Attachment 3

AUTOPRESENTATION

showing scientific description of achievements
particularly identified in article 16 section 2 Act ...

Mariusz ŻÓŁTOWSKI

UTP University of Science and Technology
in Bydgoszcz

Bydgoszcz, 2016r.

AUTOPRESENTATION

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Attachment 3

AUTOREFERAT

1. AUTHOR DATA

Imię i nazwisko: **Mariusz ŻÓŁTOWSKI (born 19.03.1981 in Pile)**

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UTP University of Science and Technology
Bydgoszcz, POLAND
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2. POSSESSED DIPLOMAS AND SCIENTIFIC DEGREES

- **Doctoral degree: 2009**. Szczecin University of Technology, Faculty of Civil Engineering and Architecture**, specialization: civil engineering, PhD in technical sciences, discipline: civil engineering.**
- Thesis title: **Diagnosis of masonry using modal analysis.**

Promoter: **prof. Roman ORŁOWICZ**
Reviewers: **prof. Adam PODHORECKI**
prof. Jerzy KASZYŃSKI

- 2000-2004 University of Warmia and Mazury in Olsztyn, Faculty of Technical Sciences, course of Ground Engineering, full-time, Master of Science.
- Thesis title: **Sulfur concrete properties in alkaline environment.**
- Promoter: **prof. Juri j Orlowski, UWM Olsztyn.**
- 1996-2000 II Community High School in Bydgoszcz. General profile with extend English language.

3. INFORMATION ABOUT EMPLOYMENT

- 01.02. 2010 - still, **UTP University of Science and Technology**, Bydgoszcz
- Position: **Assistant Professor**
- Responsibilities: conducting classes of subjects: Applied Mechanics, Vibrations in construction, construction materials and economics building, costing and property valuation, scheduling works.

- 10.02.2009-01.10.2013 **KPSW University**, Bydgoszcz
- Position: **Assistant Professor**
- Responsibilities: conducting classes of items: economics of construction, costing and property valuation, scheduling works.

- 11.08.2009-01.10.2013 **School of Bydgoszcz**, Bydgoszcz
- Position: **Assistant Professor**
- Responsibilities: lectures and exercises with subjects: Mechanics of buildings, Building Materials, Construction, Designing of construction technology, costing.

- 01.10.2008 - 01.02.2009 **Science and Business Centre "ZAK",** Toruń
- Position: **lecturer**
- Responsibilities: track applications and e classes of drawing and engineering graphics and design documentation.

CIVIL ENGINERRING EXPERIENCE

Candidate is currently an assistant professor at the UTP University of Science and Technology in Bydgoszcz. For several years (2005 - 2009) he worked in the industry, receiving his first professional experience, getting acquainted with the problems of engineering, construction and management methods in the industry.

01.06.2008 - 01.02.2009 **MARBUD.,** Toruń
Position: **Engineer**
Responsibilities: supervision of the construction work on the construction site, preparing quotes and proposals, negotiation of prices with subcontractors.

01.02.2008- 01.06.2008 **ALSTAL CONSTRUCTION**., Jacewo
Position: **Engineer**
Responsibilities: supervision of the construction work on the construction site, preparing quotes and proposals, negotiation of prices with subcontractors.

07.06.2007-15.12.2007 **SHIMIZU Corporation SA**, Toruń
Position: **Engineer**
Responsibilities: supervision of the construction work on the construction site, preparing quotes and proposals, negotiation of prices with subcontractors.

19.01.2007 - 01.06.2007 **EUROMETAL Sp z o o**., Toruń
Position: **Manager**
Responsibilities: preparation of technical offers - pricing, preparation of as-built documentation, keeping contact with customers and design companies, coordinating the process of orders, participation in making decisions, quality control elements on production, coordinating the assembly of the structure.

01.07.2006 - 19.01.2007 **FBR Kamila Wisniewska**, Bydgoszcz
Position: **Construction engineer**
Responsibilities: supervision over production and subsequent installation of steel structures.

01.07.2005 - 01.07.2006 **PZU SA Claims Centre**, Bydgoszcz
Position: **building damage coast calculation**
Responsibilities: Building damage inspection, valuation and payment of compensation.

Languages: language English - good.
skills: software known, and used: Windows, MS Office, AutoCAD, MATLAB, CATIA, INVENTOR, ARETICS, and many others supporting the work of the engineer.

Hobbies: running, body building, skiing, swimming.

4. INDICATION OF SCIENTIFIC ACHIEVEMENT RESULTING FROM THE ACT OF MARCH 14, 2003.

Candidate scientific achievement candidate, obtained after receiving a doctoral degree, which constitutes a contribution to the development of a scientific discipline 'Construction' 'as defined in Art. 16 paragraph 2 point 1 of the Act, are the results of comprehensive research described in monothematic series of publications (books and articles scientific) entitled: Study the degradation of components, materials and constructions methods of modal analysis in terms of modeling and evaluation of the functional characteristics of the structure and technical systems (machines, vehicles) in the construction industry.

The basic element of this cycle are shown here (author of 2 and coauthor of 1 monograph), which are compact summary of the main part of conducted discussions and a study on the impact of evolutionary variable condition of the material and construction (construction and engineering), determined the conditions and parameters of manufacturing processes, the state and transformation processes of destruction in the operation and use.

Complemented monothematic series of papers books publications (indicated here in 7), which presented the results of research and analysis, which extend the area of knowledge in the field of scientific achievement. They describe the copyright concepts of individual solutions, including: the formulation of the scientific problem, the principle of selection of research methodology, the conduct and the conclusion of the performance. The results of these works relate to the study of factors affecting the transformation of the status of materials and structures, and technical systems in construction.

Singled out and discussed "a series of publications that are all related", in the area of theory, research processes and the use of vibration modal analysis capabilities include mainly the issues of mechanics and structural dynamics and construction of new diagnostic applications, building and operation of technical systems in construction.

4.1. Series of one topic publications entitled: "*THE DEGRADATION TEST COMPONENTS, MATERIALS AND CONSTRUCTIONS METHODS OF MODAL ANALYSIS*", which is a scientific achievement obtained after receiving a doctoral degree

The theme of a publications series is to monitor destruction changes of components, materials and constructions with trembling methods, using the methods of modal analysis. The cycle consists 3 selected books (att. 5 pt: 5.1,5.2,5.3), and 10 articles (att.5, pt.5.4 - 5.10). All these articles and indicated the book are written in English, including 6 published in journals with Impact Factor (IF). In the proposed reaching a scientific author presents solutions for degradation testing of building structures, ranging from the theoretical application and verification in practice.

The achievement: "The survey degradation of components, materials and constructions methods of modal analysis" is mounted as a researcher in the field of technical sciences in the discipline of "construction" and the selected candidates is a whole (with different levels and scope) is described and justified in the 8 positions books and 75 peer-reviewed publications (authors and co-authors), domestic and foreign, in the field of building materials, applied mechanics, dynamics, vibration, as well as in the areas of support, from the area, building engineering, production management, use and exploitation.

A series of publications that are all related, representing a significant scientific activity was presented chronologically and contains works, which included (attachment 5):

- books studies:

1. Żółtowski M.: **Modal analysis in the research of civil engineering materials**. Bydgoszcz 2011, ITE-PIB Radom, ISBN 978-83-7204-918-6, Publication weight 20 pkt. MNiSW – share 100%.

2. Żółtowski M: **Operational modal analysis in the research of civil engineering constructions**. Bydgoszcz 2012, Publisher of UTP w Bydgoszczy, ISBN 978-83-64235-32-0, Publication weight 20 pkt. MNiSW – share 100%.

3. Żółtowski M. ii: **Vibration signals in mechanical engineering and construction**. Bydgoszcz 2015, ITE-PIB Radom. ISBN 978-83-7789-350-0, Publication weight 25 pkt. MNiSW – share 50%.
   The percentage of 50%, was to co-develop the concept of substantive content, the analysis of the scope of the content of each chapter, the development of research methodology and presentation of research results, participation in the development of applications, editing and selection of data illustrating the substantive issues, the development of selected learning content.

- research publications:

4. Żółtowski M.: Investigations of harbour brick structures by using operational modal analysis. Polish Maritime Research, No. 1/(81), vol.21, ISSN 1233-2585, 2014, pp. 42-54. (100%) IF 0,324
5. Żółtowski M. ii.: Truss harbour cranes modal design elements research. Polish Maritime Research, 4(88), Vol. 22, 2015; pp. 84-92. (70%) IF 0,324
   The percentage of 70%, was to propose a research problem, methodology of implementation, development results, participation in the development of applications, editorial article.
6. Żółtowski M. ii.: Study of the state Francis Turbine. Polish Maritime Research, No.2/78, vol.20, ISSN 1233-2585, 2013, pp. 41-48. (50%) IF 0,324
   The percentage of 70%, consisted of proposals for substantive content, the development of research methodology, development of statistical results, participation in the development of applications and editing the article.
7. Żółtowski M.: Assessment State of Masonry Components Degradation. Applied Mechanics and Materials, Vol. 617(2014), Trans Tech Publications, Switzerland, 2014, ISSN 1662-7482, pp.142-147. (100%)
8. Żółtowski M.: The difference of wall elements state including the FRF function. International Journal of modern Engineering Research (IJMER), Vol.3, Issue 1, ISSN 2249–6645, Jan-Feb. 2013. pp.456-462. (100%)
9. Żółtowski M. ii: Methodology of the signal vibration signal use in evaluation of degradation. Indian Journal of Applied Research, Vol.4, Issue 7, ISSN 2250-1991, July 2015. pp. 404-406. (60%) IF- 3,41.
   The percentage of 60%, was to co-develop the concept of publication, the scope of the content of each chapter, the development and presentation of research results, participation in the development of applications, editing and selection of data illustrating the contents of the selected substance.
10. Żółtowski M.ii.: The use of applied mechanics in the diagnosis of the state of degradation. PARIPEX – Indian Journal of Research, Vol.5, Issue 2, 2016. pp. 17-22.(50%) IF 5,21**.**
    Participation percentage estimate on 50% and consisted of analysis of the issues, study methodology implementation and description of research and development results; co-participation in the development of applications editorial article.

