Paving Commercial Application

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Hello and thank you for having me speak today, I know that going at the end of the day here means that I am what stands between you and a beer! This presentation will cover certain aspects of commercial paving. There are many applications and many projects that fall into this category and there are no absolute rules for project planning, layout, and completion. However, most projects have certain things in common and certain issues that need to be addressed. Some of these issues are: specification requirements, grade conditions, project planning, equipment selection, and compaction. All these elements will be covered in this presentation.

Paving Commercial Application

- Grade Conditions
- Trucking
- Obstacles
- Project Planning
- Compaction

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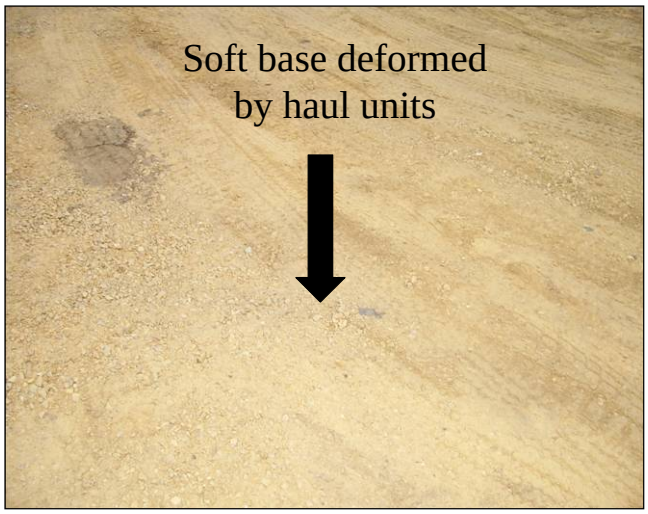
The content is designed to highlight issues, to recognize the causes of these issues, to find ways to solve the issues, and, finally, how to plan to avoid these issues.

Grade Conditions



- Grade conditions are often overlooked as causes of mat quality issues
- Mat defects from grade conditions are unrelated to paving techniques
- Correct grade defects or adjust paving to avoid poor mat quality

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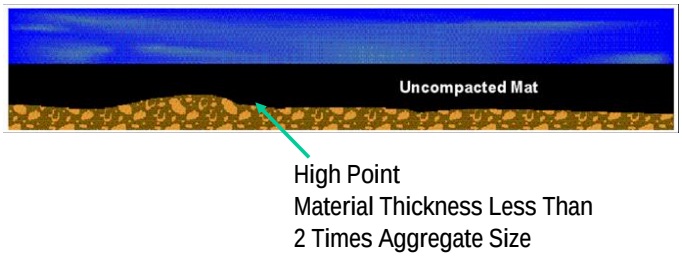
No structure is stronger then the foundation on which it is built. The same is true with asphalt paving. To produce a quality mat, there must be a quality foundation or “base” to build on. Grade conditions will be reflected in the mat. Sometimes these defects show up immediately and at other times they take longer. Let’s discuss how different grade defects can result in poor quality mats and premature failures.

High Spot in Grade



- High points cause thin mats
- Ratio of mat thickness/aggregate size too low
- Open texture
- Non-uniform density
- Bumps

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High points in the existing grade will cause the mat placed over the high points to be less than the desired thickness. When mat thickness is less than two times greater than the largest aggregate in the mix, the affected area can show an open texture, pulling of material and/or fractured aggregates. Areas with a thin mat compact at a different rate than areas where the mat is thicker. If mat thickness over the high spot is the same or less than the aggregate size, the screed will rise creating a bump.

If the thickness of material over a high point is at least two times the aggregate size or greater, the appearance of the mat will probably show no difference. But the material over these areas will not compact the same as the thicker areas. Density will be non-uniform and smoothness will be affected, too.

Grade Conditions: High Spots

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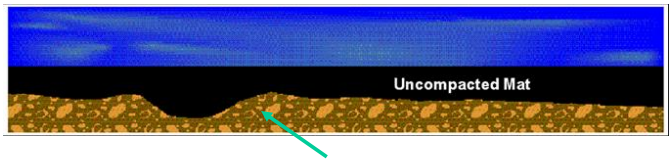
This is a good example of a high spot in the grade. The mat has an open texture with a very poor visual appearance. Compaction will be difficult in this area. Most likely there will be broken aggregates and premature failure. There will probably be a bump in this area so ride comfort will be affected, too. It will be difficult to get full pay for a project with appearance and quality issues like this.

Low Spot in Grade



Low Point
Material Thickness Greater Than
Surrounding Areas

- Material thickness too great
- Compacts as a dip
- Compacts as a low density area
- May not show up in the mat visually

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When a mat is placed over a low point in the existing grade, the material thickness is greater than the surrounding areas. When compacted, these areas will compact at a higher rate and a dip will be produced. If the low spot is smaller in diameter than the width of the roller, the roller will bridge over the low spot and a low-density area will result.

The visual appearance of an uncompacted mat that has been placed over a low spot is normally the same as the rest of the mat. But a thermal image will probably show a hotspot where the mat is thicker – that's the area over the dip.

Grade Conditions: Low Spots

- Amount of time to show failure depends on:
- Traffic
- Seasons
- Compaction

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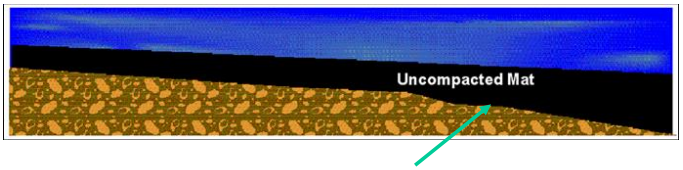
The pneumatic roller has done its job of “proofing” the mat. It found the dip in the grade and the mat followed, creating a place for water to gather. A steel drum compactor would have bridged this area and there would be no visual difference but there would still be uneven density. This will create the opportunity for a pothole to develop. The amount of time it takes to show up will be determined by the amount of traffic, temperature variances from season to season, and how well it compacted.

Slope Change in Grade



Severe Slope Change on Grade

- Mat thickness varies 3 mm (1/8”) per 30 cm (1.0 ft) of 1% slope deviation in the base, picture 1cm per metre at 1% changes
- Incorrect yield
- Variable compaction rate

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The slope of the existing grade may create a problem if it varies significantly from the mat placed over it. For example, if the slope of the grade is running at 4% and a mat with 2% slope is placed over it, the mat thickness will vary correspondingly. Or, if the slope of the grade changes significantly at some point, the mat thickness will change at that point also. The mat will compact at a different rate and it is likely the specifications for density and yield will not be met.

Grade Conditions: Variable Slope

- Slope (profile) affects drainage, critical in parking lots
- Check and correct slope before paving to avoid yield and compaction issues
- Costly to correct with paver

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This view shows a large parking lot base profile during the installation of the first lift and shows how the profile is planned to promote effective drainage. The slope (profile) of the base should be correct and is the responsibility of the base prep crew. Prior to paving, the base prep foreman and the paving foreman should check slopes and correct slopes. The paving crew can correct slope errors, but corrections with hot mix asphalt can be costly.

Not only will grade issues affect our quality but they can have a direct effect on our bottom line.

Slope Corrections Affect Tow Point Height

- Slope corrections in Auto mode cause large tow point movements
- Affects “line of pull”
- Can quickly “bottom out” tow point cylinder stroke
- Crew may have to “buy back” cylinder

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If the crew has to correct slope with the paver using Auto Slope mode, slope corrections will be created by changing the height of the tow point. Auto slope control will cause relatively large and rapid changes in tow point height that can be problematic. For one thing, the line of pull will be affected whenever the tow point height is significantly out of center. Second, the tow point cylinder can bottom out meaning that Auto slope will send signals that may be ignored. To correct the problem, the crew will have to buy back cylinder travel – a time-consuming process that often causes confusion.

Survey Mode for Slope Control

- Use survey mode to avoid problems when making large slope corrections.
- In survey mode, control box acts as a smart level.
- Crew manually makes corrections while watching the slope display.
- Tow point unaffected

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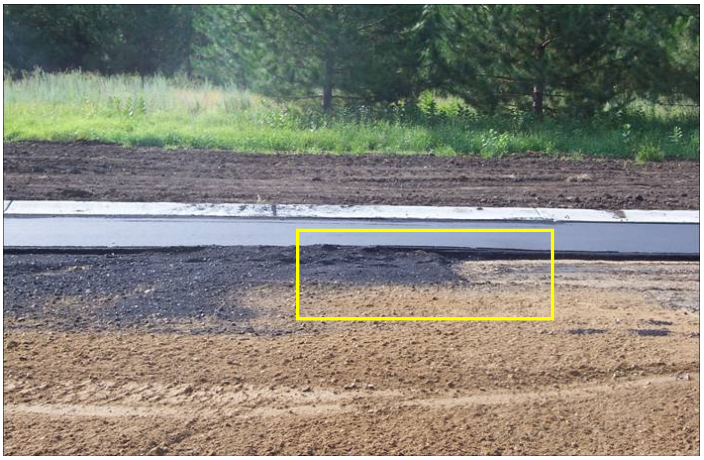
To avoid tow point height problems when trying to make large slope corrections, put the slope control in the Survey mode. In a parking lot, varying slopes becomes a challenge. If the control box has been properly calibrated at the start of paving, the display window will function as an electronic smart level and will display the actual slope of the screed. The crew member can use the manual depth crank to change mat thickness and therefore mat slope while watching the display box. The tow point height remains unaffected by this process. All screed operators should know how to select the survey mode and how to manually install the specified slopes.

Grade Conditions Affect Quality



- Slope variations, high spots, low spots, soft spots affect quality and yield
- Quality and yield affect your bottom line

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This view shows a difference in the elevation of the grade. Depending on the specifications of the job, it could be considered either a high or low spot in the grade. Considering it a high spot in the grade, if the requirements of this job dictate a minimum depth requirement, there may be a penalty for a “skinny” core. If this were a low spot in the grade, yield would be affected. Depending on the number of these variations, the yield would not match the project bid calculations. High / low spots in the grade will have an effect on the quality of mats as well as the profitability of projects.

Not only will grade issues affect our quality but they can have a direct effect on our bottom line.

