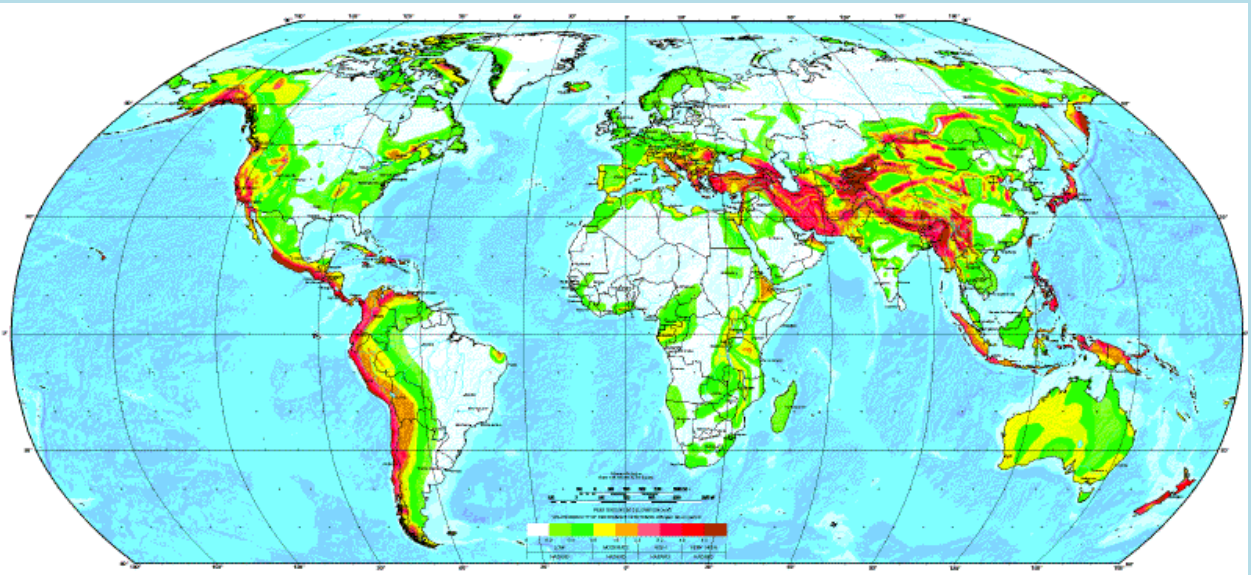
SEISMIC MICROZONATION

Seismic microzonation is subdividing a region into smaller areas having different potential for hazardous earthquake effects[1]. The earthquake effects depend on ground geomorphological attributes consisting of geological, geomorphology and geotechnical information. The parameters of geology and geomorphology, soil coverage/thickness, and rock outcrop/depth are some of the important geomorphological attributes. Other attributes are the earthquake parameters, which are estimated by hazard analysis and effects of local soil for a hazard (local site response for an earthquake). The Peak Ground Acceleration (PGA) [from deterministic or probabilistic approach], amplification/ site response, predominant frequency, liquefaction and landslide due to earthquakes are some of the important seismological attributes. Weight of the attributes depends on the region and decision maker, for example flat terrain has weight of "0" value for landslide and deep soil terrain has highest weight for site response or liquefaction.

The first attempt of seismic microzonation of any urban area i.e. an industrial as well as population center was carried out in city of Yokohama, Japan in 1954 considering various zones, corresponding soil conditions and design seismic



Global Seismic Hazard Map

Source: http://www.seismo.ethz.ch/static/GSHAP/

coefficients for different types of structures located in that different zones[2]. Subsequently, in view of the immense usefulness of microzonation studies were conducted in few earthquake prone areas of the World.

Need for Seismic Microzonation[2]

Seismic microzonation is the first step in earthquake risk mitigation study and requires multidisciplinary approach with major contributions from the fields of geology, seismology, geophysics, geotechnical and structural engineering. This is very important to identify the tectonic and geological formations in the study area which is essential for determining the seismic sources and also for establishing a realistic earthquake hazard models for the investigation.
Seismic microzonation involves a very detailed field investigation to evaluate the hazard. It is very effective in delineating the spatial variations in the seismic hazard. They are also useful to evaluate the risk scenarios in the study area. Seismic microzonation maps are very useful in urban planning because they help to predict the impact of future earthquakes and can also be used to locate key facilities like hospitals, fire stations, emergency operation centers etc. Microzonation studies are also very useful to save the heritage and important structures from future major earthquakes.