Existing structures, such as buildings, tall masts, chimneys, foundations for machines, cantilever roofs and others are subjected to considerable dynamic loads from the environment, as reflected well in the generated vibration processes. Dynamic effects caused by wind, earthquakes, work machines, rail traffic and road transport, explosions in the quarries, the waves become important in the process of structural design and have an impact on their safety and durability.

These vibrations can affect the condition of the works by reducing the comfort of the people working there, as they can reach the level of endangering the safety of the structure. Effect of vibration on structure manifests itself primarily as additional stresses in the considered section, which add to the stress from acting on the static structure. Dynamic load can cause devastating effects in buildings with different types of structures or lead to catastrophic destruction.

Recognizing the need to improve methods for quality testing of masonry building structures in order to assess their condition and assess the safety factors of the wall in a proposed scientific achievement was to evaluate the quality of the destruction of selected materials, components and masonry structures using methods of modal analysis and the procedure of these methods - estimators vibration. Issues assessment of masonry walls and building structures is the domain of diagnostics of building structures and specialized diagnostic procedures, which should be continuously improved.

New tools in this area of research are related to the possibility of using methods of modal analysis, as well as modern acquisition and processing of vibration - to assess the state of degradation of structures and machines in the construction industry, which are the basis for discussion. In practical applications they enable a better understanding of the behavior of complex structures, optimize the process of designing and evaluating unsafe conditions. In the latter area to locate the content of a subject, seeking measures of assessment of the destruction of the masonry walls of new and long-term, often for unknown state of wear and the unknown factor of the security wall.

Modal analysis method used in the discussion was adapted from the dynamics of the mechanical design. Its usefulness is more homogenous structures, steel structures, than for building materials such as masonry elements, where each test result is associated with the structure, shape and physical condition of the sample. It is feared that the heterogeneity and coarse structure of concrete and ceramics can be an obstacle, as to the effectiveness of the proposed high-precision measurement technology.

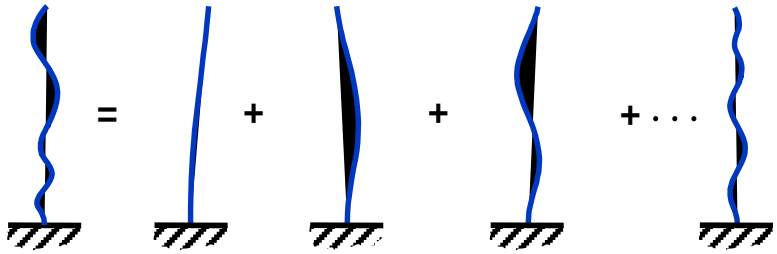
Modal analysis is used for design modification, degradation diagnosis condition of the structure, for the synthesis of control systems, active vibration reduction, and for the purposes of verification and validation of numerical models, such as finite element models and boundary element.

Modal analysis can be used, under the following assumptions:

- the system is linear and its dynamics can be described by a linear system of ordinary differential equations or partial;
- coefficients of equations describing the dynamics of the object are fixed at the time of measurement;
- the system is observable and it is possible to measure all the characteristics, which are necessary for identification of the model;
- tested the system satisfies the principle of reciprocity Maxwell;
- damping in the system is small or proportionate.

An important limitation of the use of modal analysis is the assumption of a limited number of degrees of freedom of the test, which involves the dimension of the matrix mass, stiffness and damping, and the number of theoretical own frequency and mode shapes.

At the meeting above assumptions modal analysis can be defined as the transformation (transformation) complex system whose dynamics is described by the differential equations on a set of systems with one degree of freedom described by the independent differential equations of second order.



$$\{X(t)\} = q_1(t)\{\phi\}_1 + q_2(t)\{\phi\}_2 + q_3(t)\{\phi\}_3 + \cdots + q_n(t)\{\phi\}_n$$

Fig.1. Distribution of vibration complex vibration simple

Mathematically, this task can be defined as the uncoupling of ordinary differential equations describing the dynamics of the study k clearances for.

The theoretical modal analysis is defined as a problem of its own observation matrix depends on the mass matrix, rigidity and damping. The theoretical modal analysis requires addressing issues of their own structural model adopted for the study of the structure. Designated here sets the frequency of their own, attenuation coefficients for the frequency of their forms and vibrations allow the simulation of structural behavior at any extortion, design modification and others. It is applicable in the design process, when there is no feasibility study on the subject. Using track changes as vibrations, you can specify an area in which there is a significant destruction.

Experimental modal analysis is one of the techniques to identify modal parameters of the structure. Experimental modal analysis is a frequently used technique in practice, study the properties of objects, both at the design stage and in operation. Identification experiment in experimental modal analysis involves forcing vibration object while measuring the exciting force and response system, usually in the form of the spectrum of vibration acceleration. Modal model is obtained from the diagram of stability and presented character animation software vibrations.

Operational modal analysis is used to identify objects d of bulky space and large masses, is based on the measurement of the response to the operating force, as a result of external forces or extortion kinematic and the process of destruction of the building elements.

Today, more and more frequently used modal models to assess the state of destruction of building materials construction. The idea behind this method is that sends - device changes the parameters of the model (in this case the modal model), resulting from the consumption, based on the current observation of the object. In this method, the modal model is created for the object without damage, as a pattern, and then during operation modal model is identified and examined the correlation d return the object intact.

The use of modal analysis to solve research problems - regulations and engineering demonstrate the versatility and efficiency of the method.

Experiment to identify the state of destruction of the test piece, segments or masonry is the primary source of information and on that basis, establish the value of measurement and the structure of the model. On the one hand, the quality of the test results depends on the quality of the resulting model, on the other hand the manner of conducting experiment determines the structure of the identified model.

The test piece subjected walled forcing corresponds to a vibration signal, proportional to the state of destruction. Signal extortion and answers used further to determine the function of the FRF and the stability diagram, and the frequency of oscillations. By the way, these procedures are available for other interesting cognitive processes vibration estimators, which are also used in further studies. The test results after processing by different algorithms shall be statistically analyzed.

The use of classical modal analysis to identify the modal parameters of the object under investigation determined modal parameters based on the measurement involving the controlled forcing vibration system and measuring the response in the spectrum of vibration acceleration. Based on the knowledge of extortion and spectral response is made to identify the characteristics of the course partially tested system. With the help of such methods implemented in the field of frequency, we are able to determine the parameters of the modal system in the environment of a single frequency on their own or in a selected frequency band containing more than one's own frequency.

For many structures in operational conditions operate on a completely different system of forces to enforce that as to the nature of the course of time, spatial distribution and amplitude may not be performed in the laboratory. Similarly, for the boundary conditions which in the course of the experiment, depends on the possibility of mounting the object on the bench, they differ from the conditions during operation.

In practical applications implementation of research modal facilities, studied the system is too large and has too much mass to be able to enforce the corresponding amplitude of movement in conditions of active experiment. These constraints are mitigated by the use of methods of modal analysis undertaken on the basis of the measurements carried out during normal operation of the facility.

Modal model parameters allow anarchy equations describing the vibration system, and their value is determined from the relationship:

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Operational modal analysis is used to identify objects with high spatial dimensions and large masses, is based on the measurement of the response to the operating force, as a result of external forces or extortion kinematic and the process of destruction of the building elements.

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Fashion model parameters allow anarchy equations describing the vibration system, and Their value is determined from the relationship:

$$m_r = \frac{1}{2j\varpi_r R_{ir}}; \quad k_r = \varpi_{nr}^2 m_r; \quad c_r = 2m_r \varpi_{rn} \delta_m \qquad (1)$$

These figures describe the properties of the system associated with r - this own frequency and changes the frequency of its own depend directly proportional to the amount of change of stiffness or mass, and also differ according to the development in damage to the structure. The justification is sufficient to describe changes to the destruction of masonry, and the whole theory from the modal analysis has been described in many (books and articles) materials such proceedings.

The use of cutting-edge technologies in the modal analysis results that the resulting modal models become more reliable and can be used to solve many problems associated with the construction of the complex of buildings with specified dynamic properties.

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The aim of the experiment modal analysis is to force movement of the test piece masonry by providing energy measurement and answers to extortion. On the basis of the measured values of the vibration process is carried out estimation characteristics studied masonry. The general procedure for carrying out of many studies – is shown in Fig. 2.

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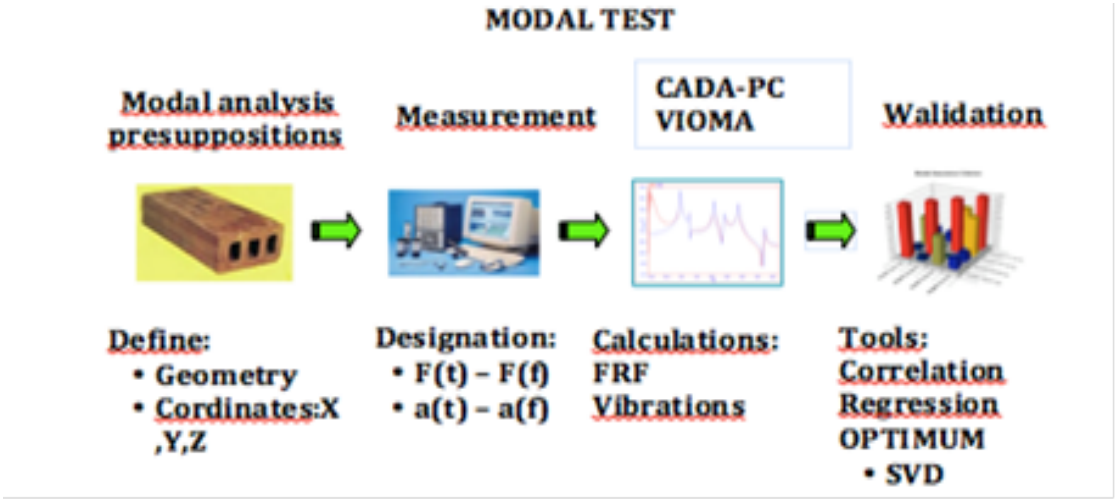


Fig. 2. The essence of the measurement path using modal analysis

The ability to quickly identify damage objects (technical, construction) give information technologies for:

- acquisition processes vibration studies modal,
- processing processes of vibration,
- examining the interaction processes of vibration,

- susceptibility testing of vibration symptoms,
- statistical inference,
- visualization of the analysis results.

