

## UTILIZATION OF EPOXY RESIN AS A FILLER IN CONCRETE

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**Abstract—** The objective of this research were to compare the split tensile strength and compressive strength of normal concrete and Epoxy Resin as filler in concrete. Specimen were tested for tensile strength and compressive strength after 7 days, 14 days and 28 days of standard curing in order to find out if concrete would show an increase in strength. Mix design used in this research work is based on previous research work. The water-cement ratio, cement, aggregate all content were kept same except epoxy resin.

**Keywords—** Epoxy Resin, Tensile strength, Compressive strength, Standard curing.

### I. INTRODUCTION

Epoxy resin used in concrete construction due to its compressive and tensile strength properties as well as adhesive properties. Application of epoxy resin is bonding concrete to concrete for repairing damaged structure. In concrete by replacing cement paste withy epoxy resin increases compressive as well as tensile strength. It is not widely used because of its high cost and less knowledge of handling. Damaged bridges with high traffic rate can be repaired by using epoxy resin due to its fast setting properties and bridges can be opened in few hours.

#### Advantages of Epoxy Resin Filled Concrete:

- 1) It increase compressive strength as well as tensile strength of concrete.
- 2) It prevents crack in concrete
- 3) It is used in bridge repair work.
- 4) It gives dynamic looks of flooring
- 5) Repair any type of crack, honeycomb, voids in concrete
- 6) It is chemical and electric resistant

### II. MATERIALS AND METHODOLOGY

#### Materials:

- 1) **Epoxy:** Epoxy has indefinite self-life and in uncured condition epoxy is clear plastic. Epoxy resin is classified in different grades by its viscosity and epoxide equivalent. While adding diluents in epoxy it reduce its viscosity. Sometimes diluents also decrease physical properties of epoxy. Epoxy required additional influence to convert in to solid mass.
- 2) **Hardener:** this is a additional influence which convert epoxy resin in to a solid mass. The conversation of solid mass produces heat. Large quantities of mixture increased the speed of hardening than the smaller ones because of its heat loss in large mass. Mixture of epoxy resin must be used in short times because of its fast hardening properties. Usable time limit of mixture is called “pot life”. Pot life depends on grade of resin and hardener, quantity of hardener, compound formulation process.
- 3) **Cement:** PPC 53 grade Tata Brand cement is used for the test throughout the work. 53 grade cement has average compressive strength at 28 days as per Indian standard code is 53 N/mm<sup>2</sup>.
- 4) **Aggregate:** well graded coarse and fine aggregate conforming to IS 383-1970 are used for project work. Maximum size of fine aggregate is 4.75mm.



Fig: 1 Epoxy Resin and Hardener

**Slump Test:**

Concrete slump test measures the consistency of fresh concrete before it sets. It is performed to check workability of fresh concrete. To check flow property, mixtures are tested to flow intensity after mixing component.

**Mix proportion of concrete:**

Table 1 Mix proportion of concrete

Mix ID	Cement(Kg)	Coarse aggregate(Kg)	Fine aggregate(Kg)	Water
M30	455	1070	605	191.5

Mix proportion of epoxy resin and hardener is in ratio 2:1. For ex ER5 mix means quantity of epoxy resin is 5ml where 3 ml resin and 2 ml hardener is mixed for 5 to 10 minutes. Epoxy resin and hardener quantity are shown in below table.

Table 2 Epoxy resin Proportion

Mix. No.	Mix. ID	Resin	Hardener
1	ER0	0	0
2	ER5	3	2
3	ER10	6	4
4	ER15	9	6
5	ER20	12	8
6	ER25	15	10

**III. RESULTS AND DISCUSSION**

Cubes and cylinder are casted for normal concrete and epoxy resin filled concrete. Testing of concrete respectively for 7 days, 14 days and 28 days. The result of testing and graphs are shown below.

3.1 Results of compressive strength of concrete mixes:

Table 3 Epoxy Resin filled concrete compressive strength

Mix No.	Mix ID	7 days Compressive strength	14 days Compressive strength	28 days Compressive strength
1	ER0	25.01	30.80	35.65
2	ER5	28.03	33.02	38.15
3	ER10	34.59	36.35	40.18
4	ER15	38.25	40.29	41.90
5	ER20	40.16	41.93	44.08
6	ER25	44.30	43.30	46.85