Seismic Zoning and Seismic Microzonation[3]

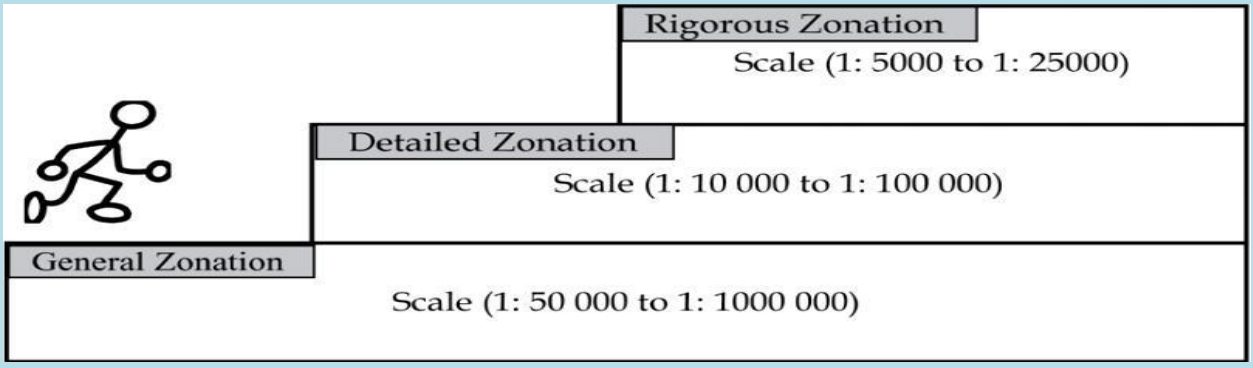
Seismic zoning consists of subdividing a national territory into several seismic zones indicating progressive levels of expected seismic intensity or peak ground acceleration for different return periods based on historic and predicted intensity of ground motion. It is common to see countries classified into three, four or more seismic zones and seismic design requirements for buildings are generally the same within a defined seismic zone. Such maps are small scale maps covering a large territory.

Seismic microzoning provides detailed information on earthquake hazard on a much larger scale. It recognizes the fact that spectral acceleration values for sites within a seismic zone vary in tune with the location specific geological conditions. It therefore consists of mapping in detail all possible earthquake and earthquake-

induced hazards. It necessarily involves seismological, geological, geotechnical and hydro-geological mapping and their integration to provide a picture of levels of hazard distribution comprehensible to urban planners, engineers and architects.

Levels of Seismic Microzonation[3]

Levels of Seismic Microzonation generally float with the choice of scale of mapping as also with the degree and scope of scientific investigation fashioned to minimize uncertainties in seismic hazard evaluation for a specific set of objectives. The quantum and quality of basic maps and information required for making a head tart with the mapping work are rarely available. Since seismic microzonation work cannot wait for all the required information, a first cut microzonation map is prepared based on a minimum programme of investigation. Choosing an appropriate mapping scale and thinking to scale while mapping are the two challenges common to every such programme. What is to be included and what is to be left out for future investigation will have to be decided on a case to case basis. Degree of detailing and scrutiny expands with increase of mapping scale. Three levels of Seismic Microzonation expressed as Grade1: General Zonation; Grade 2: Detailed Zonation and Grade 3: Rigorous Zonation were favoured by the Technical Committee on Earthquake Geotechnical Engineering of the International Society of Soil Mechanics and Foundation Engineering (1993). The recommendation essentially meant making a beginning with relatively small scale mapping and move on to higher levels of microzonation by obtaining added quality inputs that could justify large scale mapping.



Three Grades of Seismic Microzonation recommended by the Technical Committee of the International Society of Soil Mechanics and Foundation Engineering (ISSMFE)

