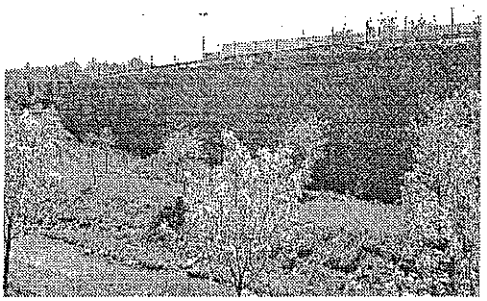
KENTUCKY TRANSPORTATION CENTER

College of Engineering

VISUAL INSPECTION OF KEYSTONE BLOCK WALL AND EMBANKMENT SLIDE AT MIST LAKE PLAZA IN LEXINGTON, KENTUCKY



UNIVERSITY OF KENTUCKY

Research Report KTC-97-11

VISUAL INSPECTION OF KEYSTONE BLOCK WALL AND EMBANKMENT SLIDE AT MIST LAKE PLAZA IN LEXINGTON, KENTUCKY

by

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INTRODUCTION

The Kentucky Transportation Center was requested by Bhate Engineering Corporation and A.B. Shopping Center Properties, Inc. to evaluate and monitor apparent movement in the Keystone Block retaining structure and the earth embankment located next to the Walmart Department Store at Mist Lake Plaza in Lexington, Kentucky. This report summarizes work that has been conducted to date. This work includes inspection of surface drainage, inspection of subsurface storm water drainage, inspection of the embankment, and inspection and photologging of current wall distress. At present, control monitoring points are being established (to be completed by the first of June).

INSPECTION OF SURFACE WATER DRAINAGE

Surface Drainage Adjacent to Wall Structure

Surface drainage was inspected on May 8, 1997 shortly after a rainfall event. It is evident that the surface drainage conditions are likely causing additional distress in the retaining wall structure and the soil embankment. Figure 1 shows water standing even with the top of the curb on the north end of the parking area (north end of the wall). The photo also shows that water has been running through a break in the curb. It is apparent that this area of the parking lot has settled and that surface water is no longer flowing to the storm drains.

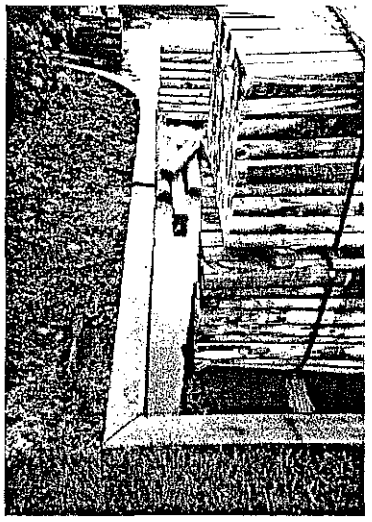

Figure 1

Figure 2 also indicates that water is not reaching the collection system. The drop inlet box is located toward the center of the retaining structure. A significant amount of this water is likely percolating through the pavement and saturating the fill behind the retaining structure. Figure 3 shows staining that is occurring in the face of the retaining structure located directly in front of the drop box inlet shown in Figure 2. It is also likely that a portion of the percolating surface water is flushing backfill fines through the structure.