Grade Conditions: Trucking

- Trucking can affect base conditions
- Loose material and lack of density allow trucks to deform the base
- Not suitable for paving

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Trucking has a major impact on the paving process and can affect grade conditions.

This grade should not be considered suitable for paving. If the grade is loose enough to be rutted by the incoming haul units, it is not properly compacted. The mat placed on this grade is going to be too thick in places and too thin in others. Densities will be variable. And, there probably will be areas where the granular material is mixed with the hot mix asphalt and will have to be cut out. This is not the time to be finding soft spots in the grade.

Prior to paving, there are several ways to correct this issue. Really, the wet or poor material should be removed and replaced with stronger base material. It may be possible to simply bring in some more fill, spread and compact. In the long run, it is better to suspend paving until all base issues are resolved. Otherwise, there will be re-work that is more costly than before failure repair.

Material Dumped on Grade

- "It's just a parking lot."
- Minimize spills

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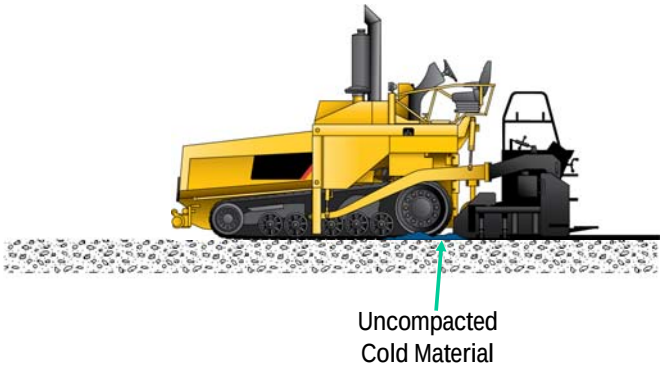
Often spills on the grade in front of the paver are ignored because, "It's just a parking lot." In reality, we must try to minimize spills and clean up the ones that happen.

Material Dumped on Grade



- Fresh mix laid over cold piles
- Cold mix just under surface or partially exposed
- Temperature variations

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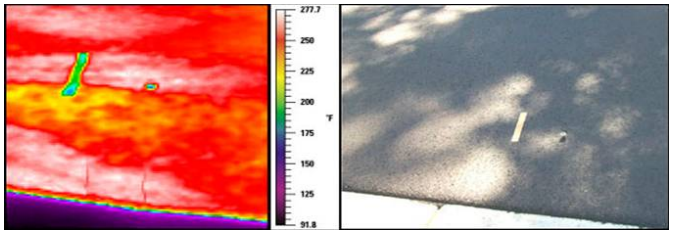
As the screed passes over these materials, fresh hot material is deposited over them. Any place the dropped material is thicker than the mat, it will be sheared off or will pick up the screed and not allow it to float properly. This will leave an area in the mat where the cold materials are just under the surface of the mat or are partially exposed.

Material Dumped on Grade



- Mat may not show any visual defect from small pile of mix
- Thermal image shows cold pile spread by screed
- Uneven compaction results
- Maybe a bump

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Visual inspection of the mat (photo on right) may not show any apparent defect since the material dumped on the grade has been “buried”. But, a thermal image of the same area (left photo) reveals a cold streak where the dumped material has been leveled and spread by the screed. The cold area will not compact the same as the rest of the mat. A bump can be produced.

Material Dumped on Grade

- Pile compacted by truck or paver
- May be completely covered by mat depending on thickness

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Often material dumped on the grade is run over by the next truck as it approaches the paver. Or, the paver itself may run over it. A small amount of compacted material, depending on the thickness of the mat, may be completely covered by fresh, hot asphalt as the screed passes over the compacted pile.

Material Dumped on Grade

- Small compacted pile usually not visible in mat surface
- Thin layer of fresh mix for compaction
- Uneven compaction
- Bump
- Fractured aggregates

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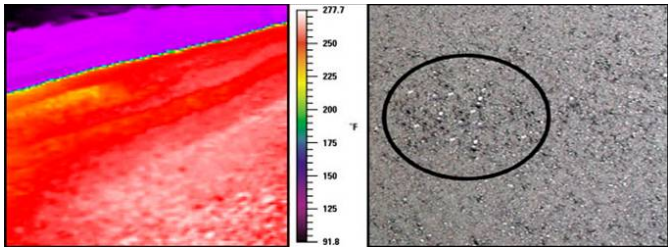
As the screed passes over the compacted pile, hot material is deposited over it. Normally, the small pile is undetected in the mat. But when the roller passes over the pile, the thinner layer of fresh material can not be compacted at the same rate. A bump may be created and aggregates may be fractured, too.

Material Dumped on Grade



- Uncoated rock shows in mat surface
- Open texture over compacted pile
- Cold spot

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Because the mat is so thin over the pile of pre-compacted asphalt, the force of the compactor can fracture aggregates. The area in the mat that has been circled contains fractured aggregate which show as uncoated rock surfaces.

The thermal image indicates that this area is cooler because the surface texture is more open. The compaction rate will be uneven and a bump will be detected by smoothness measuring devices.

Trucking

- Truck drivers are part of the team
- Truck drivers need instructions just like every other crew member

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Truck drivers do more than simply deliver material from the plant to the job site. They are an important part of the team and must be given clear instructions.

Trucking: Light Brake Pressure

- Too much pressure applied to the brakes can create issues
- Sliding lifts base

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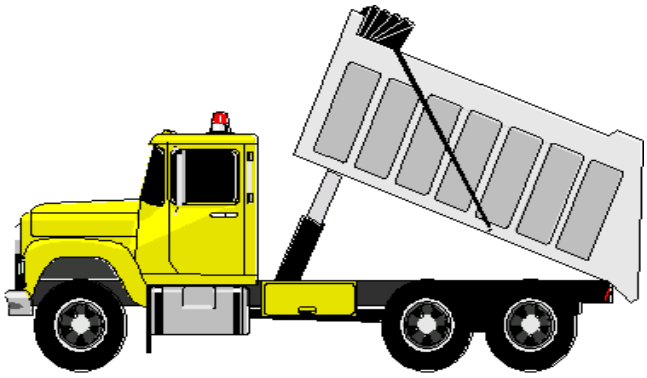
Too much pressure applied to the trucks' brakes can create issues as well. Soft base can be piled in front of the tires and create a pile higher than the mat to be laid. There will be a lot of work to bring this area back to specification. Fixing the problem prior to paving would have been much more efficient. A project owner or inspector will hate to see this type of problem appear in the mat.

Proper Truck Dumping



- Cover up
- Bed raised slightly
- Release tail gate
- Raise bed enough to dump mass of mix into hopper – not trickle mix into hopper

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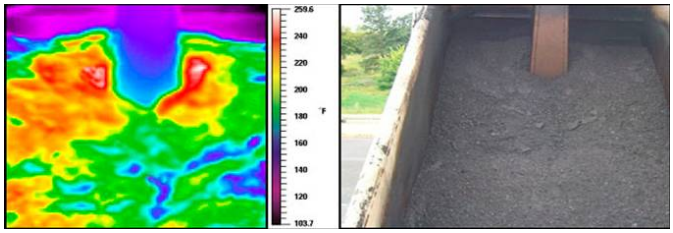
The way that trucks dump into the hopper affects how much segregation, if any, occurs in the hopper.

Dump trucks, if equipped with a load cover, should have the cover up before backing up to the paver.

The bed should be raised slightly as the truck backs up; this saves time. When the tail gate is released, the bed should be raised high enough to dump a mass of mix into the hopper. Avoid trickling or dribbling mix into the hopper. If mix trickles into the hopper, the larger aggregates will roll off the pile and create segregation.

Keep Truck Bed Raised



- Signal truck driver to keep bed angle high
- Don't allow crust or large aggregates to trickle into the hopper

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As the truck is dumping into the hopper, the operator or dump person should signal the truck driver when to increase the dump angle. The bed needs to be kept raised high enough to prevent mix trickling into the hopper.

In this example, a thin crust has formed on the top of the load. The dump angle is not high enough. So, the crust is starting to slide off rather than move with the entire load into the hopper. This action can create cold spots and material segregation depending on the type of mix.

Cycling Hopper Wings – Yes or No

- Mix not segregating in hopper – OK to cycle hopper wings
- Mix segregating in hopper – cycling hopper wings not recommended

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At this point in the truck exchange sequence, the operator has to make a decision: cycle the hopper wings and pave forward a little more or stop and wait for the next truck.

It all depends on how the mix is behaving as it is dumped into the hopper. If the mix is not segregating in the hopper, it's probably a good idea to cycle the wings as long as the deck is still covered as shown in this example.

If segregation is present at the sides of the hopper, it's probably a good idea to not cycle the hopper wings. Of course, this means some extra clean-up work at the end of the shift, but it will help eliminate repetitive end-of-load segregation.

Cycling Hopper Wings too Late

- Conveyors run empty or low on mix
- Cycling hopper wings can cause end-of-load segregation

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Continuing to pave during truck exchanges is normal practice. And, it is acceptable to cycle hopper wings during truck exchanges. But, if the conveyors are emptied before the hopper wings are cycled, large aggregates that may have accumulated at the sides of the hopper will be dumped directly into the conveyors. Cycling hopper wings too late is a frequent cause of end-of-load segregation.

When laying down any mix which is prone to segregation, it may be advisable to limit, or even prohibit, cycling hopper wings.

Obstacles

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Commercial paving is normally filled with obstacles. Jobs progress most efficiently when planning for obstacles happens at the beginning of a job rather than simply dealing with obstacles as they appear during each pull..

