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16. ABSTRACT

This report is to serve as a guide for local officials in selecting and installing geotextiles on rural unpaved roads.

Various techniques are presented to address most of the common conditions and situations present on rural roads.

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INTRODUCTION

BACKGROUND

The majority of the finished goods that travel down America's super highways took their first trip as raw material down a rural road. Even if the raw material was pumped through a pipeline, it would not have been discovered or produced without the use of rural roads. A somewhat similar statement could be made about the roads on, to and from America's recreation and government lands. In most cases these roads are not built to interstate standards. The vast majority of these roads are not hard-surfaced and depend upon timely maintenance during seasonably bad weather conditions.

In many instances, "timely maintenance" means almost continuous maintenance due to severe local problems that cannot be solved by reasonable investment of available funds. Examples of these problems would include underground springs, extreme boggy conditions due to poor soils, severe drainage problems due to the local topography; i.e. the weak spots that everyone knows are next to impassable at certain times of the year without almost weekly applications of gravel or other surface material.

These types of problems can be eliminated or at least significantly reduced by the use of geotextiles. Their ability to solve these type of problems is well documented. Based on recent research and demonstration results, conventional guidelines for application (suitable for state and federal highway design requirements) appear to be unnecessarily conservative and exorbitantly costly for local rural roads. As a result, many of the most crucial and beneficial applications of geotextiles are not considered because of having been erroneously labeled as "too expensive" or "not cost effective."

The first use of geotextiles, or fabric as they are commonly referred to, began in the time of the Romans, but it was not until the mid 1960's that geotextiles began to be considered and installed in roadway operations. Probably the most common use of geotextiles is in asphalt overlay projects.

According to the United States Department of Transportation publication "Our Nation's Highways: Facts and Figures" there are 3.9 million total miles of roadway in the United States of which 3.2 million miles are <u>rural roads.</u> Approximately 45% (1.75 million miles) of the rural roads are surfaced with gravel or gravel and soil.

GEOTEXTILES FOR RURAL ROAD PROBLEMS

This paper specifically addresses the use of geotextile fabric on rural roads. Manuals providing detailed engineering information for major highways and interstate roadways are available from a variety of sources.

Soil is the foundation material for all roads, whether in the form of native undisturbed subgrade materials, transported material or native embankment material. Vehicle loads are transmitted to the roadbed and if adequate support does not exist, severe rutting or washboarding (corrugations) will result.

In roadbeds composed of fine grained materials, the stability is moisture dependent. In areas where there is poor drainage or subsurface water conditions it is almost impossible to keep the roadway from rutting. Even though gravel is added to these locations, the roadway will experience ruts as soon as the next rainfall occurs. Installing a geotextile, or fabric as it is sometimes called, with 4 inches or more of gravel on these locations will, in most cases, eliminate the rutting and provide all weather service for the roadway.

This manual is written for and intended to be used by the local road official/supervisor of our nation's 3.2 million miles of rural roads. It is intended to serve as a basic guide book covering the following areas:

1. Identifying and classifying the type of problem at the site.

2. Selecting and matching the fabric to the problem type.

3. Suggestions on how to roll out and install the fabric

4. How to place or dump the aggregate on the fabric under different conditions and with different kinds of equipment.

5. How to spread the aggregate on the fabric under different conditions and with different kinds of equipment.

Demonstrations indicate that the use of fabric beneath the layer of gravel on a rural road basically provides one critical function, separation. The gravel on top is separated from the soil in the roadbed underneath. Without the fabric, in the case of organic material (clay, silt, peat), as the roadbed becomes saturated with water, a mud slurry is formed. As vehicles travel over the softened roadbed, the slurry is pumped upward. As the mud slurry is pumped up through the rock surface, the individual rocks are coated with the slurry. This has the same effect as pouring 10 weight motor oil on the rock. Dry aggregates have a lot of surface friction when rubbed against one another and as a mixture tend to be very stable. When coated with the mud slurry, the aggregate loses this surface friction and slides easily past one another and disappears into the roadbed underneath, leaving a rut behind.

When the proper fabric is installed on the roadbed, the fines in the mud slurry cannot rise through the fabric to coat the rocks on top. The openings in the fabric are selected to be small enough such that water can get through (providing a form of drainage) but the soil fines cannot rise to the top.

Types of Fabrics Used

Both woven and non-woven geotextiles, in a variety of weights, were used in the study. The purpose of the study was to observe the performance of the different types of fabrics in a variety of situations.

Installation Procedures

A. Subgrade Preparation

In all test sites with the exception of Comanche County, preparation of the subgrade consisted mainly of using a motor grader to smooth the existing surface and the construct a crown in the roadway. There were no conventional compaction operations performed prior to installation of the geotextiles. The Comanche County site was the only location in which compaction operations were performed. The roadway elevation was raised 1 1/2 feet and a sheepsfoot and pneumatic roller were used to compact the fill area.

B. Geotextile Installation

The geotextiles were rolled out by hand in all of the test locations. All joints were overlapped approximately 18 inches and the same roll of geotextile was used to cover the full width of the roadway.

C. Types of Aggregate

The test sites were surfaced using two basic types of gravel; "crusher run" and "native gravel". The crusher run gravel used on the various test sites conformed to the following gradation recommendations. Upon closer examination of the aggregate gradation recommendations two factors become quite obvious. First, the gradation is very broad ranged. Second, the fines (minus #200 material) and Plasticity Index <u>minimum</u> requirements exceed the <u>maximum</u> allowable in most of the state Department of Transportation's in the U.S. The gradation requirements for the FHWA study were the result of several years of observation on the performance of various types of aggregate and addressed three important issues. Most quarry operations produce material from the initial crushing of the shot rock which will conform to the aggregate recommendations. By producing a material that doesn't require additional screening or washing the crusher run material is the least expensive surface aggregate the quarry produces.

The crusher run material with the "excessive" amount of fines, when compared to the specifications of most state DOT's, is the most stable material used on low volume roads at nominal depths of 4 inches or more.

The roadway aggregate specifications in most state DOT's are related mostly to a base course structure that will be hard surfaced with material such as hot mix asphalt or concrete pavement. Aggregate is used as the surface course on 1.8 million miles (45% of total mileage in the U.S.) predominantly under local government jurisdiction.

"Native gravel" is a term used to describe a wide variety of aggregate material. The native gravel used in the test sites ranged from a soft sandstone/packed sand material, to a consolidated shale, to a pit run clay gravel. The native gravel was selected to compare its performance to that of the crusher run but primarily because it is the predominant material used by the local officials participating in the study.

D. Type of Equipment Used

Each test installation required the use of a motor grader and some type of gravel truck to transport the gravel to the location. The gravel trucks used would fall into one of the three following classifications:

EQUIPMENT	Class I	Class II	Class III
Number of wheels	10	18	18
Average load (tons)	15	20	25
Approx. ground pressure (psi)	45	65	70
Method of discharge	rear	belly	rear

The motor graders used would exert ground pressures on the order of 50 psi and in each location, except Comanche County, the gravel trucks drove onto the bare fabric and dumped the gravel as they drove across the geotextile. The operators were cautioned against making sudden stops or starts and the travel speed was restricted to 15 mph or less. The 10 wheeled dump truck and the 18 wheeled belly dumps discharged the gravel after the trucks began moving forward. The 18 wheeled end dumps remained stationary while discharging and the operators were instructed not to lock the trailer brakes while dumping. The Comanche County test site utilized a chip spreader and 10 wheeled dump trucks in placing the gravel on the geotextile. The geotextile was rolled out in front of the chip spreader as the gravel was being discharged with the dump trucks backing up to the chip spreader and then driving over the geotextile and gravel section when empty. An initial thickness of 2 inches of gravel was placed on the geotextile then an additional 2 inches was placed on the final pass.

E. Spreading the Gravel

Various types of motor graders were used to spread the gravel across the geotextile. In most of the test installations over or both of the front wheels on the motor grader traveled on the exposed geotextile during the spreading operation. The operation was designed to maintain the target depth of 4 inches of aggregate cover over the geotextile. The rear tandem wheels of the motor grader were kept on the 4 inches of aggregate cover as much as possible during the installation. No conventional compaction operations were performed during the installation except for Cleveland County. The aggregate cover material at this location was water and "slush rolled" with a motor grader then compacted with a 15 ton pneumatic roller. During the exhumation of the geotextiles from the test sites, the aggregate cover in Cleveland County hardened to such a degree that a pick axe was unable to break through, therefore no samples were obtained from this location.

IDENTIFY THE PROBLEM

2.1 Introduction

There is an old saying about roads, "if you can drain it, you can maintain it." The most common cause of rutting on rural roads is the presence of excessive water in the roadbed. A secondary cause of poor roads is poor, or insufficient, base material. Actually, this only compounds the real problem caused by water.

Water can enter the roadbed from a great variety of sources. Common sources include underground springs in or near the roadbed, a high water table in areas having a flat terrain, low areas where the surrounding fields are simply higher than the roadway and there is no opportunity to divert the water elsewhere. This may be a continual problem as from ground seepage or an intermittent problem due to rain or flooding. On most rural roads there are sections of roadway where these conditions exist and cannot be remedied by conventional methods due to lack of funds. In most cases, a combination of geotextile fabric and a layer of 4 inches of aggregate can provide a cost effective solution to this common problem. Some installations have been in service for 6 years without requiring any additional gravel and with minimal grading.

There are almost an infinite number of soil types. In an effort to make the application as simple as possible, base materials will be roughly grouped into two classes.

... **Sandy/granular soils**

... **Clay or silt materials (dirt roads)**

Applications involving unusual soil types such as peat bogs should be considered by a professional engineer.

2.2 Clay or Silt Base Materials (Dirt Roads)

Roadbeds constructed of clay and/or silt most often have severe rutting when exposed to water penetration caused by one of the conditions previously described. They become boggy and are difficult to travel over in a standard vehicle such as passenger cars or pickup trucks The typical remedy is to add gravel and regrade as soon as the road dries out enough to support the motor graders and dump trucks. Unfortunately, the gravel usually disappears after the next rain and the rutting appears again. These problem roadbeds, <u>when saturated</u>, can be grouped into four categories as seen in Table 2.1.

TABLE 2.1 CLASSIFICATION OF SATURATED ROADS

Classification	Site Observation	Field Performance
Boggy	Will sink several inches when walking on roadbed.	Deep ruts, difficult to drive over in a standard vehicle.
Soft	Will sink slightly when walking on roadbed. A thumb can be pushed into roadbed with little effort.	Will produce ruts several inches deep. Requires continual grading.
Medium	Won't sink when walking on it. Strong effort needed to push thumb in.	Ruts less than one inch. Major problem is often a slick surface.
Firm	Resists penetration	No trace of rutting Carries traffic well and is not slick.

Continually adding gravel to roads that produce rutting as described in Table 2.1 has very limited and short term success. In the ideal case, every local road official would like for their roads to be asphalt surfaced. In reality, the most common, and reasonable goal is to have roads that can be used without problems for 365 days a year.

The roads that are classified in Table 2.1 as boggy and soft are definitely sites where an application of fabric and gravel is most beneficial. Judgement must be used to decide if the cost of fabric and gravel would be cost effective for roads classified as medium and firm.

2.3 Sandy/Granular Soils

Roadbeds that are nothing more than sand deposits present problems that are the opposite of the types previously described. Just as too much clay can cause rutting problems in roadbeds, a lack of this type of binding material can also cause problems. Granular roadbeds characteristically have areas of washboarding. These areas can be driven over but at greatly reduced speeds. Even at moderate speeds, 30 mph to 40 mph, this can produce severe bouncing and can cause loss of vehicle control.

FIGURE 2.1 BOGGY ROAD

The granular material in the roadbed, without clay to act as a binder, cannot lock together to produce a stable structure. It is similar to trying to stack marbles. You just can't stand on them. But, if you put a layer of dirt (fine grained soil), then a layer of marbles and so on, then it will support your weight.

In the case of a sand roadbed, as a vehicle drives over the roadbed the tires cause the rock on top of the sand to vibrate and move around. The individual sand particles act like tiny ball bearings, allowing the rock to work its way downward through the sand. When the roadbed is wet it is usually very firm and stable, however, as it dries out and the vehicles drive over the roadbed the sand will push out toward the side of the road forming "ruts" in the roadbed. When sand is confined it is a stable material. However, if you were to dump a pile of sand and drive over the pile what happens in a very short time? The pile will flatten out. As the tires drive over the sand, the sand will push outward at 90 degrees to the tires. In this situation even a small child on a bicycle can flatten out a sand pile in very little time.

FIGURE 2.2 SOFT ROAD

FIGURE 2.3 MEDIUM ROAD

FIGURE 2.4 FIRM ROAD

FIGURE 2.5 SANDY ROAD

FIGURE 2.6 GRANULAR ROAD (WASHBOARDING)

SELECTING THE GEOTEXTILE

3.1 Introduction

In Chapter 1 the two most common types of fabric used in roadway applications were briefly described. The first type is the **woven** fabric. This type resembles burlap in appearance since the fibers are machine woven. One set of threads run up and down and the other set run back and forth across the machine. The fabric threads can be flat **(slit film)** in shape, such as leather strips used in leather stitching, or round **(monofilament)** resembling fishing line in appearance. Woven fabrics are very high in tensile strength, but low in elongation.

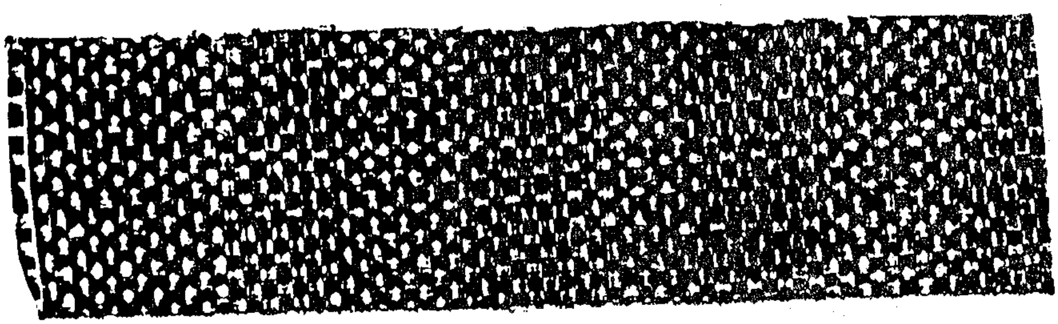


FIGURE 3.1 WOVEN FABRIC

The second type of fabric is called a non-woven. These fabrics are made from short sections of thread (staple) or from continuous threads placed on a machine belt then bonded together by a chemical reaction, heating process or intertwined by a needle punch operation. Non-woven fabric resembles felt in appearance. Non-woven fabrics have lower tensile strength and a higher level of elongation. Some have an ability to let water flow through and laterally within themselves.

As previously stated, an installation of fabric and gravel on a rural road basically provides one function; separation. The gravel on top is separated from the soil/sand in the roadbed underneath. Without the fabric, in the case of organic material (clay, silt, peat), as the roadbed becomes saturated with water, a mud slurry is formed. As vehicles travel over the soften roadbed the slurry is pumped upward, much like tapping the surface of a dampened sponge rapidly; it will bring water to the surface. As the mud slurry is pumped up through the rock surface, the individual rocks are coated with the slurry. This has the same effect as pouring

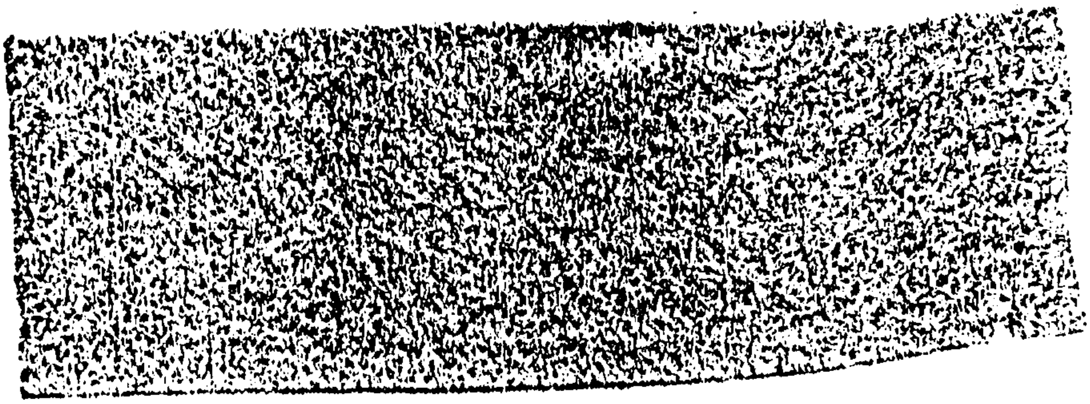


FIGURE 3.2 NON-WOVEN FABRIC

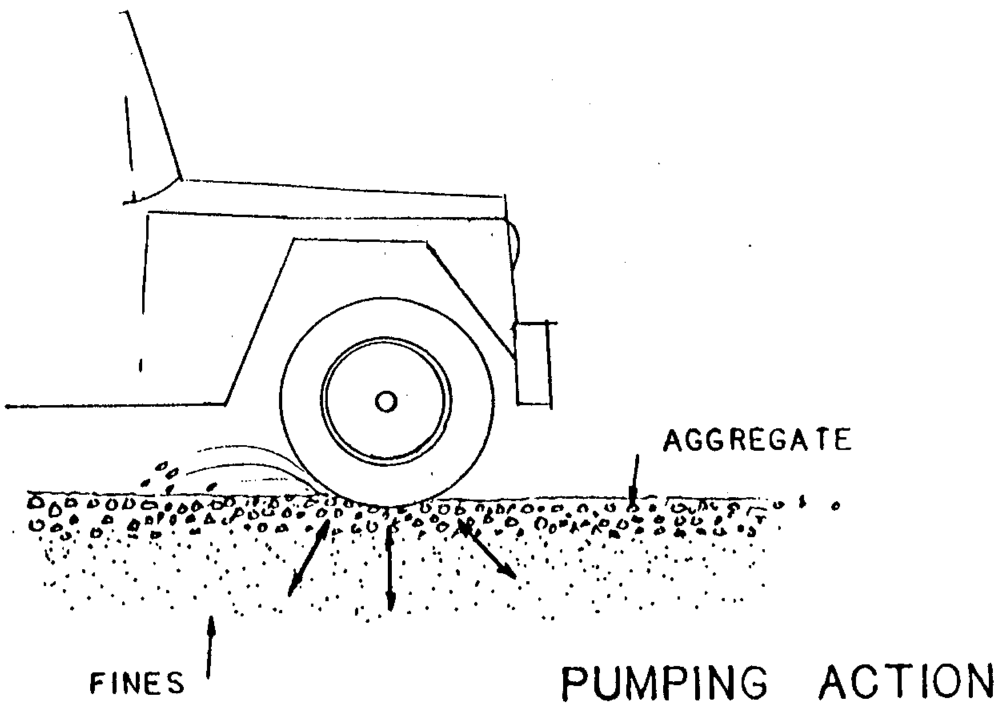
10 weight motor oil on the rock. Dry aggregates have a lot of surface friction when rubbed against one another and as a mixture tend to be very stable. However, when coated with the mud slurry, the aggregate looses this surface friction and will easily slide past one another and disappear into the roadbed underneath leaving a rut behind.

