

**“DESIGN, ASSEMBLY AND INITIAL OPERATION OF A
HIGH PERFORMANCE MULTIFUNCTION DEVICE FOR
PAVEMENT AND ROAD SAFETY CONDITION
MONITORING IN ARGENTINA”**

Author:
Eng. Gustavo D. MEZZELANI
Entity:



ITYAC, Ing. Tosticarelli y Asociados S.A.
Rosario, Argentina

October 2010



www.ityac.com.ar

30 años al servicio de la Ingeniería



Rosario,
Argentina



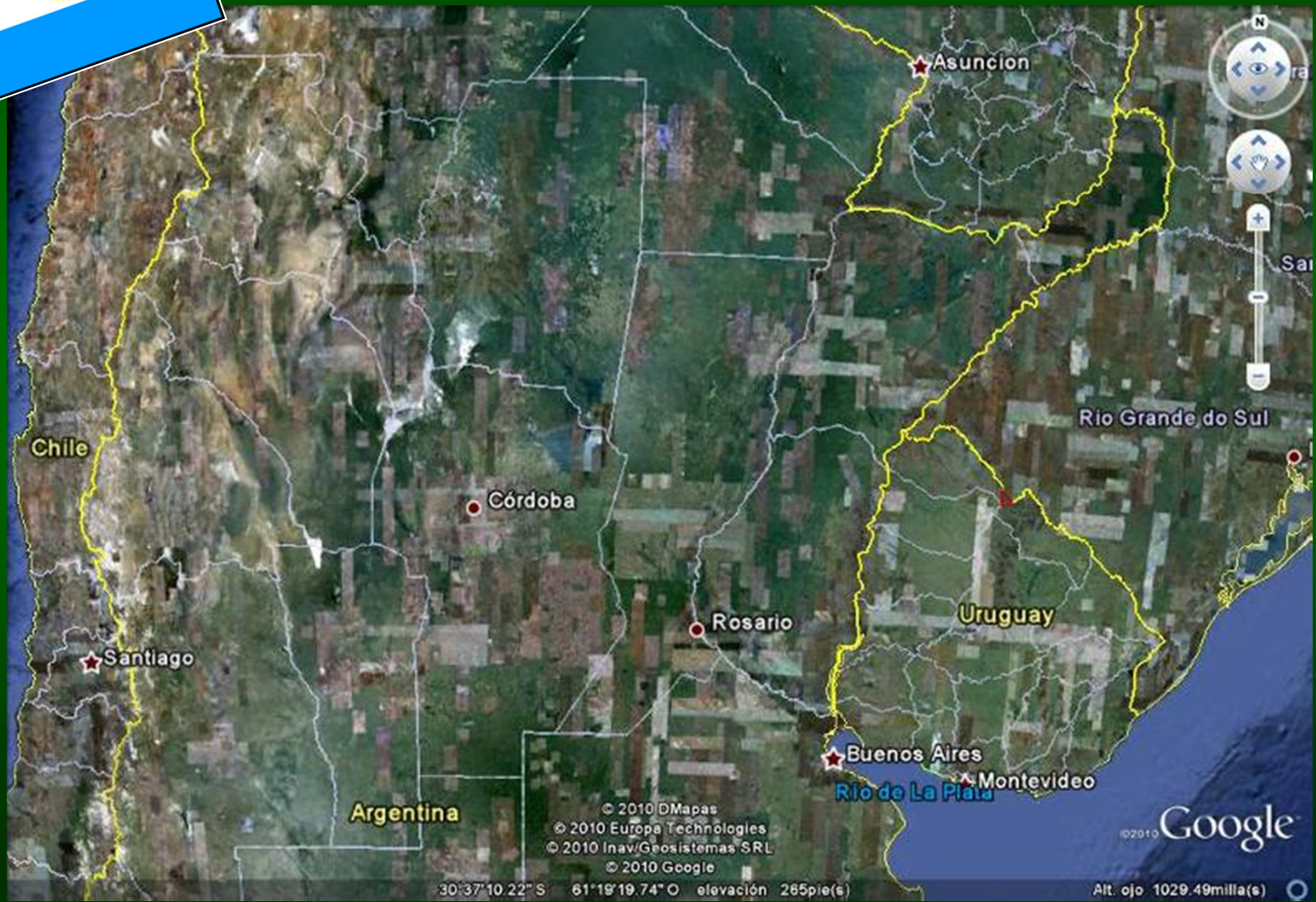


THE ARGENTINE REPUBLIC

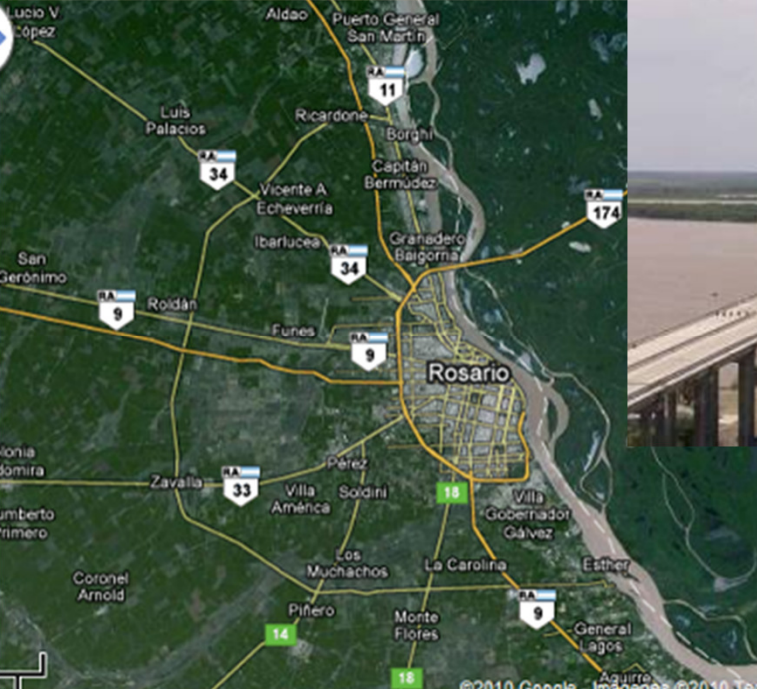




THE ARGENTINE REPUBLIC



Rosario, Argentina





Abstract

- ✓ Introduction. Overview of pavement evaluation in Argentina.
- ✓ The Transverse Profile
- ✓ Distresses and Road Inventory
- ✓ The Longitudinal Profile
- ✓ Assembly of functions in a multifunction device
- ✓ Applications in our Latin American region



PAVEMENT EVALUATION IN ARGENTINA

The 1970s: Acquisition of knowledge, equipments and beginning of implementation

- Acquisition of 3 BPR Roughmeters, 2 Mu Meters and 5 deflectographs Lacroix
- Incorporation of the subject “Pavement Evaluation” in the Post-Graduate School at the University of Buenos Aires (UBA)
- Applications of the Road Needs Study



BPR Roughmeters from the Argentinian National Road Agency (DNRV)





DNV: Mu Meter for Friction Measurements



Mu Meter: measures the transverse friction coefficient



DNV: Deflectographe Lacroix

Long Chassis Model LPC-03



First experiences in the use of the
Deflectographe Lacroix in Argentina



PAVEMENT EVALUATION IN ARGENTINA

The 1980s: *Implementation and practical applications.*

- Pavement Evaluation Methodology is established at network level
- The whole National Network is evaluated annually during the period 1980-1987
- The state parameters (roughness, rutting, cracking and ravelling) are incorporated to maintenance contracts – Toll Concessions

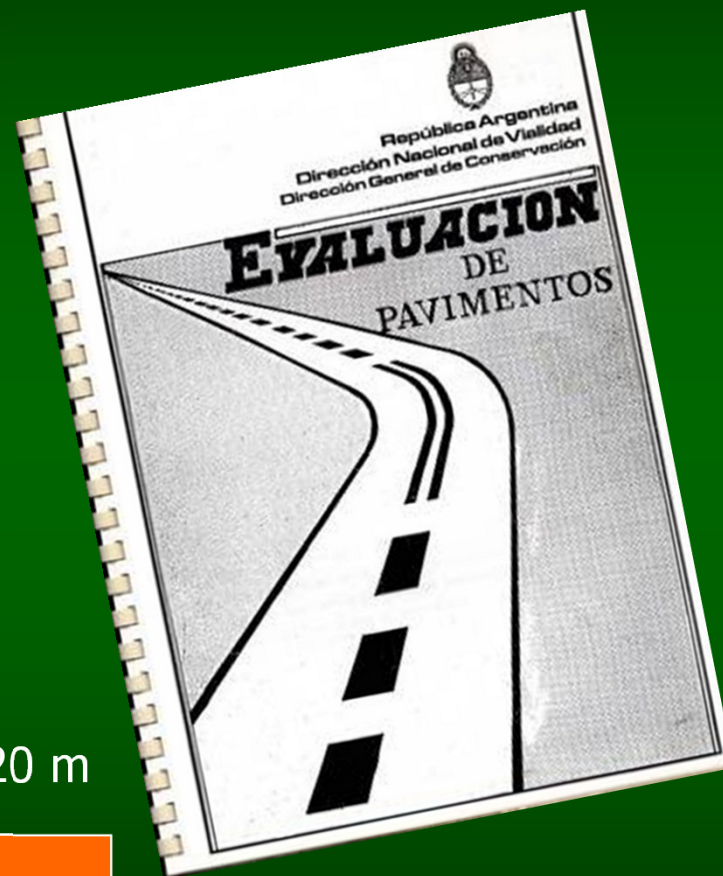


ARGENTINA – National Road Agency (DNV)

PAVEMENT EVALUATION METHODOLOGY



Sample section



20 m



2 km (1983 - 1989) 1 km (1990 - 2003)





