UC San Diego

Nepal 2015 Earthquake Data Analysis

ECE 143

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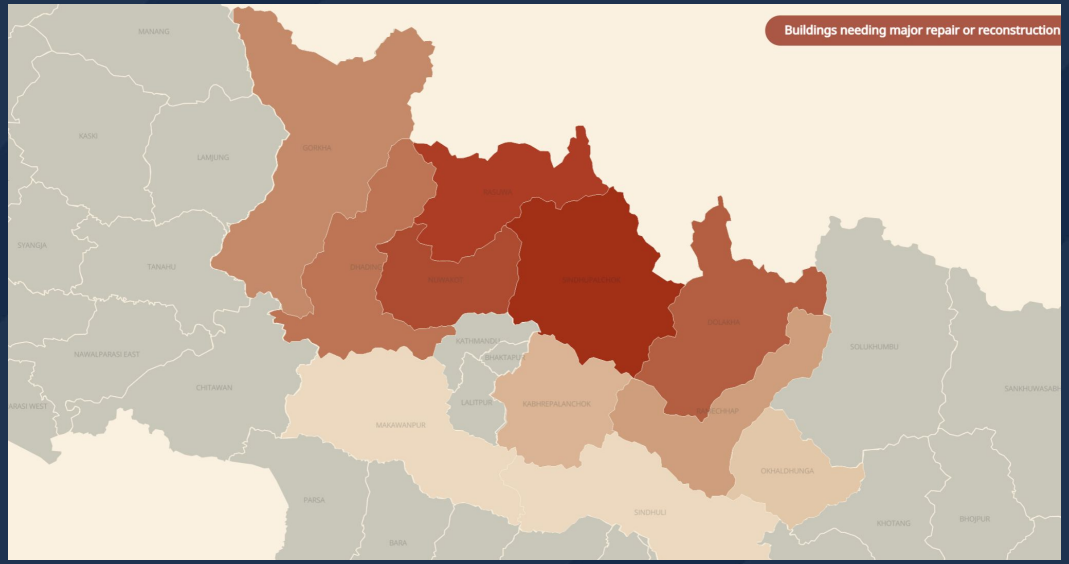
Motivation

- Earthquakes are unpreventable and cause extensives amounts of damage
- Rural communities are disproportionately affected, due to improper building practices
- Loss of lives and property damages can be prevented by using appropriate building methods

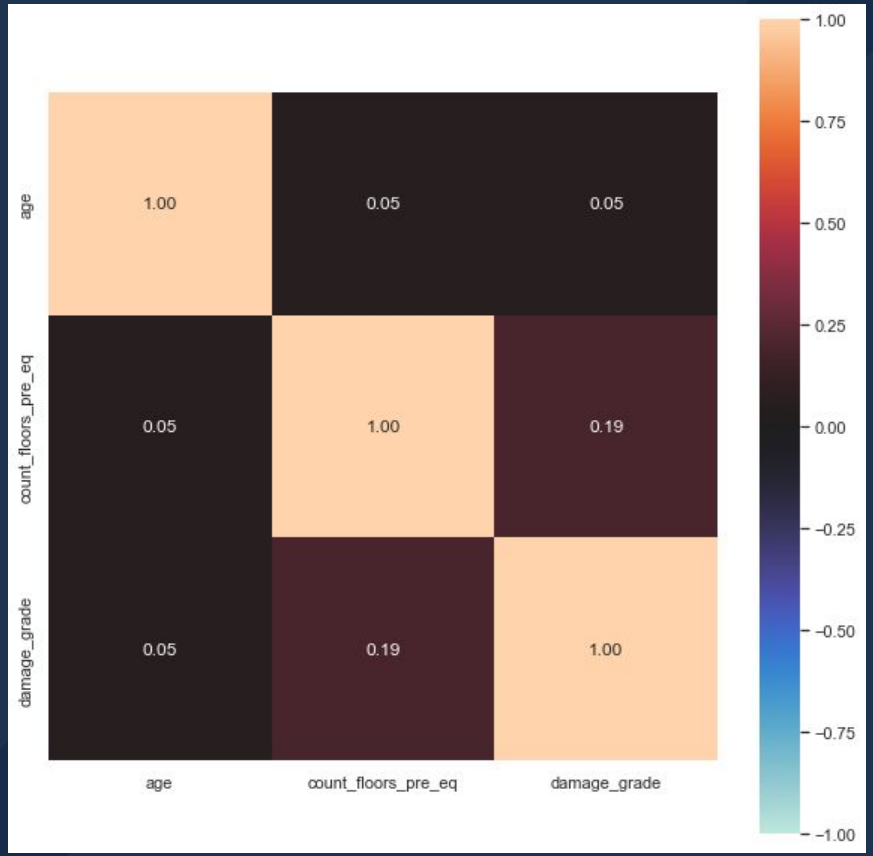
Image Source: https://earth.stanford.edu/news/2015-nepal-earthquake-offers-clues-about-hazards

