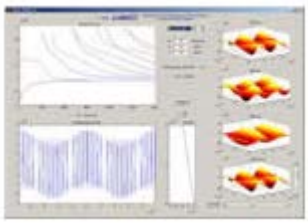
CHAPTER 6 PROBLEMS AND EXERCISES

Problem 1: Explain with sketches how the S0 and A0 Lamb waves may be similar or different from the axial and flexural waves in plates.

Equation Section (Next)

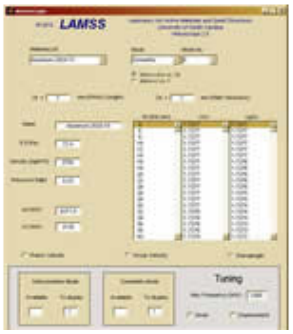
Solution

To solve this problem, one could use the software programs posted on the LAMSS website http://www.me.sc.edu/research/lamss/html/software.html . In particular, download and activate the following programs:



LAMB WAVE MODE SIMULATION

Download



WAVESCOPE: DISPERSION CURVES, GROUP VELOCITIES, AND TUNING FOR METALLIC STRUCTURES

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After activating the programs, look at the modeshape plots in the lower right corner of the Lamb wave mode simulation program and notice the following:

At low values of the *fd* product, the S0 and A0 Lamb waves are very similar to the axial and flexural waves in plates. The displacement distribution across the thickness is linear and thus resembles the displacement distribution assumed in the axial and flexural waves (Figure 1).

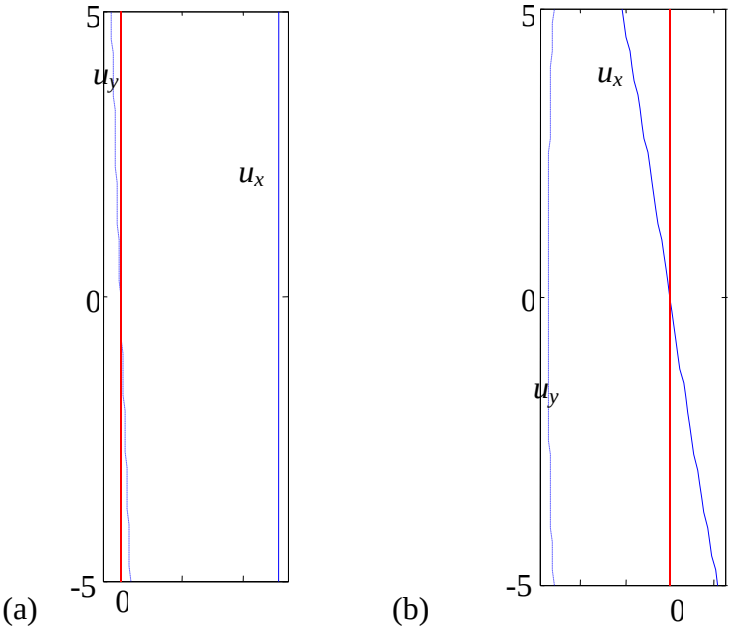

Figure 1 Displacement distribution across the thickness of S0 and A0 Lamb waves at very low *fd* values: (a) S0 Lamb wave mode; (b) A0 Lamb wave mode

At very high values of the *fd* product, the S0 and A0 Lamb waves are very different from the axial and flexural waves in plates. At this high *fd* values, the displacement distribution across the thickness is very nonlinear and limited to the near the surface, resembling the displacement distribution in Rayleigh surface waves (Figure 2). There is almost no activity in the center of the plate.

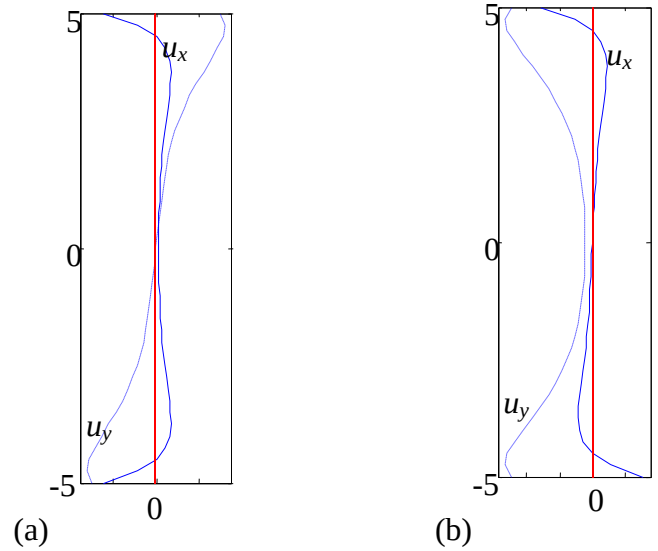

Figure 2 Displacement distribution across the thickness of S0 and A0 Lamb waves at very high *fd* values: (a) S0 Lamb wave mode; (b) A0 Lamb wave mode

Problem 2: The guided waves in a plate can be Lamb waves and shear-horizontal (SH) waves. Each of these wave types can be multimodal. Which wave mode is always nondispersive?

Solution

Indeed, both the SH waves and the Lamb waves are dispersive and multimodal, as discussed in the textbook Chapter 6, Sections 6.3 and 6.4. However, one of the SH modes is non dispersive while all the other modes are dispersive. According to the textbook Equation (6.62) and Figure 6.6, the wave mode that is always nondispersive is the first symmetric SH mode, which has a constant wave speed equal to the bulk shear wave speed c_S