Deformations caused by the movements of shear and tensile faults

Guang Y. Sheu*†‡

Department of the Civil Engineering, Feng-Chia University, Taichun, Taiwan

SUMMARY

Earlier solutions of deformations resulting from the movements of shear and tensile faults in a half space (Bull. Seismol. Soc. Amer. 1985; 75:1135, 1992; 82:1018) have been revised in view of cross-anisotropic stress–strain relationships. The dislocation theory (Canad. J. Phys. 1958; 36:192) is reviewed and the displacement field due to a concentrated force in an anisotropic half space is solved analytically for developing the current research. A fault is simulated as a point source of strain nuclei in applying the dislocation theory.

Data (Terr. Atmos. Oceanic Sci. 2000; 11(3):591, 631) that were used to study the Chi-Chi earthquake (M_L = 7.3; 1999/9/21 AM 1:47) are introduced to compare the solution with the isotropic results. Results indicate that the anisotropy of stress–strain relationships do affect the results of predicted deformations.

KEY WORDS: deformation; fault; dislocation theory; cross-anisotropic

INTRODUCTION

Okada [1,2] applied the dislocation theory [3] with the so-called Mindlin’s solutions [4] to discuss the displacement field caused by shear and tensile faults in a half space. Isotropic stress–strain relationships were assumed in developing these researches. However, it was concluded that the ground layer is anisotropic [5]. For example, the recent Chi-Chi earthquake (M_L = 7.3; 1999/9/21 AM 1:47) [6,7] mainly attacked the Zhuo-Shui-Xi alluvial fan of the western Taiwan. Results of the ground displacements that were measured after the earthquake (Figure 1) [8] indicate the possible anisotropy in stress–strain relationships of the fan. Therefore, Okada’s research [1,2] may be further revised by including an anisotropic stress–strain relationship.

This paper presents the results of revising Okada’s studies [1,2] by introducing a cross-anisotropic stress–strain relationship. Besides, a fault is assumed as a point source of strain nuclei.