Experimental Investigation on Properties of Concrete By Partial Replacement of Cement With Dolomite Powder And Fine Aggregate With Quarry Dust

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Abstract- *Concrete is most useful material in the construction industry. In recent years, there is a lot of development in the field of concrete. M_{30} grade concrete specimen were made by replacing 0%,5%.10%,15% of cement with Dolomite powder and fine aggregate with Quarry dust. The Compressive strength, split tensile strength and flexural strength of the specimen were found on the 7^{th} the 28^{th} days. The water cement ratio 0.45 for this experiment. The use of dolomite powder & quarry dust uses the cost of construction.*

I. INTRODUCTION

Cement is a binding substance. It is the main constituent in concrete. Concrete is made up of cement, aggregate & water. These materials are mixed with certain proportion. The production of ordinary Portland cement produces 7% approximately of the total greenhouse gas emitted to the atmosphere. The use of advanced concrete technology can reduce the consumption of natural resources and also less the environmental pollution.

When industrial waste recycled, it also reduces Co_2 emission are reduced. & reduced the residual products. . Fly ash, blast furnace slag and silica fume are most widely used industrial wastes in place of cement for concrete production. This project deals with partial replacement of cement with dolomite powder & fine aggregate with quarry dust.

In quarrying process, the rock has been crushed into various sizes , during the process the dust generated is called quarry dust .So it becomes useless material and it causes air pollution .By replacement of fine aggregate with quarry dust , it can solve the problem of natural sand. It is available locally, it reduces the cost of construction.

It can be used as substitute to sand wholly & partly. It offers a comparatively good strength as compared to sand with or without concrete admixture.

Objective

1. The main objective of this project is to study the strength of partial replacement of cement with Dolomite powder & fine aggregate with Quarry dust .
2. The compressive strength, split tensile strength & flexure strength of M30 grade of concrete are obtained similarly compressive strength , tensile strength and flexure strength were obtained for 0%, 5%, 10%, 15% replacement of cement with dolomite powder by weight & fine aggregate also replaced with Quarry dust for 0%, 5 %, 10%,15%.
3. To investigate the effect of using dolomite powder & quarry dust as a partial replacement of cement & fine aggregate in concrete.

II. LITERATURE REVIEW

2.2.1 A Study has been conducted by Athulya Sugathan (2017)- have done on their research on "Experimental Investigation on partial Replacement of Cement with dolomite powder ".It examines the possibilities using dolomite powder as a partial replacement material to cement . The replacement in percentages 0%, 5%, 7.5 %, 10%, 15% of cement. The compressive, split tensile strength is determined. The Compressive strength of Cubes are increased with addition of dolomite powder up to 15% replaced by weight of cement and further any addition of dolomite powder the compressive strength decreases. The split tensile strength of Cylinders are increased with addition of dolomite powder up to 15% replaced by weight of cement and further any addition of dolomite powder the Split Tensile strength decreases

2.2.2 A Study has been conducted by Chandana Sukesh, et al (2012)- have done on their research on " Partial replacement of sand with Quarry dust in Concrete" In this research replacement of sand with quarry dust is improved compressive strength and workability. The properties of quarry dust and natural sand is same. The replacement of sand with quarry dust is about 55to 75 % compressive strength is increased.fly ash replaced with cement is about10%, 20%, 30%,40%,50% . The further increasing the percentage of

replacement can be made useful by adding 50% fly ash along with the quarry dust so that 100% replacement of sand strength is increased.

2.2.3 A Study has been conducted by J Sateesh Kumar (2016) have done on their research on " Physical and Chemical characteristics of dolomite for partial replacement of cement in M_{20} Concrete ." The investigation of this paper to study the fresh & hardened concrete when cement is partially replaced by dolomite powder .The percentage of dolomite powder are replaced cement in this investigation are 0%, 5%, 10%, 15%& 20%.The fresh property is workability and hardened properties are compressive strength, flexural strength, split tensile strength . 5%wt and more than 20%wt dolomite limestone into cement always reduces compressive strengths after 7 and 28 days. Specimens containing 10% dolomite limestone powder by weight have the maximal compressive strengths.

