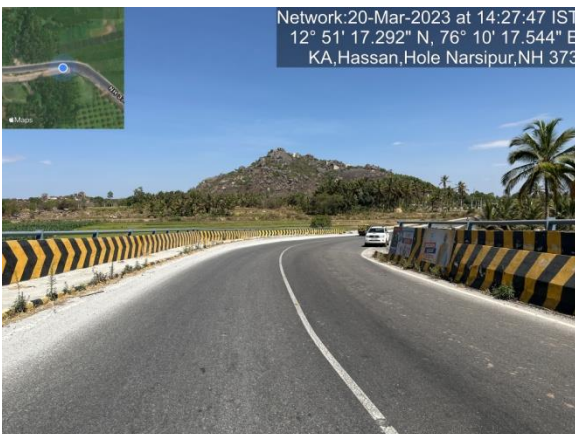




GOVERNMENT OF KARNATAKA
(Public Works Department
National Highway Division
Hassan

Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

HYDRAULIC REPORT



DECEMBER 2023

Submitted by



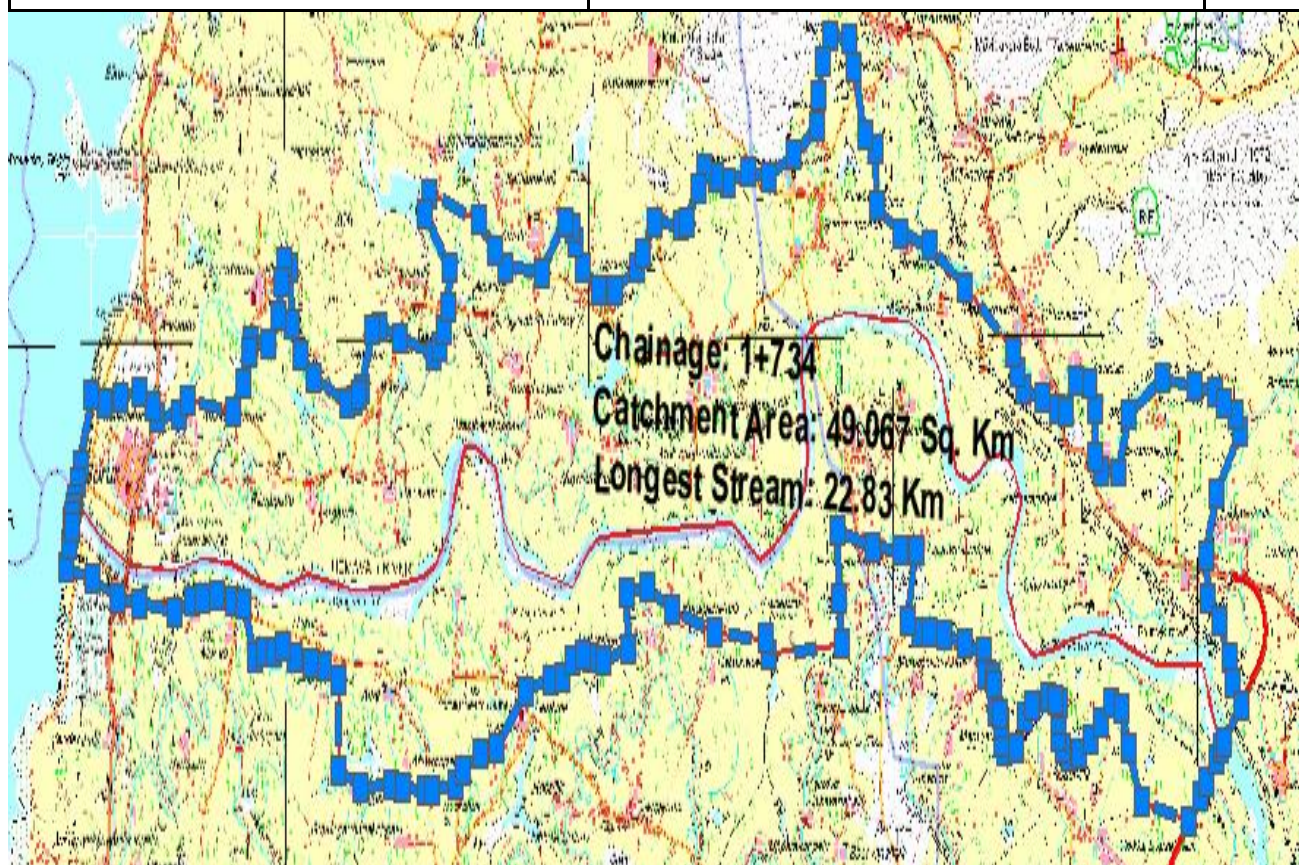
INDIAN TECHNOCRAT LIMITED
in Association with VIATAARA INFRA CONSULTANTS
Plot No.8,Sector B-7, Local Shopping Complex,
Vasant Kunj, New Delhi - 110070

**Project: Construction of Bypass to the Holenarasipura
Town from Km 87.280 (near Chikknahalli) to Km 97.580
(Near Hullahalli) on NH-373 in the State of Karnataka on
EPC mode under NH(O) Annual Plan 2023-24**

**HYDRAULIC CALCULATION OF HIGH LEVEL
BRIDGE AT Hemavati River CH-1+754**

own from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karn

Proposed chainage:	1+731 (7x40)



Total Existing Bridge Length	240.00 m
a) Proposed Bridge Description:	The Proposed Bridge is a Simply Supported PSC I-Girder Bridge with Double D-Wall type Pier and wall type Abutment on open Foundation. The Crossing of River is nearly Straight
b) River:	Hemavati River
c) Strata type	As per Enclosed Soil Investigation Report
d) Design Proposal: Span arrangement Outer carriageway width Type of structure	6x40 2 x 10.5 PSC I Girder With open Foundation
e) Geotech:	As per Enclosed Report Yellow Sandy Soil with Silt
f) Hydrology: HFL Design Discharge	833.07 m 5120.51 cumec

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

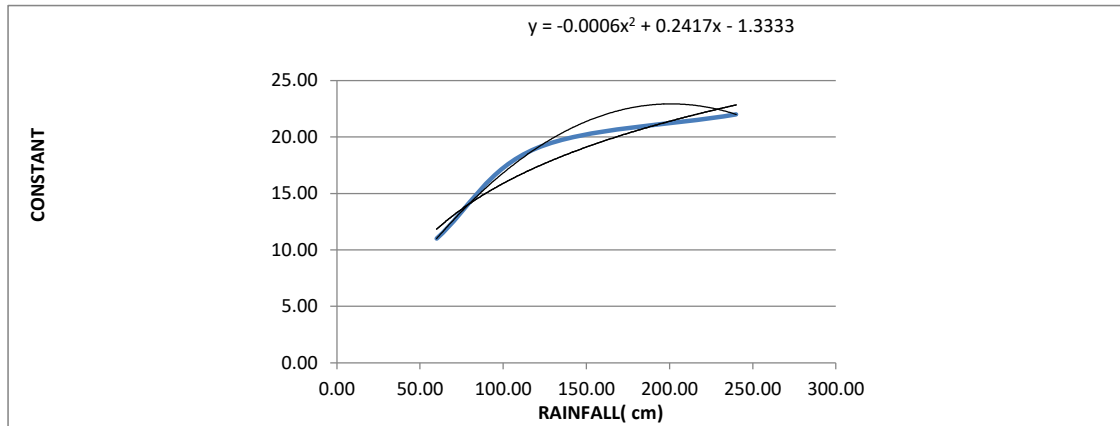
Abstract of Hydraulic Particulars

* Discharge using Emperical formulae	260 Cumec
* Discharge using Ryve's formulae	134 Cumec
* Discharge received of Existing bridge	14530 Cumec
* Discharge using A - V method	5120.11 Cumec
* Design Discharge	5120.51 Cumec
* Modified HFL	833.22 m
* Linear Water way and Afflux	264.00 m
Catchment area Excluding area above u/s Barrage	49.07 sq. km
Existing	
Proposed span arrangement	6x40 m (MJB) New Construction
Design Discharge	5120.51 Cumecs
Design Velocity	6.31 m/s
LBL	825.320 m
HFL	833.067 m
Afflux	0.150 m
Vertical Clearance	1.500 m
Soffit Level	834.717 m
Required FRL	837.757 m
Proposed Soffit Level	843.951 m
Proposed FRL	<u>846.991</u> m

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

EMPERICAL FORMULA CONSTANT CALCULATION CURVE

X-value (RAINFALL)		Y-value (CONSTANT)	
	0.00		0.00
	60.00		11.00
	120.00		19.00
	240.00		22.00



Constant after calculating from above graph for 80 cm Rainfall as per Isopluvial maps =

14.0

C = 11 to 14 where the annual rainfall is 60 to 120 cm
 = 14 to 19 where the annual rainfall is more than 120 cm

Ref.- IRC SP 13- 2022 cl:-4.2

For Rainfall Less than 60cm the constants are not provided in Dickens,
 Hence Interpolation Function is made use of to arrive at proper dickens discharge coefficient.

om Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka

SILT FACTOR CALCULATION

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Sieve size (mm)	Wt retained in grms	%age Wt retained	Ave size of sieve	Col 3 X 4	Mean Dia= Col 5/100
1	2	3	4	5	6

20	0	0	-	-	
10	0	0	15	-	
4.75	0	0	7.375	-	
1.18	4	0.4	2.965	1.19	0.456
0.6	224	22.4	0.89	19.94	
0.3	318	31.8	0.45	14.31	
0.15	454	45.40	0.225	10.22	

PAN

- - - -

TOTAL	1,000.00	100.00		45.65	
-------	----------	--------	--	-------	--

SILT FACTOR = $1.76 (5.375)^{1/2}$ 1.188

SILT FACTOR CALCULATION

Sieve size (mm)	Wt retained in grms	% age Wt retained	Ave size of sieve	Col 3 X 4	Mean Dia= Col 5/100
1	2	3	4	5	6

20	0	0	-	-	
10	0	0	15	-	
4.75	0	0	7.375	-	
1.18	12	1.2	2.965	3.56	0.496
0.6	204	20.4	0.89	18.16	
0.3	454	45.4	0.45	20.43	
0.15	330	33	0.225	7.43	

PAN

- - - -

TOTAL	1,000.00	100.00		49.57	
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SILT FACTOR = $1.76 (5.437)^{1/2}$ 1.24

Kf = $(4.080 + 4.104)/2$ 1.214

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Catchment area, A =		49.067 sq. km																		
I	Emperical formula Dicken's formula Discharge, $Q = C \times A^{(3/4)}$ Constant C is calculated using Best fit curve method from Empirical coeff. Given in IRC:SP-13-2004. The Site is located in area where annual Rainfall is 20cm as per isopluvial maps provide in flood estimation report of Mahi & Sabermati subzone 3(a) prepared by CWC Constant, C = "From Empirical constant calculation curve " 14 Discharge, Q = 259.55 Cumecs	Ref.- IRC SP 13- 2022 cl.no. - 4.2																		
II	ii) RYVE'S FORMULA, $Q = CM^{2/3}$ where, C = 6.8 for areas within 25 Km of the coast 8.5 for areas between 25 and 160KM of 10 for limited areas near the hills Taken C = 10 (for this case) Discharge, Q = 134.027 Cumec	Ref.- IRC SP 13- 2022 cl.no. - 4.3																		
III	Rational formula $Q = 0.028 \times A \times P \times I_c \times f$ Catchment Area = 4906.70 hectares L = Distance from critical point to bridge Site in Km. = 7.50 Km. H= Fall in level from the critical point to the bridge = 37 m Time of concentration, t_c = 2.41 hrs. Co-efficient of runoff, P = 0.80 Spread fraction, f = 1.00 Max. Daily Rainfall, F = 20.00 cm/day 1 hr rain fall intensity = 10.42 cm/hr. Conveyance Factor, I = 0.01315 Discharge, Q = 672.09 Cumecs	(eq. 4.7.5.2 of SP 13) (Table. 4.1 of SP 13) (Fig. 4.2 of SP 13) As Per Isopluvial Maps																		
IV	OTHER RELEVANT DATA Calculation For Bed Slope of Nallah Length 348.63 Mtr Local Bed Slope 0.00587 or 1 in 170.39 Rugosity Co-efficient (Ref table 5.1 of IRC SP 13) 0.045 Constant intensity V spread of storm 'P' (P26 of SP 13) 0.73 Maximum intensity of rainfall in one hour(I_o) severest strome 20 CM / Hr Percentage co-efficient runoff (p) 0.80 Silt Factor (K_{sf}) 1.21 HFL 833.07 Mtr OFL 832.70 Mtr LWL 827.32 Mtr Table 4.1 Maximum Value of P in the Formula $Q = 0.028 PAI_c$ <table><tr><td>Steep, bare rock and also city pavements</td><td>0.90</td></tr><tr><td>Rock, steep but wooded</td><td>0.80</td></tr><tr><td>Plateaus, lightly covered</td><td>0.70</td></tr><tr><td>Clayey soils, stiff and bare</td><td>0.60</td></tr><tr><td>-do- lightly covered</td><td>0.50</td></tr><tr><td>Loam, lightly cultivated or covered</td><td>0.40</td></tr><tr><td>-do- largely cultivated</td><td>0.30</td></tr><tr><td>Sandy soil, light growth</td><td>0.20</td></tr><tr><td>-do- covered, heavy brush</td><td>0.10</td></tr></table>	Steep, bare rock and also city pavements	0.90	Rock, steep but wooded	0.80	Plateaus, lightly covered	0.70	Clayey soils, stiff and bare	0.60	-do- lightly covered	0.50	Loam, lightly cultivated or covered	0.40	-do- largely cultivated	0.30	Sandy soil, light growth	0.20	-do- covered, heavy brush	0.10	In the vicinity of Bridge site Fig 4.3 IRC:SP-13-2022 Flood Estimation report Table 4.1 IRC:SP-13-2022 (IRC:78-2014 CL. No.703.2.2.1)
Steep, bare rock and also city pavements	0.90																			
Rock, steep but wooded	0.80																			
Plateaus, lightly covered	0.70																			
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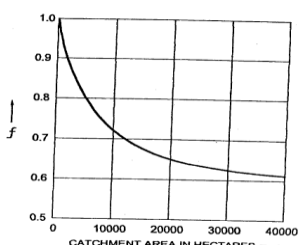
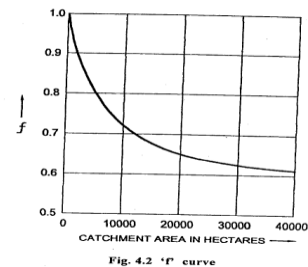


