VOL - 2 ISSUE - 11

RNI - MAHENG / 2021 / 80480

TYCOONS

CONSTRUCTION & ARCHITECTURE

Published by
I WORLD MEDIA PVT.LTD.

February 2023 - March 2023 Price - 100/-

www.iworldmedia21.com

TRIUMPH ROYALTY OF COMPANIES

MAHESH MUDDA,
MANAGING DIRECTOR & CEO,
NEW CONSOLIDATED CONSTRUCTION CO. LTD.

JAGDISH KADAM,
CHAIRMAN & MANAGING DIRECTOR,
RAJ PATH INFRACON PVT. LTD.

SNEHA GURJAR,
DIRECTOR,
CEM ENGINEERS

Most Futuristic Business Leaders

MANISH MEHAN,
CEO & MANAGING DIRECTOR,
TK ELEVATOR INDIA PRIVATE LIMITED

ANIL SETHI,
FOUNDER & CHAIRMAN,
PUMP ACADEMY PRIVATE LIMITED

PRAMOD JAIN,
FOUNDER AND OPERATIONAL HEAD,
CREATIVE ARCHITECTS AND INTERIORS (CAI

Table Of CONTENT

Feb'23 - Mar'23

Most Futuristic Business Leaders

Earthquake Resistant Architecture: Designing Safe and Resilient Structures

Sneha Gurjar, Director, CEM Engineers

With over 15 years of extensive experience of designing and leading institutional, industrial, residential and prestigious infrastructural projects across the country, Sneha Gurjar is an architect of excellent professional aptitude. As a director at CEM Engineers, one of India's leading comprehensive consultancy for master planning, architectural design, engineering and project management services, she has been instrumental in steering the growth trajectory of the firm over the past decade.

A firm believer in simplifying complex design and engineering problems, Sneha brings an inside out approach to a project. Over the years, she has spearheaded the development of several projects including mission critical facilities, radiochemical laboratories, nuclear safety structures, nuclear waste management facilities, communication infrastructure and blast resistant facilities. Being associated with such complex and momentous projects illustrate the length and breadth of Sneha's experience and the proficiency of her professional knowledge. The complexity of design and understanding required in developing these projects is a challenging process involving innovation at both the design side and the project delivery end. The multi-disciplinary engagement, the long term impact and hope that these large-scale developments foster drive her work.

Sneha graduated from the TVB School of Habitat Studies in 2007 and, since then, has honed the perseverance and patience required for delivering large-scale developments. She is also an accomplished track and field athlete, an interest that contributes to her disciplined approach to professional life.

The after-shocks of the Kahramanmaras earthquake in Turkey and closer-to-home disasters such as the Joshimath crisis have made a global impact, compelling us to look closer into available engineering solutions for natural disasters and how to enforce them. Considering the current national and global events, safety concerns have driven architects to revisit earthquake-resistant designs. In India, earthquakes have been recorded throughout the nation's history, ranging in intensity within different earthquake zones, from minor tremors to major ones of devastating magnitudes. The damage caused is not just by the motion of the ground causing vertical and horizontal movement, but also the after-effects such as landslides, floods, fires and disruption to communication. Hence understanding the seismic history and threats of the locality and the ground you are building on is crucial for structural planning.

The Indian National Building code has a general set of guidelines that necessitate accounting for seismic data from studies of regional earthquakes as a part of the design brief in the first stages of planning a project. IS codes provide guidelines for all types of structures: buildings, industrial facilities, bridges, dams, liquid retaining tanks etc. The codes such as IS1893, IS 4326, IS 13920 IS 13827 and IS 13828 are some of the essential seismic codes, ranging from general to intensity-specific, lay down regulations to ensure that structures can respond to shocks of moderate intensities without structural damage and to shocks of heavy intensities without total collapse.

In highly seismic areas, construction entailing heavy debris such as masonry, particularly mud masonry and rubble masonry, should preferably be avoided since they factor into higher loss of life in the event of an earthquake. Moreover, a minimum of M20 grade of concrete should preferably be used for all buildings over three storeys in height. Besides general design considerations and codes, the NBC also specifies guidelines for specific structural members. Therefore, considering the vertical and horizontal loads during the earthquake and after-shocks entails minute technical guidelines that must be addressed.

IS 13920, for example, lays down the criterias for detailing beams and columns with the aim of providing these elements adequate toughness and ductility to make the structural components capable of undergoing extensive inelastic deformations and stably dissipating seismic energy. These include detailed specifications on dimension ratios, reinforcements, materials and other strategies. For example, according to NBC, the minimum width of a beam should be more than 0.3 times the depth of the beam and 0.75 times the breadth of the supporting column, and not less than 200mm or the width of the supporting column. In addition, the width of a column should not be less than 200 mm for the span of framing beams up to 5 metres and the effective height of the column up to 4 metres.

The codes also regulate the requirements for detailing reinforcement in beams and columns, including joint faces, splices, and anchorage requirements. Provisions are also included for calculating design shear force and detailing transverse reinforcement in beams. This becomes essential considering how columns and beams form the core structural framework, and earthquake-related compressive and expansive forces can cause a myriad of damage, such as tears and cracks that jeopardise the entire building. In the case of beams, dimensional constraints are imposed on the cross-section for members subjected to axial load and flexure. For example, the beam should have at least two 12mm dia bars on the top and bottom face, that is, at least one 12 dia bar located on every corner of the beam. The maximum longitudinal steel ratio provided on any face at any section must be 0.025. Additionally, longitudinal steel on the beam's bottom face and near the column's face must be at least half the steel on its top face at the same section and at least 1/4th of longitudinal steel provided at the top face of the beam and column at any section. On the exterior, the beams' top and bottom bars must be provided with Anchorage length beyond the inner face of the column. In the case of columns, links and cross-links must be provided over the entire splice length at a spacing of not more than 150 mm, with not more than 50 % of bars to be spliced at one section, and longitudinal bars spacing should not exceed 300 mm.

The response to earthquakes for different structures is also affected by different types of foundation systems, as the shock intensity of an earthquake could vary locally due to variations in soil conditions. Essentially during an earthquake, the ground movement directly impacts the foundation of any building. The National Building Code provides design guidelines with response spectra for three founding strata types: rock and hard, medium, and soft soil. In-depth research and abiding by these tried and tested codes can be the difference between life and death for users.

Earthquakes not only pose a threat to the users of a structure but also to the surrounding areas in case of a collapse. Deaths in the case of major earthquakes happen not due to the shaking of the ground directly but primarily due to debris and failing structures. This makes a compelling argument that architects and engineers have an irrefutable responsibility to create safer and stronger structures that can withstand earthquakes and other natural disasters while providing refuge during such perils, and the safest way to ensure structural stability and strength is by devotedly following building bylaws and codes to build resilient structures.