Data Explanation

- 2015 Nepal Earthquake
  - Records affected buildings
  - Details building location, materials, age, purpose
- 762,106 buildings recorded
- Investigating how age and materials affect stability of buildings



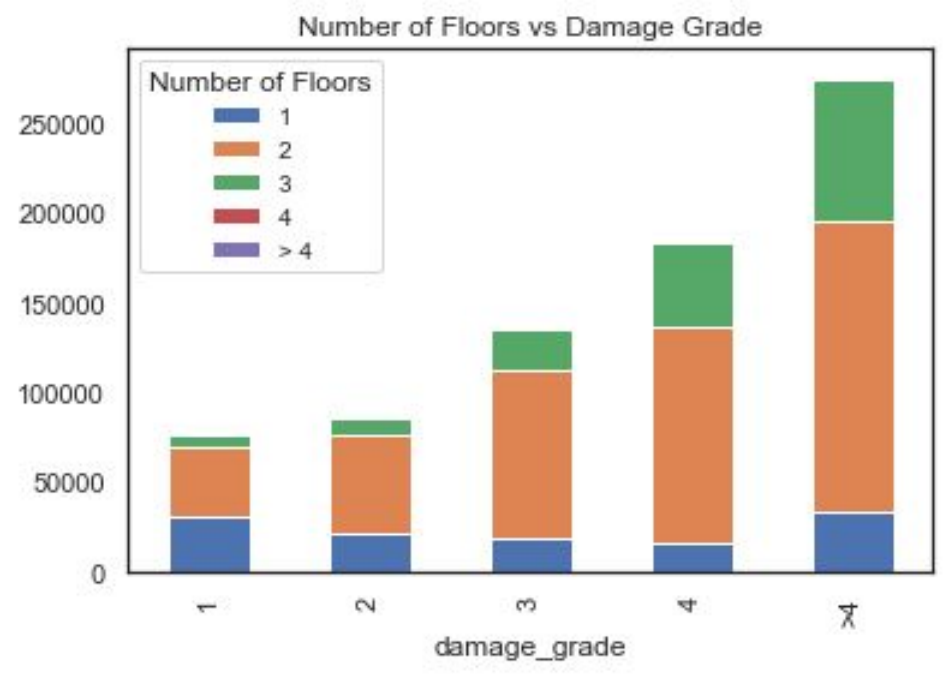
Impact of Structure Features

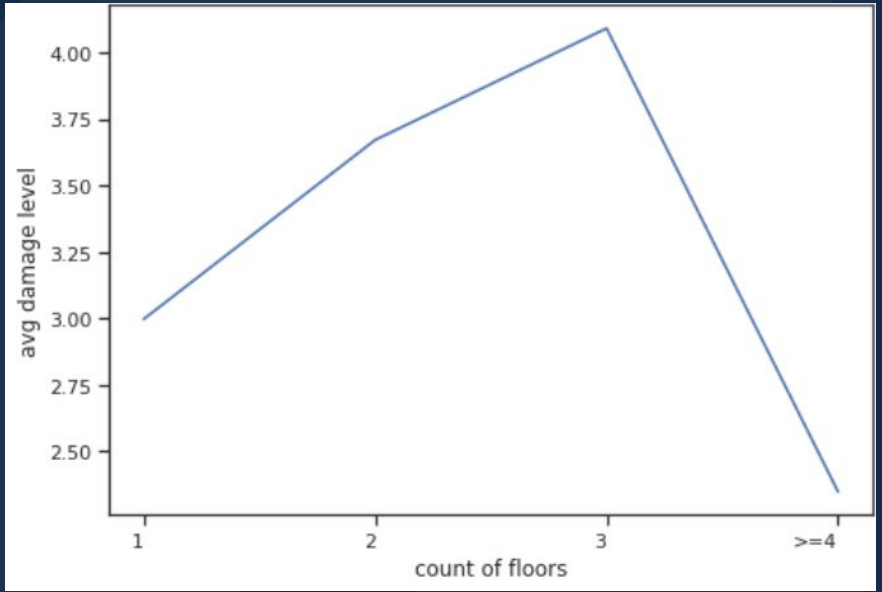


- Correlation Matrix between age, number of floors in a building as well as damage grade.
- There is some weak correlation between the number of floors in a building and the damage grade.

