Mechanical behavior of concrete having springs at different zones

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Abstract

Concrete durability, strength, manageability, and economy have made it the world’s most generally utilized development material. The term Concrete alludes to a blend of totals, normally sand, and either (rock or smashed stone) coarse aggregates, held together by a binder of cementitious paste. Concrete has great compressive quality however almost no rigidity, subsequently constraining its utilization in development. Thus it needs assistance in opposing pliable anxieties caused by twisting forces from connected burdens which would bring about breaking and at last disappointment. Due to the increasing demands of concrete strength & ductility in our modern day construction, increases the demand to address the importance of this concept once again. As many techniques/researches has been carried to improve the strength of concrete prior which has been successful to some extent but still increase in the strength of plain cement concrete considered to be a future challenge. In this research the focus on increasing the strength of concrete is by embedding steel springs phenomena in the different zones of concrete samples are studied. Tension and compression steel springs attached to base plate embedded in the concrete samples, and are tested for compressive and tensile strength of the concrete. Results shows that steel springs can be effective in the strength of concrete at specified zones. Hence it is recommended using steel springs in the concrete at effective zones to increase the strength of concrete.

Keywords: Mechanical behavior of concrete, twisting forces, concrete strength & ductility, Tension and compression steel springs
I. Introduction

Concrete durability, strength, manageability, and economy have made it the world's most generally utilized development material. The term Concrete alludes to a blend of totals, normally sand, and either (rock or smashed stone) coarse aggregates, held together by a binder of cementitious paste [I]. Concrete has great compressive quality however almost no rigidity, subsequently constraining its utilization in development. Thus it needs assistance in opposing pliable anxieties caused by twisting forces from connected burdens which would bring about breaking and at last disappointment. The most widely recognized sort of Reinforcement is as steel bars which are considered quite strong in resistance to tensile stress [VIII].

Most concrete basic individuals encounter joined load conditions made out of tensile, strain, compression and shear. Particularly on account of strengthened concrete individuals, the key thought that concrete opposes compression force and steel that opposes ductile/tensile force is the essential premise of the basic plan of Reinforces concrete [V].

Now the capacity of the steel spring to expect static and dynamic loads over a drawn out time frame relies upon the steel being made. The steel material for the generation of springs is normally called spring steel. Spring steels have the exceptional element of having the capacity to withstand significant torsional or bending forces with no distortion [X]. These fabricated steels spring can be bent, compacted, extended or twisted consistently, and will come back to their unique shape without agony distortions. This trademark is characterized as high versatile execution and is the aftereffect of the particular structure and solidifying of the steels [VII].

II. Related Work

Shock absorber used to retain stuns or vibrations. These are to a great degree basic in engine vehicles, so travelers would not feel the bumps in a cruel way [II]. This thought of a damper was utilized in structures externally. The thought was that if there were a huge quake in the area of a multi-story working, there should be an instrument to help neutralize these huge seismic waves [III]. The shock absorbers were utilized since the 1960's to secure tall structures against the impacts of wind and in 1990's were used to ensure structures against the impacts of quakes. Damping frameworks were first presented in the mechanical business and experimentation with damping in development enterprises started amid the 1950’s. The main application in tall structures goes back to 1969 with the World Trade Center [IX]. Damping was generally utilized in the 1980s as a major aspect of modernization of existing structures (for instance, John Hancock Tower, Boston) or in new structures (for instance, Citicorp, New York, One Canada Square, London, and Yokohama Landmark Tower, Yokohama) [IV]. The current accessible damping frameworks can be subdivided into two principle classifications: inactive and dynamic systems. Inactive system have settled properties, while dynamic system change their properties as indicated by the load/demand and require an outer vitality source to enact [VI].
III. Methodology

