

CHAPTER II

HISTORY OF SLOPE FAILURES

The highway embankment on the colluvial slope between KM.12.658 and 12.765 was constructed across a 5 meter wide stream valley. Since the heavy rainfall period in 1981 three repeated failures have occurred at this location. The total restoration cost has been estimated by the Department of Highways to be about 14 million bahts. The history of these slope failures is as follows.:

2.1 First Failure in 1981.

2.1.1 History of failure.

In 1981 during the rainy season the first failure occurred on the filled highway embankment(5 to 9 meters high) between KM. 12.650 and KM. 12.750 where a box culvert [2 (3.30 x 3.30) x 20 meters at KM. 12.678 to KM. 12.684.6] was buried (Figure 2.1). Unfortunately, no systematic study on the failure nature was performed then.

2.1.2 Remedial measures.

The reconstruction of the first failure was done in the following year. The damaged embankment and box culvert were removed and replaced with a reinforced concrete bridge of 8 meters wide from KM. 12.658 to KM. 12.714. The bridge consisted of following sections (1 x 8.00) + (1 x 10.00) + (1 x 20.00) + (1 x 10.00) + (1 x 8.00).The construction cost was estimated to be 3,470,000 bahts.

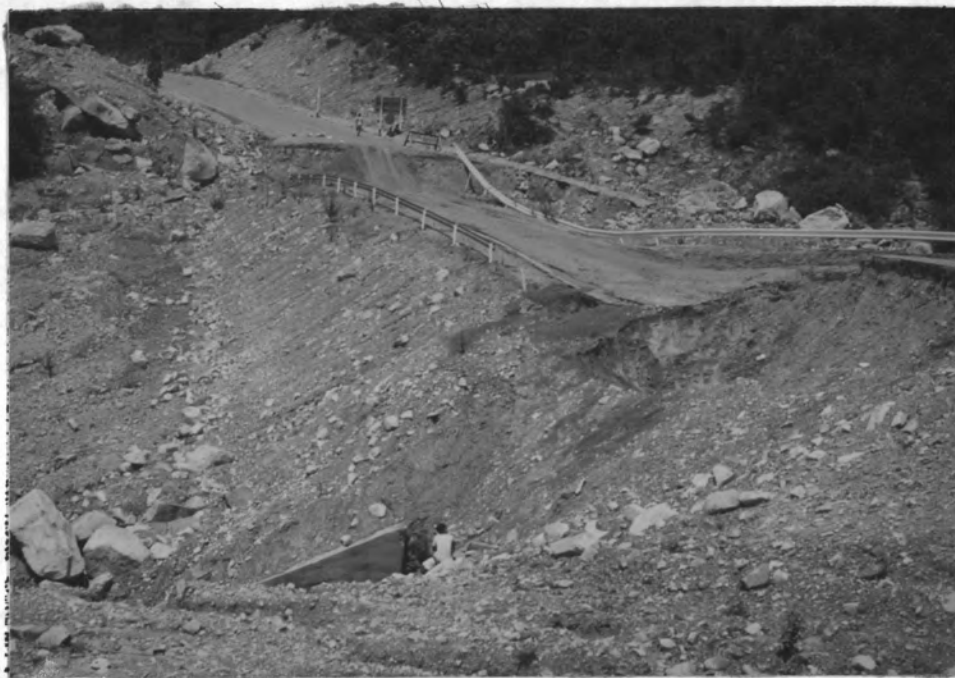


Figure 2.1 First failure on the embankment and box culvert between KM. 12.650 and KM. 12.750 in 1981. The photograph was taken looking uphill toward Khao Yai National Park.

2.2 Second Failure in 1983.

2.2.1 History of failure.

One year after the remedy, the second failure occurred again in August, 1983 when 506 mm. of rainfall was recorded. A bridge approached abutment between KM. 12.714 and KM. 12.745 (northern abutment) failed while the bridge between KM.12.696 and KM. 12.714 was damaged (Figures. 2.2, 2.3.)

2.2.2 Nature and type of failure.

In this failure a detailed geotechnical investigation was done by the author. The slope failure was a debris slide with the type of movement of translation. The failure surface was uncertain, but believed to be along the interface between the colluvial soil and firm bedrocks.

2.2.3 Movement of failure.

The movement of the bridge approached abutment was oblique to the bridge. The vertical displacement of tension cracks were observed both on the road pavement and on the side slope. The major tension cracks formed a very clear concave upward scarp which cut across the road centerline at KM. 12.745. The vertical displacement of 0.40 to 1.50 meter was observed at this major scarp. The construction of temporary road and bailey bridge was 230,000 bahts in 1985.

a)



b)



Figure 2.2 Second failure on the bridge and bridge approached abutment between KM. 12.696 and KM. 12.745.

