these earthquake triggered landslides are most likely to occur where the slopes are inherently unstable. Again these conditions exist mainly along the south coast road

PLATE 6.2: Cut slope prone to rockslides

in Tortola. In the event of such an earthquake event, the failure of these road cuts is likely to be far more extensive than the failures which have resulted from heavy rainfall. An additional hazard is created by the possible movement of large rounded boulders downslope as a result of a high magnitude earthquake. These large boulders which are sometimes as large as 15 feet in diameter, are the result of spherical weathering of granitic plutonic rocks. These boulders while common in the south of Virgin Gorda and on Beef Island, are mainly found at the eastern end of Tortola, and in a few places perched on hillsides around Road Town.

6.2.1 LANDSLIDE DISTRIBUTION

The strong association between hill slope modification and the occurrence of landslides in the BVI is such that the distribution of landslides is determined to a large extent by the location of these modifications. This means that they are located mostly along roads which have been built along steep slopes. **Map 6.1** shows the sections of roads in Tortola where landslides are most likely to occur. These susceptible locations have been determined based on the occurrence of landslides in these areas in the past and the general condition of the modified hills lopes.

6.3 CONCLUSIONS

In general steep natural hill slopes in the BVI are fairly stable and the most significant landslide hazard is due to construction of roads. Failure of these unstable road cuts due to extreme rainfall events or a high magnitude earthquake is likely to block roadways and generally restrict the flow of traffic. In places small soil and debris slides may bring down utility poles.

Although no significant failures have occurred in the steep cuts made for house construction, the height of these cuts on the steeper slopes suggests that in some cases the potential for failure might exist. In these cases site specific studies would be required for slope stability determination and the necessary slope design or structural remedial measures implemented. It appears that in most cases slope cuts of up to 10 feet in height are relatively stable. Slope cuts which exceed about 15 feet should be specifically studied for possible slope instability problems.

MAP 6.1