CATDAT

Integrated Historical Global Catastrophe Database

A Worldwide Building Inventory and Vulnerability Index

abstract

Problem Definition

The need for a worldwide building inventory has been seen for analysis of rapid losses from any natural disaster worldwide. Due to the lack of information in certain regions, assumptions made from using other countries building inventories can be wrong.

What is contained in this study?

In this study, a country-by-country global building inventory has been produced for 244 nations using individual country studies. The global building inventory produced presents a new advancement for the rapid estimation of socio-economic losses as more accurate estimates are possible using a building inventory based on first-order building typologies for each country than building inventories based with regionalized assumptions as in PAGER. A significant first step was made by PAGER in producing a global building inventory encompassing the World Housing Encyclopedia (WHE), research studies, some census data and some United Nations data in 87 HAZUS classes for residential and non-residential inventories.

For this study, over 1500 individual census reports and statistical yearbooks from over 200 countries were audited, with a review of possible parameters to be used for building inventories as per the OPAL project. In addition, demographic and health surveys, WHE-PAGER reports, United Nations data, individual government reports, energy building stock reports and many other sources were utilized on a country-by-country basis to create an urban and rural building inventory. Parameters in the residential building database include building typologies (houses, apartments, single family and multi-family living arrangements, etc.), wall and roof type (in terms of HAZUS classes), age of the buildings (8 classes of year ranges), number of floors, number of rooms, building quality, number of buildings, building cost data and household size (occupancy).

A general building practice factor has been created using a combination of socio-economic indices such as corruption, relative income and other parameters. For earthquakes, a review of the various seismic resistant codes around the world has been undertaken and these have been subjectively ranked in comparison to the relative hazard of a particular country. A case study has also been undertaken for the entire Asia-Pacific region in terms of a physical and socio-economic risk index for floods and earthquakes using this building inventory and other socio-economic indicator information.

How does this help the community?

This dataset provides a useful tool for rapid natural disaster loss estimation on a country level and a useful first step in country exposure as seen through the case studies. For detailed natural disaster analysis, further levels of regional data must be used, as various regional practices, economics, cultural influences and natural materials vary across a nation.

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Country-by-Country Building Inventory

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What are the parameters collected?

Parameters in the building database include:-

- **building typologies (houses, apartments, single family and multi-family living arrangements, etc.),**
- **wall and roof type (in terms of HAZUS classes)**
- **age of the buildings (8 classes of year ranges)**
- **number of floors, number of rooms, number of buildings,**
- **building quality, building cost data and household size (occupancy).**

From the census dataset survey alone, 157 countries contain wall type information and 118 countries contain roof type information. The building typologies were classed into the same 87 HAZUS classes as in PAGER.

The relative urban and rural population of each country from 1900-2011 has been compiled from a combination of sources including the CIA Factbook, UN Census Round information and other population estimation sources (CIESIN, worldgazetteer and urbaninfo). In addition, the labour force statistics produced in CATDAT from a combination of World Bank and UN information were incorporated.

Census Data

Over 1500 census forms have been reviewed as part of the building inventory production. Of 238 countries, the following census values were found for building parameters among others.