Obstacles

- Identify obstacles and include them in your paving plan
- Know the abilities and limitations of your machines
- Know how changes in speed and head of material will affect the screed

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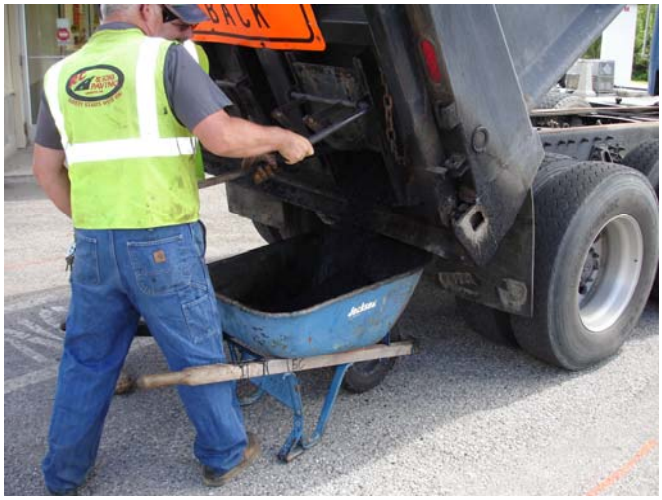
Identifying obstacles and including them in the paving plan will decrease handwork and make the job flow more efficiently. Planning for obstacles requires a thorough knowledge of each machine's capabilities and limitations.

Obstacles



- Plan your handwork
- Have the right tools
- Minimize dumping piles on the grade

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If you plan ahead for the work around obstacles and have the right tools available, the crew will not have to exert as much physical energy. Try as much as possible to avoid dumping piles on the base. Clean up will be easier and faster.

Obstacles

- Take care of “orphan” areas prior to starting a pull
- Try to minimize large changes in paving width

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Try to do as much handwork as possible before setting up the paver at the starting joint for long pulls. You can often take care of “orphans” and not have to change the paving widths as often and as drastically.

Obstacles

- Leaving cut up areas and orphan areas can be a problem
- How do we fill in?
  - -- pave it
  - -- hand work
  - -- two lifts
  - -- one lift

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The space between the two asphalt surfaces is a potential problem. This area between the islands is a primary entrance and will have a high volume of traffic. At this point, there are only two choices. The paver could place the material between the two mats. This will require a lot of extra handwork to clean up but would most likely provide the best results by creating a mat with density that is equivalent to the other mats, supporting the next lift and high traffic volume the best.

The other choice is to put the material in by hand. This will require a lot of hand work as well. The main issue with doing it by hand is the compaction in this area will not be equivalent to the other two mats. The density of the material in this area is critical due to the high traffic it will experience. Poor density will equal premature failure.

Or, this area could be paved in one lift when the final lift is laid down. But that will produce different depths of material compacting at different rates. Most likely, paving and compacting over this area during the second lift will create a low spot between the islands. This will be unacceptable, since there definitely should not be a water puddle at the entrance to a parking area.

Planning is important to prevent potential problems.

Obstacles

- Plan your pulls
- Take advantage of the paver's capabilities
- Reducing handwork improves quality and reduces crew fatigue

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Instead of leaving the notch between two islands, pave as much as possible using the maximum capability of the paver and screed. By reducing the area that's needs to be filled in by hand, you are being more productive and producing higher quality. Crew fatigue is reduced, too.

Planning is important to prevent potential problems.

Obstacles

- Doing handwork first means fewer abrupt paving width changes
- Raising the end gate to clear the obstacle may help reduce handwork

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There are also a number of small things that can be done to help when paving around obstacles. For example, when laying multiple lifts, raise the end gate prior to the obstacle or maybe have the end gate up at the start of this pull. Having the end gate up will allow material to flow under and as close to the obstacle as possible. As the extender is retracted, as shown in this view, the end gate will clear the obstacle making for less handwork.

Paving Up to Obstacles

- As you approach an obstacle inside the paving width:
  - -- paving speed decreases
  - -- head of material increases
- Adjustment of screed to approach for drainage etc.

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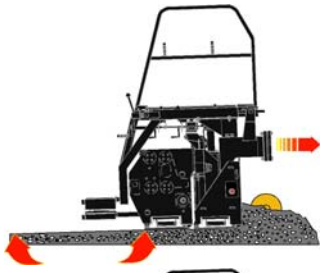
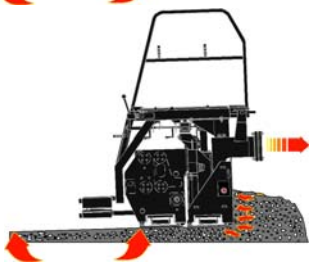
As you approach an obstacle that is within the paving width, two things normally happen. The paver operator slows down to help the screed operator control the paving width as he brings the screed extension in. Then, as the screed extension is closed the head of material in front of the extension increases.

Factors Affecting Screed





Decreased Speed

- Shear factor increases
- Depth increases
- Amount of depth change varies with amount of speed change

Head of Material Increased

- Resistance increased
- Depth increases

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When the paving is decreased, the shear factor acting on the front of the screed increases. Less mix can pass under the nose of the screed and the screed rides up. The distance that the screed climbs depends on how drastically the speed is reduced.

When an extension is brought in, normally the head of material in front of the extension increases. More mix increases the resistance felt by the screed and the screed climbs. The change in mat thickness is abrupt and not spread out over several paver lengths.

Paving Up to Obstacles

- Some obstacles close to minimum paving width
- May have to shovel out mix in front of the extension
- Plan pulls to avoid large paving width changes

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Some obstacles end up being very close to the minimum paving width. Depending on the type screed you are using, you may have to shovel out of some of the mix in front of the extension so you can retract the extension all the way. Whenever possible, try to lay out the pulls to avoid these types of large paving width changes.

Paving Past Obstacles

- Back up to normal paving speed

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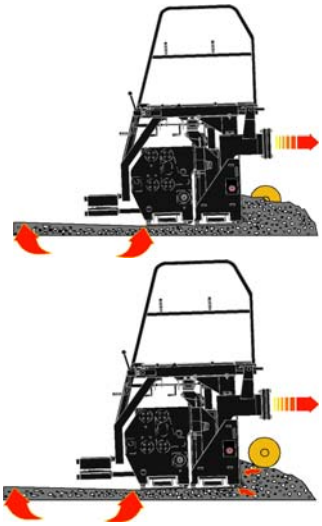
As the paver pulls past the obstacle, the operator normally brings the paving speed back up to the normal range.

Factors Affecting Screed



Increased Speed

- Shear factor decreases
- Depth decreases

Head of Material Decreased

- Resistance decreased
- Depth decreases

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As paving speed increases, the shear factor decreases . More mix gets pushed in front of the screed and less mix passes under the nose of the screed. Consequently, the depth of the mat decreases until all the forces acting on the screed stabilize.

During those times when the head of material in front of the main screed or screed extension drops below the desired one-half ager level, the screed will drop due to reduced resistance. The mat thickness will decrease quickly.

Paving Past Obstacles

- Screed extension back out to original paving width
- May have to manually refill the area in front of the extension

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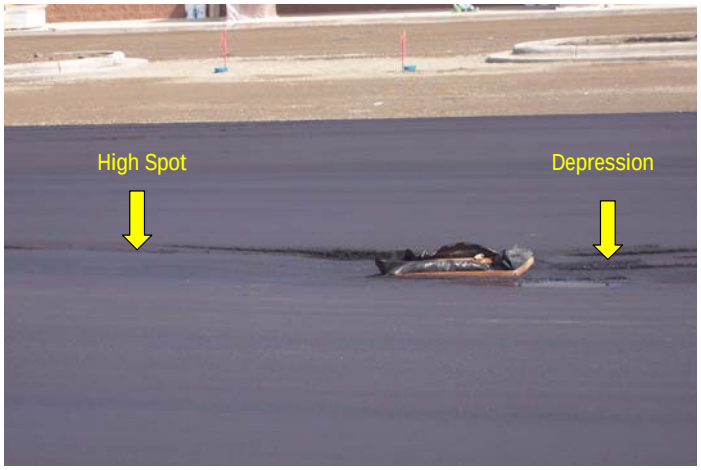
When the extension is brought back out to original paving width especially if the extension was retracted all the way, there is likely to be a lack of mix in front of the extension. You may have to shovel mix out to the end gate to avoid leaving voids in the back.

Obstacles



- Variations in paving speed and head of material create “bird baths”
- Height mismatch confirms bumps and dips on either side of the catch basin

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One of the worst flaws in a parking lot is a “bird bath” or depression. This view shows the high spot in front of the catch basin and the dip behind the catch basin. These mat defects are common and are caused by changes in paving speed and head of material. Part of the problem is also due to the hand work done prior to paving. There is one more lift to try to get it right, but the low spots will still compact down to low spots in front of the catch basin.

Variable Width Paving Tips

- Variable width paving is the norm in parking lots
- Sonic feeder sensors commonly used
- Understand the logic of sonic feeder sensors

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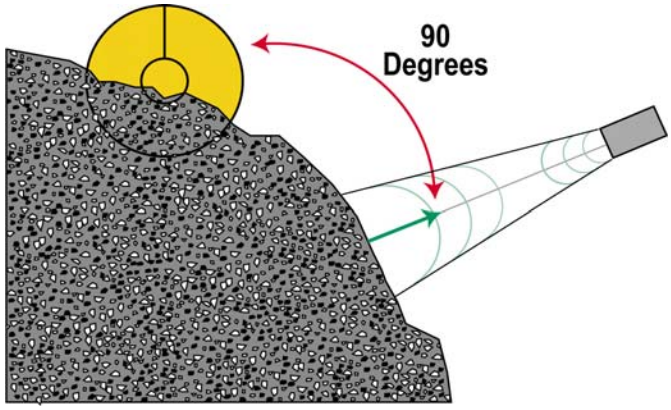
In parking lots, the crew is constantly challenged by variable widths. Since sonic feeder sensors are commonly used to help control the material feed system in parking lots, the crew has to understand the logic behind sonic sensors.

Principles of the Sonic Sensor



Sonic Sensor Alignment

- **The sensor should be targeted perpendicular to the material face**

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The sonic sensor must be installed so the sensor is perpendicular to the target. The sensor emits 40 sound pulses per second and expects to receive 40 returning echoes in order to make accurate calculations. When the sensor is aimed incorrectly, some of the sound pulse echoes do not go back to the sensor. Lacking full information from the sensor, the feeder system acts erratically.

Be careful not to target the end of the auger shaft. That's a stationary target. Likewise, don't get the rotating half auger segment in the target area.

