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Autor(en): **Prakash, K.B. / Krishnaswamy, K.T.**

Objektyp: **Article**

Zeitschrift: **IABSE reports = Rapports AIPC = IVBH Berichte**

Band (Jahr): **79 (1998)**

PDF erstellt am: **27.06.2024**

Persistenter Link: <https://doi.org/10.5169/seals-59987>

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Suitability of Recycled Aggregate Concrete in High-Rise Construction

K.B. PRAKASH

Assist. Prof.
T.K. Inst. of Eng & Technology
Warananagar, India

K.T. KRISHNASWAMY

Head of Dept, Applied Mech.
Walchand College of Eng.
Sangli, India

Summary

This paper presents the results of an experimental investigation carried out on the suitability of recycled aggregate concrete for the construction of high rise structures. The strength and workability of conventional natural aggregate concrete obtained from high grade cements (43 grade & 53 grade) is compared with recycled aggregate concrete obtained from high grade cements. Also, it is shown that, the shortcomings of recycled aggregate concrete in strength and workability can be overcome by the use of superplasticizers.

1. Experimental Work

In this experimental programme the strength parameters and workability of three different concretes (with different w/c ratios to cater the needs of workability) were compared. Viz -

- a. concrete with conventional natural aggregates. (w/c = 0.45)
- b. concrete with recycled aggregates (w/c = 0.55)
- c. concrete with recycled aggregates and known dosage of superplasticizers (w/c = 0.45)

The tests were conducted on a mix of proportion 1:2:4. Zentriment Super BV superplasticizer (lignosulphonate based) was used with a dosage of 0.7%.

2. Experimental Results

Table 1 gives the strength parameters (compressive strength, tensile strength and flexural strength) of different categories of concretes produced from 43 grade & 53 grade cements.

Table 2 gives the workability of different categories of concretes produced from 43 grade & 53 grade cements. The workability of 43 grade & 53 grade concretes are almost same.



Table - 1 Results of strength parameters.

| Particulars of concrete | Conventional natural aggregate concrete produced from | | Recycled aggregate concrete produced from | | Recycled aggregate concrete with superplasticizer produced from | |
|-------------------------|---|----------|---|----------|---|----------|
| | 43 grade | 53 grade | 43 grade | 53 grade | 43 grade | 53 grade |
| Comp. strength (MPa) | | | | | | |
| 7 days | 16.92 | 19.93 | 12.00 | 13.64 | 22.71 | 24.00 |
| 28 days | 18.92 | 22.66 | 16.44 | 18.66 | 24.79 | 32.88 |
| 2 months | 29.77 | 35.50 | 28.53 | 32.44 | 32.08 | 36.79 |
| Tensile strength (MPa) | | | | | | |
| 7 days | 1.95 | 3.27 | 1.79 | 2.19 | 2.40 | 3.96 |
| 28 days | 2.70 | 3.82 | 2.06 | 3.13 | 3.97 | 4.52 |
| 2 months | 4.38 | 4.78 | 4.07 | 3.90 | 5.45 | 5.27 |
| Flexural strength (MPa) | | | | | | |
| 7 days | 4.64 | 5.36 | 2.96 | 3.76 | 5.04 | 5.96 |
| 28 days | 5.40 | 5.80 | 5.04 | 4.04 | 7.00 | 7.44 |
| 2 months | 5.84 | 8.52 | 5.24 | 7.36 | 8.92 | 9.36 |

Table 2 - Results of Workability

| Particulars of Concrete | w/c ratio | Slump (mm) | C.F. | V.B Degree (sec) | % Flow |
|---|-----------|------------|------|------------------|--------|
| Conventional natural aggregate concrete | 0.45 | 0 | 0.87 | 20 | 4 |
| | 0.60 | 10 | 0.90 | 12 | 13 |
| | 0.70 | 15 | 0.92 | 6 | 20 |
| | 0.80 | 20 | 0.94 | 4 | 60 |
| | 0.90 | Collapse | 0.97 | 2 | 80 |
| Recycled aggregate concrete | 0.45 | 0 | 0.84 | 25 | 2 |
| | 0.60 | 0 | 0.86 | 14 | 9 |
| | 0.70 | 12 | 0.90 | 8 | 15 |
| | 0.80 | 18 | 0.92 | 7 | 52 |
| | 0.90 | Collapse | 0.95 | 3 | 71 |
| Recycled aggregate concrete with superplasticizer | 0.45 | 0 | 0.89 | 18 | 5 |
| | 0.60 | 8 | 0.93 | 10 | 14 |
| | 0.70 | 14 | 0.94 | 5 | 21 |
| | 0.80 | Collapse | 0.96 | 4 | 60 |
| | 0.90 | Collapse | 0.98 | 2 | 80 |

3. Conclusions

The following conclusions can be drawn -

- The compressive strength, tensile strength and flexural strength of conventional natural aggregate concrete is more than that of recycled aggregate concrete. But the strength of recycled aggregate concrete with superplasticizer show a distinct rise in the strength compared to the conventional natural aggregate concrete. Thus the offset in the strength properties of recycled aggregate concrete can be overcome by using a right dosage of superplasticizer.
- The strength properties are distinctly greater for concrete produced from 53 grade cement as compared to concrete produced from 43 grade cement.
- The workability is distinctly more for recycled aggregate concrete with superplasticizer.
- Hence recycled aggregate concrete can be effectively used in the construction of high rise buildings, especially near the vicinity where recycled aggregates are available in plenty.