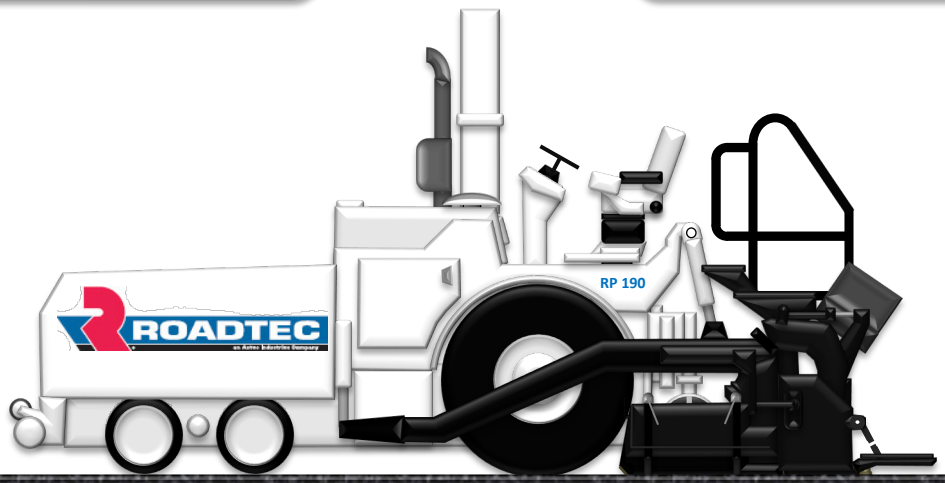
ROADTEC
an Astec Industries Company

Taller de Buenas Prácticas Constructivas

Ing. Paul Lavaud
plavaud351@gmail.com

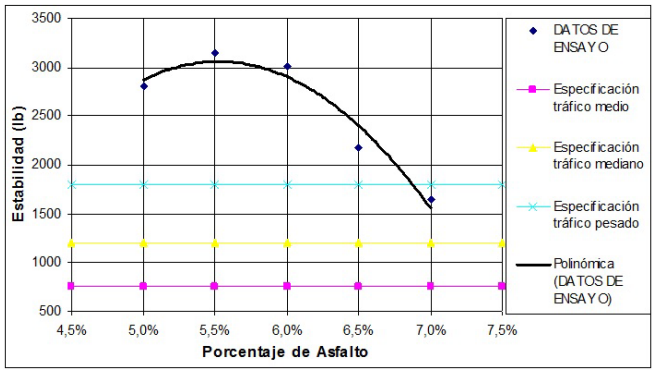
PAVING PROFESSIONALS
workshop

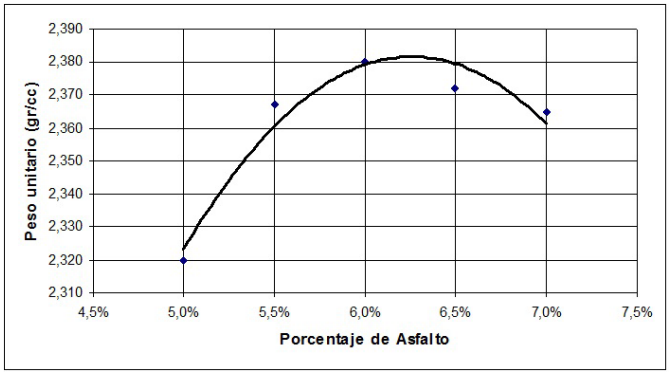


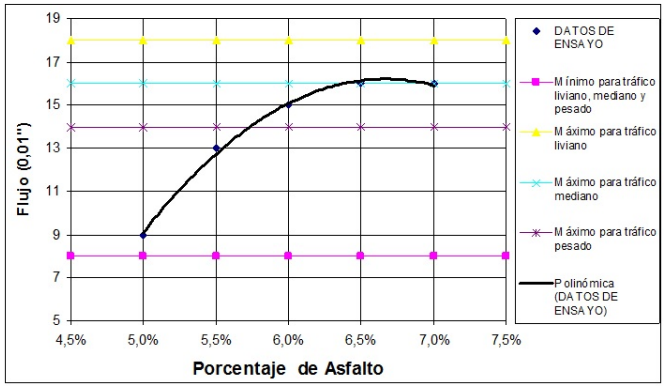
Construcción de Mezclas Asfálticas Duraderas

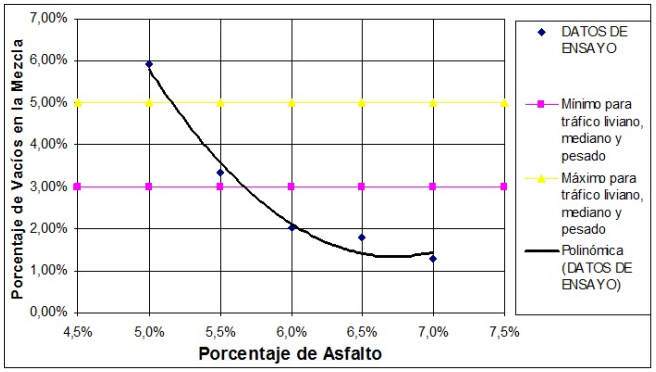
Materiales

Diseño Marshall









Determinar el contenido óptimo de asfalto para una combinación específica de asfalto.

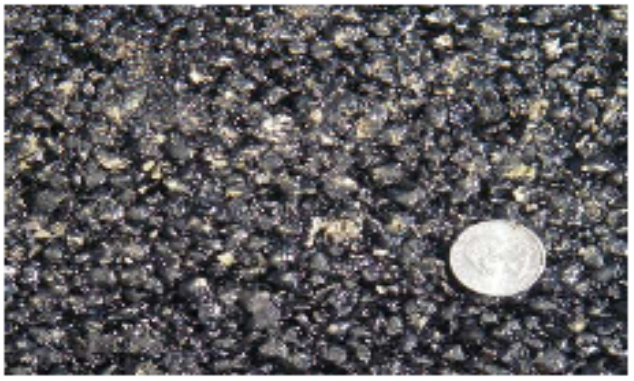
Post-Construction and Performance Report
Experimental Feature 07-01

Washington State Department of Transportation

Evaluation of Long-Term Pavement Performance and Noise Characteristics of Open-Graded Friction Courses – Project 2

Contract 7353
SR-520
Eastside Quieter Pavement Evaluation Project
MP 4.24 to MP 5.82



¿Porqué las carpetas de asfalto se dañan prematuramente?

