A Fundamental Study on the Effect of Pigment Use Amount on the Color of Colored Mortar - Method of Setting the Pigment Substitution Rate for Cement -

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ABSTRACT

In the previous study, the author measured the change in color of colored mortars with different amounts of pigments over time. As a result, it was found that in the mixture design of colored mortars, considering color change over time is as important as setting the pigment use amount. Therefore, in this study, a method to set the pigment substitution rate for cement based on the measured color values of mortar was investigated.

1. INTRODUCTION

The color of concrete is considered to be largely determined by the color of the cement, water and fine aggregate at the surface of the concrete. Therefore, to determine the color of concrete, it is sufficient to determine the color of the mortar, which is the concrete minus the coarse aggregate.

The color of mortar is considered to be largely determined by the color of the cement paste, which consists of cement and water. Further, the color of the fine aggregate near the surface layer of the mortar also slightly affects the color of the mortar. Therefore, in the previous study, the author fabricated a white mortar using white cement and fine aggregate, and also fabricated a colored mortar in which some of the cement of the mortar was replaced with pigment, to experimentally verify the effect of the pigment substitution rate and other factors on the color of the mortar surface layer. The results of this experiment confirmed that the production of colored mortar (concrete) of the desired color requires not only setting of the pigment use amount, but also consideration of the change in color of the mortar over time. The change in the color of mortar over time was confirmed to be due to evaporation of the water in the mortar over time.

Therefore, in this study, a method to set the pigment substitution rate for cement based on the measured color values of mortar was investigated.

2. Proposed flow of colored concrete mixture design

The proposed flow of colored concrete mixture design is shown in Fig. 1. First, the target color of the colored concrete is set. Next, an experiment to measure the L*a*b* values of the colored mortar is performed. In this experiment, the effects of the pigment substitution rate and the lapse of time on the L*a*b* values is investigated. As an example, Fig. 2 and Fig. 3 show figures from the examination of the effects of the pigment substitution rate and the lapse of time on the L*a*b* values based on the experimental data obtained in the previous study. Figure 2 shows the results of examination of mortar with the water binder ratio of 0.5, and Fig. 3 shows the results of examination of mortar with the water binder ratio of 0.2. As can be seen from these figures, the relation between the pigment substitution rate and the L*a*b* values changes over time. The timing at which these changes cease occurring depends on the mixture design of the mortar. In this study's experiment, it was thought that if the pigment substitution rate is set based on the measurement data for about one month, it will be possible to design colored concrete that retains almost the same L*a*b* values even after two years. Lastly, the mixture design of the colored concrete is performed so as to achieve the pigment substitution rate determined as described. This design method prevents defects such as deviation of color of the colored concrete from the target color over time.

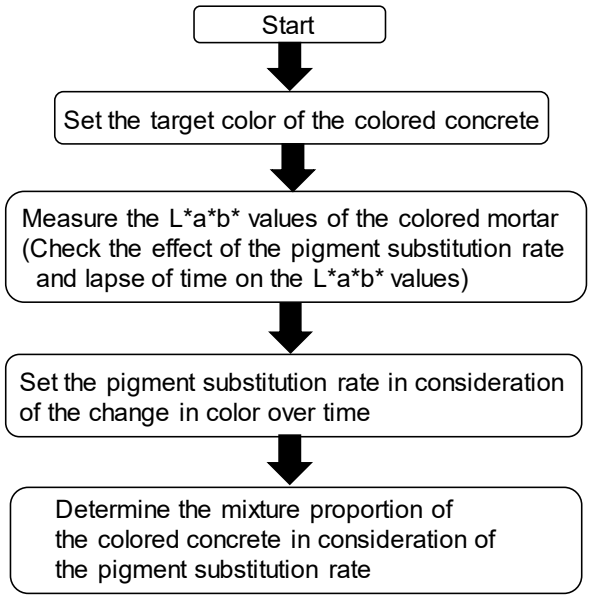

Fig.1 Design flow of colored mortar (concrete)

