DYNAMIC PROPERTIES OF OFFSHORE STRUCTURES WITH DIFFERENT FOUNDATION TYPES BY THE RANDOM DECREMENT TECHNIQUE

by

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Last but not least, I offer my sincere thanks to my parents for their love and support, and to Cassie, for her love for me and her help in producing this paper.

ABSTRACT

Title of Thesis: Dynamic Properties of Offshore Structures with Different Foundation Types by the Random Decrement Technique

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Dynamic testing was performed on two models of an offshore oil platform to determine their dynamic properties with different types of foundations using the Random Decrement Technique. The two model platforms were welded-steel space frames with four primary legs. Scale factors of the two models to an existing oil platform off the Gulf of Mexico were 1/40 for the small model and 1/14 for the larger one. Tests using classical methods of damping and natural frequency determination were carried out on the models and results were compared to the results from Random Decrement analysis for several foundation conditions.

The major objectives of this research were to determine: (a) The effects of the type of foundations on the vibration characteristics, particularly damping and natural frequency of the two models, and (b) The ability of the Random Decrement Technique to accurately calculate the damping ratio and resonant frequencies of a complex linearly damped structure.

It was concluded that for the cases studied, the effect of the type of foundation significantly influenced the resonant frequencies and the damping of the structures. Also, by comparison of sine sweep results to Random Decrement analysis it was apparent that for a linear multi-degree of freedom system the Random Decrement technique works, resulting in a free vibration decay curve from which damping can be calculated by the logarithmic decrement technique. Results also indicated that due to the simplicity and short time duration of the tests, the Random Decrement Technique was preferable to the more classical methods of damping calculations.

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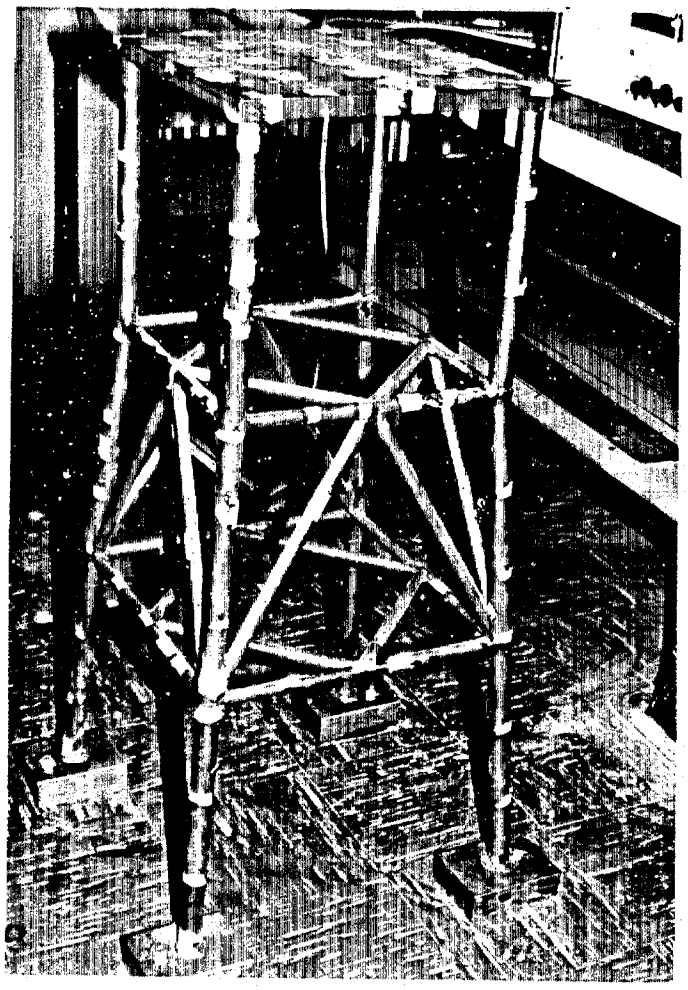


