Fig. 5.3 Rockslide on California State Highway 154, near San Marcos Pass (see Fig. 1.3 for location). (Santa Barbara News-Press photo. Reproduced by permission).

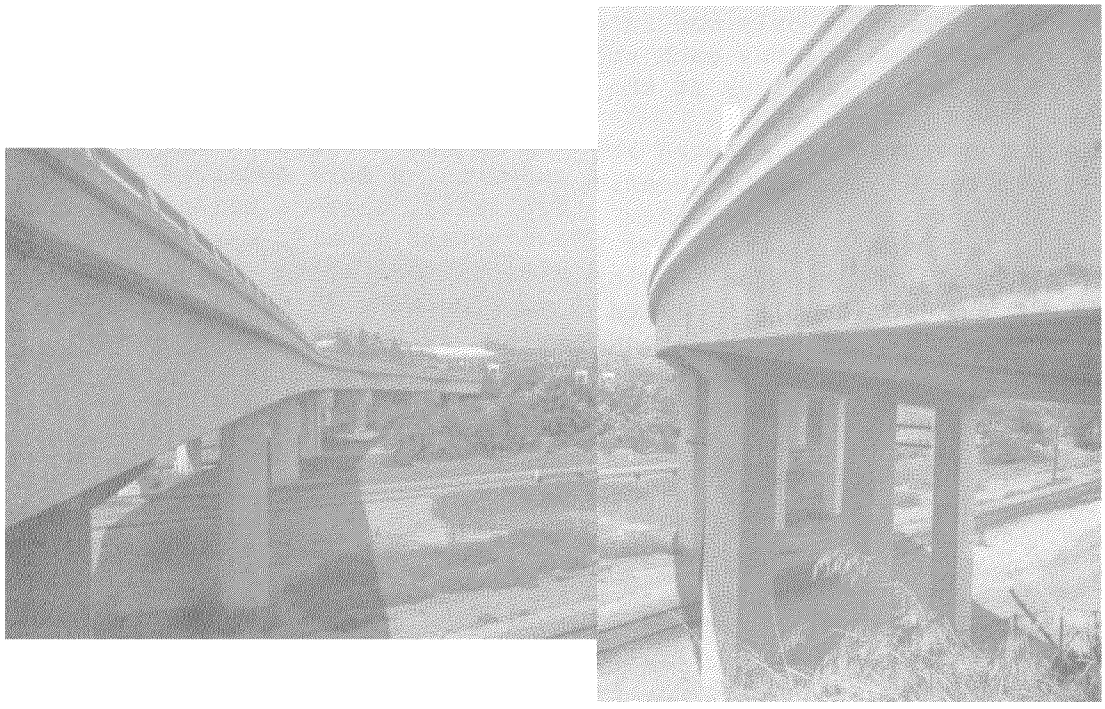

Fig. 5.4 Ward Memorial Boulevard bridges over U.S. Highway 101 (see Fig. 1.2 for location). View looking north from southern abutment.

A total of four overpasses crossing Highway 101, all steel-reinforced concrete structures, suffered significant earthquake damage (see Fig. 1.2 for locations). Specifically, these include the two adjacent curving bridges on Ward Memorial Boulevard (where the boulevard meets Highway 101), one bridge on the western end of Hollister Avenue, and another on Glenn Annie Road. All except the last bridge named are state owned; the last bridge is a county bridge. The most extensive damage was sustained by the Ward Memorial bridges and the least by the Glenn Annie bridge. All the damaged bridges share a common design feature in that all have rocker bearing supports at the abutments. One of the Ward Memorial bridges has rocker bearings at some of its intermediate support points as well. In general, the earthquake subjected the bridges to considerable transverse motion which shifted the superstructures relative to the abutments causing the concrete to crack and spall at a number of places.

As mentioned, the most significantly damaged bridges were the two adjacent Ward Memorial bridges. The damage to these bridges occurred at several places and was relatively minor. The bridges are visible in Fig. 5.4, which is a view north along the sides of the bridges, and in Fig. 5.5, which is a view south. The bridges share a common abutment at their southern ends. The bridge on the left in Fig. 5.4 is 660 feet long and consists of eight spans. The spans are continuous reinforced concrete box girder structures except for two intermediate spans over Highway 101 which are single precast-prestressed concrete I girders. The bridge is supported by a series of two and three column bents that are sharply skewed. At the abutments, as well as at some of the precast-prestressed girder support points, the bridge deck rests on steel rocker bearings. The bridge on the right in Fig. 5.4 is 482 feet long and has six spans. The spans are continuous reinforced concrete box girder structures and there is only one intermediate hinge. The bents under this bridge have two columns each and are sharply skewed. The bridge deck rests on rocker bearings at the abutments.

Since the earthquake induced shifting of all damaged bridge decks was most evident at the rocker bearing supports, a more detailed description of these supports will be given next. Typically, where a bridge deck rests on rocker bearings, there are five bearings equally spaced across the width of the bridge. The bearings are cylindrical in shape, with an oblong cross-section, and are placed on edge between 1" thick steel plates, with the bottom plate fastened to the supporting substructure (called the masonry plate) and the top plate fastened to the bridge deck (called the sole plate). A view of a rocker bearing installation is shown in Fig. 5.6, which is the installation at the southern-most abutment of the Ward Memorial bridge on the left in Fig. 5.5. A close-up is shown in Fig. 5.7. The rocker bearing surfaces in contact with the plates are rounded to a radius of 8". The axes of the bearings are always oriented normal to the bridge centerline. Thus, functionally, the bearings permit the bridge deck to move longitudinally, parallel to the bridge deck centerline. The bearings are held captive laterally by loosely fitted 1" thick keeper plates that are bolted with 1" bolts to the masonry and sole plates at the two ends of the bearings, as can be seen from the damaged installation in Fig. 5.7. Notches in the keeper plates mesh with vertical keys protruding from the end faces of the