Compaction Best Practices

Asphalt 101 - 103

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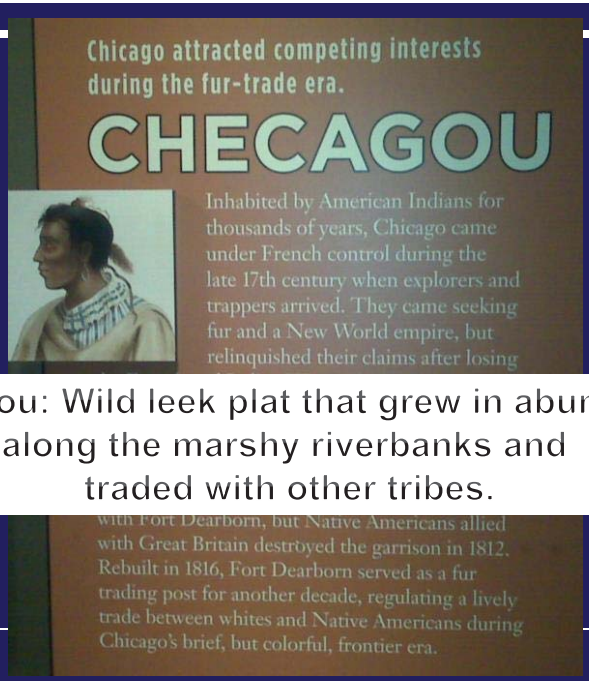


Checagou: Wild leek plat that grew in abundance along the marshy riverbanks and traded with other tribes.

Why do we care about compaction?

- Density, → Permeability,
- Smoothness, → Public,
- Strength. → Power.

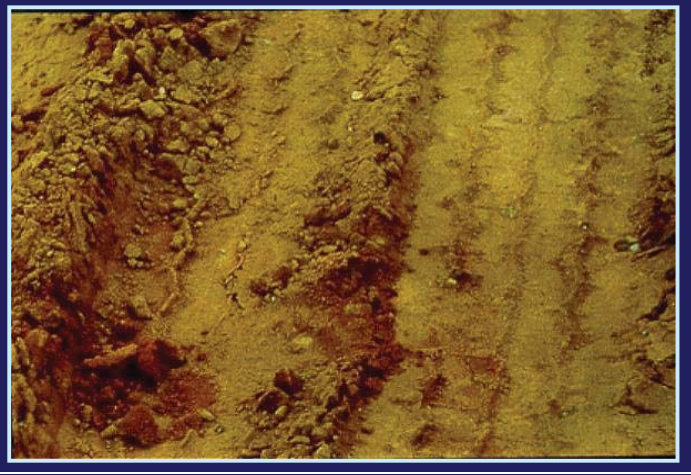
Fatigue and low temperature cracking.

How do we ensure adequate compaction?

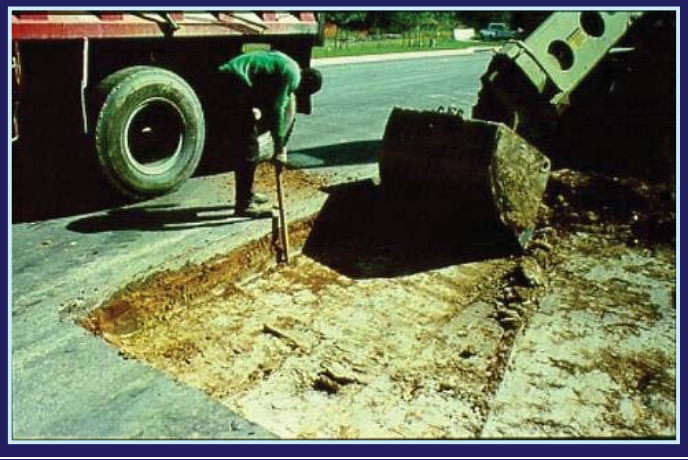
Forces must be equal and opposite

- Sub-grade,
- Sub-base,
- Existing pavement structure.

