

**Research Report
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THE USE AND PERFORMANCE OF GEOGRIDS IN KENTUCKY

by

Aric Cowne
Research Assistant

Richard Reitenour
Engineering Technician

David L. Allen, P.E., P.G.
Program Manager, Pavements and Materials

R. Clark Graves, P.E., P.G.
Associate Program Manager, Pavement and Materials

Kentucky Transportation Center
College of Engineering
University of Kentucky
Lexington, Kentucky

in cooperation with
Transportation Cabinet
Commonwealth of Kentucky

and

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Introduction

This report will investigate the history and usage of geogrids, a subfamily of geosynthetics, in Kentucky. The American Society for Testing and Materials (ASTM – 1994) has defined a geosynthetic as a planar product manufactured from a polymeric material used with soil, rock, earth, or other geotechnical-related material as an integral part of a civil engineering project, structure, or system. Geogrids, geosynthetics primarily used for reinforcement, are formed by a regular network of tensile elements with apertures of sufficient size to interlock with surrounding fill material. Geogrids are used as reinforcement by adding tensile strength to a soil matrix, thereby providing a more competent structural material. Reinforcement enables embankments to be constructed over very soft foundations and permits the construction of steep slopes and retaining walls.

History and Use

The principle use of geogrids in Kentucky has been for road and pavement construction. Geogrids increase stability and strength, and improve performance of weak subgrade soils. A geogrid placed at the interface between the aggregate base and the subgrade functions as a separator to prevent two dissimilar materials (subgrade soils and aggregates) from intermixing. Geogrids perform this function by preventing penetration of the aggregate into the subgrade. It is important to note, however, that geogrids rarely perform as well as other geosynthetics at aggregate/subgrade separators. The small amount of separation that is achieved via geogrid is a secondary benefit from its principle usage.

Geogrids provide reinforcement through three possible mechanisms.

1. Lateral restraint of the base and subgrade through friction and interlock between the aggregate, soil, and if applicable, the geosynthetic.
2. Increase in the road bearing capacity by forcing the potential failure surface to develop along an alternate, higher shear strength surface.
3. Material support of the wheel loads.

Typically, when an aggregate is applied by a load it tends to shift laterally, unless restrained by the subgrade. Geogrid strengthens the subgrade's ability to resist by providing a higher tensile resistance to lateral aggregate movement.

Some of the specific reasons that geogrids might be used are to reduce the depth of excavation required for the removal of unsuitable subgrade materials, reduce the thickness of aggregate required to stabilize the subgrade, reduce the disturbance of the subgrade during construction, and reduce maintenance and extending the life of the pavement. Geogrids have been purported to reduce the wear and tear on roads that cause structural and functional failures. Furthermore, geogrid manufacturers indicate that a geogrid placed at the bottom of the aggregate base may permit a 10 to 20% base thickness reduction (Barksdale, et al., 1989).

The costs of geogrid typically varied, but according to *Geosynthetic Engineering* the material cost of geogrid ranged from \$1.50 – 3.50 per square meter. This cost does not include installation and contractor's markup (Berg, et al., 1997).

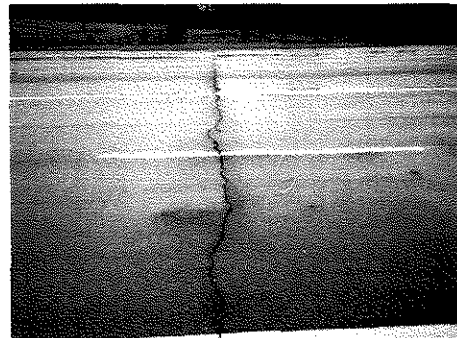
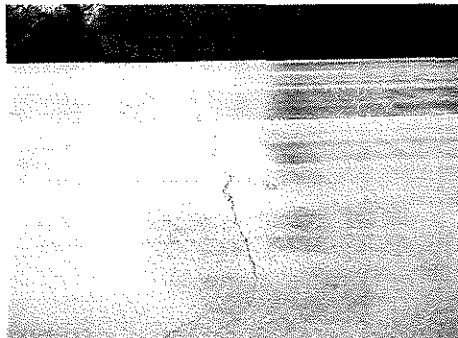
Specific Projects in Kentucky

Project 1: John Puryear Road, McCracken County, Kentucky

1. **Location** - John Puryear Rd., McCracken County, Kentucky. Geogrid starts at the east bound exit ramp from I-24, milepoint 3.7 and continues to milepoint 5.4.