When the proper fabric is installed on the roadbed, the fines in the mud slurry cannot rise up through the fabric to coat the rocks on top. The openings in the fabric should be selected so that water can get through (providing a form of drainage) but the soil fines cannot rise.

In addition, as in the case of a sand road, the fabric is a physical barrier between the rock on top and the roadbed underneath. The only way the rock can disappear is to be pushed through the fabric. Now, let's look at selecting a fabric for these problem locations.

3.2 Subsurface Water Problems

Roadbeds with subsurface water problems usually are classified as **boggy** (see Table 2.1). The most important factor to be considered is the presence of a tremendous amount of water in the roadbed. The fabric must first prevent pumping of the mud slurry from the roadbed into the gravel cover on top and secondly, be strong enough to carry the traffic across the boggy area. Table 3-1 shows suggested **minimum** recommendations for non-woven fabrics.



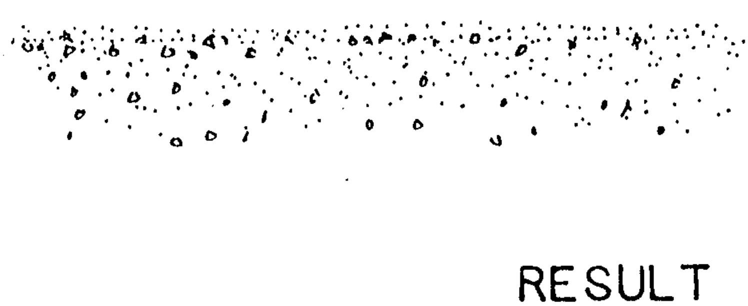


FIGURE 3.3 FINES PUMPING THROUGH THE GRAVEL

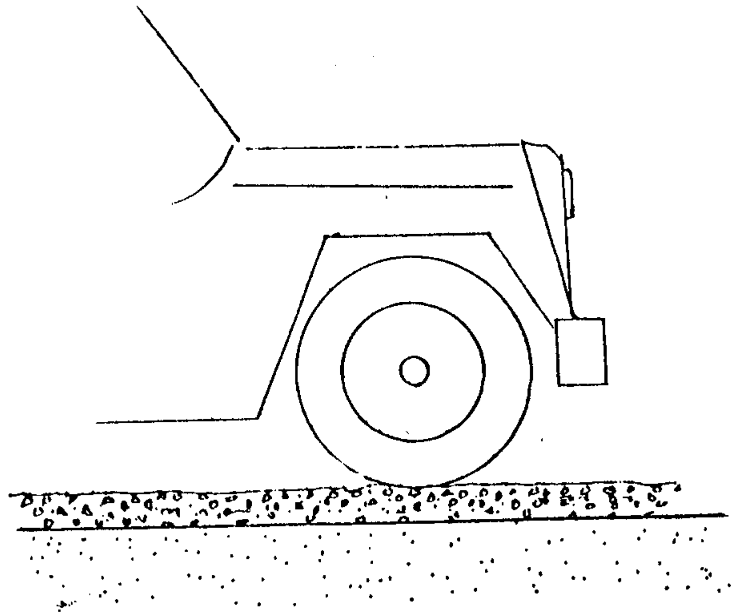


FIGURE 3.4 FABRIC SEPARATION

Figure 3.5 is to be used for determining the Tensile, Mullen burst and Puncture requirements for a non-woven fabric that will support the most common type of vehicle traveling on the roadway. All non-woven fabrics should meet the following minimum requirements in addition to the values determined by using Figure 3.5.

PROPERTY	SPECIFICATION
Minimum Weight	4 oz./sq.yd. (ASTM D 1910)
Minimum Elongation	50% (ASTM D 1682)
Apparent Opening Size (US Standard Sieve)	60 MINIMUM (Corps. of Engrs. CW-02215-77)

In looking at Example 3.1, the tensile strength requirement needed to support a 40,000 pound vehicle can be found by following the procedure listed below:

1. Go across the bottom scale (Vehicle Weight) to the 40,000 pound mark (Pounds x 1000).

2. Draw a straight line up from the 40,000 pound mark until it touches the line in the graph (Point A).

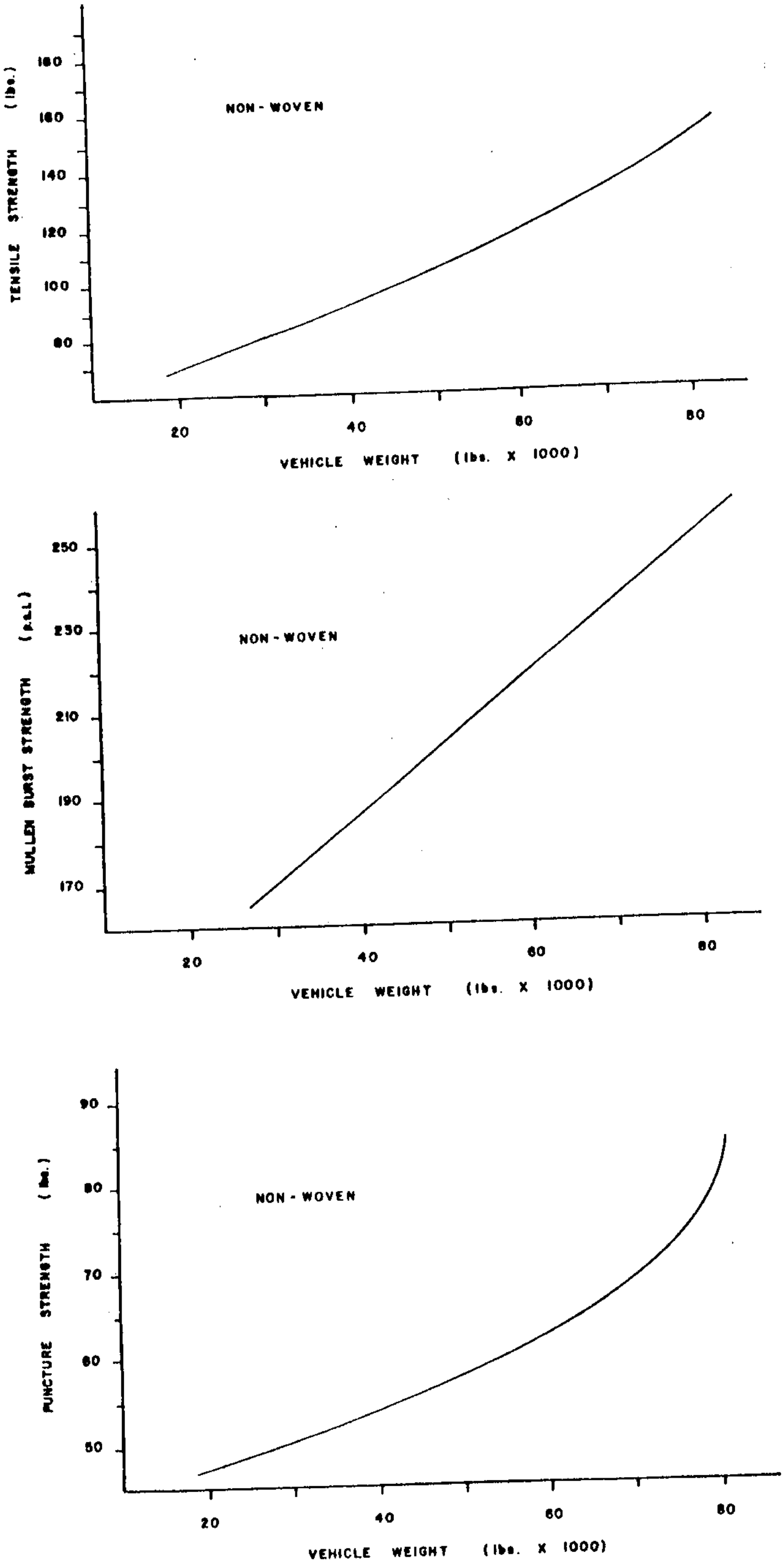
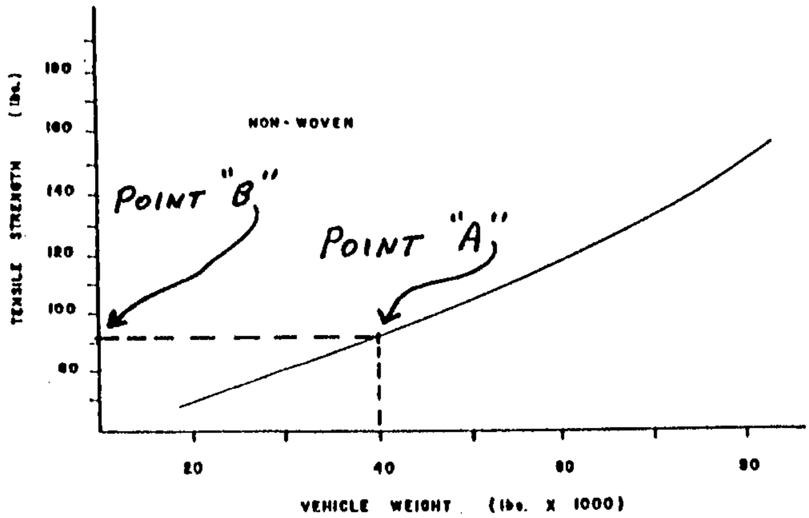


FIGURE 3.5 MINIMUM RECOMMENDATIONS FOR NON-WOVEN FABRIC

3. From this point, read the value on the left scale to determine the tensile strength requirements for a 40,000 pound vehicle (Point B).



EXAMPLE 3.1

Using Figure 3.5 to find the Mullen burst and Puncture strength for the same 40,000 pound vehicle results in the following recommendations for a **non-woven fabric:**

PROPERTY	SPECIFICATION
Minimum Weight	4 oz/sq.yd.
Minimum Elongation	50%
Apparent Opening Size	60 (US Std. Sieve)
Tensile	92 (lbs)
Mullen burst	185 (psi)
Puncture	57 (lbs)

The same procedure would be followed using Figure 3.6 when selecting a woven fabric for the same conditions. All woven fabrics should meet the following recommendations in addition to the values determined by using Figure 3.2:

PROPERTY	SPECIFICATION
Minimum Weight	4 oz/sq.yd.
Minimum Elongation	10%
Equivalent Opening Size	60 Min (U.S. Sieve)

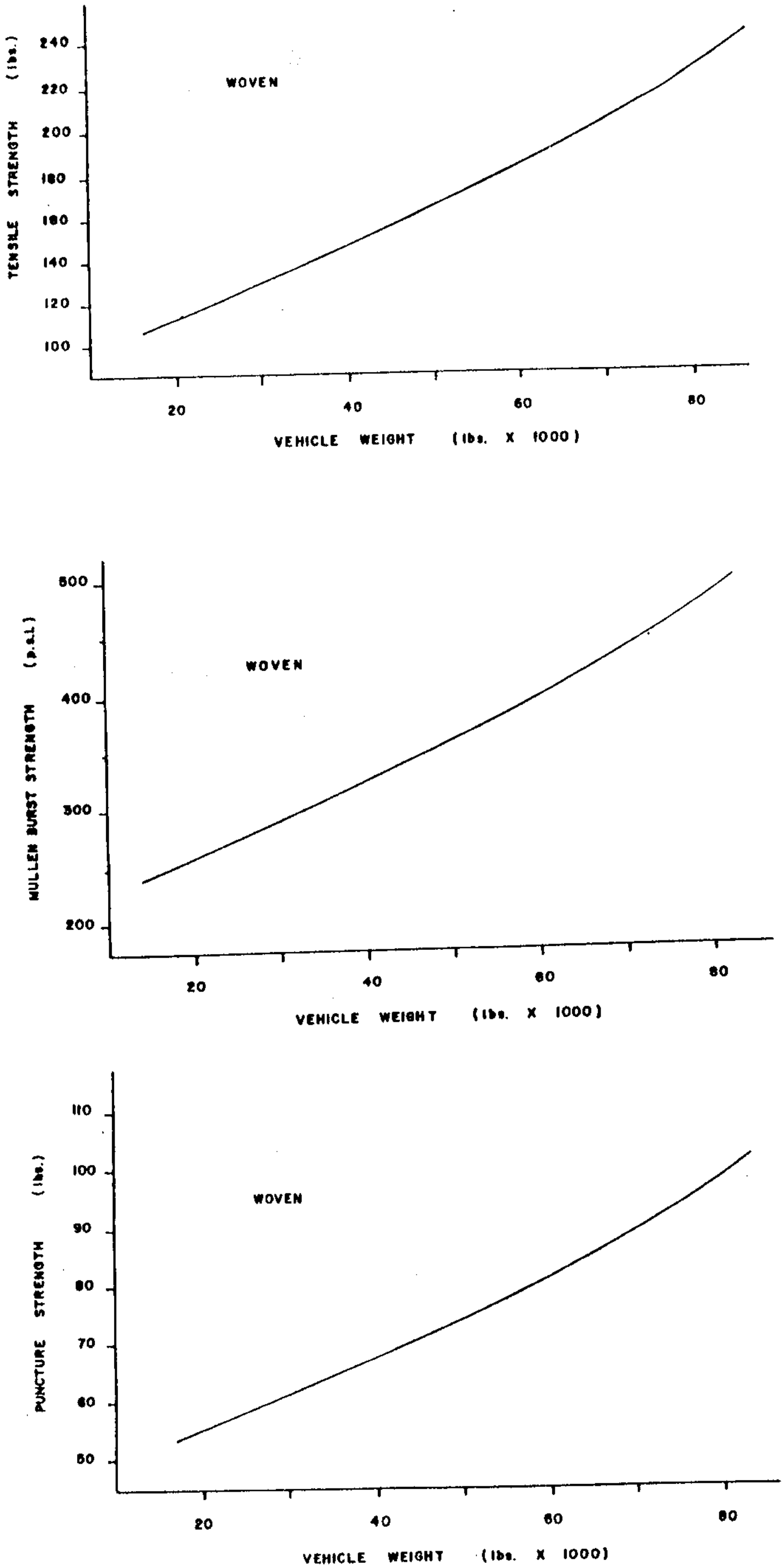


FIGURE 3.6 DETERMINING REQUIREMENTS FOR WOVEN FABRIC

3.3 Soft Roadbeds

Roadbeds classified as soft (see Table 2.1) present problems of a less severe nature. Generally, traffic is able to travel down the roadway but not without difficulty. However, responding to complaints by adding more gravel to this roadway is a very expensive answer, but not a solution to the problem. The fabric must be selected to prevent the pumping of the mud slurry from underneath up into the gravel. Secondly, the fabric must be able to withstand the abrasion of the traffic on top of the gravel. In demonstration installations the non-woven fabrics presented the least amount of problems during placement and spreading of the gravel in this type of condition. Bulges or "boils" were produced when using woven fabric in these locations while the non-woven fabrics did not exhibit this problem. Recommended **minimum** specifications for a fabric in this location are found in Figure 3.5.

3.4 Medium and Firm Roadbeds

Roadbeds from Table 2.1 falling into the **Medium** and **Firm** classifications present different considerations. There is an old adage "if it works, don't fix it". If the road is going to remain as a gravel road some thought should be given to justifying the cost of fabric and gravel. Several items should be considered. First, what is the service life? If several inches of gravel added to the roadway without fabric will last 4 to 5 years then the cost of fabric probably is not justified. However, if additional gravel will only last 2 years or less then the fabric cost is justified. If the roadway is going to be upgraded to a asphalt surface of some type, a fabric and 4 inches or more of gravel is probably the most cost effective operation associated with preparing the base for the new surfacing. The recommendations for a fabric in these locations can be found using either Figure 3.5 or 3.6.

3.5 Granular/Sand Roadbeds

Granular/sand roadbeds are not subjected to the problems of mud slurry previously described. The major problem is the inability of the roadbed material to stick together into a stable mixture. Granular roadbeds don't produce ruts, instead, washboards develop which makes traveling down the roadway extremely rough, bouncing across the washboards.

Sand roads are in the worst condition when they are dry. As the sand dries the material becomes more and more unstable. As vehicles travel over the sand, it wallows around under the tires forming mini sand dunes in the road. In some locations traffic may become stuck as the tires are unable to grab the sand to pull the vehicle out.

Selection of a fabric for these locations needs to provide the basic function of separation. The fabric is subjected to abrasion both from the traffic and gravel on top as well as the granular material underneath. When using a shallow thickness of gravel such as a 4 inch thickness of gravel, the non-woven fabric produced the best performance. When using 4 inches of gravel the woven fabrics exhibited problems due to abrasion. As the vehicles travel down the roadway the tires cause the gravel to move or grind across the surface of the fabric. The woven fabrics have a very low elongation property and therefore are subjected to continual abrasion from the gravel. In a short time (3 months in some locations) the gravel has ground holes in the fabric, allowing the soil fines to pump through. As the soil fines intermix with the gravel and moisture, such as rainfall, is present a paste is formed. The paste begins to coat the gravel, allowing the gravel to move around even more. The gravel will then begin to ravel out producing a "pothole". As the gravel is raveled out by the vehicles tires the thickness is reduced and the abrasion is increased, increasing the size of the pothole. In field observations non-woven fabrics did not produce this problem. The non-woven fabrics have a very high elongation property. As the non-wovens are subjected to this same abrasive stress the non-woven fabric will stretch back and forth with the movement of the gravel instead of allowing the gravel to grind across the surface of the fabric. A woven fabric may be used in these locations but a minimum of 8 inches of gravel is recommended to reduce the abrasive forces placed upon the woven fabric. Recommendations for minimum specifications for a fabric for these locations are found in Figure 3-5.

INSTALLING THE FABRIC

4.1 Site Preparation

Ideally, the roadbed should be graded smooth and a normal crown established. This operation serves to fulfill several purposes. First, the period of time when the fabric is subjected to the most stress and most apt to be ripped or torn is when construction traffic drives on the bare fabric. Tight blading the roadway will provide a smooth surface to support the fabric. In locations where the roadbed material contains gravel, as the blade on the grader drags the surface of the roadbed, the sharp tips and edges of the gravel will be rolled over and become flush with the surface of the roadbed. This will greatly reduce the possibility of a puncture or tear in the fabric during installation of the fabric and gravel.

Secondly, tight blading the roadbed will establish a crown in the roadbed. The crown will provide drainage for surface run off when it rains and will provide a smooth surface to insure an even thickness of gravel placed on the fabric. If the roadbed surface has high and low places, blading a level layer of gravel across the fabric is extremely difficult. As shown in Figure 4.1, taking a gravel measurement in a low place such as a rut, will result in a false measurement for the rest of the roadway with the result being two inches or less in depth across the high places.