Agrietamiento Térmico

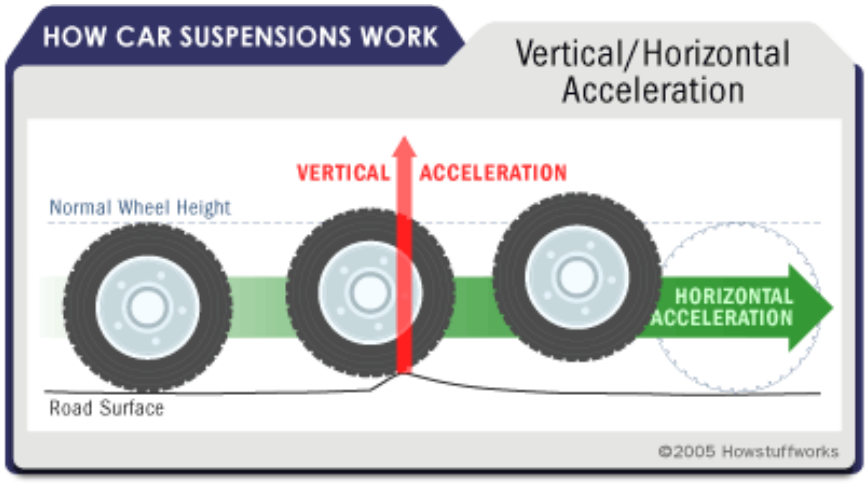
Agrietamiento por fatiga

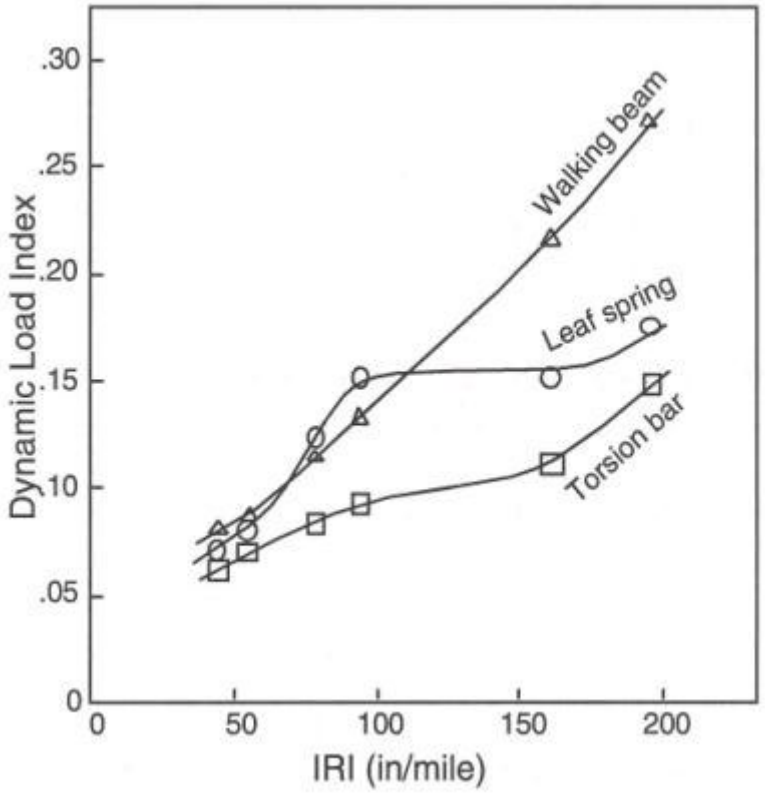
Baja serviciabilidad,

Baches

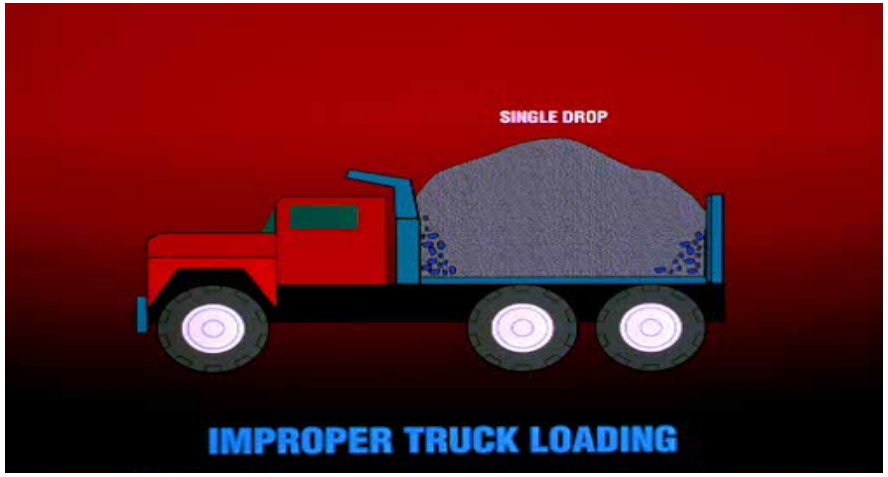
Desprendimiento

Cargas Dinámica se incrementan con la rugosidad





SEGREGACION DE AGREGADOS



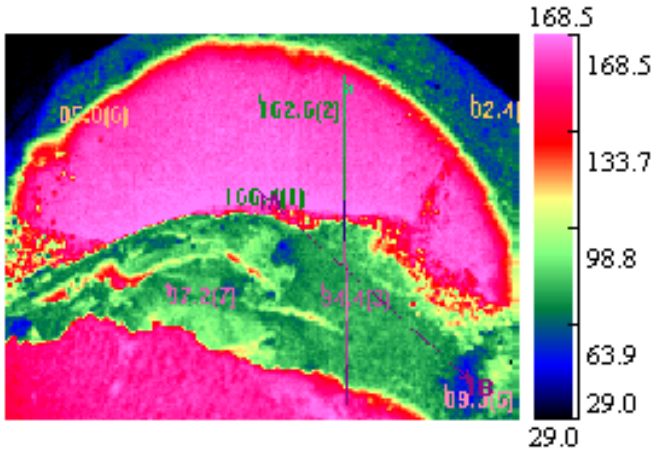
Descarga de mezcla del camion

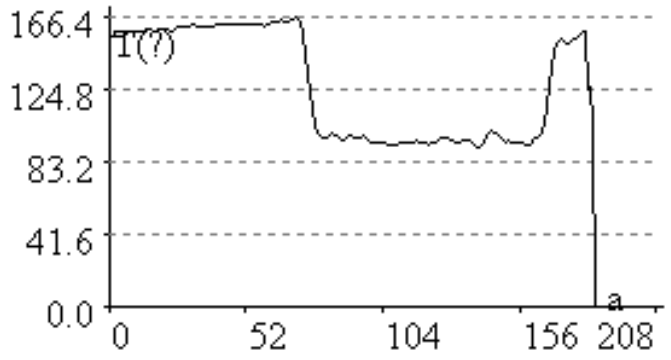
Service Provider : INFRATHERM

Service Receiver : ROADTEC-DIMAQ

Operate by : FC

Date : R7-14





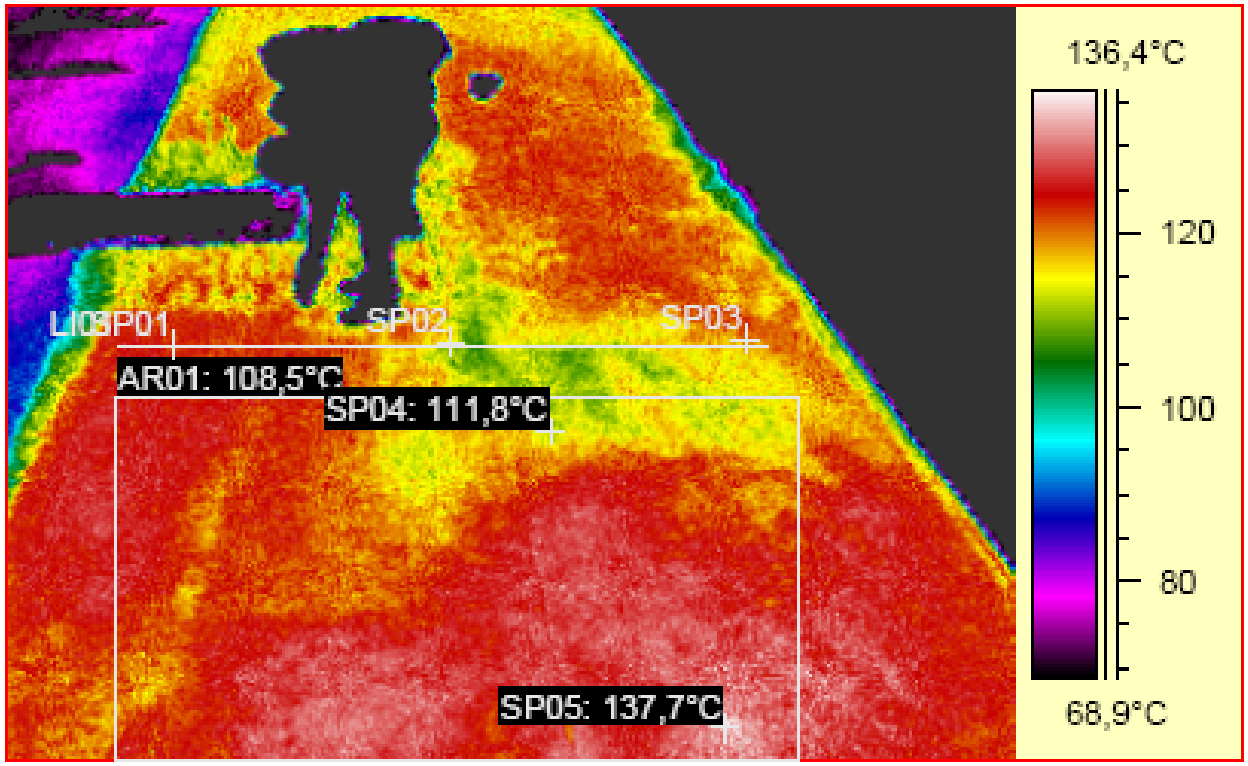
	P	Area			Delta-T			
	T	Max	Min	Avg	A	B	Delta	Ratio
1	166.4				168.5	74.2	94.3	71.2
2	162.6							
3	94.4							
4	82.4							
5	89.3							

