



Evaluation of rust friction surface of bolted joint by a colorimeter

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Summary

The purpose of this study is to establish a management method and digitized color index of appropriate rust friction surface to ensure the slip coefficient of high strength bolted friction joints more stable and higher. The rust generation were measured using a colorimeter under various conditions (removal method of mill-scale, temperature, humidity, strength of the steel, surface treatment, interval time of spraying water, type of water, chemical treatment and so on). From these measurements, we suggested that the chroma of digitized color is appropriate for an index for evaluating the rust friction surface. Therefore, from the results of slip test of high strength bolted friction joint, we obtained a conclusion that the slip coefficients can be evaluated by the chroma of rust friction surface, regardless of the rust generating process.

Keywords: high strength bolt; friction joint; slip coefficient; rust; colorimeter; $L^*a^*b^*$ color system; chroma.

1. Introduction

High strength bolted friction joints is frequently used in steel structures. With the progress of high-rise buildings and the using of high tensile strength steel in recent years, the needs for the high strength joint is high. Applying a stable and high slip coefficient to a appropriate rust friction surface is widely recognized. However, an index and management method of a rust friction surface has not been established in the current guidelines^{[1],[2]}. The current criteria of appropriate red rust friction surface is a subjective photograph matching, the quantitative evaluation is not performed. Therefore, in this study, we shall try to evaluate the rust friction surface quantitatively by the digitized color of red rust in the $L^*a^*b^*$ color system^[3] by using a colorimeter. The purpose of this study is to establish a management method and digitized color index of appropriate rust friction surface to ensure the slip coefficient of high strength bolted friction joints more stable and higher.

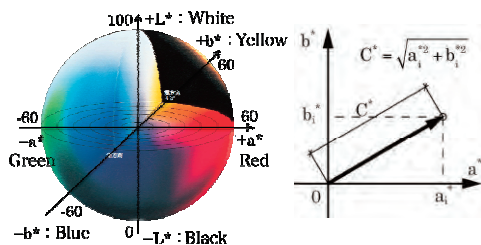


Fig. 1 : $L^*a^*b^*$ color system and the chroma C^*

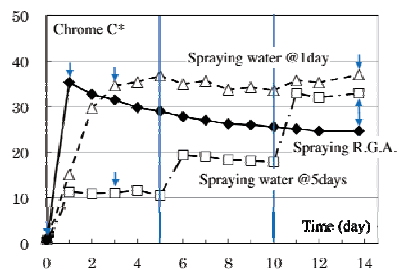


Fig. 2 : Time history of the chroma C^*

2. The rust quatification test using a colorimeter

In the case of horizontal setting, surface preparation by 1 time shot blast and thickness 16mm, the time history of chrome C^* is shown in Figure 2. When R.G.A. is used, C^* shows maximum around 35 after dispersion in around 24 hours. Then, C^* is asymptotically reduced to about 25. On the other hand, in the case of spraying water, C is increased every spraying, and indicate the maximum value 35 regardless of the spraying intervals. In the following, the maximum C^* in the period of rust generation is defined as C^*_{max} and the index value of the specimen.

3. Influence of several parameters to rust generation

In this chapter, the several parameters (type of water, air condition, steel grade etc.) affected on rust generation are estimated by the Chrome C^* . The influence of steel grade to rust generation is shown in figure 3.

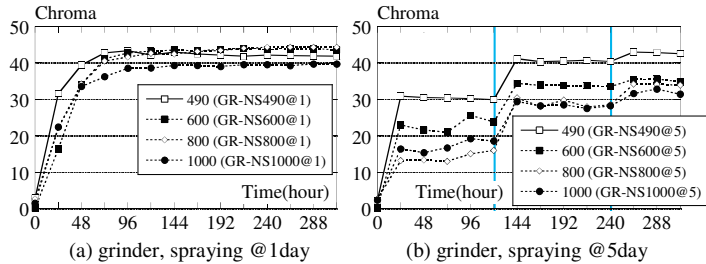


Fig. 3 : Influence of grade of steel

4. Slip coefficient and the chrome relationship

To investigate the effects of the rust generation on the slip coefficient, slip tests of high strength bolted joint and measurements of friction surface by a colorimeter are conducted.

Figure 3 shows in case of surface preparation by a grinder and spraying water. C^*_{max} affected the slip coefficient, the relationship between the two value is nearly linear, regardless of the rust generating process. Surface roughness of surface preparation by a grinder (about $Rz5\mu m$) is very small as compared with the case of shot blast (about $Rz26\mu m$). Therefore, rust generation (C^*_{max}) directly affected the slip coefficient.

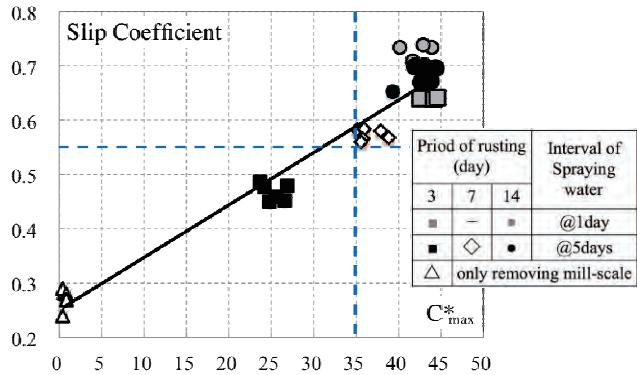


Fig. 4 : Slip coefficient and C^*_{max} relationship

5. Conclusion

The rust generation were measured with a colorimeter under various conditions (Removal method of mill-scale, temperature, humidity, strength of the steel, surface treatment, interval time of watering, type of water, chemical treatment and so on). From these measurements, we suggested that the chroma C^*_{max} of digitized color is appropriate for an index for evaluating the rust friction surface. Therefore, from the results of slip test of high strength bolted friction joint, we considered the relationship of the chroma of rust friction surface by colorimeter and the slip coefficient. We obtained a conclusion that the slip coefficients can be evaluated by the chroma of rust friction surface, regardless of the rust generation process.