There is a need to improve methods for testing the dynamic characteristics of structures, especially those which are accompanied by high dynamic loads. Placed on building new materials and new technologies and design solutions to help boost productivity and quality creations, but often accompanied by dangerous and high dynamic loads. These issues is devoted to recently more and more attention, especially during the design and construction of buildings.

New tools in this area of research relate to the possibility of using methods of modal analysis, as well as modern acquisition and processing of process vibration - to assess the quality of construction and masonry, which are the basis of these studies it proceedings.

Presented in the materials "scientific achievements" and other publications of the author's problems allows a better understanding of the behavior of complex structures and their optimization in the design and evaluation of dangerous conditions. In the latter area invest mainly contents of the attached scientific studies and research of the proceedings, seeking measures of assessment of the state of degradation of construction and masonry, both new and long-term (old) walls, often with unknown state of destruction and the unknown factor of safety of buildings.

Many aspects of basic theory and practice of the possibility of using methods of modal analysis in the assessment of the state of degradation of the building systems and technical discussed the proposed books and articles discuss in detail many of the original proposals and solutions.

The proposed research methods and means to dismantling about prices y-quality materials and construction elements of building and research status of destruction in the evolution of building systems and technology, represent the essence of scientific achievement and a significant scientific activity.

4.2. Scientific discussion

The main scientific objective single issue series of publications (3 books + 7 articles), in accordance from his subject: "The degradation test components, materials and constructions methods of modal analysis," the description and examine the state of degradation of materials, components and structures.

Today structures they are under considerable strain dynamic, well showed generated in the process of vibration. These vibrations can have an impact on reducing the comfort of the people working there, as they can reach the level of endangering the safety of causing devastating consequences and even lead to catastrophic destruction [5.1,5.2,5.3,5.4-5.10].

Recognizing the need to improve methods for testing the quality of building structures in the publications of "scientific achievements" with the problem of recognition and develop methodology survey conducted degradation (quality) buildings (structures, segments, elements) masonry using the methods of vibration and methods of modal analysis. Presented problems in practical applications allows for better understanding of the behavior of complex structures and their optimization in the design and evaluation of dangerous conditions.

Taken subject is located in the area of research and evaluation of the destruction of structures, building small to optimize their dynamic state, reflecting the flow of energy in modern designs, with different excitations. An overview of the achievements of the 'scientific achievement " summarizes in thematic groups, related to the methodology of implementation of the research task.

4.2.1. Areas of scientific inquiry - research "scientific achievements"

A. RESEARCH OF MATERIALS AND BUILDING CONSTRUCTIONS

Properties and distribution of building materials and masonry has been widely discussed in [5.1,5.2,5.4,5.5], which shows the latest classification of types and properties of materials, building small, physical characteristics and principles of their research in terms of compressive strength, tensile and shear . it was also indicated on other properties of masonry (absorption, frost resistance, the content of soluble salts, resistance to acids or bases, expansion splinter ceramic thermal formability) valid for masonry structures and potential user that.

There are many criteria for the distribution of building materials. E view of a method of obtaining a distinction is made building materials: natural origin (eg. a stone, sand, clay, wood, reed), and industrial origin (eg. cement, brick, lime, concrete, glass, metals Plastics). Construction products is divided into the - for the purposes of operating the building structure: construction materials (rock solid, wood, plain concrete, steel) and materials not construction (plastics, lightweight concrete, mineral wool, glass). due to the use and functions of the individual elements of buildings, certain products and building materials are part of a variety of technology and construction.

Among the methods for assessing the quality of these materials in recent times much attention is devoted to non-destructive testing methods, successfully used to assess the quality of semi-finished products, end products, equipment and structures in the construction industry e. For non-destructive methods include: acoustic emission, ultrasonic methods, methods of thermal imaging, laser and others [5.1,5.2].

Status of research materials and structures is to justify taking the search for new testing methods of destruction.

B. DYNAMIC RESEARCH STATUS OF CONSTRUCTION BUILDING

The proposed methodology testing of materials and structures - research methodology modal - is a new, original approach in research de gradation of the state. It is used here, one of the newer research tools in assessing changes in the burden of building structures, which are the methods of modal analysis describing the dynamic state of the tested object using vibration signals [5.1,5.2,5.3].

Dynamic properties of building structures have a direct impact on the level of generated vibrations emitted noise, fatigue strength, controllability and stability of the structure. The analysis of the dynamic properties of the structure is identified based on structural models built on the basis of experiments or the real object.

Assessment of dynamic building structures using processes vibration, requires the association structure traits evaluated object with a set of measurement and evaluation processes output. Introduced vibrations to the object are dynamic and keep the conditions of equilibrium between the state of inertia, elasticity, damping and extortion. Disturbances propagation from the source - as a wave a manner dependent, on the physical properties, and the limits of the configuration, dimensions and shapes of buildings. This results, consequently, the power dissipation of the waves, the diffraction, reflection, and the overlap. As a result, the existence of the input and execution states representing the transition characteristics and properties of the structure is formed that can be measured by a number of symptoms characteristic of the processes contained in the starting [5.3,5.7,5.10].

There is a large class of buildings, which allowed for the practice of accuracy can be represented by linear models, for which the practical exploration of cause - effect relationships between the state of destruction and the generated signals are relatively easy.

Depending on the purpose of analysis of dynamic object put different requirements on built models and their evaluation is carried out using various experimental methods [5.3,5.4].

In studies of the dynamic state of building structures you can stack large number of different methods of considerations identified in the work of the author of the characteristics of fitness, which as the main quoted below.

Finite element method (FEM)

A characteristic feature of MES is the modeling and calculation of dynamic object properties and the ability to quickly make changes in the design and evaluation of their impact on the generated vibrations [5,3].

The method of rigid finite element (MSES)

This method is compared with the FE method is simplified, but much faster and less labor intensive. Its main advantage is ease of interpretation and calculation. Using the methods of the SES can be a simple way to study qualitatively the effect of some treatments on the construction noise level. Developed program allows comparison of the noise generated by the plates smooth or ribbed the desired weight and rigidity. The plate is modeled using rigid finite elements (SES) and elements of elastic - damping (EST) [5.3,5.8].

Modal Analysis

The objective is to stimulate modal analysis object into vibration by means of different excitations and measuring the response (vibration acceleration) in one or more points of the object, which is used to structure the model and determination of parameters. Parameters modal model: natural frequencies, damping and eigenvectors (hereinafter figures vibration) are defined at the identification experiment [5.1,5.2,5.9].

Restore vibration using laser interferometry (VPI)

This method allows you to quickly check the serial dynamics of structural elements by obtaining color - three-dimensional image shake the whole structure. Performing the measurement is possible by using such interference, using a radiation source, a laser. The laser beam works contactless state of displacement of vibration surface structure or element [5 .1].

Acoustic holography

Acoustic holography deals with the preparation and use of recording information about the amplitude and phase coherent radiation reflected from the object. By using two beams of radiation and using the phenomenon of interference is achieved the status of surface movements structural element fixed on the hologram [5.2].

Many real elements and structures of construction can be with good accuracy tested under the conditions including a narrow range of frequencies extortion and small amplitude motion, traffic analysis such modeling and optimization, as well as the use of simple identification procedures [5.3].

The experiment tests the identification is performed using a specialized signal analyzer or using a computer as control unit and a calculation interface equipped with a special measuring. As, a force of vibration in the experimental identification used: harmonic signal with variable frequency in a discrete or continuous, pulse signal generated by the strike carried out by a specialized modal hammer or a random signal. For driving loads, in addition to the aforementioned hammer with built-modal force applied to inductors with different operating principles, for example. Inductors, electromagnetic sensitive and broad scope of the generated frequency and high amplitude range forces, to induce large structures for example. Construction used inductors hydraulic high amplitude strength, but a relatively narrow band of frequencies generated. The choice of the inductor depends on the characteristics of the object and the scope of the required frequency force.

The test pulse is relatively easy and fast to carry out, while the results obtained for a number of very broad design. Test harmonic gives more accurate results, but it is more labor

intensive and necessary for its implementation apparatus much more expensive. The test pulse is most often used for preliminary research facilities installed in industrial environments, while the harmonic test for laboratory analysis is required quantitative analysis of dynamic phenomena occurring smokers in the test object. Measured on the object vibration signals, usually accelerate Ginseng and vibration exciting force require processing and archiving.

The basic method of signal processing used in the experiment identify cation is a frequency analysis, which is carried out either by specialized analyzer, or using specialized software implemented on the computer used to operate the experiment. Software of this type is CADA-X's LMS, and in particular the so-called. Fourier Monitor for computers work - station and SAAS software for desktop PCs. Due to the large number of measuring points are closely related to the geometry of the system for archiving tion of measurement data used databases are included in the firmware -making for modal analysis.

C. VIBRATIONS IN THE DIAGNOSIS OF CONSTRUCTION BUILDING

Analyzing the impact of dynamic impact on the building, its walls and elements can each be distinguished: the source of the vibration, the vibration propagation path, receiver vibration [5,3,5,7]. In terms of systemic problem of loads and dynamic interactions are recognized in the form of the relationship between input (forcing vibration) and output (reaction force). Thus, the impact on the dynamic structures (walls, segments walling, masonry components) come from the source of vibration and shake well describe the changes of extortion.

On the basis of statutory (PN, directive: 2001/42 /EC, 2003/35 / EC, 85/337 /EEC) issued a regulation containing clarifications with regard to the permissible parameters and the tasks and responsibilities of manufacturers, authorities relating to the protection and security environment against vibration. The criteria used in the diagnosis of buildings are recognized directly (in the form of preset limit values) or indirectly (related to: stress, strength, cross-cutting move).