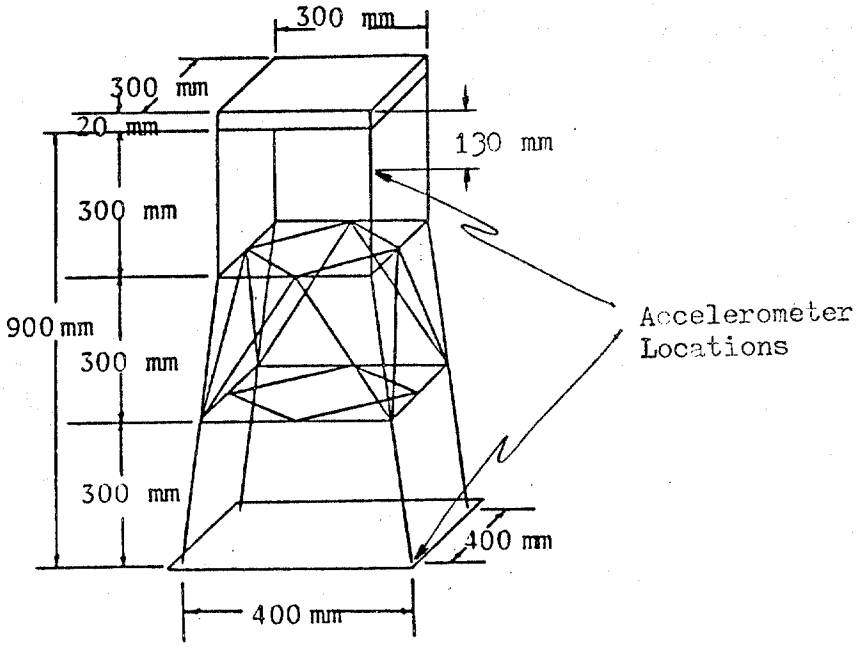


FIG. 3-1. OFFSHORE PLATFORM MODEL, 1/40 SCALE

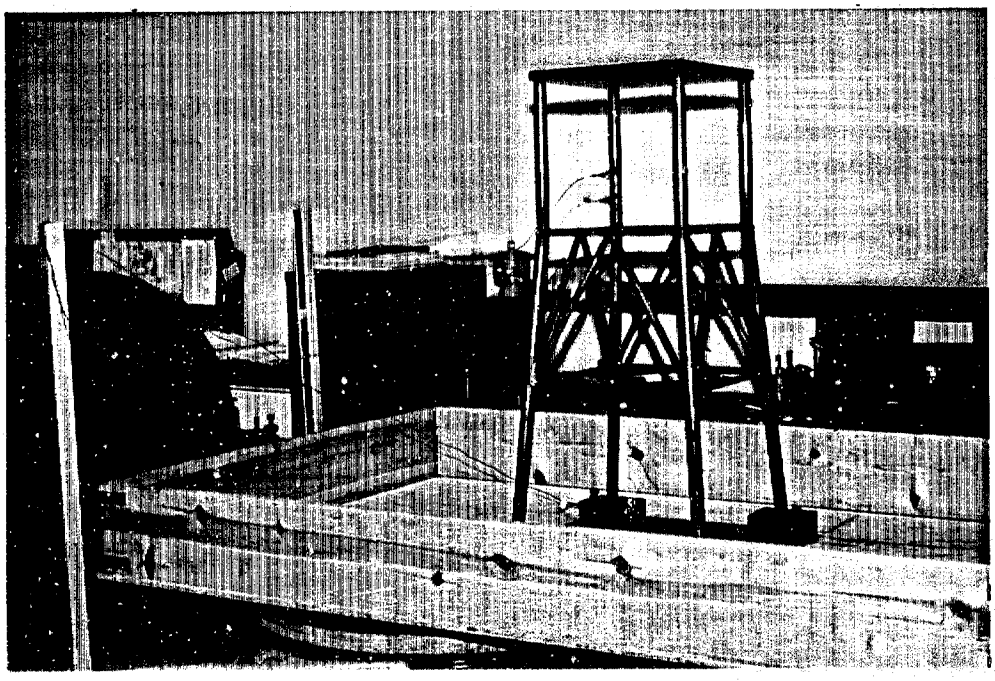


FIG. 3-3. SHAKE TABLE AND TEST MODEL, RIGID AND FREE BASE CONDITION