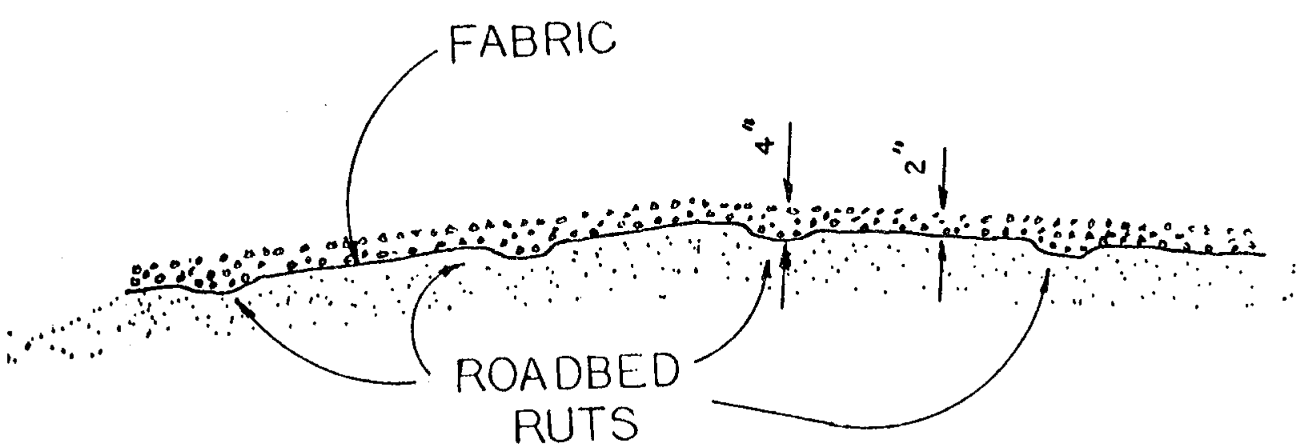


FIGURE 4.1 MEASURING GRAVEL IN RUTS IN ROAD

Additionally, this is when the blade is most likely to hang and tear the fabric. If you have ever sat in the cab of a grader and tried to drift an exact thickness of material down a roadway you can understand the difficulty involved. A level surface makes the blading and spreading of the gravel considerably easier and lessens the chance of tearing the fabric. Installing fabric on a roadbed with ruts increases the cost of the operation. The fabric will sink into the ruts, requiring more gravel to fill the ruts to the top of the roadway so that you have a level surface.

From a safety standpoint, a roadway with ruts or otherwise unlevel surface creates a hazard when dumping gravel from 10 wheeler dump trucks. This is especially true when dumping with tractor-trailer dumps. A sudden movement or shift of weight caused by the rear wheels dropping into a rut or low place can be extremely dangerous to the dump trucks when they are spreading the gravel with their beds in a raised position. This sudden movement, with all the weight high in the air, can cause the truck to turn over on its side.

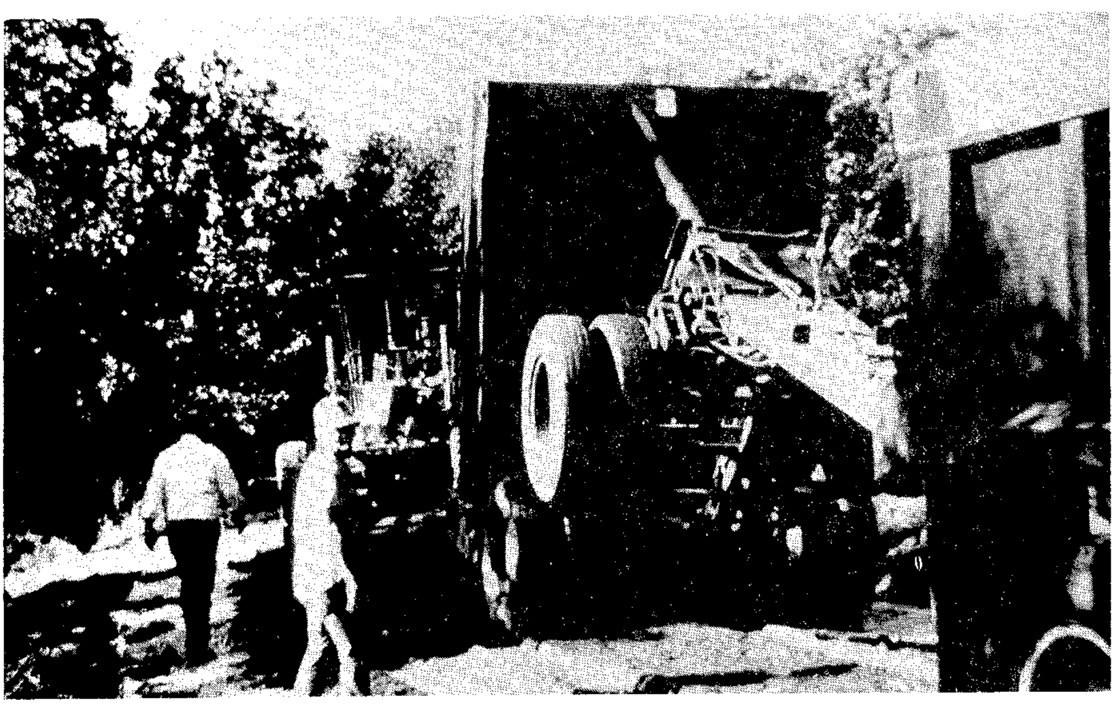


FIGURE 4.2 TRAILER TURNED OVER

It is not mandatory to try to achieve full compaction on the section of roadway prior to installing the fabric and gravel. If you can fully compact the roadbed there probably are not any severe rutting problems. The historical problem spot is the location where the fabric is most beneficial. These areas are subjected to frequent, or in some cases, continual saturation with water. Attempts to compact these areas would be very difficult, if not impossible. Pulling or running a compactor over these soft or boggy areas will only result in mashing the roadbed down in the middle and creating bulges along the edges.

When the roadbed is firm enough to support a motor grader and the material is dry enough to spread evenly; use the motor grader to shape the roadbed, establish the crown and fill in any ruts. When shaping the roadbed be aware that the grader is not leaving large clods on the roadway. If fabric is rolled out over these clods it causes the fabric to be pushed up from the surface. These bulges are areas that may be cut by the blade on the grader, causing a tear in the fabric.

In the case of unusual conditions such as a spring in the roadbed, it will not be possible to shape the roadbed. Installation of the fabric and gravel for this type of location will be covered in Section 4-9.

4.2 Installing the Fabric

Most manufactures produce the fabric in nominal roll widths of 12 1/2 feet and 15 feet. It generally will take 2 rolls side by side to completely cover the roadbed. Most rolls are <u>generally</u> 300 feet long and weigh an average of 140 to 150 pounds (much heavier when wet!). The fabric can be rolled out one roll at a time or two rolls simultaneously. Windy conditions and boggy roadbeds usually present the biggest problem in installation of the fabric. The following sections will describe the various techniques that may be used for installation of the fabric.

4.3 Single Roll Installation

The first roll is lined up on one edge of the roadway, starting about 20 feet before the problem area. The other edge of the roll should extend at least 18 inches beyond the center line as shown in Figure 4.3 . You should measure the roadway width to make sure the fabric has at least an 18 inch overlap near the center line and will reach the edge of the roadway. Having more than 18 inches of overlap doesn't hurt anything, but the excess material in the overlap increases the cost of the fabric for the project. The fabric can then be rolled out over the problem area using the rollers shown in Figure 4.4 or by bending over the roll of fabric and pushing it by hand.

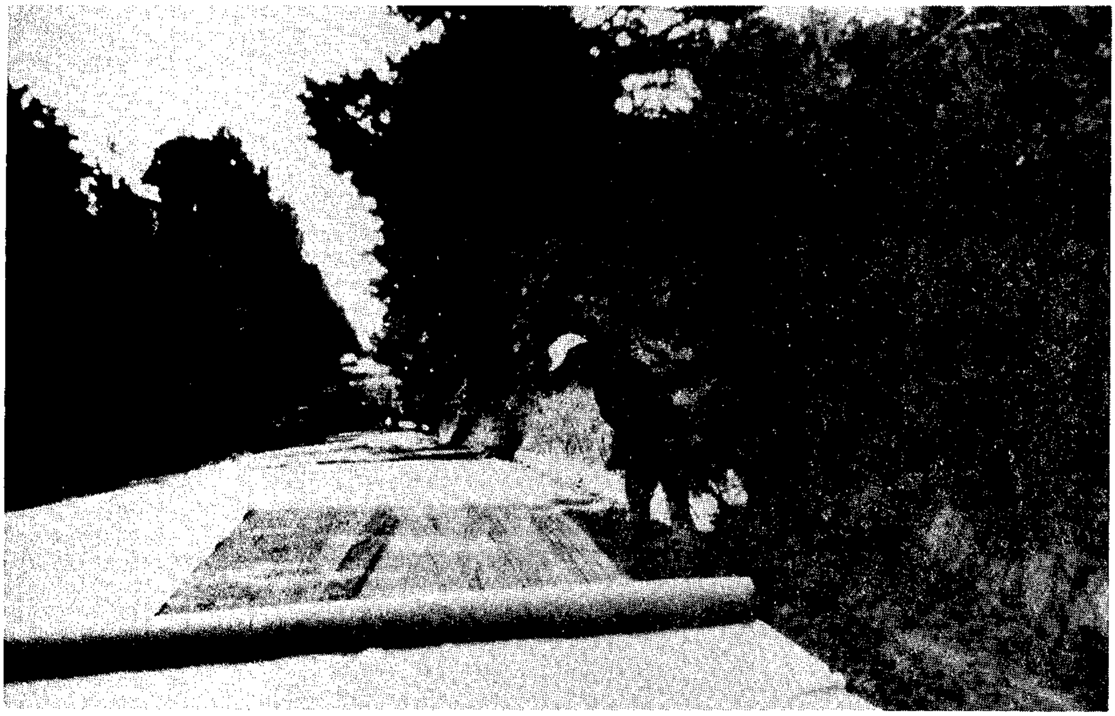


FIGURE 4.3 OVERLAP ON CENTER OF ROAD

Be sure the fabric extends approximately 20 feet beyond the problem area.

As the fabric is being rolled out, check the 18 inch overlap at the center line. This usually is accomplished by one person standing on the end of the fabric and looking down the roadway center line. If the roll of fabric needs to be straightened, it is easily accomplished by the following steps:

1. One man on each end of the roll picks up the roll.

2. Lift roll up and pull, stretching the fabric straight down the roadway. This action will take the wrinkles out of the fabric.

3. While stretching the fabric, move the roll right or left to correctly align the edges.

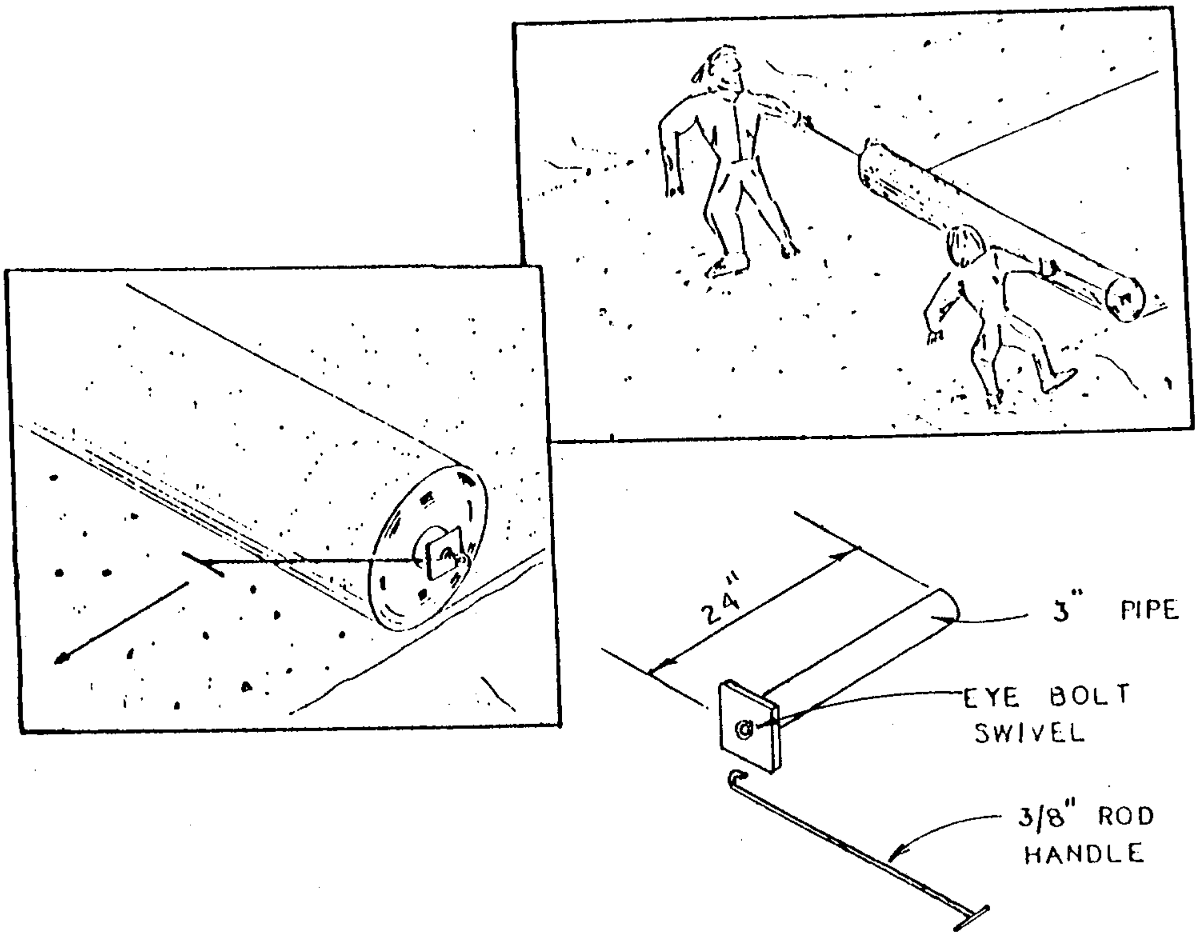


FIGURE 4.4 FABRIC ROLLERS

If there isn't any wind there will not be any problem with the edges of the fabric. When the first roll has been installed, then the second roll is rolled out to cover the other half of the roadway. The second roll is installed in the same manner as the first roll.

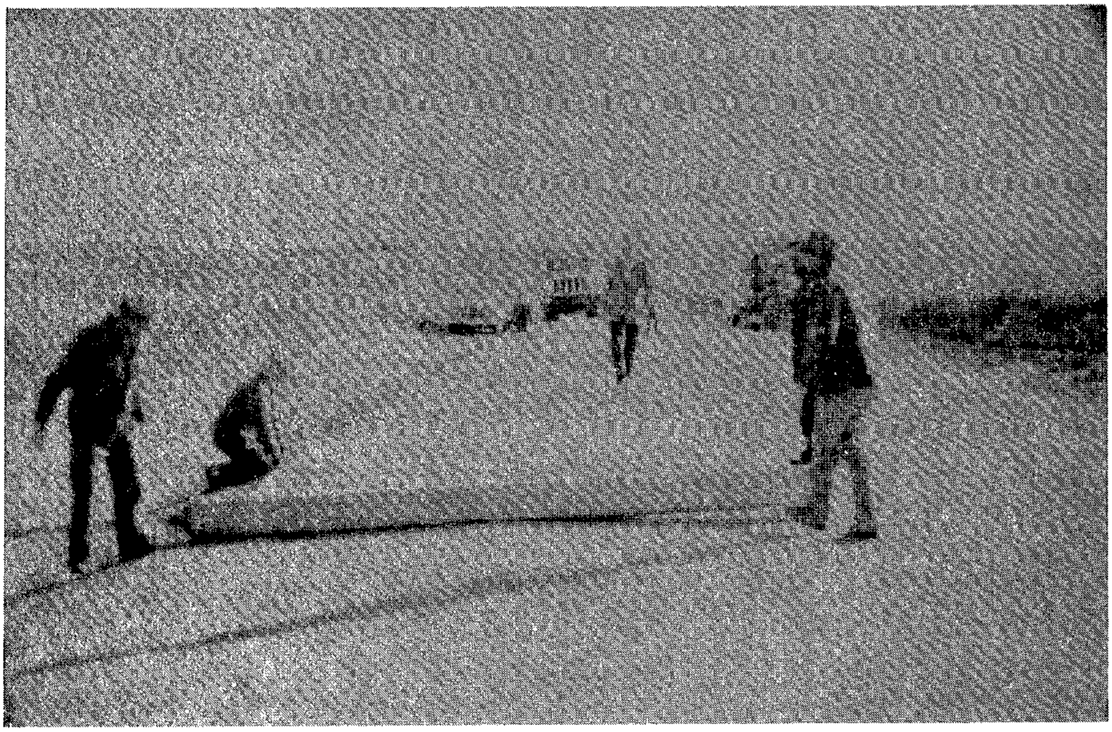


FIGURE 4.5 LIFT ROLL AND PULL TO STRAIGHTEN

Again check to see if you have an 18 inch over lap near the center line of the roadway and occasionally pull the roll of fabric to smooth out the wrinkles.

4.4 Dual Roll Installation

Installing two rolls of fabric at one time is similar to installing one roll at a time. Begin by lining the edge of the first roll with one edge of the road and unroll the fabric about 10 feet. Line up the edge of the second roll with the other edge near the center line and make sure you have at least 18 inch of overlap as seen in Figure 4.3 .

Once the two rolls are lined up and the overlap is correct, the fabric can be rolled out. As the lead roll is being rolled out, the second roll follows about 10 feet behind. If the second roll, which is the top layer of fabric on the overlap, needs to be straightened or smoothed out, follow the procedure previously discussed in Section 4.3. If the first roll, which is the bottom layer on the overlap, needs to be straightened the following procedure is suggested:

- Lift the end of the second roll on the overlap and swing it back as shown in Figure 4.7.

- Lift the first roll and pull to straighten and smooth the fabric.
- Pull the end of the second roll back around to its original position. Then lift and pull the second roll to straighten and smooth if necessary.

FIGURE 4.6 DUAL ROLL INSTALLATION

Rolling one roll of fabric at a time generally doesn't prohibit vehicles from traveling down the roadway. However, unrolling two rolls at one time creates a problem for the vehicles. It is not advisable to let vehicles drive over the rolls of fabric. Besides taking the chance to tearing the fabric, a vehicle driving over a roll of fabric will flatten the cardboard core. If the core is broken or flattened, it becomes very difficult to roll out the fabric.

In most cases the road should be closed to traffic when installing the fabric and gravel. In some locations it may not be practical (or politically feasible) to close the road.

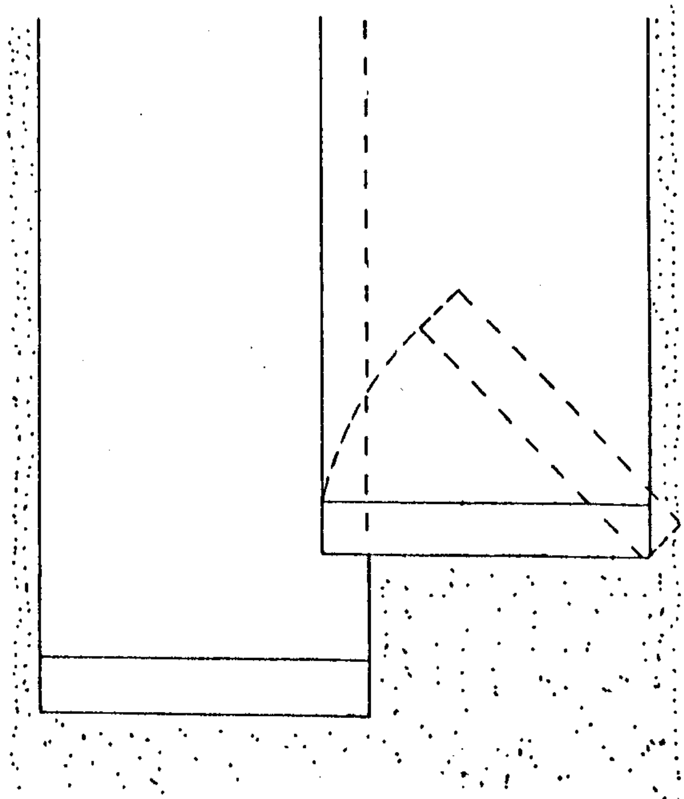


FIGURE 4.7 SWING TOP ROLL BACK

Generally, letting normal rubber tired traffic drive over the fabric is not harmful to the fabric as long as the speed is kept low and the vehicles don't skid or spin a tire on the bare fabric. **NEVER**, let a track type vehicle (such as a dozer, track loader, etc.) drive on the bare fabric. The grabs on the tracks can tear the fabric, especially if the steering brakes are engaged.