Fig. 4.2 'f' curve

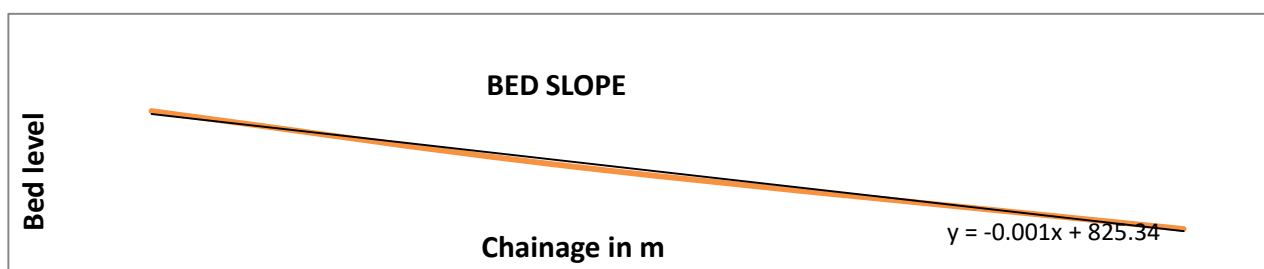


Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Bed Slope / Longitudinal Slope of River/ stream

S. No.	length	LBL
1	-250.64	825.596
2	0.00	825.320
3	348.63	825.021

Bed slope = 0.00586886 - ve sign indicate Down Ward Slope



1 Description

Name and Number of Subzone	=	Krishna & Pennar subzone (3h)		
Name of Site	=			
Name of Place	=			
Name of Stream	=	Hemavati River		
Shape of the Catchment	=	Leaf		
Topography	=	Moderate Steep Slope	Latitude	12.804655
			Longitude	76.212083

2 Design data

Catchment Area	(A) =	49.07	sqkm	from Toposheet
Length of Longest Stream	(L) =	22.83	km	from Toposheet
Length of Longest Stream from cg to site	(L _c) =	7.61	km	
Unit Duration of Unitgraph	(t _u) =	1.00	hr	
Loss Rate	=	1.00	mm/hr	(Para 3.7) from central water comissi

3 Computation of Equivalent Stream Slope (S)

Sl. No.	Reduced distance	Reduced levels	L_i	D_i	$D_{i-1} + D_i$	$L_i(D_{i-1} + D_i)$
	(kms)	(m)	(kms)	(m)	(m)	(mxkm)
1	2	3	4	5	6	7
1	0.000	826	0.000	0		0.00
2	1.250	855	1.250	29	29.49	36.86
3	2.500	863	1.250	37	66.97	83.71
4	3.750	863	1.250	37	74.97	93.71
5	5.000	863	1.250	37	74.97	93.71
6	6.250	863	1.250	37	74.97	93.71
7	7.500	863	1.250	37	74.97	93.71
8	8.750	863	1.250	37	74.97	93.71
9	10.000	863	1.250	37	74.97	93.71
10	11.250	867	1.250	41	78.97	98.71
11	12.500	868	1.250	42	83.97	104.96
12	13.750	868	1.250	42	84.97	106.21
13	15.000	865	1.250	39	81.97	102.46
14	16.250	876	1.250	50	89.97	112.46
15	17.500	870	1.250	44	94.97	118.71
16	18.750	873	1.250	47	91.97	114.96
17	20.000	874	1.250	48	95.97	119.96
18	21.250	879	1.250	53	101.97	127.46
19	22.500	885	1.250	59	112.97	141.21
20	22.830	900	0.330	74	133.97	44.21
			x		Sum	1874.18

$$\text{Slope (S)} = S \frac{\text{Li}(\text{Di-1} + \text{Di})}{\text{I}_c^2} = 3.60 \text{ m/km}$$

4 Determination of Synthetic 1-hr Unitgraph Parameters

tr	=	1.0 hr	
Unit rain fall duration in hrs.			
$t_p = 0.325(L_c/S^{0.5})^{0.447}$		2.448 hrs	2.50 say
Time lag from center of unit rainfall duration to Peak of unit hydrograph in hrs.			
$q_p = 0.996/(t_p)^{0.492}$	=	0.635 cumec/sqkm	
Peak discharge of unit hydrograph per unit area per sq.km. in cumecs			
$W_{50} = 2.389(q_p)^{-1.065}$	=	3.88 hrs	
Width of UH at 50% of peak discharge (Qp) in hrs.			
$W_{75} = 1.415(q_p)^{-1.067}$	=	2.30 hrs	
Width of UH at 75% of peak discharge (Qp) in hrs.			
$W_{R50} = 0.753(q_p)^{-1.229}$	=	1.32 hrs	
Width of UH at 50% of Qp bet. Raign limb and Qp ordinate in hrs.			
$W_{R75} = 0.558(q_p)^{-1.088}$	=	0.92 hrs	
Width of UH at 75% of Qp bet. Raign limb and Qp ordinate in hrs.			

$$T_B = 7.392(t_p)0.524$$

$$= 11.98 \text{ hrs}$$

12.00 say

Base Period of UH in hrs.

$$t_m = t_p + t_r/2$$

$$= 3.00 \text{ hrs}$$

Time from start of raising limb to peak of UH in hrs.

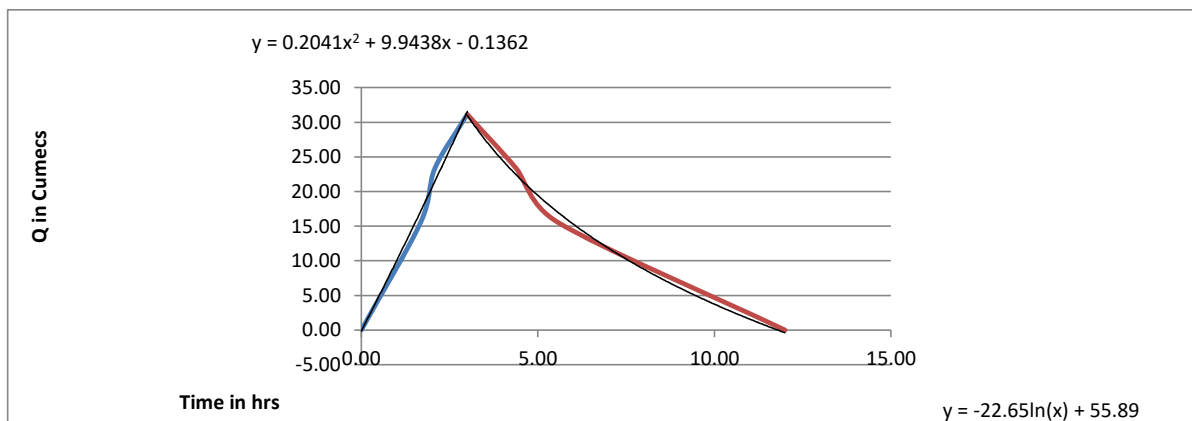
$$Q_p = q_p \times A$$

$$= 31.14 \text{ cumec}$$

Peak discharge of unit hydrograph in hrs.

UG Ordinates from above formulae

X-value		Y-value	
0	0.00	0	0.00
$t_m - W_{R50}$	1.68	$Q_p * 0.5$	15.57
$t_m - W_{R75}$	2.08	$Q_p * 0.75$	23.35
t_m	3.00	$Q_p * 1.0$	31.14
$t_m + W_{75} - W_{R75}$	4.38	$Q_p * 0.75$	23.35
$t_m + W_{50} - W_{R50}$	5.56	$Q_p * 0.5$	15.57
T_B	12.00	0	0.00



UG Ordinates from graph(from equation for rising and recession limb)

Abcissa	values from the first equation	values from the Second equation	Adjusted values
0.00	0.00		0.00
0.50	4.89		4.89
0.80	7.95		7.95
1.60	16.30		16.30
2.97	31.20	31.23	31.20
3.70		26.26	26.26
4.50		21.82	21.82
6.50		13.49	13.49
8.00		8.79	8.79
10.00		3.74	3.74
11.00		1.58	1.58
11.79		0.00	0.00

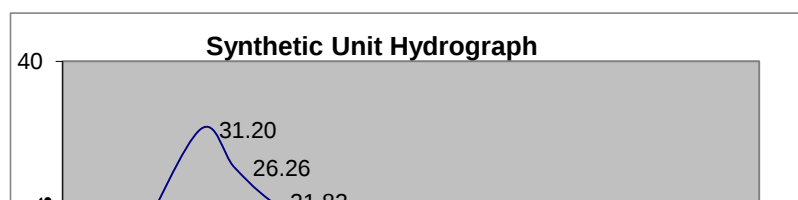
Total 136.01

Depth (d) = 1.00

$$S Q_i = (A * D) / (0.36 * tr) = 136.01$$

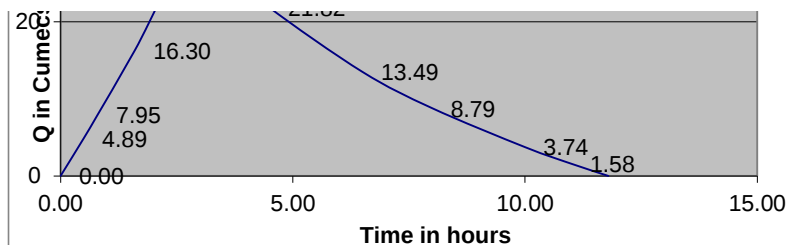
5 UG Ordinates from graph

Time in hours	Adjusted values
0.00	0.00
0.50	4.89
0.80	7.95
1.60	16.30
2.97	31.20
3.70	26.26



4.50	21.82
6.50	13.49
8.00	8.79
10.00	3.74
11.00	1.58
11.79	0.00

Total 136.01



6 Design Storm Duration

Design Storm Duration (T_D) = $1.1 \times t_p$ = 1.1×2.5 = **3.00** say

As per the section 5.2

7 Design Storm Rainfall

50 year-24hour Point rainfall = 20 cm from isopluvial maps Plate 9 P 72
 Conversion factor for T_D -hour i.e. 3.00 = 1 from Fig.10

Duration (t) In Hours	Conversion Ratio	25 - Year t - Hour Rainfall
		25 - Year 24 Hour Rainfall
1		0.44
3		0.63
6		0.72
9		0.79
12		0.84
15		0.89
18		0.93
24		1.00

∴ 50 Year T_D - Hour Point Rainfall = 20 cm

8 Storm Areal Rainfall

From Figure 12a, Page No. 93

Areal reduction factor corresponding to storm duration T_D i.e hours 3.0 and C.A of sq.km 49.067 = 0.7000

∴ 50 year T_D hour Areal Rainfall = 14.000 cm

9 Time Distribution of input storm from fig. 11 of CWC Publication for sub zone 3(h) and hourly effective rainfall increments

Time	Distribution coefficient from Annexure -(4.3) or Figure-11	Storm rainfall in Cm	Rainfall increments in cm	Loss rate/ hour (in cm)	Effective hourly rain fall
1	2	3	4	5	6
1.00	0.620	8.680	8.680	0.100	8.58
2.00	0.810	11.340	2.660	0.100	2.56
3.00	0.910	12.740	1.400	0.100	1.30
4.00	0.970	13.580	0.840	0.100	0.74
5.00	1.000	14.000	0.420	0.100	0.32

Design Base flow = 0.05 Para 3.8 Page No. 19

Total Base flow for C.A = 0.050×49.07 = 2.453 Cumecs

10 50 year flood peak

Time in hours	SUG ordinates	Rainfall Excess ordinates Arrangement	Direct runoff		
0.80	7.95	0.32	2.544		
1.60	16.30	0.74	12.059		
2.97	31.20	8.58	267.672		
3.70	26.26	2.56	67.216		
4.50	21.82	1.30	28.369		

	Total	377.86	cumecs.
	Base flow	2.45	cumecs.
	Peak dischare	380.31	cumecs.
Add u/s Hemavathy Dam, Gaorur Discharge		4740.20	cumecs.
		<u>5120.514</u>	cumecs.

