

The Performance of Unreinforced Masonry Buildings in the 2010/2011 Canterbury Earthquake Swarm

noted that the buildings were not in close proximity to each other. An example of a gable end partial failure is shown in Figure 3.18(b), which can be compared to the comparable anchorage detail shown in Figure 3.13(a) that resulted in complete failure.



(a) Wall-roof anchorage failure

(b) Gable end anchorage failure

Figure 3.18 Partial bed joint shear failure surrounding anchorage detail

There were frequent examples of wall-diaphragm anchors that had deformed plastically. In these photographs (Figure 3.19), the circular plate can be seen to be slack due to plastic stretching of the anchor rod.



(a) Overview of wall anchors

(b) Close-up view of yielded anchor

Figure 3.19 Examples of yielded wall anchors

3.1.11 Diaphragm deformations

There was one instance where it was clear that diaphragm deformation, relative to the in-plane walls, contributed to partial failure of an out-of-plane wall. Figure 3.20 shows several views of a building which suffered out-of-plane parapet failure along its long, side walls. In Figure 3.20(b) it can be seen that the roof joists have tilted towards the front of the building. This suggested that the front wall of the building was driven forward at its top. Careful inspection of the front wall (Figure 3.20(c)) revealed a substantial outwards curvature which was most pronounced at the top.

The Performance of Unreinforced Masonry Buildings in the 2010/2011 Canterbury Earthquake Swarm



(a) Overview of building



(b) Side-view of tilted joists



(c) Front wall curvature

Figure 3.20 Example of diaphragm deformation causing out-of-plane wall failure

3.1.12 Return wall separation

Many buildings exhibited substantial cracking between their front wall and side (return) walls. This damage is not necessarily a catastrophic problem if stiff horizontal diaphragms are well connected to the walls in both directions, but where there is not good diaphragm connectivity, there is the potential for complete out-of-plane collapse of one or both walls. Figure 3.21 shows some examples where major cracking was observed between the side return walls and the front parapet and wall.