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THE IMPLEMENTATION OF NEW SOFTWARE IN MODAL ANALISYS BRICKS WALLS DEGRADATION MEASUREMENTS

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The recommendation of the Polish low shows a need of control the production quality of wall elements which should provide in straight lines diagnostic tools. Requirement of this norm in range establishing the partial coefficients of wall safety of wall treats to settlement the category of works realization on building (A or B). They would support qualification «suitably qualified person controls» straight lines diagnostic methods indispensable the searches of new methods of opinion.

It recognizes the need of improvement the methods of investigation of wall building quality, and construction. In this article wall elements tests were made using the modal analysis and the delimitation of passage function FRF.

<u>*Keywords*</u>: *the modal analysis, function of passage the FRF temporary course of trembling's.*

Introduction

Existing constructions, such as: buildings, high poles, chimneys, foundations under machines, and roofs are subject to the environment and to trembling processes as well. The dynamics caused by wind, earthquakes, machines work, railway and road movement, explosions, and sea waves are important in the process of projecting constructions and influence safety and durability. Trembling in buildings decreases comfort of living, can have an influence on people working there, and can also threaten the safety level of the construction. The trembling can cause dynamic burden and even catastrophic destruction.

The previously mentioned recognizes the need of improving the methods for investigating the quality of wall building constructions, their diagnostic and the assessment of wall safety coefficients (PN - B-03002). The test used to determine the level of destruction of chosen materials was the

experimental modal analysis and the concurrent procedure of this method – the trembling estimators.

The new tools in this area of investigations concern the possibility of using modal analysis methods, and also modern logging and the processing of trembling to opinion the quality of wall elements. Practically it can be used for better understanding the behavior of constructions, which allows optimizing the projection and assessment of dangerous states.

The task of this study is to check the usefulness of new LMS Software and Matlab programs on the creation of stabilization diagrams and the calculation of function areas. The objective is to test if the state of materials can be shown in the size of these areas.

1. Measurement software

To measurements of temporary courses of the extortion and the answer, also the qualification of FRF and COH function the most modern measuring apparatus, named LMS TEST. XPRESS, was used. This software makes possible in easy way to conduct the modal analysis of wall elements and many different building constructions.
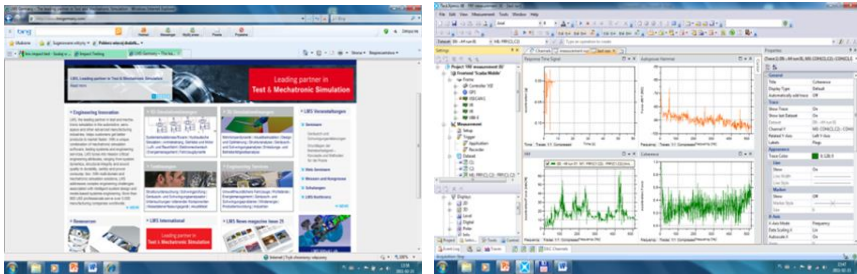

Figure 1 – Internet Shop window of manufacturer of software [www.ects.pl.]

The program possesses an easy and friendly user interface. After the program is started a new project must be created by clicking on the new project icon. From this moment all measurements will be automatically recorded in the active project.

Defining all the necessary data for the calibration of the measuring track is the next step. Then, for the investigations to be conducted at this

stage the quantity of active measuring channels must be defined. The number of channels depends on the measuring card and the number of slots it contains.
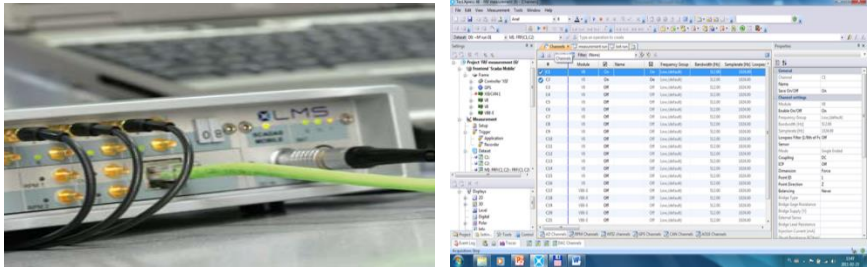