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Flood Estimation by Area-Velocity Method

Cross section at 250.64

m U/S

IRC SP 13-2022(Table 3.1)

H.F.L = 832.367 m

L.B.L = 825.596 m

Bed slope So = 0.00587

Spread length = 108.73 m

Rugosity coefficient, n =

0.0350

IRC SP 13-2022 (Table 5.1)

S.No.	H.F.L	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	832.367	0.0	830.210	2.157	0.000	0.000	0.000	0.000
2	832.367	2.0	830.208	2.159	0.000	0.000	0.000	0.000
3	832.367	3.9	830.546	1.821	0.000	0.000	0.000	0.000
4	832.367	5.7	830.405	1.962	1.892	1.751	3.312	1.757
5	832.367	7.3	828.246	4.121	3.041	1.631	4.960	2.705
6	832.367	18.2	827.860	4.507	4.314	10.840	46.764	10.847
7	832.367	27.1	827.863	4.504	4.506	8.946	40.311	8.946
8	832.367	34.3	827.651	4.716	4.610	7.183	33.116	7.186
9	832.367	40.6	827.393	4.974	4.845	6.274	30.399	6.280
10	832.367	51.6	827.030	5.337	5.155	10.994	56.679	11.000
11	832.367	60.1	826.744	5.623	5.480	8.536	46.780	8.541
12	832.367	69.3	826.541	5.826	5.724	9.172	52.507	9.175
13	832.367	77.6	826.327	6.040	5.933	8.278	49.117	8.281
14	832.367	85.8	826.013	6.354	6.197	8.293	51.395	8.299
15	832.367	93.6	825.817	6.550	6.452	7.721	49.815	7.723
16	832.367	100.6	825.596	6.771	6.660	7.009	46.679	7.012
17	832.367	107.0	825.817	6.550	6.660	6.423	42.777	6.426
18	832.367	112.7	826.144	6.223	6.387	5.680	36.273	5.689
19	832.367	118.6	826.526	5.841	6.032	5.908	35.636	5.920
20	832.367	124.8	826.838	5.529	5.685	6.222	35.374	6.230
21	832.367	132.4	827.141	5.226	5.378	7.591	40.824	7.597
22	832.367	138.3	827.407	4.960	5.093	5.868	29.886	5.874
23	832.367	147.9	833.355	0.000	2.480	9.616	23.848	10.820
24	832.367	159.6	836.725	0.000	0.000	0.000	0.000	0.000
25	832.367	165.5	836.905	0.000	0.000	0.000	0.000	0.000
26	832.367	171.4	836.923	0.000	0.000	0.000	0.000	0.000
27	832.367	177.3	836.918	0.000	0.000	0.000	0.000	0.000
28	832.367	186.2	837.052	0.000	0.000	0.000	0.000	0.000
29	832.367	194.0	839.065	0.000	0.000	0.000	0.000	0.000
30	832.367	199.9	838.830	0.000	0.000	0.000	0.000	0.000
31	832.367	206.3	838.860	0.000	0.000	0.000	0.000	0.000
32	832.367	210.6	838.896	0.000	0.000	0.000	0.000	0.000
33	832.367	216.3	837.348	0.000	0.000	0.000	0.000	0.000
34	832.367	226.7	836.341	0.000	0.000	0.000	0.000	0.000
35	832.367	232.6	837.345	0.000	0.000	0.000	0.000	0.000
36	832.367	237.6	839.468	0.000	0.000	0.000	0.000	0.000
37	832.367	243.0	839.495	0.000	0.000	0.000	0.000	0.000
38	832.367	248.1	839.525	0.000	0.000	0.000	0.000	0.000
39	832.367	252.8	839.488	0.000	0.000	0.000	0.000	0.000

Total (Cross sectional Area, A) = 756.454 sq. m

Wetted Perimeter, R in m = 146.310

Abbreviations

H.F.L. - High Flood Level

Ref:-(IRC SP-13.2014 cl.no.-(5.4))

Hydraulic Radius, R = A / P = 5.17 m

Velocity, V = $1 \left(\frac{2}{3} \right) \left(\frac{1}{2} \right)$

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Flood Estimation by Area-Velocity Method

Cross section at 250.64 m U/S

$$\left[\frac{R^{2/3}}{n} \right] \times V =$$

$$= 5.17^{(2/3)} \times (0.00587^{0.5}) / 0.035$$

$$= 6.55 \text{ m/sec}$$

Discharge, Q = A*V

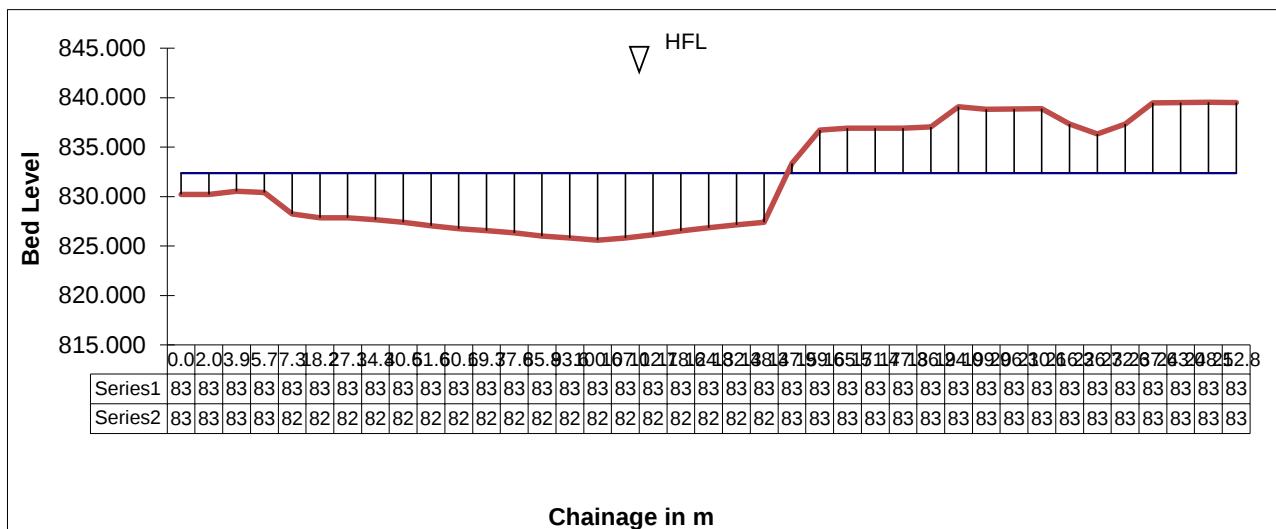
$$= 756.454 \times 6.545 = 4950.99 \text{ cumecs}$$

D.O.F. - Depth Of Flow

A.D.O.F.- Average Depth Of Flow

W.P. - Wetted Perimeter

L.B.L. - Lowest Bed Level



Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Flood Estimation by Area-Velocity Method

Cross section at **Site of crossing** 0.0 METER

H.F.L = 833.067 m L.B.L = 825.320 m

Bed slope So = 0.00587 Spread length = 164.36 m

Rugosity coefficient, n = **0.0350** IRC SP 13-2022 (Table 5.1)

S.No.	H.F.L	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	833.067	0.0	835.410	0.000	0.000	0.000	0.000	0.000
2	833.067	10.0	834.361	0.000	0.000	0.000	0.000	0.000
3	833.067	20.0	834.001	0.000	0.000	0.000	0.000	0.000
4	833.067	30.1	833.997	0.000	0.000	0.000	0.000	0.000
5	833.067	40.1	833.659	0.000	0.000	0.000	0.000	0.000
6	833.067	43.8	833.620	0.000	0.000	0.000	0.000	0.000
7	833.067	46.2	832.964	0.103	0.051	2.321	0.119	2.323
8	833.067	49.3	832.933	0.134	0.119	3.154	0.374	3.154
9	833.067	54.2	832.046	1.021	0.578	4.850	2.801	4.930
10	833.067	57.8	832.054	1.013	1.017	3.626	3.687	3.626
11	833.067	61.5	830.927	2.140	1.576	3.692	5.819	3.860
12	833.067	67.1	830.698	2.369	2.254	5.590	12.602	5.595
13	833.067	77.2	830.899	2.168	2.268	10.130	22.980	10.132
14	833.067	92.0	827.759	5.308	3.738	14.752	55.142	15.083
15	833.067	104.1	827.627	5.440	5.374	12.124	65.151	12.125
16	833.067	112.5	827.210	5.857	5.648	8.394	47.410	8.404
17	833.067	122.3	826.762	6.305	6.081	9.775	59.439	9.785
18	833.067	131.0	826.336	6.731	6.518	8.717	56.820	8.727
19	833.067	139.9	825.951	7.116	6.924	8.893	61.571	8.901
20	833.067	149.1	825.515	7.552	7.334	9.283	68.082	9.293
21	833.067	152.8	825.320	7.747	7.650	3.624	27.723	3.629
22	833.067	158.2	825.612	7.455	7.601	5.424	41.230	5.432
23	833.067	165.8	826.031	7.036	7.246	7.604	55.100	7.616
24	833.067	171.9	826.356	6.711	6.874	6.143	42.227	6.152
25	833.067	178.3	826.726	6.341	6.526	6.326	41.282	6.337
26	833.067	187.1	827.108	5.959	6.150	8.797	54.103	8.806
27	833.067	193.1	827.477	5.590	5.775	6.007	34.689	6.018
28	833.067	208.2	831.678	1.389	3.490	15.134	52.816	15.707
29	833.067	218.3	835.368	0.000	0.695	0.000	0.000	0.000
30	833.067	228.3	836.147	0.000	0.000	0.000	0.000	0.000
31	833.067	238.3	837.215	0.000	0.000	0.000	0.000	0.000
32	833.067	245.2	837.454	0.000	0.000	0.000	0.000	0.000
33	833.067	249.0	837.367	0.000	0.000	0.000	0.000	0.000
34	833.067	259.0	837.385	0.000	0.000	0.000	0.000	0.000
35	833.067	269.0	838.339	0.000	0.000	0.000	0.000	0.000
36	833.067	278.3	838.786	0.000	0.000	0.000	0.000	0.000
37	833.067	280.4	838.758	0.000	0.000	0.000	0.000	0.000
38	833.067	284.3	838.958	0.000	0.000	0.000	0.000	0.000
39	833.067	286.1	837.304	0.000	0.000	0.000	0.000	0.000
40	833.067	298.8	837.303	0.000	0.000	0.000	0.000	0.000
41	833.067	301.4	838.480	0.000	0.000	0.000	0.000	0.000
42	833.067	303.7	838.235	0.000	0.000	0.000	0.000	0.000

Total (Cross sectional Area, A) = 811.170 sq. m

Wetted Perimeter, R in m = 165.635

Abbreviations

H.F.L. - High Flood Level

Ref:-(IRC SP-13.2014 cl.no.-(5.4))

Hydraulic Radius, $R = A / P = 4.897 \text{ m}$
 Velocity, V = $\left[\frac{1}{49} \left(R^{\frac{2}{3}} \times V^{\frac{1}{2}} \right) \right]$

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Flood Estimation by Area-Velocity Method

Cross section at **Site of crossing** 0.0 METER

$$\frac{1}{n} \left(\mathbf{1}^T \mathbf{A} \mathbf{v} \right)$$

$$= 4.8973^{(2/3)} \times (0.005869^{0.5}) / 0.035$$

$$= 6.31 \text{ m/sec}$$

D.O.F. - Depth Of Flow

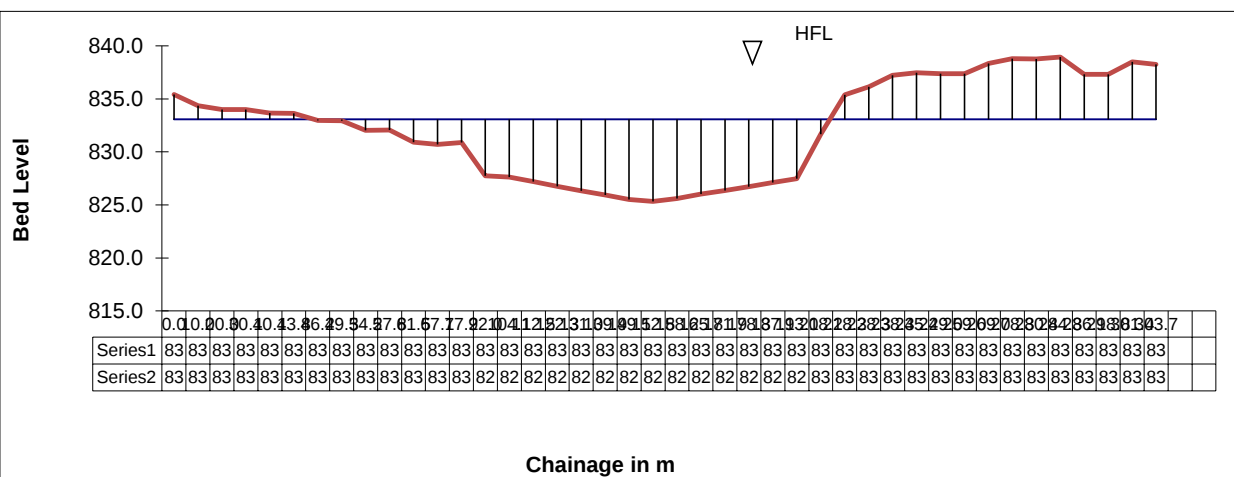
A.D.O.F.- Average Depth Of Flow

W.P. - Wetted Perimeter

L.B.L. - Lowest Bed Level

$$\text{Discharge, } Q = A \cdot V$$

$$= 811.17 \times 6.312 = 5120.105 \text{ cumecs}$$



Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Flood Estimation by Area-Velocity Method

Cross section at 348.63

m D/S

IRC SP 13-2022 (Table 3.1)

H.F.L. = 833.067 m

L.B.L. = 825.021 m

Bed slope So = 0.00587

Spread length = 142.62 m

Rugosity coefficient, n =

0.0350

IRC SP 13-2022 (Table 5.1)

