On Ways to Increase Permafrost Railroad Foundation Reliability

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ABSTRACT
Review of the ways to increase permafrost railroad foundation reliability. Main goal are to increase construction rate simultaneously decreasing costs by using new permafrost construction methods and introducing efficient geotechnical monitoring system for the temperature and acoustic fields measurement and subject flow marking. Monitoring system objective is on-line detection of the contrary foundation and its base sections for the planning and taking recovery actions.

RÉSUMÉ
Examen des manières d'augmenter la fiabilité de foundation de chemin de fer de pergélisol. L'objectif principal sont d'augmenter le taux de construction diminuant simultanément des coûts en employant de nouvelles méthodes de construction de pergélisol et en présentant le système de surveillance géotechnique efficace pour la mesure de la température et de champs acoustiques et l'inscription soumise d'écoulement. L'objectif de système de surveillance est détection en ligne de la foundation contraire et de ses sections basses pour la planification et prendre des mesures de rétablissement.

Keywords: reliability, foundation, railroad, permafrost

1 INTRODUCTION

Railroad foundation reliability assumes that the probability of failure is nil. Herewith failures are losses of operational ability such as:

- bearing resistance violation;
- geometrics violation.

By the results of geotechnical monitoring and scientific support of construction of new railroad between “Obskaya – Bovanenkovo” (Lutsky, Tokarev, Cherkasov and Shepitko, 2009; Ashpiz , 2009; Ashpiz, 2010) addressed basic trends in increasing of permafrost railroad foundation reliability indicated on Figure 1.

According to Figure 1, monitoring of the stages such as construction and operations of a permafrost railroad foundation plays the definitive role in ensuring reliability.

Continuous monitoring can be carried out by using vibroacoustic system with action principle based on Brillouin scattering measurement (OOO, 2007), which in conjunction with other methods allows to get information regarding the foundation under various conditional features, herewith – railroad foundation soils. Hardware components as sensors are set up in the railroad foundation through the whole railroad system to a data recorder concerning acoustic field changes and resulting deformations.

Infrared imagers can be another monitoring system addition (OOO, 2008). Infrared imagers installed on short-range aircrafts allows aerial geothermal mapping at the top of railroad foundation. Using of infrared imaging method with corresponding facilities allows instantly to identify negatively performing areas of the railroad foundation and its base, and then to proceed to surveys for further analysis and documentation and to prevent possible deformations quickly.

On the “Obskaya – Bovanenkovo” railway line possible dangerous places were identified using the method by the Professor E.S. Ashpiz’s method (Ashpiz, 2002). It is necessary to undertake permanent temperature measurement at these sites (Figure 2) with visual and ground penetrating radar (GPR) surveys.

All received information is collected into a database; at the base of its analysis forecast calculations and modifications of original constructional, technological and managerial decisions by feedback channels are performed.

2. MITIGATION

An important part in providing railroad foundation reliability is the application of different geosynthetic materials and technologies for railroad foundation and its base for permafrost preservation. Analysis of the best location of such materials are not presently addressed.

Well-timed building materials delivery to the area of construction has a great effect during railroad construction in remote regions, such as permafrost terrain. Generally such construction works are performed in winter with materials delivery by a winter haul road, which is interrupted during spring and fall because of seasonal weakening of soils in the causeways and haul roads. There are new trends to enhance railroad and haul roads foundation reliability; these include high technology, and inorganic astringents usage. Application of soil mixes that are enhanced by inorganic astringents, such as «KONSOLID» system (СТО, 2007) allows an increase of the dimensional stability and strength properties of the foundation and base soils.

Possibility of railroad foundation faces boost by finishing them by inorganic astringents. Usage of inorganic astringents is possible for ground stabilization under camps or partially during railroad foundation construction, for example in places needing an increase in strength properties or foundation base bearing resistance.

3. CONCLUSION

The above-named methods to increase railroad foundation bearing resistance allow an increase in the construction rate and a decrease in costs during construction and operation.