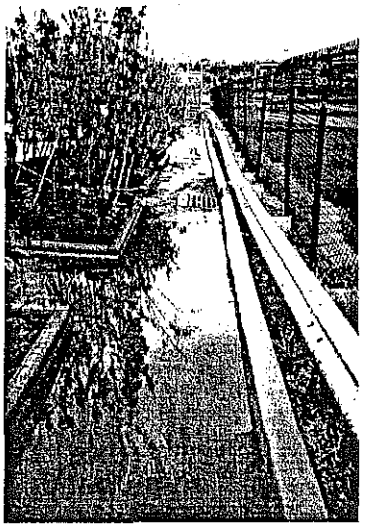

Figure 2

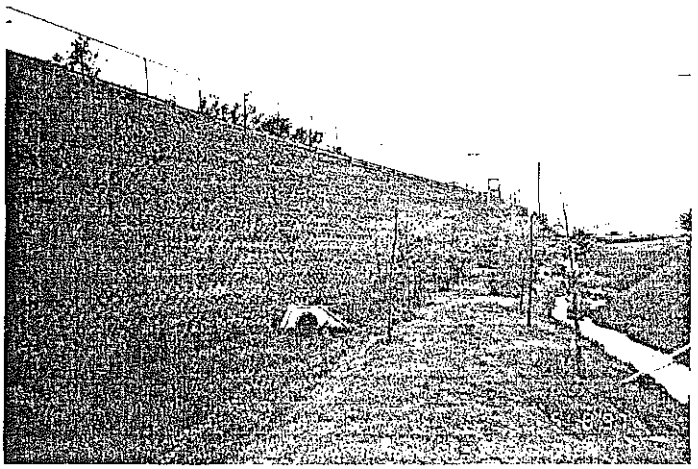

Figure 3

Surface Drainage Adjacent to Soil Embankment

A combination of storm water being discharged from the down spouts on the Walmart building and heavy truck loads traveling behind the store (at the top of the embankment) has failed the pavement structure. Rutting in the pavement is preventing water from reaching the storm water collection system. It is likely that a significant amount of this water is saturating the embankment (Figures 4 and 5). Sliding in the embankment has also caused separations between the curb and the pavement allowing water to seep into the embankment (Figure 6). The embankment slide is shown in Figure 7.

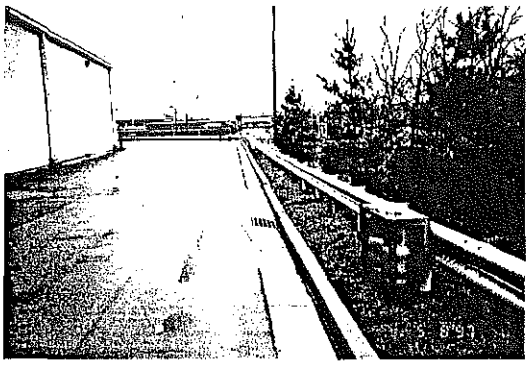

Figure 6

Figure 4

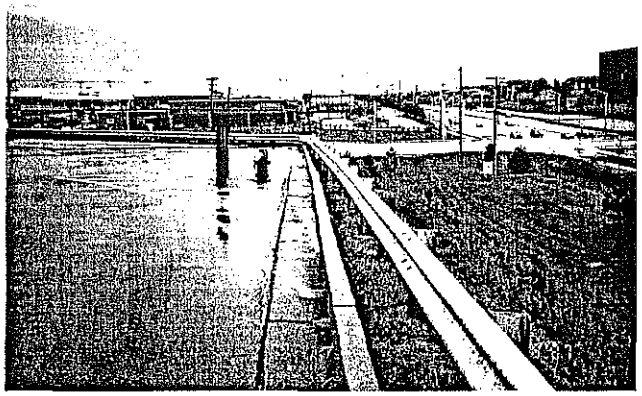

Figure 5

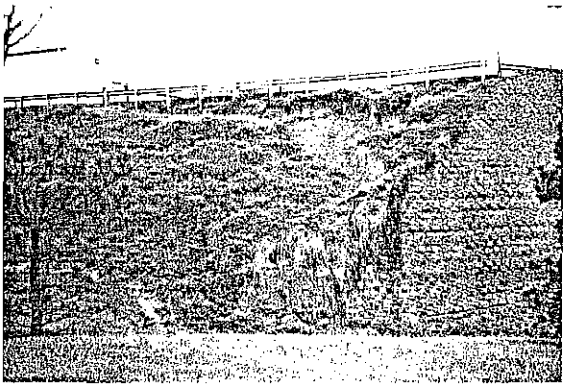

Figure 7

INSPECTION OF THE SUBSURFACE STORM WATER COLLECTION SYSTEM

The storm drain system, including the drop box inlets and the storm drain pipes were inspected on May 9, 1997. The pipes were remotely inspected with a robotically controlled pipeline inspection camera. Confined space equipment was used to access and inspect the vertical drop box inlets. A schematic diagram in Figure 8 shows the location of the storm drains and inlets that were inspected.

