พิมพ์ต้นฉบับบทคัดย่อวิทยานิพนธ์ภายในกรอบสีเขียวนี้เพียงแผ่นเดียว

C615022 : MAJOR CIVIL ENGINEERING
KEY WORD: DYNAMICS ANALYSIS / TRANSMISSION TOWER / LATTICE TOWER / NONLINEAR GEOMETRY.
AGARAT SAMAKRATTAKIT : DYNAMICS ANALYSIS ON TRANSMISSION TOWER. THESIS ADVISOR: PROF. PANITAN LUKKUNAPRASIT, Ph.D. 156 pp. ISBN 974-632610-4

This research was conducted to compare the results from the static analyses of transmission line towers using existing design criteria followed by the Electricity Generation Authority of Thailand (EGAT) and the proposed guidelines on wind loads by the University of Western Ontario (UWO). Both linear and geometric nonlinear analyses were performed, assuming elastic material properties. In addition, linear dynamic responses in internal forces and reactions were also compared with those obtained from application of UWO guidelines. The time varying wind loading function was transformed from measured wind records. All the analyses were performed by using the general propose finite element program SAP90. The structure used in the case study was the 46.68 m-high DA1 lattice tower which collapsed in the 1989 Typhoon Gay in the unstrung condition.

While the base shear resulting from statics analysis based on UWO guidelines was about 8% higher than that based on EGAT criteria, the corresponding base moment from UWO results was found to be much larger, in the order of 30%, whereas the discrepancies in the internal forces were about 10-40%. The main reason was that the UWO guidelines assume the more realistic Power Law distribution, resulting in considerable larger base moment than those predicted by the EGAT criteria which assume uniform pressure distribution based on the velocity at the average tower height. The effect of geometric nonlinearity was found to increase the internal forces in the serviceability limit state by only about 5%. The patch loading in the UWO specification which accounts for uncorrelated gusts resulted in internal forces increasing by about 10-20%.

The dynamics analyses of the tower in the case study incorporating the lower two modes yielded increase in the internal forces in the order of 5-10% for leg members, and 100-600% for diagonal members, when compared with the solutions which included only the fundamental mode. The results were not much different when all modes were included, the discrepancy being about 5-10%. The dynamic response factor was found to be 3.40 when the loading was based on the wind velocity recorded from wind tunnel tests at Chulalongkorn University. It was about 70% higher than that computed in accordance with the UWO guidelines. The large difference was due partly to the deviation of the characteristics of the wind modeled in the wind tunnel from that of the natural wind. The power spectrum density function of the modeled wind in full scale was seen to shift to the high frequency range, closer to the natural frequency of the tower when compared with the spectrum curve proposed by Melbourne (1982), with the consequence of increasing dynamic response of the structure. Furthermore, the peak response from dynamics analysis was computed based on one single wind speed event while that obtained from the UWO guidelines is the mean value of peak responses from a large ensamble of events using probability theory.

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