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YOUNG'S MODULUS OF REINFORCED CEMENT CONCRETE

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ABSTRACT
This research focused on the young's modulus of reinforced cement concrete (R.C.C). R.C.C is made up of concrete and steel. Concrete is made up of cement, fine aggregate, coarse aggregate, water and it is tough to find out the young's modulus of reinforced cement concrete by practical. Steel and concrete is have different properties, in concrete the materials which are fine aggregate, coarse aggregate, water is varying of properties depend up on the location and it is also a great difficulty to find out the young's modulus of R.C.C.in this research is used in R.C.C to find out the young's modulus of concrete by theoretically.

Keywords: Modulus of elasticity of R.CC, Young's Modulus of R.C.C, YOUNG'S MODULUS OF CONCRETE

INTRODUCTION

In case of axial loading, the ratio of tensile or compressive stress to the corresponding strain is a constant within elastic limit. This ratio is called modulus of elasticity or young's modulus and it is denoted by 'E'.

$$E = \frac{TENSILE\ STRESS}{TENSILE\ STRAIN} \quad or \quad \frac{COMPREESIVE\ STRESS}{COMPRESSIVE\ STRAIN}$$

The unit of E is same as that of stress. In this research using principle of analysis of stress developed in composite section, applying total percentage of reinforcement and IS 456:2000 code book is also used to find out the young's modulus of R.C.C.

METHEDOLOGY

As per IS 456:2000 Page no: 16, clause 6.2.3.1 the modulus of elasticity of concrete E_C can be assumed as follows:

$$\mathbf{E_C = 5000\sqrt{fck}}$$

fck = characteristic compressive strength of 150mm cube.
Where
E_C is the short term static modulus of elasticity in N/mm^2.
Actually measured values may be differ by "+ or – 20%" from the values obtained from the above expression.
Formulae from the principle of analysis of stress developed in composite section to find out the young's modulus of reinforced cement concrete is

$$\mathbf{E_{R.C.C} = ((E_S\ x\ A_S)+(\ E_C\ x\ A_C))/(\ A_S + A_C)}$$

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$E_{R.C.C}$ = young's modulus of reinforced cement concrete
E_S = young's modulus of steel = **200000 N/mm^2**
A_S =area of steel
A_C =area of concrete
$A_{R.C.C}$ =area of reinforced cement concrete

TABLE.1.YOUNG'S MODULUS OF CONCRETE

Sl.no	GROUP	GRADE OF CONCRETE	CHARACTERISTIC COMPRESSIVE STRENGTH OF CONCRETE (fck) N/mm^2	YOUNGS MODULUS OF CONCRETE $E_C = 5000\sqrt{fck}$ N/mm^2
1	Ordinary Concrete	M10	10	15811.38
2		M15	15	19364.92
3		M20	20	22360.68
4	Standard concrete	M25	25	25000.00
5		M30	30	27386.13
6		M35	35	29580.40
7		M40	40	31622.78
8		M45	45	33541.02
9		M50	50	35355.39
10		M55	55	37080.99
11	High strength concrete	M60	60	38729.83
12		M65	65	40311.29
13		M70	70	41833.00
14		M75	75	43301.27
15		M80	80	44721.36

Assume 1mm^2 is area of reinforced concrete

Take 0.1% of area of steel from area of R.C.C

$A_{R.C.C}$ =1mm^2

$A_S = \frac{0.1}{100}$ x 1 = 0.001mm^2

$$A_{R.C.C} = A_C + A_S \text{.....(1)}$$

From the equation (1)

$$A_C = A_{R.C.C} - A_S$$
$$= 1 - 0.001$$
$$= 0.999 mm^2$$

$$E_{R.C.C} = ((E_S \times A_S) + (E_C \times A_C))/(A_S + A_C)$$

If M15 grade concrete used,
From table.1.E_C = 19364.92N/mm

$$E_{R.C.C} = ((200000 \times 0.001) + (19364.92 \times 0.999))/1$$
$$E_{R.C.C} = 19545.56 \text{ N/mm}^2$$