- a) The photograph was taken looking up hill toward Khao Yai National Park.
A- KM. 12.696, B- KM. 12.714, C- KM.12.745
- b) The photograph was taken looking downhill toward Prachinburi.

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Figure 2.2(cont.) c) Damaged bridge between KM. 12.696
and KM. 12.714

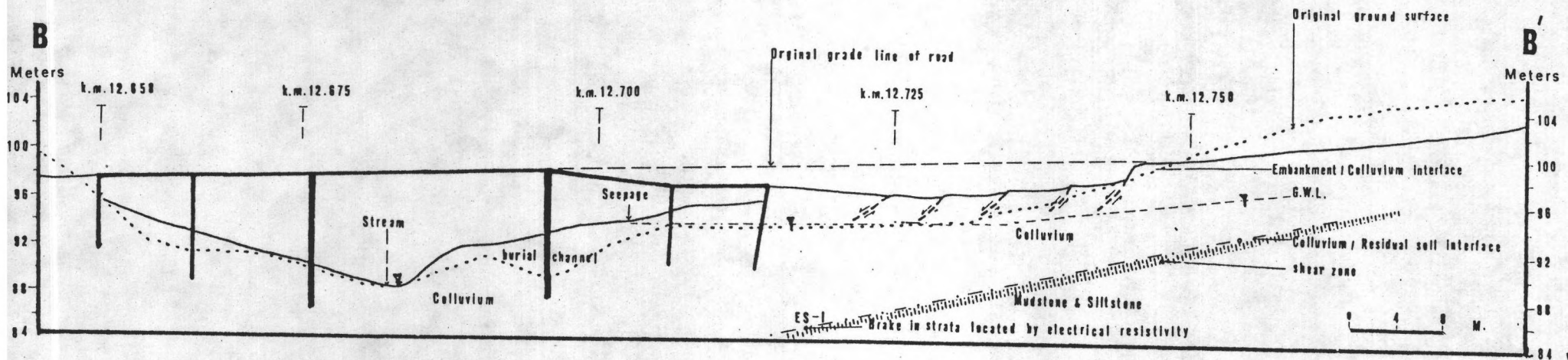


Figure 2.3 A cross-section parallel to the road centerline, showing the damage bridge and bridge approached abutment for failure in 1983.

2.2.4 Remedial measures.

The remedial work done in the dry period of 1985 and completed in April 1985 was to remove the damaged approached abutment from KMs 12.714 to 12.750. A new embankment fill with 1.5m-thick of pervious materials to form an inclined "Chimney" drain and a nearly-horizontal drainage blanket to intercept and remove seepage through the embankment was recommended. The result from subsurface investigation revealed that this gravel drained layer was not installed at the location proposed in design (Figure 2.4 a,b). This construction cost was estimated to be 4,550,000 bahts.

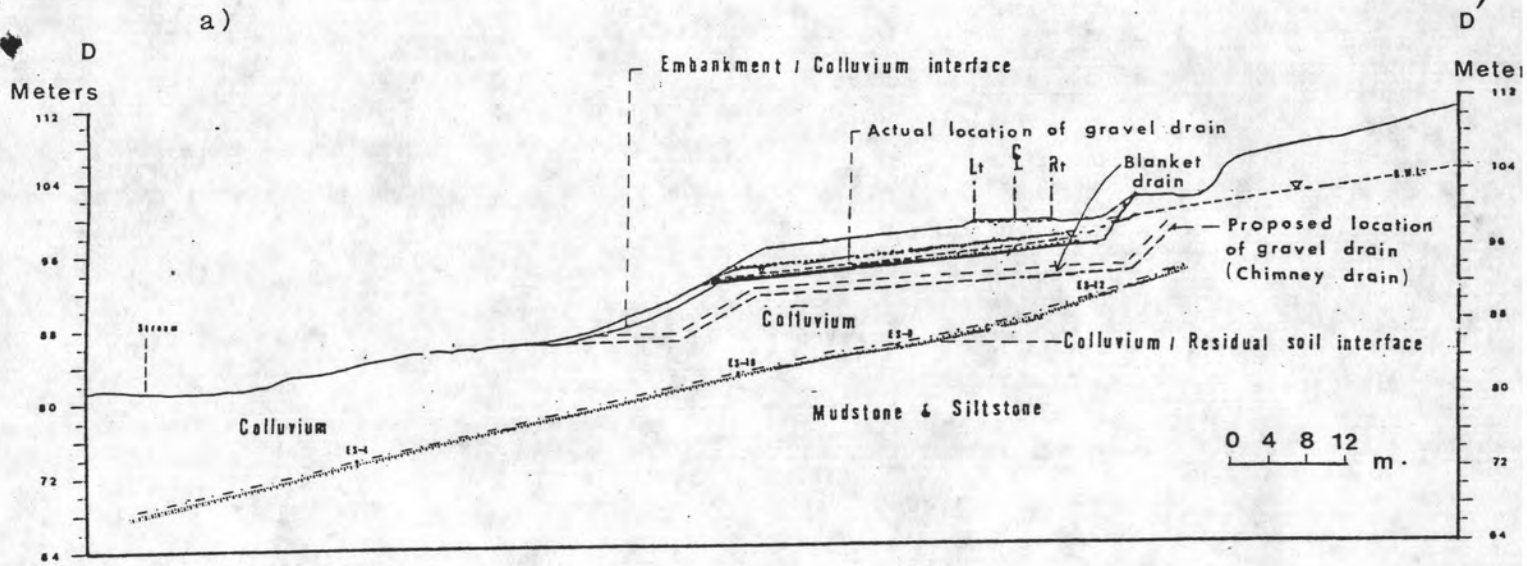
2.3 Third Failure in 1985-1986.