When installing two rolls of fabric at the same time and vehicles need to pass by, the following procedure may be used:

- Swing the end of the second roll, near the center line, back around until it is outside of the vehicle as shown in Figure 4.9 .

- Swing the end of the first roll, near the center line, back around until it is outside of the vehicle as shown in Figure 4.7 .

- Allow the vehicle to **slowly** drive over the fabric and continue down the roadway.

- After the vehicle has passed, swing the end of the first roll back around, pulling it to straighten and smooth the fabric.

- Swing the end of the second roll back around, pulling on it to straighten and smooth the fabric.

- Continue unrolling the two rolls of fabric.

FIGURE 4.8 LETTING VEHICLES THROUGH

4.5 Lapping The End Joints

It will be necessary to have "end laps" on locations that are more than the length of one roll. This is the overlap when one roll ends and another roll is added to continue down the roadway. The following procedure may be used when making an end lap.

- Decide in which direction the gravel will be dumped and spread.

- All laps must be made in the **same direction the gravel is going to be spread** (the end of the beginning roll is on top).

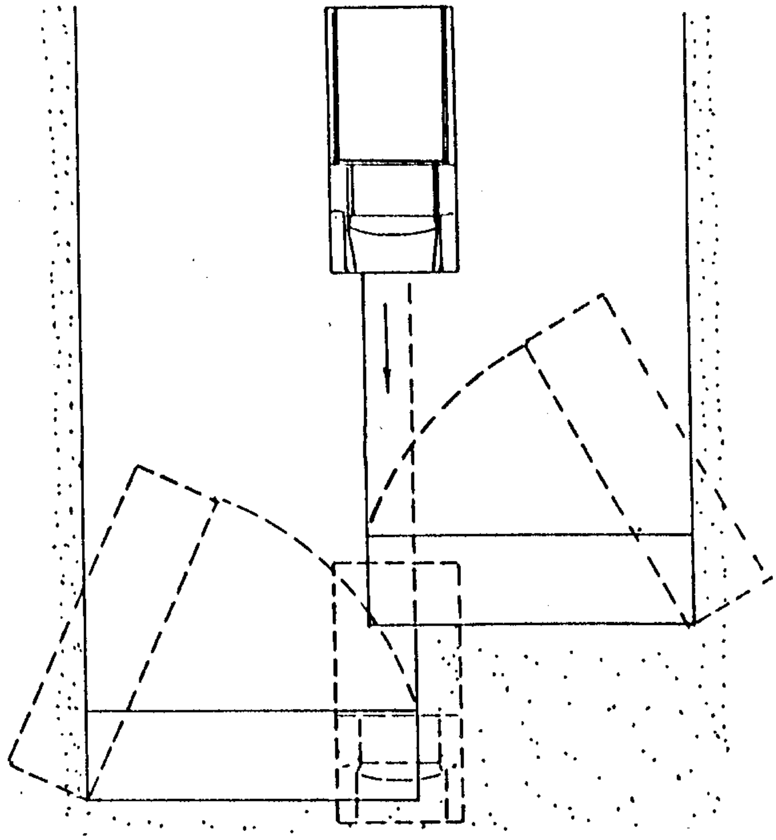


FIGURE 4.9 SWING FABRIC TO LET VEHICLE THROUGH

- When unrolling the fabric in the same direction the gravel is going to spread, take the fabric at the end of the roll and fold it back over on itself about 2 feet. Start the edge of the new roll next to the fold (Figure 4.10) and unroll the new roll several feet.

- Take the folded section of the first roll and straighten it out, unfolding it over the end of the new roll. (Figure 4.11)

- Continue unrolling the new roll.

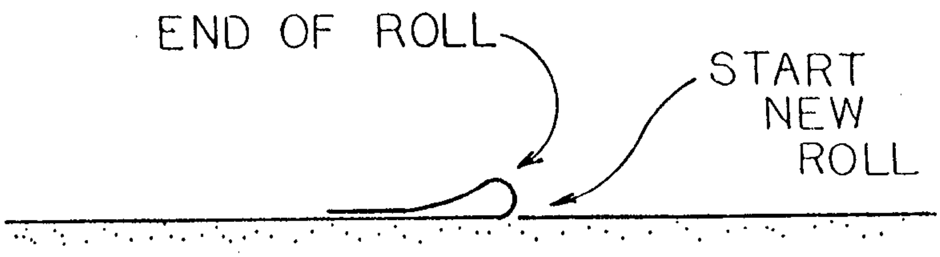


FIGURE 4.10 FOLD FABRIC AT END JOINT

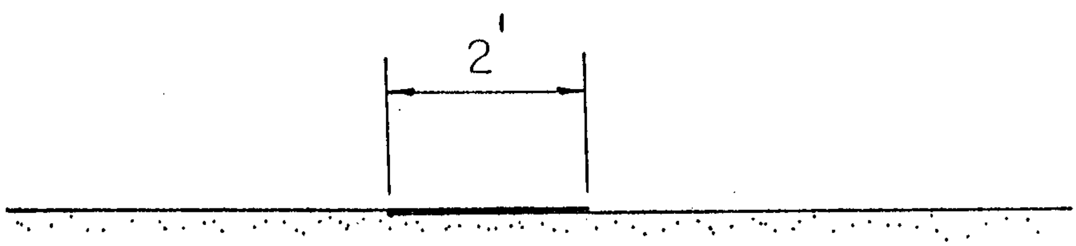


FIGURE 4.11 CORRECT END LAP

4.6 Windy Conditions

Windy conditions may create some problems in laying the fabric. Installing fabric in windy conditions is kind of like doing something right the first time; nobody appreciates how difficult it was. Using common sense and following the guidelines listed below will make installing fabric in windy conditions significantly less difficult.

- If the location requires more than one roll length, determine in which direction the laps should go. If possible lap in the same direction the wind is blowing.

- Start unrolling the first roll on the down wind side of the roadway.

- Immediately start unrolling the second roll on the upwind side of the road. As seen in Figure 4.6. This will help keep the wind from blowing the edges up on the first roll of fabric.

- As the two rolls are being rolled out, the upwind edge of the second roll will most likely have to be tied down to keep the wind from blowing it up. This can be accomplished by one of the following methods.

FIGURE 4.12 CENTER LAP BLOWN APART

1. **Weighting With Rock/Dirt**

   As the rolls are being rolled out, dump a shovel full of gravel or dirt from the edge of the road or the roadway ditch onto the upwind edge of the fabric. The material can be spaced 20 to 50 feet apart, depending on the velocity of the wind. (Figure 4.13)

   The center line joint, end laps and the downwind edge of the fabric may or may not have to be weighted down. If material is needed to be placed on these laps and edges, be sure the fabric is smooth and flat. Place the material on the top layer of fabric at the lap.

2. **Nailing The Edges and Laps**

   The edges and laps may be nailed down using 40 to 60 penny nails and flat washers. The washers help keep the head of the nail from pulling through the fabric. When using nails and washers fold the edge of the fabric back over the top about 2 to 3 inches. This gives a double thickness of fabric for the nail to go through, reducing the chances of the fabric tearing around the nail. (Figure 4.14) This procedure should be used on the edges

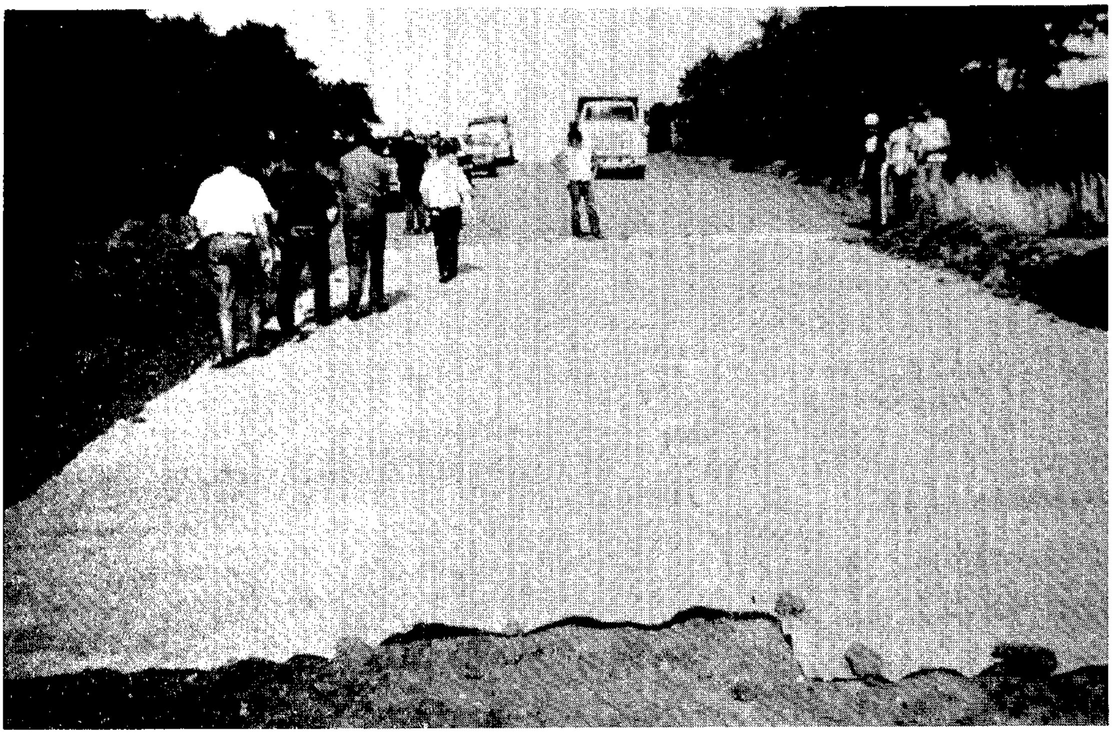


FIGURE 4.13 WEIGHTING EDGES OF FABRIC

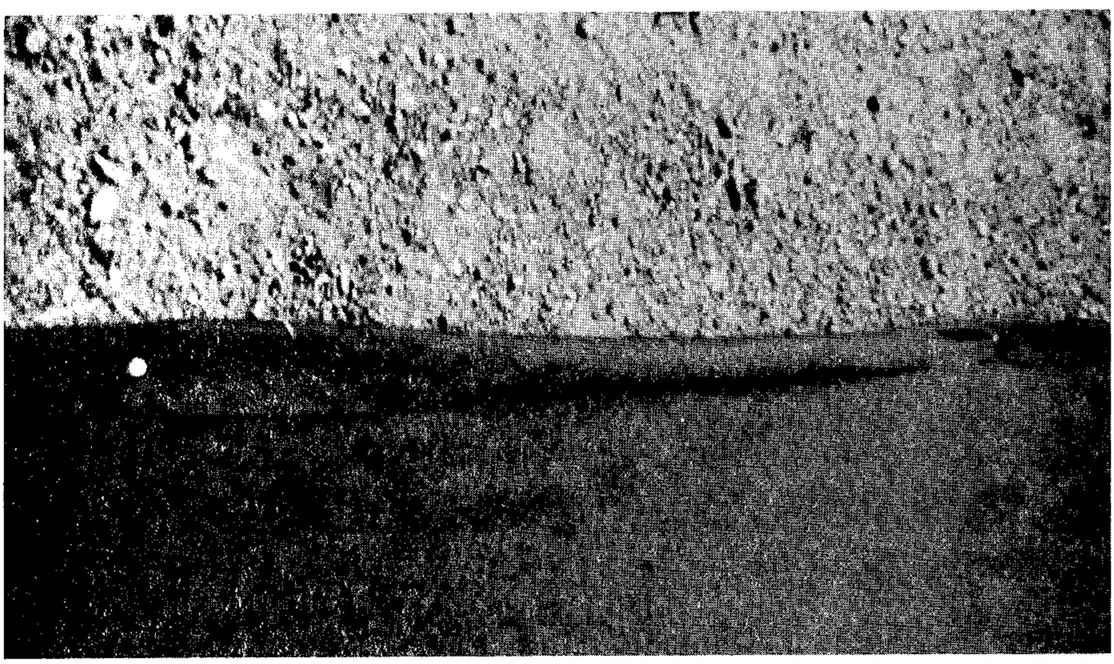


FIGURE 4.14 NAILING FABRIC EDGES

of the roadway as well as the edges of the top layer of fabric on the center line and end laps. The nails should be spaced 20 to 50 feet apart depending on the wind velocity and how securely the nails hold in the roadbed material.

3. **Bury The Edges In Trenches**

The edges of the fabric can be buried in a shallow trench along the edge of the road. A motor grader can be used to cut the trench. Position the grader on the edge of the road, with the toe of the blade swung forward and tilted down. As the grader moves forward the end of the blade cuts a trench 6 to 8 inches deep and windrows the material away from the edge of the fabric. When unrolling the fabric the edge of the fabric is placed in the trench and the grader blades the windrowed material back into the trench, securing the edge of the fabric against the wind (Figure 4.15). This procedure can only be used on the edges of the roadway. Center line and end lap edges are not able to be buried this way. They must either be weighted down with rock/dirt or nailed down.

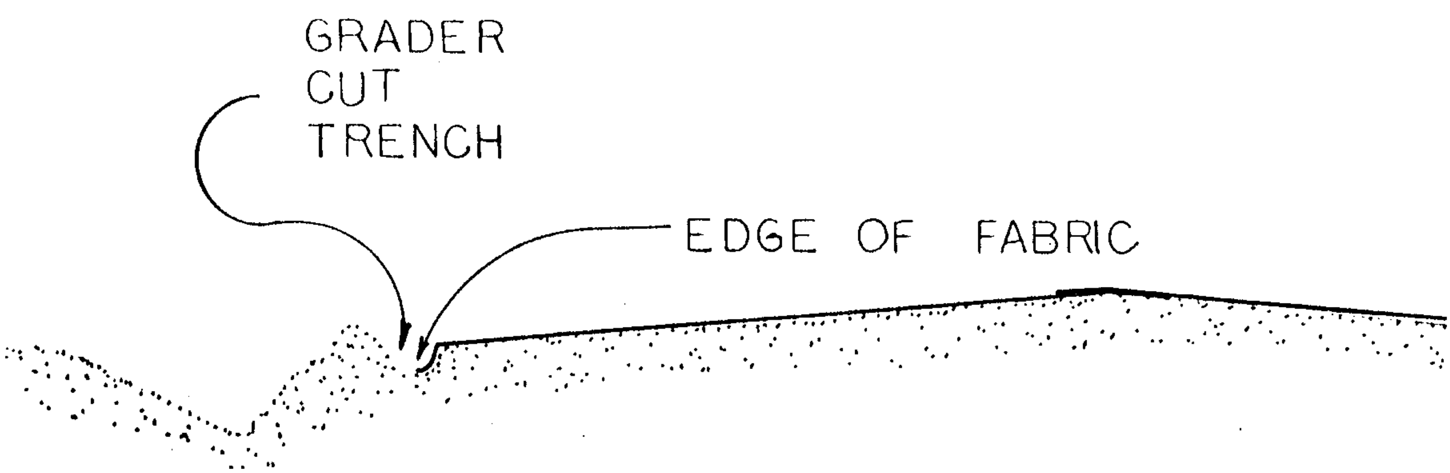


FIGURE 4.15 PLACING FABRIC IN TRENCH

4.7 Folds In The Fabric

The fabric should be installed as smooth and wrinkle free as possible. Wrinkles that are folded over and less than one inch wide, generally will not create any problems. Wrinkles and folds larger than one inch in the fabric should be corrected by one of the following methods.

- The folds should be flattened out and weighted down, or nailed, in the direction the gravel is going to be spread.

- Large folds may be cut with a knife and overlapped in the direction the gravel is going to be spread. The lap may need to be weighted with gravel or nailed to hold it in place until the gravel cover has been spread.

Larger folds can create problems when spreading the gravel cover material. As the trucks dump, the gravel material can build up on the underneath side of the fold creating a bulge in the fabric.

FIGURE 4.16 LARGE FOLDS CREATING PROBLEMS

When the grader attempts to spread the gravel, the fold will not lie flat. Instead, the fold in the fabric will lie on top of the gravel that built up on the underneath side (Figure 4.16). This condition will greatly increase the danger of tearing the fabric when spreading the gravel with the motor grader. This is caused as the blade passes over the fold and the fabric is sandwiched between the two layers of gravel. The top layer of gravel will try to slide across the fold as the grader moves forward, and most generally will tear the fabric.

4.8 Installing Fabric On Curves

Unlike installing fabric on straight sections of roadways, placing fabric on curves requires a little different technique. On most curves on rural roads it is almost impossible to unroll the fabric without creating numerous folds in the fabric. The folds may be cut and lapped or folded and nailed.

The following method has seemed to be the quickest and easiest way to unroll fabric on curves.

- Position the roll of fabric starting on the inside edge of the roadway, beginning about 20 feet from the problem on the curve. Begin unrolling the fabric.

- After about 20 to 80 feet, depending upon the sharpness of the curve, stop and lift up the roll, swing the inside (downhill) end of the roll back on top of the fabric. The roll may have to slide right or left to line up with the inside edge of the road. Judgement will have to be used to decide how far back to swing the roll in order to best line up with the inside edge of the roadway.

- When the roll has been properly aligned, either nail the edge near the center line or have someone stand on it to hold the fabric in place while unrolling the next section of the curve. Unroll the fabric about 8 to 10 feet, then stop and either cut, weight or nail the folds down flat, overlapping in the direction the gravel will be spread.

- Remember, all folds and laps must be laid in the direction the gravel is going to be spread. When using gravel to weight the fabric down under no conditions should the fabric be folded or laid on top of the gravel.

4.9 Unusual Conditions

Unique locations such as springs and boggy areas in the roadway require different techniques than those previously described. Shaping and smoothing the roadbed is almost impossible even if the grader can drive across the boggy area without getting stuck. Judgement and common sense will determine how much site preparation can be achieved.

Boggy and spring areas have much more possibility of the fabric and gravel being mashed down into the soft roadbed.

FIGURE 4.17 FABRIC INSTALLATION ON CURVE

This increases the risk of the fabric separating along the center line lap. In this type of location, the center line overlap should be a minimum of 2 to 3 feet depending upon the softness of the roadbed. Increasing the center line overlap may require using fabric of wider width for the same roadway widths. For example, two rolls of fabric 12 1/2 feet wide with an 18 inch overlap will cover a roadway surface 23 1/2 feet wide. Using a 3 foot center line overlap at this same location, the 12 1/2 foot rolls will only cover a roadway width of 21 1/2 feet. Consideration should be given to the amount of overlap required in order to determine the most cost effective roll widths to purchase.