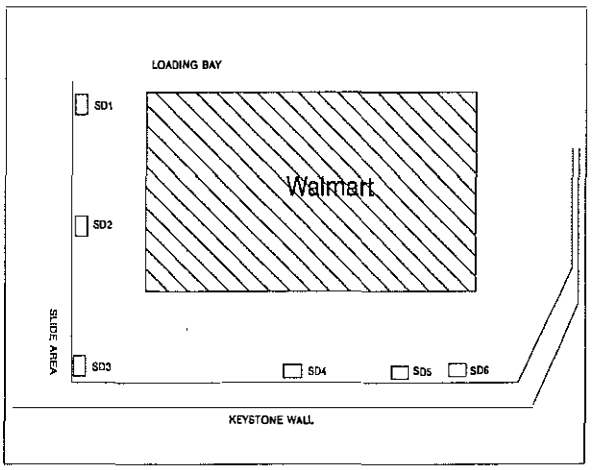

Figure 8

Significant vertical compression, sagging and bending were observed in several locations (Figures 9 and 10). A significant amount of compression and sagging was located around the drop box inlets. Settlement in the fill around the vertical inlet boxes has likely caused a significant portion of the distress.

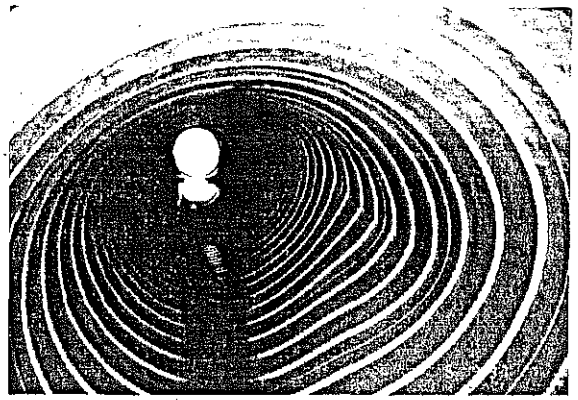

Figure 9

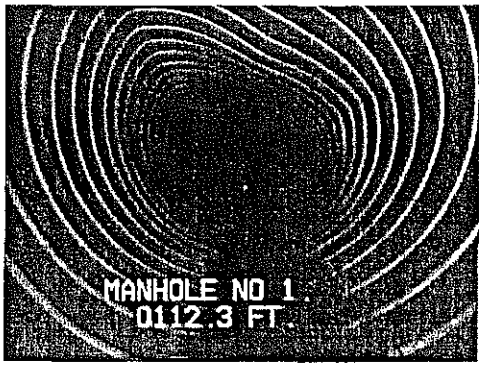

Figure 10

Significant distress was observed at Inlet No. 3 located at the south end of the wall and adjacent to the sliding embankment. Severe sagging and vertical compression were observed in the storm drain in the vicinity of the inlet (Figure 11).

