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Development of a GIS Application for seismic vulnerability and earthquake damage studies in Nicaragua

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A GIS based software is presented which permits the estimation of seismic vulnerability and the presentation of results in digital maps for single houses, groups of buildings, parts of settlements or even complete towns.

Nicaragua is a country with a high seismic activity. Thus, seismic vulnerability and risk studies have been carried out, in recent years, by several scientific groups applying different methodologies.

The assessment of seismic vulnerability requires the execution of distinct tasks, e.g. recollection of field data, integration of data from the municipal cadastre, reprocessing or screening to test the reliability of the data, definition of calculation of vulnerability functions, calculation of vulnerability for single objects as houses or buildings, calculation of mean vulnerability for certain areas as barrios or squares. Finally, the results are normally presented on maps.

Observing the work flows of the projects carried out in Nicaragua we observed that the preparation of data and the presentation of the results take much time, mainly because several separate software tools are used for distinct tasks and scientific calculations. Then the results have to be passed to other software used for the graphical presentation of results. It is common, that all the process has to be done repeatedly to observe the influence of different parameters to the final result.

In order to reduce time and effort to be spent with several unspecialized tools and procedures, an integrated software system was created the user of which has not to care about separate software tools for each part of the process. The main advantage of the software is the combination of Geographical Information System (GIS) with the logics that surrounds the specific methodologies of seismic vulnerability index, index of damages and presentation of results. This advantage is accomplished by exploiting the ability of customizing the GIS software (ArcGIS, ESRI) trough plug-in´s of its several software libraries with the specialized functionalities and the logical programming with the requested user requirements.

The new software uses a connection with an external centralized Enterprise Data Base which stores all the input information and calculation results and which is automatically synchronized for the presentation of results using GIS.

When new requirements of typologies for houses are introduced, cadastral data from the municipality is uploaded to the system. This information becomes the base data set of the current project. The cadastral information contains data on the constructive type of the house, dimensions, year of construction, type of walls, roof, number of inhabitants, etc.. These data are then processed to define groups of houses belonging to certain types or classes. For each type a number of houses is selected which will be visited to confirm the correctness of the classification. The other not selected houses get the average value of its type. This process can be run repeatedly to generate distinct results for several sets of input parameters visualizingthe results automatically over a map layout.

The system also allows to present damage scenarios for specific seismic events with given hypocenter and magnitude.

Moreover, there is another and just as important byproduct. The documentation of the software serves as a guide for students working on object oriented software engineering by using unified modeling language (UML) and software logic architecture (3-tier).

This work was carried out at the Geophysical Department of the Instituto Nicaragüense de Estudios Territoriales (INETER) and the Universidad Nacional de Ingenierìa (UNI),

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Web   page:
http://www.ineter.gob.ni/geofisica/sig/index.html