In some instances, it would be cost effective if you could purchase fabric in 1/2 of the standard widths. For instance, if a rural roadway was 18 feet wide and two rolls of fabric 12 1/2 feet wide were used, the result would be a center line overlap of 7 feet. However, cutting a 15 foot wide roll in half and using the half roll with a 12 1/2 foot roll on the same 18 foot wide roadway will result in a center line overlap only 2 feet wide. A 600 foot long section of 18 foot roadway would normally require 4 rolls of 12 1/2 foot wide fabric, each roll being 300 feet long. However, buying 3 rolls of the same fabric and cutting one roll in half, the same area can be covered effectively, saving the cost of 1 roll of fabric.

Cutting a roll of fabric in half is about like trying to push a log chain. It can be done, but is may be a little tricky. Cutting the roll in half with a sharp knife would be the easiest method to use, but the heavy cardboard core the fabric is rolled on is very difficult to cut with a knife. Probably the two most practical methods would be to use a cut-off band saw or a chain saw. The fabric is made of a type of plastic threads or fibers and is not hard to cut by either type of saw. However, the heat created by the friction of the band or chain saw will cause the fibers to melt and stick together. This becomes very noticeable when you attempt to unroll the halves. The cut ends stick together and you have to cut and pull the layers apart in order to unroll the fabric.

This problem can be reduced by running water over the cut area when cutting the fabric. Take a garden hose and run water on the fabric and the saw blade as you cut the fabric. It is best if you cut the fabric for several seconds, then let the saw cool for a couple of seconds, running the water continuously on the saw blade and the fabric. Using this method of running water on the saw blade and cutting for several seconds while letting the blade cool for a couple of seconds will result in a smoother cut with little or no sticking problem when unrolling the fabric.

4.10 Sewing Fabric Seams

Ideally the fabric should be sewn together on the center line joint to reduce the risk of separating the fabric and also make the installation a little easier. In practice, it is not normally sewn together. If desired, the laps can be sewn together using a hand sewing machine like the type used to sew up feed sacks at a feed mill.

One way to accomplish this is to completely unroll one roll of fabric. Place a second roll on top of the first, lining up the two edges so they are even. Unroll the second roll completely. Determine the width of the roadway and double sew the fabric so that when unfolded the fabric will cover the roadway from edge to edge. The sewing thread and stitching should make a seam that is at least as strong as the fabric itself. The cardboard core from the first roll may be used to roll the fabric up as it is being sown.

Position the double roll of fabric on one side of the roadway, aligning the roll with the edge of the road. Now, you can either tramp through the mud pulling the roll of

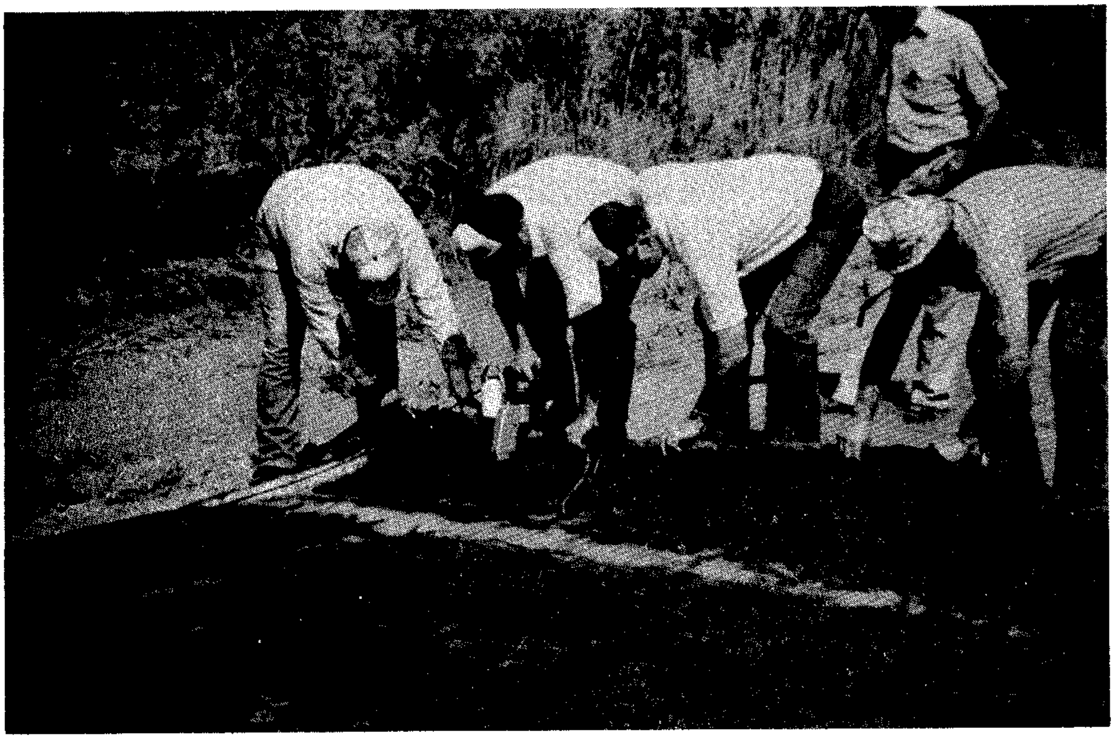


FIGURE 4.18 SEWING FABRIC SEAMS

fabric with the rollers or roll the fabric out by hand, walking on the fabric as it is unrolled. After the double roll is rolled out unfold the fabric, pulling the top layer across the side of the roadway. If the boggy spot is more than one roll length long, start the second double roll at the other end, **with the sewn edge near the center line**, on the opposite side of the road from the first roll and unroll the fabric toward the first roll. Now when pulling the top layer across the roadway you will be walking on fabric all of the time. Pull the top layer of the first roll across the roadway and on top of the end of the second roll. After pulling the wrinkles and folds out as much as possible, grasp the end of the first roll and fold it back over on top of itself until the end of the second roll is visible. Grasping the ends of the top layer of the second roll, pull the top layer of the second roll across the roadway. Now, pull the short folded section of the first roll over the second roll making the end lap. If the boggy section is more than two rolls long, someone gets the short straw! Pulling the fabric across the roadway will generally require someone walking across the boggy area. The use of common sense will determine the best method for installation of the fabric. The end result will be an installation with at least 2 feet of overlap on the end joints and having the fabric as smooth and wrinkle free as possible.

When unrolling fabric across a boggy area one roll at a time, use the same procedure as used in areas that are firm. Determine the amount of center line overlap needed and the appropriate roll width to be used. Begin by unrolling the fabric on one side of the roadway. To avoid walking through the mud, unroll the fabric directly on the roadway by hand, walking on the fabric as it is rolled out. This will produce some minor depressions from the footprints but generally they will not cause any problems.

The second roll is then placed in position with the appropriate 2 to 3 feet of center line overlap and rolled out in the same manner as the first. Additional rolls may be installed by the same procedure, overlapping the end joints at least 2 feet. **Under no condition should any vehicle be allowed to drive across the bare fabric on the boggy area.** Doing so will result in the tires mashing the fabric down into the boggy material creating ruts. As previously discussed these ruts will require more gravel to be used in filling the ruts and more importantly the danger of tearing the fabric when blading the gravel is greatly increased.

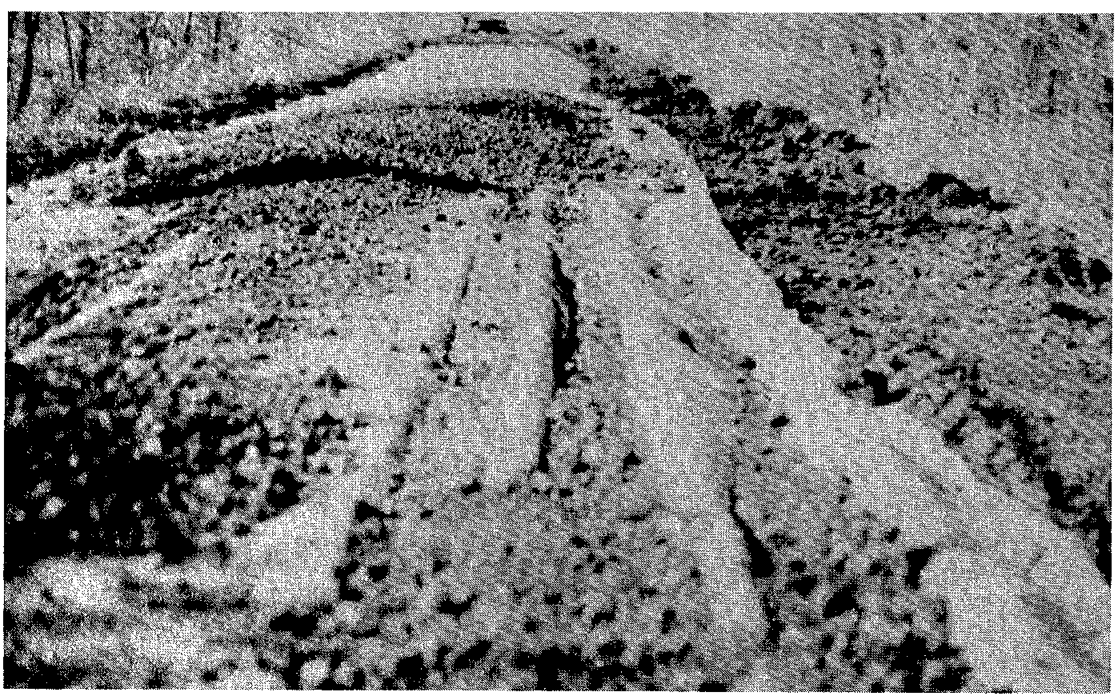


FIGURE 4.19 FABRIC RUTTED INTO BOGGY ROAD

AGGREGATE

5.1 Selecting the Aggregate

The type of gravel to be placed on the fabric will chiefly depend on the local sources available. The gravel should range in size from a maximum of 3/4 to 1 1/2 inches in diameter and have at least 15% fines or dust. This dust should not contain any significant amount of clay. The gravel should have angular sides as with crushed stone as opposed to a round river gravel.

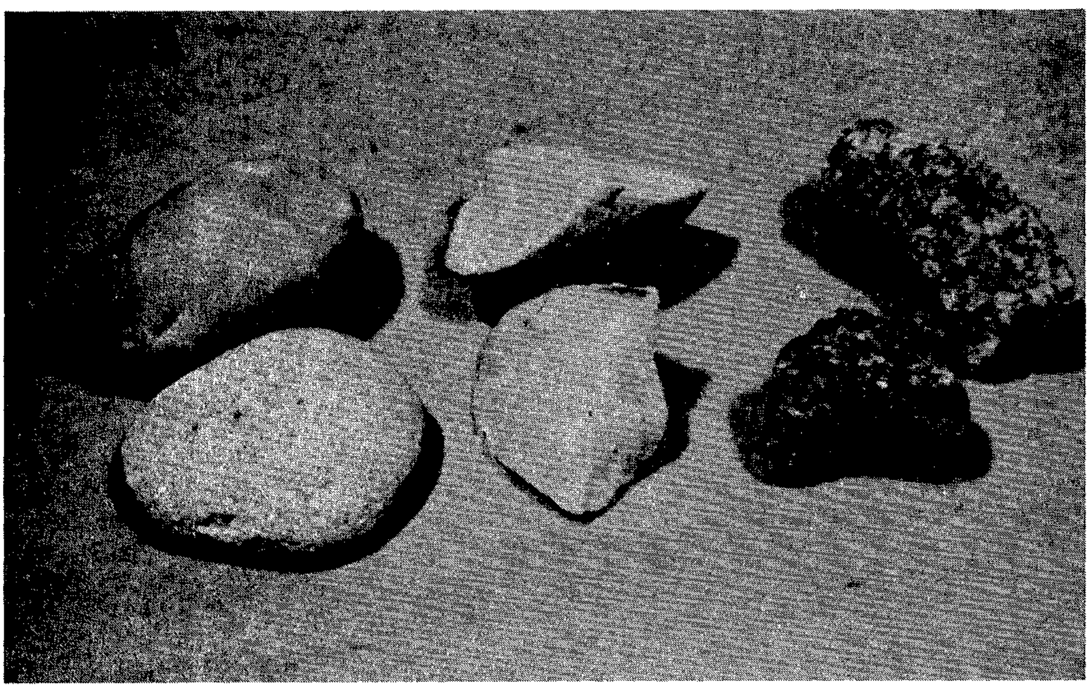


FIGURE 5.1 ROUND AND ANGULAR GRAVEL

Crusher run gravel is probably the best type of gravel to use. The adage "A rose is a rose is a rose" may be relevant when talking about roses but, when talking about "native gravel" this is a different matter. Native gravel comes in a wide variety of <u>different</u> types of material. Some native gravel consists of smooth rounded stones left in ancient river or stream beds.

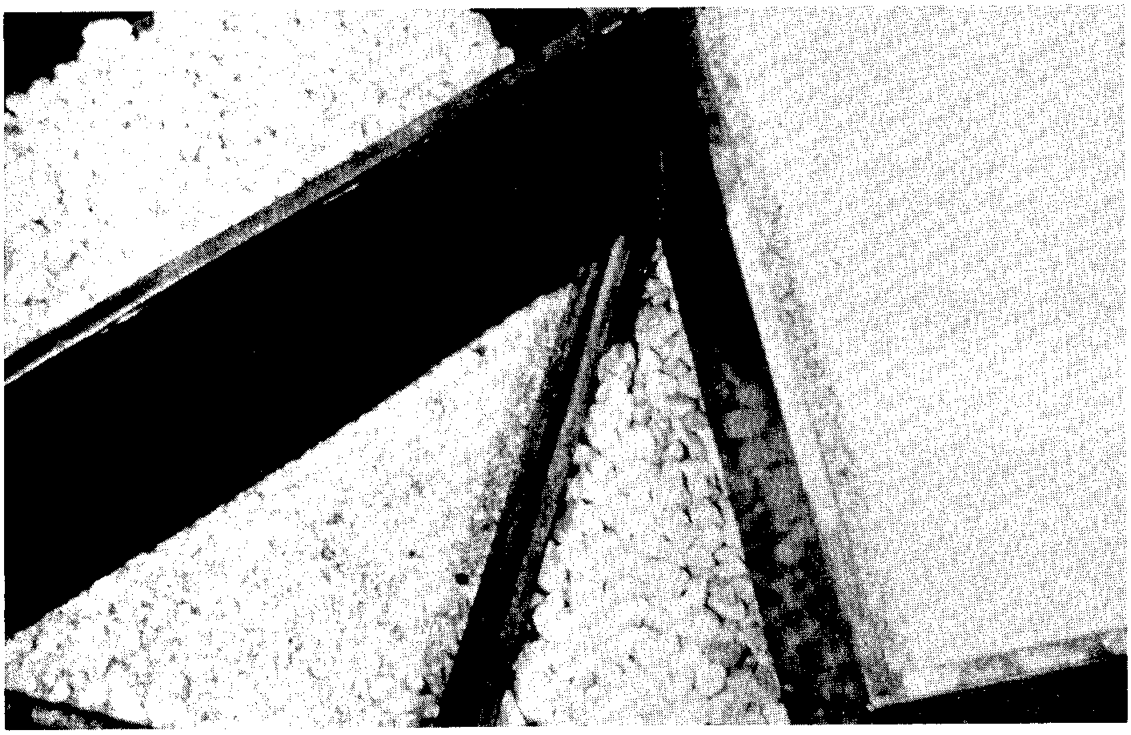


FIGURE 5.2 TYPES OF NATIVE GRAVEL

They may or may not have any fines or binder material associated with them. Some native gravel may be layers of weathered sandstone with almost no bonding property at all. Other native gravel deposits may be mixed with a clay or shale material some of which will bond and lock together to make a stable material.

Past performance and experience with particular materials will be the best basis on selecting the type of cover material to be used on the fabric. If the material used in your operations has given good performance in the past, withstanding traffic without rutting or balling up on the tires of the vehicles, then the material will most likely give satisfactory performance when used with the fabric. If there are doubts about the quality and performance of the particular type of gravel used in your operation, it may be advisable to try a short trial section and evaluate the gravel for 6 months or so under actual traffic conditions. In addition, contracting the services of a professional engineer may be beneficial. The ideal material would conform to the following specifications:

GRADATION REQUIREMENTS		PERCENT PASSING
SIEVE SIZE	(mm)	
1 1/2 in.	(37.5)	100
3/4 in.	(19.0)	90-100
No. 4	(4.75)	30-85
No. 200	(0.075)	15-25
Plasticity Index		6-15
Liquid Limit		Not more than 35

5.2 Determining Aggregate Thickness

Selecting a method for determining the required thickness of gravel to be placed on the fabric is like an opinion, everyone has one. Three of the most important items to be considered are the type of gravel to be used, the most common type of vehicle that will travel over the fabric section and the number of vehicles traveling over the section each day.

On most rural roads, the vehicles can be divided into three categories:

1. Passenger cars and pick-up trucks
2. Agriculture vehicles (up to 40,000 pounds, dual wheels/single axle)
3. Commercial vehicles (80,000 pounds, dual wheel and tandem axles)

Observations of fabric installations on rural roads since 1982, have confirmed a design criteria in which the gravel thickness requirement is related to the width of the tire print of the vehicle. The thickness requirement is calculated by determining the width of the tire print for the most common type of vehicle using the roadway. On dual wheel vehicles the width of the tire print is the overall distance from the inside of the inside wheel to the outside of the outside wheel as shown in Figure 5.5 . The gravel thickness required should be designed to support the most common type of vehicle traveling across the fabric section. Placing a gravel thickness designed to support 80,000 pound trucks on all locations would be an ideal solution. However, if you have a budget that can afford this type of operation you

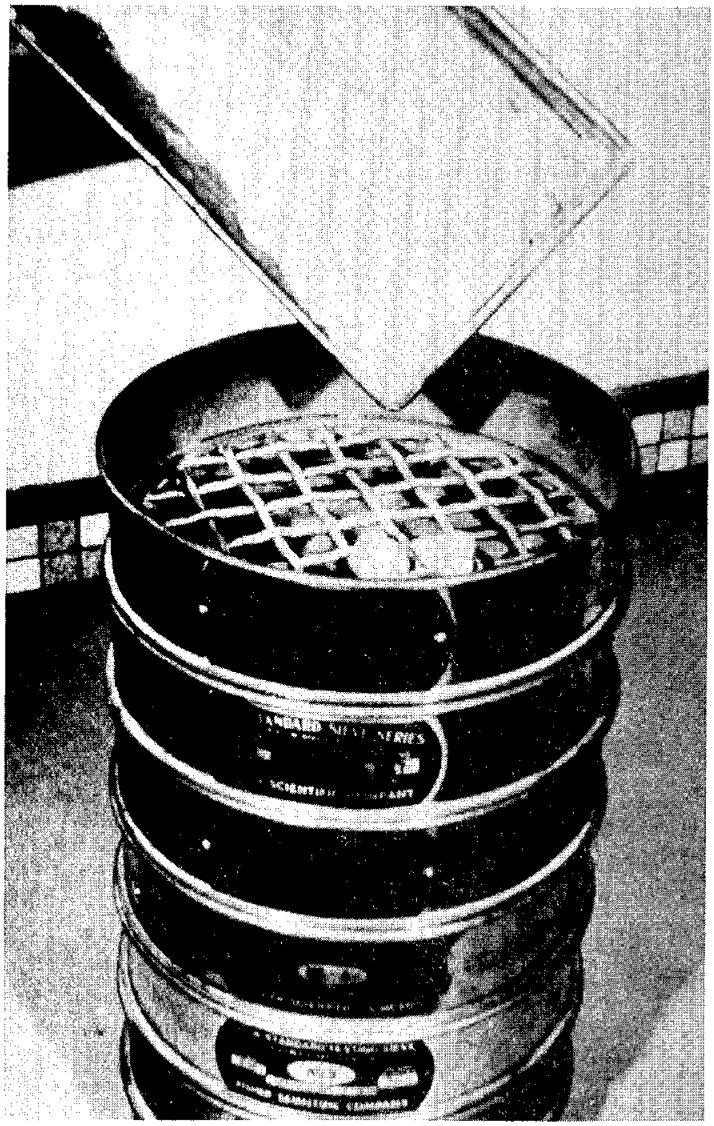


FIGURE 5.3 SCREENING GRAVEL

probably would not have any gravel roads anyway.

