Places to Survive: Assessing potential spaces for earthquake shelters
San Francisco Bay Area, CA

Introduction/Background

Earthquake is known as one of the most destructive natural disasters. The nature of California lies on the earthquake fault zones increases the risk of occurrence for earthquakes. Back in 2013, the USGS scientists discussed the chances for San Francisco Bay Area to have a magnitude >6.7 is 62% in the next 50 years [Earthquake Hazards of The Bay Area Today, 2017]. The San Francisco Bay Area contains nine counties - Alameda, Contra Costa, Marin, NAPA, San Francisco, San Mateo, San Francisco, Santa Clara, Solano, Sonoma. Multiple major cities including San Francisco, San Jose, Oakland and NAPA etc. specifically choose San Francisco Bay Area because this is the most urban area, the population density is greater than the most urban areas in California (except those major cities in the southern parts of California). Thus, it is an important issue to find out the places that fit the criteria to be an emergency earthquake shelter place.

This project will use GIS methods to access potential shelter places for earthquakes. It will evaluate specifically which nursing homes in the San Francisco Bay Area are potential shelter places for the residents around within driving distance. It is crucial to illustrate the possible options to the residents from the area. What’s even more important is planning ahead before the disasters happened. Assessing based on the data provided from previous earthquake and plan more shelter places for the residents around within driving distance. This will evaluate specifically fit the criteria to be an emergency shelter place.

This Earthquake basic data layers from association of Bay Area government Resilience Program (figure 1) indicates the Alquist Priolo Fault Zones specifically in Bay Area and the MMI showed the magnitudes for previous earthquakes. From the figure, areas that lie right above the fault zones are the higher risk places and this is one of the criteria to determine the potential places later one – avoid these areas.

The final map indicates the locations of nursing homes that fit the criteria. I found that there are more nursing homes that fit criteria close to major cities I mentioned before. In counties like Sonoma, Contra Costa and Alameda, there were not many nursing homes that have greater or equal to 1.50 beds/population. Most of the nursing homes located on the areas that used to have a magnitude of 8 or 9 earthquakes, this means these places are even more crucial (Figure 5).

Methodology

The methods I used for analyzing the potential shelter places are described in the flow chart on the right (Figure 4). Firstly, I selected the nursing homes that have beds/population more than 150 because I acquire some larger scale of nursing homes to be potential shelter places. Next, I used select by location to find the nursing homes that are at least 2 miles from the fault zones. Thirdly, I made a 2 mile buffer around each picked out nursing homes. Then, I used the 2 mile buffer layer and the lifeline routes layer to select the nursing homes that crossed by the lifeline routes. The reserved nursing homes are easier to access than the ruled out ones due to convenient transportation. After this, I used the layer from the previous step and with the census tract 2018 data layer and to make a join and summarized the population attributes by calculating the sum for each buffer zones.

Results

This Nursing Homes data layer from Homeland Infrastructure Foundation-Level Data (HIPLD) (Figure 2) illustrates the locations for nursing homes in the US. Data extraction was required to just focus on the Bay Area facilities. They are classified by natural breaks for five groups based on the ‘Bed’ account. They will be evaluated for potential places.

This 2018 U.S. census tract data layer from US. Census Bureau and Tiger/Line (figure 3) provides information like population estimates for the state of California by counties. Even though this is a “year-0 old data” set but it’s adequate enough to present the current population estimates.

Discussion/Conclusion

The 51 selected nursing homes could be possible options as shelter places for earthquakes. The reason I chose out the nursing homes as potential shelter places include these. First, nursing homes are good shelter place since they have a holistic medical team already, this meets one of the criteria discussed in the study by Klifs F et al. In addition, all of the nursing homes crossed by lifeline route, this means the accessibility will not be a problem for people around to go to the designated shelter places. Limitation for my analysis including I currently use “bed counts” as the assessment to determine the scale of the nursing homes but this is limited. Even though the nursing homes do not have equivalent beds for huge population group, there are alternative ways to solve this. In deed, future analysis is needed. In future analysis, I should acquire information like, areas for each nursing homes to check if they are capable for accommodate huge groups. My results can be used for city planning and emergency preparedness planning.

References


Data Source:

Figure 1-Alquist Priolo Fault Zones & PSHA, June 2015, Association of Bay Area Governments Resilience Program
Figure 2-Nursing Homes, 2019, HIPLD
Figure 3-Census tract, 2018, US. Census Bureau & Census tract, 2018, Tiger/Line
Figure 5-Lifeline Routes, 2014, California Metropolitan Transportation Commission

Table 1: Nursing homes with the largest population around & bed counts

<table>
<thead>
<tr>
<th>Nursing Homes</th>
<th>Population around</th>
<th>Bed Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEQUOIAS SAN FRANCISCO THL</td>
<td>2729444</td>
<td>400</td>
</tr>
<tr>
<td>SAN FRANCISCO TOWERS</td>
<td>314559</td>
<td>150</td>
</tr>
<tr>
<td>VINTAGE COVENTRY</td>
<td>306267</td>
<td>110</td>
</tr>
<tr>
<td>KINRED TRANSITIONAL CARE AND REHABILITATION - TUNNEL CENTER</td>
<td>594642</td>
<td>150</td>
</tr>
</tbody>
</table>

Table 2: Nursing homes with the least population around & bed counts

<table>
<thead>
<tr>
<th>Nursing Homes</th>
<th>Population around</th>
<th>Bed Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>BUILDING/MFG/LONG TERM CARE/D/P SNF</td>
<td>5805</td>
<td>251</td>
</tr>
<tr>
<td>STONERIDGE CREEK PLEASANTON</td>
<td>7125</td>
<td>229</td>
</tr>
<tr>
<td>LOS GATOS MEADOWS</td>
<td>23282</td>
<td>329</td>
</tr>
<tr>
<td>BROOKDALE FAIRFIELD</td>
<td>23370</td>
<td>250</td>
</tr>
</tbody>
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Table 2: Nursing homes with the least population around & bed counts

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