39th OHIO ASPHALT PAVING CONFERENCE

FEBRUARY 5TH, 2014
FAWCETT CENTER
THE OHIO STATE UNIVERSITY


FAT BOY ROLLER L.L.C.
CWD

FAT BOY ROLLER L.L.C.

CW CHUCK DEAHL
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ACHIEVING PROPER COMPACTION

- WHY?
- HOW?
- DO'S DON'T'S
- NEW DEVELOPMENTS

WHY?

- 1. COMPACTION IS THE LAST STEP IN ASPHALT PAVEMENT CONSTRUCTION
- 2. COMPACTION NOT ONLY AGFFECTS PAVEMENT PERFORMANCE; BUT OFTEN DETERMINES IF WE GET BONUS DENSITY AND SMOOTHNESS

IMPORTANCE OF COMPACTION

- IMPROVE MECHANICAL STABILITY
- IMPROVE RESISTANCE TO PERMANENT DEFORMATION
- REDUCE MOISTURE PENETRATION
- IMPROVE FATIGUE RESISTANCE

PRODUCTIVE & PROFITABLE COMPACTION

FOR ASPHALT PAVEMENTS BOTH HMA & WMA

COMPACTION GOALS

- *DENSITY*
- *SMOOTHNESS*
- *BALANCED PRODUCTION*

HOW ? DO WE COMPACT

- Is a mechanical process:
- _____ compresses HMA into a smaller denser volume after placement by applying one or more of the 4 forces of compaction
- Increases mixture stability:
- _____ forces asphalt coated aggregate particles closer together
- _____ achieves particle to particle contact

4 FORCES OF COMPACTION

- PRESSURE: A DOWNWARD FORCE
- IMPACT: A HAMMER BLOW
- VIBRATION: A RAPID SERIES OF IMPACT BLOWS
- MANIPULATION: KNEADING IN A CONFINED MANNER

FACTORS AFFECTING COMPACTION

- MIX DESIGN
- AGGREGATE AND ASPHALT CEMENT
- LAB DENSITY & FIELD DENSITY
- CLIMATIC CONDITIONS
- PAVER TYPE AND PAVING METHOD
- TEMPERATURE: MAT, BASE AMBIENT, DIRECTION OF SUN; WIND