S.No.	H.F.L	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	833.067	0	833.2133	0.000	0.000	0.000	0.00	0.000
2	833.067	4.092	832.2462	0.821	0.410	4.092	1.68	4.173
3	833.067	7.967	831.4175	1.649	1.235	3.875	4.79	3.963
4	833.067	11.841	831.79	1.277	1.463	3.874	5.67	3.892
5	833.067	15.716	830.8724	2.195	1.736	3.875	6.73	3.982
6	833.067	19.983	829.6698	3.397	2.796	4.267	11.93	4.433
7	833.067	27.925	827.4753	5.592	4.494	7.942	35.69	8.239
8	833.067	35.345	827.104	5.963	5.777	7.421	42.87	7.430
9	833.067	42.889	826.7832	6.284	6.123	7.544	46.20	7.551
10	833.067	49.377	826.5306	6.536	6.410	6.488	41.59	6.493
11	833.067	55.549	826.234	6.833	6.685	6.171	41.25	6.179
12	833.067	61.362	825.9397	7.127	6.980	5.813	40.57	5.820
13	833.067	67.665	825.6375	7.429	7.278	6.303	45.88	6.310
14	833.067	74.150	825.3174	7.750	7.590	6.485	49.22	6.493
15	833.067	78.682	825.0213	8.046	7.898	4.532	35.79	4.541
16	833.067	85.303	825.4345	7.632	7.839	6.622	51.91	6.635
17	833.067	94.612	825.859	7.208	7.420	9.308	69.07	9.318
18	833.067	102.247	826.1876	6.879	7.044	7.635	53.78	7.642
19	833.067	109.920	826.5207	6.546	6.713	7.673	51.51	7.680
20	833.067	116.546	826.8925	6.174	6.360	6.626	42.15	6.637
21	833.067	122.438	827.2183	5.849	6.012	5.892	35.42	5.901
22	833.067	128.290	827.5866	5.480	5.665	5.852	33.15	5.864
23	833.067	134.925	827.968	5.099	5.290	6.635	35.10	6.646
24	833.067	142.617	833.2173	0.000	2.549	7.692	19.61	9.229
25	833.067	150.350	836.5838	0.000	0.000	0.000	0.00	0.000
26	833.067	156.250	836.6157	0.000	0.000	0.000	0.00	0.000
27	833.067	162.133	836.6556	0.000	0.000	0.000	0.00	0.000
28	833.067	168.015	836.6718	0.000	0.000	0.000	0.00	0.000
29	833.067	173.898	836.6733	0.000	0.000	0.000	0.00	0.000
30	833.067	179.780	837.8109	0.000	0.000	0.000	0.00	0.000
31	833.067	185.663	838.9804	0.000	0.000	0.000	0.00	0.000
32	833.067	191.289	839.0427	0.000	0.000	0.000	0.00	0.000
33	833.067	197.491	839.0588	0.000	0.000	0.000	0.00	0.000
34	833.067	201.694	838.9965	0.000	0.000	0.000	0.00	0.000
35	833.067	207.844	838.872	0.000	0.000	0.000	0.00	0.000
36	833.067	211.323	837.2715	0.000	0.000	0.000	0.00	0.000
37	833.067	218.510	836.0695	0.000	0.000	0.000	0.00	0.000
38	833.067	224.947	837.2427	0.000	0.000	0.000	0.00	0.000
39	833.067	226.436	838.7031	0.000	0.000	0.000	0.00	0.000
40	833.067	231.914	838.5855	0.000	0.000	0.000	0.00	0.000
41	833.067	235.120	838.4805	0.000	0.000	0.000	0.00	0.000
42	833.067	239.346	838.41	0.000	0.000	0.000	0.00	0.000
43	833.067	240.837	838.4022	0.000	0.000	0.000	0.00	0.000
44	833.067	244.758	837.8805	0.000	0.000	0.000	0.00	0.000
45	833.067	246.720	837.8222	0.000	0.000	0.000	0.00	0.000

Total (Cross sectional Area, A) = 801.544 sq. m

Wetted Perimeter, R in m = 145.051

Abbreviations

Hydraulic Radius, $R = A / P = 5.526 \text{ m}$

H.F.L. - High Flood Level

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

Flood Estimation by Area-Velocity Method

Velocity, V =

$$\frac{1}{n} \left(R^{\frac{2}{3}} \times V^{\frac{1}{2}} \right)$$

$$= 5.526^{(2/3)} \times (0.00587^{0.5})/0.035)$$

$$= 6.84 \text{ m/sec}$$

Discharge, $Q =$

$$A^*V$$

$$= 801.544 \times 6.842 = 5484.16 \text{ cumecs}$$

Cross section at **348.63** m D/S

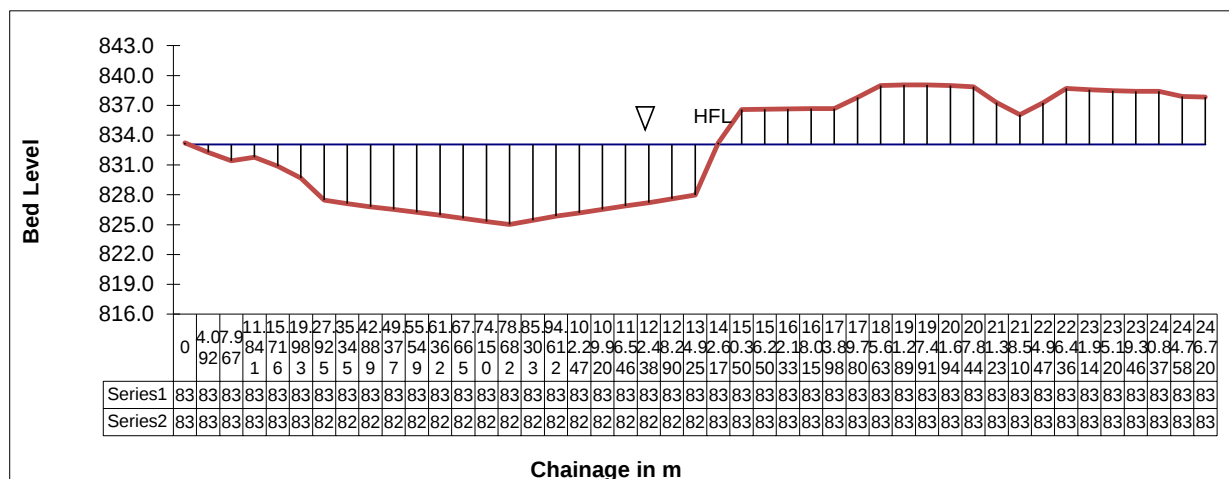
Ref:- (IRC SP-13.2014 cl.no.-(5.4))

D.O.F. - Depth Of Flow

A.D.O.F.- Average Depth Of Flow

W.P. - Wetted Perimeter

L.B.L. - Lowest Bed Level



1 Afflux Calculations

By Molesworth formula

(IRC:5-2015 CL. No.106.6.2)

$$\text{Afflux} = \left[\frac{V^2}{17.89} + 0.015 \right] \times \left[\left(\frac{Au}{Ae} \right)^2 - 1 \right]$$

$$\text{Afflux } a = ((6.32^2)/17.89) + 0.015 \times ((811.17/1217.83)^2 - 1)$$

Velocity, V =	6.31 m/sec
Unobstructed area, Au =	811.17 m ²
Effective vent area, Ae =	264 x 4.613
	1217.83 m ²
Afflux a =	0.15 m

2 **SELECTING DESIGN DISCHARGE:-**

a) Discharge by Emperical Formula	259.55 m ³ /s
b) Discharge by Ryve's Formula	134.0 m ³ /s
c) Discharge by Rational Method (Runoff Method)	672.09 m ³ /s
c) Discharge by SUH	5120.51 m ³ /s
d) Discharge by Area velocity	
(a) At U/s Side-	4950.99 m ³ /s
(b) At Site of crossing-	5120.11 m ³ /s
(c) At D/s Side-	5484.16 m ³ /s

e) SUH Snow melt Method

First highest	5120.51 Cumec
Second highest	5120.11 Cumec
1.5 times of the IInd highest	7680.16 Cumec

Selection Criteria for Design Discharge

- a) If the 1st highest > 1.5 x 2nd highest, **select design discharge as 1.5 x 2nd highest**
 b) If 1st highest < 1.5 x 2nd highest, **select design discharge as 1st highest.**

Hence the Adopted Design discharge (Q) = 5120.51 Cumec

3 Linear Water Way:

Velocity of river (V) =	6.31 m/s
HFL =	833.067 m
Lowest Bed level =	825.320 m
Mean Depth of water (H) =	4.613 m
Afflux =	0.15 m
Velocity of approach through opening (V') = VxH/(H+a)	6.11 m/s
Head due to velocity of approach = V ² / 2g	1.90 m
Total head =	2.05 m
Velocity through vent =	6.35 m/s
Required Linear water way =	$\frac{Q}{(H \times V)}$
	= 5120.51 / (6.32 x (0+0.15))
	= 170.32 m

Linear Water Way =
$$4.5 \times \sqrt{Q}$$
 = 4.5 x 5120.51 ^0.5

FROM (IRC:5-2015 CL. No.106.5.1.2 Page 21) = 322.01 m

Proposed vent way $= 7 \times 40 - (7-1) \times 3.6 - 0.5 \times 2$ = 264.00 m

3. Fixing of Soffit Level

HFL = 833.067 m

Vertical clearance (V_c) required = 1.50 m

Afflux = 0.15 m

Required Soffit Level = 834.717 m

Provided Soffit Level = 843.951 m

(As per Cl. No. 12.3 Table 12.1 of SP-13-2022)

4. Fixing of Formation Level of Bridge

Provided Span arrangement = 7 x 40.000 m

Provided Soffit Level = 843.951 m

Depth of Girder = 2.5 m

Depth of slab = 0.225 m

Wearing coat = 0.065 m

Difference in Level due to cross slope from FRL to Lowest Soffit level = 0.250 m

Minimum Formation Level to be Adopted = 837.757 m

Provided Formation Level = 846.991 m

Project: Construction of Bypass to the Holenarasipura Town from Km 87.280 (near Chikknahalli) to Km 97.580 (Near Hullahalli) on NH-373 in the State of Karnataka on EPC mode under NH(O) Annual Plan 2023-24

1 Scour Depth:

Mean Depth of Scour “dsm” in Mtr (below HFL)

$$dsm = 1.34(D_b^2/K_f)^{1/3} \quad \text{IRC 78 - 2014, cl.703.2}$$

Where, K_f = Silt Factor = 1.214

D_b = the Discharge in Cumecs per Meter Width

$$D_b = (Q + X\% \text{ of } Q)/L$$

X = 30% for catchment areas upto 3000 Sq Km

25 to 20% for catchment areas upto 3000 Sq Km to 10000 Sq Km

20 to 10% for catchment areas upto 10000 Sq Km to 40000 Sq Km

Less than 10% for catchment areas above 40000 Sq Km

Design discharge	5120.5	m ³ /s
Design discharge for foundation	5120.51	m ³ /s
Clear ventway	264.00	m
HFL	833.07	m
LBL	825.32	m

where, D_b = the discharge in cumecs per metre width.

K_{sf} = silt factor

D_b = Discharge in Cumec per meter width

$$D_b = (Q + X\% \text{ of } Q)/L = (5120.51 + 30\% \text{ of } 5120.51)/264 = \quad 23 \quad 20\% \text{ increase discharge}$$

X = 20% of design discharge IRC 78 - 2014 cl.No. 703.1.1

$K_{sf} = \quad 1.21 \quad$ Silt factor K_{sf} as per

$$dsm = 1.34 \times (23.275^2 / 1.214)^{1/3} = \quad 10.240 \quad \text{m below HFL}$$

Max. depth of scour for Piers =	2 x dsm =	20.480 m	IRC 78 - 2014
		Below HFL	cl. No.703.3.1.1
Max. depth of scour for Abutment =	1.27 x dsm =	13.005 m	IRC 78 - 2014
		Below HFL	of IRC 78 - 2014
Scour Level for Piers = 833.067 - 20.48		812.587 m	cl. No.703.3.1.1
Scour level for Abutments = 833.067 - 13.005		820.062 m	

FRL to Foundation Height = 41.23 m

Depth of Foundations, D_f

a) Erodible beds

$D_f = D_m + 1/3 D_m$ subject to condition that minimum $1/3 D_m$ is 2.00 m for open fdn./arched bridges and 1.20m for other bridges.

b) Hard Beds

$D_f = D_m + 0.6 D_m$ anchored into rock having ultimate crushing strength of 100 Kg/Cm² and above

$D_f = D_m + 1.5 D_m$ anchored into rock having ultimate crushing strength of 30-99 Kg/Cm² and above

Here, Considering the Hard Bed conditions

(i) For Abutment

So, $D_f = D_m + 1.5 D_m$ (1.5 Dm is minimum 1.5m inside hard Rock UCS > 1MPa)

$$D_f = D_m + 1.5 D_m = + 1.5 \times 32.512 \text{ Mtr}$$

Therefore, the proposed founding levels of abutment for erodible conditions as follows:-

Foundation level for Abutments	=	(833.066999947543 - 32.512)	0
	=	800.555 m	0
Foundation level for Abutments	=	(820.062 - 2)	IRC 78-2014
	=	818.062 m	cl.No.705.2.1
Adopt Foundation Level for Abutments	=	832.361 m	