Basically, rural road traffic falls into three different categories:

- Areas where passenger cars and pick up trucks are the predominant type of vehicle using the roadway.

- Areas that seasonally have a significant number of heavier agricultural vehicles.

- Areas associated with industrial or oil field activity producing a significant number of tractor/ trailer vehicles.

After determining the most predominant type of vehicle use in the area of the fabric installation, the following figures may be used as guidelines in determining the gravel thickness requirement for the fabric installation.

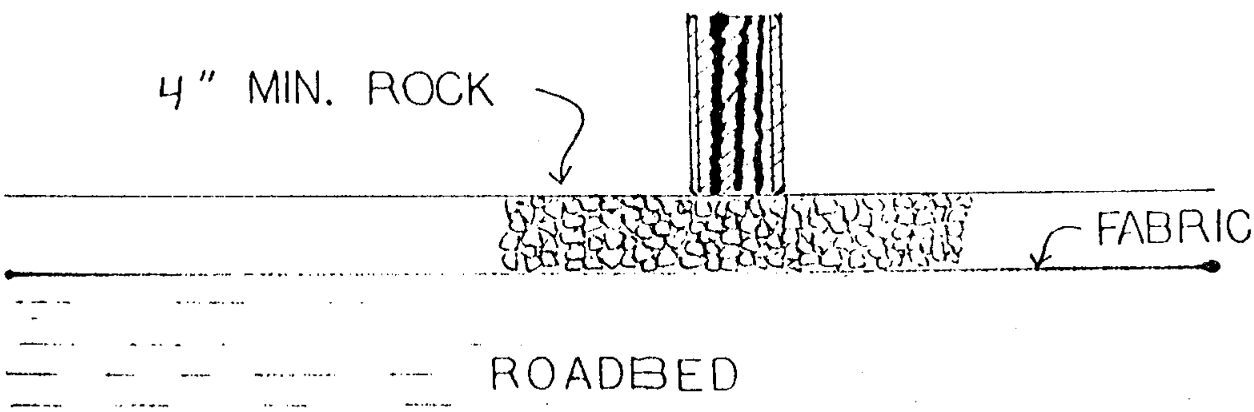


FIGURE 5.4 MINIMUM REQUIREMENT FOR CARS AND PICK-UPS

5.3 Dumping The Aggregate

As stated previously, the gravel must be spread in the same direction the fabric is lapped. Spreading the gravel into the lap can cause the fabric to separate. This results in unprotected spots in the roadbed. Once the roadbed has been shaped and the fabric rolled out over the problem area, the gravel trucks can dump the gravel. The truck drivers should be cautioned against sudden hard stops or takeoffs while the trucks are on the fabric or from turning the front wheels while on the fabric. Sudden sliding or spinning of the truck tires can tear the fabric or wrinkle the smooth surface. A smooth continuous rolling movement must be maintained.

5.4 Dumping With 10 Wheeler (Bobtail) End Dumps

Dumping with end dumps is generally best performed by 10 wheel (bobtail) trucks. These trucks are lighter in gross weight than 18 wheeler trucks and put less stress on the fabric when driving across the bare fabric. The trucks may drive across the bare fabric, dumping behind them as long as the roadbed is firm enough to support the weight of the truck. If the roadbed is soft and the trucks will make ruts when driving on the fabric they should be stopped and back

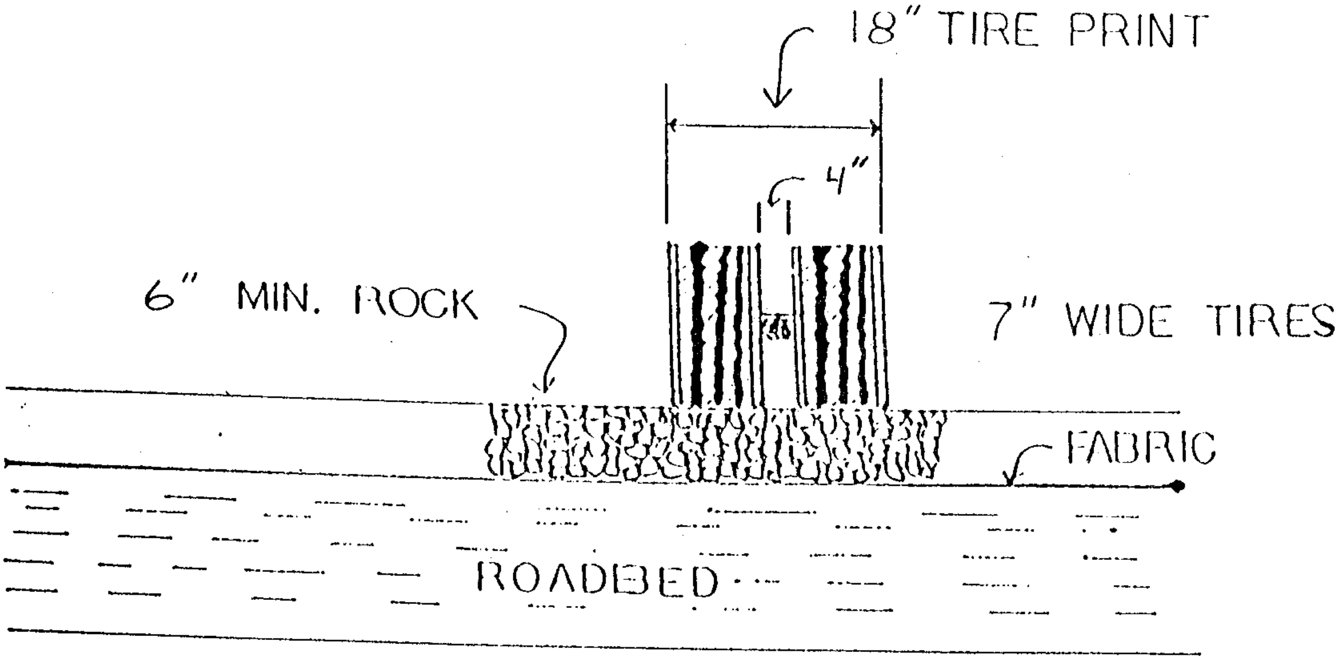


FIGURE 5.5 MINIMUM REQUIREMENT FOR AGRICULTURAL TRUCKS

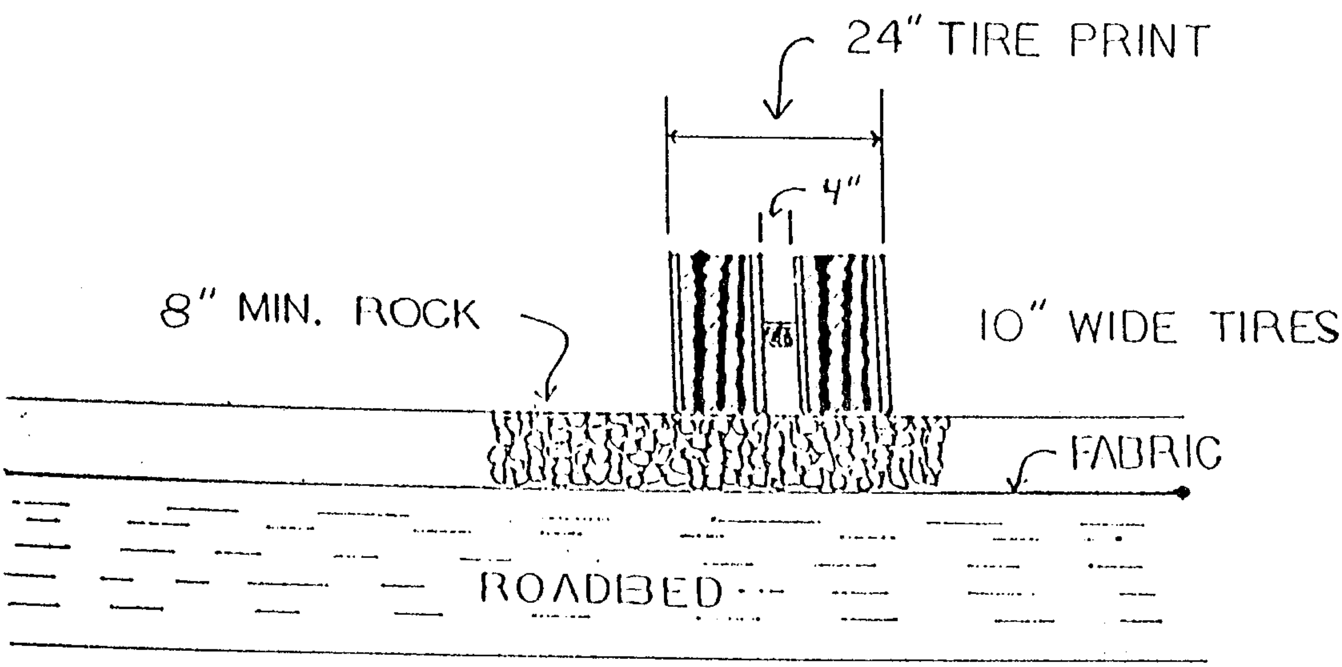


FIGURE 5.6 MINIMUM REQUIREMENTS FOR TRACTOR TRAILERS

dump across the fabric, keeping at least **4** inches of gravel between the fabric and the tires of the truck.

The trucks should always dump on the top layer of the fabric. This is the layer of fabric that is on top at the center line lap (Figure 5.7). Dumping gravel thicker than required on the top layer has several advantages. First, the layer of gravel supports the trucks and reduces the stress on the fabric. Second, the grader can windrow material **across the center line lap** onto the other layer of fabric.

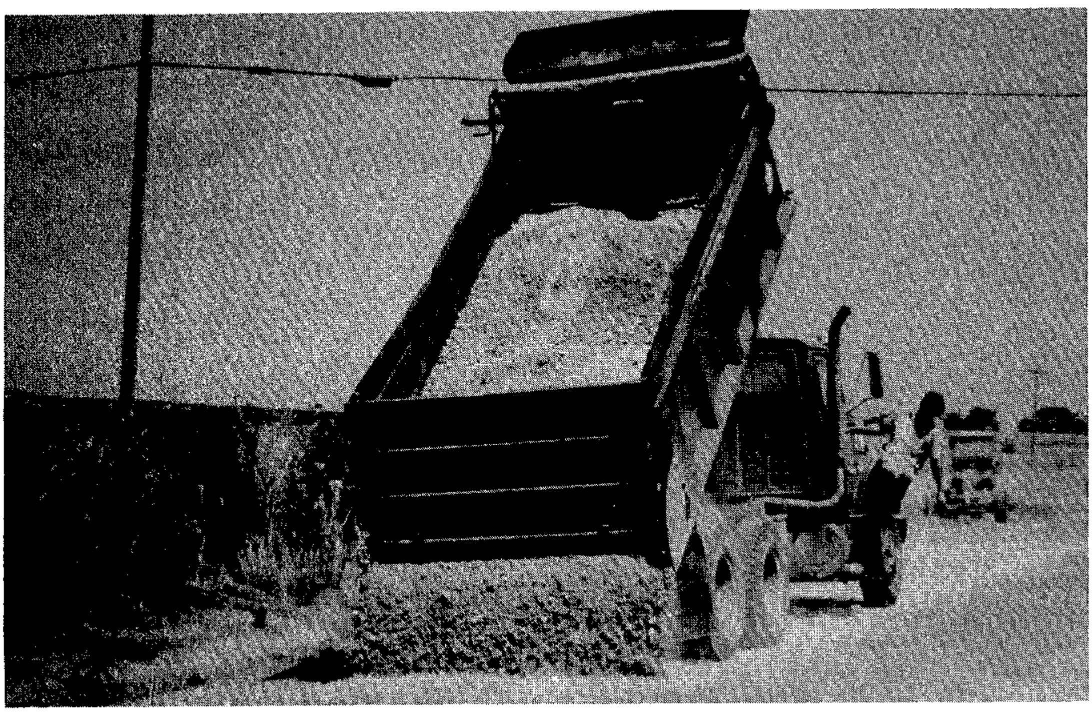


FIGURE 5.7 DUMPING WITH 10 WHEELER

Dumping the initial layer of gravel on the top layer of fabric and drifting the material across the center line lap onto the other layer also stops the fabric from wrinkling under the tires of the dump trucks.

All trucks should begin dumping the gravel **on the fabric at least 5 feet from the starting end of the fabric** (Figure 5.8). As the gravel falls out of the dump bed, a billowing cushion of air is created. If a truck begins dumping the gravel before it reaches the starting end of the fabric, the air cushion created by the falling gravel will have a tendency to blow the end of the fabric up, letting gravel get underneath. This will cause bulges in the fabric, making it almost impossible to blade the gravel across the end of the fabric. The trucks should pull onto the top layer of fabric at least 5 feet past the starting end and as nearly centered on the fabric as possible before beginning to dump the gravel.

FIGURE 5.8 DUMPING 5 FEET FROM STARTING END

5.5 Dumping With 18 Wheeler Trailer Dumps

Trailer dumps may be used in the dumping operation. This type of operation creates considerably more stress on the fabric and more work for the motor grader and usually takes more time to complete the operation. The dumping operation is basically the same as when using 10 wheeler dump truck. Start at least 5 feet onto the fabric from the starting end and position as centered as possible on the top layer of fabric. The trailer dump should try to dump in at least 2 piles.

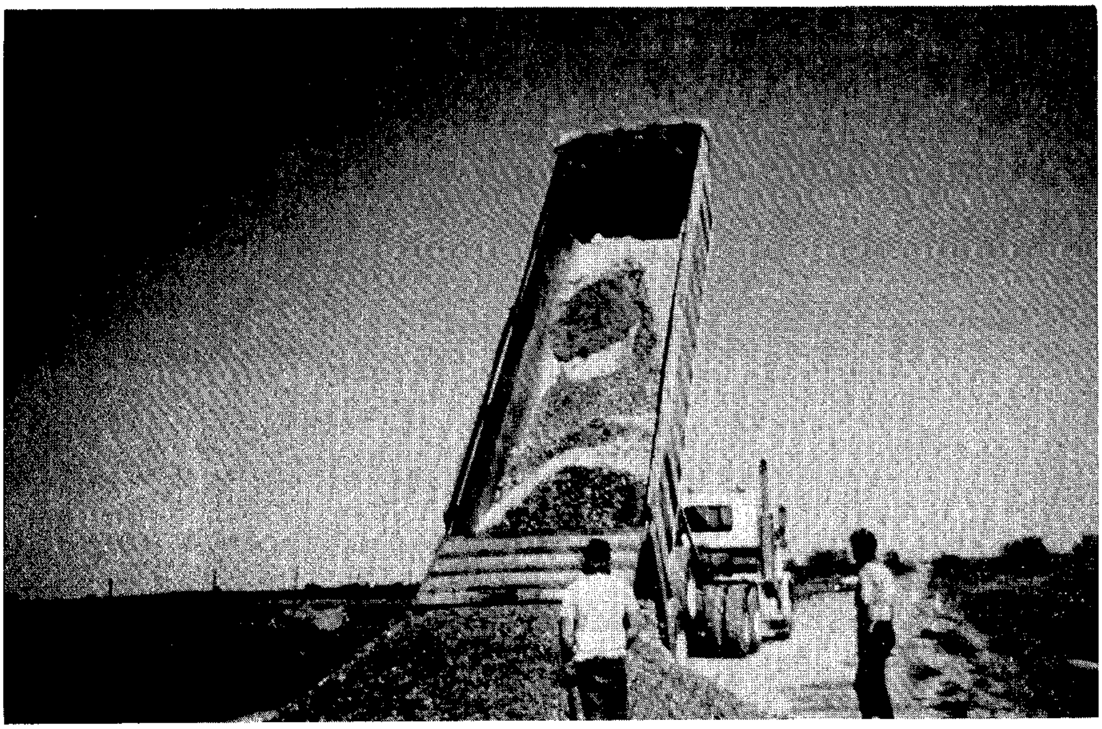


FIGURE 5.9 DUMPING WITH 18 WHEELER

Dumping 22 to 25 tons of gravel in one pile makes it difficult to spread with a motor grader. One important item should be mentioned: **<u>don't let the truck driver lock the trailer brakes while dumping the gravel!</u>** If the trailer brakes are locked, as the trailer bed is raised the trailer tires will try to slip across the fabric as it pulls the tractor backwards. This slipping action of the tires sliding across the fabric will tear the fabric. There have been recorded instances of a truck driver forgetting to release the trailer brakes before attempting to drive forward!

5.6 Dumping With Belly Dumps

The use of belly dumps is another efficient method of dumping the gravel. This dumping procedure is basically the same as when using 10 wheel dump trucks. Starting at least 5 feet upon the fabric, dump the gravel in the center of the top layer of fabric (Figure 5.12). It is recommended to have the trailer dump moving about 3 to 5 mph before opening the clam gates.

If the tractor is stopped when the gates are opened, a windrow of gravel develops under the trailer and ahead of the trailer axles. As the tractor pulls forward to windrow the rest of the gravel, the trailer axles may drag across the top or through the windrow of gravel, lifting the trailer wheels off the ground. This may cause the drive wheels on the tractor to spin as more power is needed to pull the loaded trailer across the top of the windrow. If the drive wheels spin on the fabric, a tear in the fabric may result.

