
PROJECT : MALIAKOS – KLEIDI CONCESSION MOTORWAY

SUBJECT : PAVEMENT ASSESMENT – **VISUAL INSPECTION**



Thessaloniki, January 2004

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1. PROJECT SUBJECT

The Pavement assessment related to the **PROJECT OF THE CONCESSION AGREEMENT OF THE MALIAKOS - KLEIDI MOTORWAY**

The Executive Committee decided that a general evaluation of the pavement has to be done, in the tender phase, according to a specific scale (from very good to very poor) This task is assumed by Geognosi SA and Geotest SA.

2. DEFINITION OF PAVEMENT RATING

In order to rate the pavement surface it was adopted the following scale (Called **CLASS**):

VISUAL CONDITION		CLASS	VISIBLE DISTRESS	GENERAL CONDITION
from	to			
		5 Very Good	None	New - Recent Overlay, like new.
		4 Good	No longitudinal cracks except reflection of paving joints. Occasional transverse cracks, widely spaced. All cracks sealed or tight Very little or no raveling, surface shows some traffic wear. Little or slight crack raveling. No patching or very few patches in excellent condition.	Recent seal coat - First signs of aging.
		3 Fair	Slight to moderate raveling and traffic wear especially near drains and water runoff from irrigation up to Considerable amounts of sand and loose rocks are near drains and low areas. Longitudinal cracks (open 0.5-1cm) some spaced less than 10 feet. First signs of block cracking up to 50% of surface Occasional patching or edge wedging in good condition.	Shows signs of aging. Sound structural condition.
		2 Poor	Severe surface raveling. Multiple longitudinal & transverse cracking with slight raveling and crack erosion. Longitudinal cracking in wheel path. Severe block cracking (over 50% of surface) and 'alligatoring'. Some alligator cracking (less than 25% of surface). Patching in fair condition. Occasional potholes Slight to moderate rutting or distortions (1cm deep or less). Unable to shed water.	Significant aging and first sign of need for strengthening. Needs patching and major overlay or complete recycling.
		1 Very Poor	Alligator cracking (over 25% of surface). Severe distortions (over 5 cm deep). Extensive patching in poor condition. Potholes. Severe distress with extensive loss of surface integrity.	Severe deterioration. Need reconstruction

The attention for the final rate of the pavement sections is focalized more on the description of the distresses than on the photos.

The final rating and the corresponding colors/numbers are:

Very Good	5
Good	4
Fair	3
Poor	2
Very Poor	1

3. DIVISION OF THE PAVEMENT

The whole motorway was divided in 37 branches, each branch was divided in sections (total 287 sections)

The division in branches was made mainly according to the contract works along the motorway. Then each branch was divided in two new branches, one for the **Right Carriageway (RC)** RACHES – KLEIDI direction (northbound) and one for the **Left Carriageway (LC)** KLEIDI –RACHES direction (southbound)

Finally there are 37 branches:

17 at the right carriageway (R001-R017)

17 at the left carriageway (L001-L017)

1 for the Parking areas at the right carriageway (PARK RC)

1 for the Parking areas at the left carriageway (PARK LC)

1 for the Toll areas (TOLLS)

Then each branch was divided to sections taking into account all the available information (pavement condition, type and causes of distresses, type and thickness design of layers, construction and maintenance history)

In the existing motorway there are parts of the old lining (Tempi & Platamonas) and parts with or without **Skid Resistance Course**. All these was taken into account for the division of the pavement into sections.

The division of branches into sections was made separately for every traffic lane because not all lanes will justify the same approach, regarding the appropriate maintenance treatment. So, an ID **0** was given for the emergency lane, **1** for the right hand lane, **2&3** for the next lanes.

For example:

Branch **R001** -----**Right Carriageway** first branch
 Section **0** ----- (emergency lane)
 Section **1**----- (right hand lane)
 Section **2**----- (next lane)

Finally a characterization was given to every section, according to the adopted scale.

[III.1 Table 1 Branch Listing Report](#)

Pavement Database.