NOTE:- Here is a Weather strata at this place, so the foundation is Placed 2.0 meter below the soft rock level

(ii) For Pier

So, $D_f = D_m + 1.5 D_m$ (1.5 Dm is minimum 1.5m inside hard Rock UCS > 1MPa)

$$D_f = D_m + 1.5 D_m = + 1/3 \times 51.2 \text{ Mtr}$$

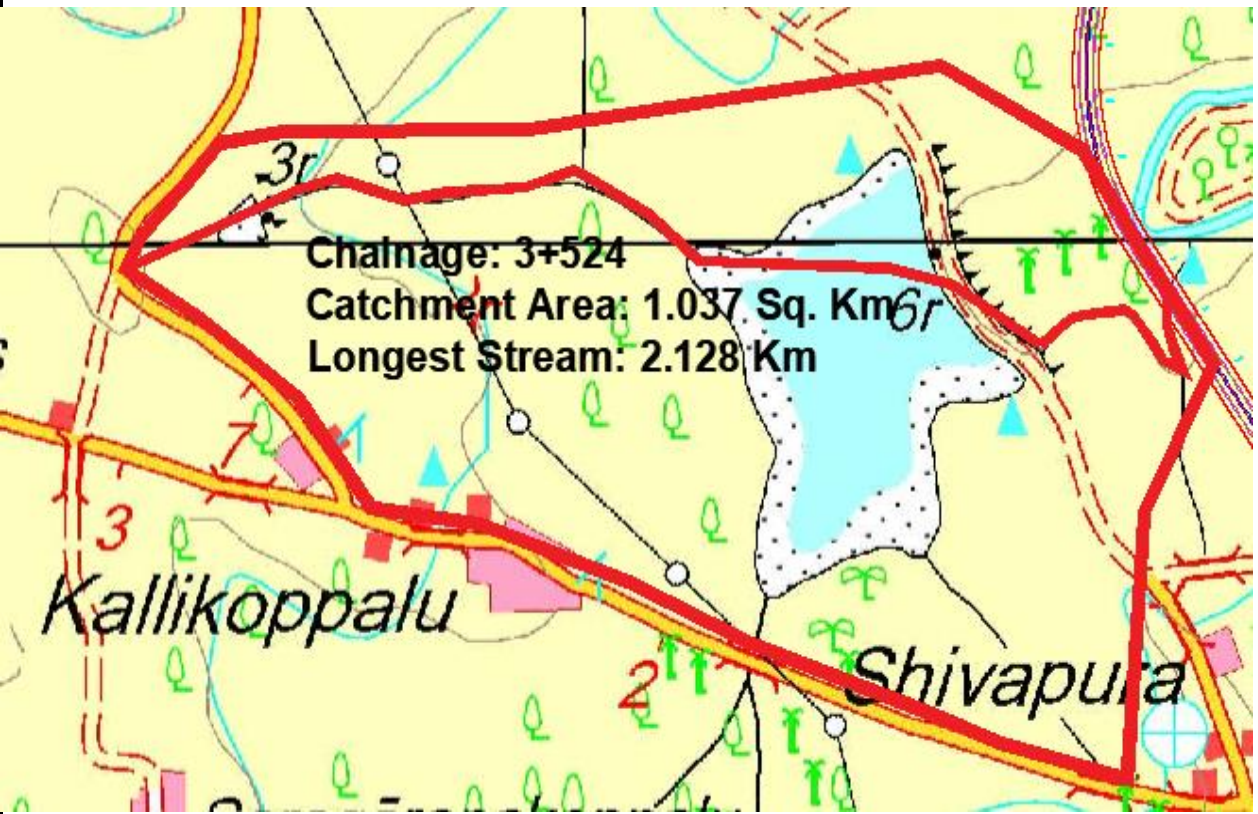
Therefore, the proposed founding levels of pier for erodible conditions as follows:-

Foundation Level for Piers	=	(833.066999947543 - 51.2)	
	=	781.867 m	
Foundation Level for Piers	=	(812.587 - 2)	IRC 78-2014
	=	810.587 m	cl.No.705.2.1
Adopt Foundation Level for Piers	=	823.820 m	

NOTE:- Here is a Weather rocky strata at this place, so the foundation is placed 1.5 below the soft rock level

**Project: Construction of Bypass to the Holenarasipura
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**Hydraulic calculation of minor Bridge at CH-
3+524 2X10X3.3**

SALIENT FEATURES OF THE STRUCTURE	
Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3	
CATCHMENT AREA	
	
a) Area description:	

<i>b) Nalla:</i>	Nala		
<i>c) Strata type</i>			
<i>d) CA Proposal:</i> Span arrangement Outer carriageway width Super-structure type Substructure			
<i>e) Design Proposal:</i> Span arrangement Outer carriageway width Type of structure Type of Foundation	2 X 10.0 X 3.1 2x 10.5 METER RCC BOX MNB RAFT		
<i>f) Geotech:</i>			
<i>g) Hydrology:</i> HFL Design Discharge	839.85 23.54	m cumec	

Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

	Design discharge				
1	Discharge By Emperical method	=	17.1	Cumecs	
	Percentage of Reduction (Due to Attenuation or Flood routng)	=	0%		
	Effective discharge by Emperical	=	17.05	Cumecs	
2	Discharge by Rational/SUH Method	=	23.54	Cumecs	
	Percentage of Reduction (Due to Attenuation or Flood routng)	=	0.00		
	Effective discharge by Rational / SUH	=	23.54	Cumecs	
3	Discharge by Area velocity Method				
	Discharge near Bridge Crossing	=	17.50	Cumecs	
	Average Discharge By Av Method	=	18.92	Cumecs	
	Discharge to be considered by AV Method (Max of Average or Discharge at Crossing)	=	18.92	Cumecs	
	Design Discharge				
	Maximum Discharge of Above Methods	=	23.54	Cumecs	
	Second Highest Discharge	=	23.54	Cumecs	
	50% increase in Second Highest discharge	=	35.31	Cumecs	
	Hence Design discharge	=	23.540	Cumecs	
	Design Discharge		=	23.540	Cumecs

Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

Abstract of Hydraulic Particulars

- * Discharge using Emperical formulae
- * Discharge using A - V method
- * Design Discharge
- * Modified HFL
- * Linear Water way and Afflux

Catchment area	1.301 sq. km
Existing	-
Proposed span arrangement	2 X 10.0 X 3.1 m (MNB) RCC BOX CULVERT
Design Discharge	23.54 Cumecs
Design Velocity	1.70 m/s
LBL	838.974 m
HFL	839.846 m
Afflux	0.150 m
Vertical Clearance	0.600 m
Soffit Level	842.819 m
Existing FRL	- m
Proposed FRL	843.734 m
Scour level of bridge	838.415 m
Invert level of bridge	838.824 m
Level of bottom slab top	838.823 m
foundation level for bridge	838.823 m
Foundation level for Retaining Wall	836.824 m

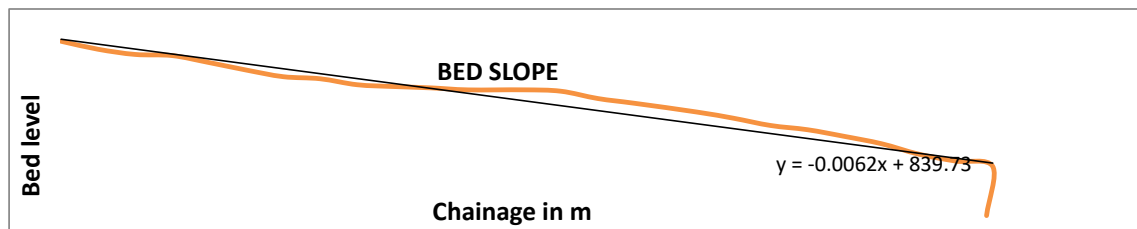
Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3	
	Flood Estimation Catchment area, A = 1.301 sq. km I Emperical formula Dicken's formula Discharge, $Q = C \times A^{(3/4)}$ Constant, C = 14 Discharge, Q = 17.05 Cumecs
II	Rational formula $Q = 0.028 \times A \times P \times I_c \times f$ Catchment Area = 130 hectares L = Distance from critical point to bridge in Km. = 2.13 Km. H= Fall in level from the critical point to the bridge = 10 m Time of concentration, t_c= 0.93 hrs. Co-efficient of runoff, P = 0.60 Spread fraction, f = 1.00 Max. Daily Rainfall, F = 20.00 cm/day 1 hr rain fall intensity 10.42 cm/hr. Conveyance Factor, k = 0.017 Discharge, Q = 23.54 Cumecs

Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

Bed Slope / Longitudinal Slope of River/ stream

S. No.	length	LBL
1	0	839.703
2	12.00	839.583
3	24.00	839.505
4	36.00	839.488
5	48.00	839.383
6	60.00	839.271
7	72.00	839.171
8	84.00	839.140
9	96.00	839.050
10	108.00	839.023
11	120.00	839.003
12	132.00	838.973
13	150.00	838.974
14	162.00	838.953
15	174.00	838.843
16	186.00	838.771
17	206.00	838.641
18	218.00	838.547
19	230.00	838.438
20	242.00	838.375
21	254.00	838.274
22	266.00	838.164
23	278.00	838.008
24	290.00	837.904
25	302.00	837.823
26	300.00	837.086

Bed slope = 0.0087 - ve sign indicate Down Ward Slope



Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

Flood Estimation by Area-Velocity Method

Cross section at 150.00 m U/S

IRC SP 13-2014(Table 3.12)

H.F.L = 840.546 m L.B.L = 839.703 m

Bed slope So = 0.00873 Spread length = 17.78 m

Rugosity coefficient, n = 0.035 IRC SP 13-2014 (Table 5.1)

S.No.	H.F.L	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	840.546	10.0	840.373	0.173	0.000	0.000	0.000	0.000
2	840.546	8.9	840.355	0.191	0.182	1.111	0.202	1.111
3	840.546	7.8	840.326	0.220	0.205	1.111	0.228	1.111
4	840.546	6.7	840.239	0.307	0.263	1.111	0.293	1.115
5	840.546	5.6	840.201	0.345	0.326	1.111	0.362	1.112
6	840.546	4.4	840.155	0.391	0.368	1.111	0.409	1.112
7	840.546	3.3	840.055	0.491	0.441	1.111	0.490	1.116
8	840.546	2.2	839.918	0.628	0.559	1.111	0.621	1.120
9	840.546	1.1	839.828	0.718	0.673	1.111	0.748	1.115
10	840.546	0.0	839.703	0.843	0.780	1.111	0.867	1.118
11	840.546	1.1	839.755	0.791	0.817	1.111	0.907	1.112
12	840.546	2.2	839.828	0.718	0.754	1.111	0.838	1.114
13	840.546	3.3	839.918	0.628	0.673	1.111	0.748	1.115
14	840.546	4.4	839.955	0.591	0.609	1.111	0.677	1.112
15	840.546	5.6	840.055	0.491	0.541	1.111	0.601	1.116
16	840.546	6.7	840.224	0.322	0.406	1.111	0.451	1.124
17	840.546	7.8	840.918	0.000	0.161	1.111	0.179	1.157
18	840.546	8.9	841.355	0.000	0.000	0.000	0.000	0.000
19	840.546	10.0	841.299	0.000	0.000	0.000	0.000	0.000

Total (Cross sectional Area, A) = 8.620 sq. m

Wetted Perimeter, R in m = 17.878

Abbreviations

H.F.L. - High Flood Level

Ref:- (IRC SP-13.2014 cl.no.-(5.4))

D.O.F. - Depth Of Flow

A.D.O.F.- Average Depth Of Flow

W.P. - Wetted Perimeter

L.B.L. - Lowest Bed Level

Hydraulic Radius, R = A / P = 0.482 m

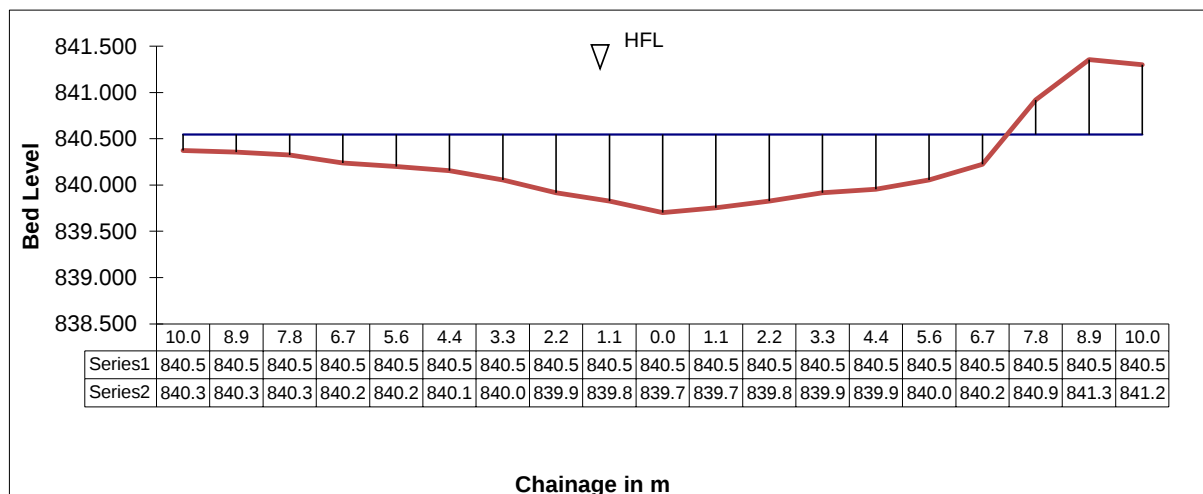
$$\text{Velocity, V} = \frac{1}{n} \left(R^{\frac{2}{3}} \times S^{\frac{1}{2}} \right)$$

$$= 0.482^{(2/3)} \times (0.00873^{0.5}) / 0.035$$

$$= 1.64 \text{ m/sec}$$

Discharge, Q = A*V

$$= 8.62 \times 1.6411 = 14.146 \text{ cumecs}$$



Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

Flood Estimation by Area-Velocity Method

H.F.L. = 839.846 m L.B.L. = 838.974 m

Bed slope S_o = 0.00870 Spread length = 20.00 m

Rugosity coefficient, n = **0.0350** IRC SP 13-2014 (Table 5.1)