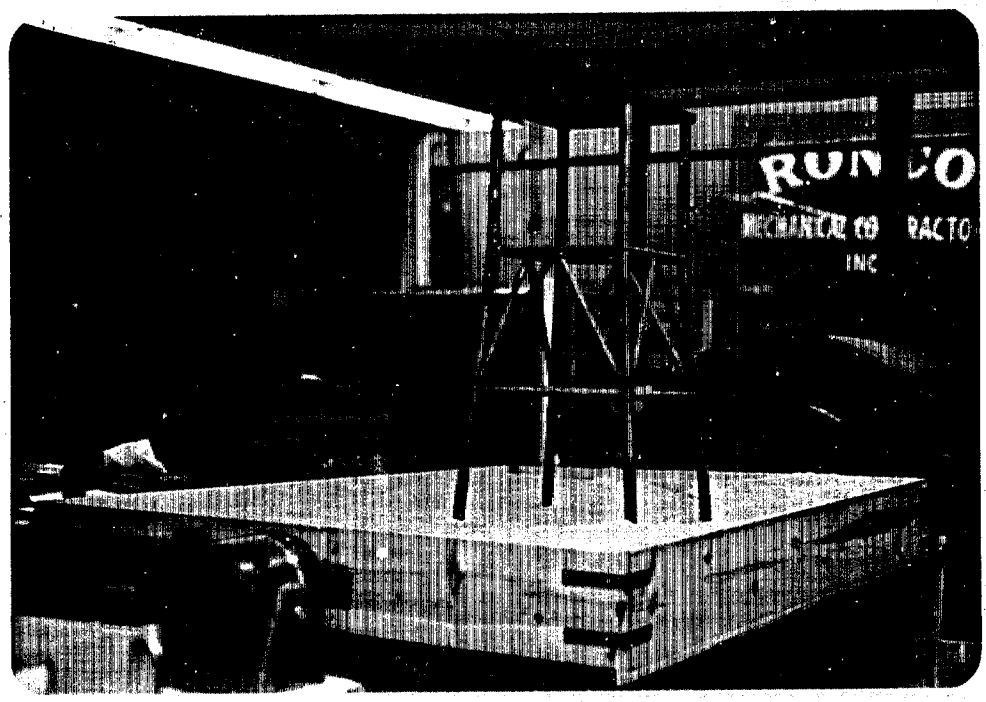


FIG. 3-4. SHAKE TABLE AND TEST MODEL, EMBEDDED IN SAND

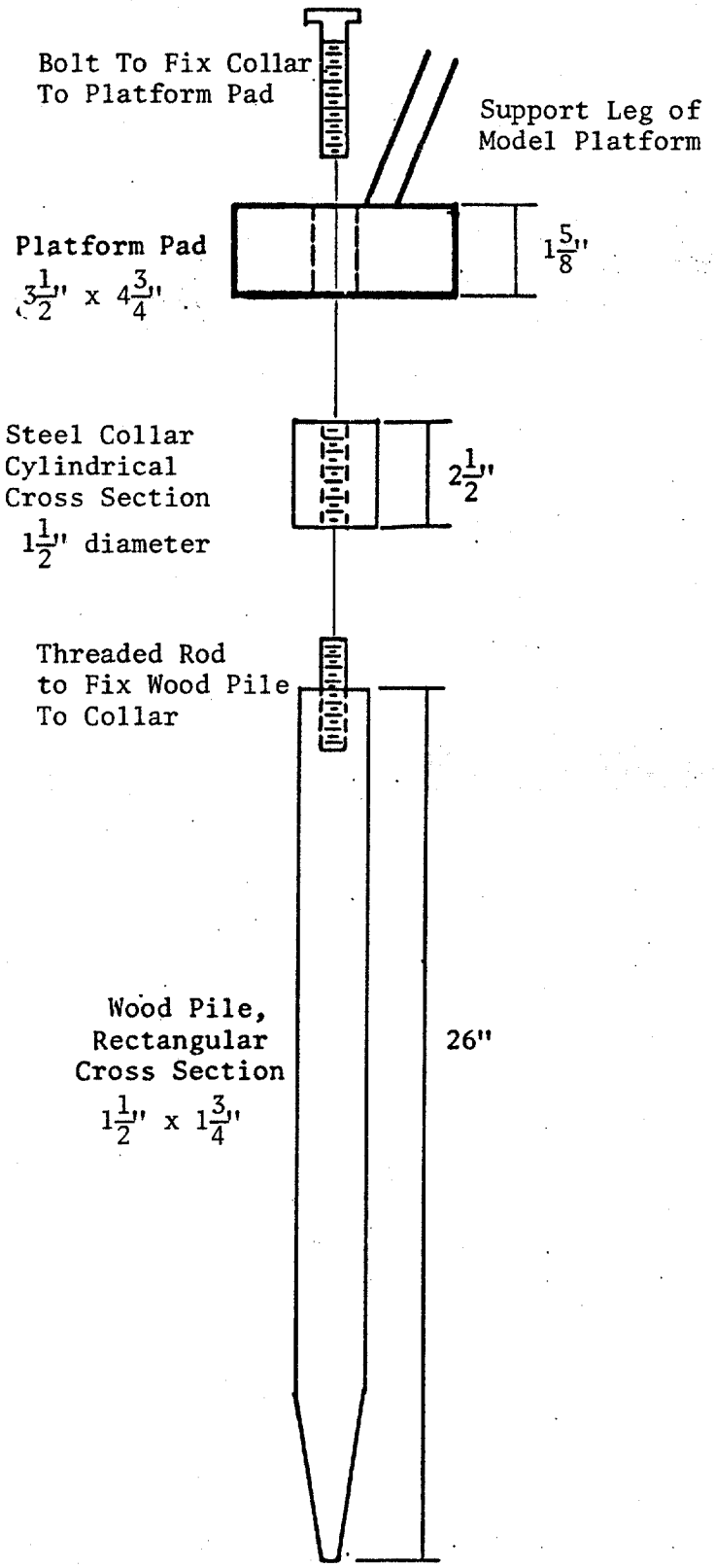
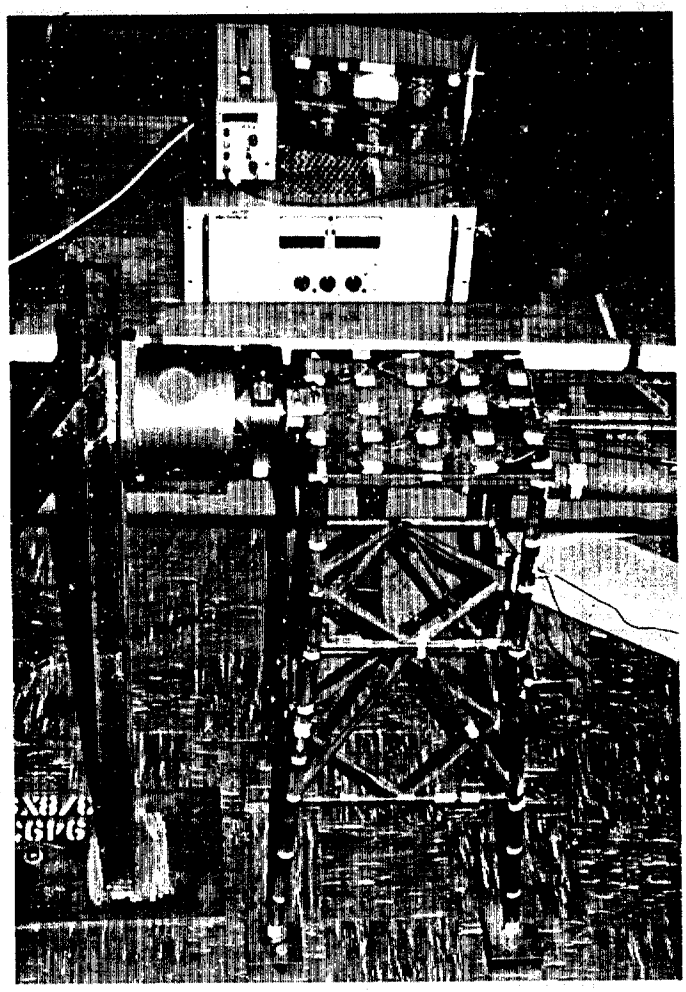


