

Project 11/2007 – Developing a fully automated Close-Proximity vehicle for measuring tyre/road noise

Project Number	11/2007						
Project Title	Developing a fully automated Close-Proximity vehicle for measuring tyre/road noise						
Principal Investigator (PI)	Dr. HUNG Wing-tat, Department of Civil and Structural Engineering of the Hong Kong Polytechnic University						
Project summary	<p>The main purposes of this project are:</p> <ul style="list-style-type: none"> a) to demonstrate the proper application of tyre/road measuring method as stipulated in the draft ISO11819-2 locally in Hong Kong; b) to develop a full automated CPX tyre/road noise measuring vehicle which can perform efficient noise measuring, especially in the local narrow road configurations of Hong Kong; c) to devise experimental setups to perform certification tests for the CPX tyre/road noise measuring vehicle necessary to meet all the requirements as specified in the draft ISO11819-2 except that the test tyre may be a locally available tyre; d) to perform road worthiness tests and trial runs for this CPX tyre/road noise measuring vehicle; e) to develop a manual for the development and use of this CPX tyre/road noise measuring vehicle in Hong Kong; and f) to disseminate all technological materials obtained from this project through a dedicated web-site and training programmes to local engineers and professionals. 						
Project Duration	21 months						
Proposed Budget	<p>The total budget is \$1,768,380, comprising the following items:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>Manpower – 1 SRA and 1 RA</td> <td>\$898,380</td> </tr> <tr> <td>Equipment – a medium goods vehicle, CPX equipment, sound measuring, recording and analytical system, a portable computer and a microwave speed meter</td> <td>\$829,000</td> </tr> <tr> <td>Miscellaneous</td> <td>\$41,000</td> </tr> </table>	Manpower – 1 SRA and 1 RA	\$898,380	Equipment – a medium goods vehicle, CPX equipment, sound measuring, recording and analytical system, a portable computer and a microwave speed meter	\$829,000	Miscellaneous	\$41,000
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Assessments/Remarks	<p>The proposal has been studied by EPD and Highways Department (HyD) and 2 external assessors. EPD and HyD support the proposal but both of them would not take up the maintenance responsibility of the vehicle.</p> <p>Members examined the proposal at the meeting held on 10.6.2008 and requested EPD and HyD to consider a long term plan on the usage of the noise measurement results of these projects, and/or any extended measurement. As EPD and HyD had indicated that they would not take up the long term maintenance of the vehicle, they should also advise how will the vehicle be best utilized after the completion of the project in 21 months.</p> <p>EPD advises that while proactive approach by proper planning between noise sensitive land use and roads is the most efficient method to avoid or minimise road traffic noise problems, there is unavoidably the adoption of engineering measures to tackle road traffic noise, especially in crowded urban areas where buffer distance between the 2 conflicting uses is limited. The engineering measures in general refer to noise barriers, enclosures and quiet road surfaces. Use of low noise road surface materials would provide appreciable reduction (by about 2-5 dB(A)) on road traffic noise without the constraints on space, fire fighting and the adverse effects caused by barriers or enclosures on aesthetic, visual and ventilation. Given the trend and research on low noise materials and quieter tyres in overseas countries and there would be likely more new low noise materials or quieter tyres developed in future, CPX trailer is required to gauge and compare the noise reduction effectiveness of such new materials. It is expected that the CPX trailer is an essential equipment for the coming years. The data obtained will form a database, which will be useful for identifying quiet tyres/road surfaces with a view to reducing the overall road traffic noise levels in Hong Kong. As EPD does not have the resources to keep and maintain the vehicle, it would be the best approach to utilize the vehicle through hire of</p>
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	<p>service after completion of the vehicle by HK PolyU.</p> <p>HyD points out that ISO/CD 11819-2 is still in draft form and is subject to further refinements. Hence further researches may be required to update the vehicle, the sophisticated measuring equipment and the computer processing software as the draft ISO standard evolves. In addition, much expertise is required to calibrate the equipment, process the raw data and generate results to make the noise data meaningful to pavement engineers in HyD. These services require a wide range of expertise that are not available within HyD, but are readily available in a research institute such as the HK PolyU. It is clearly more cost effective for the HK PolyU to own and operate the CPX vehicle in the long term, whereas HyD can hire the services as a user of the data the vehicle provides. HyD has always been outsourcing the traffic noise measurement work, where noise measurement expertise is required but not available in-house. HyD has also been outsourcing other measurements using specialised equipment in the pavement condition surveys, such as the use of ground penetrating radar to measure pavement layer thicknesses. There is no expertise in HyD to maintain such equipment. Outsourcing of service is much more cost effective.</p> <p>In respect of other types of application of the vehicle, EPD points out that the CPX trailer would be useful for various aspects of fields and hence it is expected that the potential users would also includes academics, paving contractors and materials suppliers. Currently, there are widespread researches carried out in many overseas countries, e.g. Netherlands, Denmark and Japan, for exploring and trial of different kinds of low noise materials for higher noise reduction effect and better durability. Rubberised asphalt is one of the materials which not only likely has a better performance on noise reduction and durability, but also helps to reuse/recycle the waste tyres.</p>
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A standardised method is required in order to assess the noise reduction effectiveness of the new low noise materials and compare their performance between various low noise materials. There is currently an ISO measurement method (i.e. Statistical Pass-by Method) for measuring noise emission level of individual vehicles running on the low noise material surface. However, this approach is not satisfactory, especially in Hong Kong heavy trafficked roads, as it would be influenced by other noise (e.g. engine noise of the vehicles). The ISO is now developing a standardised method, i.e. the CPX measurement (Close Proximity Method) by the proposed CPX trailer, for such purpose. Without this trailer, it is nearly impracticable to provide an accurate comparison of noise reduction by different low noise materials.