Sub-grade



Remove Weak Materials



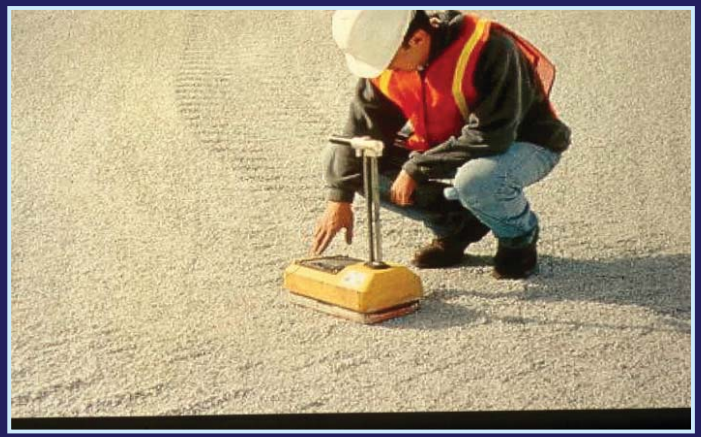
Address drainage problems

Compact sub-grade

Courteous Contractor

Sub-base

Sub-base density checks

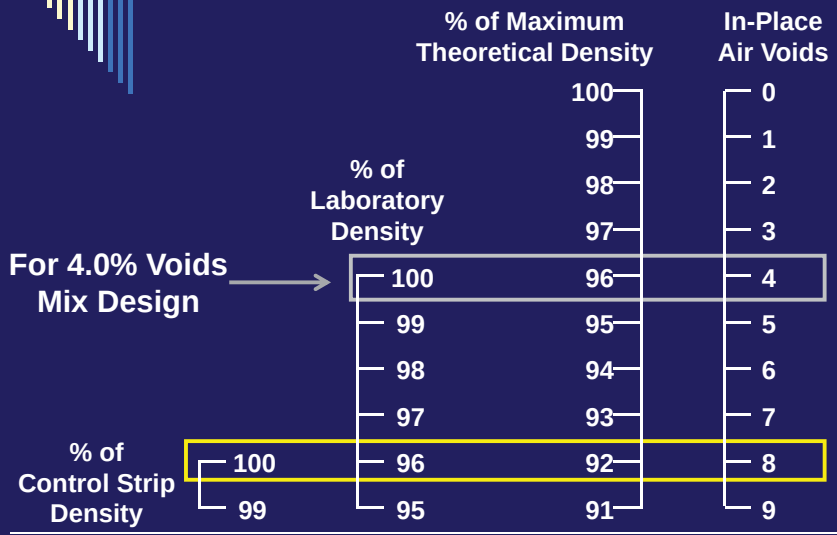


Hot Mix Asphalt (HMA)

Importance of VMA & Compaction

- Improve Mechanical Stability
- Improve Resistance to Permanent Deformation
- Reduce Moisture/Air Penetration
- Improve Fatigue Resistance
- Reduce Low-Temperature Cracking Potential

Reference Density Comparison



Recent Finding in Idaho

The Department will use the average G_{mm} (aka Theoretical Maximum Specific Gravity or 'Rice') of the test section corresponding to the Contractor's JMF to determine densities for the specified mix production paving.

Use C-JMF target asphalt content G_{mm} Do not use Acceptance Test Strip G_{mm}

- For example, if ATS is target of 5.7% AC but produced at 5.3% AC the G_{mm} will rise significantly.
- Measured compaction shall be versus corresponding G_{mm} @ 5.3% AC, not the 5.7% AC G_{mm}.

Example: Core Gravity = 2.320

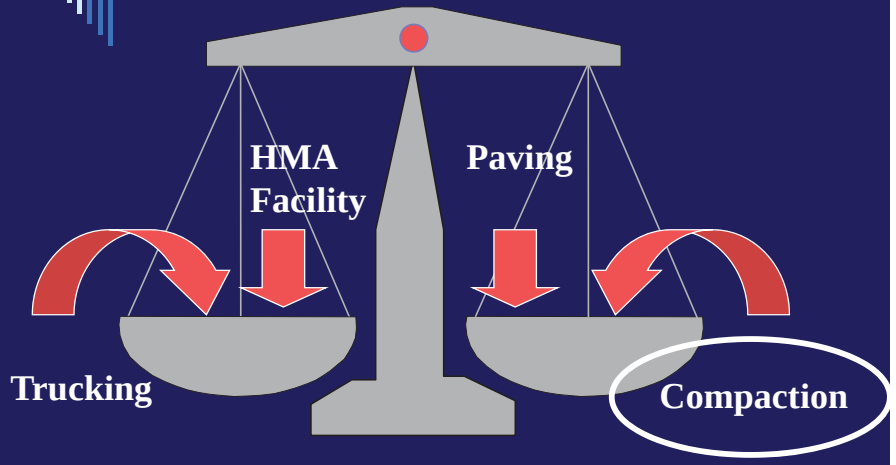
- ATS @ 5.7% AC = 2.478 (G_{mm})
  Density with 5.7% = **93.6**
- Production @ 5.3% AC = 2.478
  plus 4(0.004) = 2.494 (G_{mm})
  Density with 5.3% = **93.0**