Overriding the Feed Sensor

- Need to reduce head of material before retracting extension

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In this view, the screed operator has retracted the left screed extension while paving around an obstacle. Prior to retracting the extension, he overrode the feeder sensor to reduce the head of material. There are two ways to override the feed system.

Overriding the Feed Sensor

- Need to build up excess material prior increasing paving width

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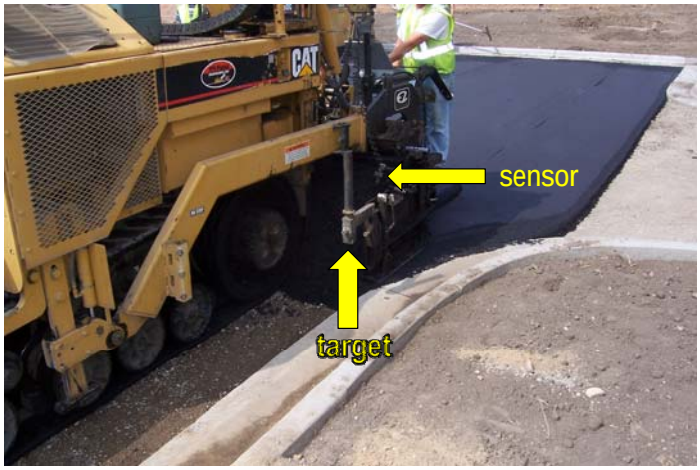
When the operator pulls past the obstacle and prepares to increase the paving width, he needs to build up excess material so there are no voids in the mat at the outer edge.

Variable Width Tips: Sensor Aiming



- Operator must plan for narrowest width
- Must avoid targeting the auger when extension is pulled in

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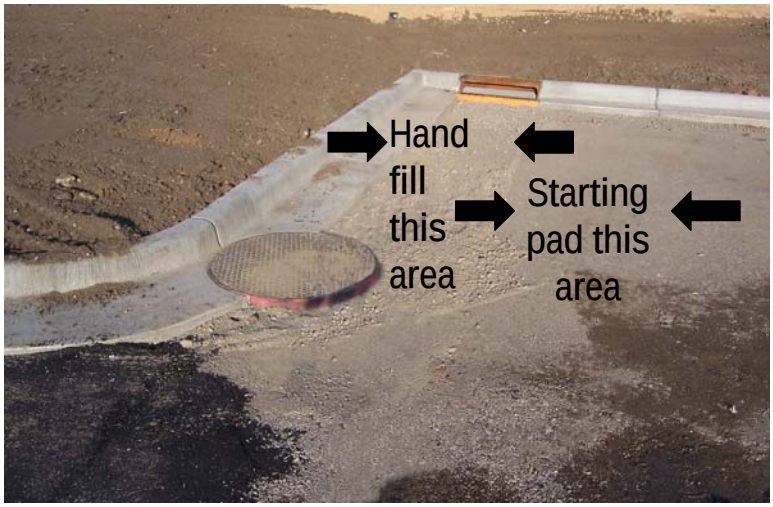
The operator has planned ahead for the narrowest paving width this pull. With the extension pulled in close to the main screed, a sonic sensor can be difficult to aim. The auger shaft is frequently in the target area and the feeder system will run erratically. By aiming the sensor almost straight down, the operator has anticipated the problem. And, as mentioned earlier, planning to avoid problems is very important when paving parking lots.

Working Around Obstacles



- Never set down on a raised manhole cover
- Do handwork to fill around manhole
- Build starting pad to correct pre-compaction height

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Never set the screed down on a manhole cover. It may look like the right place to start, but a pad built to the correct pre-compaction height is a better choice. Sometimes, no matter how well planned the project, there will be a lot of handwork around obstacles.

Starting Pads

- Time-consuming
- Difficult to create correct pre-compaction height and slope
- May create a poor reference for the screed to set on

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In parking lots, the crew will probably have to create a lot of starting pads. This activity is time-consuming and also fatiguing for the crew members. Another problem is the difficulty getting the pre-compaction height and the slope just right. Finally, there is the issue of setting the screed down on a non-compacted surface.

Starting Pads

- Alternate method – use starter boards
- Build pad around boards
- Boards provide a hard take-off surface
- Does require hand work to fill in when boards are picked up

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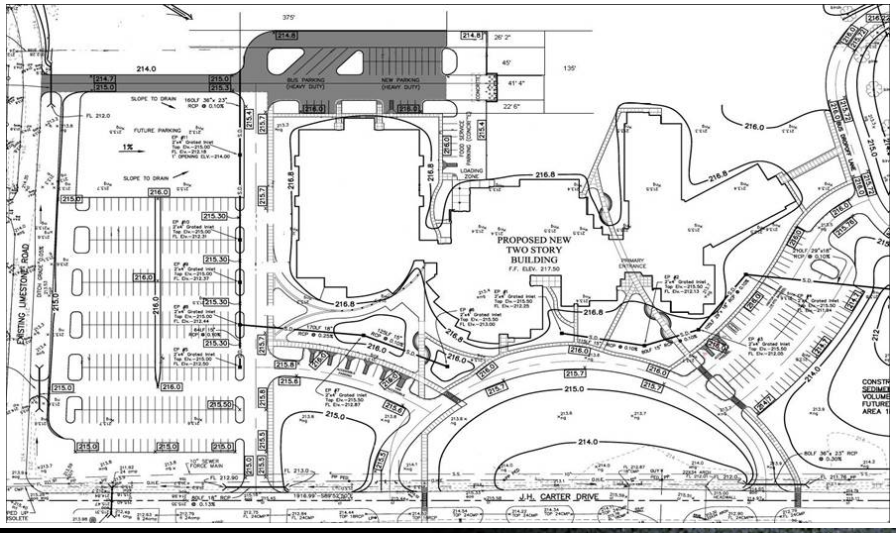
Depending on the situation, the crew may want to use starter boards to help make better pads. The boards provide a hard surface that facilitates nulling the screed and taking off with the correct angle of attack. The draw back is the requirement to do the handwork after the boards are picked up. This alternate method is recommended when making long pulls.

Project Planning



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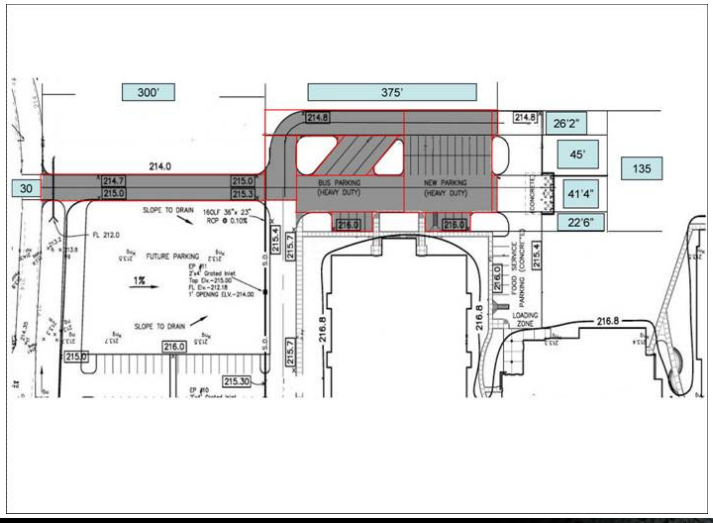
Project planning is the key to success. Although paving principles and techniques always apply to paving applications, their order of importance sometimes changes when dealing with commercial applications. Looking at this job, the limitations of the paver will dictate how the job is laid out. If there are several pavers to choose from, there are more options for planning purposes. If only one machine is available, the paving plan will revolve around that machine. After the job is laid out, a compactor that matches the paver should be selected. If there are density requirements, they will play a part in the decision for type and number of compactors. Equipment choices are an integral part of the planning process.

For a highway job, the output of the plant and the limitations of the compactors dictate the speed of the paver. In commercial applications, the constraints of the parking lot are going to dictate the speed. The same principles of starting and stopping and maintaining a constant speed apply to parking lots, but the paving process is going to be interrupted frequently.

Layout: Figuring Tonnage



- Divide your project into areas such as squares, rectangle, triangles and circles
- You can also take the whole area and subtract the area of obstacles such as islands and sidewalks

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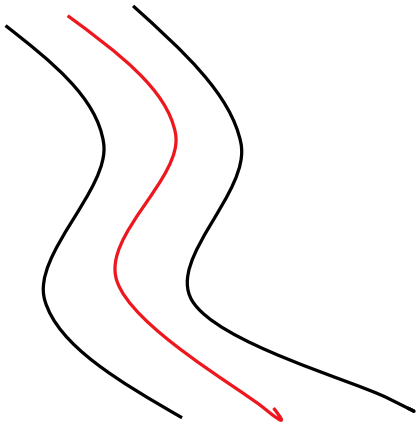
To calculate the paved surface area, divide the paved areas into geometric shapes such as squares, rectangles, triangles and circles. Another approach is to calculate the whole area and then subtract the area of the obstacles such as islands and sidewalks. Either method should produce the same square footage.

Layout: Figuring Tonnage



- When measuring curves, measure the centerline.
- Multiply the distance by the width of the mat to determine area

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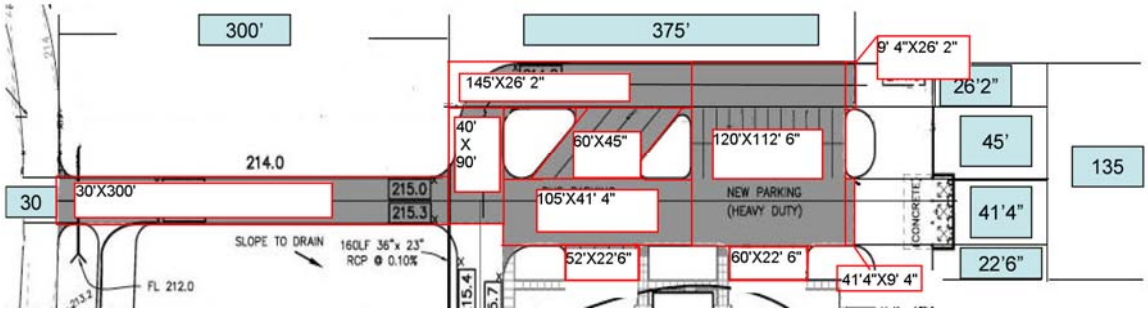
If there is a curved drive in the area to be calculated, measure the length of the curve at the centerline. Then, multiply that linear distance by the width of the mat to get the square surface area.