2.3.1 History of failure.

Again, the tension cracks were noticed in August-September, 1985 which was the month of heavy rainfall (Figure 2.5 a,b). In August 1986 which had the highest rainfall of 623 mm. a record of ten-years period, a bigger slide and larger deformation occurred on this embankment (Figure 2.6 a,b). The failure spread progressively up-slope from the initial movement location in 1985 (Figure 2.7).

2.3.2 Nature and type of failure.

The slope failure was a debris slide with the translation movement. The colluvial mass moved along the colluvium and firm-bedrocks interface.



b)



Figure 2.4 Remedial measure of second failure in 1983.

- a) The typical cross-section showing the proposed and actual location of gravel drain
- b) The finish second remedial construction in April, 1985. The photograph was taken looking up-hill toward Khao Yai National Park.

a)



Figure 2.5 Initial failure of embankment in August, 1985.

a) The photograph was taken looking up hill.

b.)



Figure 2.5(Cont.) b) The photograph was taken looking down hill.

โครงการศึกษา
การปรับปรุง
ถนนใน
พื้นที่
ศึกษา

a)



Figure 2.6 Failure of the embankment
in August, 1986.

a) The photograph was taken
looking up hill.

b)



Figure 2.6(Cont.) b) The photograph was taken looking to left.

2.3.3 Movement of failure.

The major tension cracks of 1985/1986 failures formed a very clear concave upward scarp which cut the road centerline at KM. 12.753 and KM. 12.762 (Figures 2.7 and 2.8). The vertical displacement in 1985 was 0.50 meter while the larger amount of displacement occurred in 1986. The maximum horizontal displacement was measured to be about 1.6 meter, the vertical displacement 1.65 meter at the major scarp (Figure 2.9 a) and 2.8 meters at the contact of bridge approach abutment (Figure 2.9 b). Many tension cracks also developed both on the highway embankment and colluvial slope near the toe of this embankment (Figure 2.10 a, b). The evidence of fresh soil movement was observed both in the colluvial slope and along the stream course (Figure 2.11 a,b).

The evidence of fresh mass movement and the extension of major cracks upslope indicate that this slope has a progressive failure or active landslide (Figures 2.12, 2.13).

a)



Figure 2.7 Major crack of failitre in 1985/1986.

A- major crack 1985, B- major crack 1986

C- KM. 12.762

b)



Figure 2.8 Major crack of failure in 1985.

A- major crack 1985 B- KM. 12.753

a)



b)



Figure 2.9 Vertical displacement at the major scarp, in 1986.

a) about 1.65 meter at A

b) about 2.80 meters at B

a)



b)



Figure 2.10 Tension cracks in the colluvial slope near the toe of the embankment slope

a) The photograph was taken in 1985.

b) The photograph was taken in 1986.

a)



b)



Figure 2.11 The fresh soil movement in the colluvial slope.

a) At station KM.12.743 offset road
centerline 61 meters Lt.

b) At station KM.12.724 offset road
centerline 73 meters Lt.



Figure 2.12 Fresh soil movement
(at the arrow point)
at the natural landslide
scarp.

a)



30

b)



Figure 2.13 Progressive of tension cracks upslope.

a) The photograph was taken looking to left right of way.

b) The photograph was taken further up-slope (to the back-ground) of (a).