Development of the Optimal Track Maintenance Schedule Planning Model

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1. Introduction

It is vital to effectively utilize the limited maintenance machinery, budgets and other resources in order to develop an efficient railway track maintenance schedule. Therefore, we have developed a Track Maintenance Schedule Planning Model to process track inspection and other associated data effectively and create a high-quality maintenance schedule. Fig.1 shows the whole structure of this model, which can be categorized into four major components of (1) Track Condition Diagnostics, (2) Track Maintenance Scheduling, (3) Evaluation of Maintenance Policies, and (4) Track Condition Forecasting, each consisting of submodels.
The summary of some of the submodels is introduced below.

2. Optimal Track Maintenance Scheduling Model for Track Irregularity Improvement

Many railway business operators are using heavy tamping machines called multiple tie tampers (MTT) to correct track irregularities. Proper operation is required for efficient maintenance of a large area with these tampers. Accordingly, we developed an Optimal Track Maintenance Scheduling Model for Track Irregularity Improvement to predict a future change in track irregularities by using the historical track inspection data and to schedule track maintenance for track irregularity improvement for the following fiscal year.
This model enables us to schedule maintenance according to the concept of "maintaining the track condition of the whole line section as good as possible by providing the total maintenance volume" or "maintaining the target track condition with as small maintenance volume as possible," The model considers track irregularities compared with the usual track condition and accounts for any restrictions in the MTT operation.
Fig.2 shows the changes of track condition and maintenance volume before and after the actual maintenance conducted in accordance with the schedule made by using this model. This indicates that, after commencement of the scheduled maintenance, the maintenance volume has decreased year after year and the track condition has improved.
This model was originally formulated to schedule maintenance for the tracks within the area assigned to one unit of MTT. However, it has been improved recently so that maintenance can be scheduled for more than one unit of MTT. The new model allows us to schedule maintenance for an efficient, wide-area operation of all the units of MTT with consideration of the inspection time and assigned area of each MTT and the losses caused by out-of-service distance.

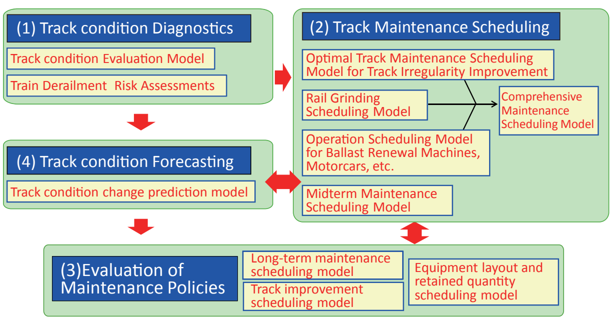

Fig.1 Optimal Track Maintenance Schedule Planning Model

3. Track Condition Evaluation Model

The Track Condition Evaluation Model enables us to choose the locations to be maintained frequently due to track irregularities; evaluate the condition of rail and/or ballast and choose the locations of quick growth of track irregularities by referring to the track inspection data; and propose appropriate maintenance methods according to the evaluation results. Generally, increased rail roughness will cause wheel load fluctuations to increase, which eventually will cause the growth of track irregularities to increase. If the ballast deteriorates, the growth of track irregularities will increase and improvements resulting from correcting track irregularities will decrease. Such a condition requires increased costs to correct track irregularities. Therefore, we chose locations where this model will turn out to be very effective in reducing the frequency of track irregularity improvement from mid- and long-term perspectives as shown in Fig. 3, and propose suitable maintenance methods to be employed accordingly.
Currently, several railway business operators are using some of the submodels.

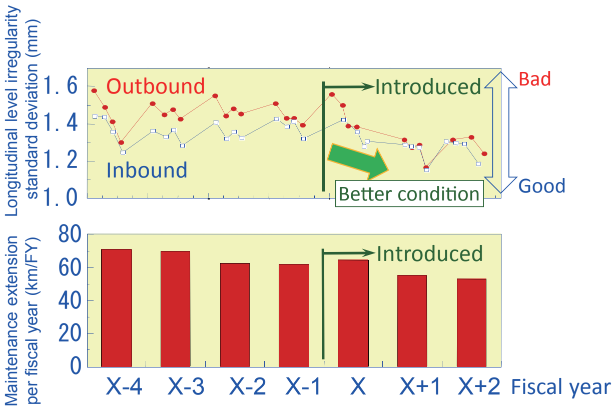

Fig.2 Track Irregularities and Maintenance Volumes Before and After Model Introduction

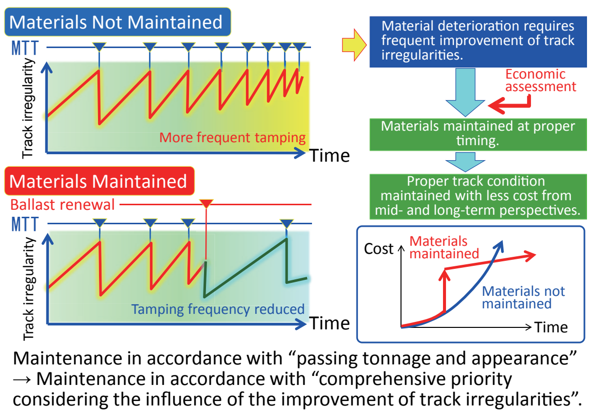

Fig.3 Choice of Maintenance Method in Consideration of Long-term Economics