Minimum Laydown Temperatures for Various Thicknesses*

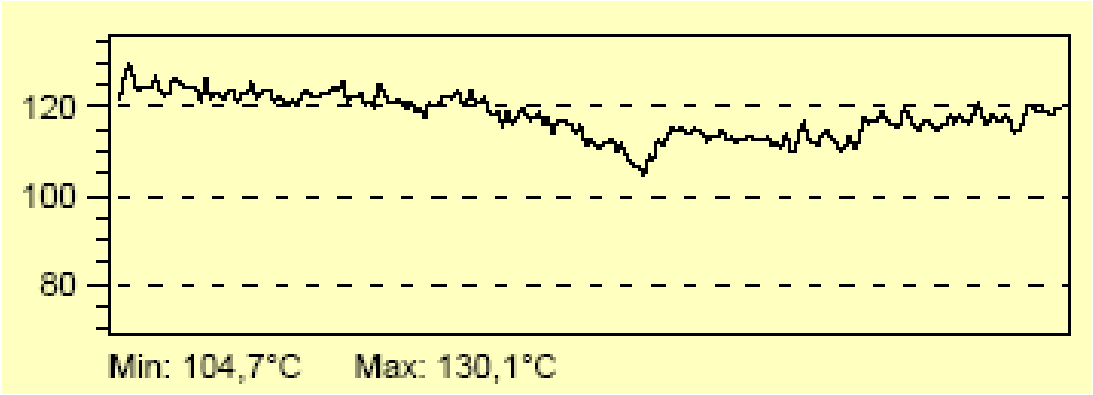
Base Temp. C (F) Degrees	Recommended Minimum Laydown Temperatures, ˚C (˚F)					
	13 mm (0.5 in)	19 mm (0.75 in)	25 mm (1 in)	38 mm (1.5 in)	50 mm (2 in)	75 mm (>3 in)
-7 to 0	—	—	—	—	—	141*
(20 – 32)	—	—	—	—	—	(285)*
1 – 4	—	—	—	152	146	138
(33 – 40)	—	—	—	(305)	(295)	(280)
5 – 10	—	—	154	149	141	135
(41 – 50)	—	—	(310)	(300)	(285)	(275)
11 – 16	—	154	149	146	138	132
(51 – 60)	—	(310)	(300)	(295)	(280)	(270)
17 – 21	154	149	143	141	135	129
(61 – 70)	(310)	(300)	(290)	(285)	(275)	(265)
22 – 27	149	143	141	138	132	129
(71 – 80)	(300)	(290)	(285)	(280)	(270)	(265)
28 – 32	143	138	135	132	129	127
(81 – 90)	(290)	(280)	(275)	(270)	(265)	(260)
>32	138	135	132	129	127	124
(>90)	(280)	(275)	(270)	(265)	(260)	(255)
			120°c		80°c	
Rolling Time, min.	4	6	8	12	15	15+

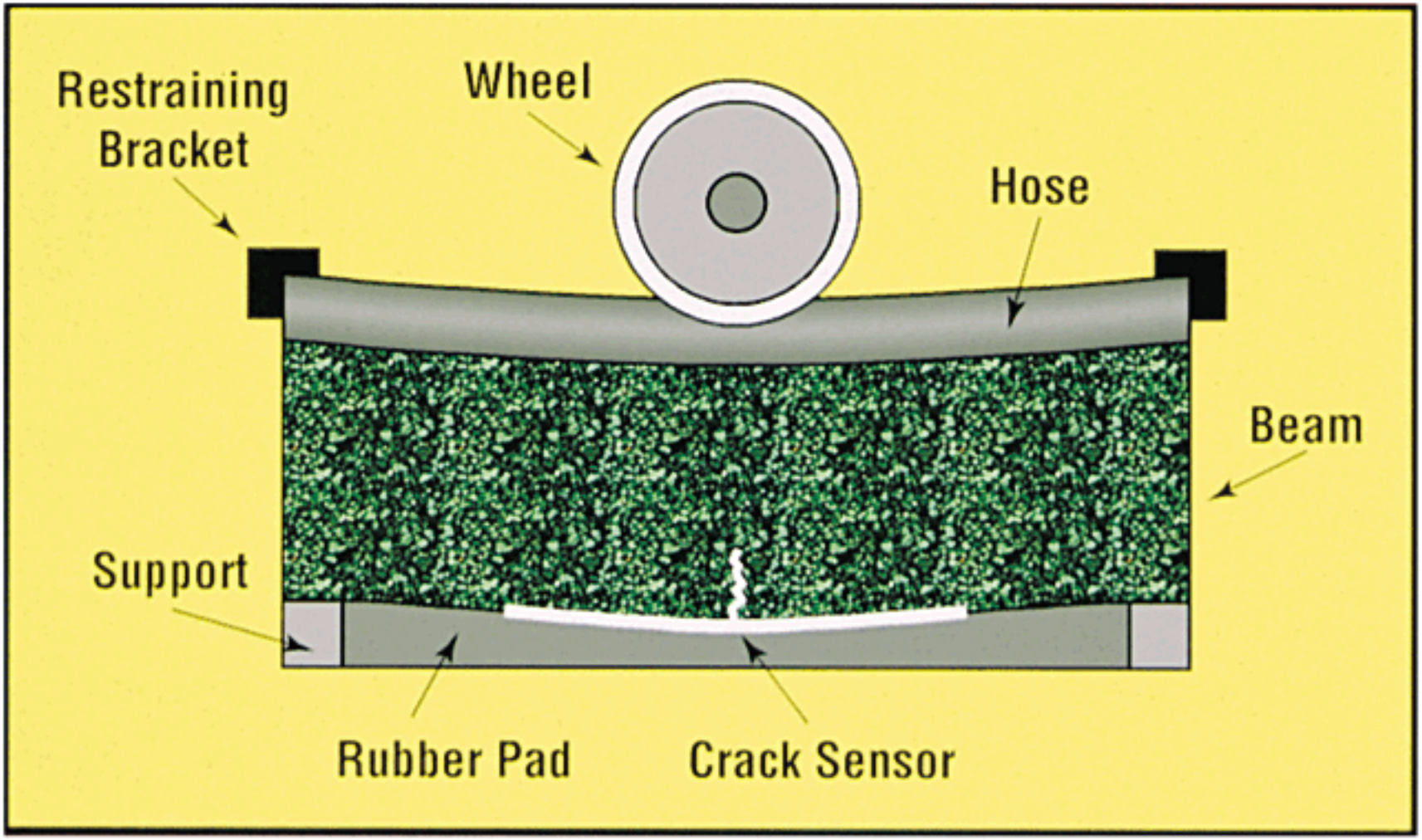
*Place only on bases made of treated materials, not on frozen soils or untreated aggregates.

Reprinted from *Shell Bitumen Handbook*, Figure 5.3.[1]


136,4°C
120
100
80
68,9°C
SP01
SP02
SP03
AR01: 108,5°C
SP04: 111,8°C
SP05: 137,7°C

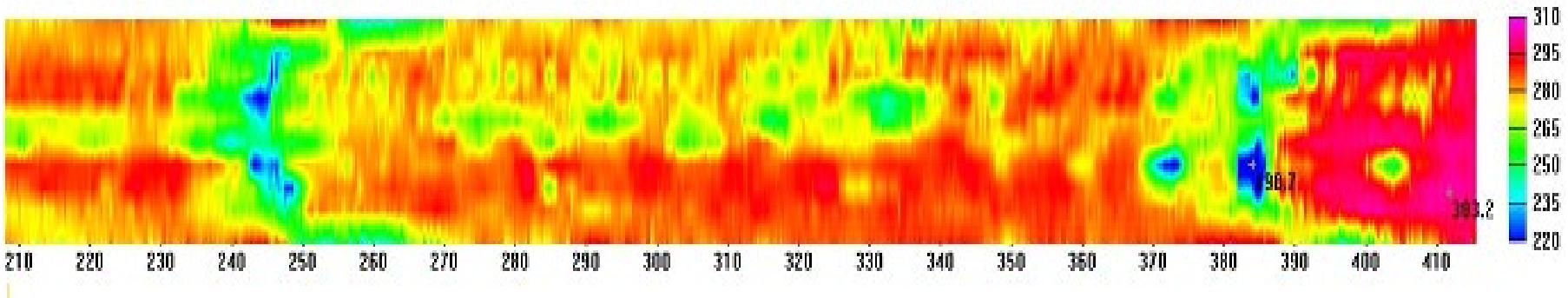
Delta **29,65**


120
100
80
Min: 104,7°C
Max: 130,1°C



FATIGUE TEST DIAGRAM

COMPACTACION A ° C	PORCENTAJE DE VACIOS (%)		AHUELLAMIENTO	FATIGA
	PRUEBA DE AHUELLAMIENTO	PRUEBA DE FATIGA	(mm)	# DE CICLOS
149	6.7	6.8	6.38	46.718
143	7.1	7.4	6.26	20.956
138	7.0	7.5	6.06	19.690
127	7.6	8.0	7.47	13.198
116	8.5	8.4	9.50	8.010
104	8.2	8.6	10.72	4.578
93	9.1	9.5	14.84	4.250



Pavimentadora 80’

SUPERPAVE - 5 AÑOS  LTPP - 20 AÑOS

En 1987 el congreso de los EE.UU. estableció un programa de investigación de 5 años, llamado **Strategic Highway Research Program (SHRP)** a un costo de $150 millones dirigido a mejorar el rendimiento, durabilidad, seguridad, y eficacia del sistema de autopistas de la nación.

