NATURAL FREQUENCY ANALYSIS OF COLUMN WITH DIFFERENT AGGREGATE STRUCTURES

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Abstract —A column profile is a vertical structural member meant to switch a seismic load. For instance, a structure would possibly switch masses from a ceiling, floor or roof slab or from a beam, to a floor or foundations. structures are normally constructed from substances along with stone, brick, block, concrete, wood, steel, and so forth, that have properly compressive energy. In our analysis, experimental investigation was performed and the model was developed by fastening concrete column structure with different aggregate sizes and mixed aggregate. In order to verify the present experimental model, the vibration analysis with their natural frequency and acceleration by using different aggregate sizes i.e. 6mm, 10mm, 20mm and mixed aggregate of size 6mm+10mm, 10mm+20mm, 6mm+10mm are compared with their effect of natural frequency the available experimental results and the design of column structures with different aggregate sizes is considered for analysis.

The results show that by applying mixed concrete of 6mm+10mm size in column structure this eliminate the seismic effect during a constant acceleration of 25 – 30m/s2, thus this column structure were used for analyzing vibration effects and, Hence column of mixed aggregate of 6mm+20mm size have ability to withstand during excessive amount of vibration , thus natural frequency of the system is increased.

Keywords— *Aggregate, column structure, natural frequency, acceleration.*

I INTRODUCTION

Reinforced concrete (RC) (additionally known as reinforced cement concrete or RCC) is a composite cloth wherein concrete's surprisingly low tensile strength and ductility are counteracted by means of the inclusion of reinforcement having better tensile power or ductility. The reinforcement is typically, though now not always, steel reinforcing bars (rebar) and is typically embedded passively inside the concrete earlier than the concrete sets. Reinforcing schemes are commonly designed to face up to tensile stresses specially regions of the concrete that could motive unacceptable cracking and/or structural failure. Modern strengthened concrete can incorporate numerous reinforcing substances fabricated from metal, polymers or trade composite fabric along side rebar or no longer. Reinforced concrete may also be permanently confused (concrete in compression, reinforcement in tension), in an effort to enhance the behaviour of the very last structure underneath operating hundreds. In the USA, the maximum common strategies of doing this are called pre-tensioning and post-tensioning. For a strong, ductile and sturdy creation the reinforcement wishes to have the following houses at least:

- High relative strength
- High toleration of tensile strain
- Good bond to the concrete, irrespective of pH, moisture, and similar factors
- Thermal compatibility, not causing unacceptable stresses (such as expansion or contraction) in response to changing temperatures.
- Durability in the concrete environment.

II BEHAVIOR OF REINFORCED CONCRETE

- **Materials-** Concrete is a mixture of coarse (stone or brick chips) and quality (commonly sand or overwhelmed stone) aggregates with a paste of binder material (commonly Portland cement) and water. When cement is blended with a small amount of water, it hydrates to shape microscopic opaque crystal lattices encapsulating and locking the mixture right into a rigid structure. The aggregates used for making concrete should be unfastened from harmful substances like natural impurities, silt, clay, lignite and so on. Typical concrete mixes have excessive resistance to compressive stresses (approximately four,000 psi (28 MPa)); but, any appreciable anxiety (e.G., due to bending) will destroy the microscopic rigid lattice, ensuing in cracking and separation of the concrete. For this motive, normal non-strengthened concrete ought to be nicely supported to save you the development of anxiety. If a fabric with high energy in anxiety, together with steel, is placed in concrete, then the composite material, strengthened concrete, resists now not most effective compression but additionally bending and different direct tensile actions. A composite section wherein the concrete resists compression and reinforcement "rebar" resists tension can be made into nearly any shape and length for the development enterprise
- **Key characteristics-** Three physical characteristics give reinforced concrete its special properties:
- The coefficient of thermal expansion of concrete is similar to that of steel, eliminating large internal stresses due to differences in thermal expansion or contraction.
- When the cement paste within the concrete hardens, this conforms to the surface details of the steel, permitting any stress to be transmitted efficiently between the different materials. Usually steel bars are roughened or corrugated to further improve the bond or cohesion between the concrete and steel.
- The alkaline chemical environment provided through the alkali reserve (KOH, NaOH) and the portlandite (calcium hydroxide) contained inside the hardened cement paste reasons a passivating movie to shape at the surface of the metal, making it tons greater proof against corrosion than it would be in impartial or acidic situations. When the cement paste is uncovered to the air and meteoric water reacts with the atmospheric CO2, portlandite and the calcium silicate hydrate (CSH) of the hardened cement paste grow to be step by step carbonated and the excessive pH regularly decreases from thirteen.Five – 12.5 to 8.5, the pH of water in equilibrium with calcite (calcium carbonate) and the steel is now not passivated. As a rule of thumb, most effective to present an idea on orders of value, steel is blanketed at pH above ~eleven but starts to corrode below ~10 depending on metallic characteristics and local physico-chemical situations when concrete will become carbonated. Carbonation of concrete along with chloride ingress are amongst the leader reasons for the failure of reinforcement bars in concrete. The relative go-sectional vicinity of metal required for standard bolstered concrete is typically pretty small and varies from 1% for most beams and slabs to 6% for some columns. Reinforcing bars are commonly spherical in cross-phase and vary in diameter. Reinforced concrete structures every so often have provisions which include ventilated hole cores to govern their moisture & humidity. Distribution of concrete (notwithstanding reinforcement) power traits alongside the move-section of vertical strengthened concrete factors is inhomogeneous

