WSDOT's Experience Resurfacing HMA Bridge Decks

DEPTH – DENSITY – WEIGHT

DEPTH – DENSITY - WEIGHT

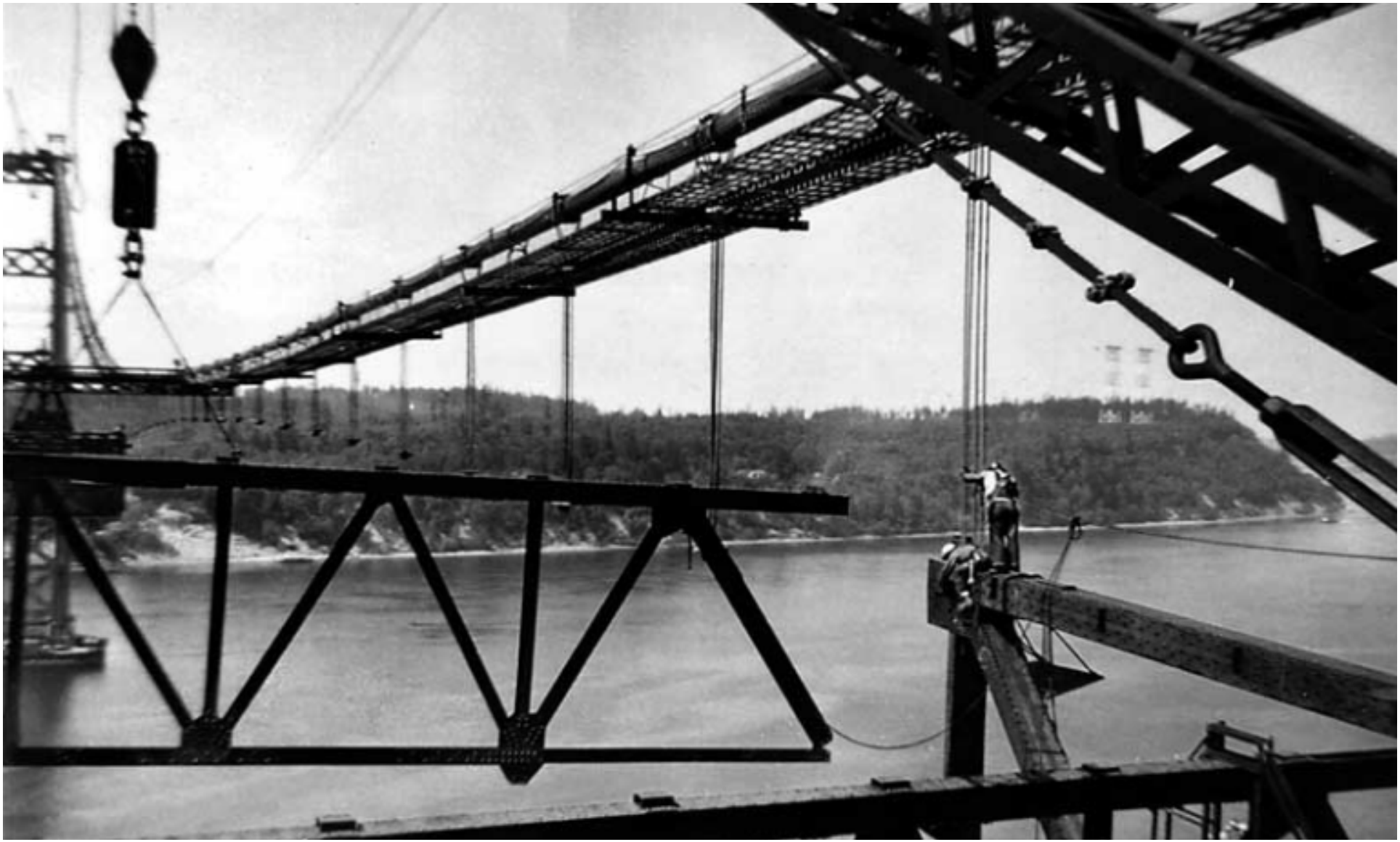
- HMA DEPTH – 0.15 feet (2”) Ideal Minimum
- ACTUALS = 1” to 8”
- HMA DENSITY – 95% Compaction
- ACTUALS = Less than 90%
- DESIGN WEIGHTS – 2” HMA + HS20 or HL93
- ACTUALS = 1”-8” HMA + Modern Equipment

SR 20 Canoe and Deception Pass

Deception Pass – Gusset Plate

SR 16 Tacoma Narrows

TNB Floor Truss



TNB Floor Truss

SR 153 Methow River Bridges

SR 153 Methow River Bridges

WSDOT's Experience Resurfacing Bridges with HMA

Bridge Paving

- Roller Vibratory Mode Is Not Allowed on WSDOT Bridges
- Density Sampling was not performed on Bridges – Nuke Gage testing used for roadway density tests will not work on thin overlays
- Result – Low density -Low petroleum content - low compaction energy- no density testing