Layout: Figuring Tonnage



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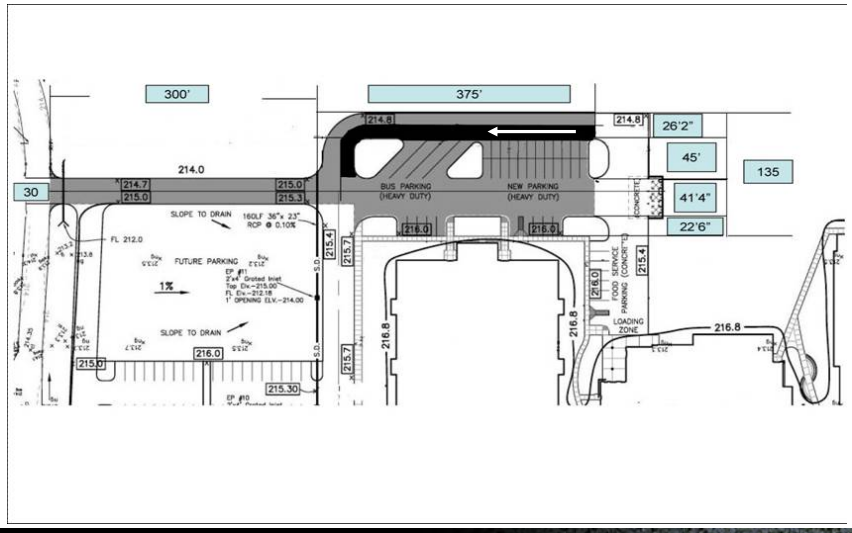
Using the dimensions of each area calculate the square footage. Round the measurements to whole numbers

30x300 = **9,000** sq ft., 145x26 = **3770** sq ft, 40x90 = **3600** sq ft, 60x45 = **2700** sq ft, 105x41 = **4305** sq ft, 52x23 = **1196** sq ft, 120x113 = **13560** sq ft, 60x23 = **1380** sq ft, 9x26 = **234** sq ft, 41x9 = **369** sq ft. Completing all the additions yields a total of **40,114 square feet**.

Layout: Parking Lot



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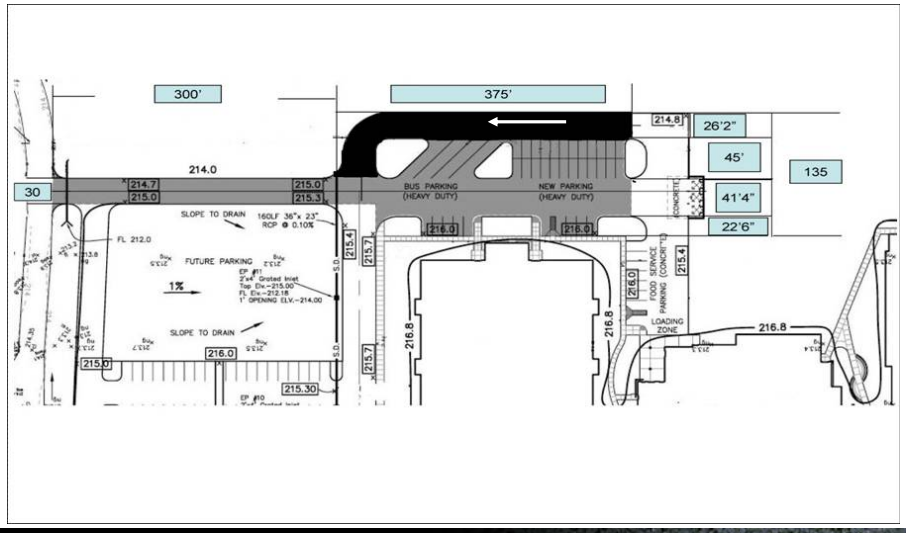
Although there are a number of ways people would attempt a job… Ideally you want to plan your pulls to eliminate truck turning or driving on the asphalt where possible, prevents marking and overcompacting of material. By pulling the left lane first, the truck drivers are in position to see the edge of the asphalt on the next pull – the right lane. Trucks are less likely to back over the edge of the fresh mat, so the paving crew will have a good joint match and produce a better end result visually.

Carefully mark out the laydown you have planned using marking paint

.

Layout: Parking Lot



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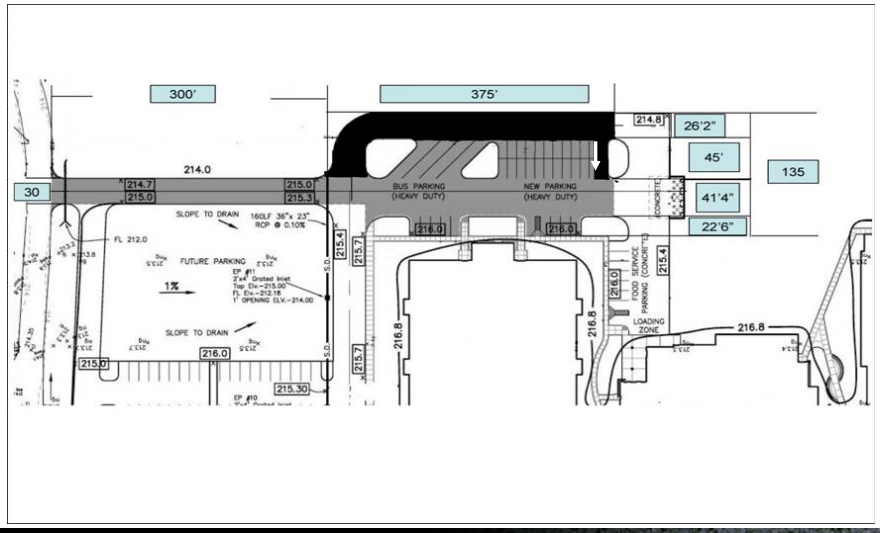
Now both drive lanes have been completed. There is a proper centerline that will line up with the painted lines. Each lane has also been pulled without a joint, allowing for the smoothest possible ride.

Layout: Parking Lot



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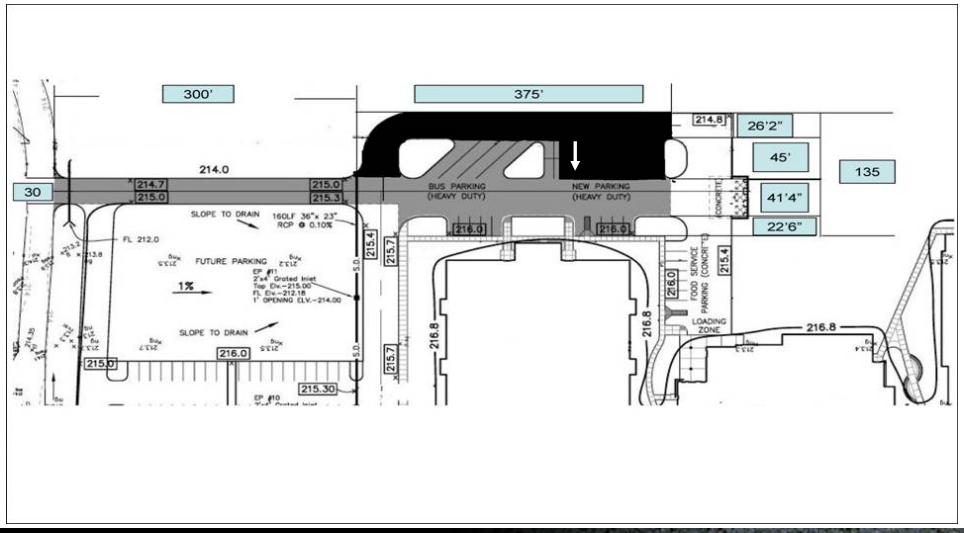
Paving Products

The next move allows using the previously laid mat as a pad to take off from. There is no need to build a starting pad so the goal of reducing strain on the crew is being met.

In this example, the screed will extend to 19 feet and 6 inches and the distance between islands is 120 feet. Eight uniform pulls that are 15 feet wide lets the crew fill in the 120-foot length. Since the pulls are less then the maximum paving width of the screed, there is room to compensate for any minor errors made during the calculations.

Layout: Parking Lot



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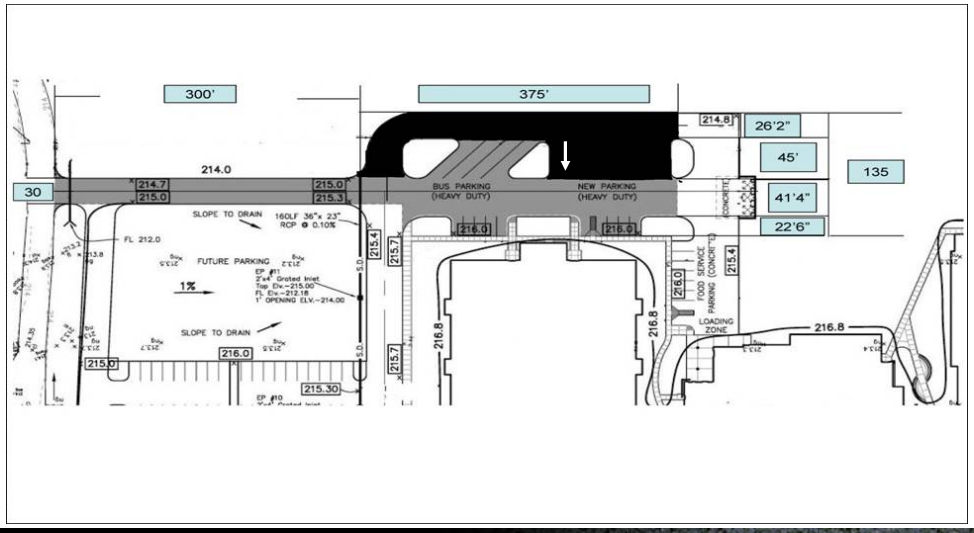
There is now one last pull between these islands. The crew can address again the “orphan” area on top of the offset center island, That area is now 33” wide by 11 feet and 3 inches long.

