

Field Observation System of a Steel Transmission Tower Subjected to Wind and Seismic Actions

Background

In Japan, the aging degradation of steel transmission towers, for example, fatigue, bolt relaxation, and corrosion, are a concern because such towers are exposed to severe natural environments. We built a field observation system on a steel transmission tower in cooperation with

Tokyo Electric Power Company (TEPCO) to investigate the responses and dynamic states of the tower due to external forces, including wind, earthquakes, snow and ice accretion, and others, under natural environments.

Outline

This system enables the ability to measure action data, such as wind speed, wind direction, temperature, humidity, atmospheric pressure, and ground acceleration, etc., along with response data such as: cable tension, axial force of a tower member, acceleration of the tower, etc., simultaneously. Measurement sensors were installed in order to evaluate response characteristics for the following three phenomena: 1) tower responses under wind and earthquake actions; 2) fatigue damage of tower members resulting from galloping;

3) redundant member vibrations due to wind. We are constantly recording data at 100 Hz, and the statistics such as averages, peak values, and standard deviations of the time histories are calculated every 10 minutes from a set of observation data. Three remote industrial televisions were also installed to record cable oscillations and redundant member vibrations. In addition, a digital communications network enables the real-time check of data at our Abiko area office, in order to obtain the statistics and to control the industrial televisions.

Specifications

The following sensors and devices are included in this system;

- (1) Accelerometers: At the first, 10th, and 15th panel (two horizontal axes), the 16th panel (vertical direction), redundant members (three axes), and the ground surface (three axes)
- (2) Axial force meters: At the fourth, the seventh, and the 16th panel (four main leg members and eight bracing members), the second cross-arm (10 cross-arm members)
- (3) Three axis strain gages: At the joint plate (redundant member of the 16th panel and the second cross-arm member), a central area of a redundant member (the 16th panel)
- (4) Anemometers: At the first and the 10th panel (vane type, horizontal wind speed, and wind direction), the 16th panel (ultrasonic type, wind speeds, three axes)
- (5) Weather observation equipments: Temperature (at the sixth panel and at the ground), humidity (at the ground), rainfall amount (at the sixth panel)
- (6) Tensiometers and deflection angle meters for cables: At the second cross-arm (horizontal and vertical angles)
- (7) Movies: Responses of lower and higher cables, redundant member vibrations
- (8) Data record system and condition monitoring system

[Installed location and date]

TEPCO service area/April 2011



Target tower



Recording device and display (at the observation station)



Vane-type anemometer

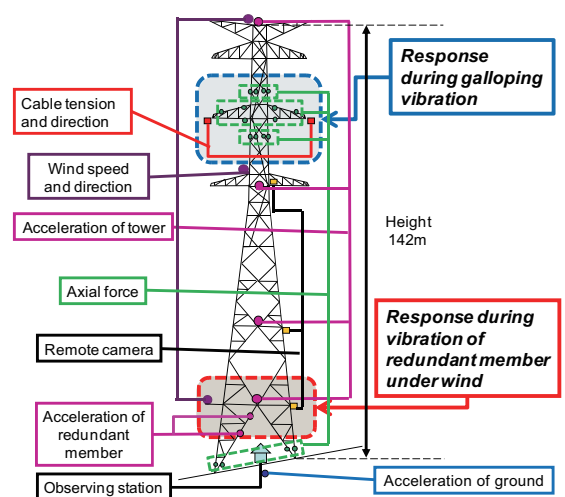


Fig. 1: Arrangement of sensors and devices

Photo 1: Outline of system