- ***Asfalto***
- ***Rendimiento de los Pavimentos***. Se encargó del programa Long Term Pavement Performance Program (LTPP), que consistía en un estudio de 20 años sobre 2000 secciones de carreteras en servicio en EE.UU. y Canadá para mejorar las especificaciones de construcción y mantenimiento de pavimentos.
- ***Concreto y estructuras***.
- ***Highway operations***

Especificaciones AASHTO 1988

Índice de Perfil		IRI	
Pulg/milla	mm/km	m/km	Ajuste de Precio unitario
3 o menos	47,6 o menos	1,068 o menos	105
Entre 3 y 4	Entre 47,4 y 63,5	Entre 1,068 y 1,128	104
Entre 4 y 5	Entre 63,5 y 79,4	Entre 1,128 y 1,188	103
Entre 5 y 6	Entre 79,4 y 95,3	Entre 1,188 y 1,248	102
Entre 6 y 7	Entre 95,3 y 111,5	Entre 1,246 y 1,308	101
Entre 7 y 10	Entre 111,1 y 158,8	Entre 1,308 y 1,489	100
Entre 10 y 11	Entre 158,8 y 174,6	Entre 1,489 y 1,549	98
Entre 11 y 12	Entre 174,6 y 190,5	Entre 1,549 y 1,609	96
Entre 12 y 13	Entre 190,5 y 206,4	Entre 1,609 y 1,669	94
Entre 13 y 14	Entre 206,4 y 222,3	Entre 1,669 y 1,729	92
Entre 14 y 15	Entre 222,3 y 238,1	1,729 y 1,789	90
Mas de 15	Más de 238,1	Más de 1,789	Se requiere trabajo Correctivo

Rango de Aprobación AASHTO 1988 110,5 a 157,9 mm/km, equivalente en IRI 1,306 a 1,605 m/km.
AASHTO Prueba California 526, 1978
Correlación IRI: 3,78601 * PI 5mm + 887,51 R2 0,77 (NCHRP web document 42 Project 20.51 (Año 2002)

Standard Specifications Constructions of Transportation Systems – Edition 2001

C. Equipment at Project Site

1. Cleaning Equipment

Provide sufficient hand tools and power equipment to clean the roadway surface before placing the bituminous tack coat. Use power equipment that complies with Subsection 424.3.02.F, "Power Broom and Power Blower."

2. Pressure Distributor

To apply the bituminous tack coat, use a pressure distributor that complies with Subsection 424.3.02.B, "Pressure Distributor."

3. Bituminous Pavers

To place hot mix asphaltic concrete, use bituminous pavers that can spread and finish courses that are:

- As wide and deep as indicated on the Plans
- True to line, grade, and cross section
- Smooth
- Uniform in density and texture

a.Continuous Line and Grade Reference Control. Furnish, place, and maintain the supports, wires, devices, and materials required to provide continuous line and grade reference control to the automatic paver control system.

b. Automatic Screed Control System. Equip the bituminous pavers with an automatic screed control system actuated from sensor-directed mechanisms or devices that will maintain the paver screed at a pre-determined transverse slope and elevation to obtain the required surface.

c. Transverse Slope Controller. Use a transverse slope controller capable of maintaining the screed at the desired slope within ± 0.1 percent. Do not use continuous paving set-ups that result in unbalanced screed widths or offcenter breaks in the main screed cross section unless approved by the Engineer.

d. Screed Control. Equip the paver to permit the following four modes of screed control. The method used shall be approved by the Engineer.

- Automatic grade sensing and slope control
- Automatic dual grade sensing
- Combination automatic and manual control
- Total manual control

Ensure that the controls are referenced with a taut string or wire set to grade, or with a ski-type device or mobile reference at least 30 ft (9 m) long when using a conventional ski. A non-contacting laser or sonar-type ski with at least four referencing mobile stations may be used with a reference at least 24 ft. (7.3 m) long. Under limited conditions, a short ski or shoe may be substituted for a long ski on the second paver operating in tandem, or when the reference plane is a newly placed adjacent lane.

Automatic screed control is required on all Projects; however, when the Engineer determines that Project conditions prohibit the use of such controls, the Engineer may waive the grade control, or slope control requirements, or both.

e. Paver Screed Extension. When the laydown width requires a paver screed extension, use bolt-on screed extensions to extend the screeds, or use an approved mechanical screed extension device. When the screed is extended, add auger extensions according to the paver manufacturer's recommendations.

4. Compaction Equipment

Ensure that the compaction equipment is in good mechanical condition and can compact the mixture to the required density. The compaction equipment number, type, size, operation, and condition is subject to the Engineer's approval

5. Materials Transfer Vehicle (MTV)

a.Use a Materials Transfer Vehicle (MTV) when placing asphaltic concrete mixtures on Projects on the state route system with the following conditions:

1) When to use:

• The ADT is equal to or greater than 6000,

• The project length is equal to or greater than 3000 linear feet (915 linear meters),

• The total tonnnage (megagrams) of all asphaltic concrete mixtures is greater than 2000 tons (1815Mg).

2) Where to use:

• Mainline of the traveled way

• Collector/distributor (C/D) lanes on Interstates and limited access roadways

• Leveling courses at the Engineer's discretion

b. Ensure the MTV and conventional paving equipment meet the following requirements:

1) MTV

• Has a truck unloading system which receives mixture from the hauling equipment and independently deliver mixtures from the hauling equipment to the paving equipment.

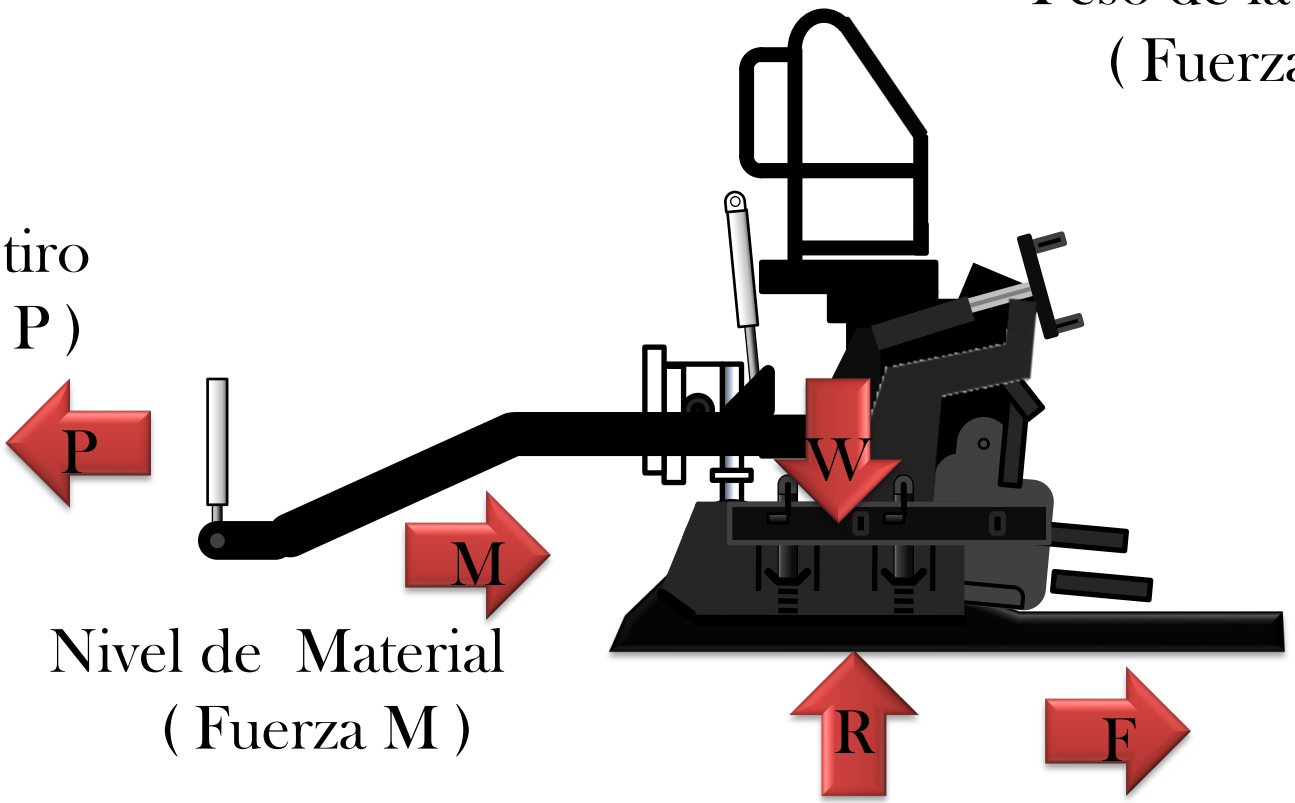
• Has mixture remixing capability by either a storage bin in the MTV with a minimum capacity of 14 tons (13 megagrams) of mixture and a remixing system in the bottom of MTV storage bin, or a dual pugmill system located in the paver hopper insert with two full length transversely mounted paddle mixers to continuously blend the mixture as it discharges to a conveyor system.

• Provides to the paver a homogeneous, non-segregated mixture of uniform temperature with no more than 20 °F(18 oC) difference between the highest and lowest temperatures when measured transversely across the width of the mat in a straight line at a distance of one foot to three feet from the screed while the paver is operating.