NEEDED FOR COMPACTION

- *CORRECT MIX TEMPERATURE*
- *CONFINMENT*

UNCOMPACTED EMBANKMENT


BOMAG

PARKING LOT SOFT SUBGRADE

TAMPING FOOT GIVES YOU IMPACT PRESSURE AND MANIPULATION

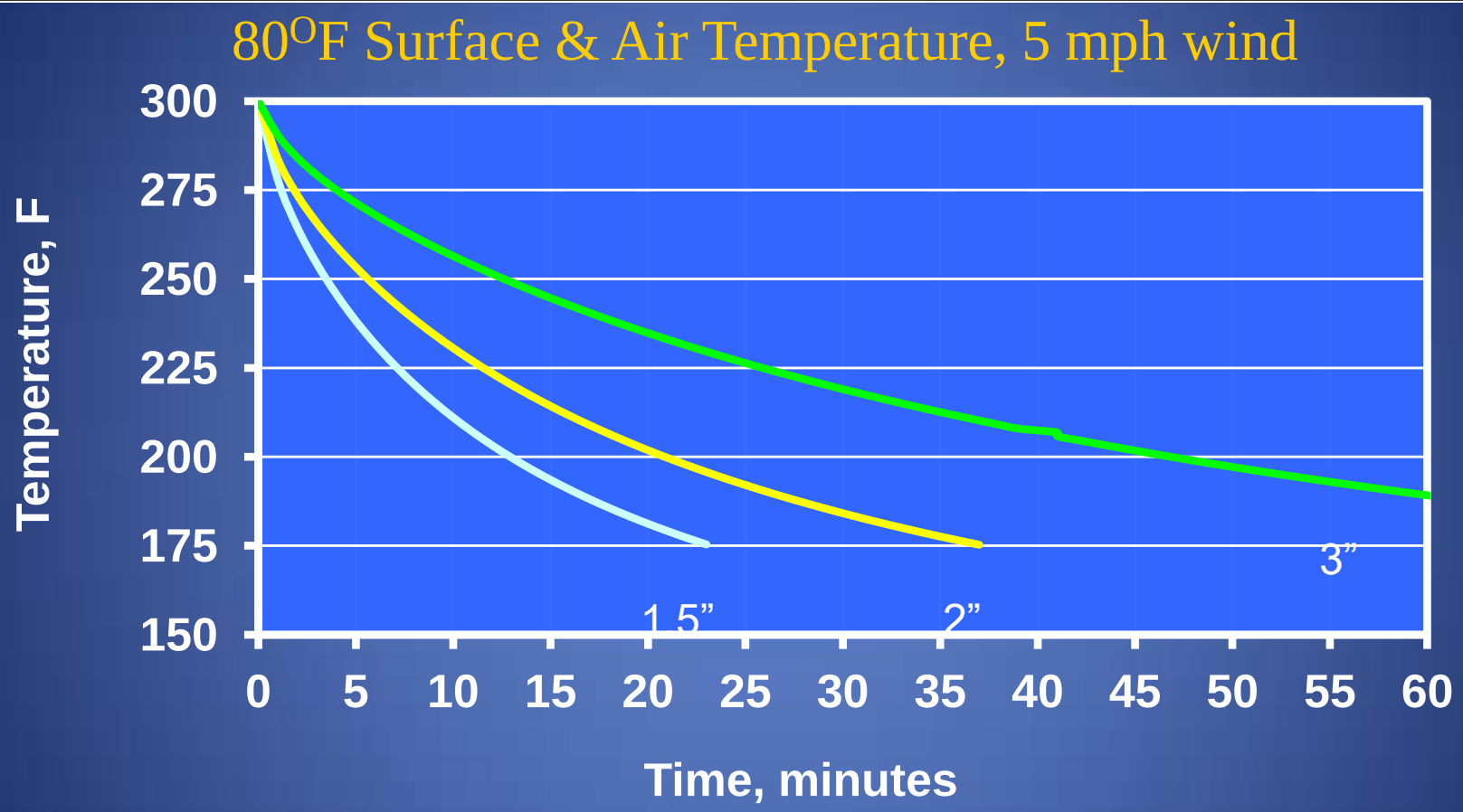
SELECT MATERIAL COMPACTED IN PLACE TO PROVIDE INSULATION LAYER

PAVED PARKING LOT WITH 2 LIFTS 11/2” BINDER & 11/2” SURFACE


ANTIGO

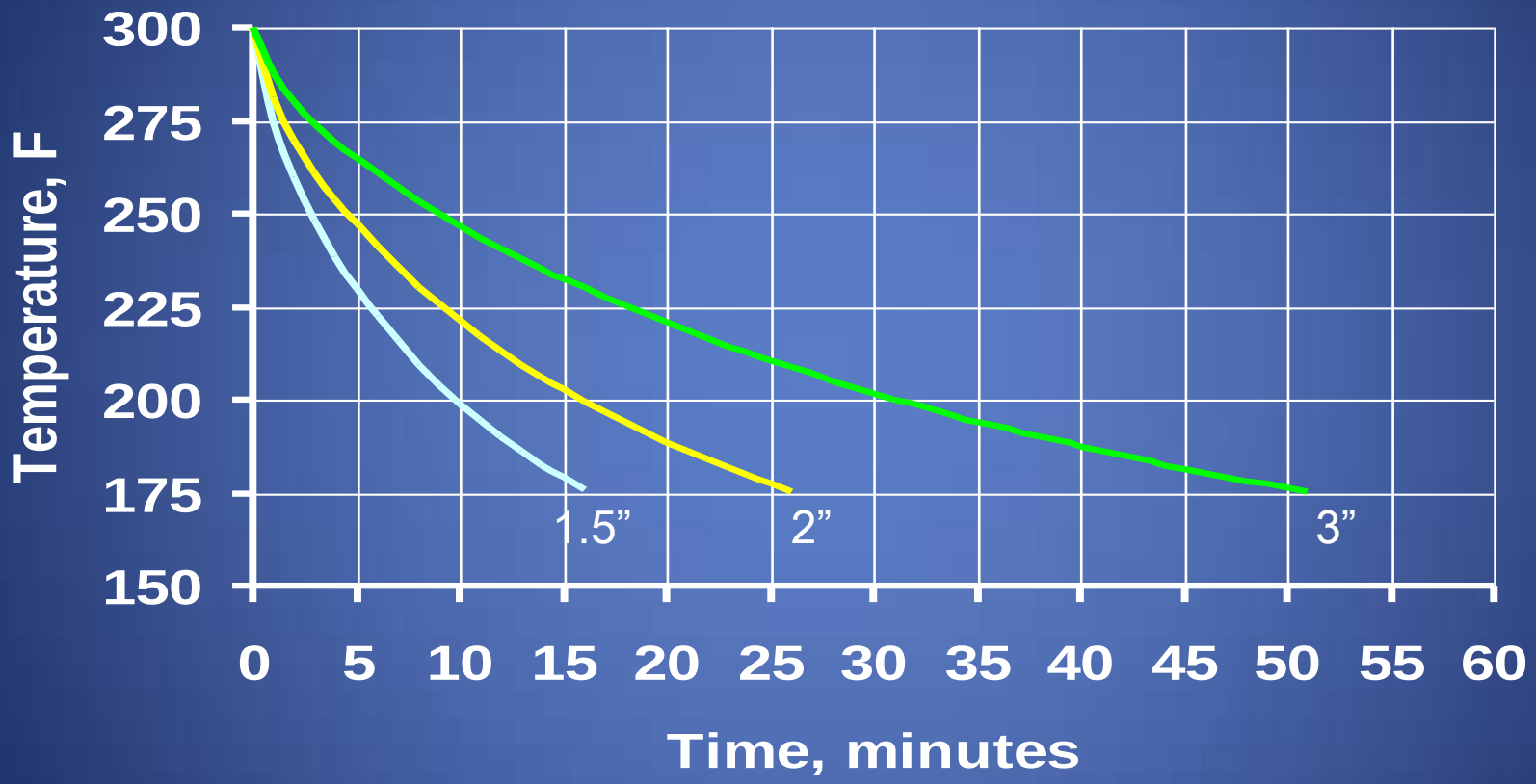

R16

Temperature



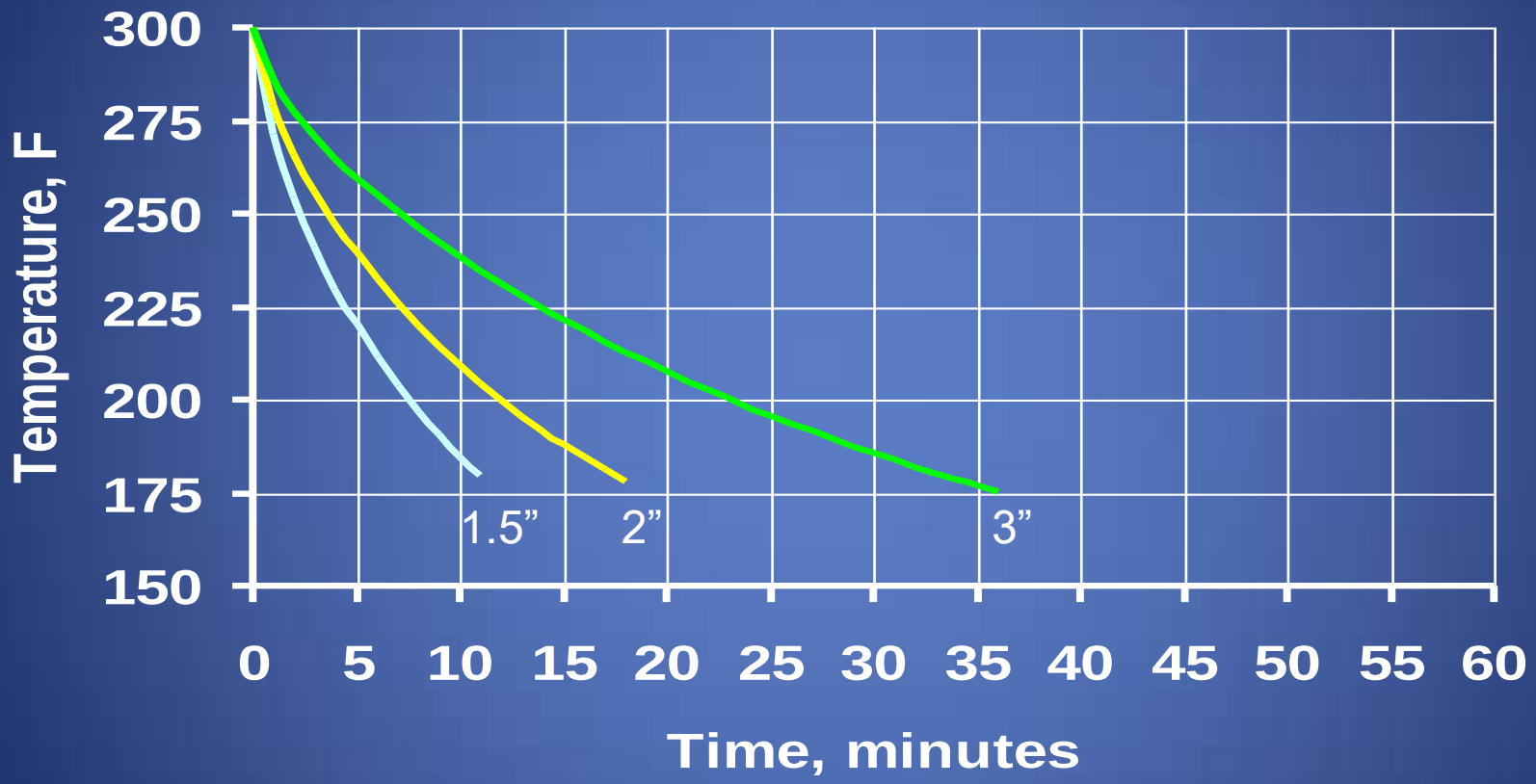
Temperature

50°F Surface & Air Temperature, 5 mph wind

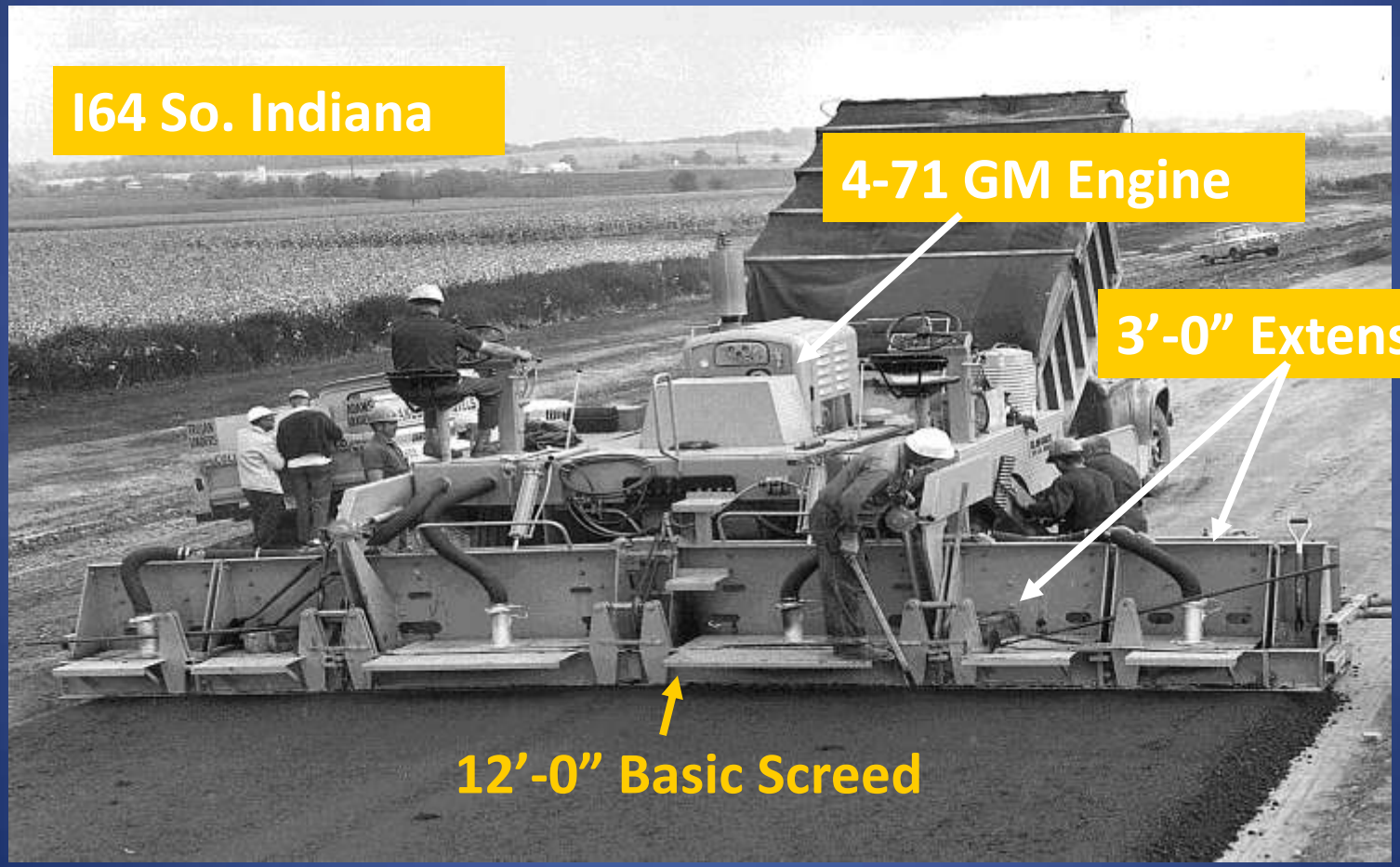


Temperature

30°F Surface, 40°F Air Temperature, 15 mph wind



Paving 24’-0” Wide Interstate



HOW DO WE BALANCE PRODUCTION

- DETERMINE PAVER SPEED
- NUMBER AND TYPE OF ROLLERS
- NUMBER OF PASSES WITH ROLLERS TO COVER THE MAT AND OBTAIN DENSITY

PAVER PRODUCTION FORMULA

- S= Paver Speed (ft./min.)
- W= Lane Width (ft.)
- L= Lift Thickness (ft.)
- D= Density (lbs./ft.3)

- Tons/Hour= S x 60 min. in1 hr.x 1 ton in 2000 lbs.x W x L x D

FORMULA EXAMPLE

- Paver Speed= 40 ft./min.
- Lane Width= 12 ft.
- Density= 135 lbs./ft.3
- Lift Thickness= .166 ft. = 2 inches

- Tons/Hour = 40 x 60 x 12 x .166 x135 divided by 2000= 322 Tons/ Hour

BALANCING ROLLERS WITH PAVER SPEED

- Breakdown Roller: 84” Double Drum Vibratory 4000 vpm
- Roller maintains a min. of 10 impacts per foot (IPF) = 400 fpm
- 400 fpm has to be reduced by # of passes to cover paving ; # of passes to obtain density=2; 2PLUS 2=4plus 1 return pass total passes = 5
- 400 fpm divided by 5 passes = 80 fpm
- 80% efficiency factor x 80 fpm= 64 fpm
- This 84” double drum vibratory roller will match 40fpm paving speed

3 PHASES OF ROLLING

- ***BREAKDOWN***
- ***INTERMEDIATE***
- ***FINISH***

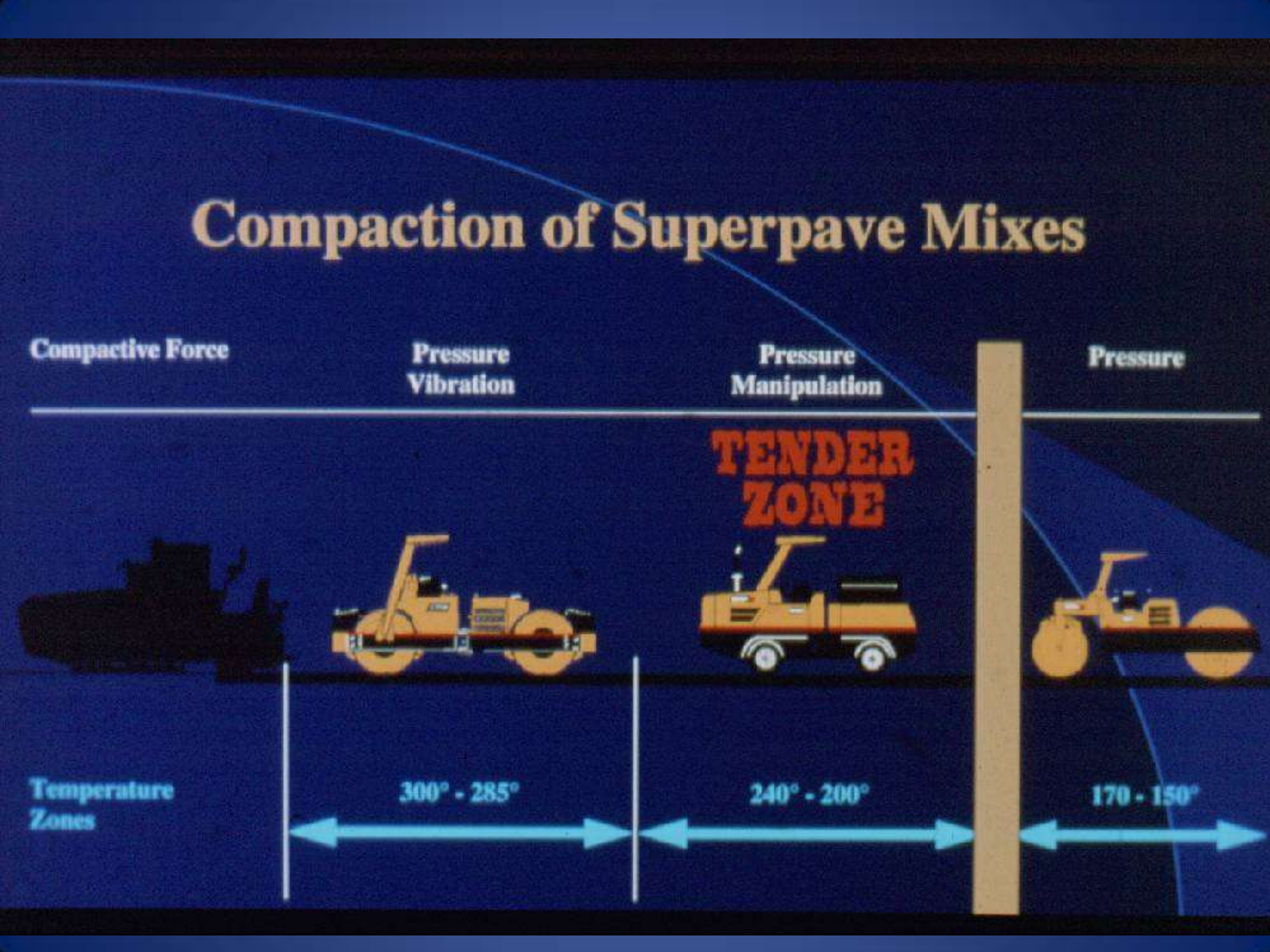
3 PHASES OF ROLLING

- EACH PHASE OF ROLLING IS A: TIME,
- TEMPERATURE, AND DISTANCE ZONE
- BREAKDOWN ROLLING: DOUBLE DRUM VIBRATORY 1 OR 2 DISTANCE:
- 200’ FROM SCREED, TEMPERATURE: 200 F-290F TIME: 10 MINUTES

