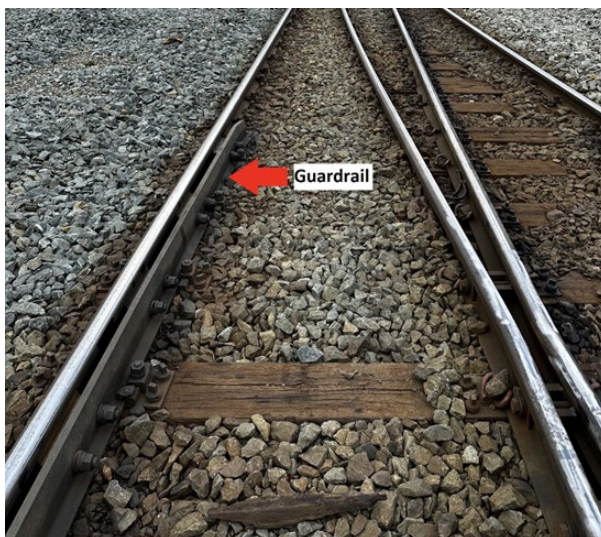


Recent Norwegian 3D scanning experience in the railway field



Forfatter: Albert Lau, Førsteamanuensis ved NTNU, Institutt for bygg- og miljøteknikk

3D scanning to produce parts for building and maintaining railway tracks is a huge cost saver and the printed components work!



Figur 1: Example Guardrail (Foto: Albert Lau)



SUMMARY

A guardrail is a critical railway component that ensures safe passage of trains through a crossover on the railway network. Early Spring 2022, Bane NOR faced a challenge with an old guardrail component on the railway infrastructure due to a lack of drawings. One possible solution was to replace the entire railway crossing with a newer type, which would have costed millions of kroner. However, an alternative suggestion was made to 3D scan the existing guardrail, creating a drawing for reproduction. NTNU, which has a 3D scanner, was called upon to assist with this task. The old guardrail was scanned and sent to a production factory, where a drawing was

generated, and a prototype was produced. The drawing has now been archived, and several new guardrails have been produced and installed on the railway track. The initial feedback suggests that the installation of the reproduced guardrail is functioning perfectly.



INTRODUCTION

A guardrail is a critical component of the railway infrastructure that ensures the safe passage of trains through railway crossover. At Trondheim Station, there are several double crossovers from the mid-1980s, and the high guide rails at the side crossings are starting to wear out and need to be replaced. However, the challenge is that the drawings of the guardrails no longer exist.

Engineers at Bane NOR contacted NTNU to explore the possibility of 3D scanning the guardrail. Together, they went to Marienborg in Trondheim and performed a test scan of a guard rail component, which was successful. They then continued to Levanger, where a less worn guardrail was dismantled from a crossover that was taken out of service for a short period to allow for scanning. The idea was to scan the guardrail and generate a drawing for reproduction by the manufacturer.



METHOD

The EinScan Pro HD scanner, which utilizes structured light technology, was employed in this

project. With an accuracy of up to 0.04 mm and a resolution of up to 0.1 mm, it can be used for both stationary and handheld scanning (1).

Prior to the actual scan in Trondheim, a test scan was conducted on a different type of guardrail one week earlier. The resulting scan was compared to the real guardrail, and it was found that the accuracy was within +5 mm (measured with a standard measuring tape).

The scanning of a less worn guardrail in Levanger was performed in a controlled environment, as seen in Fig 2. The guardrail is about 2.5m long. A black background was used to avoid scanning of any extraneous objects surrounding the guardrail. Due to its length, the scan was divided into four parts: left to middle, right to middle, front and back, with at least three repetitions collected for each part. All the scans were done handheld with quick scan setting.



Figur 2: Setup of the scan in a control environment (Foto: Albert Lau)

Following the scans, a built-in software algorithm was used to combine them. Rough measurements of the guardrail's dimensions, such as thickness, height, width, and hole-to-hole distances, were taken to verify the quality of the scanning. It took in total 8 hours for scanning and processing the scans.

RESULT

Figur 3 depicts the scan results of the guardrail, both with and without features. The scan was found to match well with reality, and the comparison of the scan to manually measured dimensions showed a variation within +3 mm. Notably, the scan was able to capture the marker

on the rail, which can be difficult to identify with the naked eye and scan with features.

It is important to note that combining the smaller scans during the post-processing stage was not without challenges, primarily due to the bending part of the guardrail. Additional complete scans were needed on the front and back side of the guardrail. The smaller scans were then used to supplement missing parts of the full scan, especially at the edges.

After the 3D scan was completed, it was sent to a rail component company to create a drawing. The drawing was then verified before a prototype was produced. This prototype was used to check for proper installation and fitting with the crossover. After confirming that the prototype worked well, additional guardrails were produced and installed. To date, no problems have been identified.



Figur 3: Scan result (top with feature, bottom without feature)

CONCLUSION

In conclusion, this project demonstrates that 3D scanning can be successfully implemented for certain railway components, such as the 2.5 m guard rail in this case. The resulting scan was highly accurate, as evidenced by the successful installation and functioning of the reproduced guardrail. However, it is important to note that certain features of the object, such as the bending of the rail, may require larger and wider scans to achieve a complete representation. Therefore, it is recommended to thoroughly assess the object and develop a scanning strategy before performing the actual scan.

REFERENCES

1. Shining 3D – EinScan Pro HD available at: <https://www.einscan.com/handheld-3d-scanner/einscan-pro-hd/>