Impact of Structure Features

- Count of floors: most buildings have less than 4 floors
- Why such correlation exists?

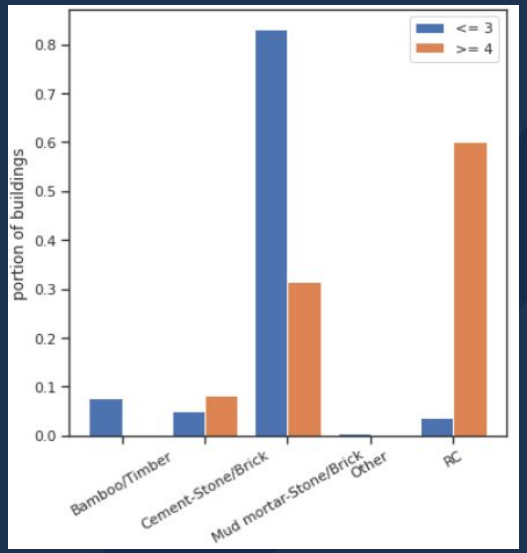




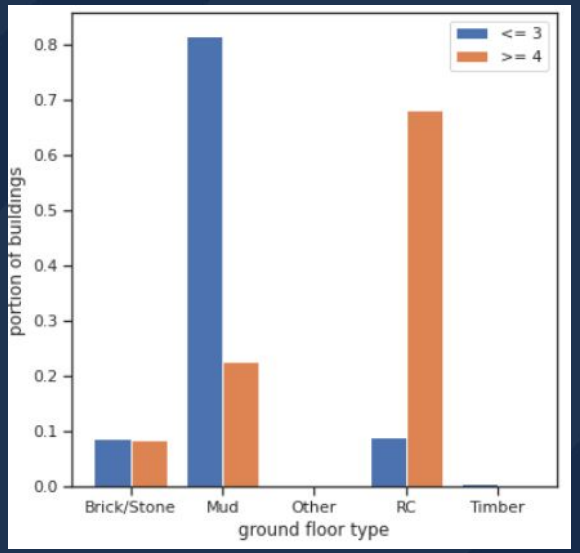
- Across any damage grade, buildings with lesser floors are most affected.
- Across all damage grades, the ratio of buildings with second floors damaged by the earthquake is the highest

Impact of Structure Features

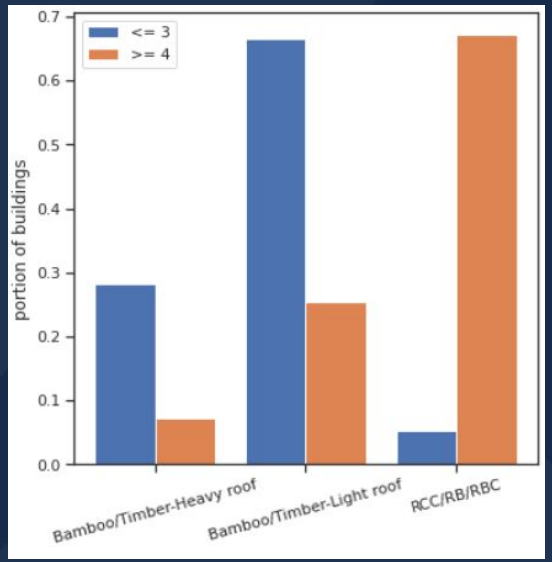
- Two groups of buildings: number of floors <= 3 or >= 4