PAVEMENT EVALUATION IN ARGENTINA

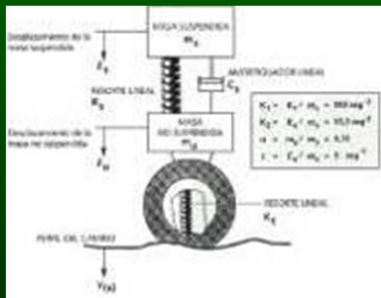
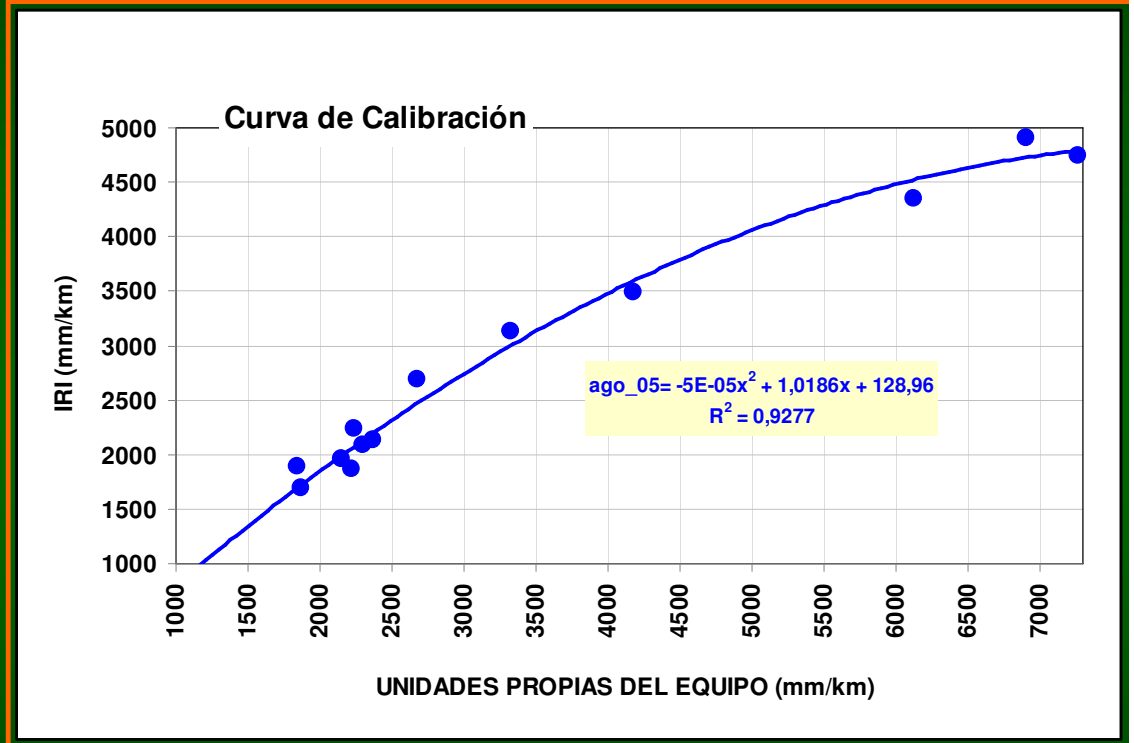
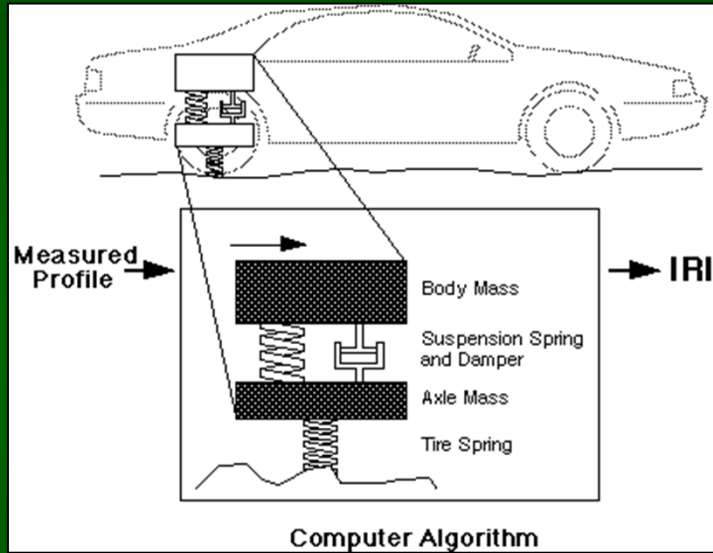
The 1990s: Masive, intensive and indiscriminate applications of the Pavement Evaluation Methodology (DNV, DPVs, OCCOVI, toll entities, etc)

- at Project Level: maintenance, overlay designs, rehabilitations, etc.
- for performance prediction and service life estimation
- for HDM III and IV implementation
- to penalise maintenance contracts - Toll concessions



Longitudinal Profile - Roughness

Response-Type (Bump Integrator)



Class III: IRI is estimated by correlation



Longitudinal Profile - Roughness

Response-Type (Bump Integrator)



100%



MAYS-JMF



Longitudinal Profile - Roughness

Bumps Integrators from
different provincial departments



Harmonization of Roughness measurement devices in
Argentina - Rosario, 1996



Cracking and distresses

MANUAL-VISUAL METHODOLOGY



Sample section

1%-2%

20 m



2 km (1983 - 1989) 1 km (1990 - 2003)



Transverse Profile - Rutting

MANUAL-VISUAL METHODOLOGY

Sample section

1%-2%

Rutting Determination with straight-edge and graduated wedge:

- Reference Length: 1,20 meters

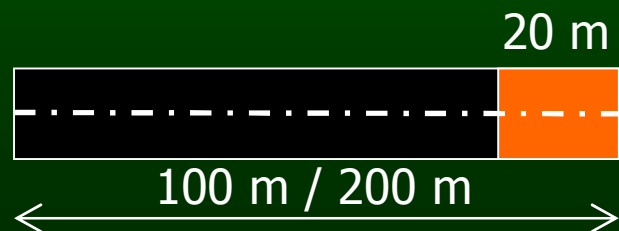




PAVEMENT EVALUATION IN ARGENTINA

The 2000s:

- In the specifications of the 2003/2008 concessions contracts, it is mentioned for the first time and as an alternative to the use of high performance equipments, and it is reduced to a sample every 200 m, i.e. 5 per Km; in some special cases as in the Access Network to Buenos Aires it is performed every 100 meters.
- DNV purchased high performance equipment for road evaluation: MRM, SCRIM, FWD, ECODYN, radar



Sample section



The 2000s



SCRIM – TEX
Friction-texture
measurements



GPR (radar)



Multifunction Road
Monitor MRM from
WDM, UK



The 2000s

**Falling Weight
Deflectometer (FWD)
KUAB from DNV**



**FWD Carl Bro from
the Santa Fe province**

**Retro-reflectance
ECODYN -Vectra,
France from DNV**



PAVEMENT EVALUATION IN ARGENTINA

The 2010s: New Concessions Contracts for the Principal National Network

- The use of high performance equipment is given priority:

“...the equipments to be used for measurements shall be preferably high performance equipments, namely those which perform a great number of on- the-spot tests and causing the minimum traffic interference

The sampling intervals shall be every 200 m, 5 per Km”



2010: Principal
National
Network under
new toll
concessions
contracts



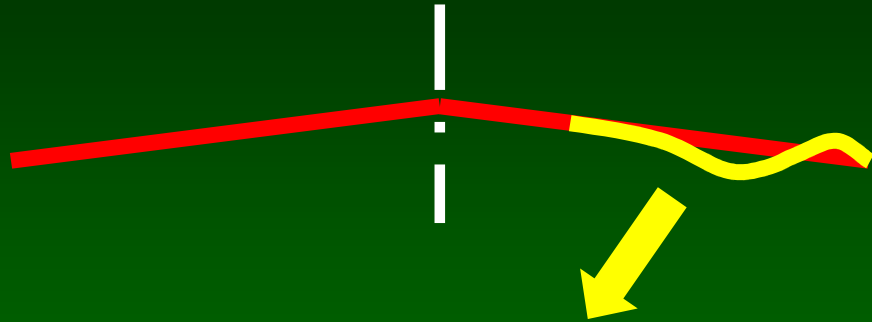


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The Transverse Profile



Transverse Profile deformations

TUS, Ultrasonic Profiler, mlpc France





The Transverse Profile

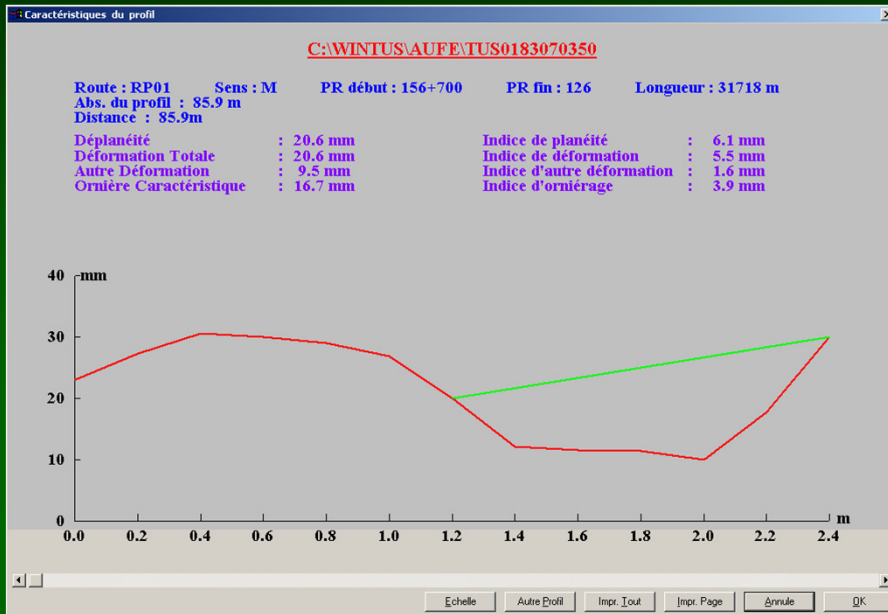
TUS Ultrasonic Profiler

- 13 ultrasonic sensors separated 20 cm from each other, cover a 2.40 m meters width and simultaneously measure the distance between pavement and straightedge
- A temperature sensor mounted at the front of the vehicle
- A distance measurement instrument (DMI) connected to an electronic unit
- Measurement interval: 3.50 mts

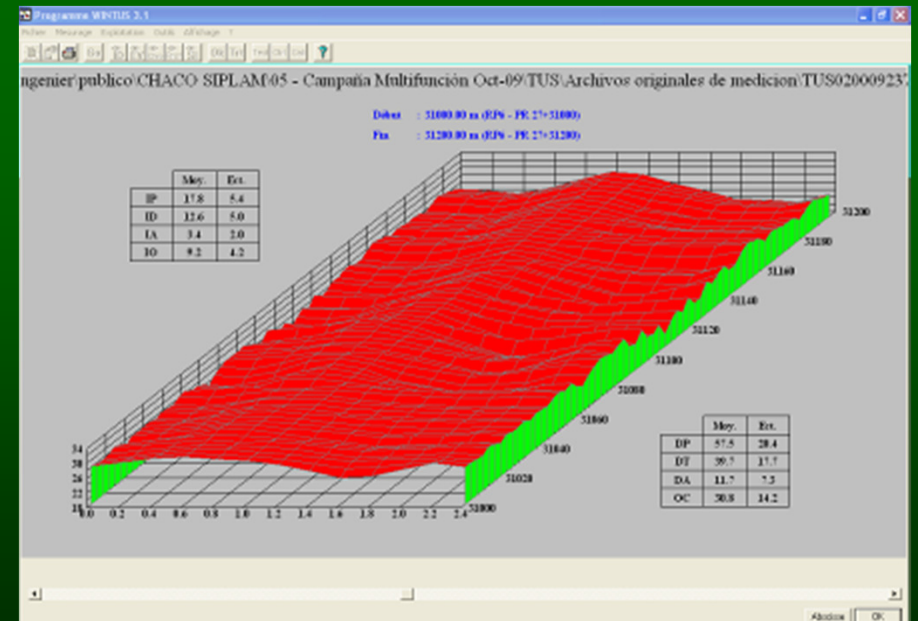
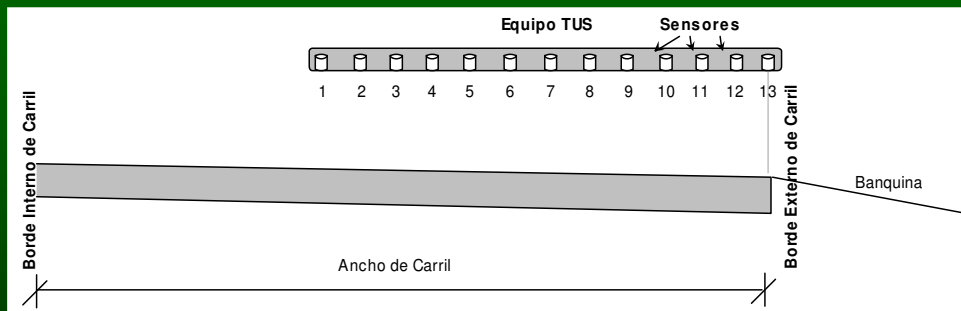