From the formula finding the young's modulus of reinforced cement concrete 0.1% to 10% area of steel used in reinforced cement concrete

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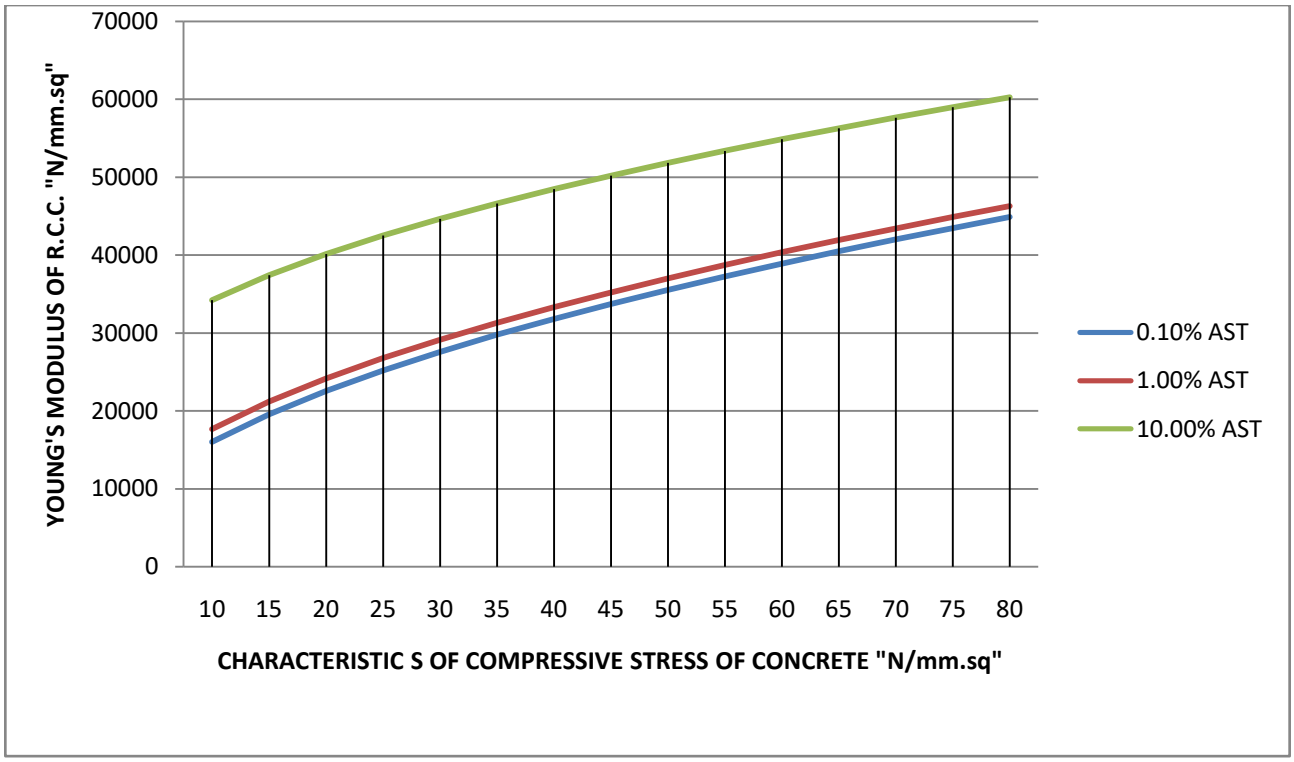
TABLE.2. YOUNG'S MODULUS OF R..C.C. 0.1, 1.0 AND 10%

SL.NO	% of Area of steel in R.C.C.	YOUNGS MODULUS OF R.C.C($E_{R.C.C}$) "N/mm^2"							
		ORDINARY CONCRETE			STANDARD CONCRETE				
		M10	M15	M20	M25	M30	M35	M40	M45
1	0.1	15995.57	**19545.55**	22538.32	25175	27558.74	29750.82	31791.16	33707.48
2	1.0	17653.28	21171.31	24137.07	26750	29112.80	31284.60	33306.52	35205.60
3	10.00	34230.02	37427.83	40124.65	42500	44638.49	46622.22	48461.08	50187.00