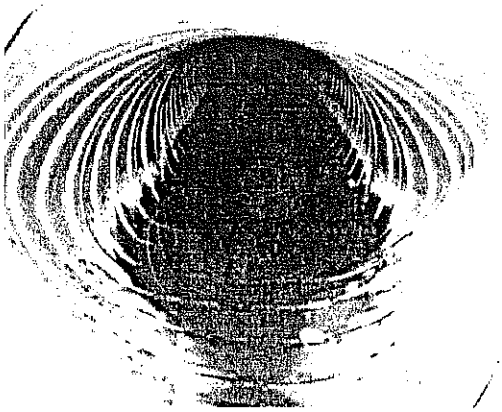

Figure 11

It is apparent that a substantial amount of water is not exiting the end of the pipe. It is likely that a portion of this water is discharging into the fill. Approximately one to two gallons per minute of water (approximately 1,400 gallons per day) were observed discharging into the drop box through a joint in the vertical risers (Figures 12 and 13.) The water discharges through the joint several days after a rainfall event. It is uncertain (at this time) if this is surface water leaking around the drop box inlet, or if this is ground water percolating through the fill, or if the fire hydratent shown in Figure 6 is leaking. This location was observed again on June 5, 1997 after several days of rain fall. It appears that the rate of inflow had doubled.

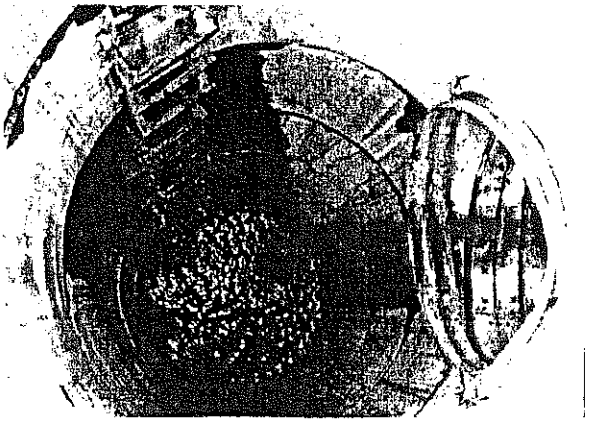

Figure 12

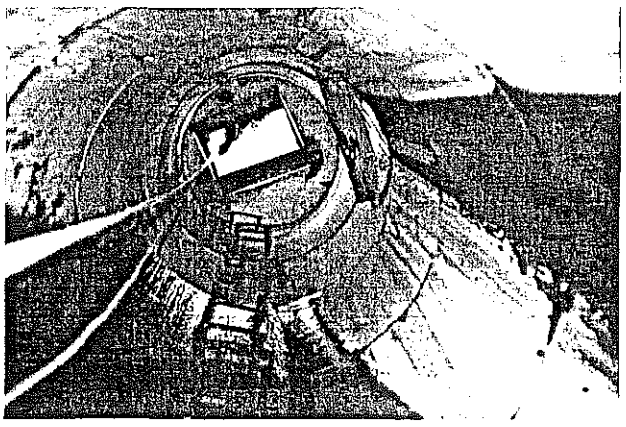

Figure 13

EMBANKMENT SLIDE

The embankment on the south end of the parking area which extends behind Walmart was inspected on May 8, 1997 and again on May 29, 1997. It is evident the embankment is sliding in several areas (Figures 14-17). The most critical area is at the south end of the Keystone Block Wall. It is evident that pavement settlement has increased around the catch basin and the slide is pulling the concrete curb away from the asphalt pavement. Water appears to be percolating out of the slide at approximately the same elevation that the water is entering the nearby vertical drop box inlet shown in Figures 12 and 13. The slide is apparently causing displacement in the blocks of Keystone Block wall. It is apparent that the slide is separating the blocks and pushing the toe of the wall forward (Figures 18 and 19).