The diagnosis of the structure of building the most diagnostic criteria derived from the terms of strength and stiffness, which is determined using the latest modeling method (FEM) and supporting programs (DIANA, ABAQUS, SIMULINK, NASTRAN, PATRAN, KOSMOS, DAADS). The approach to the description of the dynamic properties studied systems (materials) with the values of the parameters of the process of vibration allows the omission of a difficult analytical description (especially for the many degrees of freedom) and replace it with direct measurements of vibration [5.3,5.8,5.10].

Therefore speaking about, the role of vibrations in civil engineering need to distinguish their three aspects and resulting goals of dynamic analysis of elements and structures. The first aspect of the harmful effects of vibration n and construction objects and people necessitates the reduction of harmful amplitudes. The second aspect of the vibrations of useful technology defines the purpose of dynamic analysis , as to optimize processing efficiency of vibration energy into useful work. A third aspect of the use of information contained in the vibration makes it necessary to optimize the reception issues of vibration and the extraction of useful information contained in them (vibration diagnostics).

In programming measurement tasks must first determine (what, what, where, how), what parameters are to be measured. The general rule is as follows: the parts of low frequency’s to measure displacement, because usually they are pained large displacements. At high frequencies the measured acceleration, by being is proportional to the square of the frequency. Speed is measured at average when the displacement values are relatively low [5.3].

Diagnostic criteria for assessing the state of the building can be included directly in the form of a preset size limit (dynamic), for example. Permissible, amplitude displacements billing in certain frequency ranges. They can also be related to the basic size of code (eg. the permissible forces-across weight, stress) or to a specially developed criteria resulting from the

needs of a given situation (eg. the additional impact of fatigue). It should be divided into criteria for the ultimate limit state (durability) and limit states (usually described by the rigidity of the structure).

Comprehensive assessment of the dynamic constructions concerns the study dynamic interactions at the subject and includes:

- evaluation of the dynamic properties of an object,
- an assessment of the conditions of strength, stiffness and stability,
- evaluation of the harmfulness of vibration on the equipment and devices in the facility,
- assessment of nuisance or hazard vibration for people in the facility.

Given assessments are made primarily on the basis of experimental studies of the measurement and dynamic response of buildings subject to vibrations fulfill. It is not always necessary as the diagnosis of a wide range of dynamic, sometimes enough to limit to one or two grades. Most often it will assess the harmfulness of vibration on buildings (for the construction of buildings) and people staying in these buildings, or only one of these assessments.

The recorded waveforms are subjected to vibration processing and analysis, and interpretation. Assessing the harmfulness of the impact of vibration on buildings made in accordance with PN-85 / B-02170:

-using scales and dynamic influences (SWD and SWD-I-II)

-by determining the forces of inertia based on knowledge Forcing of kinematic described by the amplitude of the maximum acceleration and the corresponding frequency,

-the determination of the forces of inertia - using spectral analysis (spectrum) of response.

There is a good discernment standards and testing in evaluating the state of destruction of masonry, representing the state of design, using the vibration signal, which justifies this on skewers in the study.

D. MODAL ANALYSIS IN THE ASSESSMENT OF CONSTRUCTION STATE

Modal analysis is used already at the stage of research and improvement of the prototype structure , during the operation of the building structure as well as modifications to the existing structure. The most common usage in the diagnosis con structure for evaluation of destruction, synthesis building control systems quiver [5.2,5.3,5.9]. As a result of modal analysis obtained modal model, which is an ordered set of its own frequency, the corresponding damping factors and mode shapes corresponding to examinee.

In practical use so far used modal analysis to diagnose trusses (masts, antennas, cranes), diagnosis and diagnosing turbine set of bridges. In most of these applications, it is assumed that due to damage locally changing the rigidity of the structure, causing changes in the modal parameters of the model. Using track changes as vibrations, you can specify an area in which there is damage [5.3,5.4,5.10].

In the studies described this conduct an analysis of the usefulness and of the price performance of two methods (experimental and operational) modal, as well as selected vibration measurement process for assessing the state of destruction of selected elements and masonry buildings, which allows assessment of the respondents in the operation of building structures [5.1,5.2,5.3].

In a study of building materials dynamic stiffness of the material can be determined using experimental modal analysis, and the destruction of material changes during operation are well reflected in the complex measures of the vibration signal.

Achievements in the field of quality control and safety lead to innovative strategies to maintain the suitability of buildings and structures with the use of vibration diagnostics of buildings [5.3,5.5].

4.2.2. Objective scientific "achievements" and results

The search for new, non-invasive methods for assessing the quality of components and structures simple methods and diagnostic equipment are necessary , and even necessary [51].

To diagnose the state of building materials and structures selected estimators vibration signal, because the quality of masonry, the quality of the walls and change the quality of a well are reflected in changes in the dynamic of the structure. For this evaluation used methods of modal analysis (experimental and operational), setting for different materials segments and structures of masonry components of modal models for various test states of destruction and complex measure vibration directly associated procedures modal. The attempt to develop a method for diagnosing the elements and masonry buildings is also important, because of the many outdated building structures, requiring assessment of the condition and make a decision as to further secure their exploitation.

The main area of research described in t white proceedings concerns the assessment of the suitability of methods of modal analysis to describe the changes in the various components and structures masonry. Development of methodologies for susceptibility testing measures the state of using modern methods of statistical inference (correlation, regression, OPTIMUM, SVD) provides, practical tools and research the possibility of assessing the suitability of the analyzed parameters of the state.

Research tasks undertaken, long-term considerations justify the purpose of the main proceedings, which can be presented in the following form:

"The main objective considerations and tests described in the materials' scientific achievement," is to develop and assess the usefulness of the experimental modal analysis method for testing the quality of selected materials and construction elements and the assessment of the suitability of operational modal analysis to examine the state of existing structures construction".

The results of theoretical investigations and long-term research, described in the positions indicated by the "scientific achievements" {and in materials not included in the "scientific achievements" (83 positions - att.7.1)} of the proceedings, details about discussing:

• selected e methods y testing of building materials [5.2,5.4,5.5];

• testing (bench and consumables) vibration, in terms of usefulness in diagnosing the design and construction [5.3,5.6,5.8];

• analysis of the properties and possibilities of applications of modal analysis [5.1,5.5,5.10];

• developing a methodology for the study of modal in construction -law [5.2,5.7,5.10];

• modal testing of masonry structures using EMA [5.2,5.5,5.10];

• developing procedures for obtaining and processing the signals of vibration in civil engineering knows and statistical principles for their development [5.3,5.6,5.8];

• developing evidence for diagnostic strategy vibration of the prices suitability of design of building rations [5.2,5.3, 5.7].

The attempt of diagnose components and structures masonry is important because of the many outdated building structures, requiring assessment of the quality of the state and decide what further secure their operation. For this evaluation designate it for different materials, sections and structures of masonry components models modal for surveyed states of destruction and complex vibration measurement - directly associated procedures modal. also to develop a methodology for susceptibility testing measures the state of using modern methods of statistical inference (correlation, regression, OPTIMUM, SVD) provides practical tools and research the possibility of assessing the suitability of the analyzed parameters of the state.

4.2.3. "Scientific achievements" of conduct

Issues with were realized in a vibration non- disassembly diagnostics in the construction industry, with use of modal analysis methods, allows the synthetic formulation of the scope and the conclusions which scientific achievement proceedings. These include:

1. **Vibroacoustics (vibration and noise) in the construction industry – possibilities and applications in the assessment.**

Taking into account the possibility of vibroacoustic studies [5.3] in many works of this procedure shows the dynamic elements of design, materials and masonry buildings. They presented in these general issues to identify the dynamic state of building structures, indicating the methods and means of practical application of new methods of research in this area. Modeling dynamic state (and its stages) and analyze the usefulness of these results in the optimization of the structure and the ability to use problem-solving structural design construction is an area of interest to many new areas of research centers. Measuring vibration and vibration measurement process used to identify models of buildings, it is important for hearing issues presented in terms of the latest achievements [5.1,5.3,5.7] .

2. **Model vibration signal passage model (the process) by the structure or tested wall element.**

Assessment of dynamic building structures using processes requires a combination of vibration characteristics of the structure of the object being evaluated with a set of measurement and evaluation processes vibration. Introduced vibrations to the object are dynamic and keep the conditions of equilibrium between the state of inertia, elasticity, damping and extortion. Disorders diverge from forcing in the form of waves in a manner dependent on the physical properties and the limits of the configuration, dimensions and shapes of buildings. This results, consequently, the power dissipation of the waves, the diffraction, reflection, and the overlap. As a result, the existence of the entry and execution of the transformation process conditions representing destruction occurring in the structure is formed that can be measured by a number of symptoms characteristic contained in the processes starting from the structure.

Features of the transition of vibration signals for building construction in the conditions of random noise:

1. State the structure of the structure is mapped uniquely by the signal characteristic $\varphi(t,\theta)$, $0 \le t \le T$, $0 \le \theta \le \theta_{aw}$ generated at any forcing. This signal changes over time dynamic "t" and the evolution in their free time -„ θ„.

2. The signal characteristic is a complex process determined φ_o and accidental "n", and the intensity and rate of change characterizes the structure. So while the i-force signal is generated:

$$\varphi_i(t,\theta) = \varphi_0(t,\theta) + n_i(t,\theta) , \qquad t \in (\theta, T)$$

3. The reproduction signal which is characteristic of changes in the structure of the material is perceived as $y(t,\theta)$, and in the simplest case is the response of the structure with the impulse response $h(t,\theta)$ to force $x(t,\theta)$.. Considering the vastness of space "r" construction can write:

$$y(\theta,r) = \varphi_i(t,\theta,r) * h(t,\theta,r)$$

4. The processes starting from structure (selectively) back upon impact destructive processes and to continue the state structure by the positive feedback destructive, distorting a signal and $\varphi_i(t,\theta)$..

5. For a fixed value of the life of $\theta = const$ all building objects are treated as linear, stationary systems, the properties of which clearly describes the impulse response $h(t,\theta,r)$ or its transform: Laplace operators $H(p,\theta)$ or Fourier spectrum $H(j\omega,\theta)$..