SL.NO	% of Area of steel	YOUNGS MODULUS OF R.C.C ($E_{R.C.C}$)"N/mm^2"						
		STANDARD CONCRETE		HIGH STRENGTH CONCRETE				
		M50	M55	M60	M65	M70	M75	M80
1	0.1	35520.03	37243.91	38891.10	40470.98	41991.12	43457.97	44876.64
2	1.0	37001.88	38710.19	40342.53	41908.19	43415.01	44868.27	46274.48
3	10.0	51819.12	53372.81	54856.83	56279.93	57644.01	58970.91	60243.56

GRAPH.1.COMPARISON OF YOUNGS MODULUS OF RESULTS 0.1, 1.0 AND 10% OF AREA OF STEEL USED IN REINFORCED CEMENT CONCRETE



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RESULTS

SL.NO	% of Area of steel in R.C.C.	YOUNGS MODULUS OF R.C.C($E_{R.C.C}$) "N/mm^2"							
		ORDINARY CONCRETE			STANDARD CONCRETE				
		M10	M15	M20	M25	M30	M35	M40	M45
1	0.1	15995.57	19545.55	22538.32	25175	27558.74	29750.82	31791.16	33707.48
2	0.2	16179.76	19726.19	22715.96	25350	27731.36	29921.24	31959.53	33873.94
3	0.3	16363.95	19906.83	22893.60	25525	27904.04	30091.66	32127.90	34040.40
4	0.4	16548.14	20087.47	23071.24	25700	28076.72	30262.08	32296.28	34206.85
5	0.5	16732.33	20268.11	23248.88	25875	28249.40	30432.50	32464.65	34373.31
6	0.6	16916.52	20448.75	23426.51	26050	28422.08	30602.92	32633.03	34539.77
7	0.7	17100.71	20629.39	23604.52	26225	28594.76	30773.34	32801.40	34706.23
8	0.8	17284.90	20810.03	23781.79	26400	28767.44	30943.76	32969.77	34872.68
9	0.9	17469.09	20990.67	23959.43	26575	28940.12	31114.18	33138.15	35039.14
10	1.0	17653.28	21171.31	24137.07	26750	29112.80	31284.60	33306.52	35205.60
11	1.5	18574.21	22074.45	25025.27	27625	29975.34	32136.69	34148.44	36037.90
12	2.0	19495.14	22977.59	25913.47	28500	30837.88	32988.78	34990.36	36870.20
13	2.5	20416.07	23880.73	26801.67	29375	31700.42	33840.87	35832.28	37702.50
14	3.0	21337.00	24783.87	27689.87	30250	32562.95	34692.96	36674.20	38534.80
15	3.5	22257.93	25687.01	28578.07	31125	33425.49	35545.05	37516.12	39367.10
16	4.0	23178.86	26590.15	29466.27	32000	34288.03	36397.14	38358.04	40199.40
17	4.5	24099.79	27493.29	30354.46	32875	35150.57	37249.23	39199.96	41031.70
18	5.0	25020.72	28396.43	31242.66	33750	36013.11	38101.32	40041.88	41864.00
19	5.5	25941.65	29299.57	32130.86	34625	36875.64	38953.41	40883.80	42696.30
20	6.0	26862.58	30202.71	33019.06	35500	37738.18	39805.50	41725.72	43528.60
21	6.5	27783.51	31105.85	33907.26	36375	38600.72	40657.59	42567.64	44360.90
22	7.0	28704.44	32008.99	34795.46	37250	39463.26	41509.68	43409.56	45193.20
23	7.5	29625.37	32912.13	35683.66	38125	40325.80	42361.77	44251.48	46025.50
24	8.0	30546.30	33815.27	36571.86	39000	41188.33	43213.86	45093.40	46857.80
25	8.5	31467.23	34718.41	37460.06	39875	42050.87	44065.95	45935.32	47690.10
26	9.0	32388.16	35621.55	38348.26	40750	42913.41	44918.04	46777.24	48522.40
27	9.5	33309.09	36524.69	39236.45	41625	43775.95	45770.13	47619.16	49354.70
28	10.00	34230.02	37427.83	40124.65	42500	44638.49	46622.22	48461.08	50187.00

