Full Scale Test of Transmission Towers: Damping Characteristics

Détermination des caractéristiques d'amortissement de pylônes à haute tension à l'aide d'essais

Grossversuch zur Bestimmung des Dämpfungsverhaltens von Hochspannungsmasten

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1.INTRODUCTION

This study guantitatively clarifies how the slip deflections of the bolted joints contribute to the damping characteristics through the static loading tests, the free vibration tests and the numerical analyses of two full scale towers shown in Fig.3.

2.EXPERIMENTAL RESULTS

The following items were drawn from the experiments.

2.1 Load-Deflection Characteristics in the Static Loading Tests

-It was proved that the characteristics of the tower could be calculated by the sum of characteristics of the elements such as the members and the bolted joints shown in Eq.(1), Fig.1.

$$\delta = \Sigma \{ \bar{N} (NL/EA + \delta s) \} \qquad (1)$$

2.2 Damping Ratios in the First Natural Free Vibration Tests

-It was clarified that the damping ratios in the large amplitude were greater than 3% as shown in Fig.2.
-The damping ratios were conducted from the load-deflection characteristics of the towers as shown in Eq.(2).

$$h = 1/2\pi \cdot \ln \{(Wm+Wj)/Wm\} + 0.005 \qquad (2)$$

$$Wm=1/2 \cdot \Sigma(N^2L/EA),\ Wj=\Sigma(Ns\delta s)$$

-The gradual decreased amplitudes in free vibration test can obtain the vibration characteristics such as the damping ratios and the periods consecutively.

3.ANALYTICAL RESULUTS

The following items were drawn from the non-linear respnse analyses.
-The accuracy of the dynamic response analytical method incorporated with non-linear spring elements having the simplified slip characteristics of the bolted joints was proved by comparing with the free vibration tests as shown in Fig.2.

-The non-linear responses by the damping ratios varied according to amplitudes were compared with the linear seismic responses by the fixed equivalent damping ratios. And it was clarified that the equivalent damping ratios in the great earthquakes exceeding 200 gal were greater than 1.5%.

4.CONCLUSION

We are now pushing on normalization of the aseismic design method with combination of these seismic design data and the dynamic response analyses.