2) Conventional Paving Equipment

• Has a paver hopper insert with a minimum capacity of 14 tons (13 Mg) installed in the hopper of conventional paving equipment when an MTV is used.

FUERZAS QUE ACTUAN SOBRE LA PLANCHA

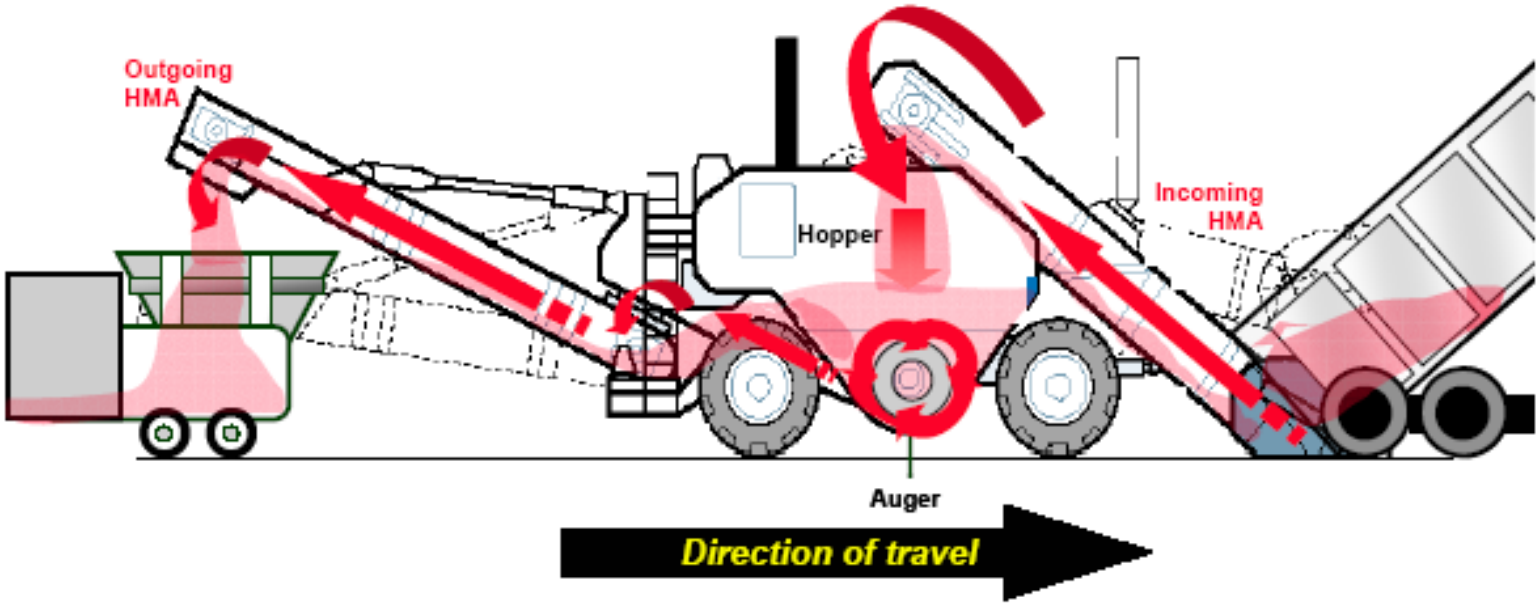


Auger Overloaded

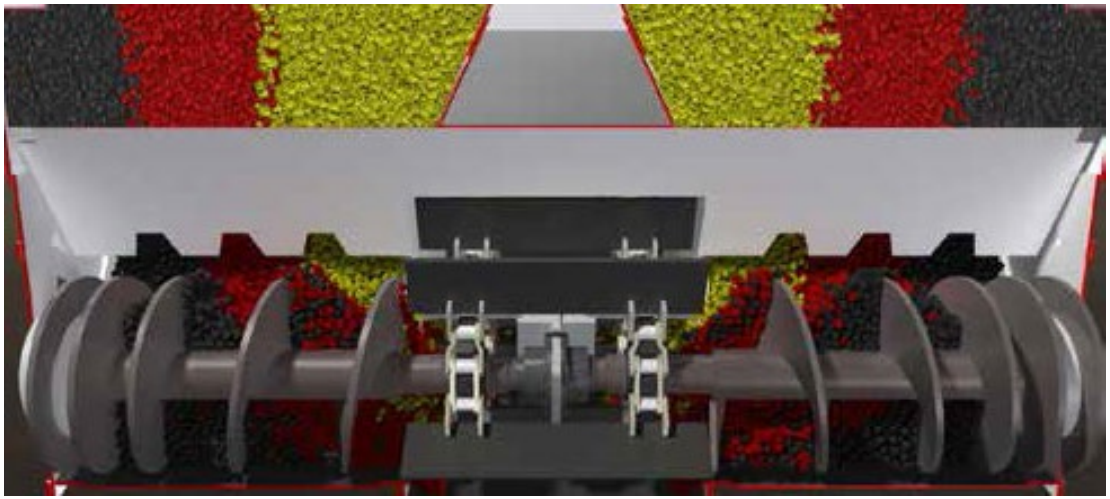
Correct Elevation

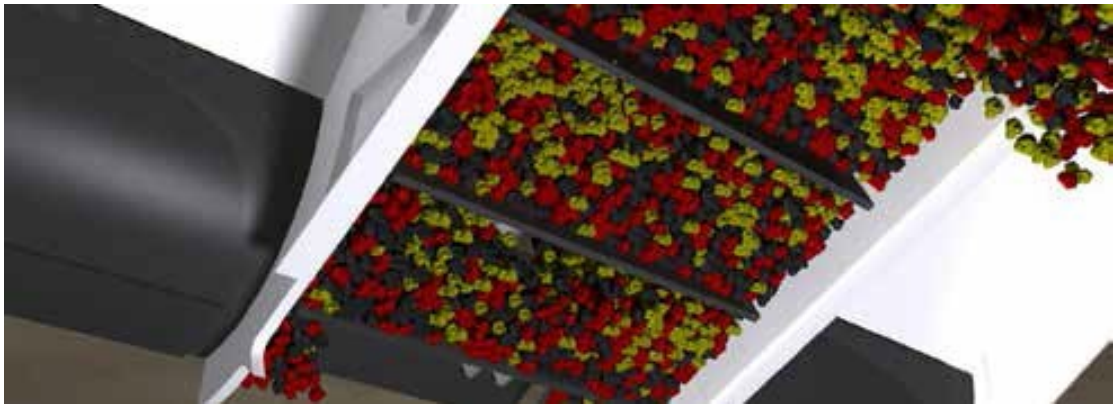
Auger Underloaded

Funcionamiento del Vehículo de Transferencia de Material



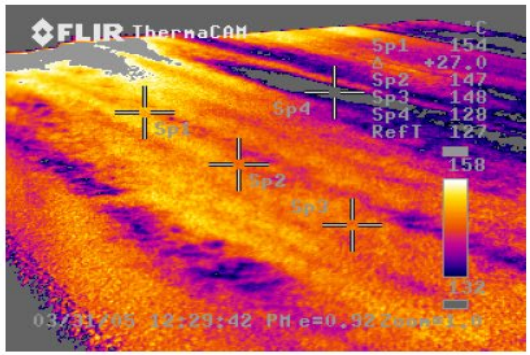
Tornillo sinfín de tres etapas



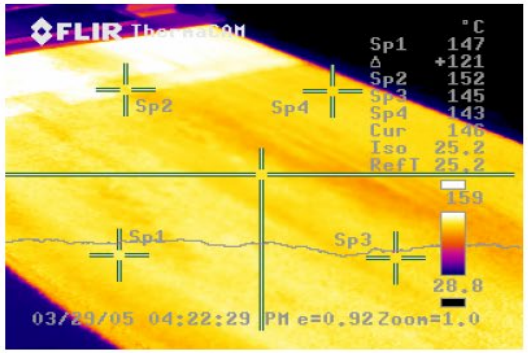


Análisis de Diferencial de Temperatura durante colocación de mezcla de asfalto en caliente

PROYECTO : Autovía EX A1
LUGAR : Malpartida de Plasencia
CONTRATISTA : Sacyr
FECHA : 31 de Marzo de 2005
TECNICA USADA : Análisis Infrarrojo, Cámara FLIR
REALIZADO POR : SACYR ESPAÑA -TEMAC ESPAÑA - ROADTEC EE.UU.



Detrás de pavimentadora y camión.
Diferencial de Temperatura.



Detrás de pavimentadora y Vehiculo de Transferencia de Material Shuttle Buggy.
Temperatura uniforme.