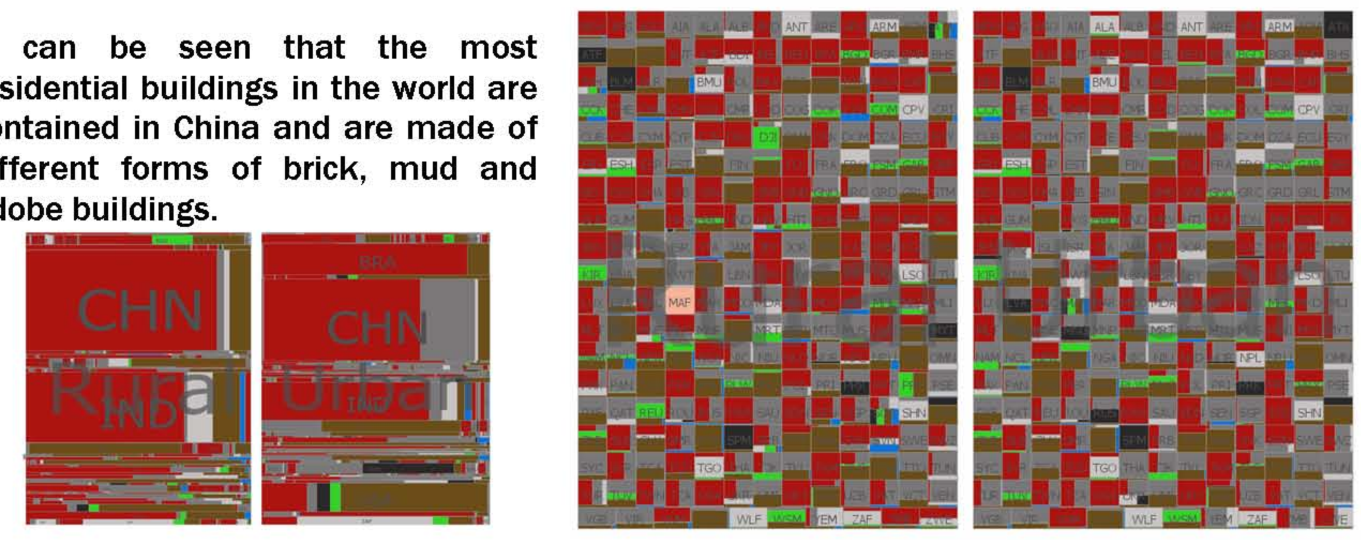
Building Parameter	No. Of Countries	%
Building Types (Apts, etc.)	205	86.13
Wall Materials	157	65.97
Roof Materials	118	49.58
No. Of Buildings	187	78.57
Year of Construction	104	43.70
Improvised/Quality	53	22.27
No. Of Rooms	197	82.77
Cost data	28	11.76
No. Of floors	33	13.87

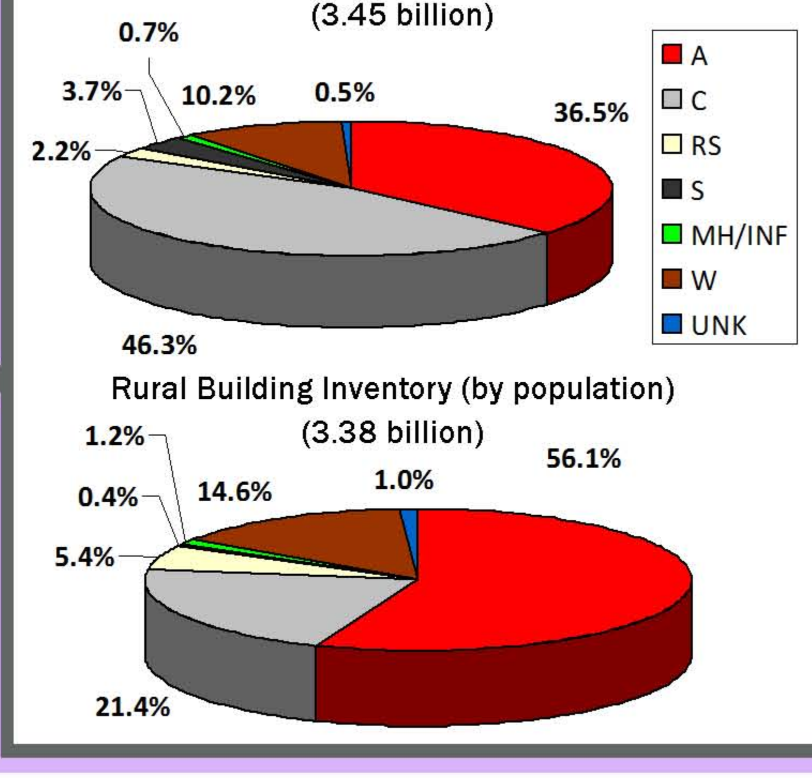
Each parameter has been added for each country to the inventory as well as additional DHS survey and other UN studies. With additional studies and PAGER data, the inventory is built!