Cross section at Site of crossing

S.No.	H.F.L.	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	839.846	10.0	839.738	0.108	0.108	0.000	0.000	0.000
2	839.846	8.9	839.728	0.118	0.113	1.111	0.126	1.111
3	839.846	7.8	839.680	0.166	0.142	1.111	0.158	1.112
4	839.846	6.7	839.653	0.193	0.179	1.111	0.199	1.111
5	839.846	5.6	839.551	0.295	0.244	1.111	0.271	1.116
6	839.846	4.4	839.382	0.464	0.379	1.111	0.422	1.124
7	839.846	3.3	839.355	0.491	0.477	1.111	0.530	1.111
8	839.846	2.2	839.155	0.691	0.591	1.111	0.657	1.129
9	839.846	1.1	839.030	0.816	0.753	1.111	0.837	1.118
10	839.846	0.0	838.974	0.872	0.844	1.111	0.938	1.113
11	839.846	1.1	839.082	0.764	0.818	1.111	0.909	1.116
12	839.846	2.2	839.082	0.764	0.764	1.111	0.849	1.111
13	839.846	3.3	839.155	0.691	0.727	1.111	0.808	1.114
14	839.846	4.4	839.245	0.601	0.646	1.111	0.718	1.115
15	839.846	5.6	839.282	0.564	0.582	1.111	0.647	1.112
16	839.846	6.7	839.343	0.503	0.534	1.111	0.593	1.113
17	839.846	7.8	839.350	0.496	0.500	1.111	0.555	1.111
18	839.846	8.9	839.379	0.467	0.482	1.111	0.535	1.111
19	839.846	10.0	839.392	0.454	0.461	1.111	0.512	1.111

839.345

2.380

Total (Cross sectional Area, A) = 10.264

sq. m

Wetted Perimeter, R in m = 20.059

Abbreviations

Hydraulic Radius, $R = A / P = 0.512$ m

Velocity, $V = \frac{1}{n} \left(R^{\frac{2}{3}} \times S^{\frac{1}{2}} \right)$

= $0.5117^{(2/3)} \times (0.0087^{0.5}) / 0.035$

= 1.70 m/sec

Discharge, $Q = A \times V$

= $10.264 \times 1.7049 = 17.50$ cumecs

H.F.L. - High Flood Level

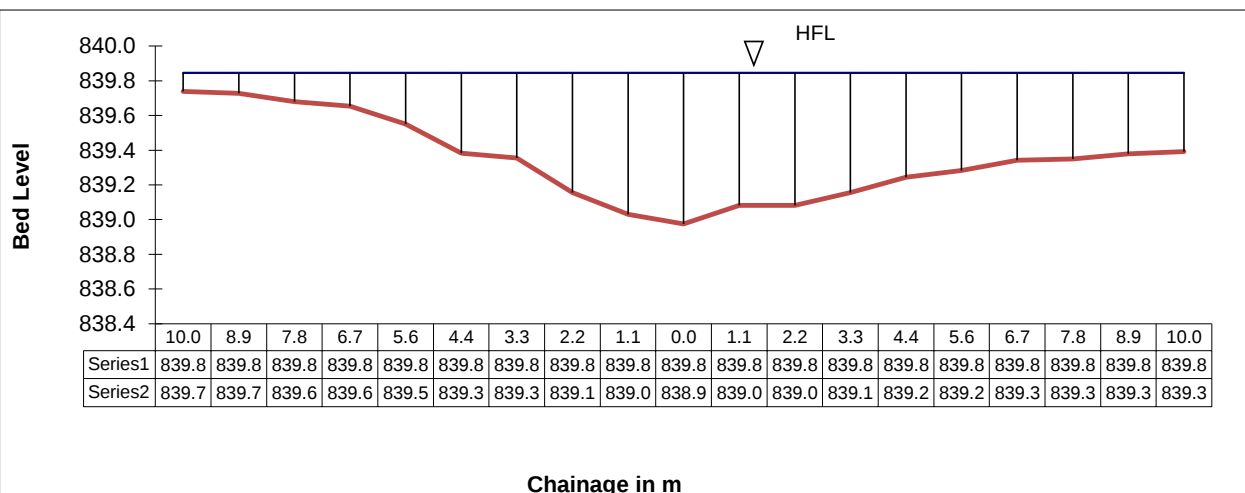
Ref:- (IRC SP-13.2014 cl.no.-(5.4))

D.O.F. - Depth Of Flow

A.D.O.F.- Average Depth Of Flow

W.P. - Wetted Perimeter

L.B.L. - Lowest Bed Level



Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

Flood Estimation by Area-Velocity Method

Cross section at Site of crossing

Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

Flood Estimation by Area-Velocity Method

Cross section at **150.00**

m D/S

IRC SP 13-2014(Table 3.12)

H.F.L = **838.646** m L.B.L = 840.449 m

Bed slope So = 0.00870 Spread length = 14.44 m

Rugosity coefficient, n = **0.0350** IRC SP 13-2014 (Table 5.1)

S.No.	H.F.L	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	838.646	10.0	840.449	0.000	0.000	0.000	0.00	0.000
2	838.646	8.9	839.474	0.000	0.000	0.000	0.00	0.000
3	838.646	7.8	839.211	0.000	0.000	0.000	0.00	0.000
4	838.646	6.7	838.738	0.000	0.000	0.000	0.00	0.000
5	838.646	5.6	838.537	0.109	0.055	1.111	0.06	1.116
6	838.646	4.4	838.296	0.350	0.230	1.111	0.26	1.137
7	838.646	3.3	837.940	0.706	0.528	1.111	0.59	1.167
8	838.646	2.2	837.607	1.039	0.873	1.111	0.97	1.160
9	838.646	1.1	837.338	1.308	1.174	1.111	1.30	1.143
10	838.646	0.0	837.086	1.560	1.434	1.111	1.59	1.139
11	838.646	1.1	837.159	1.487	1.524	1.111	1.69	1.114
12	838.646	2.2	837.301	1.345	1.416	1.111	1.57	1.120
13	838.646	3.3	837.438	1.208	1.277	1.111	1.42	1.120
14	838.646	4.4	838.098	0.548	0.878	1.111	0.98	1.292
15	838.646	5.6	838.337	0.309	0.429	1.111	0.48	1.137
16	838.646	6.7	838.438	0.208	0.259	1.111	0.29	1.116
17	838.646	7.8	838.940	0.000	0.104	1.111	0.12	1.130
18	838.646	8.9	839.337	0.000	0.000	0.000	0.00	0.000
19	838.646	10.0	840.354	0.000	0.000	0.000	0.00	0.000

Total (Cross sectional Area, A) = 11.313 sq. m

Wetted Perimeter, R in m = 14.891

Abbreviations

H.F.L. - High Flood Level

Ref-(IRC SP-13.2014 cl.no.-(5.4))

Hydraulic Radius, R = A / P = 0.760 m

$$\text{Velocity, } V = \frac{1}{n} \left(R^{\frac{2}{3}} \times S^{\frac{1}{2}} \right)$$

$$= 0.76^{2/3} \times (0.0087^{0.5}) / 0.035$$

$$= 2.22 \text{ m/sec}$$

D.O.F. - Depth Of Flow

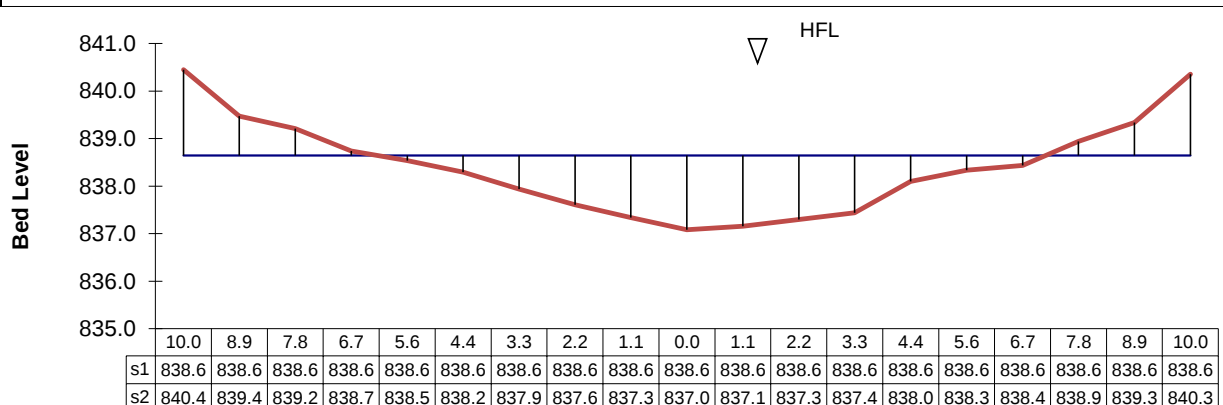
A.D.O.F.- Average Depth Of Flow

W.P. - Wetted Perimeter

L.B.L. - Lowest Bed Level

$$\text{Discharge, } Q = A \times V$$

$$= 11.313 \times 2.219 = 25.104 \text{ cumecs}$$



Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3			
Flood Estimation by Area-Velocity Method	Chainage in m	Cross section at 150.00	m D/S

Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

1 Afflux Calculations

By Molesworth formula

(IRC:5-2015 CL. No.106.6.2)

$$\text{Afflux} = \left[\frac{V^2}{17.89} + 0.015 \right] \times \left[\left(\frac{A_u}{A_e} \right)^2 - 1 \right]$$

$$\text{Afflux} = ((1.71^2)/17.89) + 0.015 \times ((10.26/47.59)^2 - 1)$$

Velocity, V = 1.70 m/sec

Unobstructed area, Au = 10.26 m²

Effective vent area, Ae = 47.59 m²

Afflux = 0.15 m

If afflux is less than 150mm, We consider minimum 150 mm

2 Linear Water Way:

Discharge by Empericle 17.05 m³/s

Discharge by Area velocity

(a) At U/s Side- 14.15 m³/s

(b) At Bridge Side- 17.50 m³/s

(c) At D/s Side- 25.10 m³/s

Design discharge (Q) = $Q/(H \times V)$ 23.5 m³/s

Velocity of river (V) = 1.705 m/s

HFL = 839.84599 m

Lowest Bed level = 838.974 m

Mean Depth of water (H) = 2.38 m

Afflux = 0.15 m

Required Linear water way = 23.54/(1.7 x (2.38+0.15))

5.46 m

Proposed vent way 20.00 m

Silt Factor "f" = 3.9 (IRC:78-2014 CL. No.703.2.2.1)

Linear Water Way = 4.8*23.54^0.5

23.29 m

(IRC:5-2015 CL. No.106.5.1)

3. Fixing of Soffit Level

Vertical clearance (V_c) required = 0.60 m (As per Cl. No. 106.8.2 of IRC: - 5-2015)

Required Soffit Level 840.596 m

Hence, provided Soffit Level **842.819 m**

4. Fixing of Formation Level of Bridge

Provided Span arrangement **2 X 10.0 X 3.1 m**

Provided Soffit Level = 842.819 m

Depth of GIRDER = 0 m

Depth of slab = 0.60 m

Wearing coat = 0.065 m

FRL to Lowest Soffit level = 0.250 m

Minimum Formation Level to be Adopted = 843.734 m

Provided Formation Level = 843.734 m

Hydraulic calculation of minor Bridge at CH-3+524_2X10X3.3

1 Scour Depth:

Design discharge	23.5 m ³ /s
Design discharge for foundation	23.5 m ³ /s
Clear ventway	20.00 m
HFL	839.85 m
LBL	838.97 m

$$d_{sm} = 1.34 (Db^2 / K_{sf})^{1/3} \quad \text{IRC 78 - 2014}$$

where, Db = the discharge in cumecs per metre width. cl.703.2

K_{sf} = silt factor

$$Db = 1.53 \quad \text{cumecs/m} \quad \begin{array}{l} \text{30\% increase discharge} \\ \text{IRC 78 - 2014} \\ \text{cl.No. 703.1.1} \end{array}$$

$$K_{sf} = 3.935 \quad \text{Silt factor } K_{sf} \text{ as per}$$

$$d_{sm} = 1.34 \times (1.53^2 / 3.935479640399) = 1.13 \quad \text{m below HFL}$$

703.3.2 For the design of floor protection works for raft or open foundations, the following values of maximum scour depth may be adopted:

- i) In a straight reach $1.27 d_{sm}$
 - ii) In a bend $1.50 d_{sm}$ or on the basis of concentration of flow
- 11**

$$\text{Max. depth of scour in a straight reach} = 1.27 \times d_{sm} = 1.43 \quad \text{m} \quad \begin{array}{l} \text{IRC 78 - 2014} \\ \text{Below HFL} \\ \text{cl. No.703.3.1.1} \end{array}$$

