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# ANALYSIS OF THE RESTORATION PROCESS OF SURFACES OF RAILWAY TURNOUT ELEMENTS BY BUILD-UP WELDING

***Abstract***

*The practice has show that restoration of the surface of railway turnout elements by a build-up welding very often is unsuccessful due to subsequent origination of areas of premature destructions such as shivers, stratification, spalling, a.o. Experimental study revealed that causes of the defects are due to welding technology violations and ineffective turnout element existing defect diagnosis methods applied.*

## INTRODUCTION

On railway in Latvia mainly Austrian railway turnouts are installed. The practice of exploitation of turnouts in high-speed and increased load conditions has revealed that the elements of turnouts require restoration due to local defects or wear and tear.

## 1. EXPERIMENTAL STUDY

Currently exploit practice of thermite welding of rail ends in turnouts makes the process of replacement of turnout elements with new ones considerably difficult. To prolong the exploitation time of the costly turnouts, the surface of turnout elements is often restored by a build-up welding. Restoration applying build-up welding is used for restoration of cores and wing rails, restoration of switchblades and stockrails, restoration of ends of stockrails. Notwithstanding the fact that build-up welding is performed in accordance with currently applicable standard procedures [1], the areas of premature destructions such as shivers, stratification, spalling, a.o. of renewed build-up weld areas are often discovered (mainly within following 3-7 days). To establish the causes of such high perishability of welded layers, a qualified specialist made experimental build-up welds on wing rails, stockrails and switchblades following the recommended technology.

As it is known, it is not purposeful to restore worn surfaces of the metal with the build-up welding, if the structure of the area which has to be build-up has suffered irreversible changes or there are other defects. In this respect, before the commencement of the restoration works, the build-up welding technology requires to eliminate the surface defects that are detected with color defectoscopy and with ultrasound analysis. It should be mentioned that all procedures prescribed in the technology were followed during the study, including ultrasound control of the worn elements, which revealed no anomalies.

Multiple studies have showed that satisfactory structure of the welded stitch and heat treated area for welded objects can be achieved only by heating up the object to the optimal temperature $400^0$C and sustaining this temperature constant during all welding period [2]. This condition can be achieved only in case the process of welding is performed simultaneously with supervised heating of welded object. Due to intensive loss of heat, the temperature of the welded object quickly decreases below recommended temperature and becomes considerably lower than recommended in the technology already during welding process of one layer of the sector. In practice to sustain the necessary temperature, welder must periodically interrupt the welding process to heat up the object. As a result, instead of permanent temperature regime there is a cyclic heating up and cooling of periods that can create areas of increased-deformation in the metal which is an obvious violation of the technology.

## 2. RESULTS OF THE EXPERIMENTAL STUDY

After the completion of all procedures prescribed in the technology, to assess the condition of the metal in the heat treated area and in deep layers under the welded area ultrasound control was performed. It was established that none of the defectograms of the performed welds showed the defects. At the same time subsequent metallographic studies showed their presence or other welding defects in the area of welded layers almost in all samples made (lack of fusion (Fig. 1), lack of fusion of separate welded layers, porosity (Fig. 2), inclusions (Fig. 3) and detachment of the welded surface (Fig. 4). Most often structure defects were established on the borderlines of separate welding sectors in the welded areas.

**Fig. 1.** Lack of fusion of base metal and weld metal

**Fig. 2.** Lack of fusion of separate welded layers, porosity

**Fig. 3.** Inclusions


**Fig. 4.** Detachment of the welded surface

## CONCLUSIONS

The analysis of the experimental studies, ultrasound control and metallographic analysis of the condition of the metal after performance of experimental build-up welding allow making following conclusions:

1. Prolonged exploitation time of worn elements of the turnout using build-up welding can be achieved only if:
   - during the process of restoration the required temperature regime is maintained;
   - the analysis of the condition of the metal before and after the build-up welding includes the control of structural changes, level and distribution of tensile strength in the stitches and heat treated areas with a reliable diagnose methods.
2. Currently used ultrasound method of non-destructive inspection is intended for developed defects, but has low effectiveness for diagnosis of immature welding defects, especially if in respect to the condition of the metal in the area of welded stitch and in undersurface of heat treated area.
3. Development of the effective methods for diagnosis of welded elements of railway that would allow detecting the areas of concentration of internal mechanical forces is the first task that would ensure the quality of restoration technology.

## REFERENCES

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