III CORROSION

Corrosion is a natural manner that converts a elegant steel to a extra chemically-stable shape, including its oxide, hydroxide, or sulfide. It is the slow destruction of materials (normally metals) by way of chemical and/or electrochemical response with their surroundings. Corrosion engineering is the field devoted to controlling and preventing corrosion. In the most common use of the phrase, this means electrochemical oxidation of metal in response with an oxidant which include oxygen or sulfates. Rusting, the formation of iron oxides, is a famous instance of electrochemical corrosion. This form of damage normally produces oxide(s) or salt(s) of the authentic metallic, and outcomes in a one-of-a-kind orange colouration. Corrosion also can arise in materials other than metals, such as ceramics or polymers, despite the fact that on this context, the time period "degradation" is more not unusual. Corrosion degrades the beneficial houses of materials and structures together with power, look and permeability to beverages and gases. Many structural alloys corrode simply from exposure to moisture in air, however the process may be strongly laid low with publicity to sure materials. Corrosion may be concentrated domestically to shape a pit or crack, or it is able to make bigger throughout a wide location more or much less uniformly corroding the surface. Because corrosion is a spread-controlled system, it happens on exposed surfaces. As a end result, strategies to reduce the pastime of the exposed floor, which include passivation and chromate conversion, can boom a material's corrosion resistance. However, some corrosion mechanisms are much less seen and less predictable.

V ANTI-CORROSION MEASURES

In moist and cold climates, bolstered concrete for roads, bridges, parking systems and other systems that can be exposed to deicing salt may also advantage from use of corrosion-resistant reinforcement including uncoated, low carbon/chromium (micro composite), epoxy-coated, hot dip galvanised or stainless-steel rebar. Good layout and a well-selected concrete mix will offer extra protection for many programs. Uncoated, low carbon/chromium rebar appears much like general carbon steel rebar because of its lack of a coating; its fantastically corrosion-resistant functions are inherent within the steel microstructure. It can be identified with the aid of the particular ASTM exact mill marking on its easy, dark charcoal end. Epoxy lined rebar can without difficulty be diagnosed by using the mild green coloration of its epoxy coating. Hot dip galvanized rebar can be vibrant or stupid gray relying on length of exposure, and stainless rebar exhibits a typical white steel sheen this is with ease distinguishable from carbon steel reinforcing bar. ASTM popular specifications A1035/A1035M Standard Specification for Deformed and Plain Low-carbon, Chromium, Steel Bars for Concrete Reinforcement, A767 Standard Specification for Hot Dip Galvanised Reinforcing Bars, A775 Standard Specification for Epoxy Coated Steel Reinforcing Bars and A955 Standard Specification for Deformed and Plain Stainless Bars for Concrete Reinforcement. Another, cheaper manner of protective rebars is coating them with zinc phosphate. Zinc phosphate slowly reacts with calcium cations and the hydroxyl anions present within the cement pore water and paperwork a strong hydroxyapatite layer. Penetrating sealants commonly ought to be carried out some time after curing. Sealants include paint, plastic foams, movies and aluminum foil, felts or fabric mats sealed with tar, and layers of bentonite clay, occasionally used to seal roadbeds. Corrosion inhibitors, which includes calcium nitrite [Ca(NO2)2], also can be introduced to the water mix before pouring concrete. Generally, 1–2 wt. % of [Ca(NO2)2] with appreciate to cement weight is needed to save you corrosion of the rebars. The nitrite anion is a slight oxidizer that oxidizes the soluble and cell ferrous ions (Fe2+) gift on the surface of the corroding metal and causes them to precipitate as an insoluble ferric hydroxide (Fe(OH)three). This causes the passivation of steel on the anodic oxidation websites. Nitrite is a miles more energetic corrosion inhibitor than nitrate, that is a much less powerful oxidizer of the divalent iron

