have been in force, and ceilings built according to these regulations showed no damage. In building spaces used as offices, wall partitions were moved, some as much as one inch. At one company owned laboratory, the earthquake induced structural motion activated the overhead fire supression sprinkler system. The typical type of interior damage suffered by commercial and governmental buildings is shown in Fig. 8.7, which shows the cracking of the plaster walls in the stairway of the Santa Barbara County Administration Building located in the downtown sector of the city. The total damage to the building was estimated to be $100,000.

8.3 Equipment Damage

Mechanical equipment on or near the roof tops of multistory buildings incurred considerable damage from building motion, particularly on the UCSB campus. In many instances, such equipment is spring mounted for vibration isolation purposes. When these supports did not provide sufficient lateral restraint, swaying motion of the buildings tended to knock the equipment off its supports as was amply evident from a survey of the damages. Figures 8.8 through 8.10 show an overall view and two close-ups of the collapsed supports under a 14,000-lb centrifugal water chiller on the top of the eight-story section of the UCSB campus Library (see Fig. 7.38). At the same location, several hot water pumps were wrenched from their anchor bolts, and in one instance, a pump's mounting base integrally cast with the pump motor case was simply broken off, as seen in Fig. 8.11. On the top of this and more than twenty other UCSB buildings, boilers and fans were shifted from their vibration isolation supports when inadequate lateral restraints were present, bolted down pumps were shorn loose, and the supports under cooling towers and were buckled and bent. In many cases the elevated concrete housekeeping pads on which the equipment rests were chipped and cracked. A typical example is shown in Figs. 8.12 and 8.13 which show an overall view of a boiler installation on top of six-story Ellison Hall, and a close-up of the damaged supports. A similarly sized boiler on top of six-story Phelps Hall, shown in Fig. 8.14, which has seismic restraints that conform with the current code and are of the type shown in the close-up in Fig. 8.15, received no damage. Such seismic restraints were the exception rather than the rule on the UCSB mechanical equipment surveyed. Equipment lighter in weight, such as fans, did not fare better. Figures 8.16 and 8.17 show a series of fans which fell off their supports on the roof of the Biological Science II building. Equipment control cabinets, electrical junction boxes and wiring were also dislodged and moved.

The lack of antisway braces on mechanical equipment piping, combined with the excessive unrestrained motion of the connected machinery, caused pipes and their hangers to bend and break. As a result, large sections of piping networks were shifted from their normal positions. Pipe connections were put under exceptionally high stresses and, in some cases, the pipes sheared in two as visible in Fig. 8.18. Where flexible connections were provided, such as between fans and their outlet ducts, or between pumps and pipes, these were invariably damaged or broken when the attached machinery was displaced. At places where pipes and ducts penetrate walls, the penetrating conduit or the wall tended to be damaged. For example, the piping system supplying sea water to the UCSB Marine Research facility suffered several system disabling breaks at wall

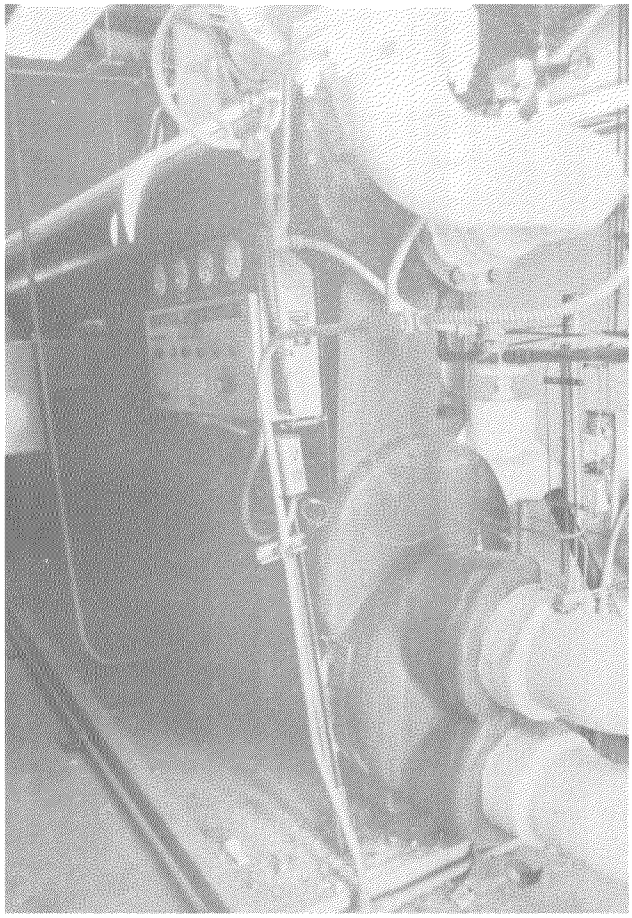

Fig. 8.8 14,000 lb centrifugal water chiller on top of Library III Building at UCSB (see Fig. 7.38). Vibration isolation supports were damaged.

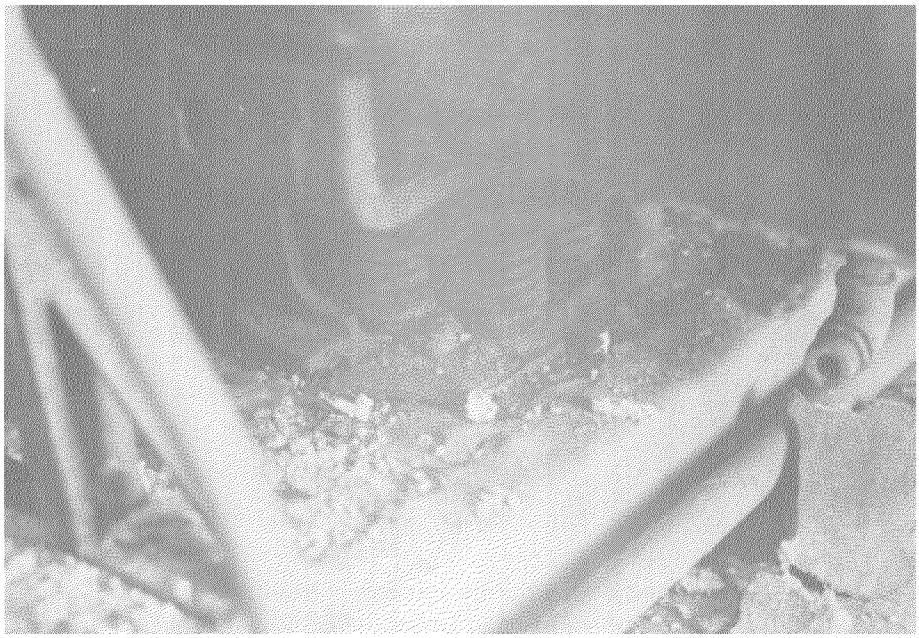

Fig. 8.9 Close up of damaged supports at front of chiller (Fig. 8.8).