Permeability and rutting

Lack of smoothness

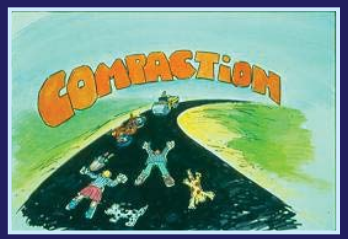
Building smooth & strong HMA pavements

Balancing Production



How do we get compaction

- Proper equipment,
- Proper use,
- Proper understanding.



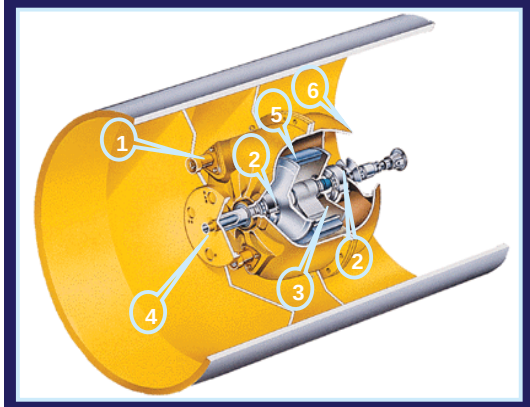
Types of rollers

- Vibratory (a/k/a Breakdown)
- Pneumatic (a/k/a Rubber tire)
- Static Steel Wheel (a/k/a Finish)

Vibratory roller

Roller vs. paving widths

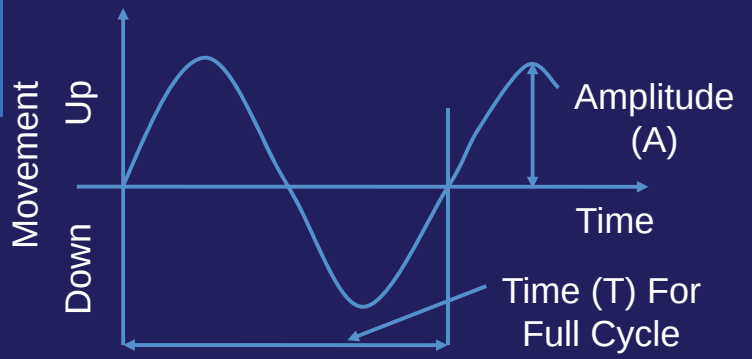
Eccentric Weight System



1) Oil level sight gauge
2) Eccentric weight shaft bearings
3) Three-position counterweight
4) Amplitude selection wheel
5) Fixed eccentric weight
6) Pod-style housing