NetworkID	BranchID	Name	Use	Number of Sections	True Area Unit: SqM	Comments
MAL_KL	L001	LC 240.300-244.500	ROADWAY	3	45.150,00	RACHES - AGROINVEST
MAL_KL	L002	LC 244.500-250.000	ROADWAY	3	59.125,00	AGROINVEST - PELASGIA
MAL_KL	L003	LC 250.000-261.350	ROADWAY	3	118.250,00	PELASGIA - AG.THEODOROI
MAL_KL	L004	LC 261.350-287.510	ROADWAY	12	281.220,00	AG. THEODOROI - ALMYROS
MAL_KL	L005	LC 287.510-303.000	ROADWAY	3	166.517,50	ALMYROS-AERINO
MAL_KL	L006	LC 303.000-323.000	ROADWAY	3	215.000,00	AERINO- M.MONASTIRI
MAL_KL	L007	LC 323.000-346.000	ROADWAY	3	244.025,00	M.MONASTIRI - START OF LARISA DEVIATION
MAL_KL	L008	LC 346.000-368.000	ROADWAY	4	242.875,00	LARISA DEVIATION
MAL_KL	L009	LC 368.000-377.500	ROADWAY	4	107.750,00	GIRTONI - TEMPI
MAL_KL	L010	LC 377.500-393.000	ROADWAY	4	87.000,00	TEMPI
MAL_KL	L011	LC 393.000-399.000	ROADWAY	6	64.500,00	TEMPI-PLATAMONAS
MAL_KL	L012	LC 399.000-410.000	ROADWAY	4	71.500,00	PLATAMONAS
MAL_KL	L013	LC 410.000-419.000	ROADWAY	8	126.150,00	PLATAMONAS - DION
MAL_KL	L014	LC 419.000-424.000	ROADWAY	4	72.500,00	DION - LITOCORO
MAL_KL	L015	LC 424.000-436.000	ROADWAY	12	174.000,00	LITOCORO - KATERINI
MAL_KL	L016	LC 436.000-440.000	ROADWAY	4	58.000,00	KATERINI DEVIATION
MAL_KL	L017	LC 440.000-472.000	ROADWAY	15	464.000,00	KATERINI - MAKRIGIALOS - KLEIDI
MAL_KL	PARK LC	PARKINGS LEFT	PARKING	53	56.000,00	LEFT, AREA APPROXIMATELY
MAL_KL	PARK RC	PARKINGS RIGHT	PARKING	42	54.850,00	RIGHT, AREA APPROXIMATELY
MAL_KL	R001	RC 240.300-244.500	ROADWAY	3	34.400,00	RACHES - AGROINVEST
MAL_KL	R002	RC 244.500-250.000	ROADWAY	3	59.125,00	AGROINVEST - PELASGIA
MAL_KL	R003	RC 250.000-261.350	ROADWAY	3	118.250,00	PELASGIA - AG.THEODOROI
MAL_KL	R004	RC 261.350-287.510	ROADWAY	11	279.982,50	AG. THEODOROI - ALMYROS
MAL_KL	R005	R 287.510-303.000	ROADWAY	3	166.517,50	ALMYROS-AERINO
MAL_KL	R006	RC 303.000 - 323.000	ROADWAY	3	215.000,00	AERINO- M.MONASTIRI
MAL_KL	R007	RC 323.000-346.000	ROADWAY	3	239.525,00	M.MONASTIRI - START OF LARISA DEVIATION
MAL_KL	R008	RC 346.000-368.000	ROADWAY	4	242.875,00	LARISA DEVIATION
MAL_KL	R009	RC 368.000-377.500	ROADWAY	4	107.750,00	GIRTONI - TEMPI
MAL_KL	R010	RC 377.500-393.000	ROADWAY	3	87.000,00	TEMPI

Pavement Database.

NetworkID	BranchID	Name	Use	Number of Sections	True Area Unit: SqM	Comments
MAL_KL	R011	RC 393.000-399.000	ROADWAY	6	64.500,00	TEMPI-PLATAMONAS
MAL_KL	R012	RC 399.000-410.000	ROADWAY	2	71.500,00	PLATAMONAS
MAL_KL	R013	RC 410.000-419.000	ROADWAY	8	126.150,00	PLATAMONAS - DION
MAL_KL	R014	RC 419.000-424.000	ROADWAY	4	72.500,00	DION - LITOCORO
MAL_KL	R015	RC 424.000-436.000	ROADWAY	12	174.000,00	LITOCORO - KATERINI
MAL_KL	R016	RC 436.000-440.000	ROADWAY	4	58.000,00	KATERINI DEVIATION
MAL_KL	R017	RC 440.000-472.000	ROADWAY	17	464.000,00	KATERINI - MAKRIGIALOS - KLEIDI
MAL_KL	TOLLS	TOLLS	TOLLS	4	48.500,00	TOLLS

Pavement Database.