The received signal output anywhere in the building is a weighted sum of the responses to all elementary events $U_n(t,\theta,r)$ in the respective dynamic sub-systems of the pulse transfer function $h_n(t,\theta,r)$. These interactions are adding up, with the change of the reception signal "r" is also connected with the change of transmittance [5.3] . The model is the cornerstone of deliberations in the dynamics and diagnosis of the state of degradation of materials, components and structures - using vibration and procedures modal analysis.

3. Susceptibility testing and determination of parameters of vibration describing the changes and evolution of degradation of buildings and masonry structures.

In the studies of this problem fully described with the available systems for information and testing oscillation, showing practice of measuring and converting processes of vibration [5.3,5.8] . The search for a good diagnostic symptoms, as defined in the time domain, amplitude and frequency spectrum supported the proposed test procedures the sensitivity of the type: PCA BEDIND, OPTIMUM and SVD [5.3,5.6]. So determined vibration measurement process used in further research of cause - and effect, which is the model inference. Among the assessed different models of diagnostic simplest, because regression models have proven to be effective - high R^2 [5.1,5.2,5.3]. Discussed the main elements of statistics on inference cause - effect, aimed at multi-criteria method of selecting the best measures for the destruction of the tested materials, used further development of research results [5.3,5.10] .

MATLAB, STATISTICA, EXCEL, STATGRAF are examples of programs the system used for statistical data analysis, charting, to operate on databases, perform the transformation d rations and application development.

Available software for testing vibration perfectly facilitates the implementation of research and thus deduce the cause - effect [5.3].

4. The use of modal analysis in the diagnosis of the materials and structures degradation state

Opportunities in assessing the condition of the structure, which forms the basis for motivating undertake research and which sets the range of issues to practical solutions are presented based on assumptions methods of modal analysis. The said base and environmentally damaging methods of modal analysis, and contains basic information that is necessary for implementation, and identification experiment. According to the principles of research methodology is detailed objects of research (research materials - masonry elements and segments), test stand (for destructive testing and testing destruction) and test conditions. Agreed measures and the modal parameters for the tested materials and structures [5.1,5.2, 5.3].

5. The use of developed statistical inference procedures

Results and development implemented by the proposed methodology conduct the research, taking into account the results of stand tests and consumables with their development Cause of - effect relationship and statistics. In order presented here the results of canvassing and prepare the data for further processing procedures designate estimate that the

process of vibration in the functional form of the estimators numerical (vibration discriminant), the results of the method OPTIMUM, SVD, correlation and regression [5.3].

Used elements of artificial intelligence research led to the development of the program SIBI, performing the sequence of events: SIBI - data - visualization - sensitivity analysis - model inference - the goodness of the model R^2. Presented each an example of the results of these studies, illustrate the nature and seriousness of the problem under consideration, verifying the suitability of the proposed procedures research. Developed in research methodology for the application of vibration and modal analysis to assess the state of degradation of materials and structures is described in detail in the materials of conduct [5.3,5 .5,5.7].

6. Description of changes in the design or technical system, together with an analysis of the effects of degradation, taking into account environmental impact and safety tasks.

Content basic and important research in the field of building materials and structures, are the reasons for the degradation of the state of the elements and structures in operation. In this regard, it highlights the problems of modern exploitation strategy in the construction industry, pointing to achievements that should find its place as the innovation perfecting existing solutions. Risk, safety, rules, methods and tools for testing the quality of support available information techniques used in construction practice, the scope of the proposed accomplishments utilitarian this procedure [5.2,5.3,5.10].

4.3. The rating of studies books and publications

Basic scientific achievements in one title series of books and articles that make up the "scientific procedure" can be presented in a number of problem groups. Their characteristics included in the basic content of publications (recorded for scientific achievement) is elaborated in a number of publications, not counting the mainstream publications and shown in Attachment 6,and partly 7, in section 8.1 of Attachment 8.

MAIN PROBLEMS scientific achievements include:

- testing of materials (production, old objects);
- search for new, non-invasive methods for assessing changes in the state;
- review of the methods of modal analysis in construction;
- programmable examination of the degradation (acquisition, processing, development of statistical inference);
- the proposed strategy for the use of building structures.

The problems have been examined in detail and described (formulation of the problem, hypothesis, the main goal, specific objectives, scope of work, results, conclusion) in many publications [Attachment 8].

DEGRADATION OF DESIGN AND CONSTRUCTION describes in detail the considerations in respect of:

- selected elements of the theory of degradation;
- description of test methods and modeling of degradation (unimodal, multi-criteria);
- describe and study the effectiveness of strategies available to maintain fitness.

A detailed description of these considerations and proposals for construction is in various publications - Attachment 6.

Modal analysis (MA) for the degradation test building materials and structures addressed in the discussion as the mainstream inquiry, especially experimental, includes a description of and research on the actual construction works. This applies mainly to:

- description of the nature and types of MA;
- characteristics of the theoretical MA;
- stand tests in experimental MA;
- presentation of the essence and research results in operational MA.

Many years of research in this area was published in many important positions in the books and articles of different rank (with IF, conference, domestic and foreign), the list of which is contained in Attachment 6 and 7.

MEASUREMENT SYSTEMS used in research vibration diagnostics and experimental and operational modal analysis, the latest hardware and software solutions. From the viewpoint of experimental modal analysis methods can be divided into:

1. A method of driving loads of the multiple actuators for the excitation of vibrations of one embodiment;

2. The method of forcing movement of the one or more points in order to measure the transfer function.

Practical implementation of these methods requires the selection of appropriate measurement systems. In one group of methods is carried out manually moving system so as to force the vibration in accordance with one embodiment of the vibration. This requires a complex system of control of actuators in order to obtain the appropriate phase shifts force. The second group used any force depends on the type of the object. A set of apparatus to carry out experimental modal analysis is made up of components:

- measurement system forcing traffic and response measurement
- the signal conditioning (pre-processing)
- the collection and processing of signals,
- forcing the system to generate a signal,
- the vibration excitation.

Their recognition and adaptation to specific applications in the diagnostic components, materials and structures are presented in terms of:

- description and measurement calibration kit for the diagnosis of the vibration;
- configuration and system testing VIOMA;
- adaptation of the LMS TEST.XPRESS requirements modal analysis procedures;
- develop and compliance test conditions;
- software implementation methodology of testing (acquisition, measurement, selection sensitivity, models, quality assessment).

The easiest for the handling of the solution is to use signal analyzer, but the most modern, giving the greatest potential solution is based on a workstation and a specialized interface measurement. The basic operation performed by all used in modal analysis measurements instruments is analog-to-digital, which allows the use of digital signal processing techniques to determine required by the modal analysis of the characteristics of estimators.

Detailed description of the problems depicted vibration measurement during testing and using modal analysis methods is presented in a number of works, mainly [5.3] and the work list in Attachment 6.

CASE STUDIES presenting detailed results of laboratory tests and consumables, respectively on materials, components and construction works reflect the capabilities and usefulness of methods of modal analysis in the diagnosis of the state of degradation.

Methods of identification in the research building construction (including construction materials) are utility methods to estimate changes in operating structure. Modal analysis of its

varieties, which are realized increasingly used by civil engineers, and the modal model accurately reflects the destruction of objects.

The search for mapping models with models of vibration modal bench in research and studies on real objects, allows assessing the similarity of the models, the accuracy of decisions and effectiveness of the methods.

In many works of this procedure details the research of selected masonry, studies various segments of masonry and sample test results of building structures.

It is relatively simple study of modal elements and sections of masonry in the laboratory, where experiments can be successfully applied active and passive, facilitating the construction of models cause - effect.

In practical applications implementation of research modal facilities, studied the system is too large and has too much mass to be able to enforce the corresponding amplitude of movement in conditions of active experiment. These constraints are mitigated by the use of methods of modal analysis undertaken on the basis of measurements carried out during normal use of the building. The result is a modal model of the structure which can be applied to solve many engineering problems, for example. To the synthesis of building systems, analysis of behavior of the structure under different excitations, modifying dynamic properties, minimize radiation of acoustic energy, fatigue analysis.

The search methods for non-destructive testing of materials and structures points to the possibility of using modal analysis in the assessment of their degradation, as shown in many publications mainstream considerations [5.1,5.2] and in Annex 6.

STRATEGY RESEARCH DEGRADATION CONSTRUCTION - as a result of the practical use of methods of modal analysis, in practice, the use of systems design and construction.

Modern structures and machines in industry, construction and transport are very powerful, yet complex and expensive. Any accident, damage and stop the associated often cause large economic losses and environmental hazards. For the purpose of maintaining the suitability of the process of use, safety and environmental protection is developing the theory and practice of the maintenance, improving the existing exploitation strategies. Constantly develops and improves rarely even used in practice operating system for exchange of prevention facilities, developing more and better models of such a solution.

Effective exploitation strategies, obtaining information about usage and operating the technical use, of fast reliable and user - friendly information about the state of technical diagnostics. Modern information technologies provide a lot of original solutions in the area of acquisition, processing and redundancy information to facilitate modeling of cause - effect relationships, inferences about the state, forecasting. In the literature, the following strategies are known operation of machinery: the reliability of economic efficiency, the amount of work done, according to the technical condition and proposed in this paper a new concept for safe and rational exploitation - a strategy tolerated damage [7.6,7.8].

Difficult way data mining to generate the knowledge needed to implement the chosen strategy operation causes further problems forcing the development and construction of the system agree the decision and dedicated diagnostic systems in a multi-dimensional approach - assessing the quality of contemporary design.

The processes of destruction of structures and technical systems need an input to supervise changes in their status, especially at the stage of operation. Methods and means of modern technical diagnostics, including methods of modal analysis, are a tool for diagnosing the technical condition of which allows rational and safe use of [7.6].

Summary of the operational strategy of tolerable faults in the technical state of the system design and equipment is reduced to change the trajectories which moves the actual

position of the technical state of the system in such a way that at the time of completion of the use of point state of the system was as close to the point of the boundary condition [7.8].