The Transverse Profile



Post-processing software with virtual 1.20 m length straightedge

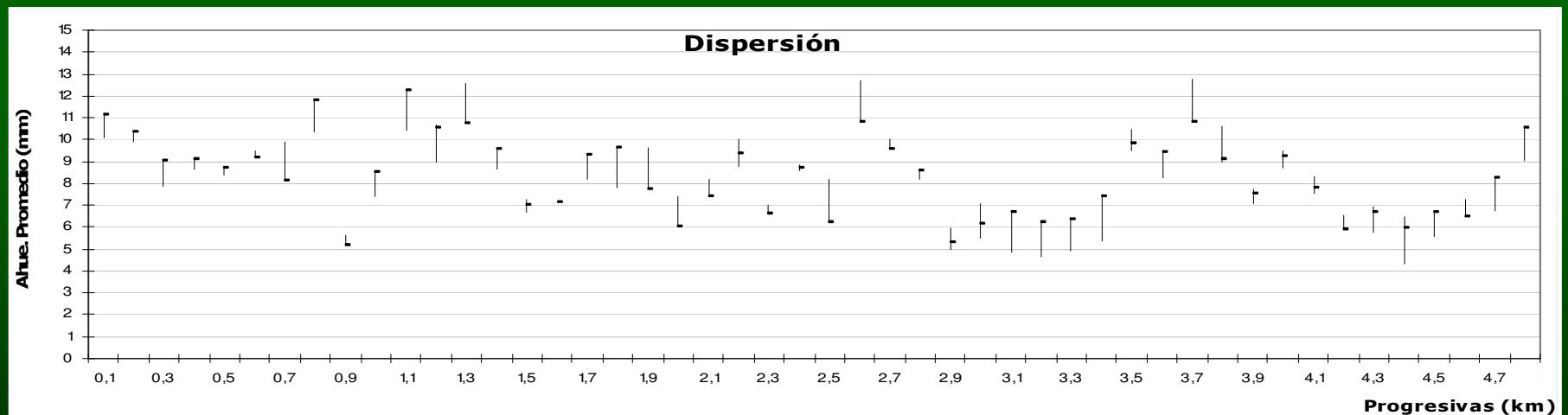
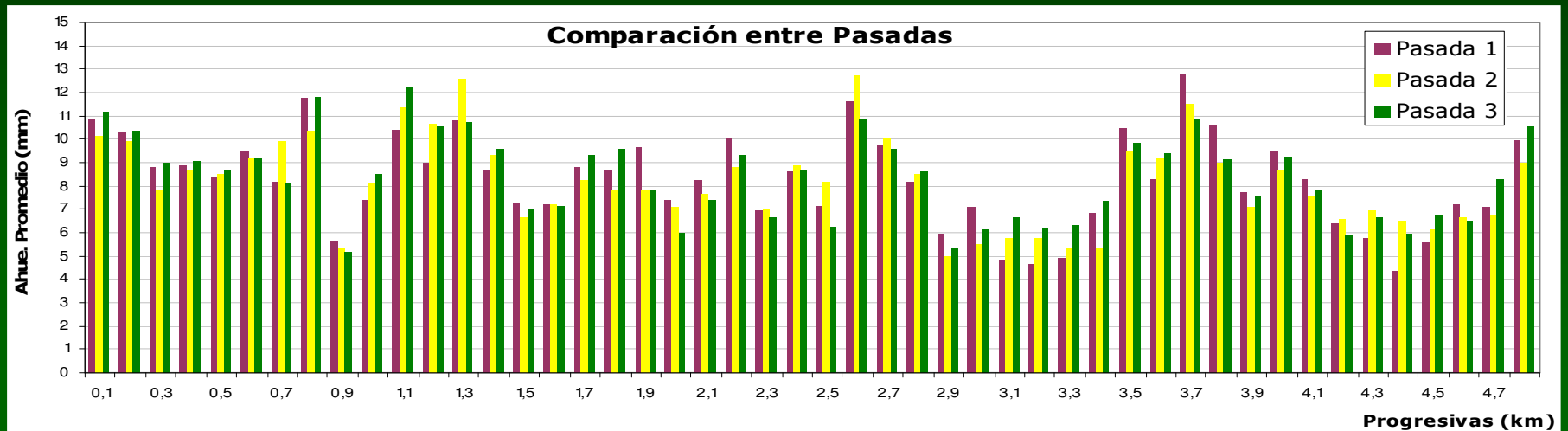