Figure Not To Scale

FIG. 3-7. EXPLODED VIEW OF PILE



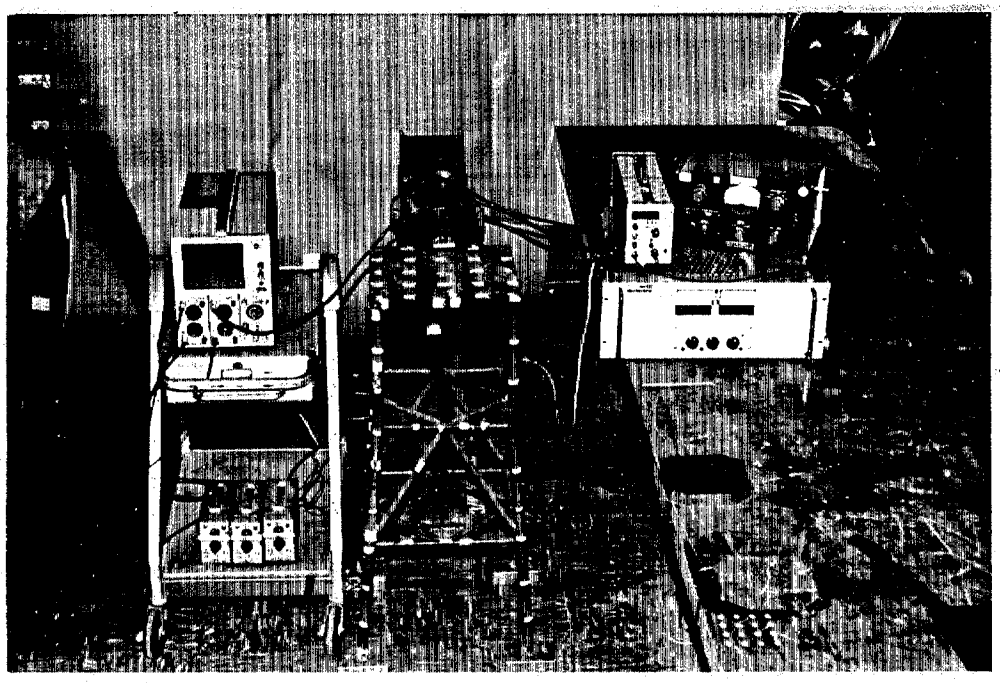


FIG. 3-8. PILE FOUNDATION