2. **Site Description** – The pavement appears to be in good condition. There are no longitudinal or map cracks. There also are no base failures. However, there are many transverse cracks. Of the section of road that exists beyond the geogrid section, the road is in much worse condition. The pictures below support this.

3. Pictures of site –



4. **Conclusions about site** – This 1.7 mile section of geogrid appears to be in good condition. Considering that the road is in a low, swampy region, and that the rest of the road (nongeogrid) is in worse condition, it appears that the geogrid has helped the road maintain a longer life. There are, however, transverse and one longitudinal crack that need to be repaired. There are no apparent base failures to report.

Project 2: US 231, Warren County, Kentucky

1. Location – US 231 Warren County, Kentucky. This section of geogrid is a small section that has been used to repair a sinkhole along Milepost 7.4.

2. Site Description – There is a large sinkhole alongside US 231. When the road was built, a sinkhole formed under the subgrade. The sinkhole under the road was repaired and geogrid fabric was placed on top of the subgrade below the rock. At the time of the pictures, this part of US 231 has a base but does not have a surface and has not been opened to traffic.

3. Pictures of Site –



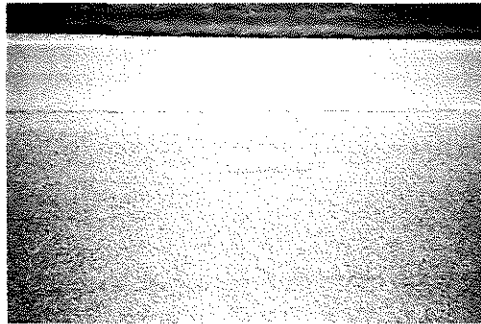
4. Conclusions About Site – The road appears to be in good structural condition. However, water has collected in the right lane and further drainage may be necessary. A follow-up survey should be performed to see how the road handles repeated loading once it is opened to traffic.

Project 3: – I-65, Hart County, Kentucky

1. Location – I-65 Hart County, Kentucky. This section of geogrid covers both the north and south bound lanes from milepoint 58 to milepoint 62.2.

2. Site Description – There are many, around 15, small holes in I-65 (Pictures 3 and 4). There are also many areas, around 20, that exhibit minor bleeding. The pavement appears to be in excellent condition, however, except for the area around milepoint 61.0.

3. Pictures of Site –



4. Conclusions About Site – Besides the small holes in the road, the 4.2 mile stretch of I-65 appears to be in good condition. Further analysis should be conducted in the future to monitor the road's condition.

Project 4: I-64 and I-264, Jefferson County, Kentucky

1. Location – I-64 and I-264 Jefferson County, Kentucky. This section of geogrid exists from I-64 between 22nd Street exit and the Sherman Minton Bridge, and also from Minton Bridge to Banks Street exit on I-264.

2. Site Description – The road was constructed in 1993. The subgrade was undercut by one foot, and then the geogrid was put down followed by one foot of #2's, wrapped, then six inches of 57's. Finally PCC pavement was placed on top.