The Transverse Profile

1. TUS Repetibility

18,000 m Testing Section

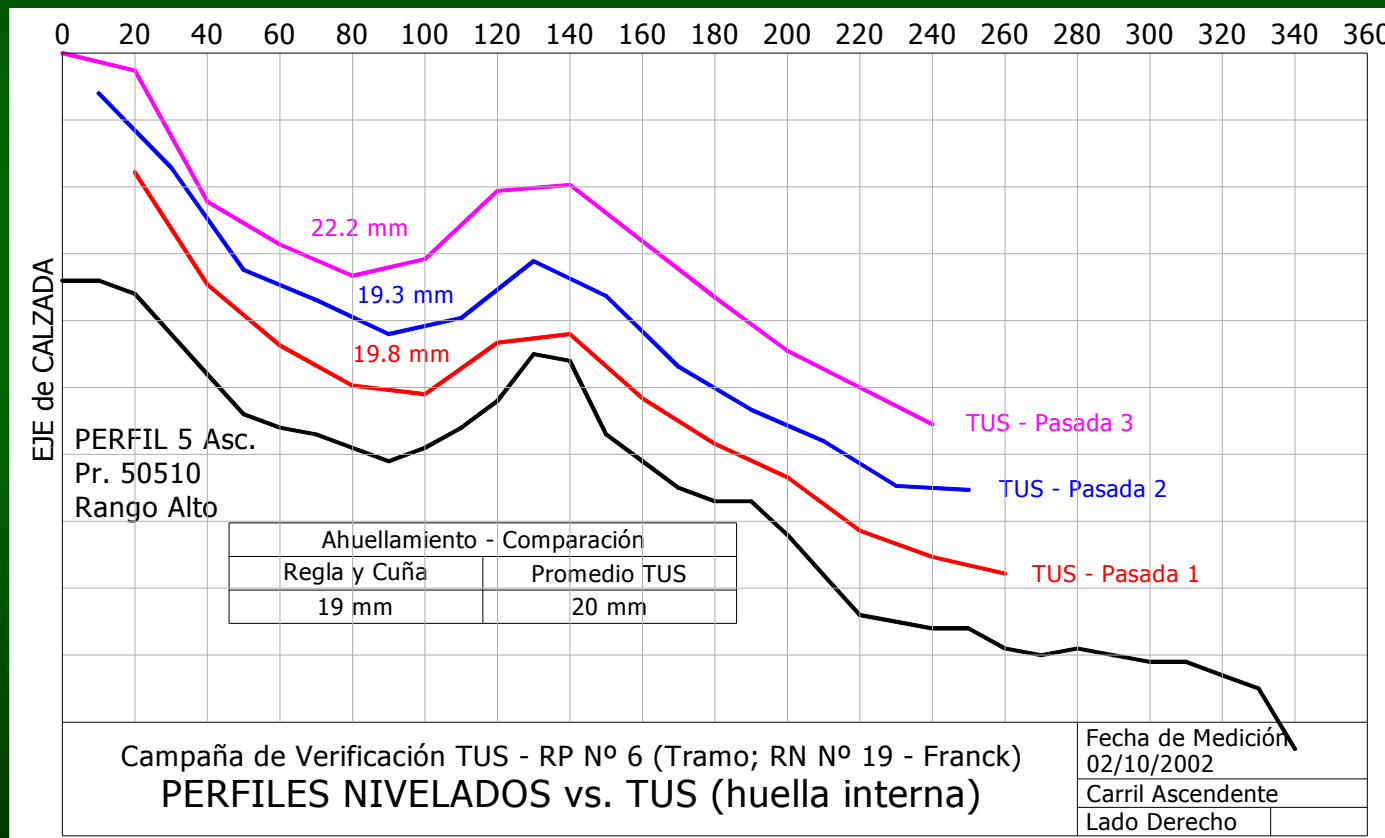


- TUS – Mean Rut Depth every 100 m
- Results in a range lower than 2/3 mm



The Transverse Profile

2. TUS Accuracy vs transverse leveled profiles (Rod and Level)



Vert. Scale 1:1

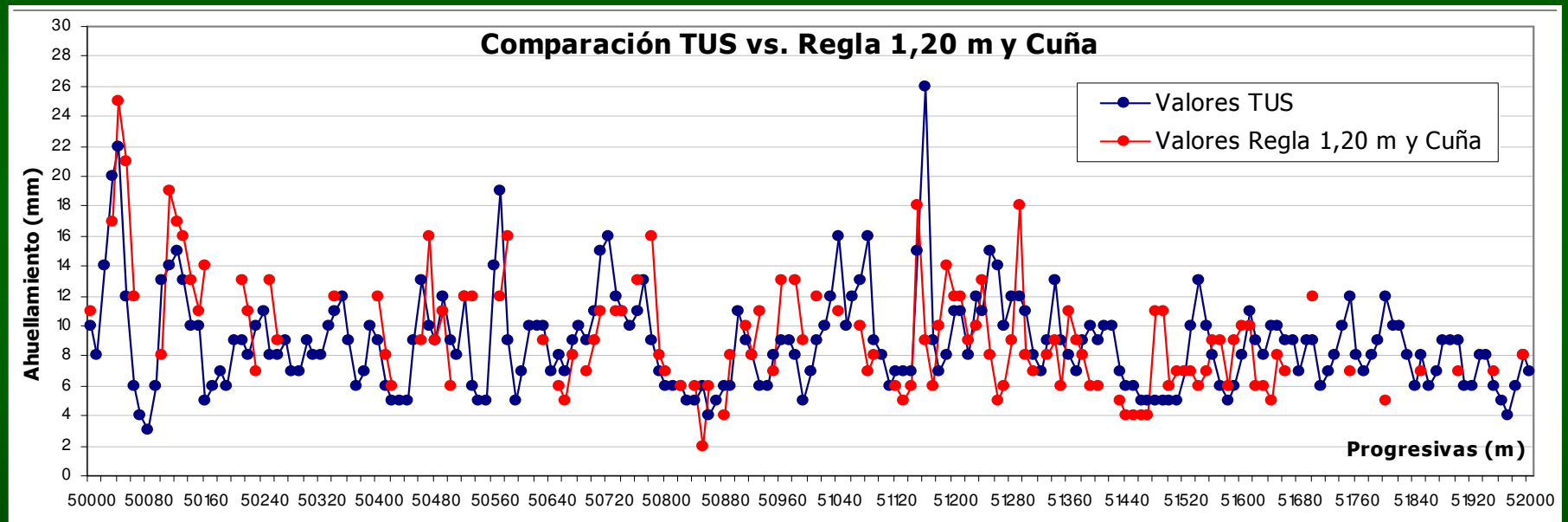
Horiz. Scale 1:20



The Transverse Profile

18,000 m Testing Section

3. Reliability or accuracy vs Manual measurements with 1.20 m edge



- TUS – Mean Rut Depths every 10 m
- Manual Rut Depths determinations with edge and wedge every 10 m



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Distresses and Inventory

ASTRA System



Cracking and distress
evaluation

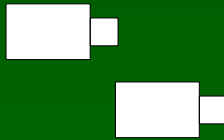
Road Inventory

Distresses and Inventory



Equipos montados en vehículo

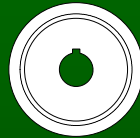
Cámara Digital



Receptor GPS

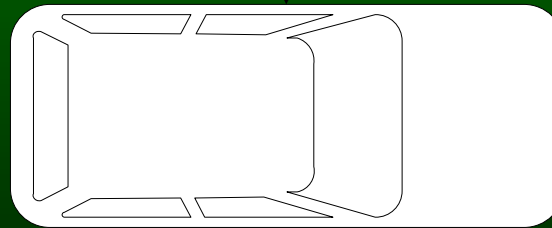
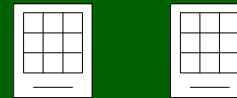


Odómetro de Precisión



Equipo Industrial

Teclados de Eventos



Vehículo de montaje





Distresses and Inventory

SYSTEM APPLICATIONS

I. ROAD INVENTORY

*Color environmental videos by digital cameras:
creation of bank of images digitized in realtime JPEG
format.*



Distresses and Inventory

Auxiliary configurable keyboards

TECLADO DERECHO

BERMA PAVIMENTADA (BERPAV)	BERMA NO PAVIMENTADA (BERNOPAV)	ACERA (ACERA)	CICLOVÍA (CICLOVIA)	OBSERVACION (OBSCON)
Estado B-R-M	Estado B-R-M	Estado B-R-M	Estado B-R-M	
BARANDA DEF METAL (BARMET)	BARANDA DEF CONCRETO (BARCON)	SEÑALIZACIÓN HORIZ BORDES (SHBORDES)	SEÑALIZACIÓN HORIZ EJE (SHEJE)	TALUDES (TALUDES)
Estado B-R-M	Estado B-R-M	Estado B-R-M-F	Estado B-R-M-F	Erosión B-R-M
ZANJA COR. SIN REVESTIR (ZJSINREV)	ZANJA COR. REVESTIDA (ZJREV)	CUNETA SIN REVESTIR (CUNSINREV)	CUNETA REVESTIDA (CUNREV)	SECCIÓN (SECCION)
Limpieza FUN-ERS-TAP-F	Limpieza / Estado FUN-DET-TAP	Limpieza FUN-ERS-TAP-F	Limpieza / Estado FUN-DET-TAP	Tipo CJ-TR-ML-SM
CANALES (CANALES)	VEGETACIÓN MENOR (VEGMEN)	VEGETACIÓN MAYOR (VEGMAY)	PENDIENTE LONGITUDINAL (PENDLONG)	TERRENO - PEND. TRANS. (PENDTRANS)
Limpieza / Estado FUN-DET-TAP	Altura CO-RO-F	Estado CO-PO-F	Tipo P1-P2-P3	Tipo OND-MON-ESC



Distresses and Inventory

Field data collection





Adquisición CAMPAÑA : Prueba 2 SESIÓN N°012

Identificación
Ruta: Tro 010 1 Sentido: ASC N° 1 Inicio PK: 0 Fin PK: 15
Velocidad (km/h): 0 Imagen N°: 00009 Abscisas: 0 Abscisas: 0

GPS

FK adq: 0 Validar FK Dist. de FK (en m): 93 Dist. Total (en m): 93

LARGO_ALTO



Final Adquisición PAUSA Captura Cancelar

1 SVERTIZQ	21 BERPAV
2 SVERTDER	22 BERNOPAV
3 SCRITICO	23 ACERA
4 VADOBATEA	24 CICLOVIA
5 PR	25 OBSCONT
6 PUENTE	26 BARMET
7 ALC	27 BARCON
8 MUROIQZ	28 SHBORDES
9 MURODER	29 SHEJE
10 OBSPUN	30 TALUDES
11 DISENERG	31 ZJSINREV
12	32 ZJREV
13	33 CUNSINREV
14	34 CUNREV
15	35 SECCION
16	36 CANALES
17	37 VEGMEN
18	38 VEGMAY
19	39 PENDLONG
20	40 PENDTRANS



Distresses and Inventory

Once field data collection has been carried out, the inventory can be visualized and reviewed at the office.

If necessary, new events can be entered and corrections can be made, if necessary

Distresses and Inventory

Visualización CAMPAÑA : ZIPACON-CARTAGENITA SESIÓN N°000

Identificación

N°

Ruta/Vía

Sentido

Inicio PK Fin PK

Abscisas Abscisas

Posición

Imagen N°

Pk + abscisas

Visualización

INICIO FIN


◀ ▶

◀▶ ◀▶

◀▶ ▶◀ ▶◀

PK- PK+

LARGO_ALTO



Evento	PkInicio	AbsInicio	PkFinal	AbsFinal	Info1	Info2	Info3	Info4
ACERA	0	0	0	2471	BUENO	xx	xx	xx
TERRENO PENDIENTE TRAN	0	0	0	9784	ONDULAD	xx	xx	xx
PENDIENTE LONGITUDINAL	0	228	0	6715	P2(6-12)%	xx	xx	xx

Evento : Inicio : Fin : Type : Type : Type : Type :

Código : Abs :

Distresses and Inventory



Surface measurements

Visualización

Identificación
 N° 1
 Ruta/Vía Col 00-13
 Servicio
 Inicio Fin
 PK PK
 Abscisa Abscisa
 Posición
 Imagen N° 00052
 Pk + abscisa PR0+520
 Visualización
 INICIO FIN
 Vel. Simulada (km/h) 30

SUPERFICIE
 Superficie (m²) 2000458
 Largo (m) 613974.7 Abs (cm) 2035690

Evento	PkInicio	AbscInic	PkFinal	AbscFinal	Info1	Info2	Info3
SHUL. HUMID.	2	108	2	328	xx	xx	xx
EMULACION	2	118	2	1006	xx	xx	xx
PFLAJURAS.1	2	242	2	528	xx	xx	xx
F.S. LONG. - F.S. RETRAC.	2	441	2	565	xx	xx	xx

Latitud 0628.950046 Longitud 07300.01572 Altitud 2570.02 M Zona WGS84

Visualización

Identificación
 N° 1
 Ruta/Vía Col 01-01
 Sentido croissant
 Inicio Fin
 PK PK
 Abscisa Abscisa
 Posición
 Imagen N° 00050
 Pk + abscisa PR0+500
 Visualización
 INICIO FIN
 Vel. Simulada (km/h) 90

LARGO_ALTO
 Largo (cm) 672.3 Alto (cm) 41.8

Evento	PkInicio	AbscInic	PkFinal	AbscFinal	Info1	Info2	Info3	Info4
TERRENO PENDIENTE TRAN	0	0	0	22212	ONDULAD	xx	xx	xx
SECCION	0	0	0	17692	MEDLADEF	xx	xx	xx
SEÑALIZACION HORIZ EJE	0	13	0	22068	BUENO	xx	xx	xx
SEÑALIZACION HORIZ BORD	0	17	0	22069	BUENO	xx	xx	xx
CUNETA DEFECTIVA	0	20	0	500	FUNCIONA	xx	xx	xx

Latitud 0417.500230 Longitud 07449.64918 Altitud 307.99 M Zona WGS84 Cerrar



Width measurements



Distresses and Inventory

SYSTEM APPLICATIONS

II. ROAD SAFETY AUDITS (RSA)



Distresses and Inventory



Road Safety Audits (RSA)

Distresses and Inventory



Road Safety Audits (RSA)



Distresses and Inventory

Ruta : R003
Distancia al origen : 53,155
Latitud : 3506,231501 S
Longitud : 05844,103918 W
Altura : 37,78
Sentido : Asc
Camara : 2



Road Safety Audits (RSA)



SYSTEM APPLICATIONS

III. SURFACE DISTRESS EVALUATION



Distresses and Inventory

Evento :	Inicio :	Fin :	Tipo	Porcentaje (%)
Fisuración	PK : 1		2	0-10
Código : fis	Abs : 30		2	
			4	
			6	
				Suprimir
				Cancelar
				Validar

Argentinian DNV Methodology

Evento :	Inicio :	Fin :	Severidad	Superficie (m2)
1. Fatiga	PK : 1		Alta	11
1. Fatiga	Abs : 40			
2. En Bloque				
3. De borde				
				Suprimir
				Cancelar
				Validar

SHRP LTPP Methodology

Others... VIZIR, etc



Distresses and Inventory

DNV Methodology


Visualización CAMPAÑA : AECSA SESIÓN N°018

Identificación
N° 1
Ruta/Vía Tro EZ CA 1
Sentido décroissant
Inicio PK 63 Abscisas 430
Fin PK 27 Abscisas 0

Posición
Imagen N° 00551
Pk + abscisas PR63+1564

Visualización
INICIO FIN
◀ ▶
◀▶ ▶◀
◀▶ ▶◀
PK- PK+
Vel. Simulada (km/h) 110
◀ auto ▶ auto

LARGO_ALTO



Evento	PkInicio	AbsInicio	PKFinal	AbsFinal	Info1	Info2	Info3	Info4
Observ Continua	63	678	63	4586	xx	Acc Cañ	xx	xx

Latitud 3501.057736 Longitud 05844.41731 Altitud 28.26 M Zona WGS84 Cerrar

Cracking evaluation – Asphalt pavement



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The Longitudinal Profile

NEW LASER PROFILER: LASERPROF (Greenwood Eng.)