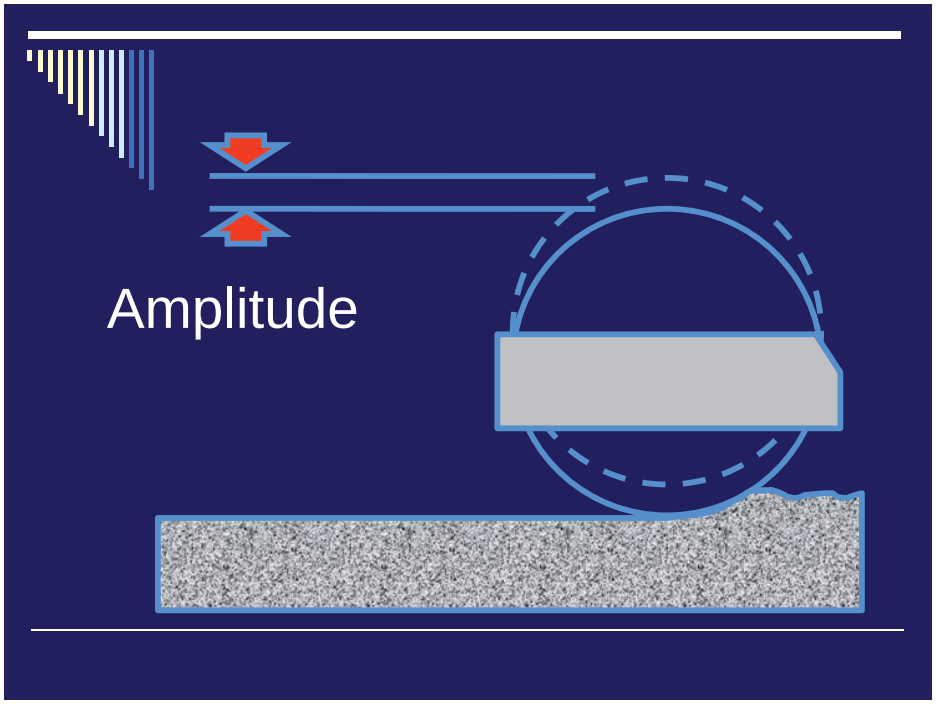
CAT

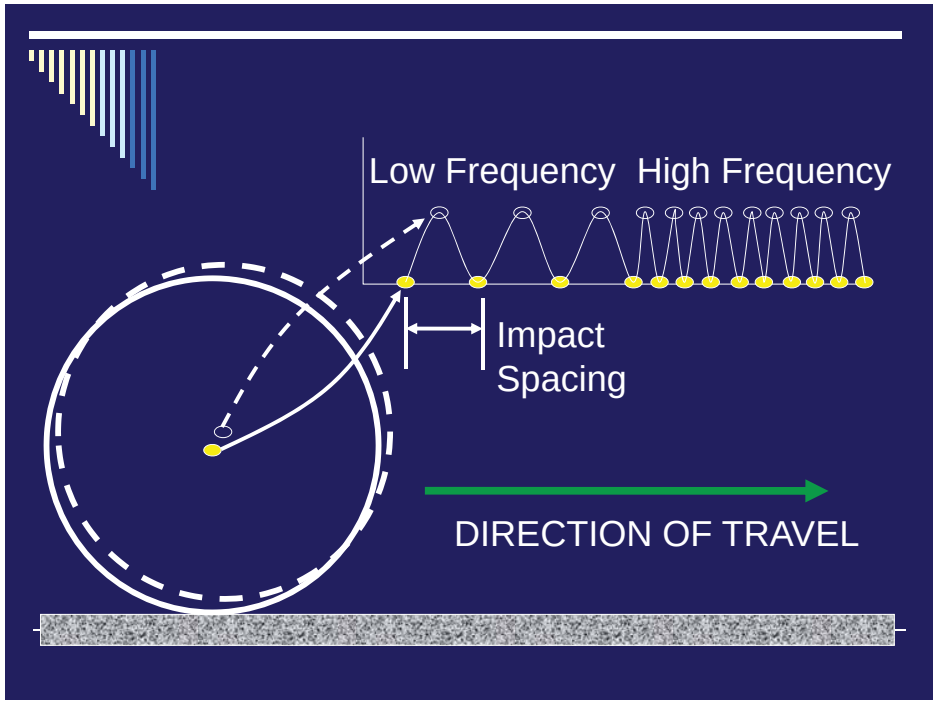
Courtesy of Caterpillar Paving Products



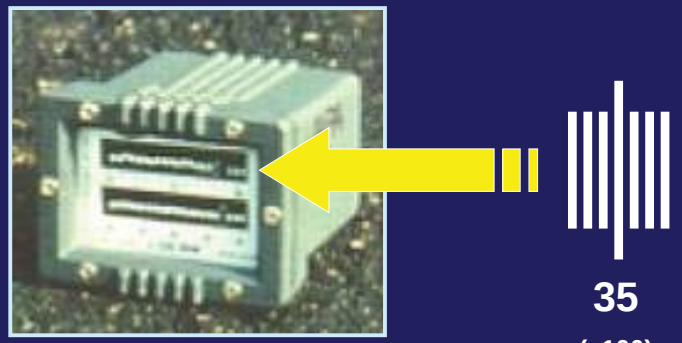
Frequency, f = the number of hertz (cycles/s)--a single cycle is one full rotation of the eccentric weight. Frequency = 1/T

Amplitude, A = the maximum deviation from position at rest -- one-half the total movement.





