

Overview on Transportation Infrastructure Research in Portugal

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The road infrastructures in Portugal have a great importance in the general transportation system, and the investments made in the last decades in the Portuguese road network resulted in road infrastructures of very good quality, classified by OECD (Organization for Economic Cooperation and Development) in the best places between the OECD countries. Concomitantly, the number of road accidents in Portugal deeply decreased into values only observed a few decades ago, when the traffic volume was substantially lower, which allowed to save significant amounts of the state budget. These excellent indicators obtained in Portugal are also a consequence of the advanced state of development of the Road Industry in cooperation with the main Research Centers in this field, namely the University of Minho. However, new challenges are currently posed to the transportation infrastructure Research Centers and Industry in Portugal, due to the economic crisis in the EU (European Union) and because the Portuguese road network is almost complete, needing essentially to be maintained. In fact, the pressure to get the most out of existing networks will continue to grow in Portugal, while the Portuguese companies working in this field are pursuing new opportunities to use their experience in the construction of new roads in emerging markets, namely in Eastern Europe, Northern Africa and Arabic countries, Portuguese-speaking African and American countries (Brazil, Angola and Mozambique), among others.

Thus, transportation infrastructure research in Portugal should support these new needs of road network maintenance and the investigation support of the Portuguese companies working in these new countries with totally different realities concerning the availability of natural resources and quality of construction materials, climate conditions, and suitability of construction methods. Moreover, the Portuguese road research centers must compete for high competitive EU funding, namely in the scope of the EU framework programme for research and innovation Horizon 2020 (80 billion Euros), which is only possible if when developing high quality and innovative investigation in areas clearly defined by the European Commission. This programme has three main lines of development:

- 1- science excellence (science quality is the foundation of tomorrow's technologies, employment and welfare; Europe needs to attract and retain research talents; researchers need access to better infrastructures);
- 2- industrial leadership (strategic investments in key technologies sustain innovation in emerging and in traditional sectors; Europe needs to attract more private investment in research/innovation; Europe needs more innovative small/medium enterprises to create growth and jobs);
- 3- social challenges (the concerns of citizens and society, namely the European policy objectives for climate, environment, energy, transport, among others, cannot be achieved without innovation; innovative solutions come from multidisciplinary collaboration, including social sciences and humanities; promising solutions have to come to the market to generate business, growth and jobs).

The new challenges for road infrastructures research in Portugal/Europe, according to FEHRL, will outcome from the following premises: 1) Growing pressure to get the most out of existing networks; 2) Greater attention to the user as consumer; 3) The chase for sustainability will grow; 4) Information will increase dramatically; 5) New financial models will enable change; 6) Innovation will increase the likelihood of step change. Thus, the future research in this field will be carried out the physical roads themselves, in the communications and control systems that link roads, vehicles and drivers and in the financial systems that pay the roads and the communications and control systems. Concerning the road infrastructure itself, the investigation should be focused in: 1) the development of fast, off-site construction methods; 2) long-life roads and more durable structures; 3) investment for construction/maintenance on basis of whole-life costs (namely through sustainable construction and reduction of fuel consumption) and low maintenance disruption; 4) intelligent monitoring of roads and structures; 5) minimized "down time" for maintenance and accident clearance.

The University of Minho is one of the main organizations developing research and innovation in the area of road infrastructures, having five professors fully working in this field of investigation, as well as two technicians, and a laboratory equipped to perform advanced testing on asphalt binders and mixtures, surface characteristics, pavement structural and functional performance *in situ*, noise abatement evaluation, among others. The research experience of University of Minho grew up in cooperation with other well known national and international institutions in several research projects, namely the Iowa State University (USA), University of Nottingham (UK), IFSTTAR (France), Korea Institute of Construction Technology (South Korea), among others. The main lines of research under development at University of Minho, and their future trends, are in consonance with the directives mentioned by the EU Commission and the perspectives for Europe presented by FEHRL. Thus, the road infrastructure research group at University of Minho is presently developing investigation in the following areas:

- Incorporation of waste materials (e.g. plastic), high RAP content and warm recycling and other innovative materials for road pavements;
- New half-warm/warm asphalt mixtures and sustainability analysis (e.g. emission of pollutants) of pavement rehabilitation strategies;
- Self-healing materials and development of new functional asphalt materials using nanotechnologies;
- Advanced characterization (micro, physical, chemical and mechanical analysis) of asphalt binders, including bio-binders;
- Development of a device and application of the cohesive zone model and fracture mechanics in the study of cracking propagation;
- Development of more durable materials and pavement structures, and evaluation of their performance *in situ*;
- Development of functional performance indicators for transport infrastructures, namely through the study of the users-vehicle interaction, comfort, noise, safety models and driver behavior;
- Study of rolling resistance to reduce fuel consumption costs during exploitation and new energy harvesting systems for road pavements;
- Development of sustainable infrastructures management systems.