The research work is composed of experimental work to mechanical property (tensile and compressive strength) of concrete. As per standard code split tensile tests are carried out in the laboratory. For split tensile test eight samples were prepared. Each sample consists of two cylindrical samples that include three zones and one controlled sample (fig 2). Zones samples consist of embedded plates having tension springs at three different zones; one in centre only, two on sides and one in centre and third zone sample consist of one springs plate at each two sides (springs diameter 0.6’’ & length 5’’). Controlled sample is free of tension spring plates. Similarly compression test is carried out with eight samples in which springs are attached to base plate 30 degree spaced (fig 5). Sample of 30 degree spaced were classified into eight cylindrical samples that include two each at three zones and two controlled samples. Zones sample in compression were embedded plates having compression springs (diameter 0.6’’ & length 2’’) at neutral axis, 2’’ below neutral axis and 2’’ above neutral axis. Controlled samples in compression are free of compression springs plates.

IV. Results/Discussion

Split Tensile Test (ASTM C496/C 496M – 04)

Split tensile strength test was conducted for the mix of 28 days curing.

| Spring Zone | Tensile Strength (Psi) |
|-------------|------------------------|
|             | Sample 1               | Sample 2               | Average     | % increase |
|             | Load (Kn) | Load (Lbs) | Strength (Psi) | Load (Kn) | Load (Lbs) | Strength (Psi) |           |           |
| Control sample | 92.7 3 | 20846.5 3 | 184.41 | 94.45 | 12234.3 3 | 187.847 | 186.13 | 0 |
| 1 spring at N/A | 131.67 | 29588.9 | 261.75 | 118.80 | 26707.5 3 | 236.266 | 249.01 | 25.25 |
| 2 springs at both end | 148.04 | 33282.7 4 | 294.43 | 152.64 | 34316.4 1 | 303.577 | 299.00 | 37.74 |
| 1 spring at N/A and 2 at ends | 190.08 | 42732.3 6 | 378.02 | 168.35 | 37846.8 1 | 334.809 | 356.41 | 47.77 |

Table 1. Tensile strength results
After the results it is concluded that one spring with base plate in neutral axis concrete cylinder, its strength increased by approximately 25% compare to controlled sample. When two springs were attached above and below the neutral axis with base plates in concrete cylinder, then its strength increased by approximately 37% with compare to controlled sample. At last when one spring at Neutral Axis and two at both ends with the base plate of concrete cylinder, then its strength increased by approximately 50% with compare to controlled sample.
Compressive strength test (ASTM Designation: C 39-04a)

Compressive strength test was conducted for the mix of 28 days curing.

Table 1. Compression strength results

| Spring Zone | Load (KN) | Strength (Psi) | Load (KN) | Strength (Psi) | Average | Percent Increase/Decrease |
|-------------|-----------|----------------|-----------|----------------|---------|--------------------------|
| Control Sample | 401.909 | 3197.210272 | 408.464 | 3249.355691 | 3223.283 | 0 |
| 2” Above Neutral Axis | 265.817 | 2114.590225 | 262.892 | 2091.321674 | 2102.956 | -53.27391817 |
| Neutral Axis | 285.775 | 2273.357316 | 219.106 | 1743.00141 | 2008.179 | -37.69770217 |
| 2” Below Neutral Axis | 322.412 | 2564.806855 | 332.615 | 2645.972334 | 2605.39 | -19.16969099 |
The compression tests we have done after 28 days of curing. The results shows that the concrete cylinders with springs embedded at 30 degree have reduced the strength of concrete at all zones.

**Figure 4. Compression strength graphical representation**

The compression tests we have done after 28 days of curing. The results shows that the concrete cylinders with springs embedded at 30 degree have reduced the strength of concrete at all zones.

**Compressive test samples zones**

**Figure 5. Effective zones**
Figure 6. Compression springs plates

V. Conclusion

In split tensile test springs embedded (one spring at neutral axis and two at both ends were attached with the base plate) internally in zones of concrete cylinder, its strength increased approximately 50% compare to controlled sample. Hence it is concluded that the springs with base plate used internally has good impact on the strength of concrete. Where as in compressive test the results are below the control sample where it can be further modified with spacing more than 30 degree between the compression springs.

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