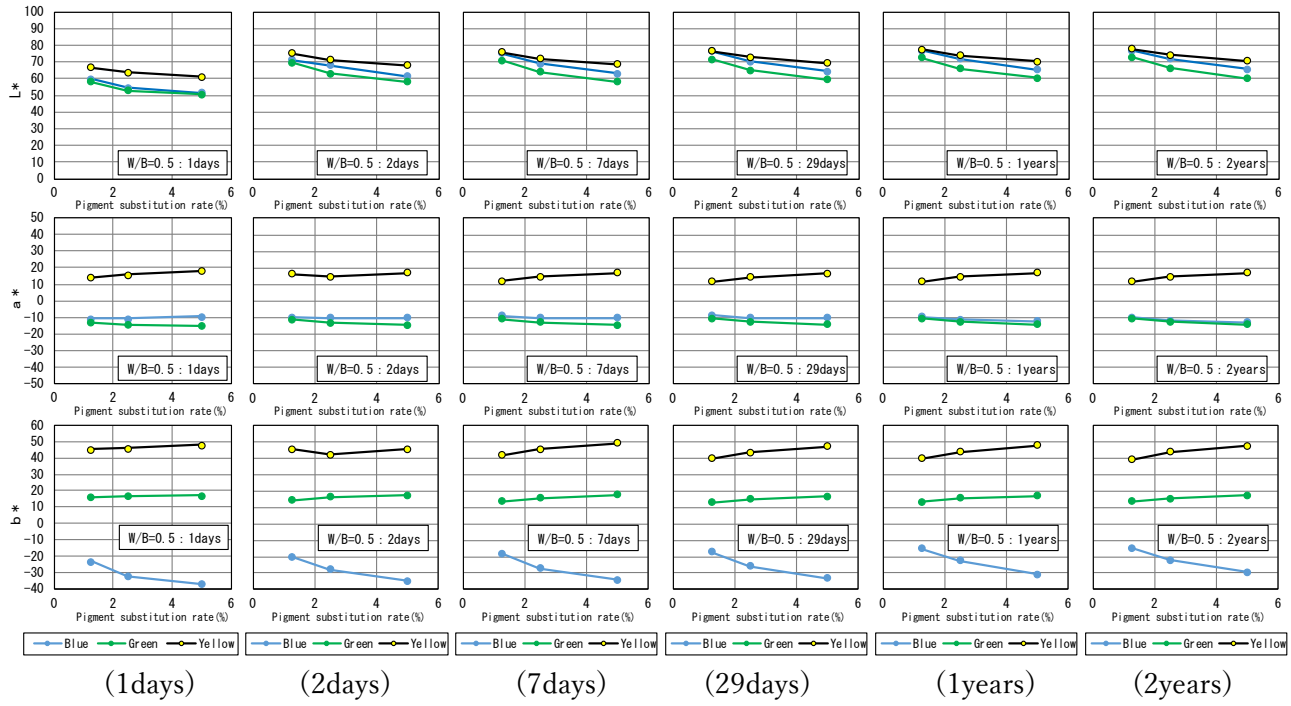

Fig.2 Relation between pigment substitution rate and L*a*b* value (W/B=0.5：Flat plate specimens)

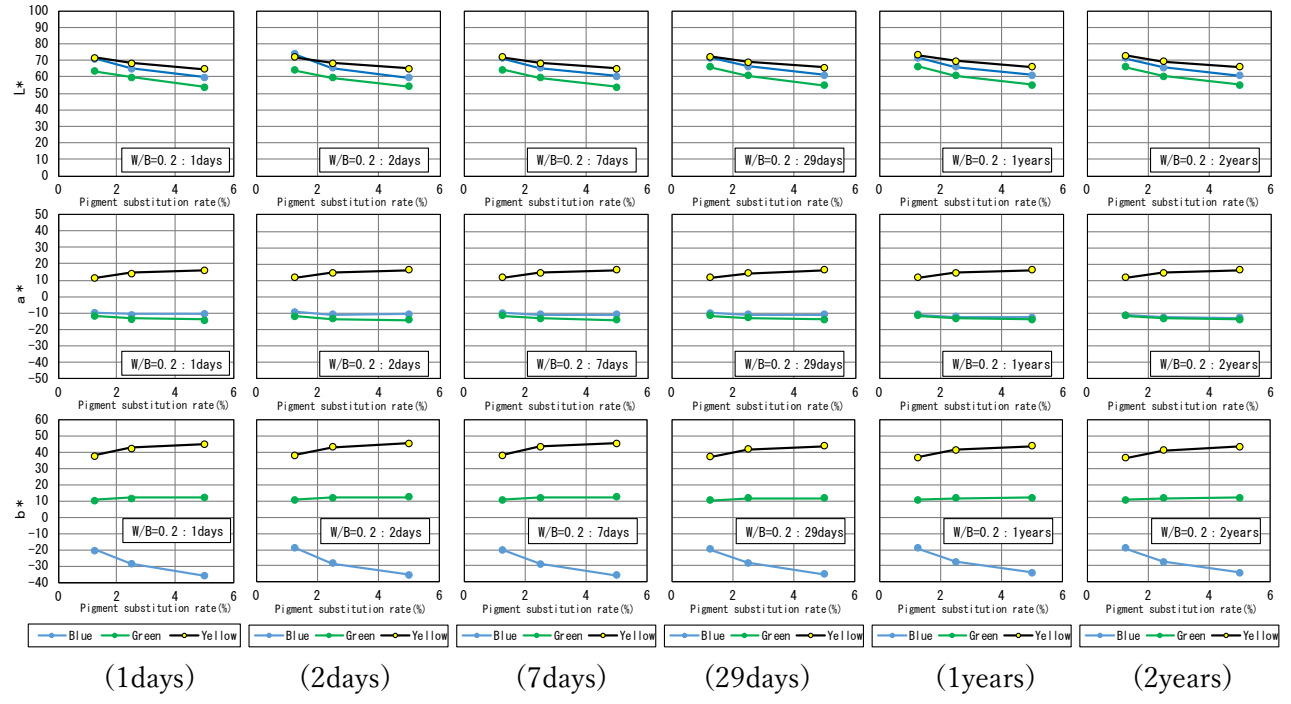

Fig.3 Relation between pigment substitution rate and L*a*b* value (W/B=0.2：Flat plate specimens)

3. CONCLUSION

Based on the experimental data from the previous study, a flow for the mixture design of colored concrete is proposed. This design method is thought to prevent defects such as deviation of color of colored concrete from the target color over time.