DYNAMICAL MODELS CONFIGURATION OF JIGGING SCREEN ANALYSIS

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Abstract *: A mechanical system could be explored by two approaches via the analytical and experimental methods which leads to describe dynamic models like : real-time model , frequency domain model and modal models. This paper focuses the choice and the configuration of dynamic models used in civil engineering plant equipment analysis as jigging screen.*

1.INTRODUCTION

The dynamic model concept is differently perceived in the technical and scientifically papers and journals. Thus ones of the authors have considered this model like a mathematical or physical model with concentrated parameters (**m, k, c**) . Another deems that the dynamic model could be characterized by a modal model with modal parameters ($\mathbf{m}^*$, $\mathbf{k}^*$, $\mathbf{c}^*$).

A mechanical system could be fully described by a frequency domain model via a transfer function matrix $[H] = [H(\omega)]$ choose as dynamic parameter.

This matrix will be determined via the experimental amplitude-frequency and phase-frequency diagrams exploration. A connection between these models was been presented in the papers *[1]*.

This paper focuses the approach methods that lead to determinate the main parameters describing the dynamic behavior of a mechanical system as well the adequately dynamic models. As the same time a connection between the dynamic models is showed as well the possibility to go by a model to another one with special relevance of two-mass jigging screen.

2.APPROACH METHODS

The dynamic behavior parameter's configuration of a mechanical system will be in depending on dynamic model used.

For a mechanical system it could be taken in consideration two approach methods namely : the analytical method and the experimental one. The two approach methods are shown in the figure 1.

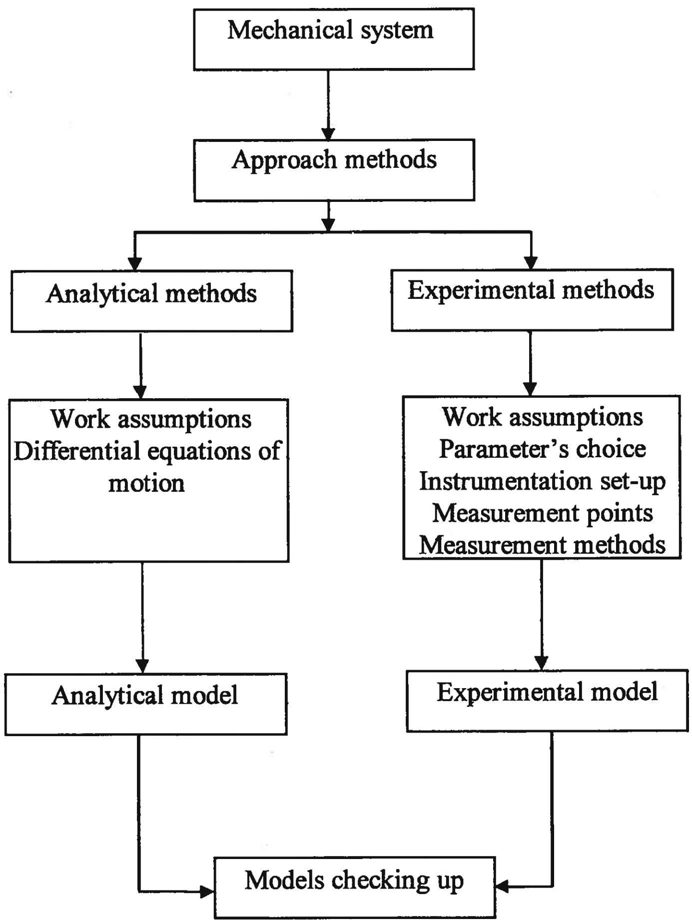

Fig.1. The approach methods

3.ANALYTICAL MODELS

3.1.Real-time model

In the real-time domain , the system configuration parameters are selected as deflections in the structure determined points. The differential equation of motion for this model will be written using analytical methods like : D'Alembert principle , virtual work principle , Lagrange differential equations of second kind ; etc.

This differential equation appears as follows :

$$[M]\{\ddot{q}\}+[C]\{\dot{q}\}+[K]\{q\}=\{F\} \quad (1)$$

Where :

$[M]$ = mass square matrix
$[C]$ = damping square matrix
$[K]$ = stiffness square matrix
$\{q\}$ = configuration parameter column vector
$\{F\}$ = external force column vector

This differential equation is always coupling by damping or by stiffness and a previous knowledge of the matrix $[M]$,$[C]$ and $[K]$ is required.

3.2.Modal model

Modal model focuses the following advantages :

- a modal space where the uncoupled differential equations of motion are defined
- dynamic characteristics of the vibrating system are described via a minimum configuration parameters number

Differential equations of motion is :

$$[M^*]\{\ddot{p}\}+[C^*]\{\dot{p}\}+[K^*]\{p\}=\{F^*\} \quad (2)$$

where :

$[M^*]$ = diagonal matrix of modal mass
$[C^*]$ = diagonal matrix of modal damping when

$$[C]=\alpha[M]+\beta[K] \quad (3)$$

$\left[K^*\right]$ = diagonal matrix of modal stiffness

$$\left[M^*\right] = [\Phi]^T [M][\Phi] \quad (4)$$

$$\left[C^*\right] = [\Phi]^T [C][\Phi] \quad (5)$$

$$\left[K^*\right] = [\Phi]^T [K][\Phi] \quad (6)$$

where :

$[\Phi]$ = modal square matrix formed with „n" eigenvectors of dynamic matrix $[D]$ defined as follow :

$$[D] = [K] - \omega^2 [M] \quad (7)$$

The eigenvalues of the dynamic matrix $[D]$ determination as well the modal matrix $[\Phi]$ building is possible via the dedicated software as **MATLAB** or **MATCAD.**

ω = the eigenpulsation of the undamped differential equations

$\left\{F^*\right\}$ = column vector of the modal forces

$\{p\}$ = column vector of modal coordinates

The relationship between $\{q\}$ and $\{p\}$ is the follow :

$$\{q\} = [\Phi]\{p\} \quad (8)$$

The modal model has been composed by a temporal series of one degree vibrating uncoupled systems.