When the crew sets back on the starting reference, the screed can be widened to reduce the width of the unpaved area in front of the island to 81” As the paver pulls off and moves toward the island, the right extension is brought in to run flush to the island curb.

Layout: Parking Lot



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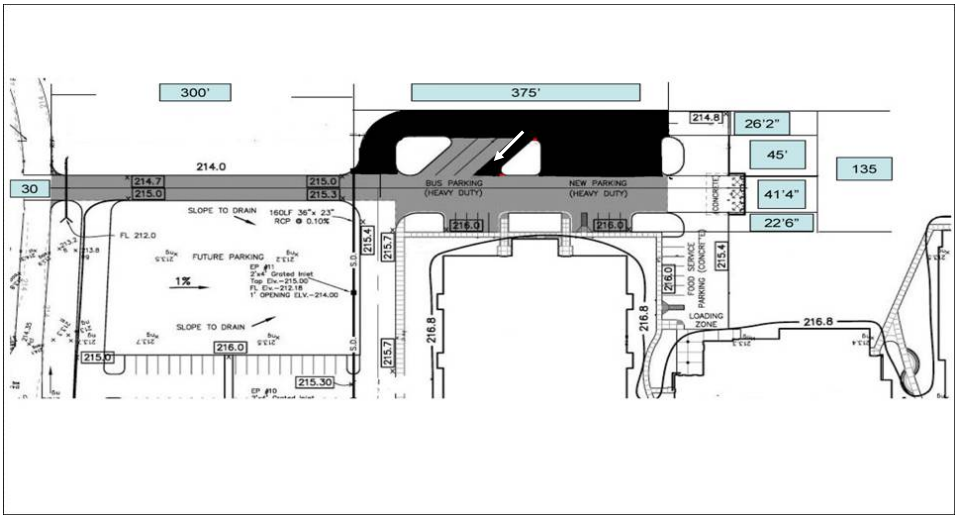
Paving Products

Notice how the curbs of both islands have changed angles. To maintain even pulls and perform the least amount of hand work, the crew will be required to make the next series of pulls parallel to the curbs.

The distance between the curbs is 60 feet making each lane 15 feet wide. As before, the left extender will be moved out 54 inches at the start of the pull towards the curb. This will decrease the 81 inch void at the top of the curb to 27 inches.

Layout: Parking Lot



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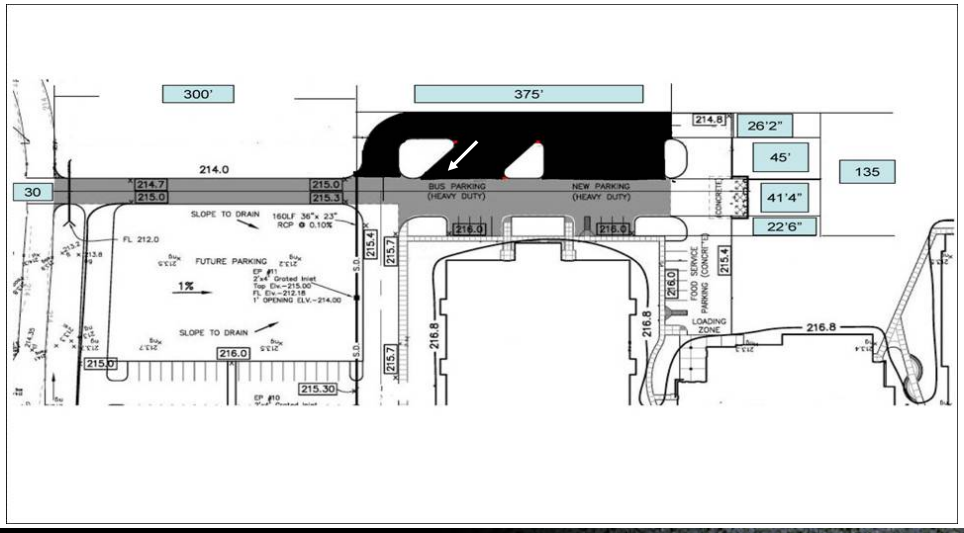
Paving Products

The red spots indicate hand work. At the top of the island there remains a void that is 27 inches by 33 inches. This will have to be filled in by hand. The advantage is the crew has a mat on each side of this void they can use to maintain the proper depth of material. The worst case scenario is that this area could be low and hold water. However, a low spot, if any, will be away from the driving lane and not in a parking spot.

The effort of the crew was to minimze hand work and to leave any hand work for an area that is out of the traffic flow and parking areas. That was accomplished in this example.

The same is true with the red spot at the bottom of the island.

Layout: Parking Lot



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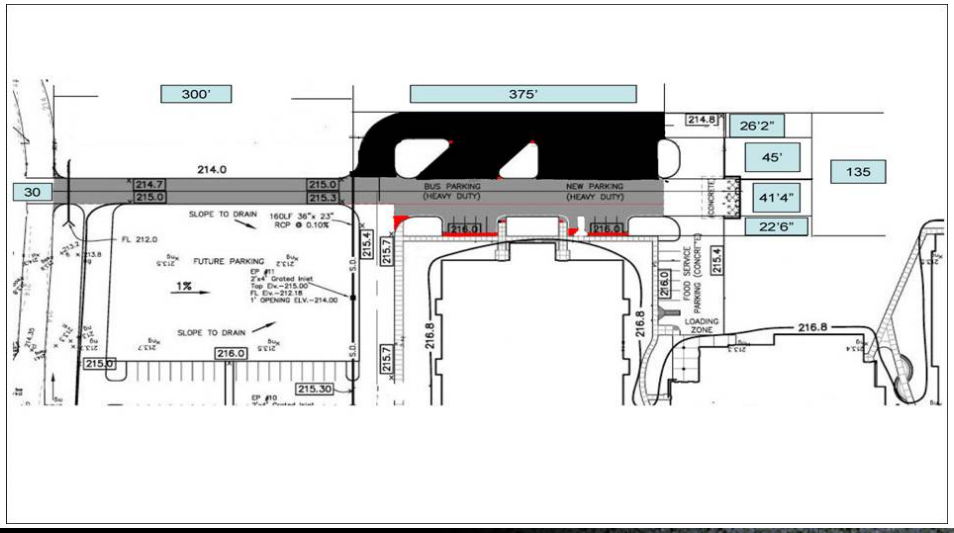
Paving Products

The last pull completes the area. The screed width had ample extension left to correct the final pull width. A small amount of hand work is required at the ends of the curved island.

Layout: Parking Lot



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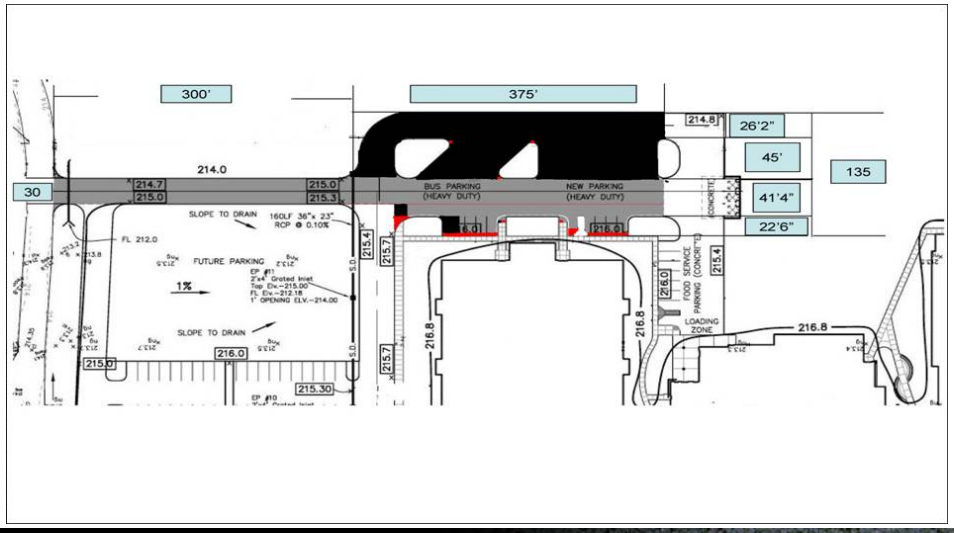
Now the crew moves to the lower portion of the parking lot where more hand work is needed. At the left end, the tapered area will be filled by hand. The tapers in the center and the area between the sidewalks also get filled in by hand. Both lower parking areas will need pads built for starting reference as no suitable reference exists.

Layout: Parking Lot



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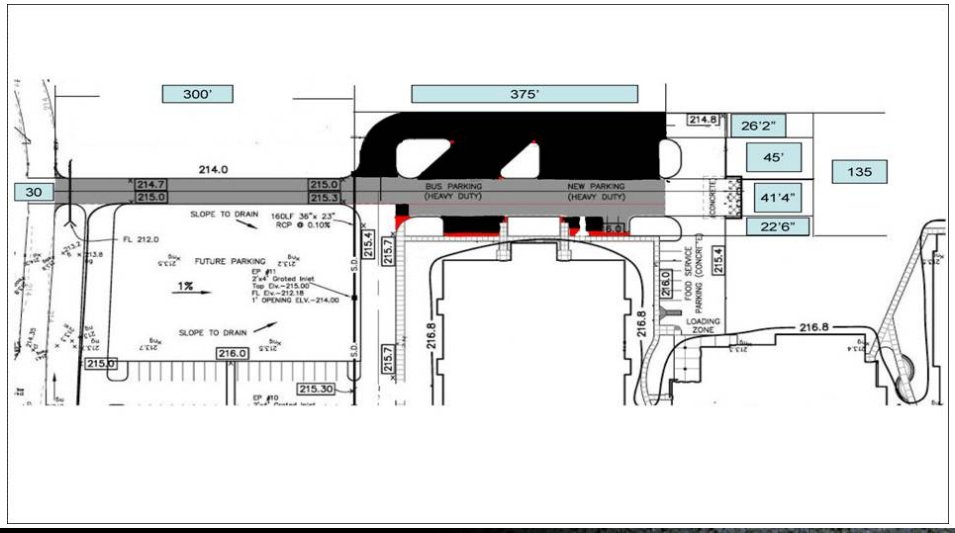
The crew starts out with a short pull to the left. It is roughly 11 feet long but is necessary as it it will serve as a starting pad later.

