18 OFFSHORE STRUCTURE FOUNDATIONS

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18.1 INTRODUCTION

18.1.1 Foundation Types

Marine foundations are used to transmit structural design loadings to the subsoil. The type of foundation element to be employed will depend on (1) the nature of loading, (2) the stiffness and strength of the surface sediments, and (3) the desires of the builder. A summary of the common platform types is shown in Figure 18.1. The two major foundation types are those that employ a surface loading mechanism (shallow foundations) and those that extend down through the surface sediments to a lower layer (deep foundations). An example of a foundation system for surface loading is the mat used on a gravity platform. The deep pile that is used on a jacket platform is an example of a deep foundation system. Examples of various marine foundation types are presented in Figures 18.2a and 18.2b.

This chapter is organized into an introductory section that discusses both the geologic and soil conditions of the marine environment. This introduction is followed by sections on loadings, pile structures, gravity platforms, anchor uplift capacity, pipelines, jack-up platforms, and hydraulic filled islands.

18.1.2 Geologic Conditions

The seafloor of the oceans is a complex environment consisting broadly of a continental shelf, continental slope, and abyssal plain areas. The majority of man-made construction takes place in the relatively shallow area of the continental shelf and to a lesser degree on the continental slopes. The complexity of the shelf areas is due to its geologic history and the action of the various environmental elements. These shelves vary in width depending on whether the continental margin is rising or slowly subsiding. Thus, the east coast of the United States has a very wide continental shelf owing to accretion, whereas that on the Pacific coast of South America is very narrow as a result of subduction of oceanic plates. Beyond the continental shelves are the slopes, averaging 4° down to the abyssal plain. Submarine canyons, which cut through both the shelf and slope, may have side slopes as great as 30°. They usually terminate in a fan on the deep seafloor.

The Pleistocene had a very dramatic influence on the continental shelf areas. For example, when the Wisconsin ice age was at its peak about 15 000 to 20 000 years ago, large quantities of water were stored at the poles, lowering the sea level by as much as 100 m. This lowering of the sea level resulted in the partial exposure of the continental shelves. On these coastal shelves, rivers discharging from the dry land cut channels into the sediments and land erosion processes took place. Since the rivers were steeper and velocities higher, sedimentary deposits were coarser. As the oceans have risen, the velocities have been reduced, and finer sediments—sands and silts—have been deposited on the shelves adjacent to large rivers.

During the ice ages, glaciers extended into the ocean basins, carving deep trenches such as the Norwegian Trench, Cook Inlet, and the Straits of San Juan de Fuca. With the subsequent warming period, the sea level has been rising, slowly but

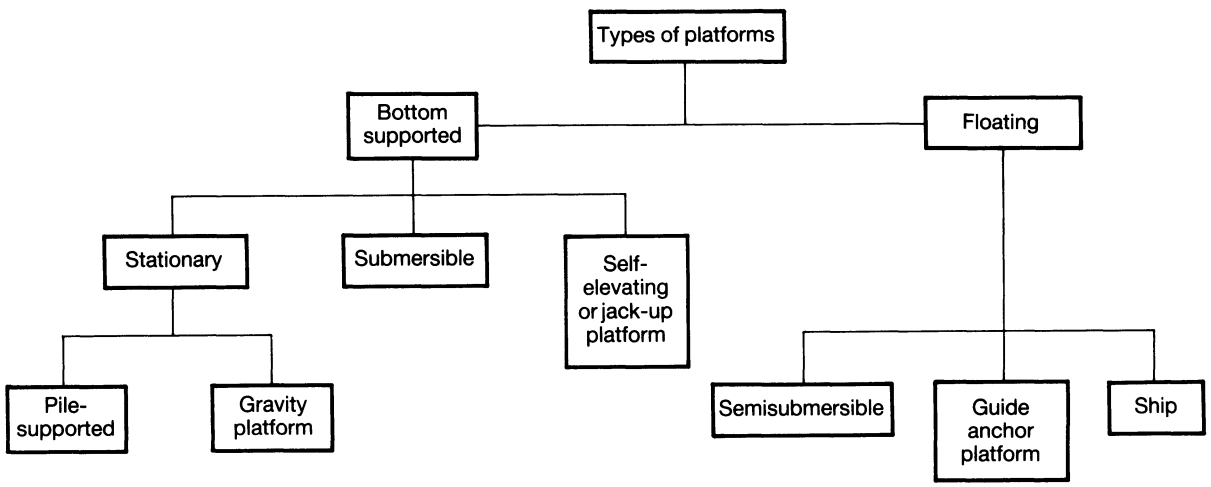

Fig. 18.1 Summary of platform types.