Total Number of Networks:	1
Total Number of Branches:	37
Total Number of Sections:	287
Total True Area:	5.337.987,50 SqM
Average Branch True Area:	144.269,93 SqM

4. PAVEMENT STRUCTURE

Generally there are three types of structures:

Type I (Called RCC)

AC	16 cm*	7 cm (base course) 5 cm (binder course) 4 cm (SRC: Skid Resistance Course)
Cement stabilized aggregates (Rolled Compacted Concrete)	38 cm* (20+18cm)	

Type II (Called UNBOUND)

AC	19 cm*	5 cm (base course) 5 cm (base course) 5 cm (binder course) 4 cm (SRC: Skid Resistance Course)
Unbound aggregates	50 cm* (5x10cm)	

Type III (UNKNOWN)

AAC (Asphalt overlay over asphalt concrete)	? cm	
AC	? cm	
Unbound aggregates		? cm

*Design values

[III. Table 4 Branches and Base Type Material](#)

Table 4
BRANCHES AND TYPE OF BASE MATERIAL (excluding Tolls&Parking)

Branch ID	Name	Base Material	Area	Area Units
R001	RC 240.300-244.500	RCC	34,400.00	SqM
L001	LC 240.300-244.500	RCC	45,150.00	SqM
L016	LC 436.000-440.000	UNBOUND	58,000.00	SqM
R016	RC 436.000-440.000	UNBOUND	58,000.00	SqM
L002	LC 244.500-250.000	RCC	59,125.00	SqM
R002	RC 244.500-250.000	RCC	59,125.00	SqM
L011	LC 393.000-399.000	UNBOUND	64,500.00	SqM
R011	RC 393.000-399.000	UNBOUND	64,500.00	SqM
L012	LC 399.000-410.000	UNBOUND	71,500.00	SqM
R012	RC 399.000-410.000	UNBOUND	71,500.00	SqM
L014	LC 419.000-424.000	UNBOUND	72,500.00	SqM
R014	RC 419.000-424.000	UNBOUND	72,500.00	SqM
L010	LC 377.500-393.000	UNBOUND	87,000.00	SqM
R010	RC 377.500-393.000	UNBOUND	87,000.00	SqM
L009	LC 368.000-377.500	UNBOUND	107,750.00	SqM
R009	RC 368.000-377.500	UNBOUND	107,750.00	SqM
L003	LC 250.000-261.350	RCC	118,250.00	SqM
R003	RC 250.000-261.350	RCC	118,250.00	SqM
L013	LC 410.000-419.000	UNBOUND	126,150.00	SqM
R013	RC 410.000-419.000	UNBOUND	126,150.00	SqM
L005	LC 287.510-303.000	UNBOUND	166,518.00	SqM
R005	R 287.510-303.000	UNBOUND	166,518.00	SqM
L015	LC 424.000-436.000	UNBOUND	174,000.00	SqM
R015	RC 424.000-436.000	UNBOUND	174,000.00	SqM
L006	LC 303.000-323.000	RCC	215,000.00	SqM
R006	RC 303.000 - 323.000	RCC	215,000.00	SqM
R007	RC 323.000-346.000	RCC	239,525.00	SqM
L008	LC 346.000-368.000	RCC	242,875.00	SqM
R008	RC 346.000-368.000	RCC	242,875.00	SqM
L007	LC 323.000-346.000	RCC	244,025.00	SqM
R004	RC 261.350-287.510	UNBOUND	279,982.00	SqM
L004	LC 261.350-287.510	UNBOUND	281,220.00	SqM
L017	LC 440.000-472.000	UNBOUND	464,000.00	SqM
R017	RC 440.000-472.000	UNBOUND	464,000.00	SqM

		TOTAL	5,178,638	SqM
Type I RCC	Rolled Compacted Concrete	RCC BASE	1,882,100	SqM
Type II UNBOUND	Unbound aggregates	UNBOUND BASE	3,345,038	SqM

5. FURTHER INFORMATION REQUIRED

The above mentioned results are based on Visual Condition Surveys done by qualified and experienced persons along the motorway.

The total thickness of AC is based on the theoretical thickness and on the available information from cores taken during the construction. However consideration should be given to the additional occasional coring in order to confirm the existing data and also to determine the thickness of AC in “unknown areas”.

Cores should be taken on the cracks in order to determine their depth, direction and manner of propagation and also where rutting is present. The cores should penetrate completely through the layers to provide evidence of which layers are affected. In some cores it might be necessary that some laboratory tests be done. (binder content, mix gradation, void content, aggregate character)

There is also a need for the association of the Deflection data results and Visual Condition. This would be very useful for identifying strong or weak areas for further investigation. Besides the interpretation of deflection data in poor or suspicious areas is more necessary than elsewhere.

In conclusion the results of the Visual Surveys should not be used partially in order to evaluate the pavement condition but in combination to all the other available data. This matter will decrease the uncertainty of the final Pavement assessment.