a) Histogram of foundation type



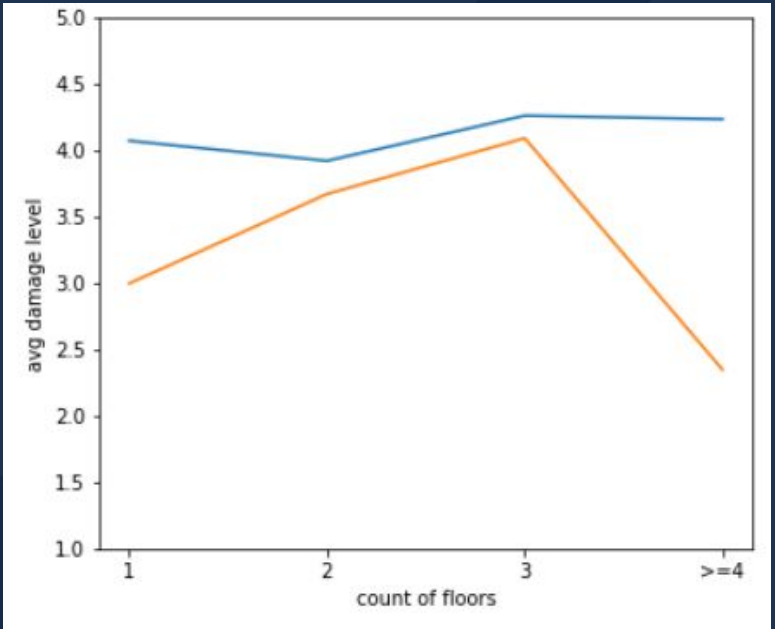
b) Histogram of ground floor type



c) Histogram of roof type

Impact of Structure Features

- By fixing other structure features, the plot of average damage grade is almost a horizontal line: hardly any correlation between count of floors and damage grade
- Simpson's paradox

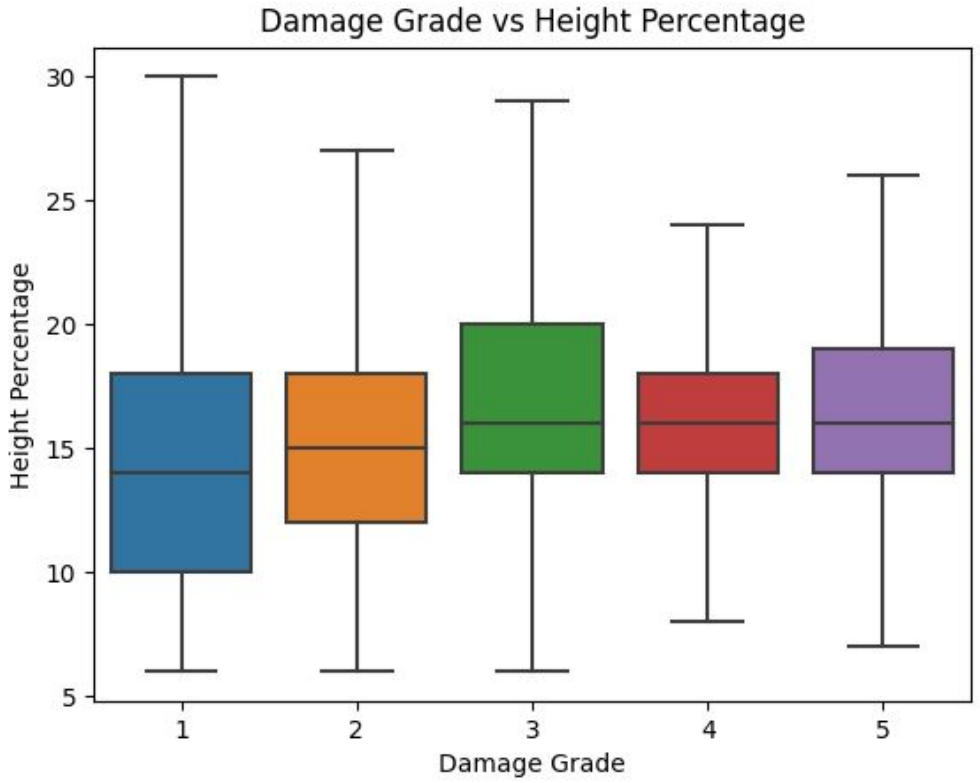


Plot of the average damage grade

- blue: structure features fixed (Brick foundation; Mud ground floor; Bamboo roof)