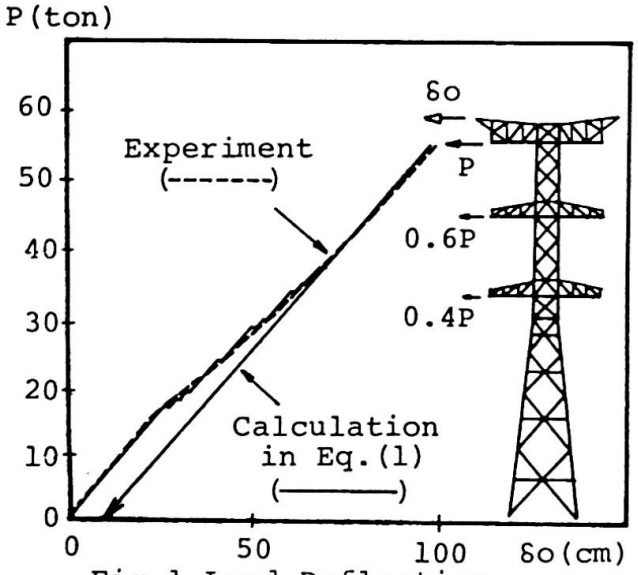

Fig.1 Load-Deflection Relationships

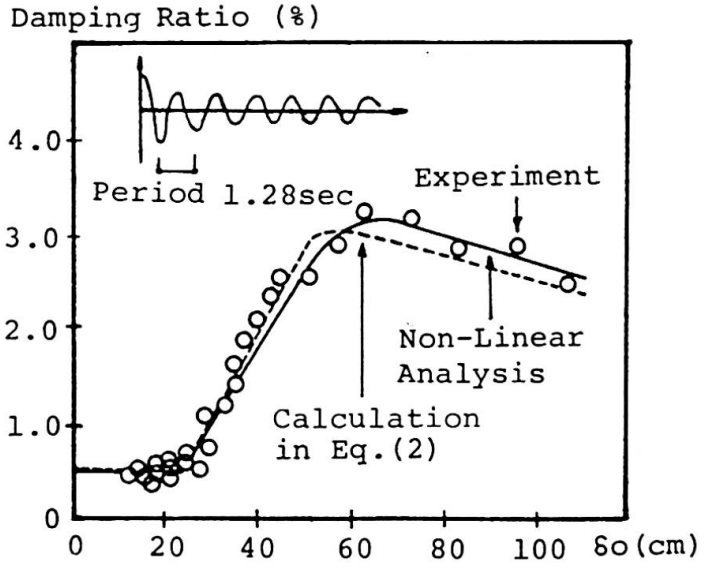

Fig.2 Damping Ratio -Deflection Relationships

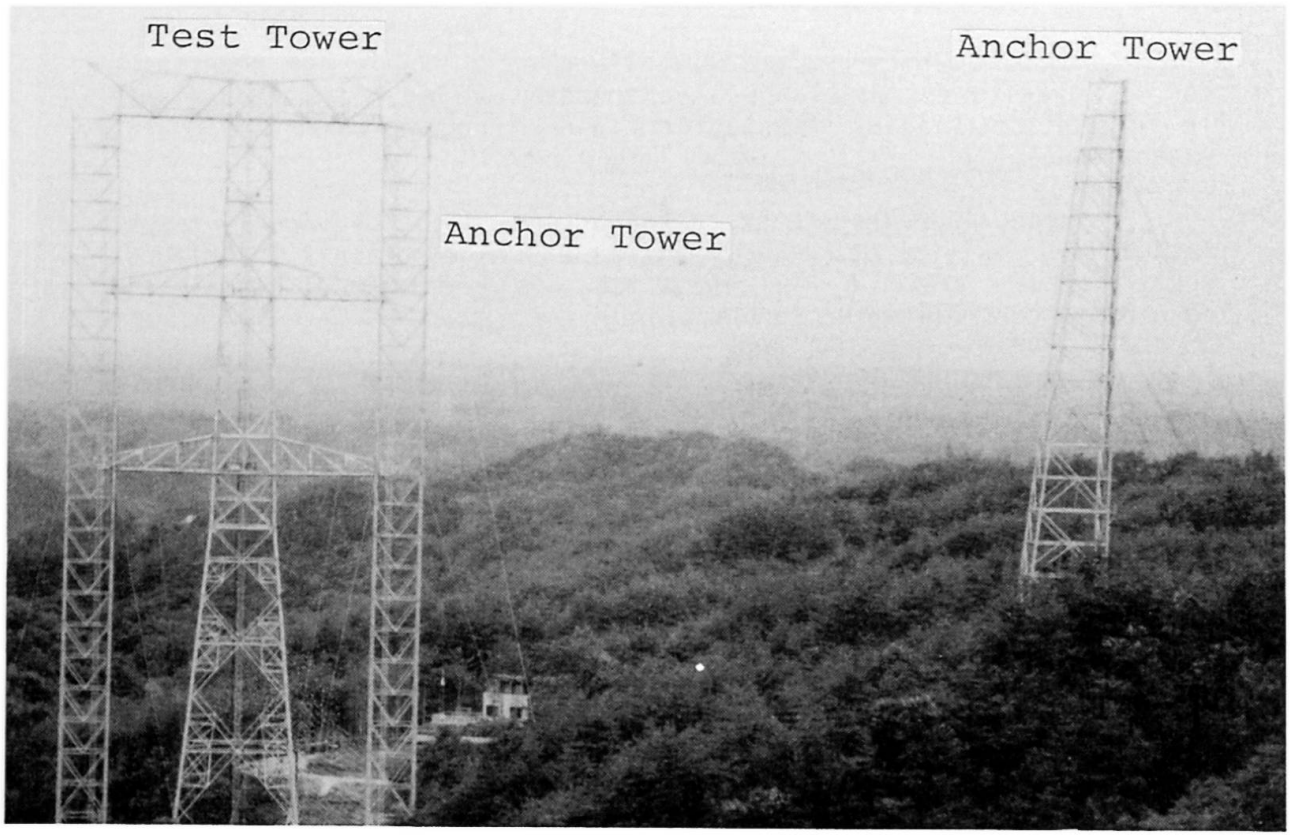

Fig.3 View of Experimental Plant