2.3.4 A Study has been conducted by K. Sathishkumar et al (2017) have done on their research on "Experimental investigation on partial replacement of cement by dolomite and fine aggregate by copper slag." The replacement percentages of cement by dolomite powder is 20%, 25% & 30% and fine aggregate by copper slag is 20% by the weight of M20 grade concrete. Cubes & cylinder casted & after 7 ,14 & 28 days Split tensile , compreesive test can be done. Replacement of dolomite powder with 30% the compressive strength is increased. Split tensile strength of concrete is also increased.

2.2.5 A Study has been conducted by R Dharsana et al have been their research on " "Experimenatal study on strength property of concrete by partial replacement of fine aggregate with dolomite powder." The investigation of this paper to study dolomite powder is replaces for fine aggregate in the ratio of 10%, 20%, 30% ,40%. The compressive strength , split tensile strength & flexural strength of concrete compared with control concrete .In this research it is found that optimum percentage for replacement of dolomite powder with fine aggregate & it is 30% replacement increases for all cubes, cylinders, beam and further addition it decreases. concrete is also increased.

2.2.6 A Study has been conducted by Ragulraj et al (2017) have been their research on "A Study on self compacting concrete by replacing fine aggregate & cement by foundry sand and dolomite powder. It is observed that the use of foundry sand and dolomite powder is economical. It is observed that foundry sand can be replaced partially for sand up to 30% and the hardened concrete test result are satisfactory. Strength are obtained for mix (DP -10% & FS -30%) with an strength of 38.66Mpa at 28 days and further addition is decreases.

III. METHODOLOGY

3.1 Material used –

1. **Cement**-Ordinary Portland cement conforming to BIS 269-1976 and IS 4031-1968 was adopted in entire experiment. The cement is used .
2. **Water –**In this research potable water free from organic substance was used for mixing as well as curing of concrete.
3. **Coarse aggregate-** - Crushed coarse aggregate with nominal sizes of 20 mm maximum size is used for the experiment.
4. **Fine aggregate –** The material which passed through I.S. sieve no 480 (4.75mm) is termed as fine aggregate . Sand may be obtained from river, sea, It is naturally available. material.
5. **Dolomite powder –** Dolomite powder was collected from manufacturing factory. It is sieved by IS-90 micron sieve before mixing the concrete. Dolomite is the sedimentary type of rock. Calcium & magnesium is the main constituent in dolomite. It's chemical composition is $CaMg(Co_3)_2$.

Table 1- Properties of dolomite

Sr.no	Property	Dolomite powder
1	Chemical classification	Carbonate
2	Color	white , pink, green
3	Tenacity	Brittle
4	Specific gravity	2.85
5	Moisture content	Nil
6	Fineness modulus	2.50

6. **Quarry dust-** It is obtained from crushing process of rock. It is useless material. It can be available easily.

Physical properties of quarry dust & natural sand –
(Table no -2)

Sr. no.	Property	Quarry dust	River sand
1	Specific gravity	2.57	2.62
2.	Bulk density (kg/ m³)	1780	1470
3.	Absorption (%)	1.25	Nil
4 .	Moisture content	Nil	1.4
5.	Finer particles less than 0.075mm (%)	12-15	05

3.2 Specimen details –

Cubes of size (150*150*150) mm, beam specimen of size(100*100*500) mm & cylinder specimen sizes of size (300*100)mm were cast to study the mechanical strength properties such as compressive strength, split tensile strength and flexural strength according to Indian Standard.

3.3 Casting and curing –

The moulds were tightly fitted so as to prevent leakage and the inner side should be painted with oil before going to concreting. The prepared concrete was placed in the mould and properly compacted. Operation of curing is designed to overcome the problem of loss of hydration. The prepared specimens are cured in curing tank for 7&28 days.

3.4 Mix proportion –

Mix concrete -1 are divided into following four mix fine aggregate (MFA_0,MFA_1, MFA_2,MFA_3)

Mix concrete -1 (MC_0)	MFA_0 (C: DP: QD:FA) (100: 0: 0 :100)
	MFA_1 (C : DP : QD : FA) (100 : 0: 5 : 95)
	MFA_2 (C : DP : QD : FA (100 : 0: 10: 90)
	MFA_3 (C : DP : QD: FA) (100 : 0: 15:85)

(Table no-3)

Mix concrete -II are divided into following four mix fine aggregate (MFA_0,MFA_1, MFA_2,MFA_3)

