

COST PROPOSAL

ROAD DAMAGE, SAFETY AND ENVIRONMENTAL EFFECTS OF WIDE SINGLE TYRES AND DUAL TYRES

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4. TITLE OF PROPOSED RESEARCH PROJECT

Road damage, safety and environmental effects of wide single and dual tyres.

5. GENERAL OBJECTIVES

The main objective of the proposed project is to establish the relative effects of wide single tyres and dual tyre assemblies in respect of road pavement damage, vehicle safety and environment, particularly noise. Quantified and reliable information on this topic will enable national governments and the EU to consider the policies that might apply in respect of the use of wide single tyres, the recovery or distribution of any additional costs or benefits arising from their use, and any necessary harmonisation of safety or environmental standards.

6. SECONDARY OBJECTIVES

Because there will be a need to employ extensive modelling, the project will also contribute to the development of vehicle operating costs models, and to the wider use of whole life cost models for road pavements.

7. CURRENT STATE OF KNOWLEDGE IN THE PROPOSED FIELD OF RESEARCH

Wide single tyres on heavy vehicles are not a recent innovation. Although they have been available to vehicle operators for many years, there has been an apparent reluctance on the part of many operators to adopt them as standard equipment, perhaps because vehicle operators have been mistrustful of the performance of wide single tyres.

In the past ten years, however, as economic pressures on operators have increased, the adoption of wide and super single tyres as fitments to heavy goods vehicles has become more widespread. They offer the vehicle operator lower unladen weights, and on the larger heavy goods vehicles, this can represent a significant payload advantage. Coupled with changes in axle and vehicle weight limits in a number of EU member states, therefore, the advantages of super single tyres have overcome the previous reservations of vehicle operators, and have led to their very much wider use on the national and international fleets of heavy goods vehicles.

Studies of the potential of such tyre equipment to bring about structural wear in road pavements have indicated the possibility of significantly increased wear, (see References in Section 17) and this has given rise to concern that the use of super single tyres does not adequately comply with the principle of cost recovery that applies in many member states to construction and maintenance costs for the national road network.

The question of the possible contribution to road wear of wide single tyres has received considerable world-wide attention. Generally, however, reported work has been either based on the use of models of pavement response and performance, or has involved the use of limited experimental work in which direct comparisons with the wear cause by conventional dual-wheel assemblies were made. Only one study is known in which long term testing of a full scale pavement has been used to compare the wear effects of the two tyre types. Unfortunately, this test was carried out on a pavement that is not typical of those used in

Finally, the project committee will need to carefully examine the relationship of the work proposed to that being undertaken by other COST groups, notably COST 324 (PAV-LIFE) and COST 333 (PAV-DES).

9. GROUND FOR DESIRABILITY OF CARRYING OUT RESEARCH IN THE FIELD IN QUESTION

As noted earlier, the available work on the topic indicates that wide single tyres may be up to twice as damaging to road pavements as dual tyres. This is particularly important at a time when specialised and costly road surfacings (pervious spray-reducing mixtures, for example) are being introduced throughout the EU. The costs of the increased damage may, however, be offset by savings arising from increased vehicle safety and from reduced noise emissions. In order to confirm these indications, and to assist national and international policy-makers in the formulation of appropriate measures, further work needs to be carried out that will quantify each of the effects, and that will develop techniques for assessing overall advantages and disadvantages.

10. BENEFITS OF THE PROPOSED RESEARCH PROJECT

The proposed project will:

- contribute to further European harmonisation on vehicle weights and dimensions.
- benefit European industry by maximising the efficiency of road transport within the EU and adding to the competitiveness of European industry.
- stimulate consideration of new technological developments.
- provide valuable input data to other COST projects now running.
- encourage cooperation between teams of workers having different expertise, and with access to different facilities.

11. DESCRIPTION OF THE PROPOSED RESEARCH PROJECT

At this stage, it is anticipated that the proposed project will comprise the following stages:

1. Comprehensive literature search to establish the extent and quality of information available on the effects of wide single tyres on pavement wear, vehicle safety, and noise emission.
2. Evaluation of the information derived from the literature survey.

Europe, and under conditions which make the translation of results to European conditions of truck weights and climate extremely difficult.