TESTS, 1/40 SCALE MODEL, FIXED BASE CONDITION

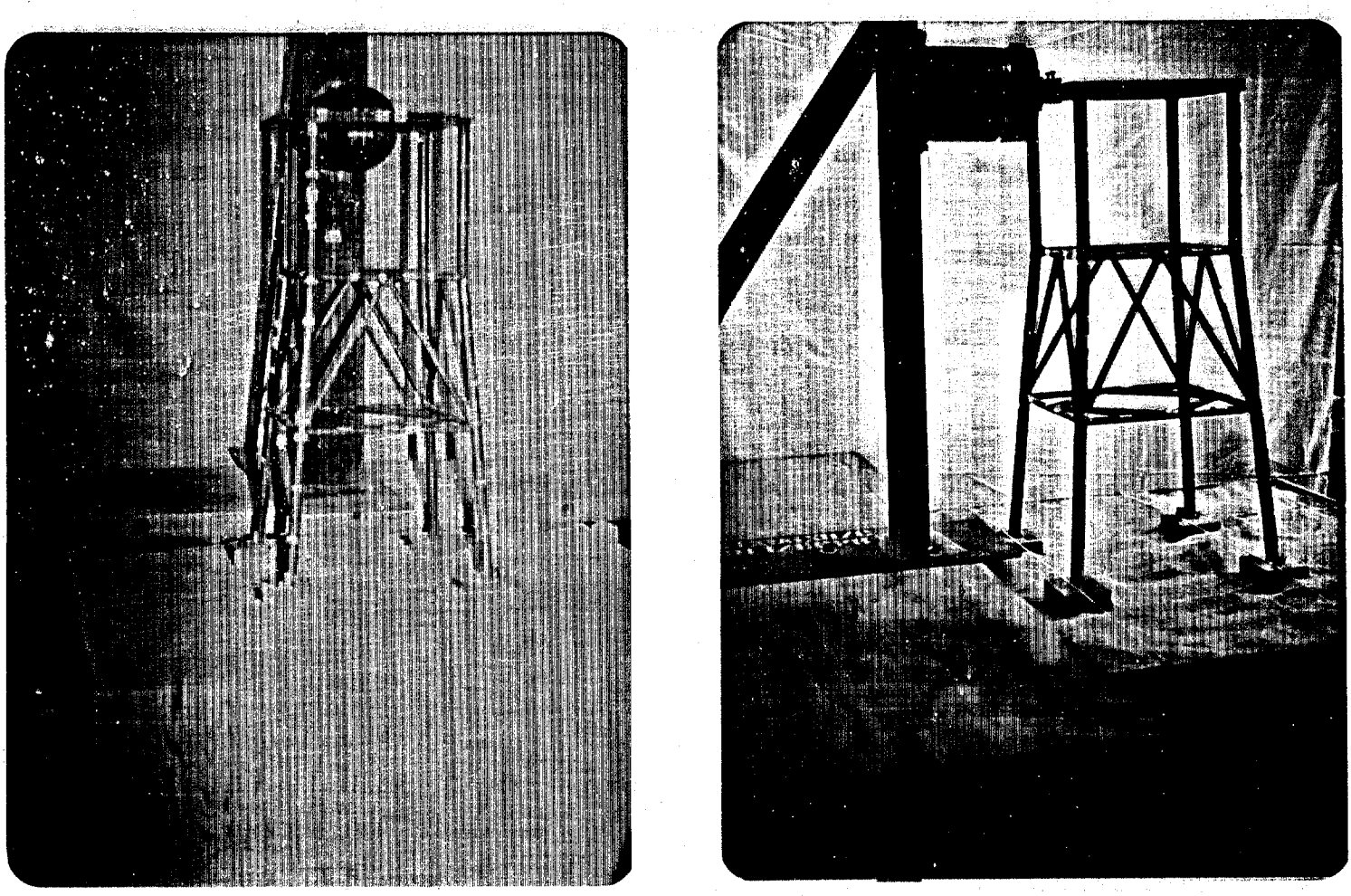
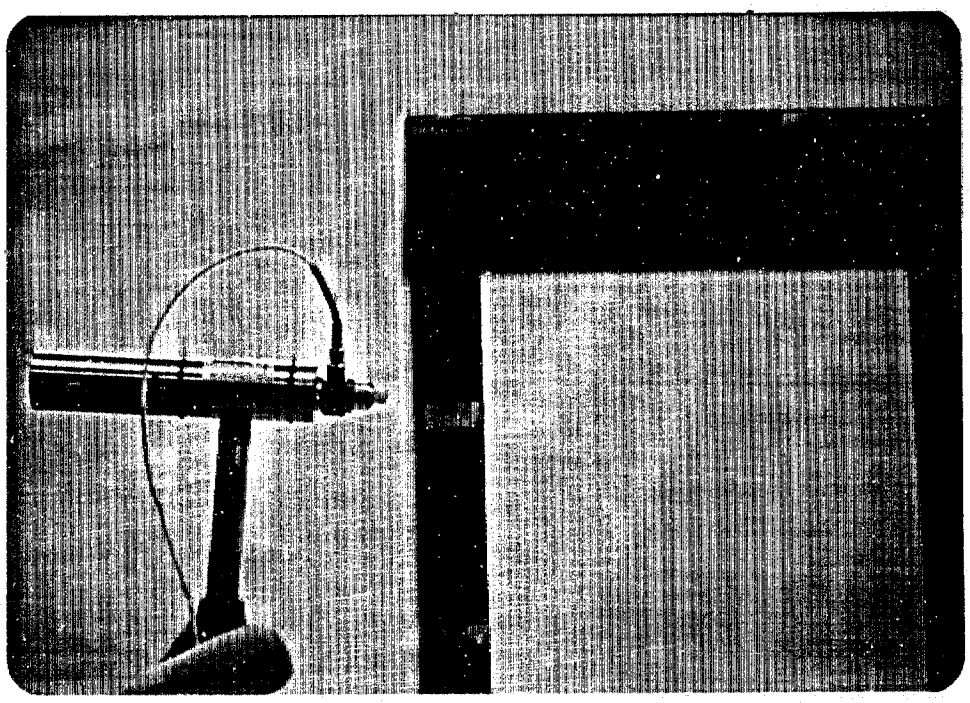