Any system consist of an eigenmode of vibration characterized by his eigenpulsation.

3.3.The finite element method

The two previous analyzing models will describe the analytical model which will create a finite element model via the dedicated computational software like : **ANSYS , NASTRAN , NISA , LUTAS**

The finite element model will be check in with the frequency domain model and in function of the correlation degree the dynamic modeling will be considered finished or will be modify the analytical model until wishing correlation obtaining.

4.EXPERIMENTAL MODEL

4.1.Frequency domain model

In the frequency domain , the mechanical system is characterized by transfer functions between different degrees of freedom. The frequency domain model can describe the frequency domain behavior of the mechanical system via experimental measurements of the amplitudes $x_i(\omega)$ obtained in the interesting points for external forces $F_j(\omega)$ applied in the „j" points. The transfer matrix function $\left[H_{ij}(\omega)\right]$ between the i and j degrees of freedom is given by follow relationship :

$$\left[H_{ij}(\omega)\right] = \frac{\{x_i(\omega)\}}{\{F_j(\omega)\}} \quad (9)$$

where :

$\left[H_{ij}(\omega)\right]$ = the transfer function square matrix

$\{x_i(\omega)\}$ = vibrations deflection vector

$\{F_j(\omega)\}$ = external forces vector

Frequency domain model is general used as favorite model of the experimental analysis.

The transfer functions could be extracted via a vibrating measurement unit with a two -channels Fourier analyzer directly from the experimental measurements.

5.DYNAMIC MODELLING OF MECHANICAL SYSTEMS

The dynamic models used for describing the behavior of civil engineering plant equipment via the two approach methods as well the connection between dynamic models is presented in the figure 2.

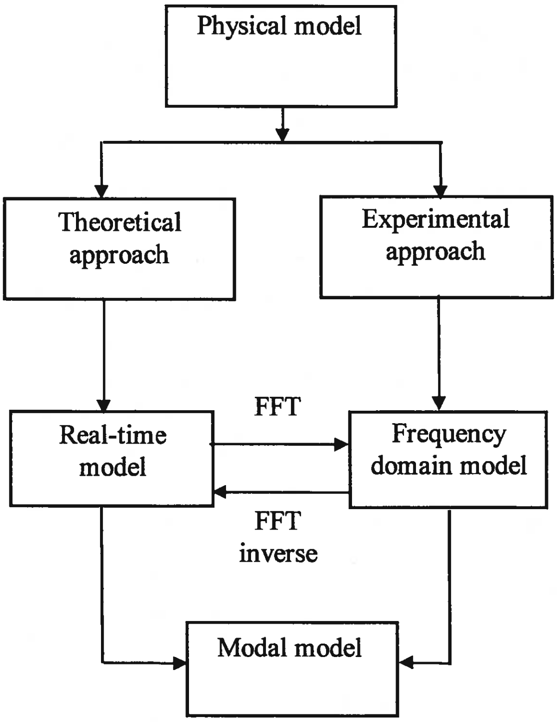

Fig.2. Dynamic modeling of mechanical systems

6.DYNAMIC MODELS CONFIGURATION OF JIGGING SCREEN ANALYSIS

This paper focus the dynamic models configuration of two-mass jigging screen having the following data:

m_1= 1730 kg , m_2= 1510 kg ; $k_1=k_2=4.10^6$ N/m.

A correlation between dynamic models for the previous dates is presented via the table 1 and the chart showed in the figure 3.

Table 1. Correlation between dynamic models of two-mass jigging screen

Pulsation (s^{-1})	Analytical Models			Experimental Model
	Real time	Modal	F.E.	Frequency domain
	Model 1	Model 2	Model 3	Model 4
p_1	68	68	67.89	67.583
p_2	51.469	51.469	51.325	52.712

Pulsations of dynamic models of two-mass jigging screen

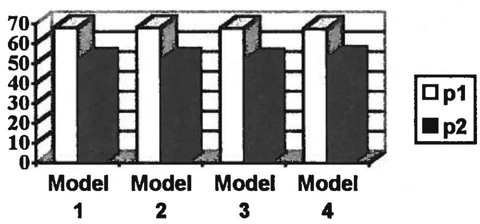

Fig.3. Correlation of dynamic models

CONCLUSIONS

A good correlation between dynamic models corresponding of the two-mass jigging screen was presented via the table 1.

The different small values between the analytical models pulsation versus the experimental one could be explained by the nonlinearities of the mechanical system analyzed under real-time constraints.

REFERENCIES

BAUSIC Fl. , DIACONU Cr. : *Dynamic models used in the jigging screens behavior analysis;* Bull. of the Second Conf. of Dynamics of Machines , vol. 1, p. 53-56 , Brasov, ROMANIA , 1997.