In addition, the possible effects on safety of vehicles equipped with super single tyres needs to be examined. The handling and braking characteristics of such vehicles may be adversely or helpfully affected, although little is known of this at present. It is thought, for example, that the use of wide single tyres leads to a wider wheel-wheel distance on an axle, conferring greater stability on that vehicle. However, few if any experimentally derived results are available, and only limited modelling of the possibility has been undertaken.

Finally, it has been suggested that the use of super single tyres may have effects on noise emissions from the road/tyre interface. Again, this needs to be quantified so that informed overall judgements on the use of wide single tyres can be made.

8. SPECIFICATION OF REQUIREMENTS FOR CARRYING OUT RESEARCH IN THE FIELD IN QUESTION

As noted earlier, some work has already been undertaken, particularly on the question of the pavement structural wear caused by wide single tyres. This work needs to be set in the European context, so that road owners, vehicle operators and policy makers are able to agree, if necessary, on standards for the use of these tyre types.

Given that little, if any, quantified work has been undertaken on questions of vehicle safety and noise emissions, the requirements for research that needs to be carried out now are as follows:

- Specialist input of knowledge from members of the proposed project committee, to establish that the current state of knowledge in Europe is exactly as described.
- Design of experiments or modelling that will establish the relative effects of wide single and dual tyres on pavement wear, vehicle safety, and road noise.
- Application of modelling techniques that will combine these effects and enable judgements to be made on the overall advantages or disadvantages of the use of wide single tyres.
- Extension of the results to the wide range of conditions that apply in European countries, and assessment of national or international actions that may be required.

These research elements will require consideration of the experimental and modelling facilities that are necessary and available, field studies that will establish the incidence of use of wide single tyres (and other types), and coordination of the research activities of a number of member states.

14. DURATION OF THE PROPOSED RESEARCH PROJECT

At present, it is anticipated that the project will begin work in mid-1995, and that the work will continue for three years. The timescale will be dependent on the agreed programme of work, but will be no longer than 4 years, and no shorter than two years.

15. APPROXIMATE ESTIMATE OF THE COST/INDICATION OF THE SCALE OF THE PROJECT AT NATIONAL AND INTERNATIONAL LEVELS

The present project in the United Kingdom is being undertaken at an approximate cost of ECU 100,000. It is estimated that similar work undertaken in other member states will require similar expenditure.

The costs of carrying out the proposed programme of work are estimated to be ECU 1,000,000.

16. LIST OF RECENT PUBLICATIONS IN THE RESEARCH FIELD IN QUESTION

WANG, M C. An investigation of potential pavement damage due to super single tires relative to dual tires. Final report. PTI 8223 PTI 8223 Pennsylvania State University, Pennsylvania Transportation Institute, Research Building B, University Park, Pennsylvania 16802, USA 1982-11

SAMUELS, S E. The collection and application of highway speed vehicle load data Australian Road Research Board. 24th ARRB Regional Symposium, Bundaberg, Queensland, 1986; program and papers 1986 p1-18. Australian Road Research Board, 500 Burwood Highway, Vermont South, Victoria 3133, Australia.

ANDERSSON, O. Strain distribution in thin surfacings under wheel load. Royal Inst of Technol, Stockholm, Sweden. Bitumen, flexible and durable. 3rd Eurobitume Symposium 1985 held at The Hague, September 11-13 1985. Volume 1: summaries and papers 1985 p327-31. Eurobitume, BD Emile Bockstael 351, Bruxelles, 1020, Belgium.

EISEMANN, J., HILMER, A. Influence of wheel load and inflation pressure on the rutting effect at asphalt-pavements - experiments and theoretical investigations. Sixth international conference, structural design of asphalt pavements, Volume I, Proceedings, University of Michigan, July 13-17, 1987, Ann Arbor, Michigan. 1987-01-01 p392-403. Michigan University, Ann Arbor, Department of Civil Engineering, Ann Arbor, Michigan 48109, USA.

HUHTALA, M, PIHLAJAMAEMI, J. Truck Tires and Pavements. Technical Res Centre of Finland Road & Traffic Lab. Third International Conference on Bearing Capacity of Roads and Airfields. Proceedings. The Norwegian Institute of Technology, Trondheim, Norway, July 3-5 1990. Volume 2 1990 p669-79.

3. Specification of the experimental work necessary to confirm the relative wear effects on pavements of single and dual tyres.
4. Specification, and development if necessary, of the models necessary to evaluate the effects on vehicle operating costs of the use of wide single tyres.
5. Use of existing models to examine the total financial consequences of the use of wide single tyres on heavy goods vehicles.
6. Examination of selected "case studies" in different member states, using readily available input data.
7. Evaluation of the study, and reporting.

