Study on Design Methodology for the Anchorage of Precast Wall Balustrade on Steel Bridge Decks

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Clarify the behavior of the Precast Wall Balustrade and the anchoring part of the steel deck up to the point of failure

BACKGROUND

There have been no previous cases of applying precast concrete (PCa) wall Balustrade to steel deck slabs. Currently, no methods have been proposed for the connection between PCa barrier walls and steel deck slabs, nor for the design of anchorage zones.

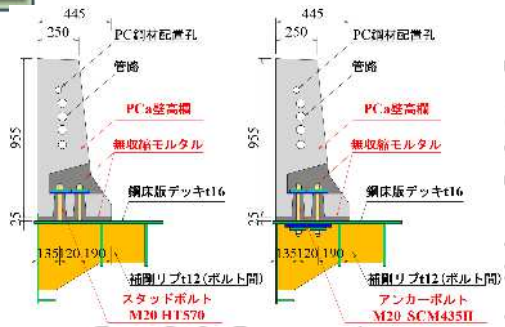

Fig. 1 Joining method

This study investigates the joining method of the anchorage part of a PCa (precast concrete) wall balustrade applied to steel deck slabs using FEM analysis. Among them, a full-scale PCa wall balustrade test specimen with an anchor bolt anchorage structure is subjected to a collision test to clarify the behavior up to the damage condition of the anchorage part.

METHOD

This study uses FEM analysis to investigate the connection method for the anchorage parts of PCa wall parapets applied to steel decks, and will then conduct collision tests on a full-scale PCa wall parapet specimen that reproduces the anchor bolt anchorage structure to clarify the behavior of the anchorage parts up to the point of damage.

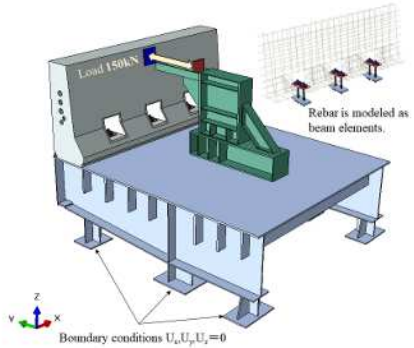

Fig.2 Analysis model

Fig 3 shows the horizontal displacement of the precast concrete (PCa) barrier wall. It can be observed that the barrier wall behaves as a rigid body and rotates uniformly.
Figure 3 shows the out-of-plane deformation of the steel deck plate. Under twice the design load, an out-of-plane deformation of 2.5 mm is observed.

KEYWORDS

Precast Wall Balustrade, Steel Deck, Anchor bolt

RESULTS

The deflection during impact, δi, based on impact load and the law of conservation of energy, can be expressed by Equation (1):

$$\delta i = \delta\left(1+\sqrt{1+\frac{2h}{\delta}}\right)=\delta k \qquad \text{Equation (1)}$$

$$k=\left(1+\sqrt{1+\frac{2h}{\delta}}\right) \qquad \text{Equation (2)}$$

Here, k is a dimensionless coefficient representing the ratio of static load to impact load, δ is the static deflection, and h is the drop height of the load.
Since the wall parapet of the vehicle protective barrier can be considered a rigid body, based on the nearly equal values of the horizontal displacement shown in Figure 2 and the out-of-plane deformation of the steel deck plate shown in Figure 3, it is assumed that $\sqrt{\frac{2h}{\delta}}=0$ in Equation (1).
From this assumption, the coefficient k becomes 2.

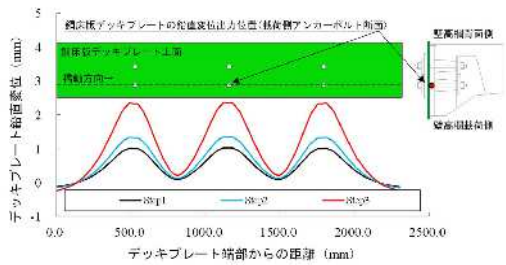

Fig.3 Vertical Displacement of the Deck Plate

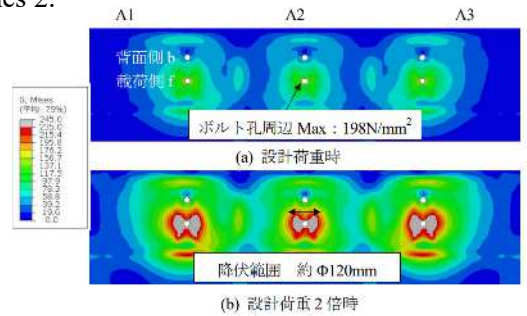

Fig. 4 Mises Stress Contour Plot of the Deck Plate

SUMMARY

(1) It is proposed that the design load for anchor bolts be set at twice the impact load F.
(2) The out-of-plane deformation of the steel deck plate should be verified to remain within 3 mm, assuming a concentrated load is applied to a plate fixed on all four sides.