3 PHASES OF ROLLING

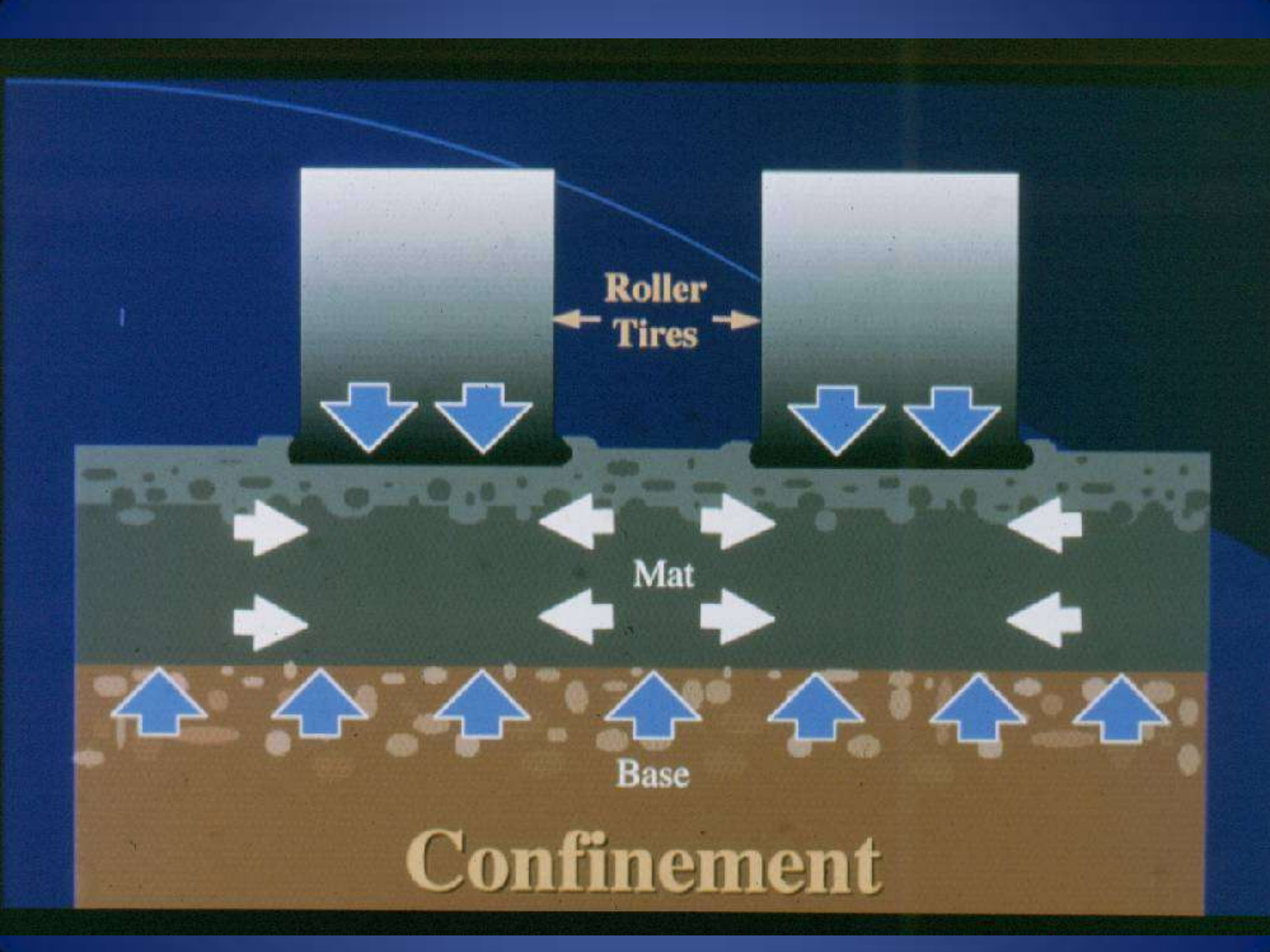
- INTERMEDIATE: SECOND OR THIRD DOUBLE DRUM VIBRATORY OR 20 TON AND ABOVE PNEUMATIC ROLLER
- DISTANCE: 200’ TEMPERATURE: 170 F – 200F TIME: 5 MINUTES
- FINISH: DOUBLE DRUM VIBRATORY RUN IN STATIC
- DISTANCE 100’ TEMPERATURE 100F-150-170F TIME 10 MINUTES

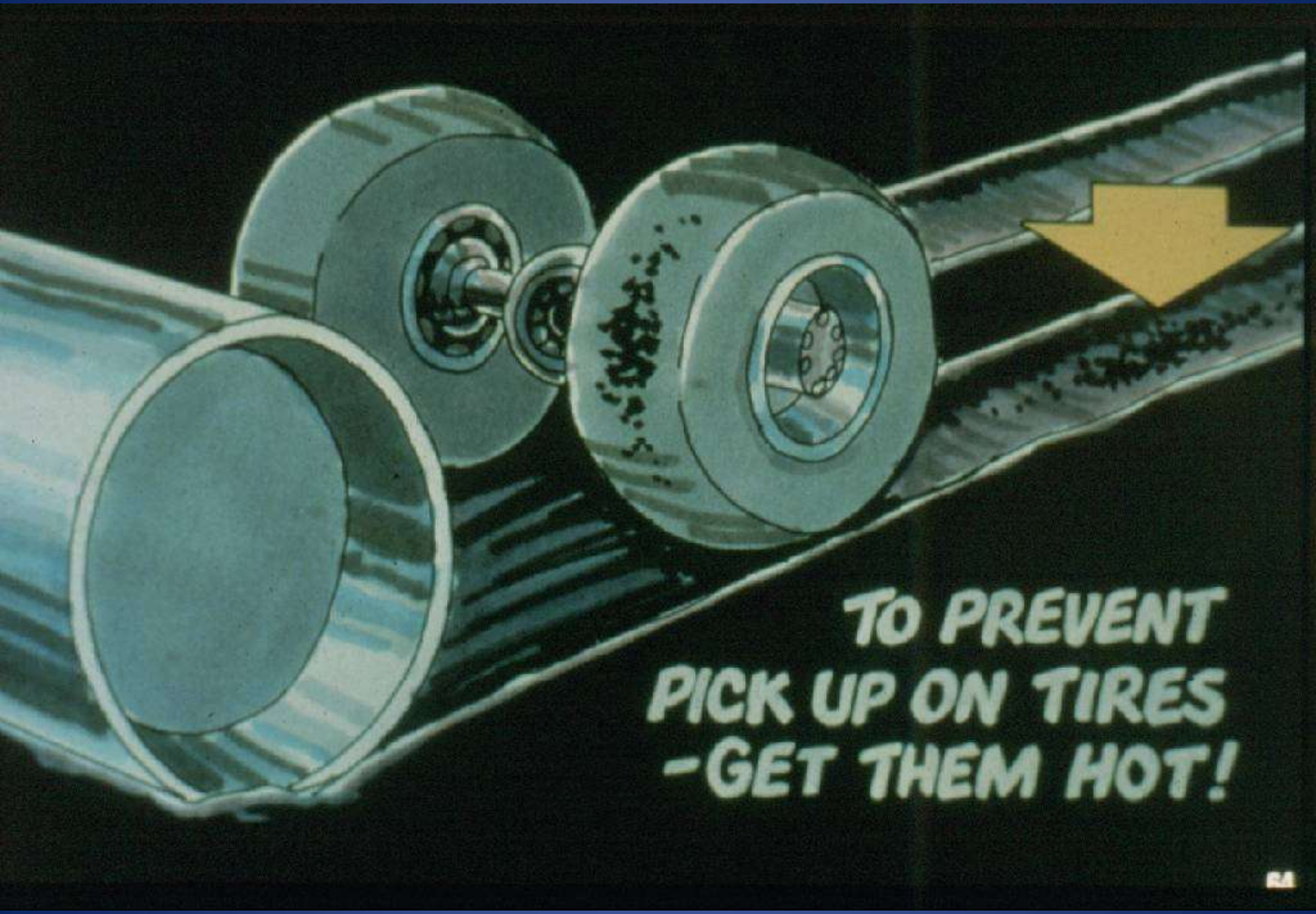
Compaction of Superpave Mixes




HYPAC
SPEED
LIMIT
45
$150 FINE
MINIMUM
'01 5 16


BOMAG


Roller
Tires
Mat
Base
Confinement


TO PREVENT
PICK UP ON TIRES
-GET THEM HOT!


KEEP
RIGHT


HYPAC

PNEUMATIC ROLLER ON POLYMER MODIFIED MIX BAD PICK UP

Asphalt sticks to the tires - Rubber tired rollers

A separating agent or formwork oil should be used until tires have right temperature. (60 °C)

PNEUMATIC ON POLYMER MODIFIED NO PICK UP; SPRAY SYSTEM WORKING, CONTROLLED TEMPERATURE ROLLING ZONE 185 F-212 F. GOOD RELEASE AGENT

MEASURING TEMP

PNEUMATIC TIRE RULES

- INFLATE ALL TIRES TO EQUAL PRESSURE LOOK AT TIRE INFLATION CHART
- GET TIRES CLEAN
- GET TIRES HOT BEFORE GETTING ON THE MAT
- USE GOOD RELEASE AGENT

PNEUMATIC TIRE RULES

- ON NEAT ASPHALT USE WATER SPRAY ON INTERMITTENT LOW
- RUN ROLLER BETWEEN 190F-225F
- ON MODIFIED ASPHALT USE WATER SPRAY ALL THE TIME
- RUN THE ROLLER BETWEEN 185F-212F ALL TEMPERATURES ARE SURFACE TEMPS.

