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Research Article

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Corrosion study on reinforced concrete slab with replacement of fly ash with various percentages in cement concrete

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ABSTRACT

The main concern and consideration in civil engineering infrastructures are subjected to various climatic conditions environmental and atmospheric conditions, properties and behavior of metals and materials used in constructions. Studies on damage, deterioration and durability of components attract of civil engineers of today. Among the most pressing concerns for structural concrete durability is the corrosion of steel reinforcement. Concrete is a high alkalinity material. The pH of newly produced concrete is usually between 12 to13. In these range of alkalinity, embedded steel is protected from corrosion by a passivating film bonded to the reinforcing bar surface. However, when the passivating film is disrupted, corrosion may take place the damage caused by rebar corrosion in concrete structure has been considered as one of the major durability problem affecting the service life of concrete structures. Statics have indicated that cover 40% of failure of structure due to corrosion of reinforcement. Measurement of corrosion in concrete structures is a very important work for civil engineers. Half-cell is an instrument used to measure corrosion. It is a semi destructive testing instrument. This paper represent about the corrosion measurement in various Reinforced cement concrete elements. Using half-cell potential measurement and also explain how to measure the corrosion without breaking the concrete surface. That means how to convert the semi destructive testing instrument to non-destructive testing instrument.

INTRODUCTION

1.1 GENERAL

Deterioration of concrete structures due to severe environmental conditions leads to performance degradation of RC structures is a major concern for engineers and researchers. Deterioration rate of structures depends on the exposure conditions and extent of maintenance. Corrosion, a result of chemical or electro - chemical actions, is the most common mechanism responsible for deterioration of Reinforced concrete structures which is mainly governed by chloride ingress and carbonation depth of RC structures. Usually, there are two major factors which cause corrosion of rebar in concrete structures, carbonation and ingress of chloride ions. When chloride ions penetrate in concrete more than the threshold value or when carbonation depth exceeds concrete cover, then it initiates the corrosion of Reinforced concrete structures. If the corrosion is initiated in concrete structures, it progresses and reduces service life of the structures and rate of corrosion affects the remaining service life of RC structures. However, these severe environments can cause corrosion of reinforcement only if required amounts of oxygen and moisture are available at the rebar level in concrete structures.

Generally corrosion is a major problem in corrosion in reinforced concrete elements. Durability of the structures gets reduced because of corrosion. To measure this corrosion there are several methods are available. But the most appropriate method is using half-cell potentiometers. The main aim of the project is to measuring the corrosion level of steel in Reinforced concrete without breaking the concrete structures. For that purpose corrosion measurements can be made with double half-cell methods, for this method we need not connect positive terminal of digital volt meter with the steel rod.

1.2 NEED FOR THE PROJECT:

- To evaluate the durability properties namely corrosion resistance of fly ash concrete with respect to conventional concrete.
- To prevent the breakage of concrete surface for corrosion measurement.

1.3 SCOPE OF THE PROJECT:

- To prevent the concrete surface from cracking during corrosion.
- Corrosion measurement to be taken with single half-cell nondestructive testing instrument for corrosion.
- To study and identify the initiation and propagation of corrosion at early days.
- To know the corrosion activities at various stages of corrosion.

2. CONCRETE SLABS

- Two numbers of Conventional RCC slabs
- C80 FA20 (cement 80% and fly ash 20%)
- C60 FA40 (cement 60% and fly ash 40%)
- C40 FA60 (cement 40% and fly ash 6

C60FA40 & C40 FA 60RC SLABS

2 CONVENYIONAL& C80 FA20 RC SLABS

HALFCELL POTENTIALMETER

Half –cell potentiometer measurements were taken on slabs (C100, C80FA20, C60FA40, and C40FA60) before the corrosion acceleration. After the corrosion acceleration is given to the slabs for 10, 20, 30, 40, hours of the impressed current.

The corrosion measurements are tabulated for ten hours of accelerates corrosion. The remaining corrosion data up to 40 hours of accelerate corrosion are plotted as equipotential contours. The corrosion maps are clearly indicates the ASTM C 876 corrosion limits through equipotential contour maps**.**

HALFCELLPOTENTIALREADINGS

IN -mv AT 10 Hrs. FOR C80 FA20 SLAB

246	242	234	245	268	245	278	286
235	237	233	240	263	242	274	282
228	236	222	234	258	239	270	277
265	214	211	226	254	234	267	270
276	292	203	221	252	230	265	269
252	284	285	214	250	242	267	268
241	273	278	208	247	241	262	265
229	274	277	206	239	236	258	266
227	275	276	206	239	234	258	266

