Geoenvironmental and Geotechnical Criterion for Selection of River Deposits for Construction Material

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Abstract

To cope up with rapidly growing populations, India is on fast track to buildup new infrastructures in terms of industries, townships, route corridors, etc. To harness the huge renewable water resource of the country, infrastructure development in virgin areas of proposed hydro projects has become a prerequisite. The country also frequently experiences several natural hazards like, earthquakes, landslides, floods etc, destructing civil structures and properties; restoration and reconstruction of these becomes need of the hour. Consequently, to cater to these developments vast quantities of construction material is required. India being a tropical country is blessed with numerous perennial and ephemeral rivers from Himalayan, extra-peninsular and peninsular tracts. The potential targets for easy availability of the construction material especially fine aggregates are the river borne material (RBM). Moreover, Indian rivers are facing huge siltation reducing carrying capacity of the rivers. As a result severe bank erosion/channel migration and floods occurs every year. However, indiscriminate mining of river bed (sand, gravel) is causing severe environmental degradation. In general dredging of huge silt deposited along the rivers in plains, mouth of the rivers, hilly tracts and their disposal is not a practical solution on economic consideration and also due to environmental degradation at the disposal sites. A little amount of the same can be used for manufacturing of bricks.

There is a need to utilize the river deposits in a scientific and eco-friendly manner to increase the carrying capacity of the rivers as well as to meet the growing demand of

construction material. The mining should not only be aimed for extraction of resources but also towards protection and restoration of the ecological system, prevention of damages to the river regime, assessment of sediment influx/ replenishment capacity of the river, restoration of the river configuration, prevention of contamination & depletion of ground water, restoration of the riparian rights & instream habitats etc. Abandoned channels/ terrace / inactive floodplains instead of active channels and their floodplains are the suitable locales for mining. Replenishment of ground water should also be ensured if excessive pumping out of water is required during mining. Large rivers and streams whose periodic sediment replenishment capacity are larger, segments of braided river system, scraping of sediment bars above the water flow level in the lean period may be preferred for sustainable mining. At the foothills, where channel banks are not well defined, particularly in the braided river system, midstream areas should be selected for mining. Diversion of stream, mining below subterranean water level, mining at the concave side of the river channel, continued riverbed mining in a particular segment of the river etc. should be avoided. Dumping of mining waste should be done properly during coarse aggregate mining to avoid environmental degradation.

As a number of hydroelectric projects are coming up in the mountainous regions of Himalayan and north-eastern parts of India, huge quantities of suitable construction material, both coarse and fine aggregates is required for construction purposes. Thrust should be given to use river borne material for mitigation of siltation problem. In general, boulder, gravel, sand can be used for construction of roads, semi-permanent settlements, etc. However, their use in hydroprojects depends on their physico-mechanical and chemical properties for different type of structures such as, concrete dam, rock fill dam, cofferdam, tunnel, underground cavern etc. Quality of coarse aggregate also depends on the disposition of the structures w.r.t to contact with water. For example, coarse aggregate for wearing surfaces concrete is usable in upstream part of dam, hydro-tunnel as they remains in contact with water, whereas, the aggregate for non-wearing surfaces are used for the structures like, powerhouse, downstream portion of dam and other structures and buildings which do not remain in contact with water permanently.

Therefore, the suitability of river borne material (RBM) for both coarse and fine aggregate is to be pre-tested for use in concrete/ masonry/ rockfill/earth dams, powerhouse and other structures. The tests like Water absorption, Specific gravity, Aggregate impact value, Aggregate crushing value, Aggregate abrasion (Los Angeles) value, Soundness, Flakiness Index, Elongation Index, Alkali-aggregate reactivity, Porosity, Compressive strength, specific gravity, petrography etc. are required to judge the suitability of the coarse aggregate for use in different structures of the project components. Similarly, for fine aggregates (sand) the tests required are Gradation, Specific gravity, Fineness modulus, Silt and clay content, Organic impurities, Soundness, Compressive strength of cement-sand mortar, Alkali-aggregate reactivity etc. for selecting their uses in various purposes. In addition, composition of the sand, plays important role. Higher percentage quartz is preferred and presence of rock fragments, flaky minerals, strained quartz etc. have adverse effects and their percentage should be limited.

Therefore, selection of construction material from river bed should consider the various site specific geoenvironmental and geotechnical criterion for optimum use of the same in a eco-friendly manner.