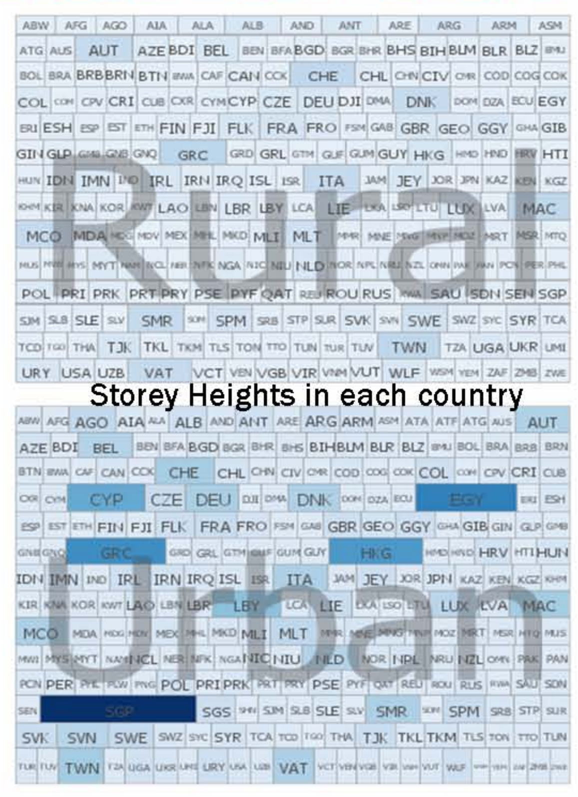
Building inventory comparisons of the world

Using HiDE and other software, the following views of data can be seen.

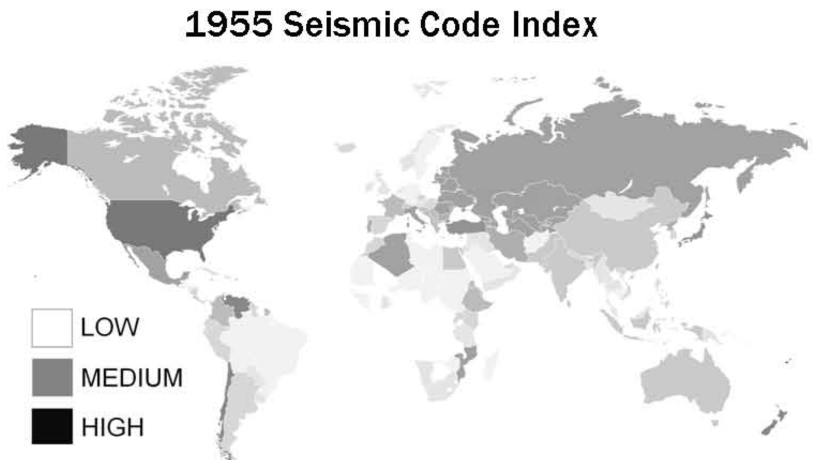
It can be seen that the most residential buildings in the world are contained in China and are made of different forms of brick, mud and adobe buildings.





