Readers' Forum

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Comment on "Flutter of Orthotropic Panels in Supersonic Flow Using Affine Transformations"

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THE purpose of the present discussion is twofold: first, to congratulate the author for his timely and very valuable contribution[1] and, second, to briefly discuss a few references dealing with an approach related to the author's methodology and which may prove useful to the interested reader.

Dr. Oyibo is to be complimented for showing that with the help of the affine transformations, a generalized form of solution can be obtained for orthotropic panels for which the solutions obtained for isotropic structural elements by other authors can be used in a highly efficient manner.

Almost two decades ago Rajappa[2] developed an approach called the "reduction method." In his paper Rajappa uses the method to estimate the natural frequency of a specially orthotropic rectangular plate using the results of a "reduced" isotropic rectangular plate.

In another interesting study, Ashton[3] analyzed the correlation between the deflections of a rectangular plate of generalized orthotropy and a reduced isotropic skew plate by means of a linear transformation applied to one of the coordinate axes parallel to the principal material axes. As a result, the natural frequency of a specially orthotropic plate can be evaluated from that of the reduced isotropic plate.

Important contributions in the development of reduction methods are due to Sakata,[4-6] who has treated specially orthotropic continuous plates, generally orthotropic plates of complicated boundary shape, etc. Sakata's approach can be extended to plates with free boundary, plates of variable thickness and subject to in-plane forces, etc.[6]

For instance, an interesting treatment is available in Refs. 4 and 5 for th case of specially orthotropic continuous plates subject to biaxial in-plane forces. Sakata obtains the reduction equation by assuming

$$\bar{b}=b(D_x/H)^{1/2}$$

Furthermore, he shows that the mode shape of the specially orthotropic plate reduces to that of the isotropic plate by the transformation

$$\bar{y}=y(D_x/H)^{1/2}$$

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In the case of a generally orthotropic plate with arbitrary shape, Sakata shows that the problem of transverse vibrations of an orthotropic plate with the special flexural rigidities D_x, $H=(D_xD_y)^{1/2}$, D_y and D_l reduces to that of an isotropic plate of an ideal material for which $\mu=D_l/H$ where μ is Poisson's ratio.

For a generally orthotropic simply supported skew plate with the special flexural rigidities D_x, $H=(D_xD_y)^{1/2}$, and D_y, he derives[5] an exact expression using the transformation

$$\bar{y}=y(D_x/H)^{1/2}$$

Sakata has also derived an approximate reduction method applicable to orthotropic plates of arbitrary shape and with arbitrary flexural rigidities.[6]

The reduction method has also been applied successfully when dealing with elastic stability problems of specially orthotropic plates using the buckling results of a reduced isotropic rectangular plate.[7] A rather thorough survey is also available.[8]

With regard to the boundary conditions met by the orthotropic panels studied by Oyibo,[1] it is important to point out that in the case of rigidly clamped edges or edges elastically restrained against rotation it may prove useful to approximate the modal shapes using polynomial coordinate functions as shown in previous studies by the writer and coworkers in the case of free and forced vibrations.[9,10]

References

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