PUERTO RICO - BETTEROADS

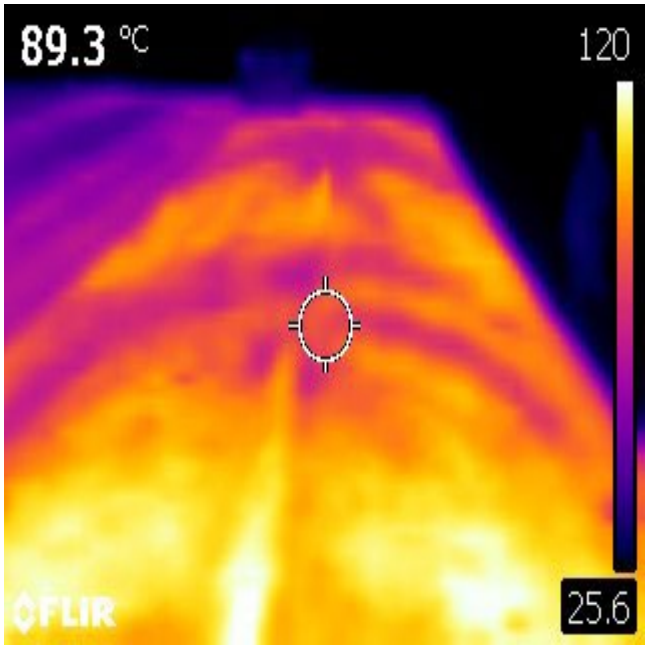
MEXICO – CAMINOS Y PAVIMENTOS DEL SUR

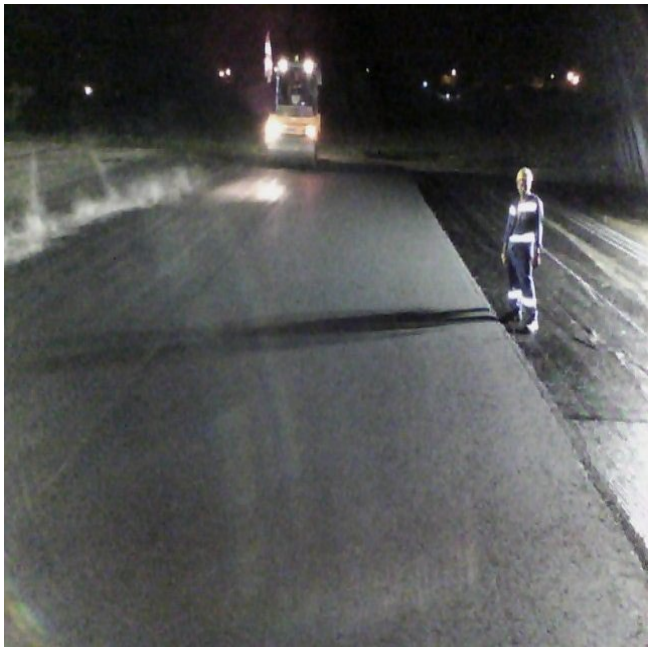
PERU

SHUTTLE BUGGY MHC COLOMBIA

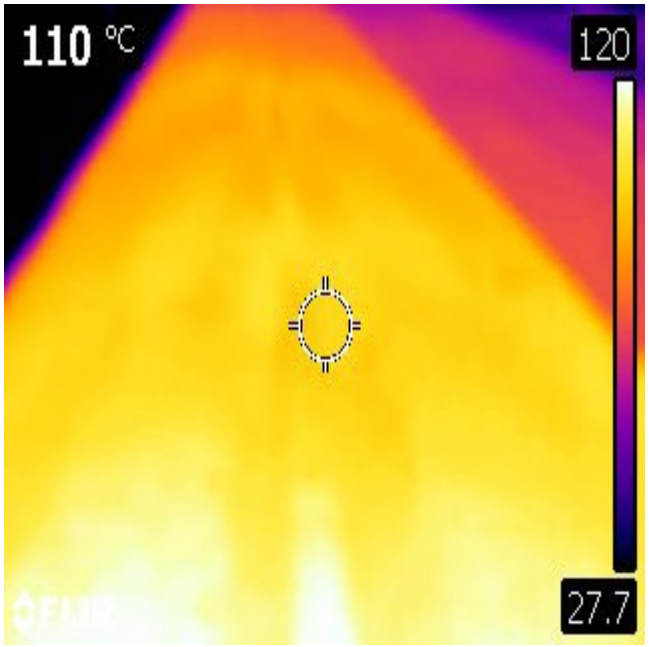
Descarga directa y con SHUTTLE BUGGY

Sin SHUTTLE BUGGY





Con SHUTTLE BUGGY



VENEZUELA -COFLAN

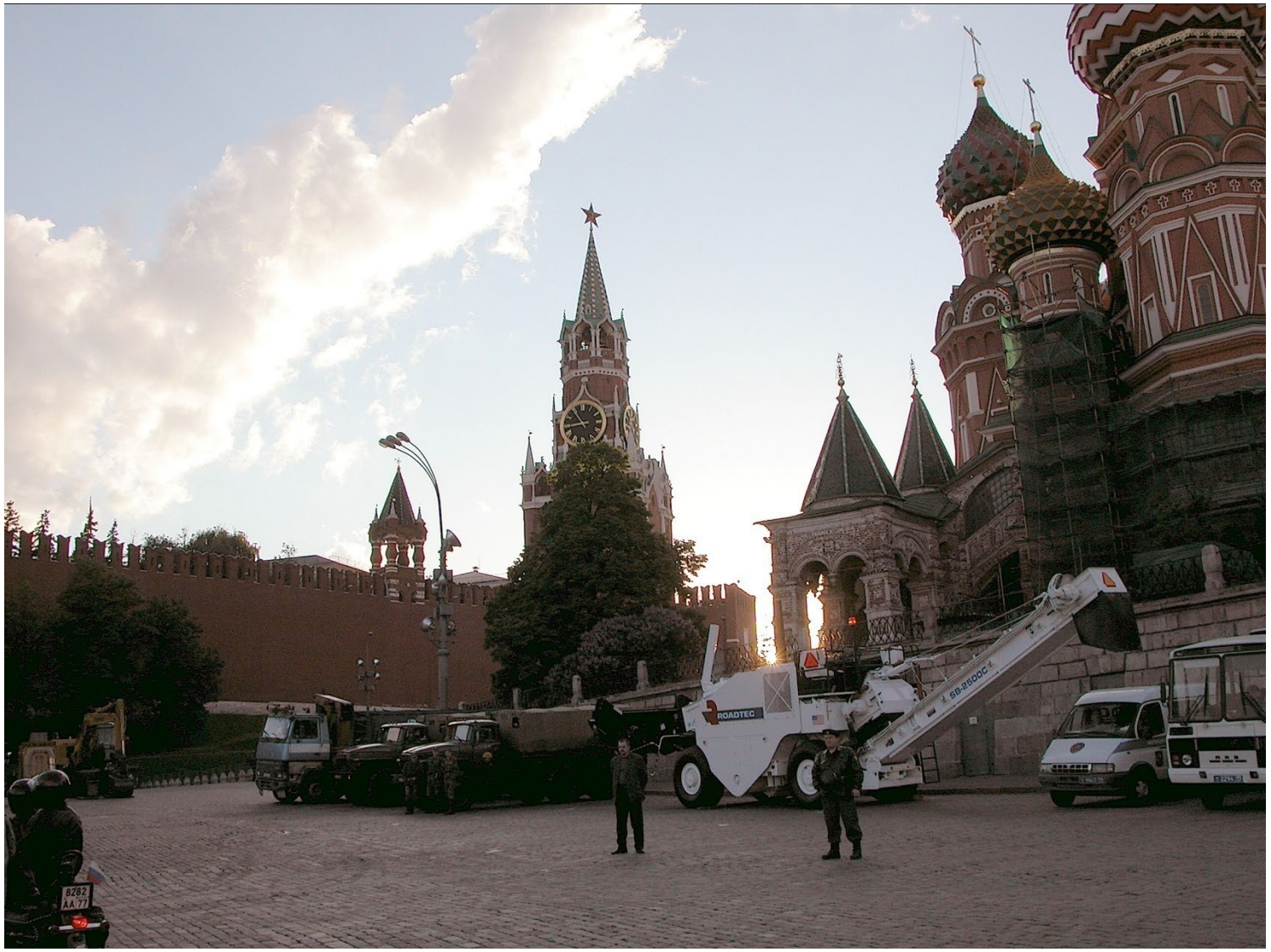
PANAMA - TCT

AUSTRALIA


Pioneer


STOP
Pioneer
Road Services

Rusia



China

Alemania

BITAFAL - URUGUAY

ODEBRECHT BRASIL

¿Cómo mejorar los procesos constructivos?

Buenas Prácticas de Contratistas para mejorar el IRI

- Materiales y técnica de pavimentación. Uso de polímeros (25% de proyectos en USA) y minimizar la segregación.
- Uso de vehículos de transferencia de material, para evitar que la pavimentadora produzca ondulaciones. Pavimentación contínua.
- Medición diaria del IRI (42% de contratistas lo hace, 28% el gobierno y 30% ambos)
- Cultivar una “Mentalidad de Calidad” dentro de las empresas.