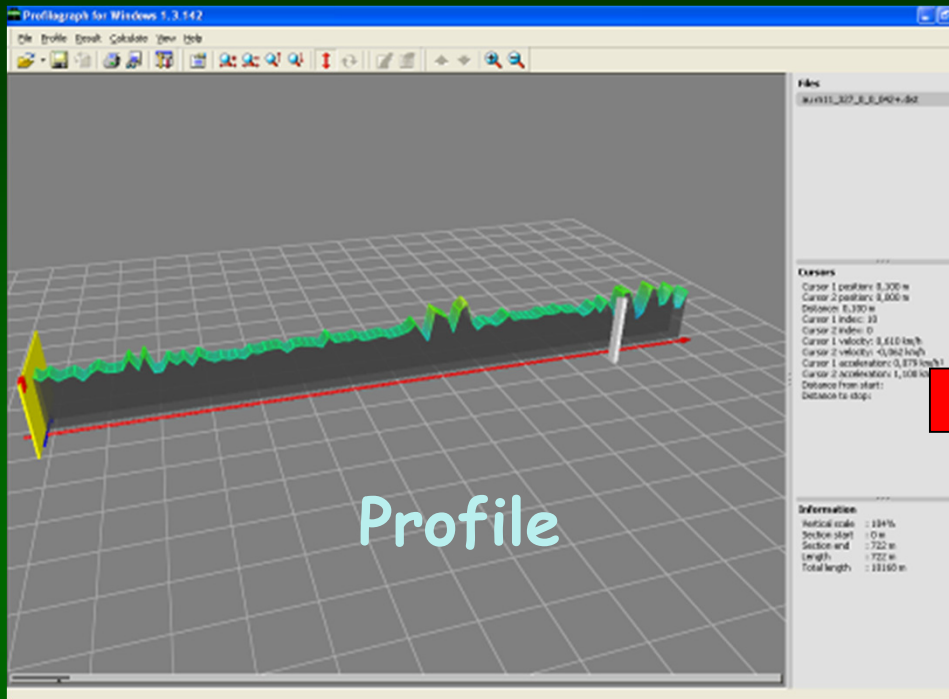


Inertial profilometer Class I:

Laser+Accelerometer

Measures long. Profile +
macrotexture

The Longitudinal Profile



Calculation profile: iri test [Save as ...] [Delete]

Lasers: 1 [L]

Filter length: 100 [m]

Velocity: 80 [km/h]

Suspension: 63,3

Tyre: 653

Damping: 6

Unsprung mass: 0,15

[Ok] [Cancel] [Apply]

IRI results in 100 m intervals

Export

Filters

- Curvature [pgd]
- Gradient [pgd]
- Rutting [pgd]
- Crossfall [pgd]
- IRI [pgd]
- HRI [pgd]
- Viagraf [pgd]
- Video images [pgd]
- GPS improved [pggpsimp]
- GPS raw [pggpraw]
- MPD [pgbstsd]

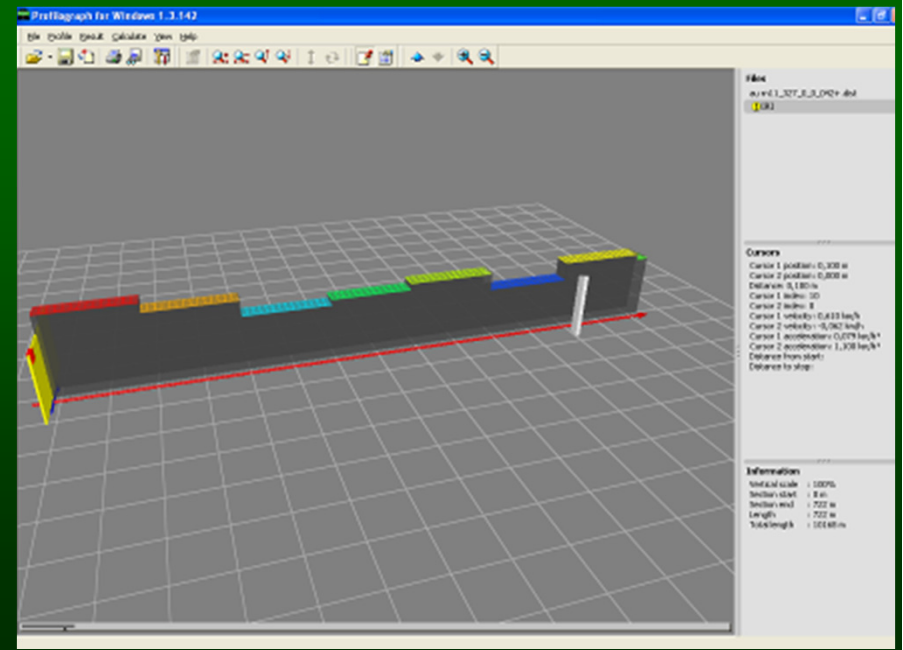
Formats

- Standard format
- Microsoft Excel sheet
- View report on the screen

Path: C:\Users\HP PAVILION\Desktop\Bolivia\RUGO\Resultados exportados\F01\ ...

[Ok] [Cancel] [Apply]

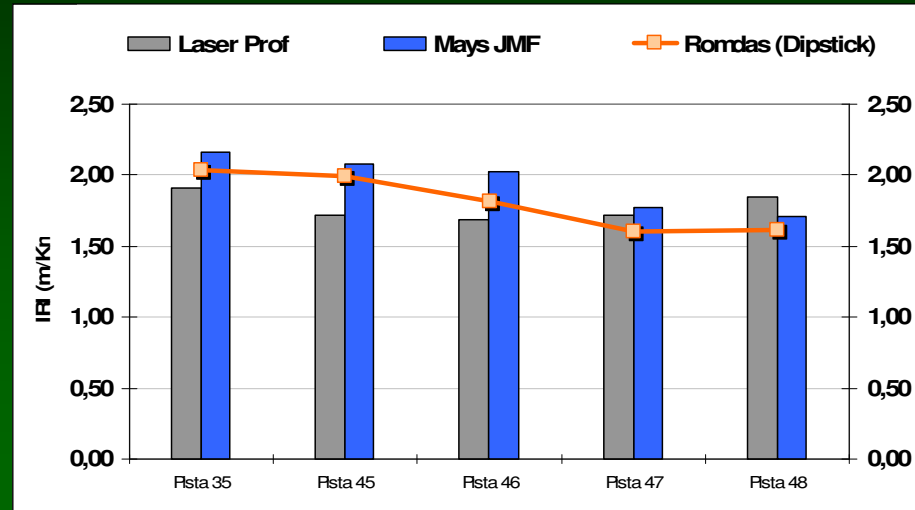
IRI and MPD



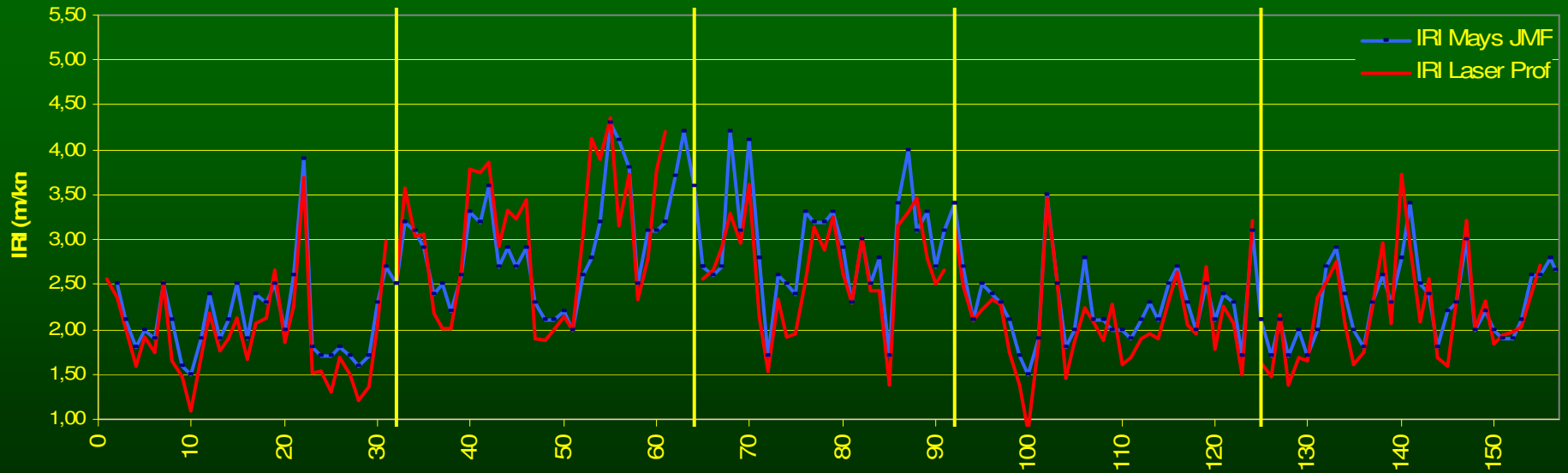


The Longitudinal Profile

Compared
IRI results



CALZADA ASCENDENTE - CARRIL EXTERNO





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ITYAC's Modular Multifunction device: ASTRA



Keyboards for data entry

2 high definition digital cameras



DGPS



Industrial rack-mounted computer



Long Profile and texture (laser + accelerometer)