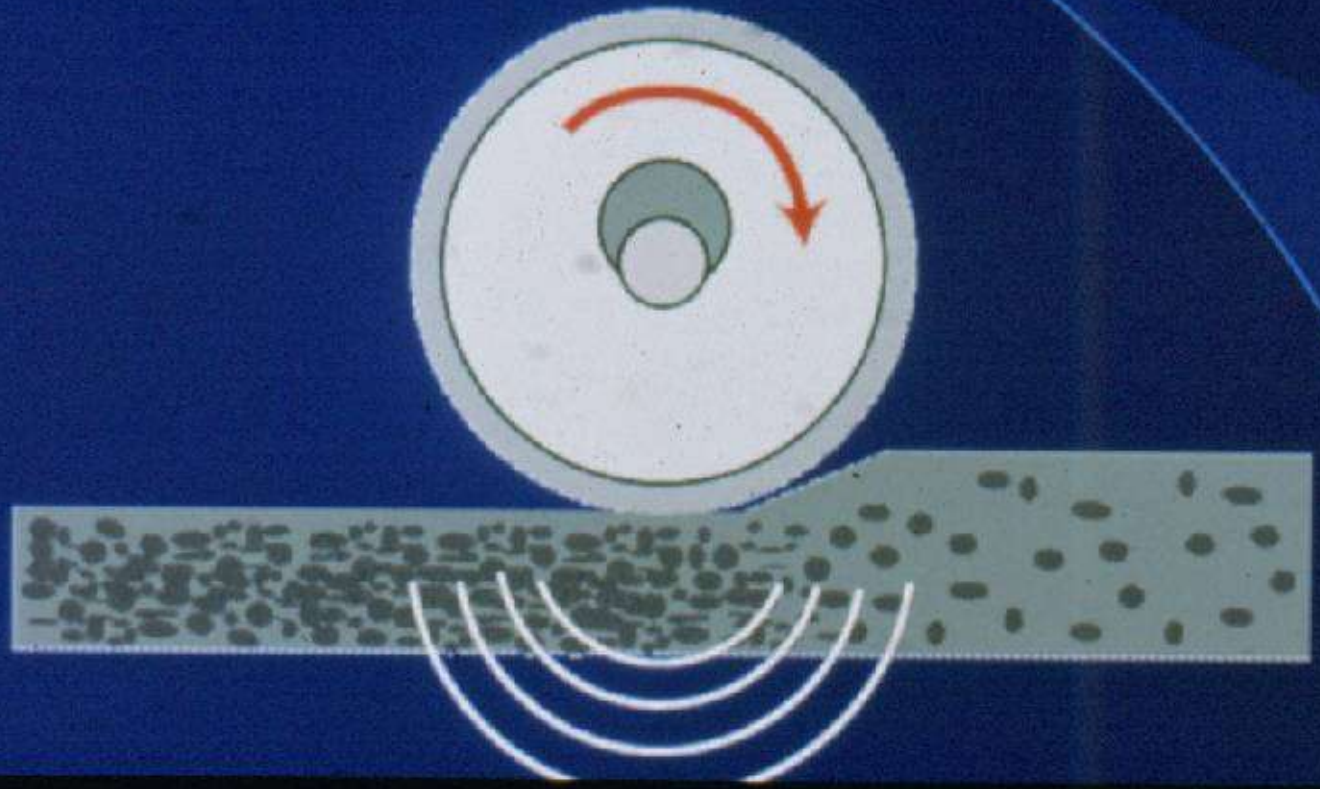

103
dB
65-376


FISCHER


FISCHER

Vibration

Compaction by Vibration is Particle Rearrangement



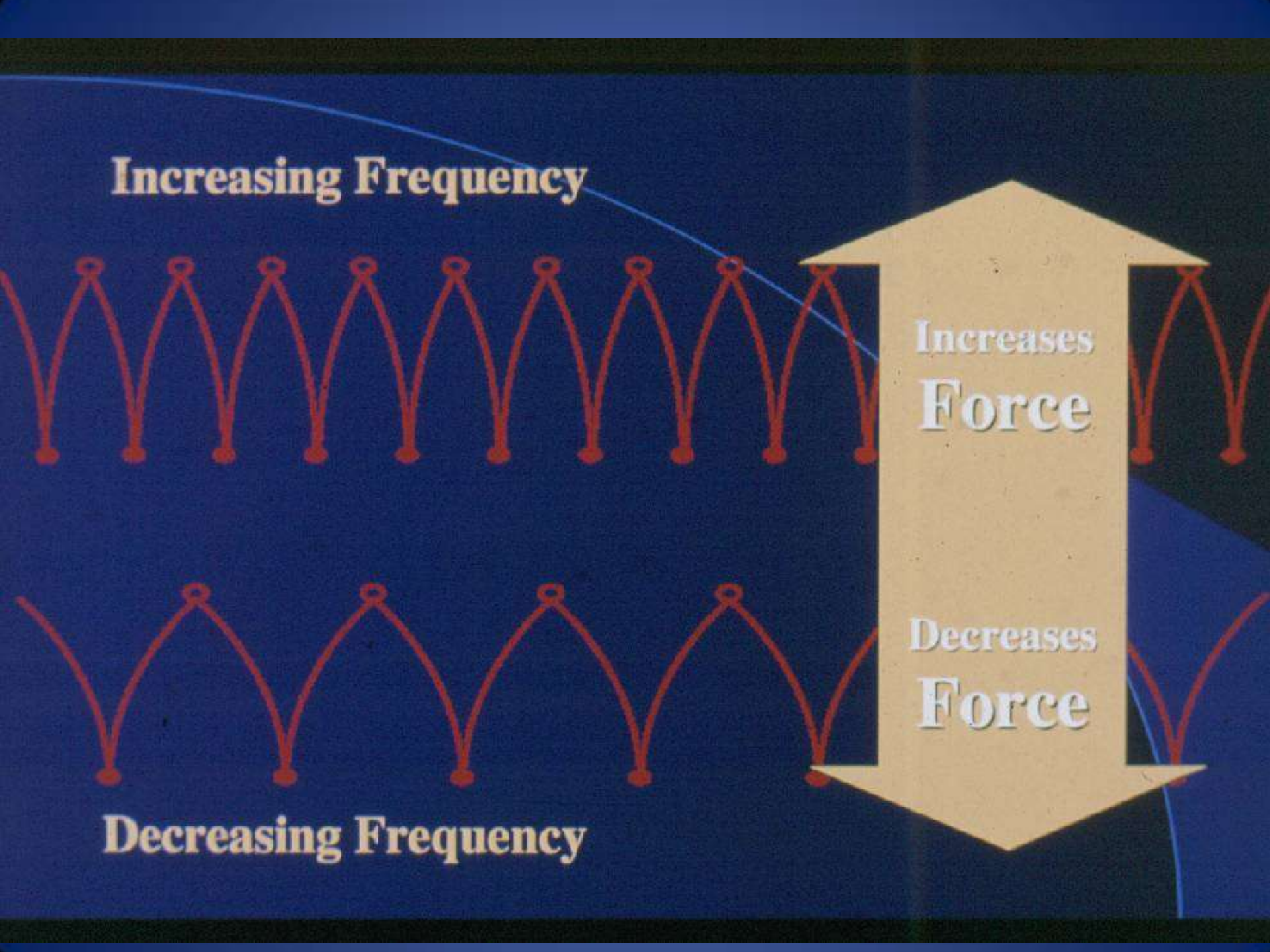
COMPACTION BY VIBRATION

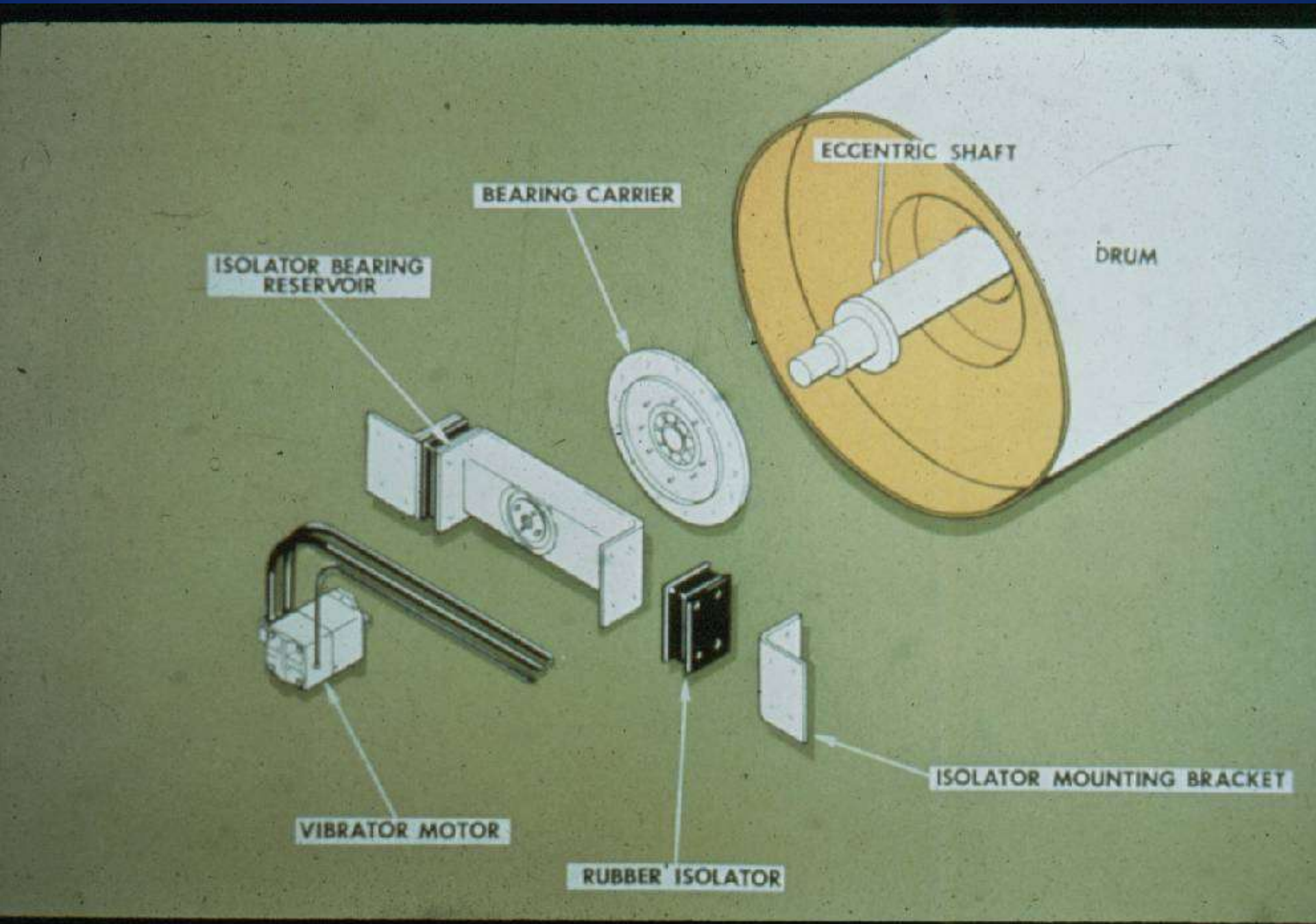
- WE REARRANGE THE AGGREGATE
- WE LOCK UP THE AGGREGATE STRUCTURE
- WE LEAVE IMPACT MARKS IN THE HMA MAT
- WE CONTROL THE SPACING OF THESE IMPACT MARKS, SO YOU WILL NOT SEE OR FEEL THEM, BY MATCHING- TRAVEL SPEED & FREQUENCY

SYSTEMS ON VIBRATORY ROLLERS

- AMPLITUDE: THE HEIGHT THE VIBRATING MASS MOVES FROM THE MATERIAL BEING COMPACTED- IN ONE ROTATION OF THE VIBRATING MASS.
- FREQUENCY: THE NUMBER OF TIMES THE VIBRATING MASS MOVES IN A MINUTE- VIBRATIONS PER MINUTE OR V.P.M.
- FREQUENCY AND AMPLITUDE CREATE A GIVEN AMOUNT OF CENTRIFUGAL FORCE.


Amplitude


Increasing Frequency
Increases
Force
Decreases
Force
Decreasing Frequency


ECCENTRIC SHAFT
BEARING CARRIER
DRUM
ISOLATOR BEARING RESERVOIR
ISOLATOR MOUNTING BRACKET
VIBRATOR MOTOR
RUBBER ISOLATOR

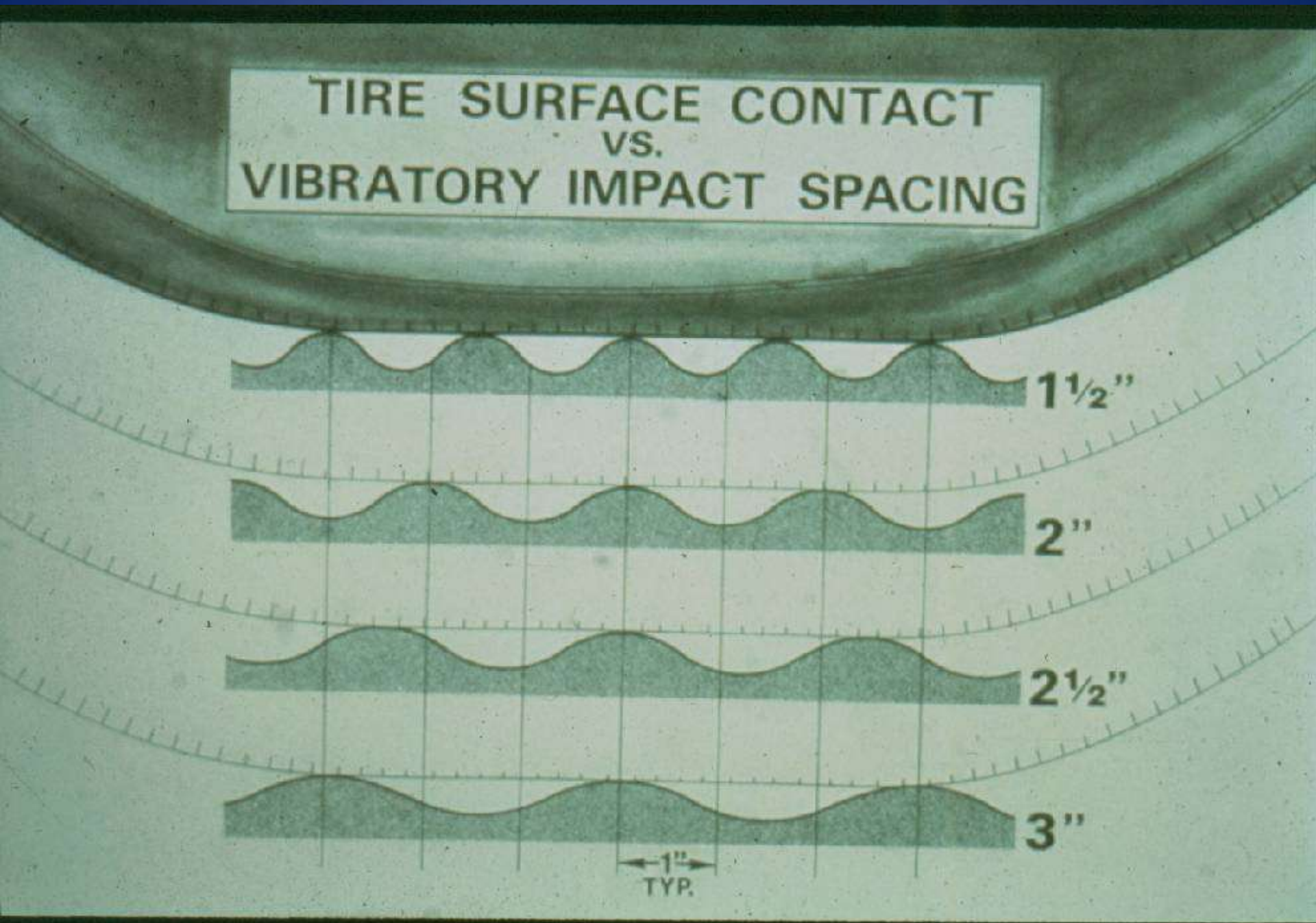
Smoothness

Frequency & Travel Speed

VIBRATORY IMPACTS PER FOOT IPF

MAINTAIN BETWEEN 10-14 IPF

IPF GIVES US DENSITY, SMOOTHNESS, AND BALANCED PRODUCTION


TIRE SURFACE CONTACT
VS.
VIBRATORY IMPACT SPACING
1½"
2"
2½"
3"
1"
TYP.

