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Analysis of Change Orders in Geotechnical Engineering Work at INDOT

Introduction

There was a perception at INDOT that the number of change orders connected with geotechnical work was excessive, and that, as a consequence, geotechnical projects were not completed on time or within budget. It was reported that INDOT construction projects had in fact experienced a large increase in the number and cost of change orders attributed to geotechnical conditions.

The only way to assess whether the number and cost of change orders to INDOT is indeed excessive is by conducting a detailed analysis of INDOT's processes and procedures in the geotechnical office, including the process of selecting code numbers that correspond to the reasons for change orders. It is only by understanding the reasons for change orders in each particular case that a determination could be made on whether change orders were preventable or not. Through this critical evaluation, problems that need to be addressed could be identified, and procedures or steps that should have been taken to allow prevention or minimization of change orders could be clearly established. This study organized the observations and information in a database. By analyzing the data collected and conducting interviews with INDOT personnel involved with change orders, recommendations were made to the geotechnical office for future procedures on construction projects that will help alleviate the problems identified.

Findings

The results of the agency survey conducted indicated that INDOT faired medially with respect to construction costs. The agencies provided very minimal data for change orders, and hence it was not possible to make clear comparisons. The analysis conducted on the data collected from 300 contracts of INDOT revealed some useful information. The average geotechnical change order amount per district per year was 1.34 percent of the total estimated construction cost per district per year. The average geotechnical change order amount per district per year was 10.25 percent of the average amount of total change orders per district per year. The average net overrun due to geotechnical change orders was $707,000 per district per year. About 28 percent (84 contracts) of the contracts that were considered in this study experienced geotechnical change orders. In total, 158 geotechnical change orders were recorded in all the contracts. Forty-six contracts (out of the 84 contracts that underwent geotechnical change orders) experienced only one geotechnical change order, while 24 contracts experienced 2 geotechnical change orders. About 41% of the total road contracts (155 contracts) experienced geotechnical change orders. About 37% of the total bridge contracts (44 contracts) experienced geotechnical change orders. The other contract types of this study's dataset were insignificant as far as geotechnical change orders were concerned. Reason code 206 – Constructability: Soils-Related – was assigned to 101 geotechnical change orders. Reason code 405 – Changed Field Conditions: Soils-Related – was assigned to 46 geotechnical change orders. Reason code 108 – Errors and Omissions: Soils-Related – was assigned to the 11 remaining geotechnical change orders. When compared to the total number of items that underwent change due to Errors and Omissions in all change orders (637), the occurrence of errors and omissions in geotechnical change orders is relatively low, which is a positive sign.

Most of the interviewees mentioned that they did not see geotechnical problems as the main contributor to change orders on INDOT projects. Though they acknowledged the fact that the variability of soil is so great that it would be literally impossible to eliminate geotechnical change orders, they did recognize the need to address the following issues that lead to geotechnical change orders:

1. Failure to identify areas of poor subgrade soil.
2. Mismatch in piling quantities.
3. Omissions and constructability issues associated with erosion control work.

Implementation Recommendations

This research effort was directed towards initiating the process of identifying and addressing areas of concern that cause geotechnical change orders frequently on INDOT projects. Accordingly, the study provided some basic answers towards reducing the number of geotechnical change

orders. The recommendations from this study could be considered at the planning stage of projects. With the help of the recommendations from this study it is possible to implement a methodology towards handling geotechnical change orders. Related studies could be conducted to formulate a refined methodology that includes all the recommendations in a suitable manner, in order to be implemented on a standard basis on all INDOT projects. Further research can be undertaken on analyzing individual reasons for geotechnical change orders to identify specific methods to avoid such issues.

Items for implementation:

1. The correct attitude of preventing change orders, rather than dealing with them, needs to be developed among one and all.

2. Reason codes for every change order have to be formulated free of ambiguity.

3. The geotechnical report must not only identify all problems but should also provide a discussion of all possible solutions to the geotechnical issues on the project.

4. For large projects, site investigation must be extensive and flexible, suitable to the particular soil type/region of state, to avoid subgrade treatment problems. In areas of problematic soil, the preliminary investigation should be followed by a secondary investigation with more number of boreholes.

5. The geotechnical engineer should coordinate with the design and district construction personnel while making recommendations.

6. Change orders related to geotechnical work should be routed through the geotechnical office so that the designer is made aware of the occurrence and the reason for the change orders.

7. Detailed constructability reviews, with the participation of the geotechnical office, must be conducted before the letting of major projects. Especially, traffic regulation and factors that can affect the quality of subgrade must be assessed from a constructability viewpoint.

8. Designers need to be aware of geotechnical foundation information, especially with respect to conditions below the subgrade so that they can include relevant items in the contract documents.

9. Impact of construction traffic in urban settings, needs to be accounted for in design.

10. Variation in moisture content from site investigation to construction should be accounted for in design.

11. Specifications need to be evaluated for constructability, before implementation.

12. Rock excavations must be accurate and the quality of rock must be well examined.

13. Shelved projects need to have a secondary site investigation. Anomalies during construction should also be sorted out through a second site investigation, with involvement of the geotechnical office.

14. More attention must be focused towards determining piling quantities accurately and suitable research could be conducted in this area.

15. An effective software system needs to be used to record change orders.

References

Prezzi, M., McCullouch, B., Mohan, V. K. D. *Analysis of Change Orders in Geotechnical Engineering Work at INDOT.* Publication FHWA/IN/JTRP-2011/10. Joint Transportation Research Program, Indiana Department of Transportation and Purdue University, West Lafayette, Indiana, 2011, DOI: 10.5703/1288284314623

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