CONCLUSIONES :

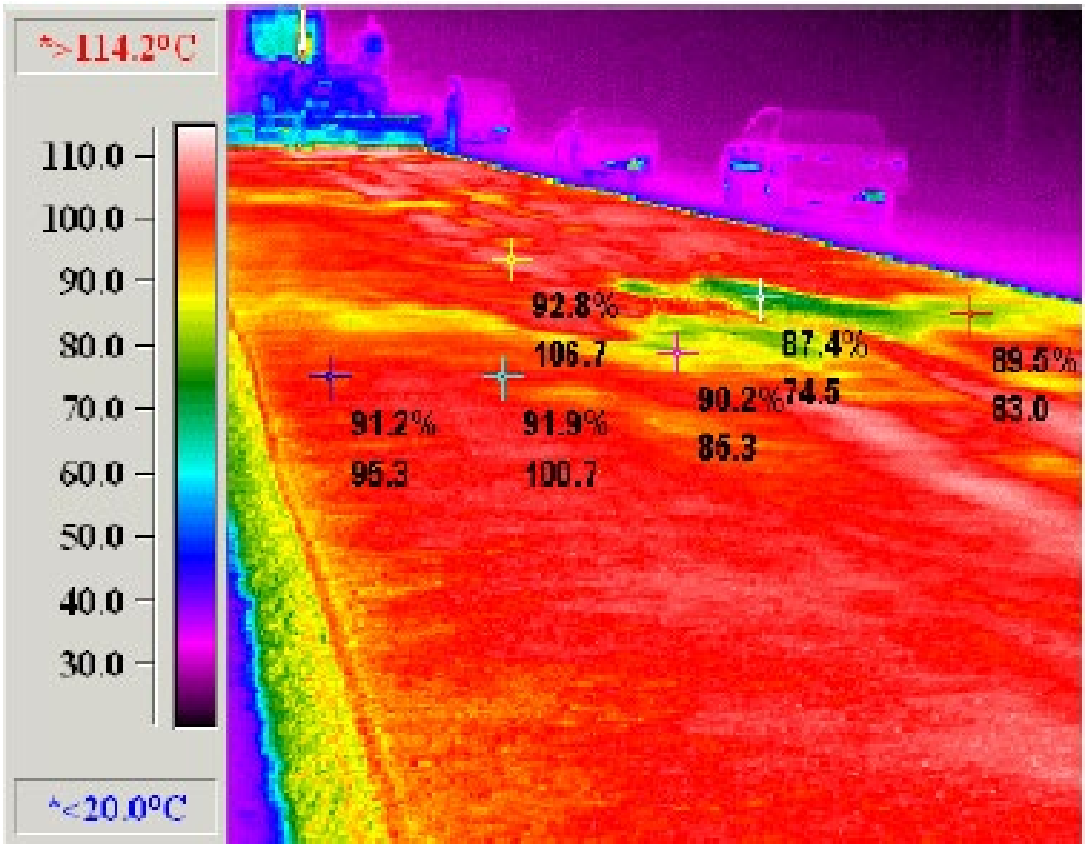
COLOCAR UNA MEZCLA HOMOGENEA POR MEDIO DE LA PAVIMENTACION CONTINUA (VELOCIDAD CONSTANTE) SOBRE UNA SUPERFICIE PLANA

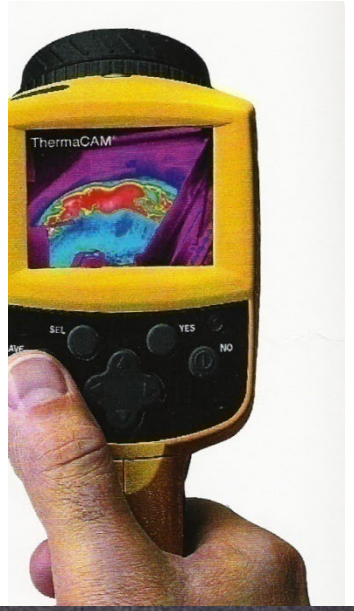
Buenas Prácticas de Gobierno

- Contar con metas sobre nivel de IRI en la red de carreteras.
- *Usar Incentivos de bonos por mejores resultados. El 83% de las agencias tiene incentivo/desincentivo; El 3% tiene solo desincentivo.
- *Trabajar junto con los contratistas para alcanzar resultados
- Integrar opinión de usuarios
- Inversión en mejor capacidad estructural de los pavimentos y plan de mantenimiento antes que sea más costosa la reparación
- Nuevas especificaciones

Incentivos de Construcción de Pavimentos DOT Arizona

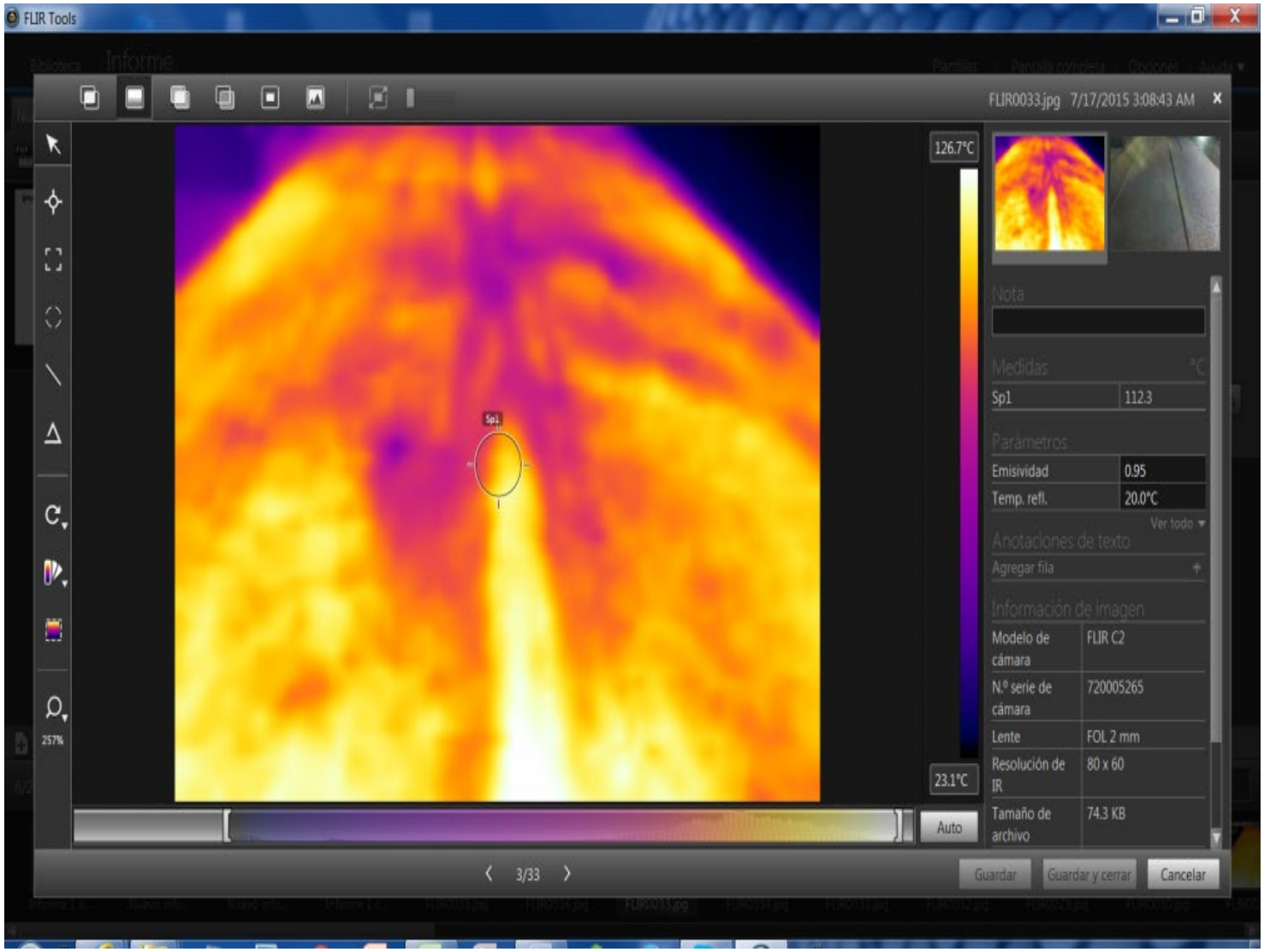
IRI (in/mi)	IRI (m/km)	Porcentage de ajuste
< 51	< 0.80	+10%
51 – 60	0.80 – 0.95	+5%
61 – 80	0.96 – 1.26	0
81 – 101	1.27 – 1.58	-5%
101 – 110	1.59 – 1.74	-10%
111 – 120	1.75 – 1.89	-25%
> 120	> 1.89	Requiere Corrección