Figure 2 – Example measuring segment and calibration window [www.ects.pl]

For the measurement of temporary courses of strength two channels should be used. First calibrate the modal hammer (strength imput), and second the output of trembling accelerations (signal passage through element). With measurements obtained from this channel calibration allows developing the FRF function. The calibration window that is shows all the sensors that can be used to make the measurements, from which two must be selected: C1 and C2. This article shows that using the LMS program it is possible to make measurements FRF function in wall elements and to obtain a graphic visualization of the FRF function. The measurements were made for different kind of materials in all directions.

2. Getting the stabilization diagrams and FRF functions diagnostics

To get the stabilization diagrams from the LMS TestXpress 4A software it is necessary to proceed in the way that is shown below. The program records the time courses in xdf files (Test Xpress Date File).

With the files open in Vioma, it is possible to generate the stabilization diagram thanks to the LSCE function. A new window will appear which contains data that will be used to create the stabilization diagram by clicking on Estimate poles.
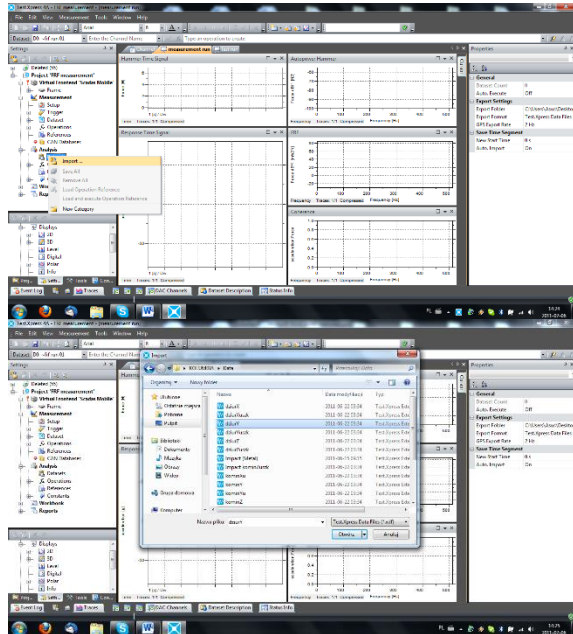
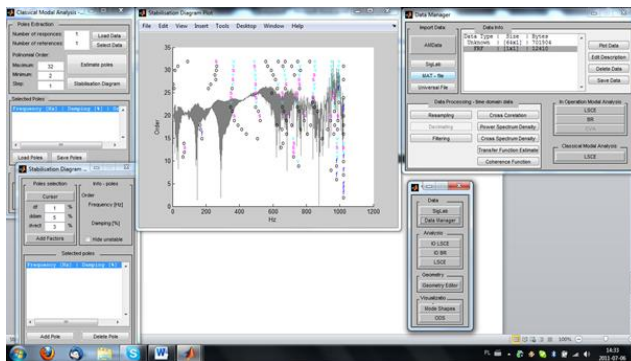Figure 3 – Importing the files of recorded measurements