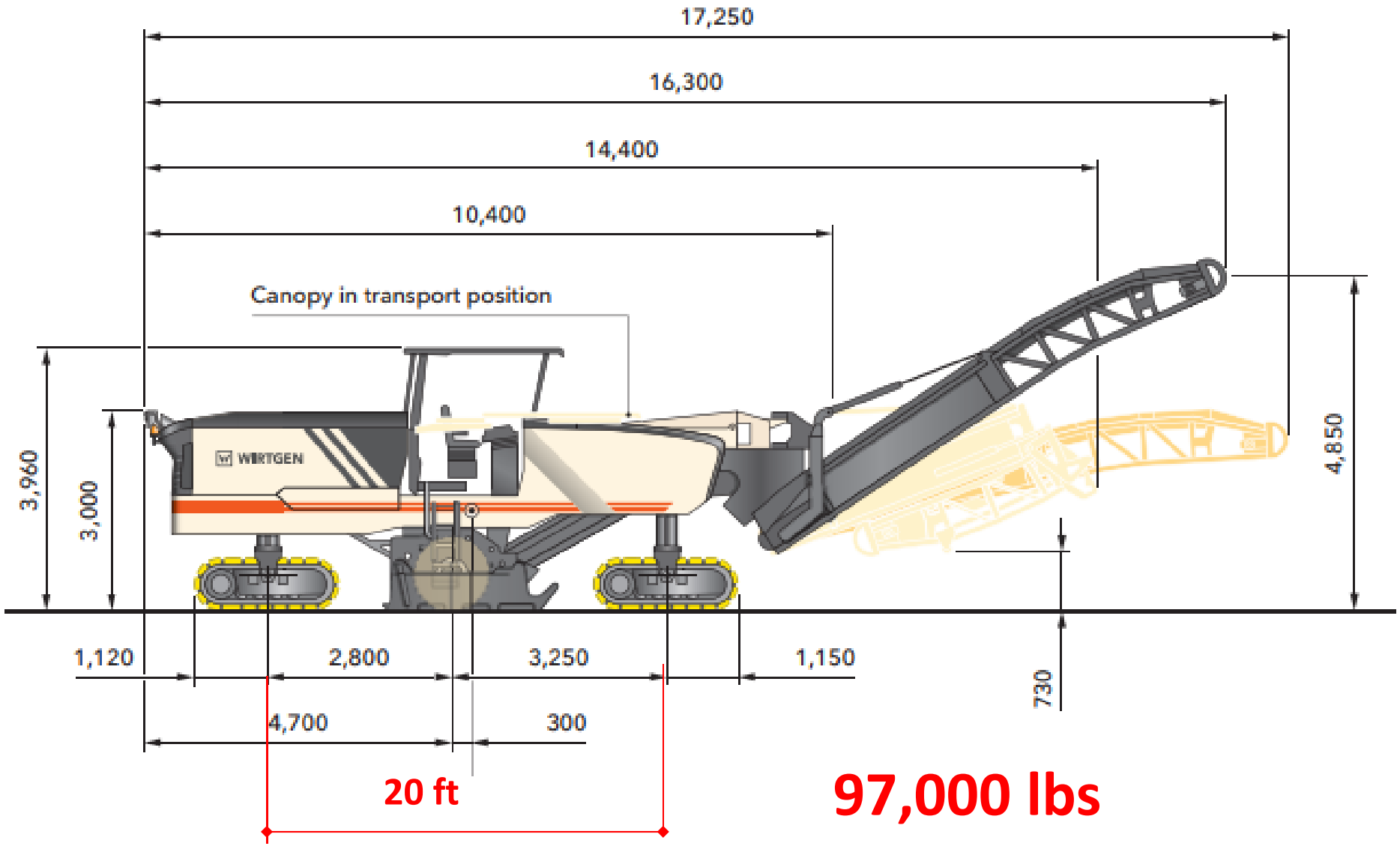
REMOVING HMA - COLD MILLING

TRUCK QUEUE for HMA Harvest


REECE
TRUCKING & EXCAVATING
PM200
CAT

WIRTGEN W250i

57 ft

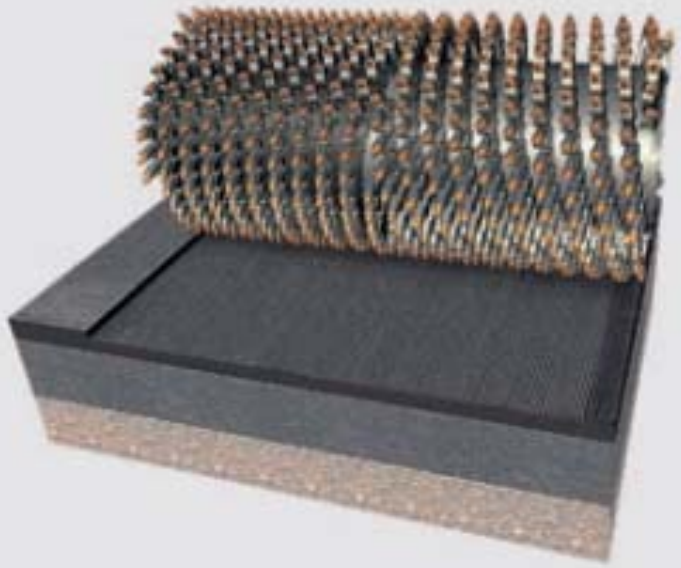


97,000 lbs

Cold Milling Drums

Standard milling drum

Milling width:	2.2 m
Milling depth:	0 - 350 mm
Tool spacing:	15 mm

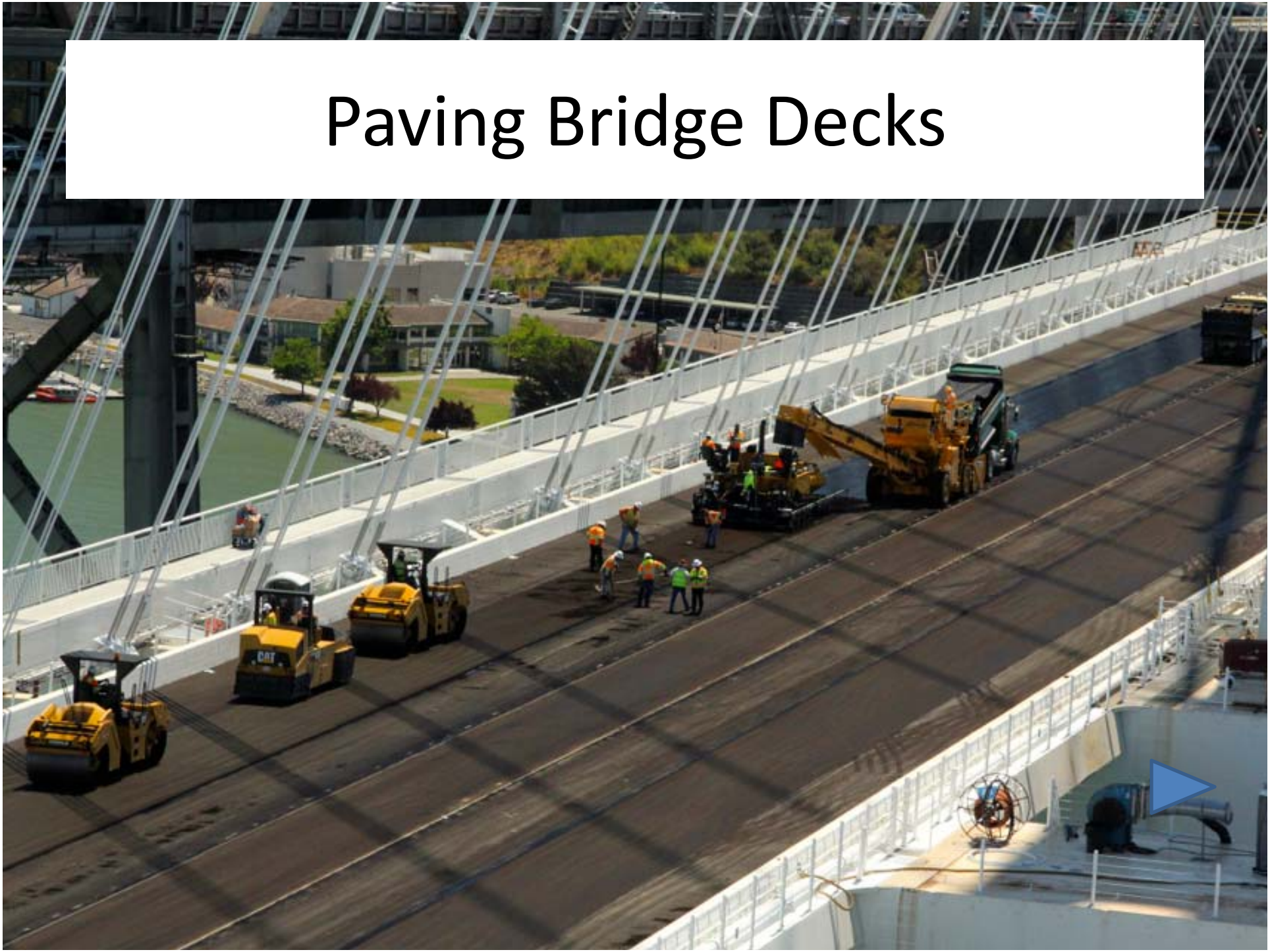


Micro-fine milling drum

Milling width:	2.2 m
Milling depth:	0 - 30 mm
Tool spacing:	6 x 2 mm

Cold Milling Bridge Decks

Paving Bridge Decks



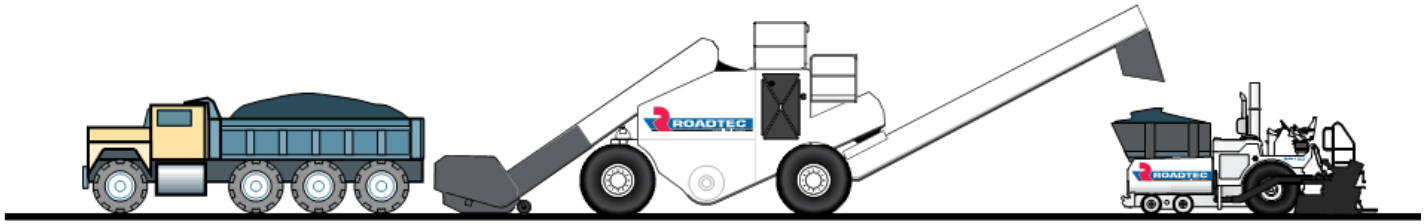

E1250
A6

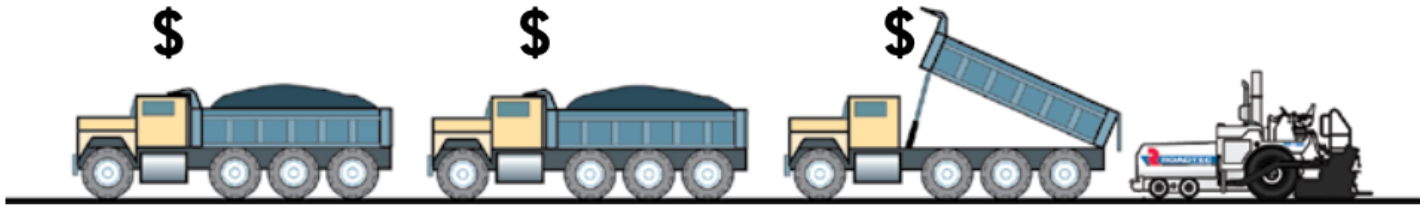

CATERPILLAR

MTV – ROADTEC 2500

MTV ECONOMICS

If you can create a buffer of material at the job site by using a Shuttle Buggy® MTV, you won' have to use trucks as storage bins to keep the paver supplied with mix. Don't let money sit or the road. Use fewer trucks.