Final scour depth level

$$\text{HFL -Depth of Scour} = (839.8 - 1.43) \quad \text{m}$$

$$\text{Scour Level at Stream} = \text{Below HFL} \quad \begin{array}{l} \text{of IRC 78 - 2014} \\ \text{cl. No.703.3.1.1} \end{array}$$

$$838.415 \quad \text{m}$$

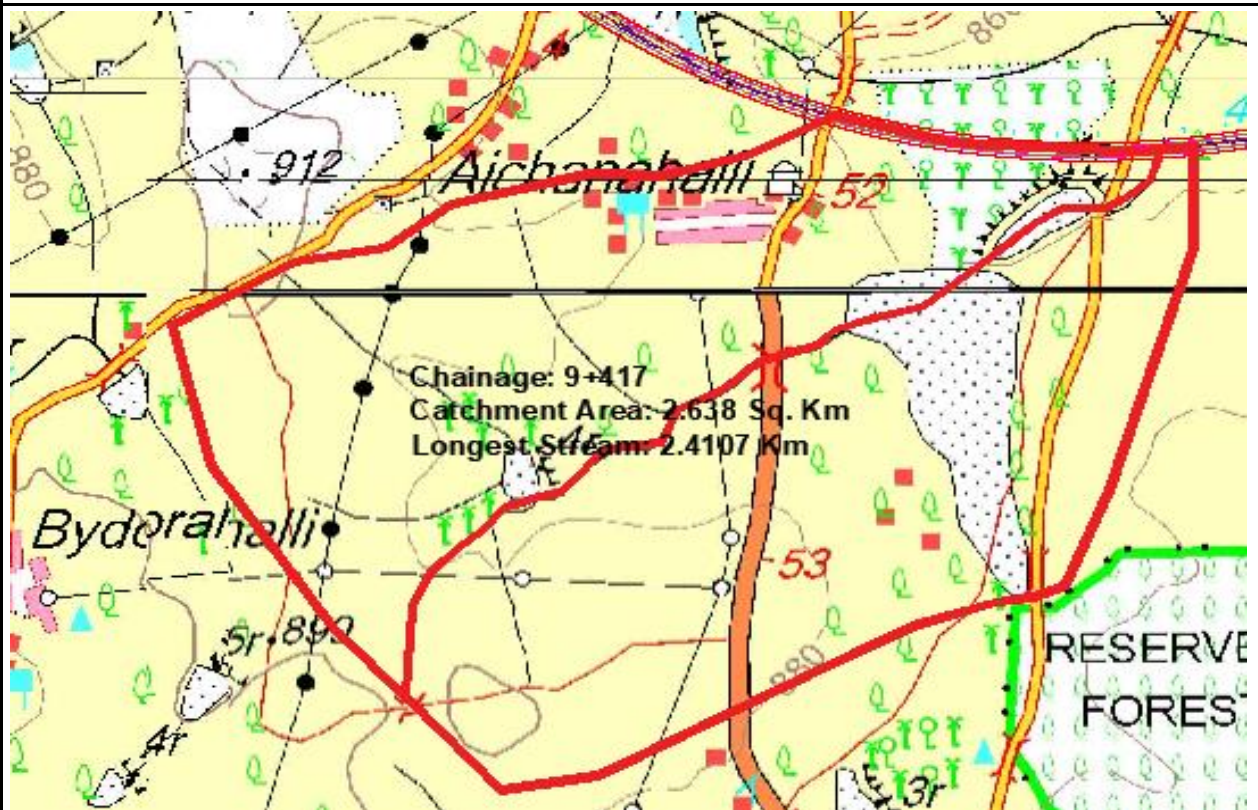
**Project: Construction of Bypass to the Holenarasipura
Town from Km 87.280 (near Chikknahalli) to Km 97.580
(Near Hullahalli) on NH-373 in the State of Karnataka on
EPC mode under NH(O) Annual Plan 2023-24**

**Project: Hydraulic calculation of minor Bridge
(Chikkamagaluru to Belur section of NH - 373) CH-
9+417 1X12X3**

SALIENT FEATURES OF THE STRUCTURE

Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

CATCHMENT AREA



a) Area description:

<i>b) Nalla:</i>	Nala		
<i>c) Strata type</i>			
<i>d) CA Proposal:</i> Span arrangement Outer carriageway width Super-structure type Substructure			
<i>e) Design Proposal:</i> Span arrangement Outer carriageway width Type of structure Type of Foundation	1 X 12.0 X 3.0 2x 10.5 METER RCC BOX MNB RAFT		
<i>f) Geotech:</i>			
<i>g) Hydrology:</i> HFL Design Discharge	860.43 44.40	m cumec	

Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

	Design discharge				
1	Discharge By Emperical method	=	29.0	Cumecs	
	Percentage of Reduction (Due to Attenuation or Flood routng)	=	0%		
	Effective discharge by Emperical	=	28.97	Cumecs	
2	Discharge by Rational/SUH Method	=	44.40	Cumecs	
	Percentage of Reduction (Due to Attenuation or Flood routng)	=	0.00		
	Effective discharge by Rational / SUH	=	44.40	Cumecs	
3	Discharge by Area velocity Method				
	Discharge near Bridge Crossing	=	44.39	Cumecs	
	Average Discharge By Av Method	=	43.83	Cumecs	
	Discharge to be considered by AV Method (Max of Average or Discharge at Crossing)	=	44.39	Cumecs	
	Design Discharge				
	Maximum Discharge of Above Methods	=	44.40	Cumecs	
	Second Highest Discharge	=	44.40	Cumecs	
	50% increase in Second Highest discharge	=	66.60	Cumecs	
	Hence Design discharge	=	44.398	Cumecs	
	Design Discharge		=	44.398	Cumecs

Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

Abstract of Hydraulic Particulars

- * Discharge using Emperical formulae
- * Discharge using A - V method
- * Design Discharge
- * Modified HFL
- * Linear Water way and Afflux

Catchment area	2.637 sq. km
Existing	-
Proposed span arrangement	1 X 12.0 X 3.0 m (MNB) RCC BOX CULVERT
Design Discharge	44.40 Cumecs
Design Velocity	2.38 m/s
LBL	858.294 m
HFL	860.431 m
Afflux	0.150 m
Vertical Clearance	0.900 m
Soffit Level	861.293 m
Existing FRL	- m
Proposed FRL	862.258 m
Scour level of bridge	857.361 m
Invert level of bridge	857.994 m
Level of bottom slab top	857.993 m
foundation level for bridge	857.993 m
Foundation level for Retaining Wall	855.994 m

Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

Flood Estimation

Catchment area, A = 2.637 sq. km

I Emperical formula

Dicken's formula

Discharge, $Q = C \times A^{(3/4)}$

Constant, C =

14

Discharge, Q =

28.97 Cumecs

II Rational formula

$Q = 0.028 \times A \times P \times I_c \times f$

Catchment Area = 264 hectares

L = Distance from critical point to bridge in Km. = 2.41 Km.

H= Fall in level from the critical point to the bridge = 10 m

Time of concentration, t_c = 1.08 hrs.

Co-efficient of runoff, P = 0.60

Spread fraction, f = 1.00

Max. Daily Rainfall, F = 20.00 cm/day

1 hr rain fall intensity 10.42 cm/hr.

Conveyance Factor, k = 0.016

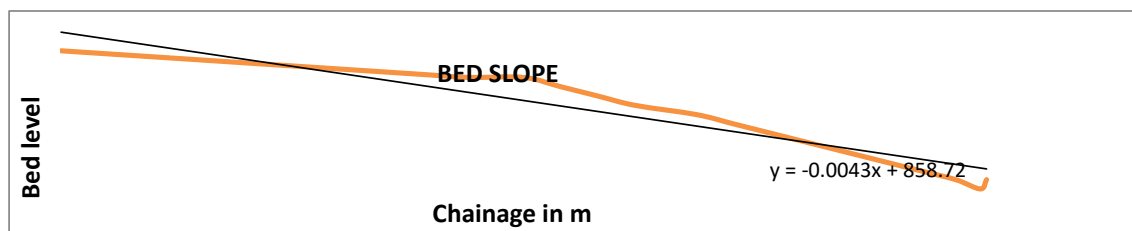
Discharge, Q = 44.40 Cumecs

Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

Bed Slope / Longitudinal Slope of River/ stream

S. No.	length	LBL
1	0	858.544
2	12.00	858.521
3	24.00	858.498
4	36.00	858.476
5	48.00	858.453
6	60.00	858.430
7	72.00	858.407
8	84.00	858.385
9	96.00	858.362
10	108.00	858.339
11	120.00	858.316
12	132.00	858.294
13	150.00	858.294
14	162.00	858.207
15	174.00	858.119
16	186.00	858.032
17	206.00	857.945
18	218.00	857.858
19	230.00	857.771
20	242.00	857.683
21	254.00	857.596
22	266.00	857.509
23	278.00	857.422
24	290.00	857.335
25	298.00	857.247
26	300.00	857.335

Bed slope = 0.0040 - ve sign indicate Down Ward Slope



Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

Flood Estimation by Area-Velocity Method

Cross section at 150.00 m U/S

IRC SP 13-2014(Table 3.12)

H.F.L. = 862.031 m L.B.L. = 858.544 m

Bed slope So = 0.00403 Spread length = 11.33 m

Rugosity coefficient, n = 0.035 IRC SP 13-2014 (Table 5.1)

S.No.	H.F.L	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	862.031	6.0	862.450	0.000	0.000	0.000	0.000	0.000
2	862.031	5.3	862.047	0.000	0.000	0.000	0.000	0.000
3	862.031	4.7	861.647	0.385	0.192	0.667	0.128	0.770
4	862.031	4.0	861.400	0.632	0.508	0.667	0.339	0.711
5	862.031	3.3	860.775	1.257	0.944	0.667	0.629	0.914
6	862.031	2.7	860.437	1.595	1.426	0.667	0.950	0.747
7	862.031	2.0	859.757	2.275	1.935	0.667	1.290	0.952
8	862.031	1.3	859.526	2.506	2.390	0.667	1.593	0.706
9	862.031	0.7	859.087	2.945	2.725	0.667	1.817	0.798
10	862.031	0.0	858.544	3.488	3.216	0.667	2.144	0.860
11	862.031	0.7	859.065	2.967	3.227	0.667	2.151	0.846
12	862.031	1.3	859.580	2.452	2.709	0.667	1.806	0.842
13	862.031	2.0	860.407	1.624	2.038	0.667	1.359	1.062
14	862.031	2.7	860.556	1.475	1.550	0.667	1.033	0.683
15	862.031	3.3	860.800	1.232	1.354	0.667	0.902	0.710
16	862.031	4.0	861.076	0.956	1.094	0.667	0.729	0.722
17	862.031	4.7	861.407	0.625	0.790	0.667	0.527	0.744
18	862.031	5.3	861.538	0.494	0.559	0.667	0.373	0.679
19	862.031	6.0	861.630	0.402	0.448	0.667	0.298	0.673

Total (Cross sectional Area, A) = 18.070 sq. m

Wetted Perimeter, R in m = 13.420

Abbreviations

H.F.L. - High Flood Level

Ref-(IRC SP-13.2014 cl.no.-(5.4))

D.O.F. - Depth Of Flow

A.D.O.F.- Average Depth Of Flow

W.P. - Wetted Perimeter

L.B.L. - Lowest Bed Level

Hydraulic Radius, R = A / P = 1.347 m

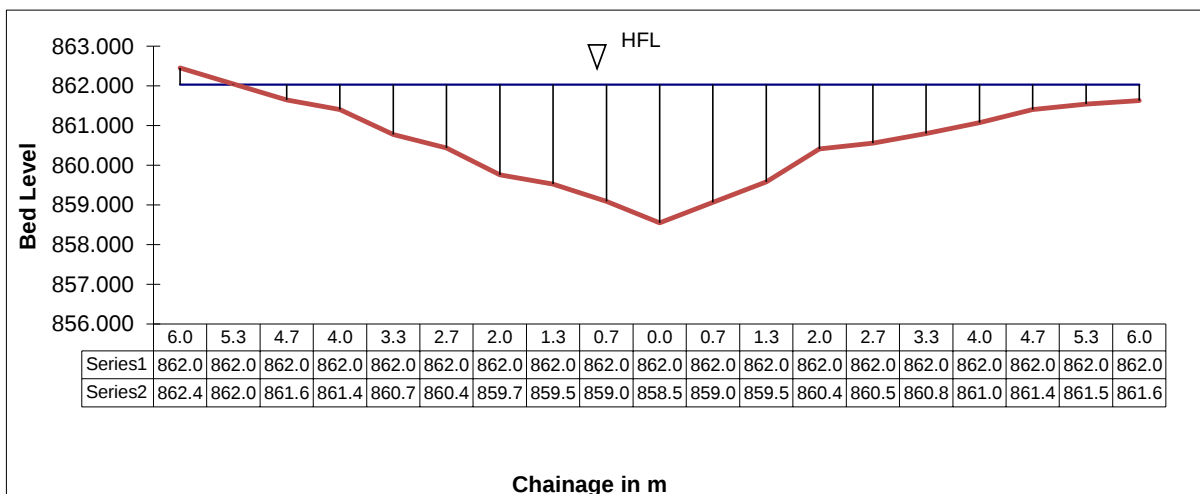
$$\text{Velocity, V} = \frac{1}{n} \left(R^{\frac{2}{3}} \times S^{\frac{1}{2}} \right)$$

$$= 1.347^{(2/3)} \times (0.00403^{0.5}) / 0.035$$

$$= 2.21 \text{ m/sec}$$

Discharge, Q = A*V

$$= 18.07 \times 2.2122 = 39.974 \text{ cumecs}$$



Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

Flood Estimation by Area-Velocity Method

Cross section at Site of crossing

H.F.L = 860.431 m L.B.L = 858.294 m

Bed slope So = 0.00400 Spread length = 12.00 m

Rugosity coefficient, n = **0.0350** IRC SP 13-2014 (Table 5.1)