HALF CELL POTENTIAL READINGS

IN -mv AT 10 Hrs. FOR C100 SLAB

145	154	156	164	174	177	181	182	185
148	155	156	167	176	180	185	187	178
148	159	165	171	181	187	192	193	188
150	163	168	176	188	195	193	192	191
164	170	173	181	193	196	190	193	198
172	176	182	190	197	198	193	182	196
185	187	190	199	182	183	186	184	183
185	191	195	181	186	187	181	189	189
166	188	196	185	190	191	182	190	185

HALF CELL POTENTIAL READINGS

IN -mv AT 10 Hrs. FOR C60 FA40 SLAB

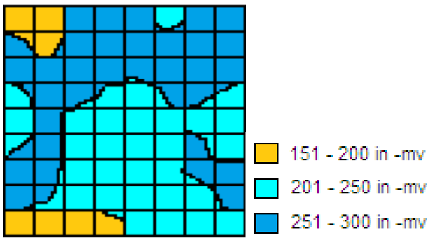
206	165	157	130	123	112	122
206	177	187	115	120	108	114
212	122	186	163	115	107	104
180	127	137	153	112	106	199
195	161	136	150	128	105	179
180	136	130	165	160	111	184
170	130	120	162	181	110	188
180	126	119	161	188	112	190
127	142	249	158	200	117	107

HALFCELLPOTENTIAL READINGS

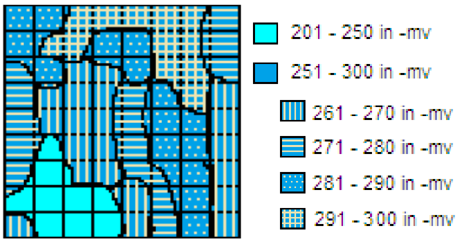
IN -mv AT 10 Hrs. FOR C40 FA60 SLAB

188	163	141	133	111	144	201	140
86	163	144	131	112	155	171	134
176	158	137	134	114	164	175	120
175	159	141	130	118	127	155	112
176	137	150	137	118	139	145	104
161	143	144	138	125	146	144	100
162	164	139	141	127	154	140	94
154	162	141	140	118	163	167	86
161	159	148	139	116	162	166	83

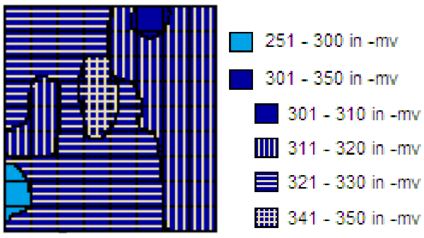
Equipotential Contour Map Showing Corrosion Level of Reinforcement In RCC Slab At 0 Hrs For C100 Slab.



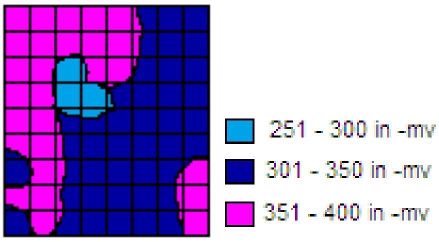
Equipotential Contour Map Showing Corrosion Level of Reinforcement in Rcc Slab At 20 Hrs For C100 Slab



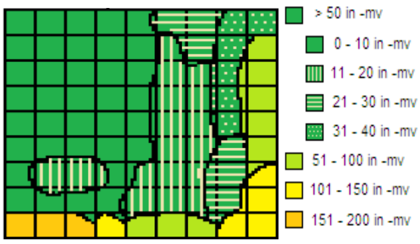
Equipotential Contour Map Showing Corrosion Level Of Reinforcement In Rcc Slab At 30 Hrs For C100 Slab



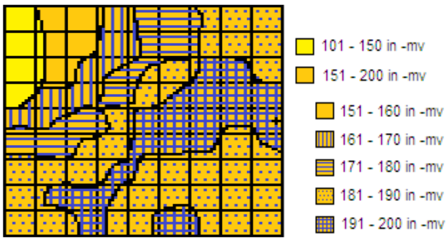
Equipotential Contour Map Showing Corrosion Level of Reinforcement in RCC Slab At 40 Hrs For C100 Slab.



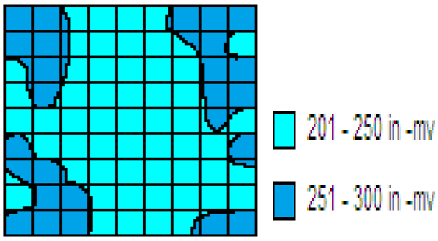
Equipotential contour map showing Corrosion level of reinforcement in RCC slab at 0 hrs for C80 FA20 slab.