Figure 4 – Stabilization diagram generated in VIOMA

The stabilization diagram provides information on the state of materials; however it is not comprehensive of all that is taking place within the material in the destruction process. For this purpose, a FUNCTIONS ANALYISIS program was created to give further information about the

material state based on the coherence function and its areas, which will mark the difference between good and bad materials.
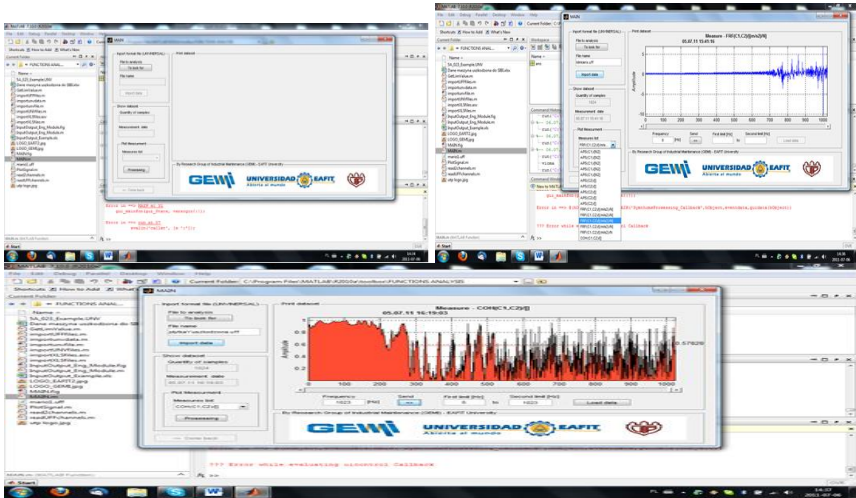

Figure 5 – The main screen of the FUNCTIONS ANALYSIS program

The programs open the unv files that were create earlier by selecting them and clicking on the Import date icon. The program opens a new window that shows all the recorded data the file contains. From this data, the program creates the drawing of the selected function.

Thanks to the slider located below the drawing it is possible to mark the function areas which will be counted. The marked area is shown in red. For this investigation, the whole range of values was considered, explaining why the whole area shown in Fig. 5 is in red, and considered the FRF and cohesion functions.

3. Measurements results

The results of measurements for wall brick are illustrated below. These results are introduced by comparing the calculations of three items in the axles X, Y, and Z: stabilization diagrams, the counted area of the FRF function, and coherence function.
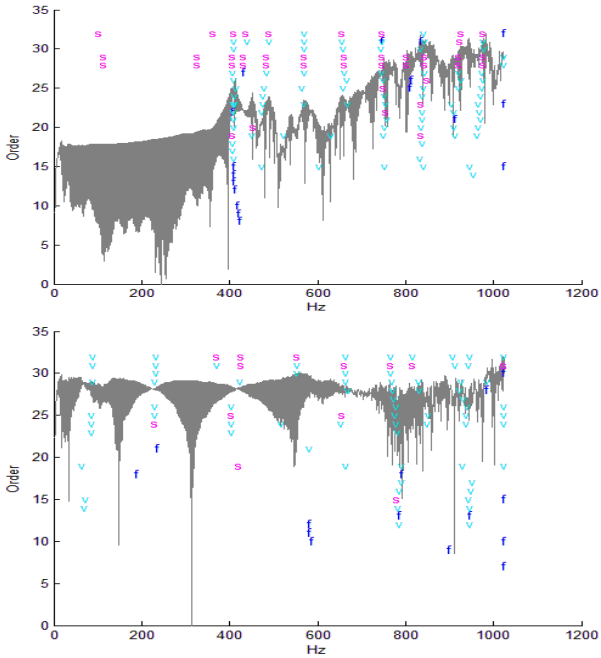
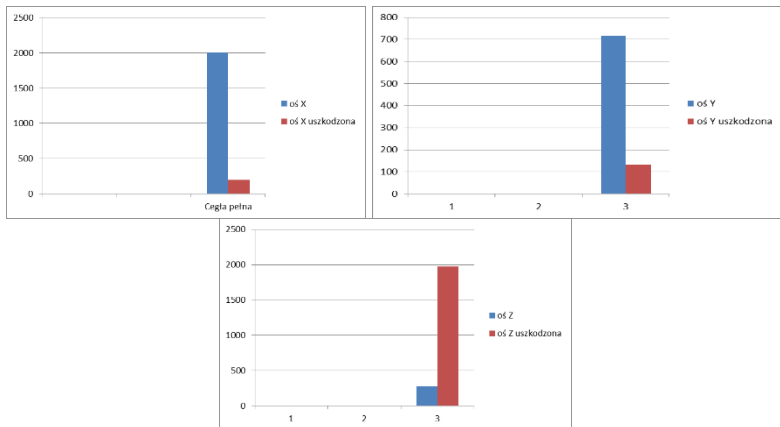Figure 6 – Stabilization diagrams for good and destroyed brick in axel X