- yellow: structure features unfixed

Impact of Height Percentage



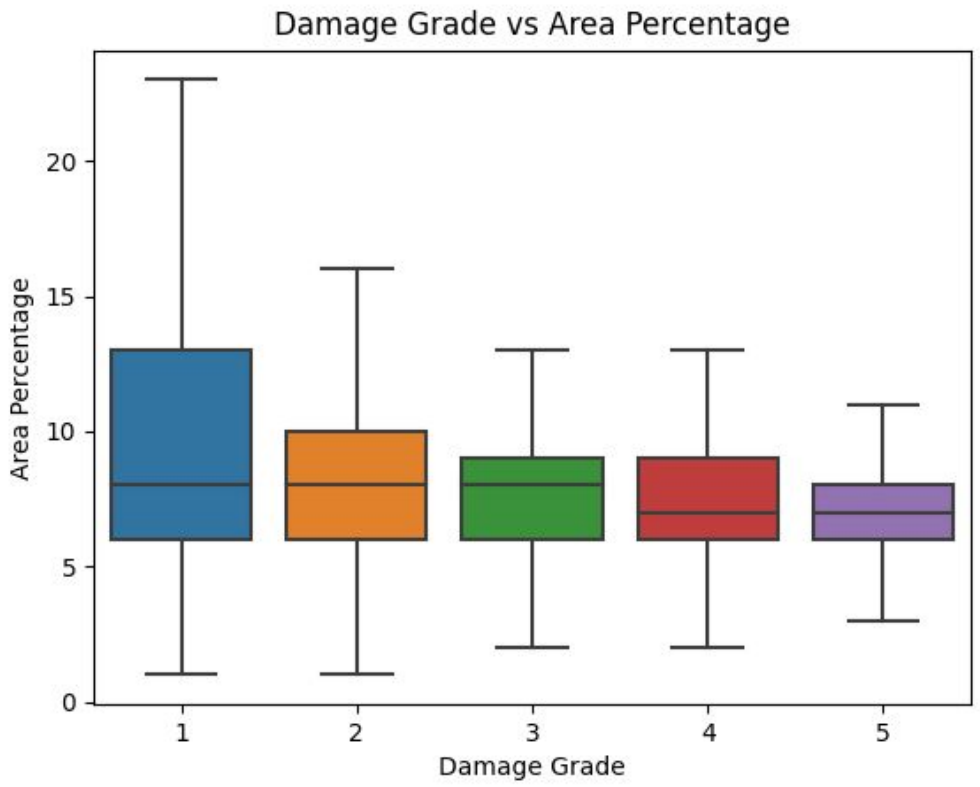
- Higher height percentage leads to a greater damage grade.

Higher height percentage

↓

More torque exerted on the base and higher likelihood of disastrous outcomes

Impact of Area Percentage



- Higher area percentage leads to lesser damage grades.

Larger area coverage

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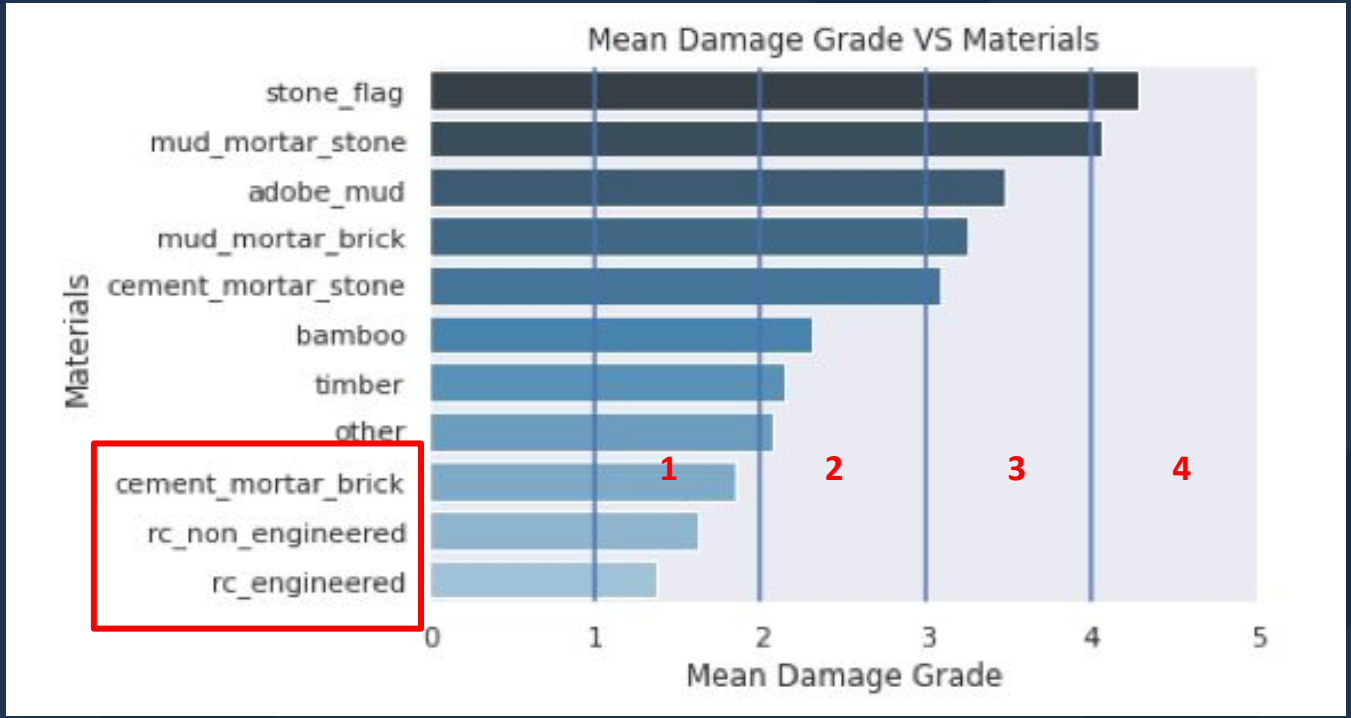
Parts of the structure are taking less concentrated forces