How to Maximize Storage Capacity

The Roadtec Shuttle Buggy® MTV has a 25-ton (22.7 metric tons) storage bin. Add an insert to the paver and you get another 10-15 tons (9-14 metric tons) of

TRUCK CYCLE CALCULATION

	Without Shuttle Buggy	With Shuttle Buggy

UNIFORM THERMAL MIX

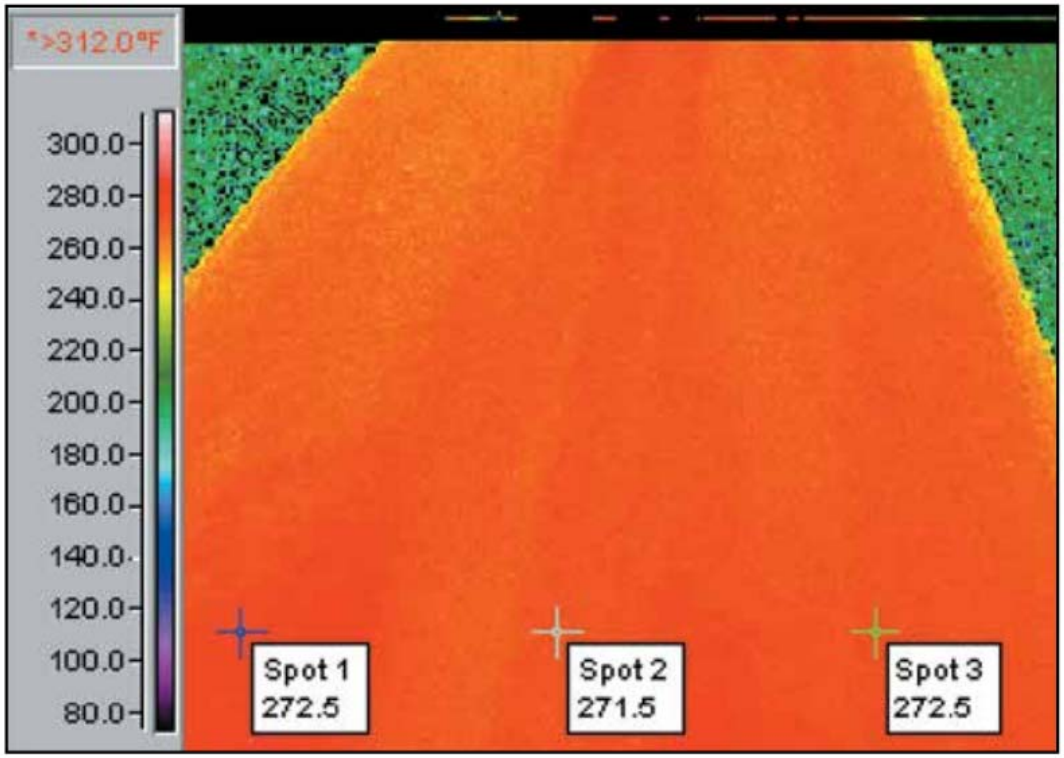
Roadtec Remixing Technology

Infrared images show the quality of remixing that takes place with different devices. Time after time Roadtec machines have consistently performed better than others. Roadtec mixing technology is better engineered and achieves superior results.

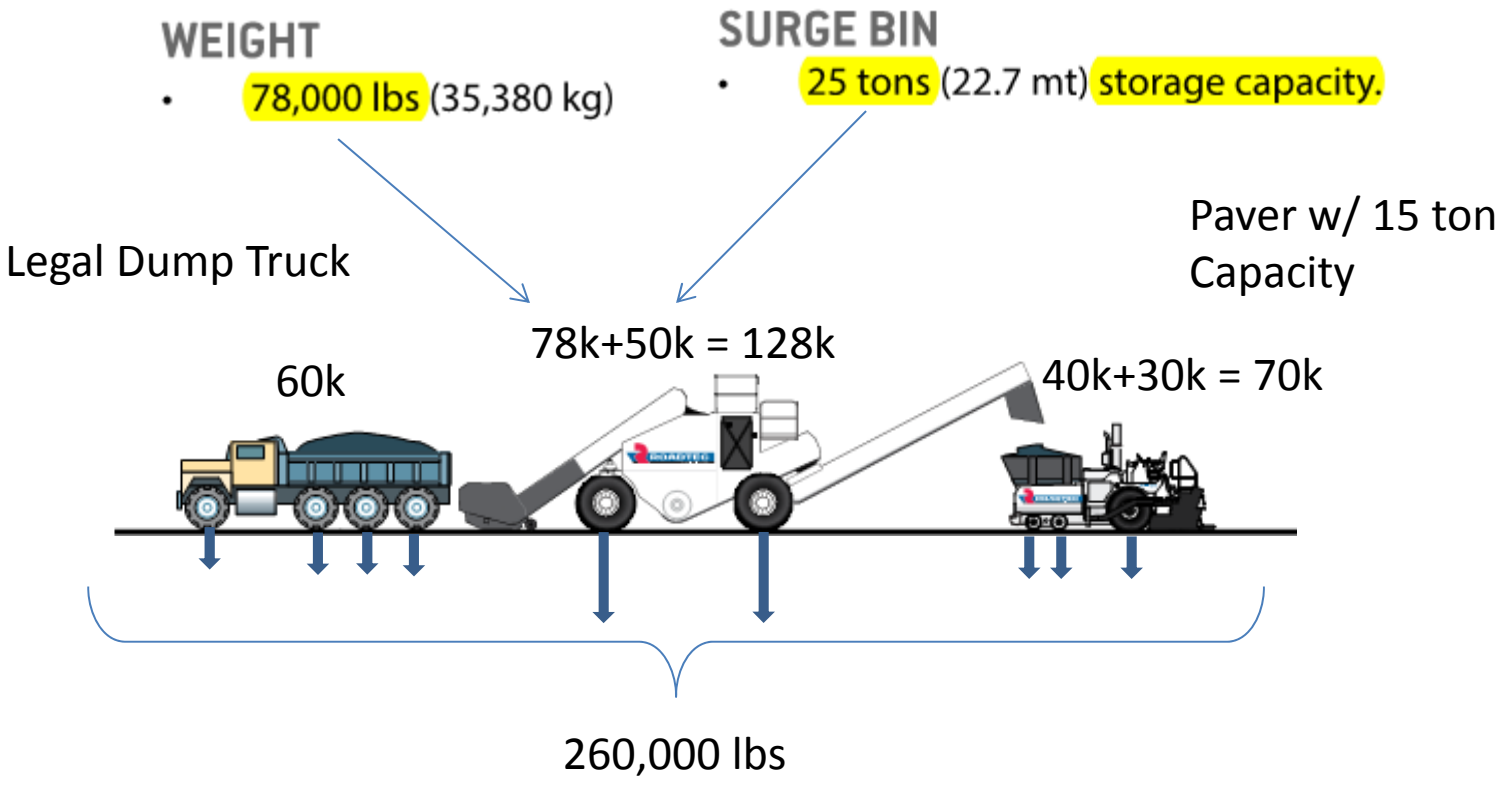
Proof in Thermal Imaging

Infrared images have been taken behind numerous machines and are shown below. Color variations in the infrared photos show temperature differences. Uniform density cannot be achieved when mix temperatures vary. Cold spots become potholes.