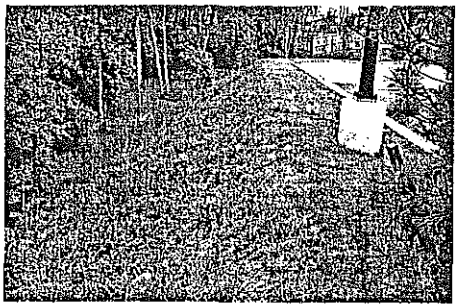

Figure 14

Figure 15

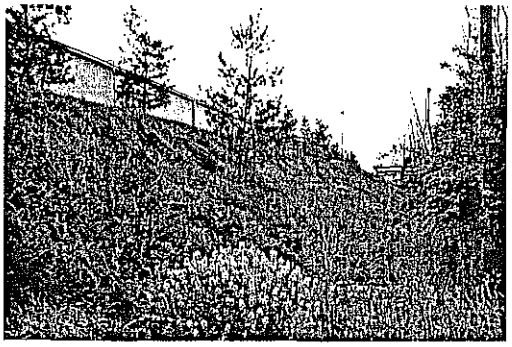

Figure 16

Figure 17

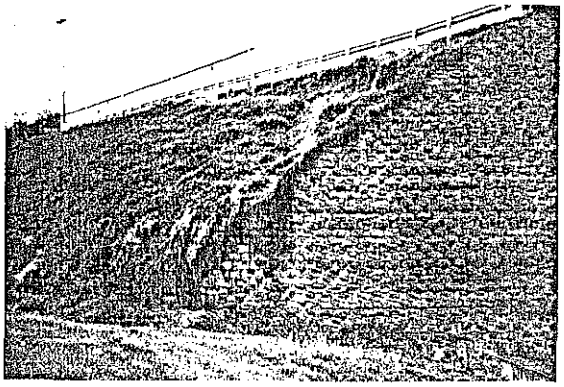

Figure 18

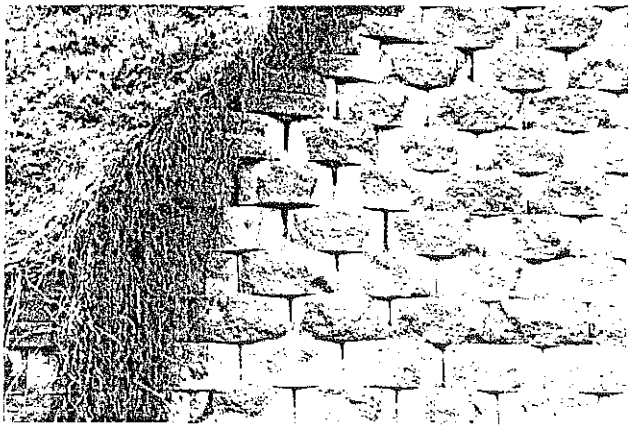

Figure 19

DISTRESS SURVEY OF KEYSTONE BLOCK WALL

The face of the wall was inspected on May 13, 1997. All observed distresses were cataloged and photographed. This was conducted prior to placing control monitoring points which will supply more information on where movement may be occurring. The wall was divided into five sections for monitoring. A schematic of the wall and the observed distress is shown in Figure 20.

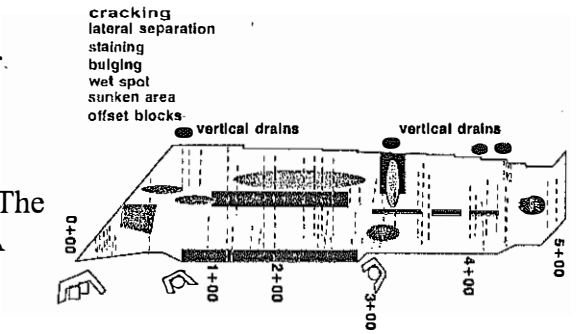

Figure 20

From the distress survey, it is apparent that movement has occurred in all five sections. Significant amounts of crushed stone appear to be migrating from horizontal separations in the Keystone Block. Significant amounts of forward movement had occurred on the north end of the wall. The top half appears to have moved (slid) forward approximately four inches. This is currently being monitored. (Figure 21).