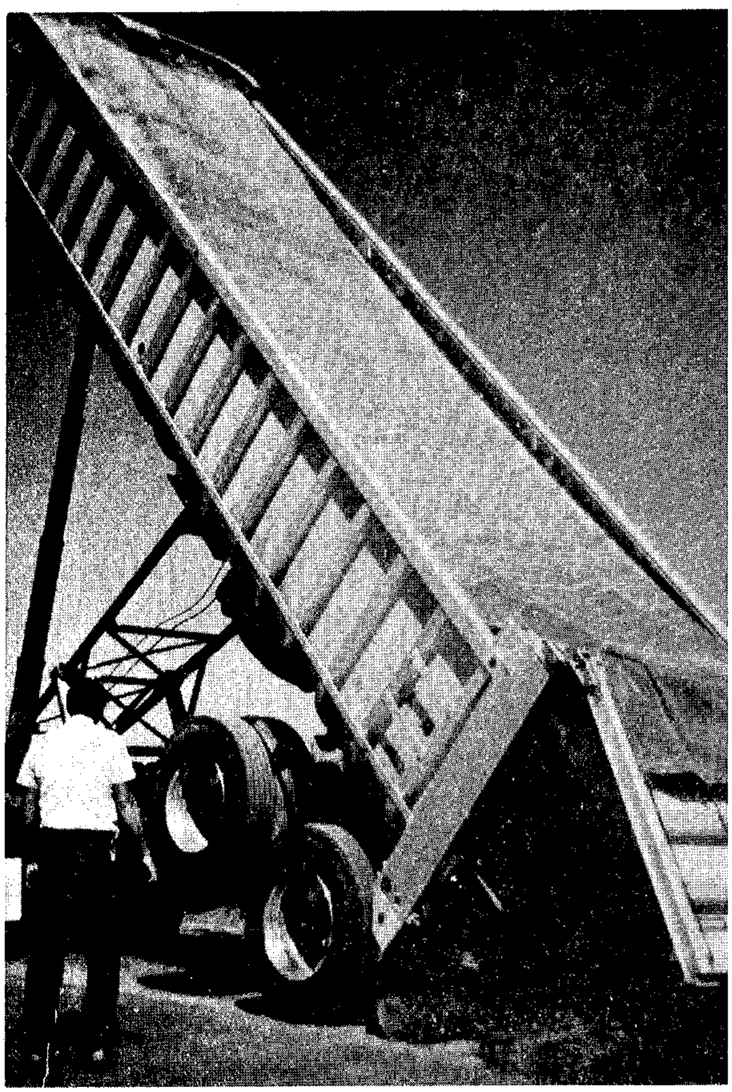


FIGURE 5.10 18 WHEELER WITH LOCKED BRAKES

FIGURE 5.11 FABRIC TORN FROM LOCKED BRAKES

FIGURE 5.12 DUMPING WITH BELLY DUMP

FIGURE 5.13 DRAGGING AXLES THROUGH WINDROW

Blading The Aggregate

6.1 Introduction

The use of a motor grader is essential when spreading the gravel across the fabric. Blading the gravel is not a particularly difficult operation although certain procedures should be followed to insure that the fabric is not damaged. The grader operator should try to maintain at least 4 inches of gravel between the drive wheels and the fabric at all times. As the grader builds a windrow of gravel across the moldboard more power is required of the drive wheels as the grader travels forward or backward. The minimum thickness of 4 inches of gravel will support the weight of the grader and absorb the torque action of the drive wheels. In field demonstrations, the following guidelines have been proven to be the most efficient method of operation with the least danger of tearing the fabric.

6.2 Spreading Gravel From 10 Wheeler Dump Trucks

As previously discussed, 10 wheel trucks will dump the gravel either by chaining the tailgate and dumping a somewhat level layer of gravel or by unlocking the tailgate and dumping the gravel, moving forward as the bed is continually raised. Remembering that the gravel has been dumped about 5 feet after the starting end, drive the grader onto the gravel layer until the blade is about 15 feet from the starting end.

Swing the blade into the position shown in Figure 6.1. The blade should be rolled forward about 20° to 30° so as to produce a dragging action. Drop the blade to cut about 3 to 4 inches off the gravel layer. The gravel layer should be thick enough so that at no time is the blade closer than 4 inches to the fabric as shown in Figure 6.2.

Backdrag the gravel across the starting end of the fabric. The blade will also drift gravel across the center line lap. Repeat the process until the required thickness or a minimum of 4 inches of gravel remains on top of the fabric. The grader may pull further up the roadway to get more material or additional gravel may have to be added to achieve the required thickness of gravel.

The gravel should extend off the fabric for a distance of 8 to 10 feet forming a **taper section** as shown in Figure 6.3. This taper section will provide a smooth transition onto the fabric section instead of leaving a 4 inch hump to drive over. A minimum of 4 inches of gravel is required on the fabric regardless of which direction you are blading. **Attempting to blade gravel from the roadway base onto the end**

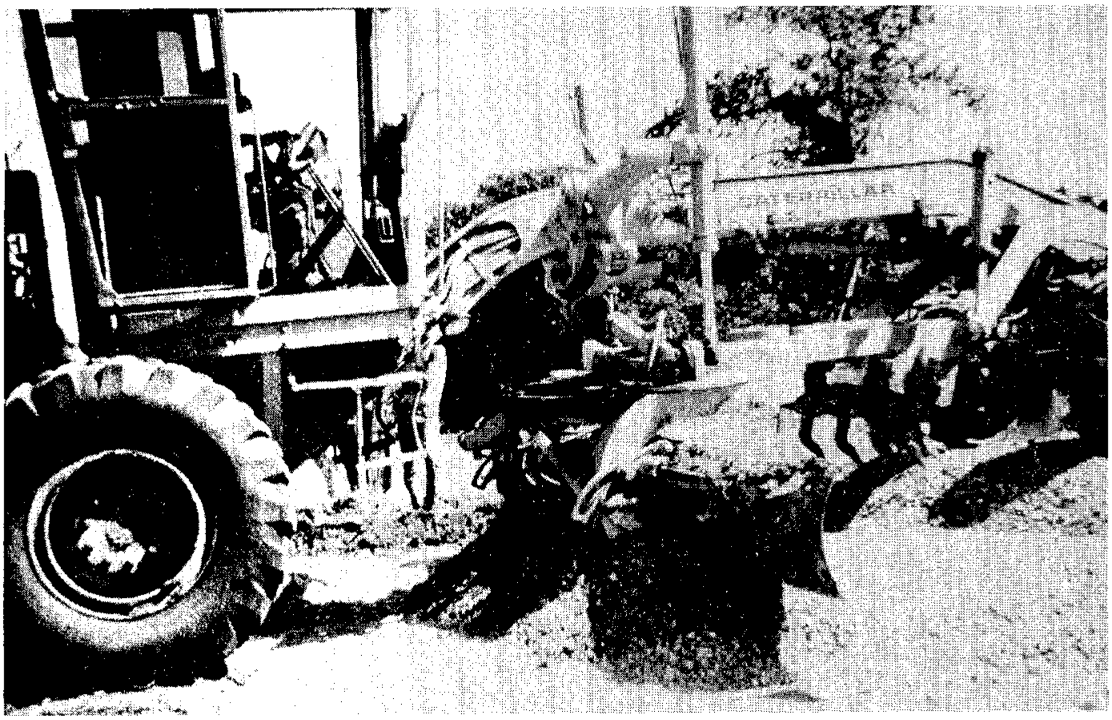


FIGURE 6.1 BACK DRAGGING THE GRAVEL

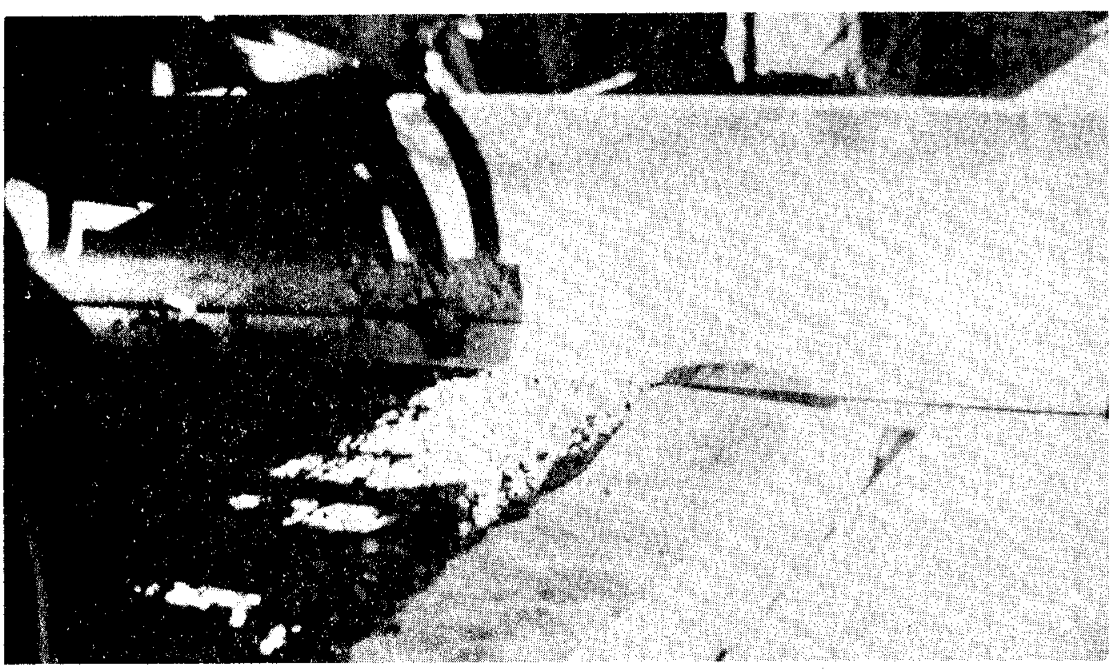


FIGURE 6.2 BLADE TOO CLOSE TO FABRIC

of the bare fabric will result in the gravel pushing the end of the fabric forward, creating large folds with gravel being pushed under the fabric.

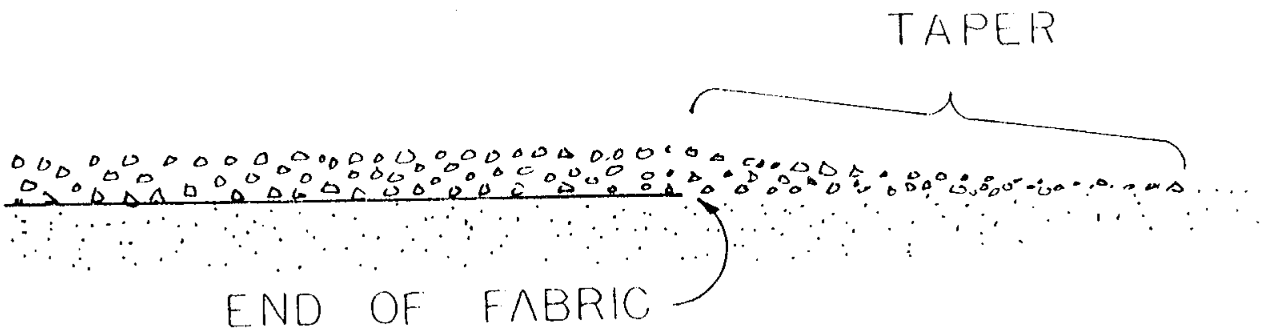


FIGURE 6.3 TAPER SECTION

To continue the spreading operation, pull the grader onto the gravel to the point where it began its last cut. Swing the blade into the position shown in Figure 6.4 keeping the blade tilted forward in the spreading position.

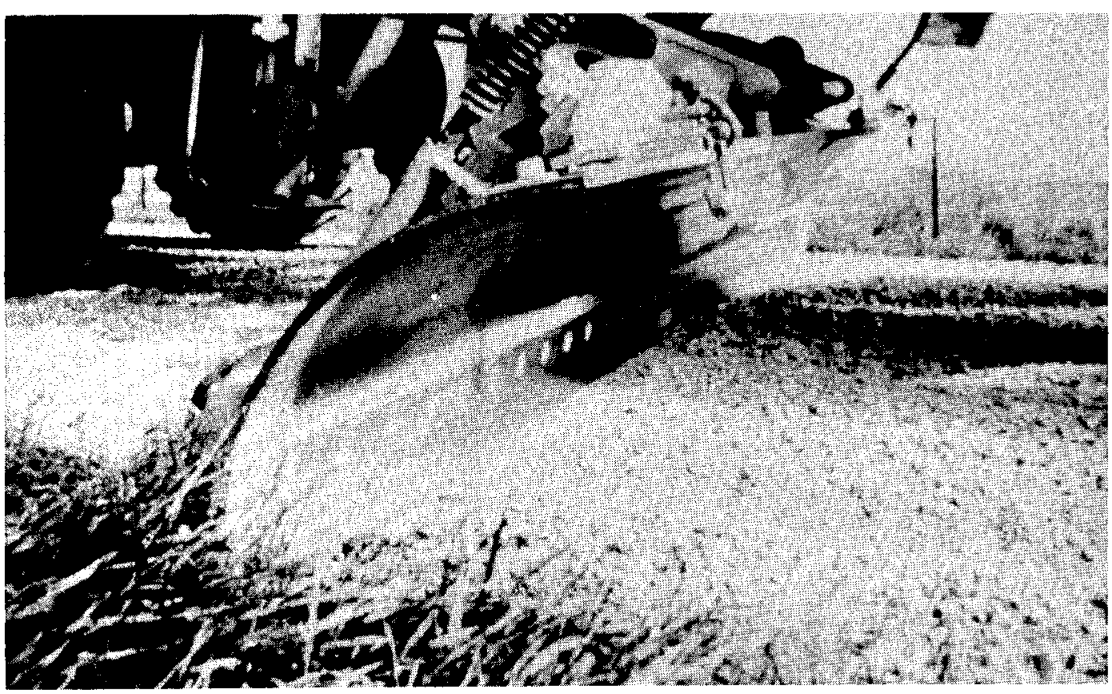


FIGURE 6.4 BLADE IN SPREADING POSITION

Drop the blade to cut into the gravel layer at the required thickness and maintain at least 4 inches of gravel on top of the fabric. As the grader moves forward the gravel will slide down the moldboard discharging gravel to the edge of the roadway. Continue blading forward until the end of the gravel layer is reached. This process will begin smoothing the gravel surface and generally a windrow will be produced from the leading end of the blade.

During the blading operation, observe the gravel on the moldboard. If the gravel builds up on the moldboard to the point of spilling over the top, decrease the depth of cut. When this condition exists, if you stand along the side of the grader and look at the moldboard you will see the gravel mounding out in front of the blade. The mounding or waving action is a result of the gravel attempting to slide across

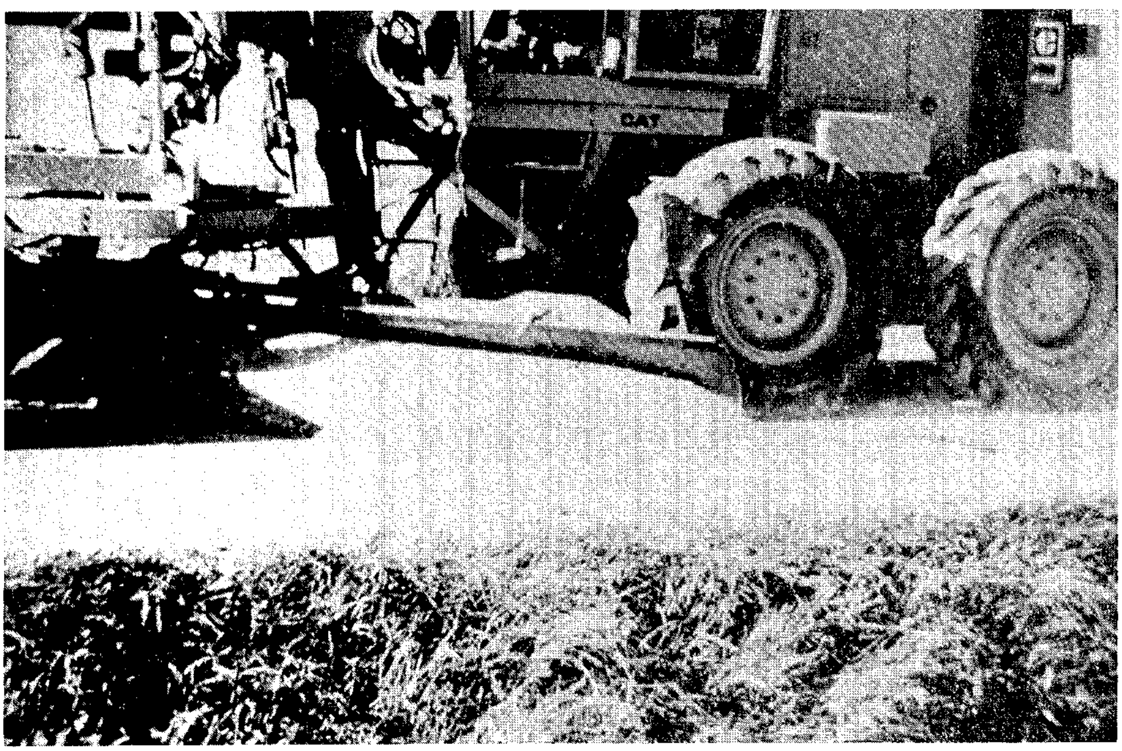


FIGURE 6.5 CORRECT AMOUNT OF GRAVEL ON MOLDBOARD

the surface of the fabric. The blade may also be tilted too far forward, creating excessive down pressure for the type of gravel being used. Experience is the best teacher in setting the correct amount of tilt for the type of gravel being used. The correct amount of gravel to carry on the moldboard is shown in Figure 6.5.

After the first pass has been completed, the grader may either back-up to the starting end or turn around, whichever is most convenient. On the second pass position the grader wheel next to the edge of the windrow left from the first cut, side shift the blade past the windrow as far as possible, then lower the blade until flush with the surface of the gravel which was spread on the first pass. Be sure to keep the outside end of the blade at least 4 inches above the fabric. The first pass should result in a relatively smooth surface and serve as a guide for the blade on additional passes. Proceed with the second pass, moving the grader forward and discharging the gravel onto the uncovered sections of the fabric. Repeat additional passes, moving over each time, until the windrow is spread to the required thickness as shown in Figure 6.6.

Thickness measurements should be taken to determine if the required thickness of gravel is in place, with a **minimum of 4 inches** being required. If the gravel thickness needs to be

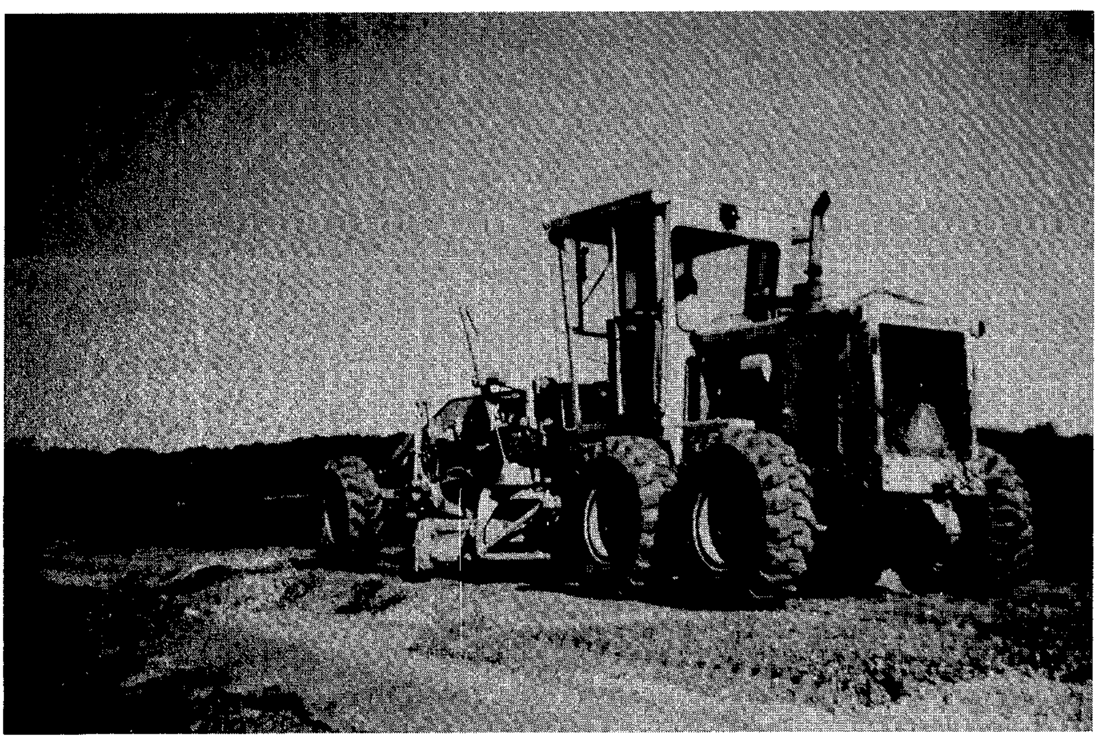


FIGURE 6.6 MAKING A SECOND PASS

reduced, begin at the starting end of the fabric with the leading end of the blade swung forward about 30° to 40° and positioned on the edge of the roadway. Blade forward, discharging the gravel in a windrow to the side of the grader. Continue with additional passes, side shifting the blade while keeping the grader wheels near the edge of the windrow and discharging to the side of the grader.