V METHODOLOGY

3.1 Testing Apparatus for column with earthquake analyzer

The below shown figure represent a column with different aggregate size is configured on shaker table for determination of natural frequency and acceleration along column structure, the vibration testing machine is of Siemens shaker table 396 have ability to accelerate 30 m/s^2 also configured with accelerometer and vibrometer for calculation of natural frequency induced during testing of column structures. As shown, each column had a footing and a cap with the dimensions of 400×400×150mm (length × width × height) and 500×500× 150mm (length × width × height).

Figure 3.1 table shakers with fastening fixtures.

3.2 Test machine Specification

Product Specification	Permissible values
Product name	30 m/s^2 Automatic shaker Machine
Product code	ST-R0058
Capacity(kN)	108KN
Roughness(µm)	≤ 3.2
Φ Lower Platen (cm)	20.8
Φ Upper Platen (cm)	28.58
Acceleration	30m/s^2

Figure 3.2Schematic view of column with steel bars

Figure 3.3 Schematic of column without mould

Above shown figure represent a column is attach with accelerometer on the different location for determination of natural frequency and acceleration on the vibration testing machine

VI RESULT AND DISCUSSION

Table-(4.1) Experimental Result for the three towers of adjacent steel structures without polymer elements.

Natural Frequency (Hz)	
Modes	**6mm (Aggregate)**
1	18.86
2	19.25
3	20.15
4	22.58
5	24.56
6	28.59

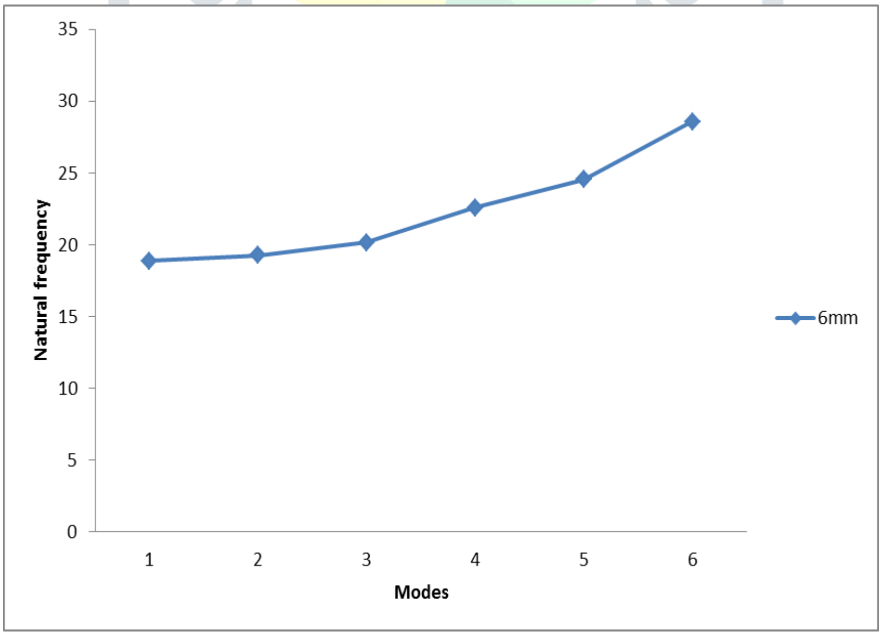

Fig 4.6 Experimental Result for the three towers of adjacent steel structures without polymer elements.