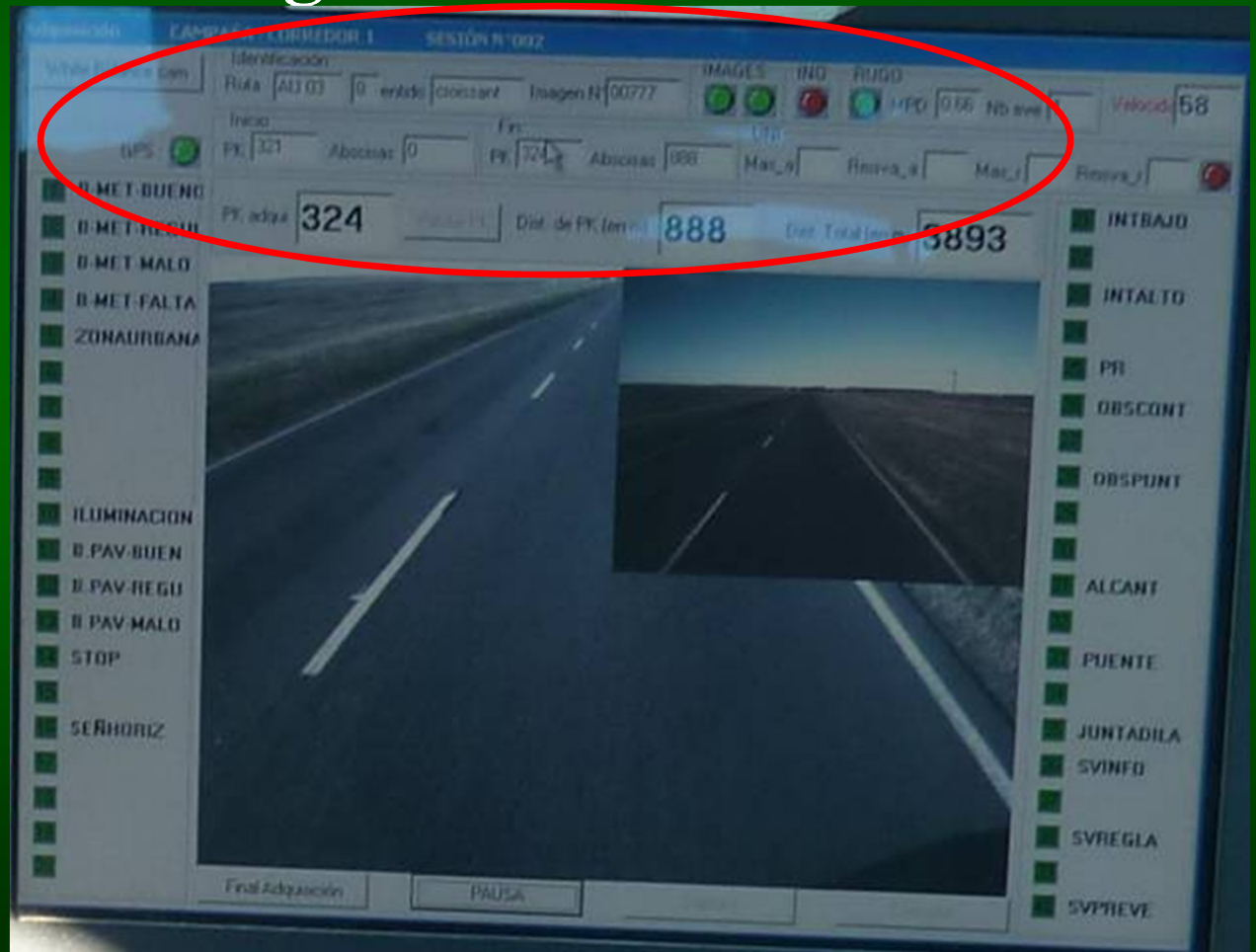
Rutting (13 US)



ITYAC's Modular Multifunction device: ASTRA



ASTRA Multifunction general dashboard





ITYAC's Modular Multifunction device: ASTRA





Abstract

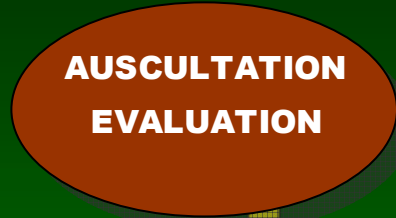
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SIPLAM FUNCTIONAL MODULES

WHAT WE HAVE ?



WHAT IT IS LIKE ?



WHAT IT SHOULD BE LIKE?



WHAT TO DO, WHEN AND WHERE ?



Inventory, Evaluation and Monitoring System (SIEM)



Maintenance Planning Models (MPM)



Road Maintenance Planning System (SIPLAM)



VERY IMPORTANT

Every Road Management System (RMS) requires data and must be periodically and continuously fed with updated data to obtain valid and confident results



NO DATA = NO MANAGEMENT SYSTEM



Data Acquisition scheme for Inventory and Road Evaluation

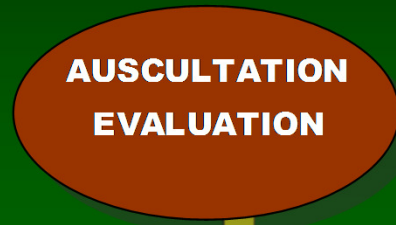
ROAD INVENTORY



WHAT WE HAVE ?



WHAT IT IS LIKE ?