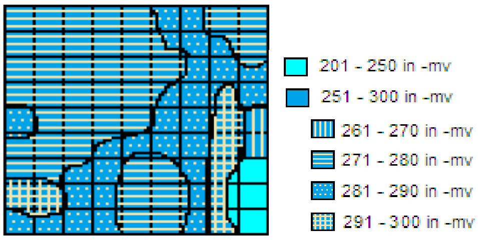
Equipotential contour map showing Corrosion level of reinforcement In RCC Slab at 10HRS FOR C80 FA20 SLAB



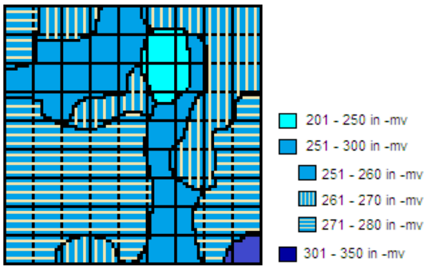
Equipotential Contour Map Showing Corrosion Level Of Reinforcement In RCC Slab At 20 hrs for C80 FA20 slab



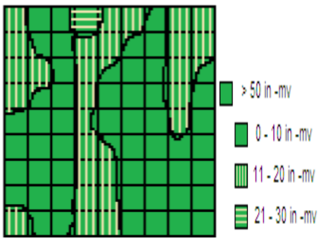
Equipotential contour map showing Corrosion level of reinforcement in RCC slab at 30 hrs for C80 FA20 slab



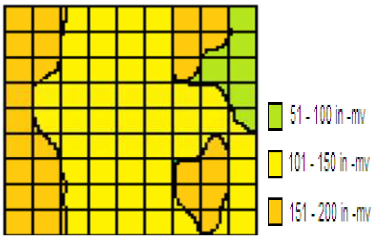
Equipotential contour map showing Corrosion level of reinforcement in RC slab at 40 hrs for C80 FA20 slab



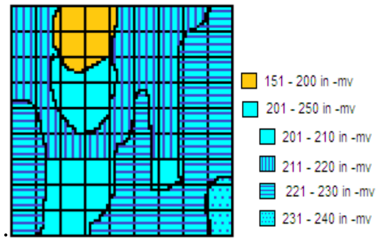
Equipotential contour map showing Corrosion level of reinforcement In RCC slab at 0 hrs for C60 FA40 Slab in RCC slab at 0 HRS for C60 FA40 slab



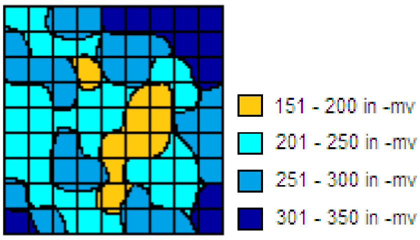
Equipotential contour map showing Corrosion level of reinforcement in RCC slab AT 10 hrs for C60 FA40 slab.



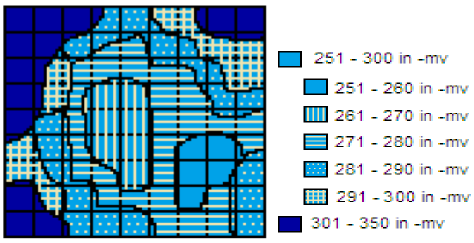
Equipotential Contour Map Showing Corrosion Level of Reinforcement in RCC Slab at T 20 hrs for C60 FA40slab



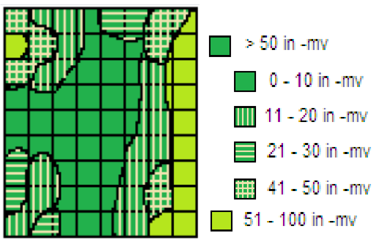
Equipotential Contour Map Showing Corrosion Level of Reinforcement in RCC slab AT 30 hrs for C60 FA40 slab



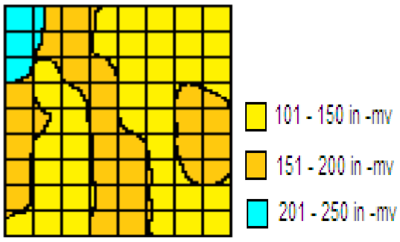
Equipotential contour map showing Corrosion level of reinforcement In RCC slab at 40 hrs for C60 FA40 slab