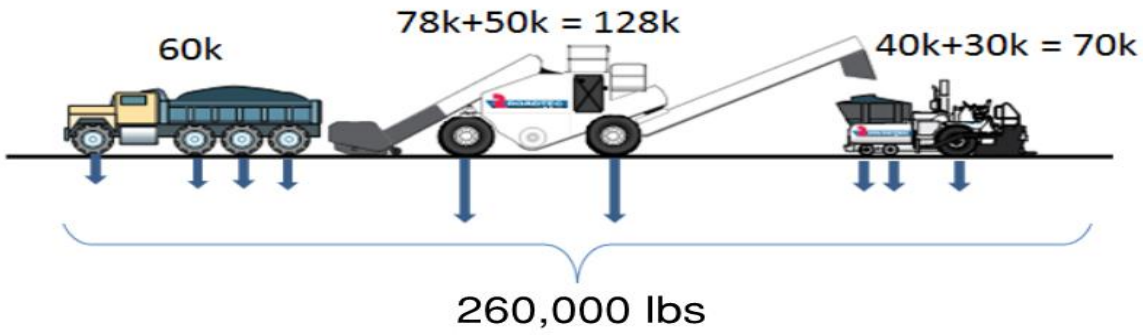
1

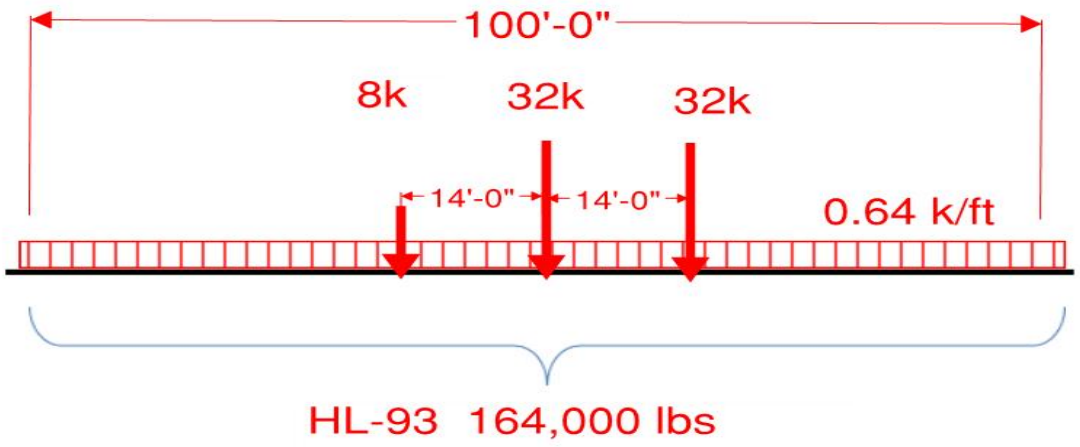


TRUCK – MTV - PAVER



PAVING LOADS vs HL-93





Std Spec

- Contractor shall comply with all laws that control traffic or limit loads
- All vehicles subject to license on a tonnage basis shall be licensed to maximum legal capacity before operating under these limits
- Structures Designed for Direct Bearing of Live Loads – The gross or maximum load on each vehicle axle shall not exceed the legal load limit by more than 35 percent. No more than one vehicle shall operate over any Structure at one time.

Federal Bridge Law

Federal regulations limit vehicle size and weight on federal highways. This includes all interstate highways across the country, as well as other federal roads designated within the National Highway System or National Network.

Vehicle Weight Limits

Federal weight limits of vehicles and axle loading limits are governed by the **Federal Bridge Law (FBL)**, which has four primary rules:

1. The maximum weight allowed on a **single axle** is **20,000 lbs**
2. The maximum total weight allowed on **any two consecutive axles spaced eight or fewer feet apart** (*like tandem axles*) is **34,000 lbs**
3. The maximum allowed **Gross Vehicle Weight (GVW)**, or the maximum allowed **total weight on any group of consecutive axles** on a vehicle, is determined by the **Federal Bridge Formula (FBF).**
4. The maximum Gross Vehicle Weight (GVW) on **Interstate highways** is **80,000 lbs**, even when the result of the formula is greater.

The Federal Bridge Formula (FBF)

$$W = [\ (\ (LN)\ /\ (N - 1)\ )\ + 12N + 36\ ]$$

Where:

W = the maximum allowed total weight *in pounds* for all axles in the group (rounded to the nearest 500 lbs, and rounding down when right in the middle - i.e. 62,250 lbs rounds to 62,000, while 62,300 lbs rounds to 62,500)

L = the length or distance *in feet (rounded to the nearest foot)* from the center of the forward-most axle in the group to the center of the rear-most axle in the group

N = the total number of axles in the group

WSDOT Solutions for Paving Weight Limits

DEPTH – DENSITY - WEIGHT

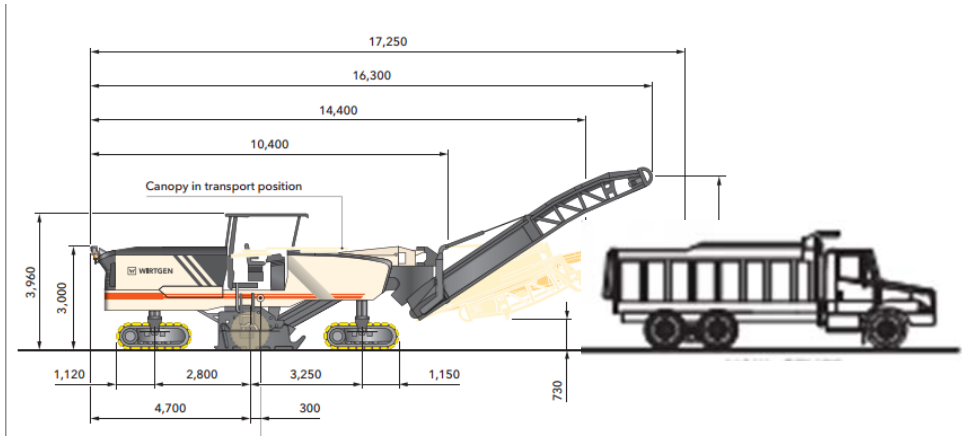
COLD MILLING

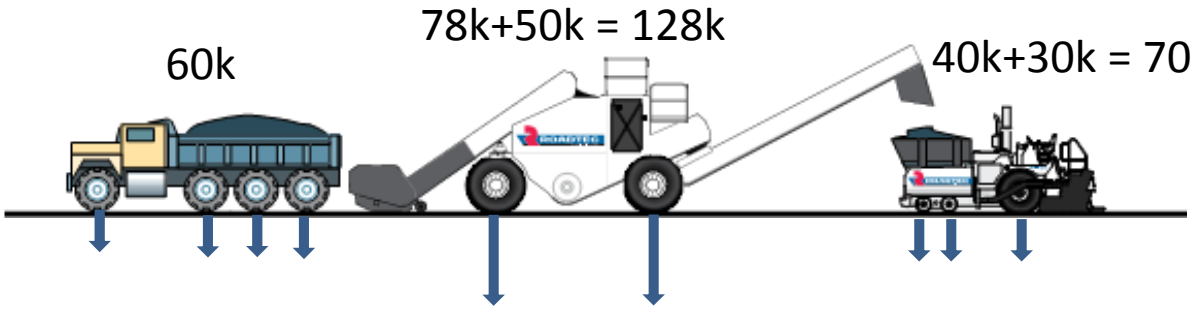
- PROVIDE 0.15’ of HMA and expect 0.10’ of future Chip Seal Seal
- Future Mill and Fill limited to 0.15’ to provide a 0.10’ buffer to deck and membrane
- Buffer is needed.
- Milling may vary by 0.1’
- ADDRESS Equipment Weight Limits and Truck Staging