The observations allowed us to refine the definition of strategies tolerated of damages, supervisor detected growing damage to the dedicated diagnostic system, as the distance of a symptom of the state of the limit value in the features of the state. Contents of this problem inspiration to continue to work hard in the subject engineering operation of machinery, especially in the practical implementation of technical diagnostics, improve methods of diagnostic tests and ways of calculating economic effects, and therefore the issues of rational use [5.2,5.5,5.8,5.10].

Substantive determine the profile of achievements can further define the scope of work of theoretical and experimental including:

1. Research model (elements of masonry, steel beams, masonry segments) and operational (masonry structures, machine parts and assemblies) in the vibration assessment of the degradation of components, materials and structures.

2. Examination of the effectiveness of the tools and procedures of vibration and modal analysis methods in the test area degradation in the quality of materials and construction.

3. Implementation of studies for the analysis methods for identifying the status of materials and design and construction to reduce the set of diagnostic parameters.

4. The use of modal analysis in the diagnosis of the state of degradation of building materials and structures.

5. Evaluation of the implementation of information technology in the organization and management systems, construction and manufacturing.

6. Practical indication procedures for applying virtual engineering in the areas of buildings and constructions (diagnostics, reliability, design, construction, technology, production, operation, safety, environmental protection).

7. Practical aspects of the application of the proposed solutions in the area of construction, engineering, production, quality creations and operation (operation and maintenance of airworthiness) - Proposals for the implementation of the strategy by the state and tolerated damage to the system to maintain fitness in the construction industry.

8. Analysis of the available solutions currently used diagnostic tools, research equipment and testing procedures changes in components, materials and structures and mechanical objects in the construction industry.

The study area of the main "scientific achievements" refers primarily assess the suitability of the process of vibration and modal analysis methods to describe changes in the status of various elements, segments and building and construction.

Verified virtually susceptibility methods for modal analysis, of degradation building and machine structure – is shown to the satisfaction of practice differences, between the structure and damage. It is possible, therefore, to determine the risks of building structures and machine based on the study of the frequency of vibration and form, using operational modal analysis.

These issues, as demonstrated in the descriptions of "scientific achievements" also have more general implications beyond the basic issues, engaging study of the degradation of components, materials and constructions methods of modal analysis.

5. SCIENTIFIC, EDUCATIONAL AND ORGANIZATIONAL ACHIEVEMENTS

The scientific activity candidate deals with the problems of testing of materials and structures, engineering management and information technology used in the management, planning, implementation and development of the experimental results. Innovative activities in the implementation of methods to determine the state of destruction of building materials and strategies for development of quality products and services, which is a management philosophy that is more and more recognition, and based on a systematic improvement of the quality of the products of, the areas of current scientific inquiry.

Long-term research fellowships at Berkeley University in the US, EAFIT University in Colombia, Technical University of Chemitz in Germany and Khmelnytsky University of Ukraine provided the enormity of experience cognitive and triggered many research challenges in the field of engineering, management and non-destructive methods for testing the state of degradation of building materials and structures. this is evident in the ongoing research projects, intensive international cooperation, as well as many original scientific works.

GENERAL CONSTRUCTION on discipline special interests of the candidate, including:

1. **Mechanical engineering construction -** mechanics and dynamics of structures, modeling methods and examination of the processes vibration in construction, building materials.
2. **Methods Modal Analysis (theoretical, experimental and operational)** - the procedures and means to determine the state of degradation of materials, segments and structures in a non-invasive method of testing, does not cause destruction of the structure and / or test material.

The list of main topics in the field, accomplishments include:

[In the area of the dynamics of building structures, models, analytical, numerical and experimental methods applied mechanics, dynamics of the technical system and control the degradation of the state structures and systems technical]

- developing new procedures research methodology in terms of the original strategy for the development of measurement data;

- to develop a model of transition vibration signal by masonry structures in order to assess changes in their degradation under variable load;

- verification of the results of the suitability of methods of modal analysis to evaluate the destruction of elements and structures of masonry;

- developing a methodology for the study of destruction of elements and sections of masonry using the estimators of vibration;

- developing a system of acquisition, processing and statistical inference for vibration signals in the study of destructive elements and masonry structures;

- verification of the suitability of the **OPTIMUM** method and the **SVD** method in the assessment of statistical estimators examined vibration of masonry.

The achievements of the research presented in numerous publications, books and articles of domestic and foreign and conferences allow to conclude that the candidate is already recognizable in the discipline: construction .

5.1. Other scientific achievements

These include mainly the issues of mechanics and dynamics of building structures, the problem of vibration and modal analysis applications in the diagnosis of buildings and technical systems in the building industry, the assessment of material quality and construction elements as well as the destruction of the state in the evolution of building systems and engineering.

Production engineering control systems as fishbone and manage production management at the places related to areas of interest in professional and scientific, using methods and means and tools of research in the basic interests.

In this subject can be distinguished two areas of interest:

I. ENGINEERING QUALITY PRODUCTION

1.Impact on the quality of a product

1.1. The principles of quality management (ZZJ) - general laws (rules, standards of conduct) governing processes impact on quality.

1.2. Methods of quality management (MZJ) - consciously and consistently applied procedures (set of activities and resources) used to achieve a particular purpose of the tasks associated with quality assurance.

1.3. Tools Quality Management (IBD) - used for direct interaction in various stages of quality assurance and management (by collecting, organizing, and presenting the results of the tests and measurements of the quality).

2.The methods of quality assurance

2.1. Design methods for quality - used in the phases of the identification of needs and formulation requirements in the design of products and processes, and preparation of production.

2.2. Control methods and quality control - mainly used in the production.

II. MAINTENANCE OF CONSTRUCTION AND TECHNICAL OBJECTS

1. Total Quality Management (TQM) as a strategy for development of quality products and services, which is a management philosophy that is more and more recognition, and based on a systematic improvement of the quality of the products of, inherent in the process of inspiration and pulling people behind him by the plant.

2. Total Productive Maintenance (TPM) - a system airworthy Task Force (productivity), machines and equipment used in production strategies. TPM is a modern way of managing technical systems, in terms of maintaining an airworthy condition, technical readiness and safety of operating facilities.

3. Quality function deployment - virtual, the purpose of which is complete and correct to identify the needs and expectations of customers, the impact on their features and specifications of the product and unambiguous determination of tasks for organizational units of the company.

4. Management Information Systems in Production Engineering - supporting the management and operation of fixed assets based on modern information technologies.

5. For scientific achievements of selected areas of interest include the developed issues relating to the issue:

- risk analysis and safety evaluation of " quality " of materials and constructions methods applied mechanics;
- maintenance and evaluation of the suitability of building methods from the "quality";
- innovative research and description of the operation of building materials and structures using the methods and tools of management ;
- computer systems and procedures for testing the suitability of facilities, the proposed algorithms acquisition, processing and visualization of production engineering ;
- the new elements of the strategy management maintained em suitability of building structures;
- non-invasive evaluation of " quality " of newly manufactured building materials;
- methods for the assessment of long-term degradation of building structures.

The results of this work and new concepts have been presented at scientific conferences and publications in scientific and technical (Attachment 6).

5.2.Specification of scientific achievements

Comprehensive scientific achievements and professional candidate includes: original creative works, monographs and textbooks, research projects, commissioned work and technical expertise, which are listed in the application. Published achievements candidate includes (according to the statement of quantitative scientific achievements), a total of more than 83 positions, including 8 papers, 17 publications, 21 conference articles of domestic and foreign numerous implementation works and many works of special (Attachment 8.1. - application of documentation).

Summary of parametric whole scientific achievements are summarized in table 1. Achievements in this area was divided into two periods: before and after obtaining a doctoral degree.

Table 1. Summary of parametric of whole scientific achievements

Type of output	Before doctoral degree	After doctoral degree	Together
MNiSW points		445	445
Publications in JCR	-	9	9
Compact publikations - monographs	-	8	8
Monography chapters - including international	-	3 2	3 2
Articles in ZN and journals - including international	9	17 14	26 14
Conference materials - national - international	2	 12 7	 14 7
Student books	-	0	0
TOGETHER	11	72	83

It is worth emphasizing that scientific articles and papers were published in Polish sources, and in 5 European countries, South America and the USA. Publications that have been published in international journals and conference proceedings published in the following countries: Denmark, Greece, Colombia, USA, Germany, Ukraine, Slovakia.

BIBLIOGRAPHIC DATA

The total impact factor of the list Journa1 Citation Reports (JCR), according to the year of publication [Attachment 8.1]: **IF = 15.756**

Citations - 18

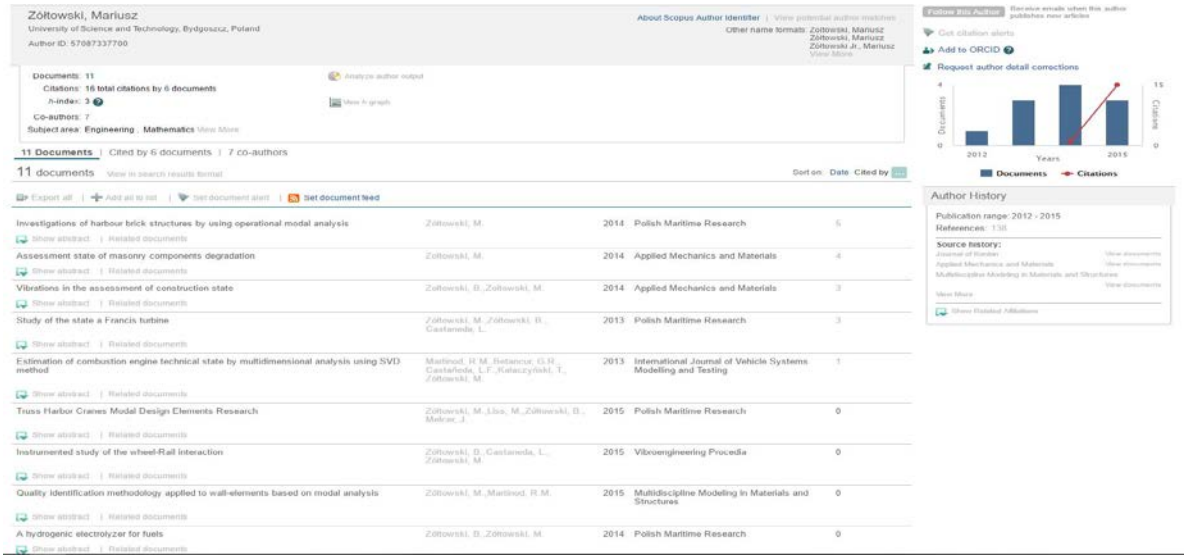
SCOPUS:	**WoS**
Citations – **16**	Citations – 2
h-index – 3	**h-index - 1**

MNiSW points – 445 pkt.