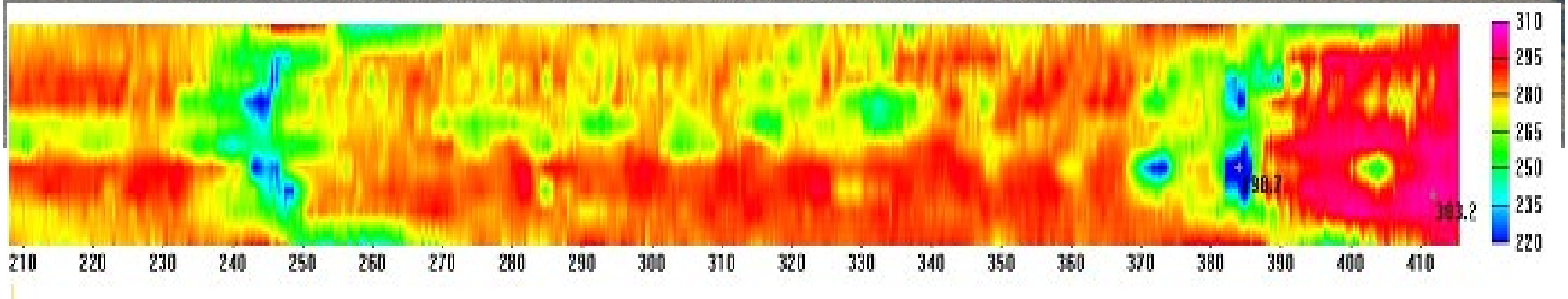


Dirección de Tránsito de Washington 1999

Software para reporte




EXTEND-A-MAT


98.7
383.2
310
295
280
265
250
235
220
210
220
230
240
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
400
410

Perfilógrafos ligeros

Westrack

Consumo medio de camiones fue 4,2 millas (6,72 km) por galón.

Luego de uma rehabilitación se redujo el IRI enm 10% y el rendimiento de combustible aumentó 4,5%.

NAPA NEWS RELEASE

NATIONAL ASPHALT PAVEMENT ASSOCIATION 5100 FORBES BLVD. LANHAM, MD USA 20706-4407
Toll Free: 888-468-6499 / Tel: 301-731-4748 / Fax: 301-731-4621
Homepage: www.hotmix.org / E-mail:napa@hotmix.org

IMMEDIATE RELEASE
July 18, 2011

Research Report Points Out Road to Energy Savings; U.S. Could Save 3.3 Billion Gallons of Fuel per Year

Incline Village, NV – A new study shows that one road to energy savings could already be under the wheels of our cars: smoother pavements. Dr. Richard Willis, an assistant research professor at Auburn University, reported today that modest improvements in the smoothness of pavements could save up to 2.4 billion gallons of gasoline and over 900 million gallons of diesel for the U.S. every year – a total of more than 3.3 billion gallons of fuel for the vehicles being driven on our highways. In other terms, smoothing out America's roads and highways could save around $12.5 billion for the U.S. economy every year.

Willis and Auburn's Dr. Rob Jackson have just completed an analysis of more than 20 studies from throughout the world. At the Midyear Meeting of the National Asphalt Pavement Association, Willis presented a preview of a study that will be published soon by Auburn. He reported that smoothness is a pavement characteristic that has one of the greatest impacts on fuel economy. "We know that, of all the factors that influence fuel economy – vehicle aerodynamics, engine dynamics, ambient air temperature, tire geometry, vehicle speed, tire pressure, and so forth – there is only one that pavements can affect, and that is rolling resistance," said Willis.

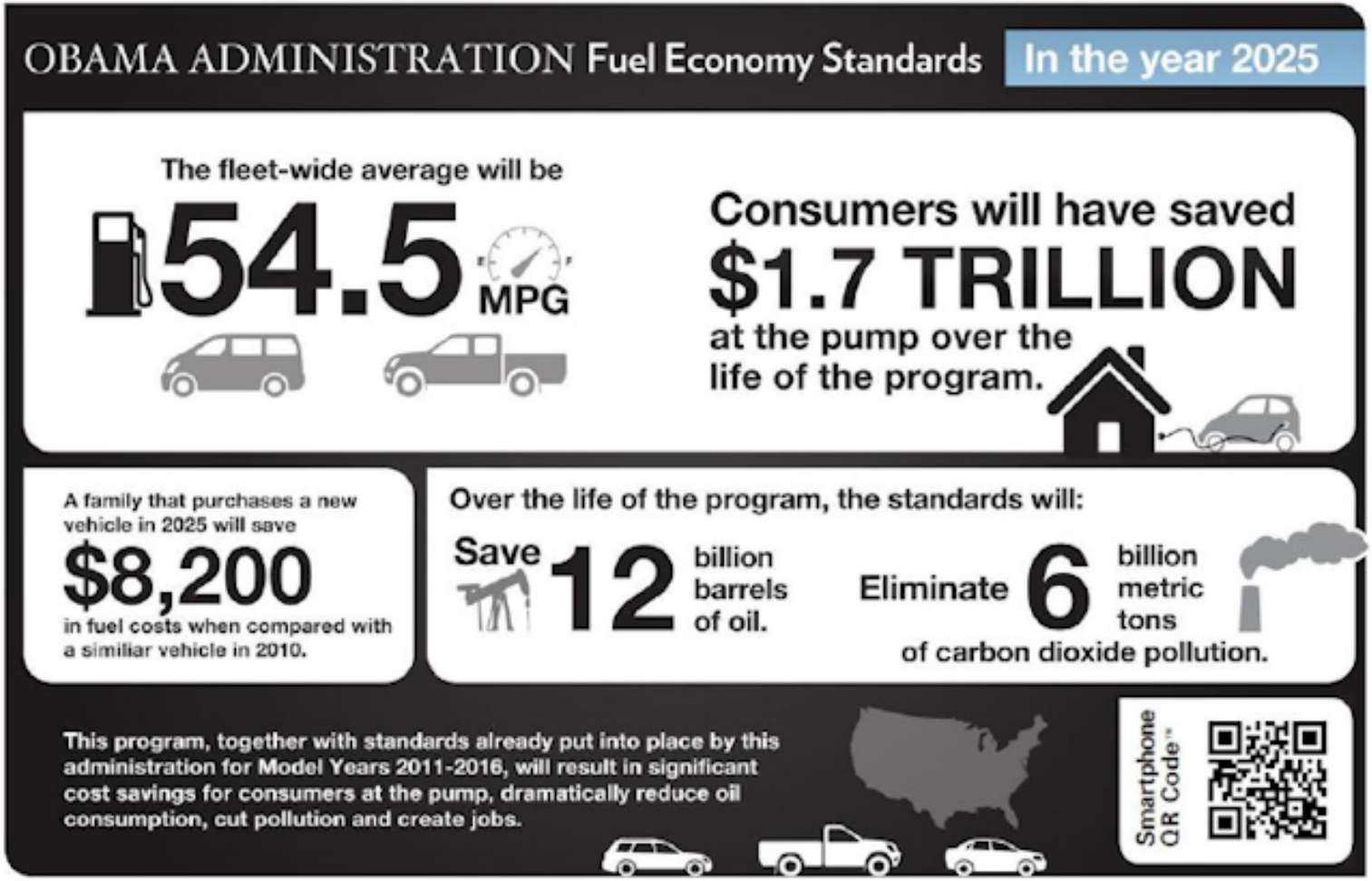
Asked to define his terms, Willis said, "Rolling resistance can be thought of as the force required to keep tires rolling. It could also be thought of as the energy lost between the vehicle and the pavement. Of the two main influences on rolling resistance related to pavements – those due to the stiffness properties of the tire and those due to imperfections in the pavement surface – the pavement industry has the opportunity to influence only one, the pavement itself."

ECONOMIA DE COMBUSTIBLE

TPDA	Tipo de Autos	%	Cantidad	Recorrido	Consumo		Precio Gal	Total	Ahorro 4,5%		
			Uni.	Km / dia	Km/ Gal	Gal/ día	US$	US$/día	US$/día Uni	USS / día	US$ /Año
	Sedan	85%	4.250	50	30	1,67	5,77	9,6	0,43	1.839	671.214
	Ómnibus	5%	250	50	26	1,92	4,69	9,0	0,41	101	37.025
5.000	Camión	10%	500	50	12	4,17	4,69	19,5	0,88	440	160.440
									Total	**2.380**	**868.678**
									10 Años		**8.686.780**

50.000 m x 3.5 m x 0.07 m x 2.2 ton/ mt3 x 100 US$/ton x 20% =$ 539.000

2010 al 2025
EFICIENCIA ENERGETICA Y MENOR CONTAMINACIÓN



Carros del Futuro

Eléctricos

- Son más sencillos de fabricar
- Requieren menos mantenimiento, no necesitan aceite
- Cero emisión
- Más eficientes

Autónomos

- Funcionan casi sin errores
- Vehículos coordinados en los cruces
- Buscaran solos estacionamiento.
- Ya empezaron a usarse

Por donde transitarán los autos del futuro
Eléctricos y Autónomos para brindar economía y seguridad

Gracias!

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