DEPTH - DENSITY

- REQUIRE Deck Profile Survey and HMA Depths prior to HMA Removal
- IDENTIFY – CORRECT – CONFIRM HMA Depths
- REQUIRE Core Sampling to determine HMA Density on Bridge Decks (multiples are needed)
- USE Performance Specification with Density Confirmation

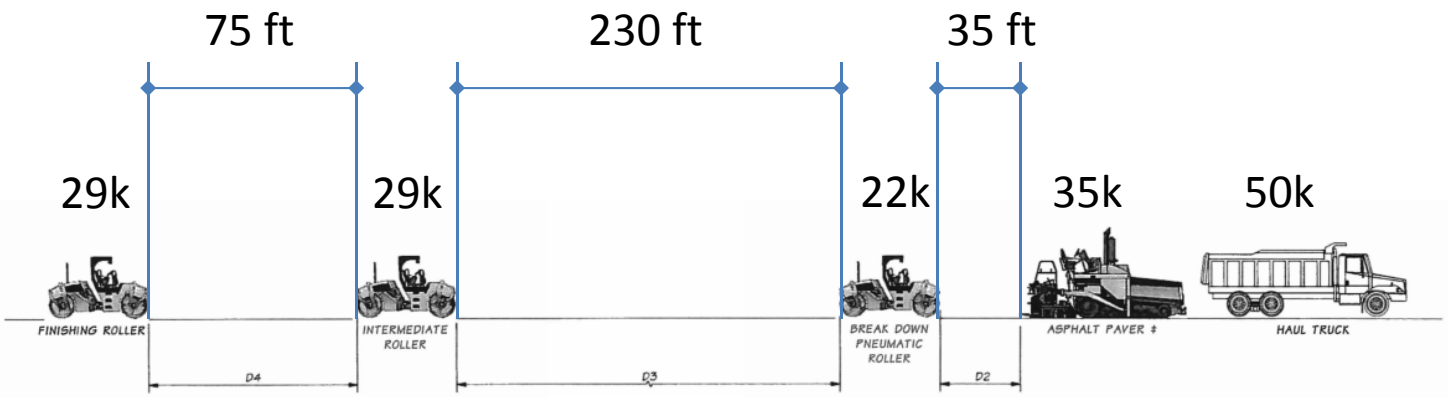
WEIGHT Limits





SR 20 Canoe and Deception Pass

SR 20 Canoe and Deception Pass



APPROVED ASPHALT PAVING TRAIN ~ OPTION 2

THE BREAK DOWN ROLLER SHALL BE A PNEUMATIC ROLLER. VIBRATION MODE IS NOT ALLOWED FOR ANY ROLLERS.
D2 SHALL BE GREATER THAN 20'-0" AT ALL TIMES.
D3 SHALL BE GREATER THAN 230'-0" AT ALL TIMES.
D4 SHALL BE GREATER THAN 75'-0" AT ALL TIMES.
ONLY ONE HAUL TRUCK IS ALLOWED ON THE ENTIRE BRIDGE AT ANY ONE TIME.
‡ NO MORE THAN 5 TONS OF ASPHALT SHALL BE LOADED ONTO THE ASPHALT PAVER HOPPER AT ANY TIME.
THE PAVER SHALL BE POSITIONED AT THE CENTER OF EACH LANE AND THE ENTIRE 11' LANE WIDTH PAVED IN ONE PASS.

OPTION 2 PAVING TRAIN

ITEM	MAXIMUM GROSS WEIGHT (LBS)
HAUL TRUCK	50,000.0 *
ASPHALT PAVER	35,000.0 α
BREAKDOWN ROLLER	22,100.0
INTERMEDIATE ROLLER	28,700.0
FINISHING ROLLER	28,700.0

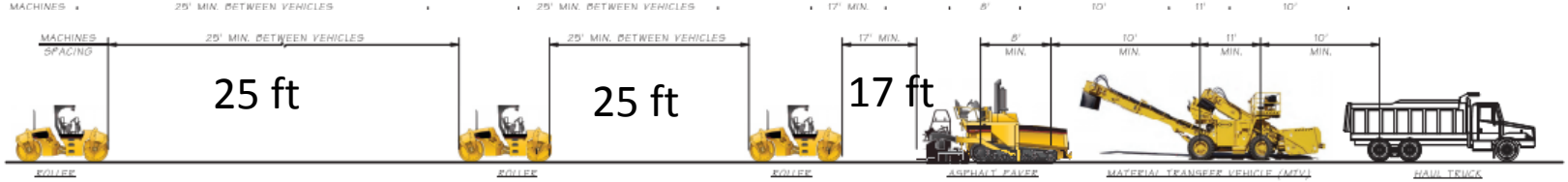
* FULLY LOADED TOTAL WEIGHT
α OPERATING WEIGHT WITHOUT ASPHALT

Paving Train Modeled as a Single Multi-Axle Permit Vehicle
Compare Member Forces to Detailed Load Rating Analysis (by others)
Portable Truck Scales - Reduced Live Load Factor down to 1.1

SR 16 Tacoma Narrows

SR 16 Tacoma Narrows

40k 40k 40k 34k 52k 50k



ASPHALT PAVING TRAIN

OTHER CONFIGURATIONS MUST BE APPROVED BY THE ENGINEER.

NOTES FOR ASPHALT PAVING TRAIN:

1. THE MATERIAL TRANSFER VEHICLE (MTV) SHALL BE POSITIONED AT THE CENTER OF PAVED SURFACE LANE. NO MORE THAN 5 TONS OF ASPHALT SHALL BE LOADED ON THE MTV ASPHALT HOPPER AT ANY TIME.
2. THE DISTANCE BETWEEN HAUL TRUCKS IN THE SAME LANE OR ADJACENT LANE SHALL BE GREATER THAN 120 FEET AT ALL TIMES.
3. THE ASPHALT PAVER SHALL BE POSITIONED AT THE CENTER OF THE PAVED SURFACE LANE. NO MORE THAN 5 TONS OF ASPHALT SHALL BE LOADED ON THE ASPHALT PAVER HOPPER AT ANY TIME. THE ENTIRE LANE WIDTH SHALL BE PAVED IN ONE PASS.
4. THE ASPHALT PAVER HOPPER AND MTV SHALL NOT BE IN THE SAME LANE.
5. CONTACTOR MAY PLACE LEGAL VEHICLE LOADS IN ONE OF THE LANES NOT OCCUPIED BY THE MTV OR PAVER AND ROLLERS.
6. PUBLIC VEHICULAR TRAFFIC IS NOT ALLOWED ON THE BRIDGE AT ANY TIME WHEN THE ASPHALT PAVER HOPPER OR MTV IS ON BRIDGE.
7. MACHINE AND VEHICLE SPACING DIMENSIONS ARE BASED ON ASSUMED AXLE WEIGHTS AND GROSS VEHICLE WEIGHTS BUT DO NOT SPECIFY REQUIRED EQUIPMENT MODELS TO BE USED.
8. LIMITS OF GROSS WEIGHT :

ITEM	MAXIMUM GROSS WEIGHT (LBS.)
HAUL TRUCK	50,000.0 *
MTV	52,000.0 *
ASPHALT PAVER HOPPER	34,000.0 α
BREAKDOWN ROLLER	40,000.0
INTERMEDIATE ROLLER	40,000.0
FINISHING ROLLER	40,000.0