VIBRATORY ROLLER CONTROLS

- ABILITY TO SET TRAVEL SPEED AND LIMIT OVERSPEEDING
- SET TRAVEL SPEED IN RELATIONSHIP WITH FREQUENCY
- THIS GIVES US A READOUT IN REAL TIME OF IMPACTS PER FOOT

How To Measure Roughness?

- Equipment

1.Straightedge

2. Inertial Profiler

TEXAS ASPHALT PAVEMENT ASSOCIATION

Dedicated To Quality


SOUTHE
AMES ENGIN
HIGH SPEED

HYPAC

Quick-reference asphalt compaction charts

Maximum Rolling Speed (fpm)
Speed in feet per minute required to achieve desired impacts per foot.

	Impacts per Linear Foot (IPF)				
VPM	10	11	12	13	14
1850	185	168.2	154.2	142.3	132.1
2000	200	181.8	166.7	153.8	142.9
2500	250	227.3	208.3	192.3	178.6
2700	270	245.5	225	207.7	192.9
3000	300	272.7	250	230.8	214.3
3100	310	281.8	258.3	238.5	221.4
3200	320	290.9	266.7	246.2	228.6
3400	340	309.1	283.3	261.5	242.9
3600	360	327.3	300	276.9	257.1
3800	380	345.5	316.7	292.3	271.4
4000	400	363.6	333.3	307.7	285.7

Maximum Rolling Speed (mph)
Speed in miles per hour required to achieve desired impacts per foot.

	Impacts per Linear Foot (IPF)				
VPM	10	11	12	13	14
1850	2.1	1.9	1.8	1.6	1.5
2000	2.3	2.1	1.9	1.7	1.6
2500	2.8	2.6	2.4	2.2	2.0
2700	3.1	2.8	2.6	2.4	2.2
3000	3.4	3.1	2.8	2.6	2.4
3100	3.5	3.2	2.9	2.7	2.5
3200	3.6	3.3	3.0	2.8	2.6
3400	3.9	3.5	3.2	3.0	2.8
3600	4.1	3.7	3.4	3.1	2.9
3800	4.3	3.9	3.6	3.3	3.1
4000	4.5	4.1	3.8	3.5	3.2

Passes Needed for One Coverage
Equals the paving width divided by the width of the drum minus six inch overlap.

Pave	Roller Drum Width			
Width	54"	66"	78"	84"
10'	3	2	2	2
11'	3	3	2	2
12'	3	3	2	2
13'	4	3	3	2
14'	4	3	3	3
15'	4	3	3	3
16'	4	4	3	3
17'	5	4	3	3
18'	5	4	3	3
19'	5	4	4	3
20'	5	4	4	4
21'	6	5	4	4
22'	6	5	4	4
23'	6	5	4	4
24'	6	5	4	4

English/Metric Conversions

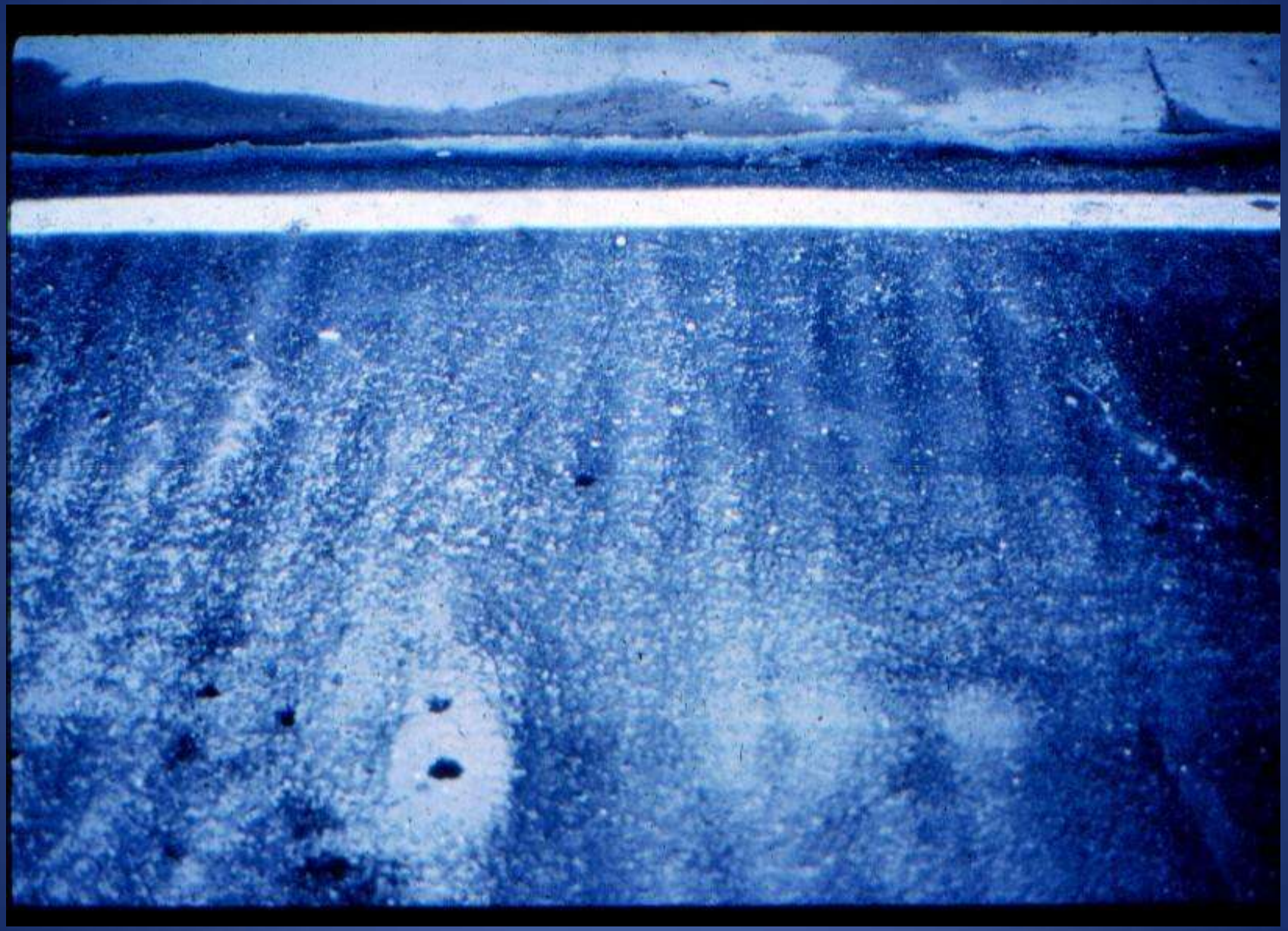
C	F
76	169
74	165
72	162
68	154
64	147
62	144
0	32
-18	0
-22	-8
-24	-11
-26	-15
-28	-18
-30	-22
-32	-26

Aggregate size	
Mm	inch
75	3.0
64	2.5
50	2.0
37.5	1.5
32	1.3
25	1.0
19	0.8
12.5	0.5
9.5	0.4
7	0.3

Always start compaction at the highest temperature at which the asphalt will allow rolling.

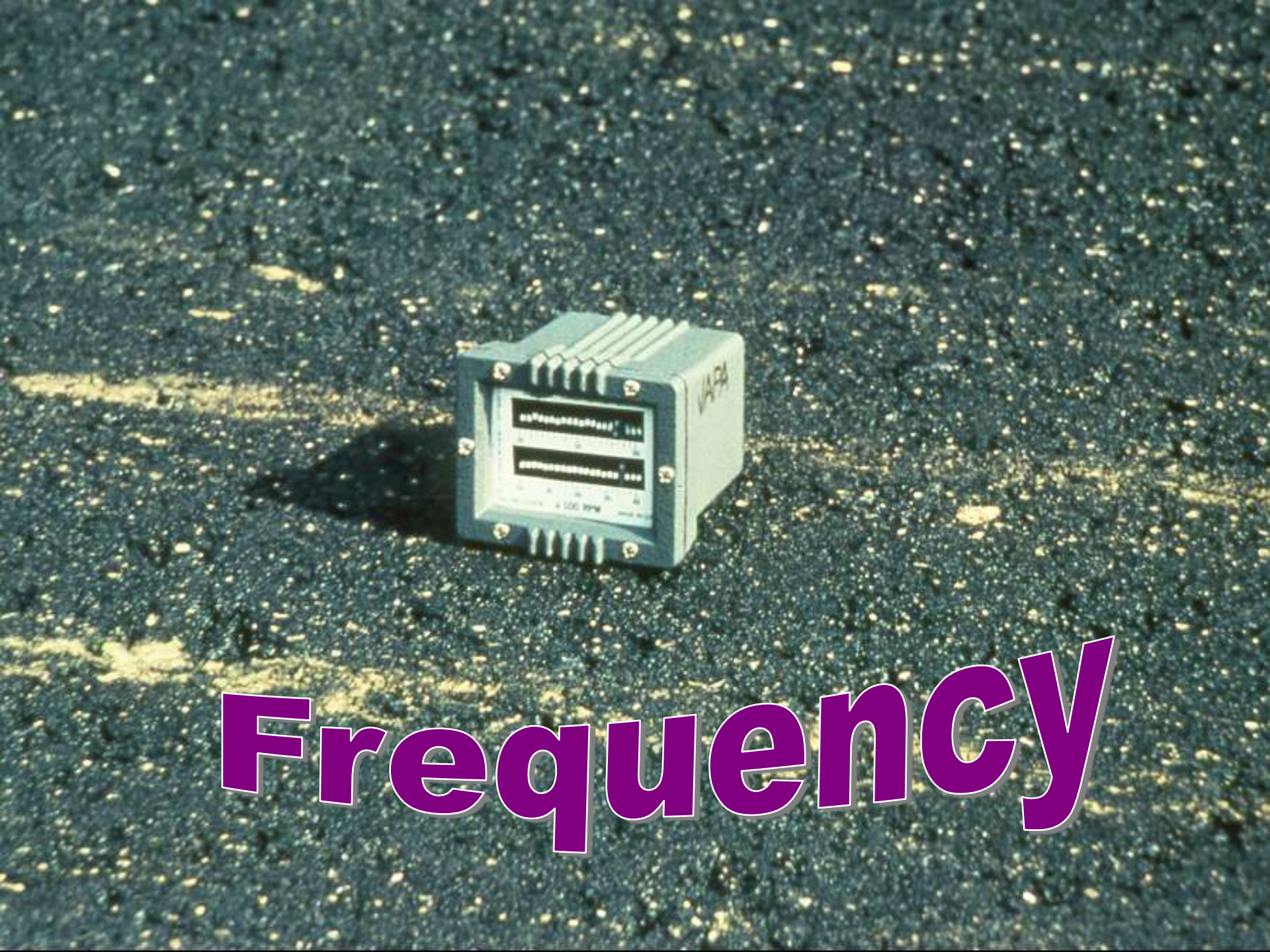
Impact Spacing

Frequency	2 MPH	3 MPH	4 MPH	5 MPH
2000 vpm	1.06	1.58	2.14	2.64
2200 vpm	0.96	1.44	1.92	2.40
2400 vpm	0.88	1.32	1.76	2.20
2600 vpm	0.81	1.22	1.63	2.03
2800 vpm	0.75	1.13	1.51	1.89
3000 vpm	0.70	1.06	1.41	1.76
3200 vpm	0.66	0.99	1.33	1.65
3400 vpm	0.62	0.93	1.24	1.55
3600 vpm	0.59	0.88	1.17	1.47
3800 vpm	0.56	0.83	1.11	1.39



Drum Impacts per foot (10/ft minimum)

Frequency	2 MPH	3 MPH	4 MPH	5 MPH
2000 vpm	11.36	7.58	5.68	4.55
2200 vpm	12.50	8.33	6.25	5.00
2400 vpm	13.64	9.09	6.82	5.45
2600 vpm	14.77	9.84	7.39	5.91
2800 vpm	15.91	10.61	7.95	6.36
3000 vpm	17.05	11.36	8.52	6.82
3200 vpm	18.18	12.12	9.09	7.27
3400 vpm	19.32	12.88	9.66	7.72
3600 vpm	20.45	13.64	10.22	8.18
3800 vpm	21.59	14.39	10.80	8.63


