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## Tradition of earthquake safe construction in Uttarakhand

Earthquakes do not kill but the buildings do. Imbibing this basic fact, and employing the accumulated knowledge of generations as also learning from their mistakes indigenous people around the world devised ways of constructing earthquake safe dwelling units. These often put forth challenges for the present day scientists and technocrats as to what prompted these people to go in for particular level of detailing while designing these structures.

With reducing access to traditional construction material, universalization of construction material and techniques largely unaccompanied by technical know how, interesting and innovative construction styles hitherto unheard of in any code of construction practices are cropping up in most areas. These are contributing to seismic vulnerability of the masses.

Unplanned and unsystematic multistoried construction with poorly detailed reinforcement is fast becoming common in the hills. Being erected for countering the challenges put forth by topography, these structures clearly defy all earthquake safety norms. But the scenario was not always the same. The state of Uttarakhand shows age-old tradition of constructing earthquake safe houses, salient features of which include: (i) sound site selection, (ii) simple layout, (iii) small openings, (iv) sound detailing of the foundation and construction on elaborate, solid and raised platform, (v) judicious use of locally available building material, (vi) incorporation of wooden beams all through the height of the building at regular intervals, and (vii) shear walls.

Four to five storied houses constructed with a distinct architectural style were common in Yamuna and Bhagirathi valleys as early as 1000 years Before Present. These were constructed in a style that resembles frames structures of present times and incorporate all essential elements of earthquake safety. A number of representatives of this architectural style are still intact in this earthquake-prone region. But for the incorporation of well thought of safety norms these would have long been razed to ground.

Detailed investigations and research into the finer aspects of this distinct and magnificent construction style holds promise for unearthing some engineering principles hitherto not known as also for initiating a new line of construction that might prove to be better suited for the region. **See page 475**.

## Assimilation of sub-surface temperature profiles from Argo floats

Ocean state estimation is important in the sense that oceans play significant role in affecting the climate. The latent and sensible heat release from the oceans alters the atmospheric circulation. The lack of observations over the oceans has resulted in the dependency on the numerical ocean models in getting the 3-dimensional ocean structure. However, due to several assumptions that are made in the model physics, the simulations from numerical models result in drifts and biases with respect to the observations. Data assimilation is one such technique by which one can use the available observations to correct the models at the initial state.

An attempt at assessing the impact of *in situ* observations on the performance of Ocean General Circulation Model (OGCM) has been made (**page 495**). With the availability of Argo temperature and salinity profiles, the assimilation of sub-surface observations over the entire Indian Ocean is now possible. An OGCM (Modular Ocean Model version-3, MOM-3) with a 0.5 degree spatial resolution in the Indian Ocean (2 degree resolution elsewhere) has been used. The period of study is January to December 2004 in which the Argo data has been assimilated till May 2004. The assimilation of the profiles has been carried out using two different techniques; Nudging and Cressman's. Model simulations (control run and assimilated runs) were compared with independent observations during both assimilative phase and the forecast phase. Assimilation resulted in improvement in model simulations (depth of 20 degree isotherm and mixed layer depth) especially in the deeper layers.

This study is an effort to demonstrate the potential of data assimilation which will help in generating a reasonably accurate Ocean State for the Indian Ocean Region.

## Carbon capture and storage

Carbon capture and storage (CCS) is an approach to mitigate climate change. There are various means for $CO_2$ sequestration such as storage in empty gas and oil fields, coal beds, ocean and water containing subsurface aquifers, mineral sequestration, afforestation and agriculture. Among the other known sources to enhance CCS, the role of soils, as an important natural resource, in capturing and storing has been explained in an article by Bhattacharyya *et al.* (**page 482**). The authors show that soils capture and store both organic and inorganic forms of carbon and thus act as both source and sink for atmospheric $CO_2$. The quality of soils and climate determine the amount of carbon that could be sequestered in a soil. This has been estimated as carbon stock using soil and landscape parameters such as carbon content, bulk density, depth of soils and their areal extent. To determine carbon stock of soils in spatial domains, various base maps, viz. agro-climatic zones, bioclimatic systems and the agro-ecosubregions have been utilized. Soil datasets of the country have been utilized to develop thematic maps on soil carbon stocks to focus geographical locations for soil carbon sequestration on priority.

The study shows the sequestration of atmospheric $CO_2$ in the form of PEDOGENIC calcium carbonate and its unique role in enhancing soil organic carbon in drier parts of the country through management interventions.