FIG. 3-9. PILE FOUNDATION TEST, 1/40 SCALE MODEL, SOIL FOUNDATION CONDITION



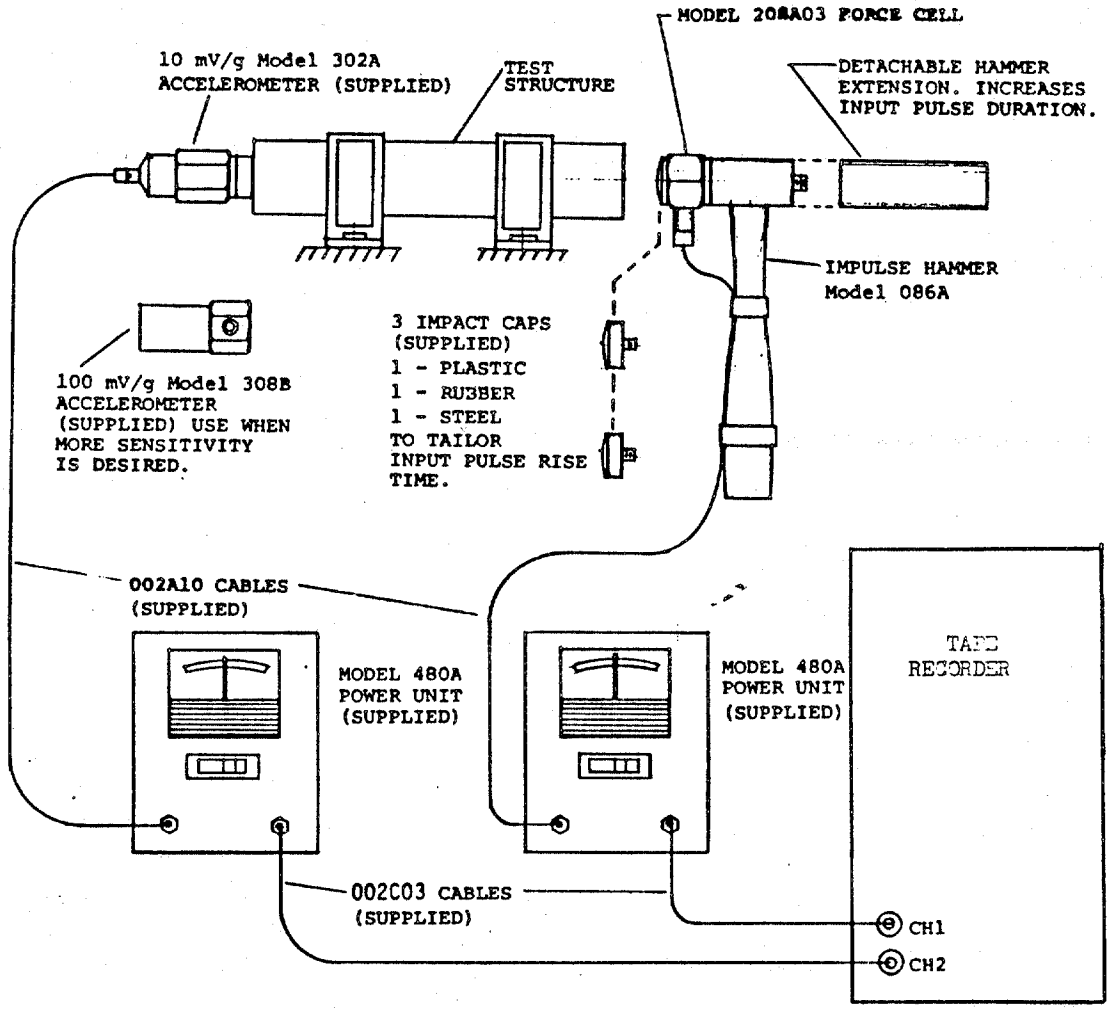


FIG. 3-10. IMPACT HAMMER, 1/40 SCALE MODEL

