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SUSTAINABLE ROAD PAVEMENTS. ACCELERATED TESTS

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SUSTAINABLE ROAD PAVEMENTS. ACCELERATED TESTS

Romania as a PIARC founder member is making significant efforts to integrate his transport infrastructure into the huge European road network.

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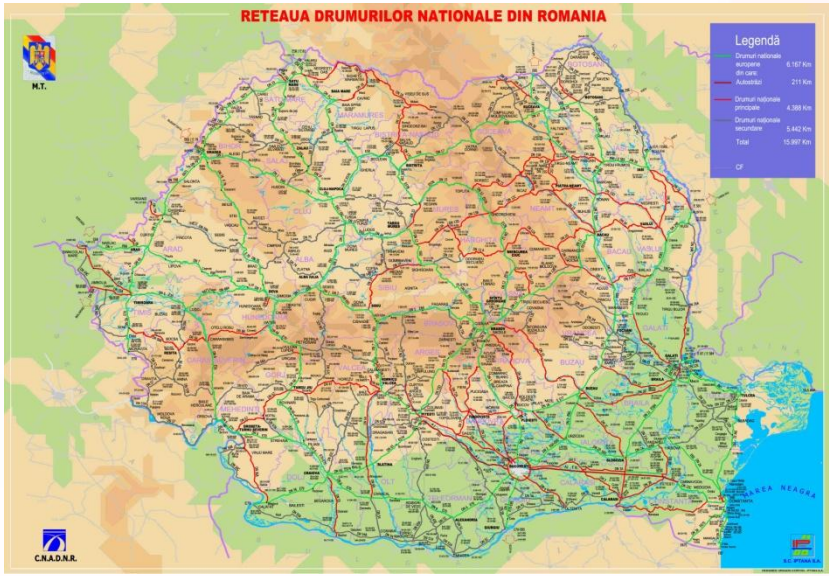
Romanian significant efforts to integrate his transport infrastructure in the modern European road network

- **Rehabilitation and extension of existing road network**
- **Assimilation & implementation of new technologies and sustainable pavements**
  - Stone Matrix Asphalt – (SMA/MASF)
- **Assimilation of new methods for structural design of pavements:**
  - Romanian method PD 177/2001
  - ME-PDG (USA)
  - APA (Long Lasting Flexible Pavement)



SUSTAINABLE ROAD PAVEMENTS. ACCELERATED TESTS

SUMMARY

•. The particularities of pavement design. Evolution of pavement conception and design

• Addressing the robustness of road network and of pavement structures. Failure criteria

• The use of Accelerating Loading Test facilities for validation of the new design concepts

• Developing new design concepts for flexible and rigid pavements in Romania

•Future research trends. SupeRoads

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Significant milestones in the evolution of pavement conception and design. The six generations of pavements

- Primitive Roads
- Roman Roads
- McAdam's, Tresagues & Telford concepts
- Modern Roads
- Variable Road Pavements Structures –VRPS
- Durable Roads : LLRP & LLFP