3. Pictures of Site –



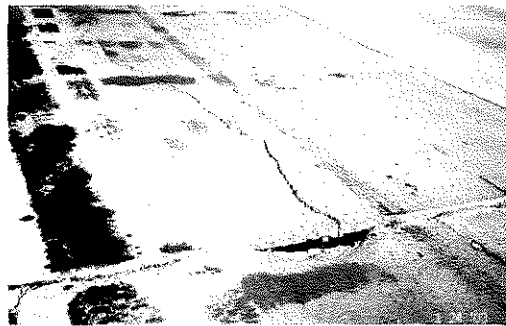
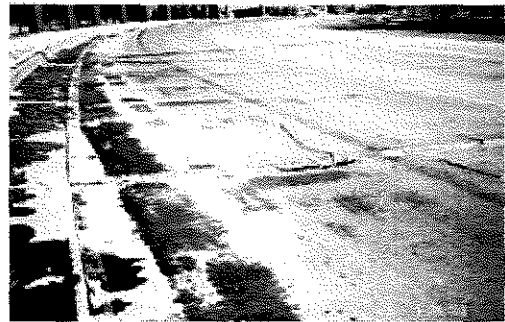
4. Conclusions About Site – Overall the pavement looks to be in good condition. There are a few cracks and many places where the pavement is breaking apart around areas where the pavement markers are missing. There are many bridges or overpasses on this section and consequently much of the pavement is on a bridge or ramp. A lack of shoulder space limits the ability to get more pictures for this site. Recommendation for the future would be to have right lane closed and more pictures taken.

Project 5: Grade Lane, Jefferson County, Kentucky

1. Location – Grade Lane Jefferson County, Kentucky. This is a short section of geogrid that exists at the end of Grade Lane.

2. Site Description – The end of Grade Lane was widened to four lanes in 1999.

3. Pictures of Site –



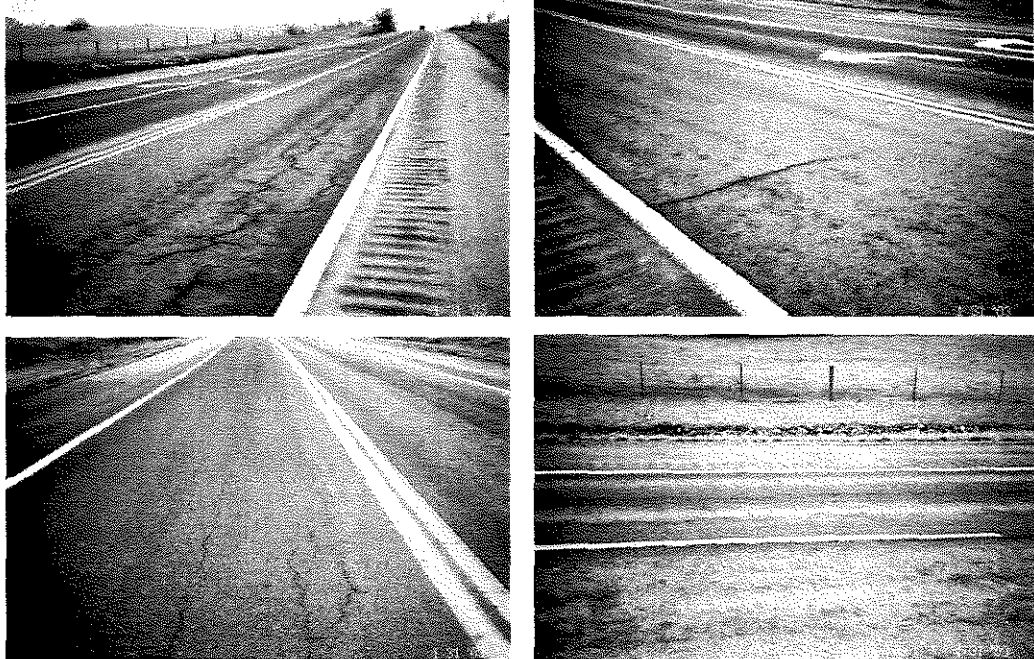
4. Conclusions About Site – Overall this section of Grade Lane appears to be in good condition, except for one problem area presented in the above pictures. There is a slab of concrete around a utility manhole that has recessed badly. This section needs to be fixed.

