Zeitschrift: IABSE reports = Rapports AIPC = IVBH Berichte
Band: 77 (1998)

Artikel: Dynamic characteristics as indicator of structural integrity
Autor: Sigmund, Vladimir / Herman, Krešimir
DOI: https://doi.org/10.5169/seals-58185

Dynamic Characteristics as Indicator of Structural Integrity

Vladimir SIGMUND
Assist. Professor
University of Osijek
Osijek, Croatia

Krešimir HERMAN
Professor
University of Zagreb
Zagreb, Croatia

Summary:

Detecting structural state of historical monuments and their adequate strengthening is very complex problem and requires cooperation among various specialists. Knowing the real state of historical monuments is very important before and after the strengthening and can only be established experimentally. Dynamic tests can reveal us the structural state without any damage to the structure. Usage examples of various dynamic tests, performed in order to determine dynamic characteristics and to conclude about the structural behavior and state, are outlined. Measured dynamic characteristics are then used to formulate precise mathematical model on which simulations of the extreme actions can be done. By collecting and statistically analyzing the measured data broader knowledge about the previous building methods can be gained and, many times, learned on the knowledge of old builders.

Keywords: historical monuments, structural state, dynamic tests, test-analysis corelation

1. Ferhad-Pasha Mosque

Experimental results indicated poor structural state and they were used to establish a real distribution of mass and stiffness along the height and to attribute earthquake forces, according to the real stiffness distribution. By knowing the measured results, reliable mathematical model could have been established and further analytical studies were made. Seismic strengthening was necessary and the chosen strengthening method did not disturb the mosque's historic value and was simple enough for construction.

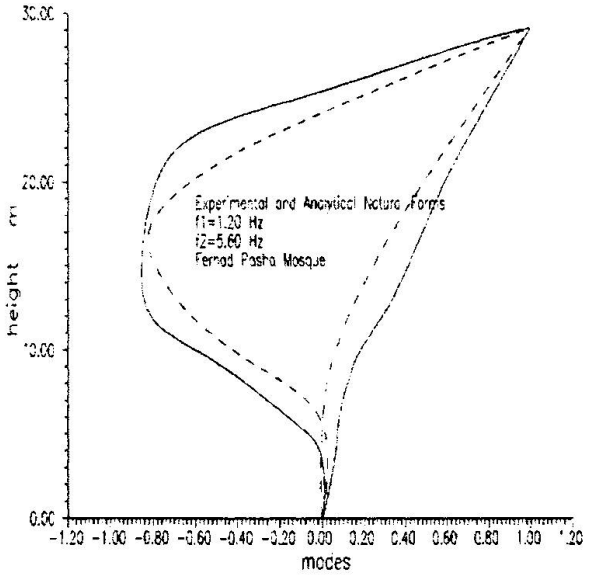

Fig. 1 Calculated and measured mode forms

2. Retaining Wall Structure on the Maria Luisa Road

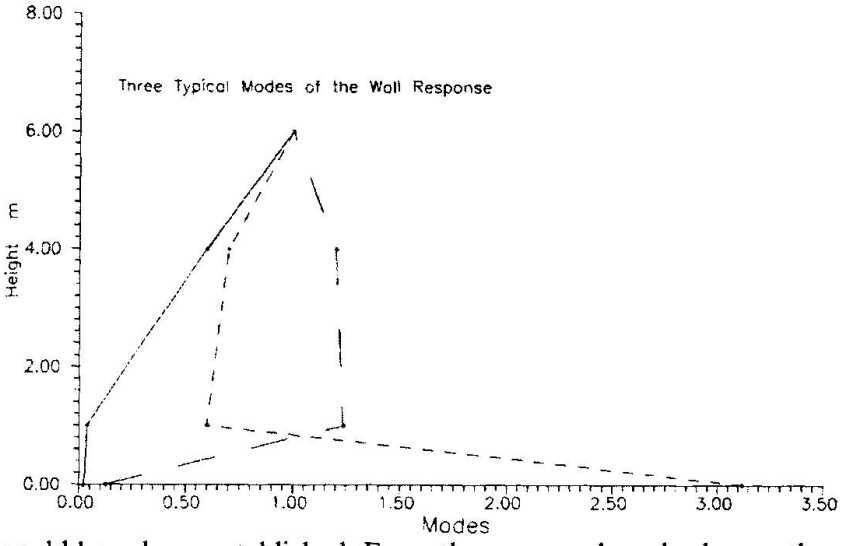

Fig 2. Three typical measured mode forms

Dynamic testing of the wall sections was performed as the only applicable method for evaluation of the structural state. Two methods were applied: (a) impulse tests and (b)transfer function test. As a result of both methods, wall response to dynamic excitation along the height was obtained, and the mode shapes of vibration could have been established. From the measured mode shapes, three main cases of the wall displacements could have been established and stability of the wall sections estimated on the ground of the measured quantity:

3. Mostar's Old Bridge

The measured mode shapes revealed that for vertical loading bridge behaves as an arch but of a smaller span, while for the perpendicular direction it behaves as a beam with fixed supports. Based on the experimental results, analytical model was modified until a satisfactory correlation among measured and analytical results was achieved.

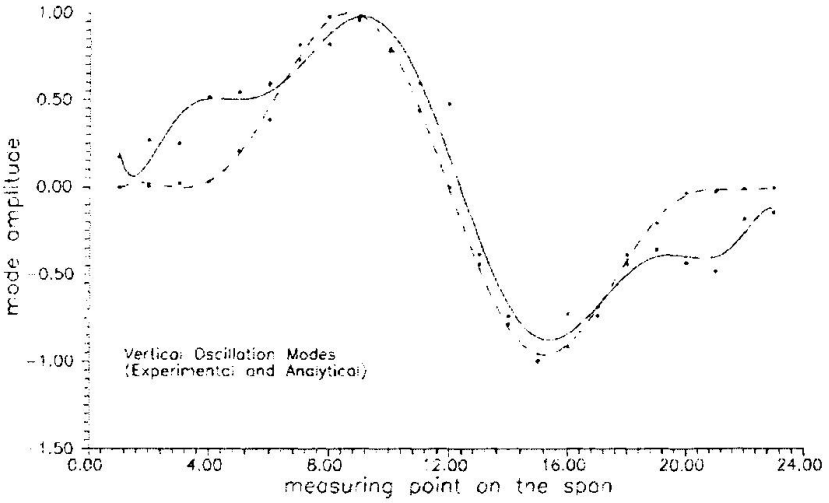

Fig. 3 Vertical mode shapes

Good correlation is obvious, and such mathematical model could be used for structural analysis and to check the influence and meaning of the various strengthening methods.

Dynamic characteristics reveal the most important structural data and represent the "personal" card of the structure. Changes in: measured mode shapes indicate change in strength distribution and reveal the real strength distribution; damping characteristics indicate change in the homogeneity; natural frequencies indicate change in the overall structural state.