Reed tachometer, vibrations per minute (vpm)



Informational Charts

Parameter	Typical Values	Effect on Dynamic Force
Frequency	1,600 to 3,600 vibrations per minute	Frequency α (Dynamic Force)^2
Amplitude	0.25 to 1.02 mm (0.01 to 0.04 inches)	Amplitude α Dynamic Force

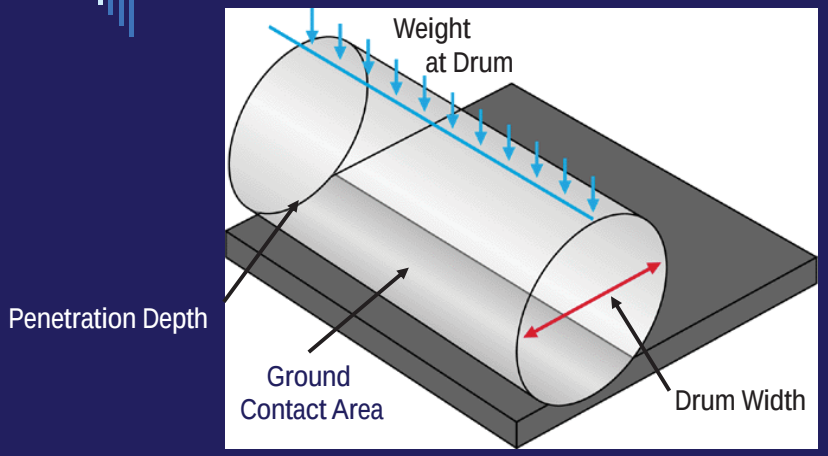
Typical Vibratory Settings (from TRB, 2000)

Informational Charts

HMA Mat Characteristic	Frequency	Amplitude
Thin Lifts (< about 30mm (1.25 inches))	Operate in static mode. Under vibratory mode, as the pavement increases in density the drums may begin to bounce, which may cause the HMA to shove and become less dense. Also, some of the aggregates may be crushed.	
Lifts between 30 mm and 65 mm (1.25 and 2.5 inches)	High frequency	Low amplitude
Lifts beyond 65 mm (2.5 inches)	High frequency	Higher amplitude
Stiff (more viscous) HMA	High frequency	Higher amplitude

Vibratory Steel Wheel Roller Parameters (after TRB, 2000)

Contact Pressure



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Typical Data for Vibratory Tandem Rollers

Vibratory Steel Tandem (ton)	*Oper. Wt. (lb.)*	*Drum Diam. (ft.)*	*Drum Width (ft.)*	*Static Drum (pli)*	*Dynamic Drum (pli)*	*VPM*	*Nom. Amp. (in.)*
6.0-8.0	14,700	3.6	4.6	130	260	2,900	0.025
9.5-11.0	20,500	3.9	5.6	158	384	2,600	0.03
> 13.0	30,000	4.9	6.9	186	423	2,400	0.03

