Earthbag Building: Finding Suitable Locations in Northern California

Abstract

Earthbag homes are sustainable, structurally sound buildings that are cost-effective, easy to build, and good for the environment. The project's goal was to find the most suitable locations in Northern California to build earthbag homes. The criteria for the property was to find southfacing land with a gradual slope in Humboldt and Mendocino counties that also had the proper soil type required to build the earthbag homes. Using a GIS software, ArcMap, and raster processing we utilized a variety of techniques to achieve this goal, including downloading the digital elevation models (DEMs) from EarthExplorer website. Soil layers were accessed from the United States Department of Agriculture (USDA). There are a number of things to consider when planning a project like this, such as accessibility to the property by roads and proximity to cell towers.

Introduction

Earthbag homes are sustainable buildings that are constructed utilizing local, natural material surrounding an area. They have been around for at least a century, originally used for flood control and military bunkers. Currently, they make for great homes because they are easy and fast to build, inexpensive, and structurally sound. They are essentially constructed by filling polypropylene sandbags with soil and stacking the bags in a variety of architectural forms, usually dome shaped. They are cost effective and sustainable since virtually all of the material required for construction can be found onsite. They are very structurally sound, bypassing California's earthquake codes by 200% (Hart and Geiger).

An important factor when building earthbag homes is the location. The bags need to be filled with the proper ratio of clay to sandy/loam soil. The ideal soil type best for earthbag building is 10-30% clay. Ideally, a building site that already has this soil ratio existing on the property would be best to build an earthbag building on. That way you don't have ship in as much additional material.

For this project, our main objective was to find the most suitable locations in Northern California that had the proper soil ratio needed to build earthbag homes, south-facing, area, and gradually sloping. We utilized various skills in ArcMap to come up with a strategy to locate these areas.

Methods

Soil Data was acquired from the USDA website and downloaded as a Microsoft Access Database. This Database contained information on a wide range of soil attributes. To use this data in ArcMap a separate client application was needed. This application was provided by the USDA and was capable of generating thematic maps based on different soil attributes. For this project, we used the application to create a map based on the physical properties of the soil. Once this map was generated we then selected for areas which contained the percentages of clay mentioned above. This selection was exported and clipped to the boundaries of Mendocino and Humboldt county.

After downloading the DEMs for both Humboldt and Mendocino counties from the EarthExplorer website, we imported them to ArcMap. The resolutions of the DEM raster files are 30 meters. We used "Mosaic to New Raster" to mosaic the DEMs together. Then, we used "Extract by Mask" to create DEMs specific to the county outlines. Using the DEMs as a reference, we could calculate the slope of the areas using the "Slope" tool. With "Raster Calculator," we calculated the slope of the county between 1 and 10 degrees. From there, we could find the aspect of the area and use "Raster Calculator" again to find the regions in the counties that had a south-facing slope between 112 and 247 degrees. Using "Raster Calculator," we multiplied the aspect dataset and the slope dataset to find where the two intersect. This raster was then converted into a shapefile for further analysis.

Using select by location allowed for the selection of areas that had both the ideal soil composition as well as relatively flat south facing slopes. Once these areas were selected and exported as their own layer the areas were calculated using the calculate geometry tool. With the areas calculated in acres we then selected locations which had areas between 45 and 55 acres which is ideal for small farm or homestead. These locations were then change from polygons to point features to improve the final map layout.

Results

We found that areas in Humboldt and Mendocino Counties had many suitable sites with the criteria of slope, area, elevation and soil type appropriate for building earthbag homes (Fig. 1). Mendocino County has more sites than Humboldt County (Fig. 2).



Figure 1. Locator map of Humboldt and Mendocino counties in California.



Figure 2. The final parcels in Humboldt and Mendocino counties that have all the required criteria for earthbag homes.

The images were prepped to the size of 6 x 6 in and exported into a 300 dbi JPG.

Conclusion

There are a few things to take into account when planning a project such as this one. The first would be to consider the accessibility to roads. This would allow for the delivery of extra material necessary for the construction of the homes to the site without too much hassle. Another thing to consider when selecting a location is the proximity to cell towers for internet access for residents.

Work Cited

Hart, K. and O. Geiger. 2014. <<u>http://www.earthbagbuilding.com/index.htm</u>>. Accessed 25 April 2017.

Humboldt County GIS Data Download. 2017.

<<u>http://www.humboldtgov.org/276/GIS-Data-Download</u>>. Accessed 11 April 2017.

Undergraduate Studies in Earthquake Information Technology. 2012.

<<u>http://52.26.186.219/internships/useit/content/california-counties-shapefiles</u>>. Accessed 25 April 2017.

United States Department of Agriculture. 2017.

<<u>https://gdg.sc.egov.usda.gov/GDGOrder.aspx?order=QuickState</u>>. Accessed 11 April 2017.

United States Geological Survey: EarthExplorer. 2017. <<u>https://earthexplorer.usgs.gov/</u>>.

Accessed 18 April 2017.