Mix concrete -II (MC_1)	MFA_0 (C: DP: QD:FA) (95: 5 :0 :100)
	MFA_1 (C : DP : QD : FA) (95 :5 :5 :95)
	MFA_2 (C : DP : QD : FA (95 : 5: 10: 90)
	MFA_3 (C : DP : QD: FA) (95: 5 : 15: 85))

(Table no- 4)

Mix concrete -III are divided into following four mix fine aggregate (MFA_0,MFA_1, MFA_2,MFA_3)

Mix concrete -III (MC_2)	MFA_0 (C: DP: QD:FA) (90: 10 :0 : 100)
	MFA_1 (C : DP : QD : FA) (90: 10 : 5 :95)
	MFA_2 (C : DP : QD : FA (90 : 10 ; 10:85)
	MFA_3 (C : DP : QD: FA) (90 : 10 : 15 : 85)

(Table no- 5)

Mix concrete -1V are divided into following four mix fine aggregate (MFA_0,MFA_1, MFA_2,MFA_3)

Mix concrete- IV- (MC_0)	MFA_0 (C: DP: QD:FA) (85 : 15 : 0 :100)
	MFA_1 (C : DP : QD : FA) (85 : 15 : 5 : 95)
	MFA_2 (C : DP : QD : FA (85 :15 : 10: 90)
	MFA_3 (C : DP : QD: FA) (85 : 15 : 15 ;85)

(Table no. 6)

No. of combination -16
Duration- 7 days & 28days
No of test – 3
No. of specimen per combination - 3
Therefore total no of specimen- 16*2*3*3 = 288.
Cube – 96 , Beam – 96 , cylinder -96.

IV. RESULT & DISCUSSION

4.1 Compressive strength –

Mix	Details	7 days (N/mm^2)	28 days (N/mm^2)
Mix -1	Control Concrete	21.94	30.52
	MC_0 & MFA_1	22.08	30.66
	MC_0 & MFA_2	22.32	30.95
	MC_0 & MFA_3	22.67	31.24
Mix - II	MC_1& MFA_0	22.95	31.38
	MC_1& MFA_1	23.10	31.53
	MC_1 & MFA_2	23.24	31.67
	MC_1& MFA_3	23.54	31.82
Mix -III	MC_2 & MFA_0	23.68	31.96
	MC_2& MFA_1	23.83	32. 26
	MC_2 & MFA_2	23.98	32.55
	MC_2 & MFA_3	24.41	32.70
Mix - IV	MC_3& MFA_0	23.25	31.86
	MC_3& MFA_1	22.95	31.68
	MC_3& MFA_2	22.67	31.38
	MC_3& MFA_3	22.65	31.09

(Table no 7)