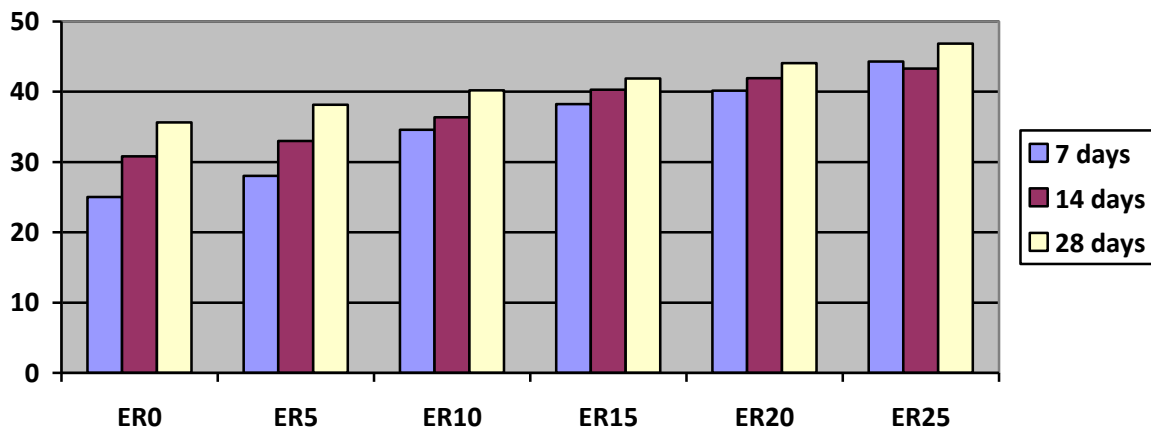


Fig: 2 Epoxy Resin filled concrete compressive strength

3.2 Results of Split Tensile Strength of Concrete cylinder containing epoxy resin as a filler:

Table 4 epoxy resin filled concrete tensile strength

Mix No.	Mix ID	Resin	Hardener	28 days Compressive strength
1	ER0	0	0	3.15
2	ER5	3	2	3.30
3	ER10	6	4	3.65
4	ER15	9	6	3.80
5	ER20	12	8	3.90
6	ER25	15	10	4.10

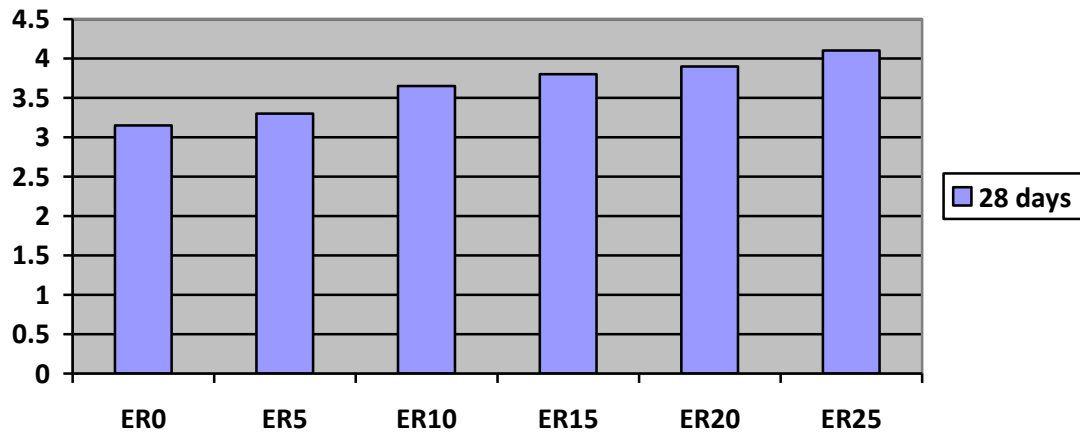


Fig: 3 Epoxy resin filled concrete Split Tensile strength

### 3.3 Results of flexural strength of epoxy resin filled beam component:

The flexural strength of mix ER25 was found to be 4.40MPa, which is better as compared to the average standard flexural strength for M30 grade concrete

Table 5 Flexural strength of epoxy resin filled beam component

Mix No.	Mix ID	Resin	Hardener	28 days Compressive strength
1	ER0	0	0	3.03
2	ER5	3	2	3.39
3	ER10	6	4	3.70
4	ER15	9	6	4.12
5	ER20	12	8	4.25
6	ER25	15	10	4.40

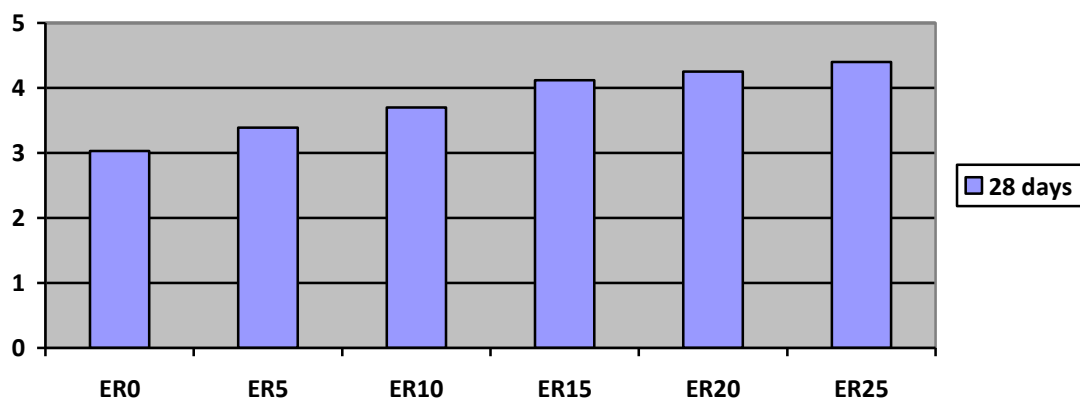


Figure: 4 flexural strength of epoxy resin filled beam component

#### IV. CONCLUSIONS

- [1] The mix ER25 has achieved the compressive strength of 46.85 MPa which indicates 23% rise as compared to the compressive strength of control mix at the age of 28-days. This confirms the increase in compressive strength of concrete with increase in epoxy resin compound.
- [2] As a thumb rule the split tensile strength of concrete should be 7-15% of that of. At 25% level of epoxy resin, it increased by 23.17% which is remarkable at the age of 28-days.
- [3] The flexural strength of mix ER25 was found to be 4.40MPa, which is better as compared to the average standard flexural strength for M30 grade concrete i.e., 3.83 MPa.

#### 1) **Future Scope of Work:**

- Effects of epoxy resin on different grade of concrete can be done.
- Use of epoxy resin in steel structure and its properties.
- Used with Different fibers materials, polymer material and its affects.

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