6. CONCLUSION

The whole motorway was divided in 37 Branches and in 287 Sections

The total pavement area is about **5,337,988 SqM**.

The final Skid Resistance Course has been applied to **3,091,705 SqM**.

The final Skid Resistance Course has not been applied yet to **1,769,933 SqM**.

There are **317,000 SqM** of old lining (Tempi & Platamonas)

The area of Parking is **110,850 SqM**.

The area of Tolls is **48,500 SqM**.

During the last year and continuing at the time being the final Skid Resistance Course (4 cm thickness) has been applied. So the condition of these sections is Very Good. There are also sections without this final layer. The age of these sections is 0-6 year and the Condition range is from Poor to Very Good (**Table 3**) These sections represent about 33 % off the total Pavement Area (1,769,933 SqM) and the deformations (especially rutting) are not rare. For relatively old pavements with age

of 3 years or more there is an increased probability that the defects will extend further into the pavement structure.

Generally for all these sections some kind of treatment has been done (Patching – Crack overbanding - Overlay), sometimes soon after the opening of the road in traffic.

As a logical sense we could say that the same Condition exists more or less to the pavements under the Skid Resistance Course (where this has been applied)

One of the common distresses is rutting. The cause of this is usually the produced asphalt concrete which is usually out of the limits of mix design (low air voids) and sometimes the uncompacted base material.

The Poor Joint which appears often is because of poor workmanship and sometimes the density of cores taken on the joints is very low.

Very common also is the Lane/Shoulder Drop-Off (difference in elevation between the pavement edge and the shoulder.

Generally the materials used for the construction of the base (aggregates) are within the limits. We couldn't say the same about the subgrade (embankments) material because each company tries to use the available on site materials. Also the thicknesses of the asphalt layers are in the most cases within the limits. Sometimes the produced asphalt concrete doesn't follow the mix design and the placement of the material has been done without the appropriate equipment and attention (poor workmanship)

There are 1,882,100 SqM constructed following the Type I structure (Base material: cement stabilized aggregates) That type of construction was made for the first time in Greece and approved problematic. For that reason it was given up. Also several problems have been appeared in almost all those areas, not only after the pavement had been given to traffic but also during the construction.

For the working out of the data collected the PAVER 5.1 software were used which could be used also further (deflection data, cores, PCI data etc)

For Geotest S.A.

For Geognosi S.A.

Tsingistras E.

Lontzetidis K.

III.3 Table 3 Section Conditions Report (Summarized)

Table 3 Section Condition Report (Summarized)

	Number of Sections	Pavement Area (SqM)	Pct Area (%)	Condition (SqM - %)									
				Very Good		Good		Fair		Poor		Very Poor	
Whole Motorway	287	5,337,988	100%	3,269,038	61%	1,254,350	23%	735,475	14%	79,125	1%	0	0%
Old Lining (Tempi,Platamonas)	13	317,000	6%	0	0%	140,750	44%	139,650	44%	36,600	12%	0	0%
New Lining	175	4,861,638	91%	3,234,638	67%	1,046,050	22%	567,825	11%	13,125	0%	0	0%
New Lining with Skid Resistance Course	90	3,091,705.00	58%	3,087,955	100%	3,750	0%	0	0%	0	0%	0	0%
New Lining without Skid Resistance Course	85	1,769,933	33%	146,863	8%	1,042,300	59%	567,825	32%	13,125	1%	0	0%
Parking Area	95	110,850	2%	14,900	13%	67,550	61%	28,000	25%	400	1%	0	0%
Tools	4	48,500	1%	19,500	40%	0	0%	0	0%	29,000	60%	0	0%

The Pct (%) of the Condition refers to each line

7. APPENDIX

I. Comments for each Branch

II. Tables

III. Charts

I. COMMENTS FOR EACH BRANCH

I.1 R001&L001, Ch. 240+300 – 244+500

BRANCH R001 Right Carriageway Ch. 240+300 – 244+500

BRANCH L001 Left Carriageway Ch. 240+300 – 244+500

STRUCTURE TYPE I (RCC)

During 1995 construction and before the skid resistance course placement (2003) it was found that the pavement had a lot of irregularities due to poor workmanship. Approximately a new layer of 8 cm was placed after grinding the existing surface.

Total thickness of AC is

7+5+8+4=24 cm (maximum)



Photo 1 RC Ch.241 (VERY GOOD)

- Lane/shoulder drop off in many places (sometimes more than 10 cm difference in elevation)



Photo 2 RC Ch.241 (Lane/Shoulder Drop-Off)

- Rare bleeding on emergency and right hand lane (0.5-4 m²)



Photo 3 RC Ch.241 (Bleeding)