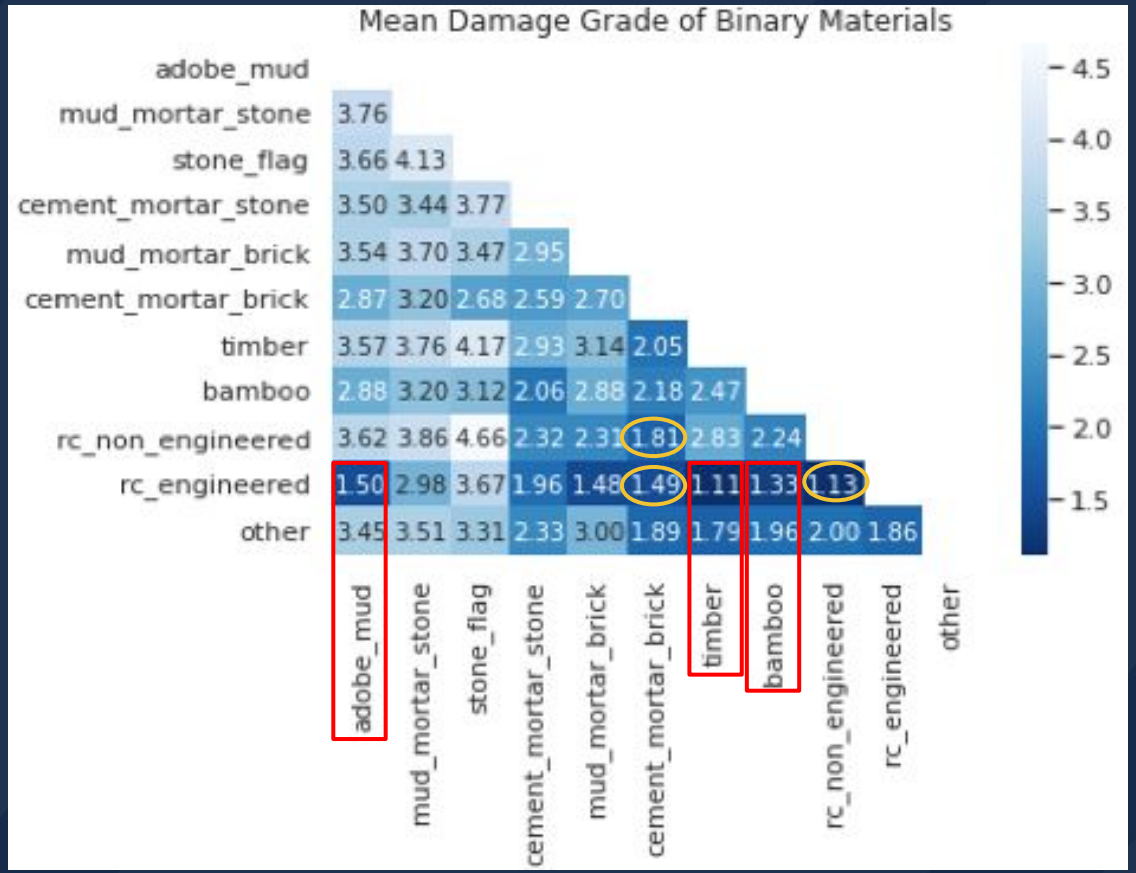
Impact of Superstructure Materials (Single Materials)