Project 6: KY 2168, Boyle County, Kentucky

1. Location – KY 2168 Boyle County, Kentucky. This section of geogrid is 1.5 miles long and joins KY 33 & US 127.

2. Site Description – This part of the road was constructed in 1991 and geogrid material was used.

3. Pictures of Site –



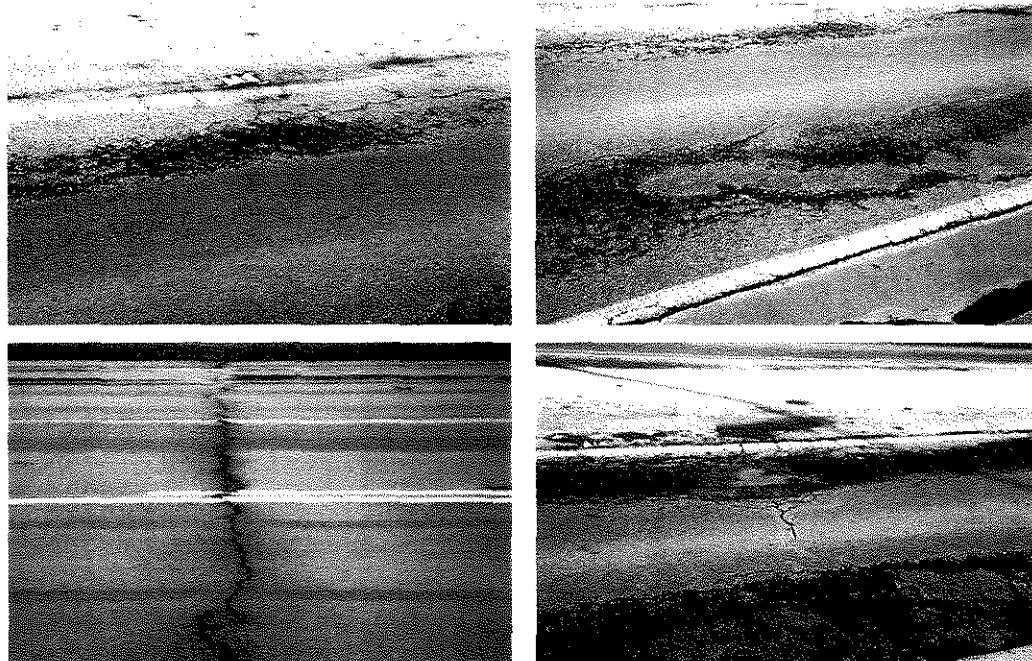
4. Conclusions About Site – Overall the road looks good, but there are many longitudinal cracks over the entire length of the project. These cracks should be patched and the road monitored for future stress problems.

Project 7: Hopeful Church Road, Boone County, Kentucky

1. Location – Hopeful Church Rd. Boone County, Kentucky. This geogrid project runs between KY 118 and US 42, a total distance of 2.2 miles.

2. Site Description – Geogrid was used between #2's and dense grade. This pavement stretch has many problems: longitudinal cracks, map cracking, and patches.

3. Pictures of Site-



4. Conclusions About Site – From 0-0.29 miles north of US 42, there are many stress fractures of the pavement, although no base failures to report. After this section, the pavement looks better, but there are still many longitudinal and map cracks in a number of areas.

Project 8: KY 419, Grant County, Kentucky

1. Location – KY 419, Grant County, Kentucky. This section of geogrid was used between I-75 and US 25.

2. Site Description – This section of geogrid runs for about 500-600 feet and was constructed in 2000. Fabric and geogrid were used on top of the subgrade, between subgrade and dense-grade. The fabric was placed on the subgrade and then the geogrid was placed on top of the fabric. There are no exhibits of defects of any form, the pavement looks very good.

