**Assignment**

This exercise focuses on the damage and loss assessment part of the PBE workflow. Your tasks is to characterize the expected damages and the corresponding repair costs and injuries for a 12-story reinforced concrete shear wall building. Assume that you work with other engineers who have already developed a high-fidelity finite element model of the investigated building and ran nonlinear response history analyses to characterize its response.

You received three sets of Engineering Demand Parameter (EDP) data from them that correspond to a seismic hazard with 2%, 10%, and 50% exceedance probability in 50 years, respectively. Each dataset provides Peak Interstory Drift (PID) and Peak Floor Acceleration (PFA) values for every story of the building in two horizontal directions from 50 nonlinear analyses. (Each analysis used a different ground motion record that was carefully selected by the other engineers to represent the seismic hazard.)

**Q1**

Process the EDP\_data files and plot the distribution of drift (PID) and acceleration (PFA) values along the height of the building in each direction for the three seismic hazard intensities (i.e., 2%, 10%, 50% in 50 yrs). Discuss how you would quickly check that the data is reasonable considering the type of building and the intensity of the ground shaking.

You also received a performance model for the building that identifies the structural and non-structural components, their location and quantities in the building. Three input files are provided that correspond to 72, 475, and 2475-year return periods earthquake scenarios. You can use the SimCenter PBE Application and load one of these files to automatically populate the application with the settings for the given scenario. Note that the inputs for this exercise are provided in the Damage and Loss (DL) panel in the application.

**Q2**

Perform three analyses in the PBE Application, one for each scenario (72, 475, 2475-year return period) using the corresponding input files and demand data (i.e., EDP\_data file). Review the aggregate results in the Summary tab of the application and report the following measures:

1. mean and 90th percentile repair cost;
2. mean repair times assuming tasks either performed in parallel or in serial fashion;
3. expected number of severe injuries and fatalities;
4. probability of collapse;
5. probability that the structure is not repairable due to excessive residual displacements.

**Q3**

Review the detailed results from each scenario analysis (see the slides from the introduction to PBE presentation or the PBE documentation for details on how to access these results) to answer the following questions:

1. Which type of components (out of structural, non-structural, contents) contributes most to the mean repair cost, the mean repair time, and the expected number of injuries?
(The description of each component is available under the Components tab in the PBE Application. Use the DV\_rec\_cost\_agg.csv, DV\_rec\_time\_agg.csv, DV\_injuries\_0\_agg.csv, and DV\_injuries\_1\_agg.csv to see the contribution of each component to the various losses. Aggregate losses across components within each group – such as structural – to answer this question.)
2. Which components are the most important contributors to the mean repair cost, the mean repair time, and the expected number of injuries?
(Use the component-specific information from the previous question but look at individual component contributions this time.)
3. How many injuries and fatalities are expected if the building collapses, and how many if the building does not collapse?
(Use the DL\_summary.csv to obtain the number of injuries for collapse and non-collapse realizations.)
4. How are the consequences in terms of loss of life change depending on the time of the event during the day?
(Use the DL\_summary.csv to obtain the number of fatalities and the time of the event for each realization)

**Q4**

Review the results for the three scenarios and comment on how the consequences change as the intensity of the earthquake increases.