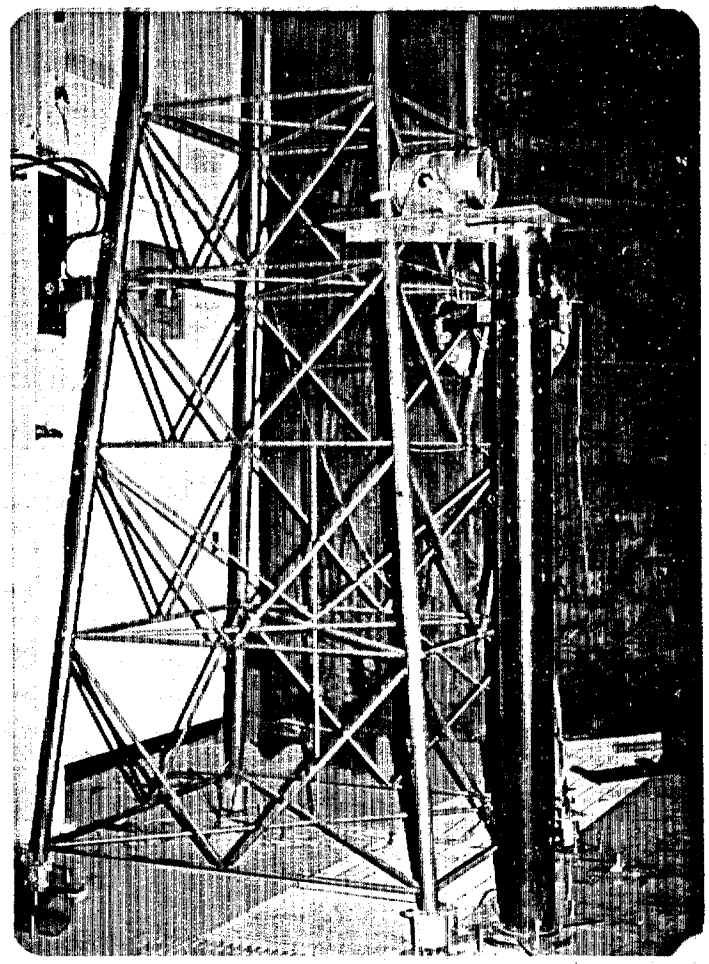


FIG. 3-11. OFFSHORE PLATFORM MODEL, 1/14 SCALE, FIXED BASE CONDITION

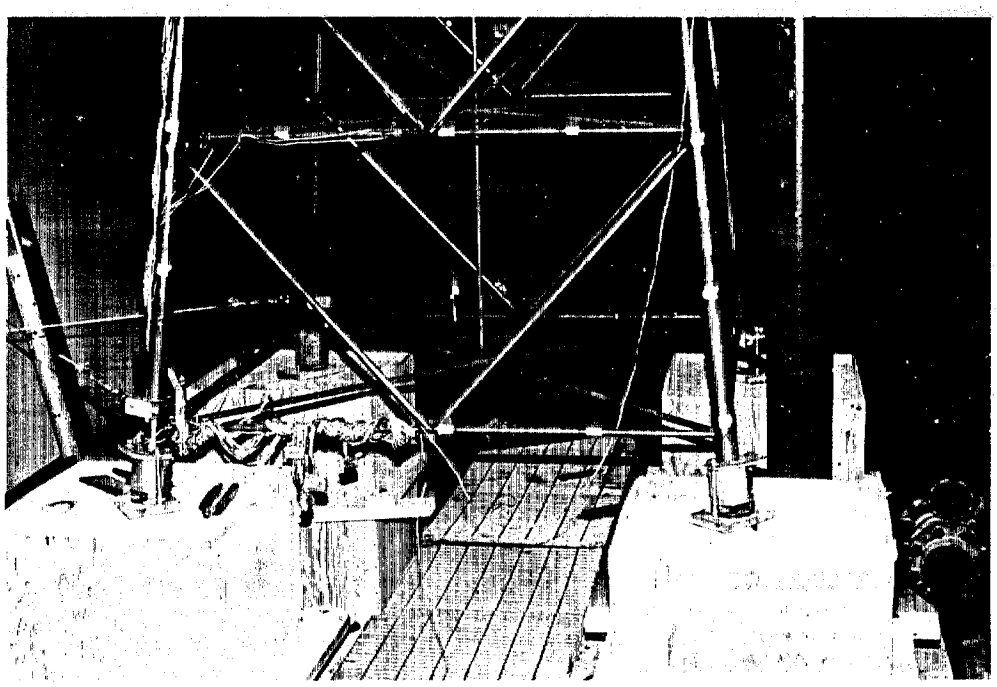
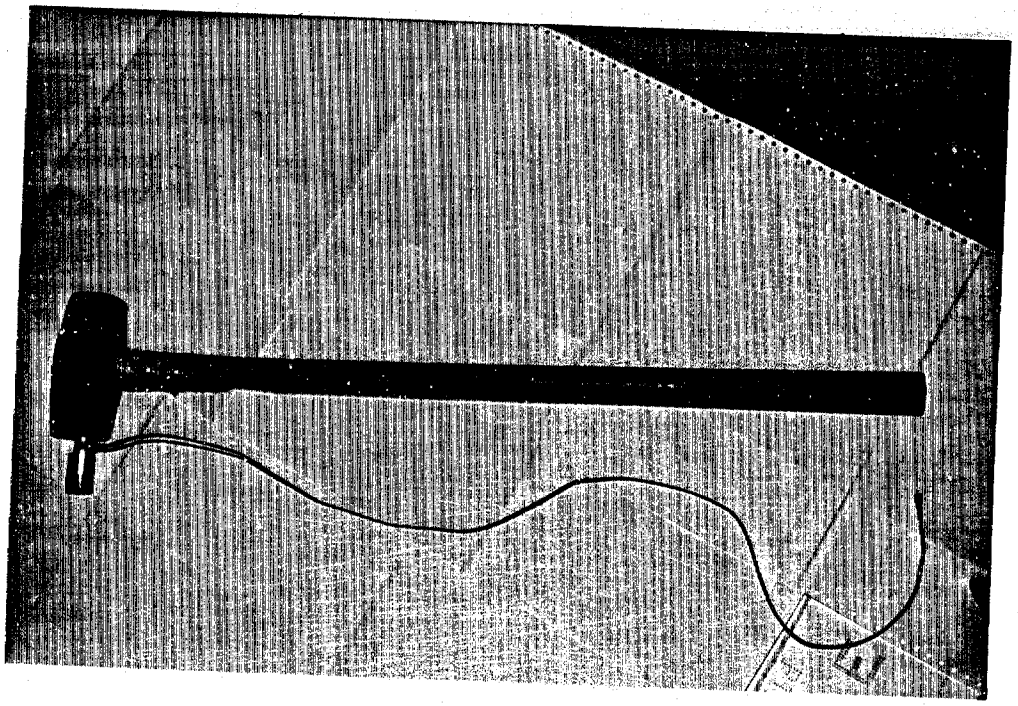