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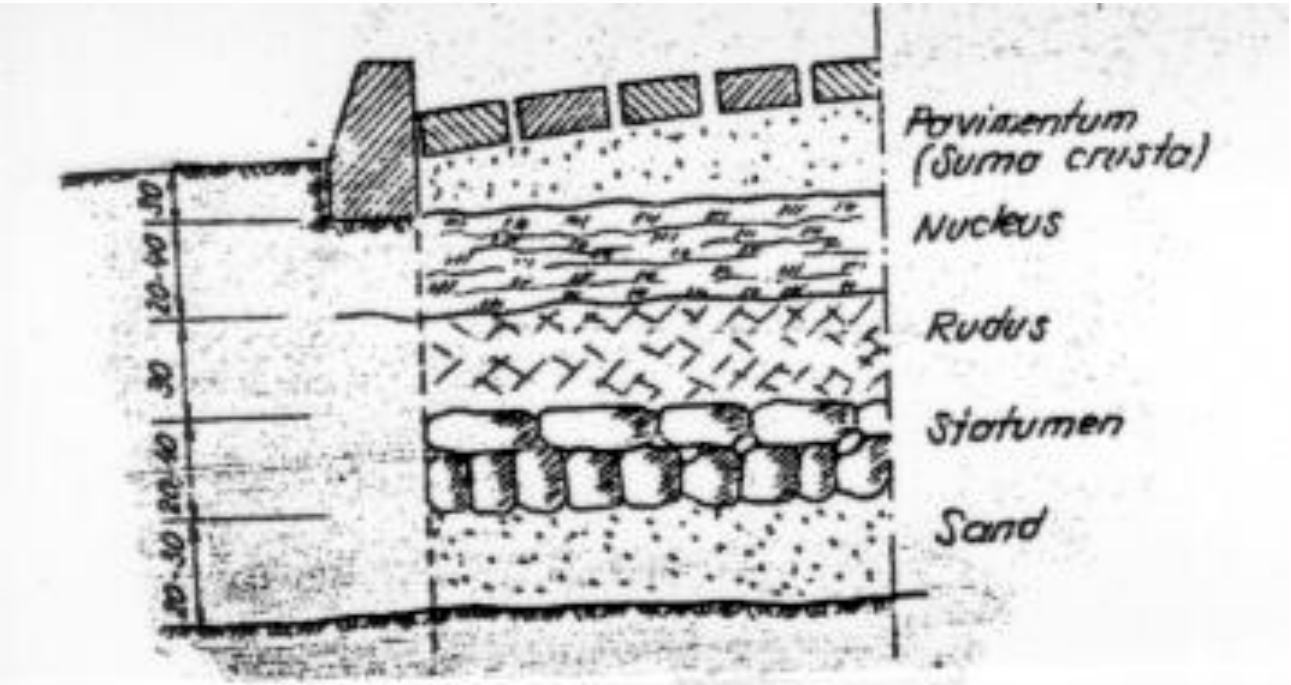
The evolution of the design concepts

Roman Roads



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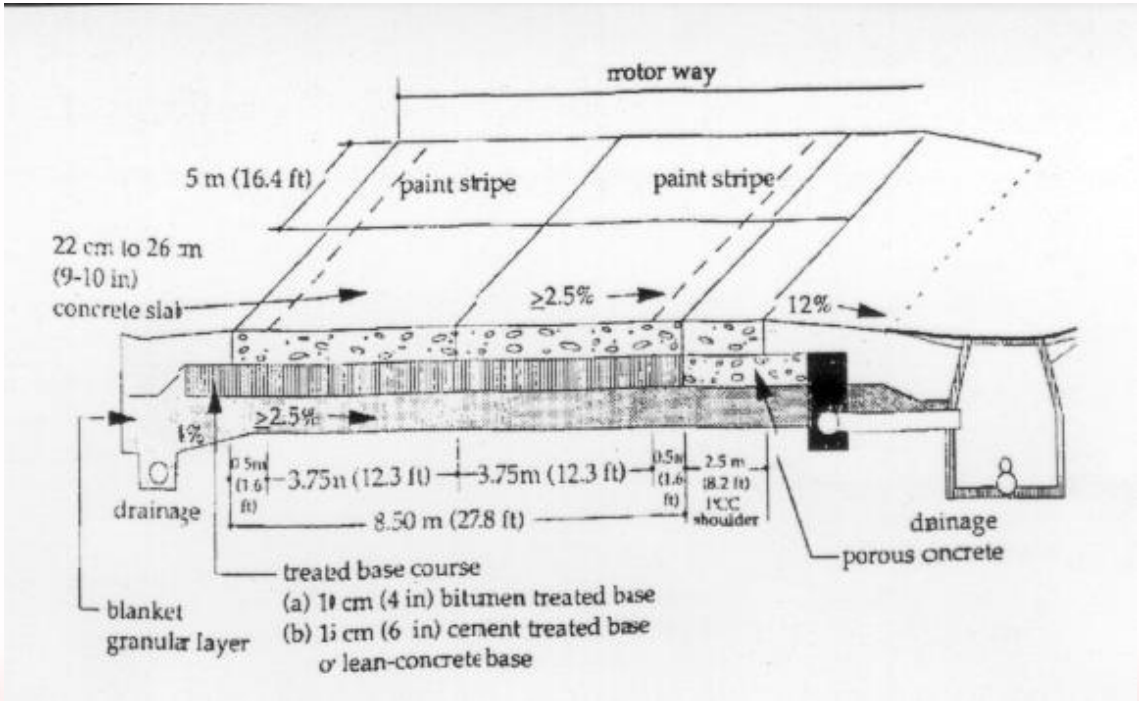
The evolution of the design concepts