SR 153 Methow River Bridges

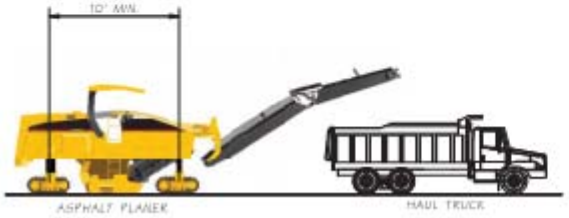
SR 153 Methow River Bridges

ASPHALT REMOVAL TRAIN

ASPHALT REMOVAL TRAIN

ITEM	MAXIMUM GROSS WEIGHT (LBS)
HAUL TRUCK	80,000.0 *
ASPHALT SCRAPER	34,000.0 *

* FULLY LOADED TOTAL WEIGHT



ASPHALT REMOVAL TRAIN - PARTIAL PLANING OPTION

ITEM	MAXIMUM GROSS WEIGHT (LBS)
HAUL TRUCK	80,000.0 *
ASPHALT PLANER	45,000.0 *

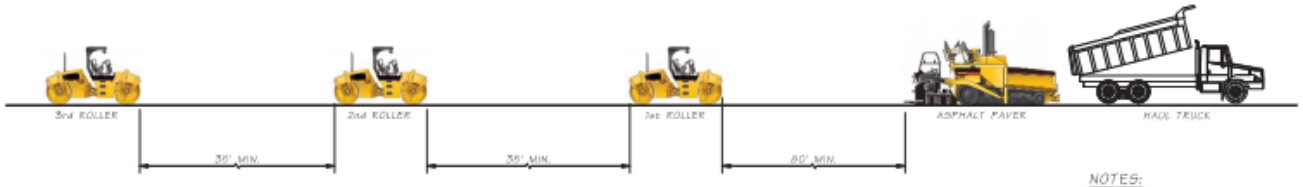
* FULLY LOADED TOTAL WEIGHT

SR 153 Methow River Bridges

CONFIGURATION 1 PAVING TRAIN

ITEM	MAXIMUM GROSS WEIGHT (LBS)
HAUL TRUCK	34,000.0 *
ASPHALT PAVER	18,000.0 α
1st ROLLER	30,000.0
2nd ROLLER	30,000.0
3rd ROLLER	30,000.0

* FULLY LOADED TOTAL WEIGHT
α OPERATING WEIGHT WITH SCREED AND ASPHALT

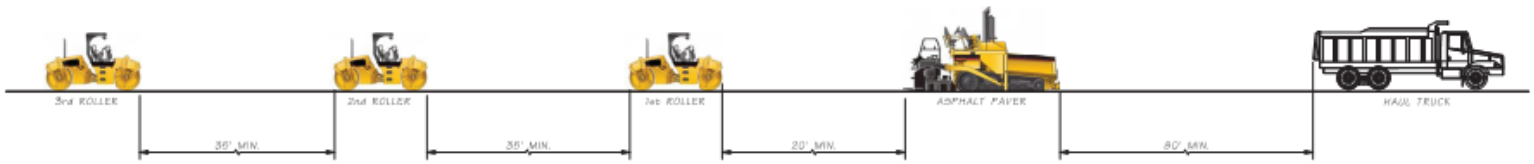


ASPHALT PAVING TRAIN ~ CONFIGURATION 1

HAUL TRUCK LOADING PAVER

NOTES:

1. VIBRATION MODE IS NOT ALLOWED FOR ANY ROLLERS.
2. PAVING TRAIN LIMITS ARE BASED ON EXPECTED AXLE WEIGHTS AND GROSS WEIGHTS, BUT DO NOT SPECIFY EQUIPMENT MODELS OR MANUFACTURES.
3. ONLY ONE HAUL TRUCK IS PERMITTED IN THE LANE BEING PAVED WITHIN THE LIMITS OF THE BRIDGE AT ANY ONE TIME.
4. ADDITIONAL ROLLERS MAY BE USED IF ROLLER SPACING LIMITS ARE MAINTAINED.
5. THE USE OF WINDROWS IS NOT ALLOWED.



ASPHALT PAVING TRAIN ~ CONFIGURATION 2

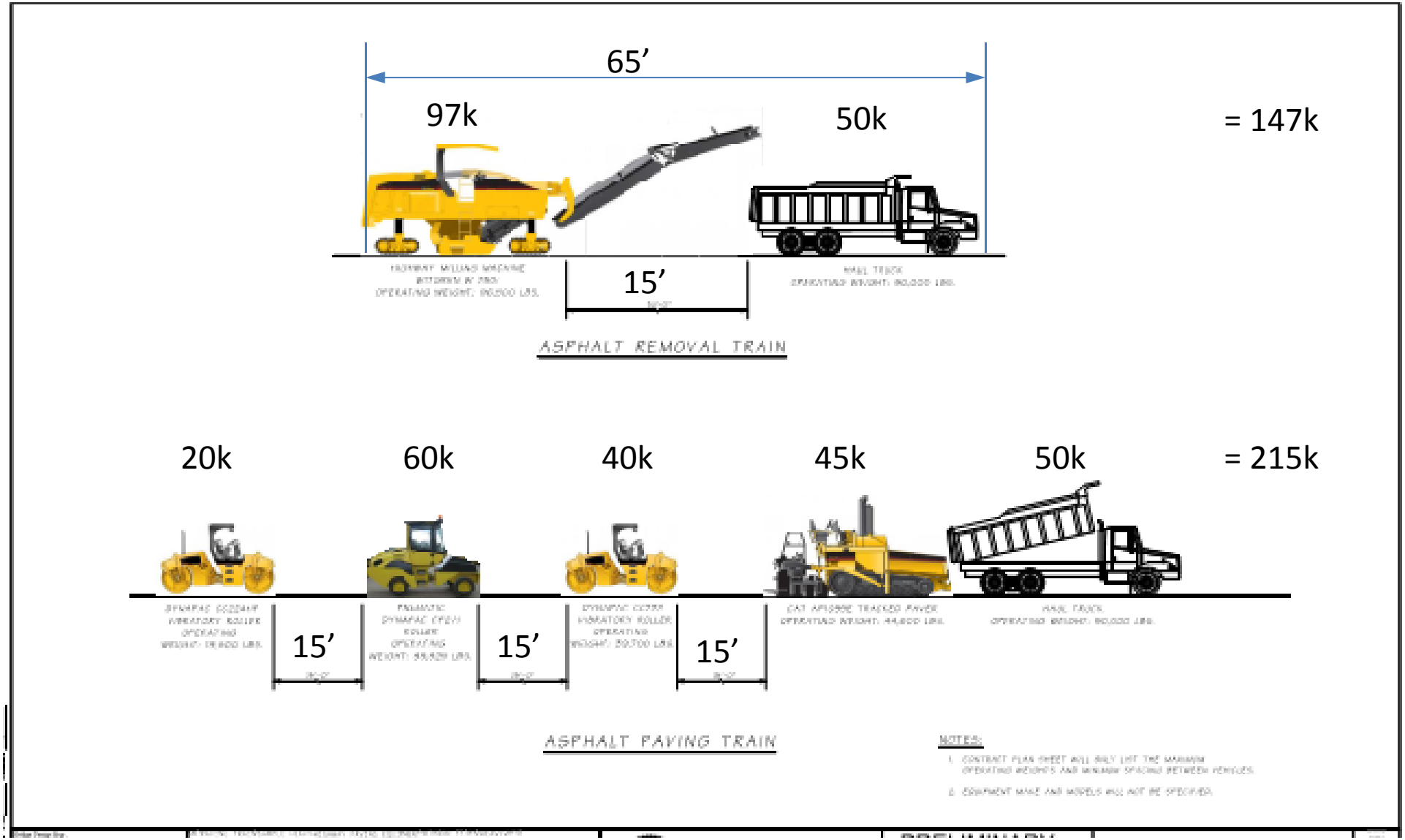
HAUL TRUCK WAITING TO LOAD

CONFIGURATION 2 PAVING TRAIN

ITEM	MAXIMUM GROSS WEIGHT (LBS)
HAUL TRUCK	34,000.0 *
ASPHALT PAVER	18,000.0 α
1st ROLLER	30,000.0
2nd ROLLER	30,000.0
3rd ROLLER	30,000.0