Frequency

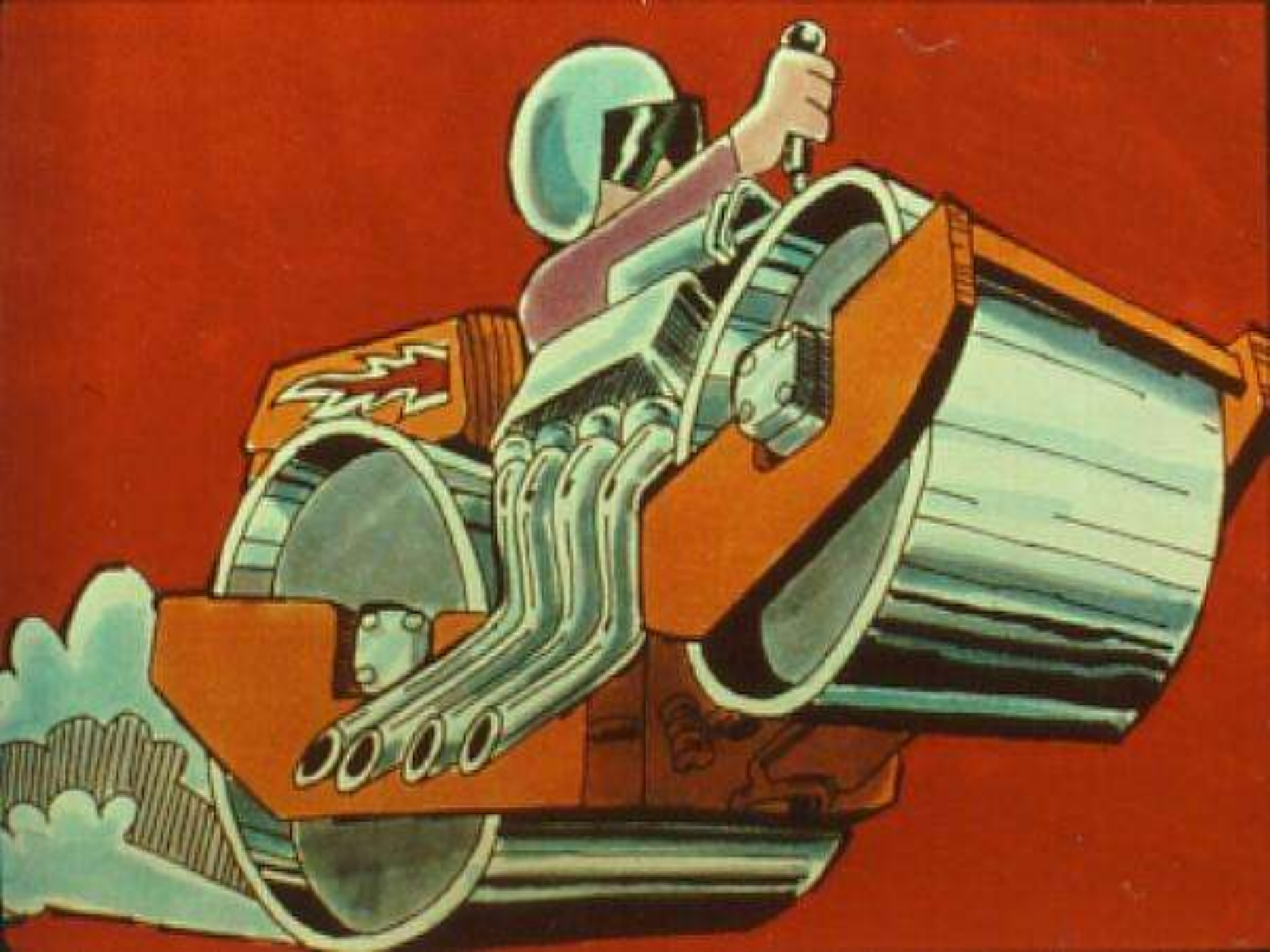
TRAVEL SPEED OF ROLLERS

DOUBLE DRUM VIBRATORY 2-4 MPH

PNEUMATIC ROLLER 2-3 MPH

STATIC STEEL WHEEL ROLLER 3-5 MPH

SPEED CAN KILL

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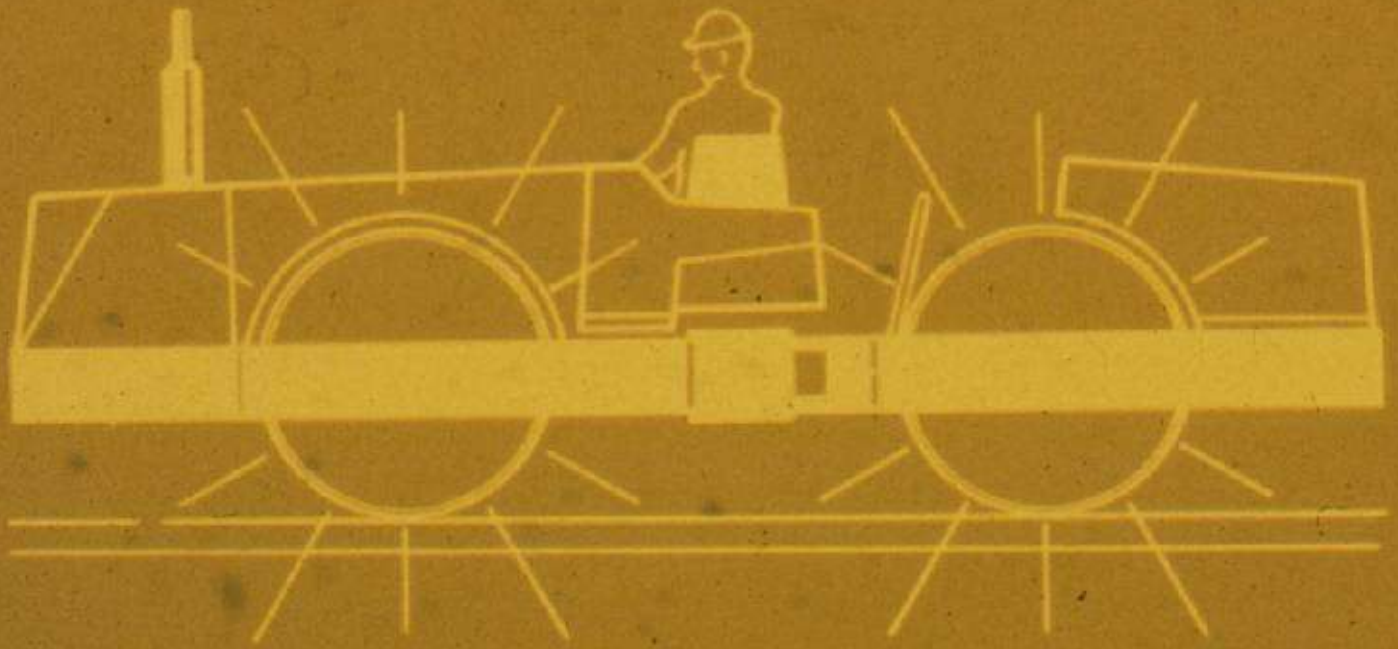
VOLVO


INGERSOLL-RAND

DRUM RINGING

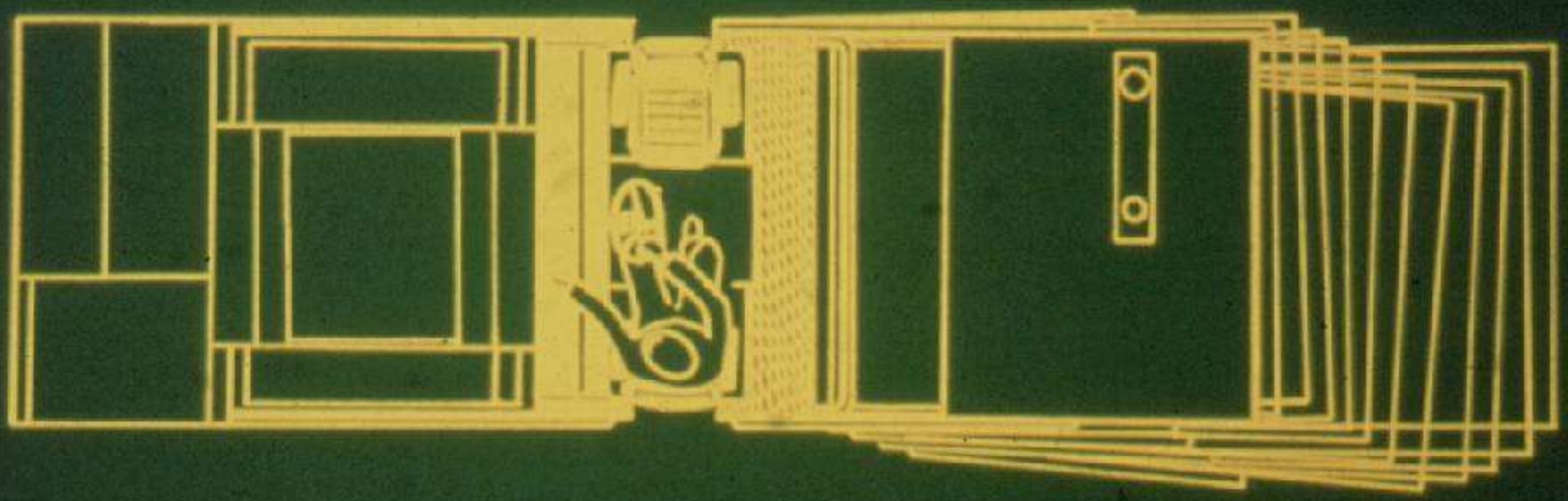


Too many vibratory passes

Reduce passes

Lower vibratory force

ROLLER CRAWLING OR HOPPING



Applying too much force

Mat becoming hard

BEST PRACTICE FOR VIBRATORY ROLLERS

- 1. CONTROL FRQUENCY AND AMPLITUDE- BEST: LOW AMPLITUDE AND HIGH FREQUENCY
- 2. CONTROL TRAVEL SPEED AND # OF VIBRATORY PASSES TO ACHIEVE DENSITY AND SMOOTHNESS AND BALANCE PRODUCTION BY CONTROLLING IMPACT SPACING IPF
- 3. MINIMUM: IPF 10 IN 12” MAX: 14 IPF

Lift Thickness

- Recommended 3:1 to 6:1 Thickness:NMAS
- Thin lifts cool faster
  - less time available for compaction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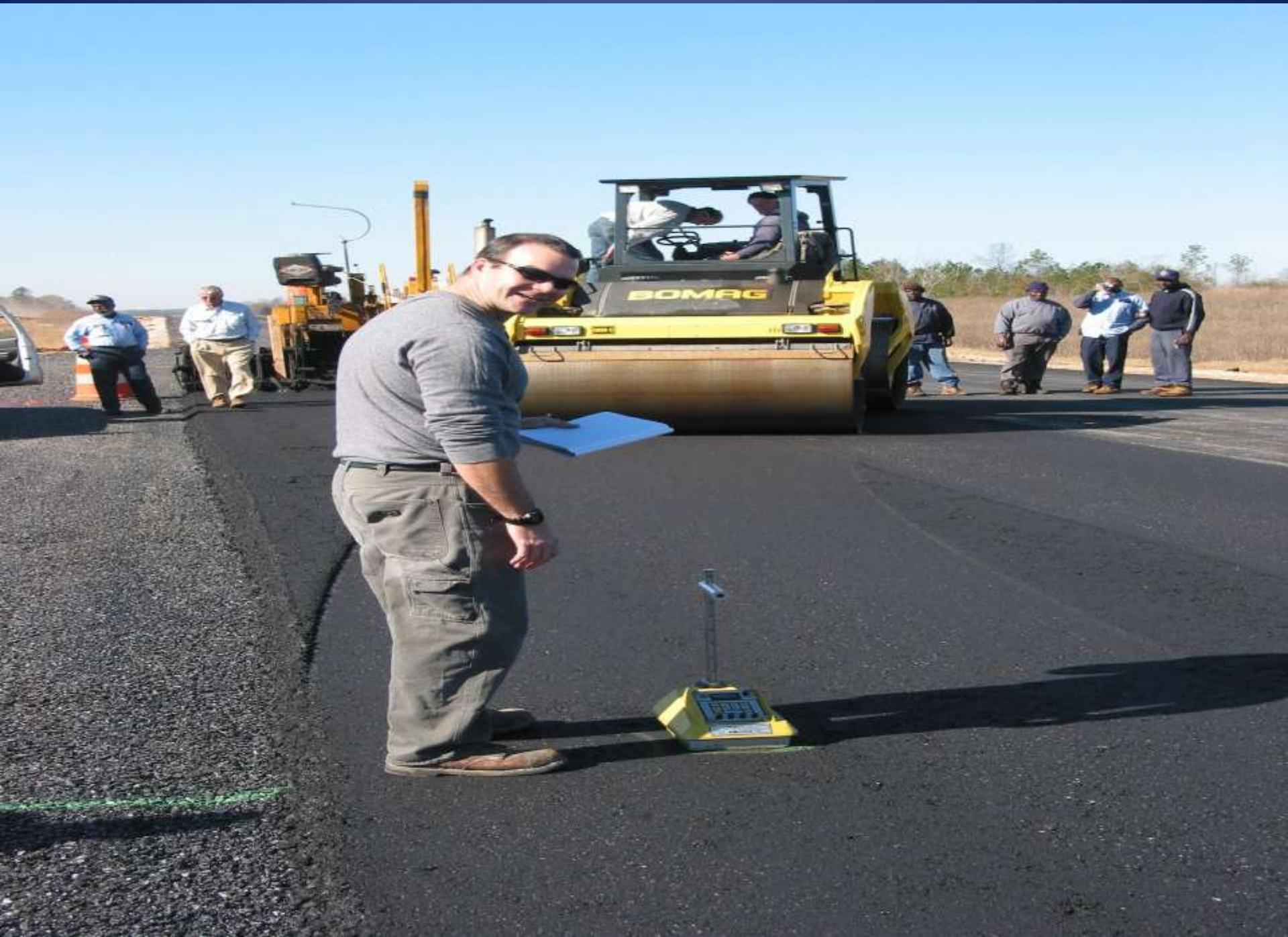
PATTERN DECISIONS:

