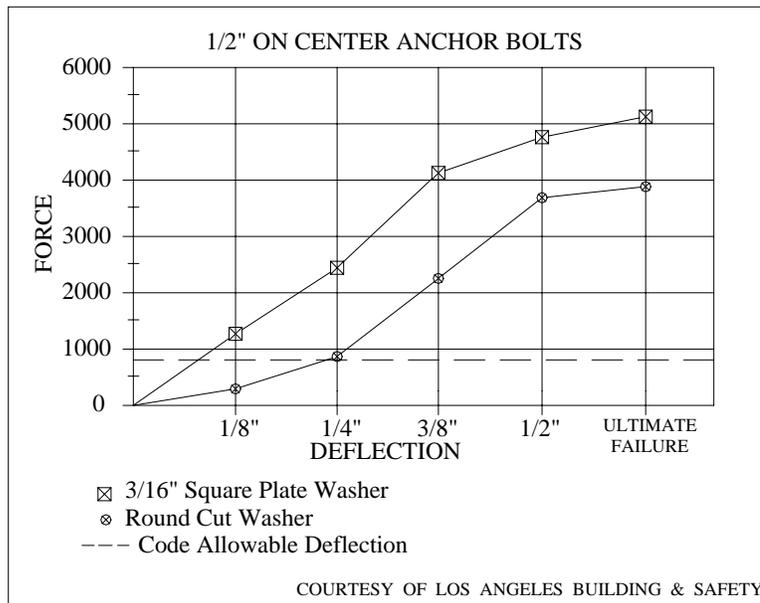


The Importance of Plate washers

The type of washer installed on a foundation has a huge impact on the bolt's ability to perform. As an earthquake applies large lateral forces to the mudsill such that the mudsill pushes against the bolts, the bolts do not snap off, rather the mudsill splits down the middle with the bolt acting somewhat like a dull ax (see illustration at end of this article.) The failure occurs in the mudsill this because the steel bolts and the concrete foundation are much stronger than the wood mudsill. For this reason modern retrofit codes do all they can to strengthen wood to bolt connection by installing the mudsill at its connection with the bolts by requiring special washers know as Bearing Plates or BP washers.

The graph below illustrates the advantages of using plate washers over round-cut washers.