Figure 6 – The visualization of the calculation areas for axels X, Y, and Z

Summary

The introduced results of this investigation show the existing possibility of distinguishing changes of material properties that influence the properties of materials. The investigation confirmed that the application is useful as it makes possible to create stabilization diagrams and area counting of functions in Matlab. The data obtained from the stabilization diagrams and area counting of the functions allows assessing the state of materials by comparing their fitness.

From the results obtained, the following statement can be made:

For a full fit brick, a stable pole can be generated in the X axle at the level of 420 Hz of the stabilization. In case of a damaged brick, it is not possible to generate a stable pole in the stabilization diagram. The situation is the same when comparing X and Y stabilization diagrams. This means that for a full fit brick a stable pole can be generated in the X axle at the level of 790Hz of the stabilization. In case of a damaged brick, it is not possible to generate a stable pole in the stabilization diagram.

For axle Z, it was not possible to generate stabilization diagrams neither for good or bad materials. The studies performed in this axle did not provide any answers and therefore further investigation should only be performed in the first to axles, X and Y.

By comparing the area of functions, it was possible to notice that the field of the FRF function for fit materials is many times larger than for damaged units. The situation is similar when studies the results of the coherence function, in which fit units have a larger function area than damaged ones.

References

1. Ameliańczyk A.: Optimization in problems steering and management. Ossolineum, Wrocław, 1984.

2. Bendat J. S., Piersol A. G.: Method of analysis and measurement of random signals. PWN, Warszawa, 1996.

3. Bishop R. D., Gladwell G. M., Michaelson S.: Matric analysis of tremblings. PWN, Warszawa, 1972.

4. Broch J. T.: Mechanical Vibration and Shock Measurements. Brüel & Kjaer, 1980.

5. Cempel C.: Practical Wibroakustyka. Warsaw of, PWN, 1989.

6. Eykhoff P.: Identification in dynamic arrangements. BNInż. Warsaw.1980.

7. Giergiel J., Uhl T.: Identification of mechanical arrangements. PWN, Warszawa, 1990.

8. Giergiel J.: Mechanical trembling. AGH, Kraków, 2000.

9. Kaczmarek J.: Basis of theory of trembling and dynamics of machines. Higher Morska Szkoła, Szczecin, 1993.

10. Morrison F.: Art of modelling of dynamic arrangements. WNT, Warszawa, 1996.

11. Paczkowski W. M.: Chosen problems of discreet evolutionary optimization. Papers PS of, Nr 554, Szczecin, 1999.

12. Tylicki H.: Optimization of process of forecasting of technical state of motor vehicles. Qualifies for professorship trial of No. 86, ATR Bydgoszcz, 1999.

13. Uhl T., Lisowski W.: Practical problems of analysis of modal construction. CCATIE, Kraków, 1996.

14. Uhl T.: By computer helped identification of models of mechanical constructions. WNT, Warszawa. 1997.

15. Żółtowski M., Orłowicz R.: Chosen questions of acoustic isolation of wood ceilings. Ogólne building, ZN ATR, Bydgoszcz 2005, s.367-374.

16. Żółtowski M.: Identification of the vibration threats of building objects., ZN ATR, Bydgoszcz 2005, s. 375–382.

17. Żółtowski M.: Measurements of property of acoustic materials. DIAGNOSTICS, PTDT of, PAN, vol. 33, 2005.