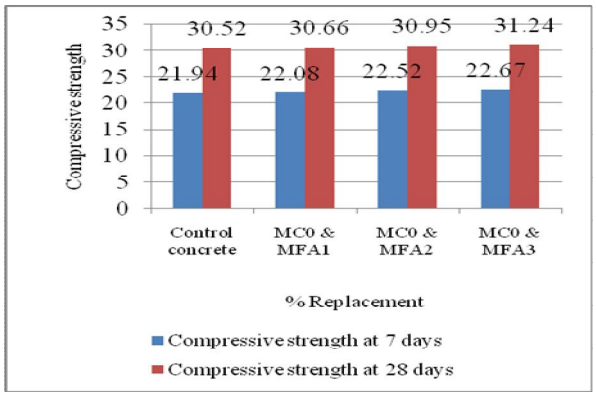


Fig 1- Compressive strength Vs Mix -I

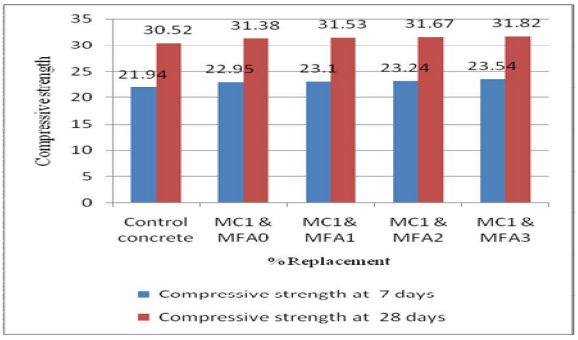


Fig -2 Compressive strength Vs Mix –II

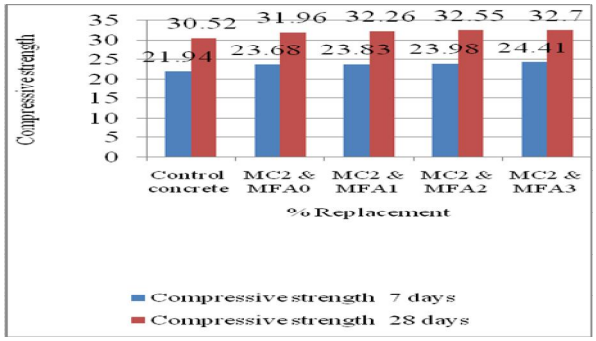


Fig -3 Compressive strength Vs Mix- III

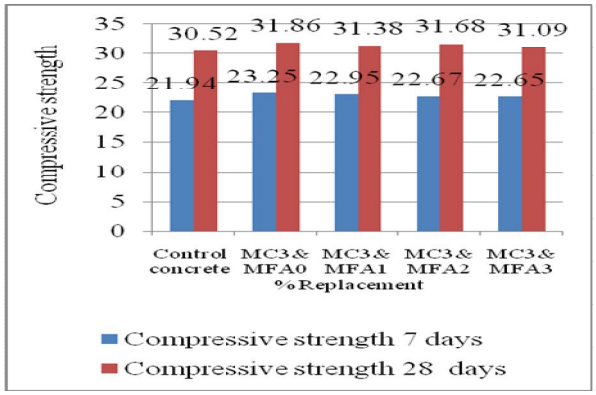


Fig -4 Compressive strength Vs Mix –IV

4.2 Split tensile strength –

Mix	Details	7 days (N/mm²)	28 days (N/mm²)
Mix -I	Control Concrete	2.15	3.15
	MC_0 & MFA_1	2.20	3.20
	MC_0 & MFA_2	2.24	3.30
	MC_0 & MFA_3	2.27	3.35
Mix - II	MC_1 & MFA_0	2.30	3.45
	MC_1 & MFA_1	2.34	3.50
	MC_1 & MFA_2	2.38	3.55
	MC_1 & MFA_3	2.43	3.65
Mix -III	MC_2 & MFA_0	2.48	3.70
	MC_2 & MFA_1	2.67	3.83
	MC_2 & MFA_2	2.86	3.91
	MC_2 & MFA_3	3.05	4.00
Mix - IV	MC_3 & MFA_0	2.62	3.78
	MC_3 & MFA_1	2.25	3.43
	MC_3 & MFA_2	2.20	3.28
	MC_3 & MFA_3	2.17	3.23

(Table no. 8)

