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Professional paper

REPAIRING OF COLUMNS OF THE SKI LIFT IN THE SKI CENTER

Nazif Jashari[1], Sveto Cvetkovski[2]

[1]Deparment of Faculty of Applied Sciences, University of Tetova
[2]Faculty of Technology and Metallurgy, Ruger Boskovic 16, Skopje
[2]IMS Institute, Bulevar vojvode Misica 43, Belgrade
**Corresponding author e-mail: sveto@tmf.ukim.edu.mk*

Abstract

This practical research work has described the procedure for repairing three columns of a ski lift. During the long period of exploitation, more than 40 years, these columns were corroded and seriously damaged. Corrosion leads to thinning of the column wall or even complete perforation of it (formation of cracks). After the determination of the problem, it was decided to undertake measures to solve this problem and put the ski lift in normal function. It was concluded that three columns must be immediately repaired. So, it was prescribed technology for repairing by welding

The plan for repairing consists of the following phases:

Cutting off damaged segments and embedding new segments from the same material and thickness.

Additionally strengthening of columns by two half segments of pipes screw-up and welded for columns.

Prepared segments were welded for columns using manual metal arc welding process special attention was paid to protecting columns from demolition during the cutting of corroded parts of columns. The same filler materials were used in this case too.

The repair was successfully performed, and the ski lift was put into exploitation.

Keywords: steel column, repairing, perforation, MMA welding, damage

1 Introduction

Before the beginning of the winter tourist season, it was detected during the inspection that there are some visible damages to the three columns of the ski lift. More concretely, perforations of columns wall were found (cracks). Because of that ski lift was not used all season. After finishing the winter season, the owner of the ski complex required the competent institution to inspect, define the problem and propose a technical solution how to solve it, and put the ski lift in normal and safe exploitation. After inspecting the damaged columns and analyzing the technical data's it was given concrete proposal for repairing of columns.

2 Experimental

2.1 *Prescribed technology for repairing of columns*

The damages of the columns are given in figure 1 It is obvious that they are the result of a corrosion attack of a long period of exploitation in extreme weather conditions, and that they can cause the demolition of the ski-lift if repair is not performed. The most characteristic is column 6. Part of the columns is completely perforated. The first thing which was made is measuring of thickness of columns around the cracks. It was concluded that the thickness around the cracks is very low. Because of that is decided to cut this thinned and perforated. Layer and embed new segments from the same material and thickness as the column itself. Segments with dimensions 800x200x5should are prepared for all columns.

4 6 10

Figure 1. Damaged columns of the ski-lift

In the workshop were prepared segments which gas to be inserted in column after removing the corroded part, Figure 2.

Figure 2. New segments for replacement of corroded parts

A schematic illustration of the column after rehabilitation is given in figure 3 after welding a new segment, grinding of welds will be done.

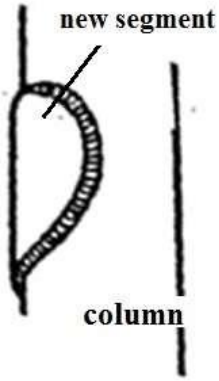

Figure 3. Column after performed repairing

2.2 *Preparation for welding*

It must cut perforated and thinned segments. To prepare and shape a new segment from the same material and identical thickness like a column. Between the segment and column must form V- groove. Preparation is to be made as in figure 4. The number of passes is shown a figure5. Tack welds are planned between the segment and column. The length of tack weld must be about 10 mm.

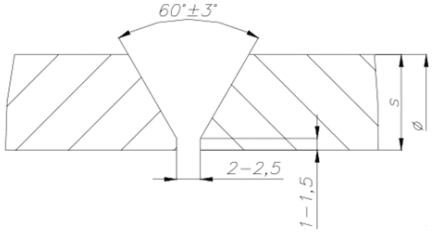

Figure 4. Prepared V-groove

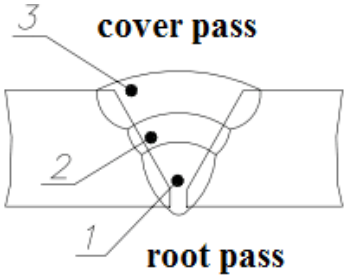

Figure 5. Number of passes

Edges of the column must be grounded to remove corrosion products. And after lying off the new pass it must be grounded and cleaned with a steel brush. It is recommended to sandblast the surfaces of columns.

Before to start with cutting the damaged sections it is planned to make strengthen of columns. It means that temporary welding of ribs must be done. Tack welding is predicted to connect ribs for columns. Ribs are located on the opposite side of the damaged segment which must be cut. The ribs will be set up temporarily with short welds (figure 6). The predicted dimensions of ribs are 900x1000x10. If there is pass over weld, the proper notch must be made. After finishing with the cutting of corroded segments and embedding a new one, temporary ribs are removed.