FIG. 3-12. OFFSHORE PLATFORM MODEL, 1/14 SCALE, SOIL FOUNDATION CONDITION



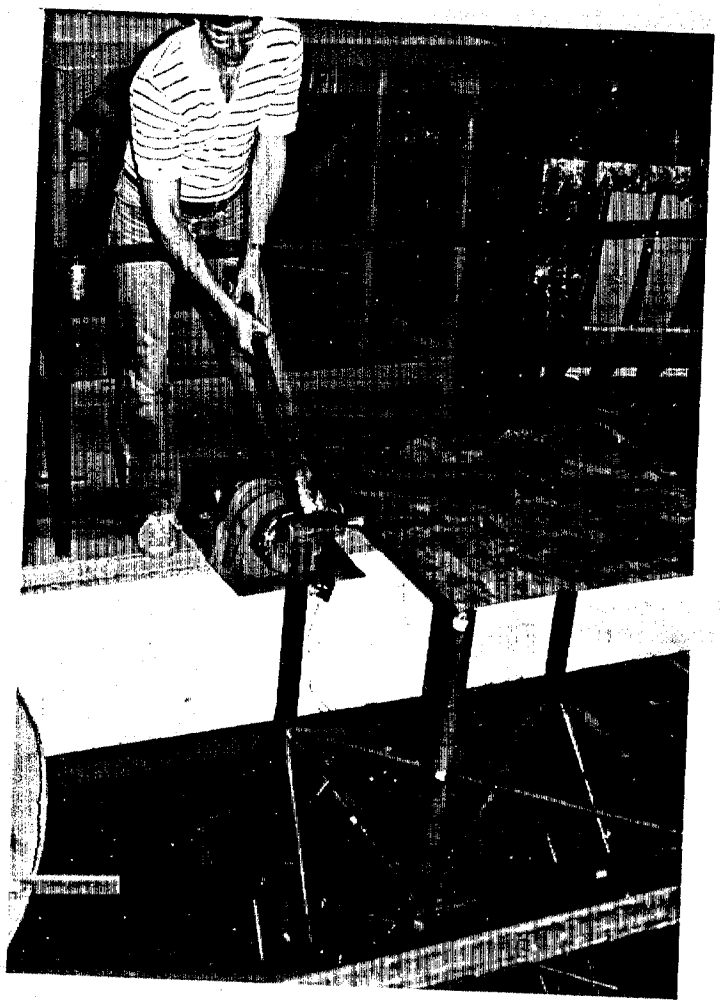


FIG. 3-13. IMPACT HAMMER, 1/14 SCALE MODEL