1. How many passes?
2. How many repeat passes?
3. How to be sure mix is rolled at correct temperature?
4. How fast to roll?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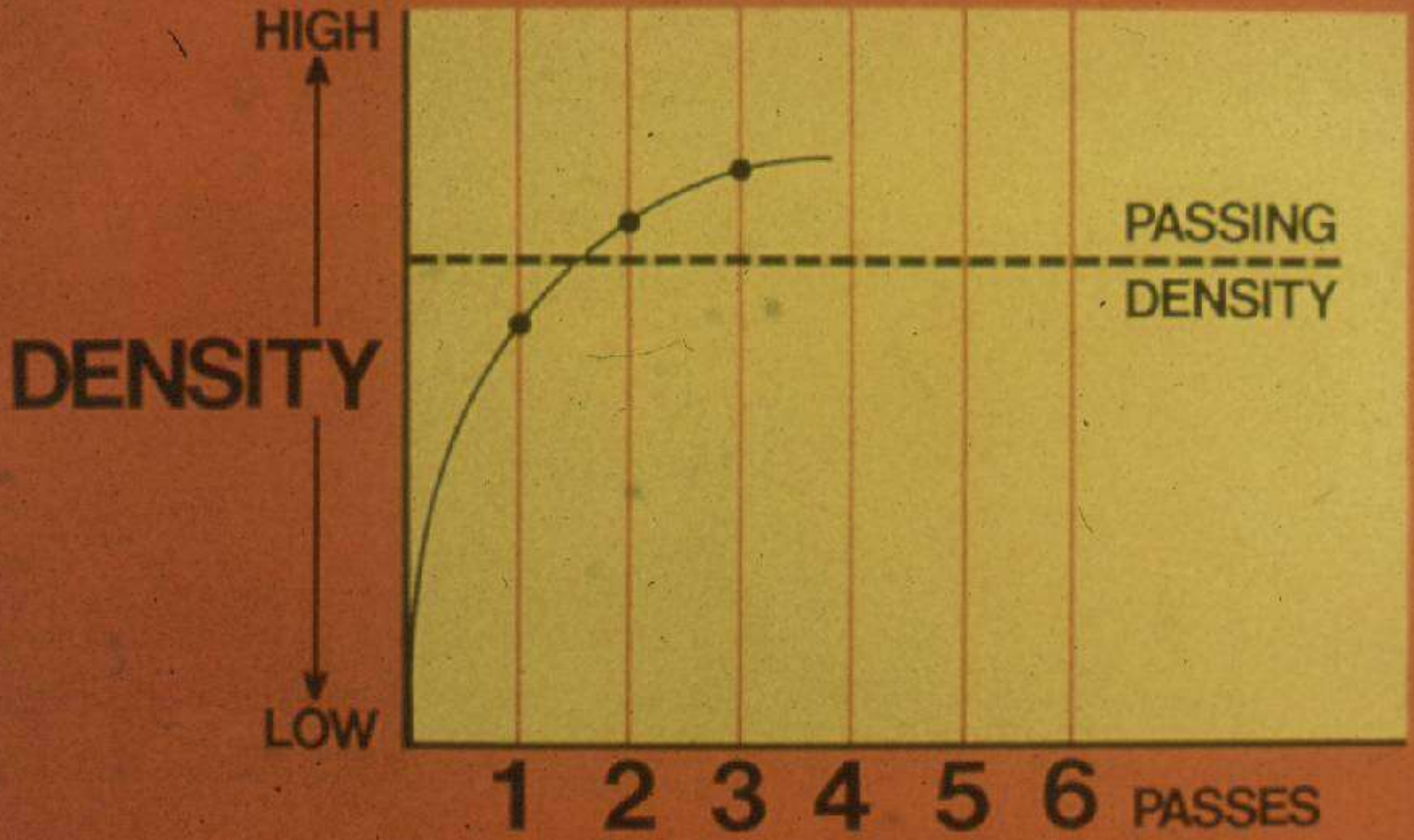
example



PAVING SPEED 50 FPM; 3 ROLLERS IN ECHELON; 2-84” & 1- 66”
SMOOTH NESS IRI “20”

“3 IN 1”

QCTECH
PAVING FOREMAN
ROLLER OPERATORS

PAVING FOREMAN RESPONSIBILITIES

SAFETY OF CREW

QUALITY PPRODUCTION

SET GOALS FOR CREW

COMMUNICATE WITH CREW MMEMBERS & QUALITY CONTROL

TRAIN CREW

QUALITY CONTROL TECH RESPONSIBILITIES

OVERALL JOB QUALITY

UNDERSTAND JOB SPECS:MIX DESIGN, LIFT THICKNESS, DENSITY AND SMOOTHNESS SPECS

SET UP INITIAL TEST STRIP BEFOR EACH DAY'S PRODUCTION

WORK WITH PAVING FOREMAN AND ROLLER OPERATORS TO SET ROLLING PATTERNS TO ACHIIEVE QUALITY PRODUCTION, BONUS DENSITY AND BONUS SMOOTHNESS

COMMUNICATE WITH ROLLER OPERATORS AND PAVING FOREMAN

ROLLER OPERATOR RESPONSIBILITIES

UNDERSTAND THE CONTROLS AND SETTINGS ON ROLLER

MAINTAIN THE ROLLER WITH DAILY MAINTENANCE

KNOW THE DENSITY AND SMOOTHNESS SPECS; LIFT THICKNESS, PAVING WIDTH, AND PRODUCTION RATE

ESTABLISH CONSISTENT ROLLING PATTERN WITH QC & COMMUNICATE WITH PAVING FOREMAN

MAINTAIN ROLLER TYPE IN BREAKDOWN, INTERMEDATE, OR FINISH ROLLING ZONE TO OBTAIN QUALITY PRODUCTION, BONUS DENSITY AND SMOOTHNESS

NEW DEVELOPMENTS

- TRAINING
- NEW MIX DESIGN: WARM MIX WITH RAP & RAS
- NEW DEVELOPMENTS IN COMPACTION : INTELLIGENT COMPACTION
- VIBRATORY PNEUMATIC
- OSCILLATORY VIBRATORY ROLLERS

NAPA TOOL BOX TALKS

- LONGITUDINAL JOINT CONSTRUCTION
- OPERATION OF MTV
- PROPER ROLLING PROCEDURES
- 4 FORCES OF COMPACTION
- TRUCKING
- OPERATION OF PAVER

Steps in Making Good Longitudinal Joints

1- Control Segregation at the Outside Edges of the Mat
2- Steer a Straight Line
3- Compact Unconfined Edge
4- Maintain Correct Overlap
5- Place the Proper Depth for Roll Down
6- Do Not Lute the Joint
7- Compact the Joint for Density

90% of the reason for joint failures or not achieving density at the joint; is ROBBING THE JOINT OF MATERIAL


BOMAG
10/07/2009

November 9, 2010
Bradford County, PA

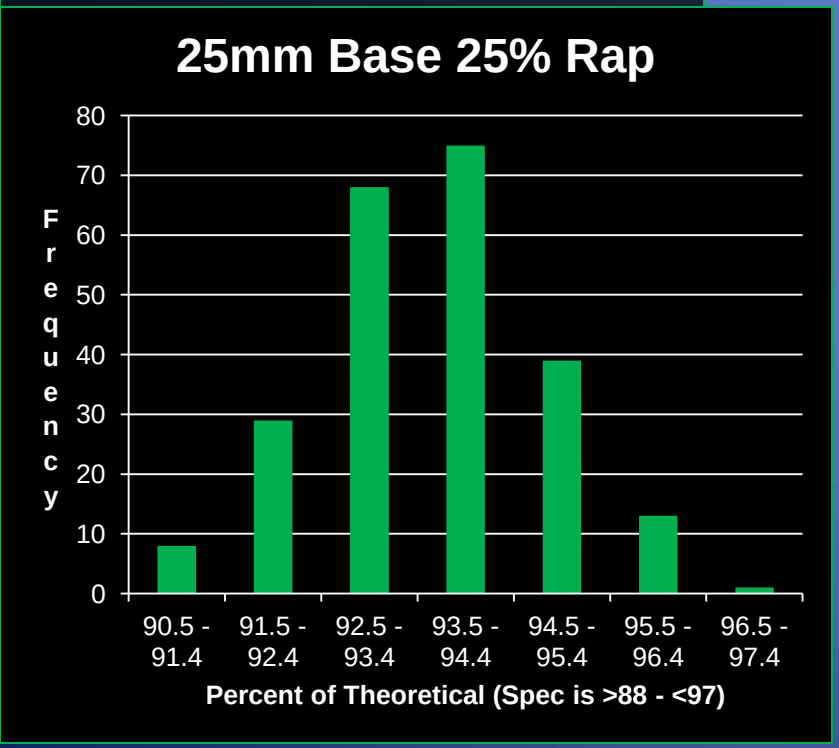
19mm .3<3 25% RAP…

WMA with MAXXAM Foaming Process

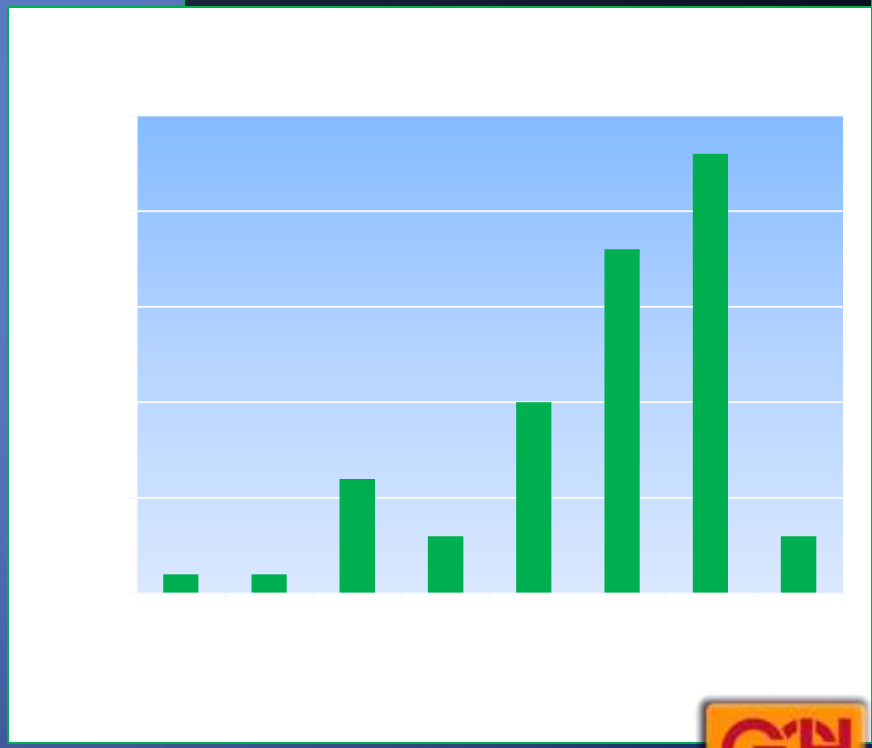
Air temp = 42°F

Extended 2010 Season Compaction Results

Spread of results of 233 cores



Spread of results of 65 cores




ASTEC


ASTEC


CATERPILLAR
igloo


SAKAI
SAKAI
HYPAC


HAMM

INTELLIGENT COMPACTION IS:

- A SYSTEM FOR MEASURING THE STIFFNESS OF HMA ON THE ROLLER
- A RECORDING OF THAT STIFFNESS MEASUREMENT; IS A GOOD PROOF ROLLER
- PROOF OF THE STIFFNESS OF THE HMA AS RELATED TO DENSITY
- PROVIDES INFORMATION FOR THE ROLLER TO MAKE DECISIONS – NOT THE ROLLER OPERATOR
- A QUALITY CONTROL SYSTEM THAT PROVIDES FEEDBACK ON MATERIAL STIFFNESS AS RELATED TO THE NUMBER OF PASSES MADE AND LOCATION OF PASSES

INTELLIGENT COMPACTION IS NOT:

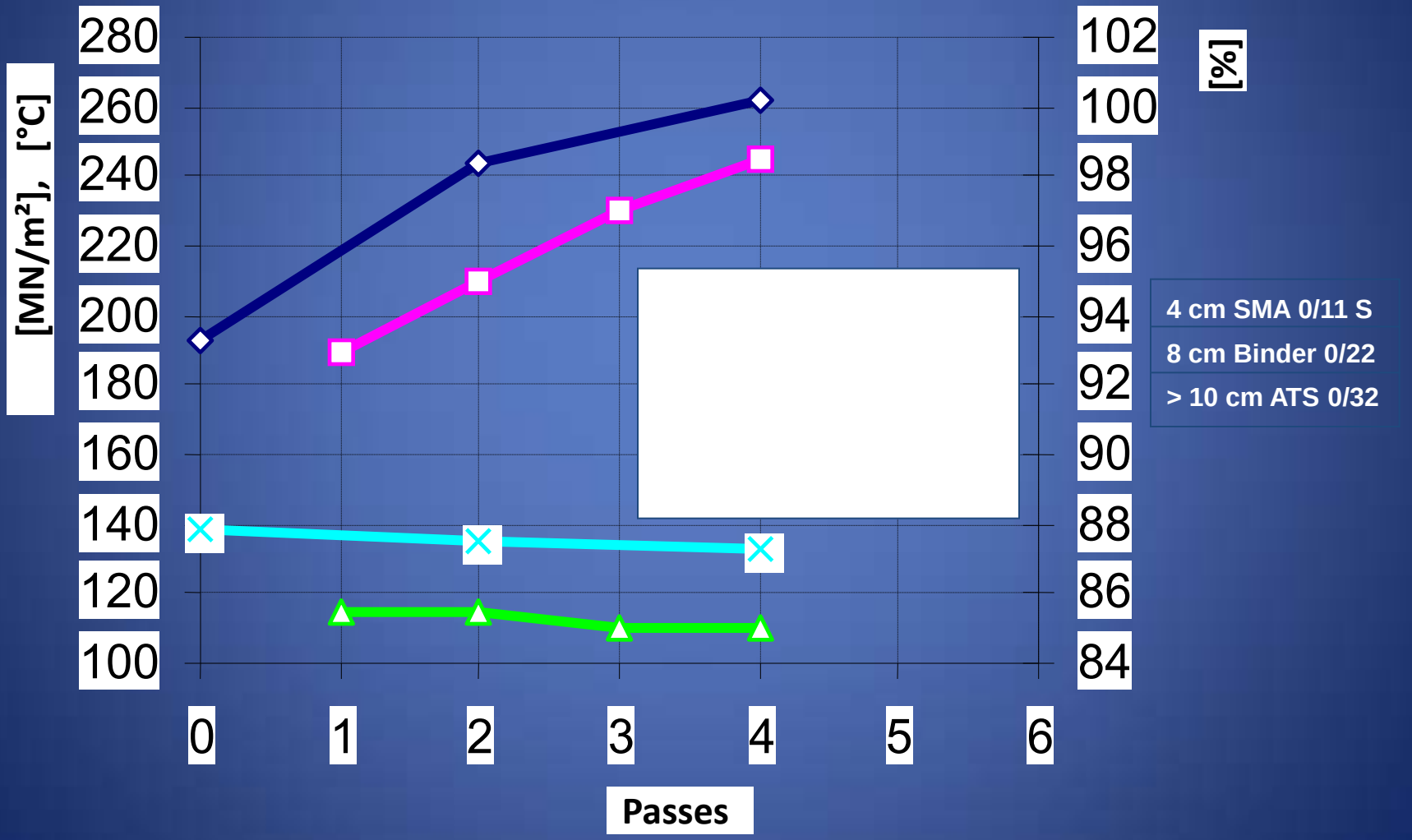
- A SYSTEM THAT MEASURES DENSITY
- ALWAYS AN ACCURATE MEASUREMENT OF STIFFNESS AS RELATED TO DENSITY; IT DEPENDS ON QUALITY OF BASE
- NOT NEEDED ON ALL ROLLERS

COMPONENTS OF INTELLIGENT COMPACTION

- OPERATIONAL SYSTEMS
- MAPPING SYSTEMS
- GPS


Automatic prof
EVIB
482 PSI x100
0 100 200 300 400 500
266 °F
0 100 200 300 400
0.20 in
0 0.012 0.024 0.035
0-2in
0-2in
2-4in
2-4in
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
F12
F13
F14
F10
F11
F12
F13
A
B
C
P1
P2
P3
?
ESC
Enter

E_{VIB} and Density as function of passes; BW 174 AD Asphalt Manager, Automatic mode; Asphalt Base 0/32 CS B65, Nürnberg A3




BOMAG

ULTIMATE SMOOTHNESS

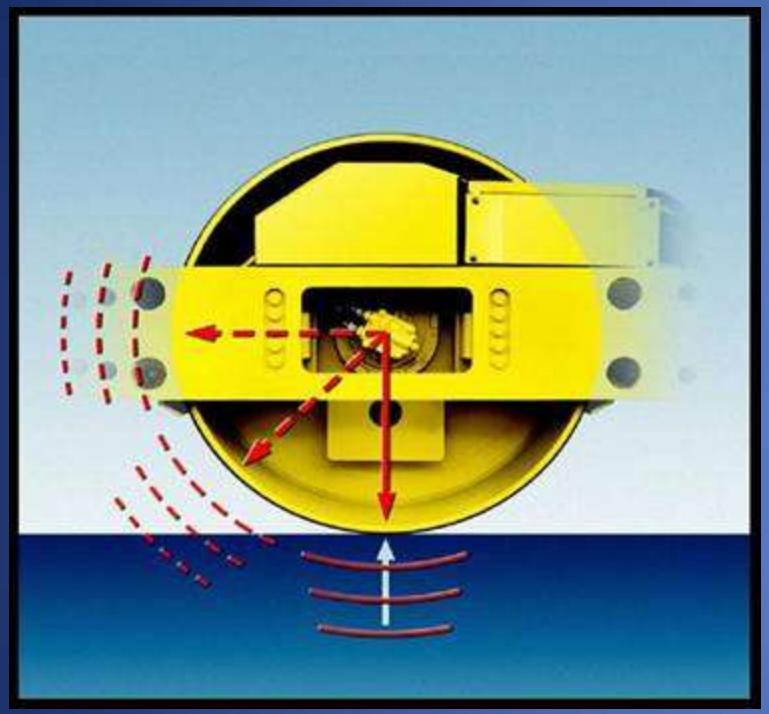
- ONE DRUM VIBRATING IN HORIZONTAL VIBRATION DIRECTION---FRONT DRUM
- REAR DRUM SHUT OFF
- 13/4INCH LOOSE LIFT 2PASSES-DENSITY 93.7% MTD
- SMOOTHNESS 38.5-42.0 IRI MEASURED WITH A LAZER MOUNTED VEHICLE

2 PASSES VERSUS 3 IN TEST STRIP

$ VALUE

- I/C MEASURES THE STIFFNESS OF A LIFT OF HMA
- DENSOMETERS MEASURE DENSITY OF HMA
- THIS GIVES US TWO MEASUREMENTS OF THE STABILITY OF THE HMA
- WHY CUT SO MANY CORES THAT COST $800.00-$1000.00 A CORE

IC Vario Benefits – Why IC ???



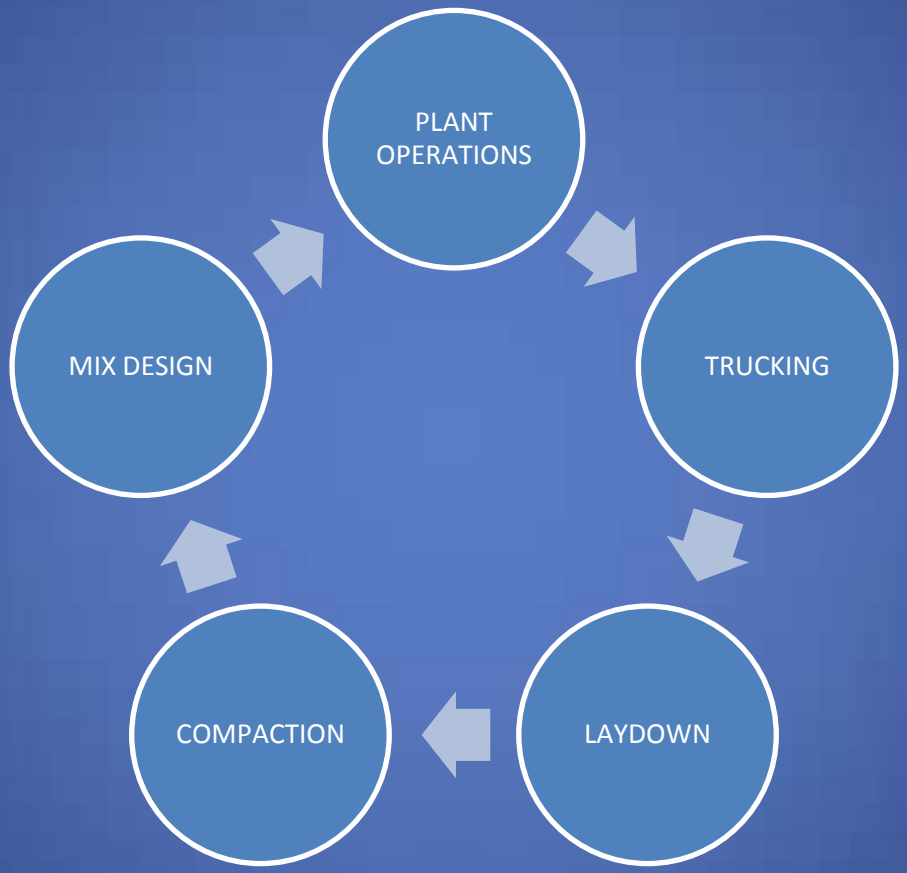
- Enhances Quality Control
- Consistent Rolling Patterns
- Exceptional Compaction Performance
- Real Time Data Display
- Wide Range of Adaptability
- Reduced Shock Loads to Surroundings
- Increased Depth Effect
- Proof Rolling to identify soft spots
- Under Compaction is avoided
- Over Compaction is avoided
- Unnecessary Passes are avoided
- Yields Fuel and Labor Savings
- Reduces In-Situ Measurements / Cost
- Reduces Highway Maintenance / Repair
- Provides Clear Documentation

ASPHALT COMPACTION BEST PRACTICE

BEST PRACTICE

- KNOW THE SPECIFICATIONS
- KNOW THE OPERATION OF THE ROLLERS
- BALANCE PRODUCTION

THE PAVING CYCLE



BASIC PRINCIPLES OF GOOD COMPACTION

- KNOW THE VARIABLES
- KNOW THE SPECS KNOW THE LAYOUT
- ESTABLISH A PATTERN TO ACHIEVE: COVERAGE, DENSITY, SMOOTHNESS, AND BALANCED PRODUCTION
- KNOW THE BASIC OPERATION OF EACH TYPE OF ROLLER

THANK YOU


HYPAC


HYPAC