Modern Roads



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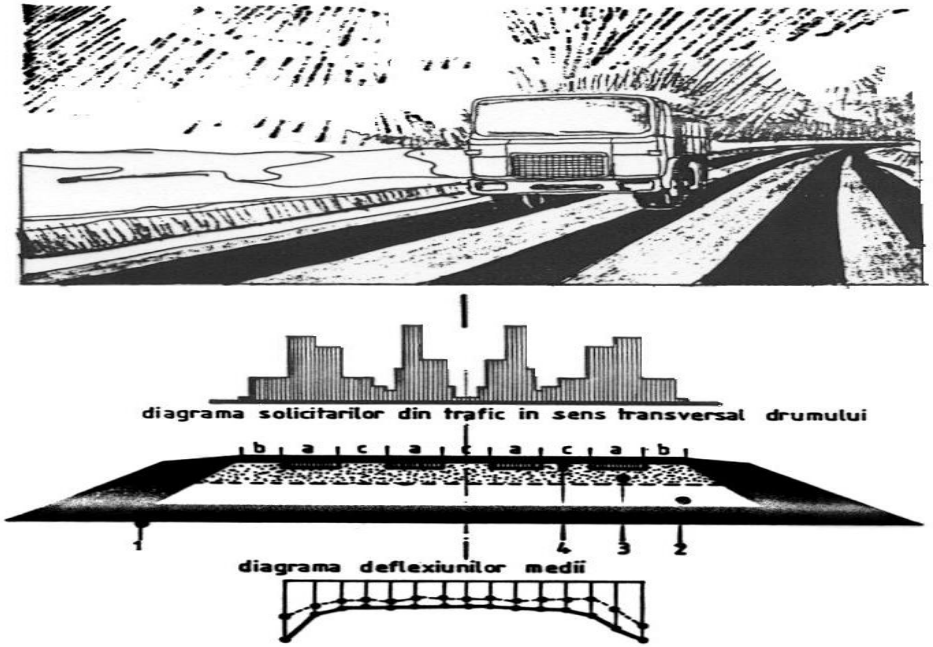
The evolution of the pavement design concepts