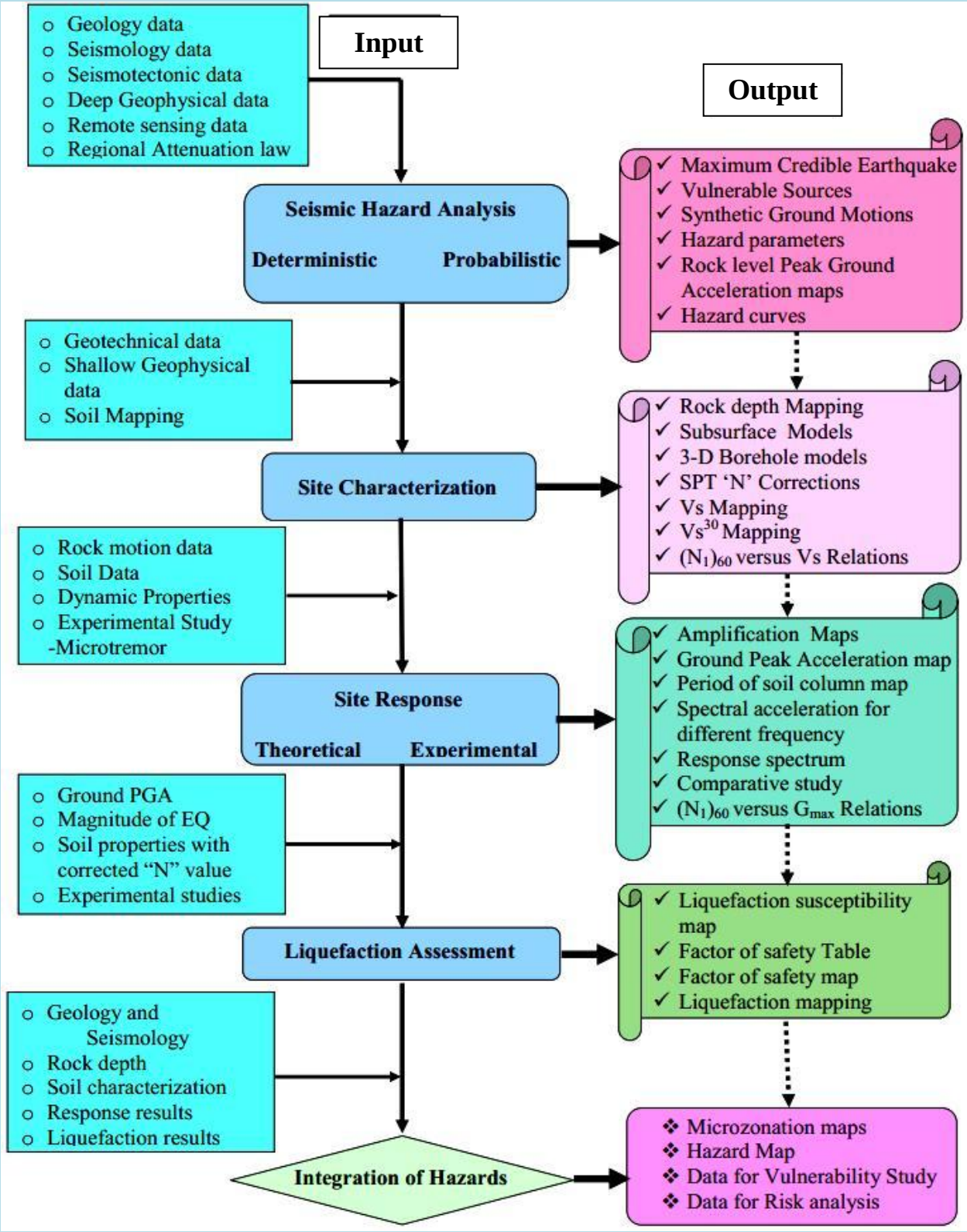
Microzonation Framework

Seismic microzonation process is initiated with rudimentary assessments based on existing regional level hazard estimation, seismotectonic and macro-seismic studies [4]. Several local specific hazard factors are, thereafter, evaluated and mapped on a Geographical Information System (GIS) platform with a uniform and consistent geo-referencing scheme. A general methodology in doing the seismic microzonation of a region can be divided into the following four major heads[2]:

- Estimation of the ground motion parameters using the historical seismicity and recorded earthquake motion data which includes the location of potential sources, magnitude, mechanism, epicentral distances.
- Site characterization using geological, geomorphological, geophysical and geotechnical data.

- Assessment of the local site effects which includes site amplification, predominant frequency, liquefaction hazard, landslides, tsunami etc.
- Preparation of the seismic microzonation maps

A General Framework for Seismic Microzonation Studies[2]



References

[1] http://dod.nic.in/handbook.pdf
[2] http://ndma.gov.in/images/pdf/NDMA_Geotech_Sitharam_August_16_2011.pdf
[3] http://saarc-sdmc.nic.in/pdf/publications/SEISMIC%20MICROZONATION.pdf
[4] http://dod.nic.in/manual.pdf