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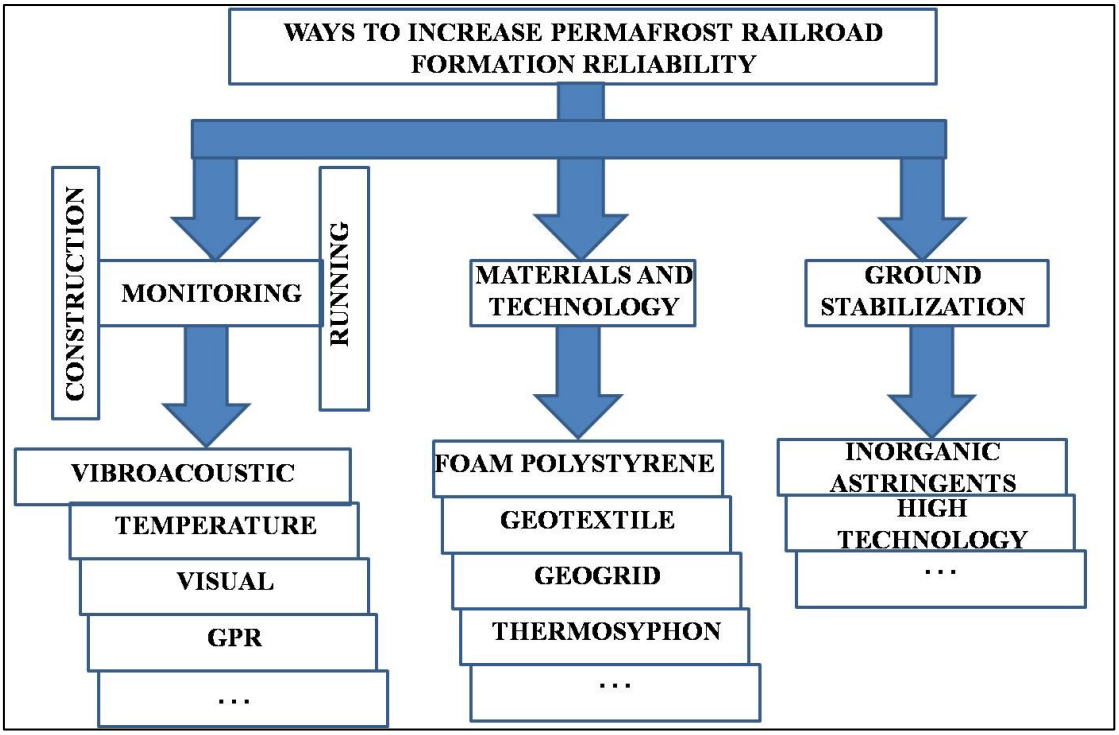

Figure 1 – Ways to increase permafrost railroad foundation reliability

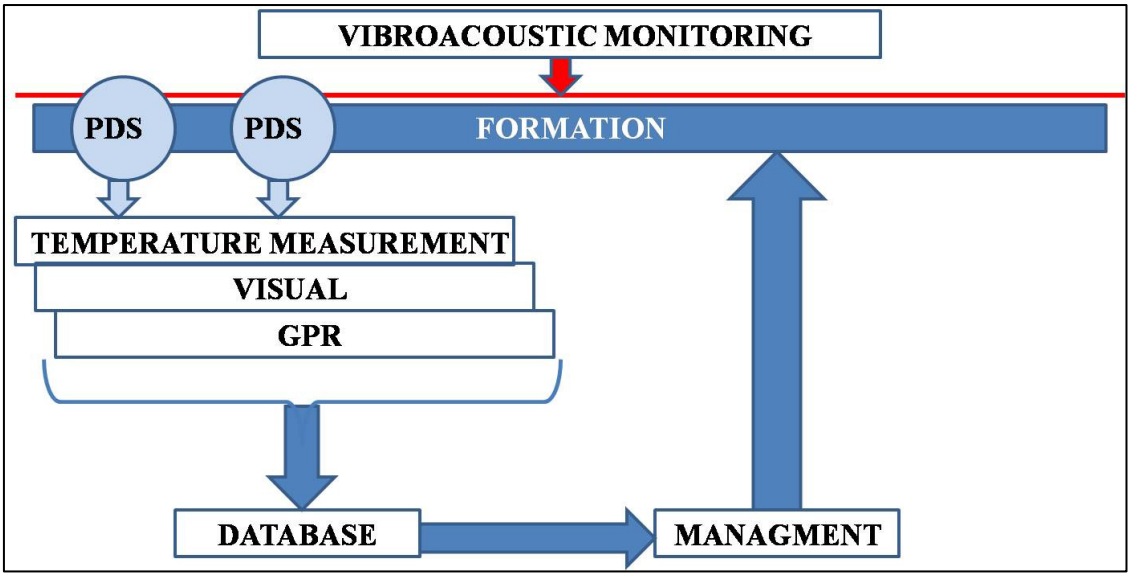

Figure 2 – permafrost railroad foundation monitoring implementation scheme.
Note: PDS means possible dangerous place; GPR meansground penetration radar.