Variable Road Pavements Structures –VRPS



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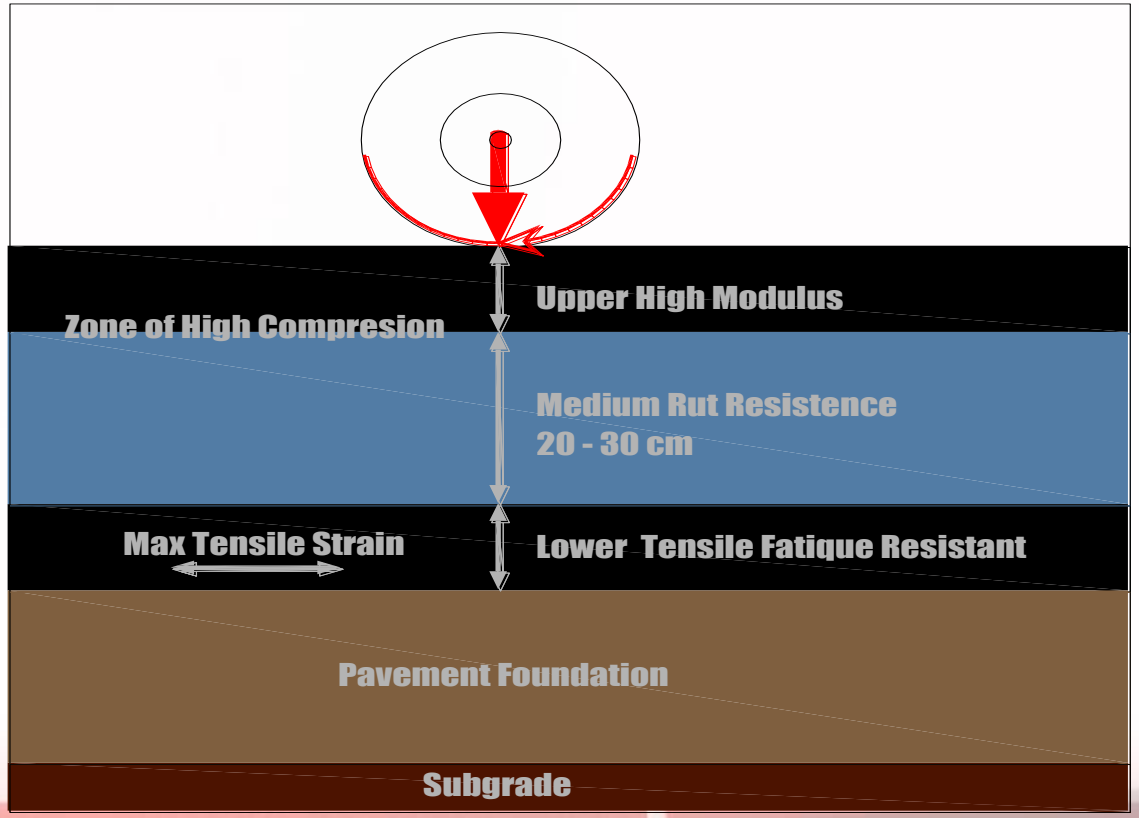
The evolution of the pavement design concepts . The sixth generation : LLFP & LLRP



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The unique feature of pavement design

Pavements, considered as a complementary invention of the wheel, are the only engineering structures, conceived and designed to fail after a specific period of time (design life);

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Addressing the robustness of road networks and of pavement structures. Failure criteria

-**observing the performance** of existing pavements ;

-**relate with the observed failure** (of an initial strain, occurring in a specific layer and in a critical place, under the repeated action of the traffic loads) ;

-**derive design equations,** used for computing the number of the ESAL cycles leading to the **imminent failure**

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Failure criteria considered in the structural design. Flexible pavements

* **fatigue cracking** of the asphalt layer

* **rutting** which can initiate in any layer of the structure (vertical compressive strain ε_v initiated at the top of the subgrade layer.)

* **spring seasonal deflection**

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Failure criteria considered in structural design. Rigid pavements

The main aspects/tasks which have to be addressed in an ideal mechanistic design procedures (according Huang, : Pavement Analysis and Design)	UK Highway Agency method (TRRL Report 87)	ME-PDG method (USA)	Romanian NP 081-2002
Structural model: Finite Element(FE) or Layered (L)	L	FE	FE
Fatigue cracking model: Combined loading /Truck Placement(TP) and Curling Stresses(CS)	TP&CS	TP &CS	TP&CS
Pumping and Erosion models(P&E)	-	P &E	-
Faulting model (F)	-	F	-
Joint Deterioration (JD)	-	JD	-
Punchout model (P)	-	P	-

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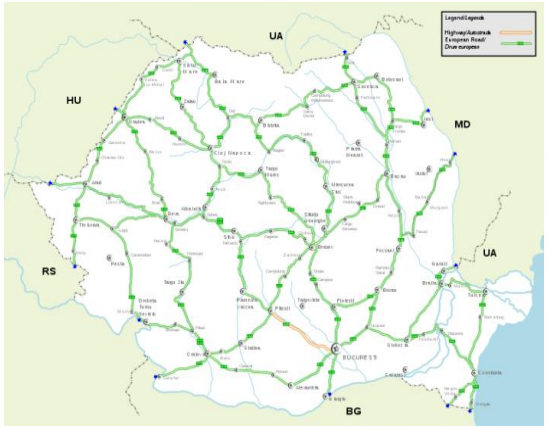
RO-LTPP research program, ALT facility of Technical University « Gh. Asachi » Iasi and the road network