3. Pictures of Site –



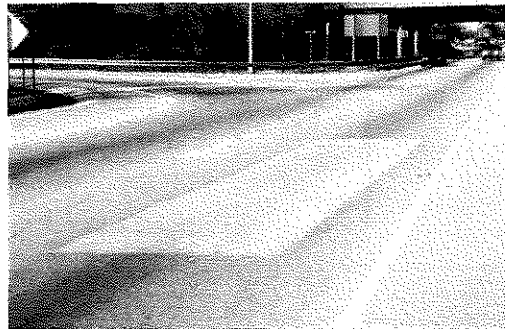
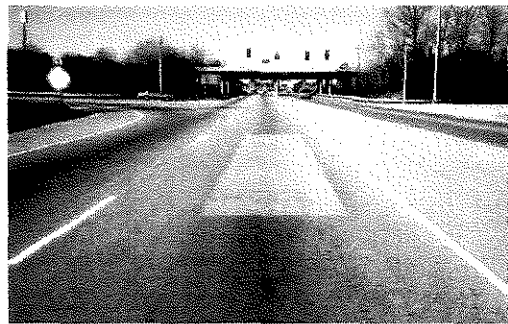
4. Conclusions About Site - While this section of pavement is extremely young (three years), the road appears to be in good shape. Further monitoring is recommended.

Project 9: US 25 & I-75, Knox County, Kentucky

1. Location – US 25 & I-75 Knox County, Kentucky. This section of geogrid is on US 25 eastbound, just past the I-75 overpass.

2. Description of Site – Geogrid was used to repair a blow-up in the inside lane on US 25 eastbound.

3. Pictures of Site –



4. Conclusions About Site – The patch fixed with geogrid appears to be in good condition and it covers only a very small area.

Project 10: KY 74 (Cumberland Ave), Middlesboro, Bell County, Kentucky

1. Location – KY 74 (Cumberland Ave) Middlesboro, Bell County, Kentucky. This section of geogrid exists from 38th St through 40th St in front of the fire house.

2. Description of Site – This road appears to be in good condition.

3. Pictures of Site –



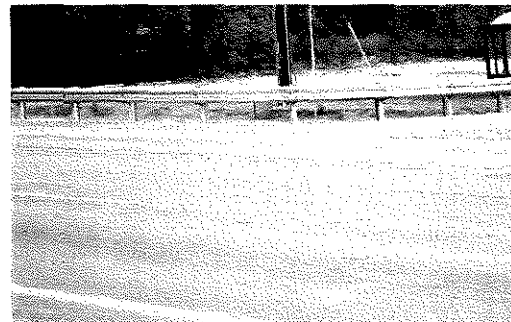
4. Conclusions About Site – This section of the road, with geogrids, is in good condition.

Project 11: US 60, Morehead, Rowan County, Kentucky

1. Location – US 60 Morehead, Rowan County, Kentucky. This section of geogrid starts on the Bypass, Section 3, in front of Morehead Field House and extends 1.3 miles to the east.

2. Description of Site – This section of the road under cut the subgrade by two feet, and then Type IV fabric was filled with two feet of #2 crushed limestone and was finally wrapped with fabric. There was also Type I fabric used under storm sewers. The trench was wrapped with fabric, the pipe was installed, and then covered with one foot of rock.

3. Pictures of Site –



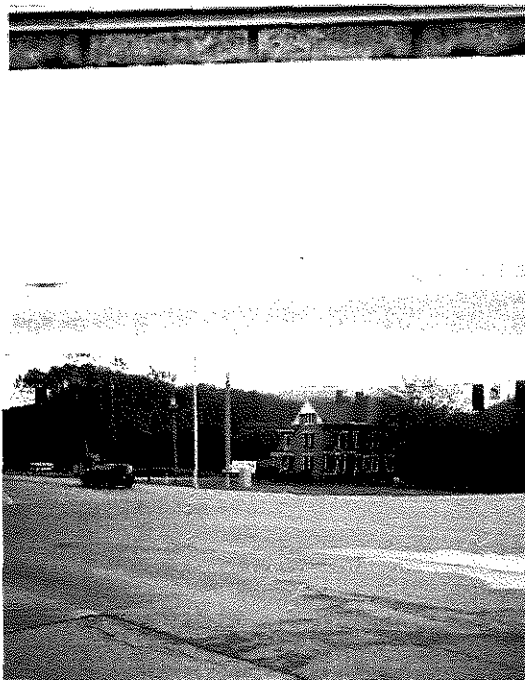
4. Conclusions About Site – This section of road, used with geogrid, is in good condition.