	Total number	Total number of MNiSW	Total value of MNiSW
All together	70	57	445.000
Reasearch articles in national journals	30	24	213.000
Reasearch articles in international journals	11	7	34.000
Article in profesional Polish journals	3	3	12.000
Scientific book	1	1	25.000
Popular science book	1	1	12.000
Monograpf	4	4	72.000
Book chapter	17	17	77.000
diagram			

Google

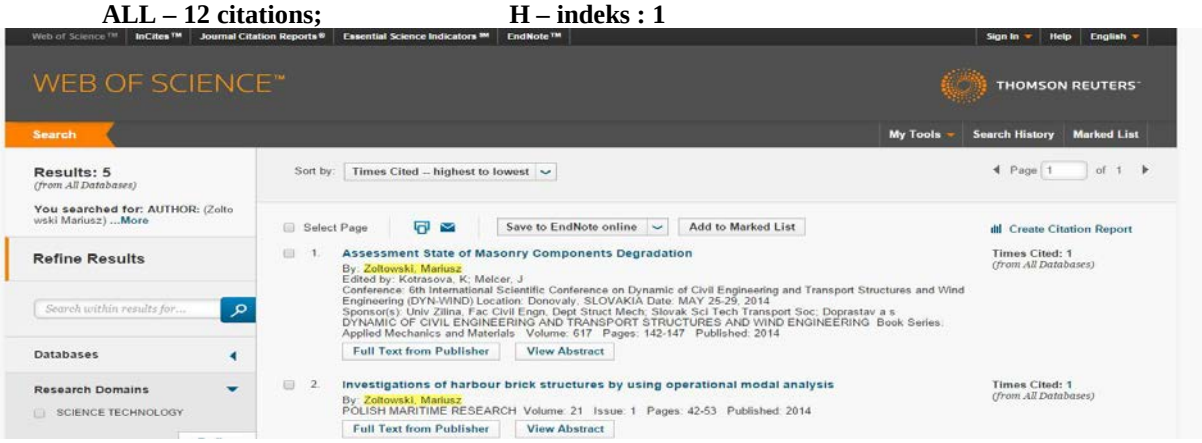
Citation index	Total
Citations	**135**
h-indeks	**7**
i10-indeks	**3**



Web of Science Core Collection

Self citated: 2014 – 10 citrations
2013 – 1 citation
2011 – 1 citation

ALL – 12 citations; H – indeks : 1



5.3. Commissioned studies and research projects

The execution of 10 industrial developments concerning the degradation of the elements, segments, building materials and structures, machines, methods of applied mechanics, including:

• establish a system for maintenance of construction machinery;
• strategy airworthy building structures;
• co-author of the study "Elements of the management and operation of machines";
• developing procedures for the determination of stability diagrams and function values FRF;
• laboratory testing of components using modal analysis;
• performance testing of brick masonry buildings in rural;
• establish a system for information management operation of construction machinery in the manufacturing plant;
• assessment of the quality of steel materials methods of experimental modal analysis;
• tests carried segments of masonry using modal analysis;
• QFD methodology for the virtual coordination of product life cycle in the organization.

In total, we made many valuable studies in the area of materials testing masonry, management and operation of construction equipment useful in the practice of the operation of businesses. The achievements presented in these studies have been and are used by some businesses and their employees.

Research Reports - cooperation

Developing active international cooperation in the development of methods for testing of new products, as well as the state of degradation of the buildings with the countries, which include: USA (University of California, Berkeley University), Colombia (EAFIT University), Germany (Technische Universität Chemnitz), Khmelnytsky University of Ukraine , Slovakia (Faculty of Civil Engineering, University of Žilina), and Research Center - University of Žilina. The experience gained during study visits and internships, and research contributed to the development of science, consultancy, publications and research practice. A brief overview of documentary evidence of this cooperation is presented below. The planned further active cooperation to further research, exchange of experience - accompanied GRANTS, publications and development.

Active work of scientific - research includes a variety of initiatives, the most important (described in detail in Section VI of Annex 4 of this document) is at the department in the implementation of 7 research projects, many foreign visits as internships scientific, 7 papers and expertise, and 3 projects university. The most important are:

1. Contractor in the research project by the Programme Innovative Economy, years 2009 - 2012, Vrtual technics research status, security threats and environmental operated machines - WND-POIG.01.03.01-00-212 / 09, Bydgoszcz, Poland from 2009 to 2012 r.

2. Contractor in the project of the National Science Centre (NSC): Research risk f e s loss of airworthiness ś you to environmental system ó the technical. Project no. 4832 / T02 / 2010/39. WIM, UTP, Bydgoszcz, 2010-2013.

3. Partner of the international research project (contractor) research group GEMI conducted at the Faculty of Mechanical Engineering of the University EAFIT in Medellin,[27] Colombia, 2011. Dir.: Prof. Dr. Eng. L. Castaneda.

4. Partner of the project Knowledge Center FACC JPI: Modeling of Agriculture of the European Climate Change for Food Safety, FACC MACSUR (P110) Bydgoszcz, Poland 2013. Dir.: Prof.. Eng. W. Bojar, prof.UTP.

5. Partner of the research project at TU Chemnitz Professur Strukturleichtbau und Kunststoffverarbeitung (SLK), Chemnitz, Germany 2013. Dir.: Prof. L. Kroll.

6. Partner of the projection research (contractor) research group: The Berkeley Micromechanical Analysis and Design (BMAD) at University of Berkeley, USA 2013. Dir.: Prof. dr. Eng. A. Pissano.

7. Contractor of the project OPIE 01.04.00-14-067 / 13 under the Operational Programme Innovative Economy, Measure 1.4 for the project Fri. "Innovative measures for de-icing vehicles and ground infrastructure." Project duration: 06.01.2014 to 30.11.2015 r

5.4. Characteristics of teaching activities

Activities of teaching and educational conducted since 2008 he devoted Candidate lot of care and energy, leading classes / lectures, seminars, laboratories, practice / theory and design of buildings, machinery construction , technology, construction , basics of machine design, dynamics and operation of machines and structures .

For the purposes of the teaching process developed specific curricula conducted subjects participated in the work related to the preparation of teaching aids, laboratory construction jobs and develop instructions for exercises. In addition, he participated in the development of 8 work (also co-author) in the form of manuals and scripts academic (as listed achievements in research work: Attachment 7 . He was a promoter of many work undergraduate (21) and engineering (20) - Attachment 8.4 and 8.5.

He led the development of the basics of the educational process on different specialties to create study plans, framework curricula for individual subjects and developing scripts and manuals, as well as writing and executing scripts video teaching. He organized, together with a team of specialized laboratory testing and maintenance of fitness machines, for which he designed and built laboratory positions, enabling the education of students. Led by its classes have a rich knowledge of substance innovative approach to these issues and are related to the needs of the economy.

For special achievements in the business of teaching - educational Candidate include:

- management and direct participation in the development of curricula and teaching content of many subjects in the area of production engineering , safety and the construction and operation of machines and structures ;
- to introduce and develop teaching and problem activating teaching methods using information technology and audiovisual means;
- expansion and modernization of teaching facilities;
- developing scripts and methodology studies.

For several years, the candidate took care student scientific circles, and he held several educational and organizational. It also participates in the exams conducted diploma and promotion, as well as conducting seminars teaching and research.

For the overall activity of teaching and education received a number of awards and distinctions (list is provided in the application).

While working at the University as an academic teacher conducts classes virtually all types of lectures, laboratory exercises and auditorium and designing and seminars. Selected items are shown below:

a) items that taught (full-time and part-time):

- mechanics theoretical;
- mechanics used in construction;
- building Materials;
- costing in construction;
- geometry and technical drawing (CAD).

b) exercise and laboratory classes, which ran:

- mechanics applied;

- mechanical structures II - exercise, the project;
- testing of building materials - exercises;
- statics building structures - exercise, the project;
- costing in the construction industry - training project;
- drawing techniques MANUAL (CAD) - exercises, project.

The candidate actively participates directly in the activities of education and teaching at all times in a period of six years for directions "Building Construction" in various universities of the Kujawsko - Pomeranian. The work of teaching and education were carried out at different times in the following universities: Faculty of Civil Engineering UTP in Bydgoszcz, Direction of Production Engineering at the Faculty of Management - UTP in Bydgoszcz, Direction Construction in Kujawsko Pomeranian School and the School of Bydgoszcz.

Member of the Departmental Committee:

- member of the diploma commissions;
- member of the faculty study commission.

TEACHING:

- didactic work (lectures, exercises auditorium, laboratory exercises, projects transitional consultation) in 3 schools: KPSW, BSW, UTP;
- the development of teaching programs for courses of Building Construction (Building Materials, costing construction, dynamics of building structures, information technologies in the construction sector);
- 2 vintages tutor students in the UTP;
- 3 tutor student placement (year 1 month);
- 6 tutor students individual course of study;
- promoter of many theses (engineering undergraduate);
- author of books (scripts) used in academic teaching;
- a member of many committees and diploma exam.

Teaching is characterized by a rich theoretical knowledge, innovative approach to these issues, and linked to current and prospective needs of the economy. They are always well prepared in terms of methodology and implemented at the high professional level, which is confirmed by the results of observing them.

He managed the development and organization of educational process on the basis of various specialties to create study plans, framework curricula for individual subjects, and developing a teaching material in the field of building materials, structural dynamics, and production engineering.

