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Performance Evaluation of Gravel Road Sections Sealed with Surface Dressing

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Abstract

The rural population of India lack adequate transport infrastructure to access the nearby towns/headquarters. The Ministry of Rural Development (MoRD), Government of India (GoI) decided to develop various rural roads under Pradhan Mantri Gram Sadak Yojna (PMGSY). The main objective of PMGSY is to achieve all weather connectivity to all habitations. Hence, a pilot study was initiated over a 7 km gravel road stretch from "Ghanapur-Palakurthy Public Works Department (PWD) Road to Komatigudem via Ippagudem, and Rangaraigudem" in the Warangal district of Telangana State, India. There are various disadvantages associated with construction using gravel like dust generation and gravel loss over a period of time due to passage of vehicles. The best solution to minimize these problems is to seal the gravel roads. The pilot road considered in this study was constructed using locally available gravel up to the surface course and then sealed using surface dressing. The performance of the road sections were evaluated in terms of roughness, skid resistance, and texture depth. The initial set of data was collected immediately after construction and one month after construction. Later, four sets of pavement performance data was collected after seven months of construction of the surface dressing layer in November 2013, January 2014, April 2014, and June 2014. Altogether, six sets of data were collected. The data was analyzed and important observations are reported in this paper. There is a considerable change in surface texture and skid resistance values after the first one month of construction whereas no significant changes were observed in the roughness values. Further, there is no significant difference in the results of surface texture, skid resistance and roughness values when the pavement sub-sections were evaluated for four times even after seven months of construction of the sealing layer.

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Keywords: Roughness; rural roads; sealing; skid resistance; surface dressing; texture depth.

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1. Introduction

Rural road connectivity is a key component of rural development, since it promotes access to economic and social services, thereby generating increased agricultural productivity, employment, which in turn expand rural growth opportunities through which poverty can be reduced. The MoRD, GoI has decided to develop various rural roads under PMGSY. The main objective of PMGSY is to achieve all weather connectivity to all the habitations with population more than 500 (250 for hilly areas) by the end of tenth five year plan i.e. by 2007. Gravel roads are important components of the road transportation network throughout the world which have not yet been paved. In many developing countries, more than 75% of the road network consists of gravel and earth roads. Aggregate surfaced roads are referred to as unpaved roads. Gravel pavement will not only carry traffic loads but will also be resistant to shear deformation and wear i.e. they have sufficient strength and durability (Cygas and Zilioniene, 2002).

To meet simple transportation needs by local people, unpaved rural roads are constructed by considering the natural topography using locally available gravel without having any scientific input in the form of well-defined geometric design, both length-wise and cross-wise (Almeida et al., 2007). Generally gravel is used for surfacing rural roads. Due to the movement of traffic and climatic changes over a period of time, the issues with gravel are numerous like dust generation, gravel loss, safety hazard, health hazard, discomfort and nuisance, air pollution, and inaccessibility of roads during rainy season. This leads to the increased maintenance cost in terms of regraveling. In order to eliminate these effects and to improve the performance of the gravel roads the best alternate is found to be sealing of gravel roads. Thus, the main objective of this study is to evaluate the performance of gravel surface sealed with surface dressing.

2. Experimental Program

The sealed layer constructed on strong stable base will lower the distresses such as rutting and thermal cracks (Johnson, 2003). The recommended CBR value as per Ministry of Rural Development specifications for gravel base and surface courses is 30%. However, the gravel samples obtained from the local quarries failed to meet the requirement. Thus, the gravel was modified by blending with suitable proportion of aggregate. The longitudinal section of the road and the sub-sections along with the chainages are shown in Figure 1. Two types of gravel surface courses were used. First type of surface course (surface course type-1 [T_1]) consists of 50% of gravel, 40% of 12.5 mm passing chips and 10% of 4.75 mm passing dust where the gravel was collected from first quarry. Second type of surface type (surface course type-2 [T_2]) consists of 60% of gravel, 20% of 6.3 mm passing chips and 20% of 4.75 mm passing dust where the gravel was collected from a second quarry. Two types of prime coats were used i.e. priming-1 (P_1) at the rate of 9 kg per 10 m^2 and priming-2 (P_2) at the rate of 12 kg per 10 m^2. Surface dressing (SD) was used for sealing the gravel road in this study. Gransberg and Zaman (2005) reported that emulsion chip seals performed as well as the hot asphalt cement seals. Thus, in this study, viscosity grade bitumen and bitumen emulsion were used as binders in the construction of surface dressing. Slow setting bitumen emulsion was used as a primer. The surface dressing layer was designed and constructed as per the Indian Roads Congress guidelines (IRC:110, 2005).

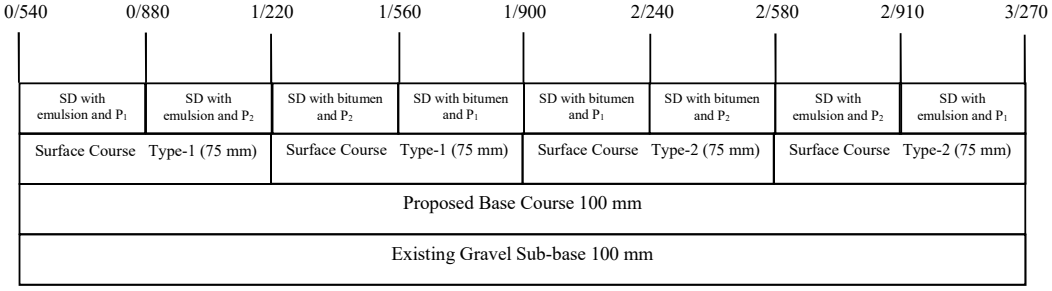

Fig. 1 Longitudinal section of the road showing various sub-sections