Project 12: US 460 & US 23, Johnson County, Kentucky

1. Location – US 460 & US 23 Johnson County, Kentucky.

2. Site Description – US 460 intersects US 23 which passes over on a overpass. The pavement at the intersection looks good but has many longitudinal cracks. On the eastbound side the turn lane onto KY 40 and US 23 NB has been replaced with a PCC overlay. The entire intersection is 1825 feet long, and includes a ramp to US 23 SB. A ramp extends from US 23 NB and to a ramp through US 23 NB. However, there is no ramp from US 23 SB at the intersection. On the ramp to US 23 NB there is a large patch over almost the entire intersection. This is also where the PCC lane ends and there is water standing at the end of that lane. There are several large cracks in the PCC lane.

3. Pictures of Site –





4. Conclusions About Site – This road has many cracks and ruts and needs to be repaired.

Project 13: US 23, Boyd County, Kentucky

1. Location – US 23 Boyd County, Kentucky. This section of geogrid starts at Lawrence County and travels northbound for approximately three miles.

2. Description of Site – At milepoint 0.02, the right lane exhibits an extreme area of sunken pavement about 150 to 200 feet long.

3. Pictures of Site –



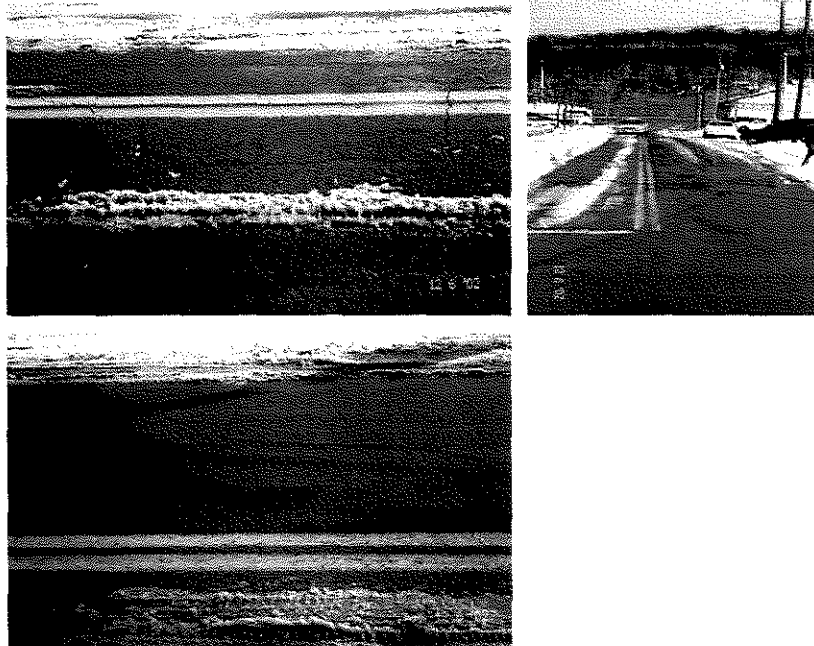
4. Conclusions About Site – Overall, apart from the 150 foot area of sunken pavement, the project looks good. There is a small amount of rutting in the right lane at various locations.