4.4.2 Acceleration –

Table 4.2- experimental results obtained of present model to determine the natural frequency

Natural Frequency	
Modes	**10mm (Aggregate)**
1	23.65
2	25.68
3	26.65
4	27.88
5	29.54
6	30.58

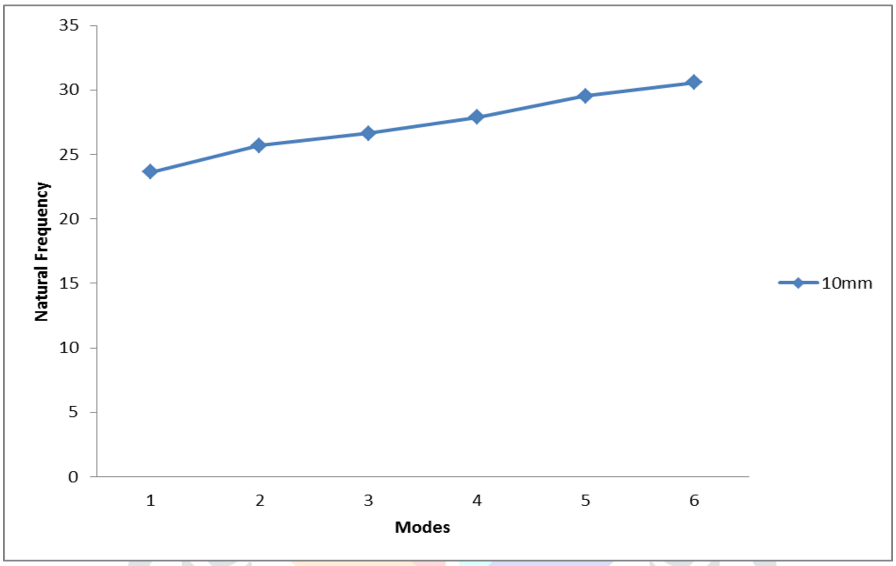

Fig 4.7 Experimental results obtained of present model to determine the natural frequency

Table 4.3-Experimental result of natural frequency of column with 20mm aggregate structures.

Natural Frequency	
Modes	**20mm(Aggregate)**
1	19.68
2	20.61
3	25.68
4	27.82
5	35.45
6	36.25

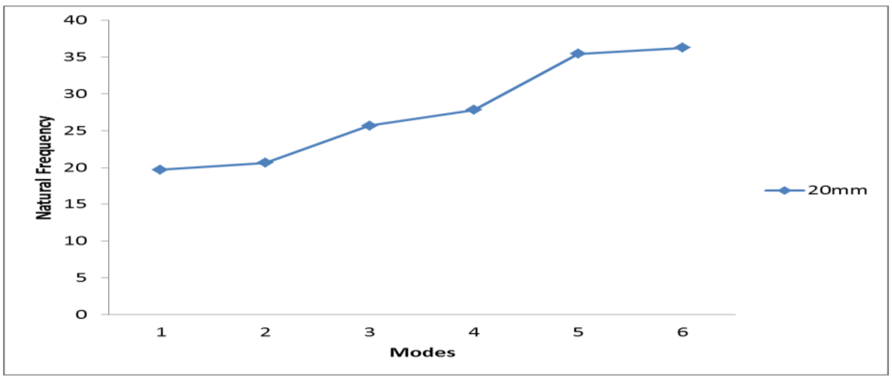

Fig 4.8 Experimental result of natural frequency of column with 20mm aggregate structures.

4.5 Overall comparative result: -

Table 4.4 Experimental result of natural frequency of column with different size aggregate structures.

Natural Frequency [Hz]			
Modes	**6mm(Aggregate)**	**10mm(Aggregate)**	**20mm(Aggregate)**
1	18.86	23.65	19.68
2	19.25	25.68	20.61
3	20.15	26.65	25.68
4	22.58	27.88	27.82
5	24.56	29.54	35.45
6	28.59	30.58	36.25