* FULLY LOADED TOTAL WEIGHT
α OPERATING WEIGHT WITH SCREED AND ASPHALT

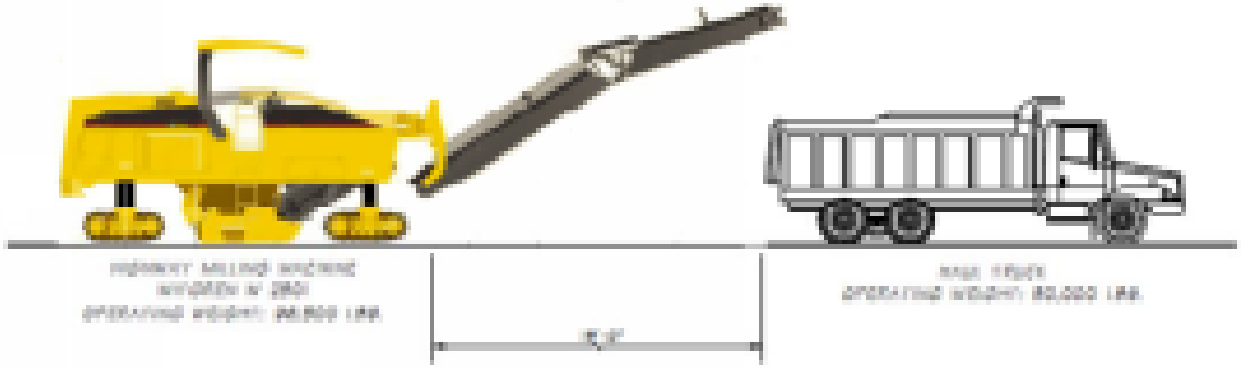
WAPA Endorsed Paving Equipment



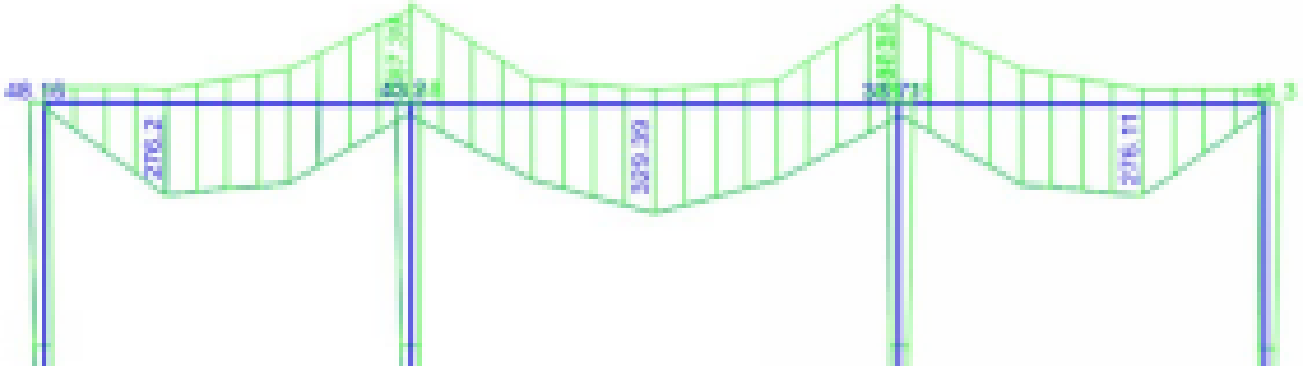
WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

BRIDGE AND STRUCTURES OFFICE

Paving Train Investigation



ASPHALT REMOVAL TRAIN



WSDOT Paving Train Investigation

- WAPA Heavy Configurations vs Load Rating Trucks
- Load Ratings for Bridge Spans $\leq$ 50’

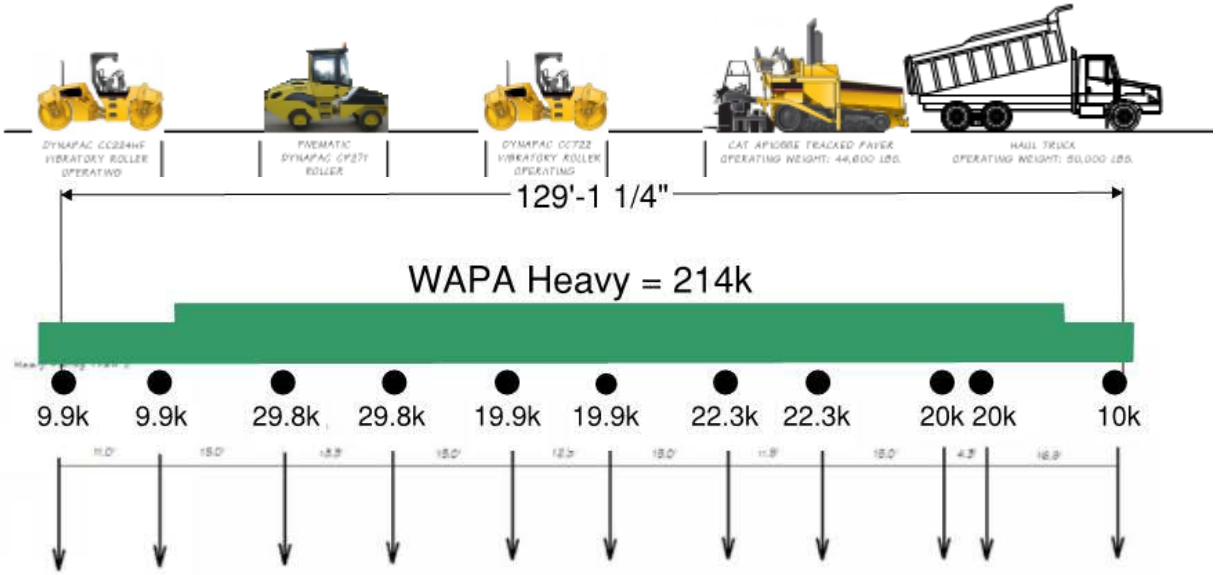
- OL Truck #2 $\geq$ 1.0 = Milling Eq. - OK
- HS20 Truck $\geq$ 1.0 = Paving Eq. - OK

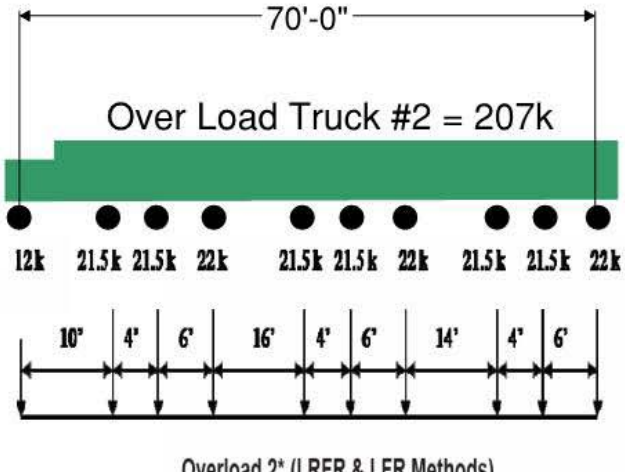
WSDOT Paving Train Investigation

- WAPA Heavy Configurations vs Load Rating Trucks
- Load Ratings for Bridge Spans > 50’

- OL Truck #2 $\geq$ 1.0 = Milling Eq. - OK
- OL Truck #2 $\geq$ 1.0 = Paving Eq. - OK