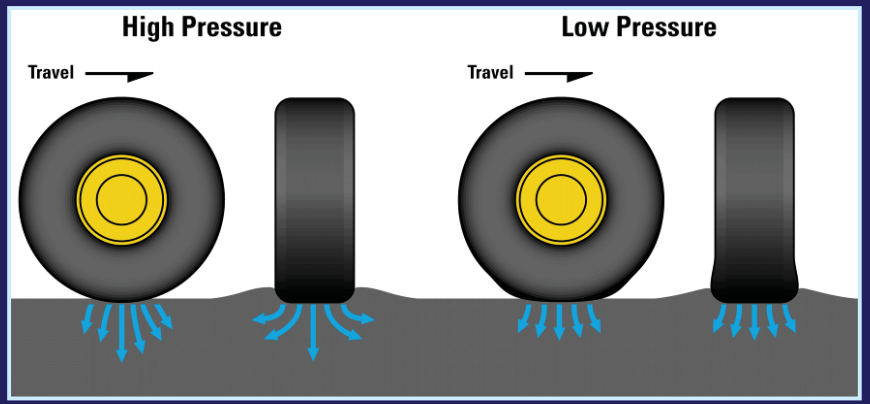
Check Your Settings Daily

Do not vibrate thin lifts of Asphalt

Do not vibrate thin lifts of Asphalt

Skirted pneumatic roller

Tire inflation pressure vs. ground contact pressure



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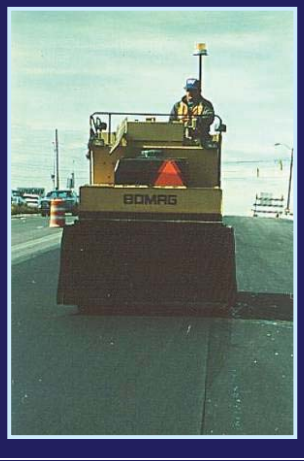
Tire pressure matters

Intermediate, breakdown, & longitudinal joint compaction



Inflation Pressure and Ground Contact Pressure at Various Wheel Loads and Ply Ratings

	Ply Rating	Wheel Load lb	Tire Pressure psi	Contact Area in^2	Ground Contact Pressure psi
*	14	1,250	130	16	78
	14	2,800	130	30	92
*	14	2,300	35	41	56
	14	2,300	130	26	88
*	10	2,800	90	38	73
	14	2,800	130	30	92

Finish rolling removes marks and gets a touch more density with pounds per lineal inch (PLI) ~ 280

Ballasting finish roller to get PLI > 330

Densification up close

UNIT TOTAL APPLIED FORCE (UTAF)

'What is a method of expressing a vibratory roller's impact force on the asphalt pavement?', Alex.

Unit Total Applied Force (UTAF)

- **Increase with lift thickness.**
- **Vary with mix characteristics.**

Desirable UTAF Ranges

		UTAF (lb. / in.)
1”	Surface Course	290 - 370
1 – ½”	Binder Course	330 - 420
3”	Base Course	400 - 500
4” plus	Base Course	440 - 600

What we have learned

Hot Mix Asphalt motor speedways

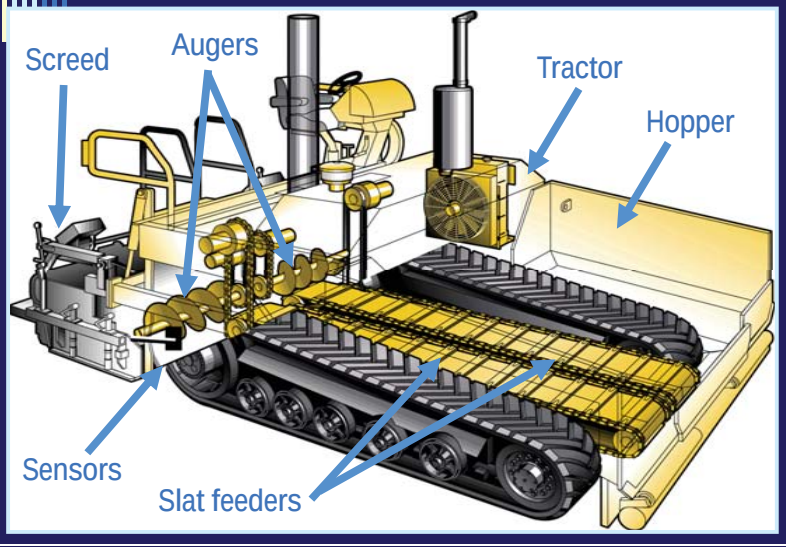
Oil & chip

Oil & chip

Placement Equipment

Screed Unit

Courtesy of Blaw-Knox Ingersoll Rand Paving Products



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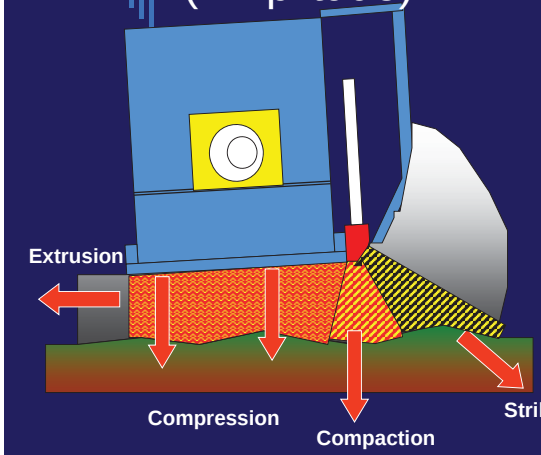
Vibrator RPM & Stroke (Amplitude)