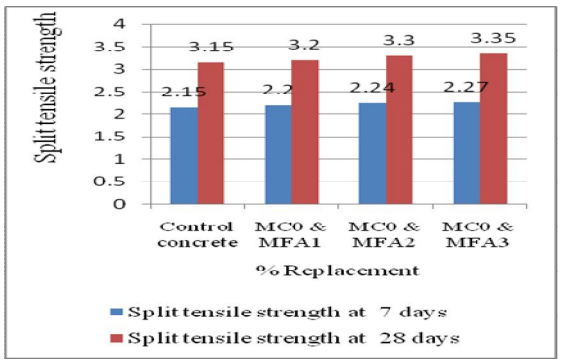


Fig -5 Split tensile strength Vs Mix –I

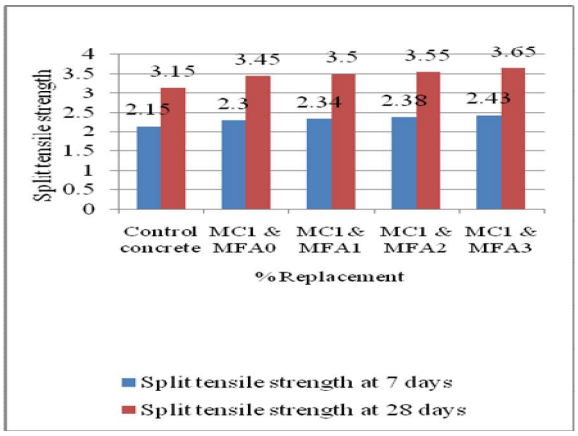


Fig -6 Split tensile strength Vs Mix – II

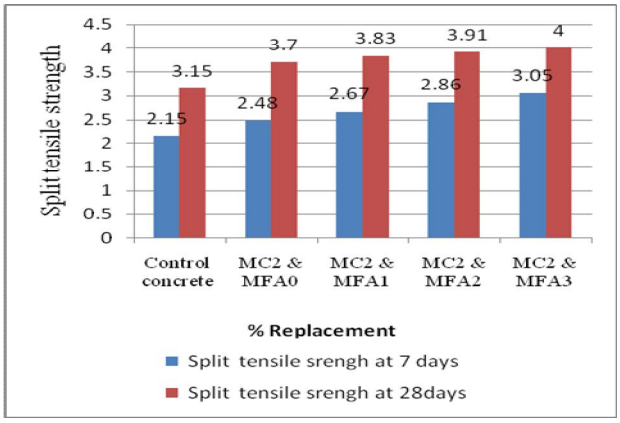


Fig 7 Split tensile strength Vs Mix III

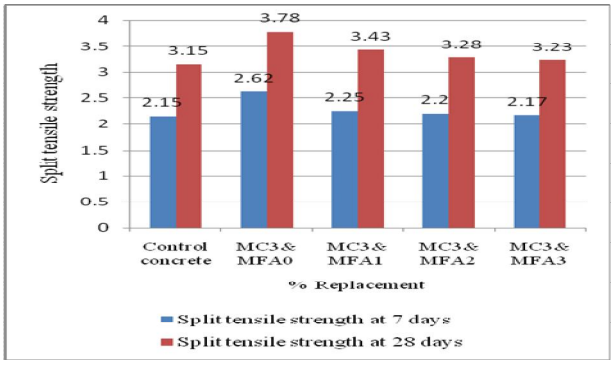


Fig 8 Split tensile strength Vs Mix – IV

5.3 Flexural strength –

Mix	Details	7 days	28 days
Mix -1	Control Concrete	2.16	3.62
	MC_0 & MFA_1	2.46	3.78
	MC_0 & MFA_2	2.58	3.84
	MC_0 & MFA_3	2.64	4.01
Mix - II	MC_1 & MFA_0	2.76	4.06
	MC_1 & MFA_1	3.00	4.12
	MC_1 & MFA_2	3.12	4.28
	MC_1 & MFA_3	3.18	4.34
Mix -III	MC_2 & MFA_0	3.30	4.39
	MC_2 & MFA_1	3.36	4.50
	MC_2 & MFA_2	3.42	4.62
	MC_2 & MFA_3	3.48	4.72
Mix - IV	MC_3 & MFA_0	3.00	4.23
	MC_3 & MFA_1	2.96	4.17
	MC_3 & MFA_2	2.88	4.01
	MC_3 & MFA_3	2.76	3.95

(Table no .9)