In addition to low noise materials, the European countries are also exploring the possibility of quieter tyres to reduce road traffic noise. CPX measurement is also an essential measurement method to compare the acoustical performance of different tyre tread patterns.

Furthermore, CPX measurement would provide valuable information for the researcher to understand more on the noise emission mechanism of tyre/road noise, the effects due to different compositions and configurations and paving methods and hence helpful in developing better low noise materials and/or quieter tyres.

EPD also remarks that the current proposal is much useful and essential to provide a realistic assessment of the noise emission of the low noise material under measurement. The one-wheel vehicle adopted in the previous project could only assess the noise performance of the materials at the centre line of the lane (in fact there is in general no wheel running on the centre line of the lane, except the motor cycle) and hence could not reflect the actual situation with the wheels running near the sides of the lane.

HyD advises that the development of low noise road surface (LNRS) is continuing world wide, and the same is being done in Hong Kong. Since the technology of LNRS is being continually developed, there is a clear long term need to compare the noise performance of various types of road surfaces, including newly developed ones, and to continually monitor their performance over time as the road surfaces are progressively damaged under traffic loading and the elements, such as rain and temperature variations. The results will provide important reference data for the further development of LNRS with improved performance.

In the past, HyD has been using a roadside measurement method to assess the traffic noise. This method measures the traffic noise generated by the traffic stream, which includes three main types of noise, those generated by the engine and power transmission unit, those generated by the vibration of the vehicle chassis, and those generated by the interaction between the vehicle tyre and road surface. This method of measurement is also affected by reflected noises from the surrounding environment and other ambient noises.

This projects aims at developing a vehicle that measures the noise generated between standardised vehicle tyres and the road surface in accordance with the CPX method (ISO/CD 11819-2). It isolates the tyre/road surface noise from the other types of noises and provides a more accurate assessment on the noise performance of the road surface itself. This type of traffic noise measurement is widely adopted in Europe, and some variants of similar measurement methods are also adopted in other countries, such as the US and Japan. It is necessary for Hong Kong to have convenient access to such a vehicle for assessing the noise performance of various types of road surfaces.

The noise performance of the LNRS in urban area is an important factor to consider in the planning of maintenance schedule. Therefore the availability of a CPX vehicle

	<p>provides an equipment for HyD to conveniently monitor the noise performance of the LNRS, and to use the results in the planning of maintenance requirements. It is our target to continually develop and improve both the structural and noise performance of LNRS to make them more durable and reduce the maintenance frequency required.</p> <p>Taking into account the details provided by EPD and HyD as above, Members are invited to advise whether the application for ECF should be supported and if supported, the exact amount of fund to be recommended to the ECF Committee for approval.</p>
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Secretariat, ECF Research Projects Vetting Subcommittee
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