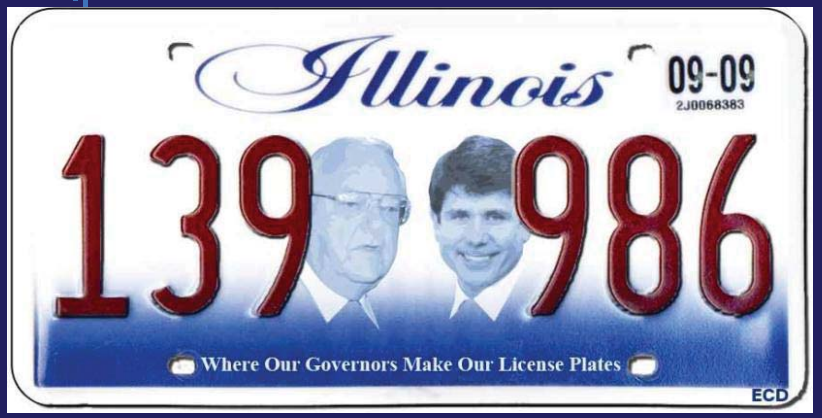
FEWER IMPACTS PER METER = LESS COMPACTION

MORE IMPACTS PER METER = INCREASED COMPACTION

Blaw-Knox

Courtesy of Blaw-Knox Ingersoll Rand Paving Products

Hello Idaho… with love from IL



Auger Extensions Missing

Compaction problems along the longitudinal joint

Compaction problems along the longitudinal joint

Compaction problems along the longitudinal joint

Longitudinal joint compaction problem solutions

- Specify minimum longitudinal joint density based on maximum achievable.
- Standardize density based on road type and mix type.

Longitudinal joint compaction problem solutions

Pick a number and let ingenuity of contractor solve the problem;

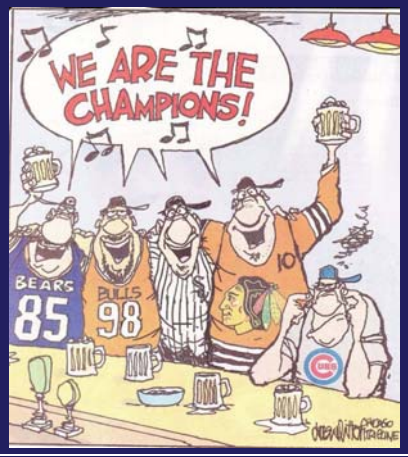
- 90.0% minimum unconfined.
- 92.0% minimum confined.

Longitudinal joint solution

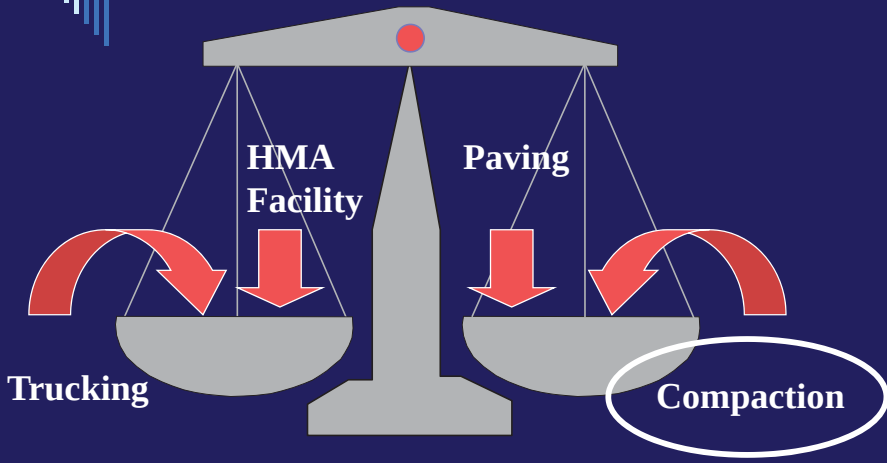
Echelon Paving, Part II

Timing: Deliveries

How you will feel with longitudinal joint density specification and without



Balancing Production



Quick Call

Murphy Pavement Technology, Inc.

Teaching - Training - Troubleshooting - Testifying

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