Project 14: 11th Street, Ashland, Boyd County, Kentucky

1. Location – 11th Street, Ashland, Boyd County, Kentucky.

2. Description of Site – At the time of inspection, the road was partially covered with ice. Parts that are showing exhibit many transverse and longitudinal cracks. There also is some map cracking, although not as much. This street is two lanes wide, with one lane in each direction.

3. Pictures of Site –



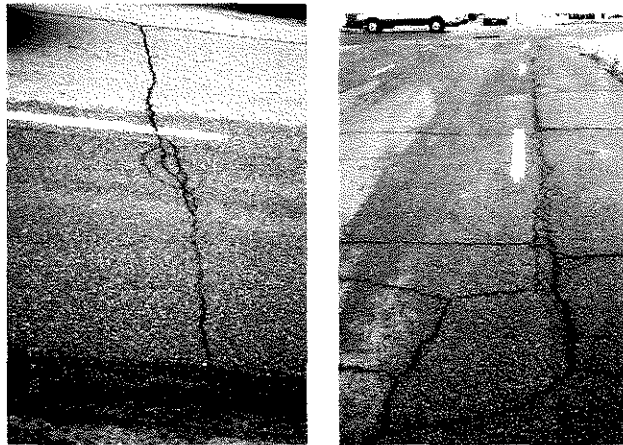
4. Conclusions About Site – Further inspection needs to be conducted, but it appears that the existing cracks should be fixed before more damage occurs.

Project 15: 12th Street, Ashland, Boyd County, Kentucky

1. Location – 12th Street, Ashland, Boyd County, Kentucky. This street is the same as Martin Luther King Jr. Blvd.

2. Description of Site – MLK Blvd. is between 11th and 13th street. 12th street is cracked in many places. It appears to be in the same condition as 11th street. A lot of transverse and longitudinal cracking, but with very little map cracking in this section. This street is 4 lanes wide and it is a one-way street.

3. Pictures of Site –



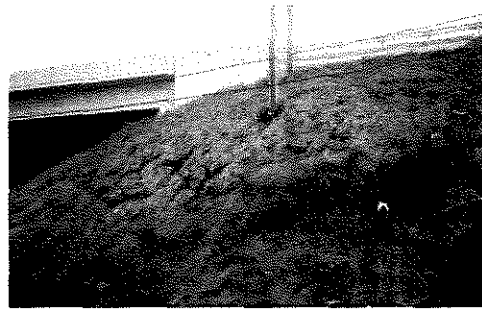
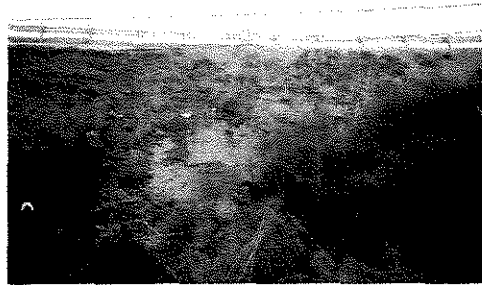
4. Conclusions About Site – Distresses at this site indicate a high volume of traffic. There are many cracks that need to be repaired. There appear to be no structural failures with the road, at this time. Careful monitoring is recommended.

Project 16: US 23 & KY 114, Floyd County, Kentucky

1. Location – US 23 & KY 114, Floyd County, Kentucky.

2. Site Description – This geogrid project is a slope stabilization between two bridges on US 23 along side the Glenview Plaza shopping center. This slope is about 10 years old, and overall it looks to be in good condition. In places where the geogrid fabric is visible, the fabric is deteriorating but it looks to have fulfilled its purpose by holding the slope together so that vegetation could take hold. At one end of the slope, which is very steep, there is some slippage. There is also some heavier geogrid showing. In addition, geogrid may have been used in other areas but it could not be determined.