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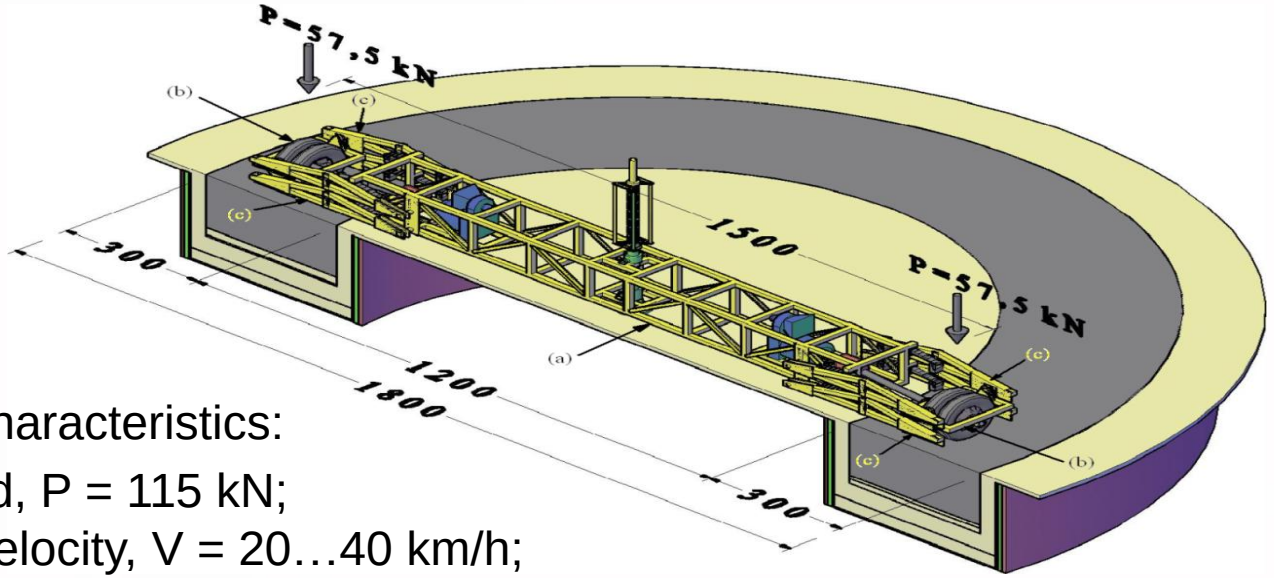
The ALT facility of Technical University »Gh. Asachi »Iasi



- Technical characteristics:
  - Axle load, P = 115 kN;
  - Wheel velocity, V = 20…40 km/h;
  - Circulated lane width : 0.65 m(the same trace), 0.87 m (alternating);
  - Track width, 3.00m
  - Controlled hydrological conditions

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The role of the accelerated tests ALT for validation of the the Long Lasting Rigid Pavement (LLRP)

The European FP6 EcoLanes Research Project :

- conceive and experiment the LLRP
- use recycled innovative materials: SRFC
- develop new pavement construction: RCC
- use ALT Facility & Demonstration Projects :