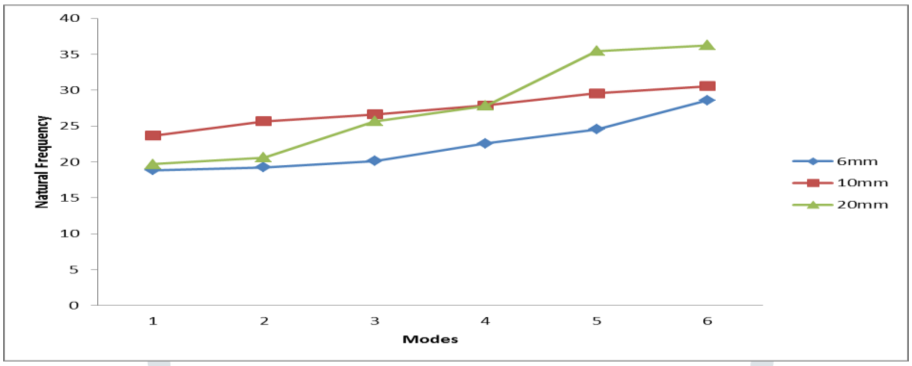

Fig 4.9 Experimental result of natural frequency of column with different size aggregate structures.

4.6 Natural Frequency of different sizes mixed Aggregate –

Table 4.5 Experimental result of natural frequency for **6mm+10mm(Aggregate)** concrete column structures.

Natural Frequency	
Modes	**6mm+10mm (Aggregate)**
1	28.35
2	29.68
3	31.15
4	31.20
5	33.38
6	34.56

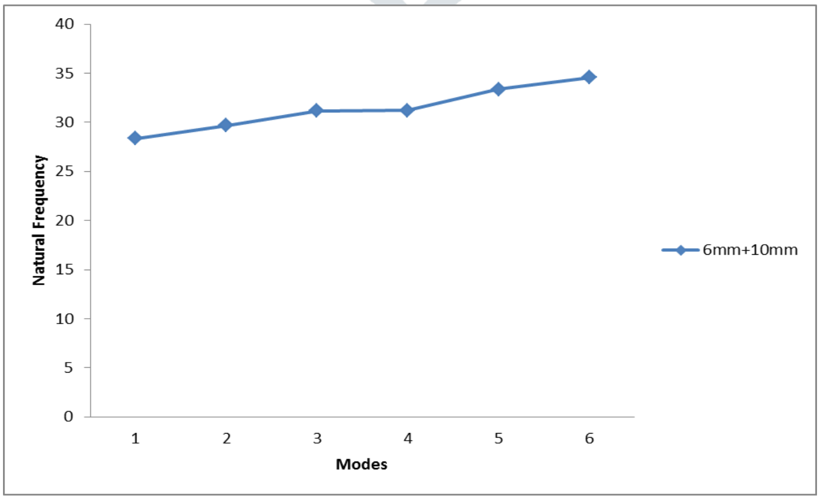

Fig 4.10 Experimental result of natural frequency for **6mm+10mm (Aggregate)** concrete column structures.

4.7 Natural Frequency of 10mm+20mm Aggregate

Table 4.6 Experimental result of natural frequency for **10mm+20mm (Aggregate)** concrete column structures.

Natural Frequency	
Modes	**10mm+20mm (Aggregate)**
1	29.68
2	32.25
3	33.65
4	34.56
5	36.58
6	39.65