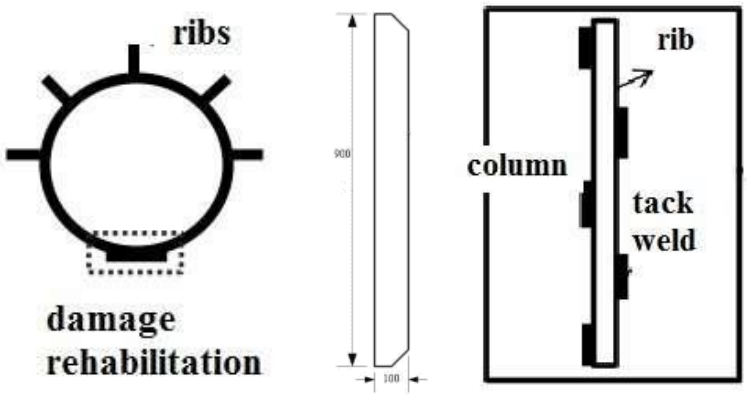

Figure 6. Strengthening of column by ribs [1-4]

2.3 *Choice of filler material*

Base material i.e., column is made of spirally welded, non-alloyed pipe with designation S235. The mechanical properties of the filler material should be higher than the base material. Welding of a new segment should be made by manual metal arc welding (111). Root weld should be made by the medium-coated rutile-cellulose electrode, and the cover passes with the basic electrode.

This rutile electrode for root pass has very good penetration. Welding in all positions is possible. It is characterized by a stable arc and easy removal of slag. Its designation according to EN 499 is E 42 0 RC 11. Covering of the groove shall be with a basic electrode (two passes). Root EN 499 is E 42 4 B 42 H5. The electrode for root weld has a diameter of f2.5, and the basic electrode has a diameter of f3.25. The filler material must be brought on the object in original boxes. The general characteristic of electrodes is given in table 1.

Table 1. Filler materials for repairing of columns

Pass	Welding process	Filler material	Electrode diameter ϕ	Welding parameters		
				Currently A	Voltage V	Polarity
1 root	111	EZ 8 RC	2.5	80-85		-
2-3	111	EZ 50 B	3.25	105 -115		- +

After welding a new segment, a painting of the segment itself shall be made. Additionally strengthening of the columns shall be made. Two halves of pipes shall be screwed and welded, figures 7 and 8.

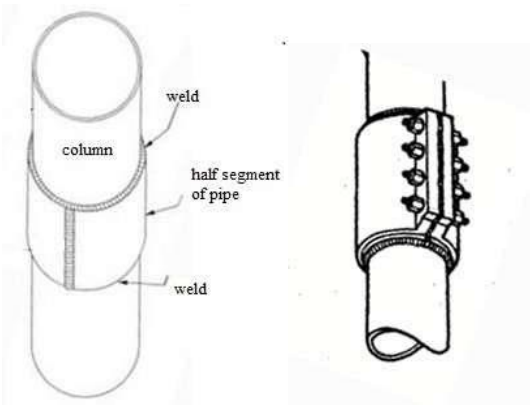

Figure 7. Column after strengthening [5-9]

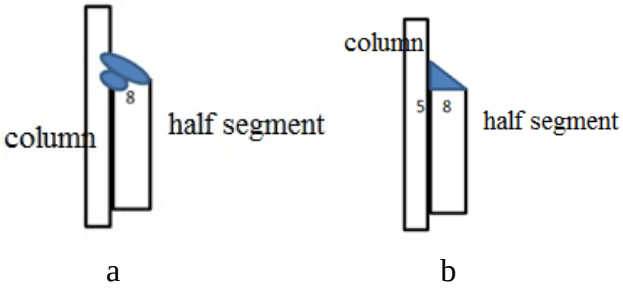

Figure 8. Welding of half pipes for columns

2.4 *Performing repairing of columns*

Used electrodes for repairing are given in the figure 9.

Figure 9. Electrodes used for repairing columns according to prescribed technology

Electrodes were properly stored during transport in the original covering. Before usage, they were dried at the appropriate temperature, figure 10.

Figure 10. Drier for electrodes

Activity for rehabilitation of columns starts with marking the corroded positions which must be cut, as is shown in figure 11.

Figure 11. Columns for repairing

According to the prescribed technology temporary ribs for stiffening was tack welded to suppress the demolition of columns before cutting off corroded segments as is shown in figure 12.

Figure 12. Welding temporary ribs

Then carefully cutting of corroded (damaged) segments starts at positions where new segments had to be embedded (figure 13). After cutting the segment much corrosion damages was detected on the inner side of the column as can be seen in the figure 13.

Figure 13. Columns after cutting

The next activity was the preparation of segments and columns for welding. It is shown in figure 14. Edges of segments and columns were made by grinding. Tack welding of segments for columns is shown in figure 15.

Figure 14. Preparing of parts for welding

Figure 15. Tack welding

When the positioning of segments was completed, their welding started. A rutile electrode was used for the root pass and a basic electrode for the covering pass. (Figure 16).

Figure 16. Welding of embedded segments

After laying any new pass grinding and cleaning of the weld with a steel brush was made. NDT inspection was done to check the quality of the wedding operation. And, after that painting was done.

Figure 17. Painting of welded segments

3 Results and discusion

The basic idea in this practical work was to prescribe technology for repairing three columns of a ski lift that were damaged by corrosion after a long period of exploitation in extreme weather conditions. As first was prescribed technology based on technical knowledge and experience confirmed by literature dates. This technology was practically implemented for repairing steel columns. NDT testing was performed for welds and finally, loading of the ski lift was made after repairing to check its capacity.

Conclusion

Finally, testing of the ski lift was performed by loading the system. The complete system together with repaired columns sustain loading which was the main interest in this work. It means that prescribed technology for repairing, and its practical implementation in-situ was successfully conducted.

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