LONG EVENNESS IRI



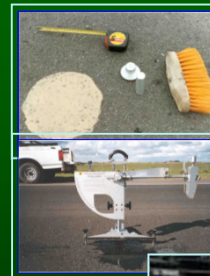
RUTTING



DEFLECTIONS



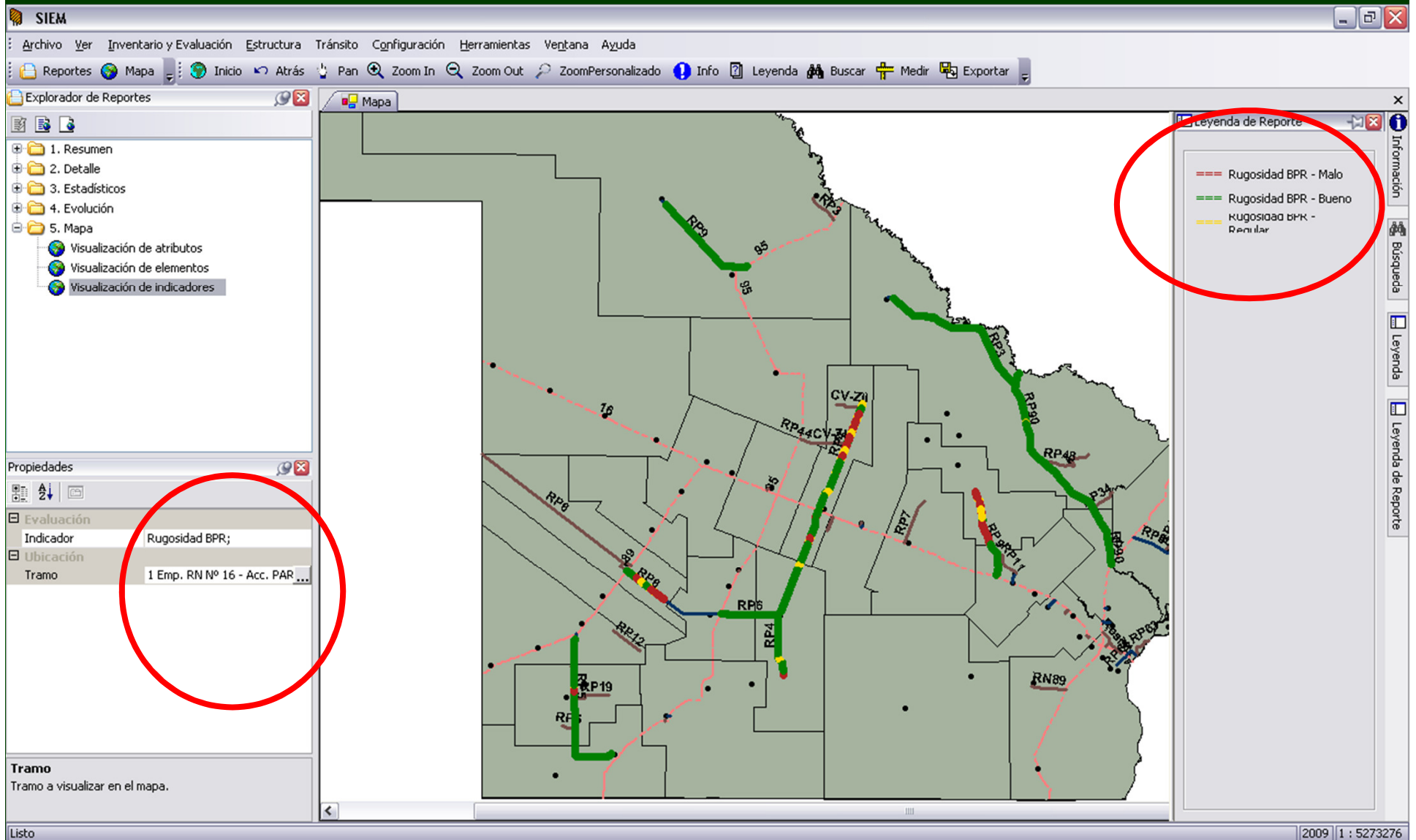
FRICITION AND TEXTURE



CRACKING AND DISTRESSES



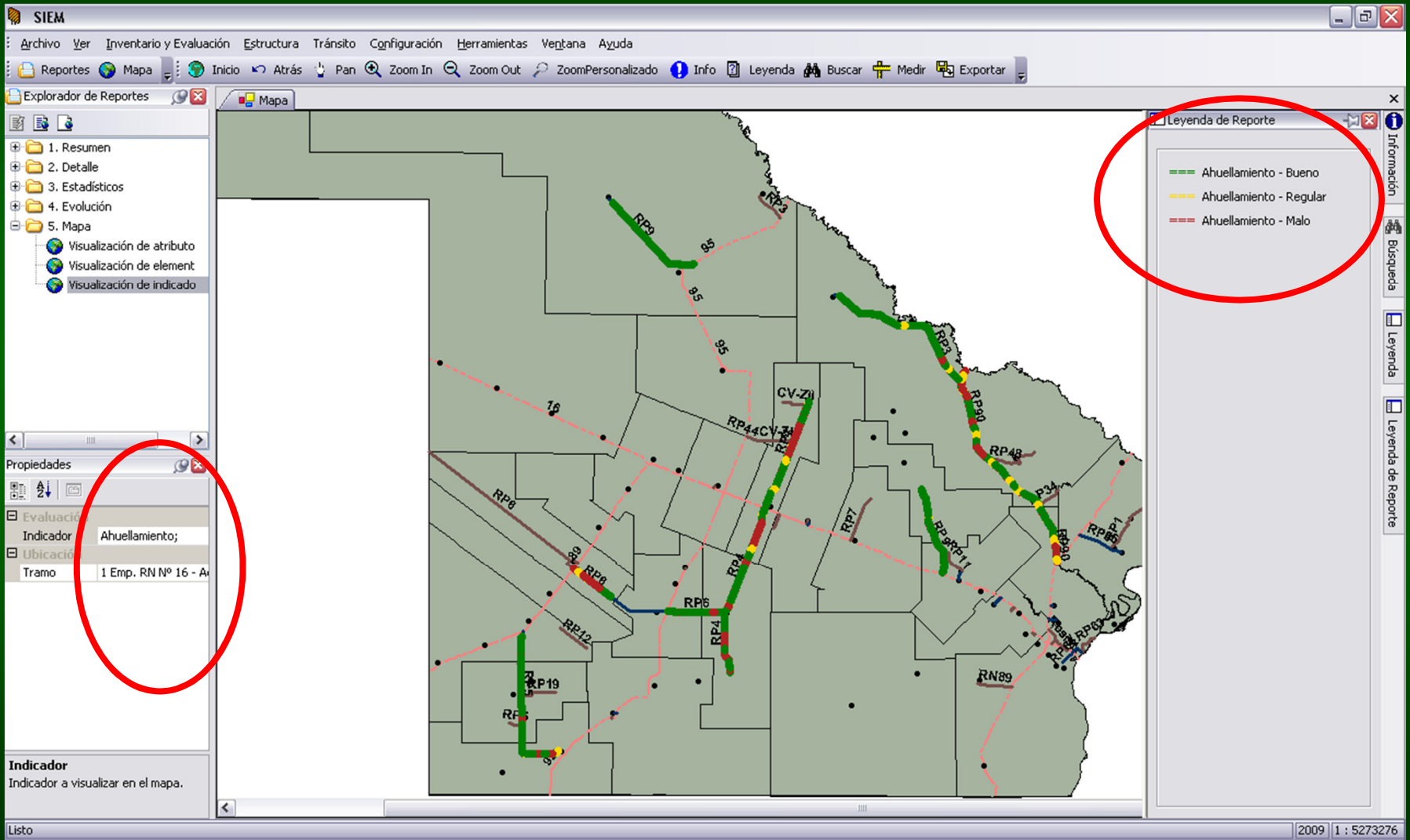
Province of Chaco, Argentina



Ride - Longitudinal evenness



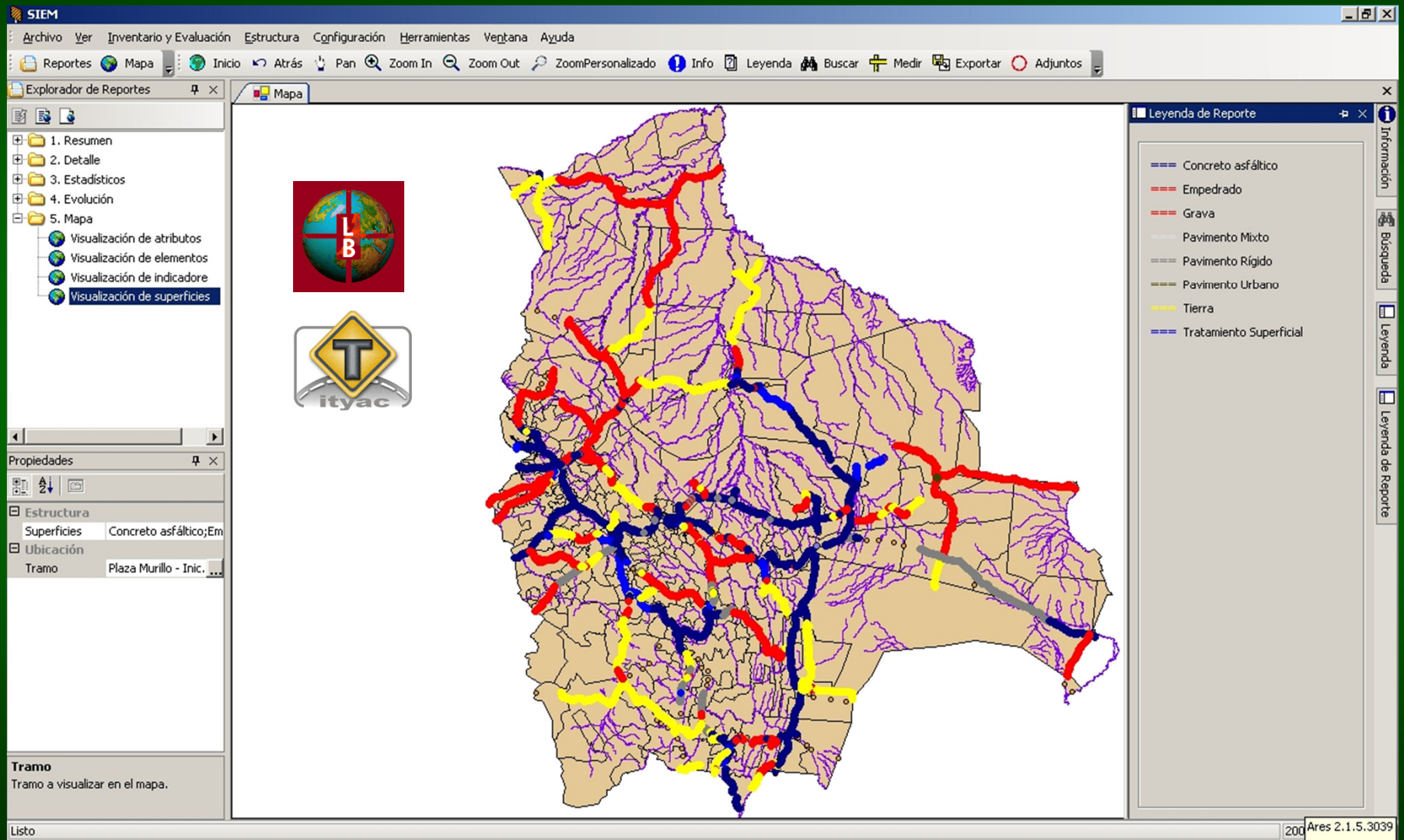
Province of Chaco, Argentina



Transverse Profile, Rut Depths

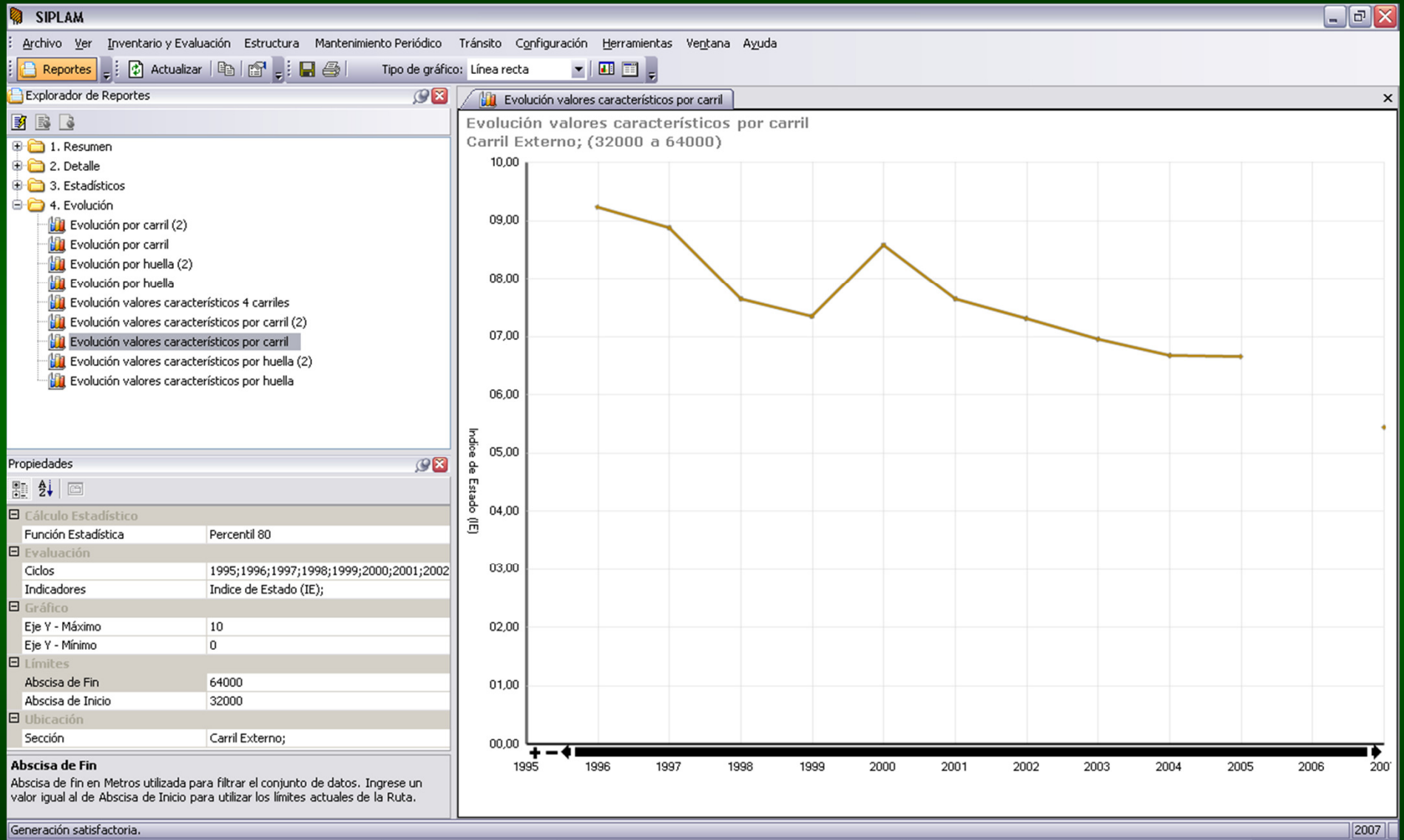


Fundamental Road Network from the Republic of Bolivia (ABC)



Inventory and Evaluation of 16,000 Km

Rosario-Santa Fe Highway, Argentina



Monitoring of State Rate

RN 7 Province of Mendoza, Argentina

Visor de Sesiones

Archivo Configuración Herramientas Ventana Ayuda

Abrir... Inicio rápido Reportes Actualizar Zoom: 50 : 1000 (px) Reportes

RN 7 - SECCIÓN S7 y S8 - DESC

Eventos Continuos

- Fisuras de Fatiga
- Huecos
- Peladuras

Eventos Puntuales

- Baches
- Observación puntual
- PR
- Secciones
- Señal. Vert. Informativa
- Señal. Vert. Preventiva
- Señal. Vert. Preventiva (Falta)
- Señal. Vert. Reglamentaria
- Señal. Vert. Reglamentaria (Falta)

1194 1193 1192 1191 1190 1189 1188

PR1192+420

Información

Arrastre hasta aquí un título de columna para agrupar las filas por ese criterio.

Icono	Evento	Inicio	Fin	Valor	Estilo	Umbral
[Icono]	Fisuras de Fatiga	12993	13114	2	[Estilo]	Moderado
[Icono]	Fisuras de Fatiga	13139	13263	3	[Estilo]	Alto
[Icono]	Fisuras de Fatiga	13289	13437	2	[Estilo]	Moderado
[Icono]	Peladuras	13374	13406	3	[Estilo]	Alto
[Icono]	Fisuras de Fatiga	13437	13665	1	[Estilo]	Leve
[Icono]	Peladuras	13471	14561	3	[Estilo]	Alto

Generación satisfactoria.

