

**Zeitschrift:** IABSE reports = Rapports AIPC = IVBH Berichte  
**Band:** 83 (1999)

**Artikel:** Active control for the operational safety of control-towers  
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**DOI:** <https://doi.org/10.5169/seals-62883>

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## Active Control for the Operational Safety of Control-Towers

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### Summary

Operator's comfort in control towers can be troubled by the oscillations induced by winds and moderate earthquakes with consequences on the safety of the air traffic. An active control system, inserted at the top of the tower, can reduce the movements. Results of numerical simulations carried out on a sample tower, show that the effects of wind induced motion can be lowered below the satisfactory threshold and, when moderate earthquakes act, the response remain under the tolerability limit.

**Keywords:** Active and hybrid control; operator comfort; operational safety; wind; earthquake.

### 1. Abstract

The typical structural scheme of control towers (inverse pendulum) make them very sensitive to lateral dynamic actions. Depending on the frequency content and the acceleration values, induced lateral oscillations can trouble the operators jeopardising the appropriate progress of operations with risk for the air traffic safety.

Wind induced oscillations usually go on for a long time provoking discomfort and loss of attention. Short motions, like earthquakes of moderate intensity, not damaging structures nor endangering human life, can induce anxiety, fright, or even panic. Human perception of motion depends on acceleration, for short duration motions, and on acceleration variation, for a long excitation. The reduction of those response parameters limits perception.

ENAV (Ente Nazionale Assistenza al Volo), the Italian authority supervising the air traffic, pointed out the problem of providing a proper security to tower operators when lateral oscillations occur. The use of active control systems, already tested or installed on high buildings, was suggested for the high efficiency in reducing the response of systems characterised by a dominant frequency. Numerical simulations of the effect of a hybrid control system installed at the top of a typical control tower, aiming at reducing or eliminating the discomfort, have been carried out.

A typical configuration, reported in Figure 1, was suggested by ENAV to simulate the behaviour of a tower equipped with a hybrid control system. The mass values resulting from the load analysis are: 509 t for the service block, 350 t for the control block and 26 t/m for the column. The fundamental tower frequency results 0.606 Hz. A hybrid control device, shown in Figure 2, is

