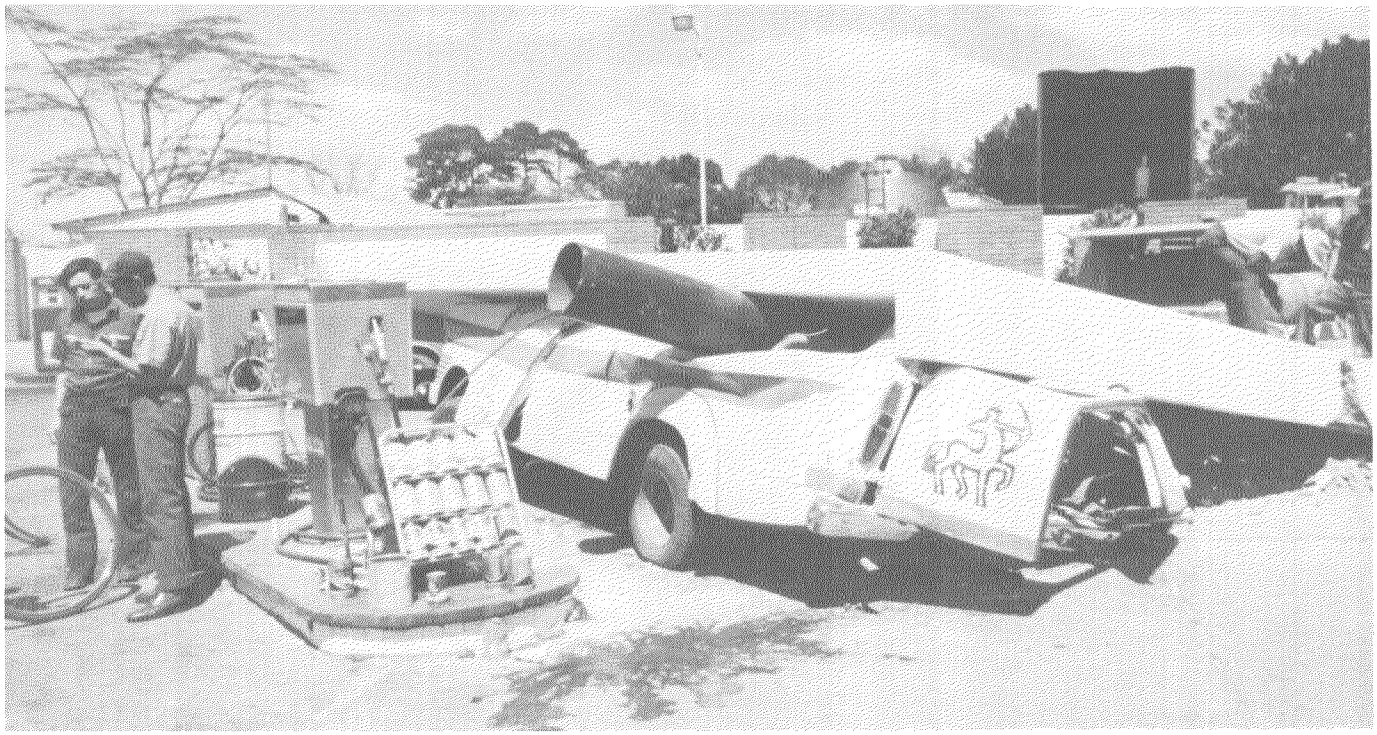

FIGURE 56.—Collapse of inverted-pendulum gas-station structure, Guatemala City (Zone 7).

Although chimneys are not common on homes in Guatemala City because of the mild weather, several of those that did exist collapsed.

Adobe construction is not earthquake resistant; some examples of the unsatisfactory performance of adobe is shown in figures 69*A*, *B*, *C*, and *D*. Considering the fact that it is not economically feasible to eliminate adobe construction in Guatemala, it would be desirable to make an inventory of the different types of adobe used countrywide and prepare recommendations for simple modifications that might improve the strength of adobe houses subjected to earthquakes.

A common design for multistory structures in Guatemala City utilizes principal frames in the transverse direction only. The horizontal loads in the longitudinal direction are resisted with a "pseudorigid" frame in which the normal beams are replaced by wide strips of slab (flat beams) that join the tops of the columns. As an example, figure 70 shows a five-story reinforced-concrete structure that sustained serious damage when flat beams were almost destroyed; the building had to be evacuated. Buildings of this design are usually very flexible and have long fundamental periods. It is probable that the behavior of the multistory buildings would have been less satisfactory if they had been subjected to a stronger ground shaking or to shaking of similar amplitude but longer periods.

A close look at the effects of the February 4 earthquake in Guatemala City shows the following aspects:

1. Strengths of reinforced-concrete lateral-load-resisting elements were often unrelated to their stiffnesses.
2. Masonry filler walls in multistory buildings lacked minimum reinforcement.
3. Numerous heavy parapets collapsed and created a serious hazard in Guatemala City.
4. Reinforced-concrete column ties were frequently too widely spaced and sometimes not adequately hooked.
5. Brick walls often lacked reinforced-concrete corner columns, and long walls also lacked intermediate reinforced-concrete columns.
6. Surface breakage on secondary faulting occurred in developed areas.
7. Adobe construction sustained heavy damage. Adobe houses did not have any edge members.
8. Heavy roofs of adobe and unreinforced masonry houses frequently collapsed.
9. Elevated water tanks often failed. From the number of collapses, types of connections, and sizes of resisting elements, it is suspected that the lateral-force seismic coefficient used for the design was too low.
10. Corrugated-steel grain silos frequently failed, and several collapses were observed.