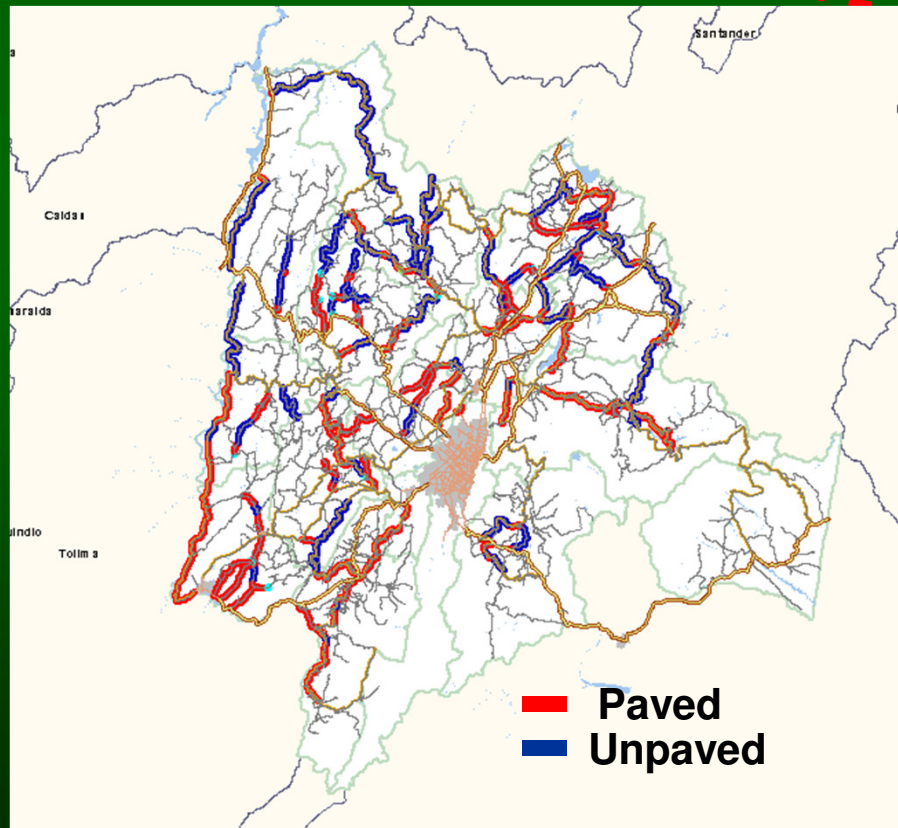
Visor de Imágenes

Vista en Planta

Visor de Altitud

Itinerary scheme

THE COLOMBIAN REPUBLIC DEPARTAMENT OF CUNDINAMARCA 2004/05



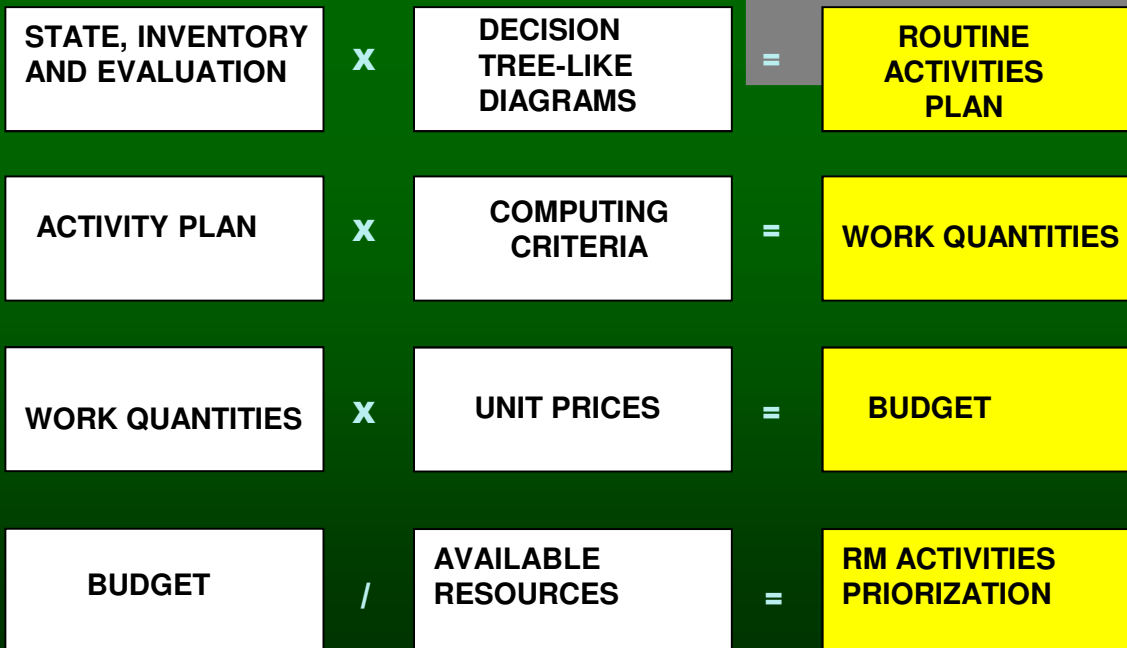
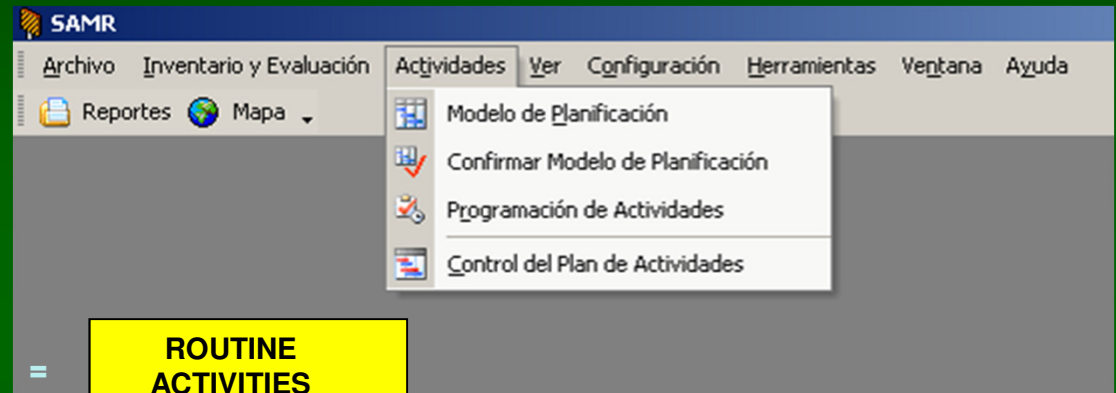
**SAMR
TRIAL PLAN 1500 Km**

**Routine
Maintenance
Administration
System (SAMR)**



Department of Cundinamarca, Colombia

Planning of Routine maintenance activities

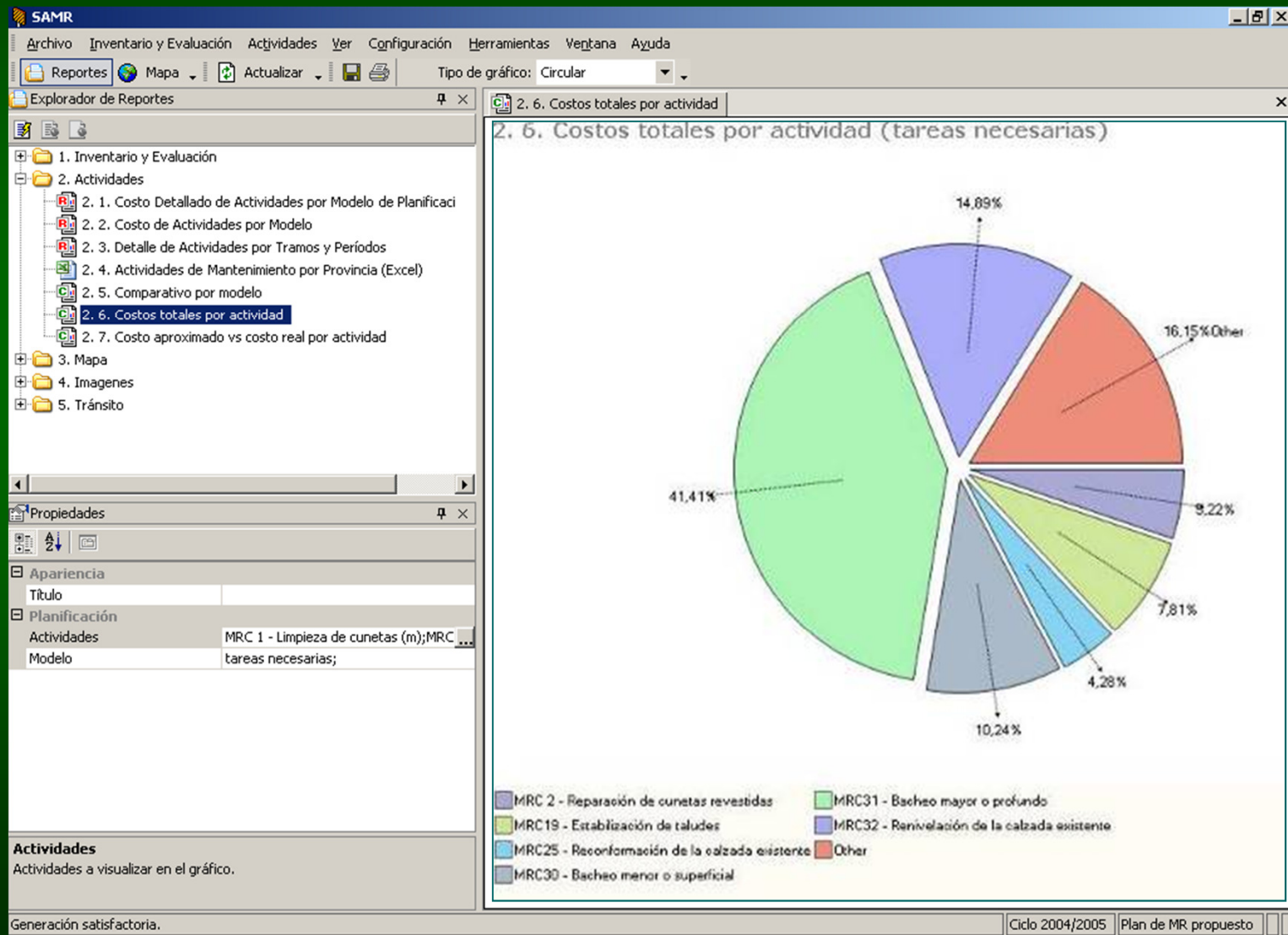


It's possible to make different simulations, to establish an annual plan of activities and its programming in terms (monthly, etc)



Department of Cundinamarca, Colombia

Planning of Routine maintenance activities





FINAL CONSIDERATIONS

- We have designed, assembled and tuned up a multifunction device for Automated Pavement Evaluation and Road Inventory in Argentina.
- Our aim was to produce a substantial improvement in terms of objectivity, accuracy, performance and safety in the production and administration of information for pavement management in order to conform to the new requirements established in maintenance contracts.
- The ASTRA system has characteristics of a multifunction device, but at the same time it is capable of evolution, flexible and modular.
- ASTRA has already been used with satisfactory results in Argentina and other Latin-American countries, and is therefore available for use in the region.



....THANK YOU VERY MUCH FOR YOUR ATTENTION !

g.mezzelani@ityac.com.ar