12. EXISTING OR PLANNED WORK IN THE PROPOSED STATE

At present, the United Kingdom Department of Transport has commissioned Transport Research Laboratory to examine the feasibility of carrying out studies aimed at evaluating the effects of the use of wide single tyres in the UK. It is recognised that this work will be somewhat limited, and will need, for example, to develop simple but adequate models of vehicle operating costs able to deal with tyre parameters.

The planned work, if the feasibility is established, may include limited, but long-term experimental testing of full scale pavements, and the use of techniques to evaluate overall effects on pavement construction and maintenance costs. Limited work may be carried out on the effects on vehicle operating costs and noise emissions.

13. LIST OF UNDERSTANDINGS AND/OR RESEARCH INSTITUTES IN THE PROPOSING STATE ACTIVE OR INTERESTED IN THE PROPOSED RESEARCH PROJECT

The United Kingdom Department of Transport (Vehicle Standards and engineering Branch) deals with all aspects of the legislation for, and regulation of, aspects of vehicle design and safety that apply particularly to heavy goods vehicles. The branch has commissioned a limited project with Transport Research Laboratory.

The Highways Agency of the United Kingdom is the Executive Agency of the Department of transport responsible for the construction and maintenance of all motorways, trunk and principal roads in UK. They commission research into all aspects of pavement design and maintenance, including traffic input data.

The Transport Research Laboratory is an executive Agency of the Department of Transport, carrying out research into all aspects of highway and bridge infrastructure, traffic and transport. It undertakes research for both Department of Transport and Highways Agency customers, as well as an increasing number of private sector clients.

SOUTHGATE, H F. Effect of increased tire pressures and load limits on existing pavements - a sensitivity analysis. Kentucky Transp Centre, USA. Third International Conference on bearing capacity of roads and airfields. Proceedings. The Norwegian Institute of Technology, Trondheim, Norway, July 3-5 1990. Volume 2 1990 p681-90.

HUHTALA, M, PIHLAMAMAKI, J and PIENIMAKI, M. Effects of tires and tire pressures on road pavements. Transportation Research Record 1989-01-01 n1227 p107-114 Washington DC, USA.

SOUTHGATE, H F. Distributions of strain components and work within flexible pavement structures. Transportation Research Record 1991-01-01 n1307 p39-50 Washington DC, USA.

VON BECKER, P J. Impacts on the road and their effects on road construction and road preservation costs. Federal Ministry Transport, Bonn, Germany. Heavy vehicles and roads: technology, safety and policy. Proceedings of the Third International Symposium on heavy vehicle weights and dimensions, 28 June - 2 July 1992, Queen's College Cambridge, UK 1992 p109-15.

BONAQUIST, R. An assessment of the increased damage potential of wide based single tires. Federal Highway Administration, Virginia, USA. Proceedings of the 7th International Conference on Asphalt Pavements. Volume 3. Design and Performance 1992 p1-16 International Society for Asphalt Pavements (ISAP), c/o Texas Research and Development Foundation, 2602. Dellana Lane, Austin, Texas 78746, USA.

GROENENDIJK, J., VOGELZANG, C H., DOHMEN, L J M. and BOUMAN, S R. Lintrack-responsmetingen : vergelijken van gemeten asfaltrekken met voorspelde waarden (Lintrack response measurements : comparison of measured and predicted asphalt strains) Dutch. Wegbouwkundige Werkdagen 1992. Deel 2 (Crow Publikatie 60-ii) 1992 n60-ii p603-14. Crow, Galvanistraat 1, Ede, 6716 ae, Netherlands.

HENRY, J J (ed), WAMBOLD, J C (ed) and SEBAALY, P E. Pavement damage as related to tires, pressures, axle loads and configurations. Nevada Univ, Reno, USA. Vehicle, tire, pavement interface (STP 1164) 1992 p54-68. American Society for Testing and Materials (ASTM).

AKRAM, T, SCULLION, T, SMITH, R E and FERNANDO, E G. Estimating damage effects of dual versus wide base tires with multidepth deflectometers. Texas A&M Univ, USA. Transportation Research Record 1992 n 1355 p59-66, Washington, DC, USA.

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