- X: mean damage grade
- Y: materials type

Fig. Mean Damage Grade of Using Different Superstructure Materials

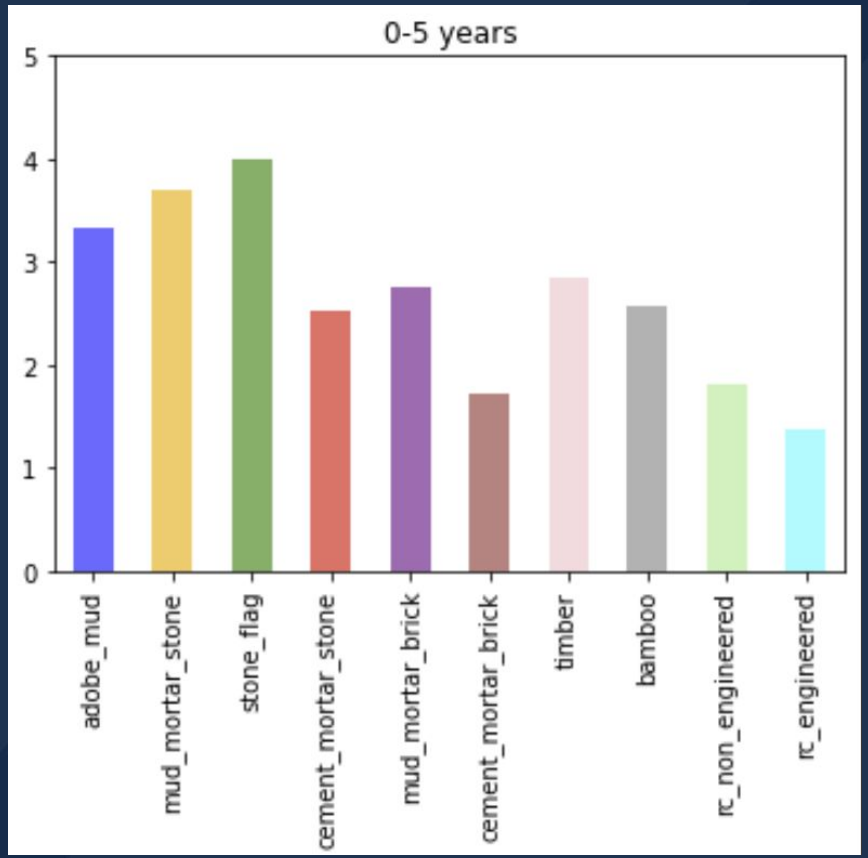
Impact of Superstructure Materials(Combined Materials)

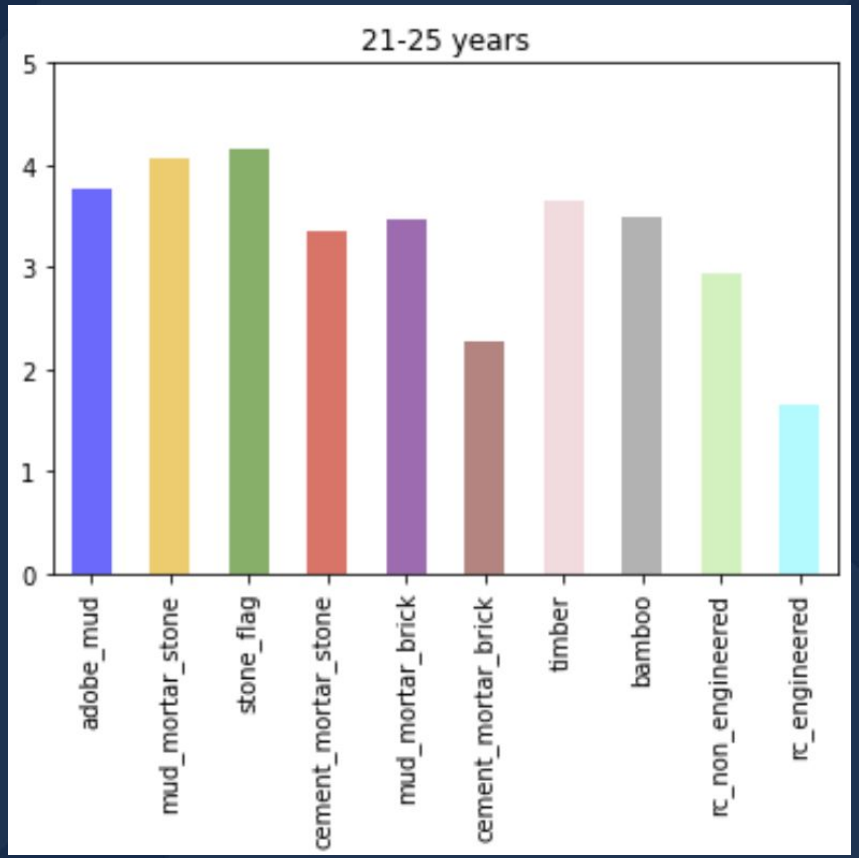


- X: materials type
- Y: materials type
- Heatmap value: mean damage grade of materials combination