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SL.NO	% of Area of steel	YOUNGS MODULUS OF R.C.C ($E_{R.C.C}$)"N/mm^2"						
		STANDARD CONCRETE		HIGH STRENGTH CONCRETE				
		M50	M55	M60	M65	M70	M75	M80
1	0.1	35520.03	37243.91	38891.10	40470.98	41991.12	43457.97	44876.64
2	0.2	35684.68	37406.83	39052.37	40630.67	42149.33	43614.67	45031.92
3	0.3	35849.33	37569.75	39213.64	40790.36	42307.54	43771.37	45187.24
4	0.4	36013.98	37732.67	39374.91	40950.05	42465.75	43928.07	45342.56
5	0.5	36178.63	37895.59	39536.18	41109.74	42623.96	44084.77	45497.88
6	0.6	36343.28	38058.51	39697.45	41269.43	42782.17	44241.47	45653.20
7	0.7	36507.93	38221.43	39858.72	41429.12	42940.38	44398.17	45808.52
8	0.8	36672.58	38384.35	40019.99	41588.81	43098.57	44554.87	45963.84
9	0.9	36837.23	38547.27	40181.26	41748.50	43256.80	44711.57	46119.16
10	1.0	37001.88	38710.19	40342.53	41908.19	43415.01	44868.27	46274.48
11	1.5	37825.06	39524.78	41148.88	42706.62	44205.51	45651.75	47050.54
12	2.0	38648.24	40339.37	41955.23	43505.05	44996.01	46435.23	47826.60
13	2.5	39471.42	41153.96	42761.58	44303.48	45786.51	47218.71	48602.66
14	3.0	40294.60	41968.55	43567.93	45101.91	46577.01	48002.19	49378.72
15	3.5	41117.78	42783.14	44374.28	45900.34	47367.51	48785.67	50154.78
16	4.0	41940.96	43597.73	45180.63	46698.77	48158.01	49569.15	50930.84
17	4.5	42764.14	44412.32	45986.98	47497.20	48948.51	50352.63	51706.90
18	5.0	43587.32	45226.91	46793.33	48295.63	49739.01	51136.11	52482.96
19	5.5	44410.50	46041.50	47599.68	49094.06	50529.51	51919.59	53259.02
20	6.0	45233.68	46856.09	48406.03	49892.49	51320.01	52703.07	54035.08
21	6.5	46056.86	47670.68	49212.38	50690.92	52110.51	53486.55	54811.14
22	7.0	46880.04	48485.27	50018.73	51489.35	52901.01	54270.03	55587.20
23	7.5	47703.22	49299.86	50825.08	52287.78	53691.51	55053.51	56363.26
24	8.0	48526.40	50114.45	51631.43	53086.21	54482.01	55836.99	57139.32
25	8.5	49349.58	50929.04	52437.78	53884.64	55272.51	56620.47	57915.38
26	9.0	50172.76	51743.63	53244.13	54683.07	56063.01	57403.95	58691.44
27	9.5	50995.94	52558.22	54050.48	55481.50	56853.51	58187.43	59467.50
28	10.0	51819.12	53372.81	54856.83	56279.93	57644.01	58970.91	60243.56

CONCLUSIONS

In the design of reinforced concrete structure always we are using limit state and working stress method. The young's modulus of reinforced cement concrete found out and I believe any other new method for design of reinforced concrete structure formed from our research. I hope this research is use full for researchers

REFERENCES

[1] RAMAMRUTHA.S.*Theory Of Structures,dhanpat rai publishing company,9th edition*
[2] IS 456:2000 Indian Standard Plain and Reinforced Concrete – CODE OF PRACTICE.