Next, the crew begins to work its way across the parking spaces, starting on hand made pads and making 22-foot long pulls. The distance between curbs is 52 feet 6 inches. Planning ahead, the crew makes the first two pulls at 15 feet, 9 inches. The last two pulls are made with the screed at 10 feet, 6 inches. The shorter widths on the last pulls give the crew extension length to catch the area at the end of the sidewalk. It is important to always try to take advantage of the screed's capabilities rather than doing hand work.

Layout: Parking Lot



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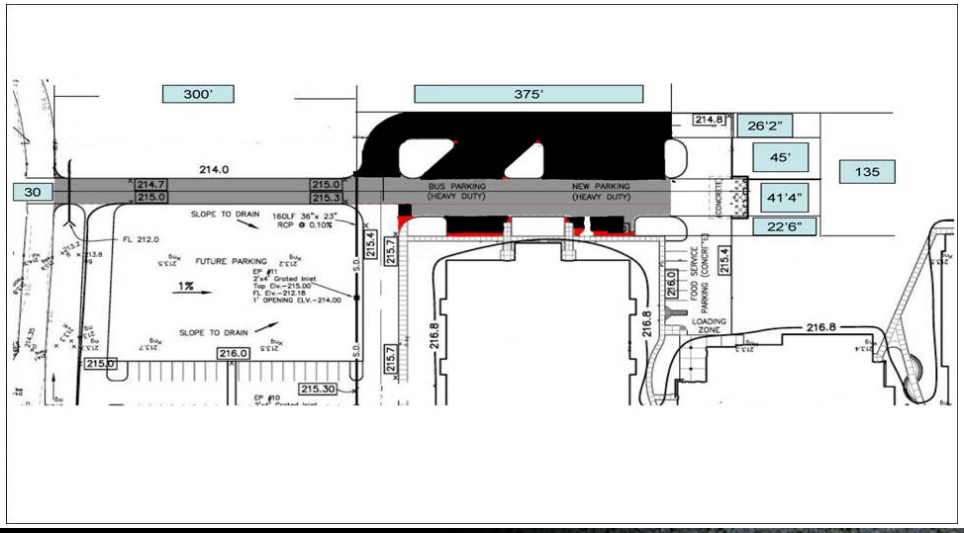
As the crew moves to the other side of the lower parking lot, they can either do hand work between the side walk and center island or they can do as little hand work as possible and use the paver for the last 10 to 14 feet.

Layout: Parking Lot



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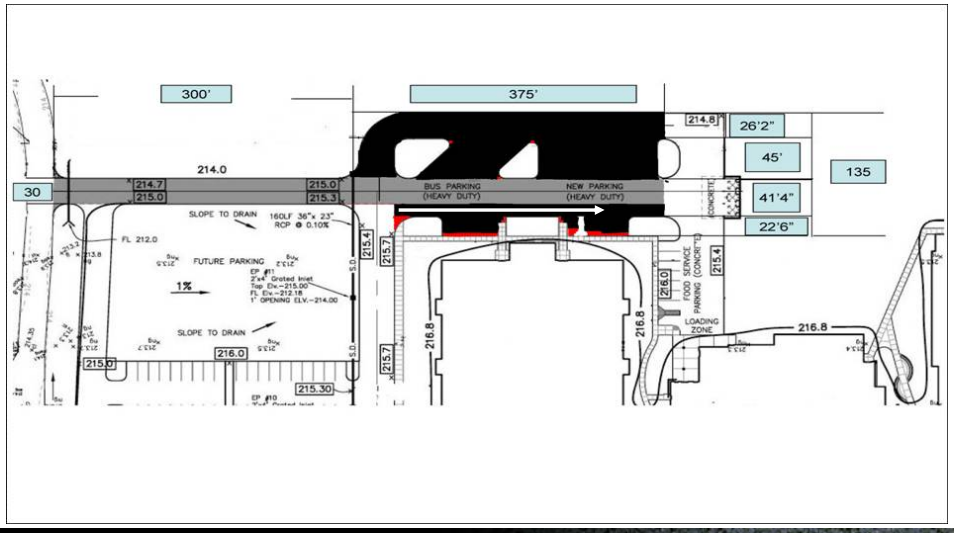
Moving across the lot the crew will continue to measure the remaining width and set up the screed to make pulls as evenly spaced as possible. The visual appearance is improved, plus the crew is trying to avoid, whenever possible, creating situations where they must overlap the previous mat (hot lap).

Layout: Parking Lot



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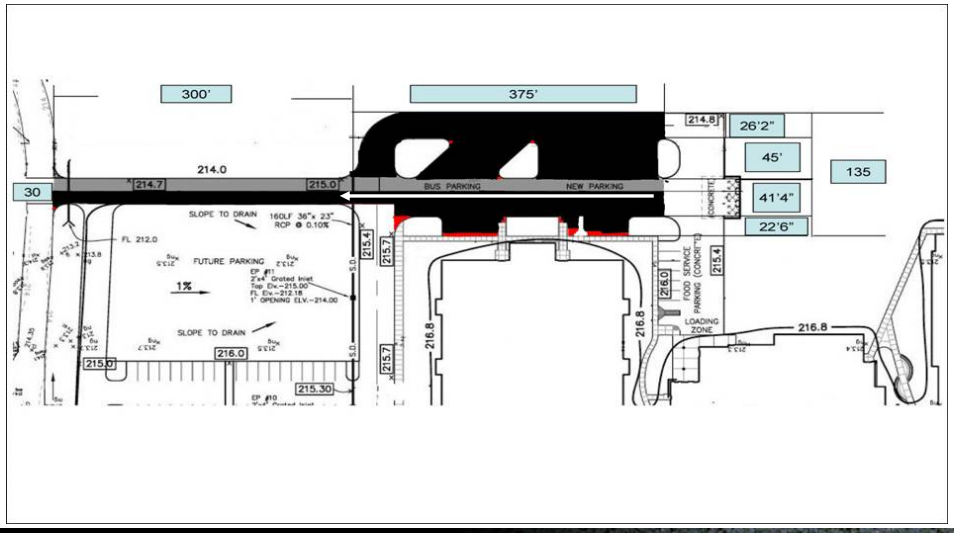
The crew was able to make one last long pull from left to right to finish the parking area. The starting pad was already there because the left end was the first paved in the lower lot. The crew is able to end the pull by taking the paver all the way up on the concrete apron.

Now, the crew is in a position to finish by making two 15 foot pulls straight out to the main road.

Layout: Parking Lot



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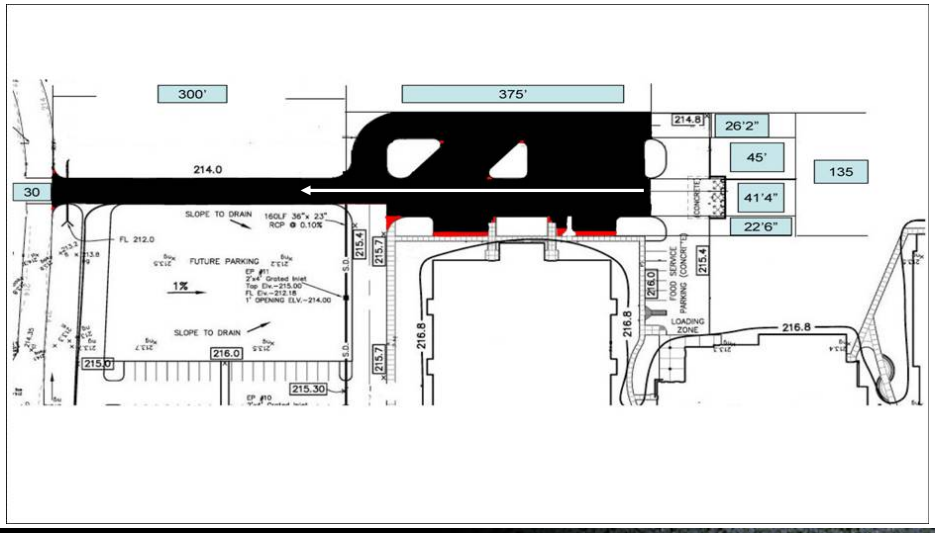
Again, the crew deliberately pulled the left lane first so the truck drivers have the best visual contact with the centerline edge when backing into the right lane. The operator should be following a string or paint mark at the centerline of the entrance lanes to provide a straight joint for matching. The left side of the screed is height matching the pull made across the lower lots. Then, the left side reference changes, maybe to a specified slope for the last half of the pull. The left side screed operator may have to change end gate height as well as the grade / slope use.