  Turkey & Cyprus , Romania &UK

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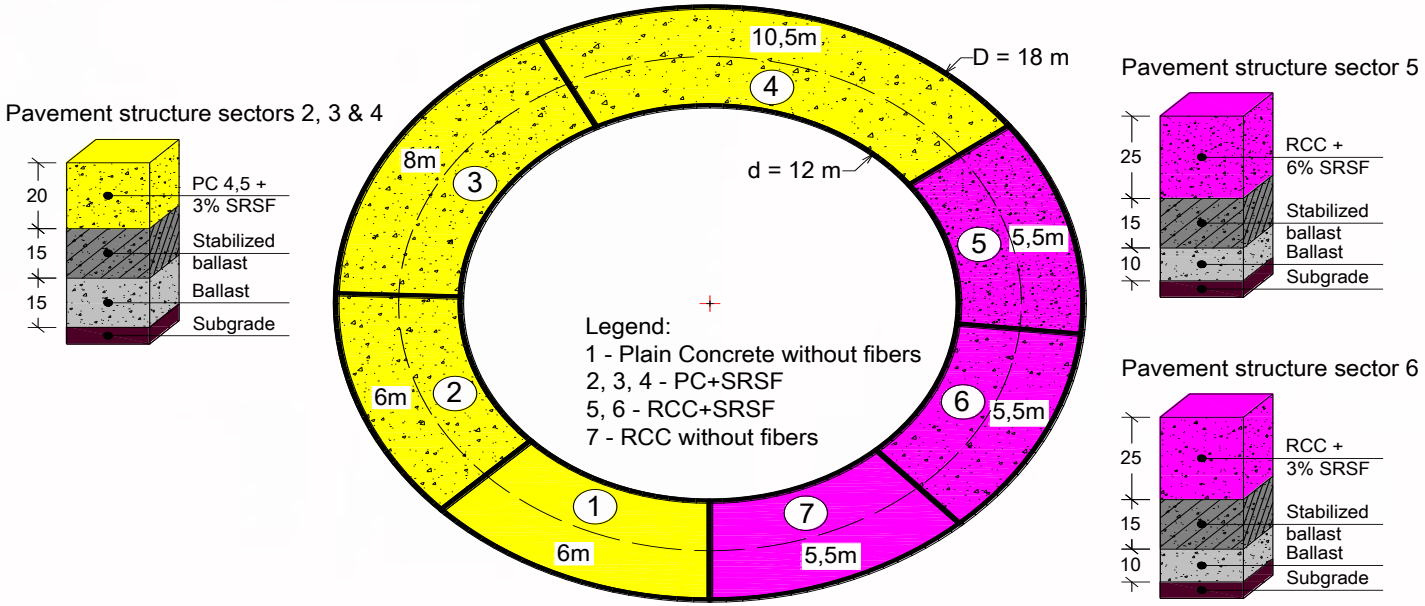
Experimental sectors constructed on the circular ALT facility and their rigid pavement structures



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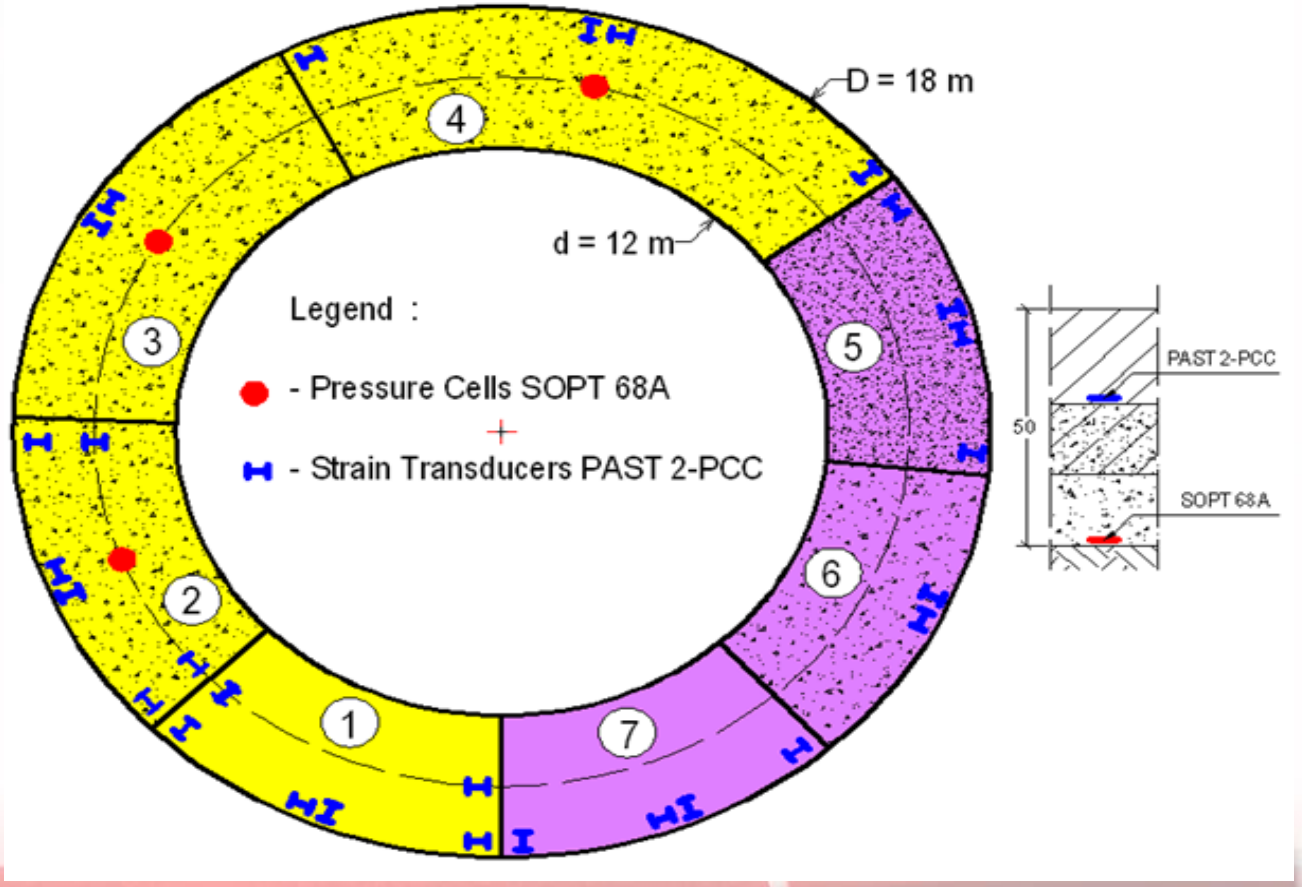
Placement of the transducers on the experimental sectors