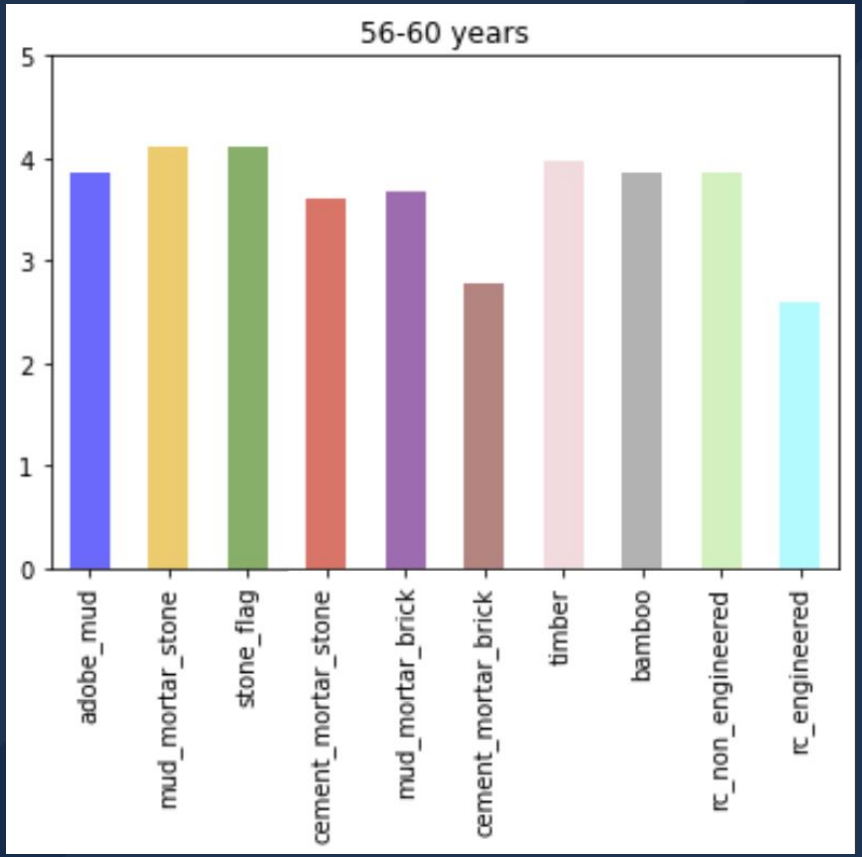
- Choices for Single Materials
  - Rc non engineered
  - Rc engineered
  - cement - mortar brick

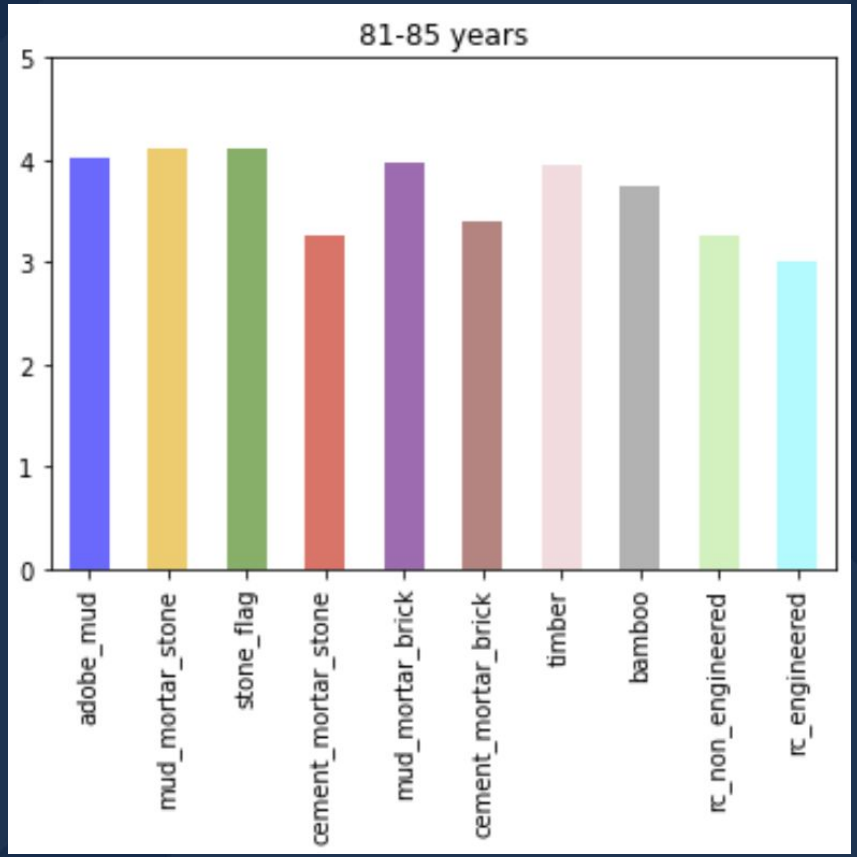
Impact of Materials by Age Group - Recent Buildings





Impact of Materials by Age Group - Older Buildings





Thank You!

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