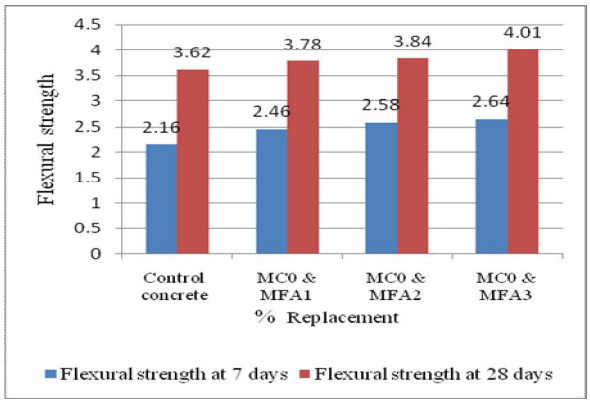


Fig 9 Flexural strength Vs Mix -I

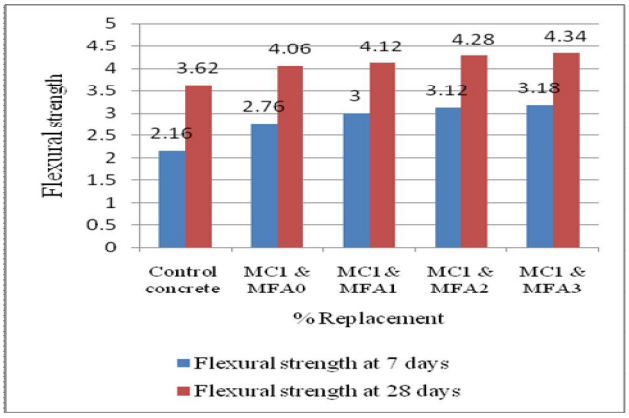


Fig 10 Flexural strength Vs Mix –II

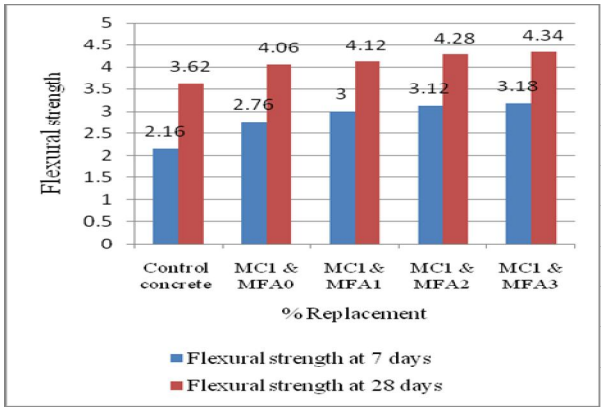


Fig 11. Flexural strength Vs Mix –III

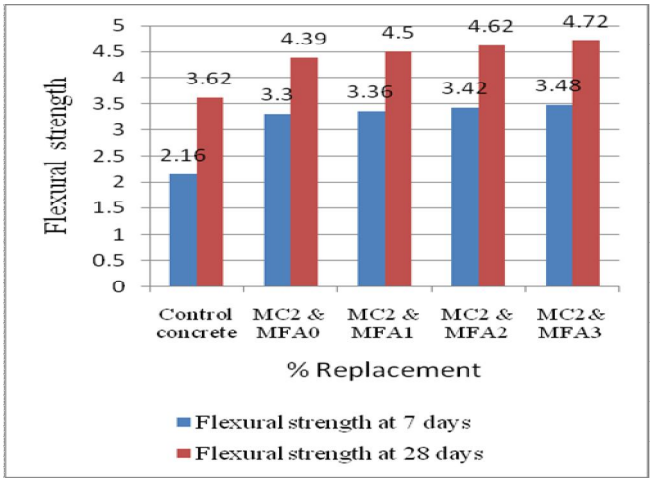
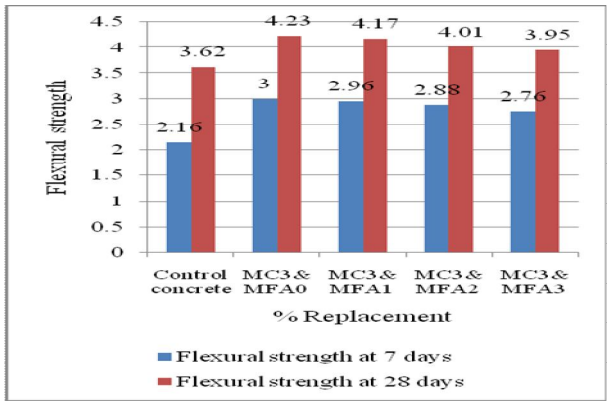


Fig 12 Flexural strength Vs Mix –IV



VI. CONCLUSION

1. Compressive strength of cubes is increased by dolomite powder and quarry with 10 % replacement .Considerable reduction in strength is observed at 15% replacement of dolomite powder . It was observed that compressive strength is increased by 7.41% with replacement of 10% dolomite powder & quarry dust.
2. Split tensile strength of cylinder is increased by dolomite powder and quarry dust with 10 % replacement. Considerable reduction in strength is observed in 15 % replacement of dolomite powder .It was observed that Split tensile strength of concrete is increased by 26 98 % than control concrete with replacement of 10 % dolomite powder & quarry dust.
3. Flexural strength of beam is increased by dolomite powder & quarry dust with 10% replacement .Considerable reduction in strength is observed in 15 % replacement of dolomite Powder. It is observed that flexural strength of concrete is increased by 30.38% than control concrete with replacement of 10 % dolomite powder & quarry dust

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