S.No.	H.F.L	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	860.431	6.0	859.921	0.511	0.511	0.000	0.000	0.000
2	860.431	5.3	859.822	0.610	0.560	0.667	0.374	0.674
3	860.431	4.7	859.706	0.726	0.668	0.667	0.445	0.677
4	860.431	4.0	859.618	0.814	0.770	0.667	0.513	0.672
5	860.431	3.3	859.373	1.058	0.936	0.667	0.624	0.710
6	860.431	2.7	859.242	1.190	1.124	0.667	0.749	0.680
7	860.431	2.0	858.893	1.539	1.364	0.667	0.910	0.752
8	860.431	1.3	858.714	1.718	1.628	0.667	1.086	0.690
9	860.431	0.7	858.350	2.082	1.900	0.667	1.267	0.760
10	860.431	0.0	858.294	2.138	2.110	0.667	1.407	0.669
11	860.431	0.7	858.402	2.030	2.084	0.667	1.389	0.675
12	860.431	1.3	858.402	2.030	2.030	0.667	1.353	0.667
13	860.431	2.0	858.475	1.957	1.993	0.667	1.329	0.671
14	860.431	2.7	858.565	1.867	1.912	0.667	1.275	0.673
15	860.431	3.3	858.602	1.830	1.848	0.667	1.232	0.668
16	860.431	4.0	858.662	1.769	1.799	0.667	1.200	0.669
17	860.431	4.7	858.670	1.762	1.766	0.667	1.177	0.667
18	860.431	5.3	858.698	1.733	1.747	0.667	1.165	0.667
19	860.431	6.0	858.746	1.686	1.709	0.667	1.140	0.668

858.903

Total (Cross sectional Area, A) = 18.632 sq. m

7.262 Wetted Perimeter, R in m = 12.309

Abbreviations

Hydraulic Radius, R = A / P = 1.514 m

H.F.L. - High Flood Level

Velocity, V = $\frac{1}{n} \left(R^{\frac{2}{3}} \times S^{\frac{1}{2}} \right)$

Ref:- (IRC SP-13.2014 cl.no.-(5.4))

= $1.5137^{(2/3)} \times (0.004^{(1/2)}) / 0.035$

D.O.F. - Depth Of Flow

= 2.38 m/sec

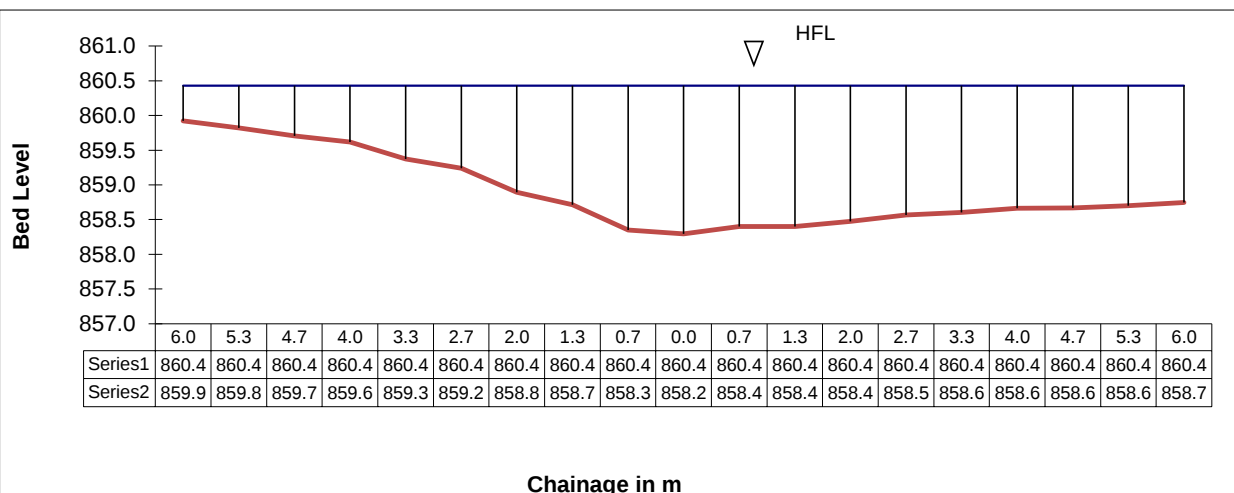
A.D.O.F.- Average Depth Of Flow

Discharge, Q = A*V

W.P. - Wetted Perimeter

= 18.632 x 2.3823 = 44.39 cumecs

L.B.L. - Lowest Bed Level



Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

Flood Estimation by Area-Velocity Method

Cross section at Site of crossing

Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

Flood Estimation by Area-Velocity Method

Cross section at 150.00

m D/S

IRC SP 13-2014(Table 3.12)

H.F.L = 859.731 m L.B.L = 859.001 m

Bed slope So = 0.00400 Spread length = 12.00 m

Rugosity coefficient, n = 0.0350 IRC SP 13-2014 (Table 5.1)

S.No.	H.F.L	Length (m)	Bed Level	D.O.F	A.D.O.F	Distance	Area	W.P
1	859.731	6.0	859.001	0.731	0.000	0.000	0.00	0.000
2	859.731	5.3	858.779	0.953	0.842	0.667	0.56	0.703
3	859.731	4.7	858.758	0.974	0.963	0.667	0.64	0.667
4	859.731	4.0	858.663	1.069	1.021	0.667	0.68	0.673
5	859.731	3.3	858.358	1.373	1.221	0.667	0.81	0.733
6	859.731	2.7	858.227	1.505	1.439	0.667	0.96	0.680
7	859.731	2.0	857.898	1.834	1.669	0.667	1.11	0.743
8	859.731	1.3	857.767	1.965	1.899	0.667	1.27	0.679
9	859.731	0.7	857.570	2.162	2.063	0.667	1.38	0.695
10	859.731	0.0	857.335	2.397	2.279	0.667	1.52	0.707
11	859.731	0.7	857.408	2.324	2.360	0.667	1.57	0.671
12	859.731	1.3	857.550	2.182	2.253	0.667	1.50	0.682
13	859.731	2.0	857.687	2.045	2.113	0.667	1.41	0.681
14	859.731	2.7	857.867	1.865	1.955	0.667	1.30	0.691
15	859.731	3.3	858.186	1.546	1.705	0.667	1.14	0.739
16	859.731	4.0	858.358	1.374	1.460	0.667	0.97	0.689
17	859.731	4.7	858.434	1.298	1.336	0.667	0.89	0.671
18	859.731	5.3	858.485	1.247	1.272	0.667	0.85	0.669
19	859.731	6.0	858.509	1.223	1.235	0.667	0.82	0.667

Total (Cross sectional Area, A) = 19.392 sq. m

Wetted Perimeter, R in m = 12.438

Abbreviations

H.F.L. - High Flood Level

Ref-(IRC SP-13.2014 cl.no.-(5.4))

Hydraulic Radius, R = A / P = 1.559 m

$$\text{Velocity, } V = \frac{1}{n} \left(R^{\frac{2}{3}} \times S^{\frac{1}{2}} \right)$$

$$= 1.56^{(2/3)} \times (0.004^{0.5}) / 0.035$$

$$= 2.43 \text{ m/sec}$$

D.O.F. - Depth Of Flow

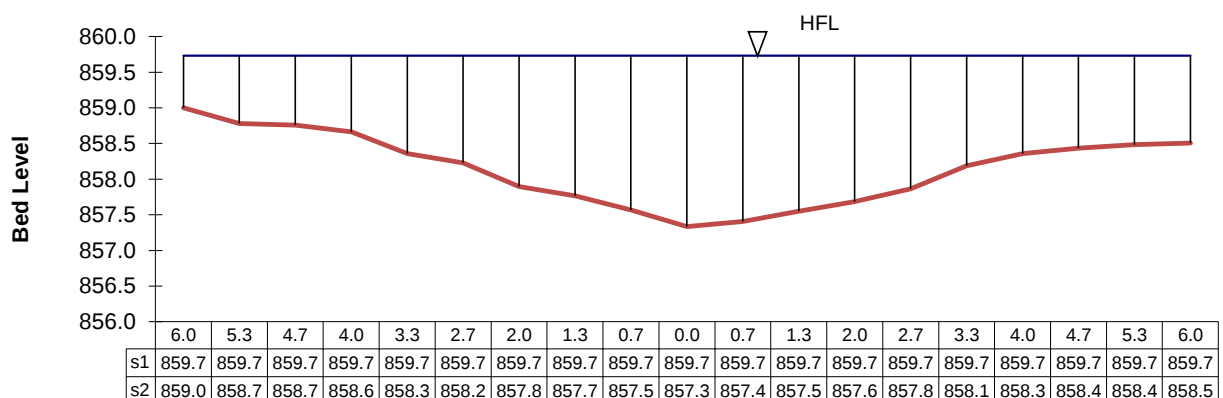
A.D.O.F.- Average Depth Of Flow

W.P. - Wetted Perimeter

L.B.L. - Lowest Bed Level

$$\text{Discharge, } Q = A \times V$$

$$= 19.392 \times 2.43 = 47.123 \text{ cumecs}$$



Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3		
Flood Estimation by Area-Velocity Method	Cross section at 150.00	m D/S
Chainage in m		

1 Afflux Calculations

By Molesworth formula

(IRC:5-2015 CL. No.106.6.2)

$$\text{Afflux} = \left[\frac{V^2}{17.89} + 0.015 \right] \times \left[\left(\frac{A_u}{A_e} \right)^2 - 1 \right]$$

$$\text{Afflux} = ((2.39^2)/17.89)+0.015 \times (((18.632/87.13)^2)-1)$$

Velocity, V = 2.38 m/sec

Unobstructed area, Au = 18.63 m²

Effective vent area, Ae = 87.14 m²

Afflux = 0.15 m If afflux is less than 150mm, We consider minimum 150 mm

2 Linear Water Way:

Discharge by Empericle 28.97 m³/s

Discharge by Area velocity

(a) At U/s Side- 39.97 m³/s

(b) At Bridge Side- 44.39 m³/s

(c) At D/s Side- 47.12 m³/s

Design discharge (Q) = $Q/(H \times V)$ 44.4 m³/s

Velocity of river (V) = 2.382 m/s

HFL = 860.43145 m

Lowest Bed level = 858.294 m

Mean Depth of water (H) = 7.26 m

Afflux = 0.15 m

Required Linear water way = $44.398/(2.38 \times (7.262+0.15))$
2.51 m

Proposed vent way 12.00 m

Silt Factor "f" = 3.9 (IRC:78-2014 CL. No.703.2.2.1)

Linear Water Way = $4.8 \times 44.398^{0.5}$
31.98 m

(IRC:5-2015 CL. No.106.5.1)

3. Fixing of Soffit Level

Vertical clearance (V_c) required = 0.90 m (As per Cl. No. 106.8.2 of IRC: - 5-2015)

Required Soffit Level 861.293 m

Hence, provided Soffit Level 861.293 m

4. Fixing of Formation Level of Bridge

Provided Span arrangement 1 X 12.0 X 3.0 m

Provided Soffit Level = 861.293 m

Depth of GIRDER = 0 m

Depth of slab = 0.65 m

Wearing coat = 0.065 m

FRL to Lowest Soffit level = 0.250 m

Minimum Formation Level to be Adopted = 862.258 m

Provided Formation Level = 862.258 m

Project: Hydraulic calculation of minor Bridge (Chikkamagaluru to Belur section of NH - 373) CH-9+417_1X12X3

1 Scour Depth:

Design discharge	44.4 m ³ /s
Design discharge for foundation	44.4 m ³ /s
Clear ventway	12.00 m
HFL	860.43 m
LBL	858.29 m

$$d_{sm} = 1.34 (D_b^2 / K_{sf})^{1/3} \quad \text{IRC 78 - 2014}$$

where, D_b = the discharge in cumecs per metre width. cl.703.2

K_{sf} = silt factor

$$D_b = 4.81 \quad \text{cumecs/m} \quad \begin{array}{l} 30\% \text{ increase discharge} \\ \text{IRC 78 - 2014} \\ \text{cl.No. 703.1.1} \end{array}$$

$$K_{sf} = 3.935 \quad \text{Silt factor } K_{sf} \text{ as per}$$

$$d_{sm} = 1.34 \times (4.81^2 / 3.935479640399) = 2.42 \quad \text{m below HFL}$$

703.3.2 For the design of floor protection works for raft or open foundations, the following values of maximum scour depth may be adopted:

- i) In a straight reach $1.27 d_{sm}$
 - ii) In a bend $1.50 d_{sm}$ or on the basis of concentration of flow
- 11**

$$\text{Max. depth of scour in a straight reach} = 1.27 \times d_{sm} = 3.07 \quad \text{m} \quad \begin{array}{l} \text{IRC 78 - 2014} \\ \text{Below HFL} \\ \text{cl. No.703.3.1.1} \end{array}$$

Final scour depth level

$$\text{HFL -Depth of Scour} = (860.4 - 3.07) \quad \text{m}$$

$$\text{Scour Level at Stream} = \text{Below HFL} \quad \begin{array}{l} \text{of IRC 78 - 2014} \\ \text{cl. No.703.3.1.1} \end{array}$$