3. Pictures of Site –



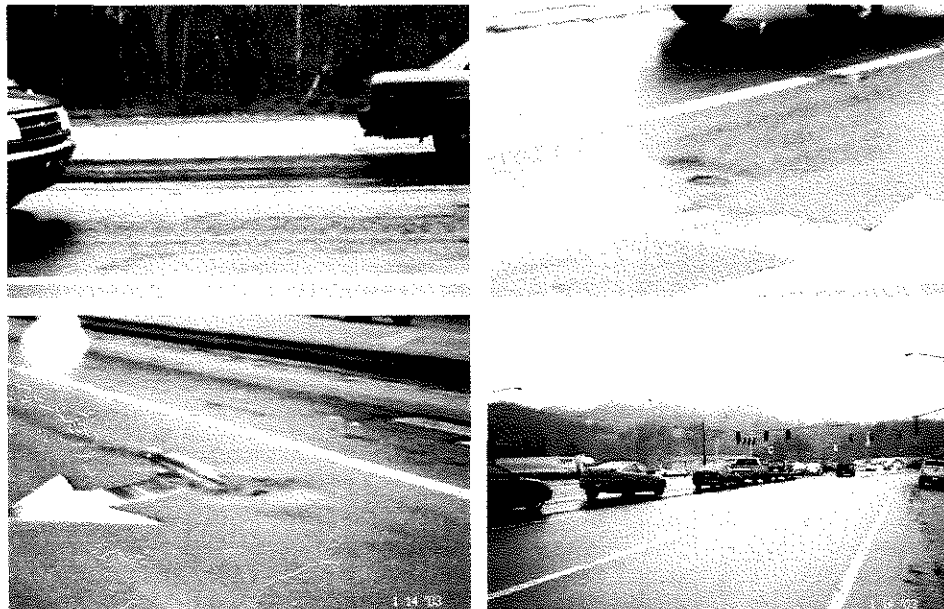
4. Conclusions About Site – This project appears to be in good condition. Further monitoring is recommended.

Project 17: US 119 & US 23 (Buckley's Creek), Pike County, Kentucky

1. Location – US 119 & US 23 (Buckley's Creek), Pike County, Kentucky. This section of geogrid is where US 119 turns north off of US 23 NB.

2. Site Description – There is a lot of rutting in this intersection. This probably occurs due to the high volume of coal truck traffic. The left turn lane from US 119 WB onto US 23 SB is severely rutted, in some places more than one inch. The other lanes are rutted but not as badly. There is, however, one distressed location in the right turn lane US 119 EB onto US 23 NB (in the left wheel path). This circular area is about 30 inches in diameter and has sunk about 2 or 3 inches.

3. Pictures of Site –



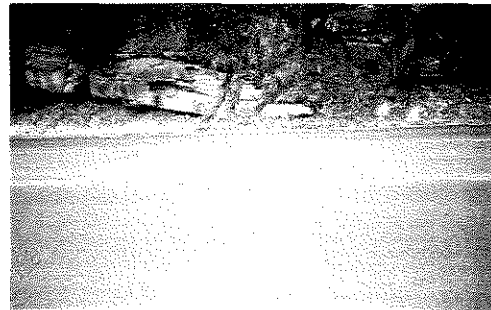
4. Conclusions About Site – This project appears to be in good condition, for the most part, considering the routine heavy loading that is applied to the pavement. A number of sunken spots should be fixed.

Project 18: US 119 & KY 194, Pike County, Kentucky

1. Location – US 119 & KY 194 Pike County, Kentucky. This section of geogrid is about four-tenths of a mile onto US 119 where it meets KY 194, east bound.

2. Site Description – This site is purported to have geogrid, although that has not been confirmed. There is about 50 feet of road on KY 194 and the intersection between KY 194 and US 119 that has been investigated. Everything looks good, but there are a few areas of longitudinal cracks. The right wheel path in the right lane on US 119 NB, just before KY 194, east bound, has a large number of cracks. This road is a coal haul route.

3. Pictures of Site –



4. Conclusions About Site – This project is in good condition, considering the heavy loads, however, a definitive word on whether geogrid has or has not been used cannot be made.

Conclusions and Recommendations