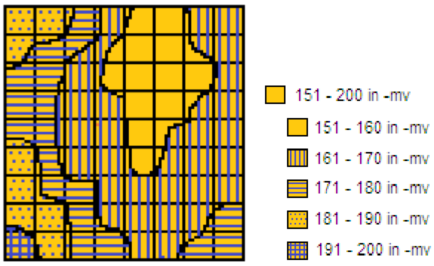
Equipotential contour map showing Corrosion level of reinforcement in RCC slab at 0 hrs for C40 FA60 slab



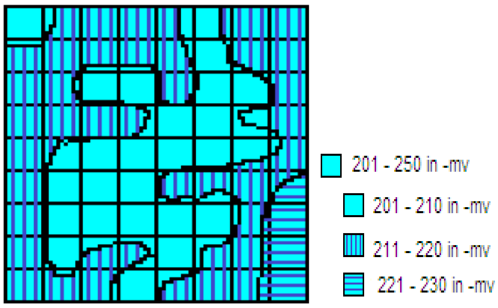
Equipotential contour map showing corrosion level of reinforcement in RCC slab at 10 hrs for C40 FA60 slab



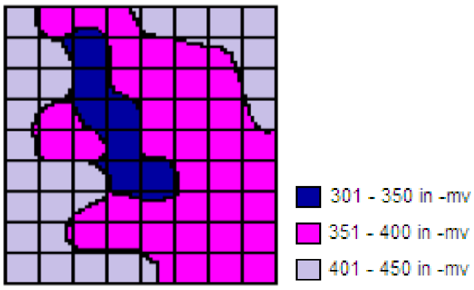
Equipotential contour map showing Corrosion level of reinforcement In RCC slab at 20 hrs for C40 FA60 slab



Equipotential contour map showing Corrosion level of reinforcement in RCC slab at 30 hrs for C40 FA60 slab

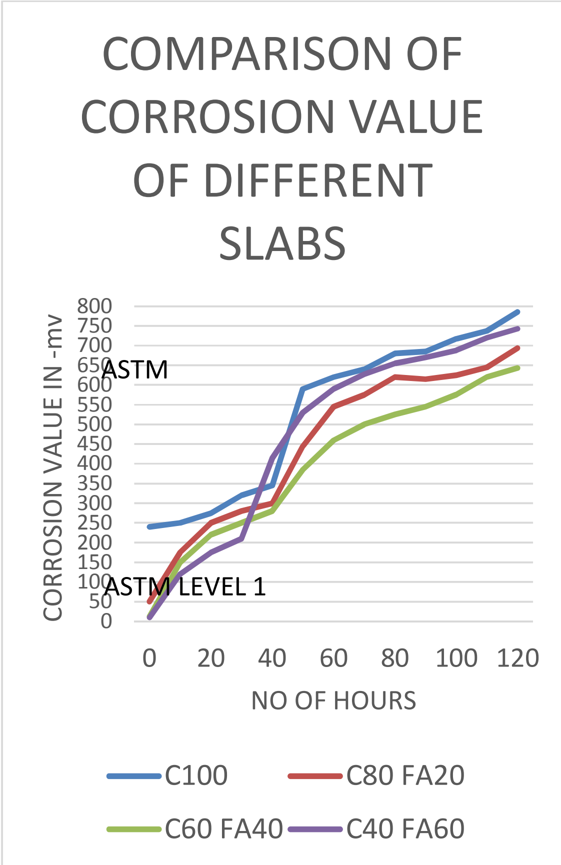


Equipotential contour map showingCorrosion level of reinforcement in RCC slab at 40 hrs for C40 FA60 slab



Probability of Corrosion According To Half-Cell Readings

NOTIFICATION	POTENTIAL DIFFERENCE (mv)	CHANCE OF REBAR BEING CORRODED
ASTM LEVEL 4	Less than -500 mv	Visible evidence of corrosion
ASTM LEVEL 3	-350 to -500 mv	95%
ASTM LEVEL 2	-200 to -350 mv	50%
ASTM LEVEL 1	More than -200mv	5%



CONCLUSION

Slabs subjected 40 hours of accelerated corrosion are shown ASTM C-786 with in ASTM corrosion level 3(more negative than 500 mv) Based on strength consideration c100(conventional 100%) slab and C80 FA20conventional 80%&flyash 20%) slabs are preferable. Based on corrosion consideration C80 FA 40 (conventional 80%&flyash 20%)slab is preferable.Based on corrosion consideration C60 FA40(conventional 60%& flyash 40%) slab is preferable.From the above information for corrosion is found with slow propagation and for long term stability against corrosion C60 FA40 slab is preferable.

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