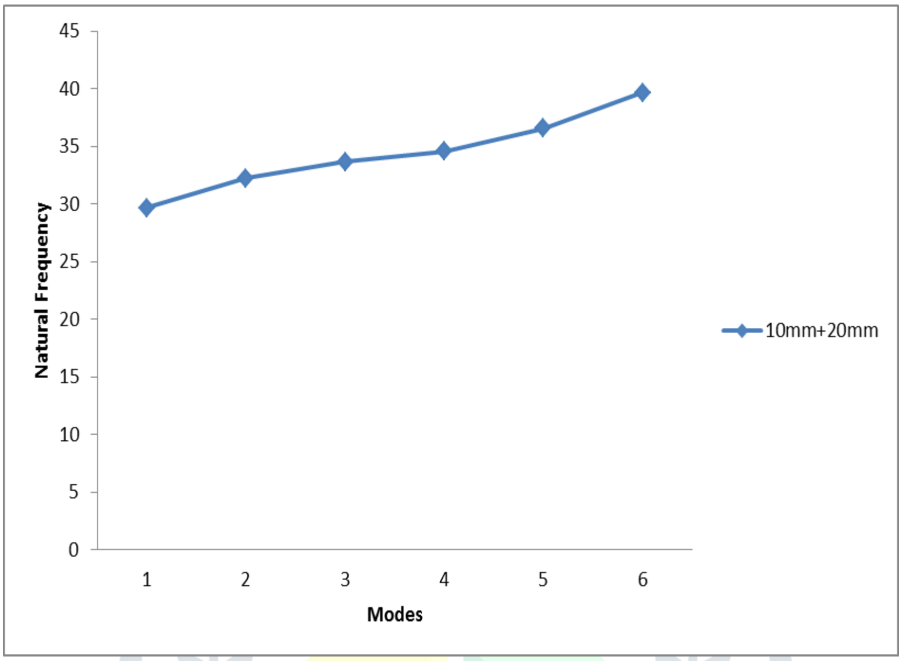

Fig 4.11 Experimental result of natural frequency for **10mm+20mm (Aggregate)** concrete column structures.

4.8 Natural Frequency of different sizes mixed Aggregate

Table 4.7 Experimental result of natural frequency for **6mm+20mm (Aggregate)** concrete column structures.

Natural Frequency	
Modes	**6mm+20mm (Aggregate)**
1	20.56
2	22.25
3	26.39
4	30.25
5	48.59
6	42.56

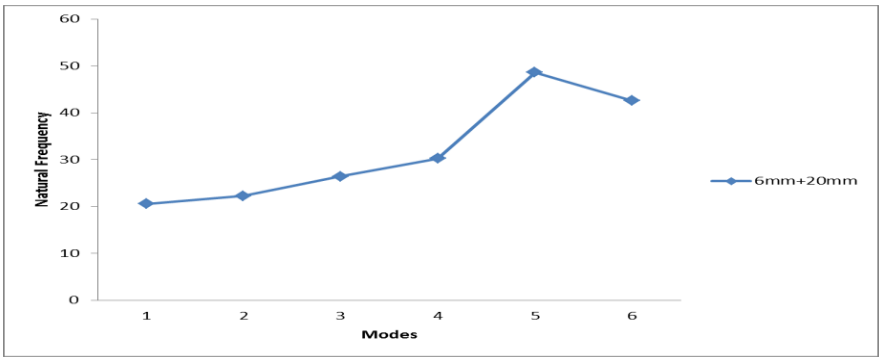

Fig 4.12 Experimental result of natural frequency for **6mm+20mm (Aggregate)** concrete column structures.

4.9 Overall comparative result of different size aggregate: -

Table 4.8 Experimental result of natural frequency for **different size (Aggregate) for** concrete column structures.

Natural Frequency [Hz]			
Modes	**6mm+10mm (Aggregate)**	**10mm+20mm (Aggregate)**	**6mm+20mm (Aggregate)**
1	28.35	29.68	20.56
2	29.68	32.25	22.25
3	31.15	33.65	26.39
4	31.20	34.56	30.25
5	33.38	36.58	48.59
6	34.56	39.65	42.56

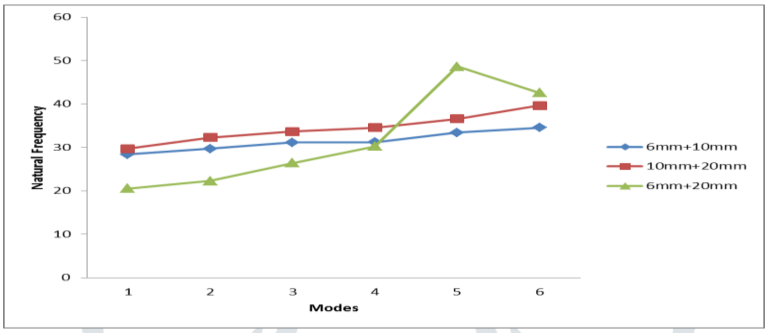

Fig 4.13 Experimental result of natural frequency for **different size (Aggregate) for** concrete column structures.

VII CONCLUSION

- The natural frequency along the concrete column structure profile is found to be optimum of the mixed aggregate size of 6mm+20mm. The acceleration distribution along the structure and middle portion of a column structure with mixed aggregate is found maximum.
- The magnitude of the acceleration is minimum in the case of mixed aggregate of size 6mm+20mm.
- The nature of the vibration is minimum by using mixed aggregate of concrete column structures.
- In a comparison with the different aggregate sizes column between structures for elimination of earthquake effect due to higher natural frequency, thus it provides converged solutions for earthquake resistance.

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