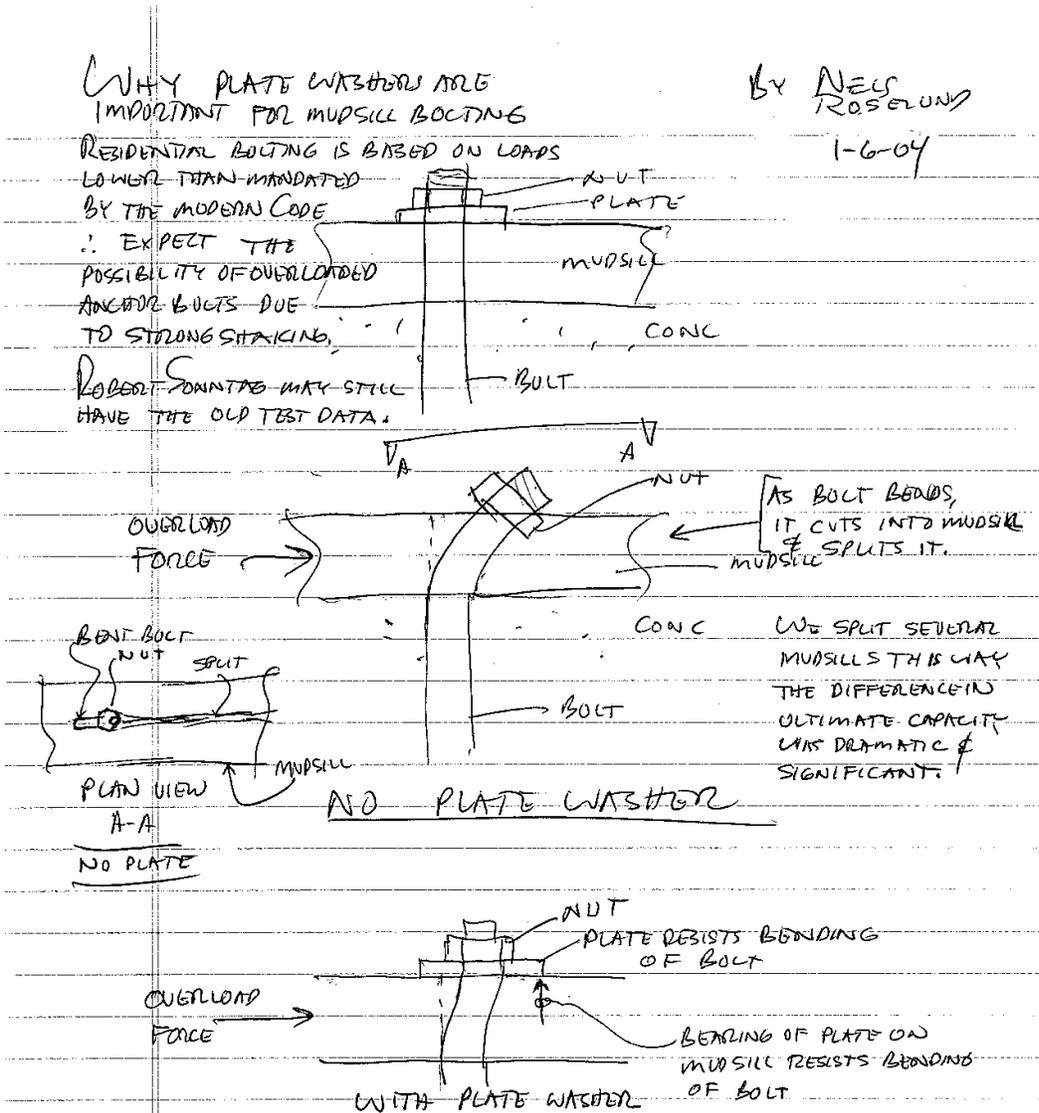
The Y axis of this chart represents force applied to a mudsill measured in pounds. The X axis represents the amount of movement (deflection) of the mudsill in inches. The lower line measures deflection with a standard round-cut washer. The upper line measures deflection with a plate washer.

The code requirement for bearing plates came out of observation made by the SEAOSC Existing Building Committee while doing research on mudsill bolting. This was done prior to scheduled demolition of concrete foundations after the house had already been removed in an urban renewal project. Sections of mudsill were isolated so that a jack could be used to apply a horizontal force on the end of a mudsill section. This would result in a shear force being applied to various anchor devices: existing anchor bolts, retrofit anchor bolts of various types, steel side plates, etc. For anchor bolts, it was observed that the failure mode resulted from bending of the anchor bolt which caused the bolt to bend. This bolt then cut into the mudsill like a dull knife, splitting the mudsill. When a plate washer was installed on the bolt, the plate would restrain against

excessive bending by holding the nut up, in effect applying a resisting moment to the top of the bolt. Higher ultimate shear capacities were achieved this way.

Harlen's MSP and Simpson's BP plates were adaptations to help attain higher capacities. Los Angeles City began requiring plate washers on anchor bolts soon after these tests were completed.

Subsequently, other engineering thinking began to consider the advantage of the plate washers in helping the plate resist uplift near a hold down: As the hold down deflected slightly the plywood would lift the mudsill at the edges where it was nailed to the mudsill. It was theorized, and also confirmed by the American Plywood Association, that anchor bolts and plate washers restrained the mudsill against uplift and mitigated splitting of the mudsill caused by cross grain bending. It was later theorized that perhaps even larger plate would do more to resist this cause of mudsill splitting.



THE ABOVE IS BASED ON TESTS BY THE SEAOSC HAZARDOUS BUILDINGS COMMITTEE IN ABOUT 1994. WE WERE GIVEN ACCESS TO OLD PANS AND TESTED ALTERNATIVE BOLTING METHODS.