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Structural Design Features for Various EcoLanes Demonstration Projects in Europe

	ROMANIA	CYPRUS	TURKEY
Design traffic (m.s.a of 115kN)	20.43	13.50	14.93
Climate type	III	II	II
Modulus of subbase reaction K (MPa/m)	58	58	65
Strength of the concrete at 28 days R^k_{inc} (Mpa)	5.0	4.0	4.5
Flexural strength σ_{tadm} (N/mm2)	3.48	3.05	3.17
Thickness of the concrete slab (cm)	22	24	23

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Research & Development of the Long Lasting Flexible Pavement (LLFP)

① - Classical pavement structure currently used No.1

② - The new long lasting pavements LLP 1 No.2

③ - Classical pavement structure currently used No.3

④ - The new long lasting pavements LLP 3 No.4

⑤ - Classical pavement structure currently used No.5

⑥ - The new long lasting pavements LLP 3 No.6

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The final results of the comparative study of both Classical and LLFP pavements

Classical pavement structure				Long lasting pavement structure-LLFP			
Layer	Design Traffic			Layer	Design Traffic		
	10 msa	30 msa	60 msa		20 msa	60 msa	120 msa
Wearing course (MASF 16/SMA)	4	5	5	Upper (Wearing) course (MASF 16/SMA)	5	5	5
Binder course (B.A.D. 25)	6	10	10	Medium Compression Resistance course (Asphalt Macadam)	25	30	30
Bituminous base - AB2	15	15	15	Lower Tensile Resistance course (MASF 8/SMA)	5	5	5
Ballast stabilized with cement	20	20	30	Ballast Subbase	25	30	45
Foundation	25	35	35	Subgrade/Soil Type P5	∞	∞	∞
Subgrade P5	∞	∞	∞				
Total thickness (cm)	70	75	95	Total thickness (cm)	60	70	85

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Conclusions

- use asphalt materials with superior elasticity modulus value (E = 6000…7000 MPa);

- dispose asphalt layers, according the LLFP concept;

- design & construct LLFP with similar or less thickness than classical ones, but capable to support higher design traffic;

- extend the pavement design life accordingly

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Future Research & Development of LLRP & LLFP

Construction of the envisaged ALT experimental sectors & Demonstration projects on the existing road network

Monitoring performances in time and drafting of specific technical recommendations for the design and construction of LLFP &LLRP

Assimilation and implementation of ME-PDG for various climatic regions of Europe (**SupeRoad FP7** project proposal)