

## INTISARI

Pembangunan *Trial Embankment* Jalan Tol Semarang – Demak (JTSD) ditujukan sebagai tanggul laut sekaligus penahan banjir rob di Semarang. Pekerjaan JTSD per 26 Januari 2023 telah selesai dan memasuki fase konsolidasi. Pemantauan pergeseran material pada *Trial Embankment* JTSD fase konsolidasi perlu dilakukan untuk mengidentifikasi tren dan arah pemadatan yang terjadi. Penelitian terdahulu menunjukkan bahwa fase konsolidasi hari ke-10 pada derajat konsolidasi 90% menghasilkan penurunan tanah sebesar 0,573 m. Jika penurunan tersebut dirata-rata, maka kecepatan penurunan material per harinya mencapai 5 cm/hari. *Low cost Global Navigation Satellite System* (GNSS) dapat menjadi alternatif untuk pemantauan pergeseran material karena ketelitian posisi horizontal dan vertikal yang dihasilkan mencapai fraksi sentimeter. Pemadatan material dapat dipengaruhi oleh curah hujan. Curah hujan yang mempengaruhi kompresibilitas material dapat mempengaruhi kecepatan penurunan tanah yang terjadi. Penelitian ini mengkaji ketelitian *low cost* GNSS untuk pengamatan pergeseran material, besar pergeseran beserta tren pergeseran material, dan pengaruh curah hujan terhadap besar pergeseran.

Penelitian menggunakan data pengamatan selama tujuh hari dengan durasi per harinya sekitar enam jam. *Receiver* GNSS yang digunakan pada pengamatan ini yaitu GNSS *low cost* GeoPEN dengan modul pen dan antena helix. Metode pengolahan data yang digunakan terdiri atas metode jaring dan radial statik. Metode jaring statik digunakan untuk penentuan nilai koordinat titik acuan. Ketelitian penentuan posisi *low cost* GNSS ditentukan berdasar *Root Mean Square Error* (RMSE). Cek ketelitian digunakan untuk mengevaluasi apakah ketelitian GNSS *low cost* memenuhi ketelitian yang diperlukan. Pada penelitian ini, pengolahan *baseline* moda radial digunakan untuk penentuan besar pergeseran material. Penentuan besar pergeseran menggunakan koordinat dalam sistem toposentrik (N, E, dan U). Besar pergeseran pergeseran diidentifikasi dengan menghitung perbedaan koordinat toposentrik hari pertama s.d. hari ketujuh. Besar pergeseran tersebut kemungkinan dapat dipengaruhi oleh curah hujan. Perhitungan korelasi dilakukan untuk mengidentifikasi apakah curah hujan memiliki pengaruh terhadap laju pergeseran material.

Penelitian ini menghasilkan ketelitian *low cost* GNSS, besar pergeseran beserta arahnya, dan korelasi curah hujan terhadap besar pergeseran material. Pengecekan ketelitian *low cost* GNSS menghasilkan nilai RMSE horizontal sebesar 0,011 m dan nilai RMSE vertikal sebesar 0,013 m. Selanjutnya, analisis pergeseran material melalui pengolahan *baseline* menghasilkan pergeseran akumulasi dengan komponen U mengalami penurunan sejauh 82,6 mm, pergeseran komponen N sejauh 0 mm, dan komponen E sejauh 2,2 mm ke arah timur. Besar pergeseran tersebut dikorelasikan dengan parameter curah hujan. Perhitungan korelasi antara keduanya menghasilkan korelasi positif yang kuat dengan nilai koefisien korelasi sebesar 0,719.

**Kata kunci :** pergeseran material, *low cost* GNSS, ketelitian, *baseline*, curah hujan

## ABSTRACT

The construction of the Semarang-Demak Toll Road Trial Embankment (JTSD) serves as a coastal embankment and a barrier against tidal floods in Semarang. The JTSD project has been completed as of January 26, 2023, and entered the consolidation phase. Monitoring the material subsidence during the consolidation phase of the JTSD Trial Embankment is necessary to identify trends and the direction of compaction. Previous research has shown that on the 10<sup>th</sup> day of the consolidation phase, at a 90% consolidation degree, there was a soil settlement of 0.573 m. If this settlement is averaged, it indicates a daily material settlement rate of 5 cm/day. Low-cost GNSS (Global Navigation Satellite System) can be an alternative for monitoring material subsidence due to its high precision in horizontal and vertical positioning, achieving sub-sentimeter accuracy. Material compaction can be influenced by rainfall. Rainfall, which affects material compressibility, can impact the rate of settlement. This study investigates the accuracy of low-cost GNSS for monitoring material subsidence, the magnitude and direction of material subsidence, and the influence of rainfall on the magnitude of subsidence.

The research was conducted with observations spanning seven days, with each day lasting around six hours. The GNSS receiver used for the observations is the low-cost GNSS GeoPEN with the Unicorecom UM980 module and helix antenna. The data processing methods used included static network and radial methods. The static network method was used to determine the coordinates of reference points. The accuracy of determining the position of low-cost GNSS is determined based on the Root Mean Square Error (RMSE). Accuracy check is used to evaluate whether the accuracy of low-cost GNSS meets the required precision. In this research, the baseline processing with the radial mode is used for determining the magnitude of material displacement. The determination of the magnitude of displacement utilizes coordinates in the topocentric system (N, E, and U). The magnitude of displacement is identified by calculating the difference in topocentric coordinates from the first to the seventh day. The magnitude of displacement is likely influenced by rainfall. Correlation calculations are performed to identify whether rainfall has an influence on the rate of material displacement.

This study yielded the accuracy of low-cost GNSS, the magnitude and direction of subsidence, and the correlation between rainfall and the magnitude of material subsidence. The accuracy of low-cost GNSS was checked through RMSE calculations, resulting in a horizontal RMSE value of 0,011 m and a vertical RMSE value of 0,013 m. Furthermore, the analysis of material subsidence through baseline processing resulted in cumulative subsidence with a downward component (U) experiencing a decrease of 82,6 mm, no subsidence in the north component (N), and an eastward subsidence (E) of 2,2 mm. The magnitude of subsidence was correlated with rainfall parameters. The correlation calculation between the two factors yielded a strong positive correlation with a correlation coefficient value of 0,719.

**Keywords :** subsidence, low cost GNSS, accuracy, baseline, rainfall