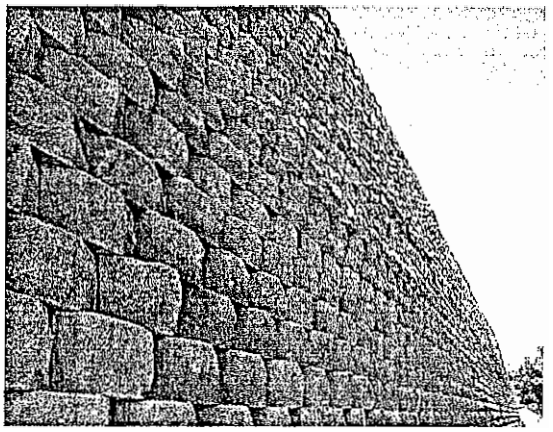

Figure 21

Cracking of the Keystone Blocks was observed in several locations along the wall. The most severe cracking had occurred 442 feet from the south end (Figure 22). The surface of the blocks also appeared to be wet in several areas (Figure 23). This indicates the backfill may be saturated behind the retaining structure.

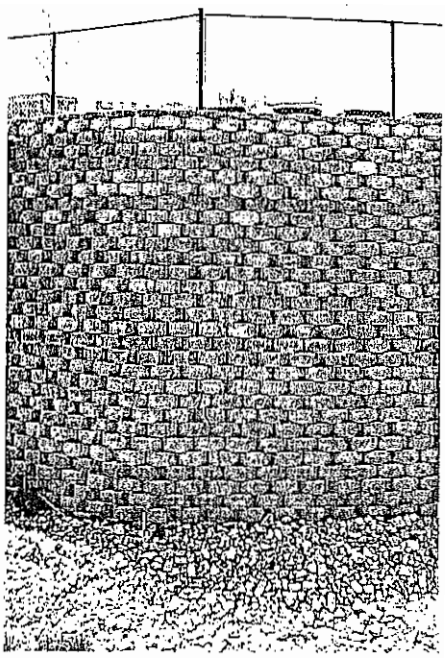

Figure 22

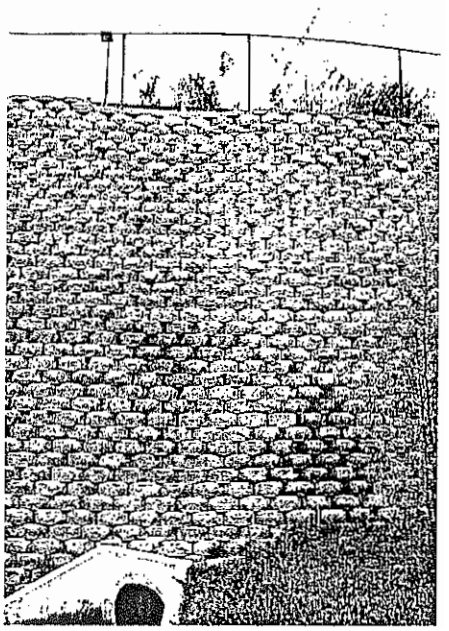

Figure 23

CONCLUSIONS

It is apparent from the visual observations of the wall in the last year that cracking and horizontal separations between blocks have increased. It also appears that settlement in the surface of the parking lot behind the wall as also increased. It is evident that surface water is not entirely reaching the designed catch basins. It is likely that this water is having a substantial impact on the performance of the wall structure. Further analysis needs to be conducted to find the source of the ground water discharging into the side of Drop Box Inlet No. 3. This inflow of water needs should be located and channeled prior to repairing the slope failure. It is likely this water is saturating the soil at the top of the embankment and is exacerbating the embankment slide. It is likely that a significant amount of the water is percolating through the pavement and not reaching the drop box inlets.

RECOMMENDATIONS

It is recommend that the parking lot along the wall and the access road behind the store also be repaved. It is also recommended that the breaks in the concrete curb be repaired. In addition, it is recommended that a french drain be installed to collect the water being discharged along the back of the store from the roof gutters. It is recommended the embankment be repaired as soon as possible to eliminate any further damage to the retaining structure and the parking lot. It is recommended that the surface water infiltrating the drop box inlets and the slide be isolated. If this water is found to be flowing from the cut and fill, it is recommended that a cutoff trench be installed to intercept the water before it reaches the embankment and the retaining structure.