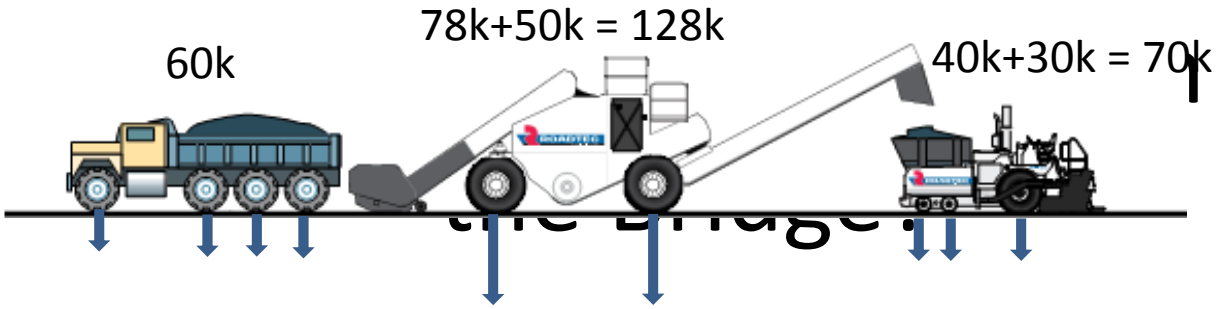
WAPA vs OL Truck #2





Overload 2* (LRFR & LFR Methods)

So[illegible] the Bridge? Cross



- To get to the other side.
- To place HMA Protection on the Bridge Deck.
- To Provide a smooth ride.
- To Address Roadway Drainage.
- Because the Bridge Engineer was not looking?
- All of the above.

Questions?

Problem Statement

- HMA on Bridges has not lasting as long as it use to
- HMA depths greatly exceed depth assumed during design
- Deck wear, and HMA scarification is much greater than ½” assumed in the design
- Modern Paving equipment can exceed safe structural limits

HMA Density

- Achieved by
- High Petroleum content
- High Heat
- High Compaction Energy

HMA Economics

- Reduce High Cost ingredient (Petroleum)
- Maintain Heat of HMA from Batch Plant to Roadway (Large volumes and Large MTV's)
- Increase Compaction Energy with Vibration

HMA Density Tests on Bridges

- WSDOT mandates density tests using an array of core samples
- Contractors are providing Different mix for bridge decks – Achieving Densities

Controlling HMA Removal

- Milling only allowed where deck is a secondary structural element. The girders were designed for simple span Dead Load and Live Load (WSDOT PSG design criteria)
- Scraping required when deck are the primary structural element. Slab, T-Beams, Box Girder bridges

Scraping Equipment

Scraping Plate

50,000 lbs

330F L Medium Hydraulic Excavator

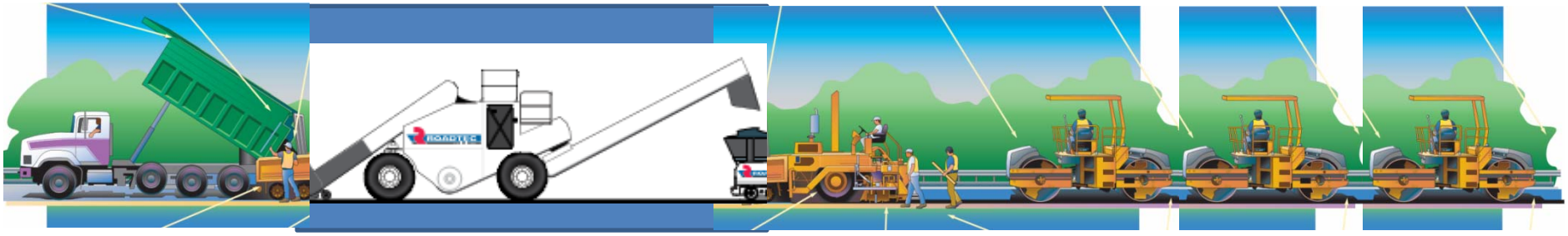

1:34PM
AUG 2 2006


JOHN DEERE

Paving Equipment

- Dump Trucks
- Mobile Transfer Vehicles (MTV)
- Pavers
- Breakdown Roller
- Intermediate Roller
- Finish Roller

Paving Train



Dump Truck

MTV

Paver

Breakdown Roller

Intermediate Roller

Finish Roller

Key Topics

- HMA Density
- Excessive HMA Depth
- Excessive Scarification Damage
- Equipment Weight Limitations

WSDOT Std Spec

1-07.7 Load Limits

1-07.7(1) General

While moving equipment or materials on any public Highway, the Contractor shall comply with all laws that control traffic or limit loads. The Contract neither exempts the Contractor from such laws nor licenses overloads. At the Engineer's request, the Contractor shall provide any facts needed to compute the equipment's weight on the Roadway.

When the Contractor moves equipment or materials within the project limits as shown in the Plans, legal load limits shall apply on:

1. Any road open to and in use by public traffic; or
2. Any existing road not scheduled for major reconstruction under the current Contract; o
3. Any newly paved road (with final lift in place) built under this Contract. The Contracto may haul overloads (not more than 25 percent above load limits) on such roads not ope to public traffic if this does not damage completed Work. The Contractor shall pay all repair costs of any overload damage.

Elsewhere on the project, the Contractor may operate equipment with only the load-limit restrictions in 1, 2, and 3 in Section 1-07.7(2). The Contractor shall remain responsible, however, for all load-caused damage. All vehicles subject to license on a tonnage basis shall be licensed to maximum legal capacity before operating under these limits.

If necessary and safe to do so, and if the Contractor submits a Type 2E Working Drawing, the Engineer may allow higher load limits than those in the load-limit restrictions in 1, 2, and 3 in Section 1-07.7(2). The submittal shall:

1. Describe loading details;
2. Describe the arrangement, movement, and position of equipment on the Structure or over culverts and pipes; and
3. State that the Contractor assumes all risk for damage.

Unit prices shall cover all costs for operating over bridges and culverts. Nothing in this Section affects the Contractor's other responsibilities under these Specifications or under public Highway laws.

1-07.7(2) Load-Limit Restrictions

1. **Structures Designed for Direct Bearing of Live Loads –** The gross or maximum load on each vehicle axle shall not exceed the legal load limit by more than 35 percent. No more than one vehicle shall operate over any Structure at one time. The Contractor shall immediately remove any dirt, rock, or debris that may gather on the Structure's Roadway surface.

   If the Contractor desires to utilize work methods resulting in load that exceed any of the restrictions described above, the Contractor shall submit a Type 3E Working Drawing consisting of calculations and other supporting information (as specified in Section 6-01.6 for bridges under construction).

2. **Underpasses and Reinforced Concrete Box Culverts Under Embankments –** Loads shall not exceed 24,000 pounds on a single axle and 16,000 pounds each on tandem axles spaced less than 10 feet apart. These limits are permitted only if the embankment has: (a) been built to Specifications, and (b) reached at least 3 feet above the top of the underpass or culvert.

   When the embankment has reached 5 feet above the top of the underpass or culvert, the Contractor may increase per-axle loads up to 100,000 pounds if outside wheel spacing is at least 7 feet on axle centers.

3. **Pipe Culverts and Sewer Pipes –** Loads over pipe culverts and sewer pipes shall not exceed 24,000 pounds on a single axle and 16,000 pounds each on tandem axles spaced less than 10 feet apart. These limits are permitted only if: (a) the culvert or pipe has been installed and backfilled to Specifications, and (b) the embankment has reached at least 2 feet above the top limit of pipe compaction.

   When the embankment has reached 5 feet above the top limit of pipe compaction, the Contractor may increase per-axle loads up to 100,000 pounds if outside wheel spacing is at least 7 feet on axle centers, except that:

   a. For Class III reinforced concrete pipes, the embankment shall have risen above the top limit of compaction at least 6 feet.

   b. For Class II reinforced concrete pipes, the maximum load for each axle shall be 80,000 pounds if outside wheel spacing is at least 7 feet on axle centers. In this case, the embankment shall have risen above the top limit of compaction at least 6 feet.