Layout: Parking Lot



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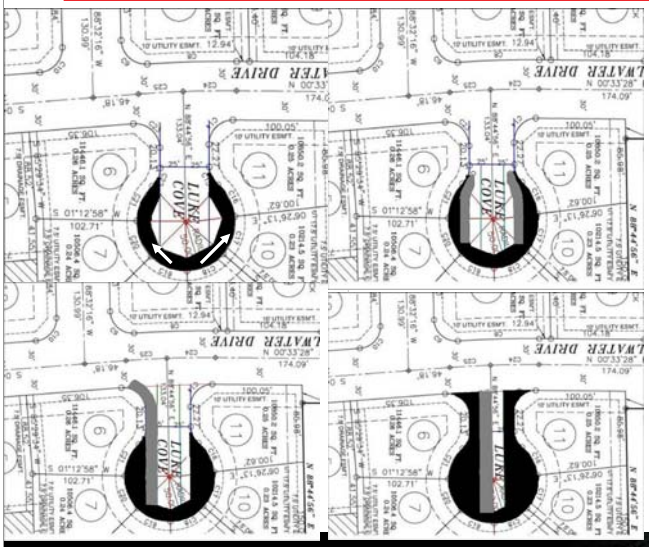
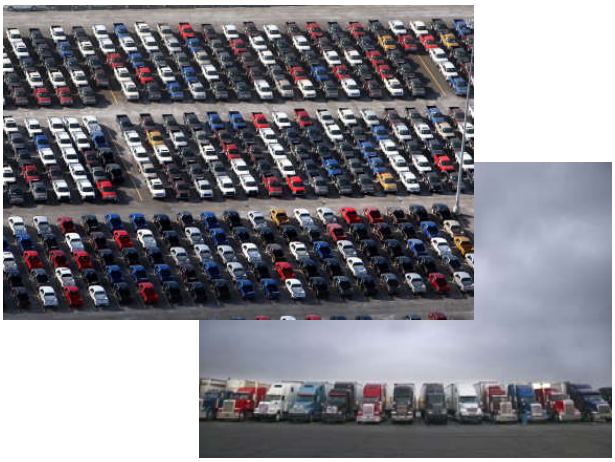
Finally, the crew makes the last pull. In the case, the paver is set up to joint match on the left side for the entire pull. Automatic grade control will make the joint match much easier than running the screed manually. The right side of the screed will joint match for the first half of the pull. Then, the grade reference changes. The screed operator will have to make the decision how to run the screed through the changing references. It depends on what the specifications dictate and also what existing grade reference is available. Even in parking lots, it is recommended to use the paver's grade and slope system whenever possible for control of yield and control of profile for drainage.

Project Planning: Cul de Sacs



- Have an exit strategy!
- Number of pulls depends on the diameter and paver
- Take care of those orphan spots where needed

Load Factor and Frequency



- Consider specifications
- Heavy traffic
- Constant heavy loads
- Mix requirements

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Is the parking lot used frequently? Consistent heavy traffic or loads? Gas stations, truck stops, need more consideration vs average parking lots.

This should already be considered by the customer and understood.

Compactor Selection

- Variety of sizes needed
- Hand tampers
- Utility Class
- Production class

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Most of the time in parking lots, you're going to need a variety of compaction equipment – ranging from hand tampers to utility size compactors up to production class compactors.

Utility Size Compactor

- One meter (40”) or less drum width
- Confined areas
- Transverse joints
- Tight radius

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We classify utility compactors as having drum width one meter (40”) or less. The utility class compactor is needed to work in confined areas and around tight radius obstacles. They are also useful when compacting transverse joints and there isn’t much room to come on from the side of the joint.

Radius Compaction

- Hand tamper
- Utility Compactor
- Motorized tamper
- Clogs?

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In this view, we se a tight radius around an island in the parking lot. Successful compaction will require a hand tamper or a utility class compactor.

Radius Compaction: Wide Drum

- Outside edge of wide drum is shoving hot mix
- Mat distorted and cracked
- Consider split-drum machine

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If we use a production class compactor to roll around a radius, the mat will crack. The outer edges of the drums will tear the mat in tight radius compaction. Only a split drum production class compactor would be acceptable for this application. I ideally, we would use a narrow drum, utility size compactor.

Calculating Required Drum Width

Paving Width	Roller Width 31"	Roller Width 35"	Roller Width 39"	Roller Width 47"	Roller Width 51"	Roller Width 59"	Roller Width 67"	Roller Width 79"	Roller Width 84"	
8'	4	3.5	3	2.5	2.3	2	1.8			
9'	4.25	3.8	3.4	2.8	2.5	2.2	2	1.7		
10'	4.6	4.1	3.6	3	2.8	2.4	2.1	1.8	1.7	
11'		4.5	4	3.3	3	2.6	2.3	2	1.9	
12'			4.3	3.6	3.2	2.8	2.5	2.1	2	
13'			4.6	3.8	3.5	3	2.7	2.2	2.1	
14'				4.1	3.8	3.3	2.8	2.4	2.3	
15'					4	3.5	3	2.6	2.4	
16'					4.2	3.7	3.2	2.7	2.6	
17'					4.5	3.9	3.4	2.9	2.7	
18'						4.1	3.6	3	2.9	
To determine minimum drum width for a maximum 3 overlapping pass coverage: ((Paving width X inches) + 24 inch drum overlap) divided by 3										

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This chart is a quick reference for how many passes a certain width roller will have to make to cover a mat. The chart shows that drum width must be at least 59” to cover a 12-foot mat in three overlapping passes. Wide drums on narrow mats are always going to be a problem. Weight of the compactor is important, too. But, for commercial applications, drum width is normally the primary consideration.

Doing many 10ft-11ft passes or less? Example using a 51” compactor may be enough to get the coverage you need.

Compaction – Combination Rollers

- Good alternative particularly for parking lot work
- Use of breakdown and kneading effect of tires
- Space convenient, transport simplified

Phases of Compaction

- Breakdown
- Intermediate (rubber tire – kneading effect)
- Finish (no vibe, remove marks from rubber tire)
- In cases, combi may do the work of two machines

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No matter how many compactors are on the job site, the compaction process must be arranged in three phases: breakdown, intermediate and finish

Breakdown Compaction

- Parking lot mixes can be tender
- Watch for distortion due to high temperature
- Temperatures will vary with mat thickness
- Stay back from the paver if there is mat distortion

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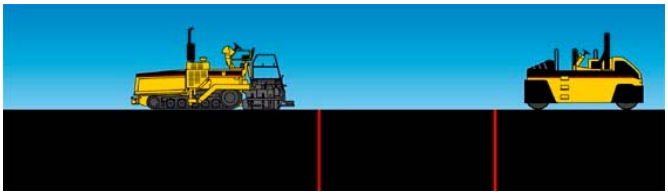
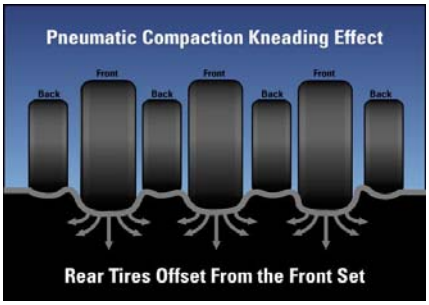
During the breakdown compaction phase, the compactor is working on the hottest mat. Since parking lot mixes are usually relatively fine, they may be tender due to temperature. Watch for mat distortion in front of and alongside the drums. Where the mat is thick, the temperature will be the highest. Move the breakdown compactor back away from the paver if there is tenderness due to high temperature.

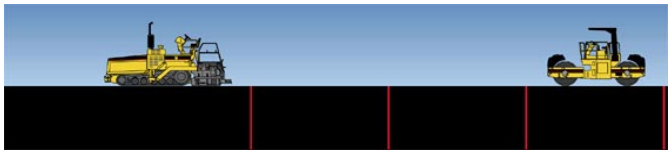
Intermediate Compaction





- Next step in getting density and initial smoothness
- Mat hot enough to allow aggregate movement
- Mat already close to final density
- Too much force will fracture aggregate

Finish Compaction



- Minimal compaction
- Main purpose is smoothness and removal of any marks
- Once smooth, stop rolling

Selecting Compaction Amplitude

LOWER AMPLITUDES

Parameter Level ⇦	Parameter	⇦ Parameter Level
Thin* < 2" ⇦	**Mat Thickness**	⇦ Thick > 2"
Rigid ⇦	**Base Support**	⇦ Flexible
Low ⇦	**AC Viscosity**	⇦ High
Rounded ⇦	**Aggregate**	⇦ Angular
High ⇦	**Temperature Base Air**	⇦ Low

HIGHER AMPLITUDES

* For very thin lifts, vibration is not recommended, especially on rigid base supports.

- Consider factors which affect compaction when selecting equipment and setting rolling pattern
- Commercial leans to the left typically

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This chart helps tie together all the compaction factors that just been covered and will help us determine how much compactive force is needed for a particular application. Down the left side are the application factors which would tend to lead us to select lower compactive forces.

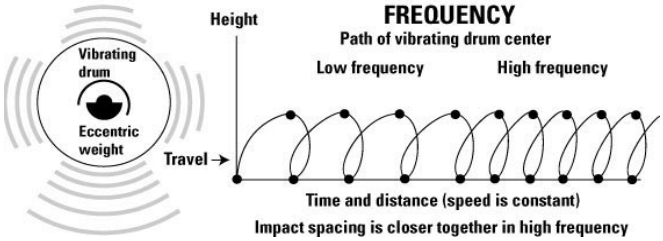
- The mat is thin – 2 inches or less.
- The base is rigid – like an overlay
- Asphalt cement viscosity is low – it flows easily.
- Aggregates are rounded – low internal friction.
- Ambient temperature is high.

Down the right side are the application factors which would tend to lead us to select higher compactive force.

- The mat is thicker than 2 inches.
- The base is flexible – as in new construction.
- Asphalt cement viscosity is high – in other words, it is stiff.
- Aggregates are angular – high internal friction.
- Ambient temperature is low.

Not every application has all the factors neatly lined up like this. Often, there is a mixture of “high force” and “low force” factors. And some are more important than others.

Vibratory Frequency



- Frequency is drum impacts per minute
- Working speed must match frequency
- Best results when impact spacing is 8-14 per foot

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The other aspect of vibratory force is frequency. Frequency is defined as the number of times that the drum hits the mat and is rated in vibrations, or impacts, per minute.

The important thing to know about vibratory frequency is its relationship to the machine's working speed. For a given working speed, a machine with a low frequency will produce relatively wide impact spacing. If the same speed is used on a machine with a high frequency, the impact spacing is closer.

The best impact spacing can vary from mat to mat. But as a rule of thumb, the smoothest mat and best production results when impact spacing is maintained between 8 impacts per foot and 14 impacts per foot.

The Compaction Process

- Just as important as mix production and laydown
- Operator must understand forces of compaction
- Know how to balance weight, tire pressure, amplitude, frequency and rolling speed

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In summary, asphalt compaction is a crucial part of the total paving process – just as important as the mix production at the asphalt plant or laydown by the paver. The compactor operator must understand the compactive forces generated by the machine and how those forces help to get density in the mat. Achieving the maximum compactive force is usually accomplished by experimentation with the variables which the operator can control – ballast weight, tire pressure, amplitude, frequency and rolling speed.

Commercial Applications

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