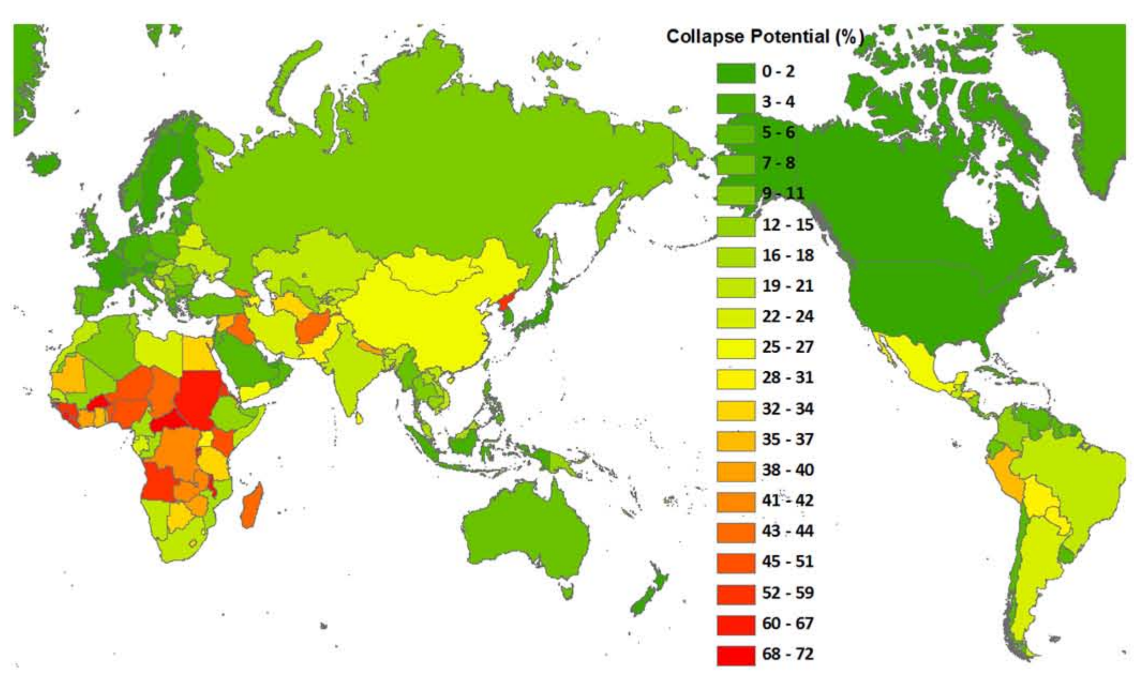


Seismic Codes and Building Practice

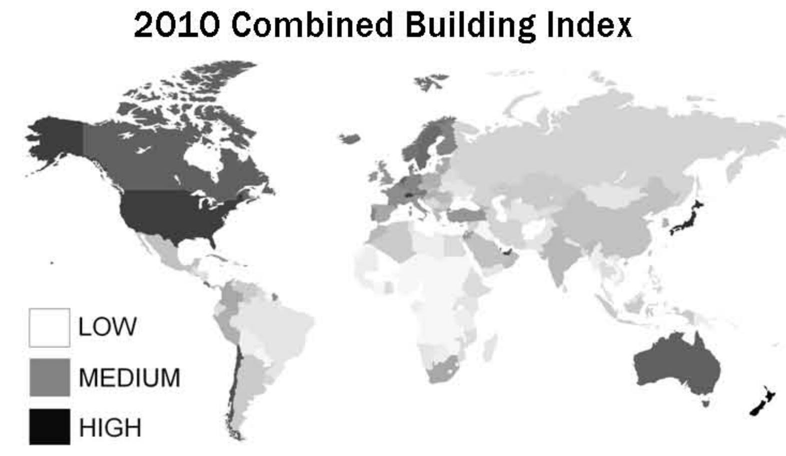


Vulnerability of Building types + the combined Building Index

If countries are assumed to build equally to the hazard within the country across zones. i.e. earthquake zones build to a higher standard vs. Lower seismic zones, then the following view of the world results in terms of vulnerability using building practice, building fragility function and seismic codes.



- The seismic code index ranks the quality of seismic codes since 1900 in each nation.
- The building practice factor ranks the quality in terms of corruption and practice, engineering etc.
- The fragility function comes from the 87 HAZUS classes described above for 244 nations. These have been adapted from PAGER to the building inventory created in this study.



Vulnerability, Global Risk and Conclusions

This global risk map has been produced using old EQ Hazard Maps and the Worldwide Building Inventory and Seismic Code Index described in this poster. Additional small grid estimates have been created (i.e. 2.5sec grid). This building inventory has also been used in estimates for the 2011 Tohoku Earthquake.