Once the fabric has been covered with the required thickness of gravel, the end sections will probably need to be smoothed to give a smooth transition onto the fabric section. Blading out from the end sections and tapering down is recommended as opposed to blading from the end of the taper onto the end of the fabric. This requires continually raising the blade and usually does not produce a smooth taper.

6.3 Blading Windrow From Belly Dumps

Blading the gravel from windrows created by belly dumps is somewhat the same as the procedure used in Section 6.2 but with several modifications.

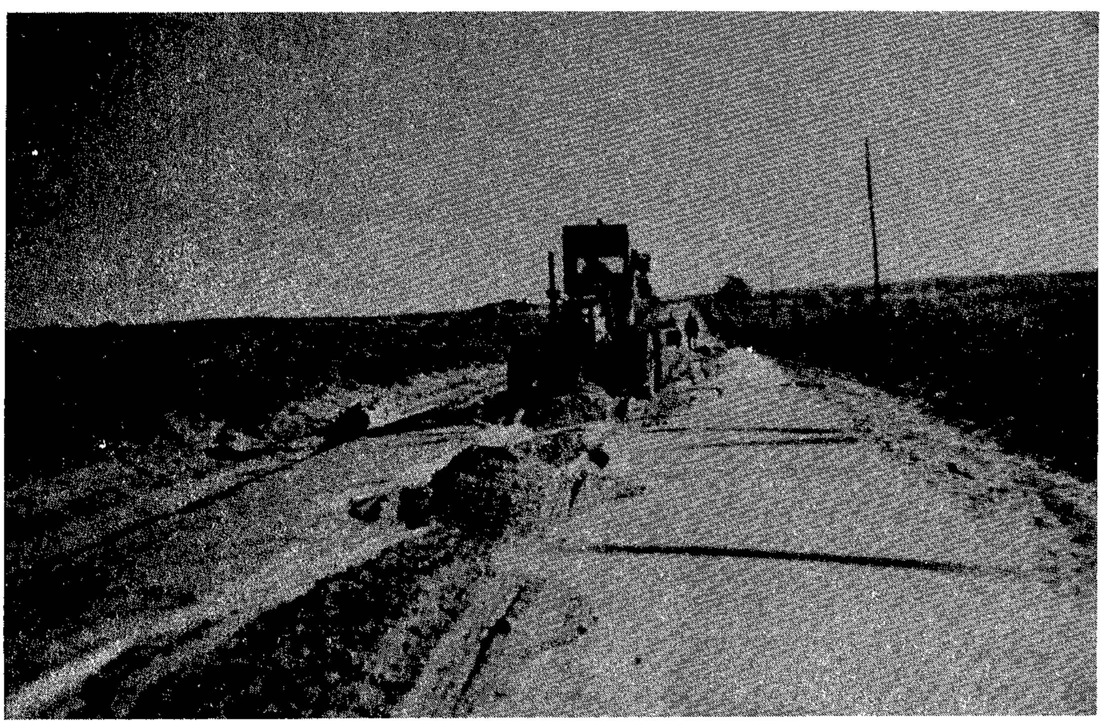


FIGURE 6.7 BLADING WINDROW FROM BELLY DUMP

Centering the grader on the windrow as shown in Figure 6.7, drive the grader onto the windrow a short distance. The blade should be swung 30° to 40° to the right or left, rolled forward to a dragging position and lowered into the windrow 4 to 6 inches. Back drag the gravel over the end of the fabric. Avoid spinning the drive wheels when back dragging. The blade may be swung from right to left with each pass to spread the gravel over the entire end of the fabric.

After the end of the fabric is covered with at least 4 inches of gravel, position the grader on the outside edge of the windrow. Swing the end of the blade next to the windrow forward about 40°, making sure the blade discharges the gravel outside of the drive wheels. Drive the grader forward pulling and cutting about one half of the windrow while spreading the gravel. Keep at least 4 inches of gravel on top of the fabric. Continue down the windrow until reaching the end.

During the blading operation, observe the gravel on the moldboard. If the gravel builds up on the moldboard to the point of spilling over the top, decrease the depth of cut. When this condition exists, if you stand along the side of the grader and look at the moldboard, you will see the gravel mounding out in front of the blade. The mounding or waving action is a result of the gravel attempting to slide across the surface of the fabric. The blade may also be tilted too far forward, creating excessive down pressure for the type of gravel being used.

After the first pass has been completed, the grader may either back-up to the starting point or turn around, whichever is most convenient. On the second pass, position the grader wheel next to the edge of the windrow that resulted from the first cut, side shift the blade past the windrow as far as possible, then lower the blade until flush with the surface of the gravel which was spread on the first pass. Be sure to keep the blade at least 4 inches above the fabric. The first pass should result in a relatively smooth surface and will serve as a guide for the blade on additional passes.

Proceed with the second pass, moving the grader forward and discharging the gravel onto the uncovered sections of the fabric. Repeat additional passes, moving over each time, until the windrow is spread to the required thickness.

Thickness measurements should be taken to determine if the required thickness of gravel is in place, maintaining a **minimum of 4 inches**. If the gravel thickness needs to be reduced, begin at the starting end of the fabric with the leading end of the blade swung forward about 30° to 40° and positioned on the edge of the roadway. Blade forward, discharging the gravel in a windrow to the side of the grader. Continue with additional passes, side shifting the blade, while keeping the grader wheels near the edge of the windrow and discharging to the side of the grader.

Once the fabric has been covered with the required thickness of gravel, the end sections will probably need to be smoothed to give a smooth transition onto the fabric section. Blading out from the end sections and tapering down is recommended as opposed to blading from the end of the taper onto the end of the fabric. This requires continually raising the blade and usually does not produce a smooth taper.

6.4 Spreading Gravel From 18 Wheeler Trailer Dumps

Dumping and spreading gravel from trailer dumps is probably the most difficult and least efficient method used. However, in some operations this may be the only type of equipment available. The trailer dump results in large mounds of gravel which requires more blading time as shown in Figure 6.8. In general, the blading and spreading is similar to that outlined in Section 6.2.

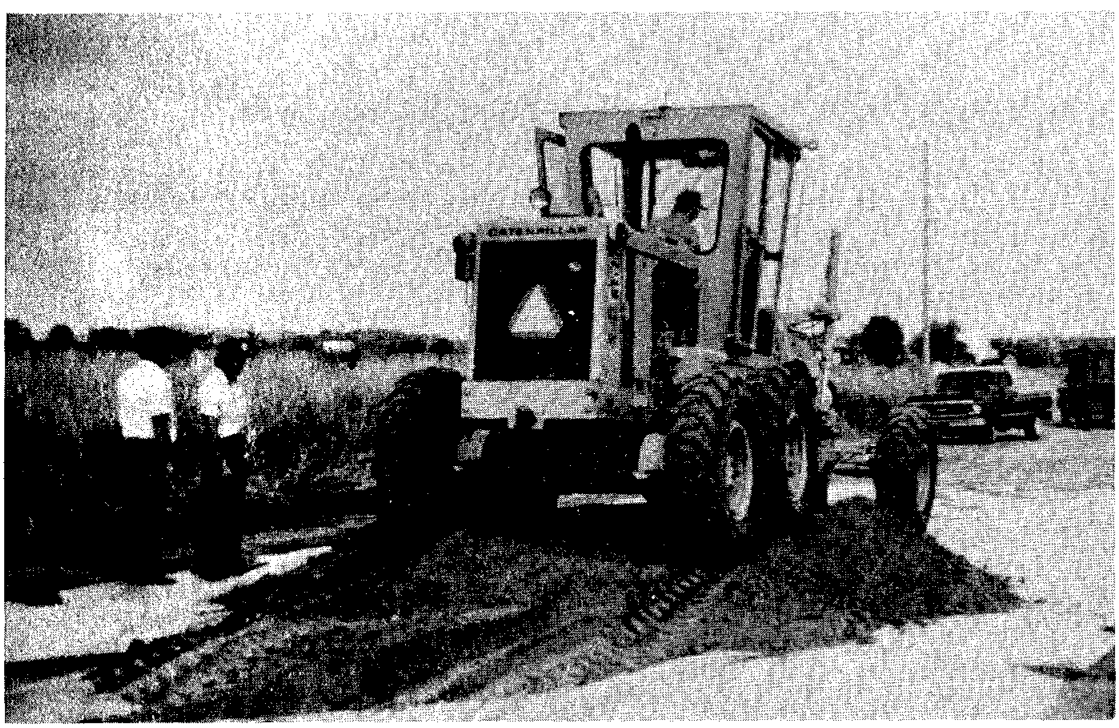


FIGURE 6.8 BLADING MOUNDS FROM TRAILER DUMP

Drive the grader onto the gravel layer until the blade is about 10 feet from the starting end. Swing the blade into the position shown in Figure 6.1. The blade should be rolled forward about 20° to 30° to produce a dragging action. Drop the blade to cut about 3 to 4 inches off the gravel layer. The gravel layer should be thick enough so that **at no time is the blade closer than 4 inches to the fabric.**

Backdrag the gravel across the starting end of the fabric. The blade will also drift gravel across the center line lap. Repeat the process until the required thickness or a minimum of 4 inches of gravel remains on top of the fabric. Additional gravel may have to be added to achieve the required thickness of gravel or the grader may pull further up the roadway to get more material.

The gravel should extend off the fabric for a distance of 8 to 10 feet forming a taper as shown in Figure 6.3. This taper section will provide a smooth transition onto the fabric section instead of leaving a 4 inch hump to drive over. A minimum of 4 inches of gravel is required on the fabric regardless of which direction you are blading.

Attempting to blade gravel from the roadway base onto the end of the bare fabric will result in the gravel pushing the end of the fabric forward, creating large folds with gravel being pushed under the fabric.

For the back dragging operation, pull the grader onto the gravel to the point where it began its last cut. Swing the blade into the position which was shown in Figure 6.6 keeping the blade tilted forward in the dragging position. Drop the blade to cut into the gravel layer at the required thickness and **maintain at least 4 inches of gravel on top of the fabric.** As the grader moves forward the gravel will slide down the moldboard discharging gravel to the edge of the roadway.

Continue blading forward until the end of the gravel layer is reached. This process will begin smoothing the gravel surface and generally a windrow will be produced from the leading end of the blade.

During the blading operation, observe the gravel on the moldboard. If the gravel builds up on the moldboard to the point of spilling over the top, decrease the depth of cut. When this condition exists, if you stand along the side of the grader and look at the moldboard you will see the gravel mounding out in front of the blade. The mounding or waving action is a result of the gravel attempting to slide across the surface of the fabric. The blade may also be tilted too far forward, creating excessive down pressure for the type of gravel being used.

After the first pass has been completed the grader may either back-up to the starting end or turn around, whichever is most convenient. On the second pass, position the grader wheel next to the edge of the windrow left from the first cut, side shift the blade past the windrow as far as possible, then lower the blade until flush with the surface of the gravel which was spread on the first pass. Be sure to keep the outside end of the blade at least 4 inches above the fabric. The first pass should result in a relatively smooth surface and will serve as a guide for the blade on additional passes.

Proceed with the second pass, moving the grader forward and discharging the gravel onto the uncovered sections of the fabric. Repeat additional passes, moving over each time, until the windrow is spread to the required thickness.

Thickness measurements should be taken to determine if the required thickness of gravel is in place, maintaining a **minimum of 4 inches** . If the gravel thickness needs to be reduced, begin at the starting end of the fabric with the leading end of the blade swung forward about 30° to 40° and positioned on the edge of the roadway; moving forward, discharging the gravel in a windrow to the side of the grader. Continue with additional passes, side shifting the blade, while keeping the grader wheels near the edge of the windrow and discharging to the side of the grader as shown in Figure 6.5.

Once the fabric has been covered with the required thickness of gravel, the end sections will probably need to be smoothed to give a smooth transition onto the fabric section. Blading out from the end sections and tapering down is recommended as opposed to blading from the end of the taper onto the end of the fabric. This requires continually raising the blade and usually does not produce a smooth taper.

6.5 Finish Blading

The final blading may be performed after the fabric has been completely covered with the required thickness of gravel and the taper section on both ends smoothed out. The final blading will consist of lightly dragging the surface of the gravel, starting at the edge of the roadway and drifting the material toward the center.

- Position the grader on one edge of the roadway.

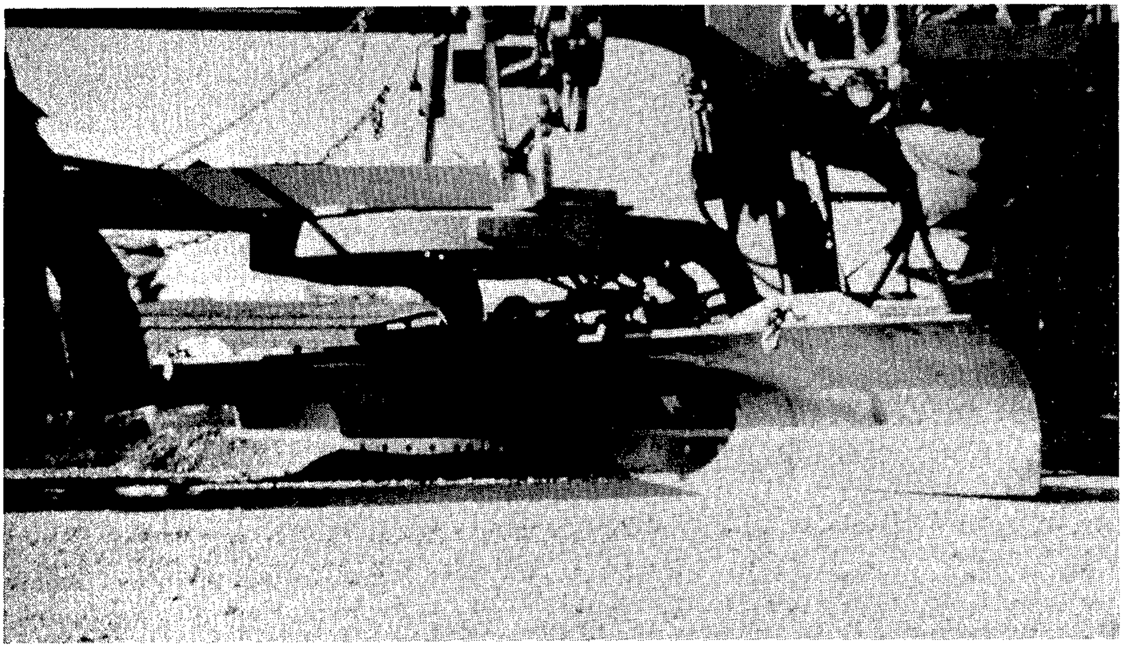


FIGURE 6.10 BLADE POSITION FOR FINAL PASS

- Swing the outside end of the blade forward to a 30° to 40° angle.

- Roll the blade forward to a dragging position. (Usually this is a 20° to 30° angle)

- To make a light cut on the gravel, lower the toe of the blade next to the edge of the roadway, Make one pass over the fabric section, discharging the gravel toward the center line and outside of the drive wheels as shown in Figure 6.10.

- Back the grader to the starting end and position the grader so that the slope on the crown and the windrow of gravel (if any) is carried to the center line.

  (NOTE: The second pass may not be necessary if the gravel is windrowed to the center line on the first pass.)

- Back the grader to the starting end and position the grader so that the toe of the blade is on the center line and flush with the gravel surface. Lower the heel of the blade to cut the same slope on the other half of the roadway. Make additional passes as necessary to cut the slope of the crown to the other edge of the roadway.

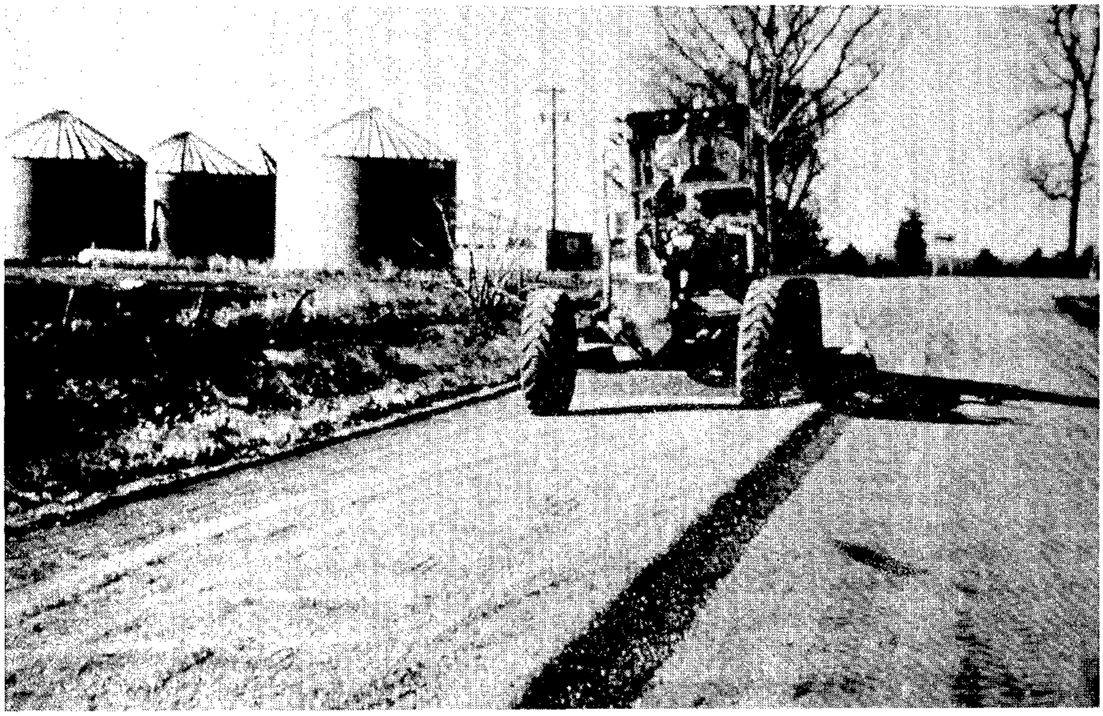


FIGURE 6.11 BLADING CROWN ON FINISHED SURFACE