H.-Y. Fang (ed.), *Foundation Engineering Handbook*

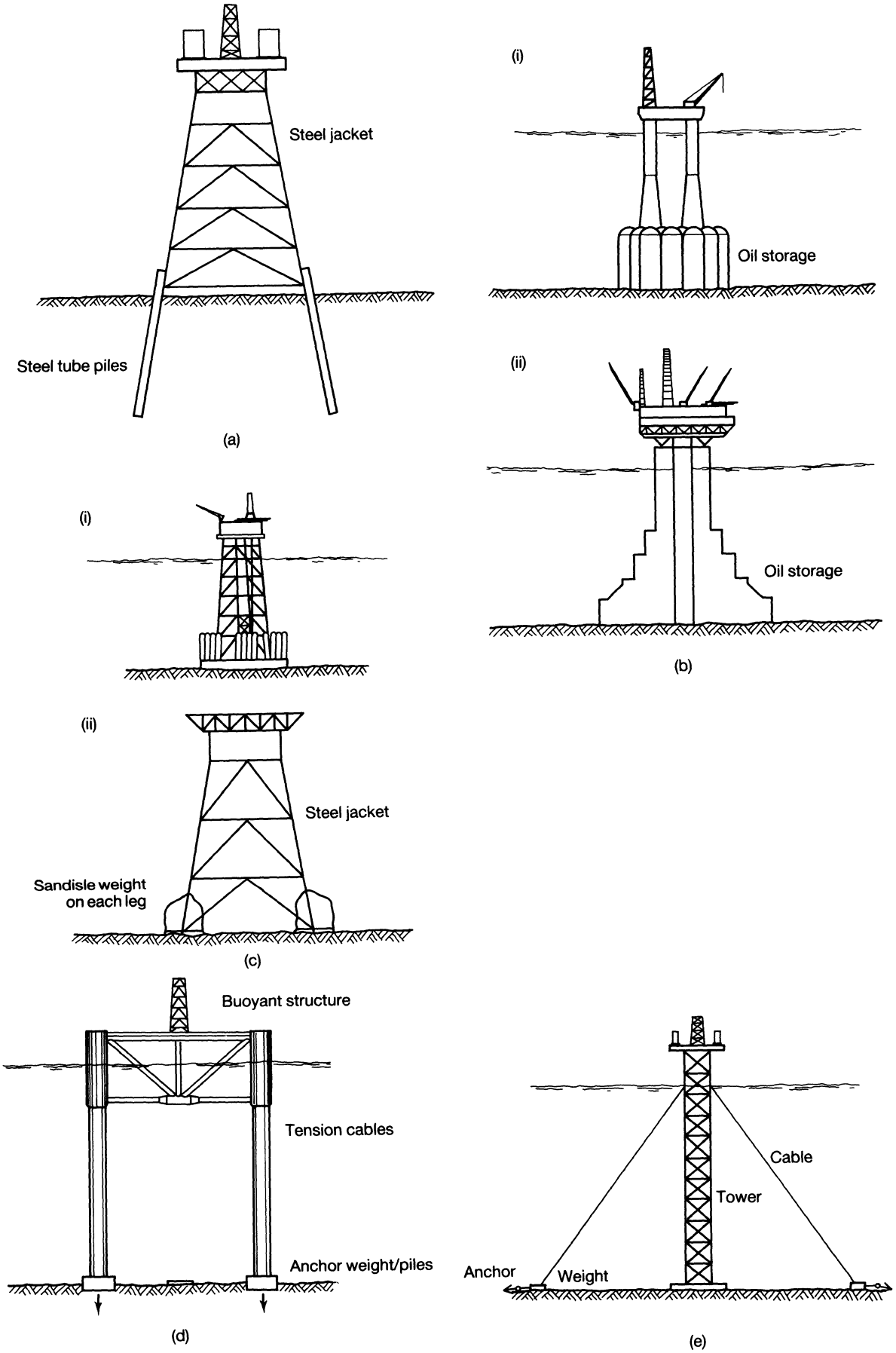

Fig. 18.2 Examples of marine foundation types. (a) Typical piled steel jacket structure. (b) Typical concrete gravity structures: (i) Condeep; (ii) Howard-Doris. (c) Hybrid steel gravity structures: (i) RDL hybrid; (ii) Sandpod. (d) Typical tension leg structure. (e) Guyed tower structure. (*After Gibson and Dowse, 1981.*)