Candidate for special achievements in teaching activities include:

- management and direct participation in the development of curricula and teaching content of many subjects (KRK) ;
- to introduce and develop teaching and problem activating teaching methods using information technology and audiovisual means;
- expansion and modernization of teaching facilities.

With its distinctive business candidate received a number of honors and awards:

- rector's awards (annual) for achievements in research and teaching in the years 2012, 2014 and 2015.
- prize - special annual (financial) for outstanding young (35 years old) academics - in 2013;

He participated in the trainings:

- time management and team work;
- acquisition projects and manage their execution;
- planning and financial management;
- the strategic management of the university.

5.5. Achievements in the organizational activities

Organizational activities integrally related to the years of work in the field of training and education and research triggered a number of interests, initiatives and even passionate organization. Activity mural candidate is associated with membership in a variety of organizations and associated cooperation with industrial plants.

COOPERATION WITH INDUSTRY

Verified practically studies the author's assumptions of research methodology using available varieties of modal analysis - as a tool for applied mechanics construction - are used in many research centers and industry in Poland and abroad (Germany, Colombia, Ukraine, Slovakia).

In order to identify the main problems studies when assessing degradation (destruction) components, segments and building structures using the vibration signal (in the methodology of modal analysis) used available masonry components, which usually are the basic building blocks of the walls of a number of buildings. Procedure, as the methodology of implementation of research segments and masonry structures are shown in Fig.3.

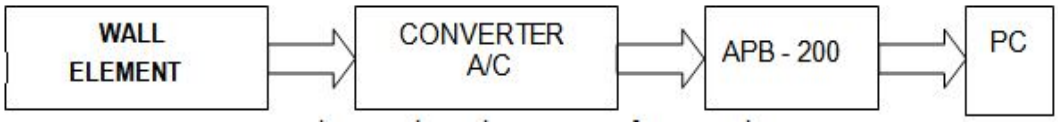


Fig.3. The structure of the research system

Implementation of research in real conditions of selected plants creates a lot of interesting and challenging situation, cognitive, and their preparation is time-consuming and costly. Hammers modal, fitness machine and measuring software LMS and some of the tested building materials used in industrial research are presented in Fig.4.

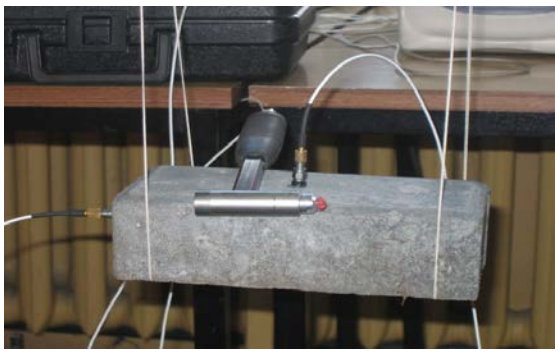


Fig.4. View the elements and positions of measuring modal analysis above

Implementation of research and processing of vibration signals for different materials establishments, for different times of life test piece construction, carried out is practically a system of measuring LMS TEST.XPRESS – Fig.5.

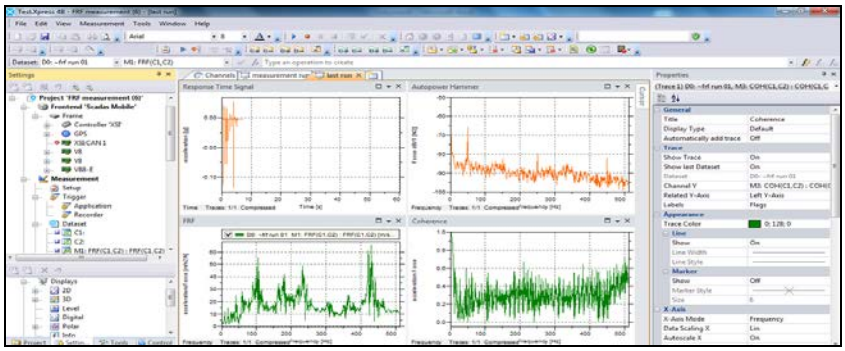


Fig.5. Visualize fragment of test results using the LMS

This software allows you to easily carry out the proposed algorithm examination of the degradation of components and materials, masonry, including any building structures (including long-term). Diagrams stabilization (fig.6) obtained on modal analysis to evaluate and variables steel structures, including material degradation construction products, including aging, fatigue and corrosion.

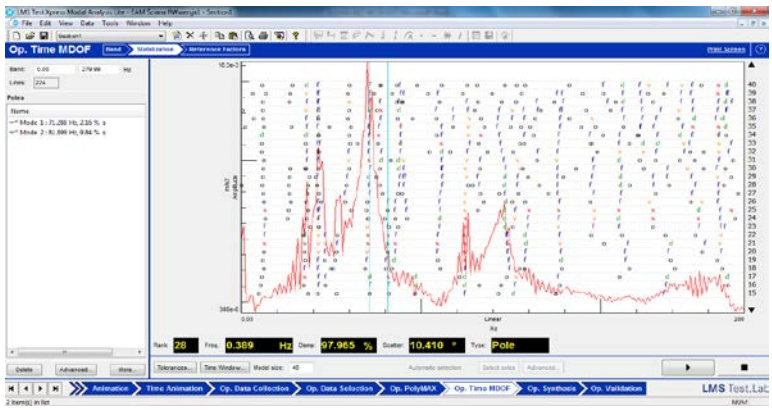


Fig.6. The sample of stabilization diagram

Tested building products and scope of the study

Examination of the basic materials of construction used in the industry includes representatives : - (EC6V) ceramic elements ; - (EN 771-1) bricks, blocks, elements POROTHERM ; - silicate (EN 771-2) cellular concrete (suporeks) and the element y concre e ; (EN 771 -3) - brick paving , paving, concrete block.

Tests include:

-examination of existing structures using methods of experimental above and operational modal analysis,

-study elements masonry with the use of operational modal analysis;

-research diagrams stabilization of frequencies highlighted the process of destruction;

-study the function FRF for components and materials, walls of segment;

-management and operation of the property.

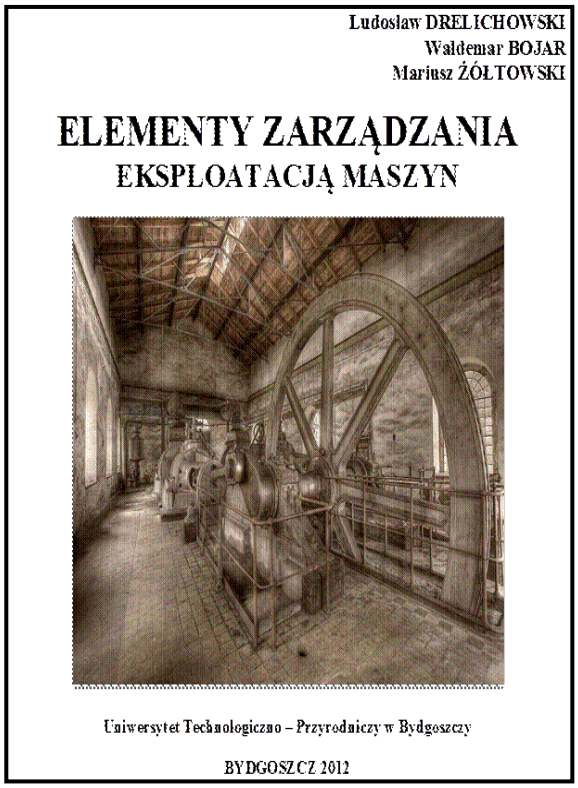
The list of companies that are particularly often use the achievements in the field of vibration testing of materials and structures in the industry:

- PUBR sp. z oo , Rail Vehicles PESA Bydgoszcz SA , Construction Company Kambud Tumlin - Coals , PW And - Rem - Bud , Regional Dairy Cooperative , GRAFPOL Bydgoszcz.

Books for industry

1 - ***RESEARCH AND DEVELOPMENT OF INNOVATIVE ECONOMY - [Attachment 7 pt. 5].***

2 - ***MANAGEMENT ELEMENTS OF MACHINERY OPERATION - [Attachment 7 pt.6].***



However, the special noteworthy, that many of the demands resulting from theoretical considerations, and realized research found it practical application, on a number of useful solutions in construction, and production engineering.

Lifetime Achievement organizational candidate was several times distinguished different types of awards and diplomas.

Recognizing presented in publications references series related thematically with materials describing the accompanying activity, confirms by it to realize proposed his achievements Scientific him, and justified the essence of a broad scientific activity and publication- candidate.

6. Summary

In In summary presented the achievements of publishing and scientific achievements in the subject of the proceedings can be synthetically of indicate the activity in specific areas:

- ***Scientific activity***:

• authorship of more than 80 publications,

• participation in several conferences,

• participation in the organizing committee and the scientific national and international conferences,

• participation in projects and realization of lectures abroad,

- "***Recognition in the environment***":
• invitation to studies of joint Polish and foreign scientific publications,
• reviewing journal articles foreign and domestic,
• invitation to the editorial committees;
- ***Scientific achievements and contribution to the development of the discipline***:
• 8 thematic monograph,
• total scores of scientific achievements by scoring 445 points Higher Education,
• chapters in monographs,
• award of the Rector of the University of Technology - Life Sciences in Bydgoszcz in the category for scientific activity.

In summary, this area of activity should be noted that the candidate is actively involved in both his alma mater, as well as on the national.

The candidate has also received considerable international authority, as evidenced by:
- qualifying reported his original papers to the agenda of the conference of foreign
- the inviting to foreign centers of scientific - technical in order to present the achievements and directions of scientific research.

The above achievements Candidate allow you to define the nature and essence of contribution to the development of science and applied research, which could include:
- the development of research in the field of construction and the design life of buildings;
- improving discipline "construction" in terms of the needs of modern design, durability and reliability of the products, and their rational use;
- the development of a methodology of using different modeling tools and description of the study design and quality of machines in construction;
- the development of research methodology quality construction and equipment specific to the operation of construction machinery.

Mariusz Żółtowski